Model
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THE

Model Engineer

AND

Electrician.

A Journal of Practical Mechanics and Electricity.

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The asterisk (*) indicates that the subject is illustrated.

GENERAL INDEX.

INDEX TO QUERIES AND REPLIES.

THE

Model Engineer

And Electrician.

A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 349. JANUARY 2, 1908. PUBLISHED WEEKLY

Model Making for Beginners.

A Model of H.M.S. "Black Prince."

By C. F. W. AND A. R. H.

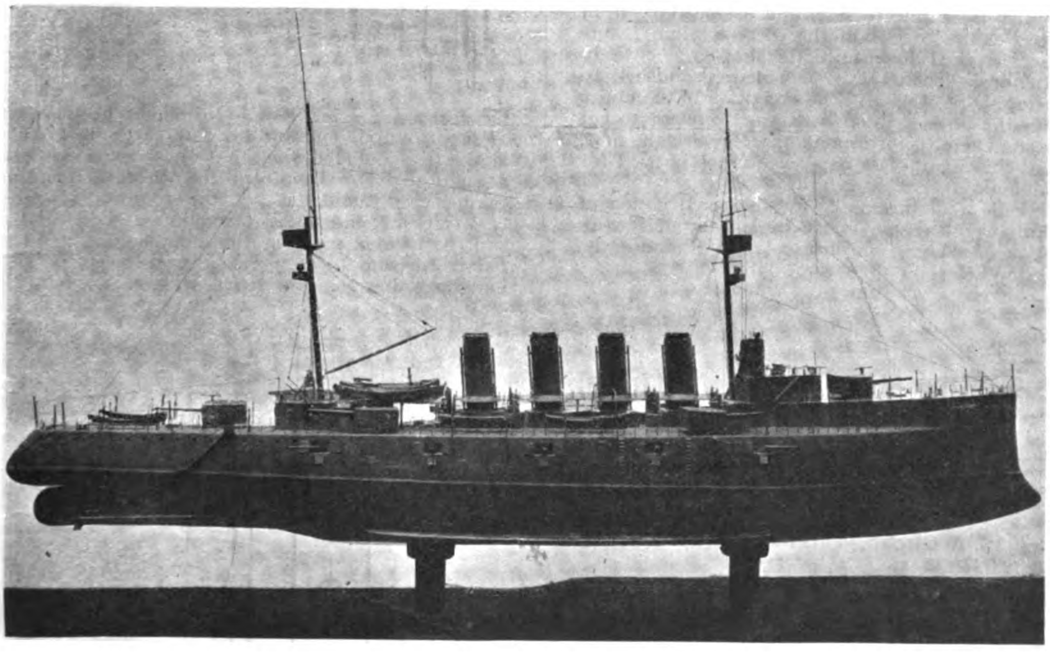


FIG. 1.—BROADSIDE VIEW OF MODEL BATTLESHIP.

AN account of our model of H.M.S. *Black Prince* will, we think, be of interest to readers of THE MODEL ENGINEER. The construction has occupied our spare time for a period of about six months, the first two of which were devoted to collecting pictures and drawings of the ship and making dimensioned sketches for the model. These had to be frequently corrected, until we felt our drawings were as near to the original as we should get. The object of this article is to give sufficient particulars to enable any reader so inclined to make a similar model.

The hull was the first piece of work undertaken. The chief dimensions are :—Length over all, 37 ins. ; extreme beam, 5 ins. ; total depth (forward), 5½ ins. ; total depth (amidship), 4 ins. It is built of Christiania pine, in two pieces glued together along the middle line, *i.e.*, each side of the ship is a separate piece of wood. This is a most satisfactory way of building, as each half can be carved before glueing, and the inside surface is always flat, and very convenient for working.

Here we will mention a simple but very useful device for the bench to use instead of a metal "stop," and so prevent injury to tools. It is made of wood with holes for screws deeply countersunk. (See Fig. 2, which explains itself.)

Before finishing the boards, but after glueing the two halves together, the raised foc'sle, roughly shaped, is screwed into place, and then finished as

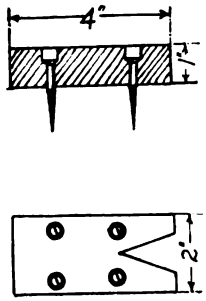


FIG. 2. SHOWING PLAN AND SECTION OF A BENCH STOP.

one piece with the hull. The deck has a slight convexity from side to side, and a concavity from end to end. To obtain the correct "lines," one side was worked down until the shape was entirely satisfactory. Then the other side was finished to the same shape, *i.e.*, with the exception of the upper part of the bows. Great care was exercised to get the second side to correspond exactly with the first. A 3-in. chisel and glass-paper were mostly used for finishing.

The only tools necessary for the construction of the hull were, a ¾-in. gouge outside ground, 2-in. chisel, spokeshave, and iron plane. Shaping the hull occupied about fourteen hours.

(To be continued.)

Workshop Notes and Notions.

*[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "*WORKSHOP*" on the envelope.]*

A Cheap Water Gauge.

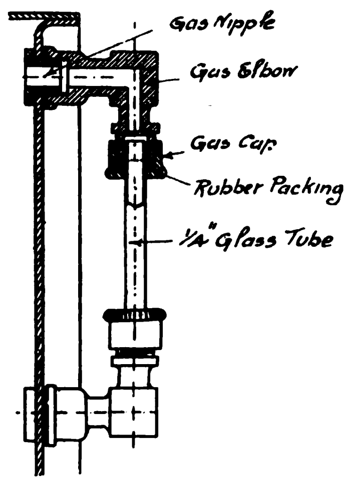
By "ADES II."

The following description is of a simple method of making a water gauge for a model boiler, and has been in use on a well-known steamer for the past two years, giving every satisfaction. Two ferrules are first soldered in the ends of the boiler, with the screwed portion outside; an elbow is then screwed on and asbestos string used to pack the joint by winding round a few turns. Then drill two gas caps ¼ in. diameter and screw on to each end of the elbows, and you have the simplest of water gauges, being most reliable, for the glass is ¼ in. diameter and not at all liable to choke as those expensive fittings with taps, etc., and which cost twenty times as much, and all are standard gas fittings procurable anywhere. India-rubber tube forms the packing for the glass. The drawing explains itself.

Hand Tapping or Reamering Apparatus.

By W. H. WITNEY.

This apparatus will be found to be very useful for reamering or tapping small holes. It can be held in the vice by piece B, and the work held with one hand while the other revolves the tool by means of handle A, Fig. 1. For the construction, first take a piece of 1-in. by ¼-in. mild steel bar and cut off a



SKETCH SHOWING CONSTRUCTION OF A CHEAP WATER GAUGE FOR SMALL BOILER.

piece about 10½ ins. long. Now heat up at about 2¼ ins. from one end and bend up carefully at right angles (it should be seen that these ends are bent at right angles). Then bend the other end the same, taking care that you get the required distance between each end. As it requires a good deal of skill to bend a piece in this manner, it would be better to bend to as near a dimension as possible and then alter the other parts to suit.

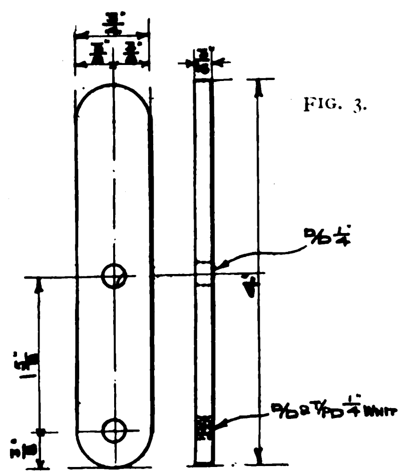
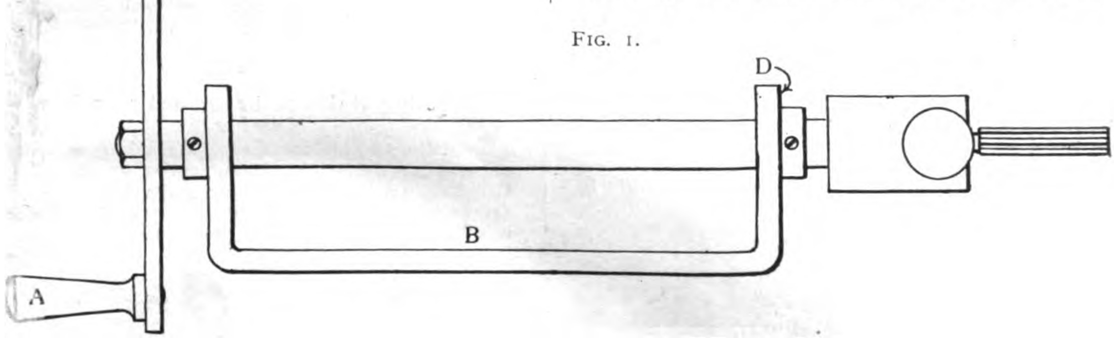


FIG. 3.

Another method is to get hold of a piece of metal 5½ ins. long by about 2 ins. or so across, and bend round that and then just square the ends up. The piece of metal need not necessarily be 5½ ins.; it can be any length, but whatever length it is, the dimensions for the other parts will have to be

altered in the same proportion. The next thing is to carefully mark out and drill out holes for spindle. These should be executed with a great deal of care, as the whole working of the apparatus depends on the bearngs. If the holes are out of line, our spindle will either have to be turned small, and then will run very much out of truth; or be forced as in Fig. 4. The spindle (Fig. 5) should then be drilled as shown at C, and one of the collars fitted on and fastened with a 4 B.A. grub screw. Before fitting the spindle into bearing, we ought to face bearing down as shown where marked in Fig. 1. Then put spindle in an ease-down to suit. Then surface down other end of bearing and put collar on other end of spindle, and drill spindle when in this position for other spindle collar. If thought necessary, two small holes could be drilled in

FIG. 1.



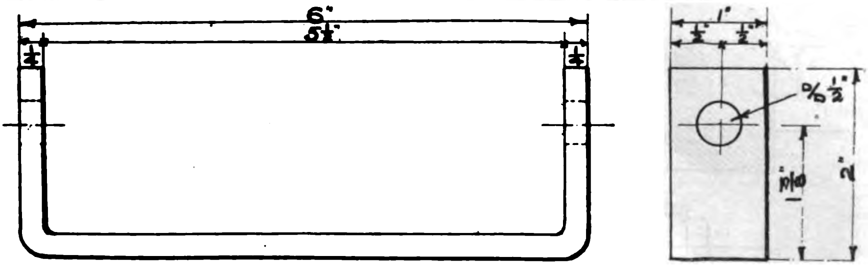


FIG. 2.

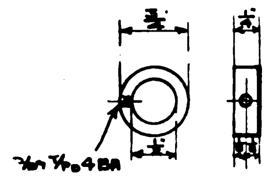


FIG. 4.

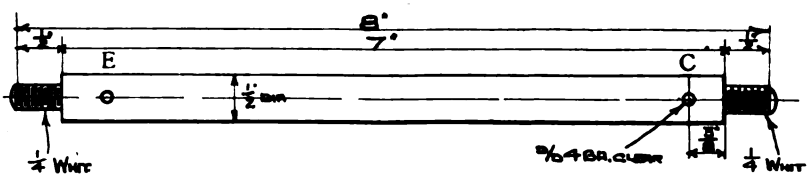


FIG. 5.

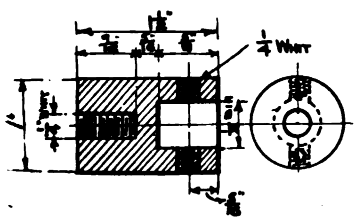


FIG. 6.

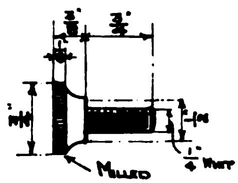


FIG. 7.

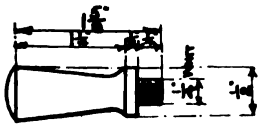


FIG. 8.

DETAILS OF A HAND TAPPING AND REAMERING APPARATUS.

.. and then, of course, will run stiff. We should ... turn our spindle to suit. A piece of bright ..ld steel rod would do very well, as this rolled ..el is generally very round and practically up to ..e. After we have turned our spindle we should ..n turn our collars to suit, and drill and tap them bearing for lubricating purposes. The next thing to do is to machine the parts for the handle, viz., Figs. 3 and 8, and fit up on our spindle. Then we have only the chuck left to deal with. The chuck shown is a very crude design, but will suit most purposes. There is only accommodation for two screws, but two more can be fitted if required. Of course, the reader can make up a much more elaborate chuck if desired. One like that described in the issue of November 14th would do very well.

Turning Rubber.

By C. Holt.

The following method of turning rubber is the most suitable that I know.

Get an old razor, bend the handle end square with the blade, mount it in a holder as at Fig. 1, and you have one of the finest turning tools for rubber you could wish for, and I can safely say from experience the quickest. When using this tool, care should be taken to bring the blade about 1-64th in. below centre. To set up the tools for cutting, measure from the mandrel or the spindle that the rubber is being turned on. If an extra good finish is

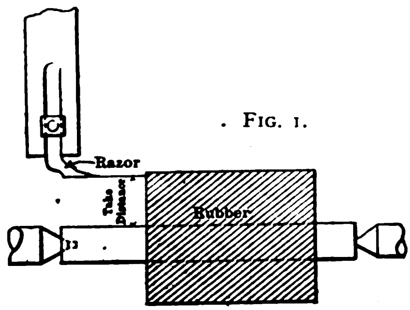


Fig. 1.

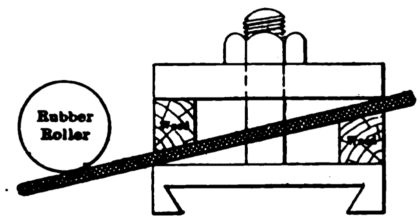


Fig. 2.

Showing Method of Turning Rubber.

required, touch with very smooth glass-paper, finally using a little French chalk.

Fig. 2 shows my way of trueing a rubber roller when there is not sufficient stock for a cut. Get a sharp file, bolting it in the tool rest, as shown, or in fact, any way you can. Anyone having any difficulties with turning rubber will soon get over them by adopting these methods. — *American Machinist.*

Small Name-plates.

By Wm. M. Graham.

In model making, especially electrical work, the amateur very often sees that the look of the model or apparatus would be much enhanced by the addition of small name-plates, such as labelling a switch, as in The Model Engineer Handbook No. 22 on "Electric Lighting for Amateurs," page 30, or for labelling the terminals of a coil, or the studs of a resistance board. Ivorine name-plates being too expensive, I cut little labels out of strong cardboard, such as is used for mounting sketches on, and printed it with ordinary pen and ink—red for initials and black for the remainder looks best. Then I bevelled the edges with a pocket-knife and gave the whole two coats of copal varnish. Dozens of labels will only cost a few pence. The thin copal varnish sold in little bottles by artists' colourmen is much dearer and not so good. Spirit varnish would do, but it does not produce such a glossy effect; besides, red ink is apt to run and smear if coated with it. It is really difficult even at close quarters to tell the difference between these cards and ivorine, especially if the cards be nicely bevelled.

Locating Holes to be Drilled in a New Casting.

In fitting a new casting on a machine it is not an easy matter to locate the holes to be drilled. If a large centre-punch or a round staking tool be driven in the holes, as shown in sketch at A, Fig. 1, it will make a small ridge around the hole as shown

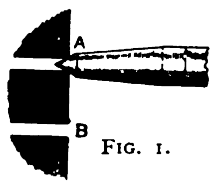


Fig. 1.

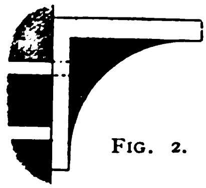


Fig. 2.

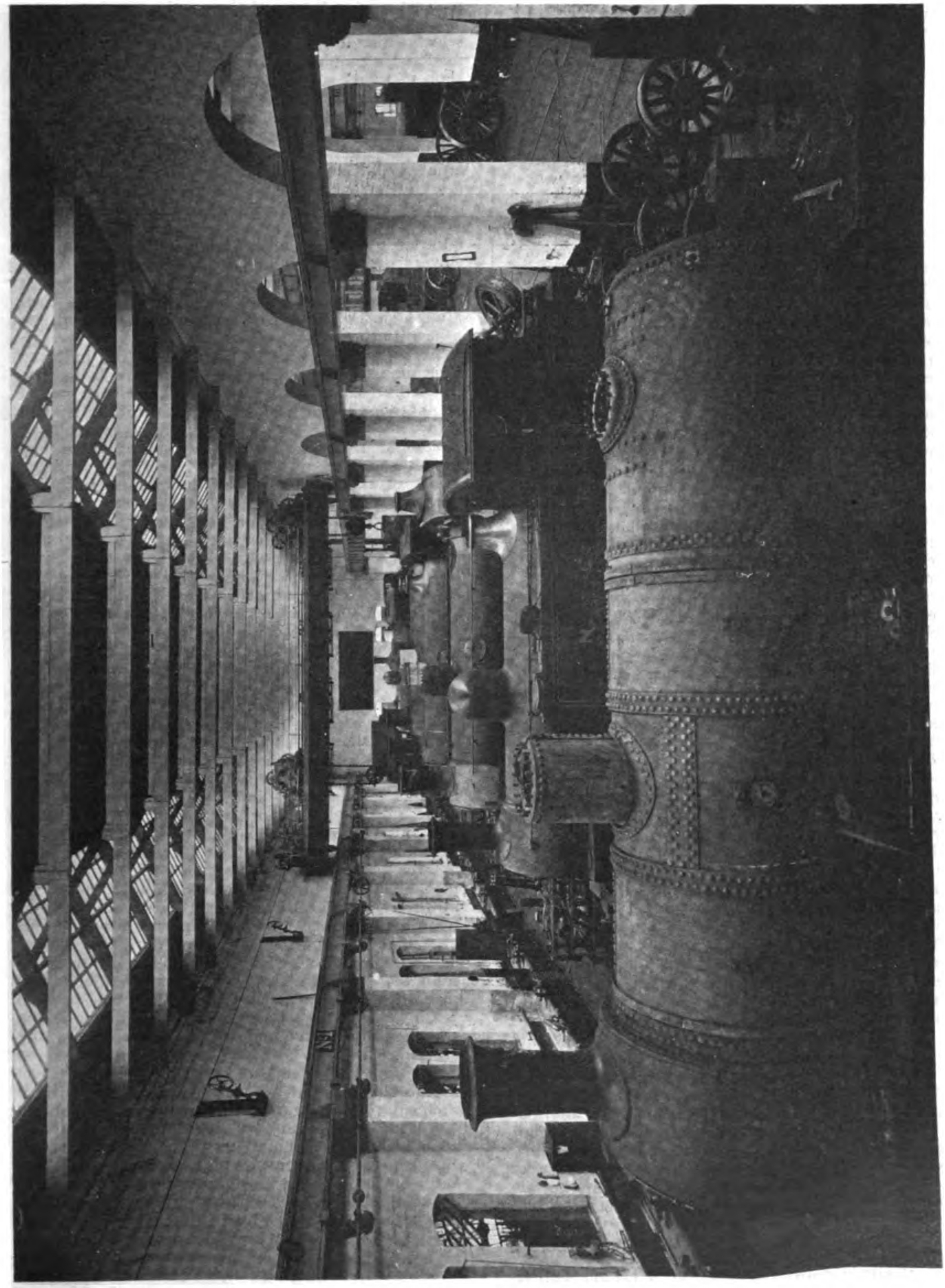
Showing How to Locate Holes for Drilling.

in B. Take the new casting and chalk the side that is to be fitted to the machine. Place this chalked side at the proper place against the holes (Fig. 2) that have been rigged by the punch and strike the casting lightly with a hammer. This will make a small ring where the hole is to be drilled, which can be centered with the dividers. — *Popular Mechanics.*

N.E.R. Locomotive Repair Shop at Darlington Works.

The illustration on the opposite page shows a portion of the locomotive repairing shop at the Darlington Works of the North-Eastern Railway, subsidiary to the main erecting shop, which is a very fine building, 508 ft. long by 196 ft. wide, where the erection and repair of locomotives is carried out under the most modern and convenient conditions. The north bay of this repairing shop is 196 ft. long by 50 ft. wide. It contains several engine pits, and is served by overhead rope-driven travelling cranes having a capacity each of 25 tons. The fitters' benches run along the sides of the shop, and racks are placed between each of the engine pits for holding the parts of the motion and other details belonging to locomotives under repair.

Only goods and tank engines are built at Darlington Works, but passenger engines with tenders are repaired there also, the capacity of the shops being sufficient for 500 to 600 locomotive repairs and for the building of thirty new locomotives per annum. The works cover an area of 20 acres, of which 7 acres are roofed over. The number of men employed is, on the average, 1,800.—C. S. L.



A View of Engine Repair Shop, N.E.R. Locomotive Works, Darlington.

How to Become a Mechanical Engineer.

By Alfred W. Marshall, M.I.Mech.E., A.M.I.E.E.

THE answer to this problem partly depends upon the meaning which the querist desires to attach to the term "mechanical engineer." It would presumably be required by someone who knows nothing about the subject, but having developed a liking for making or handling machines desires to earn his living by that occupation. To one, the ability to use tools and make a machine or part of a machine would gratify his ambition or ideas; another would wish to be able to design machines; and a third would imagine a mechanical engineer to be a man who drives a locomotive, the engines on a steamship, or stationary engines in a manufactory.

The first would become an artisan or mechanic, the second a professional man, and the third a machine minder. In each instance a definite career is open, the degree of success varying according to the ability of the person engaging in it. An artisan must be trained in the skilful use of his hands by practice in a workshop; he should understand the nature of the materials with which he has to deal, and be able to read the particular kind of drawings by which directions are given to him. He need not understand the theory of the machinery or parts which he makes, or decide their proportions, shapes or the kind of material employed. Manual skill is the commodity which he sells to his employer, and upon which he depends to earn a living. Such a man is not, strictly speaking, a mechanical engineer, though he may call himself one. His pay will be that of a mechanic, and be determined by the general custom ruling in the branch of the trade in which he is engaged. Opportunities may occur by which he can rise superior to his fellows, and if gifted with inventive ability, may make a fortune, not because of theoretical training, but by reason of natural talent which takes its place, enabling him to know intuitively that which others acquire by study.

Driving a locomotive or other engine is a different thing. The man who does this need not be an artisan. He is an attendant to the engine, and depends upon experience with its working gained during an interval of time, his responsibility proceeding by degrees. It is necessary for him to understand the construction of the engine and the object of the various parts. He should be able to make adjustments necessary to regulate their operation. He need not understand the theory upon which the engine depends for its efficient performance, but must be well acquainted with its practical working. His work is to make the engine go with a minimum of repair or breakdown and a maximum of economy. The remuneration of this work varies according to responsibility. Men engaged in it are also not, strictly speaking, mechanical engineers. They are really engine drivers or attendants. It is quite possible to attain better position or fortune by conceiving improvements due to intelligent observation rather than theoretical knowledge, or by a capacity for organisation and command.

A mechanical engineer is really a person who is able to design machines. To do this one must understand the theory of the machine and its parts, also of the properties of materials, so that he can select those suitable from which the parts can be made. He should further be acquainted with workshop methods and tools, and be able to express his ideas by means of drawings. He must be able to make calculations and have a working knowledge of common sciences. His mind must be capable of originating new ideas and conceiving their shape as a mental picture. The earnings of men of this description do not follow any custom; they largely depend upon the amount of energy and business ability which any particular one may possess in addition to his mechanical talents. An exceedingly clever man of weak health or modest disposition may not be able to make as good an income as an artisan, and one of equal or less ability may earn almost any amount if he is very energetic and has a keen business faculty.

Actually these general divisions of the industry intermix to a considerable extent. A lad starts in one line of work, and takes the knowledge gained to another branch, and so on. Natural ability will show itself, and the genius follows no rule or particular training. But it is well if a lad can predetermine the direction which will fit in with the limits of the mental picture he has formed of a mechanical engineer. If his fancy be for working with tools and making or fitting together machine parts, but he avoids drawing, theory, and calculations as distasteful or very difficult to understand, he should follow the training which will make him an artisan. This means that his years of apprenticeship should be entirely applied to workshop practice as likely to develop his ability to the best advantage to himself. Theoretical study will probably worry and exhaust his faculties without yielding a benefit in proportion to the energy expended. It will be better for him to become a first-class artisan than an indifferent engineer.

Should the lad, however, be fond of starting engines to work, managing them, making adjustments, attending to the feed and firing of the boiler, running pumps and injectors, but working at a lathe, filing, sawing or cutting with a hammer and chisel is monotonous and troublesome to him, he should direct his attention to obtaining experience in the care and management of engines and machinery. Some experience in the use of tools is, however, of much advantage, but he should not enter upon a workshop apprenticeship which will compel him to devote all his time to acquiring the skill of an artisan. The time should be divided into a minimum of work in making parts of engines and machines, and as much time as possible spent in taking engines and boilers to pieces, putting them together, and attending to them whilst they are working.

The lad who intends to be a mechanical engineer in the real sense of the term should be one who is inclined to investigate and experiment with almost any kind of apparatus or machine. He should be fond of making calculations and sketching plans of his ideas for arrangements of parts, and take a great interest not only in the working and manufacture of machinery, but in theoretical principles involved. His interest in them should extend to their commercial value, how cost of production can be reduced, the value of raw material and labour, economy in running expenses. Mechanical problems and their solution should be attractive to him, and he should find a pleasure in acquiring mathematical and scientific knowledge. He should have a sufficient liking for working with tools to enable him either to make machinery or apparatus himself, or to judge the workmanship of others who may be carrying his designs into practice. The training for such a lad should be a judicious combination of practical experience with workshop tools and processes and theoretical study. The latter ought to include practice in making engineering drawings and acquaintance with cost of materials and labour.

Thus three broad kinds of engineering careers are open to a lad, and each is divided into a variety of branches. Commencement is easiest when the lad leaves school, say at about the age of sixteen years, without having entered any other business. It becomes more difficult as age increases, though with means a person may take up this occupation when he has reached years of manhood.

(To be continued.)

The Junior Institution of Engineers.

A NUMEROUSLY attended visit of this Institution was recently paid to Woolwich Arsenal, appropriately arranged to follow the striking Inaugural Address on "Some Comparisons between French and English Artillery," which had been delivered by the newly-elected President (M. Gustave Canet), the eminent French artillerist.

The Chief Superintendent of Ordnance Factories (Mr. H. F. Donaldson), received the members, and under the guidance of the chief mechanical engineer (Mr. Douglas Heap) and other officials, several hours were spent by the visitors in an inspection of the interesting processes of manufacture involved in the production of metal time fuses; bullets for the magazine rifle; siege, field quick-firing and machine-gun carriages; mountings for heavy ordnance; woodwork for carriages; small arm and quick-firing ammunition boxes; wheels; heavy breech-loading guns, including the hoops and tubes for them. Rifling operations were shown, and working models of breech mechanisms of heavy breech-loading guns. The process of wire-winding was also seen, and in view of M. Canet's observations on that topic in his address, attracted particular attention.

The Chairman of the Institution (Mr. Frank R. Durham), expressed to Mr. Donaldson the members' appreciation of the special arrangements which he had kindly made for their reception, enabling so much to be seen in the limited time at disposal.

At the ensuing meeting on January 8th, a paper on "Recent Improvements in Electric Conduit Construction" is to be read by Mr. FitzRoy Roose, of the London County Council Tramways Reconstruction Department.

ACCORDING to *The American Machinist*, the first attempt to establish iron and steel works in India has just been started by a rich firm in Bombay, supported by other wealthy individuals and by the Government of India. The district in which the plant will be situated will be near Sini Junction on the Bengal-Nagpur Railway, where there is abundance of water, and where iron ore, coal, and limestone can be assembled at low cost of transit.

Design for a Model Motor Fire Engine.

(With Coloured Supplement.)

By FRANK FINCH.

IN selecting the above subject for the design of this year's supplement, the writer is assured of its favourable acceptance for two reasons—firstly, because of the enthusiasm displayed for the fire engine by all classes of individuals; and, secondly, on account of it being something comparatively new in so far as model engineering is concerned. The fire engine—in its own way—is as fascinating to the general public as the railway locomotive. In actual fire fighting the now popular motor engine has come to stay, and it is thought that the design and construction of models of this type, although scarcely thought of yet by readers of "ours," may develop an interest and popularity, at least approaching, that displayed in model locomotives.

There has not been published until now a design of a model of this class of engine, although it must be stated that a few models of the old style, viz., horse-drawn engines, have been made and described in these pages from time to time. By way of introduction, it is as well to study briefly the general principle adopted in the design. It may have already appealed to the notice of readers that in general outline an effort has been made to resemble in miniature one of the now well-known Merryweather types; although, so far as scale is concerned, it has been found impossible to adhere strictly on account of a great difficulty in securing the exact leading dimensions of the prototype—an obstacle which doubtless accounts for the lack of any previous designs of this nature. Generally, however, it is to a scale of 1¼ in. to 1 ft. An encroachment upon the proportional width of the engine has been forced owing to the boiler space necessary to render the steaming powers of the model efficient.

The location of the various features of an actual engine has been more or less maintained. For instance, the tanks to carry the supply of water for boiler-feed are situated on either side of boiler, and rest upon the frame (the water is fed into boiler at intervals, by means of a simple hand-pump in the right-hand tank, the two tanks being connected by a small tube across the front of boiler). The tank containing the methylated spirit for firing the boiler through the five-wick lamp is situated as in the prototype, at the fore-end of the framework, under the driver's box, and between the front pair of wheels; the admission of spirit to the wicks is *via* an air-valve actuated by a turn of the small handle at the back of the driver's seat. Those who have studied the motor fire engine will recognise that the position of engine and pumps in the design corresponds with that of the original, but the double-acting pumps are necessarily more bulky in proportion. There are two simple engine cylinders, each ⅝-in. bore by ⅞-in. stroke, and the slide-valves and eccentrics are placed between the cylinders; the piston-rods drive the pump plungers direct through the medium of the slotted crossheads shown in the drawing. It is thought that the air-vessel, being of polished copper, will add greatly to the attractiveness of the model when completed, and for that reason it has not been covered up by the wooden box arrangement, as in the case of many of the Merryweather class of engine. A continuous jet of water of 9 to 10 ft. will be thrown by this pump.

Propulsion is effected by a dual method, as follows: To release the pump from the engine the pump rods are unscrewed below the crossheads, and by means of a small clutch (to be subsequently described) a tooth wheel on the crankshaft is brought into gear with a similar wheel on a pinion below. On the said pinion is also a grooved wheel, which, in turn, transmits the power by a gut band to a grooved wheel attached on the inner side of the rear wheel, as indicated in the drawing. A driving wheel is shown on one side only, and a band brake occupies the corresponding portion on the opposite side. Of course, a driver on either side would be more effectual, in which case it is feared the band brake must be substituted for the block pattern rim brake, usual on horse-drawn vehicles, and, indeed, the writer has observed them on some of the earlier types of motor engines; but of this more anon. The principle of steering is copied somewhat, and is exceedingly simple, the front wheels being actuated to the right or left by a slight turn, in the desired direction, of the hand-wheel, and clamped in any required position by the small "compass" screw shown dotted in the longitudinal elevation. Thus are the main features of the model described.

In subsequent issues details will be dealt with more fully. For the present, drawings are given showing construction of the framing.

Two lengths of brass channel section should be obtained from any metal merchant. The writer has not been able to procure the exact section—viz., ½-in. by ⅜-in.—the nearest being ½-in. by ½ in., which, being ⅛-in. too wide, must be filed down, unless the builder of the model does not object to the deep channel. One end of each length is to be rounded off as shown. A casting will form the front end of the frame, and, for the sake of lightness, it is proposed to make it of aluminium—this will answer the purpose equally as well as heavier metal. The dimensions given are finished sizes. Other cross members of the frame, it will be seen, are small pieces of angle brass attached to the sides by means of small angle brackets and riveted as indicated; the cross piece, shown about midway, should be a casting. No great difficulty presents itself in this piece of work, and by the time some have completed it, the construction of a more interesting part will be given.

(*To be continued.*)

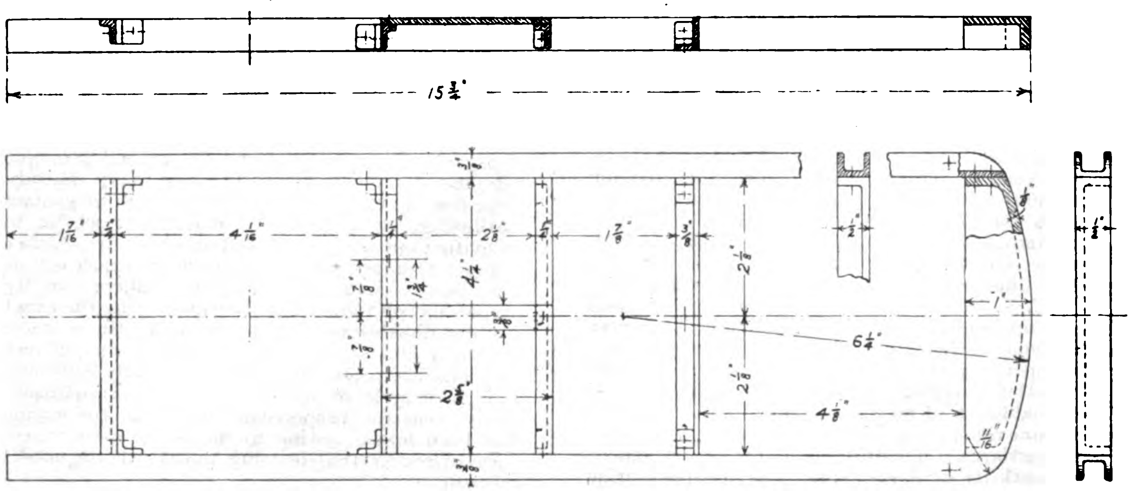


Fig. 1.—Detail of Main Frame for Model Motor Fire Engine.

(*Scale: One-third full size.*)

Gas from Mineral Oils.—The experiments at the Caledonian Brass Works, Barrhead, in connection with a patent for the manufacture of gas from refined paraffin, petrol or other mineral oils, have been continued with success (says the *Gas Engineers' Magazine*). By the Bruce system of manufacture and installation it is claimed that it is possible to obtain gas from refined paraffin or petrol at a cost of a 1s. per 1,000 cub. ft., and that the light, besides being less trying to the eyesight, is twice as powerful as that of ordinary coal gas. The light is given off from incandescent mantles.

A writer in a contemporary states that he examined the envelope of a balloon which burst at the International Exhibition at Milan in 1906. A number of spots were visible on the envelope, and at these places the material could be easily torn, whereas at other parts it showed great resistance to tearing. These spots were found to have been caused by phosphoric and arsenic acids, produced by oxidation from arseniuretted and phosphoretted hydrogen contained in the hydrogen gas. The presence of these impurities is due to the use of impure materials in the preparation of the hydrogen, and the author recommends that the preparation of the gas for filling balloons should be under strict chemical control.

Elementary Ornamental Turning.

By T. Goldsworthy-Crump.

(*Continued from page* 621, *Vol. XVII.*)

A FURTHER example of surface drill work is shown in Fig. 7, being a design for a wall block for a gas bracket. It is 5½ ins. in diameter and ½ in. thick, and the section is as Fig. 8. The back portion was turned first, and the block reversed and re-chucked by the recess, when the face and edge were completed and brought to a finished surface. The interlacing circles were produced with a cranked drill (No. 23) having a radius of ½ in. The 96 circle was used, each hole being employed. It will be noticed that the drill spindle was set slightly out of parallel, to give greater penetration on the outside (movement E). For the outer rim a drill (No. 27 × 15-100ths) was taken and keenly set on inside and outside edges. The 96 circle was employed, every other hole being used, the drill having been carefully adjusted to cut a portion of a hole so that it revolved free of the work for about one-third of its circumference. The drill was then advanced right through to the back of the block, thus producing the perforated edge. This portion being completed, the cross-slide screw was given half a revolution, bringing the drill 1-20th in. nearer the centre of work. The 96 circle was again used; each intermediate hole was employed, and the drill given

Fig. 9.—Snuff Box.

just enough penetration to produce the crescent. This pattern was again repeated, the cross-slide being given another half-revolution, and the same holes used for dividing as for the outside. The work was then unchucked, and the centre-holes bored for pipe and screws.

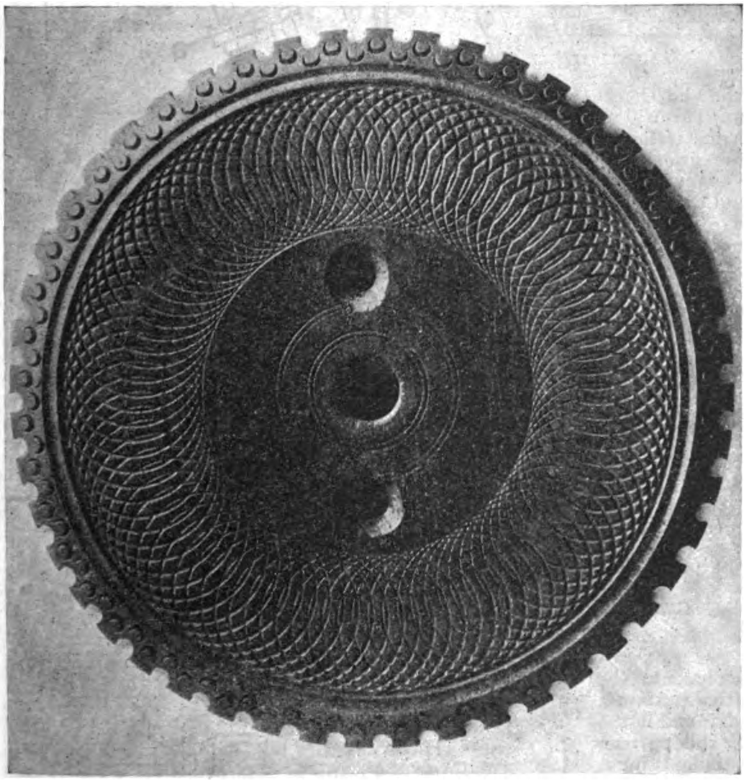


Fig. 7.—Wall Block for Gas Bracket.

We will now consider the production of the snuff-box shown in Figs. 9 and 10, which is a combination of surface and cylindrical drill work. A piece of coco wood, 3 ins. long and 3 ins. in diameter, was chucked in a jaw chuck and the inside of the cover turned on its end. The rim may be screwed or not, and the inside may be finished with plain rings, or a small pattern may be formed in the centre. The top of the box is then cut off with a parting tool, the latter being held at an angle, so as to leave the top convex. The next operation is to form the rim on box so as to exactly fit the recessed cover. This must be carefully done, otherwise the cover will not be rigid enough to stand finishing and ornamentation. Having satisfactorily fitted the cover, it should now be turned to its proper proportions and hand-polished with the shavings and dust.

The drill spindle is now fixed up and the central figure cut with drill No. 23 × 35-100ths radius, the 96 circle being used and forty-eight interlacing circles produced by missing every other hole. The drill spindle is now fixed at right angles to the lathe bed, and drill No. 32 × 10-100ths inserted. The rest is now adjusted so that edge of drill will just touch about one-tenth of an inch from the outside edge of work. The index pointer is set at zero on the 96 circle. The drill is now run at a high speed and slowly advanced by the top slide until the necessary amount is removed. A stop should now be fixed as a precaution, although by counting the revolutions of slide-rest screw, it is possible to do without. The drill is withdrawn and the work revolved six holes, and the next cut made, and so on for the sixteen flutes required.

The drill is now replaced by head tool No. 17 × 15-100ths, and adjusted to edge of cover. The 96 circle is employed, using every third hole for the thirty-two beads. This completes the cover, which can now be removed.

A word may not be out of place as to the necessity of perfect security of work when operated in this way. Should there be the slightest slip, the work is spoilt and cannot be rectified. Seccotine and paper should be used if there is any doubt, and a general precaution in a good fit is to chalk the parts before putting together.

The bottom of the box can now be turned to general shape and bored out. The ornamentation is a spiral basket pattern, and is produced by drill No. 32 × 10-100ths, the drill spindle being set parallel with the lathe centres. The

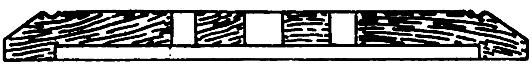


FIG. 8.

pointer is set at zero on the 96 circle, and the drill adjusted to cut just under the rim. The drill is advanced into cut, giving a greatest penetration of one-tenth in., and a stop fixed to secure this depth. The drill being brought out of cut, the division-plate is revolved six holes and drill advanced, this being continued for the sixteen cuts required. The first ring having been completed, the main slide of rest is advanced one-tenth in.—one revolution of screw—towards the headstock and the index pointer set in No. 1 hole. The drill is now advanced and withdrawn, and pointer inserted in No. 7 hole, and so on. In cutting the next

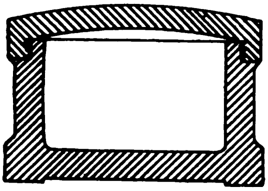


FIG. 10.

ring the holes would be 2, 8, 14, 20, etc.; in the fourth, 3, 9, 15, 21, etc., in the fifth, 4, 10, 16, 22, etc.; in the sixth, 5, 11, 17, 23, etc.; and in the last, 6, 12, 18, 24, etc. The cutting of this pattern requires considerable care in setting the tool. It must be exactly to width, as may be required by the lead-screw—in this case 1-10th in.—otherwise the cuts would overlap and destroy the pattern. The cutter must have clearance, and be set as sharp as possible. The work must be held immovable, as in using this drill there is great tendency to pull the pointer from the division-plate.

The work should now be cut off or unchucked and remounted the reverse way, using the inside of box for this purpose. The bottom can then be turned and recessed, and the box is completed.

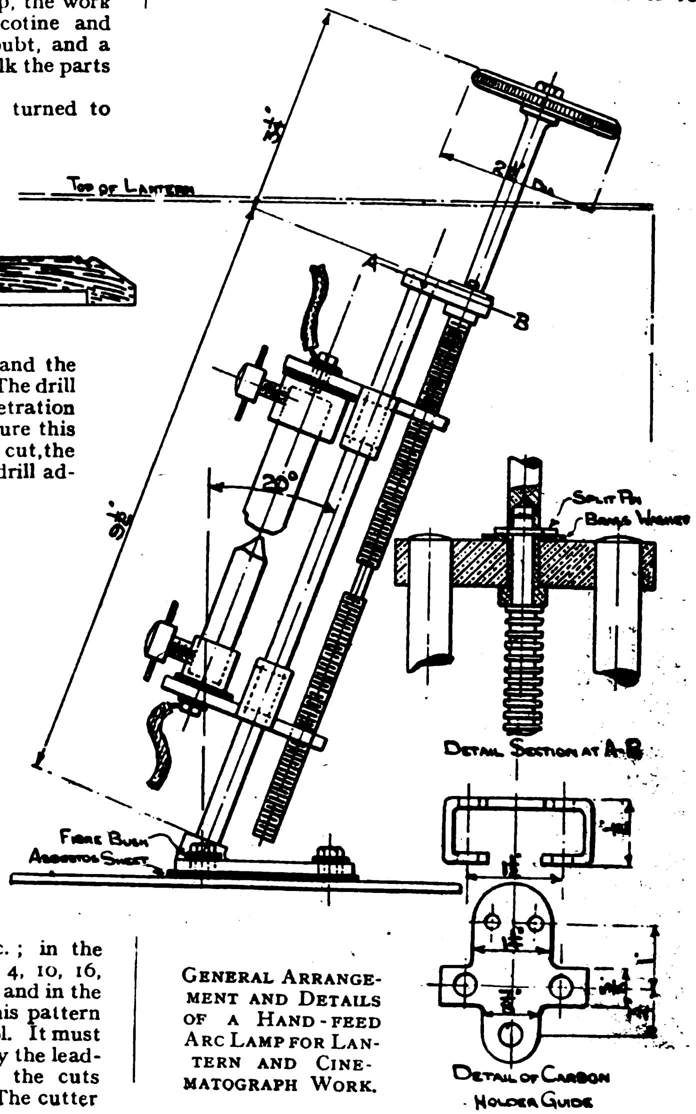
(*To be continued.*)

A Hand-feed Arc Lamp.

For Lantern and Cinematograph Work.

By A. M.

THE following is a description of a hand-feed arc lamp of the inclined type which I made some time ago, and is now running satisfactorily. It is designed to take a current of 10



GENERAL ARRANGEMENT AND DETAILS OF A HAND-FEED ARC LAMP FOR LANTERN AND CINEMATOGRAPH WORK.

amps., with an arc voltage of fifty carbons, 18 mm. positive and 12 mm. negative.

The baseplate (which also serves as an ash tray) is made of ⅛-in. sheet brass, to which is clamped, by means of No. 1 B.A. studs and nuts, a casting of three-cornered design, which carries the brass side rods of ⅜ in. diameter. This casting is insulated from the base by means of a sheet of asbestos cut to the shape of the casting, and fibre bushes to the clamping screws. The carbon holder guides are shaped as shown in sketch, and are made from 3-16ths-in. brass sheet. The purpose of the turned-down lugs is apparent, as it will be readily understood that there would be trouble by the guide sticking on the rods were it not for this extra bearing surface. The carbon-holders themselves are made from brass rod, 1⅛ ins. diameter in the case of the positive and ⅞ in. diameter in the case of the negative, and are bored ½ mm. larger than the carbon size and tapped to take tommy-screws for clamping the carbons. They are fastened to the carbon-holder guides, and insulated therefrom by means of two brass screws fitted with red fibre bushes and a mica plate.

The current is brought to the carbon-holders by two asbestos-covered leads, and it is essential that they should be insulated thus, as the heat soon destroys all forms of ordinary insulation.

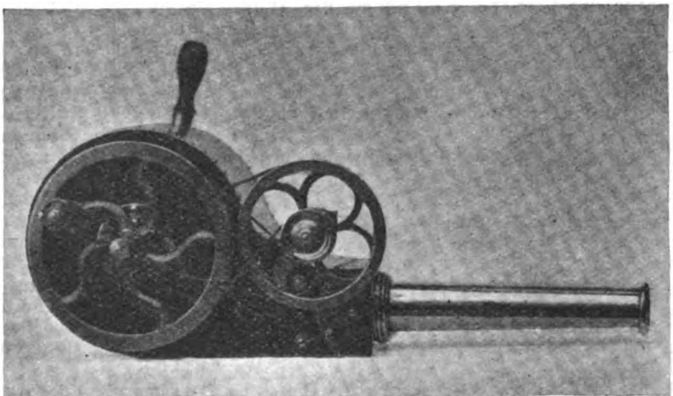
The feed-screw is made of brass rod 5-16ths in. diameter and cut with a square thread, one half right hand and the other left hand, though an ordinary V-thread would be quite as efficient. The apparently complicated arrangement at the top of the feed-screw is necessary, so as to allow the top carbon-holder to be got into position. The feed-wheel is made of ebonite, and is fixed by a nut clamping it against a shoulder on the spindle.

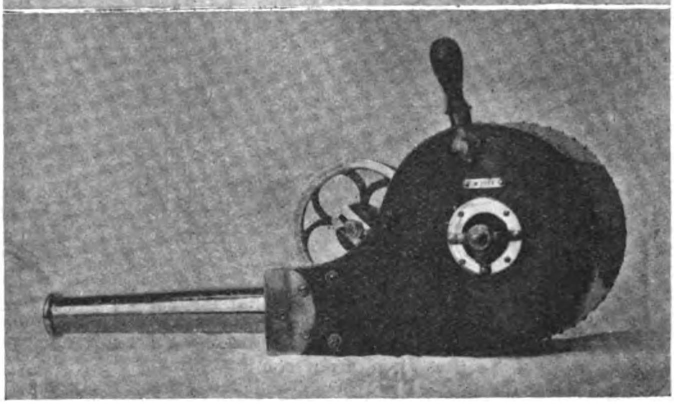
I may say that the lamp burns for about five hours, and the illumination s excellent when run on a 100-volt circuit with a suitable line resistance.

How to Make a Useful Domestic Fan.

By Wm. Bell.

THE following description, with drawings and photographs shown, will assist the reader to make a useful house fan. The writer has taken four first prizes with his at the Industrial Home-workers' Exhibitions, bringing in return six times the cost of materials for making. As the fittings are entirely made of brass, it would be advisable to make the patterns and get castings made altogether, thereby getting them all of the same colour. When making the patterns, allow from 1-32nd in. to 1-16th in. to all machined parts, and polish every part except the spokes of the wheels, which are finally painted a bright vermillion. The box should be taken in hand first, and for this procure two pieces, either walnut or mahogany, 11 ins. by 8 ins. by ⅜ in., and with the compasses mark off the circles, as in Fig. 10. Cut these to the shape required, also cut the 1⅞-in. hole in centre (a fret machine is suitable for this). Fix the sides together by a piece of hard wood, say beech, 7 ins. by 4 ins. by ¼ in., on the bottom, notching a piece out ¼ in. to receive it (as at A Fig. 10), and fix by screws from under side. This allows brass cover to come right round and be screwed to bottom of box at D (Fig. 10). Now cut a piece of wood to fit in between sides at B (Fig. 10). This is to stiffen the box and take the strain of the nozzle bracket (Fig. 12) which fits over the end of box. Cut away ¼ in. off the sides at C (Fig. 10), to let the nozzle bracket slip on, thus allowing same to be flush with sides of box. Of course, there should be a 1¾-in. hole through this piece of wood to allow the air to pass from the fan blades to the nozzle, the last-named being made from a piece of sheet brass 10 ins. long, 5½ ins. broad at one end, tapering equally on each side to 4 ins. at the other (Fig. 21). This is bent round, overlapped ¼ in., and soft-soldered.





Two Views of a Useful Domestic Fan constructed by Mr. Wm. Bell.

The nozzle bracket—previous to any parts being attached to it—should be well polished; then the nozzle pushed through the hole in bracket to receive it. Slightly bend over the edge and solder from the inside; slip on the two rings (Figs. 11 and 14); then solder these also, taking care not to allow solder to be seen, finally fixing to box by screws, as seen in the photograph. Now fix on bracket (Fig. 19 to Fig. 13) with three 3-16ths-in. screws; then put this on hole in side of box; fix there by four screws. Proceed to fit spindle, which is a piece of cast steel ¼ in. round (Fig. 15). This runs on centres, and can be adjusted with screw (Fig. 17). The spindle bracket has the stud left on at driving side for the driving wheel running on; but at opposite side it is cut off to make room for adjusting screw for spindle. On the inside of bracket at driving side screw in a cast-steel pivot (hardened) for end of spindle running in. After spindle is fitted, take out again, and make ends dead-hard. Then give a good polish in the lathe, drive on the small pulley (Fig. 4), on spindle, and proceed to make the hub for carrying spokes which the fan blades are riveted to (Fig. 15). Make up according to sizes in the drawings, and fix to spindle with two setscrews A A (Fig. 15) for the purpose of balancing fans, which run at a high speed.

The spokes—there being four of them—are

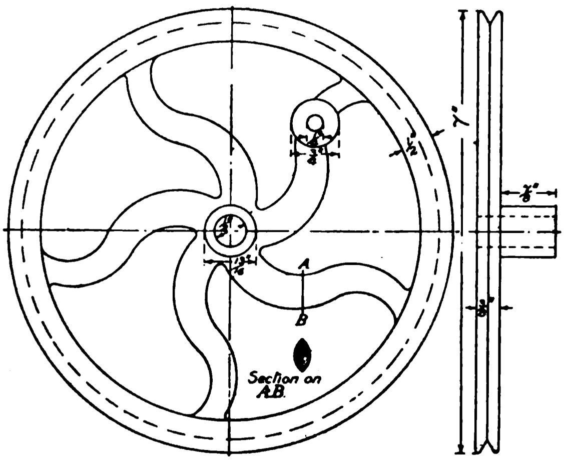


Fig. 1.

3-16ths-in. round mild steel, and made flat on one side to allow fan blades to be flat on. Screw the spokes into the hub; then give them a touch of solder. This secures them from coming slack. When fitting the blades in the box, leave ⅛-in. clearance all round, and set back spokes as at B (Fig. 15).

Proceed to put on cover, which is a piece of sheet brass 24 ins. long, 4 ins. broad. Fix this round the box with ½-in. snap-head screws. They can be put anything between ½-in. and 1 in. apart; in this case they are ½ in., as it looks better. Nothing is put between the cover and the wood, as the screws take the brass down and make a neat joint. Do not attempt to hammer the brass down, as it takes the natural bend when being screwed on. This makes the box complete.

Proceed now to put all wheels and other fittings in their respective places, as will be seen in the photographs. I may mention here that I have ball bearings fitted to the intermediate wheel-stud; but this is not necessary, unless the maker likes to go to the extra trouble.

The driving handle looks very well when built up from thin pieces of wood of different colours; then turned. Put a piece of brass tube through centre, with ¼-in. hole, forming a bush to run on screw (Fig. 18), which is screwed into arm of driving wheel, which, being put on stud, is kept on by a collar (Fig. 20) and held either by a setscrew or a pin right through.

The intermediate wheels (Figs. 2 and 3) can be cast all in one piece, or the small one can be slipped on the boss of the big one, and held by three small pins driven tight into holes bored half on boss of big wheel and half on small wheel. I may mention here for the benefit of amateur turners who have not the use of a lathe with back-gear for turning these large diameter brass wheels, that a good plan is to get the rim to be turned as true as possible and hold a coarse file against the rim when revolving in the lathe, until the skin is entirely off. Then take a smooth file and hold it in the same way; then a good rub with emery-paper for a finish.

Regarding the handle for steadying the fans when in use, get a piece of hard wood 4½ ins. by 1½ ins. by 1½ ins. Bore a ¼-in. hole right through centre, and turn the same as an ordinary file handle, using a brass ferrule. Put the holder (Fig. 16) through the hole, and fix there with a small round nut sunk into the wood about ¼ in. After screwing tight, file off flush and smooth all over. Fix this on box with four screws, as seen in photograph.

The bracket (Fig. 9) for carrying the intermediate wheel-stud (Fig. 8) is slotted for the purpose of tightening both driving bands at the same time. Fig. 5 is the thumb-nut for fixing stud; Fig. 6 goes on outside of slotted bracket, and Fig. 7 goes on inside.

The driving bands, which are ordinary leather bootlaces about ⅛ in. diameter, serve the purpose very well, and if the V-grooves in the wheels are cut a little deep, and to a sharp point, the bands will not require to be very tight, as they tend to bite the groove when properly made.

After everything is in working order, take off all fittings except nozzle and cover, and have the sides of box French-polished. Before replacing the fittings again, give a good finish with emery-paper, first using coarse, then fine, finishing off with good brass polish. Use brass snap-head screws throughout, fix finally together again, and the maker will find himself in posesssion of a handsome and useful household accessory.

Mr. B. W. Hewlett, Butterrow, near Stroud, would be glad to hear from the Secretary of the nearest Society of Model Engineers with a view to joining the same.

A new form of selenium cell, described by the *Electrical World*, is of especially robust construction. The central support of the selenium is a fused quartz tube covered with a thin film of aluminium, which is coated with the selenium. The selenium is first heated to a high temperature, so that it is softened to a putty-like consistency. While it is in this plastic condition, the tube is rolled between two plates of polished glass under moderate pressure, so that the selenium becomes uniform in density and thickness. Upon the outer surface of the selenium there is placed a thin transparent film of aluminium. The completed cell is sealed in a quartz tube similar in general form to an electric incandescent lamp.

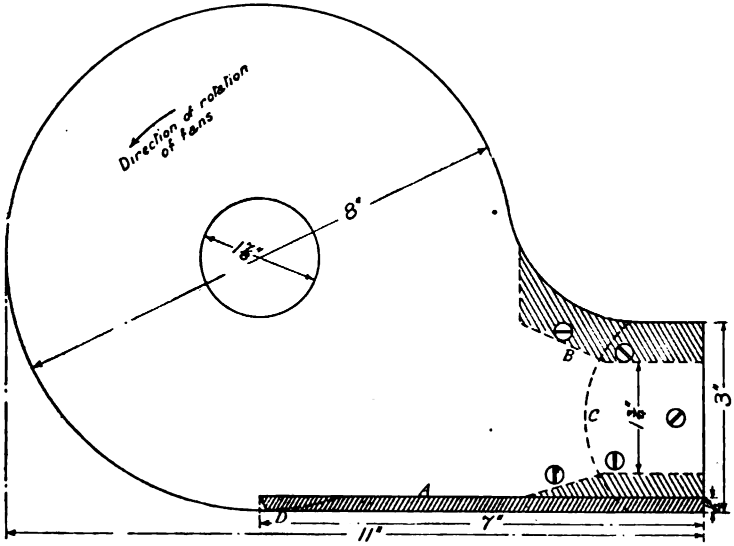


Fig. 10.

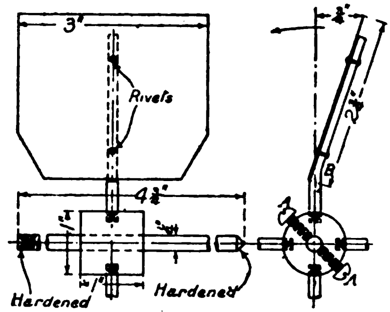


Fig. 15.

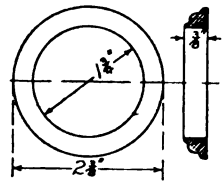


Fig. 11.

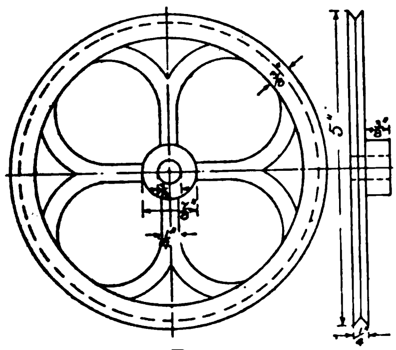


Fig. 2.

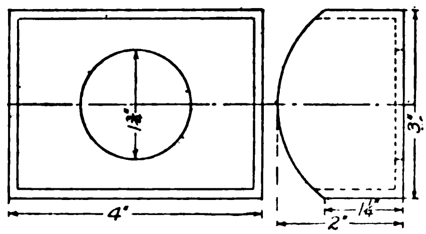


Fig. 12.

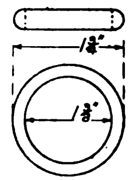


Fig. 14.

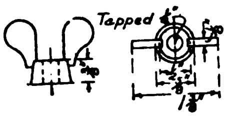
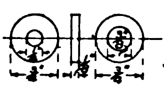


Fig. 5.



Figs. 6 and 7.

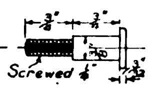


Fig. 8.

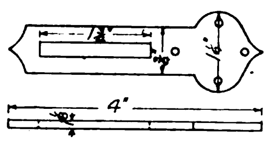


Fig. 9.

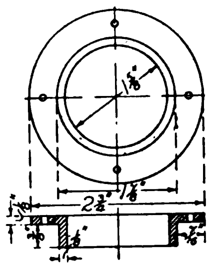
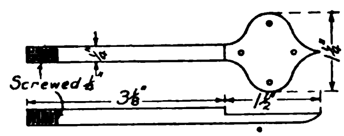


Fig. 13.

Fig. 16.



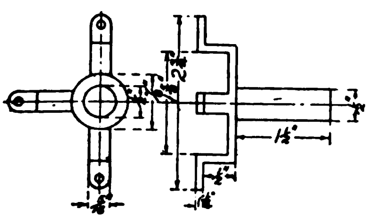


Fig. 19.

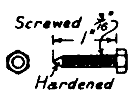


Fig. 17.

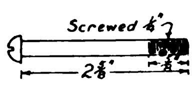


Fig. 18.

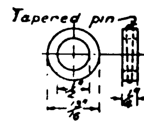


Fig. 20.

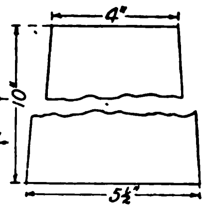


Fig. 21.

DETAILS SHOWING CONSTRUCTION OF DOMESTIC FAN.

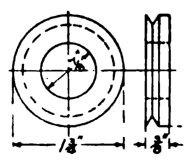


Fig. 3.

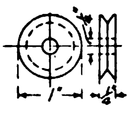


Fig. 4.

Chats on Model Locomotives.

By H. Greenly.

ELECTRICALLY DRIVEN LOCOMOTIVES.

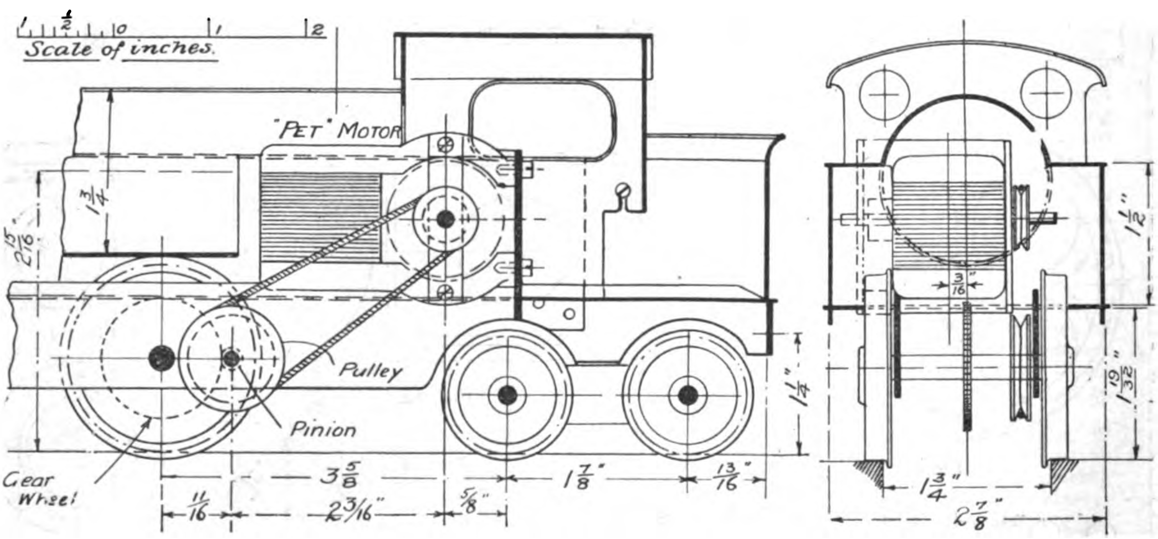
(*Continued from page* 624, *Vol. XVII.*)

As I understand many readers have enquired how they may best fit electro-motors of commercial patterns, like Messrs. Darton and Co.'s excellent "Pet" and "Don" motors to models of steam locomotives, a few notes are included herewith.

Having great faith in the efficacy of the coiled wire model driving-band, I suggest that a very fair efficiency would be obtained by either using a belt drive throughout (see Fig. 23), or by using a belt drive from the armature shaft to the counter-shaft and a plain spur and pinion gear between the latter and the driving axle.

by a slot in the side of the cab fitting over a screw projecting from the insides of the side tanks and bunker. It may be necessary in fitting the motor to substitute countersunk for cheese-headed screws in the bearing brackets. The countershaft may be made from a piece of pinion wire with a lead, type-metal, or fibre wheel, cast or driven on to the pinion wire (see Fig. , *ante*). The gearwheel should have about fifty or sixty teeth to eight in the pinion, and the belt drive may be arranged to give a reduction of 1 to 2, the diameter of the pulley wheel on the countershaft being as large as possible.

The design for the Great Western engine may include a "Pet" or other similar motor; but, as the side tanks are much higher and the cab more capacious, to say nothing of the presence of the Belpaire firebox, a more powerful type of motor is shown in the drawings. The fault of most of the cheaper pattern motors is the small amount of iron used in their construction, and therefore those



Sectional Elevation. Cross-section.

FIG. 21.—SHOWING A STANDARD "PET" MOTOR APPLIED TO A MODEL 1¾-IN. GAUGE S.E. & C.R. 0—4—4 TYPE TANK LOCOMOTIVE.

Fig. 21 shows the combined gear and belt drive applied to the model S.E. & C.R. locomotive illustrated in the last article. The motor, which is one of the smallest size "Pet" motors, is fixed to a vertical brass plate of the shape indicated in sketch (Fig. 22). This plate must be of brass or other non-magnetic metal.

It will be noticed by reference to the cross-sectional view (Fig. 21) that the motor is placed to one side (3-16ths in. out of the centre actually), so that the belt pulley which is fixed on the opposite end of the armature shaft to the commutator. This settles the position of the motor longitudinally on the locomotive. The bearing-plate on the commutator side projecting well over the frames and wheels, and being higher than the top of the side tanks of the locomotive, the bearing and brush gear must go in the cab. The cab, as hinted last week, may be made removable, a method of fastening

who can make their own motors should endeavour to do so, as much more satisfactory results in the matter of efficiency will be obtained — always premising that the workmanship in each case is equal.

A strong field-magnet is a *sine qua non* in a model traction motor, and as in the ⅛-in. scale model of the locomotive now being considered there is plenty of room for a much heavier electro-motor, makers of the model will be well advised to go in for such a motor in preference to the lighter commercial patterns. Greater power will be obtained for a smaller consumpton of current, as both yokes and armatures may be larger and the amount of wire wound on them increased considerably.

Where tripolar armatures are used—and for all *small* work, if the field-magnets are of the proper shape, they will be found to give equal results with armatures of more difficult construction—the largest possible diameter should be adopted, as a better turning movement is obtained and a greater efficiency is possible with a given speed.

The motor in the locomotive is shown fitted with ordinary cross-bearing plate, and it will be seen the bottom lug on the field-magnet will have to be cut away to allow the trailing coupled wheel to clear. Furthermore, the motor will have to be placed so that the bearing plates may project into the cab. To overcome this, the design of the bearing brackets is modified to the detail drawings (Figs. 25 and 27).

The field-magnets of this motor may be cast in one piece, as indicated, or for convenience in winding may be made in three pieces, *i.e.*, with two pole-pieces, and preferably a wrought-iron yoke, which should be turned down at the ends to, say 7-16ths in. diameter and fit tightly into holes in the cast-iron pole-pieces, a countersunk steel or iron screw being used to secure the same. Personally, I like the solid construction, or, where wrought-iron yokes are used, would fix them, riveting over the ends before boring out the armature bore of the field-magnet. The use in one case of a field without

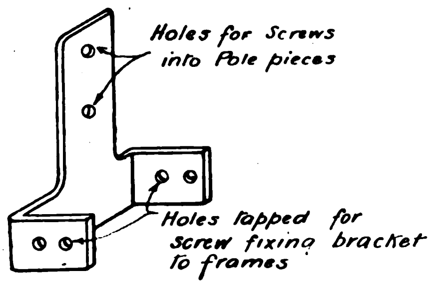


Fig. 22.—Bracket for Holding Motor to Frames of Model S.E. & C.R. Locomotive.

joints or the provision of the more efficient wrought-iron core fixed before boring, outweighs the inconvenience in winding such a magnet. The yoke is oblong, as the field-magnet coil may be almost any length, but must not measure more than 1⅜ ins. wide.

The bearing bracket is a **U**-shaped piece of brass which fixes on to the ends of pole-pieces. The commutator side has provision for fixing split studs to hold the brushes, one stud being fitted into hole bushed with insulating material.

The only peculiarity of the armature is the core of the pole-pieces. As on both sides the armature windings may project beyond the face of the field-magnet, there is no reason why advantage should not be taken of this, especially on the opposite side of the motor to the commutator. If a casting can be obtained for an armature, 1½-ins. long, suitable for say a 1½-in. tunnel, the pole-pieces may be cut away to drawing (Fig. 26), leaving the core the original diameter, or the pattern may be made to the size given. In a commercial motor which I have before me the windings being kept within the sides of the pole-pieces, the cores are only 3-16ths in. by 5-16ths in. in section, and it stands to reason, if the metal in the cores can be increased to 7-32nds in. by ⅞ in. (or say three times the area), a greater magnetic effect will be produced with a given amount of current.

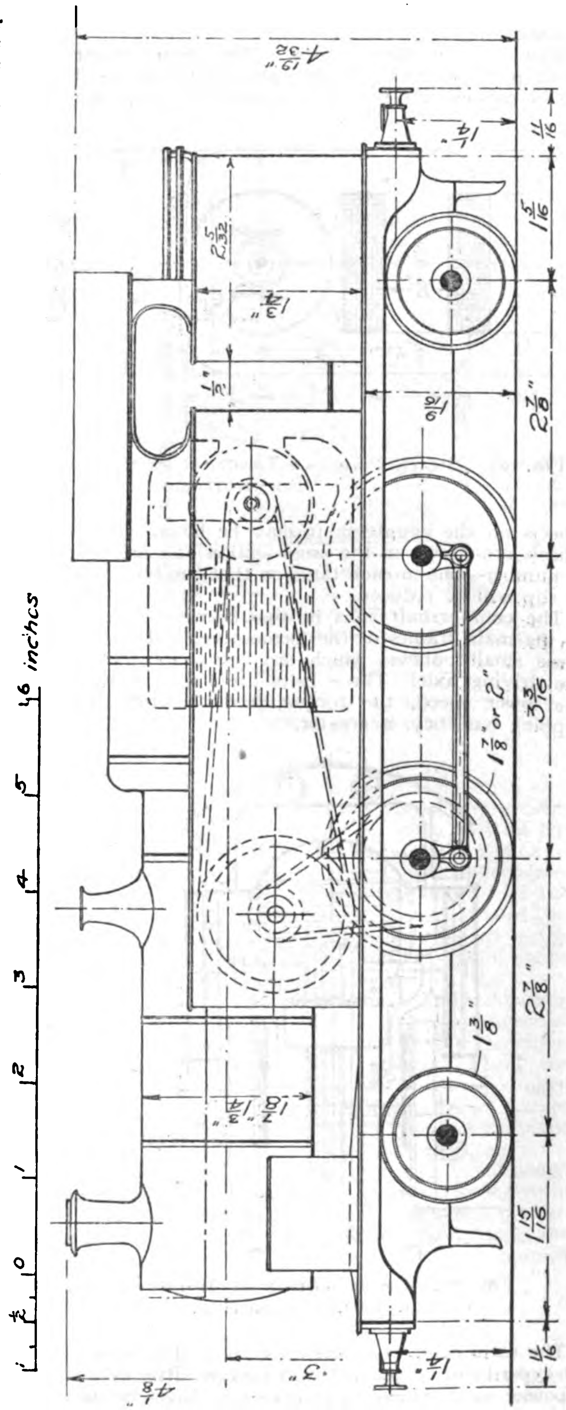


Fig. 23.—Model G.W.R. 2—4—2 Type Tank Locomotive, arranged for Electric Driving by Belts only.

Using the motor shown in detail in Fig. 25, there is no obstacle to placing it further forward quite out of sight under the Belpaire firebox, which may be made to lift off to get at the brushes and the bearings.

Now to the driving gear. The motor shaft being parallel to the driving axle, the belt need not be crossed, and the tanks being high, the pulley

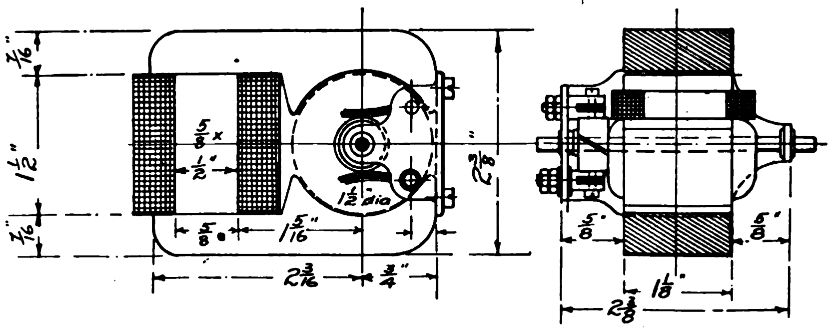


FIG. 25.—SMALL TRIPOLAR TRACTION MOTOR FOR 1¾-IN. GAUGE LOCOMOTIVE.

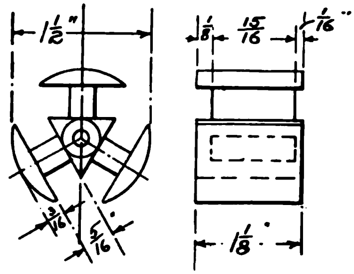


FIG. 26. ARMATURE (TRIPOLAR, SOFT CAST IRON).

wheels on the countershaft may be large. These wheels are shown in the cross-section and are two in number—one in each tank, so that the tendency to slip will be reduced.

The countershaft runs in two bearings secured to the main frames of the locomotive, and carries three small pulleys, which are belt-connected to the driving axle. Three belts are used, as with the lower speed, the torque, and therefore the slipping tendency, is greater.

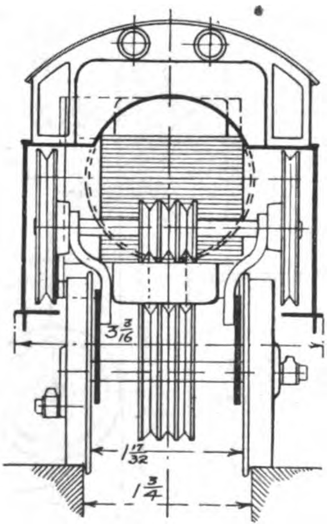


FIG. 24.—CROSS-SECTION OF MODEL G.W.R. TANK LOCOMOTIVE.

The ratio of gearing will have to be determined by experiment; but such will involve little or no expense, as it would only mean a change on the small "driving" pulley wheels. The large or "driven" pulleys should be as large as the tanks and the height of the third rail will allow. The ratio recommended from practical observation is—armature shaft pulley, ½ in. outside diameter; countershaft-driven pulley wheels, 1⅞ ins. diameter; countershaft pulley wheels (three off), ⅝ in. outside diameter; pulley wheels on driving axle (three off) 1 7-16ths ins. outside diameter. The grooves should be made with sides at an angle of 60 degs., and should be sufficiently deep to just allow the small size band to lie flush with the outer edge.

The ratio of gearing would be approximately as 1 to 8, which, with a motor speed of 2,000, will give 250 revolutions per minute of the driving wheels and a speed of approximately 1½ miles per hour. At any rate, the gear should be noiseless in action, which is something worth aiming at, and the tension of the belts should prevent the irritating rattle of the motors in bearings which are at all slack. The friction absorbed by the drive should not amount to very much, and success should be obtained without the locomotive exhibiting any tendency to "amp.-eating," such as is

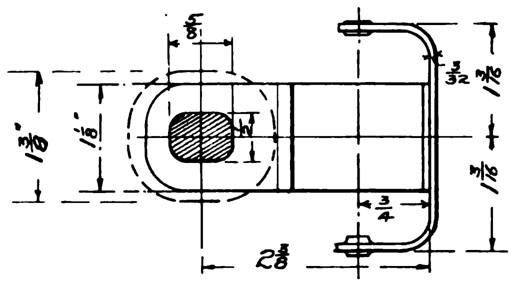


FIG. 27.—SECTIONAL PLAN OF SMALL TRIPOLAR MOTOR, SHOWING FIELD-MAGNET CORE AND BEARING BRACKETS.

too common where motors are inefficient and the driving gear still more so.

The next system of driving is one which is used by toymakers and in cheapei models. It is very simple and obtained by friction only, the whole weight of the locomotive on the driving wheels being made available for adhesion both between rails and wheels and wheels and friction rollers.

In engines such as the G.N.R. eight-coupled tank engines shown in the accompanying figure (29),

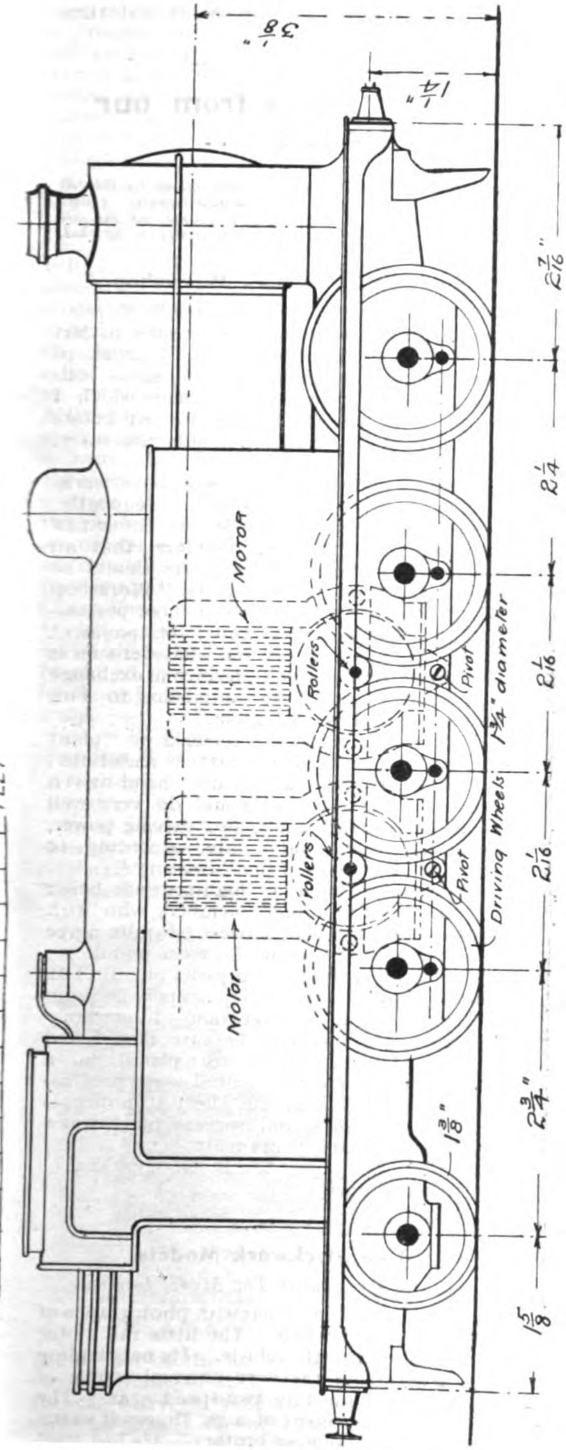


FIG. 28.—DESIGN FOR ELECTRICAL MODEL G.N.R. EIGHT-COUPLED TANK LOCOMOTIVE WITH FRICTION DRIVE.
(Half size for 1¾ in. gauge model. This system of drive may be applied to any engine with driving wheels close together.)

where the driving wheels are close together and where the presence of side tanks enables the builder to satisfactorily hide the motors from view, the motors may be placed between two adjacent driving wheels, so that each roller grips two driving wheels. The G.N.R. tank being a large engine, two "Pet" motors may be employed, as shown in the drawing. As these motors will be found to be too wide for the gauge used (1¾ ins.), it will be necessary to take off the bearing brackets and commutator, and to reduce the latter and file down the projecting lugs of the field-magnet, so that the distance between the bearing brackets measures not more than 1⅜ ins. Countersunk screws will be required to fix the bearing brackets in place of

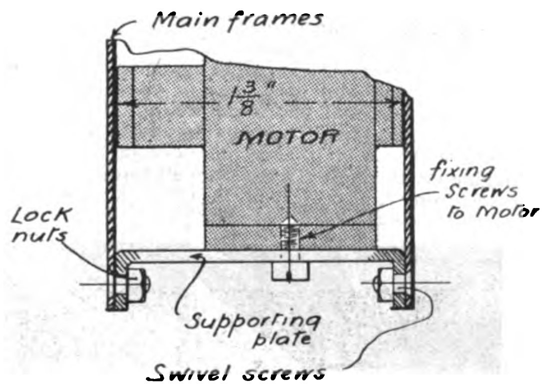


FIG. 29.—CROSS-SECTION OF FRAMES, SHOWING MOTOR, SUPPORTING PLATE, AND SWIVEL SCREWS.

the cheese-headed screws, in the motors when purchased. Whilst the armatures are out, a few extra coils of wire may be wound on them and on the fields (if there be room). Better results will then be obtained with the same current. The rollers may be of brass or iron, and both the flanges of the wheels and the roller should be roughened by *rolling* a coarse file over them when they are in the lathe. The diameter of the rollers should not be more than 5-16ths in.

The coupling-rods should be made in three pieces, the centre rod fitting outside the two end ones, and the wheels should run in slotted bearings. To obtain an equal pressure on each wheel the motors should be fastened to a plate with flanged ends to fit between the frames. These flanges should project downwards and be tapped for a pivot or sling screw driven through the main frames.

Improved results would, of course, be obtained with a motor designed on the lines of that shown in Fig. 25, the motor being made narrow to suit the exigencies of space. The main frames might form the bearing-plates, and in this way the space occupied by these necessary fittings would be saved.

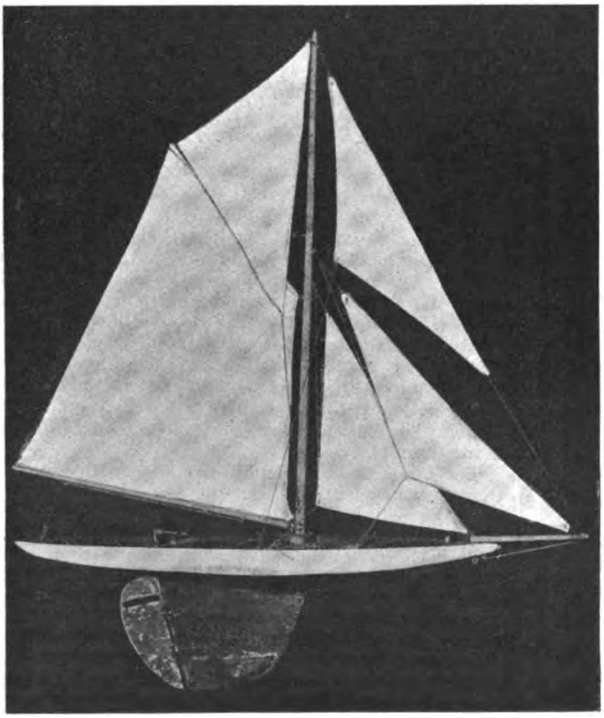
(To be continued.)

UNDER orders recently issued every enlisted man of the Russian army will be provided with a pocket compass, fitted with a luminous needle. Contracts have already been placed for 300,000 compasses to cost £80,000.

A Small Model Racing Yacht.

By Alexander P. Laing.

The photograph herewith is of a model yacht 24 ins. long by 5 ins. beam. The model is made from a very rough sketch of the American yacht *Independence*, which I found in an old magazine. The *Independence*, it will be remembered, was sister ship to the *Constitution*, the two defenders of the American Cup in the year of the *Shamrock II*, although they did not require to run. The hull is cut from a block of ordinary white pine, which I was fortunate enough to secure very free from knots. The deck is a piece of yellow pine backing, and is lined to represent planking. The keel and rudder are of stout zinc plates, and the bulb is formed by thick lead plate being doubled over and cut to shape. The spars and bowsprit are of beech, while the mast is of yellow pine. The former wood I find admirable for this sort of work, as very thin and yet strong spars can be made, and also very clean holes can be drilled for rigging cords, etc. The sails are all taped, and are made from sailcloth from the Clyde Model Dock



Mr. A. P. Laing's Model Racing Yacht.

Yard. The rudder can either hang free or be controlled by the rack on the deck. The model received three coats of paint and two coats of copal varnish, and was well rubbed down each time with fine sandpaper. The hull is painted white and emerald green, and the deck has two coats of varnish. This boat, although small, has been a most satisfactory one, and the pleasure derived from sailing it more than repays one for the energy and time spent in making it.

Practical Letters from our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily for publication.]*

Re Suggestion for S.M.E. Workshop.

To the Editor of *The Model Engineer*.

Dear Sir,—I was very much interested in Mr. Savage's letter, published in your Journal of December 5th. In the main, I quite agree with him; but there are certain amendments which I would, with your permission, like to put before readers, and which I consider not only necessary, but fair.

Now, there are many gentlemen who have workshops of their own, and who would, consequently, not require the use of The Model Engineer lathe, etc. I propose, therefore, that all members and intending members should be given the option of joining the "Workshop Section" of the S.M.E., whilst those possessing no such facilities would, on payment of the extra half-guinea (or whatever sum is eventually decided upon), receive in exchange a "season ticket" for admission to The Model Engineer workroom.

I think Mr. Savage's remarks *re* "plant and machinery" sound rather ambitious! A good treadle lathe and hand-driven bench drilling machine would do very well as a start, further tools, also driving power, being added at a later date, according to the financial status of the "treasury."

With regard to the "high-pressure boiler for the benefit of such members who wish to use steam for their models," I quite agree that this addition would be most useful.

I am not a member myself, but if The Model Engineer workshop actually becomes a permanent institution (and I sincerely hope it will), you may be sure that I and very many others who are placed in a similar position—or, shall I say, predicament—would join at the shortest notice.—Wishing you luck and success in this new venture, I remain, yours truly,

E. G. Evezard.

Purley, Surrey.

Two Clockwork Models.

To the Editor of *The Model Engineer*.

Dear Sir,—I send herewith photographs of my two latest models. The little rail motor (Fig. 1) is a peculiar little vehicle. Its outstanding points of interest are the very unusual source of motive power, and the tiny two-speed gear. The "engine" is the movement of a 5s. Ingersoll watch purchased from my younger brother. He had tried adjusting it, and succeeded in crippling the balance-spring and losing the lever. Its timekeeping qualities being in some measure prejudiced by this incident, I conceived the idea of utilising it as a model. The rail motor (one could scarcely call it a locomotive) will ascend on the low gear the formidable gradient of 1 in 4, and on the high gear, on the level, purrs easily along at about 24 ft. per minute—to be exact, 12·7 cms. per second. The two-speed gear is of the motor-car sliding type, operated by a single lever.

Fig. 2.—This is a more orthodox model. It is a ¾-in. scale representation of car No. 2, Volk's Electric Railway, Brighton. Visitors to this town will remember the line along the beach. The model is not electrically driven, for reasons of economy and convenience. The "motor" is an Ansonia "Bee" clock. Although only a single gear is used, and the car is heavy for the size of the clock, it can ascend a grade of 1 in 7. In the photograph the name on the car is not so plain as it might be, as gold photographs dark. Its dimensions are . length, 15 ins.; width, 4¼ ins.; wheel diameter, 1¾ ins.; height of roof above rail level, 5½ ins. — Yours truly,

P. J. Palmer.
Clapham Rise, S.W.

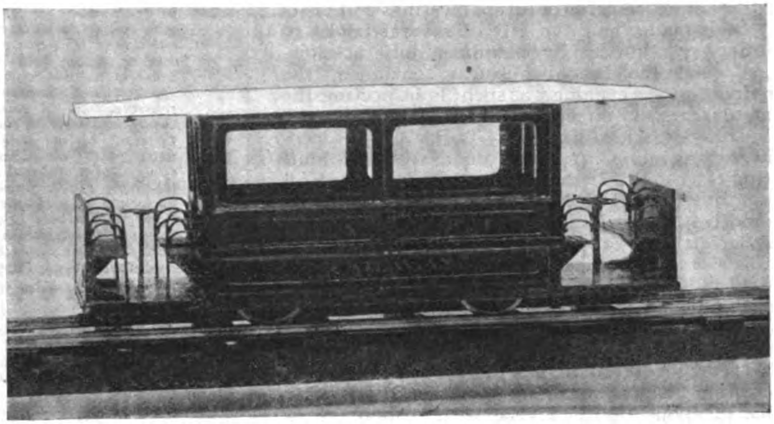


Fig. 2.—A ¾-in. Scale Clockwork Model of Volk's Electric Railway Car, Brighton.

It is reported that an American engineer has recently patented a device for preventing the collection of sleet upon the windows of car vestibules. The method calls into play deflectors, which receive the impact of the air as the car moves ahead and cause currents of air to draw warm air from within the car body or vestibule, spreading it over the outer surface of the windows, and, thus, by means of the thin layer of air substantially parallel to the outer surface of the glass, keep it free from snow and sleet.

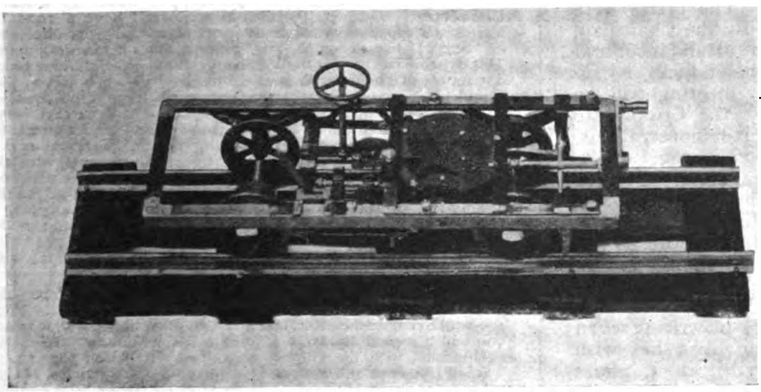


Fig. 1.—Miniature Rail Motor driven by Watch Movement.

The Society of Model Engineers.

Reports of meetings should be sent to the offices of The Model Engineer *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

An ordinary meeting of the Society was held on Monday, December 16th, 1907, at the Cripplegate Institute, Golden Lane, E.C., Mr. A. M. H. Solomon taking the chair, and upwards of ninety members amd visitors being present.

The minutes of the last meeting having been read and fourteen gentlemen elected members, the Chairman stated he had pleasure in announcing that arrangements had been made with several well-known firms for the supply of tools, materials, models, castings, etc., to members of the Society at special rates of discount, and urged the members to take full advantage of the privileges afforded. It was also suggested from the chair that a twist-drill grinding machine be purchased out of the funds for the use of members, who would be able to bring drills to any of the meetings and sharpen them during the evening. The suggestion was considered a very good one, as also another that a portion of the Capital Fund be expended in adding to the collection of special tools loaned to members, and it was announced that both suggestions would be acted upon.

The Chairman also reported what the Committee was doing with regard to the Permanent Workshop Scheme, touched upon at the last annual general meeting, and stated that the present committee found (as, indeed, all committees had done in the past) that the cost of renting a workshop sufficiently large and centrally situated to be available to as many members as possible, was so very excessive that there appeared little hope of the scheme being carried out without greatly increasing the annual subscription. He, however, stated that the Committee would keep the matter constantly before it, in the hope that some means might be found of accomplishing the object which each committee had in turn discussed and enquired into, and finally put aside as unworkable.

After announcements of future meetings and visits had been made, and the gift of several books to the Society's library by members duly acknowledged, and the formal business concluded, the remainder of the evening was spent in inspecting the numerous models on view. Those shown at work included—Mr. J. Chadwick Taylor's old locomotive "Agenoria" (running on a specially built testing table), Mr. Denvil's ¾-in. scale "Atlantic" locomotive, Mr. Hildersley's self-contained electric locomotive, Mr. Baxter's Wimshurst machine, Mr. Barrett's six-coupled Brighton engine, and Mr. Riddle's steam crane. Among the unfinished locomotives were two very fine examples of ¾-in. scale "Caledonian" engines, by Mr. Blankenburg and Mr. Corner respectively; also a ¾-in. scale compound two-cylinder locomotive, with Joy's valve gear (modified), by Mr. C. M. Keiller. A very interesting exhibit was a signal-box interlocking frame of about twenty levers, with accompanying diagrams, by Mr. W. B. Hart, several telegraph instruments by Mr. F. J. Hunt, a large water-tube firebox for vertical boiler by Mr. Glover, and Mr. Fraser demonstrated his ingenious method of expanding boiler tubes on both sides of the tubeplates. The ballot for prizes was taken at 9.30 with the result that Mr. J. Chadwick Taylor's "Agenoria" deservedly took first place, with Mr. C. S. Barrett's Brighton engine a good second, while Mr. Hildersley's electric locomotive and Mr. Denvil's small "Atlantic" locomotive divided the honours equally for third place. The prizes were handed to the several gentlemen by the Chairman, and a record meeting, both in attendance and interest, came to an end shortly after ten.

FUTURE MEETINGS.—The next meeting will be held on Friday, January 3rd, at the Cripplegate Institute, when a series of workshop demonstrations, comprising metal turning, wire drawing, silver-soldering, marking out, and tool making and grinding will be given by various members. It is also hoped that the twist-drill grinding machine will be in use for the first time at this meeting. The following meeting is fixed for Tuesday, January 28th.

VISITS.—The following visits have been arranged. Members wishing to participate are notified that they must so inform the Secretary in writing seven days before the date of the visit or visits they wish to join. Saturday, January 11th, at 3 p.m.: Messrs. Schuchardt & Shutte's Machine Tool Testing Rooms, at Palmer Street, Westminster (party limited to forty). Tuesday, January 21st, at 2 p.m: Messrs. Siemens' Cable Works, etc., at Woolwich. Saturday, February 15th, at 3 p.m.: Messrs. D. Napier & Sons' Motor Works, at Acton (limited to fifty). Wednesday, March 4th: The Bow Works of the North London Railway (limited to forty).—Full particulars of the Society and forms of application may be obtained from the Secretary, HERBERT G. RIDDLE, 37, Minard Road, Hither Green, S.E.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, 26–29, *Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[18,513] **Armature Windings.** J. J. W. (Witton) writes: Would you oblige me by letting me know what is the best wire for a Manchester type dynamo for 30 volts or 60 volts for 8 c.-p. lamps? Size of field-magnets is 6¾ ins. long, 1¼ ins. wide; size of armature, 6¼ ins. long, 2 ins. diameter. Commutator has two nicks across it.

Wind field-magnet with about 5 lbs. No. 22 gauge s.c.c. copper wire on each core; the coils to be joined in series with each other and in shunt to the brushes. Wind armature with No. 16 gauge D.C.C. copper wire; get on as much as you can; about 1 lb. will be wanted. Run at 2,400 r.p.m. The voltage can be adjusted to some extent by running the armature at higher or lower speed. We cannot say what you are likely to obtain, as your particulars are not sufficiently complete, but if the machine has a fair amount of iron in it you may obtain 50 to 60 volts. The winding is suitable for this voltage, but can be made suitable for 30 volts by connecting the field coils in parallel with each other and in shunt to the brushes. If you do not obtain 50 volts or more with the field coils in series with each other, try them in parallel and see if you can get 30 volts. Armature wire will carry an output of 10 amps.

[18,488] **Converting 500-watt Kapp Dynamo to Rotary Converter.** S. F. H. (Plymouth) writes: I have a 100-watt Manchester type ring armature dynamo, made from your directions in "Small Dynamos and Motors," page 51, Fig. 13, 20 volts 5 amps. This dynamo has been in use for about eight months, running every day for about 8 hours, with excellent results. I have, however, now completed a 500-watt (50 volts 10 amps.) Kapp type dynamo (page 49, Fig. 11), and on trial to-day gave full current with sparkless commutation. What I want to know is, can I convert the ring armature dynamo into a rotary converter? The armature is a 12-part one. What I thought I might be able to do was, wind six alternate slots with fine wire for the motor part, and in the other six with thicker wire for generated current. Will you kindly tell me the weight and size of wire for the field-magnets and armature? I understand the motor current supplies the magnetism for the generator. The motor supply will be 50 volts. Wanted, generator current to give 10 volts 3–4 amps. Could I use any of the wire that is now on the machine?

A motor generator is a motor with a second winding upon the armature—in this instance, to produce the second current. Your 100-watt dynamo, therefore, becomes a shunt-wound motor, to which you add a second armature winding and commutator. Wind the field-magnet with the winding given in the table on page 51 of "Small Dynamos and Motors" for 50 volts, namely 2¾ lbs. No. 24 s.c.c. copper wire. Six coils, and therefore six commutator sections is rather a small number for a ring armature, and we advise you to keep to twelve coils. This would also enable you to use the present commutator for the motor winding without altering it. To have room for the two sets of coils you must wind two coils, that is one of each winding in each slot. We advise you to wind the motor coils in first and the generator coils over them. This will enable you to adjust the generator voltage by winding on or taking off some turns if this voltage is too low or too high. The voltage ratio between that supplied to the motor winding and that given by the generator winding depends upon the relative number of turns in the two armature windings. As we do not know the size of your armature slots, we cannot say exactly the size of wires to use. You ought to get on nearly as many turns for the motor winding as at present, so you must use a finer gauge wire. If you do not get on so many, the motor will merely run at a higher speed. Wind the motor coils with No. 28 gauge D.C.C. copper wire, and the generator coils with No. 22 gauge D.C.C. copper wire. About ¾ lb. of No. 28 will probably be wanted. The No. 22 gauge can be taken from the present armature coils. Try a winding ratio of 4 to 1—that is, give the generator coils a quarter of the number of turns which you get on for the motor. This will be an allowance for lost volts in the two windings. The exact number of turns which you get on the motor winding does not matter. The greater the number of turns, the lower the speed at which it will run.

[18,047] **G.N.R. No. 251 Smokebox.** J. McI. (Kilmarnock) writes: Please insert a sketch of smokebox door to open for ¾-in. scale G.N.R. No. 251. This is shown in Mr. Greenly's model locomotive as solid front.

We append herewith a sketch (Fig. 1) showing the general proportions of the G.N.R. "Atlantic" type locomotive smokebox and also a suitable arrangement for a ¾-in. scale model where the door is required to open. The usual lock may be fitted, but the device shown in diagram (Fig. 2) will give good results. The collar should be screwed up to the end of the thread and brazed. The handles should be driven on tightly and pinned, as indicated on the drawing. Both the smokebox front and door may be made of cast iron, the hinge, straps, and centre boss being left bright.

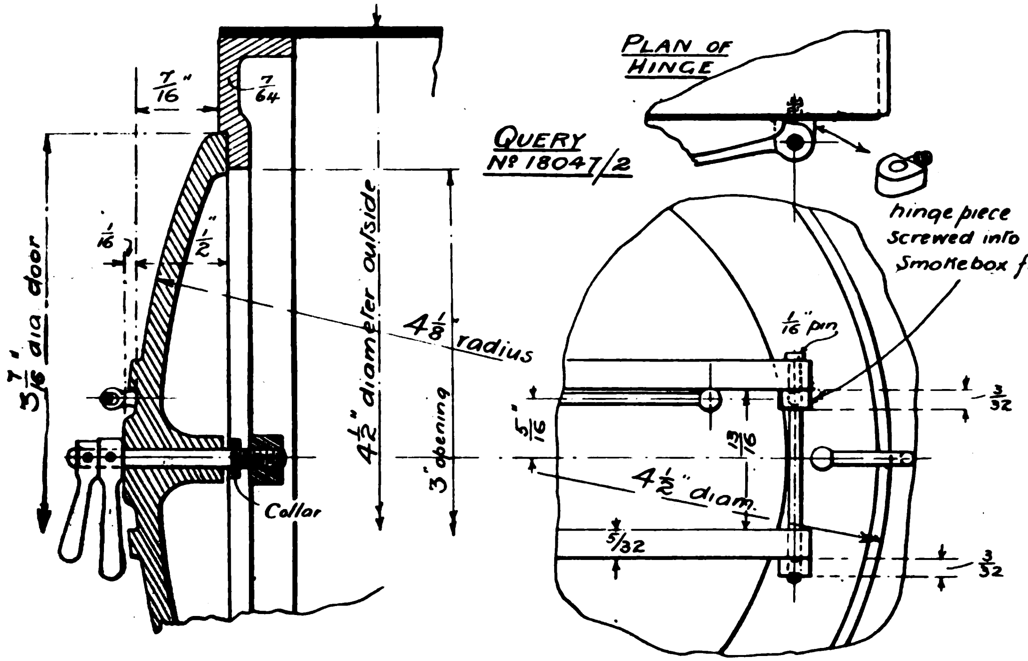


FIG. 2.—SMOKEBOX DOOR FOR ¾-IN. SCALE MODEL G.N.R. "ATLANTIC," NO. 251 CLASS.
(*Scale: Full size.*)

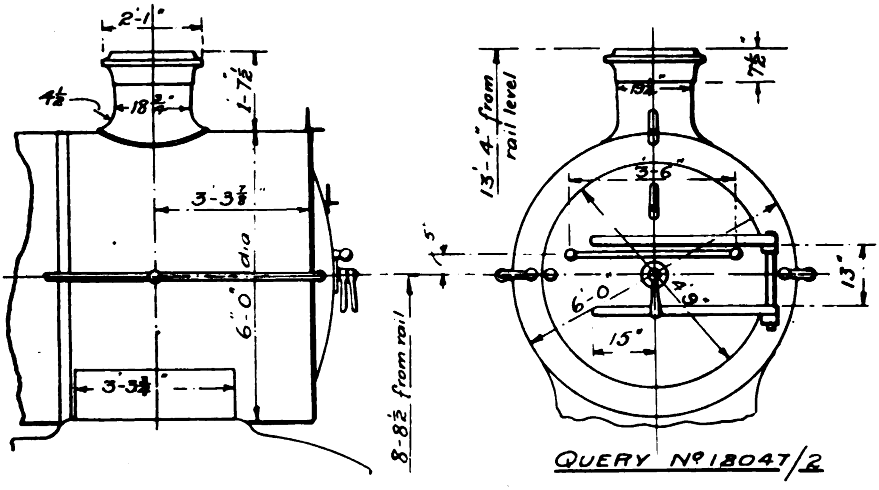
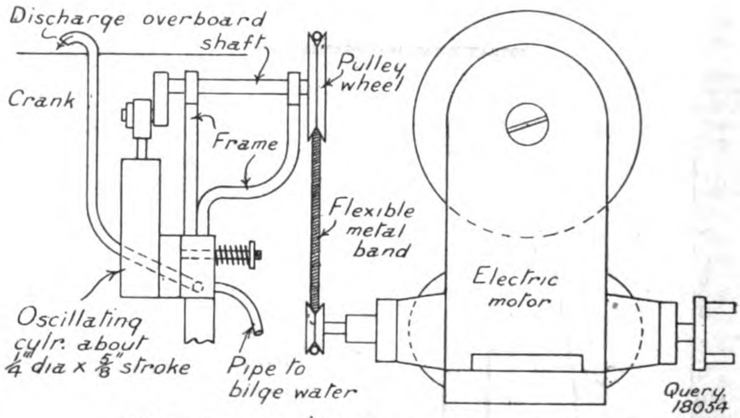


FIG. 1.—GENERAL DIMENSIONS OF G.N.R. NO. 251 SMOKEBOX AND CHIMNEY.
(*Scale: ½ in. to the foot.*)

[18,054] **Bilge Pump for Model Steamer Electric Boat.** J. S. B. (Cumberland) writes: Could you oblige by sending me a plan of a model pump suitable for pumping water out of a model steamer, 4 ft. 3 ins. long by 6 ins. by 5 ins. I want the pump to work from the boat motor, which is an "Exceptional" electromotor (1-20th h.-p.).

The simplest thing you can use is a small oscillating cylinder worked by a belt (coiled wire spring). From the armature shaft the ratio of gearing should be at least 3 to 1, and the cylinder, ¼ in. bore, altered to ⅝-in. or 5-16ths-in. stroke. This type of pump will give absolute satisfaction, as the valves are mechanically operated. See that in rearranging the stroke that at the bottom of the stroke there is only a small amount of clearance, and also that the "oscillation" is sufficient to properly open and close the ports. If it can be managed, enlarge the ports slightly. You can obtain such a cylinder complete for about 7d. or 8d.



BILGE PUMP FOR MODEL ELECTRIC BOAT.

[184,69] **Switchboard Connections.** W. L (Peebles) writes: If I am not asking too much, would you do me a favour by filling in the connections on a diagram of a switchboard which you will find enclosed?

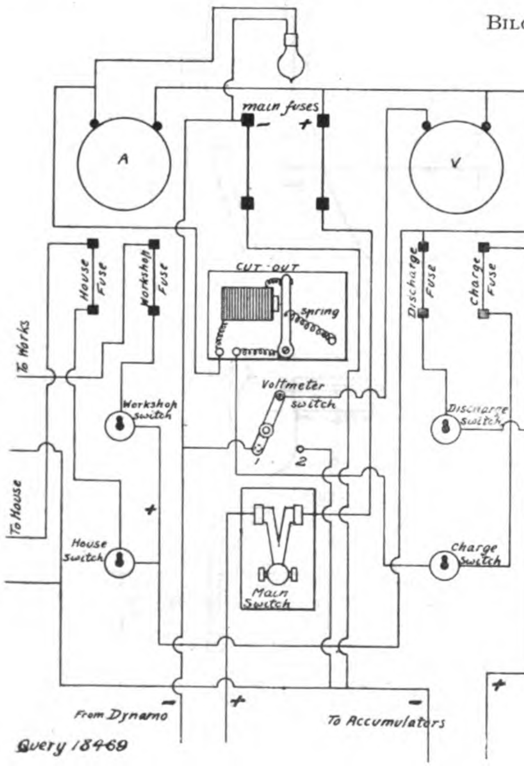


DIAGRAM SHOWING CONNECTIONS FOR SWITCHBOARD.

Main switch to be switched on before any of the smaller switches can be switched on. When main switch is switched on current to pass through the two fuses, through lamp at the top of the board, and through the two meters. Voltmeter switch (1) for dynamo voltage, (2) for accumulator voltage. I wish cut-out to be connected with small switch named "charge" only. By switching on discharge switch I could be able to light lamps in either workshop or house or both.

We give diagram of switchboard connections herewith which will meet your requirements.

[18,347] **Leclanches for Charging; Lighting Lamps in Series.** J. A. B. (Heyside) writes: I have bought your handbooks on "Electric Batteries," "Accumulators," and "Electric Lighting for Amateurs," but have not been able to understand the following:—(1) How to make a battery for an electric torch. (2) How do you charge accumulators by Leclanché cells? Also, does it do the Leclanché cells or accumulator harm to leave them connected up when fully charged—that is, when neither is in use? (3) I have a 4-volt curved pocket accumulator, but the terminals are eaten away and one broke in the filling at top. Now, how would you repair it and what is the material you use for the top and to stick the vulcanite in the vents? (4) Supposing I had a dynamo giving 40 volts and I wanted to light eight different lamps of 5 volts each in different places, how should I wire it?

(1) A dry battery as described in handbook is very suitable for this purpose, but the lamp used should be very efficient, and take a small current; certainly not more than ½ amp. (2) If you turn up your back numbers of this Journal, you will find some correspondence on this subject. The Leclanché cells should be coupled up in series with each other, so that the sum of their voltage is a little higher than the accumulators being charged. Thus, the latter will be continually charging at a low rate, the rate decreasing as they get more and more fully charged. (3) Molten pitch with a little bee's-wax is a good filling for the tops of accumulators. It sets hard when cold, and holds the vent tubes in position. (4) The lamps will have to be run in series and each lamp must take the same amount of current—*i.e.*, be of same candle-power, otherwise they will not burn with the same brilliancy.

[18,514] **Boat Building.** L. E. P. (Newport) writes: I have been most interested in your yachting articles, and having built a very successful model from drawings from an old number which I had given me, I am desirous of "going one better," and making a big one for sailing in, and write to you in the hope that you will help me. The idea is one commonly known as a "cat boat" or "skim dish," and for ballast I propose fixing a fin-keel weighing 4½ cwt., no inside ballast. (1) Could it be built by an amateur? (2) Would white pine be suitable? (3) Would she be fast (about 8 knots)? (4) Would you kindly give a rough sail plan? The mainsail in the sketch (not reproduced) is on the lug sail principle, the gaff going up on a hook only with the bottom of the sail fixed to a boom. Would this be satisfactory, as I am given to understand that it is an easy spread to manage.

(1) This depends entirely upon his experience and capabilities. Many amateurs have built successful craft. (2) Yes; cedar or mahogany would be preferable. (3) We really cannot say. (4) You should, we think, consult some publication on the subject. *The Yachtsman*, 143, Strand, W.C., would supply you with a useful book on this matter. The rig you mention is quite easily managed single-handed.

[18,381] **Wiring for Electric Lamps.** A. O. G. (Wimbledon) writes: I should be very glad if you could help me in the following. My house is supplied with a current of 220 volts and I wish to use "Osram" lamp in one of the rooms where the connections are as sketch (not reproduced), there being three lamps controlled by two switches, and since "Osram" lamps are not made up to 220 volts I want to know if I could use three "Osram" lamps of $\frac{220}{3}$ = 73 volts (approx.) or only two of $\frac{220}{2}$ = 110 volts. It really consists of an electrolier with four wires coming from the ceiling, two of

which go to lamp A, two to lamp B, and lamp C is connected as shown to lamp A. If I could only use two lamps could I use an ordinary lamp together with the two "Osrams" to fill up the gap?

Whatever lamps you use in series the sum of their voltage must equal, approximately, the voltage of supply; and, moreover, lamps run in series must be of equal candle-power—*i.e.*, take the same amount of current. According to your diagram, lamps A and C are in parallel, and B is in series with A and C, hence the candle-power (or current consumption) of B is, or should be, twice that of A or C, or equal to that of A plus C (as these latter two may be of different candle-power though of same voltage). You should use any candle-power lamps you choose, but if your wiring cannot be altered so as to run the three or four "Osram" lamps in series, then work upon the above information *re* their relative candle-power.

[18,471] **Model Steamers.** C. J. H. D. (Warminster) writes: Would you please be kind enough to give me your advice on the following? If you will, I shall be greatly obliged. I am about to start making a small speed launch as per sketch enclosed (not reproduced). Length overall, 3 ft. 3 ins.; maximum beam, 6 ins.; depth (amidships), 4½ ins. (1) Are the above dimensions in proportion? (2) Would a ⅞-in. H.-P. by 1½-in. L.-P. by 1½-in. stroke compound engine, without air pump and condenser, give a fair speed at 50 lbs. boiler pressure? (3) Would the boiler illustrated on page 406 of Vol. IX, without the dome and fired by a blowlamp like the one illustrated on page 230 of Vol. XI, No. 176, be suitable? (4) How many revolutions a minute ought the propeller to revolve in air? (5) What ought the diameters of the water tubes, superheater, and steam pipe to be? (6) What is meant by the pitch of a propeller? (7) Would a propeller of 2¼ ins. diameter be suitable?

(1) Yes: generally the tumble-home is perhaps a little too marked. Make the deck 5 ins. wide amidships. (2) The engine is a little heavy. (3) No, the boiler you have chosen is quite out of the question. We would advise the boiler illustrated on page 46 of "Model Boiler Making" (Revised Edition). The diameter will have to be 4 ins. and the length 9 ins. Furnace tube, 2 ins. diameter. (4) This is quite beside the point, and nothing of value could be deduced from the performance of the model under such conditions. (5) Water tubes for boiler mentioned above, ¼ in. diameter outside. (6) The pitch of the screw or helices formed by the blades. (7) Propeller, 2 ins. to 2¼ ins.; pitch, 3 ins. See articles in Vol. VIII on Propellers.

[18,516] **Small Oil Engine.** "LIONEL" writes: I am wishing to make a small paraffin oil engine (or petrol), tube ignition, of a capacity of 1-100th h.-p. Will one of your readers kindly assist me with the necessary details and information?

You should read up the recent articles in back numbers. See Mr. Smith's description of his engine in early part of Vol. XVII.

[18,517] **Carbon for Batteries.** R. A. W. (S. Woodford) writes: I am making some batteries of the type described on page 16 of THE MODEL ENGINEER, July 1st, 1901, No. 52 of Vol. V. I have got everything but the gas carbon, which I cannot obtain because the gasworks are closed whenever I can go to them. Will you kindly tell me of a substitute, or if I can get the gas carbon elsewhere?

You will find coke answers your purpose almost as well. Any of our electrical advertisers would supply you.

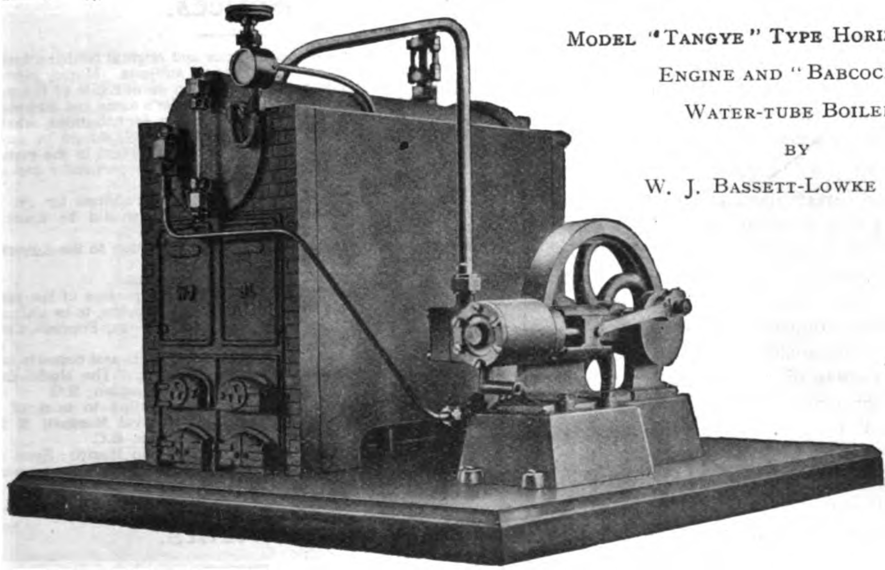
The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

* *Reviews distinguished by the asterisk have been based on actual Editorial Inspection of the goods noticed.*

*** Workshop Appliances and Castings.**

We have recently received for inspection from Mr. A. G. Powell, of Morledge, Derby, a small bench lathe (2½-in. centres) capable of taking work 9 ins. long. The over-all dimensions of the base are 22 ins. by 3½ ins. The lathe is suitable for the beginner requiring a cheap tool, considering the low price, we think it of good value. For a slight increase in cost, the lathe may be had with 18-in., 24-in., and 30-in. bed; castings and forgings for construction of lathe are also supplied. Other specimens sent to us show to what extent Mr. Powell can meet the needs of our readers, and include castings and parts for a 1-12th h.-p. high-speed engine, also castings for a petrol motor, and miscellaneous items in iron and gun-metal, which appear to be quite satisfactory.



MODEL "TANGYE" TYPE HORIZONTAL ENGINE AND "BABCOCK" WATER-TUBE BOILER, BY W. J. BASSETT-LOWKE & CO.

Several specimens of taps, dies, chasers, etc., and some examples of small spur wheels cut from the solid are such that we would recommend readers who require similar articles to send to the above address for price list, mentioning THE MODEL ENGINEER in their application.

New Catalogues and Lists.

W. J. Bassett-Lowke & Co., Northampton, have sent us a copy of the latest issue of Section B of their catalogue. The usual contents of this section comprise model vertical and horizontal engines, boilers, engine and boiler fittings, materials required by model engineers such as sheet metal, rod, tubing, bolts, nuts, etc., also miniature working machine tools, and a large selection of tools and appliances suitable for the amateur mechanic's workshop. A new line which Messrs. Bassett-Lowke are introducing is included, being a model "Tangye" type horizontal engine with "Babcock" water-tube boiler, as shown in the accompanying illustration. Other new items illustrated in the list are model oscillating launch engines, "Tangye" engine, "Tangye" engine and boiler, MODEL ENGINEER small undertype engine, "Babcock & Wilcox" boiler. There is also a fine selection of new locomotive wheels, from 7-16ths in. to 3 ins. scale. The price of the list is 4d.

Archibald J. Wright, Ltd., Leyton Green Road, London, N.E.—We have received a list of electrical novelties which this firm supply, such as pocket flash lamps, electric torches, scarf pins, model "Metropolitan" and "Tube" electric trains, electric tramways, and accessories. The list will be sent post free to readers of this journal.

The Editor's Page.

HEARTY good wishes to all our readers for health and prosperity in the coming year! May their interest and their achievements in their hobby, and in their business, beat all records.

* * *

The subject of the coloured plate which we present with this issue is rather a novelty from a model making point of view. Quite a number of readers have at one time or another asked us for a model fire engine design, and we hope that the type we have selected for treatment will prove generally acceptable. It has the merit of being quite up-to-date, and also has the double attraction of being a self-propelled vehicle, as well as a steam pump. From the point of view of appearance, a fire engine has much in its favour, and our design should make up into a very handsome model. It will provide ample scope for those who like to impart a high degree of finish to their work.

* * *

We should like to direct special attention to a series of articles we are commencing in this issue on the subject of "How to Become a Mechanical Engineer." We receive so many requests, both from youths and from their parents, for advice on entering the profession, that we feel sure the present series will be of much value. In addition to a general explanation of the various branches of mechanical engineering and the prospects in each, particulars will be given of the apprenticeship and pupilage systems of several leading engineering firms, which, we are sure, will be of great interest. We may perhaps remind our readers that we have already dealt with the subject of "How to Become an Electrical Engineer" in a series of articles in our issues for July 1st and 15th and August 1st, 1902. These issues are still in print, and may be obtained from our publishing department post free, 3d. each.

* * *

By the time this issue is published, the 1907 Model Speed Boat Competition will have closed. From what we hear at the time of writing, the 1906 record will be wiped out pretty handsomely, and some new figures set up which will take a lot of beating. We shall publish the results in the first possible issue.

* * *

On the first page of this issue we commence an article describing the building of a model battleship. We have only included a very small instalment of the article owing to there being numerous detail drawings to follow, which, we think, readers like to have kept together as far as possible, and space in this issue would not allow of their appearance. The article will be continued next week.

Answers to Correspondents.

G. H. R. (Brightside).—Messrs. W. J. Bassett-Lowke & Co., Northampton, will supply you with what you require.

E. DE BATZ (Bordeaux).—(1) You can only cut threads of a limited number in this way, depending on the ratio of the speed of feed screw and lathe mandrel. See "Practical Lessons in Metal Turning," by P. Marshall, 2s. 6d. post free. (2) If connected as a shunt machine without rewinding, the output would be considerably reduced, as a high resistance would have to be used in the field-magnet circuit. We do not advise it.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 26-29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[The asterisk (*) denotes that the subject is illustrated.]

THE

Model Engineer

And Electrician.

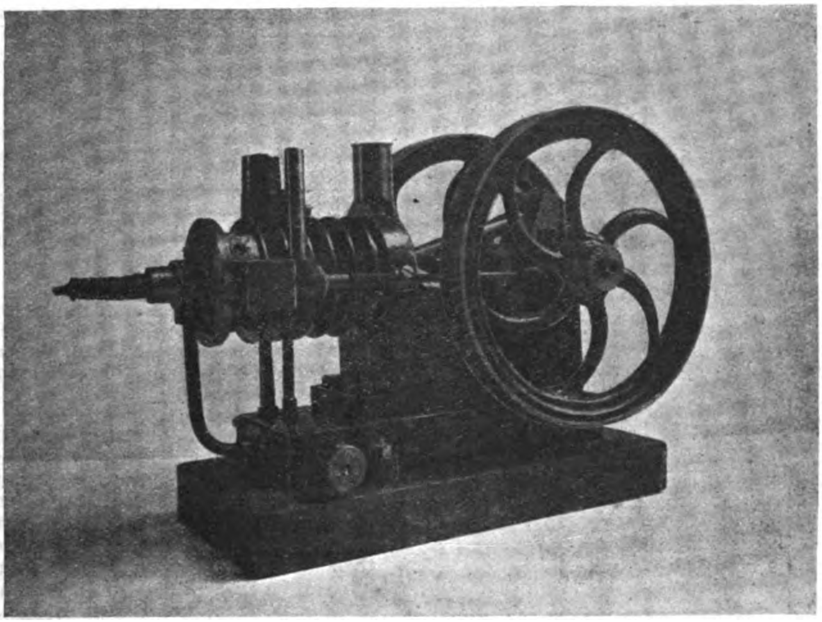
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 350. JANUARY 9, 1908. PUBLISHED WEEKLY

A Model Gas Engine.

By JOHN EAGLE.



MR. JOHN EAGLE'S MODEL GAS ENGINE. *(Cylinder: 1 in. diam., 2 in. stroke.)*

THE accompanying photograph may be interesting to fellow model makers. It is of a 1-in. by 2-in. atmospheric gas engine. Gas engines for some time past have been of special interest to me, mostly because no boiler is required, and I think model makers have not given this type the honour and attention it deserves. My first two engines were made from bought castings, but lately I have made my own designs and patterns, and this makes the engine more my own than when made from bought castings; another point in its favour is that if the amateur is at all faddy, he gets just what he fancies.

The main dimensions of this engine are: Cylinder, 1 in. diameter; stroke, 2 ins.; flywheels, 5 ins. diameter; crankshaft, 9-32nds in. diameter; exhaust valve spindle, ⅛ in. diameter; inlet valve spindle, 3-32nds in. diameter; length over all, 10 ins; height, 6 ins.; diameter of inlet openings—air 3-16ths in., gas, three holes 23 B.W.G.; diameter of exhaust opening, ¼ in.; diameter of hole in burner, 23 B.W.G.; diameter of ignition hole in cylinder, 17 B.W.G. I might add that to find out these last two sizes needed the making of an experimental engine, which would account for fifty or sixty hours' work. The only guide in this was the instructions with one of the sets of castings, which spoke of "small holes" without giving the diameter. The puzzle was to find the drill size of "small holes."

The lower portion of the bed is cast hollow, forming the gas-bag, and a piece of indiarubber sheeting is inserted between the bed and the wooden base; this wooden base being hollowed out to allow for the expansion and contraction of the indiarubber.

To mention a few peculiarities of this engine: Have as little clearance as possible behind the piston and in the valve chamber. The spring on the suction inlet gas and air valve at the back of the cylinder must be very light, and practically only act as a buffer. Any machine oil used in the cylinder will soon cake on the sides and stop the engine. The crank should be turned out of the solid and the flywheels keyed on, as the explosion is so sharp a built-up crank is liable to be knocked loose. The engine fires on every outward stroke.

The speed of the above engine is about 500 r.p.m., and the time spent in the making as follows—Working drawings, six hours; patterns, sixteen hours; machining, forty-seven hours; adjusting, painting, and fitting up, eleven hours: total, eighty hours.

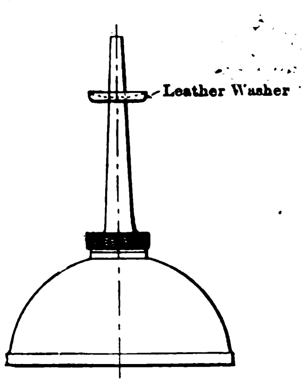
Workshop Notes and Notions.

[*Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked* "WORKSHOP" *on the envelope.*]

Oil Can Drip Preventer.

By W. CONRAD.

The accompanying sketch makes clear a hint with regard to oil cans, and needs little explanation. The idea of the leather washer is to keep any oil from running down the outside of the spout on to



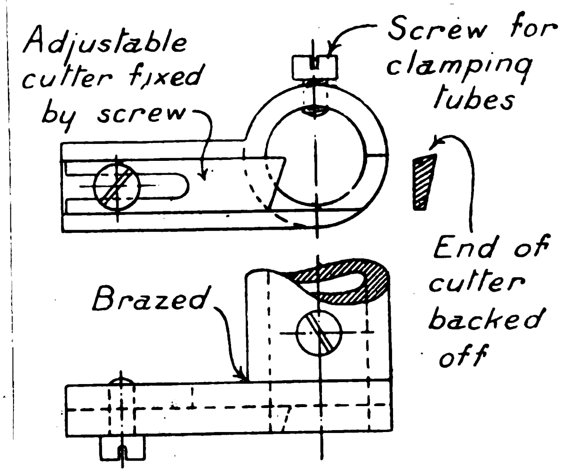
OIL CAN DRIP PREVENTER.

the bench, or wherever the can happens to be. I do not claim this to be an original idea, but think there may be some of your readers who have not seen it.—*American Machinist.*

A Useful Pivot Cutter.

By H. MAYER.

Much difficulty is often encountered in cutting pivots truly on the ends of long rods, and having several to do I designed and made the following tool, which I have found saves very much time. First procure a piece of round iron or brass, $\frac{3}{4}$ in. diameter $1\frac{1}{2}$ ins. long. Drill or bore a hole through this $\frac{1}{2}$ in. diameter quite true. At one end braze a piece of iron or brass 5-16ths in. by $\frac{1}{2}$ in. on the side (below the centre as shown). This end must now be turned true and a slot filed across $\frac{1}{8}$ in. deep, $\frac{3}{8}$ in. wide, one side of the slot being level with the centre. Drill and tap a 3-16ths in. Whitworth hole in the middle of the slot in the position as shown.



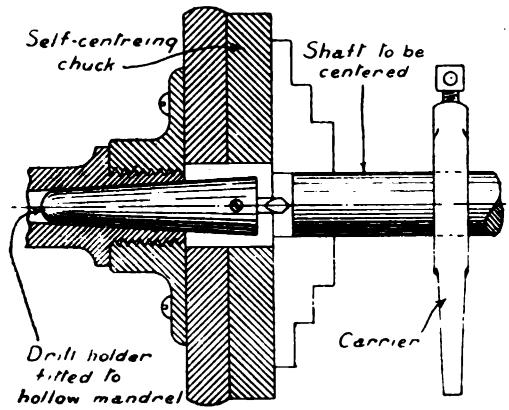
DETAILS OF PIVOT CUTTER.

This is for the screw to clamp the cutter, which is a piece of cast steel $\frac{1}{8}$ in. thick made to fit in the slot, the cutting edge to be filed as shown. A slot should now be filed down the middle of the cutter 3-16ths in. wide to within about $\frac{3}{8}$ in. of the cutting edge. This should now be hardened and tempered very light straw. The tool is now only suitable for cutting pivots on $\frac{1}{2}$-in. rod as the hole in the body is $\frac{1}{2}$ in., so pieces of iron must be cut off now $1\frac{3}{8}$ ins. long to fit in the $\frac{1}{2}$-in. hole. These pieces of iron are then drilled to fit over the metal on which pivots have to be cut. I find that the handiest sizes are 3-16ths in. by $\frac{1}{4}$ in. and 5-16ths in. by $\frac{3}{8}$ in. A 3-16ths in. Whitworth hole should be tapped in the side of the body to clamp these tubes and the tool is then finished. The tube, which fits the metal to be worked, is slipped in the body and clamped by the screw, the cutter set to cut the right size pivot, and with the rod running in the tube and held in the chuck, the cut is taken by feeding the cutter on by the back centre, and the pivot will be found absolutely true.

Centreing Work for Lathe.

By A. GREEN.

Nearly everyone must have experienced the great difficulty in centreing a piece of shaft or rod to turn or screw between the centres. Nine times out of ten, according to my experience, either the centre-punch mark is not truly central, or the drill draws away and the rod runs very much out of truth. Having a number of ⅜-in. brass rods to screw which



An Appliance for Centreing Work in the Lathe.

had to be true and kept to size, I arranged to drill the centres in the following manner: A piece of ½-in. mild steel was turned down to fit hollow mandrel and drilled to take drill point, a grub screw being fitted to hold it secure. The three-jaw self-centreing chuck was then screwed on lathe and closed over rod, which was held from turning by a carrier and fed up by back centre. This resulted in the rods being drilled absolutely true, quickly, and at one operation. It will be seen that any size up to capacity of chuck can be centred, and I recommend all fellow readers possessing a self-centreing chuck to fit themselves up with this arrangement.

Imitating Pewter on Brass.

A pewter-like appearance may be imparted to brass by boiling the castings in a cream of tartar solution containing a small amount of chloride of tin.—*Foundry.*

To the account of the Canadian Northern Railway, eighty-one engines and thirty-four passenger cars, and over twelve hundred other cars have been delivered from the beginning of 1907 to the present time.

An Expensive Model.—A model of the *Mauretania* has been made by Messrs. R. Smith & Co., a Stockton firm, for the Cunard Company at a cost of close upon £2,000. The model, which is 15 ft. long, has been on view for the benefit of local charities.

It has been proposed to use electro-magnets for lifting and handling large panes of glass. This is accomplished by placing a piece of sheet iron under the glass and applying one or more electro-magnets on the upper face of the glass. The electro-magnets attract the sheet iron, and thereby hold the glass suspended while moving.

A Miniature Electric Motor.

By F. Cooper.

When I started to build this motor my idea was to construct one as small as possible, and thinking that one with an armature less than ⅝ in. diameter would be very difficult to make, decided on this size.

The field-magnet stands 2 ins. high and is made of a piece of iron hooping ⅞ in. wide and 1-16th in. thick, bent to shape.

The yoke is a piece of 5-16ths-in. round iron, with shoulders filed at each end and riveted into the pole-pieces. The feet are tapped to receive screws through the base. The whole was then softened in the fire and given a coat of Brunswick black.

The armature is a six-cog drum—⅝ in. diameter and ⅞ in. long, and is wound in three sections.

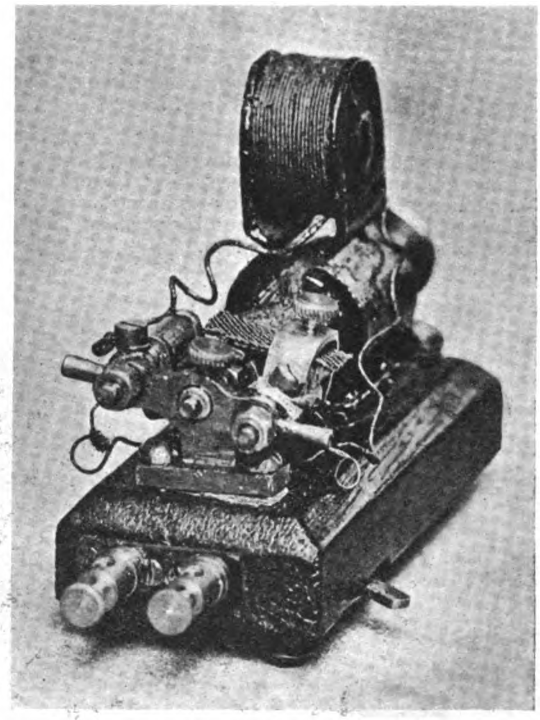


Fig. 1.—End View of Electric Motor, showing Brush Rocker.

It is built up of forty pieces of sheet iron, which were first cut into discs and drilled ⅛ in. for the shaft. They were then annealed and painted on both sides with Brunswick black; next, they were strung on a spindle and six slots 5-32nds in. by ⅛ in. filed in. The shaft is of brass, ⅛ in. diameter. A ⅛-in. Whitworth thread is cut along it to within ¾ in. of one end, and a nut run along it. The laminations were then strung on, and another nut binds them together tightly.

Both armature and field-magnet are wound with No. 30 B.W.G. d.c.c. wire, and well shellaced.

The commutator is made of a piece of ⅜-in. brass tube forced on to a piece of ebonite, and a hole drilled for the shaft. It was then sawn into three segments, each of which is held in place by seccotine. It was then put on the shaft and drawn up

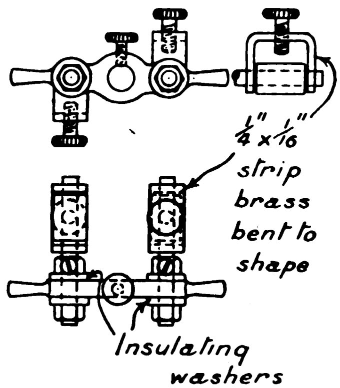


FIG. 3.—SKETCH SHOWING DETAIL OF BRUSH ROCKER. (*Full size.*)

against the armature with a nut, an ebonite washer being first interposed between the armature and commutator. The armature connections were then soldered to the commutator segments and a layer of string wound over them.

The brush rocker is a piece of sheet brass filed to shape, with handles turned at each end; it is fitted with a screw for holding it in position.

The brush-holders are carried by two pieces of ⅛-in. brass rod, passing through holes in the brush-rocker and drawn up by a nut on each side, insulating washers being first interposed on each side. The two inside nuts are tapped for screws with which to make the connections. Details of the brush-holders will be seen from the drawings (Fig. 3).

The brushes are two thicknesses of copper gauze. The pulley is ⅝ in. diameter, and has a setscrew for holding it in position on the left. The base is of polished mahogany, and is raised by four brass screws. The terminals are screwed into a piece of ebonite fixed to the end of the base.

A two-speed switch is fitted into the base, and a fuse made to blow at 1–5 amps. The field-magnet is enamelled green, and all brass parts are filed bright.

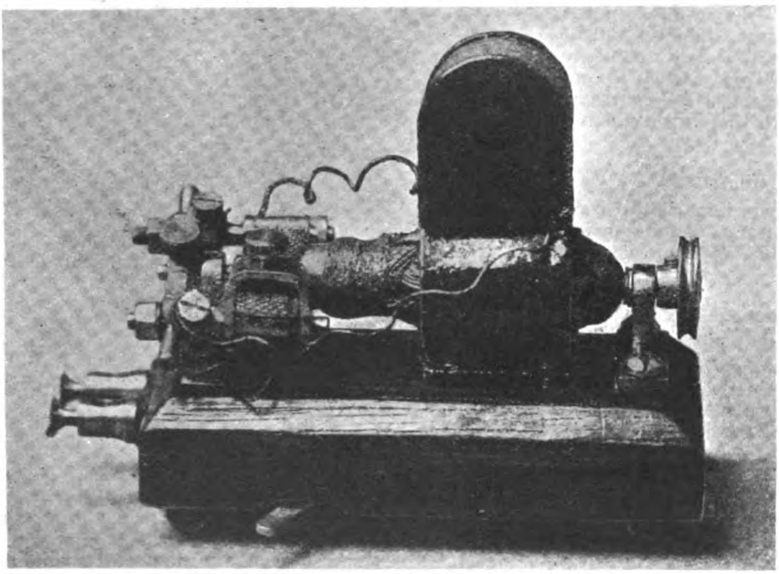


FIG. 2.—FRONT VIEW OF MR. F. COOPER'S ELECTRIC MOTOR.

The bearings are made of ⅜-in. by ⅛-in. brass rod, the upright piece having a shoulder filed at one end and screwed and soldered into the foot. One bearing has a 3-16ths-in. boss screwed in to carry the brush rocker. Oil-holes are drilled in the top of the bearings.

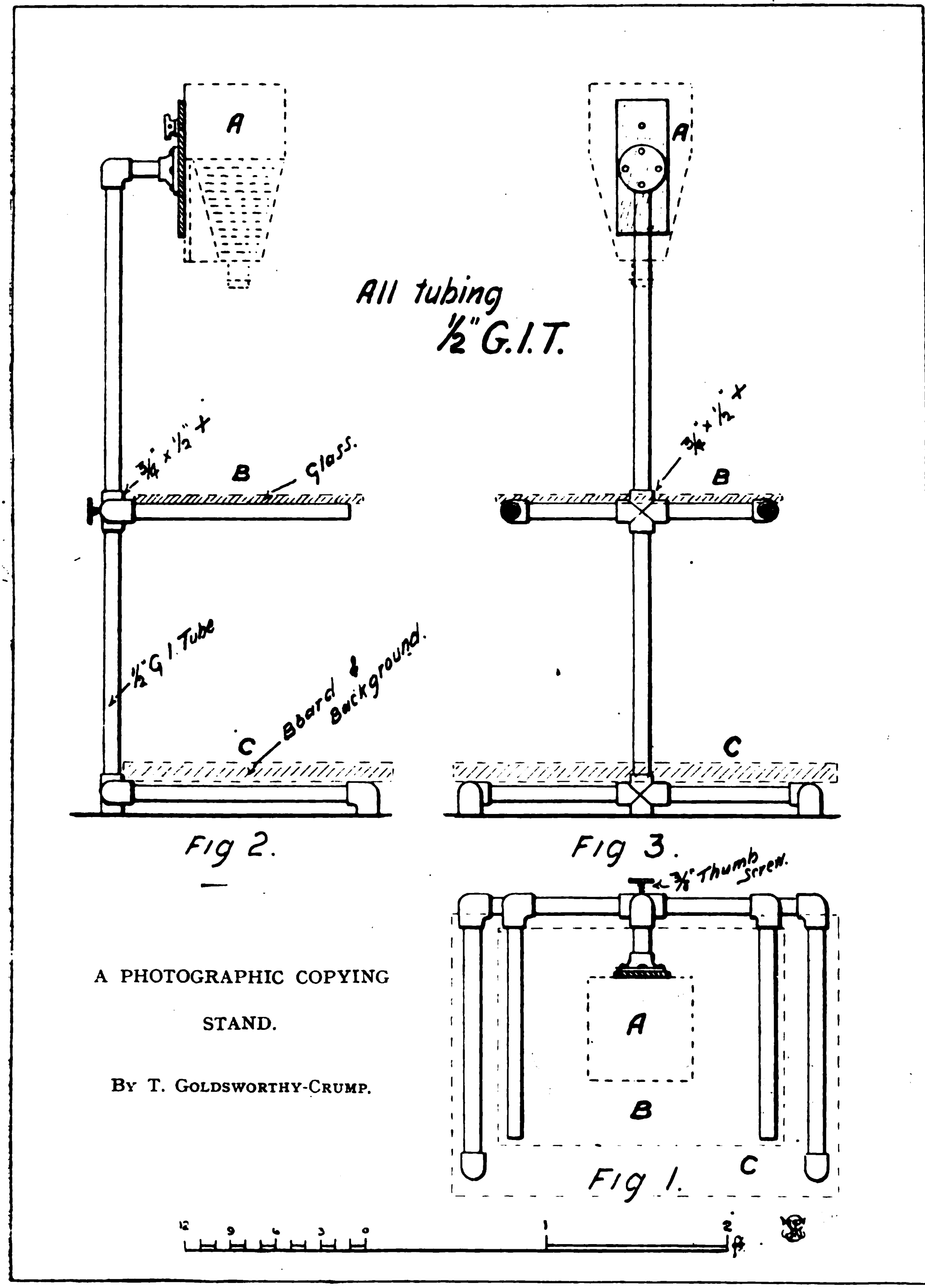
Photographic Copying Stand.

By T. GOLDSWORTHY-CRUMP.

IN looking through THE MODEL ENGINEER and other technical illustrated papers, one is often struck by the unsuitable position, bad lighting, and defective photographic rendering of the article depicted. These difficulties in many cases could have been entirely avoided by the use of a suitable support for the camera, object, and background.

For book illustration it is often an advantage to show an object with a perfectly plain background and no cast shadows. With the stand to be described this is a very simple matter, as will be seen presently.

On reference to the drawings, Fig. 1 is a plan, and Figs. 2 and 3 side and front elevations respectively. The stand is very easily constructed as the tubing can be obtained from an ironmonger cut to the various lengths and screwed ready for assembling. The various elbows, T's, and +, etc., are standard fittings, and are clearly shown on the drawings. Note that the + piece, which carries B, has two ½-in. on one ¾-in. so as to allow of sliding on the upright member. Should there be any slackness in the screwed joints when brought into position, a small hole should be drilled through elbow and pipe and a pin fitted. The ends of elbows and + which come in contact with the ground, should be corked so as to prevent slipping and damage to the floor.



A PHOTOGRAPHIC COPYING STAND.

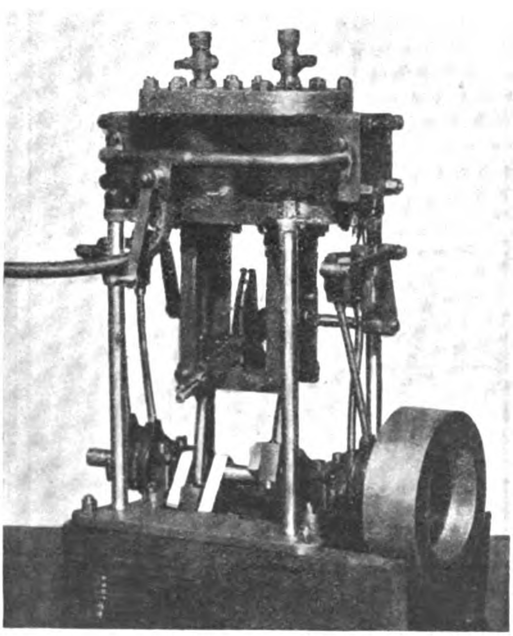
BY T. GOLDSWORTHY-CRUMP.

The camera A is attached to a board which is screwed to the iron flange. The sliding frame B is capable of being fixed at any height by means of the thumbscrew, and carries a piece of glass or board to support the object being photographed. The base C carries a fairly heavy board on which the background—generally paper—can be laid ; or, if necessary, a mirror can be adjusted at a suitable angle to reflect the light upwards for a transparent subject. It will now be seen that any article placed on the glass plate B with a white background at C will be rendered in the finished photograph as entirely isolated without cast shadows, and the somewhat troublesome operation of blocking out is avoided. This is also a most useful piece of apparatus for copying drawings or pages from books, and, in fact, any small object. Total cost of stand, 11s. 6d.

A Model Marine Engine.

By H. Fairhurst.

THE photograph below represents a double-cylindered marine engine, designed and constructed by myself during three months of my spare time. The engine is 1¼-in. bore and 1¼-in stroke, the cylinders being cast in brass. The



Model Marine Engine, constructed by Mr. H. Fairhurst.

crankshaft was made from a steel key drilled, cut out, and twisted in the ordinary way. The slide-bars are attached to the cylinder covers with set screws, and are made permanent at the bottom with stay bolts, which also hold the reversing lever quadrant. The connecting-rods have marine ends, the crosshead being cut out to receive the fork portion. Stephenson's reversing gear is fitted to this engine, all the motion work, including slide-bars, connecting-rods, pedestals, levers, and bed-plate, were made from solid pieces of steel. Taper pins were fitted in the crossheads and reversing shaft levers. The steam ports, which are ⅛ in. by ⅝ in., and exhaust 5-32nds in. by ⅝ in., were cut out and filed square, the valve having a travel of 5-16ths in., with 1-32nd-in. lap and 1-32nd-in. lead. The eccentrics, which are separate, were held with grub screws while being set, and afterwards sweated on the shaft. The steam and exhaust pipes have all sweated and screwed joints, the regulator fitting near the reversing lever. The engine works very well, and is considerably powerful. Every part of the engine was made by myself, including nuts, screws and oil cups. I started this interesting hobby through reading The Model Engineer, to which I am greatly indebted.

The Latest in Engineering.

Gas-Driven Boat.—The ex-naval gunboat *Rattler*, which for some considerable time has been in the hands of Messrs. William Beardmore & Co., undergiong the change necessary to equip her with propulsive power on the gas engine system, has recently been put through thorough tests as to speed, using anthracite coal as fuel for gas production, and the results, the *Times* reports, are considered highly satisfactory. The engine installed is of 600 i.h-p. of the Beardmore-Capitaine type. Developing this power and running at 89 revolutions, the engine has driven the *Rattler* at 11¾ knots speed as the mean of three runs over the measured mile.

Greenwich Time for Ships.—In order to afford to passing ships an opportunity of obtaining correct Greenwich mean time for regulating their chronometers, the German Atlantic Cable Company have set up, at the expense of the German Government, an astronomical clock at Horta in the Azores, on the Island of Fayal, to which regular time signals are transmitted by cable from the Hamburg Observatory every Monday between 9 and 9.20 a.m. mid-European time. The signals, which take place over a period of 30 seconds at intervals of five seconds, are sent in each direction, as the pendulum clock is provided with automatic contacts for intervals of five seconds, and when the signals are ended the observatory sends back the error in order that the clock may be adjusted to correct time. It is stated that the system works well and gives satisfaction.

Railway Train Speeds.—In the summer railway time-tables are to be found at least three trains booked to run at speeds above 60 miles per hour. Of these, the fastest is from Darlington to York, on the North-Eastern Railway, 44¼ miles booked at 61·7 miles per hour. The next fastest is on the Caledonian, from Forfar to Perth, 32½ miles, at 60·9 miles per hour ; and the third, from York to Darlington, on the North-Eastern Railway, at 60·3 miles per hour. These distances are, however, comparatively short, and for long-distance travelling the best runs are to be found on the Great Western Railway, Paddington to Bristol *via* Bath, 118¾ miles, at 59·2 miles per hour; or *via* Badminton, 117¾ miles, at 58·8 miles per hour.—*Mechanical World.*

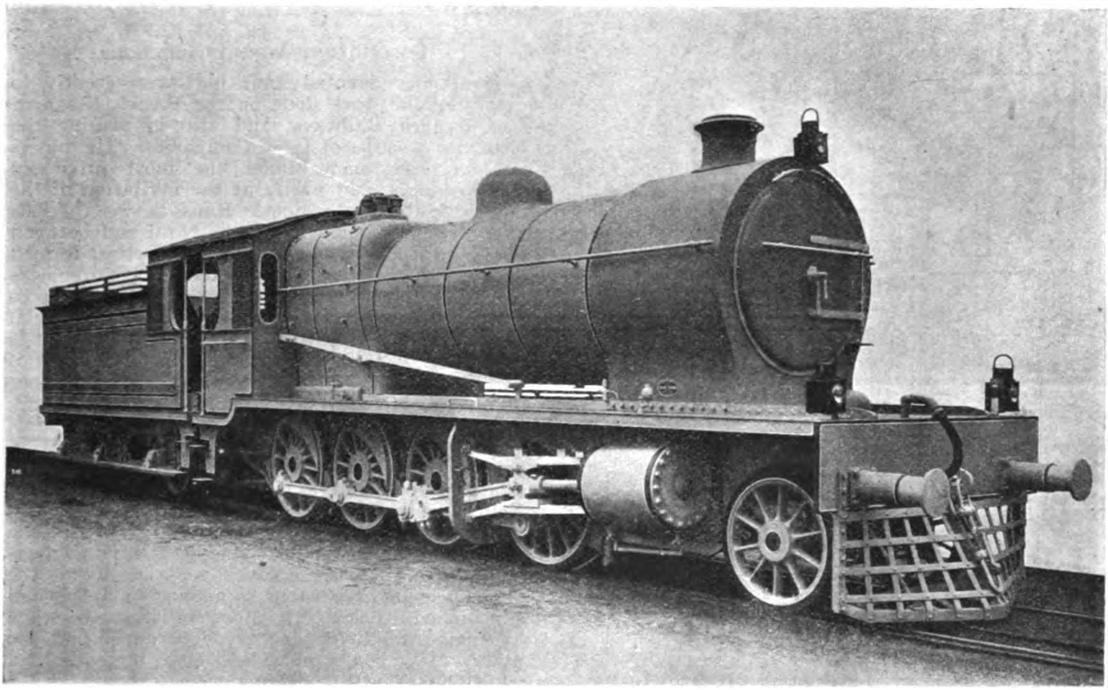
Advance of the Turbine.—According to a recent utterance of Hon. Charles A. Parsons, the turbine inventor, six years ago there were 75,000 horse-power of turbines on land and 25,000 on sea. At present there are more than 2,000,000 horse-power on land and 800,000 horse-power at work or building for use at sea.

Locomotive Notes.

By Chas. S. Lake, A.M.I.Mech.E.

New Indian Locomotives.

The latest locomotives to be despatched to India from this country are some very large "Consolidation" type engines which have been built at the works of the Vulcan Foundry, Ltd., at Newton-le-Willows. The first of these engines is illustrated herewith by courtesy of the builders. The design is substantially that recommended by the Engineering Standards Committee for Indian Locomotives. Outside cylinders driving the second pair of coupled wheels are employed, and the slide-valves, which are of the Richardson balanced pattern, are worked by Stephenson link-motion. The boiler is built of steel plates and is fitted with the Belpaire type of firebox upon which are mounted four safety valves of the Ramsbottom type. The two-wheeled truck at the leading end is of the swinging bolster pattern compensated through the beam to the spring of the leading coupled wheel.



"Consolidation" Type Locomotive: North-Western Railway of India.

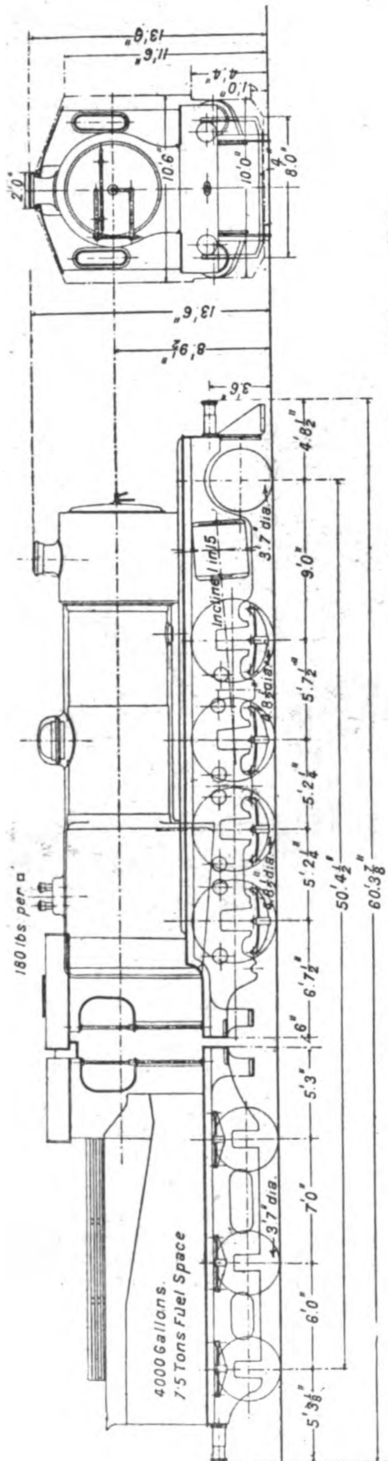
The lateral movement of the truck is 5¼ ins. or 2⅝ ins. each way. The weight of the bogie complete is 2½ tons. These locomotives are among the heaviest and most powerful of any yet built in this country, and the work put into them, as the writer can testify from actual observation at Newton-le-Willows during their construction, is of the highest character. The order is for forty engines and about ten of the number have been completed. They are for heavy goods train service on the Indian Government, or North-Western Railway, and they will have to perform under the most arduous conditions, with trains of 900 tons weight behind the tender and more on occasions. A few of the leading dimensions are given below:—

Cylinders: Diameter, 20 ins.; stroke of pistons, 26 ins.

Wheels: Truck diameter, 3 ft. 7 ins.; coupled, 4 ft. 8½ ins.

Wheelbase: Rigid, 16 ft.; total engine, 25 ft.; total engine and tender, 50 ft. 4½ ins.

Boiler: Height of centre above rail, 8 ft. 9½ ins.; diameter of boiler, 5 ft. 6 ins.; length, 12 ft. 6 ins.



Weight empty	5·75 tons	7·4 tons	8·15 tons	13·6 tons	13·7 tons	14·5 tons	14·4 tons	7·5 tons.
" in working order	15·6 "	15·6 "	15·15 "	15·75 "	15·8 "	15·8 "	15·8 "	8·1 "

Total weight empty—engine ... ... 63·7 tons.
" " tender ... ... 21·3 "
" " engine and tender ... 85·0 "

Total weight in working order—engine ... ... 71·25 tons
" " " tender ... ... 46·65 "

"CONSOLIDATION" TYPE LOCOMOTIVE: NORTH WESTERN RAILWAY OF INDIA.

Heating surface: Tubes, 1,914 sq. ft.; firebox, 173 sq. ft.: total, 2,087 sq. ft.
Grate area, 32 sq. ft.
Working steam pressure, 180 lbs.
Weight of engine (in working order), 71¼ tons.
Weight available for adhesion, 63¼ tons.
Weight of tender loaded, 46¾ tons.
Capacity of tender—for water, 4,000 gallons; coal, 7½ tons.

The manner in which the weight is distributed may be gathered from the accompanying diagram.

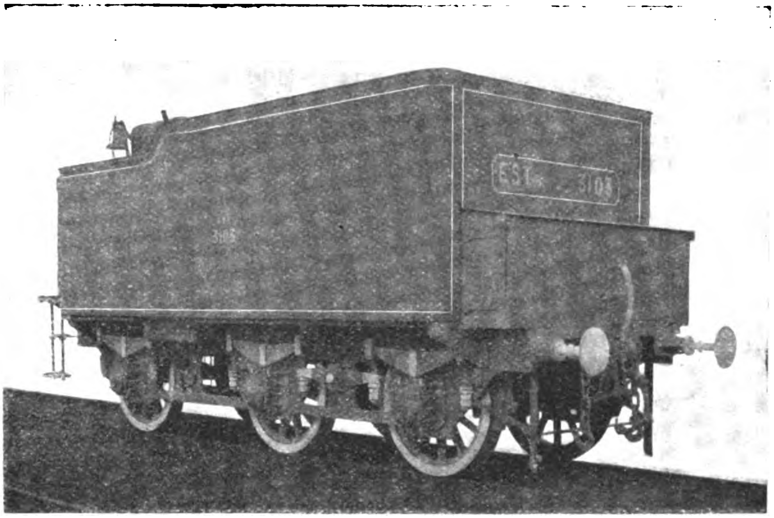
LOCOMOTIVE WORK IN FRANCE.

The writer devoted some ten days recently to observing the work done on the French Northern and Eastern Railways, and also in visiting the locomotive works of these Companies. The observations were made under the most privileged circumstances, and partly at the invitation of the authorities of both lines. Runs between Calais and Paris and Boulogne on the Nord and between Paris and Epernay and Belfort on the East formed a part of the programme, and the writer was assisted in the compilation of notes by being provided with gradient diagrams, train loads, official passing times, and other data, without which it is impossible to form a true estimate of the value of locomotive work. The work done by the engines of both Companies was equally meritorious, and, in many respects it certainly was superior to what we are accustomed to in this country, and that, of course, is saying a great deal. Two of the trips made on the Eastern Railway between Paris and Belfort were with the heaviest and fastest trains in the day, and the return journey to Paris in one case was made by the through Rapide from Switzerland. The engines employed were mostly of the Series 9, which have four compound cylinders and six-coupled drivers. The Epernay runs were made by engines of the 4—4—0 type, Series 8; and also by 4—6—0 compounds belonging to Series 10, which have smaller driving wheels than Series 9 engines.

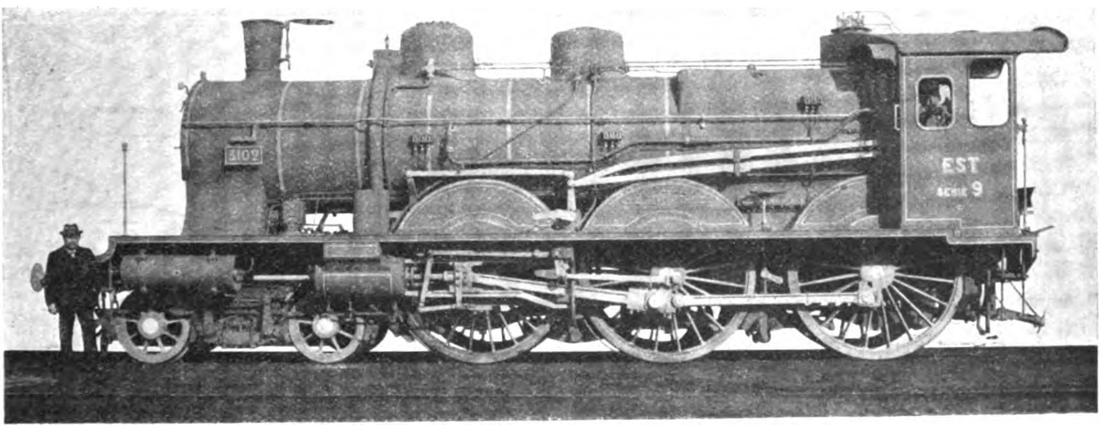
Although the writer is not at liberty at the present juncture to give in these notes the detailed particulars of the runs it will be possible in a later issue, should the Editor deem it sufficiently interesting, to give not only the speeds attained but also some additional and as yet unpublished matter showing what is being daily performed on the two French railways mentioned above. The rolling-stock of which the trains were made up was of the most comfortable description, the whole of the vehicles being of the bogie type with side or centre corridors and vestibuled ends. The writer, in addition to inspecting the railway shops, was courteously afforded facilities for looking over the works of the Société Alsacienne de Constructions Mécaniques at Belfort and Mulhouse, and saw much of interest there. A visit to the very fine new station at Bâle, where an opportunity of examining some of the latest Swiss and Baden State locomotives presented itself, was not the least interesting item of the tour. The drivers on many of the fastest trains on the Est line make a practice of wearing motor "goggles," and in this respect they differ from any others so far as the writer has seen on the Continental railways, either on this or on previous occasions.

A New Locomotive Type on the Nord.

When passing through the engine erecting shop of the Paris La-Chapelle works of the Northern Railway of France recently, the writer was shown a locomotive recently built for the Company by Schneider and Co., of Creusot. It has the same cylinder arrangement as the other compound locomotives employed on this line, viz., the usual de Glehn disposition of cylinders and valve gears, but in place of the pair of carrying wheels under the firebox there is a four-wheeled bogie, thus converting the engine into 4—4—4 type. The firebox is of the wide type, and rests at each side on the top of the engine frame. It is fitted with water tubes which connect at the bottom with a collector fed with hot water from the boiler through two outside pipes, one on each side, starting from the vicinity of the steam dome. The water after evaporation enters a chamber at the top of the firebox, and then traverses a large internal pipe running longitudinally along the boiler and passes to the regulator and thence through the pipe leading to the high-pressure cylinder.



Standard Tender for Eastern Railway of France: 4—6—0 Express Locomotive, Series 9



Largest Type of 4—6—0 Type Compound Express Locomotive, Eastern Railway of France. Series 9. (*Designed by* Mons. L. Salamon, *Ingénieur-en-Chef*.)

Cylinders: H.-P., 13⅜ ins. by 26 ins.; L.-P., 22 ins. by 26 ins. Coupled wheels, 6 ft. 10¼ ins. diameter. Total heating surface, 2,410 sq. ft. Grate area, 30·75 sq. ft. Working pressure, 227 lbs. Weight (in working order), 70 tons 12 cwt. Adhesion weight, 51 tons.

By means of this arrangement the temperature of the steam is raised, and its dryness thereby increased before it reaches the pistons. The engine will be run for some time experimentally and, if it shows a material advantage over the ordinary type, will be adopted for more extended use. Near to this engine were two of M. du Bosquet's extremely large articulated tank engines under construction.

The first of this type to be introduced on the Nord Railway was exhibited at the Liège Exposition of 1905. It will be remembered that these engines have in all fourteen wheels, of which twelve are coupled in groups of six each, and the usual disposition of cylinders, flexible piping, etc., is present.

Model Making for Beginners.

A Model of H.M.S. "Black Prince."

By C. F. W. and A. R. H.

(*Continued from page 2.*)

THE next job taken in hand was cutting the ports for the ten 6-in. guns. After gauging them from the deck for height and marking off for width, taking great care to get them exact on both sides, they were roughed out to a depth of ½-in. with chisel and mallet, and then finished to correct size with a sharp chisel of slightly smaller size than the port's smallest dimensions, care being taken to leave the edges square and sharp. At a much later stage they are finished off and fitted with guns and doors (see Fig. 14).

The port holes were spaced off with dividers, then drilled with a small twist drill to a depth of about ½ in., but of a slightly smaller diameter than that of the finished port hole. Each hole will now have a burr round it. Remove this with glasspaper. Now the hull is painted, no care being taken to keep the paint out of the ports. When the paint is quite set a steel pin is pushed in with a rotary motion in one direction only, and then withdrawn. If this is repeated after every coat of paint is dry a very round clean hole will result. The hull is broadest about 1 in. below the deck level. The stern tubes are worked up out of American white wood and glued on to the hull. A rolling keel, ¼ in. by 1-16th in. by 14½ ins., is fitted each side by seccotine and nails (see photographs).

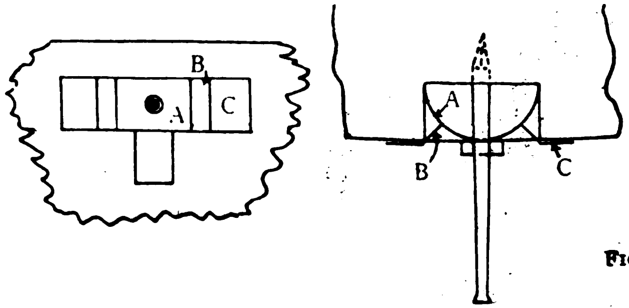
Superstructures.

Forward: Built of American whitewood (see plan) with a pasteboard deck overlapping all round about 1-64th in. There are steps up each side in front, from the foc'sle. It has railings all round, and carries the conning-tower, six machine guns (3-pounder semi-automatic), navigating officer's room, and the bridge. It is reached by a ladder on the port side behind.

The bridge is built of thin cardboard, and has the charthouse on it. It is supported by four stanchions made of pins (see Fig. 15).

The charthouse has eight windows made by seccotining silver paper on to the front aspect and covering it with a piece of cartridge paper cut to the correct shape with windows. There is a searchlight on the roof, which is reached by a ladder.

Aft: Built in the same way, but square on plan. Carries eight machine guns, bridge, and two searchlights. It has doors on either side from deck, and a boom with gear to the mast (see photographs and elevation). The mainmast is stepped just for'ard



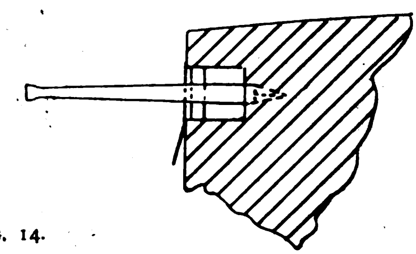


Fig. 14.

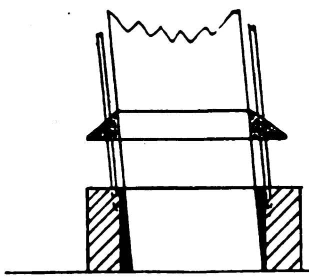


Fig. 8.

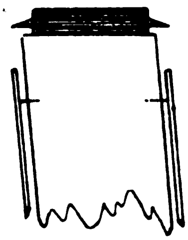


Fig. 9.

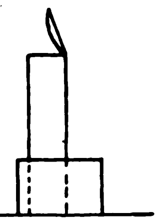


Fig. 10.

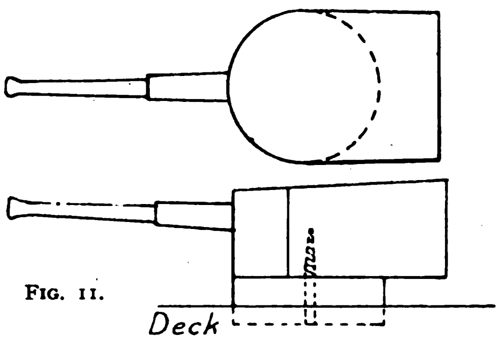
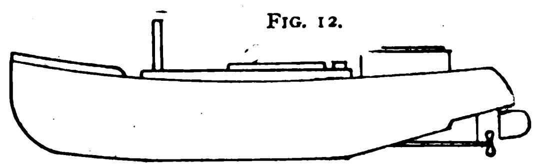


Fig. 11.

Fig. 12.



DETAILS OF MODEL BATTLESHIP.

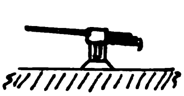


FIG. 5.

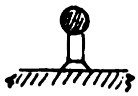


FIG. 6.

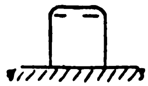


FIG. 7.


FIG. 17.


FIG. 19.

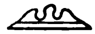


FIG. 20.

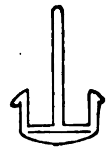
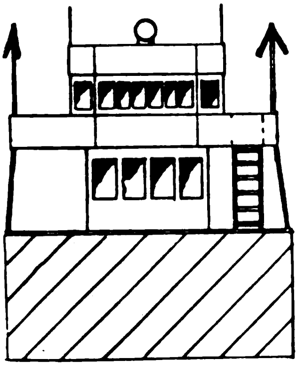


FIG. 21



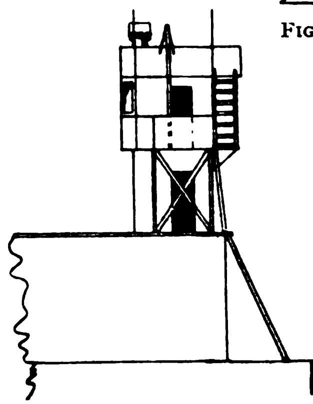
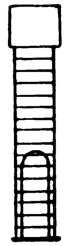


FIG. 15.



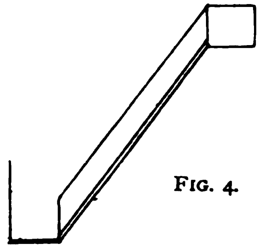


FIG. 4.

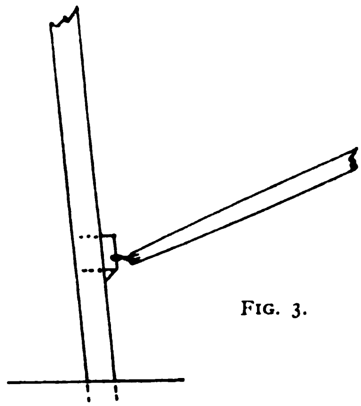
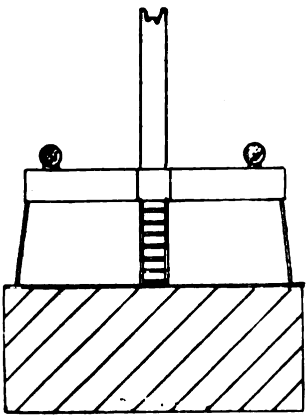


FIG. 3.



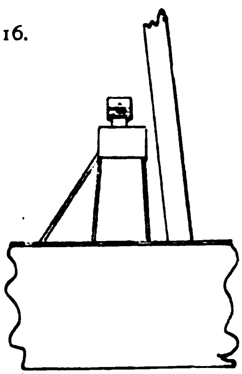


FIG. 16.

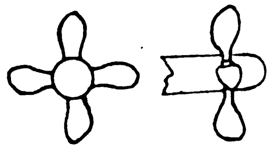


FIG. 13.

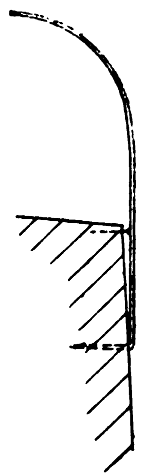
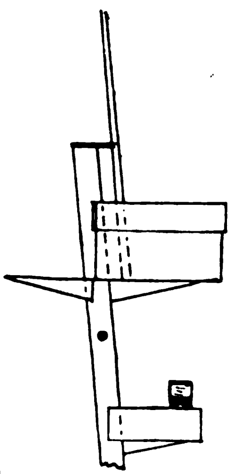


FIG. 18.



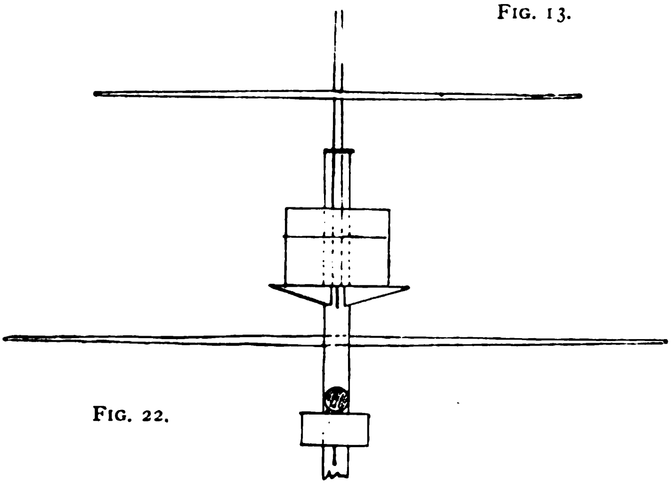


FIG. 22.

DETAILS OF MODEL BATTLESHIP.

of the bridge. There is a ladder on the starboard side to deck (see plan) and ladder up to bridge.

The fore and aft bridge joins the foc'sle to the after superstructure where it becomes continuous with the boat deck. It is made of pine planed to 1-32nd in. and is 14 ins. long, and has railings its entire length, which will be shown in elevation and plan. It has ten supports (in pairs) made of thick pins. The railings were very difficult to make. First their positions were marked off with compasses. The points were then pricked through with a pin, then the standards were cut and gauged to length, seccotined and pushed in flush with the underside and allowed to dry. The cotton "rails" start and end on firm pins in foc'sle and after superstructure, and are then seccotined to the intermediate pins without exerting any pressure. The boat deck carries three boats, a barge, picquet boat (Fig. 12), and steam cutter. We may here mention that a surgical scalpel, pair of scissors, and fine forceps are extremely useful tools for cutting and sticking paper and pasteboard.

Funnels are turned up from pine, diameter ⅞ in., height 3 ins. The required rake is given as follows. Each funnel is glued into a block of wood, the base, which has a hole bored through it of a slightly larger diameter than the funnel. They are held at the required rake until the glue is set, and then when quite hard, sawn off on the top to right height, the top being made parallel to the bases, finished off with "tops," rings round the lower part, and, two steam pipes (Figs. 8 and 9, and elevation). Funnel tops are built up of ten layers of cardboard discs of smaller diameter than the funnels, the sixth from the top being of greater diameter than funnel. then the sixth to third are filled up with wax and worked quite round (Fig. 9). Rings round the base are made of tight-fitting circles of cardboard and wax as in "tops" (Fig. 8). The steam pipes are eight in number, and are made of 1-16th-in. galvanised iron wire. They come from the base through the "rings" and to within ½ in. of the top of the funnel.

The masts are 3-16ths in. in diameter and 6¼ ins. high, and are worked round from American whitewood, and fit into holes in the deck which are bored in at the required rake (parallel with funnels). Care should be taken with this, as the slightest difference in rake gives the ship a peculiar and very noticeable appearance. Each mast carries a fire-control platform and crosstree, and below this a platform for a searchlight. The main mast carries a boom for hoisting in and out boats on the boat deck (see elevation and Fig. 1). This actually swivels to either side and lifts. It is made of American whitewood, and is fitted with a metal swivel made out of a pin bent at right angles and hooked into a small wire loop on the boom (Fig. 3), with a small triangle of cardboard underneath. The two sheaves on the tackle are punched out of cartridge paper, stuck on and painted black.

The top masts are steel knitting needles, and are seccotined to the floor of the fire-control platforms, and spaced from the masts by pieces of cardboard (see Fig. 22). Each carries a crosstree of fine wire seccotined on.

The rigging is made of black cotton, and can be seen clearly in the photographs. The main top-mast carries the Marconi gaff. Under each fire-control platform are three angle pieces made of cardboard.

(*To be continued.*)

How to Become a Mechanical Engineer.

By Alfred W. Marshall, M.I.Mech.E., A.M.I.E.E.

(*Continued from page 7.*)

THE present system of training young men as mechanical engineers, using the term in a broad sense, but excluding engine drivers and attendants, divides them into two main classes. In one the course of instruction is wider than the other, and is intended to suit young men desiring to become designers or engineers in the professional sense. They must (in general) be able to pay a large premium, say 150 to 300 guineas, and serve for at least three years. Experience is given in various departments of the work, and possibly theoretical instruction or facilities for obtaining it in addition. The other class of training (in general) comprises practical instruction in one department of work only, and a lad learns a handicraft; he becomes an artisan. Any theoretical or other information would have to be obtained outside the works during his leisure time. He may be required to pay a premium of, say, £25 to £50, and serve for a term of five to seven years, some firms, however, do not require a premium to be paid. The construction of engines and machinery has the following departments:—fitting, turning, blacksmith's work, boiler and metal plate work, iron founding, brass founding, coppersmith's work, pattern-making, carpenters' and joiners' work. Each of these is a distinct trade.

Fitting means putting together the various parts of a machine or engine which have been made by the other departments. When these parts have been made accurately to size by machinery, the fitting work is scarcely more than assembling them together. But if the parts are not entirely finished, or the system allows at least some of the smaller pieces to be in a rough state when they reach the fitting department, a considerable amount of finishing is done there. The work may include reducing surplus metal and finishing to a polished condition and size by filing, cutting by hammer and chisel, drilling holes by hand tools and machine, cutting screws by means of hand and power screwing tools, and scraping surfaces to remove surplus metal by hand scraping tools. Men who do this work are called fitters. Putting together the entire parts of a machine or engine is called erecting. It is really included in fitting, but involves the exercise of more extended thought than purely fitting work, as parts have to be assembled in order, adjustments of motions made, holes, rods and wheels fixed in line, and so on. Some fitters ultimately keep to erecting work.

Turning means finishing parts to size and polish by machines. Strictly speaking, the term defines work of this kind done with a lathe; but in general it is used to embrace all machine work. The parts made by the blacksmiths' foundry or other department are cut to size by lathes, planing, slotting, shaping, milling, and other machines. The men who do this work are called turners, planers, slotters, millers, and so on, but frequently a man is trained to work at several machines. Usually, however, he keeps to one particular kind of machine after his period of training is over. Some of these machine tools are of very large size, so large that a separate engine or electric motor is often used to drive one tool.

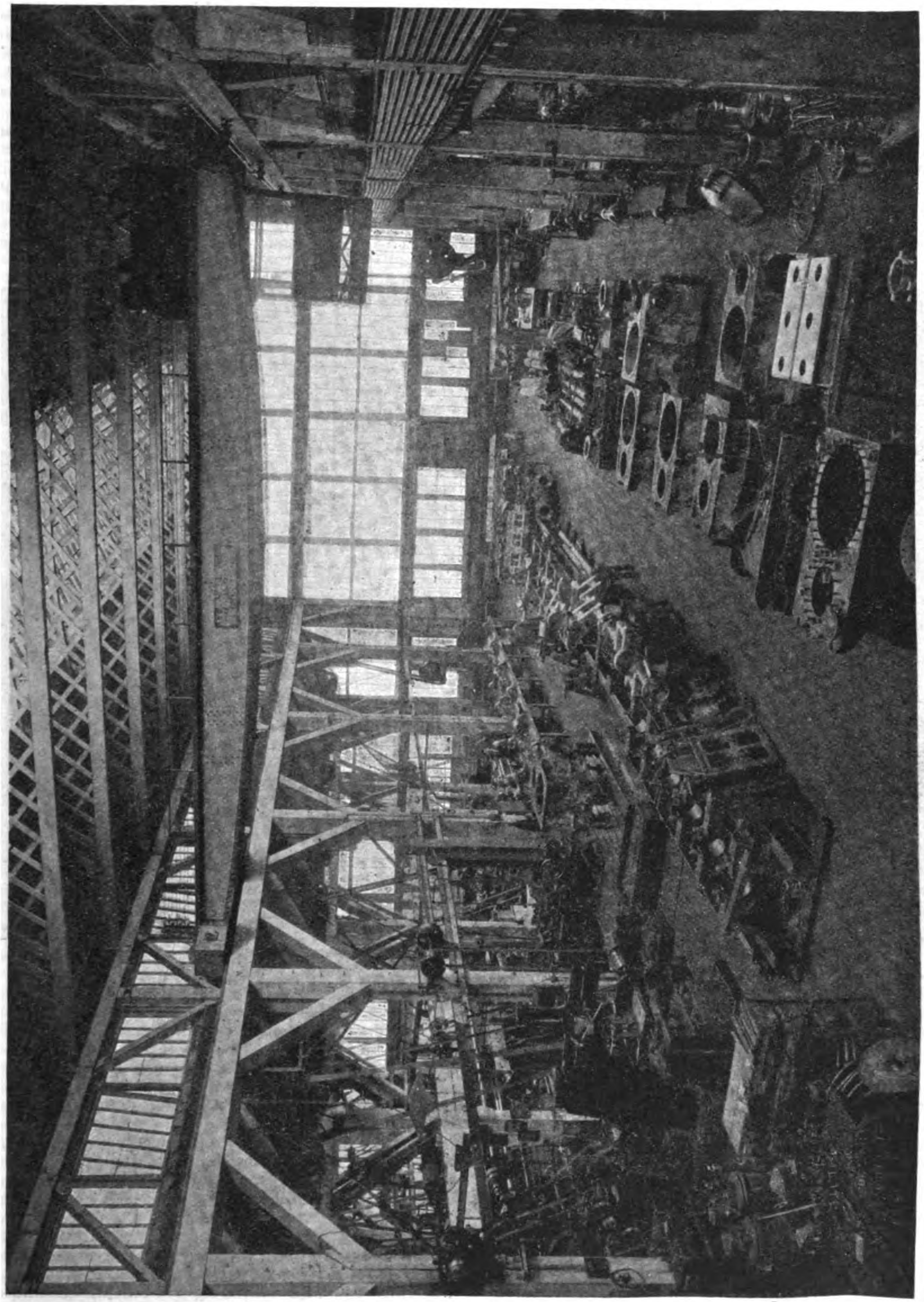


FIG. 2.—ONE BAY OF NEW ERECTING SHOP: MESSRS. J. I. THORNYCROFT'S WORKS, CHISWICK.

Blacksmiths' work comprises the forging to shape of machine parts in iron and steel. These parts may be large and heavy, so that steam hammers and presses worked by hydraulic power are necessary to do the work. The ordinary blacksmith's hand forge and tools give no idea of the immense furnaces, hammers, and appliances used in the smithy of a large engineering works.

Boiler and plate work is cutting, bending, and riveting together iron, steel and copper plates, punching and drilling the holes for the rivets, etc., assembling the parts and fitting on various accessories, such as cocks, valves, gauges, fire doors, and manhole covers, bending and fitting tubes in place, cutting screws in holes, and caulking joints by hammer and tool. Some of the work is very large and heavy, the plates being more than an inch thick. Men engaged in this trade are called boilermakers. The work, especially upon modern water-tube boilers, sometimes comes very near to fitters' work. Pressing machines of large size are used for the purpose of forming the sheet metal into flanged or dished shapes; the riveting is done by machines and hand-applied tools driven by compressed air or by hydraulic power, as well as by the older method of closing the ends of the rivets by ordinary hammers.

Iron and brass founding is the art of producing shaped metal by the process of pouring it into moulds when in a melted condition. When the metal has cooled and become solid it retains the shape of the mould, which is opened or destroyed to release it. Though the work is of a similar nature with both iron and brass, the men engaged in it usually deal with the one or the other only, and are called respectively iron moulders and brass moulders, technical differences existing in their methods. The mould consists of sand retained in iron frames, the shape being produced by a pattern piece which is made of wood or metal. This piece being buried in the sand leaves an impression of its shape when it is removed, and it is into the shape thus left that the molten metal is poured. The art of the moulder consists in preparing the sand so that the pattern leaves a true impression, and so arranging the mould that the metal can flow into all its parts. To this end he assists the effect of the pattern by various trowels and other tools, smoothing away irregularities, and providing channels through which the metal may enter and vents by which air or gases may escape. Though the primitive idea of founding is simple, in practice a great deal of skill and knowledge is required, owing to the complicated shapes of many patterns and behaviour of molten metal under various circumstances of flow. Very large shapes are moulded in the ground or in moulds built up to form a structure. A knowledge of the composition of alloys, methods of melting and management of furnaces is included. When many castings are required to be repeated from one pattern, moulding machines are used. Grinding and cutting machines are employed to trim rough places or superfluous

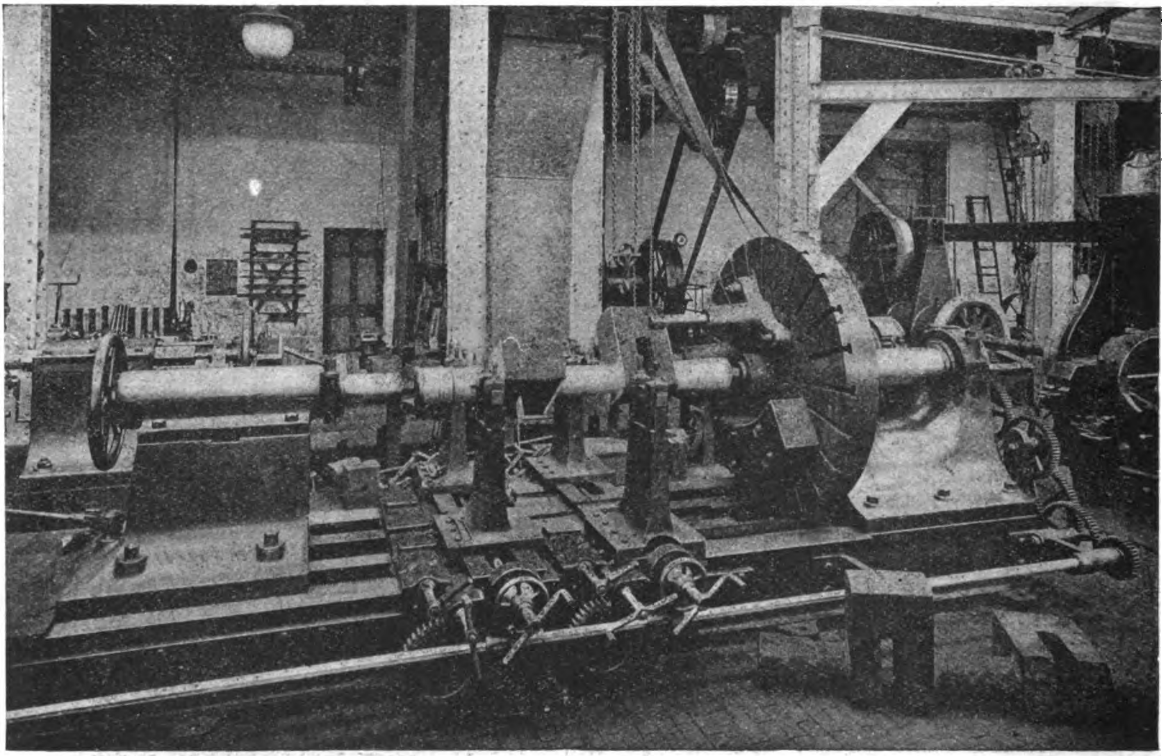


FIG. 1.—LOCO CRANK-AXLE LATHE: MESSRS. PECKETT & SONS' WORKS, BRISTOL.

metal. Iron is melted in vertical tower-shaped furnaces, an air blast assisting to produce the requisite temperature. Copper and its kindred metals used to produce brass and other alloys are usually melted in pots made of fireclay or other heat-resisting material placed in a furnace built in the floor of the foundry.

A coppersmith is a worker in copper. This metal can be shaped and forged when hot in a similar manner to iron, but the coppersmith does more than this. He practises the art of joining pieces of copper together by the method of brazing, which consists in causing melted brass to flow over the surfaces to be united. He produces dished or flanged shapes by hammering the metal when in a cold state. During the process he must exercise judgment to avoid straining the metal so that it cracks, and must soften it from time to time by the heating and cooling process called annealing. Steam and water pipes, parts for boilers, tanks, pipe coils, and boiling pans are made by coppersmiths.

Anyone whose ideas of mechanical engineers' tools and workshops are derived only from a knowledge of a treadle lathe, vice, files, etc., or the equipment of a jobbing blacksmith's or cycle repairer's workshop, can form no conception of the world of machinery which exists or the size and complexity of an engineering factory. To aid such readers and show them the kind of tools and conditions they will meet with as mechanical engineers, these articles are illustrated with some selected photographs of machine tools and works. Fig. 1 is from the workshops of Messrs. Peckett & Sons, of Bristol, a well-known firm of engineers, who devote themselves entirely to making tank locomotives of all types. Messrs. Peckett & Sons have kindly lent us the block from which this illustation is printed; it is one of a number from their beautiful art pamphlet descriptive of these workshops. The massive character of the lathe is well shown—a two-throw locomotive crankshaft is suspended between the centres, and four slide-rests of special form carry tools which can be made to cut simultaneously upon four portions of the work, thus enabling it to be machined in a minimum of time and therefore at less cost than if a single tool only was at work. This is an example of the commercial aspect of mechanical engineering which compels the engineer to be constantly thinking how to decrease the cost of the machinery which he designs in order that he may meet competition. In this direction a revolution has taken place during the past few years owing to the introduction of what is known as "high-speed" steel. By merely making the cutting tools of steel which will continue to cut well even if the cutting edge becomes red hot with friction, it is possible to remove the surplus metal from the castings, forgings etc., at a very much faster rate than with tools made of ordinary tool steel. Speeds and cuts of a rate and depth previously thought impossible are now common; machine tools are made to stand this heavier strain, and work is produced much more cheaply than by the older way. The lathe in the illustration would rotate slowly, as the work is massive. A rough crank forging is shown in front on the floor, the two webs having been slotted as a preliminary process to turning.

A very good example of a modern engineer's workshop is shown in Fig. 2. In this department the various parts of the engines, etc., for torpedo boats are put together, after having been finished in the turning and other machine departments. As many of these parts are too heavy to be lifted conveniently by hand, a crane is provided. It spans across the bay at the top of the picture, and is called a travelling crane. The driving and lifting power is electrictiy. There are three motions—one for lifting, one across the bay, and one along the length of the bay. A piece can be thus lifted and transported to any place on the floor area. The photograph has been kindly lent by Messrs. J. I. Thornycroft & Co., Ltd., of Chiswick and Southampton, the eminent firm of torpedo boat and launch builders. Their conditions and terms for apprentices and pupils will be referred to in a later portion of these articles.

(To be continued.)

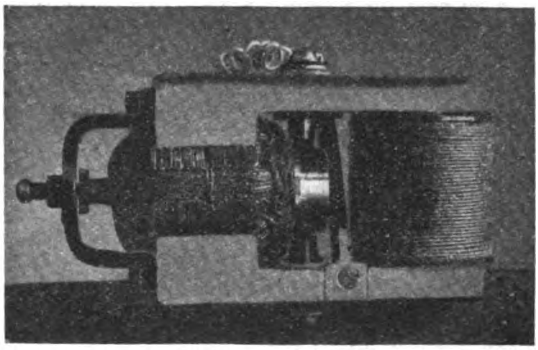
Chats on Model Locomotives.

By H. Greenly.

Electrically Driven Locomotives and Electromotors.

(Continued from page 17.)

In view of the limitations in the design of the ordinary electro-motor when used for model locomotives and traction work, I have lately designed a motor suitable for the purpose, which is an adaptation of the well-known "tramcar" motor, first introduced to Model Engineer readers by Mr. A. H. Avery.



Photograph of Finished 1¾-in. Gauge Motor shown in Fig. 1.

The motor is arranged to take the minimum space both as regards length and width. Two sizes are shown: one (see Figs. 1 and 3) for 1¾-in. gauge engine, and the other for standard 7-16ths in. scale models running on 2-in. gauge.

The smaller motor is intended to go between frames, which, by the way, must be made of brass, 1⅜ ins. apart, and may be provided with a 1¼-in. or 1 3-16ths-in. armature. A motor I had made for experimental purpose for this purpose is shown in the photograph above. This motor was designed for separate excitation, the 2-volt accumulator for working the fields being placed in the tender of the locomotive for which it was intended. The field coil is wound with No. 24 S.W.G., cotton-covered wire, and takes about ½ ampere at 4 volts, which is not an extravagant amount. The armature is an eight-cog drum wound extremely close with No. 26 S.W.G., and is intended for 6- to 10-volt currents. The bearings run on points and the brushes are fitted into holes in the top and bottom limbs of the field-magnets. The field-magnet core is a separate fitting, made of wrought iron, and drives tightly into holes in the two limbs of the magnet, screws 3-16ths in. diameter securing the joint.

An application of this motor is shown in Figs. 2 and 3, the design of locomotive being the well-known 2015 class of 4—4—0 type engines of the North - Eastern Railway. This drawing shows the necessity for a compact motor.

The driving gear consists of a double reduction train of wheels, a pinion being fitted on or made solid with the armature shaft. This pinion drives a suitable crown wheel, which is attached to a countershaft running in bearings formed by the main frames of the locomotive. On the end of the countershaft another pinion is fitted which gears into a plain spur wheel on the driving axle. The ratio of gearing should be about 14 or 16 to 1.

The driving axle, it will be noted, is not fitted with springs, but should run in solid bearing brasses fixed to the main frames. The coupled wheels may have springs, and to allow greater flexibility the bogie may be mounted on a rocking equaliser bar, having axle-boxes solid with the ends, as in the case of The Model Engineer steam locomotive of 1904. Roller brushes are shown placed near the centre of the engine, another brush, placed on the tender of course, being necessary. These points, however, will be described later on in dealing with the track and its equipment. The drawing of the motor shows a flat plate with lugs for the back point centre, while the motor in the photograph has the cross brace. For centre point bearings the plate is to be preferred as providing a much more rigid support, and is an arrangement which I can recommend.

In Figs. 4, 5, and 6 I include a full-size design for the same type of motor arranged for 2-in. gauge locomotives. In this motor a 1½-in. armature is possible, as the usual dimensions between frames for 2-in. gauge engines is 1 9-16ths ins. The field-magnets are not stinted for iron, and the space for the wires is not restricted by being employed for the back bearing. The core may be cast solid or be made of soft wrought iron. In the drawings it is shown oval in cross section, so that the maximum amount of iron for the space available is obtained. Where the voltage is low and the wire thick the core may be made to the smaller dimensions, as winding space is not so completely used where coarse wire is employed. The armatures may be of the tripolar pattern, and if the fields are made to drawing and the armature stampings used have pole-pieces as long as those shown in the diagrams no

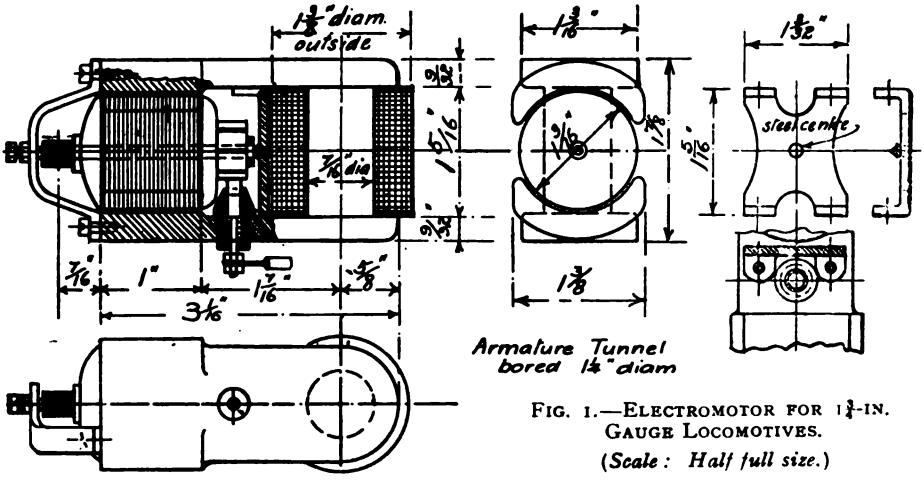


Fig. 1.—Electromotor for 1¾-in. Gauge Locomotives.
(*Scale: Half full size.*)

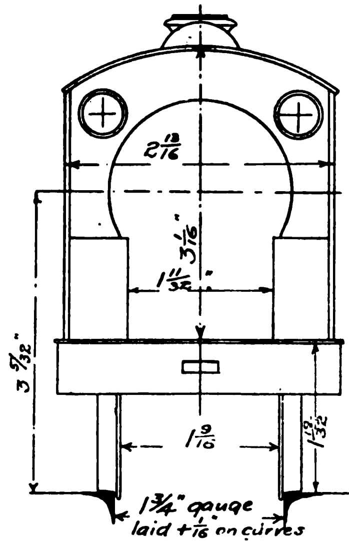


Fig. 2. Rear End View, 1¾-in. N.E.R. Locomotive.

trouble will accrue in the matter of self-starting. I have found in actual practice that tripolar armatures are quite satisfactory, both as regards the power obtained and the consumption of current, but the armatures must be properly made and be designed to hold a fair amount of wire. It is only when the amount of iron in the pole-pieces and the winding cores is cut down to unreasonable limits that waste of energy in working occurs.

The brushes are fitted into holes provided in the top and bottom limbs of the magnet. These brushes may be both insulated in the manner shown according to the requirements of the wiring diagram

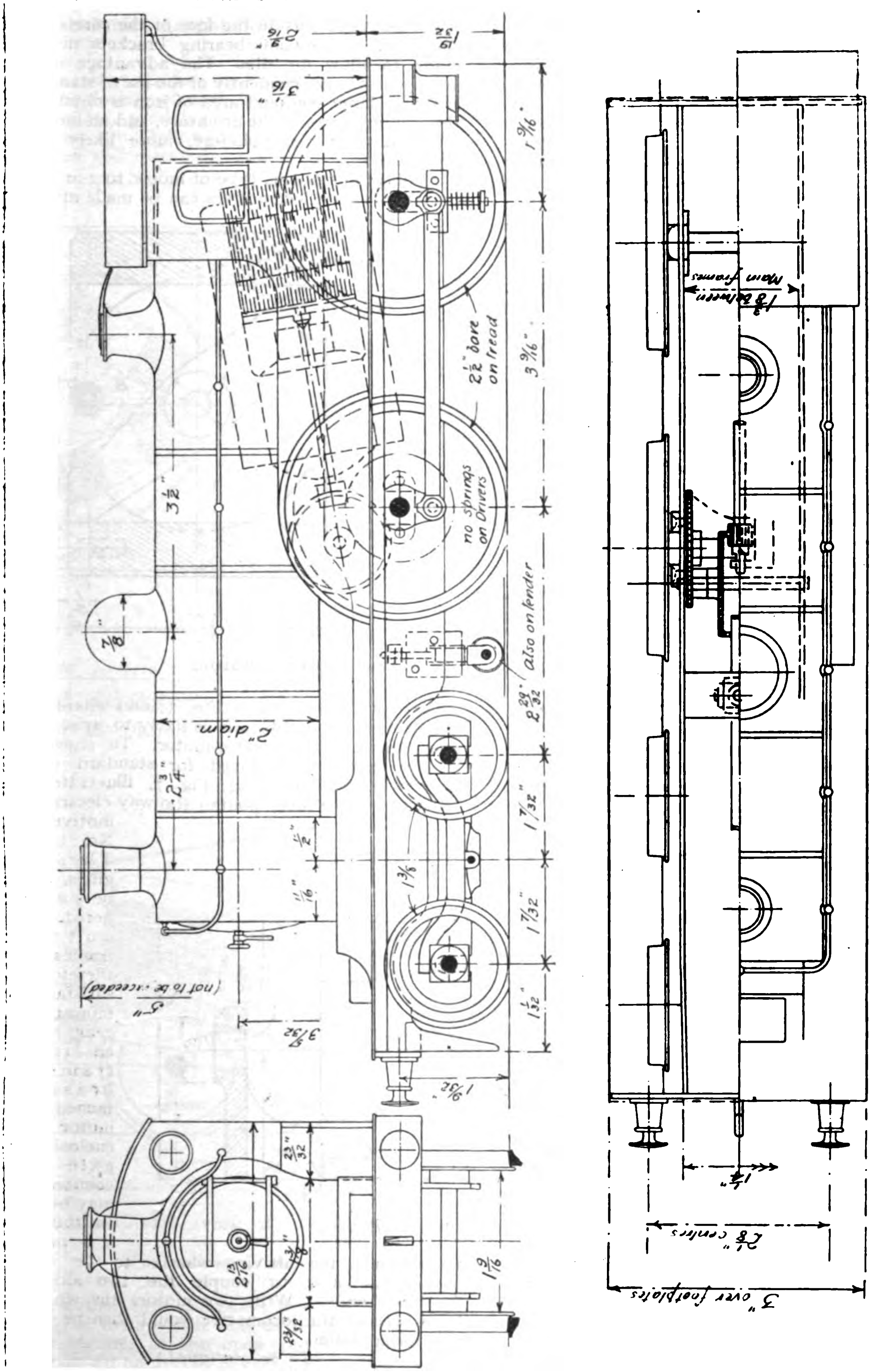


FIG. 3.—DESIGN FOR A MODEL ELECTRICALLY DRIVEN NORTH-EASTERN RAILWAY 4—4—0 TYPE LOCOMOTIVE.

(Scale, ⅜ in.; Gauge, 1¼ ins. Drawing: Half full size.)

or one may be in short circuit with the magnet. The commutator is of the ordinary cylindrical pattern, which is a type which gives the best results in practice, and where space can be found for it, can be recommended without equivocation.

The bearing brackets are designed to take up the least possible space. The one at the back (or inside) consists of a cross brace which has palmed ends and is intended to be let into the magnet limbs so that the joint is quite flush. This is wire to extend outside the face of the core at each end, and the outside bearing brackets must be made to allow for this. The advantage of this arrangement, independently of the use of stampings, is that a large sectional area of iron is obtained in the winding cores of the armature, and an increased magnetic effect is, therefore, more likely to be obtained.

Applications of this type of motor to 2-in. gauge models of steam locomotives can be made after the

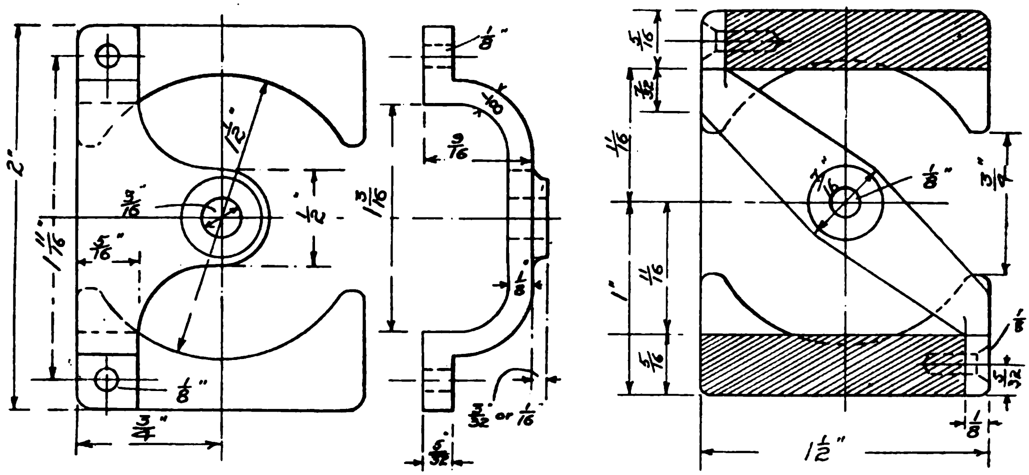


Fig. 6.—Bearing Brackets for 2-in. Gauge Electro-motor.

necessary, as in a locomotive the "between frame dimension" is one which admits of very little alteration. The outside bearing is placed to one side. This is essential in a locomotive motor, as very often the system of gearing adopted renders the same imperative.

fashion of that shown in Fig. 3; and where worm gear is desired, no difficulty is likely to arise in the adaptation of the electro-motor. To show that it may also be employed for standard electric engines, a small drawing, Fig. 7, illustrates the application to a Metropolitan Railway electric locomotive of the No. 1 class. These engines, it will be remembered, have outside frames, and therefore, to satisfactorily mount the gear wheels an inside frame (of brass) attached to the motor and enclosing the axle and counter shaft may be used. In this way it is possible to arrange the driving wheels to be spring borne and also to couple the two axles by flexible bands. With two motors the whole of the wheels of the locomotive would then be available for adhesion.

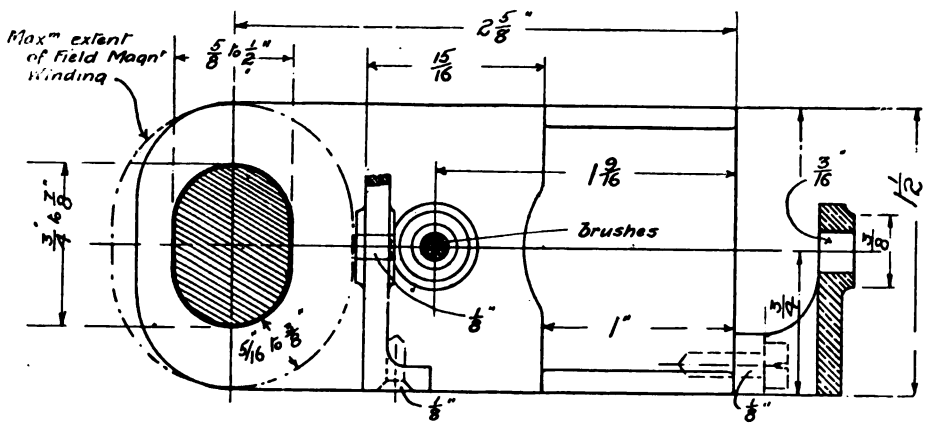


Fig. 5.—Plan of 2-in. Gauge Motor. (*Full size.*)

For 4-volt series working the fields may be wound with No. 20 S.W.G. wire and the armature with No. 22 S.W.G. For 6 to 8 volts the wire used may be No. 22 S.W.G. and No. 24 S.W.G. respectively.

The armature, it will be noticed, is built up of iron stampings. This makes it necessary for the

(*To be continued.*)

The Junior Institution of Engineers.

At a recent meeting of this Institution, held at the Society of Arts, the chairman, Mr. Frank R. Durham, presiding, a paper, entitled "Some Notes on Arc Lighting," by Mr. William Krause, was read and discussed.

The author first compared the position of arc lighting of to-day with that of ten years ago, the special features of the open and enclosed types being pointed out. The development of the former was apparent from the increase in the number of lamps for public lighting; by the year 1907, out of 428 stations giving returns, 280 reported public arc lighting, with a total of 23,134 lamps. The open type was, however, now on the wane, and there were indications that it would eventually become quite obsolete. With reference to the enclosed type, the author touched upon the various systems of control, and considered that for internal lighting that lamp would maintain its position for some time to come. The inverted arc system of reflection gave excellent illuminating results,

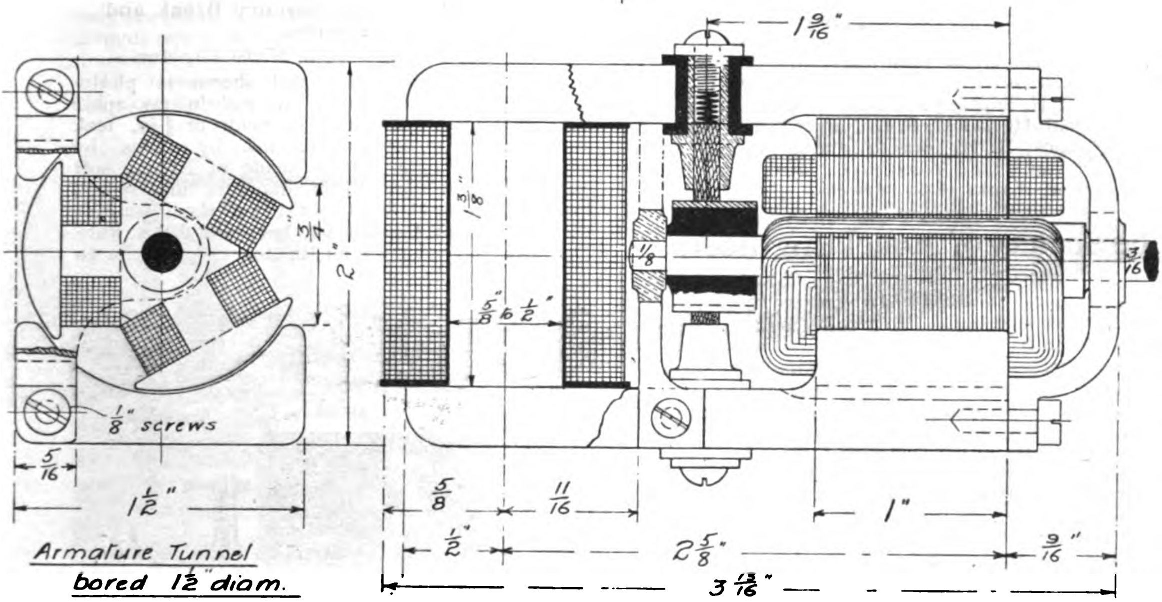


Fig. 4.—Design for Electro-motor for 2-in. Gauge Locomotives, with Steam or Electric Locomotive Outlines. (*Scale : Full size.*)

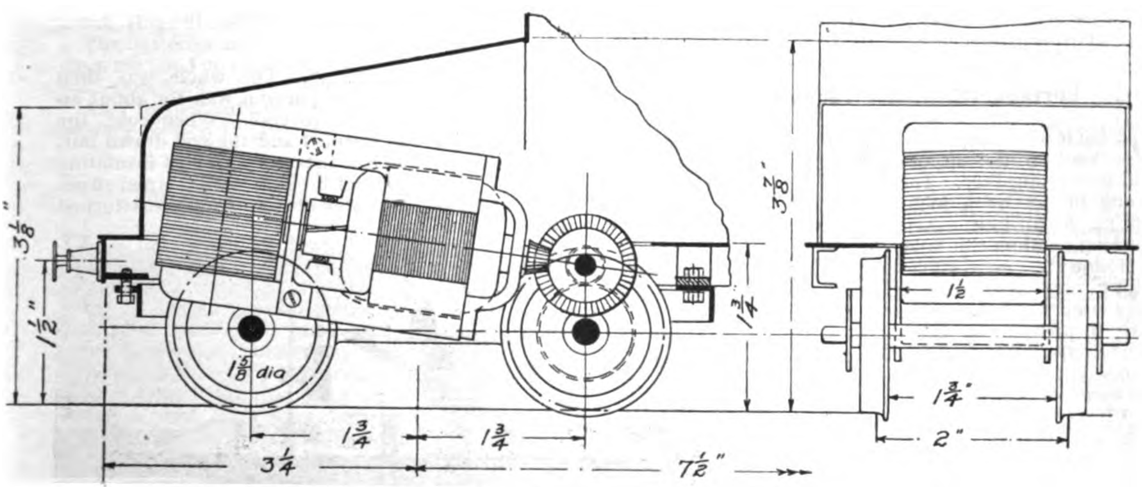


Fig. 7.—Application of Electro-motor (shown in Figs. 4 to 6) to a Model No. 1 Class Metropolitan Electric Engine.

(*For outline of this engine see page 94 of issue of July 25, 1907, Vol. XVII.*)

but its cost, which was about 40 per cent. greater than that of direct lighting, limited its application. Dealing with the composition of carbons, the different effects produced in the colour of the light by the introduction of various salts and metals were described, and consideration given to questions relating to the arrangement of the carbons. Comparisons of mean hemispherical candle-power of different types of lamps followed, after which some notes on "Flame Arc Lighting" were given, and the paper concluded with a plea for the introduction of a two-colour light standard.

In the discussion which ensued, Messrs. A. W. Marshall, C. H. Smith, C. G. Evans, M. H. Hankin, H. E. Angold, H. Brooks, F. D. Napier, W. T. Hogg, A. H. Stanley, R. H. Parsons, and the Chairman took part, and the proceedings closed with the usual vote of thanks.

The Society of Model Engineers.

London.

THE next meeting is fixed for Tuesday, January 28th.

VISITS.—The following visits have been arranged. Members wishing to participate are notified that they must so inform the Secretary in writing seven days before the date of the visit or visits they wish to join. Saturday, January 11th, at 3 p.m.: Messrs. Schuchardt & Shutte's Machine Tool Testing Rooms, at Palmer Street, Westminster (party limited to forty). Tuesday, January 21st, at 2 p.m: Messrs. Siemens' Cable Works, etc., at Woolwich. Saturday, February 15th, at 3 p.m.: Messrs. D. Napier & Sons' Motor Works, at Acton (limited to fifty). Wednesday, March 4th: The Bow Works of the North London Railway (limited to forty).—Full particulars of the Society and forms of application may be obtained from the Secretary, HERBERT G. RIDDLE, 37, Minard Road, Hither Green, S.E.

Portsmouth Model Yacht Club.

UNDER the auspices of the Portsmouth Model Yacht Club, an open race for 10-raters was held on Boxing Day. The boats were set going in a strong breeze by a member of the staff of THE MODEL ENGINEER. After a fast morning's sailing the boats finished as follows: Mr. Tallack's *Sport* taking first prize with 20 points; Mr. Critchell's *Sphinx*, second prize with 16 points; Mr. Clive Wilson's *Florence* securing third position with 12 points. Mr. Morris' *Bluebell* and Mr. Powell's *Nell*, only being finished on Christmas Day, were hardly in trim, but received 6 points each.—CLIVE WILSON, Hon. Sec. P.M.Y.C., 343, Fawcett Road, Southsea.

LIVERPOOL AND DISTRICT ELECTRICAL ASSOCIATION. — The next meeting will be held at the Common Hall at 8 p.m., January 14th, 1908. Readers of THE MODEL ENGINEER may obtain a card of admission on application to the Hon. Secretary, S. FRITH, 77, St. John's Road, Bootle.

Practical Letters from our Readers.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily for publication.*]

A 1-in. Spark Coil Mercury Break and Batteries.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—The spark coil shown in photograph (Fig. 1) was made by me in my spare time last year. The base is made of ⅞-in. teak and French polished — 12 ins. by 9 ins. by 1½ ins. deep. The core is made of No. 22 soft iron wire, 7 ins. long, ⅞ in. diameter, and wound with two layers of No. 16 s.c.c., and then insulated with a strip of calico 1 yd. long and 6 ins. wide. The secondary is wound in four sections with

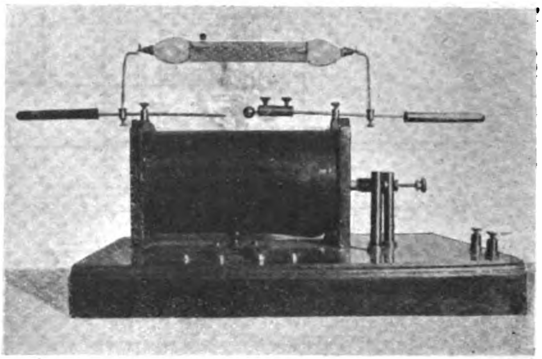


FIG. 1.—A 1-IN. SPARK COIL.

1½ lbs. of s.c.c., No. 36. The whole was then immersed in a jar of hot paraffin wax for about an hour and then allowed to cool. When cold, the side of the jar was warmed and the coil drawn out. This, I found, was a satisfactory way of insulating the coil. The contact-breaker was turned from ⅜-in. brass rod, and the bottom flange was turned

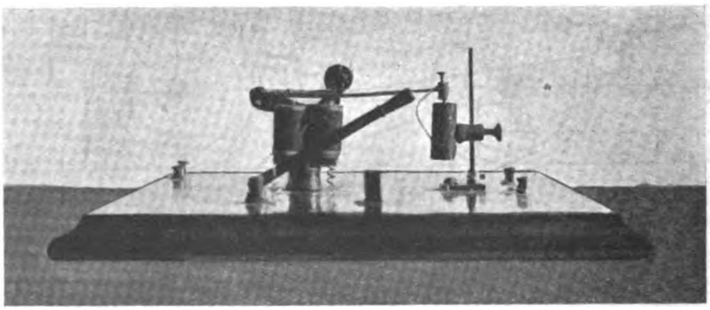


FIG. 2.—MERCURY BREAK.

from ⅛-in. The springs are made from German silver 3 ins. long, ½ in. wide. The hammer was turned from ⅜-in. iron rod (to T-shape). The commutator is the switch type, having four contact studs turned from ⅛-in. brass rod, the two centre ones being the off-position. The condenser was built up as follows: I cut fifty sheets of tinfoil 6 ins. by 3 ins., and then made six books of waxed foreign note-paper, each containing twelve leaves and interleaved with a sheet of tinfoil. The whole was then pressed together between two boards 14½ ins. long, 7½ ins. wide, ¼ in. thick. The discharge rods are made of 1-16th-in. brass rod, inserted into a small test tube filled with pitch, 3 ins. long, ½ in. diameter.

The mercury break was made from a part of an old electric bell. The cup is of glass cased with

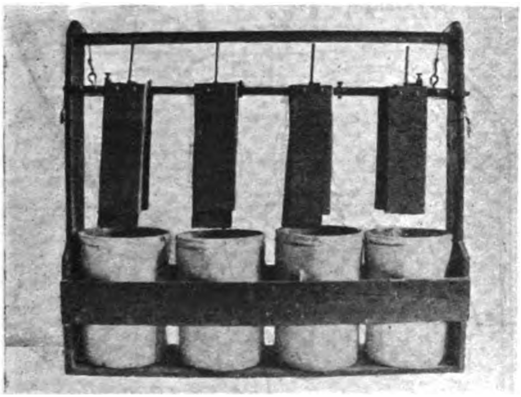


Fig. 3.—Chromic Acid Batteries.

brass, with a terminal at side which fits on an upright brass rod, by means of which the cup can be raised or lowered at will. The switch is of a knife pattern, as shown in photograph. I found this break (Fig. 2) work very satisfactorily.

The batteries are four chromic acid (Fig. 3). The zincs are fixed on brass rods, which are fixed in blocks with setscrews.

Any further information on the subject I shall be very pleased to give, if required.—Yours truly,

A. E. Watkins.

The Proell Steam Calculator.

We have received from Messrs. John J. Griffin and Sons, Ltd., of Kingsway, W.C., the steam calculator of Doctor Proell, three large cards with an explanatory handbook. Unlike many diagrams, which are almost as complex as the thermodynamics underlying them, the curves forming the Proell diagrams are in separated, though related groups, and are reduced to straight lines, so that they show very easily and openly the relations between temperature, pressure, and total heat—wetness pressure, and total heat—pressure and entropy—total heat, pressure, and specific volume — *specific volume, velocity, and specific section*—total heat and velocity—pressure and critical pressure.

One set of curves is metric, another similar set is specially prepared for electrical engineers using the kilowatt-hour unit, and the third is based on the ordinary British units. The Calculator is of real value for all the usual steam calculations involving the quantities above referred to in connection with reciprocating engines, and, in addition for many calculations concerning the behaviour of steam in turbines.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No oth r matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* The Model Engineer, *26-29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[18,526] **Electric Engraving Machine.** J. W. P. (Alfreton) writes: I shall be pleased if you will kindly help me with the following. I want to make an electrical engraving machine, but fail to find any books relating to the subject. I shall be obliged if you would kindly forward me sketch and dimensions of same, or tell me of a book relating to the above. You once gave dimensions in your valuable paper—The Model Engineer—some time ago, but I fail to find the book now. Trusting you will kindly comply with my request.

See issues for March 26th, April 2nd, and May 7th (1903) for full details of the machine you require to make.

[18,523] **Hot-wire Voltmeter.** F. J. F. (Harrow) writes: (1) I have got a "hot-wire" voltmeter, and wish to sell it. I enclose a diagram of same. It is a good instrument, well made and finished. It is in good condition, with fuse and screw corrector. The makers are W. T. Goolden & Co., London. (2) Can you give me their full address? (3) For how much could I sell it? (4) Where could I sell it, and would Goolden's give me more for it than anyone else? They could make a good profit on it by re-selling it.

(1) We regret we have not been able to trace this firm up to the present. (2) We cannot possibly say. (3) We should say the makers might allow you something on the instrument, but would not be likely to give you cash. An exchange for other goods would be most probable. (4) We advise you to try an advertisement in our Sale and Exchange Column.

[18,520] **Water Motor for 300-watt Dynamo.** W. K. (Penicuik) writes: I have an overtype dynamo (50-volt 6-amp.), and I would like to drive it with a water motor. The supply pipe is ¾ in. internal diameter, and the water pressure is 60 lbs. per sq. in. tested with a steam gauge. What power would the dynamo need? Could I get enough power by this means; if so, please give principal dimensions of wheel? Do the divisions in the buckets of a water motor contribute to its efficiency, or are they there to strengthen the buckets? Would you please show connections to a voltmeter and ammeter for above dynamo, and also show where a fuse should be placed?

With a ¾-in. jet and a pressure of 60 lbs. you would get about ·9 h.-p. with 12-in. or 15-in. wheel, running at approximately 1,000 r.p.m. The water consumption would be high, being in the neighbourhood of 4 to 4½ cub. ft. per minute. This would give you ample power for the dynamo, and you would have to find by trial what gearing is necessary. We can recommend you to read up the articles in back numbers on water wheels, etc. See Vol. IX, page 222. See also "Electric Lighting for Amateurs," 7d. post free, for volt and ammeter connections.

[18,525] **Chief's Certificates; Permanent Magnet Generators.** C. P. J. (Barry) writes: Being a constant reader of your two valuable Journals, *i.e.*, The Model Engineer and *The Engineer-in-Charge*, I shall be very much obliged if you will answer the following questions—Can I make a successful dynamo of the permanent magneto, as sketch (not reproduced); if so, what size armature, wire, and how much; also size, weight, and position of field-magnet, if any? Winding wanted to give 15 watts, 5 volts 3 amps. Will engine ¾ in. by 1½ ins. at 100 lbs. per sq. in., with

6-in. flywheel, drive same? Is it necessary to go to sea to get your chief's certificate? I intend being a marine engineer. Would a tramway and lighting power station be a suitable place to learn electrical engineering?

No, we do not advise permanent magnets for generating machines, except where very small powers are concerned, such as magneto machines for ignition purposes, and telephone work. Much better make a 20-watt machine from any of the designs and data in handbook, "Small Dynamos and Motors," 7d. post free. Your engine would easily cope with such a machine, provided the boiler capacity is sufficient. *Re* chief's certificate. Yes, actual service at sea is essential. See "Regulations relating to the Examinations of Engineers in the Mercantile Marine," 7d. post free, from Eyre & Spottiswoode, East Harding Street, Fleet Street, E.C. Yes; a lighting and power station would be the place for obtaining a wide and varied experience.

[18,518] **Small Gas Engine Trouble.** G. O. E. (Hampstead) writes: I have just bought a small gas engine ¼ h.-p. I have made numerous trials with it, but have not been able to start it. I have got your handbook on "Gas and Oil Engines," but it does not apply to my engine. It has got only one valve operated by a cam; this is the exhaust valve. It first, on the outward stroke, draws the gas and air in, the compression occurs on the inward stroke, but just as it is on the dead centre the explosion occurs and pushes the crank in the wrong direction, as there is no valve on the ignition and I do not see any means of altering this. I shall be much obliged if you will help me by letting me know how to put it right. Can you also tell me if I am at liberty to ask for my money back if I cannot make the engine go? It is not worth half what I gave for it, even if it did go.

We much regret to hear of your difficulty with your gas engine, and can only suggest that it is a matter of careful trial and experiment to get good results. Where no governor is supplied, the regulation depends on two factors: the load, and the quality of the mixture of gas and air admitted to the cylinder. If you could once get the engine started, we believe it would run all right at a fairly high speed. If tube ignition is employed, later firing may be obtained by heating the tube further away from the combustion chamber end. Even the best gas engines of this size are sometimes difficult to start, but we think you are quite justified in asking to be reimbursed if the makers cannot prove to you that it can be made to run properly. We can only once again point out that it is cheaper in the end to obtain a really good article at a good price, when the engine is required to do real work. Small gas engines should never be purchased without a written guarantee to the effect that they will give their listed brake horse-power and, moreover, any maker of repute is quite agreeable to give such guarantee in writing.

[18,568] **Coil for Ignition Purposes.** B. G. (Exeter) writes: I've started making a coil for a motor bike, would you be kind enough to let me know how much wire to put on the primary and secondary coils respectively?

We advise you to make the ½" spark coil as described in our handbook, "Induction Coils," 7d., post free. Particulars of winding are given in tabular form in this handbook.

[18,524] **Two- and Four-pole Machines.** W.K.W. (Erith) writes: I have purchased the "A B C of Dynamo Design"; would you be kind enough to supplement it, as it just fails to meet my needs? Mr. Avery gives an example of a 2 kw. 100 v. 20 amps. Would it be too much to ask you for the field and armature windings (cogged drum type); also (2) face area of each pole of a four-pole machine, 2 kw. at 900 revs., 25 volts by 80 amps. Essential speed is 900. If this is beyond the scope of your esteemed paper, THE MODEL ENGINEER, do you publish a book that deals with this subject about small machines in a lucid manner? I have your small dynamo and motor book; but these are too small.

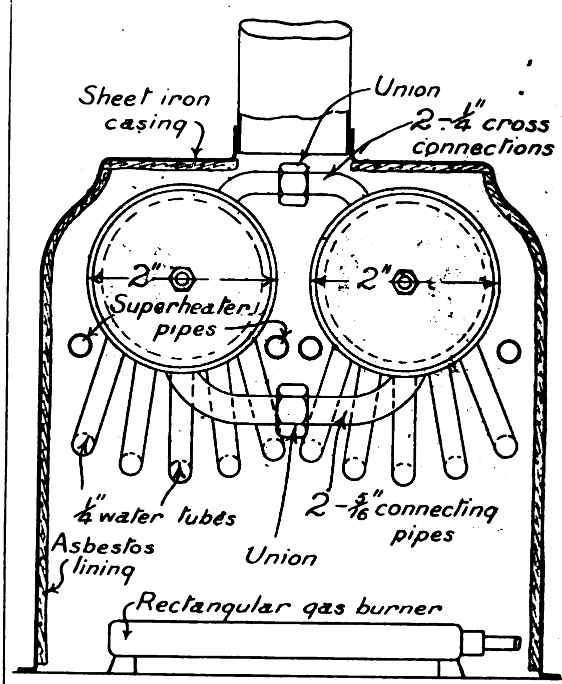
In reply to your inquiry for a 2 kw. 4-pole dynamo to run at 900 r.p.m., we beg to say we have no detailed working drawings of such a machine at present; but the next edition of our "A B C" will contain a complete series of designs for 4-pole machines of the most modern type from 30 watts to 4 kw. It may suffice for the present to inform you that the addition of another pair of poles to a bipolar machine will double the output at a given speed, or halve the speed for a given output. Therefore, if you take the magnetic dimensions given in the "A B C" for the 2 kw. bipolar dynamo, adding another pair of poles, you will get the same output at approximately 900 revs. per minute. The windings can be re-adjusted on the same lines as with bipolar machines, calculating for *one pair* of poles as regards voltage, and for *four circuits* through the armature as regards carrying capacity of conductors.

[18,538] **Globes for Nernst Lamps.** (J. B. L. (Kirkcaldy) writes: I have a Nernst lamp, B type, ½ amp. 230 volts, with opaline globe. Could you tell me of any colour or pigment that might be used in order to counteract the glare, and not interfere too much with the light?

We do not quite grasp your meaning. Coloured globes for this class of lamp would probably be difficult to obtain, as the Nernst lamp is used chiefly on account of its peculiar illuminating properties. A large globe of somewhat different tint might perhaps be obtained, and fixed over the existing one by means of a specially made carrier, or coloured lamp varnish could be used.

[17,934] **Boiler and Engine for Dynamo Driving.** E. W. Maidenhead) writes: (1) How could I use up five lengths of 1-16th brass tube, 10 ins. long by 2 ins. diameter for a horizontal boiler with a few tubes to work a 1-in. by 1-in. engine? (2) Is the engine large enough to drive a 10-watt dynamo, diameter of armature 1¼ ins. by 1¾ ins.? If so, what pressure should I want? (3) Would engine be stronger with longer stroke? (4) Would a solid 5-in. flywheel, 4 lbs., be too heavy? (5) Does it make any difference to the output of a dynamo how hard the brushes bear on the armature? (6) Would springy brass do as well as copper for brushes?

(1) We advise you to use two lengths of the tube making a double drum water-tube boiler as shown in the sketch. The water



Query 17934

WATER-TUBE BOILER WITH TWO DRUMS.

tubes should be silver-soldered into the barrel; indeed, the whole of joints of the boiler would be better if secured in this way. To ensure the two drums having the same level of water in them, four cross connections should be arranged. These should couple by ground joint unions, so that the two generators may be made separately. (2) Yes, at 40 to 50 lbs. pressure and 500 r.p.m.; that is, presuming good workmanship. (3) Yes, at the same speed, but the steam consumption will be greater and the engine will not be so steady at the given speed, even if it will attain the same speed as the short stroke engine. (4) Yes; it is a little heavy, but might be used. (5) Only in small machines and within certain limits. (6) Yes, springy brass will do.

[18,575] **Forming Lead Plates.** F. W. M. (Ilford) writes: I thank you very much for your reply to my last query *re* accumulator. How are negative plates formed when made from litharge and sulphuric acid, as mentioned in your Handbook, *i.e.*, the usual commercial or other process, when precipitated lead is not used?

In reply to your question *re* negative plates, we have already replied to a similar query to this recently. Negative plates, when made of litharge, are formed by repeated charging and discharging; when precipitated lead is used the forming process is not so lengthy.

[18,571] **Bichromate Batteries.** J. E. H. (Hadfield) writes: I have started to read THE MODEL ENGINEER AND ELECTRICIAN, and I want to construct a bichromate battery. I have not got any back numbers of the above paper in which you may have given the directions to make the battery, so would be pleased if you would forward me the directions.

You will find a full description in our handbook, "Electric Batteries," price 7d., post free. Back numbers can be obtained from this office.

[18,572] **Books on Wiring.** G. H. (Hunslet) writes: (1) I would like to know the method wiremen employ in wiring these fuse boards, the switches being placed in each room; also wiring of a switchboard and fuses combined for, say, eight circuits, as wired from the corporation's mains. (2) Can an arc lamp be connected to an ordinary incandescent 200-volt circuit for shop lighting? Are different switches and fuses used to control these to the ordinary incandescent lamp? (3) What book would be most suitable for explaining different methods of wiring, building, etc., and distribution of power?

(1) See "Electric Light and Power Distribution," by Perrin Maycock, price 6s. 4d. post free. See also "Electric Wiring, Fitting and Switches," by the same author, 6s. 4d. post free. (2) Specially made small arc lamps can be obtained for connecting two ordinary lighting circuits, but large arc lamps require to be wired for the purpose. (3) See above.

[18,560] **Resistance and Reduction of Voltage.** M. J. L. (Belfast) writes: I should be very much obliged if you could give me some information about a little resistance box I am thinking of making. It is for use with a small electric railway, $1\frac{3}{4}$" gauge. I intend working it from 2 four-volt accumulators. What I wish to know is what amount of wire would be necessary to pass 8 volts at 2 amps., and 8 volts at 4 amps.? If you could append a small sketch of what you consider the most suitable size of resistance for this amount of current, together with the gauge and quality and kind of wire necessary, and firms who stock this wire, and a short description of the general arrangement, I would feel very much obliged?

Assuming that you are working with your two 4-volt accumulators in series, the only thing you have to consider is, how much current will be passed through a given resistance, and not how many volts will be passed. The problem is a simple one, and may be settled by a reference to Ohm's law, which is $C = \frac{E}{R}$. Any of the resistance frames recently described in these pages would meet your requirements, and the exact quantity of wire necessary may be had by reference to the above-mentioned rule. German silver wire would be best, and any of our advertisers would supply you.

[18,569.] **Running Small Motors from Supply Mains.** J.B.H. (Birkdale) writes: Would you kindly answer the following:—(1) I want to run a (2 B, 4 volt) motor from Thompson's from the electric light mains, which are 230 volts. Please tell me how many 16 c.-p. lamps I must run in parallel to reduce the voltage to run the above motor? (2) I have a "Briton" Dynamo which is supposed to give 20 c.-p.; the voltage is 10, and if I want to use it as a motor, must I give it 10 volts? (3) Does it spoil a dynamo to run it as a motor? (4) Can you use an ordinary induction coil with an alternating current? (5) And if you do, do you need a condenser and a contact-breaker?

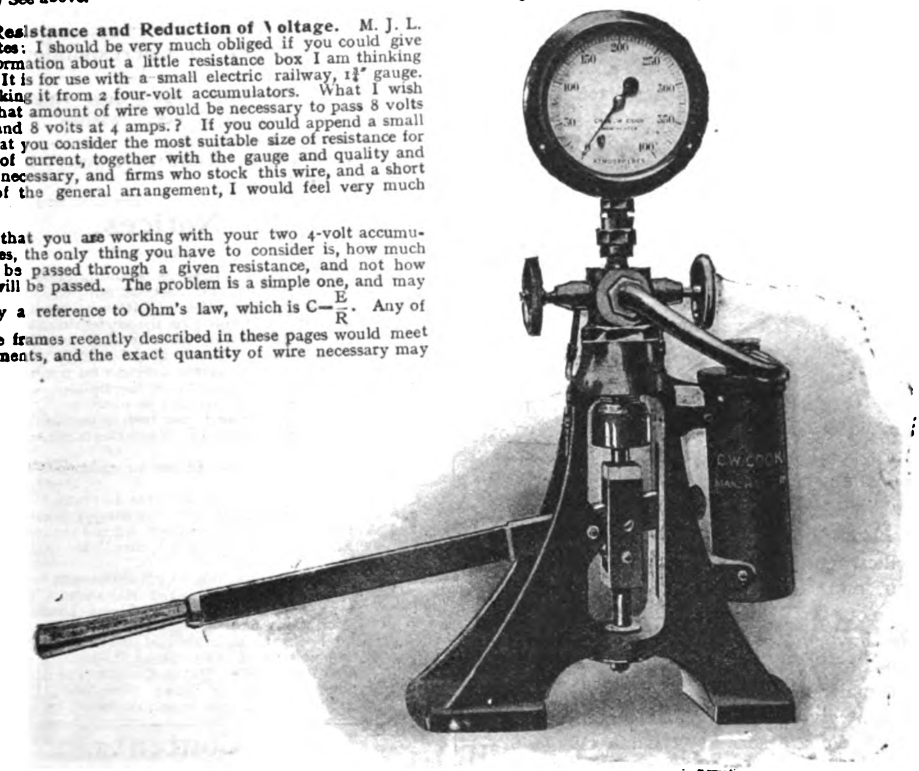
(1) Connect your motor to three or four 16 c.-p. lamps, the lamps to be connected in parallel. If you find more current is required, add a few more lamps in parallel. (2) Try your machine with 10 volts supply to begin with. It is possible that it will take a very heavy current, and you must be prepared to supply it with at least 4 or 5 amps., that is, assuming that the rating is about 4 watts per candle-power. (3) No. Of course, large machines must not be run as motors when in parallel. Much depends upon the conditions of running, which you give no data concerning. (4) Yes. (5) You need a condenser, but no contact-breaker, as the alternating current is the equivalent of this, provided the periodicity is high enough.

The News of the Trade.

** Reviews distinguished by the asterisk have been based on actual Editorial Inspection of the goods noticed.*

Hydraulic Test Pumps.

The design of pump shown in the accompanying illustration, introduced by Mr. Chas. W. Cook, is a small and effective apparatus for testing to high pressures, ranging up to 6 tons per square inch. It will be useful to amateurs, as nothing further than water or oil is required, and it works equally well at low as at high pressures. It may be used for testing boilers and small work at low strength. It is made of a special bronze, and is so arranged that with a lever of 2 ft. in length the highest pressures are attained with comparative ease. The pump is fitted with four valves, two automatic and two screw-down; the two automatic valves are of Mr. Cook's own design and are metal faced; the screw-down valves are fitted, one to the pressure side and the other to the suction side of pump. The one on the pressure side is for releasing the pressure, and the one on suction side releases the air in cylinder, and by means of this latter valve fluid may be brought from considerable distances, the air being released at each stroke of the piston. A reservoir is affixed to the pump, thus making it self-contained; the connection from reservoir to pump inlet may be easily removed and pump connected to any desired vessel, thus converting it into an ordinary suction pump of small volume, and at the same time a force pump for high pressure. It may be affixed to wall, floor or table, and the dimensions are 2 ft. from floor to top of gauge, 15 ins. by 6 ins. floor space. Further particulars may be obtained of Mr. Chas. W. Cook, Coupland and Huntingdon Streets, Manchester.



MR. CHAS. W. COOK'S NEW HIGH-PRESSURE PUMP FOR TESTING.

Model Locomotive Pictures.

A magnificent coloured photograph has been prepared of Messrs. James Carson & Co.'s ¾-in. scale model of the G.W. "Pacific" type locomotive, "The Great Bear." The photograph is on the finest art card, plate sunk, and correct in all detail, and is eminently suitable for framing; size, 8 ins. by 5 ins. Messrs. Carson can also now supply small prints of the above and the C. R. 903 which were unavoidably omitted, to readers who have already obtained their list, on receipt of post-card. The price list of this firm now contains illustrations of the above, and will be sent post free for 6d. upon application to James Carson & Co., Ltd., 51, Summer Row, Birmingham.

The Editor's Page.

THE feature of 1907 which eclipsed all others in the particular sphere with which we are concerned was, of course, THE MODEL ENGINEER Exhibition. Since the close of that notable week we have been quietly gathering opinions as to the desirability of repeating the event. It is generally agreed that the whole affair was so successful and so enjoyable that another must be held—but not too soon. An interval of two years seems to be thought desirable, so that the probability is that the autumn of 1909 will see the next Exhibition opened. It must not be forgotten that in coming to a decision of this kind there are many interests to be considered, and while the private model engineering enthusiast might be willing to support an Exhibition every year, the exhibitors themselves, both trade and private, have other claims upon their energies, and might not all be able to take part. In other fields of activity Exhibitions have been overdone. We have no wish that our own pet venture should suffer in the same way, and we are sure that both amateurs and the trade will commend our decision not to attempt too much. The breathing space which a two years' interval will afford will, in any case, ensure that, good as the last Exhibition was, the next will be a better one.

* * *

We are pleased to say that we have received some excellent entries for our 1907 Speed-Boat Competition, and we hope to be able to publish the awards in our next issue. Some of the intending competitors have, however, rather misunderstood the conditions of the competition, and have merely sent us a formal notification of their wish to enter a boat, without giving any certificate of the boat's performance. We are sorry that such entries are not eligible to compete for the 1907 medals, but as the competition will be repeated in 1908, the senders will have ample time to comply with our requirements for the next event.

* * *

We regret to learn that the premises of the Alexandra Model Yacht Club, together with all the models, over 110 in number, including fifteen new 12-metre models, were totally destroyed by fire on the morning of December 19th. We understand, however, that matters will not stand still, for with characteristic enthusiasm it has been decided to reconstruct and reorganise the Club on entirely modern and up-to-date lines. The measurement and other rules of the International Racing Union will govern the new Club, in so far as the exigencies of model yachting will permit. The 12-metre model will be the official Club type, and the possession of this model will be a *sine qua non* of membership, all other types, being obsolete, will be rigidly excluded, making the Club, in fact, a *miniature* Yacht Club. The Hon. Secretary, Mr. W. G. Brittain, 84, Clinton Road, Bow, will be pleased to hear from those interested in the adoption of the real model of present-day yachts for their sport, and who desire to forgo the obsolete types and discard the ordinary rut of model yachting. A few vacancies will be reserved for enthusiastic and keen model yachtsmen prepared to make model yachting a live and scientific pursuit.

Answers to Correspondents.

TO MANY READERS.—Our best thanks for your greeting cards and good wishes. We heartily reciprocate the latter.

E. G. E.—We appreciate your pretty little drawing very much.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 26-29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk (*) denotes that the subject is illustrated.*]

THE
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EDITED BY PERCIVAL MARSHALL, A.I.MECH.E

VOL. XVIII. No. 351. JANUARY 16, 1908. PUBLISHED WEEKLY

A Motor Interrupter for Spark Coils.

By JOHN PIKE.

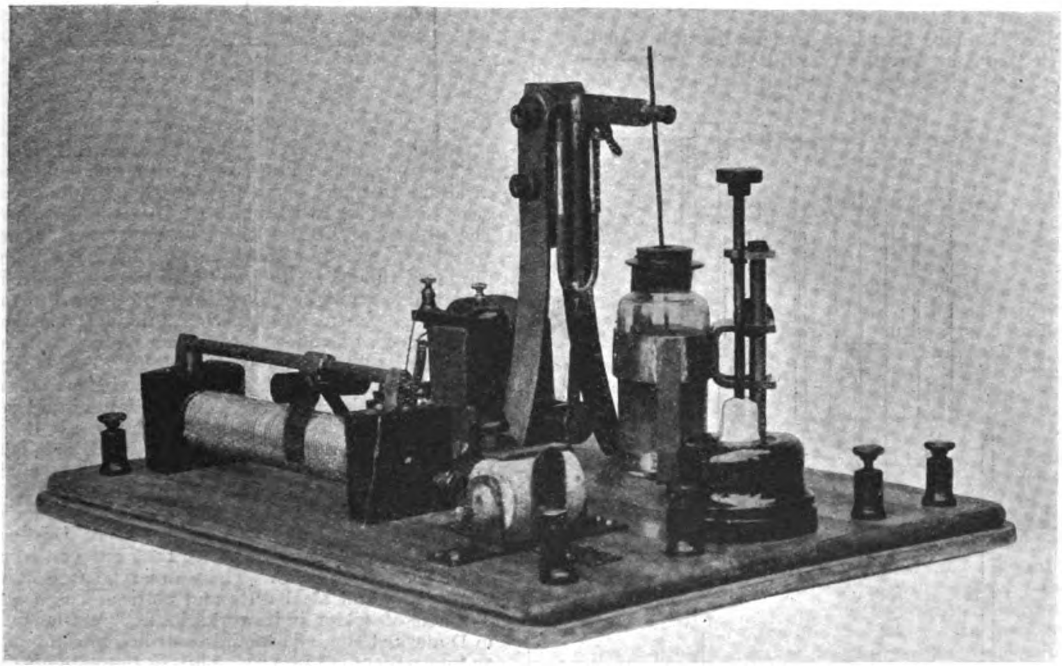


FIG. 1.—MR. JOHN PIKE'S MOTOR INTERRUPTER FOR SPARK COILS

THE output of a spark coil will vary considerably with the make or design of the "break" or interrupter. If the usual, and rather old-fashioned hammer break is fitted, the spark length will almost certainly be least. Change to a good mercury break, and the result will be 50 to 30 per cent. better.

One of the first coils made by the writer, having about 2½ lbs. of wire in the secondary, gave, with a hammer break, a 2-in. spark, and required 8 volts and about 6 amps. to produce that result. With a mercury break it gave easily 4-in. sparks, and on various occasions 5 ins., with the same E.M.F.

I fancy that most amateur coil builders fail or get unsatisfactory results on account of the inefficiency of the break provided, rather than by errors in the winding. I have had coils submitted to me by amateur makers which I found to be very well made—so far, of course, as one could judge; they were coils built from reliable specifications, but failed to give good results with the breaks fitted to them; tested, however, with one or other of my breaks, no difficulty was found in getting full-length sparks. The breaks referred to have been illustrated and described in previous articles. Here is another, which any reader will find not only efficient, but easily made.

The photograph explains itself in great measure, but details are given of the various parts. Briefly, what we want is a vertical and straight up-and-down movement of the dipping-rod into the mercury cup. This means a very much diminished agitation of the mercury and paraffin covering it—the contents of the cup therefore last longer. The motive power is given by a small motor fed from a two-cell battery (accumulator), and by means of the rheostat we can vary the speed. The last consideration is worth something, because at full speed we can use more E.M.F.—12 or 16 volts say; or, with a moderate speed and 8 volts, get shorter but fatter sparks. For my own part I find 12 volts, *i.e.*, six cells, all that are required for ordinary purposes.

For a quick-acting break such as this will be—and for a coil giving 8–10-in. sparks—an E.M.F. of 12 volts is not much more than half that usually designated for a coil of this size.

The standard shown in the photograph is made with two 8-in. lengths of stout brass, 3-32nds in. section and ¾-in. wide, bent as shown. At least

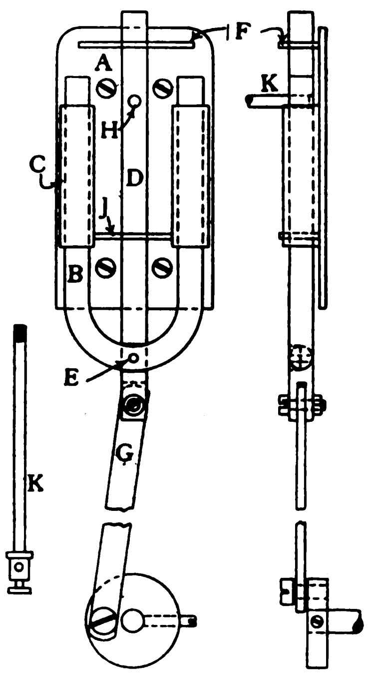


Fig. 3.

1½ ins. must be left, bent to shape for the purpose of clamping to the baseboard (see Fig. 2.) At the top part they are bolted together, with a block of hard wood intervening. The size of this block does not matter; the face, however, need not be wider than the brass fitting to be screwed thereon. The straddle of this two-legged standard is also of no moment, except that no part comes in actual contact with the motor.

In Fig. 3 is shown, in plan and section, the crank movement used. I have several designs, more or less elaborate, but the one figured and *used* certainly answers very well indeed, and is very easily made.

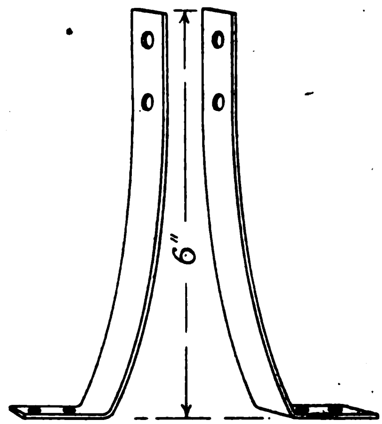


Fig. 2.

A is a brass plate ⅞ in. by 2½ ins., hard brass 3-32nds in. thick. B is a piece of brass rod 3-16ths in. or so, which having been filed and smoothed carefully to make a good fit (without shake) in a piece of *tube* brass, is then bent **U**-shape, as shown. The *straight* portions of this need not exceed 1½ ins. or 1¾ ins., but they must be parallel. This done, the brass tube C is divided into two pieces—1 in. or so will be enough. Place these tubes on A, rather below the centre, and having previously inserted the **U**-piece, as shown, hold them tightly between pliers and solder them to the plate. The **U**-piece should work easily, *i.e.*, freely, but without shake. D is a piece of brass rod perfectly straight and 4½ ins., in length—about the same thickness as B. It is pinned and soldered to the bend in B, first filing both pieces at the parts shown E. A guide-plate F should be soldered on the plate A at the top end, so that the centre rod moves easily through. Now the lower end of D should be sawn through and drilled to take one end of the brass rod or crank G. There must be free movement here, and steel nuts and bolts are used, with a touch of solder if it works loose. At the point in D marked H a hole should be drilled and threaded to take a piece of brass rod, 2 ins. or thereabouts (K), and no thicker than absolutely necessary. This rod should screw in tightly and have a small terminal put on the other and projecting end. It will be clearly seen now that the brass connecting-rod or crank G has only to be bolted to the pulley—fixed at the end of the motor shaft, to practically finish the fitting. The length of G will require to be adjusted to the height at which the plate A is fixed above the pulley; but if we make G 2 ins., or a little over, the plate may be held in position and trial made. The pulley, I may say, is insulated from the motor shaft by a very thin piece of sheet-ebonite warmed and bent to fit, and it should also be tightly secured to the shaft. A second guide-plate might be put on at the bottom part, as at J, but the arrangement works very well indeed as it is; by making the rod K to screw into D, the latter fitting can, of course, be withdrawn entirely. The plate A and fitting being adjusted and screwed to the standard, a straight piece of copper wire 14 B.W.G. may be put through the terminal; the movement should be as straight up and down as possible.

I do not think a break of this kind is any the better for being too well balanced. It would be possible, of course, to reduce the weight and the work thrown on the motor. We should then get more speed, but the results in spark length might not be commensurate.

A "resistance" is easily made. Having a lot of Eureka wire about No. 18 S.W.G., I tried the motor, break, and two cells, and found that 5 yds. or so would be about right. Take a hard wood ruler, 1 in. diameter, and get a plumber to put a thread on this for about 6 ins. of its length. (Pitch of screw, fourteen or fifteen to the inch.) Make two hard wood ends for the ruler—6 ins. or so will be wanted for this. These ends are 2 ins. square and ½ in. or ⅝ in. thick. With brace and bit make holes in each to take the ends of the rod—the holes may be about two-thirds the way through. Now take the rod which has been threaded and drill two holes, one at each end, about ⅜ in. from the ends; use rather a fine drill—the thickness of the resistance wire. For winding, and to get even and tight layers, fasten a heavy weight to one end of the wire to be wound, put the other end through one of the holes in the rod, and turn it down. Now put the weight over the bannister-rail, out of the window, or any way so that the weight hangs freely with wire taut and bearing on the rod. Starting from where the wire is inserted, we easily guide the wire into the grooves, revolving the rod slowly and always at the same tension until, arrived at the opposite end, we cut off and bend and insert through the second hole. Leave at one end about 4 ins. of free wire for connections; the other may be trimmed close. This done, the rheostat can be put into the wood blocks and the latter screwed on. The *free* wire is to be passed through the baseboard for attachment ultimately to the switch (see Fig. 4). The bar and sliding adjustable fitting is next made. Provide a straight brass rod 3-16ths or ¼ in. thick—the full length of the coil just made. Mount it temporarily above the coil and at an equal distance from end to end.

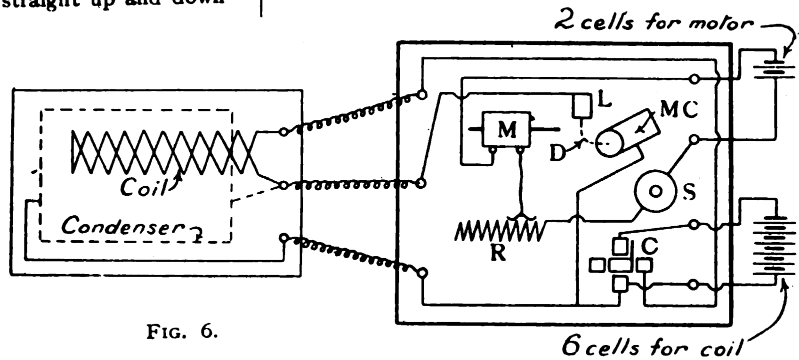


FIG. 6.

It will be understood, of course, that one would not use such material as wood for the purpose if the resistance was for use with more than two or three cells. If much current is absorbed the wire gets hot, and the proper material to use will be slate or porcelain and, I understand, that *grooved rods* are to be had in this material; therefore, if the reader can procure the commercial article readily he should do so, decidedly.

The slide is best shown in the next figure (5). The spring is made of German silver or thin brass, about ⅜ in. or ½ in. wide, bent approximately to the shape in the figure. Take a piece of brass tube ½ in. long and of a diameter equal to that of the rod; make a tight fit; then split the tube up at one side by making a sawcut in the place and in the manner shown, and secure it to the spring by means of solder. By means of pliers we can adjust the pressure on the rod, and having got a good fit, retain it. To move this easily along the rod, two ebonite knobs placed in the position figured, are now to be made. A screw is passed right through the spring, with or without the nuts, though the latter are perhaps easier to adjust the pressure on the turns of wire. Small blocks of ebonite are drilled and put on the ends of this screw, and should, of course, be polished. Being now placed on the rod, the latter may be permanently fixed. The ends of the rod may be drilled to take a 1-in. screw and packed up to the requisite height by pieces of brass tube, and before finally screwing up, the end of a piece of wire should be slipped under, to be passed through the baseboard for connection to one terminal of the motor. In Fig. 5 the rod is shown in section, with a groove at each side. If this be done, the part, with the resistance wire stretched over it, makes a good spring contact with the sliding spring; but it is not absolutely necessary to the working of a small resistance such as this is.

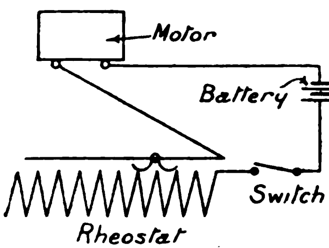


FIG. 4.

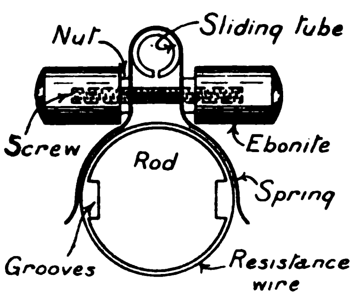


FIG. 5.

The part now remaining is the holder for the mercury cup. For details of this I must refer readers to Fig. 17, chap. viii. of articles entitled "Induction Coils for *X*-ray and other Purposes" (THE MODEL ENGINEER, Aug. 2, 1906, p. 113). It provides a means of raising and lowering the vessel containing the mercury, and is in electrical contact with spark coil and condenser. The cup itself may be of metal or glass; if the latter, a piece of thin copper must be used (or wire) to make contact with the mercury.

Good electrical contact must also be made between the dipping-rod or arm and one of the legs of the stand (Fig. 2). It may be enough to merely bring the plate A (Fig. 3) into contact, but I prefer to connect the arm K (Fig. 3) to one of the legs by means of a short length of flexible wire.

Fig. 6 shows the method of wiring. I arrange my spark coils always as in this figure, with three terminals, as shown. The breaks also, no matter what design, are finished or wired similarly, so that all that is required is to attach wires straight across, as in the figure.

This break works remarkably well, and the speed is easily varied. The wires connecting *to and with the motor* may be No. 22 or 20; but for the other parts, it is best to wire throughout with a gauge similar to that on the coil primary; if the latter is No. 12 or No. 14, make all connections with a similar gauge, and solder joins wherever possible.

Workshop Notes and Notions.

[*Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked* "WORKSHOP" *on the envelope.*]

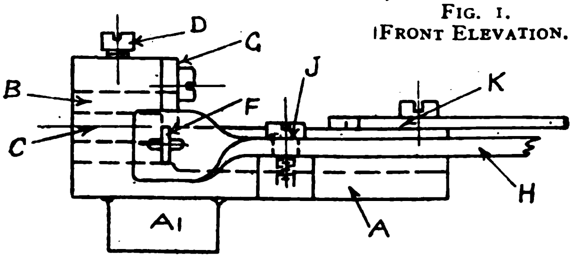
An Appliance for Parting Short Lengths of Rod.

By R. C.

The accompanying sketches illustrate a very handy little tool for parting off short lengths of steel rod for use as rollers, punches, etc., especially when a number have to be made of the same length.

A is a casting with a projection A_1, to be clamped in tool rest of lathe. It has a hole drilled in the end large enough to receive a hardenea steel brush B, which is held in place by screw D. There is a narrow slot or groove milled across it at E, in which slides a piece of $\frac{1}{2}$-in. by $\frac{1}{8}$-in. tool steel, F. The latter is fed inwards by means of the lever H, hinged at J, which is a pin screwed into another projection from the casting A. The tool F is kept in place by a rectangular plate G, which has a semicircle cut out of its under side to clear the hole in which the bush B is fastened. Several of these steel bushes may be made, with different sized holes C, to accommodate the material to be cut. The casting A has a recess throughout its length deep and wide enough to clear the largest size of rod likely to be used. An adjustable stop is shown at K, which has proved useful when a number of duplicate pieces have had to be cut off.

FIG. 1. FRONT ELEVATION.



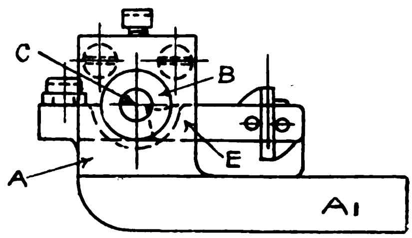


FIG. 3.—END ELEVATION.

AN APPLIANCE FOR PARTING RODS INTO SHORT LENGTHS.

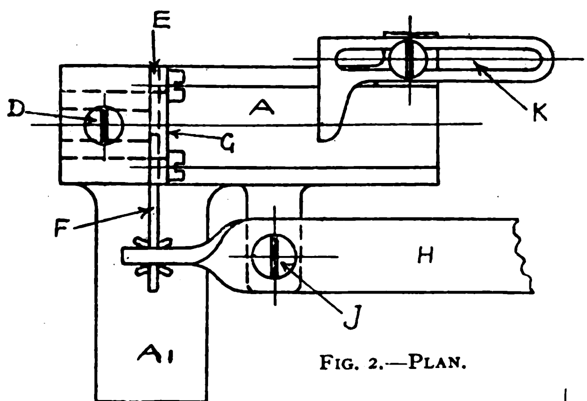


FIG. 2.—PLAN.

Cutting Glass Bottles.

By J. M. K.

I have tried the various methods for cutting glass bottles, but without success. The following method has proved itself highly successful, and was discovered purely by accident. Fill the bottle with moist sand to the point at which it is to be cut; immerse in water to the same depth as the sand. Then pour molten lead over the surface of the sand to a depth of about $\frac{1}{4}$ in. Immediately, a click will indicate that the glass is cut as required.

Handle for Hand-turning Tools.

The handle, A, Fig. 1, is made from a piece of steel tube about 7 ins. long and ½ in. in diameter. With a few blows of the hammer form the tube at one end into a square, as shown in B. The tools (Fig. 2) are formed by grinding, and are made from 5-16ths-in. tool steel. It will be found that the tool will fit securely in the handle when the latter is brought down quickly in a vertical position on an anvil or any solid piece of iron. This causes the angles at the base of the tool to jam into the circular part of the tubular handle. When it is required to

FIG. 1.

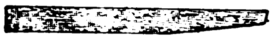


FIG. 2.

HANDLE FOR HAND-TURNING TOOLS.

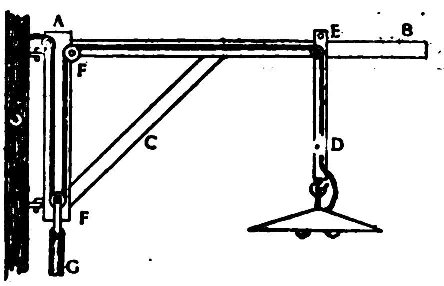
release the tool, insert a small rod into the handle and strike the rod with a hammer. The tube may be wound with whipcord so as to increase the grip and to avoid handling the bare steel.—*Popular Mechanics.*

Valve Packing.

A mixture of lead, wool, and graphite is now being successfully used for packing valves. It is used in the same manner as asbestos or other similar packing is employed. This mixture may be used for high temperature, and has some advantages over asbestos.

An Adjustable and Portable Electric Light Bracket.

The use of an electric light over the bench always requires some little time to adjust and find something to hang the cord over to get the globe in the right place. A small light bracket or crane, constructed as shown in the sketch, which we reproduce from *Popular Mechanics*, will make a



AN ARRANGEMENT OF PORTABLE ELECTRIC LIGHT BRACKET FOR WORKSHOP.

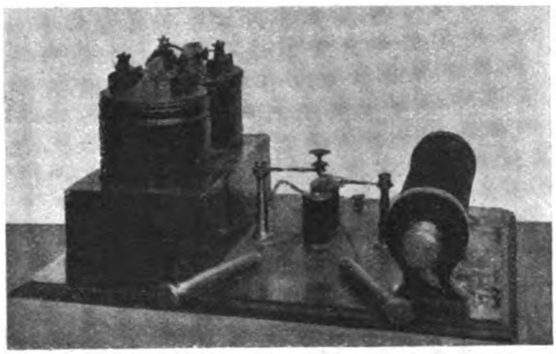
handy device to bring the electric globe in proper position quickly.

Cut a piece of wood, A, 2 ins. by 4 ins., 4 ft. long and attach to it a horizontal piece of wood, B, 1¼ ins. by 2 ins., of any length desired, braced with a piece of the same material, C. Bend a ¼-in. by 1-in. band iron, D, in the shape of a **U** and drill a hole in the ends at E and insert a roller that is just a little longer than the wood B is wide. At the other end, or the bottom end of the **U** band iron, fasten a hook or eye, to which is attached an adjustable cord connecting the lamp holder and shade. The points marked F are pulleys over which the flexible electric wire moves to take up the slack by the weight, G.

A Shocking Coil

By S. DAWSON.

THE illustration below shows a coil I made about eight years ago, but regret I cannot now give length of wire on it, but it was



MR. S. DAWSON'S SHOCKING COIL.

wound with three lengths of wire—primary, and bobbins, No. 18 D.C.C.; secondary, No. 24 S.C. wire; and third length, No. 36 S.C. wire. In winding I gave a good coat of shellac between each layer, then covered coils with a piece of dark red plush. It is worked by one or two bichromates, as desired, which are made out of two 3-lb. marmalade jars, painted and grained to match mahogany base and coil cheeks. The barrel is numbered up to 100 on top, with a groove underneath, in which the little fiddle-shaped piece of brass seen screwed to the cheek fits to form a guide. There are two two-pole switches, and one one-way. The nearest one—seen at right-hand side of base—is for switching on third coil of wire. The middle one is for putting in second cell, as required; but to do this the further switch has to be moved to "off." With all switches to left hand, current is "off"; then, by moving the further on to right, one cell and two coils are in action, with all power "on." By simply moving middle switch to left, the whole current is cut off. I always give zincs a wash after being used, and place in slots alongside cell made for that purpose. I have never had any trouble with coil. Length of coil between cheeks 8 ins., diameter 2½ ins.; length of bobbins between cheeks 1¾ ins., diameter 1 in.

Model Making for Beginners.

A Model of H.M.S. "Black Prince."

By C. F. W. and A. R. H.

(*Continued from page* 36.)

THE remaining details of the construction of the model battleship are given herewith.

Guns: six 9·2-in., ten 6-in., and twenty machine. The 9·2-in. are turned from mahogany, and are 1½ ins. in length, tapered and belled at the muzzle. The gun houses are American whitewood. Their shape and mode of mounting can be seen in Fig. 11. The barbettes are turned from pine, and are 1 1-16th ins. in diameter, sunk into the deck, seccotined and tapped level. This method was employed because the surface of the deck is arched. Each gunhouse has a central screw to allow the correct arc of fire (Fig. 11). There is a depression guard under each gun.

The 6-in. guns are made of iron nails "turned" with a file in a lathe, length 1¼ ins. The method of fixing can be best understood from drawings, Fig. 14.

Into the holes carved in the hull a curved piece of cardboard, the same height as the port, is put, fitting into the far corners, its convexity coming flush with the side of the ship. This has a hole for the gun, and represents the revolving shield (A). Two pieces of cardboard (B) pass in to A, also acting as shields or deflectors. Three doors (C) complete the port.

The machine guns are standardised and made to gauges. The standards are the unthreaded portions of steel screws filed to the correct height in a gauge. This is a pair of flat-nosed pliers with jaws the same width as height of standard. A V-groove is filed on top of each for the barrel, a piece of a large pin with the point cut off to give the required taper. The breech casing and recoil jacket and crutch are put on last and made of paper. The finished guns look very well (see Fig. 5, elevation, and plan).

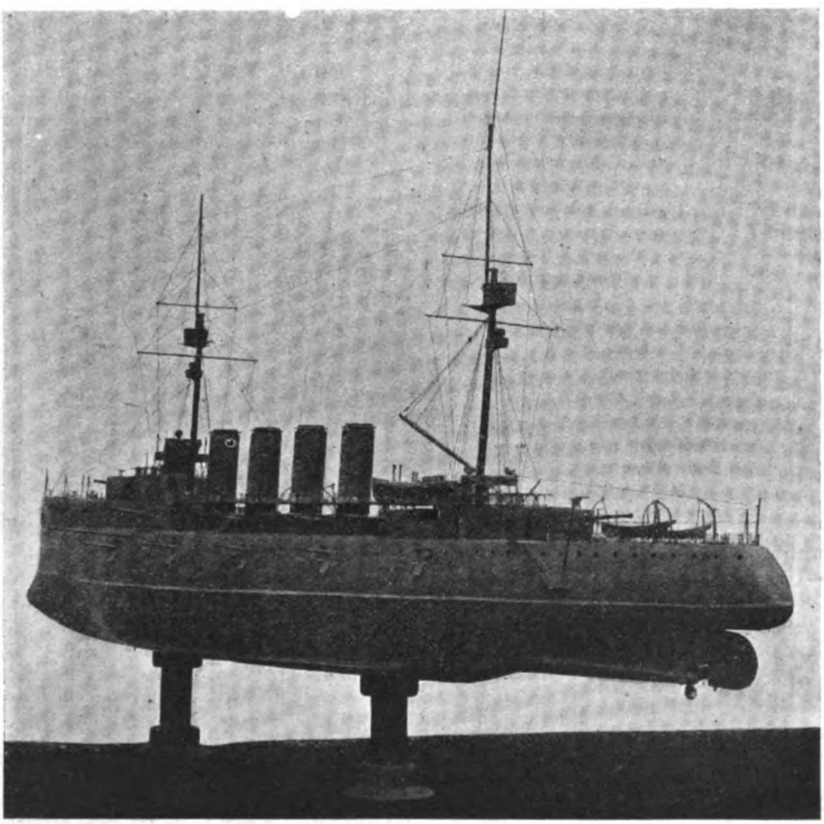


Fig. 23.—Another View of Model H.M.S. "Black Prince."

The ventilators are made of wooden knitting needles ¾ in. high by ¼ in. diameter, fitted into blocks of wood ⅝ in. by ⅜ in., which should contain electric air fans. They have paper cowls on top, but differ in shape from the old-fashioned cowls (see Fig. 10).

Nine boats are carried in all, including two steam-boats. These are carved from American whitewood and have brass funnels, shafts (pins) and paper three-bladed propellers (Fig. 12). All the other boats are made entirely of paper, and have ten thwarts (see plan). These are on chocks on the deck, and two on the quarter-deck. They are all furnished with davits and falls (see deck plan. The davits are made of iron wire tapered with a fine file and emery cloth at the upper end and bent at right angles at the lower end and stuck into the hull, a pin's head being stuck against each just below the deck level to act as a support (Fig. 18).

The searchlights are made of the same standards as the machine guns with a piece of wooden knitting needle seccotined on Fig. 6). The accommodation ladders are made of cardboard, and each has seventeen steps, hand-rail of fine brass wire, davits, and falls (Fig. 4).

The propellers are four-bladed, and made correctly to both revolve inwards. They are cut out of thick sheet lead, and carefully filed on the edges, then twisted and bent until they have quite the appearance of castings (see Fig. 13). They are ⅞ in. diameter. They are fixed to the stern tubes by a nail, and the boss built up of hard wax.

The rudder is made of cardboard and seccotined

Key to Plan of Model Battleship.

A, 9·2-in. Guns.
B, 6-in. Guns.
C, Conning Tower.
D, Funnels.
E, Ventilators.
F, Charthouse, bridge, etc.
G, Fore and aft bridge.
H, Accommodation ladders.
J, Masts.
K, Skylights.
L, Bunker Hatches.
M, Capstans.
N, Fairleads.
O, Bollards.
P, Chain locker hatches.
Q, Machine guns.
R, Boat deck.
S, Davits.

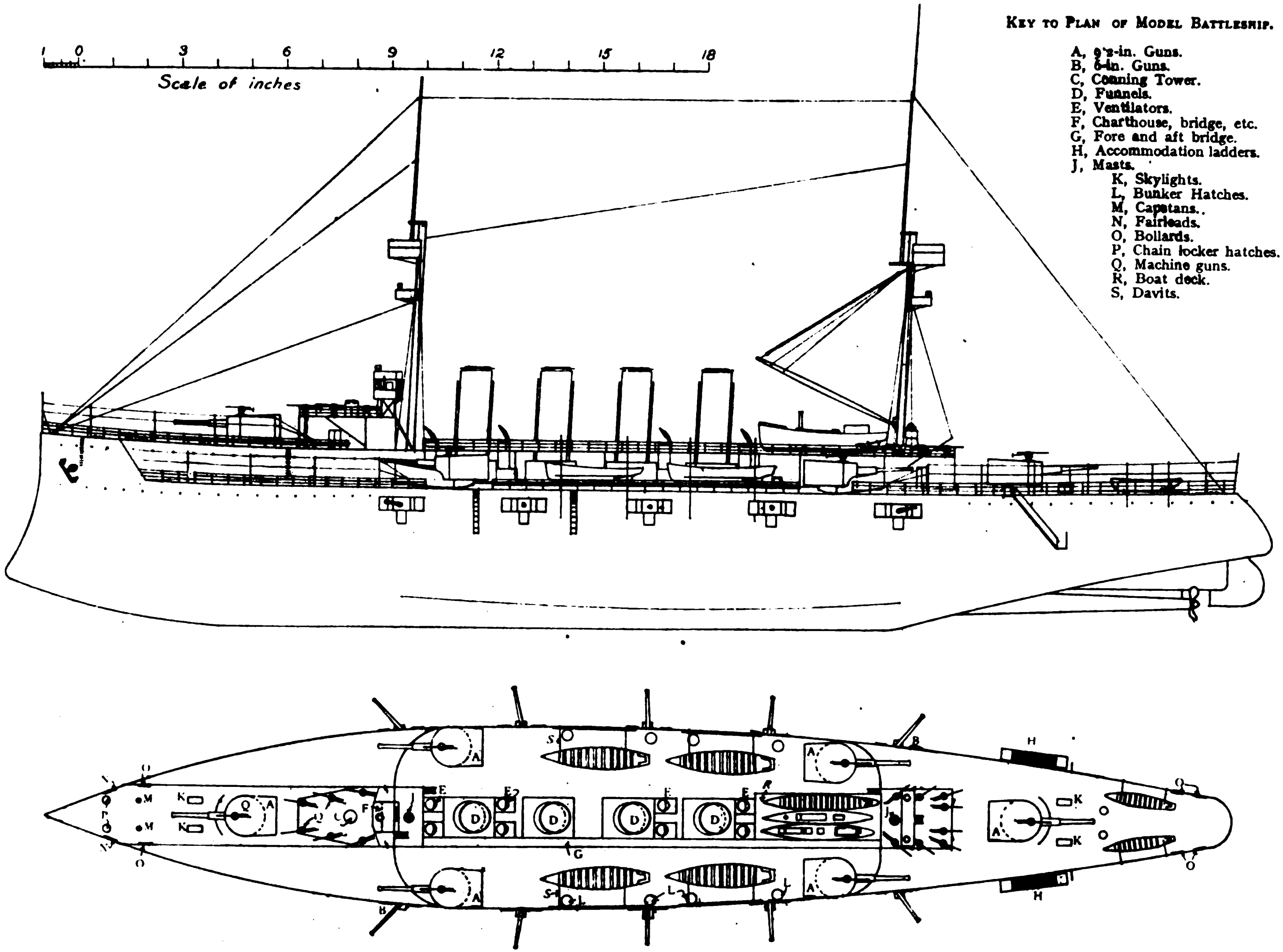


Fig. 24.—Longitudinal Elevation and Deck Plan of Model H.M.S. "Black Prince."

into position. Four fairleads and four bollards are fitted—two of each for'ard and two aft. They are made of lead filed from sheet (see Figs. 19 and 20 and deck plan). Two capstans are placed on the foc'sle turned out of brass rod (Fig. 17). The remaining deck fittings are :—Two skylights and two hatches to chain lockers on foc'sle, four bunker hatches between the side 9·2 ins. guns, and hatchway with railing under boat deck starboard side, two skylights and two hatchways on the quarter-deck. All these small fittings can be seen in the plan.

The anchors (Fig. 21) are cut from sheet lead, and are of the patent stockless type now used in the navy ; three are carried—two starboard and one port. The hawse pipes are ⅛-in. brass tubing filed off flush with the side and let into drilled holes. Just abaft the foremast there are two booms used in port in connection with boats. The semaphores are made of pins with paper arms —two on the fore bridge.

There are six ladders, all fitted with steps on deck—one leading from upper deck to foc'sle, one from foc'sle to for'ard superstructure, one from superstructure to bridge, and one from bridge to charthouse roof ; aft : one from deck to super - structure and from there to upper bridge. There are four rope ladders, two a side, made by seccotining two parallel strips of cotton down the side and fitting short length of pins between them (see elevation). The steps seen on foc'sle down to anchors, etc., are also made of pins. The railings are made of lace pins gauged to correct height and fitted with three layers of fine cotton. The high awning stanchions are made of pins with shorter pieces for supports, and are fitted with two strands of cotton.

The ship is painted dull grey all over above the white water-line, below which all is red. The funnel tops are black, as are the ventilator tops and gun muzzles, searchlight faces, and rigging.

The finished model amply repays the time and trouble taken in building her, and for show appearance a ship is very hard to beat.

Cutting Steel by Oxygen Gas.—A new method of cutting steel is said to have been patented by a Belgian engineer. The process consists in first heating the metal by means of an oxyhydrogen flame and then cutting it by a small stream of oxygen gas, which unites with the steel and forms a fusible oxide, which flows freely from the cut. It is said that the cut is fully as smooth as that made by the saw, and is only one-thousandth of an inch wide.

In a type of gas engine, developed by the Allis-Chalmers Company, Milwaukee, Wis., for the power houses of the Indiana Steel Company, at Gary, Ind., 44-in. gas engine cylinders for 54-in. stroke are being built. These are claimed to be the largest cylinder diameters of any engines built in the United States. The engines are four-cycle, twin-tandem, direct-acting types designed to give 4,000 h.-p. on blast furnace gas and up to 5,000 h.-p. on richer gases. They are intended for direct connection to alternating current generators. The crank-pins are 20 ins. in diameter, the shaft 30 ins., and the flywheel 23 ft. The flywheel weighs (approximately) 90 tons, and the entire engine (roughly) 670 tons.

A Visit to The Royal Scottish Museum, Edinburgh.

The Machinery and Metallurgical Sections.

Readers of The Model Engineer resident in the vicinity of the charming city of Edinburgh must consider themselves fortunate in having access to such a splendid collection of models as is to be seen in the machinery hall of the Royal Scottish Museum, situated in Chambers Street, Edinburgh. It was our privilege to pay a visit to this section a short time ago, with the result that the favourable impression which was carried away has prompted the following few notes for the benefit of the great majority of our readers who have not experienced the pleasure of a similar visit. For the photographs which we shall publish from time to time, our thanks are due to the kindness of the Director, and of Dr. Alexander Galt, the keeper of the Technological Department of the Museum, who has also provided us with necessary particulars which will help, it is hoped, to render the pictures interesting to those who peruse them.

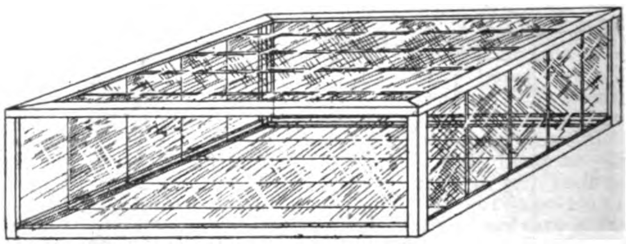


Fig. 4.—Glass Model, showing Sections of Midlothian Coal Basin.

It is true that to the visitor at the Model Section of the Victoria and Albert Museum at South Kensington the Edinburgh collection would appear small, and reasonably so ; but one must admit that the exhibits are well representative of practically every branch of engineering, and the choice of subjects dealt with reflects great credit upon the organising staff. Most of the models, it may be observed, are professionally made—that is to say, are constructed in the workshop attached to the Museum. The workmanship, therefore, leaves nothing to be desired. A view of the interior of one of the workshops is given herewith.

Before entering the machinery hall, a walk through the section devoted to the science of mining and metallurgy brought to notice some models which are both interesting and instructive. There are two which it is thought are worthy of mention. One is a part sectional model of an up-to-date blast furnace. A study of this will clearly show the average student the process employed for extracting iron from its ores. The model was constructed in the workshops of the Museum from drawings supplied by the Glengarnock Iron and Steel Company, Ltd. One-quarter of the furnace has been cut away from top to bottom to show the internal form and construction. In former times the

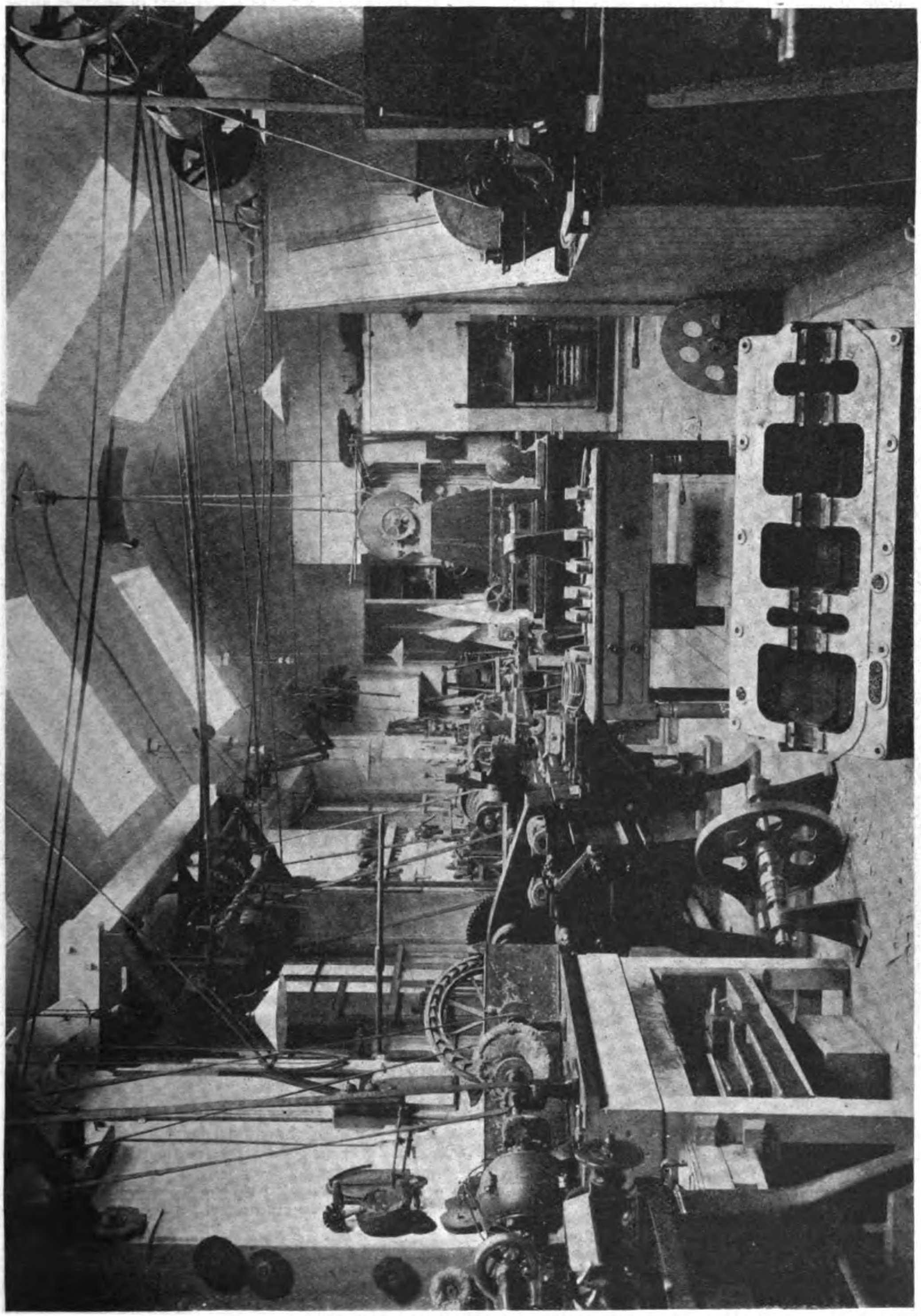


Fig. 1.—Showing Interior of Engineering Workshop, Royal Scottish Museum, Edinburgh.

gases were allowed to escape into the air from the wide-open mouth of the furnace where they were burned, illuminating the country at night for miles around ; but now the gases are checked by the bell and cone arrangement, which, as shown in position with the chauffer, closes the mouth of the furnace. The fire in the chauffer burns the inflammable gases, which escape when the bell is periodically lowered to allow mixed charges of ore, coal, and limestone to fall into the furnace.

The charging of a blast furnace goes on all day and night, from the platform, as shown in the photograph, a charge consisting of a barrow-load of coal, ore, and limestone, the furnace being kept full to within about 2 ft. of the top. The ore takes about 36 hours before it can come out as iron, and the molten metal is usually drawn off twice in twenty-four hours. The large pipe connected to the furnace just below the gallery carries off the gases, which are used as fuel for heating the blast. For this purpose two Cowper stoves are required for each furnace. The model shows one stove complete, sectioned like the blast furnace, and the lower part of another stove in horizontal section. With these two sections to assist him, the student can easily understand the mode of operation of the Cowper stove. While the honeycomb brickwork inside one stove is being heated by the flames of the burning gases, the other stove, which has already undergone this heating process, is used to heat the blast. Cold air under pressure is driven through the stove by a blowing engine, and the heated air is passed on through the hot-blast main pipe to the twyers, where it enters the furnace as the hot blast. The blowing engine is not seen in the model, but a model of such an engine to a larger scale is exhibited in the adjacent machinery hall.

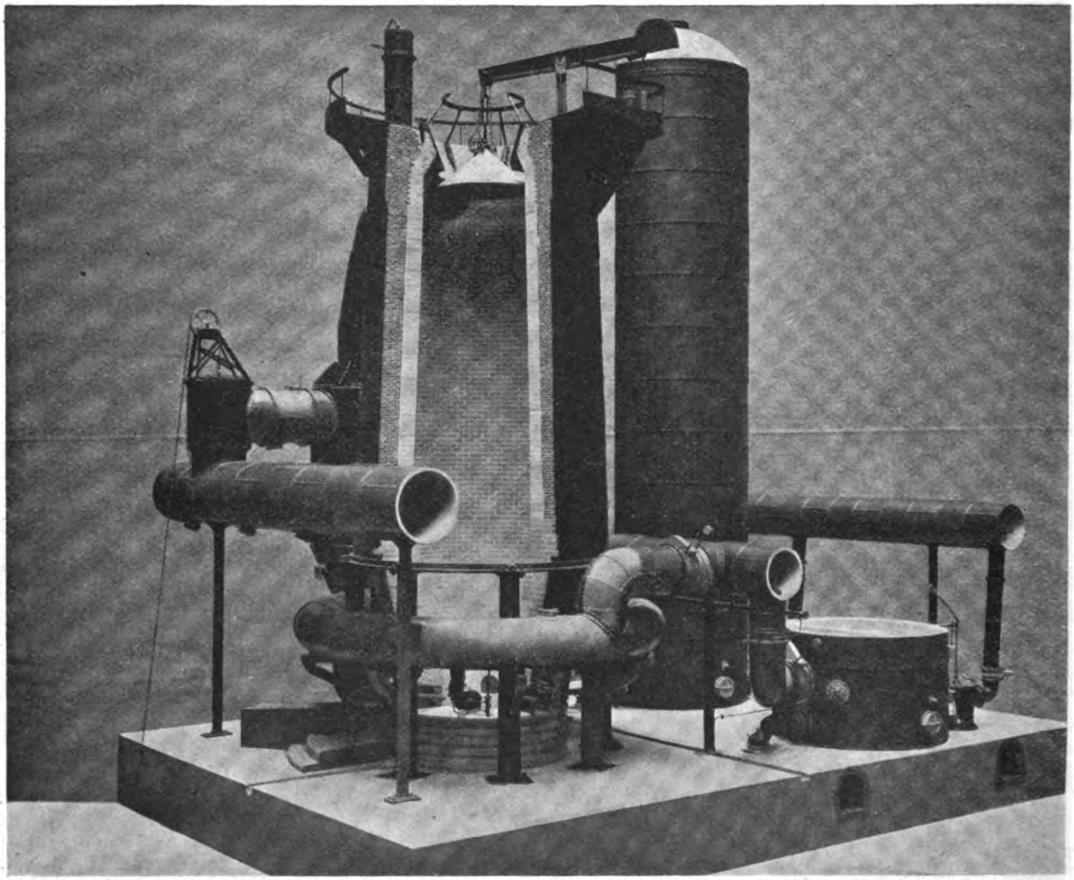


FIG. 2.—VIEW SHOWING THE FURNACE IN SECTION.

MODEL BLAST FURNACE IN THE METALLURGICAL SECTION, THE ROYAL SCOTTISH MUSEUM, EDINBURGH.

The details of the lower part of the furnace are completely indicated in the model. These include the twyers for admission of hot air under pressure, the hot blast into the furnace, and the exit passages for the slag and molten metal. The form and arrangement of the twyers are plainly seen, and the section affords a view of the coil of water-cooling pipes surrounding the nozzle of each twyer to prevent it from melting at its point of entrance into the furnace. The elaborate arrangement of cold water pipes for cooling the twyers and controlling valves is easily followed in the model, one distinctive colour being used throughout for these pipes. The arrangement of pipes for conveying the furnace gases towards the ammonia recovery plant is shown.

The next item worthy of mention in this section is that of a geological model of the Midlothian Coal Basin. This model, which has brought forth praise from eminent mining engineers from this and other countries, was constructed in the museum from data kindly supplied by H.M. Geological Survey. It represents an area of country of 7 miles by 5 miles, or 35 square miles, to a scale of 9 ins. to the mile, composed of sheets of plate glass. The accompanying sketch, Fig. 3, will help to show the novelty of the idea. There are six vertical sheets 9 ins. from each other representing 1-mile sections: on each of these is marked the coal seams and strata as it would appear at each section. A horizontal sheet is placed on top, on which are marked in respective colours, rivers, lakes, hills, etc. The coal seams are marked and named in black, and owing to the fact that the model is entirely of glass, a realistic view of the Midlothian Coal Basin can be seen at a glance.

(*To be continued.*)

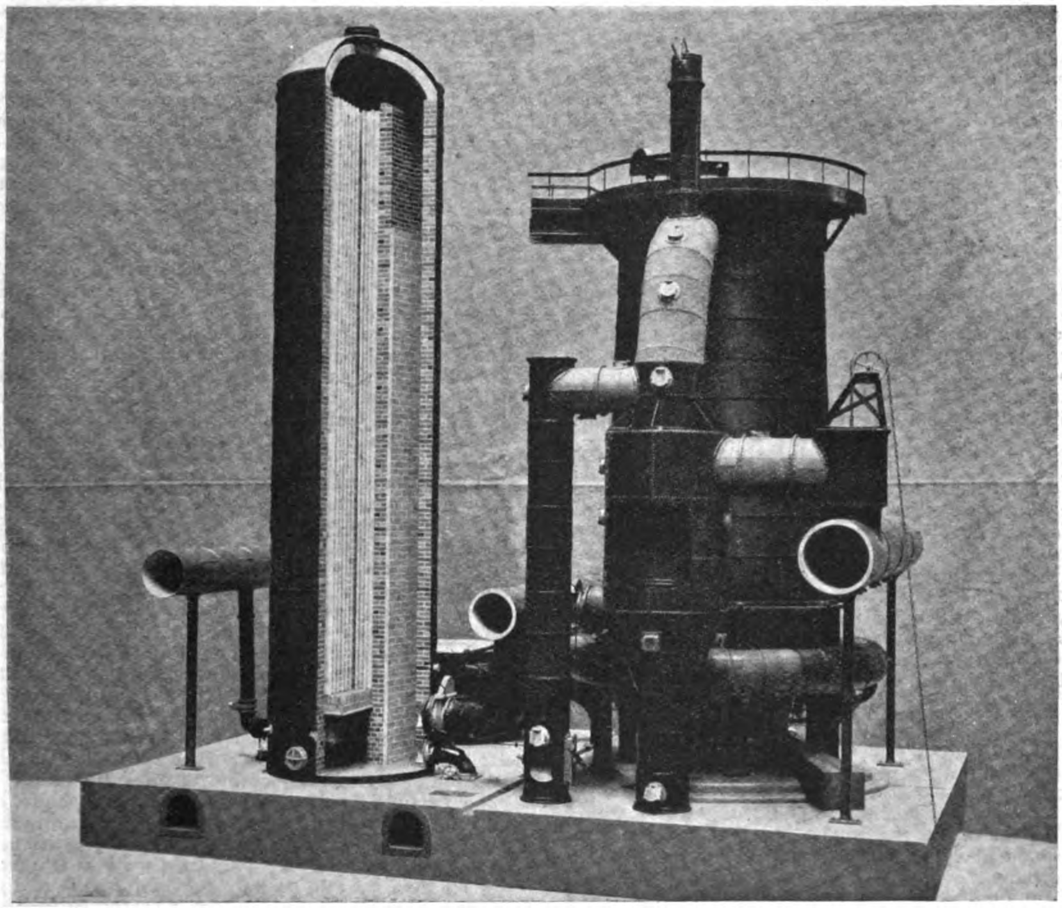


Fig. 3.—View showing the Cowper Stove in Section.

Engineering Drawing for Beginners.

By H. Muncaster, A.M.I.Mech.E.

(*Continued from page 420, Vol. XVII.*)

A MOST useful and interesting method of representing simple objects is that known as isometric projection. By this method three faces can be shown in one view, generally in such a way that the shape of the object can be more readily understood. For this reason drawings illustrating articles or descriptions of machinery and appliances are often done in isometric projection.

Two examples are given, the first of which is a view of a Stuart Turner cylinder for a model engine (Fig. 79). The other a view of a type of crank the particulars of which have already been given in these articles. In these examples we have plan, side elevation, and end elevation in one view, and so drawn that the dimensions may be scaled off accurately in either direction. In the case of the cylinder, *a b* is the length, *c d* the diameter of the flange, *e f* and *g h* the dimensions of the valve face; all the intermediate sizes can be measured off along these lines.

In the drawing of the crank the length, centre to centre, is set off along the line *a b*, the distance *b c* showing the amount that the face of the smaller boss stands back from the plane in which the face of the larger boss is situated; the diameters of the bosses and holes can be scaled off along the lines *d e* and *f g*. The distances *a h* and *c j* show the depth of the bosses; the size of the keyways may be also measured accurately by scaling.

The theory of isometric projection will be readily understood by a reference to Fig. 81. Suppose *c* to be the centre of a circle of a radius equal to *a c*, the vertical line *a e* is drawn to pass through the centre *c*, beginning at *a*. The circle is divided into six equal chords each exactly of the same length as the radius. Therefore *c g* is equal to *e f*, and *c e* equal to *g f*. It follows (Euclid I, 33) that *e f* is parallel to *c g* and *g f* parallel to *c e*. We may consider the figure inside the circle* to represent a cube, of which one diagonal is perpendicular to the plane of the paper and all the edges of the cube are inclined at the same angle to the paper, and consequently foreshortened to an equal amount. To find the actual length of the edge, set off (Fig. 81) the line *c h* at right angles to *a c*, bisect the angle *a c h* by the line *c k*, produce the line *f g* to intersect this line at *k*; then *c k* will be the actual length of the line *c g*, the proportion $\frac{cg}{ck}$ being $= \frac{1 \cdot 1547005}{1 \cdot 4142136}$ (nearly). It is, however, not usual to scale dimensions except on lines *parallel to the edges of the cube*, so that it is, for all practical purposes, unnecessary to make a special scale.

We can therefore measure off the three dimensions—length, breadth, and depth, using the same scale for each dimension. If *a e* be vertical, then *c h* being at right angles will be horizontal. In the triangle *a c g* all the sides are equal, therefore all the angles are equal (Euclid I, 6) to each other; *a c g* will therefore equal $\frac{180^\circ}{3} = 60^\circ$. The angle *g c h* will then $= (90^\circ - 60) = 30^\circ$. The same method may be used to prove that the angle $b c j = 30^\circ$.

It follows then that all lines that are parallel to either of the *horizontal* edges of the cube are inclined at an angle of 30° to a horizontal line on the paper.

The method of using an ordinary set-square with 30° and 60° in angles is shown in Figs. 82 and 83, all lines being drawn by means of the T and set-square.

* The circle does not represent the sphere in which the cube is contained. To find the diameter of the containing sphere, draw *k l* at right angles to *k f* and extend *d b* to meet it at *l*; set off *l m* $= c k$, join *k m*; *k m* will equal the diameter of a sphere touching each of the eight corners of the cube.

As an example, let it be required to draw to a scale of 3 ins. = 1 ft. a wood trough, say 12 ins. × 10 ins. × 6 ins. deep inside, made of 1½-in. boards, with a chamfer ½ in. wide on the top outside edges.

Begin by drawing the line *a b* equal to 12 ins. + 1½ ins. + 1½ ins., together equal to 15 ins. on the scale. Then *a c* equal to 10 + 1½ + 1½ = 13 ins.; next the vertical lines over *a b c* of sufficient length to ensure these extending the full height. Set off *a d* equal to 1½ ins. the thickness of the board, and from *d* draw lines parallel to *a b* and *a c*. Set off *d e* equal to 6 ins., the depth of the tank; draw *k g* and *k f* cutting the vertical lines in *f* and *g*; draw the lines *f h* and *g h* intersecting at *h*, using still the 30° edge of the set-square. Now set off *e j*, *e k*, *f m*, *g l* each equal to 1½ ins. The outline of the tank may now be completed. To determine the chamfer, set out (Fig. 85) the corner in section, and find out the dimension *x*. To transfer this to the isometrical drawing, set off *e y*, *e z*, and *e w*, each equal to *x* (we give the corner *e* (Fig. 84) enlarged in Fig. 86, to show more clearly the method of setting out the chamfer), from *w*, *y*, and *z* draw the lines, as shown. In finishing the drawing the parts *s y* and *s z* of the lines will not be drawn in, and at *j* the lines *j t* and *j r* must be omitted, *t r* being drawn instead.

Where circles occur, these may be determined by offsets on lines parallel to either edges of the cube, or with reference to any line parallel to any edge of the cube. The circle will always be represented by an ellipse, the major axis of which is on (or parallel to) the longer diagonal of the face of the cube, as will be seen from the diagram (Fig. 87), and that in any plane parallel to the faces of the cube a circle in a horizontal plane will always have its major axis on a horizontal line, but parallel to one of the faces of the cube. A circle on a vertical plane *a* will always have its major axis inclined at 60° to a horizontal line* or 30° from the vertical. This will be more readily understood if it be taken into consideration that our point of view is assumed to be above the centre of the circle.

To find the principal axes of an ellipse representing a circle on a horizontal plane, using the 30° set-square, set off the line (Fig. 88) *a b*, equal to the diameter of the given circle, and a horizontal line *a d*, on which will be the major axis of the ellipse; with the 30° set-square draw *b d* from the point *b*, draw *a e* parallel to *b d*, and *d e* parallel to *a b*. From the point *e* where these lines meet, draw the vertical *e f* passing through the point *b*, and cutting the line *a d* in *c*; make *a f* equal to *a c*, join *a* and *f*, bisect *a f* in *g*†; with radius *c g* from *c* as a centre, describe the arc *g h*, through the point *h*, draw *h j* parallel to *a b* cutting *c f* in *j*; then *h c* will be half the major axis and *j c*

* Some thirty years ago the writer fell into a hornets' nest at an exhibition in the North of England by suggesting that a mortar mill was incorrectly shown on a drawing presuming to be an isometrical view, where the axes of the ellipses representing the rollers were vertical. Probably the appearance of being elongated would have condemned it had it not been the work of a local engineering magnate.

† In practice *a f* and *c g* would be drawn by means of a 45° set-square from the points *a* and *c*.

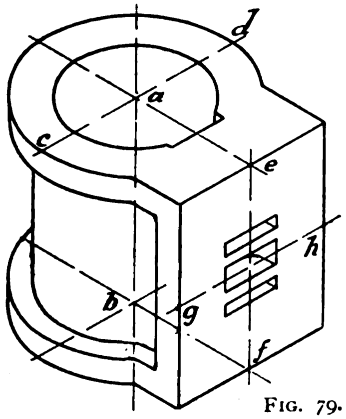


Fig. 79.

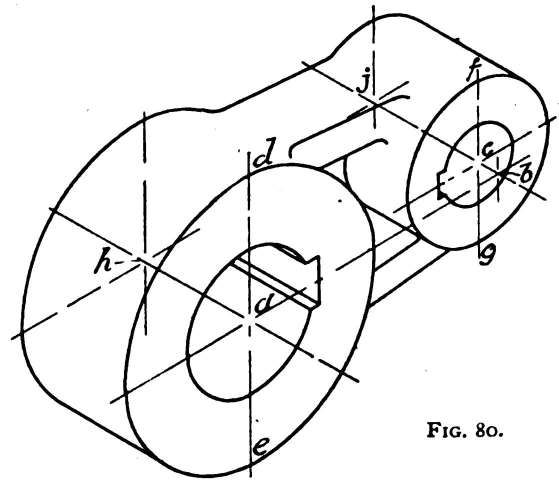


Fig. 80.

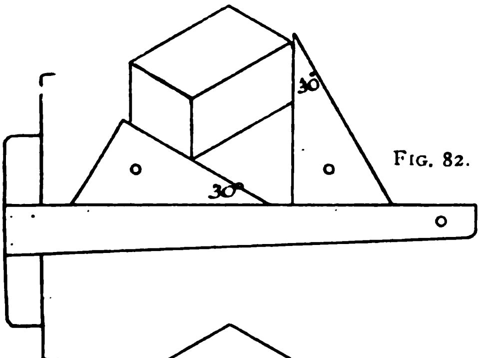


Fig. 82.

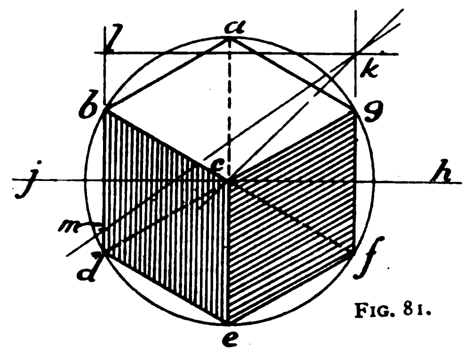


Fig. 81.

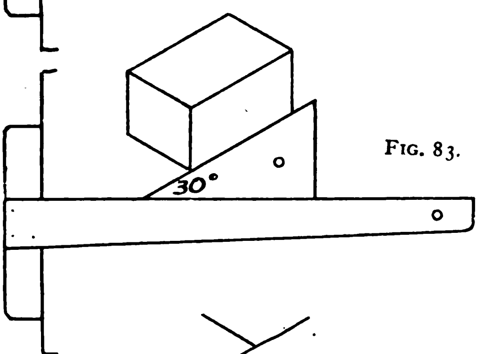


Fig. 83.

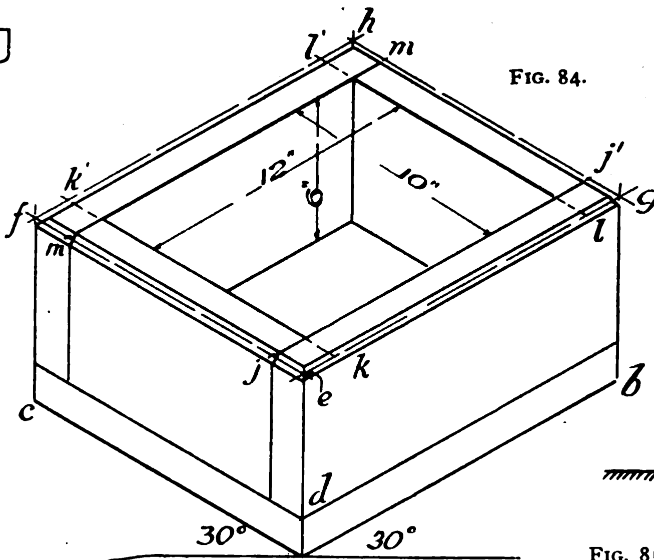


Fig. 84.

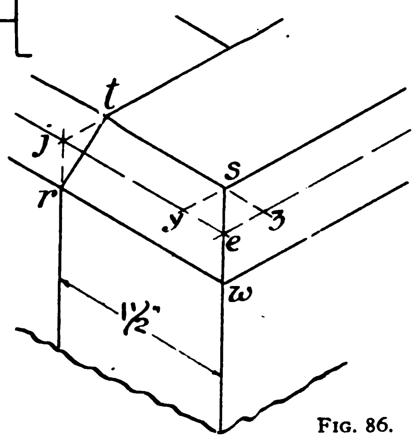


Fig. 86.

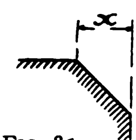


Fig. 85.

ENGINEERING DRAWING FOR BEGINNERS.

half the minor axis of the required ellipse. From *g* drop the vertical line *g m*, cutting *a b* and *a e* in *k* and *m*; the ellipse will have the lines tangent at these points.

A very convenient way of drawing the ellipse with the compasses is shown in Fig. 89. Having found the point *h*, as in the last example, set off *c p* = *c h*, draw the lines *p m* and *p n* with the set-square, having the edge 30° from the vertical

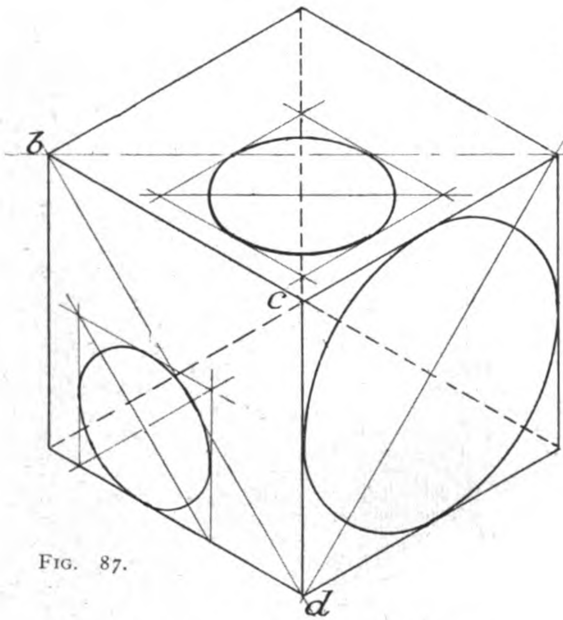


FIG. 87.

through the points *x* and *y* where these lines cut the major axis, using the set-square as before, draw *l k* and *o k*; with *p* as centre and radius *m p*, describe the arc *m n*; with same radius, and *k* as centre, describe the arc *l o*, from *x* and *y* as centres, and radius *l x*; describe *l m* and *o m* to complete the ellipse. The ellipse thus described

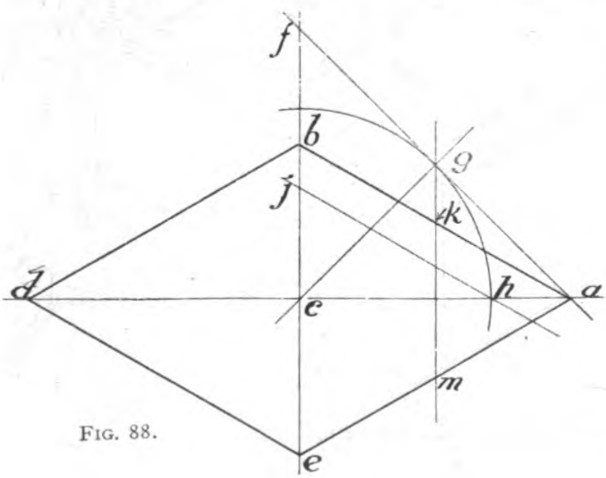


FIG. 88.

will be a very close approximation to the ellipse required and near enough for all practical pur poses. The axes will be found to almost coincide

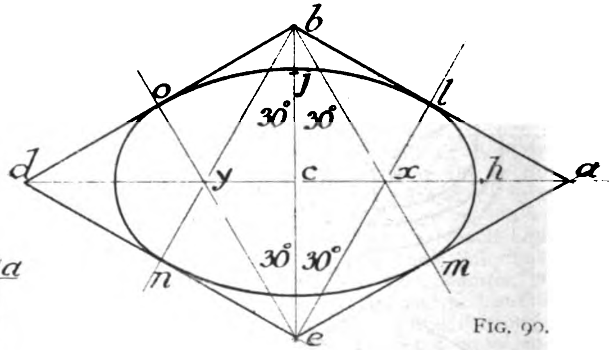


FIG. 90.

with those found by the previous example, although the points *m* and *l* do not exactly coincide with *m* and *k*; the difference will be hardly appreciable, as can be demonstrated by dropping from the point *b* (Fig. 89) the line *b m'* at 30° from the vertical; *m'* will be the point of actual contact, corresponding with *m* (Fig. 88).

A still more simple method is shown in Fig. 90. This method gives the points at *l* and *m* perfectly accurate in position; the major axis is, however,

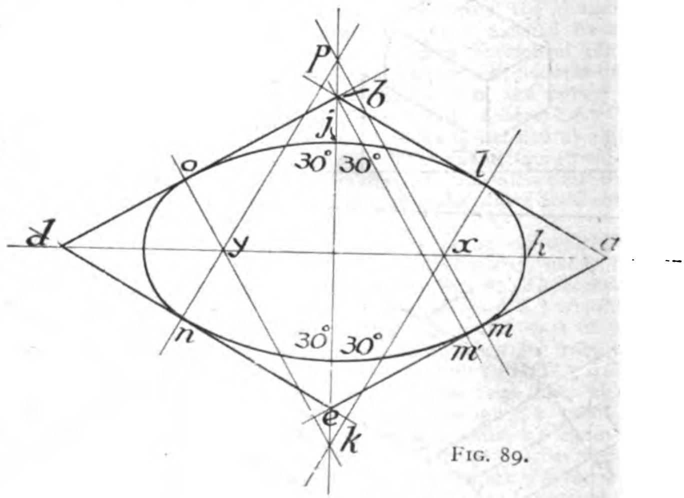


FIG. 89.

about 5 per cent. too short, and the minor axis 3 per cent. too long. The writer almost invariably employs it, the error not being very apparent in work that isometrical projection is suitable for.

Having set out the parallelogram, as before, with side *a b* equal to the diameter of the circle; from *b* and *e* draw the lines *b m*, *b m*, *c l*, and *c o* each 30° from the vertical, with *b* and *e* as centres and radius *b m*, and with *x* and *y* as centres and radius equal to the line *x l*, complete the ellipse, as shown.

(*To be continued.*)

How to Become a Mechanical Engineer.

By Alfred W. Marshall, M.I.Mech.E., A.M.I.E.E.

(*Continued from page* 39.)

PATTERN-MAKING is one of the most important and one of the most interesting branches of mechanical engineering work. It ranks with the drawing office and carpenter's shop as a department in which the work is clean. Though similar to carpentry and joinery in that it is woodworking, the pattern-maker must possess engineering knowledge and exercise special skill in making wood shapes of many kinds, some being intricate or of advanced geometrical form. He should be able to readily "think in the solid"—that is, to picture a shape in his mind which so far has had no actual existence, but is only an arrangement of lines upon paper, called the drawing. Pattern-makers work at a carpenter's bench and with similar tools, but as the things which they make are really models of parts of machinery, a great deal of their work consists in cutting curved surfaces. This involves skill in turning wood by means of a lathe, and much use of files, rasps, scrapers, and special planes. The pattern-maker must be able to read an engineering drawing, understand the behaviour of metals in the foundry, if they shrink or swell when cooling from the molten state, how the moulder places the pattern in the sand, and contrive it so that it can be withdrawn when the sand has been rammed around it. He must understand the behaviour of different kinds of woods, that the pattern may be constructed to stand firm and not warp out of shape. A considerable amount of reliance is often placed upon him to make the shape of suitable proportions to serve its intended purpose. Some acquaintance with the methods of the fitter and turner are required, as the pattern may be made intentionally large in places to allow a margin of metal in the casting to be cut off or drilled out. Carpenters and joiners are required to make the wood parts which are frequently attached to engines and machinery; no special knowledge is necessary beyond ordinary carpenters' and joiners' work.

The average lad probably derives his ideas of mechanical engineering from an acquaintance with railway locomotives and marine engines. He thinks that engineering workshops are devoted to making steam engines only, and mentally decides that his apprenticeship must be passed in this particular work to enable him to become a mechanical engineer. The practice of mechanical engineering, however, comprises a great variety of work. Some workshops are devoted to making one particular kind of machine, others manufacture appliances of several kinds and used for quite different purposes. If the lad is determined to specialise in one permanent direction, he should certainly select a workshop manufacturing that kind of machinery. But should he have formed no definite resolution on this point, it does not matter to what class of work he is apprenticed. Some of the branches of mechanical engineering work are as follows: Steam locomotives for railways are made by workshops specially devoted to this purpose in the majority of cases, but some firms, such as the Brush Electrical Engineering Company, at Loughborough, make them in addition to other specialities. Railway companies have locomotive departments where their locomotive engines and carriages are made and repaired. Some of these works, such as the Great Western Railway Company's factory at Swindon, are of very large size. There are also private firms engaged in the business, which is of considerable importance. Many locomotives are sent abroad, and even in the United Kingdom railway companies frequently purchase locomotives from private firms, though they may have their own factory engaged in this work. Marine engines are made by firms who devote themselves entirely to this work, and in departments of dockyards and shipbuilding yards. The work ranges from light engines for use in launches, small yachts, and torpedo vessels, to the very large engines used for propelling battleships, cruisers, and merchant steamships. Stationary engines comprise gas, petrol, and steam engines. They range from very small engines of about 1 h.-p. to large sizes used for driving mills, pumps, electric machines, etc., of 1,000 h.-p. or more. Considerable numbers are used as auxiliary engines on steam ships for driving fans, pumps, and winches, etc. Some—but not necessarily all of these—auxiliary engines are made in marine engine workshops. All engine work includes not merely the parts of the engine itself, but pumps, wheel gearing, and steam or water pipes connected with it. Steam boilers are made in the boiler departments of engine workshops and by firms who specialise as boiler makers only. A steam boiler is an integral part of a steam locomotive, and a locomotive workshop necessarily makes the boilers also, but a marine engine maker will perhaps not make boilers. Portable steam engines and boilers and road traction engines, such as are used for agricultural purposes, are a distinct class of work. The firms making them specialise in agricultural machinery, which includes ploughs, threshing, reaping, and similar machines.

Woodworking machinery comprises sawing, planing, moulding, boring, mortising, and turning machines. There are also machines for particular purposes, such as those for making boxes and shaping gun and rifle stocks. They are usually made by firms who specialise in this direction and make only woodworking machines. Printing machinery ranges from small treadle or hand-driven platen jobbing machines to large multiple newspaper presses designed to print some particular journal. The latter have heavy frames and many rollers and gearwheels, with devices for pasting, cutting, and counting the sheets of paper as they are printed. A great deal of ingenious mechanism is used in printing machines, and a considerable variety of patterns are made. The makers usually specialise in this branch also. Another special manufacture is textile machinery. It includes weaving, spinning, combing, lacemaking, and similar machines, some of a very intricate character. The making of hydraulic machinery is a distinct branch of work. Much of the apparatus must be designed to withstand very heavy water pressure—perhaps, several tons to the square inch. It is an important class of machinery, and includes lifts, cranes presses, tools for riveting, flanging, and forging, as well as the pumps for this special high-pressure service.

Constructional work, although belonging rather to the profession of civil engineering, is mechanical engineering, as far as making iron and steel framing is concerned. Lattice and plate girders for bridges and cranes, columns, water wheels, overhead winding gear for mines, the iron or steel hulls of ships, tanks, gas-holders, and so on, are all mechanical engineering work. Making guns and their carriages, projectiles, and torpedoes is another special branch. It is entirely mechanical engineering and undertaken by private firms, often in machines for drilling small holes of 1-16th to ¼ in. in diameter, and boring machines for truing the inside of cylinders 6 ft. or 7 ft. in diameter. Light quick-running shaping machines with, say a stroke of 6 ins., and powerful planers for shaping and planing the armour plates of battleships. Milling machines in great variety, gear-cutting machines for producing straight and helical teeth upon spur and bevel wheels. Slotting machines for cutting keyways, crankshafts, links, etc., machines for punching holes for rivets in iron and steel plates

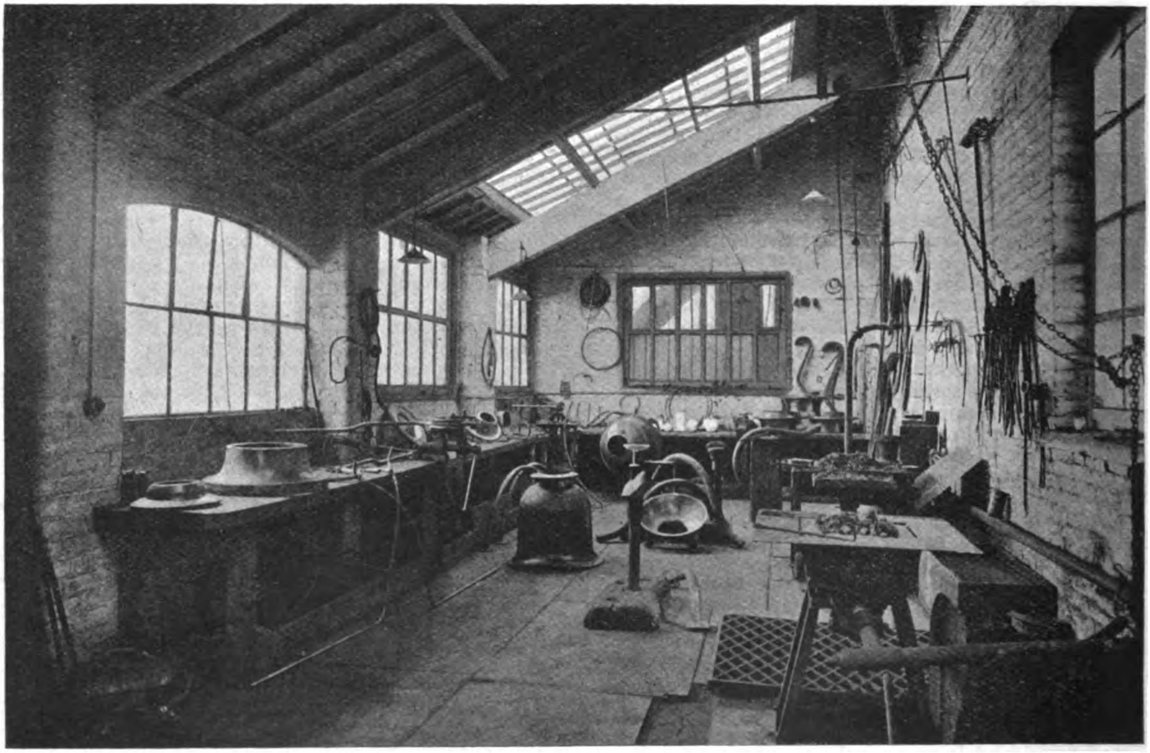


FIG. 3.—INTERIOR OF COPPERSMITH'S SHOP: MESSRS. PECKETT & SONS' WORKS, BRISTOL.

addition to other work, as well as in Government arsenals. Pump making, as distinct from high-pressure hydraulic machinery, ranges from the small pumps used for feeding steam boilers or delivering small quantities of water to the large centrifugal or direct-acting pumps used for irrigation and public water supply, capable of delivering, say 500,000 gallons of water per hour. There are many patterns of pumps made, separate or directly coupled to steam engines, and arranged with belt or toothed gearing. Machine tool-making is also mechanical engineering; it is carried on by firms specialising in the work, or as a department by large general engineering establishments. Lathes from the small sizes of 3-in. centres to huge machines in which heavy guns and engine shafts are turned. Special lathes for turning flywheels and similar work, weighing many tons. Sensitive drilling and for shearing off plates and bars to size. Screwing machines to produce screws; forging, rolling, bending, machines; grinding machines, not only the ordinary grindstone, but very accurate tools, by means of which spindles and flat surfaces, holes, and cylinders are ground to fine limits of size. The manufacture of motor-cars is also mechanical engineering, and there is a large range of machines, such as dynamos, electric motors, bottling, malting, weighing, pressing, embossing machines, shafting, pulleys, bearings, etc., which are made in engineering workshops.

The workshop methods and processes are similar for the manufacture of all machines. Turning, planing, slotting, milling, filing, and fitting. Boring cylinders, making patterns, casting iron, steel, and brass, cutting screws and gearwheels, brazing pipes, riveting plates together; the work is practically the same to make a locomotive or a printing machine. There will be no boiler and pipe work for the latter, but bolts, screws, rods, wheels, castings, etc., must be made for both, and an apprentice having served his time making one can afterwards engage in making the other, if he desires to do so. If he has learnt one department only, he would have to keep to that particular trade. An apprentice serving his time as a moulder could not work as a fitter, for example; but if he has served his time in the foundry of a printing machine maker, he could work afterwards in the foundry of a locomotive works, and so on. An apprentice fitter could serve his time making printing machines or pumps, and work afterwards in the fitting department of a locomotive or marine engine works. He would be probably at a slight disadvantage at first, through want of familiarity with small practical details, but would soon acquire a knowledge of the difference in the two classes of work.

The photograph (Fig. 3) is typical of a coppersmith's workshop. It contains appliances for bending pipes, a forge for heating copper bars and plates so that they can be hammered to various shapes, as copper may be worked by a smith in a similar manner to wrought iron. A brazing hearth, either worked by a gas blowpipe or bellows, is also used for melting the spelter (a soft variety of brass), by which the joints and seams of copper pipes are fastened together. Various parts of locomotive copper work are on the bench and floor.

(To be continued.)

The Junior Institution of Engineers.

BY special permission of the Exhibition Executive and other respective authorities visits of this Institution were recently paid to (1) the site of the Franco British Exhibition at Shepherd's Bush, covering an area of 140 acres, for an inspection of the constructional engineering work, etc., in process of erection there; (2) the Exhibition Extension Works of the Central London Railway; and (3) the generating station of that Railway.

The Exhibition buildings, having advanced to about the half finished stage in their construction, were examined with great interest under the guidance of Mr. J. S. Ferguson, Mr. L. H. Rugg, and other gentlemen, the features calling for special observation being pointed out.

The Central London Railway extension to the Exhibition will form a loop at the end of the railway, running up from the present Shepherd's Bush Station, passing through the yard, where a station will be constructed convenient for the Exhibition, and descending again by a tunnel that is now being constructed to the present Shepherd's Bush Station. In this way the trains will run round instead of being, as at present, "crossed-over" at the terminus.

At the generating station, the chief engineer (Mr. E. Groove), Mr. C. Forgan, and other officials showed the members round. The current is generated at 5,000 volts alternating, and is sent out to transforming stations at Notting Hill Gate, Marble Arch, Bond Street, and Post Office, where it is reduced to 550 volts direct, and at that pressure delivered to the motors. The engines consist of six horizontal cross compound condensing, made by Allis, of Milwaukee, U.S.A., and run at 96 r.p.m. The electric generator is fixed directly to the flywheel. Each is 850 kw. capacity or about 1,000 h.-p. Five engines are only required at time of greatest load. An additional engine for 2,000 kw. capacity is now being installed. There are sixteen Babcock & Wilcox boilers, and four of the Lancashire type. Klein & Wheeler cooling towers are used, and there is also a brick tower. The water supply is obtained from two artesian wells—one fitted with a deep well pump, the other lifting by compressed air. The output of current amounts to about 50,000 units per diem. The car sheds and repair shops were also seen.

Before the members dispersed, the Chairman of the Institution (Mr. Frank R. Durham) expressed their thanks for all the arrangements which had been made for their reception. At the ensuing meeting a paper on "The Conduit System of Electric Tramway Construction" is to be read by Mr. Fitzroy Reese of the L.C.C. Tramways Reconstruction Department.

Practical Letters from Our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume if desired, but the full name and address of the sender MUST *invariably be attached, though not necessarily for publication.]*

A Model Water Turbine.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—The following is a description of a model hydraulic turbine I have recently finished. The case is made of two pieces of sheet brass, with a ring sweated on the inside of each to form a flange to fit

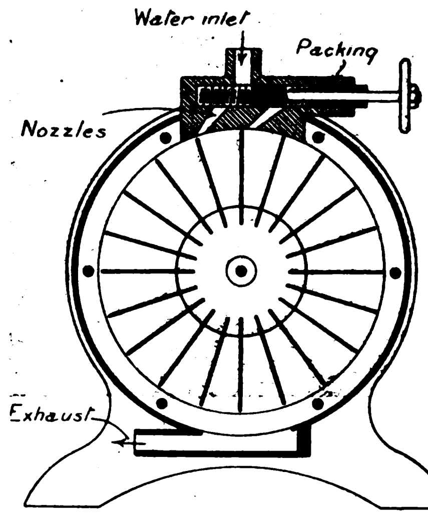


FIG. 1.—SECTION THROUGH MODEL WATER TURBINE.

the tube forming the cylinder, and is bolted together by six ⅛-in. bolts and nuts. The wheel is of the ordinary type, 2 ins. diameter, and is made from a piece of solid brass and turned to form a boss on each side of the centre-piece, which is ½-in. wide. In the centre-piece is cut twenty slots, and the blades were knocked into these tight and then sweated, thus making a good wheel. I trued it by revolving it in the lathe and holding a sharp file in the desired position, taking care not to let it follow the wheel. This method did not bend the blades, but made the wheel quite true. It was next bored for the shaft, this being ¼ in. diameter. The valve is, I think, a novel feature, and its method of working will be best explained by sketch, which shows one nozzle open.

I have had the machine connected to the house water tap, and was surprised at its power and speed. I gripped the shaft with my finger and thumb, and it was with an effort that I could stay it; then I connected a speed indicator to it by a piece of small rubber tube, and it ran nearly 3,000 r.p.m.—Yours truly, W. SLINGSBY.

Standardisation of the G.W.R. Locomotives.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—On page 502 in your issue of November 21st, Mr. Lake writes that the opinion has been expressed in more than one quarter that it might be a good plan for the G.W.R. Locomotive Department to adopt a settled design for each class of locomotive as standard, and build to that design while that efficiency lasted, rather than to construct only a comparatively few engines to each design and change the latter at frequent intervals. Bearing

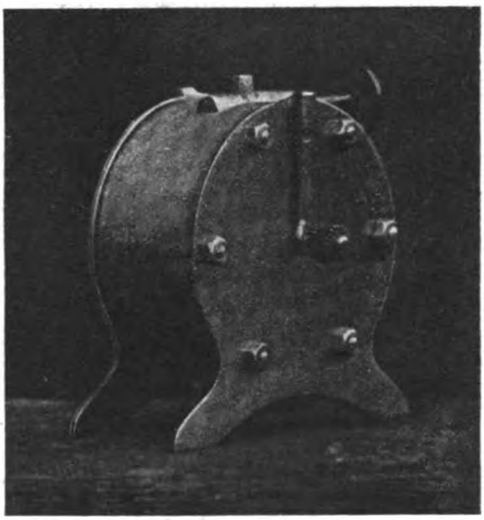


FIG. 2.—VIEW SHOWING EXTERIOR OF MODEL WATER TURBINE. (*See page* 65.)

in mind the different sections of the Great Western Railway and the difficulties the designer has to contend with, I maintain that Mr. Lake's suggestion has been, and is being, carried out. Perhaps no railway in this country is possessed of a track more level, and yet in some places with steeper gradients or sharper curves, than the G.W. Railway. The consequence is that different classes of locomotives have to be designed for different sections. Again, some parts of the line are not strong enough to stand locomotives of more than a certain weight. For instance, no locomotive heavier than a "City" is allowed beyond Cardiff, and no engine heavier than a "Dominion" beyond Plymouth.

The Locomotive Department of the G.W.R. is perhaps more progressive than any other in this country. The maxims of its excellent chief are efficiency and economy. "Handsome is as handsome does," says Mr. Churchward, and yet he has designed the cheapest express locomotive of modern times in this country, perhaps in the world, viz., the "County" class.

That standardisation is one of the objects Mr. Churchward has in view is exemplified by the fact that: (1) All the parts (except wheels), boilers and fittings of the outside-cylinder engines classes 4—4—0, 4—4—2 tanks, and 2—6—2 tanks are standard and interchangeable. (2) All the parts, boilers and fittings of the 4—4—2, 4—6—0, and 2—8—0's are standard and interchangeable. (3) The parts of the "Stars" and the new "Pacifics" are standard and interchangeable. (4) All the parts of the "Cities," "Atbaras," "Bulldogs," "Badmintons," "Camels," "Dominions," and "Duke of Cornwalls," and 2—6—0's are all standard and interchangeable. (5) When the process of rebuilding all the 4—4—0's with outside frames is completed, all of these engines will have the same type of boiler as the "City" class. The two standard boilers for the modern locomotives are the "City" and the 4—6—0 types. These two classes of boilers are probably the most economical in the country, creating more steam per square foot of heating surface on a smaller consumption of fuel than any other.

Mr. Churchward has not designed a single locomotive since he became locomotive superintendent that has not been a perfect success in every respect. Perhaps one of the most successful of his designs is the 2—6—2 class of tanks, which haul about 1,000 tons between Banbury and London and back every night, and yet these engines are kept in readiness at Newbury and Newton to take the Riviera express in case of breakdown of the train engine. These engines run very steadily at 70 miles per hour. They are most economical in coal consumption, and, even when hauling the heaviest load burn no more coal than the wonderful (?) Great Northern 0—8—2 tanks did when hauling suburban trains. It is a great pity that Mr. Ivatt does not copy this Great Western type of locomotive, as it would improve the suburban services on the G.N.R. enormously.

The 4—6—0 two-cylinder classes during the summer season often take the 11.50 *ex*-Paddington, with 420 tons behind the tender, to Exeter under three hours on a coal consumption of 35 to 40 lbs. per mile. Can Mr. Lake quote better work on any other English railway on the same coal consumption?

The reasons for the design of the four-cylinder engines are not far to seek. The de Glehn "Atlantics" proved such steady running locomotives, being so well balanced, that Mr. Churchward designed his perfectly balanced four-cylinder high-pressure engines, the contention being that in a long stroke H.-P. cylinder having a large steam passages a cut-off of 12 per cent. gives better results than compounding. That the design is successful is evidenced by the fact that the "Stars" will take a load of one coach more than the "Saints" (4—6—0) on the same consumption of fuel, and are the best riding engines in the country. The diagram obtained of the cylinders working with a

12 per cent. cut-off is perfect, and I should like to know of any other locomotives that can cut-off successfully at 12 per cent. and give a good diagram.

The loads of some of the Plymouth trains are to be greatly increased, and the locomotive department has been told that more powerful locomotives are required. Hence the new "Pacific," which has moderately sized cylinders, the largest boiler in this country, superheated steam, and 225 lbs. per square inch working pressure. The boiler has already proved most successful, so I think the "Great Bear" will prove to be one of the finest locomotives in the world, both as regards speed and haulage power.

The G.W.R. locomotive department is the first in this country to adopt superheating successfully. The new standard superheater is most simple and effective, and is a great advance upon the Schmidt superheater.

I think, from the above remarks, your readers will agree with me that the Locomotive Department of the G.W.R. is the most progressive in this country, and that the policy of one of the greatest locomotive engineers that has ever lived, namely, Mr. G. J. Churchward, should be imitated instead of criticised.—Believe me to remain, yours faithfully,

JAMES C. CREBBIN
("MODEL COMPOUND LOCO.").

TO THE EDITOR OF *The Model Engineer.*

SIR,—I am much obliged to you for your courtesy in permitting me to see a proof of Mr. J. C. Crebbin's long and not uninteresting letter on the subject of Great Western Railway locomotive practice.

It is obvious from this that, in Mr. Crebbin, the locomotive department of the railway referred to possesses a staunch and enthusiastic champion, and one who must, before he can write as he does, believe that in the G.W.R. locomotive standards we have concentrated all that is best in the world's locomotive practice. If not, how, for one moment, can such claims as those made by your correspondent be seriously put forward? These are as follows:—

(1) Mr. Churchward has not designed a single locomotive since he became locomotive superintendent that has not been a perfect success. [This being so, how can the 2—6—2 tank or any other type be the *most* successful?]

(2) The "County" class engines are the cheapest express locomotives of modern times in this country, perhaps in the world. [Cheapest to build or run—which?]

(3) The coned boilers of the G.W.R create more steam per square foot of heating surface on a smaller consumption of fuel than any other.

(4) The 4—6—0 locomotives, with four cylinders, are the best riding engines in the country.

(5) The new G.W.R. standard superheater is a great advance upon the Schmidt superheater.

These are bold assertions, requiring a very great deal of substantiation before they can be generally accepted by practical men. No doubt they express a large amount of truth and represent entirely the views of Mr. Crebbin, and, in a lesser degree perhaps, those held at Swindon; but we outsiders may not be so ready to admit them offhand in their entirety in the absence of more detailed information.

Lest it may be understood to the contrary, I would at once say that I find very much to cordially admire in the present-day locomotives of the Great Western Railway; indeed, who, among those acquainted with the subject, can do otherwise? It does not necessarily follow, however, that there is nothing to criticise in the methods of that line.

I have no doubt that a system of standardising is in progress on the G.W.R. where locomotive parts are concerned; but, as regards the standardising of engine *types*, I see no evidence whatever of this.

As regards the hauling of 420-ton trains on an average coal consumption of from 35 to 40 lbs. per mile, and your correspondent's invitation to me to say whether I can quote better work on any other English railway on the sàme coal consumption, I should think that no one could expect to obtain better work on this coal consumption than the hauling of 420-ton trains at express speed, and the engine that does it is, of course, performing excellently. Who has not heard though of the less powerful engines which some years ago were alleged to be consistently hauling (and over a much heavier road than the Paddington-Exeter length) trains weighing from 350 to 400 tons behind the tender on an average coal consumption of 30 lbs. —or was it 20 lbs.—per mile? Here, again, we cannot accept bald figures offhand.

As to its being a pity that Mr. Ivatt does not copy the Great Western 2—6—2 type tank engine, which, according to Mr. Crebbin, would improve the G.N.R. suburban services enormously, from what I know of Mr. Ivatt he is not likely to copy anyone in his locomotive designs, and still less likely to accept gratuitous—and non-professional—advice coming from outside.

I may say in conclusion, that I have neither the time nor the inclination to enter into a controversy on this subject. In the course of my travels during the year, both in this country and abroad, I come in contact with a good many of the leading men in the railway profession and with those who are engaged in building locomotives outside of the railways, and it would indeed be curious if I did not hear numerous opinions expressed on current matters coming within this field.

Reference to these opinions in print evidently involves the risk of stirring up opposition from one or other of the ardent advocates who see in such reference criticism of their favourite line, and although the resulting correspondence may form interesting reading to others, participation in it offers no attraction for yours faithfully,

Finchley, N. CHAS. S. LAKE.

TO LEICESTER READERS.—A Society of Model Engineers is being formed in this district, and readers and others interested are asked to attend the first general meeting, to be held at the Rutland Coffee House, on Friday, January 17th, at 8 p.m. —D. MERTON, 5, Dundonald Road, Leicester.

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

AN ordinary meeting of the above Society was held on Friday, January 3rd, 1908, at the Cripplegate Institute, Golden Lane, E.C., Mr. F. R. Welsman taking the chair, and upwards of eighty members being present.

The minutes of the previous meeting having been read and eight gentlemen elected members, the Chairman announced further gifts of books to the Society's library and the list of tools to be purchased for inclusion in the loan collection. After announcing the dates of future meetings and visits, as below, the formal business concluded, and the remainder of the evening was spent in attending the demonstrations in workshop processes given by various members. A very instructive demonstration was given by Mr. A. W. Marshall, M.I.Mech.E., with the aid of the Society's instruments, in marking out castings and forgings prior to machining, giving a very clear explanation of the methods to be adopted in marking out castings of many diverse shapes. Mr. Hildersley attracted a deal of notice in a demonstration of the methods of making brass and copper tubing out of flat sheet metal by means of drawplates and silver-soldering the seam. This method of making tubes appeared particularly useful in connection with scale model work, as pipes of very small sizes can be made, even to one with a bore of 1-40th in. Mr. Blankenberg had gone to considerable trouble in bringing up his lathe, and demonstrated iron turning and wheel fitting on a pair of large locomotive driving wheels. Mr. F. R. Welsman interested and initiated several members in the messy but useful art of French polishing. The ease with which he obtained a beautiful finish on the work was a revelation to many whose attempts in that direction had more often than not ended in failure. An interesting and well-made exhibit was brought by Mr. Wilkins, in the shape of an indicator for testing lathes and other machine tools for accuracy, the needle having an exceptionally wide range of movement in recording discrepancies less than 1-1,000th in. in extent. A very instructive meeting was brought to a conclusion at ten o'clock.

FUTURE MEETINGS.—The next meeting takes place on Tuesday, January 28th, when Mr. A. W. Marshall will give a series of wrinkles in connection with the construction and use of various types of primary batteries, illustrating his remarks with many experiments and demonstrations. The following meeting is fixed for Tuesday, Feb. 25th.

VISITS.—On Tuesday, January 21st, to the Works of Messrs. Siemens, Ltd., at Woolwich, where cable construction and the method of operating railway points electrically will be seen. Last day for joining this party is Friday, January 17th. On Saturday, February 15th, at three o'clock, the Motor Works of Messrs. D. Napier & Sons, at Acton, will be visited. On Wednesday, March 4th, to the Bow Works of the North London Railway.—Full particulars of the Society and forms of application may be obtained from the Secretary, HERBERT G. RIDDLE, 37, Minard Road, Hither Green, S.E.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26-29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[18,564] **Charging Secondary from Primary Cells.** W. L. (Lewisham) writes: I noticed in your Handbook on "Amateur Electric Lighting" that you advise gravity Daniell cells to keep accumulators fully charged. I should be pleased if you would tell me how many of such cells I should require to keep a 4-volt 20 amp.-hour accumulator fully charged, and would it do accumulator harm to discharge it at the rate of 2 amps. by lighting two 4-volt Osrams from it at the same time?

Connect up sufficient number of Daniell cells so that their combined voltage in series is slightly over the voltage of the accumulators to be charged. If you refer to recent issues, you will find a lot of information on this subject. Discharge rate of accumulator should not exceed 5 amps. per sq. ft. of positive plate surface.

[18,565] **Small Gas Engine Trouble.** S. W. P. (Liverpool) writes: Being a reader of your valuable paper, I would be very pleased if you could give me some help as regards my gas engine. I herewith enclose the dimensions (sketch not reproduced), etc., and may also add that I use petrol (surface carburettor) with it instead of gas. It is ⅛ h.-p., 3-in. bore, 6-in. stroke. I have just finished making it, and now I cannot get it to go. I think the valves are too small. The cylinder cover has two ½-in. holes—one for gas and one for air (air and gas admitted through the same valve, which is automatically operated). The exhaust is mechanically operated by a 2 : 1 gear, and the passage is ½ in. The enclosed diagram will explain. The valve seating and valve head is only ½ in. (both valves). Tube and electric ignition; but, with tube, I find that pre-ignition occurs. With electric, the explosion does not seem to be strong enough to carry the piston over compression stroke. The mixture is right and exhaust set right. The compression is fairly good, but owing to the rings being a little too narrow there is a leakage; but, in my opinion, not too much to keep it from working.

In reply to your letter *re* gas engine difficulty, we can only say—as we have often said before—that provided you can once get the engine to run at all, it is only a matter of careful adjustment and persuasion to get it to run properly. The ½-in. valves are both much too small. They should be at least 1 in. diameter, and the exhaust might, with advantage, be 1¼ ins. diameter. The ports, passages, and pipes, etc., could be even larger. Small engines of this type are not easily adjusted, and, moreover, everything must be made to run perfectly smoothly and easily, so that there is as little loss in friction as possible, and there is very little power to spare for doing useful work. Everything depends upon the correct setting of the valves and also the timing of the spark ignition. A little leakage past the piston rings would never stop the engine running altogether, although, of course, it is detrimental to best possible results. Also, once again, we wish to impress upon you and other readers the necessity of obtaining a guarantee in writing from any firms from whom you purchase a small gas engine. All makers of repute would not hesitate to give such a guarantee, and without one, the engine usually turns out to be not worth having. We suggest that you write to the firm in question and get them to put the engine in proper running condition for you, or, failing this, to obtain the services of some gas engine engineer in your neighbourhood. You might, with advantage, read our Handbook, "Gas and Oil Engines," 7d. post free, which would help you considerably in the solution of your difficulties. Let us know if you are still in trouble.

[18,597] **Dry Batteries for Charging Cells.** T. M. (New Bilton) writes: I have a small hand-lamp (electric), and would like to charge the accumulator myself. Would the battery I am asking questions about do? Will you please tell me if the Excelsior batteries can be used to charge accumulators? They are made up of two carbons (5 ins. by 1 in. by ½ in.) and one zinc, bichromate potash, etc. How many cells would be required to charge a 4-volt 10-amp. accumulator, charging rate ·5 amp.? How long will it take one of those batteries to charge one accumulator, like above (assuming they will do it)? How long will the accumulator have to be connected before the battery is run down? What should be done when it runs down? How long will one of these batteries last before the solution wants renewing?

Use six of these cells connected in series parallel to give 6 volts. It will take about ten hours to charge; the solution will last for two such charges. Always keep the voltage of cells above that of the accumulators. See recent replies on this subject for further instructions.

[18,339] **G.E.R. 4—2—2 Type Express Engine.** L. W. (Liverpool) writes: Kindly publish at your convenience a drawing of the G.E.R. 4—2—2 type express engine.

We include herewith a drawing to scale showing the leading features of the Holden "bogie singles" of the No. 10 class on the Great Eastern Railway. The length of the firebox is 7 ft., but in a steam model this might be increased to 8 ft. with advantage. A coloured picture of the engine was given as a supplement to the *Locomotive Magazine* for September, 1899.

[18,581] **Lead Burning.** D. V. G. (Deansgate) writes: Will you please give me full particulars of the apparatus required for lead burning and the way of using same?

Lead burning is usually carried out with the aid of a hydrogen flame; but for small jobs, such as accumulator lugs, it can be done with a hot, clean soldering-iron. Apply the hot iron to the two ends of the pieces of lead to be joined, and at the moment the metal begins to run, withdraw the iron and allow the metal to run together, holding each piece steadily until the molten metal has set. Too much heat must not be used, as an oxide would form on its surface under such circumstances and prevent the metal uniting properly.

[18,582] **Dynamo for ½ h.-p. Gas Engine.** L. P. (Falmouth) writes: The information I require is—(1) Particulars of dynamo to charge a five-cell accumulator. Each cell has three positive and four negative (dimensions 8 ins. by 5 ins.) I have a gas engine capable of developing ½ b.h.-p. Would a dynamo (12-volt 5-amp.) suit? (2) The heaviest current I can safely take from the plate.

You will require a dynamo of about 50 watts output, 15 or 20 volts, and 3 or 4 amps. Your gas engine should drive this comfortably, if it is a good design and make. The maximum discharge rate should not exceed 5 to 6 amps. per sq. ft. of positive plate surface.

[18,583] **Colouring Gun Barrels.** W. A. (Howden) writes: I shall be much obliged if you can tell me how to brown gun barrels.

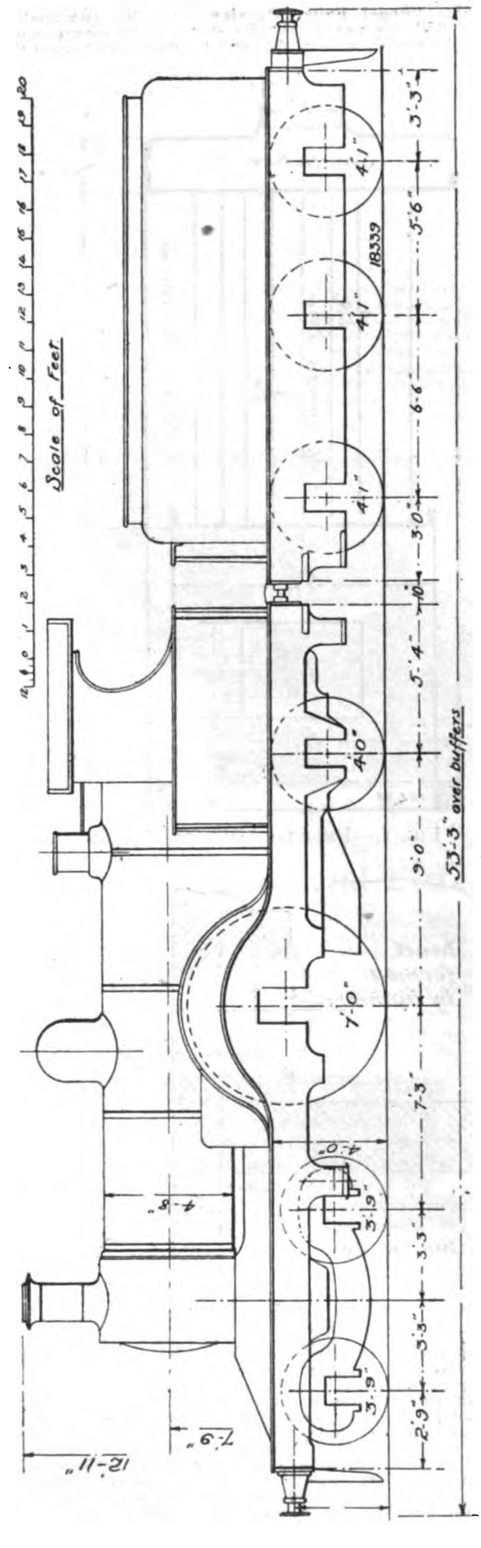
We have no definite information on this subject, but believe the colouring is obtained in the tempering of the metal, which is usually carried out in oil kept at a very high temperature. You might try the experiment for yourself on a small scale first.

[18,584] **½ h.-p. Gas Engine Ignition, Etc.** W. B. (Ilford) writes: I should be greatly obliged if you could advise me as to the method usually employed in the following circumstances. I have a small gas engine of ½ h.-p. The gas and air enter by the same valve, but there is no means of mixing them. (1) Is a gas-bag necessary? (2) Should I fit a mixing arrangement, such as is used in incandescent gas burners: and, if so, should the gas-bag be fitted before or after such an arrangement? A sketch of necessary fittings would greatly oblige. I should add that the gas and air-valve is operated by suction, and the ignition is electric.

(1) Yes. At least, it is advantageous to use a gas-bag. (2) We do not think it is absolutely necessary to fix a new mixing chamber, and we should advise you to try and get the engine to run as at present arranged, if possible. You will find some useful notes on running and adjusting small engines in our Handbook, "Gas and Oil Engines," 7d. post free. See also the articles on small Otto cycle gas engines, which commenced in January, 1906.

[18,590] **250-watt Dynamo Windings.** W. B. (Alexandria, N.B.) writes: I have been a reader of your Model Engineer for the past eighteen months, and I should be very much obliged if you would help me out of difficulties. I intend constructing a Manchester type dynamo, with drum armature, giving an output of 50 volts 5 amps. I also should like to know what size stampings should be used, amount and size of wire for field-magnets and armature. Would you please send me sketch of field-magnets?

We recommend you to build one of the Manchester type dynamos described in Handbook—"Small Dynamos and Motors." The size of the armature of such a machine would be 3½ ins. by 3½ ins. The armature would be wound with 1¾ lbs. No. 20 S.W.G., and the field-magnets with 11½ lbs. No. 21 S.W.G. Drawing to scale is also given in the above-mentioned book, to which please refer.



Great Eastern Railway Bogie Single Express Locomotive, No. 10 Class.

[18,481]] **Model Boiler Queries.** G. M. (Manchester) writes: With reference to the boiler shown on the accompanying sketch (not reproduced)—(1 Would it be satisfactory to rivet the

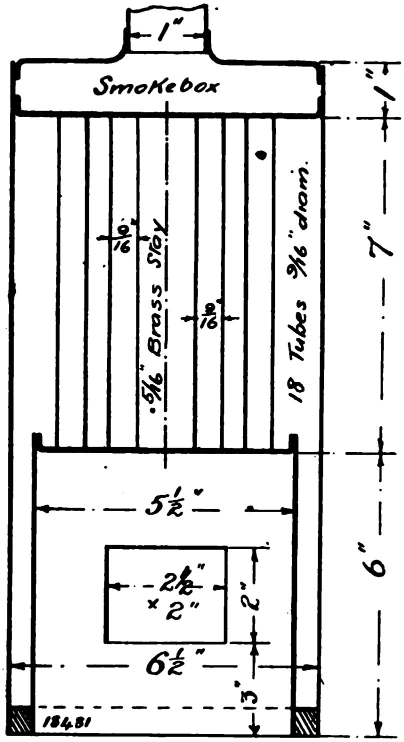
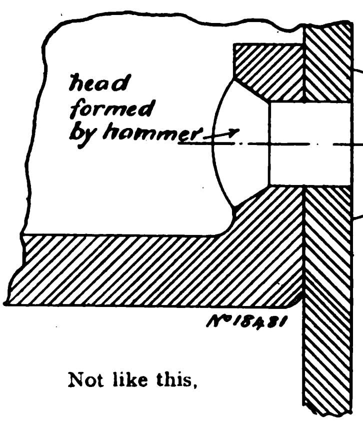
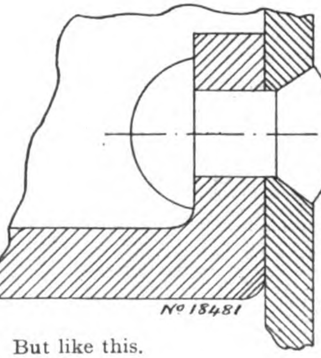


FIG. 1.—PROPOSED MODEL BOILER.



Not like this,



But like this.

FIG. 2.—RIVETING FLANGED JOINT OF MODEL BOILER.

top joint, as shown in Fig. 2? (2) Would this boiler drive an (horizontal) engine with cylinder 1¼-in. bore and 2¼-in. stroke; if not, what size would it drive? (3) What pressure could it be worked at? (4) What clearance hole in the safety valve and steam valve? (5) What size of bore and stroke for the ram of feed-pump, or would you recommend an injector? (6) I thought of making a small donkey pump, to be fixed to boiler foundation, about ⅜-in. bore and ¼-in. or ⅜-in. stroke, so that I could pump water independent of the larger engine. (7) Would like to hear your opinion on it. Perhaps the boiler would not make enough steam to supply both engines. You might point out any mistakes you see in the construction.

(1) The head formed by the hammer should be on the outside. Of course, if a "snap" is available, cup-headed rivets may be formed instead of the countersunk shown. (2) The engine is a little large for the boiler. We would suggest 1⅛ ins. by 2 ins. (3) The pressure maintained will depend on the speed. An engine having a cylinder of the size just mentioned coupled to this boiler would run at 30 lbs. pressure and 250 r.p.m. The boiler may be pressed to 40 or 50 lbs. (4) Use ⅛-in. or 3-16ths-in. safety valve and 5-16ths-in. outside diameter steam pipe, with a suitable steam stop valve. (5) The feed-pump may be 5-16ths in. diameter, with a stroke of ⅜ in. A small injector might be fitted, but a properly adjusted feed-pump will give better satisfaction. (6) We do not recommend a donkey pump where the boiler is rather small for the work it has to do. (7) The theoretical indicated horse-power of the plant is about 1-10th i.h.-p. Good workmanship and perfect adjustment of parts will be necessary to obtain this amount of power. We recommend you to make the crown joint of firebox as Fig. 3 and not with the flange turned upwards. The firedoor should be figured as on the reproduction of your sketch. It is a mistake to make it too small and too low.

[18,591] **Gas Engine and Producer Trouble.** A. L. (Mossley) writes: I will be very glad if you will answer me a few questions. I am in charge of a 40 h.-p. gas engine and gas plant, and have never had any learning for same. On starting from the week-end stoppage, and the engine has run for about an hour or two, it brings with the gas water, which gets on the valves and gets them stuck open, which causes trouble. It also gets on the sparking plug and stops the gas from firing. As I drain all the water from it, I cannot tell where it comes from, unless it is drawn with the gas from the scrubber. Say, if you can, what is the cause. Could you tell me where I could obtain books on gas engines and plants, and what prices they are? I have Tookey's. We have also a dynamo which a firm has put in, and which they have in hand yet. I complained of it sparking very badly, and the cam getting black and hot, until at last it would not light, and now when the strap is put on, the lights will not come in until I hold a stick against the edge of the pulley, which stops the sparking. Please state what you think is wrong with it.

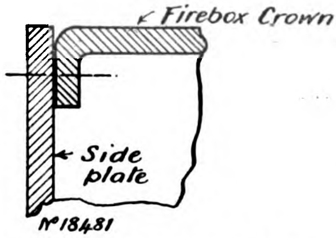


FIG. 3.—FIREBOX CROWN JOINT.

We think the cause of your trouble is due to condensed water forming in the pipes between the scrubber and the engine. If you fit the cock at the lowest point in the pipe and drain this before starting the engine off, we think you will find your trouble disappear. We do not quite understand what you say with reference to the sparking being bad and the belt coming off; if you would explain this point more fully, we should be pleased to assist you.

[18,566] **Small Motor and Cells for Model Boat.** J. H. (Scotstoun) writes: Answers to the following questions will oblige. (1) I have a motor (electric), which is wound to take 4 volts 4 amps. What ampére capacity would you advise, and what voltage would be required to drive the motor (which will be in a boat) for about one hour, using an accumulator? I have got a boat 3 ft. long, 4 ins. beam, and 3½ ins. deep, so space is limited for accumulator. (2) Would T. W. Thompson's accumulator, which gives 4 volts 5 amps.-hour, size 4⅞ ins. by 2 ins. by 2 ins., drive it for about one hour? Would the motor not take all the current at a rush, say in about five minutes; or, would a resistance be necessary? Say what gauge and quantity of German silver wire would be necessary, if any?

(1) Find out by experiment exactly what weight your boat will carry, then choose an accumulator 4 volts and as many ampéres as is possible, bearing in mind the weight limit. The discharge rate for accumulator should not be more than 5 or 6 amps. per

sq. ft. of positive plate surface. (2) The accumulator you mention would hardly be large enough to discharge at the rate—4 amps. We should advise you to use a motor of, say 8 volts and 2 amps. A resistance in the circuit would only be a waste of power: it is much better to have your motor wound to suit the accumulator being used.

The News of the Trade.

[*The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.*]

* *Reviews distinguished by an asterisk have been based on actual Editorial Inspection of the goods noticed.*

A Fine "North British" Model.

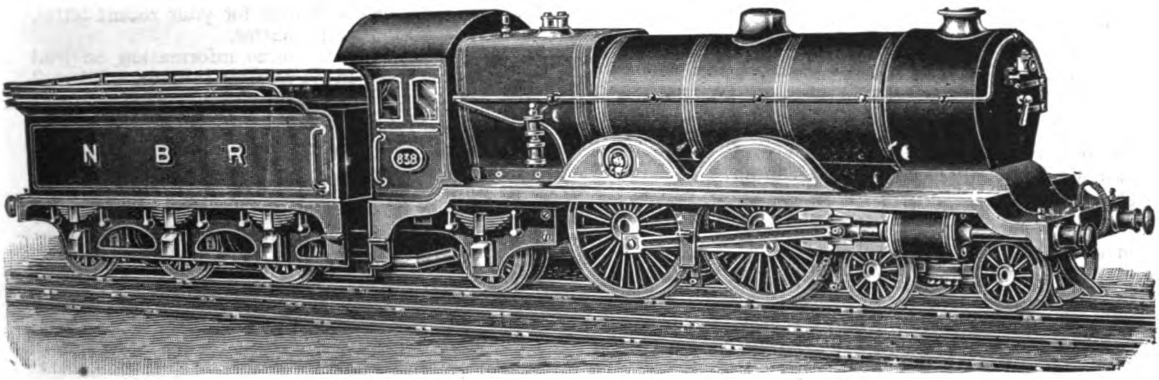
Among the new lines in the recently issued model engine catalogue of the Clyde Model Dockyard and Engine Depot, Argyll Arcade, Glasgow, is the scale model North British Railway Company's locomotive, shown in the accompanying illustration. This has a seamless copper water-tube boiler, with safety-valve, steam pressure gauge, glass water gauge, hand force pump for filling boiler, and the other usual fittings. It is made in four sizes, viz., ½ in., ¾ in., ¾ in., and ⅞ in. scales, and we understand that a ⅞ in. scale model supplied to the North British Railway may be seen in the booking hall of the Waverley Station. The over-all length of the ⅞ in. scale model is 2 ft. 9 ins., and the boiler is tested to 85 lbs. per square inch. It is guaranteed to pull from 40 to 50 lbs., while the ⅞ in. scale models will pull a man. A large number of model engines and boats of various types are included in this list, while on the front cover is an attractive picture of a model railway, belonging to one of the firm's customers, showing a North British Railway model under steam.

*Seamless Copper Vertical Boilers.

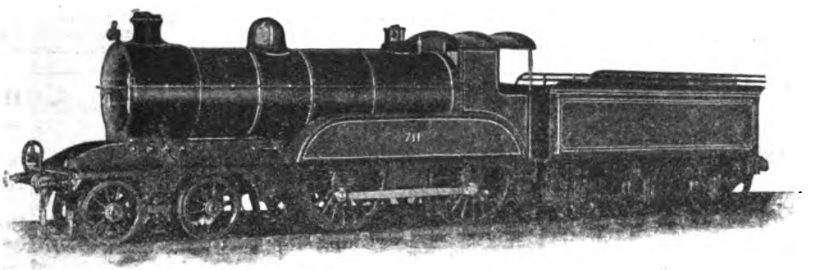
We have recently received for inspection a specimen of the small vertical copper boilers which are advertised by Mr. E. Heil, of 12, Harcourt Avenue, Southend, Essex. The dimensions of the boiler are: diameter, 5 ins., height over boiler proper, 8 ins., height to top of chimney, 12 ins. The boiler barrel and dome is one piece of seamless copper, being flanged and brazed on to the firebox. There are six ⅜-in. diameter water tubes silver soldered across the firebox, the centre flue, which acts as a stay, being a piece of 1-in. diameter tube. The boiler has been tested to 75 lbs., and we think it to be well-constructed and specially suitable for driving small stationary engines. Readers in want of a boiler for such a purpose should write to the above firm for further particulars. A photograph will be sent upon receipt of two penny stamps. Mr. Heil also supplies marine engine castings, and undertakes other small boiler work.

Model Locomotives and Rolling Stock.

The accompanying illustration of an electrically-driven model express locomotive depicts one of the special items in the new Railway Section (A C) of Messrs. W. J. Bassett-Lowke's catalogue. Whilst the above is not a model of any particular design, the proportions agree with modern locomotive practice. The sets of castings and parts for 2, 2½, and 3½ in. gauge are capable of being made into a very neat-looking engine, such as seen in the untouched photograph reproduced. Among other special novelties included in the list are a steam rail motor coach, a "Peckett" clockwork locomotive in gauge 1 and 3, a G.N.R. "Atlantic" Locomotive (No. 251) driven by clockwork, a G.W.R. "Albion" 4-6-0 type express locomotive (2-in. gauge), and a steam-driven model of the "Little Giant" (3½-in. gauge). Particulars are also given of model "Metropolitan" electric locomotive. Castings and parts are obtainable for many of the models referred to. The pages devoted to 2 and 2½-in. gauge rolling stock have, we notice, been added to, and there are many interesting lines in coaches and permanent way accessories. The list contains 156 pages, and is quite up to the usual high standard of this firm's trade publications. A copy will be sent to readers of The Model Engineer post free for six penny stamps.



Model N.B.R. Co.'s Express Locomotive, manufactured by the Clyde Model Dockyard and Engine Depot.



W. J. Bassett-Lowke & Co.'s Electrically Driven Four-coupled Express Locomotive.

New Catalogues and Lists.

F. Darton & Co., 142, St. John Street, London, E.C.—The new catalogue of electrical novelties which this firm has just issued, contains many items of interest to our readers. A large assortment of small electric motors, carded sets of motor parts, bell and electro-plating outfits, armature stampings, wire, magnets, small dynamos, and complete sets of castings. Volt and ampere meters, pocket flash lamps, scarf-pins, accumulators, bells, small incandescent electric bulbs, telephones, shocking and medical coils, and numerous accessories frequently required by amateur electricians. Special mention might be made of the new revolving display stand, illustrated on page 28, driven by a small electric motor, and designed for the use of shopkeepers. The list will be forwarded to readers of this journal post free for two penny stamps.

The Editor's Page.

We reproduce below the entries for our 1907 Speed Boat Competition and the nature of the awards gained for the various performances. It will be observed that a distinct advance has been made on previous records, and some rather remarkable performances have been recorded. The highest speed of the year has been accomplished by a boat in Class B, *viz.*, the *Moraima*, of Messrs. W. H. and F. G. Arkell, who, we think, are deserving of every congratulation on their success. It will be remembered by many of our readers that the machinery of this boat was shown at work at the recent Model Engineer Exhibition. Mr. W. H. Rimmer has also put up a fine performance with his *Wolf*, his speed falling but little short of that of the *Moraima*. One of the most remarkable results obtained, however, is that of Mr. A. J. Midler's *Marearad*, a boat under 3 ft. long, which has been certified as doing 7·3 miles per hour. Mr. Samuel Thompson's *Disappointment*, in Class B, and Mr. Thomas Dysart's *Hermes* in Class C, have also done excellent work. We have applied to the various competitors for particulars of their boats, in accordance with the conditions of the competition, and we have no doubt these will be looked for with interest by our readers.

1907 Speed Boat Competition Results.

Class A (5ft. 6 ins. to 7 ft.).

(1) Mr. W. H. Rimmer's *Wolf* (6 ft. 10¾ ins. L.W.L.; Sefton Model Steamer Club), 9·58 miles per hour (*Silver Medal*).

(2) Messrs. Coxon Bros.' *Ades II* (6ft. 9½ ins. L.W.L.; Sefton Model Steamer Club), 6·81 miles per hour (*Certificate*).

Class B (3 ft. 4 ins. to 5 ft. 6 ins.).

(3) Messrs. W. H. and F. G. Arkell's petrol boat *Moraima* (5 ft. L.O.A.; Clapham Steam and Sailing Club), 9·71 miles per hour (*Silver Medal*).

(4) Mr. Samuel Thompson's *Disappointment* (5 ft. 3 ins. L.O.A.; Sefton Park Model Steamer Club), 6·81 miles per hour (*Bronze Medal*).

(5) Mr. John McDonald's *Archer* (5 ft. 5½ ins.; Aberdeen Model Steamer Club), 5·47 miles per hour (*Certificate*).

(6) Mr. William Bunting's *Swordfish* (4 ft. 6 ins.; Aberdeen Model Steamer Club), 4·54 miles per hour (*Certificate*).

Class C (3 ft. 4 ins. and under).

(7) Mr. A. J. Midler's *Marearad* (2 ft. 11 ins. L.W.L.; Aberdeen Model Steamer Club), 7·3 miles per hour (*Silver Medal*).

(8) Mr. Thomas Dysart's *Hermes* (3 ft. 3⅜ ins. L.W.L.; Victoria Model Steamer Club), 6·52 miles per hour (*Bronze Medal*).

(9) Mr. T. B. Duff's *Ena* (3 ft. 3⅜ ins. L.W.L.; Victoria Model Steamer Club), 4.41 miles per hour (*Certificate*).

(10) Mr. R. Church's *Mavis* (3 ft. 3⅜ ins. L.W.L.; Victoria Model Steamer Club), 3·31 miles per hour (*Certificate*).

(11) Mr. Ben Gibbon's *Dolphin* (3 ft. L.W.L., electric; Aberdeen Model Steamer Club), 3·29 miles per hour (*Certificate*).

Answers to Correspondents.

H. A. (Tweedmouth).—Very many thanks for your interesting post-card.

G. W. S. (Hunslet).—Your inquiry is not very clearly stated, but we think Cotton & Johnson, 14, Gerrard St., Soho, W.C., would supply you with worm gearing.

N. B. (Barnsley).—An illustration of the class of engine you refer to appears in the issue of April 20th last.

W. J. M. (Bristol).—Thanks for your recent letter. We will look into the matter.

D. V. J. (Deansgate).—Some information on lead burning is given in "Practical Plumber's Work," edited by P. N. Hasluck, 2s. 3d. post free.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

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THE

Model Engineer

And Electrician.

A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.Mech.E.

Vol. XVIII. No. 352. JANUARY 23, 1908. PUBLISHED WEEKLY

A D'Arsonval Galvanometer.

By C. P. W.

THE photograph, Fig. 1 herewith, and side elevation, Fig. 2 (shown on the next page), depict a galvanometer of the above-named type, which I have made from odds and ends generally going by the name of "scrap." The instrument has proved very useful.

The magnet was taken from an old magneto machine, and the wood for the base was once the lid of a packing-case. The construction and details of the base will be seen in the drawing. The pieces A are four in number (one at each corner), and serve the purpose of keeping a glass cover in position, the rim of which has velvet ribbon cemented to it to keep it dust-tight. The magnet is secured to the base by the wooden brackets B, and is further clamped by the copper cleats C.

The other fittings on the base are the tension spring (for adjusting the tension of the silver wires (which support the coil), made from a piece of springy brass, and the supports for the scale, also made of brass.

The scale was drawn on paper, and then gummed to a strip of sheet zinc bent to the required radius, and provided with two clips at the back which slip on to the top of the supports.

The arrangement shown at E allows for the entire adjustment of the coil (its position between the poles of the magnet and its height, etc.). The clamping-piece D is made of copper strip bent to the shape, as shown, and is secured to the brass rod H by clamping nuts and washers.

At the lower end of this rod is supported a solid soft-iron cylinder F, so arranged as to be in the centre of the coil, as will be seen in the photograph.

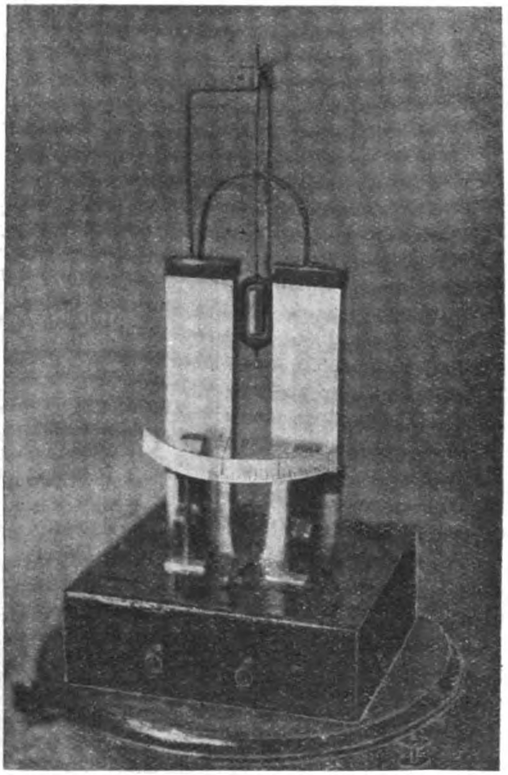


Fig. 1.—Showing a D'Arsonval Type Galvanometer.

The two illustrations clearly show the method of fixing this rod in position. As will be seen, it is secured to the U shape piece of copper by a small bracket, the ends of the U being provided with caps of the same material, which are cemented and pressed on to the poles of the magnet (which makes quite a strong job). A ¼-in. hole is also provided on the top of this support, through which the silver wire of the coil passes.

The coil itself consists of a number of turns of 40 S.W.G. cotton-covered copper wire, previously

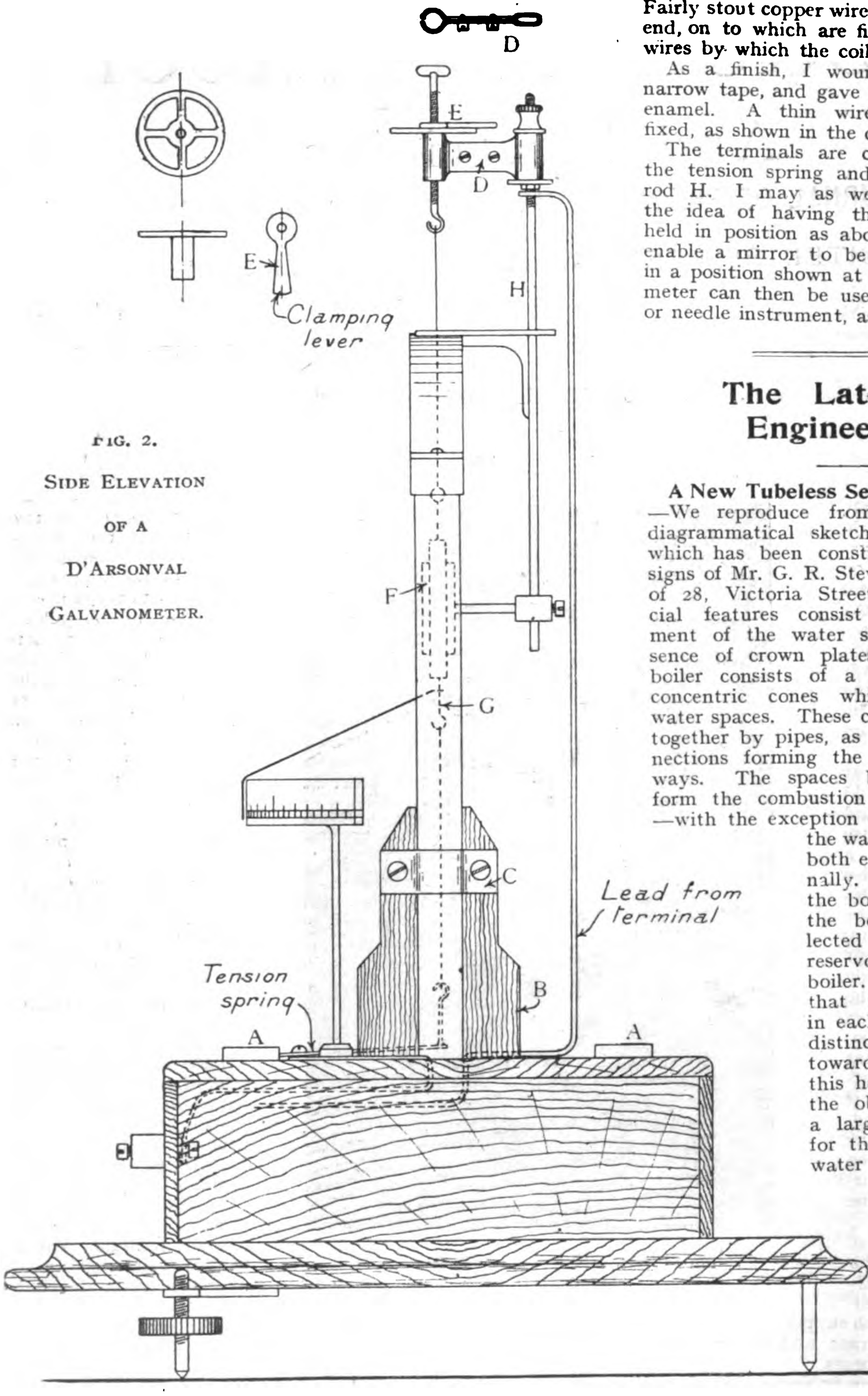


FIG. 2.

SIDE ELEVATION OF A D'ARSONVAL GALVANOMETER.

run through some melted paraffin wax. Fairly stout copper wires are fixed at each end, on to which are fixed the fine silver wires by which the coil is hung.

As a finish, I wound the coil with narrow tape, and gave it a coat of black enamel. A thin wire needle was also fixed, as shown in the drawing.

The terminals are connected, one to the tension spring and the other to the rod H. I may as well say here that the idea of having this rod short and held in position as above described is to enable a mirror to be fixed to the coil in a position shown at G. The galvanometer can then be used as a reflecting or needle instrument, as desired.

The Latest in Engineering.

A New Tubeless Semi-Flash Boiler.—We reproduce from the *Engineer* a diagrammatical sketch of a new boiler which has been constructed to the designs of Mr. G. R. Steward, M.I.Mech.E., of 28, Victoria Street, S.W. The special features consist in the arrangement of the water spaces and the absence of crown plates and tubes. The boiler consists of a number of hollow concentric cones which form annular water spaces. These cones are connected together by pipes, as shown, these connections forming the steam and waterways. The spaces between the cones form the combustion chamber, and thus—with the exception of the outer shell—the water spaces are fired both externally and internally. The main feed to the boiler is carried in at the bottom, and is collected from the special reservoir at the top of the boiler. It will be noticed that the water column in each chamber shows a distinct thinning away towards the water level; this has been done with the object of presenting a larger heating surface for the same volume of water at this part where the temperature of the gases is lower. In order to keep the water at a constant level the special reservoir or water belt already referred to was provided. It is fixed to the outer shell or casing, and communication is made by small perforations at the bottom of the reservoir for the water to pass into the boiler, and perforations at the top for the steam to pass out. There is a circular pipe—perforated—at the bottom of this reservoir, which is supplied with live steam from the central superheater. By this means the boiler is fed with water which is somewhere near the boiling point. It will be noticed that the cones have a varying height. This is done with the double object of giving freedom to the gases at the bottom ends of the several cones, and also of securing an increasing steam space to the central cone previous to the steam entering the superheater. In order to protect the superheater tube from extreme

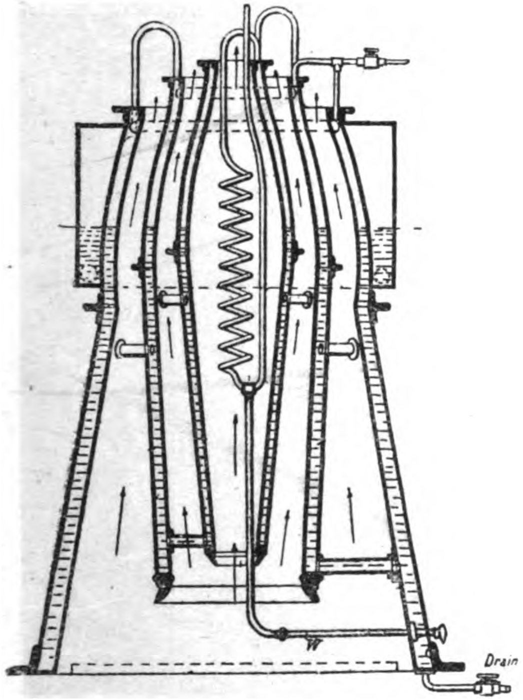


DIAGRAM OF TUBELESS SEMI-FLASH BOILER.

heat while raising steam, it can be filled with water through the tube W up to the water-level of the upper cone. It then forms part of the generator; but when sufficient steam is raised, it is again closed and performs the function of the superheater. The boiler is claimed to be practically primeless. The chief dimensions are:—Diameter at the top, 1 ft. 6 ins.; diameter at the bottom, 1 ft. 10½ ins.; height of boiler, 2 ft.; and it is estimated to develop 10 h.-p. at 150 lbs. working pressure. This estimate is calculated on the basis of keeping the working pressure at 150 lbs. per sq. in., with two ¼-in. bore cocks open, and at the same time maintaining the water at a constant level. At a recent inspection the boiler was fired with an ordinary oil fuel burner using paraffin oil, and from the time of lighting it took just a little over 6 minutes to raise 100 lbs. of steam; the pressure then very rapidly rose to 140 lbs. The time taken to obtain the first indications of steam was a fraction over 2¼ minutes. There were four gallons of water in the boiler when the test was started. Steam was then blown off till the pressure gauge recorded zero, and during this time two gallons of water were pumped in. The burner was again lighted, the time taken to raise 140 lbs. of steam under these conditions was 3 mins. 10 secs.

Locomotive Notes.

By CHAS. S. LAKE, A.M.I.Mech.E.

THE NEW L.S.W.R. 4—6—0 TYPE LOCOMOTIVES.

The first of a new series of 4—6—0 type locomotives with four simple cylinders was completed at the Nine Elms Works of the London and South-Western Railway at the end of last year and is illustrated on the next page. It will be seen that in all its principal characteristics the design resembles that of the 330 class of engines of the same railway built at the end of 1905. The main difference between the two series is that these later engines have larger cylinders than their predecessors, and another point in which an alteration has been made is that the outside slide-valves work above the cylinders in the engine illustrated, instead of below as in the earlier designs. The addition of ½ in. to the diameter of the cylinders is not in itself a great matter, but the fact of its being combined with a lengthening of the stroke of all four pistons by 2 ins. renders the increase in power considerable. With the longer stroke now adopted the engines will be even better starters and pullers than those of the earlier class, and this is saying a great deal. The boilers of these locomotives are not only very large, but exceedingly well arranged, and the devices with which they are fitted undoubtedly add greatly to their general efficiency. The distribution of the cylinders and running gear and the presence of the balanced crank axle for the driving wheels of the inside cylinders combine to make the engine noteworthy for smoothness of running and, considering their great weight, those already in service have proved easy on the track.

The writer has at various times been privileged by Mr. Dugald Drummond, chief mechanical engineer of the L. & S.W. Railway, to make trips upon the footplates of locomotives employed on that line, and of these none have provided greater interest than the experiences gained with the heavy summer expresses on the West of Salisbury division. The frequency and steepness of the grades on this section, and the speeds at which the fastest trains are booked to run, necessitate locomotive work of the highest excellence. Some of the notes in the writer's possession give particulars of runs made between Salisbury and Exeter with trains weighing, according to official figures, 270 to 285 tons behind the tender and the actual speeds attained during the observations provide averages of 52 and 53½ miles per hour. To mention only one of the gradients which have to be negotiated. The Honiton incline is 10 miles in length and has a ruling gradient of 1 in 80, while for a distance of about half-a-mile the gradient increases in steepness to 1 in 70.

The distance between Salisbury and Exeter (Queen Street) is 88½ miles, and on one occasion the 11 a.m. Plymouth corridor express from Waterloo, consisting of seven 30-ton vestibuled corridor cars and one 40-ton dining-car, was hauled on this distance in 1 hour 40 mins., giving an average speed of 52·8 miles per hour. Figures supplied by the L. & S.W.R. locomotive department show that the coal consumption of the engines during the heaviest period of service, viz., July, August, and September, average 40 lbs. per mile with evaporation of water at the rate of 10 lbs. per lb. of coal burned.

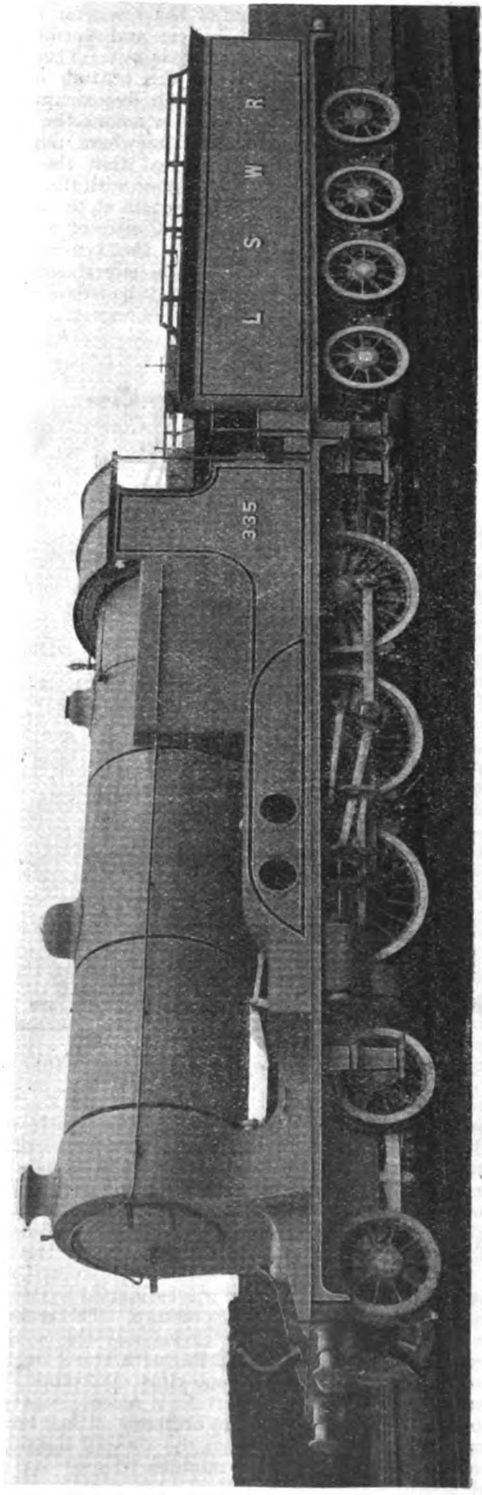
During the winter months these engines are largely employed for hauling fast goods trains between Salisbury and Exmouth Junction. The trains make one intermediate stop of 30 minutes duration at Yeovil Junction, and they are allowed 4 hours. 6 mins. gross or 3 hours 36 mins. net running time in which to perform the journey. The trains are made up of from forty-five to fifty loaded cars, of varying descriptions, and the total weight of train is between 600 and 700 tons behind the tender. Some of the leading dimensions are given below :—

- Cylinders: Diameter, 16½ ins.; piston stroke, 26 ins.
- Bogie wheels diameter, 3 ft. 7 ins.
- Coupled wheels diameter, 6 ft.
- Rigid wheelbase, 13 ft. 4 ins.; total engine wheelbase, 29 ft. 10 ins.
- Boiler: Inside diameter front end, 5 ft. 6 ins.; length between tube plates, 14 ft. 2 ins.
- Heating surface: Tubes, 2,210 sq. ft.; water tubes, 357 sq. ft.; firebox, 160 sq. ft.: total, 2,727 sq. ft.
- Grate area, 31·5 sq. ft.
- Working pressure, 175 lbs.
- Weight on coupled wheels, 54 tons.
- Total weight of engine and tender (in working order), 74 tons.
- Coal capacity of tender, 4·5 tons.
- Water capacity of tender, 4,000 gallons.

A Noteworthy American Locomotive.

The American Locomotive Company recently delivered to the Chesapeake Ohio Railroad some very large and powerful eight-coupled goods locomotives of the 2—8—0 or "Consolidation" type, with outside simple cylinders driving the third pair of coupled wheels. The general appearance may be gathered from the illustration on the opposite page, which has been reproduced from an original photograph kindly supplied by the builders. The Walschaerts' valve gear is coming daily into increasing use on the American railways, and it has been applied to the engines at present under consideration. The boiler is fitted with the wide type of firebox, and a very ample total heating surface is obtained. The leading two-wheeled truck is of the swing bolster pattern with a fair amount of side play.

The piston valves of this engine have a maximum travel of 5½ ins., a steam lap of 1 in., and lead in full gear 3-16ths in. The cylinders have a diameter of 22 ins., and a piston stroke of 30 ins. The truck wheels are 2 ft. 6 ins. diameter on tread, and the coupled wheels 4 ft. 8 ins. The rigid wheelbase is 16 ft. 6 ins., and the engine wheelbase 25 ft. 2 ins.



Four-cylinder Simple (4—6—0 Type) Passenger Locomotive, London and South-Western Railway.

The boiler has a diameter of 6 ft. 4½ ins. and contains 376 tubes of 2 ins. diameter by 14 ft. 9 ins. in length. These tubes provide 2,912 sq. ft. of heating surface, and a further 169 sq. ft. is derived from the firebox, giving a total heating surface of 3,081 sq. ft. The grate area is 48·44 sq. ft. The boiler carries a working pressure of 185 lbs. per sq. in. In working order the engine, without tender, weighs 98 tons, of which 84 tons are available for adhesion. The eight-wheeled tender carries 7,000 gallons of water and 10 tons of coal.

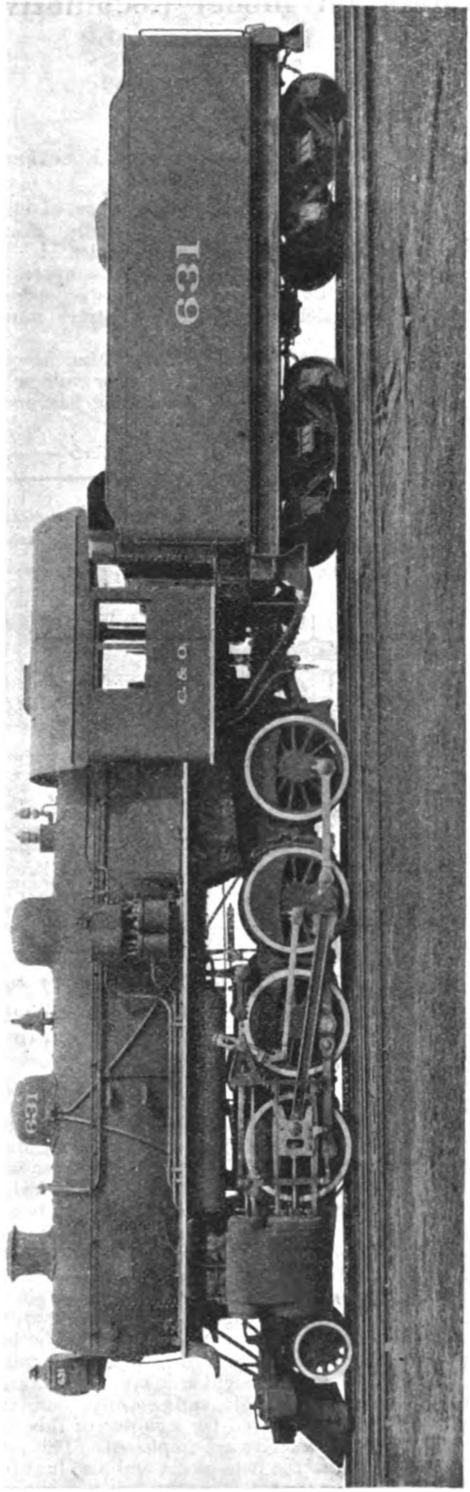
The design of this engine incorporates some of the latest ideas held in the United States on locomotive construction, and the design may be regarded as embodying some of the best features of modern locomotive practice. The drawings, which for lack of space cannot be reproduced here, show that great care has been given to the designing of the boiler.

A Correspondent on the G.N.R. "Atlantics."

A correspondent writes as follows: "I cannot understand why Mr. Ivatt, on the Great Northern employs such relatively small cylinders for his "Atlantic" type locomotives of the "251" class, seeing that the predominant feature of the design of these engines is the largeness of the boiler and, further, in view of the fact that the engines have some of the hardest work to do in the way of express passenger traffic on any of the railways running out of London. Surely such large boilers could easily supply all the steam that 19½-in. or even 20-in. cylinders require when the engine is working at its hardest." There can be no doubt whatever that the boilers of the "251" engines are sufficiently powerful to meet the demands of larger cylinders than those fitted, but the experience on the Great Northern Railway is that the 18¾-in. by 24-in. cylinders, with their 566 sq. ins. of piston area exposed to steam, are large enough for their purpose. The proportions of locomotive cylinders are largely determined by the amount of adhesion weight at command, and the latter in turn largely depends on the ability of the track to withstand concentrated loads. The axle load to be observed on the G.N.R. is 18¼ tons maximum, and therefore these "Atlantic" locomotives can at most have a total adhesion of only 36½ tons. But relatively small cylinders such as these, if always well filled with steam, are better than larger ones which may at times have to go begging. It is always possible to increase the power of the engine by cutting off a little later, and with plenty of steam generating capacity to go upon this is an efficient temporary method. By limiting the cylinder capacity and augmenting as far as possible the boiler power of his engines, Mr. Ivatt is beyond doubt following a wise policy.

A brass much used in marine-vessel construction, because of its excellent resistance to the corrosive action of sea-water, contains 1 part tin, 39 parts zinc, and 60 parts copper.

Three grammes (about 46 grains) of radium have been made in the Vienna University laboratory. This is the greatest quantity yet produced, and to obtain it 10 tons of uranium pitchblende had to be employed. The process of obtaining the radium cost £2,000.



"Consolidation" (2—8—0 Type) Freight Locomotive, Chesapeake and Ohio Railroad, U.S.A.

Chats on Model Locomotives.

By H. Greenly.

(*Continued from page 29.*)

MANCHESTER TYPE MOTORS FOR ELECTRICALLY DRIVEN MODELS.

BEFORE describing the circular type of electro-motor, which I have specially designed for locomotive work, and which is being marketed by the well-known Northampton firm, the possibilities of the Manchester type of motor for models of steam locomotives must be considered.

The point in favour of the Manchester is that where the width of the motor suffers from little or no restriction, a very strong field-magnet the casting obtained will do for either the top or bottom pole-pieces.

The method of fixing the cores is not indicated on the drawings, but where soft wrought iron is adopted, the best way will be to turn down a spigot on each end, say ½-in. diameter in the present case, facing the ends of the cores whilst they are between the centres of the lathe. The magnet limbs should be drilled a tight fit for the spigots (or which is perhaps the better way to put it, the spigots should be turned down a tight fit in the hole in the limbs), and so that a good electric contact is obtained, the limbs should be faced in an approved manner, by the planer, or in the lathe, finishing the parts not accessible in the particular machine tool employed, with the file.

To secure the cores with a flush joint—the usual nut top and bottom is out of the question—a small screw (iron or steel) about 5-32nds in. or 3-16ths in. diameter may be placed on either side, as indicated

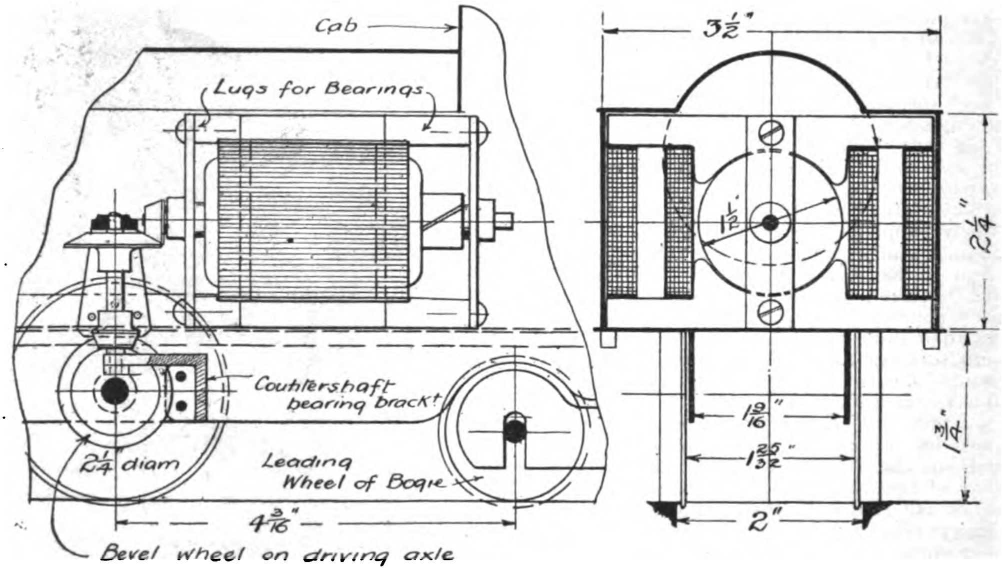


FIG. 1.—APPLICATION OF MANCHESTER TYPE MOTOR TO MODEL 2-IN. GAUGE 0—4—4 TYPE TANK LOCOMOTIVE. (*Scale: Half full size.*)

can be obtained and ample winding spaces can be provided for.

Considering tank engines for the moment, it will be obvious even to the novice in electrical work that the box-like form of the Manchester will fit in a model of a tank locomotive very comfortably; and to show how large a motor can be got in a 2-in. gauge model, a half full size drawing of a tank locomotive is included herewith. The engine is of the trailing bogie type, and the armature shaft is placed parallel to the centre line of the engine.

The motor is as large as the height and width of the side tanks will allow, and to obtain the largest possible diameter of armature the field coils are flat and wound on wrought-iron cores of rectangular section with rounded ends. Only one simple pattern will be required for a motor of this kind—or two if cast-iron cores are employed. This pattern should comprise the pole-pieces and also lugs for the bearing plates, and the motor being symmetrical, in the sketch, Fig. 3, herewith. The tunnel can, of course, be bored on an angle-plate with the magnet, put together, and the parts being afterwards taken apart, the cores can be wound in the lathe. In winding flat coils precautions are necessary to get the winding on the side as flat as possible. The wire should be stretched taut, hammered down at intervals, with a piece of leather or other soft material intervening. The iron in the cores is extended so that the winding projects beyond the limbs of the magnet, and to mitigate the difficulty of winding them quite flat the cores can be tapered slightly so that at each end of the section the width is say 1-32nd less than ½ in.; in fact, the true section will then be an elongated oval.

The gearing may be accomplished by means of ordinary bevel gear in the manner shown in Fig. 1, the countershaft being quite vertical. Of course, any of the belt driving arrangements which have been described and are applicable (that contained in the issue of October 24th last, Fig. 7, page 401, for instance) may be adopted in place of spur gear; but in a 2-in. gauge engine and larger sizes where heavy loads may have to be hauled, a positive drive is perhaps the best.

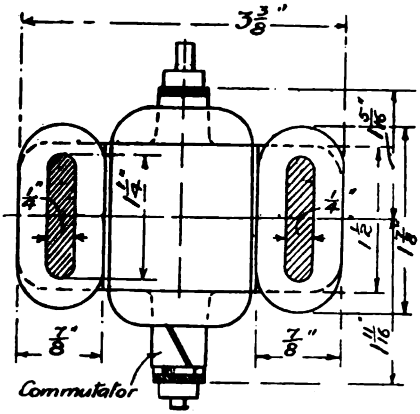


FIG. 2.—PLAN OF MANCHESTER TYPE MOTOR FOR 2-IN. GAUGE MODEL TANK LOCOMOTIVE.

previous motors described—the exception being the circular permanent magnet motor illustrated in the issue of October 17th and 24th last—con-

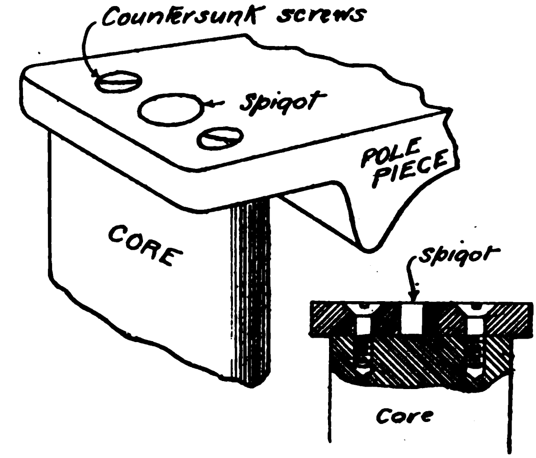
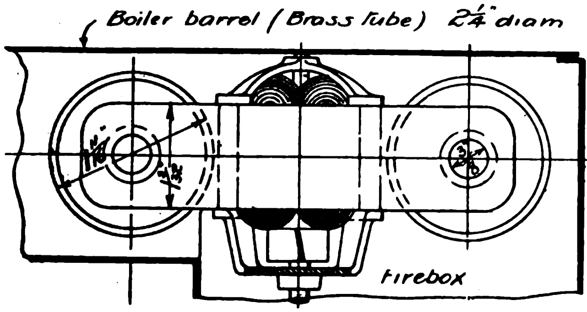
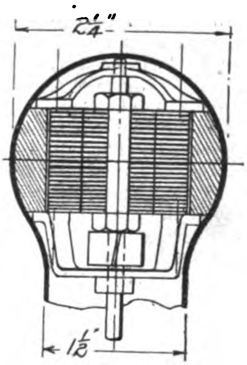


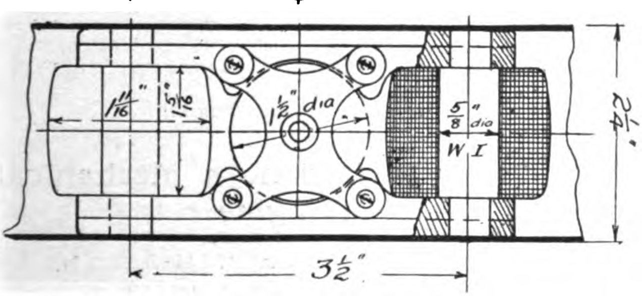
FIG. 3.—FIXING CORE OF MANCHESTER TYPE FIELD-MAGNET TO UPPER AND LOWER LIMBS.

Elevation of Motor.

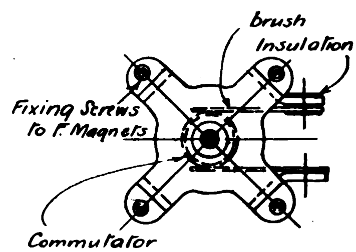




Cross-section.



Plan of Motor.



Plan of Bottom Bearing Bracket and Brush Gear.

FIG. 4.—MANCHESTER TYPE MOTOR ADAPTED FOR BOILER BARRELS OF MODEL STEAM LOCOMOTIVES. (*Scale: Half full size for Motor suitable for 2-in. gauge locos.*)

Another type of engine to which the Manchester type of motor might be applied is the Great Northern "Atlantic" No. 251, with the wide firebox. The motor could be arranged in an exactly similar manner across the frames in the firebox and cab, the over-all sizes being made to suit.

It will have been noticed that in nearly all the previous motors described—the exception being the circular permanent magnet motor illustrated in the issue of October 17th and 24th last—considerable differences in proportions and over-all dimensions are necessary when a given type of motor is required to be fitted to another class of locomotive to that for which it was designed. None of them (except the motor mentioned) can be called truly universal in their application, and it was the study of this point that led me to evolve the particular design of Manchester type motor shown in the accompanying drawing, Fig. 4.

I had a job to fit a given Manchester type to a G.N.R. engine, and after twisting and turning the motor about it was found that the only suitable position for the motor in the boiler was with the armature shaft placed vertical. In this way the frames did not interfere with the electrical portion of the equipment, and the particular arrangement of wheels and countershafts was more or less immaterial. A larger and heavier motor was also obtained.

The motor shown in Fig. 4 is arranged to exactly fit the barrel of the boiler, which, by the way, for electrical reasons, should be made of brass or other non-magnetic material. The diameter of the motor is fixed by scale diameter of the average locomotive boiler barrel. Of course, if the boiler diameter of the locomotive to be modelled is abnormal, advantage can be taken of this fact; but for the most part it will be good policy if patterns are made to more ordinary dimensions, so that the motor may be used in any future engine of another type.

The field-magnet cores are shown circular, although there is no reason why cores of oval section should not be fitted if the maximum amount of iron in the magnets is desired.

In a 2-in. gauge engine a 1½-in. armature is possible without creating any constructive difficulty. The bearings may be castings in gun-metal, and, as shown in the cross section, should be designed to come within the limits of an ordinary locomotive type boiler shell at the firebox. The armature may be made up of laminations with the end windings projecting as indicated. The bottom bearing must also be designed to enclose the commutator and hold the brush gear, a simple method of accomplishing the latter being illustrated in the separate view of the bottom bearings, Fig. 4. Here the lugs are left on two of the legs of the bearing, or are affixed after the bearings are made. On these lugs are

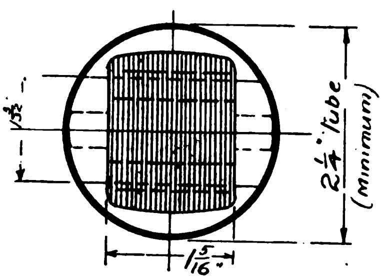


Fig. 6.—End View of Manchester Type Boiler Motor.

fitted the brushes, one being insulated from the body of the motor. The brushes should lie parallel to the longitudinal centre line of the locomotive, and may be made of thin strips of springy copper or strip brass covered with copper gauze.

The brushes are, of course, fixed, and all adjustments must be made by twisting the commutator on the shaft. While the use of fixed brushes is not a serious drawback where it is possible to fit adjustable ones without extra trouble or inconvenience, this course should be adopted, and a device suitable to the motor at present under consideration is shown in the two sketches, Fig. 7. The brush rocker consists of a piece of brass plate drilled to fit over the bearing boss and slotted for the adjusting screw. At its other extremity a piece of fibre or other insulating material is fixed. This holds the brushes as shown in the perspective sketch, the whole arrangement allowing for a limited movement of the brushes one way or the other, which the builder will appreciate.

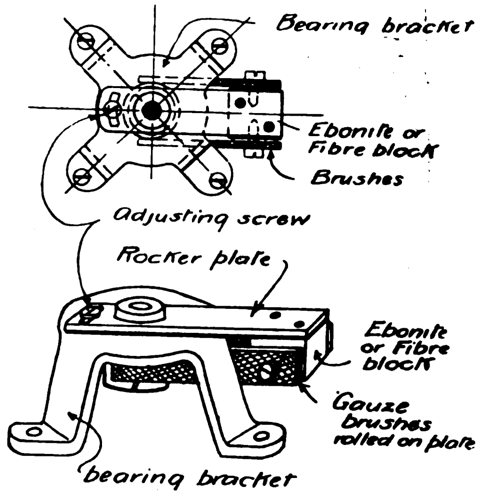


Fig. 7.—Plan and Sketch of Brush arrangement with Adjustable Rocker.

While the Manchester type motor modified as shown in the drawings herewith, has many points in its favour as a universal motor for steam locomotive models, it is not absolutely perfect. In the next article I hope to describe the other cylindrical motor, which has several advantages and none of the disadvantages of the motor shown in Fig. 4. The chief drawback of the Manchester is that the magnetic circuit is not so favourable for the purpose to which it is applied, and that there are certain types of engines in which a standard size of motor could not be used. Moreover, the armature diameter is limited.

(*To be continued.*)

How to Become a Mechanical Engineer.

By Alfred W. Marshall, M.I.Mech.E., A.M.I.E.E.

(*Continued from page* 65.)

THE hours of work and rates of pay are practically the same in all these different departments or trades of mechanical engineering. Overtime would add to this, and is in operation when the work requires to be expedited. Occasionally two sets of men are at work, one during the day and the other during the night. An apprentice may be required to work overtime or not, according to the practice of the particular firm. Rates of pay for workmen vary according to the district, and skill of the worker; it is paid, however, at a rate of so

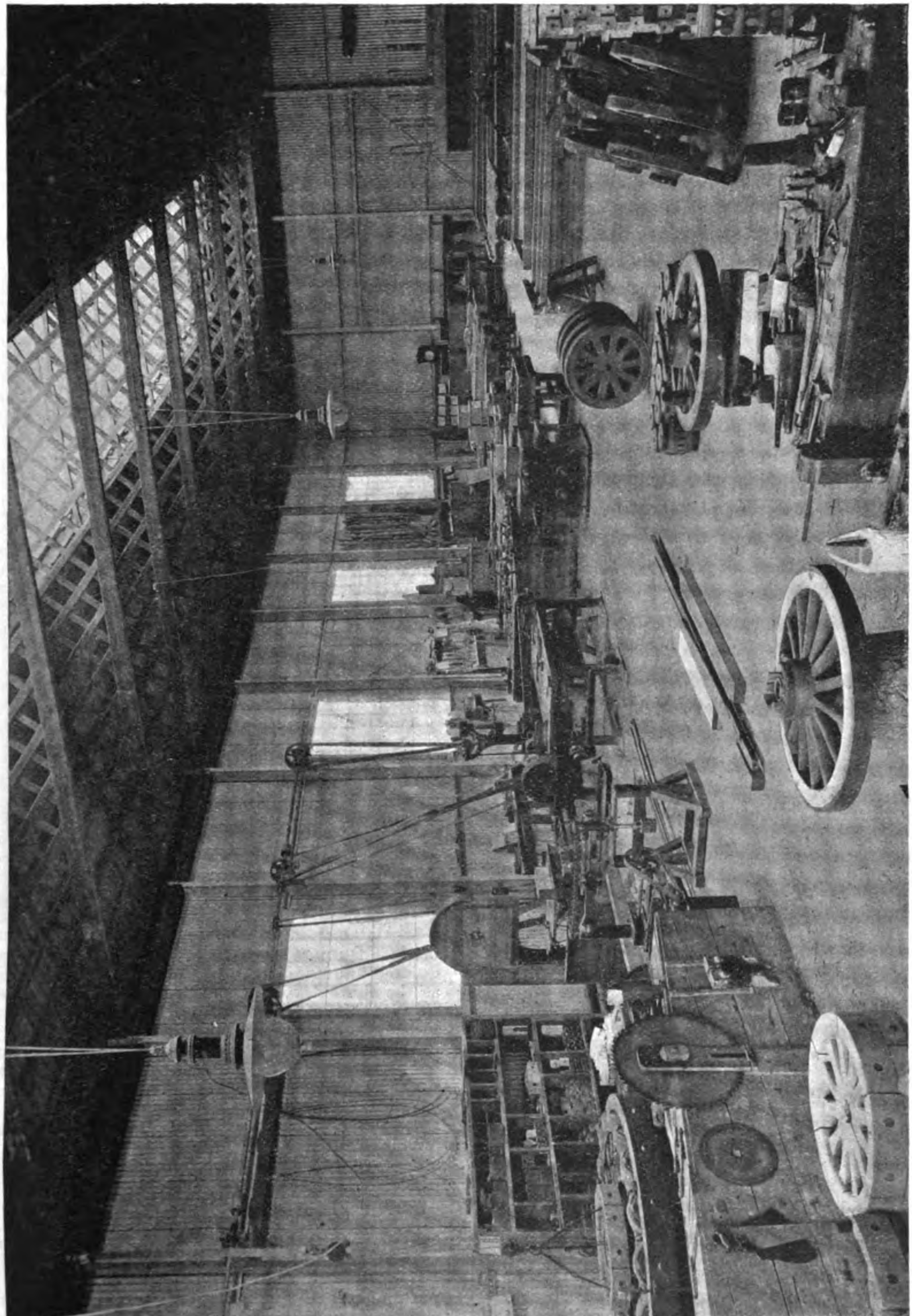


Fig. 5.—Showing a Portion of Car Erecting Shop: Messrs. J. I. Thornycroft, Basingstoke Works.

much per hour, and all lost time is deducted. Overtime and night work is paid at extra rates, and may be at the rate of a quarter or half as much again, according to circumstances. Workmen are also paid by piece-work or bonus systems—that is, according to the amount of work accomplished.

The method of training young men as mechanical engineers has lately received much attention from eminent firms, engineers, and others interested in the subject. Modifications have been made in the old apprenticeship system, which, in fact, has almost disappeared. Enquiry has been made by the Editor of THE MODEL ENGINEER of a number of leading firms of mechanical engineers in the United Kingdom, asking for particulars of the conditions upon which young men would be admitted for training in their works. The information obtained thus can be regarded as indicating the latest practice. A considerable number of the firms replied: some take premium pupils and apprentices; others do not favour this system. In some instances firms have so many applications that there is small chance of anyone obtaining admittance without influence; this is especially the case where apprentices are taken without being required to pay a premium. Certain firms only give admittance to the sons of their workmen or to lads living in the locality. Several employers have arranged special courses of instruction and training; they admit premium pupils to these as vacancies occur.

Messrs. W. H. Allen, Son & Co., Ltd., Queen's Engineering Works, Bedford, restrict non-premium apprentices to sons of their workmen or to boys from local elementary schools. For premium pupils and apprentices together they have approximately six to ten vacancies per annum. The firm send copies of three prospectuses of courses of instruction for pupils, apprentices, and third-class apprentices, from which the following particulars are abstracted:—Pupils are taken at ages from 17 to 21 years for a period of three to four years, and pass through the works and drawing office. The premium is 300 guineas for the complete course, payable yearly in advance at the rate of 100 guineas per annum. A probationary term of at least three months is desired in the first instance; a fee of 20 guineas is charged for this, payable in advance, which forms part of the premium if the agreement is completed. The pupil must be physically fit and suitably educated, including good mathematical knowledge. The company impress upon parents and guardians of candidates the extreme desirability of the candidate spending a period of two or three years in some college either before or after his apprenticeship. Prizes and privileges are given by the Company to pupils deserving them, and they also offer further annual prizes of 25 guineas and 50 guineas for competition by pupils after their pupilage is completed.

Apprentices are taken at ages from 15 to 18 years for a period of five years. During this time they may receive instruction in either (1) turning and dynamo department, (2) fitting, erecting, and dynamo department, or (3) fitting, erecting, and turning department. The premium for either course is 100 guineas, to be paid in full on signing indenture. Wages are paid to the apprentice at the rate of 4s. per week for the first year and increased by 1s. per week for each year. A probationary term of one to three months is required and a fee of 5 guineas is charged, payable in advance, and forming part of the premium if the indenture is completed. A qualified demonstrator is in constant attendance for the purpose of giving instruction in science and its application to practical work, as well as generally supervising the apprentices. Each apprentice must attend the lectures delivered for his benefit, and be capable of passing a fair examination in his own time so often as his masters may require. Two weeks' holiday are allowed during the summer months and one week at Christmas, besides holidays which the workmen have at other times. Prizes and privileges are awarded to deserving apprentices. There is also a prize of 10 guineas minimum or to this value awarded annually for competition by apprentices after they have completed their apprenticeship.

Third-class apprentices are taken at ages from 14 to 16 years, but will not be apprenticed until 15 years of age. The term of apprenticeship is five years, which will be spent in one department of the works only; the drawing office is included in the list. Candidates must be of suitable education, and will be required to pass a short test in arithmetic and dictation in which both writing and spelling will be considered. Wages are paid at the rate of 3s. per week for the first year, and increase by 1s. each year. Six months' trial is required, during which wages of 3s. per week are paid. Special facilities are offered by the Company to their apprentices for free tuition in the various subjects connected with their work at the classes of the Bedford Evening Institution, the cost of tuition being defrayed by the Company. Apprentices making good progress in relation to these facilities are rewarded by more ample advances in wages. Prizes are given in the form of tools at Christmas each year to deserving apprentices.

The Company also require from time to time junior clerks, and take boys between the ages of 14 and 16 years to be engaged in the offices. There is a prospect of promotion. Wages are paid at the rate of 4s. per week for the first year, increasing normally by 1s. each year, but those who avail themselves of the instruction given by the Bedford Evening Institution and who make good progress will be rewarded by the Company by receiving more ample advances in wages. Candidates must have received suitable education, and are required to pass a special test in handwriting, spelling, and arithmetic. During their term of service with the Company junior clerks will enjoy the same privileges as the third-class apprentices in the way of opportunities of free tuition during the winter evenings in subjects connected with their work.

Messrs. The Brush Electrical Engineering Company, Ltd., Falcon Works, Loughborough, receive a limited number of pupils for systematic training in their workshops. The course is usually for three years, a premium of 100 guineas per annum, payble in advance, being required. Monthly reports are issued to parents and guardians regarding the progress, behaviour and attendance of each pupil. Two distinct courses are available, either being selected according to the desire of the pupil. One comprises a training in electrical and mechanical engineering, and the other in traction engineering. Pamphlets are issued by the Company giving particulars. In the first-named course the following shops are available for instruction purposes: pattern shop, iron foundry, brass foundry, smithy, dynamo shop, motor shop, lamp shop, winding shop, car-wiring shop, truck shop, heavy engine and machine shop, erecting shop, and testing room. A few selected pupils are also allowed a period of instruction in the drawing offices. Candidates must give evidence of satisfactory elementary technical knowledge, physical fitness, and personal character. The first six months of the pupilage is regarded as probationary. Payment is made for work done by pupils at not less than 3s. or more than 18s. per week, or at current piece-work prices when they are engaged on piece-work.

Pupils who select the traction engineering section become familiar with the design, construction and use of all the most modern types of railway, tramway, and road vehicles. The course provides for sufficient time being spent in the Company's various engineering shops. A pupil has opportunities of acquainting himself with general mechanical and electrical engineering practice in regard to the generation and transmission of power. The traction course is intended to fit the pupil for either the commercial direction, traffic management or engineering side of traction undertakings. Pupils who have had previous practical training in approved engineering workshops may be accepted for a shorter period than three years. A few selected pupils are allowed a period of instruction in the drawing offices, others are attached to the various branch offices to acquire a knowledge of the commercial side of the business.

Pupils entering for one year only pay a fee of 150 guineas. Wages are paid as in the electrical and mechanical engineering course. The Company does not undertake to give theoretical instruction, but a qualified instructor holds daily classes which are free. Pupils are expected to attend them regularly. They are not, however, intended to take the place of home study or a course at a technical institution.

The Company does a variety of work, including the manufacture of steam engines and turbines, locomotives, tramcars, etc.

An engineering blacksmith's workshop is shown by Fig. 4. This is a view in the forging department of Messrs. Peckett & Sons' locomotive works, Bristol (also taken, by kind permission, from their illustrated pamphlet). Though a considerable amount of forging work is done in an engineering smithy by means of the familiar hand forge and tools, the necessity of economising time and thus saving cost of production as much as possible causes the use of power hammers for comparatively small as well as very large forgings. In Fig. 4 the furnace for heating the iron or steel pieces is shown in the background to the right of the picture. It has a sliding door, which opens vertically, and allows the pieces to be quickly put in or taken out of the fire. The crane is for the purpose of carrying heavy forgings from the furnace to the steam hammer shown to the left of the picture, and supports

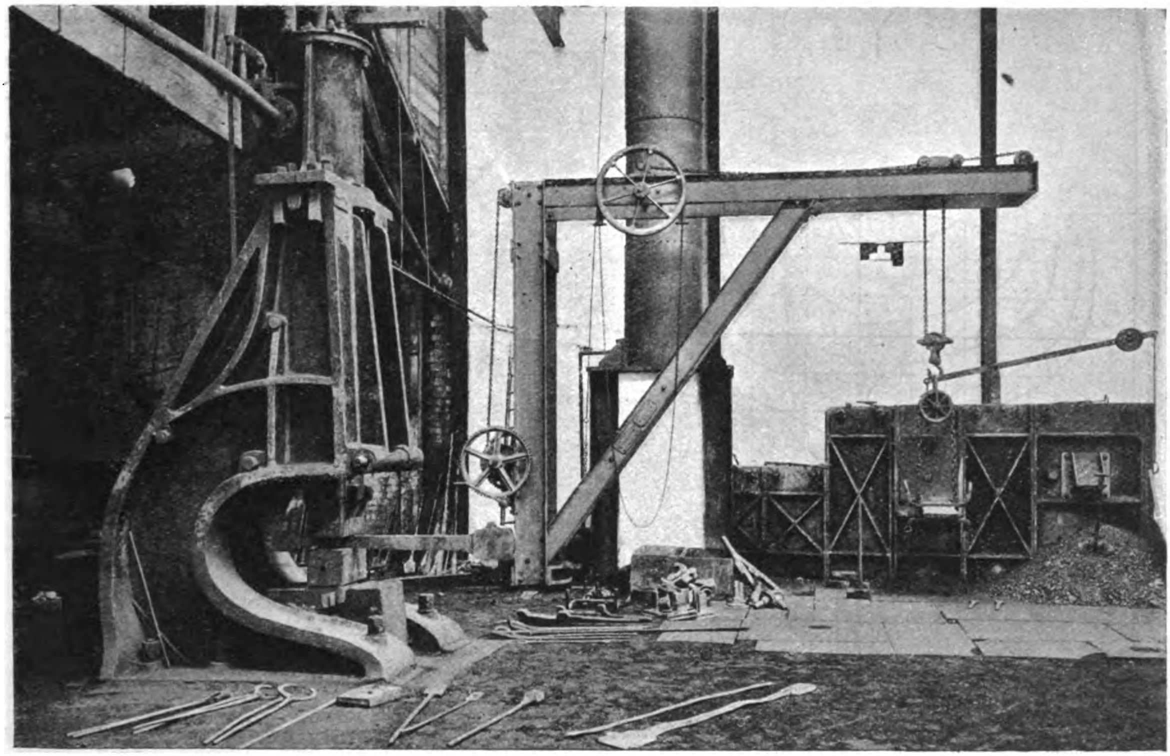
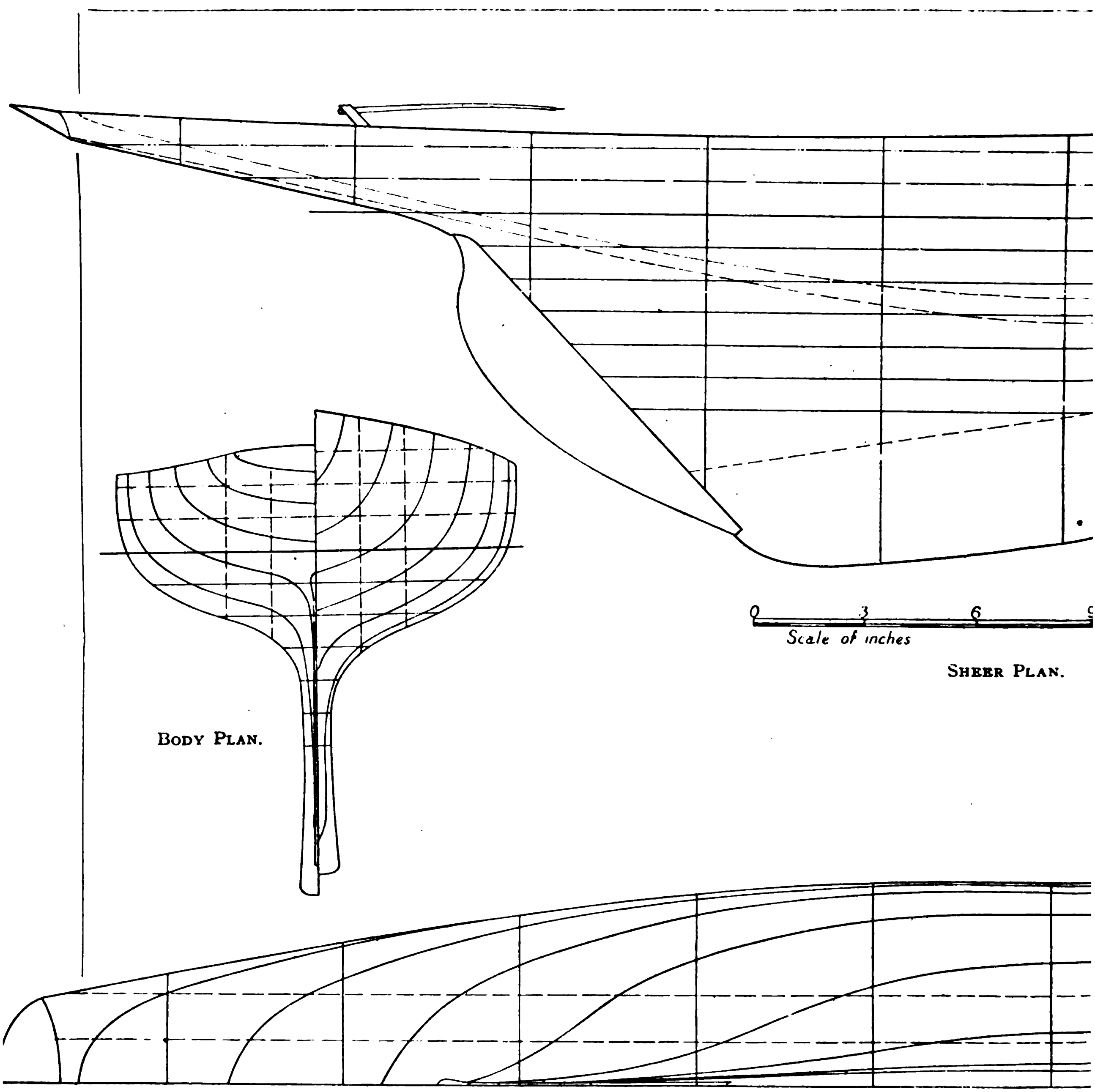


FIG. 4.—SMITHY FORGE: MESSRS. PECKETT & SONS' WORKS, BRISTOL



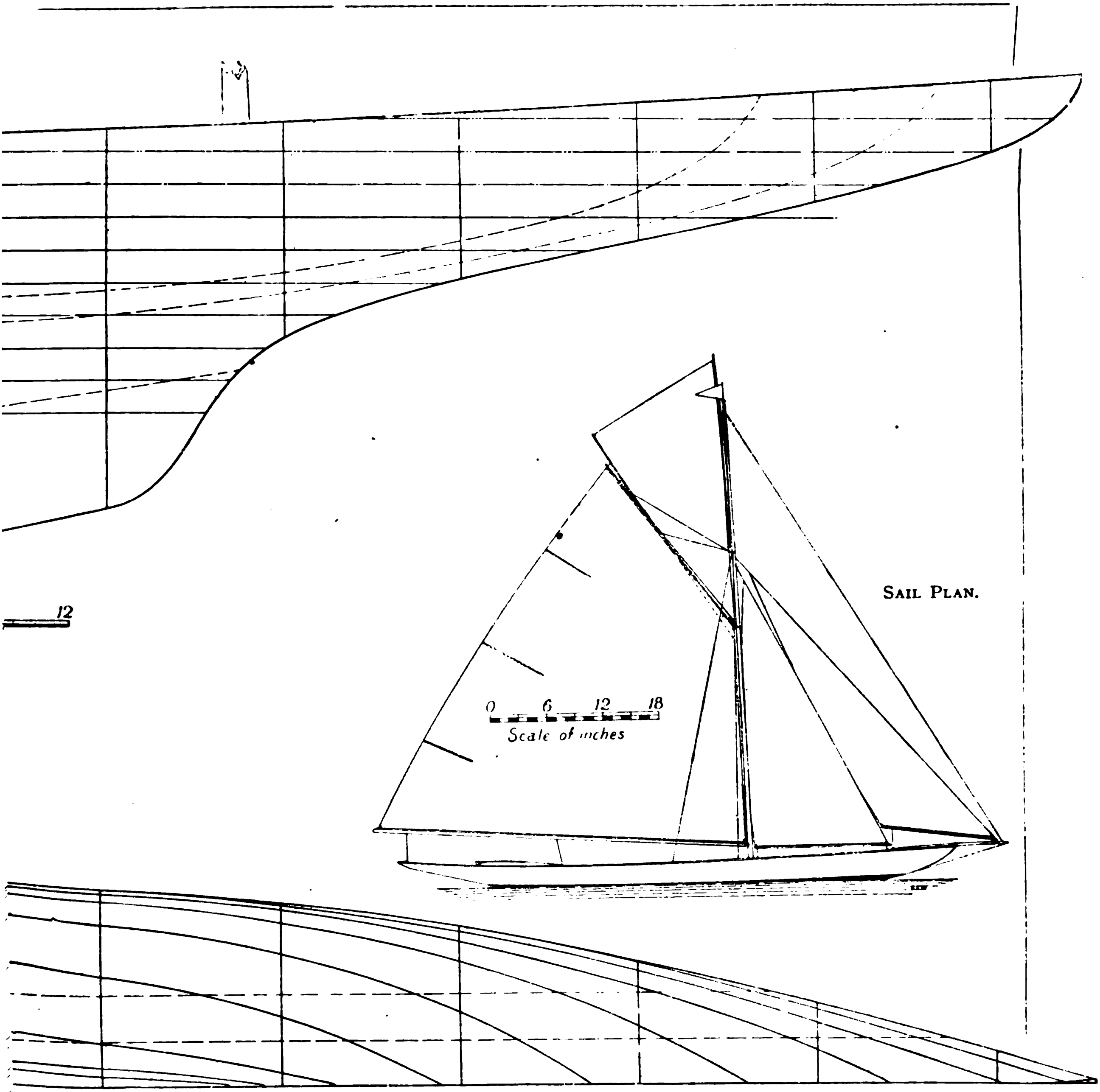
HALF BI

DESIGN FOR 10-RATER MODEL

By G.

Length over-all, 59¼ ins.; Length on water line, 3

For description]



oth Plan.

ILING YACHT: CUTTER RIGGED.

Weguelin.

ins.; Beam, 10⅞ ins.; Sail area, 1,510 square inches.

[see page 89.

them when required whilst they are manipulated upon the anvil. The piece can be balanced upon a chain and wheel at the crane hook, so that, though very heavy, it may be rotated and moved about by the smith with comparative ease. A connecting-rod forging for a locomotive is shown gripped between the hammer and the anvil. The hammer rises and falls vertically, being lifted and the blow struck by the power of steam, which is admitted into the cylinder at the top of the hammer frame. Perfect control both of rapidity and force of blow is obtained by means of a valve operated by hand lever. A lad usually works this lever under the direction of the smith.

An engineer's woodworking department is shown by Fig. 5. In this particular case the special work of wheel-making is done. Some machine tools for woodworking are in the mid-distance. Operations such as drilling, planing, and shaping curves being rapidly done by high-speed cutters. The wood is also cut off to length and shape by circular and band saws, the one being a revolving disc with the saw teeth cut in the edge, and the other kind an endless steel band with saw teeth cut in one edge. This band is stretched over a pair of pulleys so that it is vertical. It runs at high speed like a flat machine driving belt, through a slot in an iron table upon which the work to be cut is placed. At the extreme left of the picture is a pressing appliance, made specially for the work. By means of this press the component wood parts of the wheel, the boss, spokes and rim pieces, are pressed together by hydraulic power in a few seconds after they are placed in position. Another example of a machine to reduce cost of production. Some circular saws are in front of this machine. When in use they would be clamped upon a steel spindle in the sawing machine. The photograph is from their Basingstoke Works, by kind permission of Messrs. J. I. Thornycroft & Co., Ltd. Steam wagons of various kinds for industrial purposes are made at this factory, the wheel-making and woodworking department would therefore be a very important one.

(To be continued.)

For the Bookshelf.

[Any book reviewed under this heading may be obtained from THE MODEL ENGINEER *Book Department, 26–29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.]*

THE SLIDE RULE. By Robert Gordon Blaine, A.M.I.C.E., etc. London: E. & F. N. Spon, Ltd. Price 2s. 6d.; post free, 2s. 8d.

This book is fittingly styled a simple explanation of the theory and use of the slide rule, logarithms, etc. In the second edition not only has a revision been made, but considerable new matter has been added, including a complete explanation of various methods of finding cube-roots, with clear rules for dealing with the ambiguity which arises with the reversed slide. There is included also a description of Professor Perry's new form of slide rule with log log scale, new forms of cursors, and other minor additions, as well as logarithmic tables. The numerous examples worked out will be of great assistance to the student.

Engineering Works and Accessories for Model Railways.

By ERNEST W. TWINING.

(Continued from page 616, Vol. XVII.)

I NOW propose to illustrate two or three tunnels on the London and North Western Railway. The first to be encountered on leaving Euston is the well-known one through Primrose Hill, 1,120 yds. in length. I should like to have illustrated this, but fear that the amount of elaboration in the masonry fronts would be too great to attempt in a model. Indeed, Wishaw, in his work on the railways of Britain, published in 1840, says that the

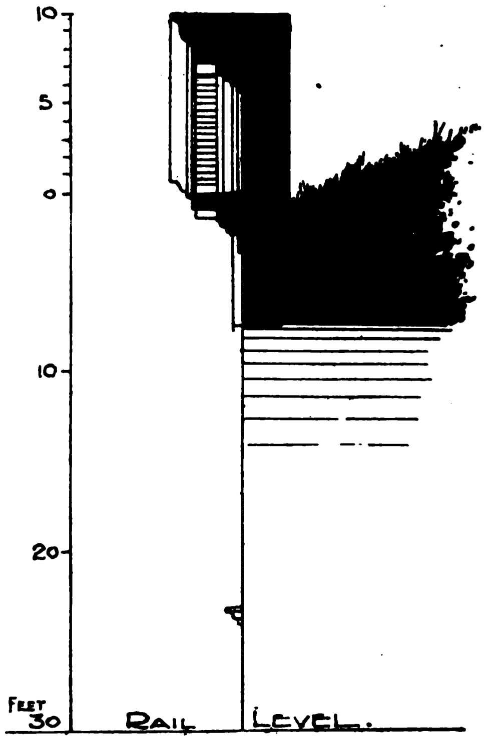


FIG. 13*a*.—CROSS-SECTION THROUGH SOUTHERN END OF WATFORD TUNNEL.

architectural design of this tunnel is far too elaborate, with which remark I am inclined to agree: it is certainly massive and heavy, but with all its elaboration it is not beautiful. So we will pass on to the next tunnel of importance, viz., Watford.

In Fig. 13 I have illustrated the southern face of this. From the drawing it will be seen that the architectural style is Roman classic, and though not nearly so beautiful or elaborate as Box on the G.W.R., will be quite sufficiently complicated to reproduce in a model. Next to Box, it is one of the finest examples of classic tunnel fronts we have. I do not happen to have by me the official length of this tunnel. Wishaw gives the length as 1,830 yds., whilst Bourne's work on the London and Birmingham Railway states the measurement to be 1 mile 31 yds., a discrepancy of 39 yds. The bore has a

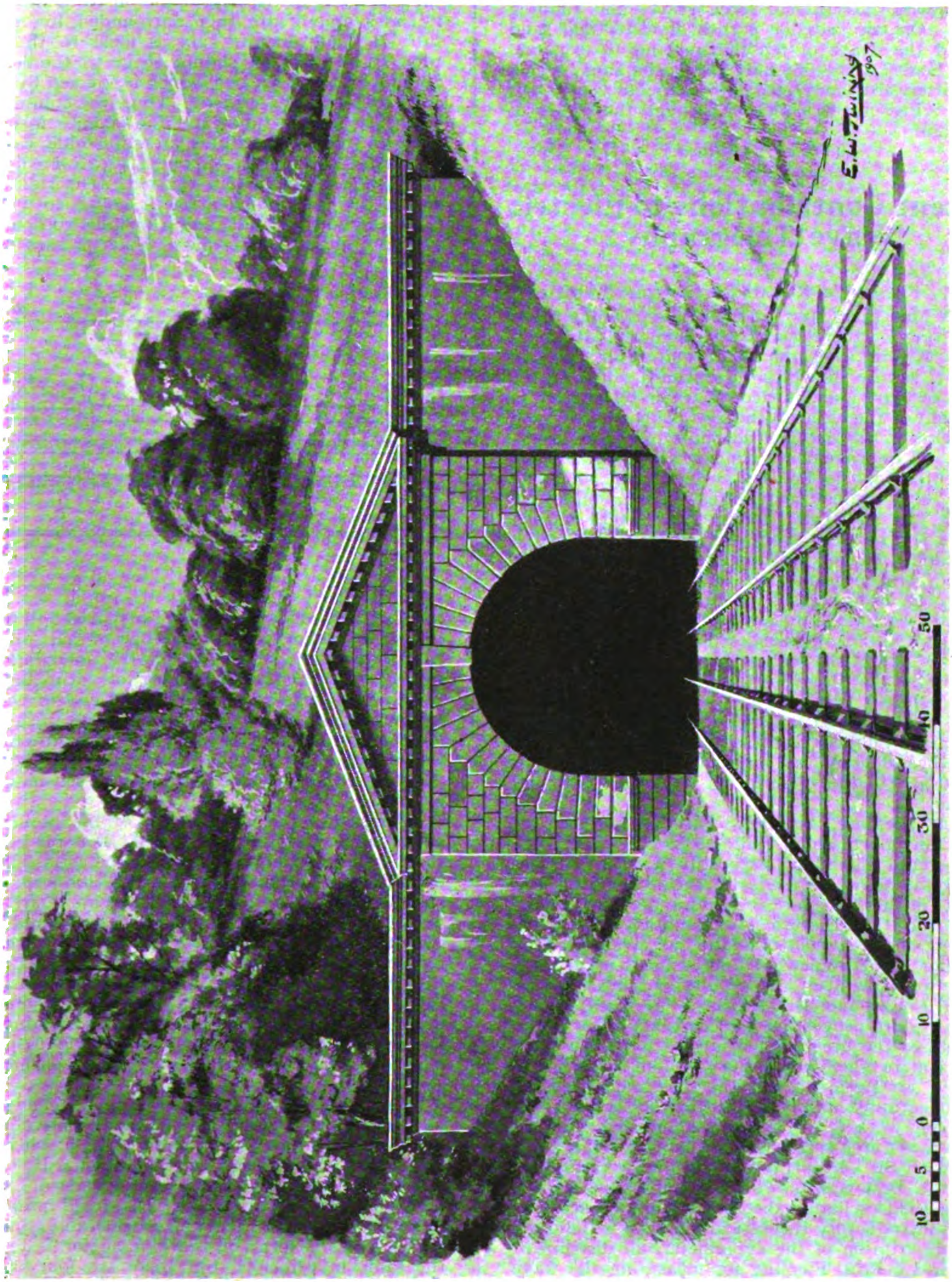


Fig. 13.—Southern Face of Watford Tunnel: L.N.W. Ry.

width of 24 ft. at the level of the springing of the arch, and the height of the crown above rail is 23 ft. The arch is semicircular throughout.

Watford tunnel was cut through a stratum of chalk with intervals of loose gravel and running sand. On one occasion a rush of water and sand caused the death of ten miners, and to excavate their bodies a special shaft had to be sunk, which was afterwards converted into a double ventilating shaft. Fig. 13*a* is a section through the centre of the arch.

(To be continued.)

Recent Contributions to Electric Wave Telegraphy.

PROF. FLEMING'S ROYAL INSTITUTION LECTURE.

ON May 24th, 1907, at the Friday evening meeting of the Royal Institution, the late Lord Kelvin took the chair and Prof. Fleming gave a lecture in which he outlined some of the more recent views of electric wave telegraphy in the light of the electron theory. This was followed by more or less detailed accounts of recent inventions and improvements, among which was a short description of the Poulsen system, with which we made our readers acquainted in our issues of March 7th and 14th, 1907. The lecture opened with a few remarks about the importance of radiotelegraphy for various maritime purposes, both warlike and peaceful, an importance which can hardly be exaggerated. Mention followed of the splendid work done by Admiral Sir Henry Jackson, who, as Captain Jackson, will always be remembered as one of the earliest experimenters to apply practically the discoveries and inventions of Prof. Hertz and Sir Oliver Lodge.

We are always glad to see the work of such men recognised publicly, especially by one who, in the past, has devoted so large a proportion of his attention to the description of one particular system.

Prof. Fleming, however, entirely ignored the important part which radiotelegraphy must play in overland signalling, especially in time of war. The great advances made by the Lodge-Muirhead system in this branch of the art are of great importance, and the theoretical explanation of the behaviour of an earthed oscillator, as given by Prof. Fleming, seems somewhat limited in its application when we remember the results obtained by Sir Oliver Lodge and Dr. Muirhead in recent years. These results prove that two capacity-areas raised one above the other and insulated from the earth form a more efficient radiatory system than the old earthed arrangement used in the earlier days of radiotelegraphy and still obstinately adhered to by some workers. The results improve steadily as the lower area is raised, and this is in full accordance with Sir Oliver Lodge's original contention—that the best results would be obtained from a non-earthed oscillator absolutely free in space.

The introductory theoretical matter was followed by a description of the cymometer, an instrument devised by Prof. Fleming for measuring the wave lengths of different radiators. This instrument was described in 1905, but as many of our readers may not be acquainted with it we give a short account with a sketch.

The illustration (Fig. 1) shows diagrammatically an early form of the cymometer, which is constructed in the following way. A is a brass tube 3 or 4 ft. long, held in a collar on an insulated support fixed to the base of the instrument. Over it slides an ebonite tube surrounded by a brass tube B. The ebonite tube is fixed to the outer tube B, so that on sliding them to the left the amount of the inner one, which is covered by them, is correspondingly lessened. Thus, the combination of the two brass tubes and the ebonite insulation between them constitutes an adjustable capacity the value of which is, of course, greatest when the inner tube is completely covered. The right-hand end of the outer tube carries a collar to which is fixed an ebonite handle and a metallic rod carrying a sliding metal contact-piece which presses on the

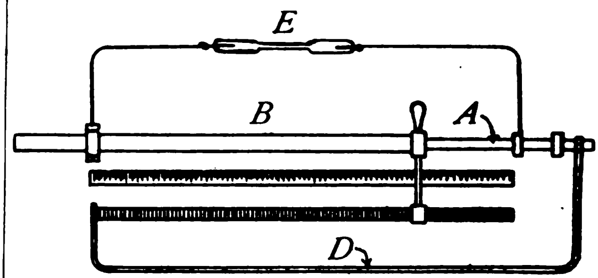


FIG. 1.

coil C. This coil is of bare copper spaced and wound on an insulating supporting tube or rod, so that when the sliding portion of the instrument is moved to the left the number of turns between the contact-piece and the left-hand end of the coil is diminished. In this way the decrease in capacity is accompanied by a decrease of self-induction in the circuit. It will be seen that the straight copper bar D connects the capacity and self-induction in series.

To measure the wave-length of the oscillations in an aerial or other wire, the bar D is placed at a short distance from and parallel to the aerial, so that oscillatory electromotive forces are induced. The surgings set up in the cymometer circuit are comparatively feeble unless the capacity and self-induction are so adjusted as to give accurate resonance or syntony. If this condition is satisfied, the potential difference between the two brass tubes rises to a high value and its existence is indicated by a vacuum tube E. The residual gas in the tube was neon, which was found to give a glow of characteristic tint with very considerable regularity.

The sliding portion of the instrument is adjusted until the glow is at its maximum, the wave-length being read off direct on a scale, over which moves an indicator attached to the slider. By using differently graduated scales and standard Leyden jars and coils, small capacities and self-inductions can be measured with ease and considerable accuracy.

The present form of the cymometer is exactly the same in principle, but there are four tubular condensers in parallel instead of only one, and the whole instrument is somewhat larger. Thus, the apparatus is of considerable use in the laboratory as well as in the radiotelegraphic station; besides this, it presents no serious difficulties of construction and should be cheap to make.

In leading up to the consideration of Mr. Poulsen's system of generating continuous or undamped trains of waves, Prof. Fleming gave interesting particulars of the work which was done previously to Mr. Duddell's discoveries.

In the issue mentioned above, the enormous advantages to be gained by the generation of undamped alternations of high frequency is fully explained, and though the various attempts to produce such alternations were not all made with their application to radiotelegraphy in view, they are none the less interesting and instructive.

Prof. Fleming recalled alternators built by Mr. Tesla and Prof. Elihu Thomson sixteen or seventeen years ago, one due to Mr. Tesla being capable of delivering 10 amps. at from 10,000 to 15,000 cycles per second. The power was mentioned as amounting to 1,000 watts, which, if there were no lag, would be given by a voltage of 100. It is probable, however, that the voltage was considerably higher.

An alternator constructed by Mr. S. G. Brown was shown on the table; this gave 20 volts and 50 watts at a frequency of 12,000 per second. Another machine recently described by Prof. Fessenden gave an E.M.F. of 60 volts at 10,000 r.p.m., the output being 250 watts. The frequency of 60,000 cycles per second which he obtained is a considerable advance on those previously mentioned. If such a machine were used for wireless telegraphy, the aerial, which must be of such dimensions as to make its natural period equal to that of the current, would present difficulties of construction and expense which would make it quite impracticable. The wave-length corresponding to a frequency of 60,000 per second is a little over three miles. If currents of any considerable value are required, there is a very serious drop in a high-frequency armature containing active iron, and insurmountable constructional difficulties present themselves if the iron is eliminated.

(To be continued.)

Design for 10-Rater Model Sailing Yacht.

WE reproduce on pages 84 and 85 of this issue the lines of a 10-rater model sailing yacht with cutter rig. The design is by Mr. G. C. Weguelin and the following are the principal dimensions: Length over-all, 59¼ ins.; length on water line, 39¾ ins.; beam, 10⅞ ins.; sail area, 1,510 square inches. We understand that a number of boats have been built to this design, and have proved very satisfactory.

ACCORDING to an American contemporary, the Lake Shore Electric Railway Company is testing a trolley finder, which consists of a small trolley wheel placed on the pole midway between the car and the trolley wire. When the trolley wheel slips off the wire, it is intended that this small wheel shall strike the wire and furnish current until the trolley pole can be replaced.

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

ON Saturday afternoon, January 11th, a large party of the members, at the invitation of the firm, spent several hours in the machine-testing rooms of Messrs. Schuchardt & Schutte, at Palmer Street, Westminster. The party was met by Messrs. Judson and Smith, and conducted all over what was perhaps the most interesting and up-to-date machine tool shop the members have yet inspected. Starting with the Electrical Department on the top floor, a very compact type of enclosed motor was taken to pieces and explained, and its application to the direct driving of twist drills, emery wheels and similar tools demonstrated and explained. A novel application of the magnetic properties of iron was noticed in the form of a portable bar for applying pressure to hand and electric drilling machines, the bar being about 4 ft. long by about 2 ins. diameter, fitted into and protruding through the centre of an inverted cup-shaped base, also of iron. In the hollow base is wound a coil of insulated wire, and on the bar being placed horizontally with the base against an iron structure (even a round column) and the necessary current applied, the magnetised base rigidly supported the bar against any ordinary pressure that could be applied to it. On the same floor was noticed a large stock of split pulleys of all sizes made entirely of thin sheets of bent steel, being both very strong and little heavier than wood pulleys. They are applicable to all sizes of shafting by means of interchangeable bushings, also of bent steel. The lower floor contained a large assortment of high-class machine tools of all descriptions, the interesting features of which were fully explained and nearly all of them shown working in another part of the building. The power for driving the large number of machine tools is derived from two sections of shafting direct-coupled by toothed reduction gearing to two electric motors. The whole of the tools shown in operation cannot be enumerated here, but the most interesting items were perhaps the machines engaged in cutting worm wheel blanks, by means of spiral hobs, four or five blanks being cut at one time, and the tool being adjustable for all sizes of wheels, and the special machine for grinding the spiral hobs was also very interesting. A very large emery wheel engaged in grinding 2-in. square self-hardening steel bars for machine tools, and requiring 8 h.-p. to drive it was a fearsome machine to watch, the steel being torn off at such a rate that a great flame seemed constantly streaming from the edge of the wheel. A large lathe for cutting threads from 4 to 60 per inch without change of gear wheels, was also seen in operation, also an excellent shaping machine, vertical combination drills and tapping machines, power hammers and twist drill grinders.

A visit to the small tool department, where a large number of the highest class tools of all descriptions, but particularly delicate and accurate measuring instruments, were on show, brought a most instructive afternoon to a close. Before leaving, the thanks of the members were tendered to the firm through Messrs. Judson and Smith for the special arrangements made for the members' benefit, and the interesting and exhaustive descriptions of the various machines which had been given, they in reply extending a cordial welcome to any member of the Society not able to be present that day to inspect their show-rooms at any time on short appointment.

FUTURE MEETINGS.—Tuesday, January 28th, at the Cripplegate Institute, Golden Lane: Mr. A. W. Marshall on the construction and uses of various types of primary batteries, with demonstrations and experiments. Members will have the use of the twist drill grinder at this meeting. Next meeting, Tuesday, February 25th.

VISITS.—On Saturday, February 15th, at three, the motor works of Messrs. D. Napier & Sons, at Acton, will be visited. On Wednesday, March 4th, the Bow Works of the North London Railway will be visited. On Thursday, March 26th, the Stratford works of the Great Eastern Railway will be visited.

Full particulars of the Society, and forms of application may be obtained from the Secretary, HERBERT G. RIDDLE, 37, Minard Road, Hither Green, S.E.

A Small Telegraph Instrument.

By G. P. POTTS.

THE photograph (Fig. 1) illustrates one of a pair of electric telegraph instruments I have made. The base is of ¾-in. pine, and the upright measures 7 ins. by 3¼ ins. by 7-16ths in.,

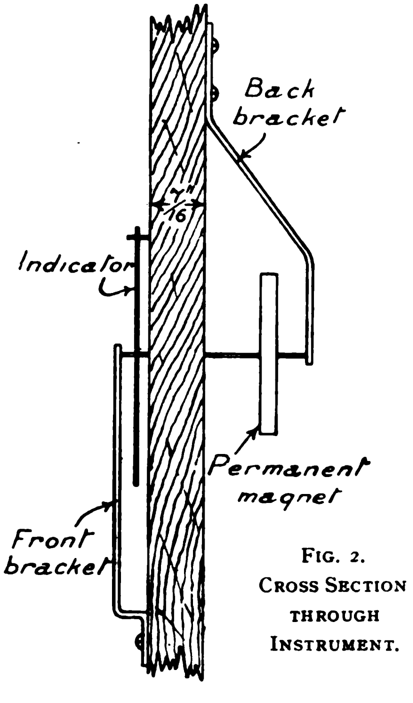


FIG. 2. CROSS SECTION THROUGH INSTRUMENT.

being held in position by three screws from underneath and a bracket on each side.

The permanent magnet is placed behind the upright, being fixed to a needle working between two brackets, as shown, which are punched for the points of the needle to work in. A pointer is fixed on the needle in front of the bracket to indicate the movement of the magnet, as will be seen in the sketch.

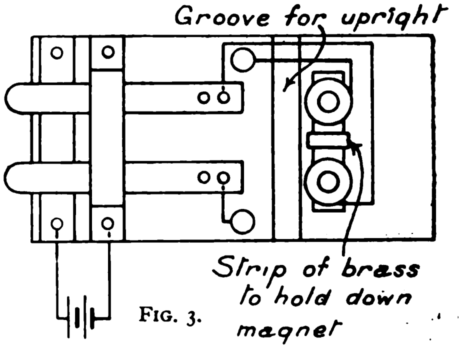


FIG. 3.

The electro-magnet for actuating the permanent one is made from two pieces of 5-16ths in. diameter wrought iron riveted into a piece of ⅛-in. flat iron, and is wound with No. 22 D.C.C. wire. The keys, etc., were all cut from 1-16th in. brass, which was

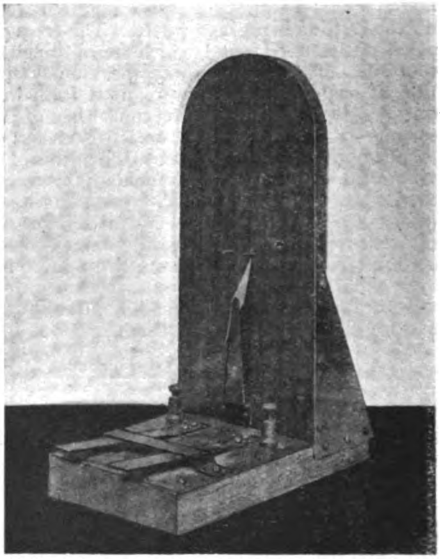


FIG. 1.—SMALL TELEGRAPH INSTRUMENT.

well hammered to make it springy, round-headed brass screws being used throughout for fixing same. The brackets were also cut from sheet brass, and each is fixed with six brass screws. The instruments are each worked by a dry battery, two pins to give different sounds being put one each side of the pointer to sound the dot and dash. The permanent magnet is of lozenge shape, cut from ⅛-in. steel, being 1¼ ins. long, tapering from ¼ in. wide at the centre to ⅛ in. at either end, and a 1-32nd in. hole drilled through for spindle. It was then hardened and magnetised on a friend's dynamo. The electro-magnet is held down by a strip of brass, screwed to base. The diagram of connections is given in Fig. 3, the terminals being for the line wires.

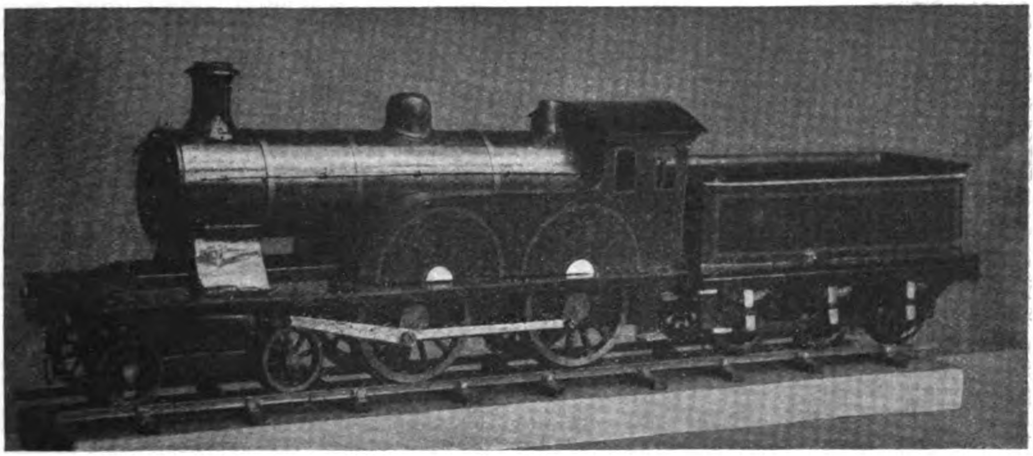
Practical Letters from our Readers.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily for publication.*]

Model 2½-in. Gauge N.E.R. Locomotive.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I am sending you photograph and a few particulars of a N.E.R. locomotive I have just completed. It is 2½-in. gauge and 2 ft. 3 ins. long, and enamelled green and black, with brass bands round the boiler, and lined yellow on the splashers, tender, etc. I am sorry the photographer



MR. W. CLIFFORD'S MODEL N.E.R. LOCOMOTIVE, 2½-IN. GAUGE

has not been able to do it justice owing to the bad light, and I am unable to account for the marks on the throatplate, as it is really quite smooth. The engine wheels are of gun-metal, and the tender wheels of iron, fitted with dummy springs. The inner boiler is 2 ins. diameter, with 3-in. by ¼-in. tubes, and a long superheater, the exhaust pipes from cylinders leading to smokebox. Cylinders are ½-in. bore and slip reversing. The only other fittings are steam pressure gauge, safety valve, and the starting tap in cab. The lamp has 3-in. by ½-in. wicks, and boiler makes plenty of steam. In order to get the lining of tender perfectly straight, I sweated on four pieces of thin watch-spring, and. having smoothed them down, the painting was then quite an easy matter. The enamelling was done in the oven, as per the instructions you sent me a few years ago.—Yours faithfully,

Manchester. W. CLIFFORD.

Re Hardening Circular Saws.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—Referring to the article by Mr. Buckman on hardening circular saws, he does not say what the "blocks" are made of, and whether the edge or teeth of saw should overlap the blocks or be covered by them. One "block" looks like a funnel. An answer will oblige your truly,

F. W. MACCALL.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—Referring to your correspondent's letter *re* the "Hardening of Circular Saws," I think he will find one of his queries answered by a careful perusal of the article. It mentions that the blocks are larger than the saw, meaning, of course, that the faces of the blocks are larger. I use two iron blocks, which are nice and flat. The one that looks like a funnel is merely shown in that way to form some convenient handle. Hoping this will be quite clear to your correspondent, I remain, yours truly,

Chesterfield. B. J. BUCKMAN.

To Prevent Tools and Lathe from Rusting.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—If your correspondent T. C. H., Lower Edmonton, in issue of December 5th, 1907, will follow the practice I have adopted for some time, he will have little or no trouble with rust. All such parts that are not actually in metal-to-metal contact, should be made bright as new, wiped free of all greasiness with a linen rag dipped in petrol. When dry these parts should be lightly and only once brushed over with a flat camel's hair brush in one direction, with Crane's "Zapon" Enamel, which is quite transparent if applied as above. This will ensure all bright parts keeping bright for months, even if in constant contact with moist hands. It is the finest thing I have ever come across, and nothing seems to fetch it off short of emery cloth. It is applied cold, and dries at once. The working parts should be wiped with a fine flannel rag smeared with vaseline. Applied to pulleys and flywheels it effectually prevents all slipping of belt.—Yours truly,

A. NORGATE.

THE spectrum of the light coming from the mercury vapour lamp contains all the prismatic colours except red.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[18,629] **Induction Coil Failure.** F. W. (Smethwick) writes: I should be very pleased if you could help me in the following matter. I have made a ½-in. spark coil from instructions given in your handbook No. 11, and have a difficulty in making it work. I have adhered to the instructions except in the secondary. In this I have the bobbins as follows: A layer of wire (shellaced), another layer covered with paper, next layer (shellaced), etc. The condenser I made to the instructions, but it would not work, so I made another like that given in No. 252, Vol. XIV of THE MODEL ENGINEER. To test it, I connected up one end of primary to the terminal of 3-cell bichromate battery, the other end of primary was connected to one tag of the condenser, the other tag being connected to battery. I broke the circuit by touching and separating the wire from condenser and the battery terminal. This gave no result. I then tried without condenser, and obtained a very small spark made by touching secondary wires together. Is this a true test for the condenser, and ought not I to have a longer spark than I got with condenser out of circuit? Also could you tell me where I could get a condenser for ½-in. spark coil? I have not quite finished a mercury break I am making. Should I have had this in circuit when testing condenser? The secondary, I may say, is connected right.

We think the cause of your trouble is due to not using a proper method of making and breaking this circuit. If you will fit either a good mechanical break of the ordinary type or the mercury break, such as you propose to use, and then start your coil, you will find that you will get very much better results. You must remember that the whole action of an induction coil depends upon the rapidity of the making and breaking of the circuit. Any of our advertisers, such as Messrs. T. W. Thompson & Co., 28, Deptford Bridge, Greenwich, London, S.E., or Messrs. Whitney, 117, City Road, London, E.C., would supply you with a suitable condenser, although we have every confidence in particulars of condensers in handbooks being workable; some experimenting is often necessary in such cases even with the very best made coils. If you had sent a diagram of your connections it would have been better, but as it is we can only advise you to make quite sure that they are as given in our handbook.

[18,668] **Bichromate Cells.** C. B. (Acocks Green) writes: I should be glad if you would answer me the following. Has the double-fluid bichromate battery any advantage over the single-fluid for charging purposes? If so, what? I wish to make up a 3-cell bichromate battery to give a current of 1 amp. for charging a 10 amp.-hour accumulator. What is the most suitable size for this battery? What active surface of carbons and zincs (two carbons, one zinc) would be required to give 1 amp.? Where could I buy cut carbons (flat) suitable for this battery and what would be the cost of same?

The double-fluid chromic acid cell is a little more constant than the single-fluid type; but for purposes where the capacity of the cell will not be overtaxed, you will get as good results from the single-fluid cell. For charging purposes, however, you will find the chromic acid cell, particulars of which have been given from time to time in our Query Replies columns, the most satisfactory. A quart size cell of this type could be discharged at 1 amp. rate for a considerable time, probably sixteen to twenty hours, before it became run down. Carbons may be obtained from almost any of our electrical advertisers.

[18,619] **¼ h.-p. Alternating Current Motor.** J. P. (Seacombe) writes: I wish to build an alternating current motor, about ¼ h.-p., to drive a printing press and dispense with treadle. I intend to use the Corporation supply, which is 2,000 volts, transformed to 100 volts, 50 periods (Wallasey U.D.C.). I shall require rough notes and dimensioned sketches.

To supply you with full detailed drawings of a ¼ h.-p. alternating current motor is, we regret, beyond the scope of the query column. We should be pleased to quote you a price through the medium of our Expert Service Department, if you would send us full particulars of what you require. But we must say that you would find it much cheaper to buy a motor ready made from some reliable firm.

[18,620] **Upkeep of Accumulator Plates.** W. P. P. (Acton Vale) writes: My accumulators have been standing uncharged for a week or two and the plates have naturally become corroded by the acid. I shall be glad if you will be kind enough to let me know the best way to repair my accumulator.

Your accumulator should be discharged and the plates taken out, scraped, and washed in dilute sulphuric acid. This should put them in thorough working order again, provided they are not badly sulphated. Further information on the subject may be had on referring to our handbook—"Small Accumulators," price 7d. post free, and also to Query Replies in recent issues of this Journal.

[18,661] **The British Electro Therapeutic Society.** A. J. (Cark-in-Cartmel) writes: Can you tell me what examination, nominations or fees are required in order to become a member of the British Electro Therapeutic Society? What is the address of the secretary of the above society? Do you know of any diplomas, certificates granted for proficiency in electro therapeutic work?

The address of the British Electro Therapeutic Society is c/o The Royal Society of Medicine, 20, Hanover Square, London, W. For the particulars you require, we suggest that you write to Dr. Reginald Morton, who is hon. secretary, and who would be pleased to give you any information you require. Dr. Reginald Morton's address is Queen Anne Street, Cavendish Square, W.

[18,653] **Study of Electrical Engineering.** T. J. (Mysore State, South India) writes: I desire to become an electrical engineer. I am 16 years old. Would you kindly answer the following, for which I shall be greatly obliged. (1) As there are no technical schools here, would it be advisable to study through the correspondence system? (2) Of those advertised—(*a*) the Electrical Engineering Institute, England; (*b*) The Correspondence Schools, America; (*c*) Thos. Wall & Sons, Ltd., Wigan—which would you recommend? (3) What books would you recommend for one who has had no previous technical education?

(1) Correspondence instruction is very good provided the student has practical work and experience during the day, but unless this is the case it is next door to useless. That is to say, you cannot learn the profession of electrical engineering from theoretical or paper study alone. (2) There is not much to choose between the two Institutes you mention; the third one, we may remind you, is devoted chiefly to mining engineering. (3) We would recommend you to obtain our book "A Guide to Electrical Examinations," 1s. 3d. post free. We enclose a list of books, which we think will be specially useful to you.

[18,654] **Surface Contact System.** H. E. (Stratford) writes: I should be much obliged if you could furnish me with a rough sketch of the surface contact system of trams which is being laid between Bow and Aldgate, for I want to know how the car gets the current from button to button. If stopped midway, does the car carry accumulators for the continuous light between buttons?

If you will refer to our issue of Feb. 11th, 1904, Vol. X, you will find an illustrated article on the surface contact system for tramways. This can be obtained from the Publishing Department, 3d. post free.

[18,663] **Capacity and Discharge Rate of Accumulators.** F. L. P. (Hampstead) writes: I should be much obliged if you would answer the following queries. (1) I have a 4-volt 10-amp. accumulator which I use for lighting small "Osram" lamps. I wish to know the highest rate at which I can discharge it without buckling the plates. There are three plates per cell and the separating material between the plates seems to be a sort of cotton wool. I have your handbook No. 1, but I cannot find in it any rule for determining the greatest permissible rate of discharge for any given capacity of accumulator. (2) I have made a shocking coil as described in the handbook on "Induction Coils," and I find that at full power I can obtain a spark of nearly ⅛-in. Would it be possible to fit a condenser to the coil which would enable small vacuum tubes to be illuminated by it?

(1) It is the usual practice to allow a discharge rate of about 5 amps. per sq. ft. of positive plate surface, but this varies according to the type and make of cell. We should say that this figure would in all probability apply in your case. (2) Yes, a condenser could easily be fitted to the coil which would be used for carrying out the experiments you mention. Particulars of suitable condensers are given in tabular form in the handbook.

[18,684] **Running Speeds for Small Lighting Plant.** "AN OLD READER" writes: I have a high-speed steam engine, 2-in. bore, and 2-in. stroke, which is advertised to run at 1,000

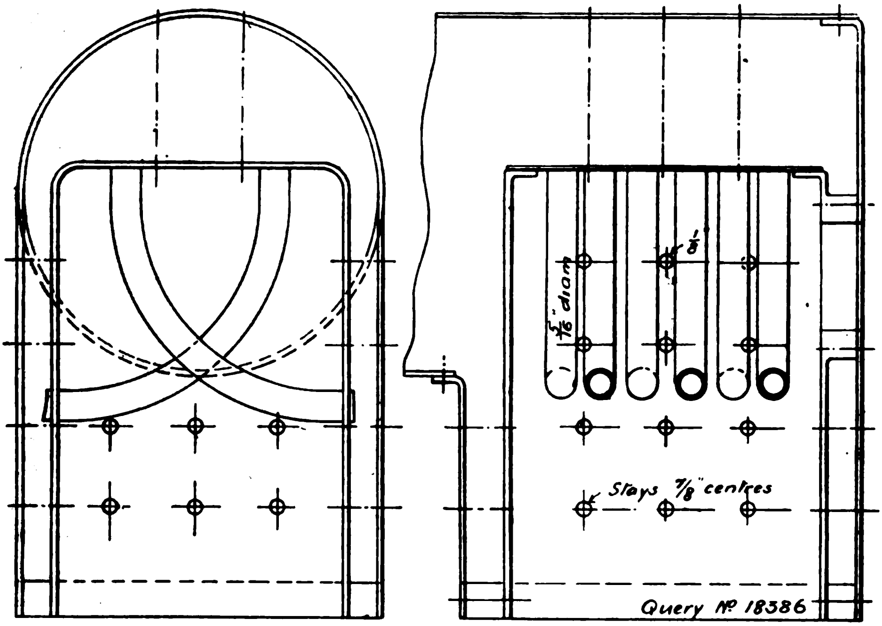
r.p.m. at 80 lbs. steam per sq. in. I have a flywheel on it 7½ ins. diameter, and this is coupled to a dynamo pulley 2 ins. diameter. The output of dynamo is 100 volts 1·5 amps., and is connected with a 1-in. belt. I run engine at 120 lbs. at boiler and it runs at a terrific speed, blows out all the packing, etc. Now, I don't want to run the engine at such a high speed, I want a medium steady speed. The dynamo is marked—speed 2,500. Will you kindly tell me if I ought to get 2,500 easily from my flywheel without running engine at such high speed? What speed ought I to get, engine 1,000 revs. on my dynamo? Should I get over 2,500 on my dynamo? Have I got plenty of speed in engine without running so high? Do I want a larger flywheel? I can only get about 60 volts when my engine is tearing itself to pieces. Kindly give me the speeds of dynamo, say, engine at 500, 600, 700, 800, and 900 r.p.m. Not getting sufficient voltage I only get about half an amp., and filaments are a little over red-hot.

In reply to your enquiry *re* steam engine and dynamo, we think it would be advisable to keep the speed of the engine as high as possible, though not necessarily beyond its rated speed, as if you reduce the speed you also reduce the power available. The ratio of the pulley on engine to the pulley on the dynamo is as 7 : 2. Thus, at 1,000 revolutions a minute the dynamo speed would be at 3,500. You could easily calculate the speeds of your dynamo from the following rule: As the size of the engine pulley is to the size of the dynamo pulley so is *x* to the speed of the engine. Multiply by the two extremes and divide by the other known factor, the result gives you *x*, which is the speed of dynamo; thus, to find the speed at which your engine must run to give dynamo a speed of 2,500, the equation will be as 7 . 2 :: 2,500 : *x*. This gives approximately 714, which will be a suitable speed for your engine. We trust these details will assist you. In all probability your belt is slipping as the 2,500 revs. should be high enough speed for your dynamo.

[18,616] **Compressed Air Motor Cycle.** S. P. B. (Leicester) writes: I tender my first request for your assistance *re* a compressed air motor for a motor cycle. This method of propulsion I have had in my mind for a long time, and this is also the first time I have disclosed it to anyone. The arrangement comprises a chamber (fitted in the same position as a petrol tank) cylindrical, and pressed to develop 3½ to 4 h.-p., and fitted with a pressure gauge and release valve and regulator. The motor I propose to construct on the water wheel principle. A flywheel with a heavy rim and recesses on its circumference has a plate on each side; the latter is held in position against the wheel by spiral springs, adjusted so as not to bear too heavily and yet to prevent any air escaping from the recesses into the case. Speed about 1,200 or 1,300 r.p.m. A shaft running in line with engine shaft has two eccentrics fitted on it to work two pumps for replenishing the chamber, over-pressure to escape through release valve. In working on the road the motor would be started up slowly and then the clutch let in. On running down long hills the pumps would be supplying the tank by the machine's momentum with the clutch withdrawn; an air brake could be fitted and controlled from the handlebar. Do you think the idea would work satisfactorily?

In reply to your query *re* compressed air motor cycle, your idea is quite impracticable. The size of the tank and the pressure required would have to be enormous before you could get a machine that would carry you more than a very few yards. The suggestion that the pumps would work on going down hill and replenish the supply of compressed air is quite correct as far as it goes, but the balance would still be very much on the wrong side. We regret that we cannot give you any encouragement to pursue the idea.

[18,386] **Locomotive Type Boiler.** H. C. B. (Tewkesbury) writes: Would a boiler made to the enclosed design (not reproduced), and a single-cylinder 1¼ ins. by 1¼ ins., flywheel 6¼ ins. diameter, drive a 10 or 12-watt dynamo? I propose pressure 40 lbs. to 50 lbs., and to use a Primus burner. If not, will you please say if the design could be amended internally. I am anxious to keep to outside measurements, as I have the necessary parts for building up a model traction engine to 1½-in. scale. The dynamo is the smallest Simplex, and made from instructions in your book. "Small Dynamos and Motors," and it very agreeably surprised me when it lit up five small lamps the first time I tried it without having to excite it from any outside source.



Water-tubes in Firebox of a Model Traction or Portable Engine Boiler.
(*Half full size.*)

We see nothing against the proposal. The boiler should steam the cylinder at the pressure named easily. There are rather too many stays in the firebox, but we presume you wish to imitate the prototype as nearly as possible. A few water tubes placed as in sketch, and silver-soldered into the firebox plates would improve the firebox circulation. The number of stays shown in our sketch will prove sufficient for all practical purposes at least.

[18,602] **Examinations.** R. F. (Bournemouth) writes: Would you kindly answer the following questions. Is it possible to enter for a preliminary examination in electrical engineering from home study? If so, could you give me full particulars as to age, subjects, where held, fees, and what books would be best to study from? I have the "Harmsworth Self-Educator."

Yes, you can study at home for this examination, but certain forms have to be filled up some time before the examination takes place. You can obtain full particulars from any of the teachers at any technical institute or evening school, or from the Secretary, Gresham College, Basinghall Street, London, E.C. See our "Guide to Electrical Examination" 1s. 3d. post free.

[18,643] **Magneto Shocking Machine.** J. G. S. (Plumstead) writes: I have by me a couple of strong magnets (horseshoe) taken from an old telephone box which I am desirous of converting into a magneto machine. Will you kindly give me a simple and easy method of making this machine, as I have no expensive tools to work with? I have also the two coils of wire used for bell of same machine. What I want to know is, how to make the shock and to regulate the same.

What you really require is a thorough description of how to make a magneto shocking machine, and we think you will be well advised to buy Bottone's "Electrical Instrument Making," price 3s. 3d. post free, in which you will find a very good description of such a machine.

[18,374] **Steam Engine Proportions.** G. O. (Weston-super-Mare) writes: I shall be obliged if you will kindly answer the following queries for me. I have a set of castings for horizontal engine, 1½-in. bore, 2-in. stroke. What size should the steam and exhaust ports be, lap and lead of valve, also travel, diameter of piston-rod, and what horse-power might be expected using 30 lbs. boiler pressure?

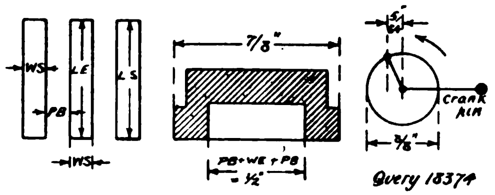
The rule for moderate speeds is—

Width of steam port — 1-16th the stroke of piston.
Length of steam port — ¾ the diameter of piston.
Length of exhaust port — " "
Width of exhaust port — ⅛ the stroke of piston.
Width of portbar — 1-16th " "

In your engine, if these rules are adopted, the sizes will be as follows:—

W.S. — 1-16th of 2 ins. — ⅛ in.
P.B. — 1-16th of 2 ins. — ⅛ in.
W.S. — ⅛ of 2 ins. — ¼ in.
L.E. and L.S. — ¾ of 1½ ins. — [illegible] in.

The lap of the valve should be about half the width of the steam



STEAM PORT PROPORTIONS.

port, say, 1-16th in. The total length of the valve will therefore be—

W.S.+P.B.+W.E.+P.B.+W.S.+2 lap —
= ⅛ + ⅛ + ¼ + ⅛ + ⅛ +2 lap —
¾+2×1-16th — ⅞ in.

The travel of the valve of a model steam engine should always be—

W.S.+lap×2 —
+1-16th×2 —
3-16ths×2 — ⅜.

The angle of advance should be equal to the lap plus the lead. The lead may be 1-64th in.; therefore, the advance — 5-64ths in. (as illustrated). The cavity of the normal valve should be—

P.B.+W.S.+P.B.

The diameter of the piston-rod may be 3-16ths or 7-32nds in., and 30 lbs. boiler pressure and 500 r.p.m., the engine should develop 1-7th i.h.-p. The brake horse-power will depend on the mechanical efficiency of the engine.

[18,642] **Small Induction Coil Failure.** J. R. (Crook) writes: Would you kindly help me out of a little difficulty with a shocking coil which I have been making. The primary coil is of No. 22 gauge copper wire (silk-covered) and is wound on a wooden reel. The secondary coil is of No. 40 gauge copper wire (insulated). The quantity of wire used is 2 ozs. on the primary coil and 4 ozs. on the secondary coil. The terminals and other fittings were bought. I have tried it with a bichromate cell and find that I can get a slight shock off secondary coil showing that there must be a current passing. The point of difficulty is—with the current passing, why does it not magnetise the core and work the armature of the contact-breaker, either when the sliding-rod is in or not? The way I have it connected is shown in the diagram. A is the core. The thick lines round the core are the primary coil. The thin lines are the secondary coil. The battery is connected to the primary. One contact of the battery is connected to the contact-breaker, which forms a circuit through armature to one end of primary coil, the current passing through the coil, back to the battery. Also would a tinfoil paraffin condenser be of any advantage towards strengthening the shock?

It appears that your contact-breaker is at fault. We do not quite understand from your sketch exactly how you have made it, and we advise you to compare your sketch with drawings already published in our handbook—"Induction Coils," 7d. post free. The contact-breaker of any coil is an important part of the whole and requires very careful adjustment. The strength of the spring used also enters largely into the working and the results obtained, and it would be an advantage if you added a small condenser connected up across the break. If you work on these few suggestions we think you will get better results.

[18,367] **Making Grids and Moulds for Accumulators.** A. W. (Barnsbury) writes: I am making an accumulator to the instructions given in your handbook No. 1, "Small Accumulators" (tenth edition), Chap. III, page 18. I have made the first half of the mould and have tried to take a wax cast from it as described, but I find it is impossible to take the wax out of the mould whole; it breaks up each time and I have difficulty in getting the wax out of the perforations. I should be obliged if you could help me in this matter. Is there anything with which I have to coat the mould so that the wax shall leave easily? The mould is of plaster-of-Paris as described. Where can I obtain antimony?

There is no special method to be adopted which will enable you to do this job successfully; it is purely a matter of careful manipulation. Antimony may be obtained from Messrs. Townson and Mercer, manufacturing chemists, 89, Bishopsgate Street Within, London, E.C. A query reply on the subject you write about was published a short time ago in this journal and this may assist you somewhat.

[18,635] **60-watt Dynamo Windings.** J. H. H. writes: I want to construct a small lighting and charging plant. I have had the field-magnets made at a blacksmith's, size as enclosed sketch (not reproduced). What voltage and amperage could I get from it? Could I charge two 4-volt accumulators at once, and how many 4 c.-p. lamps could be lighted? How long would it take to charge the accumulators? What gauge and quantity of wire should I have? What would be the cost for wire and stampings, and what number of stampings would cover 2½ ins.? The armature is 2½ ins. diameter by 2½ ins; twelve slots, ⅜ in. wide by 3-10ths in. deep. I have also a cylinder, 1-in. bore by 2-in. stroke. Would this be large enough to work the dynamo, and what horse-power would it take to drive it, and what is the smallest size boiler it would take, and also what type? I should prefer oil fuel. Please could you tell me what would be the best kind of burner to have that would want no attention so as to charge the accumulators overnight? What diameter flywheel should I have for the engine?

The machine you have in hand should give approximately 60 watts output, but the amount of metal in your field-magnets and core is rather small. We should advise you to wind armature with about 7 ozs. No. 22 wire, and field-magnets with as much as you can get on of No. 23 S.W.G. This should give you about 15 or 20 volts and 4 or 4½ amps. at 3,000 r.p.m. We strongly advise you, however, to put more iron in your field-magnets. If you compare your design with the designs for similar machines in our handbook—"Small Dynamos and Motors"—you will see exactly where you are wrong. The cost for wire and stampings would not be great, and any of our advertisers would give you a quotation on application. A 1-in. by 2-in. cylinder engine should just about cope with this work provided you had ample boiler capacity. A suitable boiler is illustrated and described in handbook—"Model Boiler Making" (revised edition). You could charge two 4-volt accumulators at once on your machine easily, and the number of 4 c.-p. lamps which could be lighted depends upon the kind of lamps and the watts taken per candle-power. If you read recent query replies on this subject you will get much information which will be of use to you.

[18,667] **Dry Cells.** F. G. W. (Sutton) writes: Can you please answer me the following? Is there any way of reviving dry cells and, if so, would the same apply to porous pots?

As a rule, it is not worth while trying to do anything with exhausted dry cells, and your best plan would be to make a fresh charge entirely. Particulars of a good type of dry cell are given in our handbook—"Electric Batteries," 7d. post free.

The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

* *Reviews distinguished by the asterisk have been based on actual Editorial Inspection of the goods noticed.*

An Up-to-date Model Locomotive.

Many of our readers will remember the model of the G.W.R. "Pacific" type locomotive, "The Great Bear," which attracted so much attention on the stand of Messrs. Carson & Co., Ltd., Birmingham, at the recent MODEL ENGINEER Exhibition, and was to many minds the most interesting of all the locomotive exhibits. We reproduce in Fig. 1 a photograph of the finished engine. This model is unusual, if not unique, in that within the comparatively small space available in a ¾-in. scale model, rendered even smaller by the tucking in of the frames as on the prototype, the builders have been able to fit the four cylinders and the complete Walschaerts valve gear of Mr. Churchward's engine, and moreover, what is even more important, have been able with a single burner of the Primus type to supply four ¾-in. bore by 1¼-in. stroke cylinders

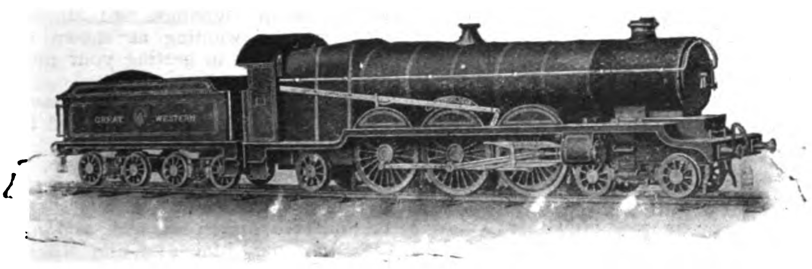


FIG. 1.—MODEL G.W.R. "PACIFIC" TYPE LOCOMOTIVE, "THE GREAT BEAR."
(*Constructed by Messrs. James Carson & Co., Ltd.*)

with steam. The latter feature is due, no doubt, to a rather novel type of boiler, and the very careful adjustment of the blast orifice which has been characteristic of all the model locomotives turned out by this firm. As to the details of the motion shown in Fig. 2,

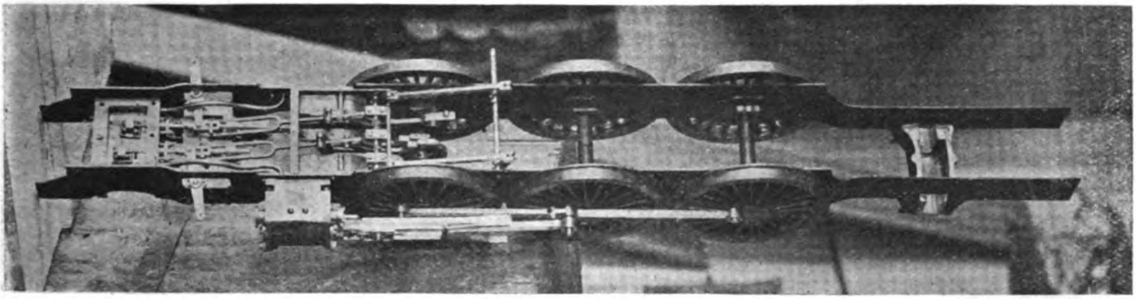


FIG. 2.—SHOWING ARRANGEMENT OF "MOTION" OF NEW MODEL G.W.R. "PACIFIC" TYPE LOCOMOTIVE.

the prototype has been followed throughout. The eccentrics work the curved rocker, through which the valve rods pass. At the front end, the latter are coupled to the combining lever, while at the back end they extend into the forked anus of the weighshaft, the rods being slotted to allow of the necessary movement. The arrangement will be familiar to those acquainted with the recent G.W. "Star" class, and possesses the advantage that no drag links are required. In fact, they would have been almost impossible in these engines. The motion is transmitted to the valves of the outside cylinders by the horizontal levers which can be plainly seen on the "Star" engines, but which in the new class are hidden behind the front step, this latter being a new feature. In the model, the piston valves have been simulated by the use of semi-circular D valves working in bored chests. The covers of this chest, therefore, present exactly the appearance of the prototype. The bogies of both engine and tender are of the "bar" type, recently adopted by the G.W. Company, and the brake gear fitted to them on the model is complete externally, so that if desired these can be converted into working brakes at any time. The driving wheels are fitted with steam brakes, full equalising gear being provided. They are sufficiently powerful to stop the engine with full steam on, and by the design of brake cylinder adopted, no trouble is experienced with condensed water, the usual *bete noir* of the model steam brake. The fuel and water supplies are in the tender, all connections being arranged above the tender footplate for greater convenience. The cab fittings consist of the usual gauges, etc., and a screw reversing gear in polished German silver adds considerably to the general appearance. This metal is used throughout in the motion, etc., the advantages to the model maker and user being too obvious to admit of any question. As the engine has not yet been thoroughly "run in," the tests for tractive effort, etc., have not been made, but according to the usual formula, the model will pull from 300 lbs. to 400 lbs. Ample steam is made even with the pump running continuously. The large size of this engine may be realised when it is stated that the engine alone measures 44 ft. 3 ins. over the buffer planks. Messrs. Carson & Co. deserve hearty congratulations upon their enterprise in producing such an up-to-date piece of work, and we wish them every success in this venture. The model C.R. express locomotive, "Cardean," which we illustrate in Fig. 3, shows another speciality of this firm's manufacture, and built in various scales. Further particulars will be supplied upon application to Messrs. James Carson & Co., Ltd., 51, Summer Row, Birmingham.

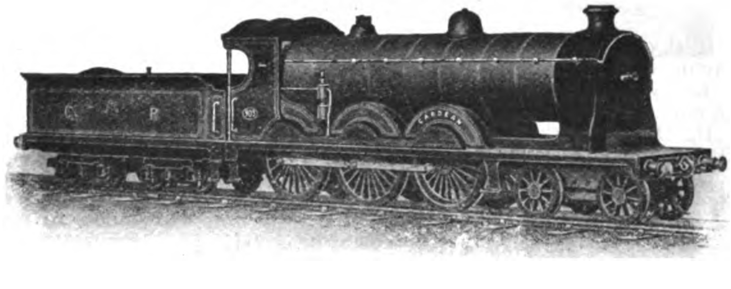


FIG. 3.—MODEL SIX-COUPLED CALEDONIAN RAILWAY EXPRESS LOCOMOTIVE.

A New Calendar.

We have received from Messrs. S. Holmes & Co., manufacturers of machine tools, &c., Albion Works, Bradford, an artistic wall calendar for 1908, on which is displayed a very beautiful specimen of colour reproduction (6½ ins. by 8 ins.) of the painting "Mildred," from the original by Carle J. Blenner. At the base there are the usual date tear-off slips for each month.

———

MANY of our readers will doubtless be interested to know of the two new railway papers just published. One is *Railways and Tramways*, published monthly by Biggs & Sons, Salisbury Court, Fleet Street, London E.C., price 3d.; and the other is *Railways*, published weekly from the *Graphic* office, Tallis Street, E.C., price 1d.

The Editor's Page.

As it is some time since we have arranged any Prize Competitions for our readers, we now have pleasure in offering a prize of £2 2s. for the best article on "Finishing Model Engines." This should deal with painting and enamelling, polishing, lacquering, and the other points and processes which are involved in neatly finishing off a model engine after all the constructive work has been done. An otherwise well-made model often loses much by being finished off in poor style, and as there is a right and a wrong way of doing the finishing work it is as well that as many readers as possible should have all the hints which other readers can give them. Entries should be marked on the envelope "Competition No. 43." We also offer a prize of £2 2s. for the best article on "Small Dynamo and Motor Testing." This article should describe how to test for faults during construction, and how to test the working of the machine when finished. Entries should be marked on the envelope "Competition No. 44." In both the above Competitions we do not place any definite length on the articles, but leave it to the competitors to make their information as comprehensive and as helpful as possible within reasonable limits. Articles should be written in ink on one side of the paper only, and should bear the full name and address of the sender. Any drawings which may be necessary should be in indian ink on good white paper or cardboard. No coloured lines or washes should be used. The Editor reserves the right to print any portion of the unsuccessful articles which he may think worthy of publication, but for matter so used payment will be made according to length and merit. The last date for sending in for both Competitions is March 2nd, 1908.

Answers to Correspondents.

R. H. C. (Dulwich).—We will deal with this matter at the earliest possible date.

H. K. (Weymouth).—Your inquiry is in hand and a reply will be published in an early issue.

J. H. Drage (Eltham).—About 2½ h.-p. boiler. We cannot give definite advice, as you do not send full particulars of the cylinder. A scale drawing of the S.E. & C.R. locomotive No. 735 is being prepared for publication.

T. A. S. (Montreal).—Thank you for your good wishes. We should be pleased to see drawings for a ¾-in. scale express if you will kindly send them along at your convenience. A good design would be appreciated on both sides.

F. S. (Newark).—Harger Bros., Settle, Yorks, will supply you with the tools and materials you require.

E. C. J. (Royston, Herts).—We thank you for your contribution, but regret we cannot see our way to insert.

A. R. M. (Birmingham).—We thank you for your small article, but regret we cannot see our way to accept same for publication.

J. H. D. (Darnen).—We advise you to use a drum armature wound in eight sections, as shown in our handbook "Small Dynamos and Motors." If you carry out the winding as shown you should have no difficulty in getting your motor to run properly.

J. C. (Carnmoney).—Your enquiry *re* boiler is having our attention and the matter will be looked into immediately.

W. H. B. (Sutton).—A design for a ½ h.-p. gas engine appeared in the following issues of The Model Engineer: January 4th and 18th, February 1st and 15th, March 1st, 15th, and 29th, May 3rd, 17th, and 31st, June 21st, and November 15th, 1906. Back numbers can be had from the Publishing Department, 3d. each post free. Castings and forgings of the above engine can be obtained from Henry Butler, Alvaston Works, Derby.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended **for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.**

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

How to Address Letters.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to The Editor, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to The Advertisement Manager, "The Model Engineer," 26-29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

Sole Agents for United States, Canada, and Mexico: Spon and Chamberlain, 123, Liberty Street, New York, U.S.A., to whom all subscriptions from these countries should be addressed.

Contents.

[*The asterisk (*) denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E

VOL. XVIII. No. 353. JANUARY 30, 1908. PUBLISHED WEEKLY.

Model Railways.

No. XVII.—The Mossvill Model Railway.

By COL. W. HAMILTON.

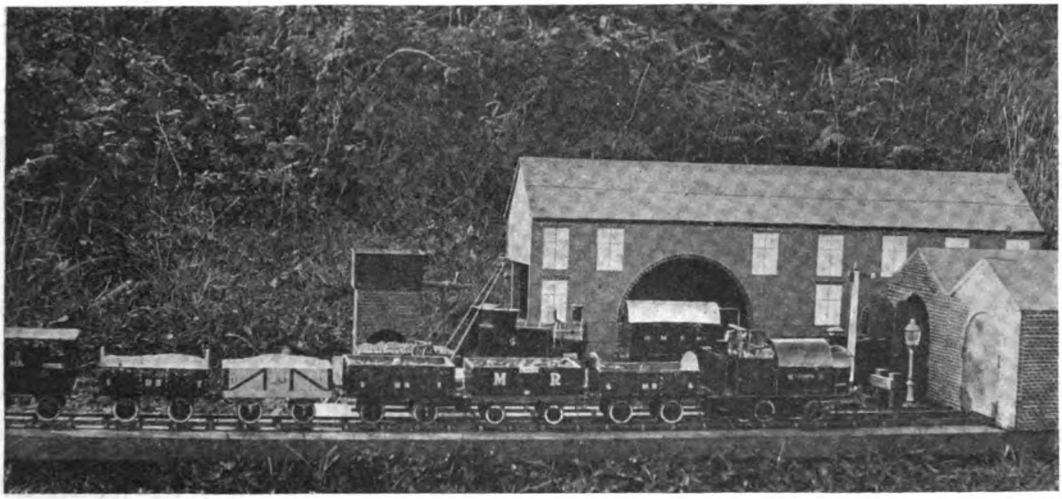


FIG. 1.—A VIEW ON THE "MOSSVILL" MODEL RAILWAY.

SOME readers may recollect that an account of my first attempt at model railway engineering appeared in the September issue, 1899, of THE MODEL ENGINEER. However, as since then I have completely rearranged and relaid my entire system, and have (like some railway companies) added locomotives of thoroughly up-to-date design, a brief description of my railway, as it is at present, with rolling-stock, may prove interesting. For the information of those who have only begun to take THE MODEL ENGINEER in later years, I give a few particulars which apply to both past and present systems. It was at first intended to be distinctly an indoor railway, and the road consisted of T-iron rails screwed to ¾-in. lengths of deal. For this is now substituted ¾-in. scale permanent-way rails, as advertised, attached by chairs to lengths of pitch pine 2 ins. deep. Of course, this is unusually heavy for my present rolling-stock, but it has this advantage—it can be utilised for outside as well as inside, and is strong enough for any sized models to run upon.

The end platforms, on which are the workshops and engine shed, as well as road, are supported on trestles 3½ ft. high, a convenient height for driving the locomotives. For I may here remark that my idea of taking amusement out of a model railway is to work my locomotives the same as the real ones—go fast, go slow, reverse, notch up, and not simply to see how many times a model locomotive can rush round a circle in a certain time. However, *chacun a son goût.*

The curves on my system are necessarily of less radius than I could wish, viz., 56 ins., with a super-elevation of outer rail of 3-16ths in. I find, however, that the only six-wheeled bit of rolling-stock I have—the tender referred to in the locomotive list—takes these curves freely. The axles have a fairish amount of lateral play. The gauge between rails is, on straight runs, 2 15-16ths ins., and on curves 3 ins. (full). This allows ⅛ in. between flange and rail.

My first railway was put up in a long room, but on moving to a new house I found there was no room in it long enough, so I removed the end window in the only room I could get, and built an addition with a lean-to roof, making an arched doorway where the window originally was. I also made two tunnels through the outside wall of the house. These are lined with painted zinc to represent stone and brick, and look very realistic.

The engine is driven by two slide-valve cylinders (¾-in. bore by 1¼-in. stroke), fitted with lubricators. Piston-rods and valve spindles are German silver. There is a motion-plate fitted, exactly as in real locomotives, with guides and lubricators. The reversing gear is Stephenson's link motion, operated by lever and quadrant in cab. The driving and coupled wheels are 2⅜ ins. on tread, bogie wheels 1¼ in. Rigid wheelbase, 4 ins.; total wheelbase, 10 ins. Length of engine over buffers, 13½ ins.; height of footplate (from rail), 2⅛ ins.; width of footplate, 4¼ ins. All wheels have axle-boxes and springs, also places for lubrication.

The chimney is of the "Mossvill" railway standard pattern, with brass cap. "Vulcan" is enamelled the correct Midland red (which I had specially made by Etruria Porcelain Company), picked out

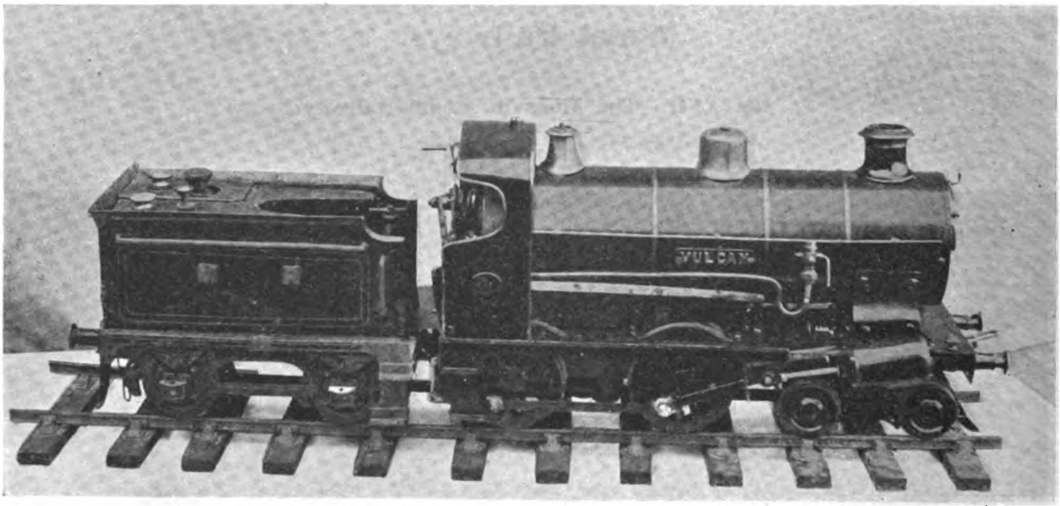


FIG. 2.—MODEL FOUR-COUPLED BOGIE MINERAL ENGINE: THE "MOSSVILL" MODEL RAILWAY.

Owing to the time of year and bad light I was unable to get any views of the railway as it really is; all I could do was to take parts of it to pieces and set it up anyhow outside. I may add, I designed and made everything connected with the railway except the locomotives, which were made to my drawings.

With regard to locomotives, there are three. No. 1—"Vulcan," illustrated herewith—is a four-coupled bogie mineral engine, and, like the others, was built entirely to my own design. It has a Smithies' type water-tube boiler, with downcomer and superheater (made by the inventor). Outer shell, 11 ins. by 3¼ ins.; generator, 1-16th in.; solid-drawn copper tube, 2½ ins. diameter, with cast ends riveted, stayed, and sweated. The fittings are—steam pressure gauge, clack valve, gauge cocks, whistle, and regulator. This last is the only fitting out of proper proportion; my reason was for convenience in driving, as a ⅝-in. scale regulator is rather small, particularly if it is under a cab.

By the way, my first design of cab was of the G.N. style; but I found that this greatly interfered with the manipulation of the reversing lever, so had it cut away at the sides, and it now is like the G.N. of Ireland.

with black and yellow. Lagging bands are polished brass; buffer beams, connecting and coupling-rods, vermilion. Lettering and numerals polished brass; weight of engine (empty), 14 lbs.

Tender runs on four wheels, and is provided with two tanks—one for water, the other for methylated spirit. The former is fitted with a hand-pump for supplying boiler, the latter with a needle valve for regulating the supply of spirit to lamp reservoir under footplate. There is also a hand-brake, spring buffers, and spring drawhook and coupling chains. Length of tender, 8½ ins.; weight (empty), 5 lbs. There is also a six-wheeled tender, which can be utilised for No. 1.

No. 2—"Fury"—is a four-coupled saddle tank. The boiler is of my own design—something like the earlier Smithies' type. The saddle tank, instead of containing water, is packed with asbestos, as are also the sideplates. This has a very good effect in preventing radiation. The main steam pipe is brought outside and underneath the boiler, passing through the flame of the lamp, which dries the steam thoroughly and to a great extent obviates priming. The fittings are—regulator (with lubricator)—a very useful thing in small locomotives where brass taps are liable to get very hot and stick), steam pressure gauge, Ramsbottom safety valve and gauge cocks. The reversing gear is slip motion, though there is a dummy reversing lever in cab which makes things more realistic, so that when the lever is pushed forward or drawn back, the locomotive is moved, at the same time bringing eccentrics into forward or backward gear. This engine very closely resembles the model design which appeared in THE MODEL ENGINEER of March, 1902, the principal difference being that in my design two outside cylinders are used and the tube containing the lamp burners is extended the whole length of the boiler. The boiler is a solid-drawn copper tube (8-in. by 3-in.). with cast gun-metal ends riveted and stayed. It is painted and lined the standard M.R. colour. This is a splendid little engine, and I would strongly recommend the design to beginners, or those who do not care to go in for elaborate details and expense.

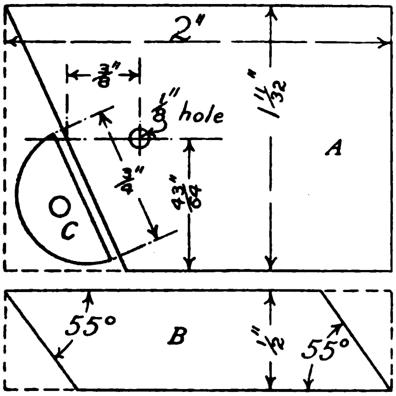


FIG. 1.—MARKING OFF STEEL PLATES FOR COMBINATION GAUGE.

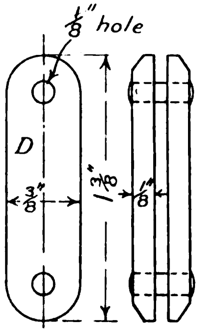


FIG. 2.—DETAIL OF STEEL ARMS.

No. 4—"Jupiter"—was the original No. 1 of the line. It has been converted into a front coupled trailing bogie side tank, and is painted black with red and white lining.

My rolling-stock consists of trucks and wagons of various kinds. A few specimens may be seen in the accompanying photograph, but owing to want of time and space I am obliged to leave a good many out, amongst others a long truck running on two bogies, a travelling crane, ballast trucks, etc.

With the exception of a few of the older trucks, which are light lead colour, the whole of the rolling-stock is painted the standard dark lake, with black ironwork and white lettering; guards' vans have vermilion ends.

MESSRS. HARPER AND BROTHERS are adding to their series of electrical handbooks a volume, entitled "Electric Arc Lamps," by Mr. J. Zeidler and Mr. J. Lustgarten. It deals with the principles, construction and working of arc lamps, is profusely illustrated, and gives tables, curves, etc. Among the contents may be noted: open, enclosed, and flame (including magazine) arc lamps, candle power, light distribution and application of arc lamps for lighting purposes, accessories for installation, and comparative cost of different sources of light.

Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "WORKSHOP" on the envelope.]

A Combination Gauge.

By HARRY WALKER.

To make this gauge, procure a piece ot sheet steel 2 1-16th ins. square, 11-32nds in. thick, and mark

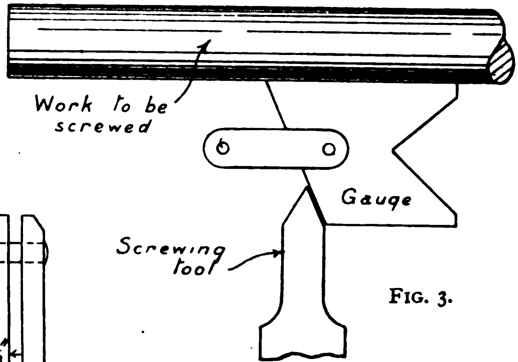


FIG. 3.

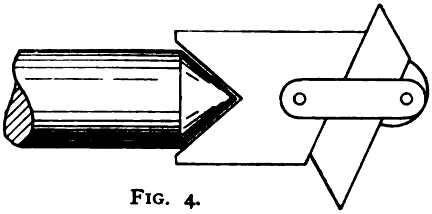


FIG. 4.

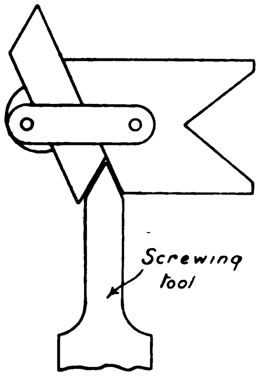


FIG. 5.

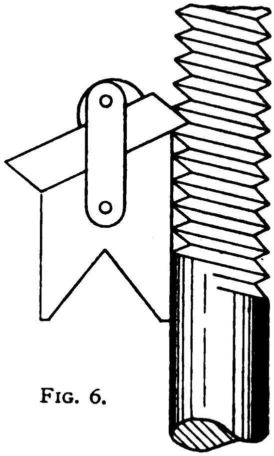


FIG. 6.

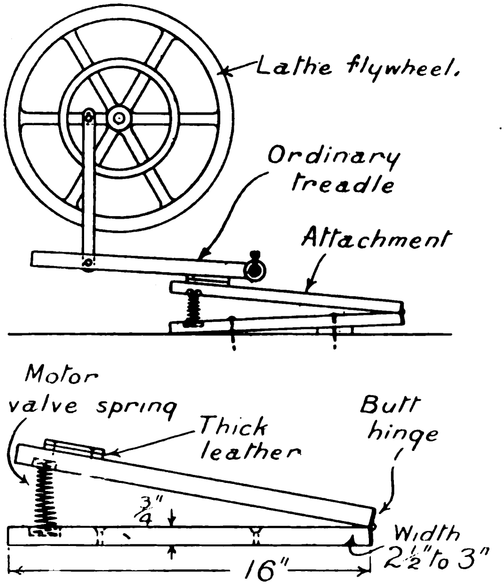
SHOWING USES OF THE COMBINATION GAUGE.

off parts A, B and C, as shown in Fig. 1. Cut out with thin sharp chisel, and file edges perfectly flat, and to angles given. The two arms (D, Fig. 2) are made from a piece of steel 3/8 in. by 1/8 in. Nicely bevel outer edges, leaving inside perfectly flat. When riveting the cam C to arms leave these rather a loose fit, but rivet tight to body A (Fig. 1) so that arms will work similar to a pair of calipers. On inserting blade B between cam and body and through arms, and then passing cam down on the blade, it will be found to be quite rigid enough for practical work. Figs. 3, 4, 5 and 6 show the application of the tool for various purposes.

Dead Point in Lathe Flywheel.

By A. H. W. NORGATE.

Having been accustomed for some time to a counterbalanced flywheel on a lathe, when I purchased a Drummond lathe I found that the wheel, being constructed to come to rest at a dead point, was to me a source of irritation. The makers explain this by saying that it gives greater evenness in rotation. I constructed the following device in a few minutes, and it has worked admirably



REMEDY FOR DEAD POINT IN LATHE FLYWHEEL.

and will bring the crank over the dead points at all times. The drawing explains itself. It is exactly right for the treadle of a 3½-in. centre lathe; for others, it will have to be adapted accordingly.

A Composition for Grinding.

By C. COVENTRY.

In grinding valves in place on their seats or oscillating cylinder faces, slide valves in the steam chests, and similar work, a very useful preparation has been found in what is known as "R.R." rifle-cleanieg composition. It may be purchased at most gunsmiths in 6d. collapsible tubes. It may be usefully followed by "Matchless" metal polish as a finisher, and saves a lot of time and makes a good clean job.

Fireproofing Woods and Cloths.

A French formula for the fireproofing of woods and cloths consists of sulphate of ammonia, 135 grammes; borate of soda, 15 grammes; boric acid, 5 grammes; water, 1,000 grammes.

Blueing Steel.

A common method of blueing small steel goods by dipping, according to American practice, is to melt saltpetre in an iron pot; then immerse the previously polished and cleaned articles until sufficiently blued; remove and cool at once in paraffin oil, and afterwards dry out in sawdust.

Design for Model Motor Fire Engine.

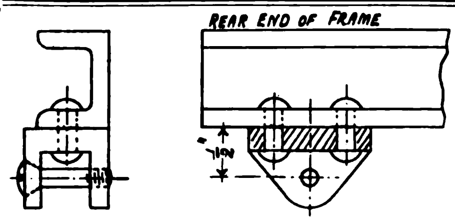
By FRANK FINCH.

(*Continued from page* 8.)

SPRINGS AND FITTINGS.

ACTING upon the principle of doing the simplest things first, the builder of this model, before laying aside the frame, as desciibed in the last article—pending the completion of other parts of the model—should proceed to make the small fittings by which the springs are to be attached to the frame. Details of these, shown full size (Figs. 2, 3, 4, and 5), are given herewith, and but a few words are needed concerning their construction. There are two brackets required for each of the springs carrying the rear shaft—one as shown in Fig. 2, and the other as Fig. 3. These small fittings will be best filed from solid brass or gunmetal, but before filing out the hollow between the lugs the required holes for the pins should be drilled right through whilst there is greater substance to withstand the strain of drilling. Finished sizes are indicated in every case on the drawings. Each fitting should be finished off smooth and clean, and the necessary holes tapped, as shown. The fittings should then be attached to the under side of frame by two ⅛-in. rivets. To secure the rear end of the springs in their respective brackets, two setscrews will have to be made to the size given and having countersunk heads. The bracket for the forward end of the rear axle spring (shown in detail in Fig. 3) has on each side a slot. The spring is held in each of the said brackets by a small bolt and nut. The fittings shown in Fig. 4 connecting the rear ends of the forward springs with the transverse spring are filed up out of the solid in a similar manner to Figs. 2 and 3. Fig. 5 shows detail of the finished forging for the forward end of the front pair of springs. A piece of tube is fitted as a sleeve between the flanges of the main frame, and the bolt is taken right through; this is done for the purpose of rigidity.

Regarding the springs, the designer has endeavoured to adhere to the prototype for appearance' sake, and consequently there will be an absence of resiliency; but this is compensated to some extent by the application of rubber tyres to the wheels, which will be referred to in a future article. It will be noticed by the sketches that it is proposed to build up the springs of laminations, these being strips of steel ¼ in. wide, 3-64ths in. thick, and forged accurately to the curve required, the extremities of each lamination being sharpened off to come flush with its adjacent lamination in preference to leaving the square ends. In the top lamination sufficient length should be allowed for bending over to form an eye at each end for attaching to the fittings described above. The laminations of springs (Figs. 6 and 7) are held laterally in position by the small staple bolts, as shown, and a



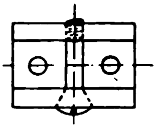
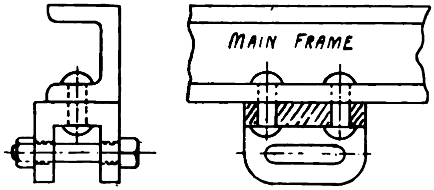


FIG. 2.—TWO THUS FOR REAR SPRINGS. (*Full size.*)



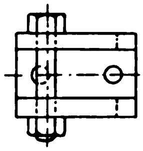


FIG. 3.—TWO THUS FOR FORWARD ENDS OF REAR SPRINGS. (*Full size.*)

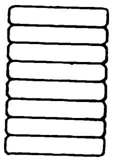


FIG. 9. ENLARGED SECTION THROUGH LAMINATIONS, SHOWING THE CHAMFERING.

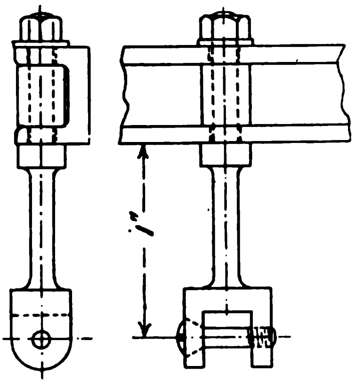


FIG. 4.—TWO THUS FOR FORWARD SPRINGS. (*Full size.*)

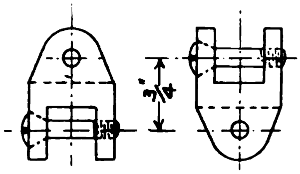


FIG. 5.—TWO THUS FOR COUPLING FORWARD SPRINGS TO THE TRANSVERSE SPRING. (*Full size.*)

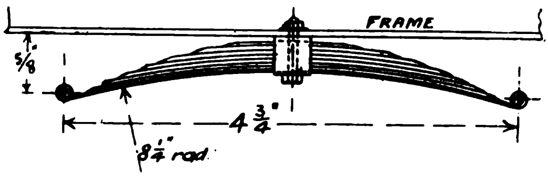


FIG. 8—TRANSVERSE SPRING. (*Half full size.*)

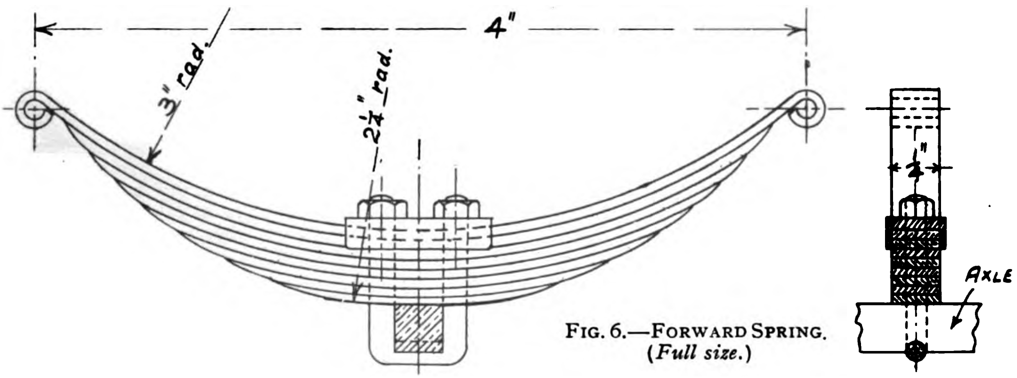


FIG. 6.—FORWARD SPRING. (*Full size.*)

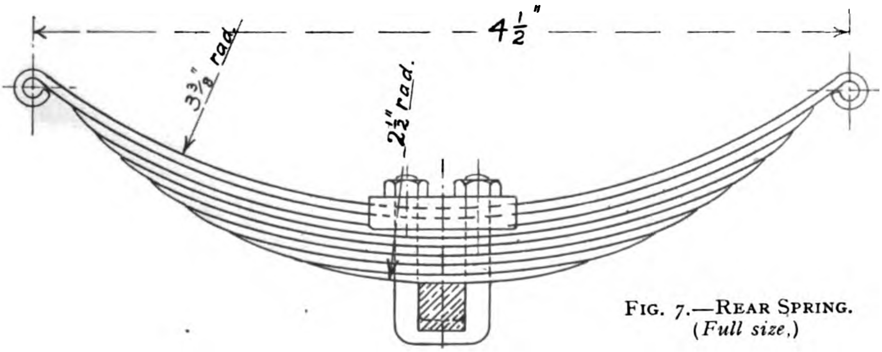


FIG. 7.—REAR SPRING. (*Full size.*)

DETAILS OF SPRINGS AND FITTINGS FOR MODEL MOTOR FIRE ENGINE.

special washer to overlap on two sides. The transverse spring (Fig. 8) has a wide band encircling the body of laminations in the centre, and through this is placed a single bolt, which holds the whole spring to the cross-member of the frame. (See Fig. 1 in the last article). Fig. 9 is an enlarged section of the eight laminations, to show how each edge of the strips should be chamfered; this may be done with a file before bending, and will greatly add to the realistic effect of the spring.

It is perhaps hardly necessary to state that instead of building up, as suggested, a casting in one piece could be used for the "springs" if preferred, from patterns made in accordance with the dimensions already given.

(To be continued.)

Locomotive Notes.

By Chas. S. Lake, A.M.I.Mech.E.

The Capacity of the "Single-Driver."

A correspondent writes as follows: "It seems difficult to reconcile the generally held opinion that the 'single-driver' type of locomotive is unsuitable for the needs of modern railway traffic with the work which is being daily performed on the Midland, Great Western, and other lines by engines of this description. The train by which I travelled northwards just before the Christmas holidays consisted of eight of the latest Midland corridor bogie carriages and two six-wheeled vehicles, with a four-wheeled guard's van next the engine. This load would represent quite 270 tons behind the tender with all aboard, and the weather was such as to hamper the engine in its work, which consisted of hauling this heavy train to Leicester, 99½ miles, in 117 minutes. The engine was one of the 7 ft. 9-in. single-drivers (No. 2,602), with double-bogie tender, and the run was performed in the allotted time apparently without any difficulty whatever. The slight amount of slipping at starting had no effect on the observance of punctuality, and some of the passing times between London and Bedford were better than those I have experienced with the more powerful coupled engines of later design."

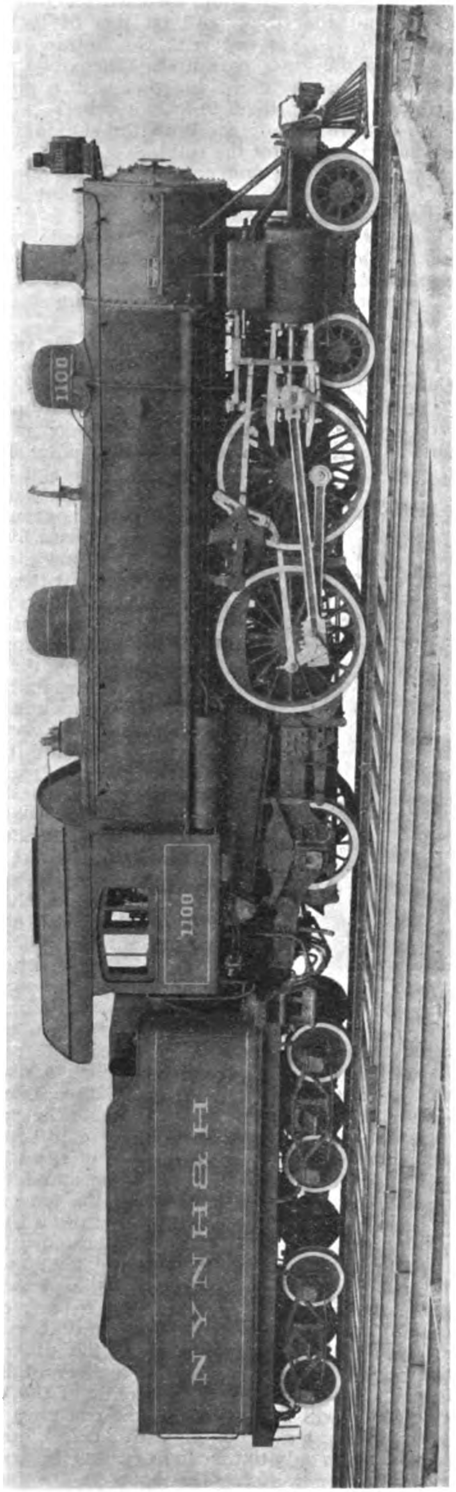
The experience of this correspondent is only what everyone will find who interest themselves in the matter of locomotive performance to the extent of investigating what is daily being done upon our railways. The single-driver type of engine is in reality a highly efficient type, but the efficiency, it must be remembered, gains as the speed increases. It is impossible to place sufficient adhesion weight on one able to make the engine really reliable at starting, and rapidity and certainty in accelerating heavy trains has to be depended upon very largely for the punctual observance of the scheduled timings. In the case referred to by the correspondent, as in many others, the engine made a good start, but the natural tendency for the single engine is to lose time in the initial stages by slipping of the driving wheels, due to lack of adhesion. With cylinders 19½ ins. in diameter by 26-in. stroke, and under 19 tons of adhesion, it would indeed be astonishing if undue slipping did not at times occur, and a thing which is very noticeable with single locomotives is their propensity to slip the driving wheels almost imperceptibly, but nevertheless continuously, when running on up grades. The weak point with these engines is that they cannot be relied upon to give such *average* good results as the coupled types, and with the heavy loads of the present day it is of the greatest moment that only locomotives which are able to do this with regularity should be employed.

A quotation from a well-known text-book on this subject is interesting here. This reads as follows: "The opinion is very commonly expressed that this class of engine (the single-driver) must suffer from lack of adhesion, but this is really not the case, except when starting. A modern engine has generally about 18½ tons on the driving wheels, and with the steam sanding apparatus a co-efficient of adhesion of 450 lbs. per ton can be relied on, giving an adhesive force of 8,325 lbs. At a speed of 25 miles per hour this represents 555 effective horse-power at the rails. Supposing the mechanical efficiency to be 80 per cent., this represents nearly 700 i.h.-p., for which the boiler would be unable to supply steam at such an inefficiently low speed. Hence, at speeds of over 25 miles per hour the adhesion will be ample, and in modern express work the smoother running and greater economy of this type more than compensate for the slight loss at starting.

A New American "Atlantic" Locomotive.

Towards the end of last year the American Locomotive Company delivered to the New York, New Haven, and Hertford Railroad some "Atlantic" type express passenger locomotives which they had built at their Schenectady Works, and of which one, No. 1,100, is illustrated on the opposite page. The design, in all its general features, is similar to that of most American locomotives of the same type, but the employment of Walschaerts' valve gear actuating balanced slide-valves, working on top of the cylinders, helps to distinguish the engine from others of equally recent build. It is one of the most noteworthy indications of the direction which thought is taking in the United States in connection with locomotive engineering—this general adoption of the Walschaerts' valve gear for almost all classes of engine, for the practice hitherto observed in that country on all railways has been to use link motion, with rocking shafts. The Walschaerts' gear is used to greatest advantage in conjunction with outside cylinders, or, rather, it is the best type of gear to carry on the outside of the frames; and as nearly all American locomotives have outside cylinders only, the method is likely, having once started, to find the widest application.

The N.Y.N.H. and H. "Atlantic" locomotive is fitted with a boiler of the coned pattern, having a wide firebox. The total heating surface is large, and there is an ample area of firegrate, while a high working pressure is carried. The cylinders have a diameter of 21 ins. and a stroke of 26 ins. The diameter of bogie wheels is 3 ft., of coupled wheels 6 ft. 7 ins., and of trailing wheels 4 ft. 3 ins. The coupled wheelbase is 7 ft. 3 ins., rigid base 16 ft. 9 ins., and total of engine 28 ft. 2 ins. The boiler, outside first ring, is 5 ft. 7¼ ins. diameter, and it contains 347 charcoal iron tubes 16 ft. long by 2 ins. diameter. The heating surface of the tubes is 3041·3 sq. ft., and



"ATLANTIC" TYPE LOCOMOTIVE, WITH WALSCHAERTS' VALVE GEAR, FOR THE NEW YORK, NEW HAVEN, AND HERTFORD RAILROAD.

in the firebox 185·5 sq. ft. The arch tubes provide a further 27·2 sq. ft., making the total heating surface 3254·7 sq. ft. The grate area is 53·6 sq. ft., and the working steam pressure 200 lbs. per sq. in. In working order the engine, without tender, weighs 90 tons, of which 50 tons (or 25 tons per axle) rest upon the coupled wheels for adhesion. The tender carries 6,000 gallons of water and 24 tons of bituminous coal, and weighs in working order 56 tons, the total weight of engine and tender together and in working order being therefore 146 tons.

THE GREAT NORTHERN AND GREAT CENTRAL AMALGAMATION.

Perhaps *the* event of the English railway world during 1907 was the fusion of the Great Northern and Great Central Railways, the effect of which must be far-reaching and cannot fail to be of benefit to the shareholders of both undertakings. From a locomotive point of view, the "combine" is likely to have interesting consequences, although to outside firms of locomotive builders they are pretty sure not to react favourably. Gorton Works, despite the highly efficient manner in which they are controlled, may be regarded as one thing, and the resources of Gorton and Doncaster combined another. The allotment of the post of chief mechanical engineer had been provisionally settled before the amalgamation scheme was placed before the shareholders, and it will surprise few perhaps if it is found that, so far as active work is concerned, Mr. Ivatt enters upon his well-earned retirement a little earlier than might otherwise have been the case. His has been a most useful career, and during his tenure of office at Doncaster he has done much to uphold not only the reputation of the Great Northern Railway for locomotive efficiency, but also the reputation of the country at large in regard to this branch of engineering.

THE SCHMIDT SUPERHEATER.

As a result of the publication of the article on the Schmidt system of locomotive superheating in THE MODEL ENGINEER, the writer has received a further long and interesting communication from the originator of that system—Mr. Wilhelm Schmidt—who states that it is the intention of the Prussian State Railway Administration to abandon the use of the smokebox type of apparatus, and in future to apply solely, to all new engines, the smoke tube superheater. This decision has been come to because of the latter proving cheaper and just as efficient as the smokebox pattern. Up to the present more than 1,000 locomotives have been equipped, on the Prussian State Lines, with the Schmidt smoke tube superheater, while the total number of engines using superheated steam on the Schmidt system is 2,412, on seventy different railways.

MERCURY spilled on a table or floor is somewhat hard to collect, unless special precautions are taken, owing to its tendency to divide into small globules, which roll away at the slightest touch. If a wet ring is made round the spilled mercury by the aid of a wash bottle or other similar means, it will be found that the globules of mercury cannot readily cross this ring; the mercury can then be collected in a small shovel made from a piece of thin card, or even an ordinary envelope.

Some Exhibits at the N.Z. International Exposition, Christchurch.

By "A Londoner Abroad."

(*Continued from page 587, Vol. XVII.*)

A NEW ZEALANDER who has reason to be proud of his performance is Edgar R. Williams, whose exhibit is illustrated in Figs. 19 and 20. The model in question is an electric "beam" engine; and when it is understood that the designer and builder of this little machine was but 13 years of age at the time he undertook the task, the excellence of the workmanship will be the better appreciated.

This type of model was chosen specially to enable its designer to make a working machine that did not require the use of a lathe; indeed, the list of tools required is such that every amateur may be certain he has at least a similar outfit. The materials, too, are amongst the simplest, as will be obvious from drawings and description.

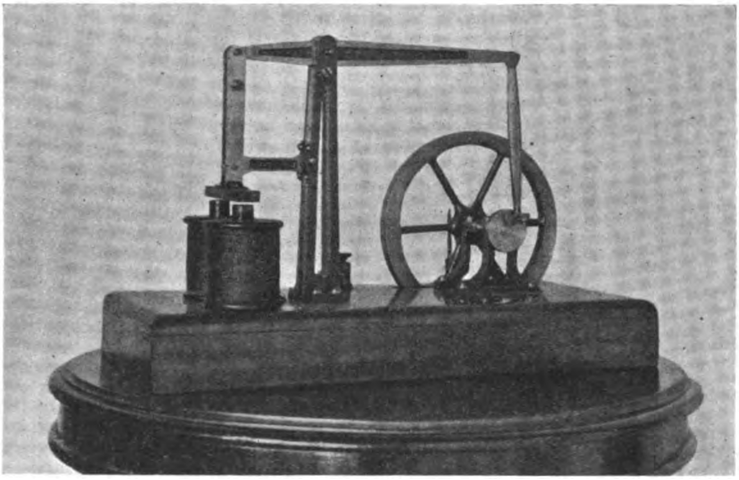


Fig. 19.—Mr. E. R. Williams' Model Electric Beam Engine.

Mr. Williams gives a number of hints to fellow amateurs who may contemplate making a similar machine, and as his views will be of use, particularly to younger readers, I reproduce them in his own words. Commencing with the baseboard, he says:

"The sides can be cut in the mitre-box, thus making a good corner, and if the whole is glued together properly it will require no nails and will be very neat when dressed and sandpapered up with a chamfer on the edge.

The field-magnet should be made of the very softest round iron it is possible to get. Any blacksmith will knock it out while you wait, but be careful that he does not dip it into water. It should be put in the fire and made red-hot and allowed to cool down very slowly in the ashes all night, and in the morning will be very soft. The armature should be dealt with in the same way.

The beam is made from two pieces of ⅛-in. board, 8 ins. long by 1½ ins. wide, fastened together with tacks round the edges, and on this the beam is marked off and cut out with the fretsaw, taking care to do the inner part first. These two pieces of wood should be glued together with a piece of cardboard between them to form a web.

One pattern will do for both the standards and this can be cut out of the solid.

For the bearings one pattern will do, and this can be cut with the fretsaw out of board a little thicker than finished size is required.

The parallel motion rod can be made of two pieces of wood and a piece of cardboard in the same way as the beam.

The connecting-rod can be carved out of a strip of wood with a pocket knife.

The disc crank can be cut out with the fretsaw.

The magnet fastening can be made of two pieces of wood glued together at a right angle.

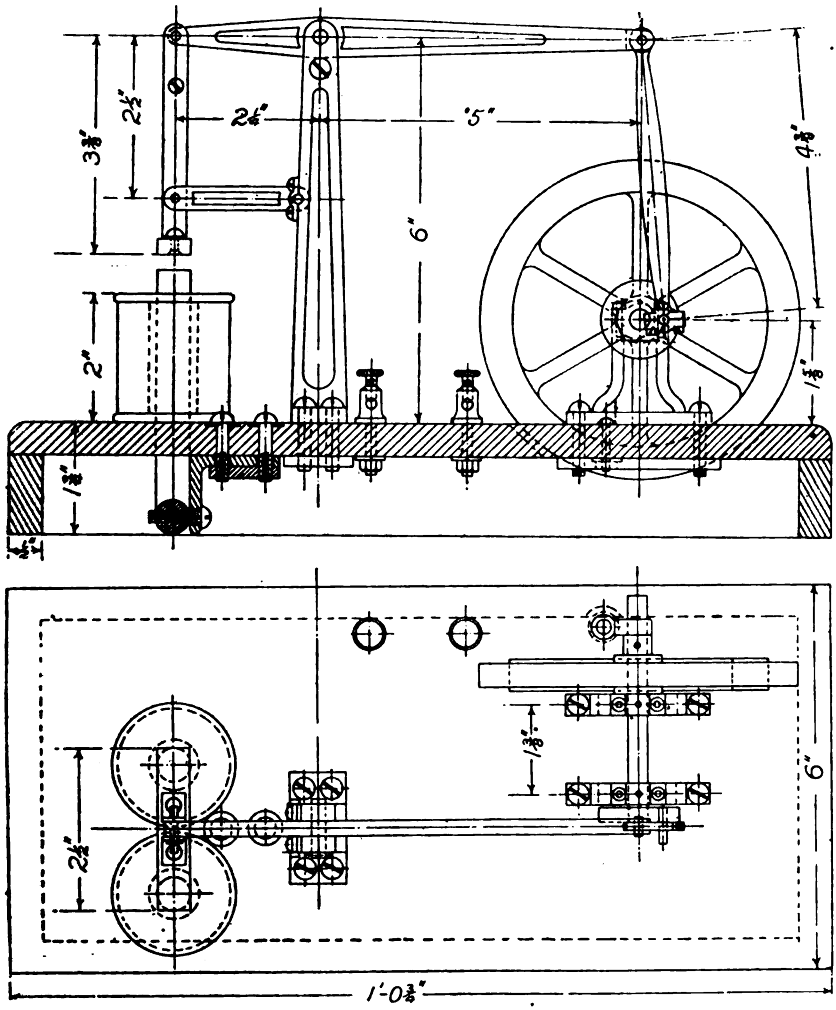
The sides of the beam should be filed by placing it on a board with a thin strip of wood in front of it. The sides should also be filed parallel with each other, and the slot in the end can be cut with a hacksaw and warding file. The standards can be filed on a board like the beam, but the bottoms must be carefully done so that they lean out from each other, and also that, when bolted on, the holes for the beam pin are opposite each other, otherwise the connecting-rod will perhaps press hard against the crank and cause slow and uneven movement, while on the other hand it may come right away altogether. The standards can be drawn together to suit the beam by means of a screw just under the beam. Two strips of 1-16th in. brass bent at right angles and riveted to the armature hold it to the beam, but the holes at the top must be parallel with the bottom of the armature or it will not hang square with the magnet. Of course, the magnet can be adjusted to a certain degree to suit if it should not be quite square. These two strips can be adjusted with a screw to suit the thickness of the beam in the same way as the standards. The pin that holds the parallel motion on to the standards is fastened to the standards by means of two caps made of sheet brass, and, of course, two grooves in the standards to make the caps draw up as shown in the drawing.

The bobbins can be turned up out of twine reels by taking the side handle out of an ordinary breast drill and putting in a setscrew and holding it in the vice; the hole in the reel can be pressed up against the jaws of the chuck and a back centre made of an old bolt or anything else that will suit can be fixed against the hole at the other end, while a T-rest can be made of a piece of board. Now, if someone turns on the handle of the breast drill, which will be horizontal, the reel may easily be turned into a nice bobbin with a chisel, but care must be taken only to take light cuts as the arrangement is not powerful. The holes in the bobbins can now be bored out with a ½-in. bit.

The bobbins should be wound with about No. 22 gauge D.C.C. copper wire, taking care to put the same number of layers on each bobbin, otherwise the attraction will be greater towards one end of the armature and probably cause it to touch and knock. The magnet fastening must have the holes left larger to allow for adjusting as the magnet is not at all likely to come perfectly square and parallel with the armature.

position on the bearings, and mark the holes and also mark the caps, which bearings they belong to and which way they go on, otherwise they may not fit. Now drill the holes in the bearings and tap them and screw two small studs in each. The caps can then be put on, and the nuts put on and screwed down. If the amateur is in possession of a lathe he can make the nuts; if not, he can buy them or use screws. The holes for the shaft can

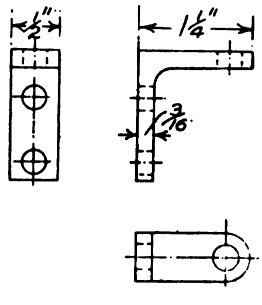
Elevation.



Plan.

FIG. 20.—MODEL ELECTRIC BEAM ENGINE, BY E. R. WILLIAMS.

(*Scale: One third full size.*)



DETAIL OF BRACKET.

now be drilled. The bearings can now be placed against each other on a short piece of shaft or the drill and the bottoms filed up so as to have them exactly the same height, otherwise the shaft will bind. The connecting-rod can be split in the same way. The shaft must be the size of the hole in the wheel, which will be about 5-16ths in.; but if the amateur has a lathe, he can bush the wheel and bore it out smaller so as to be able to use a smaller shaft.

A disc crank can be used if the amateur has a lathe with which he can turn it up, or if he can get someone to turn it up for him; if not, he can make an ordinary crank. The crank can either be shrunk, sweated, or screwed on to the shaft. Shrinking is done by boring the hole a little smaller

The sides of the bearings can be filed on a board in the same way as the beam. They should then be placed against each other and the insides and outsides filed up, by which method they will both be alike. If preferred, the bearings can be split: this is done by cutting the tops off with the hack-saw and then filing them and the bottoms flat; then drill the holes in the caps, place the caps in

than will slip over the shaft, and then making it hot and putting it on to the shaft and allowing it to cool, when it will be tight on. Sweating is done by tinning the hole and the end of the shaft with solder, putting the crank on and melting the solder together. Screwing is done by turning the end of the shaft down and screwing it, and tapping and countersinking the hole in the crank and screwing it tight on and riveting the shaft over into the countersink so as to prevent it from coming off. I recommend shrinking.

The flywheel can be fastened to the shaft by means of two small setscrews, one on each side of the spokes; these should not be too tight or the wheel will run eccentric, and if one is tighter than the other the wheel will wobble.

The contact is worked by an eccentric and spring; the eccentric can either be turned or filed out of brass, and should be about 1-16th in. throw. There should be a light spring from the baseboard pressing against this. The eccentric should have a setscrew so that it can be regulated.

One end of the magnet coil should be connected to one of the terminals and the other end to one of the bolts of the bearings; the current passes up the bearing, along the shaft to the eccentric, and down the spring and along a wire to the other terminal. All wires should be under the baseboard.

With regard to setting the eccentric, if the spring is placed on the side the bobbins are, the wheel will run backwards, and if on the other side it will run forwards. The eccentric should be in such a position that it will touch the spring just as the crank comes over the bottom dead-point, and cut off by leaving the spring just before the crank comes to the top dead-point. The spring should not be too stiff but very springy, or else it will not come back to its proper position after the eccentric has passed over it, and if it is too stiff the machine will not travel nearly so fast.

Painting and polishing can be done to the taste of the amateur. In my model I painted the bobbins with red sealing-wax dissolved in methylated spirit; the baseboard I varnished, the armature and ends of the magnet I painted black, and the bearings (except the tops) and the spokes of the wheel, and the inside of the beam, etc., brown. All bright brasswork—such as the beam, disc crank, connecting-rod, bearing tops, brass strips on the armature, etc.—I lacquered. This is done by first polishing up well with emery-cloth using very fine towards the last, and then brilliantly shine; but be careful and do not touch them with greasy fingers after they are finally polished. They should then receive one coat of lacquer, cold, one sweep of the brush (not half-a-dozen, until it gets tacky and the bristles come out of the brush). They should then be heated just hot enough to bear on the back of one's hand and receive one more coat of lacquer. The lacquer should not be heated.

When it is all finished and painted up it is a very pretty little model and runs at quite a speed off four bichromate cells or three accumulators. It is not a powerful model no matter how large it is, because all the power is lost in the beam in order to get a large stroke and a very small travel for the armature, so that when the latter is on top position it is not beyond the range of attraction of the magnet.

For this exhibit I received 'Commended,' but possibly I should have got more had I put with it a description and my age, as did some of the others."

(To be continued.)

Following the negotiations between the English and German authorities as to the position of the Plimsoll mark on vessels, it is stated that Germany will practically adopt the English system of measurement.

Engineering Works and Accessories for Model Railways.

By E. W. Twining.

(Continued from page 88.)

The next tunnel on the North Western of which I have made drawings is Kilsby, distant 76 miles from London, the ends of which are shown in elevation in Figs. 14 and 15, and in section in Fig. 14*a*. Here we are back to the heavy mediæval style of architecture which we had in some of the Great Western tunnels; indeed, the top of the masonry, the

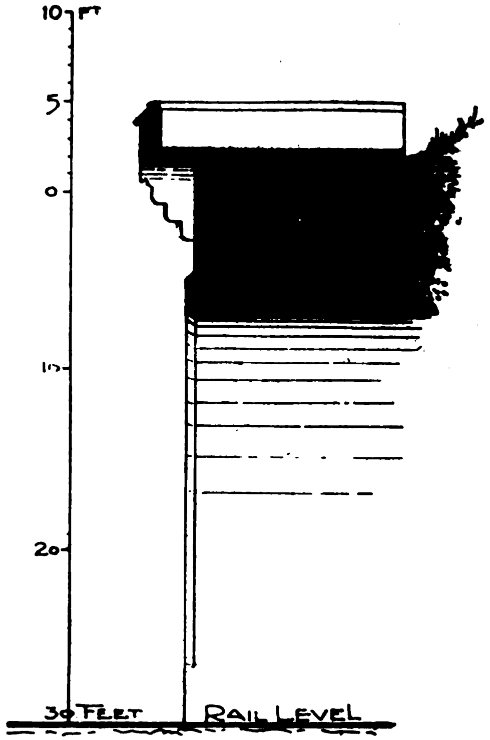


Fig. 14*a*.—Cross-section of Kilsby Tunnel End, L.N.W.Ry.

parapet wall carried upon multiple corbels, is very similar to the Great Western No. 2 tunnel. Examples of this form of building construction are to be found in the castles of the Middle Ages in different parts of the country and on the Continent. It is an outstanding feature in the Castle of Chillon, Lake Geneva, Switzerland; and is most marked in the Castle of Warwick and Conway Castle, North Wales. The same characteristic was copied by Robert Stephenson in the piers of his tubular bridge at Conway.

The masonry fronts of Kilsby tunnel, though very fine, especially the one with wing walls, seem small by comparison with the Great Western tunnels, when we consider that the total height to the top of the coping of Kilsby is approximately

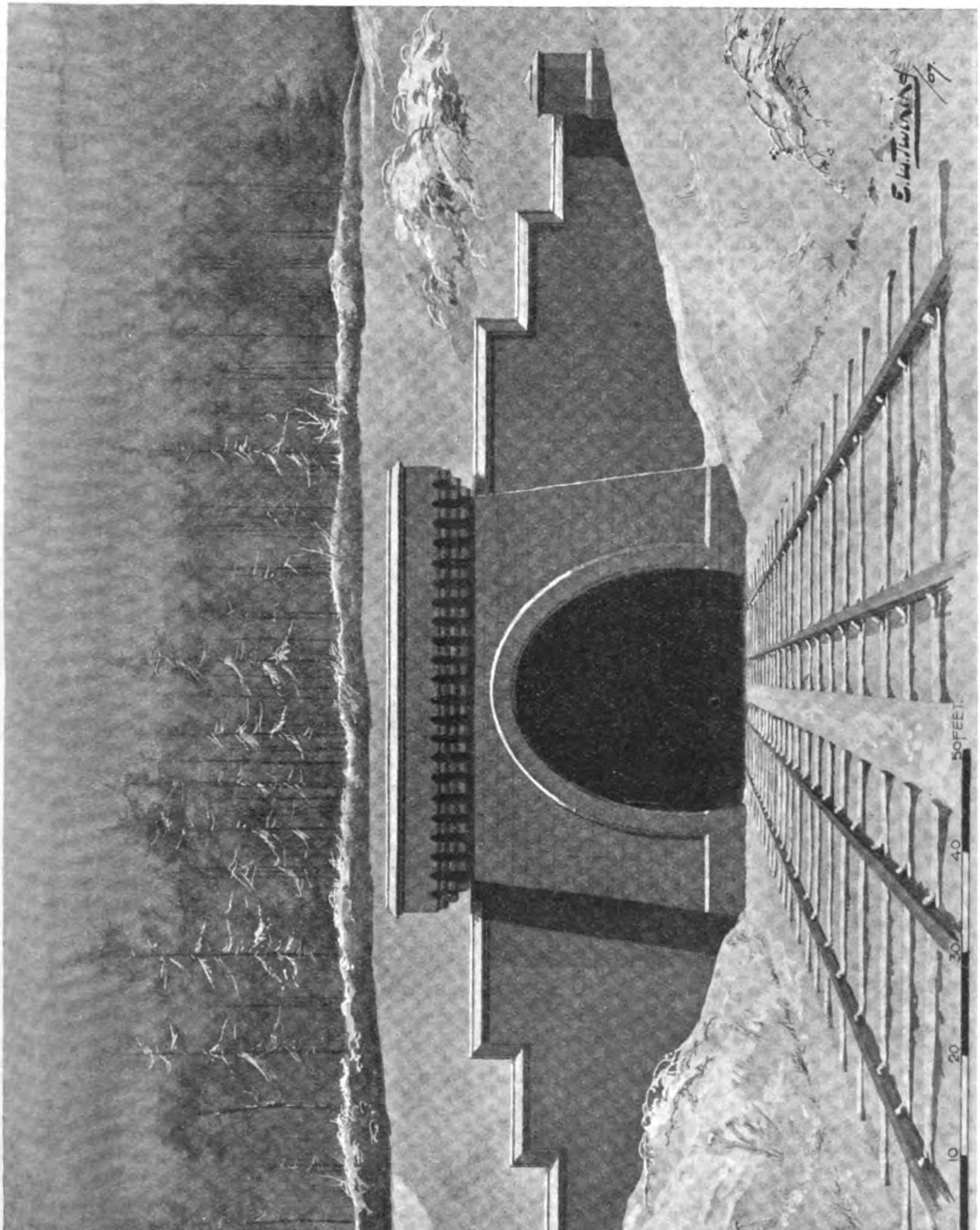


Fig. 14.—Southern End of Kilsby Tunnel, L.N.W.Ry.

the same as the clear height of the arch in the Great Western examples I have given, viz., 35 ft. So that were models of Kilsby and, say, Brislington Long Tunnel made, it would be found that one would pass edgeways completely inside the other.

Kilsby tunnel has an opening 24 ft. wide and 23 ft. high above rails, and a total length of 2,398 yds. It was cut through oolite and shale, and was let to the contractor as such; but a bed of running sand (quicksand) was encountered, extending for 450 yds. in length between the shafts under a bed of clay 40 ft. thick, which the trial borings had escaped. When this was pierced, such a deluge of water and sand came down that the men had to swim for their lives. Special pumping plants of 160 h.-p. each had to be erected to clear this away. As a consequence the cost, which was estimated at £40 per lineal yard, became nearly £130, about £30 per yard more than Box tunnel. Kilsby tunnel was built by means of eighteen working shafts, of which ten remain for ventilation.

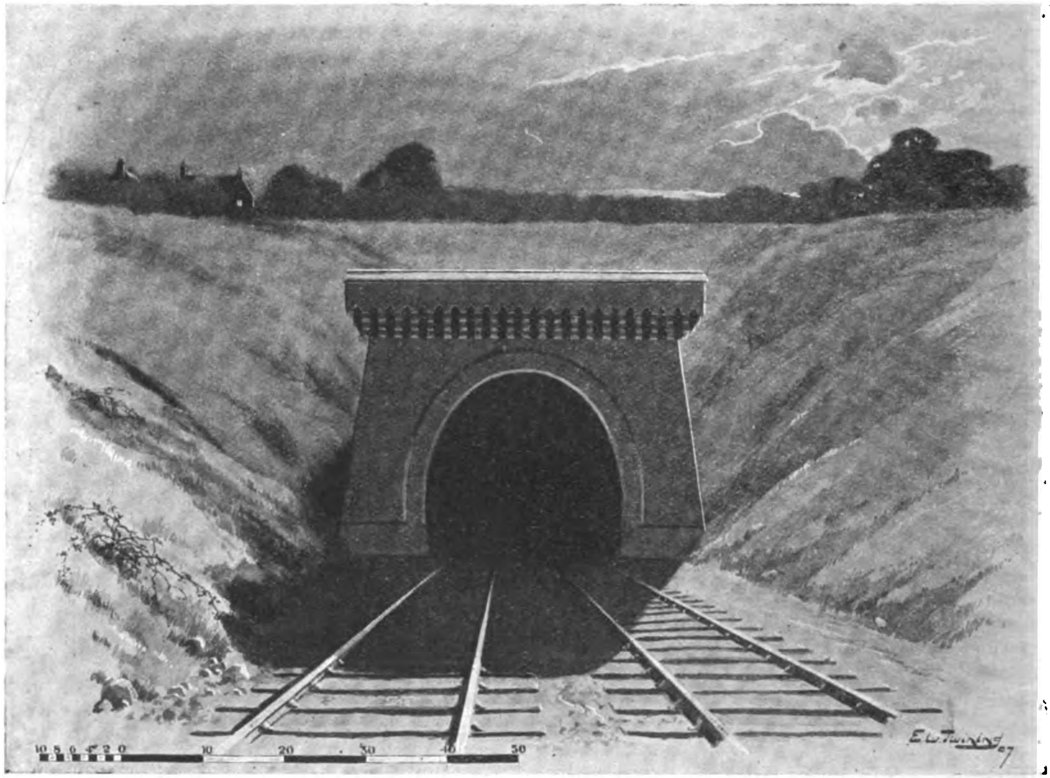


FIG. 15.—NORTHERN END, KILSBY TUNNEL: L.N.W.RY.

NEW NAVAL INVENTION.—An improved fire-control apparatus for warships has been invented by an engineer officer in the Navy. If the trial is successful, the existing methods of fire control will be completely changed, as the new invention does away with the exposed spatting station on the mast.

For the Bookshelf.

[Any book reviewed under this heading may be obtained from THE MODEL ENGINEER *Book Department, 26–29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.]*

ENGLISH PRICES WITH FRENCH EQUIVALENTS. By Hugh P. McCartney. London: E. & F. N. Spon, Ltd. Price 1s. nett; post free, 1s. 1d.

A little book that will be found useful by those who have to do with the transaction of business between English and Continental merchants. Rates per lb. and equivalents per ton in English are given, with equivalents in francs (gold) per 100 kilos, calculated at seven rates of exchange. The book is a very suitable size for the pocket, measuring only 4 ins. by 3 ins.

THE use of artificial graphite is on the increase. The quantity manufactured in 1906 amounted to 5,074,757 lbs., valued at £67,441, which is the largest quantity produced in any year since its first introduction in 1897. Of the total output 2,766,000 lbs. were ground to a fine powder, and this product was valued at £18,915. A process has recently been developed for treating artificial graphite with tannin. The resulting deflocculated graphite is claimed to be adapted especially for use in lubrication, with either water or oil as a vehicle

Chats on Model Locomotives.

By H. Greenly.

(*Continued from page* 80.)

The "Universal" Motor for Model Locomotives.

No apologies are required in introducing as a subject of an article the description of some device which obviously satisfies an urgent demand. As I have before mentioned, the limitations of the ordinary traction motor are keenly felt when the modelling of electrically driven "steam" locomotives is attempted. In addition, the many advantages of electric locomotives over steam models do not weigh with a large number of model engineers unless means are provided of reversing as well as merely controlling the speed of the locomotive from the track. The sport soon becomes tame if the only thing that can be done, short of following the locomotive up and down the railway, is to run it in any pre-determined direction. With an efficient automatic reverser an engine can be controlled in a life-like manner without the operator having to move from his station. The accompanying photograph shows a complete motor and reverser, kindly lent me by the makers, Messrs. W. J. Bassett-Lowke and Co., of Northampton. This motor was taken from the 2-in. gauge model L.N.W.R. "Experiment" locomotive exhibited at Dublin last year, where it worked daily for a period of over five months without a failure of any account. The design of the motor was the outcome of much "mental experiment" (if this term may be allowed) on the part of the writer and of the no less necessary practical experiments conducted by Mr. G. Winteringham, of the above firm; and although I may be considered as being somewhat biassed in my opinions, I think that the design provides a motor of the maximum size and power that can be put into a model of an express locomotive.

The advantages of the motor over most of the designs already described are as follows:—

(1) Compact cylindrical form, enabling it to be completely hidden in boiler and firebox.

(2) Large diameter armature for given rail gauge and size of boiler in which it is placed ($1\frac{3}{4}$ ins. diameter armature for 2-in. gauge locomotive). The size of the motor and armature is limited only by boiler diameter, not directly by the gauge.

(3) Universality of application. The motor can be applied just as readily to an eight-coupled coal engine as to a model of a single express locomotive.

(4) Closed magnetic circuit.

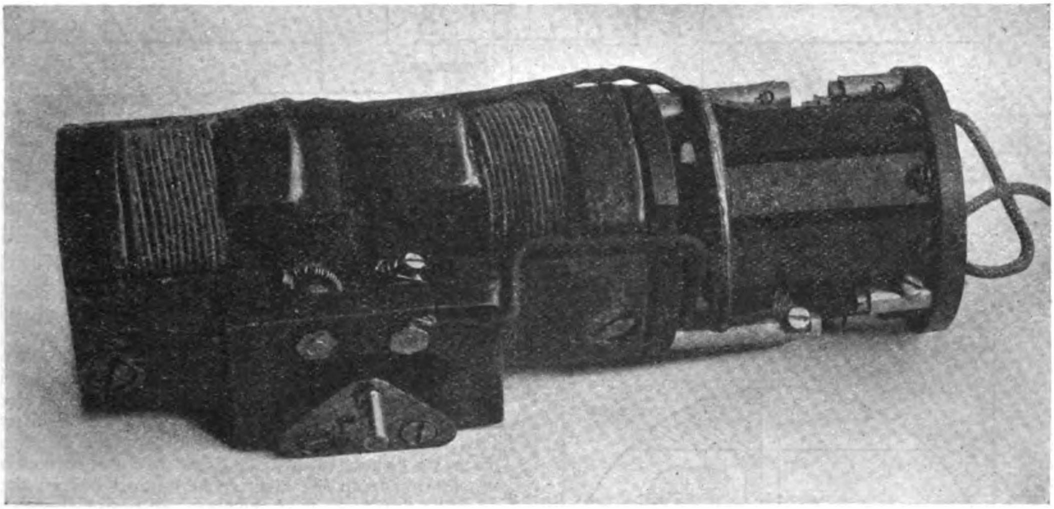


Fig. 1.—Showing the Universal Electro-motor for Model Locomotives, with Automatic Polarised Reversing Switch attached.

The reverser is cylindrical, the same as the motor, and fits on the end of the motor, so that the whole of the operating mechanism is hidden in the boiler out of sight and is put in position in one piece with only a single wire coming out from it to the current collector, as shown in the photograph.

The general proportions of the motor are shown in the sketches herewith. The field-magnet consists of four pieces of cast iron—the two combined pole-pieces and ends, and the top and bottom caps. The section of the top cap is in shape like a sector of a circle, but the bottom limb is only of this shape at the two ends. In the centre it is rectangular and is stepped down to allow space for the commutator and brush gear.

The castings having been obtained, the first thing to do is to face the four joints accurately and fit the fixing screws (3-16ths in. iron or steel countersunk). The magnet may then be rigged up on the faceplate, and the armature tunnel bored out and the hole for the brass bearing bush drilled at the

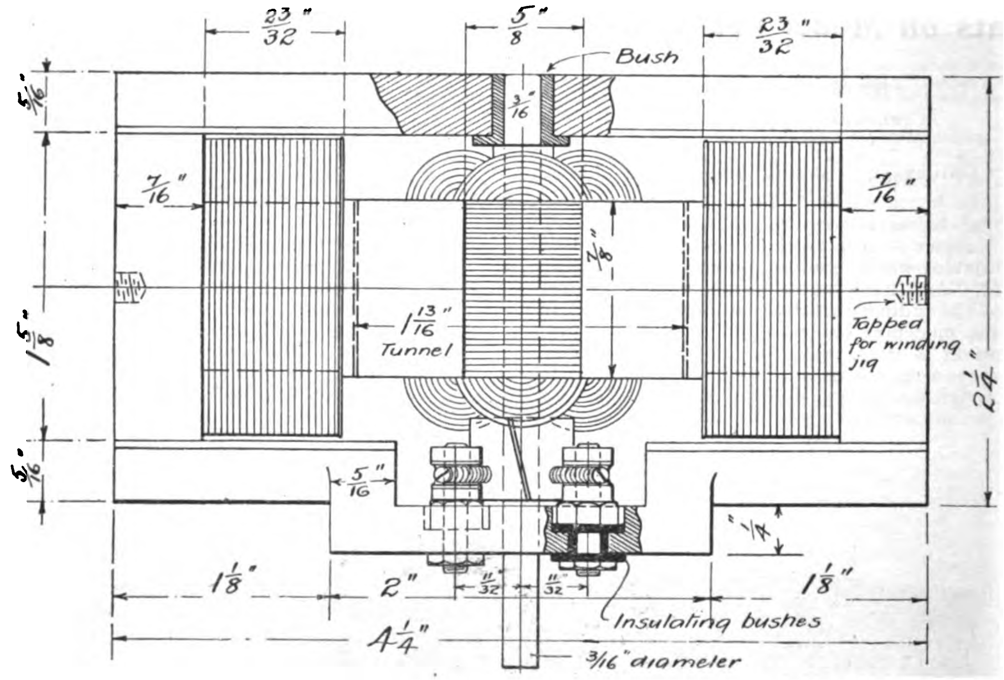


Fig. 2.—Elevation.

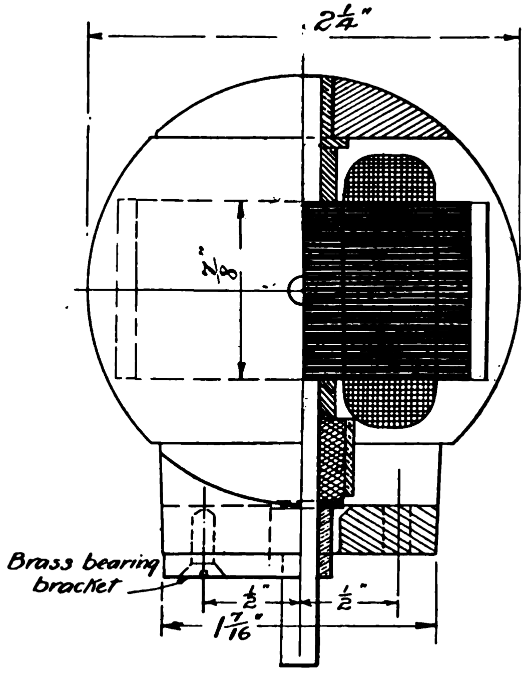


Fig. 5.
Half End View. Half Section

one setting. Before placing in the lathe, a couple of steadying pins in the joints of the top cap and pole-pieces will assist to preserve the alignment of the motor, or if it is thought preferable two screws may be used instead of the single fixing shown in the drawings. The bottom limb may then be put on again and faced square with the axis of the armature. This may, if the fixings of the magnet to the face-plate or chuck allow, be done without removing the casting from the lathe, a facing cut being taken over the flat bottom of the cap. When lathe work is completed the magnet may be removed and any rough places cleaned down with the file, so that it will fit in the boiler tube for which it is intended.

The casting should also be filed away at the joints of the caps and ends, as shown in sketch (Fig. 4), to allow the wires to pass to and from the reverser. Three wires are necessary and, therefore, three passages should be formed in the end of the motor nearest the reverser.

The bearing bush at the top is driven into the magnet to a shoulder and is bored 3-16ths in. diameter. The bottom bearing is of gun-metal and is of ample dimensions—another feature of this motor. It is screwed with two screws on to the lower face of the bottom limb or cap, and if the joint face of the bearing is machined in the lathe from the circular portion or bore, accuracy in the setting up is assured, and, what is more important than all, the armature can be fitted into the tunnel with the minimum air-gap. Obtain the correct position of the bottom bearing, the armature should be built up and the bearings fitted to the shaft. Then with a piece of paper wound once or twice round the armature the whole motor

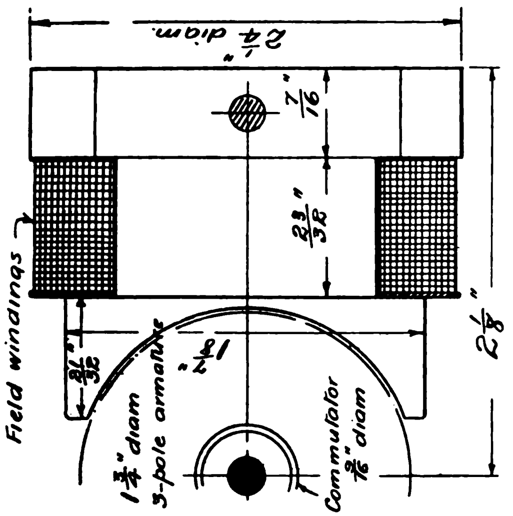


Fig. 4.—Plan of Pole-pieces, showing Winding Space.

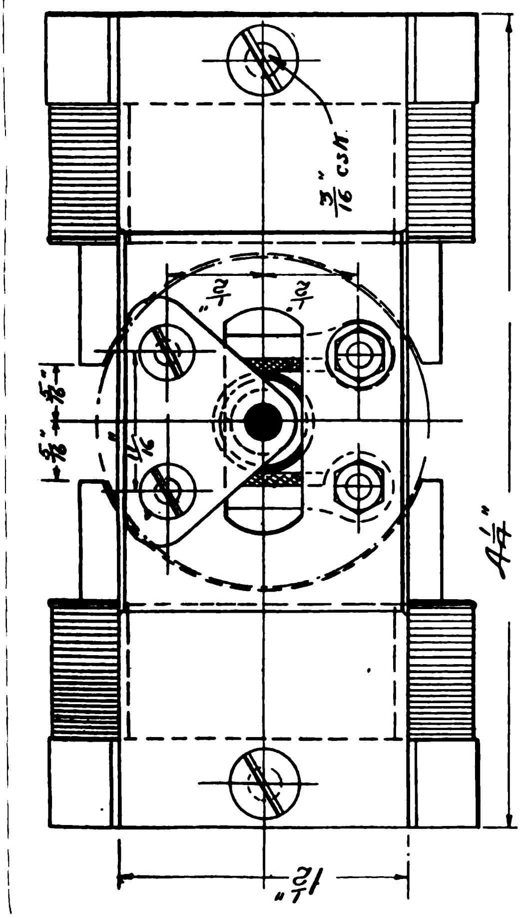


Fig. 3.—Plan of Underside.

The Universal Electro-motor for Electrically Driven Models of Steam Locomotives. (*Scale: Full size for 2-in. gauge locomotive.*)

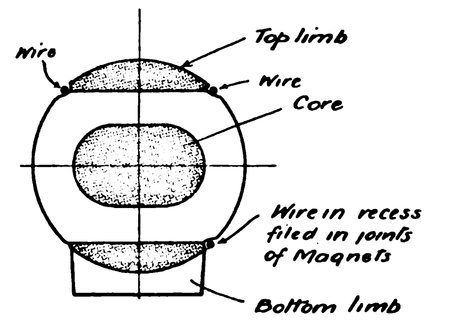


Fig. 6.—Sketch showing Recesses in Field-magnets for Leads to and from Automatic Reverser.

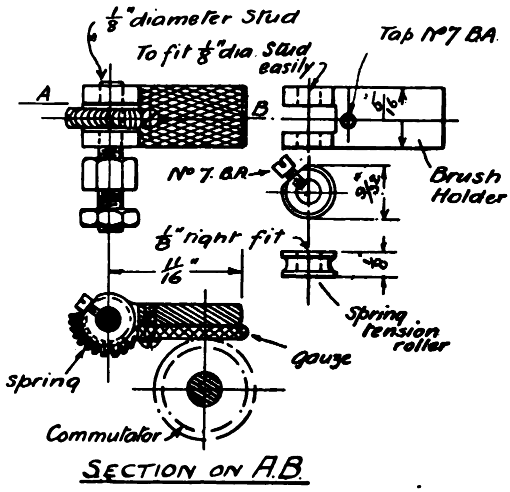


Fig. 7.—Brush Gear.

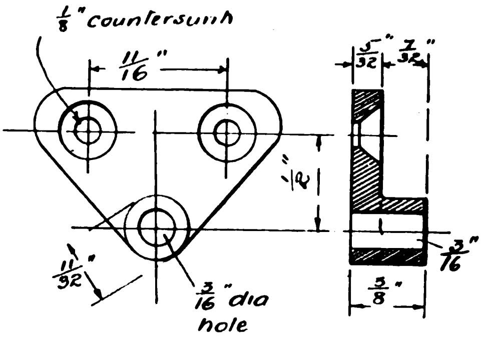


Fig. 8.—Bottom Bearing Bracket.

may be put together and the bottom bearing fitted in place. If there is any tendency for the fixing screws of the bottom bearing to bind the bearing on the armature spindle, then the error should be located and the face of the bearing or magnet limb scraped down until the two bed together accurately.

The field-magnets may be wound on the lathe, either between centres, on a screwed stud, or by holding the circular portion in the chuck, No. 24 S.W.G. cotton-covered wire being used for series wound motors working from 8 to 10 volts.

The armature is of the tripolar pattern, built up of soft iron laminations and, as I have advised heretofore, the end windings should extend beyond the edge of the pole-pieces, a state of things possible in this particular type of motor.

The commutator is of the plain cylindrical type with flat "wipe" brushes. The brush gear provides for wear and the amount of pressure is adjustable. It consists of two brass terminal studs fixed in the bottom limb of the field-magnets, one of these studs being in short circuit with the motor and, therefore, with the frame of the locomotive. To ensure perfect contact, it may be connected by a short wire to the bottom bearing bracket, or, if desired, to the frame of the locomotive. On these are fixed the brush holders and the spring collars. These spring collars are fixed by a setscrew which grips the stud and they are also channelled for the tension spring. The brush holders are faced by copper gauze. The armatures may be wound with No. 26 S.W.G. single cotton-covered wire. I must point out that all trading rights in connection with this design of motor have been covered in the Patent Office, and now belong to the above firm.

(*To be continued.*)

How to Become a Mechanical Engineer.

By ALFRED W. MARSHALL, M.I.Mech.E., A.M.I.E.E.

(*Continued from page* 86.)

PREMIUM pupils or apprentices are not received by Messrs. The Campbell Gas Engine Company, Ltd., Halifax, England, under any conditions, but they admit apprentices without payment of a premium. These are paid wages of 5s. per week to commence and 15s. per week under normal conditions. The latter figure is at times increased if the apprentice shows sufficient ability to warrant it.

Messrs. Fielding & Platt, Ltd., Atlas Works, Gloucester, take about a dozen premium pupils per annum. They also take apprentices without premium, the number varying according to the state of trade. Pupils are required to pay a premium of £75 per annum for a term of four years, to be divided between turning, fitting, pattern-making, and the last year in the drawing office. One month's trial is required before signing indentures. Wages are paid at 5s., 6s., 7s., and 8s. per week each year respectively. Apprentices learn one branch of the work, namely, turning, fitting, pattern-making ing, moulding, or drawing office. The term is seven years. Wages are paid at 4s., 5s., 6s., 7s., 8s., 9s., and 11s. per week each year respectively. One month's trial without wages is required before signing indentures. The work consists chiefly in making hydraulic machinery and gas and oil engines, but is of a very varied character.

Messrs. John Fowler & Co., steam plough and locomotive works, Leeds, take three classes of premium apprentices as follows:—First-class apprentices shall keep the regular hours of the shop, failing which, they render themselves liable to be discharged without notice and forfeit the premium paid. They will be moved from one shop to another in rotation as per schedule: pattern shop, 6 months; foundry, boiler shop or smiths' shop, 3 months; fitting shop, 6 months; erecting shop, 9 months; drawing office, 12 months. Terms of engagement, not less than three years. Premium, £120 per annum, paid in advance. Second-class apprentices shall keep the regular hours of the shop as in first class, and will be removed from one shop to another when the Company consider them fit for the change. They will be put in the drawing office should they be considered suitable. Terms of engagement, three years. Premium, £80 per annum, paid in advance. Third-class apprentices shall keep the shop hours as in first class. They will only be removed to another department as it suits the Company, and will not be taken into the drawing office. The term of engagement is for three years, and the premium £50 per annum, paid in advance.

Messrs. Johnson & Phillips, Ltd., engineers, electricians and contractors, Victoria Works, Charlton S.O., Kent, receive premium pupils and apprentices. They do not admit non-premium apprentices. The first-class pupils are sixteen years of age and upwards, to learn the profession of electrical and telegraph engineering and cable making by a three years' course; the premium is fixed at 300 guineas for the complete course, payable in advance. Pupils pass through the various workshops, testing rooms, drawing offices, and estimating departments, and are also free to learn the commercial part of the business at the London offices of the firm. A professor is specially engaged to give theoretical instruction to the pupils concurrently with the practical course. Premium apprentices enter for a three years' course, and are allowed to choose any two workshops of any department, and, if deserving, are given a period in the drawing office also. The premium required is £100 for the course. Departments are: electrical machinery, switchgear, cable-making, junction box, arc lamps, telegraph instruments, cable making machinery, submarine cable gear, contract department, and general engineering department. The average number of vacancies is two per annum.

Messrs. C. A. Parsons & Co., Heaton Works, Newcastle-on-Tyne, take a very limited number of premium apprentices, but vacancies rarely occur. They also take ordinary apprentices. The names of applicants are entered on a list and vacancies filled as they occur.

Messrs. John I. Thornycroft & Co., Ltd., Church Wharf, Chiswick, London, W., enter technical apprentices and trade apprentices as opportunities occur. The first-named are required to pay a premium of 300 guineas and serve a term of three years. They must be young men of good character who have studied for at least three years at some approved technical college in the United Kingdom, and who can produce certificates of good conduct and proficiency from the engineering professor of such college; also a medical certificate from an approved physician or surgeon as to general health and working ability. Wages will be paid at 12s. per week during the period of three years. Trade apprentices are entitled to learn any of the following trades: fitters and turners, platers and riveters, blacksmiths, carpenters, pattern-makers, coppersmiths, and moulders. No premium is required except for fitters and turners; in this case a premium of £50 must be paid. The term of apprenticeship for any trade is five years. Wages are paid at the rate of 4s. 6d., 6s. 9d., 9s., 11s. 3d., and 13s. 6d. per week for each year respectively. Applicants are to be youths of good character and fair education, between the ages of 15 and 16 years, who can produce certificates of good conduct and general health, and who can pass a physical examination by the medical adviser to the firm. Names of applicants for either form of apprenticeship will be entered in the order received, and selections made for a month's trial when vacancies occur, but no promise is made that any applicant will be selected. The work done is the manufacture of marine motors, and motor vehicles for commercial purposes. The shipbuilding work has been transferred to Southampton: these particulars only apply to the Chiswick Works.

Boy Artificers in His Majesty's Navy. A limited number of boy artificers will be entered annually for training for the rating of engine-room artificer in the Royal Navy. Candidates must be sons of British subjects, and between the ages of 15 and 16 years on January 1st for entry in January; May 1st for entry in the August following. They must be in good health and of sound constitution, and will be medically examined at the Admiralty, 7, Whitehall Place, London, or at a naval port or establishment, or recruiting office, or on one of His Majesty's ships which will be selected by the Admiralty as near as possible to their place of residence. They must also produce certificates that they have been re-vaccinated, or be re-vaccinated before they can be considered eligible for entry. Candidates are admitted by open competition or on the recommendation of certain Naval Commanders-in-Chief on account of service claims, or on the recommendation of certain education authorities. Boy artificers will be permitted to select, subject to the requirements of His Majesty's Service, which of the four trades of fitter, boiler-maker, engine smith, or coppersmith, they will follow. Opportunities will be afforded them of obtaining an insight into the trade they do not select, and also of making working sketches so as to fit them to carry out all the duties of an engine-room artificer in His Majesty's Navy. The duration of training will be about four years. During this period the boys undergo a course of

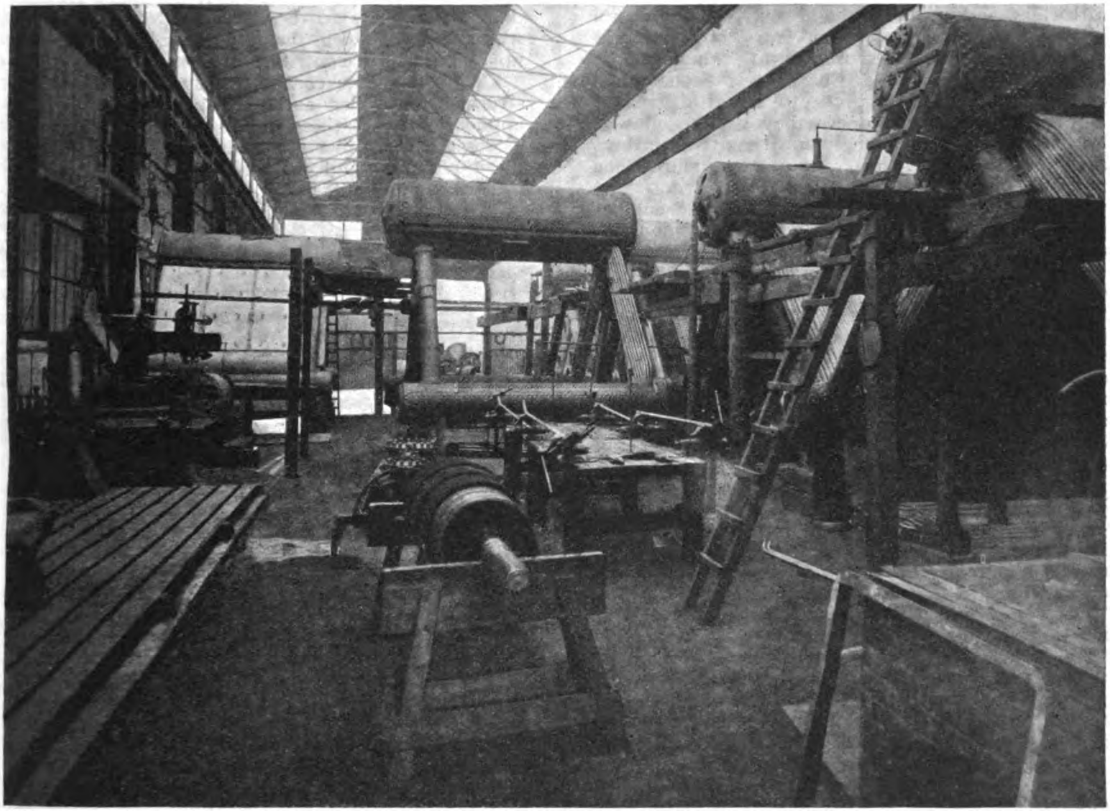


FIG. 7.—ONE BAY OF BOILER SHOP: MESSRS. J. I. THORNYCROFT'S SOUTHAMPTON WORKS.

general and technical education, in addition to workshop training. In the first two years they will receive instruction in practical mathematics, English, elementary science, heat, etc. Those who qualify, by examination, will then be permitted to take the second part of the course, which comprises applied mechanics, workshop appliances, electricity, marine engines and boilers, and mechanical drawing. Boy artificers who fail to pass in either the first or second course will be discharged, as a rule, unless special circumstances should justify their retention, when they will be re-examined after a further period of training. Those who qualify will be rated engine-room artificers, fifth class, and sent to seagoing ships for one year's practical sea experience. On entry boy artificers will be provided with a free outfit; they will be berthed and victualled at Chatham or Portsmouth, and subject in all respects to naval discipline. Under certain circumstances they will be allowed leave to stay at their homes on alternate Saturdays and Sundays. Daily rates of pay are allowed as follows: first year, 6d., second year, 7d., third year 8d., fourth year 9d.; on being rated engine-room artificer, fifth class, 3s.; acting engine-room artificer, fourth class, 5s. 6d.

Naval cadets enter the Service under identical conditions, and are trained together until they pass for the rank of lieutenant. After passing they may be required to serve either as general service officers or in one of the special branches, undertaking either engineering, gunnery, torpedo, navigation, or marine duty. Copies of the regulations for entry of Naval cadets and boy artificers may be obtained by application to the Admiralty, Whitehall, London.

Part of a boiler-making department is shown in Fig. 7. The work done in this instance is a speciality, viz., making patent water-tube boilers. This kind of boiler is now very much used, in various patterns, for both marine and stationary work. That in the photograph consists of a cylindrical part at the top made of steel plates riveted together and two similar, but much smaller, cylindrical parts at the bottom. The top part is joined to the lower by a pair of large steel tubes at one end and by a very large number of small curved steel tubes. The central boiler in the picture has the large tubes and a few of the small tubes in position. At left and right of the picture are more of these boilers nearer completion, with all the small tubes fixed in place. The work of making the top and bottom cylindrical parts consists largely in cutting, bending, and riveting the plates and is boiler-making, as the term was formerly understood to mean. Fixing the small curved tubes involves a great deal of drilling and fitting, such as would formerly be understood as fitters' work. Many boilers of the older patterns are still made, but the art is becoming broader, and, as the illustration indicates, a modern boiler-making workshop is almost as much a fitting workshop as an engine fitters' department. Boiler making thus at the present time is a branch of mechanical engineering of increasing interest, the design of boilers requiring a higher order of scientific knowledge and engineering skill than formerly and having wider possibilities. It is very far from being a mere matter of riveting together iron plates of ample thickness, as determined by rule-of-thumb. The Thornycroft water-tube boilers represent the reasoning of a scientific mind of high order; they are a remarkable example of engineering genius.

(To be continued.)

The Construction and Repairing of Motor Bicycles.

By "SREGOR."

(Continued from page 389, Vol. XVI.)

BEFORE attempting the continuation of this subject, the writer feels it necessary to offer an apology to those readers of the journal who are interested in the articles for failing to keep up a more regular contribution recently.

The last articles contained remarks on the construction of roller and ball bearings and their applications. As these details are not so common as some of the other motor details, I will continue these remarks, and in doing so I shall trespass somewhat on details of car construction to illustrate

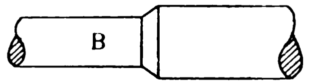


FIG. 86.

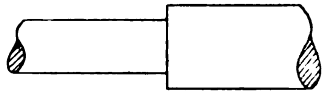


FIG. 87.

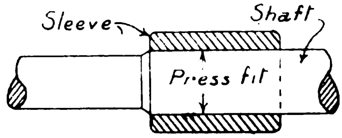


FIG. 88.

the points in question; but, as soon as the various details of the motor bicycle have been dealt with, I propose a continuation, with remarks on details of motor tricycles and car construction, so that these remarks on ball and roller bearings will not be so much out of order.

The last paper and sketch showed a suitable roller bearing for the main bearing of the ordinary motor bicycle engines, as shown in Figs. 79 and 85. Fig. 79 shows the journal of the crank in contact with the rollers. I would mention here the advisability of using a good mild steel for the shaft, and carbonising same to form the necessary hardening surface for the rollers to run upon. The special feature of the mild steel shaft is the fact of being able to form the necessary hard surface, at the same time retaining the soft and tough nature of the steel at the centre. These combined features form an ideal shaft, which is subjected to much vibration and shock. By using the ordinary cast steel and hardening right throughout the shaft, is taking great risk of forming small cracks, which soon develop when subjected to shocks. It is advisable, when using a roller bearing shaft, to make the design as shown in Fig. 86. This design offers at least two distinct advantages—it provides a distinct amount of surface to be ground to size after hardening, and allows the clearance part, shown at B, to pass through the bearing readily. When assembling the parts together. it is advisable to form this part where the two diameters differ, as shown in Fig. 86, and not as shown in Fig. 87. This method offers two advantages—it breaks the differences between the two diameters more gradually, and consequently very materially strengthens the part; and it also forms the necessary gradual taper which makes it comparatively easy to enter the shaft into the bearing when assembling, as it should be remembered that the bearing must be a good fit without any shakes.

Another advantage of the two diameters is the fact that should the journal require re-turning, the shaft can be softened and the old part of journal turned down to receive a sleeve, as shown in Fig. 88. In fact, this method of construction is advisable to adopt in the original designs in the case of using a roller bearing on the larger size of cranks, such as is used on a car engine, when it is required to keep the other parts of crank soft. The first process for the bush should be to turn the diameter to about ·005 in. of finished size and leave the length about $\frac{1}{8}$ in. over finished size, leaving the centre solid. The sleeves can now be carbonised, after which it must be set true in lathe and bored to a press fit size for shaft; or, if facilities are at hand, leave a small amount to grind out after hardening; then either press on to the shaft and grind diameter, or grind diameter on a mandrel, then press on to shaft. This ensures the hardened journal being true with the crank without putting it into the fire.

The bush, as shown in Fig. 79, is made in a similar way, only that the necessary hardened surfaces must be in the bore instead of the diameter, this being, of course, the part which receives the wear.

(*To be continued.*)

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

FUTURE MEETING.—The next meeting will be held at the Cripplegate Institute, Golden Lane, on Tuesday, February 25th.

VISITS.—On Saturday, February 15th, at three, the motor works of Messrs. D. Napier & Sons, at Acton, will be visited. On Wednesday, March 4th, the Bow Works of the North London Railway will be visited. On Thursday, March 26th, the Stratford works of the Great Eastern Railway will be visited.

Full particulars of the Society, and forms of application may be obtained from the Secretary, HERBERT G. RIDDLE, 37, Minard Road, Hither Green, S.E.

Provincial Society.

Leicester.—A meeting was held at the Rutland Coffee House on Friday, January 17th, with the object of forming a Model Engineer Society. There was a very good attendance, and twenty-two were enrolled as members of the Society. The business of electing Chairman, Secretary, and Committee was gone through, and a few exceptionally good models were exhibited. Owing to lack of time, however, discussion on them had to be postponed to the next meeting, which will be held on Friday, January 31st, at the Rutland Coffee House, at 8 p.m., when a good show of models is expected. Anyone interested is invited to attend the meeting or to apply to the Secretary, D. MORTON, 5, Dundonald Road, Leicester.

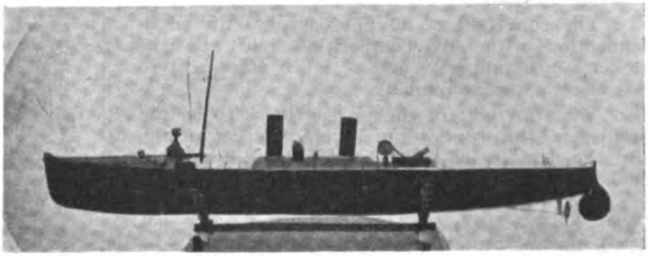
Practical Letters from Our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached though not necessarily for publication.]*

A Model Torpedo Boat.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—The following is a short description of a model torpedo boat which I have built. The dimensions are: Length, 3 ft.; beam, 3 ins.; depth, 3 ins. I built it upside down on a plank of wood. The planking was old venetian-blind laths cut in pieces, $\frac{3}{8}$ in. wide, each plank reaching from stem to stern. For ribs I used American elm placed at 3-in. pitch. The deck is yellow pine with a turtle back of tin at the fore end. At the after end of the turtle back is a searchlight mounted on a stand. The rudder is operated by a wheel on the quarter deck.



MR. F. BOOTYMAN'S MODEL TORPEDO BOAT.

The engine is of the single-cylinder double-acting slide valve type, $\frac{1}{2}$-in. bore, $\frac{1}{2}$-in. stroke, being built of scrap metal. For the cylinder I used a piece of copper tube to which brass flanges and steam chest are sweated. The connection-rod and slipper are of aluminium. The propeller shaft is $\frac{1}{8}$ in. diameter, with a propeller of brass. The blades are sweated to the boss, which is secured to the shaft by a set-screw. The boiler is a saddle type, made of copper, with 9 vertical smoke-tubes. On the top is the smokebox, through which is led the steam pipe to the engine, this acting as a superheater. The boiler is fired with a 7-burner lamp, burning methylated spirits from a tank in the bow of the boat.

The boat is painted black with a white deck, which gives it a very good appearance. I have tried it on the river, and it behaves splendidly, steaming at a good speed.—Yours truly,

F. BOOTYMAN.

Prize Competitions.

Competition No. 43.—A Prize of Two Guineas will be awarded to the reader sending the best article on "Finishing Model Engines." The work of painting and enamelling, polishing, lacquering, and the other points and processes which are involved in neatly finishing off a model engine after all the constructive work has been done should be dealt with. The closing date of this Competition is March 2nd, 1908.

Competition No. 44.—A Prize of Two Guineas will be awarded to the reader sending the best article on "Small Dynamo and Motor Testing," describing how to test for faults during construction, and how to test the working of the machine when finished. The closing date of this Competition is March 2nd, 1908.

General Conditions.

1. All articles should be written in ink on one side of the paper only.

2. Any drawings which may be necessary should be in good black ink on white Bristol board. No coloured lines or washes should be used. The drawings should be large enough to allow for reducing to half.

3. The copyright of all photographs entered in connection with any competition must be the sender's own property, and a signed statement to this effect must accompany same.

4. The copyright of the prize articles to be the property of the proprietor of The Model Engineer, and the decision of the Editor to be accepted as final.

5. The Editor reserves the right to print the whole or any portion of an unsuccessful article which he may think worthy of publication, upon the understanding that remuneration is given at the Editor's discretion in proportion to the length and merit of the matter used.

6. All competitions should be addressed to the Editor, The Model Engineer, 26 to 29, Poppin's Court, Fleet Street, London, E.C., and should be marked outside with the number of the Competition for which they are intended. A stamped addressed envelope should accompany all Competitions for their return in the event of being unsuccessful. All MSS. and drawings should bear the sender's full name and address on the back.

To help in starting a large motor generator, which is being used by the Edison Illuminating Company, of Detroit, a pneumatic jack has been designed, which consists of an air cylinder with a piston connected to an arm, this arm having a pawl engaging a ratchet on the armature shaft. The idea is for this jack to give the armature a single impulse or kick to overcome the standing bearing friction, which is considerably higher than the running friction of any plain bearing, and also to overcome some of the inertia of the rotating parts. It is found by the use of this device that the machine can be started with a maximum current of 500 or 600 ampères, as against 1,500 ampères when it is started in the usual manner from rest.—*Engineer.*

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* The Model Engineer, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[18,734] **Armature Winding; Filling in Accumulators** H. P. (Torquay) writes: (1) Will you please show me how to wind a 16-slot drum armature in eight sections, also commutator connections (not shown in your handbook "Dynamos and Motors"? (2) Can you give recipe for cement used in sealing small accumulators? Have tried pitch and marine glue.

(1) The winding for a 16-slot 8-section armature is precisely similar to the winding shown for the 24-slot 12-section armature on page 35 of "Small Dynamos and Motors," to which please refer. (2) A very satisfactory filling for the top of accumulators is ordinary British pitch with which is mixed a small quantity of beeswax. The two are melted together and run in whilst hot. Previous to this, of course, the top of the plates should be covered over with a filling-in piece of vulcanite cut to the size required and with holes for the lugs of the plates to come through.

[18,815] **Charging Switchboards.** W. J. B. (Beltoy) writes: In November 7th issue of The Model Engineer I saw a drawing of a switchboard for charging, etc. I have got a 12-volt 9-amp. dynamo of Bottone's make, and I wish to construct a switchboard so that I can charge my car accumulators; the dynamo to be driven by an oil engine. I am not quite clear on some points in regard to switchboard illustrated, especially the auto. cut-out. How does it act, and how are the connections made on the cut-out itself? Could I not have a simpler arrangement? Why have two double-pole switches? I would be much obliged for an explanation of the wiring of above switch, and what gauge of wire should be used in making the different connections. Could you recommend a good book on the dynamo in which the construction of switches for charging accumulators, etc., is fully dealt with? I could do all the mechanical work if I understood the functions of all the wires and connections.

A full description of an automatic cut-down is given in our issue for April 5th, 1906, to which please refer. A simpler design for switchboard has appeared in back numbers which you could use if you choose. A double-pole switch is not essential in a small installation, but, of course, has a more realistic appearance if any attempt is being made at modelling; the same remark applies to double-pole fuses. The discharging ammeter shows current given out by accumulators when they are supplying current to the external circuit. We have marked on the page we are returning herewith the three regulating cells which are used to bring the voltage up to its normal point after the other accumulators have been discharged some time, as you know a battery of accumulators gradually falls off in voltage as it becomes discharged. These three cells, therefore, are switched in as required to bring the voltage up again to suit the lamps. We can recommend you to obtain Maycock's "Electric Light Fitting, Switches, etc.", price 6s. 4d. post free, for further information on lamps, batteries, and their wiring.

[18,727] **Wimshurst Machines.** L. C. writes: I am thinking of making a Wimshurst machine with two glass plates 10 ins. diam. About how many sectors should I have on each plate? How many pin points should there be in the collectors, and how far from the plates should the points be? What size spark would this machine give? In a price list of an electrical apparatus dealer who advertises in The Model Engineer, there is listed copper foil silvered one side for Wimshurst machines. Is this better than tinfoil? Could you recommend me any book on small Wimshurst machines?

You should make your sectors about ⅜ in. to ½ in. wide at their widest part and allow approximately an equal space between each sector. Such space to be about the same width as sector. The number of points on the collectors is immaterial. We should advise five or six. About 1-16th in. space between plate and point. Spark length can only be ascertained by trial; approximately you may get 1½ ins. The tinfoil is quite satisfactory for Wimshurst machine. A good description of such a machine is to be found in Bottone's "Electrical Instrument Making," price 3s. 3d. post free. But a better book dealing with influence machines is Gray's "Electrical Influence Machines," price 3s. 9d. post free.

[18,731] **Induction Coil Failure.** H. B. (Manchester) writes: I have just finished a 4-in. spark coil which is made as near as possible to the one described in your sixpenny Handbook No. 11. There are 36 sections, silk covered, No. 36 gauge (about 4½ lbs.) on secondary, and I am certain that they are connected up properly. The primary has two layers of 14 D.C.C. on core, 7 ins. by ¾ in.; condenser, 75 sheets tinfoil, 7 ins. by 4½ ins.; mercury break (as described in No. 11 handbook). All other details are same as the coil described in book. With three large bichromate cells in series I only get 1½-in. spark. Each cell has two carbons and one zinc, 7 ins. by 2 ins. On disconnecting condenser I can get ½-in. spark. I shall be very much obliged if you can suggest anything, as I have rebuilt secondary and condenser with no better results.

We regret we cannot point out anything definitely wrong from the data you give. It appears to be a matter for personal inspection and trial to find out what the trouble is due to. We have known coils made to this data give excellent results, and even slight variations from the particulars given may be introduced sometimes without detrimental results. We advise you to work your coil in a dark room with all covering removed and see if you cannot find out where some leakage is taking place. It is quite possible a small leakage would be noticeable in a dark room which would quite escape observation under any other conditions.

[18,694] **Charging Accumulators of Various Capacities.** A. C. (Hants) writes: I have a small dynamo (50-volt 5-amp.) which I use for charging motor accumulators. Would it be practicable to have, say four 2-volt cells to charge up from the dynamo, then the accumulators from the cells? I get mixed size accumulators to charge, and should I arrange them to charge them together? Should I require any resistance between the cells and accumulator? How long would it take to charge up four 100-amp. cells the first charge, or what size would you recommend?

We do not quite grasp what your difficulty is, but as far as charging various size accumulators goes the best plan to adopt is to connect them in series, assuming that your supply voltage could be at least 25 per cent. higher than the sum of the voltages of the accumulators connected together and to pass current through the whole lot for such a time as is necessary to fully charge the smallest of the cells in the group. The charging rate must also be suited to the capacity of the smallest cell—that is, if you have four cells in the group, the largest of which has 3 sq. ft. of positive plate surface, and the smallest only ½ sq. ft., your charging rate would have to be not more than 2½ to 3 amps., working on the basis of 6 amps. per sq. ft. of positive plate surface. When the smallest cell is fully charged you could take it out of circuit, connect up the group again, and adjust your dynamo voltage to the required amount, and charge up the remaining cells, and so on till the whole of the cells are properly charged. Your last enquiry is also rather vague, and you do not mention whether you refer to forming the plates in the first instance, or to the first charge given to an already formed accumulator.

[18,690] **Power for Driving 350-watt Dynamo.** J. S. (Bulwell) writes: What horse-power gas engine would it take to drive 350-watt dynamo (not brake horse-power), so you have plenty of power? Also, would a fan revolving in window stop it from steaming?

You will require at least 1 b.h.-p. to drive your 350-watt machine. We think ventilation at the top of your window, either with or without a fan, would obviate steaming.

[18,681] **Four-pole Dynamo Construction.** T. M. C. (Boyle) writes: I have a four-pole dynamo, which I am completing. I want to have it compound wound. There are a few points I am not clear about, and I will be very much obliged if you explain them to me. I have several books on the dynamo, including "Small Dynamos and Motors" and "Practical Dynamo and Motor Construction." The armature is a drum, with sixteen slots, and I am winding it as described on pages 36 and 37 of "Small Dynamos and Motors." (1) How are the opposite segments of the commutator cross-connected, so that only two brushes need be used? (2) How can I connect the wires of the shunt and series coils to terminals, so that I may use the dynamo as a shunt machine when charging accumulators? (3) Must the regulating resistance (for varying voltage) be in series with the shunt coils? (4) How are the coils on armature (as shown at page 36 already mentioned) connected to each other? (5) After winding coil marked 1, should No. 2 be next wound on, and so on?

(1) The opposite sections of the commutator should be cross-connected by means of either copper strips or copper wires, each strip having the capacity to carry the full current flowing in the armature. The strips may be connected by screws and soldering. (2) When using the machine as a shunt-wound dynamo, you may either disconnect the series coils entirely, or connect them up in such a way as they are in series with the shunt winding. There would be no appreciable difference in the result whichever method you adopt, as the compound turns are few, and the current flowing in them when connected in series with the shunt winding would only be that which the shunt winding takes itself. (3) The coil of the resistance for regulating the voltage is in series with the shunt coils. If you refer to Query No. 18,682, you will see a diagram of connections which will assist you. (4) We do not quite see what your difficulty is with regard to connecting the coils on armature, but may say any of the usual methods described in "Practical Dynamo and Motor Construction" may be used. (5) There being two coils in each slot, you may wind them either side by side or one on top of the other. This method is also shown in our book just referred to. Some further nteresting information relating to compound dynamos may be found on reference to December 10th (1903) issue, pages 556 to 562. See also Volume XIII, pages 343, 201, 176, 154, 126, 87, and 6.

[18,708] **Power for Charging Cells; Consumption of Water Motor.** H. J. G. (Llanberis) writes: Would a 100-volt dynamo charge the fifty-three cells in series without overheating, or would it be better to instal a dynamo of, say 110 volts, and run it at about 100 volts when lighting direct, and run it at full voltage when charging only? Are there any Nernst lamps suitable for 100 volts, or what are the latest lamps out, *i.e.*, giving the most light with the least consumption, such as would be suitable for dining-room? Will a galvanised ¾-in. pipe working from a head of 90 ft. (same being free from any bends or curves) convey sufficient water for a 1 b.h.-p. Pelton wheel; and, if so, what would be size of nozzle?

For charging fifty-three cells in series you will need a voltage of at least 125 volts, that is, practically 25 per cent. above the voltage of the cells to be charged. The output in amperes of the dynamo must, of course, be equal to supplying the amperes taken by the cells. You do not mention the capacity of your cells, so we cannot say what sized dynamo you will require. Nernst lamps can be had to run on 100-volt circuit, but for our own part we should recommend you to instal some of the new metal filament lamps, such as the Tantalum. You will need a discharge nozzle of ⅜ in. diameter to obtain 1 b.h.-p. The consumption will be, approximately, 9 cub. ft. per minute.

[18,620] **Strength of Model Boiler.** T. I. K. (Bristol) writes: Would you kindly oblige me by answering the following questions—(1) Can an ordinary steam gauge be used for testing a boiler by water pressure? (2) I am building a Cornish pattern boiler 2 ft. by 9 ins., with a 4-in. flue of 3-32nds-in. mild steel. Would you tell me the highest safe pressure to work at? Will the rusting of the metal be very severe, and what precautions (if any) to take against it?

(1) Yes, certainly; but, of course, obtain a gauge which reads higher than the test pressure. It is a mistake to use gauges above 75 per cent. of the maximum reading marked on the dial. (2) We would require to know more exactly the size of riveted joint used (if any). See the rules given in our sixpenny Handbook, "Model Boiler Making." However, presuming that the joint is a single-riveted lap joint, the safe pressure, with a factor of safety of 5, would be—

$$\frac{40{,}000 \times \text{3-32nds} \times 2}{5 \times 9 \times 2} = 80 \text{ lbs.}$$

approximately. but as the plate does not allow for corrosion the pressure would have to be reduced as the boiler got older. We recommend you to keep the boiler quite full of water when not in use, or else entirely empty and dry, the inside being well ventilated.

[18,593] **Naming of Locomotives.** H. N. (Aston) writes: Could you tell me whether the following railway companies have names on their engines—North British, Great Northern, North-Eastern, Caledonian, London B. & S.C.R., Midland, Great Central, London & S.W., and Glasgow & S.W. Railways?

London & N.W. Rly., all passenger engines named, goods engines numbered only; North British Railway, not named as a rule; Great Northern Rly., not named as a rule; North-Eastern Rly., not named at all; Caledonian Rly., not named as a rule; L.B. and S.C.R., all engines named under old *regime* (the practice is now being discontinued); Midland Rly., not named as a rule; Great Central Rly., not named as a rule; London & S.W.R., as far as we know, they are now not named at all; Glasgow & S.W.R., we do not think any of this Company's engines bear names; G.W.R., most passenger express engines named. The following engines belong to the Companies mentioned above who do not usually name their engines—North British, "Aberdonian," "Atlantic" type; Caledonian, "Sir James Thompson," six-coupled bogie express; G.N.R., "Sir Henry Oakley," "Atlantic" type; Midland, "Princess of Wales," single express; G.C.R., "Immingham," six-coupled bogie express.

[18,766] **Dynamo for Charging Accumulators** T. B. M. (Preston) writes: Please will you tell me whether a 6-volt 5-amp. shunt dynamo can charge a 4-volt 25-amp.-hour accumulator? What should the charging rate be for a 25 amp.-hour accumulator?

In reply to your enquiry *re* dynamo for charging 25 amp.-hour accumulator your machine should be quite equal to this provided you have sufficient power to keep it running properly. The charging rate for a well-made 25 amp.-hour cell would be about 4 or 5 amps.

[18,614] **Model Vertical Boiler.** W C. H. (Cheltenham) writes: I enclose rough drawings (not reproduced) of a vertical tubular boiler I am making. Will you please tell me what will be its safe pressure? It has thirteen ⅜-in. tubes, hard-soldered into smokebox and firebox. I propose to fix the ends in with ⅛-in. brass screws (about 1 in. apart and soldered). Will it do if the bushings for water gauge, taps, etc., are sweated into boiler with soft solder?

Yes, the boiler is quite right in design and should be all right to about 30 lbs. pressure, if the tubes are flanged over the tubeplates at each end. Otherwise, we recommend a central stay, 3-16ths in. diameter (brass or copper), to keep the ends from bulging. The flanged ends should be secured by brass screws about ¾ in. apart. If it be possible, solder the bushings for the fittings with the collar (or flanged portion) inside the boiler. Soft solder will then suffice. Provide plenty of ventilating holes in the flame guard for the lamp.

[17,768] **Relays for Wireless Telegraphy.** G. V. B. (Brockley) writes: I should esteem it a great favour if you would kindly answer the following queries. Enclosed you will see a design for a relay for wireless telegraphy. Is it a good design, also could you suggest any improvements? Is it likely to give good results? In your latest book by Howgrave-Graham, there is a Siemens relay described, but there are no dimensions given. Could you oblige me with same? Could you tell me of a firm which produces wireless apparatus, because I want to buy a wheel for a coherer of the Lodge-Muirhead pattern? When a relay is working, does it make a continual chatter?

The relay given should work, though its action would be very coarse. You appear to rely on gravity for holding it in the off position, and you show no arrangement for regulating the gravitational force. This is a serious drawback. The moving part is also too long and the whole thing too big and clumsy. We *strongly* recommend the polarised type for wireless work. The relay described in Mr. Howgrave-Graham's book is drawn full size. We know only of one firm which produces the wheels. This is the firm of Messrs. Muirhead & Co., the inventors and users of it. Their works are at Elmers End, Beckenham, Kent. We would advise you to write to them. The relay should not chatter, though, of course, it should vibrate if its current is intermittent, as is the case when tapper and coherer are at work.

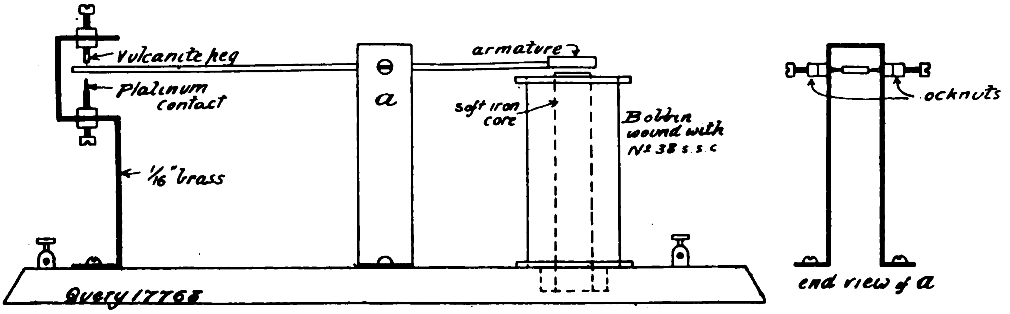
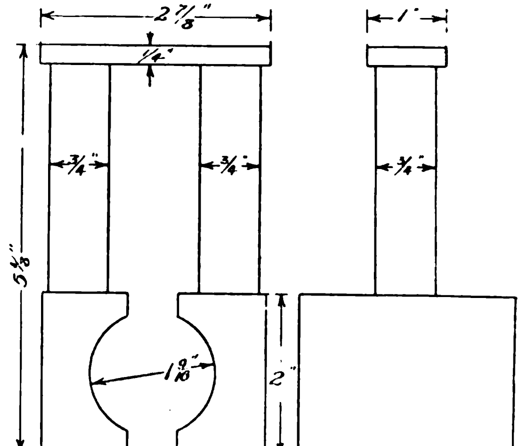


DIAGRAM OF RELAY FOR WIRELESS TELEGRAPHY.

[18,750] **Running Motor as Generator.** H. J. J. R. (Wandsworth) writes: I have a "Crocker Wheeler" electro-motor of the type shown in diagram. It is wound for 115 volts ·75 amp. I have been trying to run it as a dynamo by reversing the leads and connecting coils in series and in shunt with the brushes, but it has failed to produce current. I have also applied tests given in THE MODEL ENGINEER, and also those in your handbook. The windings of the field-magnets and armature do not leak and are not broken. I have tried adjusting the brushes and driving the motor at different speeds, but without avail. Would you kindly tell me if there is any way of converting it into a dynamo By rewinding the field-magnets only? If not, what windings are suitable for both field-magnets and armature, and with what output? The motor is very well made, and is, as it now stands, of no practical use to me. Any advice as to windings, etc., will be of great value to me. The following are the dimensions:—Diameter of armature, 3 5-16ths ins.; commutator, 1¼ ins.; number of segments in commutator, 12; width of commutator, ⅝ in.; length of armature, 2¼ ins.; width of field-magnets, 1¼ins.; width of field coils, 2¼ ins.; total weight, 20 lbs. I cannot see how the armature is wound, as it is covered over with black varnished cloth. The shape, as it appears from exterior, is shown in sketch (not reproduced).

It is often the case that such motors as these refuse to generate, although they may run very well as motors. When running up your machine as a dynamo it is necessary to connect in the outer circuit a suitable resistance. We advise you to try one or two 115-volt lamps in series; if the resistance is too low, the result is to impoverish the field supply and the machine consequently refuses to build up. We note that the air-gap is also rather large for a generator of this size, and we should recommend you to reduce this by winding over with iron wire. Beyond these few suggestions we regret that we cannot give you any definite information. The matter appears to be one requiring actual experiment and trial, but we think if you work on the lines suggested you will get some results. You do not mention what speed you have run the motor at; as this is an important point, we think you should make quite sure that you are driving it at least 2,600 revolutions a minute.

[18,472] **30-watt Dynamo Windings.** R. F. (Hull) writes: I reproduce below sketch and dimensions of a pair of field-magnets which I possess. I have no other parts, so would like your advice so as to build it to the best advantage. I should like to run it at about 10 or 12 volts, and shunt wound to charge accumulators. (1) Please state whether tripolar or quadripolar (1½-in.) laminations would be best for armature? (2) Gauge of wire to suit both field-magnets and armature, and also quantity in weight? (3) Is shellac varnish or paper best for separating laminations? (4) About how many revolutions will armature have to revolve per minute? (5) What should be its output in watts? (6) The iron connecting piece at the top of field-magnets you will notice is only ¼ in. thick, and is fastened on by 3-16ths in. screws through ⅛-in. holes. Does this make any difference, or would it make any material difference if a thicker piece was used and tapping it also to receive the screws? (7) The laminations usually (for small dynamos like this) have ⅛-in holes. If a ¼-in. shaft is used which would be the best method to fix them on? (8) I enclose a sample of wire, of which I have a very large quantity. Would this be of any use in winding field-magnets? Kindly tell me gauge of enclosed wire. (9) In the event of my finishing it, is it essential to send a current through it first, or will it generate straight away?



FIELD-MAGNETS FOR 30-WATT UNDERTYPE DYNAMO.

(1) Use a drum armature of eight slots, as shown on page 30, Fig. 24, of "Small Dynamos and Motors," 7d. post free. (2) Armature, 5 ozs. No. 20 (as sample you enclosed); fields, 20 ozs. No. 21. (3) Shellac. (4) 2,900 or 3,000. (5) Approximately 25 or 30 watts.

(6) It should be at least ⅜ in. thick, *i.e.*, equal or more than equal the cross sectional area of the field cores. The joints must also be perfect fitting, metal-to-metal. (7) See "Practical Dynamo and Motor Construction," 1s. 2d. post free. (8) No. 20 S.W.G.. can be used for armature. (9) Fields should be magnetised first by passing a current through windings.

[18,743] **Castings and Patterns for Gas Engine Cylinder and Jacket.** F. C. L. (Sutton) writes: What kind of patterns are used for casting gas engine water jackets and liners of cylinders? Are they simply solid cylinders of wood with the usual indications of cores? What is the principle of the hot-air engine? I take it that a certain volume of air is expanded by heat and therefore creates a pressure; but how is the succession of pressures caused necessary to work the engine?

The series of articles on "Pattern-making for Gas Engine Castings" appeared shortly after the articles on "THE MODEL ENGINEER Gas Engine" were concluded in Vol. XIV. These articles went fully into the matter of preparation for patterns, and we advise you to refer to same. Pattern-making is a process which cannot be explained in a few words. The principle upon which the hot-air engine works is fully explained in our handbook, "Simple Mechanical Working Models," 7d. post free.

[18,425] **Chemical Rectifier** P. T. W. (Hanley) writes: Will you kindly answer me the following queries? I have made a chemical rectifier which does not work satisfactorily. It consists of four 2-lb. jam jars, in each of which is a sheet of aluminium, 3 ins. by 6 ins., and a Leclanché carbon in a solution of Rochelle salts (strength, ½ lb. of salts to 1 pt. of water). It is connected up as per enclosed sketch. On connecting up the alternating current with a 100-volt 32 c.-p. lamp in series, the lamp lights dimly when the direct current wires are apart, but when a 4-volt accumulator is connected to the direct current wires the lamp lights brightly. When I transform the alternating current down to 20 volts and connect with a small wire resistance in series, it blows a 10-amp. main fuse with the direct current wires apart. I may say the supply here is 100 volts 90 cycles.

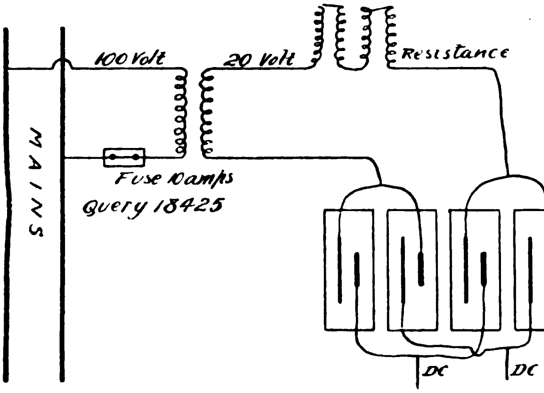


DIAGRAM OF CONNECTIONS FOR CHEMICAL RECTIFIER.

Your cell connections are correct, but the current appears to leak through the cells, as shown by the fact that the lamp becomes red when the direct current wires are open. Try lead or iron plates instead of carbon and a saturated solution of ammonium phosphate. See THE MODEL ENGINEER for September 27th, 1907, page 303. Your iron wire must be of low total resistance as the cells seem to be almost a short circuit upon the transformer. Perhaps there is a short circuit in them somewhere, or the plates are not connected in correct order. According to your sketch, the right-hand plates should all be of one metal, and the left-hand plates of the other metal. Are you sure the transformer has no fault in it?

[18,739] **Tools for Model Engineering.** H. S. (Edinburgh) writes: As I am thinking of taking up model engineering, I should be glad of a little advice on the following points. In building an engine, say, horizontal or high-speed vertical, from castings, should I need a large outfit of tools? I must consider the question of cost and have not room for a lathe. If you could give me a rough idea of the essential tools, or let me know of a book in which I could obtain such information I should be obliged.

You do not mention the size of the engine you propose to build, so we cannot say quite definitely what tools you would require. However, if you will consult our handbook, "Metal Working Tools and their Uses," you will find a good deal to interest you. The lathe is almost indispensable, especially if you do not have any of your castings machined for you by the firm from whom you purchase. If you had given us some idea of the figure to which you are prepared to go for the purchase of tools, we could have advised you more definitely.

[18,814] **Charging Accumulators from Primary Cells** B. D. (Walton) writes: *Re* the installation described in Chap. VI of THE MODEL ENGINEER Handbook No. 22, I would be much obliged if you answer the following query. Can the installation be successfully run with the primary batteries alone, and will the batteries light a lamp or two continuously until they require replenishing with fresh copper sulphate and zinc? I would also like to know if the zinc is being used up when no lamp or anything is in the circuit, as it is in the solution all the time? I may add that I propose to use one or two 6-volt Osram lamps.

Any set of batteries which is capable of charging accumulators, which in turn are used to light lamps, is capable also of lighting the lamps direct, provided the power taken by them is not such as to cause the batteries to discharge above their rated rate. It is possible to obtain from a set of accumulators, say, a discharge rate of 5 amps., and yet at the same time a set of batteries only capable of discharging 2-amp. rate will charge these accumulators. It all turns on the question of time. We trust this explanation will clear up your difficulty. The zinc in a Daniell cell need not be removed.

[18,769] **Windings for 6-ft. Boat 30-watt Motor.** A. H. (Richmond) writes: Being a subscriber to your invaluable journal, THE MODEL ENGINEER, I shall be glad if you will reply to the following questions. I am having castings made for an electric boat motor which is to drive a 6-ft. boat on 8 volts 3½ amps., and what I want to know is how much wire (and gauge) to wind on armature, 1½ ins. long, 1½ ins. diameter (8-cog drum), and also how much wire to wind on field and gauge? Enclosed is a copy from which I am taking castings. Field core is 1¾ ins. long.

For the armature use 4 ozs. No. 20 S.W.G., and for the fields 1½ lbs. of No. 22 S.W.G. You will need a fairly large accumulator to supply this machine, one capable of discharging at least 3 amps. rate would be suitable.

[18,752] **Small Lighting Installation.** B. W. L. (Kingston Hill) writes: I am thinking of setting up in our house a small accumulator installation, the same as described in Chap. VI of "Electric Lighting for Amateurs" (No. 22 of THE MODEL ENGINEER series). The lamps used throughout will be pear-shaped Osram. I thought of raising the pressure to 12 volts, thus requiring two more accumulators. How many more gravity cells shall I require to keep these six accumulators charged? My object in using six accumulators instead of four is that an Osram lamp of 9 c.-p. at 12 volts only consumes 0·75 amp., wherefore an 8 c.-p. lamp at 8 volts consumes 1 amp. Would you recommend using six accumulators? Thus, by having additional pressure less current is consumed and more light is obtained. With a pressure of 12 volts, should I use 3/20 S.W.G. cable, or would 1/16 S.W.G. wire be better? Each circuit will carry no more than 3 amps. Being such a low pressure, would 300 megohms per mile insulation be too great, as I do not want to pay a lot for insulation when a far weaker insulation will suffice? What should length and fusing current be for a fuse wire inserted in a 3-amp. circuit? I should be much obliged if I could have answers to the above queries.

In reply to your query *re* proposed lighting scheme, the one rule to remember is that you must always keep the voltage of your charging cells at least 25 per cent. higher than that of the accumulators to be charged. As a rule, it is more efficient to use a higher voltage lamp so that in your case you will be well advised to adopt 12-volt lamps instead of a lower figure. No. 16 S.W.G. wire would be suitable. You do not need to trouble very much about insulation; very ordinary insulating material will be effective at this low voltage. If you refer to the table of wires given in handbook, "Small Electric Motors," you will get all the information you require regarding carrying capacity and also fuse wires.

[18,730] **Static Electricity.** J. S. R. (Rochester) writes: Will you kindly answer the following question? Is it possible for a person to charge himself with electricity so that in touching another person (who is not charged) that person will receive a shock?

A person may be charged with electricity and can retain that charge so long as he is insulated from earth by standing on an insulating stool. Leakage will, of course, gradually take place, and it is also possible for him to discharge himself by touching any object, person, or otherwise in connection with earth. You would do well to look up the subject in some text-book, such as the one by S. P. Thompson, "Electricity and Magnetism."

[18,811] **Winding for 100-watt Dynamo.** H. H. (Manchester) writes: Will you kindly assist me in the following? I have some castings of a dynamo (Manchester type) with armature 2 1-16th ins. by 2½ ins. The armature has twelve circular slots. I think they call them tunnels. (1) What length or amount of wire and what gauge shall I require for the field-magnets? (2) What amount and gauge for the armature? (3) What speed should I have to run at? I want to get a voltage of 20–24, at 5 amps. if possible. I have made sketch (not reproduced). I don't know whether dimensions are correct for this output.

Windings for your Manchester type dynamo would be: For the armature, 6½ ozs. No. 22 S.W.G.; for the field-magnets, 2 lbs. 14 ozs. of the same gauge connected in shunt. This would give you approximately 20 volts 5 amps.

The Editor's Page.

BY the time this issue is published we hope to have ready "Locomotives of 1907." This will be a companion volume to Mr. C. S. Lake's previous works, "The World's Locomotives," and "Locomotives of 1906," and anyone possessing these three books will have a standard reference library of the latest locomotive practice of the world. "Locomotives of 1907," which has a newly-designed artistic cover, will be published at 1s. net, or post free 1s. 3d. It may be ordered through any agent of THE MODEL ENGINEER.

* * *

We have just issued a little book of amusing engineering stories, entitled "Tales Worth Telling," in which some very good yarns of a more or less technical flavour are related. A number of excellent original sketches by the well-known humorous artist, Mr. Arthur Moreland, add considerably to the fun. The price of the book is 3d. net, but as its main purpose is to draw attention to the features of our monthly Journal, *The Engineer-in-Charge and Works Manager*, we shall be pleased to send a free copy to the first hundred readers of THE MODEL ENGINEER who send a stamp for postage. The supply is limited, so write early. A free copy will be sent to any foreign or Colonial reader who writes by return mail enclosing stamp to the English equivalent ot one penny. It is a book for those who like a good laugh.

* * *

The skipper of *Ades II* writes as follows in regard to our Model Speed Boat Competition: "May I make a suggestion (but in doing so I would first assure you I make it in no way to doubt the veracity of the recent published performances), and that is—you publish the conditions under which the various boats ran, *i.e.*, the length of course and duration of interval between the successive trips pertaining to the short course for each individual boat. I contend that a boat running over a short course three times is at an advantage to the boat over the long, continuous course. When the boat has come in after 100 yds.' sprint, steam is turned off and the pressure allowed to accumulate. Now, it is a well-known factor in steamers that a higher pressure requires a further movement of the tiller to counteract this; but a pressure of 5 lbs. will not affect the straightness to a great extent over a 100-yds. length, so when the first run is over the steam has undoubtedly dropped, and the long-course boat is plodding away with its corresponding reduction, while the short-course boat is ripening up to its normal head of steam. Certainly some steamers keep their steam well, but in racing for the championship of All England one is apt to overdo the capacity of the boiler in putting, perhaps, a larger engine. This is one advantage. Again, in the long course it is many times harder to keep a straight course. Two boats in point. *Wolf* (W. H. Rimmer) and *Ades II* (Coxon Bros.)—the angles of running were 160 degs. and 150 degs. respectively, which, when the path is worked out to miles per hour becomes a much higher speed than taking the shortest distance between the two points of the course. I would like to hear what other competitors think of the matter. The publishing of particulars asked for would confer a great benefit on the members of the Sefton Model Steamer Club and the skipper of *Ades II*."

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This Journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

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All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 26–29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE

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And Electrician.

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EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 354. FEBRUARY 6, 1908. PUBLISHED WEEKLY

Model N.E.R. Engines and Rolling-Stock.

By T. B. CROOKS.

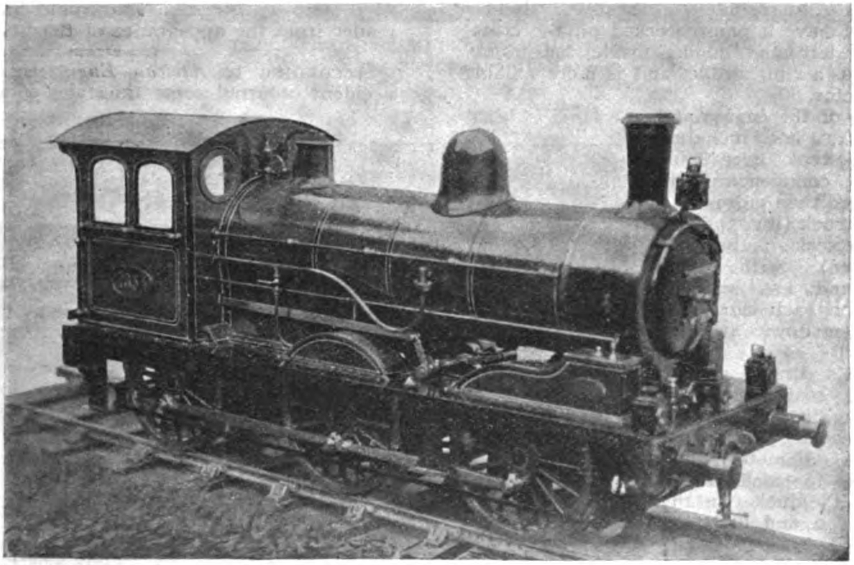


FIG. 1.—1-IN. SCALE MODEL N.E.R. GOODS LOCOMOTIVE, CONSTRUCTED BY MR. T. B. CROOKS.

THE photograph above shows a model of the North-Eastern Railway locomotive, No. 1,854, built to 1-in. scale, having six coupled wheels of 5 ins. diameter, with cylinders 1-in. bore by 2-in. stroke, and Stephenson's link motion, hand-brake with blocks to all six wheels. The boiler and firebox is of sheet copper riveted together with copper stays in firebox, tapped, screwed, and riveted the same as in the large engine. The boiler contains sixty-two brass tubes (expanded and brazed). I have had it tested to 100 lbs. per sq. in., have run it with 80 lbs. with steam, but find that from 30 to 50 lbs. is quite sufficient for any purpose. At the exhibitions where they supply compressed air the engine will run (chocked up) with the gauge as low as 5 lbs., and I have the valves screwed down to 50 lbs. pressure.

The frames are of steel and riveted together, steel spring buffers and spring couplings.

The dome case, valve cover, and chimney top are of polished brass. Two whistles and hand-railing, all of polished brass.

The tender, which runs on cast steel wheels ($3\frac{3}{4}$ ins. diameter), is entirely built of brass, and brazed (not riveted) brass axle-boxes and built-up springs of thin sheet. Hand-screw brake, with blocks to all six wheels.

I have a burner in the firebox which burns petroleum oil, which is worked (or supplied) from a tank placed in the coal space in the tender, with a valve on the top, and acts similar to a blow-lamp, and it can be regulated as required. Besides the injector I have a pump worked off the cross-head of the left-hand engine inside the frame, and which has a 2-in. stroke, and is more reliable than an injector.

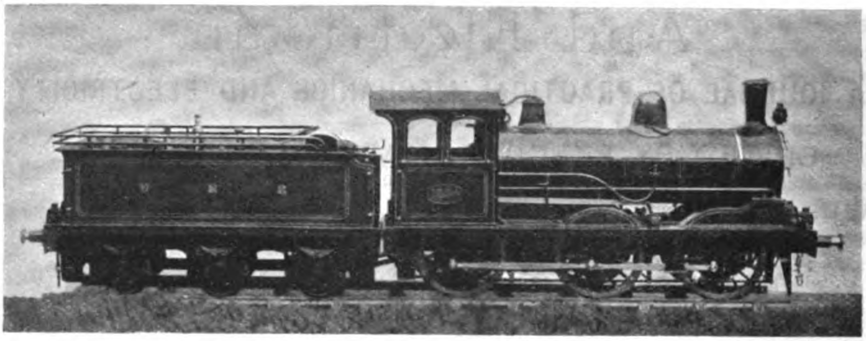


Fig. 2.—A Side View of Model N.E.R. Goods Engine.

The length of the engine and tender is 4 ft. 4 ins., including buffers, and took over nine years from commencing to finishing (spare time only).

The goods truck (Fig. 5) which is exactly to scale, is built of oak (polished), with brass mountings, and has separate brake lever on each side, with doors to open down at each side.

The guard's brake van is also to 1-in. scale, with oak under-framing, spring buffers, springs, axle-boxes, and four wheels (3 ins. diameter), and brake blocks to each wheel, worked from the ducket in the inside of the van, and all hand-railing polished brass; wood seats, brass stove, desk, etc.

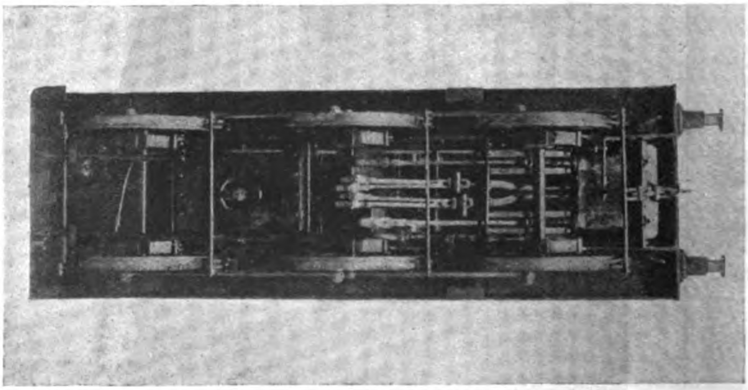


Fig. 3.—Underside View of Mr. T. B. Crook's N.E.R. Goods Engine.

The passenger express engine, 1,505, of the "Tennant" class, is built to the same scale, viz., 1 in., with four coupled driving and trailing wheels of 7 ins. diameter, and leading wheels (outside bearings) 4 ins. diameter; cylinders, 1¼-in. bore by 2-in. stroke, with Stephenson's link motion and screw-reversing gear.

The boiler and firebox are of copper, riveted and stayed, the same as the goods engine (Figs. 1, 2 and 3), but with only five tubes, though these are larger, and for a model give better results in getting steam.

The smokebox of this engine is of steel; chimney top, dome cover, and valve case—as in the other—are of polished brass, and also the bands round the boiler and handrailing.

The tender is practically the same as the goods engine tender, but with wheels 4 ins. and built of strong sheet zinc instead of brass.

The two engines are painted the N.E.R. green, picked out with black and white lining. The frames chocolate and black, with vermilion lining. I may say that the engines have been highly praised by everyone who has seen them, and I owe all my success to The Model Engineer, having been a reader from the appearance of the first number.

According to *African Engineering*, a curious accident occurred some time ago on a Californian railway. A locomotive's boiler exploded and fell on the track 300 ft. in front of the train. The latter, impelled by its momentum, ran on and collided with its own boiler.

Proposed Exhibition of Models at Darlington.—The Rev. J. Shores hopes to be able to arrange for an exhibition of model engines, etc., in aid of the Darlington Temperance Institute Extension Scheme, about October or November, 1908. Will those who have models which they would be willing to lend kindly call upon or write to Mr. Shores, Westbrook Villas, Darlington. All kinds of models will be acceptable—engines, boilers, dynamos, cars, etc., as well as any kind of work in iron, brass, wood, etc.

For the Bookshelf.

[Any book reviewed under this heading may be obtained from THE MODEL ENGINEER *Book Department, 26–29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.]*

THE PRACTICAL ELECTRICIAN'S POCKET BOOK AND DIARY, 1908. London: S. Rentell & Co., Ltd. Cloth, 1s. net; leather, 1s. 6d. net; postage, 2d.

The preceding edition of this well-known pocket book has been revised in the sections dealing with steam turbines, electric power and polyphase currents, Home Office and mining rules, electricity meters, telephones, switchboards, arc lamps, photometry and accumulators. To the last named, a section has been added on ignition cells. The latest Standard Institution wiring table is substituted for the old one, and a new voltage-drop table has been added. We also notice that the illustrations of obsolete patterns of plant and apparatus have been replaced by new ones. The usual diary pages are contained, one page being devoted for a week. A number of perforated tear-out pages are included at the end of the book, which will be found very useful to wiremen and others estimating or ordering materials for their various jobs.

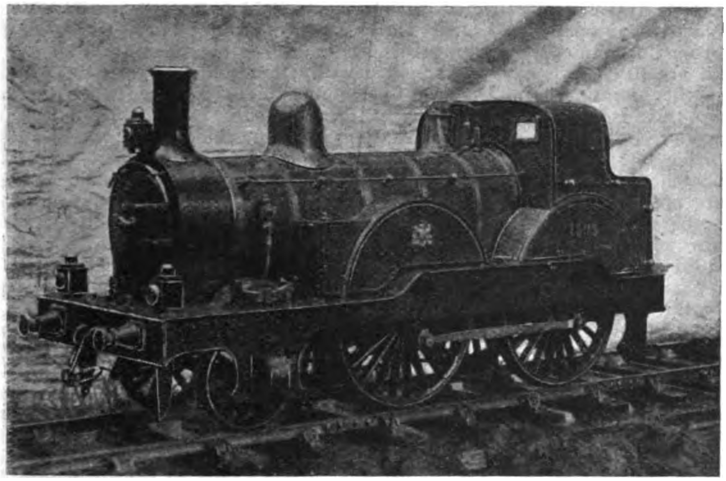


FIG. 4.—MODEL N.E.R. PASSENGER EXPRESS LOCOMOTIVE.

INVENTIONS, PATENTS AND DESIGNS. By G. Croydon Marks, M.P. London: The Technical Publishing Co., Ltd. Price 3s. 6d.; postage, 3d.

The full text of New British Patents and Designs Act, 1907, which came into force on January 1st of this year, is included in this work, together with numerous helpful notes under the following chapter headings: — "The Meaning of Patent," "What is Patentable," "Opposition to Patent," "Surrender and Revocation of Patent," "Licensing an Invention," "Infringements of Patents," "Working in England," "Applying for Injunction," "How to Work a Patent," and "Designs."

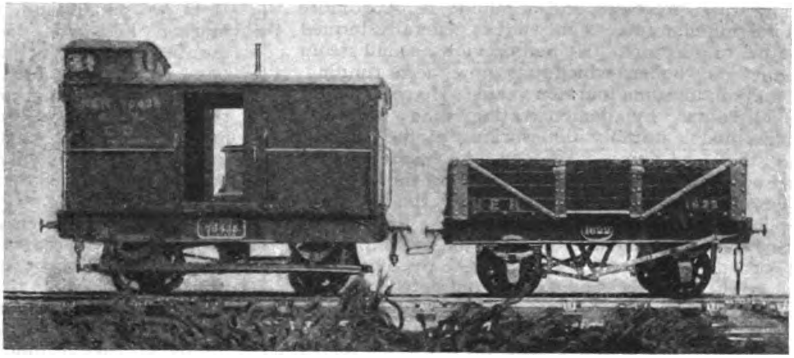


FIG. 5.—SHOWING MODELS OF GOODS WAGON AND GUARD'S BRAKE VAN, CONSTRUCTED BY MR. T. B. CROOKS.

THE LOCOMOTIVE ENGINEER'S POCKET BOOK AND DIARY, 1908. London: The Locomotive Publishing Co., Ltd. Price 1s.; postage, 1d.

This little book is a compilation of useful data concerning the construction and running of steam locomotives. Diagrams are given showing tractive power of locomotives, revolutions of driving wheels per mile, piston speeds in feet per minute, cylinder arrangements, loading gauges, and draw-bar pull. Notes on firing, boiler feed, arrangement of shops, lubrication, injector faults, vacuum brakes, and engine construction. Table of mileage and rolling-stock of principal British railways is included, and a list of British and Colonial locomotive superintendents. Pages are reserved for a diary at the end of the book.

"THE ILLUMINATING ENGINEER."—The first number of the journal by this name, and published by The Illuminating Engineering Publishing Co., Ltd., contains, amongst others, the following articles: — "Illumination, its Distribution and Measurement," by A. P. Trotter; "The Present Status of Acetylene Lighting," by F. H. Leeds; "Vacuum Tube Electric Lighting," by J. A. Fleming; "The Production and Utilization of Light," by C. V. Drysdale; "Petrol-Air Gas Lighting," by W. H. Y. Webber; "Researches on Reflected and Transmitted Light," by H. Kruss; "Finality reached in Gas Testing," by W. Grafton. The journal is published monthly at 1s. per copy, or 10s. 6d. yearly.

Some Further Wrinkles in Model Making.

On November 14th last the Society of Model Engineers had a further opportunity of learning much of interest from the lecture delivered by Mr. L. M. G. Ferreira. Perhaps it is not quite correct to say "lecture," for, in truth, Mr. Ferreira's running discourse upon model engineering processes and methods is of a more interesting character than what is generally termed a paper or a lecture. He had on view a small steam engine and boiler, which has now been running, off and on, for some fourteen years. He commenced his discourse by demonstrating many features of his model, notably the working of the injector and the feed-pump. He ran the model under load and also light, and illustrated how the knock of a worn bearing may be silenced by the judicious application of a drop of oil.

Suggested by the run of his talk, he explained how easily a boiler may be tested by expansion due to heat. His plan is to completely fill the boiler with water, allowing no air to be present; then to apply heat slowly and watch the pressure gauge. In this manner pressures up to about 150 lbs. can easily be tested without the use of a hydraulic pump. Such a simple means of carrying out an important job which every model engineer must meet with sooner or later, was met with great applause; and, notwithstanding the almost obviousness of the method, it does not appear to be one which is commonly used.

He next showed us a very quick means of getting out symmetrical castings, and, as an instance, showed us a portion of a three-bladed propeller. His method is to make a wood pattern of one blade and one-third of the boss. From this, three soft metal castings are taken, which are filed up, etc., and then soldered accurately together, forming a complete propeller. Then, using this as the pattern, the final castings are made.

A quick and easy method of getting out deck planks for model yachts was then sketched on the blackboard. A number of planks are prepared of, say, ¼-in. thickness, and glued together. Fig. 1 illustrates this method of procedure, and it will be seen that by cutting down with the saw in the direction indicated, any number of planks can be quickly made. The method of effecting the appearance of a caulked joint is shown in Fig. 2, and is produced by raking out the top of the joint and filling with white lead.

The question as to the best material for covering small steam pipes then arose, and Mr. Ferreira advocated the use of string; but not, he added, with a view to hiding kinks. For bending pipes, he remarked that he always adhered to the use of resin for filling in. This material can be used in all kinds of small pipes, and is, perhaps, the most satisfactory method of any in common use. Fig. 3 illustrates a small pipe being filled. When the bending to the required shape is completed, the pipe is heated and the resin run out in a liquid state.

He then showed the members a number of small pin drills, which he had made for special purposes, notably for facing the surface of bolt holes on small bearings, such as we illustrate in Fig. 4.

Another drill—of the type shown in Fig. 5—he explained had often been used by him for drilling out ports, etc. He remarked that he had cut six ports in cast iron a ½ in. deep by this method. It should be noted that the sides of this drill should *not* be sharp; otherwise when the drill is travelled forward, it is apt to run out of line. If the sides are left dull, practically a straight cut is accomplished.

A new type of cutter bar for the lathe was next described, a diagram of which we give in Fig. 19. It is, we understand, shortly to be placed on the market, and was designed by the lecturer. A number of small cutting tools and drills were then passed round amongst the audience. All of these were made by filing, not forging, ¼-in. steel. Also two particularly well-made tools—one for cutting inside grooves in such as eccentric straps, and the other for forming valve seats, were passed round, with examples of the work they had performed (Figs. 15 and 16).

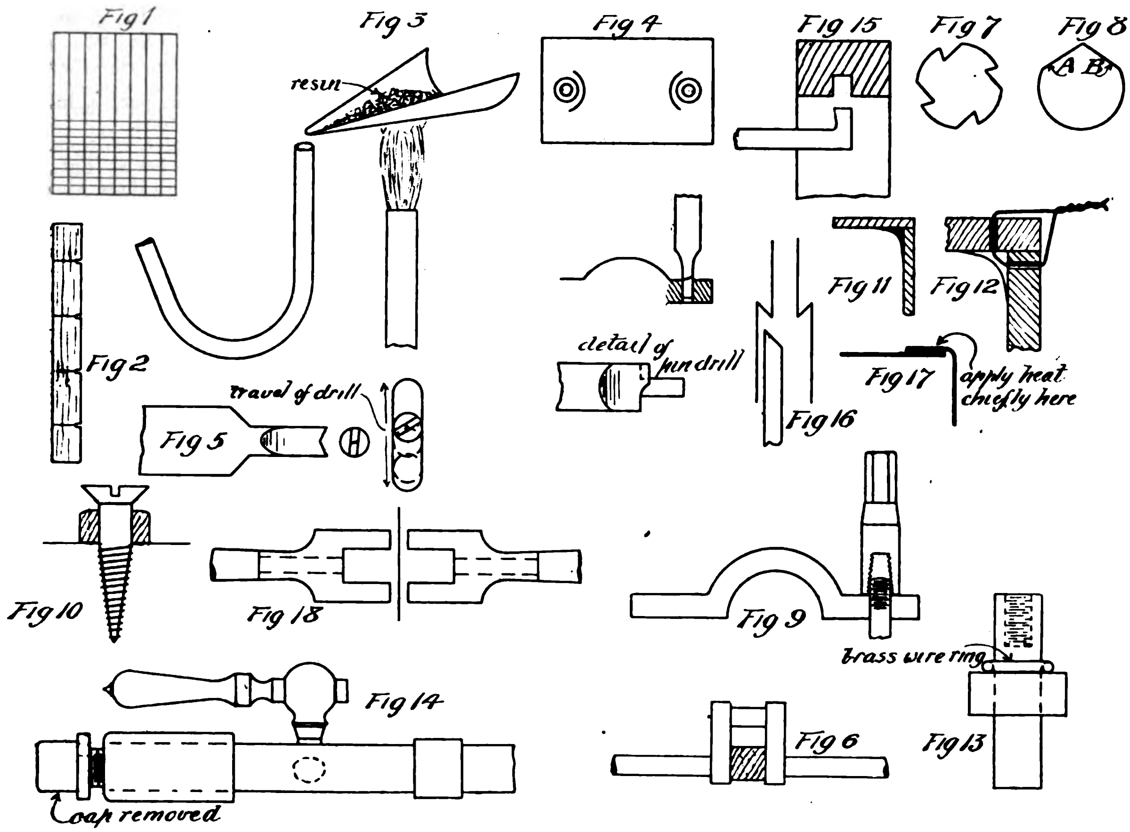
Amongst other remarks on turning and turning processes, the lecturer said that it was an axiom of his to fit a job by turning it to fit the hole, and not boring the hole to fit the job. He then asked the members to ask any questions they chose, so as to give him a lead, as he said, for further discourse. Regarding his method of tempering the small tools we had seen, he told us that he quenched right out, then the blowpipe was brought into use, and the job heated away from the end, and he watched for the colour required appearing. At the moment it appeared he quenched in the ordinary way, with water. For taps he used oil.

Fig. 7 illustrates a method of making taps for oneself. The thread is cut, and then, by means of a square file, four grooves are cut as shown, which gives a remarkably strong tap and cutting edge. The best type of reamer for fine work—*not* for taking off 1-32nd in.—is as shown in Fig. 8. It works in either direction, and it is essential to note that the full diameter is not reduced when the two flats A and B are made. After this, a number of small castings of various kinds were passed round, the lecturer remarking that he made it a practice of always keeping on hand a number of castings off these patterns, which could be used for all kinds of general work, such as for water cocks, clack valves, injectors, etc.—(laughter)—with very slight alteration.

A handy device, calculated to save much time when fitting a model together, is shown in Fig. 9. Everyone knows what a time it takes to screw on and off very minute nuts, especially in special positions where small spanners cannot be used effectively. The device shown is again almost obvious, and yet, curiously enough, seldom met with. For making coach screws, ordinary wood screws are soldered into an ordinary hexagon nut, and the head of the screw cut off, as shown in Fig. 10.

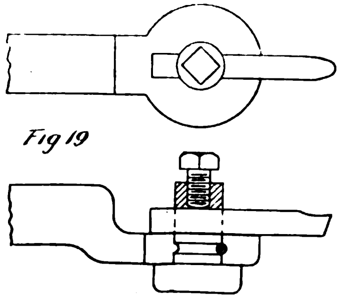
Coming on to silver-soldering, he emphasised that silver solder will run in a tight joint best, provided it is hot enough. The flux he uses for general work is simply borax mixed up to a thin cream and applied to the work. A full red heat is necessary—a little short of melting point of sheet brass. In reply to questions on methods of assembling work previous to silver-soldering, many useful illustrations were given, amongst which we show two in Figs. 11 and 12. In Fig. 11, with the solder run round the corner, as shown we get as good as a flanged joint. In Fig. 12 the two parts are held together by a threaded wire of similar or dissimilar metal, through the holes bored for it. It is twisted together as shown. The job is then proceeded with in the ordinary way, leaving the wires in. When finished the wire is cut off, and on the surface there is practically no sign of anything to be seen except perhaps a couple of small

done, to cut them in two. Reverting once more to silver-soldering, he pointed out that porous joints were frequently due to quick cooling, and emphasised the fact that the greatest heat should always be applied at the farthest end of the joint, as the solder has a natural tendency to run to the hottest point. Fig. 17 illustrates this. We are afraid that the foregoing will give but a very in-



Sketches showing Numerous Useful Model Making Wrinkles.

spots if a different coloured wire has been used. For brazing iron or steel together he recommended ordinary brass wire. Fig. 13 illustrates a job of brazing on a collar, which he carried out himself some little time ago. Gas stoves are particuarly useful for all kinds of work, and for bigger jobs where a good supply for blow pipe or furnace is required, and no proper connection is at hand, a useful plan is to take off the cap of the supply pipe fitted to all gas cooking stoves, as shown in Fig. 14. An ordinary union is then fitted, and you can take your supply quite easily to wherever it is wanted. In turning crankshafts he referred to the well-known process of fitting a distance piece between the webs, and recommended soldering it in place and leaving there until the whole job is finished. Some further remarks on turning enabled him to suggest a plan he often used himself, namely, making two of a thing in one piece, such as two crossheads, and then after all the turning, etc., is



adequate idea of the thorough practical ability with which Mr. Ferreira interested his audience on this occasion, and it is only one occasion of the many upon which he has given his services and placed his experience so readily at the disposal of the members of the London Society. We think, with them, that the hearty vote of thanks which he was accorded on this occasion was as thoroughly deserved as his lecture was appreciated.

Locomotive Notes.

By Chas. S. Lake, A.M.I.Mech.E.

Two Noteworthy Continental Locomotives.

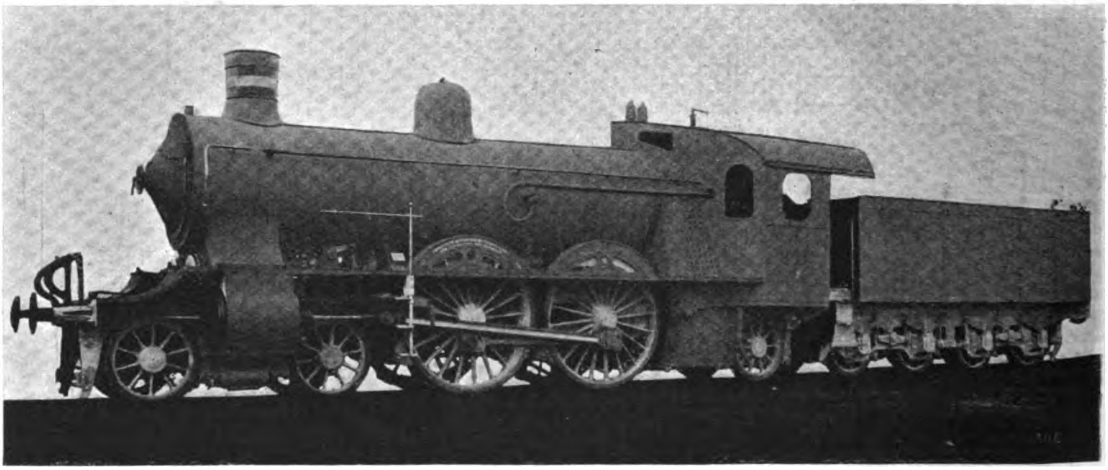
The locomotives illustrated herewith are both noteworthy as representing a marked development in the practice of the railway upon which they are employed. The first engine is an "Atlantic" type four-cylinder compound built by the Hannover'sche Maschinenbau Company for the Danish State Railways. Reference to these engines was made in these Notes at the time they were commenced at the Hanover Works, and now that the first series has been delivered it is of interest to study the design, especially as the engines are the first of their type and by far the largest locomotives yet employed in passenger service on the Danish railways. The four compound cylinders are set in line below the smokebox, with the high-pressure between and the low-pressure outside the frames. The inside cylinders drive the crank-axle of the leading coupled wheels, while the connecting-rods of the outside cylinders act on crank pins in the second pair of coupled wheels. Steam distribution to each pair of cylinders, viz., one high and the other low-pressure, is controlled by a single large piston valve worked by a Walschaerts valve gear, and the fact that the valve motion is placed inside the frames and therefore out of sight constitutes, in itself, a departure from customary locomotive practice on Continental railways. The two valve gears are worked by eccentrics off the high-pressure driving axle.

The boiler is of large size, and is fitted with an extended smokebox and the wide type of firebox, the latter resting upon the top of the frames. The smokebox front and also the front sheets of the cab are brought to a point with a view to lessening the wind pressure.

Below is given a list of the principal dimensions of these interesting locomotives :—

Cylinders diameter : H.-P., 13¾ ins. ; L.-P., 22 7-16th ins.
Piston stroke, 23⅝ ins.
Wheels diameter : Bogie, 3 ft. 6 ins. ; coupled, 6 ft. 6 ins. ; trailing, 3 ft. 6 ins.
Wheelbase : Coupled, 6 ft. 10¾ ins. ; engine total, 29 ft. 4¾ ins.
Boiler : Centre line above rails, 8 ft. 8½ ins.
Heating surface : Tubes, 2,071·05 sq. ft. ; firebox, 130·25 sq. ft. : total, 2,201 sq. ft.
Grate area, 34·75 sq. ft.
Working steam pressure, 220 lbs. per sq. in.
Weight on coupled wheels, 31½ tons.
Weight of engine in working order, 66 tons.

The tender runs upon eight wheels, but a peculiarity of its construction is that all these wheels are rigid instead of being arranged in bogies as usual. The water-carrying capacity of the tender is 4,620 gallons and 5¾ tons of fuel are carried. These locomotives, as before said, mark a very great advance upon the hitherto largest Danish express engines. They are built to the designs of Mr. Otto Busse, chief mechanical engineer of the Danish State Railways.



"Atlantic" Type 4-cylinder Compound Locomotive : Danish State Railways.

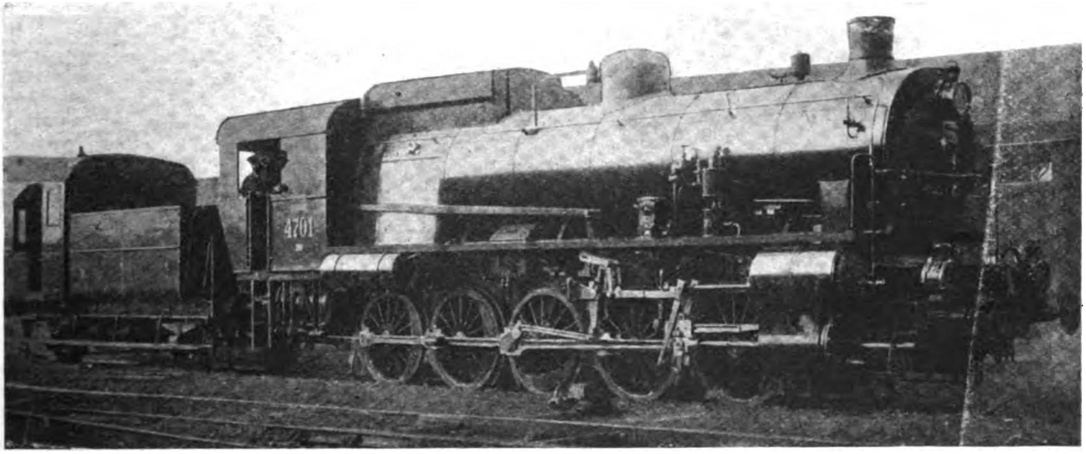
The second locomotive illustrated is an extremely large and powerful engine of the tank engine type, built at Milan for the State Railways of Italy. It has four compound cylinders driving ten coupled wheels. The cylinders are planned in the unique fashion which has already been described in these Notes when dealing with some new passenger locomotives built for the Italian State Railways during 1907. It will be remembered that the two cylinders on one side of the engine are both high-pressure ones and the two on the opposite side low-pressure. Thus we get H.-P., H.-P., L.-P., L.-P., instead of the two cylinders of the same style, whether high or low-pressure, being placed next one another between the frames, with the other pair one on each side of them. The steam distributing valves, as in the locomotive last described, are only two in number. They are large diameter piston type, working above the outside cylinder on each side. These valves govern crossed steam ports, hence the use of only one of them in conjunction with four cylinders. Starting mechanism is provided, andt his is so arranged that when the regulator is open a hole in the seating of the semi-balanced throttle valve is uncovered, and steam is introduced into the receiver by means of a pipe and a slide-valve attached to the extension-rod of the high-pressure piston valve. By keeping the regulator about one-eighth full open, the driver can admit boiler steam to the low-pressure cylinder, but at a greater opening the hole in the seating is covered and the engine works compound.

The boiler is of large proportions with wide fire-box, and the extended smokebox contains a spark arrester and a variable blast pipe.

A four-wheeled tender is attached to the engine, and this is fitted with a brakesman's hut so that in one sense the engine can hardly be properly described as a tank engine, although it is complete in itself with enclosed cab and two sets of buffers and buffer beams as in an ordinary tank locomotive, and not as in an engine intended for coupling up to a tender.

The leading dimensions are:—

Cylinders diameter: H.-P., 15 ins.; L.-P., 24½ ins.
Piston stroke, 26 ins.
Wheels diameter, 4 ft. 6 ins.
Wheelbase, 20 ft.
Boiler: Diameter, 5 ft. 2 ins.; length between tube plates, 17 ft. 2 ins.; height of centre line above rail, 9 ft. 4 ins.
Total heating surface, 1,653 sq. ft.
Grate area, 32·4 sq. ft.
Steam pressure, 212 lbs. per sq. in.
Height, rail to top of chimney, 14 ft. 2 ins.
Length over buffers, 41 ft. 5 ins.



TEN WHEELS COUPLED 4-CYLINDER COMPOUND LOCOMOTIVE: ITALIAN STATE RAILWAYS.

THE "SINGLE DRIVER" AGAIN.

As though to further drive home the fact that the single engine is by no means obsolete even in these days of heavy train loads, a point dealt with in a previous Note on the suggestion of a correspondent, the writer recently had the pleasure of being in a Great Northern train which was hauled by one of Mr. Ivatt's bogie "singles," namely, the pioneer engine of the class No. 266, from King's Cross to Grantham, 105 miles, in 1 hour 58 minutes. The load was not less, and probably a good deal more, than 250 tons, and the engine never seemed to have any difficulty, whether on the up grades or not, in keeping this heavy train moving at a merry pace. She passed Potters Bar in 20 minutes, and Hatfield in 26 minutes, and was well on time when passing through Peterborough. This, with an engine having such a small amount of adhesion and on a wet night, is real good work.

A BRITISH BROTAN BOILER LOCOMOTIVE.

Messrs. Beyer, Peacock & Co., Ltd., recently delivered to the British Mannesman Tube Company, Ltd., of Landore, a four-wheeled side tank locomotive fitted with the Brotan type of boiler, and the engine is believed to be the first in this country to have a complete water-tube firebox. The boiler consists of a main barrel containing smoke tubes, and above this is a parallel drum connecting with the lower portion through two necks or saddles. The upper drum at its rear end consists on the underside of a thick tube plate in which the water-tubes are secured, and at their lower ends these tubes are expanded into a rectangular cast steel circulating chamber connected to the underside of the main barrel, at its rear end, by a large pipe. This chamber has a number of holes on its underside and these correspond with the water-tubes for the purpose of expanding the latter into the upper wall of the chamber. The holes are closed by doors which can be removed for inspection purposes without its being necessary to interfere with the setting of the boiler as a whole. The engine has four wheels, the rear pair being driven by outside cylinders, steam to which is distributed by Walschaerts valve gear

Some Exhibits at the N.Z. International Exposition, Christchurch.

By "A Londoner Abroad."

(Concluded from page 106.)

ANOTHER very creditable piece of work was the vertical boiler by Mr. H. G. Coker, shown by the drawings (Figs. 22 and 23). The drawing is very fully dimensioned and leaves little to describe, but the following facts will be of interest :—

There are three Galloway tubes in the boiler, the diameter of each being 1¼ ins. outside on the large end and ⅞ in. diameter outside on small end. They are made of ⅛-in. plate bent on a mandrel, 1 in. diameter, tapered to ⅝ in., and then brazed, keeping brazed seams to the top of box, so as not to be affected by the fire. They are placed crossways, as shown in drawing. No. 1, or longest, is 6¼ ins., adding ⅝ in. for beading over after expanding into place (height in box, 3⅝ ins.); No. 2, 5¾ ins. long, or 6⅛ ins. over all (height in box, 5¼ ins.); No. 3 is 5⅜ ins., or 5¾ ins. over all (height in box, 6⅝ ins.). The firehole is 1¼ ins. in diameter; the ring is made on the bevel on one side only, as shown in section, being 2¾ ins. diameter over all, and set to the circumference of the boiler or firebox. The best way is to turn this up in a lathe, and then set it in the boiler, afterwards making it hot to ensure it fitting into position. The foundation ring is ¾ in. by ¼ in., welded. The rivets around firehole ring and at the foundation are all countersunk on the outside.

The cost of material is as follows: Plates, 6s. 6d.; rivets, 1s. 3d. It would be hard to state the exact time taken to build the model, but, roughly, it is about ninety-six hours. The only trouble experienced was in brazing in the uptake into the crownplate of the firebox, but perseverance overcame that.

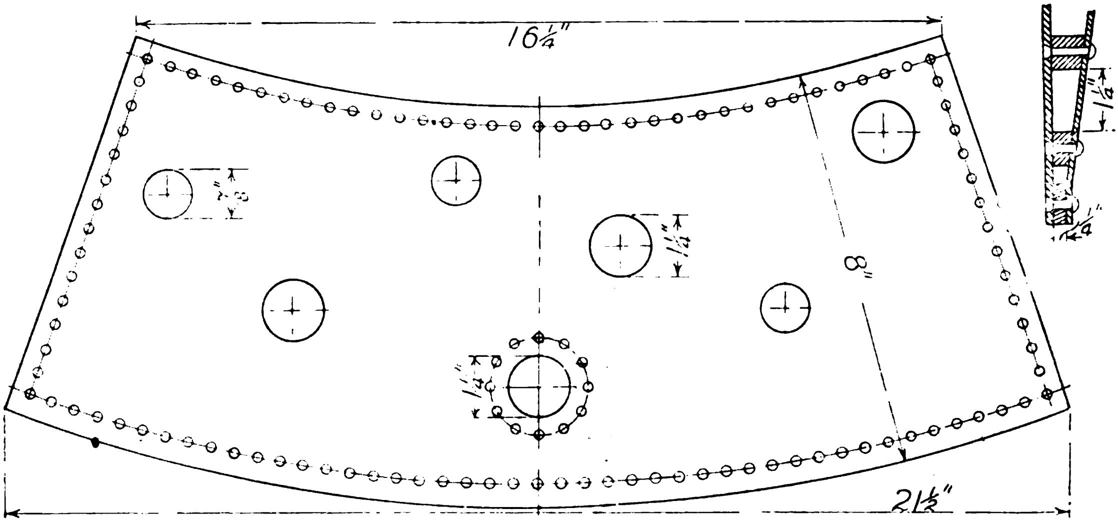


Fig. 23.—Showing Detail of Firebox Plate for Model Boiler.

A "first attempt" was the descrpition given by Mr. R. G. Ekins of his little model horizontal engine (shown in Fig. 24), the photograph of which perhaps hardly does justice to the workmanship. As an example of a type of engine that will always be honoured amongst engineers (model or otherwise), this little machine should interest other beginners. The builder makes the following statements in regard to its construction :—

"This, my first attempt in model engine building, took me about three months. The cylinder is double-action, ¾ in. bore by-1½-in. stroke, with 1-16th in. for cushioning. The flywheel is 3¾ ins. diameter by ½ in. I started by making the pattern of the cylinder, which was cast in brass. I then bored it out. The two ends I turned out of solid brass. Then I cut the ports with a small cold chisel made from a small file. I then made the patterns of the valve and chest, which were also cast in brass. The packing gland was off a bicycle pump. The two ends and chest were screwed on with 3-32nds-in. brass screws; the piston has a groove in it for packing. The piston-rod is a ⅛-in. silver steel knitting needle. The fork connecting-rod was also cast in brass. The crankshaft was sawn out of 1-in. by ¼-in. mild steel and turned in the lathe. The eccentric was turned out of solid brass, with boss left on for setscrew. I then made the patterns of the flywheel and the base, which were cast in iron. The rim of the flywheel was turned to give it a good finish. Then I put it together and gave it a coat of green paint, and the spokes of the flywheel black. When dry, I lined it in silver paint. This little engine will drive a small churn, and works at a good steady speed. The materials used cost me about 3s."

I am now at the end of my tether. Not that the few examples comprised in these articles were all that appeared in the exhibition, but they are all I am able—either by the incomprehensible actions of some exhibition authorities or for other reasons—to present to readers of The Model Engineer. I do not think I claim too much when I suggest that New Zealand model makers have every reason to be proud of their skill, not merely "considering," but absolutely as compared with, the work of their co-mates in England.

Model makers in New Zealand are necessarily

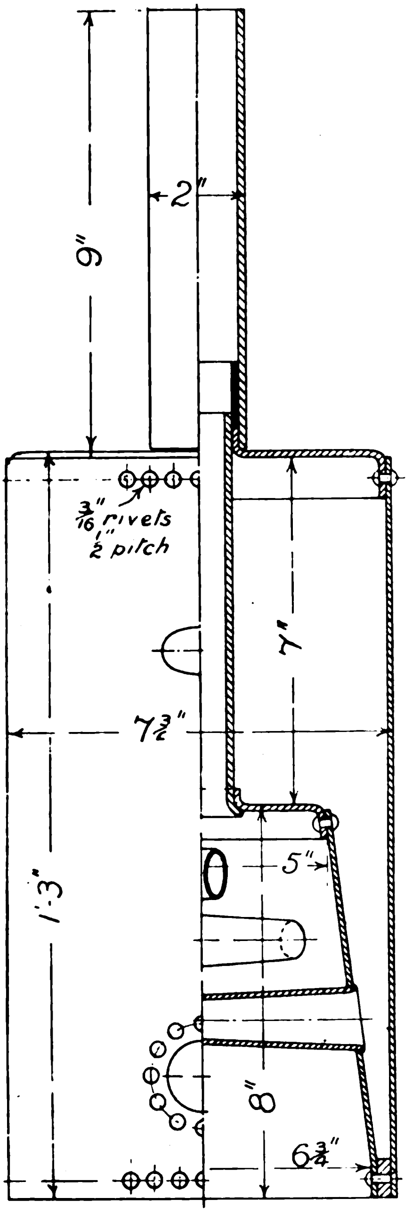


FIG. 21.—HALF SECTIONAL ELEVATION OF MR. H. G. COKER'S VERTICAL MODEL BOILER. (*Scale: Quarter full size.*)

scattered over a wide area, and the number in any one centre cannot be very great. But the present writer would suggest that they are not so far apart nor so few as to make combination an impossibility. It seems quite time that branches of the Society of Model Engineers should be formed at least in Auckland, Wellington, Christchurch, and

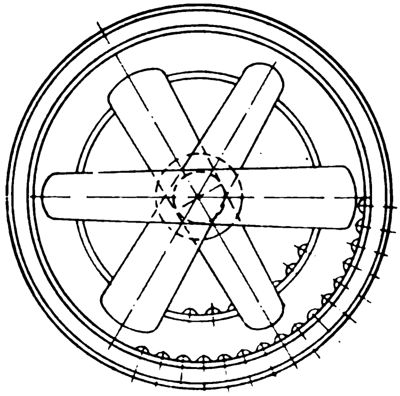


FIG. 22.—UNDER SIDE PLAN OF BOILER, SHOWING WATER TUBES.

Dunedin. Surely, if but one faithful spirit be found in each of those centres, the formation of a Society would be a fairly easy and congenial task for him.

I would suggest to those to whom this particularly appeals that an advertisement be inserted in the local paper, asking interested persons to communicate with advertiser, with a view to the formation of a branch of the Society of Model Engineers. Preliminaries would then soon be arranged, and

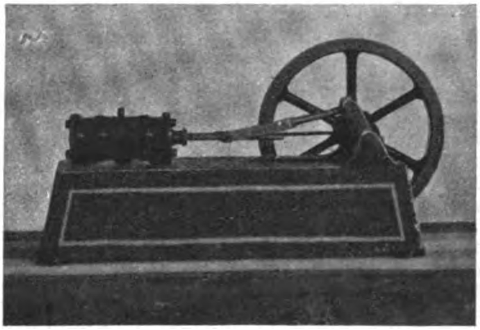


FIG. 24.—MR. R. G. EKINS' MODEL HORIZONTAL ENGINE.

the (perhaps provisional) Secretary could be advertised in THE MODEL ENGINEER, after which the whole thing would be regularised and the branch established on a firm footing. At all events, it is obviously worth trying, and with that suggestion I leave for the present the subject of New Zealand model making.

To bronze iron wire, the iron is galvanised by laying it in very dilute hydrochloric acid, in which it is in contact with zinc, then dip it in a solution of four parts of blue vitriol and three parts of tin chloride and pass it finally through the drawing iron.

How to Become a Mechanical Engineer.

By ALFRED W. MARSHALL, M.I.Mech.E., A.M.I.E.E.

(*Continued from page 114.*)

A NUMBER of eminent engineers have recently formed a committee, appointed by the Council of the Institution of Civil Engineers, to consider the question of "Education and Training for Engineers." Their report, adopted April 24th, 1906, is full of valuable opinions and advice, representing not only the views of the members of the committee, but of a number of engineers of whom enquiries were made. The report states that it is desirable that a boy intended for the engineering profession should, before leaving school and commencing to specialise, have attained a standard of education equivalent to that required by the Institution Studentship Examinations, and that he should not commence his special training until he is about 17 years of age. Greek should not be required, but an elementary knowledge of Latin is desirable. The study of Latin should, however, be discontinued during the last two years of attendance at school, or after the standard required for the leaving-school certificate has been attained. Modern languages, especially French and German, should be studied. The geometrical side of mathematics should be fostered, and before they leave school boys should be conversant with the use of logarithms, including the solution of triangles. It is preferable that boys should attain at school a general knowledge of elementary physics and chemistry, or what is sometimes called natural philosophy, rather than that they should pursue in detail some particular department of science. Special attention should be given to drawing. The instruction should include ordinary geometrical drawing with orthographic projection, curve drawing, freehand drawing, and practical mensuration. Work in the nature of handicraft, such as carpentry or turning, or elementary field surveying, may be encouraged as a recreation, but should not be required as a school exercise.

The committee were unanimous in the opinion that engineering training must include several years of practical work as well as a proper academic training. The average boy should leave school when he is about 17 years of age. Much depends upon the development of individual boys, but the minimum age should be 16 and the maximum 18 years. The practical training should be divided into two parts whenever that arrangement can be made, and the preliminary stage of practical training should consist in all cases of at least a year spent in mechanical engineering workshops. Where the introductory workshop course is possible before the college training, it should not be less than one year, nor more than two years. Nothing should be done in the form of evening study which would impose undue strain upon the physique of boys. However, many boys can attend evening classes without physical injury and with no little educational advantage. The committee think it is most important that all boys should at least maintain their scholastic acquirements during the introductory workshop course. Nothing should be done to discourage boys who so desire, and are physically fit, from adding to their knowledge, either by private study or by attendance at classes.

As a rule, it is preferable to proceed to a technical college or university on the completion of the introductory workshop course. In some cases—as, for example, when boys are intended to become mechanical engineers—it may be advantageous to complete the practical training before entering college; but if this be done, it becomes more important that simultaneous education during practical training should be secured by private tuition or in evening classes; otherwise boys would lose seriously during four or five years' suspension of systematic study, and would be disadvantaged on entering college. For the average student the period of college study should be three sessions, provided he is well prepared before entering college.

A sound and extensive knowledge of mathematics is necessary in all branches of engineering, although some of these branches require more advanced mathematics in their practice than others. The capacity for acquiring mathematical knowledge varies greatly in individual students, and many who become competent engineers have not the power of acquiring the higher mathematics. A sufficient time should be allotted to the study of pure mathematics during the common college course, to permit the best students to obtain a sound knowledge of algebra, trigonometry, analytical and practical plane geometry, the elements of solid geometry and a working knowledge of the differential and integral calculus, and of the simpler differential equations. To this must be added instruction in applied mathematics and mechanics. In the judgment of the committee it is most important that, when teachers consider that individual students are lacking in the power of proceeding successfully with their higher mathematical studies, time should not be wasted in persevering therewith. At least three to four years should be spent in practical training, inclusive of the "introductory workshop course" previously mentioned. The committee recommend strongly efficient instruction in engineering drawing.

Though the position of attendant-in-charge of a steam engine, or similar machine, need not necessarily be an artisan, in many instances they are required to be so. Drivers of locomotive engines are a notable exception. They are trained specially as such, and have not, as a rule, received a workshop training. For service abroad, or on lines in remote districts, they may be required to undertake repairs to the engine as well as drive, and therefore men who have received a training as fitters and turners are selected. Men who have charge of the engines and auxiliary machinery on board ships are required to have a workshop training for similar reasons. They must also have theoretical knowledge of steam, the action of pumps, and combustion of coal and other fuels in furnaces, inorganic chemistry and mechanical drawing.

In seeking "how to become a mechanical engineer" a youth should first try to decide the meaning which the term conveys to himself. In any case he will be taking a safe course by serving a term of instruction in the fitting and turning workshops. These are to be found not only in the establishments of the firms existing as manufacturers of engines and machinery, but in connection with large industrial concerns. Some of these, such as mines, tinplate and ironworks, railways, and so on, have engineering departments, which comprise several if not all of the separate trades included in mechanical engineering. A lad wishing to enter

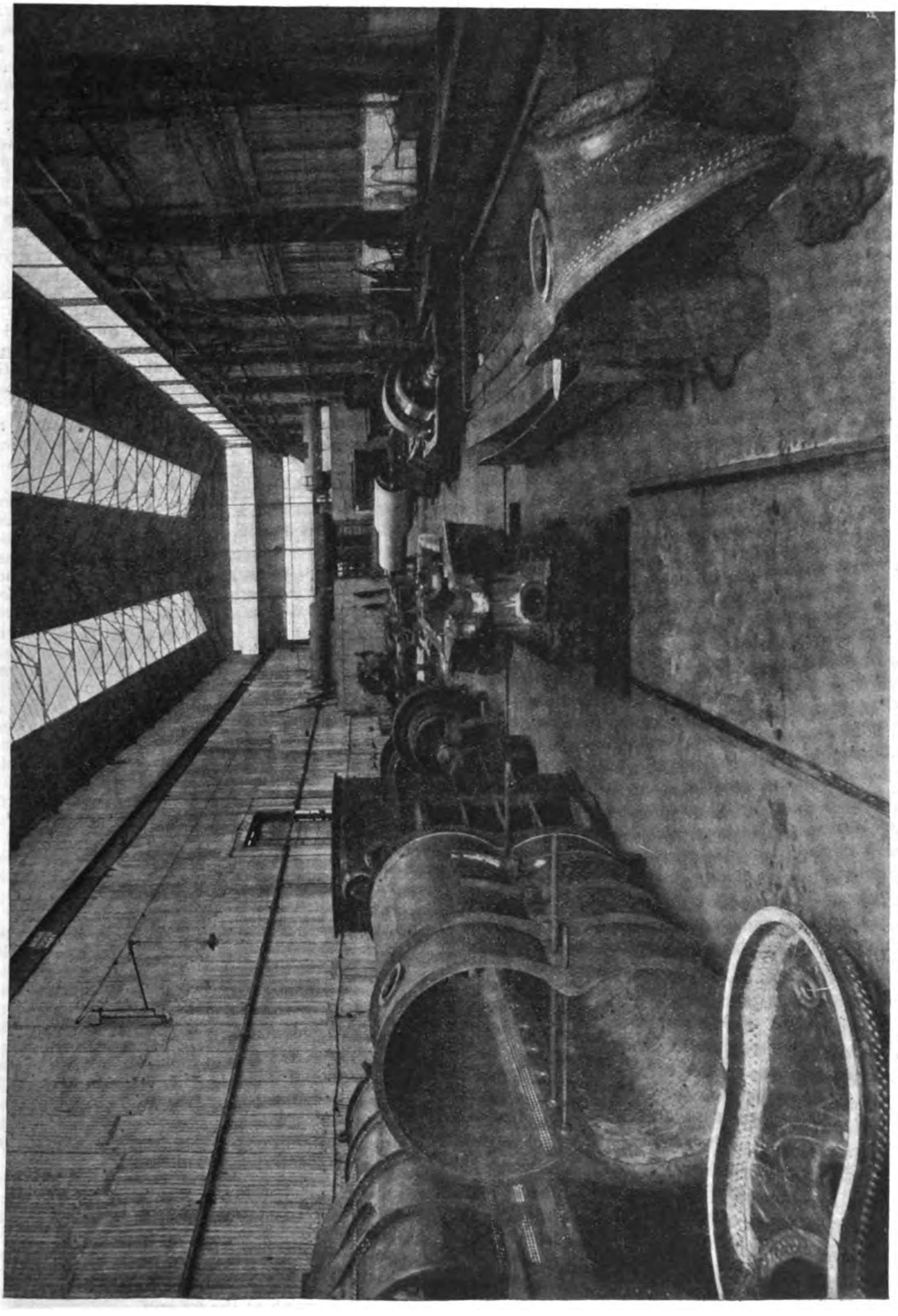


FIG. 8.—ONE BAY OF TURBINE SHOP: MESSRS. J. I. THORNYCROFT'S SOUTHAMPTON WORKS.

engineering workshops should, therefore, not only make application to firms of manufacturing engineers, but to any large industrial concern in his neighbourhood, enquiring if they have an engineering department and would receive an apprentice. If he desires to earn his living as an artisan it is advisable for him to consider which department of the workshop will teach him the more remunerative trade. A conversation with one of the foremen or a good mechanic will help to decide this. Having made a selection he should devote his attention to becoming as skilful as possible in his work, adding book knowledge bearing upon the subject to an extent within his capacity.

The youth who desires to become a designer of machinery should endeavour to arrange a combined course of workshop training and college study. He may spend his days in the workshops of an engineer and his evenings attending lectures at a technical college or studying at home. This is, physically, an exhausting method, but to the majority who have small means usually the only one. There are courses to be obtained at technical colleges where practical workshop training is included, but it cannot properly take the place of practice in the workshops of an engineer or those attached to some industrial concern. A youth who is unable, through want of funds, to pay a pupil's premium, or lucky enough to be entered at a workshop where this is not required, should make workshop training his first consideration, and serve a term of at least three years, attending evening classes as far as his strength and means permit. In many towns there are technical institutions where courses of theoretical study in engineering subjects can be attended at very moderate fees. Some of these institutions are equipped with laboratories in which the students make experiments with apparatus specially arranged to supplement theory by practical investigation. A student desirous of advancing his theoretical knowledge as much as possible should ascertain from his teachers if any scholarships are open for competition. These, such as the Whitworth Scholarships, founded by the celebrated mechanical engineer, Sir Joseph Whitworth, are of great advantage to the student of moderate means, and enable him to obtain a scientific engineering training at small expense. There are also "correspondence schools" of engineering by which theoretical instruction can be obtained through the post, so that an apprentice living away from a large town is not out of reach of a scientific training to add to his practical experience. Such institutions can be found by reference to the advertisement columns of technical journals. A system of training by which theoretical instruction is sandwiched in between periods of practical work is also advocated. The pupil would spend the six winter months each year at a college, and the six summer months in an engineering workshop, the periods alternating in this way during the whole of his pupilage. It is possible to do this in some instances where engineering firms have supported the idea, but, so far, the system has not come into extensive practice. A good knowledge of machine drawing is absolutely necessary. This may be obtained by spending part of the pupilage time in the drawing office of the engineering works. In this department the designs and plans are prepared, to which the machines or engines will be made. Even in the actual delineation upon the paper, theory is of assistance to proper understanding, as engineering drawing work is the application of plane and solid geometry to a practical use. The pupil need not be an expert in draughtsmanship; it is sufficient for him to be able to make a fairly neat, accurate drawing, and he must know how to read drawings which have been made by others. Practice in freehand and perspective drawing is also required. An engineer who is a designer will be frequently making rough sketches of machine parts and give them to draughtsmen, who will prepare the drawings for use in the workshop. If an apprentice has no opportunity of entering the drawing office of the firm with whom he is serving, he can obtain a very good training by attending evening classes for machine drawing and geometry. The knowledge thus acquired can be quite sufficient to serve his purpose as a designing engineer, but it would be well to try and obtain a short term of employment in the drawing office of some engineering works that he may become familiar with the routine practice.

So valuable is intimate acquaintance with the actual conditions under which engines and machinery are commercially made that experience in this direction should be widened as much as possible. It is of advantage to join one of the recognised engineering bodies, such as the Junior Institution of Engineers, which was specially founded for the junior members of the profession, or the Institution of Mechanical Engineers, as a graduate, which he may do when he has attained the age of eighteen years. By doing this he will come into contact with other members, hear papers read upon various subjects connected with engineering, and have opportunities of discussing them; visits are also made to works and objects of technical interest.

The work done in the workshop shown in Fig. 8 is a recent development of steam engine design and practice, viz., the construction of steam turbines. Instead of the large number of rods, levers, links, brackets and fittings with the crankshaft, bedplate and cylinders which are comprised in direct-acting engines, steam turbines consist of two principal parts—the rotor and the casing. The photograph (Fig. 8), therefore, presents a great contrast to Fig. 2, where Messrs. Thornycroft erect their direct-acting engines. They are both erecting shops, and illustrate very well how varied in character the work of a mechanical engineer or artisan may be. Simple though the rotor of a steam turbine looks, it is made up with thousands of thin blades, each of which requires to be made and fixed in position with great accuracy. The whole construction must finally be in perfect balance, as it will revolve with great speed when at work, and would set up fatal vibration if it did not run truly balanced. It may be doing work at the rate of thousands of horse-power under impact of steam exerting a pressure of 200 lbs. or more per square inch in the boiler. The blades of the rotor are placed in rows, and a very small clearance space is allowed to exist between them and the fixed parts in the casing.

A very high grade, indeed, of scientific knowledge has been applied to produce this class of steam engine and develop it to an efficient stage so that it could become a commercial success. Exceptional mechanical skill and ingenuity have been required to design and make the parts of sufficient strength to withstand the working strains. A rotor is in the centre of the photograph at the far end.

(*To be continued.*)

Elementary Ornamental Turning.

By T. Goldsworthy-Crump.

(*Continued from page* 10.)

ANOTHER example of the use of this pattern for box or cylindrical ornamentation is shown in the small snuff box illustrated in Figs. 11, 12, 13, and 14; Fig. 11 being a side view, Fig. 13 top of box, Fig. 12 inside of top, and Fig. 14 inside of bottom. The general mode of procedure is as previously described. A piece of xylonite or ivory is taken of the necessary size and suitably chucked, and the inside of the top hand-turned to general form and the internal thread chased. A drill No. 1 or No. 2 is then used to produce the fluted star. The 96 circle on the division plate is required, every third hole being used to produce the 32 flutes. The portion to form the cover is now severed from the block, and the latter is then hand-turned on the outside and the external screw chased to nicely fit the thread previously cut in the cover. The cover is now screwed well home, care being taken to see that a perfectly even joint is formed between the lid and the bottom as any discrepancy here will be most noticeable.

The lid should now be hand-turned to general form, the centre being left plain for monogram or initial. The central portion of ornament is produced with a cranked drill as shown in No. 30, but with a cutting edge as shown in No. 36; the diameter of circle cut being equal to the distance from A to B in Fig. 11*a*. It will be seen that the penetration is deeper on one side of the circle produced than on the other, which was obtained by setting the drill spindle at a slight *vertical* angle by means of packing under one end, thus producing a different result to that previously described as movement E, the idea of the pattern being to lead the eye to the initial. In forming this pattern it will be noticed that the position of the drill is eccentric and so arranged that the various cuts clear the centre. The ring of beads is formed with a small bead tool as Nos. 4 or 5, 32 being required, the divisions being obtained from the 96 circle. Now it would have been better to have used an even division for the beads instead of every third hole, and made the number say 48 or 24, as by so doing there would be no difficulty of placing the small exterior cuts exactly halfway between each bead. However, the beads having been completed, it will serve to show how the difficulty can be overcome. The index pointer being in engagement with a hole in the division circle corresponding to the position of one of the beads, wedges or other means are used to firmly hold the mandrel. The pointer is then withdrawn and adjusted to exactly one and a half holes away, either up or down, and secured. The wedges can now be removed, and the dividing proceeded with. These cuts are produced with the bead tool, the

Fig. 11.

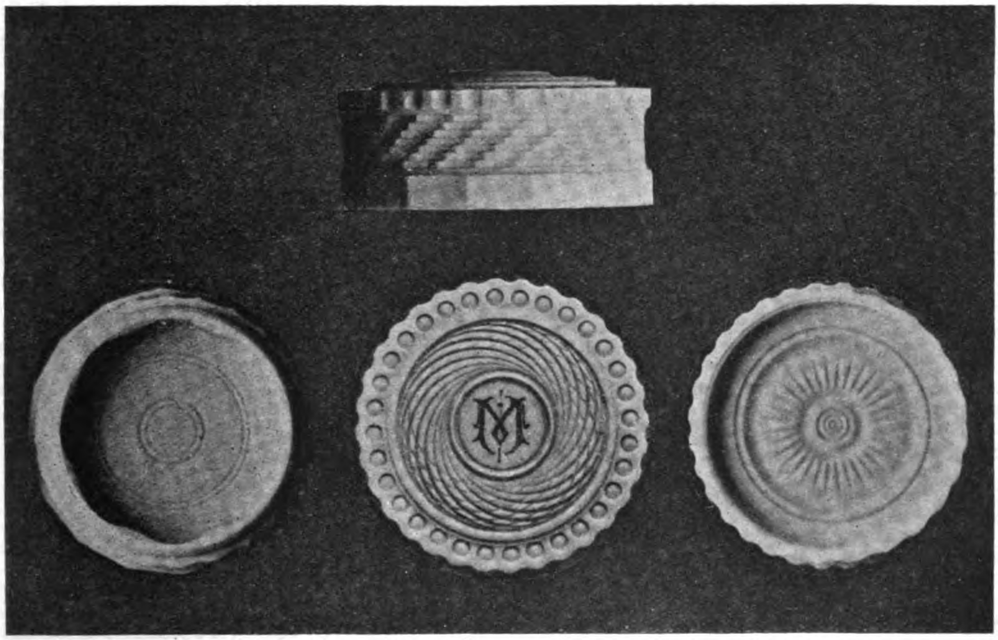


Fig. 12. Fig. 13. Fig. 14.

Ornamental Turning: A Snuff Box.

spindle being so adjusted that the tool is only in cut during a portion of its revolution. The basket pattern can now be cut as previously described, but with this precaution. The first ring should be cut on the edge of the lid so as to exactly cut on the line of division between the top and bottom of the box, as by so doing the line of juncture will not be noticeable in the pattern when the lid is properly screwed up. The drill should be of smaller radius and width than used for the previous example.

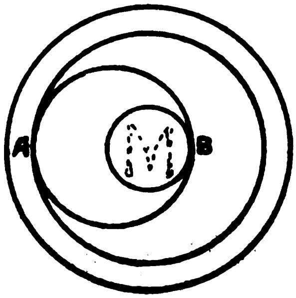


FIG. 11*a*.

The inside should now be bored out and polished and the rings turned in the bottom with a point tool. The same cranked drill as was used for the basket pattern is used to produce the eight internal semicircular cuts, the amount of penetration and depth of cut being carefully adjusted.

The work is now unchucked and remounted, using the inside of the box for this purpose. The underside is now hand-turned and slightly recessed, and the sixteen flat facets are produced with a crank drill as No. 24, every sixth hole being used on 96 circle for the necessary divisions, the drill spindle being set at right angles to the line of centres. The box is now complete with the exception of the monogram, which should be neatly executed with a graver and filled in with heelball.

In Fig. 15 is shown a small example of step drill-work on the hollow cylinder. A piece of wood about 2 ins. in length by 1 in. in diameter is held in a grip chuck and bored out. A wooden mandrel is now made to be a good fit and carefully inserted. A step drill, such as Nos. 7, 8, or 9 by 15-100ths is selected, and the index pointer adjusted to the 144 division circle for the 18 rows of holes required, every eighth hole being used for this purpose. The longitudinal divisions are obtained with the slide-rest screw, which, having ten threads per inch, and the drill having a diameter of 15-100ths, allows each hole to cut into its neighbour, and each revolution of the screw shifts the drill the required distance of 10-100ths in., and so on for the thirteen holes required in one row. The work is then revolved the required distance, and the next row cut, and so on, until the 234 holes have been completed. The question may be asked, of what use is the inserted mandrel or plug? There are two reasons: Firstly, to give support to the very thin cylinder while being operated upon, and, secondly, to receive the point of the drill and ensure a clean and perfect cut. The mandrel should be bored out nearly to its diameter before attempting to withdraw it, when, by means of a fine chisel or other tool, it may be carefully cut through in one or more places, when it can be removed without damaging the work. In nearly all hollow work it is advisable to use a mandrel, as generally the design and substance of the material are somewhat delicate and require all available support during execution.

As there may be some readers of these articles who may not desire to practise the fine work or do not possess the necessary division plate required for the production of closely divided work, it is proposed to shortly consider some of the various

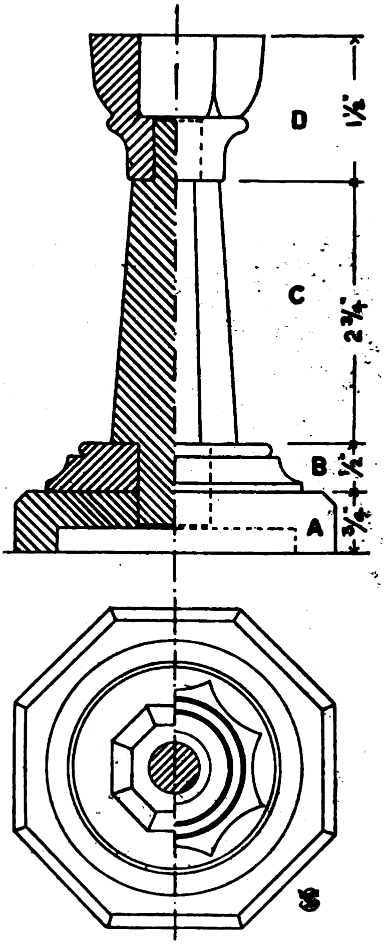


FIG. 16*a*.

solid forms with simple divisions which can be obtained from, say, the back gear wheel of a lathe or similar means.

In Fig. 16 is shown a pair of oak candlesticks made with two cranked drills and eight divisions, obtained from a gear wheel as above. Each candlestick consists of four pieces as shown in Fig 16*a*, and the method of their production was as follows. The wood having been roughed out, the portions marked A were first taken in hand. Each piece being held in a grip chuck, the underside was turned to a true surface, and a recess formed 2½ ins. in diameter by ¼ in. deep for the purpose of re-chucking.

Two wood chucks are now carefully faced and turned down at the end to 2½ ins. diameter, with a bare ¼ in. projection, and the pieces A were fitted and then glued up. It is always advisable in making a pair of articles to have them separately chucked, as there is not only a great saving of time in changing tools and the different adjustments, but both can be made absolutely alike as one setting is used for the production of both pieces. The glue having thoroughly set, the pieces were truly faced and turned to the largest diameter over the angles of the octagon, and ¾-in. hole bored in the centre. A cranked drill No. 24 with a radius of ¾ in. was used for producing the flats, the gradual penetration being given by the cross-slide and the travel by the main slide until the adjacent flats produced a sharp angle when a stop was fixed so as to secure each face being exactly alike.

After the lower portion of the first base was completed the chucks were changed and the second one cut. The slide-rest was then swivelled to 45° and the bevelled portion cut, the depth being secured by a stop. The first chuck was then replaced, being careful to see that it screwed up to its original position and its bevelled edge completed. The pieces B require but little explanation, as they are produced by hand turning alone and have a ¾-in. hole bored in the centre. The pieces C are first

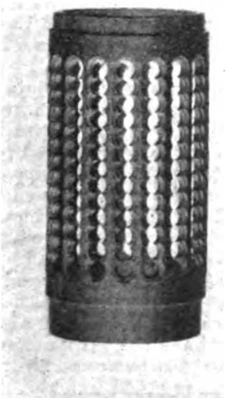


Fig. 15.—Showing an Example of Step Drill Work.

chucked in a grip chuck and the back centre brought up when the ¾-in. portions are turned to fit the bases. The work is then reversed and the top end turned down to ½ in. and of such length as to leave 2¾ ins. between the shoulders. The slide-rest is then set over to the amount of taper required or otherwise the work must be held between centres and the back poppet set over. The same drill divisions and remarks apply to the execution of these parts as previously described for the bases.

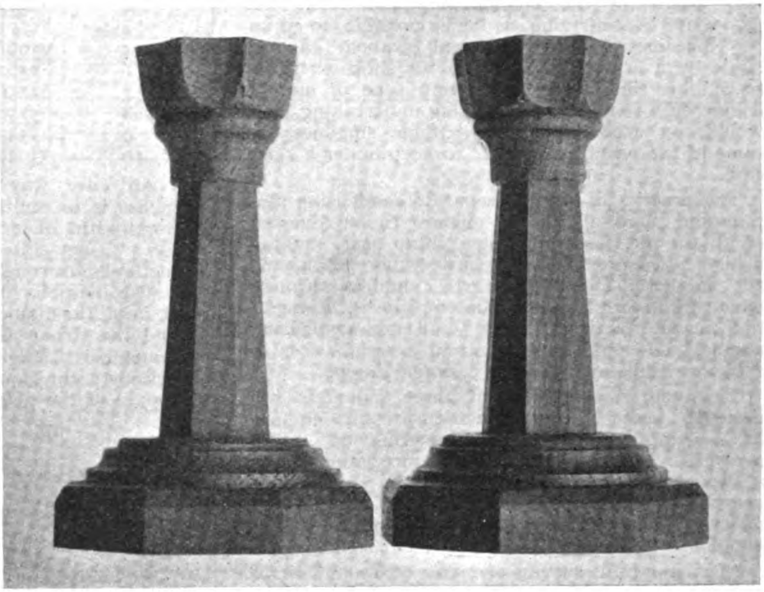


Fig. 16.—Ornamental Turning: A Pair of Oak Candlesticks.

The tops D are first held in a grip chuck and a ½-in. hole bored through. This hole is then enlarged to ¾ in. to a depth of ⅞ in. Two wood mandrels are now prepared in separate chucks to well fit the ¾-in. holes and the tops are chucked in this manner. The general form is then hand-turned and the eight semi-circular cuts produced with a drill No. 37, having ¾-in. radius, the side-rest remaining at the same angle as for shafts C.

The various parts, now being completed, can be assembled and glued up, care being taken that all the faces are in line with each other. The candlesticks may be fumed or oiled, according to the finish desired.

(*To be continued.*)

The *Scientific American* gives the following formula for ebonite:—Melt and mix 100 parts of india-rubber, 45 parts of sulphur, 10 parts of gutta-percha. Run in a suitable mould that is not affected by sulphur, and expose for two hours to a temperature of 600 deg. Fah.

It is reported that a wireless alarm system has recently been invented by a Chicago electrician. "This system will," says the *Electrician*, "allow a policeman on his beat to be called up from his central office. The receiving apparatus may be carried in the pocket or helmet, and on the signal being given from the head office a bell in the pocket will ring. The inventor is now engaged in perfecting his apparatus, with which it is hoped some tests may shortly be carried out."

Design for a Small Compound Marine Type Engine.

By W. Muncaster.

In designing the engine here described, the writer was striving, as far as possible, to go on the lines of the scout and gunboat engines made by a firm of engineers in the shop where he served his time. A copy of any type of marine engine on a reduced scale is a big undertaking, and would, on account of the extreme smallness of some of the parts, only be fit to keep under a glass case.

The practice of using a separate condensing and pumping plant allows the engines to be divested of all the air, feed, and bilge pump gear, making a high speed possible, and considerably simplifying the engines. The use of three cylinders, through which the steam is passed successively, is, however, not at all practicable in a small non-condensing engine, and could only result in a serious loss in economy as compared with a simple engine.

Two courses are open if three cylinders are desired: make three simple high-pressure engines or a compound arrangement having one high-pressure cylinder and two low-pressure, each having a capacity of one and a quarter times the high-pressure cylinder, the cranks being set at 120 degs. apart. If the diameters were in the proportion of about 8 to 9, the area would be about right.

After a careful survey of many compound high-pressure engines, the proportion of 1 to 2¼ for the capacities of the high- and low-pressure cylinders was decided on as being the most likely to work with some economy, or, at least, equal to a simple high-pressure engine. The idea is to make an engine to some extent similar to the marine engine rather than to obtain the best result for the least expenditure of labour and material. The outcome of further consideration was a two-cylinder compound of a size that might be useful for driving a lathe or drilling machine if required, substantially built so as to stand the consequent rough usage.

Then the opportunity suggested itself of working to the metrical scale for the sake of the experience to be gained in the use of it, and to become to some extent familiar with expressing one's self in millimetres. The difficulties to be met in working to the metrical scale strictly throughout were soon apparent, especially when it came to bolts, taps, and drills. As, however, the experiment was likely to result in picking up a lot of useful information, it was decided to attempt it, and the metrical scale was adopted, at the same time using what drills, taps, bolts, gauges, etc., of English practice were available. To this end it was agreed that in speaking of the diameter of bolts and studs, 2 mm. should mean 3-32nds in., 3 mm. = ⅛ in., 4 mm. = 5-32nds in., 5 mm. = 3-16ths in., 6 mm. = ¼ in., 7 mm. = 9-32nds in., 8 mm. = 5-16ths in., which would be the largest size likely to occur in an engine of the size suggested.

The annexed table gives the corresponding list of screw threads, according to the "Système International" coming largely into use on the Continent.

Table of Metrical Screw Threads, Système International.

Dia. of bolt, mm.	Dia. of bolt, inch.	Dia. to nearest 1-64th in.	Pitch in mm.	Threads per in., approx.
3	·1181	⅛	0·55	46
3·5	·1378	9-64	0·55	46
4	·1574	5-32	0·7	36¼
4·5	·1771	11-64	0·7	36¼
5	·1968	13-64	0·85	30
6	·2362	15-64	1	25⅛
7	·2756	9-32	1	25½
8	·3150	5-16	1·25	20⅓
9	·3543	23-64	1·25	20⅓
10	·3937	25-64	1·5	17

An easy way of converting millimetres into inches is to multiply by 4 and treat the result as hundredths of inches, or multiply by 2 and divide by 3 to get sixteenths of an inch. Both of these methods are roughly approximate only.

The diameter of the H.-P. cylinder was taken as 50 mm., the diameter of the L.-P. cylinder as 75 mm., and the stroke as 60 mm., all being figures easily remembered. The stroke being the same in both cylinders the capacities will be in proportion to the square of the diameters

$$\frac{50^2}{75^2} = \frac{1}{2\cdot25}$$

the capacity thus being approximately equal to an engine 2 ins. and 3 ins. by 2¼ ins. stroke, a very handy size for those not accustomed to delicate work.

Figs. 1 and 2 show the general design of the engine. It will be seen that the usual features of the larger types of gunboat engines are retained, while all gear not necessary is dispensed with. The omission of reversing motion, pumps, turning gear, etc., not only simplifies, but also, by divesting the engine of all superfluous moving parts, enables a fairly high rate of speed to be attained without undue shake and rattle.

As the steam pressure should be about 100 lbs. a form of piston valve will be desirable. The arrangement shown provides for the steam to enter from the middle of the valve and relieves the glands of the valve-rod from the strain and wear due to high-pressure steam.

To enable the power to be got into a small space, especially where head room is limited, the engines on the torpedo boats and destroyers are made with a very short stroke in proportion to the cylinder diameter. The squat appearance is due to this cause, and not to the designer's idea of the beauty or symmetry of the engines. The model, however, not being limited to any height, a moderately long stroke was decided upon.

The length of the connecting-rod is sometimes curtailed to twice the stroke or less in extreme cases, but this is not desirable if it can be avoided, and two and a quarter times the stroke was fixed as the minimum length centre to centre. In short, no limitations were imposed on the design due to conditions that might exist in the prototype, but not likely to exist in the model.

Most of the engines fitted to torpedo boats and destroyers have the cylinder carried on round steel columns, the slide bars being bolted to bearers carried between and attached to the columns, diagonal bracings being introduced to give rigidity to the framing.

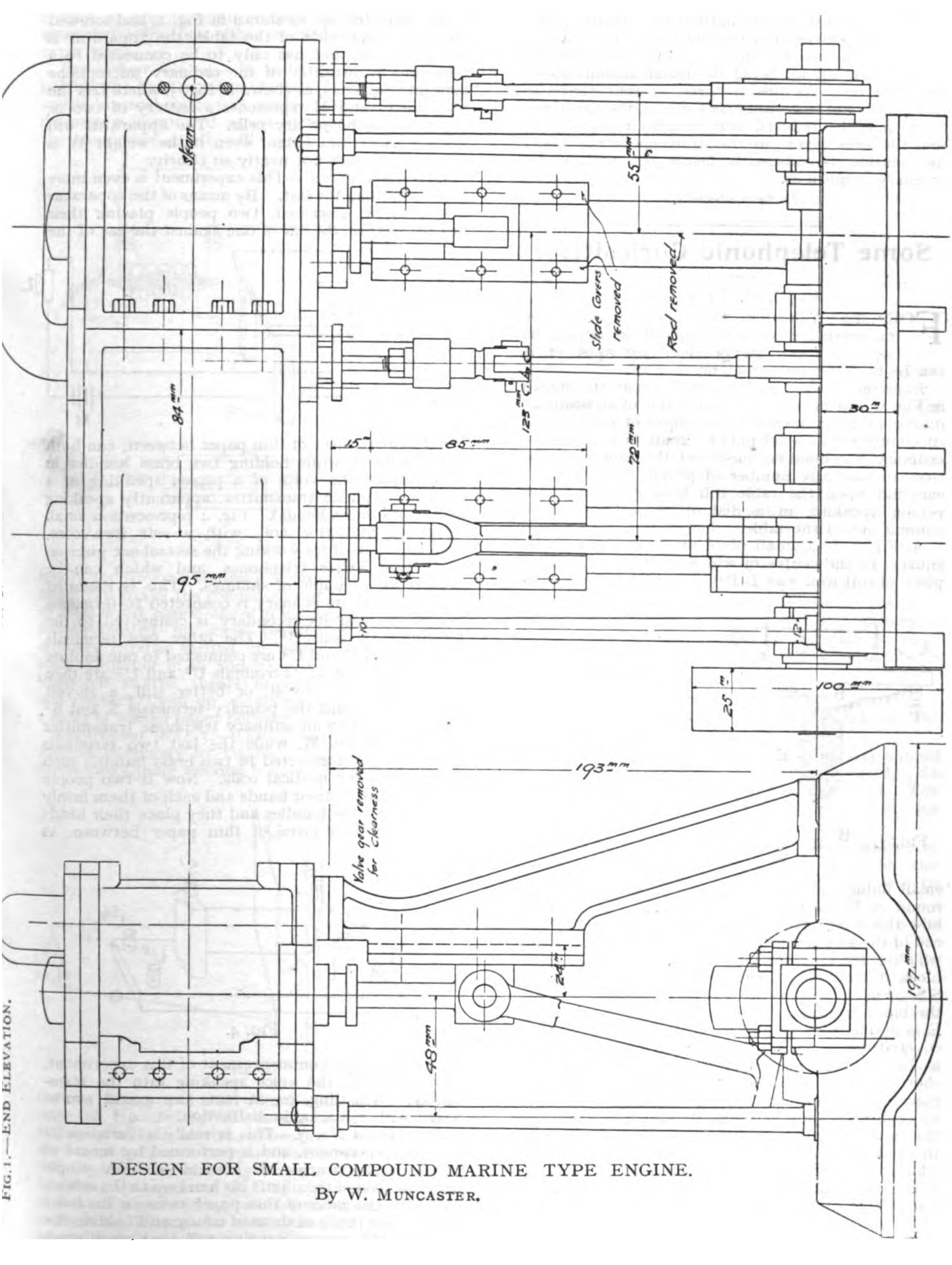


FIG. 1.—END ELEVATION.

DESIGN FOR SMALL COMPOUND MARINE TYPE ENGINE.

By W. MUNCASTER.

With regard to the strength of the moving parts, it must be remembered that on board the class of boats mentioned the steam pressure is excessive 300 lbs. per sq. in. being the usual amount to b provided for. As this is three or four times as much as would be desirable in a model, the size of the parts may be reduced very much in proportion, and the sizes given on the drawings of the model are considered sufficiently heavy for work under ordinary conditions.

(*To be continued.*)

Some Telephonic Curiosities.

By G. G. Blake.

For the following experiments very few materials are necessary, and all the apparatus used is quite inexpensive, and most of it can be made by any amateur.

Experiment No. 1.—The small apparatus shown in Fig. 1, if attached to the under side of an ordinary dining table by means of a couple of screws, will (if connected to a telephone circuit in place of an ordinary telephone ear-piece) set the table in vibration, so that any number of people who put their ears flat upon the table will hear the voice of a person speaking in a distant room, apparently coming out of the table.

A, Fig. 1, is a small piece of wood about 5 ins. square, to the centre of which is attached a short piece of soft iron wire B B^1 (as used for the core of

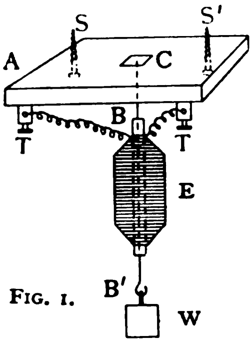


Fig. 1.

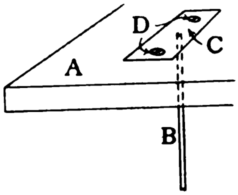


Fig. 2.

small induction coils) about 4 ins. long, and bent round at B^1 to form a small hock. Fig. 2 shows how this wire (B) is attached to the wood. The end of the wire is soldered on to a small brass plate C, which is let in flush with the surface of the wood block A, and then screwed on firmly at D and D. S S^1, Fig. 1, are the two screws by means of which the block is attached to the underside of the table. E is a small coil of No. 24 B.W.G. silk or cotton-covered wire, wound as shown in figure, tapering at both ends. This small coil is wound round a short piece of quill 1¾ ins. long, so that when in place on the iron wire B B^1 it is quite free to move up or down it (any very fine tube such as a piece of thin glass, or a piece of straw, will do in place of the quill). W is a lead weight weighing 2 or 3 ozs., which has a small eye on the top of it by means of which it is attached to B^1 (the correct weight can be found best by experiment).

T and T are two terminals to which the two ends of the coil are connected. When everything has been connected up, as shown in Fig. 1, and screwed on to the underside of the table, the apparatus is ready for use, and has only to be connected to a telephone transmitter of the ordinary microphone type and batteries, as shown in Fig. 3, where L is the transmitter and M represents a battery of two or three Leclanché or dry cells. The apparatus will work to a certain extent even if the weight W is removed, though not nearly so clearly.

Experiment No. 2.—This experiment is even more wonderful than the last. By means of the apparatus about to be described, two people placing their heads together, the ear of one against the ear of the

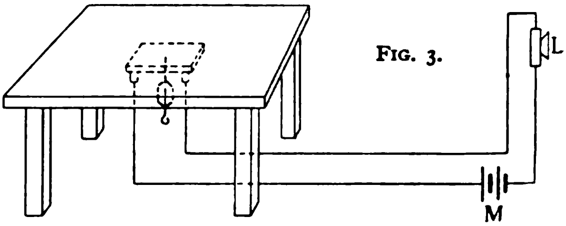


Fig. 3.

other, with a sheet of thin paper between, can both of them hear (while holding two brass handles in their hands) the voice of a person speaking at a distant telephone transmitter, apparently speaking in one another's heads). Fig. 4 represents a small telephone induction coil, with a soft iron core, such as are used for working the second ear-piece on most Post Office telephones, and which can be bought for a couple of shillings. This is mounted on a stand O, its primary is connected to terminals S and S^1, and its secondary is connected to the terminals U^1 and U^3. The other two terminals on the stand U and U^2 are connected to one another as shown in Fig. 5. Terminals U^2 and U^3 are then connected to a 12-volt, or better still, a 16-volt accumulator, and the primary terminals S and S^1. are connected to an ordinary telephone transmitter L and batteries M, while the last two terminals U and U^1 are connected to two brass handles such as are used for medical coils. Now if two people slightly moisten their hands and each of them firmly grasp one of the handles and they place their heads together with a piece of thin paper between, as

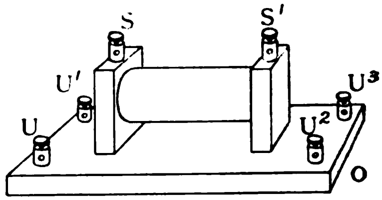


Fig. 4.

described at the commencement of this experiment, they will hear the voice speaking into the transmitter. Whistling, or, in fact, any music, can be heard with remarkable distinction.

Experiment No. 3.—This is really a variation of the last experiment, and is performed by means of the same apparatus. If instead of both people listening, one of them puts his hand up to the other's ear, with the sheet of thin paper between the hand and the ear (both of them of course still holding the handles) the person listening will hear every word spoken at the transmitter and much louder and more distinctly than either of them did in the last experiment.

Experiment No. 4.—If instead of two people holding the handles, as in the two preceding experiments, a small condenser, made up in the following manner, is connected across terminals U and U¹, the condenser itself will speak and sufficiently

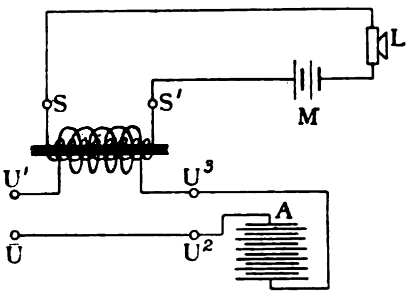


FIG. 5.

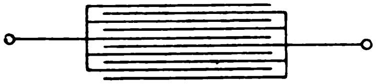


FIG. 5A.

loudly for anyone standing several yards away to hear. To make the condenser, cut about 12 sheets of good stout paper, about 6 ins. square, and after having melted up some paraffin wax (in fact, ordinary candles melted up would do) thoroughly soak the paper in it, and hang it up while it sets. Then cut twelve sheets of tinfoil 5 ins. square, and connect them up as shown in Fig. 5A, with a sheet of waxed paper between each sheet of foil.

Experiment No. 5.—This is an experiment in wireless telephony by means of induction. Fig. 6 shows two square wooden frames, Q and R, each of

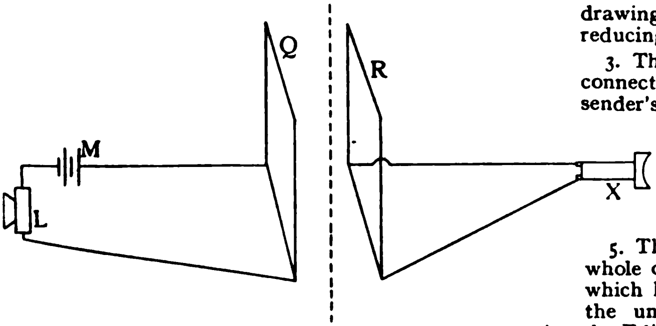


FIG. 6.

them 4 ft. square, and wound with ten turns or more of No. 22 B.W.G. insulated wire (ordinary bell wire will do nicely). The two ends of coil R are connected to an ordinary telephone receiver X, and the two ends of coil Q are connected through a telephone transmitter L and batteries M. By means of these two square frames speech can be carried on through a solid stone or other wall several feet in thickness, providing the two frames are put into position exactly opposite to one another as in Fig. 6. If the two ends of the coil R are disconnected from the telephone and joined directly to each other it will be found that the sounds can still be heard in the telephone receiver, provided it is held pointing towards the centre of the coil R and not too far away from it.

Experiment No. 6.—In a daily paper a short time since I saw the following novel experiment, which I have myself tried and find that it certainly does answer quite well. If a telephone transmitter is held tightly pressed against the chest, elbow, or even the heel, a person listening at the receiver will still be able to hear the speaker. This experiment is not nearly so wonderful as it seems at first glance, as no doubt the vibration of the body when a person is speaking accounts for the result.

Prize Competitions.

Competition No. 43.—A Prize of Two Guineas will be awarded to the reader sending the best article on "Finishing Model Engines." The work of painting and enamelling, polishing, lacquering, and the other points and processes which are involved in neatly finishing off a model engine after all the constructive work has been done should be dealt with. The closing date of this competition is March 2nd, 1908.

Competition No. 44.—A Prize of Two Guineas will be awarded to the reader sending the best article on "Small Dynamo and Motor Testing," describing how to test for faults during construction, and how to test the working of the machine when finished. The closing date of this competition is March 2nd, 1908.

GENERAL CONDITIONS.

1. All articles should be written in ink on one side of the paper only.

2. Any drawings which may be necessary should be in good black ink on white Bristol board. No coloured lines or washes should be used. The drawings should be large enough to allow for reducing to half.

3. The copyright of all photographs entered in connection with any competition must be the sender's own property, and a signed statement to this effect must accompany same.

4. The copyright of the prize articles to be the property of the proprietor of THE MODEL ENGINEER, and the decision of the Editor to be accepted as final.

5. The Editor reserves the right to print the whole or any portion of an unsucccessful article which he may think worthy of publication, upon the understanding that remuneration is given at the Editor's discretion in proportion to the length and merit of the matter used.

6. All competitions should be addressed to the Editor, THE MODEL ENGINEER, 26 to 29, Poppin's Court, Fleet Street, London, E.C., and should be marked outside with the number of the Competition for which they are intended. A stamped addressed envelope should accompany all Competitions for their return in the event of being unsuccessful. All MSS. and drawings should bear the sender's full name and address on the back.

The Society of Model Engineers.

[*Reports of meetings should be sent to the offices of* THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.*]

London.

A NUMBER of members on Tuesday, January 21st last, made a visit to the well-known works of Messrs. Siemens Brothers & Co., Ltd., at Woolwich, and were conducted over the works by Mr. Reece.

The members found great interest in the showrooms, containing electric repeaters, receivers, Morse and Druce instruments, telegraph pole insulators, linesman's tools, ship telegraphs, railway signals, gongs and contacts (as used on continental railways), searchlights, and various other electrical devices for finding ranges, torpedo instruction signals from conning-tower, and sections of submarine, telephone, and other cables. The making of a telephone cable was then fully inspected. The first instrument shown was cutting paper into narrow strips for winding by machinery round the wire, which process was next seen. The wires were then wound in pairs and more paper wound on, and numbers of pairs ultimately wound together and a temporary band of cloth wound round to hold all together. The cable was then inspected in the vacuum chamber, rolled in shallow trays. Here they may be left for as long as sixty hours, to extract all moisture. After all the moisture has been extracted, the cable is finally passed through a press and the necessary lead covering pressed on. The water tank was next visited. Here the cable wound on the drum is left for some twenty-four hours before being finally tested and the ends sealed up. A section of a cable for telephone purposes was seen in the showroom containing 605 pairs of wire.

The party was next conducted through the machine shops and railway signalling department, where a working model of railway signal and points was fully demonstrated and explained and a large frame for a signal-box at Birmingham in course of construction was shown. The signal for cessation of work having sounded, the party visited the power-house, and, having thanked their conductor, left the works after a very interesting visit. Unfortunately—and no doubt owing to the thick fog prevailing all day—several members who had intended joining the party failed to turn up.

FUTURE MEETINGS.—The next meeting is fixed for Tuesday, February 25th, when a special demonstration will be made of models under steam, both locomotives and stationary. A large boiler will be provided for supplying steam to such stationary engines as are brought to the meeting, an adaptable coupling being connected for all diameters of steam pipe. Prizes to the number of nine (if necessary) will be awarded by popular ballot to the most interesting models brought up by members, that is, three prizes in each of the following classes—Locomotives, Stationary Engines, and Electrical and General Exhibits. No model which has gained a prize in a similar competition this Session will be allowed to participate. The Secretary will be glad to have particulars beforehand of models to be entered in the competition, and in the case of stationary engines to be shown working it will be helpful if the internal diameter of the steam pipe is given. The following meeting will be held on Wednesday, March 18th.

VISITS.—On Saturday afternoon, February 15th, to Messrs. D. Napier & Sons' Motor Works at Acton; on Wednesday, March 4th, to Bow Works of North London Railway; on Thursday, March 26th, to Stratford Works of Great Eastern Railway.—Full particulars of the Society and forms of application for membership may be obtained from—HERBERT G. RIDDLE, Secretary, 37, Minard Road, Hither Green, S.E.

Practical Letters from our Readers.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily for publication.*]

Efficiency of Windmill.

[In reply to several recent inquiries relating to the power available from his windmill, Mr. Geo. Summers has kindly sent us the following data, which we reproduce below. Readers who have written us lately on this matter may now avail themselves of these figures.—ED., *M. E. & E.*]

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I enclose herewith particulars of test carried out some short time since, these being the only figures I have by me.

The mill now requiring some repairs—which are unfortunately delayed by my absence—I regret I cannot add a few trials to the list giving results from various wind velocities, but this I will endeavour to do at some future date. The power developed in the trial given you may consider rather low, the wind at the time being only a fair breeze.

Windmill made 80 r.p.m.; gear ratio of wheels 2 to 1 = 40 strokes of pump per minute, raising 20 gallons of water per hour from a depth of 5 ft.
20 galls. = 200 lbs. × 5 ft. = 1,000 ft.-lbs. per hour.
Pump capacity = area × stroke = 1·76 × 2 = 3·52 c. ins.
3·52 × 40 strokes × 60 minutes = 8,468 cub. ins. per hr.
8,468 = cub. ft. per hr. = 4·9
4·9 cub. ft. × 6¼ galls. = 30·6 galls.
So efficiency = 66 per cent.

Trusting this will give you the desired information, yours truly, GEO. SUMMERS, Jun.

Re Electrically Driven Model Steamer.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—Some of your readers will perhaps remember seeing a photograph of model steamer, *Ethel*, which appeared in the "Practical Letters" column of this journal for August 15th, 1907. As the photograph shows, it is a well-made model, and the original may now be seen exhibited in Millgate, Wigan. I advise all fellow-readers in the district who, like myself, are interested, to make a point of seeing it at their earliest convenience, and I feel sure that they will not be disappointed.—Yours truly, "ADMIRER."

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[18,703] **Small Transformer Windings.** F. T. E. (Bournemouth) writes: I wish to construct a small transformer. What quantities of wire and gauge to reduce 200 volts to 10 and 12 volts? I do not wish to pass more than ⅓ amp. in primary at full load. What amperage should I be able to get from secondary at 10 volts, allowing losses? The resistance of both windings would suit me as I could measure this better, or must I keep to the number of turns and layers? Would it make any difference if I wound primary and secondary separate on each limb, or would better results be obtained if I wound half primary first on each limb and secondary over after?

From a table of wire gauges you must find out the gauge of wire which will carry ⅓ amp., and wind on a sufficient number of turns as will give the required resistance to allow a flow of current of ⅓ amp. Thus the watts taken by a primary circuit will be one-third of 200, that is, approximately 70. The secondary wire must therefore be capable of carrying a current of 7 or 8 amps., and the number of turns must be in the same proportion as 200 : 10. There have been several query replies on this subject in recent issues, and we think that if you will refer to these you will get some further information which will assist you.

[18,701] **Buying Dynamo for Charging Cells.** T. B. M. (Whalley) writes: Please will you tell me what output (in volts and amperes) a dynamo ought to have to be able to charge a 4-volt 25 amp.-hour motor-car accumulator? In your advertisement columns I notice several dynamos priced from 15s. to 20s.; would it be safe to buy one of these for the work?

You would require a dynamo capable of giving 10 volts and at least 2 amps. output. Thus a 20- or 30-watt machine would be suitable. We advise you to pay a good price and ensure getting a thoroughly good machine. If the machine is second-hand when you purchase it, you should get a guarantee in writing that it will give its full output in volts and amps., and not in candle-power, as the latter is a somewhat vague term now-a-days.

[18,723] **Small Model Launch.** T. D. (Belfast) writes: I should be much obliged if you would give me the following information. I have a horizontal tubular launch boiler (cylindrical type), 7½ ins. by 4 ins., of copper, and a slide-valve engine (one of Whitney's type D launch engines), ½ in. bore, ½-in. stroke, weighing about 10 ozs. I wish to make a boat as small as possible. Please give me dimensions. Would 5 ins. beam do? Also, what kind of boat would be best to fit it up as (not liner, cargo, or battleship)? I should like a speedy boat. What size and pitch of propeller should you recommend?

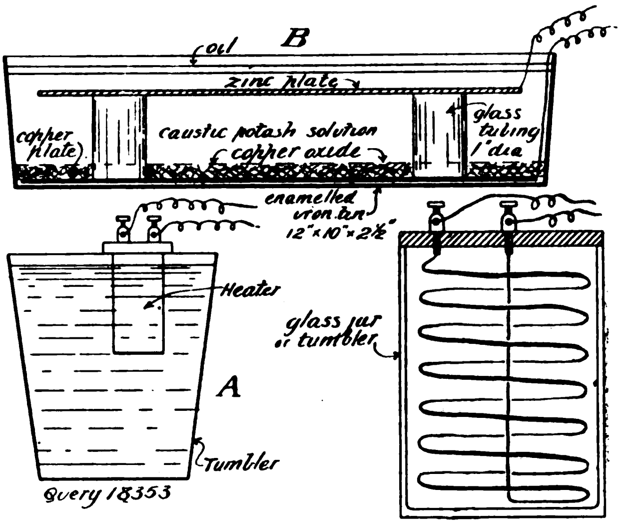
The kind of boat you are going to use is purely a matter of choice, and we advise you to select one of the many designs which have been published in recent issues; you could also refer to our Handbook, "Model Steamer Building." The approximate dimensions for a useful craft would be—5½ ins. beam, 4 ins. draft, and 2 ft. 6 ins. over-all length. Use a propeller 1 in. diameter and 2½-in. pitch.

[18,709] **Size of Petrol Motor for Model Motor Boat.** F. W. P. (Queen's Park) writes: Having taken your valuable Journal for a number of years, I should be very pleased if you will answer the following queries. For my model boat I wish to develop ½ h.-p. by means of a petrol motor. Could you give me the dimensions of cylinders required, keeping the motor as low as possible; length no object?

You will require an engine with 1½-in. cylinder by 1½-in. stroke. As the speed is an important factor of the brake horse-power developed, you will require to run at a fairly high speed, probably about 1,000 r.p.m. Several small petrol engines have recently been described in back numbers, to which you will do well to refer.

[18,353] **Electric Heating Apparatus.** H. V. C. (Chiswick) writes: (1) Will you kindly give me instructions (or refer me to an inexpensive book) how to make a small electric heater? I wish the heater to heat about half a pint of water, and to be made in such a form that I can place it in a tumbler of water when the water is required to be heated (see sketch A). (2) Would a battery of about ten cells (see Queries 3 and 4) be sufficient to work the above? (3) I am about to permanently instal a battery to work the above heater, and also to light a small lamp about three hours daily. What type of cell would you recommend? Would large sized gravity Daniells do, or would the Edison-Lalande be better? Would a cell made on the following lines act well? I wish to avoid porous pots if possible. (4) For the containing vessel an enamelled iron tin about 12 ins. by 10 ins. by 2½ ins. deep, with a thin sheet of copper on the bottom, covered to about ½ in. with black oxide of copper, and a zinc plate supported in the caustic potash solution (see sketch B).

(1) The construction of electrical heating apparatus is full of practical difficulties, and you must be prepared to experiment. We do not know of any book giving the information you require. Your best chance of success will probably be to make a fairly stiff coil of some resistance, say, No. 18 gauge "Eureka" bare wire, and immerse it bare into the water, then add battery power until you get the heating effect desired. Provided that the coils are not touching each other the water will not short-circuit them. Sketch shows the idea. If you enclose the coil in a tube, the layer of air between the coils and tube is a bad conductor of heat and very much reduces the efficiency of the apparatus. (2) A matter for trial; battery should have plates as large as possible. (3) Edison-Lalande. (4) This battery should do fairly well; it is worth trying, though not the most efficient way of arranging the plates. Use earthenware dishes for preference. You may find it necessary to have the zinc closer to the copper.



DIAGRAMS ILLUSTRATING AN ELECTRIC HEATING APPARATUS.

[18,710] **Partial Failure of "Attraction" Electro Motor for Car.** F. M. B. (Oldham) writes: I have been making the small electric tramcar motor described on pages 52 to 55 of your Handbook—No. 8—and have followed the instructions most carefully, but have not been able to make it work. The only difference I have made is to wind the magnets with silk-covered wire instead of the cotton-covered mentioned. I wound the magnets all the same way round. It does not tell you which way round they should be wound, but they are all wound this way, two pieces of No. 9 and 10, starting ends at the bends, finishing end at the poles. I tried it with a bichromate cell, but it does not seem to have enough attraction to pull the armature round. Thinking the armature was too heavy, I cut the wood away somewhat, but it has not altered it. I have set the contact-breaker in all sorts of positions —with no effect. If I touch the bearing E with the wire from the zinc when the contact-breaker is *not* touching the square piece of brass, it pulls the iron in the armature opposite the poles, but it will not take them past it. I should be obliged if you would tell me where I have gone wrong. It has not got the wheels on yet; I want

to get the motor working first. I connect the wire from carbon of battery to the starting end of magnets and the zinc to the wire on contact-breaker. Everything is connected up exactly as described in the instructions. There are no wires broken, as when I spin the armature round, it sparks well at the contact-breaker.

We think it is most probable that your failure is due to the contact not being broken at the correct moment. The contact-breaker should be arranged so that the circuit is made up to the point when the piece of iron in the armature is just opposite the magnet poles; at this point contact should be broken, as, if the current is allowed to flow for a longer period, it will have the effect of putting a brake on the armature, and thus retarding or even stopping the armature rotating.

[18,395] **Steam Port Proportions.** J. P. S. (Hartlepool) writes: I am making a double-cylinder, single-acting steam engine, with cylinders 1⅜ in. bore and 1-in. stroke. Can you please give me—(1) Steam and exhaust port details, sizes of valve, and travel of valve, steam and exhaust pipe sizes, and suitable boiler pressure. (2) Rules for determining size of balance-weights on crank webs.

(1) The port and pipe proportions may be as follows: Steam ports, ⅜ in. by 3-32nds in. wide; exhaust, ⅜ in. by 3-16ths in. wide; port bar, 3-32nds in. wide; valve, 1-16th in. lap, 11-16ths in. long; travel of valve, 5-16ths in.; advance of eccentric, 3-32nds in. (bore); steam pipe, 5-16ths in. (outside), exhaust pipe, ⅜ in. (outside). (2) Read recent articles on balancing and balance-weights, under heading, "Chats on Model Locomotives," by H. Greenly in issues—August 8th, August 15th, and August 29th, 1907. The stroke of your engine could be 1¼ ins. with advantage, instead of 1 in.

[18,510] **Model Steamer Building.** H. M. (Clerkenwell) writes: I am constructing a double-cylinder double-acting slide-valve vertical engine (⅞-in. bore, 1½-in. stroke), which I intend to put in a speedy boat, if engine will work quick enough. The ports are 3-32nds in. and exhaust ⅛ in. (1) At what speeds will engine work at 60 lbs. and 80 lbs. pressure per sq. in.? (2) What proportions of force-pump to suit engine? (3) What size propeller do you advise for boat 4 ft. or 4 ft. 6 ins. long? (4) Where can I obtain yellow pine or white, as set forth in your Handbook, "Model Steamer Building"? (5) What packing is best for pistons; rings or cotton, etc.?

(1) You do not give the full dimensions of the ports, and therefore we cannot say what would be the best speed at which to run the engine or what is the probable maximum speed. The length of the ports should be half the bore of the cylinder. (2) Make the pump large enough, and adjust the feed by a by-pass cock. We suggest a 5-16ths-in. by ⅜-in. pump geared down 2 to 1. (3) Try 3 in. diameter and 4½-in. pitch. (4) Young's, Virginia Road, London, N.E. (5) Rings, if you can make them properly; but for ordinary work you will find asbestos yarn satisfactory.

[18,533] **Model Boiler.** T. A. (Islington) writes: Will you please answer these questions for me? (1) What is the best means to fire a marine boiler whose outside dimensions are 12½ ins. long by 5¼ ins. diameter. It has a tubular fire space—10⅜ ins. long by 1⅞ ins. diameter, and five tubes—10⅜ ins. long by 11-16ths in. diameter. (2) Will the above boiler satisfactorily drive an engine of ⅞-in. bore by 1½-in. stroke, and at what pressure? (3) Will this engine drive the 5-volt 2-amp. dynamo, as described in "Small Dynamos and Motors"?

Fired by a benzoline blowlamp, the boiler, which, we presume from the particulars you send, is of the furnace type, would run the engine at a moderate pressure (say 30 lbs.). The boiler, however, is unsuitable for stationary work for dynamo driving, unless it is cased in as shown in the new edition of "Model Boiler Making," (Fig. 3B), and fired by a powerful gas-ring or coal fire.

[18,696] **Capacity of a 60-watt Machine.** M. F. A. (Cumberland) writes: I have a casting of enclosed full size drawing (not reproduced), and can get no idea as to its capabilities. I addressed an enquiry to one of your advertisers, and they supplied me with laminations for armature (eight-pole), commutator (⅞ in. diameter), 1½ lbs. No. 20 D.C.C. and 1 lb. No. 22 D.C.C. wire, and stated the capacity of the finished machine would drive a 4-in. lathe from accumulators, and, running as a dynamo, would light three or four lamps. Now, in a few words, I wish to know (1) the exact capacity, in voltage, etc., and also table for winding, etc. I have studied "Small Motors" and "How to Make a Dynamo," and whether I am slightly dense or not, I cannot get the drift from these books on the subject stated. (2) What is the space —measuring along spindle—if a *definite* space or distance is possible, between the last armature stamping and the commutator? Also the space between the two poles of the field-magnet?

(1) The output of your machine —from the data you give—should be approximately 60 watts, and the windings for the armature should be 6 ozs. No. 20 S.W.G., and for the fields about 2½ lbs. No. 22 S.W.G. Such a machine could be run from accumulators, but they would have to be of very large capacity in order to discharge at a rate of about 5 or 6 amps. (2) The space between the last armature stamping and the commutators may be as small as possible; in fact, just enough to allow you to get your end windings of the armature comfortably connected. Or, if you connect your armature coils on the circumference of the commutators, the commutator ring may butt up against the armature winding, practically touching them. As for your machine driving a 4-in. lathe, this, of course, is a very vague way of putting it, and depends entirely upon what work you will do in your lathe. The windings given above should be suitable for a 10- or 12-volt supply.

[18,275] **Electric Light Wiring.** A. W. B. (Clapham Common) writes: I should be much obliged if you could supply me with information on the following subject. In a bedroom of a house supplied with the electric light there are two drop lights controlled by two separate switches. I want to transfer one of these lights to a landing and put in another switch. The idea will be clearer from the sketch given below. A is existing light controlled by switch C, which I propose to do without; B is the proposed new fitting; D is the switch controlling B, providing, of course, that switch C is "on"; 1 and 2 are the wires which are to connect ceiling-rose of B with switch D and ceiling-rose of A. In order to gather all the information I could on the subject I purchased a book on "House Wiring," in which it states that "it is always the unearthed wire (which in a two-wire system is the

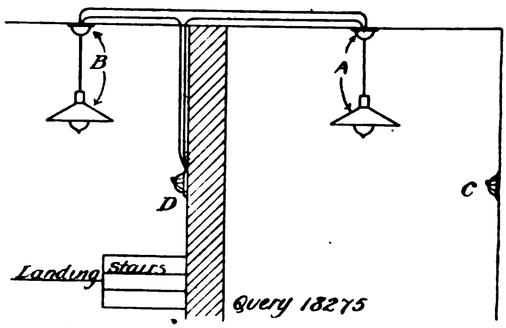


DIAGRAM OF ELECTRIC LIGHT WIRING.

positive) in which any tumbler switch is inserted," yet on page 4 of this book a diagram is given in which the tumbler switch appears to have been inserted in the negative wire. (1) Can you throw any light on this apparent anomaly? (2) In accordance with the before-mentioned extract can you state whether it is necessary to have wire 2 leading to switch D as the positive wire? (3) Can you give me the technical description of the wire I shall have to purchase? The pressure is 230 volts. I shall, of course, cover the wires with the ordinary whitewood casing.

(1) On a three-wire system of distribution the middle wire is earthed if the pressure between the outers exceeds 400 volts. If the installation in a house is connected between the middle and negative wires of the system the negative wires in the house would be the unearthed wires. Perhaps this is the explanation. (2) When fixing your new switch it will be advisable to connect it according to the wiring leading to the other switches already installed. The wires are frequently coloured red for positive and black for negative; if your house wiring has been carried out on this plan you will be able to identify the wire to which the other switches are connected. (3) Size should be No. 18 tinned copper, vulcanized and pure rubber covered, taped and braided; insulation to be at least 2,000 megohms per mile resistance. Our shilling handbook, "Private House Electric Lighting" will give you a great deal of practical information on this subject.

[18,784] **Heating and Drying a Small Workshop.** W. H. B. (Erdington) writes: I have a small workshop that I use for my hobbies, which is rather damp, and I should be very glad if you think the following idea would act to keep it dry. To build a small windmill (as described in THE MODEL ENGINEER, December 12th, 1907) and the windmill to drive a fan (as described in THE MODEL ENGINEER, January 2nd, 1908). The fan would force the air through a pipe in the kitchen firegrate (which would heat the air) and then taken by pipes a distance of about 20 ft. and the hot-air blown into workshop. Would you please say what kind of pipe would be best to go in the firegrate? As hot-air rises, do you think it would make much difference me having to take the pipe upwards from the grate and then bringing it down again 3 ft. or 4 ft.?

We see no objection to the method you advocate for heating and drying your workshop, and should think the idea could be easily worked out. The rise and fall in the pipe between the fire and the workshop would be immaterial as the draught from the fan would propel the air in the required direction. We should suggest the use of copper pipe for that portion which is in direct contact with the heat supplied by the fire.

[18,695] **Power and Lighting Plant for Workshop.** P. W. F. (Leamington) writes: Having a small shop (15 ft. by 10 ft by 6 ft. to eaves), I wish to light it, etc., and should require two lights—one small boiling stove (for gluepot), one heating stove, and power (say 1 h.-p.) to drive a small lathe in the near future. I should get gas (or electric) mains laid in for about £5 extra for fittings and power; but do not wish to have the garden disturbed with the laying of the mains, so should prefer a small working plant of, say, acetylene or petrol gas, to which I am very partial, as there is no smell as in the former, on account of its cheapness. Of course, the original outlay must be in keeping with a hobby, and compare more favourably, if possible, to that of putting in gas; also, if it can be managed, defer the extra cost of the power until a later date, when I shall get a new lathe.

In reply to your enquiry *re* amount of power and light to instal in your workshop, we should certainly recommend gas in preference to anything else. The installation of either acetylene or a petrol gas plant would greatly exceed the outlay required to run gas piping, even a considerable distance. Besides this, such plant would require more or less constant attention, and cost of upkeep would also not have to be neglected. As regards disfiguring the garden, we do not think that this need enter into the question at all, as a very small trench is all that is required to lay an ordinary size gas pipe. For light, the incandescent gas burner is far and away more efficient than any other illuminant, and a gas engine is also more handy, more easily started, and costs no more for upkeep than any other type of engine.

[18,781] **High and Low Voltage Windings for Dynamos.** A. E. G. (Oldham) writes: Will you answer the following questions in The Model Engineer:—(1) What size of wire for armature and fields of Manchester dynamo made to scale in Model Engineer Handbook, armature 8-slot cog, diameter 2¾ ins. by 2¾ ins.? (2) There is a choice of three windings in the handbook. Will you kindly explain the use and advantage (if any) of the different windings?

The windings given in our handbook are for various voltages. The thicker the gauge of wire used the lower the voltage given by the machine at any given speed. The choice of winding depends upon the purposes for which you intend to use the machine. Thus, for ordinary charging purposes a 20 or 30-volt winding would be suitable. On the other hand, if you require to light at 100 volts use the 100-volt winding as given in table on page 50 of handbook No. 10. We trust this will clear up your difficulty.

[18,720] **Power of Windmill.** S. M. (Hampstead) writes: If you would answer the following queries I should be much pleased—(1) What is the largest dynamo that could be driven by the windmill described in the last two issues of The Model Engineer? I live on high ground, and only need to work the dynamo intermittently. (2) I thought of fixing it on the roof. Are there any restrictions, *i.e.*, have I to get permission from the Council? (3) I wish to make some accumulator cases of wood lined with lead. How thick should the lead lining be? (4) I am making a wireless telegraph, and should be pleased if you could tell me of some castings to build an electric motor suitable for working a Lodge-Muirhead coherer and Morse printer. (5) I wish to make a 6-in. spark coil, as described in your Model Engineer Series, No. 11, and am in need of a good contact-breaker. Your book mentions the "Wehnelt interrupter," but on reading the book, "Wireless Telegraphy for Amateurs," by R. P. Howgrave-Graham, I find that this break has disadvantages for wireless work. Would the new "Buzzer break" (invented by Muirhead, I think) do? (6) If so, where can I find particulars for making same?

It is largely a matter of trial to find exactly what power the windmill will give, but we should say that with a fair breeze it would give enough power to run a 20-watt dynamo. See "Practical Letter" column in present issue. We do not know that there are any restrictions as regards fixing it on your roof, but you would soon hear about it from the Borough Council if there were. *Re* accumulator cases, ordinary sheet ebonite or vulcanite would do. Any of the 40-watt motors described in "Small Dynamos and Motors" would do. We should recommend the "C" type. We should advise a good mercury break for your coil. Messrs. Cox and Co., electrical instrument makers, would supply you with a good type of break for this purpose.

[18,600] **Model Locomotive Queries.** A. C. B. (Wallington) writes: (1) I am building the ¾-in. scale G.W.R. tank engine given in "The Model Locomotive," page 254, and I do not quite see how the inner boiler barrel is fixed, as the only support shown in the drawing appears to be the safety valve. (2) In riveting the boiler ends, can you tell me how the first end is riveted, as I do not see how one can hold a rivet firmly the whole length of the boiler; of course, the other end is easy, owing to the flange being outside. (3) Are water tubes absolutely necessary, or would wire screwed into the barrel, as suggested by Mr. Greenly, in his "Chats on Locomotives," do? What pressure would it be possible to get by this method (a superheater and one cylinder being used)? (4) If water tubes are necessary, would a cast upcomer be all right, if sweated with soft solder? (5) What diameter (outside) should the T downcomer be, and could a casting be used? (6) Is a glass gauge necessary, or can the water level be determined by means of water cocks; if so, what are the best positions for such? (7) What pressure—steam and water—should the boiler be tested to to ensure safety, and what should the safety valve blow off at? (8) What would be a moderate load for an engine of this size and build to pull?

(1) There are several methods of fixing the inner boiler, although, as a rule, it is found that no fixing of the front end is required. The inner boiler will generally jamb into position, the water tubes resting on the bottom of the outer shell near the throatplate. You will find a very efficient method of fixing the inner barrel at the top in Plate II of the book mentioned (a stud under dome cover). This stud, in the G.W.R. model, may be just behind the chimney, and the nut may be made in the form of a lubricator. (2) These boilers are best silver-soldered, and not riveted and soft soldered. In the case you mention, the riveting must be done on a round stake in the vice. (3) Yes, in such a large boiler, an *end-to-end* circulation is of utmost importance. The other idea is suitable only to the smallest models. (4) You are courting failure by employing soft solder in the boiler. It will repay you to have the inner boiler barrel brazed throughout, if you cannot do it yourself. (5) You can get a standard casting for a downcomer, but with ½-in. water tubes there is no real need for a downcomer. (6) A water gauge is not necessary, if a brazed boiler is used. Employ two small screw-down blow-off cocks, as recommended for the small undertype engine. (7) The boiler will be quite safe to all ordinary pressures, whether it is brazed or riveted and soft soldered—that is, presuming either methods are properly done. The latter course being adopted, we recommend a pressure not higher than 50 lbs. With a brazed boiler, you might press the safety valve to 80 lbs. (8) Continuously about 20 to 30 lbs., according to the train-resistance factor. On maximum test, we have known a single-cylinder engine of this design to pull 120 lbs.; but, of course, such tests are valueless, except perhaps to show that the valves are correctly set and that the pistons and glands do not leak to any appreciable extent.

[18,587] **Model Boiler for River Skiff.** T. V. U. (Exeter) writes: Will you please answer the following? (1) About what size boat and what diameter propeller should a cylinder (2-in. by 2-in.) drive at a pressure of 50 lbs.? (2) What would be the best way of firing boiler, as sketch (not reproduced), paraffin preferred? (3) Would boiler in sketch provide enough steam for cylinder mentioned? The boiler is a plain vertical one (16 ins. by 20 ins. high), without water space in firebox, and with four tubes (1½ ins. diameter).

(1) You ought to do well with a 14-ft. skiff on a lake or slow-running river. Propeller—9 ins. or 10 ins. diameter, 14-in. pitch. (2) By a battery of about eight Hekla burners, each consuming about ½ to ¾ pint of oil per hour. (3) The tube arrangements you propose are quite out of the question. About forty or fifty small tubes (⅝ in. diameter) should be used.

The News of the Trade.

[*The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case wher the goods are not of sufficient interest to his readers.*]

* *Reviews distinguished by the asterisk have been based on actua Editorial Inspection of the goods noticed.*

* Slide Valve Indicator.

The very important operation of setting a slide valve of an engine is clearly explained in a little booklet accompanying a slide valve indicator whcih we have received from The Locomotive Publishing Co., Ltd. The type of engine selected for illustration is the ordinary two-cylindered high-pressure locomotive with "Stephenson" link reversing gear. Readers who do not actually have this kind of work to do, or who might have to undertake such in the future, may add to their knowledge of the subject. The indicator, which is composed of three concentric cardboard discs, 4 ins. diameter over all, shows the ports open and shut in fore, mid and back gear, and relative positions of connecting-rod big ends.

New Catalogues and Lists.

Schuchardt & Schutte, 34, Victoria Street, Westminster, London, S.W.—We have received from the above copies of sections A and B of their catalogue, which comprise numerous high-class small tools and measuring instruments of special aid to model makers. Amongst other items we might mention are steel rules, squares, straightedges, centre gauges, combination squares, protractors, calipers, surface and depth gauges, micrometers, speed indicators, twist drill and wire gauges, surface plates, etc., etc.

T. J. Marshall & Co., Paper-making Engineers, Stoke Newington, London, N., have issued, for the twenty-eighth consecutive year, their unique water-marked calendar. The sheet appears as a blank until placed with the light behind it. Where it is convenient to hang in the window of a room the novelty can more easily be appreciated.

The Editor's Page.

MESSRS. STUART TURNER, LTD., of Shiplake, ask us to publish the following letter in expression of their views on the allowance of trade discounts :—" Several of our customers—who are members of the Society of Model Engineers —having expressed surprise that our name does not appear on the list of firms who are prepared to supply goods at reduced prices to the members of the Society, we have to say that we were duly approached by the Secretary of the London branch, and wrote him that we did not favour the idea—(in our opinion the scheme is open to abuse)—but we suggested that if the Society would order a parcel of goods for the members, so that we could send in bulk, we would be prepared to allow a trade discount. We do a very large wholesale, as well as retail, trade all over the world, and we are always open to supply any trading firm at trade prices, if the goods are for re-sale by *bona fide* traders. Fully one-half of our inquiries for discounts are from persons employed in engineering works, and on this ground they expect trade terms. Now, if we gave the trade discount to all these we should simply have to increase the prices in our lists to a proportionate extent, and the genuine amateur, who pays list prices, would suffer. We referred previously to the Society of Model Engineers' scheme being open to abuse, and we have reason to believe that at least one member is buying goods for his friends at reduced prices under his membership card. The Society's intention to increase the number of their members is thus nullified from the commencement. We have notified all our agents that we shall cease to supply our goods to any agent selling them under list price. We believe our policy in the matter, as herein stated, serves the best interest of *all* our customers and also ourselves." The subject of trade and special discounts is a very debatable one, and it would be interesting to have the views of other people interested from either the trade or private side of the question.

Answers to Correspondents.

M. E. N. (Birmingham).—Many thanks for your appreciative letter.

F. D. (Wigan).—Channel section brass can be obtained of Messrs. Smith, metal merchants, St. John's Street, Clerkenwell, London, E.C. The ring must be a casting.

H. D. S. (Harpenden).—We are pleased to know of your success; but regret we cannot see our way to publish same.

F. W. G. (Birmingham).—We are obliged by your letter calling our attention to the error.

N. A. E. (Wall Grange).—Messrs. Moeller & Condrup, 78, Fore Street, London, E.C.

S. M. M. (Hampstead).—We should advise you to use either celluloid or vulcanite cases for your accumulators, in preference to any form of lined cells. Any of the small motors of about 40-watt size would answer your purpose. Regarding the windmill you refer to, we have written to the owner for further particulars regarding its capabilities, and his reply is published elsewhere in this issue. We believe your other enquiries were replied to some time ago, and so we will leave this reply as it stands.

J. B. (Ross).—Thanks for your Workshop Note, but we regret we are unable to insert same.

W. S. (Penge).—Both methods are correct, and in small machines there is not much to choose between them. You will find some further information on armature winding very clearly explained in our Handbook, "Small Dynamos and Motors," to which please refer.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

How to Address Letters.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to The Editor, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to The Advertisement Manager, "The Model Engineer," 26–29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

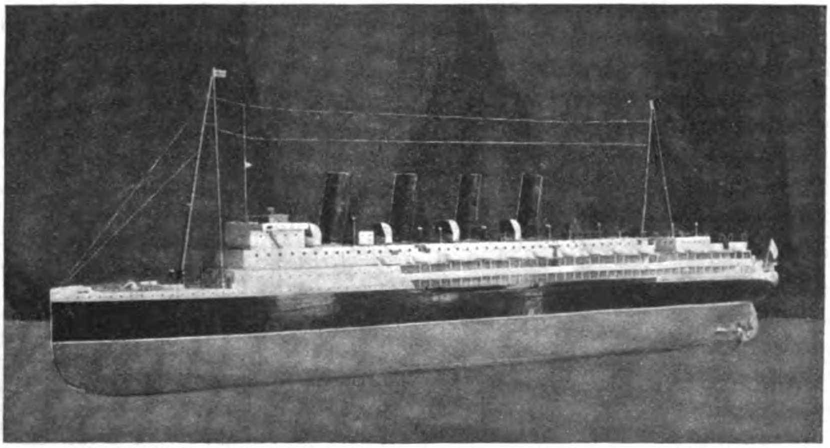
THE
Model Engineer
And Electrician.
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 355. FEBRUARY 13, 1908. PUBLISHED WEEKLY.

A Model Ocean Liner.

By R. LEYLAND, JUN.



MR. R. LEYLAND'S MODEL OCEAN LINER.

THIS model of the *Mauretania* was built in ten months during my spare time in the evenings from a picture post-card, at the same time building her as far as possible to scale from dimensions obtained from Lloyd's Register. She is 8 ft. 3 ins. long, 11 ins. wide, and 9 ins. deep, from the main deck, and is built of planks laid on top of one another, in the same manner as was suggested in a recent issue of the *M.E.*

The model is worked by four separate motors which drive the propellers, these being placed as in the original. In addition there is another motor which drives the windlass. These motors are driven by two 4-volt 10-amp.-hour accumulators, which also supply the power for lighting the following lights: two masthead lights, two sidelights, one stern light, two lights inside the vessel, and the searchlight, which can be seen on top of the bridge. All these lights and motors are controlled by separate switches placed in convenient places on the deck. It is possible to get at the engines by simply lifting off the upper deck from the main mast to the second funnel, and also by lifting up a part of the deck aft. She has nearly all fittings complete, including ladders made from cigar-box wood, 28 boats made from a light wood, davits from brass wire complete with blocks, and all rails, over 14 dozen stanchions being used for them. The stern is heavy above the water-line with a hanging rudder the same as on the original. Altogether the whole boat weighs under 40 lbs. The boat has no keel, being therefore nearly perfectly flat underneath. I find that the weight of the accumulators and engines is enough to keep her upright and steady in the water, where she will do about 3½ knots at full speed. Some further idea as to the size of the model from the photograph may be gained when I say that the funnels are 3 ins. diameter.

Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "Workshop" on the envelope.]

Two Useful Appliances.

By O. G. A. Pettersson.

The ratchet drill stand shown herewith would be very suitable for the small ratchet, illustrated in the October issue of the *Engineer-in-Charge*, and reproduced in Fig. 10 herewith, which is suitable for drilling small holes.

The drill stand can be used for drilling by putting small drills in its drill spindle (D, Fig. 1), or a centre can be fixed in its socket, and a ratchet worked by hand, the screw C being used for putting the feed on, if desired. Compared with ordinary drill stands, this one is remarkably handy for most jobs. The arm B, for instance, can be revolved on its axis, as well as adjusted in and out of its socket, and the pillar A also turns on its axis, thus giving a pretty wide drilling range.

The method of fixing stand is simple; the plates F and G clamping the work, or anything handy, by the bolt J being tightened up, the setscrew K is then adjusted until the pillar A can be moved easily by hand, and which is then set to suit drilling operations. It will be noticed that as F and G are made to slide up and down the pillar A, they can be fastened on to pretty thick work if required—for example, they can easily fasten on to a girder of, say, 12 ins. thickness; an ordinary drilling cramp, large enough to span 12 ins., would be rather a heavy and cumbersome article.

If the pillars A, B, and D are made hollow, the weight would be considerably reduced, and the stand would be found to be very light for its size.

Fig. 1 shows the stand assembled, and consists of a round pillar A, with an adjustable arm B, having a socket which is tapped out for a feed-screw C, which screw is hollow, having a drill spindle D running through it, and which is revolved by the handle E, wheel H being used for putting the weight on.

Fig. 2 shows a side and end elevation of the pillar A, and is machined all over. It has a socket for the horizontal arm, 1 in. diameter, and a ½-in. tapped hole for a setscrew.

Fig. 3 shows the horizontal arm B, and has a socket at its end drilled and tapped out for a 1-16th-in. square thread, 1 in. diameter. The arm B can be made from a forging, or turned down from the solid bar, and should be a neat fit in the pillar A, without any shake.

Fig. 4 shows one of the cramp plates F, and it is drilled 1¼ ins., to be a sliding fit on the pillar A. It has a ⅜-in. hole for the bolt I (Fig. 1), and is tapped out at its end ½ in. for the pinch screw, which, on being tightened, holds the pillar A from moving. It also has two holes, tapped out ½ in., at the other end, which will be found useful for keeping the plates F and G from slipping on iron, etc.; by inserting setscrews, when used on a bench as a fixture, can have ⅜-in. bolts through them, as shown in Fig. 1, and which makes it still more secure.

Fig. 5 shows the bottom clamping plate, and has a ⅜ in. hole tapped in it, as shown, for the adjusting screw K (Fig. 1). Both these plates are machined all over.

Fig. 6 is the feed-screw C, and has a 1-16th-in. square thread on it, being made a good fit in the arm B. It has a 9-16ths-in. hole drilled through it for the drill spindle, and is reduced to 13-16ths in. at the top for a cast-iron wheel H (Fig. 1) with which to put the weight on; it has a keyway ⅛ in. by 1-16th in. deep.

Fig. 7 shows the drill spindle, and is a good working fit in C. Its socket is drilled ⅜ in., to take parallel shanked drills, at the other end it has a ⅛ in. by 1-16th in. keyway for the handle E.

Fig. 8 shows the drill spindle handle E, and it might with advantage be made with a ratchet handle.

Fig. 9 shows the feed screw wheel of cast-iron, and has an oil hole for oiling the drill spindle D.

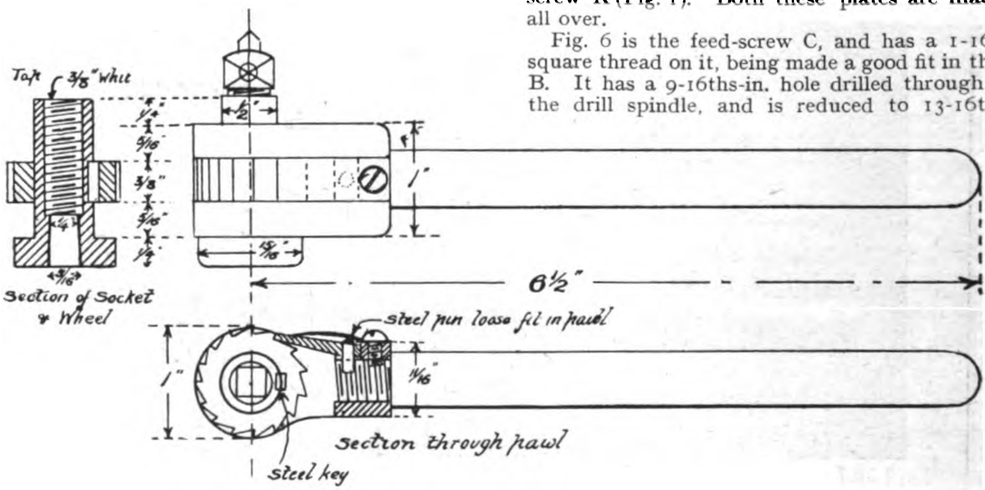


Fig. 10.—A Small Ratchet.

A Good Makeshift for Cutting a Rack.

By F. W.

Desiring to fit a rack and pinion on a small machine I was making, and not having any proper apparatus for rack cutting, I rigged up the following with very satisfactory results. The main screws on my slide-rest being ten threads to 1 in.,

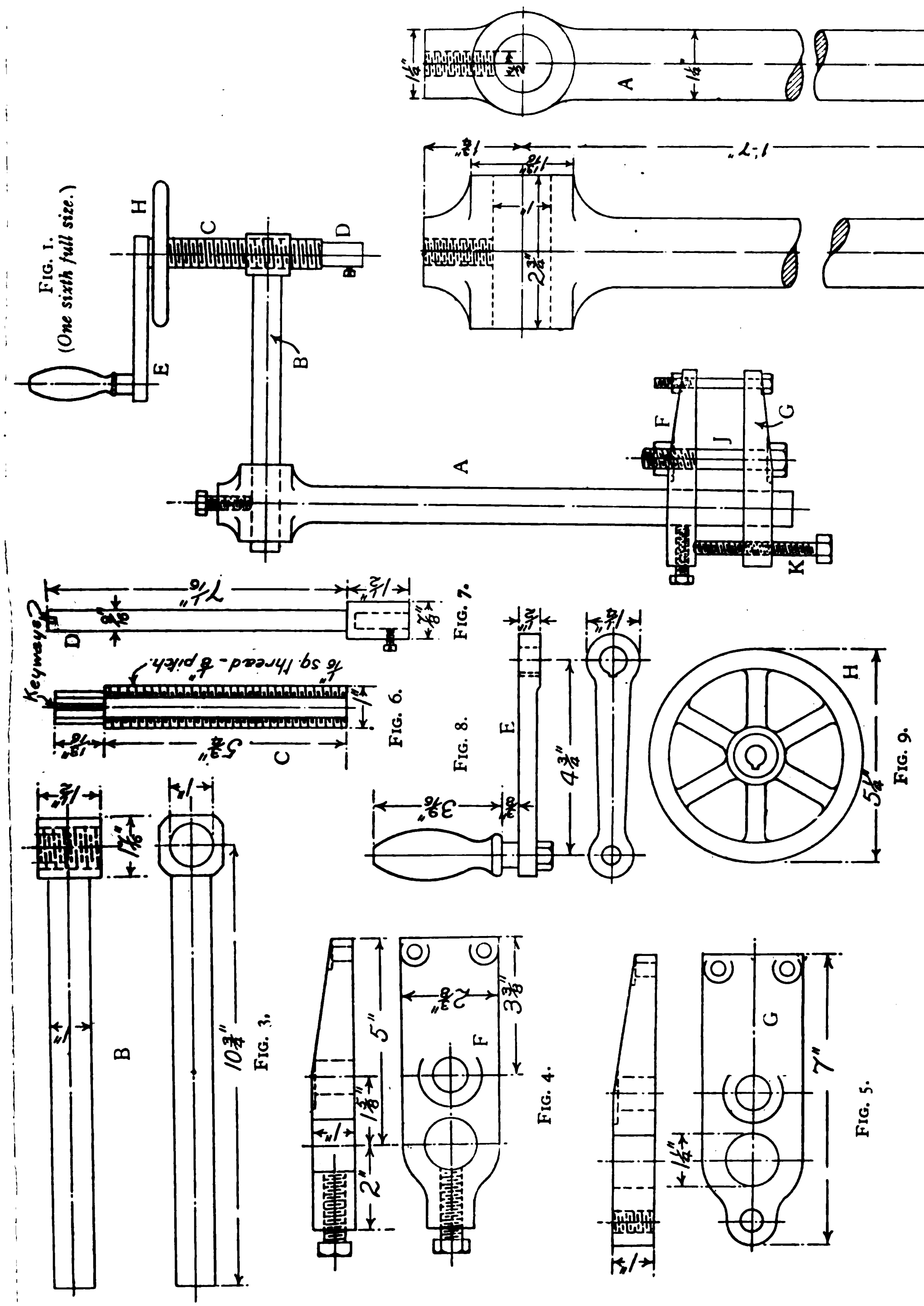


Fig. 2. (One third full size.)

DETAILS OF SMALL DRILL STAND.

(*Figs.* 3, 4, 5, 6, 7, 8, *and* 9, *One quarter full size.*)

and the number of teeth I wanted to cut on the rack being 25 to 1 in., I got a 2-in. brass disc 1-16th in. thick, and marking off from the centre a circle 1⅜ ins. in diameter, I divided it up into five equal parts and drilled a ⅛-in. hole at each of the five points (Fig. 1). The centre I drilled out so that it just fitted over the screw of my slide-rest. Taking off the small plate which kept the slide-rest screw in place, I drilled two holes in the brass disc to suit the small screwholes in the plate. The brass disc was then put over the slide-rest screw and the small steel plate screwed tight up against it, holding it firmly in place. A piece of 1-16th-in. brass was then filed up to the shape shown in Fig. 2, a boss was soldered on made from ⅝-in. round brass and a square hole put through the centre of the boss the same size as the squared part of my slide-rest screw; in the other end of the 1-16th-in. brass a ⅛-in. hole was drilled at a radius of 13-16ths in. from the centre of the boss. Both ends of a piece of 3-16ths-in. iron were turned down to ⅛ in. diameter, one end being put into the ⅛-in. hole in the brass and riveted over. This divider or stop being now complete, it was fitted on the slide-rest screw, the 3-16ths-in. pin being left long enough to allow of the part turned down to enter the divided plate

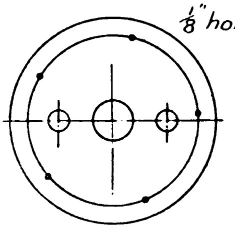


FIG. 1.

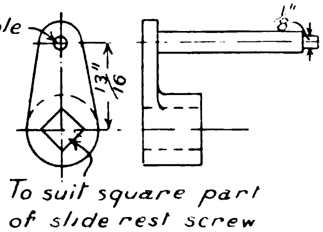


FIG. 2.

holes. The cutter I used was a fly cutter, made from a piece of 3-16ths-in. square steel, and used in an ordinary cutter bar run between the lathe centres. In making the cutter I used the pinion, which I wanted to run with the rack as a gauge to file it to. The brass I was going to use as a rack was 3-16ths in. thick, so I put a line central along the edge of it and packed it up on the slide-rest so that the line came level with the lathe centres. Before bolting it down I made sure that it was exactly square with the slide-rest. All now being ready, I set the lathe going at a fast speed, and gently turning the slide-rest handle at right angles to the lathe, I cut the first tooth. When I had run the slide-rest back, I pulled the stop on the divided plate back so that the pin just cleared the holes in the plate. Then I gave it a turn so that the pin came opposite the second hole past the one I had just taken it from; then, pushing the pin home, I cut the second tooth; and so, by using every second hole in plate, I cut twenty-five teeth to 1 in. After cutting the first tooth, I fix a piece of strip brass along the bottom part of the slide-rest to act as a stop, in this way getting all of the teeth the same depth.

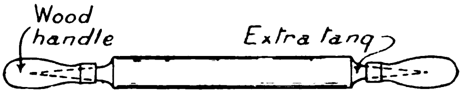
A Burnisher.

By J. H. P. B.

A burnisher is a very useful tool in the model engineer's workshop, and an old half-round file provides just the material for the purpose. Having obtained one, first grind away all the teeth and round the corners until you have a smooth surface of the section (shown in Fig. 1).

Then, with an emery stick and No. 1 emery, the ground surface should be worked up quite smooth, and finally finished with No. 0 emery.

FIG. 2.



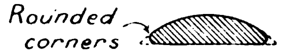


FIG. 1.

I have found when using the tool it is an advantage to have two handles, and for this an extra tang should be ground at the other end, as Fig. 2. With the aid of this tool a brilliant finish can be given to such little things as screwheads, cotters, and the like, and well repays the time spent on its manufacture.

A Visit to the Royal Scottish Museum, Edinburgh.

(*Continued from page 59.*)

The Machinery Section.

THE usefulness of the Museum to the student is increased by many of the models in the Machinery Hall being working models, and the system adopted for driving them is of considerable interest. A small motor is placed on the floor of any case containing a model to be worked, and by means of speed-reducing gear the model is driven at a very slow speed by the motor, on the visitor pressing a button. The slow speed is adopted to enable the visitor to note the relative movements of the different parts. Different makes of motors and various forms of reducing gear, such as belts, chains, worm gear, and spur gear are purposely introduced, as lending additional interest to the exhibits.

The most interesting feature in this section to locomotive enthusiasts is doubtless the well-preserved "Wylam Dilly" locomotive, designed and constructed by the late Mr. William Hedley, at Wylam, in 1813, for the purpose of conveying coal wagons between Wylam Colliery and Lemington-on-Tyne. We illustrate in Fig. 5 a working model of this historic locomotive, which is exhibited close by its prototype, and for purposes of illustration the model is to be preferred, as part of the boiler shell is taken away, and one of the cylinders is in section. The model was constructed in the Museum workshops. It is to a scale of 4 ins. to the foot.

A brief record of its interesting history is attached to the locomotive, which states that: "This engine, in conjunction with another built by Mr. Hedley in the same year (now in the South Kensington Museum), demonstrated the sufficiency, for all practical purposes, of smooth wheel and rail traction. The excessive expense incurred by the owner of Wylam Colliery, Mr. Christopher Blackett, at that time, in the conveying of coals from the pit to Lemington, caused him great anxiety, which was shared by Mr. Hedley, who had full management. This resulted in Mr. Hedley's experiments in October. 1812, to test his idea of the smooth wheel principle and the next year he constructed the two engines engine was taken off its wheels and put into a paddle-fitted keel, and used for towing purposes, and was the means of stopping the strike. After some months of this work it was restored to its proper

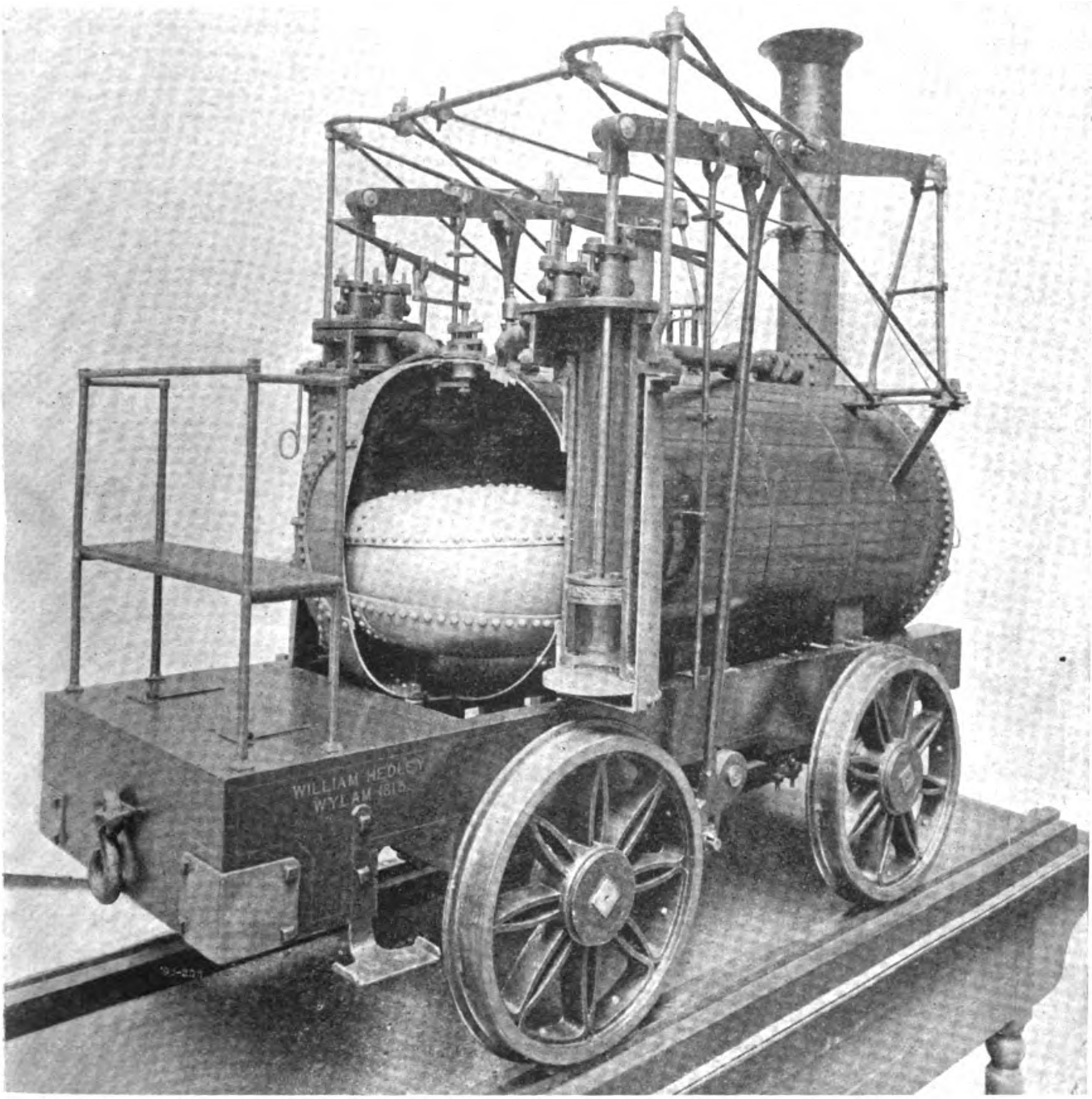


FIG. 5.—MODEL OF HISTORIC LOCOMOTIVE, "WYLAM DILLY": ROYAL SCOTTISH MUSEUM, EDINBURGH.

here alluded to. The "Wylam Dilly" ran on the Wylam wagon-way until 1862, when the colliery was closed and the materials sold. Mr. Hedley's sons bought this locomotive, and have kept it in good preservation. They have lent it for exhibition. During the keelmen's strike on the Tyne in 1822, the duties on the Wylam wagon-way. Besides the smooth wheels there are other important features in this locomotive, viz., the return-tube boiler, and the exhaust pipe carried into the chimney, which latter (the chimney) it will be observed is about the same diameter as experience would make it for such an engine at the present time. The original wheels were smooth and unflanged to run in or on the flat rails with which the Wylam wagon-way was laid at that time, but when the way was laid with edge or round-topped rails in 1830 the present wheels were substituted. The exhaust pipe as originally placed entered the chimney higher up than at present. This alteration must have been subsequent to 1825, and the intermediate chamber, through which Mr. Hedley caused the steam to pass (in order to deaden the noise) was removed at the same time. The initials J. B. and J. L. which have been cut with a chisel on the boiler-end next to where the driver stood, are those of John Bell, driver, and J. Lawson, fireman. These men had charge of the locomotive about the year 1820, and Bell went with the engine when it was fixed in the keel in 1822."

It is interesting to note a few of the principal dimensions of the "Wylam Dilly," which are as follows:—Cylinders, 7½ ins. diameter by 3-ft. stroke; boiler, 10 ft. long by 4 ft. 3 ins. diameter; firebox, 1 ft. 8½ ins. wide by 2 ft. 7 ins. long; wheels, 3 ft. 2 ins. diameter; axles, 3¼ ins. square. The front end of the engine is shown to the left of the photograph. Firing was done from the smokebox end. The coal, and a barrel for boiler feed being carried on a four-wheeled tender, similarly to "Puffing Billy."

From this we pass on to the next locomotive exhibit—a sectional *working* model of a North British Railway four-wheeled coupled express locomotive built about 1880. The model is to the scale of 2 ins. to 1 ft., and was made in the Museum workshops, from drawings supplied by Mr. Dugald Drummond, M.Inst.C.E. The photograph we reproduce of the model, Fig. 6, shows very clearly the general arrangement and construction of the firebox, boiler, smokebox, and cab, which are in section. It may be interesting for some readers, who wish to compare with the modern express engines of this company, to know the principal dimensions of the actual engine of this class, and these are as follows: Diameter of cylinders, 17 ins.; stroke, 26 ins.; diameter of driving wheels, 6 ft. 6 ins.; total wheelbase, 21 ft. 1 in.; maximum travel of slide valve 4¼ ins.; lap, 1 in.; lead, ⅛ in.; angle of advance, forward eccentric, 13½ degs.; angle of advance, backward eccentric, 14 degs.; heating surface, tubes 1,050 sq. ft., firebox 90 sq. ft.; fire-grate area, 16·5 sq. ft.

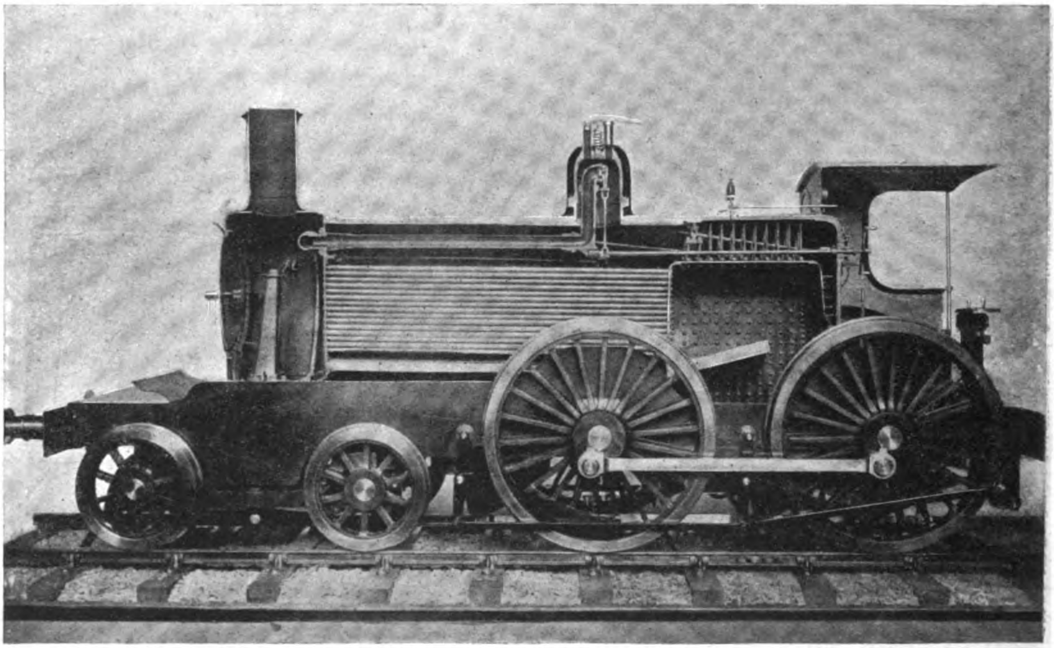


Fig. 6.—Sectional Working Model, North British Passenger Express Locomotive: Royal Scottish Museum, Edinburgh.

We have just been informed that the working scale model loom, constructed by Mr. Wm. Bell, and illustrated in these pages in the issue for March 28th, 1907, Vol. XVI., has now been purchased by the Museum.

(*To be continued.*)

The Junior Institution of Engineers.

At the last meeting of this Institution, held at the Society of Arts, the chairman, Mr. F. R. Durham, presiding, a very interesting, well illustrated, and useful paper on "The Conduit System of Electric Tramway Construction and Recent Improvements" was read by Mr. Fitz Roy Roose, of the L.C.C. Engineer's Department. The salient features of the original line from Westminster to Tooting were first briefly described, and the differences between them and the present system of construction were dwelt upon at length. The extended yokes which were now used, besides carrying the slot rails, formed anchors to which the track rails were fixed at intervals of 7 ft. 6 ins., and would be found of great advantage when renewals of track rails had to be carried out. A cast-iron plate now formed the cover to the insulator pockets, instead of cast-iron boxes, as previously, which, as they became worn by traffic, had to be replaced, and were also the cause of a great deal of dirt getting into the conduit. Drainage, insulators, cable-connectors, etc., were dealt with, and special work at crossovers and junctions, and insertion of junctions during reconstruction, were referred to. The side-slot system was touched upon, as also the electrical supply to the line. A description was given of the plough or collector, and in conclusion the following figures were cited as the cost per mile (single) of the respective systems, including special work, as pipe diversions, etc. Conduit £17,000; surface contact, £9,700; overhead, £9,200. An animated discussion followed, in which Messrs. L. H. Rugg, F. D. Napier, H. C. King, W. De Ritter, C. Singleton, R. Marshall, E. Boult, A. Millar, A. Marshall, C. H. Smith, P. Brown, and the Chairman took part.

On the following Saturday afternoon, as a supplement to the paper, by permission of Mr. Maurice FitzMaurice, Chief Engineer to the London County Council, an inspection was made of the reconstruction work in progress in Stockwell Road, the members being shown over by the resident engineer, Mr. Alex. Millar, and the author. The method of forming the concrete conduit by means of the improved sheet-iron centreing, the process of inserting the copper connecting-pieces between the lengths of conductor-bars, the insertion of the insulators, and manner of carrying out other special work was demonstrated. The members, conducted by Mr. J. Bowden, rolling-stock superintendent, afterwards proceeded by one of the latest types of cars (Class EI) to the sheds at Clapham High Street. Switched off the main track, the car was run into the shed on to the electric traverser, and moved thereon to illustrate the method of bringing the cars into their place in the depot. The Motor School — where the drivers are instructed in the manipulation and operation of the controllers, brakes, etc.— was then shown much interest being manifested in the skeleton stationary and working car. All the leads, etc,. for traction and lighting being visible, the men can be readily taught how the various connections are made. The sub-station was also seen, containing three motor generators (a fourth is now being erected). Delivered at a pressure of 6,600 volts from the generating station at Greenwich, the three-phase alternating current is transferred to 550 volts continuous for use on the lines. About 5 miles of double track are fed from the station.

Chats on Model Locomotives.

By Henry Greenly.

(*Continued from page 112.*)

The "Universal" Electro-Motor and Automatic Reverser.

To show that the motor described in the last article can be applied with equal ease to locomotives with all sizes of driving wheels, I include herewith a sketch showing that should it be necessary for the boiler barrel of the locomotive to be cut away to allow the scale size driving wheels required to clear, there is nothing in the main construction of the "Universal" motor to prevent such a course being adopted. The sketch shows a 7-16ths in. scale locomotive with a boiler barrel of about 4 ft. 8 ins. diameter placed 8 ft. above the rails and driving wheels, the scale equivalent of 6 ft. 9 ins. on tread. It will be seen that with these proportions it is possible to employ a standard motor, and if the locomotive had large driving wheels, all that would be necessary to make the design of motor applicable would be to reduce the diameter of the armature to, say, 1 11-16ths in. instead of 1¾ ins. This could be done without altering the castings. With the "Manchester" type boiler motor, described in the issue of January 23rd (Fig. 4, page 79) this would not be possible, as, even with a 1-in. by 1⅜-in. diameter armature motor and relatively small wheels (for a single express locomotive) of 6 ft. 9 ins. diameter, the field-magnet would foul the flanges of the driving wheels.

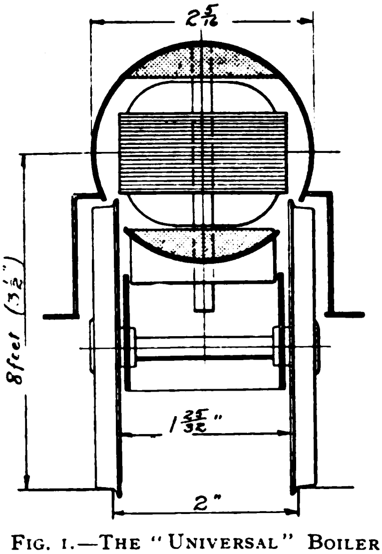


Fig. 1.—The "Universal" Boiler Motor appied to a Single-Wheeled Express Locomotive.

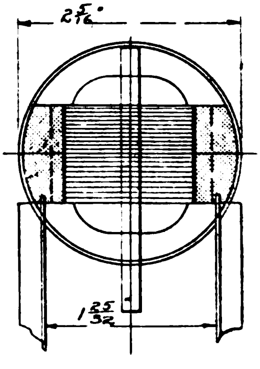


Fig. 2.—Showing the Disadvantage of the "Manchester" Boiler Motor when Used in a Locomotive of the Dimensions given in Fig. 1.

Except for the system of gearing which may be employed in conjunction with these two vertical armature motors, nothing remains but to describe the automatic reverser. The gearing question is a rather difficult one. It is well known that worm gearing provides the most simple solution, but then worm gearing has one bad fault—it is not reversible in its action. With the velocity ratios usually employed—say, 1 to 8 or 1 to 10—the worm will drive the worm wheel; but when the current is shut off and the engine wants to roll along by virtue of its momentum, the worm wheel on the driving axle will not drive the worm and the armature to which it is attached and the driving wheels of the locomotive pick-up. Of course, the arrangements suggested in the article in the issue of October 31st, page 416, may be adopted, and with careful "driving" very fair results might be obtained. Magnetic clutches to free the worm wheel from the shaft are possible, but will generally be agreed as too complicated; and most free wheel devices of a mechanical nature would prevent the braking action of the motor when reversed. All things considered, therefore, worm gearing in model railway work does not seem to have any marked advantages, and while it is an attractive type of speed reduction gear, it generally has—at the test of practical experience—to give way to other forms.

I am indebted to Messrs. W. J. Bassett-Lowke and Co. for a copy of a working drawing of their No. G 711 2-in. gauge locomotive, and herewith publish a part of the drawing which shows the method of gearing the motor to the driving wheel which has been found the most serviceable.

The arrangement involves two sets of bevel gear, a 15-toothed bevel pinion being fitted to the armature shaft and driving the 44-toothed wheel on the countershaft. The pinion on the countershaft fits inside the boss of the bevel wheel—it would be impossible to cut the teeth of the pinion with the two in one piece—and the countershaft, which is 7-32nds in. diameter, runs in a box-like casting fixed inside the main frames. This casting forms a very neat imitation ashpan and provides bearings of ample dimensions for the work they have to do. The ratio of the drive is

$$\frac{15}{44} \times \frac{15}{44} = 8\frac{1}{2} \text{ to } 1 \text{ approximately,}$$

the bevel wheels and pinions being identical in the matter of number of teeth. The drawing shows the general arrangement of the engine, the position of the reverser, and also its external outline.

The automatic reverser shown in the drawings and photographs is the joint invention of Mr. John Cole, the well-known electrical manufacturer, and Mr. Winteringham, of Messrs. W. J. Bassett-Lowke and Co. (the designer of the locomotive just referred to), and this instrument has overcome all the difficulties with regard to the range of voltage at which it will work and the efficiency of the contacts both of which troubled experimenters in the past. No mercury cups, as suggested and made by a contributor to THE MODEL ENGINEER some years ago, are required, and while the reverser takes a very small current when the locomotive is working, the consumption is nothing nearly as much as under the separately excited system.

The action of the reverser will be understood by the accompanying diagrams (Figs. 5 and 6), the series wound diagram being the one generally used. There is no advantage in the shunt winding of the motor for traction purposes. The main portion of the reverser consists of a permanent field-magnet between the poles of which oscillate an armature comprised of a few **H** or Siemens' armature stampings. This armature is wound with fine silk-covered wire and is connected in shunt across the main flow and return circuits to the motor.

The permanent field is built up of no less than six small bar magnets arranged in cylindrical form in two sets of three on a yoke piece at the top. The bottom of each of the three bar magnets is fixed to a curved pole-piece and between these pole-pieces swings the armature, the shaft of which is parallel to and in the centre of the ring of bar magnets.

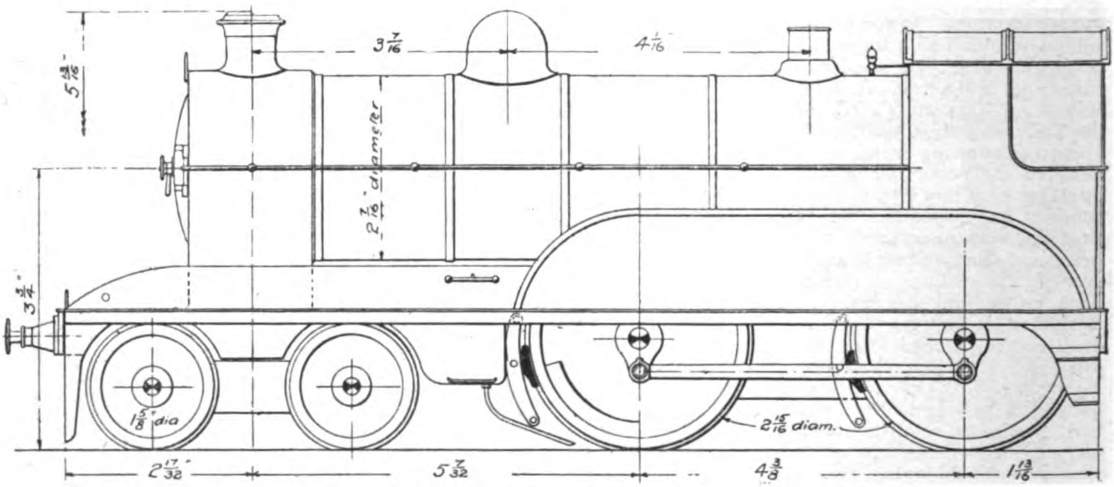
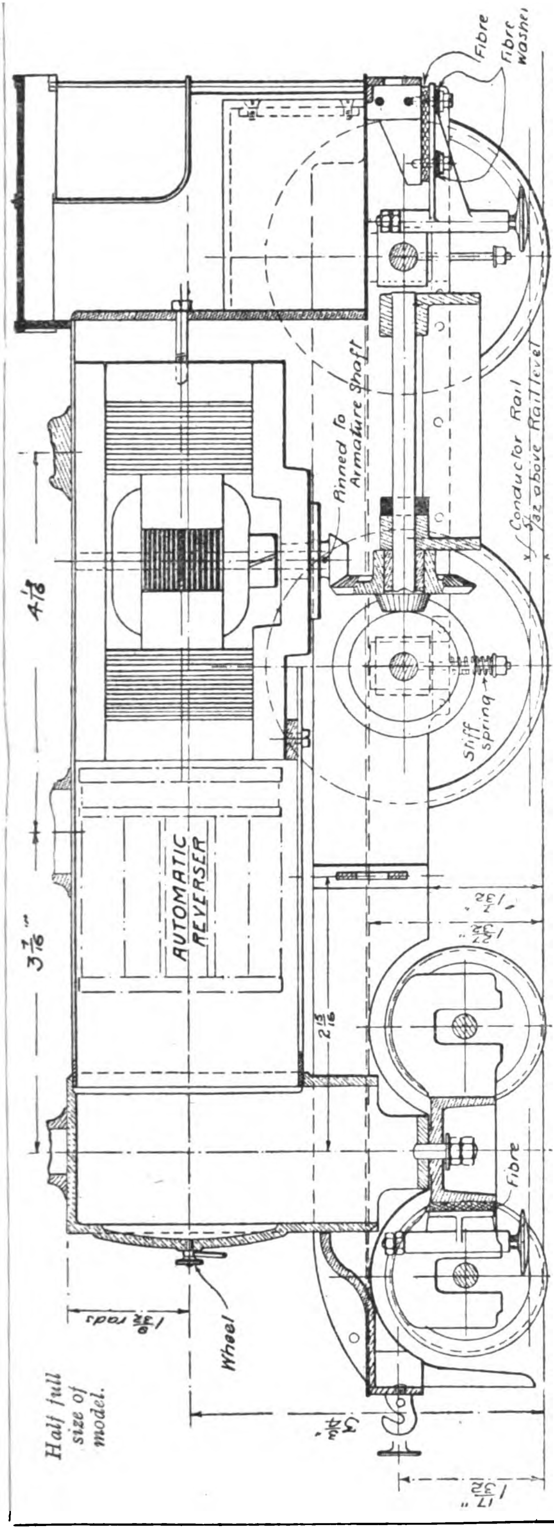
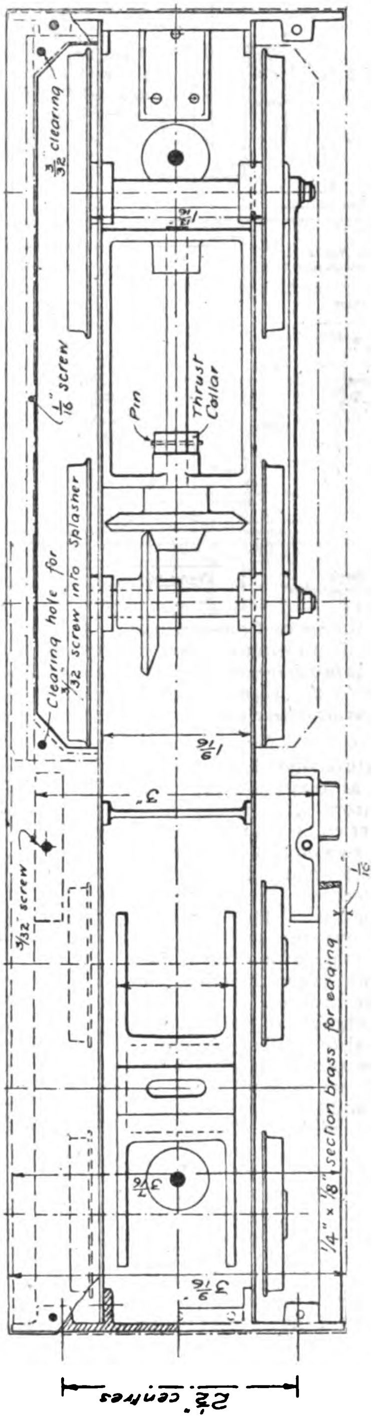


FIG. 3.—EXTERNAL ELEVATION OF ELECTRICALLY DRIVEN 2-IN. GAUGE MODEL EXPRESS LOCOMOTIVE.



Sectional Elevation, showing Position of Motor Reverser and Gearing.



Plan of Framing and Gearing.

Fig. 4.—Model 4—4—0 Type Electrically Driven Express Locomotive.

(Scale: 7-16ths-in. to the foot; 2 in. gauge.)

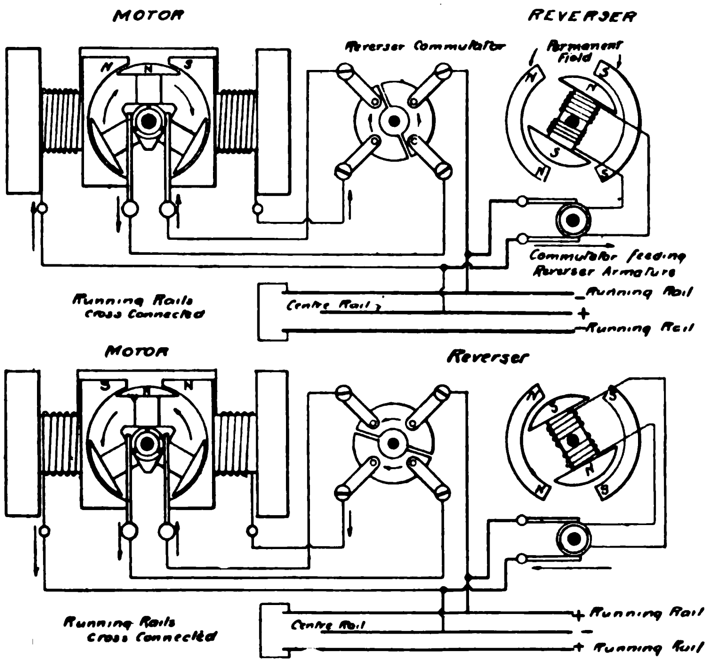


FIG. 5.—DIAGRAM OF CONNECTIONS OF PATENT AUTOMATIC MOTOR REVERSER FOR SERIES WOUND MOTORS.

(*Note.—The two diagrams show the relative polarities of the various magnet poles when the motor is running in both the forward and reverse direction.*

On the armature shaft is fixed two commutators, at least, only one is a real commutator. The small cylindrical two-part commutator is connected to the two ends of the armature coil and is really a slip ring device for feeding the partially rotating armature. The brushes never travel over the slots of the commutator, but always feed the current in the same direction as applied to the brushes.

The disc commutator further up the shaft is also divided into two parts, but is provided with four brushes which are connected up to the line wires and to the field-magnet and armature brushes of the motor as indicated.

In the upper diagrams of both Figs. 5 and 6 the motor is shown going in a clock-wise direction. To reverse the direction of rotation the main current supplied to the section of the rails over which the locomotive is travelling is reversed. Now, the field-magnet of the reverser being permanent—that is, always north on one pole and south on the other—the reversal of the main supply current, according to the law of electro-magnets, causes the armature to be magnetised in an exactly opposite way, and as like poles repel and unlike attract the reverser armature swings over carrying with it the two commutators. The swinging over of the small commutator does not effect any change in the feeding of the current to the reverser armature and therefore it remains. The larger disc commutator with the four brushes alters the passage of the current through these four brushes and consequently through the fields and armature of the electro-motor, causing the polarity of the fields to remain constant and that of the armature to be changed. Naturally, the electro-motor then runs in the opposite direction, as indicated in the lower diagrams. Fig. 6 shows the method of connecting a motor in shunt.

As will be seen, the contacts in this polarised relay (for such the instrument is) does not depend on the magnet directly: the four brushes are made of springy metal and always press on the commutator with a given pressure. Therefore, once set over, the passage of the current is not interrupted, and all the magnet has to do is to overcome the friction of the brushes sliding on the commutator. Those readers who are not well acquainted with the elementary principles of the electromotor will do well to study the above

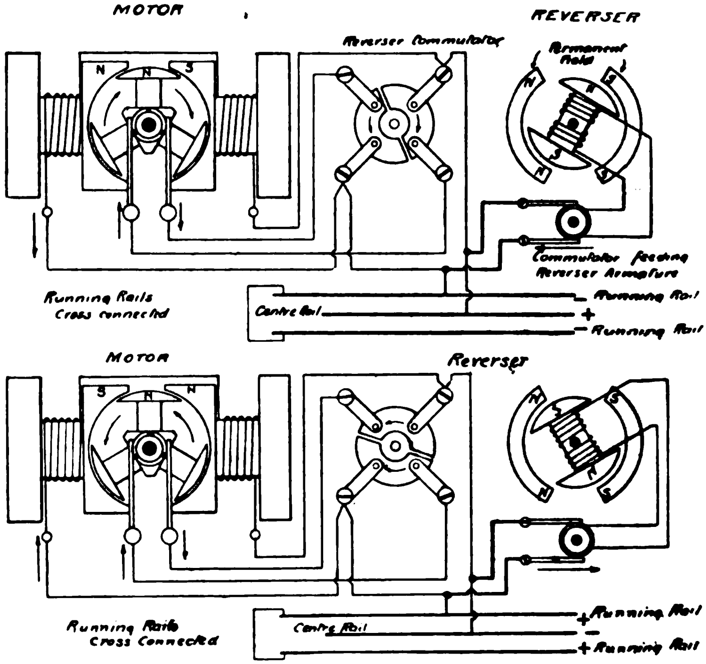


FIG. 6.—DIAGRAM OF CONNECTIONS OF PATENT AUTOMATIC MOTOR REVERSER FOR SHUNT WOUND MOTORS.

(*Note.—The two diagrams show the relative polarities of the various magnet poles with the motor running in both forward and reverse directions.*)

diagrams in conjunction with those given in the first article on the subject of Electrical Locomotives, and also with "A. W. M.'s" articles under the heading "How It Works" in the issues for Jan. 4th to Feb. 15th, 1906, inclusive.

(*To be continued.*)

Design for a Small Compound Marine Type Engine.

By W. MUNCASTER.

(*Continued from page* 138.)

REFERRING to Figs. 3 and 4, which are sections of the cylinders, it will be seen these are cast separately, and arranged with the valves they are thus so much better to handle, and can be more easily machined where only a small lathe is available.

It will be noticed that the pistons are coned to the extent of 7 mm., the sole object being to reduce the height of the cylinders by allowing the stuffing boxes to be put further into the cover.

The difficulty of facing the valve seat which occurs when the steam chest is cast on is avoided in the L.-P. cylinder, as the ends of the chest are open and the facing can be planed right through, or, if no machine be available, can be filed. In this case it would be well to have it cast so that only the part over which the valve works would need facing, the remainder being cast short of this line.

Both piston-rods are of the same diameter and both valve spindles. This tends to uniformity, and

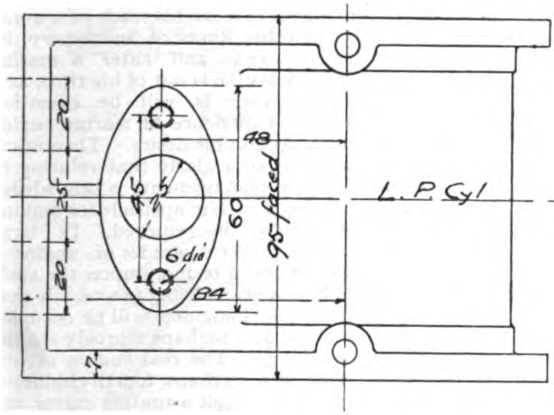


FIG. 6.

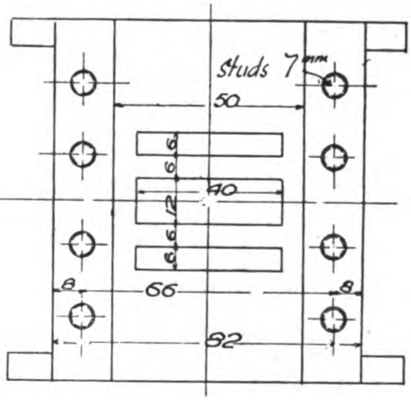


FIG. 7.

ELEVATIONS OF LOW-PRESSURE CYLINDER.

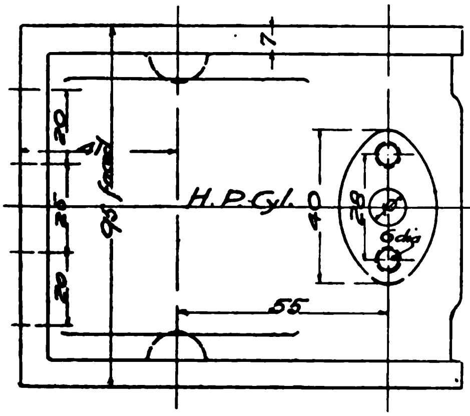


FIG. 8.

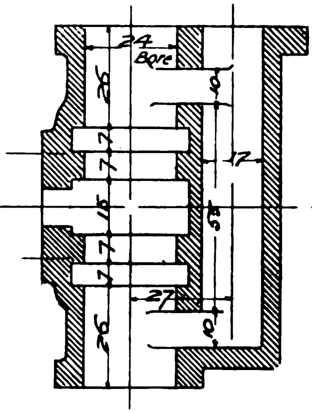


FIG. 9.

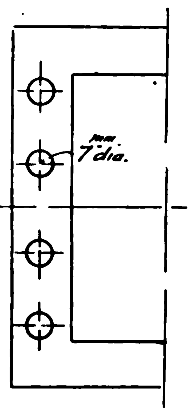


FIG. 10.

HIGH-PRESSURE CYLINDER.

of the L.-P. cylinder between. The H.-P. cylinder is cast in one piece with the casing for the liner of the piston-valve, all the ports being cored, and also the passage connecting the exhaust from the bottom to the top of the valve.

The writer prefers the cylinders cast separately; the corresponding parts are in pairs, both engines being precisely alike. The stroke of the valve is the same in both cylinders, the H.-P. valve having a lap of 3 mm., and the L.-P. a lap of 2 mm. The H.-P. eccentric will not, however, be in the same relative position. The valve admitting steam from the nside edge instead of the outside edge, as in the ordinary slide valve, will be in a position on the shaft opposite to that assumed in the latter case.

Fig. 5 shows an inverted plan of the cylinder. It will be noticed that the standard as well as the frame columns are fitted to the covers. Before finally bolting up, however, the covers will be fixed to the cylinder, as countersunk screws are arranged under the seats of the standards for this purpose. External views of the L.-P. cylinder are given in Figs. 6 and 7, and of the H.-P. cylinder in Figs. 8, 9, and 10.

Fig. 9 gives a section showing the cores for the ports of the piston valve. The seat for the liner is bored to 24 mm. The liner, after being turned and the ports cut (see Fig. 11), should be driven in tightly and secured by a small grub screw through the casing, then bored and carefully lapped.

The cylinders, after being bored, should have the ends faced, care being taken to make both cylinders exactly of the same length.

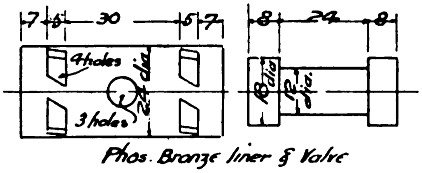


FIG. 11.—H.-P. CYLINDER LINER AND VALVE.

Referring to the transverse section of the cylinders Fig. 4), it will be seen that the space for the intermediate steam is arranged so as not to any great extent come in contact with the H.-P. cylinder, on account of the cooling effect of the lower pressure steam. This may be still further improved by a plate across the recess against the H.-P. cylinder if desired. In this view a boss is shown to be cast on for a starting valve. This was not intended to be fitted at first, but at any future time an arrangement might be made to pass live steam from the centre port into the intermediate pipe by means of a small valve fitted here.

The outside dimensions of the cylinder and valve for the H.-P. is shown in Fig. 11. No rings are fitted, but it should be a good fit in the liner. A piece of phosphor-bronze rod or good gun-metal might be used for both of these, the rolled or extruded metal being more solid and reliable than a casting.

(To be continued.)

The *Elektrotechnischer Anzeiger* gives the following method of sharpening files and other similar tools:—The file is connected with the positive pole of a battery consisting of twelve Bunsen cells, and is then placed in a bath made up of 40 parts of sulphuric acid and 1,000 parts of water. The negative electrode is of copper wire wound in spiral form round the file, but not touching it. The action takes about ten minutes. It is said that files treated in this way appear to be almost like new ones, and are satisfactory in use.

How to Become a Mechanical Engineer.

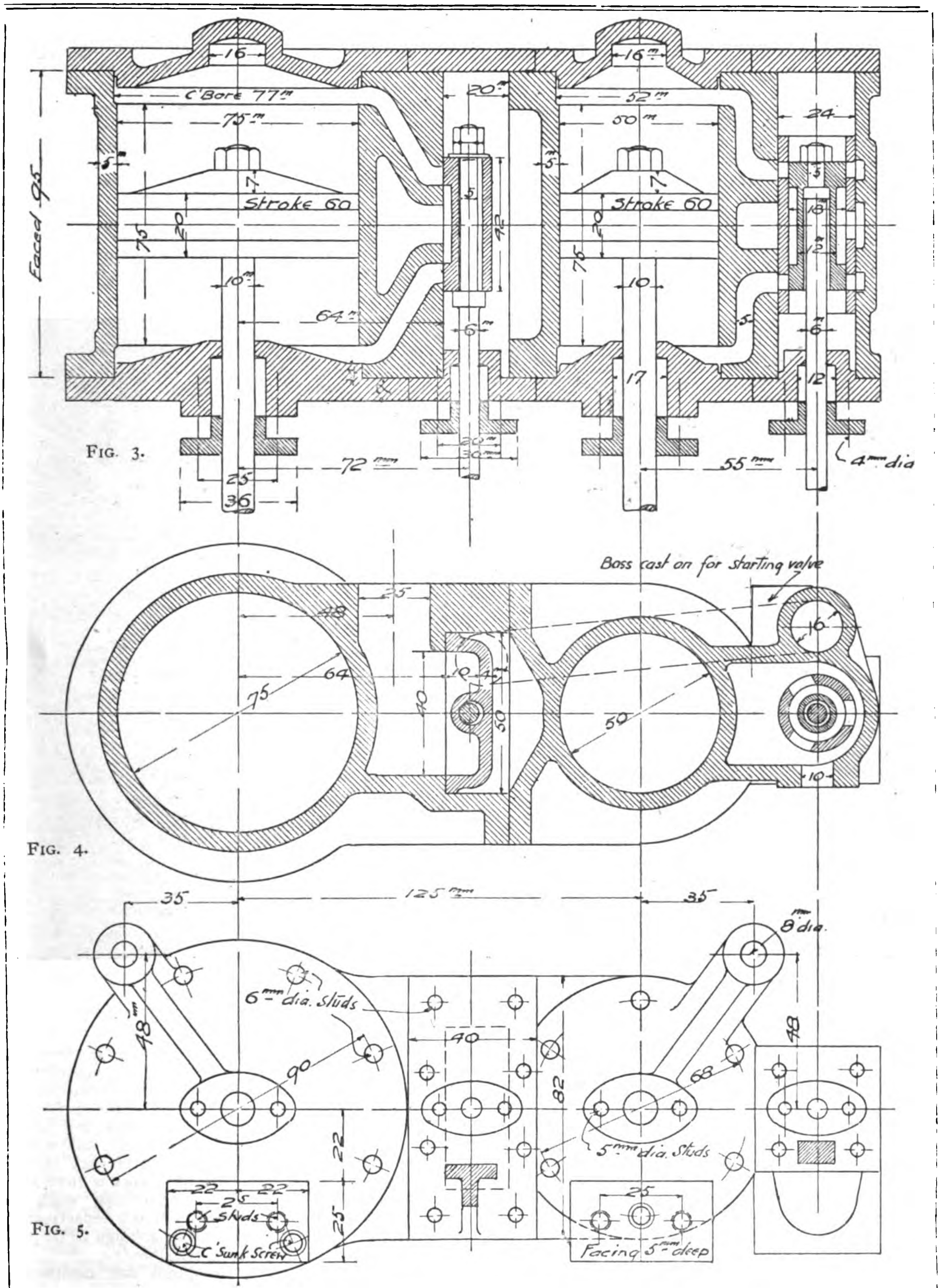
By ALFRED W. MARSHALL, M.I.Mech.E., A.M.I.E.E.

(Continued from page 132.)

IF a lad desires to have charge of engines on board a ship in the mercantile service—that is, to become a sea-going engineer, as it is termed—he should preferably serve his apprenticeship or pupilage with a firm manufacturing or repairing marine engines and boilers. Should he, through force of circumstances have to spend his time in one department of such a works, the fitting and erecting shop is the one to suit him. He will, in fact, become a fitter. It is not absolutely necessary, however, that his appreticeship is served at a marine engine works. If he finds it more convenient to learn his trade in a works making or repairing other kinds of machinery, he can serve in such a works and enter a marine engineer's workshop, when he is out of his time, as a journeyman or improver. It will be essential, however, to have this experience of marine engine making if he is to succeed in his desire. Theoretical study must be added, particularly that relating to steam production and management; a knowledge of mechanical drawing and fair aptitude for making arithmetical calculations is required. In large steamships there are several grades of engineer. Perhaps there may be seven or more upon the staff. The duties of the lowest grade being practically that of a fitter artisan, the chief engineer will be occupied with business matters, and perhaps scarcely see the engines during a voyage. The real engine drivers are the second, third, and, perhaps, fourth engineers. All, however, must go through a routine career and work their way upwards, passing examinations held by the Board of Trade to obtain the necessary qualifying certificates.

To become a locomotive engine driver application should be made to the superintendent of the locomotive department of a railway. A lad will not be taught to make or repair parts of locomotives, but will serve a routine experience in managing locomotives. At first he will be placed in the running sheds and have to clean the engines when they come in, a term of service as fireman upon a shunting engine is the next step, then, perhaps, fireman on a goods engine, back again as driver of a shunting engine, fireman or driver on a suburban train, and so on. The position of express or long distance driver is only reached after a considerable number of years' service. Smartness and ability will make advancement come more quickly, but it is not a matter of serving a certain number of years as apprentice, and then being promoted at once to a responsible place as driver on account of the qualification so obtained.

The lad who wishes to become a mechanical engineer, whatever the direction in which his imagination tends, must be prepared to "rough it" during the earlier part of his career at least. Conditions of workshop life have very much improved, but some amount of dirt is unavoidable. Hours of work are long, eight to nine and a half hours a day, perhaps overtime for weeks or months at the rate of two hours or more per evening, and all-night work may occasionally be necessary. The regulations of the Factory Acts intervene, but the work is hard and long, nevertheless. Engineering



DESIGN FOR A SMALL COMPOUND MARINE ENGINE.

workshops are frequently situated in places where the facilities for obtaining meals are not very good when they have to be taken outside the works.

At one time it was the universal custom to commence work at six o'clock in the morning, with intervals for breakfast and dinner. The factory gates would be shut punctually at the hour, and late comers admitted at each quarter or half-hour to seven o'clock; after that admittance could not be obtained until the time of starting after the breakfast interval, say at nine o'clock. Anyone arriving later than ten o'clock would not be admitted that day. The time thus lost would be deducted from wages. Modifications have now been made in the working possible, but cannot afford to pay a pupil's premium, he should try to serve in a small rather than a large works. It sounds well to be employed at a large works, but a small workshop doing a variety of work will give the more useful training in handicraft. The lad who intends to be a designing engineer or occupy responsible positions in charge of large constructive work should serve in the works of a large firm, as a pupil, if possible, though he may still do well if circumstances cause him to be trained in a small workshop.

With respect to the various trades comprised in mechanical engineering, pattern-making is clean, very interesting, and perhaps the most comfortable

Fig. 9.—View in Iron Foundry: Messrs. Peckett & Sons' Works, Bristol.

hours. Starting at six o'clock a.m. is still the rule with some firms, others commence at eight o'clock, the hour of leaving off being later, a minimum total of fifty to fifty-four hours' work being made for the week. On Saturdays work ceases at twelve or one o'clock. A summer holiday of a week or fortnight is not recognised by many firms, but an extra day or two is usually given at the bank holidays; time thus lost is deducted, as a rule, from the wages of the journeymen, but in the case of an apprentice it would be decided by the indentures, if any have been executed.

If the apprentice intends to qualify primarily as an artisan, and learn one branch of the trade, or wishes to obtain as much general knowledge as to work at. Coppersmiths' work is moderately clean; machine shop work may be moderately clean or very dirty, according to local circumstances. Boiler-making is dirty work, and the noise of repeated hammering may be distressing and cause deafness. It is, however, a good trade, and worth consideration. Iron-foundry work is very dirty, but is a good trade. Blacksmith's work is dirty and laborious, but interesting. Engineering work is varied; it may be light or heavy in any department, and a weaker lad could probably arrange to be put to the light work as much as possible.

When an apprentice or pupil has completed his time of service he may have the opportunity of continuing in the employment of the firm.

He would then be almost sure to receive a considerable increase in his wages, perhaps to almost a full journeyman's wage if he has been apprenticed to one branch of the work, or to a salary upon which he can support himself if he has been a pupil or through several of the departments. It may be a good policy to accept such an offer, but the qualification which will be the most valuable and bring best remuneration and success eventually is experience. Book knowledge can be acquired by anybody; this kind of education is now so inexpensive and facilities for obtaining it within the reach of so many, that it cannot alone command a high rate of remuneration or secure responsible positions in engineering work. Experience with practical work, however, can only be acquired slowly and by actually engaging in the routine of every-day requirements. This kind of knowledge is personal to the owner, and not another man's ideas put into print, which may or may not be correct in practice or under other circumstances.

Unless, therefore, such an offer is likely to lead to a permanent and advantageous position or further experience will be immediately gained, it is a good plan to make a change at the end or shortly after the expiration of apprenticeship. After spending some years in one works, under the protection of an apprenticeship indenture, by virtue of which he cannot be discharged by reason of mistakes or lack of skill in his work, a young man feels very much at home there. It is easy to continue at the work and place with which he is so familiar. But the more he remains, the greater the disadvantage he will experience when taking a new situation. On the other hand, if he makes a move very soon, and repeats it from time to time during the next few years, he will extend his experience of other works and conditions. This will give him confidence and adaptability increasing his market value. Probably, he will not earn so much money at first, but will be less likely to be out of employment than if he narrows his experience by remaining long at the firm with which he served his time.

Assuming that the apprentice determines to find a new situation when his indentures are completed, his best plan is to try and obtain an introduction to either a principal or someone in authority. He can call upon engineering firms, but that is not a very satisfactory way, as he will find everybody busy, and only perhaps succeed in seeing a very subordinate official. If he can obtain a personal introduction to a manager or foreman, he will have a much better chance. He should also reply to advertisements in the "situations vacant" columns of the engineering or other journals. Sometimes engineering vacancies are advertised in the daily papers. Another plan is to select the names and addresses of engineering firms from the engineering journals or directories, and make application in writing.

If the apprentice has served his time in a small works, he should try and obtain situations in one or two large works. This will broaden his views, and he will see work done on a large scale. He must not expect to obtain a responsible position at once, but should pursue a steady policy of adding to his experience and theoretical knowledge. A certain amount of time should be regularly devoted to study, according to his intentions and capabilities. If he is intending to remain an artisan, he should still acquire knowledge of the theoretical part of his trade. If he desires to attain to the highest positions in mechanical engineering, he must contrive to study during the whole of his career. A great deal of information is given in the proceedings of the engineering institutions, and he should join at least one of them—the Institution of Civil Engineers, Great George Street, London, S.W.; the Institution of Mechanical Engineers, Storey's Gate, St. James' Park, London; the Institution of Electrical Engineers, Victoria Street, London, S.W.; the Institution of Naval Architects, The North-East Coast Institution of Engineers and Shipbuilders and others. Full information as to the conditions of joining can be obtained from the secretaries. The Junior Institution of Engineers, 39, Victoria Street, London, S.W., is a particularly suitable institution for a young engineer to join.

The iron and brass castings are not always made at the same establishment where machine and engine making or other mechanical engineering work is carried on. Founding is undertaken as a distinct business by many firms who engage in no other kind of engineering work. Their business is to supply castings to outside firms, the customer usually sending his own patterns to the founder, castings being made from these as required. It is very convenient, however, for an engineer to have a foundry as a department of his works. Fig. 9 shows the iron foundry department of Messrs. Peckett & Sons' locomotive Works, Bristol. The furnaces in which the iron is melted are not shown, but the general equipment is well indicated. Various iron boxes, or moulding flasks as they are termed, in which the sand for forming moulds is placed are at the right of the picture, and in the rear corner at the left hand. Sliding doors in the wall at the back open into ovens in which moulds and sand cores are dried before being placed in position to receive the molten metal. The jib crane in the centre covers the floor space in its movement, and serves to lift castings from the moulds or parts of the moulds into position. Patterns, cores, and boxes in which the cores are formed may be seen in the centre. Each moulder has his own equipment of small tools, consisting of special hand trowels, with which he shapes and smoothes away parts of the mould not perfectly formed by the pattern. The metal is usually poured at certain regular hours, perhaps once a day; a number of moulds being prepared in readiness. Large castings are poured from iron ladles suspended by the crane, small castings are poured from iron pots carried in a frame by hand; copper and alloys are usually poured from a crucible carried to the mould.

(To be continued.)

It is computed that about 14,000 words were sent over the Atlantic on the opening day of the wireless telegraphy service from the United Kingdom to Canada.

A notable achievement in warship wireless telegraphy was made by the staff of the *Cornwallis* on the way home from Gibraltar by keeping in touch with that port during the entire passage, extending over 900 miles, and also in communicating with the Scilly Island station when almost 200 miles distant. The instruments in the *Cornwallis* are of the improved service type, and the results are said to have been highly satisfactory.

Engineering Works and Accessories for Model Railways.

By E. W. Twining.

(*Continued from page* 108.)

ONE other tunnel on the London and North-Western line I propose to illustrate and describe, namely, Shugborough, situated four miles south of Stafford. Both ends are very fine. The northern front may be justly said to be bold and imposing in the extreme, the other is neither very bold nor imposing, but very beautiful. The style of architecture employed in the two ends is altogether different, that at the northern end being Norman and at the southern Roman Classic. Fig. 16 is an elevation of the northern entrance.

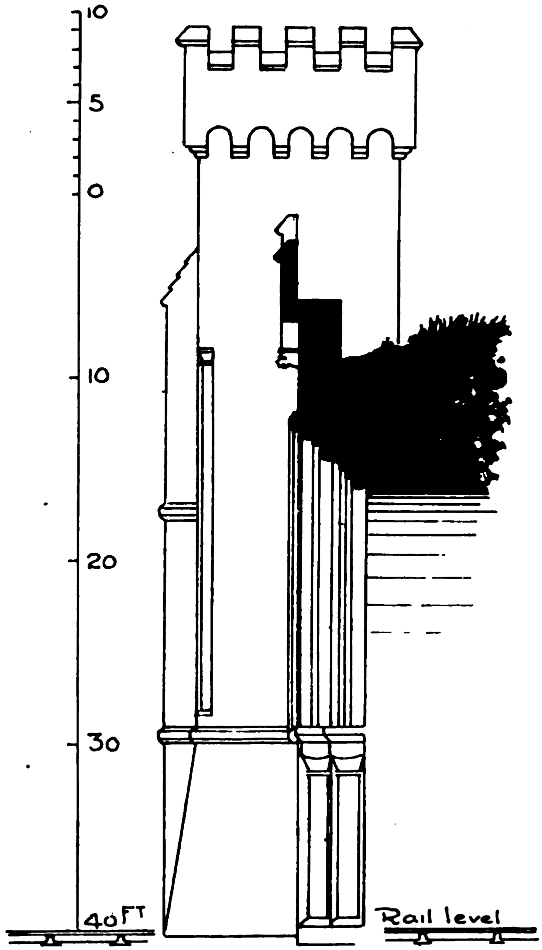


FIG. 16*a*.—CROSS-SECTION THROUGH THE ARCH OF SHUGBOROUGH TUNNEL, NORTHERN END.

A comparison between this and the Great Western tunnel given in Fig. 1 will appear to exhibit few features in common, although both are in the Norman or rather Anglo-Norman style; the explanation is that the Norman of the Great Western example is that of an earlier period, namely about the time of the conquest in 1066, whilst Shugborough

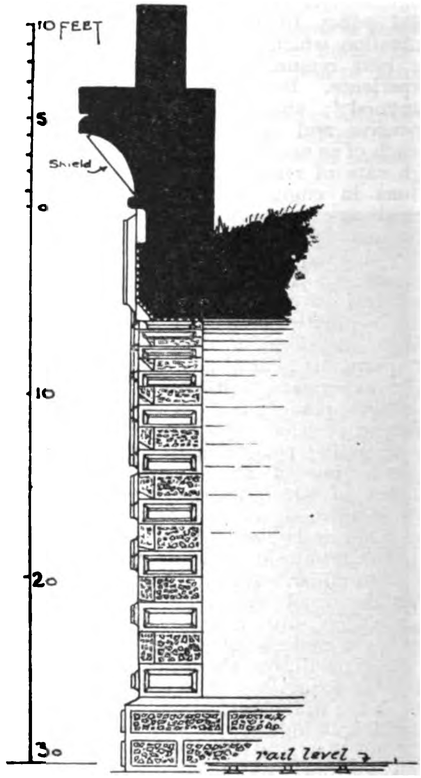


FIG. 17*a*.—CROSS-SECTION THROUGH THE ARCH OF SHUGBOROUGH TUNNEL: SOUTHERN END.

represents the style at a somewhat later period, when builders began to make columns and mouldings less heavy. As will be seen from the drawings, the entrance is flanked on either side by large embattled towers which are square in plan. The tops of these towers are enlarged and supported upon corbel stones, as is the parapet in Kilsby and other examples I have given. To use the correct expression, they are "machiolated."

If may not be amiss to state here that in mediæval castles the object of such construction was that it was very necessary to protect the walls and gateways from the operations of besieging parties, and this was accomplished by leaving in the floor of the parapet between each of the corbels or multiple corbels openings through which the defenders of the fortress were able to shoot arrows, and drop stones and molten lead upon the enemy beneath without rendering themselves visible above the parapet wall. This may be made clear by a reference to the cross section of Kilsby tunnel by imagining vertical holes in the portion of the paving of the parapet which projects forward beyond the main wall. This digression has, of course, no reference to the modelling of tunnels, but may nevertheless

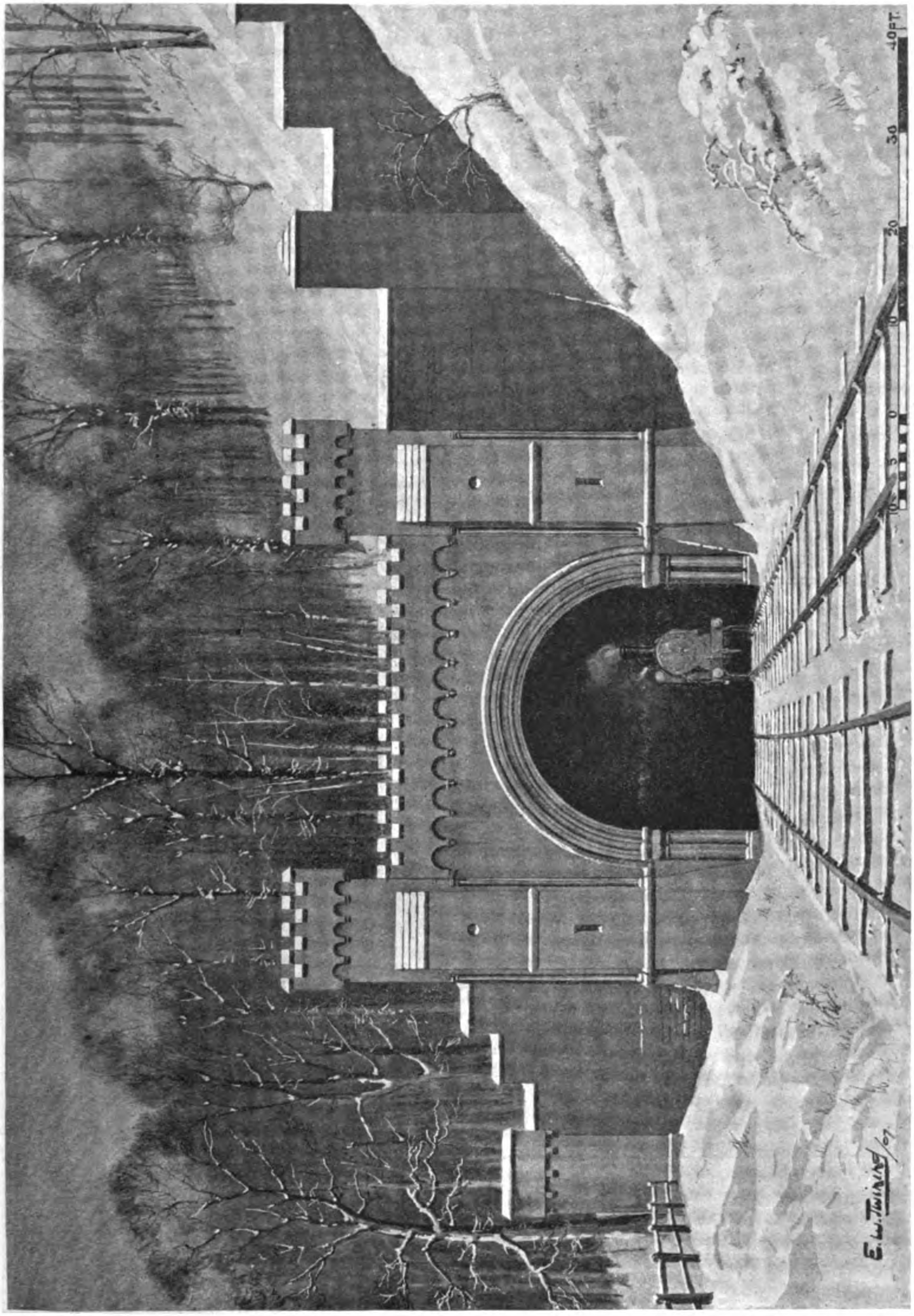


FIG. 16.—NORTHERN END OF SHUGBOROUGH TUNNEL: L.N.W. RAILWAY.

be of interest to some readers of an archæological turn of mind. The main wall of Shugborough north end has machiolations like the towers. A section through the arch is shown in Fig. 16*a*.

Turning to the southern entrance, illustrated by Fig. 17, there is something of Egyptian character about the general outline. The principal point of beauty lies in the elaborately worked *voussoirs* of the face of the arch: these are indeed worthy of the finest class of classic building. Each alternate stone is relieved with a panel raised and chamfered, not only on the face, but also on the inside of the arch, the keystone being similarly treated, whilst the intervening stones are bevelled on their inner angles and carved all over in vermiculated rustic. Underneath the deeply projecting cornice there is a shield carrying the armorial bearings of the Earl of Lichfield through whose estate the tunnel passes. A cross section is given in Fig. 17*a*.

Shugborough tunnel is 2,328 ft. long, 26 ft. wide at the level of the springing of the arch and 24 ft. high above rails. There are no ventilating shafts probably owing to the fact that such would be considered a nuisance on a private estate. It was cut through sandstone and hard conglomerate.

Before leaving the North-Western I may remark on the hideousness of some of the other tunnel fronts; some are in no style at all and, moreover, have no compensating beauty of their own.

(To be continued.)

The Society of Model Engineers.

London.

An ordinary meeting of the Society was held on Tuesday, January 28th, 1908, at the Cripplegate Institute, Golden Lane, E.C., Mr. F. R. Welsman taking the chair, and between eighty and ninety members being present.

The minutes of the previous meeting having been read and two gentlemen elected members, the Chairman reported that Mr. H. Hildersley had resigned his position as Librarian, and that the Committee had appointed Mr. Edward Seldon, of 224, Croxted Road, Herne Hill, in his place, to whom all future communications regarding the library should be addressed. On the motion of Mr. D. Corse Glen, a hearty vote of thanks was accorded Mr. Hildersley for his services as Librarian. After announcing future meetings as below, and also the arrangements the Committee proposed making for the combined Model Making Competition and Conversazione to be held in May next, the Chairman requested Mr. A. W. Marshall to deliver his lecture on "Electric Batteries." The lecturer, with the aid of a quantity of apparatus, very clearly explained the action of various types of primary batteries and their suitability for working various electrical mechanisms; he also showed, by means of tank slides placed in the lantern and projected on to the screen, the actual production of hydrogen gas from elements placed in the electrolyte on the outer circuit being closed. Some explanation was given of the principles of secondary batteries and the actual charging of a small accumulator shown, and the lecture concluded with experiments in the direct production of electricity from heat by means of thermopiles. A very hearty vote of thanks was, on the motion of Mr. D. Corse Glen, given the lecturer for his instructive lecture. The tools recently purchased for loan to members were on view, and the twist drill grinding machine was shown in operation.

Future Meetings.—The next meeting will be held on Tuesday, February 25th, and will be made a special model and track night. A boiler will be provided, to which stationary engines not provided with their own boiler may be connected, and an adjustable coupling will be provided to suit all ordinary sizes of steam pipe. The models exhibited will be divided into three classes, viz.—(1) locomotives, (2) stationary engines, (3) electrical and general exhibits. If the entries warrant it, three cash prizes will be awarded in each class by popular ballot of the members present. No model having gained a prize in a previous competition held this Session will be allowed to enter. The following meeting will be held on Wednesday, March 18th.

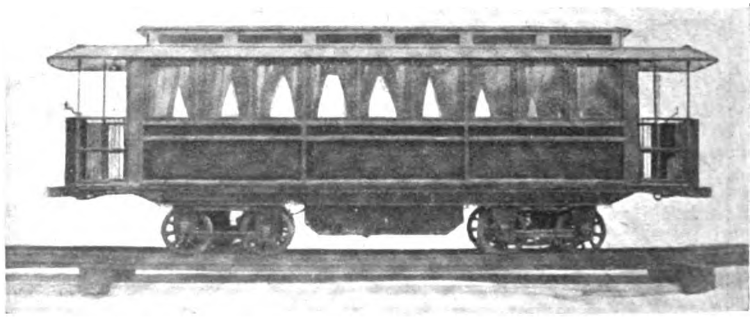
Visits.—On Saturday, February 15th, to Napier Motor Works, Acton; on Wednesday, March 4th, to North London Railway Works, Bow; on Thursday, March 26th, to Great Eastern Railway Works, Stratford.—Herbert G. Riddle, Secretary, 37, Minard Road, Hither Green, S.E.

Practical Letters from Our Readers.

A Model Electric Tramcar.

To the Editor of *The Model Engineer*.

Dear Sir,—The enclosed photograph is of an electric car which I have constructed in my spare time, and which I thought might be of interest to readers of The Model Engineer. When I began it, I intended to make a "Tube" carriage, but later I decided to make it into an electric car—hence its rather unorthodox appearance. It works on the third rail system, and has two motors, one fixed under each bogie. These gear by spur gearing



A Model Electric Tramcar.

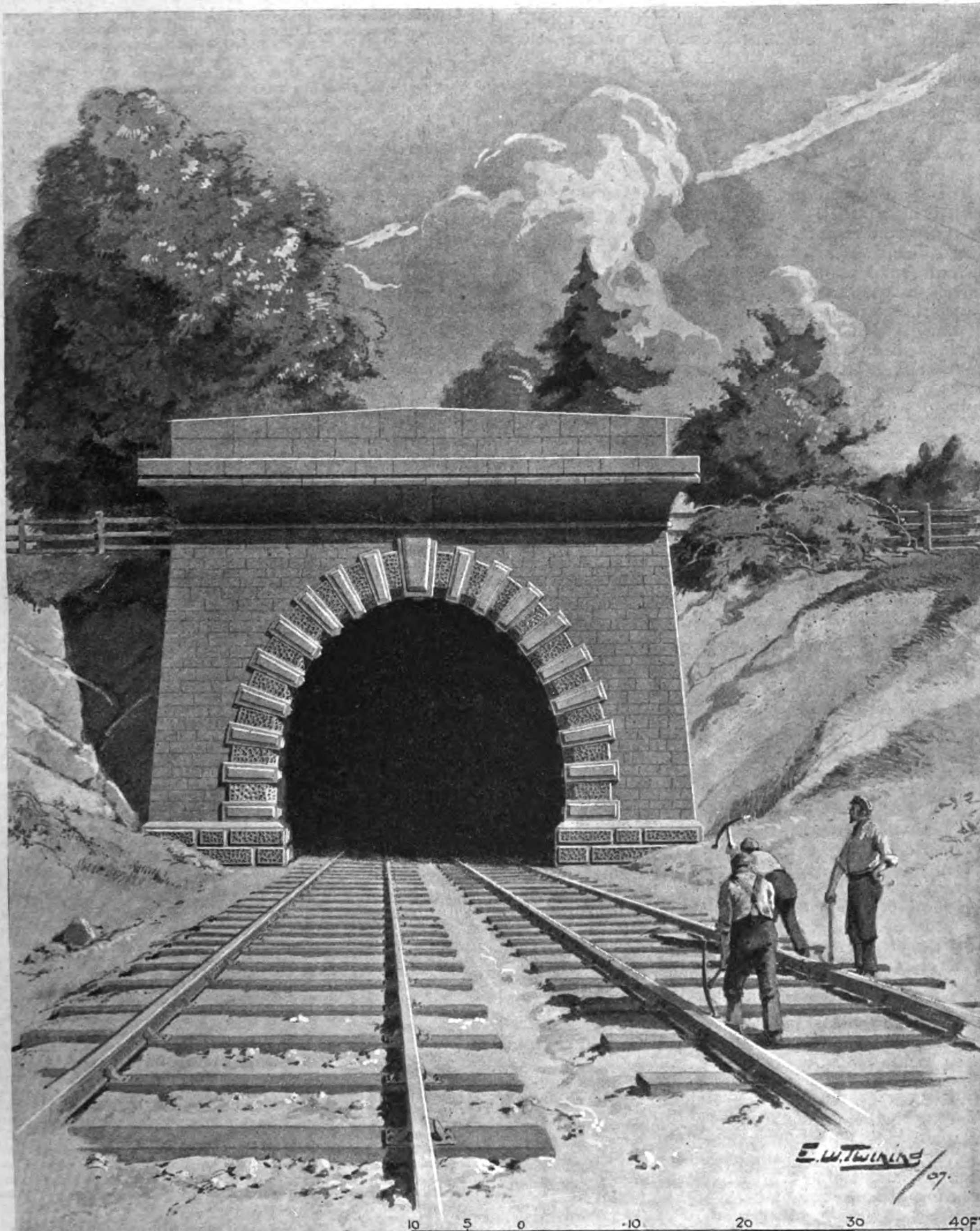


FIG. 17.—SOUTHERN END OF SHUGBOROUGH TUNNEL: L.N.W. RAILWAY.

on to the inner wheels, about 5 : 1. They were wound for a low voltage when I bought them, so I rewound them with finer wire. They now take from 4 to 8 volts. They are connected in parallel.

There are two collecting shoes, one under each bogie. The reversing switch is fixed behind the board between the bogies, and, as it has to reverse two motors in parallel, has three arms instead of two. The controllers at each end of the car are switches, but contain no resistances. The axle-boxes are separate brass castings, and slide up slots cut in the bogies.

There are seven lights (6-volt pea lamps connected in parallel)—three are inside, one at each end under the roof, and one behind each bull's-eye. These, being ordinary efficiency, use such a large current that I seldom use them.

The dimensions are as follows:—Length, 2 ft. 1½ ins.; breadth, 6 ins.; height, 8½ ins.; diameter of wheels, 1¾ ins.; gauge, 3 ins. It is enamelled in red, white, yellow, and black, and the curtains are red silk. The body of the car appears all black in the photograph, because one part is red.—Yours truly, G. B.

Construction of a Steel Sledge for Ice Tracks.

To the Editor of *The Model Engineer*.

Dear Sir,—Can you give me any particulars of the construction of a light steel sledge, as used on the ice tracks in Switzerland?—such as the section of the metal used, and whether mild steel or hardened and tempered, the position of stays, etc.

If you cannot answer above, can you advise me where to obtain the information?—Yours truly,

W. S. Williamson.

Wyngate, Prestwich Park, Manchester.

Re Alternating Current Motor.

To the Editor of *The Model Engineer*.

Dear Sir,—I note the enquiry under Query No. 18,619 for alternating current motor 100 volts fifty periods, and having myself made several of them, from ⅛ h.-p. to 1 h.-p., in my spare time with very limited appliances, I sympathise with enquirer in his efforts to do the same.

With due deference to you, I consider a ½ h.-p. alternating-current single-phase self-starting induction motor quite within the capabilities of almost any amateur, being, in fact, much easier to make than a corresponding size for direct current.

The chief difficulty is to obtain suitable stampings; if, however, say half a dozen individuals expressed a desire to construct motors of ¼ to ½ h.-p. (and the same stamping could be used for both), that difficulty could be overcome, and the stampings ready within three weeks.

As a ¼ h.-p. induction motor is powerful enough to drive a 6-in. screw-cutting lathe or other corresponding tool, is fairly easy and cheap to construct, and, when made, is always saleable, such should meet the needs of many amateurs who find treadling laborious, and I am surprised instructions for constructing same have not been offered before.

Should 18,619 or other readers of The Model Engineer require information, I should be pleased to assist, when, if successful, probably the Editor would find room for an illustrated article from me concerning them.—Yours faithfully,

Leeds. J. C. Birch.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

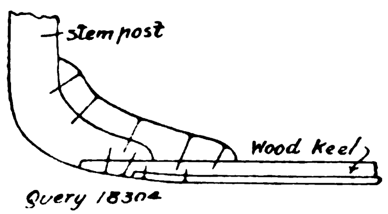
Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* The Model Engineer, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[18,611] **Choice of Gas Engine for Electric Lighting.** R. M. (Dundee) writes: I am requiring a gas engine for electric lighting purposes, and as I have the option of two gas engines—one is a 1·2 b.h.-p., the other a vertical engine, 2 b.h.-p.,—I would feel obliged for your opinion of which would be the most suitable. The first engine having only one flywheel and no governor, I was afraid it would not give a steady light, whilst the other engine is at present run on petrol. Therefore, what alteration is required to convert into gas engine?

In reply to your enquiry *re* gas engine, we should advise you to go in for a really good modern engine. We have not had experience with the particular make of vertical engine you mention, and would prefer a horizontal type ourselves. You do not state whether the engine is second-hand or new, but we should not recommend you to invest in a second-hand one unless you have every confidence in the person you are buying from. In any case, you should obtain a guarantee in writing from whichever firm you deal with as to the brake horse-power of the engine. We should not recommend an engine without a governor as it would be practically useless at any except absolutely full or constant load. We do not think either that it will be worth your while to convert the vertical engine from petrol to gas. Certain alterations would be required, and unless the firm you bought from would undertake this for you you would find it cheaper to go in for a thoroughly modern engine exactly suited to your immediate requirements.

[18,304] **Keel for Model Beach Yawl.** H. D. A. (Clapham) writes: Would you be so kind as to let me know what weight of lead is required for the keel of the model beach yawl on page 88 of your "Model Sailing Yachts," No. 4 Manual? Also what width the keel should be? I propose to build one to this design.



Sketch showing Method of Fitting Keel to a Model Beach Yawl.

About 5 lbs. of keel, or ballast, will be suitable. Your best plan is to make your hull first, then find by trial what weight is needed to bring her down to the L.W.L. If a lead keel is fitted, it should be of flat section (about ½-in. by ⅜-in.), tapering at the bow to a suitable point, and a notch cut in the stern post to receive it, as per sketch. Adjustment of weight can be made by using more or less ballast under the floor boards.

[18,398] **Small Model Undertype Engine.** J. C. (Sydenham) writes: I shall be very glad to be assisted in the following. I propose making a locomotive type boiler, 3 ins. diameter, 12 ins. diameter. Should I have to put water tubes in; if so, how many and what size? Or is there any way of not using them, to make the boiler as powerful? What size cylinder (using one) could I use with this boiler?

Yes, water tubes will be necessary: see the recent query, which was replied to in these columns. We can, of course, recommend you a standard water tube boiler in place of the locomotive type, where the minimum attention is required. Cylinder, ⅞-in. by 1-in. stroke: if two cylinders are used, they may be ¾ in. by 1 in.

[18,692] **Alternating-Current Solenoids.** A. E. D. S. (London) writes: I want some simple calculations for making alternating-current solenoids to use on single two- and three-phase circuits to act as brakes, to give a brake power of 20 or 30 lbs. Could you use these solenoids in series on a motor circuit, say of 200 volts or 500 volts, or would this tend to act as a damping or choking coil? Would it be better to shunt them across one phase? Please let me have a sketch showing best method of making the solenoid up, also the connections. If there is a book on the subject, please let me know; but it must be practical. I require some simple calculations for making up alternating-current starters, for using with one-, two- and three-phase motors from ½ to 10 h.-p. Motors start from no load up to a maximum load for a short period of not more than half a minute. Motors to be self-starting and get up speed quickly. I have a book, "Starters and Regulatos," by Rudolf Krause, which gives the theory but no examples worked out which would help me to understand. I should be glad of some examples put in ordinary simple calculation, giving the proper ratio of starting current and steps.

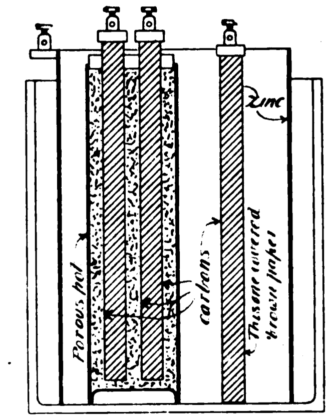
These queries are beyond the scope of our columns. There are no simple rules for calculating alternating-current solenoids. You will find information on electro-magnets in Professor S. P. Thompson's book, "The Electro-magnet," also in Fowler's "Electrical Engineer's Year Book" (Pocket Book), but an electro-magnet acts differently (a solenoid also) with alternating current to the way in which it acts with continuous current. As the magnet armature or solenoid core is pulled in, the power of the magnet decreases, owing to the self-induction increasing in the coils with the consequent falling off of current. We can only recommend you to read up the subject, and then make trials with various designs of cores and windings. The cores must be laminated. In this query also we can only recommend you to determine your resistances by experiment. Both of these queries really ask for the experience of a manufacturer. It may be practicable to start these motors without a resistance if the current is supplied from a large source of power.

[18,618] **Loco Paint Preserving; Scales and Gauges.** J. R. D. G. (Ireland) writes: (1) I am at work on plans and patterns for a ⅝-in. scale 3½ gauge tank engine, and had intended to use a water-tube boiler, with outer case made of two thicknesses of sheet iron with asbestos in between. Am I to understand from your reply to Query No. 18,409 in a recent Model Engineer that this arrangement will not be successful in fully preserving the paint? Can you suggest any better method? The outer shell in my plan is dented in at the driving wheels, as shown on Fig. 362 of "The Model Locomotive," so as to allow of the extra diameter. I see by your reply to No. 18,041, giving standard buffer heights, you give "11-16ths scale 3½ gauge," and make no mention of "⅝ scale 3½ gauge." (2) Am I to understand that ⅝ scale for this gauge has been dropped and the standard stock for 3½ gauge, such as Bassett-Lowke's, is now being built 11-16ths. Note in your reply just quoted, should not columns 3 and 4 be the other way about?

(1) The only satisfactory way we can think of is to entirely isolate the outer shell, using short studs in the lining of the outer shell to maintain an air-space (say ⅛ in.) between them. A few holes should be drilled in the painted casting to provide a circulation of air. These holes should be small and situate in places where they are least likely to be seen. Do not indent the lining at the driving wheels, only the painted casing. This is the best suggestion we can offer, and the writer is making the experiment with a 3½ gauge Great Northern Railway "Atlantic" locomotive. (2) Yes, the ⅝ in. is practically non-existent. The reason is that the enormous cost (where a large range of goods is required) of patterns, moulds, dies, etc., for wagon parts, permanent way, and signals renders it not worth while to stock both ⅝-in. and 11/16-in. scale sizes. Most of these fittings can be made to suit either 3⅛-in. or 3½-in. gauge models where the scale adopted is 11-16ths in. to the foot. The titles to the columns are in error; they should be transposed. Thanks for the correction.

[18,340] **Electrical Queries—Batteries, etc.** H. R. P. (Ulverston) writes: In one of my recent queries I asked you how to clean mercury otherwise than filtering or distilling, and you told me to use "nitric acid." Could you tell me the best way to use it? Has it to be diluted, or not; if it has, what proportions? The mercury is used in an interrupter. Will the acid have any effect on the teeth on the revolving drum, or has it to go through another cleaning bath before using? Please give me full instructions for the using of the acid. *Motors.*—Could you get me some further particulars of the little motor given in May 11th (1905) issue, by A. P. Whittle—width of armature, width of pole-pieces (face), length of pole-pieces; also, will the sample of wire enclosed do for armature and fields; if so, what weight on each? What gauge is it? Could you also give me particulars of the motor made by Dr. Martinetti, of Italy, which appeared in Ferbruary 4th (1904) issue—size of armature in inches, also bore of tunnel, height of field-magnet, thickness, width, length of pole-piece, distance between pole-piece and sides? *Shunt Battery.*—What charging in solutions does this battery—which appeared in The Model Engineer—require when run down? Is it only the salt solution which requires renewing, or has the battery to be dismantled and remade up every time. It gives out 3 volts and 3 amps. for 10 hours. Is the output stated? This is a rough sketch of same.

Shunt Battery.—We have no actual experience with this battery, but should say that both solutions will require to be renewed when battery is run down. That is, the porous pot could be poured out through the hole left in the pitch. To clean mercury, pour it out of the interrupter into a glass or earthenware jar. Cover it with nitric acid diluted with water, and shake the jar so that the mercury is well washed; this will remove the oxide. If red or brown fumes are given off, the acid is too strong, and should be



Query 18340

SECTION THROUGH QUERIST'S SHUNT BATTERY.

further diluted. When thoroughly washed, pour off acid and then pour the mercury from the jar into another one backwards and forwards until acid is removed. Finally, strain mercury through a filter paper placed in a glass funnel; it is necessary to make a very small hole in the paper to let the mercury go through. *Re* Motors. That first mentioned is illustrated by photographs, and you could get dimensions fairly near by making them in proportion to the frame, the size of which is stated in the article by Mr. Whittle. From this the armature appears to be ¾ in. length by 1¼ ins. diameter. A good winding for battery work would be No. 26 gauge d.s.c. copper wire for the armature and No. 20 gauge s.c.c. copper for the field coils; these should be connected in series with the armature. Probably about 1½ ozs. for armature and 4 ozs. for fields, but exact quantity does not matter. We do not find the sample of your wire. About 4 volts should suit the motor. Our handbook—No. 10—will give you details of winding, etc., and an idea of the proportions for motors. Diameter of armature is 1 in, tunnel 1-32nd in. larger than this, that is, diameter of bore 1 1-32nd ins. You can get proportions of field-magnets by measuring the illustration and reading the description, which gives some of the dimensions. Draw it on a piece of paper and you will get an idea of sizes.

[18,578] **Model Boat Construction.** C. J. T. (Southsea) writes: I have before now had the benefit of your advice, and I wish to ask you if you can help me with any suggestion now. I am making a model (¼ in. to the foot scale) of an old 74-gun ship, built 1795, of which I have got the actual building plans from the Admiralty. It will be about 24 ins. long. Now I cannot attempt to build it properly, so I am going to make it of layers of wood about ¼ in. deep and a ¼ in. thick, and the full length of the ship; these layers will correspond with the horizontal lines of the ship. Now my difficulty is—How to fasten them securely together. A one-sixteenth screw about ⅜ in. is rather weak and liable to break in the hole; and, besides, at the bow—where the wood, being in one piece, the grain would be cross—there is danger of splitting. Of course, I could use wire nails, but I thought that you or your readers might have a better suggestion to make, that would not weaken the wood. I would also like to know the strongest and most effective glue or cement to use in building it.

We do not know of any better method of fixing your planks than very fine screws, with the holes previously drilled for them. A method often used in yacht building is to practically sew the planks on to the ribs with thin wire, but this method we have not used ourselves. Ordinary Scotch glue, with a small quantity of linseed oil, is about as good a glue as you can have for standing a moderate amount of damp, but no glue we know of is absolutely water-proof.

[18,561] **Model Ship Builders.** H. B. H. (Marple) writes: Will you kindly send me full particulars of how I may become a model boat builder to a firm of shipbuilders? I am 18 years of age and I am in a joiner's shop. I have just completed the hull, deck, and fittings of a 5-ft. scale model steam yacht, and a sailor has pronounced it to be "a beauty." I had not previously heard of model boat building as a profession, until he told me about it. I have a good knowledge of ships, as I read up and study plans of them, etc. I am considered a good geometrical drawer and woodworker. Will you kindly send me full particulars of how to become one—(I cannot afford to pay a premium)—what the duties are, and the wages?

We do not know that the profession you mention is a large one or that many people are employed in this business. As far as we know, many shipbuilding firms employ one of their own men to make any models which they require, such men usually being drafted from the woodwork shops in the shipbuilding yard. We think perhaps your best course would be to call or write to several shipbuilding firms and ask if they have a vacancy for such a workman, or if they would consider placing an order with you for any future models which they may wish to have built. Beyond this, we regret that we cannot give you any definite information. Perhaps some of our readers who can speak authoritatively on this subject will be kind enough to communicate with us. Any information we receive will be conveyed to you.

[18,567] **Charging Motor Car Accumulators.** G B. (Colchester) writes: I am anxious to utilise the 210-volt installation in my house for the purpose of charging my motor-car accumulators, which are of the Van Raaden 50 amp.-hour 4-volt type. Could you give me instructions as to a charging-board which I could improvise for the purpose?

You will require a resistance of 40 ohms; this will cut down the current flowing to approximately 5 amps. From a wire table, such as is given in our Handbook, "Small Electric Motors," you can calculate the size of German silver wire which will give you the required resistance. You could arrange the wire in a series of coils similar to any of the resistance boards recently published in these pages, and arrange it so that the resistance could be cut-out as required.

[18,609] **Joy's Valve Motion for Model 3½-in. L. & N.W.R. "Precursor" Locomotive.** D. H. (Tottenham) writes: Will you kindly send me a drawing, with dimensions, of inside valve motion for an 11-16ths-in. scale inside cylinders "Precursor" type locomotive?

We cannot quite follow the dimensions on your sketch. However, we presume that you are building a 3½-in. gauge, 11-16ths-in. scale model of the "Precursor." The cylinders should be 11-16ths in. or ⅞ in. by 1⅛-in. stroke, and the proportions of the various links made as shown in the accompanying *full size* drawing. This drawing is a working drawing from which a very fine model of the L. & N.W.R. "Precursor" Locomotive has recently been made and tested. The gear worked extremely well, and admitted enough steam to keep the engine running when nearly in mid-gear. The motion should be made of mild steel, and all working pin joints should be case-hardened with yellow prussiate of potash. The curved slides and weighshaft were built up on a jig, the slides being machined in the lathe previous to being brazed together. As the normal amount of lap in a small model will not allow of two pins being used in the vibrating lever to provide for the functions of advance, the device suggested in Greenly's book—'The Model Locomotive," viz., an eccentric top pin, has been adopted. This is brazed into one of the levers (it cannot be fixed to the other, as this would prevent the radius rod being fixed in position afterwards), and the amount of lap, of course, depends on the eccentricity. In the actual engine the anchor links are "anchored" to brackets fixed on the slide-bars. This would not be good practice in a model: therefore, two brackets, as shown in Fig. 6, are fixed to the frames, and the anchor links are pivoted to a long bolt, with suitable distance pieces, fixed to these brackets. The slide-bars are not fixed in the ordinary way, but are square section bars of bright steel, turned down at the ends to 3-32nds-in. diameter, and fitted into holes in the cylinder cover and motion-plate. The whole of the work is intended to be wrought out of the solid stuff, or in the case of some of the levers and connecting-rods, from forgings. The length of the connecting-rod between centres is 4⅞ ins.

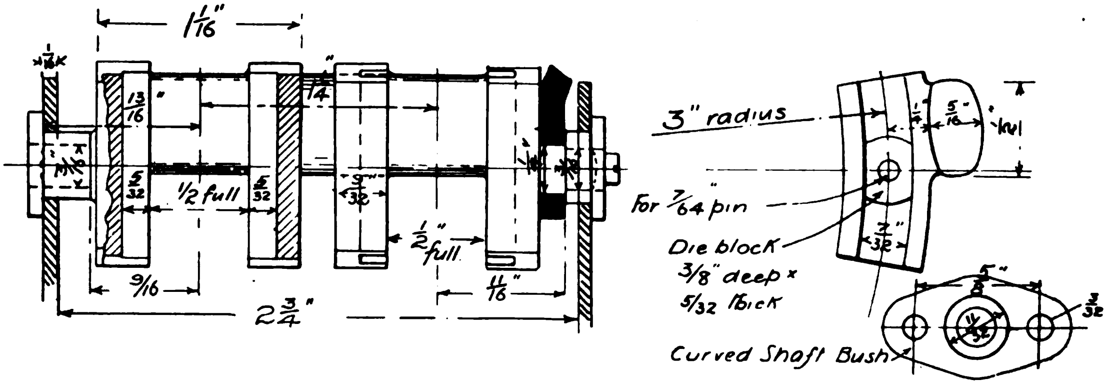


FIG. 2.—CURVED SLIDE.

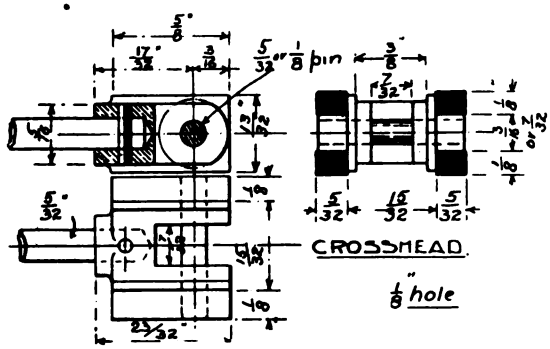


FIG. 4.—CROSSHEAD.

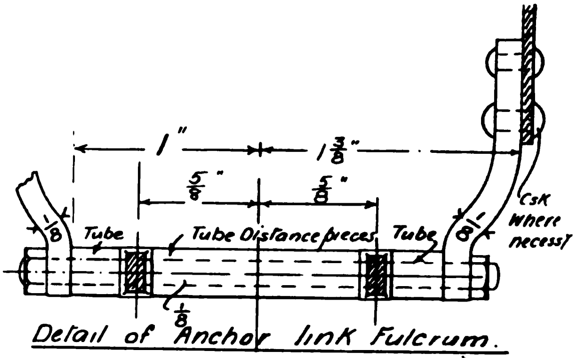
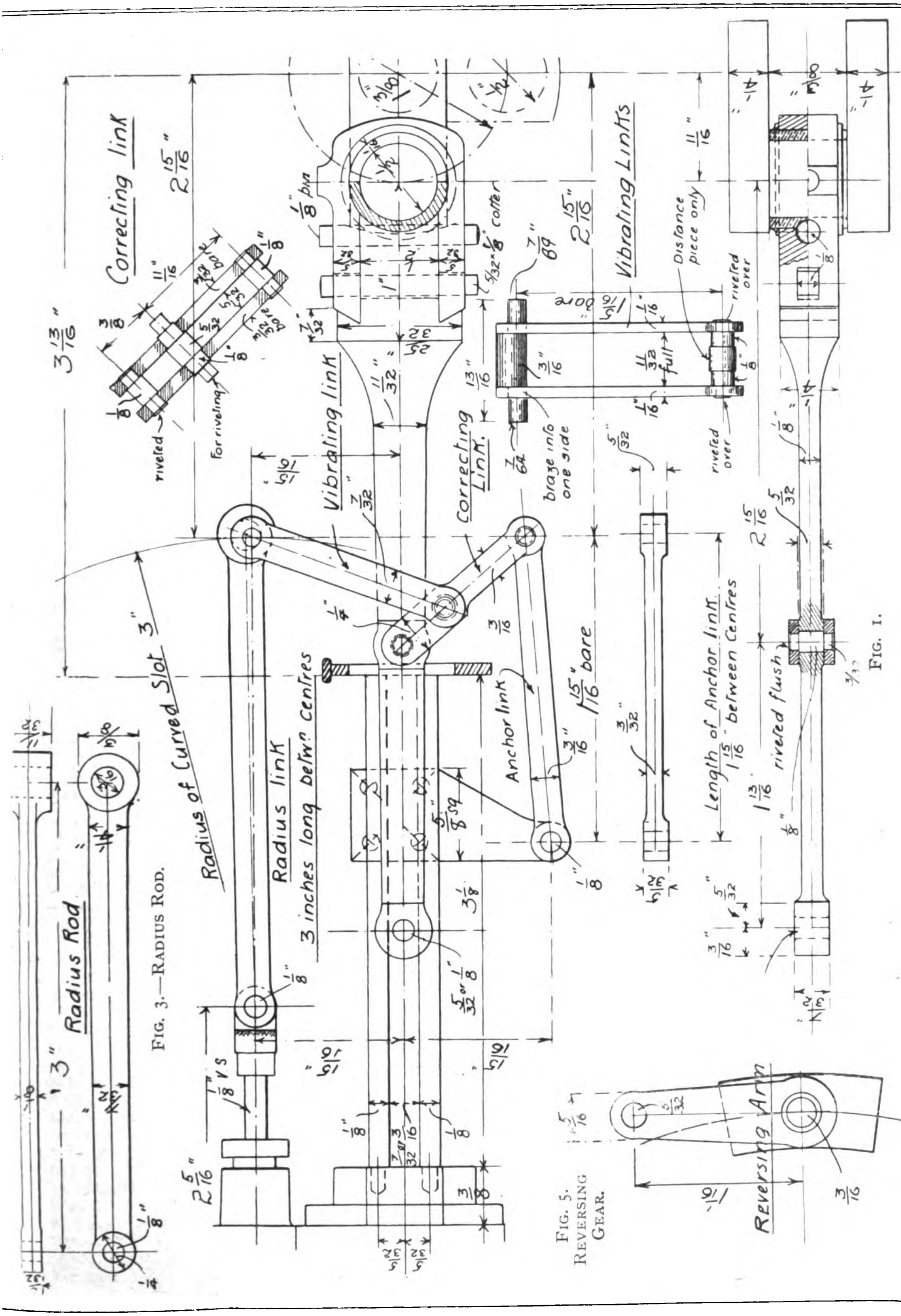


FIG. 6.—ANCHOR LINK BRACKETS.



Query No. 18,609. **Full Size Drawing of Joy's Motion as Fitted to an 11-16ths-in. Scale Model L.N.W.R. Co.'s Locomotive, "Precursor."**

The Editor's Page.

THE little book, entitled "TALES WORTH TELLING," which we have been distributing, has been very much appreciated by readers of THE MODEL ENGINEER, so much so that the first 100 copies promised were exhausted within a day or two of our notice appearing. As there are no doubt many readers who refrained from writing because they thought their applications might not reach us in time, we have decided to extend our offer, and we will therefore send a free copy of the book to any reader who sends us a penny stamp for postage before the last day of this month. The humour of the book has inspired one of the recipients to send us the sketch reproduced herewith, wherein the model engineer depicted is so deeply interested in the stories that he has sawn through his job and halfway through the vice without noticing it! Just think of its value in a workshop when it makes the tools cut like this! By the

way, some readers have not thought it necessary to send the stamp for which we asked, and have merely sent their applications on post-cards. We are afraid we must ask them to try again, paying more attention to the conditions of our offer.

Answers to Correspondents.

O. P. (London, S.E.).—Thanks for your letter calling our attention to the error.

H. L. (Cheltenham).—We regret we do not understand what information you are asking for; you do not say what size accumulators you wish to use, nor the number or size of lamps required for lighting, neither do you mention any dimensions relating to the screw-cutting lathe you wish to drive.

N. W. B. (Newton Stewart, N.B.).—Thanks for your note, which we shall be pleased to use in an early issue.

F. B. (Northwood).—We can only say the paint is mixed to the required colour in the usual way. We do not know of any radical change pending.

H. M. (Bloomsbury, W.C.).—We thank you for your contribution, but regret we cannot see our way to accept the same for publication. A stamp should be enclosed if you desire the MSS. returned.

R. (Halton).—We have no drawings of this engine at the moment, but if we can obtain the same will insert them. We cannot send you full size sketches as an ordinary query. We recommend you "The Model Locomotive," by Greenly, for information on the other points.

D. M. S. (Punjab, India).—We thank you for your interesting letter and photograph, which you may look forward to seeing reproduced in an early issue.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, B.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 26–29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE
Model Engineer
And Electrician.
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.Mech.E.

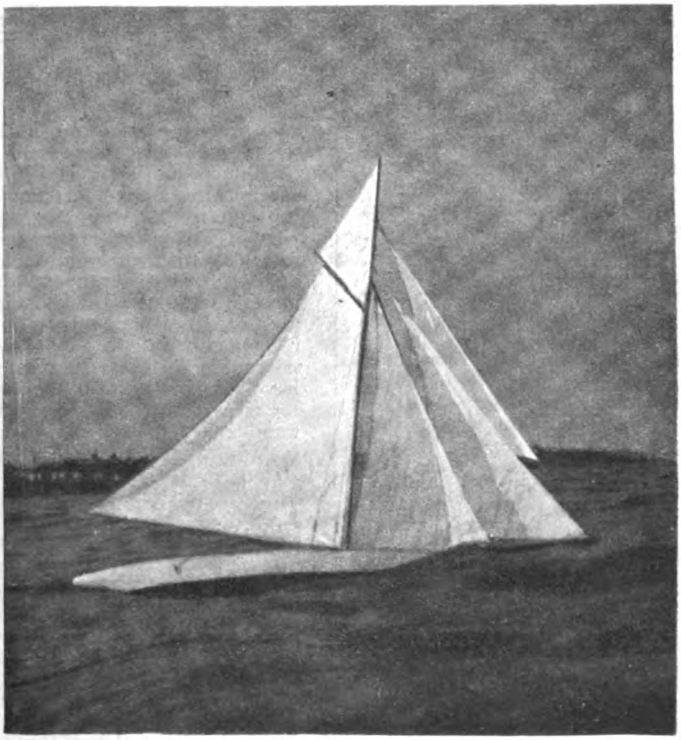
Vol. XVIII. No. 356. FEBRUARY 20, 1908. PUBLISHED WEEKLY

A Sea-going Model Sailing Yacht.

By E. E. Benest.

THE accompanying photograph is of my model yacht, *Hildegarde*. Full sized working drawings were first made. Then a piece of the best yellow pine, 6 ft. by 9 ins. by 2½ ins. was obtained. From this I cut a piece 39½ ins. long; the remainder I glued to the bottom of the first plank. I next sawed out the shape of the deck, and then proceeded to shape the hull. All went well until the hollowing out. I unglued the two pieces and cut the inside out of the top layer. Having hollowed it out to ⅛ in. at the sides, this left ¼ in. at the two places where the pins were to go through. I joined the two pieces with two long screws at the stem and stern, and some marine glue at the sides. The deck is a piece of ⅛-in. yellow pine. Deck beams were placed—one just forward of the mast, and one 12 ins. from the stern.

The spars were made of yellow pine, which makes a good job. The 6 yds. of white silk was handed over to the "authorities." The bulb was moulded and cast, after which it was planed up and bolts fastened to it.



Mr. E. E. Benest's Sea-going Model Yacht.

For the first time there was a moderate breeze and a smooth sea. I was delighted with the way she sailed, but presently it was noticed that she was getting lower in the water and was labouring in a most untoward fashion. I got alongside her just in time and found the seam between the two halves had opened and a penny could be slipped between them in places. For some time I could not make out how to hold the pieces firmly, as the sides were so thin. How bitterly I repented having so zealously hollowed her out! At length a piece of silk and some "knotting" was placed all round the sides inside. Over this were screwed three ribs on each side, made of ¼-in. by ½-in. elm. The whole of the inside was given a coat of copal varnish. The result has proved very satisfactory, and, though she has been subjected to some pretty heavy strains, she does not "open" a bit.

My next trouble was with the fins. These were pieces of aluminium plate cut to shape. Owing to the thinness of the bottom, she leaked round them. I stayed them up as much as possible without the use of bulkheads, which I did not want to fit. Aluminium angle-plates were riveted to the fins on the outside.

The principal dimensions are as follows:—Length over all, 39½ ins.; length (L.W.L.), 34 ins.; beam (extreme), 8½ ins.; height of mast (above deck), 40 ins.; length of bowsprit (out-board), 10 ins.; weight of lead bulb, 10¾ lbs.

The boat is painted green below the water-line and white above, which gives her a good appearance. I am thinking of fitting a small pump under a small hatch, as I do not want to fit a big hatch. She is a good sea-boat—fast, and sets a course perfectly. Unfortunately, nobody takes much interest in model yachting here (Walmer) so she has been unable to "pit" herself against another craft, though I am sure she would do so creditably.

Workshop Notes and Notions.

Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "WORKSHOP" *on the envelope.*]

An Easily Made Micrometer.

By Dr. THOMAS R. BAKER, Rollin College, Florida.

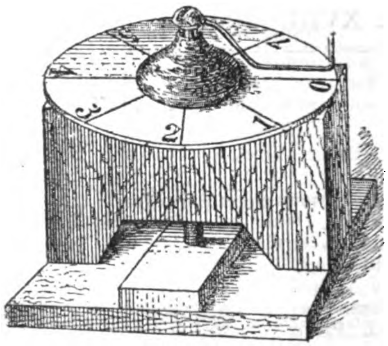
It often becomes necessary for the experimenter or practical worker to find the thickness of material so thin, or inconvenient to measure, that the thickness cannot be found by means of a foot rule, or other common measuring device. A simple, fairly accurate, and easily made apparatus of the micrometer form may be constructed as follows:

Get a common iron or brass bolt about ¼ in. in diameter and about 2½ ins. long, with as fine a thread as possible, and the thread cut to within a short distance of the head of the bolt. A bolt with a cut in the head for a screwdriver should be used. Clamp together two blocks of wood with square corners about 1 in. wide, ¾ in. thick, and 2¼ ins. long, with their narrower faces in contact (the width of the clamped blocks being 2 ins.), and bore a ¼-in. hole through the centre of the blocks in the 2-in. direction. Now remove the clamp, and let the nut of the bolt into one of the blocks, so that its hole will be continuous with the hole in the wood; then glue the blocks together with the nut between them. Cut out a piece from the block combination, leaving it shaped somewhat like a bench, and glue the bottoms of the legs to a piece of thin board about 2½ ins. square for a support. Solder one end of a stiff wire about 2 ins. long to the head of the bolt at right angles to the shaft, and fix a disc of heavy pasteboard with a radius equal to the length of the wire, and with its circumference graduated into equal spaces, to serve in measuring revolutions and parts of revolutions of the end of the wire, to the top of the bench; put the bolt in the hole, screwing it through the nut, and the construction is complete.

The base is improved for the measuring work by glueing to a central section of it, covering the place where the end of the bolt meets it, a small piece of stiff metal; and it is convenient to have the graduated disc capable of rotating, so that its zero line may be made to coincide with the wire.

Find the number of threads of the screw to the inch by placing the bolt on a measuring rule, and counting the threads in an inch or half an inch of its length. The bolt in making one revolution will descend a distance equal to the distance between the threads.

To use the apparatus, put the object whose thickness is to be measured on the base under the bolt,



AN EASILY MADE MICROMETER.

and screw the bolt down until its end just touches the object; then remove the object, and screw the bolt down until its end just touches the base, carefully noting while doing so the distance that the end of the wire moves over the scale. The part of a rotation of the bolt, or the number of rotations with any additional parts of a rotation added, divided by the number of threads to the inch, will be the thickness of the object. Quite accurate measurements may be made with this instrument, and in the absence of the expensive micrometer, it serves a very useful purpose. I have used it in the beginning classes in electricity for measuring the diameter of wire, for finding the numbers of wires from reference tables, and for making various other measurements.—*Scientific American.*

Small Drilling Machine Vice.

By W. SPIERS.

A description of a small drilling machine vice I have made may be of some use to other readers of "ours." I first procured a piece of blacksmith's iron 5 11-16ths ins. long, 2¼ ins. wide, and 5-16ths in. thick. I got a slot punched in it ⅜ in. wide and about 5 ins. long; it then required straightening and the slot squaring up. Two pieces of ½-in. square bright steel were turned to dimensions shown in the drawings; they were then fixed ¾ in. apart by pieces of ¼-in. steel rod screwed in and filed off flush. The whole was next fixed in the lathe and the bottom faced up so as to lay flat on the drilling machine table. The fixed jaw B needs little description, being fixed in place by two ⅜-in. nuts. Two small holes may be drilled (as shown by the two crosses *b b*), by which I attach a small piece of a file to grip anything which may have a tendency to slip; but I seldom use it, as the jaws have held all that I have put in. The loose jaw C is shown in section, to show how it works on the nut by two ¼-in. nuts. Both jaws are case-hardened with potash, and have a nice appearance. The vice took a week to make, working about two hours a night, and is well worth any reader's time spent in the making. I have shown one of the square

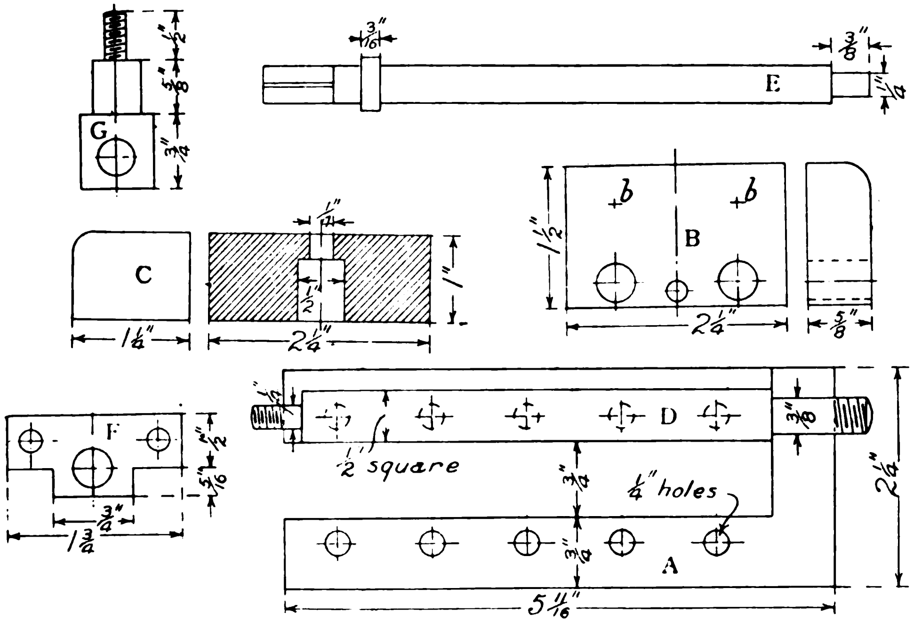


FIG. 2.—DETAILS OF SMALL DRILLING MACHINE VICE.

G. The two jaws were faced on all sides in the lathe, and then all the necessary holes were drilled. The nut G was made from a piece of ¾-in. square bright steel centred and turned to sizes shown, the small end being screwed twenty-six threads to 1 in. The screw E was made from a piece of silver steel ⅜ in. and 6¼ ins. long, turned down at one end to ¼ in.; it was then screwed ⅜-in. Whitworth for a length of 4⅞ ins., and a ⅜-in. nut was screwed on and was turned up to form a shoulder, the end of screw being filed square to take a suitable handle. The end plate F is made from a piece of 3-16ths-in. plate, and needs no description, being put into place after the screw and nut, and secured pieces D in place and the necessary holes to secure it on opposite side.

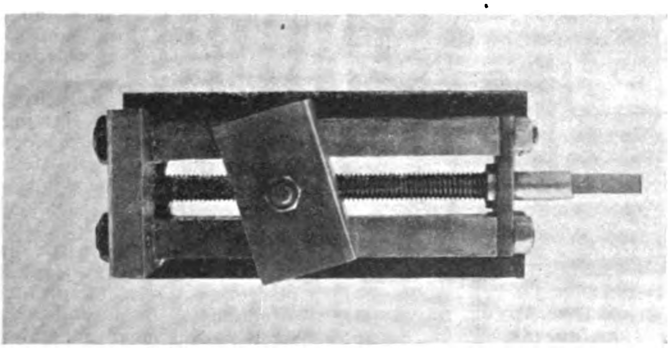
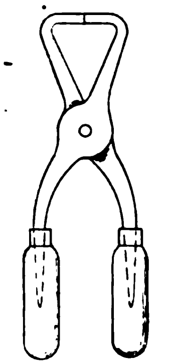


FIG. 1.—MR. SPIERS' DRILLING MACHINE VICE.

Useful Forge Tongs.

By H. MEYER.

A very useful pair of tongs may be made in the following manner. First procure an old pair of long flat nose pliers, and bend about ⅜ in. over at right angles, then file the ends square to meet properly. Now knock a tool handle on each handle of the pliers and the tongs are finished. These will be found invaluable when soldering strips of metal, etc., or for use on the forge, as they hold quite parallel and the handles do not get hot.



FORGE TONGS.

Recent Developments in *X*-Ray Apparatus.

THE Electro Therapeutical Section of the Royal Society of Medicine, 20, Hanover Square, London, W., again held their annual Conversazione and Exhibition of Apparatus at the Small Queen's Hall, London, on Friday evening, December 13th last. At this very pleasant function there was a good display of electro-medical appliances, many being exhibited at work by various makers. During a conversation with the Hon. Secretary, Dr. Reginald Morton, who takes a very keen interest in this branch of medical work, we were told that treatment from both induction coils and static machines is progressing. Induction coils and current interrupters have advanced considerably, very heavy discharges being now readily obtainable. The piece of apparatus requiring improvement is the *X*-ray tube itself, so that these heavy discharges can be fully utilised. The moto-magnetic interrupter, breaking contact in an atmosphere of gas, as described on page 207 of Vol. XVI of THE MODEL ENGINEER, was to be seen on several makers' stands, and seems to be gaining favour. Messrs. Newton & Co., of 3, Fleet Street, London, have fitted a field-magnet to this pattern of interrupter, so that it is self-contained; the magnet coils are connected in series with the primary winding of the induction coil, and are shunted by a resistance which can be varied to alter the speed of rotation of the break. This firm exhibited a fine multiple Wimshurst machine having eight 24-in. diameter glass plates and accessories for static treatment. The brass fittings of this machine were entirely sheathed with ebonite to prevent leakage in moist climates, and rods are fitted by means of which the Leyden jars can be instantly disconnected without opening the glass case with which the machine is enclosed. The neutralising brushes are permanently fixed in one position. An electric motor of about ¼ h.-p. was used to rotate the plates, and a spark of 11½ ins. length could be obtained. These machines are made up to a size having fourteen 36-in. plates, which the makers state will give 500 milli-amperes of current output, and also claim as a special feature that they will always excite in any climate.

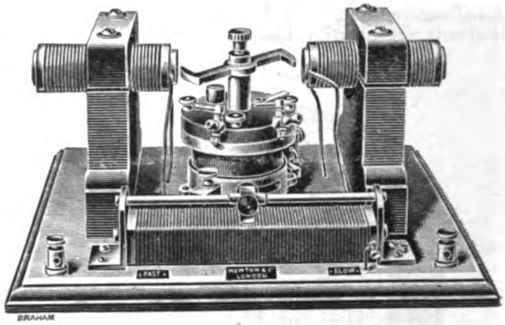


FIG. 1.—MOTO-MAGNETIC INTERRUPTER BY MESSRS. NEWTON & CO.

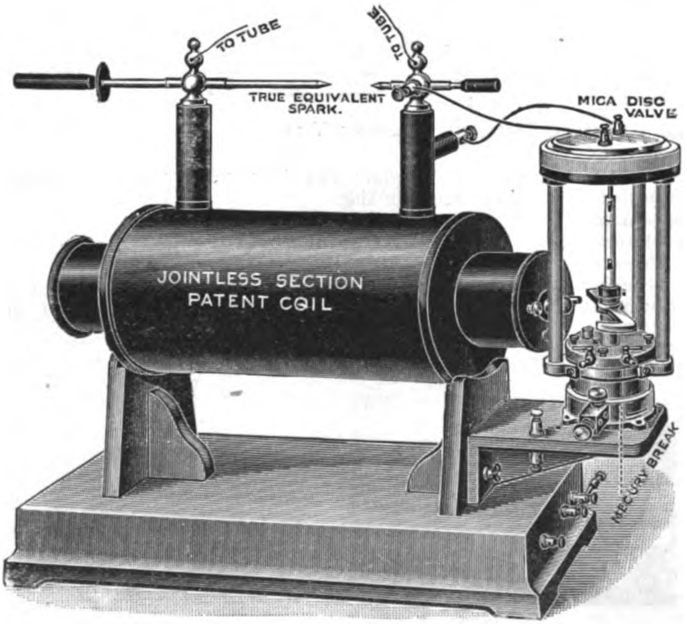


FIG. 2.—MR. LESLIE MILLER'S MICA DISC VALVE, DRIVEN BY MOTO-MAGNETIC INTERRUPTER.

A novelty made and exhibited by Mesrs. Newton was Dr. Morton's arrangement of electric valve for stopping the reverse current flow from an induction coil when the contact-breaker is making circuit. This consists of a spark-gap interposed in the tube circuit, the gap being between a point and a circular plate. Discharge of current takes place at " break " from the point to the plate, but at " make " the reverse discharge is not powerful enough to flow from the plate to the point, and is therefore prevented from flowing through the tube. This valve depends for its action upon the fact that electricity discharges more readily from a point than from a plate forming the end of a conductor. Electric valves on this principle were exhibited by other makers, but Dr. Morton's design is made so that the glass-topped box containing the spark-gap can be rotated through 180 degs., thus reversing the connections to the point and plate respectively, if desired. The construction is simple and strong, with screw adjustment for altering the length of the gap. Valves of the spark-gap principle appear to be displacing the tube valves of the kind described on page 177 of THE MODEL ENGINEER, Vol. XVI, which are liable to alterations of vacuum and of breakage.

Mr. Leslie Miller, 93, Hatton Garden, London, W.C., exhibited his arrangement of spark-gap valve at work, with one of his well-known jointless section induction coils. He does not use the point and plate, but interposes a circular disc of mica between the discharge terminals of the valve. This disc is perforated with two holes spaced at equal distances, and is rotated at a speed to synchronise with the interrupter. At moment of

Fig. 3.—Mica Disc of Mr. Leslie Miller's Valve.

breaking contact through the primary, a hole is between the discharge terminals, but at moment of make the disc has rotated and interposed the mica between the discharge terminals. Current can only flow therefore at moments of "break" when a hole is between the terminals.

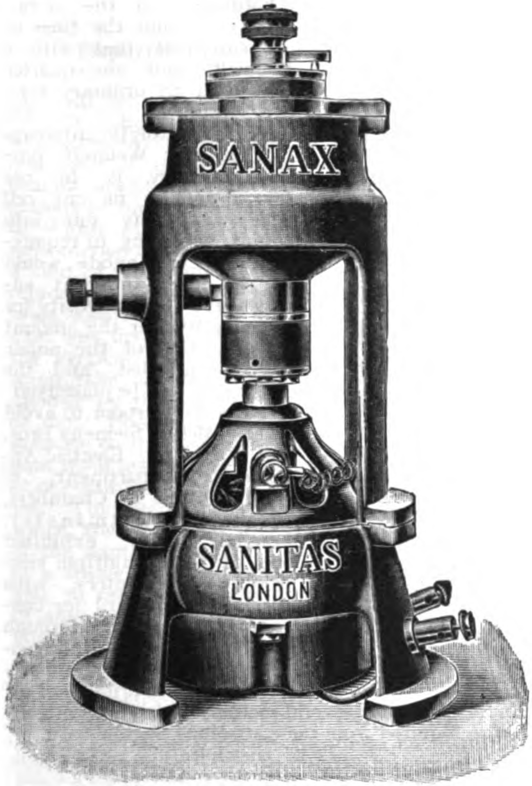


Fig. 4.—Messrs. The Sanitas Electrical Co.'s New Mercury Interrupter.

A novelty in mercury interrupters is the "Sanax," exhibited by Messrs. The Sanitas Electrical Company, Ltd., 61, New Cavendish Street, London, W. It consists of a pear-shaped cast-iron cup mounted upon a vertical spindle, with its large part uppermost. The driving power is by an electric motor placed underneath, with its spindle directly connected to the cup spindle and in vertical line with it. The two are supported by a containing metal frame. Inside the cup is a horizontal circular disc of insulating material which is fitted with two metal contact pieces placed diametrically opposite. This disc is free to rotate upon a vertical spindle carried by a support which can be adjusted by rotating the knob shown at the top of the illustration to move the disc towards or away from the side of the cup. The spindle is fixed and does not

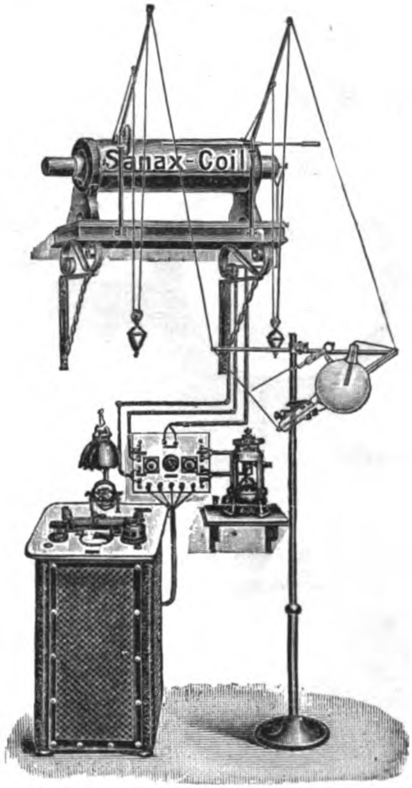


Fig. 5.—The Sanitas Electrical Company's Complete *X*-ray Outfit with "Sanax" Interrupter.

rotate; the disc revolves upon ball bearings which are carried by the spindle. Current is conveyed to the mercury by the contact ring and brush shown at the side of the supporting frame. When the pear-shaped cup is rotated the mercury contained in it rotates also and rises to the level of the horizontal disc previously referred to; remaining there by reason of centrifugal force, it assumes the form of a ring or band. If the knob shown at the top of the illustration is moved so as to bring the edge of the disc into contact with the mercury, the disc will be rotated. The arrangement is on the principle of a pinion rotating inside and gearing into an internal toothed wheel. To make the movement certain, notches are cut in the edge of the disc, which is thus similar to a toothed pinion. As the disc rotates, the contacts (which are really the ends of a flat copper bar carried upon the surface of the disc) dip into and out of the mercury, thus completing and interrupting the circuit twice during each revolution of the disc. The disc is half the diameter of the cup, and therefore rotates twice for each revolution of the cup. At highest speed the motor rotates at about 2,500 r.p.m.; the disc will therefore cause contact to be made

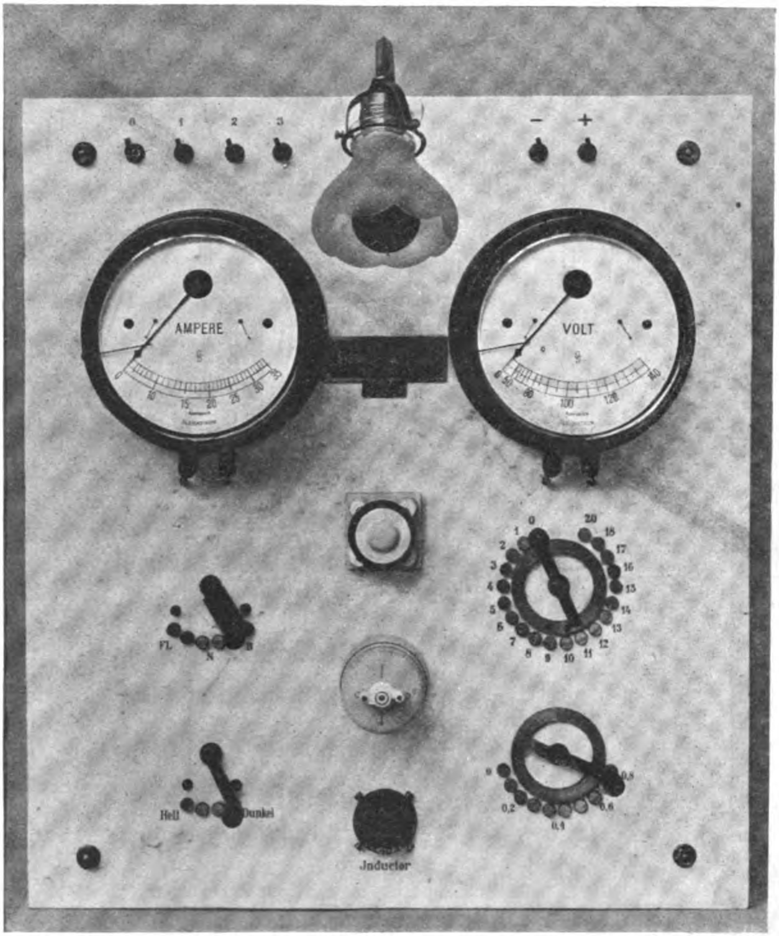


FIG. 7.—MESSRS. SIEMENS BROS.' CONTROLLING SWITCHBOARD FOR *X*-RAY WORK.

and interrupted 10,000 times per minute approximately, as it will rotate at double the speed of the motor and make and break twice during each of its revolutions. The current passes from the contact bar to the fixed spindle and away through a connecting terminal. Contact between the spindle and rotating bar is ingeniously made by mercury contained at the upper bearing, the container being filled through a vertical hole in the fixed spindle, which also serves as the inlet to the pear-shaped cup. Duration of contact is adjusted by moving the knob down at the top of the illustration, so as to cause the edge of the disc to be immersed in the mercury ring to a greater or less extent, as in putting a pinion more or less deeply into gear with a spur wheel. The movement is produced by an eccentric setting of the disc bearing. By varying the speed of the motor, variation in the number of interruptions per minute is obtained through a considerable range. At high speed this interrupter produces a flaming discharge similar to that produced by a Wehnelt break; a very even illumination of the *X*-ray tube is obtained; screen pictures are remarkably clear, and the movement of a person's heart is easily seen. The makers claim that the mercury is self-cleaning in this interrupter, the centrifugal action preventing it from becoming muddy, as it disintegrates automatically and remains metallically clean. The mean consumption of current is stated to be 2½ to 4 amps., according to the degree of "hardness" of the *X*-ray tube used, and the time of exposure half that with a Wehnelt, and one-quarter that with an ordinary mercury break.

With electrolytic interrupters of the Wehnelt type the tendency is to use several anodes in one cell and switch any one into circuit, according to requirements. Each anode would be set to a different adjustment; the necessity for stopping to alter the amount of projection of the anode is thus avoided, and the interrupter can be placed outside the *X*-ray room to avoid noise. Messrs. Siemens Bros. and Co., Ltd., Electric Appliances' Department, of Queen Anne's Chambers, Broadway, Westminster, London, S.W., exhibited one of these multiple electrolytic interrupters, with special switchboard for controlling the coil through triple anodes. In this connection it is also the practice to wind the primary of the induction coil in several sections, which are switched in as required from the controlling switchboard.

(To be continued.)

A CLOCK has been installed in the observatory of the Case School of Applied Science, Cleveland, O., which is so nearly perfect that it has attracted the attention of the Smithsonian Institution at Washington. Tests are said to have proved that the mechanism is so accurate that the clock will not vary more than fifteen one-thousandths of a second from the exact time in twenty-four hours.

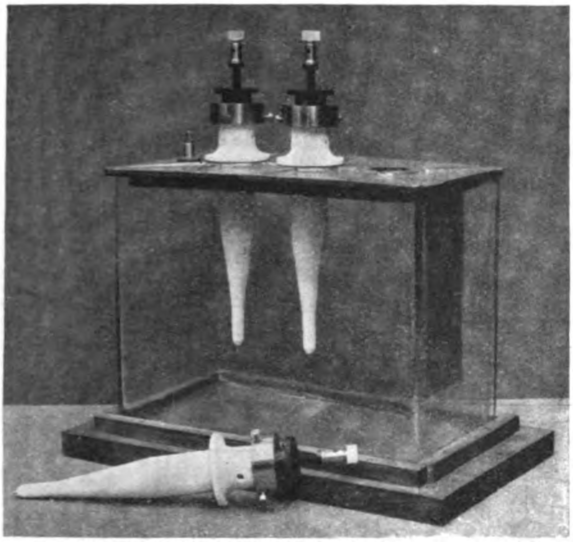
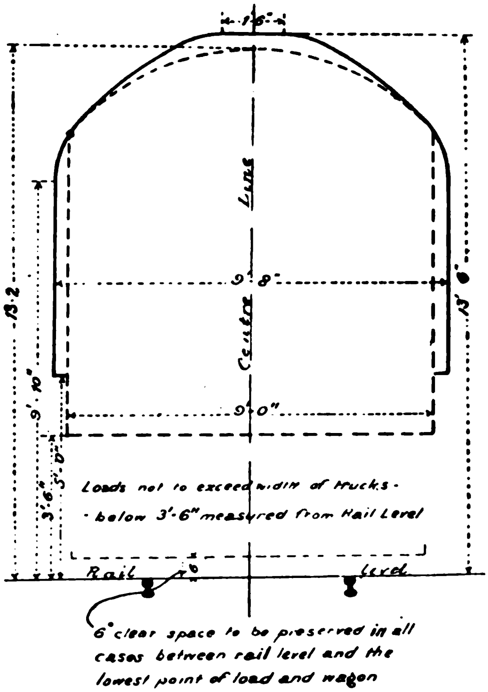


FIG. 6.—MESSRS. SIEMENS BROS. TRIPLE ANODE WEHNELT INTERRUPTER.

Experiments with Clay Models.

AT an ordinary meeting of the Institution of Civil Engineers recently, an interesting paper was discussed by Sir John W. Ottley, K.C.I.E., and A. W. Brightmore, D.Sc., M.Inst.C.E., dealing specifically with "Experimental Investigations of the Stresses in Masonry Dams Subjected to Water Pressure." The experiments described were carried out with models made of "Plasticine," a kind of modelling clay, which appeared likely to reproduce, on a small scale, many of the conditions existing in a "full size" structure. The dam was first modelled of triangular section, with the vertical face exposed to the pressure of the water, the base being made equal to the height divided by the square root of the specific gravity of the "Plasticine," so that the resultant of the pressure on the base (due to the weight of the model dam itself and the pressure of the water) would act at one-third of the width of the base from the outer toe. The height of the model was taken at 30 ins., which, therefore, gave a base of 26 ins. The length of the dam was 12 ins. The model was moulded in a frame furnished with thick plate-glass sides, and, in order to permit of accurate measurement of any displacement in the model, corresponding horizontal and vertical lines, 2 ins. apart, were scratched on both the glass and the "Plasticine." The glass sides were made adjustable, and, previous to the application of water pressure, care was taken to see that the lines on the glass coincided accurately with the corresponding lines on the "Plasticine." A clearance was left between the glass sides and the model, to ensure that the latter should receive no support from friction between it and the glass. Water pressure was applied to the face of the model by water contained in a thin rectangular india-rubber bag made to fit the frame. The weight of the model as first made (with a 26-in. base) was 230 lbs.; the water pressure on the vertical face being 195 lbs. This gave an average value for the intensity of normal pressure on the base of about 0·74 lb. per sq. in., and an average intensity of shearing stress over the horizontal base of about 0·62 lb. per sq. in., thus keeping well within the elastic limit of the "Plasticine" The displacements of the originally vertical and horizontal lines were shown in the various diagrams submitted. The first of these represented the condition of affairs after the water pressure has been left on for one day. After these measurements had been taken, the water was siphoned off, and in the course of a few days the model entirely recovered its original form, thus showing that the material was elastic under the pressure to which it had been subjected for the comparatively short period of one day. More important results were obtained when the water pressure was left on for a longer time so as to allow the model to become permanently deformed owing to its plasticity, as it thus became possible to show more definitely the distribution of the stresses in the structure.

NEW G.W.R. STANDARD LOAD GAUGE.—We reproduce a diagram from the *G.W.R. Magazine* giving leading dimensions of the enlarged Standard Load Gauge, operative from January 1st on the



Great Western Railway Company's principal routes. It is noteworthy that the increased gauge is the largest in point of width in Great Britain.

RESULTS of tests of superheaters on the Canadian Pacific Railway extending for a period of about six months show that a saving of from 10 to 15 per cent. is realised in freight service, and 15 to 20 per cent. in passenger service, over engines using saturated steam.

Design for a Small Compound Marine Type Engine.

By W. Muncaster.

(*Continued from page* 156.)

THE additional details of the covers are given in Figs. 12 and 13. The edges of each of the covers can be turned in the lathe, the boss for the columns being dropped to clear. This will give a gauge to which the cylinder flanges can be cover. The guide is bored to 12 mm. diameter, which is the same as the stuffing-box, so that both might be bored at the same time, the intention being to use a ½-in. drill and follow by a smaller drill to the size of the valve spindle. The smaller cover may then be mounted on a suitable mandrel and turned to fit the base, also faced to the cylinder end. The spindle of the valve and guide ought then to be perfectly in line with each other. No peepholes are shown for setting the valve, the removal of the top covers enabling this to be done. A gauge for each valve should be made, giving the exact

Fig. 12.

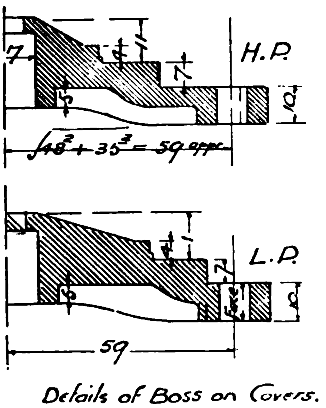


Fig. 13.

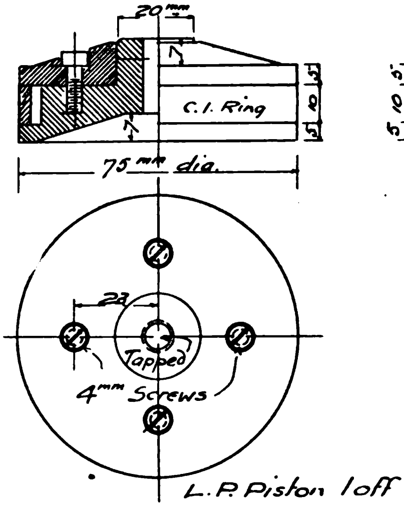


Fig. 16.

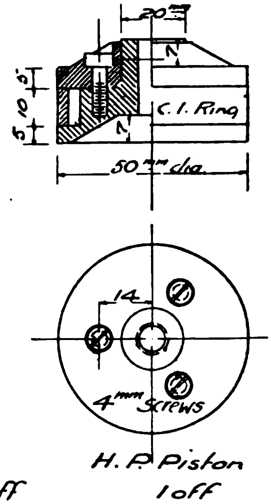


Fig. 17.

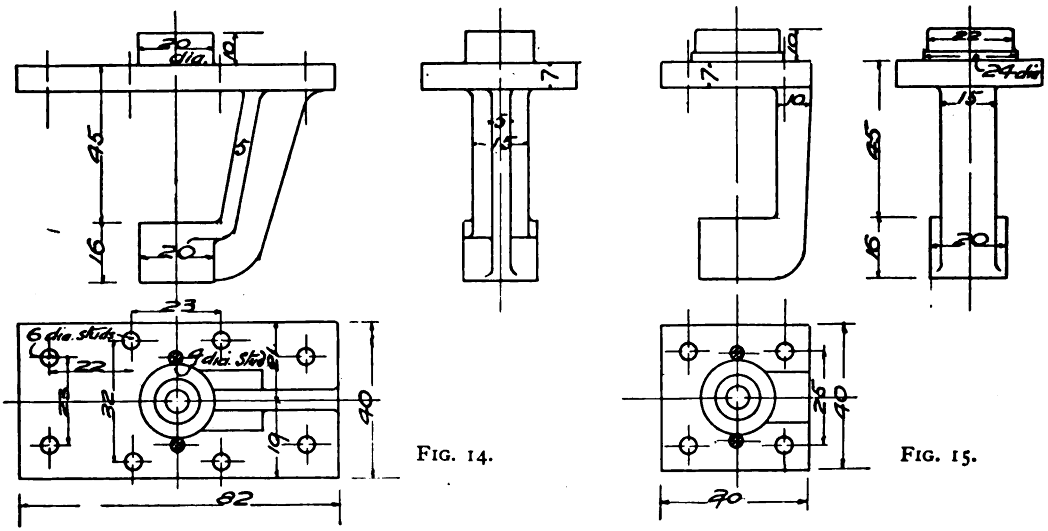


Fig. 14. Fig. 15.

DETAILS OF INTERMEDIATE VALVE CHEST COVERS.

trued. Flats will be required on the H.-P. cylinder covers to clear the valve chest covers.

Figs. 14 and 15 give details of the covers for the intermediate valve chest and the cylindrical valve. In each case the valve spindle guide is cast in the distance of the valve from the top to the most important points.

Details of the pistons are given in Figs. 16 and 17, each of these being fitted with a junk-plate held down by screws. The ring is a substantial cast

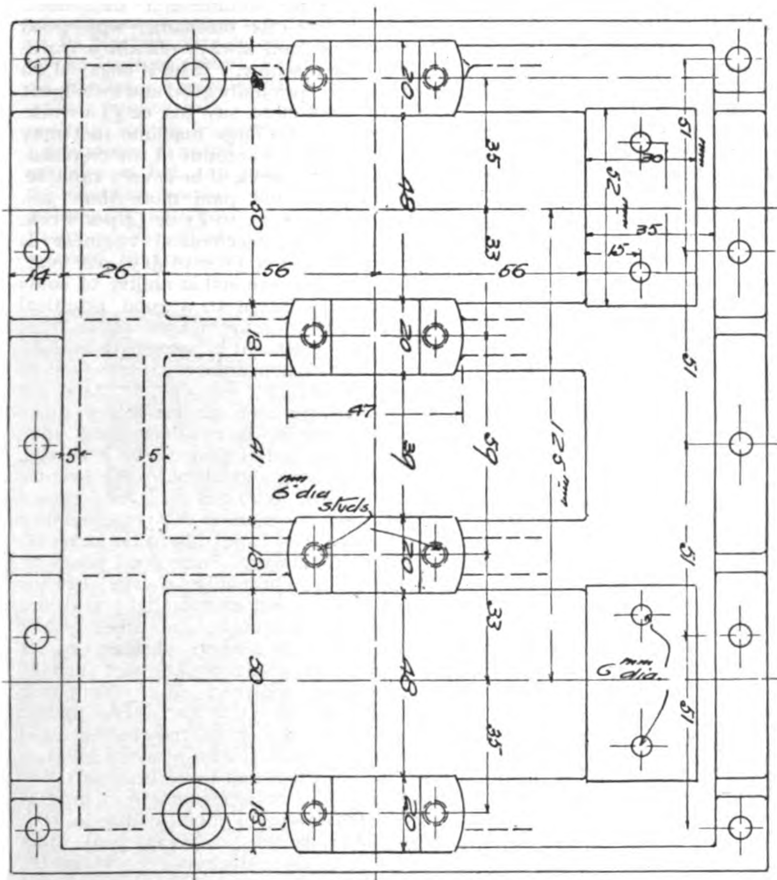


FIG. 19.—PLAN OF BEDPLATE.

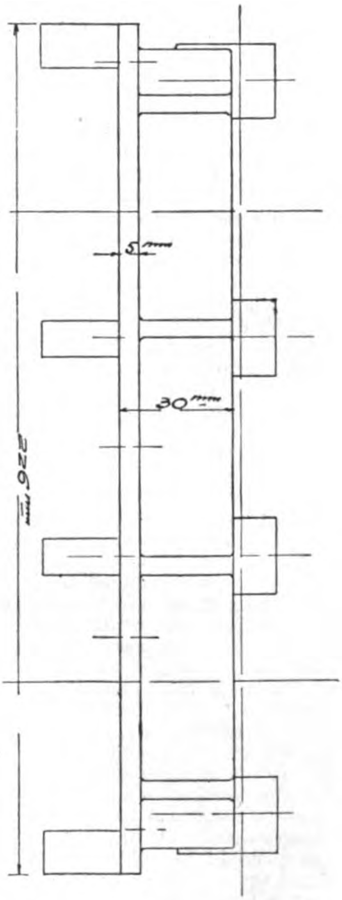


FIG. 18.—FRONT ELEVATION.

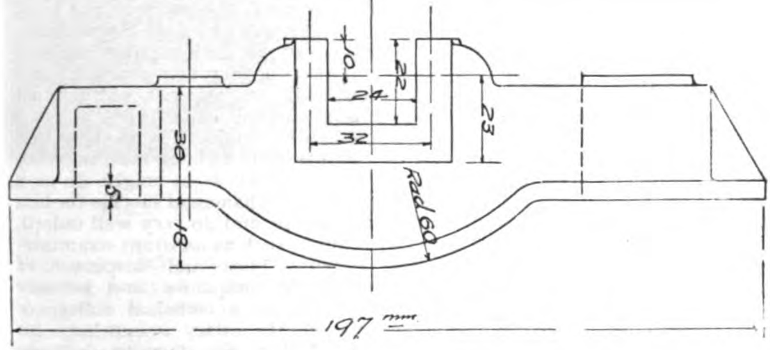


FIG. 20.—SIDE ELEVATION.

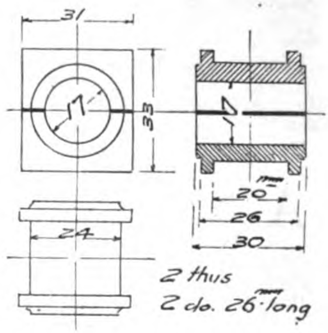


FIG. 22.—BEARINGS.

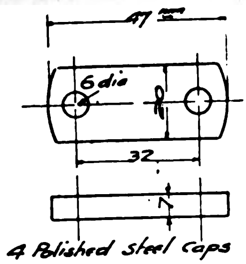


FIG. 21. STEEL CAPS.

DESIGN FOR SMALL COMPOUND MARINE ENGINE.

By W. MUNCASTER.

iron one turned only slightly larger than the cylinder and fitted with a tongue at the joint. The piston is tapped to suit the thread on the rod, then roughly turned on a mandrel, and afterwards screwed home on the rod and finished true in the lathe, the nut being screwed up so as to bring them under the conditions that would exist when in working order. As the piston must be removed when erecting in order to thread the cylinder cover and the gland on the rod, great care should be exercised in getting each piston on the rod it has been turned on and screwed to exactly the same place.

Figs. 18, 19, and 20 give the details of the bed-plate. This is after the usual style of the marine bed where it has to be bolted to the steel framing attached to the bottom of the boat. In the case of a small engine intended to drive a dynamo the same arrangement may be handy for fixing to an extension of the base of the dynamo. If it be preferred to make a flat base to the bed the depth may be increased to, say, 50 mm., dispensing with the flanges and making a plinth along the bottom, say 10 mm. deep. The holes for the column should be first drilled to a depth of, say, 6 mm. for a clear hole, then the remaining depth with a tapping drill to suit the column, then tapped to take the screwed end of the column.

Allowance should be made for facing the seats of the bearing brasses, loose pieces being provided in the pattern for the necessary facings, which should not, for the sake of appearance, extend to the bottom of the bed, as is often the case.

The caps for the bearings (Fig. 21) will be of steel, bright all over. These, when polished, look very well in the larger engines, and should give a good appearance to a model.

Details of the bearings are given in Fig. 22. Two of the bearings will be as shown. The returning two bearings will be 26 mm. only, or the same as above with bosses omitted. These will be of bronze, and should be soldered together, bored, and the ends turned, then fitted to the bed, a small amount being left in the boring so that the shaft can be properly bedded.

(To be continued.)

How to Become a Mechanical Engineer.

By Alfred W. Marshall, M.I.Mech.E., A.M.I.E.E.

(Continued from page 159.)

APPRENTICES frequently imagine that the road to a prominent position is through the drawing office, and make great efforts to obtain employment as a draughtsman directly they have completed their time. This is unnecessary, however, and though a drawing office experience is valuable, the better way is to try and advance through the workshops or by connection with the actual constructive work of engineering undertakings. Future prospects for a would-be mechanical engineer are as good as in any other business. Remuneration is not high for the many, considering the skill, application, and responsibility involved, and there are plenty of good men engaged in it. A young man may earn his living as a fitter, turner, moulder, pattern maker, draughtsman, and so on. His wages will be from about 34s. to 40s. per week, and he may never obtain a better income. Promotion does not go by regular steps or pay by regular increments, as in some commercial businesses. A man may be a first-rate mechanic, with good theoretical knowledge, and always remain a workman at the bench or machine. If he is engaged on piece work, or is an exceptionally good and intelligent workman, he may earn more, say 50s. or £3 a week. A mechanic in charge of a large machine tool may be paid at a special rate on account of the responsibility and earn £3 or £4 a week, if he is very capable. Many draughtsmen are not paid more than 30s. per week, but others earn up to £3 or £4 per week. Speaking generally, the mechanical engineer is likely to make an income of £100 to £150 per year.

The few who have exceptionable ability of some kind or another, in addition to a good practical and theoretical training, may rise to above this. By way of the drawing office it is possible to become a leading draughtsman at a salary of, say £200 to £250 per year, or a chief at, say £300 to £400 per year, or works manager at a similar salary up to perhaps £600 per year or more, depending upon the size of the works and responsibility involved. By way of the workshops a good man may become leading hand at £2 10s. to £3 per week, or foreman at £3 to £5 per week, or more if the responsibility is sufficient; he may rise from this to be assistant works manager and manager. Some good positions are obtainable as engineers in charge of the machinery at pumping and electric light stations, docks, manufactories, hospitals, and other public institutions, also as workshop instructors at technical colleges. The salaries are not usually more than about £200 per year. If a young man cares for the life, the navy or mercantile marine offer good prospects. He may rise to be chief engineer of a large steamship with a salary of £300, to £700 per year, and perhaps from that to engineering superintendent to a steamship company. There are also engineering appointments in connection with public bodies, railways, and other companies, at Government dockyards, and in the service of the War Department. Salaries would range from about £150 to £1,000 or more per year. To obtain the higher positions in mechanical engineering a man must be very capable indeed; he must have not only a thorough practical and theoretical training, with long experience, but must have originality and business capacity.

The field of mechanical engineering is, however, a very wide one, and though a young man may not at first earn as high a salary as he might do as a commercial man, there are chances of success for him always, and he may in the end do very well indeed. There are side openings, such as assistant examinerships in the Patent Office and inspector of machinery for insurance companies, and he may take up teaching work at a technical college or university, and though the salary is not large for assistants or demonstrators, say £100 to £200 per year, there is a possibility of securing a professorship at £500 a year or more. To commence in business as a manufacturer of some speciality or undertaking general work is becoming more difficult unless a considerable sum is available as capital, or the speciality is a patented invention which can attract a capitalist or a company or syndicate can be formed to exploit it. The tendency is for work to be done by large firms, and a mechanical engineer with small capital only will probably make a better living as department manager of a large firm than in business on his own account.

Names of engineering firms can be found in the advertisement pages of the *Engineer*, published at 33, Norfolk Street, Strand, W.C.; *Engineering*, 35-36, Bedford Street, Strand, W.C.; the *Electrical Review*, 4, Ludgate Hill, London, E.C., and other similar publications. These are journals devoted entirely to the engineering business; they have "Situations Wanted" columns, in which at small expense a lad can state his requirements. Also "Situations Vacant" columns, in which employers frequently announce the vacancies occurring at their works. Many of the positions previously referred to are advertised in these journals when vacancies take place, and an apprentice or pupil having completed his time should study them to ascertain if there is a suitable opening for which he can apply.

The course to take if a lad has just left school and intends to become a mechanical engineer, is to look through the engineering journals mentioned, a directory as well (Iron and Steel Trades Directory), and select some names of firms likely to meet with his desires as to locality and kind of work. He should then (or through his parents) write to them, stating shortly and explicitly what he wishes to do, and if he is prepared to pay a premium or not. Brief particulars of his education should be given. If he intends to specialise permanently in locomotive work, the firms to select are locomotive builders or the locomotive superintendent of a railway. If he intends to specialise in marine work, a firm of marine engine makers should be selected, or the superintending engineer of a shipping company or dockyard. Refusals are to be expected, and the lad should persevere. If to start with he cannot obtain exactly what he desires, he should take the best which offers, and trust that an opportunity will occur later for him to enter the branch he particularly wishes to be engaged in. The Navy offers very good prospects for engineers, by comparison with other branches of the business. It is necessary when dealing with small or obscure firms or individuals to ascertain that a real business is done by them before paying a premium or signing any indentures. A lad may do quite as well, if not better, with a small firm than with a large one. In a small workshop he will have a greater variety of work, and have to tackle difficulties with makeshift appliances. He will be more in touch with his master, and become a better all-round mechanic than he probably would in a large works. On the other hand, there is more going on in a large works, and his experience will be broader, with more chance of an opening when he has completed his time.

An apprentice or pupil should make up his mind to be diligent, punctual, and conscientious. If he makes a mistake in his work, he should not try and hide it up, but frankly inform his foreman or the person over him. As an apprentice he is

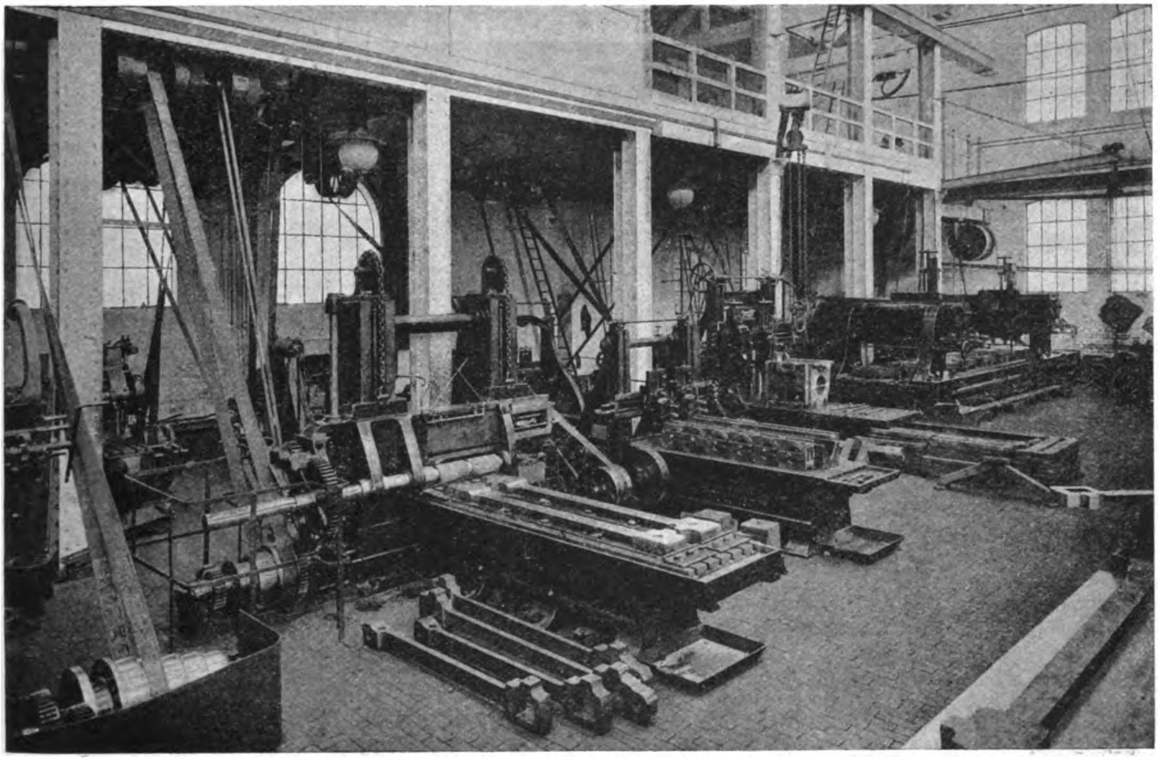


Fig. 10.—A View in Heavy Machine Shop: Messrs. Peckett & Sons' Works, Bristol.

a learner, and cannot be justly blamed if he makes errors and spoils a job. Even if he has been careless, he should not hide up a mistake; everybody is human, and if an apprentice does his best on the whole, he can do no more. Let him be natural and have some fun, but with discretion. He should associate with the workmen as one of them, and never refuse to listen to advice about the work. He should not try to teach them or to appear superior, but ask for whatever information he requires and use common-sense when applying it. It is the universal custom for apprentices and pupils to live "out doors"; "indoor" apprenticeships are rarely arranged in the engineering business. Some firms who take special interest in their apprentices and pupils will recommend suitable lodgings in the neighbourhood of the works.

The following books would be useful to a youth intending to study the theoretical as well as the practical side of mechanical engineering: The "Elements of Machine Design" (by W. C. Unwin), Molesworth's "Pocket Book of Engineering Formulæ," "The Elements of Mechanism" (by T. M. Goodeve,) "Principles of Mechanics" (by T. M. Goodeve), "Practical Plane and Solid Geometry" (by Angell), "Machine Construction and Mechanical Drawing" (by T. Cryer and H. G. Jordan). A drawing board, size 32 ins. by 23 ins., that known as engineers' pattern, with one ebony inlaid edge and battened at the back, a T-square to suit, taper blade pattern, preferably made of mahogany with ebony edge, one 60° 10-in. size set-square, and one 45° set-square, 7-in. size; those made of vulcanite are the kind to procure. A pocket case of drawing instruments, which should contain at least one 4½-in. compass, with pen and pencil points, one pencil bow and one ink bow compass, one drawing pen. The very cheap foreign made instruments and the cheap wood squares and drawing-boards used for elementary drawing at schools, are not satisfactory for engineering drawing work. The work must be done very accurately, and the drawing instruments and appliances should be of good English manufacture. The sizes mentioned are convenient, but need not be strictly adhered to. Buy the very best instruments if possible, but very serviceable second-grade appliances and instruments are made by English firms. The compasses should be of modern pattern, arranged to take solid lead in the pencil fittings. Pencils should be of hard grade, H.H.H. or equivalent brand. Indian (really Chinese) ink is required; writing inks corrode the pen points, and should not be used. For workshop equipment, the following tools will be required, unless the firm provides them: One 12-in. engineer's steel rule (marked to 1-64th in., also to 1-100th in.); a metric scale is also useful marked to ½ mm. (it can be upon

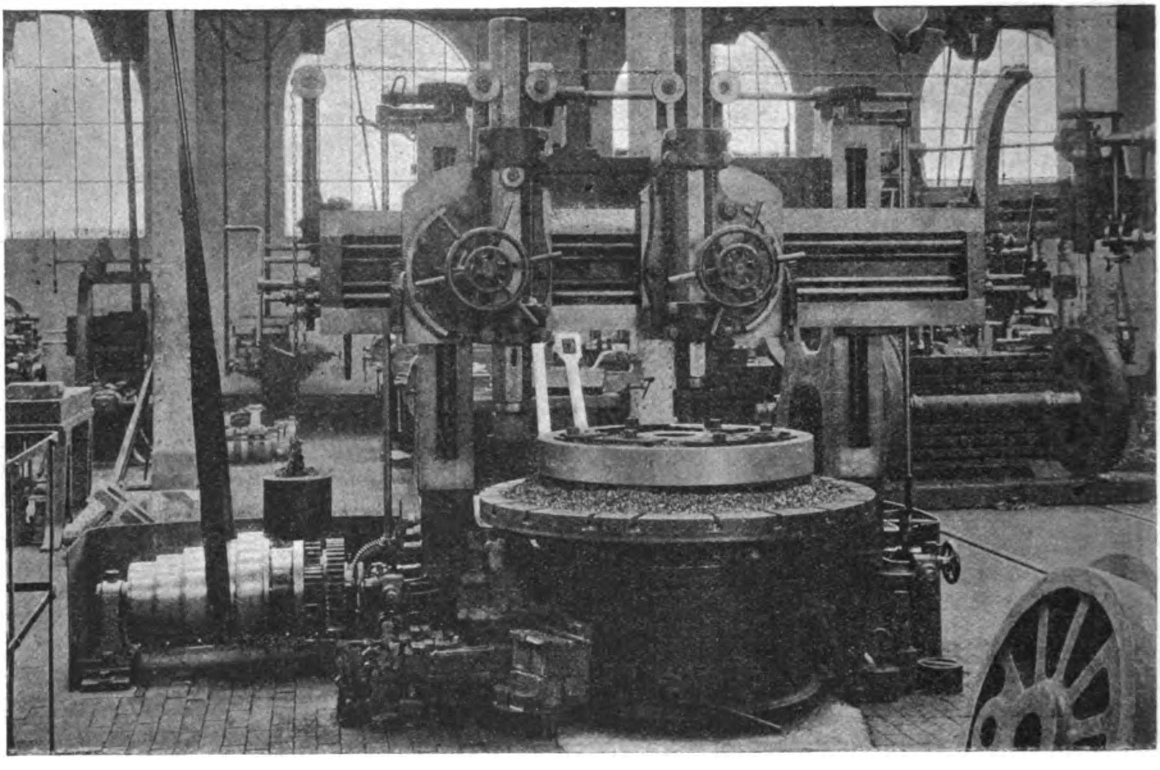


FIG. 11.—SHOWING HORIZONTAL TURNING AND BORING MILL: MESSRS. PECKETT & SONS' WORKS, BRISTOL.

the same rule); one pair each of outside, inside and leg and point callipers, medium size; one, scriber, one surface gauge, one centre-punch, one steel try-square (blade about 5 ins. in length), one pair spring dividers. These tools are to be obtained at engineers' tool shops. Two suits of canvas overall clothes are necessary; several patterns are obtainable from engineer's supply stores or firms of outfitters in the neighbourhood of engineering works.

Two good examples typical of a large modern engineer's machine department are given by Figs. 10 and 11. Planing surfaces suggests to the novice something in the nature of a carpenter's plane as the tool employed. In engineering work, however, the operation though carried out on the same principle—that is, the copying of a master surface contained in the tool—is necessarily a more slow and difficult process owing to the harder nature of the materials dealt with. A very small strip of metal is, in fact, removed by the tool at each cut and the combination of a large number of such cuts accurately made at one level constitutes the surface produced. The work is done by a machine called a planing machine if the tool is provided with a single cutting point or edge, or by a milling machine if the tool is provided with a number of cutting points or edges like a cog wheel, and rotated so that each edge in turn takes a cut at the metal to be planed. Each kind of machine is made in various forms. A milling machine is shown in the centre of Fig. 10; it is engaged in planing the connecting rods for locomotive engines. Two of these are in position on the table of the machine which carries them slowly under the revolving cutters. Four partly finished connecting rods are in the front of the picture. Two planing machines are to the right of the milling machine, one having a number of bearings and the other a cylinder fastened to the tables. In each case the machine is provided with two toolholders so that two shavings can be cut simultaneously. This is an instance of economising time by using two tools at once to make cuts instead of a single tool. Another example to effect this is the machine in the extreme background. It is a planing machine specially designed for the work. There is only one table to which the work is fastened, but the toolholder portion of the machine with it slides and gear is duplicated. In fact, a second complete planing device is added to a single machine so that a complete second cutting operation takes place independently of the first. Two separate surfaces can be planed simultaneously. A rough connecting rod forging is to the extreme right of the picture and may be contrasted with the partly finished ones near the milling machine.

Lathes have been superseded to a considerable extent by turning and boring machines for the production of short circular surfaces. The work is more conveniently fixed and the support is firmer upon a horizontal table than upon the vertical faceplate of a lathe. Rapidity of manipulation is thus secured and an economy in time effected. One of these machines is shown in Fig. 11. The work to be turned is bolted to the table and is in a partly finished state. It appears to be a wheel. The table rotates and the two vertical toolholders can be set to operate simultaneously. Thus, one tool can be cutting the rim and the other boring the hole for the shaft. The mechanic in charge controls the movements of the tool by the various handles shown at the ends of the horizontal slide and in front of the toolholders. Nearly all machine tools are fitted with automatic gear. He need not be continually winding the handles to give the tool its motion. Having adjusted the depth of the cut by trial he would set the automatic gear (or self-acting gear as it is called) into operation. The cutting then goes on by power from the machine and he need only watch to see that it proceeds correctly. He may stop it at any moment by a simple movement or this may be automatically done by the machine itself. A comparatively weak mechanic can thus operate a large machine tool. He is merely required to direct its movements.

(To be continued.)

Prize Competitions.

Competition No. 43.—A Prize of Two Guineas will be awarded to the reader sending the best article on "Finishing Model Engines." The work of painting and enamelling, polishing, lacquering and the other points and processes which are involved in neatly finishing off a model engine after all the constructive work has been done should be dealt with. The closing date of this Competition is March 2nd, 1908.

Competition No. 44.—A Prize of Two Guineas will be awarded to the reader sending the best article on "Small Dynamo and Motor Testing," describing how to test for faults during construction, and how to test the working of the machine when finished. The closing date of this Competition is March 2nd, 1908.

General Conditions.

1. All articles should be written in ink on one side of the paper only.

2. Any drawings which may be necessary should be in good black ink on white Bristol board. No coloured lines or washes should be used. The drawings should be large enough to allow for reducing to half.

3. The copyright of all photographs entered in connection with any competition must be the sender's own property, and a signed statement to this effect must accompany same.

4. The copyright of the prize articles to be the property of the proprietor of The Model Engineer, and the decision of the Editor to be accepted as final.

5. The Editor reserves the right to print the whole or any portion of an unsuccessful article which he may think worthy of publication, upon the understanding that remuneration is given at the Editor's discretion in proportion to the length and merit of the matter used.

6. All competitions should be addressed to the Editor, The Model Engineer, 26 to 29, Poppin's Court, Fleet Street, London, E.C., and should be marked outside with the number of the Competition for which they are intended. A stamped addressed envelope should accompany all Competitions for their return in the event of being unsuccessful. All MSS. and drawings should bear the sender's full name and address on the back.

How to Produce the Ultra-Violet Rays, and Some Experiments with Them.

By G. G. Blake.

Any amateur who possesses a coil capable of producing a 1-in. spark can, without much trouble or expense, fit up and work an ultra-violet ray apparatus.

Fig. 1 shows a diagram of the apparatus :—A, switch; B, battery; C, coil; D, condenser (or Leyden jar); E and E are two small steel rods; F, box of wood or cardboard; G, hole cut in the side of box; H, coil of stout copper wire.

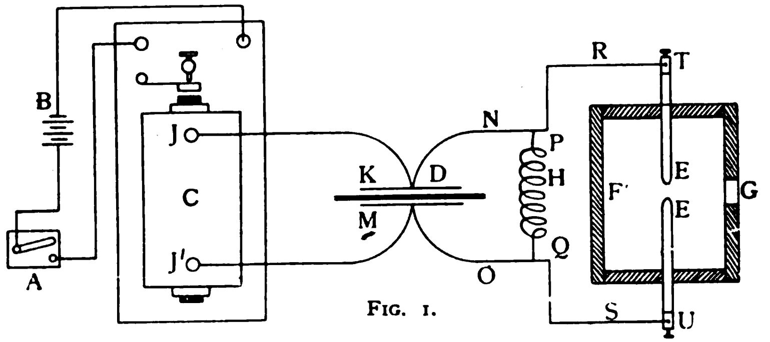


Fig. 1.

The battery, coil and switch need, I think, no further description, so I will pass on to describe the condenser D. There are various ways of making this. The figure shows it made of a square piece of window glass 14 ins. square, coated on each side with tinfoil, to within about 1 in. of the edge. This is best stuck on with shellac paste, made by dissolving shellac in methylated spirits, and it is just as well, while using the shellac, to coat the edges of the glass with it, so as to prevent condensation of the moisture in the air from settling on the glass, as it is so apt to do.

Another form of condenser which would serve the purpose almost equally well is the old-fashioned Leyden jar. A very serviceable one can be made

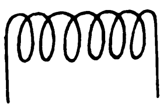


Fig. 2.

out of a tumbler coated inside and out to within about 1 in. of its edge, with tinfoil, and the remaining exposed glass coated with shellac as in the last case.

Whichever form of condenser is used, one of the wires leading from the secondary of the coil J is connected to one coating of foil K, and wire J^1 from the other secondary terminal is connected to the other coating of the condenser M. H is a coil of stout copper wire about 4 ins. in diameter and 10 ins. long (see Fig. 2). It consists of only one single layer of wire. This should be quite uninsulated and of such a thickness that after it has been coiled into shape (round the body of a wine bottle, or anything cylindrical in shape) it will retain its shape when the bottle is afterwards removed.

The two ends of this coil, P and Q, are connected to the two coatings of the condenser by wires N and O respectively, and are also joined by wires R and S to the two steel rods E and E. These steel rods are made out of two pieces of stout steel wire about ⅛ in. in diameter and the two ends E and E are nicely rounded with a file.

Box F can be made either of wood or cardboard. About 4 ins. square is a convenient size (see Fig. 3). The steel rods E and E push in and out through holes in the sides of the box, so that the size of the spark gap between them can be regulated. On the other ends of the rods are soldered terminals T and U. G is a hole in the box 1½ ins. in diameter, opposite the spark gap.

Experiment I.—Procure a small piece of willemite (it is a natural silicate of zinc), any chemist will probably be able to get this for you for a few pence, and place it in front of the opening of the box G, and in a perfectly dark room start the coil working. A bright blue spark will be seen between the rods E E, which makes a loud snapping noise, and the willemite will be seen to fluoresce a beautiful green colour. If a small crumb of willemite be looked at under a microscope while it is fluorescing, it is especially beautiful. When a fairly large coil is used to work the apparatus, the willemite can be made to fluoresce, even when several yards separate it from the window G. If a piece of thin glass be now put in front of the opening G, the willemite will no longer fluoresce, but if a piece of quartz (say an

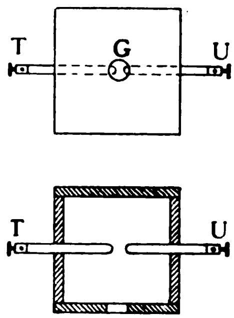


Fig. 3.

old quartz lens from a pair of spectacles) be put in front of the opening, it will fluoresce quite as well as it did in the first case. This experiment proves the presence of the ultra-violet rays (which are invisible to the unaided eye), for if it had been the visible light rays which caused the willemite to fluoresce, the glass would not have stopped the fluorescence. And it also shows that whereas glass is opaque to the rays, quartz is quite transparent. Ice is also found to be transparent, and a small piece can be substituted for the quartz, with the same result.

Experiment II.—Several other substances also fluoresce under the action of the ultra-violet rays. Silicate of soda fluoresces blue, and it is especially noticeable with this chemical that the fluorescence continues for 5 or 6 seconds after the apparatus has stopped working. Should the reader happen to possess a platino-cyanide of barium *X*-ray screen, he will see that this will also fluoresce under the action of the ultra-violet rays.

Experiment III.—Another proof of the existence of the ultra-violet rays produced from the spark between the steel rods is their power to discharge an

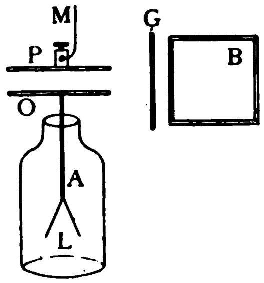


Fig. 4.

electroscope. Fig. 4 shows a gold leaf electroscope charged either negatively or positively, so that the two gold leaves L are wide apart. P is a disc of brass the same size as the disc O, belonging to the electroscope, P is suspended by a wire M about 1½ ins. above O, and is connected to the earth by wire M. A gas or water pipe makes a splendid earth connection. B is the ultra-violet ray box, and G is a piece of glass in front of the window between it and the electroscope. On the rays being generated nothing happens to the electroscope while the blue light coming through the glass passes between the plates P and O, but directly the glass is removed, and the ultra-violet rays are allowed to play on the air between the two plates,

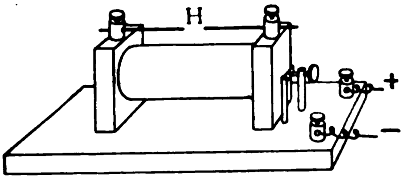


Fig. 5.

the air becomes a partial conductor, and all the electricity escapes from the electroscope to earth, with the result, of course, that the leaves close. A simple way of connecting up this experiment is to suspend plate P from a gasolier.

Experiment IV.—This is another experiment which shows the action of the ultra-violet rays upon the air. A small coil is arranged as shown in Fig. 5, so as to have a spark gap between the secondary terminals, which is so arranged that it is just too great to allow a spark to pass when the coil is worked. If now the ultra-violet rays are allowed to play on the air in the spark gap, a spark will pass, showing again that the air becomes more conductive when under the action of the rays.

There is a great similarity between the ultra-violet rays, the *X*-rays, and the Gamma rays which emanate from radium. Any of these rays will discharge a charged electroscope, affect a photographic plate or cause willemite, and other substances, to fluoresce, all are invisible to the unaided eye, and they are all of them ether vibrations. Violet is the highest rate of vibration which our eyes are capable of seeing, and above this next comes the ultra-violet. These rays have only about the same penetrative power as ordinary light. Higher than these in the spectrum we come to the *X*-rays, and the Gamma rays, both of these having wonderful penetrative power, the latter in particular. With a small quantity of radium (6 milligrammes) I find that the rays will penetrate through nine pennies, placed one above the other, and will cause distinct fluorescence on a piece of willemite.

Locomotive Notes.

By Chas. S. Lake, A.M.I.Mech.E.

New Great Northern Tank Engines.

Several new tank locomotives of the six-wheels coupled, radial, or 0—6—2 type, belonging to the No. 190 class introduced on the Great Northern Railway during 1907, have recently made their appearance on suburban traffic in the London district. The new engines bear numbers commencing with 1,500, and apparently the design has not been altered in any of its important details. The original engine (No. 190) proved so successful in every respect, and the proportions throughout are so well adapted to the work to be performed, that it is not at all surprising to find the type developing into a standard one for working the heavy short distance passenger traffic running to and from King's Cross.

British-Built Locomotives for Abroad.

Messrs. Robert Stephenson & Co., Ltd., of Darlington, dispatched recently locomotives which they had built for the Argentina Great Western and Burma Railways. The engines for the first-named railway are of the 2—6—2 tank type, with outside cylinders and valve gear, the latter being of the Walschaerts' pattern actuating balanced Richardson slide-valves which work above the cylinders.

The boiler is fitted with the Belpaire type of firebox, while the smokebox is extended and contains a spark-arresting device. The design taken generally presents quite an English appearance, but this is a distinguishing feature of A.G.W.R. locomotives, the majority of which are built in this country. The tank engine illustrated, and others of the same class, have been built to the specification of Mr. Chas. H. Fox, consulting engineer in London, and the following is a list of the leading dimensions:—

Cylinders diameter, 17½ ins.
Piston stroke, 24 ins.
Coupled wheels diameter, 4 ft. 6 ins.
Leading and trailing wheels diameter, 3 ft.
Wheelbase (rigid), 12 ft.; total, 26 ft. 6 ins.
Heating surface: Tubes, 1283·8; firebox, 109·3: total, 1393·1.
Grate area, 22¼ sq. ft.
Working pressure, 180 lbs.

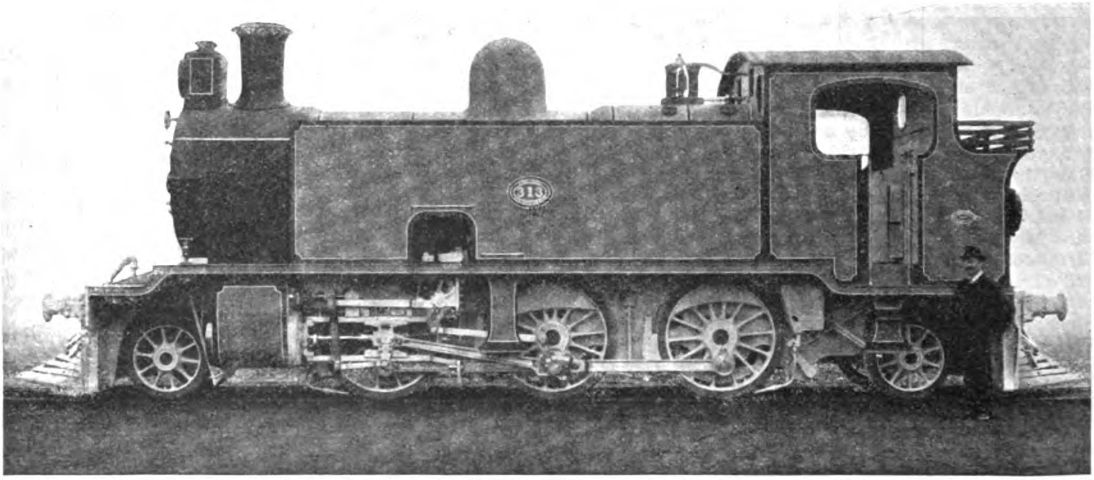
Capacity of tanks, 2,000 gallons; coal bunkers, 2¾ tons.
Total weight in working order, 71¼ tons.
Maximum weight per axle, 15 tons.

The Burma locomotive is a 4—6—0 type engine with tender. It is designed for working on the metre gauge, and has outside cylinders driving the middle pair of coupled wheels. Walschaerts gear is again employed outside the frames in conjunction with superposed Richardson type slide-valves. A Belpaire firebox is fitted. The tender is surmounted at sides and back by high railings to allow of the fuel being stacked up and a good supply carried. The engines are for mixed train working, and some similar locomotives, but with larger cylinders and coupled wheels, have been sent out to the same railway for working metre gauge passenger trains. The boiler motion and all important parts are duplicate in both series. The passenger engines are fitted with the vacuum brake on engine and tenders; and the mixed traffic engines, with steam brake on the engine and tender, and with a vacuum ejector for working the brake on the train. The engines are built to the Engineering Standards Committee design and to the specification of Sir A. M. Rendel and Robertson, consulting engineers. They have the following principal dimensions :—

Cylinders diameter, 15 ins., and for passenger engines, 15½ ins.
Piston stroke, 26 ins., and for passenger engines, 26 ins.
Coupled wheels, diameter, 4 ft., and for passenger engines 4 ft. 9 ins.
Wheelbase (fixed), 12 ft.; engine total, 21 ft. 1½ ins.
Heating surface: Tubes, 954 sq. ft.; firebox, 108 sq. ft.: total, 1,062 sq. ft.
Grate area, 16 sq. ft.
Working pressure, 180 lbs.
Weight in working order, 35 tons.
Weight on coupled wheels, 26 tons.
The tender carries 1,850 gallons of water and 5½ tons of fuel.

New Glasgow & South-Western Railway Locomotives.

The new express locomotives designed by Mr. James Manson for the Glasgow & South-Western Railway are of the 4—4—0 type with inside cylinders. They approximate in appearance to the latest engines of this pattern on the Midland Railway with which the G. & S.W. works in conjunction at Carlisle for the Anglo-Scottish traffic between London, St. Pancras, and Glasgow, St. Enochs. The boiler is set rather higher above rail level than usual in 4—4—0 locomotives on this line, and other distinguishing features are the cast-iron chimney with wind cap and the plates instead of railings along the top sides of the tender. The cylinders are 18¼ ins. by 26 ins., and the coupled wheels 6 ft. 9 ins. diameter. Other dimensions will be given later with, it is hoped, an illustration.



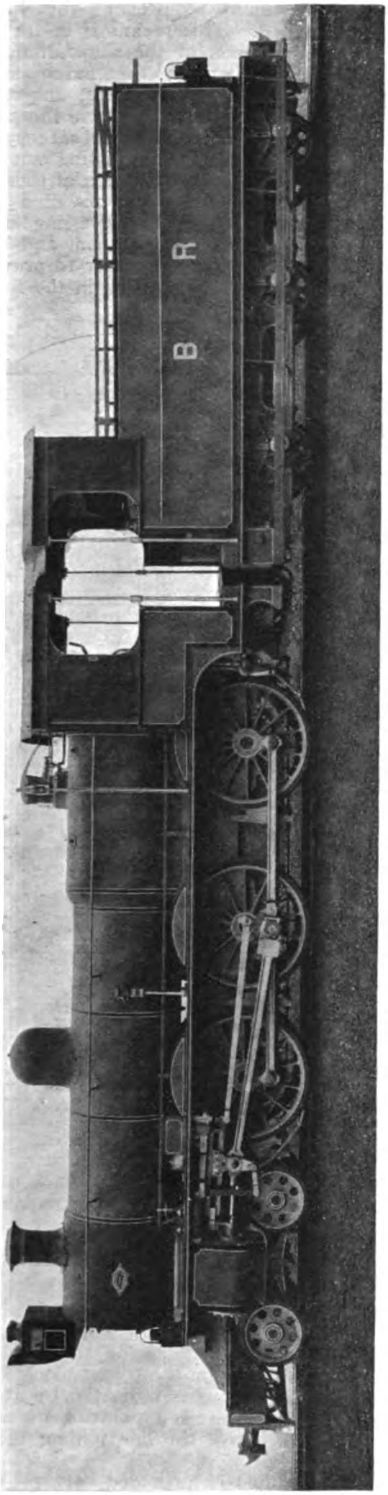
2—6—2 Type Tank Locomotive: Argentina Great Western Railway.

The Society of Model Engineers.

London.

Future Meetings.—The next meeting will be held on Tuesday, February 25th, and will be made a special model and track night. It is hoped that a boiler will be provided, to which stationary engines not provided with their own boiler may be connected, and an adjustable coupling will be provided to suit all ordinary sizes of steam pipe. The models exhibited will be divided into three classes, viz.—(1) locomotives, (2), stationary engines, (3), electrical and general exhibits. If the entries warrant it, three cash prizes will be awarded in each class by popular ballot of the members present. No model having gained a prize in a previous competition held this Session will be allowed to enter. The following meeting will be held on Wednesday, March 18th.

Visits.—On Wednesday, March 4th, to North London Railway Works, Bow; on Thursday, March 26th, to Great Eastern Railway Works, Stratford.—Herbert G. Riddle, Hon. Secretary, 37, Minard Road, Hither Green, S.E.



4—6—0 TYPE ENGINE WITH TENDER: BURMA RAILWAY.

Practical Letters from Our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily for publication.]*

Model Steamer Racing.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I notice (in the "Editor's Page") a letter from one of your correspondents on the subject of "Model Steamer Racing," and as the points he has raised let some light on the methods adopted by over-enthusiastic competitors in the sport, I beg leave to go into the matter a little. Your correspondent suggests the publishing of fuller details of the running of the competing boats. Let us have it, by all means. We have to thank him already for some interesting particulars of steamer racing that have presumably come before his notice, and it is evident that some slight reforms will have to be made in the next speed competition. Up till the present, it has been thought sufficient to limit the space of time between *turning on full power* and starting to 15 seconds, but it is evident that this is not sufficient to eliminate the "wound-up spring" element in model steamer racing. We of the Victoria Model Steamer Club have found that 15 seconds is quite enough to drain the reserve power out of our little "metre" boat boilers, but as we have always interpreted "running pressure" to mean "working pressure," and have barred the practice of saving up steam, for more reasons than one, we should be quite content to turn power on for 10 minutes before the start, were it not for the difficulty of the water getting low. As it is, I think that whatever new penalty is inflicted on the small boats, it is time that the tasks set for the winning of the awards should be in direct ratio to the size of the models. It is absurd to give a small boat the same course to cover as one twice its size and eight times the boiler capacity, in order to win a similar prize. The one great point is the steering, and I commend the idea to you, Mr. Editor, of offering a prize for the boat that can make the best "bee line." In any racing on a given length of course, the boat with the longest water-line will keep the straightest course, all other things being equal. Therefore, it should not be considered an inferior performance for a small boat to cover a less distance than its big sister. We have great difficulty in getting our "metres" to cover even 100 yards in one lap. It is usually done in a series of arcs with a corresponding number of "headings off," and it is almost superfluous to volunteer the information that the process of "heading off" an incoming boat is not conducive to the acceleration of speed in an onward direction, unless one is an expert billiard player.

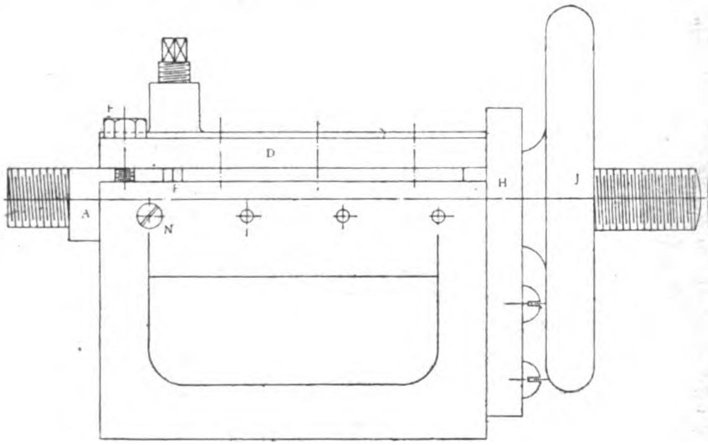
Summing up, I beg to reiterate my opening remarks—I quite agree with your correspondent as to the publishing of fuller details of the competing boats and their manner of running. I trust that the next Speed Competition will be on lines of fairer comparison for big and little boats, and I trust your correspondent will not interpret my remarks in any other manner than that of friendly criticism. As pioneers of a new sport that will soon be attracting universal attention, I make the request that all interested should keep it clean and above suspicion, and to that end refrain from the objectionable practice of saving up steam when racing.—Yours faithfully,

Stepney, E. W. L. Blaney.

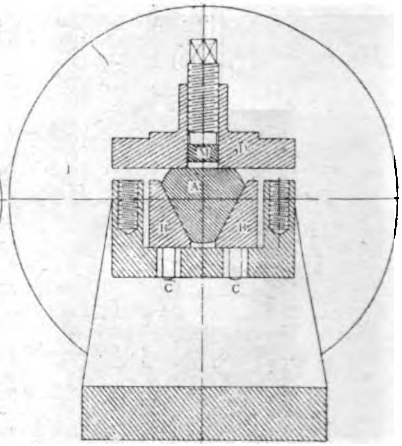
An Adjustable Backstock.

To the Editor of *The Model Engineer*.

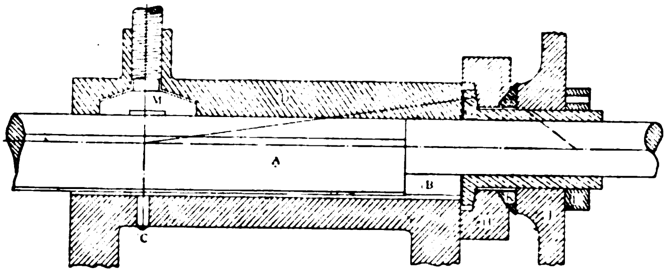
Dear Sir,—The drawings herewith show my design for a tailstock which can be adjusted to eliminate wear of the sliding barrel. It can also be adjusted to exactly coincide with the lathe centre. The sliding barrel is triangular in section, with the corners cut away. One end of this bar is turned down circular, the diameter of this part being conveniently the same as that of the live nose. The turned-down part should be screwed with a square thread preferably, and on it will move the driving nut (of some hard brass) producing protrusion or withdrawal of the centre. This barrel slides upon two suitably planed strips B B. These strips are held up to their work by the adjusting screws N, which should be provided, as usual, with locknuts (not shown). The barrel is kept in position by means of a planed top-plate D, secured by setscrews E. This top-plate might easily, in the hands of a careless workman, be screwed so tightly down as to prevent all motion of the barrel, and even possibly to rupture the casting (if such movement were attempted), if a means of adjustment to prevent this happening were not provided. This means is in the form of short, headless screws, of the same diameter and of the same number as the fixing setscrews, and provided with tommy-holes, inserted into tapped holes intermediate between those for the fixing screws in such a manner that each fixing screw has its corresponding resisting screw. One such is shown at F. The function of these screws is, when moved upward by means of a spanner, to offer resistance to the compressing action of the setscrews E, and locking them and the top-plate in such a position as neither to prevent free motion of, nor yet permit shake in the fit of, the sliding barrel.



Front Elevation.



Cross Section.



Longitudinal Section.

A PROPOSED ADJUSTABLE TAILSTOCK FOR LATHE.

It will be perceived that with suitable manipulation of the set and resisting screws E and F, together with that of the adjusting screws N, wear may be eliminated and the whole barrel moved bodily up and down, in order to bring the centres into exact coincidence.

All these adjustments would, however, be of little or no value if the thrust of the nut, when actuating the barrel, were not sufficiently received upon surfaces in intimate and wide contact. This end is obtained by making the thrust bearing of the hard brass nut G on the thrust-block H part of a sphere, whose radius is indicated by the arrow. The centre of curvature is a point on the axial line, perpendicularly above the line joining the centres of the pins C.

Ample play must be provided between the inner holes in the thrust-block and washer K and the exterior of the nut G. The pull of the nut when withdrawing the barrel into the backstock is taken up by the hand-wheel J, which actuates the nut G through a key (not shown) let into both hand-nut sleeve and wheel boss. The hand-wheel is held tight from slipping off the sleeve G of the nut by means of the nut L. From the hand-wheel the pull is transmitted by the flat face of the boss to the spherical washer K, which is prevented from rotating by some simple means, such as a pin fastened in the thrust-plate H, engaging in a radial sawcut, or milled slot in K, which, nevertheless, is free to move to adjust itself with its flat face in close bearing contact with the flat boss of the hand-wheel while it is still rigidly supported by the intimate contact which its spherical form gives it with the thrust-block. Any shake is taken up by a slight adjustment of the nut L.—Yours truly,

NATHAN SHARPE.

A Model Electric Locomotive from America.

To the Editor of *The Model Engineer*.

DEAR SIR,—I am sending you herewith several photographs of a ½-in. scale model electric locomotive completed by me some time ago, of which the following is a description:—The current is supplied through a trolley of the pantograph type as used on some of the largest electric locomotives recently built in this country, and I think is something new on model electric locomotives. It adds considerably more interest to the working of the car than the use of the third rail would, and gives no more trouble than the latter. The roller, which rides on the wire, is 3-16ths in. diameter and 1½ ins. long. The upper limbs of the trolley are 1 13-16ths ins. long, and the lower limbs 1½ ins. long, these being set 13-16ths in. apart on the trolley stand. The limbs are made of bicycle spokes with brass ends sweated on to make the joints.

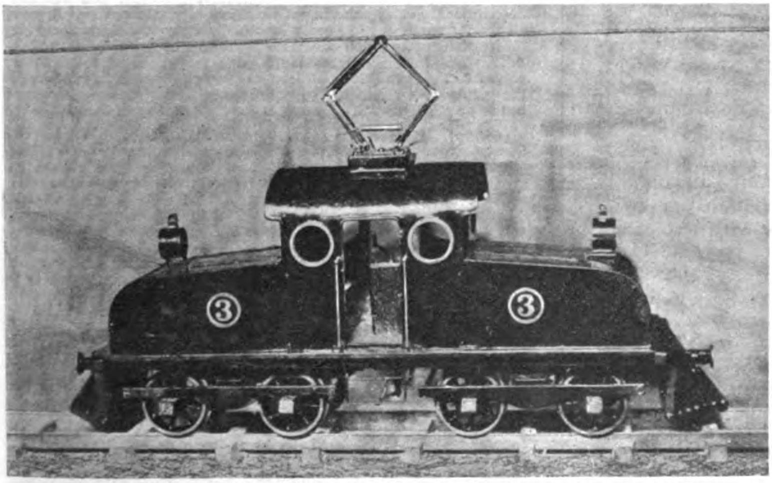


FIG. 1.—SIDE VIEW OF MODEL ELECTRIC LOCO.

The cab (top and sides) is made of one piece of metal with brass rings sweated on around the ports. The end tanks are built up of wood and have a hatch on top through which the king bolts can be reached to allow of the trucks being removed for repairs or adjustment.

The truck frames are of ¼-in. iron, and the wheels were cast in brass by myself, being 1½ ins. in diameter, with eight spokes. Only one truck is now fitted with a motor, but I intend to put one on the other truck also as soon as I complete a new dynamo which I am now working on, my old one not being large enough to work two motors satisfactorily. The motor has a tripolar armature 1½ ins. in diameter, which drives on to one axle of the truck by means of a double-threaded worm and worm wheel, the armature shaft being set vertically. I have two worm wheels on this axle—one of 24 teeth and one of 30 teeth, and the motor can be adjusted on the truck to fit either. The centre bearing for this truck is right at the top of the tank, the frame for this passing over the top of the motor. I have used point bearings on the motor which can be adjusted in any direction, the one on the top being made to take up the slack. These bearings are very satisfactory, as is also the worm method of driving, the latter having given practically no trouble whatever as regards starting, and it also acts very nicely as a brake, bringing the car to a nice stop in the proper distance.

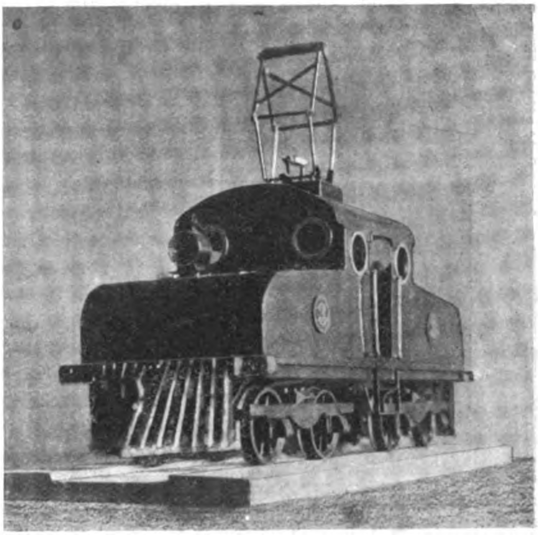


FIG. 2.—ANOTHER VIEW OF MODEL ELECTRIC LOCOMOTIVE.

I at first had some doubt as to whether the motor was strong enough, but as I experimented with it as I built, I found that when I had finished and weighted the car down with lead it still had power enough to start and spin the wheels while being held. I can get over forty model miles an hour on a very sharp circular track with the large worm wheel.

The controller in the cab is made to scale, but is a dummy. It has a brass plate on top with stops and notches, but is used only to reverse the car, the spindle passing right on through the floor where the reverse is fitted and a handle on the end for regular use.

The headlights on each end are built up, the body being made of brass tube, and have a removable back. The pilots are built up of wood and

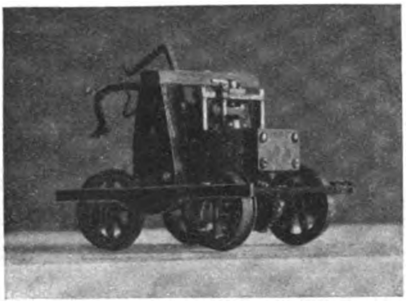


Fig. 3.—Showing Motor for Model Electric Locomotive.

have thirteen bars, each ⅛ in. wide. They are well braced and very strong.

The locomotive is painted black all over with the exception of the inside of the cab, which is painted green. There is no lining whatever. The tyres, hand-rails, window-rings, and number plates are left bright. I followed Mr. Upton's notes on "Model Painting" in one of the back issues, and made a very good job.

The following are a few dimensions:—Gauge, 2½ ins.; height rail to roof of cab, 6⅛ ins.; height rail to extreme trolley limit, 9¾ ins.; total wheelbase, 9½ ins.; truck wheelbase, 2¾ ins.; length over-all, 15¾ ins.; width over-all, 4¾ ins.; total weight, 4¼ lbs.—Yours truly,

St. Louis, Mo., U.S.A. H. F. Jurgens.

"The Modern Practice of Coal Mining," by Daniel Burns and George L. Kerr, is being published by Whittaker & Co. in about ten parts, price 2s. each net. Part II deals with explosives and blastings, and transmission of power. There are numerous illustrations.

Competition for Aeroplane Models.—At the Munich Exhibition to be held this year there is to be a prize competition for models of aeroplanes. This has been arranged by the Sports Committee of the Exhibition, with the co-operation of the Munich Aerial Navigation Club. The area of the planes of the competing models must not be less than 1 square metre or more than 2 square metres, and the total weight at least 0·5 kilogramme per square metre. No restrictions are placed on the weight of models provided with motors. Trials will be held, for which also several regulations have been laid down. Names must be entered by March 1st, 1908. Further particulars may be obtained by application to the offices of the Sports Committee, Neuhauserstrasse 10, Munich, Bavaria.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* The Model Engineer, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[18,624] **Wimshurst Machines.** W. B. (Beith) writes: I thank you for your letter of the 18th inst., sending me on the back numbers of The Model Engineer, and you handbook No. 18. This latter book I got to guide me in the making of a Wimshurst machine for ordinary static experiments, but it does not give any guidance as to largest spark length of machine required for the various experiments. Will you be so kind as to tell me what size of Wimshurst machine I should make for ordinary static experiments as described in the above book, also spark length required. If you could give me this information it would greatly oblige me. I presume when making the machine that both plates revolve in opposite directions. I hope that I am not troubling you too much, and shall be greatly obliged if you can tell me what size of machine to make—that is, give the size of plates, to be suitable for the ordinary static experiments. I enclose you a cutting I have taken from a paper, in which you will see that it says that the dynamo pressure was raised from 200 volts to 750 volts. Could this actually be done, taking into consideration the circumstances. I should be glad of your reply on this point. You gave me dates of three back numbers with descriptions of Wimshurst machines. Can you tell me if any of these are descriptions of small sized machines, such as I should require. I shall be very much obliged if you can let me have the information as asked above. I want the Wimshurst machine to be as small as possible consistent with giving the required results.

In reply to your enquiry *re* Wimshurst machine, you will find descriptions given in the issues we previously referred to will give all the information you need. Another very good description with illustrations of an usual size Wimshurst will be found in Bottone's "Electrical Instrument Making," price 3s. 3d., post free. With regard to the cutting you enclose, the most probable way in which the voltage was raised to 750 was by means of a rotary converter but as no particulars are given it is merely a matter of conjecture.

[18,769] **Boiler for 1-in. by 2-in. Engine.** W. H. H. (East Grinstead) writes: As a reader of your valuable paper, The Model Engineer, I am writing to ask you to be kind enough to give me sketch and dimensions for a vertical boiler to drive horizontal engine; cylinder, 1-in. bore, 2-in. stroke. I wish to drive a small dynamo (10 volts 1 amp.) with above. I intend using gas firing, so will you please give me (1) drawings and dimensions for a suitable boiler? (2) Would you recommend one central tube or multitubular, and how many tubes? (3) What pressure would it work at with safety? (4) At how many revolutions per minute should I have to run dynamo to get above results? Size of flywheel, 5¼ ins. and size of dynamo pulley, ⅞ in.

You will find particulars of a suitable boiler in our handbook "Model Boiler Making," revised edition. Your engine will run at approximately 800 r.p.m., and according to the size of the flywheel you must arrange your drive to the dynamo, which should run at 2,600 r.p.m. Assuming you have 5-in. flywheel on engine, the dynamo pulley would have to be approximately 1⅝ ins. to give you the required number of revolutions a minute. A vertical multitubular boiler of 12 ins. diameter by 24 ins. high, with 11 ins. height of firebox, and twelve 1-in. tubes; plates, 3-16ths in. thickness, would also meet your requirements.

[18,823] **Cleaning Primus Burners.** E. J. S. (Bromyard) writes: Kindly inform me what (and what strength of same) is used in which to boil the "hot brass head" of a petroleum torch or of a Primus burner. I believe a deposit is in time formed on the inside, which lessens its efficiency.

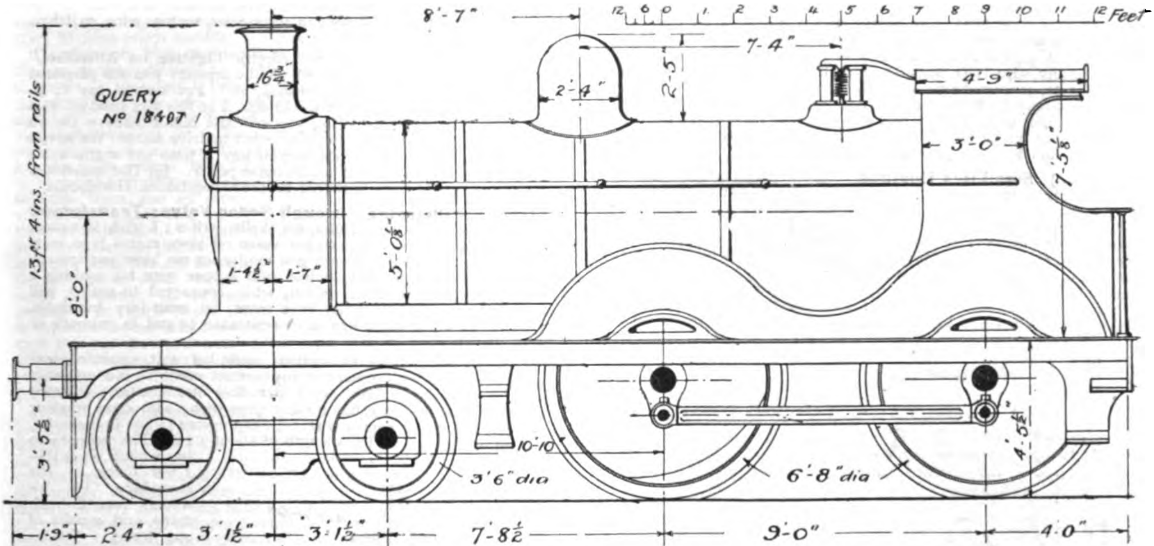
You should use sulphuric acid, dilute, for pickling your Primus burner, one of acid to ten of water. The solution may be boiled for a matter of 10 minutes whilst the burner is in it. We published some particulars on this subject in our issue for Oct. 1st, 1903.

[18,407] **S. E. & C. R. Express Locomotive, No. 735.** J. H. R. (Eltham, Kent) writes: I shall be glad if you will give a scale drawing of one of the S.E. & C.R. latest express passenger engines, No. 735, etc.

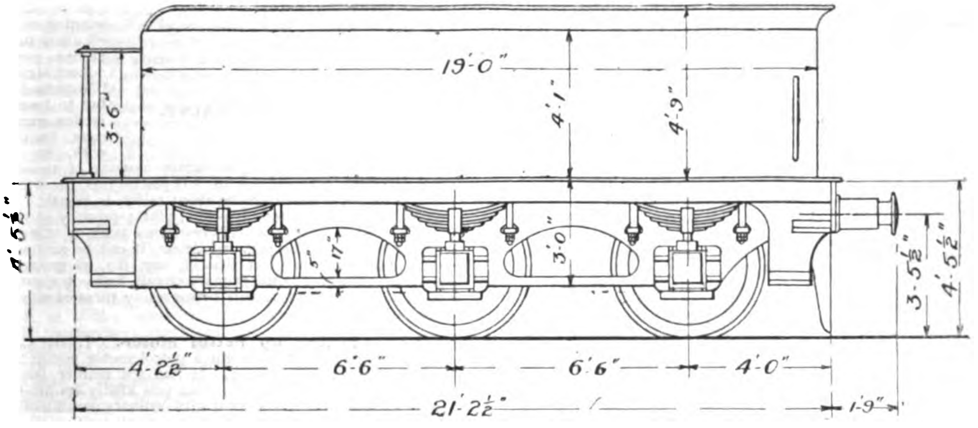
We append herewith a drawing of engine No. 735 S.E. & C.R. to a scale of ½ in. to the foot. In the matter of frame and motion details many of the drawings of the Caledonian Railway locomotive contained in Vols. IV and V should be found useful where a 3½-in. gauge model is desired.

[18,612] **Partial Failure of 4-Pole Motor.** J. B. (Bedford) writes: I should be greatly obliged if you can help me out of the following trouble. Enclosed you will find a sketch of a small model 4-pole motor (not reproduced) with armature of the 8-slot drum type, wound with 2 ozs. of No. 20 D.C.C. wire, connected to an 8-part commutator, cross connected so that two brushes are enough. The poles are wound with about 1½ ozs. of No. 16 D.C.C. wire on each limb, connected up in series with armature. Now, I cannot get this motor to work. I have gone carefully through all the parts, but cannot find anything that can account for this. The dimensions were copied from a book and were supposed to take about 12 amps. 4 volts. Do you think the winding is suitable for this? If not, can you give me the size and amount of wire for fields so as to use the same armature? The carcase of motor is of soft cast iron of good quality. What is your opinion of cross connecting armatures? Is it better to use four brushes? I have cross connected commutator with fine silk wire. Is this sufficient, or should it be done with the same size as winding?

We think the fault probably lies in the very high resistance on your cross connections to the brushes. These should be of ample size and capable of carrying the full current the motor takes. Your winding appears to be fairly correct, and we should advise you to try a higher voltage. Also you should make sure that the source of supply is capable of giving the required current. If you are using accumulators, it is possible that they are not sufficiently large to discharge at the rate required. This would account in a great measure for the partial failure of your motor. Some information on 4-pole motors is to be found in our handbook—"Small Electric Motors," and also in the Query columns of back numbers of THE MODEL ENGINEER.



S.E. & C.R., No. 735 CLASS, 4—4—0 TYPE EXPRESS LOCOMOTIVE. (*Scale: ½ in. to the foot.*)



TENDER FOR S.E & C.R. LOCOMOTIVE.

[18,539] **Installing Small Lighting Plant.** W. G. (Bowes Park, N.) writes: I intend fitting up my house with an electric lighting plant (lighting from accumulators charged with gas engine and dynamo), and I shall be obliged if you will be good enough to give me the following information—(1) The dynamo I think of purchasing is the "Colonial," giving 20 volts 5 amps. at 3,200 revs. Is this make reliable to run for, say twelve hours at a time; or, do you recommend any other? (2) What horse-power gas engine shall I require to drive above, and what do you recommend? (3) I shall use 16-volt 1-amp. 16 c.-p. Osram lamps. What gauge

wire shall I use for mains? (I should never want more than five-sixths lamps on at one time.) (4) Also what gauge for branch feeding four, two, and one lamp? (5) With reference to insurance. For such a low voltage, will it be necessary to conform with fire office regulations — such as (*a*) requiring fuseboard and cut-outs for every branch circuit; (*b*) requiring casing and capping when running wires under floors? Will not one main cut-out do on the switchboard in the former case, and fixing wires to joists with staple, in the latter? (6) Still considering low voltage, am I bound to inform Board of Trade and let them test installation?

(1) **Yes.** (2) Not less than ½ b.h.-p. And we wish to impress upon you, whatever firm you go to for your gas engine, *do not buy one without* obtaining a *guarantee in writing* that it will give its rated brake horse-power for continuous work. If, after this warning, you get hold of an engine that is not up to its work, we think you will have no one to blame but yourself. A cheap, low-priced gas engine is invariably a bad bargain in the long run. (3) See any wire table, such as given in Electrical Pocket Books. (4) The gauge must be such as will carry the maximum likely current that may be flowing in the respective branches at any time. (5) It would be advisable to have the fact mentioned in your policy; but we do not think any special requirements in the way of insulation are necessary cr demanded. (6) No.

[18,820] **Small Gas Engines.** J. T. (Elgin) writes: Would you kindly answer the following queries *re* gas engine conversion. I bought castings for engine, but found they were of the atmospheric type, with air-cooled cylinder, and I would like it to work on the Otto cycle, with compression stroke. I enclose the directions I received with castings, and drawing (Fig. 1) is about one-third full size of my engine, which is said to be ¼ b.h.-p. I would like engine to drive a 30-watt dynamo, Kapp type, as Fig. 11 in your Handbook, No. 10, which I have made, and which works splendidly, only I had to wind armature with No. 22 wire to get it

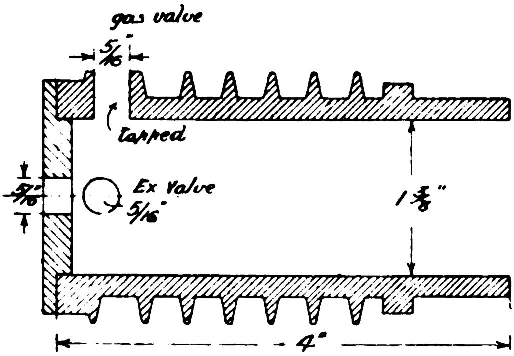


Fig. 1.—Section through Gas Engine Cylinder.

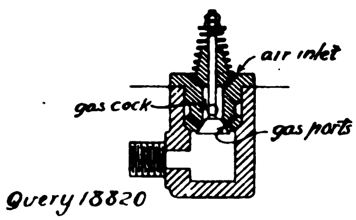


Fig. 2.—Gas and Air Valve.

to excite itself. The leading dimensions of engine are—cylinder, 1⅝-in. bore by 2½-in. stroke; cylinder walls are 3-16ths in. thick, with seven radiating ribs, and are 4 ins. long. I can get ⅜-in. compression space with piston right back. Would this be enough? The holes are all drilled and tapped 5-16ths in. in places shown in drawing. Would this do, or would they need enlarging; if so, kindly give sizes? Would inlet valve made as full-sized drawing enclosed suit; if so, could you give sizes of air and gas ports, also size of exhaust valve and pipe. Could you give drawing of suitable ignition, with dimensions? Does ⅛-in. gas barrel mean ⅛-in. bore? Flywheels are 7 ins. diameter and 2¼ lbs. each—4½ lbs. total; would they be heavy enough? Would inlet valve be opened by sideshaft or by suction? Exhaust to be opened by 2 : 1 shaft.

In reply to your enquiry *re* gas engine, we think, with a little careful planning, you will be able to get your engine to run on the Otto cycle fairly satisfactorily. No estimate can be given of the power, as so much depends upon several unknown factors. The only means of arriving at this is to actually make a test of the engine when it is finished. You should make your exhaust valve and port much larger if you possibly can—⅜ in. would not be too large; the same remark applies to the air and gas valve inlets. These should be not less than half the diameter of the cylinder. The gas valve, of which you enclose a full size sketch, is a little small, and it is rather liable to choke up when of such size. Provided you can ensure it always keeping perfectly clean, you would probably get enough gas through it as it is. The difficulty would be with the air supply, which we are afraid would be inadequate; you should reckon upon the total air inlet being ten times as large in area as the gas inlet. If you figure this matter out, you will find that you are considerably short as regards air aperture. You could use hot tube ignition, made of ⅛ gas barrel. One-eight gas tubing is ¼ bore. The flywheels are none too heavy for the job, but as your compression will not be high, you will probably find them sufficient; if not, you must either obtain a heavier wheel or one with a greater diameter, yet built the same way as the present. The inlet valve had better be operated by suction and the exhaust operated by the sideshaft. We think if you work on the foregoing suggestions you should turn out a passably good engine.

[18,548] **Small Lighting Plant.** H. B. (Bradford) writes: Being a new reader, and having no previous knowledge of electricity, I would deem it a favour if you would answer me the following questions—(1) I want to fix up a small lighting plant to light about eight lamps in a small workshop. I do not know what candle-power the lamps should be, but I want them the size of those you see in shop windows. (2) What kind of a dynamo would you recommend, also number of watts, voltage, amp.-hour, etc.? (3) What kind of an engine would drive the same, and what horse-power? (4) What sundries and accessories, such as wire, switches, lamps, etc., is required for above?

(1) We advise you to read "Electric Lighting for Amateurs," 7d. post free. (2) This depends on the amount you are prepared to spend, the size of your workshop, etc. For a shop, say 12 ft. by 14 ft., three 8 c.-p. lamps would do. For this you need at least a 40-watt machine, assuming you will use high-efficiency Osram lamps. (3) Engine of ⅛ b.h.-p. is needed to drive same. We advise a good gas engine, but whoever you buy it from get a guarantee in writing as to its rated brake horse-power. (4) The remainder of your questions are answered in above-mentioned Handbook.

[18,633] **Charging Through Nodon Valve; Transformer Windings.** F. A. F. (Tunbridge Wells) writes: I wish to charge some accumulators with Nodon's valve off town mains (220 volts alternating pressure). Would you kindly let me have particulars, viz., gauge and quantity of iron and copper wire for making a "hedgehog" transformer, which, when connected to mains, will give a pressure of 35 volts at 5 amps. on secondary terminals. Also please state what size lamp resistance to put in primary or main circuit.

Core to be circular in section, made of soft annealed iron wire, varnished with shellac or any enamel varnish; No. 20 gauge wire approximately, the exact size does not matter. Primary winding to be No. 23 gauge D.C.C. copper wire; secondary winding No. 17 gauge D.C.C. copper wire. Make the core 1¼ ins. in diameter, and wind the coils on for a length of about 5 ins. The primary to be wound on first—1,300 turns. The secondary to be wound over the primary, and consist of 200 turns. Insulation must be on core and between primary and secondary. The secondary voltage can be adjusted by winding on or taking off a few turns. We advise you not to adhere strictly to the "hedgehog" pattern, but to bend the projecting wires from the ends, back over the coils, so that they interlace, leaving, however, a certain amount of space to allow the heat to escape from the coils. If you do this, the wires forming the core will each require to be about 15 ins. in length. Estimated weights will then be as follows—core, 3 lbs.; primary and secondary, about 1½ lbs. of wire each. No resistance lamp or other resistance will be required in the primary circuit, it can be connected direct to the 220-volt mains. A fuse of, say, No. 28 gauge tin wire, should be connected in the primary circuit, and you must be careful not to have any short circuits between any turns of either primary or secondary coils.

[18,918] **Fitting up Petrol Motor.** J. A. C. (Newton-le-Willows) writes: I have got a petrol motor engine; cylinders 4¼ ins. diameter, 5-in. stroke. It has got neither ignition tube, sparking plug, nor vaporiser. Will you kindly let me know what will be the best design to work it with ordinary paraffin oil? I want the engine to drive a mechanic's shop; not more than about 2½ h.-p. will ever be required, usually about 1 h.-p. I think I should like to fit electrical ignition. What kind of sparking do you advise? Also size and particulars of coil, size of vaporiser, and how heated, and how near must it be placed to engine cylinder?

We advise you to purchase one of the standard makes of vaporiser or carburettor which are at present on the market. It would be better to run from petrol than from paraffin oil, and we suggest that you obtain a Longuemare carburettor, which could be obtained from any of the advertisers of such goods in our journal. For ignition we recommend the electric spark, which you could either fit up yourself or obtain ready for fitting from any firm of petrol motor engineers. Some particulars of suitable ignition devices will be found in our issue for March 29th, 1906, and also in Bottone's book "Magnetos for Automobilists," which was recently reviewed in our journal.

[18,755] **Windings for Step-down Transformer.** J. S. B. (Johannesburg) writes: Would you kindly oblige me with particulars of a small step-down transformer which I wish to make. We are supplied with single-phase alternating current at 200 volts, 50 cycles. I intend having a variety of tappings from the secondary to obtain various voltages. The largest requirement will be for a small hand-feed arc lamp about 50 volts, 5 to 6 amps.; the smallest output will be about 15 volts 2 amps. I will have to use soft iron wire for the core, as ring stampings are not obtainable here. Would you tell me (1) gauge and number of turns for primary, (2) gauge and number of turns for secondary, (3) dimensions for iron wire core? (4) Will the 20-watt Simplex type of dynamo, as described in handbook No. 10, run from alternating current as a rotary converter to charge cells, if two slip rings are connected to opposite commutator segments? Would the winding as given for 10 volts 2 amps. be suitable, or would you advise a different winding? I would like it to start without much trouble.

Transformer: ring core made of soft iron wire varnished, about No. 20 gauge; dimensions, 6 ins. outside diameter, 4 ins. inside diameter, 2 ins. deep. Primary winding, 1,100 turns of No. 21 gauge D.C.C. copper wire; secondary winding, 200 turns of No. 16 gauge D.C.C. copper wire, to give 40 volts, as this will be ample for an alternating current arc. The windings are at the rate of five turns per volt, so you can from this determine where to tap the secondary for any volts desired, thus for 15 volts tap at 75 turns. Primary to be wound on first and secondary on top of primary; insulation between them also on core. If you do not obtain exactly the voltage you want, wind on a few more or take off a few secondary turns as adjustment. Approximate weights—core, 6 lbs.; primary and secondary, 2½ lbs. each. Use a wire resistance, say half an ohm, in series with the arc to steady it, say 3 or 4 yds. No. 16 gauge German silver wire. Mount the transformers so that heat can easily get away. *Re* dynamo as converter; you may succeed in getting it to run, but you would have to run the armature up to synchronous speed before switching on the alternating current. The ratio between the continuous and alternating current sides would be approximately 75 alternating to 100 continuous. With the 10-volt winding you should, therefore, apply alternating current at about 7 volts. Speed would be 3,000 r.p.m. for any winding.

[18,806] **Apprenticeship.** R. B. (Hanwell, W.) writes: I want to try and get into Yarrow's as a pupil under Scheme B, which, as perhaps you know, means that I must pass an examination in the following subjects: arithmetic and mensuration; algebra (to quadratics); trigonometry (to solution of triangles); logarithms; elementary mechanics, heat and electricity; machine drawing; Euclid. Now I am 18, and have been for three years in my father's nursery, which I do not like, having always had a decided taste for engineering, and at school (a good private one) was always strong on mathematics. Having told you these facts, I should be very much obliged if you would answer the following queries for me as fully as possible. I have looked through THE MODEL ENGINEER for the last eight volumes, which I have taken in, but cannot find any query that answers them. (1) Would the four years' pupilage that I should serve be counted the same as apprenticeship mentioned in the Board of Trade examination regulations? (2) Is the examination a stiff one? (3) Do you know where I could get more particulars, such as recent papers? (4) Can you give me a list of the most suitable books and publishers for the different subjects for home study? (5) Do you think that Yarrow's would suit me as well as any other, or do you know of a more suitable one? I wish to become a marine engineer. With regard to one or two things about THE MODEL ENGINEER, I think it would save a deal of trouble if you published the prices in the "News of the Trade" column. Also I should like to see a complete index of THE MODEL ENGINEER published in either one or two volumes, as one often remembers having seen a good wrinkle on the job being done, but with not the ghost of an idea in which volume to look for it. And I think an article or series of articles on the best way to enter the different engineering and kindred professions would be very acceptable.

You will have seen that by now that we have had a series of articles on the subject you write about; we also enclose a list of books, some of which we have marked and which will be particularly useful to you. We regret that we have no details of the papers set at the examination referred to, nor do we know that they are obtainable by the public. Probably the firm of engineers you speak about could supply you with further details. It is, of course, a thoroughly good firm, and on this account they have many more applications from apprentices than they can possibly deal with, but there is no reason why you should not make an attempt to get it. The Board of Trade make certain allowances for time served in any engineering works such as these as a pupil, and you will find full particulars if you obtain "The Rules and Regulations relating to the Examination of Engineers in the Mercantile Marine," 7d. post free, from Messrs. Eyre and Spottiswoode, East Harding Street, Fleet Street, London, E.C.

[18,818]. **Electric Alarm Clock.** R. A. (Hindley Green writes: Will you kindly oblige me with a sketch of an electric contact for electric alarm clock to fit on hour shaft?

You will find an article on "Electric Alarm Clock" in our issue for December 1st, Vol. 7, to which please refer.

[18,902] **Re-magnetising Magnets.** C. F. (Cardiff) writes: I shall esteem it a great favour if you will advise me as to the best method of re-magnetising magnets from magnetos for electric ignition.

The process for re-magnetising consists of winding a number of turns of wire round your magnets and passing a current through these coils. The resistance of the wire should be such that it will allow a fairly heavy current to flow, and also you must look to your battery or source of supply and make sure that it is capable of supplying the amperes which the coil will take. You must also, of course, ascertain that the direction or flow of current in the coil is such as to assist the polarity of the magnets as at present formed, otherwise you will have to demagnetise your magnets entirely, change their polarity, and again magnetise them, which would be useless waste of power.

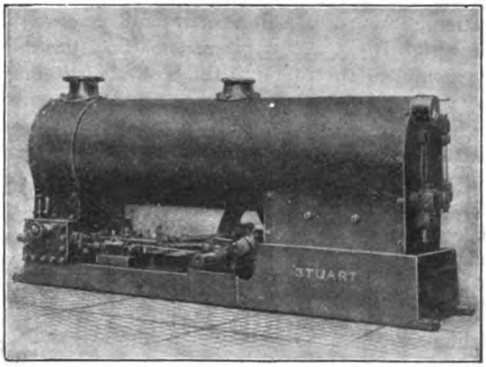
The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

* *Reviews distinguished by an asterisk have been based on actual Editorial Inspection of the goods noticed.*

The "M.E." Undertype Model.

We have received from Messrs. Stuart Turner, Ltd., Shiplake, Henley-on-Thames, the accompanying photograph of one of the *M.E.* undertype steam engines built from a set of their castings. We have previously reported very favourably on the quality of



THE "M.E." UNDERTYPE ENGINE BUILT BY MESSRS. STUART TURNER, LTD.

these castings, and the illustration shows how well they make up. They are supplied complete with all copper and brass tubes, and sheet and rod metal necessary to complete the model at a very reasonable price.

*A Grease Remover.

We have recently tested the merits of a composition known as "Gre-solvent," which is an antiseptic paste supplied in small tins. It is claimed for "Gre-solvent" that it will remove grease, paint, tar, rust, ink, metal, and fruit stains, and we recommend it to our readers for cleaning grease and grime from their hands when leaving the workshop. "Gre-solvent" can be obtained at most cycle stores, ironmongers, tool dealers, etc.

*Pocket Steel Rule.

The Liverpool Castings and Tool Supply Co. have sent us a specimen of one of their specialities in the form of a 4-in. steel rule, suitable for the waistcoat pocket. It is divided on one edge into inches—16ths, 32nds, and 64ths—and on the other edge are metric measurements.

New Catalogues and Lists.

H. G. Kingston, Tokenhouse Yard, High Street, Putney, have informed us on a leaflet that they are producing a new small power governed gas engine. Particulars will be sent to interested readers upon application to the above address.

The Universal Tool Supply Co., 24-26, Holborn, London, E.C.—From this firm we have received a list comprising a variety of measures, tapes and rules, calliper gauges, feeler gauges, centre gauges, engineers' steel squares, calipers, &c. The list will be sent to readers of this journal post free upon application.

The Editor's Page.

REFERRING to the subject of special discounts we have received the following letter from Mr. F. R. Welsman (Vice-Chairman of the Society of Model Engineers):—" Having read the letter from Messrs. Stuart Turner, Ltd., in your issue of the 6th inst., I shall be glad if you can spare space for the following remarks. It appears from their letter that they were quite ready to give the members of the S.M.E. a trade discount, but wished to impose certain conditions. These were considered by the Committee, who decided they were unworkable, and so informed your correspondent. It looks to me that having let their opportunity go by they now desire to raise the question of discounts as being open to abuse and, in so doing, lose sight of the fact that their offer would have come under the same ban (if such really exists). Surely, Messrs. Stuart Turner must be aware that in all trades special discounts have been in existence for years to large Societies, Clubs, etc., and personally I think rightly so, as the power such Societies have of recommendation (one of the best advertisements any firm can have) together with the amount of trade they bring to the firms so recommended fully entitle them to such discounts. I should like to add that Messrs. Stuart Turner's reference to the 'Societies intentions, etc.', to say the least, is a little out of place, and that the S.M.E. are the best judges of what is likely to be to their interests."

* * *

The Hon. Secretary of the Clapham Steam and Sailing Club sends the following invitation to our readers:—" We are holding our second annual exhibition of models on Friday and Saturday, the 6th and 7th March, at our head-quarters, Alexandra Hotel, Clapham Common. If any of your readers care to give us a look in on those dates we shall be very pleased to see them. The exhibition will be held in the Concert Hall and will be open on Friday from 3 o'clock to 11 o'clock, and on Saturday from 2 p.m. until 11 p.m. We can promise a very good collection of craft, as last year (our first year of existence) we were able to muster over thirty steamers and twenty sailing craft. This year we hope to materially increase these numbers."

Answers to Correspondents.

T. D. (Whitchurch).—We will endeavour to deal with your letter as soon as possible.

F. R. (Stratford-on-Avon).—No sketch was sent with your letter.

THOS. B. (Glasgow).—We could not obtain this for you under one guinea.

W. B. (Clapham Junction).—Whitney's or Thompson's; 20-watt size.

A. J. M. (Muswell Hill).—Yes, same gauge.

W. HALL (Sheffield).—Your letter has been returned to us as " Gone away." (1) Steam ports, 9-16ths or ⅝ by 5-32nds; exhaust, 9-16ths or ⅝ by 5-16ths; lap of valve, 3-32nds in.; port bar, 5-32nds in. wide. (2) Depends on the stuffing-box sizes and on the design of the crosshead. (3) Not a complete design. (4) The largest size engine we would recommend would be 1¼ by 1¾. It would drive such an engine at about 300 r.p.m. under load. With induced draught and everything in the best order and with a superheater formed by coiling the steam pipe in the large central tube, the boiler would no doubt run the engine mentioned above at light load.

" JUPITER."—James Webb, of Church Street, Bloxwich, would supply you with these castings. Use accumulator as large as possible. Its weight will be the limiting factor.

W. G. (Coatbridge).—Wind armature with 5½ ozs. No. 24 S.W.G., and fields with 2½ lbs. No. 25 S.W.G. The horse-power required would not be less than ⅛.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 26–29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

Sole Agents for United States, Canada, and Mexico: Spon and Chamberlain, 123, Liberty Street, New York, U.S.A., to whom all subscriptions from these countries should be addressed.

Contents.

[*The asterisk (*) denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

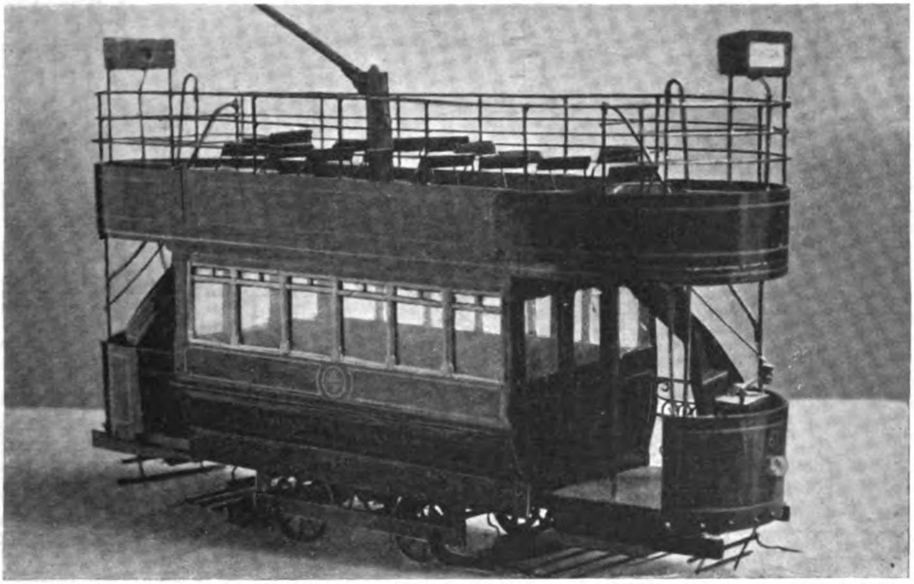
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 357. FEBRUARY 27, 1908. PUBLISHED WEEKLY.

A Model Electric Tramcar.

By ERNEST JONES.



MR. ERNEST JONES' MODEL ELECTRIC TRAMCAR.

THE model electric tramcar shown above is the result of my spare time labours during recent months when not working at my daily occupation, viz., on the electric tramcars at Stalybridge. The over-all dimensions of the car are: Length, 22 ins.; width, 7 ins.; height, 14 ins. The model is driven by means of a small electromotor (tripolar) with self-starting armature, the diameter of which is ¾ in. The motor drives on to one of the axles through a reducing arrangement of small spur wheels. Electric lamps are fitted up for lighting the car. Necessary current for driving and lighting is obtained from two 4-volt 20 amp.-hour accumulators. An automatic reversing switch is fitted under one end of the car, by which the car can be reversed at any point of the track. Two controllers are fitted, one for the lamps, of which there are four (4-volts each), connected in two circuits of 8 volts in series. The other controller, with handle showing in the photograph, controls the motor. Sliding doors are fitted; these are constructed of 3-32nds in. iron. If made of wood and they were broken, there would be no way of replacing them. The trolley beam is 14 ins. long, and will turn in either direction, and the tension will lift about 4 ozs. The truck is of iron and attached to the car body by four screws. Each of the eighteen windows is a separate piece of glass. The backs of the seats on the top are made reversible.

Design for a Cheap Sensitive Drilling Machine.

By "TWIST DRILL."

PROBABLY there is nothing that causes more vexation to the enthusiastic votaries of model engineering than to find their work has been practically spoiled during the drilling thoroughly convinced that a vertical high-speed drilling machine of the sensitive type is the exact tool required for small and delicate work.

Briefly described it is as follows: The machine is designed to bolt to a lathe bed at the extreme right hand (which is seldom used). Motion is given to the drill spindle from the overhead gear by a cord passing around the adjustable guide-pulleys, and thence to the spindle pulley. The work is fed to the drill by the lifting table; the

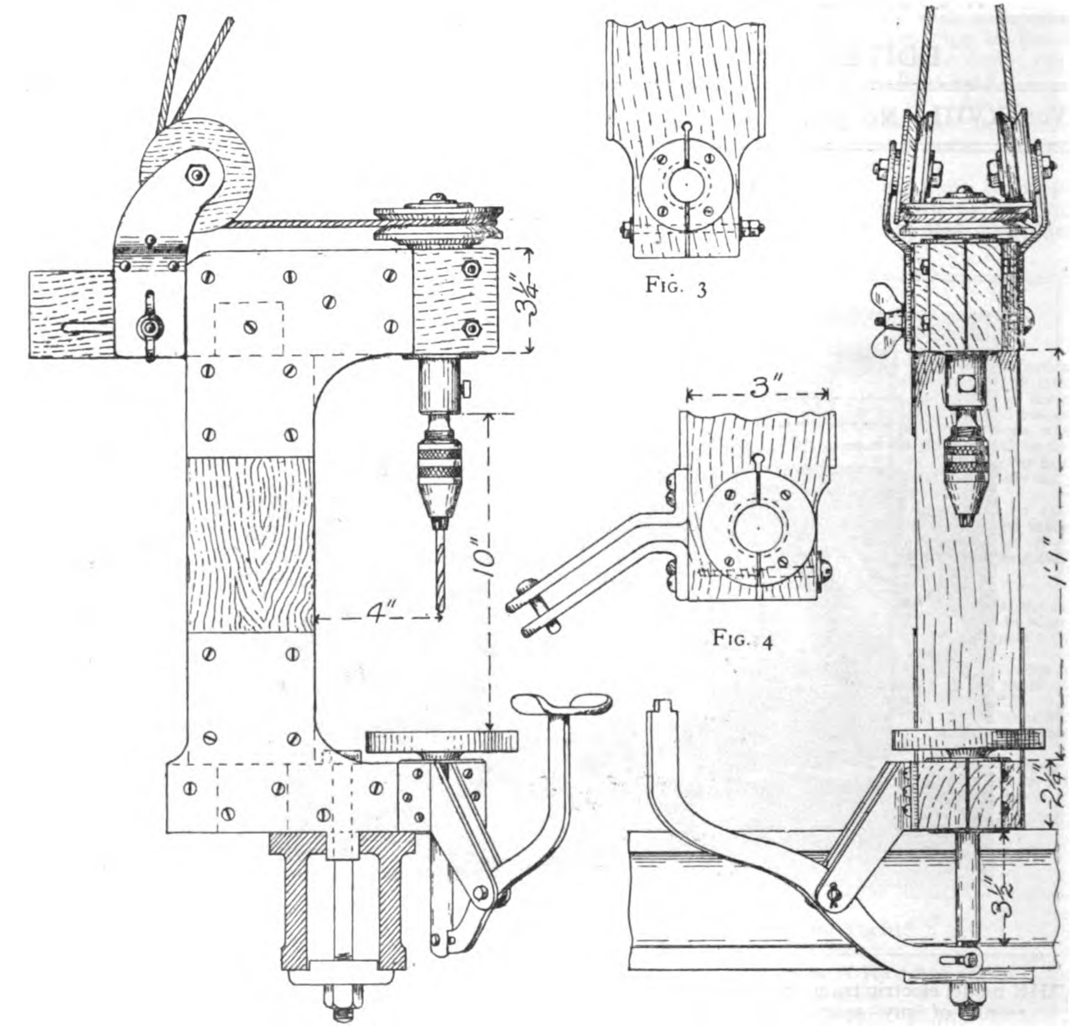


FIG. 1.—SIDE ELEVATION OF SENSITIVE DRILLING MACHINE. FIG. 2.—FRONT VIEW.
FIG. 3.—PLAN OF PULLEY BEARING. FIG. 4.—PLAN OF LEVER BRACKETS AND TABLE SHANK BEARING.

operation. While the possession of a lathe is considered an absolute necessity if one is to be successful in model making, it is quite inadequate to cope in a satisfactory manner with the numerous small and accurate holes that are required, unless fitted with elaborate and expensive attachments. The writer has gone through many little difficulties personally, and the experience so gained left him

latter has a travel of 3½ ins., and is lifted by the elbow lever. The elbow end of the left fore-arm rests upon the lever, and a slight pressure downwards lifts the table towards the drill; the high speed of the latter induces rapid cutting without apparently much effort upon the feed-lever, and frequent raising and lowering of the table while drilling fine holes automatically clears them of chips; both hands are thus free to hold and lubricate the work. Thin material is supported upon parallel blocks of wood or metal, so as to bring it nearer the drill; thick work is bolted

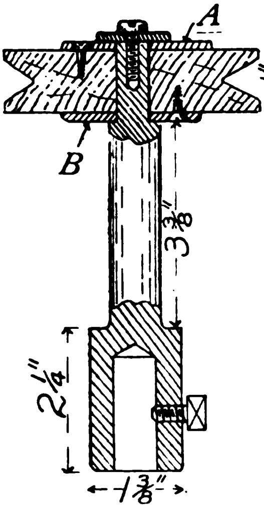


FIG. 5.—DETAIL OF DRILL SPINDLE.

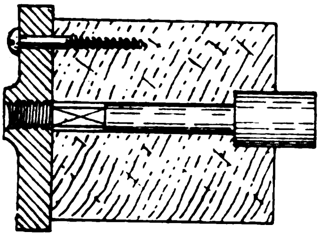


FIG. 6.—CHUCKING SPINDLE.

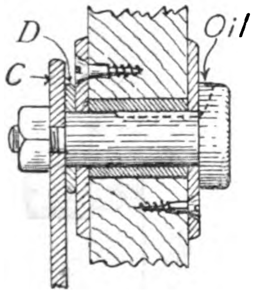


FIG. 7. ENLARGED DETAIL OF GUIDE-PULLEY.

direct to the table; and shallow metal parts that require accurately drilled holes are supported in a parallel vice. The latter is arranged with a slewing and traversing movement, thus enabling differently spaced holes in the work to be brought under the drill point at one setting in the vice.

In designing the machine, the restrictions imposed on the home-worker have been fully borne in mind, and, where possible, wood has been introduced and the easiest methods devised; even then, for the machine to be a success, the best efforts of the amateur toolmaker must be devoted to its construction. The chief difficulty, and one that must be surmounted, is to get the spindle at right angles to the plane of table; this, however, will be described as we go along.

The wood for the frame should be of thoroughly seasoned beech or hornbeam, or some very old sound oak; then we shall have no troubles from shrinking or warping. The centre upright is 1 ft. 4½ ins. long by 3 ins. by 4 ins; these sizes are finished ones; cut the stuff somewhat larger. The lower arm is 10 ins. by 3 ins. by 2½ ins.; top arm, 1 ft. 3 ins. by 3 ins. by 3¼ ins. First plane up the top and bottom faces of both arms; the faces must be parallel and left well over thickness as yet. Now square off lines on the arms to represent where the shoulder of the upright will eventually come when it is mortised to them. This gives us a starting point. Assuming the sides and ends of stuff are practically square with top and bottom faces and still a little over size, take the marking gauge and set a centre line on the arms. On this line measure off 4 ins. This will be the position for the holes for drill spindle bush and table bush respectively. The bushes are solid-drawn mandrel brass tubing. The spindle bush will have a ⅝-in. internal diameter and a probable ¾-in. outer diameter; while the table bush will be ¾ in. internal and ⅞ in. external. It will be advisable to make sure of the outer sizes before boring holes in the wood. Being assured of these the holes may be bored of such a size as to enable the bushes to lightly tap in with a mallet. It must be remembered that upon the squareness of these holes to their respective faces and to each arm, the accuracy of the machine entirely depends; therefore, it would fully repay one for his trouble if the pieces were taken to a machine joinery to get the holes bored by machine. If this course is not practicable, bore the holes in the usual way; then pass a well-fitting straight rod through it; try the straight-edge on the sides of arms (the latter being laid horizontally on the bench) to see if the holes are parallel with side. If the hole proves out when tried with calipers between straight-edge and rod, then plane the side to suit the hole next by the square-stock on the centre line of underface, with the blade coinciding with the rod in the hole, and plane the bottom face to suit this reading and at the same time square or at right angles with the sides that have previously been trued. This method should bring the stuff at sides parallel with the hole and top and bottom at right angles

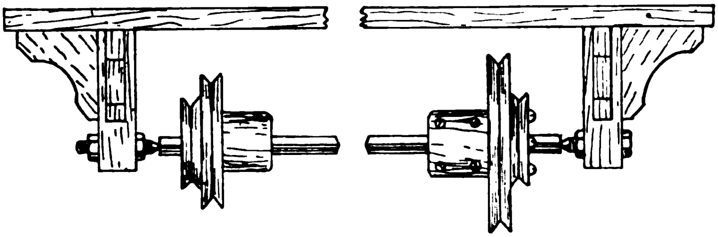


FIG. 9.—OVERHEAD GEAR.

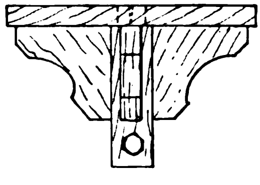


FIG. 10.—OVERHEAD GEAR.

with it. Form the stub tenon on upright and mortise to suit in the upper arm, also the tenon and mortise on lower end. Cramp them tightly together, and again insert the ¾-in. and ⅞-in. rods in their respective holes. Try the straight-edge on the ⅞-in. rod—both at the side and front. If the holes are parallel, there should be a parallel space at any point along the ¾-in. rod between the straight-edge of 1-16th in. Should, however, one side show ⅛ in., and the opposite be *nil*, this would pass. All that is required is that the holes should be in parallel, and not necessarily concentric; dered down and riveted to side plate. (See Figs. 1 and 2 for these plates.) Cut the slot in the tail-end of top arm for the adjusting bolt to slide in. Next make a fine cut longitudinally through the hole in the top arm, as shown in Fig. 3, and make two adjusting bolts from 3-16ths-in. wire. Make two split washers from 1-16th-in. iron plate for the double purpose of retaining the bush and affording a surface for the thrust of drill spindle socket and surface of pulley on top. The brass tubular bush has a single longitudinal sawcut down the whole length of one side. This cut should coincide with

FIG. 13.—END VIEW, WITH VICE BLOCKS REMOVED.

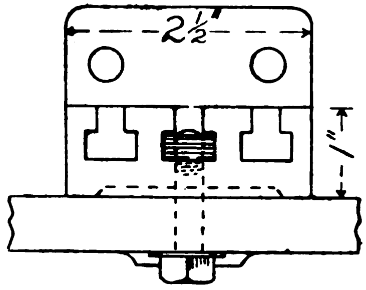
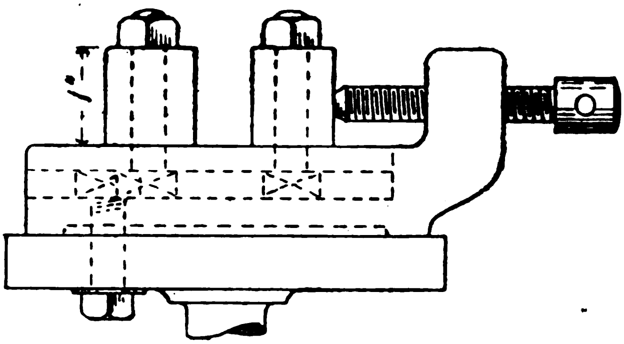


FIG. 12.—SIDE VIEW.



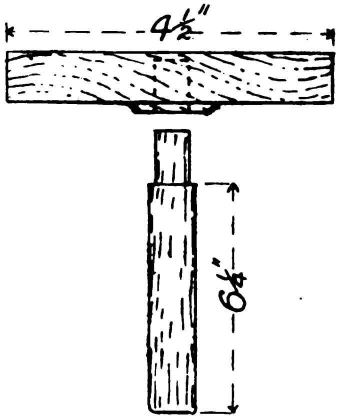


FIG. 8.—PATTERN IN WOOD FOR TABLE.

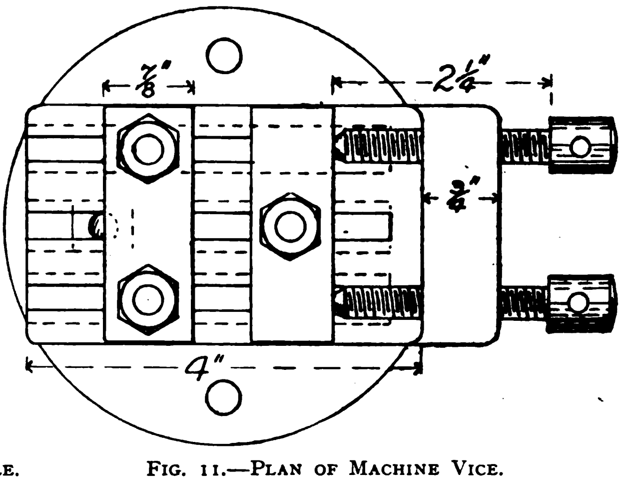


FIG. 11.—PLAN OF MACHINE VICE.

any slight alteration can be made at the shoulders of the upright to set the arms over, if required. Cramp up again between the faceplate of lathe and a block of wood between poppit centre. Try the rods again to make sure if all is right, wedge up bottom, and fox-wedge top stub tenon; squeeze up in lathe centre again, plane off sides of arms and uprights flush, cut out the side plates from 1-16th-in. thick iron plate, drill and countersink holes for screws. The lower plate has the tenon formed on it to fit between sheers of lathe bed.

Next cut the guide-pulley brackets from 1-12th-in. plate; cut and bend to shape, drill holes for adjusting bolt 5-16ths in. diameter, also the three holes immediately above ¼ in. diameter, to receive the three distance-rods of 3-16ths-in. iron wire shoul-

the cut on the arm; then the action of tightening up the 3-16ths-in. bolts will be to squeeze in the bush, and thus make up for wear.

The tube must be held between soft wood clamps while operating on it in the vice, so as not to cause any indentations or otherwise squeeze it out of its cylindrical form. The clamps are blocks of soft pine hollowed with the gouge to fit the cylindrical surface of the tube. After filing the ends of tube square and making the sawcuts, carefully remove the burrs with a small half-round smooth file; next turn up a hard wood mandrel for each tube, which should fit them easily; run the mandrels between lathe centres, oil them, and sprinkle on No. 1 or F emery-powder. Now enter the bush on the mandrel or lap, as it is usually called, run the lathe at top speed, slide the bush to and fro constantly to prevent the emery grooving, ; give them a quarter of an hour of this treatment ; finally, clean out with paraffin oil. The result should be a nice smooth bore, to which there should be no trouble on turning the spindle and table shank to fit.

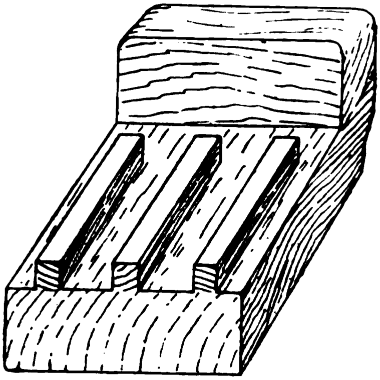


FIG. 14.—PERSPECTIVE VIEW OF PATTERN.

Fig. 4 shows a similar arrangement for the table bush and also the plan shape of the feed-lever brackets; these are made from ¼-in. plate, and fixed with wood screws, as shown. From fulcrum pin in brackets to centre of table is about 5 ins., and from fulcrum to elbow-plate is 10 ins. Bend

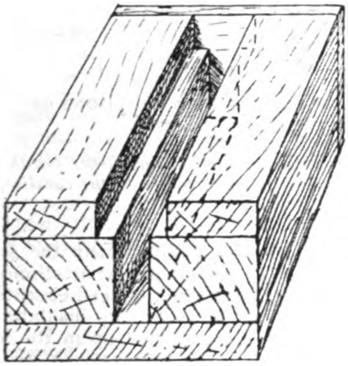


FIG. 15.—VIEW OF T-CORE BOX.

a piece of ¼-in. wire to the proposed shape of lever, and get it forged to templet. The elbow-plate is omitted in Fig. 2, which reveals the method of fixing it to lever; the length of slot in the lower end can be obtained by trial.

Turning now to Fig. 5, where the drill spindle and pulley is shown, get a piece of round iron or mild steel, have it forged down to ¾ in. for 4½ ins. of its length, and let the remaining 2½ ins. be 1½ ins. dia. Centre and true up in the lathe, file a square on the top end to receive the square hole washers which are attached to beechwood pulley of 4 ins. diameter, and drill and tap a hole in square end for the retaining washer and screw. Bore the hole in the spindle for the drill chuck shank—a chuck from a breast drill may be utilised. Messrs. Nurse & Co. list a good self-centreing chuck with, I believe, ½-in. shank, for 6s. 6d. If a bell or other chuck is not available on the lathe, get a block of hard wood and firmly secure it to the faceplate with stout screws; then bore the wood with an internal wood-boring tool fixed in the slide-rest to receive the spindle. The latter should drive in tightly (see Fig. 6). Drill a small hole the required depth, and open out with successive drills, and finish with a boring tool. Make the hole a good fit for the shank of drill chuck; drill and tap setscrew hole.

Fig. 7 shows enlarged part section of guide-pulley. The letters H represent the bracket, I loose washer, J the oilway (cut with a small round-nose gauge and shown by dotted lines). These pulleys are brass-tube bushed; the bushes are, of course, solid. The sideplate washers retain the bush and afford a hard metallic wearing surface.

The pattern for table is indicated at Fig. 8; for moulding purposes the shank is made a detachable easy fit. The overhead gear is of the most simple construction; it is shown by Figs. 9 and 10. It may be fixed either to the wall or the ceiling. The left-hand pulleys are driven from the lathe flywheel and the right-hand drives the drilling machine.

The machine parallel vice (shown in plan and elevations, Figs. 11 to 13) is a most useful adjunct. The body of the vice is provided with three T-slots; these receive the T-headed bolts for securing the jaws; the latter can be moved about to suit irregular shaped work. The vice is attached to the circular table of machine by a bolt passed up and screwing into a square nut in the centre slot; by loosening the bolt the vice may be moved in the direction of the slot or transversely, that is, slewing motion. Thus, supposing a piece of work—say an engine cylinder—were gripped in the vice by virtue of the two motions first described, any hole could be brought to the drill point without releasing its setting in the jaws, and, if necessary, the table bolt could be secured upon drilling each hole, rendering its running from the drill well-nigh impossible, and ensuring all the holes being drilled in the same vertical plane.

A perspective view of the pattern in wood for moulding from is shown at Fig. 14. The three fillets shown are "prints" for locating the position in the sand and supporting the cores for the T-slots to be formed in the metal. Strips of ⅛-in. by ½-in. wide stuff should be bedded on the bottom of pattern to form facing strips in the metal and so reduce the surface to be filed.

The construction of the box in which the moulder makes the T-cores is shown in perspective at Fig. 15. The top is left open. The front end is shown removed for the sake of clearness. The depth of T is the depth of slot in the metal plus the depth of print in the pattern. The patterns are made from yellow pine; they should have a smooth finish and also a slight taper, to ensure clean delivery from the sand. The shank of table pattern should be smaller at the lower end, while the vice pattern will be moulded in a two-part mould. The core prints and lug for vice screws will be downwards in lower half of mould, therefore the taper must be in that direction; while the base of vice will be in the upper part of mould, and must taper towards facing strips accordingly. When the castings are received, remove the sand and scale from them on a large grindstone; then file the top and bottom faces parallel. The scale can also be ground from circular table before it is centred and turned in the lathe.

Chats on Model Locomotives.

By H. Greenly.

(*Continued from page* 155.)

Electric Locomotives: Collector Gears and Wiring Diagrams.

ONE of the chief features in the construction of a model electrically-driven locomotive is the design and arrangement of the collector shoes which pick up the current from the insulated "third" rail. Two brushes are, of course, required in every case where points and crossings have to be negotiated by the locomotive, as at these portions of the track the mechanical continuity of the conductor rail must, of necessity, be broken. The distance apart of the brushes is an important item, and to make sure that contact is not interrupted, they should not be less than about the scale equivalent of 20 ft. apart. That is:—

1¾-in. gauge = 7½ ins. apart.
2-in. „ = 9 „
2½-in. „ = 10 „
3½-in. „ = 14 „

If desired, in the case of a tender locomotive one collector may be placed on the tender and the other on the engine. This will necessitate a flexible connection between engine and tender, and cause a little more trouble in disconnecting the two vehicles, but the longest broken section of "third" rail can be bridged in this way. Care should be taken in arranging collectors to place them on the locomotive in such a way that the lateral displacement on the curved portions of the line does not cause the collector to leave the "third" rail. It would be obviously unwise to put the collector on the front buffer beam of a 4—4—0 or 4—4—2 type locomotive, as on a sharp curve the sort of thing shown in the diagram (Fig. 1) would be likely to happen. Therefore, if the two collectors are placed on the locomotive only, the best place for the leading one is on the bogie frame, as this part swings over with the curve and will keep the collector more nearly central with the third rail, the rear collector being placed near the trailing coupled axle, as shown in the design for the model express locomotive included in the last article.

In the design on page 41 of the issue of January 9th last, the collector is shown fixed near the centre of the locomotive, a similar one being placed on the tender.

Where the flow of the current through the locomotive is from the insulated conductor rail, *via* the collectors to the motor, returning from thence through the frames of the engine and wheels to the running rails and back to the battery or other source of power, the collector gear must be electrically insulated from the frames of the locomotive. At the same time any frail form of fixing must be avoided, as collectors come in for a certain amount of rough usage. The simplest method is to fix a block or bar of fibre to the frames of the locomotive, either across them (as shown in Fig. 41 in the issue of January 9th) or on the face. This block may be bored to suit a piece of brass tube, the plunger of the collector sliding in this tube, as shown in the sketch, and the leads being affixed to the spindle.

As the circular type of collector offers some advantages, in that they do not wear in grooves, more perfect freedom to rotate may be provided by tapping a stud through the fibre so that it makes electrical contact with the brass sleeve, as shown in Fig. 3. Where the "leads" are attached to the spindle of the collector, as indicated in Fig. 2, of course only a limited amount of rotation is possible.

In the design illustrated in the last article the collector gear consists of strong gun-metal bracket castings, with plunger and circular shoe—the rear collector being fixed to a lug cast on the buffer beam, and the one on the bogie to the face of the vertical web joining the two side frames of the bogie. Details to full size are included herewith, and it will be noticed the insulation is mainly effected by strips of vulcanised fibre, with washers of the same material to insulate the fixing screws, which, being tapped into the frames of the engine, are in electrical contact with the rail returns. To prevent the screwheads piercing the insulating washers, brass or steel washers should be inserted under the heads of the screws. The holes in the brass brackets should be full large, and a piece of fibre tube—or, if this is not obtainable, a section of cycle valve

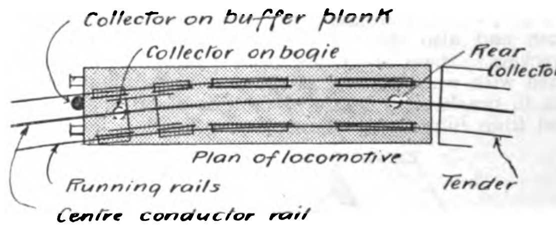


Fig. 1.—Showing Best Positions of Collector Shoes.

(*Note.—If the shoe is placed on the buffer plank of a bogie engine it is likely to leave the conductor rail when on a curve.*)

rubber tube—may be used to prevent the screw touching the collector bracket and short-circuiting the wiring system. Of course, flanged ebonite or vulcanite bushes may be used to insulate the screws, these bushes being turned up in the lathe out of rod material. The connections to the collectors may be fixed to any convenient position on the bracket casting, care being taken to prevent any fixing screws or terminal nuts coming in contact with the frame of the locomotive.

The standard distance of the conductor rail above the running rail has been fixed at 5-32nds in., and it is important that at points and crossings the collectors should not drop so low as to touch the running rails, as not only is damage to the collector likely to ensue, but every time the collector touches the running rails the main current will be short-circuited. Therefore, the two nuts on the top of the plunger spindle should be adjusted so that the fall of the plunger below the normal position is restricted to 1-16th in., or at the most 3-32nds in. The collectors will then always clear the running rails by at least 1-16th in., and no short-circuiting will occur. Double nuts are used to provide against the loosening of the fixing by vibration.

In wiring the motor to the collectors it will be found most convenient in electrically driven models of steam locomotives to cross-connect the two collectors by a single rubber-covered wire and to take a "lead," preferably from the fixed portion of the collector, or, where there is one on the engine and one on the tender, from a fixed point —the engine collector to the motor or automatic reverser, as the case may be.

On the design for the model electric locomotive which formed the coloured plate for the first issue

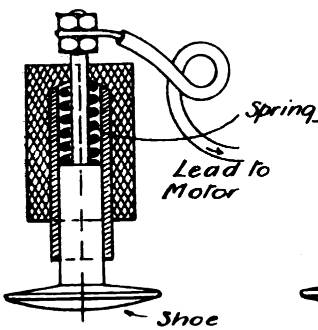


FIG. 2.—COLLECTOR FIXED IN FIBRE BLOCK WITH CONNECTION TO SPINDLE.

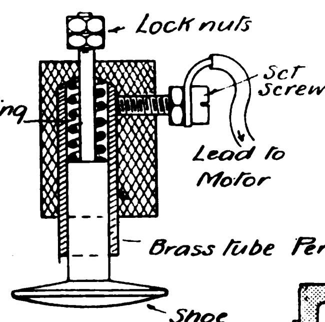


FIG. 3.—SIMILAR COLLECTOR WITH SIDE CONNECTION.

in January, 1905, roller brushes were suggested, practical experiment on a model railway working at 30 volts having shown that a slightly increased speed was obtained by fitting roller conductors in place of the ordinary sliding pattern. Later experiments with lower voltage lines, however, indicate that roller collectors are, generally speaking, not so good, as they pick up dirt and in time the roller becomes more or less coated with a film of insulating material which offers a resistance to the flow of the current to the motor.

The "return" current from the motor is generally conducted through the frames, axle-boxes, axles, and wheels of the locomotive to the running rails,

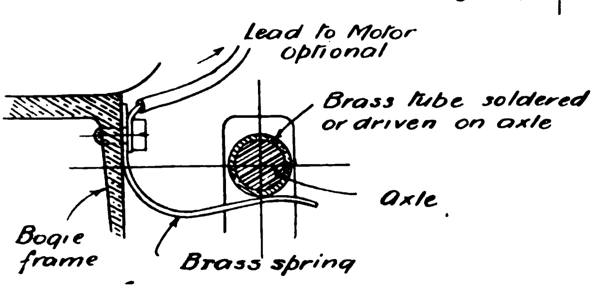


FIG. 4.—BRUSH GEAR ON AXLE FOR "RETURN" CURRENT TO RAILS.

and thence back to the accumulator or battery, one of the armature brushes usually being in short-circuit with the motor. Therefore, the path of the current is through the screws which fix the motor in position in the boiler barrel, and from thence through the frames, etc., as mentioned above. Where there is any indication of excessive resistance to the flow of the "return" current (owing perhaps to grease and oil in the bearings), brushes may be used to conduct it directly to the axles, say about two out of the total number, in addition to the path through the frames and axle-boxes.

These brushes should not be made to rub on the tyres of the wheels, as was suggested some years ago in these pages, as my personal experience of this method proved that a brush lightly pressing on the tyre made considerable noise and, in a small locomotive, there was an appreciable addition to the travelling resistance of the model. I would advise, therefore, a light brass or copper brush rubbing on the axle, either direct on the axle or with a brass slip ring, as shown in the accompanying sketch Fig. 4, intervening.

The connections required for the various systems are comparatively simple—except perhaps where an automatic reverser is used, and even then the connections are not so highly complicated in the actual

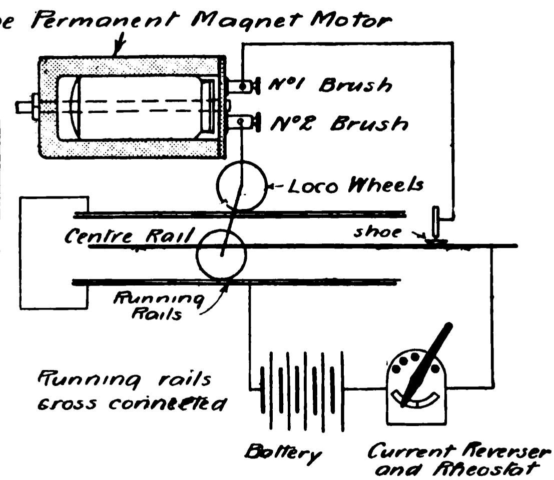


FIG. 6.—DIAGRAM OF CONNECTIONS FOR PERMANENT MAGNET MOTOR.

instrument, as sent out, as would appear from the diagrams.

In the case of permanent magnet motors the running rails should be connected to one end of the battery of accumulators, and the frame of the locomotive to one of the armature brushes of the motor. The other brush terminal should be wired to the current collectors. Between the "third" rail and the battery a variable resistance switch and simple current reversing switch are required, as shown in the diagram of connection (Fig.6), so that both the direction of travel and speed of the loco. may be controlled from a convenient point.

With reference to the accumulator system—that is, the system in which the fields are excited from a separate source to the armature—it is always the best policy to supply the fields with a constant current, and for speed control to work the armature from the rails through the medium of a resistance switch in the usual way.

It would not appear that the requirements of traction work are fulfilled where an accumulator on board the locomotive is used for working the armature and the current for the fields is supplied from the rails. As accumulators, bulk for bulk, have less total capacity the greater the voltage—*i.e.*, the larger the number of cellular divisions and sets of plates, the voltage chosen should be much lower than the voltage of the armature where accumulators are employed to work the field-magnets. For instance, the ratio used may be 2 to 4 or 6, and, in large motors, 4 to 8 or 12.

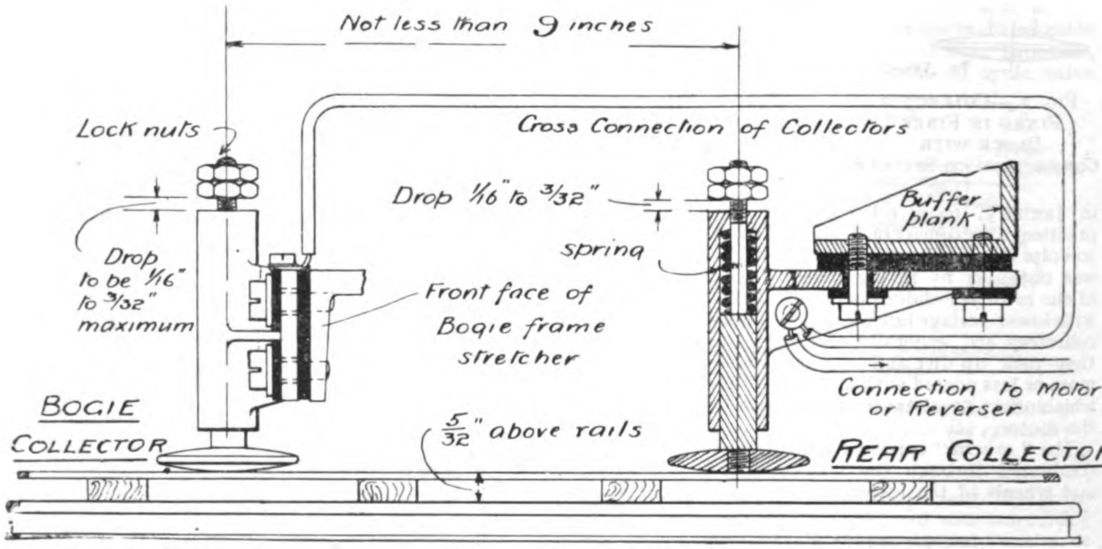
Of course, there is a certain amount of waste with the separately excited or accumulator systems of automatic reversing, as the field current is always flowing, but where only one engine is employed, it is certain to be in pretty constant use. There is not much in this objection, as even the automatic reverser uses a certain small amount of current in the shunt circuit all the time the engine is at work. The chief objection to the separately excited system is the difficulty in getting horizontal accumulators sufficiently low to go in the tenders of small models, and the fact that small portable accumulators are messy things.

the field current when the supply of current to the rails—and therefore to the armature—ceases. With careful workmanship, no doubt this could be done with a consumption of not more than ½ amp. at 10 volts. A diagram is shown in Fig. 8. For the four-rail method, I would refer readers to the articles in the issues of THE MODEL ENGINEER for January 1st and 15th, 1902 (Vol. VI).

(To be continued.)

ON Sunday, January 19th, a trial run was made over the electrified section of the Lancaster-Heysham-Morecambe line between Heysham and Torrisholme Junction. This is (says the *Engineer*) the first time a train has been run in Great Britain on the single-phase system. The trial was completely successful.

THE Boston Elevated Railway has distributed to its workpeople £12,000 in the shape of rewards



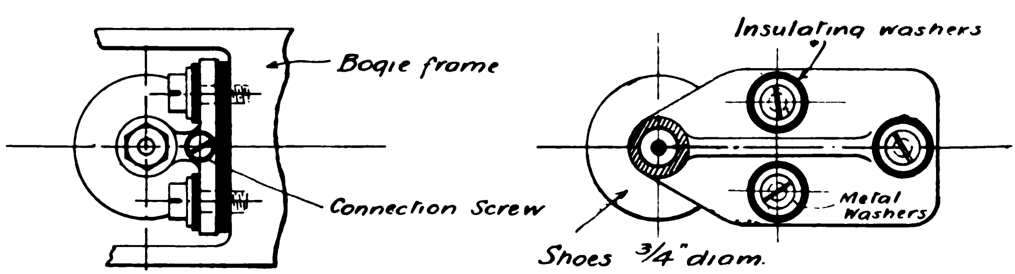


FIG. 5.—DETAILS OF CURRENT COLLECTORS FOR MODEL QUICK GAUGE 4-4-0 TYPE ELECTRICALLY-DRIVEN EXPRESS LOCOMOTIVE.

(See Issue of February 13th, 1907).

With regard to the waste due to the constant flow of the field current, a part of this could be saved by a small magnetic relay switch, which, when the armature circuit is closed also closes the field circuit, a spring being used to shut off

of £3 each to those who during the past year have not been reported for delinquency or misconduct. It is said that this year 85 per cent. of the men received the rewards. This is the fifth time the Company has made New Year gifts of this kind.

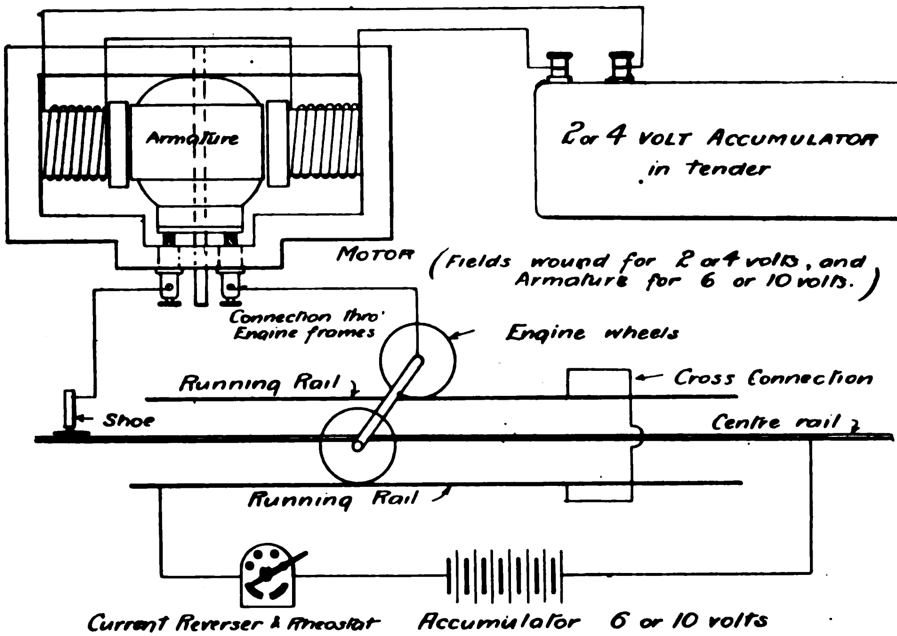


FIG. 7.—DIAGRAM OF CONNECTIONS FOR ACCUMULATOR SYSTEMS OF AUTOMATIC CONTROL FOR MODEL ELECTRIC LOCOMOTIVES.

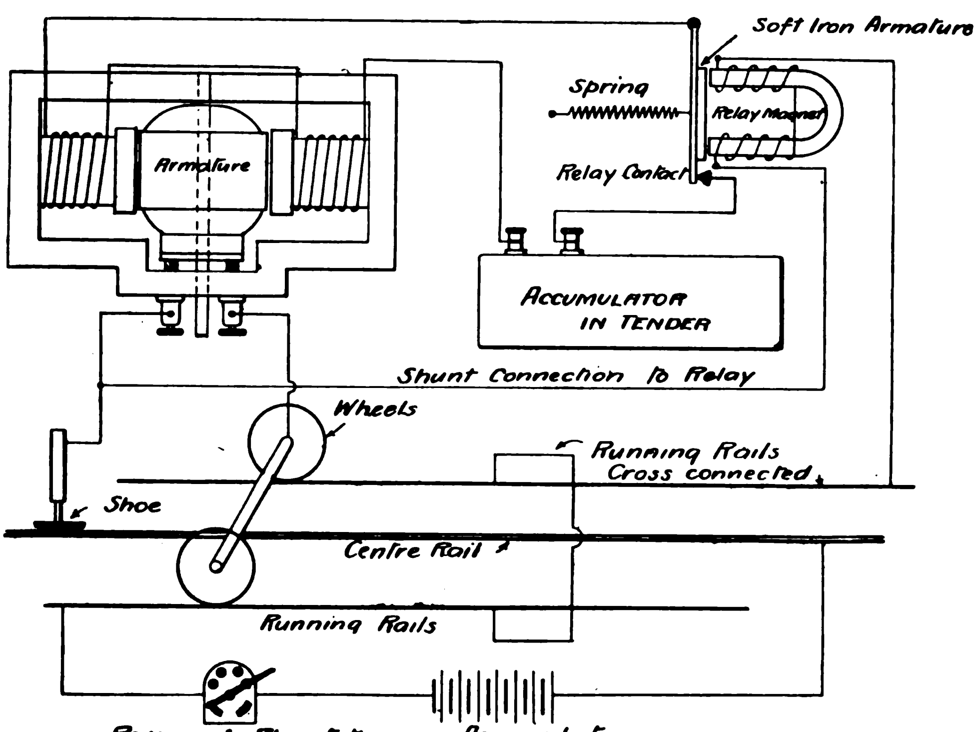


FIG. 8.—DIAGRAM OF CONNECTIONS FOR ACCUMULATOR SYSTEMS OF AUTOMATIC CONTROL WITH SUGGESTED RELAY SWITCH FOR SAVING THE FIELD CURRENTS WHEN LOCOMOTIVE IS NOT WORKING.

Recent Developments in X-Ray Apparatus.

(*Continued from page* 174.)

MESSRS. SIEMENS make an interesting horse-gear dynamo as one solution of the problem of driving a dynamo for charging accumulators in places where engine power is not available. The photographs—reproduced by their kind permission from their catalogue album—show clearly the arrangement. At the bottom right-hand corner of the framework is the dynamo, of circular pattern. A bevel wheel upon the vertical spindle speeds up a bevel pinion upon the first horizontal spindle, which transmits the motion through three successive accelerating gears to the dynamo shaft. The slow movement of the horses—reckoned at five complete revolutions per minute—is therefore multiplied at the dynamo armature, the gearing being planned so that it normally runs at 1,000 r.p.m., giving an output of 10 amps. at 30 volts. At the four bottom corners of the frame are lugs, with which it is securely held to the ground by means of screwed pegs. A covering of waterproof sail-cloth protects the dynamo and gear from dirt. The steel tubular cross-shaft is collapsible and in two portions. Other features of this exhibit were a large protective *X*-ray screen of wood and glass. The windows are fitted with lead glass and the woodwork lead-lined, so that the operator was effectively protected from *X*-rays. A protective tube stand for a similar purpose was also shown, the tube being entirely enclosed in a specially lined wood case fitted with lead glass observation windows.

Messrs. Siemens have applied the metal "Tantalum" to *X*-ray tubes, the advantages being that it has a very high melting point and disintegrates very little, if at all, even when raised to a white heat *in vacuo*. In these tubes the anti-cathode consists of a thin disc of tantalum secured by wire supports of the same metal; no cooling device is necessary, as the metal can be used at a high state of incandescence. The illustration shows the auxiliary wire by which some of the discharge can be diverted to the side chamber for the purpose of lowering the vacuum of the tube. Water cooling device to prevent incandescence of the anti-cathode can be applied, if desired.

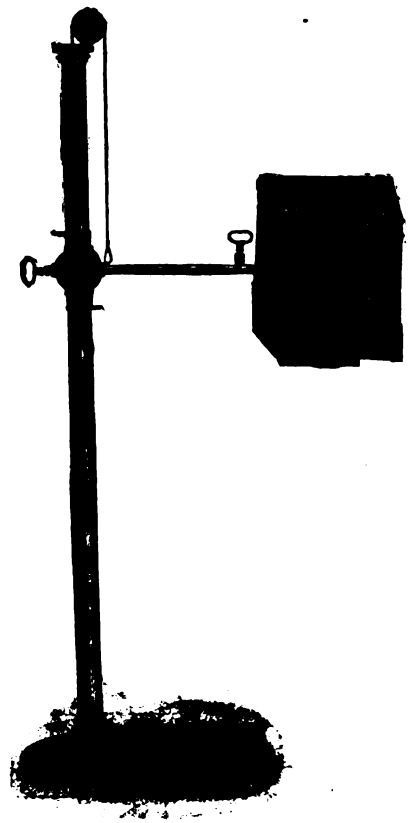


FIG. 10.—MESSRS. SIEMENS BROS.' PROTECTIVE *X*-RAY TUBE STAND.

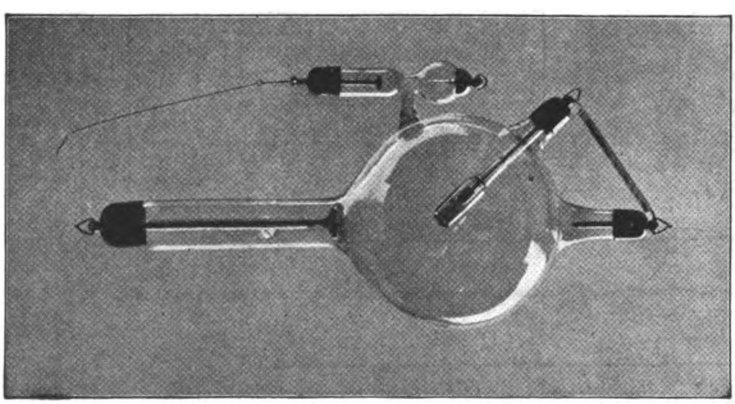


FIG. 11.—MESSRS. SIEMENS BROS.' TANTALUM *X*-RAY TUBE WITHOUT WATER-COOLING DEVICE.

Messrs. A. Favre & Co., of 21, Mincing Lane, London, E.C., exhibited "Bauer" air-cooled *X*-ray tubes on the system invented by an engineer, Mr. Henry Bauer, of Berlin. They call these tubes the Bauer *X*-ray tube "Beta." The anti-cathode is massive and of copper supported upon a glass tube, the inner surface of which is open to and cooled by the outer air. To ensure a better distribution of heat the copper is fluted upon the part of its surface near the anti-cathode or target. For the purpose of preventing reverse currents the anode consists of a hollow cylinder made smaller at each end and completely

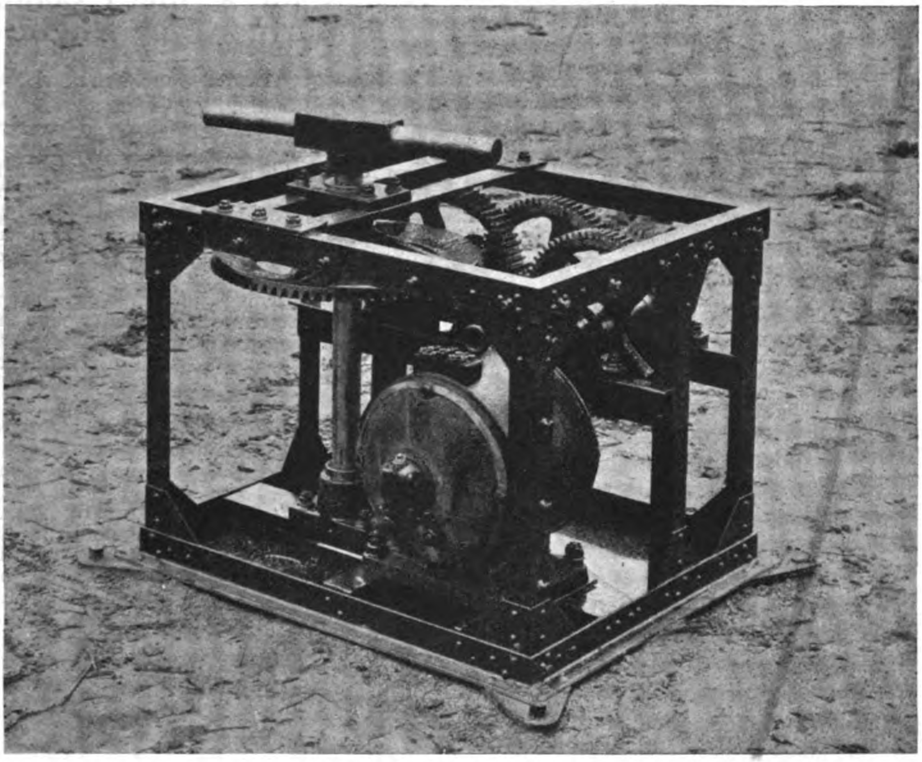


FIG. 9.—MESSRS. SIEMENS BROS.' HORSE GEAR DYNAMO, SHOWING ARRANGEMENT OF DYNAMO AND GEAR WHEELS.

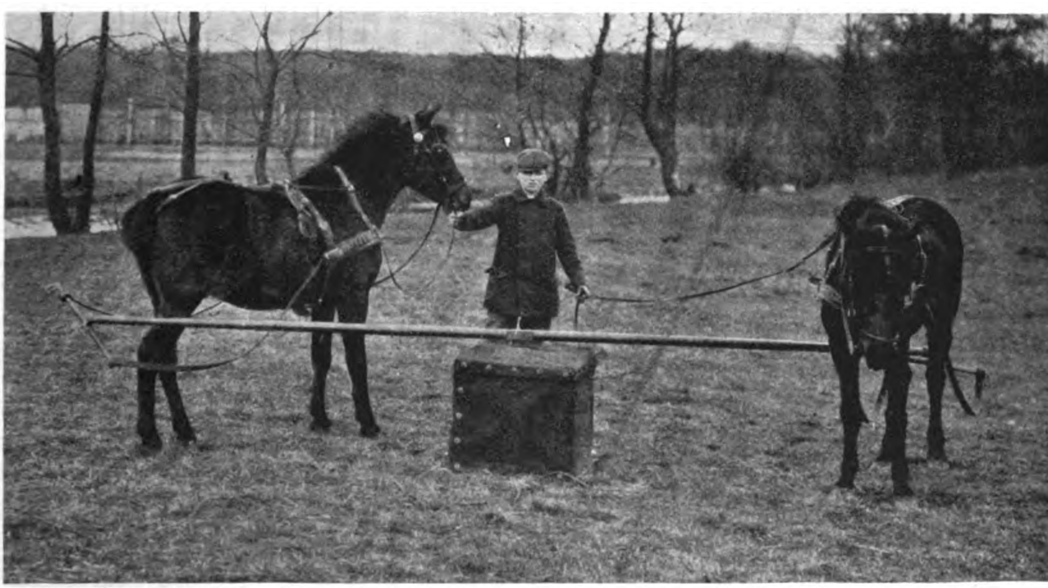


FIG. 8.—MESSRS. SIEMENS BROS.' HORSE GEAR DYNAMO.

surrounded by glass; this excludes the formation of cathode rays. The anti-cathode is not connected directly to the anode, but. through a spark-gap. It charges itself automatically when at work, attaining a low positive potential, whereby disintegration is prevented. The charge passes when the glass walls surrounding the anode become too highly charged. When it may be advantageous to connect the anti-cathode directly to the anode in harder tubes, the connection

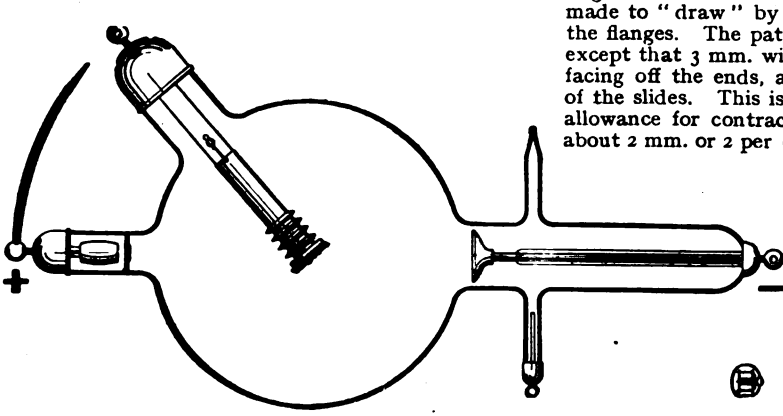


FIG. 12.—MESSRS. A. FAVRE & CO.'S "BAUER" *X*-RAY TUBE WITH AIR-COOLING DEVICE.

is made by means of a choking coil and not merely by a wire. This opposes the reverse currents by its high apparent resistance, whereas the static charge easily adjusts itself. A choking coil can be used with softer tubes, instead of a spark-gap, if desired.

(*To be continued.*)

It is stated that Mr. Müller, a Bavarian inventor, has patented a new insulating material which is claimed to have a high specific resistance approaching that of gutta-percha and porcelain, and is almost incombustible, as it will stand even exposure for a short time to the electric arc without burning. According to the patent specification, the composition of the substance is as follows:—
100 parts of mineral pitch are dissolved in 20 parts of a volatile solvent—such, for example, as benzine—and from 25 to 75 parts of this solution are added to 100 parts of finely-ground asbestos. The mixture is then submitted to very great pressure, and is dried at a low temperature to expel the whole of the solvent.

A NEW electrically-propelled fire escape has been added to the equipment of the Liverpool Fire Brigade. The power for propelling and operating the escape is obtained from storage batteries located at the front of the vehicle. It has a speed capacity of 18 to 20 miles an hour, and the ladder can be extended to its extreme length of 87 ft. in about half a minute. The ladder can be turned in any direction and laid to any angle.

Design for a Small Compound Marine Type Engine.

By W. MUNCASTER.

(*Continued from page 178.*)

FOR the standards (Fig. 23) a pattern will be required. This should be made out of baywood; a stout cigar-box of good quality might be useful. The pattern would be easily made to "draw" by a little extra sandpapering of the flanges. The pattern will be exactly as shown, except that 3 mm. will be allowed in the length for facing off the ends, and about 1 mm. on the face of the slides. This is, of course, in addition to the allowance for contraction, which would amount to about 2 mm. or 2 per cent.

In place of the recess for the shoe on the crosshead a print would be fixed to the pattern, say 20 mm. wide and 16 mm. deep. A small core 20 mm. square placed in the mould in the space left by this print would form the recess required. This method is preferred to leaving any loose pieces on the pattern.

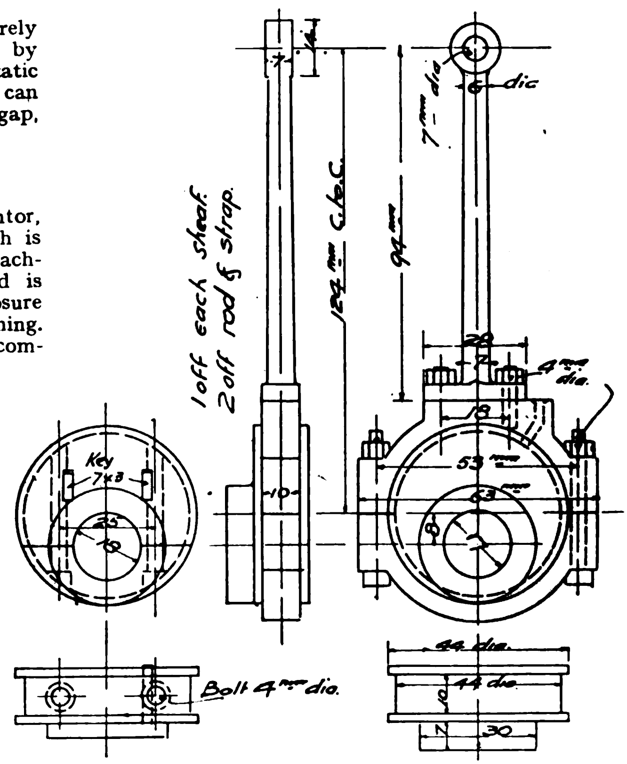


FIG. 25.—DETAILS OF ECCENTRIC AND STRAPS.

The castings will be alike for the H.-P. and the L.-P. side, and should be finished to the dimensions given on the sketch. When fitting the standards the faces for the guides should be first got up true, then the ends carefully squared to suit, after which the bolt and screw holes should be marked off and drilled. A surface plate and a good steel square. if available, will be of great service in these operations.

The glands for the piston-rods and valve-rods (Fig. 24) are of gun-metal. It is not generally necessary to make patterns for these, as they may often be turned out of scrap pieces of metal. The time spent on patterns will more than cover the extra time in taking off superfluous material.

The eccentric and strap are intended to be of cast iron. If it is preferred to make the latter of wrought iron or mild steel it may be cut out of a piece of 2½-in. by ⅜-in. flat bar, bored in the lathe and filed to shape. It will be noticed that one of the eccentrics is in halves. This is necessary, as it has to be got on the shaft between the cranks.

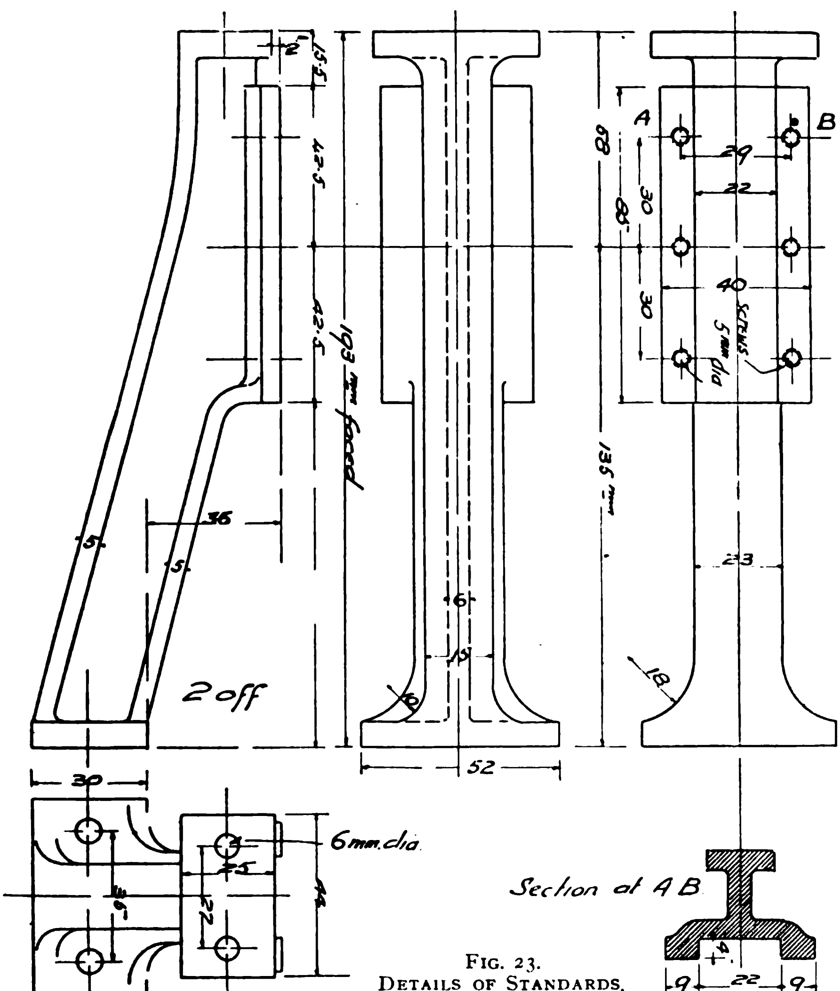


FIG. 23.
DETAILS OF STANDARDS.

The cotters (or keys) shown do not pass through a slot in the bolt, but merely lay in a recess filed on the side of the bolt. The writer has found this method satisfactory in several cases.

(*To be continued.*)

How to Become a Mechanical Engineer.

By ALFRED W. MARSHALL, M.I.Mech.E., A.M.I.E.E.

(*Concluded from page 181.*)

MESSRS. YARROW & CO., LTD., Isle of Dogs, Poplar, London, E. (removing to Glasgow), interest themselves to a marked extent in the training of young men as mechanical engineers. It is worth observing that in their regulations for the admission of pupils to their works, Messrs. Yarrow & Co. state it is their—" strong conviction that the best course of training of engineer pupils consists in spending the winter months at a university or technical college, and the summer months on practical work in the shops." This opinion, coming from such an eminent firm, is an excellent guide to a young man intending to train himself as a mechanical engineer in the full sense of the term. The following particulars abbreviated from Messrs. Yarrow & Co.'s regulations, show that the firm endeavour to put their opinions into practice by admitting pupils and apprentices to their works under a scheme of training' definitely arranged

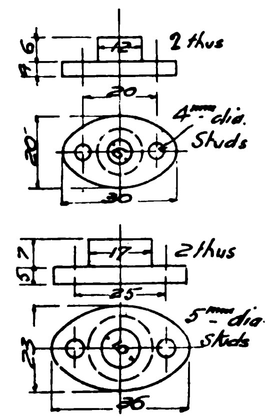


FIG. 24.—GLANDS.

to permit them acquiring combined theoretical and practical knowledge. Pupils may enter in section A, B, or C, and must give proof that their school and college career has been satisfactory as regards diligence, punctuality and general conduct. They will be required to serve three months upon trial. Under section A candidates are admitted who have obtained first-class certificates after a complete course of instruction, extending over at least three years, at an approved technical engineering college, or who have a first-class honours degree or its equivalent in an approved engineering course at a university. Candidates who have received a similar training, but have obtained lower class certificates, may submit their names if they can be strongly recommended by the professors; those who have obtained the highest honours, however, will have the preference. The time to be served is three years. Wages are paid at the rate of 20s. per week, with a yearly increase of 5s. per week. Under section B candidates are admitted who have not obtained university or technical college certificates. They must be between the ages of sixteen and nineteen years, and be examined by a competent examiner chosen by the firm in the following: arithmetic and mensuration, algebra (to quadratic equations), geometry, first four and sixth books of Euclid, theory and use of logarithms, trigonometry (up to the solution of triangles), elementary theoretical mechanics, heat and electricity, freehand and mechanical drawing. The matriculation examination of an approved university, or the school-leaving certificate of the University of London will be accepted in so far as the subjects above have been covered. The time to be served is four years. Wages are paid at 10s. per week with a yearly increase of 5s. per week. Every facility is given to pupils under this section to attend evening classes, and it is required that at least two evenings a week shall be devoted to study. Under section C pupils who enter under section B may spend the summer months of their term in practical work in the workshops, and the six or seven winter months at an approved technical engineering college, provided a complete and satisfactory course can be arranged By this means the pupil combines practice in the workshops with a university or technical college course. Whilst in the workshops the pupil is paid wages at 10s. per week, rising gradually to 30s. per week. No premium is required under any of the above schemes. Assuming a lad's school training terminates prior to his arriving at the age of 18, under section A he can get his college qualification at 21 and finish his workshop experience at 24; under scheme B he can complete his workshop time at 22; under scheme C he can finish his technical and workshop experience at 23 or 24. The firm reserve to themselves the power to modify these schemes in exceptional cases, but no personal influence will in any case be allowed to affect their decision. Apprentices enter at 16 years of age or under. Satisfactory proof must be given that during their school life they have been diligent and regular in their attendance, and are specially apt in those subjects which it is necessary for an engineer to be well acquainted with. Wages will be paid, 6s. per week for the first year, second year 8s. per week, advancing annually by 2s. per week. The apprenticeship period expires at 21 years of age. Every facility will be given to apprentices attending evening classes, and it is expected that at least two evenings a week will be devoted to study, on which evenings they will not be required to work overtime. Apprentices who show marked diligence and ability in the works and are able to pass the examination required by section B will come under the regulations which apply to pupils. No premium is required.

An illustration of some of Messrs. Yarrow and Co.'s work is given in Fig. 12, which also gives an idea of the conditions of work in a shipbuilding and marine engineering factory. The picture shows two single-screw shallow draught steamers in a partly finished state. Steam appears to be issuing from the boiler safety valves indicating that some trial of the propelling machinery is being made. These vessels are specially designed for use on shallow lakes and rivers. The length is 85 ft., beam 12 ft., depth of hull 5 ft. 6 ins. The draught, with the vessel light, but with steam up, is only 15 ins. Under these conditions a speed of about 11½ miles per hour can be obtained. If loaded with 40 tons, the draught is 3 ft. and speed about 10 miles per hour. They are made on the "Yarrow system," and can be taken to pieces in sections, sent abroad and re-erected on the site from which they are to be used. The photograph shows the method of numbering the sections so that they can be identified with drawings sent with them to facilitate putting together the various parts—an instance of the commercial part, as distinct from the scientific and constructional part of mechanical engineering.

In conclusion, reference may again be made to the report on the education and training of engineers already mentioned, as follows:—"The committee recognise that necessity will always exist for providing suitable means of training for young men who have not been able to secure a thorough training before beginning actual professional work as engineers, and 'who work their way by sheer ability and force of character.'" "The committee also recognise the certainty that other most valuable recruits for the engineering profession will continue to enter at a later period of life, and from other systems of education and employment." These eminent men, therefore, do not infer that no one can become an engineer unless he commences at a certain age and passes through a definite course of training. They have given their opinion as to the best procedure for the average boy, but admit that exceptions can and will become engineers by various ways and means.

The writer very much appreciates the kind response made by a number of mechanical engineering firms to his request for the loan of illustrations of their works. In particular to Messrs. Peckett & Sons, locomotive makers, of Bristol; Messrs. J. I. Thornycroft & Co., Ltd., marine engineers and steam vehicle makers, of London, Southampton, and Basingstoke; and Messrs. Yarrow and Co., Ltd., marine engineers, Poplar, London. Readers will quite understand that the question of space in the pages of THE MODEL ENGINEER has unavoidably influenced the selection made. The illustrations are given as fair examples oi different departments of a mechanical engineering factory, that an intending engineer will see the kind of work and surroundings amongst which his practical training will be acquired.

To the firms who have so courteously permitted publication of their regulations for admittance of pupils and apprentices to their works the writer expresses his sincere thanks. He desires to say

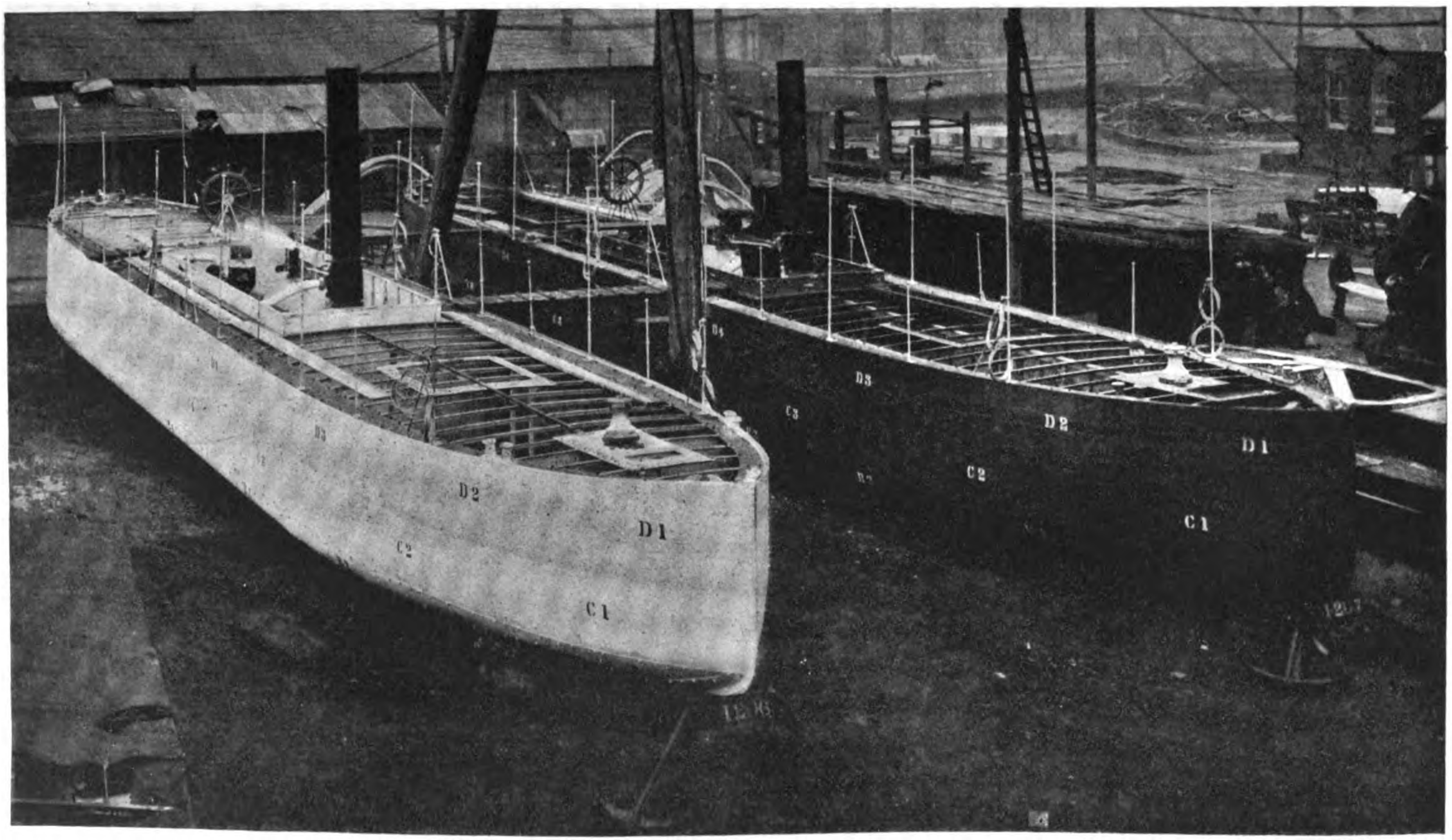


FIG. 12.—VIEW IN MESSRS. YARROW & CO.'S SHIPBUILDING YARD, POPLAR, LONDON, SHOWING SHALLOW DRAUGHT SCREW STEAMERS, "YARROW SYSTEM," DURING CONSTRUCTION.

Length 85 *feet*; *Beam*, 12 *feet*; *Depth*, 5 *feet* 6 *inches*.

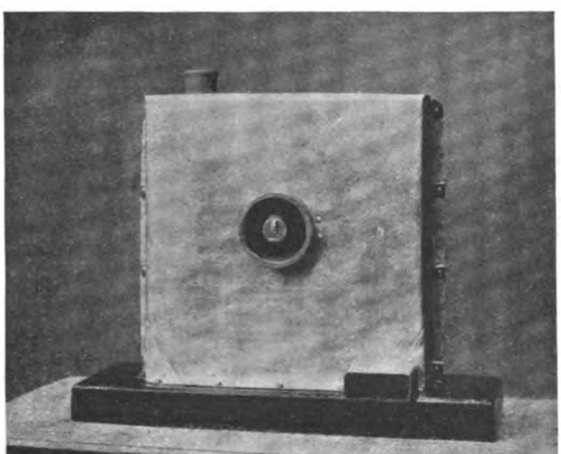
that other firms kindly forwarded particulars, but preferred that the information should not be published. To them his thanks are also due; the information has been useful in confirming the general practice at the moment regarding conditions of apprenticeship and pupilage. To the reader who decides—perhaps after some hesitation—to adopt a career in mechanical engineering, he says: "Be hopeful." There is no finality in practice—that which seems to have reached its limit to-day is altered to-morrow. Many brains are at work, and from time to time one or other conceives an invention which may create a new branch of industry. Take as your guiding star the motto of that great inventor and engineer, Sir Henry Bessemer—"Onward ever."

An Easily Constructed Water Motor.

By G. Berresford.

The motor to be described in the following article, though not of the strength and durability of one made from castings, will be found to work very satisfactorily, and be capable of a good deal of useful work. It has the recommendation of being simple in construction, and the cost is very low. With a fair water pressure a motor of this size will drive a Singer's sewing machine.

For the wheel is required a disc of galvanised iron about No. 18 wire gauge (Fig. 6), 5 ins. in diameter. This can be cut with shears or chisel to near the size



Mr. G. Berresford's Small Water Motor.

and afterwards trued up in the lathe. Two plates are needed to form a boss for the wheel. These can be made of wrought iron, and will be best turned as shown (Fig. 4 and Fig. 6 B), though if more convenient they may be cut in a triangular shape from iron 3-16ths in. thick. Bore a hole through the centre ⅛ in. or 3-16ths in., and also a hole of the same size through the centre of the disc. Place a plate in position on either side of the disc, and drive a piece of round iron a tight fit through them to keep in position whilst three rivet holes ⅛ in. diameter are being drilled. Having secured the plates with steel rivets knock the iron out of the centre and open the hole out with a ⅜-in. twisted drill, to take the shaft (Fig. 5) which is made of mild steel. The shaft should now be turned, and having keyed the wheel to it temporarily, it will form a mandrel on which to set the disc as true as possible, and turn up the edge to the finished size. The buckets are made preferably of sheet brass. No. 24 wire gauge will do cut to the shape (Fig. 8) and bent along the dotted lines into the form (Fig. 9). Divide the edge of the disc into fifteen equal parts and secure the buckets with two copper rivets each, as shown (Fig. 6). For the case, which is made in two pieces, either tinplate or zinc is used. Zinc has the advantage that it will not rust, but if zinc is used it should be somewhat thicker than tinplate. Whichever is chosen, it should not be too thin. For tinplate, No. 24 wire gauge or rather thicker, but nothing thinner should be used. Cut two pieces (Fig. 11 and 12). These are to be bent along the dotted lines to form the two halves of the case, Fig. 1. The corners C overlap ⅛ in., and are to be soldered. Also the corners D will need soldering.

In Fig. 1 A are shown eight square pieces of brass which are soldered to the case to be drilled ⅛ in. clearance in one half and tapped for ⅛ in. brass setscrews in the other half of the case. There are also two small brass plates soldered inside the top of the case, tapped for ⅛ in. setscrews to hold the top of the case which overlaps together.

The bearings will be best cast in brass as shown (Fig. 7), though it is possible to make them without castings. They are held in place by rivets, either brass or copper. The illustration shows a spout for waste water in the side of the case. If it is thought to be more convenient, it can be carried through the baseboard instead, but in any case it should not be smaller than the size given as any waste water accumulating will clog the free working of the wheel.

In Fig. 1 B, are shown plates which may be added to strengthen the corners. The water jet (Fig. 3), made of brass, has an opening ⅛ in. diameter. It should be adjusted to just clear the buckets, and is soldered in the half of the case (Fig. 11, J), and further supported by a bracket (Fig. 10) made of the same stuff as the case. The exact length can hardly be given, as the diameter of the wheel may vary from about 6½ ins. to 7 ins., according to how the buckets are set, but if the jet is made 1½ ins. from the shoulder, and bored ⅛ in. parallel for some little distance up before it widens out, it can be shortened if found necessary when the wheel is in position. A jet might be bought from some ironmongers, such as is used for a hose pipe, and adapted. The pulley is brass, and can be turned to suit individual requirements. If it should be thought desirable to build a larger motor on this principle, it will be advisable not only to use thicker material for the case, but also to solder webs across the sides of the case to give it greater rigidity. The joints between the flanges and between the case and the baseboard can be made with thin leather. Round-headed brass screws are used to secure the case to a baseboard made of ash or oak. It will be well to paint the wood to prevent it absorbing the wet, and also to paint the shaft inside the case and any other parts likely to get rusty by contact with the water.

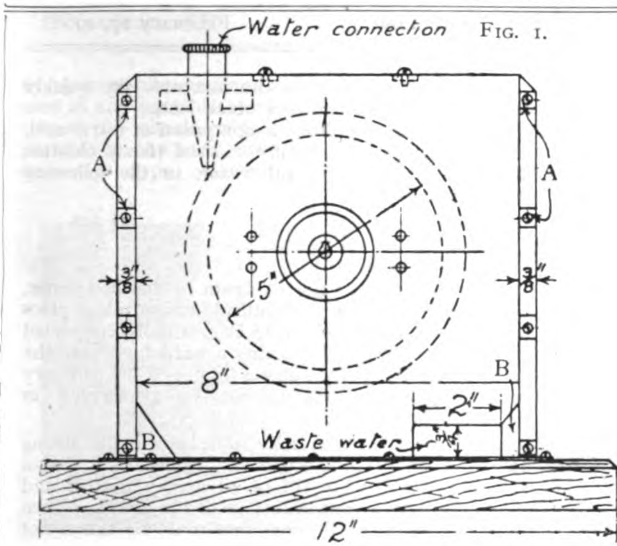


Fig. 1.

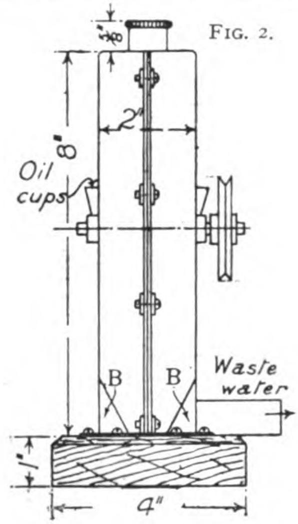


Fig. 2.

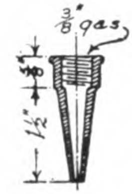


Fig. 3.
Nozzle.

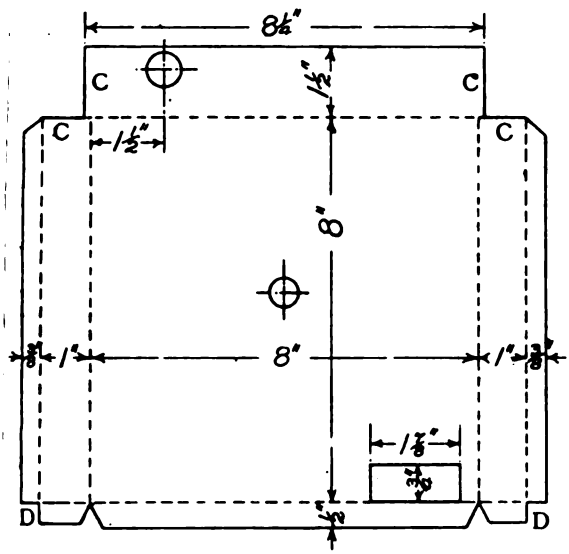


Fig. 11.

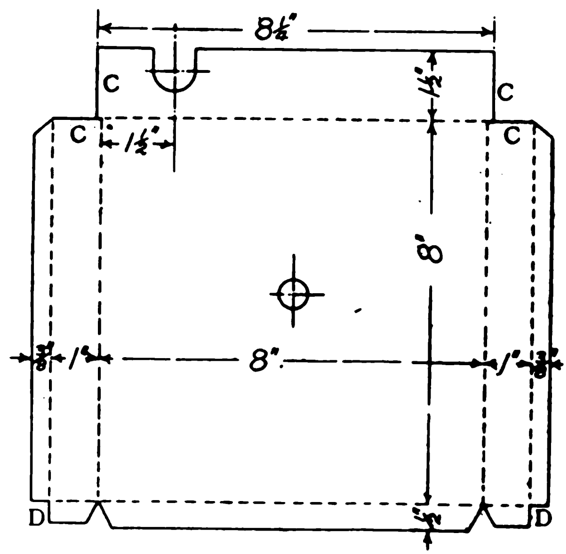


Fig. 12.

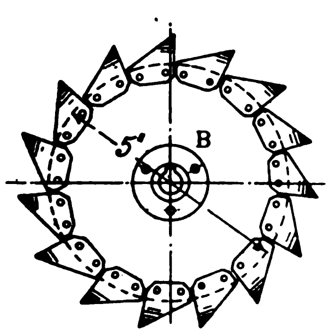


Fig. 6.

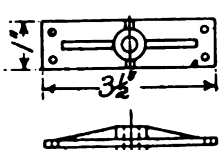


Fig. 7.

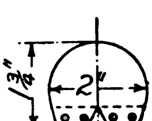


Fig. 8.

Fig. 9.

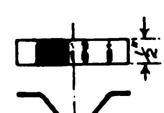


Fig. 10.

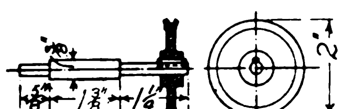


Fig. 5.

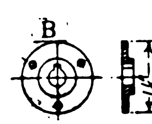


Fig. 4.

DETAILS OF CONSTRUCTION OF A SIMPLE WATER MOTOR.

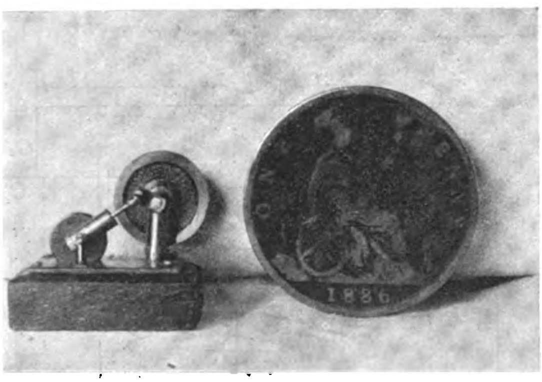
Practical Letters from our Readers.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily for publication.*]

A Miniature Oscillating Engine.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—This miniature engine took me about six weeks, in my spare time, to make. It is a single-action oscillating. The cylinder is 3-32nds-in. bore, and the stroke is just over 3-16ths in. It is all made of brass, with the exception of the piston-rod, shaft, and small pivots that the cylinder rocks on, which are of steel. The steam feed is taken from the far side of the steam block, and is



A MINIATURE OSCILLATING STEAM ENGINE. (*Actual size.*)

about 1-32nd in. diameter inside. I have had it running with 2 or 3 lbs. pressure of steam at an enormous rate, so fast that you really can't see that it is going, and the sound of it is like the hum of a fly's wing. The photograph shows it taken by the side of an ordinary penny.—Yours truly,

P. C. S.

Bronzing and Browning Gun Barrels.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—On the "Queries and Replies" page of THE MODEL ENGINEER for January 16th "W. A." asks how to brown gun barrels. The following is the method actually employed for such work.

(1) Clean the article in soda water, and afterwards rinse in clean water, or dip article in acid and then rinse in clean water.

(2) Heat the article slightly and apply "bronzing mixture" with camel's-hair brush. It consists of—

Acid (hydrochloric)	10 parts.
Arsenic (white)	3 ,,
Sulphate of copper	1 ,,
Sulphate of iron	1 ,,

Thoroughly mixed.

(3) After coating with the mixture, dry quickly and polish with brush and black lead.

The browning mixture is composed of nitric acid, methylated spirits, tincture of steel (ferric chloride dissolved in alcohol), and water, in the following proportions :—

Acid nitric	2½ ozs.
Methylated spirits	2 ,,
Steel (tincture of)	5 ,,

To be mixed with 3 pints of rain or distilled water.

During browning a chemical action takes place in which the ferric chloride is gradually converted into oxide of iron, and forms a hard layer on the outside of the metal, protecting it from ordinary rust. The operations should be performed in the following order :—

(1) Well wash the articles to be browned in strong potash water (1 lb. American potash : 1 gallon boiling water) to get rid of all greasy matter and oil which may be on the surface of the metal. Then wash in clean, hot water ; care must be taken not to touch the metal with anything greasy or even with the hands, after washing.

(2) While the article is still warm, wash in hydrochloric acid (1 part water to 1 part acid) to remove old browning and oxide ; then wash in clean water ; then thoroughly dry and polish with emery cloth.

(3) When the article is quite cold, apply the browning mixture with a piece of sponge on the end of a stick ; then let it stand for about twelve hours in a warm room. Then rub off the rust with scratch-card and brush. Care must be taken when "carding" not to rub too hard and scratch the metal, as it is only necessary to remove the rust and obtain a good surface.

(4) Apply the mixture as before, and let it stand in warm room for six hours. Repeat this night and morning for about six times.

(5) Previous to the carding the article should be immersed in boiling water for about twenty minutes, after which the rust is removed by carding and brushing, and, while still warm, coated with olive oil.

The result is that the article is "blue black" in colour called brown.—Yours truly,

"A READER."

Model Locomotive Building in India.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—From time to time I have observed in your paper letters from foreign and colonial correspondents, and have been thereby encouraged to send you some photographs of my ⅜-in. scale model Midland Railway No. 2,632.

The model has been made in my spare time during the last three years, and is not quite complete yet, as you will notice that it is not yet painted. It has, however, been through its steam trials very satisfactorily on a circular track 32 ft. in diameter. This diameter gives a length of track of almost exactly 100 ft., round which the model is able to steam in 14 seconds, the speed being thus almost exactly 5 miles an hour.

The model is very close to scale, the working plans being prepared from a fully dimensioned general arrangement plan of the original, published in *Engineering* on February 6th, 1903. The rails are laid to 3-in. gauge, being the almost exact equivalent of the standard 4 ft. 8½ in. gauge in use on British railways. The cylinders are ⅞ in. diameter by 1½-in. stroke, and are built up, no castings being used in any part of the model, with the sole exception of the wheels, which I got cast from my own patterns in the local bazaar. The boiler is of the single-flue type, with internal firebox and cross

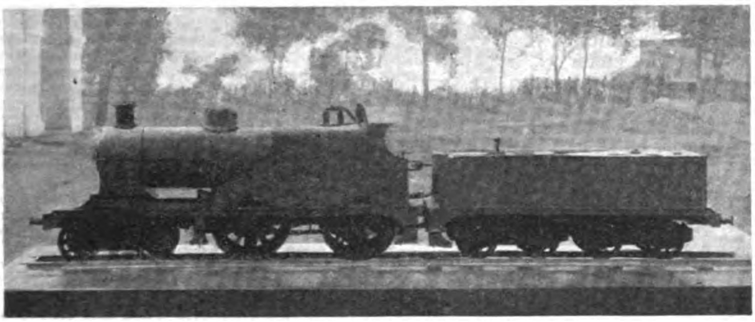


FIG. 1.—SIDE VIEW OF ½-IN. SCALE MODEL M.R. LOCOMOTIVE.

water tubes. It is fired by a Bunsen burner consuming vaporised methylated spirit. The vaporiser is situated on the back portion of the tender, the middle of which is occupied by a spirit tank for supplying the pilot light and burner for heating the vaporiser. The forward portion of the tender contains a water tank, with a hand-feed pump for supplying the boiler. The boiler, which is constructed of copper throughout, is jacketed with flannel, and the "deading" is tin-plate. It is fitted with pressure and water gauges, as may be seen from the photograph, the regulator handle being reversed to avoid interference with those fittings. The dome is in two parts, hammered up from sheet copper and hiding a large size filling plug.

The engine is fitted with link-motion reversing gear, operated from the footplate by a screw, as in the original, and has proved most satisfactory in practice, the engine running freely, with a considerable amount of linking up. Engine and tender are mounted throughout on springs, those of the driving wheels being spiral, all others laminated and constructed on the open system, packing strips being inserted between each plate.

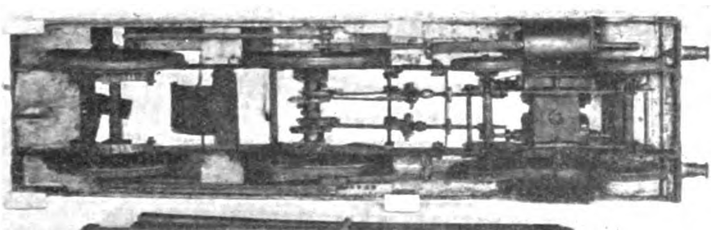


FIG. 2.—UNDERSIDE VIEW OF ENGINE.

Home readers will scarcely appreciate the difficulties which beset the model maker in India. Nothing but the plainest varieties of sheet metals are to be obtained locally, and sometimes not even those. Also small screws, bolts, etc., have to be sent for from England, about two months elapsing before supplies come to hand. Bazaar made castings are extremely crude, and would horrify those accustomed to the smooth beautifully moulded castings obtainable so easily in England.—Yours truly,

D. M. STEWART,
A.M.Inst.C.E., P.W. Dept.

Boiler for Clarkson's Motor Bus.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I shall be glad if any of your readers will inform me what type of boiler is now used upon the Clarkson steam 'buses, as I notice they are now fitted with water gauges. — Yours truly,

R. W. B.
Ivy Dene, Harpenden,
Herts.

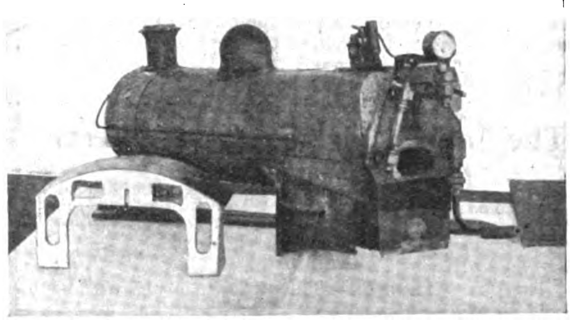


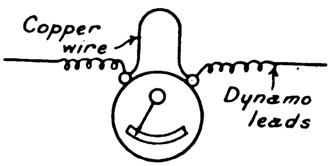
FIG. 3.—SHOWING BOILER DISMANTLED.

A Hint to Young Electricians.

TO THE EDITOR OF *The Model Engineer*

DEAR SIR, — Many readers, no doubt, have at one time or the other had to consider the necessity of purchasing another ampere meter, owing to having a larger dynamo which gives a greater output than the present meter will show. To those readers I submit this account of one way out of the difficulty without any expense whatever.

Supposing you have a meter reading up to about 20 amps., and you want one to read up to 30. The first thing to do is to run the dynamo to show exactly 10 amps. by the present meter. Now take a piece of *bare* copper wire which will carry 15 to 20 amps., bend it U-shape, and insert it between the terminals of your ampere meter, as per sketch. Regulate the length of the wire so that the meter only shows 5 amps. You will see by that that the



copper wire is carrying 5 amps. which are not shown on the meter. An ampere meter must now be borrowed to read to 35, and connected in series with your own. The dynamo is run up to 30 amps. by the borrowed meter and the length of wire adjusted so that your meter shows 15 while the other is stationary at 30.

Your apparatus is now completed, and you have an ampere meter which shows *half* of whatever the dynamo may be giving. By this means you escape the expense of a new meter. This plan will do for any output provided the wire will carry the current. This is no use whatever for a voltmeter.—Yours truly, G. W. M.

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

FUTURE MEETINGS.—The next meeting will be held on Wednesday, March 18th.

VISITS.—On Wednesday, March 4th, to North London Railway Works, Bow; on Thursday, March 26th, to Great Eastern Railway Works, Stratford.—HERBERT G. RIDDLE, Hon. Secretary, 37, Minard Road, Hither Green, S.E.

Prize Competitions.

Competition No. 43.—A Prize of Two Guineas will be awarded to the reader sending the best article on "Finishing Model Engines." The work of painting and enamelling, polishing, lacquering, and the other points and processes which are involved in neatly finishing off a model engine after all the constructive work has been done should be dealt with. The closing date of this Competition is March 2nd, 1908.

Competition No. 44.—A Prize of Two Guineas will be awarded to the reader sending the best article on "Small Dynamo and Motor Testing," describing how to test for faults during construction, and how to test the working of the machine when finished. The closing date of this Competition is March 2nd, 1908.

For conditions of Competitions see previous issues.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, 26–29, *Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[18,008] **Dynamo Windings.** J. S. (Bolton) writes: I should be pleased if you would kindly help me in the following matter. I have the finished parts of an iron-clad motor, and I want to wind this as a dynamo to give about 50 volts. It has two poles, one above and one below, the winding space of which is 2¾ ins. long by 2½ ins. broad and 1 in. deep. The armature is 3 ins. long by 3¼ ins. diameter. It has 18 slots 7-32nds in. wide by 7-16ths in. deep. The commutator has also 18 segments. Kindly reply at your earliest convenience, stating amount of wire required on fields and armature.

Your machine should be wound with about 1 lb. of No. 23 S.W.G. on armature and 6½ lbs. of No. 24 S.W.G. on field-magnets. Speed should not be less than 2,500 r.p.m.

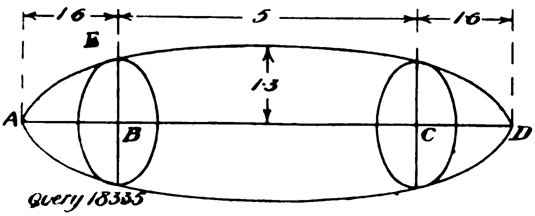
[18,906] **Motor, etc., for Barber's Shop.** D. W. (Glanamman) writes: I am about to put hairdressing machines in my saloon, to be driven by an electric motor. I should like to be advised whether same can be driven by an accumulator, and what size of motor should I get to drive same for one chair?

We are not certain exactly what power is required for this purpose, but should say about ⅛ h.-p. would be needed, that is approximately 100-watt motor. At 100 volts supply this motor would take 1 amp., or at 25 volts it would take 4 amps., hence if you require to run from accumulators you would need a set of at least 12 cells coupled in series, each cell capable of discharging at 4 amps. The minimum size for such cells to discharge at this rate would be those containing 1 sq. ft. of positive plate surface per cell. Such cells would have a capacity of about 20–25 amp.-hours, therefore the maximum length of time you could use the motor would be from 4 to 5 hours. Such a battery would be not only very heavy, but very large and bulky, and unless you have some convenient means for having them recharged we do not think you will find it practicable to instal them. On the other hand, if your means for re-charging are so convenient, why not drop the idea of using batteries, and run your motor direct from supply mains? Primary batteries, of course, are quite out of the question. We are therefore afraid that unless you can obtain a supply from the electricity mains, it is quite out of the question to attempt to drive by electricity.

[18,800] **Magnetos for Ignition.** F. T. (Brighton) writes: I have a machine which I wish to use for magneto-ignition for my ¾-h.-p. gas engine. The machine consists of four permanent magnets, 5 ins. high, ¾ in. wide, ½ in. thick. These magnets slide over pole-pieces at the bottom. H armature, 3½ ins. long. 1½ ins. diameter. Current is collected from the armature by a spring pressing on end of armature spindle. I propose to put a small pulley on this spindle and run off the shaft at a low speed, instead of the usual lever and oscillatory movement generally adopted, as I have no room for a cam on the side shaft where the cam is required. (1) Do you think this will answer? (2) What gauge and quantity of wire to wind armature (present winding burnt out)? (3) Please give sketch of connections to spark plug and make-and-break contacts on side shaft. (4) Approximate speed to run the machine.

The action of an ordinary magneto-machine for ignition purposes is such that the armature must be rotated at a certain speed when the current or circuit is suddenly broken. You could run your machine continuously if you chose, but you must provide some means for breaking the circuit suddenly at the moment the spark is required. For information on magneto machines for ignition purposes we must refer you to Bottone's book, "Magnetos for Automobilists," which was recently reviewed in these pages. Further, you should read the article on "Small Otto-cycle Gas Engine" in March 29th, 1906, issue.

[18,335] **Lifting Power of Model Airship's Balloon.** R. P. S. (Clifton) writes: I shall be much obliged if you can supply me with the following information. What would be the price of a cigar-shaped balloon 8 ft. long and 2½ ft. in diameter in the widest part, and tapering up to a point either end? And how many ounces would such a balloon lift (exclusive of its own weight), if filled with pure hydrogen? Can you also give me a formula for finding the lifting power of such balloons, and also for finding the cubical contents of any such balloon, having given the length and diameter of the balloon? Can you tell me the name, the author, and the publisher of a book dealing with the practical construction of model airships, especially with the balloon part, and also, if possible, with the motive power for same and the framework. Could you also give me a fully dimensioned drawing of a small aluminium framework for the balloon before mentioned, and could I get this



balloon made in gold-beater's skin or silk anywhere? Could you tell me the best way to make the hydrogen and also give a sketch of the apparatus for making it?

Volume of balloon—approximately, $3BE^2 \times BC + 2AB \times BE^2$.

$$= 3\left(\frac{5}{4}\right)^2 \times 5 + 2 \times \frac{3}{2} \times \left(\frac{5}{4}\right)^2.$$

$$= 3 \times \frac{25}{16} \times 5 + \frac{2 \times 3 \times 25.}{2 \times 16}$$

$$= \frac{450}{16}$$

= 28 cub. ft. approximately, or 792·4 litres.

11·2 litres of hydrogen will lift 13·4 grammes.

Therefore, 792·4 litres will lift 938 grammes, or 33 ozs. approximately. Your other enquiries are matters for experiment and individual trial. No practical work on the subject has yet been published, as the art is in quite an experimental stage yet, everyone working "on his own," so to speak. *Re* hydrogen making. Consult a book on chemistry.

[18,816] **Supply Current for Motor for Model Locomotive.** N. R. (Sturla, Genoa) writes: Being a subscriber to your valuable paper THE MODEL ENGINEER, I would like to ask the following questions, hoping you will be able to help me. (1) I am building a model 4—4—2 type locomotive and tender to drive by electric power, and having one of Messrs. F. Darton & Co.'s "Pet" type motors, the 9s. size, I hoped to be able to use same, but I find that it does not seem powerful enough to drive locomotive even slowly, for all that locomotive and tender only weigh about 4½ lbs. (2) I have two batteries of the sack Leclanché type, and although they give plenty of current, the motor will not move the locomotive at all. Some time back there appeared in these pages drawings and instructions for building an electric locomotive, and it was pointed out that as purchased the field-magnet windings are of 22-gauge wire, and that if wound with 26-gauge wire it would consume less current. Would this mean more power? (3) If I fitted an 8-section drum armature on motor, leaving same magnet windings on, could I get more power with same current? The locomotive is ½-in. scale, 2½-in. gauge, and over-all length 28 ins.

You will find that the sole cause of your trouble is due to the fact that Leclanché cells are quite unsuitable for the purpose. If you put an ammeter in circuit you will see that practically no current is being given by the cells, or at least what little is being supplied very soon diminishes to a very low figure. You could re-wind your field with 26-gauge wire, and would probably get very much better results, but this alone would not compensate for the use of unsuitable cells. We should advise you to use your present armature with bichromate cells or accumulators.

[18,954] **Accumulators.** F. H. V. (Redditch) writes: Would you kindly answer the following questions *re* accumulators. I have a motor cycle accumulator which makes a hissing noise, either when just charged or run down, although it does not apparently discharge any gas as there are no bubbles on surface of acid. Is this usual, or does it show that anything is wrong with it? The plates are in good condition and there is no trace of sulphating. Would it injure accumulators to light a lamp from them for, say, half-an-hour and then charge them fully again from dynamo, as I should not wish to run dynamo for more than an hour at a time.

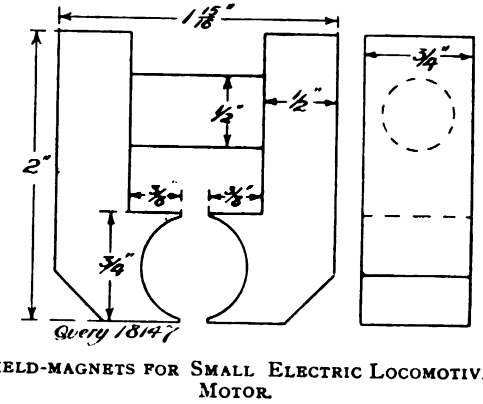
This is immaterial provided your accumulator is in other respects doing its work properly. The main thing is whether it will give its rated output properly. *Re* accumulators for lighting lamp. It is a very good plan to never allow the accumulator to run down very much, hence it will only do it good if you use it in the way you suggest, namely, work it for a short time and then recharge it again.

[17,935] **Small Power Boiler.** J. B. (Peckham) writes: I propose making a boiler for an engine I have made. I enclose rough sketch of same. For the flanged ends of boiler I propose to use gun-metal castings 3-16ths thick, and to screw the tubes into the bottom end and to expand the ends of the tubes into the top end. What I wish to know is, will this method make a good boiler, and will the flanged ends of boiler do without stays? If not, how many stays should be used and diameter of same? Will the top ends of tubes do without soldering or brazing after being expanded into end plate?

Yes, you will find that a single stay in the centre will be required. In proportion to the number of tubes used the unsupported area is rather large, and therefore we recommend a single copper stay made out of ½-in. bar in the centre. This should be screwed into both plates and lock-nutted on outside. Of course, you can make the rod parallel throughout and screw the two ends only. The stay should then be fixed in one end, say, the bottom, by screwing into a tapped hole and lock-nutting afterwards on the outside. The top plate should be drilled ½ in. clearing and lock-nutted both sides, the inside nut being adjusted before the top plate is riveted in. With the same number of larger tubes or a much larger number, staying would not be absolutely necessary. No soldering will be required if the top ends of the tubes are properly expanded in. Why not use copper for the outer shell instead of brass? You can, of course, expand the tubes in at both ends. There is no great advantage in screwing them in at the bottom with such a large boiler, as it is not a question of being unable to use the expander for want of room as often occurs in the case of a small model locomotive boiler.

[18,147] **Small Motor Electric Locomotive.** A. T. C. (Dublin) writes: Will you kindly advise me through THE MODEL ENGINEER regarding the enclosed sketch of small motor. Will a motor made to the size shown be powerful enough to drive a model electric locomotive 9 ins. long, 3 ins. wide, and about 6 ins. high, and weighing about 4 or 5 lbs.? What windings do you recommend for fields and armature to get the greatest power from the motor, and how many watts will drive it? Will a tripolar armature be best? The motor must be self-starting, and will a motor so fitted be reversible (from rails)? If one motor would not be powerful enough, how should I fit and wire up two of them to drive car? Owing to the end bonnets on locomotive, I could not have the motors any larger than shown; I do not wish to encroach on cab space (which is in the centre). If the type I propose using is unsuitable can you suggest any other? I shall be pleased to send you a description and photographs of the model when finished, if you care to publish same. It is my first "offence" in the model making line.

The smallest size given by the scales of Figs. on page 16 of Handbook is a 10-watt motor, with a 1¼-in. by 1¼-in. armature; but you could, of course, reduce this if desired to a ⅞ in. diameter



FIELD-MAGNETS FOR SMALL ELECTRIC LOCOMOTIVE MOTOR.

armature. It would then run from a 6-volt supply and take about 1 amp. Wind with No. 24 S.W.G. on armature and No. 26 on fields. Get on as much wire as you can in the space. Yes, a tripolar armature. By using plenty of *battery power*, you will find motor is quite equal to its work. We shall be glad to hear how your "first offence" turns out.

[18,783] **Motor for Driving Electrical Apparatus; Breaks for Induction Coils.** S. M. M. (Hampstead) writes: I should be much obliged if you would reply to my following queries. (1) I wish to get motor castings (electric) to build a motor to drive a Lodge-Muirhead coherer and a Morse ink printer. Could you

advise me any particular make? (2) Where can I get designs for the ordinary "direct writer" Morse printer? (3) I wish to make a 12-volt 32-amp.-hour accumulator, as described in your handbook, in Chapter III, and wish to make the case of wood lined with lead. Is this the cheapest? (4) What thickness of lead should be used for lining? (5) How much would it cost to make the accumulator? (6) I intend making a 6-in. spark coil (as described in your handbook), and want break for same. I wish to use the coil for wireless telegraph purposes. Your handbook mentions the "Wehnelt break," but in "Wireless Telegraphy," by Howgrave-Graham, it mentions that this break has disadvantages for wireless work. Is the Lodge-Muirhead break called "Buzzer" good?

We would not advise a motor at all for this purpose. If the coherer is at all sensitive, slight variations of current and small sparks at the commutator are quite liable to cause coherence and make the working unsatisfactory and irregular. However, any ordinary small motor will do as the power required is not great. We would advise a type of machine with several parts to the commutator. On no account must a motor be used of the make-and-break type with an unwound armature. (2) We would advise you to examine the Morse printer and make your own sketch, as we have none to hand. You could probably see one at either of the South Kensington Museums, and would certainly find account and illustrations at the Patent Office Library in the shelf devoted to telegraphy. (3) Use ebonite. (4) See above. (5) A few shillings, probably 6s. or 7s. (6) We would not advise a "Buzzer" break for amateur work, as the speed is not very easily regulated. Try a rotating dipper break, preferably of the two-crank type. See Mr. Pike's article in THE MODEL ENGINEER, January 16th, 1908, page 49.

[18,530] **Protection from Lightning.** H. K. (Weymouth) writes: Will you please tell me how to protect aerials (for wireless telegraphy) from lightning. I have obtained a licence to experiment, and I am going to fit up an aerial, but I fail to see how to fit a lightning conductor without a chance of leakage from aerial to earth.

We have not heard of much difficulty or danger from lightning. The aerial should be of stout copper, and should always be disconnected from the receiver and thoroughly earthed if there is the least danger from storms. Probably the aerial itself so treated would form a fairly efficient conductor for minor disturbances. We can offer no further suggestion unless that the aerial be taken down bodily when there is risk of a storm, particularly if it is erected on the top of a house.

[18,647] **1½-in. by 2½-in. Steam Engine and Boiler.** G. S. T. (Birmingham) writes: I have a horizontal single-cylinder steam engine, 1½-in. bore by 2½-in. stroke, with which I propose to drive, by belt, a dynamo giving 3½ amps. at 8 volts at 3,000 r.p.m., which requires ½ h.-p. to drive it. (1) Kindly inform me what speed you would run the engine at so as not to make ratio of pulleys too great. (2) Also, what boiler pressure and point of cut-off you would recommend. (3) The boiler I shall have to make, and shall be glad if you would give me dimensions of a vertical boiler of suitable capacity to drive the set. I propose to burn coal. I may add that I have your handbook on "Model Boiler-making," and of the three shown (vertical type), the first appears too small and others too large. Would boiler have smoke tubes or single uptake? (4) What weight of flywheel for engine, acting at a 6-in. circle of gyration, as I am afraid the one I have on is a shade too light?

(1) The speed may be 500 to 600 r.p.m. (2) 50 lbs. per square inch. Cut-off at 66 per cent. of stroke. (3) We should make a fairly large boiler, say a 12 ins. by 24 ins., with ten or twelve tubes 1 in. or ¾ in. diameter. We would prefer ten 1-in. tubes. You will find a steel boiler quite satisfactory if carefully kept when out of use. Rules for thickness of plates are given in handbook No. 6, "Model Boiler-making." Of course, in a steel boiler allowances for rusting must be made. We recommend 5-32nds-in. or 11-64ths-in. plate for 40 or 50 lbs. working pressure, and 3-16ths-in. for 100 lbs. pressure. (4) The section may be 1¼ ins. by 1 in. at the rim of the wheel.

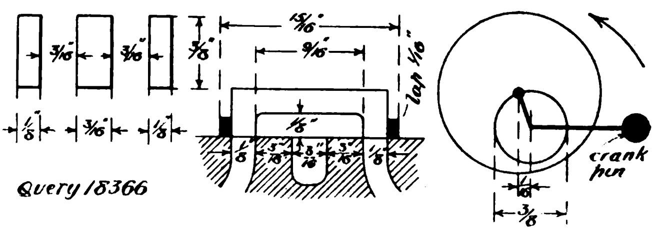
[18,669] **Static Electricity Experiments.** G. E. H. (Flint, N. Wales) writes: I should feel obliged if you would explain the following difficulty for me. I received to-day an electrophorus from one of the leading manufacturing firms, and I fail entirely to get a single spark from the cover after lifting it from the excited disc. The "cake" consists of a round piece of ebonite ¼ in. thick, 8 ins. diameter, covered with tinfoil on the under side. The cover is a disc of highly polished brass, 7 ins. diameter, 1-16th in. thick, with a spark ball and a glass handle. I excite the ebonite plate (on the uncovered side) with a piece of warm flannel, by beating the plate briskly, and then place the cover on, touch it, then lift it up; but, although I take hold of the handle with a piece of warm silk, I cannot get any spark from it. Can you tell me what is the matter? Once I put one finger on the tinfoil of the cake, and then put another near the top of the cover, and I got a brilliant spark (and a sore finger), so there is no doubt that the cake is excited. I also notice sometimes that in placing the cover on the cake a spark jumps between the two. Always, when I place the cover on the cake, there is a crackling noise. Will these sparks neutralise the charge on the cake? I withdraw the cover briskly. Is this right? You might also tell me if the two following conductors can be properly charged with an electrophorus to prove the theory of "influence," or do they require a Wimshurst machine to charge them?

You should be able to obtain sparks from the cover; a damp atmosphere, however, will often cause experiments with static electricity to fail, and we surmise that this is the cause of your failure. Warm the apparatus before making your trials, and conduct them in a dry, warm room. The ebonite cake should be at least ½ in. thick, as the effect is partly due to the charge on the cake being pulled down into it by induction between the negative charge and the positive charge induced upon the tinfoil backing. The fact that your cake is only ¼ in. thick would not cause failure. When the cover is placed upon the cake it becomes highly charged negatively; a spark will therefore pass between it and the tinfoil backing, if the one is brought into near contact with the other. This explains the spark to your finger when you touched the backing and presented the finger to the cover. It seems that in some way the plate and backing are brought into near contact when you place the cover on the ebonite, a spark passing each time. This will not interfere with the action, as it is equivalent to you touching the cover deliberately. The speed at which you withdraw the cover is immaterial. You can charge insulated conductors to a high potential by repeated doses from the electrophorus cover; allow the charge to pass as a spark. A Wimshurst machine will do it more quickly. The thing to be careful about is to have everything warm and very dry, and no points upon the conductors to be charged.

[18,824] **Boiler and Dynamo for 1-in. by 2-in. Engine.** R. J. M. (Highbury, N.) writes: I shall be glad if you will answer the following queries: (1) I have a horizontal engine, 2-in. stroke, 1-in. bore. What kind of boiler would you advise me to make to drive it at full strength, and what dimensions would you recommend for this boiler? (2) In the above engine, what is the greatest number of revolutions a minute I can get? (3) Can I drive a small dynamo with it, and, if so, what is the limit?

You can use a boiler 12 ins. diameter, 24 ins. high. The height of firebox about 11 ins., containing twelve 1-in. tubes. Boiler to be of 3-16ths-in. steel plate. The revolutions per minute on your engine will depend partly upon its design and workmanship—probably 800 a minute would be about the figure. It should drive a 30-watt dynamo comfortably.

[18,366] **Steam Port and Valve Proportion.** F. M. R. (London) writes: Please will you enclose a sketch, with dimensions, of a slide-valve to suit ports (which I have already drilled).



STEAM PORT AND VALVE PROPORTIONS.

The above sketch gives the particulars required; the valve should cover the ports by a full 3-32nds in. on each side, and therefore will be ⅜+3-16ths—9-16ths wide, at least. The port bars are a little wide, and you would do well to chip out the exhaust port to ¼ in., thus making the port bars ⅛ in. wide. This will not affect the proportions of the valve and eccentric.

[18,882] **Making Accumulator Plates.** J. McI. (Jarrow) writes: I should be much obliged if you could find time to explain to me how to fill the negative plates of a small accumulator. I have your handbook, "Small Accumulators: How Made and Used," and have followed the instructions therein, but have not got satisfactory results. My accumulator is a 4 volts. 20 amps. The paste has all fallen out of the grids, and I want them refilled. Could you inform me of the best method for doing so? I have tried a solution of acetate of lead. Your book says precipitated lead may be obtained by lowering a strip of zinc into solution of acetate of lead, when the crystals will be seen to form on the zinc. I have tried a strong and a weak solution, but with the same results. I get the acetate from a chemist, but he called it "sugar of lead," and said it was acetate under another name. Can I have got the wrong stuff? The crystals formed set hard immediately they are taken from the zinc, and, of course, not being in a paste or porous mass (as your book says), it is impossible to place them into the grids.

A certain amount of force is, of course, necessary to get the crystals pushed well into the grids, and experience alone will enable you to do this successfully. If you still have difficulty with this process, we advise you to use the ordinary paste made of litharge and sulphuric acid as described in handbook. These plates will then need forming in the usual way. Acetate of lead goes by the other name you mention, namely, sugar of lead.

[18,627] **Model Electric Railways.** F. H. (Acton Cliff) writes: I wish to electrify a model railway, gauge I. I have double lines, consisting of one oval line inside another; the outer line has a straight length at each end, and the total length is 14 ft. There are points leading from one line to the other. Can this be electrified by using a dynamo direct? What size of dynamo would this require? Also, what power of steam or hot air engine would drive above dynamo? There are no gas or electric mains near my residence.

You should have no difficulty in electrifying your model railway. You will have to lay a middle or third rail, and instal a small dynamo of about 30 watts, say 10 volts 3 amps. For this you will need an engine of at least ¼ h.-p. We should advise gas in preference to any other type. For further particulars and details of how to set about the job you should refer to back numbers of this journal, in which numerous articles have been published dealing with small electric railways. See January issue for 1905, and following issues.

[18,657] **On Wireless Telegraphy.** R. E. (Tonbridge) writes: I should be much obliged if you will answer the following queries by an early date. (1) I am thinking of setting up a small wireless telegraph station and I am not quite certain of a few points. I have Mr. Howgrave-Graham's book, but cannot find out if it is necessary to raise the aerial as the distance increases. I have a Lodge-Muirhead aerial, 50 ft. high. Can I telegraph over a distance of 5 miles? (2) What power must I have to signal over this distance? Would a 2-in. coil do? (3) Can I make an aerial of galvanised wire? (4) Is a licence always granted, and must it be obtained before I commence constructing my stations?

(1) If your aerial is 50 ft. high, you certainly should be able to signal 5 miles, especially if it is 50 ft. clear of the ground and not raised on a house. Height certainly affects distance. The higher the better. Also the higher the ground is on which the aerials are placed, the better will the signalling be. (2) It is impossible to say whether a 2-in. spark will prove sufficient. Under favourable circumstances, and with a well-made receiver, it probably would. We would suggest that you should note what Mr. Howgrave-Graham says on page 62 of his book. (3) We would not recommend galvanised wire for an aerial. The skin effect is considerably more serious in iron than in copper. (4) It is clearly stated in the above-mentioned book that a licence must be obtained (see page 38). Not being connected with H.M. Post Office, we cannot say whether a licence is always granted. Surely the simplest course is to make application as directed in Mr. Howgrave-Graham's book.

[18,728] **Winding for a Plating Dynamo.** "Electric" writes: Will you kindly answer the following questions? I wish to make a plater. I am well up at making dynamos for lighting, and can wind any sort of armature, but I am nothing at calculating. I have armature stampings 3½ ins. diameter (drum type). I thought of making it 2½ ins. long. I wish to get 20 or 25 amps. at about 8 volts. How many active wires should I require on the armature, and what size wire (supposing it was single wire)? But I thought of winding with more than one, three or four in parallel, and 30 section commutator in two circuits. The machine is a two-pole overtype. Please state winding space on fields and size of wire. Is it worth while to have the magnet cores of malleable iron?

The armature wire should be No. 16 gauge for a single wire. Get on as many turns in the slots as you can. If the core is a plain one, you will find about six turns per coil convenient; 16 coils and a 16 section commutator will be ample, but the greater the number of coils and sections the better. Make field magnet to the 400-watt scale, design Fig. 11, page 18, of our handbook No. 10, but about 2½ inches in armature length. If you use cast iron for the magnet, which will do very well, make the thickness of limbs and yoke about half as thick again as the design. If your armature core is not slotted, we should prefer to make the length about the same as the design, that is, about 5 ins., and make the magnet of cast iron of same thickness as the design. Wind field magnet with about 3 lbs. No. 17 gauge D.C.C. copper wire on each limb. It is not worth while to go to the trouble of malleable cast iron if you can get good soft ordinary castings. Speed to be found by trial, say 1,800 r.p.m.

[18,825] **Switchboard Attendants.** L. R. S. (Streatham) writes: I have been an apprentice in a firm of electric light contractors in London for two years, and am just out of my time. I have had experience in their brass finishing shop, smith's shop, carpenter's shop, and drawing office, and have also been on several buildings where they have installed electric light. I am anxious now to get a wider experience, especially in connection with plant. Can you advise me what is the best thing to do? Could I get into any of the big electrical plant manufacturing firms, and what sort of post ought I to get? Or could I get into any power station, and in what position and at what wages? I shall feel very much obliged if you can help me in this matter.

We think your best plan would be to watch the advertisement columns in some of the trade papers, such as *The Electrical Review*, and also to make personal inquiries at the various central stations in and around London; you could also try advertising for a position yourself as junior switchboard attendant. You do not say whether you have had any experience in running electrical machines, but if not we should advise you to take a course of training at some of the technical institutes in order to gain some practical experience for such a post as switch-board attendant. The wages for such a job range from 15s. to 35s. and 40s. a week. The latter figure, however, would be for high-tension and alternating current work, sub-station work, etc. Everything depends upon your personal efforts and experience, and we can only advise you to keep a constant look-out and watch what is going on in the way of vacant posts.

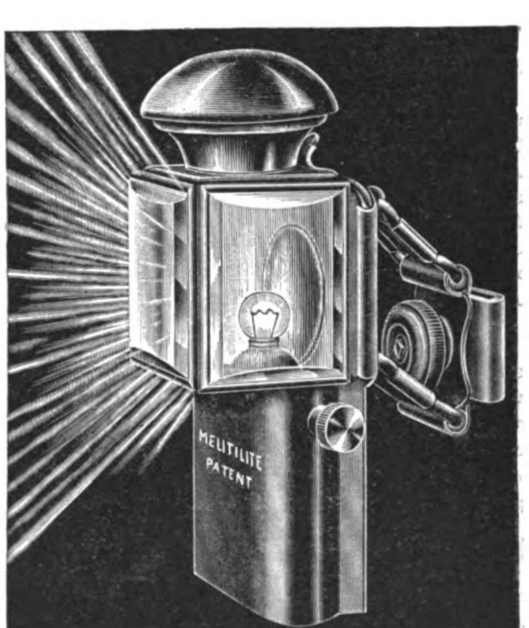
The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

** Reviews distinguished by an asterisk have been based on actual Editorial Inspection of the goods noticed.*

A New Electric Cycle Lamp.

The accompanying illustration shows a new form of electric cycle lamp which is being introduced by Messrs. Ward & Goldstone, Sampson Works, Salford, Manchester. The two special features of this lamp are—firstly, the fact that it is entirely self-contained, there being no wires, satchels, or separate accumulators; and, secondly, that a new type of accumulator is used, this being carried in the base of the lamp. This accumulator contains no liquid acid, the plates being separated by glass wool, which absorbs the acid, and thus prevents any spilling or corrosion. The plates



THE "MELITILITE" CYCLE LAMP.

are made by a secret process, and we are informed that they give a result superior to that of any other accumulator of similar size. The accumulator case is sealed, and is made of a composition similar to ebonite. The lamp bulb is of the latest metal filament type, and gives a bright white light, this showing both ahead and at both sides of the road. The light is turned on and off by a turn of a screw, and a single charge of the accumulator gives from eight to ten hours' light. The "Melitilite" lamp, as it is called, appears to be thoroughly well designed, and is made in two finishes, enamelled and part plated, and entirely plated. Full particulars may be had from the makers at the above address.

The Editor's Page.

WE thought it would come—the suggestion that we should start a "Limerick" Competition in THE MODEL ENGINEER. Here it is, in our correspondent's own words: "I wish respectfully to ask you if you could introduce a 'Limerick Competition' in THE MODEL ENGINEER, the prizes being a lathe, tools, etc., as I think it would be a very fair way of many amateurs getting tools. I myself have taken in weekly THE MODEL ENGINEER for over ten years, and have had to pass by many interesting models owing to not having a lathe, as £13 is a lot of money for a lathe for a hobby (especially when matrimony is staring you in the face). I have spoken to many regular readers of the book about my suggestion, and they approve of it very much. I think myself that many amateur engineers neglect model making (which is the foundation to success in engineering) through lack of tools." As our correspondent informs us that he has matrimony staring him in the face, we are not quite sure whether he wants the prize-money to buy tools with or to get married with, or whether he thinks that if he gets married first he won't be able to buy any tools afterwards. In any case, we regret that we are unable to introduce contests of this kind into the pages of THE MODEL ENGINEER. Our correspondent overlooks the fact that there are plenty of such competitions in other papers where he has just as good a chance of winning a prize as he would have in THE MODEL ENGINEER, and the money would be just as useful for buying tools with as any money he would get through a competition of ours.

* * *

We went out to lunch after penning the above note, and on our return found that our office boy, who has evidently been bitten by the prevailing craze, had deposited the following lines on our desk:—

"There was a young reader named Toddles,
Who was really devoted to models,
But he said, 'Only fools,
Try to work without tools,
So let's earn some tools by our noddles.'"

* * *

We have now got a new office-boy and a larger waste-paper basket.

Answers to Correspondents.

E. H. N. (Basingstoke).—We thank you for your letter, and will consider the points you raise.

G. J. W. (King's Lynn).—We will endeavour to obtain the particulars you require.

H. E. S. (Sheffield).—Thanks for your further reply to query.

"CALEDONIAN."—We will endeavour to publish the views you desire in the near future.

J. J. (Worcester).—We should suggest 3-in. centres, with a gap-bed. See the advertisers in this journal. We do not know of any firms who supply the particular castings you require. Gilbert and Co., Gray Street, Waterloo Road, S.E., would make the castings from your patterns.

R. F. (Hull).—Your letter has been returned to us through the post. (1) Use a drum armature of eight slots, as shown on page 30, Fig. 24, of "Small Dynamos and Motors," 7d. post free. (2) Armature, 5 ozs. No. 20 (as sample you enclosed); fields, 20 ozs. No. 21. (3) Shellac. (4) 2,900 or 3,000. (5) Approximately 25 or 30 watts. (6) It should be at least ⅜ in. thick—*i.e.*, equal, or more than equal, the cross sectional area of the field cores. The joints must also be perfect fitting, metal to metal. (7) See "Practical Dynamo and Motor Construction," 1s. 2d. post free. (8) No. 20 S.W.G. can be used for armature. (9) Fields should be magnetised first by passing a current through windings. (10) We have asked the author to supply further details.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 26-29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

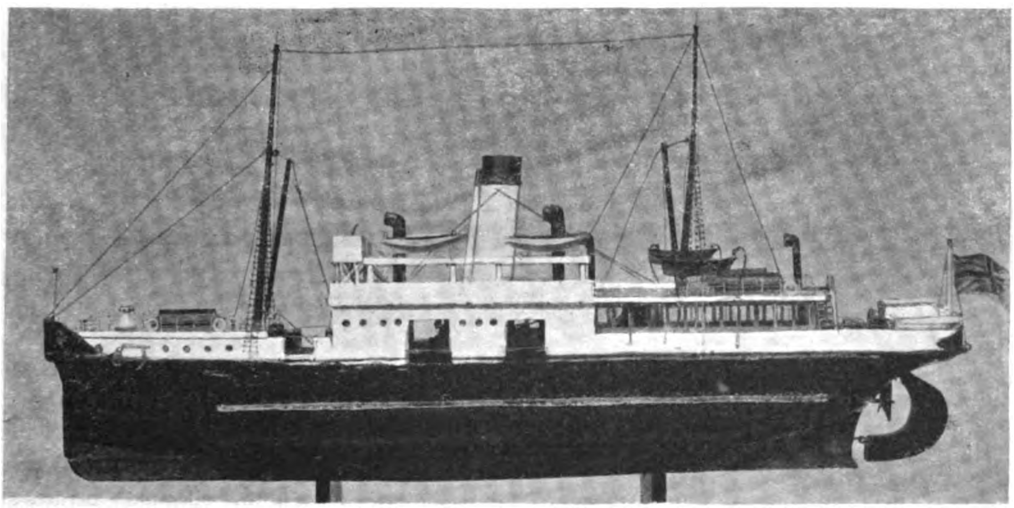
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 358. MARCH 5, 1908. PUBLISHED WEEKLY

A Model L.S.W.R. Cross-Channel Steamer.

By H. OSBORN.

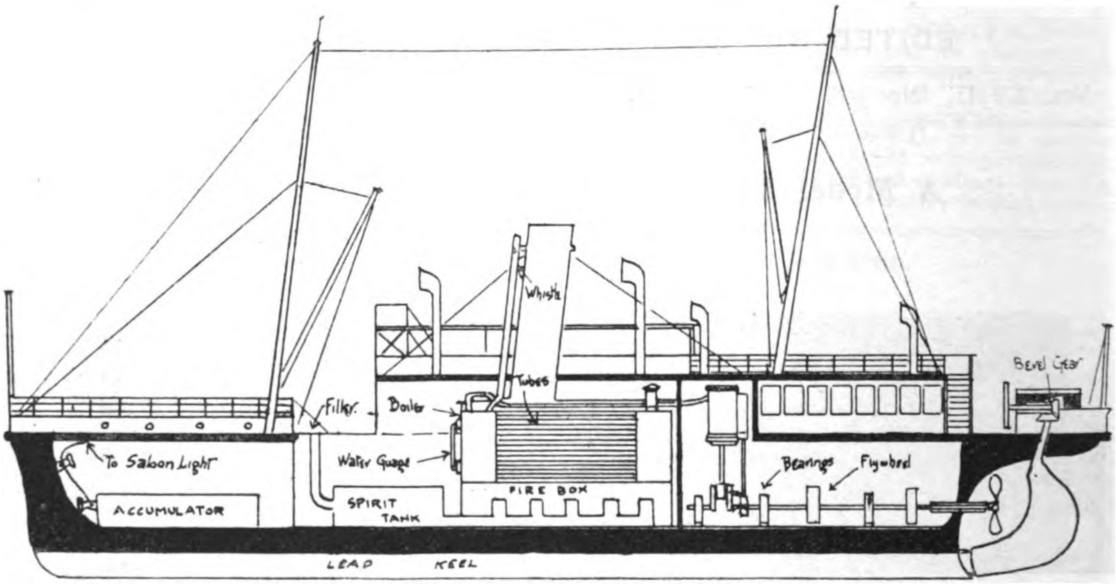


MR. H. OSBORN'S MODEL L.S.W.R. CROSS-CHANNEL STEAMER.

THE following description of a model South-Western Company's cross-Channel steamer which I have recently completed may be of interest to fellow-readers. It has taken about eight months of my spare time to build. The chief dimensions are—Length over all, 3 ft. 3 ins.; beam, 5½ ins.; depth, 6 ins. The hull was carved out, and bulwarks made of sash parting bead, planted on to form required height. The sides of engine-room are made of zinc, with gangway doors hinged to open and shut. The upper and lower decks are cut from ¼-in. whitewood, raised in the centre and lined in to represent planking. The cabin sides are made of thin glass, the inside of which is painted to represent the windows and doors. The floor is covered with red carpet; the seats are made to represent polished mahogany, and the lighting is by a 4-volt electric lamp in the ceiling, worked by an accumulator carried in the hull.

The engine is a double-action brass vertical cylinder—⅞-in. stroke, ⅜-in. bore, with crosshead. The boiler contains sixteen circulating tubes, expanded into brass sink grids and soldered on the inside. The two end drums are made of 2½-in. brass tubing, with brass ends. The fittings consist of water gauge, steam escape, starting cock, blow-off cock, and steam siren, fixed to front of funnel. The firing is by a five-wick methylated spirit lamp. The boiler will raise steam from "all cold" in five minutes. The funnel is made from sheet copper, enamelled white and polished bright above bead.

The propeller is made of gun-metal and is 2½ ins. diameter. The rudder is made of wood and worked by brass bevel gear, as may be seen in the accompanying drawing. The other fittings are—six ventilating cowls (made from copper tube), six boats on derricks, seats on upper and lower decks, twelve lifebelts (made of brass eyelets enamelled white), captain's bridge (with speaking tube to engine-room), two anchors (with capstan). The railings are made of pins and thread, painted white.



SECTIONAL ELEVATION OF MODEL CROSS-CHANNEL STEAMER.

The masts are fitted with working derricks. The ship travels at a good pace in the water. The total weight (in working order) is 21 lbs.

A NOVEL motor race took place recently from Leagate, near Prestor, to Lytham, to test the slowness of motor-cars. There were eleven entries, but seven dropped out before half the journey was covered, only four finishing. The winner covered a mile and three-quarters in one hour and thirty-four minutes.

WE have received from Messrs. Phipps & Connor, 13 and 14, Tothill Street, Westminster, S.W., a little booklet of twenty-four pages on the subject of the railway and tramcar truck invented by Mr. J. S. Warner. While the book has the merit of being neatly produced, and of presenting Mr. Warner's views on vehicle control in a forcible fashion, we think the price charged, viz., 1s. 6d. in paper covers, and 2s. 6d. in cloth boards, is hardly likely to stimulate the demand for what is obviously an advertisement.

How It Works.

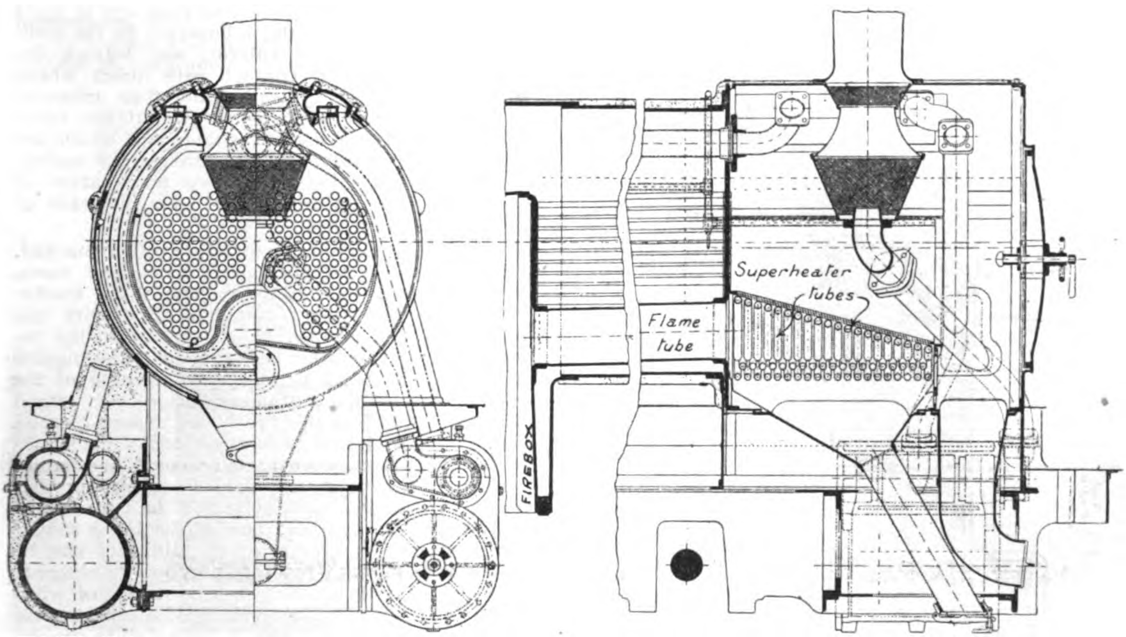
XIV. The Schmidt Smokebox Superheater for Locomotives.

By CHAS. S. LAKE, A.M.I.Mech.E.

THE issues of THE MODEL ENGINEER for December 19th and 26th, 1907, contained an illustrated description of the Schmidt smoketube system of superheating for locomotives. At the conclusion of the article, it was stated that a similar description of the smokebox type of apparatus originated by the same inventor would follow. The present article appears in fulfilment of the promise referred to.

This system of superheating is based on the principle that the gases of combustion on issuing from the firebox are divided into two separate currents, of which one, the larger current, passes through the ordinary tubes in the boiler and generates steam in the usual manner; while the other, and smaller, current flows through a single large tube, or flue, which extends from the firebox and along the lower part of the boiler barrel to the superheater apparatus in the smokebox. The gases in this flue are cooled only to a comparatively small extent by the water, and the heat is consequently utilised for superheating purposes; therefore, as the temperature of the gases entering the apparatus is comparatively high, a relatively small amount of heating surface, easily provided and accommodated, suffices to highly superheat the steam before it reaches the valve chests. Approximately, 10 per cent. of the heat developed on the grate is employed in this way, and the heating surface of the boiler is but inappreciably diminished. On the other hand, the total cross-sectional tube area is increased—a fact of much importance where hard work has to be done: while the superheater sensibly increases the total heating surface, and thus secures a better use of the gases of combustion than would otherwise be possible. As a matter of fact, the efficiency and draught of the boiler are improved by the increased cross-section of free passage for the gases, since the vacuum in the firebox will be greater, and more coal can therefore be burned per hour than in an ordinary locomotive.

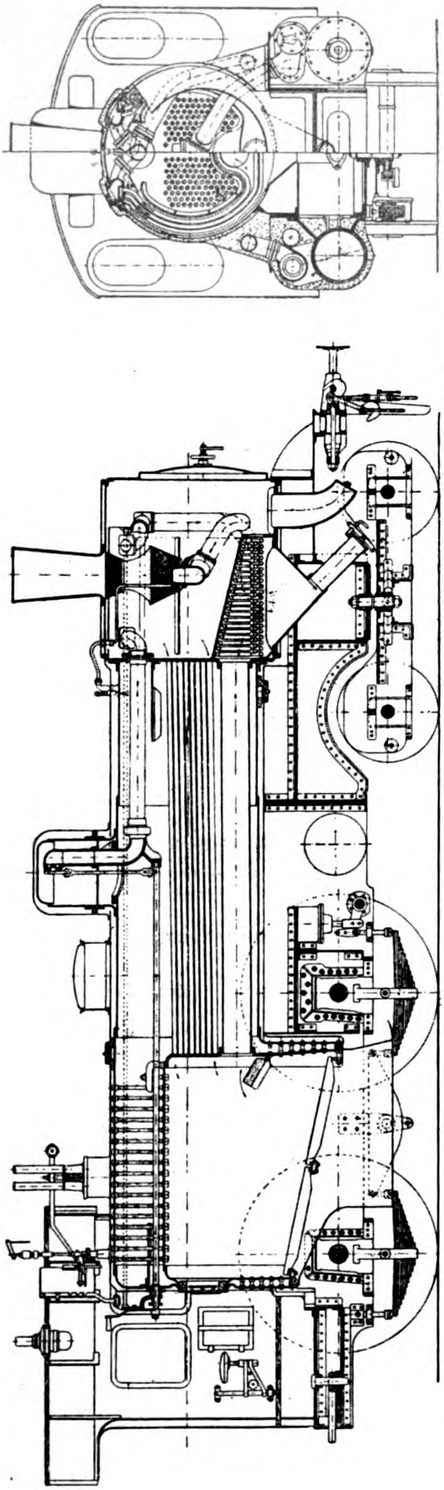
The accompanying drawings (Figs. 1 and 2) show that the large flue tube in the lower portion of the boiler conducts the hot gases from the firebox direct to the superheater, and that the latter consists of a number of small tubes arranged in three concentric rows and situated in the annular space of the extended smokebox. The inner row is so bent as to constitute an arched continuation of the flame tube, and this arch has a gradually decreasing radius towards the front of the smokebox, thus forming a passage which conduces to a uniform distribution of the gases in the superheater. The superheater tubes are expanded into the walls of two cast steel headers or steam chambers which are fixed in a longitudinal position inside the roof of the smokebox, one on each side of the chimney, and are covered on the outside by detachable steel casings packed with asbestos and secured by screws. The space occupied by the superheater is separated from the remainder of the smokebox by a wall of removable plates, which extends almost up to the headers and is shaped to the form of the superheater tubes, which, in turn, follow the contour of the smokebox internally. This wall is effectually protected from the destructive action of the high temperature of the gases in the superheater by the rows of tubes located in front of it, and from the abrading action of the cinders in the smokebox by guard-plates, which are capable of being easily and inexpensively changed. Between each header and the top of the wall on either side a long narrow opening is left, through which the superheater gases pass on the way to the chimney, and each of these openings is covered by a damper operated from the footplate. For the purpose of collecting the cinders which fall between the superheater tubes, a hopper, which can be emptied on the completion of a journey, is fitted below the apparatus. During the run, soot and ashes can be removed from the superheater coils by means of either superheated steam or compressed air, the device for effecting this operation being controlled from the cab. In order to facilitate inspection and cleaning, the inner casing of the apparatus can be taken down if required, but experience has shown this to be seldom necessary.



General Arrangement of the Schmidt Smokebox Superheater.

With a view to avoiding loss of heat by radiation, the superheater is provided with plates arranged just inside the walls of the smokebox, while it is further protected by asbestos sheeting covered by plates on the outside of the smokebox. The hot gases enter the arched distributing channel, and ascend between the superheater tubes on each side of the apparatus. When the engine is working, or when the blower is closed and the engine stationary, the superheater dampers are open, and the gases are then discharged into the smokebox, where they combine with those issuing from the boiler tubes, and finally escape through the chimney into the atmosphere.

The action of the superheater is as follows: When the regulator is opened, steam flows direct from the main steam pipe to the left-hand header, and then passes through the inner row of superheater tubes to the right-hand header. In this latter there is a baffle-plate or cover fitted over the ends



EXPRESS LOCOMOTIVE OF THE PRUSSIAN STATE RAILWAYS FITTED WITH SCHMIDT'S SMOKEBOX SUPERHEATER.

of the inner and middle rows of tubes by means of which the steam, on leaving the header, is diverted into the central rings and returns through them to the left-hand header. This header also contains a baffle-plate which, fixed in this case over the openings of the middle and outer rows of tubes, is so arranged that the steam is conducted from the central rings of tubes into the outermost ones, and thus finally flows back to the right-hand header, from which it passes in a highly superheated condition to the valve chests and cylinders.

In this way the steam is made to traverse the superheater three times, viz., from left- to right-hand header and *vice versa*, and from left to right again, before reaching the cylinders. As the combustion gases, both on entering and leaving the superheater, come in contact with tubes whose surfaces are cooled by wet steam, their temperature is sufficiently reduced to prevent the tubes which contain superheated steam, and which are therefore much hotter than the others, from becoming overheated. Thus, the high temperature of the gases cannot act injuriously on the walls of the superheater tubes.

The headers, as has already been remarked, are provided with detachable covers, and these, in reality, form part of the outside of the smokebox and afford direct communication with the interior of the headers. They can be readily removed for the purpose of expanding or plugging the tube ends when necessary. Loosening of the joints is a remote contingency, since, by reason of their bent form the tubes can expand freely, and, as their extremities lie at the top of the superheater, they consequently only come in contact with gases having a temperature varying approximately from a minimum of 570° F. to a maximum of 750° F. If, however, any of the tubes should get loose in course of time, the difficulty can be easily overcome for temporary purposes by plugging those tubes, without the necessity arising of withdrawing the engine from service. If a considerable number of tubes become so defective as to require renewing, the upper part of the smokebox, together with the complete superheater, can be removed so that the whole of the apparatus is capable of being readily examined and repaired.

In a general way, regulation of the superheating effect by means of the dampers is wholly unnecessary, but their provision enables the driver to reduce or entirely stop superheating, as the case may be, when special circumstances render either course advisable.

As a rule, therefore, the driver does not have to pay any attention whatever to the superheater whilst running, so that he can devote his time entirely to the usual duties. A steel mercury pyrometer is fixed in the cab for the purpose of indicating the degree of superheating.

The writer is requested by Mr. Schmidt to state that, although the smokebox type of superheater proved highly satisfactory, it has not so many practical advantages as the smoketube apparatus, and, as a consequence of this, it is being superseded by the other method.

In all, some 540 locomotives are in service fitted with the smokebox device, while the number provided with the smoketube superheater is over 2,000.

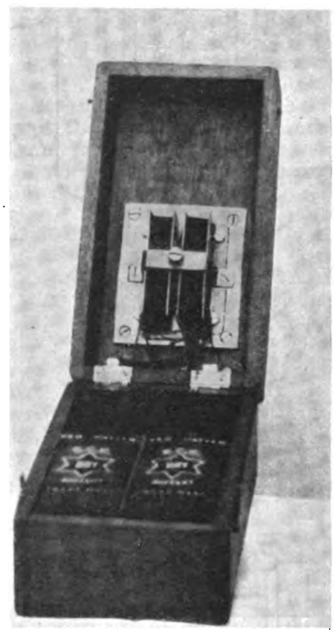
A Linesman's Detector.

By George H. Wood.

A LINESMAN'S detector is undoubtedly one of the most useful accessories of the amateur electrician. It is practically essential in fitting and repairing bell and telephone lines, testing dynamo windings for continuity and leakage, and many other important uses. The instrument here described is a very convenient form of such, being compact and reliable, and wound for "intensity" and "quantity," and moreover is inexpensive.

The Case.—This is made in two halves from 5-16ths in. mahogany, the size being decided upon description, fitted on the top, would also be convenient for carrying the instrument.

The instrument itself is made to the dimensioned drawings given, which, with the exception of the spindle, are all full size. The backplate A is first made out of sheet brass about 3-32nds in. thick, measuring 2½ ins. by 3 ins. It is now marked out from the drawings, for the two formers, front and back centre supports, aud then drilled and tapped for 5 B.A. screws, and finally polished. The two bobbins or formers B must now be made out of 22's gauge sheet brass. Two sides are cut out 2¼ ins. long by 1 3-16ths ins. wide, and two 2¼ ins. long by ¾ in. wide. The two larger sides are now turned up 5-16ths in. on one long edge to form a foot for screwing to backplate; then

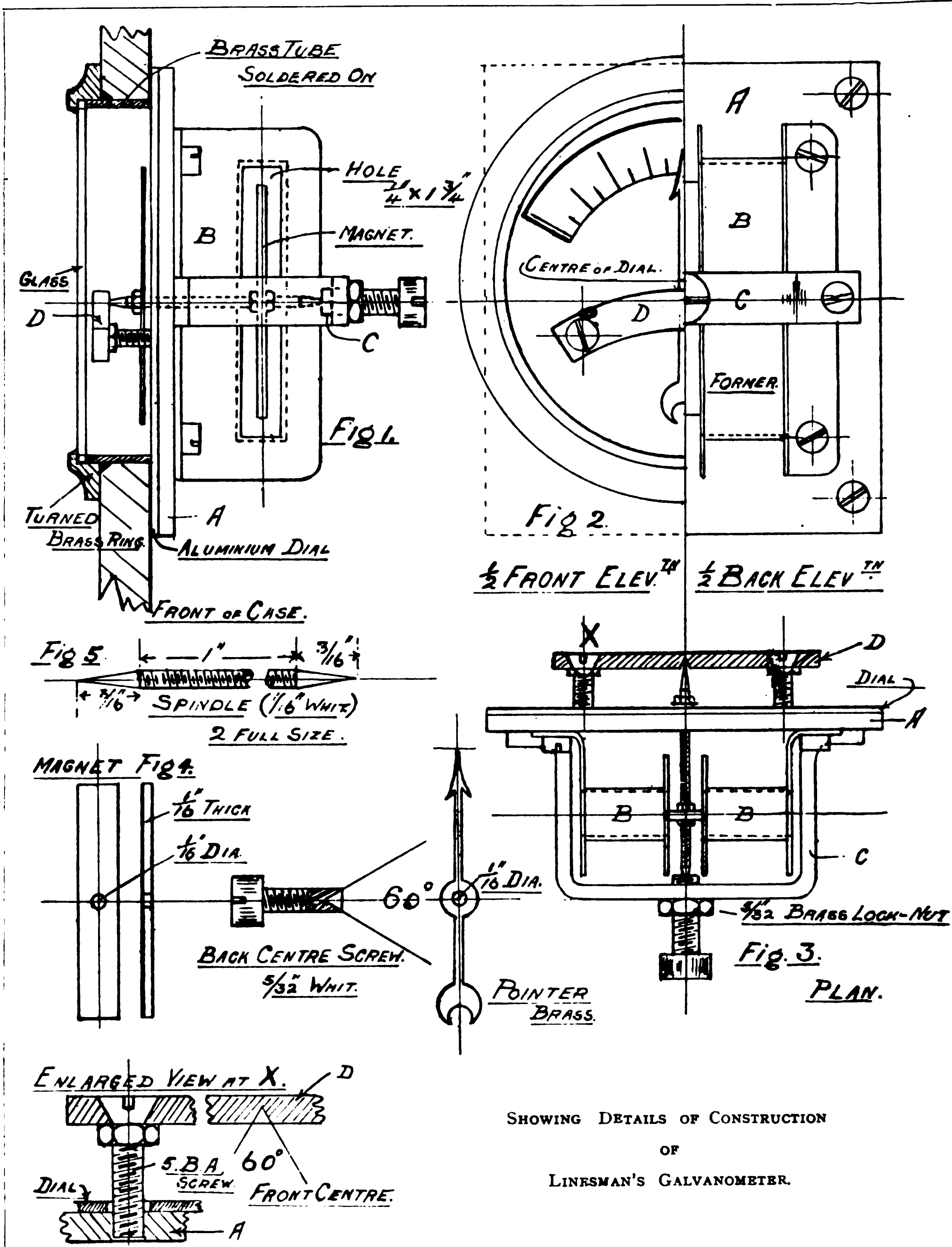


Two Views of a Linesman's Galvanometer.

chiefly by the cells which are placed in it, In my case each half is 6 ins. high by 3¼ ins. wide by 1½ ins. broad—inside measurements. The cells I use are two E.C.C. dry cells, No. 4, improved pattern, 1½ ins. square by 4-ins. high, which are reliable and easily obtained. The sides are dovetailed together, and the front and back screwed on with brass screws. The front must have a circular piece cut out, 2⅜ ins. diameter, to take the dial, the centre of which is 2¼ ins. from the top, before being screwed on. The two halves are hinged at the top with two good brass hinges, the hinges afterwards being used to make contact between the cells in the back half of the case and the instrument in the front half. Two fasteners must be fitted at the bottom of the sides of the case, for keeping it closed, and the case finished off by varnishing or polishing, as desired. A handle of some drilled for screws. The holes through all four sides are 1¾ ins. long by ¼ in. wide, and ¼ in. from the edges. Two distance pieces must now be cut ½ in. wide and about 4 ins. long, and bent so that they are the shape of the holes in the former sides. The sides are now soldered to the distance piece, taking care to have the sides quite square all ways and to leave the winding space smooth.

The back bracket C for the back centre is next made out of 3-32nds-in. brass, 5-16ths in. wide, and bent so that it is a nice fit over the formers. It is drilled and fastened to the backplate by two countersunk 5 B.A. screws. The front centre D is also cut out of the same material to the shape shown in Fig. 2, and then countersunk for the spindle centre.

The magnet (Fig. 4) is made out of best cast steel, 1½ ins. long by ¼ in. wide by 1-16th in. thick·



Showing Details of Construction of Linesman's Galvanometer.

It is drilled with a 1-16th-in. hole in the centre, to suit the spindle; then heated cherry red and plunged into cold water. It must now be magnetised by being placed on a dynamo pole-piece, or by wrapping it with fine insulated wire and sending a current through the wire for a short time.

The spindle is made from silver steel, turned taper at the ends and screwed 1-16th-in. Whitworth, and fitted with four brass nuts for securing the magnet and pointer in position on same. The ends of the spindle are tapered to 30 degs., and the front and back centres countersunk to about 60 degs., and finally hardened.

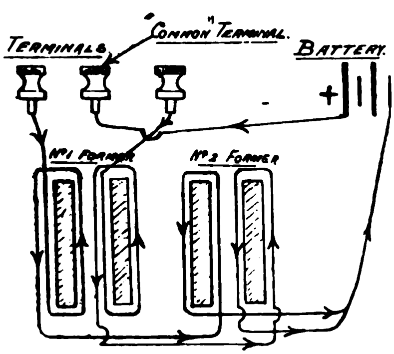


FIG. 6.—SHOWING CONNECTIONS OF GALVANOMETER.

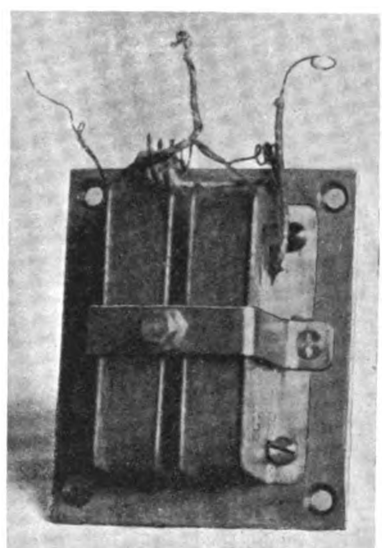
The pointer is cut from sheet brass, to sketch, and is hammered so that it is slightly heavier at the bottom than at the top, so that it always hangs when not in use.

The dial is made from frosted aluminium, the divisions being cut in and then filled in with black enamel, and screwed to the backplate. All brass work ought now to be highly polished and lacquered to preserve its colour.

Having made all the parts, the winding of the formers may be taken in hand. These must first be carefully insulated, and this is easily done with a material sold as "black compound tape." This is an excellent insulating tape with a sticky surface, so that when it is pressed on to the sides of the formers it adheres to them without any trouble. Of course, if this is not handy, then shellaced tape or even paper will do, but it is not so convenient to put on. To facilitate winding the holes through the formers are filled up with a piece of wood and then mounted between centres or on a thin mandrel, so that they may be easily rotated.

The "quantity" wire is the first to be put on, and this consists of two layers of 22 or 24 S.W.G D.C.C. copper wire on each former, care being taken to get the same number of turns on each. Over this is put a layer of tape, and then the "intensity" wire put on. This consists of eight or nine layers of 40 S.W.G. S.S.C. copper wire on each former. Before winding this wire on, a piece of thicker wire would be better soldered to the beginning, and to the end when wound for connecting purposes as 40's wire is so easily broken. In winding these coils a piece of paraffined paper ought to be put between each layer to keep it even, and to insulate one layer from the other. The coils, when wound, will present a very neat appearance if a layer of, say, 28 S.W.G. green silk wire is wound over them, this also serving to protect the fine wire from injury.

The parts can now be fitted together, the back centre screw being regulated to give the magnet a perfectly free swing, but without shake, and fastened by the locknut. The instrument is fitted to the front half of the case by brass screws, and the cells in the back half. The connections are made between the cells, which are connected in series, and the instrument by soldering wires to the under side of the two hinges, hence the reason for having good brass hinges. Three terminals are required on the front half of the case, the middle one being the "common" terminal and the outside ones the "quantity" and "intensity" terminals. In the photograph there appears to be four terminals, but one is a mere "screw-down" switch. Connection between the different ends of the coils and the terminals are next made, and these can be best described by reference to the diagram (Fig. 6), where the thick lines indicate the thick wire and the thin lines the fine wire. Should one of the coils have been wound in the wrong direction, it can be made right by reversing the connection for that coil, *i.e.*, that which was the beginning of the coil connect it as though it was the end, and *vice versa*. Where possible, all connections ought to be soldered, so that there is no fear of them working loose and so making bad contact, and ought also to be well insulated.



Two flexible leads about 18 ins. long should be carried from the terminals for testing purposes, and then, so far as constructional details go, the instrument is complete. In use, the "quantity" coils are used for measuring heavy currents and testing small circuits, and the "intensity" coils for detecting leakages in line wires, detecting a break in the same, identifying the ends of a number of coils, say a dynamo armature, etc.

The "quantity" coils can also be used for finding the polarity of a dynamo or battery, etc., by disconnecting the cell from the instrument and then connecting the required dynamo or battery in its place and noting in which direction the pointer is deflected.

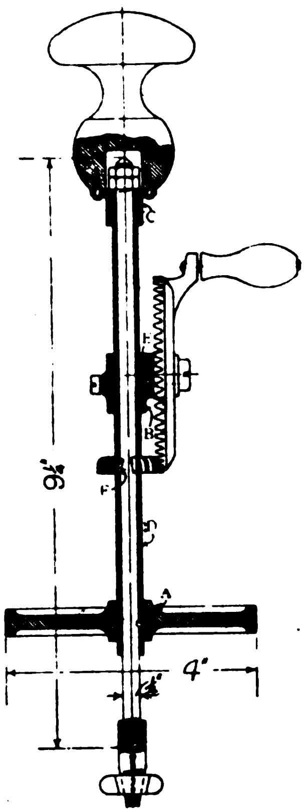
An improvement might be made by fitting a small 4-volt accumulator and switch in place of the two dry cells, so that 2 or 4 volts may be used as desired, for long circuits.

Workshop Notes and Notions.

A Simple Driller.

By Wm. Phelps.

The accompanying sketch shows how the amateur can construct a simple yet efficient drilling machine of small capacity from ⅛ in. down, and I may say it is a most useful tool for model work, and yet costs only a few pence. First procure a length of silver steel, ¼ in. diameter, and a piece of iron tubing with a bore of ¼ in. diameter. The steel rod should fit the bore without a shake. The bracket B should be made as shown in sketch, and is tapped at E to take ¼-in. pin for the large gear wheel to turn on. The collar C can be threaded with ⅜-in. gas. Perhaps the amateur may happen to have a collar, or can procure one from the local plumber, or should he not have a gas tap for threading the collar, it should be bored to fit the tube tight and then pinched with a set screw (same method as the bracket is secured). Three or four holes should be drilled in the flange to take screws to fasten to wood stock. I myself have taken the stock and chuck from a worn-out fretwork drill. The gear wheels are taken off an old egg-beater. The method of fastening the small pinion wheel is shown in sketch at P. The keyway is drilled with a small fretwork drill (you will notice the keyway is not drilled parallel with the spindle). The key is made from a stout knitting pin or 3-32nds-in. silver steel. After driving in the key tight, it should be filed flush with pinion wheel, so that the sleeve D should be slipped up close to the pinion wheel to prevent the key from working out. The sleeve and balance wheel are also prevented from working down by the grub screw being tapped through the boss of wheel and tube and a little way in the spindle, as shown at A. The spindle should now be screwed both ends a little way down to take chuck and locknuts respectively. Clearance is cut away in woodstock so that the lock nuts on spindle may turn without touching the sides of the wood.



A Wire Straightener.

By J. B.

The following is a description of a handy wire straightener which is no trouble to make and is very satisfactory for insulated wire, there being no fear of spoiling the cover. I think the drawings make it clear. The base is a piece of wood 12 ins. by 5 ins. by ¾ in.; at right angles to base are two pieces, 2½ ins. by 5 ins. by ½ in.. to guide wire through the two china knobs, used for cupboard

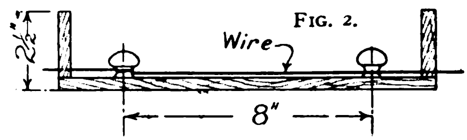


Fig. 2.

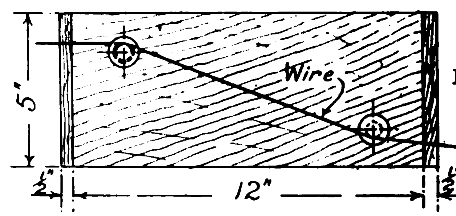


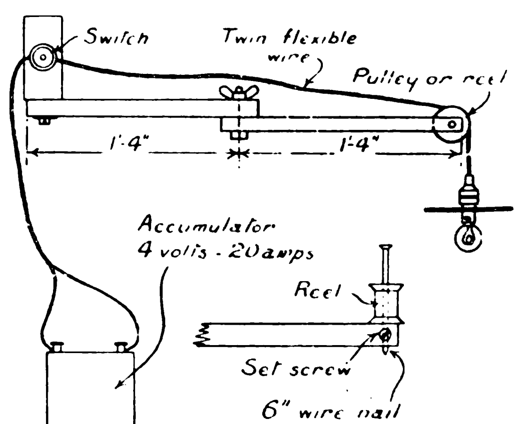
Fig. 1.

doors (8 ins. apart), as Fig. 2. Wire to be straightened is passed through a hole in left-hand upright, once round knob, then across base to other knob, which guides wire out of right-hand upright. Sometimes it may be found necessary to turn the wire once round second knob as well as first. I find the smooth china knobs better than nails, as used for bare wire.

A Handy Electric Lamp Bracket for Lathe.

By A. H. W. Norgate.

However well lights are arranged, it seems impossible to get rid of a shadow on the part being operated upon when working a lathe at night.



The lamp bracket I have devised I have found quite invaluable for throwing a light exactly where it is required. It can be constructed in a few minutes. I find that a 4-volt Osram lamp gives a splendid light with a 20 amp.-hour accumulator, which I replace as required. The light is most useful when changing the wheels also. A tin reflector is also much better than any glass shade.

Recent Contributions to Electric Wave Telegraphy.

PROFESSOR FLEMING'S ROYAL INSTITUTION LECTURE.

(*Continued from page* 89.)

PROF. FLEMING followed up his remarks on high-frequency alternators by an account of the Poulsen system, which has already been described in our pages.

In some introductory notes he mentioned a patent filed in 1892 by Prof. Elihu Thomson in the United States, the object being to produce high-frequency currents continuously. The apparatus described consisted of a condenser and self-induction in parallel with a continuous current arc, the latter being subjected to an air-blast or powerful magnetic field. The oscillations produced in the condenser-circuit by this arrangement were supposed to be due to the partial blowing out of the arc by the air-blast or field when the condenser was at a high voltage, this being followed by an oscillatory discharge of the condenser on the re-establishment of the arc.

Prof. Thomson said that he had obtained oscillations up to 50,000 per second.

Mr. S. G. Brown also has produced continuous oscillations by using, instead of the arc, a revolving aluminium wheel against which a copper spring pressed lightly.

The explanation of the action of the Duddell and Poulsen arcs is based on the following property of the ordinary electric arc.

It has long been known that a slight decrease of current in an ordinary arc produces an increase of the potential difference between the electrodes, and as the resistance of various apparatus is commonly measured by dividing the voltage across the apparatus by the current passing through it, there was at one time a wholly mistaken idea that the arc had a negative resistance. The assumption that the arc must obey Ohm's Law and could have no varying back electromotive forces was, of course, unnecessary.

Returning to the Duddell arc, the instability which makes it possible to obtain undamped oscillations is provided by this inverse relation between potential difference and current for small charges.

Thus, at the moment of switching on the current the condenser is charged and deprives the arc of some of its current; this raises the potential difference between the carbons and causes an increase in the charge of the condenser. Gradually, however, the rush of current into the condenser gets less until a moment arrives when the charge is at its maximum value. The arc is now in a steady state for an extremely short period of time, for the condenser has no sooner reached its maximum charge than it begins to discharge back through the arc in the direction of the main current so that the total current is increased. This results in a decrease of potential difference so that the condenser is able to discharge itself still further, the inertia-like effect of self-induction being sufficient to cause it to overshoot the mark and charge the condenser in the opposite direction to that of the original charge.

Meanwhile, as the current lessens and the difference of potential increases until the former is zero and the latter maximum, when the discharge in the original direction recommences and the whole cycle of operations is repeated.

The action bears considerable resemblance to that of an organ pipe in which the alternate waves of compression and rarefaction represent movements either with or against the main current of air which is blown through the pipe. Just as the values of the changing vibratory pressure in the organ pipe are much greater than that of the steady pressure maintained by the air inlet, so the R.M.S. value of the potential difference between the condenser terminals may amount to 1,000 or 1,500 volts when the continuous voltage across the arc is only 220 or 300.

Two conditions must apparently be fulfilled if this process is to be automatically continuous. The arc must be formed between terminals of such a nature and in such surroundings that rapid changes of its current produce correspondingly large and rapid variations of potential difference *in an inverse* sense—that is, the P.D. must be increased when the current is diminished and *vice versa*. In other words, the characteristic curve of the arc must be a steep and falling one. The characteristic curve is the curve which shows how the potential difference varies with the current.

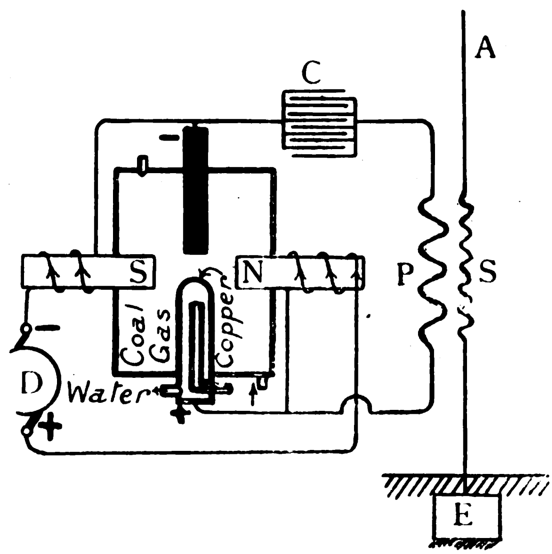


FIG. 1.—DIAGRAM OF CONNECTIONS FOR POULSEN'S APPARATUS FOR GENERATING UNDAMPED OSCILLATIONS.

Fig. 2 shows the characteristic curve of an ordinary arc in air between carbons and that of an arc between copper and carbon in hydrogen. The length of both was 1·25 mm. Needless to say, the latter is by far the best for the production of continuous oscillations. It is also necessary for the arc to have the power of restarting itself if entirely extinguished for a short time, but this should not be possible until the potential difference between the terminals exceeds a certain value. If the arc is formed between carbon terminals these conditions are only satisfied at frequencies up to a certain value and large condensers are necessary, the variations produced being slow enough to cause the emission of musical notes by the expansion and contraction of the air heated by the arc.

Such were the "singing" or "musical" arcs with which Mr. Duddell carried on his fascinating experiments, the frequencies ranging up to 10,000 alternations per second.

Mr. Poulsen's improvements have been dealt with by us elsewhere, and they consist chiefly of devices which tend to a steep characteristic curve resembling the copper-carbon curve in Fig. 2.

Prof. Fleming, who, with Mr. W. L. Upson, has made valuable contributions to the study of the Poulsen arc, finds that the oscillations are not absolutely continuous but are broken up, irregularly into groups of varying length; this was demonstrated by moving, in the neighbourhood of the apparatus, vacuum tubes of small bore which assumed the appearance of a broad band of light broken up irregularly by dark lines and spaces. A neon tube rotated near the coil appeared as a disc of light with dark radial bands here and there. To obtain these high frequency undamped oscillations the strength of field, length of arc, and supply of coal gas must be carefully adjusted with reference to the capacity and inductance used and the voltage of the arc.

Prof. Fleming said that he did not find the apparatus altogether simple and easy to use; slight inexactitude of adjustment caused the arc to fluctuate greatly in current, and sometimes extinguished it, the comparison between the Poulsen system and the ordinary spark-discharge method being distinctly in favour of the latter with regard to general convenience and ease of working.

The great advantage of the undamped waves is that they can be reduced to so small an amplitude that they will not affect other neighbouring wireless receivers which are even only a very little out of syntony, while they can, by the cumulative effects of resonance, actuate their own syntonised receiver at a greater distance. This, however, depends essentially upon the nature of the receiving circuit, and is only true within certain limits.

Prof. Fleming proceeds to further comparative criticisms of the arc and spark methods, and points out that an ordinary 10-in. spark coil takes 1-5th h.-p. when in full work and can send messages 200 miles or more from ships, whereas he finds that at least 1 or 1½ h.-p. must be expended in the arc before sufficiently high-frequency oscillations can be obtained.

At Mr. Poulsen's first demonstration in England, Sir William Preece informed the world with immense solemnity that the arc method sounded the death-knell of spark telegraphy.

We may quote Prof. Fleming's rather amusing words in this connection: "It is always advisable to exercise some caution in issuing obituary notices of well-tried inventions prior to their actual decease, and in this case, although the power to create continuous trains of electric waves will doubtless greatly assist space telegraphy, it does not follow that their generation by the arc method is the best or final method."

Prof. Fleming followed this up by a statement that in the production of continuous oscillations we are not limited to the arc method. Mr. Marconi, he said, had for some time been engaged in developing an ingenious method of creating undamped electric waves for telegraphic purposes which involves neither arc nor alternator, but is a new mechanical method of great simplicity by which astonishingly large alternating currents of very high frequency can be obtained. Long distances were stated to have been telegraphically covered with every prospect of great efficiency.

In concluding his *résumé* of this aspect of the

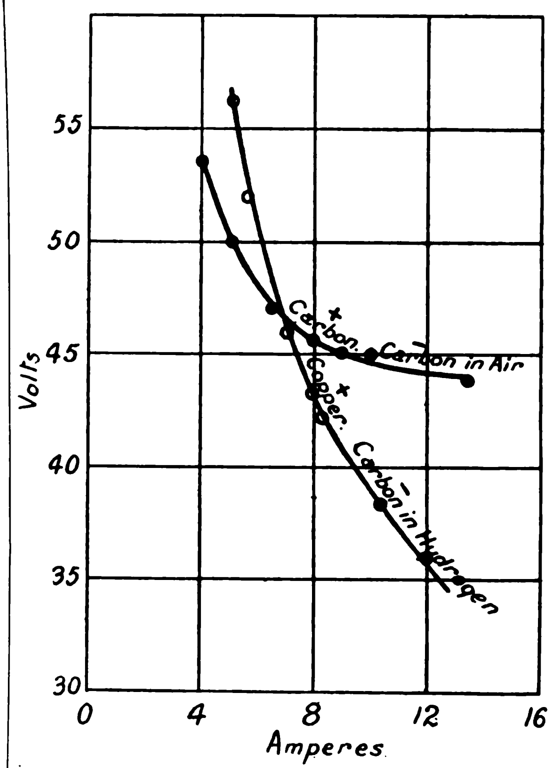


FIG. 2.—CHARACTERISTIC CURVES FOR CONTINUOUS CURRENT ARC IN AIR AND HYDROGEN (UPSON). ARC LENGTH = 1·25 MM.

subject, Prof. Fleming said: "Unfortunately, the incomplete state of certain foreign patents prevents me from entering into details of this method now, but I hope he himself (Mr. Marconi) will be able to do so soon."

We await the development of the method with interest, though similar statements made before in the wireless world have somewhat damped the ardour of our expectations.

(*To be continued.*)

A MAINSHAFT 200 ft. long and driven at one end made three-quarters of a turn there before the pulley on the opposite end moved.—*Wood Craft.*

TRIAL trips have been made on a new railway up the Wetterhorn, which is so steep that it is called an "elevator." It rises 450 metres in a length of 600, which is a gradient of 3,960 ft. per mile or 75 per cent.

see 246

A 16-ft. Windmill.

Designed and Constructed by the New Zealand Government Railway Department.

AT the New Zealand International Exhibition, held at Christchurch 1906–7, a very well-built windmill was exhibited by the New Zealand Government Railway Department. The present writer—struck with the substantial make and clever design of this machine—considered that a description of it would be of use to many readers of The Model Engineer, particularly as some recent correspondence in "ours" has proved the existence of no little interest in wind motors. Application to the Railway Department for particulars was met by a prompt compliance, together with drawings and description, which are here reproduced. For this courtesy—which all will appreciate—I am indebted to Mr. John Coom, M.Inst.C.E., chief engineer, Maintenance Branch, New Zealand Government Railways.

Although the drawings supplied by the Department are complete, from the point of view of an erector, and in any case are clear to one conversant with windmill design, I have presumed to add to them some explanatory matter for the benefit of those who may not be familiar with this class of work. The design is particularly an "engineer's" design—well thought-out, well-proportioned, substantial, and effective in appearance. That many readers are likely to copy it minutely is not for a moment to be supposed, but those who care to investigate a good windmill design will find this an excellent example, and others who wish to build, can undoubtedly found their plans on it with safety.

Before discussing details which require further explanation than the official drawing affords, a short description furnished by the New Zealand Railway Department may be perused, as showing generally the nature of this machine :—

"The windmill erected in the Christchurch Exhibition is the standard pattern used for pumping water for engine purposes on the New Zealand railways.

"The vanes of the mill and framework are built of timber, the working parts, bolts, and stays being of steel.

"It is furnshied with an automatic cut-off, which throws the mill out of gear when the tanks are filled.

"One of these, tested at Rakaia, in Canterbury, raised 650 gallons of water per hour to a height of 40 ft.

"The cost erected complete is £100."

The statistics with reference to the power of the mill, as evinced in its water-raising capacity call for some remark.

The rate of work shown in this instance is only $\frac{1}{4}$ h.-p., and, of course, appears exceedingly small for so large a mill and at such a cost; but such figures are only too often misleading. A 16-ft. windmill, under good conditions and with a good breeze of about 16 miles per hour blowing, should develop about $\frac{1}{2}$ h.-p. easily. There is nothing to show that this mill was not able to do this under suitable conditions. At the same time, it is quite possible that some modification of the sails would produce better results. It will be noticed that the vanes or sails are so close that they present a practically solid surface to the wind. This, until recently, has been considered a desideratum in windmill practice, but unimpeachable experiments have proved that it is very far from being the case. It is not only possible, but indeed very probable, that the removal of two-thirds of the vanes would give a substantially better result, and the writer has no hesitation in advising any prospective builder to design his mill with considerable spaces between the vanes, as indicated above.

Again, the plane of revolution of the sails is flat, whereas experiment has proved the desirability of a concave formation towards the wind. The axis is horizontal, instead of being inclined at a slight angle to meet the wind "square on." Both these points are adverse to the uttermost efficiency, but obviously, both are favourable to simplicity, which is often of much greater importance. They are mentioned here for the purpose of explanation, and to remind readers that many conditions besides efficiency govern an engineer's design.

The windmill illustrated is particularly adapted to water pumping, but there is no reason why it should not be applied to other work. Instead of the crank at the head, a pair of bevel wheels may be fitted, and a rotating shaft take the place of the pump rod. This will even simplify some of the construction.

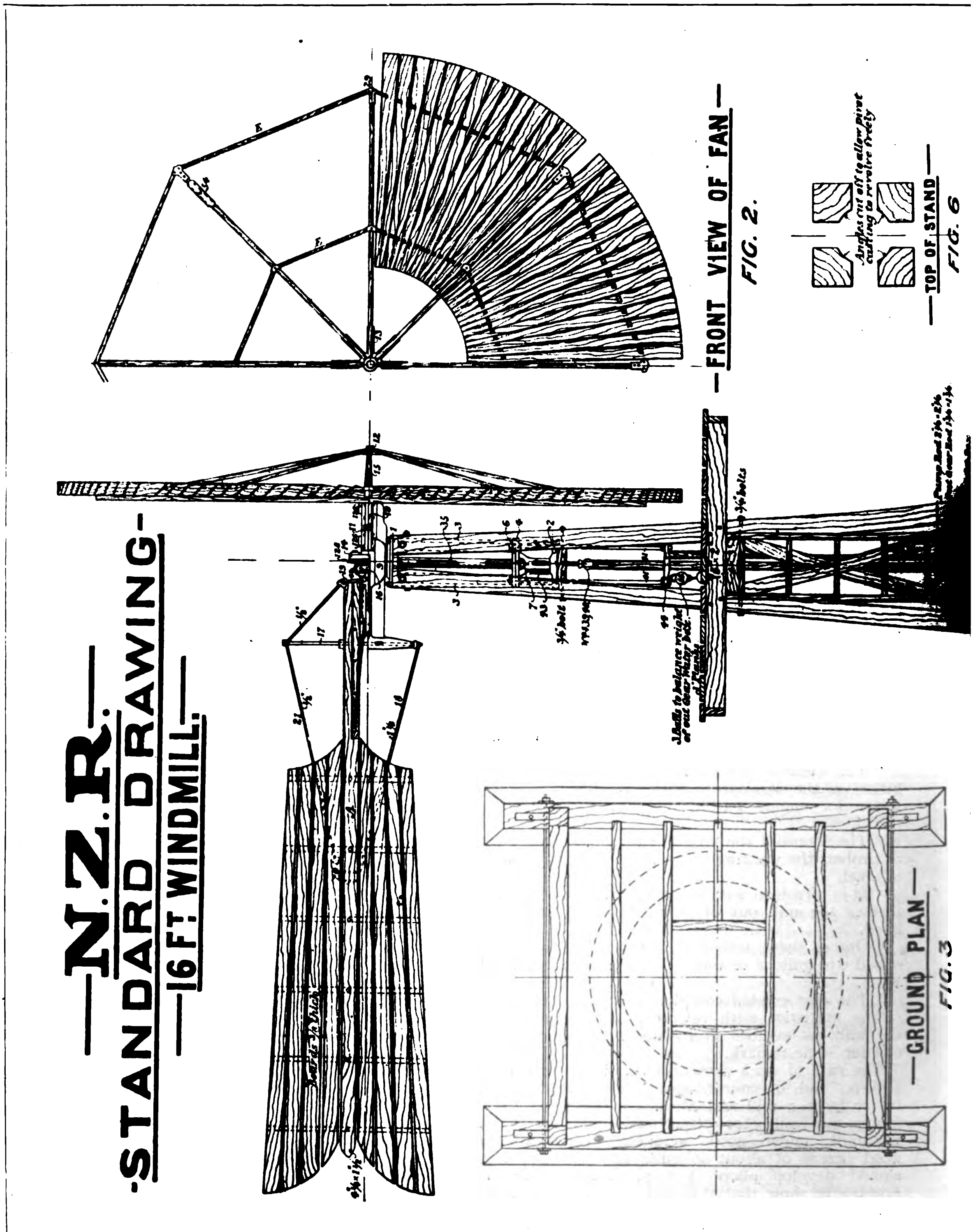
A very careful inspection of the drawings, together with the numbered list of parts, will repay the labour. The main outlines of the design are as follows :—

The sails, mounted on a spider casting, are secured to a shaft (No. 15) which revolves in a long bearing (Nos. 10 and 11). Its inner end carries a crank on a disc, and operates the connecting-rod or pitman (No. 35). The main shaft and its bearings are carried by a somewhat intricate casting (No. 9), which performs several important functions. In the first place, it is capable of revolving (and thereby allowing the sails to face the wind) in a cap casting (No. 1). It has a long tuning-fork shaped extension, which rests on a casting (No. 2) lower down the framework of the tower. In direct line with the axis of main shaft, it carries a pivot and bolt on which is mounted the tail, and at right angles to these on one side is an extension to which is fixed the regulating vane (Fig. 11*), which will be illustrated in the following article.

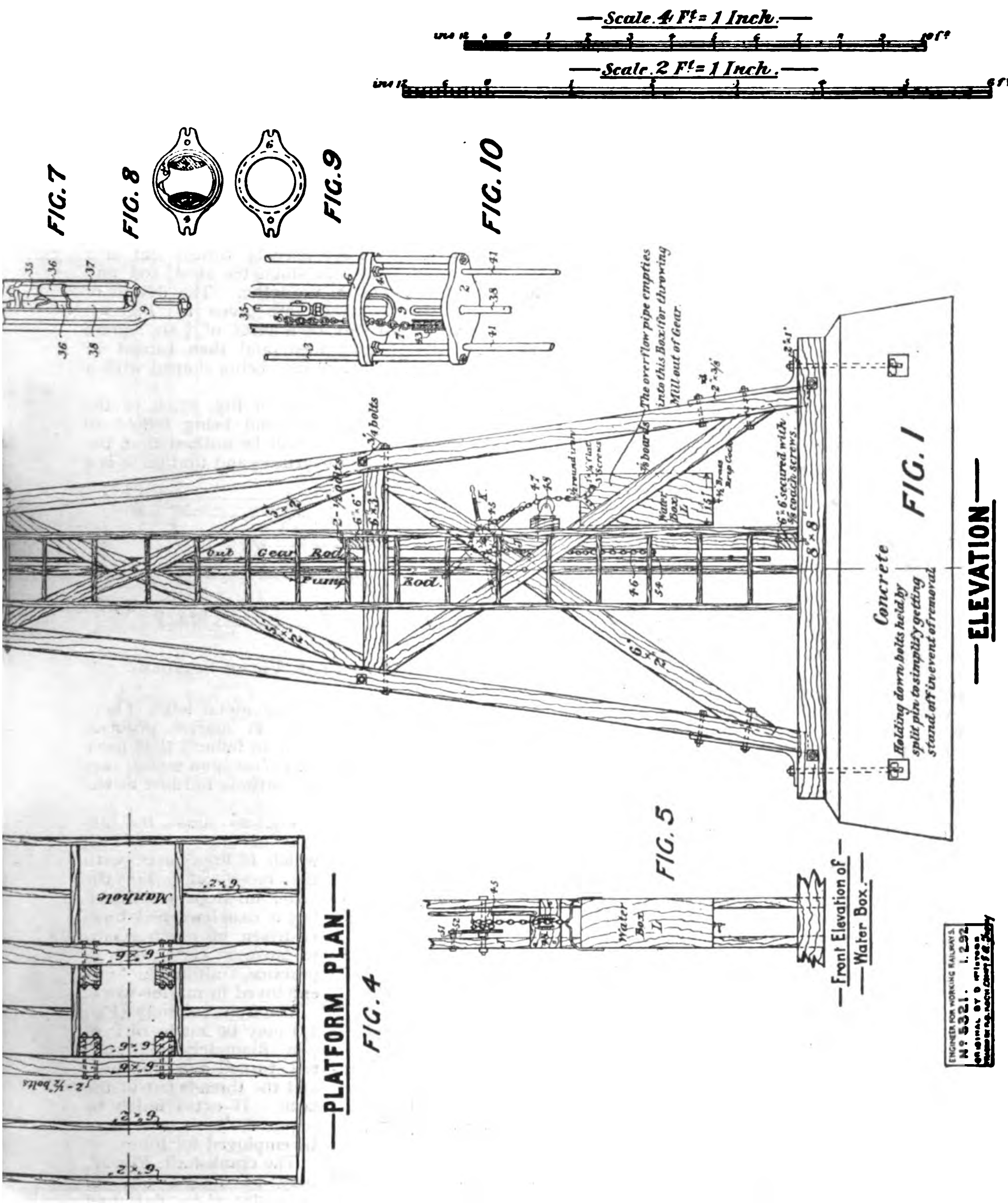
It will be seen that the tail is so mounted that it can swivel on the king-bolt (No. 17), so as to lie almost in the same plane as the sails. (Note its dotted position in Fig. 11*.) Normally, of course the object of the tail is to keep the sails square up to the wind, in which position they are most effective. But in the event of heavy wind—which would not only cause the mill to race, but might also cause damage when so large a sail area was exposed—the side vane comes into play. This has the effect of veering the sails to one side, the tail, of course, still keeping in line with the wind.

Attached to the sail is a semicircular board (B, Figs 11* and 12*) which moves with it and carries two chains (Nos. 7 and 8). These chains are guided round the sheaves (No. 42), down the side of the tuning-fork extension of No. 9, and round a larger pulley (No. 43), which is carried on a stud or screw fixed in the pivot end of No. 9. One of the chains,

* These illustrations will appear in following article.



—N.Z.R.—
—STANDARD DRAWING—
—16 FT. WINDMILL—
—FRONT VIEW OF FAN—
FIG. 2.
Angles cut off to allow pivot casting to revolve freely
—TOP OF STAND—
FIG. 6
—GROUND PLAN—
FIG. 3
3/4 bolts


Scale 4 Ft = 1 Inch.
Scale 2 Ft = 1 Inch.
FIG. 7
FIG. 8
FIG. 9
FIG. 10
The overflow pipe empties into this Box for throwing Mill out of Gear.
Out Gear Rod
Pump Rod
Water Box
8×8
Concrete
Holding down bolts held by split pin to simplify getting stand off in event of removal.
FIG. 1
ELEVATION
FIG. 5
Front Elevation of Water Box.
Manhole
PLATFORM PLAN
FIG. 4

en route for the larger pulley, is attached to the ring (No. 4), and this, it will be seen, carries, by means of the rods (No. 41), the out-gear or shut-off pole G.

The effect, then, of any movement of the head due to the side vane is to cause chains (Nos. 7 and 8) to move the pulley (No 43) and to raise the ring (No. 4) and all that is attached to it. Apart from its own weight and that of the out-gear pole, the weight-box (Fig. 1) has also to be raised, and all these, of course, tend to bring the sails back to face the wind, so that after a heavy puff of wind the sails automatically return to their normal position—square with the tail.

The same gear is used to throw the mill out of use, either automatically or by hand. This is done by means of the tiller wheel K and the water-box L (Fig. 1). The latter tends to pull up the out-gear pole, by means of a chain passing over a pulley or reel (No. 45). It is made to act automatically by the simple but ingenious method of running an overflow pipe into the box from the tank which is to be filled. The hand-action is simply that of applying a virtual weight by turning the reel arms K and so forcing the out-gear rod upwards, which, as before explained, causes the tail to set in the same plane as the sails, which are thus thrown edgewise on to the wind. The automatic part of the gear, of course, is only applicable in the form shown—when the purpose of the mill is water raising; but it is not difficult to imagine a system in which a fully charged accumulator, supplied by a dynamo driven by the mill, might be made to act in a similar fashion.

The foregoing is intended to make the *modus operandi* tolerably clear, as it should do, if the drawings are carefully studied. Some remarks having reference to constructional matters might naturally follow; but, before touching on these, let me add a list of the figure numbers, with such details as may be called for by the drawings.

Fig. 1 (scale, 4 ft. to 1 in.) is the general arrangement of the mill, as seen in side elevation. The side regulating vane is not shown at all in this view. Note that the four 6-in. by 6-in. uprights are not straight, but curve like the corner pillars of the Eiffel Tower.

Fig. 2 (4 ft. to 1 in.) is a (half) front elevation of the sails and arms.

Figs. 3, 4, 5, 6 (4 ft. to 1 in.) are self-explanatory.

Figs. 7 to 10 are to a scale of 2 ft. to 1 in. They must be studied in connection with the same parts, as shown in Figs. 1 and 12, and are simply intended to show the working gear for the raising of shut-off pole G. Fig. 7 is part of the tuning-fork portion of pivot casting, with pitman and guides. Fig. 10 shows the same part, but with rings, rods, and chain, as already described.

Fig. 8 is not perhaps easy to understand at a glance; but the sections of the two arms of "tuning-fork" (9, 9) are to be noted, and are embraced by the *two* rings 4 and 5. The latter turns in a suitable groove in the former, and the small hole is for fastening the lifting chain to it. The peculiar shape of this casting is simply to ensure that ring 5 shall remain in one position relatively to the pivot casting (9, 9), though it is, of course, free to move up and down with it, together with rings 4 and 6. Ring 5, indeed, is clasped between these others, and the object of this arrangement is to provide for both the vertical movement of all the rings together, with independent circular movement on the "tuning-fork" casting. The attachment of chain to ring 5 ensures its alignment with the pulleys 42 and 43, over which it has to pass.

(*To be continued.*)

Design for a Small Compound Marine Type Engine.

By W. Muncaster.

(*Continued from page* 178.)

THE H.-P. and L.-P. valve spindles are shown in Fig. 23. They may be turned out of a piece of 5-16ths in. diameter steel rod and the screw thread cut on the lathe. The details of the valve spindle guides are given in Fig. 24. These may be cut out of a piece of ⅜-in. square mild steel rod roughly filed, and then turned in the lathe, the jaws afterwards being shaped with a file.

The connecting-rod, shown in Fig. 25, is of the usual marine type, the top end being forked to take the crosshead in. It will be noticed that the crutch is shaped with flat surfaces and that there is a comparatively large amount of metal left. There has lately been a tendency in marine practice to make this part heavier, due to failures that have taken place here. The steps, of gun-metal, are designed so that they can be entirely finished in the lathe.

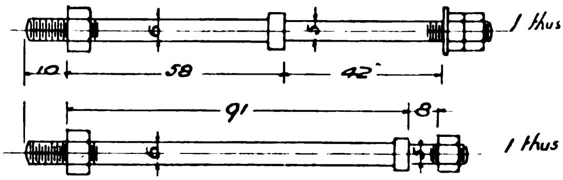


FIG. 23.—H.-P. AND L.-P. VALVE SPINDLES.

Fig. 26 shows the details of the piston-rod, which is in a piece with the crosshead. To the latter no steps are fitted, but a case-hardened bush is driven in which seems to answer very well in practice, although not employed in marine work.

The front columns (Fig. 27) may be made out of ⅜-in. diameter mild steel rod, turned and polished, and the threads cut in the lathe. If extra finish be required, tool steel may be employed for these.

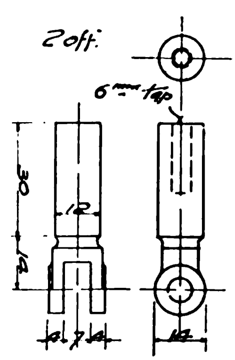


FIG. 24.
VALVE SPINDLE GUIDES.

The crankshaft, Fig. 28, may be forged out of 2½-in. by 1¼-in. flat mild steel, the ends and middle part being swaged down to about ¾ in. diameter. The middle part is then well heated, and the cranks twisted to bring them to planes at right angles with each other; a final swaging of the middle part will generally finish a

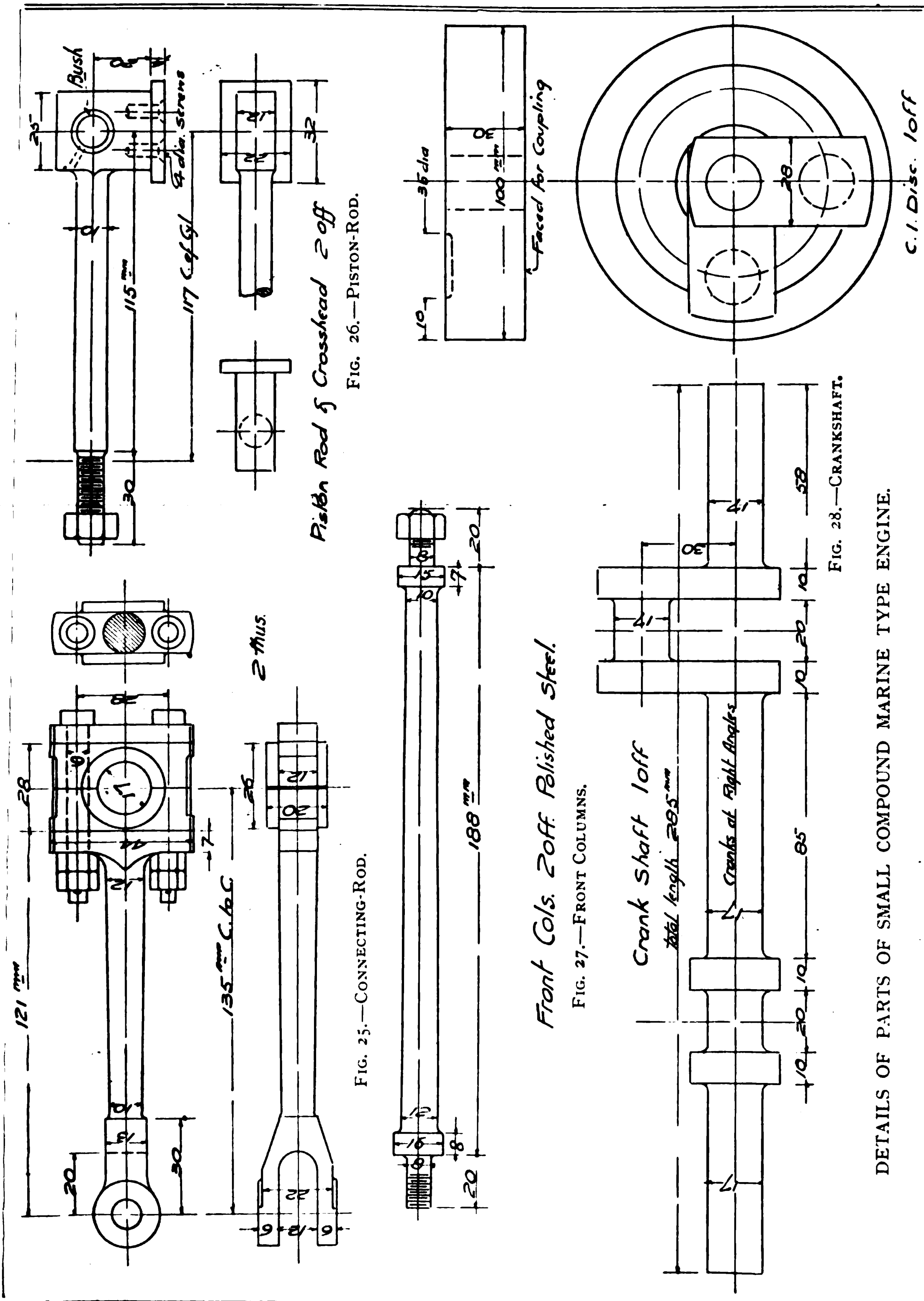


Fig. 25.—Connecting-Rod.

Fig. 26.—Piston-Rod.

Fig. 27.—Front Columns.

Fig. 28.—Crankshaft.

DETAILS OF PARTS OF SMALL COMPOUND MARINE TYPE ENGINE.

satisfactory forging, especially where the cranks are some distance apart, as in the present instance.

A suitable disc is shown, to act as a flywheel and coupling. Where a dynamo is connected the armature will be found to give the necessary momentum. A flywheel will add to the appearance and steady the running of the engine, about 6 ins. diameter and 1½ ins. width of face would be suitable.

(To be continued.)

Recent Developments in *X*-Ray Apparatus.

(Concluded from page 204.)

MR. K. SCHALL, of 75, New Cavendish Street, London, W., also exhibited a multiple anode Wehnelt electrolytic interrupter, with improvements to deaden the noise usually made by electrolytic interrupters, which is often an objection. Each anode is enclosed in a rubber air cushion bag contained in a porcelain case, with the result that the interrupter was almost noiseless though passing a current of 16 amps. It was working one of Mr. Schall's improved induction coils, the primary having four windings. These are arranged in short ebonite tubes, and can be removed without disturbing the secondary coils. The larger sizes of the induction coils, viz., from 12 to 24 ins. spark length, are made with this system of multiple primary windings for the purpose of varying the self-induction, an advantage when an electrolytic interrupter is used. Control of the interrupter and coil was by a switchboard of special design, which had two important features. One of these was the protection of the contacts of the regulators by glass discs so that an operator manipulating the switches, in a darkened room is not liable to receive a shock by accidentally touching the metal parts. The other is an arrangement of mounting the resistance coils and connection so that the marble front and fittings can be easily removed by unscrewing some nuts at the back, leaving the coils and connecting wires in perfect order and undisturbed. These switchboards give, according to the makers, the most complete control it is possible to obtain. The illustration clearly shows the protective glass discs over the regulator and reverser contacts. An arrangement of switches is made so that the self-induction of the primary coil can be altered four degs., a mercury jet or Wehnelt type interrupter inserted in the circuit and the different anodes of a multiple Wehnelt type interrupter changed over. The standard arrangement of resistances is for a maximum current of 12 amps. for a mercury jet, or 25 amps. for an electrolytic interrupter. Mr. Schall has kindly lent two interesting illustrations, showing photographs of the different character of discharge from one of these

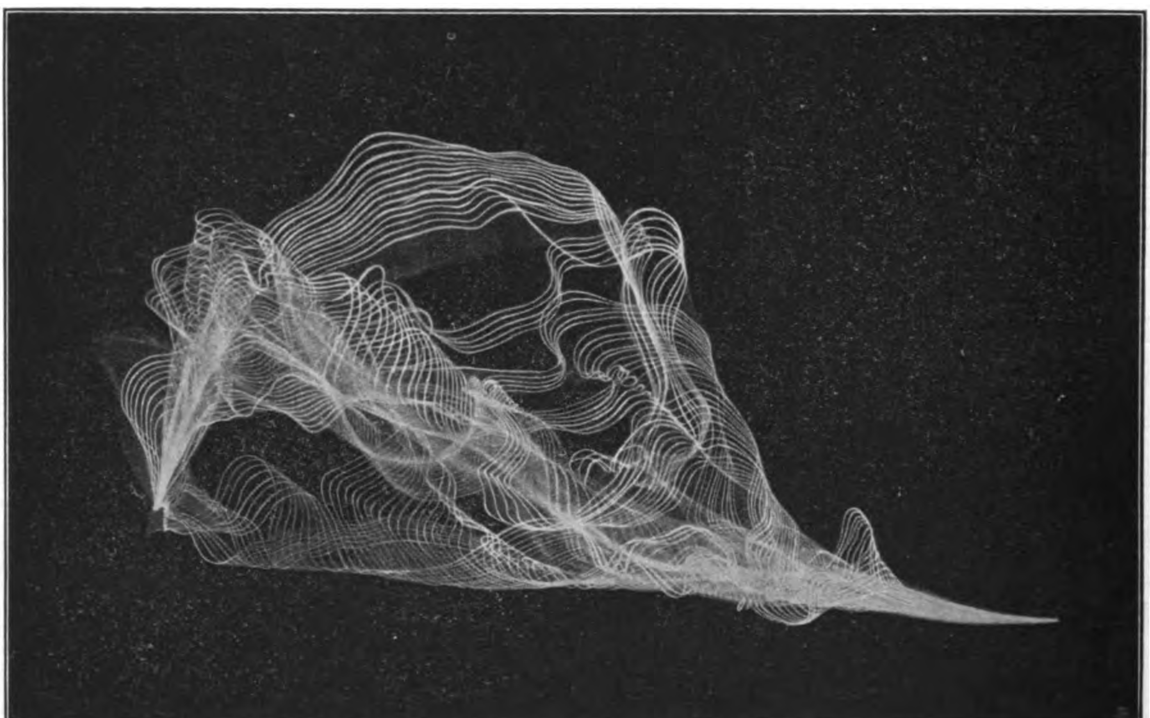


FIG. 14.—PHOTOGRAPH OF DISCHARGE OBTAINED FROM A SCHALL INDUCTION COIL WORKED BY WEHNELT INTERRUPTER.

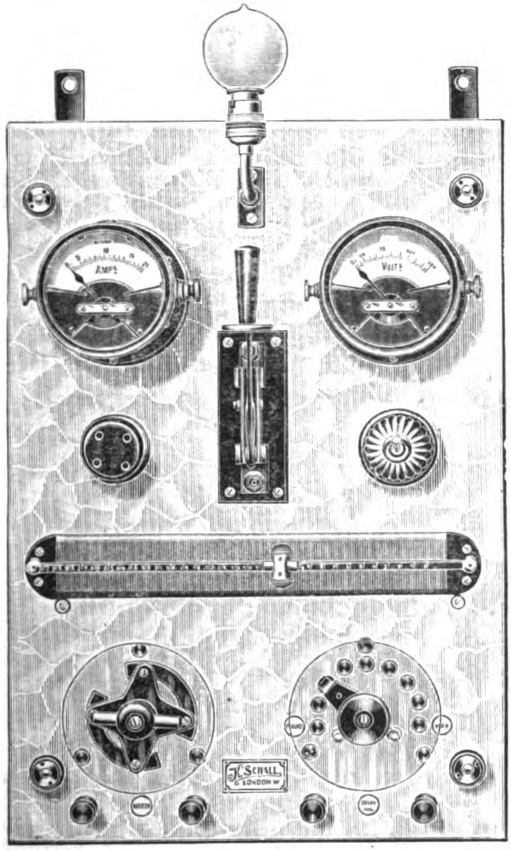


FIG. 13.—MR. K. SCHALL'S CONTROL SWITCHBOARD WITH GLASS-PROTECTED CONTACTS.

induction coils. This exhibit included a recent pattern of orthodiagraph, an instrument by which outlines, showing actual size and position of the heart or other organ can be traced upon paper or the patient's skin, with the aid of a beam of *X*-rays. The *X*-ray tube, a metal diaphragm which is pierced with a small central hole, and the fluorescent screen are mounted upon rods, so that they are in the same axial line with the source of the rays. At the back of the tube is a pencil, also in axial line with the hole in the disc. The patient is placed between the diaphragm and the screen. A ray passing through the central hole will thus be in line with the pencil, and passing through the patient, will throw upon the screen a shadow of a point upon the heart or other organ which is in its path. The tube disc and screen, being mounted upon movable balanced levers can be moved about by the operator to trace a series of points upon the curved outline of the heart, etc., each point being observed by him as it is shadowed upon the screen. As the operator thus follows the outline, each point is recorded upon a sheet of paper stretched on a fixed board at the back of the apparatus. The pencil point is normally away from the surface of the paper, and is pressed against it by a pneumatic transmission (as each point is determined); the indiarubber ball is held in the hand of the operator when in use. In Fig. 16 the paper sheet is placed in front of the patient and the marking pencil operated direct by hand through the fluorescent screen. The patient is not necessarily in an upright position, as the apparatus can be tilted to any angle and examinations can be made over a horizontal couch. Reference to the illustration shows that the tube disc and screen move together and are always in a straight line. The bar upon which their supporting rods are clamped, rotates in a bearing which slides backwards and forwards in the horizontal slotted frame. They thus have universal movement in a vertical plane.

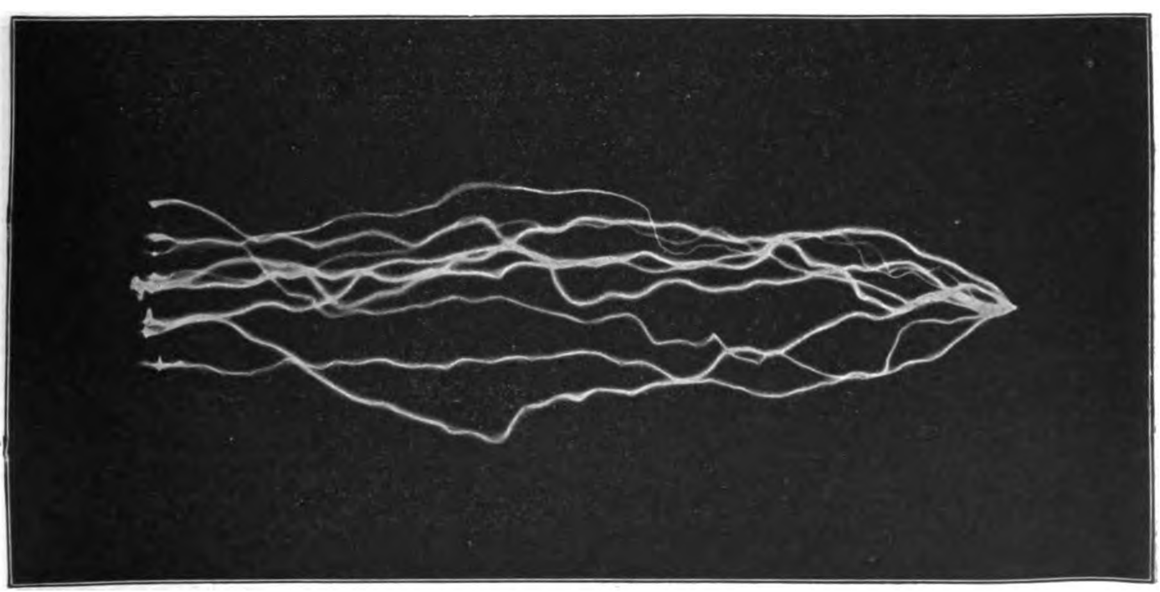


FIG. 15.—PHOTOGRAPH OF DISCHARGE OBTAINED FROM A SCHALL INDUCTION COIL WORKED BY MERCURY JET INTERRUPTER.

Electric motors are steadily becoming more useful in medical work. They are not only used for driving surgeons' drills and saws, but are being arranged as converters to supply single and polyphase alter-

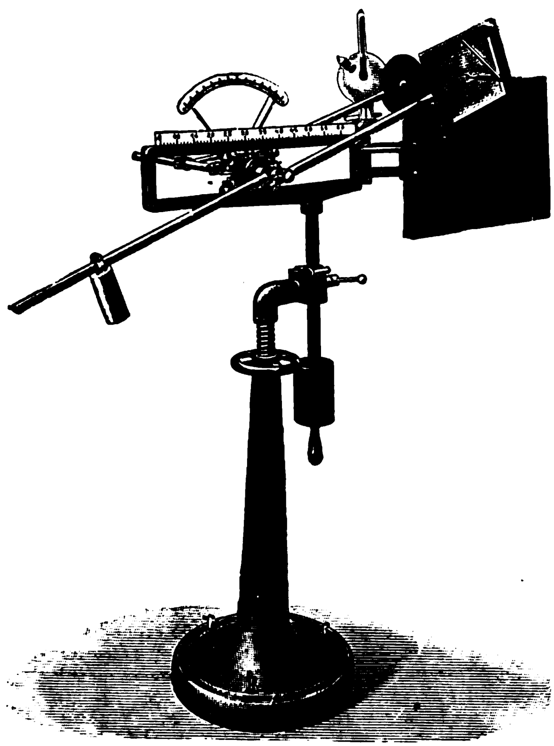


FIG. 16.—MR. K. SCHALL'S ORTHODIAGRAPH FOR MAKING DRAWINGS OF HEART, ETC.

nating current from continuous current supply mains for treatment, lighting low-voltage examination lamps and heating cautery burners, etc., also for driving centrifugal apparatus for analysis of liquids and apparatus for vibratory massage.

Mr. A. E. Dean, of 82, Hatton Garden, exhibited one of these universal motors. It is fitted with collector rings, from which the alternating current is taken, and a small static alternating current transformer is fixed on the base for the purpose of reducing the voltage. A speed regulating resistance is arranged under the motor; it is operated by the switch handle shown at the right of the illustration. The transformer is undei the commutator bearing; in front of it is a small slide resistance for the purpose of regulating the current. Various fittings for massage, a head lamp, and cautery holder are shown. The flexible shaft is to take drills, saws, and massage fittings, etc.

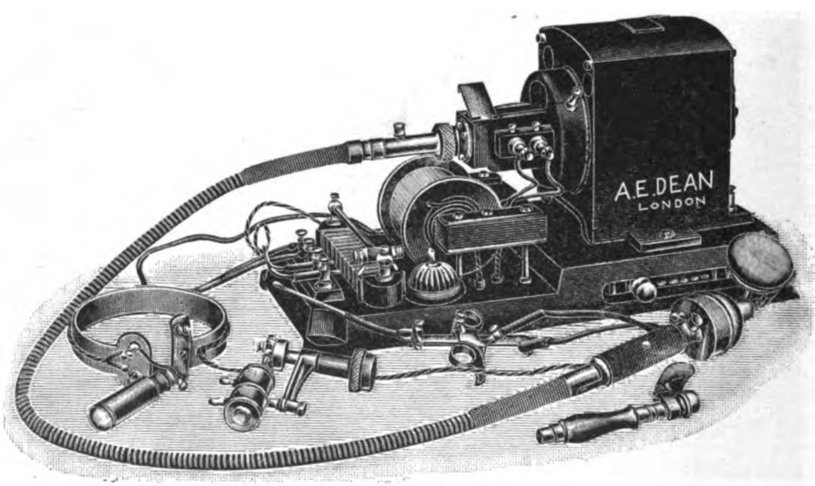


FIG. 18.—MR. A. E. DEAN'S UNIVERSAL ELECTRO-MOTOR FOR MEDICAL PURPOSES.

Some special X-ray tubes were exhibited by Mr. W. R. Walters, of 19, Denmark Street, Charing Cross Road, London, W.C., who undertakes repairs

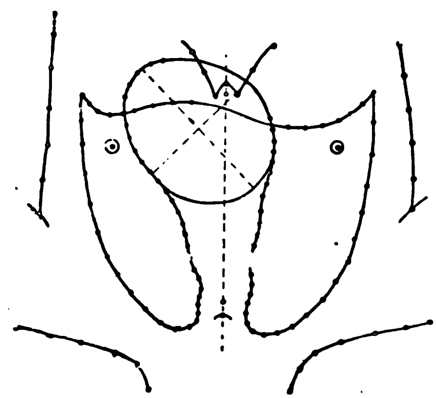


FIG. 17.—AN ORTHODIAGRAPH SKETCH.

to all kinds of tubes and will re-build them to his system, making an allowance for the old plates.

In conclusion, we have to thank the Electro-Therapeutical Section of the Royal Society of Medicine and their hon. secretary, Dr. Morton, for a very interesting evening. We also desire to acknowledge the courtesy of the several manufacturers mentioned, who have very kindly placed their blocks and information at our disposal.

Practical Letters from Our Readers.

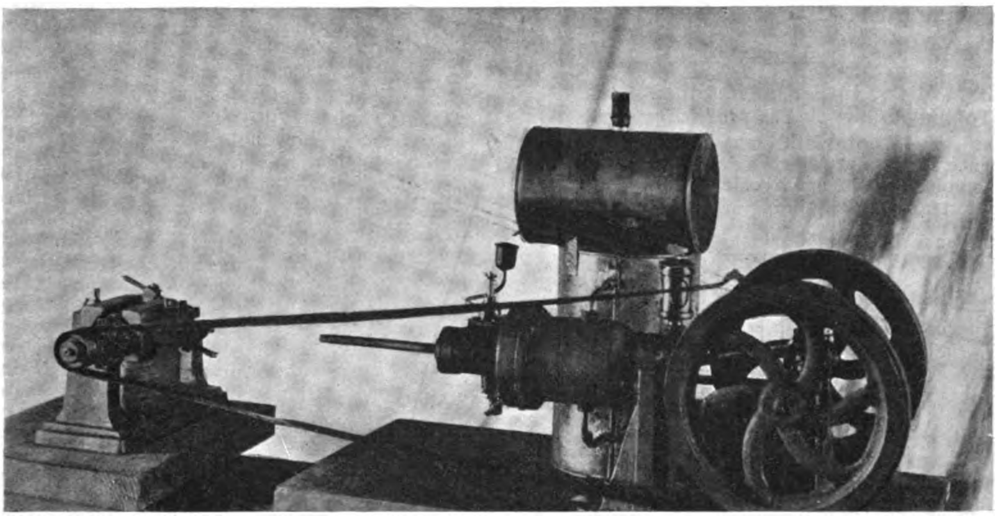
[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily for publication.]*

An Electric Light Plant.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—The accompanying photograph is of my electric lighting plant, and a few details may be of interest to some of your readers. The castings were bought from a firm advertising in THE MODEL ENGINEER. The engine, an oil one, is of the Otto type. The dimensions are: Bore of cylinder, 2 ins.; stroke, 2½ ins.; crankshaft, ½ in. in diameter; crank-pin, 7-16ths in.; flywheels, 9 ins. by 1 in. broad. Speed, about 500 r.p.m. Bearings are fitted with grease cups, and sight-feed oil cup to cylinder. The dynamo is an overtype shunt-wound machine, and gives about 25 volts 5 amps, at a speed of 2,500 r.p.m. This was my first attempt at model building, and I have had little or no trouble with either engine or dynamo since they were completed.

JOHN STEPHEN.



MR JOHN STEPHEN'S MODEL GAS ENGINE AND DYNAMO.

Re Model Shipbuilding Trade.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—In reply to "H. B. H.," No. 18,561, where he asks about the prospects of becoming a ship modeller, I may be able to give him a little information.

In the shipyards where they employ modellers they are usually men who have been employed in the yard, and in all cases I believe they get the metal fittings made for them.

There are very few firms of model makers who make both the model and the fittings complete, there being about three in Glasgow, one in Sunderland, one in Manchester, and one in London, while there are several fitting makers in Glasgow, Sunderland, and Newcastle.

"H. B. H." will see from the above that even should he succeed in getting apprenticed to the trade, the after prospects are not at all rosy, and he would probably do better by sticking to his present trade, because, even should he find employment when a journeyman, the wages are about £2 for a week of 53½ hours.

The trade was very much better some years ago, when the better class model yachting helped to keep things going, but now there is very little professional model yacht building.

In conclusion, I may say that I myself served seven years apprenticeship, but am now working at quite a different trade, because there are no signs of the business ever again being worth anything.—Yours truly,

H. S. S.

Glue for Model Boat Building.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—In reading through the "Queries and Replies" column of "ours" to-day, I notice your correspondent No. 18,578 is in a difficulty *re* the best glue to use for fixing parts of his model ships, and probably I can help him if he will use the following recipe, given me by a photographic friend some years ago, and which I can assure him is absolutely waterproof, and holds better and stronger than anything I ever used. I made a model steamer hull two years ago on the "bread and butter" plan, and glued it with the preparation, and to test it left it floating six hours, and it never showed any signs of leaking or opening out. Of course, it might not be suitable (owing to its thinness) for the purposes of fixing the planking, as querist suggests, by itself, but I think, with your suggestion of a few fine screws driven through the edge of the planks at fairly long intervals to keep it in place until the "glue" sets properly, will answer the purpose very well. The recipe is as follows :—

Take a 6d. packet of Nelson's No. 1 gelatine, and soak it in water until it swells, and will absorb no more water. Pour off any surplus water, and put the gelatine on the fire (in any pan handy) until it is just melted, and when it is just beginning to boil stir into it thoroughly ½ oz. of *glacial* acetic acid. Take off the fire at once and keep it in a jar covered up with a piece of parchment, and it will keep for any length of time.

To use, warm up the jar in a vessel of hot water and apply as thinly as possible with a brush; squeeze well out, and set the work aside for about twenty-four hours, when the surplus may be rubbed off with glass paper.

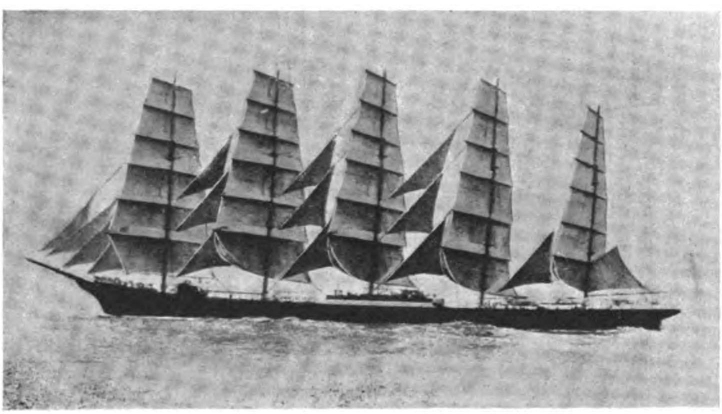
I hope this will be of service.—Yours truly,

J. S. Relton.

Model Full-Rigged Ships.

To the Editor of *The Model Engineer.*

Dear Sir,—I note with great interest the correspondence on model full-rigged ships. As yet no one has volunteered to give scale drawings or necessary information for building same. If this could be done, I am sure it would be greatly appreciated and help some of your readers. I enclose photo of the *Prussien*. It was taken in mid-ocean. This was referred to in a recent issue and will be of interest to some readers.—Yours truly, G. K. H.



The Five-masted Sailing Ship *Prussien.*

Re A Long Speaking Tube.

To the Editor of *The Model Engineer.*

Dear Sir,—It is required to put down some means of speaking over a shooting range of 500 yards, and I was thinking of using a telephone for the purpose, but as it would probably be frequently out of order and would also have to be laid in the ground, as we cannot use overhead wires, I have discarded that idea. Now, I would be very glad if you would advise me about a speaking tube. My idea is to lay one ½-in. or ¾-in. steam pipe in the ground and get the necessary fittings for same for each end. Could any of your readers tell me if it would be possible to speak over that distance and be heard plainly. I shall be glad if you could give me any advice on the matter.—Yours faithfully,

W. B. W.

Fleetwood.

The Society of Model Engineers.

[*Reports of meetings should be sent to the offices of* The Model Engineer *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.*]

London.

By kind permission of Messrs. D. Napier & Son, Ltd., a party, numbering between 45 and 50, of the members visited their fine works at Acton, on the afternoon of Saturday, February 15th, and saw the famous six-cylinder Napier cars in every stage of construction. Under the guidance of the Chairman of the Society and Messrs. Lane, a very complete inspection was made. Starting in the general machine shop, the huge assembly of automatic tools of all descriptions was inspected. These included a very large number of self-acting grinding machines for finishing the surfaces of cylinder pistons, crankshaft journals, etc., some of these machines being shown at work for the delectation of the members. The testing shop was next visited and a six-cylinder engine, coupled up to a device for taking the brake horse-power, was shown in motion. The smith's shop, where springs and forgings of various parts were being made with the aid of a power hammer and other devices, excited much interest; as also did the moulding shop, where preparations for the casting of some large cylinders and crank chambers were in active progress and the members gained much practical knowledge of moulding and removing patterns from the sand, watching the expert craftsmen engaged in these operations. Passing through the marking-out room, where members of the staff were engaged in their interesting work, the party reached the power house which excited great admiration for its cleanliness and general arrangement. The whole of the machinery in the works is electrically driven by motors taking current at 235 volts pressure, the shafting being divided into a number of units each with its own motor. The electrical energy is supplied by a Westinghouse 8-pole continuous current slow speed dynamo direct-coupled to a very fine horizontal compound Ruston-Proctor condensing steam engine of 250 h.-p. Another multipolar dynamo by the Electric Construction Co., is also installed direct-coupled to a large size National gas engine. Considerable time was then spent in the erecting shop, where chassis in all stages of completeness were examined, the party being greatly impressed with the magnificent workmanship shown in every detail of their construction. Items of particular interest were several racing cars, one of which, an 80 h.-p., recently attained a speed of 117 miles an hour on Brooklands track. The engine-fitting bays, the gear box steering, carburettor, electrical ignition, clutch and axle departments, were all visited in their turn, and critically examined, special interest being taken by many members in the action of the differential gear. A noticeable feature of these works is the remarkable order and cleanliness observable everywhere. Another point that struck the visitors was the extreme care and accuracy with which each part is made and the rigid examination and test of everything after it leaves the machine and before it is put on a chassis. The system would appear to preclude the possibility of any fault in the finished car.

After a hearty vote of thanks to Messrs. Napier for the pleasure given to the members that afternoon and to the guides aforementioned for their services, the party dispersed about 6 p.m.

FUTURE MEETINGS.—The next meeting will be held, on Wednesday, March 18th, when Mr. D. Corse Glen, M.I.Mech.E., will give a short paper on his experiences in the inspection and testing of engineering materials. The following meeting is fixed for Tuesday, April 7th.

VISIT.—The visit to the Stratford Works of the Great Eastern Railway Company, will take place on Thursday, March 26th. Members wishing to be present should no-tify the Secretary without delay.

Readers are reminded that now is a very favourable opportunity for joining the Society, a half yearly subscription paid now covering the eight months to October 31st next. Full particulars and forms of application may be obtained from the Secretary, HERBERT G. RIDDLE, 37, Minard Road, Hither Green, S.E.

Dublin Society of Model Engineers.

THE above newly formed Society has held two meetings during the current year, mainly devoted to business matters. At the January meeting the officers and committee for 1908 were elected, Mr. P. S. Sheardown, M.I.E.E., being elected president, Mr. E. M. Murphy hon. treasurer, Mr. J. A. Cotter hon. secretary, Messrs. Connell, Dillon, Mayne, Blood, Kelly, Kearney, and Henley committee. A large number of interesting models were exhibited, and several of the Society's coveted certificates of merit were awarded. A model yacht, by Mr. E. M. Murphy, was much admired, and Mr. Skelton's model locomotive and T.B.D. also received their due meed of admiration. The other certificates went to Mr. Wynall for electrical apparatus and Mr. Henley for a water motor.

The February meeting was held on the 20th inst. in the Pillar Café, and after the routine business was transacted, the meeting adjourned to the Society's new rooms, at 32, Lower Abbey Street, to inspect the arrangements which had been made. The rooms comprise a large meeting-room capable of accommodating over 100 members, a library —for which a large number of volumes have already been acquired, and where the current numbers of all the leading engineering periodicals will be at the disposal of members, the place of honour being, of course, occupied by " Ours "—and a well-equipped workshop. The latter, of course, formed the leading attraction, its equipment including a 3-in. centre lathe, with slide-rest, a smaller plain lathe, a work bench, and an extensive supply of ordinary and special tools. The workshop and library are not yet fully equipped, as a delay has occurred in the delivery of special electric light fittings for the former, and the numbering and cataloguing of the volumes in the latter form a task still to be faced by the energetic committee.

The model yachting side of the pursuit seems to have attracted much attention in Dublin, and, recognising this, the Committee have made preliminary arrangements for a model regatta, to be held in July. The publication of the conditions, etc., would be at present premature, as the arrangements are subject to revision. Full details will, however, be shortly published, and, given fine weather, the function should be a brilliant success. Over 100 entries have been provisionally promised for this regatta, most of the races of which will be open to the public.

Enquiries and applications for membership should be addressed in the first instance to the Hon. Secretary—JAMES A. COTTER, 32, St. Anne's Road, Drumcondra; or, at the Society's premises, 32, Lower Abbey Street, Dublin.

Liverpool and District Electrical Association.

ON March 7th, Saturday, the members of the above Association will pay a visit to the works of the British Insulated and Helsby Cables, Prescot, by 2.30 p.m. train from Lime Street.—S. FRITH, Hon. Sec. and Treas., 77, St. John's Road, Bootle, Liverpool.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[18,971] **150-watt Machine Low Voltage Winding.** T. B. S. (Burton-on-Trent) writes: Will you kindly let me know gauge and amount of wire for armature and field coils of the 150-watt dynamo (Fig. 11 in your handbook No. 10) to give an output of 20 amps. at 8 volts to be shunt wound?

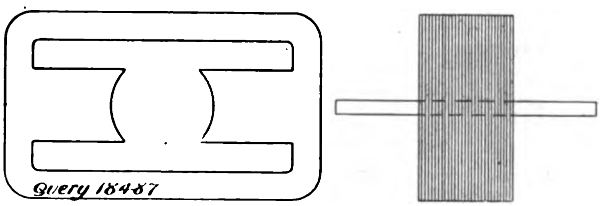
Wind armature with as much as you can get on of No. 14 S.W.G. and field-magnet coils with 4½ lbs. No. 16 S.W.G.

[18,935] **Motor for Electric Boats.** R. T. S. (Colchester) writes: I am contemplating making a model locomotive which I intend to be driven by electrical power. I want to make the model like the present G.E.R. express engines. Will you please oblige

me with a drawing of the latest G.E.R. express engine? I should like to make the model 1¾-in. gauge, so would like a drawing for that size. I should be obliged for a front elevation as well. Will you also please tell me the best material to make the boiler, footplate, and frame with, as this is my first attempt at making an engine, and I do not want to make these parts so that the current will run away? Will you please give me your opinion upon the boat motor upon the enclosed leaflet (the size marked)? Do you think it would drive a boat which weighs 16 lbs. at four miles per hour? The motor to be supplied by accumulator 4-volt 10 amp.-hours.

You will find some particulars and drawings of Great Eastern Railway locomotives in recent issues of this journal, any of which we think would be suitable for your purpose. You say, "I do not want to make these parts so that the current will run away." If you use the frame of the engine as a return path for the motor current, the other leads of the motor (that is, those of opposite polarity) should, of course, be well insulated so that the current on its way to the motor does not leak to the frame of the engine before it has passed through the motor armature. *Re* the boat motor, particulars of which you enclose, these are practically 10-watt motors and your accumulator should be capable of supplying sufficient current to drive one such motor. We cannot give any guarantee as to the speed you will obtain, as very much depends upon the design and workmanship of the boat concerned. It is a matter for actual trial and experiment.

[18,487] **Small Motor made from Scrap Tin.** J. M. (Glasgow) writes: Being a reader of THE MODEL ENGINEER, perhaps I might take the liberty of asking a few questions regarding electric motors. (1) Would an armature 1 in. diameter by 1 in. long, constructed of laminations cut out of ordinary "tin," work at all satisfactorily? I mean the tinned iron that ordinary syrup cans etc., are made of, which, I think, is about 1-100th in. thick. (2) Would a motor of the Lahmeyer type, as shown on page 20, of



Handbook 14, do, with the field-magnet laminations placed at right angles to the spindle instead of parallel to it, as shown in my sketch above? I intend making the field-magnets of the same tin as the armature, if you think the motor would run. Any information would be very acceptable.

(1) Yes, but most of the tin should be cleaned off by wiping with a rag when the laminations or larger sheets, are quite hot. (2) Yes. But the fields do not need to be laminated unless the motor is intended to run on alternating current.

[18,827] **Miscellany.** J. H. (Blyth) writes: How do you take the lids off accumulators made of celluloid, as I want to take the plates out to clean? Where could I obtain dials about 4½ ins. in diameter, divided up from 1 to 100, and what price would they cost? What is the proper way to measure up horse-power, and what would 1 h.-p. pull?

Use amyl acetate for dissolving the top of your accumulator to get the lid off. *Re* dials. You would probably have to get these specially made for you; any of the electrical instrument makers advertising with us would quote you a price on application. Your third query *re* horse-power is very vague. You should study some text-book on the subject, such as Jamieson's book, "Applied Mechanics." You will also find a short description and method of arriving at horse-power in our handbook, "Gas and Oil Engines," together with notes on testing.

[18,934] **Gearing for Clockwork Machine.** G. F. P. (Muswell Hill) writes: I am thinking of making a strong clockwork machine to be worked by a weight. I think of making it with chain wheels as in cycles. The first wheel having 120 teeth ½-in. pitch, the chain working on to a wheel with six teeth, would that multiply by twenty in one step and is that the best way to apply such a high step or would it be best to work it cog to cog? If so, my first wheel would be 20 ins. in diameter working on to one 1 in. in diameter, which I am afraid would wear away very quickly.

We do not quite grasp what you wish to be at. If you would gear from one wheel having 120 teeth on to another having six teeth—each wheel of the same pitch, of course—you will get a ratio of 20 to 1. In the same way, if you gear from a 20-in. wheel to a 1-in. wheel you will also have a ratio of 20 to 1. As regards wear and tear, we should say, speaking generally, that it would be advisable to use larger wheels than those mentioned in order to avoid the smaller of the two being so small, but this is a matter which could only be settled definitely by anyone in possession of the full particulars and conditions under which the mechanism will work. If only small powers are concerned then the 20-in. to 1-in. wheels should be quite satisfactory.

[18,994] **Model T.B.D.** T. H. (London) writes: Will you kindly explain if it is necessary to have a lead keel to the model torpedo boat described in your handbook, "Model Boat Building"? If so, would you kindly tell me the most practical way of fitting same? It seems to me, according to the book mentioned, that it is not necessary to fit one. I have also looked up different articles on "Model Racing Craft," described in THE MODEL ENGINEER for some time back, but can find nothing mentioned on the matter. The boiler I have for the above boat is a single flue with cross tubes and return tubes, and the lamp is as described in your handbook, "Machinery for Model Boats." The engine will be a compound slide-valve type.

No lead keel is required for this craft, but the engine and boiler must be arranged so that the centre of gravity comes below the water line of the vessel—the lower the better. We hope very shortly to publish some details and particulars of various speed boats from which we think you will obtain some useful information which will help you in the construction of your own craft.

[18,740] **Gas- or Oil-Fired Vertical Boiler.** D. M. (Kilmarnock) writes: I intend to make a small vertical gas-fired boiler. I want it to evaporate 6 cubic feet of steam per minute at a pressure of 60 lbs. per sq. in. I shall be much obliged if you would tell me the size of boiler and the size of heating surface I should need.

6 cubic ft. of steam = $6 \times 1{,}728$ cubic ins. of steam, which at 60 lbs. pressure is equal to

$$\frac{6 \times 1{,}728}{353} = 30 \text{ cubic ins. (approx.) of water per minute.}$$

You will require a boiler with a shell measuring 12 ins. or 14 ins. diameter by 24 ins. high, and fitted with 70 tubes ⅝ in. diameter. This would give about 3,200 sq. ins. of tube heating surface, and if properly fired would evaporate the amount of steam required; about six burners of the "Primus" type might be used. For rough usage the "Vesuvius" or "Hekla" non-silent burner would give the greatest satisfaction. The shell may be made of 3-16ths-in. steel with a double-riveted seam, and the end plates should be stayed in the centre. The tubes should be expanded in with end beads over the tube plates. If you prefer gas firing, we recommend the suggestion for increasing the efficiency of the flame contained in the recent query.

[18,656] **½-I.h.-p. Boiler.** A. T. (Eton) writes: Would you be so kind as to let me know what sized boiler I should require to drive a horizontal steam engine ½ h.-p., 1¼-in. bore, 5½-in. stroke? Could you also tell me where I should be likely to get one with necessary fittings, including a force pump? I have been very successful over making my first engine, as I have already seen it working on a friend's boiler, and so far as I know, it works as well as it should.

We recommend you a boiler built after the design in our handbook No. 6, "Model Boiler Making." You can obtain a boiler of this kind from T. Goodhand, 37, Paget Street, New Brompton, Gillingham, Kent, with force pump and all fittings.

[18,550] **Boiler and Oil Burner.** W. D. (Bradford) writes: I should be glad if you would kindly answer my query: (1) What size boiler will be required to drive slide valve horizontal engine, 1½-in. bore, 3-in. stroke. (2) Also, what size burner will be required; oil burner preferred?

(1) There are many types of boiler to choose from. However, a vertical boiler with a large number of small flue tubes and without waterspace firebox will do very well. We recommend either 9–10-in. by 16-in. boiler, with 25 to 30 tubes, ⅝ in. diameter, fired by an "Intensive" stove with four burners; or, for heavier work, a 11-in. by 18-in. boiler with 30 to 35 tubes, ⅝ in. diameter, fired by an eight-burner stove of the same type.

[18,946] **Fitting Magneto to Gas Engine.** D. G. Y. (Crouch End) writes: We are thinking of fitting a magneto to our gas engine (Crossley's 3 h.-p.). (1) Are magnetos reliable? (2) Is there any after cost after fitting? (3) Can repairs be done by an inexperienced person? (4) Are there any magnetos that fire at any speed? I think I have seen one fitted to the petrol engine at the South Kensington Museum. (5) Who are the best people to go to? (6) What will the cost be, roughly speaking, for a good reliable one? It must be reliable as it is wanted in Japan, where repairs will take a long time to finish. (7) Are there any to use with magneto sparking plugs for gas engines, or will the way described in your book on "Gas Engines" be better? How long ought a sparking plug to last when it is used continuously for six out of seven days every week?

(1) Yes. (2) There is sure to be at one time or other some slight repair necessary, but nothing to speak of. (3) Yes, anyone with ordinary intelligence and who has looked up the subject can easily undertake this work. (4) There are various forms and makes, and up to fairly high speeds the ordinary magneto ignition device runs quite satisfactorily. (5) Messrs. Blake & Co., of Station Parade, Kew Gardens, London, S.W., would supply you. (6) The price would vary from £4 to £7. (7) We do not grasp what your difficulty is or what you want to know. Spark plugs last indefinitely and only require cleaning occasionally.

[18,843] **Electric Motor for Sewing Machine.** B. K. (Wandsworth) writes: I shall be pleased if you can help me with the following. I wish to drive a sewing machine by power of some kind, and I should like to know the best way of doing it. I have a small workshop and could manage an electric motor. (1) What power should I want? (2) What would be the simplest type as my capabilities are limited? (3) Can you give me a rough sketch showing sizes and windings? (4) Could I drive it with a battery or should I use the mains, which are about 220 volts I am told. I would run about six hours a day. (5) About what would be the cost (*a*) for the motor, (*b*) for the battery or accumulator if I made them, (*c*) for running expenses per week?

There would be no difficulty in making or buying an electrical motor to work the sewing machine, but the trouble would lie in the direction of obtaining a large enough battery to supply the motor with current. A 60-watt motor (as Fig. 12 in our handbook, "Small Dynamos and Motors") would meet your requirements. The batteries to supply this would have to be five in number in series, each cell to be capable of discharging at 6 amps. rate; that is, each cell would have to contain 1 sq. ft. of positive plate surface. Wind your machine for 15 volts 4 amps. If you run off the mains you could also use one of the motors described in handbook preferably wound for 100 volts. In this case a 100-watt motor would be more suitable and you should use a starting resistance which any of our electrical advertisers could supply, either with or without a motor. The running expense would depend very largely upon the efficiency of the motor, etc., and the price you can obtain current for. Roughly, we should estimate the cost at about 1d. per hour.

[18,928] **Portable Power Set.** D. M. (Malta) writes: I am intending to make a small workbox, about 12 by 16 by 28 ins., but as I want to have a small bench lathe amongst other tools and I would like to have it driven by power, would you kindly tell me which would be the best—electric, steam, or oil, as I want to get a maximum of power in the minimum of space. The lathe would be about 12 ins. long, which I intend to make myself or buy through the advertisement columns of your paper if I can. If I choose electric power, could I drive the motor from two dry cells or any other kind of simple cell? I am a soldier, hence my unusual request. As my box would have to be as light and portable as possible, I hope you will be able to help me through THE MODEL ENGINEER.

In reply to your enquiry *re* power for driving small lathe, steam is quite out of the question, and an electric motor we are afraid is also barred on account of the size and weight of the batteries required to give any appreciable power. We think, perhaps, the simplest and most convenient form you could use would be a small petrol or oil motor, though even this would be comparatively heavy. We should say a small high-speed petrol motor giving about 1-6th to ¼ h.-p. would be the best to use, although a great deal depends upon the work you intend doing on your lathe. We might add that dry cells, or in fact any form of primary battery, would be quite unsuitable for driving a motor.

[18,884] **Bichromate Cells.** J. P. R. (Sunderland) writes: (1) I have two ½-pint bottle bichromate batteries, as per sketch (not reproduced) and should be pleased to know if these connected in series would be sufficient to charge the following accumulators (one at a time)—one 2 volts 5 amp.-hours, and one 2 volts 10 amp.-hours. (2) If not, how many more will I require? (3) What proportions or quantity of chromic and sulphuric acid will I require per cell with the fluid at the height given in the sketch, which is just about level with the top of zinc when right down? (4) Will I need any resistance? If so, will an Osram lamp do? Give size. (5) How long will each respective accumulator require to charge? (6) Would you recommend the zincs fully immersed for the whole time in charging? If not, how much? I notice in the current issue of THE MODEL ENGINEER, in your reply to query 18,564, you refer to recent numbers *re* primary cells. I regret that I haven't these numbers, and should feel very much obliged if you can furnish me with the information I am seeking.

As your bichromate cell will not give more than 2 volts, it will be necessary to have two such cells in series for charging your accumulators. It would, however, be advisable to have two in series and two in parallel in order that they may not become run down so quickly. A good electrolyte for chromic acid cells consists of the following proportions—12 ozs. of chromic acid, 11 pints of water, 1 pint of concentrated sulphuric acid. No resistance will be required in charging, but if you require to charge at a lower rate, it would be advisable to use two sets of cells in series, thus obtaining four volts. If the difference in pressure between the charging cells and the cells to be charged is not so great, the flow of current will also be somewhat less than in the former case. We recommend you to look up a list of our back numbers, which you will find useful.

[18,974] **Electric Motor Boat.** D. R. D. (London) writes: I started taking in your splendid paper about six months ago, and became fired with the ambition to own a model. Having very little time at my disposal, I had a hull built. For many reasons I prefer electric power, but, knowing very little about boats and nothing of electrical matters, I am at a standstill. An answer to the questions below would be much appreciated. The boat is 3 ft. 5 ins. long. The hull is of cedar and is "built up." Her design is similar to the motor boat described in THE MODEL ENGINEER, September 7th, 1905. (1) How many pounds ought a 3-ft. 5-in. hull to carry easily? (2) Is it possible to mount two electric motors to work twin screws in a boat of her size? (3) Assuming she can carry two motors, would a couple of Thomson's "Greenwich" motors, each weighing 1¼ lbs., and giving 1,500° to 2,000 r.p.m., 4 to 6 volts, suitable for a 4-ft. boat, be too powerful for my 3-ft. 5-in. hull? Would one motor be too powerful? (4) Can I run the two motors from one accumulator, the consumption of current of one of above motors being 1½ to 3 amps.? (5) What power accumulator should I require to drive one motor only? (6) Is there a petrol engine suitable for marine work small enough to fix in my boat if electric power does not suit me? (7) Which would give most satisfaction, a single or twin-screw boat?

(1) You should put the hull in water and load her up until she sinks to her proper L.W.L., then weigh the cargo, and this will give you her carrying capacity at her proper displacement. (2) You could use two electric motors for twin screws, but we should not advise this course. (3) The motors you mention are about the best you could use for this purpose. We should say one motor of about 20 watts size would be suitable. (4) Provided you can carry sufficient large accumulators to give the required output, namely, 6 amps., you could use the two motors. (5) It is always the weight of the accumulators which is the limiting factor in such jobs as this. The actual size of the motor is quite a secondary matter. Allowing, say, 1½ to 2 lbs. weight for your motor, you should devote all the extra available carrying capacity to your accumulators. (6) If you read up the recent articles and notes on our speed boats, you will find some useful information. Particulars of Mr. Arkell's model petrol boat should assist you also. (7) Twin screw boats have many advantages, but the disadvantage is that if two motors are used the efficiency of the whole business becomes greatly reduced, because the smaller the motor the smaller the efficiency.

The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

* *Reviews distinguished by an asterisk have been based on actual Editorial Inspection of the goods noticed.*

The Directors of John Oakey & Sons, Ltd., recommend the payment of a final dividend of 5 per cent. to the ordinary shareholders, making a total of 10 per cent. for the year, and in addition a bonus of 5 per cent. free of income-tax. They also recommend that £3,000 of the year's profits be carried to the general reserve, raising this account to £80,000, making, with the capital reserve, a total reserve of £83,734 16s. 10d., leaving a balance of £8,311 3s. to be carried forward to next year.

Messrs. S. Holmes & Co., of Bradford, ask us to state that trouble with the engine at their works has been the cause of delayed delivery of a number of orders. They have decided to put in a larger engine at once, and hope soon to catch up the arrears.

New Catalogues and Lists.

Goodwins Engineers, Leek.—This firm have sent us an advance copy of a new 72-page illustrated catalogue they are issuing. It deals with lathes, chucks, drilling machines, twist drills, grinders, shaping machines, vices, small tools, workshop fittings, model steam engines, gas engines, locomotives, steam fittings, etc. It is a very comprehensive production, and should be found of interest by many of our readers.

Moeller & Condrup, Ltd., 78, Fore Street, London, E.C.—A new catalogue of wickless oil stoves, blow-lamps, furnaces, etc., has reached us from this firm, who are sole agents for the well-known "Primus" specialities of this nature. It is a very complete list, giving not only particulars of complete lamps, but also prices of spare parts for repairs and renewals. The "Primus" blowlamps are adapted to a number of different industrial and domestic uses, many of which are doubtless familiar to our readers.

Carburation, Ltd., Byron House, 85, Fleet Street, London, E.C.—This company are putting on the market a new form of carburettor for petrol motors of all kinds. It is claimed for this device that it effects an immense saving in consumption of petrol; that it increases the speed capacity and power of the motor; and that it saves much of the trouble by avoiding the necessity of making frequent changes of gear. The invention is fully described in two nicely-printed booklets issued by the company, which will be sent free to any of our readers who are interested in motor work.

The Editor's Page.

THE following is to hand from "L. G. T." (Tufnell Park):—"With reference to the series of articles at present appearing in your Journal on 'How to Become a Mechanical Engineer,' may I be permitted, as a humble, though enthusiastic reader, to pass a few remarks regarding the instalment contained in your issue of the 20th inst.? I notice in the paragraph in which Mr. Marshall gives some advice to apprentices and pupils upon entering the profession, he states that 'He' (the apprentice or pupil) 'should associate with the workmen as one of them.' Of course, this policy, when looked at from a certain point, is a very sound one; but do you not think yourself, Sir, that, owing to the way in which your worthy contributor words this hint, that it is likely to convey to the juvenile, and perhaps the adult mind, that he (the learner) should place himself upon good familiar terms with both his inferiors and equals? Well, this is advisable when looked at in a certain sense; but there is this view to take of the matter:—A lad (if he be at all diligent) should naturally desire to make the first good impressions upon his superiors, and give his fellow-workmen second consideration. Therefore, he can make a very good one by not being too familiar with those around him, since, as it is widely known in all professional circles, and I have learnt from personal experience, that the more reserved a workman is, no matter what his grade be, the more responsibility and reliability will be placed upon him by both foreman or any other person in authority. I do not mean that he should be haughty, or that he should consider himself elevated, either socially or in any other form; but simply to bear in mind that he is employed by his superiors and that to them first consideration is due. *Then*, when he has established for himself a good reputation among his chiefs, he may (still without being too familiar) interest himself a little more in those with whom he is more directly connected."

* * *

We do not think that many of our readers are likely to misunderstand the meaning of the author of the articles in question, but in any case we hardly agree with the views of our correspondent, "L. G. T.," on the proper behaviour of an apprentice. We are quite sure that any apprentice who maintained an attitude of reserve, to put it politely, towards his fellow workmen, in order to demonstrate his superiority to his employers, would have a very unhappy time in the shops, and deservedly so, for he would thereby write himself a snob. While the apprentice is within the four walls of the factory he is but a unit in the industrial army, and a pretty insignificant one at that. The men around him are, so far as their technical skill and knowledge go, his superiors in every sense, and he should respect them greatly on this account. It is largely on their good-will and kindly help that his advancement in practical knowledge will depend, and the more he makes himself one of them in the sense of endeavouring to attain the same ability in his work and by way of mutual consideration and friendly co-operation, the more will he be appreciated by his employers. In our own apprenticeship days there were men in the shop who evoked in us an admiration amounting almost to reverence by the skill with which they did their work, and we still have the liveliest recollection of the many kindnesses we received at their hands in the way of useful instruction and explanation. While, of course, there are "undesirables" in every large works, there are also many men of sterling character and principles working at the bench, and there should not be the least difficulty for any lad of common-sense, however good his private social position may be, in maintaining perfectly friendly relations with the men around him in the shop without forfeiting his self-respect or without injuring his position in the eye of his employers in any way. Indeed, the best test of the real worth of a lad is the way he gets on with the men. The apprentice who is popular with the workpeople is the apprentice who is going to make headway in after life.

Answers to Correspondents.

A. H. (Pernambuco).—We have not any details of this method of cleaning ship's hulls. You might experiment, as you already have some of the required plant, and perhaps glean some further particulars from some of the men who are working on the jobs.

Contents.

[The asterisk (*) denotes that the subject is illustrated.]

THE

Model Engineer

And Electrician.

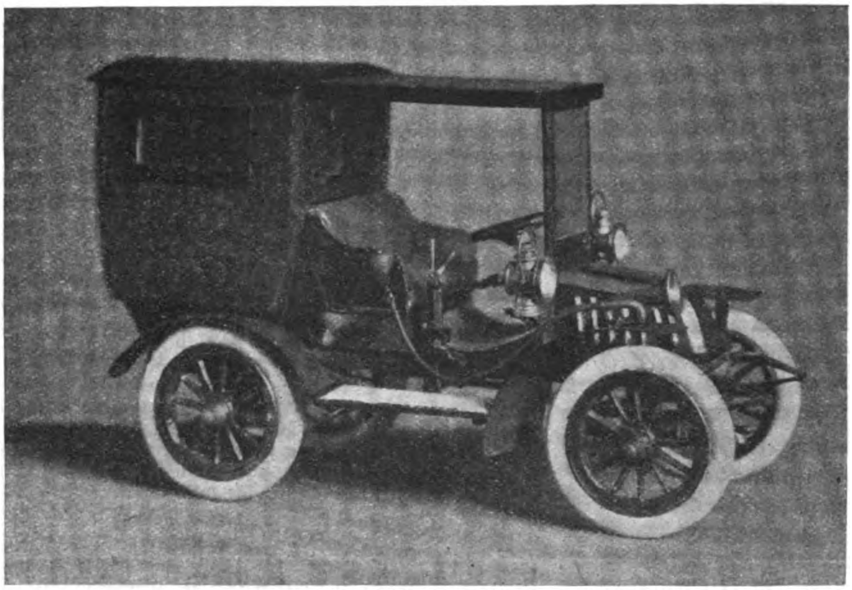
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 359. MARCH 12, 1908. PUBLISHED WEEKLY.

A Model Motor Car.

By PERCY W. MAYHEW.



MR. P. W. MAYHEW'S MODEL MOTOR CAR.

THE car illustrated herewith is made principally of ash, ebony having been used on parts where extra strength was necessary, and minor parts of brass. The cab contains a moderately powerful clockwork motor, there being no room under the bonnet, which can be disconnected from the rear axle by a clutch and can be operated by a lever at the side of the car, so that when the car is at a standstill the motor can be worked. The car is controlled by a lever under the steering wheel, which works on a brass plate provided with notches. The motor can be attended to by means of a door at the back of the car. All wheels have springs made of oak, and by cutting them very thin, they have a fair amount of resiliency. I have gilded the parts where wood is used in place of brass, such as the horn, wheel bosses, etc. The lamps are made of wood. The mudguards were of tin bent on a template and fixed by brackets with small screws. The wheels are made of hardwood, and the tyres are turned on. The seat is upholstered with black leather. A foot-brake is also fitted, and on working same it presses a band on to a pulley fixed to the rear axle. The frames are tenoned, screwed, and glued.

The principal dimensions are as follows: Wheelbase, 7½ ins.; diameter of wheels, 3 ins.; total length, 13 ins.; height, 7½ ins. width, 5¾ ins.

How It is Done.

[For insertion under this heading, the Editor invites readers to submit practical articles describing actual workshop methods. Accepted contributions will be paid for on publication, if desired, according to merit.]

Boring a Cylinder.

By H. MUNCASTER, A.M.I.Mech.E.

SOME short time ago the writer undertook to bore four small cylinders of diameters equal to 1 in., $1\frac{1}{2}$ ins., and 2 ins. Thinking that the operations would afford some useful experience, he decided to try various methods that might be easily at hand, and that would be generally available to the ordinary amateur model engineer.

The cylinders were all of the same design, as will be seen, arranged for a separate steam-chest. Beginning on the smaller size cylinder, the valve face was first filed up level and true, but not finished. The cylinder was then prepared for holding down to the saddle of the lathe (which is a $3\frac{1}{2}$-in. centre screw-cutting), after removing the slide-rest, as shown on

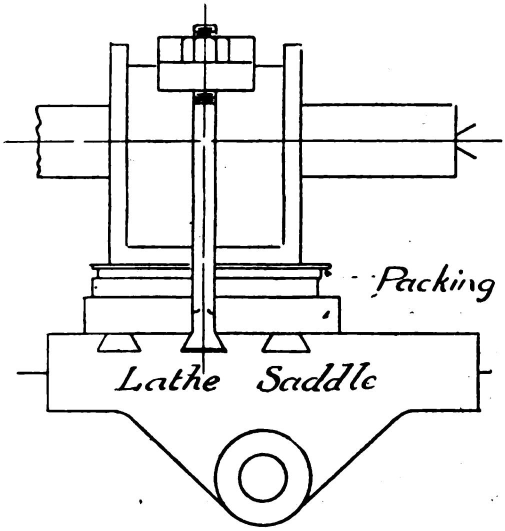


FIG. 1.

sketch, Fig. 1. A piece of mild steel, $\frac{7}{8}$ in. diameter and 8 ins. long, was turned up in the lathe, one cut being taken along it by means of the screwcutting gear, at 150 cuts per inch. At a distance of $3\frac{1}{2}$ ins from one end a hole, 3-16ths in. diameter, was drilled through the bar as shown, in Fig. 2, and another hole, $\frac{1}{4}$ in. tapping, drilled to meet it. The latter holes were tapped and fitted with a $\frac{1}{4}$-in. grub screw. A short piece of 3-16ths in. diameter round steel was broken off a bar and filed as shown on sketch, Fig. 3, and slightly flattened where shown by dotted lines. This was then made hot, a dull red, and dropped into a cup of water to harden—rather a rough way, but in this case quite successful. (This has since bored several small cylinders, and seems quite sharp still.) Before fitting in the bar, the cutter was held in the vice and the edge very carefully sharpened with a small oil stone.

The bar, after fixing the carrier dog, was then put through the cylinder and mounted between the lathe centres, sufficient packing having been found to raise the cylinder to the correct height above the saddle, when resting on the valve face. The whole was then bolted down by means of a piece of $1\frac{1}{4}$ in. by $\frac{3}{4}$-in. flat iron and two 5-16ths-in. bolts. The exact position for the cylinder was found by using a small pair of callipers, gauging from the bar to the edge of the flanges of the cylinder (it was for this purpose that the boring bar was turned true).

The slowest gear available was then looked up among the change wheels, giving a speed of 190

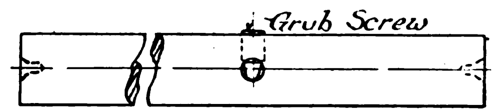


FIG. 2.

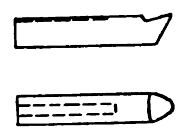


FIG. 3.

revolutions per inch of travel. The cutter was fixed in the bar and held by means of the grub screw, so as to give a substantial cut, and the lathe started, using the back gear of the headstock.

In taking a first cut from a casting, the writer makes a practice of getting well below the skin where possible, as the surface is generally hard, and will sometimes grind the edge of the tool without cutting at all if a very fine cut be attempted.

In the case of the smaller cylinder castings (which were Stuart Turner's), the core had been cast so nearly true that the skin had practically all been removed by the first cut. The question was then merely one of boring to size. A second cut was made, leaving only about 1-32nd in. for a final cut. It is not wise to stop in the middle of a cut. Once having started, keep the lathe going until clean through. If it be necessary to stop to gauge the size of the bore, do so before the cut has gone beyond the part intended to be counterbored.

A slight counterbore was made about 3-16ths in. into the cylinder, and about 1-32nd in. each side

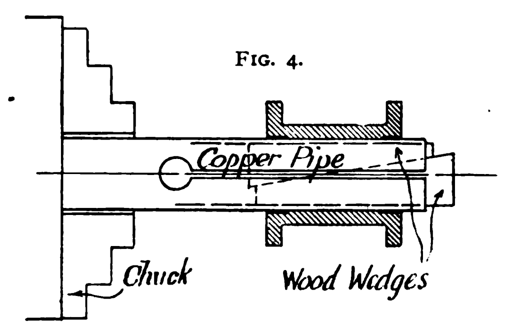


FIG. 4.

larger than the bore. At one end another gear wheel was fitted into the lathe to give the travel in the contrary direction.

The cylinder was then taken off and tested, principally to find if the diameter of the parallel part was the same at each end. No difference could, however, be found by gauging, and the work was considered satisfactory.

To true the ends of the cylinder a mandrel was carefully turned up, the cylinder driven on, and the flanges turned, this method ensuring the flanges being exactly normal to the bore.

A piece of copper tube was found about 1 in. outside diameter and 5 ins. long, split down each side 3 ins. from one end and the other end fixed in the chuck. The bore of the cylinder was ground to a smooth surface by means of a mixture of oil and fine emery daubed on the surface of the copper tube, wooden wedges being driven into the tube to give the necessary "bite" (see Fig. 4). The result was a thoroughly good job.

The question might be asked, in boring a cylinder in this manner, are you making the best use of the appliances? Why not use the self-centreing chuck or a faceplate to hold the cylinder, and dispense with the boring bar?

As has already been said, the chief aim was to gain experience, and the second cylinder, 1½ ins. diameter, would be bored in a manner that would not involve the fitting up of a special bar. It was therefore mounted in a Cushman chuck, the work of a very few minutes, the face of the chuck forming a guide for the face of the cylinder. The work was chucked without any trouble, as the steam-chest did not interfere with the jaws of the chuck, as will be seen from Fig. 5.

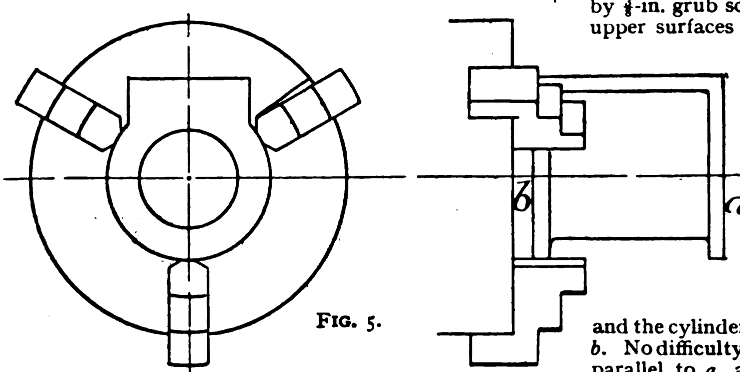


Fig. 5.

One point to consider in chucking a cylinder in this manner is that both ends of it cannot be finished off without resetting. On this account the end taking the cover having the piston-rod stuffing box, should have the preference, and would be at *a*, enabling it to be finished before taking out of the chuck (Fig. 5), the face *b* being machined after re-chucking the cylinder.

A tool, shown in Fig. 6, was fixed in the slide-rest, the screw-cutting gear rigged up to give a travel of 1 in. per 190 revolutions, as before. A couple of cuts sufficed to take out all trace of the moulded surface of the core. The bore was then carefully measured by the callipers, and found to be 1-32nd in. smaller at the end marked *b*. This was at first assumed to be due to the gradual loss of the keenness of the edge of the tool as the work proceeded, or to the spring of the tool; but on reflection it did not appear that there should be any more spring on the tool at *b* than at *a*, and the spring on lathe spindle would be less. Another cut was taken to see if it were in any way due to the difference in hardness of the metal, without any better result. It was then remembered that the lathe had been taken to pieces to illustrate the series of articles on "A Handy Lathe," and not put together with due care;

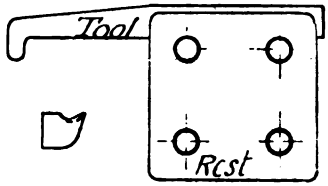


Fig. 6.

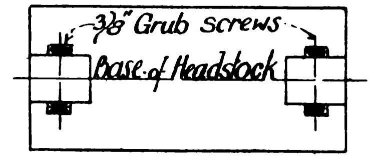


Fig. 8.

probably the spindle was not parallel to the line of travel of the saddle along the bed, as shown exaggerated in Fig. 7, the headstock being adjustable by ⅜-in. grub screws fitting against the flange of the upper surfaces of the bed, as shown in Fig. 8.

The spindle, together with the chuck and cylinder, were removed, and the bed carefully lined out by a piece of piano wire, and the headstock adjusted accordingly. After replacing the spindle, another cut was taken out of the bore, which was then found to be perfectly parallel.

After taking a final light cut to finish the bore, and the end counterbored to 1-16th in. larger in diameter, the end was faced and the cylinder reversed in the chuck to face the end *b*. No difficulty being experienced in getting the face parallel to *a*, as the face of the chuck afforded a guide for this. There was, however, some little trouble in getting the bore central, so as to counterbore. A bit of flat steel under one of the jaws finally gave the needful adjustment, and the work was quite satisfactorily performed.

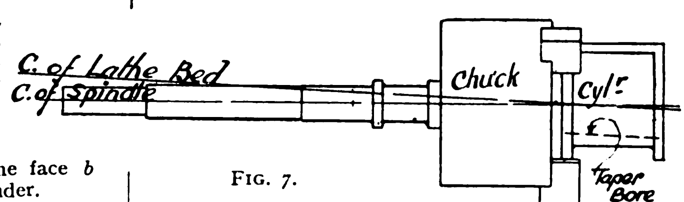


Fig. 7.

A piece of round wood was held in the slide-rest and a piece of emery cloth wrapped around the end in such a manner as the work would tend to tighten it. The work was spun at a higher speed, and the cylinder bore ground to a beautifully true and smooth surface in a few minutes.

The time spent in the actual boring and facing of the cylinder would not, probably, exceed one and a half hours, although the total time occupied was considerably in excess of this, owing to the necessity of adjusting the headstock, as explained, which was demonstrated in so forcible a way by the taper in the cylinder bore. The time so spent in adjusting the lathe headstock was very usefully employed, and may be debited to any future jobs requiring accurate workmanship.

(To be continued.)

The 1907 Model Speed Boat Competition.

IT is a pleasing fact to record that, both in regard to the number of competitors and speeds obtained, THE MODEL ENGINEER Speed Boat Competition, which closed on December 31st last, has eclipsed all previous contests. In order to fulfil the promise made in our issue of January 16th, when the results of the competition were published, we give herewith as far as possible particulars of the successful boats, which we know are eagerly awaited by many of our readers.

Last year's record was held by Mr. Weaver's *Era*, which developed a speed of 8·766 miles per hour. This has now been beaten by Messrs. W. H. and F. G. Arkell's model petrol-driven T.B.D. *Moraima's* latest speed of 9·71 m.p.h. In consequence of the addition of a new class, altering the minimum dimensions of Class A boats, the *Moraima* was entered in Class B. A description of the boat and machinery appeared in our issue of April 26th, 1906, and at THE MODEL ENGINEER Exhibition the machinery was shown running at intervals. The official details of the test are as follows :—

Length O.A., 5 ft. ; weight, 22½ lbs. ; petrol engine, tandem propellers. First run, 29 1-5 seconds ; second run, 32 1-5 seconds ; third run, 30 1-5 seconds. Length of each run, 145 yards. Speed : 9·71 *miles per hour.* Built and owned by Messrs. W. H. and F. G. Arkell.

We, the undersigned, witnessed the runs, and certify the above times to be correct. G. Arthur Smith, Clapham Steam and Sailing Club ; Henry Charles Whetstone, Hon. Sec., Serpentine Model Yacht Club. Messrs. Arkell are members of the Clapham Steam and Sailing Club.

The second fastest boat has proved to be the steam model *Wolf*, owned by Mr. W. H. Rimmer, of the Sefton Model Steamer Club. The latest speed performance of 9·58 miles per hour is not only an advance upon her effort last year, which resulted in a speed of 7·67 miles per hour, but is in excess of the highest speed of the last contest, that obtained by Mr. W. R. Weaver's *Era*—8·766 m.h.p.

In a letter referring to the difference in the speed, he says : "There are no alterations in the machinery of the steamer *Wolf*, the difference in her speed is accounted for by better trimming." A description and photographs of this boat appeared in the issue for February 21st, 1907. Mr. Rimmer has accordingly been awarded a Silver Medal in Class A ; the only other competing boat in this class being Messrs. Coxon Bros., whose steam-driven boat *Ades II* has attained a speed of 6·81 miles per hour. A full description and drawings were given in the issue for November 28th, 1907. A Certificate of Merit has accordingly been awarded. Following is a copy of the official certificate of the test of the last two boats :—

We, the undersigned, hereby certify that the undermentioned particulars are correct as taken by us December 14th, 1907, steamers having run over a course of 300 yards on Sefton Park Lake, and complying with MODEL ENGINEER rules for Model Steamer Speed Competition, 1907 :—

Mr. W. H. Rimmer's *Wolf*, 6 ft. 10¾ ins. L.W.L., Class A, time 64 secs. Messrs. Coxon Bros.' *Ades II*, 6 ft. 9½ ins. L.W.L., Class A, time 90 secs. George F. Paris, Hon. Sec., 123A, Westminster Road, Kirkdale ; James M. Wood, 27, Spencer Street, Everton. Liverpool, December 14th, 1907.

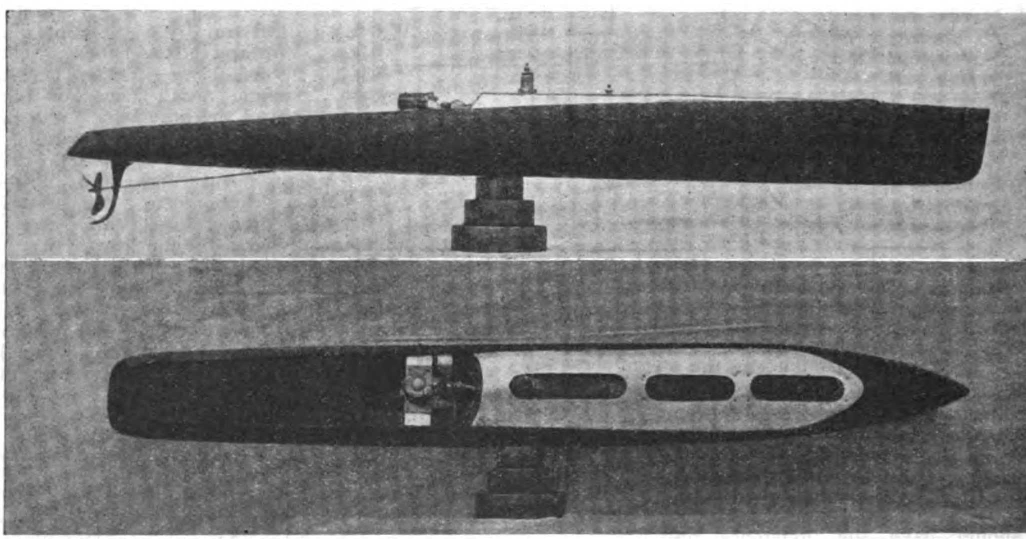
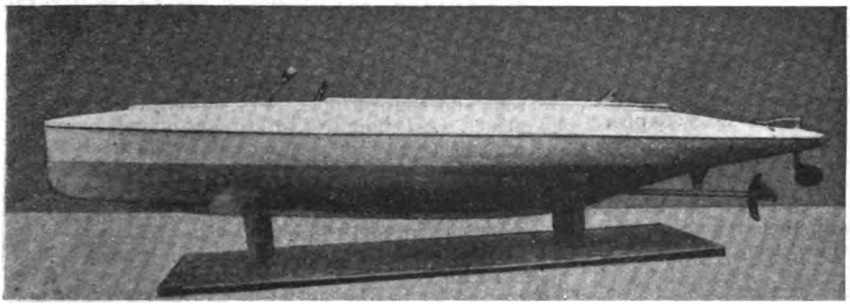


FIG. 1.—MR. A. J. MIDLER'S MODEL STEAM MOTOR BOAT "MOREARAD."
(Winner of Silver Medal in Class C.)

The following are the results and dimensions of Mr. Alex. J. Midler's motor boat *Morearad*, Class C, Aberdeen Model Steamer Club:—First 100 yards, time 28 secs.; second 100 yards, time 27 secs.; third 100 yards, time 29 secs. Power turned on and held for a period of 30 secs. before released. Interval between first and second trips, 25 secs. Interval between second and third trips, 18 secs. Course measured 100 yards. We, the undersigned, state that we were present and witnessed the tests of Mr. Alex. J. Midler's boat, and that the boat was timed by us as herein stated. Signed, W. Bunting (vice-president) and John S. Henry (secretary and treasurer), Aberdeen Model Steamer Club.

Mr. Midler says: "The hull of my model motor boat *Morearad* is dug out of yellow pine and left no thicker than 1-16th in. in some places, as weight of hull will indicate (1 lb. 2 ozs.). The deck is of aluminium, and inside of hull is covered with Japanese silk which is fixed with a specially prepared varnish. Length on water line, 2 ft. 11 ins. The engine, having cylinders ⅞-in. bore and ½-in. stroke, was built up and has no bedplate, the crankshaft bearing being hung from cylinder by steel rods. The engine is swung from the sides of the hull, the weight being 4 ozs.; the cylinder is lagged. The boiler and vaporiser are made in conjunction, petrol being used for firing. The boiler has sixteen water tubes and has a heating surface of 60 sq. ins., is 6½ ins. long, 3½ ins. wide, 3 ins. deep, and weigh 1 lb. The propeller shaft is connected to crankshaft by Universal couplings. The propeller itself is the outcome of a series of experiments. Diameter is 2 ins. The hull is also the outcome of several experiments, this being the fourth hull and the one that has been found most successful, the action being almost hydroplanic. The method of steering is by adjusting skeg at stern of boat. The entire weight of boat is 2 lbs. 6 ozs.; working pressure, 50 lbs."



MR. SAMUEL THOMPSON'S MODEL SPEED BOAT, "DISAPPOINTMENT."
(*Winner of Bronze Medal in Class B.*)

The boat has been designed throughout and constructed, with exception of the pressure gauge, by Mr. A. J. Midler, and for the undoubtedly excellent speed for a boat of the dimensions given above, the owner has gained a Silver Medal in Class C. We illustrate two views of Mr. Midler's *Morearad.*

Following close upon the speed of the last boat comes that of *Disappointment*, owned by Mr. Samuel Thompson, of Sefton Park Model Steamer Club. The boat is built out of two pieces of yellow pine, 3 ins. thick, placed bread-and-butter fashion, and her dimensions are: L.O.A., 5 ft. 3 ins.; L.W.L., 5 ft. 1 in.; Beam, 10½ ins.; inside depth, 5 ins. The boiler is a water-tube, something after the style of Mr. David Scott's (Aberdeen). The engine (single) is 1¼ in. bore by 1 in. stroke. The lamp has two burners with three nipples in each. The propeller is 5½ ins. diameter and a 7½ ins. pitch. The boiler is fed by a hand pump, and holds just sufficient water to carry her 500 yards under 80 lbs. pressure. Mr. Thompson says he tested the boat on several courses of 300 yards, all of which were covered in less than 100 secs. each. On the day of the test the weather was very boisterous. The speed is officially certified at 6·81 miles per hour. We reproduce herewith two photographs of the boat. The following gentlemen assisted in the trials: J. C. McGonagle (witness); Thos. Taylor acted as timekeeper.

(*To be continued.*)

VIEW SHOWING ARRANGEMENT OF THE "DISAPPOINTMENT'S" MACHINERY.

MOTOR SHOW.—From the 21st to 25th of this month Cordingley's thirteenth international motor show will be held at the Agricultural Hall. Many new types of British automobiles will be exhibited for the first time. Among the innovations that will be made is an inventors' section, in which will be given a demonstration of the interest with which men of ingenuity are tackling the minor problems associated with the development of the automobile. An aero section will again be a feature of the Exhibition.

A Model Boiler Trial.

AN interesting example of this was shown to the members of the Junior Institution of Engineers on the occasion of their recent visit to the engineering laboratories of King's College, Strand, London. For the purpose of educating students in the process to be followed when making a boiler trial a model Thornycroft water-tube boiler is arranged upon a bench with the testing apparatus permanently connected to it. Gas firing is used, a standard meter measuring the consumption of gas. The whole forms a set of educational apparatus, and a student can perform the necessary tests and obtain a knowledge of the essential measurements to be made to ascertain the efficiency of a boiler. Professor D. S. Capper, M.A., M.Inst.C.E., in showing the model, made the interesting statement that the figures of efficiency tests which he had obtained came within a decimal place of the actual figures obtained by Messrs. Thornycroft & Co., Ltd., with their full size water-tube boilers made to the same design.

A 16-ft. Windmill.

DESIGNED AND CONSTRUCTED BY THE NEW ZEALAND GOVERNMENT RAILWAY DEPARTMENT.

(*Continued from page* 230.)

FIGS. 11 and 12—again to a scale of 2 ft. to 1 in. —must be taken together. They particularly show the regulating gear, and the general form of the pivot casting (No. 9) is very clearly indicated. These are so straight forward that further explanation is hardly necessary.

The most intricate part of the whole machine is undoubtedly the cleverly designed top pivot casting (No. 9). Such a piece of work is beyond the scope of the amateur, either in regard to pattern-making or machining, but it can be modified so as to be partly built up. In comparison with this all other metal parts are simple, and, individually present nothing very novel to any engineer. The sails would be something of an undertaking, and would be cut from ⅜-in. boards and strung on the chords at an angle of from 45 degs. to the axis of the wind.

This "angle of weather" is a weak spot in the design. These vanes should lie much flatter to the wind—certainly at no greater than 20 degs. to the plane of evolution—and means should be taken to improve in that direction. The system adopted in the present instance—of threading the vanes on the wooden chords—militates against any such flatness of "weather."

With the scales of the drawings clearly indicated, not much need be said as to dimensions; but attention might be called to the imperative need for a substantial foundation, good holding-down methods, and thoroughly sound construction throughout. The thorough painting of every part before putting together, and again on completing the erection, will go a long way to ensure safety and lasting qualities in the weather.

Following are the instructions issued by the Railway Department for erecting the mill, all the parts being assembled on the ground:—

"The stand of mill should be put together complete on the ground, with tower cap No. 1 fixed and platform attached. Up-end the structure on foundations and screw down knees at foot of stand to foundations. Fix pivot step (No. 2) plumb-centre with centre of tower cap; fix guide-rods (No. 3) with rings (Nos. 4, 5, 6), as shewn; in placing No. 5 centre ring in lower ring (No. 4), keep the numbered side up. Hoist pivot casting (No. 9) into position. Fix securing or check-piece (No. 53) on to pivot casting. Rings 4 and 6 should pass freely up and down pivot casting; support them half-way up, and securely fix pull rods (No. 41) in rings. Fix out-gear crosshead (No. 44) to pull rods and shut-off pole. Fix out-gear reel (No. 45) attach short chain (No. 46) to shut-off pole by means of clips (No. 54); see that it works freely. Fix pawl (No. 52) and clip (No. 51) so as to fit ratchet of out-gear wheel; let the reel take weight of out-gear. Fix shive stand (No. 16) and side vane pedestal (No. 22) to pivot casting (No. 9).

"Put the tail together on the ground; then hoist into position, put king-bolt through pivot casting, and screw up tail brace till the tail stands out level. Screw large shive (No. 43) to lower end of pivot casting. Fix small shive (No. 42), attach long chain (No. 7) to lower side centre ring (No. 5), pass under No. 43 up alongside of pivot casting over No. 42, and on to hook in corner of circle board; screw short chain No. 8 on top of centre ring, pass up alongside pivot casting over No. 42 and on to hook on corner of circle board, then screw up long chain till all the slack is up, but not too tight.

"Put side vane together complete on the ground, hoist into position, make bar level and vane plumb. Fix securely. Key spider casting (No. 13) to main shaft (No. 15), fix braceplate (No. 12) on, and face-plate (No. 14) to end prepared for it; remove cover (No. 11), place main shaft in position, replace No. 11, and screw firmly down; see that it works freely. Place lower half pitman box (No. 34) in forks of pitman (No. 35), fix pitman knuckle (No. 36) on lower end of pitman, place in position, and put upper half of pitman box (No. 33) on pin; then screw up tight; see that it works free. Place pitman guide (No. 37) through pitman knuckle, and fix in slots of pivot casting, fixing it firmly. Put collar (No. 57) on piston (No. 38), pass the end of piston through lower end of pivot casting; then place on nut, leaving room to screw into pitman knuckle, screw the piston (No. 38) in; then bring the nut up close and screw tight, taking care that it does not jam the pitman. Place swivel-box (No. 39) on lower end of piston; put on cap (No. 40) and fix, bringing the collar down so that there will be little play, and fix it securely.

"Bolt on pump pole, as shown in drawing. Fix balls (No. 49) to shut-off pole, and place weight-box ½ in. clear of pole, so that there is no friction. Fix wheel arms C in spider casting and wheel-arm brace D in braceplate and to arms, having first fixed outside front wheel clip (No. 29) to the arms, taking care that they all bed in their sockets, or the wheel will not run true; then fix the fans in and fix with wheel clips (Nos. 30, 31, 32). Fix lubricators on cover of main box and upper half of pitman-box."

LIST OF PARTS OF 16-FT. WINDMILL.

Ironwork.—(1) Tower cap, (2) pivot step, (3) guide-rods, (4) lower ring, (5) centre ring, (6) upper ring, (7) long chain, (8) short chain, (9) pivot casting, (10) lower half main box, (11) upper half main box, (12) braceplate, (13) spider casting, (14) faceplate, (15) main shaft, (16) shive stand, (17) king-bolt, (18) tail brace, (19) tail casting, front, (20) tail casting, back, (21) tail truss rod, (22) side-vane pedestal, (23) side-vane bar, (24) side-vane front brace, (25) side-vane top brace, (26) side-vane back brace, (27) side-vane rod clip, (28) side-vane cross bar clip, (29) outside front wheel clip, (30) inside front wheel clip, (31) outside back wheel clip, (32) inside back wheel clip, (33) upper half pitman box, (34) lower half pitman box, (35) pitman, (36) pitman knuckle, (37) pitman guide, (38) piston, (39) swivel-box, (40) swivel-box cap, (41) pull rods, (42) small shives, (43) large shives), (44) out-gear cross-head, (45) out-gear reel, (46) short reel chain, (47) long reel chain, (48) reel shive, (49) regulating balls, (51) clip for pawl for out-gear reel, (52) pawl for out-gear reel, (53) securing-piece for pivot casting, (54) clip for regulating weightbox, (55) coupling for chain, (57) collar for piston of swivel-box, (56) balance-weight, (126) lubricator seat, (128) lubricator.

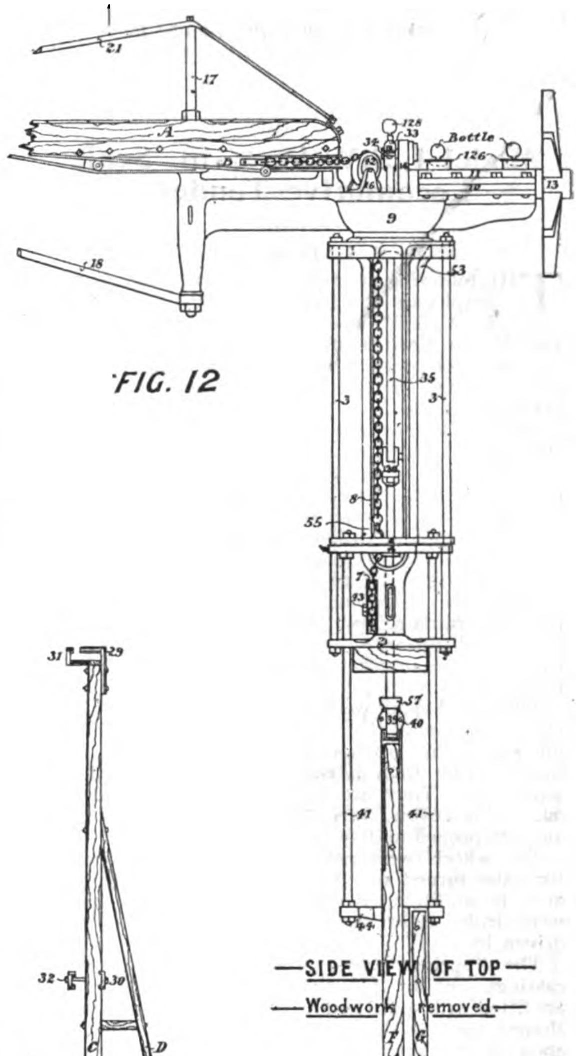


FIG. 12

SIDE VIEW OF TOP

Woodwork removed

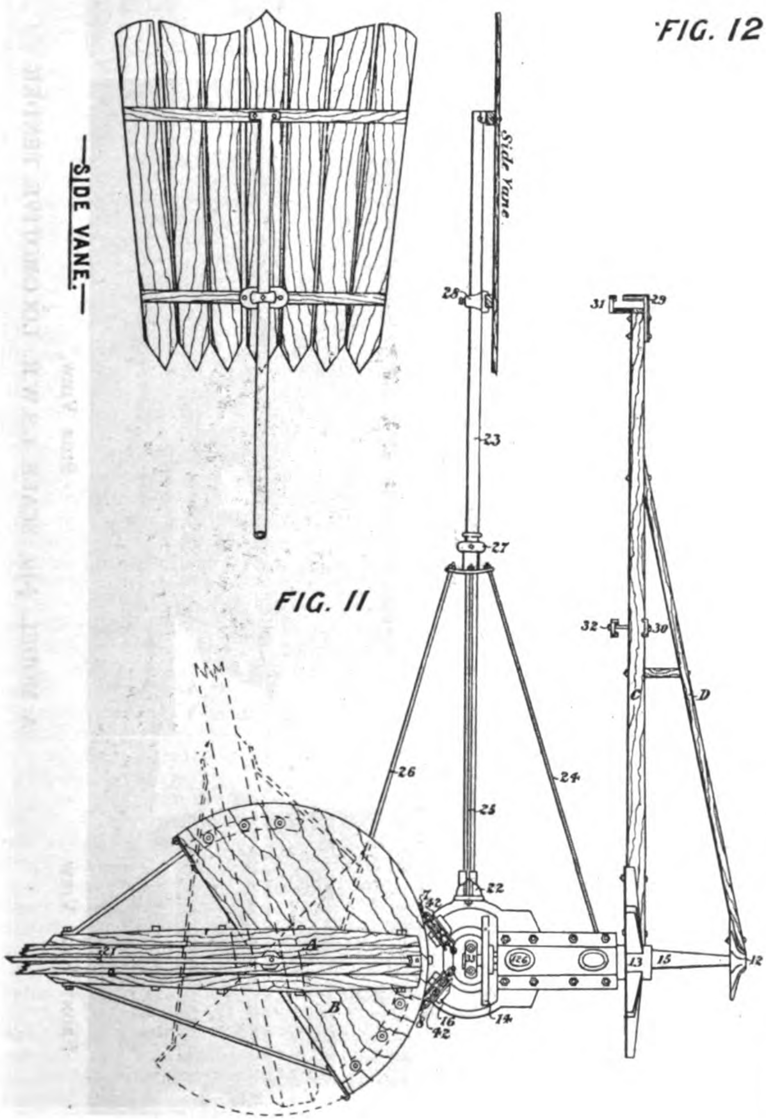


FIG. 11

PLAN OF TOP

Woodwork. — (A) tail bar,

(B) circle board, (C) wheel arms, (D) wheel-arm brace, (E) wheel-arm girt, (F) pump pole, (G) shut-off pole, (H) ball-box, (J) reel standard, (K) reel arms, (L) water-box.

Model L.S.W.R. ¾-in. Scale Locomotive Tender.

By S. L. Thompstone.

THE following description, drawings, and photographs are of a ¾-in. scale tender for a model L. & S.W. locomotive, which appeared in THE MODEL ENGINEER (No. 213), May 25th, 1905. The order of procedure was first to make the full-size drawings, then the patterns were made and castings obtained.

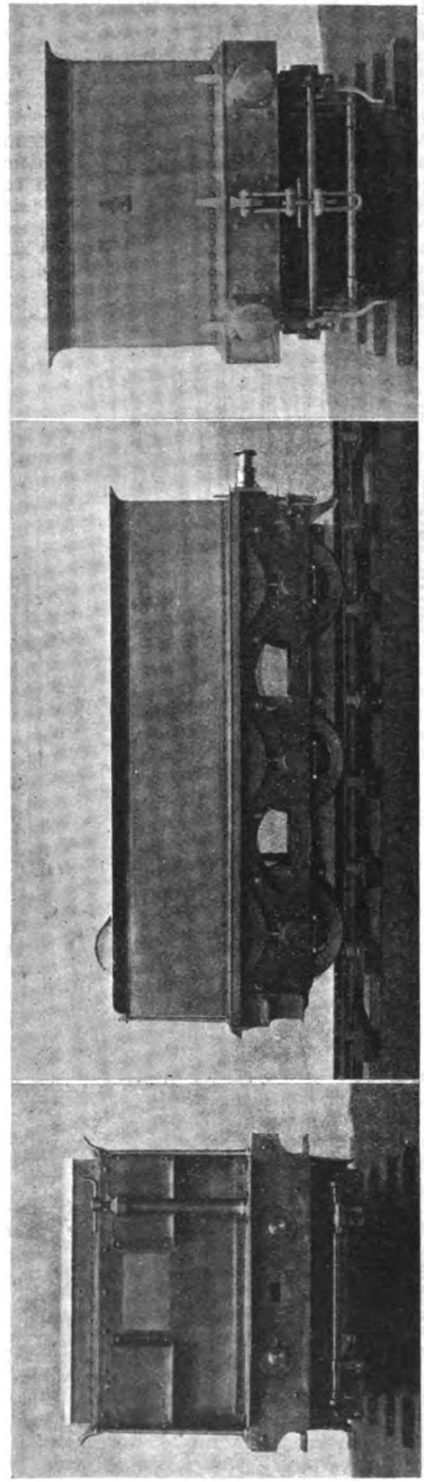
The side frames were then taken in hand; these were sawn from ⅛-in. brass sheet, filed up together, and then framed up with six gun-metal stretcher pieces and ⅛-in. angle brass all screwed together. The horn blocks were sweated together in pairs and filed up and drilled for screws to template, unsweated, then screwed to the side frames; and the fitting required to get these exact was very troublesome. The ends of same project below the side framing, and these are fitted in between by turned distance-pieces, and held in position by a 3-32nds-in. bolt passing through and fixed by a locknut.

The axle-blocks were then planed up from one bar of gun-metal, then each block cut off and bored for axles, this method being much quicker and easier fitting than if each had been squared up separately. They are also recessed for retaining oil. The covers, thus, ◘ are separate castings, and are pegged and sweated on to the blocks.

The wheels were next turned up to size, then the axles turned and the wheels forced on to same, and, in addition, the hubs of wheels and axles were drilled right through and a taper steel plug driven in.

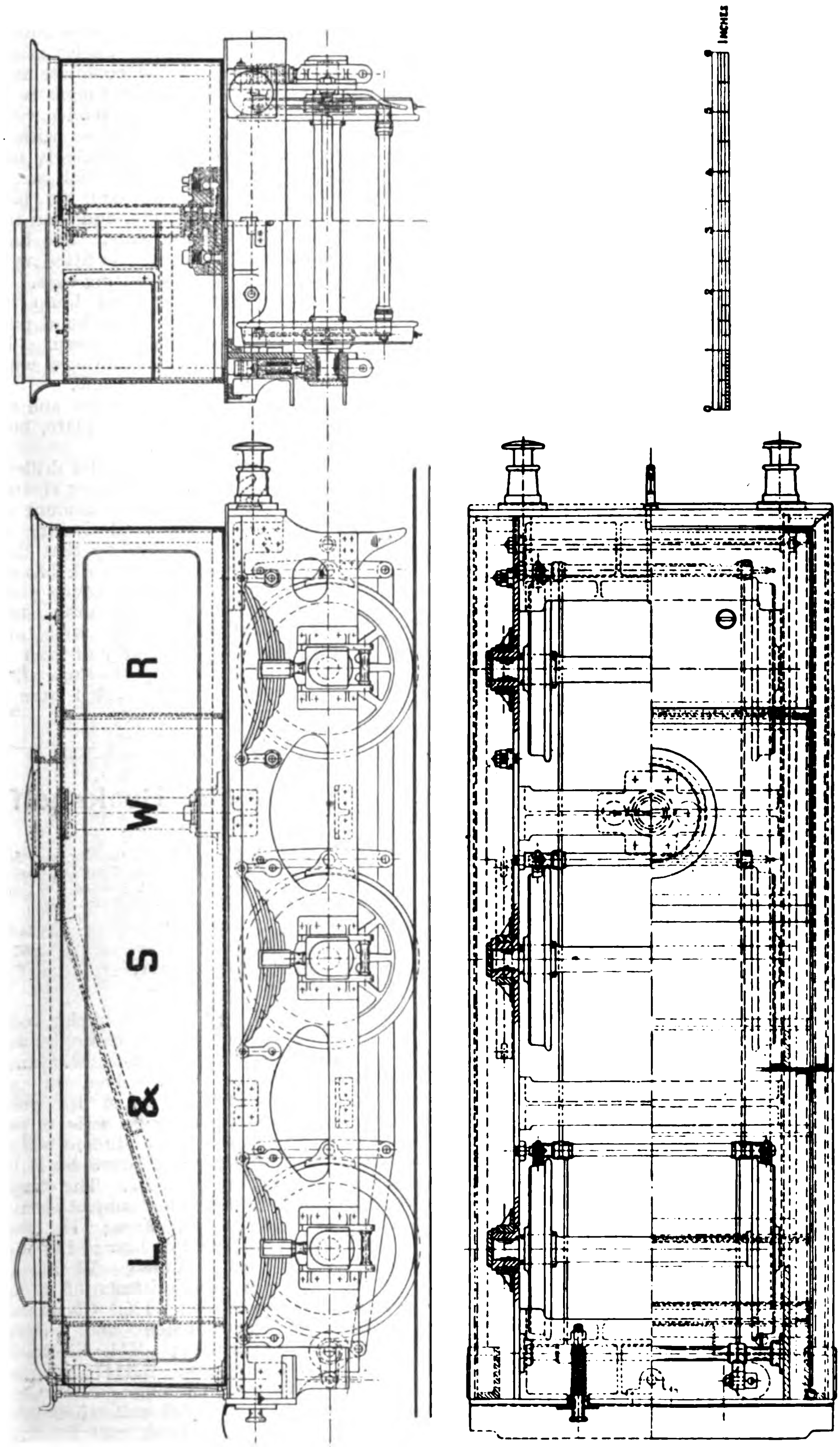
The "springs" are dummy in a way, being castings, but are bored up in the "buckle" and are fitted with spiral springs, these resting on turned, shaped pins, as shown on the drawings. The top ends of the pins projecting through the buckle are tapped 1-16th in. and fitted with nuts; by this means the pins cannot drop low enough to show the spiral springs, and yet are set with sufficient freedom to give the requisite amount of spring. By adopting this kind of cast spring the scale could be far better kept to. The ends of the "springs" are slotted to receive the mild steel hangers, and are fixed to same with 3-32nds-in. bolts and nuts. The hangers were cut from the sheet to the template, and are hung to side frames by special shaped lugs with ⅛-in. nuts.

The buffer planks were cut from ⅛-in. brass sheet, and firmly screwed to brackets and framing. The rear buffers are out of gun-metal, turned and fitted with steel springs and finished bright, and are bolted to buffer plank by four 1-16th-in. bolts to each. The buffers on the front of tender are made rather differently, as will be seen by the drawing, the shanks of same coming through the stretcher casting and being fitted with stiff steel springs and held in position by 5-32nds-in. nuts. The pin



Rear End View. Side View. Front End View.

A MODEL ¾-IN. SCALE L.S.W.R. LOCOMOTIVE TENDER.



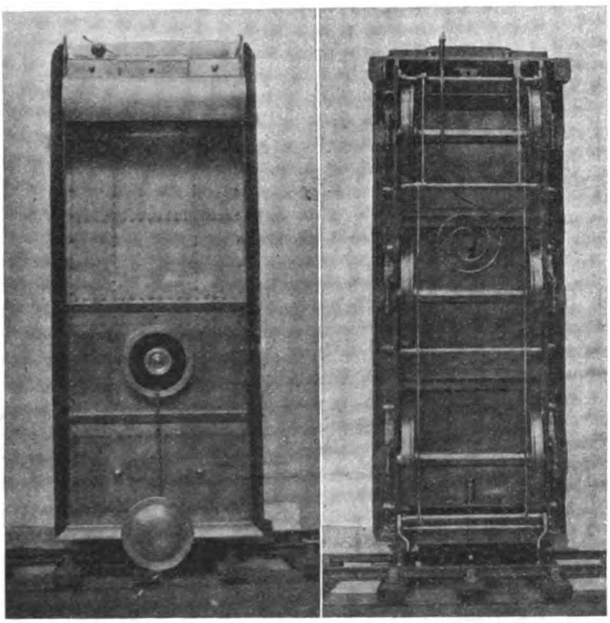
TENDER FOR ¾-IN. SCALE MODEL L.S.W.R. BOGIE EXPRESS PASSENGER LOCOMOTIVE.

By S. L. Thompstone.

For description] [*see pages 248–250.*

for drawhook is silver steel, and screws into a gun-metal bracket, as shown. The drawhook was cut from mild steel sheet, and has a slotted hole through one end to give with the buffers. The hook and shackle at the back were also cut from sheet steel and polished bright, the end of the hook passes through buffer beam and casting, and is fitted with stout spring and nut.

The wheels are braked by a hand-brake, the blocks being gun-metal and fitted to steel hangers, the latter hanging from steel studs screwed in on the inside of framing and held in place by 1-16th-in. nuts. The bottom end of hangers are attached to steel rods and cross-stays, which, in turn, are connected to steel levers leading to the gun-metal brake column, the whole of the steelwork of the



PLAN. UNDERSIDE VIEW.

MR. S. L. THOMPSTONE'S ¾-IN. SCALE MODEL L.S.W.R. TENDER.

brakes being polished bright. The three cross-stays of the brakework were drilled through and a ⅛-in. steel rod passed through, with ⅛-in. nuts on either end to hold same in position.

The line clearers are of mild steel, filed and bent to shape, and screwed to framing, as shown.

The tender tank was built up of No. 18 gauge sheet brass, as shown on the drawings and photograph, and riveted and screwed together with angle brass and cross-divisions on to the brass foundation-plate. This plate is 1-16th in. thick, and is secured by six ⅛-in. screws to tender framing. This makes it only a moment's work to pull off the tender body from the framing, if required to do so. The coping round the top of the tender was cut from hard-drawn brass tubing, and has D-shaped wire riveted and sweated to the edge of same, the coping being riveted to the tender sides and back, as shown. On the front of the coalplate are fixed two tool-boxes with loose lids; these were made from sheet and angle brass. The tool-box along the top of the coalplate is also of sheet brass, with curved lid and hinges to same.

The manhole on the top of the tender was turned from a gun-metal casting and fitted with lid and chain. Directly under this manhole is the hand force-pump, the connections of which are of ⅛-in. copper tubing, and pass through the bottom of tank, and has a coil as a spring, and then to engine connection beneath the footplate. The back part of the tender is a dry end, and is fitted with loose lid, as shown, with two small lifting eyes.

There are four polished steel lamp brackets fixed to the back of tender. The hand pillars are of mild steel, and fixed as shown. The step brackets are gun-metal castings, with sheet brass steps riveted on to same.

The gap between the tender and engine is covered by a curved brass plate, hinged to buffer beam of tender.

There have been 1,845 holes drilled in the tender tank alone for screws or rivets, which will give some idea of the amount of work expended on screwing and riveting alone.

In conclusion, I may say that the whole of the engine and tender work has occupied principally spare time of seven years. I have recently completed a table and show-case in Austrian oak for same, and if it would be of interest to any of your readers, I shall only be too happy to show the model.

The drawings may be scaled from, as they are reduced to scale.

For the Bookshelf.

[Any book reviewed under this heading may be obtained from THE MODEL ENGINEER *Book Department, 26-29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.]*

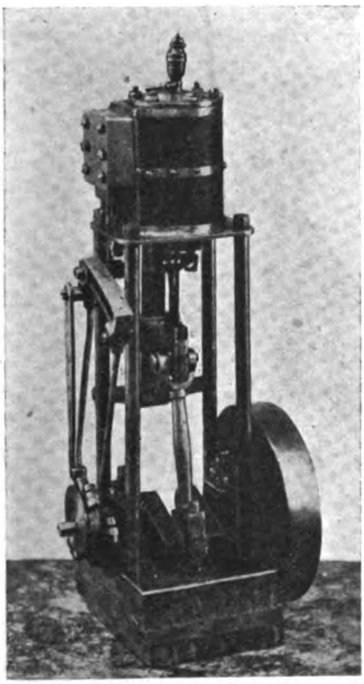
ARITHMETIC OF ELECTRICAL ENGINEERING FOR TECHNICAL STUDENTS AND ENGINEERS. London: Whittaker & Co. Price 1s.; postage 2d.

In this volume are brought together a large number of worked examples and exercises relating to the various laws and fundamental principles involved in practical electrical work. The object of its publication is to provide a carefully-arranged series of problems, by working through which the student will familiarise himself with the kind of work he is likely to meet with in everyday practice. The chapters are arranged under the following subject headings:—I, Units of Length and Mass; II, Conductors and Resistance; III, Ohm's Law; IV, Work and Power; V, Divided Circuits; VI, Arrangement of Cells; VII, Heating Effects of a Current; VIII, Electro-Chemistry; IX, Condensers and Capacity; X, Transmission and Distribution; XI, Magnetic Quantities; XII, Electro-Magnetism and Galvanometers; XIII, Magnetisation of Iron and Magnetic Circuits; XIV, Generators and Motors. As a useful collection of various types of problems, the book may be thoroughly recommended.

A Small Marine Engine.

By Thos. Tavener.

THE accompanying photograph illustrates my first attempt at model making. The model launch engine is made from scrap material, excepting the balance-wheel. Before starting to make the engine, I constructed a lathe very cheaply. The bed, head- and tail-stocks were made of wood; the flywheel was a bicycle wheel, loaded at the the rim with iron. The crank and connecting-rod of engine are ½-in. bolts; the other rods and standards are from an old sewing machine, the cylinder being a piece of brass tubing, all the rest being steel and polished. Under the cylinder everything is steel excepting bearings, bushes, and eccentrics, the



A Small Marine Engine for Propelling a Canoe.

bedplate being cut from the same steel plate (an old tank) that the top and bottom flanges and cover, steamchest and cover were made from. The link was also made of plate. All the screws I made myself, the taps in the first place being screws case-hardened, and the screwplate an old file, taps being afterwards made from the screwplate. All the brasses were cut and turned from scrap, the hacksaw being a clock spring. The crankshaft bearings were easily made, and are perfectly rigid. The engine is 1½-in. bore and 2-in. stroke, and everything is polished steel and brass. The cylinder is lagged with teak, with steel bands, the stand itself being only wood, as the engine was for a canoe.

Engineering Works and Accessories for Model Railways.

By E. W. Twining.

(*Continued from page* 162.)

I HAD been hoping to be able to collect sufficient material and data to enable me to illustrate some good architectural features of tunnel fronts on other lines, more particularly so as I have argued that it would be well if models of certain Companies' engines could be made to run through miniature tunnels situated on their respective prototype lines. Engines of the Midland, North-Eastern, Great Northern, etc., have been modelled in very large numbers, and of tunnels on these, and one or two other Companies' lines, I should like to have given drawings—providing such can be found of sufficiently chaste and good design. As I am not yet able to do this, I propose to leave tunnels for the present, reverting again to the subject later on should I have any particulars and designs worth giving to Model Engineer readers.

Viaducts may well claim our attention next, and I herewith give, in Fig. 18, drawings of an example which has been described by more than one writer as one of the most elegant of its kind.

Of large viaducts in this country there are very few which have any feature whatever of recognised architectural style. Whether built of brickwork or stone, no classic cornice or Gothic arch and string course is introduced. In rare instances are they anything but severely plain, and only in outline are a few of them graceful and symmetrical.

The example here given is the Wharncliffe viaduct, carrying the Great Western Railway over the valley of the Brent at Hanwell, about 7½ miles from Paddington.

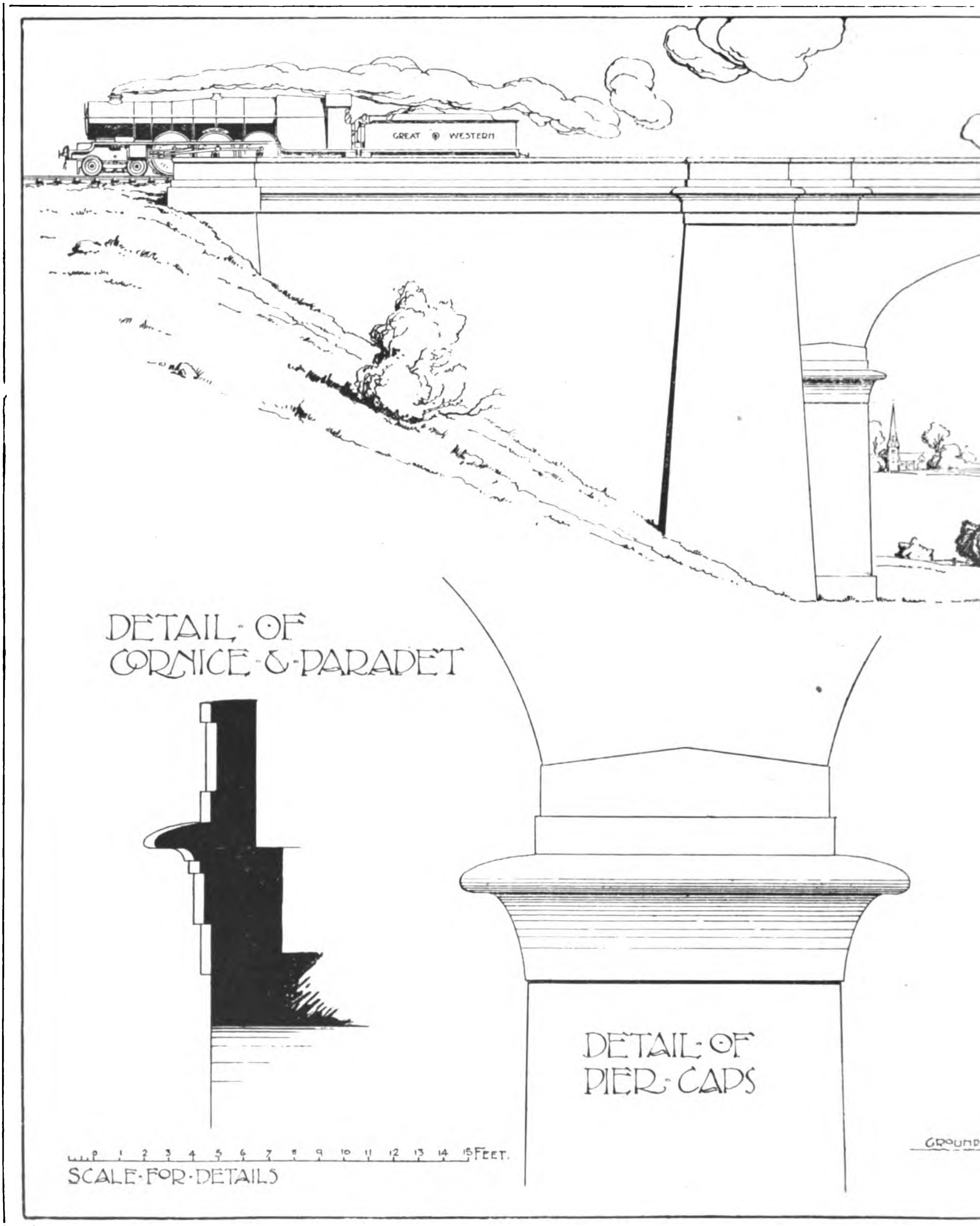
It is in the Egyptian style, and is constructed of brickwork, with pier caps, springing stones, cornice, and copings of Bramley Fall stone. The arches are semi-elliptical, eight in number; the span of each is 70 ft., and the rise of the arch or height of the crown above the level of the springing is 17 ft. 6 ins. The piers between the arches are divided into three massive brickwork columns, each with a slight batter on all faces, measuring 12 ft. ft. 6 ins. square under the caps and 13 ft. 6 ins. square where they rest upon the base.

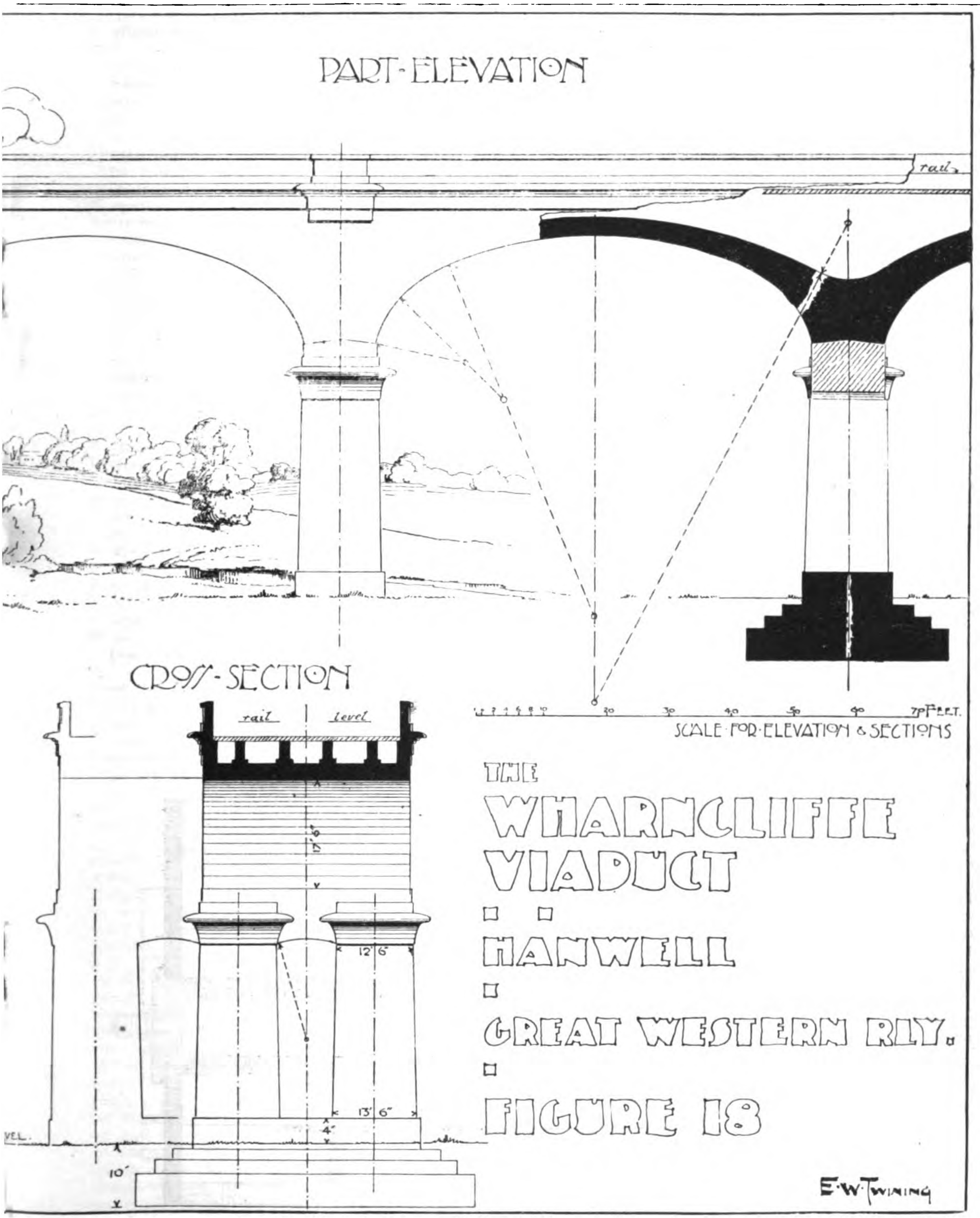
The arches are constructed in rings and measure 3 ft. thick at the crown, gradually increasing to nearly double this thickness at the haunches. The whole length of the viaduct is 886 ft., and the height from bottom of the foundation to top of parapet is 81 ft. The height from ground level to the springing of the arches is 40 ft. 6 ins.

The foundations are carried to a depth of 10 ft., well into the London blue clay, and have several courses extending to 9 ft. beyond the face of each pier all round.

As originally built, the viaduct was little more than half its present width; it carried two sets of broad gauge rails, and at that time was only 30 ft. wide between parapets. There were then only two columns to each pier.

The intermediate spandril walls, four in number, rising from the arches, were 18 ins. thick, and were placed 7 ft. apart, centre to centre, serving as foundations for the longitudinal timbers of the 7-ft. gauge


GREAT WESTERN
DETAIL OF CORNICE & PARAPET
DETAIL OF PIER CAPS
GROUND
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 FEET.
SCALE FOR DETAILS


PART-ELEVATION
rail
CROSS-SECTION
rail level
17'6"
12'6"
13'6"
4"
10'
70 FEET.
SCALE FOR ELEVATION & SECTIONS
THE
WHARNCLIFFE
VIADUCT
HANWELL
GREAT WESTERN RLY.
FIGURE 18
E.W. TWINING

track. The space between the spandril walls was covered by York-stone flags and upon these the ballast was laid. The added portion of the work, which is on the north side, is shown at the left-hand side of the cross-section in Fig. 18 in outline only.

The structure now accommodates four sets of metals; but for a model railway two up and two down lines would scarcely be required, therefore the original portion of the viaduct is all that need be modelled to carry a miniature track, and that only has been given in detail in the drawing.

The River Brent passes under the viaduct through the second arch from the eastern end. The view in the elevation at the top of Fig. 18 is supposed to be of the southern face at the western end of the structure.

A simple method of setting out the semi-ellipse of the arch by means of radius lines is given to the right-hand end of the elevation drawing. If the length of these is taken from the scale, and the angle between each carefully measured geometrically, a good curve should result.

The Wharncliffe viaduct was so named in acknowledgment of the valuable services rendered to the Company by Lord Wharncliffe, as chairman to the Lords Committee, when the Bill was before Parliament. Lord Wharncliffe's armorial bearings, carved in stone, appear on the centre of the southern face of the work.

(*To be continued.*)

Notes on Wireless Telegraphy Apparatus.

By V. W. Delves-Broughton.

(*Continued from page 615, Vol. XVII.*)

Transformers or Induction Coils.

In his book on "Wireless Telegraphy" Mr. Howgrave-Graham points out that a long spark is not necessary for long-distance work, the most important factor being the quantity of the current flowing combined with the character of the spark, which must be very fat and emitting a short crack with each spark, which in a large coil develops into a continuous roar.

It seems to me that the usual design of induction coils is imperfect for this purpose (wireless telegraphy), being unnecessarily powerful in one direction, whilst leaving much to be desired in the other. The very term — 6-, 8-, or 10-in. spark — which is used to designate the size of a coil shows the error of its construction.

A coil for wireless work is practically never required to give more than a 2-in. spark; but it should be designed to give that spark, when connected to large capacity areas, with practically the same power as when disconnected.

I have therefore come to the conclusion that a coil built more on the transformer principle would be much more effective than a coil built with the usual fine wire.

The great objection to the use of fine wire is that so much space is taken up by the insulation that the mean length of the convolutions becomes so great that a large proportion of the wire is wasted, and when it is not a question of a high voltage or length of spark alone in the induced current, but a question of the total number of watts, more economy can be obtained with a thicker wire, which will lie closer and receive a larger proportion of the magnetic lines developed in the soft iron core.

If a complete magnetic circuit could be obtained, the coil would give a much higher efficiency, but this is practically prohibited by the fact that it would be extremely difficult to design a coil or transformer in such a manner that the high-tension current could be prevented from sparking across to the external iron completing the circuit without making the iron circuit abnormally long.

I have got out the design for a 500-watt transformer coil which should give good results, and, at any rate, I hope will lead to some discussion. This coil would be economical to build considering its power, and considerably easier than those described in Handbook No. 11, except for the small sizes, which would be useless for anything except room experiments. The first requirement is a mandrel on which to build the coil. This is formed out of three pieces of 16 ins. × 2½ ins. × 1 in. beech or other hard wood planed up to form wedges and screwed together by countersunk screws, whilst being turned down to a cylinder 2 ins. (bare) in diameter.

Before turning to size, brass plates should be screwed to the ends to form centres on which it can be hung in the lathe and to hold the three parts of the mandrel together when the countersunk screws are removed. The object of making the mandrel of this form is to enable it to be

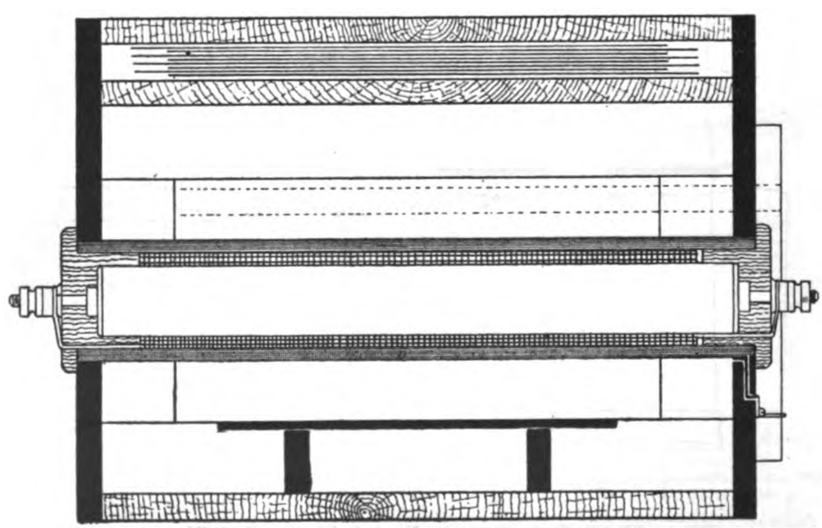


Fig. 1.

moved easily when the coil is completed, which is effected by withdrawing the central wedge first.

Further, to prevent the mandrel sticking during the subsequent boiling process, it is advisable to wrap a piece of "tea lead" round the wooden mandrel in such a manner that the edges will just butt together. (This can be done by first allowing them to overlap and then cutting through the double thickness with a sharp knife.)

Next take some sheets of blotting-paper 14½ ins. wide and as long as convenient, and after thoroughly boiling in a mixture of equal parts of clear resin and paraffin wax, and ironing out as much as possible of the surplus wax, proceed to wind this round the mandrel as tightly and evenly as possible, ironing the paper down with a hot iron during the process till a tube is formed ¼ in. thick.

Next fix a straight-edge on to a T-piece so that it can be fixed in the T-rest support at the back of the lathe, and mark off a distance of 10 ins., so that the winding can be kept a regular width on the centre of the mandrel.

Now obtain about 12 lbs. of No. 29 s.c.c. copper wire. This should be first thoroughly dried in an oven and kept in an air-tight box with a few pieces of chloride of calcium in zinc trays (to keep the air in the box thoroughly dry) till required, and the coil should be stored in this box pending the completion of the winding process.

Also prepare a number of sheets of waxed tissue paper 13½ ins. wide and as long as convenient and a number of strips of waxed blotting-paper 1¾ ins. wide, prepared as already described. All is ready for winding now except a knife-edged tool made out of an old toothbrush handle; the best shape will be found by trial. First solder the wire to a thin strip of sheet copper (about 30 S.W.G.) ¼ × 4 ins.; one end of this should be tacked to the wooden mandrel, and the other extended about ¼ in. under the winding, so that it will be held securely at each end. Now proceed to wind as explained on page 25 *et seq.*, No. 11 Handbook, care being taken to keep the layers as regular as possible and exactly the same length; if anything, reducing the length as the winding increases in diameter. When one layer has been completed a strip of the prepared blotting-paper should be wrapped round each end of the tube to make up the diameter to the thickness over the wire. After this one of the strips of tissue paper should be wrapped twice round the whole coil, and the paper ironed down with a hot iron. After each succeeding layer of wire has been wound the process must be repeated till the whole of the wire has been wound on—about forty-five layers in all.

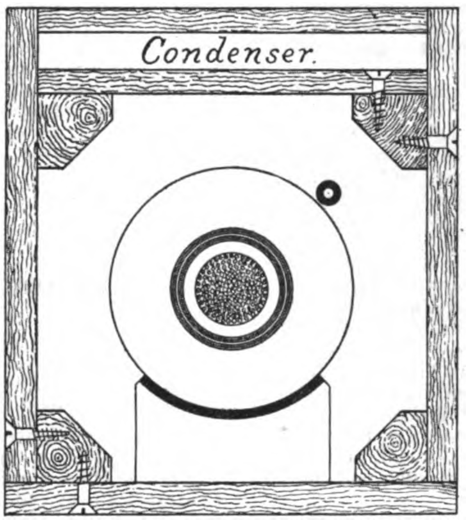


Fig. 2.

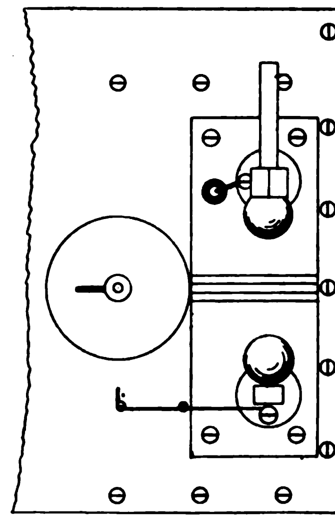


Fig. 3.

If any of the wires do not lay up close to one another a little persuasion with the toothbrush handle will make them go all right. Great care must be exercised, however, not to injure the tissue paper between the layers. All joints in the wire must be soldered and insulated with little pieces of sarsenet ribbon dipped in the resin-wax cement, which will be found to stick nicely. Any projection of the ribbon must be ironed down quite smooth, and if any openings remain between the wires near the joint, they must be filled in with a little wax mixture with the aid of a hot iron. If these precautions are not taken, the wire in the next layer might cut through the tissue paper and cause serious damage to the coil; besides which, if any irregularities are allowed to occur in any of the layers, this is liable to become increased in the next, and so on, till it will be extremely difficult to wind the coil at all regularly towards the finish.

Special care must be taken in fitting the blotting-paper at the ends to make up the space occupied by the wire, as if this should remain either smaller or larger than the central position of the coil, it will be next to impossible to get the tissue paper to iron down flat.

Having completed the winding of the coil, a thick piece of wire (18 or 20 gauge) should be soldered to the end of the thin wire and left projecting, whilst the rest of the coil is neatly and tightly bound round with cotton tape, which should be caught together with a needle and thread at frequent intervals.

The next stage is to construct a tin pot ½ in. larger in diameter than the coil and 16 ins. high. This should be joined throughout by folded joints as well as soldered, as should it become accidentally overheated, the solder might give way and cause a serious accident. A cradle should be constructed on which to rest the coil, so that the weight is taken on the end of the paper and not on the mandrel. To this cradle should be secured four wires, led up to form a handle by which the coil can be withdrawn.

Handles must also be fastened to the tin pot to enable that to be conveniently held whilst withdrawing the coil. The coil having been placed in the pot, resting on the cradle, the whole should be nearly filled with a melted mixture of paraffin wax and resin in equal parts, and the coil boiled till all bubbles cease to rise. A chemical thermometer should be used during this process, and the temperature kept between 250 and 260° F. This is most important, as if a higher temperature is used, there is a danger of burning the whole coil, and if less, the moisture will not be thoroughly expelled.

After thoroughly boiling and allowing the coil to cool in the wax, and observing that the pot is kept quite full of wax melted in another pot, the coil is melted out as quickly as possible by heating the tin pot by standing it on a gas-ring and applying a blowlamp to the sides in such a manner that only the outer skin of wax is melted, and the coil withdrawn.

The cradle on which the coil rested during the boiling process is next to be removed by melting away the wax with a hot bar of iron and a heated bit of clock spring, and after this is done the coil is put back in the lathe and the ends trimmed up with a sharp knife tool, which must be constantly wiped clean, as the wax adheres, with a rag dipped in benzoline. The length of the coil proper should be 13 ins., *i.e.*, a mass of paper and wax 1½ ins. long should be left beyond the wire at each end, and the central tube should project ½ in. at each end and measure 2½ ins. in diameter.

Care must be taken when turning down the end that the copper strip is not accidentally cut off, as this is liable to happen, and would be very difficult, if not impossible, to repair.

The wax on one side of the coil should be cleared away by heating and scraping till the protecting tape is found, and a piece of hard fibre 8 ins. × 4 ins. and about 3-16ths in. thick, whilst still hot from being boiled in the wax mixture, is bent round the coil and securely tied with string or tape, as shown in Figs. 1 and 2.

The coil can now be mounted in a wooden case

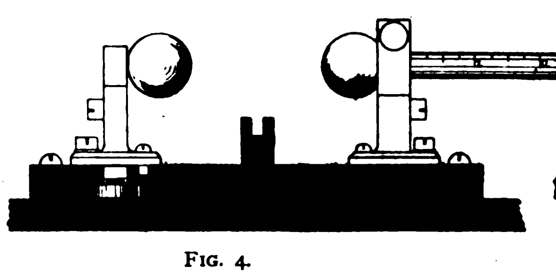


FIG. 4.

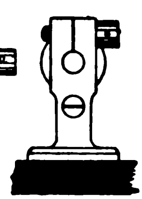


FIG. 5.

with ½-in. ebonite ends, as shown in the drawings, with the ebonite bearers fitted to take the weight of the coil, the spark-gap shown in detail in Figs. 3, 4, and 5 fitted, and the ends of the coil connected to the spark-gap pedestals, the case being finally fitted up with boiling wax and the wooden mandrel removed. This can be done by cutting an inch off the thick ends of the outer wedges and lightly tapping the exposed end of the central wedge, after which the lead foil can be peeled out, and if found to stick, can be released by slightly heating with a hot iron, care being taken not to unstick the inner coils of the blotting-paper tube.

The spark-gap, as will be seen from the drawings, is constructed in such a manner that a gap of 2 ins. cannot be exceeded. The secondary ebonite base carrying the spark-gap arrangement is provided with an ebonite bridge dovetailed in and cemented with thick shellac varnish to prevent sparks jumping along the base in damp weather. The rest of the details are sufficiently clear to require no special remarks, except that the base should be cemented to the ebonite end of the case with a little wax and resin to prevent all chance of sparks passing between the two pieces of ebonite. The balls should have two discs of platinum about ½ in. or ⅜ in. in diameter hammered over their faces, and soldered on to retard the erosion of the surface of the balls, which would be excessive if of brass only.

(*To be continued.*)

Locomotive Notes.

By CHAS. S. LAKE, A.M.I.Mech.E.

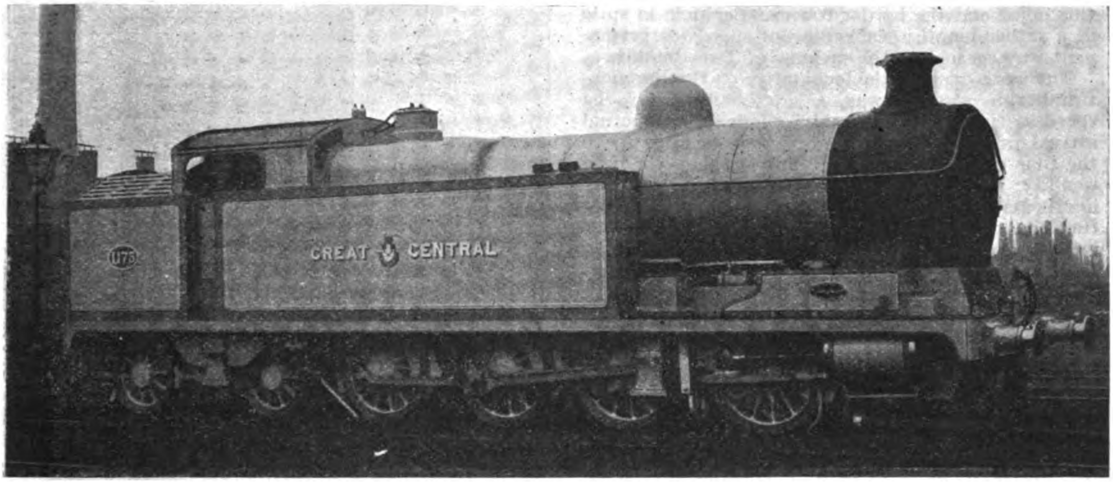
THE NEW TANK LOCOMOTIVES FOR WATH.

The heavy eight-coupled bogie tank engines, 0—8—4 type, specially designed by Mr. J. G. Robinson, chief mechanical engineer of the Great Central Railway, for working in that Company's gravity shunting yard at Wath, near Doncaster—itself a new institution—have now been placed in service. An illustration of the first of the engines to be delivered is, by Mr. Robinson's courtesy, illustrated herewith. There are three cylinders placed in line below the smokebox, all using boiler steam, and of these the inside cylinder drives the crank-axle of the second pair of coupled wheels, while the two outside ones directly operate the third pair. A separate Stephenson valve gear is provided for each cylinder, the slide-valves of the outside cylinders working at the sides of the ports and the inside valve works on the top of its cylinder. All three cylinders are carried in a slightly inclined position. The engine main frames are brought in closer together forward of the second coupled wheels so that the leading wheels are given a greater scope for side play, while at the trailing end, of course, the four-wheeled bogie provides for flexibility of movement. The boiler is of the same pattern and proportions as those fitted to the large "Atlantic" type express locomotives of the Great Central Railway, being fitted with the Belpaire type of firebox and slightly extended smokebox.

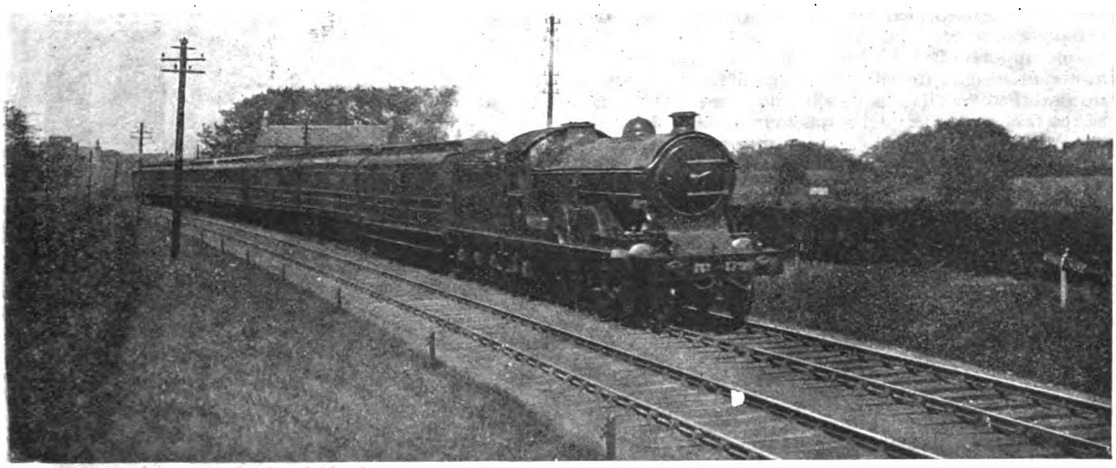
The writer was privileged to examine these engines during their construction at the works of Messrs. Beyer, Peacock & Co., Ltd., at Gorton, and has since been afforded an opportunity of seeing them working in the yard at Wath. They present an exceptionally fine appearance and are, of course, the largest and most powerful tank locomotives in the country.

Their work is to push long trains of wagons up the gradient of 1 in 199 to the top of the "hump" which constitutes the distinguishing feature of the sidings at Wath, and the wagons descend by force of gravity down the other side, passing over varying successive gradients, each less severe than its predecessor, until they reach the level of the sidings, where they are switched off in turn into the roads forming their several destinations. This principle has its advantages in reducing the amount of engine power required for the work of sorting the wagons, and generally tends to the observance of economy and despatch.

The Wath yard is equipped with locomotive water cranes, engine pits, and a 65-ft. turntable, and is replete in every way for its purpose. The new 0—8—4 tank engines, of which a fully dimensioned diagram (elevation and plan) will be found on page 21 of "Locomotives of 1907."



EIGHT-COUPLED BOGIE TANK ENGINE: G.C. RAILWAY.



N.E.R. (CLASS V) SIMPLE "ATLANTIC" ENGINE HAULING NEWCASTLE-EDINBURGH NON-STOP EXPRESS.

A GOOD RUN ON THE NORTH-EASTERN.

Travelling between London and Edinburgh by East Coast route recently, the writer noted some very smart locomotive work on the North-Eastern Railway with the non-stop train leaving Newcastle at 3.41 p.m. and due at Edinburgh at 6,15 p.m. This is the 10 a.m. train from King's Cross and does not convey "local" passengers between Newcastle and Edinburgh. On the occasion noted, the train was 12 minutes late in leaving Newcastle, owing largely to slackenings of speed between York and Darlington, and a virtual stop near Durham. The engine attached at Newcastle for the non-stop run to the Scottish capital was No.

1,790 of the Class "V" simple "Atlantic" type. The load consisted of eight 12-wheeled vestibuled cars of the latest E.C.J.S. pattern, and the weight loaded would be between 300 and 325 tons. On passing Morpeth, 16½ miles from Newcastle, a full minute had been made up, and, some very fine running ensuing, this advantage had been increased so that the train was only eight minutes behind schedule when passing Belford, 51½ miles from the start. A further two minutes was gained between this point and the border town of Berwick, in spite of a rather lengthy slackening of speed for permanent-way reasons in the vicinity of Tweedmouth.

The work done by the locomotive on the Berwick-Edinburgh stretch was exceptionally fine, the speed at times being very high; indeed, a punctual arrival at Waverley seemed almost certain up to the time of reaching Dunbar, but at this point time was lost, apparently owing to a goods train occupying the line ahead. At any rate, after passing such a train in a siding at East Linton there were no further interruptions, and Edinburgh was reached four minutes behind time. The distance of 124½ miles had been covered in 2 hours 26 minutes, an average speed of 51¼ miles per hour.

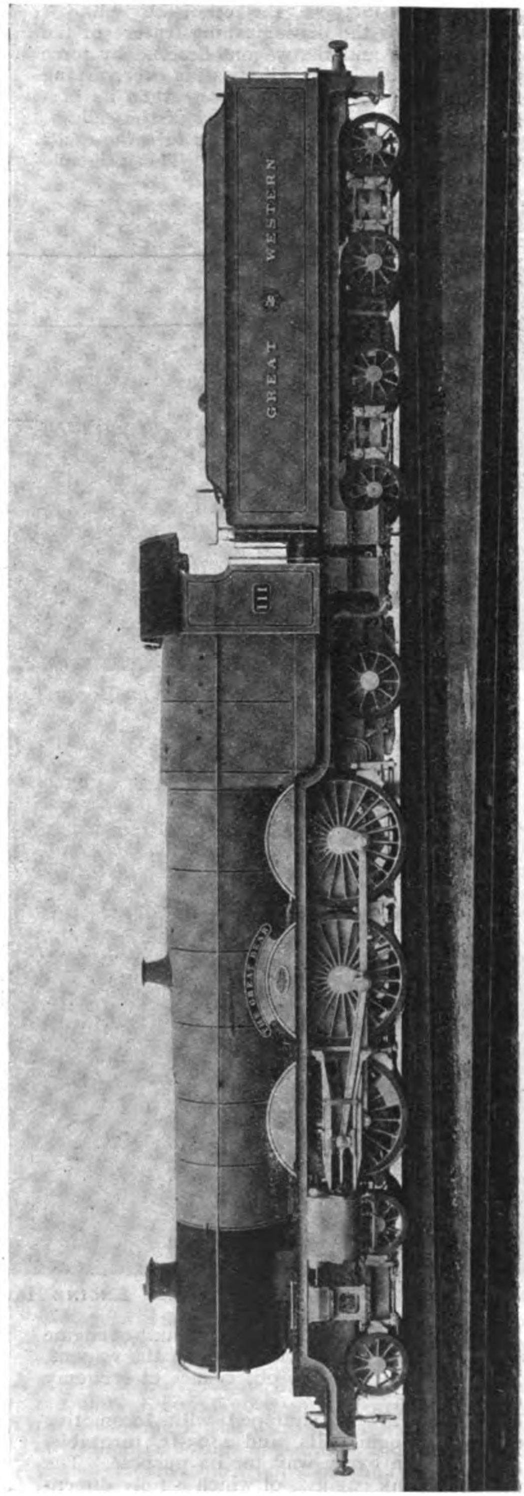
The G.W.R. "Pacific."

The long looked-for "Pacific" type locomotive of the Great Western Railway is now in service, and a very fine engine she appears to be. The design is practically an enlargement of the "Star" class of 4—6—0 type locomotives introduced by Mr. Churchward during 1907, and the engine may be regarded as nearing the ultimatum in steam locomotive construction for the British gauge, at any rate, while present standards exist. The discontinuance on the Great Western Railway of the "Atlantic" type of engine and the disadvantages of the 4—6—0, where freedom in designing the firebox is concerned, led directly to the adoption of the 4—6—2 or "Pacific" type, which combines ample opportunity of employing a large amount of adhesion weight distributed over three axles with no practical restrictions in selecting the proportions of the firebox. The engine has four simple cylinders arranged two inside the frames in advance of the bogie centre, driving the crank axle of the leading coupled wheels, and two outside cylinders at the rear thereof driving the second pair. Only two sets of modified Walschaerts valve gear are employed for actuating the four slide-valves. The boiler is of the coned pattern with wide Belpaire firebox, and a superheater of the Swindon type is fitted. The tender is of the eight-wheeled double bogie pattern, an innovation for the G.W.R.

The leading dimensions are given below:—

Wheels: Driving 6 ft. 8½ ins.; bogie, 3 ft. 2 ins.; trailing, 3 ft. 8 ins.
Wheelbase: Centre of bogie to leading, 9 ft.; driving, 14 ft.; trailing to carrying, 8 ft.
Cylinders (4): Diameter, 15 ins.; stroke, 26 ins.
Boiler barrel: Length, 23 ft.; diameter (maximum), 6 ft.
Heating surface: Tubes, 2,242 sq. ft.; firebox, 158 sq. ft.: total, 2,400 sq. ft.
Grate area, 42 sq. ft.
Working pressure, 225 lbs.
Tractive effort, 29,430.

By the kindness of the Great Western Railway Company we are enabled to reproduce a photograph of the engine described above.



New "Pacific" Type Locomotive, "The Great Bear": Great Western Railway.

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

AN ordinary meeting of the Society was held on Tuesday February 25th, at the Cripplegate Institute, Golden Lane, E.C. Mr. A. M. H. Solomon taking the chair, and over 100 members and visitors being present.

The minutes of the previous meeting having been read by the Secretary and signed, eleven new members elected and other business announcements made, the rules governing the evening's exhibition and competition were announced and the remainder of the meeting spent in examining the various models brought up and observing the working of those under steam. Steam was supplied to such of the stationary engines as were shown running by Mr. W. G. Corner's model Babcock and Wilcox water-tube boiler, which easily met all demands made upon it and elicited much admiration from the members. The stationary models included a 1½-in. × 2-in. vertical engine by Mr. Barrett shown driving Mr. Welsman's small dynamo, Mr. Dawson's small double cylinder winch engine and boiler, and two horizontal engines by Mr. T. C. Simpson, one a very minute one. Amongst the general exhibits were Mr. Hildersley's 4-in. spark coil shown working an *X*-ray tube, a switchboard and instruments by Mr. Welsman; interlocking signal frame by Mr. Hart, model steam yacht by Mr. Tiefenbock, a model steam hammer by Mr. J. C. Taylor, wireless telegraphy apparatus by Mr. Hunt, and a patented change speed gear by Mr. Dennant. The Locomotive Section comprised an electric locomotive and trucks shown at work by Mr. Steer, Mr. Blankenburg's unfinished Caledonian locomotive, Mr. Russell's L. & S.W. engine, and Mr. Riddle's steam travelling crane. The ballot for prizes was taken at 9 o'clock and resulted in Mr. Blankenburg, Mr. Russell, and Mr. Riddle taking the first, second, and third prizes respectively in the Locomotive Section; Mr. Barrett, Mr. Simpson, and Mr. Dawson taking the prizes in the Stationary Engine Class; and Mr. Hildersley, Mr. Tiefenbock and Mr. J. C. Taylor in the General Exhibit Section. An interesting model in the shape of a 4-coupled tank locomotive was shown by Mr. D. Corse Glen under steam, the engine having recently been rebuilt by Mr. F. Smithies, a late member of the Society and orginator of the type of model boiler bearing his name. After hearty votes of thanks had been, on the motion of the Chairman, accorded to the Scrutineers (Messrs. Wills, Ferreira and Hart), to Mr. Comer and to Mr. Bunt who had provided the electrical power, one of the most interesting and largely attended meetings of the session terminated at 10 p.m.

FUTURE MEETINGS.—The next meeting is fixed for Wednesday, March 18th: Mr. D. Corse Glen discourses on his experiences in the testing and inspection of machinery and engineering materials. The twist drill grinder will be available to members at the meeting. The following meeting is fixed for Tuesday, April 7th.

VISITS.—On Thursday, March 26th, to the Stratford Works of the Great Eastern Railway. On Saturday, April 11th, to the Paper Mills, at Croxley, near Watford, of Messrs. John Dickinson & Co., Ltd. On Wednesday evening, May 13th, to the Power Station at Bankside of the City of London Electric Lighting Co., Ltd.

Forms of application for membership and particulars may be obtained from the Secretary, HERBERT G. RIDDLE, 37, Minard Road, Hither Green, S.E.

TO BEDFORD READERS.—Model engineers and others interested in the formation of a local Society are invited to communicate with Mr. J. L. A. SILLEM, 51, Waterloo Road, Bedford.

Practical Letters from our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily for publication.]*

Model Airship.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—In further reply to "R. P. S." (Clifton), 18,335, the price of a fusiform balloon, 12 ft. long by 2 ft. 3 ins. diameter, made of double skin, varnished, is £2. This balloon lifts 1½ lbs. when inflated with hydrogen. Other sizes and prices may be seen in the list issued by C. G. Spencer and Sons, 56A, Highbury Grove, London, N. The formula for finding the cubic contents of such balloons has been given, but for speedy calculations it is only necessary to multiply the length by the breadth and depth and halve the result. The lifting power of hydrogen is 7 lbs. per 100 cubic feet, and of coal gas 4 lbs. per 100 cubic feet. For experiments with such balloons hydrogen compressed in tubes is far more convenient and economical than making the gas. Such tubes may be obtained from lantern dealers, or from the British Oxygen Company, Saltley Works, Birmingham.—Yours truly, PERCIVAL SPENCER (Aeronaut).

45B, Aberdeen Park, London, N

Re Alternating Current Motor.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—Referring to Mr. Birch's letter, published in last week's issue, I am glad to see that he suggests the building of some useful machinery. I would, however, suggest that the range of machines be extended up to, say 1 h.-p. and also for voltages up to 220, as I do not think a ¼ h.-p. will be found, in practice, sufficient for a 6-in. centre lathe, unless limited to very light cuts, etc.

I, for one, should welcome any illustrated article by Mr. Birch on the construction of a 1 h.-p. 210-volt 50-cycle motor. Perhaps Mr. Birch will kindly give some idea of the cost of castings and stampings.

Further, as ¼ to 1 h.-p. gas engine castings, parts, etc., can now be purchased so cheaply, the necessary castings and stampings for induction motors from ¼ to 1 h.-p. should not be expensive.

Perhaps, with assistance from your valuable columns, in making the necessary patterns, readers could obtain their own castings, which would greatly reduce the cost of building.—Yours faithfully,

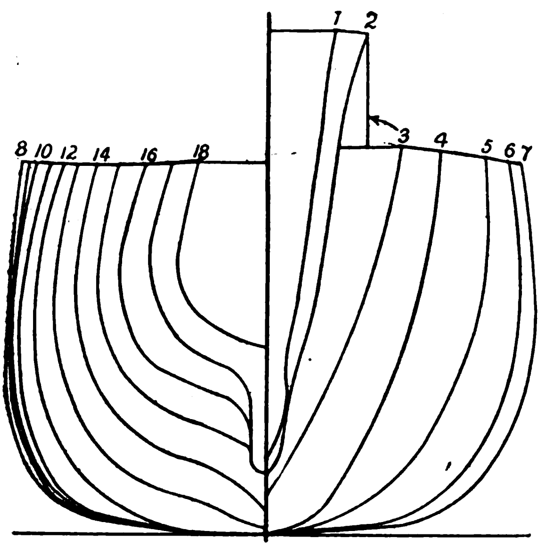
E. C. Stocken.

Re Model of H.M.S. "Black Prince."

To the Editor of *The Model Engineer*.

Dear Sir,—We enclose the body plan of H.M.S. *Black Prince*, as requested by you, which we hope will be of use to your readers. Any further particulars we can give we shall be pleased to supply.

The rather curious shape of the last two or three sections is due to the fact that the stern tubes were built in separately (see articles, January 2, 9, and 16 last), and are not shown here. The enclosed



Body Plan of Model H.M.S. "Black Prince."

(*Half full size.*)

No. 1 = 1 in. from Bows.
Nos. 2 to 18 = 2 in. intervals.

we believe to be quite correct. The lower part of sections 1 and 2 show section of ram (see elevation in article).—Yours faithfully,

C. F. W. and A. R. H.

Wireless Telegraphy.—In a lecture delivered recently by Mr. G. Marconi on wireless telegraphy before the Liverpool Chamber of Commerce, he stated that 90,000 words of "commercial" messages had been transmitted between the Company's stations in Canada and Ireland, and that it was now possible to transmit at the rate of 100 words per minute, but a speed of 20 words per minute was that regularly maintained. A 2,000-word wireless telegram from New York had been printed in an issue of the *Times*.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* The Model Engineer, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[19,083] **Accumulators and Engine Power.** A. F. (Bristol) writes: Will you kindly answer me the following queries? (1) 8-volt accumulator, each cell containing three plates, 3½ ins. by 2½ ins., what is its amp. hr. capacity? (2) What is the highest candle-power "Osram" lamp this will light efficiently? (3) Using a 10-volt dynamo to charge this accumulator, what amperage should it be (smallest)? If I use a gas engine (small), what size should cylinder be? If I use steam engine (*a*) what size should cylinder be? (*b*) What size boiler, and how many tubes and what pressure? (*c*) Would a Bunsen gas burner supply enough heat to get necessary pressure?

(1) The capacity of an accumulator may be rated at 15 amp.-hour per sq. ft. of positive plate surface. From this the capacity of your cell works out at approximately 2 amp. hours. (2) The highest candle-power "Osram" lamp you can use will be about 10 c.p. Write to some of the manufacturers; they will send you their most recent lists. (3) Your dynamo should be capable of generating at least 8 amps. to supply the above accumulators. We are calculating upon the basis of one positive plate to two negative plates. You do not mention whether the plate is inside or out. *Re* gas engine required. Cylinder should not be less than 2½-in. bore by 3-in. stroke. *Re* steam engine. If you refer to recent Query Replies you will see the sizes given for engines capable of doing this work.

[18,996] **200-watt Transformer.** A. V. G. H. (Leeds) writes: Could you give me any information on the following? I want to make a transformer, our supply being 200 volts single-phase, fifty periods. I want to transform down to 100 volts at about 2 amps. I have some ring laminations. Could I utilise these, and about what thickness should I require? Could you say what amount and size of wire on primary and secondary? Have you any books on the winding of alternating motors, giving methods of coupling up for various phases, cycles, and voltage, and the calculating of the same?

Iron core to be ring stampings, 5½ ins. outside diameter, 3½ in. inside diameter, thickness to be made up to about 1½ ins. Primary winding 1,200 turns of No. 23 gauge D.C.C. copper wire, secondary winding 600 turns approximately of No. 20 gauge D.C.C. copper wire. The secondary voltage can be adjusted by winding on or taking off a few turns of secondary winding. About 1 lb. of wire will be the weight of primary, and about 1½ lbs. the weight of the secondary, but you should make ample allowance on account of the irregular lay of a ring winding. You can use your present rings, if desired, making the outside diameter 7 ins. and inside about 5 ins.; they will be easier to wind than smaller rings. We do not know of any simple book on the subject of windings and connections or calculations of alternating current motors. The alternating current section of Professor Sylvanus P. Thompson's "Dynamo — Electric Machinery" is a good book, but it is advanced in character and expensive.

[19,053] **Civil Engineering.** W. J. H. (Canterbury) writes: Would you be so kind as to tell me in brief what course to pursue with regard to my boy becoming a civil engineer? Age 17½, and of good education (King's School, Canterbury). I want him to stay at school another year, if possible. Expense and residence in London no object. I hope you will be able to help me.

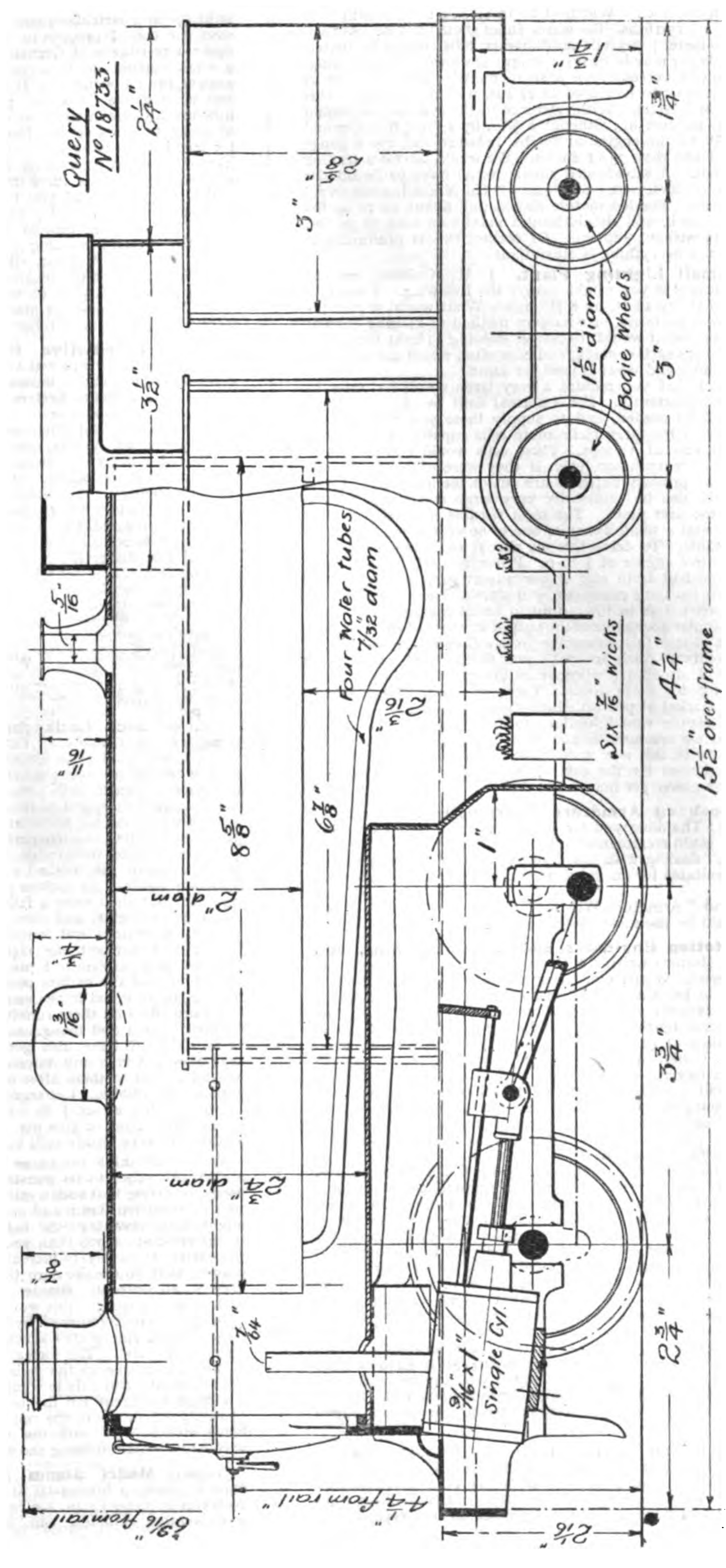
In reply to your enquiry *re* your son becoming a civil engineer we are afraid we can only give you a few general hints on the course to pursue. In the first place the conditions and circumstances of your particular case will influence the course you adopt very considerably. It is desirable that he should have a thoroughly good mechanical and electrical grounding in all matters pertaining to these two professions before he begins the larger constructive work which he proposes to take up. For the first year or two at some technical college his work would be practically the same as that for mechanical and electrical engineers; after this, he would specialise by either taking a further course at some of the larger colleges or become a premiumed pupil to some firm of civil engineers. To attain this position, it would be necessary to advertise in some of the engineering papers, stating your requirements as to the kind of work you wish him to take up. After such an appointment has been obtained, it will rest entirely with him as to what progress he makes, provided he gets with a suitable firm and is afforded an opportunity of gaining actual practical experience in constructional work. We trust the foregoing suggestions will assist you, but we may add the matter is so entirely dependent upon the circumstances — of which we know practically nothing—that you will see that it is very difficult for us to give any definite information.

[19,088] **Power of Engine for Dynamo Driving.** H. A. (Birkenhead) writes: Can you answer the following question? What horse-power two-cylinder petrol engine will I require to drive dynamo direct-coupled 60 volts 50 amps.? I want it for lighting, and would run lights direct, without accumulators. I should be much obliged if you could help me on this point.

You would require a machine giving at least 6 b.h.-p.; but it would be better to allow eight, for the various losses which cannot be avoided.

[18,733] **Model Tank Locomotive.** A. W. L. (Sheffield) writes: I intend making a model similar to The Model Engineer locomotive (described in The Model Engineer, January 7th, 1904). The gauge I have decided on is 2½ ins.; boiler (inner tube) 2 ins. diameter, 8 ins. long; four water-tubes, ¼ in. or 3-16ths in. diameter; outer tube, 2¼ ins. diameter, 10 ins. long; driving wheels, 2½ ins. on tread, placed as above model, with trailing bogie or pony truck. One cylinder only, to be fitted either ½ in. by 1 in. or ⅝ in. by 1¼ ins. Which of the above-mentioned cylinders would you advise me to adopt, and how to fix same? If you think ½ in. by 1 in. best, please give size of ports and lap and travel of valve. I can get sizes of ⅝ in. by 1¼ ins. from above locomotives. Boiler to be made of drawn copper tubes, tested to 100 lbs., working pressure 30 lbs. What gauge shall I require? Would copper or brass tube be best for outer tube; also give gauge for same? Will you send me sketch of pony truck suitable for above, and how to fit same? What should the distance be from rail to centre of boiler? Which would be best for water tubes, ¼ in. or 3-16ths in.? What should locomotive pull on a level road?

We include herewith a design for a model such as you require. The width between the frames should be 2 ins. Thickness of



Sketch Design for ½-in. Scale Model 0—4—4 Type Tank Engine with Single Cylinders.

(Drawing half size for model.)

frames, 1-16th-in. steel. Width of footplate, 4½ ins.; width over tanks, 4 ins. or 3 15-16ths. The water tubes should not be less than 3-16ths in. diameter; 7-32nds in. diameter tubes would be better, and the inner boiler may be 8¾ ins.; length as shown on the drawing. No downcomer is necessary on a small model. The diameter of the outer shell may be increased to 2½ ins. with advantage. This may be of brass or steel. With reference to the cylinder, we would advise 9-16ths in. by 1 in., although a ½ in. by 1 in. cylinder would work well. Work the engine at 60 lbs. pressure and use a gauge reading to not less than 75 or 80 lbs. We would advise a trailing bogie, as shown. A six-wheeled engine would have to be smaller in all directions to look well. See design, "The Model Locomotive," page 36, Fig. 29. The locomotive should pull about 30 to 40 lbs in continuous track, and should haul a maximum load of 70 lbs. or thereabouts without slipping. Of course, this is presuming it is well made and everything is steamtight.

[18,992] **Small Lighting Plant.** J. H. (Cosham) writes: I would be pleased if you would answer the following. I want to light a room 9 ft. by 10 ft. by 8 ft. high. What would it cost for lamps, wire, and batteries, or whatever method of making current is cheapest; also what would it cost per evening to light the lamps for, say, five hours each evening, and how often would the batteries want replenishing, and what is used for same?

You will find that you require a very large set of batteries to light your room efficiently. For a normal light two 8 c.-p. lamps, at least, would be needed, and to supply these you will need at least a battery of ten large bichromate cells capable of supplying current at the rate of 3 amps. These cells would not last more than fifteen to twenty hours, even if they were each of 2-quart size, so we think primary batteries are out of the question. Accumulators would also be necessarily very large and would cost a good deal in the first place. The most feasible method to adopt would be to instal a small dynamo, one of 60 or 100 watts output would be suitable. To drive this we should recommend either a small oil or petrol engine of ½ h.-p. Prices of both dynamo and engine could be had from any of our advertisers, but whichever firm you go to for both machines, you should certainly obtain a guarantee in writing as to the output in brake horse-power of the engine and a similar guarantee of the output in watts of the dynamo. If you do not obtain this guarantee, you will run a probable risk of getting machines which are not equal to the work required of them. You will also find it cheaper in the end to pay a reasonably good price for these goods. There are many other cheap makes on the market at present which should be carefully avoided. No maker of repute would hesitate to give you a guarantee in writing, which we recommend you to obtain. The cost of generating electricity in this way would vary slightly according to the price of the oil used for the engine, but should not exceed 1½d. per brake horse-power per hour.

[18,987] **Book on Armature Construction.** A. H. M. (Erith) writes: Thanking you for past services, I should be much obliged if you could recommend to me a standard book on "Armature Winding," dealing with the practical side of the question. I want a book suitable for an apprentice learning to be an armature winder.

You will find "Armature Winding," by Hobart, price 15s. 4d. post free, would be the most useful book for you.

[18,986] **Station Engineers and Apprenticeships, etc.** T. H. (South Molton) writes: I thank you for your reply to my question last week. Would you please answer following questions? I am anxious to become an electrical engineer and should like to know how to proceed without having to pay a heavy premium. There is a central lighting station at Barnstaple (near here) where pupils are taken at £100 premium, £60 of which is returned in three years. Could equal experience be obtained here as can be obtained in larger towns or cities, and do you think it a good start in a small town? Is premium reasonable? Is there any possibility of going through works without paying heavy premium? If I went through lighting station three years, what salary could I expect to get; also could I ever become manager of a station? What are salaries of managers?

The questions you ask depend entirely upon the circumstances of the case. No doubt premium pupils or apprentices obtain some advantages which ordinary apprentices do not, but personally we are not in favour of such a system, and think it would be better if you could get into some station or works at a very low wage for the first few years, but entirely on the strength of your qualifications and not on account of any premium paid. Of course, if it is not possible to get any other job, you will have no choice in the matter, and should of course take what offers without delay. Regarding the salary you might expect at the finish of your time, this also depends entirely on your capabilities and whether you are well adapted for your work or not. The salaries of chief engineers for this class of station range from £150 to £250 or £300 per year. We regret that we cannot give you any more definite information as the whole matter really depends upon your circumstances and other conditions, regarding which we do not know very much.

[18,982] **Induction Coils.** J. H. J. (Coventry) writes: I wish to make a shocking coil and I should be glad of some information. A friend of mine has a coil giving both galvanic and Faradic currents for medical purposes, and I should like to get the same result. I have a bobbin as per sketch (not reproduced) built up on a cartridge-paper tube. Instead of having a draw tube over the core, I propose to make ½-in. core to fit bobbin tight and make a resistance of German silver wire so that I can give from a weak current up to a very powerful shock. Will you kindly answer the following: (1) How much primary and secondary wire, and what gauge for a very powerful coil? (2) What gauge, and how much German silver wire for resistance of ten stops? (3) How to generate galvanic and Faradic currents? (4) How to wire up for terminals so that I can change from one terminal to the other like coils seen at bazaars (or by switches if preferable)? I propose working from two or three dry cells.

We can recommend you to follow the directions given in "Induction Coils," price 7d. post free, for the ½-in. coil, particulars of which are given in tabular form. A resistance to use in circuit with the primary winding and cells could be made out of a few yards of No. 28 German silver wire, S.W.G. The latter should be divided up into ten lengths and arranged in the manner shown in recent Query Replies on this subject. For connections showing how to get combined primary and secondary shocks, you should refer to our issue of October 18th, 1906, page 381.

[18,771] **Locomotive Boiler Queries.** J. N. B. (Birmingham) writes: Will you kindly answer me the following queries. I am about to build a locomotive type boiler to work at 150 lbs. per sq. in., Belpaire firebox, 8-in. barrel. (1) Length of barrel. (2) Length of smokebox. (3) Length, height, and width of outer shell of firebox. (4) Distance between outer and inner shells for water space in firebox, and how much taper in legs of box. (5) Would 9-16ths in. outside diameter flue tubes do? (6) Thickness of metal for plates. (7) Size of firehole, and what form is best for boiler? (8) Distance of centres of stays apart? All plates, stays and tubes copper.

(1) We presume the boiler is for stationary purposes. The barrel may be 20 ins. long, 9 ins. diameter over lagging. (2) Smokebox, 9½ ins. diameter; length, 5½ or 6 ins. (3) Firebox, 8½ ins. wide by 10 ins. long by 6 ins. deep below bottom of barrel. (4) The water space should be ⅝ or ¾ in. The taper may be practically *nil*, say, one-eighth in maximum. (5) Flue tubes for stationary boiler, ¾ in. diameter. About eighteen can be used. (6) See "Model Boiler Making" for rules as to plate thickness for various materials and methods of riveting; also see "The Model Locomotive." The latter book gives rules for staying. (7) Firehole should be oval and as large as the inner firebox will allow. (8) Depends on material used.

[18,980] **Sack Leclanche Cells.** J. D. (Sutton) writes: Being a constant reader of THE MODEL ENGINEER for the last four years, I have taken the liberty of writing to you and should feel greatly obliged if you could help me in the following. I am making four Sack Leclanché cells; they are the same size as those sold by the Universal Supply Co., the Empire Sack cells they are called. Now, if you could tell me what mixture the Sack contains, also the proper quantities of each material (it will take about 2 lbs. altogether to charge them); also if the above people use any other chemical beside the crushed carbon and crushed manganese in the Sack—of course, the carbon pencil included. I made four some time ago but they were a failure, only lighting a 4-volt lamp for about five minutes, and then they gradually ran down. I tested all the connections and found they were all right, so I concluded that I had not got the right mixture nor the proper quantities of each material. I used ½ lb. of manganese to each pound of carbon, and the carbon pencil I used was the same as they use for arc lamps, cored in the centre. I was wondering if that would have any effect on them running down so quickly. I obtained the crushed carbon and manganese from Whitney's, so that ought to be all right. I have also got your handbook on Batteries, but that does not give any information on Sack batteries. I found when I looked at them after some time that the zinc was covered with small bubbles. I charged them with the ordinary Leclanché solution, using about ½ lb. of sal-ammoniac. If you could help me in this matter or give me any hint I shall feel greatly obliged, as they are very handy cells for intermittent lighting.

We do not think the cause of the apparent failure of your cell is due altogether to its construction or the ingredients you have used, but rather that such a cell is only suitable for supplying current to a very efficient lamp and one taking a very small current. You might with advantage use rather more manganese in proportion to the crushed carbon than you are using at present. The duty of the carbon is merely to increase the conductivity of the cell. We suggest that you make sure that the lamp you are using takes a very small current. Besides this, you might try two or more such cells in parallel; this would enable them to cope more readily with the current required by the lamp. You should also use a large circular zinc plate encircling the Sack instead of the ordinary form of zinc rod. The formation of small bubbles on the surface of the zinc is due to the cells being discharged at a rate beyond their capacity and this is what causes the cell to refuse to supply a sufficient current for the lamps; therefore, the larger the area of zinc you can use in the cell the more chance there is of the cell being able to cope with the work. We see no reason, however, why you should not bring the matter to a successful issue.

[18,909] **Model Steam Plant.** H. H. (Malta) writes: I wish to make a horizontal steam engine to drive a dynamo of 20 watts at 3,000 r.p.m. for two or three hours at a stretch. Will a slide-valve cylinder, 1-in. bore 2-in. stroke, drive the above

dynamo at full output? What should be the pressure supplied to cylinder? Can you give me a sketch of boiler for above engine, showing sizes, etc.? What size flywheel must be used? Can the boiler be fired by ordinary household petroleum? If so, can you give me a sketch of lamp? Is a force pump absolutely necessary?

You will do better with a high-speed type of engine. Work with a boiler pressure of about 50 lbs. and design the engine with a cylinder about 1½-in. stroke by 1½-in. bore. The flywheel must suit the pulley of dynamo. The speed of the engine would be about 500 revs. per minute. A 12 × 24 vertical multitubular boiler, with about ten tubes 1¼ ins. diameter, is recommended for this work if you can obtain coal. The shell may be of mild steel, 5-32nds in. or 3-16ths in. thick. This boiler should, for solid fuel, have a water space firebox 11 ins. high. For general design, see our sixpenny handbook, "Model Boiler Making." This book also includes a design for an oil or gas-fired vertical boiler. This type of boiler may be made 10 ins. diameter and 18 ins. high, and provided with thirty tubes ⅝ in. diameter. This type of boiler was illustrated in a recent query (October 31st issue of last year). An eight-burner vaporising oil stove of the "Intensive" pattern may be used in conjunction with this type of boiler if you have no gas. You could not make a satisfactory stove. Yes, a force pump and a carefully regulated feed is an absolute necessity.

[18,782] **Horse-power of Locomotive.** G. M. J. (Bedford) writes: Please could you answer the following query. I should like to know the horse-power developed by the new L. & S.W.R. 4-cylinder compound locomotive, 4—6—0 type?

Everything depends on the circumstances under which the power is measured. Standing still the horse-power developed would be *nil*; the same might be the case when the train is running down hill if the steam were shut off. With a heavy load on the level at the maximum speed the indicated horse-power developed would be in the neighbourhood of 1,000 i.h.-p. We have seen no indicator diagram from this engine, and therefore cannot say definitely. The engine *is not a compound*, by the way. It should also be remembered that the whole boiler pressure is seldom, if ever, available in the steam chest, or, in any case, in the cylinders at point of full admission when the engine is running.

[18,915] **Steam Plant for Electric Lighting.** F. W. B (Bristol) writes: I have a rather heavily built model engine, 1½-in ore by 1½-in. stroke, fitted with a 6-in. flywheel, and want to utilise same for driving a dynamo for lighting purposes. Will you please let me know (1) What size boiler I should require, and diameter of steam pipe? (2) What size dynamo would this engine drive? (3) How many 16 c.-p. lamps would it light?

(1) For coal firing use at least a 12 × 24 boiler, multitubular preferred. The shell may be of steel 5-32nds in. or 3-16ths in. thick (double or single riveted seam respectively), and the firebox should be 11 ins. high. Ten tubes may be employed, diameter 1 or 1¼ ins. Steam pipe may be 5-16ths in. diameter copper pipe. Boiler pressure, 50 lbs. (2) We cannot recommend larger than 40 watts, say, 20 volts 2 amps. (3) Hardly 16 c.-p. total.

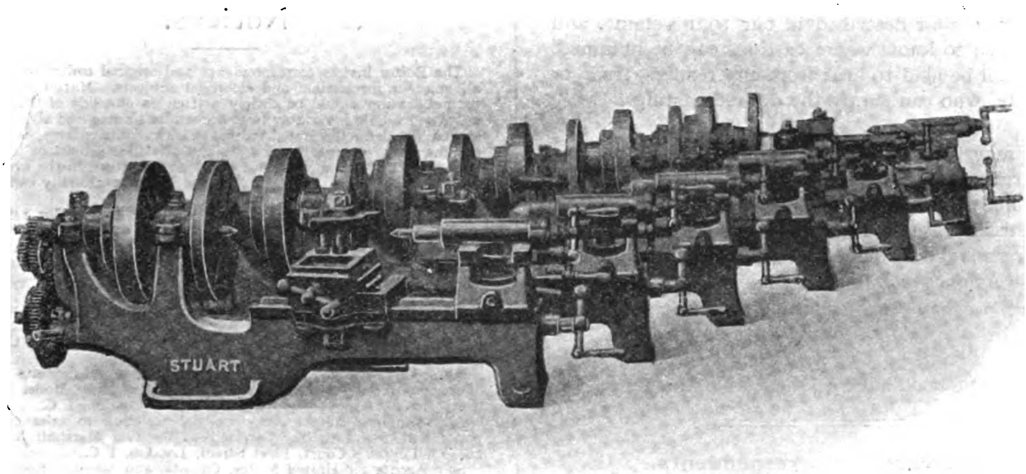
The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

** Reviews distinguished by an asterisk have been based on actual Editorial Inspection of the goods noticed.*

The "Stuart" Lathe.

Visitors to the recent MODEL ENGINEER Exhibition will remember the great interest which was aroused by the introduction of a £5 5s. screw-cutting lathe by Messrs. Stuart Turner, Ltd., of Shiplake, Henley-on-Thames. This lathe has served to fill a want among amateur mechanics, and is rapidly achieving the popularity it deserves. It has recently been improved by making the tailstock to set over for taper turning, while the tailstock barrel now has a separate spindle bored Morse taper and fitted with a screw and handle. Owing to improved methods of manufacture, the makers are able to guarantee an accuracy of at least a 2,000th part of an inch. The ordinary pattern takes 9 ins. between centres, but at an extra cost of 5s. a longer bed, to enable 12 ins. to be turned between centres, can be supplied. The lathes are sent out on approval, and the makers are quite willing to send them under the conditions of the *M.E.* deposit system. Indeed, they recommend intending customers to avail themselves of the advantages of our deposit system, and they offer to defray all the expenses incurred in its application. The accompanying illustration shows a group of the latest pattern "Stuart" lathes lately completed in the makers' shops. It is a tool we can confidently recommend to our readers as excellent value. A full descriptive booklet may be had by sending a 1d. stamp to the makers, as above.



A GROUP OF "STUART" LATHES.

An Exhibition of Correspondence Instruction.

A novel exhibition will be held in the Arbitration Room No. 12, Safe Deposit Buildings, Chancery Lane, W.C., from March 9th to 18th inclusive. It is intended to show what can be accomplished by the I.C.S. correspondence system of education, and will give our readers an excellent opportunity of personally investigating the methods of this well-known school, and of seeing the work done by students. Free admission tickets may be obtained from The Manager, International Correspondence Schools, 59N, Chancery Lane, London, W.C.

The Editor's Page.

A PICTURE post-card of a model engine has been sent us by Mr. W. Pentney, 51, Milton Street, Derby, who informs us that the model depicted is to be drawn for on April 10th. The proceeds are to be devoted to the Orphan Fund of the Amalgamated Society of Railway Servants. The price of the post-cards is 2d. each, and all purchasers of a card participate in the draw. The model, which is a large one, is an outside cylinder 4-coupled engine, 6 ft. 5½ ins. over all, and 6½ ins. gauge. It took a second prize and bronze medal when exhibited at Sheffield in May, 1906.

* * *

We have lately had several enquiries from readers who wish to build a model Caledonian locomotive similar to that described in our 1901 volume, and who wish to know where castings can be obtained. We shall be glad to hear from any readers, trade or private, who can suppy the desired castings.

* * *

It may be interesting to our readers to know that the reinsertion of our offer to send free copies of our little book "Tales Worth Telling" brought us a tremendous rush of applications; these coming in for several days at the rate of over one hundred a day. As our stock has thus been considerably depleted, we have now suspended the free offer, but shall be pleased to supply copies, so far as the stock lasts out, post free for 3½d. each. The little jokes in the book have been greatly appreciated.

Answers to Correspondents.

K. H. (Frankfurt).—Thank you for your letter. We appreciate your suggestion *re* handbook, which we will bear in mind. Glad to hear the paper is so helpful to you.

J. M. (Rio de Janeiro).—Bound copies of Vol. XVII are now on sale. The cost, post free, to Rio de Janeiro would be 7s. 6d. Bassett-Lowke & Co., Northampton, could supply the valves you require. Sorry we could not get this reply into our March 5th issue, as desired.

L. G. C. (Siracusa).—Thanks for your letter. The book of tales has been forwarded as desired. We are sorry your suggestion for increasing the size of THE MODEL ENGINEER is not workable. Always pleased to hear from you. Your English is excellent.

R. B. (Leeds).—We thank you for your letter, and as you will see, the article you mention is commenced in this issue. We shall be pleased to see photographs of your work.

M. R. (Co. Durham).—You will find full instructions on "Silver Soldering" in the issue of April 23rd 1903, price 3d. post free from this office. Borax is used for flux and, as in most soldering processes, the metals to be joined must be quite clean.

H. C. A. (Leeds).—Write to the Agent-General for Australia, Victoria Street, Westminster, who will give you all particulars.

M. E. A. (Musselburgh).—In reply to your enquiry *re* connections, the alternating current and the direct current leads will be to their respective circuits just as though you were connecting up two quite separate machines. The voltage of the lamps used on the respective circuits must be the same as the machine generates. Your machine appears to be of about 700 watts output and it will take fully 1½ b.h.-p. to drive it. The direct current supply will be used for charging purposes. The value of the machine depends upon its condition, of which we know nothing. Probably the machine was built for some special purpose, but such dynamos are not in common use now-a-days.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 26-29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

Sole Agents for United States, Canada, and Mexico: Spon and Chamberlain, 123, Liberty Street, New York, U.S.A., to whom all subscriptions from these countries should be addressed.

Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

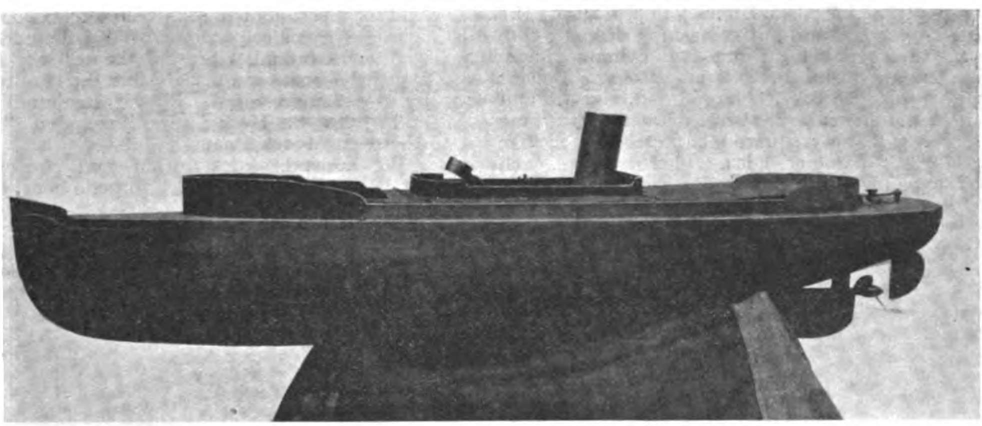
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 360. MARCH 19, 1908. PUBLISHED WEEKLY

The 1907 Model Speed Boat Competition.

(Continued from page 245.)



MR. THOMAS DYSART'S MODEL STEAM LAUNCH "HERMES."

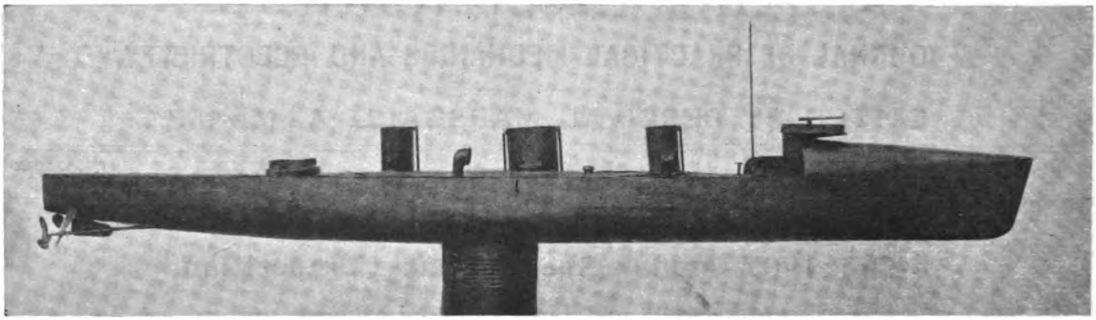
(Winner of Bronze Medal in Class C.)

THE winner of a Bronze Medal in Class C was the metre boat *Hermes*, designed and built throughout, with the exception of the pressure gauge, by Mr. Thomas Dysart, of the Victoria Model Steamboat Club; the boat attained a speed of 6·52 miles per hour. Tested on a course of 100 yards, measured along the west side of the Bathing Lake, Victoria Park, on December 26th. Speed, first trial (wind abaft), 28 secs.; interval 2 minutes. Second trial (against the wind), 34 secs.; interval 7 mins. Third trial (wind abaft), 32 secs. Timed by W. L. Blaney, Chairman V.M.S.C.; Wm. Poole, Hon Sec., V.M.S.C.

This boat, which is illustrated herewith, is of the open launch type, with deep coamings to keep the water "outboard." The hull is built of tin-plate in sections, in a manner already described in THE MODEL ENGINEER. It measures 1 metre over-all, 7-in. beam, and 3-in. draught. The lines of the hull was a matter of very careful design, and we hope to give these in a future issue. The engine is a single cylinder, high pressure, ordinary slide-valve type, ⅝-in. bore by ⅜-in. stroke, with special attention paid to the cut-off and lead of the valve. It drives a 2¾ ins. diameter, 7-in. pitch propeller at about 1,800 r.p.m. The boiler is of the orthodox single flue type, 6 ins. long in the water space and 4⅞ ins. diameter. The flue tube is 2 9-16ths in. diameter, within which are twenty-three cross water tubes, 5-16ths in. diameter. The superheater is a long length of steel tube arranged in a peculiar bunch in the front of the flue tube, right in the path of the flame. The working pressure is 90 lbs. per sq. in. The benzoline blowlamp is of ordinary form, but is the most powerful that could be got within the space available. The speed recorded between two lines, 100 yards apart, does not represent the actual speed of the model, as it made the course in a succession of arcs and consequently covered a greater distance.

The following are the results and dimensions of Mr. John McDonald's T.B.D. *Archer*:—Class B; 300 yards measured course; time, 112 secs. Power turned on and held for a period of 20 secs. before released. Average speed, 5·478 miles per hour. and that the boat was timed by us as herein stated. Signed, W. Bunting, vice-president; and John S. Henry, secretary and treasurer, Aberdeen Model Steamer Club."

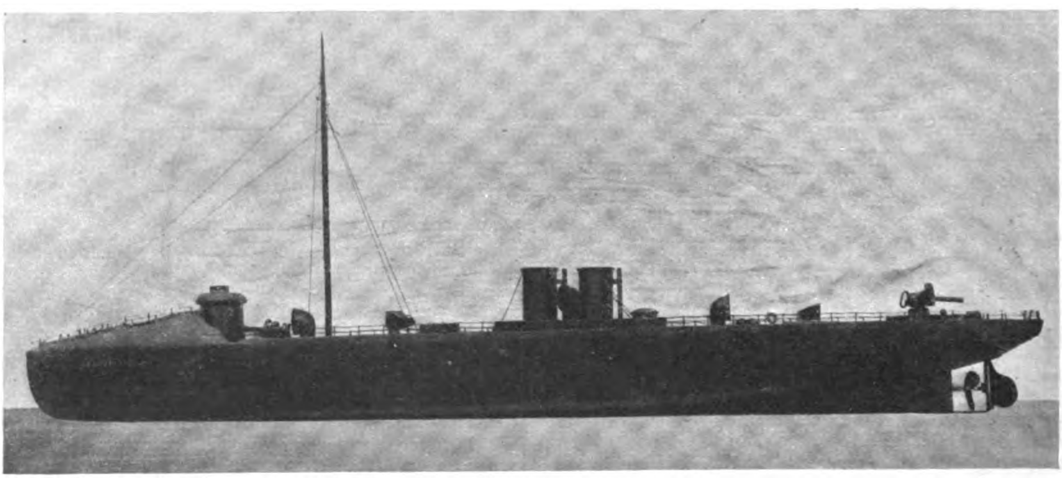
The following are the official results of the speed test of the *Swordfish*:—Class B, 300 yards measured course; time, 135 secs. Power turned on and



MR. JOHN McDONALD'S MODEL T.B.D. "ARCHER." (*Class B.*)

Length, 5 ft. 5½ ins.; beam, 6 ins.; depth, 5 ins.; the hull is built bread-and-butter fashion of red wood, average thickness being ¼ in.; twin-cylinder single-acting engine, 1-in. bore, ⅝-in. stroke. Boiler: Cornish type; 20 B.W.G. lap-jointed, riveted and sweated, the flue tube is 2½ ins. diameter; working pressure, 45 lbs. per square inch, tested to 70 lbs.; length, 1 ft.; diameter, 4 ins.; 18 cross tubes, each tube is expanded in and soldered; petrol blowlamp; held for a period of 18 secs. before released. Average speed, 4·545 miles per hour. "We, the undersigned, were present and witnessed the tests of Mr. Wm. Bunting's boat, and declare that the boat was timed by us as herein stated. Signed, Benjamin Gibbons, and John S. Henry, Secretary and Treasurer, Aberdeen Model Steamer Club."

We append a description and photograph of Mr. Wm. Bunting's model torpedo-boat destroyer



MR. WM. BUNTING'S ELECTRICALLY DRIVEN MODEL T.B.D. "SWORDFISH." (*Class B.*)

regulated by needle valve, which can be seen in photograph immediately behind the mast; the rudder is balanced; twin propellers, 3 ins. diameter; shafts are silver steel, and taken out through hull at a slight angle and suspended by two ½-in. brackets, one driving the other by means of gear wheels. We publish a copy of the certificate of performance: "We, the undersigned, swear that we were present and witnessed the tests of Mr. John McDonald's boat, *Swordfish*, Class B: The hull was dug out of a block of yellow pine, and the design is from THE MODEL ENGINEER handbook on "Model Steamer Building." The measurements are: Length, 4 ft. 6 ins.; beam, 6 ins.; depth, 4½ ins. It is dug out to an average thickness of 3-16ths in. The turtle deck is a separate piece fastened on the deck line. The boat is worked by a "Triumph" motor supplied by a local electrician of Aberdeen and wound for 8 volts, and it is driven by two 4-volt 10-amp. accumulators. Approximately the boat weighs about 20 lbs. with everything on board. The whole of the deck fittings were made entirely by Mr. Bunting, including four ventilators, three quick-firing guns, chart deck, torpedo tube, etc., the searchlight, which is lighted by a "pea" lamp connected from accumulators, also conning-tower, which is lighted with a 6-volt "Osram" lamp. The method of driving propeller was by means of crank disc and pin; but finding that a good deal of noise and friction was being set up, Mr. Bunting put on a spiral spring coupling, with the result that a good deal of friction was done away with and noise entirely disappeared except for the hum of the motor, and the speed of the motor was considerably increased. The hull and fittings are painted a dark grey and the deck chocolate brown and finished with coach-body varnish, which gives it a skin that glitters like a mirror. The railing is made from pins, and thin gauge steel wire is taken from each with a single turn round pins and soldered. The lifebuoys are made from bone buttons, the centre being bored out. The ventilators are made in two halves of copper sheet beaten into shape with a mould and brass rings round the mouths which are polished. Since the above photograph was taken, Mr. Bunting has made the hatch larger and added another funnel and two more ventilators. The switch is on deck immediately below the muzzle of the stern gun. The whole of the boat and fittings are finely proportioned, excepting the stern gun, which is just large enough.

(To be continued.)

Experiments with Primary Batteries.

As already mentioned in the usual report of its proceedings, Mr. A. W. Marshall, A.M.I.E.E., member, gave a lecture upon primary electric batteries at the London Society of Model Engineers' meeting, on January 28th last. This lecture was illustrated by experiments intended to demonstrate the essential points of the information useful for a novice to know, and which will assist him to select the right kind of battery for a particular purpose. The space devoted in this journal to the Society's reports being limited, an extended account of these experiments is given here, for the assistance of our readers in general, and for the benefit of those who may care to repeat them for amusement.

The production of electricity by primary batteries is due to chemical effect. As usually constructed, such batteries consist of plates of metal or other material immersed in a chemical solution which is capable of attacking one of the plates. One complete element, consisting of the solution and plates contained in a suitable vessel is called a primary cell. Two or more of such cells connected together for the purpose of united action is called an electric battery. The term battery is often incorrectly applied to mean a single cell: this is inaccurate—the word battery should only be applied to a group of two or more cells.

In any primary cell electricity will not be produced unless the solution, also called the electrolyte, attacks one of the plates to a greater extent than the other. Two plates are necessary, and they must not touch one another or be in conducting connection with one another when the cell is required to be inactive, except through the solution. If two plates of similar material be immersed in a chemical solution capable of attacking them equally, no electrical effect results. Take two clean plates or pieces of copper and immerse them to three parts of their length in a solution of dilute sulphuric acid—no immediate action takes place. Connect them by a piece of copper wire outside the solution (Fig. 1)—no apparent effect occurs. Connect them by separate wires to a sensitive galvanometer (Fig. 2) and no appreciable deflection of the needle is produced. The acid acts equally upon each plate, and therefore no electrical effect is produced. Repeat the experiment with two clean zinc plates: the result is the same. Replace one of the plates by a clean copper plate: no action takes place unless the plates are connected by a

Fig. 1.

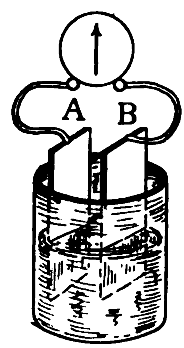


Fig. 2.

wire, as in Fig. 1. When this is done, bubbles of gas are given off by the solution; the equilibrium has been disturbed, and an electrical effect is produced. The reason is that the acid attacks the zinc to a greater extent than it attacks the copper. Connect the plates to a galvanometer, as in Fig. 2: the needle will be deflected, showing that a current of electricity is produced.

This simple arrangement of plates and solution contains the elements of a primary cell. All those in use have these essential constituents, namely, two plates (of dissimilar material), rods, or material in any convenient form, a chemical solution, and the containing vessel, which may form one of the plates, as in certain patterns of dry cells. The plate which is attacked by the solution (neglecting the comparatively slow corrosion which may take place at the other plate) is eventually eaten up by it, if the cell is allowed to continue giving electric current. This consumption is the principal part of the price which must be paid to obtain the electricity produced by the cell. The plate is dissolved by the solution and the metal is still there. It may be recovered, but not without expense, which may be greater than the value of the material regained. In any case, you must pay some price in this way for the electricity which you obtain from the cell.

When the wires are connected to the galvanometer, as in Fig. 2, the needle is deflected in one direction—this is, to right or left hand. If the wires are changed over so that the left-hand wire is connected to plate B and the right-hand wire to plate A, the needle will be deflected in the opposite direction to that in which it moved when the connecting wires were as Fig. 2. This shows that the current goes (we do not really know if a flow takes place at all, but assume it does) from one plate to the other through the wires, because in changing over the wires we direct the current through the galvanometer coils in a reverse direction. If the current is assumed to go from B to A through the wires it enters at the right-hand terminal in Fig. 2, but at the left-hand terminal if the wires are changed over. The plate from which the current leaves the cell is often referred to as the positive plate. This is not correct; the positive plate is the one from which the current starts in the first instance. The current is produced by the chemical action between the solution and the plate which it attacks the most. It flows through the solution to the other plate, and from that to the wires which connect the plates outside the solution, finally reaching the plate from which it started. This plate is really the positive one, and the other plate is the true negative. If A, Fig. 2, is the plate which is dissolved by the solution, the current starting at A flows through the solution to B, therefore the true positive plate is A. As the current, however, flows from B to A through the connecting wires, B is positive to A outside the solution—that is, in the outer circuit. Correctly, therefore, B is the positive terminal of the cell, but is not the positive plate.

The important function of a primary cell is to supply a current of electricity. It is the current which does the work in any circuit. Whether this work is the driving of an electric motor, lighting a

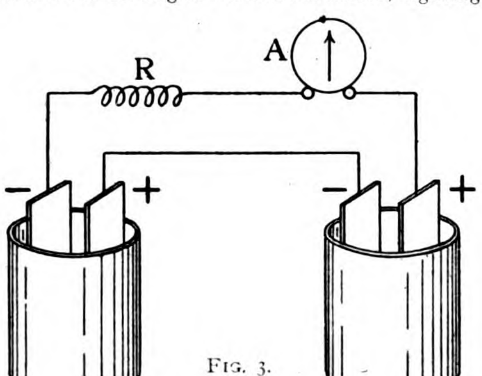


FIG. 3.

lamp, exciting an electro-magnet and so on, the effects are produced by the flow of current. Provided the necessary flow is obtained, the voltage of the battery is immaterial. Take a length of very fine iron wire, say about 12 ins. of No. 30 gauge. Connect it to the terminals of a battery which is capable of discharging a fairly heavy current of 10 amps. or so. A large size bichromate or Bunsen battery, or an accumulator of two or three cells in series, for example. Adjust matters so that a very small current flows through the wire. It will not become very hot, and remain black. Without altering the number of cells, reduce the length of the wire until a large current flows through it. The wire will now become red hot, and perhaps be fused. This experiment shows that, without altering the voltage, you have succeeded in heating the wire to redness. What has done this work? Not the voltage, because that has not been increased. It is the flow of current which has produced the heating

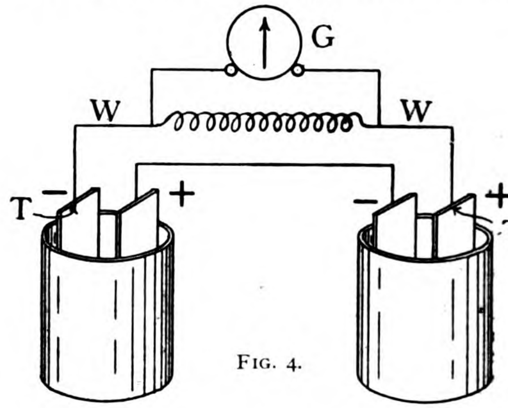


FIG. 4.

effect. By increasing the flow of current, you have caused more work to be done in the circuit.

The voltage of a cell is the difference of electric pressure at its terminals by which it can send a flow of current against the resistance of the external circuit of wires, lamps, motors, etc. It is caused by the difference in chemical action taking place at the negative plate as compared to the positive plate. Various metals are electro-positive or electro-negative to one another in a definite series, commencing at one end with zinc as positive, and proceeding through the series to platinum and carbon (which are almost equal) as negative. A metal about mid-way, such as nickel, is electro-negative to zinc, but electro-positive to platinum and carbon. The greater the distance apart which any two metals are in the series, the greater will be the difference produced by the chemical action of the solution upon them. This difference is the electric pressure or voltage which tends to send the current from the positive plate to the negative plate. The voltage can be regarded as existing at the terminals of the cell even when no current is being taken from it. A pressure expressed in volts exists, as it were, ready to send a flow of current through any circuit which may be connected to the terminals. But the pressure produces no effect beyond pushing the current through the resistance of the wires, etc., of the circuit. As the current cannot flow without the aid of the voltage, and as the voltage must be raised accordingly as the resistance of the circuit increases, the only way to obtain the required flow through a given circuit is to apply a sufficiently high pressure to the ends of the circuit.

If the voltage is insufficient with one cell, it may be raised by one of two methods. Either a cell which produces a higher voltage can be used, or the voltages of two or more cells can be added together. It is of no use to increase the size of the cell, if it already is of a capacity to provide the required current. Voltage is independent of the size of the cell. It depends upon the particular kind of metal used for the plates, and upon the solution. This can be experimentally proved by connecting several sizes of the same kind of cell to a voltmeter or galvanometer, as in Fig. 2. Each size of cell will cause the needle to move to the same degree of deflection. The galvanometer must be wound with coils having a comparatively high resistance, so that a very small amount of current will flow from the cell. If a comparatively large current is allowed to flow, the deflection may not be the same with each size of cell, owing to the secondary effect of internal resistance, which will be explained later. The voltage given by the various primary cells in general use ranges from about half-a-volt to two volts per cell. To add the voltage of one cell to that of a second, the positive terminal of one cell must be connected to the negative terminal of the other, as in Fig. 3. In this diagram A is an amperemeter or galvanometer, having coils of low resistance, so that they offer scarcely any opposition to the flow of current. The circuit in which the work is to be done is indicated by R. If the addition of the voltage of two cells is sufficient to cause the required flow of current the amperemeter will show that the value of current is flowing through R. An amperemeter is merely a low-resistance galvanometer

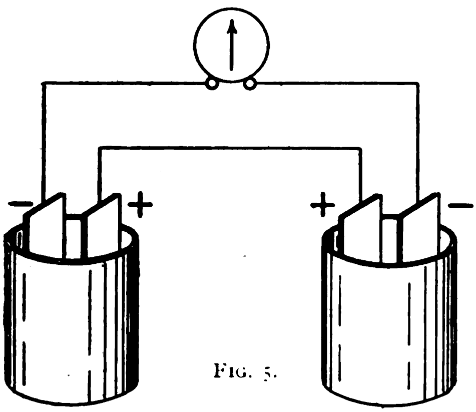


FIG. 5.

which has been calibrated. This means that the deflections of the needle produced by various values of flow of current have been noted and recorded either upon the scale in figures or as so many degrees of deflection. It is a known fact that the flow of current in a simple circuit is the same in all parts of that circuit. If two amperes of current are flowing through R, the same two amperes and no more nor less will be flowing through A and through each cell. A flow of current of this value, in fact, exists and continues in every part of the circuit shown by the diagram.

If it be desired to know the value of the voltage given by the cells, the galvanometer should not be connected as Fig. 3, but as Fig. 4. It must be a high-resistance galvanometer, so that only a very small flow of current passes through its coils. The proper instrument to use is a voltmeter, which is merely a suitable galvanometer which has been calibrated to indicate pressure instead of flow of current. If the connecting wires W are of considerable length or of very small size, so that they offer appreciable resistance to the flow of current, the voltmeter will indicate a smaller voltage than that produced by the cells. To ascertain the true voltage given by the cells, connect the voltmeter terminals to the terminals T T of the cells, Fig. 4, so as to remove the error due to the resistance of the wires W.

If the cells are connected so that the positive terminal of one is joined to the positive terminal of the other, the voltages will be in opposition, and no current will flow through the circuit. This can be proved by connecting a voltmeter or galvanometer, as in Fig. 5. There will be no deflection of

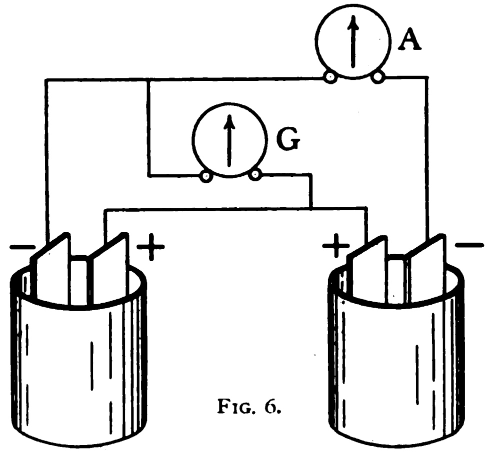


FIG. 6.

the needle. Connect an amperemeter in the circuit as A, Fig. 6: there will be no deflection of the needle. Connect the voltmeter as shown at G, Fig. 6: the needle will indicate a voltage equal to that of one cell, proving that each cell still produces its voltage. The voltage of any number of cells may be added by connecting them on the principle shown in Figs. 3 and 4, the positive terminal of each cell being connected to the negative terminal of the next in the series. Join two pieces of the very thin iron wire previously mentioned to a battery of cells, as Fig. 7; connect a voltmeter G: the needle will be deflected, and show that the voltage of the

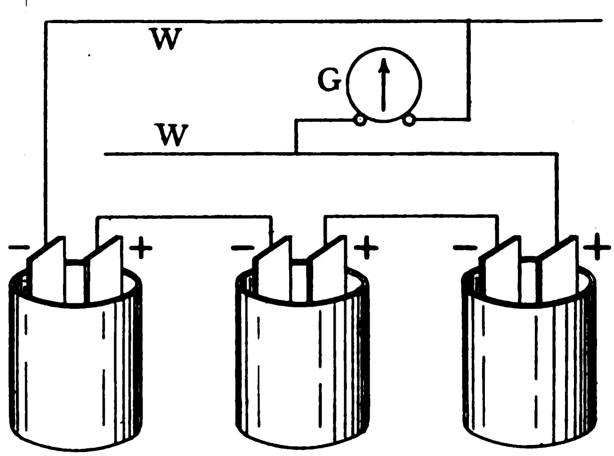


FIG. 7.

battery is existing. Remove the voltmeter: the wires remain quite cool, as no current is flowing through them. No current, no work done in the circuit.

(To be continued.)

How It is Done.

[For insertion under this heading, the Editor invites readers to submit practical articles describing actual workshop methods. Accepted contributions will be paid for on publication, if desired, according to merit.]

Boring a Cylinder.

By H. Muncaster, A.M.I.Mech.E.

(*Continued from page* 243.)

THE next essay was to bore the 2-in. by 2-in. cylinder. In this case the self-centreing chuck was not used, principally on account of the extra overhang that the work would have in comparison with the work as fixed to the ordinary faceplate when measured from the bearing of the lathe spindle.

Fig. 9 shows the method of fixing the casting to

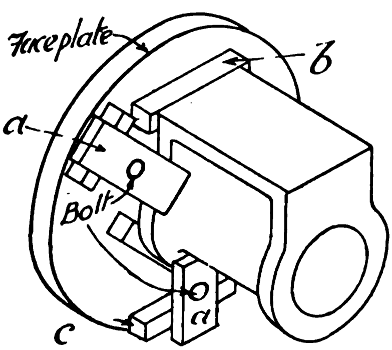


Fig. 9.

the faceplate. The apparatus consists of three pieces of 1½-in. by ⅜-in. flat bar (*a*), with a ⅜-in. hole about ½ in. from one end; three pieces of 5-16ths-in. square tool steel (*b*) for backing; three pieces of ¼-in. square mild steel bar (*c*), and three bolts 1-56ths in. diameter, 2½ ins. long. The sketch will make the arrangement quite clear.

The adjustment was made by the aid of a pointed tool fixed in the slide-rest, which scribed a circle on the end of the cylinder when the work was rotated; as soon as the position was found where the circle scribed was concentric with the cast hole, the bolts were tightened up. The flange next to the

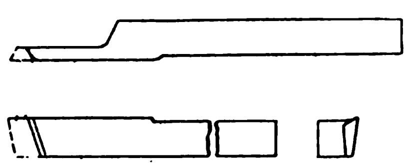


Fig. 10.

faceplate was measured from the edge of the faceplate to see if this was also concentric, and found correct. If this had not been the case, on account of the unevenness of the casting, a little extra packing against the faceplate under one of the steel pieces would have in the ordinary way adjusted matters.

The bent tool, shown in Fig. 6, was found to be rather too short, as well as too slender, as it would have to project a matter of 3 ins. out from the slide-rest, and an ordinary right-hand knife tool, ground to the dotted lines (Fig. 10) was taken, and the point reduced as shown. This was fixed in the rest at about the angle shown in Fig. 11, and the gearing arranged to give about 120 cuts per inch of feed, using at the same time the back gearing of the head-stock. Three cuts were taken, and the cylinder was then measured to find if the bores were parallel. Being found satisfactory in this respect, the speed was reduced to 190 cuts per inch, and a final cut taken. The end was then counterbored, using the same tool, for a distance of about 5-16ths in. to a diameter of 2 1-16th ins.

The end was faced in the usual manner, and tested by a straight-edge to find if the face was true and not coned, as would be the case if the cross traverse were not normal to the lathe centre.

The beginner must not understand that it is meant that the tool shown in Fig. 11 is the most suitable for the work, as it will be evident on a slight consideration that such a tool could only be used when the bore was of some considerable diameter and comparatively short. It is, however, given as an example of what may be done by unorthodox methods if circumstances warrant them.

A suitable tool for this class of work may readily be made out of a piece of square bar of a length to suit the requirements. The annexed sketch (Fig. 12) shows such a tool. The bar may be partly of octagonal section, as the part *l*, which should be long enough to reach the work, *m* long enough to give a good hold in the rest. If it is desired in

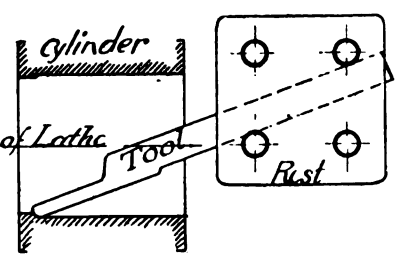


Fig. 11.

boring a short cylinder to reduce the overhang, the octagonal part may be set back on the rest. For this reason this section of bar is recommended in preference to a round one. The distance *y* should be reduced to the smallest practical amount.

Having bored the cylinder, the question was, next, how is the bore to be made perfectly true and smooth, without resorting to the somewhat primitive methods already employed in the case of the smaller-sized cylinders?

Having in hand a few small emery wheels, it was decided to rig up a grinding arrangement, which was done in the following manner. A spindle, Fig. 13, ½ in. diameter and about 5 ins. long, was turned out of ¾-in. round steel, leaving a collar of as large a diameter as the stuff would allow. The shank was carefully turned with a taper slightly smaller towards the pulley end. A piece of gas pipe 3½ ins. long, ⅝ in. bore, was obtained, the ends of the pipe being notched as shown in Fig. 15, and a hole drilled for oiling the spindle. A piece of twine was wound round the spindle to form the space between the bearings, which were run in with patent metal, the object of the notches in the pipe being to firmly hold the metal. As soon as the metal was set the pipe was held in the vice and the spindle removed, a lathe dog having been previously fixed on the wheel seat of the spindle to wrench it with. If there is any tendency for the spindle to stick, a few light taps on the pipe over the journals will generally serve to loosen it sufficiently to enable the spindle to be twisted out. A little scraping with the small blade of a pocket-knife on the inside of the metal bushes gave the necessary freedom, and the spindle was a comfortable fit. The twine which had been wound around the spindle was easily removed from the tube by means of a scriber.

A ¼-in. tapping hole was drilled and tapped in the wheel end of the spindle, to suit a countersunk-headed screw. Two washers were turned 1¼ ins. diameter—one with ½-in. hole, the other with ¼-in. countersunk hole. A 2-in. brass pulley with a V-groove was turned up and fitted with a ¼-in. grub screw. The spindle was then ready to fit together.

To hold the spindle in the lathe, two pieces of flat bar were bent to shape shown in sketch, Fig. 15, to grip the tube when the top plate of the tool-holder is screwed down.

To drive the spindle two sources were open. Either drive off the lathe wheel, using a pair of guide pulleys to return the driving band on to the spindle pulleys, or to rig up an existing electric motor driven by an accumulator. The latter method was finally decided on. The motor was set on the floor under the lathe on a stout board, which

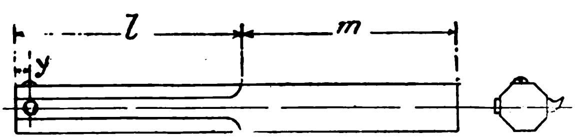


FIG. 12.

was loaded up to keep it steady. A 3-in. V pulley was fastened on the end of the armature shaft of the motor, and a round leather band, as used on sewing machines, passes up through the opening in the lathe bed and over the pulley of the grinding spindle.

There is no great danger of too great a speed on the grinding wheel. The difficulty seems to be to get enough speed with the small diameter wheels. The speed was probably over 4,000 r.p.m. on the spindle in this case, which, without a counter, is rather hard to estimate correctly, as there seems to be a

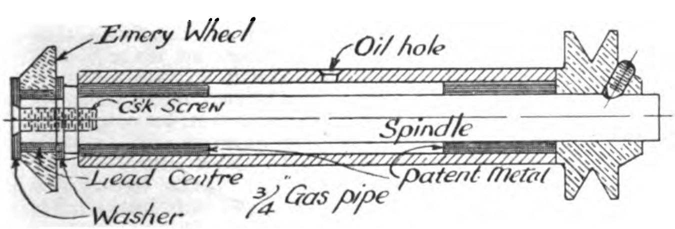


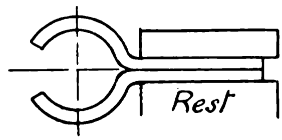
FIG. 13.

considerable amount of slip, as the band must not be too tight or the friction at this speed will be excessive.

The grinding spindle was attached to the slide-rest so as to allow the emery wheel to reach to the faceplate, then a stop was arranged out of a piece of board abutting against the headstock at one end and the lathe saddle at the other, to prevent the wheel from quite touching the faceplate. A similar stop was fixed to gauge the distance of travel in the other direction. This gave an amount that would nicely clear the bore at each end of the cylinder.

All the feed gear was taken away except the largest spur wheel, which was allowed to remain

FIG. 14.



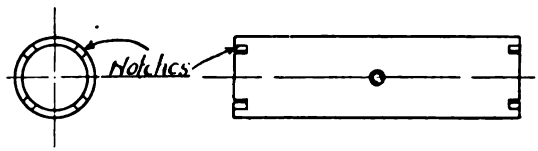


FIG. 15.

on the leading screw. When all was ready the current was switched on to the motor, and the lathe started by means of the treadle, the back gear of the headstock not being used. The slide-rest was then adjusted so that the wheel would barely touch the work, and the grinding commenced. Two persons were necessary, one to work the treadle and the other to move the saddle backwards and forwards. This was done by catching hold of the wheel on the end of the leading screw and twisting vigorously first one way and then the other until the saddle came into contact with the stop It is desirable that the grinding should be done in this manner. If the traverse were so arranged that the wheel moved slowly up the bore, at the same speed, say, as the boring tool moves, the chances are that there would be a sensible amount of taper, as the wear of the wheel would reduce the bite as the work proceeded. It is therefore much more satisfactory to let the wheel pass rapidly over the work a great number of times. After a dozen or more cuts in each direction, and without a second adjustment of the grinding wheel, the work was stopped for examination. The result was quite a surprise. All trace of the cutting tool had gone, and a beautiful smooth surface was found over the entire bore of the cylinder. To those who have only tried the old-fashioned method of "lapping," the result of grinding is a revelation.

The work must be so arranged that the direction in which the wheel revolves shall be opposite to that of the cylinder, and great care must be taken not to put too much "bite" on when adjusting the slide-rest. Do not attempt to set the wheel before both it and the work are in motion.

For those who desire the best of work the writer recommends the grinding arrangement, which may also be used for finishing the outside of turned work, whether it has been previously hardened or not.

(To be continued.)

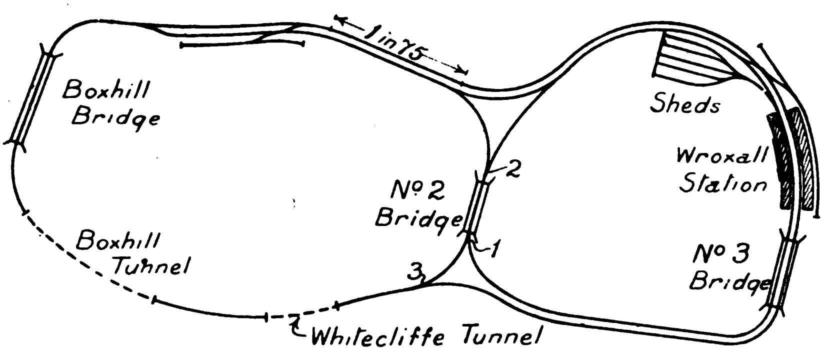
Model Railways.

No. XVIII.—The "Monsal Valley" Railway.

By R. A. P. Davison, Jun.

THIS railway is situated, not, as the name might suggest, in the beautiful Peak District of Derbyshire, but in a small garden at the foot of the steepest part of South Norwood Hill, a place not yet entirely given over to the wielders of bricks and mortar. The garden rises sharply on one side, and it is this, together with a little rockery and landscape gardening, which accounts for most of the scenery on the line.

It will be seen from the rough plan (which is not drawn exactly to scale) that the track, which is double for a considerable distance, is more or less in the form of the figure eight. It was an exceedingly difficult matter to plan out a satisfactory route for the line, as, owing to the fact that clockwork engines were to be used, the track had to be of such a length, and the junctions so situated, that the trains would just run into the stations at the end of a run. A plan was at length evolved which would meet all requirements, and the line was made double all the way round. This was afterwards found to be too complicated at the junctions, and so the plan was modified, as shown, and some of the rails taken up.



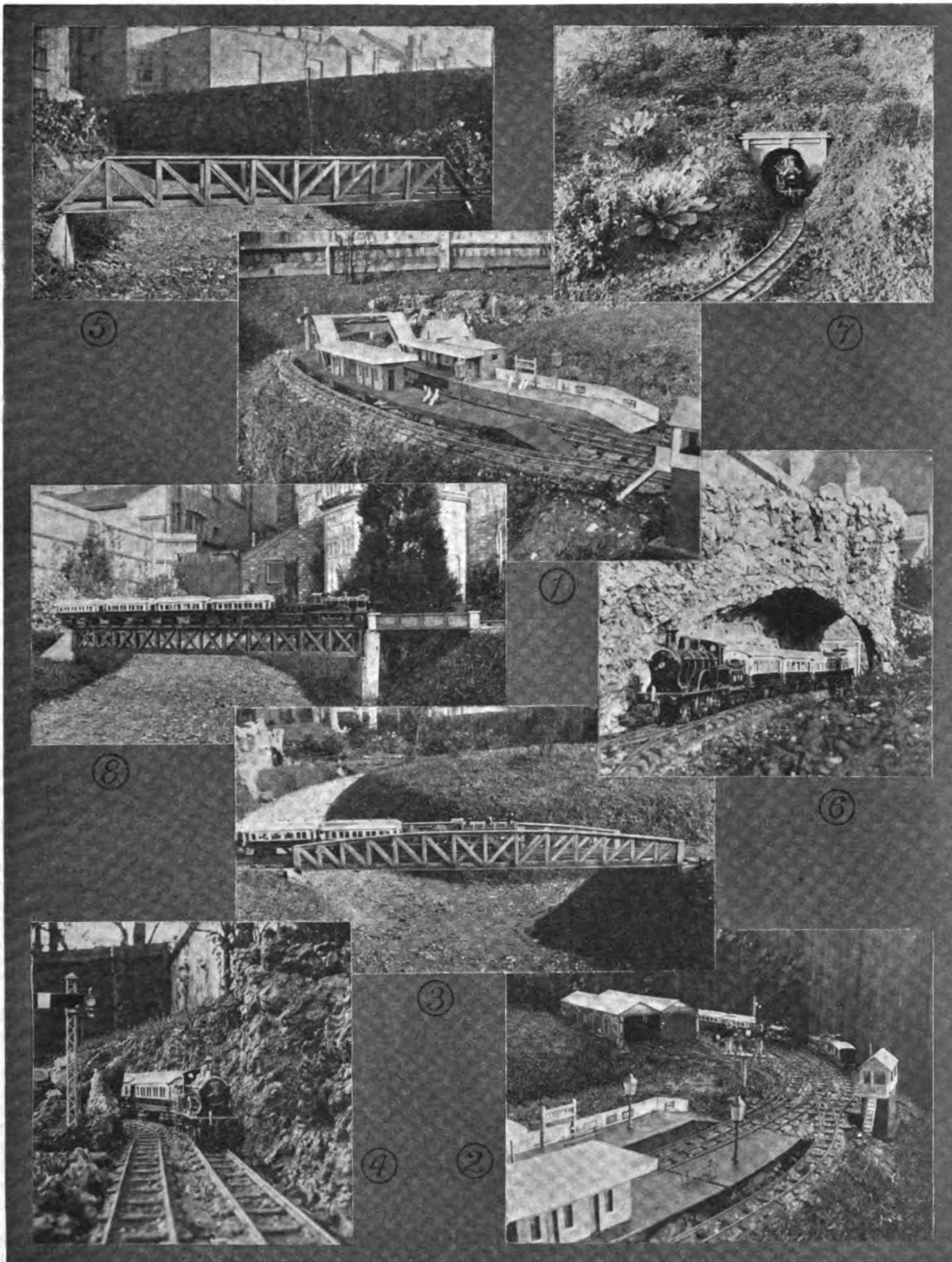
SKETCH PLAN OF THE "MONSAL VALLEY" RAILWAY.

The gauge of the line is 1¾ ins., and there are about 300 ft. of track, inclusive of sidings. The rails are of brass, bought in 16-in. lengths, and are soldered to tin sleepers well painted, there being six per length. The track is laid on a bed of cement from 1 in. to 1½ ins. in thickness, and is ballasted with cement, coarse sand being thrown on while it was still wet. At first, fine cinders mixed with cement were used for ballasting, but this method was not entirely satisfactory, and in a few months' time the cement came off the cinders here and there. In places the bed was not made thick enough, and in the summer cracks appeared at intervals of 2 ft., and the cement became concave, thus necessitating the relaying of nearly half the track.

The railway was commenced in December, 1906, and is not yet quite complete, there still being another station to make. I decided to start work on the most difficult part of the line, viz., "Boxhill" Tunnel, which is 10 ft. long and took a month to construct. It was originally made for a double line; but when the alterations in the plan were made, new entrances were fitted, ideas for which were obtained from the Merstham Tunnel on the Brighton Railway. The method of construction was as follows: a cutting some 4 ft. deep was made, which was no easy job in stiff London clay, and the cement foundation laid. Two double lengths of rail were then laid in the middle of the cutting, and two sheets of zinc bent to the shape of the tunnel and placed over them. Cement was then laid on these to a thickness of nearly 2 ins., and allowed to set, when the moulds were drawn out and the process repeated until the ends of the tunnel were reached. At night the cutting was well covered with paper and boards, and oil lamps were placed inside to keep out the frost. Indeed, these precautions were taken with all cement work during the winter. I was heartily glad when the tunnel was finished, for, although its construction may appear simple enough from the description, when one has a combination of rain, frost, and mud to contend with, it is quite a different matter. "Whitecliffe" Tunnel, which is only 4 ft. long, was constructed in exactly the same manner, and was a comparatively easy job, though there was a sharp curve at one end.

As the line crosses a gravel path in three places, three movable bridges had to be made. The first of these—"Boxhill" Bridge—is 5 ft. long, and was originally the other way up, and the embankment came right up to the end. But as the abutments were being continually pushed forward by the earth behind, I cut away the embankment and made another short bridge, which got over the difficulty very well. No. 2 bridge is 3 ft. 9 ins. long and is somewhat interesting. There are facing points at the end (1 in the plan), which, owing to their great distance from the signal-box, are worked electrically, and for the purpose of locking these when the train is passing over them, I have fitted a locking-bar at the end of the bridge. Points 2 and 3 are trailing points, and are worked automatically by the engine passing over a treadle. No. 3 bridge is 4 ft. 4½ ins. long. All these bridges are built of 3-16ths-in. fretwood fastened together with thin nails and screws, and the floors are made of corrugated zinc. They are painted dark grey.

"Wroxall" Station is at present the only one on the line, and has two platforms 6 ft. long by 5 ins. wide. They are made of fretwood well painted, and are fitted with seats, advertisements, etc., the lamps being fitted for electric light. The station buildings are also made of fretwood, with zinc roofs, and the windows are cut out with a fretsaw, and pieces of zinc painted black placed behind the openings. The footbridge does not come out very well in the photograph, but is copied from that over the Brighton Railway at Wandsworth Common Station, and is built up of zinc painted pale green and lined in purple-brown.



VIEWS OF THE "MONSAL VALLEY" RAILWAY.

(1) *"Wroxall" Station.*
(2) *General View of Sheds, etc.*
(3) *No. 3 Bridge.*
(4) *Commencement of "Undercliff."*
(5) *No. 2 Bridge.*
(6) *"Natural" arch in "Undercliff."*
(7) *"Boxhill" Tunnel, S.E. entrance.*
(8) *"Boxhill" Bridge.*

The signal-box contains ten levers, the two controlling the electric points and signal at the junction being interlocked. The signals are all connected with stop-catches, and I may here say that the signals, station lamps, and rolling-stock were the only things bought ready made. The sheds are made with double roofs, and are 4 ft. long, with five roads.

The rolling-stock at present consists of two "Charles Dickens" clockwork engines, three bogie corridor coaches, and a bogie dining-car, a few trucks, and a train of four-wheelers is on order. I have fitted them with automatic couplings with spring drawhooks, but owing to the absence of spring buffers, they will not couple on a sharp curve. The best of these engines will take the four bogie coaches, which weigh 2 lbs. each, at a good 3 miles an hour, and this is quite fast enough on curves of 3-ft. 6-in. radius.

A brief description of the "country" through which the line runs may be of interest. Leaving "Wroxall" Station, the line crosses No. 3 bridge, and, bending sharply to the right, runs along for 40 ft. or so at the foot of some miniature rock-work cliffs, which represent, to a certain extent, part of the Undercliff district in the Isle of Wight. At a distance of 25 ft. these cliffs rise to a height of some 3 or 4 ft., and from this point the line is single, running along under a rocky archway, with a gently sloping hill on the right. From here the line is on a slightly falling grade, and, passing through "Whitecliffe" Tunnel 10 ft. further on, runs along for 9 ft. in a cutting, at the further end of which is "Boxhill" Tunnel. At the other end of the tunnel the line crosses "Boxhill" Bridge, and from there is carried on an embankment 16 ins. high and over 50 ft. long as far as "Wroxall" Station. From the end of the bridge the line curves sharply to the right, and falls at 1 in 110 as far as the site for the second station, at the other end of which it again bends to the right and rises for some 10 ft. at 1 in 75, but from the summit to the station it is practically level.

I am now making plans for the electrification of the line, and hope to have it all completed by the beginning of next summer. Such things as gradient boards and warnings to trespassers have yet to be made.

THE WORLD'S LARGEST IRONCLADS.—The fourteen largest ironclads of the chief naval Powers of the world are:—*Michigan* (United States of America), 16,250 tons displacement; *Dreadnought* (Great Britain and Ireland), 18,000 tons displacement; *Ersatz-Bayern* (Germany), 18,700 tons displacement; *Lord Nelson* (Great Britain and Ireland), 16,750 tons displacement; *Voltaire* (France), 18,000 tons displacement; *Katori* (Japan), 16,250 tons displacement; *Paul I* (Russia), 17,400 tons displacement; *Louisiania* (United States of America), 16,250 tons displacement; *Démocratie* (France), 14,850 tons displacement; *Virginia* (United States of America), 15,200 tons displacement; *King Edward VII* (Great Britain and Ireland), 16,600 tons displacement; *République* (France), 14,850 tons displacement; *Mississippi* (United States of America), 13,200 tons displacement; and *Hanover* (Germany), 13,200 tons displacement.

Chats on Model Locomotives.

By HENRY GREENLY.

(*Continued from page* 200.)

I.—STANDARD PARTS FOR 1½-IN. AND 2-IN. SCALE LOCOMOTIVES: DOME AND REGULATOR.

HAVING dealt with the possibilities of the electrically-driven model locomotive in a more or less comprehensive manner, it is intended to give the subject a rest in favour of steam locomotives of a size capable of being ridden on. This is the outcome of a suggestion that complete designs should be published, either for a 1½-in. scale locomotive or a traction engine. It would appear that the traction engine gained the day, and, therefore, to satisfy those who voted for the railway locomotive, it is my intention to submit each week full drawings of the component parts suitable for 2-in. gauge locomotives with notes on their use in the 1½-in. and 1¼-in. scale sizes.

My experiences with the 3-in. scale engine "Little Giant," and with the no less successful miniature locomotive "Nipper," have enabled me to standardise many of the parts used in the construction of engines of this class. For something like eight years, which is the measure of my active connection with model locomotive building and designing, I have been endeavouring to standardise parts and fittings. When I commenced, it was impossible to obtain cylinders suitable for the inside cylinder engines which could be built up with any pretence to scale gauge, without a deal of scheming and altering, to say nothing of the difficulties in arranging the piping to and from the smokebox. This is not the case to-day, as almost all manufacturers have adopted the arrangement of cylinders which was included in THE MODEL ENGINEER steam locomotive of 1904, and which had previously been tried in several models I had had built for private gentlemen. Furthermore, the range of sizes is from 7-16ths-in. to 1-in. scale, and in each case the standard frame width (which is about 4 ft. in actual locomotives) may be used in conjunction with them. There are a few gaps in the sizes obtainable, but these are gradually being filled up as castings for new model locomotives are brought out.

Be this as it may, just lately I have had occasion to design some standard parts for a 2-in. gauge boiler, and, therefore, propose to commence with a description of these particular fittings, and include tables showing the main sizes in the smaller scales of 1¼-in. and 1½-ins. to the foot.

It will be noticed that in the smaller sizes screws and other parts must be made slightly coarser than would appear to be necessary where the dimensions are simply proportioned down, according to the ratio of the respective scales. Again, odd sizes must be avoided, and the varying casting thicknesses allowed for, all of which points have been considered in preparing the tables of dimensions given below.

Where several engines are required, many of the parts can be cast instead of being built up out of raw material, and in the drawings published herewith practically the whole of the work is submitted to the pattern-maker. Of course, the first cost is higher, but even if one job only has to be done, it will in some cases be found advisable to make a

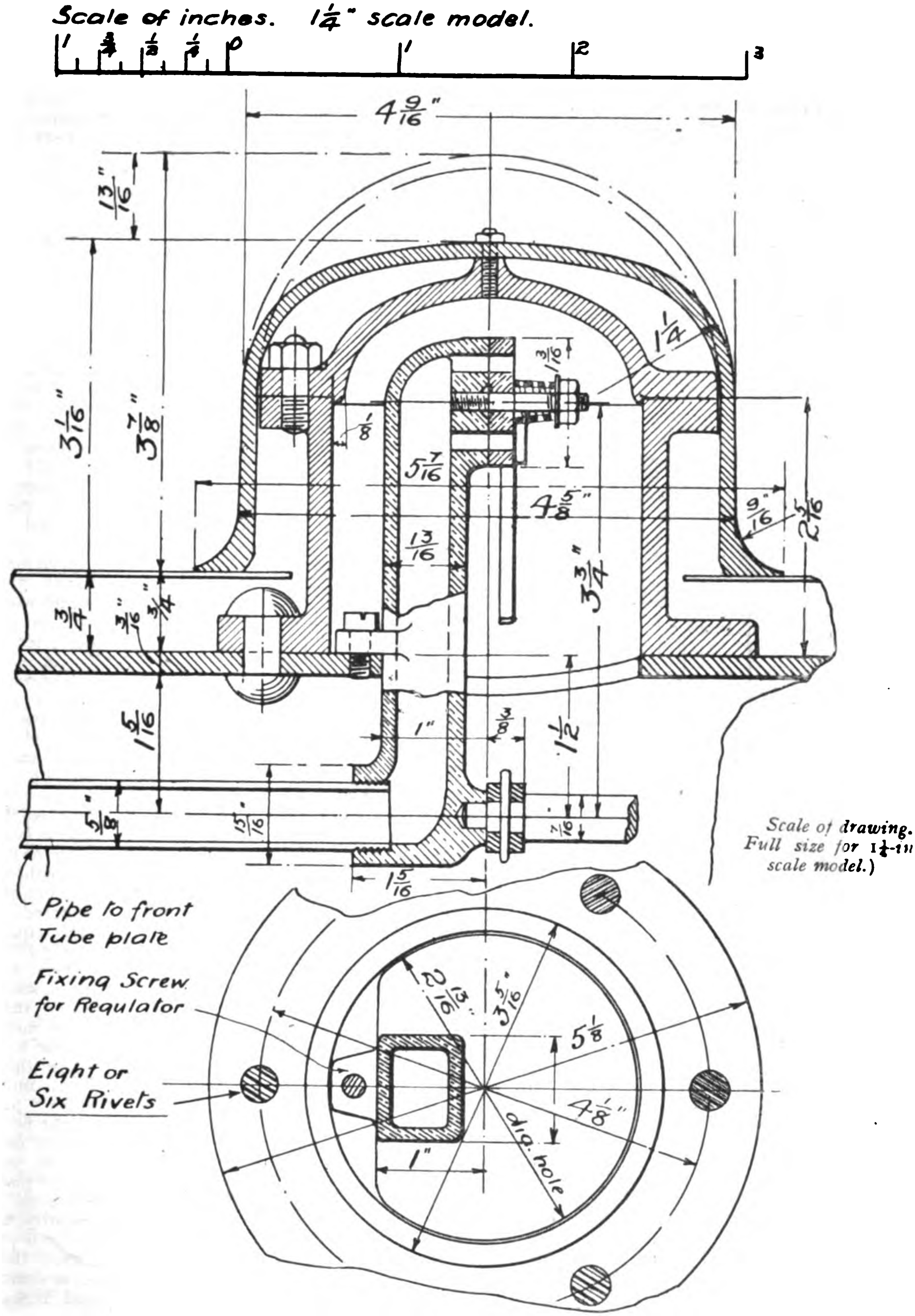


FIG. 1.—DOME AND REGULATOR FOR 1¼, 1½, AND 2-IN. SCALE LOCOMOTIVES.

NOTES FOR 1¼-IN. SCALE LOCOMOTIVES.—Thickness of dome casing, 3-32nds in. or 7-64ths in. Rivets of inner dome, eight 7-32nds in. Diameter over lower flange, 3¼ ins.; over top flange, 2⅜ ins. Cover fixed by ten screws, 5-32nds in. diameter. Section of regulater casting, ½ in. by ⅝ in.; thickness of walls, ⅛ in. Centres of casting, 2⅜ ins. Holes in regulator, four, ⅛-in. diameter. Lever pins or bolts, ⅛-in. diameter, brass.

pattern and obtain castings rather than go a longer way round to attain the same result.

The drawings are here reproduced to full size for a 1½-in. scale model, but they are reductions from the 2-in. scale drawings for which the parts were designed. Therefore, except where the dimensions given in the tables show otherwise, the sizes for minor parts may be scaled off in the ordinary way. Two other scales of inches are given in the drawings to enable the builder to adapt the designs to either of the sizes mentioned.

The question of boiler diameter arose early in the consideration of the design of the patterns for the model above referred to, and so that the patterns should be as useful as possible, I dimensioned them to fit on a boiler barrel 10¼ ins. diameter, the outside diameter over the lagging plate (cleading) being 11⅝ ins., that is, a scale equivalent of 5 ft. 10½ ins. In the case of the tall dome casing (the one with the round top), the latter should be saddled to fit over lagging plate not more than 11 ins. diameter.

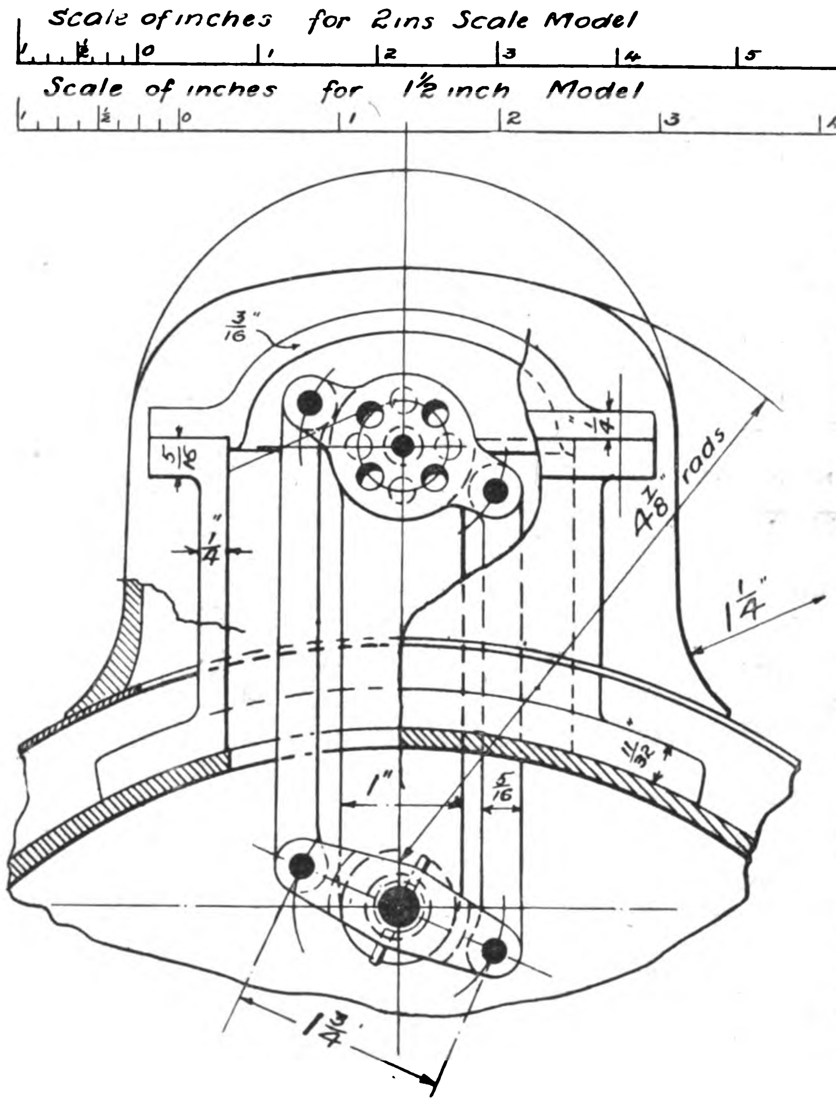


Fig. 2.—End View of Dome, showing Regulator Levers and Ports in Valve.

The flanges of the base casting of the inner dome were made of ample thicknesses, so that a slight difference in boiler diameter could be allowed for and the inner dome being arranged normally for a 5 ft. 3 ins. barrel would work in for a 5 ft. or 5 ft. 6 ins. diameter boiler barrel.

The outside lagging diameter of 5 ft. 10½ ins. perhaps errs on the large size, but many modern boilers have already reached this figure, and in combination with the flat-topped dome the dimension is more likely to be adopted than a scale equivalent of, say, 5 ft.

For 2-in. and 1½-in. scale locomotives the outer dome may be made in cast iron, except where the casing is not painted. The same material might be employed in the case of the 1½-in. scale, but where patterns are intended to be frequently used, and where the smallest amount of labour is required to be done on the final iron castings, the wooden pattern should be made with a double shrinkage, and also a machinery allowance, and brass castings obtained and machined and filed up almost to finished size.

This, perhaps, does not concern the amateur directly, as he generally requires but one casting from each of his patterns (which may be more or less rough), but it will explain how it is that model castings are, when good, rather more expensive than the weight of iron or brass in them would appear to warrant.

The inner dome should in 2-in. and 1½-in. scale locomotives be cast in malleable iron or cast mild steel, so that it will not crack when being riveted on to the barrel and to allow the same to be caulked.

In a 1¼-in. scale engine, which would in most cases be provided with a copper boiler, and in a 1½-in. scale boiler of the same material gun-metal would be used, with a gun-metal cap. The casing in the smaller type would be of brass, if from a wooden pattern, or iron from a metal pattern.

With reference to the riveting, the drawing is marked for six or eight rivets. In 2-in. scale, where the working pressure may be 120 lbs. per sq. in., the pressure tending to blow the cover off may be reckoned as 120 by area of 2⅞ = 120 × 6½ = 780 lbs. Now when rivets are in tension, the joint cannot be considered as good a fixing as when the rivets are in single or double shear, the exact shape of head making a considerable difference in the strength of the joint. Even presuming that the heads of the rivets are of reasonable formation, I should not recommend a smaller factor of safety than, say, 15, and a stress allowance of 10 tons (say 23,000 lbs.) as the hammered head of a small rivet has generally a tendency to become hard and brittle, especially when driven cold.* And, again, there is the caulking to be thought of.

The smallest number of rivets advisable (if 5-16ths inch size is chosen for the 2" scale model) may be calculated as follows:

$$N = \frac{\text{Load on dome in lbs.} \times \text{Factor of safety}}{\text{Area of rivet chosen} \times \text{Strength of material}}$$

* The rivet hole may be slightly countersunk on both sides — at least on the outside under the head which has to be formed—so that the stress on the head of the rivet is somewhat relieved.

where N = number of rivets required. In the present case this would work as follows:

$$N = \frac{780 \times 15}{\cdot075 \times 23{,}000}$$

$$N = \frac{780 \times 1{,}000 \times 15}{75 \times 23{,}000}$$

$$N = \frac{100}{15} = 7 \text{ rivets approximately.}$$

I recommend six or eight, eight preferably for the 2-in. scale boiler. In smaller copper boilers nearly the same figure for the strength of the material for the rivets may be allowed, as copper is more ductile and malleable than steel, and the rivet heads would be stronger in proportion.

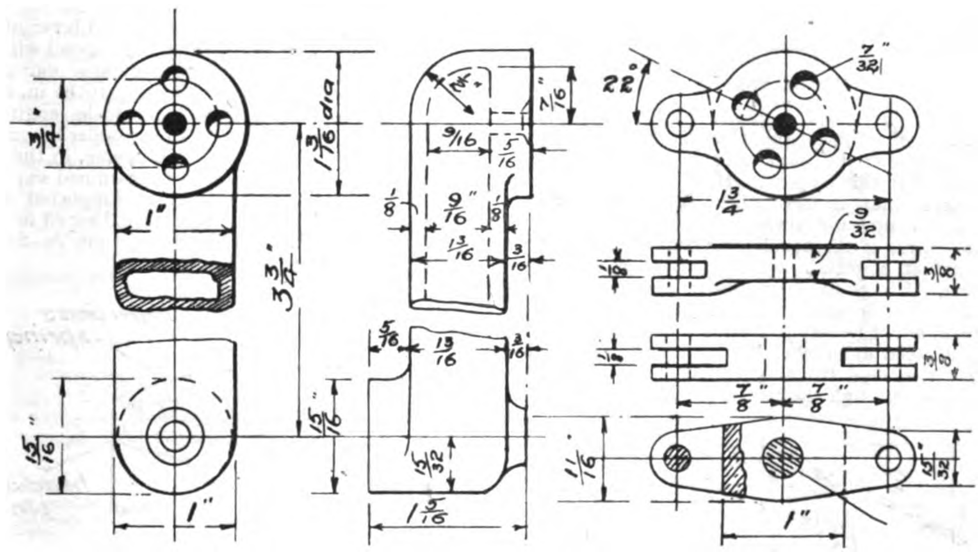


Fig. 3.—Details of Regulator.

The hole in the boiler barrel at the dome should not be truly circular, but should be shaped like the hole in a D washer, and thus provide a fixing for the regulator. In a large model it would not be wise to trust to the stiffness of the steam pipe to give support to the regulator, and therefore I recommend that a lug be cast on the back of the regulator pipe which may rest on the top of the barrel and be secured by a brass cheese-headed set screw. Care should be taken to see that the regulator is placed in exactly the position in the dome shown on the drawings. Otherwise the trouble occasioned in one of the recent 3-in. scale models under my charge may result; the moving valve fouling the cover in full on and off positions owing to the regulator being fixed too far back during my absence.

The regulator casting may be in gun-metal, in all sizes, and should be cored with a blind core right to the head. In previous engines I have generally made the regulator casting circular, but, as from the pattern-maker's point of view the square cross-section does not involve any more trouble, and a greater area of steam passage is obtained, I recommend the shape shown in the drawing. The internal walls of this casting are bound to be more or less rough, and, therefore, the lower the speed of the steam through this portion the better.

The ports must be drilled into the cored space in the head of the regulator, and although I have found that four holes ¼ in. diameter would feed the 3¼ ins. diameter cylinders of the "Little Giant," with a boiler pressure of 125 lbs., I have reason to believe that making the ports with radial sides

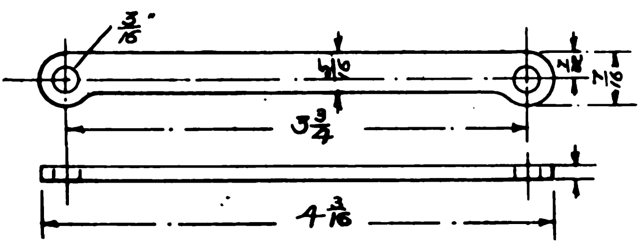


FIG. 4.—REGULATOR LEVERS. (*Hard brass.*)

as shown in the detail (Fig. 5) would allow a lower boiler pressure to be used, and in new engines I am seeing that this is done. However, it must be remembered that if the boiler is strong enough to stand the pressure there will be less tendency for it to prime if the regulator opening is not too large, and if a certain amount of wire drawing is present. I have fixed on four 7-32nds-in. holes, especially if made with radial sides, as the largest size which would be required by a 2-in. scale model, and would feed cylinders 2½ ins. by 4 ins. without the least trouble. Roughly calculating the speed of the steam through the ports, I find that it works

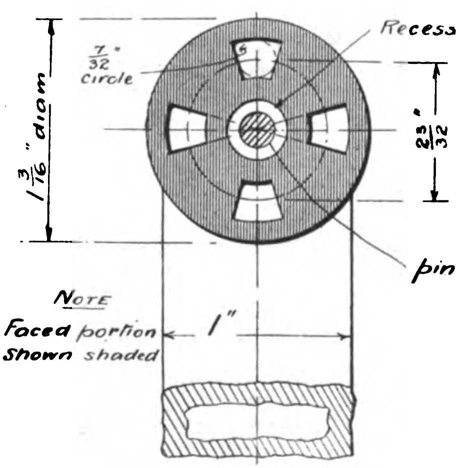


FIG. 5.—SKETCH SHOWING SETTING OUT OF RADIAL HOLES IN REGULATOR HEAD AND VALVE. (*Full size for 2-in. scale model.*)

out, reckoning the engine speed, at 8 miles an hour and the load heavy, at about 160 ft. per second, a little higher than the allowance in ordinary practice for the speed of steam in cylinder ports; but this throttling in a small boiler is, as mentioned above, an advantage, especially where the locomotive is over-cylindered.

As will be seen by the drawings, the regulator is of the Stroudley type, and the moving valve partially rotates on a centre pin fixed in the head of the regulator. This pin should be of brass or German silver, so as to resist corrosion, and the valve should be kept up to its face by a short stiff hard brass helical spring. A flat brass spring may be used as indicated in the sketch (Fig. 6) herewith, the ends of the spring being nicked to fit round the head of the lever pins. It is very important that the centre portion of the valve face or head (or both) should be recessed so that they do not bear on each other. This may be done when the parts are in the lathe. The recesses should be at least 3-64ths in., so that they need not be renewed for some time, and so that the valve may be repeatedly ground in.

The regulator rod from the cab is provided with a double-armed lever of brass, the centres of which correspond with those of the lugs on the regulator valve. The regulator rod may be 7-16ths in. or ⅜ in. diameter in the 2-in. scale engine, and should be of brass, if the life of the boiler is considered of permanent importance. Of course, in the largest model a steel rod would do if examined say once a year. The end of the rod is supported by the regulator casting in the manner indicated in Fig. 1, and the lever may be fixed by a pin or fitted on squared end to the rod.

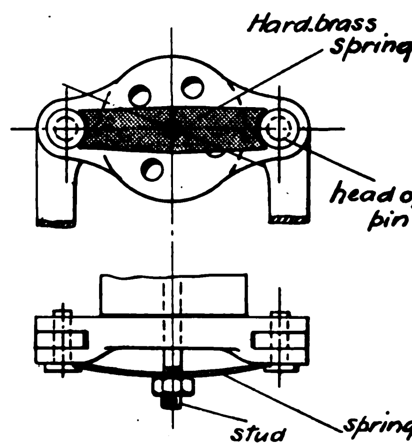


FIG. 6.—ALTERNATIVE SPRING DEVICE FOR REGULATOR VALVE.

The links between the valve and the lever on the regulator rod should be made of brass strip, and shaped as shown on the detail drawing. Fig. 4. All the pins should be of brass, and may be quite plain pins with cheese heads at one end, and riveted over or drilled up a short distance and burred over with a centre punch at the other end.

To render the patterns interchangeable the spigot on the cover of the inner dome should be made long enough to take either a round dome casing or the flat topped casing shown in section in the drawings. In the latter case there is none too much room for the studs for the inner dome cover, and these must be placed on as small a pitch circle as possible, and the holes in the top counterbored, so that the corners of the nuts will clear.

Ten studs are recommended, and reckoning that the most suitable diameter for a 2-in. gauge model is ¼ in., with a factor of safety of 10 (say a safe load of 4,000 lbs. per sq. in.), they should be quite reliable for a working pressure of 150 lbs. per square inch.

The safe load on the above basis would be:

Number of studs × Area of studs at bottom of thread × 4,000 lbs. =
10 × 1·40 × 4,000 = 1,000 lbs.

The actual load at 150 lbs. per square inch would be:

Area of dome cover inside × 150 lbs.
= 6 × 150 = 900 lbs.

So there would appear to be a margin of safety under all likely conditions of service.

In the case of a 1½-in. scale locomotive 3-16ths-in. studs should be used, and if it is desired to work to the above standard of safety an extra two studs may be used. However, as the working steam pressure is not likely to be so high as 150 lbs. per square inch, only ten studs are advised in the table of dimensions herewith. For a 1¼-in. scale locomotive where a brass inner dome would be used, 5-32nds-in. cheese-headed screws will be found the most convenient fixing.

TABLE OF DIMENSIONS OF DOME AND REGULATOR FOR 1½-IN. SCALE LOCOMOTIVE.

Part referred to.	Size. Ins.	Remarks and Notes on Materials.
Diameter of boiler barrel ..	7⅝–7 11-16	Steel 5-32-in. plate; copper, ⅛-in. plate.
" over lagging: Round dome	8 5-16	1-32-in. cleading plate.
Flat dome..	8 13-16	Thickness of lagging, 9-16 in.
" Outside dome: Bottom	3 15-32	Cast iron, full 3-32-in. thickness.
Top ..	3 7-16	Ditto
Height of outside dome: Round	2⅝	Ditto
Flat	2 5-16	Ditto
Radius of flat casing: Large	3⅜	
Small	15-16	
Diameter of inner dome ..	2 7-16	Cast steel or gun-metal; thickness of metal, 3-16 or 5-32 in.
Height of inner dome to joint	1 11-16	Flanges, ¼ in. thick.
Rivets to shell (eight) ..	¼ or 7-32	¼ in. for steel boiler, 7-32 in. for copper.
Studs for cover (ten) ..	3-16	Use 5-32-in. nuts tapped 3-16 in.
Regulator holes (four) ..	9-64	Thickness of cored walls of regulator casting, ⅛ in.
Centre of valve to centre of rod	2 13-16	
Diameter of pins in links ..	5-32	Brass pins or bolts.
Links (centres)	2 13-16	Out of 5-16 in. by 3-32 in. brass strip.
Regulator rod (diameter) ..	5-16	Brass rod.
Steam pipe, outside diameter	½	Copper pipe.

The next article will include drawings of a suitable safety-valve, and also the regulator handle used in connection with the above design of regulator.

(*To be continued.*)

DISTINGUISHING IRON AND STEEL PIPES.—Soft steel pipe, cut in very short lengths or rings, flattens smoothly and evenly without breaking, while wrought iron pipe usually fractures at two or more places when flattened.

Notes on Wireless Telegraphy Apparatus.

By V. W. DELVES-BROUGHTON.

TRANSFORMERS OR INDUCTION COILS.
(*Continued from page 256.*)

THE next thing to be made is the primary and core. The core consists of a bundle of iron wire (about No. 22 gauge) 14 ins. long by 1¼ ins. diameter;* this is sewed over at intervals with fine sewing-cotton, and from end to end with sarsenet ribbon stitched down carefully. This wire can be bought in straight lengths, accurately cut, which saves a lot of trouble and does not add much to the cost.

After being made up into a bundle, the whole should be thoroughly soaked in shellac and baked, repeating the process till the wires are thoroughly agglomerated together. The primary must be chosen with a due regard to the exciting current to be used. For a 100-volt alternating current, supplied by the small machine to be described, about 2¼ lbs. of No. 16 S.W.G. D.C.C. wire, wound on in three layers for a length of 11½ ins., will be found about the right quantity. The manner of leading out the ends of the wire through the hard wood or ebonite caps to the the terminals is shown in the drawing. The core and primary coil should be made in such a manner that it is entirely independent from the rest of the coil, and can be easily taken out and changed for another in the event of a change being made in the manner of exciting the coil or any other alteration being required.

The condenser required will be about 100 sheets of 10-in. × 6-in. tinfoil, separated by double sheets of waxed tissue paper, which can be bought commercially prepared. In building condensers I have found it convenient to make up several small sections and add to the number as required; in this manner, if any fault is found in one section, the whole need not be pulled apart to find the error.

In building a condenser two pieces of sound wood should be planed up, a piece of "tea lead" laid on one, then three or four thicknesses of waxed paper, then the tinfoil, alternating with waxed paper, as described in Handbook 11, finishing up with a few extra sheets of waxed paper, over which another sheet of tea lead is laid and the second piece of wood screwed down as tight as possible by ordinary wood screws round the edge. The projecting pieces of tinfoil are then clamped together between a short length of "compo" pipe, which has been split down one side, and the tinfoil and compo burned together with a hot soldering iron. The whole should be then placed in a hot oven and left for several hours, the screws being periodically tightened up during the heating process.

Next allow the whole to cool down, when the screws can be taken out and the wood removed, and, lastly, the "tea lead" stripped off. The tea lead is to prevent the waxed paper sticking to the wood.

When the right quantity of condenser has been found by trial, the several sections are placed in the partition provided in the case, and top screwed down by screws, as shown in the drawings.

Precautions to be Observed in Making Coils.

(1) Get all your materials as dry as possible, and chose dry weather to wind your coil, if possible,

and store all materials in an air-tight box containing trays of calcium chloride.

(2) Take care that the winding is tight and even and the cavities at the ends of the wire coils are thoroughly filled up with paper, or when the coil is up-ended during the boiling process, some of the wires may slip down between the separating layers of tissue paper.

(3) Use only the best paraffin wax, which is to be obtained from Price's, or some other large refiner's.

(4) Carefully examine all sheets of tissue paper, and discard any showing pinholes.

(5) The wood used for the case should be thoroughly seasoned, and as a further precaution should be thoroughly boiled and allowed to cool in wax; this will "kill the nature" of the wood and prevent it warping and twisting, and also prevent it absorbing moisture. This should be done before finally cutting to size, as the wood will shrink and twist considerably during the process.

The design of this coil at first sight may be thought wanting in insulating resistance, but when it is remembered that it is provided with a "safety valve" in the spark-gap, which cannot be lengthened beyond 2 ins., it will be seen that the insulation is ample. Perhaps the weakest point is the blotting-paper tube, but when it is remembered that ¼ in. of blotting-paper and wax will safely resist a 6-in. spark, and that the tension can never exceed that due to a 2-in. spark, this should be ample; if, however, any doubt rests in my readers' minds as to the safety of this part, perfect safety can be secured by substituting an ebonite tube, in which case it would be advisable to make it project 1 in. beyond the ends of the case at each end.

If this coil were to be wound in sections with No. 36 wire, according to the usual practice, about 6 lbs. of wire would be placed in the same space as the 12 lbs. of wire used in the construction of the proposed coil, so that the weight of wire—on which the efficiency depends—would be more than twice that obtained in the usual manner, as in comparing the weights a greater allowance will have to be made for the insulation of the finer wire than the thicker.

This coil, if it were tried, would give about a 4-in. spark; but would probably break down under the strain, so should never be tried at a higher potential, *i.e.*, when disconnected from the spark-gap.

This coil would be quite useless for radiography, as the sparks will not have a sufficient potential to strike across the very high vacuum, except in very small tubes, and if they did pass they would very soon destroy the tube.

I believe that it would be advantageous to surround the balls of the spark-gap with an atmosphere of an inert gas, say coal gas. This could easily be done by placing a glass tube accurately fitting the balls round them with a T-piece connected by a flexible tube to a gas-burner. I began to make some experiments on using a spark-gap consisting of two carbon balls enclosed in a glass tube containing a small piece of stick phosphorus to eliminate the oxgyen in the air, and as far as my experiments went the results seemed to point to some improvement in the efficiency of the spark; but these investigations take a long time, and I changed my house before any definite conclusions had been arrived at. As I am now living in a house with one of the towers of the Crystal Palace within 50 yds., and in a direct line between me and my fellow-investigator, I have thought that the cost of erecting an aerial, obtaining a licence, and other incidentals are too great to warrant my making further experiments, which would probably fail on account of the "blanketing" effect of the mass of iron-work in the Crystal Palace tower.

The sliding bar of the upper ball is shown with a graduated scale marked upon it to enable the distance to be accurately and quickly regulated.

I estimate the cost of a coil as described above at—

	£	s.	d.
2¾ lbs. No. 16 D.C.C. wire	0	5	3
12 lbs. No. 29 S.C.C. ,, ...	2	8	0
Ebonite	0	10	0
Wax, timber, screws, paper, sundries, foil, etc.	0	11	9
Platinum discs for spark-gap	0	15	0
	£4	10	0

which appears to the writer very small when compared with what it would cost to construct an ordinary 10-in. coil, the wire for which alone would cost £7, and would probably not give such good results over a wireless telegraph system. The labour required would bear no comparison. Any amateur capable of using his head and his hands could construct a coil as above, but it requires a very specially trained man to tackle a 10-in. coil.

The voltage developed in the secondary coil of an induction coil cannot be calculated according to the rules used in calculating transformers. Neglecting losses, the voltage developed in the secondary of a transformer is found by the formula:

$$V = \frac{N \times v}{n}$$

where V = secondary voltage,
v = primary ,,
N = number of turns on secondary,
n = ,, ,, primary;

so that if used on an alternating current without any interrupter the voltage developed in the coil would be—

$$V = \frac{20{,}000 \times 100}{200} = 10{,}000,$$

or would give about 1-10th-in. spark. But when using the interrupter the action differs entirely, as then the voltage depends on the sudden cessation of the flow of magnetic lines through the core, and if the interruption were really instantaneous, and there was no self-induction or magnetic lag caused by hysteresis, the voltage developed would be infinite, whatever the voltage of the primary.

Practically, it is impossible to calculate the voltage of a coil with any degree of accuracy, but the following rule will give the length of spark within about 25 per cent.:

$$\text{Length of spark} = \frac{N \times v}{n \times 2{,}500}$$

In the coil under discussion the formula gives:

$$\frac{20{,}000 \times 100}{200 \times 2{,}500} = 4 \text{ ins.}$$

On the other hand, if the coil were wound in sections with No. 36 wire, probably 30,000 turns would be got on to the coil, and the spark would be 6 ins.; but the current flowing will be greater in the coil wound with No. 29 gauge wire in direct proportion to the area of cross-section; thus, the true power of the two coils will be as—

$$29 \times 6 : 94 \times 4,^{*}$$

or the coil wound with No. 29 gauge wire will be $\frac{376}{174}$, or rather more than twice as powerful as that wound with No. 36 wire in the usual manner.

As stated above, it is impossible to calculate coils with any degree of accuracy. As an example of this, I once tested some twenty coils wound in an automatic winding machine by a professional winder, the quantity of wire, number of turns, etc., being exactly similar, and, finally, the coils were boiled simultaneously in the same bath. These coils were tested with the same core, using the same interrupter and condenser, yet some of the coils would give a 1-in. spark, whilst others would not give more than $\frac{5}{8}$ in.

These coils were specially made to try and find in what the difference lay, but practically no difference was found, except the length of the spark, and the cause for one coil being better than another remained a mystery. There was very little difference in the resistance of any two of these coils, and some of the coils with a higher resistance gave better results than coils with a lower resistance, and *vice versa*.

My own coil—wound with some 7 lbs. of No. 30 gauge cotton-covered wire in thirty sections—gives a 4-in. spark, and when used with the special alternator (to be described in the next article) gave such a heavy spark over a 1-in. gap that it was quite impossible to carry on a conversation in the same room, so what the result would be on a coil wound as described above I cannot quite foresee, but I think it should prove itself useful for wireless work.

(*To be continued.*)

A Home-made Automatic Acetylene Generator.

By JOHN WILSON, B.Sc.

THE generator about to be described works on the principle of the water falling on the carbide. It is admirably suited to house

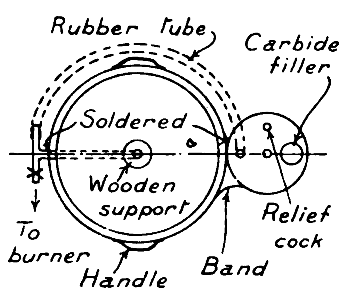


FIG. 3.—PLAN.

lighting, being so designed that recharging can be done even while the lights are burning.

The reader will notice from the photograph (Fig. 1) that the generator consists of two parts—the gas-holder and the generator. Gas-holder A is made of tinned sheet iron in the form of a cylinder, 2 ft. high by 1 ft. diameter. Inside this we have the

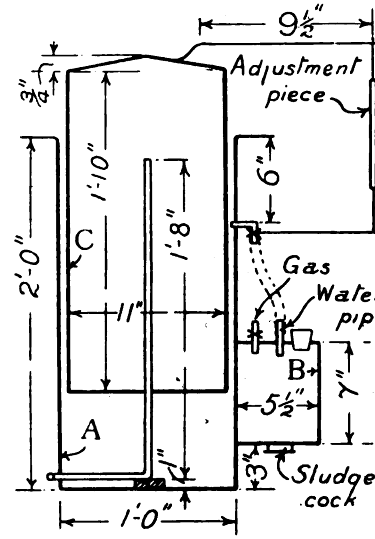


FIG. 2.—SECTION.

gas bell C, which is also cylindrical, and is made of the same material as A. The top is dished as shown, and the dimensions are 1 ft. 10 ins. by 11 ins. diameter, while the "dish" is about $\frac{3}{4}$ in. high at centre.

Fig. 2 gives dimensions of parts. Around the outside edge of A is an iron wire bead giving strength to the whole. Two handles are fixed to the outside, so that the whole is portable. Attached to A about 6 ins. down from top is an elbow-piece of pipe about $\frac{3}{8}$ in. inside diameter. Soldered to this pipe is an ordinary "on" and "off" gas cock.

Generator B is cylindrical, 5½ ins. diameter by 7 ins. high, and into the top of which we have a carbide filling hole with a rubber cork for a stopper, a piece of tube $\frac{1}{4}$ in. inside diameter for water, a relief cock, and a gas cock. The relative positions of these are shown in Fig. 3.

Let us now return to gas-holder A. There is a piece of $\frac{1}{4}$ in. inside diameter pipe bent at right angles in the centre soldered in as shown in Fig. 3. On the outside end of this a tee-piece with a gas "on" and "off" cock at one end—the burner end. The other end is connected to the gas cock on B by means of a piece of rubber tubing seen in Fig. 1. From the water cock on A to the water-tube on B there is also a piece of rubber tube connecting them. On the bottom of B there is a sludge cap of ample dimensions. To charge the generator, take out rubber stopper, fill with carbide, replace stopper. A is supposed to be full of water. Open relief cock on B. Close cock to gas bell. Water will pass from A to B and is regulated by the two rods—one soldered to the cock on water pipe, the other to the gas bell. Between the ends there is a wire or other stiffish piece, which can be adjusted for regulation of water supply. Gas is now generated. Close relief cock, open gas cock, close cock to burners, thus allowing gas to enter gas bell. The

* The area of No. 36 gauge wire is ·029 mm., and No. 29 wire ·094 mm.

water is shut off as bell rises; open cock to burners and light up. To recharge while in operation, close gas cock on B, open relief valve, remove stopper, and sludge. Add carbide and proceed as explained above.

In the course of my experiments, I tried a water-cooled generator but found that it was not necessary, the whole being in close proximity to the tank A, the carbide was kept comparatively cool.

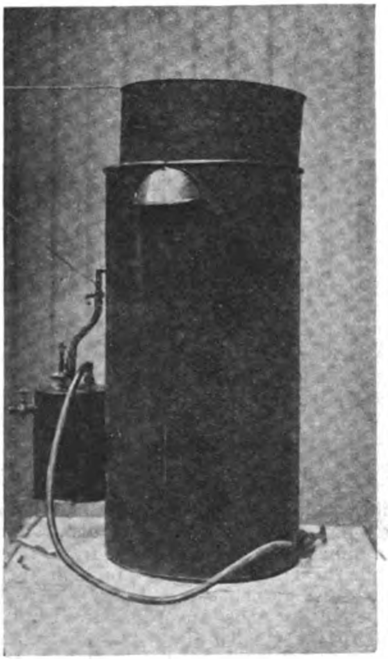


FIG. 1.—A HOME-MADE AUTOMATIC ACETYLENE GENERATOR.

A guide for gas bell—similar to that shown on page 33 of THE MODEL ENGINEER handbook, "Acetylene Gas"—has been added lately, also a purifier similar to that described on page 49 of the above book. The cost of the whole to make is trifling—about 8s. It has been used constantly in my workshop, and being portable, is often taken to outside evening entertainments. If any reader is in doubt about any point, I would be most happy to communicate with him through the Editor.

Scottish Model Yacht Association.

A SUCCESSFUL attempt was made to form a Model Yacht Association on Saturday afternoon, February 22nd, when representatives from a number of model yacht clubs met in White's Commercial Hotel, Glasgow; and it was unanimously agreed to form an Association that would govern the Measurement Rule for model yachts, so that when inter-club matches take place, they will all sail under the same rule. A new measurement rule was submitted for the representatives present to express their opinions on. The rule is: Half the length of L.W.L. in inches × half extreme breadth in inches × sail area in square inches ÷ by 19,500, which equals rating.
and after some discussion it was agreed to accept it as the rule that the Association regattas should be sailed under. It was also proposed to have a trophy to be sailed for by a representative boat from each club, but no definite arrangements will be made concerning this until the Association gets into proper working order. Mr. Jas. Ballantyne, of the Alexandra M.Y.C., was elected as Commodore, and Mr. Robt. Constable, of the Paisley M.Y.C., was elected as Secretary of the Association, and a Working Committee has to be formed by a representative from each club that joins the Association. The following clubs were represented at the meeting: Dennistoun, Victoria, Edinburgh, Edinburgh and Leith, Springburn, Greenock, Alexandra, Maxwell, Kilsyth, and Paisley.

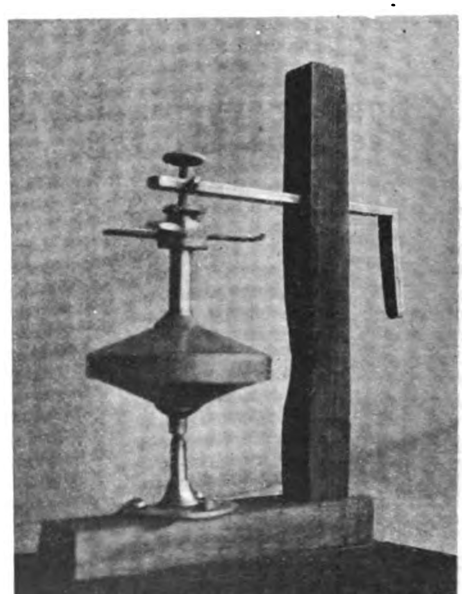
Practical Letters from Our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily for publication.]*

An Interesting Steam Model.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I enclose a photograph of a model, which works on the principle of Hero's re-action steam turbine, which latter, as readers know, was



A MODEL STEAM TURBINE.

constructed about the year 130 B.C. The boiler requires a blowlamp to heat it, in order to get a good pressure of steam on. The whole engine revolves between two steel centres, one of which is a screw, and has another lock screw to prevent it turning round. The whole of the engine is constructed of brass, and is kept highly polished. I will be pleased to forward any particulars about this model to anyone interested in it, if a stamped addressed envelope is forwarded. The total height of the engine is 7·75 ins.; speed, about 500 r.p.m.—Yours truly,

WILLIAM OLLIVER.

Darlington.

Re A Long Speaking Tube.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—Referring to "W. B. W.'s" letter *re* long speaking tube, I am doubtful whether it would be possible to make the voice carry such a distance as 500 yds.; but if he decides to experiment, he will find the following suggestion of use. Some years ago I read in your contemporary *Work* a letter from a reader describing a speaking tube he had put in the ground from his workshop to the house kitchen about 100 yds. away, and he said he found that the bore of tube usually sold commercially was altogether too large and the sound "got lost" before it arrived at its destination. He took it up and replaced it with ordinary compo. tube, ¼ in. diameter, and found on trying it that the fine bore tube carried the sound much better and made the whistles at each end sound much clearer, and that without the same expenditure of breath. I have proved the truth of this by having the speaking tubes from our workshops to front shop refitted with the small bore piping and they have worked quite satisfactorily, and voices can easily be heard above the din of the machines. Of course, in my own case, the distance is not nearly so great as 500 yds. and, as I said before, I am doubtful if any kind of speaking tube would work over this distance.

Personally, I should advise "W. B. W." to use telephones and lay the wires in tubes or some other weatherproof covering; and if carefully laid and the instruments treated with a fair amount of reasonable care, they should work all right.—Yours truly, "ONE OF OURS."

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

ON Wednesday, March 4th, the Society, represented by twenty-eight members, visited the Locomotive and Carriage Works of the North London Railway, at Bow. The party divided into three and under the pilotage of Mr. G. C. Caswell and Messrs. E. J. C. and L. Manico visited every part of these extensive and up-to-date works. A very complete and efficient system of manufacture is employed, everything being made and charged to stock, and each engine is then built by assembling the various parts taken from the store and the exact cost charged to it. The store keeper having a complete named and numbered list of all parts and details, against each item being marked the quantity he should have in stock, any part that is short of that number he immediately orders from the works. It follows that the building of an engine is never delayed by the necessity of waiting for some minor detail. Several special machines designed and made at Bow Works are in use and proved very interesting, particularly one for turning, cutting off and finishing the oak pins used in fastening chairs to sleepers. The members were also fortunate in seeing some special tensile tests of steel in the laboratory. The party heard the 5 o'clock gong with great regret, but did not finally disperse till half an hour later, after Mr. Caswell had shewn them some of the original drawings of the North London engines in the drawing office. After the usual acknowledgements had been made to Mr. Henry J. Pryce, the Locomotive Superintendent, for the permission given and to the guides for their unwearied attentions, the party dispersed.

FUTURE MEETINGS.—The next meeting is fixed for Wednesday, March 18th: Mr. D. Corse Glen discourses on his experience in the testing and inspection of machinery and engineering materials. The twist drill grinder will be available to members at the meeting. The following meeting is fixed for Tuesday, April 7th.

VISITS.—On Thursday, March 26th, to the Stratford Works of the Great Eastern Railway. On Saturday, April 11th, to the Paper Mills, at Croxley, near Watford, of Messrs. John Dickinson & Co., Ltd. On Wednesday evening, May 13th, to the Power Station at Bankside of the City of London Electric Lighting Co., Ltd.—Forms of application and particulars may be obtained from the Secretary. HERBERT G. RIDDLE, 37, Minard Road, Hither Green, S.E.

The Junior Institution of Engineers.

ON Saturday, February 22nd, a visit of great interest was paid to King's College, London, for an inspection of the experimental apparatus, etc., in the engineering laboratory, the Siemens Electrical Engineering Laboratory, and the Wheatstone Laboratory, through arrangements kindly made by Professor D. S. Capper, M.A., M.Inst.C.E. (hon. member), Professor H. Wilson, F.R.S., Professor Ernest Wilson, M.I.E.E., and Professor Waynforth. The apparatus includes various machines for testing materials and obtaining a thorough knowledge of their nature and properties. For thermodynamic work there are a 60 i.h.-p. Marshall experimental compound engine, 20 kw. Belliss Siemens direct-driven set, Parsons' steam turbine, and direct driven dynamo, Davey Paxman and Babcock Wilcox boilers, Dowson suction gas plant, Crossley high-speed gas engine, condensing plant, various calorimeters, apparatus for flue and exhaust gas analysis, etc. Appliances are also provided for the determination of the cutting power of tools, and efficiency of machine tools, and belts and pulleys, and apparatus for determining the effect of blows on springs, and the resisting power of asphalte.

The Siemens Laboratory is equipped with very complete and modern apparatus suitable for the practical instruction of students in every branch of electrical engineering. Direct current is obtained from the supply company's public mains, from a battery of chloride cells, and from a Siemens 50 kw. generator of 500 to 550 volts. Alternating current is supplied from a Siemens 100 kw. eight-pole revolving field type of alternator arranged to give one, two, or three-phase currents at frequencies ranging from 50 to 25; also from two Siemens generators, each of 10 kw. output, with a special coupling which allows the phase displacement of the armatures to be altered. A complete tramcar equipment is provided, fitted with two 35 h.-p. motors, with arrangements for testing draw-bar pulls, efficiencies, etc.

In the Wheatstone Laboratory were shown the dark room for optical experiments, workshops for repairs, the celebrated George III and Wheatstone collections, which include the lodestone which belonged to Daniell, and was used by Faraday in his classic experiments on the induction of currents; the coils of insulated copper strip used by Henry in his experiments; the rotating mirror which Wheatstone employed in his experiments on the velocity of electricity along wires; the original Wheatstone bridge and resistance boxes, and Clerk Maxwell's dynamical model to illustrate the induction of electric currents.

At the conclusion the members were entertained to tea and the chairman, Mr. F. R. Durham, expressed their thanks for the exceedingly interesting afternoon which had been kindly provided for them, and Professor Capper responded.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[18,844] **Vertical Boiler.** J. W. B. (Monton) writes: I am making a vertical central flue boiler, in copper. The size is 12 ins. by 6 ins. diameter; firebox, 7 ins. high by 5 ins. diameter; flue, 1¼ ins. diameter; intended pressure, 50 lbs. per sq. in., solid fuel. I propose fitting three cross water tubes, slightly inclined. (1) What size of cross tubes would you recommend, and what strength? (2) Would you advise more or less than three cross tubes? (3) Are any stays necessary between the crown plates? (4) What is the best method of fixing the cross tubes? (5) Would you advise anything different to the cross tubes? (6) Would you advise the style of water tubes shown in the coloured plate of Fire Engine in preference? (7) In riveting, what size of a rivet set is most suitable for ⅛-in. copper rivets—*i.e.*, the diameter and depth of the hollow?

We cannot recommend a centre flue boiler of small size. Centre flue boilers are quite satisfactory when considerably larger than absolutely necessary for the work and when they do not need to be forced. There is hardly room for the fuel and flame in a firebox of the size mentioned without blocking it up with water tubes. We would recommend about six tubes ⅜ in. diameter, instead of the single flue 1¼ ins. diameter. However, we reply to your questions as they stand. (1) ⅜ in. diameter, thickness 1-32nd in. (2) No, for reasons above stated. (3) No, the surfaces are small and the flue tube stays the crown plates. (4) Silver soldering is the only satisfactory method. (5) See preliminary remarks to replies. (6) They are rather too low as shown. You might very well employ similar tubes (say, 5-16ths in. diameter, 1-32nd in. thick), the entry into the side sheets being at least 1½ ins. above the level of the fuel, or, say, 2½ ins. above the level of the grate. (7) The heads of rivets should be 7-32nds in. diameter and 3-32nds in. high. Make the set to suit.

[18,813] **Model Flash Boiler.** H. E. M. (London) writes: As a reader of THE MODEL ENGINEER could you favour me by answering the following? I am making a semi-flash boiler (as in your issue of No. 327, Vol. XVII) but modified in the following: instead of ⅛-in. by 5-16ths-in. by ⅛-in. steel tube being employed, I have put 3-16ths-in. by ⅛-in. by 5-16ths-in. copper tube, the thinnest being 1-32nd in. Would blowlamp (as described in "Machinery for Model Steamers") be suitable for engine and boiler? Could I use paraffin oil in above lamp; and, if not, why? What working pressure would the boiler stand?

We know nothing of the practical performances of this design. However, the use of copper tube is quite out of the question. Copper tube gets dangerously weak when heated to red heat. The blowlamp might do, but we have no previous experience to guide us. It is quite a matter for experiment. The blowlamp is a benzoline lamp, and would not work with an oil with a higher flash point.

[18,948] **Design of Small Steam Engine.** M. L. (Sydney) writes: I want to build a 6–10 h.-p. triple expansion high-speed engine and would deem it a great favour if you could answer me the following queries. (1) How is an engine of this kind designed for a certain number of revolutions per minute? (2) How is it designed to give a certain horse-power? (3) How are the sizes of the cylinders found? (4) How are the sizes of the receivers found? (5) How are the sizes of the steam and exhaust ports found? (6) Could you give me a rough sketch of the setting of the eccentrics and cranks, link motion to be employed for reversing gear? (7) Would it be good to work the engine at 200 lbs. boiler pressure? (8) How is the number of cubic feet of steam, at a certain pressure a boiler will generate per minute, calculated? (9) Would you advise a water-tube boiler, such as that described in THE MODEL ENGINEER, No. 339? Of course, it would have to be larger and stronger. Would you advise steel tubes, ⅜ in. diameter, for the water tubes of the boiler?

(1) In designing an engine for a given number of revolutions per minute, the chief point to be considered is the size of the steam ports. Should these be made too small, it is obvious that a sufficient amount of steam will not be able to enter the cylinder to develop the required horse-power. The required speed will only be obtained by reducing the load and, therefore, the horse-power will be lower than would be the case if the ports were properly proportioned. The speed of the exhaust steam in a small power engine should not exceed about 40 ft. per second. (2) The indicated horse-power of a steam engine is calculated by the formula:—

$$\frac{P \times L \times A \times N}{33{,}000} = \text{i.h.-p.}$$

Where P — Average forward pressure of steam on the piston, less the average back pressure (if any) in lbs. per sq. in.
L — Length of stroke in feet.
A — Area of piston in sq. ins.
N — Number of strokes per minute.

Therefore, if you know the revolutions, and determine the pressure of steam, the area and length of stroke may be fixed to suit practical requirements. (3 and 4) By experience and by expansion diagrams. See Mr. W. J. Tennant's excellent book, "Compound Engines," price 2s. 6d. net, 2s. 9d. post free. (5) See reply No. 1. (6) Quite out of the scope of a query. (7) The higher the pressure the greater will be the gain by the expansion of the steam—within limits of course. (8) By observation of the power given out by boilers of the same type. (9) It depends on many circumstances and the purpose for which the engine is required, to say nothing of local conditions. Quite possibly ⅜-in. tubes would do. We may mention that the design of a plant such as you contemplate building would occupy the time of an experienced draughtsman several weeks. We recommend you to study the following books: Lineham's "Mechanical Engineering," Greenly's "The Model Locomotive," Tennant's "Slide-valve Simply Explained," Jamieson's "Steam Engine."

[18,758] **Electric Motor for Tramcars.** E. V. (Liverpool) writes: I am constructing three model tramcars (electric), one bogie type and two truck type, the first weighing about 25 lbs., the trucks about 21 lbs. each. What power motor would you advise, and what type of gearing? What are the connections for lighting six 4-volt lamps in the interior of car? How would you feed the current into overhead wires from accumulators?

The size of your motor for the respective cars will be limited by the available space you have for carrying accumulators. If you are running the cars from an overhead wire or third rail the case is different. We should then advise you to fit a 20-watt motor, say, 10 volts 2 amps. The gear ratio will depend upon the size of your driving wheels and the speed the motor runs at. This involves a very simple calculation. Assuming that the motor runs at 2,000 r.p.m. and drives on to a 2-in. wheel on the car axle, the motor itself having a gear wheel of ⅓ in. dia., the result would be a ratio of 6 to 1; that is, the car axle would revolve at one-sixth the rate of the motor armature. Multiplying this speed by the circumference of the car wheels you will arrive at the distance travelled per minute. The small lamps inside the car may be run in sets of two in series, assuming your supply voltage to be 10. It would, however, be advisable to either reduce the supply voltage to 8 to suit the lamp or use 5-volt lamps in series to suit a 10-volt supply, but these details you can easily arrange for yourself. You can use either accumulators or a dynamo to feed the overhead wires; it is simply a matter of choice. If a dynamo is used, of course, you will need some kind of engine to drive it.

[18,846] **Marine Engineers.** A. E. (Ladywood) writes: Might I trouble you to answer the following questions. How should I set about getting a post on a foreign-going cargo boat? I have been through an electrical engineering works (three years), and twelve months on electrical contracting, mostly plant work. What "screw" should I be likely to get? If I ever wanted to go in for mate's and master's certificates, would this count? I have the book, "Regulations Relating to Examinations of Engineer's in the Mercantile Marine," but this gives no information on the subject.

You do not say in your letter what kind of a post you wish to obtain, whether as engineer, electrical engineer, or to become one of the deck-hands. For the engineer's department you have full particulars of the requirements in the regulations which you say you have, published by Messrs. Eyre & Spottiswoode: for an electrical engineer your qualifications are, of course, all right, judging by your experience, but it is not every boat that carries electrical engineers, and we think we are correct in saying that no cargo boats do so. To obtain any information you will have to make application to any of the leading steamship companies, either personally or in writing, stating your experience. If they have no vacancies at present, the only thing you can do is to ask them to put you on their list and to be good enough to notify you when such vacancy occurs. As regards wages, these vary enormously, and it would be no use us hazarding an estimate of what you would be likely to obtain when we know none of the circumstances of the case. This experience would not count if you wish to go up for mate's or master's position. For this you need to serve a number of years before the mast, or as an apprentice, before you can sit for the first examination, and we do not think you would feel disposed to do this even if it were possible.

[18,729] **Morse Sounder.** H. G. (Sheffield) writes: I am about to make a Morse sounder and key (a sketch of sounder

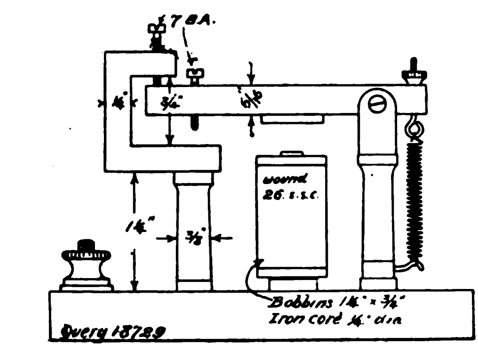


Fig. 1.—Morse Sounder.

enclosed). Could you suggest any improvement in my design? About what distance would it work up to with two dry cells? Should I require a relay, and would a relay as used for bell work be suitable, as a polarised relay would be too difficult for me to

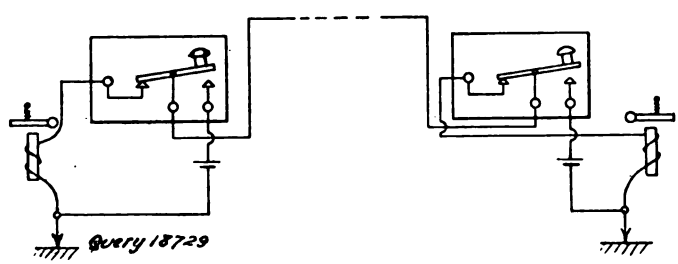


Fig. 2.—Diagram of Connections.

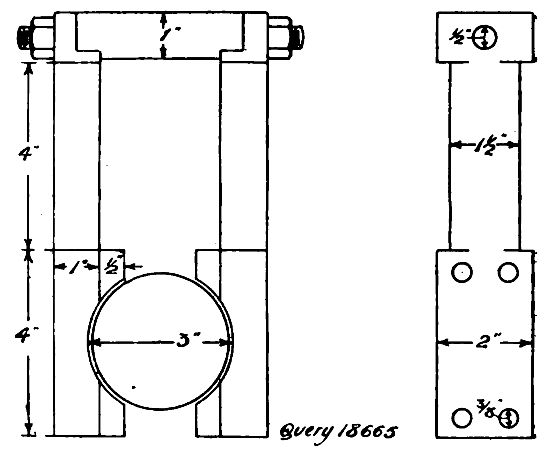
construct? Would you also oblige me with a diagram for connecting two stations using Morse keys with three terminals?

You should provide locking nuts on the No. 7 screws, limiting the play of the armature, otherwise the vibration of this up and down on the anvil would loosen the screws and the play would be continually varying. The cores of the electro-magnets should be brought up to within 1-16th in. of the armature. In your sketch they are a great deal too far away. The pillar supporting the anvil, together with that carrying the armature and the yoke piece of the electro-magnet should all be fixed to a piece of sheet brass ⅛ in. thick, and this should be screwed to the wooden base by three screws, two at the back and one at the front, washers being interposed between the brass and the base. It ought to work a hundred yards or so with two or three dry cells. We append diagram of connections.

[18,859] **Apprenticeships.** T. H. B. (North Ormesby) writes: Would you be so good as to tell me if an apprentice on such machines as planers, millers, borers, shapers, etc., is called a machinist? When he has served his time could that machinist be an engineer?

Yes; it is merely a matter of study, and, to put it briefly, making oneself more conversant with the theoretical and scientific side of engineering work in general. It depends entirely upon one's own personal efforts.

[18,665] **80 - Watt Dynamo Windings.** G. S. (co. Tipperary) writes: I would feel much obliged if you would advise me in the matter of a dynamo winding. I send a sketch of field-magnet. The cross-section of core is about 1¼ sq. ins. The armature is an 8-slot drum, 2¼ ins. diameter, 2 ins. wide. The slots are ¼ in. wide by ⅜ in. deep. I wish to wind for about 150–200 watts. What gauge and amount of wire would you recommend for field-magnet and armature respectively? The voltage might



Field-magnets for 80-watt Dynamo.

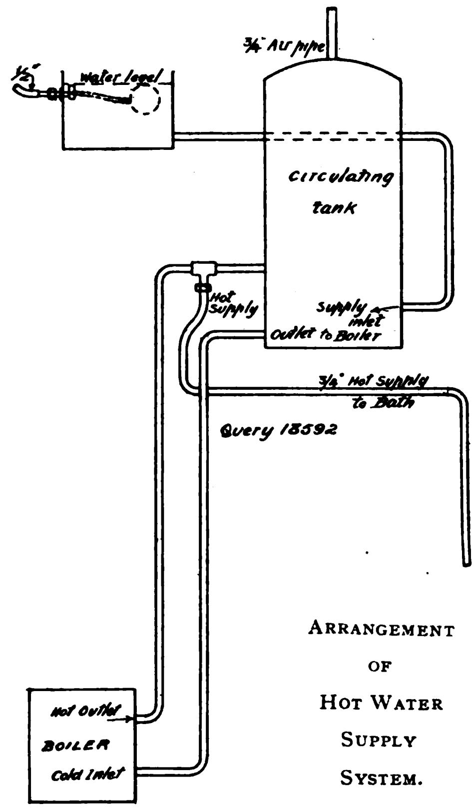
be about 50 or 60. I have both your books on motors and dynamos, but they do not give any calculations for armatures whose width is less than their diameter. I could get 2,000–2,500 r.p.m. on the machine. I made the field-magnet from soft wrought iron. I am winding in eight sections for an 8-part commutator.

Your machine will not give more than 80 or 100 watts. To obtain 50 volts and about 1¾ amps., you should wind armature with 8 ozs. No. 24 S.W.G., and field-magnets with 3 lbs. No. 25 S.W.G. connected in shunt. Speed to be 2,900 r.p.m.

[18,631] **"Yarrow" Type Model Boiler.** H. S. B. (Sunderland) writes: I intend constructing a water-tube boiler for a model racing boat, and think the design shown in "Model Boiler Making" (fifth edition), Fig. 16, page 48, will be suitable. I wish to keep the same height as shown in the design. How much should the length be increased to drive a compound engine, H.-P. cylinder 1 in. diameter, L.-P. cylinder 1¾ ins. diameter, stroke 1 in., at 1,500 r.p.m., working pressure 100 lbs.? Also what length of boiler (same design) would be required to drive a twin-cylinder engine, 1⅛-in. bore, 1¼-in. stroke, under the same conditions? I propose to make the upper drum of 18·1 S.W.G. rolled drawn copper tube, with ends of copper 5-62nds-in. thick. Would one 3-16ths-in. brass stay be sufficient? Would you also please state in *detail* the strongest method of fixing in the 5-16ths-in. water tubes, and the number and type of burners required? If water tubes are expanded in, give particulars of tool required.

We would recommend you to lengthen the boiler about 1 in. The boiler would require to have over double the heating surface for the simple engine mentioned, and this would involve a much larger generator altogether. The joints would have to be designed in a manner which would not involve the necessity of brazing. The boiler illustrated in the handbook is intended to have water tubes brazed or silver-soldered into the drums. An expander cannot be used, and soft solder is out of the question. One stay will be sufficient in the top drum. Use two "Primus" burners, silent type, 3 ins. diameter, No. 5.

[18,592] **Hot Water Supply System.** W. G. (Vauxhall) writes: Can you please inform me if you can see anything wrong with the fitting up of this hot water circulator? I have fitted this affair up, as I show in rough sketch, but cannot obtain enough supply of hot water. I can get about 4 gallons of hot water, and then it runs cold. The hot water circulating tank is about 30 gallons capacity, and I only seem to draw from the bottom. I should take it as a great favour to receive an early reply. I have been a reader of your book for some considerable time, but cannot remember ever having seen the solution or explanation of this question.



ARRANGEMENT OF HOT WATER SUPPLY SYSTEM.

We can only suggest that you take the hot water outlet from the boiler nearer to the top of the circulating tank and tap your hot water supply to the other branches also from the top of the circulating tank, or at any rate nearer to the top than you have it in your sketch. We advise you to read the series of articles which have appeared from time to time in *The Engineer-in-Charge*, commencing April, 1906, copies can be obtained at 3½d. each, post free, from this office.

[18,756] **Locomotive Boiler Queries.** S. H. (Stoke-on-Trent) writes: Will you kindly advise me on the following questions? What size and number of tubes for a locomotive boiler 7 ins. diameter; length of firebox outside, 12 ins. by 5½ ins.? Size of cylinders (two) 1¼ ins. by 2½ ins., with Walschaerts' valve motion. Would boiler drive larger cylinders comfortably, say 1⅜ ins.? Also what size steam and exhaust pipes? I intended ⅜-in. steam, and ½-in. exhaust. (3) Also, what size exhaust orifice, and what height above centre of boiler? (4) Would pump ½-in. bore, ¾-in. stroke be suitable for above boiler? (5) Also could you give me scale drawings of Gresham & Craven's injectors, as I want to make two ½ full size.?

(1) We cannot tell you exactly how many tubes you will be able to get in the boiler, and you do not say whether the shell is of copper or of steel. Steel boilers generally have thicker plates. For natural draught use ¾-in. tubes, but where the blast will be employed to induce a draught, ½-in. tubes may be fitted. ½-in. tubes should be placed at ¾-in. centres, and ¾-in. tubes at 1 1-16th-in. or 1 1-32nd-in. centres. The crown of the boiler should not be higher than ½-in. or ¾ in. above the centre line of the barrel of the boiler. (2) Cylinders (if two high-pressure are used) should not be larger than 1⅜ in. by 2½-in. stroke. 1¼ ins. by 2½ ins. might be used. (3) See rules given in our book "The Model Locomotive," by H Greenly, for steam-pipe and blast-pipe sizes. (4) Yes, the pump will be plenty large enough. You might gear it down 2 to 1. Fit a bye-pass valve to regulate feed. (5) We regret that this is beyond the scope of a query.

[18,922] **Phonograph Motor.** F. J. B. (Rugby) writes: I wish to make an electric motor to replace the clockwork in a gramophone (disc machine) to be enclosed in the same case, and run from a 6-volt 10 amp.-hour accumulator. If you would kindly oblige me by giving particulars as to the best type of motor for the work, size and wiring, and, if possible, a little sketch, I should be greatly helped. I should prefer a slow-speed motor, if possible, in order to avoid the hum necessarily caused by a high-speed motor. The motor to be economical in current consumption.

We can recommend you to use any of the small 4-pole motors illustrated and described in handbook—"Small Electric Motors." If you require a slow speed motor, it will, of course, to give an equivalent power, have to be much larger than a high-speed motor. Some particulars for such a motor as you require will also be found in our issue for May 28th, 1903, page 525.

[18,938] **Power to Drive Dynamo.** H. A. S. (Bromley) writes: If I can get the power to drive it, I want to make quite a small dynamo. I do not want to have any engine either steam or gas. (1) Would a weight of ½ cwt. or 1 cwt. with proper gearing and a drop of about 9 ft. produce enough power to run a small dynamo for half an hour or one hour? (2) If so, about how big a dynamo could one use? (3) Does any maker sell suitable gearing for this purpose?

You would get quite an infinitesimal power by the means you suggest. Taking 1 cwt. and dropping it 10 ft. and spreading the time over one hour in which the weight will travel this distance, the result works out that you would obtain practically $\frac{1}{229 \cdot 5}$ h.-p., which, as you will readily see, is far too small a figure for any practical purposes. Horse-power equals the rate of doing work which equals 33,000 foot-pounds per minute. (3) No.

[18,998] **Bichromate Cells.** F. C. W. (Chatham) writes: Will you kindly say whether a non-polarising bichromate cell with the zinc in sal-ammoniac (as described in your handbook, "Electric Batteries,") will deteriorate at all when not in use on account of the solutions gradually mingling, or in any other way, as I wish to light a 16-volt "Osram" lamp for only about an hour each day, and so I want to make a battery that will not spoil when not in use, at least for several weeks? If it would do so through the solutions mingling, could I prevent this by thickening them a little? Would a little glycerine or glycerine and plaster-of-Paris answer the purpose, and would it do to thicken the bichromate solution in the same way? Can you recommend any other kind of battery that would be more suitable or cheaper to use?

You have apparently not read the instructions in the book no "Electric Batteries" carefully. Sal-ammoniac is not used in ordinary bichromate cells. The zinc in these cells must be removed when the cell is not being used, and if you object to this you could use some type of Daniell cell, which is also described fully in handbook. We do not recommend anything for thickening the electrolyte and do not think any such course is necessary. If you require further particulars on primary batteries you could consult "Primary Batteries," by Bottone, which will give you much useful information. To light a 16-volt "Osram" lamp you must remember that you will need at least eight bichromate cells in series; or, if any other type of cell is used except accumulator, a larger number will be needed in series as the voltage is somewhat less per cell.

[18,891] **Perpetual Motion Again.** A. P. (Exeter) writes: I should be much obliged it you would kindly answer the two attached queries. (1) Would a mechanism producing perpetual motion (a wheel or otherwise) without external influence, such as heat, light, etc., be of any value on the market? This machine is constructed to run till worn out (a good number of years, according to workmanship), and to start without assistance, no matter how often it is stopped, for any reason. (2) Would an automatic contrivance to prevent the falling of a cage in a mine when the cable breaks be likely to be taken up, and if so, could you direct me to some one likely to do so?

Certainly if you could devise a perpetual motion machine, you will have no difficulty in finding a market for it, but as the proposal is absolutely impossible, we cannot give you any encouragement to proceed further with the idea. *Re* automatic contrivance or safety device for falling cage, we believe several such devices are already on the market, some being better than others, but we cannot say more definitely whether yours will be likely to meet with a good reception, unless we had full particulars of same. You will be well advised, if you think your idea is practicable, to take out a provisional patent for it with which object in view you should read our handbook on "Patents," 7d. post free.

[19,139] **Lighting Small Lamps from Supply Mains.** A. H. (Richmond) writes: Thanks for last enquiry, but I must trouble you again for advice. I am making a model of a church abroad, which is to be lighted with four 5-volt lamps (as sample following). The lamps, if possible, are to be lighted from the mains (240 volts). Please let me know how to cut down the voltage.

If you connect your small lamps in series with a couple of 8 c.-p. lamps connected in series on your 240-volt main, you will allow a current of approximately ·07 amp. to flow through it. We cannot say exactly what candle-power your lamp is now or exactly what current it will take; but if you find that it does not glow brightly enough when in series with the two 8 c.-p. lamps, you must use your discretion and cut out one of the 8 c.-p. lamps in order to give a higher current. It is essential, of course, that the 8 c.-p. lamps be made to run on 240-volt supply, and it is also essential that the two be connected in series when you first try your lamp, otherwise there is a possibility of the little lamp being burnt out.

[19,202] **Patent Agents' Qualifications.** C. W. H. F. (Barnes) writes: I should be much obliged if you would give me the following information. I am contemplating entering a patent agent's office, and I wish to know if there are any examinations specially suitable for Patent Agents and, if so, where could I obtain particulars and papers?

We do not know that there are any particular qualifications required, except that to become valuable to your firm you should be thoroughly well acquainted with the technicalities of the subjects you propose to deal with—that is to say, that if you require to obtain such a position as that of an authority on any particular branch of engineering science you will have to have a thorough training in the principles and the practical work involved before you can advise anyone on the worth of the patents they bring along for you to deal with. For purely clerical work in a patent agent's office no special knowledge is required.

[19,216] **Boilers for 1¼-in. × 2-in. Vertical High-Speed Engine.** G. S. (Doncaster) writes: Will you please let me know what size vertical centre-flue boiler I shall want to drive a vertical high-speed engine (one cylinder) bore 1¼-in., stroke 2-in., running at 400 r.p.m., working pressure 40 lbs. per sq. in. I might say that I have got a steel boiler in sight, 18 ins. high, 9 ins. diameter, but cannot say whether it will be large enough to drive the engine.

You should have a boiler of the vertical steel multi-tubular type—22 ins. diameter, 36 ins. high, with firebox approximately 18 ins., made of ⅛-in. steel plate and containing thirty 1¼-in. tubes. With forced draught, a boiler 18 ins. diameter and 30 ins. high would do, with eighteen 1¼-in. tubes; height of firebox, 12 ins. A vertical centre-flue boiler would have to have the following dimensions—30 ins. diameter, 42 ins. high, firebox 24 ins. high, ¼-in. steel plate.

[19,010] **Colouring Electric Lamp Bulbs.** E. H. C (Heckmondwike) writes: How can I convert ordinary electric incandescent bulbs into coloured ones? I should like your opinion as to best medium (and method of application) for applying the colour to the bulb. Also, what colour or dyestuff is productive of the nearest match for daylight?

Coloured varnish can be obtained for dipping these lamps. Any of our advertisers of electrical goods will supply you with any colour required. To obtain light more nearly allied to daylight, we should say a very pale blue would have to be used in conjunction with an ordinary metal filament lamp, but we do not know that satisfactory effects can be obtained in this way, and it is more usual to employ some other form and type of lamp, such as the Nernst.

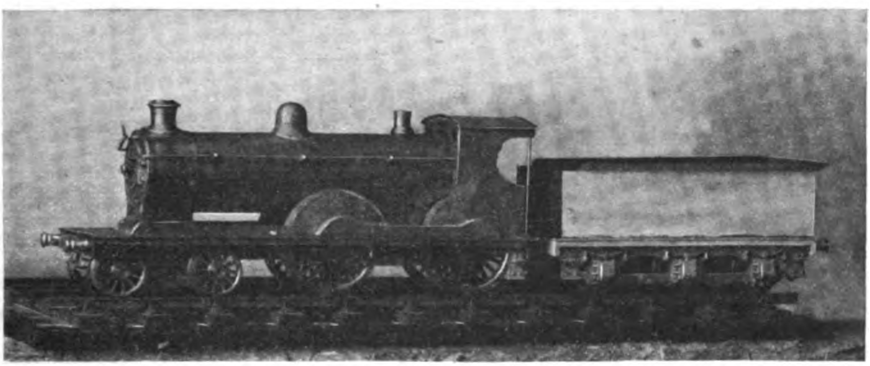
The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

** Reviews distinguished by an asterisk have been based on actual Editorial Inspection of the goods noticed.*

*** Cheap Scale Model Locomotives.**

A new departure is being made in the production of an inexpensive line in model locomotives, the special feature being that the model for the greater part is constructed of brass castings, by which means the scale measurements as regards outward appearance and loading gauge are guaranteed to be absolutely correct. We recently inspected, at the Southwark Engineering and Model Works, a 7-16ths-in. scale model of the Caledonian express locomotive, "Dunalastair No. IV," such as we illustrate herewith; but it will be noticed that a six-wheeled tender is fitted instead of an eight-wheeled tender, as in the prototype; this is for purpose of cheapness. The model is fitted with a Smithies' type water-tube boiler, and a single inside slide valve cylinder, ⅞ in. bore by 1 in. stroke. The length of the engine is 14½ ins.; tender, 9¾ ins.; gauge, 2 ins.; and weight about 15 lbs. At the time of our visit the model was running continuously, hauling a number of trucks laden with castings, etc., for close upon half-an-hour, when the supply of methylated spirit, stored in the tank in the tender, was used up; the spirit tank capacity being gauged by experiment so that the fuel is always exhausted whilst there is still water in the boiler. This automatic safety arrangement will commend itself to all of our readers. The complete set of castings and parts which were shown to us also appeared to be of excellent quality. The above firm, whose address is 155-157, Southwark Bridge Road, London, S.E., will be pleased to supply further particulars and prices to our readers who enclose a stamped addressed envelope.



7-16THS-IN. MODEL CALEDONIAN EXPRESS LOCOMOTIVE, "DUNALASTAIR NO. IV."
(By the Southwark Engineering and Model Works.)

New Catalogues and Lists.

Gilbert & Co., 11 and 13, Gray Street, Waterloo Road, London, S.E.—The 1908 list of specialities for model makers gives prices of brass rod of various sections, sheet brass, aluminium, tool steel silver steel, screws, bolts, nuts, taps, stocks, dies, reamers, files and numerous useful accessories for the model engineer's workshop. Present prices per pound for castings in gunmetal, brass, aluminium and iron from customer's own patterns are given. Readers should mention THE MODEL ENGINEER when applying for this list, which will be sent post free.

The Liverpool Castings and Tool Supply Co., 5, Church Lane, Liverpool, have recently issued No. 8 of their smart little publication, the "Amateur Mechanic," which is double the size of previous issues, and contains a number of useful notes for amateurs. Prices for their specialities, such as engine and boiler fittings, materials for model making, tools and workshop accessories, model vertical launch engines (complete or in parts), a burner for model steamers, pumps, model propellers, etc., are also included. The illustrations are excellent, and special mention should be made of the amusing prehistoric picture.

The Editor's Page.

WE have received advance particulars of a forthcoming publication of special interest to model yachtsmen. It is to be called the "British Model Yacht Clubs Guide and Official Year Book." The scheme of the book is to include articles on model yachting, formulæ for the various rating and measuring rules, flags of the British clubs, national sailing rules, and a full list of British Model Yacht Clubs and officers. Another attractive feature will be an illustrated list of model-yacht ponds in various parts of the country. The price of the book is to be 1s., or post free 1s. 3d., and we are informed that it will probably be ready in about a month or so. It is being compiled by Mr. G. Colman Green, 15, Southwell Road, Grove Road, Norwich, who would be pleased to hear from anyone interested in the subject of the book.

* * *

With reference to the remarks we made on this page in our issue for March 5th, we think the following letter—which we have since received—will be found of special interest, as it comes from an apprentice in a well-known engineering works. Our correspondent, under the initials "W. H. N.," writes: "Just a few lines in answer to 'L. G. T.' If he contemplates entering works, my advice is *don't*—that is, if he really imagines that he is going to be superior to the men. I am in a position to tell him this, as at the present moment I happen to be with one of the firms mentioned by Mr. Marshall in his able article. I fully agree with your editorial criticism that, although there are and must be 'wasters' in every works, there are, among the men, real good fellows, though they do use language which would be out of place in a Mayfair drawing-room. 'If you go to Rome, do as the Romans do.' One must be versatile. If you can't be one of the men, and don't like soiling your hands, don't go at all, as you will learn nothing, and your life won't be worth living. As for my private social status I will say nothing, save that I was educated at Charterhouse and when at home wear a nice white linen collar. Here I wear a scarf, and have been known to attend a workman's 'smoker' in the evening, take a hand in their games, and return their salutations in the streets. Nett result: my charge-hand gives me all the best jobs, any of the men will show me anything I don't know, and should I make a mistake will be only too pleased to help me to rectify it. Let 'L. G. T' remember, that although their hands and faces may be black, underneath they are white and have real good hearts, and are what I may call 'practical' Christians, ready to do one of their mates a good turn, and from my own personal experience I can say that their morals are in many cases far and away above those of some of the so-called society people whom I meet at functions at home. In conclusion, I may say I am having a real good time in works, as I have been a model-maker for the last seven years—(you published a description of a gas engine driven charging plant some eighteen months ago)—although one finds the difference in erecting a 3 by 6 gas engine and a 1,500 b.h.-p. triple-expansion engine, with cylinders 19 by 29 by 46 by 18 stroke. Congratulating you on your excellent article, and acknowledging the many tips I have seen in your paper, to which I am a subscriber."

* * *

We have to congratulate the members of the Clapham Steam and Sailing Club on the very interesting exhibition of their club boats which they held at the Alexandra Hotel on the 6th and 7th inst. It formed a striking testimony to the enterprise and ability of the members of this body, and in our next issue we shall devote some space to a description of the exhibits.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 26-29, Poppin's Court, Fleet Street, London, E.C.

Sole Agents for United States, Canada, and Mexico: Spon and Chamberlain, 123, Liberty Street, New York, U.S.A., to whom all subscriptions from these countries should be addressed.

Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

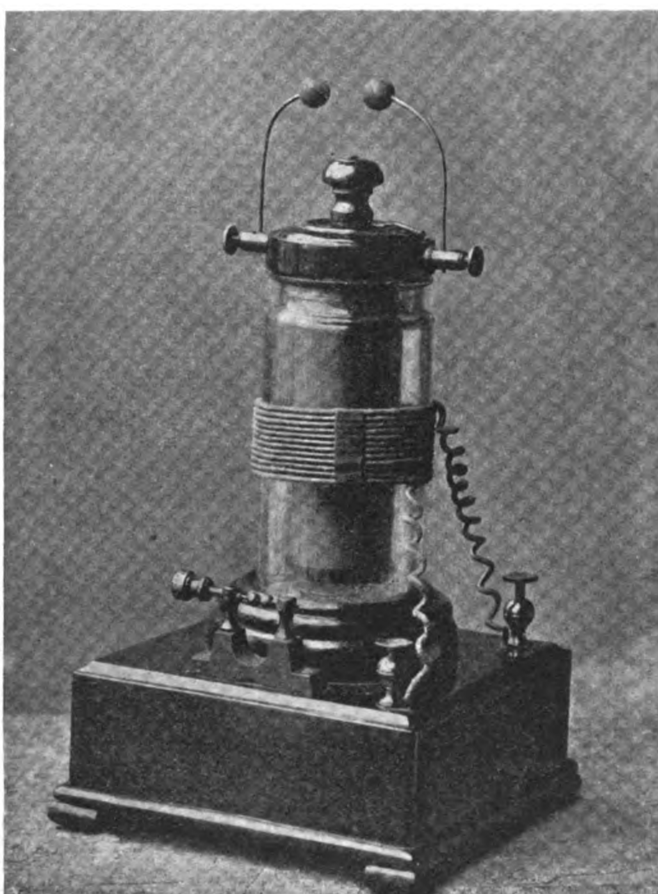
EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 361. MARCH 26, 1908. PUBLISHED WEEKLY.

A Compact Tesla Coil.

By F. T. WEBB.

I THINK this apparatus will be admitted to be as interesting a piece of mechanism as an electrical enthusiast can have as an accessory to a spark coil. I have made several varieties from the excellent instructions given in THE MODEL ENGINEER; but the Leyden jar I found very liable to get broken, and the oil had a nasty way of leaking out of the wood box, if it was not very carefully made, so I substituted a condenser of Franklin's panes instead of a Leyden jar, a glass jar replaced the wood box, and I generally re-arranged the construction in a more compact manner, as shown in photograph and description. This, when tested, proved so satisfactory that I give a description:—



The Primary Coil.—Glue three strips of tape on a 1-lb. thick glass jam jar, and wind twelve turns of india-rubber-coated bell wire (about No. 22 gauge). Fold the ends of the tape over the wire and glue down securely, as shown in photograph, also cementing the jar into the base with thick shellac varnish.

The Secondary Coil.—Select a suitable piece of wood, and, after drying in the oven all night, soak immediately in melted paraffin wax to exclude moisture, turn to shape, and bore a hole in centre for wire (india-rubber-coated bell wire). French-polish and wind close with No. 38 s.c.c. wire, which, I think, will be better if soaked in melted paraffin wax before winding, as it helps to space the wire slightly further apart. Solder the ends of the wire to the two screws shown in Fig. 2.

The Condenser.—This consists of a series of Franklin's panes (old half-plate negative glass cut to size with the sharp point of a broken file). The tinfoil is placed on one side of the glass only, and is stuck on with flour paste, also strips for connection. When the condenser is placed in position

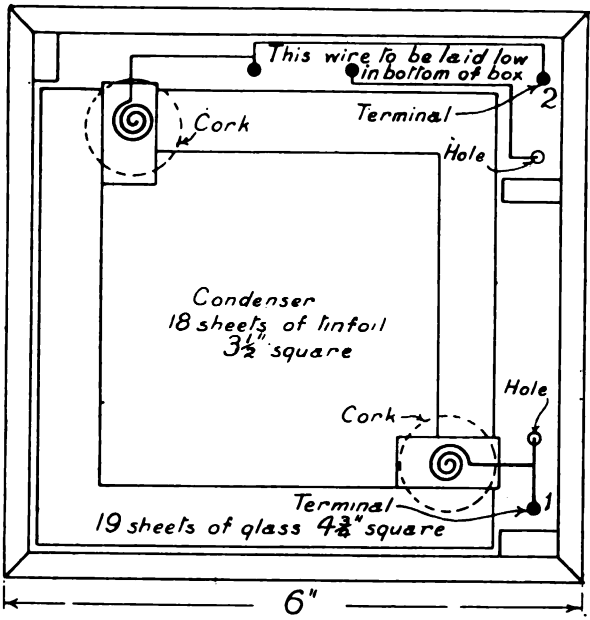


Fig. 1.—Plan of Condenser.

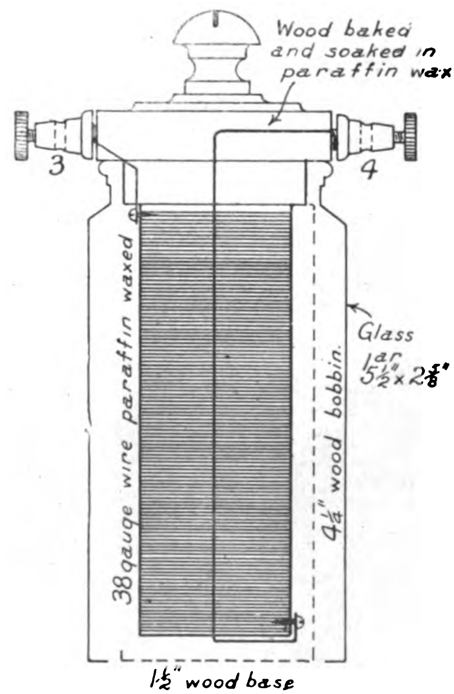


Fig. 2. Secondary Coil.

in base, the spirals forming the connections are pressed down by the two corks when screwing down the baseboard by the three screws (Fig. 3). The coil being now finished, except placing the secondary coil in jar, and nearly filling with boiled linseed oil and cementing up with thick shellac varnish or paraffin wax.

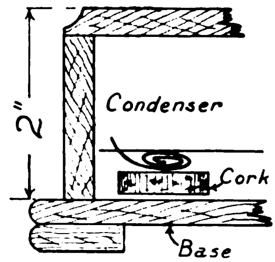


Fig. 3.

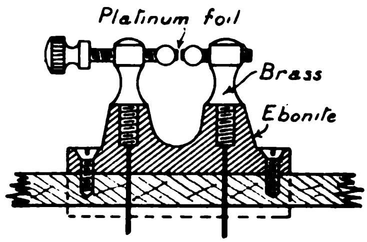


Fig. 4. Spark Gap.

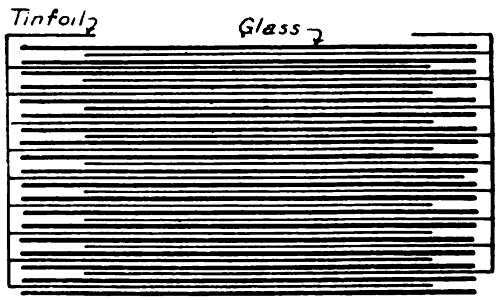


Fig. 5.—Condenser.

The coil, when completed and started to work, at first was not satisfactory; but the next day, when the oil had settled down to business, the coil worked splendidly, lighting up a 6-in. vacuum tube brilliantly with a ¼-in. spark. If the terminals 1 or 2 are connected to 3 or 4, a more brilliant effect is obtained, and a 6-volt burnt-out lamp, hanging on only one wire, illuminated with a pale blue glow when attached to terminal 3 or 4. Sparks can be drawn from the fingers; vacuum tubes lighted up by just holding to terminal 3 or 4, and no shock is felt.

Directions have been given that in ships fitted with Babcock & Wilcox boilers, and also in ships having combined installations of water-tube and cylindrical boilers, experiments are to be made with a view to determining the least amount of lime required to maintain the water in the boilers slightly alkaline. Reports on this point are to be forwarded to the Admiralty from all ships so fitted in three months' time.

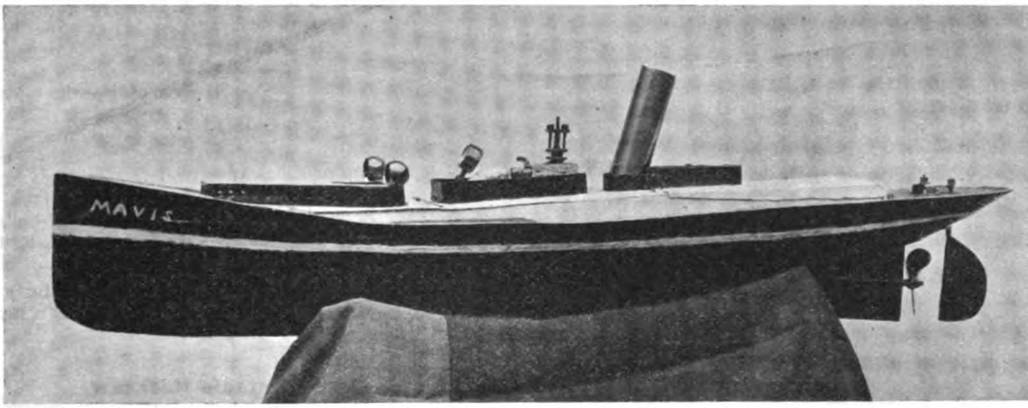
The 1907 Model Speed Boat Competition.

(*Continued from page 266.*)

THE next place for speed (4·41 m.p.h.) is occupied by Mr. T. B. Duff's *Ena*, Class C, the winner of a Certificate. Readers will doubtless remember this metre boat being described in THE MODEL ENGINEER for February 21st, 1907. The *Ena* was designed and built by Mr. T. B. Duff. Tested on the same course as Mr. Dysart's *Hermes*, on December 22nd. Speed: First trial (wind abeam), 48 secs.; interval 4 minutes. Second trial (wind abeam), 46 secs.; interval 5 minutes. Third trial (wind abeam), 45 secs. Timed by W. L. Blaney and Wm. Poole, Hon. Sec.

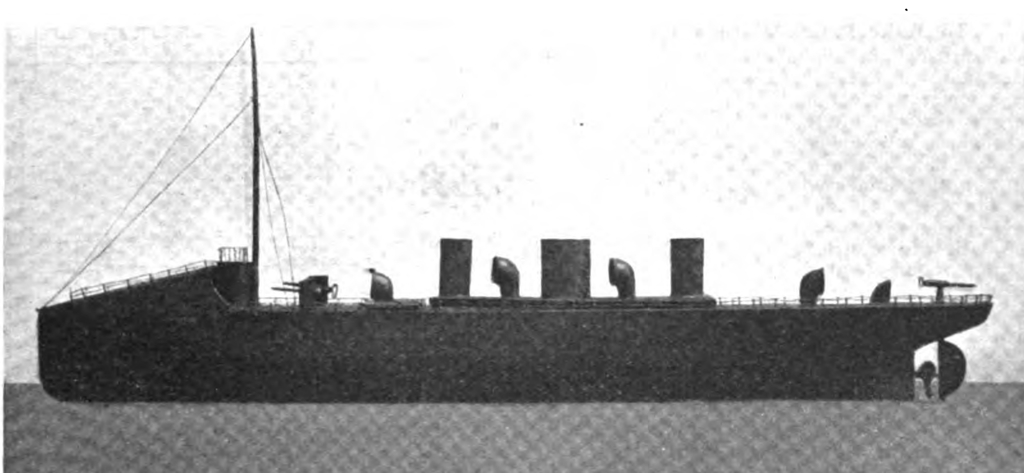
The *Ena* also figured in the 1906 Competition, winning a Bronze Medal for a speed of over 5 miles per hour. Mr. Duff accounts for the falling off of speed by the general deterioration of the machinery through wear and tear.

Another metre boat in Class C is the *Mavis*, a Certificate winner, designed and built by Mr. R. Church and Mr. T. B. Duff, Victoria Model Steamboat Club, owned by Mr. R. Church. Tested as above on December 22nd. Speed: First trial (wind abaft), 58 secs.; interval 1 min. 30 secs. Second trial (against strong wind), 63 secs.; interval 4 minutes. Third trial (against strong wind), 64 secs. Timed by W. L. Blaney and Wm. Poole.



MR. R. CHURCH'S MODEL STEAM LAUNCH, "MAVIS."

The *Mavis* is a sister boat to the *Ena*, but with a slight difference in the hull lines. The hull, built of tinplate, measures 1 metre in length over-all, 8½-in. beam, and 3½ ins. draught. The boiler has a double riveted outer shell, 4 ins. diameter and 6½ ins. long in the water space. The furnace tube is 2¼ ins. diameter, and is fitted with twenty-four water tubes, ¼ in. diameter, placed vertically. The working



MR. BEN. GIBBONS' ELECTRICALLY DRIVEN MODEL T.B.D., "DOLPHIN."

pressure is 60 lbs. per sq. in. Steam is raised by a Seivert "Rapid" benzoline blowlamp. The engine is a compound, $\frac{5}{8}$-in. by $\frac{7}{8}$-in. bores by $\frac{5}{8}$-in. stroke, and the apparently poor performance of this in comparison with the single high-pressure cylinder of the other boats is explained by the fact that careful examination of the engine subsequent to the race has revealed a bad flaw in the high-pressure cylinder casting, much to Mr. Church's disgust (a bye-pass from one end of the cylinder to the other), such are the troubles of a model marine engineer.

The following are the results and dimensions of Mr. Ben. Gibbons' torpedo-boat destroyer *Dolphin*, Aberdeen Model Steamer Club. 300 yards measured course. Time, 186 secs. Power turned on and held for a period of 26 secs, before released. Average speed, 3·299 miles per hour. Description of boat: Hull, yellow pine; (dug out) length W.L., 3 ft.; beam, 3 ins.; depth, 3 ins. Driven by a single coil type electric motor with $1\frac{1}{2}$ in. tripolar armature wound for 4 volts and taking 4 amps. Current supplied with a 4-volt horizontal boat accumulator, 5 ins. long, $2\frac{1}{8}$ ins. broad, $1\frac{5}{8}$ ins. high, 9 amp.-hour capacity. Weight of complete boat, 5 lbs. We give a copy of the certifiate of performance. "We, the undersigned, were present and witnessed the tests of Mr. Ben. Gibbons' boat, and the boat was timed by us as herein stated. Signed, W. Bunting, Vice-president; John S. Henry, Sec. and Treasurer, Aberdeen Model Steamer Club."

Workshop Notes and Notions.

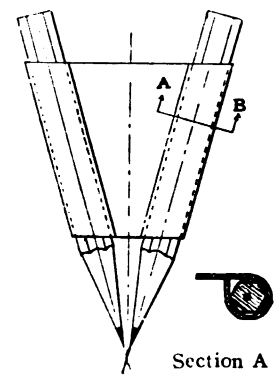
[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "WORKSHOP" *on the envelope.]*

To Make Paper Waterproof.

Waterproofed paper makes excellent packing for certain purposes. A contemporary gives a process for waterproofing paper, as follows: Articles of paper or cellulose are soaked in a solution of resin soap, then immersed in a hot bath of zinc chloride, passed between rollers, well washed, dried in a hot room, treated with paraffin oil, and run through a calender. A waterproof pasteboard is secured by immersing sheets of ordinary paper in a bath of nitric acid, or solution, placing the sheets one on top of another, and then submitting them to heavy pressure.

A Hint for Draughtsmen.

The illustration herewith is of an excellent device for use by draughtsmen, contributed to the *American Machinist*, by A. L. Campbell. It finds its use in the drawing, with one stroke, of two parallel lines to be used as guide lines for lettering on a drawing. It consists of a thin sheet of tin or aluminium, bent as shown, with two common lead pencils held in the pockets at each edge of the sheet. These pencils may be readily moved up or down to vary the placing of the lines, and can easily be removed for sharpening. This instrument is a time saver, but its chief merit lies in the fact that by its use the lettering on a drawing is much more



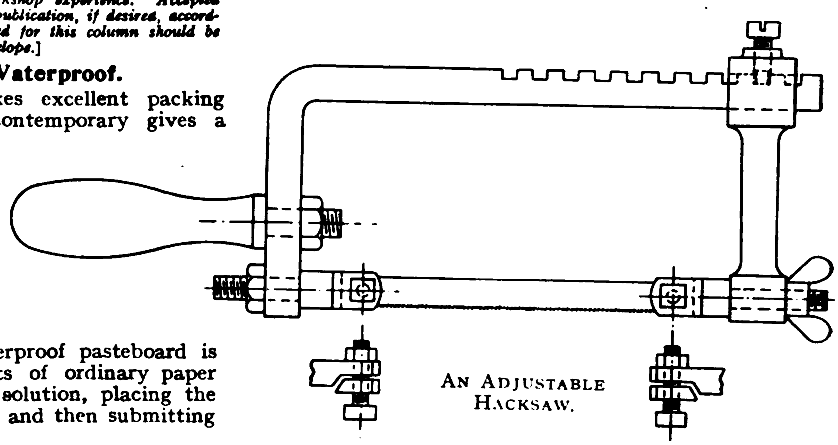
A DEVICE FOR DRAWING PARALLEL LINES.

uniform in height than when the guide lines are spaced by guess, and the work presents a neater appearance.

An Adjustable Hacksaw.

By "BOBBIN."

The accompanying sketch is a design for an adjustable hacksaw. The frame is a piece of $\frac{3}{8}$-in. steel bent to a right angle: the upright has grooves slotted in it so that the cross-piece can be adjusted by a $\frac{1}{4}$-in. pin. This pin secures it firm by fitting



AN ADJUSTABLE HACKSAW.

in the grooves. The handle is made of iron, and is held on the frame by a $\frac{1}{4}$-in. nut. The handle has also got a $\frac{1}{4}$-in. thread on it. The blades are fitted in the same way as they are fitted in a fretsaw. They are secured tight in the frame by a wing nut ($\frac{1}{4}$-in. thread).

A Recessing Tool.

By "SREGOR."

The accompanying sketches show a design for a recessing tool, the function of which is to bore and face a diameter larger than the bore of a hole immediately above it, as shown in Fig. 1, which is a section of a cylinder showing the valve ports. In this case the operation of the tool is to face off level the irregular casting and increase the diameter of the port where indicated by C C, Fig. 1. As this diameter is larger than the bore as indicated by D, through which the tool must pass, it is obvious that some form of expanding arrangement must be used. There are, of course, well-known methods of accomplishing this, and the tool here shown is a simple and easy one to make, and is intended to be used in the drilling machine. The assembled tool is shown in Fig. 1 ready for use, the outer shell E being shown in section to illustrate action of plunger and cutter, F and G. The taper part H fits on the valve seat, and forms the location. As soon as these two faces meet by feeding down the machine spindle to which the tool is fixed, the plunger commences to compress the spring K and the pin L, which is a sliding fit in the cutter, forces the cutter outwards along the slot. The angular slot in the cutter, as will readily be seen, regulates the maximum diameter the tool is capable of recessing. The angle of this slot with the vertical line should be as acute as practicable to provide a maximum amount of spindle feed with a minimum amount of cutter travel: when a definite and unvarying size of diameter is required the two locknuts M M can be fixed to regulate the necessary size. The driving medium of the tool is the pin N, which travels in the slot O, and fits in the plunger, and the sides of slot P, and drives the cutter. The width of the slot in plunger must be an easy fit to ensure that this does not receive any pressure of the drive, this being obviously too weak to perform the function. The only pressure this should receive is by forcing the cutter outwards. The tension of the spring withdraws the cutter to its normal position as soon as the feed of the machine spindle is reversed. The tool can be adapted to perform many recessing operations found in general work with slight variation in the design to meet the particular case. Fig. 2 shows outline of the shell E, and Fig. 3 outline of plunger F; Fig. 4 a cross section through line A B in Fig. 1; Fig. 5 shows the cutter G, showing dimension of the slot.

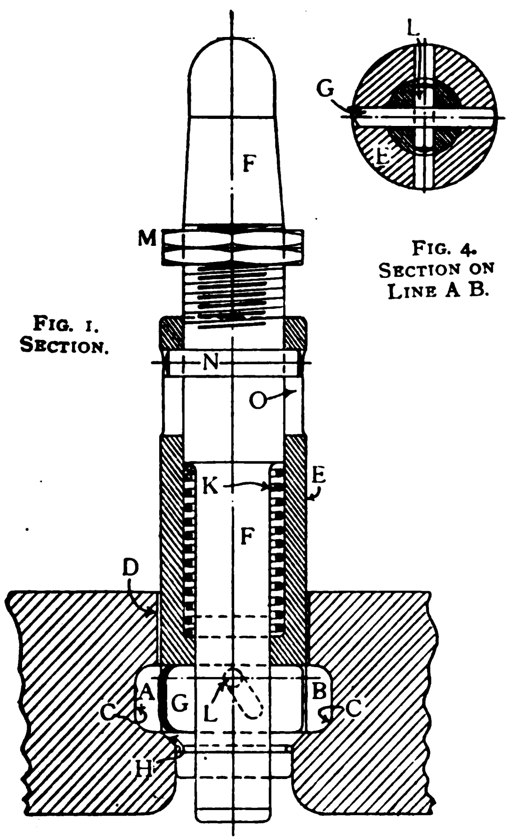
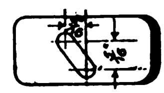


Fig. 1. Section.

Fig. 4. Section on Line A B.

Fig. 5.—Cutter.



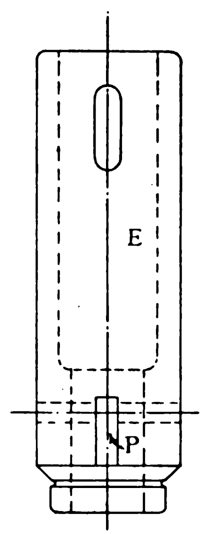


Fig. 2.—Sleeve.

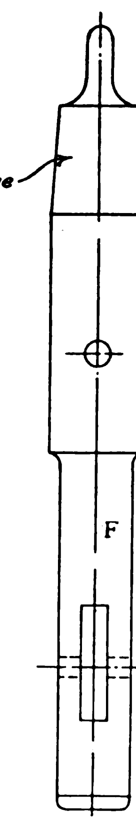


Fig. 3. Plunger.

A Recessing Tool.

The Latest in Engineering.

A Weed Burner for American Railroads.—We have received from a reader a cutting from the *Sunset Magazine* (San Francisco), describing a solution to the problem of keeping the right-of-way on American railroad branch lines free from weeds during the summer, which form a great obstruction to the movement of trains, and cause slippery rails. A gasoline weed burner has been developed in the shops of the Union Pacific, at Omaha, which is doing the work very successfully. The weed burner, as designed, consists of a four-wheel car entirely of steel, with regulation standard wheels, axles, boxes, pedestals, etc. At one end of the car is a gasoline engine mounted on the floor, which is used for propelling the car and pumping air, the air being used to force gasoline to the burners and to elevate the side wings. The propelling mechanism is designed with two speeds—slow speed used while burning weeds at three to four miles per hour, and the high speed used for going to and from work at twelve to fifteen miles per hour. Attached to the car are a number of tanks carrying the supply of gasoline sufficient for the day's run on the road. This gasoline is forced into a system of burners carried on the back of the car, making a very hot flame close to the ground, which practically kills the weeds, while by cutting them the growth is in no way stopped. At the rear of the car, carried close to the ground, is a framework carrying the piping, to which are secured a number of burners placed in rows across the track. The framework is divided into three sections — the centre section extending a little beyond the rails, and the side sections being hinged to the centre section in order that they may be lifted out of the way of obstructions outside of the track, and to clear cattle guards along the right-of-way. They can also be set at any elevation in order to get the burners close to the ground on any kind of grading. With these three sections in operation a strip 12 ft. wide is burned, or 3½ ft. on each side of the rails. It has been found advisable to make a first burning early in the year when the growth has reached 6 to 8 ins. in height, then going over it again a few days later, when it has dried somewhat, and this time the weeds are entirely consumed and the roots killed. It is sometimes necessary to repeat this performance three months later. The machine is capable of burning from twenty to twenty-five miles a day, running about three to four miles an hour. Three men, all told, are required to handle the car, which is handled on the road, under orders, as a regular train. Where the weeds are cut by hand it requires approximately sixteen men to cut one mile of track per day, hence the machine does the equivalent work of about 300 men. It will be seen that this innovation and solution of a difficult railroad problem has really been a very simple matter. The gasoline weed burner is in reality an automobile mounted on railroad car wheels and equipped with the weed-burning apparatus.

Experiments with Primary Batteries.

(*Continued from page 269.*)

As previously explained with reference to Fig. 3, the same current which a cell is sending through an external circuit of lamps, coils, motor, etc., will also be flowing through the solution in the cell from the positive to the negative plate. The resistance which the voltage of the cell must be able to overcome in order to make the current flow is, therefore, composed of two parts. One is the resistance of the circuit of lamps, coils, motor, etc., which may be connected outside the cell to the terminals. This is called the external resistance. The other part is the resistance offered by the solution inside the cell. In fact, the solution and anything else interposed inside the cell between the plates will oppose the current in its flow from the positive to the negative plate. This is called the internal resistance of the cell. Upon it will depend the capability of the cell to give a small or large flow of current. If the internal resistance is high, the cell cannot give a large flow of current, because its voltage will be expended to a considerable extent in sending the current through the solution. Connect a voltmeter or high resistance galvanometer to a Leclanché cell, as Fig. 2, and notice the deflection of the needle. Connect a short piece of copper wire to the terminals of the cell, as C, Fig. 8 (the galvanometer being also connected): the deflection of the needle will now be less than it was in the first instance.

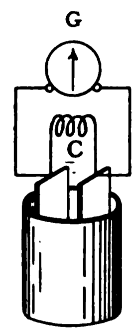


FIG. 8.

Before the wire was connected the cell was only required to give the small current taken by the galvanometer. This it can do without expending much of its voltage upon the internal resistance, as the current flowing is very small. But if a circuit of low resistance, such as the piece of copper wire C, is connected to the terminals a comparatively large current commences to flow. The voltage of the cell is, therefore, absorbed to a considerable extent in driving this current through the solution from the positive to the negative plate. Less voltage thus appears at the terminals than when the very small current was flowing. Matters adjust themselves so that the nett result is that you cannot obtain a large flow of current from a cell which has a high internal resistance, because the voltage falls rapidly as the current is increased. Repeat the experiments with a cell which has a low internal resistance. A Grove, Bunsen, or simple bichromate pattern cell, having large plates, would be suitable. With such a cell you can obtain a large flow of current without a considerable fall of voltage.

The following experiment demonstrates in an emphatic manner the effect of internal resistance. Arrange a low-resistance battery of, say, six cells in series. The best kind would be accumulator cells, to light an incandescent lamp which requires a comparatively large flow of current to cause the filament to glow brightly. Two or three lamps in parallel will do equally well, but it is necessary to have a current flow of one or two amperes. Matters being adjusted so that the light is brilliant, connect a primary cell which has a high internal resistance in series with the battery and lamp. The connection is to be made so that the voltage of the cell is assisting and not opposing the voltage of the battery. A Minotto cell is a good one for the purpose. As the cell is thus connected so that its voltage is added to that of the battery, the lamp should glow more brightly than before. On the contrary, the filament now is not bright, but glows dull red. The internal resistance of the cell opposes the flow of current, and is so great that not only is the voltage of the cell absorbed in passing the current from the positive to the negative plate, but some of the voltage of the battery of cells is also absorbed for the same purpose. The nett result is a diminished, instead of an increased, flow of current.

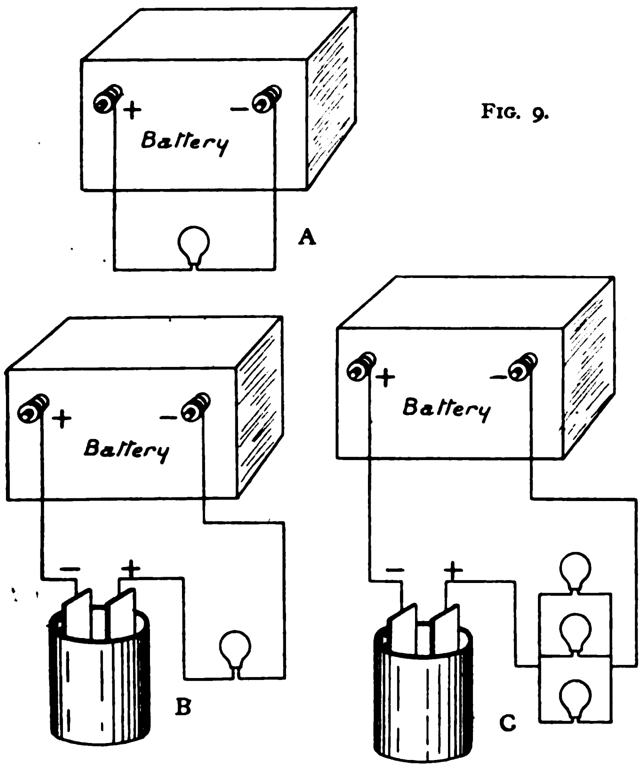


Fig. 9.

Continue the experiment by inserting in the circuit a cell having not so high an internal resistance, such as a Leclanché cell. The lamp now glows as brightly as when connected to the battery alone. It does not glow more brilliantly, because the internal resistance of the added cell is just sufficient to absorb its own voltage. Therefore, the cell does not interfere with the flow of current. Connect a low internal resistance cell, such as a Bunsen, bichromate, or accumulator cell, in the place of the medium resistance cell. The brightness of the lamp filament is now increased. The additional voltage of the cell is more than sufficient to send the current through the resistance of its own solution, and assists to overcome the total resistance of the entire circuit. The result is an increase in the flow of current. Fig. 9 shows the arrangement of apparatus: A, with the lamp and battery; B, with the high-resistance or other cell in circuit. If a single lamp does not take sufficient current to produce the effect, several lamps can be connected in parallel, as C, Fig. 9.

A cell which has a high internal resistance is not necessarily bad. It may be a very good one if applied to work suitable for it to do. When selecting a cell, consider the resistance of the circuit to which it is required to supply current. The higher the resistance of such a circuit, the less important is the internal resistance of the battery. It should always be much less than the resistance of the external circuit. A high-resistance circuit usually requires a small flow of current, and, therefore, the cells supplying the current may be of a type having high internal resistance. A low resistance usually requires a comparatively large flow of current, and therefore the cells supplying the current should have low internal resistance. It is, however, good that the internal resistance of a cell should be as low as possible, no matter whether the circuit connected to it has a high or low resistance. Connect a battery of Leclanché or other high-resistance cells to an electric motor or induction coil which requires one or two amperes of current: little or no effect will be produced. Replace the battery by another made up with cells of the Bunsen or bichromate pattern, or accumulator cells: the motor or coil will receive an adequate supply of current and work accordingly. Connect the Leclanché or similar cells to an electric bell or to a high-resistance galvanometer, which would represent a telegraph instrument: the cells will send an ample flow of current to make the apparatus work. Replace the Leclanché or high resistance cells by the Bunsen or low resistance cells: the bell or galvanometer will receive an adequate supply of current as before.

Consider as an example a cell having an internal resistance of 2 ohms and an electromotive force or pressure of 2 volts. It would not be possible to obtain a current of 1 amp. from such a cell, as the pressure would be entirely absorbed in trying to send the current through the solution from positive to negative plate. No benefit would be gained by adding such cells in series. The same flow of current taking place, as already explained, in all parts of the complete circuit, the voltage of each cell would be absorbed in sending the current through the solution of that cell. But a smaller flow of current, say, half an ampere, could be obtained, because only 1 volt of the electro-motive force of the

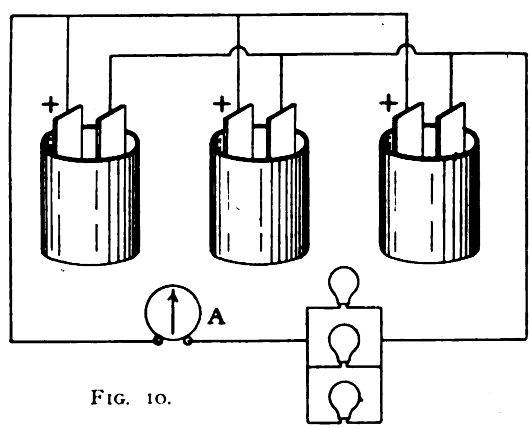


Fig. 10.

cell would be absorbed in sending the current through the solution, leaving 1 volt available at the terminals for sending the current through the external circuit. If the external circuit had a resistance of 2 ohms, this 1 volt would be sufficient to send the flow of ½ amp. of current through it. If the external circuit has 3 ohms, the total resistance through which the current is required to flow would be 5 ohms. The flow of current would, however, only be diminished to ·4 amp., because only ·8 of a volt would be absorbed in sending the current through the solution, leaving 1·2 volts available to send current through the external circuit.

The capability of a cell to produce current will depend upon its size. Other factors being equal, the larger the cell the greater is the flow of current which it can give. This assumes that the size of the plates is increased in proportion. If the size of the plates is not increased, the advantage gained will be in duration of work done before a fresh charge of solution is required. The capability of the cell to produce current really, therefore, depends upon the active area of the plates—that is, the area immersed in the solution. Its capacity for work, therefore, depends upon the quantity of the solution. A cell, or battery of cells, will give the maximum flow of current when the internal resistance is equal to that of the external circuit of lamps, motor, etc., connected to the terminals. In practice this proportion is not desirable; the internal resistance should always be as low as possible, and less than that of the external circuit. If a large flow of current is required, the cell should have plates with as large an active area as possible; the plates should be as close together as possible; the voltage should be as high as possible. These conditions have to be reconciled to meet various difficulties. They are obtained to a considerable extent in accumulator cells, which have a very low internal resistance and high voltage (for battery cells) per

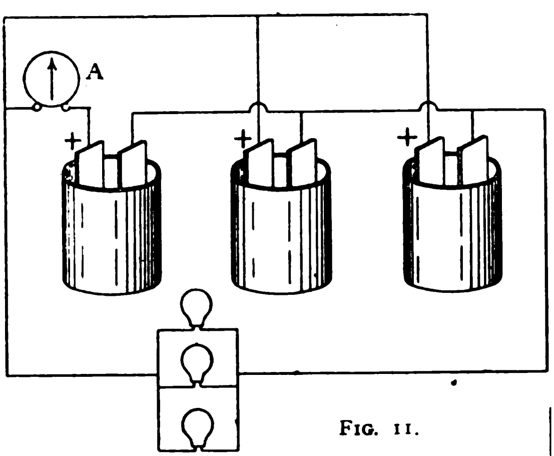


FIG. 11.

cell. When a sufficient flow of current cannot be obtained from a cell of a certain size, a number of such cells can be combined to form a battery having a voltage equal to that of a single cell, but the capacity of a larger cell. Such an arrangement is called a battery of cells in parallel. In effect the flow of current from each cell is conducted to one wire, the combined qualities uniting to form one large flow. The arrangement is shown by diagram Fig. 10. If the total current taken by the external circuit of lamps is 3 amps., each cell will give 1 amp. This can be proved experimentally by connecting an amperemeter (A) in the external circuit, as Fig. 10, and then in circuit with each cell in turn, as Fig. 11. The battery is the equivalent of one large cell. If a voltmeter is connected to the

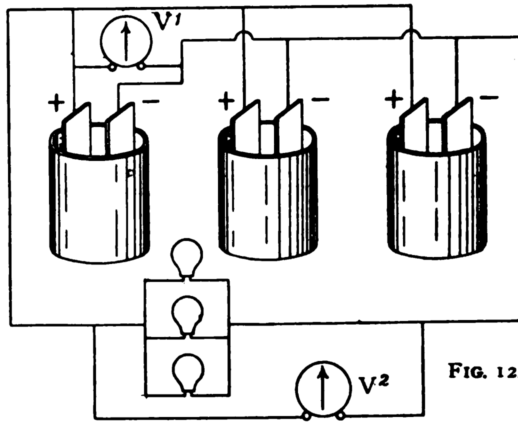


FIG. 12.

terminals of each cell, as V^1, Fig. 12, in turn, and then connected across the terminals of the battery as V^2, it will indicate the same voltage in each instance, and not three times the voltage, as the amperemeter indicated three times the flow of current from each cell in Fig. 10. The cells need not be of equal size, but it is necessary that they should each give equal voltage when the current is flowing, or the cells which give the highest voltage will discharge current through the cells giving lower voltage. The latter are then useless and a drain upon the useful cells. On this account it is advisable that the cells should be all of the same kind and size.

(To be continued.)

Chats on Model Locomotives.

By Henry Greenly.

(Continued from page 279.)

II.—Component Parts for 1¼, 1½, and 2-in. Scale Engines.

THE chief point in designing a regulator handle and gland is to ensure steam tightness and the smallest possible hole in the backplate. The pattern shown in the accompanying Fig. 7 herewith, as a rule, meets all requirements and is not a difficult fitting to make. In the smaller scales the diameter of the gland and the length of the handle may be proportionally greater than in the 2-in. scale model, as indicated on the table. In setting out the centre of the hole on the backplate for the gland it must be remembered that, as a rule, the wrapper-plate of the firebox is the amount of the plate thickness higher than the top of the barrel, and therefore, if the regulator rod is 1¼ ins. below the top of the barrel at the dome, the measurement must be taken from the inside of the wrapper-plate, as shown on the drawings.

The gland and stuffing-box should be of gun-metal in all cases, and the regulator handle of mild steel. The stuffing-box flange includes the sector-plate and the stops, which, by the way, may be lettered O and S, according to which position is open or shut.

The fixing studs for the gland casting are four in number, and may, with advantage, be made of brass. The nuts should be reduced in thickness and diameter over corners so that they will clear the regulator handle and gland.

The studded glands should be provided with

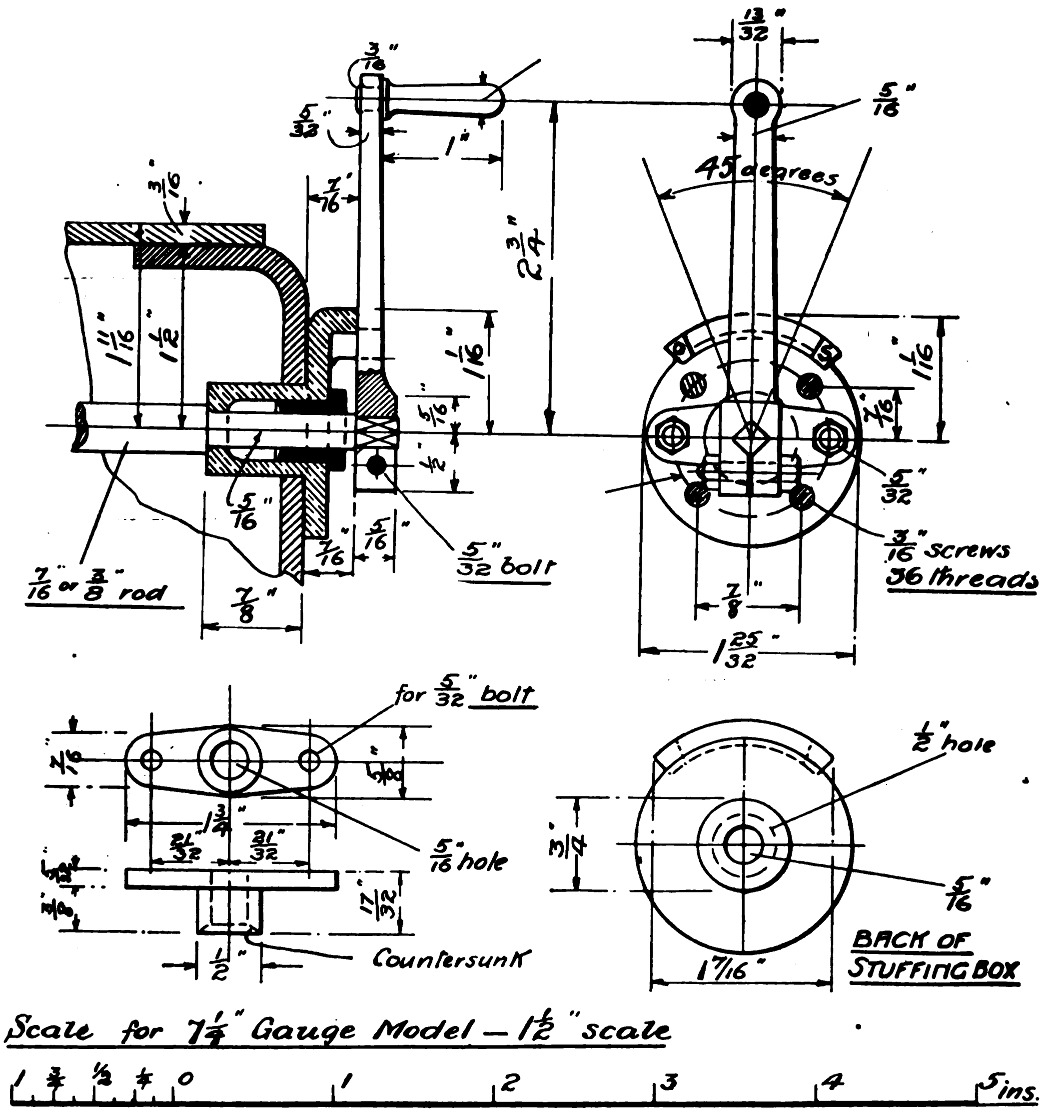


FIG. 7.—REGULATOR HANDLE AND GLAND DETAILS.

(Drawings dimensioned for 2-in. scale loco., and reproduced approximately full size for 1½ in. scale models.)

The direction of the lever to open the regulator is generally away from the driver, therefore, if the reversing lever is placed on the right-hand side, movement to the left-hand stop (which should be stamped O) will fully open the regulator. This has to be settled before the ports are drilled in the regulator valve. As shown in the drawing (Fig. 2) published with the last article, the ports are drilled correctly for a right-handed engine.

lengthy flanges and ordinary packing adjusting studs and double nuts. The positions of these studs and the fixing screws of the stuffing-box must be set out so that the heads clear all adjacent parts. It is really this that governs the size of the whole regulator gland and accounts for the difference in proportions in the three scales.

The regulator lever should be wrought out of strip steel, and the handle turned out of rod steel of suitable size, and either screwed and riveted or turned to fit and riveted into the upright lever. The lower end should fit on the squared end of the regulator rod, a round hole the size of the squared end of the regulator rod being first drilled in the rectangular boss of the lever. The hole can be filed out square to fit tightly over the rod, and then, drilling a hole for the clamping bolt or screw, the boss may be sawn down the centre with a fine hacksaw to meet the lower corner of the square hole.

At the other end of the boiler a hole is required for the steam pipe from the regulator, and it is the arrangements for connecting the steam pipes at this point which more or less govern the position of the regulator and steam pipe. Fig. 8 shows a single union joint for the steam connection to the cylinders or superheater, as the case may be. The steam pipe from the regulator is expanded into the tube plate, and a gun-metal flanged union joint is bolted over the hole. The size of the flange of this joint should be sufficiently large to take three or four studs, as shown in the drawings, and the centre of the hole below the crown of the barrel should allow sufficient clearance for double the thickness of the plate used in the boiler and the radius of the flanged tube plate.

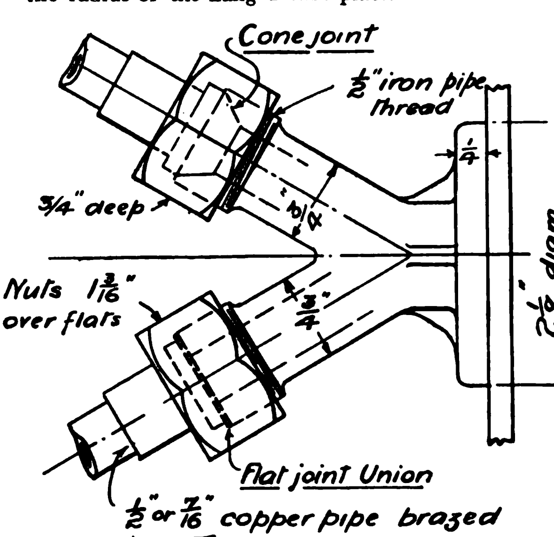


FIG. 9.—Y UNION JOINT FOR MAIN STEAM PIPES TO CYLINDERS.

(*Suitable for outside cylinder engines with coiled unjointed superheaters.*)

This form of union joint should be found very suitable for locomotives where the gridiron type of superheater is used, especially with inside cylinders, and, of course, may be placed with the elbow pointing vertically or inclined at any required angle, according to the piping arrangements in the smokebox. As the steam pipe may be slightly beaded over the tubeplate—it is sure not to be absolutely flush—the face of the flange may be recessed in the manner indicated on the drawing.

In the case of the design for the 3-in. scale model locomotives, to which I have already referred, it was thought that a large amount of superheater surface was not necessary, the steam pressure

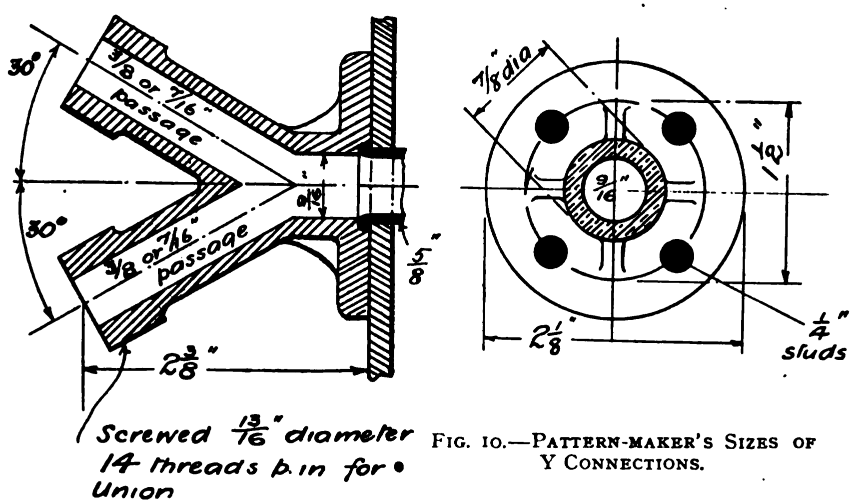


FIG. 10.—PATTERN-MAKER'S SIZES OF Y CONNECTIONS.

being fairly high (120 sq. in.) and the power of the engine—for a model—above the normal. Therefore, instead of using a gridiron superheater with a large number of brazed joints, a Y-joint was designed for the engine, the proportions being much the same as that shown in Fig. 9. The steam pipes to each cylinder were separated by this Y-piece, and were coiled a few times round the petticoat pipes and blast pipe in the smokebox, the pipe from the left-hand union passing to the right-hand, cylinder and *vice versa*. Unions were placed on the other end to connect with the upright pieces of pipe projecting into the smokebox from the steam chests. Fig. 10 gives the "pattern-maker's" dimensions of the Y-pipe, and also shows the disposition of the fixing studs.

With regard to the unions, there are three methods of arranging these joints in common use. In Fig. 8 it is intended that a collar be brazed directly on to the pipe and coned in the lathe. This is convenient where the union nut is best kept to the minimum dimensions and where the pipe is short and readily handled. It can be recommended in this instance as the pipe to the gridiron superheater would not be very long. The method indicated in the uppermost arm of the Y pipe (Fig. 9) is very common where the union parts employed are stock articles. The joint is a coned one, with metal to metal face, ground in, and the steam pipe is screwed or fitted in the tail piece and brazed or silver-soldered. The other joint is the well-known flat joint, an asbestos washer,

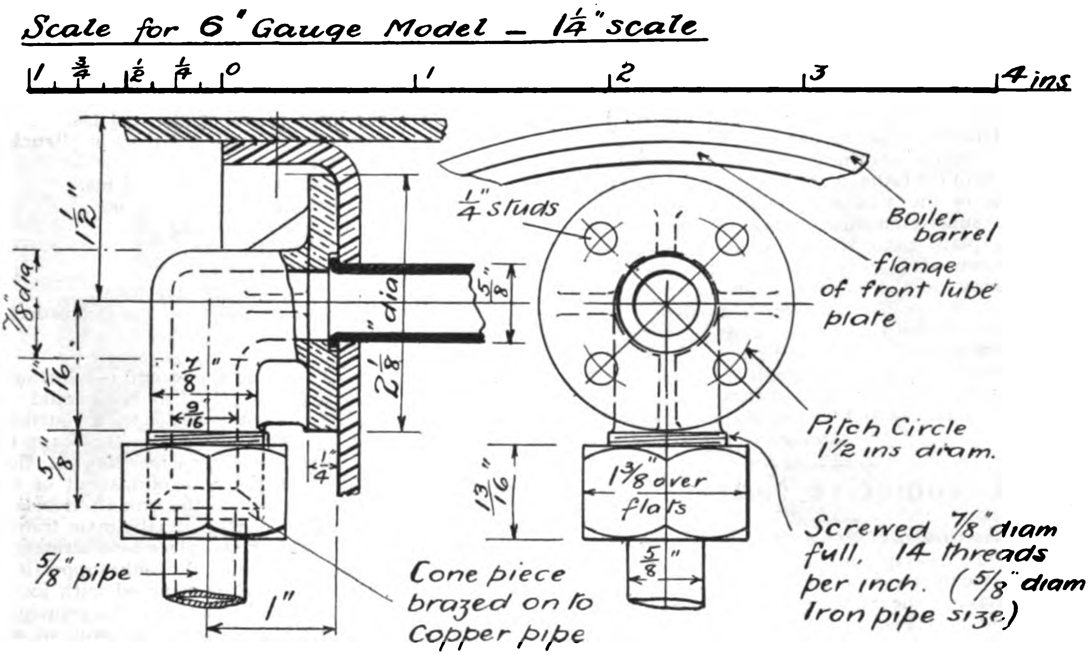


Fig. 8.—Single Pipe Flanged Union Elbow Connection for Main Steampipe.

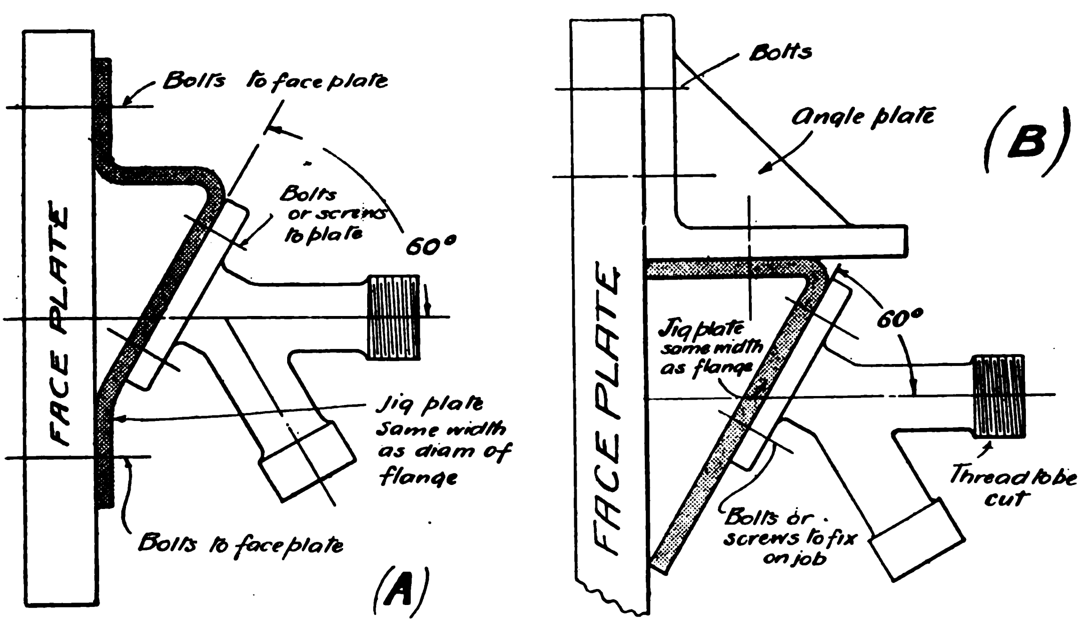


Fig. 11.—Showing Two Methods of Cutting the Union Thread on Y-pipe Connections.

or a copper asbestos washer preferably, being used to make the joint steam-tight. A tailpiece is used, as in the preceding arrangement.

The thread on the spigot portion of the connection, shown in Fig. 8, may be cut in the lathe, the flange being bolted down to an angle-plate fixed to the faceplate in the usual way. In the case of the Y-joint, illustrated in Fig. 9, a special jig will be required. This may take the form of a piece of plate, bent to the shape shown in the sketch, fixed to the faceplate of the lathe, or, as I noticed the chargeman of one of the 3-in. scale engines being built under my superintendence doing, by means of a piece of plate fixed to the angle-plate in the manner shown at B (Fig. 11). The first method, however, may be the most suitable, as it would appear that it can be used on a smaller lathe. All the passages in the Y-pipe may be cored in the larger sizes and cleared with a drill. In the case of the 1½-in. scale locomotive, however, it will hardly be worth coring the castings, where the patterns are only required for one engine especially.

(*To be continued.*)

Locomotive Notes.

LOCOMOTIVES OF THE ITALIAN STATE RAILWAYS.

Illustrated descriptions of the four-cylinder compound locomotives in use on the Italian State Railways having the "Prairie" or 2—6—2 wheel arrangement in express passenger service were given in these "Notes" some time back, and the writer is now enabled to deal similarly with two other types of engine employed on the same system of railways and both of which have distinctive features. Both locomotives are two-cylinder compounds on different systems, the tank engine, however, being built on the Gōlsdorf principle, and the "Mogul" express engine having a cylinder arrangement and valve arrangement which differs from those usually employed in any system of compounding. The two cylinders are placed inside the frames and inclined downwards towards the crank axle of the second pair of coupled wheels which they drive; but the valve chests and the whole of the valve mechanism are carried on the outside of the frames, the valves being of the piston type and the gear Walschaerts. It will be noticed that the return crank on the end of the driving crank-pin is differently formed to what is usual, so as to give two throws, and there are independent rods for the expansion link and the valve spindle, presumably because the motion of the crosshead cannot be employed for lead owing to the relative location of the cylinders and valve chests. The engine at its forward end is supported upon a two-wheeled truck of the Krauss pattern, having disc type wheel centres. The axle-boxes of this truck and those of the leading coupled wheels are connected together by rigid cross stays, and matters are so arranged between the two pairs of wheels that the radial movement of the truck compensates with the lateral motion of the leading coupled wheels, and suitable pin joints are inserted in the side rods, to allow of the variations in movement, with the result that the engine takes curves of small radius very readily in spite of its six-coupled wheels, the actual rigid wheelbase being in reality only represented by the distance which separates the driving from the trailing wheel centres.

The engines have been designed for express passenger service and may be considered as constituting a departure from customary practice in having the 2—6—0 wheel arrangement outside the requirements of goods-traffic purposes. The leading dimensions are as given below:—

Cylinders—diameter: H.-P. (1), 17 ins.; L.-P. (1), 26¾ ins.; piston stroke, 27½ ins.
Wheels—diameter: Coupled, 6 ft. 0½ in.; truck, 3 ft. 1¼ ins.
Boiler: Diameter of barrel, 4 ft. 6¼ ins.
Firebox: Length outside, 7 ft. 1¼ ins.
Total heating surface, 1,862 sq. ft.
Grate area, 25·8 sq. ft.
Working pressure, 235 lbs.
Weight (in working order), 53¾ tons.
Weight of engine and tender (in working order), 89 tons.

The tank engine, shown in the second illustration, is of the 2—6—2 pattern. It is, as before said, a two-cylinder Gōlsdorf compound, with outside cylinders and valve mechanism. In this case it will be noticed that the expansion link of the Walschaerts gear is to the rear of instead of in advance of the driving wheel, the link itself being supported off a bracket attached to the main frame and stayed to the slide-bar end plate by a stretcher bolted to both the latter and the link supporting bracket. No starting valve is required with locomotives built on the Gōlsdorf system, the principle being that when additional power is required at starting or when working on heavy grades the fact of putting the valves in either full forward or backward position has the effect of uncovering two small apertures in the low-pressure port faces alternately by means of a rib cast in the valve. These apertures are located one at each end of the valve travel, so that it is only when the latter is at its maximum that the openings are alternately uncovered. At all normal points of cut-off the apertures are both covered, and the low-pressure cylinder then utilises the high-pressure exhaust and the engine works compound.

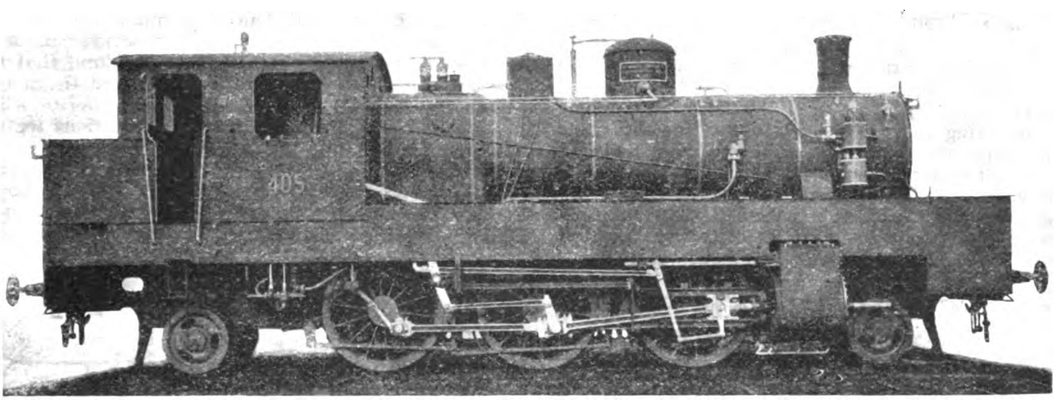
The manner in which the tanks are disposed in this engine constitutes another distinctive feature of the design. These tanks extend the full length of the framing, being about on a level at the top with the under side of the boiler. At the front end there is a cross tank of greater depth than the others, and this communicates with both of the latter. By this arrangement the distribution of weight is improved, and the conditions are rendered more even when the engine is running on up grades.

Both the locomotives illustrated were built by Messrs. Ansal do Armstrong & Co., of Sampierdarena, Italy, and the dimensions of the tank engine are as follows:—

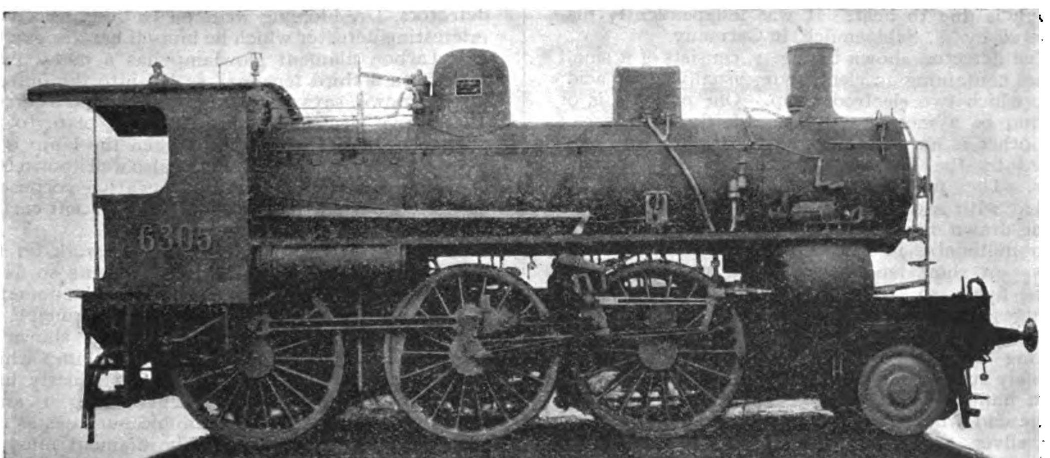
Cylinder—diameter: H.-P., 18 ins.; L.-P., 27½ ins.; piston stroke, 23⅝ ins.
Wheels — diameter: truck, 2 ft. 8¾ ins.; coupled, 4 ft. 11 ins.
Diameter of boiler barrel, 4 ft. 7¼ ins.
Number of tubes, 222.
Diameter of tubes, 2¼ ins.
Length of firebox, 7 ft. 2¾ ins.
Total heating surface, 1,636 sq. ft.
Grate area, 25·6 sq. ft.
Boiler pressure, 190 lbs.
Capacity of tank, 990 gallons.
Weight of engine (working order), 64 tons.

A Correspondent on Great Central Railway Manchester Service.

A correspondent, in the course of a somewhat lengthy letter to the writer, expresses a very poor opinion of the Great Central service between London and Manchester and *vice versa*. He says that in the course of his business wanderings he has occasionally to travel between the points mentioned, and with a view to making a trial of the G.C.R. route, he recently travelled by the "Sheffield Special" leaving Marylebone at 3.20 p.m. and being due in Manchester at 7.20 p.m. An involuntary stop had to be made at Woodford to change the "Atlantic" engine attached at Marylebone for No. 105, a 4—4—0, the former having developed an overheated tender axle-box. What with the delay in changing engines and the time dropped by No. 105 on the run from Woodford to Manchester, the arrival at the latter place was 35 minutes late. Returning, a few days later, by the 2.15 p.m. express from London Road, due into Marylebone at 6.35 p.m., time was lost "in the most miserable manner" by general slackness in running, the departures from Sheffield, Nottingham, and Leicester being all behind time, and the arrival in London 20 minutes later than it ought to have been. The correspondent in question contrasts this with the London-Manchester service of the L. & N.W.R. which he describes as being "notoriously punctual, admirably conducted, and a credit to the Company which runs it." The writer is in some position to speak of the service between London and Manchester by both G.C. and L.N.W. routes, being a frequent traveller over this ground by the services of both Companies. It is hardly possible to compare with fairness the two routes, as the Great Central is handicapped in many ways where its rival is not. The road between Harrow-on-the-Hill and Quainton Road Junction is joint property, and none of the best either, in regard to profile or stability, for the purpose of running at the high speeds with heavy stock for which the "All L.N.W.R." route is noted throughout. Then the distance by G.C.R. is some 20 miles longer



2—6—2 Type "Gölsdorf" Compound Tank Engine: Italian State Railways.



"Mogul" Type Two-cylinder Compound Locomotive: Italian State Railways.

than the other way, and the Sheffield-Manchester length is a very difficult one to work over. The 2.15 p.m. train from London Road (Manchester), is one by which the writer often travels. It stops at Guide Bridge, Penistone, Sheffield, Nottingham, and Leicester, and runs from the last-named place to Marylebone without a stop. The total time allowance for the complete run of 204 miles is 4 hours 20 minutes, and the stops usually account for quite 16 or 17 minutes of this (and sometimes 20 minutes) reducing the nett running time from 4 hours 4 minutes to the level 4 hours. This, in the writer's experience, has often meant that the Leicester-London stretch has had to be covered in well under the two hours, and reference to notes taken during 1907 shows that out of fourteen runs made with this train in the course of the twelve months, ten were absolutely punctually performed, two gave 10 minutes late, and the remaining two were respectively 4 and 6 minutes late. In three cases the 103 miles between Leicester and London were covered in approximately 1 hour 50 minutes.

Recent Contributions to Electric Wave Telegraphy.

PROFESSOR FLEMING'S ROYAL INSTITUTION LECTURE.

(*Continued from page* 226.)

AFTER a brief reference to coherers and magnetic detectors, Professor Fleming proceeded to give an account of the so-called electrolytic detector which is used in Germany and the United States. In America Professor Fessenden and Dr. Lee de Forest have both worked with detectors of this type, the former having styled it a "liquid barreter," on the supposition that its action is due to heat. It was independently discovered by W. Schloemilch, in Germany.

The detector, shown in Fig. 1, consists of a small vessel containing an electrolyte, usually nitric acid, into which two electrodes dip. One of these is of carbon or a metal, and has a fairly large area; the other is an extremely fine platinum wire prepared by the Wollaston process in the following way. The finest procurable platinum wire is plated with a coating of silver, the resultant wire being drawn out until its platinum core is 1-1000th of a millimetre in thickness. A short length is then] fixed so that it emerges from the tip of a fused glass tube, the projecting length being extremely small. The tip is then immersed in strong nitric acid, which dissolves the silver away, leaving the excessively fine core of platinum exposed. The cell is connected in the circuit of the receiving aerial and also forms part of a circuit containing a shunted voltaic cell and a telephone. The connections are so arranged that the final wire is positive in the cell. When the waves set up oscillations in the receiving aerial

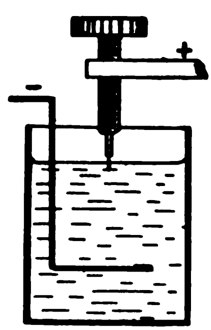


FIG. 1.—ELECTROLYTIC DETECTOR.

the resistance of the cell seems to be suddenly decreased or increased for an extremely small length of time, and a click is heard in the telephone.

According to one theory, the weak current normally passing through the cell sets up polarisation effects on the fine wire and the film of hydrogen is broken down or otherwise dispersed by the action of the received oscillations. It has also been found by Rothmund and Lessing that the cell can be made to generate its own current by making the thicker wire of some other metal than platinum.

According to Dr. Fleming, the action cannot be wholly due to polarisation, as it is found that the platinum slowly dissolves away under the action of the oscillatory currents.

Fig. 2 shows the diagram of connections for the circuit. C C are condensers, presumably for syntonising and for preventing the voltaic cell B from being short-circuited; T is a telephone; L_1 L_1 are choking coils; S is a shunt, and L_2 is an inductance coil connected in the aerial circuit.

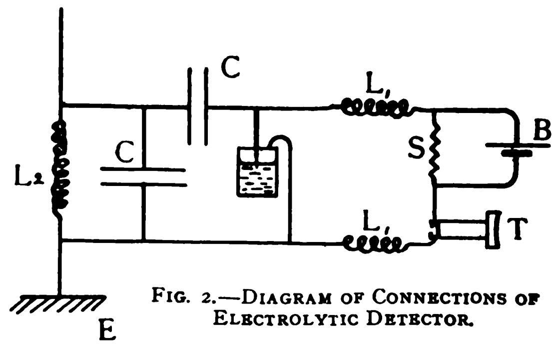


FIG. 2.—DIAGRAM OF CONNECTIONS OF ELECTROLYTIC DETECTOR.

Continuing with the subject of electric wave detectors, Dr. Fleming went on to describe a very interesting detector which he himself has discovered. If a carbon filament glowlamp has a metal plate carried on a third terminal sealed into the bulb, it is well known, says Professor Fleming, that a current of negative electricity flows from the plate to the positive terminal of the lamp when the lamp is lit by a continuous current. It is also well known that incandescent bodies discharge negative corpuscles or electrons from their surface, incandescent carbon in vacuum being particularly active.

In 1904 Professor Fleming was at work on the problem of rectifying oscillatory currents so as to make them detectable by an ordinary galvanometer. It then occurred to him to apply this principle by means of a simple piece of apparatus shown in Fig. 3. F is the carbon filament of a lamp which Dr. Fleming says need not be a particularly high voltage one. A 4-volt filament taking 1 amp. works quite as well for telegraphic purposes as one requiring 12 or 100 volts. The filament must be at a certain critical temperature to give the best results, and the vacuum also must be extremely good. Surrounding the filament is a metal cylinder, C, supported by wires fused into the glass at the base of the lamp, and provided with a platinum connecting wire T, passing through the side of the bulb. The supporting wires have been accidentally omitted in the illustration.

The connections of the circuit in which this oscillation valve, as Dr. Fleming calls it, is inserted, are shown in Fig. 4. The surging currents from the aerial pass through the primary P of an oscillation transformer, one end of the secondary S being connected to the negative terminal of the lamp filament, which is fed by the battery B. The other secondary terminal is connected through the galvanometer G to the cylinder in the lamp bulb, the cylinder being represented as a plate in the diagram. A condenser is connected across the transformer secondary. A flow of negative electricity can take place from the filament to the cylinder, and is carried by the electrons emitted from the hot carbon. An opposite flow, however, cannot take place, and thus the arrangement acts as a rectifier—that is, it stops one half of every wave which arrives from the transmitter. The instrument was shown in action by Professor Fleming at the Royal Society in 1905, and in France a distance of 50 kilometres has been covered. Employing a telephone in place of a galvanometer, Mr. Marconi has found it very sensitive over distances of 200 miles or more.

Dr. Wehnelt finds that the carbon filament may be replaced by a wire covered with certain earthy metallic oxides, and Professor Fleming speaks of some success obtained by the use of a flame in which two platinum wires are immersed, one being provided with a bead of potassium sulphate from which the negative electricity can pass to the other wire with greater ease than it can pass in the opposite direction. The same principle is involved in this arrangement, but Dr. Fleming has found no device so simple and useful as the low voltage carbon filament glow lamp. " Moreover," says Dr. Fleming, " other inventors have endorsed its utility by granting it the compliment of imitation." He then instances Dr. de Forest's description of an

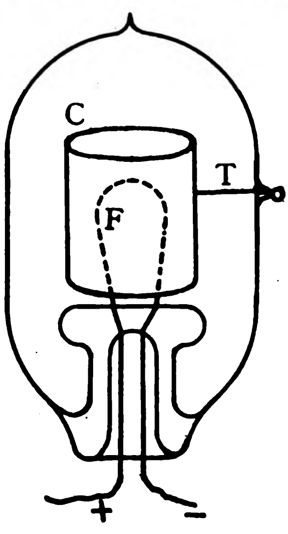


Fig. 3. Oscillation Valve.

appliance called an " audion, which is merely a replica of my oscillation valve, described to the Royal Society eighteen months previously, and to the Physical Society of London six months before, particularly with reference to its use as a wireless telegraph receiver. Apart from the name, the only difference introduced by him was to substitute a telephone and battery in series connected between the middle plate and positive terminal of the filament for the galvanometer used by me connected between the middle plate and the negative terminal. As Mr. Marconi had before that time used my oscillation valve with a telephone for long distance work, and M. Tissot has found a galvanometer, used as I described it, effective up to 50 kilometres, the modification made by Dr. de Forest does not make any fundamental difference in the operation of the device as a wave detector."

Speaking of the use of oscillation valves with transmitters producing undamped waves, Dr.

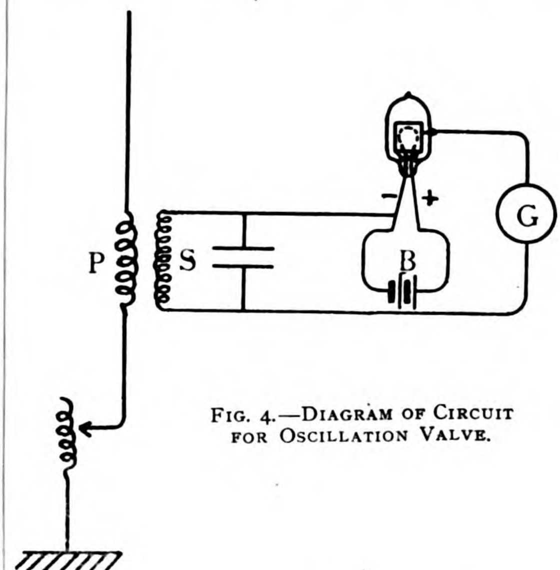


Fig. 4.—Diagram of Circuit for Oscillation Valve.

Fleming pointed out that the effects must be very greatly increased, because the intervals of rest between spark discharges are very long indeed, compared with the time occupied by the violent surgings which occur with each spark. He also said that, generally speaking, all thermal detectors work better with undamped waves than with spark-groups of radiations, and implied that this is true even when the mean value of the power is the same for both cases.

In Dr. Fleming's opinion the oscillation valve is peculiarly adapted to a method of telegraphy by ordinary electro-magnetic induction between closed circuits, high frequency arc-generated currents being employed instead of ordinary alternations.

(*To be continued.*)

A curious instance of interference by a rat with the electric lighting of a town was recently given in a report from Berlin (states the *Engineer*). The town of Charlottenburg was suddenly plunged into darkness at an advanced hour on Tuesday evening, February 18th, by a failure of the electric current. The stoppage, which lasted half-an-hour, was caused by a rat which had jumped in among the bus-bars at the power station. It is the second occasion on which Charlottenburg has been deprived of light by such a cause.

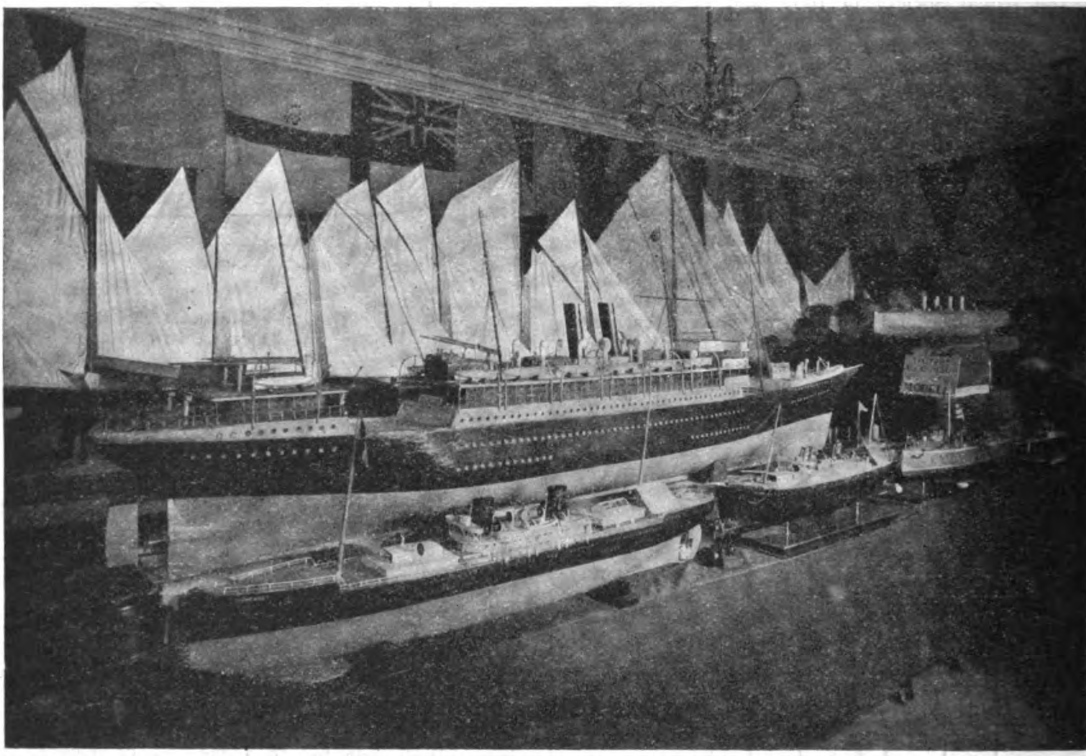
The Clapham Steam and Sailing Club.

THE Long Pond on Clapham Common has for many years past been the heart of model yachting, so far as the South of London is concerned, and many have been the trial trips, the club races, and the private cruises which have been sailed on its placid waters. Although in its accessibility, its freedom from weeds, and its open banks the Long Pond possesses great advantages for the purposes of the model yachtsman, it has for a long time suffered from the drawbacks of having very shallow water round the edges and of affording no protection to the model steamer owner from the crowds of inquisitive folk who invariably flock round a craft of any size when steam is being raised or adjustments are being made. As the result of representations to the London County Council from the enterprising executive of the Clapham Steam and Sailing Club, both these troubles have been removed. There is now ample depth of water all round the banks of the pond, and a convenient little space has been railed off, where the model skipper can attend to the requirements of his craft without being fallen upon by a crowd of well-meaning but highly-embarrassing spectators.

The present Clapham Steam and Sailing Club has risen Phœnix-like, from the ashes of former clubs which sailed the pond, and bids fair to outshine in vigour, in numbers, and in the quality of its craft any of its predecessors, if, indeed, this has not already been accomplished.

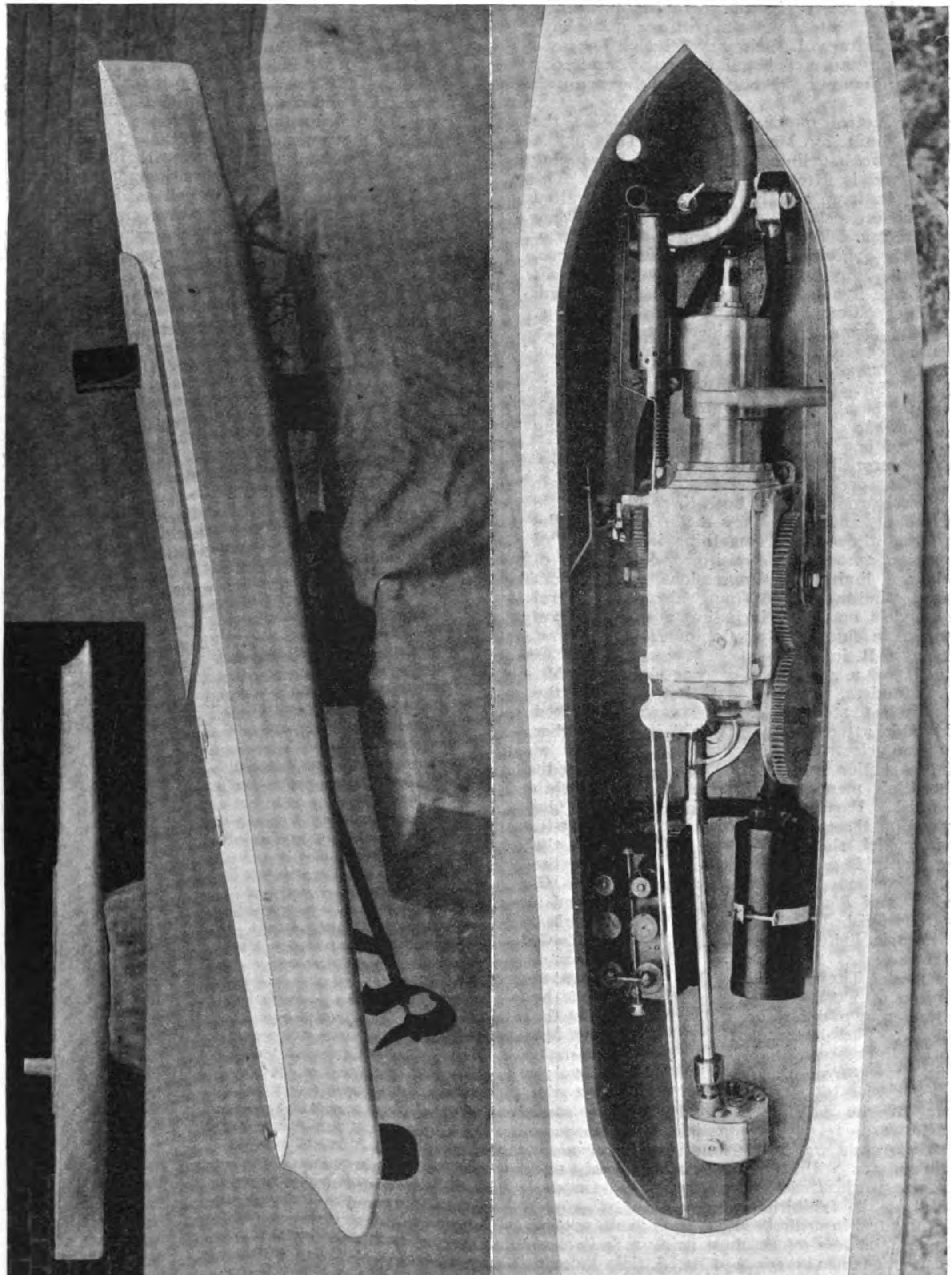
As already noted in our columns, the Club recently held an exhibition of its craft at the Alexandra Hotel, S.W., and no better proof could be desired of the strength of the present organisation than the really splendid show then made. This was the second event of the kind, and fresh premises will certainly be required for the next if the same rate of progress is maintained.

The accompanying photograph gives a fair idea of the appearance of the room in which the principal exhibits were placed, but this, of course, only includes a portion of the craft on view. There were many others which did not come within the range of the camera, while an adjoining room contained still further examples of the members' work. There were over thirty model steam, petrol, and electric boats, several very interesting sets of engines and propelling machinery, and more than forty sailing craft.



A GROUP OF MODELS AT THE CLAPHAM STEAM AND SAILING CLUB'S EXHIBITION.

In point of interest we think first place must be accorded to *Moraima II*, the new craft built by Messrs. Arkell, the winners of a silver medal in our 1907 Speed Competition. The machinery of this boat is the same as in the original *Moraima*, but an entirely new speed hull has been designed and constructed, and it is expected that all previous speed records will easily be beaten. We are



THREE VIEWS OF MESSRS. W. H. & F. G. ARKELL'S PETROL SPEED BOAT, "MORAIMA II."

fortunate enough, by the courtesy of Messrs. Arkell, to be able to give photographs of the new boat, so that intending competitors may have an early glimpse of their new rival. The two MODEL ENGINEER medals gained in 1906 and 1907 by the *Moraima* were also on view, and were much admired.

Another petrol motor boat on view was the *Speedwell*, built by Mr. A. Shead. This has a horizontal double-cylinder petrol motor, developing 1¼ h.-p., and is fitted with tandem screws. The boat is 7 ft. long, and her trials will be awaited with much interest.

The large model seen in the centre of the photograph of the exhibition room is the liner *Fairholme*, built by the Hon. Secretary of the Club, Mr. G. F. Young. She is a model of one of the Royal Mail Steam Packet Company's boats, and is 10 ft. 6 ins. long. The propelling machinery consists of a Siemens enclosed type electric motor driven by accumulators, and the speed obtained is 7 miles per hour. Mr. Young is evidently a lover of big models, for he also exhibited another 10-ft. model, the *Minnehaha;* this, as the name implies, being a model of one of the Atlantic transport liners. It is also propelled by a Siemens electric motor, and gives a speed of 5 miles per hour. The scale and general proportions of both these large models are excellent, and when they make a trip on the Long Pond they create something in the way of a sensation among those visitors whose ideas of models are limited to impressions gained from toy-shop windows. Mr. Young also had several other models on view, including a pretty steam yacht and a fine scale model of *H.M.S. Essex*, this being 6 ft. long.

The *Myra*, a 4-ft. steamer, was shown by Mr. H. C. Saunders, and the fact that this was the Club's fastest steamer of last season attracted considerable attention to this exhibit. The other steam and electric models were all worthy of careful inspection, and redound greatly to the credit of the Club members in point of workmanship and finish. Particular commendation may be bestowed on the torpedo destroyer, No. 44, a 5-ft. electric model, shown by Mr. G. A. Smith; the racing boat, *Damiler III*, by Mr. Stowell; the Cunard liner models, *Margaret*, by Mr. H. C. Saunders, and *Florida*, by Mr. A. Lawson; and a beautifully finished model of the destroyer, *Thresher*, with electric lighting installation, by Mr. F. G. Glover.

The model Thames tug, by Mr. Parkins, was a nice piece of work, but suffered rather from the fact that above deck she did not resemble the prototype. The destroyer *Ealing*, shown by Mr. F. Bothwell, possessed two special points of interest. The first arose from the fact that at one time in her career she lay for eighteen months at the bottom of the Round Pond, Kensington, and was afterwards recovered practically undamaged; while the second was to be found in an ingenious electric buzzer with which she was fitted, and which was worked with great effect from time to time during the exhibition.

Of pure engineering work there were several good examples, one of the best being a fine set of twin-screw engines, made by Mr. J. W. Palmer. A very pretty and effective model of a Thames lock was constructed by Mr. T. Whitmore. This was shown complete, with a dainty model electric pleasure-launch, and a glass peephole in the lock retaining wall enabled the working of the launch's screw in the water to be very clearly seen, electric light being fitted for this purpose.

The show of model sailing yachts was very fine, and, indeed, there were so many of really excellent workmanship and design that it is difficult to select any individual boats for mention. The present exhibition showed conclusively that the Clapham Club boats can bear comparison with those of any other club. The sailing boats included 5-, 10-, 15-, and 20-rater cutters, as well as one 36- and one 42-rater. There was also one representative of the metre class, and several schooners and punts.

In concluding this notice, we may say that the indefatigable Hon. Secretary, Mr. G. F. Young, and the Stewards, Messrs. G. Arthur Smith, A. J. Upton, H. C. Saunders, and T. Whitmore, are deserving of every congratulation, both in the arrangement of the exhibits and of the success of the event. There were over 1,000 visitors on the Friday, while on the Saturday the doors had to be repeatedly closed to prevent overcrowding.

Design for Model Motor Fire Engine.

By FRANK FINCH.

(*Continued from page* 102.)

ROAD WHEELS.

HAVING dealt with the frame and springs in the preceding articles, it is in order now to describe the making of the road wheels. According to the colouring of these on the general arrangement drawing (presentation supplement, January 2nd issue), they are indicated as being made of brass or gun-metal; but there

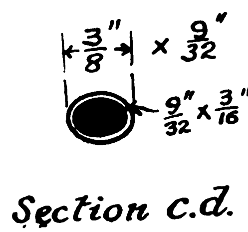


FIG. 11a.
SECTION THROUGH
REAR WHEEL SPOKES.

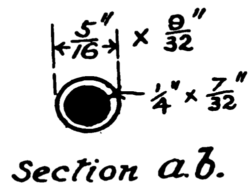
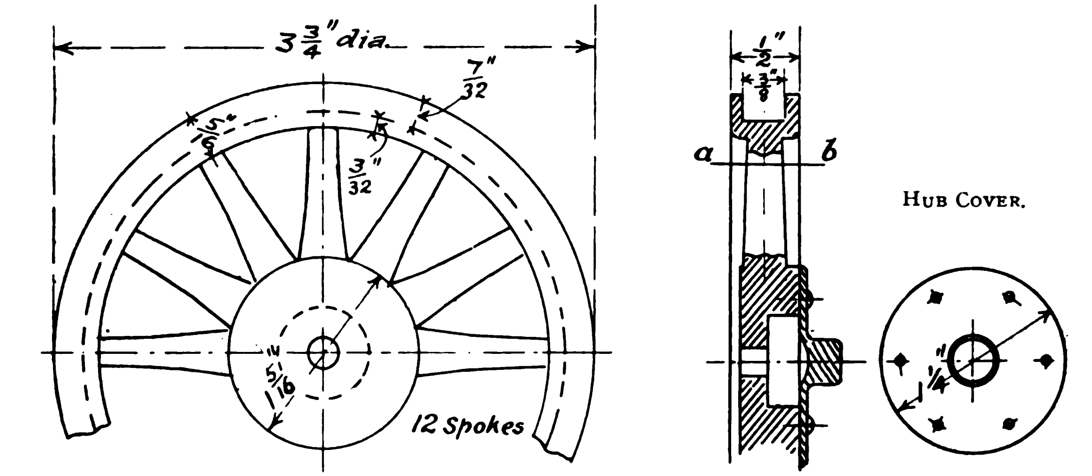


FIG. 10a.
SECTION THROUGH
FRONT WHEEL SPOKES.

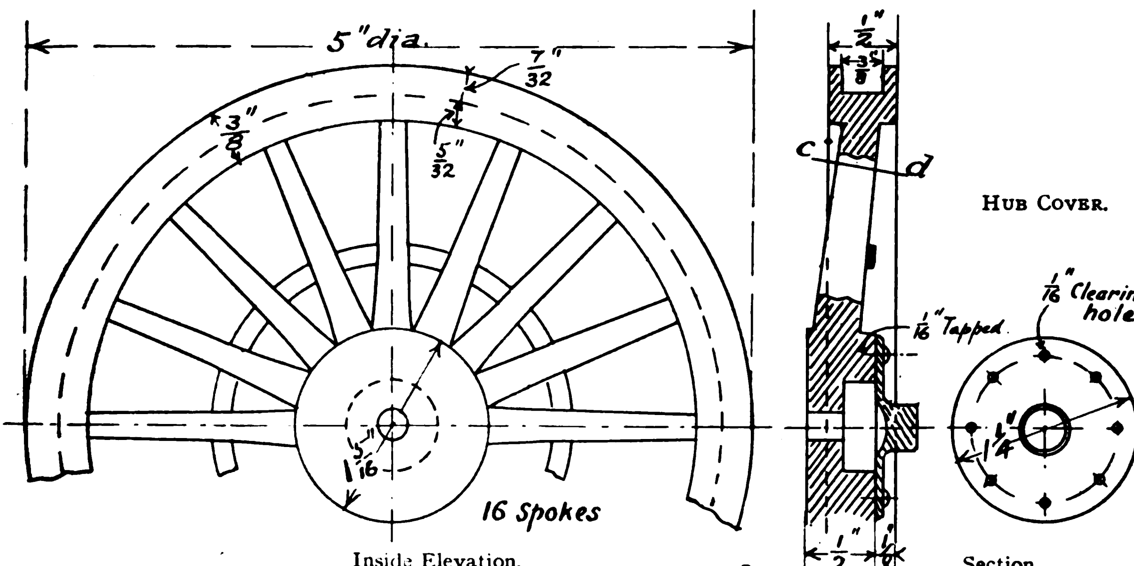
is no reason why—for the sake of lightness—the wheels should not be cast in aluminium. Builders of the model may suit their individual fancy in this respect. The fact of departing from the prototype in so far as casting the wheels instead of building up of wood may displease the eye of some. Of course, as a rule the actual wheels of a motor fire engine are built up of ash—boss, spokes and rim segments. Some who construct this model may feel inclined to build up the wheels, but in this case the dimensions may remain the same, Such a departure would entail much more work, and it is thought that most readers would prefer casting each wheel in one piece. The patterns—one for front wheels and one for the rear wheels face of wheel, leaving the boss to the required dimensions.

The groove shown in the faces of the wheels for the insertion of tyres is turned out from the solid rim of the casting, as also the circular recesses in the bosses of each pair of wheels. Referring to the patterns again,



Inside Elevation. Section.

Fig. 10.—Forward Wheel. (2 thus.)



Inside Elevation. Section.

Fig. 11.—Rear Wheel. (2 thus.) (*Scale: Three-quarters full size.*)

—can be made from a piece of hard wood and, in the case of the rear wheels, Fig. 11, of sufficient thickness to embrace the face of boss and outside face of wheel rim, and for the forward wheels, Fig. 10, the width of rim only. After marking off the rim and spokes, holes should be drilled between the latter, and then by means of fret or bow saw, the corners made sharp. The wood should then be fixed in the lathe and turned down to the desired the spokes should be shaped to the sections shown full size in Figs. 10*a* and 11*a*. No difficulty will be presented to the amateur in the moulding as the parting line would cut longitudinally through the centre of the spokes. The narrow ring shown round the spokes of the rear wheels is of no practical use on the model, but should be added for appearance sake. A strip of brass, $\frac{1}{8}$ in. wide, can be carefully bent round into a circle and attached by a spot of solder to each spoke.

One pattern will suffice for the caps of the hubs, and these are to be cast in gun-metal, and finally polished and left bright—being the only portion of the wheels unpainted on the prototypes. In one pair, six holes are drilled as indicated, each to clear a 1-16th in. screw, and in the other pair, eight similar holes are required. Corresponding holes are tapped in the outside face of the hubs, to take small round-headed 1-16th in. screws.

The writer must confess to some difficulty in obtaining rubber rings or tyres of the required diameter and section, unless they are ordered to be especially made for the job. He has found, however, that rubber section ⅛-in. sq. can be obtained in lengths, and it is possible to make one's own complete "tyres" by cutting the necessary length, and joining the two ends of each by a careful and patient manipulation of rubber solution.

(*To be continued*).

Practical Letters from our Readers.

Re Motor for River Boat.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—Through the pages of your most useful and instructive journal, THE MODEL ENGINEER, I would like to ask the kind assistance of any of its numerous subscribers to advise me as to which make or kind of oil engine or petrol motor they would consider safe and recommend as being most suitable for a 14-ft. boat, which I use for trout fishing on a fresh water loch. I do not want higher speed than, say, about 6 miles an hour.—Yours truly, A. N.

Re Model Ship Building Trade.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—In reply to "H. B. H." (No. 18,561) who asks about Model Shipbuilding. I have read "H. S. S.'s" letter replying to him and I am afraid I must differ greatly in opinion. In the first place, he says they are mostly drafted from the yard: well, in this point to a large extent he is right, but there are a large number who have never been in a shipyard to work. The metal fittings are in all cases made by outside people, who also in two or three cases make and supply the model complete, as the shipbuilders get a better job in this way, as it is a business which, if a man is not, shall we say, gifted with the ability to imitate to the smallest detail, he would be a failure. The models called working models are all made in the builders' yards. I might say that in the construction of a ship's model there are two distinct trades. Your correspondent being a joiner, would, I expect, want to go in for the woodwork. I am sure he would not be able to get into a shipyard as one, unless he had a lot of experience and I am afraid geometry does not enter much into the matter, as I know personally some of the finest modellers, and some do not, outside of their business, know B from a bull's foot. The only way he could join the trade would be to write to some of the model firms who do make all the model. I am myself a model maker in both branches, and am earning my living at it, and think it one of the nicest trades there is. I must say there are not a lot of men in the business, and the wages are good and the employment constant. I do not know that the wage of £2 per week is a bad wage, as there is no society to pay and the work is light. I would suggest that "H. S. S." was not as successful in the business as he is in the present one, and as the business is advancing by leaps and bounds, he would soon be hopelessly out of the race. If your correspondent writes to Kelso & Co., Glasgow, or the Britannia Model Works, Sunderland—the two largest people in the trade—I have no doubt they would give him a reply, and that would possibly assist him. If "H. S. S." goes to the exhibition to be held in London, he will see whether model making is going back or not. I have the pleasure to be busy with several myself, so I think I ought to know. You will find the details worked out to a fine degree. I got a gold medal in 1904 at Newcastle for the brass fittings, and a gold medal at the Crystal Palace, in 1906, for model complete.—Yours faithfully,

J. J. P.

The Junior Institution of Engineers.

AT the last meeting of the Institution, held at the Royal United Service Institution, Whitehall, the Chairman, Mr. Frank R. Durham, presiding, a useful paper, entitled "Practical Notes on the Testing of Gas Engines," was read by Mr. Gilbert Whalley, of Walton-on-the-Naze.

The author, in his introductory remarks, referred to the increasing number of gas engines which were being installed year after year, and cited the necessity for and objects of testing. He then dealt with the methods of carrying out tests, showing how to obtain expeditiously all the data required, including detailed measurements of cylinder, length of stroke, main and outer bearings, crank-pin and piston pin bearing, etc. The mode of checking the settings and lifts of all valves, electric ignition settings, etc., was entered into, and the various systems of determining the B.H.-P. by means of a dynamo, prony brake and rope brake were illustrated. Some interesting particulars with reference to the attachment of indicators and the computation of I.H.-P. from the cards were given, and reference was made to processes for the determination of fuel consumption when running on producer or town gas. The reduction of results to standard temperatures and pressures, water circulation details, preparation of report, including schedule of conditions, charts and diagrams to be submitted, formed concluding sections of the paper. In the discussion which followed, Messrs. W. A. Tookey, Stanley Hughes, George Lyge, C. G. Evans, R. W. Brewer, W. H. Stevens, and R. H. Parsons took part, and the meeting closed with a vote of thanks to the author.

The Society of Model Engineers.

FUTURE MEETINGS.—The next meeting is fixed for Tuesday, April 7th, at the Cripplegate Institute, when a Sale of Models (finished and unfinished), Parts, Tools, Electrical Apparatus, etc., will be held. Members only will be allowed to include articles in the sale or to purchase goods. Members of the Society who have not as yet been present at one of these sales will do well to attend, as apparatus of all kinds can usually be purchased at very low prices. Particulars of the Society and forms of application can be obtained from—HERBERT G. RIDDLE, Hon. Sec., 37, Minard Road, Hither Green, S.E.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[18,927] **Charging Cells.** W. J. (Newcastle-on-Tyne) writes: Will you please tell me the best way to charge small accumulators on a 500-volt circuit? The cells when charged have a capacity of 10 amps, 4 volts. If I put 250-volt lamps in series with the cell I will get amperes through the cell, but the lamps have taken all the voltage. Will the cell charge in this way, or must there be volts passing through as well as amperes? If volts are needed, what pressure must I work at to charge cell? If I raise the voltage to 510, would the lamps absorb the extra 10 volts? Is there any other way of charging at 500 volts without the use of lamps? At places where they charge cells for a few pence, is the dynamo running at a very low voltage to suit the cells?

You can charge your cells through one or more 16 c.-p. 500-volt lamps, or what is equivalent to this, two 16 c.-p. 250-volt lamps connected in series. You are evidently somewhat mixed in your ideas concerning the factors which go to make watts—that is, power. We think if you read our Query Reply, "Reduction of Voltage," in March 5th issue, 1903, you will become enlightened on this point. You should also study some elementary text-book on Electricity, which will fully explain Ohm's Law and its practical application to electrical work. Kindly comply with our rules in future.

[18,931] **Shocking Coil Connections for Primary and Secondary Combined Shocks.** H. M. (Birmingham) writes: I should be pleased if you will help me as regards to my coil. It has all come unwound. There are four layers of primary wire, and then it is wound full of the secondary wire. Would the secondary wire have to be soldered to the primary wire before winding it on? You see the draw tube goes over the outside of the coil, not in the middle of the coil like some of them. Would you give me a sketch how to connect the wires when finished?

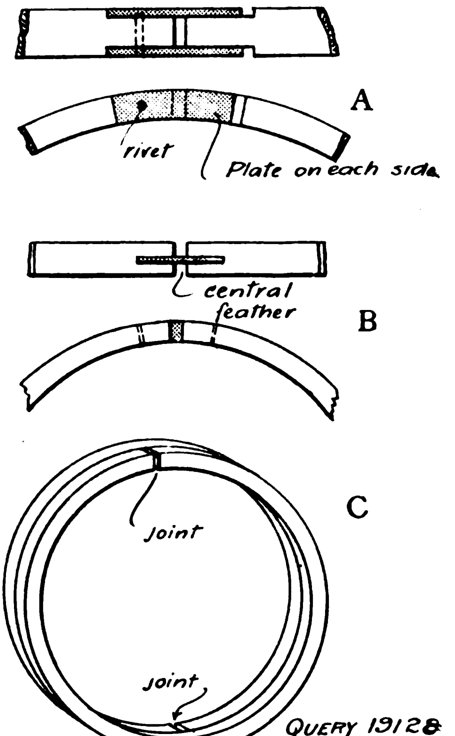
You will find particulars relating to this kind of coil on page 381 of our issue of October 18th, 1906. The connections for coils of this description are exactly as given in our handbook, "Induction Coils," which we recommend you to study carefully. The secondary wire is not connected to the primary at all.

[19,101] **Model Marine Boiler.** H. A. S. (Devon) writes: I have a boat 3 ft. long, 6½-in. beam, and 5 ins. deep, with twin-cylinder engines (⅜-in. bore, ½-in. stroke), and find the boiler I now have needs a blowlamp to keep steam. I cannot spare room for one, and fear it would be too heavy. (The boiler is already heavier for the boat than I like.) I had last year drawn a rough sketch of the boiler for it, almost exactly similar to that given in answer to Query 17,934, in January 9th issue, except that the length is only 8 ins. and the thickness of tube 3-64ths in. (1) Should not this boiler, with four ¼-in. water tubes to each barrel, be ample to keep steam with plain wick lamps? (2) How would you suggest putting on the safety valve? (3) What size opening should safety valve have? (4) If well-made, should not boiler stand a working pressure of 30 to 35 lbs. with perfect safety?

(1) Yes, a single-barrel boiler would no doubt do the work, but the difficulty is the lamp. In a boat the lamp is the trouble, and a wick lamp is hardly the most satisfactory type. (2) On a bushing projecting through the casing. (3) A 3-16ths in. diameter safety valve should suffice. (4) If well made, the boiler ought to stand 135 lbs. pressure safely. All the joints should be silver-soldered.

[19,128] **Experimental Engine; Piston Rings; Compressed Air Working.** P. R. (Cardiff) writes: I have a small double-acting engine (1⅜-in. bore, 3½-in. stroke) which I intend to use for experimental purposes. A speed of about 400 r.p.m. will be required, the working pressure not less than 20 lbs., and to keep up speed for about 1 minute. The piston has one groove ½ in. wide in the centre. What kind of packing should I use? What type and size boiler would serve best? Would a ⅜-in. steel flexible tube carry the steam to the engine, 5 or 6 ft. away from the boiler, without leakage? Could the engine be worked satisfactorily by means of compressed air? If so, what size tank would store up sufficient power to give the required number of revolutions? Would a bicycle pump (1¼ ins. diameter) be suitable for charging?

One ring with a glut-piece—either on each side over the joint, as at A, or a central feather, B—to prevent the steam passing the joint may be used. Two rings would be better, but we do not usually recommend them to be placed side by side without a fixed portion between them. As you have the groove already turned in the piston, of course two ¼-in. rings, side by side, with the joints diametrically opposite



CONSTRUCTION OF PISTON RINGS.

as shown at C, would render the use of a glut or feather unnecessary. Means should be provided to keep the rings in this relative position. The type of boiler depends on the situation and the fuel to be used. We recommend a gas-fired boiler, if possible, as you can regulate the fire so much better. A steel shell (10 ins. by 20 ins. high) fitted with about twenty or twenty-five ⅜-in. tubes expanded in should suffice. No water-space furnace would be required. The steam pipe should be coiled in the smokebox, so that the effects of condensation are reduced to the minimum. Indeed, if the engine cylinder is made of iron, it would not hurt to pass the steam through a coil of pipe in the fire. The flexible pipe will carry the steam all right, but unless well protected, there will be a considerable loss by radiation. Working by compressed air, the engine would consume 7,200 cub. ins. of free air per minute, or say 5 cub. ft. To obtain a reasonably constant pressure in the valve chest of the engine a reducing valve would be required on the storage cylinder or a very large cylinder employed, say about 10 cub. ft., with a pressure of 25 lbs. per sq. in. You would require at least 1,600 strokes of a bicycle pump to charge the vessel for 1 minute's supply. See "Model Boiler Making," price 7d. post free, for design of boiler.

[18,923] **Searchlight.** H. B. (Dartmouth) writes: Would you kindly oblige me by giving me instructions for the construction of a small searchlight? I want it to throw a strong light for a distance of about 100 yds. I know nothing whatever on the subject, and would esteem it a favour if you would give me instructions.

For this purpose you will need a small arc lamp which any of our electrical advertisers would give you prices of. To run it you would need at least a supply current at 45 volts pressure. You do not say whether you intend to run your lamp from batteries of accumulators or from the supply mains; but if the former is the case, you will find that it is next door to impossible to run your arc lamp from accumulators. Of course, if expense is not to be considered, it is possible to do so; but the size and weight of the batteries necessary would, under ordinary conditions, be quite beside the question. In conjunction with the arc lamp you would need a parabolic reflector in order that the beams of light may be thrown out parallel with one another. Such a reflector could be had from any large manufacturing optician, such as Newton and Co, Fleet Street, London, E.C., or Dollond & Co., Ltd., Ludgate Hill, London, E.C.

[18,382] **Miscellany.** J. B. (Banbury) writes: Could you please help me on the following points? (1) Should the current coming from the secondary terminals of a spark coil give enough electricity to heat a coil to boil about ½ pint cold water? (2) What size coil would be required? (3) How is an immersion coil made and connected? (4) Is that new wire, insulated with enamel, you gave an account of some time ago, good for making coils? (5) Is the above wire cheaper than cotton-covered wire? (6) Could you give me the address of the firm? I only know they are at Manchester. (7) Could you give me any way of making a bolt to lock and unlock by electricity? I have a way for unlocking or locking only, which I see is very like a design you gave a querist in October, 1906. I want to do it by two switches. (8) Is it necessary to have that lever to work the catch in your design for locking a bolt? Could it not be worked direct with a double bell magnet? (9) Could you tell me how I could make some pole-finding paper or some substitute? (10) How are the brass rims of bottle bichromate batteries fixed to the bottle neck? (11) Is there any way of making cheap openwork sacking waterproof for a tent? (12) Could you tell me how gas lighters work? What substance on coming into contact with coal gas ignites?

(1 and 2) No, a spark coil is useless; it gives small current at very high pressure; you require a large current at comparatively low pressure. (3) The construction of heating appliances is full of practical difficulties. We advise you to try a coil made of bare resistance wire wound into an open helice or screw; try No. 18 gauge Eureka or similar wire. Use a battery which will give plenty of current, such as the bichromate pattern; add cells until you get the heating effect desired. See reply to query No. 18,353, on page 141, February 6th, 1908, issue. (4) We have not seen a specimen of this wire, but it would probably do for the purpose. (5) We do not know the price; enquire of the firm mentioned. (6) Connolly Bros., Manchester, would find them. The design of electro-magnets or solenoids to give long range pulls is expert work, and always involves experimenting. Try a double core as shown in sketch or magnet made to suggestions in The Model Engineer for June 1st, 1901, page 243. (9) White blotting-paper is soaked in starch, then paste it with a solution of potassic iodide. When touched with wires carrying current, a dark blue spot appears at one wire. (10) Try plaster-of-Paris. (12) Some are on the Wimshurst machine principle. Spongy platinum will glow and cause the gas to ignite. Is that what you mean? (7 and 8) Queries like this practically ask for something to be specially invented. You must exercise your own ingenuity or employ an expert. We suggest a soft iron plunger attached to the bolt and pulled one way or the other by means of solenoids. The solenoid which has current switched on to it would be the one acting at the moment. A similar device acting at right angles to the bolt could serve as a lock, but pressed down by a spring, so that it would keep the bolt in position without current being on. You will have to try the best position for the coils with relation to the core. The locking catch to be pulled up by solenoid when bolt is to be unlocked.

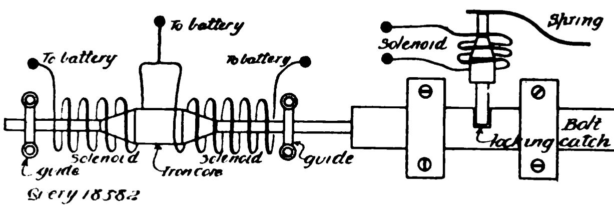


Diagram of Electric Bolt.

[18,791] **Water-proofing Model Craft.** W. A. S. (Southsea) writes: Will you please let me know what is the best way of rendering water-tight a built-up model racing yacht? I have read "Model Sailing Yachts" (Marshall's Practical Manual, No. 4), which says—"The inside of the boat may be covered with brown paper or linen, cut to fit between the ribs and moulds, and thoroughly well rubbed in with glue. I should like to know—(1) What kind of glue should be used, as, I suppose, ordinary glue will not stand water. Where can it be obtained? (2) Is tar any good? If so, is there any particular kind of tar which is best suited for the purpose, and can it be obtained in small quantities?

We should recommend you to use a number of coats of good shellac varnish in order to make your craft water-proof in every respect. This varnish may be easily made by dissolving flaked shellac in methylated spirit to the consistency of thin cream. Tar is no good for model work.

[18,794] **Wiring Electric Bell Indicators.** C. V. T. (London) writes: Would you oblige me by letting me know how to connect up the following? When an electric circuit is completed, I want the bell and indicator to act at the top of the house, and ditto in the basement. The indicators are made by Julius Sax and Co., with their own patent movement. The battery contains six Leclanché cells.

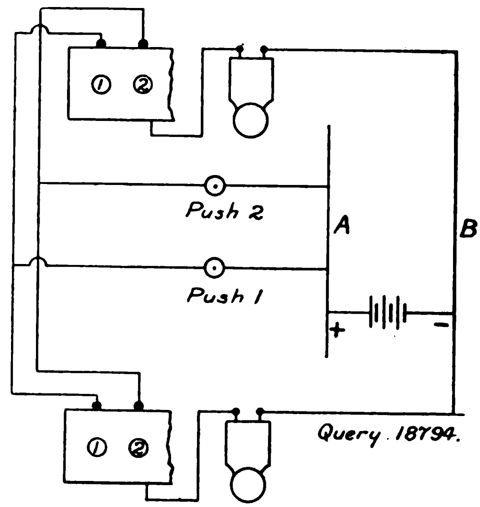


Diagram of Wiring for Electric Bell Indicators.

Herewith we give you the principle for connecting; the indicators and bells are placed in parallel. When any press is operated, the bells and indicators operate simultaneously; we presume this is what you require. Simply repeat for any number of pushes to wire A. Wire B is the return wire common to all.

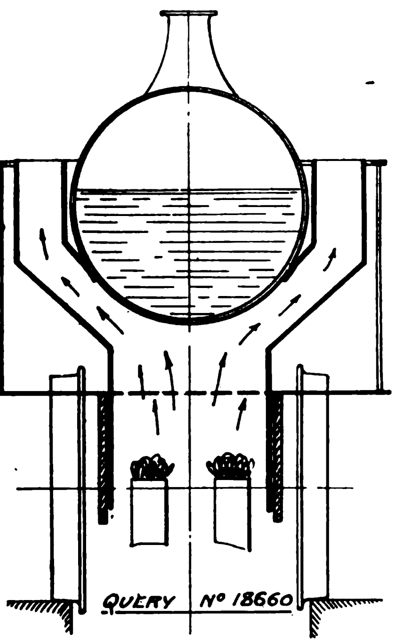
[18,925] **Miscellany.** J. H. (Hexham) writes: Will you kindly oblige me by answering the following: For carrying accumulators without lids, will the acid keep its strength if you put it into a glass bottle and then put it back into the accumulator, when you get to the end of the journey? Can I get a ½-in. spark from a spark coil without the use of a condenser? Does the secondary wire of a shocking coil where the handles are connected to, produce any voltage; if so, how many volts can be got? What do you use to clag accumulator lids on with again after you have taken them off?

Re accumulators. Yes, the acid may be emptied out and carried in a glass bottle if required. Sulphuric acid does not lose its strength if moisture is kept away from it. If it is allowed to stand in a moist atmosphere it becomes very slightly weaker, but under ordinary conditions it is not noticeable. *Re* accumulator lids. You do not say what kind of lids are used, whether temporary or fixtures. In the ordinary way for small cells the lids may be fixed on with molten pitch. *Re* spark coil. This depends upon the size of the coil. A coil made to give a ½-in. spark with a condenser will not give the same length of spark without one; on the other hand, a large coil may, of course, give a ½-in. spark even without one. The voltage across the secondary terminals of coil would be approximately 20,000 volts per inch.

[18,941] **Spark Coil Proportions.** J. M. (Bristol) writes: I propose building an induction coil to give 1½-in. spark. I notice in your handbook on "Induction Coils," on page 63, you say that a 6-in. coil takes 6 amps. at 20 volts, whereas Mr. Pike, in giving specifications of coils in The Model Engineer for November 29th, 1906, says that a 6½-in. coil only takes 5 amps. at 8 volts. I am unable to understand this, and it leads me to think that one specification or the other is unreliable. I should be very much obliged if you would give me a specification for a 1½-in. coil.

In reply to your enquiry *re* spark coil, you will find when you have had any experience with coils that it is very seldom that two coils built to exactly the same specification give precisely similar results in practice. The type of break used with the coil has a good deal to do with the current the coil takes, and it is quite a common—in fact, a well-known—fact to those who are conversant with coil-making, that the difference between the two results you instance is not at all surprising. The particulars you require for a 1½-in. spark coil may be had from our handbook, which you will find will work out satisfactorily in practice. We also recommend you to read recent query replies on this subject which will enlighten you on a good many points, particularly the widely differing behaviour of same size coils under different conditions.

[18,660] **The Simple Model Locomotive.** A. W. (Worcester) writes: I have completed a locomotive to design in issue of March 1st, 1902, with the exception of stopping up the crevices in the smokebox, but regret I am unable to make it work. I at first tried a six-wick burner, but as this would not generate sufficient steam to drive the model along, I made another with eight wicks, but this also does not seem to be able to do so. The engine will work when the wheels are raised off the floor, and in looking underneath to endeavour to discover if anything was wrong by the light of a match (which was underneath the cylinder and consequently warmed it), the engine ran much faster, and, on continuing to heat the cylinder, the engine worked with a steady hum. I shall be glad if you will kindly let me know whether the warming of the cylinder would



Additional Flue for Simple Model Locomotive. (*See Vol. VI*, 1902.)

make the piston easier and thus cause the engine to work better, or whether it would have the effect of increasing the expansion of the steam and thus have the same effect. I may say that in consequence of the information contained in a recent number of your paper, in answer to a correspondent, I have packed the cylinder tightly recently. I notice also (in the same reply, I believe) you say the flames from the spirit lamp should be orange in colour; but mine are blue, and, although I have tried different lengths of wick in the wick tubes, I cannot get all of the flames the proper colour. The rear axle gets warm with the heat from the rear burners, and it is difficult to turn the wheels round. There must be several readers of your Journal who have made similar models, and I shall be glad if you will kindly give me the benefit of the experience of any makers which has come under your notice. The engine has been made exactly to drawings, but it is rather heavy, and from the accidental experience mentioned above, I think if a simple superheater were fitted the engine would be a success. Of course, it would be necessary to make the rear axle work easier, but as the wheels were driven on after the axle-boxes were put on the axle, I do not want to disturb them unless absolutely necessary.

Without a steam blower, and also without an auxiliary blower, this model may be troublesome to start, as the firebox, being long, it is difficult to ventilate the rear wicks of the lamp. We presume that blast works properly and gives a sharp, distinct "puff," the effect of which may be observed on the lamp—at least, on the flame of the first pair of wicks. The blue colour of the flame denotes insufficient ventilation, and to accomplish this more thoroughly, without adding any more fittings, the design is shown amended in "The Model Locomotive," page 253, with the safety valve turned into an additional flue. However, you may, with little trouble, provide means of ventilating the rear part of the flame of the lamp by punching a few holes in the flame guard. A better idea is shown in the accompanying sketch, an additional flue in the side tanks, about 1½ ins. long, being made in the flame guard at the back end, say directly over the rear axle. This will effectually ventilate the lamp and also preserve the paint of side tanks and boiler from damage. The weight of the engine does not matter, but the boiler should be as light as possible, as it will then steam better. The accident whereby the beneficial effects of drying the steam was made so evident has occurred to other model engineers, and shows that the use of a superheater pipe can be justified. With regard to the stiffness of the back axle, oil it well and let it work free or run it free in the lathe. We have seen several models built to these drawings at work, both with oscillating cylinders and with the slide-crank method of drive. In one case success was not obtained until a blower was fitted.

[18,937] **Dynamo and Accumulators for Lighting Plant.** H. G. H. (Harwich) writes: I shall be much obliged if you will kindly give me the information which is asked for on the enclosed. (1) I require a dynamo and accumulator to light about twelve 8 c.-p. lamps for my motor yacht. The accumulator will chiefly be used for lighting and the dynamo for charging, although both may be required to light twenty-four 8 c.-p. lamps. How many volts and amperes should dynamo and accumulator give, and how large should latter be, allowing about ten hours for length of lighting? (2) What is the resistance of a lamp giving 1 c.-p.? Does the resistance rise in proportion to increase of candle-power? Will you give formula relating to what current and pressure should be used when various candle-power lamps are used? (3) Can you recommend a really good book which explains fully on small electric plants such as the above?

First of all you say you require a dynamo and accumulator to light about twelve 8 c.-p. lamps, then you say both may be required to light twenty-four 8 c.-p. lamps. This is rather conflicting, so we give you the size of machine and accumulator capable of dealing with the larger quantity. The dynamo should be capable of giving at least 600 watts output, although we should recommend 1 kilowatt machine—that is, 1,000 watts output. The accumulator should have an ampere-hour capacity of 120, assuming them to be coupled up to give 50 volts pressure. The maximum discharge rate for twenty-four 8 c.-p. lamps, assuming their efficiency to be 3 watts per candle-power, should be 12 amps. Working on the basis of 5 amp.-hours discharge rate per sq. ft. of positive plate surface, each cell will require to contain at least 2 sq. ft. of positive plate surface and a total of at least 25 such cells will have to be coupled in series. This will give you an available accumulator voltage of 50 volts, but the dynamo must be capable of giving 65 volts at least. Its amperage will be as stated above, reckoning 1,000 watts output, 15 amps. The resistance of a lamp depends upon the voltage it is intended to take and also the current. You can work the matter out by reference to Ohm's Law, which is

$$C = \frac{E}{R}$$

Of course, you must know two of these factors in order to arrive at the third. We can recommend you to read up any text-book, such as "Electric Light and Power Distribution," by Maycock, 6s. 4d. post free. Our handbook, "Electric Lighting for Amateurs," 7d. post free would also assist you considerably in this matter. We trust the foregoing will be of some use to you, but if you are still in the dark upon any point all you have to do is to write to us again.

New Catalogues and Lists.

T. W. Thompson & Co, 28, Deptford Bridge, **Greenwich**, S.E.—We have to hand List D of this firm's catalogue, which deals especially with charging and lighting dynamos, switchboards and accessories. Particulars are given of their dynamo exchange; also a list of dynamos, engines, etc., which can be seen running at their works. Mention should be made of the combined petrol generating plant which is illustrated; also a 3½ b.h.-p. petrol vertical engine, a 5 b.h.-p. marine petrol engine, gas engines for charging and lighting, water motors ranging from 1-50th to 2-3rds horse power. Accessories include voltmeters, ammeters, lighting cables, switches, cut-outs, lamps, holders, etc. A list will be sent to all readers for 5d. post free, which amount will be deducted from the first order.

"Rubicon" Motors, Blackburn.—In a pamphlet issued by this firm describing the "Rubicon" petrol motor, it is claimed to be especially designed for model power boats. Prices are given for complete sets of castings and parts, and for the finished motor. Readers interested in the construction of model power boats should send for a copy of this list.

The Editor's Page.

MANY readers having expressed a wish that we should reopen the "Gauge" Competition, we have decided to do so under the title of "Our Readers' Work Competition." As a large number of our readers already possess one of our "Columbus" gauge tools, offered in the previous competitions, we offer to send any tool, book, or other desired article supplied by any of our advertisers, to the value of 6s. 6d., to any reader who sends us for insertion in THE MODEL ENGINEER a sufficiently good photograph and description of any model, tool, mechanical or electrical apparatus that he has made, and which has not been already illustrated in our pages. Entries should be accompanied by a separate letter, giving the title of the article, and stating exactly what is required as a prize in the event of acceptance. When tools or apparatus are desired, the page and number of article in the firm's catalogue from which it can be obtained should be stated, if possible. It is understood, of course, that we do not promise to accept everything that is sent in, and examples of work submitted must show some degree of originality or usefulness. Ordinary every-day tools or models merely made up from purchased castings are not required. The article should be written *on one side of the paper only*, with the name and address of the sender on the back. The photographs and separate sketches enclosed with the contribution should similarly bear the name and address of the sender, otherwise delay may arise in the awarding of the prizes. It is essential in this, as in our other competitions, that the copyright of the photographs must be the property of the senders, and the covering letter should contain a declaration to this effect. The competition will close on June 30th, 1908. It may be interesting to our readers to know that since the "Gauge" Competitions were first started between 300 and 400 prizes have been awarded.

* * *

Readers in Rotherham and district will be interested to hear that Messrs. Leadbetter & Peters, of Imperial Buildings, High Street, Rotherham, are contemplating holding an exhibition of engineering and electrical models in the gallery over their shop. They would be pleased to hear from any of our readers in their neighbourhood who would be disposed to show specimens of their work, and, if a sufficiently good response is received, the necessary arrangements will be put in hand. We have intimated our willingness to offer one or two books as prizes, if suitable entries are received.

Answers to Correspondents.

NO NAME.—The sample of wire you enclose is No. 22 S.W.G.

H. JUPE.—Thompson & Co., 28, Deptford Bridge, Greenwich, would supply you, and quote price on application.

A. L. M. (Bowdon).—See "Wireless Telegraphy," by Howgrave-Graham, post free 2s. 9d.

B. A. Q. (Ipswich).—A drawing of the G.E.R. 4—4—0 type locomotive, No. 1,855 class, was given in our issue of October 17th last. Our Publishing Department can supply you with a limited number of the "Claud Hamilton" plates of working drawings. Present price, 1s. 8d. post free.

J. D. B. (Antrim).—A receipt for making pole-finding paper was given in our issue for December 22nd, 1904, page 597.

R. W. B. (Colne).—We regret we cannot see our way to publish your contribution. The idea is not new.

W. L. (Manor Park, E.).—Your sketch is not at all clear, and we regret therefore that we are quite unable to express any opinion upon the subject.

E. BARNES (Acton).—We thank you for your workshop note; but regret we cannot see our way to publish the same.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

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Contents.

[*The asterisk (*) denotes that the subject is illustrated.*]

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And Electrician.

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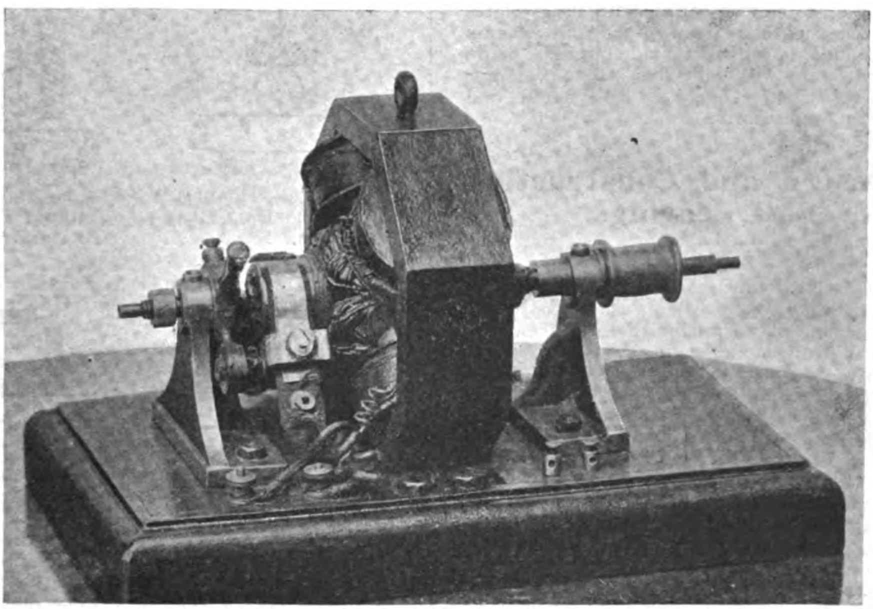
EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 362. APRIL 2, 1908. PUBLISHED WEEKLY

A Small Dynamo.

By R. Reid.



Mr. R. Reid's Dynamo.

THIS machine is a variation of a design in The Model Engineer handbook and was made about two years ago. The poles are separate castings carefully bedded on to the yoke as shown, the joint apparently offering very little extra resistance to the magnetic forces. I wound them in the lathe, getting ½ lb. of No. 24 s.c.c. wire with shellac varnish between each layer, and cardboard washers at each end. The armature is an eight slot, drum type, with 100 stampings, and wound with 7 ozs. of No. 20 D.C.C. wire with plenty of shellac varnish. As mistakes are, as a rule, instructive, I will mention one or two. I found that the insulation had given way through omitting to round the corners of the slots, and had therefore to undo and rewind it. I had also extra trouble through mixing up the ends of wire when connecting to commutator. The screws fixing on bottom poles caused a little trouble, the room being limited. The commutator is simply a brass casting fitted on the hardwood drum, which is a tight fit on shaft, and sawn into eight segments. It is fastened on with wood screws at one end and turned true on shaft. All machining was done on a wood-turning lathe except the shaft. The armature wires are soldered into saw kerfs made on the flange of segments. As there are only two brushes, 90 degs. apart, these segments are cross-connected, letting the wire into kerfs at other end.

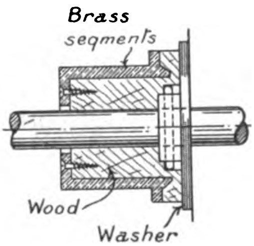


FIG. 1.
SECTION OF COMMUTATOR.

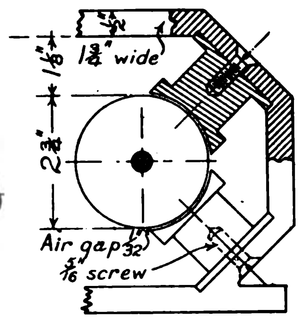


FIG. 2.
FIELD-MAGNETS.

The brushes are copper gauze, with brass plates on back to strengthen them, fixed on a brass rocker, the handle of which is made out of a piano key. The machine will light four 16. c-p. lamps at a speed of 2,500 r.p.m. as a dynamo, and develop ¼ h.-p. as a motor.

The Design and Construction of Ball Bearings.

By "ZODIAC."

CONSIDERING the many advantages that ball bearings have when used for model work, it is very surprising that such bearings are so little used by model engineers; this is probably due to the fact that the design is little understood by the amateur engineer. Bearing friction plays a very important part in the case of models, often absorbing as much as 25 per cent. of the total power, and this bearing friction can be very greatly reduced by the use of properly designed ball bearings. Several hundreds of ball-bearing patents have been taken out during the last twenty years, many being totally void of good mechanical design, and not worth the paper they were written on. A ball bearing that is perfectly satisfactory at a comparatively slow speed may fail entirely if run at a high speed.

A cycle is not really a high-speed machine, as generally supposed, for when running at 20 miles per hour the wheels only make 240 r.p.m., and, as a matter of fact, a bicycle type of ball bearing is not satisfactory if run much above 500 r.p.m.

There are two distinct types of ball bearing, viz., "Radial" and "Axial" or "Thrust."

In the "radial" type the load bears at right angles to the axis, while in the "axial" or "thrust" type the pressure is in a line with the axis or spindle of the bearing.

Fig. 1 shows the "radial" type, the balls having the axis of rotation A A; while Fig. 2 shows the "axial" or "thrust" type, the axis of rotation of the balls being B B. It is obvious that as the balls cannot have more than one axis of rotation at a time, the two types of bearing cannot be perfectly combined. Hence the faulty design of the bearing (Fig. 3), in which an attempt is made to cause the balls to simultaneously rotate about the axis A A and B B, thus causing undue sliding friction, which rapidly wears away the bearing. The four-point bearing (Fig. 4) has the same defect, the only thing the balls can do is to revolve on the axis C C, a considerable amount of sliding friction being set up at each of the four points of contact. Theoretically, a ball rolling on a flat surface (Fig. 5, *a*) makes contact at a point and rolls along a line; neither have any surface, and hence are unable to carry any load. No substance, however, is perfectly hard or incompressible; hence, the ball sinks in the surface a little so that its contact point has appreciable area, and the ball is thus able to carry a load. When the ball sinks in it is obvious from Fig. 5, *c* that as the different parts in contact are not all equally distant from the axis of rotation, they must have different peripheral speeds, and hence a certain amount of sliding is bound to take place, which means, of course, friction and wear to some extent. By making the balls and ball races as hard and smooth as possible, and keeping the arc of contact small, the difference in the peripheral speeds due to the difference in the diameters *d d'* (in Fig. 5, *c*) becomes negligible, so that the wear due to this cause is very minute indeed. V-shaped grooves (Fig. 5, *b*) are really better than circular grooves (Fig. 5, *c*), but both are extensively used in practice.

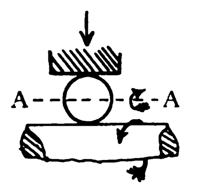


FIG. 1.—"RADIAL" TYPE BALL BEARING.

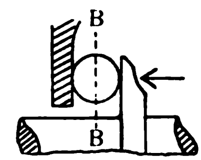


FIG. 2.—"AXIAL" OR THRUST TYPE BALL BEARING.

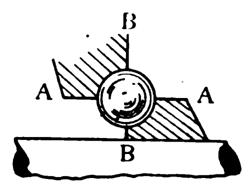


FIG. 3.—BAD DESIGN OF BEARING.

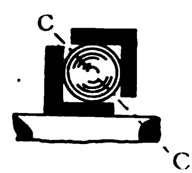


FIG. 4.—FOUR-POINT BALL BEARING.

It is evident from Fig. 6 that the circumference of the outer ring or ball race is considerably greater than that of the inner or shaft ball race, so that if the shaft makes one revolution, thus causing the balls to travel a distance equal to the shaft circumference, they will not have travelled right round the outer ring. It is thus sometimes argued by unmechanical persons that slipping must take place; this is quite wrong. Imagine the balls to be gearwheels gearing into teeth on shaft and outer ring, and that the gearwheels revolve about fixed centres; if now the shaft revolves one turn counter clockwise and has fifty teeth, the outer ring will revolve clockwise, and assuming it has 100 teeth, it will make :—

$$\frac{1 \times 100}{50} = \frac{1}{2} \text{ turn.}$$

This is, of course, the principle of the variable speed epicyclic gear. The slipping argument i therefore quite wrong; nevertheless, the write has seen it stated that on this ground the design (shown sectioned in the upper half of Fig. 7, *a*) was better than that shown in the lower half (drawn black), because the large diameter of ball worked on the outer ring and the small diameter on the inner ring. Such bearings were used on the old ordinary bicycles. As a "radial" bearing, Fig. 7, *b* is a good design, and will last very well indeed if properly lubricated; as a thrust bearing, however, it is unsatisfactory. Its only fault as a radial bearing is that no provision can be made for taking up wear. Bearings of this type are extensively used for electric motors by several leading firms; the puzzle as to how the balls are got into position will be solved later on. The bearing, as shown in Fig. 7, *a* can, of course, be readily adjusted to take up wear.

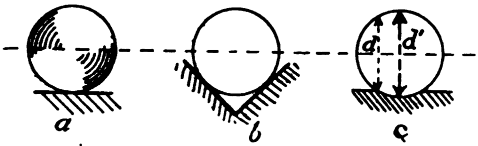


Fig. 5.—Showing Shape of Ball Grooves.
a, Flat surface; *b*, V-shaped groove; *c*, Circular groove.

One naturally looks on the ball bearing as closely connected with the bicycle, and seeing that a large number of readers are no doubt cyclists, it will make this article more interesting if a few remarks on cycle ball bearings are included. Now the

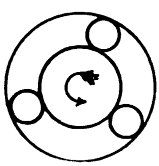


Fig. 6.—Showing that Ball Bearing is similar to Epicyclic Gear.

cycle engineer is faced with a somewhat difficult problem as regards ball bearings. In the steering head he has a thrust bearing which must at the same time take a considerable amount of side pressure, due to the more or less horizontal component of the pressure on the front forks when the machine is ridden, especially when the front wheel meets an obstacle such as a stone on the road. The bottom of the two head bearings takes all the weight; the top one takes the greater portion of the jarring side-shake strain. The actual amount of turning motion is very small, merely that due to the machine being steered from side to side. Hence such ball races have grooves turned to a radius slightly larger than that of the balls, so as to give the balls a well-defined position, and thus take up side-shake. If the grooves do not clear the balls, the balls will rapidly cut such clearance themselves. With a 3-16ths-in. or ¼-in. ball the race is turned out about 1-100th in. larger radius. Some makers use V-grooved head races. In the case of the wheels, the bearings have a considerable end thrust to deal with, especially when going round a sharp curve; the bottom bracket, on the other hand, has little or no end thrust, and is principally a "radial" bearing. In

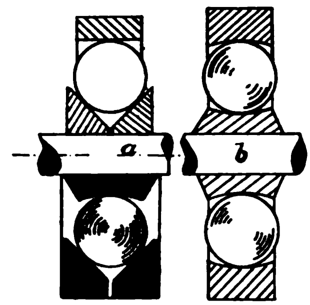


Fig. 7.
a, Adjustable Type Ball Bearing.
b, Solid Pattern Ball Bearing.

the early days the three-point bearing (Fig. 8, *a*) was extensively tried; it proved, however, to be liable to rapid wear, as a considerable amount of sliding must take place at one or other of the faces, depending on the position of the axis of rotation of the balls. The type of cycle bearing now universally

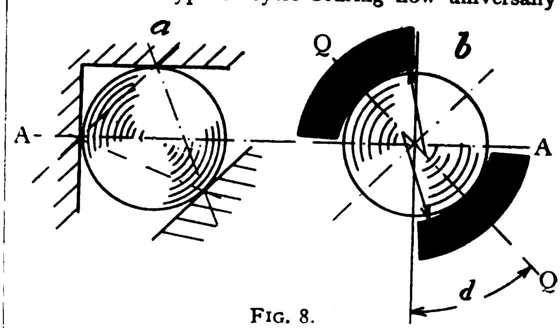


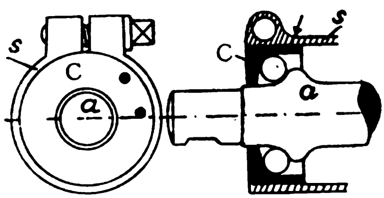
Fig. 8.
a, Three-point Cycle Bearing.
b, Modern Cycle Bearing.

in use is that shown in Fig. 8, *b*; the cups are struck out to a radius 25 per cent. greater than that of the balls, while the angle *d* is 18 degs. in the bottom bracket bearings and 20 degs. in the case of hub bearings. This is the standard practice of the best makers, such as B.S.A. and Humber's. As seen from the drawing, the balls touch the cups at diametrically opposite points, *i.e.*, along the line Q Q.

Although not theoretically perfect, such bearings run remarkably well, the life of a good cycle bearing being at the very least 25,000 to 30,000 miles, without showing undue wear, provided they are kept free from dust, and, of course, assuming first-class material is used.

There are two types or designs of ball bearings used for cycle work: The "Disc Adjustment" or Outward-facing Cone type (Fig. 9), and the Inward-facing Cone type (Fig. 10). It need hardly be pointed out that each hub or bearing requires two cones and two cups facing in opposite directions.

The disc adjusting bearing is used for crank brackets (see Fig. 9); the cones form part of the spindle A, the cups C being pushed further on to the cones to take up wear. The cups C are screwed into the bracket body S, and locked either by cotter pins or the bracket shell is slit up as far as the arrow and the cup locked by tightening the shell round it, as shown in Fig. 9. Of course, the slit must not reach to the end of the cups or dust would enter the bearing. When cotter pins are used, they are shaped so that they press against the thread of the cups, the pressure required to prevent the cups turning being very slight. A very neat method of locking the cups is used by the Chater-Lea Company; the right or chain-side bottom bracket cup is a left-hand threaded cup and screws up to a flange, and this tends to screw



G. 9.—"Disc Adjustment," or "Outward-facing Cone" Type Bearing.

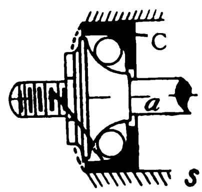
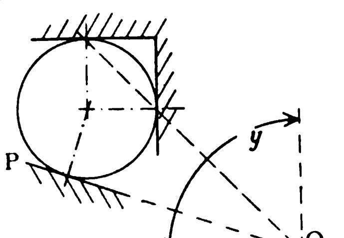


Fig. 10.—"Inward-facing Cone" Type Bearing.

up tighter to the flange when riding. The left-hand cup has a right-hand thread and projects beyond the bracket body, being secured by a locknut; it tends to tighten up against this lock nut in riding. The reason for this will be explained in due course.

The "inward-facing cone" type (Fig. 10) is now universally used for wheel hubs. The cups C are pressed tight into the hubs, the adjustment being effected by pressing the cones further into the cups. The heavy dotted line indicates the oil-retaining and dust-proof cap. Fig. 11 shows a method of setting out a three-point bearing for cases where the end thrust is only small and the bearing has to act principally as a radial one. Fig. 12 shows

Fig. 11. Method of Setting-out Three-point Bearing.



the theoretically perfect radial bearing ball, which is as free from friction as possible. the ball having a true rolling motion about the axis A A. This bearing has to be very accurately made, and is therefore expensive; it has to be carefully adjusted so that the V-grooves are central with each other along the line F F.

The design of the axial or thrust bearing must now be considered. Take the case of a ball rolling on a level surface about the point O, as shown in Fig. 13. It is evident that the ball will roll along a circumference *d e* which is less than the maximum crcumference of the ball. The smaller the distance between the centre of the ball and the point O, the smaller will be the circumference *e d*, the ball forming part of a cone O *e d* and revolving about the line M O. Now assume that the diameter of the ball is small compared with the distance from centre of ball to point O, so that practically the ball rolls along its maximum circumference corresponding to its diameter, and take the case of a thrust bearing consisting of two parallel plates with balls between, as shown in Fig. 14. From what has already been said, it is evident that if

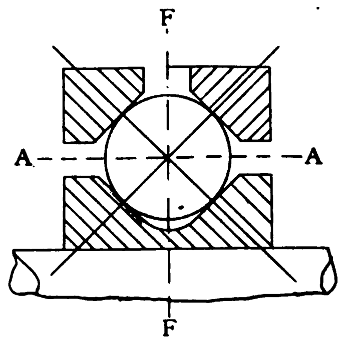


Fig. 12.—Theoretically Perfect Radial Bearing.

the ball is to have a perfect rolling contact on the lower plate about the centre O P, it must rotate about the line M O. Again, in the case of the upper

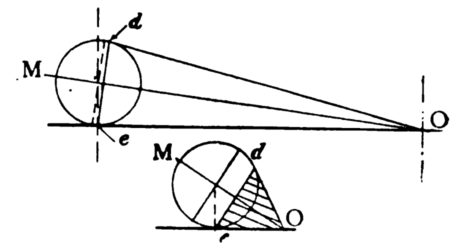


Fig. 13.—Showing Development of Thrust Bearing from Cone.

plate, the ball must rotate about the line N P, the line of contact being D in the first instance and D′ in the second. The ball clearly cannot rotate about M O and N P at the same time, so that Fig. 14

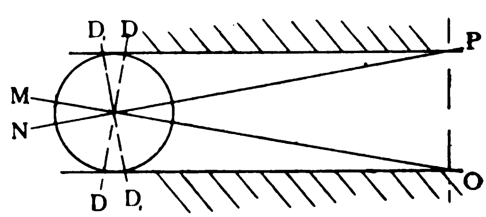


Fig. 14.—Parallel Plate Thrust Bearing.

does not give us a perfect ball thrust bearing. The same remarks, of course, apply to the case where the balls run in circular grooves.

(*To be continued.*)

Chats on Model Locomotives.

By Henry Greenly.

II.—Component Parts for 1¼, 1½, and 2-in. Scale Engines.

(*Continued from page* 300.)

THE safety valve shown in the drawings herewith, as far as external outline is concerned, follows North-Eastern Railway practice; the Great Western, Midland, L.T. & S.R., N.S.R., and L.B.S.C.R. using safety valve casings of the same type.

The valve is arranged both externally and internally to include circular work, so that most of the machining may be done on the lathe.

The seating is permanently fixed to the boiler by a flange provided with three or four rivets, and must therefore be screw-cut and bored for the valve before it is fixed in place. Of course, the sizes depend on the diameter of valve orifice chosen, but I may say that although the diameter of 9-16ths in. was fixed upon from practical experience, on checking it with the Board of Trade rules I found it about correct. These rules, according to one of the engineering pocket-books in my possession, say: The area of the valve should equal:—Area of fire grate sq. ft. × 37·5 × absolute pressure.

In a 2-in. scale engine the size of the grate would be about 15 ins. by 6 ins., or 1¼ ft. by ½ ft., which, of course, gives a grate area of

$$1\tfrac{1}{4} \times \tfrac{1}{2} = \frac{5 \times 1}{4 \times 2} = \tfrac{5}{8} \text{ sq. ft.}$$

The absolute pressure is, of course, the gauge pressure plus the pressure of the atmosphere; therefore, with a working pressure of 100 lbs. per sq. in., the absolute pressure would be 115 lbs. per sq. in. On these figures the area of the valve would work out as follows:—

$$A = \frac{5}{8} \times \frac{37 \cdot 5}{115} = \tfrac{5}{8} \times \tfrac{1}{3}$$

$$A = \frac{5}{24} = \text{say } \cdot 21 \text{ sq. in.}$$

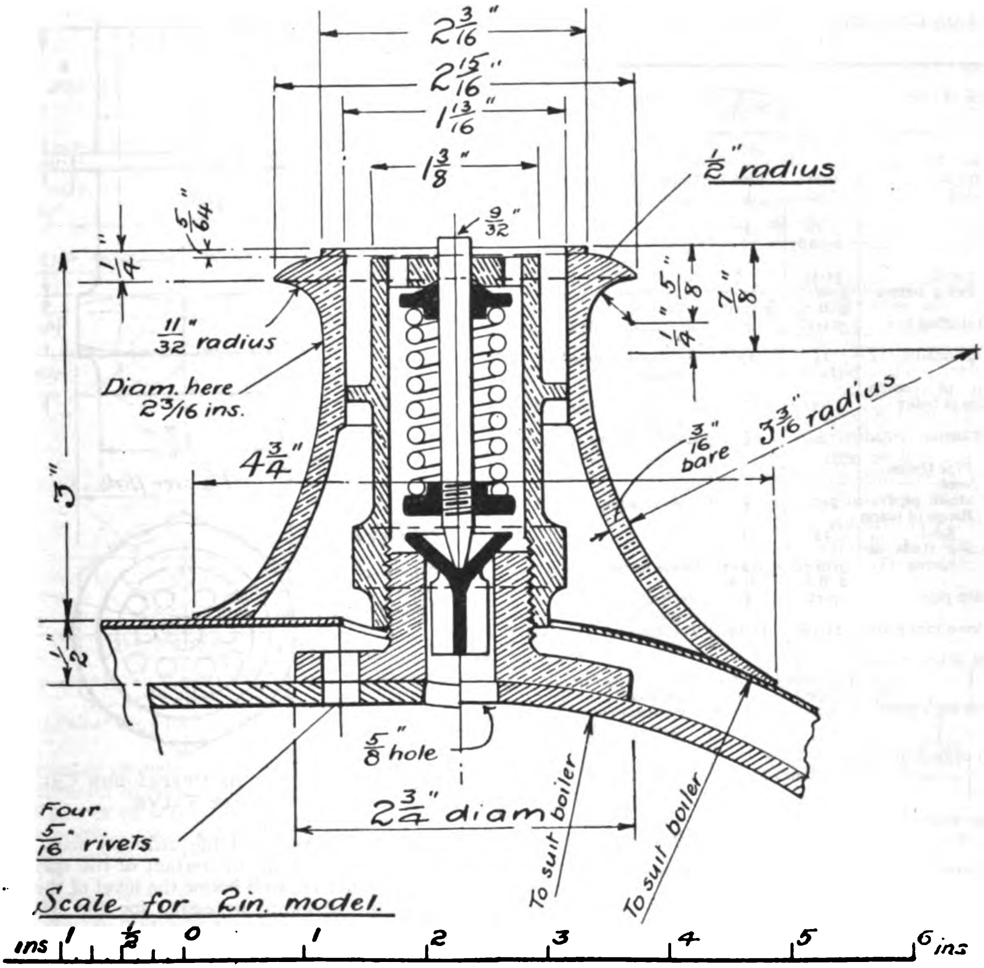


Fig. 12.—Design for Safety Valve for Large Scale Models.

Now the diameter of a circle, the area of which is ·21 in., falls between ½ in. and 9-16ths in., and therefore the chosen diameter of 9-16ths in. for the valve orifice is not below the limit of size set down in actual practice. As the pressures used in smaller model locomotives may be lower than the pressure of 90 lbs., a larger valve than the scale equivalent will be advisable, the lower pressure, of course, resulting in a larger volume. This has been allowed for in the tables herewith, the difference, however, is not so much as would make any change in the details of the safety valve. Another recommendation of the Board of Trade experts is that provision should be made to prevent the valve flying off in case of the spring breaking. This requirement is satisfied in the valve illustrated herewith.

TABLE OF DIMENSIONS FOR 1¼ AND 1½ IN. SCALE MODELS.

Name of Part.	1¼-in. Scale.	1½-in. Scale.	Remarks.
	Ins.	Ins.	
Regulator Handle.			
Diam. of regulator rod	9-32	5-16	Brass or G. silver.
„ in stuffing-box ..	7-32	¼	Square part as large as possible.
„ of stuffing-box ..	9-16	⅝	Also hole in boiler.
„ of flange ..	1 5-16	1½	Or larger, 1⅜ in. and 1 9-16 in.
„ of gland ..	11-32	⅜	As large as possible.
„ of fixing screws	⅛ or 5 B.A.	5-32 or 3 B.A.	Fine thread preferable.
Length of stuffing-box	11-16	¾	Measured behind flange.
„ reg. handle ..	1⅞	2¼	Measured between centres.
Projection of handle from face of boiler ..	11-32	⅜	Measured to back of handle.
Radius of sector ..	¾	⅞	Radius of top edge.
Steam Pipe Union Joints.			
Diam. of steam pipe ..	7-16	½	Pipe in boiler.
„ flange of union joint ..	1⅜	1⅝	
„ fixing studs or screws ..	3-16 or 2 B.A.	5-32 or 3 B.A.	Three or four.
Single union pipe ..	7-16	½	Vertical pipe to superheater.
Distance from tube plate	11-16	13-16	To centre of vertical pipe.
Thread of single union nut	¼-in. iron pipe.	¼-in. iron pipe.	Without separate tailpiece.
Small pipes for Y-joint	5-16	⅜	For outside cyclrs. and unjointed _:r._ superheater.
Thread of union nuts for same	⅜-in. iron pipe.	⅜-in. iron pipe.	With separate _7_ tail piece.
Safety Valve.			
Diam. of orifice ..	⅜	7-16	Hole in boiler 7-16 in. and ½ in.
„ spring pillar ..	5-32 or 3-16	3-16 or 7-32	Brass or G. silver.
„ valve seating, outside ..	13-16 ⅜" iron pipe	15-16 ½" iron pipe	Screwed spigot.
Threads per inch on outside of valve seating	14	14	Iron pipe threads.
Diam. of Flange ..	1⅞ ins.	2¼ ins.	Gun-metal.
Rivets (four)	7-32	¼	Copper or steel, according to boiler.
Inside diam. of casting	1 5-32	1⅜	Parallel portion.
Diam. of pepper box, outside	15-16	1 3-32	
Valve spring:			
Diameter ..	½	9-16	Seven coils.
Diameter of wire	5-64	3-32	Steel wire japanned.
Length unloaded	1 1-16	1 5-16	Check with formulas.
Holes in top (twelve) ..	5-64	3-32	Arranged as drawing.

The spring valve and pillar is encased by an elongated screw cap, which is provided with a number of holes at the top for the steam to escape. The lower end is threaded internally with a suitable iron pipe or other fine thread, and externally is shaped hexagon, so that a monkey wrench may be used to turn the cap and adjust the compression of the spring. To prevent water running down into the lagging, an external flange should be provided on the upper part of the cap, which should be turned to fit inside the parallel portion of the bore of the casing. This also forms a fixing for the casing.

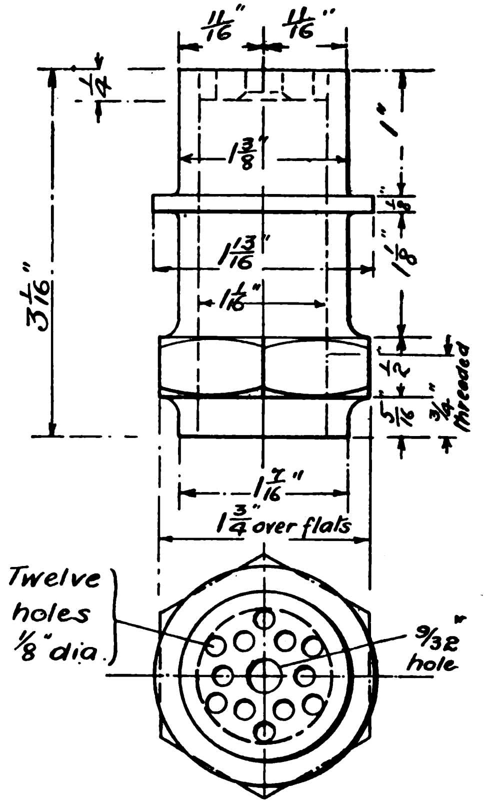


FIG. 13.—DETAIL OF PEPPER-BOX CAP FOR SAFETY VALVE.

The valve may be of the ordinary wing pattern, although, if the point of contact of the spring pillar is, as it should be, well below the level of the seating, there is no absolute necessity for the wing. The latter is only useful to keep the valve truly axial when it is being ground in.

The spring pillar may be of steel in the larger sizes and German silver or brass for 1¼-in. scale boilers. The two flange collars should be turned so that the spigots fit easily inside the coiled spring and keep same truly central. The lower collar should be screwed on the pillar tightly, and in the smaller sizes, where brass or German silver is used, the collar may be sweated on as well.

The size of the spring may be calculated as follows: The load is known and is, of course, the area of the valve × by the pressure per square inch on the boiler (say 100 lbs.). It is area of 9-16ths-in. valve viz.: ·24 × 100 lbs. = 24 lbs. There is no lever in the construction, therefore the spring must be strong enough to take this dead load. The loaded length of the spring is 1½ ins., and the most convenient diameter about ¾ in. We can reckon on a deflection of about ⅛ of the loaded length of spring, which works out at ⅛ of 1½ = 3-16ths in. The above assumptions being made, the section of wire and the number of coils only need be considered. These can be fixed upon the drawing to an approximately correct size, and then the suitability of the various factors of the spring considered by the following formulæ:—

$$\text{Deflection} = \frac{8 \times L \times n \times D^3}{C \times d^4}$$

and

$$\text{Safe Load} = \frac{\pi \times d^3 \times f}{8 \times D}$$

Where—

L = safe working load in pounds.

C = modulus of elasticity = 13,000,00 for small wire, 11,000,000 for wire over ¼.

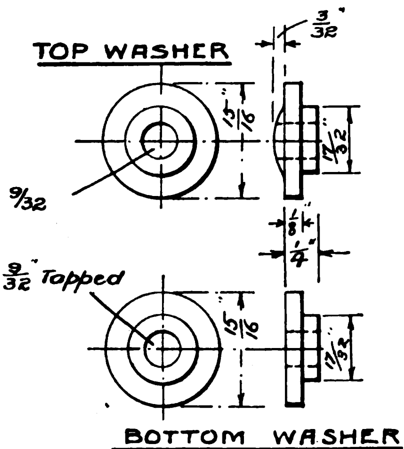


Fig. 14.—Spring Washers or Collars for Safety-Valve Pillar.
(Pillar may be 9-32nds or ¼ in.)

n = number of coils.

D = diameter of coils.

d = diameter of wire.

f = safe stress, say 50,000 lbs.

According to the above the deflection would be:

$$\text{Deflection} = \frac{8 \times 24 \times 7 \times \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4}}{13{,}000{,}000 \times \frac{1}{8} \times \frac{1}{8} \times \frac{1}{8} \times \frac{1}{8}} =$$

Deflection = 3-17ths approximately.

Our estimate was 3-16ths, therefore we can pass that as satisfactory. For maximum safe load:—

$$L = \frac{3\frac{1}{7} \times \frac{1}{8} \times \frac{1}{8} \times \frac{1}{8} \times 50{,}000}{8 \times \frac{3}{4}}$$

L = about 50 lbs.

therefore, the load of 24 lbs. proposed is well within safe limits; indeed, 7-64ths diameter of wire would probably be quite safe and provide a greater deflection.

The number of holes for the outlet of the steam may give a total area of about half the area of the valve. As a hole ⅛ diameter has an area of ·012 sq. in., twelve of them will provide an area of ·012 × 12 = ·144, which is a little over one-half of the area of the valve. The top collar on the spring pillar may be rounded, as shown in the detail, and fit in a recess cut with the point of a large drill.

(To be continued.)

Recent Contributions to Electric Wave Telegraphy.

Professor Fleming's Royal Institution Lecture.

(Concluded from page 303.)

After summarising photophonic and other methods of transmitting articulate speech to a distance without wires, the lecturer gave a brief sketch of recent progress in wireless telephony by means of undamped oscillations. He mentions most interesting experiments carried out by the German Wireless Telegraph Company between Berlin and their large station at Nauen, 20 miles distant. Twelve arcs in series, with water-cooled copper positive electrodes, were employed for transmission, the power supplied being 4 amps. at 440 volts.

A condenser and an inductance coil in series were connected in parallel with this set of arcs, and these supplied the energy to a loosely coupled aerial from which undamped electric waves, 800 metres in length, were radiated. The frequency was therefore 400,000. The oscillations in the aerial can be more or less enfeebled by shunting them to earth through a microphone transmitter, in which they meet with greater or less resistance according to the variations of contact produced by the voice. The receiver is tuned to the incoming waves, which actuate a quantitative electrolytic detector coupled inductively to the aerial and connected with a telephone. It is stated that

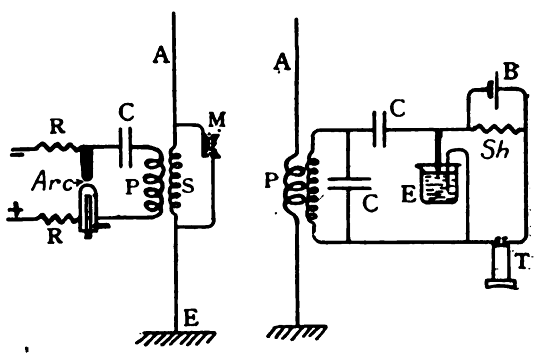


Fig. 1.—Sending and Receiving Circuits for Wireless Telephony.

in this manner speech can be transmitted to a distance of 12 miles over water with aerials about 80 ft. in height.

Fig. 1 shows the connections used; M is the microphone and E the electrolytic detector.

Professor Ernst Ruhmer has described similar experiments with a 220-volt Poulsen arc.

The method by which the rate of radiation was made to follow the sound vibrations was to connect the primary circuit with a battery and the primary of an induction coil, of which the secondary forms part of the arc circuit.

The energy-expenditure is considerable, but if the enormous advance made in wireless telegraphy during recent years is any criterion, it is, as Dr. Fleming said, quite within the bounds of possibility that we shall soon be able to speak across the English Channel without a wire, and not scientifically impossible for the sounds of the human voice to be some day transmitted from the shores of England or the United States to an Atlantic liner in mid-ocean.

In dealing with the concentration of electric waves towards particular stations and the localisation at receiving stations of the direction from which incoming waves are travelling, Professor Fleming mentioned the use of parabolic mirrors and of groups of rods, serving the same purpose, and pointed out that such arrangements afford no practical solution of the problem, because the dimensions of the mirrors must be comparable with the wave-length of the radiation to be transmitted; this is obviously out of the question with waves which are hundreds of feet in length.

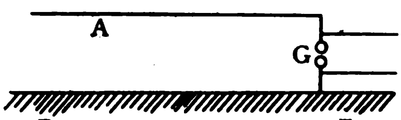


Fig. 2.—Marconi Bent Aerial for Directive Signalling.

It is hardly necessary to remind the reader that the ordinary vertical oscillator radiates with equal intensity towards all points of the compass. Several experimenters have noticed that if the aerial is not vertical, it radiates rather more in one direction than in another, and also that it is more receptive of waves in one particular direction.

Dr. Fleming made passing allusions to work along these lines carried out by various radio-telegraphists, and then proceeded to give a detailed description of Mr. Marconi's investigations, which had been communicated to the Royal Society in 1906.

The arrangement used by Mr. Marconi is shown in Fig. 2, and consists of an aerial with a very short vertical portion and a long projection running horizontally outwards from it.

Such a bent aerial emits a less intense radiation in the direction in which the free end points than in the opposite direction. Also, such an aerial will respond more readily to waves arriving from a direction opposite to that in which it points.

Thus, two similar bent aerials placed "back to back" provide a system which has a greater range of action for a given sensitiveness than it can have with any other angle of inclination between the horizontal portions. In other words, it has "directive qualities not possessed by the ordinary vertical antennæ."

Professor Fleming gave a brief explanation of the action of this arrangement, making it as clear as is possible without the aid of mathematics.

Mr. Marconi and Professor Fleming have both made quantitative tests with thermal ammeters and plotted curves, showing the intensity of action at different angles. They found a very remarkable non-symmetry of radiation.

Mr. Marconi has applied these bent aerials to the localisation of ships and other stations far enough off to be invisible.

For this purpose the horizontal portion is arranged so that it can be swivelled round the vertical part as a centre and made to point in any desired direction.

An alternative method is to arrange a number of radiating horizontal conductors like the spokes of a wheel, and provide a change-over switch, by means of which any one conductor may be used, the best one being found rapidly by trial.

Having dealt with Mr. Marconi's method, Professor Fleming went on to describe another directive system, used by Professor F. Braun, of Strassburg. To use Professor Fleming's words: "He erects three vertical antennæ at the corners of an equilateral triangle, or four at the corners of a square, the sides of which are about equal to the height of the antennæ, and he creates in them electrical oscillations which have a defined and constant difference of phase by methods contrived by him, Drs. Papalini and Mandelstam, not yet fully described. It is found that the waves sent off by these three antennæ interfere with each other, in the optical sense, exalting each other in some directions and nullifying each other in other directions, in accordance with their relative amplitude and phase difference. The resultant effect can be so arranged that the radiation is extremely unsymmetrical, being much more towards one side than the other.

The lecture concluded with a few remarks about the curious variations in the transparency of the atmosphere to long electric waves, so marked that the normal distance is often more than trebled. Daylight has an adverse effect, especially in the neighbourhood of the transmitter, where the electric forces are greatest; the amount of the effect fluctuates from hour to hour and from month to month.

A Visit to the Royal Scottish Museum, Edinburgh.

The Machinery Section.

(*Continued from page* 150.)

ONE of the most striking marine models on view in the Mechanical Section of the Museum is to be seen immediately on entering the Machinery Hall; it is that of a perfect scale sectional model of the iron steamship, *Nerbudda.* The boat is still working for the British India Steam Navigation Company. The model, constructed in the Museum workshop, is to a scale of ½ in. to 1 ft., and is over 13 ft. in length. The photograph of this imposing exhibit (which we are able to reproduce herewith in Fig. 7), shows in detail the construction of the boat, as well as the arrangement of machinery, etc. Although this model cannot be said to be that of an up-to-date steamship, it decidedly adds to the educational value of the collection. A model of the thrust-block to a larger scale occupies a position in the same case, but is not shown in the photograph.

The actual ship represented by the model was

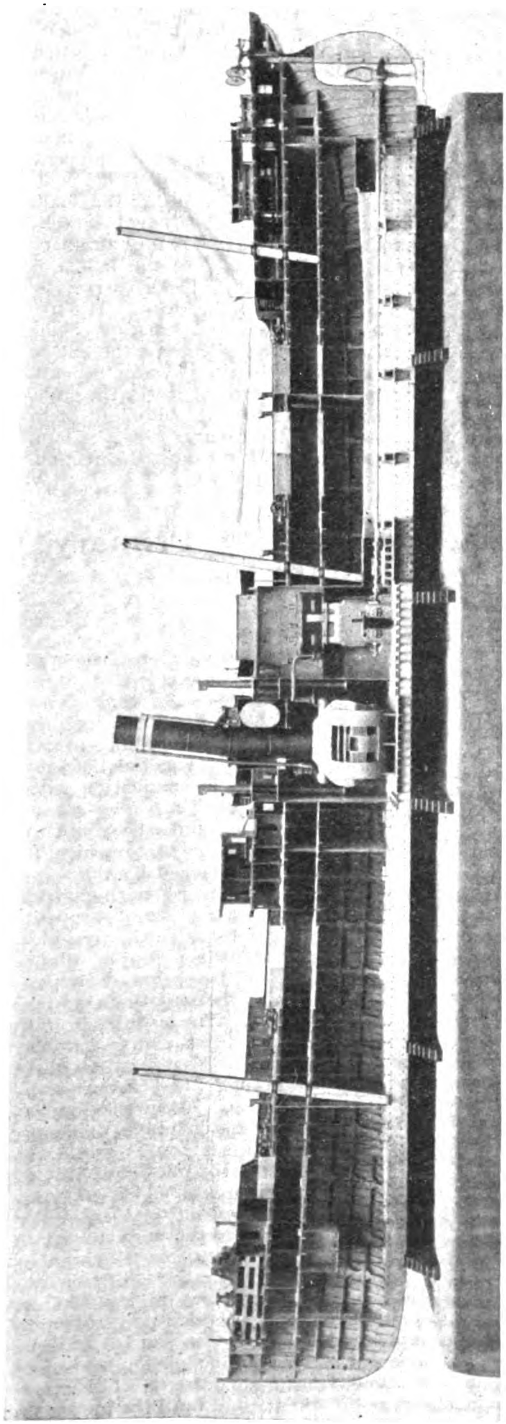


Fig. 7.—Sectional Model of Iron Steamship, "Nerbudda": The Royal Scottish Museum, Edinburgh.

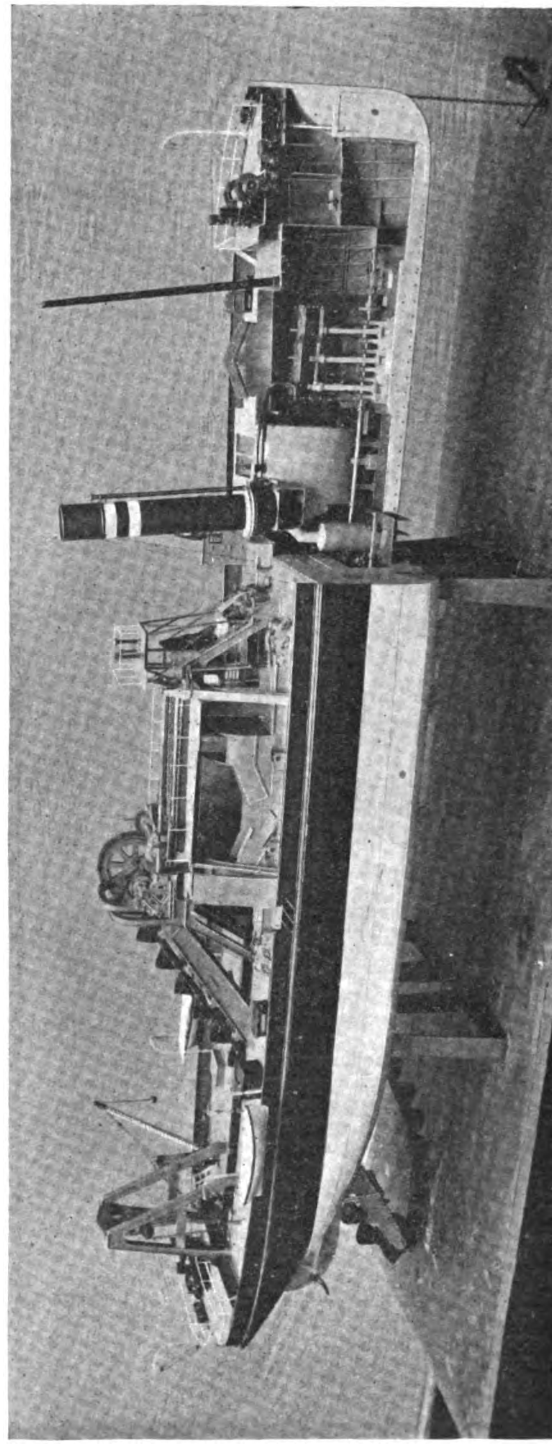


Fig. 8.—Sectional Model of Hopper Dredger, "Manchester": The Royal Scottish Museum, Edinburgh.

built by Messrs. William Denny & Brothers, Dumbarton, in the year 1884. It is constructed with a cellular bottom; length, 320 ft.; breadth, 42 ft.; depth, 28 ft. 6 ins.

The next model which we show, in Fig. 8, is of the hopper dredger *Manchester*; this model was also made in the workshop attached to the Museum, and is to a scale of ½ in. to 1 ft. The following description of the dredger will, we think, be of interest to many of our readers.

The vessel was designed and constructed by Messrs. Simons & Co., Renfrew, for use on the Manchester Ship Canal. The total length is about 200 ft., breadth 40 ft., hopper capacity 850 tons. It dredges free soil at the rate of 800 tons per hour, and the dredgings may either be passed into the vessel's hoppers, steamed out to sea, and deposited, or they may be discharged over the side of the vessel into barges to be towed away. It will dredge in 35 ft. of water when the ladder is at 45 degs., or it may be used in the shallowest water in which the vessel will float. It may also be used to dredge through sandbanks, etc., in advance of the stern.

The hull, frames, and principal structural parts of the vessel are of steel. At the stern is a longitudinal well to accommodate the bucket ladder. The open or stern end of the well is tied by a raised quarter-deck, while the inner termination is formed into a breakwater, the oblique surface of which throws the water current beneath the vessel's bottom. There are two rudders at the stern, and a third one at the stem, the former being fixed in their frames by movable pins when steaming astern, and the latter similarly fixed when going ahead. On each side of the well are four large hoppers for the dredgings; the hoppers are arranged as air-spaces to give adequate flotation and occupy about the middle third of the vessel's length. Each hopper has a pair of doors controlled by a winch on deck, which allows them to open downwards when depositing the contents of the hoppers. A very strong framing is built on deck to support the upper end of the bucket ladder.

There are twin-screw propellers at both ends of the vessel, to enable it to be easily navigated in narrow channels. Both propeller shafts run the entire length of the vessel, and each is driven by a set of triple-expansion condensing engines. One set of main engines is partly shown in the model.

The dredging machinery can be driven by either of the two sets of main engines. For this purpose the propellers are put out of gear by clutches, and one of the two spur wheels on the propeller shafts, seen near the coal bunker, is put into gear with the intermediate wheel. At the inner end of the intermediate shaft so driven are bevel wheels, not seen in the model, driving the oblique shaft seen coming up through the deck, and which transmits the motion through bevel and spur gearing to the upper tumbler shaft, and so through the square tumbler to the bucket chain. In order to prevent breakage of machinery when the buckets come in contact with a rock or other obstacle, the large spur wheel on the upper tumbler shaft is a friction wheel, the body of which turns without the rim if the strain on it should exceed a pre-arranged amount. The dredged materials, after being raised to the uppermost point by the buckets, fall down the centre shoot suspended from the carriage, and thence either into the shoots leading to hoppers, or the side shoots to barges, according to the way the shoots have been set. On one side of the model the shoot to barges is extended ready for use, while on the other side it is folded up, as when filling hoppers. With the upper end of the ladder in the position shown, the forward hoppers only are filled. When it is desired to fill the stern hoppers, the traversing carriage supporting the upper end of the ladder has to be moved forward until the centre shoot comes flush with the shoot leading to the stern hoppers. This is done by Brown's patent traversing gear, and the power is obtained either from the main engines by a vertical shaft and bevel wheels, as seen in the model, or from a small pair of auxiliary engines on deck. The lower end of the ladder is supported by chain and pulley blocks carried by strong shears firmly built upon the deck. The free end of the chain passes down to a hoisting engine below the deck, which raises or lowers the end of the ladder according to the depth of water beneath the vessel. When the dredger is at work, the crabs controlling the mooring chains at stem and stern are manipulated to move the dredger slowly astern, so that the buckets may cut in the desired direction.

(To be continued.)

Experiments with Primary Batteries.

(Continued from page 296.)

WHEN two plates of unlike metals such as zinc and copper, are immersed in dilute sulphuric acid solution, the action of the acid upon the plate which is the more readily attacked causes bubbles of gas to appear. This has been referred to in connection with Figs. 1 and 2. The gas is hydrogen, and the bubbles appear at the plate which is the less attacked by the solution, that is, at the negative plate. In the case of a copper and zinc pair the bubbles appear at the copper plate. This can be observed by performing the experiments Figs. 1 and 2. The bubbles do not all ascend to the surface of the solution. They tend to cling to the plate, and many actually do so. As the production of current continues, the negative plate becomes gradually coated with these bubbles of hydrogen gas. This opposes the flow of current from the positive to the negative plate on account of two reasons. First, because the area of negative plate in contact with the solution decreases as the bubbles accumulate on its surface. Secondly, because hydrogen gas is electro-positive to zinc. The bubbles, therefore, try to send a current from the copper plate to the zinc plate, the effect being an opposition to the flow of current. This opposition increases as the quantity of bubbles increases. The effect is called polarisation. It is one of the principal difficulties to be overcome in the design of a

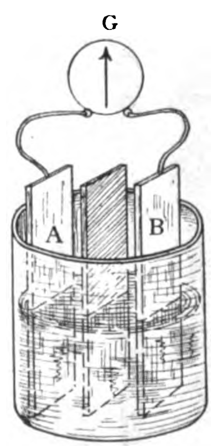


FIG. 13.

primary cell. To demonstrate it by experiment; immerse two clean copper plates (A and B) and a clean zinc plate (Z) in a solution of dilute sulphuric acid, Fig. 13. The plates must not be in metallic contact. Connect a sensitive galvanometer (G) to the copper plates A and B: the needle will not be deflected, showing that the copper plates are neither positive nor negative to one another. Connect the zinc plate Z to one of the copper plates, say B, by a piece of copper wire, for a few minutes (Fig. 14); bubbles of hydrogen gas will appear and accumulate on the surface of B. Disconnect the wire from the zinc plate and connect it to the galvanometer in circuit, Fig. 15; the needle will be deflected, showing that the balance between the state of the copper plates has been disturbed, and that a current of electricity is flowing from one plate to the other through the solution and back by way of the connecting wires and galvanometer.

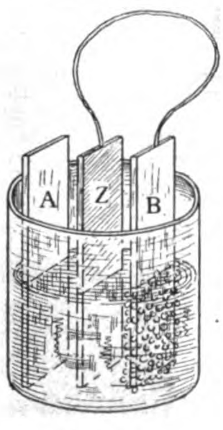


FIG. 14.

If the galvanometer has been tested to show in which direction the needle deflects when current passes one way or the other through the coils, it will indicate that current is flowing from A to B through the external circuit and from B to A through the solution. Plate B has become electro-positive to plate A, owing to the accumulation of hydrogen bubbles upon its surface. The zinc plate Z will therefore be much less effective in sending a current through the solution to B than to the clean plate A, or to B if there were no bubbles of hydrogen upon its surface.

The hydrogen clings to the surface of the negative plate, and if possible will get into it. If two palladium plates are immersed in a solution of dilute sulphuric acid and a battery is connected to them so that a current is made to flow through the solution from one plate to the other, bubbles of hydrogen gas will be produced at the plate which is connected to the negative terminal of the battery. This plate is then the equivalent of the negative plate of a primary cell, and if the metal is very thin, the hydrogen will be absorbed to such an extent that the plate will twist and bend. Reverse the flow of current, and the plate will straighten out and give up the hydrogen bubbles, others then appear at the second plate, which will in turn absorb them and twist and bend.

Unless some method is adopted to clear away the hydrogen gas as it forms at the positive plate, a primary cell will temporarily cease to give current owing to this polarisation effect. It will resume action if the external circuit is disconnected and the hydrogen allowed to disperse. Cells which polarise readily are, therefore, not suitable for work which requires a steady flow of current during a considerable length of time without intervals of rest. If the work is of a very intermittent kind the question of polarisation is not of such importance. There are two methods generally used for preventing polarisation. One is by mechanical means, and consists in providing a rough surface to the negative plate. The bubbles of hydrogen do not readily attach themselves to points, so that they will not cling to the rough surface, which approximates to a large number of very small points. They detach themselves as they are produced, so that polarisation is minimised. The Smee cell is an example. The positive plate is of zinc, but the negative plate is made of platinised silver. This has a granulated surface to which the hydrogen does not readily adhere. The solution is dilute sulphuric acid.

The other method of overcoming polarisation is by chemical means. An acid or other ingredient is used to neutralise or combine with hydrogen as it is formed. An example is the single fluid or simple pattern of bichromate cell in which bichromate of potash or chromic acid powder is mixed with the solution as a depolariser. The depolarising agent is frequently separated from the main solution by a porous partition. An example is the Bunsen cell. The main solution is dilute sulphuric acid. The plates are zinc and carbon. The carbon plate is placed in a porous pot, which is immersed in the main solution. This pot is filled with concentrated nitric acid, which attacks the hydrogen bubbles and eats them up, thus keeping the surface of the carbon plate in a free condition. The two liquids are in contact through the porous walls of the pot, so that the current can flow from the zinc to the carbon plate. Another example is the Leclanché cell. The main or exciting solution is sal-ammoniac dissolved in water. The plates are zinc and carbon. The carbon is placed in a porous pot which is immersed in the sal-ammoniac solution, and the pot is packed with crushed peroxide of manganese and carbon. The sal-ammoniac solution permeates this mixture, entering through the porous walls of the pot, so that current can flow from the zinc to the carbon. As the hydrogen is formed, it is attacked and absorbed by the manganese peroxide, being thus prevented from collecting upon the carbon plate.

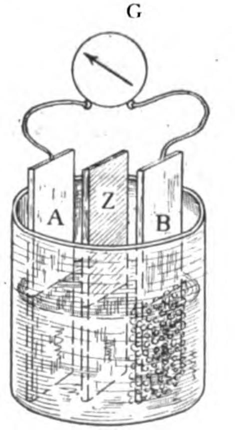


FIG. 15.

The depolarising action which takes place in these cells and others is not perfect. In practice the hydrogen is not completely absorbed, but gains upon the depolarising agent as the cell continues to do work. After an interval of time, depending upon the particular type, the cell becomes more or less polarised and the flow of current falls or ceases altogether. If the external circuit is disconnected, and the cell allowed to rest, the depolarising agent gains upon the hydrogen, and ultimately clears the surface of the negative plate. The cell will then do work and produce a flow of current again. Eventually the main or exciting solution becomes exhausted, and must be replaced before the cell will give current. This exhaustion is due to absorption of zinc or whatever the positive plate may be composed of. Eventually, also, the positive plate will be eaten up and must be renewed. The depolarising agent, when separate from the main solution, may not require to be renewed so often as the former if the solutions have not become intermixed. An example is the Grove cell, which is similar to the Bunsen; also the Leclanché cell. The peroxide of manganese remains effective during several changes of solution, and may last for years if the cell is not doing heavy work.

Having dealt with two of the three principal features which influence the practical working of primary cells, namely, internal resistance and polarisation, there remains the third, which is called local action. The zinc which is used for the positive plate is generally impure, and contains particles of carbon and metals other than zinc. The effect of this is that local currents of electricity are produced between the zinc and these substances whilst the cell is at rest as well as when it is at work. These small local currents cause a continued consumption of zinc, and being formed upon the surface of the zinc, interfere with the production of the useful current. To prevent them occurring, the surface of the zinc should be amalgamated with mercury. If this be done the zinc is efficiently used, as if it were pure. Amalgamation is effected by sulphuric or hydrochloric acid. Make a dilute solution of acid and water, place it in a shallow dish. Lay the zinc in the acid so that it is covered, and pour some drops of mercury upon it. The mercury will adhere to the zinc, and the amalgamation may be facilitated by rubbing with a rag until the entire surface of the zinc is like a mirror. Be careful not to dip your fingers in the acid. The amalgamated plate can be washed in water and is ready for use in the cell. Superfluous mercury will contain zinc, and should be retained specially for the purpose of amalgamating battery plates. As the zinc is consumed in the cell the mercury penetrates into the plate, but a re-amalgamation may occasionally be required. To maintain amalgamation the zinc in some cells is continually kept in contact with a quantity of mercury. If the zinc is placed in a porous pot, it may stand in a pool of mercury at the bottom of the pot. Another method is to cast the zinc plates with a small pocket or tray at one side near the top. This tray is then filled with mercury when the plate is placed in the cell.

(To be concluded.)

Undoubtedly the most frequent source of the cracking of aluminium castings is, says the *Brass World*, overheating or "burning" the aluminium while melted. There are several rules that must be firmly obeyed in making aluminium castings, and they are:—To melt the aluminium with a slow fire, so that the top of the metal will not become "burnt" before the remainder of the metal is melted; to avoid over-heating the metal after it has once melted; to pack the ingots in the crucible as compactly as possible, so that portions will not stick up and become exposed to the action of the flame; and last, but not least, is one which should be posted so that it actually becomes a rule of the shop—do not have the aluminium melted before the mould is ready. This is one of the most common sources of trouble.

Elementary Ornamental Turning.

By T. Goldsworthy-Crump.

(Continued from page 135).

THE oak matchbox shown in Fig. 17 is an easily executed article. A piece of wood having been selected of a suitable size is held in a grip chuck and the outside turned parallel and the groove formed, Fig. 17*a*. The top should then be faced true and the inside bored out; the drill spindle being properly adjusted and a cranked drill No. 36

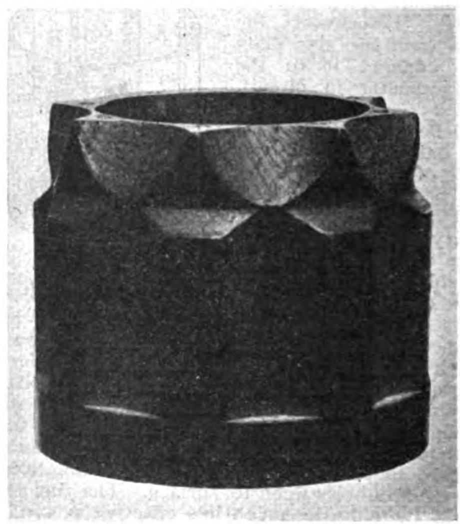


Fig. 17.

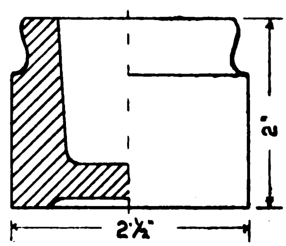


Fig. 17*a*.

× ¼ in. radius inserted. Eight flutes are required with a maxium penetration of ⅛ in., finishing exactly with a clean even cut near the bottom. These having been completed, the slide-rest is swivelled to an angle of about 30 degs. and carefully adjusted so that the finishing cuts or traverse of the drill will come together to form the points on the top edge. The same holes or teeth are used for dividing as for the parallel flutes. The slide-rest is again swivelled to 30 degs. in the opposite direction, and the drill adjusted to cut on the inside of the box, when eight tapering hollows are cut almost intersecting those on the outside. The work is then removed and re-chucked by the inside, and the bottom faced up, which completes the job.

A further example of this sort of pattern is shown in the oak bowl illustrated in Figs. 18, 19, and 19*a*. A block of oak was prepared and chucked plankways—that is, with the grain running at right angles to the mandrel—and the general form produced

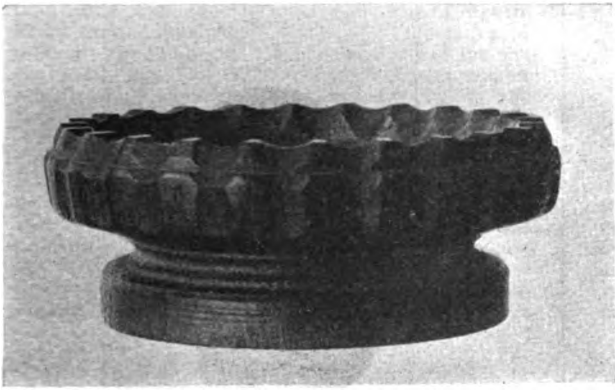


FIG. 18.

with gouge and chisel. The drill spindle was then fixed up, as in the previous example, and a No. 37 × ⅜ in. radius cranked drill inserted and employed for cutting the twenty-four parallel flutes. The slide-rest was then swivelled twice, as before, to produce the angular flutes. The drill spindle was then adjusted at right angles to the mandrel and

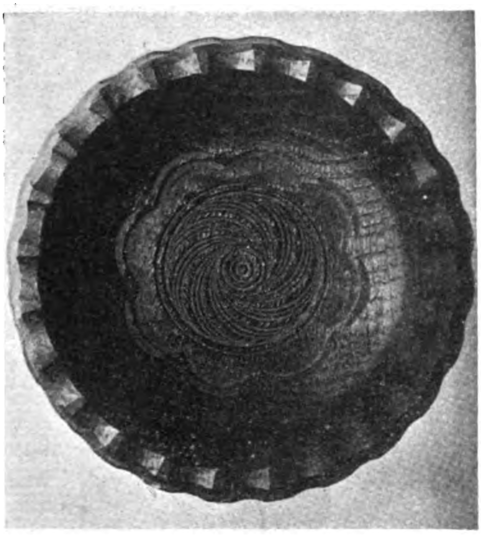


FIG. 19.

the semi-circular hollows on the top edge cut, care being taken to get the penetration to exactly agree with the hollows already cut, so that the edges of cuts came sharply together. The spindle was now fixed parallel with mandrel and the drill changed for No. 36 × ½ in. radius, and the inside of the bottom of the bowl was excavated to a perfectly flat surface, the work being slowly revolved by hand.

The eight semi-circular cuts were then made, the cross-slide being used to govern the penetration and depth of cut so that the points of inter section came up sharp. The main slide was then withdrawn a quarter turn and the second ring of cuts

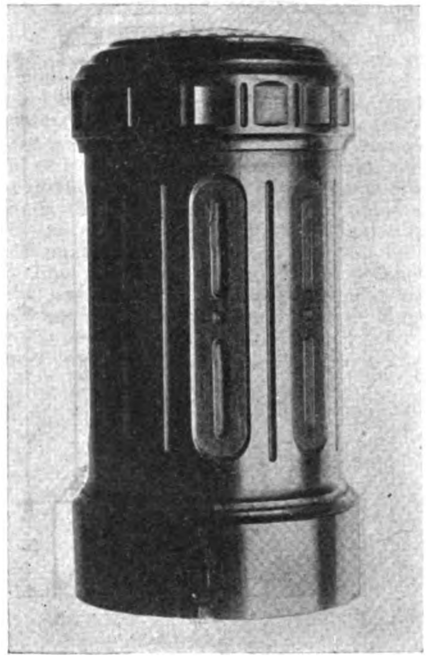


FIG. 20.

made in a similar manner. The drill was now changed for No. 23 × ½ in. radius and the drill spindle packed up slightly at the pulley end for the execution of the centre pattern, which is very like that described for the snuff box (Fig. 13), except that every fourth cut is missed—a bit Irish! The 96 circle was used and the divisions required

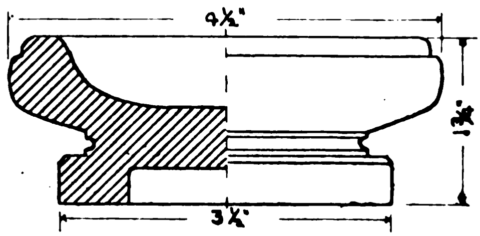


FIG. 19*a*.

(starting from zero) were 3, 6, 9, 15, 18, 21, 27, 30, 33 and so on. The turning of small circles with a point tool completes the bowl. It may be mentioned that in this case the under-side of bowl was turned first with a shoulder, on which it was re-chucked, as it would have been a somewhat difficult matter to properly finish this portion otherwise.

As a further example of plain drill work the casket shown in Fig. 20 provides an illustration of the combination and application of the various classes and styles of drills. A detailed description of its production is hardly necessary as all the movements required have been previously described. Fig. 21 shows the top, and Fig. 21*a* is a dimensioned drawing.

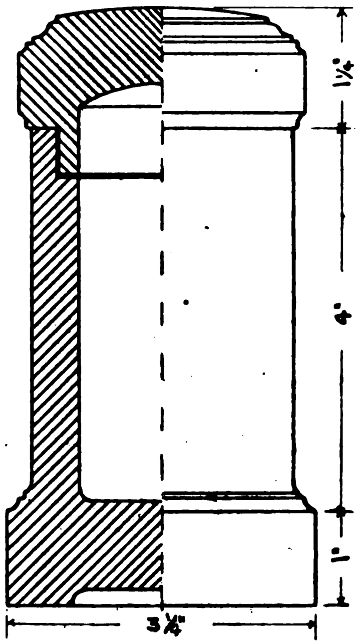


FIG. 21*a*.

There is one matter in connection with the drill spindle and cranked drills that is not generally known, and that is the production of the sphere and portions of spheres and curved forms, together

FIG. 21.

with their ornamentation. Figs. 22 and 23 illustrate work of this description.

If a piece of wood be turned parallel and the drill spindle fixed at right angles with a cranked drill, such as No. 27, in position, and both the work and the drill revolved at the same time, that is, the work revolved slowly while the drill is being

FIG. 22.

run as fast as possible and the drill gradually fed into the work, the result will be a curved figure, as shown in Fig. 23. Presuming the diameter of the work and the diameter of circle formed by the drill

FIG. 23.

to be the same, theoretically a perfect sphere would be formed, but this is impossible, as there would be no support towards the completion of the sphere. Therefore, if a spherical figure is required, such as Fig. 22, the drill spindle is set at a slight angle, so as to leave a neck or support for the work.

A further variation can be obtained by setting the spindle above or below lathe centres, which will have the effect of producing a somewhat elliptical figure, as shown in Fig. 23.

The ornamentation is produced by advancing the drill a little deeper into cut at each division than was done in forming the general figure. Many variations can be made by the application of different cutters, which should, however, have the the same radius. Work of this class provides considerable scope for thought, care, and the application of the many forms of drills.

It is also possible to form and ornament concave figures with the drill spindle and cranked drills. For this purpose the spindle must be fixed above or below lathe centres, so that the radius of the drill should be at lathe centre height, when at its highest or lowest point, as the case may be. In either case the drill will only be cutting during a portion of its revolution. The previous remarks as to ornamentation apply equally to the convex or concave figures. These applications of cranked drills can be utilised for the production of hollow or convex figures, where it is necessary that each should be of identical size and position.

(To be continued.)

COUNT ZEPPELIN has determined to construct an airship capable of carrying 100 passengers. His last airship had a length of 137 yds. and a diameter of 13 yds., and carried eleven passengers, together with 3,300 lbs. of ballast. The new ship will be 26 yds. longer and 3 yds. greater in diameter, which will give it the requisite additional lifting capacity of 17,600 lbs.—*Auto Journal.*

Engineering Drawing for Beginners.

By H. MUNCASTER, A.M.I.Mech.E.

(Continued from page 62.)

THE drawing in isometrical projection of a cylinder whose axis is normal to one of the faces of the cube is a very simple matter. Fig. 91 shows the method of determining a cylinder having the axis vertical. Let ***a, b, c, d*** represent a square, of which any side, as ***a b***, is equal to the diameter of the cylinder; as in the previous proposition, draw the oval to represent the upper end of the cylinder. The length of the cylinder may be set off on the vertical line *c e*; *e* will be the corresponding corner of a square (in isometric projection) superscribing the base of the cylinder and the oval drawn; the vertical lines tangent to the two ovals will complete the figure. The dotted lines indicating the part of the bottom end not seen need not be drawn, or, if drawn in pencil for the purpose of constructing the figure, need not be inked in.

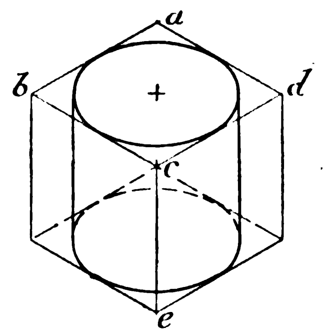


FIG. 91.

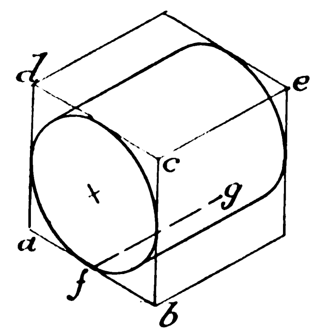


FIG. 92.

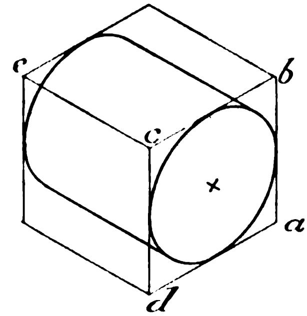


FIG. 93.

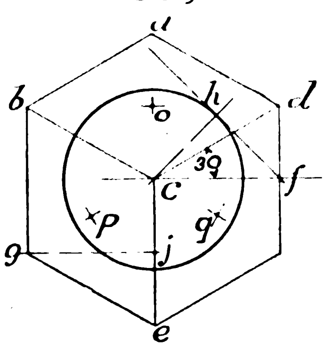


FIG. 94.

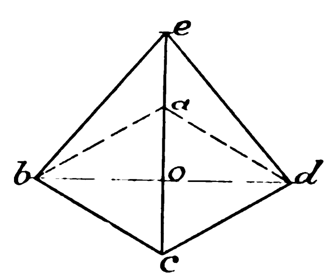


FIG. 95.

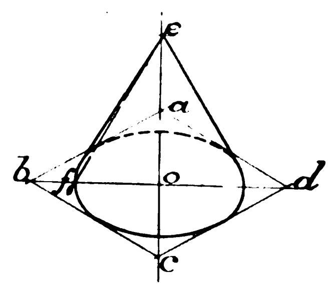


FIG. 96.

The same figure is shown lying on the horizontal plane in Fig. 92. The construction is similar; the letters apply to the preceding description. The contact with the horizontal plane may be formed by bisecting ***a b*** at ***f***, and from ***f*** drawing the line ***f g*** parallel to and of the same length as ***c e***. Fig. 93 shows the same cylinder in another position. Any cylinder not in one of the three positions shown—that is, not normal to one of the faces of an isometrical cube—will require different treatment, and would be somewhat beyond the scope of the subject.

To draw a sphere of a given diameter where the centre is given: Let *c* (Fig. 94) be the centre; draw a horizontal line *c f*, set off *c d* at 30 degs. from this line of a length equal to the *diameter* of the given sphere, draw *d f* perpendicular to *c f*, bisect the angle *c f d* by the line *f h*, draw from *c* the line *c h* perpendicular to *f h*; *c h* will be the *radius* of the required circle. (Note that the diameter of the sphere is the same as that of the circle measured along the major axis of the oval representing the circle.) Draw the vertical *c e* equal to *c d* and complete the cube; *a b c d e* will be a cube containing the sphere—that is, having each of its sides tangent to the given sphere; join *a* and *c*, *b* and *d*, by lines intersecting at *o*; *o* will be the point of contact of the sphere, and the face *a b c d* the points of contact with the other faces may be similarly found. From *g* draw the horizontal line *g j*; *j* will be the point where the sphere rests on the horizontal plane. It will be seen that the position

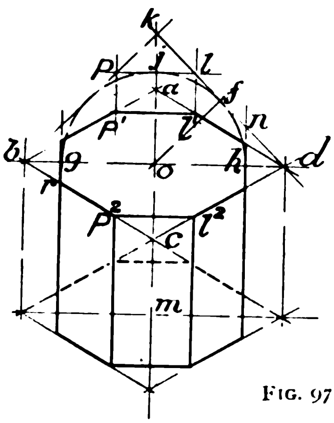


FIG. 97.

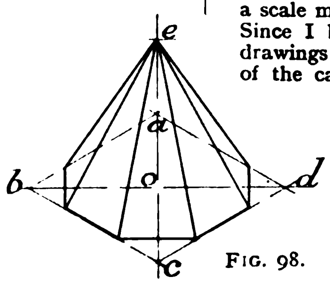


FIG. 98.

of a sphere may be defined by describing a cube containing it.

To determine the construction of a square pyramid set off the given base *a b c d* (Fig. 95), bisect the diagonals in *o*, and set off *o e* equal to the given height of the pyramid; lines joining *e* with the points *a b c d* will define the pyramid.

A cone may be defined by drawing the oval representing the base by the method previously shown, finding the centre *o* (Fig. 96) and setting off the given height *o e*; from the apex *e* draw lines *tangent* to the oval to complete the figure. Note that the lines drawn to the ends of the major axis of the oval, as *a f*, do not correctly represent it, as, on account of the superelevation of the point of sight assumed, a line further from the front than *e f* may be seen on the surface of the cone.

A further example is given in Fig. 97, which is a view of an octagonal prism. The octagon is first determined as contained in the square of which *a b* is one side; complete *a b c d*, draw the diagonals, extending the vertical to *k*, make *o k* equal to *b o*, join *k b* and *k d*, bisect *k b* at *f*; with radius *o f*, describe the semicircle *g j k*, draw *p l* tangent to the circle at *j*, project *p* and *l* vertically to p^1 p^2 and l^1 l^2, join p^1 l^1 and p^2 l^2; draw through *g* and *h* lines to meet the isometrical projection of the square, and complete the octagon. Set off the given length of the prism *o m*; *m* will be the centre of the base, which will be exactly as already constructed; lines joining the corresponding corners of the octagons will complete the figure. Note that in scaling off any dimensions, measure only on lines parallel to *a b*, *a d* on the horizontal plane and *o m* on the vertical plane; *g h* will *not* give a correct dimension, nor will p^1 p^2.

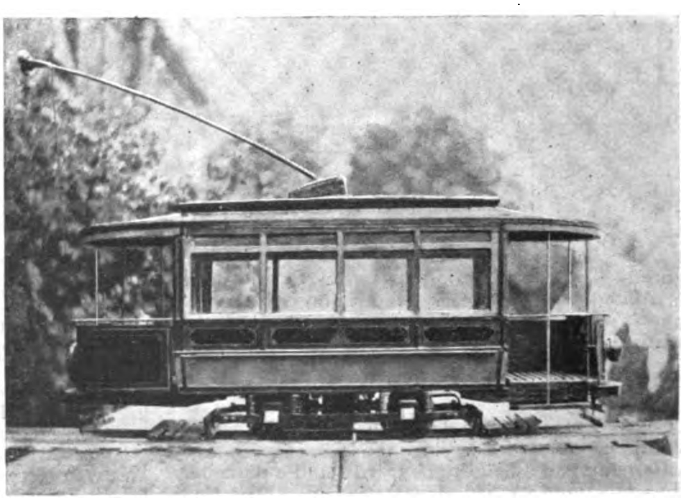
An octagonal pyramid is shown in Fig. 98. Draw the octagon to the given dimensions, set off *o e* equal to the given height, draw lines from *e* to each corner of the octagon, and complete the figure.

(*To be continued.*)

A Model Electric Tramcar.

By M. E. HARRISON.

THE accompanying photographs and drawings show an electric tramcar which I have just completed, the time taken to build it was about a year, during leisure hours only. It is not a scale model, although it is of correct proportions. Since I built it I have been able to make some drawings of the real car in the car-shed. The body of the car is made of cardboard, the sides being cut in one piece, and nine pieces being required for each end. To allow the door to slide open, four of the pieces extend one-third the width of the car. The doors, as well as the windows, are glazed with very thin glass. The roof is of cardboard, and is painted and lined inside and fitted with hand-rail and straps. The floor of the car



SIDE VIEW OF MODEL ELECTRIC TRAMCAR.

will lift up in four sections. The truck sides are cut out of iron sheet and riveted at the ends. The axle-boxes are made to slide up and down.

The motor is a " Don," and is geared 4½ to 1, and with a 10-volt accumulator develops sufficient

END VIEW OF MODEL TRAMCAR.

power to pull 15 lbs. easily, including the car's own weight (7½ lbs.). The method of fixing the motor is like that of a real car—part of its weight on the axle and part on the frame. Needless to

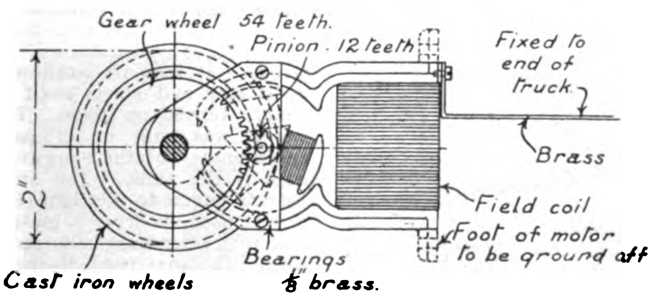
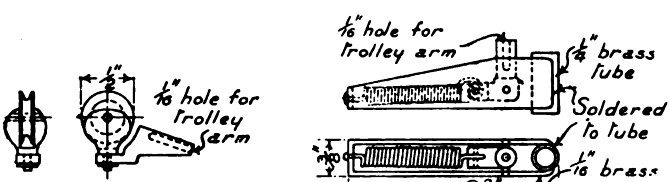


FIG. 1.—METHOD OF FIXING MOTOR TO TRUCK AND WHEELS. (*Half full size.*)



TROLLEY HEAD. (*Half full size.*)

TROLLEY BASE. (*Half full size.*)

FIG. 2.

add, I had to alter the motor to make it fit; the feet of the motor were first ground away, and new bearings were fitted, as shown in drawing (Fig. 1).

The wheels are of cast iron, and not having a lathe, and not knowing anyone possessing a lathe, I had to true them up as best I could. I first of all drilled them as near to the centre as possible, and then drove them on their axles and placed them in proper position in the truck. I then spun the wheels round and held a piece of chalk so near as to mark any uneven parts of the tread. I next filed them, and repeated the process till they were true.

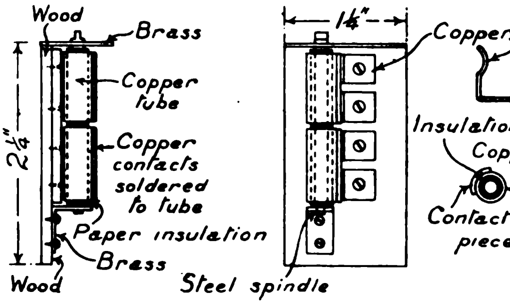


FIG. 3.—CONTROLLER. (*Half full size.*)

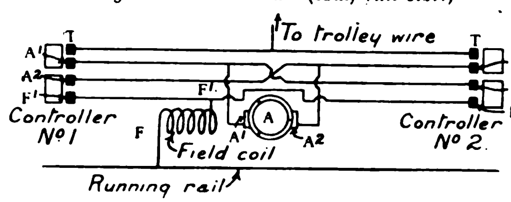


FIG. 4.—DIAGRAM OF CONNECTIONS.

The principal dimensions are as follows:—Total length of car, 1 ft. 9 ins.; total width of car, 5 ins.; total height of car, 8½ ins.; gauge of lines, 2¼ ins.; diameter of wheels on tread, 2 ins.; diameter of armature, 1¼ ins.; length of armature, ¾ in.

The armature is wound with No. 22 S.W.G. and the field-magnet with No. 18 S.W.G. The controllers (one for each end) are only fitted up to make the car go forward whichever happens to be the controller used. Drawings of controller and connections is shown (Figs. 3 and 4). The trolley pole is of the standard single deck type, and is 1 ft. long, as are shown in the drawing (Fig. 2).

The speed of the car is sufficient to make anyone run to keep up with it.

ASBESTOS in the form of waterproof slates is reported to have been placed on the market by a Munich manufacturer.

A CORRECTION.—In the article, " A Linesman's Galvanometer," in the issue of March 5th, 1908, the author points out that the paragraph headed " *The Pointer* " (page 223) should read: " so that it always hangs *vertically*, when not in use."

Practical Letters from Our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume if desired, but the full name and address of the sender MUST *invariably be attached, though not necessarily for publication.]*

Steam Model Showman's Plant.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—The accompanying photographs illustrate a set of model steam galloping horses, the result of some years' work in spare moments. As will be seen, they are made to take apart and pack up in the same manner as the prototype. Fig. 1 shows the set down, packed and ready for "the road."

Fig. 2 shows model partly erected and also the position occupied by boiler when working. A front view of the organ is shown in the centre, the decorations of which are made out of plaster-of-Paris worked on a wooden foundation. The "music" is supplied by a graphophone, there being plenty of room to conceal a 12-in. horn between the road wheels of centre truck, a piece of 1-in. rubber pipe connecting the horn with graphophone. This arrangement answers well, the sound apparently coming from organ case.

Fig. 3 gives some idea of the decorations. There are thirty-six mirrors and twenty-four "grotesque" heads made out of plaster-of-Paris besides some fretwork. The carvings are embossed paper glued on and gilded over.

Fig. 4 shows the complete model with its fifty-six horses, four abreast, the cranks which impart the galloping motion can be seen in Figs. 2 and 3. The over-all dimensions of set are 4 ft. 6 ins. diameter by 2 ft. 10 ins. high.

The engine which drives model is fixed in correct position, and is a double-cylinder, ½-in. bore 1¼-in. stroke. It does its work with great ease and starts itself by simply turning on steam. This engine was built up of parts ready-made, no lathe being available at the time. The small vertical engine to the right (Fig. 2) was used to drive a musical box with interchangeable metal discs; this has been discarded for the above arrangement for the supply of music and the engine retained only for appearance. The boiler is of the Smithies type and works well. At the left of the boiler another small vertical engine can be seen; it is intended to use this to drive a small pump to supply boiler. The whole of the revolving weight is carried on two sets of ball bearings. There are over 300 parts to put in position, many of them numbered, and it takes about six hours to build up model. Acetylene gas is used for illumination, but it is hoped at some future time to add a traction engine with dynamo to complete.—Yours truly,

H. C. BOUGHTON.

Tewkesbury, Glos.

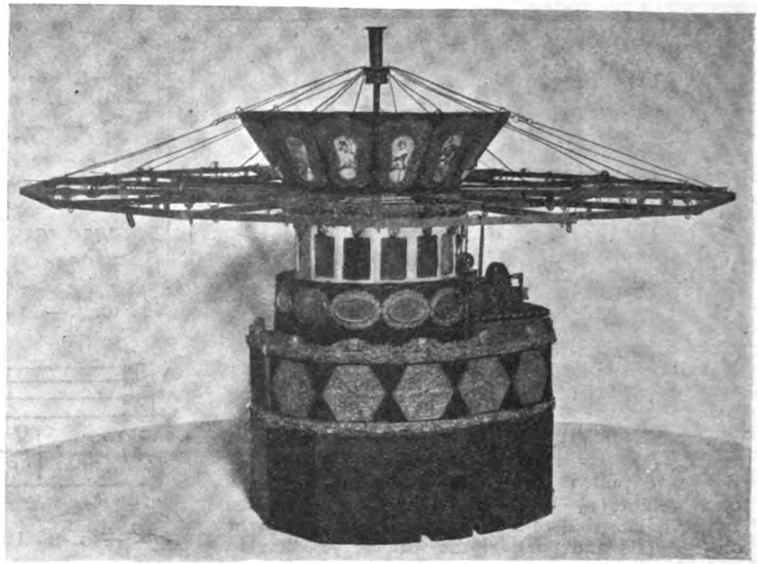


FIG. 3.—HORSES REMOVED.

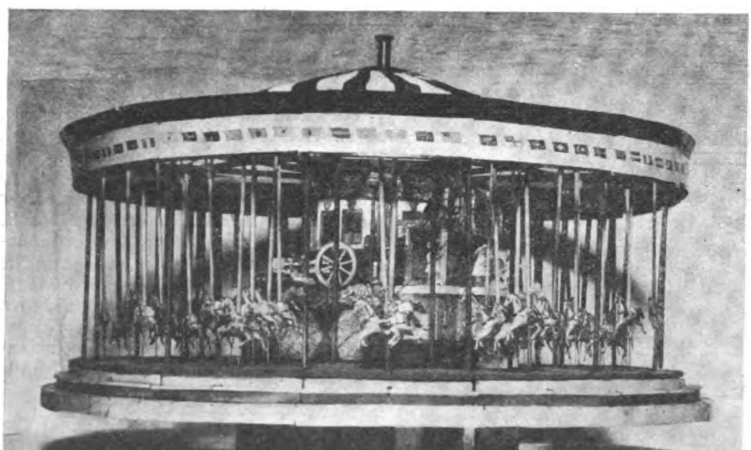


FIG. 4.—MR. H. C. BOUGHTON'S MODEL ROUNDABOUT AND GALLOPING HORSES.

For the Bookshelf.

[Any book reviewed under this heading may be obtained from THE MODEL ENGINEER *Book Department*, 26–29, *Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.]*

THE JUNIOR INSTITUTION OF ENGINEERS (Incorporated). Journal and Record of Transactions. Vol. XVII. Price 10s. 6d.; postage 4d.

This volume comprises the transactions and papers given at the Institution meetings during its twenty-sixth session, 1906-1907. The reproduction of papers and discussions of this enterprising Society makes a valuable and most interesting work. Besides the presidential address by Mr. Wm. B. Bryan, the following papers are included—"Bridge Erecting in South Africa"; "The Structural Design of Engineering Factories"; "The Protection of Inventions"; "Printing Machinery"; "The Relation of Surveying to Engineering"; "Stream Lines and their Application to Engineering Purposes"; "The Theory of the Steam Turbine"; "Water Supply"; and "Timbering of Excavations." Visits to Works, Inspections, etc., are recorded, and a list of members of the Institution is given. The illustrations accompanying the various papers are well reproduced.

THE result of the experiments in light visibility conducted by Germany and the Netherlands in harmony are given as follows:—A light of 1 c.-p. is plainly visible at 1 mile, and one of 3 c.-p. at 3 miles. A 10 c.-p. light was seen with a binocular at 4 miles, one of 29 at 5 miles, though faintly, and one of 33 c.-p. at the same distance without difficulty. On an exceptionally clear night a white light of 3·2 c.-p. could be distinguished at 3 miles, one of 5·6 at 4, and one of 17·2 at 5 miles. The experiments were made with green lights, but red lights of the same intensity can be seen at greater distances.

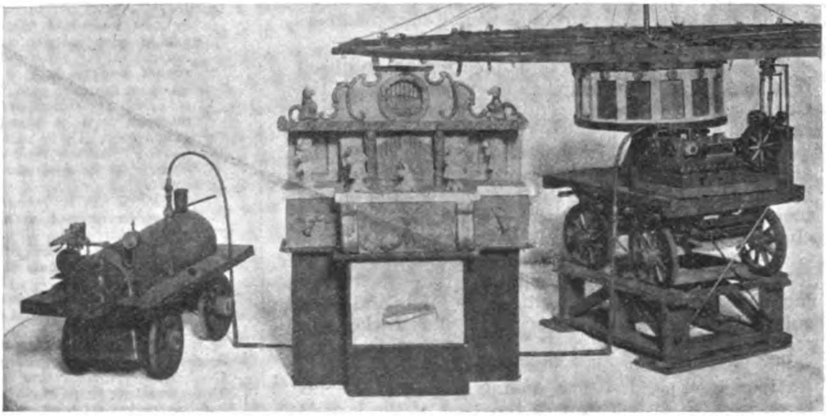


FIG. 2.—SHOWING ARRANGEMENT OF BOILER AND ENGINE.

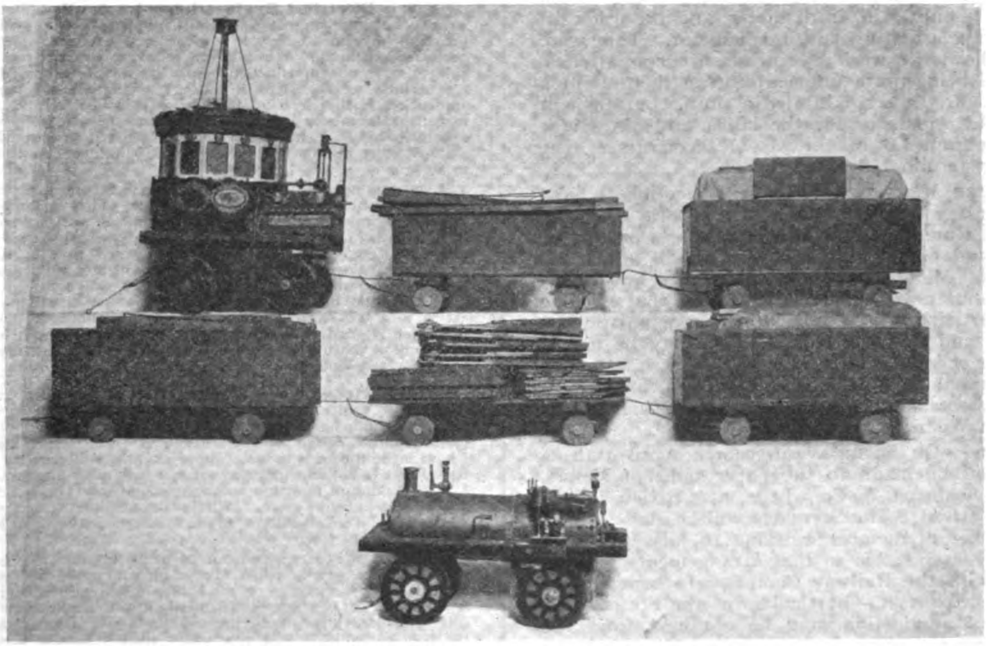


FIG. 1.—MODEL SHOWMAN'S PLANT READY FOR "THE ROAD."

The Society of Model Engineers.

London.

An ordinary meeting of the Society was held on Wednesday, March 18th, at the Cripplegate Institute, Golden Lane, E.C., Mr. A. M. H. Solomon taking the chair and seventy-four members being present.

The minutes of the previous meeting having been read and signed and four new members elected, the Chairman announced the dates of future meetings and visits as under; also that a launch trip was being arranged for June, and the question of the all-day visit in July was also receiving the attention of the Committee. With one or two announcements by the Secretary the formal business concluded, and the Chairman called upon Mr. D. Corse Glen for his lecture, and a very instructive discourse followed on the processes employed in the manufacture of iron and steel of different kinds and their suitability for various purposes, illustrating his remarks with blackboard sketches, and giving some very entertaining personal reminiscences in testing steel and other metals, concluding his remarks with an account of the trial of the largest fire engine yet constructed by Messrs. Merryweather preparatory to its shipment to Shanghai: some very interesting photographs were on view of this and other fire appliances. At the close, a hearty vote of thanks was, on the motion of Mr. Percival Marshall, accorded Mr. Glen for his interesting and instructive lecture.

Among the exhibits, two very small electric motors made and exhibited by Mr. R. A. Allman, excited much attention both by reason of their very small size and excellent construction and finish. The smallest one had an 8-cog drum armature only ⅜ in. in diameter, and the other an 8-cog ring armature 1 in. in diameter. They were both shown at work by means of dry batteries, one cell being quite sufficient to run them at high speed. Mr. Fraser exhibited a simple but efficient overhead apparatus for the lathe, and Mr. Ridge the side frames of his S.E. & C.R. locomotive. The meeting terminated at 10 p.m.

Future Meetings.—The next meeting is fixed for Tuesday, April 7th, at the Cripplegate Institute, when a Rummage Sale of models, parts of models, tools, and engineering materials of all kinds will be held. Members only are allowed to buy or sell goods, but new members elected on that evening may participate. As this is an opportunity when models and materials of all kinds may be picked up very cheaply, members who have not attended previous sales should make a point of being present on this occasion. The following meeting will be held on Wednesday, April 29th.

Visits.—On Saturday afternoon, April 11th, a visit will be made to the paper mills of Messrs. John Dickinson & Co., Ltd., at Croxley Green, near Watford. The Secretary will be glad to have the names of members wishing to join the party as early as possible so that arrangements may be made with the Railway Company to issue tickets at reduced prices.—Particulars of the Society and forms of application may be obtained from the Secretary, Herbert G. Riddle, 37, Minard Road, Hither Green, S.E.

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this Journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* The Model Engineer, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[19,180] **Construction of Primary Cells.** R. S. P. (Govan) writes: Could you give me any information on the following queries? I got a battery some time ago and it worked all right till lately. The connecting strips of carbons, I think, were of copper, and they got corroded right through. So I took them off and soldered on brass strips to connect the carbons. Since then I cannot get any voltages at all. The battery consists of four earthenware jars, with a porous pot inside of each for solution; for outside jar, sulphuric acid and bichromate of potash; the inside one, common salt and water. Do you think that the heads of the carbons require copper-plating again before I should have soldered on strips?

It is possible that if the carbon plates had been thoroughly cleaned and then coated with copper first of all, before soldering on the brass connecting-pieces, you would have got better results. It appears that there is a very high resistance, if not a completely broken connection, somewhere in your circuit, and you will have to find by trial the best means of eliminating such resistance. The contact between the carbon and the brass strip should be all right if the two surfaces are both clean and perfectly level, so that a good area of contact is obtained.

[19,197] **Electrical Engineering.** J. A. Y. (Stretford) writes: I should be greatly pleased if you would advise me on the following—I wish to become an electrical engineer. Is this a good trade to go to? Which of the following would be most suitable to serve an apprenticeship—in a contracting or manufacturing business, or an electrical station? What are the terms of apprentices in the electrical trade? Could you tell me of any works in Manchester district where I may be able to serve an apprenticeship? I should be greatly obliged if you would give me any other information on the subject that you may be able to do.

If you read our recent articles on "How to Become a Mechanical Engineer," you will get a lot of information, which applies equally to the electrical trades, as in order to become an electrical engineer it is essential to have a good mechanical knowledge also. You might also read the articles in Vol. VII on "How to Become an Electrical Engineer." We do not know of any particular firm in Manchester who have a vacancy, and you can only do as every other apprentice has to do, namely, make personal or written application to a few selected firms. We may say, however, that the profession is greatly over-run, and we do not advise you to take it up unless you feel you are well qualified and have a very great liking for the kind of work involved.

[19,132] **Alteration in Construction of Dynamo.** A. B. (Ladywood) writes: I should esteem it a favour if you would answer me the following query—I am making a small dynamo (30-watt) from design in your handbook (Kapp type, Fig. 11). I have made the fields to scale, also wound the bobbins with quantity of wire (1 lb.), but they will not pass each other over the fields. I was thinking of inserting another piece of iron between them; it will require about ¼ more. Will it make any difference as regards voltage, etc., if so, would you advise making a pattern and having them cast in one piece?

There are two courses you can adopt in this case to overcome your difficulty. First, either take a piece of wood and slightly flatten out your windings on the bobbin to an egg shape or oval. A very little out of truth will enable the two to fit on to the field-cores. Secondly, you could take off about one layer of wire on the bobbins, which would give you a slightly smaller diameter. The former method we should adopt ourselves, if we had to meet the difficulty without loss of time.

[19,043] **Hot-Air Engines.** J. F. G. (Wimbledon) writes: I should be greatly obliged if you could inform me with regard to the following—I am desirous of building a model hot-air engine, but do not know the right proportions for cylinders. I intend having the cylinders 3-in. bore. Would a stroke of about 4 ins. be right; and what bore and length should the displacer cylinder be; also, what length should the displacer itself be? If you can tell me of any book on the subject, I should be glad. Also, what power (about) would a model of this size give?

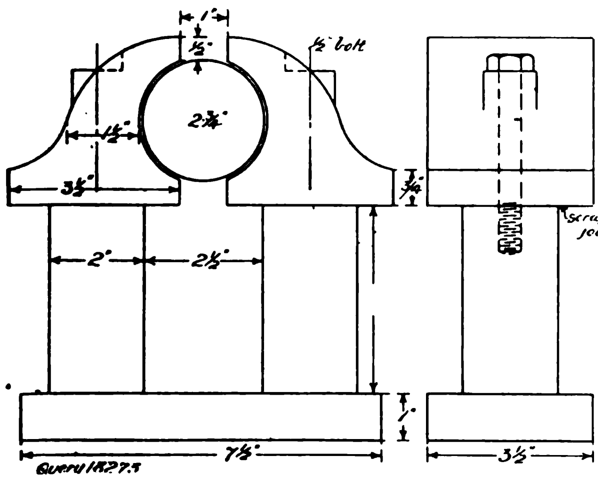
There are not many particulars published relating to hot-air engines, but if you will follow the instructions, and also keep to the *proportions* given, for the small hot-air engine described in our Handbook, "Small Mechanical Working Models," you should be able to turn out a very satisfactory engine. The powers developed by hot-air engines are exceedingly small for the size of the engine, so that if you require to generate any appreciable power, you will be well advised to go in for some other type of engine.

[18,889] **Model Yachtsmen.** A. C. G. (Glasgow) writes: (1) Can you oblige me with particulars where I could purchase a good safe blowlamp for a model steamer 5 ft. long? Say about price. (2) Why do you have so little about model yachting and model steamers in your paper? Why do you not make up and print a list of all the model yacht clubs in the kingdom, with particulars about the clubs, sailing places, colours, and sizes? (3) Why not add the canoeing recreation to your paper, with club list?

You could obtain suitable burner from Messrs. Moeller and Condrup, 78, Fore Street, London, E.C. With regard to your suggestions concerning model yachting and steamers, etc., we may say that we are only too pleased to make use of any information concerning club doings, etc., which our readers care to send us. It is well known that our pages are always open to our yachting friends, and as we say, we should be very glad to publish any particulars which come to hand. If you are interested in the subject, perhaps you would bear these facts in mind and send along any interesting information you may have.

[18,273] **150-Watt Dynamo Winding.** C. B. (Nottingham) writes: Being a regular reader of your valuable paper, I should esteem it a favour if you will answer me the following queries. I have a set of castings for a dynamo, as sizes on enclosed sketches, shunt wound. (1) What size wire shall I put on armature 12-slot drum, and how much? (2) What size on each magnet, and how much? (3) What voltage and amperage might I get? (4) What speeds? I should like the voltage and amperage to be as high as possible.

(1) Wind armature with No. 22 gauge D.C.C. copper wire, 12 coils wound two on each slot, and connected to a 12-section commutator. Slots to be 5-16ths in. wide by 5-16ths in. deep; get in as many turns as you can; should be about 42 per slot. Weight



FIELD-MAGNETS FOR 150-WATT OVERTYPE DYNAMO.

total of wire will be about ½ lb. (2) Wind field-magnet with 3 lbs. approximately No. 22 gauge S.C.C. copper wire on each core, the two to be connected in series with each other. (3) You may expect 30 volts and 5 amps. if gap clearance is made small between armature teeth and magnet poles. (4) Probably 2,700 r.p.m.; it must be determined by trial. You can increase voltage to some extent by running the speed up. We have selected a winding to give the output named as being a generally useful one for a machine of this size.

[18,186] **Shocking Coil; Cost of Accumulator Charging.** J. G. N. (Tenbury, Shropshire) writes: I should deem it a great favour if you would give me some information on the following queries—(1) My induction coil has six ends of secondary wire, three coming out of each hole; why are there six, and how do you connect them to the handles? It is an ordinary shocking coil. (2) My accumulator is 4 volts 2½ amps. It cost me 6d. to have it charged, and I want to have it charged about once a fortnight. Would it be cheaper for me to charge it with primary cells? Which would be the cheapest to make? Will it be injurious to have it charged only once a fortnight? If it is to lie by for some time, had it better be charged or discharged? Full of acid or empty? How many hours will it light a 4-volt H.E lamp safely?

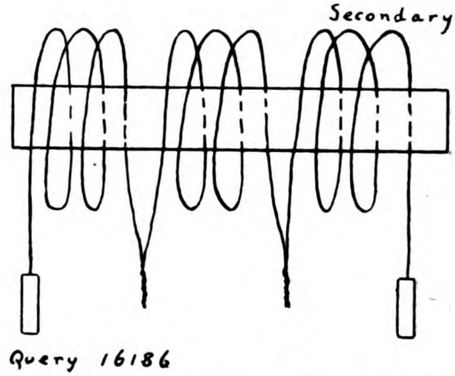


DIAGRAM OF CONNECTIONS FOR SHOCKING COIL.

(3) I find that the copper sulphate solution in my Daniell battery soaks through the porous pot and deposits copper on the zinc. What is the cause, and how can I prevent it? The porous pot is thick and entirely free from cracks.

(1) Various strengths of shock can be had by connecting the various ends to the handles in turn. If you find the two outside ends and connect them to the handles, and then join the other ends so as the middle section of the secondary is in series with the outer two, the full strength will be obtained. See sketch. (2) No. It would cost you, if anything, more to fit up primary cells and charge it yourself. Preferably charged and full of electrolyte; but, if disused for a long time, then discharged and empty. Depends upon candle-power of H.E. lamp, *i.e.*, the current it takes. You may reckon 3½ watts per c.-p. (3) The battery should be kept on closed circuit—*i.e.*, a very high resistance in circuit—when not in use.

[19,090] **Model Marine Boiler.** R. B. (London, E.C.) writes: I am about to make a boiler, which I want to supply a ¼-in. (outside) tube with steam continuously at 60 lbs. or 70 lbs. Would a return-tube boiler (as enclosed) do? This could be 12 ins. long, 4 ins. diameter, with one 1½-in. flue, seven ½-in. return tubes, and four ⅜-in. return tubes. I am rather doubtful if the draught would carry back all right. It is to be fired by a blowlamp. The alternative would be a 2-in. flue, with sixteen to twenty cross-tubes, say sixteen ⅜-in. cross-tubes. The boiler is to be fed by a donkey pump which I have made and tested to 60 lbs., and no doubt would do more. The return-tube boiler gives, on paper, 182 sq. ins. heating surface, and the cross-tube variety only about 60.

We do not understand you with reference to the statement that the boiler has to supply a ¼-in. tube. What engine is at the other end? The return-tube boiler will give good results if the draught is assisted by the exhaust. The furnace, however, may be provided with a few ½ in. diameter cross-tubes at the back end (combustion chamber end). We would recommend two flues instead of a single one, but, of course, a double-burner lamp will be necessary. There is a little difficulty in filling a 2-in. flue with flame.

[19,050] **Steam Port Proportions.** S. M. (Heywood) writes: I am making a launch engine (2 3-16ths-in. bore by 4-in. stroke). I wish for a little information. Will you please answer me the following questions? What size of steam ports shall I require? What should be the travel of eccentric? What size of steam pipe? Do you think an engine this size will develop ½ to ¾ h.-p., running at 500 r.p.m.? What size of boiler would you recommend?

For moderate speeds the rule given in "The Model Locomotive":

Length of ports	—½ diam. of cylinder	—1⅛	ins.
Width of steam port	—1-16th stroke	—¼	in.
„ exhaust	—½ „	—½	in.
„ port bar	—1-16th „	—¼	in.

Internal diam. steam pipe—¼ diam. of piston, say 9-16ths in. inside. At 50 lbs. pressure and 500 r.p.m. the indicated horse-power would be about— A×L—3¾×½—1¼ I.H.-P.

The boiler should have at least 2,000 sq. ins. of heating surface for ¾ to 1 h.-p. As to type, we cannot recommend any particular pattern until we know something more about the uses and situation of plant and also the fuel to be used.

[19,006] **Oil Engine Failure.** A. H. I. (Ashingdon) writes: I should deem it a favour if you could give me a clue to the following. I have a 1½ h.-p. oil engine which I am using to drive a chaff-cutting machine, the power required to drive same being 1 h.-p. I can get same to start easily enough and run perfectly for a matter of twenty minutes to one hour, when it stops and will not start again until it has stood some time, when I can start off again and it will do the same over again. I have had valves out and ground in and new piston rings fitted, and everything seems in perfect order. I have your book on "Gas and Oil Engines," but cannot gain any further hints on same. I might add it is a Petters oil engine, Yeovil make, which I bought second-hand, but it is practically new. It is fitted with ball governors, tube ignition.

It is almost impossible to say what is wrong with your engine from the description you give and without inspecting it. You do not say whether you do anything to the engine after it has stopped or whether you merely allow it to cool down somewhat before starting again. If the latter is the case, it points to the fact that trouble is due to either misfiring or to very excessive pre-ignition of the charge, or to one or other of the valves sticking up. Your best plan will be to carefully inspect the engine and compare its condition in every respect immediately it has stopped with the condition of things when it is in working order and ready to start. You are sure to find that something is different or something is not working as it should, and the natural sequence is to remedy this defect, whatever it may be. The exhaust valve sticking up very slightly would immediately produce the effect you describe. If you care to send us much fuller details and state exactly what you have done to put matters right, we might be able to give you some further useful hints on what to do, but with the present data we regret that we cannot suggest anything else than the foregoing.

[19,013] **Charging Cells.** H. J. G. (Llanberis) writes: Many thanks for your reply, but more especially the reply appearing in this week's issue to Query No. 18,708. I am going to ask you a few more questions on the subject again, as I am not quite clear and I cannot afford to go to all the expense of experimenting, so am compelled to worry you and to take all this liberty on your kindness. From your reply No. 18,708, January 30th, 1908, it is evident I am on the wrong track. I was under the impression that if the volts were right the "amps." would take care of themselves. In buying a 125-volt 4-amp. dynamo (1) Can I only charge 4-amp. cells? (2) How long would such cells keep one 16 c.-p. 100-volt lamp burning brilliantly? (3) What form of armature is the best for a shunt machine so as to be suitable for lighting direct and charging?

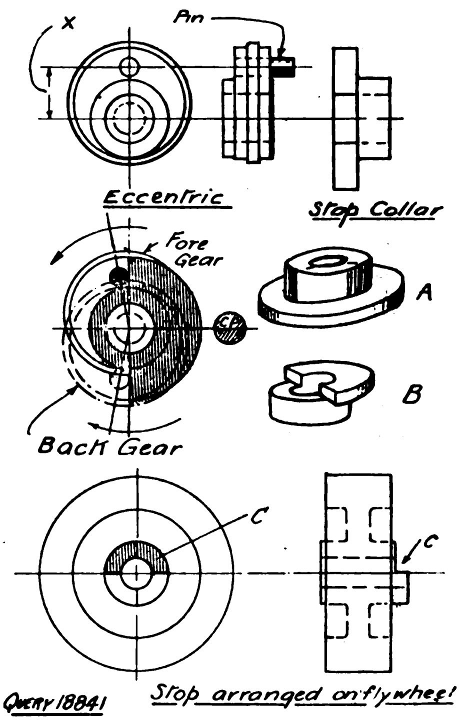
(1) In reply to your further enquiry *re* query in January 30th issue, we may say that you can only charge cells up to the maximum output of your dynamo. There is nothing to prevent you charging very large cells with the dynamo specified, but if the cells are such that their maximum allowable charging rate may be 8 amps., your dynamo having an output of only 4 amps., will only be capable of charging those cells at the 4 amps. rate—that is, at only half the rate which the cells can stand. The voltage, of course, must, as we said in our previous reply, be 25 per cent. higher than the cells to be charged. (2) A 16 c.-p. 100-volt lamp takes approximately 60 watts; say, therefore, if your cells are capable of discharging at 60 watts rate for ten hours, then they will also keep your lamp burning for ten hours before they begin to run down. You do not make it clear whether your cells are 4 amp.-hour cells or whether they are able to discharge at the rate of 4 amps. (3) We should use a drum-wound armature.

[18,822] **Model Locomotive Boiler.** W. A. (Cardiff) writes: I am making a 1-in. scale G.W.R. locomotive, and enclose partly finished drawing of boiler (3⅞-in. barrel). As you are aware, this type of engine has a raised firebox and has no dome. The barrel is to be made of 1-16th-in. copper tube, and the firebox plates will also be 1-16th-in. copper. I should be obliged for information on the following—(1) Can I make the front tube plate and the front and back outside firebox plates of cast brass ⅛ in. thick, and will they require any long stays if made of this metal? (2) On the drawing is set out the full size of tube space. Will you please tell me the best size and spacing of these? I intended putting in 9-16ths-in. tubes, but find that this is not a standard size, they being only made in ⅛-in. sizes over ½ in. (3) I intend using a plug cock for regulator of engine. I shall fix it in raised firebox, so as to get dry steam. Will you please give me sketch of a suitable arrangement, showing size of steam pipe for two 1¼-in. by 2-in. cylinders. I thought of bringing steam pipe through boiler and then making a coil in smokebox for a superheater. I have your book on "Model Boiler Making," but find no information on these points in it, and should be much obliged for any information about them.

(1) The design you send is hardly up to modern requirements. The best is not made of the available space. The barrel should be 4¼ ins. or 4½ ins. diameter, and so that the firebox may pass between the frames, the side sheets should be pinched in, the over-all width being 4 ins. bare. (2) We strongly advise you to get "The Model Locomotive: Its Design and Construction," by H. Greenly. It will save you its cost in a very few months. One inch scale model locomotive building is not quite an inexpensive hobby, and you require to be sure that your designs have reasonable chances of success before spending money on materials. For oil fuel tubes may be ½ in. or 9-16ths in. (9-16ths in. diameter tubes can be obtained); for solid fuel ⅝ in. or 9-16ths in. You will find setting out diagrams in the above book. (3) A plug cock regulator is not to be recommended for such a large boiler. Fit a superheater by all means. You cannot have referred to Fig. 22 in "Model Boiler Making." You may, of course, use gun-metal castings for some of the flanged plates. These should be 3-32nds in. to ⅛ in. thick, and should be hammered to close up the pores of the metal.

[18,841] **Slip Eccentric Reversing Gear.** F. H. (Mildmay Park) writes: I am making a double-cylinder launch engine (⅞-in. by 1⅛-in.), and should be obliged if you could tell me how same can be made to reverse by slotting the eccentric sheave. What length should slot be, etc.?

The simplest and most efficient method of arranging a small engine to reverse is by means of the "slip" or shifting eccentric.



SLIP ECCENTRIC FOR MODEL LAUNCH ENGINE.

Do not slot the eccentric sheave in any way, but fix a pin in one side, as shown in the accompanying illustration, and make a separate "stop," as shown. The pin may be placed exactly on the centre line of the eccentric, and the distance X and the diameter of the pin should be designed to give the proper amount of advance to the eccentric, according to the lap of the valve. By placing the pin in this position and choosing the right diameter (for the lap), the stop collar (which should be first turned up, as shown at A) may then have half its flange exactly filed away, as indicated at B. The pin will engage the face of the flange of the stop collar and drive the eccentric either in the proper forward or reverse direction, according to which way the engine is started. The relative positions are shown in full and dotted lines in the diagram. It will be noticed that the face of the flange of the stop collar is exactly at right angles with the crank-pin: therefore, presuming the pin in the eccentric is placed in the correct position, the work of setting the valves will be reduced to a minimum. Where the lap is considerable, it may be necessary to file not quite half of the flange of the stop collar away, but to leave 1-32nd in. or 1-16th in. on each face, according to the angle of advance of the eccentric required. In a double-cylinder marine engine you may find it difficult to arrange the stop collar on the flywheel end: therefore, to economise space, the stop collar may be formed out of the boss of the flywheel, as indicated at C, the part C in the left-hand view, shown shaded, being cut away. The eccentric is designed full size for a valve having 5-32nds-in. travel, with 1-64th-in. lap and steam ports 1-16th in. wide, the crankshaft being ½ in. diameter. The flywheel drawing is not to scale.

[19,246] **Induction Coil Supply Voltage.** G. H. (Glasgow) writes: I would like to avail myself of your services, through your query department. I have your handbook on "Induction Coils," but would like your advice on the following. I have the material at hand and wish to utilise it. *Re* your tables in handbook, you state an E.M.F. of 12 volts is essential, which will give 4 amps., but the primary wire in Table I is 14–19 yards No. 14 S.W.G., but the above wire (in Table I) is only ·673 to ·913 ohm, would you please enlighten me?

When a current is flowing in a circuit, and the circuit is repeatedly broken and then made again, there is a high back E.M.F. set up in that circuit which opposes the flow of current. The effect of this is similar to that of introducing a higher resistance into such circuit, so that although your primary wire has a low ohmic resistance, yet, due to the self-induction of the coil, the actual flow in amps. is comparatively small. You will find by trial what is the most suitable voltage to apply to your coil, and you should adhere to the one which gives the best results.

[19,030] **Gas Battery.** N. H. (London) writes: I should esteem it a favour if you would let me know if you have at any time published details of a gas battery in your paper and whether same are procurable at your office, or of any book explaining them.

Some particulars of a useful gas battery were given in our issue for Nov. 15th (Vol. VII). You will also find some useful information on this subject in "Primary Batteries," by Cooper, price 10s. 6d. or 10s. 10d. post free.

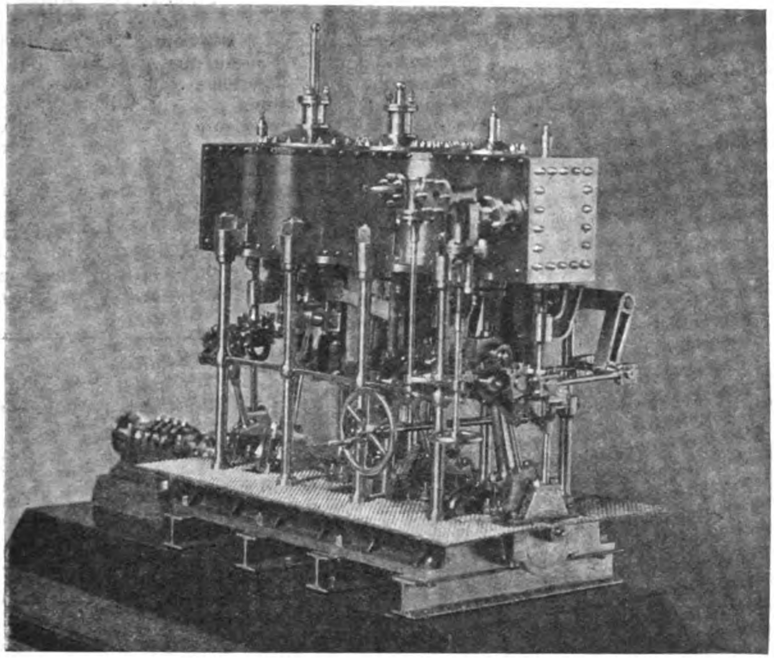
The News of the Trade.

[*The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.*]

* *Reviews distinguished by an asterisk have been based on actual Editorial Inspection of the goods noticed.*

Model Marine Engines.

Herewith we reproduce a photograph of a model T.B. engine, just completed by the Hanway Engineering Works, 8, Hanway Street, Tottenham Court Road, London. The cylinders are 19-32nds in., 29-32nds in., and 1½ ins. by 1¼-in. stroke. All cylinders are steam jacketed, the exhaust steam passing from one cylinder to the other round the jacket. The finished model may be seen at the above-mentioned works. Castings are also supplied with nine sheets of full-size drawings to amateurs desiring to build such a model. This firm is at present constructing a very fine model to scale of the 3-cylinder compound marine engines of the s.s. "Arizona." Castings and drawings of these engines may also be purchased. This is claimed to be a very complete and perfect model, and amateurs and others who desire to build a marine engine should write to the Hanway Engineering Works for further particulars, and mention The Model Engineer.



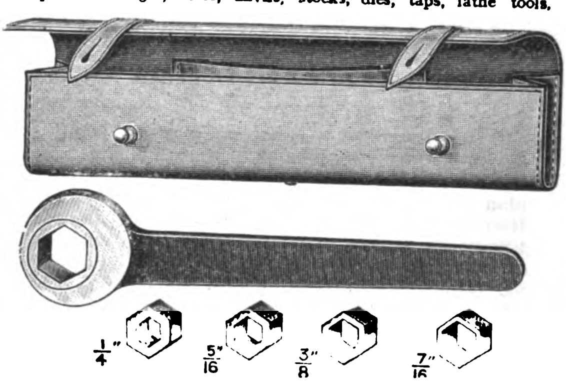
Model T.B. Engine, by the Hanway Engineering Works.

A Ratchet Spanner.

One of the latest novel and useful tools manufactured by Avery and Roberts, Ltd., of 64, Stanley Street, Liverpool, is the new patent Auto-Ratchet spanner illustrated in the accompanying engraving. The spanner is constructed on the "free-wheel" principle, having a pawl and ratchet internally fitted, and when placed on a nut it is unnecessary to remove until the operation is completed. It is useful for work in confined places. To meet the requirements of motorists and others, the spanner is fitted with four adapters to take nuts ranging from ¼ in. to 7-16ths in., so that five sizes of nuts can be taken. The set is put up in a neat leather case, as shown. For further particulars of this and other "Auto" specialities, readers should send for the new list for 1908. The adapters can also be had in French sizes.

New Catalogues and Lists.

Henry Osborn, 96, Westgate Road, Newcastle-on-Tyne.—The illustrated catalogue of tools for engineers and other metal-workers comprises specifications of a number of lathes specially suitable for amateurs, small drilling machines, lathe accessories, portable forges, vices, anvils, stocks, dies, taps, lathe tools, grindstones, screw-cutting gauges, micrometers, squares, hack-saws, polishing heads, buffs, brushes, moulding tools, etc. The list will be sent post free for threepence to readers of this journal upon application. We have also to hand from this firm a price list of material and fittings for model work, such as solid-drawn tube, brass sheet, copper rivets, screws, bolts, nuts, pressure gauges, wheel valves, water gauges, force pumps, check valves, lubricators, etc. This list will be sent post free for one penny stamp.



A New Auto Ratchet Spanner

The Editor's Page.

WE have received several replies to our request for information regarding the supply of "Dunalastair" castings, and if any readers wishing for a set will communicate with us, sending stamped, addressed envelope for reply, we will tell them where the castings can be obtained.

* * *

We give below the results of our two recent competitions, Nos. 43 and 44. For the most part the papers in both competitions are good, and in many cases the matter is based upon the actual practical experience of the writer. For the best article on "Finishing Model Engines" we are awarding the prize of two guineas to

Rev. J. SHORES,
Westbrook Villas,
Darlington.

Some good papers have been sent in by E. Howlett (Teddington), *Highly Commended*; G. R. Wright (South Norwood, S.E.) and James Aitch (Aston Manor), *Commended.*

* * *

The prize of two guineas for the best article on "Small Dynamo and Motor Testing" is awarded to

BARTON MOTT,
9, Kimberley Road,
Rugby.

The following entries are deserving of mention.:—F. H. Souden (Preston), *Highly Commended*; W. R. Armstrong (Ilfracombe), F. E. Goodden (Walthamstow), G. Chadwick (Trawden), and A. Hayward (Wolverhampton), *Commended.* We shall publish the prize articles in THE MODEL ENGINEER in due course, and may also utilise the hints in some of the other articles.

Answers to Correspondents.

E. B. B.—In reply to your enquiries *re* composition and chemical and physical changes in steel under the influence of heat, your best plan will be to refer to the report of the Alloys Research Committee of the Institute of Mechanical Engineers, a copy of whose proceedings may be obtained from the Secretary, Storey's Gate, St. James's Park, Westminster, S.W.

COOKE (Chelmsford).—Mr. Pentney, of Derby, tells us that you did not send him your address, and he is therefore unable to send you the post-cards till he hears from you.

E. H. E. (Lewisham).—Thank you for your letter.

R. G. T. (Tufnell Park).—Thank you for your letter. Will try and insert next week.

Re CALEDONIAN CASTINGS.—The following correspondents are thanked for their letters, contents of which have been noted for use as occasion arises:—E. P. (Maldon), W. H. D. (Clapham), H. W. D. (Lincoln), W. D. C. (Bristol), H. V. H. (Liverpool).

J. D. (Rotherham).—(1) Not more than ·75 amp. (2) About 1·5 amp. (3) This is proportional to the resistance of the circuit. See some text-book on Elementary Electricity.

C. D. H. (North Ferriby).—If you will send a stamp for reply, we will give you the address of our contributor, who will inform you where he obtained his castings.

E. A. (Bishop Auckland).—Your letter *re* North-Eastern engine is having our attention, and we will endeavour to publish the particulars you require without delay.

T. C. (South Shields).—Use a paraffin blowlamp.

W. J. F. (Hexham).—We thank you for your interesting post-card, and shall be pleased to receive a larger view of the model when quite finished.

J. B. (Banbury).—We do not think there are any castings to be had for the detachable cycle motor you refer to. Pleased to hear you have such satisfactory replies to your advertisement in our "Wanted" column.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 26-29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

Sole Agents for United States, Canada, and Mexico: Spon and Chamberlain, 123, Liberty Street, New York, U.S.A., to whom all subscriptions from these countries should be addressed.

Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 363. APRIL 9, 1908. PUBLISHED WEEKLY.

A Royal Engineer's Model Locomotive.

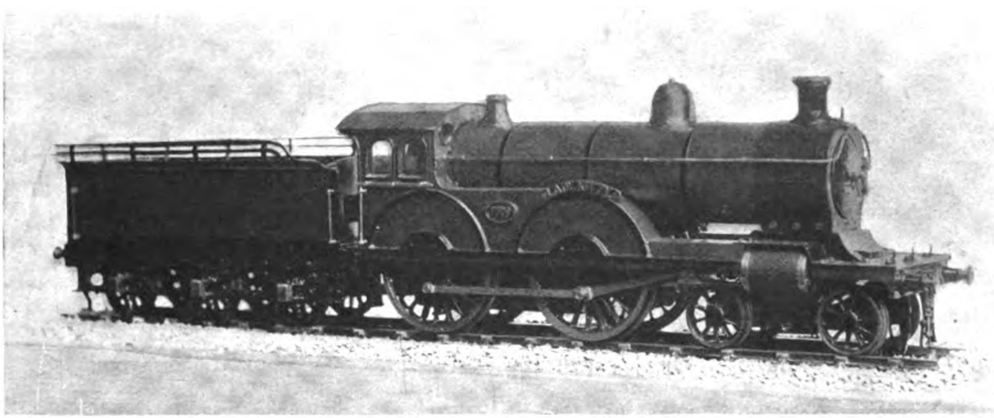


FIG. 1.—MR. R. S. HOLMAN'S MODEL LOCOMOTIVE.

THE accompanying photographs illustrate a ½-in. scale locomotive which Mr. R. S. Holman, a lance-corporal in the Royal Engineers, stationed at Cardiff, has built from castings and material obtained from advertisers in this journal. In describing the work, he says :—

The castings, etc., were intended to make up into a model of a North-Eastern engine, but having made several alterations—which appear to me to be improvements—I suppose it is now a nondescript, and not a model of any particular type.

The frames are of planished steel, and the splashers, cab sides, and front saddle, front buffer beam, and footplate, and frames for tender, etc., are iron castings.

The cylinders, which are of gun-metal, are 7-16ths-in. bore by 1-in. stroke. The guides are of steel, and are fastened at the cylinder end to a collar which slips over and is a good fit on the stuffing-box, and at the other end they are fastened to a bracket, which is secured to frames. The crossheads are of brass, with steel sides pinned on. Slip reversing gear was shown on the drawings supplied, but I have fitted a motion-plate and link gear. The eccentrics were turned from brass rod and secured to driving axle with setscrews. The straps were roughly cut from brass sheet and turned, all the rest of the gear being of steel, with the exception of bushes. As will be seen in the photograph (Fig. 2), the weigh-shaft is under the motion, and is carried in two brass brackets suspended from frames.* The reversing is done from the cab, with a lever and ratchet in the usual way. The coupled wheels are mounted on coil springs, two being fitted to each bearing. Spring buffers and drawbars are fitted throughout, buffer sockets being of brass and the heads steel. Screw couplings are also fitted, and were made from wire nails, and answer the purpose very well.

The boiler is made of 2-in. solid-drawn copper tube, with gun-metal ends and three ¼-in. water-tubes. The whole is silver-soldered together, and I have tested it to 100 lbs. per sq. in. with air-pressure. The regulator handle is in the usual position in the cab, and the regulator itself is fitted in the smokebox, and is connected to the handle with a ⅛-in. brass rod, reduced to 3-32nds in. at the cab end where it passes through the gland.

The smokebox door, as supplied with the castings, was a dummy and cast in one with the smokebox front; this I cut out, and fitted a proper hinged door, and I find I have still plenty of room to get at the unions of steam pipes, etc., with a small spanner. Hand-rails and knobs are of steel, and the name and number plates are of brass, and were made by cutting out the letters and figures and soldering them on to brass plates.

Mica is fitted in the look-outs and windows, and is clipped behind brass frames fitted inside the cab. The tender body is built of steel and is riveted throughout, angle-brass being used for the corners. The coal rails are made from copper hammered flat, and I find this answers the purpose very well, as the hammering hardens the copper. These are also riveted to the brackets which carry them, the heads of large brass pins well annealed being used as rivets. The spirit tank is fitted in the body of the tender, and is fitted with a needle valve and visible drip.

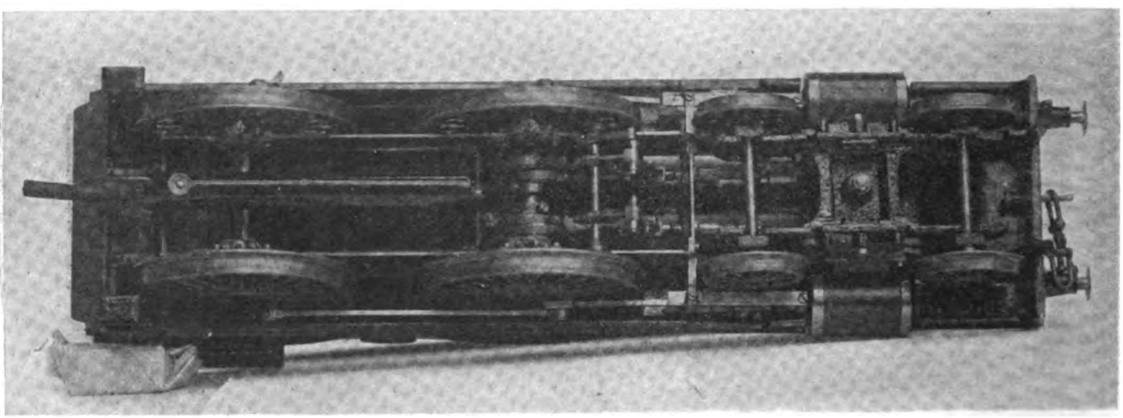


Fig. 2.—Underside View of Mr. Holman's ½-in. Scale Model Locomotive.

I have not sufficient track yet to give her a fair run, but I have had her tied up, and she slips round on the rails so far satisfactorily.

The engine and tender measures 26½ ins. over all and weighs 18 lbs. I have painted her holly green, picked out with black, with the buffer sockets, beams, underside of cab, roof, and the ground of name and number-plates red. In conclusion, I may state it took me all my spare time during seven months to complete.

A Limited Company has been formed to carry on the work of organising and managing the well-known annual Edinburgh and Midlothian and Industrial Exhibitions. The title of the Company is The Scottish Home Workers' Exhibitions, Ltd., and the Secretary is Mr. A. T. Hutchinson, 15, Leith Street, Edinburgh, who has been the moving spirit in these exhibitions since their foundation in 1897. It is intended to hold exhibitions similar to the Edinburgh one in several of the larger Scottish towns.

Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "Workshop" on the envelope.]

Plating Small Articles with Brass.

The method followed in the United States for depositing brass upon small articles, such as cigar-box nails, rivets, and safety-pins, is explained by Charles H. Proctor in *The Metal Industry*. The plating barrel is used, or a regular plating bath with woven wire baskets. The sides and ends are made of celluloid, hard rubber, hard wood, or some other non-conducting material. The bottom of the basket is made of woven brass wire of a mesh so small that the articles will not pass through. Heavy conducting wires should lead from the woven wire in the shape of hooks or supports to hang the baskets upon the negative pole while the depositing is being done. The following formula should be used for the bath:—

Water, gallons	25
Cyanide of potassium, 98 per cent., pounds	25
Carbonate of copper, pounds	10
Carbonate of zinc, pounds	5
Carbonate of soda, pounds	4
Ammonia water, 26 per cent., pints ..	2 to 3

A voltage of not less than 6 should be used, with a good amperage. The articles may be cleaned by tumbling in carbonate of soda water after the regular tumbling has been performed. A tumbling barrel may be used made up of wood, and rotated slowly. The negative conductors should be small strips of copper. On the outside of the barrel are two copper bands. Provision is made by incisions in the barrel to make connections with the anode and the conductors in the baskets. The current is taken by the copper bands by spring contact strips, and thence to the anodes and cathode or basket. The time of deposit should be from twenty minutes to half an hour. An angle barrel will be found the best, and it should be of such size as to plate from 50 to 100 lbs. at each immersion.

Attachment for Dividing on a Lathe.

By A. Norgate.

Having greatly admired the extreme accuracy and care with which several contributors have constructed a dividing wheel, it struck me that a more ready method might be adopted, although the scope of division would thereby be limited. The following attachment I devised, and find that for most purposes it works very well. It is easily and very cheaply constructed, more accurate than a badly made dividing wheel, and far more rigid than the most expensive. The drawings show the device clearly, and although fitted to a Drummond 3½-in. lathe it could be easily adapted to any other screw-cutting lathe.

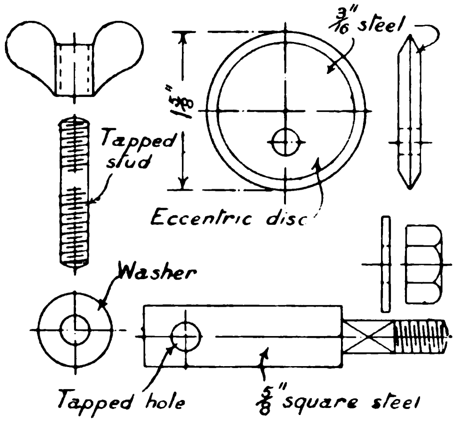


Fig. 1.—Details of Dividing Attachment. (*Half full size.*)

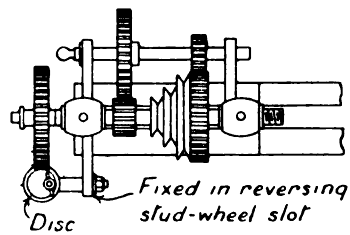


Fig. 2.—Showing Dividing Attachment on Lathe.

A Device for Screw-making.

By H. S. Cooke.

Having seen a device some time ago for screwing metal to make screws, I arranged the addition shown in the drawing—Fig. 1 being the front elevation, and Fig. 2 the side elevation; the advantage being a constant feed, and allowing both hands free, instead of having to turn the loose headstock wheel. The same method of calculating the size of step pulley required to cut a certain thread is used as with the screw-cutting lathe, the headstock screw and pulley being taken as the leading screw and wheel. The intermediate wheel is on the left of the countershaft, and may, of course, be of any size, held in position by a screw with a countersunk hole, each end of the shaft having a collar, the bearings being made of brass tube with set screws to prevent turning. All the pulleys may be made of wood, and the dimensions in accordance with lathe.

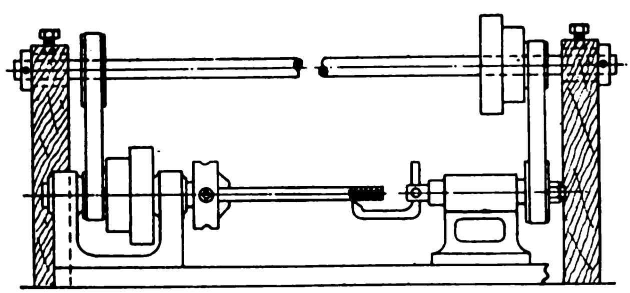


Fig. 1.

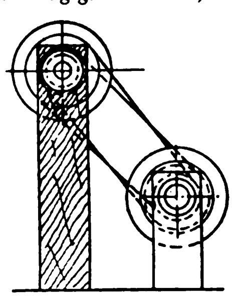


Fig. 2.

A Device for Screw-making.

Tinning by Immersion.

By C. J. T.

Well clean the articles to be tinned in a weak solution of hydrochloric acid, and then boil them in the following solution for about 30 minutes.

Tin (Granulated)	1 lb.
Bitartrate of Potash	1 oz.
Alum	1 oz.
Common Salt	1 oz.

They will then be found to have a good deposit of tin. If a lot of articles are being tinned, the strength of the solution should be maintained by the addition of small quantities of the ingredients as required. The tin can be granulated by pouring it into a perforated ladle, allowing the small streams of molten metal to drop from a height of about 3 ft. into a pail of water. The tin will then be in the form of small irregular flakes, which expose a very large surface to the action of the tinning bath.

Withdrawing Broken Taps.

Getting broken taps out, says a writer in the *American Machinist*, is, in one shop at least, performed by pouring hydrochloric acid into the hole. The acid is left there for about four minutes, and enough of the tap and the hole is eaten away to loosen the tap.

The first 60,000-volt hydro-electric plant in Japan has just been put into service. Power is obtained by impounding the Ugigawa River, a narrow and swift, but deep river. The normal capacity of the main station is 18,000 kilowatts, and is furnished by six 3,000-kilowatt, 50-cycle, 6,600-volt water-wheel-driven alternators.

How It is Done.

[For insertion under this heading, the Editor invites readers to submit practical articles describing actual workshop methods. Accepted contributions will be paid for on publication, if desired, according to merit.]

Making Model Ship's Ventilators.

By A. J. Budd.

HAPPENING to call on a friend of mine, Mr. H. Hughes, recently—who, by the way, is an enthusiastic model engineer—I noticed some well-proportioned model ventilators which he had just made for fitting to a boat then in course of construction. As the method employed in making these fittings struck me as being rather novel, I thought the following particulars might prove of interest to some readers of "Ours." The metal used is good soft No. 22 B.W.G., or about 8-lb. copper; hard rolled or bright copper should not be used, as it is not so easy to work. Each ventilator is composed of two pieces, of the shape shown in Fig. 1, the part *a* forming the mouth, and *b* the stem. The sizes given are right for making a ventilator with a mouth opening of 1 in. diameter, which is about the smallest size that can be made satisfactorily by this method. If a larger size is required, the size of these pieces must be enlarged in proportion to the size of mouth opening and diameter of stem required. Templates of sheet tin should be cut out first if a number of ventilators of the same size are to be made, as this will facilitate the marking out of the copper. Having cut the parts to the shape required the part *a* should be taken in hand first, and must be "drawn" with a wooden mallet, as shown in Fig. 2, by means of the tool *c*. A round-headed rivet of suitable diameter would answer the purpose very well, and should be held in the vice, the copper being held in position by the finger and thumb while it is gradually beaten to the necessary shape. An alternative method of shaping or "drawing" is by means of a block of lead in which a shallow saucer-shaped indentation is made, into which the part *a* is beaten with the ball pane of a hammer, as shown in Fig. 3. In any case, the novice will find that the metal will shape itself better if started in the lead block. The pane of the hammer should be of a somewhat smaller diameter than the diameter of the finished curve or belly of the mouthpiece. The copper will shape itself from the "flat," and will

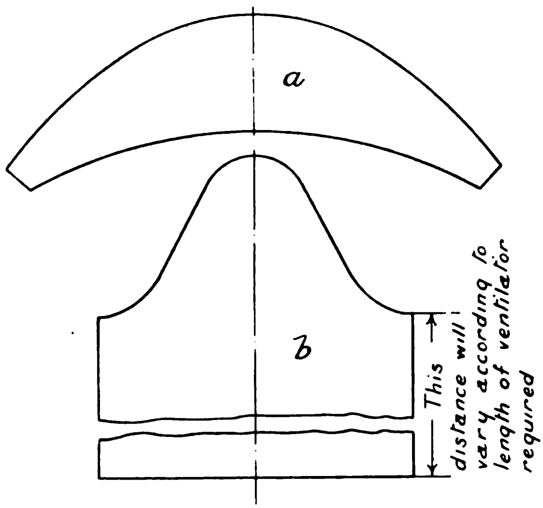


Fig. 1.—Showing Shape of Pieces forming Model Ventilator.

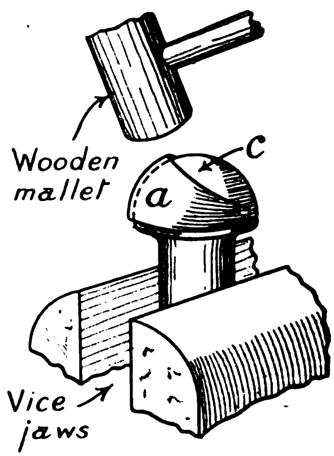


Fig. 2.—Method of "Drawing" or Stretching the Copper.

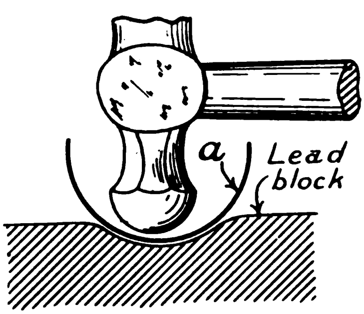


Fig. 3.—Beating the Cowl of Ventilator to Shape in an Indentation in Leaden Block.

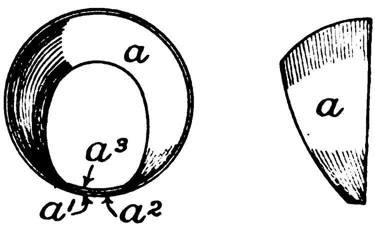


Fig. 4.—Showing shape of Cowl after Beating and "Drawing."

only require a little "humouring" with the fingers and thumbs to form a circular mouth.

The two ends *a*1 and *a*2 (see Fig. 4) should now be joined, and a small strip of metal *a*3 soldered on for additional strength, while the final shaping is being done on tool *c*, Fig. 2. After this has been done, the part *a* will appear somewhat as represented in Fig. 4. The part *b* can now be taken in hand, and should first of all be bent to a cylindrical shape, as in Fig. 5. This is best done by beating the copper round a metal mandrel of a slightly smaller diameter than the finished stem. A round wooden mallet with a nice flat face is very handy for this. The edges *j*, *k* must now be filed thin and a lap joint of about ⅛ in. made as shown at *h* and well soldered. The edges *c* and *d* are now spread or stretched with a ball pane hammer on an anvil, or a piece of steel or iron with a rounded edge, as indicated by Fig. 6, until the mouth of the stem assumes the shape shown by the dotted line *e*, Fig. 5. The top part *f* must be "drawn" forward as at *g* by means of a ball pane hammer and lead block before mentioned. The mouthpiece and stem can now be held together in their relative positions, when it will no doubt be found that a small amount of trying or "humouring" will be necessary to ensure a nice joint. After

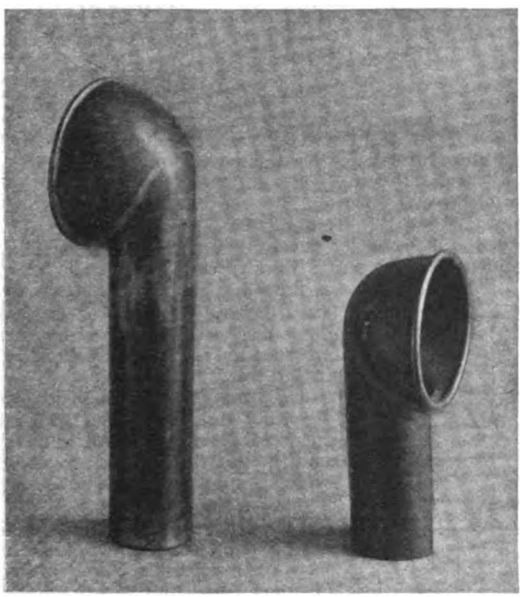


Fig. 7.—Ventilators ready for Painting.

this is done they can be soldered together, and all superfluous solder scraped away and emery paper applied to obtain a clean join. This join is clearly shown in the photograph, Fig. 7. A piece of brass wire, about 1-16th in. diameter, can be soldered round the mouth of the ventilator, which gives the fitting a very neat appearance (see Fig. 7). This wire edging should be left bright, the other parts being painted the desired colours. Before painting, a thin brass washer should be soldered on near the bottom of stem, as shown by Fig. 8, to form a flange by which the fitting can be attached to the deck. As regards the solder to be used: for those who are unacquainted with the mysteries of brazing, soft solder will answer the purpose very well, but for

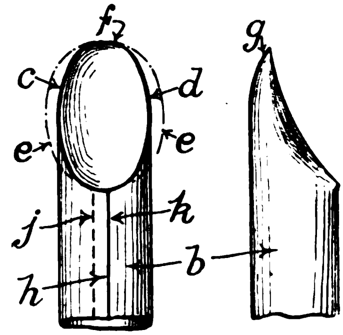


Fig. 5.—The Stem of Ventilator partly finished.

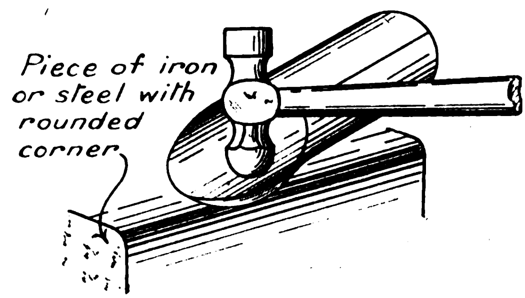


Fig. 6.—Method of Stretching or Widening the Mouth of the Stem.

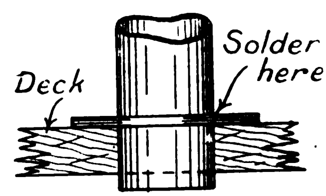


Fig. 8.—Flange Support for Attaching to Deck.

a good strong job silver soldering or brazing is, of course, preferable. I may mention that beginners will find a little experimenting necessary before they "turn out" a satisfactory ventilator by this method, but after the little difficulties met with at first have been mastered, they will find the results well worth the trouble expended.

A competition class for models of various kinds is announced in connection with the Skegness and District Second Annual Horticultural, Poultry and Pigeon Show, to be held on Thursday, August 13th, 1908. Full particulars, and entry forms may be obtained from Mr. W. G. Pick, Grantham House, Wainfleet Road, Skegness.

Chats on Model Locomotives.

By Henry Greenly.

(*Continued from page* 319.)

III.—Smokebox Doors for 1¼-in., 1½-in., and 2-in. Scale Engines.

OTHER important features of model locomotive boilers are the respective arrangements for smokebox front and firehole. Now that the circular smokebox as a feature of British locomotive practice has come to stay, and so many locomotive superintendents have recognised its advantages, no apologies are needed for suggesting it as a standard for working models which have no pretensions to being replicas of particular prototypes, but are rather designed to give the best results under actual working conditions with the least possible labour and expense. As Mr. W. J. Tennant, when giving one of his delightful discourses before the meeting of the S.M.E. some time ago, remarked, the questions of engineering are really questions of £ s. d.; and in model work the same obtains. Therefore, in suggesting castings for smokebox front in place of sheet work, the builder must consider which will come out cheaper. Where two or more engines are likely to be made, the use of castings will undoubtedly prove less expensive, and for one engine there will not be much to choose, and, owing to the better finish which can be obtained with less labour in erecting shop, the latter method may be given the preference.

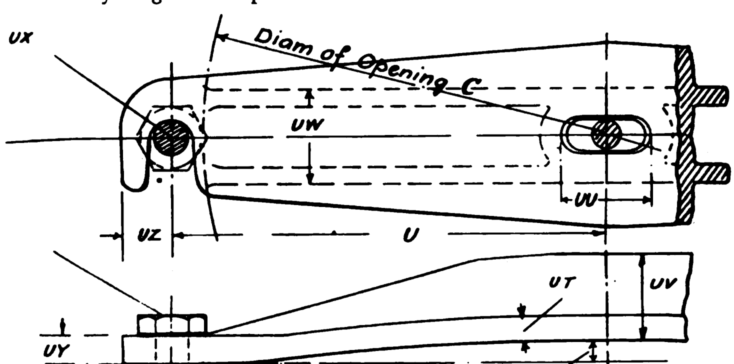


Fig. 2.—Smokebox Crossbar.

The chief trouble of the casting method is the deterioration of large flat patterns: it is extremely difficult to preserve such patterns from winding or twisting badly, and therefore, as in the first engine for which patterns made from the accompanying drawings are intended, special conditions require a slightly larger boiler, I am recommending the pattern to be made with a double shrinkage allowance, and that two sets of castings be obtained—one set for the job in hand, and the other to be cleaned up and retained as patterns. This double shrinkage allowance will, I estimate, just enable the one wooden pattern to serve the two purposes. Of course, this does not apply to the cross-bar or the two handles, which may be made out of the raw material, forged or castings, according to which is likely to be most convenient, and to the number of locomotives being built.

The smokebox is designed for a modern boiler having a 6-ft. diameter smokebox, but the flange which fits the smokebox wrapper may be arranged a little thicker than absolutely necessary, and so

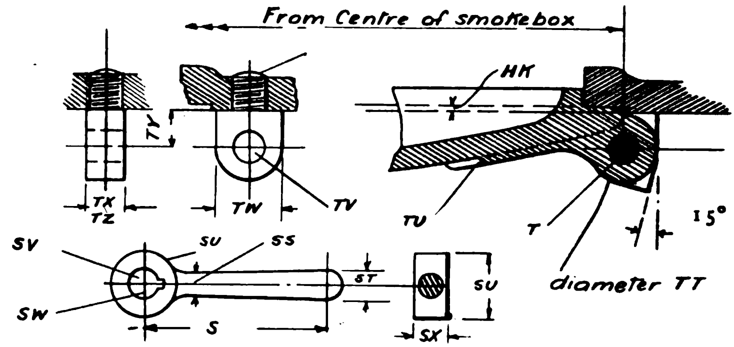


Fig. 3.—Details of Hinge and Fastenings.

allow for a slight variation in size. The recess for the door would not be arranged for in the pattern, but would be cut in the lathe. The flange of the smokebox front ring may be webbed (say six or eight webs), but it should be remembered that the webs will be better if arranged to miss the vertical and horizontal centre lines of the smokebox. This is more important in the case of the horizontal webs, otherwise they may foul the cross-bar or prevent the ready removal of the latter.

In larger engines the inside of the door may be lagged with a piece of sheet iron, and to this end the pattern may be provided with six lugs for the screws, as shown in Fig. 1.

The hinges of the doors are of the L.N.W.R. and G.C.R. patterns, and are obviously stronger than the strap hinges where iron castings are employed. Presuming that strap hinges are preferred, the idea adopted in an engine built to my drawings may be used. The strap hinges are cast solid with the door, and are raised sufficiently to allow for filing and polishing bright, but instead of only the narrow hinge lugs projecting from the casting of the door as indicated in the accompanying sketch, Fig. 4, they are supported by a pillar of metal which is drilled through for the hinge pin, but is not so large in diameter as the polished hinged straps. Fig. 5 shows the arrangement, and also includes sections of the casting at the straps and at the horizontal centre line of the smokebox. The

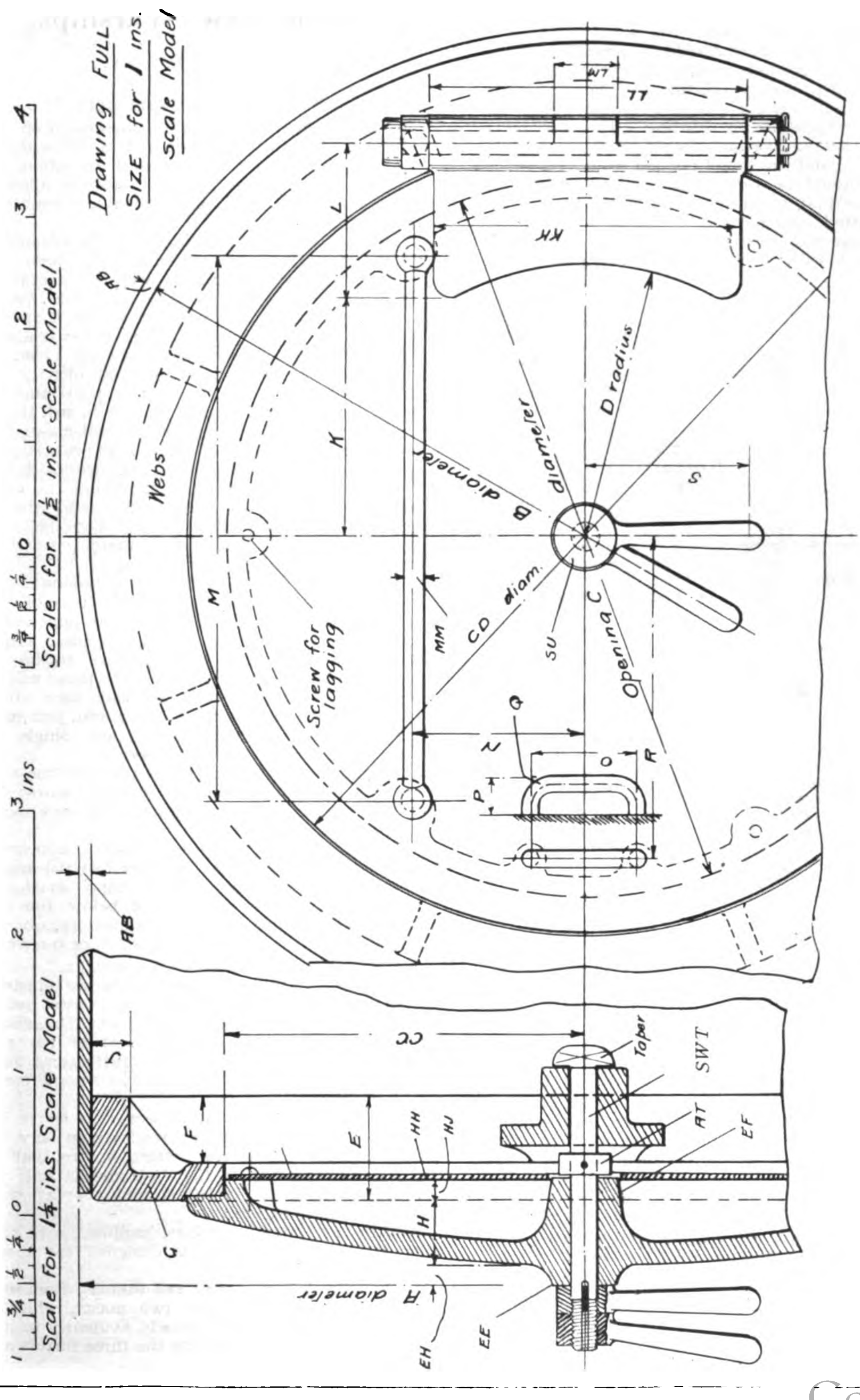


FIG. 1.—DESIGN FOR STANDARD MODEL LOCOMOTIVE SMOKEBOX FRONT AND DOOR, SUITABLE FOR 1-IN., 1¼-IN., 1½-IN., AND 2-IN. SCALE ENGINES.

strength of the hinge is then equal to that shown in the accompanying design, Fig. 1.

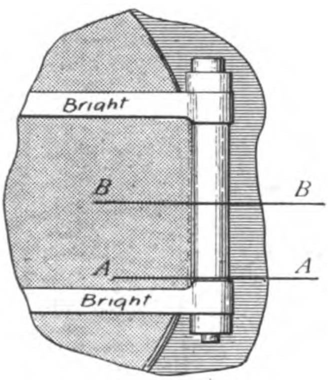
Machining allowances should be provided on the outside of the smokebox ring flange, but nowhere else, as with modern castings of good quality practically no work should be required on the castings preparatory to painting. The machining of the smokebox door face should be allowed for in the pattern, and the spigot portion which fits in the opening should be turned an easy fit or slightly tapered so that it will enter without necessitating slackly fitted hinges.

The hinge piece on the door, it will be noticed, is provided with a lug which projects with the outside face at an angle of 105 degs. to the face of the smokebox front when the door is shut. This lug acts as a door stop, and is to be found in actual practice on all modern L.N.W.R. locomotives.

The hinge pin may be of steel, and, to save turning it down from the thick bar, the circular head may be formed by screwing on a thick washer of the same material and riveting same over to prevent it coming apart. A split pin and washer will be found to be a sufficiently good fixing at the bottom of the pin. The hinge eyes fixed to the smokebox should be made of mild steel, and they may be fixed in the manner indicated, or fit tightly into clearing holes in the front ring and be secured by a nut. The bottom eye may be a little thicker than the top one, as it bears the greater portion of the weight.

The reference letters on Figs. 1, 2, and 3 will be explained by a table of dimensions to be included with the next article.

(*To be continued.*)



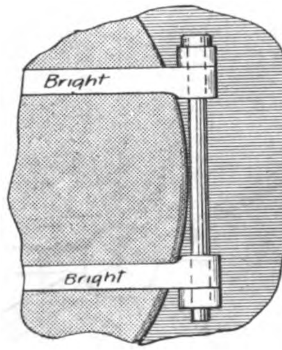
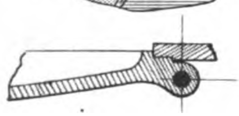
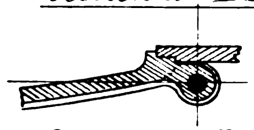


FIG. 4.



Section at BB



Section at A.A

FIG. 5.

SMOKEBOX DOORS WITH STRAP HINGES.

Some New Warships.

By C. W. PIDCOCK.

H.M. CRUISER "INFLEXIBLE."

THE new cruiser *Inflexible* (illustrated on opposite page) and her two sisters, *Invincible* and *Indomitable*, will be, without exception, when completed, the most powerful cruisers afloat, although they will have a formidable opponent in the new German cruiser, *F*.

The *Inflexible* is practically a *Dreadnought* in which protection and armament has been sacrificed to gain speed. Steam will be generated in Yarrow boilers and with Parson's turbines, generating 41,000 h.-p.; she is designed for a speed of 25 knots, and even 27 is expected at her trials.

Her main armament consists of eight 12-in. guns, and marks the resuscitation of an idea of some thirty years ago, in which the port amidships turret is placed forward of the starboard, the idea being that all guns can be fired on either broadside, as well as having an ahead and astern fire of six guns. The design is practically a mixture of the old *Inflexible* and the *Devastation*, having the central turrets *en echelon* like the former, and the fore and aft turrets like the latter. The one disadvantage of this design is that there is some side stress when firing across the deck.

There has been a great deal of discussion in naval circles *re* the actual war value of this type of vessel. Some are of an opinion that they are unnecessarily large and powerful for ordinary cruiser requirements, and therefore too expensive to be multiplied. While others say that they will not be used as cruisers at all, and that they will not be used in line of battle or squadron, but merely for running down and sinking any single ship, such as one of the *King Edwards*.

Her design is thought to be the outcome of the secret lessons taught in the Russo-Japanese War, but the lessons of one war are nearly always reversed by the next.

The *Inflexible* has quite a novel appearance, having two funnels close together forward and one on an interval aft, and a single tripod mast. The aftermost turret is on a deck below the other three. Her displacement is about 17,000 tons, and she will be armoured with an 8- or 9-in. belt.

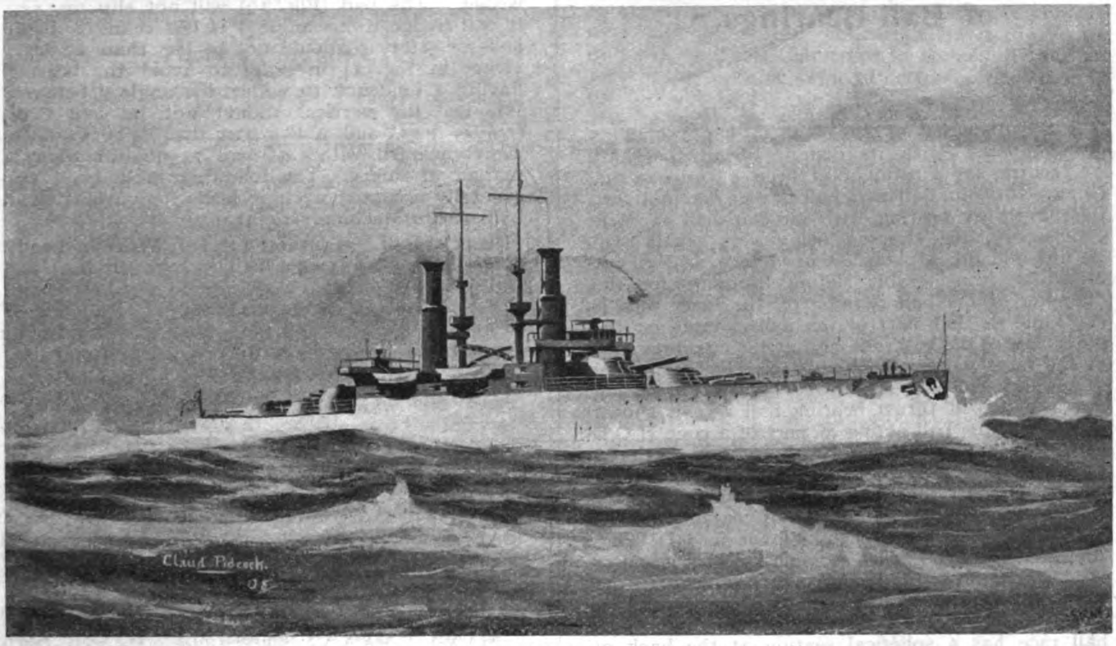
U.S. BATTLESHIP "DELAWARE."

The United States battleship *Delaware* (illustrated herewith) is the first of a new type of vessel over the water. She is a modified copy of our *Dreadnought* class, having the same armament of ten 12-in. guns, arranged somewhat differently, and an increased displacement of about 5,000 tons, making 22,000 all told.

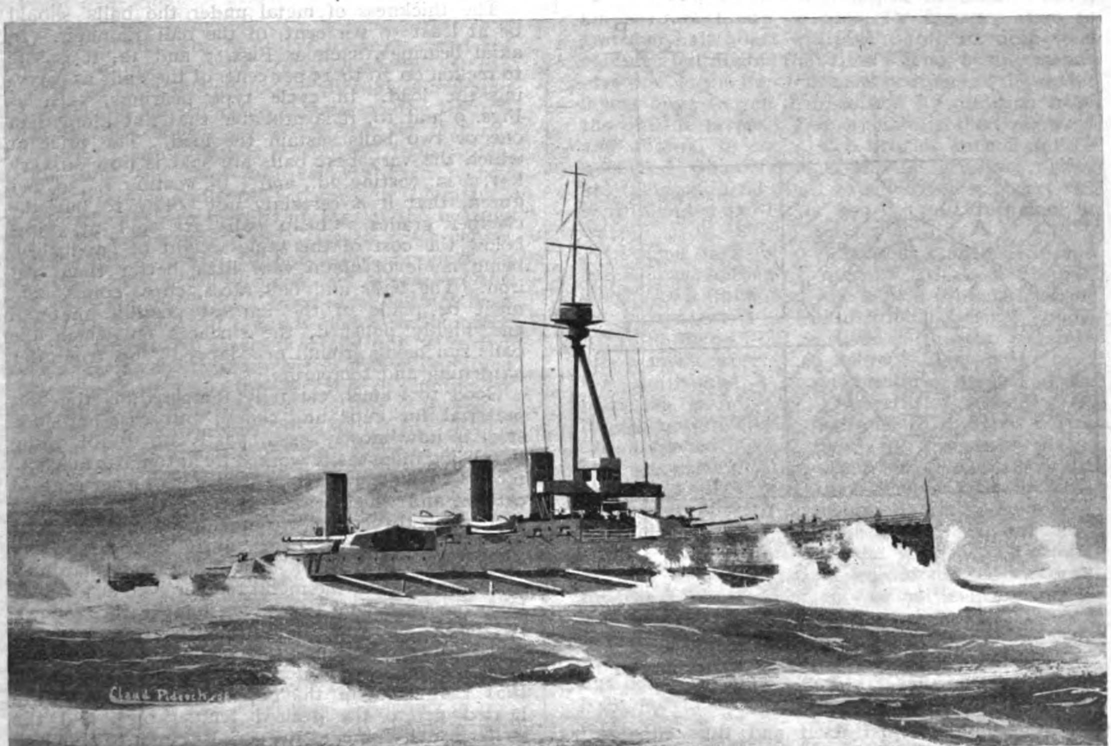
The new American ideal seems to be to have all guns firing on either broadside at any cost. They sacrifice ahead and astern fire to that end, for the ahead fire of the *Delaware* is only four 12-in. to the *Dreadnought's* six, and her astern fire is only four to our six.

With her Curtiss turbines, supplied with steam by Babcock boilers, she is designed for a speed of 21 knots.

She will have two very tall funnels, from which two bridges will join the two masts, which are placed at the sides of the funnels, evidently to allow as much space as possible for the three turrets aft.



THE UNITED STATES BATTLESHIP "DELAWARE."



THE NEW BRITISH CRUISER "INFLEXIBLE."

The Design and Construction of Ball Bearings.

By "ZODIAC."

(*Continued from page 316.*)

If the diameter of the ball is kept small as compared with its distance from the shaft centre, say a ratio of at least 1 to 10 or 12, *i.e.*, a 3-16ths-in. ball in a ball race 1½ ins. in diam., then a thrust bearing with circular ball races is satisfactory, the slipping being very small. On the other hand, a plain V-shaped race, as Fig. 5 *b*, introduces considerable sliding friction; for the diameter of the ball running on the inner race is the same as that part of the ball running on the outer face of the ball race, and as the circumference of the races varies, there must clearly be slipping at one face at least. The correct method of setting out a V-shaped thrust bearing ball race is shown in Fig. 15, the ball acting as part of a cone H O L and thus having a true rolling motion both on the outer race faces A and B and on the inner faces C and D. All four faces of the ball races are tangent to the ball at the point of contact, the top outer face A and the bottom inner face D being projected from the point P, while the bottom outer face B and the top inner face C are projected from the point Q. The lower ball race is the rotating one, *i.e.*, fixed to the shaft; the upper or stationary ball race has a spherical seating at the back of the V-grooved ring. This allows the upper ring

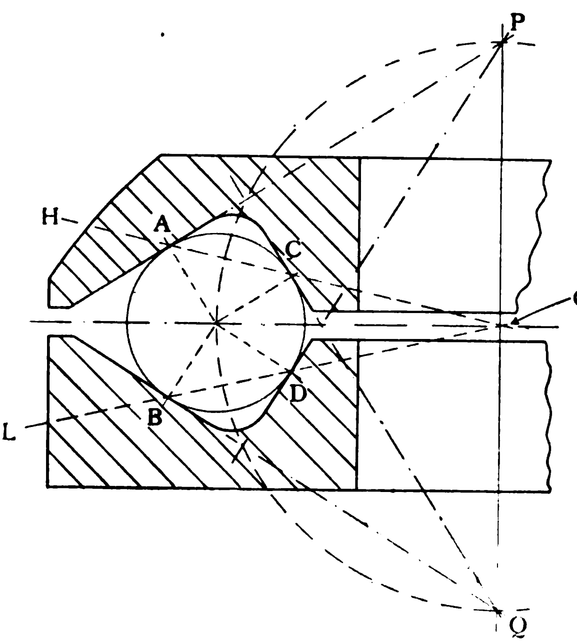


FIG. 15.—METHOD OF SETTING-OUT A V-THRUST BALL RACE.

to automatically adjust itself and thus equalise the distribution of pressure on the various balls. In any ball bearing, either radial or thrust, the angles between the faces of the races must not be too acute, or the balls will have a tendency to wedge. The ball (Fig. 16) will not slip up, *i.e.*, it will wedge if the angle *p* is less than 18 degs., and for safety *p* should not be less than 25 degs. Hence in Fig. 11 in order to avoid the bearing having a tendency to wedge, the angle *y* between P O and the vertical should not be less than (18) 25 degs., and not greater than (72) 65 degs. The bracketed values 18 and 72 do not allow a margin of safety. The following table gives the generally accepted working loads for various sized balls (Auto Machinery Company):—

Diam. of Ball (in ins.).	Crushing Load (in lbs.).	Working Load (in lbs.).
⅛	1,288	160
3-16ths	2,900	360
¼	5,150	640
5-16ths	8,050	1,000
⅜	11,600	1,450
½	20,600	2,570

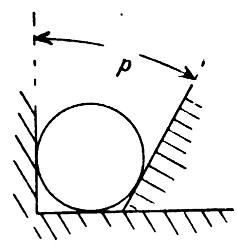


FIG. 16.—SHOWING LIMITING ANGLE OF BALL RACE.

The thickness of metal under the balls should be at least 50 per cent. of the ball diameter. In axial bearings, such as Figs. 7 and 12, it is safe to reckon on 20 to 25 per cent. of the balls as carrying the load. In cycle type bearings, such as Figs. 9 and 10, it is probable that not more than one or two balls sustain the load. The price at which the very best balls are sold is now so very low, ⅛ in. costing 2d., and ½ in. costing 1s. 3d. per dozen, that it is certainly not policy to buy the cheaper grades. Cheap balls are sold at prices below the cost of the same weight of good steel, being made of metal very little better than cast iron. The balls and ball races, cups, cones, etc., must be made of the hardest possible material and highly polished, the surfaces on which the balls run being ground or "lapped" up true after hardening and tempering.

Good tool steel, carefully tempered, is the best material for cups and cones; but case-hardened steel is now mostly used, partly no doubt owing to it being more easily worked by automatic machine tools. Tool steel contains from 1 to 1¼ per cent. of carbon, and when heated to a low cherry red heat and suddenly cooled by quenching in water, it becomes very hard, being quite unassailable by a smooth file. After hardening, the hardness can be reduced or the metal tempered to any extent by being heated up to a given temperature (shown by the colour of the oxide film that forms on the surface of the steel), and then again suddenly cooled. In tempering cups and cones, care has to be taken that the whole of the cup or cone is uniformly heated up to the desired temperature, and the writer usually plunges the cone or cup into a molten metal alloy having the required melting point, care being given to see that the metal is just melted and not overheated. The cups, etc., are left in a few minutes and then quenched. The following table will be found most useful for tempering :—

TEMPERING TABLE.

Oxide Tint.	Temp. Fah.	Tools.	Alloy of Same. Fusing Temperature. Tin.	Lead.
Very faint yellow	420	Lancets, etc.	4	7
Pale straw ..	430	Razors.. ..	8	15
Straw yellow ..	450	Taps, reamers	8	17
Orange	470	Chipping chisels	4	10
Light brown ..	490	Shears, dies ..	4	14
Brown-yellow ..	500	Planes, axes ..	8	33
Red	510	Woodwork tools	4	19
Light purple ..	520	Wood saws ..	4	25
Dark " ..	530	Watch springs .	4	30
Bright blue ..	550	Swords ..	4	48
Dark " ..	600	Hand saws ..	—	—
Just visible red..	—	Hardness almost removed.		

Tallow and most ordinary machine oils, when heated, begin to smoke at 430° F., and the light or flame goes out when a lighted taper is withdrawn at 570° F. Tin melts at 446° F., lead at 620° F., and tallow at 92° F.

Plumber's fine solder melts at 441° F., being composed of 1 part of tin to 2 parts of lead. Plumber's coarse solder melts at 482° F., and is composed of 1 part of tin to 3 parts of lead.

For the amateur the alloy method of heating is certainly the most reliable, and the alloys are really not very troublesome to make. The lead and tin should be melted under tallow, so as to prevent oxidation.

An alternative method of heating up cones, cups, drills, taps, etc., is to lay them on a red-hot iron bar or plate and carefully watch the change of colour as the steel gets heated through, quenching the article in oil or water as soon as the desired "temper," as shown by the colour, is reached. Oil gives a slightly softer "temper" than water, as oil cools the steel more slowly than water. For ball bearings and cones a pale straw "temper" is the best. Where there is no fear of the bearing having to withstand shocks, even a faint yellow temper can be used. In hardening, previous to tempering, care must be taken *not to overheat* the steel, or it will be spoilt. Good steel will not bear a white heat, and will crumble under the hammer at a very bright red heat; it should not be heated above a middle cherry red. Nitric acid will produce a black spot on steel, the darkness depending on the hardness of the steel; iron, on the other hand, if touched with nitric acid, remains bright. When hardening cones the hole in the centre should be plugged with fireclay and iron borings, or with a bolt, otherwise the water will reach the hole too soon and cool it before the body, thus causing the cone to crack.

Case-hardened material consists of iron or mild steel which, after machining, has been heated to red heat for some six to twelve hours, while in close contact with substances rich in carbon, air being excluded. By this means the amount of carbon in the metal on the surface is increased so that a coating of steel, about 1-16th in. to ⅛ in., deep, is formed. Mild steel has less than ·5 per cent. of carbon, and wrought iron about ·2 per cent., and cannot be hardened and tempered. It is beyond the scope of this article to deal very fully with case-hardening, but a few hints will be given as to the various methods.

Prussiate Potash Method.—The article is heated to a moderately bright red and the surface rubbed over with prussiate of potash; allowed to cool to dull red, and then immersed in water. This may be repeated once or twice, if desired. The coating of steel obtained is very thin, and only suited to articles where the wear is very slight.

Potassium Cyanide Method.—The articles are heated to moderately bright red and then dropped into a strong solution of potassium cyanide. The operation can be repeated. This gives a slight coating of steel, suited for very light wear. This method is open to the objection that the cyanide and its fumes are exceedingly dangerous to health, being of a most poisonous nature. Unless the amateur has had considerable chemical experience, he would be well advised not to try this process.

The Firing Method.—This is the method already referred to. The articles are packed in a crucible with a carbonising agent, such as bone dust, etc., each article being carefully separated from contact with its neighbour and the carboniser tightly packed around. The crucible should be packed in layers—first a layer of carboniser, then a layer of articles—cups, cones, etc., then a layer of carboniser, and so on; the whole being well rammed down from time to time. When full, the lid is put on and carefully sealed with fireclay; when this is dry, the whole is ready for firing. The crucible is now heated up to an orange-red heat (about 1,000° C., or 1,832° F.), and kept at this heat for from four to twelve hours, according to the size of articles and depth of steel desired. On a bracket cup or cone, for instance, two to two and half hours will give 1-16th in. deep steel coating; but double that time will not by any means give double the depth of steel coating, as the under layers have to get their carbon by diffusion from the outside layers. The crucible is then removed and allowed to cool. The articles should not be quenched when taken from the crucible. They are then again reheated to a fairly low cherry-red heat (about 1,470 F., or 800 C.), and quenched in water.

In olden days every village blacksmith had some special case-hardening mixture, which—with zeal worthy of a Chinaman—he kept a profound secret. The writer served part of his time in German shops, where he met an old Swedish smith, who certainly was a most experienced fellow. Like all the rest, this smith had a secret mixture, handed down from his grandfather. Nevertheless, the writer, though only a youth, managed to turn out better case-hardened work than the Swedish smith, who was naturally more than surprised. In return for the tip, the writer learnt the composition of the famous mixture; it consisted of horse-hoof parings, bone dust, wood charcoal, burnt seaweed, and ground flint. What use the ground flint could possibly be would puzzle Vulcan himself; like all the rest of the famous secret case-hardening recipes—a mere old smith's fad. Various carbonisers are in use, all more or less equally good, viz., horn, hoof parings, finely powdered carbonised leather, or fine bone dust. Fine and properly charred leather-coke, providing it is proper leather, and not rubbish often sold as leather, will give as good results as any. The old smiths' error consisted in quenching the articles straight out of the crucible, without letting them cool first. Any animal charcoal will give good results. For heating small crucibles, nothing can equal a good gas furnace. Any portions required to be left soft should be stopped off with clay.

As a rule, it is not necessary to temper case-hardened stuff. There is one advantage that case-hardened material has, namely, the under portions which are not subjected to wear are left soft—(for mild steel and wrought iron will not "harden" or "temper" if heated and quenched)—and are thus more fitted to stand shocks, while the wearing surfaces are dead-hard. For example, take the spindle *a* (Fig. 9). If properly case-hardened, it is all right, the centre being practically left soft mild steel, while the outside is quite hard. If made of tool steel and only let down a little, the whole spindle would be very liable to be brittle and snap in use. The case-hardened cones and cups turned out by our leading makers are satisfactory, but the bearings of the cheap foreign hubs and fittings are barely case-hardened at all, and will not stand any wear. In the cheap 2s. per pair cycle pedals the cups are simply stamped out from mild steel, and not turned at all. The model engineer should, when possible, use standard cycle cups and cones, as these can be bought much cheaper than he could possibly make them. Where this is not possible, the parts can be made either from tool steel or case-hardened iron, as described.

(To be continued.)

Notes on Wireless Telegraphy Apparatus.

By V. W. Delves-Broughton.

(Continued from page 281.)

Interrupters.

Anyone who has had any experience with large coils will have observed that whatever system is used for exciting the coil, there is some defect in the interrupter. Of all devices the Wehnelt interrupter is the best, if it could be depended upon; but in my hands it has been found to suddenly strike work from no apparent cause, and to refuse to start again for some time. Whether this is owing to some stupidity on my part, or is a universal complaint, I do not know; but the fact remains that if a Wehnelt apparatus is used another form of brake must be provided as a stand-by. Another objection to the Wehnelt interrupter is the high voltage required, and if supplied by secondary batteries this is a very serious question; but if an independent generator is used the whole difficulty can be overcome in a manner to be described in a subsequent article, the interrupter being an inherent part of the generator.

After the Wehnelt interrupter comes the ordinary mercury brake, but this has the objection that the mercury becomes whipped into fine particles, partly by the mechanical action of the dipping bar and partly by the explosive action of the spark on each interruption of the current.

The mechanical action can easily be overcome by properly designing the motion of the dipping bar, either by guiding it or applying parallel motion, as shown in Figs. 2 and 3; but the action of the spark still remains and this seems impossible to entirely obviate. A properly balanced condenser is the best solution; but the least variation in the voltage of the current or the speed of the interrupter will upset this balance, and the sparking will be as bad as ever, and the pulverising action will start fresh.

With a well-designed mercury interrupter which usually worked quite well, I have seen it start off and pulverise 1 lb. of mercury so that after 15 minutes' work scarcely an ounce of liquid mercury was to be found in the interrupter. Of course, it is now well understood that a mercury brake must contain a large mass of mercury to enable the heat generated to be dissipated as quickly as possible. On the whole a mercury brake is the most reliable, as in the event of the mercury becoming pulverised

Fig. 2.
Sectional Elevation.

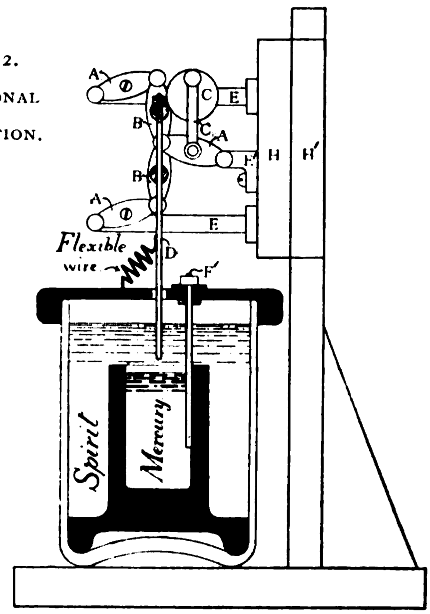
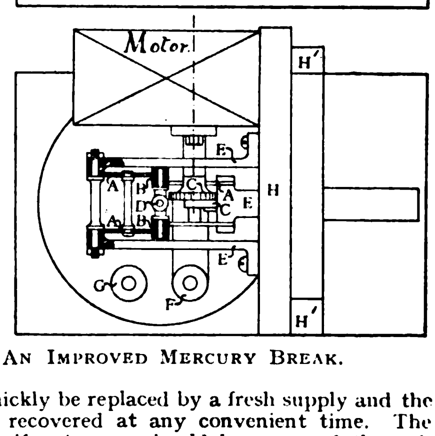


Fig. 3.
Plan.



An Improved Mercury Break.

it can quickly be replaced by a fresh supply and the mercury recovered at any convenient time. The mercury, if not pure, should be squeezed through wash-leather, as, if there is a trace of amalgam in it, it is much more liable to become pulverised. Parallel motion is much to be preferred to guides for the dipper, as the friction is much less in this form. From the drawings it may appear at first sight rather complicated, but this is really not the case, as the construction is a question of repetition, the ten links being exactly similar and bored from one jig. The whole should be constructed from aluminium, or better, magnalium, and be as light as possible, about 24 gauge sheet being amply sufficient; the distance between the centres of the links being about 1 in.

I much prefer driving this motion from a small rotary motor, or by clockwork, as the speed can be accurately timed and regulated; an ordinary reciprocating motion can be applied, however, if preferred.

It is not practical to use a mercury brake that is only put in motion when the key is depressed, as mercury brakes, like all other prime movers, require a certain period to accelerate and again to come to rest after being put in motion. This being the case, I have seen messages despatched at a fair rate, thus: – – – – – — — – – – — ; received thus: – – – – and if this is not enough to evoke even stronger language, it is enough to try any ordinary mortal's patience. The dots were not reproduced at all, and dashes only arrived as dots. This was evidently owing to the fact that the mercury brake when used in this manner could not produce sufficient sparks to send off trains of waves in quick enough succession to affect the receiving aerial till an appreciable time was allowed to elapse.

As already stated, the Wehnelt interrupter, when once checked by the key, shows a decided disinclination to start again. A friend of mine has proposed diverting the current through a choking coil in parallel with the primary of the coil instead of interrupting the circuit. This might overcome the difficulty, but would be very wasteful of current. I have not heard of this device being tried, but it might interest someone to try it. I am afraid that the alteration in the resistance or impedance of the circuit would be equally liable to stop the action.

Whatever type is used, it is advisable to provide a means of washing out the pulverised mercury by some flushing arrangement. This can be arranged by providing a glass syphon fitted through the cap with a short length of rubber fitted to the lower leg, and a spring clip to close the outlet. By this arrangement the dirty spirits and pulverised mercury can be drawn off very quickly, and a fresh supply of spirit introduced, if the necessity arises during the use of the coil.

Another hole, fitted with a suitable plug, should be provided in the cover of the container in such a position that fresh mercury can be added without disconnecting the apparatus or even stopping its action.

Fig. 1 shows diagrammatically the action of an ordinary unguided vibrating mercury brake: the lowest and highest positions of the dipper are shown in full and dot and dash lines, respectively. The dotted lines show the actual motion of the dipper, which, owing to the sudden reversals, is subjected to great bending strains, and the point, instead of working in a vertical line, will vibrate between the points A and B. This motion would be excellent for beating eggs, but is not required for the purpose under discussion!

Figs. 2 and 3 show the details of an improved mercury brake driven by a rotary motor. The radius bars A and links B are all made from the same jig. The three pairs of radius rods A are joined together by distance pieces riveted to the centre, and on one of the distance pieces a connecting-rod C1 is threaded. E and E1 are supports carrying the outer extremities of the radius rods A, the inner extremities being connected to the ends of the links B. The links B are also provided with distance pieces, but these are made so that they can turn in the holes in which they are riveted; and the dipping rod D is securely attached to the upper distance piece whilst it is free to slide in the lower distance piece. The whole of this apparatus is fixed in the sliding support H, which is guided on the upright by the two blocks H1 and fixed at the required height by a clamping screw. H also carries a small motor, to which is attached a crank disc C, which transmits a reciprocating motion to D through the intermediary of the connecting-rod C1 and the link motion. To avoid confusion the motor is not shown in Fig. 2, and only indicated in Fig. 3.

On the base carrying the upright a glass jar, containing the mercury well, is placed. This glass jar is provided with a suitable cover carrying two terminals—one, G, connected to a very flexible wire, which in turn is soldered to the dipping rod D; and the other, F, to a copper rod F1, dipping into the mercury. The glass should be held in position by fillets screwed to the base, or any arrangement

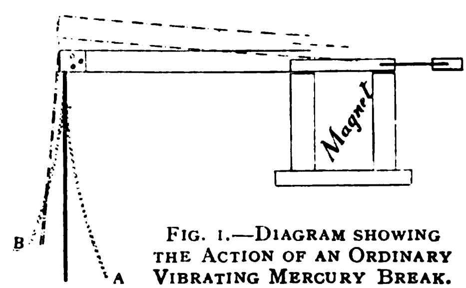


FIG. 1.—DIAGRAM SHOWING THE ACTION OF AN ORDINARY VIBRATING MERCURY BREAK.

found convenient. The mercury well can be made of wood, but perhaps the best material is cast iron; in any case the capacity should be ample, as, on account of the low specific heat of mercury, it does not take much to heat it up. A large space should be allowed between the mercury well and the glass for the pulverised mercury to settle, as, with the utmost precautions this, as already stated, is bound to be formed in considerable quantities. Both the dipper D and the rod F should be made of copper and well amalgamated at the tip before being connected up. If any difficulty is found in amalgamating the copper, dip it in a little nitric acid in which a speck of mercury has been dissolved. The drawings are half full size for an interrupter capable of dealing with 12 amps. 30 volts, but the apparatus works better when used for smaller currents.

The apparatus consists of a glass jar containing a disc of lead H, spun in the shape shown (Fig. 4). At one corner a lead lug is burned on, and to this a copper rod is soldered. Over this lug an ebonite tube F1 is fitted and nearly filled with hot wax and resin, finally being capped with the binding screw as shown. This construction might be simplified by carrying up the lead lug to the cap and finishing off with a terminal without any ebonite tube. I have not tested this arrangement, however, and cannot speak from experience.

The needle is formed out of a piece of 20 gauge platinum wire about ¾ in. long, G1, securely fixed in the end of a nickel rod G (not German silver). On the upper end of G a screw is cut at D, and after having been screwed through a tapped hole in C the milled head B is sweated on, allowing a sufficient length to project to accommodate the terminal A. G and G1 pass through an ebonite tube with a conical point (in my case I used an old stylographic pen) screwed on at the lower extremity; G being a tight sliding fit in the nose. C is a milled head attached to a tube D 1, on which a fine thread screw is cut, which works in an internally screwed flange

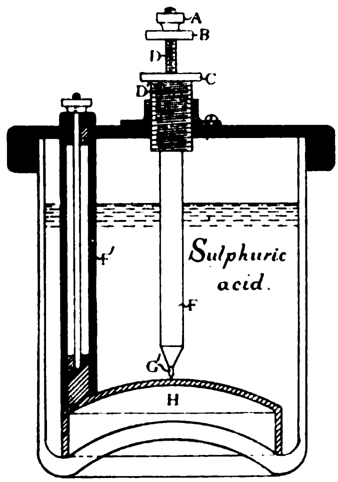


Fig. 4.—Modification of a Wehnelt Interrupter. (*One-third full size.*)

screwed to the cover of the glass jar. The ebonite tube F is securely cemented into the tube D1, care being taken that F is concentric with the screw thread, otherwise on screwing D up or down G1 will describe a circle instead of simply rising and falling.

On completion, the point of the tube F is unscrewed, and a short strip of wash-leather K is tightly packed round G and forced up to the position shown in Fig. 5, and mercury poured into the tube for a depth of about ½ in., and finally the point or nose of the tube is screwed on again. The mercury is to secure a seal which will not allow the acid to enter between the point G1 and the ebonite nose piece, and the wash-leather is to prevent contact between the mercury and the brass cap C, which would cause the brass to rot and the screw thread to seize.

In use the apparatus is connected in series with the battery (40 to 60 volts), a choking coil (consisting of about 500 turns of No. 16 wire with a movable core of iron wire) and the primary of the coil, the glass jar having been filled within 1½ ins. of the top with a mixture of one part strong sulphuric acid and five parts water.

The adjustments are effected as follows :—

1. The amount G1 projects from the ebonite sheath is regulated by turning the milled head B.

2. The distance between the point G (or the anode) and the lead disc H (or cathode) is regulated by turning the milled head C.

3. The strength of the sulphuric acid is regulated by adding more sulphuric acid or water.

4. The amount of self-induction is regulated by adjusting the depth to which the iron core is introduced into the choking coil.

These adjustments are the great objection to this type of interrupter, as it is impossible to lay down any law by which they can even be approximated, but, when once found, the only adjustment liable to require alteration is No. 2. It is, therefore, advisable to fit a lock nut on D, which can be clamped when once the correct length for G1 to project has been found; and when once the right proportion of water and sulphuric acid has been established, it is advisable to pour a little heavy mineral oil (gas engine cylinder oil) into the top of the glass jar to prevent the water evaporating.

The iron core of the choking coil can be regulated by a rod and screw clamp, or any other convenient method. Of course, if any alteration in the circuit is made, a different voltage used, or another primary fitted to the coil, practically all the adjustments will have to be re-made, except as to the strength of the acid, which when once made up will go on for years.

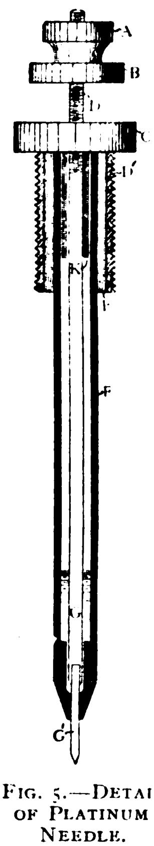


Fig. 5.—Detail of Platinum Needle. (*Two-thirds full size.*)

Great care must be taken that there is no grease on the lead disc H. It is best to wash thoroughly with caustic potash before putting together, and periodically to scrape the surface clean if it becomes sulphated opposite the anode. This can be done without removing the disc or sulphuric acid, which entails considerable trouble if oil has been used, as some of the oil is nearly certain to adhere to the lead disc, which would necessitate a thorough clean up. The lead disc is made of the disc shape shown, to prevent, as far as possible, any sediment settling on the upper surface. A few holes (not too close to the platinum point) should be provided to prevent any gas, generated on the underside, collecting.

This interrupter is specially suitable for radiograph work with fluorescent screens, as the extraordinary rapidity with which it works prevents any flicker of the image. It is also suitable for wireless telegraphy, except for the complicated adjustments required and the time required to re-start it working if once it shuts up. Variations in temperature have a great effect on the rapidity of action and amount of current passing, this latter quantity being regulated by the choknig coil. The further the iron core is pushed into the coil the less current will flow. To effect this adjustment an ampere metre should be included in the circuit, together with a fuse set to blow at the maximum capacity of the coil. No. 42 copper wire will fuse with 3 amps., and as this is easily obtainable it is a convenient mode of making up a fuse. Two blocks of brass are attached to a small base (preferably made of slate or other incombustible material), leaving a space of 1½ ins. between them, and one or more pieces of uncovered 42 wire soldered or otherwise attached to the two blocks. Care must be taken, however, that the wires, if more than one be used, are spaced at least ¼ in. apart; otherwise the wires are liable to mutually heat one another and cause the fuse to blow at a lower current than that intended. I have purposely said nothing about platinum brakes, as when used for coils beyond a 1-in. spark they are expensive in first cost, extravagant to maintain, and a source of considerable trouble to keep in order. For small coils, however, they can be relied upon, and any of the well-known types used. If extreme economy is necessary, the stud on the spring can be made of platinum, and the other contact piece of nickel—in fact, being dissimilar metals, they are less likely to weld together.

The interrupter should in any case be made to work at a very high speed, as these small coils are used with small capacity-areas, which naturally damp the oscillations much sooner than large capacities, and if the trains of waves leaving the transmitting aerial do not follow in sufficiently rapid succession they will not create a growing amplitude in the receiving aerial, however carefully it may be tuned.

An ordinary ignition coil with a very light contact-brake using a 6-volt instead of a 4-volt battery, can be adjusted to make something like 1,500 contacts per second. Great care should be taken, however, that too much current is not passed through the coil, and a suitable fuse should be included in the primary circuit in case of accidents. This extra battery power must never be used with the coil disconnected from the spark gap, which should be made in such a manner that the distance between the balls cannot be greater than ⅜ in. or the insulation of the secondary may be broken down. The current taken by a good ignition coil should not exceed 2½ amps. Of course, an ignition coil should never be used except when sending a series of dots and dashes, or is otherwise interrupted, as they are not designed for continuous work.

(To be continued.)

Experiments with Primary Batteries.

(Concluded from page 324.)

INSTEAD of separating the exciting and depolarising solutions by a porous partition, they are in some cells allowed to be in direct contact one above the other. These cells are called gravity cells. Solutions are selected which are of different specific gravities; the lighter one then floats on the top of the heavier solution. A well-known example is the gravity pattern of Daniell cell. This consists of a containing jar and zinc and copper plates, with a solution of sulphate of copper and a solution of sulphate of zinc. The copper plate is placed at the bottom of the jar and covered by the solution of sulphate of copper. The zinc plate is suspended above this solution, and immersed in the solution of zinc sulphate which floats, by reason of its smaller density, upon the copper solution. An insulated connecting wire is brought up through the liquid from the copper plate. As the solutions tend to diffuse if the cell is not at work, it should be allowed to send a very small current through a high resistance circuit when out of use, to prevent copper rising through the upper solution and depositing upon the zinc plate.

The Minotto cell previously referred to is somewhat similar. The copper plate is covered with a layer of sulphate of copper crystals without solution. Upon the top of these is a sheet of thin canvas, and over this is a quantity of sand or sawdust to a depth of several inches. At the top of the sand or sawdust is another canvas disc, and the zinc plate rests on this. A solution of zinc sulphate saturates the sand or sawdust and covers the zinc. It permeates both canvas sheets making contact with the zinc and sulphate of copper crystals.

The voltage is practically the same as that of the Daniell cell. The internal resistance is very high, and may be about 11 ohms. The cell can, therefore, only give a very small flow of current, but maintains a steady voltage for intermittent use.

A secondary cell differs from a primary cell in not being able to produce electricity unless its plates have been brought into a state of chemical transformation by means of a flow of electric current through them. Also because it is able to produce an electric current each time its plates have been so transformed, without the necessity of being supplied with a fresh charge of solution or chemicals. Every kind of secondary cell in general use consists of a solution of dilute sulphuric acid and lead for both positive and negative plates. Secondary cells are frequently called accumulators.

The action of a secondary cell can be shown by experiment as follows. Immerse a pair of plates or strips of clean lead in a solution of dilute sulphuric acid, about 1 part acid to 5 parts water, to about three-quarters of their length; connect them to a galvanometer, as Fig. 2: there will be no deflection of the needle. Remove the galvanometer and connect the plates to a battery or dynamo; send a flow of current through the solution from one plate to the other for a few minutes; disconnect the plates from the battery and connect them to the galvanometer, as Fig. 2: the needle will be deflected, proving that the lead plates give back the current which has been previously applied to them. Examine the plates, and their surfaces will appear in an altered condition as compared to their natural surface when first placed in the solution. The surface of the plate which has been connected to the positive terminal of the battery will be of a brown colour. The surface of the other plate will be of a grey or slate colour.

Connect the plates to a galvanometer (as Fig. 2) which has been tested to indicate the direction of a flow of current through its coils: the movement of the needle will indicate that the flow of current is from the grey-coloured plate to the galvanometer, and that it enters the cell by the grey-coloured plate. The direction of flow in the cell must, therefore, be from the brown-coloured plate to the brown-coloured plate. According to this reasoning, the grey plate will be the positive plate and the brown plate the negative plate, because the flow of current commences in any cell at the positive plate: it flows from that plate to the negative plate through the solution, and leaves the cell by way of the negative plate. This is precisely as already explained in relation to the action of a primary cell.

Connect the lead plates to a battery or dynamo, but with the brown-coloured plate to the positive terminal of the battery and the grey-coloured plate to the negative terminal; send a flow of current

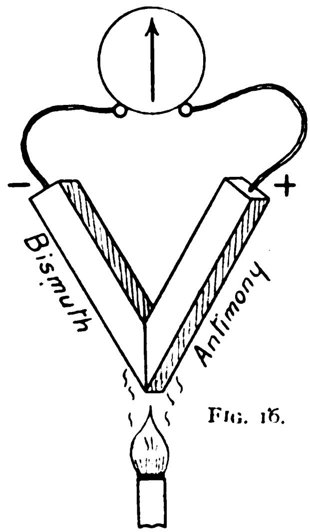


FIG. 16.

through the solution for a few minutes, but for about double the length of time of the previous charge; disconnect the battery and connect the plates to the tested galvanometer, as Fig. 2: the deflection of the needle will indicate that

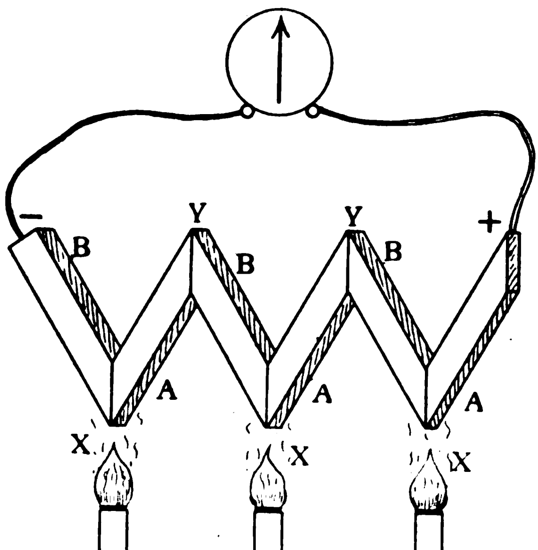


FIG. 17.

the flow of current from the plates is now in the reverse direction to the previous experiment—that is, it is leaving the cell from the plate which was grey and entering by the plate which was brown. Take the plates out of the solution and examine them. They are now reversed in colour—the plate which was grey is now brown, and the brown plate has become grey. With reversal of colour, their polarity has also reversed; if this change has not taken place, it is because the reversed charge of current has not been continued for a sufficient length of time to effect it.

The coloured surfaces are due to a chemical change which has been produced in the lead by the action of the charging current passed through them from the battery. The plate which has become coated with brown has been oxydised by the action of the current. When they are connected to-

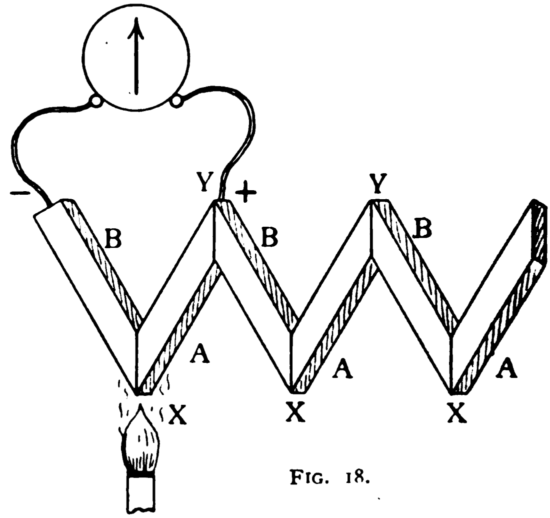


FIG. 18.

gether by a conducting circuit outside the solution, as Fig. 1, the plates gradually revert towards their original condition, and in doing so produce an electric current at the positive plate. The experiments show that the brown-coloured surface is always produced on the plate by which the current is made to flow into the cell from the charging battery or dynamo, and the grey-coloured surface is produced on the plate by which this current is conducted away from the cell. If the plates are connected to a voltmeter or high-resistance galvanometer, and allowed to send a flow of current through a circuit, as Fig. 4, the deflection of the needle will gradually become less, proving that the voltage of the cell falls as the plates resume their natural condition.

It has become the custom to call the brown-coloured plate the positive and the grey-coloured plate negative. The experiments, however, show that the grey-coloured plate is the true positive and the brown-coloured plate the true negative, as the current given by the cell flows through the solution from the grey to the brown plate. The customary terms, therefore, are only correct when the plates are considered as the terminals of the cell.

Internal resistance affects a secondary cell precisely as it affects a primary cell. The solution, however, does not become exhausted, and need not be renewed on this account. The voltage produced is the same for all sizes of cell in which lead plates and sulphuric acid solution are used. This may be proved by testing several sizes of charged cells, connecting each in turn to a galvanometer or voltmeter, as Fig. 2. The flow of current which a secondary cell will give under efficient conditions of working increases with the size of the plates. A secondary cell is not, however, affected by polarisation, as explained with reference to primary cells. It will become exhausted in a very short interval of time if the external circuit which is connected to it is of sufficiently low resistance to allow the maximum current possible to flow. This may have a very bad effect upon the plates. When selecting a secondary battery the size should be adapted to the maximum flow of current required, so that injury to the plates is not likely to occur, and an efficient rate of discharge provided. The voltage required may be obtained by connecting cells together in series, and the current required may be obtained by connecting cells in parallel, as explained with reference to Figs. 3 and 10, in the case of primary cells.

Unlike primary cells, a secondary cell should not be allowed to remain in a discharged or partly discharged condition. It should, as far as possible, be in a completely charged condition, or be receiving a charging current when not doing work. Provided the zinc is withdrawn from the solution, a primary cell may remain for any length of time in a partly or quite exhausted state; in fact, the solution will possibly recover to some extent. It is not necessary in some instances to withdraw the zinc from the solution.

An electric current may be produced by the action

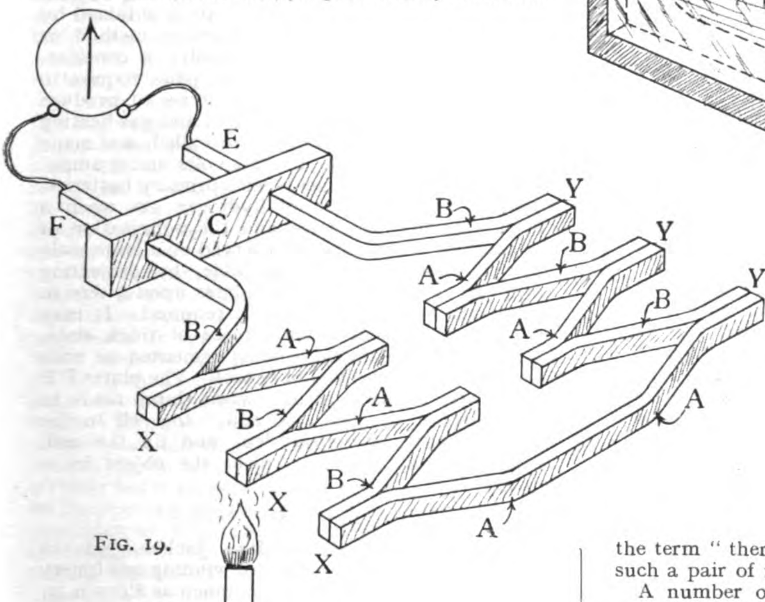
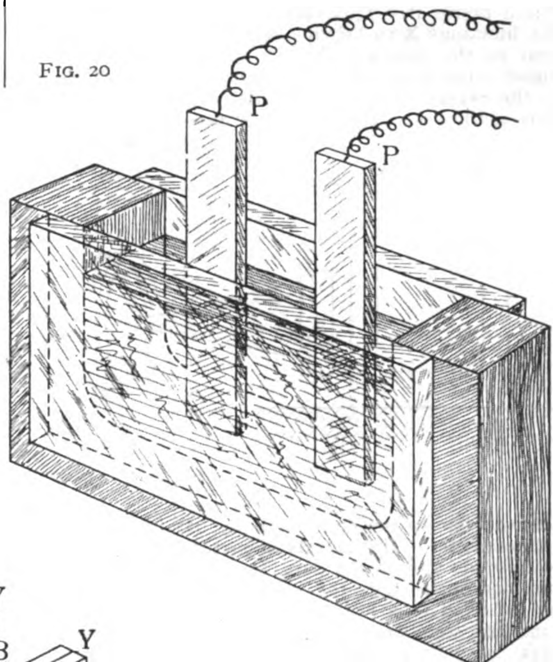


FIG. 19.

of heat upon a pair of unlike metals. In a similar manner to that in which metals are electro positive or negative to others in a series when placed in a chemical solution, so are they electro positive or negative in a series when placed in contact and the joint made hot. For practical purposes the extremes of the series are bismuth and antimony. Connect a pair of bars, one of bismuth and the other antimony, which have been soldered together at the joint, to a sensitive galvanometer, as Fig. 16. Heat the point by a gas flame or any convenient means. The needle will be deflected showing that a flow of electricity is produced. Bismuth is positive to antimony in a thermo-electric sense, and such an arrangement is called a thermo-electric couple. The flow of current commences at the bismuth bar, flows across the joint to the antimony bar, through which it passes to the galvanometer, returning to the couple through the bismuth. Comparing the arrangement with a primary cell, the bismuth is the positive plate and negative terminal, and the antimony

FIG. 20



is the negative plate and positive terminal from which the current flows to the outer circuit. The heat may be regarded as the chemical solution. If heat be applied continuously, the flow of current will continue. If the heat be taken away, the flow of current will diminish and finally cease when the joint has cooled down to normal temperature. As the effect is produced at the joint, the term "thermo-junction" is sometimes given to such a pair of metal bars.

A number of such thermo-couples can be connected together in series so that their voltage is added, as in the case of primary and secondary cells. Three couples are shown connected in this way, in Fig. 17. The voltage produced will be three times that of a single couple. Bars A are of antimony and bars B of bismuth. If the end bars are connected to a sensitive galvanometer, as shown in the diagram, and the alternate joints X are heated, the needle will be deflected, proving that a flow of current is produced. By means of a galvanometer (which indicates direction of current) the flow can be proved to go from bismuth to antimony through the bars, and from the end antimony bar to the end bismuth bar through the galvanometer. The junctions Y Y must not be heated, or they will oppose the flow of current from the junctions X, because the direction of current is from bismuth to antimony across any junction which is heated. In fact, the voltage produced will depend upon the difference of temperature between the heated junctions X and the cool junctions Y. To obtain maximum voltage and flow of current the junctions Y should have their temperature reduced below the normal instead of raised above it. This can be proved by allowing the junctions X to become cold and then applying heat to the junctions Y. A current will be produced, and it will flow through the galvanometer in the reverse direction to that when junctions X were made hot. That is, it will flow from the end bismuth bar to the end antimony bar through the galvanometer. If the galvanometer be connected to any one pair of the bars, as in Fig. 18, and the junction made hot, the galvanometer needle will be deflected to a less degree than if two or three junctions were heated, as in Fig. 17, thus showing that the voltage of a number of thermo-couples can be added together.

The direction of flow of current can be proved by the experiment shown by Fig. 19. A series of bismuth and antimony bars are soldered together at the joints, making a frame of the form shown. Bars B are bismuth, bars A are antimony, C is a bar of wood or insulating material for the purpose of keeping the terminal ends E and F in position. If the junctions X are heated, a current of electricity will be produced and flow from bismuth to antimony at the parts where the heat is applied. It will flow through the galvanometer from terminal E to F. Remove the flame and apply heat to the junctions Y: a current will be produced which will flow in the opposite direction to that produced when the flame was applied to junctions X, which will cease to produce current as they become cool. The galvanometer needle will show that current now flows from F to E. This is the same experiment as Fig. 17, but with a modified arrangement of the bars. The number of junctions is immaterial. Heat should be applied carefully, as the solder will readily melt and the junctions will come apart. On this account they should be held together by means of rivets as well as solder. If a very delicate galvanometer is available, a flow of current will be indicated if the joint (Fig. 16) is merely heated by the hand or held near to a small flame.

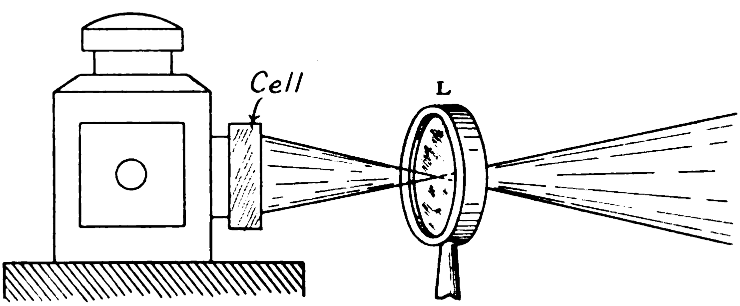


FIG. 21.

As the effect depends upon the difference of temperature between the hot and cold junctions, that is, between junctions X and Y, the bars should be horizontal when the flame is applied to prevent heat rising and affecting the opposite junctions. For the same reason, the length of each V should be greater in proportion to that indicated by the diagrams; in fact, proportioned so that junctions X are as far as possible from junctions Y, Figs. 17 and 18. Flat strips may be used or round wire. To obtain maximum effect the cold junctions may be kept at a low temperature by running water or ice applied at the same time as heat is applied to the hot junctions.

Other metals can be used instead of antimony and bismuth. Copper and iron, for example, will answer very well. The flow of current will take place from the copper to the iron across the joint. The voltage increases with increase of temperature for some couples; but in other instances, copper and iron for example, the polarity, and therefore the flow of current, reverses after a certain temperature is reached. It then falls to zero and rises again; no further reversal occurs, the temperature being made to increase the whole time of the experiment. The voltage obtained by this thermo-electric method is exceedingly small; a considerable number of pairs require to be joined in series to produce 1 volt. With efficient arrangement and gas heating practical thermopiles, as they are called, are made to give a pressure up to about 4 volts and 3 amps.

The effects in experiments with primary batteries, showing the production of hydrogen gas when a current is being generated and the polarisation of the negative plate, may be observed on a large scale if an optical lantern is available, by projecting an image of the solution and plates upon a screen. A flat cell having glass sides is required. It may be conveniently cut from a piece of thick slate, as Fig. 20, the glass sides being cemented on with Canada balsam dissolved in benzol. The plates P P can be held by hand or in a wood clamp made to fit the top of the cell. To adapt the cell to the lantern, remove the front lens and fix the cell, as indicated by Fig. 21; focus the object by a separate lens L.

IT is claimed that the Red Jacket shaft in Michigan has the most powerful winding machinery in the world, huge engines of as much as 8,000 h.-p. reeling and unreeling drums of wire cable that wind down a straight mile below the surface. These engines wind 10-ton cars of ore one mile at the rate of 40 miles an hour, or from the bottom to the top in 90 seconds. It is claimed that this is the deepest mining shaft in the world. A most interesting feature of the Red Jacket shaft is the theory that it is possible to detect the effect of the earth's revolution in it. President McNair, of the Michigan College of Mines, states that nothing dropped in this deepest of mining shafts can ever reach the bottom without colliding with the east side of the shaft.—*Engineer.*

Practical Letters from our Readers.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily for publication.*]

The 1907 Model Speed-Boat Competition.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—From the particulars of the winners in the above, given in THE MODEL ENGINEER recently, I venture to state that I think Mr. Midler's *Morearad* a wonderful piece of work. He certainly seems to have reached finality in light-weight boats. It is a pity, however, that he has not thought fit to give a few more details as to type of engine, boiler, etc., instead of a vague description which conveys nothing. The engine, he states, weighs 4 ozs. It takes very little metal even in a built-up cylinder to weigh 4 ozs., and what about the flywheel—is the weight of this included? From the photographs the engine apparently has a single cylinder, and I do not think it would drive a 2-in. diameter screw without a flywheel. From the speed of boat and diameter of propeller, the pitch of which could not well exceed 5½ ins., the revolutions of engine come out at 2,000 per minute, allowing only 30 per cent. slip on the screw. This brings the evaporation of boiler out at three cubic inches per minute—a wonderful performance for its 60 sq. ins. of heating surface. The boiler and vaporiser combined weigh only 1 lb., and I presume this includes weight of fuel and water necessary, or feed pump if one is used. If the boiler is a water tube one, the metal in it, to stand the 50 lbs. working pressure and give the 60 sq. ins. of heating surface, would weigh just under the 1 lb., leaving very little for fittings, pressure gauge, water, fuel, etc. Even if a flash boiler, the coil of tube of thin metal to give the 60 sq. ins. would weigh quite 9 ozs., leaving only 7 ozs. for fittings, pressure gauge, casing, feed pump and fuel. Any other type of boiler at this light weight is practically an impossibility. I should also like to know how the reaction of the 2-in. screw at its 2,000 r.p.m. affects the boat, which apparently, to judge by the photographs, has only about 4 ins. beam. From my experience and the boat's light weight, I should think it would almost capsize her. I think that in future "Full and accurate particulars of their boats to be given by the winners," should be incorporated in the rules. As we do not want any more of the "closely guarded secrets" style of description, let us hope that in future this will will be insisted upon.—Yours faithfully,

E. V. PIKE.

Victoria Model Steamboat Club.

Locomotive Crank-Position Indicator.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—The diagrammatic sketch herewith shown is a very simple method of indicating to a locomotive engine driver the best position to stop his engine in order that it might easily be started away again without having to run the risk of shifting the link motion. The mechanism consists simply of two pairs of mitre gears, one spindle, and an indicator, the whole of which is supported with two brackets—not shown—one supporting the two bearings at the top, and the other the bearing at the bottom. The indicator is fixed in some convenient place inside the cab, the pointer of which is fastened direct to the gear wheel immediately behind it, and would rotate at the same speed as the trailing wheel from which it gets its motion. On the face of the indicator would be printed the word "Stop" at the point indicating the best position to stop the locomotive in order that it might easily start away again. The words "Front Centre" and "Back Centre" might also be printed, indicating the position of the crank at

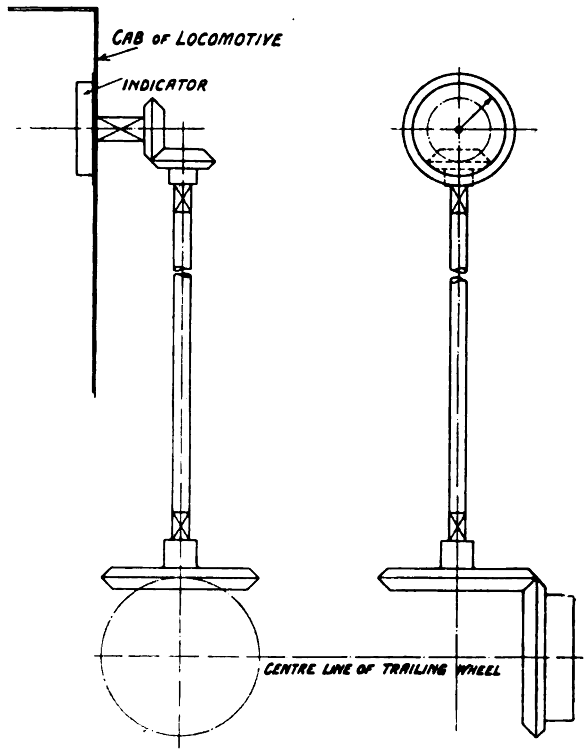


DIAGRAM OF PROPOSED LOCOMOTIVE CRANK-POSITION INDICATOR.

the front and back centres respectively; such an indicator would be of great advantage on trains which have to run up to time, and especially on local trains stopping at every station. For example, I take the trains running between Edinburgh and Glasgow, *via* Bathgate. The majority of those trains stop at every station, of which there are twenty at least. Now, if the engine happened to stop at a station with its crank in the very worst position possible—that is, with the crank and connecting-rod in a straight line—the piston would not move when the steam valve was opened. In such a case the link motion would require to be adjusted, for the two cranks are usually set at an angle of 90 degrees with each other. It might be that the engine would have to be reversed altogether—as the reader will no doubt have felt often, while sitting in a train—before it could get steam. If this state of affairs were to happen at every station—

which is not impossible—the train would be considerably late by the time it reached its destination. I have talked to a few experienced engine-drivers about an indicator of this kind, and they are all of opinion that it would eliminate the time that is wasted at every station, which is of great importance, both to the passenger and the engine driver.—Yours truly, T. A. CALDERHEAD.
Glasgow.

Our Readers' Work Competition.

TO encourage readers to send us accounts of their work, we offer to send any tool, book, or other desired article supplied by any of our advertisers, to the value of 6s. 6d., to any reader who sends us for insertion in THE MODEL ENGINEER a sufficiently good photograph and description of any model, tool, mechanical or electrical apparatus that he has made, and which has not been already illustrated in our pages. Entries should be accompanied by a separate letter giving the title of the article, and stating exactly what is required as a prize in the event of acceptance. When tools or apparatus are desired, the page and number of article in the firm's catalogue from which it can be obtained should be stated, if possible. It is understood, of course, that we do not promise to accept everything that is sent in, and examples of work submitted must show some degree of orginality or usefulness. Ordinary everyday tools or models merely made up from purchased castings are not required. The article should be written *on one side of the paper only*, with the name and address of the sender on the back. The photographs and separate sketches enclosed with the contribution should similarly bear the name and address of the sender, otherwise delay may arise in the awarding of the prizes. It is essential in this, as in our other competitions, that the copyright ot the photographs must be the property of the senders, and the covering letter should contain a declaration to this effect. The competition will close on June 30th, 1908.

The Society of Model Engineers.

London.

FUTURE MEETING.—The next meeting is fixed for Wednesday, April 29th, at the Cripplegate Institute.

VISIT.—On Saturday afternoon, April 11th, a visit will be paid to the paper mills of Messrs. John Dickinson & Co., Ltd., at Croxley Green, near Watford.—Particulars of the Society and forms of application may be obtained from the Secretary, HERBERT G. RIDDLE, 37, Minard Road, Hither Green, S.E.

THE Liverpool and District Electrical Association paid a visit to the ss. *Lusitania*, which was lying in the River Mersey, on Saturday afternoon, March 28, by the kind permission of the Cunard Steamship Co., on her return from New York. A party of about 150 members and friends took part in the excursion. —S. FRITH, Hon. Secretary, 77, St. John's Road, Bootle.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[19,290D.] **Gyroscope.** X. Y. Z. writes: In Vol. XIV, 1906, March 29th, page 305, I read an article by "J. A. H.," "A Small Manchester Type Dynamo." The dynamo here illustrated was made from particulars given in THE MODEL ENGINEER. Could you please tell me where particulars of same are to be found? Could the above-mentioned dynamo be run as a motor? If so, what b.h.-p. would it develop on a 2-in. pulley if supplied with a current of 25 volts 4 amps. Please state speed also. Is there any likelihood of an article appearing in your valuable paper describing the gyroscope?

In reply to your enquiry, the dynamo referred to is the same as the 100-watt size, Fig. 12, in our handbook "Small Dynamos and Motors," in which full particulars of windings are given. The machine would run as a motor as well as, if not better than, a dynamo. Speed should be about 2,700 r.p.m. Some particulars of a gyroscope were given in our issue for May 23rd, 1907.

[19,247.] **Small Electric Lighting Plant.** D. M. (Lochgelby) writes: Being a new reader of your valuable paper, I would like your advice on the following questions. I want to light my house with electric light, but have no knowledge of electricity or power of engines, so I would like to know if a 1-in. by 2-in. engine would drive a dynamo 20 volts 5 amps. If not, what size of engine would be required? What size of boiler would be needed to drive engine? Would the engine be also able to drive a pump to feed boiler? There is a reply in a recent issue of THE MODEL ENGINEER for a boiler for the same engine, but that size in the maker's list is very expensive; is there no other you could recommend? What would be the power of engine if well made? The boiler I should like would be for gas fire. In makers' lists there are brass and copper boilers for said engine, 4 ins. diameter by 12 ins. long. Are these not suitable? Which is the best type of boiler, vertical or horizontal? Will any boiler stand gas firing? How far apart should engine and dynamo be for a good steady drive? The dynamo referred to is the "Captain," by the Economic Electric Company, and is listed to give 90 c.-p. at 20 volts 5 amps. Do you think that sort of a machine suitable? Would it be able to light two 16 c.-p. and four 10 c.-p. lamps at once, using Osram lamps? Would 1/18 S.W.G. be the size for cables? If not what size do you advise? What would be about the speed of dynamo, as it is not given in the lists?

If you require to get a really useful power out of engine, it is absolutely necessary to have a boiler fully up to its work, therefore we cannot advise you to go in for a smaller boiler than 24 ins. high and 11 ins. diameter, with twelve 1-in. tubes, thickness of plate 5-32nds in., height of firebox 11 ins. The power developed by the engine will depend upon the pressure and speed. You can figure this out for yourself from the formula:

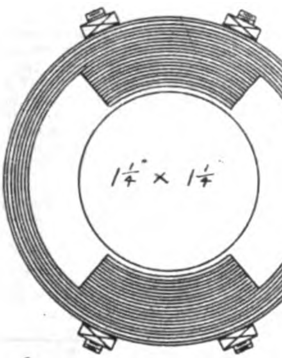
$$\frac{PLAN}{33,000} = \text{I.H.-P.}$$

Recent query replies also deal with this matter. The distance apart of engine and dynamo should be at least equal to six times the diameter of the engine driving wheel.

[19,250.] **Building Model T. B. D.'s in Metal from Plaster Mould.** R. M. (Brook Green) writes: Could you tell me whether the following method of building the hull of a model torpedo craft is feasible? Take a thin plank the shape of the deck, and on it build upside down a model of the boat in plaster-of-Paris. Then lay sheets of zinc or copper over the plaster and bend it into shape, modelling and soldering together. Could you illustrate working drawings of a torpedo boat of the *Scout* class? Are these dimensions proportional?—Length, 4 ft. 6 ins.; breadth, 5½ ins.; depth, 5 ins.

Your plan would work out very readily, and we recommend you to make one or two trials to see what results you get. We will bear your request *re* the dimensions of the torpedo boat *Scout* in mind.

[18,747] **Windings for Small Electric Motor for Locomotive.** G. L. T. (Bishop Auckland) writes: I have an electro-motor (unwound), with field-magnet, as per sketch, and laminated tripolar armature (1¼-in. by 1¼-in.). I wish to fit same into a 1¾-in. gauge electric locomotive. Will you please tell me the



Query 18747

size and amount of wire to wind it with to work from a 4-volt accumulator?

You should wind your armature with about 1½ ozs. No. 24 S.W.G.; field-magnets as much No. 26 S.W.G. as you can get on in the space.

[19,172] **Partial Failure of Dynamo.** C. G. G. (Devon) writes: (1) I have a dynamo from castings of a firm who advertise in The Model Engineer. Armature, 3 ins. diameter; length in armature tunnel — 4½ ins. The field-magnets are wound with eleven layers of wire enclosed (on each magnet). The armature was wound, and seems to be wound with wire of the same size. The machine is Kapp type, supposed to give 50 volts 10 amps., at 2,800 r.p.m. I can scarcely get 25 volts. Not enough metal was left to bore out armature tunnel, as on one side there is a large gap, while on the other the armature only just clears the magnet. Would boring out the armature tunnel and binding iron round the armature improve matters? I should be quite satisfied to get 25 volts easily, with about 15 amps. or even 20 amps. Is this possible? The brushes have to be moved to an angle of about 45 degs. to the horizontal to give the biggest current. Is this correct? (2) With this dynamo I wish to set up a set of accumulators to give about 100 c.-p. (maximum) at one time. If I have thirteen accumulators in series, each of seven plates, 3½ ins. by 2½ ins., 18 amp.-hours, should I be able to obtain this light from them for one hour if I charged up again the following day? Or would it be too high a rate of discharge? If so, I suppose I should have to put more in parallel? When an accumulator is called 15 amp.-hours, does it mean that you will have no current whatever in it if you discharge at 1 amp. for 15 hours, or will there still be enough current remaining to prevent the plates from being spoiled? (3) What is the gauge of wire enclosed? Will No. 22 S.W.G. wire carry 2 amps.? Is a 25-volt installation practicable? What current will No. 16 S.W.G. wire carry?

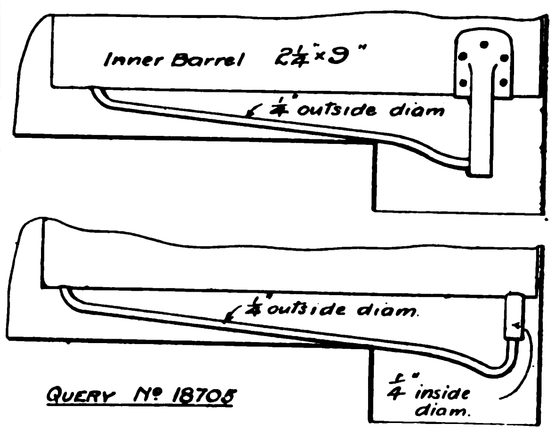
(1) It is necessary for us to see a dimensioned sketch of the dynamo to advise you fully, but the large gap clearance is undoubtedly a contributory cause of the unsatisfactory performance of the machine. We advise you to re-bore the tunnel so that it is equal on either side of the armature, and to fit a wrought-iron liner to each pole face, so as to reduce the clearance to the smallest practicable amount. Or you could fit a liner to the pole face which has the excess clearance. A reduction of clearance will very much improve matters, unless the field-magnet is already magnetically saturated when the machine is at work. It is worth a trial. Also make sure that the brushes are in good contact with the commutator and do not jump. Set the brushes to angle of best effect. (2) This is a very high rate of discharge for cells of this size. If they will stand it, there is no objection; it depends upon the make of plate. Reckoning 3 watts per candle-power as a basis, you could probably light the lamps for one hour if the plates will stand the discharge. The capacity of plates goes down as the discharge rate is increased. Otherwise you must put another set of cells in parallel, or use larger cells. It is not a good plan to discharge cells in parallel. An accumulator should never be discharged right out. The voltage falls as the discharge continues. When it falls to 1·8 volts per cell, the discharge should be stopped and charging be commenced as soon as possible. The cells suffer if allowed to stand in a discharged condition. If a cell is stated to have a capacity of 15 amp.-hours, it would not properly be run right down, but still give at least 1·8 volts per cell. (3) Wire is No. 20 B.W.G. No. 22 gauge will carry 1¾ amps., and No. 16, 6¾ amps., when used as lighting wires. A 25-volt installation is quite practicable on a small scale, but decide on your lamps first, and arrange accordingly, with voltage to suit.

[19,271] **Water Motor.** S. W. H. (Worcester) writes: I am thinking of making a small water motor and dynamo, for charging a 4-volt. accumulator for motor cycle, from the ordinary house tap (town pressure, 30 lbs.), and want to use a wheel which I have by me, made from a disc of sheet steel, ⅛ in. thick, 5½ ins. diameter, over brass cups (twelve in number), riveted on disc (sketch of cups enclosed). Will you kindly inform me: Can I get sufficient power from tap to charge a 4-volt 30-amp.-hour accumulator? What size and how many nozzles to use for water motor? Can I drive dynamo direct off same shaft of water motor, *i.e.*, rotator of water motor and armature of dynamo on same shaft? Best type of dynamo, and principal dimensions.

Unless you have a very high water-pressure the motor will not give sufficient power to drive your 120-watt dynamo. It will probably drive a 10-watt machine satisfactorily, giving an output of 1 amp. and 10 volts. Try various size nozzles, beginning with ⅛ in. diameter and gradually increase that until you get best possible results. You can find by trial what speed the motor runs at, and if sufficiently high, that is, about 2,600 r.p.m., you can drive the dynamo direct. Any of the 10-watt machines given in handbook No. 10 will suit your requirements. We should recommend Figs. 8 or 9.

[18,705] **Water-tube Boiler.** C. R. (Wood Green) writes: I am enclosing herewith rough sketch of boiler for model traction engine I am making, and should be much obliged if you would give me some idea of the pressure it would be safe to work at. I have used a piece of best-drawn brass tube, but this is, of course, brazed. (I could not get it seamless at the time.) Does this make much difference as to strength? The model seems to be getting pretty heavy. Does a bit of weight matter much in this class of model?

In reply to your query, we do not recommend a large downcomer such as shown in your sketch in a firebox which is rather restricted in the matter of length. We recommend you to braze or silver-solder on heavier tubes to the firebox ends, as shown in place of



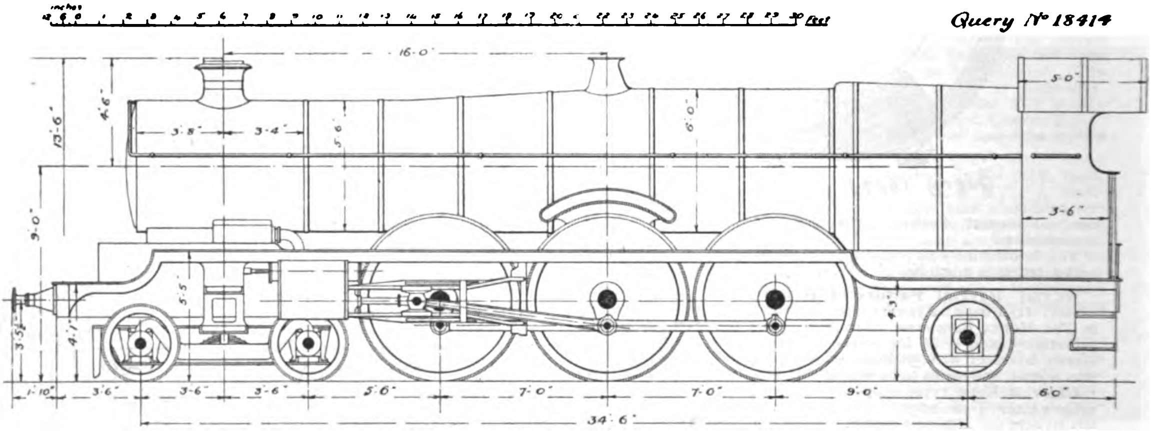
Proposed and Amended Arrangements of Water-tubes in Small Boiler.

the usual downcomer. Keep the down tubes as near the back end as possible, and arrange that the two sizes of tubes fit tightly before silver-soldering. Brazed tube for the inner barrel is not so reliable as solid-drawn copper tube, and we should not advise anything beyond, say, 100 lbs. The working pressure should be about 40 to 50 lbs., with which your engine should do all you require. Within limits, the extra weight is not detrimental. The inner boiler should, however, be as light as possible. The tubes, at least, should be silver-soldered in.

[19,349] **Electric Motors for Locomotives.** H. F. (Hitchin) writes: I have followed with great interest the articles on electrically driven "steam" locomotives published recently. I should therefore esteem it a great favour if you would reply to the following queries. I intend making one of the Universal locomotive motors, as described in The Model Engineer for January 30th (1908), and working it on the separately excited system, that is, by two dry batteries in the tender. The fields will therefore have a current of about 2 volts flowing through them. I should like to work the armature (from rails) with a current of 4 or 6 volts. (1) Please give weight and gauge of wire required for winding this motor for negative fields 2 volts, and armature 4 or 6 volts (which you think best). (2) What ampereage will it take? I intend running it from three bichromate cells. (3) Please say if a three-cell bichromate battery is suitable? (4) Will the battery power have to be increased to make up for the resistance on rails? (5) Would the motor be more powerful if wound for negative fields 4 volts and armature 8 volts, as suggested in the issue of The Model Engineer

referred to? (6) If so, please give weight and gauge of wire required for this winding, as I am anxious to get as much power as possible. (7) If you recommend accumulators in preference to bichromate batteries for railway work, please say what output I shall require in volts and amps., and also how long it will run this motor.

Wind armature with as much as you can get on of No. 26 S.W.G. and field-magnets with No. 28 S.W.G. Three large bichromate cells might possibly give enough current, but we should advise six such cells, coupled in groups of two in parallel, and three such sets in series. If you have a long length of rails, you will have to add one or two more cells to compensate for the somewhat increased resistance. We do not think there would be much appreciable difference in the power of the motor with the fields separately excited, but in any case the matter is one which lends itself to experiment, and the best results can only be obtained by actual trial. The information contained in the article is really more or less suggestive, and although a certain number of trials have been made, there is still room for considerable improvements, and improvements can only be achieved in the way we suggested above.



OUTLINE OF NEW G.W.R. 4—6—2 FOUR-CYLINDER EXPRESS LOCOMOTIVE, "THE GREAT BEAR," No. 111.

[19,278] **Small Dynamo Failure.** D. O. W. (Mostyn) writes: I should be glad of advice on the following. I have a 30-watt dynamo that won't generate. Description: Casting as No. 5 in "Small Dynamos and Motors." Field, series wound with No. 26 S.W.G., cotton covered (supplied by makers). Armature, tripolar, wound with No. 24 S.W.G. (supplied by makers). Field and armature well soaked in shellac varnish, but armature a bit more than 1-32nd in. from field one side, owing to field being not quite even. Is gauge of wire for field and armature right for 10-volt at 3 amps., and ought field to be wound series or shunt? Does the difference in air space between field and armature make all the difference? I may say that I have followed, as far as possible, the instructions in "Small Dynamos" and have tried all tests mentioned in same for faulty machines.

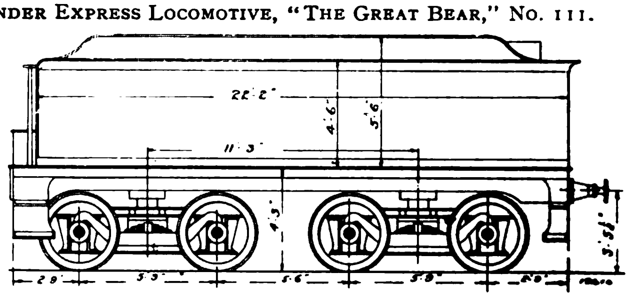
There is evidently some little mistake in your windings. For a series-wound machine No. 26 gauge on the fields is no use. You must try connecting the fields in shunt to the brushes, and then run the machine up to speed with a small lamp in circuit, and see what results you get. Failing this rewind field coil with about 1¼ lbs. of No. 20 S.W.G., and connect in series. The armature being slightly out of truth relative to the tunnel will not make a great deal of difference.

[19,220] **Leclanche Cells and Discharging Accumulators.** T. McC. (Hadley) writes: I have a number of Leclanché batteries, which are not at present of much use to me on account of them polarising. Could you tell me a way of preventing this? Could you also tell me the right gauge of copper wire for winding field-magnet and armature of "Empire" dynamo, oB size, giving out 8 volts? What voltage should I get by connecting a 2-volt 20 amp.-hours accumulator to a 4-volt 4-amp.-hour accumulator in series?

Leclanché batteries will always polarise when anything excepting a very small current is taken from them. The only remedy for this is to use circular zinc plates instead of zinc rods. *Re* "Empire" dynamo, you do not give dimensions of armature or field-magnets, so we cannot give exact windings. Winding for small dynamo will be found in Handbook No. 10, 7d. post free. By connecting your two accumulators together in series you will get 4 volts, but the smaller cell will become run out much sooner than the larger, hence the voltage will very quickly fall below 4 volts.

[18,414] **G.W.R. 4—6—2 Type Locomotive, "Great Bear."** E. G. E. (Purley) writes: You will greatly oblige by letting me have an outside side elevation of the Great Western's new "Pacific," "The Great Bear," drawn to scale (about 3-16ths in. to the foot). I am in no particular hurry, if you do not happen to have a scale drawing by you.

We do not send our readers outline drawings of locomotives, but where the subjects of the query are likely to be of general interest we publish the same at the earliest possible moment. We submit an outline drawing from the official blue-prints. We would have published the drawing before, but we wished to see whether the engine as actually built would conform to the drawing then in hand. The Great Western officials often put on the locomotive as built different details (such as chimneys) to those shown on the drawings. "The Great Bear" has the old standard chimney and is numbered 111. The tender is lettered with the words "Great Western" with the Company's arms between the two words. The firebox is of the wide pattern with practically flat sides slightly inclined to the vertical, the bottom being wider than the top. The locomotive as a prototype for a model has, of course, the great disadvantage of such a long wheelbase, and we see no points favourable to this class of locomotive for model purposes over Mr. Churchward's "North Star" or "Polar Star" class locomotives. For sharp curves the "Atlantic" locomotive "North Star" is to be preferred, and almost as much adhesive weight could be obtained



[19,232] **Water Motor for Lathe and Circular Saw.** T. B. (Blyth) writes: Will you kindly answer me the following questions? What power water motor would drive a wood-turning lathe, 8-in. centres, and a small circular saw to cut 4 ins. deep? Could the motor be driven from ordinary house water main, and what would be the cost per hour?

We are afraid a water motor to do any useful work in driving an 8-in. lathe and a circular saw would be quite out of the question. To begin with, the water consumption would be extremely high, and, even with a pressure of 30 lbs., you would use over 6 cub. ft. of water a minute to obtain ¼ h.-p. To drive the machines mentioned satisfactorily, at least 2 b.h.-p. would be needed, and we advise you to go in for a gas or oil engine instead.

[19,295] **Amalgamation Zincs.** R. H. (Murton) writes: I want to amalgamate some zincs. I have procured some mercury from our local chemist, but cannot make it adhere to the zinc. I have worked with sulphuric acid, as directed in your book. I should be thankful if you will inform me how this is done.

This is a simple process, and we do not see exactly how you can have got into difficulties. A piece of soft flannel is the best to rub the mercury well on to the zinc rods with. If you stand the zinc in a small saucer containing mercury, and well rub in the latter for some few minutes, we think you should find no further trouble in the successful amalgamation.

[19,221] **Casting Accumulator Grids.** A. W. (Barnsbury) writes: I am sorry to trouble you again, but I am again at a standstill. I am making an accumulator to the instructions given in your Handbook on "Small Accumulators," tenth edition, page 18. I have made the first plaster-of-Paris slab, as therein described. But cannot follow the paragraph which states—line eight, page 20—"To complete the mould, an exact counterpart of the half already cut is required," etc. If I lay my first wax impression on its back on the mould, I find that both mould and wax impression are the same hand, when I want one left-hand and one right-hand. Could you inform me what is best for me to do in this case?

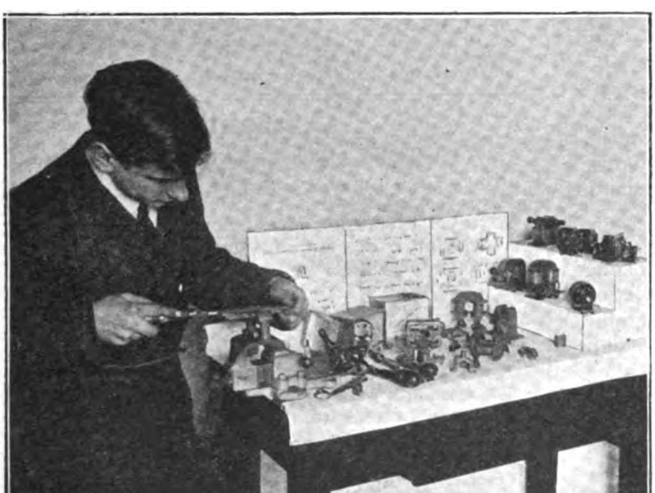
An explanation of this matter and how to overcome this difficulty was given in our issue for November 28th, 1907, page 533.

[19,136] **Blowlamp for Model Steamer.** N. A. E. (near Leek) writes: Thanks for information in a recent issue of your paper. I wrote to the firm in question, and they advised me to use one of their Aetna lamps, size No. 4, with vertical burner. A short time ago, however, I wrote to Bassett-Lowke & Co., and the Liverpool Castings Supply Company asking them whether they considered the Aetna lamp was suitable for my purpose, at the same time giving them particulars of my engine and boiler. The first-named firm, as you are probably aware, stock the Aetna lamp. Both of them, however, replied to the effect that it was not suitable, the latter firm advising me to use the lamp which they make specially for model steamboats. The price of this is rather more than I can afford to pay. Can you tell me whether their lamp is any better than the Aetna or whether you think it would be suitable to fire a boiler of the following sizes—length, 10 ins.; diameter, 4½ ins.; furnace tube, 2 ins. diameter; fitted with thirteen ¼-in. water tubes. Coil superheater in smokebox. Engine, ½-in. bore by 1½-in. stroke. Required to drive a torpedo-boat destroyer 5 ft. long, using a single screw about 4 ins. diameter. The Liverpool Castings Supply Company supply the burner of their lamp separately. I have a strong brass container (cylindrical), 6 ins. by 3 ins., fitted with filling plug and cycle valve. Do you think if I fitted one of their burners to this and derived pressure by means of a cycle pump, that it would answer all right, or do you think the Aetna would be better still? If I use the container I have, how long would the pressure keep up providing there were no leakages?

In reply to your Query, the Aetna burner does not give a sufficient volume of flame. We have tested the Liverpool Castings Company's lamp and can recommend it for model steamer work. The tank you have is quite applicable and suitable. A release valve and also a screwdown supply valve to the burner should be fitted. The release valve should be one of the new screwdown blow-off cocks recommended for the small undertype engine (smallest size will do). The pressure will fall as the oil (or spirit) is used up, owing to the increased space for the compressed air on the top of the fuel.

[19,205] H. E. W. (Weybridge) writes: I shall be much obliged if you can inform me as to where I can obtain Crane's "Zapon" enamel, as mentioned by Mr. Norgate on page 91 of THE MODEL ENGINEER, dated January 23rd, 1908.

The Fredk. Crane Chemical Company, 22–23, Newhall Hill, Birmingham.



FITTING-UP THE "AVERY" EDUCATIONAL MODELS.

[19,262] **Shunt Battery.** H. V. C. (Chiswick) writes: Will you be good enough to give me a description of the shunt battery mentioned in Query No. 18,340, as I should like to make one.

The description of the shunt battery will be found in our issue for November 9th, 1905, under the heading of "Home Electric Lighting."

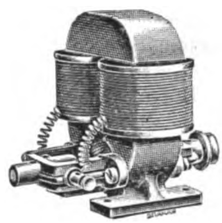
The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

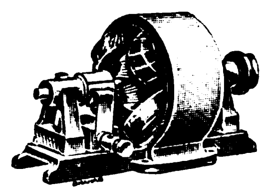
** Reviews distinguished by an asterisk have been based on actual Editorial Inspection of the goods noticed.*

The Avery Educational Models.

We are now able to illustrate some of the excellent little educational models of electrical machinery recently introduced by Mr. A. H. Avery, of Park Street, Tunbridge Wells. These models have been designed especially for the beginner in electrical work who wishes to have the building of his first dynamo or motor made as easy and simple as possible. There are six different types of machines in the series, and in each case the castings and all necessary parts are supplied neatly packed in a box, with full instructions and drawings so clearly set out that anyone who has never seen a



AN UNDERTYPE MODEL.



A MULTIPOLAR TYPE MODEL.

dynamo before can fit up a successful working machine. The details of construction have been simplified as far as possible in view of the limited workshop facilities of the beginner, and any of the models can be put together and finished off without the aid of a lathe; the only tools necessary being a file and a few drills and taps. The six machines in the series are of the following patterns: overtype, undertype, Simplex, Manchester, ironclad, and multipolar; our two illustrations showing the undertype and the multipolar type respectively. The price of each set is so small that the whole series could be completed for a moderate outlay, and the amateur electrician would then possess a highly interesting and instructive range of machines. For a first effort in electrical work, as well as for those who are looking for quite a small machine to run from a model steam or gas engine of limited power, these models are just the thing, and from a personal inspection of the series we can cordially commend them to our readers.

New Catalogues and Lists.

L. A. Vail, 284, Post Office Place, Melbourne.—We have before us an excellent list of tools and models which has recently been issued by Mr. Vail. The well-known "Stuart" engines and castings, for which Mr. Vail is agent, are catalogued in full variety, and we understand that a large stock of these lines is kept in Melbourne. We also note "Star" lathes, Leyland Barlow hand shapers, Avery dynamos, and a very useful assortment of small tools of all kinds. The list is one which our Australian readers should find of much service, as all the goods can be obtained on the spot.

The Editor's Page.

THE following interesting letter comes to hand from a reader in California, "A. W. L.": "I want to say a word of appreciation for THE MODEL ENGINEER. I have taken it in parts from the first number until December, 1904. In 1906 I bought ready bound Volumes XII, XIII, XIV, soon after which purchase, my work in railroad surveying took me away into the country and into the desert, and so for a time I was obliged to be without my useful companion. Having just returned to civilisation, I naturally turn to THE MODEL ENGINEER again, and can for the first time really delve into the delights of three new volumes. I was astonished at the great improvement and the diversity of information contained in these volumes. It should be possible for any one to find plenty of matter about their own pet subject. There is not another journal in North America which approaches THE MODEL ENGINEER, and it is to be regretted that it is not better known over here. My pet subject is 'Automatic Couplings,' in which I have taken the keenest interest for many years. It was very gratifying to find considerable space devoted to this—to me—interesting matter. In a few days I am hoping to send to New York for bound Volumes XV, XVI, XVII, and hope to find still further mention of automatic couplings. Also I have decided to resume taking your journal in weekly parts, commencing with either last January or next July, and having the parts bound. A very enthusiastic subscriber in Los Angelos advised me to do this. He said that six months was too long to wait, and that he preferred to have his MODEL ENGINEER every week. He owns a machine shop, and is the only reader of your Paper that I know on this Continent. From this you will see that we modellers are rather a lonely lot." We may say, in response to our correspondent's closing remarks, that we have a large number of readers in various parts of the United States, but scattered as they are over so large a country it is not to be wondered at that they do not more frequently come across each other.

* * *

The Society of Model Engineers are holding another Model Making Competition in connection with their forthcoming Conversazione at the Cavendish Rooms, on May 23rd. A very handsome list of prizes has been arranged, including gold, silver, and bronze medals, and in view of the greatly increased membership the Society now has, a fine show of work may be expected. With the other attractions which are usual at this function, a big success for the Society is certain.

* * *

We have received some further correspondence on the subject of the conduct of apprentices towards their fellow-workmen, for which we hope to be able to find space next week.

Answers to Correspondents.

J. A. (Belfast).—Messrs. Burton, Griffiths & Co., Ludgate Square, Ludgate Hill, London, E.C., are agents for the "Star" lathes.

J. R. F. (Edinburgh).—We thank you for your practical hint, which we may use at some future time.

A. B. (Hartford, Cheshire).—We thank you for the interesting photographs, some of which we hope to reproduce as our space will permit.

S. S. (Ipswich).—An article on an electric engraving machine appeared in our issues of March 26th and April 2nd, 1903.

F. H. (Blackburn).—Drawings for a model platen printing machine were published in the issues for December 13th and 20th, 1906. We presume you wish for a *model*.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 26–29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 364. APRIL 16, 1908. PUBLISHED WEEKLY

A Model Undertype Engine.

By "EX-PLOUGHBOY."

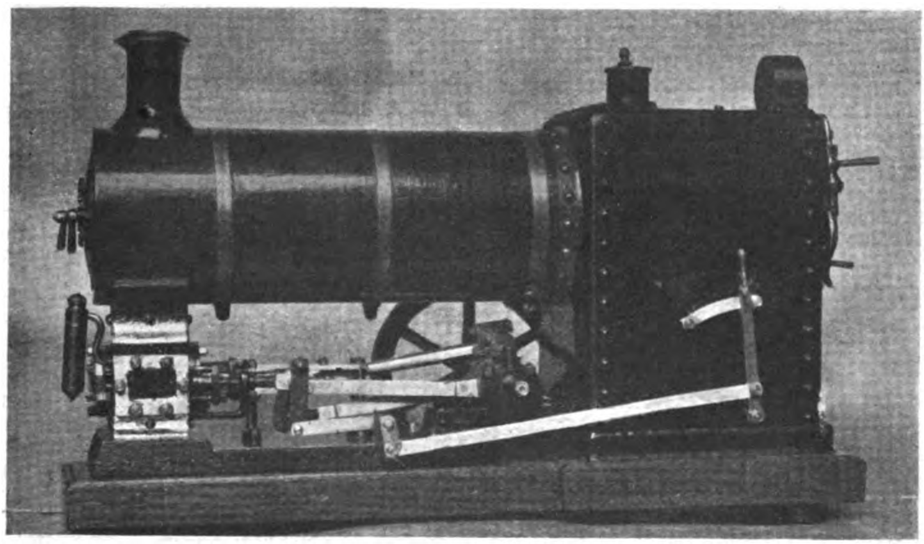


FIG. 1.—SIDE VIEW OF A MODEL UNDERTYPE STEAM ENGINE.

HAVING recently completed the building of a small undertype engine and boiler, I think a few remarks concerning the work may be welcomed by many readers.

The Boiler.—The outer barrel of this is 3 ins. diameter, 8 ins. long, and the firebox is 3½ ins. wide, 4 ins. long, 6 ins. high from baseboard. The barrel is 1-32nd in.; the firebox is the same thickness; the latter is lined with ⅛-in. thick asbestos. The throat and back plates were flanged from flat sheet brass by hand, using a round-headed hammer and wood blocks. The inner barrel is 2¼ ins. diameter and 10 ins. long; one end just comes through the back plate, on which the fittings are fixed. The barrel is also fitted with four ¼-in. water tubes. The fittings include a Bourdon pressure gauge (to 60 lbs.); a regulator in smokebox, with a rod passing through a tube to the handle, as shown; a water gauge, with 3-16ths-in. glass. The glands are oval and are fitted with two screws each. Steam blower and blow-off for emptying the boiler, and hand-feed pump, also safety valve on the top of boiler. The smokebox door hinges are made of sheet brass, as are also the handles and bolt, the door proper being made of copper. The funnel is riveted and soft-soldered to the shell; a petticoat pipe extends down inside the smokebox to the centre line of the boiler.

The Lamp.—This consists of four burners for spirit, supplied by two 3-16ths-in. tubes from the reservoir. The reservoir was at one time a patent barley tin, slightly oblong in section; since it has been trimmed up and enamelled, it looks very neat.

The Steam Cylinders.—The stroke is 1 3-16ths ins. and bore 1 3-16ths ins. After drawings, the first part I made was the slide-valve. I think the method of making is original, as in my design the distance from valve face to the centre of valve rod is only 3-16ths in., it meant close work. I was somewhat afraid of cutting the exhaust cavity from the solid, so I employed the following method. A piece of 3-32nds-in. sheet brass was cut to the size of the face of the valve, also a hole was cut in the centre ⅜ in. square to form the exhaust cavity. Another piece of brass, a shade larger than the hole and 5-32nds in. thick, was tied to it with fine iron wire and silver-soldered from inside.

The drawing (Fig. 4) shows clearly enough the method of transmitting the movement of the rod to the valve.

To get rid of the difficulty of cutting the ports I used the dodge shown in Fig. 5. A pattern was made and casting obtained; a hole ⅞ in. diameter was bored through to take a brass tube. It can be seen it was comparatively easy to cut the ports, as the drill or file can go right through. A passage must be cut to allow the steam to reach the ends of the cylinder, but the port bars must fit close against the tube. After the tube had been pressed home it was thoroughly soft-soldered with a blowlamp, special care being taken to make a good joint at the port bars. A piece of brass was hard soldered between the flanges to take the holding-down studs before the tube was placed in position.

The end plates, which are to support the smoke-box of the boiler, are shown in Fig. 6. It will be seen that they pass over the end of the cylinder and abut against a flange, as shown in Fig. 5; a piece is also cut out to allow the ends of the steam chest to come out flush; an extra piece is cut out (shown dotted, Fig. 6) to allow the stem of the valve rod guide to pass through. The end plates are cut from 1-16th-in. sheet brass and are held together by four screws 3-32nds-in. in diam. which screw into four pieces of 5-32nds-in. round brass rod, the screws passing into the ends of the rod. Holes are also drilled through the pieces of rod crossways to take the screws which hold the side plates on.

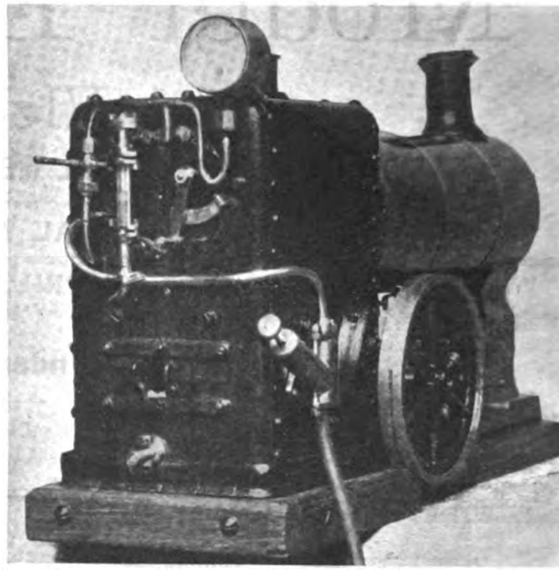


Fig. 2.—View from Firebox End.

The valve rod guide is fastened at the underside of the steam chest by two screws.

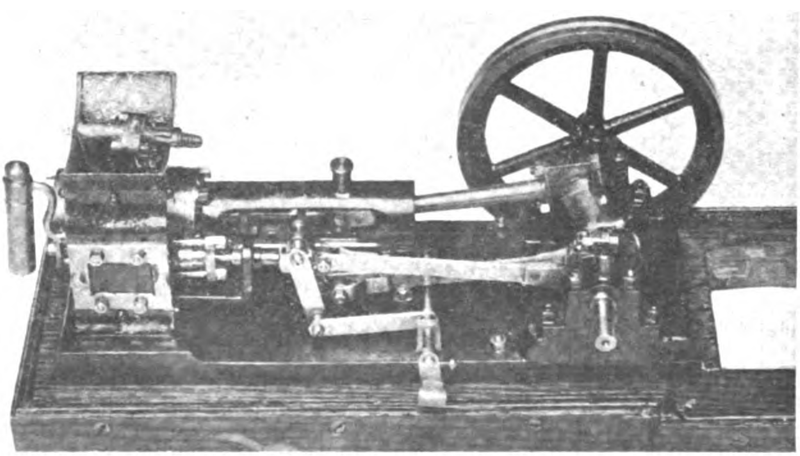


Fig. 3.—Showing Engine, Boiler removed.

The crankshaft is built up of mild steel in the usual manner; the bearings are bushed with brass. The crosshead and guide are of the circular type and are built up of odd pieces of brass. Nutted glands are fitted to the piston and valve rods, 3-32nds-in. studs being used.

Since taking the photographs I have taken away the link-reversing gear originally fitted, replacing it with ordinary slip gear, which I find works much better.

The weight of whole model complete is about 10 lbs.

Starting with cold water, and using an air-jet blower in an extended funnel, I can obtain the working pressure of 15 to 20 lbs. in seven or eight minutes. The steam blower acts very well, blowing the fire beautifully when necessary.

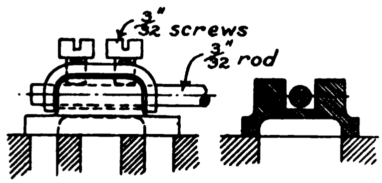


FIG. 4.—TWO VIEWS OF SLIDE VALVE. (*Full size.*

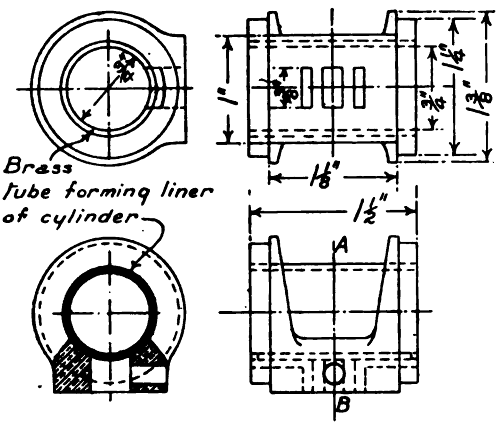


FIG. 5.—SHOWING CYLINDER CONSTRUCTION.

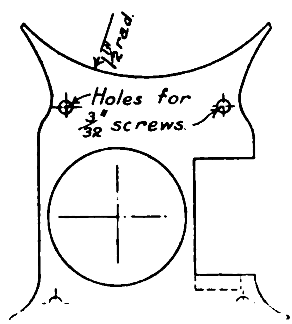


FIG. 6.—END PLATES.

I have not been able to test it to full power as yet, but I have had it running lightly loaded for over an hour on several occasions.

Workshop Notes and Notions.

[*Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked* "WORKSHOP" *on the envelope.*]

Another Method of Cutting Glass Bottles.

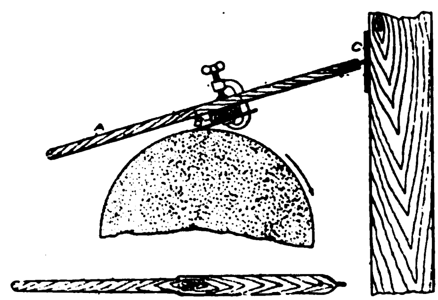
By W. M. G.

Soak a piece of worsted thread in methylated spirits and tie it loosely twice round the bottle a little below where it is wanted to break. Then set fire to the thread, and when it has burnt out, plunge the bottle into cold water. It will then crack all round and the bottle will be cut very cleanly. To do this properly, the flame must be perfectly even, *e.g.*, it must not be blown about by any draught. Also, it is better to light it at two or three places at once. The object of wrapping the thread twice round is merely to give a more lasting flame. Thick string, or anything which will freely absorb the spirits and burn readily will do. I can recommend this, as I have frequently used the method.

For Grinding Tools.

To grind a straight edge on a tool such as a chisel or a plane takes more skill than many possess and more patience than anyone likes to exercise. An easily made and inexpensive device is shown herewith by means of which the edge can be made to come true every time and the same bevel held throughout the grinding, no matter how many times the tool is examined in the course of the process.

A wooden bar 2·5 ins. by 1 in. and 3 ft. long, has one end shaped for a handle and a wood screw driven into the other to the depth of the threads, the head then being filed off to form a round-ended pivot. Against the post just back of the stone is screwed an iron strip 3/8 in. by 1 in., with several holes drilled part way through to form a bearing for the pivot in the stick. These holes are one above the other, 3/4 in. apart, and should be numbered. A



A DEVICE FOR TOOL GRINDING.

block 4 to 5 ins. long is fastened to the stick at the right point to bring the point of the tool above the centre of the stone when it projects about an inch beyond the edge of the block..

With the tool clamped to the block as shown, the pivot is tried into the holes until the one which gives the right bevel is found and the number noted. It is then a simple matter to bring the tool to an even straight edge.—*The Engineer* (Chicago).

Grinding Twist Drills.

By W. MUNCASTER.

Those who have not the luxury of a twist drill grinder find great difficulty in grinding drills to cut dead size. The chief fault lies in one cutting edge being longer than the other, as shown in Fig. 2. The drill A is correctly ground, but drill B has too much ground off the side *b*, throwing the point of the drill out of centre, which will cause the drill to cut big, and it will be necessary to grind cutting edge *a* till the outer corner is square with outer corner *b*. To do this satisfactorily a drill gauge will be required, which can be used for various sizes of drills. This can be very easily made and secured

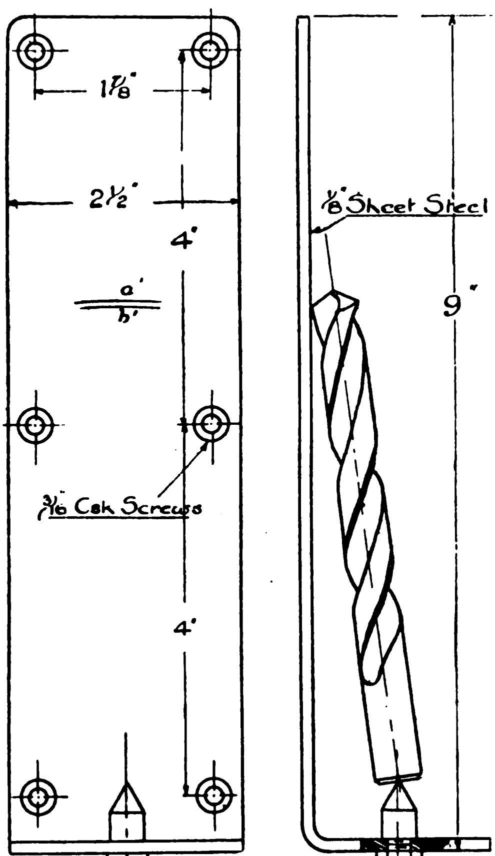


FIG. 1.

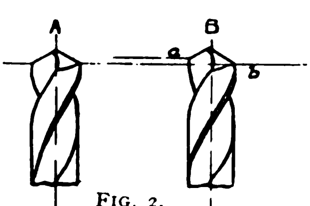


FIG. 2.

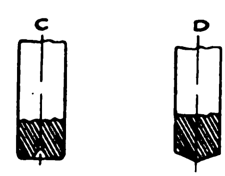


FIG. 3.

to the wall or a column near the grindstone or emery wheel. A piece of ⅛ in. sheet steel, about 12 ins. by 2½ ins., will be found very handy to make this for taking small drills up to about ¾ in. diameter. The steel should be bent at a right angle about 3 ins. from the end and a centre made from ¼ in. silver steel, secured to the short end of the plate. The centre should be hardened, which can be done by heating it to a bright red and dipping in oil. In case longer drills are required to be ground, the back of the gauge can be made 15 ins. long instead of 9 ins., which will allow it to take practically any drill now in use. Holes should be drilled in to take either 3-16ths in. or ¼ in. countersunk screws, for securing to column of wall: in the latter case the

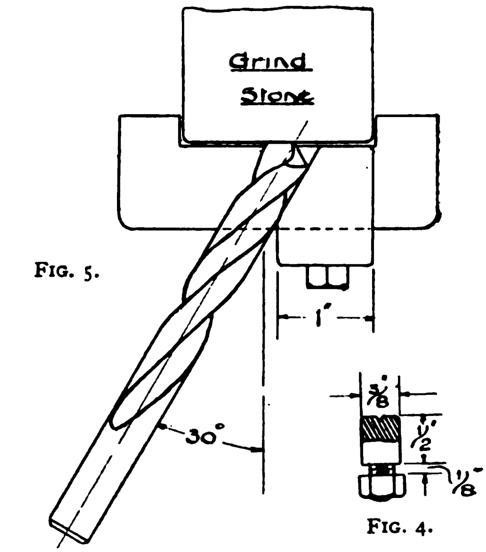


FIG. 5.

FIG. 4.

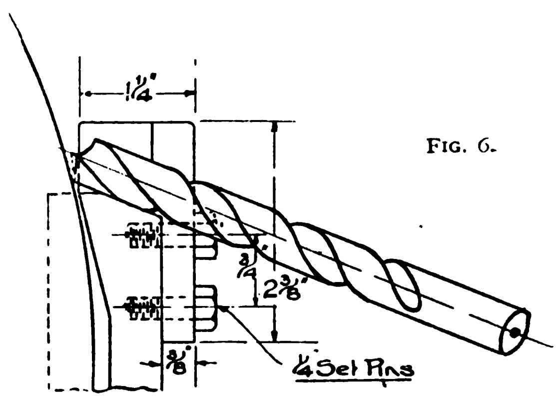


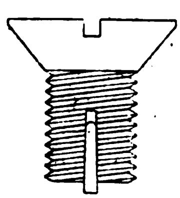
FIG. 6.

holes can be pitched to suit the joints in the brickwork, where the mortar can be cut out and wood plugs driven in. The gauge can then be screwed to the plugs with ordinary wood screws.

Having now the necessary gauge, the centre at the shank end of the drill should be placed on the centre point of gauge, and a mark made on the face of the gauge, the gauge being first chalked to show the marks clearer, with the two cutting edges. If these marks coincide and both cutting edges are the same angle to the centre line, the drill is correct; but if the cutting edge *a* is longer than cutting edge *b*, as shown in Fig. 2, the corners will make two distinct marks, *a'* and *b'*, Fig. 1. To correct this, the cutting edge *a* should be ground down till it coincides with mark *b'*. To get the correct angle, which is generally 30° to the centre line, a stop can be fixed to the rest on the grindstone, Figs. 5 and 6, one side making an angle of 60° to the face of the stone. The drill should be held against the step, with the cutting edge to the stone, face of cutting edge upwards, taking care also that this edge is horizontal, and the shank of drill worked up and down vertically. The shank of the drill must not be lifted too high when grinding, or the cutting edge will be found to be backed off in the wrong direction, and will not cut. With a little bit of practice a good job can be made this way, when it will be found possible to grind accurately without the stop fixed to the rest, the gauge, however, will always be found necessary. A large number of drills are not centre-drilled as shewn in *c*, Fig. 3, but taper to a point *d*, Fig. 3. To take these another centre must be made to replace the one shewn in Fig. 1. A piece of ⅜ in. diameter silver steel, Fig. 4, will do, turned down to ¼ in. to form shoulder and screwed to take ¼ in. nut, the other end being centred to take end of drill shank. This arrangement, although both cheaply and quickly made, will be found invaluable to any one not in possession of a special drill-grinding machine, and will soon repay for the trouble taken in making it.

To Tighten a Loose Screw.

When a machine screw is too small for the hole, a remedy given in *The Engineer* (Chicago) is as follows:—Clamp it between two pieces of wood,



A Method of Tightening a Loose Screw.

saw a slot in the end, and drive in a flat iron wedge a trifle thicker than the slot and narrower than the diameter of the screw. The same method will tighten a loose nut on a bolt or lock it fast.

An Alternative Design for a Hand-feed Arc Lamp.

By A. McL.

The hand-feed arc lamp to be described is an alternative design to the inclined lamp described in the issue for January 2nd, 1908, and is known as the "scissors" type, which provides a light concentration far superior to that of the inclined type, and also allows the use of alternate currents with far better effect. It is designed to slide inside the lantern in the position usually occupied by the limelight jet, and is so arranged that the centre of the arc can be adjusted vertically, or, to be more correct, radially, without altering the set of the carbons. This adjustment is made by the nuts at the bottom of the feed-screw, the bottom nut being provided for locking. The lamp

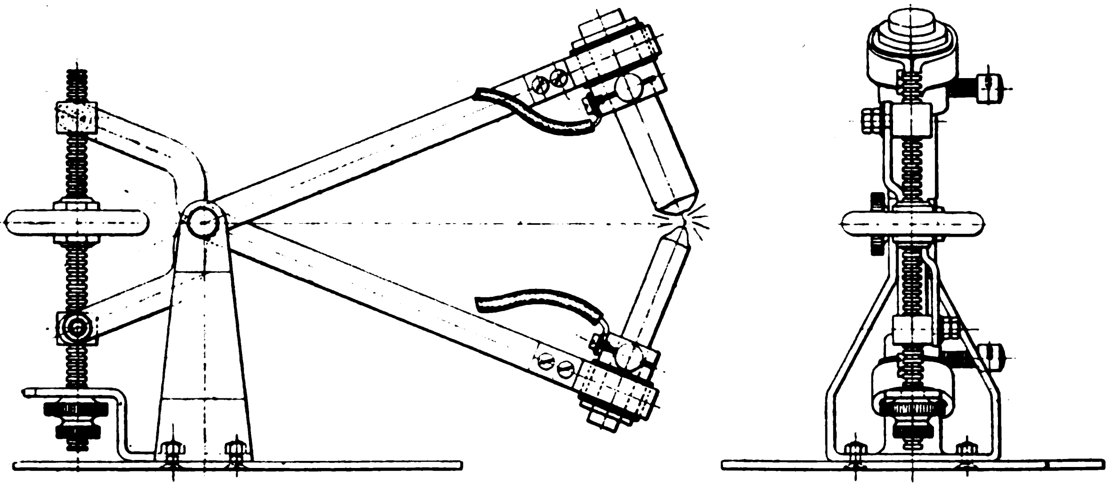


Fig. 1.—General Arrangement of Hand-feed Arc Lamp. (*One-third full size.*)

will be found to burn very well with an arc voltage of from 45–50 and current of anything from 5 to 20 amps., although much cannot be expected from the very low currents, and perhaps 10 amps. is best for all practical purposes. Cored positive carbons should always be used, and for alternating currents both carbons should be cored, as this has the effect of keeping the arc steady and in the centre, instead of wobbling from one side to the other. Below is tabulated the best carbon sizes for different currents, both continuous and alternating:—

For Continuous Currents.

Amps.		Positive (cored).	Negative.
5	..	13 mm.	8 mm.
7	..	16 mm.	9 mm.
10	..	18 mm.	12 mm.
15	..	18 mm.	13 mm.
20	..	25 mm.	18 mm.

For Alternating Currents.

Amps.		Both Cored.
10	..	Both 13 mm.
12	..	Both 15 mm.
15	..	Both 16 mm.

In the construction the use of castings has been entirely avoided. The carbon holder limbs are made from ½-in. by ⅛-in. brass strip, bent hot to shape shown. The circular bends should, of course, be both of the same diameter if an alternating lam p is being made, which also applies to the carbon holders themselves, as it will be seen by the above table that both carbons are of the same diameter in alternating current lamps.

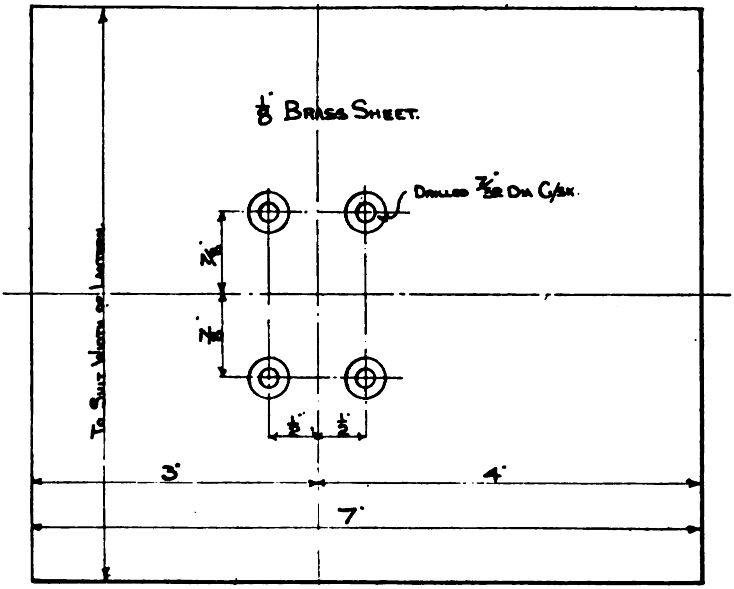


Fig. 2.—Foundation Plate.

It will be seen that the small distance-piece ¼ in. wide is to be interposed between the two carbon holder limbs on the centre spindle, and that a milled nut is provided at the end of the spindle to enable the whole to be tightened up, so that the working is without play, and that a definite turn must be given to the feed-screw to adjust the length of arc. The insulation of the carbon holders is effected by wrapping strips of mica ¾ in. wide round the carbon holders to a depth of about 1-16th in. and clamping them in firmly by the screws provided. The leads are asbestos-covered flexibles, and are screwed under the screws and washers on the carbon holders. The rest of the construction will be readily understood from the drawings.

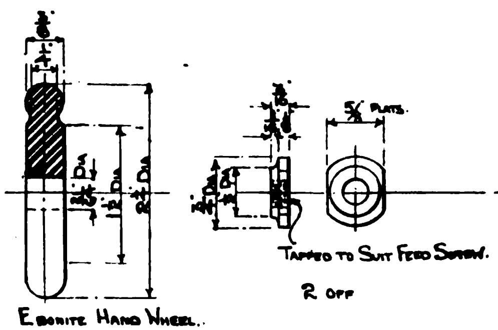


Fig. 10.—Wheel and Collar.

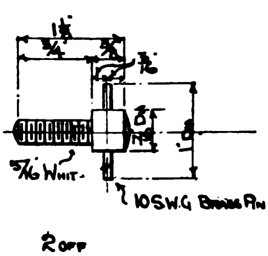


Fig. 9.—Carbon Clamping Screw.

A small resistance of 15 volts drop should always be run in circuit with the lamp, and for running off circuits of 100 volts upwards a much larger resistance must be used, to reduce the voltage sufficiently. Thus, for a 100-volt circuit, the resistance used would require to give a drop of 55 volts. Eureka resistance wire is best for this purpose, and below is given the gauge of wire to carry the different currents without getting unduly hot :—

Amps.	S.W.G. (Eureka.)
5 ..	19
6½ ..	18
7 ..	18
8 ..	16
10 ..	19 (2 wires in parallel)
12 ..	18 (2 „ „)
15 ..	19 (3 „ „)
20 ..	19 (4 „ „)

The amateur will have no difficulty in making a suitable resistance frame to suit his requirements.

For the Bookshelf.

[Any book reviewed under this heading may be obtained from The Model Engineer *Book Department, 26–29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.]*

The Encyclopædia of Practical Engineering and Allied Trades. Edited by Joseph G. Horner, A.M.I.Mech.E. Vol. VII. London: Virtue and Co. Price 7s. 6d.; postage free.

The latest volume of this up-to-date work has come to hand; as in preceding volumes, the illustrations are good, and the work is interleaved with reproductions, on art paper, of machines and appliances of special interest. Many subjects useful to our readers are included. Alphabetically this volume comprises, to mention a few items: Ores, Mechanical Treatment of; Oval Chucks; Paddle Wheels; Paints; Pantograph; Pattern-making; Pendulums; Permanent Way; Petrol Engines; Planing; Pneumatic Hammers; Power Gas; Pulleys; Pyrometers; Reamers; Riveting; Roofs; Rope Driving. Each successive volume is full of useful matter, and the whole work will be a valuable addition to the reference library of many of our readers.

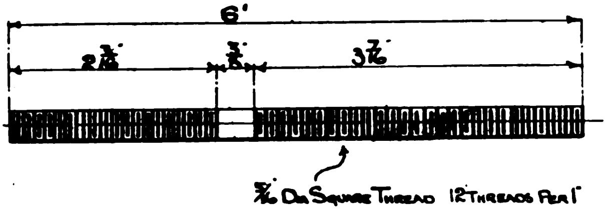


FIG. 4.—FEED SCREW.

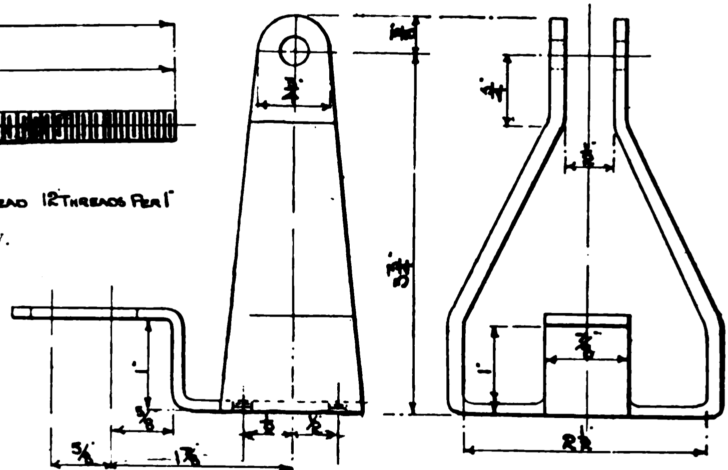


FIG. 3. STANDARD.

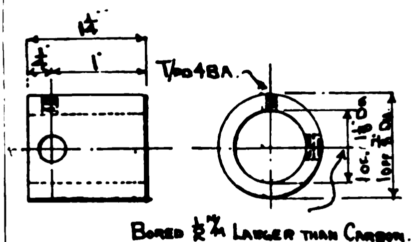


FIG. 6.—SLEEVE FOR CARBON.

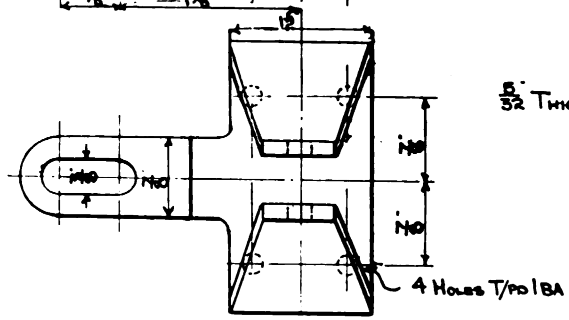


FIG. 8.—FEED SCREW FITTINGS.

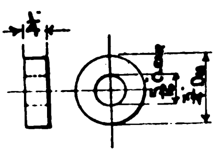


FIG. 11.—COLLAR ON PIVOT BETWEEN "SCISSORS." (*One off.*)

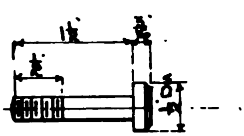
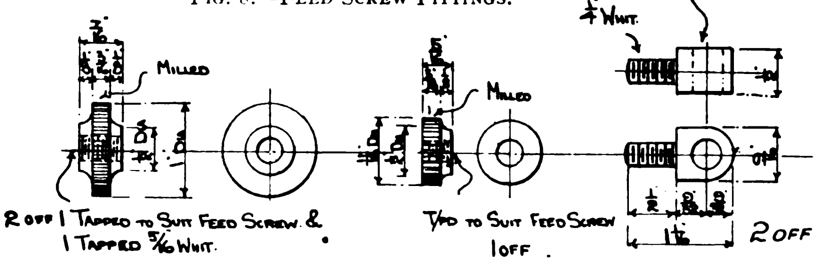


FIG. 7.—PIVOT. (*One off.*)



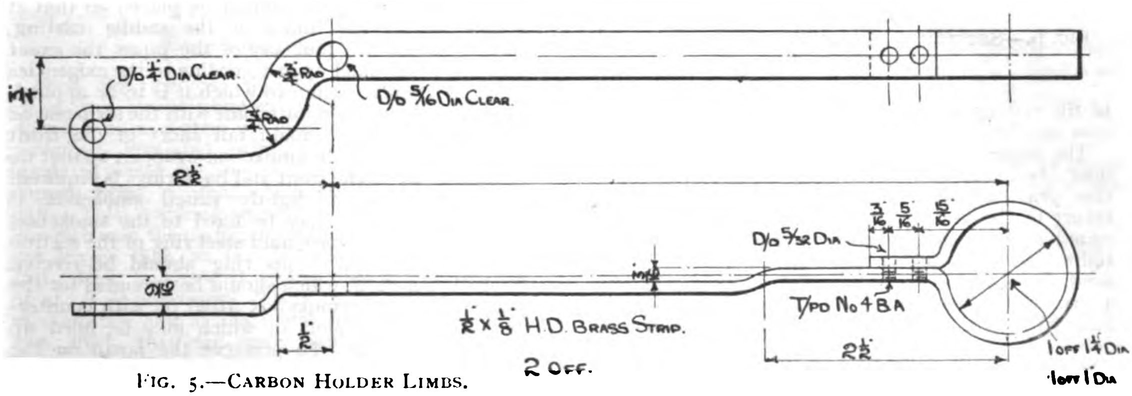


FIG. 5.—CARBON HOLDER LIMBS.

DESIGN FOR A HAND - FEED ARC LAMP.

Chats on Model Locomotives.

By Henry Greenly.

III.—Smokebox Door for 1¼-in., 1½-in., and 2-in. Scale Engine.

(*Continued from page* 344.)

It was considered best practice in bygone days, when the height of boilers above rail level seldom reached 7 ft. 9 ins., to use continuous handrails, the side handrails being bent at right angles at the smokebox, and then running round the face of the smokebox front, over and concentric with, the door. But the height at which boilers are placed in modern engines causes the advantages of the continuous handrail for the greater part to disappear, and therefore we get handrails fixed on the door itself, the side handrails ending at the smokebox front, as shown in the writer's drawings of the G.N.R. smokebox door arrangements in the first issue of this volume.

A similar arrangement is suggested for this model, and as the handrail knobs are not drilled right through, they are best fixed by bolts. In this case a level face for the nuts should be arranged in the door by the pattern-maker. Of course, if this is deemed expensive or troublesome, then ordinary screwed shank knobs may be used, one of them being drilled through to facilitate the entering

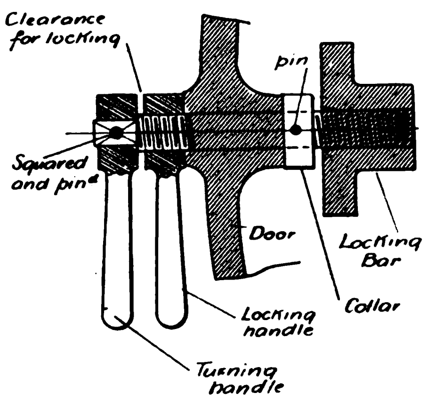


Fig. 6.—Section of Smokebox Door Locking Device.

of the rod, or the knobs may be made of nice soft iron and be riveted over on the inside.

The locking devices which may be used for the door are many and numerous. In actual locomotive practice there appears to be a tendency to revert to the use of screw dogs placed at intervals round the edge of the door to keep the same air-tight; but with turned cast-iron doors there is no need of this in a working model, even of 2 ins. or 3 ins. to the foot scale. The simplest device is a screwed centre spindle, as shown on the sketch detail, Fig. 6. which simply turns into a tapped hole in a cross-bar. Means are provided to prevent the handle falling out when the door is open, and the inside handle may be tapped and work on the threaded part of the spindle, as a lock nut, the outer one being fitted to the squared end, and be pinned in position. The threaded end of the spindle should be taper, also the hole in the bar, and the bar should not fit on the end studs too rigidly, and the hole in the door for the spindle should be counter-bored or reamered out, slightly taper, from the inside.

The bar, where only one locomotive is to be built,

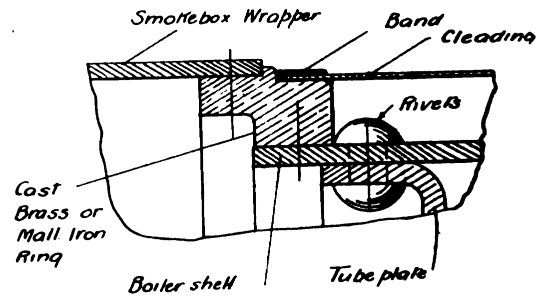


Fig. 7.—Method of Fixing Boiler to Smokebox.

may be a piece of stout plate, but in the large model engine mentioned above a webbed cast-steel bar is employed. A similar design is shown on the drawings. The locking spindle has a tee-ed end, and engages a slotted hole in the centre of the bar. This hole should always be horizontal, so that the weakening of the bar at the vital part is reduced to the minimum. The spindle is threaded and also keywayed at the outer end, the inner handle being drilled with a clearing hole and keywayed for a well-fitting steel key. The outer handle should be tapped to suit the spindle. This may be replaced by a wheel, according to the fancy of the builder of the model. To enhance the appearance of the smokebox door, a small staple-shaped handle may be fitted on the opposite side to the hinge. This may be made of steel wire bent to shape and fixed with nuts or by riveting over the stalks, as suggested for the handrail knobs.

As tube is not likely to be used for the smokebox wrapper in such large models as those now being described, the plate will have to be rolled out of the flat. The joint should be placed so that it comes within the limits of the saddle casting, but it should not foul any of the pipes, the exact position being fixed upon according to the exigencies of the particular design to which it is to be applied. The joint should be a butt joint with the strip placed inside. This strip should fall short of the front and back edges of the smokebox wrapper, so that no cutting away of the front and back rings is required. Presuming that a slightly raised smokebox is desired, the boiler may be fixed to the smokebox by a cast brass or cast mild steel ring of the section shown in Fig. 7. This ring should be riveted to the boiler shell, which should be extended for the purpose, and the smokebox fitted on with countersunk screws, the slots of which may be filled up prior to painting. To preserve the japan on the smokebox, it may be lagged with a piece of sheet iron, the space between being packed with asbestos.

The next article will deal with the construction of the firedoor.

Table of Dimensions of Smokebox Door for 1¼-in., 1½-in., and 2-in. Scale Locomotives.

Name or Index Letter.	1¼"	1½"	2"	Remarks.
A ..	7½"	9"	12"	Diam. of smokebox.
A B ..	7-64"	⅛"	5-32"	Smokebox plate thickness.
B ..	7 9-32"	8¾"	11 11-16"	Diam. of front ring.
C ..	5¼"	6 5-16"	8¼"	Diam. of opening.
C C ..	2⅝"	3 5-32"	4¼"	Radius of opening.
C D ..	5 13-16"	7"	9¼"	Diam. of door.
D ..	2"	2 7-16"	3¼"	—
E ..	¾"	15-16"	1¼"	Flange width.
E E ..	½"	⅝"	¾"	Diam. of outside boss.
E F ..	9-16"	11-16"	13-16"	Diam. of inside boss.
E H ..	5-32"	3-16"	7-32"	—
F ..	½"	9-16"	13-16"	—
G ..	7-32"	¼"	5-16"	Ring thickness.
H ..	½"	9-16"	¾"	—
H H ..	1-16"	1-16"	3-32"	Lagging plate.
H J ..	5-32"	3-16"	7-32"	—
J ..	5-16"	⅜"	7-16"	Flange thickness.
K ..	1⅞"	2¼"	2 13-16"	—
L ..	1 3-16"	1⅜"	1 13-16"	—
K→L ..	2 15-16"	3½"	4⅝"	Hinge to centre.
H K ..	3-64"	1-16"	1-16"	—
K K ..	2¼"	2 11-16"	3⅜"	—
I L ..	2⅜"	2 13-16"	3 13-16"	—
L M ..	½"	9-16"	¾"	Door stop.
M ..	4 1-16"	4⅞"	6½"	—
M M ..	5-32"	3-16"	¼"	Handrail.
N ..	1 5-16"	1 9-16"	2 1-16"	—
O ..	13-16"	15-16"	1¼"	Side handle.
P ..	5-16"	⅜"	7-16"	—
Q ..	7-64"	⅛"	3-16"	—
R ..	2⅜"	2⅞"	3 13-16"	—
S ..	1⅜"	1⅝"	1 15-16"	—
S S ..	3-16"	7-32"	¼	Smallest diam.
S T ..	7-32"	¼"	5-16"	Largest diam.
S U ..	½"	9-16"	11-16"	—
S V ..	¼"–26	¼–26"	5-16"–26	One off tapped.
S W ..	¼"	¼"	5-16"	One off clearing.
S W T ..	¼"	¼"	5-16"	Spindle diam.
S X ..	9-32"	5-16"	⅜"	—
T ..	7-32"	¼"	5-16"	—
A T ..	7-16"	½"	⅝"	—
T T ..	15-32"	9-32"	11-16"	—
T U ..	3-32"	3-32"	⅛"	—
T V ..	7-32"	¼"	5-16"	—
T W ..	15-32"	9-16"	11-16"	—
T Y ..	¼"	5-16"	⅜"	—
T X ..	¼"	9-32"	11-32"	Top eye.
T Z ..	9-32"	5-16"	13-32"	Bottom eye.
U ..	2 15-16"	3½"	4⅝"	—
U A ..	5-32"	3-16"	7-32"	—
U T ..	5-32"	3-16"	¼"	—
U U ..	⅝×¼"	⅜×5-16	1×⅜"	Taper slot.
U V ..	9-16"	11-16"	15-16"	—
U W ..	⅝"	¾"	1"	—
U X ..	7-32"	¼"	5-16"	Shouldered screw.
U Y ..	3-16"	7-32"	5-16"	—
U Z ..	5-16"	⅜"	½"	—

(*To be continued.*)

New System of Wiring.—A description is given in a recent number of the ***Elektrotechnischer Anzeiger*** of a system of interior wiring in which protected insulated wires are used. The two insulated wires are surrounded by a rigid tube of copper, brass, or iron, which fits tight around the pair. This covering may be a seamless tube, in which case the material can be procured in lengths not longer than 22 ft. If the covering is rolled and folded, however, it can be obtained in lengths of 325 ft. if necessary. These tubes are very small in diameter, and as the metal covering is only 0·3 mm. thick, they are easily handled, and bent to the required shape. Special clamp joints and other fittings are provided, and it is practically impossible for moisture to get to the insulation. The tubes can be laid on the surface or in the plaster.

The Design and Construction of Ball Bearings.

By "Zodiac."

(*Continued from page* 348.)

As already stated, cones, cups, etc., should be ground dead-true after hardening and tempering. An exceedingly good article on grinding has already appeared in The Model Engineer, so that no further reference need be made to the subject. If any signs of fire-cracks are present, the cup or cone should be rejected, as it would be a waste of time to grind or "lap" it up. Before passing on to high-speed ball bearings, a few remarks on the forces tending to screw or unscrew cups and spindles may be advisable.

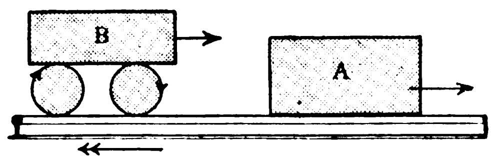


Fig. 17.—Showing Reaction in Ball Bearing.

Time was when every cycle maker made both left- and right-hand pedal pins, with a right-handed thread, and used elaborate patented devices to prevent the pedal pins unscrewing from the cranks. In modern cycles the left pedal pin has a left-handed thread, and the right pedal pin a right-handed thread; both tend to screw up tight to the crank in riding, no locking cotters or other locking devices being used. Few cyclists are aware why this is so, and, indeed, in a book on cycle construction published a few years ago, all the designs for hubs and bottom brackets are wrongly threaded.

In Fig. 17 the heavy load A being pulled along

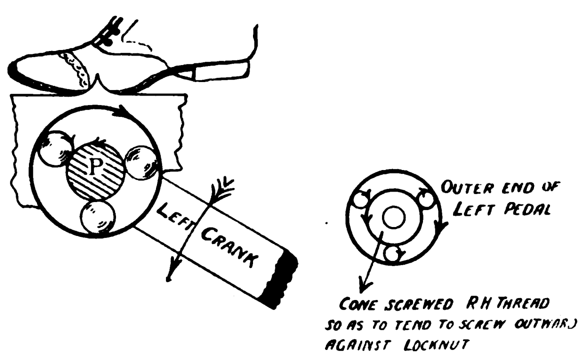


Fig. 18.—Showing Forces tending to Turn or Rotate Cycle Pedal Pin.

the rail would tend to drag the rail along, if the rail were loose, in the same direction, *i.e.*, from left to right. If, however, the load is mounted on balls, wheels, or rollers as at B (Fig. 17), then the rails tend to move in the opposite direction to that of the load. This latter action is what occurs in the case of ball bearings. The action is more clear if one imagines the balls to be prime movers, *i.e.*, motors. In the various drawings a double-headed arrow (see Fig. 17) is used to indicate the direction in which a fixed spindle tends to screw or turn in its crank, or a cup in its hub-shell. Of course, no such motion actually takes place, unless the spindle or cup is improperly locked or secured.

Taking the case of a left-side pedal (Fig. 18), when an observer faces the cycle and looks towards the left-hand crank, this rotates counter clockwise, as shown by the large arrow. The pedal is, of course, kept horizontal by the man's foot, but, with reference to the crank, moves clockwise; thus the balls *tend* to turn the pedal pin P counter-clock, and hence, if this is threaded left-handed, it will screw into the crank and tighten itself in riding. The right-hand crank, of course, turns clockwise, hence the pedal pin tends to turn clockwise, and must therefore be screwed right-handed to prevent it screwing out in riding.

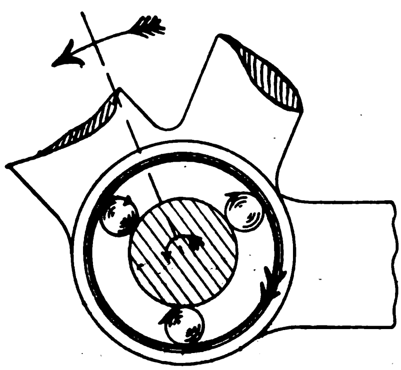


Fig. 19.—Showing Forces tending to Turn Cups in Cycle Bottom Bracket.

In Fig. 19 the same class of diagram is drawn out for the bottom bracket. The left crank and, of course, the spindle, turns counter clockwise, hence the left or adjusting cup tends to turn clockwise in the bracket-shell; it is therefore, as already stated, screwed right-handed, so that it tends to screw into the bracket during riding, the locking ring acting as a flange to prevent its turning, thus effectively locking the cup.

The right-hand or chain-side cup has a left-handed thread, which screws up to a flange; it thus also tends to screw in during riding, and is therefore practically a fixed cup. The case of the wheel with disc-adjusting hub is not quite so obvious, unless one regards the balls as prime movers when the action is more clearly seen. As seen from the left-hand side, the wheels (Fig. 20) rotate counter clockwise; the axle therefore tends to turn clockwise, but cannot of course move, as it is firmly fixed in the machine frame or the front forks. Imagine the machine is running down hill and the rim brake is in operation; the weight of rider tends to drive the wheel round counter-clock, the transmission being through the balls, hence, as seen in Fig. 20, the cup tends to turn counter clockwise relatively to the shell of the hub. The left or adjusting cup is therefore screwed left-handed thread, so that in use it tends to screw inwards against the locking ring.

In passing, attention may be called to the tangent spoking shown in Fig. 20, this being very suitable for model colliery winding engine wheels, etc.

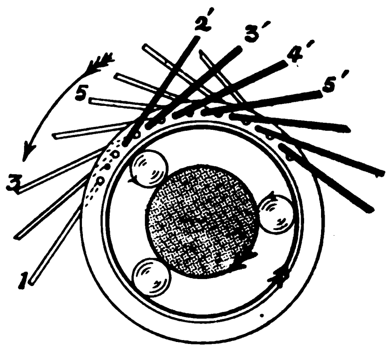


Fig. 20.—Showing Forces tending to Turn Cups in Disc-adjusting Hub.

The inside spokes (1, 2, 3, 4, 5, etc.) are all kept to the inside and do not touch or bend over the outside spokes in the manner in which bicycle wheels are usually built. In fact, the inside spokes clear the outside spokes by the thickness of the flange. Of course, the number of holes in the flange must be an equal number (not odd) and one half of the number of holes in the rim, the other half of the holes being for the spokes from the other flange. The writer prefers cycle wheels built this way, as it avoids bending the spokes and allows the tension to be truly gauged by the tone they give when touched or tapped.

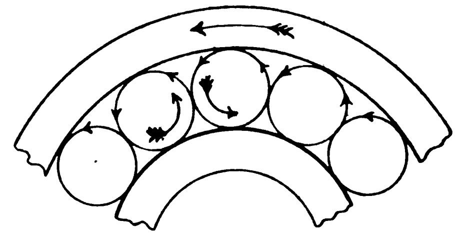


Fig. 21.—Showing Rubbing of Balls against each other.

On looking at Fig. 21, it will be noted that where the balls are in contact with each other they are revolving in opposite directions. Some inventors have claimed that this causes considerable sliding friction, and have proposed to separate the balls by cages, etc., so as to prevent them touching each other. The friction due to the balls touching is negligibly small, as the pressure between the balls themselves is quite negligible.

(To be continued.)

It is announced that the Marconi system of wireless telegraphy is to be installed on the whole of the ships of the Atlantic fleet belonging to the Canadian Pacific Railway Company.

Our Reader's Work Competition.

To encourage readers to send us accounts of their work, we offer to send any tool, book, or other desired article supplied by any of our advertisers, to the value of 6s. 6d., to any reader who sends us for insertion in The Model Engineer a sufficiently good photograph and description of any model, tool, mechanical or electrical apparatus that he has made, and which has not been already illustrated in our pages. Entries should be accompanied by a separate letter giving the title of the article, and stating exactly what is required as a prize in the event of acceptance. When tools or apparatus are desired, the page and number of article in the firm's catalogue from which it can be obtained should be stated, if possible. It is understood, of course, that we do not promise to accept everything that is sent in, and examples of work submitted must show some degree of originality or usefulness. Ordinary every-day tools or models merely made up from purchased castings are not required. The article should be written *on one side of the paper only*, with the name and address of the sender on the back. The photographs and separate sketches enclosed with the contribution should similarly bear the name and address of the sender, otherwise delay may arise in the awarding of the prizes. It is essential in this, as in our other competitions, that the copyright of the photographs must be the property of the senders, and the covering letter should contain a declaration to this effect. The competition will close on June 30th, 1908.

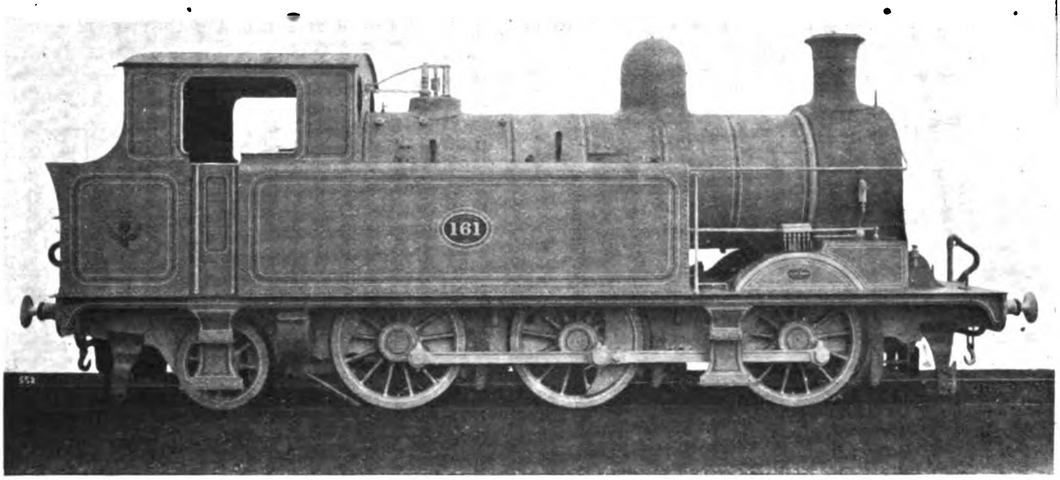
Professor Kammerlin Onnes, teacher of physics in the University of Leyden, has just made an important scientific discovery. Helium is the last of the gaseous bodies to withstand all attempts to condense it, and recently Professor Onnes succeeded in liquefying it.

Locomotive Notes.

By Chas. S. Lake, A.M.I.Mech.E.

Six-coupled Radial Tank Locomotives, Taff Vale Railway.

Those who have had an opportunity of observing the locomotive work performed on the leading Welsh Railway, *i.e.*, the Taff Vale, cannot but have been favourably impressed by the same. This Company has in service a large number of six-coupled radial tank engines of a powerful type, and the manner in which these deal with the heavy traffic on the steep gradients of the Rhonddas Valley is astonishing. The locomotives, one of which is illustrated herewith, have inside cylinders driving the crank axle of the intermediate coupled wheels, and the radial carrying wheels are located below the footplate. Steam distribution to the cylinders is by ordinary D slide-valves actuated by Stephenson link motion and a rocking shaft, and the whole design is one of simplicity combined with neatness and regularity of outline. The principal dimensions are as follows :—



Six-coupled Radial Tank Engine: Taff Vale Railway.

- Cylinders : Diameter, 17½ ins. ; stroke, 26 ins.
- Wheels—Diameter : Coupled, 4 ft. 6½ ins. ; radial, 3 ft. 1 in.
- Wheelbase : Coupled, 13 ft. 5 ins. ; total, 19 ft. 3 ins.
- Heating surface : Firebox, 84·8 sq. ft. ; tubes, 917·7 sq. ft. : total, 1002·5 sq. ft.
- Firegrate area, 19 sq. ft.
- Tank capacity, 1,400 gallons.
- Fuel capacity, 2 tons of coal.
- Weights in working order : Coupled wheels, 49½ tons ; total, 60½ tons.
- Gauge of railway, 4 ft. 8½ ins.

The engine illustrated was built by the Vulcan Foundry Company, Ltd., of Newton-le-Willows from the designs of Mr. T. Hurry Riches, M.Inst.C.E. and President Inst.Mech.E., locomotive superintendent of the Taff Vale Railway.

American Four-cylinder Locomotives.

The writer has received from the American Locomotive Company an interesting booklet containing illustrations of four-cylinder arrangements, either ones the second or third pair of wheels, according largely to the design of the engine and whether it is intended for goods or passenger traffic.

The accompanying illustrations are reproduced from the booklet in question, and Fig. 1 shows a 4—6—0 type express locomotive as built for the New York Central & Hudson River Railroad having the Cole four-cylinder arrangement. The steam distributing valves are piston type, and the

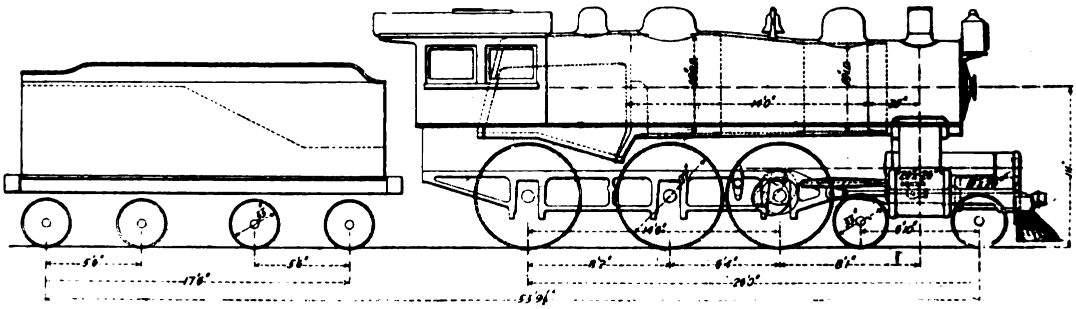


Fig. 1.—4—6—0 Type Express Locomotive with "Cole" Cylinder Arrangement.

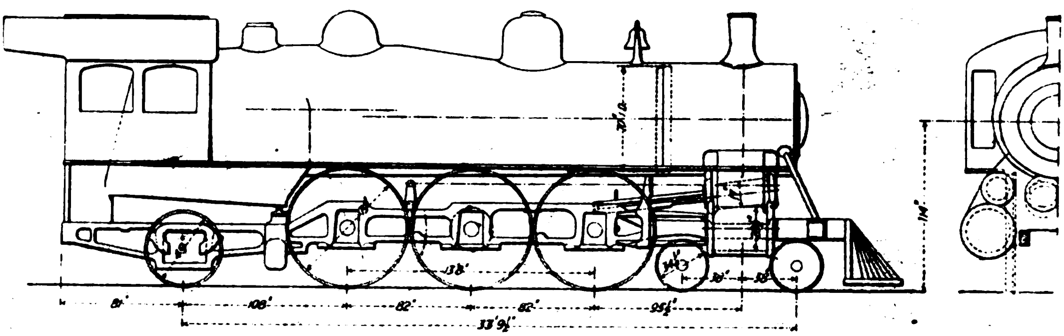


Fig. 2.—"Pacific" Type Four-cylinder Compound: H.P. Cylinders Inside (inclined), L.P. Cylinders Outside (Horizontal).

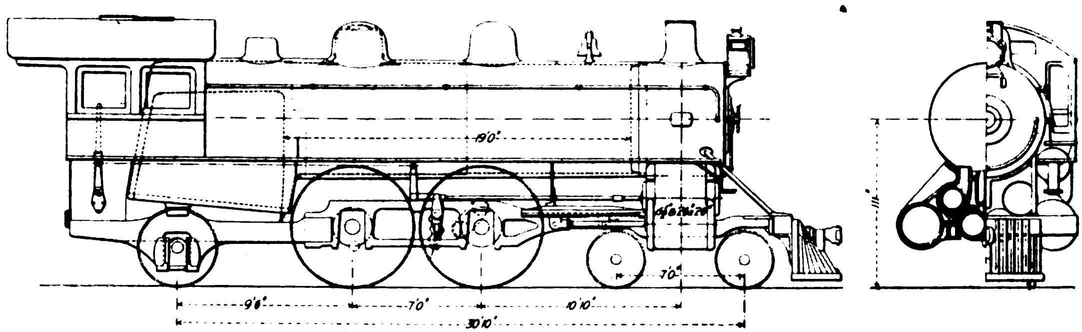


Fig. 3.—"Atlantic" Type Engine with Four Compound Cylinders in line.

actually fitted, or proposed to be fitted, to locomotives built by them. These include the Cole system of compound cylinders, in which the high-pressure are located ahead of the bogie centre inside the frames, and the low-pressure in the usual position between the bogie wheels outside the frames, the inside cylinders driving the crank axle of the leading coupled wheels and the outside two valves for each pair of cylinders are secured to the same stem and actuated by a single valve gear of the Stephenson link pattern with rocking-shaft.

Another arrangement is to place the four compound cylinders in transverse alignment but at different levels as in Fig. 2. The high-pressure cylinders are again inside the frames and are inclined somewhat steeply so that the slide-bars clear the axle of the front coupled wheels and ample room is left for the movements of the inside connecting-rods. The low-pressure cylinders are carried outside the frames, and in this design all four cylinders actuate the second coupled wheels, the axle of which is, of course, cranked to take the high-pressure connecting-rods. The eccentrics of the Stephenson link motion are secured to the rear driving axle, and there is an ordinary reversing rocking arm between the main and last pairs of driving wheels, connection between this arm and the valve being by means of a long valve stem.

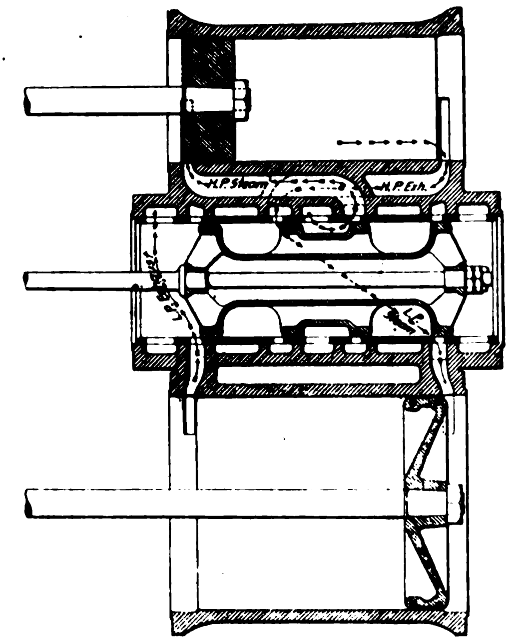


Fig. 4.—Piston Valve with Double Admission. Designed by American Locomotive Co.

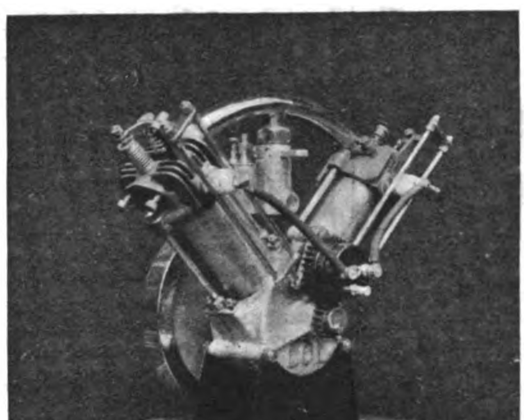
A third plan is to locate the cylinders in line below the smokebox and in the same plane as shown in Fig. 3. Here the inside (high-pressure) cylinders drive the crank axle of the leading coupled wheels, while the outside (low-pressure) ones actuate the second pair, the particular locomotive illustrated being of the "Atlantic" type. For use with both of the last-mentioned arrangements, the American Locomotive Company has devised a form of piston valve which permits of steam distribution being effected to all four cylinders by only two valves and valve gears. The arrangement is the same whether the inside cylinders are inclined or horizontal. The drawing (Fig. 4) clearly shows the design of the piston valve and the course taken by the steam is also indicated. The valve is hollow and, therefore light, and it is planned with the minimum number of packing rings possible. The ports for the high-pressure cylinder are crossed, and the arrangement is quite well adapted for application to tandem cylinders, which in America are largely employed for compound goods locomotives. The drawing (Fig. 4) shows the cylinders resolved into the same plane as the valve chamber.

A Light-weight Petrol Motor.

An interesting two-cylinder petrol engine was exhibited in the flying machine and balloon section at Messrs. Cordingley & Co.'s Annual Exhibition of Motor-cars, etc., recently held at the Agricultural Hall, Islington. By the courtesy of Mr. Leslie C. Lambert, A.M.I.C.E., the maker and designer, we are able to give an illustration and particulars of this engine. On account of its compactness and small weight in relation to power developed it should be a useful model for purposes where these considerations are of importance. The total weight is 15 lbs., and the rated horse-power is 3·2, deduced from the Royal Automobile Club's formula—

$$\frac{Dn}{2 \cdot 5}$$

Of the total weight, the flywheel weighs 5 lbs. Mr. Lambert states that for actual aeroplane work he will use a much lighter wheel, built up on cycle wheel lines. A high-tension distributor is fitted so that the two cylinders are "fired" from one spark coil. The valves are interchangeable, and the exhaust valve is mechanically operated by an overhead rocker fitted with an adjusting screw. The carburettor is of the ordinary spray type and made of aluminium. The crankshaft



is one solid forging, including the two balance-weights. By unscrewing two nuts the cylinder head and cylinder can be instantly detached. Cylinders are made of solid-drawn weldless steel tube, lapped out to finish. The contact-maker is of usual wipe type. Mr. Lambert will be pleased to assist any amateur who is interested and wishes to make one of these engines, with further particulars. He is also willing to sell sets of castings, etc., though he is not selling them in the ordinary way of trade. His address is—42, Breakspears Road, Brockley, London, S.E.

How it is Done.

[For insertion under this heading, the Editor invites readers to submit practical articles describing actual workshop methods. Accepted contributions will be paid for on publication, if desired, according to merit.]

Elementary Smiths' Work.

By C. W. Fraser.

In the following series of articles it is proposed to give plain directions for the performance of elementary smithing work as required by amateur mechanics, small motor makers and repairers, and small power engineers generally. To the amateur, the ability to satisfactorily do up broken lathe tools, chisels, and other tools, will give an added interest to his work, while the professional engineer will find the knowledge of simple smithing both lucrative and time-saving. No attempt will be made to give directions for "double handed" work—that is, work requiring the services of a striker, as such work is beyond the scope of the amateur as a rule, and to any professional smiths who may read these lines, this should serve as a sufficient explanation of the apparent crudeness of some of the methods given, where such are found to differ from the actual practice of the regular smith's shop.

The primary things required are a small forge of the kind known as a "portable" or "rivet" forge, a small anvil (say 1 cwt.), one or two old square 56-lb. weights, a good hammer (say 1½ lb. weight), and a few pairs of tongs. The forge itself may be round or square, and should be about 18 ins. or 24 ins. across the top. Wind, or "blast," as it is generally termed, should be supplied by a pair of double blast bellows placed between the legs of the forge, and worked by a foot lever, much the same as a lathe treadle. Or a small fan can be used instead, and be arranged to be driven by hand or from a small engine or motor of any kind. Blast can then be conveyed to the forge through light sheet iron pipe or stout rubber tubing. This latter allows of the forge being moved about. In any case, the blast pipe on the forge should be provided with a stop cock and connection for a blowpipe, thus rendering it of use for brazing, etc. Forges of this description can be bought complete for from about 30s. upwards; but for the benefit of those who may care to construct their own, drawings are given for a simple forge (see Figs. 1, 2, and 3). The materials may be purchased at any large ironmongers, and the drawings are fully dimensioned and self-explanatory. No bellows are shown, as the amateur is not advised to make them. They can be bought 16, 18, 20, 22, or 24 ins. diameter, as required, or pear-shaped, to suit rectangular forges. A simple wood pattern must be got out for the blast nozzle or "tue iron," as it is called, or one may be obtained from the firm who supplies the bellows and the rest of the materials. If bolts are used, instead of rivets, as shown, the whole forge can be quickly dis-

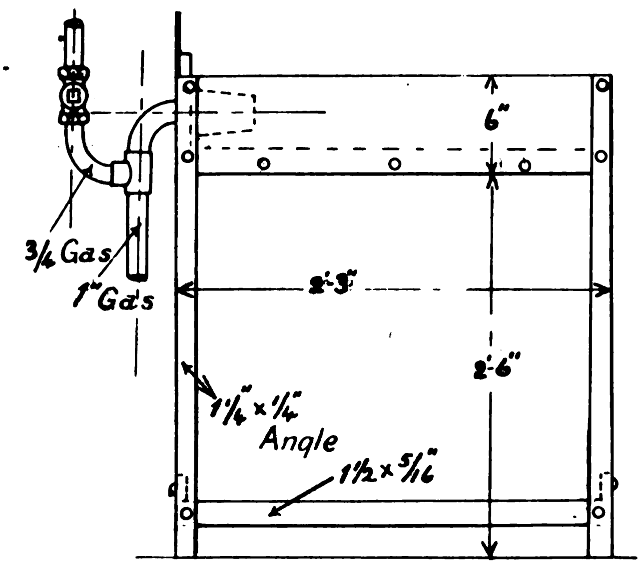


Fig. 1.—Side Elevation.

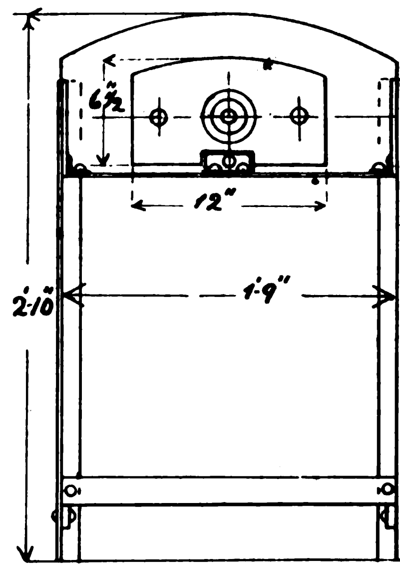


Fig. 2.—Cross-section.

A Small Portable Forge.

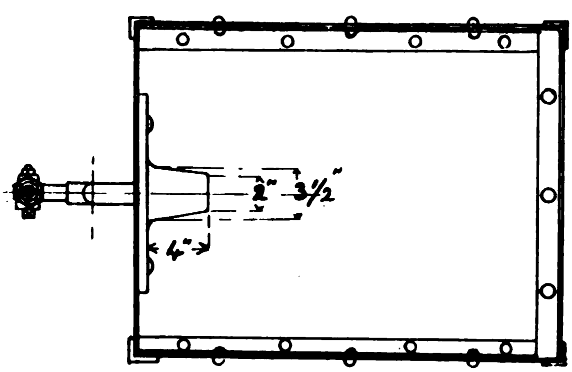


Fig. 3.—Plan.

mantled and packed flat. Explicit directions for fixing the bellows cannot be given, as the method will vary with the size and kind of bellows used. Before using the forge, it is advisable to put a layer of fire clay in the bottom about an inch thick. The anvil should be mounted on a wood block or a stout box so as to bring the face about 24 ins. from the ground, and the pointed end or "bick" should point to the left of the workman when he stands at the anvil. A great number of jobs can, however, be done on an old square 56-lb. weight. The writer has done scores of jobs on these old weights when unable to get to an anvil. The face of the anvil is hardened steel, so that in cutting plate, etc., with a cold chisel, do it on an old weight, or the anvil face and chisel will suffer.

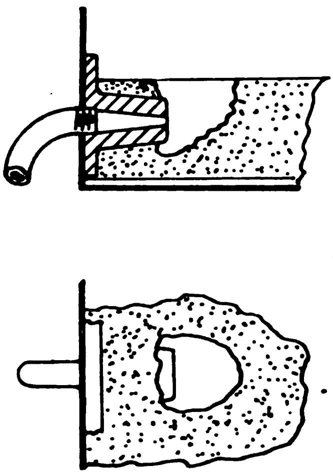


FIG. 4.

Three or four pairs of tongs will be required to hold short articles, like lathe tools, etc., and as the type and size will depend on the articles to be held, the only advice that can be given is for the reader to get a local smith to make him a few pairs (showing

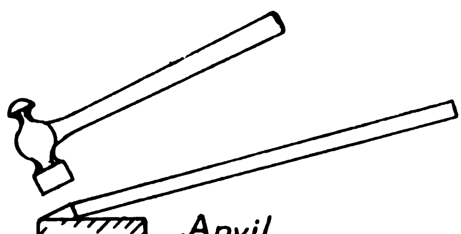
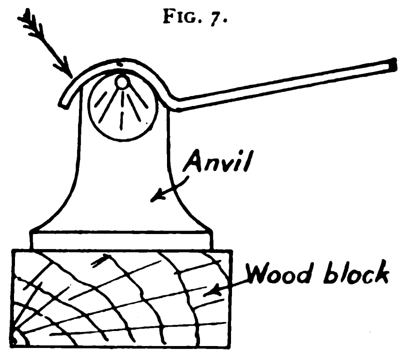


FIG. 6.

him the stuff required to be held), or to give full particulars to any firm that supplies such goods, and they may be relied on to supply the right thing. Professional smiths always make their own, but that is beyond the amateur. They can be bought for a few pence per pound weight.

Taking it for granted that the reader possesses a good strong vice and bench, and such other tools as are generally found in a small workshop, the fire may be lighted and a set of firing tools may be made. The first thing to do is to fill the pan of the forge with coal-dust and water made into a very stiff paste, taking care to leave a space about the size of your two hands in front of the blast pipe. A reference to Fig. 4 will show what is meant. Special small coal for smiths' use may be purchased from any good coal merchant, or ordinary house coal may be broken up about the size of a ¾-in. nut and used. In the space left put a handful of shavings

FIG. 7.



soaked in oil and lighted. Blow very gently, and sprinkle a little dry coal on, and when well lighted blow harder, and add more coal, till a hot clear fire is obtained. Excellent practice may be got by making the firing tools shown at Fig. 5. The dimensions are not particular, which is an advantage on a trial job. Take a piece of ⅜-in. diameter

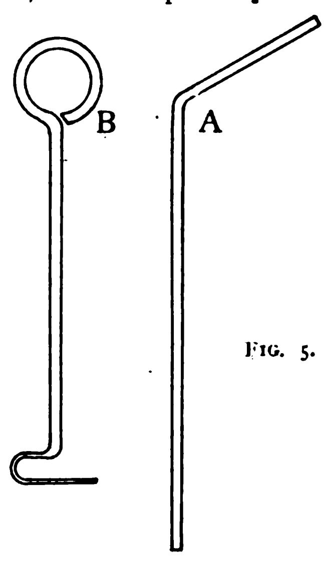


FIG. 5.

iron, about 32 ins. long, and heat 6 ins. of one end to a bright red. Grip it in the vice, and bend it down as shown at A, heat up again, and place it on the "horn" or "bick" of the anvil, tapping it round by light blows with the hammer till it takes the shape shown at B, Fig. 5. Fig. 6 is an attempt to show how it should be held on the anvil. A continuation of the process results in the formation of a circular eye as shown. Practice alone will enable these eyes to be turned out quickly and well. The rake shown to the left in Fig. 5 requires about 6 ins. heated, flattened out thin, and bent to the shape shown, the sharp bend being done in the vice and the round one on the anvil, as before. The poker requires to be pointed, and this will afford practice in "drawing down," as it is called.

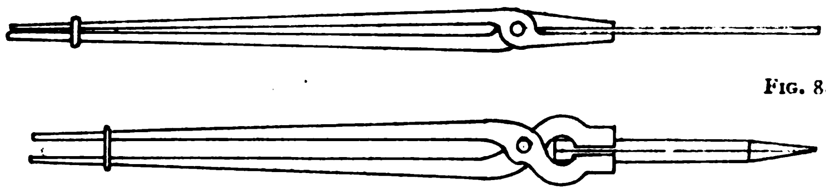


Fig. 8.

Heat the extreme point to a white heat, and place on the edge of the anvil farthest from the worker, and hammer it down to a point in the direction shown by Fig. 7, being particular to give the iron *a quarter of a turn between each blow of the hammer.* This latter is the secret of the whole thing, and should always be done when drawing down or reducing either iron or steel. It is applicable to all sizes of work, from small hand work to that of the steam hammer and press. In hand work such as we are now considering, it is done from the wrist, and the iron need not be completely revolved, but only moved backward and forward for a quarter of a turn. The result in good hands is a nice square point. If a round point is desired, heat up again after drawing down square, and tap the corners off, revolving the iron completely between the thumb and fingers this time. Too much pains cannot be taken to master this method of drawing down, and to acquire the knack of giving stuff the exact quarter turn the writer recommends practice on small bars of square or round lead, as it is about

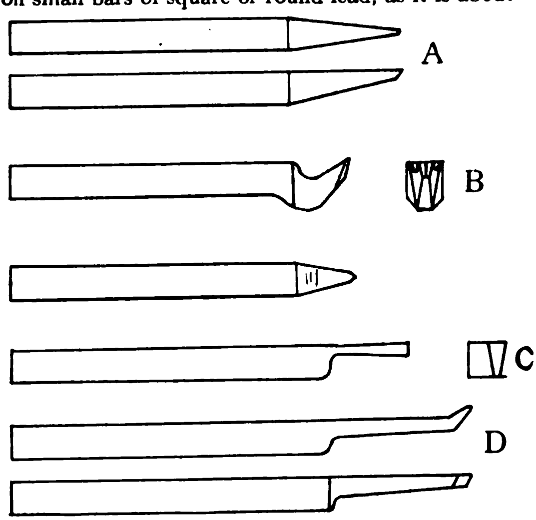


Fig. 9.

the same degree of hardness as iron at a white heat. Keep on till able to draw out a piece perfectly square and parallel, and then try a long gradual taper. Of course, the lead must be held in a pair of tongs exactly as if it were iron or steel. An aid to keeping the tongs from slipping off the work is shown at Fig. 8. It is called a "coupling," and is simply an old chain link of suitable size to go over the handle of the tongs, and its purpose is fully explained by the figure, which also shows a pair of tongs for holding thin flat stuff, and a pair for holding a lathe tool ready for re-dressing. It is a front roughing brass tool, and is about one of the easiest to do up. Heat the end of the tool to a bright red and draw out to a square taper. The correct shape is shown at A, Fig. 9. When cold the point can be filed up and hardened by heating the extreme tip, and suddenly cooling in clean cold water. Tools done this way will be about right for brass, but too hard for iron.

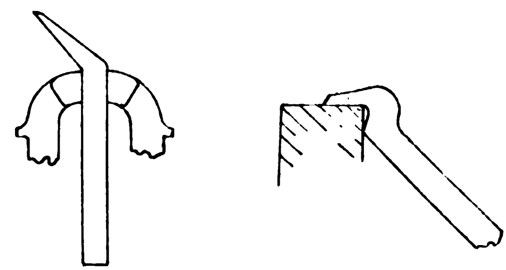


Fig 10.

At Fig. 10 is shown a right-hand side brass tool, and these are done up in exactly the same way as the foregoing, except that they are heated and bent over in the vice to the right or left as required. To re-dress a cranked front roughing tool for iron (see B, Fig. 9), draw out the same as for a front brass tool, and bend over in the vice as shown at Fig. 10, afterwards bending it backwards again in the anvil, as shown to the right of the figure. Some sight experience is necessary to make a good job of these bent tools, and here again a piece of cold lead will come in handy to practise on.

(*To be continued.*)

Practical Letters from Our Readers.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily for publication.*]

Re Induction Coils for Wireless Telegraphy.

To the Editor of *The Model Engineer.*

Dear Sir,—The amateur who is interested in wireless telegraphy will do well to make a careful study of Mr. Delves-Broughton's most interesting and valuable article published in the issue of March 12th. It gave me great pleasure to see the design of induction coils or transformers for wireless telegraphy treated in such a masterly and bold manner. Mr. Delves-Broughton has gone straight to the root of the matter, and no one who has experimented with wireless telegraphy at all can fail to appreciate the importance of obtaining a thorough grasp of the requirements of this particular branch of work. Such a grasp is shown in this article and it should prove a death blow to the obstinate determination of many amateurs to spend much unnecessary time, money and worry over buying or making coils giving long sparks when they are only for use in wireless telegraphy.

At the same time, the amateur should remember that such coils as Mr. Delves-Broughton describes are the worst possible type for radiators of small capacity, and are only an improvement for large capacity aerials in distance working. A hot fat spark is a great *disadvantage* where the capacity is small.

There are one or two other points which I should like to put before amateurs in this connection, and I hope that Mr. Delves-Broughton will pardon the intrusion into his grounds.

The amateur will always be apt to meet with contradictions and puzzles until he gets quite a clear conception of the difference between quantity and current. One can no more speak of the quantity of the current flowing than one can, in connection with a river, speak of the number of gallons of the rate of flow.

If one wanted to specify the rate of flow of a river it would be useless to say it was a thousand gallons: a thousand gallons where? A thousand gallons per yard, or per mile of length? A moment's thought will show that rate of flow must include the dimension of time. We could speak of a stream as having a rate of flow of 1,000 gallons per minute or per second, which, in precise language would mean that in every minute or second 1,000 gallons flowed past the point in question. In fact, rate of flow = quantity divided by time.

In electrical work the current is nothing but the *Rate of Flow* or the number of units of electrical quantity (coulombs) which pass any point in the circuit during a second. Quantity may be entirely dissociated from any idea of current. A quantity of electricity, or strictly speaking an equivalent storage of energy by di-electric strain, can stand motionless in between the coatings of a Leyden jar and is then static; but on joining the coatings by a wire, a flow takes place and the quantity stored passes round the circuit, manifesting itself as a current until the circuit is in equilibrium. Now what I want to emphasise is that the value of this current will depend on the nature of the discharge circuit, while the quantity which passes is fixed beforehand by the capacity of the jar and the potential difference to which its coatings are raised.

If the jar discharges through a long wet thread the current will be small and the quantity stored will take some time to get out; but if the circuit is of copper, there will be a strong current lasting for a very short time. If the right conditions are provided, this current will overshoot the mark and reverse the charge of the jars, producing oscillation; but this is another story. The great point is that the quantity is, in the simple case, fixed, and the average value of the current is the quantity divided by the time occupied by its motion. Let us now see precisely what is required of the secondary of a coil for "wireless." To begin with, the aerial must be charged to a potential sufficient to produce a spark at least a centimetre in length. As it is well to have a considerable margin to get certainty and regularity of discharge, we may design the coil to give 2 ins. spark as Mr. Delves-Broughton suggests. Furthermore, at each break of contact the *quantity* which the secondary coil can force into the aerial must be sufficient to raise it to the required potential, and the loss of voltage due to the flow of this quantity through the secondary must not be sufficient to lower the potential beyond a certain point. Mr. Delves-Broughton is therefore wise in designing for a 2-in. spark; and if everything is arranged to give the fattest spark possible, it simply means that the secondary is capable of supplying sufficient quantity to raise the capacity of the particular aerial used to the necessary potential, with sufficient margin to counteract irregularity and leakage.

The confusion between quantity and current is well illustrated in the "Linesman's Detectors" of commerce. These often have three terminals—the centre one common; and the outers marked with the absurd symbols Q and I, meaning "quantity" and "intensity." The terminals marked Q go to a thick winding and are, therefore, most suitable for indicating comparatively large currents at low voltages. The "intensity" coil is of high resistance and is, therefore, suitable for small currents at comparatively high voltages.

After the above explanations it is hardly necessary to point out the absurdity of the symbol Q. The only ordinary instruments which measure quantity are the ballistic galvanometer and the quantometer used for the measurement of magnetic flux.

Again, Mr. Delves-Broughton says that it is a question of the total number of watts produced by the secondary. The watt is a measure of the *rate of doing work*, while our concern in charging an aerial is the total amount of *energy* supplied to the aerial. *Energy* is rate of doing work multiplied by *time* during which work is done. Thus, if we wanted the most finally correct and scientific way of describing the operation of a given secondary coil with a given aerial we should give the total amount of energy supplied to the aerial and the voltage to which that energy raised it. This energy could be expressed in watt-hours or in watt-seconds or kilowatt-seconds, or ergs.

Calculations of such values are very difficult, and clear thought as to their meaning is highly necessary.

The following instance may make my meaning clearer.

A 10-in. spark coil with continuous current and contact-breaker charges a set of jars, which I use for oscillatory experiments, to a certain voltage which represents a certain energy-storage. When I substitute an alternate current supply, I obtain a flaming arc from the secondary instead of a long spark; this arc, though it can be drawn out to two or three inches when once formed, will only jump ¾ in. of air-space, and the voltage is therefore not very high.

Yet when connected to the jars it is capable of charging them to a higher potential than before (once in every half wave), and therefore the coil supplies more energy per spark than it did before.

The watts, which can only be considered as having a definite value at any one given moment or an average value over a given time, are probably much higher for a small fraction of a second at the break of the continuous circuit than they are at any moment when the supply is alternating.

Nevertheless the *energy* is more with the latter, simply because the active time is longer. All the time during which the alternating wave is rising to its maximum value energy is being stored in the jars and the total energy is the product of the average value of the watts and the time during which the energy is supplied.

With the make and break the momentary value of the power in watts is very large, but the time is so short that the energy is actually less than it is with the more gradual alternating current.

If we wanted to produce the maximum mechanical energy-storage in a strong spring we could do it more effectually by a gradual application of hand pressure than by a sharp blow with a light hammer; the rate of doing work would be greater at the moment when the hammer struck the spring, than at any moment during the application of the steady pressure of the hand.

The static energy stored in an aerial is equal to the quantity of electricity stored multiplied by the voltage to which the aerial is raised.

The dynamic energy conveyed by a current in a given time is equal to the quantity which passes during that time multiplied by the volts.

Now the quantity which passes is equal to average current multiplied by time, and the average watts equal average volts multiplied by average current. Therefore, the energy also equals average watts multiplied by the time during which the power is supplied.

The latter statements are only other ways of expressing what has gone before.

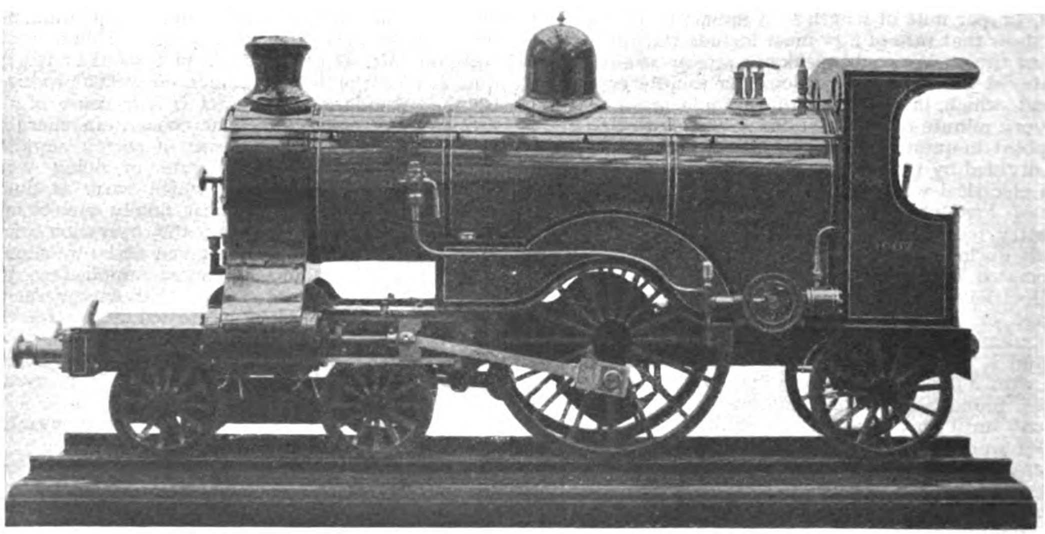
One other point arising from Mr. Delves-Broughton's article is in connection with his remarks about closed magnetic circuits. I do not think that there would really be any serious difficulty about insulating a closed circuit induction coil of such low voltage as Mr. Delves-Broughton's; at any rate, there is a far more important reason for using the plain straight cores which are usually employed.

It is well-known that a closed magnetic circuit has considerable power of retaining magnetism when the magnetising force has been entirely removed. The residual magnetism left in the core of a closed circuit spark coil is so great that the total flux change (to which the induction in the secondary is proportional) is less at the moment of breaking contact than it is when the magnetic circuit is open and can retain only a small residual flux. These remarks are solely intended to save the amateur any trouble which might arise from misconceptions as to the principles involved, and they in no way detract from the great value and originality of Mr. Delves-Broughton's article.—Yours truly, R. P. HOWGRAVE-GRAHAM.

A 1-in. Scale Model G.N.R. Locomotive.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I am sending a number of photographs of my 1-in. scale G.N.R. locomotive which was awarded THE MODEL ENGINEER Silver Medal at the 1906 Edinburgh and Midlothian Industrial Exhibition.



MR. JOHN ANDERSON'S 1-IN. SCALE MODEL G.N.R. LOCOMOTIVE

The model was built entirely in my spare time—and it took nearly ten years to complete it—from drawings that appeared in *Work*. The scale is 1 in. to the foot; cylinders, 1 5-16th-ins. bore, 2½-ins. stroke. I also had to make a larger boiler, as the one specified in *Work* could not keep the cylinders in steam. I had to increase my boiler to 4½ ins. diameter, and after doing so my model steams perfectly. I supply the boiler with a small Whitney donkey pump. I tried a small "Vic" injector, but could not get it to work properly.

The first boiler I made was heated by a central flue, 2 ins. diameter, with ten cross tubes; but it left too little water in the boiler. My present boiler has eleven ⅜-in. solid-drawn copper tubes, which gives me plenty of steam.

I have a small railway laid down in the back garden and my engine pulls myself and my little boy in a little bogie. I intend making a tender to complete it whenever I get a little spare time, and have a small tube running for the tender to supply the donkey pump with water.—Yours truly,

JOHN ANDERSON,

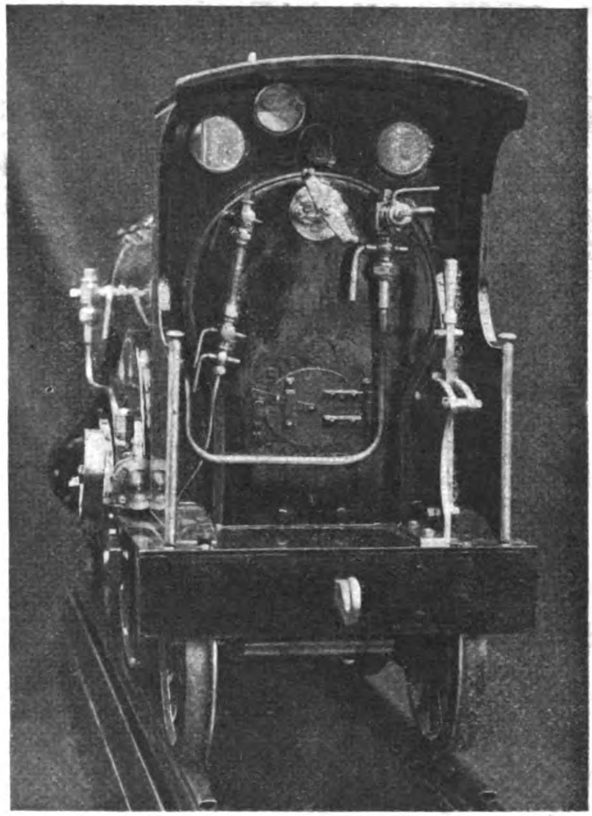
Edinburgh.

Re How to Become a Mechanical Engineer.

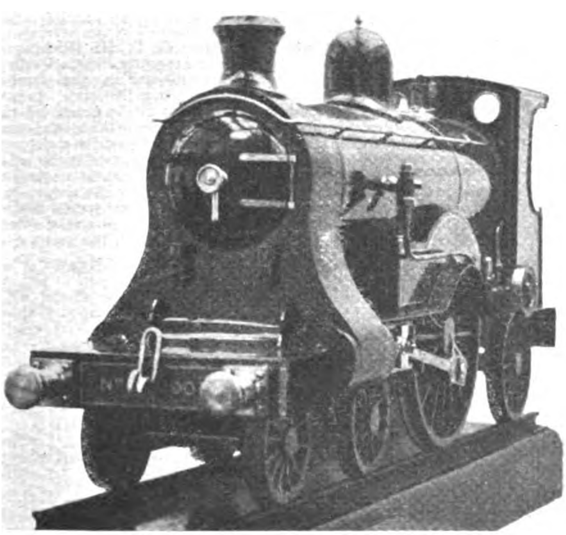
To the Editor of THE MODEL ENGINEER.

DEAR SIR,—You have recently been publishing a series of articles on "How to Become a Mechanical Engineer." In these articles you have given particulars of apprenticeships with well-known firms. The drawback to most of these is that, as a rule, a large premium is required and small wages are given, with no chance of a substantial rise. May I be allowed to bring to your notice a system in vogue at the Royal Arsenal, Woolwich. Each year at the beginning of June an examination is held for admittance to the Arsenal of boys as "Trade Lads." Thirty lads are taken on as a rule, and the subjects of examination are—Experimental Physics, Arithmetic, Geometry, Mensuration, Algebra (up to and including quadratic equations), and Freehand Drawing. Having passed the examination, each lad is placed under the care of a competent workman to instruct him in the use of his tools, the boy having been given the choice of a trade and department, where practicable. Lads showing ability are drafted to the various shops and drawing offices. One afternoon a week is given, with pay, to attend classes at the Woolwich Polytechnic, and lads are required to put in three evenings a week as well. The fees for the classes are paid by the boy himself; but if a satisfactory record is shown, the fees are returned at the end of each year by the Arsenal authorities. In addition, prize-money is given, and lads are paid for Bank Holidays, &c. The course is for three years. Wages commence at 7s. a week, rising by 2s. 6d. each year, and lads must not be more than 16 on entering. Full particulars and application forms can be obtained by applying to the Chief Superintendent, Royal Arsenal, Woolwich. Hoping that the above information may prove useful to some of the readers of your valuable paper, I am, yours faithfully,

"MICROMETER."



CAB VIEW.



FRONT VIEW.

JUNIOR INSTITUTION OF ENGINEERS.—Sir William Huggins, K.C.B., O.M., D.C.L., LL.D., F.R.S., has been elected a vice-president of the Junior Institution of Engineers, in succession to the late Lord Kelvin; also Sir Archibald Geikie, K.C.B., F.R.S., and Professor J. J. Thomson, F.R.S., have been elected. The first Local Section in connection with the Institution, now numbering over a thousand members, has been established at Birmingham, with Mr. F. S. Pilling, as Chairman, and Mr. R. B. A. Ellis, of 67, Wordsworth Road, Small Heath, Birmingham, as Hon. Secretary.

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

BY kind permission of S. D. Holden, Esq., a visit was made to the Works of the G.E. Railway, Stratford, on Thursday, March 26th, by members, twenty-eight being present. The party left Liverpool Street by the 1.52 p.m., and on arrival at Stratford were met by one of the staff and conducted to the Works, where, having split up into four groups, with a conductor to each, started on a tour which was to last about 3½ hours. The foremen of the various departments kindly interesting themselves, the members were fortunate in having the various machines and tools of special interest pointed out to them and their working shown, some of which included gear-cutting machines (one of which was pointed out as the invention of a lady); special drilling machines by which the speed of the drill being used could be regulated to a nicety by simply turning a handle, which brought a pointer over a scale marked for the various drills; vertical lathes for dealing with piston-rings, turning the inside and outside at the same time; cylinder covers, also being handled on same style of machine. It was also noted that high-speed steel was the rule for cutters, lathe tools, twist drills, etc.

In the locomotive shop was noticed the frames, ten in number, for five engines being dealt with in one solid mass, on a planing machine, and five sides at one time for drilling the holes. Other shops visited included the foundry, all casting being done here except steel; the smiths', where the foreman took a pride in showing members the fine quality of the work turned out, the many dies, and the way used, also putting several into operation to show their working. After visiting wagon department, pattern department, running and coaling sheds, and closely inspecting some of the larger engines on the roads, where was seen the special arrangement for spark arresting, consisting of a number of steel laths fixed on the inside of smokebox door on the slant, the hot cinders driving up against these are caught, fall to the bottom of smokebox, and to keep this clear a blast passes through, taking the cinders with it through pipes into boxes fixed under footplate, which, when full, can be emptied from the cab. The visit was terminated by thanking our guides for the amount of trouble taken, the members all agreeing they could not have been better treated and that their visit to Stratford Works would long be remembered.

FUTURE MEETINGS.—The next meeting will be held on Wednesday, April 29th, when demonstrations will be given by members of ball turning, wheel cutting and screw chasing, pipe and tube bending, plate flanging and rivetting, and other mechanical operations.

VISIT.—The visit to the Generating Station of the City of London Electric Lighting Company at Bankside takes place on Wednesday, May 13th, at 7 p.m. As the party is limited to a low number, early notification should be given.—HERBERT G. RIDDLE, Secretary, 37, Minard Road, Hither Green, S.E.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26-29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[19,074] **Water Motor for Dynamo.** G. A. H. (Mull) writes: Will you kindly enlighten me on the following subject? I have tested my water supply in my shop with a water meter, and find it is from 40 to 50 lbs. per sq. in. Can I get ½ h.-p. from same by using a water wheel for a dynamo of 100 watts (25 volts 4 amps.)? If I can manage it, will you let me know what size of wheel I shall need, also number of buckets and size of nozzle. I have made a small water wheel (3-in. wheel, 5 ins. over buckets), but I can only get 1,600 r.p.m., and can only light one 4-volt 4 c.-p. Osram lamp. I think I need to run dynamo at 2,500. Do you think I am getting full power from dynamo at 1,800, lighting only one 4-volt 4 c.-p. lamp. I will be very pleased if you can tell me if I will manage to drive dynamo from my water power and what size of wheel I will need. I have just finished binding the last two volumes of THE MODEL ENGINEER from instructions given in one of the volumes. And find it is much better having them bound than lying about singly. Thank you very much for the answers to my last letters about dynamo. It is working, but I cannot say much about it as I cannot get up the speed. If I am successful, I will let you know.

In reply to your enquiry *re* water motor, we think you will find the one described in December 15th issue, Vol. V, will answer your requirements. With a pressure of 40 lbs. per sq. in., a ¼-in. jet would give you just about ½ h.-p. The consumption of water would be about 1·7 cub. ft. per minute. The machine should be allowed to run as fast as possible, and after you have made a trial you can arrange the gearing to your dynamo accordingly. The ½ h.-p. should just about drive your 100-watt dynamo. We are glad to hear that you are making progress with the dynamo you recently wrote about, and we shall be very glad to hear what your final results are after you have everything in proper running order.

[19,100] **Electric Motor Trouble.** C. P. H. (Richmond) writes: I have an "Ajax" motor which I recently rewound with as much wire as I could get on the field (No. 20), and an equal number of turns on each limb of the tripolar armature (No. 22). It now sparks furiously at the lower brush, but not at the upper. I run it on 10 volts off an "Empire" dynamo. Could you tell me the cause and a good remedy for it? Would you also tell me the right wire to use on the field and armature, and also the quantity, so as to run it off 6 volts? Would "Empire" batteries do, as a source of supply? Does a resistance reduce the voltage or the amperage? Where could I get permanent magnets made to my special design, also about what price? Also, ought a polarised reversing switch to be connected across the main or in series with the motor?

It is probably owing to your brushes not being adjusted or set in the correct position, and only trial will enable you to remedy this matter. To run your machine at 6 volts, you should wind armature with one gauge coarser wire, but we are inclined to think that it will run very satisfactorily at 6 volts pressure with its present windings. Try running the machine at a higher speed by decreasing the strength of the fields; this will probably help to eliminate the sparking at the brushes, also a little black lead as a lubricant for the commutator surface is very useful at times. If the "Empire" batteries you refer to are practically sack Leclanché cells, we cannot recommend them for work where an appreciable current is required. Messrs. Thompson & Co., 28, Deptford Bridge, Greenwich, London, S.E., would supply you with anything in the permanent magnet line.

[19,098] **Small Dynamo and Water Motor.** A. W. G. W. (Croydon) writes: I should be much obliged if you would give me information on the following. I have a small 6-volt 6-amp. dynamo, which I wish to drive by a water motor. The dynamo is marked

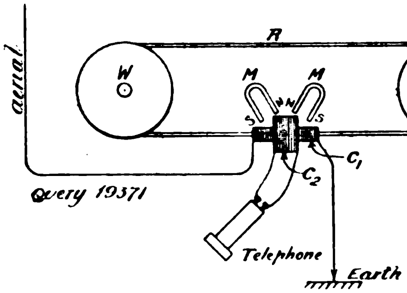
2,000 revolutions; but I think this is rather slow, and should like to know what your opinion is. What size nozzle and wheel should I use to drive it easily, leaving a margin for a higher speed, if required? The water pressure is about 60 ft.

Your best plan is to run the dynamo at its stated speed and find by trial what its actual output is. You will need a water motor capable of developing ⅛ or 1-9th h.-p. At a pressure of about 30 lbs. you would find the small ⅛ h.-p. motor in December 15th issue (Vol. V) suit your requirements very well. If you find the dynamo does not give its full output at 2,000 r.p.m., you must, of course, increase speed proportionally.

[19,108] **Charging and Lighting.** A. J. (Cork) writes: I have a 50-volt 6-amp. shunt-wound dynamo, and want to charge a 20-volt 60 amp.-hour accumulator from it (charging rate, 6 amps.). Does the extra voltage (*i.e.*, 25) matter so long as the current is correct? If the voltage is too high, could I charge through six 16 c.-p. 50-volt incandescent lamps in parallel? What ought to be the total candle-power of the above dynamo, using Osram lamps?

You can charge through your 16 c.-p. lamps connected in parallel. One such lamp would take approximately 1 amp., therefore six in parallel will give you a flow of 6 amps. You could charge direct without using these lamps by reducing the speed of your dynamo somewhat, so as to give a voltage of approximately 25 per cent. greater than that of the accumulators to be charged. Osram lamps take approximately 2 watts per c.-p.

[19,371] **Wireless Telegraphy; Coherers; Magnetic Detectors.** H. K. (Weymouth) writes: I should be much obliged if you would help me with the following problems. I want to use a coherer of the filing type, and would you please say what other objections there are than the sluggish decoherence of brass filing. I can get over the latter difficulty. Is there any better result obtained by using gas in coherers, and does mercury act on brass filings? In recent answers to queries you say that the



magnetic detector is much used now. Would you please explain what this instrument is? Would you please tell me who the makers of the filings coherers are, and who would make me one from my instructions? Would you advise me to protect the idea first? Any advice would greatly oblige.

There are no objections to brass filings, except that they are not so generally satisfactory as nickel. We are not aware that they possess any particular advantage. Mercury will certainly act on brass filings in time, and we would not recommend its use. The vacuum used in coherers is merely to prevent the oxidisation of the filings. Hydrogen has been tried, but it reduces the oxide so much that the coherer becomes too sensitive. A very fine film of oxide is needed, and when the filings are in the right state, a vacuum will prevent further oxidisation. Numerous firms manufacture filings coherers. If you want them made to instructions, you had better write to Mr. Leslie Miller, Electrical Instrument Maker, Hatton Garden, London, E.C., or to Mr. Cosson, Electrical Instrument Maker, Farringdon Road, London, E.C. We do not quite understand what idea you propose to protect—the use of brass, or the use of mercury, or the use of gas. All have been tried long ago by numberless people, and they are certainly not patentable. The magnetic detector consists of an endless rope R made up of fine wires, which passes round two grooved wheels W W and through two coils of wire. One of the wheels is driven slowly round by clockwork. Two permanent magnets M M are placed with similar poles together, so that they magnetise the iron wire inductively. As the wire rope moves through the coil, it carries a little residual magnetism with it, making the distribution of magnetic field slightly unsymmetrical. When the oscillatory currents are induced in the aerial by the waves, they demagnetise this slight residual field, causing it momentarily to shift back to a symmetrical position. This sudden movement of the magnetic field induces a transitory current in the coil C2, which gives a click in the telephone. Thus, a click is heard for every transmitter spark, a long crackle representing a Morse dash and a short one a Morse dot.

[19,173] **100-watt Dynamo Windings.** J. W. (Everton) writes: Would you be so kind as to help me in the following: I have dynamo castings (tracings enclosed) supposed to be 100 watts (20 volts 5 amps.), speed 3,200 r.p.m. Would you let me know gauge of wires (enclosed) and quantity required for winding dynamo? Also is there any practical way of reducing speed and still retaining full output? Would extra brushes or an increase of wire do any good?

Your machine will barely give 100 watts output. The wires enclosed are No. 20 and 22 S.W.G. respectively. The windings would be—on armature, about 8 ozs. No. 20 S.W.G.; and on fields, 4 lbs. of No. 21 S.W.G. The number 22 you enclosed could be used for this, as it is slightly over gauge.

[19,168] **Curious Fuse Failure.** M. T. (Totton) writes: I would be much obliged if you could give me an explanation of the following. I have an isolated plant here of 100 volts. A day or two since I was connecting up an 8-amp. radiator in the garage adjoining the stables and supplied from the stables' circuit. I accidentally "shorted" it and of course a fuse blew. Now, this is where I am fogged, for I naturally went to the distribution panel in the stables but found both the positive and negative fuses of the radiator branch (which also supplied the lamps) intact. On going to the main switchboard in the engine-room I found both positive and negative fuses of the stables' branch blown. Why should the 20-amp. main fuses blow, leaving the 10-amp. branch fuses intact? Would this be of interest in the Queries column? Perhaps other readers have had similar freaks. I may add, both sets of fuses were new.

We can suggest no reason for the larger fuses blowing and the smaller ones remaining intact, except that perhaps the two fuses were of different materials. Thus, the large fuse might be of very soft alloy, which would melt with considerably less current than the 10-amp. fuse. It is a case where personal inspection is required before a definite opinion could be given.

[19,166] **Resistance for Small Arc Lamp Running.** A. S. (Maida Vale) writes: I am making a small arc lamp for penci carbons of the scissors type. I would like you to inform me about the resistance. The current is 240 volts direct and I do not wish it to exceed at any time 5 amps. I should think 50 ohms would do me, but how shall I obtain this resistance? I intended using 10 yds. of platinoid wire about ·31 mm. in diameter, but am in doubt as to whether it would not melt. Could you also give me information as to the bobbin on which to wind it? If you think I require a greater length than 10 yds. and of greater thickness. Could you also tell me where I could get the platinoid wire, and whether they will send it by post if I send the value in stamps?

Fifty ohms resistance would give you the required current, but you will have to use No. 20 S.W.G. platinoid wire in order to carry the current flowing. 1 lb. of this gauge would give you approximately 40 ohms, so you will see you need a great deal more wire than you anticipate having to use. Any of our advertisers would supply you and quote you price on application. 3 amps. is the maximum safe working current for continuous working for this gauge of wire. A size larger, namely No. 18 S.W.G., would easily carry 6 amps., but it only has approximately 14 ohms resistance to the pound, so a much larger quantity still would be required in this case.

[18,989] **Small Telegraph Instruments.** B. J. G. (Manchester) writes: In a recent issue of THE MODEL ENGINEER there is an article under the heading of "A Small Telegraph Instrument." I have commenced making it, but there are a few things that are not quite clear to me. (1) Are both coils wound with the same piece of wire? In the sketch illustrated I see no wire shown by which the two are connected. (2) To what height has the coil to be wound? (3) Have the 5-16ths in. wrought-iron rods to be higher than the coils? If so, how much? (4) What is the distance between the permanent magnet and the top of the wrought-iron rods of the electro-magnet?

In reply to your enquiries *re* small telegraph instrument the author has replied on the several points in question. (1) No, they are wound with two pieces of equal length, a few inches being left at either end and the finishing ends being twisted together and a touch of solder applied. Both coils must be wound in the same direction. (2 and 3) To within about ⅛ in. of the top of the limbs, the length of the limbs being 2 ins. above the piece into which they are riveted and are spaced 1¼ ins. between centres. (4) The spindle of the permanent magnet is ⅛ in. above the top of electro-magnet limbs. We think you would find our handbook, "Simple Electrical Models," of much service to you. It can be had at 7d. post free from our publishing department.

[19,096] **Small Dynamo for Lighting Purposes.** W. P. (Devonport) writes: Will you kindly answer the following? (1) What winding (volts and amps.) is advisable for a 60-watt dynamo, so that it can be used for lighting a few lamps or charging accumulators? (2) How many, and what candle-power, lamps would the voltage you state light (Osrams in preference), and what gauge wire should I use for the mains to dynamo? (3) What power accumulators should I require to light one 4-volt 4 c.-p. Osram? (4) What length and gauge of German silver wire should I use for a regulating resistance? I am in possession of most of THE MODEL ENGINEER Handbooks, but I am not quite clear on the above.

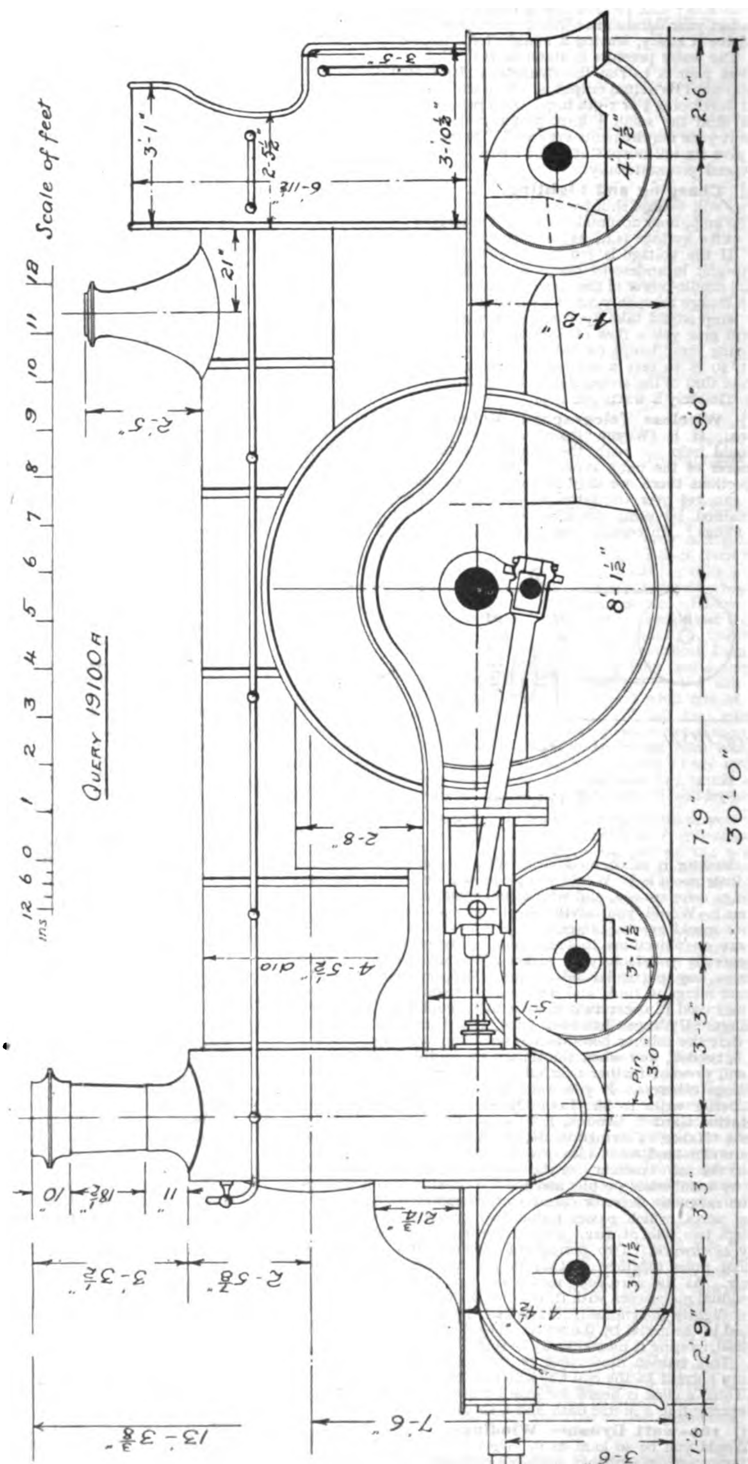
(1) Use a 15-volt 4-amp. winding for your machine. (2) Reckoning at the rate of 2 watts per c.-p., the machine should give 30 c.-p. To carry 4 amps. comfortably, you should use No. 16 S.W.G., provided only comparatively short distances of wiring are necessary. (3) An accumulator capable of discharging at at least 1 amp. per hour rate. That, of course, is the minimum size; anything above that you can readily use. (4) You do not need any resistance at all.

[19,131] **Petrol Motor for Driving Dynamo.** B. F. (Dublin) writes: I should be greatly obliged if you would kindly answer the following queries—I wish to instal a charging plant which it is desired should be portable, but at the same time must be capable of charging sixteen cells at a time. I have seen the 1½ h.-p. engine (as shown on enclosed slip) driving a boat and doing its work well. Would it be suitable for driving a dynamo to give 50 volts and 6 amps. (made by Thompson, Woolwich)? Day & Son state that, with suitable adjustment, this engine would work equally well with household gas. Would it be safe to rely on this statement? It is of the two-stroke type, and is made in America. What would be approximately the consumption per hour when working on full load, viz., 50 volts and 6 amps.—(*a*) petrol, (*b*) household gas? Would a small quantity of paraffin added to the petrol affect the output?

We think the motor you are thinking of obtaining should answer your requirements very well We have had no practical experience with this make, but in any case we think you would be well advised to obtain a guarantee in writing as to the brake horse-power the motor will give, from the makers or their agent. It should be quite equal to driving a 300-watt machine. As regards its working on gas, this is a point which can only be settled by actual trial. Many engines can be converted from one to the other with very slight alterations and give exceedingly good results in both cases; other engines will not run so well with one form of fuel as the other. Our remarks regarding guarantee apply equally in this case. The consumption, when working on petrol, is also a point which the makers must give information upon. A fairly common figure is 1 pint per brake horse-power, per hour, and for town gas anything from 18 to 25 cub. ft. per brake horse-power per hour, according to its calorific value. We do not advise the addition of paraffin to the petrol.

[19,100A] **Model G.N.R. Single (No. 1,007).** S. H. M. N. (Old Charlton) writes: Kindly publish a drawing of the last class of the "Stirling" single express locomotives suitable for a ½-in. scale model.

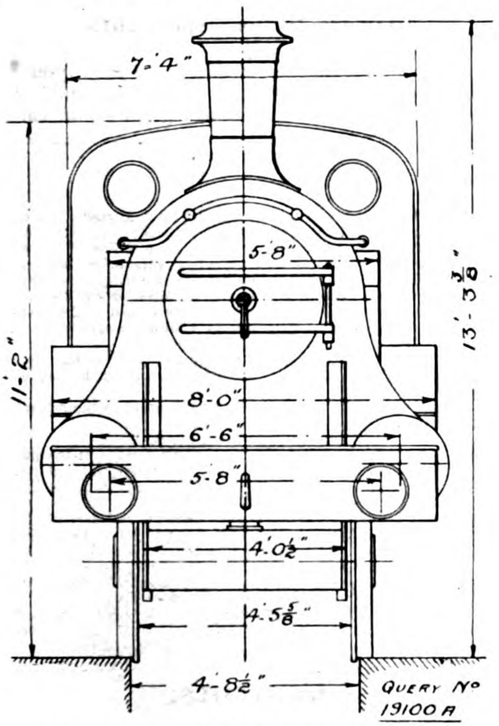
We append a drawing of the G.N.R. eight-footer of the 1,007 class, to a scale of ¼ in. to the foot, *i.e.*, half size for a ½-in. scale model. The boiler should be 2 3-16ths in. diameter outside at least, and with a distance of 2 5-16ths or 2 9-32nds between tyres you will have sufficient clearance for the driving wheels. The design of a suitable boiler for a steam model of this size is no mean task; however, we shall be pleased to help you should you encounter any difficulty in this particular. You will note that the trailing wheelbase is 4 ins. longer than the earlier No. 776 class, and that the boilers are placed 2¼ ins. higher. The roof of the cab is also slightly extended.



ELEVATION OF STIRLING'S G.N.R. 8-FT. SINGLE EXPRESS LOCOMOTIVE (No 1,007 CLASS).
(Scale: ¼ in. to the foot, or half size for ½ in. scale model.)

[19,123] **Accumulator Charging, etc.** F. R. M. (Nottingham) writes: I have a 4-volt 5 amp.-hour accumulator, and wish to buy dynamo castings to make up, in order to charge it. What kind and size should I get, and from what makers? What kind of power is the best and most economical to use to drive a dynamo? Also, has an accumulator to have fresh dilute H_2SO_4 when it is charged? Is it practicable to charge this accumulator with bichromate batteries, and what size should I want? I tried to charge my accumulator with three ½-pt. bichromate batteries, but after lighting a lamp for a few minutes, the lamp nearly goes out. What is the cause?

A 10-watt dynamo would answer your purpose very well for charging accumulators. One giving an output of 8 or 10 volts and 1 amp. would do. Any of our advertisers, such as Messrs. T. W. Thompson & Co., 28, Deptford Bridge, Greenwich, S.E., or Mr. A. H. Avery, Fulmen Works, Tunbridge Wells, or Messrs. Whitney, 117, City Road, London, E.C., would supply you. We also advise you to read our Handbook on "Small Accumulators," as well as the recent replies on this subject, which are always appearing in the Query columns. There is no advantage in charging accumulators from bichromate batteries, for you might just as



END VIEW OF G.N.R. NO. 1,007 CLASS.

well use the bichromate batteries in the first instance for the purpose required, as to waste power by charging the accumulators and then using the accumulators, for one purpose or another. You practically waste 50 per cent. by this round-about method. The fact that your lamp only burnt for a few minutes when connected to your accumulators does not show anything conclusively, for it may be a lamp taking a very heavy current, in which case the accumulators would polarise very quickly. The only way to get over your difficulty is to use a small voltmeter and to make sure your accumulators are fully charged when you think they are.

[19,120] **Thermopiles.** H. V. C. Chiswick) writes: I want to make a small thermopile. Would you kindly say if these are suitable for charging accumulators?

Thermopiles are not at all suitable for charging purposes, and to get any appreciable voltage you would have to have a very large number of couples. A few particulars on thermopiles were given in a Query Reply in our issues for July 27th (1905), page 94, also Nov. 16th (1905), page 478.

[19,242] **Compression and Explosion Pressures.** J. R. C. (Thornaby) writes: If you have a cylinder full of a mixture of petrol vapour and air, and compress it to one-third of its volume, what pressure would you have? When that mixture was exploded and the space increased to its original size, what would then be the pressure? I presume it would to some extent depend on the richness of the mixture; therefore, I would like to know the proportions of petrol and air, in order to arrive at what would be necessary to get the pressure of the exploded (and expanded) mixture higher than the compressed fresh mixture in the above.

For all practical purposes pressure multiplied by volume equals a constant. Thus, if you halve your volume, you double your pressure; if you reduce the volume one-sixth, you increase the pressure to six times its former value. The pressure at the end of an explosion stroke would be ascertained by actual measurement by an indicator diagram taken during the explosion. You will find some very useful information on explosion engines in "Gas and Oil Engines," by F. Grover, and also Dugald Clerk's book on "Gas Engines."

[18,856] **Steam Engine Queries.** W. H. (Sheffield) writes: (1) What would be the sizes of steam and exhaust, and also of slide-valve, for a 1¼-in. bore by 2½-in. stroke horizontal engine? (2) What would be the distance from centre of cylinder to centre of slide-bars? (3) Has there ever been a design for a vertical engine about 1½-in. bore, shown fitted with an air-pump and condenser, in a back number of THE MODEL ENGINEER? (4) What is the largest size engine that a vertical copper boiler 7½ ins. diameter and 15 ins. high, fitted, with eight 1-in. diameter flue-tubes and one 1¼ ins. diameter central tube, water space round fire (coal fire), outer shell 1-16th in. thick, would drive at a pressure of from 45 to 50 lbs. per sq. in.?

(1) Steam ports, 9-16ths in. or ⅝ in. by 5-32nds in.; exhaust, 9-16ths in. or ⅝ in. by 5-16ths in.; lap or valve, 3-32nds in.; port bar, 5-32nds in. wide. (2) Depends on the stuffing-box sizes and on the design of the crosshead. (3) Not a complete design. (4) The largest size we would recommend would be 1¼ ins. by 1⅝ ins. It would drive such an engine at about 300 r.p.m. under load. With induced draught and everything in the best order, and with a superheater formed by coiling the steam pipe in the large central tube, the boiler would, no doubt, run the engine mentioned above at light load.

[19,367] **Amyl Acetate for Softening Celluloid.** J. T. A. (Driffield) writes: Can you give me the address of firms supplying special glue for repairing celluloid accumulators or name of chemical, if any, for same? Also best place to get celluloid and plates and terminals. If Whitneys supply all, kindly reply.

Amyl acetate is used for this purpose. Any of our electrical advertisers, such as Messrs. Whitney, 117, City Road, E.C., would supply you.

The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

• Reviews distinguished by the asterisk have been based on actual Editorial Inspection of the goods noticed.

*Spanners for Model Work.

We have received from Messrs. W. Heckman & Sons, 41, Market Place, Henley-on-Thames, some samples of small double-ended spanners of suitable sizes for model bolts and nuts. The importance of not using too great a leverage on model bolts will be known to most of our readers, and we think these small size spanners will be generally appreciated. They are supplied both in the rough state or finished, as desired, and in varying sizes. Prices may be obtained on application to the makers as above.

Lathes at Olympia.

Messrs. Drummond Bros., Ltd., Rydes Hill, near Guildford, were exhibiting at the recent Commercial Motor Vehicle and Motor Boat Exhibition at Olympia. They had on view a 5-in. screw-cutting lathe, exactly similar to the one ordered for His Majesty the King. Their well-known 3½-in. screw-cutting lathe was also shown, and also their 7½-in. pattern. They are now manufacturing a new lathe for model makers, and will forward particulars of same on receipt of stamp for postage.

New Catalogues and Lists.

The Liverpool Castings and Tool Supply Co., 5, Church Lane, Liverpool.—This firm has sent us an illustrated sheet of their well-known specialities in small bolts and nuts, iron and brass screws, etc. The various patterns and sizes are all fully illustrated, and the sheet should be most useful for workshop reference.

The Editor's Page.

ON the subject of the attitude of apprentices in the workshop, L. G. T. (Tufnell Park) sends us the following further letter: "There appears to be a slight misunderstanding in regard to the meaning of my previous letter, for which fact I am perhaps to blame through not making myself fully explicit. I note that both yourself and 'W. H. N.' acknowledge that there are 'undesirables' in all large establishments; but the question is—What percentage of the total number of 'hands' employed do they represent? Within my knowledge, which I may say here is founded on experience in the works of one of the largest electrical manufacturing firms in Great Britain, they form a very large percentage. The man in the dirty blue overalls, with dirty face, dirty hands, knitted brow, and genial smile—the true engineer—is not, I think, such a notable personage as might be expected in a good many of the engineering concerns of to-day (either electrical or mechanical), but is superseded by the 'cheap labour' man, whose one and only thought is his money and his time. He has no interest in the nature of his work, and to ask him why such-and-such a thing is so, or anything else beyond the narrow scope he is connected with, one would probably obtain the same answer as that received from a child when asked to explain the solar system. These statements I can illustrate by an incident that I witnessed in the 'shop' a few weeks back. One of the men had been engaged in completing a certain piece of work—a small electric motor, to be correct—and upon it being finished he took it to one of the overseers to be tested. The motor was found to run in the wrong direction. The overseer accordingly asked the man if he knew how to alter the wiring so as to attain the desired result. The man looked first at the motor and then at his superior, after which he gave a slow shake of his head, followed by a drawled 'No,' as much as to say such wonderful accomplishments were far too much advanced for him. The above is not an isolated instance. I have known another man not know the difference between a condenser and an accumulator. Employers, naturally, know of this lack of interest among the majority of the men, who are content so long as they fulfil the duties for which they are intended. Therefore, if a learner enters a works—more especially if he has no indenture behind him—how are his superiors to distinguish him from the general type other than by his adopting an attitude of polite reserve, which, I think, can be carried out without giving the impression of snobbishness or superiority, unless it should be his good fortune to come across one of the true stock."

E. H. E. (Lewisham) also writes as follows: "I also am an apprentice, and entirely agree with your reader, 'W. H. N.' I find the greatest consideration and help from the men. I must also say that I never once felt offended by undue familiarity. I have found that if a fellow puts on 'side,' they will resent it and let him go his own way. One must remember that he is actually learning from the men, and not from the master, with whom he rarely comes into contact. In no instance have I ever been refused any help from them, and in exchange they have willingly accepted any tip which my superior education was able to afford."

Answers to Correspondents.

O. D. E. (Parramatta. N.S.W.).—Thank you for interesting post-cards and paper to hand. We are sending you some English picture post-cards.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

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How to Address Letters.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists &c., for review, to be addressed to The Editor. "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to The Advertisement Manager, "The Model Engineer," 26-29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

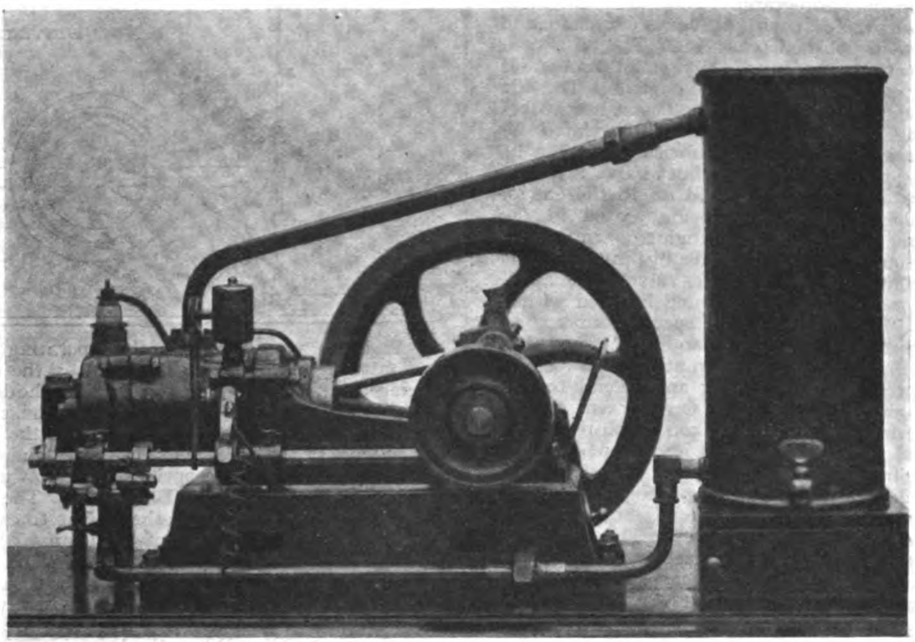
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 365. APRIL 23, 1908. PUBLISHED WEEKLY.

A Model High-Speed Petrol Gas Engine.

By H. J. B.



A MODEL PETROL GAS ENGINE.

THE enclosed photograph illustrates the result of my first attempt at model making. I commenced by making the drawings and the patterns, which occupied a good deal of time, my stock of tools being very limited. I then procured a piece of hardwood, 12 ins. × 24 ins. × 1¼ ins. thick and planed it up perfectly level for base. The bore of cylinder is 1½ ins. and length of stroke 2½ ins. As you will see by the photo, the combustion head is a separate casting with water spaces cored out. The cylinder liner and water jacket are also separate castings: the liner joint is held tight by 4 5-32nds in. Whitworth studs, and the joint is made with Klingerite packing, 1-16th in. thick, which has made a perfectly tight joint. The engine is fitted with a balanced crankshaft ⅜ in. diameter, which I built up. The webs were roughly cut out of two pieces of steel boiler plate, and after filing both pieces up level, they were soldered together. I then marked off the centres for shaft and crank pin and drilled the holes through both webs together, and after filing and polishing the edges they were separated I then polished the sides and passed the shaft and crank pin through the holes in the webs, which were set the required distance apart, and were tacked with soft solder to hold in position for drilling. I then drilled 3-16ths in. holes right through the webs and shafting together, the holes being slightly countersunk at each end. Tight fitting steel rivets completed the job, which has stood the test well, and has not shown any signs of giving way, although the engine has been run at a very high speed. After riveting, the shaft was cut through with a hack saw. The side shaft is ⅜ in. diameter and is carried by three brackets bolted on to engine frame with 5-32nds in. studs and nuts. The motion of side shaft is imparted by the usual 2 to 1 skew gear wheels. These caused me some trouble, but with a second attempt I succeeded in producing a pair of wheels which geared perfectly with each other. These were turned up as blanks and the teeth cut by hand. A thin sheet brass cover was then made to cover them, as on a larger engine. The flywheel is 8½ ins. diameter with 1⅛ in. face, the rim being ⅝ in. thick and is very heavy in proportion for its size. The flywheel end of shaft is fitted with an outer bearing which is carried on a standard. The driving pulley is 3¼ ins. diameter with 1¼ ins. face. The outer bearing cannot be seen on photograph. The outer and main bearing-keeps are cast with oil boxes complete, and are fitted with polished brass lids. The oil is conducted down to the brasses by small tubes and wool trimmers, as in many large engines. The side shaft brackets are fitted with small cycle lubricators with spring lids. The cylinder is lubricated by means of a small belt driven lubricator, as can be seen on the photograph. The inlet valve is seated in a separate valve body bolted on to the end of cylinder, the exhaust valve being seated in the combustion chamber. The engine is run off a Wick carburettor constructed by myself. The speed is controlled by a small valve, L shaped, which acts as a throttle valve and is fitted with a lock nut. I can run it any speed from 200 to 1,200 revolutions per minute, and the speed can be altered whilst running. I am at present working on a small centrifugal governor and intend to run a small dynamo for lighting. On a recent test, I ran the engine for 6 hours at 500 revolutions per minute, and she only consumed about one-third of a pint of petrol. The ignition is by electric spark. Wipe contact can be seen in photograph. I am using three "Dania" dry cells for the current and they are exceedingly satisfactory. The engine is now mounted on a polished oak base 12 ins. by 24 ins. by 6 ins. deep over all. The ignition coil (high speed trembler) and batteries and silencer are all contained in the base and are out of sight altogether. The engine is enamelled a medium green and the water tank is enamelled dark red. All pipe fittings are of solid drawn copper tube and polished. The cylinder lubricator and throttle valve are of brass, polished.

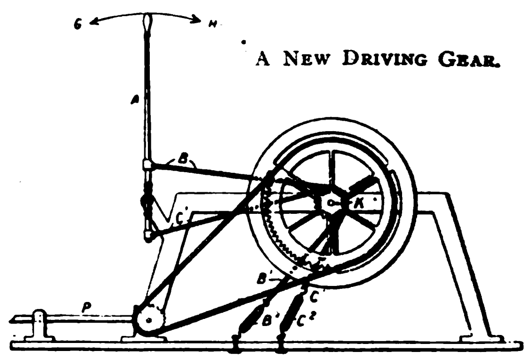
The James Watt Memorial Building at Greenock, recently erected on the site of the great inventor's birthplace from a fund subscribed to by sympathisers all over the world, is to be dedicated as a navigation and engineering school and entrusted to the care of the School Board of Greenock. An adequate sum will also be placed with the Board to be appropriated for the purpose of the future maintenance of the building.

The Latest in Engineering.

New Engine for the Maryport and Carlisle Railway.—A new and powerful six-coupled goods engine, built at the North British Locomotive Works, Glasgow, for the Maryport and Carlisle Railway Company, under the supervision of Mr. Adamson, locomotive superintendent, recently made a successful trial run from Carlisle to Brayton and back. "No. 18," which replaces one which has done good service for about forty years, weighs 80 tons, and is fitted with all the latest improvements.

A New Driving Gear.—A new form of driving gear for hand, foot, or power-driven machinery has been patented by Mr. E. W. Colman, of 22, The Embankment, Twickenham. This gear enables a rotary motion to be obtained from the to-and-fro movement of a lever in a very simple manner (says *The Engineer*). The accompanying illustration shows the system adapted for propelling a boat. On the main shaft K, which carries the flywheel, two free

A New Driving Gear.



wheels are mounted. To the operating lever A are attached two chains, B^1 and C^1; the chain B^1 being attached above the fulcrum of the lever and the chain C^1 below the fulcrum. The chain B^1 passes over one of the free wheels and the chain C^1 over the other, the ends of both chains being attached separately to springs fixed to the base of the machine, as shown at B^2 and C^2. The two free wheels are so fixed to the shaft K as to cause it to revolve only when either of the chains B^1 and C^1 are pulled by the lever A; therefore, when the lever is moved in the direction of G the chain B^1 is pulled, which causes the shaft to revolve, while the chain C^1 is drawn back free over the wheel C by the spring C^2. When the lever is moved in the direction of H the chain C^1 is pulled and causes the shaft K to revolve, while the chain B^1 is drawn back by the spring B^2. When the machine is not being used the lever A assumes a perpendicular position, owing to the half extended springs counterbalancing each other, and the lever can therefore be moved in either direction to start the machine in motion. It will be seen that in the illustration the power is transmitted to the propeller shaft P through the medium of a chain, but this part of the illustration has no connection with the method of driving. The gearing and flywheel are not essential in every machine, any more than with any other form of drive. It is obvious that the idea may be applied to numerous different machines.

Notes on Wireless Telegraphy Apparatus.

By V. W. Delves-Broughton.

(*Continued from page* 351.)

SOURCES OF SUPPLY.

In my previous article, on interrupters, I mentioned sundry objections to their use, not the least being the difficulty of interrupting the heavy currents used at the transmitting key and the unsatisfactory nature of brakes which are only put in motion on depressing the key.

Some years ago, when experimenting with fairly heavy currents (about 100 to 150 watts) I devised a system of transforming a continuous 100-volt current (house supply) into a *broken* alternating current, which was very effective for the excitation of coils. I could not obtain secondary batteries at that time, and had no experience in making them, besides which I did not then know of the existence of those excellent handbooks published by THE MODEL ENGINEER, so I was more or less forced into experimenting on generators. The supply from which I obtained my current was most erratic during the daytime, as the Electric Light Company endeavoured to equalise their "load factor" by selling power at cheap rates during the daylight hours to printers and others, who were constantly cutting in and out large motors; added to which the reversals of a large printing press worked by a motor on the same cable that supplied our house could be distinctly detected by observing the variations in the light from a glow-lamp.

This irregularity of pressure was perhaps the reason that I failed with the Wehnelt interrupter; but with the motor generator used, combined with a heavy flywheel, these fluctuations had no bad effect.

I obtained better results at night; but as the light required in the house used nearly the maximum supply for which it was wired, I did not care about experimenting very much at night, as any slight accident was sufficient to blow our main fuse and put the house in total darkness.

On page 72, in his book on "Wireless Telegraphy," Mr. Howgrave-Graham apparently advocates breaking alternating currents on the summit of each half wave, thus producing two discharges in opposite directions for each alternation.

In my first experiments I worked on this line, but obtained infinitely better results when using one break only in each alternation, using the unbroken wave below the zero line simply to demagnetise the core of the coil and obliterate any residual magnetism remaining from the previous alternation.

As already stated, I have not worked on tuned aerials, excepting some experiments carried out on a very small scale since these articles were commenced, so I cannot say if the greater rapidity would not compensate for the less efficient spark. It might, therefore, be advisable to construct the interrupter in such a manner that it breaks the circuit twice in each alternation. This is a matter for experiment, and would be a small item compared to the rest of the work involved.

On referring to Fig. 1 the forms of the different curves due to different systems of supply is clearly shown—A being that due to an uninterrupted alternating current, B a continuous current broken by any of the usual interrupters, C the current as supplied from the machine described below. The effect of self-induction has been neglected, as it would complicate the diagrams, destroy the clearness, besides probably being quite wrong!

The interruption of the current is effected by the appliance shown in Fig. 2, which takes the place of one of the slip rings in an ordinary alternator.

A is a ring connected to the segments C and to one extremity of the armature winding, the other extremity being connected to an ordinary slip ring.

B is a ring connected to the segments D and entirely insulated from the rest of the fitting. The segments D are simply used to take the wear of the brushes, as any insulating material would be liable to destruction by the friction.

G is another ring attached to the small segments E.

H is a flange screwed to a prolongation of the insulating material used to form the body of the

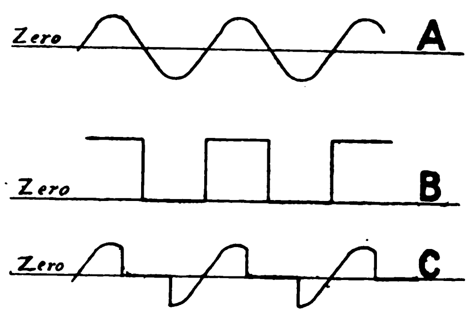


FIG. 1.

interrupter, forming a recess between H and G in which a non-inductive resistance can be wound. Two brushes are used—one bearing on the ring A, and one on the segments C, D, E; and between these brushes the condenser is fixed, a third brush bearing on the slip ring being used to provide for a return circuit.

Fig. 3 shows diagrammatically the continuous current motor attached to the alternating generator, A being an ordinary commutator, and B being the interrupter and slip ring fixed to the alternator shaft.

F is a variable resistance coil in series with the field of the motor to regulate the speed, C the transmitting key, H a non-inductive resistance to prevent the extra spark at C.

Both generator and motor were of a similar pattern, made with ordinary two-pole shuttle armatures, and the field-magnets made out of laminated stampings.

It will be seen on reference to the diagram that the field of the alternator was broken, except when the key C was depressed, and in this manner the signals were despatched. The key C was provided with a second contact (not shown in the drawings) fixed to a small spring, so that immediately after interrupting the main exciting current, the current flowing through the resistance was also broken.

The diameter of the armatures was 2 ins. by 3 ins. long, and the speed at which it was run was about 6,000 r.p.m.; but at this pace the winding gave considerable trouble, as the friction between the wires was constantly causing a breakdown of the insulation, particularly under the sudden strains caused by suddenly exciting the field.

The period, even when driven at this speed, was too low, and a larger machine, with many poles, would be infinitely superior, besides which the long loops of wire on a shuttle-wound armature are not suited to resist the strains of very high speeds. I therefore subjoin a design for an alternator (Figs. 4 and 5) which should meet all the requirements to supply the coil already described.

The armature consists of eight groups of **H**-shaped iron stampings carried on a gun-metal spider revolving at 3,000 r.p.m., which gives a period of 200 per second, which should be ample for any wireless telegraphy work.

The short coils, hung in the manner shown, cannot be affected by the centrifugal force; and although the speed may appear great when compared with continuous current machines, it will not be found excessive for this type.

The field-magnets consist of eight steel castings bolted to a non-magnetic ring, which may be made of zinc for the sake of cheapness and ease of construction.

The slip ring is shown to the left of the spider hub in Fig 5, and the interrupter on the right; the bearings, brush-holders, etc., are not shown

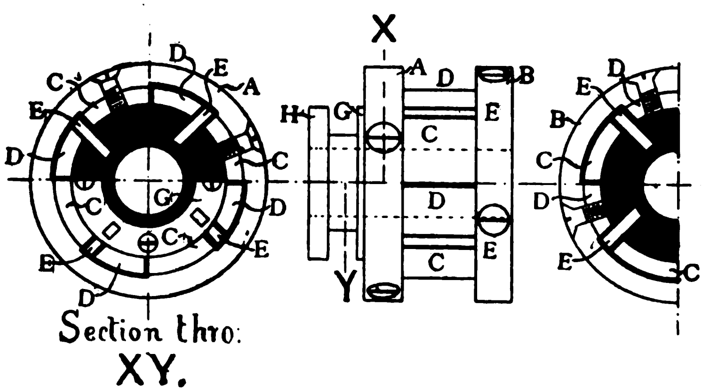


FIG. 2.

in the drawing, and the maker can design these according to his own taste. I should strongly advise the use of Hofmann ball bearings, however, as these are easily fitted, require no oiling, ensure free running, are practically everlasting, and are not very expensive. (If these are not sufficient reasons to use this type of bearing, I must leave my readers to design something better).

Each group of stampings for the armature is assembled separately, insulated by thin varnished paper, and riveted together with four light insulated rivets (shown in Fig. 5).

The wire space is then carefully insulated with several layers of tough paper (a special white wrapping paper made by Messrs. Green & Son and used by Messrs. Clowes & Sons, printers, for sending out books is very suitable for this purpose), and after having clamped temporary cheeks on to prevent the wires spreading, the recess for the wire is wound as full as possible with No. 17 wire; four layers of thirteen turns each should be got

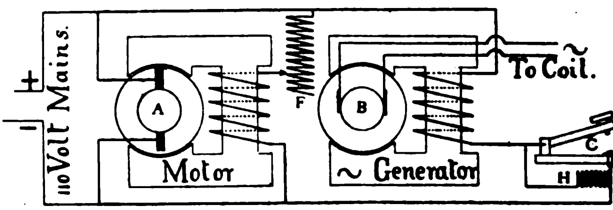


FIG. 3.

on, each layer being thoroughly saturated with varnish.

After completing the winding, the groups of stampings should be fixed in the recesses in the spider (a single thickness of wrapping paper, soaked in varnish, being jambed in between the stampings and spider), and screwed up tight with the studs shown in the drawing. This clamping must be most effectively done, as the strain on these studs will amount to about 800 lbs., due to the centrifugal force; for this reason, it is advisable to make the studs of silver or annealed cast steel.

These studs must be carefully insulated from the stampings or the cores will heat up, owing to the eddy currents set up by the alternating magnetic field through which they revolve.

The cast steel magnets should be wound with No. 20 wire to the depth shown in the drawings, after being carefully insulated with paper.

Shellac is not the most suitable varnish to use in building armatures, as, owing to the methylated spirits being a conductor of electricity, the coils cannot be tested during the process of winding. A solution of asphalte (Judah pitch) in spirits of turps is much better and is more elastic, but there are some special varnishes now on the market which can be obtained from any manufacturing electrician, which are superior to anything that can be made at home, and dry so hard that insulated wires treated with them become a solid mass which cannot be separated without cutting the wires to pieces.

The alternator should be provided with a heavy flywheel to relieve the motor from the strains which would be thrown upon it when the field of the alternator is suddenly excited. The alternator would require 4 to 6 volts to excite the field, and this could be conveniently supplied by a small battery of secondary cells. It might be thought that it would take an appreciable time for the field to become thoroughly active, but in practice the sparks reached their full value immediately on depressing the key. This system of cutting out the field-circuit when the tapper is not being used has many advantages, amongst others the economy of the exciting current, economy of power required to drive the alternator, and the small current to be interrupted by the tapper when sending a message.

The power required to drive a machine of this type is only about a quarter that required to drive an alternator of the usual construction of the same power and voltage—first, because only one half of the current is used, owing to the interrupter; and, secondly, because when transmitting a signal the key is only depressed for about half the time that is occupied in sending the message.

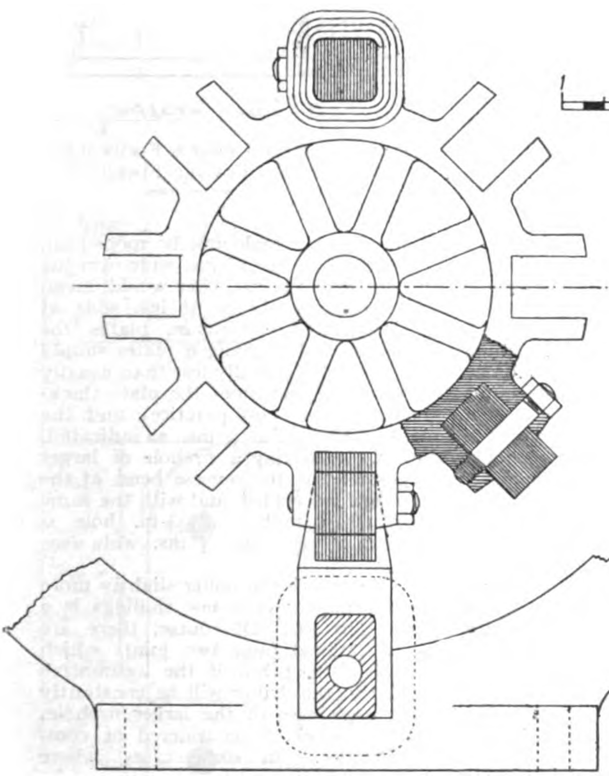


FIG. 4.

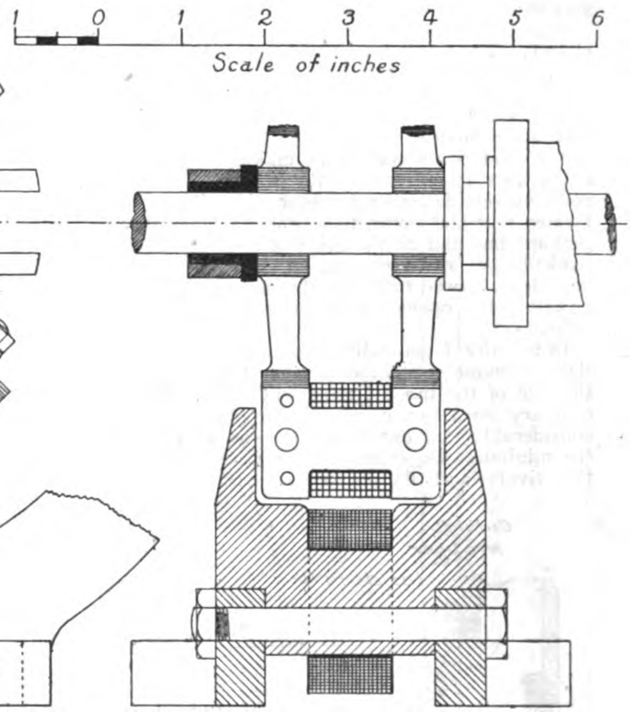


FIG. 5.

For ordinary purposes a small petrol or gas motor could be used, but for field work a couple of men, taken from the equipment of at least six that would be required to rig the aerials and provide for accidents, could do the work by turning a crank. With relays of men, the alternator could be used for radiography in a field hospital; but, if the machine is intended for either of these purposes, a small magneto dynamo should be attached to the shaft to continually charge the battery and other cells required to work the receiving apparatus in the case of Wireless Telegraphy.

It should be pointed out that the alternator described and illustrated in this article has the poles purposely arranged rather far apart. The object of this is to give a deeply serrated curve of potential resembling a Whitworth thread, in contradistinction with the usual full "sine curve" aimed at for alternators used for power or lighting. It will thus be seen that although suitable for exciting a coil, it would be most inefficient for any other purpose.

(To be continued.)

AN exhibition of various timbers was recently opened at Toxteth Dock, Liverpool, collected at the instigation of Sir Alfred Jones, and shipped from Sekondi to Liverpool. There are 400 distinct varieties of wood, all of which grow in different British possessions and Colonies in Africa. These timbers possess various qualities; some when only struck lightly with the knuckle of the hand give forth a fine musical note, some take a high polish and have beautiful figuring, and others are so light that they feel like pieces of cork instead of solid woods.

ELECTRICITY IN HORTICULTURE.—A gardener of Minneapolis, recently planted a bed of lettuce plants 2 ins. high. At one end of the bed he placed an arc light, which was turned on each day at sunset, one-half the bed being shielded from the light by a curtain. A subsequent investigation was made, and it was found that in the dark bed the lettuce was 7½ ins. high, while that under the electric light was 8¾ ins. The heads under the influence of the electric light weighed 40 per cent. more than those grown with only the sun's rays for light.

Chats on Model Locomotives.

By HENRY GREENLY.

(*Continued from page 369.*)

IV.—FIREHOLE DOOR ARRANGEMENTS FOR $1\frac{1}{4}$, $1\frac{1}{2}$, AND 2-IN. SCALE LOCOMOTIVES.

UP to quite recently most of the model locomotives built from my drawings have had firedoors made up out of raw material. However, on larger engines, such as we have been discussing in the last three articles, best results will be obtained by using castings. The accompanying full-page drawing shows in general arrangement the kind of door and tray employed on the "Little Giant" 15-in. gauge locomotives, and which I have also more recently fitted to both 2-in. and $1\frac{1}{2}$-in. scale models, being built under my charge. The drawing is dimensioned for the 2-in. scale model, but is reproduced full size for a $1\frac{1}{2}$-in. scale $7\frac{1}{4}$-in. gauge engine, and scales are included for the three sizes—$1\frac{1}{4}$ in., $1\frac{1}{2}$-in., and 2-in. scale models.

The first consideration in making the drawings for a door is, of course, the size of the firehole, and therein lie several minor difficulties. When I show a model boiler to a practical engineer who perhaps has had no particular experience in model work, he generally remarks on the smallness of the firehole. Viewed from a scale model point of view, however, the opening may be comparatively very large.

In practice I generally recommend, for an essentially working model locomotive, the largest firehole the size of the inner firebox will allow. With the ordinary steel boiler, where the plates are made considerably thicker than the scale equivalent (to minimise the effects of corrosion), and where the rivets and flanges are much more coarse,

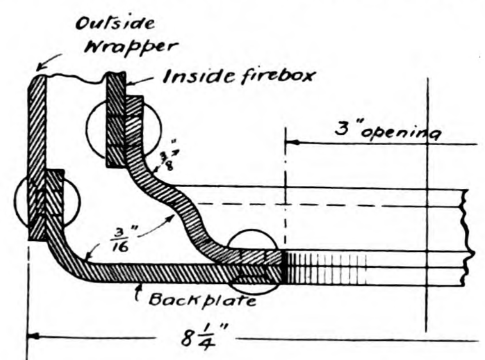


FIG. 2.—SKETCH SHOWING LIMIT TO SIZE OF FIREHOLE WHERE INSIDE PLATE IS DISHED TO FORM JOINT.

there are limits to the size of the opening. This is especially noticed when the firehole is formed by dishing the inner box to meet the backplate of the outer shell, no forged firehole ring being used. The extra thickness of steel plates employed in the construction of the boiler prevents the maker cutting so large an opening as would appear possible from a cursory glance at the finished boiler. This is readily seen from the sketch plan of this portion of a typical 2-in. scale model locomotive boiler, using 3-16ths-in. plates (see Fig. 2).

Taking the gauge at $10\frac{1}{2}$ ins., which is, of course, more than the scale equivalent, the width between

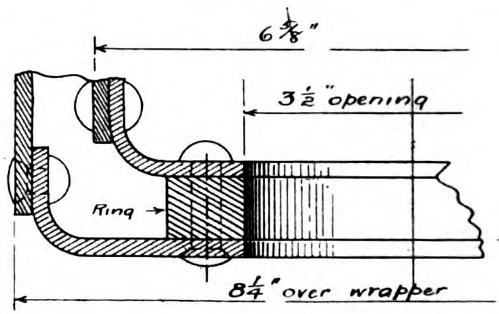


FIG. 3.—SKETCH SHOWING LARGER FIREHOLE OBTAINED BY USE OF A FORGED FIREHOLE RING.

the frames at the firebox would not be more than $8\frac{3}{4}$ ins. over the rivets, or, say $8\frac{1}{4}$ ins. wide over the wrapper-plates of the firebox. This would mean that the inside firebox would be $6\frac{5}{8}$ ins. wide at the firehole. Now, with 3-16ths-in. plates the minimum radius inside of all flanged plates should not be less than $\frac{3}{8}$ in. (this is really less than usually recommended, three or four times the plate thickness being considered the best practice), and the widest firehole would be about 3 ins., as indicated.

By providing a forged ring a firehole of larger dimensions is possible, as the reverse bend at the horizontal centre-line is avoided, and with the same over-all dimensions of firebox a $3\frac{1}{2}$-in. hole is obtainable, instead of one only 3 ins. wide (see Fig. 3).

The use of a ring makes the boiler slightly more expensive, but the matter of a few shillings is a small item on a £10 job. Of course, there are two joints to be caulked (and two joints which may leak) instead of one; but if the locomotive is worked frequently, the driver will be constantly reminded of the usefulness of the larger firehole. and any disadvantage will be considered of comparative insignificance. In some cases, where copper plates are used, the use of a ring may be avoided by dishing both the inner and outer plates to meet each other at about the centre of the water space.

The door shown on the drawings has been proportioned to suit the maximum size of opening; but, as the inner fireplate may be cut to any required size, the door may be employed without further alteration for a smaller or differently shaped firehole.

Cast iron may be used for the tray and the door, the handle being made from a wooden pattern in cast mild steel or malleable cast iron. Where only one engine is being built the smith's services may be requisitioned, and a forging in steel or wrought iron substituted for a steel casting. The smaller the locomotive the more should the door be arranged to open, as the driver has less chance to view the state of the fire in a $1\frac{1}{4}$-in. or $1\frac{1}{2}$-in. scale locomotive than in one built to a scale of 2 or 3 ins. to the foot. To allow of this, in smaller

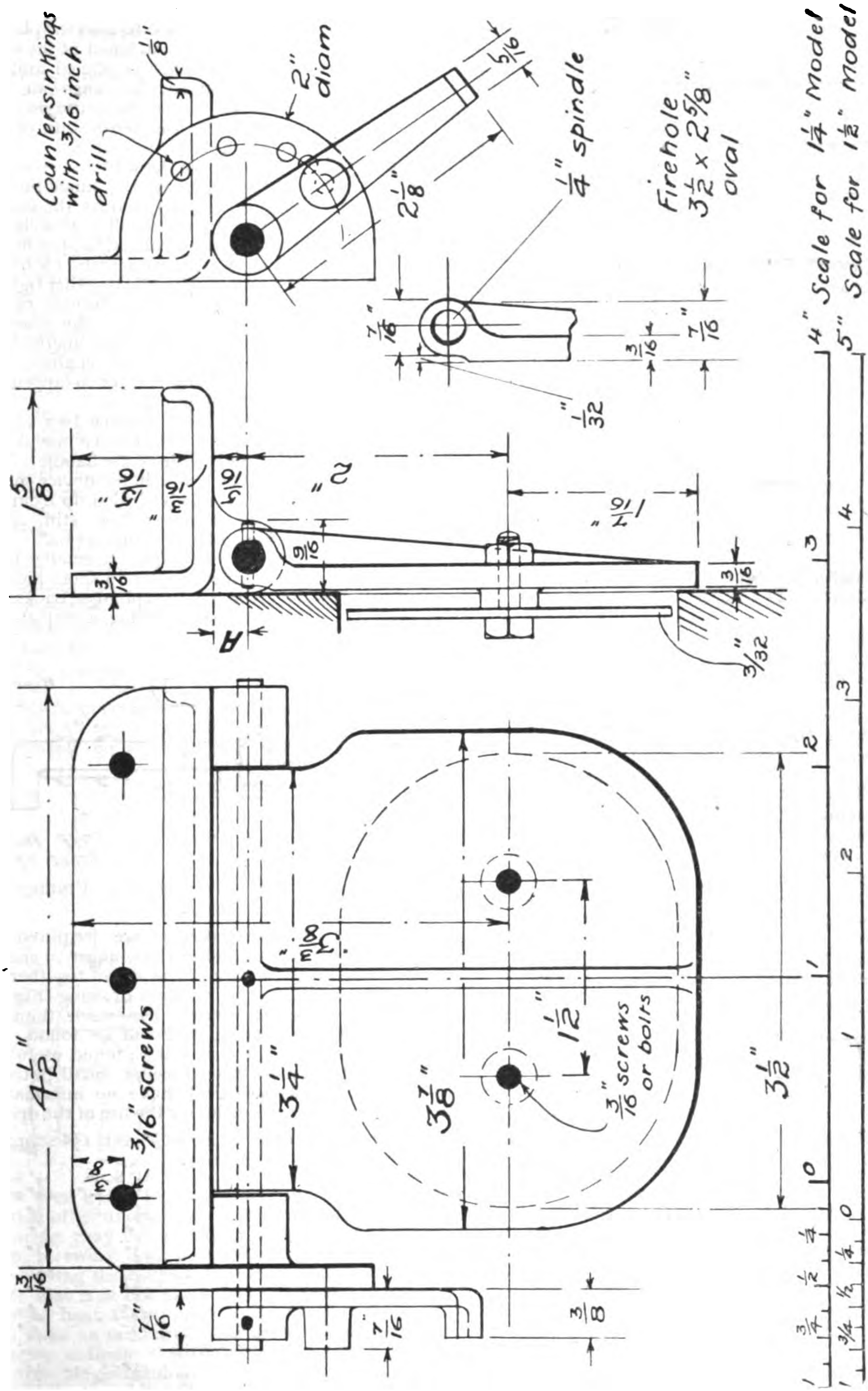


Fig. 1.—General Arrangement of Firedoor and Driver's Tray.

(Drawing full size for 1½-in. scale model and dimensioned for 2-in. scale model.)

locomotives the dimension A (see Fig. 1) should be increased in proportion. In the 1½ in. locomotive the dimension would be 5-16ths in., instead of three-quarters of 5-16ths in. = 15-64ths, the scale equivalent of the dimension fixed as the most suitable for the 2-in. scale engine (see Fig. 1).

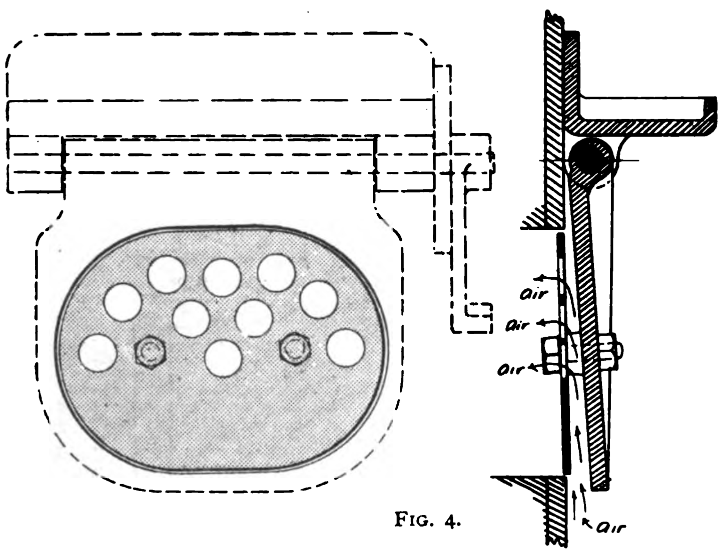


FIG. 4.

VIEW FROM INSIDE OF FIREBOX, SHOWING AIR HOLES IN FIREPLATE.

VIEW SHOWING DOOR PARTLY OPEN AND PASSAGE OF AIR.

It is well known that if a small amount of air is introduced at the firehole door more perfect combustion ensues, especially when the engine has just been fired and is either standing or only running on light load. This may be best done in the large engines by arranging the fireplate inside the door in the manner shown in the sketch (Fig. 4), several holes being cut in the plate, so that, with the door slightly open, the air passes up between the door and the plate and through the holes. The effect of this will be to slightly warm the air before it enters the firebox.

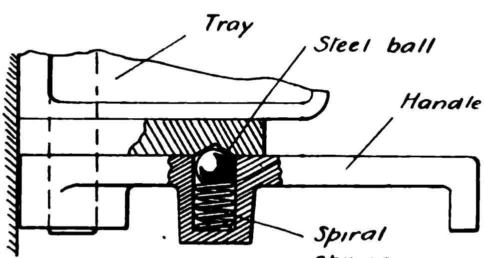


FIG. 5.—SPIRAL SPRING CATCH FOR FIREDOOR HANDLE. *(Half size for 2-in. scale model.)*

As shown on the drawings, the tray is fixed to the boiler by three screws or studs, and the door is hung by a steel hinge-pin from the lugs below the tray. The door should be drilled a tight fit for the hinge-pin, and a fixing-pin should be driven through both door and hinge-pin at the centre, just above the web cast on the door.

At one end of the tray, preferably in a right-handed engine, on the fireman's side, a sector-plate is cast. This is machined at the same time as the back is planed and the hole drilled for the hinge-pin, and should, of course, be quite flat and square with the centre-line of the latter.

The handle should be set-screwed or pinned on to the hinge-pin, so that it rubs up against the sector-plate. In the smaller models the door may be arranged to stop in any required position merely by fitting the door and handle together tightly, and relying on the stiffness of the joint. The weight of the door is, however, against this method of fitting up in larger engines, and therefore some better arrangement must be devised.

Figs. 5 and 6 show two contrivances. In both cases a boss is cast near the middle of the handle. This should be longer in the device shown in Fig. 5, and be drilled up from the face to receive a short stiff, spiral spring and a steel bicycle ball. The other device requires a smaller boss, and either a ball or a short piece of steel rod to form a plunger, backed up by a strong flat spring, as depicted in the sketch. Counter-sinkings are required in the sector-plate for the ball or the plunger to engage in, and these holes should be close together at the bottom, as shown in the main drawing (Fig. 1). Both these methods involve less work than an orthodox ratchet motion, and will be found just as serviceable. The tray will be found useful for holding and warming the oil-feeder, small patterns of which are obtainable. I have no information about miniature tea bottles for the use of the driver.

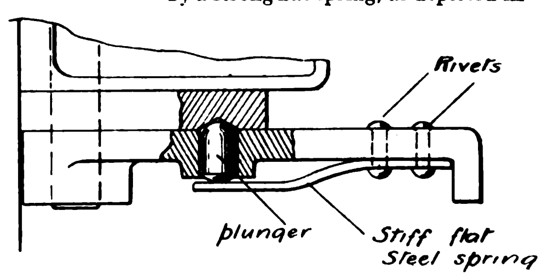


FIG. 6.—FLAT SPRING CATCH FOR FIREDOOR HANDLE.

TABLE OF DIMENSIONS FOR 1¼" AND 1½" SCALE MODEL.

Name of Part.	1¼" Scale.	1½" Scale.
Size of firehole (maximum) ..	2" × 1 11/16"	2⅜" × 1⅞"
Width of firedoor	2⅜"	2¾"
Distance A	9/32"	5/16"
Length of tray	2⅞"	3¼"
Width of tray	1 1/16"	1¼"
Length of handle	1⅜"	1⅝"
Diameter of hinge-pin ..	5/32"	3/16"
Diameter of sector-plate ..	1¼"	1 9/16"
Centre of hinge-pin to centre of firehole..	1¼"	1½"

(To be continued.)

How It Is Done.

[For insertion under this heading, the Editor invites readers to submit practical articles describing actual workshop practice. Accepted contributions will be paid for on publication, if desired, according to merit.]

Elementary Smiths' Work.

By C. W. Fraser.

(*Continued from page* 376.)

PARTING tools are about the hardest to do up single handed. The shape is shown (much exaggerated) at C, Fig. 9 (p. 376), and the method of drawing out at Fig. 11. This gives a tool that will part off close up to a shoulder, and is very useful. Boring tools should be drawn out to suit the job in hand, and then have their ends bent round like D, Fig. 9, and be finished with a file.

To harden the above tools, heat the ends for about an inch up, and quickly dip about $\frac{5}{8}$ in. in clean cold water, and keep it there till cold. Withdraw it, and quickly brighten the end with a piece of emery paper wrapped round a piece of stick, and used after the manner of a file. The colour will then be seen to run up from the heated portion at the back. When the cutting edge turns to dark straw colour, plunge the tool into water, or, better still, into oil. In the majority of cases the tools will then be right for cutting iron, mild steel, etc.; but it should be remembered that tool steels vary so much in quality that no hard and fast rule can be laid down as to a colour suitable for all grades. Old square files make excellent tools, but the teeth should be ground completely away before drawing them out, or they will crack in the hardening. Cold chisels, such as flats, cross-cuts, and diamond points, are all comparatively easy to draw out; but in tempering the colour should be let run to a dark

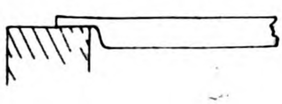


Fig. 11.

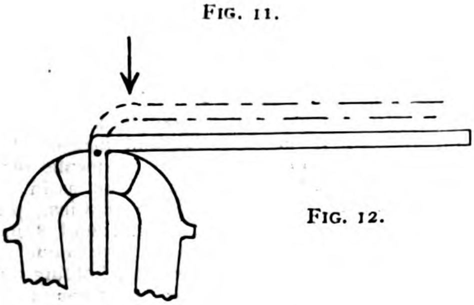


Fig. 12.

blue, or even lower, before quenching. As practice is gained, other tools, such as knife, recessing and back facing, may be attempted, and the hardening of taps, screwing dies, and twist drills gone into. Before leaving the subject of tools, it may be as well to state that it is not absolutely necessary to have a forge to heat them. Any other source of heat will do, from an ordinary house fire to a blowlamp. Of course, nothing over $\frac{5}{8}$ in. square should be attempted single-handed unless the worker is exceptionally strong in the arms.

If the foregoing instructions have been faithfully carried out, the reader should have become tolerably familiar with the forge, and may therefore turn his hand to other and more difficult work.

In Fig. 12 is shown the method of making a sharp right angle bend in bar iron. Put a deep centre dot in the edge of the iron exactly where the bend is required, and heat to a bright red at this spot, taking care to keep the heated part as short as possible. Place it quickly in the vice with the dot exactly level with the jaws (see Fig. 12), and pull down smartly. The result will probably be like the dotted line shown in the figure, and it must be

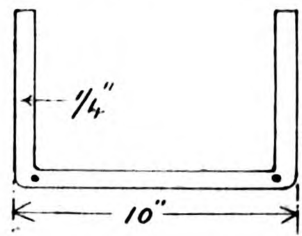


Fig. 13.

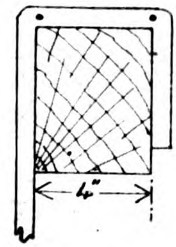


Fig. 14.

hammered down in the direction shown by the arrow till it is close down to the vice jaw, and as shown by the solid lines. It can then be taken out and tested for being square. Any old square is good enough for this work, so long as it is true, as the heat would soon spoil a good one. When true, the ends can be cut off to the desired length with a chisel or hack saw.

At Fig. 13 is shown a double bracket made from iron 1 in. by $\frac{1}{4}$ in., and it is introduced as an object-lesson in bending. The corners are bent as in the previous example, and it is important to remember that the centre pops are only $9\frac{1}{2}$ ins. apart on the metal, the double thickness of which equals $\frac{1}{2}$ in., thus making the bracket 10 ins. outside. These remarks apply to any work having a double bend, and requiring to be accurate *outside.*

In work requiring to be accurate on the inside the thickness of the metal may be neglected, and the centre dots made the required distance apart. This is clearly shown at Fig. 14, which shows part of a bracket made to embrace a 4-in. wide beam. Numerous things may be bent up from flat bar iron in the manner shown, such as hangers for light shafting bearings, special shelf brackets, light cramps, etc.

We now pass on to pipe clips, two of the commonest forms of which are shown to the right in Fig. 15. The one shown at A is a single clip for 2-in. diameter pipe, and the one at B is a double clip with square bend, and for the same size pipe. They are both made from iron $1\frac{1}{2}$ ins. by $\frac{1}{4}$ in., and the method of bending is shown at C and D. The vice jaws are opened to the diameter of the pipe plus twice the thickness of the iron used and also $\frac{1}{8}$ in. for clearance. A piece of iron having been heated to a white heat is laid across the vice, as shown at C, and on top, as shown, is held (in the left hand) a piece of iron the same size as the pipe. This is driven down with a heavy hand hammer in the direction indicated by the arrow, and the result is shown by the dotted lines at D. The round corners are then hammered down, as shown by the solid lines, and except for cutting the ends off the clip is finished. The clip B is made in the same way, but the iron is only driven down a little *less* than half its diameter. This gives a small space between the two halves of the finished clip which allows it

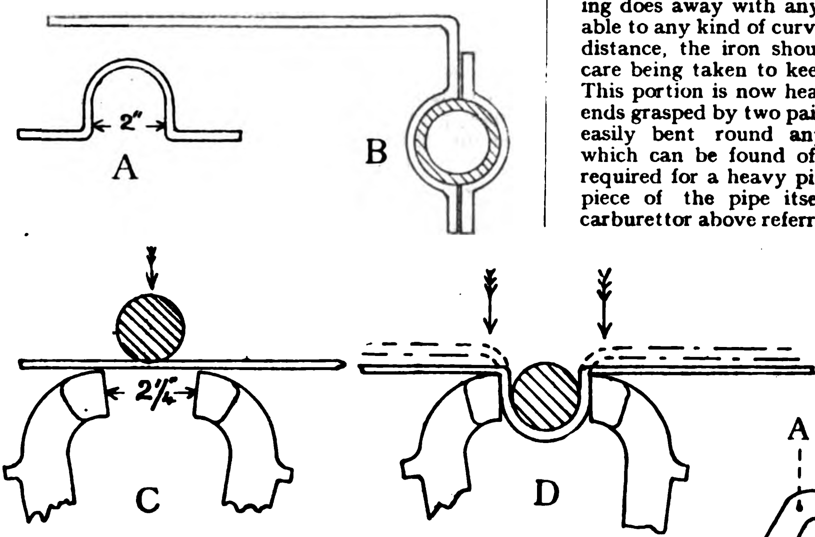
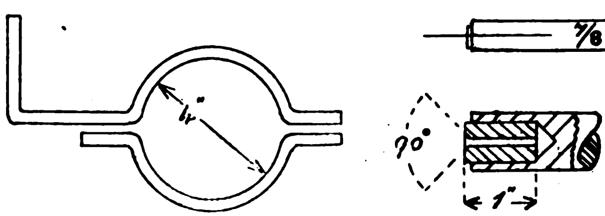


FIG. 15.

to grip the pipe tightly when the bolts are screwed up, and is usually called the " draught " of the clip. The bend in the larger half presents no difficulty. Clips may be made in strip copper or brass by the above method, but the metal must be well annealed.



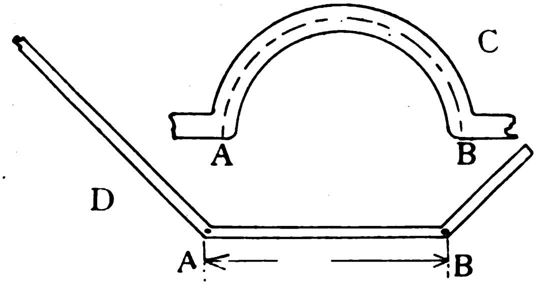


FIG. 16.

This method of making clips is applicable to small sizes only, say from ¼ in. to 2 in. For large clips the following is the correct method of bending. At Fig. 16 is shown a clip made from iron 1 in. by ⅜ in., and to hold a carburettor float chamber, 4 ins. diameter. Two stages in the making of this clip are shown at C and D, Fig. 16. First set out one half of the clip on a piece of board, full size, and measure the distance A B with a piece of thin string, being very careful to run it round the exact centre of the thickness of the metal as shown by the dotted line in the enlarged view C. This method of measuring does away with any calculations, and is applicable to any kind of curved work. Having found the distance, the iron should be bent as shown at D, care being taken to keep the distance A B correct. This portion is now heated to a good heat, and the ends grasped by two pairs of tongs. The clip is then easily bent round any convenient metal object which can be found of the required diameter. If required for a heavy pipe, etc., it can be bent on a piece of the pipe itself, but in the case of the carburettor above referred to it could not, and an old 4-in. pulley was used to pull round on. The writer has used this method of making clips of from 3 ins. to 48 ins. diameter.

Fig. 17 shows a crank bent from ⅞ in. diameter

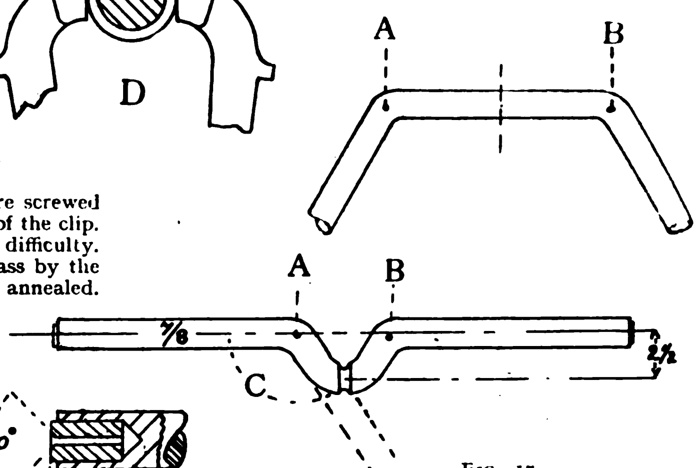


FIG. 17.

iron, and suitable for a small foot lathe, etc. In making this, set it out full size, and measure the distance between points A and B by means of a piece of string run round the centre line, as in the previous example. Assuming it to be 8 ins., put two centre dots in a piece of ⅞ in. round, 8 ins. apart. Take a very short heat (about two diameters of the iron) at the required spot, and holding one end in the vice, gently pull the other round till it is about the angle shown at C. Do not snatch or hurry it, but pull slowly but firmly, and the result should be a nice clean bend. The other corner is, of course, done in the same manner. A final short heat is taken exactly in the centre, and the crank completed by bending over the horn of the anvil. If it is not quite straight the whole of the cranked part should be heated and laid along the anvil or an old lathe bed, and the ends tapped down gently till it is level and straight. A groove should be filed round for the pitman rod to work in, and the ends should be bushed with cast steel for centres, as shown in the sectional detail view. Large foot lathe double throw cranks are bent over a block, and do not come within the range of single-handed work. Single and double throw engine cranks may be made, however, and at Fig. 18 is shown a two-throw crank marked out on a piece of mild steel bar of sufficient size to make it, and allow for machining. Holes are drilled in all the corners, and all surplus metal is cut away with a hacksaw. The crank is then heated at the spot shown by the dotted lines, and twisted to 90° or 180° as required. It is then turned and finished. Small ones are easily twisted with a pair of tongs, and large ones by a special twisting wrench shown at Fig. 18. It is made from ¾-in. diameter iron, bent to suit the job. Two throw cranks are forged in regular smiths' shops, and not cut out, but to make sure of the practicability of this method for cranks of

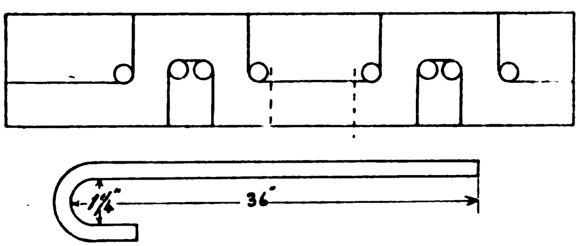


FIG. 18.

moderate size, the writer recently made one by this method from a piece of mild steel bar 16 ins. by 4½ ins. by 1¼ ins. It was a success.

(To be continued.)

A FEED-WATER purifying dome for locomotive boilers is in experimental use on some freight locomotives of the 4—8—0 class on the Norfolk and Western Railroad in America. The dome is set near the front end of the barrel, and is 17 ins. diameter, with a height of 18 ins. Within it are horizontal trays or baffle-plates, which collect a large proportion of the impurities in the water. Beneath the dome the boiler shell is pierced with sixty-one holes 1 in. in diameter, and the water falls upon a deflector within the barrel. This serves to distribute the water in a finely divided state over the surface of the hot water.—*Mechanical World.*

AN AUTOMOBILE QUICK-FIRING BATTERY.—The equipment of the French military authorities engaged in quelling the local disturbances in Morocco says the *Auto Motor Journal*, were augmented by an automobile battery consisting of a couple of Hotchkiss guns, each capable of firing 600 rounds a minute, so mounted on a 40 h.-p. Panhard chassis that one "covers" the area in front of the car while the other can be brought to bear on any object within the horizon. The crew consisted of Capt. Genty, the designer, who drove the car, a mechanic, and two artillerymen, while provision was made for carrying a supply of 3,500 cartridges. In "marching" order the car weighs under 25 cwts., and the wheels are fitted with detachable rims.

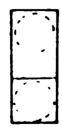
Model Railways.

XIX.—Eastlake Park Scenic Railway, Los Angeles, California.

By ARTHUR W. LINE.

THE miniature railway here described has probably more picturesque and pleasing surroundings than any other railway of its kind, being located in the most popular of the beautiful parks for which Los Angeles is so famous.

Starting at Lakeside Station, convenient to the main entrance to the park, the track runs across an arm of the lake on a steel and concrete trestle (Fig. 4), and dives into a plantation of waving Pampas plumes. Then curving, it runs parallel and close to the park boundary, and the main line of the Southern Pacific Railroad, thence along an embankment, and across a driveway bordered with stately fan palms. Winding through miniature forests of semi-tropical shrubs and trees and skirting wooded hills, Hillside Station is reached. Here are the park animal houses, and near by are the conservatories. Here also are the shops of the railway, and a double track where the locomotive is switched around to the other end of the train for the return trip.



Hillside Station is, of course, provided with water and oil tanks, engine and train sheds, and sidings. Lakeside station also has a double track for the locomotive, and a Pagoda ticket office.

On Sundays and holidays, the train is crowded and numbers gather round the station, watching with deep interest the operations of coupling, switching, oiling, etc.

The entire railway was designed by and built under the direction of Mr. John J. Coit, formerly an engineer on the Southern Pacific. The route length is 3,229 ft. or about five-eighths of a mile,

FIG. 1.

making one and one-fourth miles for the round trip. For this ride adults are charged ten cents and children five cents, the tickets being in rolls and coloured red and green respectively (Fig. 1).

The gauge is 18 ins. and there are five switches. The rails are of the T or Vignoles section, weigh 8 lbs. to the yard, and are 30 ft. long. They are ¾ in. wide on the tread and 1⅛ in. deep. All wheels have a tread width of 1¾ ins. and the flanges are ½ in. deep. There are 200 ft. of shop, double and side tracks, making a total trackage of 3,429 ft.

The rails are bolted together with four-hole fishplates, and are spiked down to wood cross-ties or sleepers, which are laid in gravel ballast. The spikes are 5-16ths in. square and 2½ ins. long, and of the regulation pattern. Over seventeen hundred ties were used, at a cost of ten cents each. They are 3 ins. deep, 6 ins. wide, and 30 ins. long, of Oregon pine, untreated, and laid on 2 ft. centres.

bearing on the rails at all times. Greater comfort also is secured to the passengers, and less wear and tear results to cars and track. The cars are equipped with Coit's miniature M.C.B. automatic couplers, weighing complete about 1,500 lbs. and costing $105 each.

Fig. 3.—Returning to Lakeside Station, Driving at Full Speed. (*Note the crossing sign post.*)

For the sake of distinction the principal dimensions of the locomotive will be classified under separate headings. A very good idea of the proportions of the locomotive may be obtained from the photographs here reproduced.

General Specifications of Locomotive.

The locomotive is of the 2—6—0 type, having an eight-wheel tender. Its total length is 19 ft., height 52 ins., and width 36 ins. Its total weight is 8,434 lbs. and Mr. Coit claims it can start a weight of 400,000 lbs. on the level. Its cost was $3,500.

Engine.

The engine proper is of the single two-cylinder type, and with the running gear was built by Johnson Machine Works of Los Angeles.

Cylinders: 5 ins. diameter, 7 ins. stroke.
Steam ports: 5 ins. by ⅜ in.
Exhaust ports: 5 ins. by 1¼ ins.
Valve gear: Coit's external motion.

The sharpest curve is of 54 ft. radius, and the heaviest grade is 7 per cent. for 30 ft. The elevation of Hillside Station is 17 ft. 9 ins. above that of Lakeside.

The equipment of the road consists of one "Mogul," or 2—6—0 locomotive, and three passenger cars. The chief interest will, of course, centre in the locomotive, but a brief description of the cars will be given in passing.

The cars are 14 ft. long, 42 ins. high, and 38 ins. wide, seating ten passengers. The trucks are four-wheel diamond frame of the usual pattern, with two helical springs at each side, and having a wheel-base of 19½ ins. They weigh 375 lbs. each and cost $75 per pair. The wheels are 9 ins. diameter with cast-iron centres and steel tyres. Mild steel axles are used with bronze journals 3-ins. long and 1½ ins. diameter. The use of steel tyres avoids the possibility of broken flanges and the resulting derailment, which, at the speed the train is run, would lead to a serious accident. Another good feature is the springing of the trucks, which gives greater safety owing to all the wheels

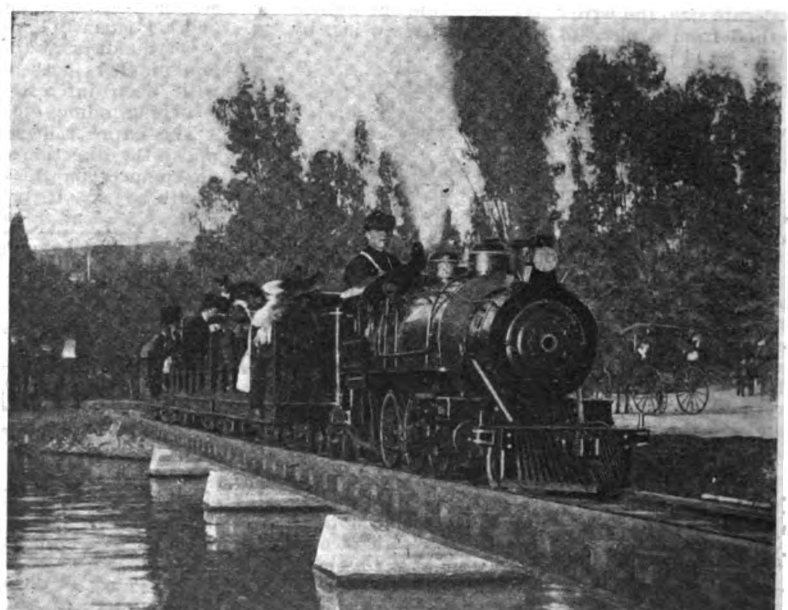


Fig. 4.—Train crossing Concrete and Steel Trestle Bridge.

Piston packing: 2 rings with water groove between.
Piston rings: ¾ in. by ⅛ in.
Piston rod: 1 in. diameter.
Guides: Upper, 2½ ins. by ⅜ in.; lower, 2 ins. by ⅜ in.

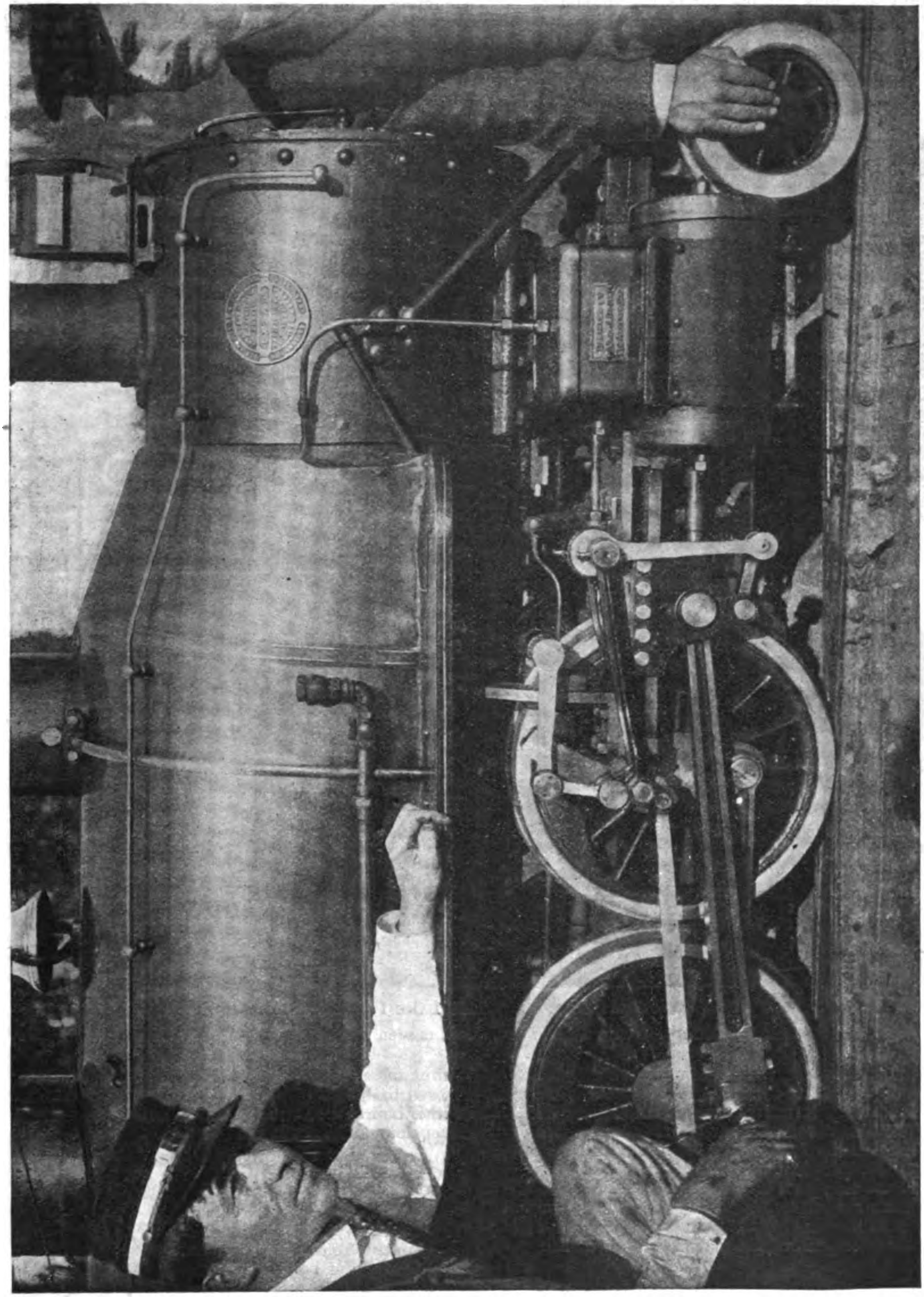


Fig. 2.—View of Miniature Locomotive, showing Outside Valve Gear. Mr. John J. Coit is seen on the left.

EASTLAKE PARK SCENIC RAILWAY, LOS ANGELES, CALIFORNIA, U.S.A.

Crosshead shoes: Bronze, 7 ins. long.
Main crank pins: 1¾ ins. by 1¾ ins. diameter.
Main crank brasses: Strapped bronze.
Side rod pins: 1⅞ ins. by 1½ ins. diameter.
Side rod brasses: Bushed bronze.
H.-P. of cylinders: 24·73 at 150 lbs. and 42 revolutions.

Angeles. No photograph of this was obtainable. Its steaming qualities are excellent, and by the use of suitable compounds, which are placed in the tenders, the formation of scale is prevented. Steam at 160 lbs. has been raised from cold water in 35 minutes, but one hour is the usual time without forcing the boiler. When shutting down the fire, the oil burner

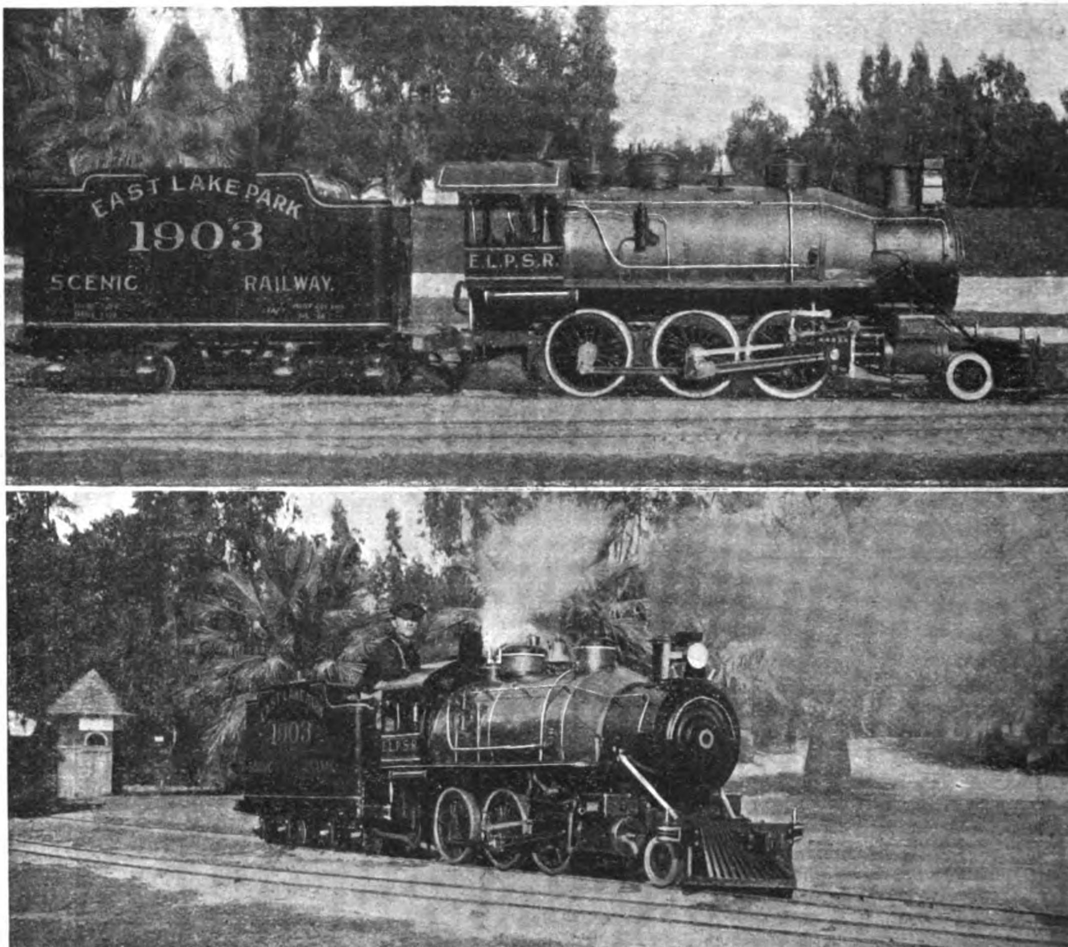


FIG. 5.—TWO VIEWS OF THE MINIATURE LOCOMOTIVE, EASTLAKE PARK SCENIC RAILWAY, LOS ANGELES.
(In the lower picture, Mr. John J. Coit is seen at the throttle.)

The most noteworthy point in the engine is the valve gear. This is a modification by Mr. Coit of certain existing forms, and in common with all similar gears has the advantage of less friction and less liability to overheating, which is a distinct gain over the Stephenson link motion. In this valve gear the only part making a complete revolution is where the valve connecting-rod is attached to driving axle. The photograph of valve and driving gear clearly shows the general arrangements.

Boiler.

The boiler is of the cylindrical firebox type, and was made by the Pacific Coast Boiler Works, Los is shut off and a small wood fire is built which is allowed to die out. This prevents too rapid cooling of the boiler, with its resultant evils. The chief dimensions and details are:—

Type: Steel cylindrical firebox.
Pressure: 160 lbs.
Material: 5-16ths in. and ⅜ in. steel.
Weight (empty): 1,400 lbs.
Length over all: 7 ft, 7 ins.
Length of barrel: 6 ft. 2 ins.
Diameter of barrel: 27 ins.
Centre above rails: 30 ins.
Flues and material: 70, of copper tube.

Flue dimensions: Length, 38½ ins.; diam., 1½ ins.
Firebox: Length, 32 ins.; diameter, 18 ins.
Heating surface: Tubes, 88 sq. ft.; firebox, 16 sq. ft.: total, 104 sq. ft.
Smokebox: Length, 19 ins.; diameter, 22 ins.
Fuel: Californian asphaltum base crude oil.
Burner: Coit's self-starting, steam atomising.
Smokestack: Height, 9¾ ins., diam. inside, 5 ins.
Lagging: Asbestos ¾ in. and Russian Iron.

Running Gear:
Frames: Steel forged and bolted.
Wheels, driving: 18 ins. diameter.
Wheels, pony truck: 9 ins. diameter.
Wheels material: Cast-iron centres, steel tyres.
Truck: Pony, with swing bolster.
Weight on driving wheels: 4,200 lbs.
Weight on truck wheels: 934 lbs.
Brakes: Straight air and steam on drivers.
Driving axle boxes: Underhung with cellar and spring-hanger in one casting.
Driving journals: 3 ins. by 2 ins. diameter.
Truck journals, 3 ins. by 1½ ins. diameter.
Wheelbases: Pony to front driver, 36 ins.; front to centre driver, 19 ins.; centre to rear driver, 22 ins.; total, 77 ins.

The running gear is remarkably flexible, responding readily to both vertical and lateral movements. The writer has ridden many miles with the locomotive in forward and back motion and observed the action of the swing bolster pony truck on curves, also the wonderfully easy riding. It is an object-lesson of the American system of springing locomotives. The axle boxes are equalised throughout, and the locomotive has that easy rolling motion when running which is characteristic of American locomotives.

Tender.
Length over all: 7 ft. 10 ins.
Width: 34 ins., height, 42 ins.
Capacity (water): 206 U.S. gallons.
Capacity (oil): 85 U.S. gallons.
Weight in working order: 3,300 lbs.
Truck centres: 5 ft. 10 ins.
Trucks: Four-wheel, plate frames.
Wheels: Cast-iron centres, steel tyres.
Wheels: Diameter, 9 ins.
Wheelbase: Trucks, 19 ins.; total wheelbase, 7 ft. 5 ins.
Journals: Bronze, 3 ins. by 1½ ins. diameter.
Brakes: Straight air, inside hung.

The tender is of the heavy type, used for modern large locomotives, and is provided with a cushioned seat in front, where the engineer rides. It is very massive in appearance and takes curves and rides easily, being well sprung.

Miscellaneous Equipment.
Air pump: stroke, 4 ins.
Air pump cylinders diameter: Steam, 4 ins., air 4½ ins.
Injectors: 2–"No. 1 U.S." Detroit Lubricator Company.
Steam gauge: Reading to 200 lbs.
Air gauge: Reading to 200 lbs.
Water gauge: "St. Louis Reliable."
Sandbox: Air blast.
Bell: Bronze, hand rung.
Whistle: Steam, 3 chime.
Headlight: Acetylene gas.
Safety valves: 2 "Lukenheimer," ¾ in.
Timepiece: Eight-day "Ansonia" clock.
Lubricators: Sight feed, Lukenheimer "O O."
Pilot: Wood, braced, vertical bar.
Couplers: Coit's miniature M.C.B. automatic.

The equipments of this locomotive are the best obtainable and their harmonious operation has justified this policy. The action of the automatic couplings is perfect, and the operations of coupling and switching always attract attention. The use of the whistle and bell is very important in the operation of the railway, as the train runs close to and across several driveways, and a collision would be disastrous to anyone struck. The writer was a passenger when an emergency stop was made, and, while very effective, it was a trifle too sudden to be comfortable—and dignified. Regular whistle signals are used as on a full size railroad. For instance, on approaching a road crossing at grade the regular "crossing" signal of two long and two short blasts of the whistle is given thus —— —— – – When approaching a station the one long blast of five seconds duration is given, and in case of danger ahead the "call for brakes" signal is blown, a continuation of short sharp blasts — — — — — —. The proper places for blowing the two first named signals are indicated to the engineer by regular signal boards in miniature. These boards are 4 ft. long, 6 ins. wide, and 1 in. thick, painted white and set upright on the right-hand side of the track. They are lettered WX for crossing signals and WS for station signals. At the crossings signs of the type shown in Fig. 3 are used, bearing the words "Railroad Crossing—Look out for the cars." These signs are set up to face vehicular traffic in both directions, and are visible from some distance away. The bell is used shortly before and during starting, during switching operations, also sometimes when crossing roads and when moving near people on the track.

The writer received at all times the most courteous treatment from Mr. Coit and his associates, and was afforded every facility for obtaining photographs and material for this article. Free transportation was cheerfully given and many pleasureable hours were spent on and about the train.

Our Readers' Work Competition.

TO encourage readers to send us accounts of their work, we offer to send any tool, book, or other desired article supplied by any of our advertisers, to the value of 6s. 6d., to any reader who sends us for insertion in THE MODEL ENGINEER a sufficiently good photograph and description of any model, tool, mechanical or electrical apparatus that he has made, and which has not been already illustrated in our pages. Entries should be accompanied by a separate letter giving the title of the article, and stating exactly what is required as a prize in the event of acceptance. When tools or apparatus are desired, the page and number of article in the firm's catalogue from which it can be obtained should be stated, if possible. It is understood, of course, that we do not promise to accept everything that is sent in, and examples of work submitted must show some degree of orginality or usefulness. Ordinary every-day tools or models merely made up from purchased castings are not required. The article should be written *on one side of the paper only*, with the name and address of the sender on the back. The photographs and separate sketches enclosed with the contribution should similarly bear the name and address of the sender, otherwise delay may arise in the awarding of the prizes. It is essential in this, as in our other competitions, that the copyright of the photographs must be the property of the senders, and the covering letter should contain a declaration to this effect. The competition will close on June 30th, 1908.

The Design and Construction of Ball Bearings.

By "Zodiac."

(Continued from page 370.)

BALL cages or retainers do not introduce any appreciable amount of friction, but they certainly introduce quite as much friction as that due to the balls rubbing, which friction they are sometimes claimed to eliminate. They are a great convenience, as tending to assist quick handling in taking apart and assembling the bearing. As stated, the rubbing friction due to the balls touching is very small; indeed, it is very questionable whether the balls do actually touch when under load.

In Fig. 22 a small ball is introduced between each large ball, so as to eliminate the imaginary rubbing of the balls. Apart from the trouble in assembling such a bearing as shown in Fig. 22, the design is faulty, as in practice the smaller balls wedge up to the outer or the inner ring, where they introduce considerable friction; they are also very liable to be rapidly cut and destroyed. The design is therefore valueless.

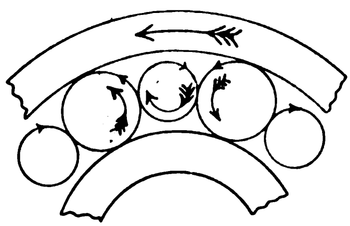


Fig. 22.—Idea to Eliminate Rubbing of Balls.

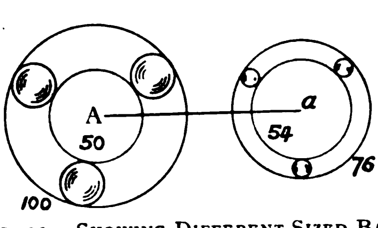


Fig. 23.—Showing Different Sized Ball Bearings Coupled Together.

Figs. 23 and 24 are intended to correct a mistaken idea that many have, not only as regards ball bearings, but also internally toothed gears, epicyclic trains, etc. If perfect rolling motion, *i.e.*, no slipping, takes place, then the ball bearing may be treated as a toothed gear with teeth equal to the circumference of cones and cups. Now if two different sized bearings, such as A and *a* (Fig. 23) be mounted on the same shaft or in the same hub, they wrongly claim that the conditions are as represented in Fig. 24. If shaft A turns one revolution, wheel B having fifty teeth drives wheel D having 100 teeth one half revolution, while wheel F drives wheel E 54-76ths of a revolution, thus twisting or breaking shaft C.

But Fig. 24, if it is to correctly represent Fig. 23, should have shaft C and wheels D and E drawn as shown, dotted. When A makes one revolution, the B D balls will travel round half a revolution, and the F E balls 54-76ths of a revolution, internal

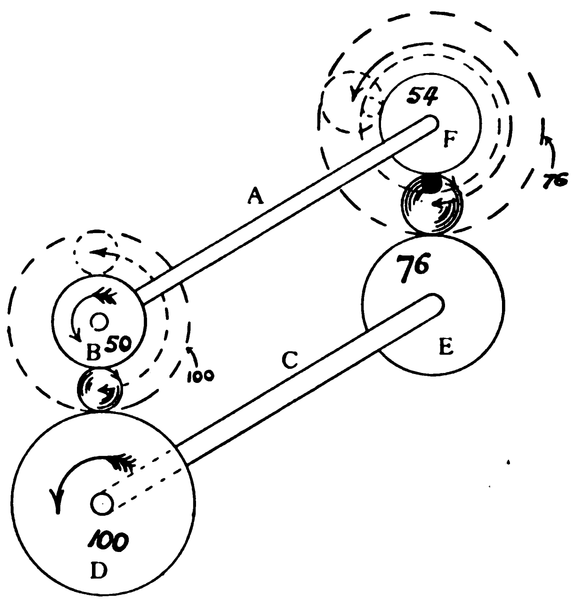


Fig. 24.—Showing Travel of Balls in Different Sized Ball Races.

toothed wheels D and E being held still. If the ball bearings (Fig. 23) are combined, the speed of the balls is unequal, that is all; no slipping is introduced whatever. The problem is not unlike that of the carriage wheel; as is well known, the top of the wheel travels twice as fast as the carriage is travelling, provided, of course, that the wheel does not skid, or slide.

The theory of the ball bearing having now been fairly well threshed out, the rules for design may be summed up as follows:—

(1) In a "radial" bearing the axis of rotation of the ball should be parallel with the shaft axis.
(2) In the "thrust" or "axial" bearing the ball rotation axis should be at right angles to the shaft.
(3) The two bearings cannot be perfectly combined unless separate sets of balls are used for "axial" and "radial" pressure respectively.
(4) The shape of the ball races should be such that practically only rolling motion takes place, sliding being absent.
(5) If either V-shaped or three-point bearings

are used, the angles of the races should be such that the balls do not wedge. (See Fig. 16.)

(6) Thrust bearings should have spherical seatings, so as to evenly distribute the load on the balls.

At high speeds additional conditions have to be provided for; the centrifugal force of the balls, especially with thrust bearings, is apt to cause them to cut through the ball cages in their efforts to fly outwards; and, further, the balls are very apt to be noisy, even if a heavy lubricant is used. The ordinary cycle type of ball bearing is exceedingly noisy, even at 300 or 400 revolutions, the cause of this being somewhat explained by Figs. 25 and 26.

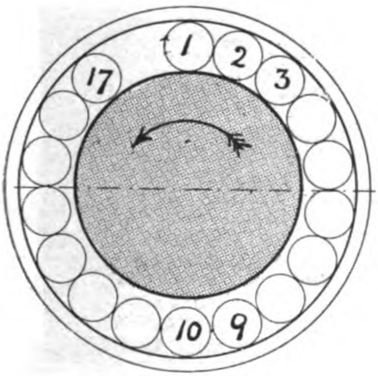


Fig. 25.—Bearing with Top Balls under Load.

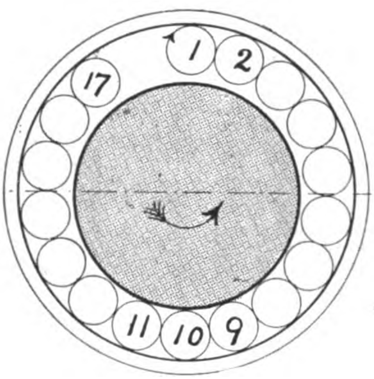


Fig. 26.—Bearing with Bottom Balls under Load.

In Fig. 25 the upper balls (1, 2, and 3) are under load, the lower balls (10, 9, etc.) being without load. As the balls are released from their load they are flung out with considerable force, so that for instance, ball 1 (Fig. 25) will be presently flung against ball 17, and then ball 2 in its turn against ball 1. At high speeds this naturally gives rise to considerable noise, which even the cushioning action of a heavy lubricant will only partially reduce.

In Fig. 26 balls 11, 10, and 9 are under load, and ball 9 will shortly be flung out; but it will have to push along balls 1 to 8, the retarding or cushioning effect of which is considerable, as, of course, they cannot have their velocity increased without the expenditure of considerable kinetic energy on the part of ball 9. Hence the impact of ball 1 with 17 is now much less, and the bearing (Fig. 26) runs much quieter than Fig. 25.

In one successful type of high-speed bearing the balls have little springs and circular plates introduced between each ball, the plates thus pressing the balls gently apart and travelling round the race with them. These bearings were very free from noise, even at speeds of 1,200 to 1,500 r.p.m., and ran very well. The fault they had was that the springs were liable to break, especially with a pulsating driving effort, and, of course, a broken spring quickly ruined the ball race, unless promptly removed.

The improved design is shown in Fig. 27; the balls run in circular grooves turned out to a radius three-quarters of the ball's diameter, *i.e.*, 50 per cent. greater than the radius of the ball. The number of balls used is one half the number required to completely fill the ball race, so that when the cage is removed, the balls run to the bottom of the race, thus allowing the inner race-ring to be removed and replaced.

A glance at Fig. 26 will show that, even with grooved ball races, the inner ring could be readily removed if only balls 6 to 14 were used. The balls (Fig. 27) are spaced apart by the ball retainer or ball cage, which consists of two rings, one on each side of the ball race, these rings being riveted together. The cage is shown partly in section, and it will be noticed that the ball practically fits the cage, but is perfectly free to revolve in its caging. The balls are thus prevented from being flung against one another, and the bearing runs smoothly and silently, even at speeds as high as 1,800 revolutions per minute. If more than one of these bearings is placed on the same shaft, the outer rings should be allowed approximately 0·25 mm. clearance on either side, so as to ensure the ball races being central about the line X X (Fig. 27). In spite of maker's statement to the contrary, this bearing is purely an axial bearing, and not suitable for end thrust. The inner and outer rings should be a *free fit* on the axle and hub, there being no shake or play. In the case of a dynamo or motor, in which the inner shaft revolves, the inner ring should be a tight fit on the dynamo shaft.

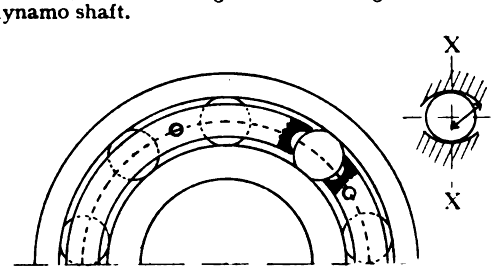


Fig. 27.—"Radial" Bearing with Ball Cage.

With high-speed ball bearings it appears desirable to reduce the load almost in proportion to the rise in speed above 200 r.p.m. A leading Continental maker gives the working load as 35 per cent. of the values given earlier in this article, viz.:—

⅛-in. ball, working load 44 lbs.
¼-in. " " " 175 "
⅜-in. " " " 395 "
½-in. " " " 705 "

Further, for the three-point bearing, such as Fig. 11, he advises reducing the load to one-fifth of the above figures, so that the ½-in. ball would then have a working load of only 141 lbs.

The writer has always found the values given by the Coventry people, and tabulated earlier in the article, to be quite reliable, at any rate up to 200 revolutions.

The ball bearing is less affected by dirt than the ordinary bearing, as the balls appear to have a tendency to clear the dirt from the ball path. Owing to the high pressure between balls and races, it is advisable to use a heavy lubricant that will not easily be squeezed cut, and thus allow the metal surfaces to actually touch. The writer uses heavy cylinder oil on his cycles with excellent results, it also having the great advantage of keeping dirt out better than the thin oil usually used for cycles. The thick oil appears to slow wheels and pedals when spun round, but spinning a wheel round is quite different to its revolving under load. A few designs will complete this article.

(To be continued.)

Practical Letters from our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily for publication.]*

A Model Girder Bridge.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—The model of bridge of which I send photographs was constructed by a Scottish working lad, who is quite unskilled in this department in the world of labour. It is a reproduction in miniature, complete in every detail, of a type of girder bridge approved by the Indian Government for their State railways, and is the handiwork of Mr. Jack T. Walker, of Motherwell, Scotland.

Bridge-building is one of the town's chief industries. To make his representation more realistic, he has added a set of rails, but it will be more readily understood what work is really in the model when the following particulars are mentioned, as taken from the explanatory card beside the model:—"Scale, ½ in. equals 1 ft.; main girders, 2 ft. by 3½ ins., eight cross-girders 6 ins. long by 1½ ins. high, fitted with buckle-plate flooring. Containing 49 ft. angle, 15 ft. T, 32 ft. plate, 8 ft. brass rod, twelve castings, 8¼ balls, 5,616 holes, 1,500 rivets, 236 bolts, nuts, and washers, 107 ft. 4⅝ ins. of brass used. 353 model parts; total number of parts, 2,561."

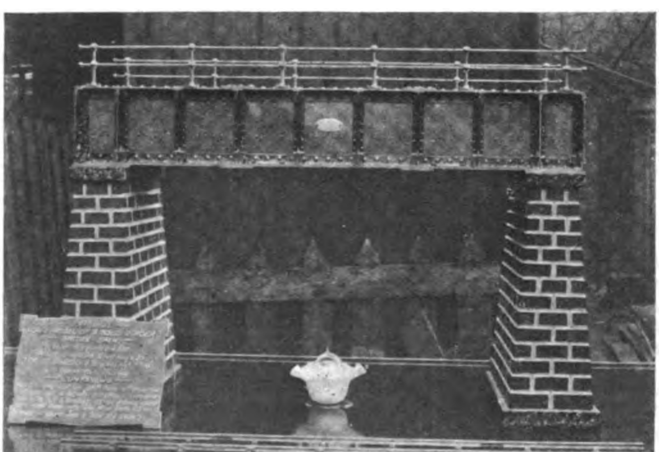


FIG. 1.—½-IN. SCALE MODEL OF GIRDER BRIDGE.

All the necessary tools—the press for curving the floorplates, riveting tools, lathe, punching and boring machines, etc.—were also of his own manufacture. The bridge, too, was erected according to ordinary workshop practice. Drawings and specifications were first prepared by Mr. Walker, and the structure gradually took shape, as do mighty girders in our bridge-works. It occupied 2½ years' spare time during construction, and this, combined with the other interesting facts mentioned, made it one of the chief attractions at a large local exhibition held recently.—Yours truly,

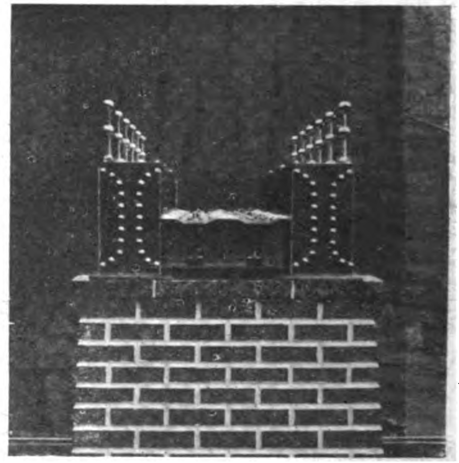


FIG. 2.—END VIEW OF BRIDGE.

JAMES A. KING.

Motherwell, N.B.

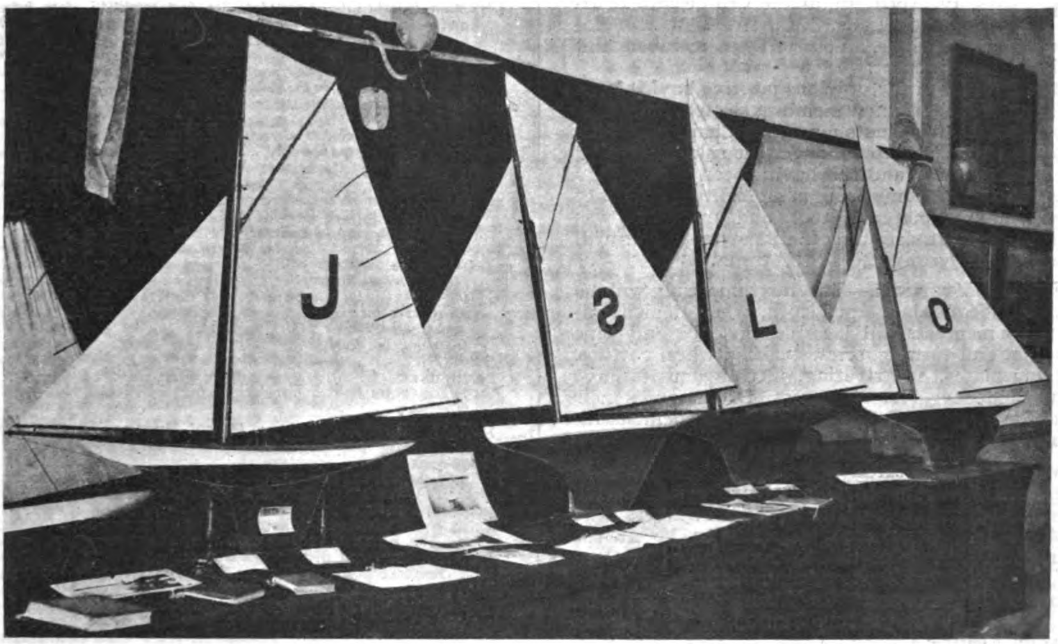
Model Yachting in Belgium.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—The accompanying photographs of the stand of the "Modèle Yacht Club," Antwerp, at the International Motor Boat Exhibition, will, I hope, interest our English friends and show how the sport of model yachting is progressing in this country.

The models T and V have had the greatest success at the Show. They are carvel-built, the hull weighing about 4½ lbs., and have a displacement of 15 to 16 lbs. The length over all of V is 56 ins., and the length on the load water line is 38 ins. The boat T has about the same dimensions.

The letters in the mainsail—green for the 10-raters (T and V), red for the 3-raters (R, P, V, M, I, L, and X)—are used in the Modèle Yacht Club for distinguishing purposes when racing, instead of numbers. This system has proved very satisfactory.



TWO VIEWS OF THE ANTWERP MODEL YACHT CLUB'S STAND AT THE INTERNATIONAL MOTOR BOAT EXHIBITION.

All the models have been built under the rule—

$$\frac{\frac{LOA + LWL}{2} + G + \sqrt{SA}}{100} = R.$$

L.O.A. = Length over all.

L.W.L. = Length load water line.

G = B + P

B = greatest beam

P = Chain girth from L.W.L. to L.W.L., passing under the keel.

$\sqrt{S.A.}$ = Square root of actual sail area (the surface of the foc is only measured, not the fore-triangle).

Under this rule the classes are of 0–3, 3–6, 6–10, and 10–12 units. But last year the four Belgian clubs formed an association, and this winter in a meeting at Ghent a modification of the International Rule was adopted :—

$$\frac{L + B + \frac{1}{2}G + 3d + \frac{1}{3}\sqrt{SA}}{2}$$

L = Length of load water line (without bow-taxes).
B = Beam.
G = Greatest chain girth from deck to deck, passing under the keel (wherever its place may be).
d = Difference between the chain girth and skin girth at the place where the chain girth G has been taken.
$\frac{1}{3}\sqrt{S.A.}$ = One-third square root of actual sail area.

This year all the races will be given under this rule, and this could perhaps lead to an International race, where the presence of some English model yachts would be of the greatest interest.—Yours faithfully, O. DIRVEN.
Avenue Plantin 22, Antwerp. Member of the M.Y.C.A.

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

AN ordinary meeting of the Society was held on Tuesday, April 7th, at the Cripplegate Institute, Golden Lane, E.C., Mr. A. M. H. Solomon taking the chair, and about 100 members and visitors being present.

The minutes of the previous meeting having been read and signed, six new members elected, and other business announcements made, the Chairman called upon the Secretary to announce the rules governing the evening's sale, and this having been done a very large collection, comprising in all eighty-nine lots of model making material, tools and apparatus, was sold to the satisfaction of all parties concerned. The meeting terminated at 10.15 p.m.

FUTURE MEETINGS.—The next meeting will be held on Wednesday, April 29th, when demonstrations by members will be given in tube and pipe bending, ball turning, screw chasing, wheel cutting, flanging plates, and riveting. Arrangements have been made for one of Messrs. Drummond's new model makers' lathes to be on show and demonstrations of its capabilities given.

VISITS.—On Saturday afternoon, April 25th, a visit will be made to the Patent Section of the South Kensington Museum. Any members who wish to be present are requested to be at the entrance to the Museum in Exhibition Road at 3 p.m. No previous communication with the Secretary is necessary. On Wednesday, May 13th, at 7 p.m., the Generating Station of the City of London Electric Lighting Company will be visited.—HERBERT G. RIDDLE, Secretary, 37, Minard Road, Hither Green, S.E.

Provincial Societies.

Dublin and District.—There was a good attendance at the Dublin Society of Model Engineers' meeting on Wednesday evening, April 1st, when Mr. E. T. Henley read an instructive paper on "Model Steam Engines," in the course of which he strongly advocated the use of compound engines for models.

Liverpool and District Electrical Association.

A MOST interesting meeting of the above association was held at the Common Hall, Hackins Hey, on Tuesday evening, April 7th, when a discussion on "Electric Incandescent Lamps" was opened by Mr. J. Maxwell.

The merits of the respective lamps were gone into in detail, and the point as to what effect the new metallic filament lamps are likely to have upon central stations was fully entered into, some of the members being of opinion that the effect would be a detrimental one, resulting in a decrease in the current consumption, which would not be fully compensated for by the additional consumers likely to be obtained; whilst others were of the opinion that the decreased current consumption would be fully met by increased business. The meeting was brought to a close with the usual vote of thanks.—S. FRITH, Hon. Secretary, 77, St. John's Road, Bootle, Liverpool.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[19,491] **Dynamo Query; Petrol Engine.** J. P. (Perth) writes: Would you kindly answer me the following queries? I have a cogged ring armature 3½ ins. diameter 1 in. long, wound in thirty-six sections and connected to a thirty-six-section commutator. It is professionally made, and was taken from an electric phonograph motor, the field-magnets of which are wound with No. 23 D.C.C. wire. I think the wire on armature is of the same gauge. What kind of field-magnets would you recommend for the above armature, and what gauge wire and what weight? Would a Manchester type, as Fig. 13 in your Handbook No. 10, suit? What diameter should the wrought-iron field-magnets be? What would be the output in volts and amperes, and at what speed? as I intend to use it for charging and lighting. What horse-power would be required to drive same? I have a water-cooled 1¼-in. bore cylinder. What length stroke and what size inlet and exhaust, and what length connecting-rod would you recommend for high speed? What would be the horse-power of above with one cylinder and with two cylinders, also, what size dynamos would either drive, direct-coupled?

You can use your armature with Manchester type fields, as described in Handbook No. 10. Make the field-magnets 1 in. diameter, and wind same with No. 24 S.W.G. wire, and get on as much as you can in the space. If you require a really good dynamo for charging work, we recommend you to make one exactly as described in handbook for Fig. 13, with the armature diameter equal to its length. *Re* petrol engine, the length of your cylinder will determine the length of the stroke. The inlet and exhaust valves should be equal to half the diameter of the cylinder, and should have a lift of one-quarter their diameter. The power of such an engine can only be determined by trial. You might possibly get a ¼ h.-p. out of it, assuming the stroke to be 1¾ ins. or 2 ins. A slight variation in the speed will make a great difference in the power developed.

[19,024] **Primary Cells.** F. C. W. (Chatham) writes: Thanks for your reply; but I am sorry I did not sufficiently explain the kind of cell I intended using. It is described in your Handbook, "Electric Batteries," as a good non-polarising bichromate battery of constant voltage (which is about 1·8 volts), and consists of outer cell containing saturated solution of bichromate of potash, with one-fifth part sulphuric acid, and an inner porous pot containing a saturated solution of sal-ammoniac, in which stands a piece of sheet zinc bent into cylinder shape, a small quantity of mercury being placed in the pot. A carbon slab, of course, stands in the outer jar in the bichromate solution, the space between carbon and inner pot being filled with small lumps of coke. It also says that it is perfectly constant and will do constant work without re-charging for about half a week; but what I wish to know is—supposing it lasts for say eighty hours right off, if used for only an hour each day, would it last out the eighty days, or run down in a much shorter time (anything worth considering)? If so, would it be on account of the sal-ammoniac gradually mingling into the bichromate solution; and, then, do you think a little glycerine or glycerine and plaster-of-Paris, as I suggested, would be of any use? I know that I should require about nine or ten cells; but, according to the list of Osram lamps, the 16-volt one does not take any more current than the 4-volt, and one of these will light from a little 6d. pocket lamp refill, so I thought that I could just as well make a large number of small cells as two or three ordinary size ones. If, however, the bichromate cells will not be suitable, I intend making Gravity Daniell cells. Could you recommend any other method of keeping the copper solution from the zinc than the sawdust and flannel arrangement, as this is inconvenient in adding fresh bluestone? I am going to try for myself with a little glycerine or something when I find time. If I keep the bluestone solution down by keeping the cells always in circuit, would such a little leakage be required as to be of no consequence as regards waste of zinc? I wish to be able to manage with the bichromate cells if feasible, as they give a strong current, because I shall require to light two or more lamps from them later on.

In further reply to your query to hand, we regret that we somewhat misunderstood your meaning, and we can only add that you might try the cells first of all, as described in the Handbook, and then, if not satisfactory, you could experiment with the glycerine, or other thickening material, as you suggest. We have, however, every confidence that if you follow the instructions given, the battery will give very satisfactory results. With regard to the Daniell cells which you propose using as an alternative if the others are not successful, a very small current indeed is all that is required to be kept flowing to prevent the two solutions mingling, so that the waste incurred in this direction is quite inappreciable. Reverting again to the bichromate, it cannot be definitely stated what your cell will do in the way of work and whether it will last out the specified time when being worked for about an hour every day. Some cells may exceed this figure, and other cells may possibly fall short, and the only way to arrive at a definite conclusion is to make an actual trial, which you can easily do.

[18,957] **Acetylene Gas for Engines.** J. V. L. (Radnorshire) writes: Is it possible to use acetylene gas for driving small model gas engines? The engine is to be 1-in. stroke, ¾-in. bore. Can you also state what power the engine would develop?

It is no doubt possible to run a small gas engine with acetylene, but no really satisfactory results are obtained in this way. The explosion of acetylene gas is so sudden and violent that any engine to work with same has to be specially constructed with a view to withstanding the enormous pressure suddenly generated. Furthermore, the regulation of the supply of air has to be carried out to such a nicety otherwise there is no end of trouble due to the formation of soot in the cylinder and valve chambers. Acetylene is sometimes used in conjunction with coal-gas, and a few notes on this subject are given in our handbook—"Acetylene Gas." Under certain conditions the practice may be successfully adopted, but for our own part we should prefer to leave acetylene gas alone where gas engines are concerned.

[19,342] **Electrical Engineering as a Profession.** J. B. (Preston) writes: Would you kindly answer me the following query. For the past eight months I have been studying electrical engineering, and I now feel that I should like to enter into the profession at some power-station, as I feel I could with confidence take up the duties of switchboard attendant. My present employment is that of a weaver, and I think that if I stop at my present employment instead of trying to enter the electrical profession, I shall never get on as I ought to do. Do you think I am too over-anxious? If not, would you kindly state the wages that a switchboard attendant is likely to receive, and could you also recommend some firm to which I might apply?

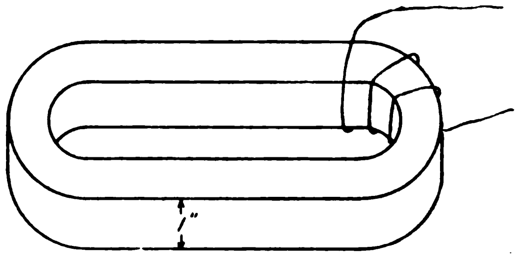
In reply to your enquiry, we do not think you will be well-advised to enter the electrical engineering profession unless you feel particularly well qualified to undertake the work and have, in fact, a natural aptitude for it. To obtain a wide experience involves a considerable outlay, because the wages that are usually paid for inexperienced hands in central stations, or, in fact, any electrical works, are totally inadequate to keep a man alive unless he has some other means to fall back upon. Switchboard attendants' wages range from 10s. to 25s. or 30s. a week, but no one is taken as a switchboard attendant unless he has had some previous experience in practical electrical work. We might also mention that the electrical engineering profession is already overcrowded.

[19,332] **Model Railway Curves.** J. T. (Aberdeen) writes: What is the smallest circle or curve for a locomotive, "Atlantic" type; wheelbase—bogie, 4 ins.; driving, 5 ins.; trailing, 4½ ins.; total, 16 ins.? The gauge of rails is 2½ ins. Also a six-coupled bogie locomotive, with wheelbase—bogie, 3½ ins.; driving, 7 ins.; total, 13 ins.; gauge, 2½ ins.?

Everything depends on the arrangements for sideplay in the bogie and trailing wheels. The curve should not be less than 16 to 18 ft. radius, and to obtain good results the larger the diameter of the circle the better. We recommend you to look up the article specially dealing with this sort of problem, in our issues of October 3rd and 10th, 1907.

[18,338] **Arc Lamp and Transformer for Working Cinematograph.** F. M. P. (Bedford) writes: Will you please answer the following queries? I have a hand-feed arc lamp which I want to use in a cinematograph. The current here is alternating 5 amps. 105 volts, 60 periods, and as I want about 8 amps., I suppose I must use a transformer and resistances. (1) Would you please give particulars of same, and state if transformer similar to the one on page 121, February 28th, 1903, would do? (2) Would you please state the size and quantities of wire for same? I should want transformer to work for two hours without getting too hot.

(1) For transformers use plain ring stampings of soft iron, such as are used for a dynamo armature. Outside diameter to be 7 ins., inside diameter to be 4½ ins., depth 1 in. Transformer can be like



SECONDARY WINDING FOR TRANSFORMER.

that in THE MODEL ENGINEER, if preferred. Section of core to be 1½ sq. ins., and winding as given here. Eight amperes seems very small for a cinematograph. Thirty amperes is not unusual with alternating current, which does not give so good a light as continuous current. Primary winding, 630 turns of No. 19 gauge D.C.C. copper wire; secondary winding, 240 turns of No. 14 gauge D.C.C. copper wire. Wind as shown in sketch above. Core must be well insulated, and primary from secondary. Wind primary on first and secondary on top of it. You must approximate the weight; the number of turns is the important thing, but a few turns more or less will not matter. A resistance will be necessary in series with the arc to steady it. (2) Try about 4 ozs. of No. 14 gauge Eureka resistance wire; put on more or less, according to effects obtained. Half a pound of No. 14 gauge German silver wire would do.

[19,382] **Steam Pump Proportions.** E. B. (Glasgow) writes: Would you kindly help me in the following? I intend making a model direct double-acting steam pump, having in my possession a steam cylinder—1½ ins. diameter, 1¾-in. stroke, and steam ports 5-16ths in. by ⅛ in. Would you kindly tell me the area of suction and delivery passages for pump. The barrel I intend to make ⅞ in. diameter, and also, if this diameter of barrel would be suitable? Steam pressure, 30 to 40 lbs.

The area of the passages should not be less than half that of the pump piston, and if the pump is to work against a pressure slightly higher than the pressure of the steam, we recommend that it be made not larger than 11-16ths in. diameter; ⅝ in. diameter would be better. The valves may be ½ in. or 9-16ths in., and the passages not less than ⅜ in. diameter for high-speed work. Make the valve seatings as recommended in the article in the issue of June 13th (1907) last.

[19,337] **Engine Steam Pipe; Dynamo Castings.** S. B. (Southampton) writes: Being a regular reader of THE MODEL ENGINEER, I should like to take the liberty of asking you a few questions. (1) What size steam pipe shall I need for an engine 1-in. bore and 1-in. stroke? (2) Where can I get a set of castings easy to construct. The above castings are for dynamo, with wire complete, and what tools shall I need for same?

(1) Use a steam pipe 3-16ths in. or ¼ in. diameter, and exhaust pipe ¼ in. or 5-16ths in., according to proposed speed of engine. (2) Your postscript is important. Obtain catalogues from our many advertisers supplying electrical goods. With regard to the tools required, we believe you can obtain machined sets. We recommend you our 1s. Handbook, "Practical Dynamo and Motor Construction." It would be impossible to deal with the various processes and the tools required within the scope of a reply to a query.

[19,059] **Gas Engine Early Firing.** A. S. C. (Repton) writes: I should be very much obliged if you could tell me the following—(1) Remedy for early firing in tube-ignited gas engine. (2) Would an ordinary sparking plug, coil, and accumulator be enough to fire a small gas engine? Gas is ordinary coal gas used for lighting purposes in Bristol.

The usual remedy for early firing in a tube ignition gas engine is to heat the tube further away from the combustion chamber—that is, nearer its top end. Other means can also be adopted, but these depend upon the conditions under which engine is running, and cannot be stated without knowing the full circumstances of the case or actually inspecting the engine. You will find some useful particulars for electric ignition for small gas engines in March 29th (1906) issue. You might also refer, with advantage, to Handbook, "Gas and Oil Engines," 7d. post free.

[19,400] **Force Pump.** C. M. P. (Dumbarton) writes: Having been a reader of your Magazine for the past eighteen months, or so, I would be glad if you would help me in the following. I had the parts of a pump (brass) given to me (Fig. 1), and would be

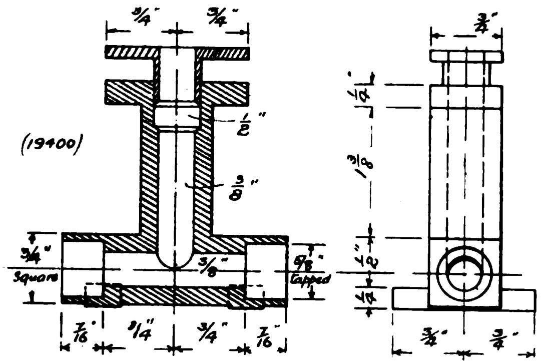


FIG. 1.—PUMP CASTING AS MACHINED.

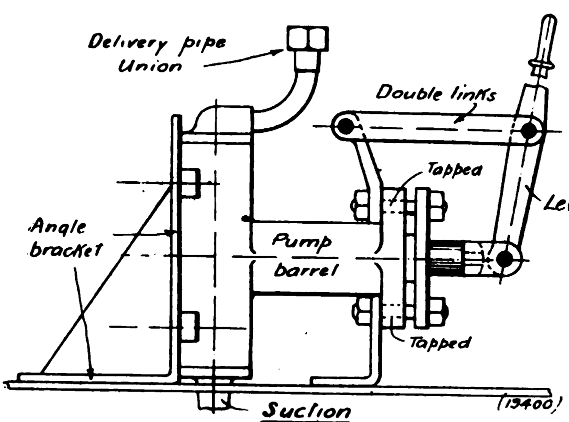


FIG. 2.—SUGGESTED GENERAL ARRANGEMENT OF PUMP.

glad if you could give me some kind of arrangement of suction and delivery valves. Will it need an air-vessel? I would like it for testing with. What pressure will it pump against?

The casting is hardly suitable for a vertical pump, and therefore we recommend that you use it as a horizontal lever pump, in the manner shown in Fig. 2 herewith. The casting would have done well for a vertical pump, if it had not been drilled. An air-vessel is not necessary, unless a steady flow of water is required. The valves (as will be seen from Fig. 3) are arranged with the type of seatings recommended in the issue of THE MODEL ENGINEER for June 13th last. The fulcrum for the lever links may be in any convenient position, or as shown in Fig. 2.

[18,577] **Small Boiler for Workshop.** J. C. (Antrim) writes: Would it take a 12-in. by 24-in. boiler to suit this engine to drive a 3-in. centre lathe. How many steel tubes 1 in. diameter would I need to have a working pressure of 80 lbs. per sq. in.? Could you give me sketch and dimensions of a boiler that would suit?

(1) The boiler might be a little larger with advantage, say, 14×28 or 14×30. The tubes should be 1 in. diameter, and at least ten should be employed. It is always advisable to have a larger boiler than absolutely necessary, as the attention it will require in working will then be considerably reduced. (2) A working pressure of 60 will be ample if the steam is delivered fairly dry. See "Model Boiler Making" for design of boiler.

[19,232B] **Motor Castings.** H. J. (Westminster) writes: Could you supply me, or tell me where I would get rough castings to make motor, size C, as described in your Handbook No. 14, pages 29–31, also some details as to its weight, etc., also as to an accumulator for the same—power, size, and weight?

In reply to your letter *re* where castings may be obtained for small motor, any of our electrical advertisers would be pleased to supply same. Messrs. Thompson & Co., 28, Deptford Bridge, Greenwich, S.E.; or Messrs. Whitney, 117, City Road, London, E.C.; or Avery, Fulmen Works, Tunbridge Wells, would be good firms to apply to. We have not a set of these castings by us, so cannot give you the exact weight. An accumulator for driving

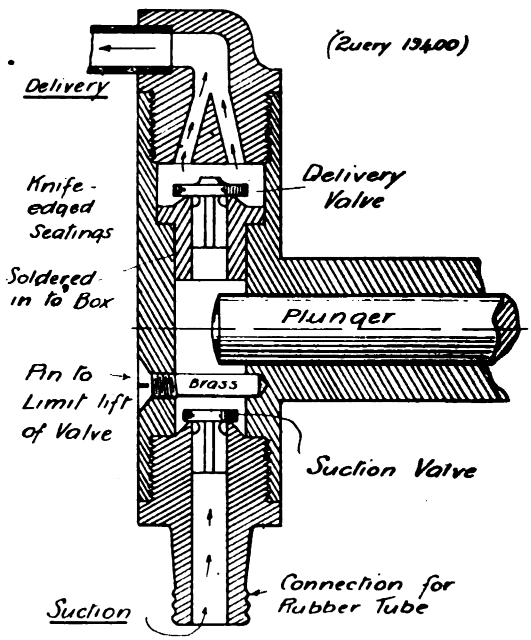


FIG. 3.—SECTION OF VALVE CHAMBER SHOWING VALVE SEATING.

this motor would have to be of a voltage corresponding to the windings of the motor; thus, for the 12-volt winding, you would need an accumulator capable of discharging at 4 amps. A cell containing about ⅞ sq. ft. of positive plate surface would be required for this.

[19,321] **Engineering as a Profession.** N. M. (N. Finchley) writes: I shall be much obliged if you will kindly answer the following queries: (1) Which is it best to follow—electrical or mechanical engineering? (2) If you attend some first-class college of engineering, such as The City and Guilds, London, say for a couple of years, is it necessary to become apprenticed after you leave, or can you start as a qualified engineer? (3) Would a firm charge the same premium for someone who has had instruction as mentioned above as they would for someone who has had no experience at all?

Your enquiry cannot be answered by a Yes or a No; neither can it be said that the electrical engineering has any advantage over mechanical engineering as a profession. The choice of subject depends entirely upon your own inclinations and ability, and also upon other circumstances, of which we know nothing. If you would read the recent articles on "How to Become a Mechanical Engineer," and also the series in Vol. VII on "How to Become an Electrical Engineer," you will find full information on every point which you raise. Whichever course of instruction you attend, and whichever college you attend, it is still essential to serve an apprenticeship with an engineering firm working on a commercial basis. Naturally, any firm would give preference to an apprentice who has had some experience in the use of tools and machines.

[19,294] **Windmills.** T. B. M. (Preston) writes: I am thinking of driving a 30-watt dynamo by means of a windmill. Please can you give me any information as to where I may obtain particulars about the construction and working of the same?

The only particulars we have of windmills are those published in the January issue of last year, commencing with the colour plate as a supplement, also the recent articles on "A Small Power Windmill," following which we published a description of a 16-ft. windmill, as used by the Government of New Zealand for pumping purposes.

[19,292] **Conversion of Engine.** S. W. I. (Dromod) writes: I should be glad if you would kindly help me in the following matter. I am constructing a ½ h.-p. gas engine from castings, and wish to convert same so as to work with paraffin oil, by the method described by R. B. Verney in THE MODEL ENGINEER of December 12th, 1907. The following are the dimensions—cylinder, 1-in. bore by 2-in. stroke; exhaust, 5-16ths in.; inlet, ¼ in. Please give dimensions or full-sized drawings of attachment, giving full details of float chamber and materials used in construction of same. Also output of dynamo same would drive and probable oil consumption per hour, and capacity of water tank. I have your book—"Gas and Oil Engines." Should the grooves for rings be turned twice as deep at one place as at the other, as the rings are to be twice as thick in one place as at the saw-cut? Would this engine drive a 3-in. lathe (iron turning)?

It is possible your machine will give slightly less horse-power when run with paraffin than with gas, and the exact power can be found by trial. Assuming it to give approximately ½ h.-p., it should drive a 30-watt machine satisfactorily. We regret we have no further particulars of the system spoken of by Mr. Verney than those already published. The probable oil consumption would be 1 pint per h.-p. per hour, but considering the small size of the engine, it will be well to allow rather more than this. A water tank the same size as you are using for gas power would do for this. The grooves for the piston-rings should be of equal depth all round, notwithstanding that the rings themselves are thick at the back and thin where split.

[19,556] **Dynamo Trouble; Ignition Systems.** W. A. R. (Siam) writes: Will you kindly inform me: A compound-wound 110-volt 14-amp. dynamo is used for lighting an installation. How must a 4-volt 20 amp.-hour accumulator be charged through brushes (I believe this is the correct method) without damage to accumulator or affecting the lights? What must the resistance be exactly, and how made up? Please give full particulars, as one good new accumulator has already been spoilt through not having connected the accurate amount of resistance. Is there a reliable complete attachment that can be purchased for this purpose? Maker's name and price (about) will oblige. I have a small dynamo, with automatic cut in and out, by Messrs. S. Bottone and Son, for accumulator charging. It is marked 5 volts 1-5 amps., at 2,500 r.p.m. I used it for charging a 4-volt 20 amp.-hour accumulator, and though new, as received from makers, when run for about eight hours in all—ammeter at 2½ only—the commutator gets cut up badly. The brushes are of fine copper wire gauze, rolled, with light spiral springs pressing them on to commutator. The commutator has been filed dead-smooth twice since, dressed with a touch of good vaseline, and a second and third trial proved no better, ampere-meter showing but 2 amps., running the dynamo easy. I tried running with carbon brushes for an hour or so, but amperemeter then registered but 1 amp., so gave that up. What is the cause of commutator getting so easily cut up? As the governor of dynamo cannot at all times be depended on, probably because of machine being new, and copper dust off commutator affecting its action, what harm would be done to the dynamo should it be running for hours unnoticed at speed that should produce 5 volts 2 amps., but with the governor cutting out? What damage will be done working spark coils of a petrol motor in boat direct from a small dynamo of 6 volts 1 amp.? Will windings of coils break down eventually, with slight varying speeds, as motor during starting, reversing, and such will be fired through accumulator?

We advise you to charge your accumulator through a group of four 16 c.-p. lamps connected in parallel with each other, the said group to be in series with the accumulator and the mains. Any of our electrical advertisers would supply you with a small board fitted with a group of lamps, complete with switch and terminals ready for connecting your 4-volt accumulator to. The fault with the commutator is probably due to the brushes not being properly adjusted. The pressure should not be very great in the first place, and it is as well to lubricate the commutator very slightly with a little vaseline; in addition to this, a slight touch of black lead from a black lead pencil, will tend to improve matters. Of course, very hard copper is the best material to use for the commutator, and it may be that too soft a material has been used. We do not quite grasp what your difficulty is with regard to the dynamo governor. At a higher speed than normal the voltage of the machine would rise somewhat, but it depends upon the resistance in circuit whether the amperes exceed a certain amount or not. *Re* spark coils for motor boat, if a dynamo is supplying the coils you will find that at starting there will be some difficulty in getting a satisfactory spark, owing to the dynamo voltage being below the normal; whereas, if it were above the normal, within certain limits there would be no detrimental effects. You would find the magneto system of firing the spark more satisfactory, as this is quite independent of the speed at which the motor is running, and the timing of the spark can be regulated at will.

[19,487] **Joy's Valve Motion.** W. N. S. (Newcastle-on-Tyne) writes: I am busy building THE MODEL ENGINEER steam locomotive, and would like a full-sized dimensioned sketch of Joy's valve motion for above locomotive.

You will find a description of Joy's valve gear in our issue for February 13th, 1908. Some further particulars will be found in "The Model Locomotive," by Greenly, 6s. 4d. post free.

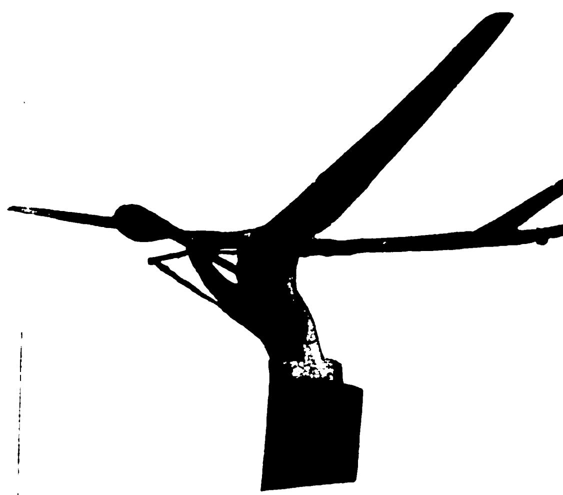
The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

* *Reviews distinguished by an asterisk have been based on actual Editorial Inspection of the goods noticed.*

* Model Aeroplane Flyer.

Messrs. T. W. K. Clarke & Co., aeronautical engineers, of 3, Union Place, Kingston-on-Thames, have recently put on the market a series of working model flying machines (Clarke's Patent Flyers). They are ingeniously made of varnished wood, and, though exceedingly light, are very strong and not liable to break when falling at the end of a flight. The propelling force is derived from a skein of rubber strips. It is evident that the design is formed upon scientific principles. The planes are of properly curved cross-section; the forward one, in all except the smallest size, is detachable, and can be adjusted to position for producing variations of flight. Small weights may be carried by attaching them to the frame by means



MESSRS. T. W. K. CLARKE & CO.'S MODEL FLYER.

of elastic bands. Four sizes (A, B, C, and D) are made. Size A is 3 feet in length of body and weighs 1¼ lbs.; size D, the smallest, is 12 ins. in length and weighs 1 oz. A very suitable size as a present for a lad, or where a space such as a large garden is available, is size C, which is 18 ins. in length by 24 ins. across the large plane, and the propeller is 10 ins. in diameter. We have seen some of the models in flight and can say that they are just the thing for any one interested in aerial navigation to do a little experimenting on his own account. Readers who have studied Chapter III of our handbook on "Flying Machines" should be specially interested. According to the makers these models have made a record flight in length for rubber-driven propellers, the A machine having flown 501 ft. on slightly falling ground. The machines are inexpensive; spare parts may be obtained, and instructions are pasted upon each model. The makers state that they "will be pleased to give one of the larger size (A) models at the end of each month for the best flight during that month which has been done with one of the size B models, provided the same has been properly measured and attested." The maximum distance so far flown by size B is stated to be 395 ft. on level ground. Enquiries may be addressed to T. W. K. Clarke, St. Catherine's, Maple Road, Surbiton.

The Editor's Page.

We have just added another handbook to The Model Engineer 6d. series. This is entitled "The Wimshurst Machine: How to Make and Use It," and besides giving an excellent explanation of the principles on which this popular piece of apparatus works, it includes working drawings and directions for its construction. A number of interesting experiments with the machine are also described, and we think the book will be a popular addition to the amateur electrician's library.

* * *

We are informed by the Editor of the *British Model Yacht Club Guide and Official Year Book*, which we recently announced, that the work is now practically completed, and the matter of finding a guarantor is being dealt with. In the meanwhile orders continue to come in, and the order-sheet already numbers several hundreds. The Editor is still waiting to hear from some clubs as to the support they are likely to be able to give, and much depends on the response as to whether this useful handbook is produced in a really complete form. Mr. C. Colman Green has undoubtedly expended much time and energy in endeavouring to place before our model yachting friends a really fine little volume at a reasonable price.

Answers to Correspondents.

B. A. Q. (Ipswich).—A drawing of the G.E.R. 1585 class was given in the issue of October 17th, 1907. There is no tension in the high-tension windings of a coil when on open circuit.

R. C. S. (Sydney, N.S.W.).—We thank you for article just to hand, and are sorry that it came too late to be included in the Competition.

A. J. A. (Invergordon, N.B.).—We think Arthur Firth, Cleckheaton, Yorks, can supply castings and parts for a small planing machine.

J. Y. (Woolwich).—Many thanks for the post-card illustration of your model. Why not send a better photograph with a short description in "Our Readers' Work Competition."

W. M. L. (Newcastle-on-Tyne).—Thanks for your Workshop Note, but the description is hardly clear enough for us to publish.

B. A. Q. (Ipswich).—We do not appear to have any letter from you in hand; but if you will let us know what the subject was, or repeat same, we should be pleased to give the matter our prompt attention.

G. R. (Abertillery).—It is impossible to say what is wrong with the machine, from your description, and the matter can only be settled by individual trial or personal inspection. The hints in the last chapter in handbook, "Small Dynamos and Motors," might possibly put you on the right track, and we advise you to read it.

R. J. M.—Particulars of dynamo such as you refer to are to be found in Handbook No. 10, 7d. post free.

A. A. Dyer (Barcaldine).—Presuming that the trouble is simply due to insufficient boiler power the proposed alteration will be advantageous, although from the point of view of "work done" the boiler, of course, is the important point. If, instead of bothering to turn the engine into a compound, you were to make arangements to wire-draw the steam, the same results would be obtained. We rather think that there is something wrong with the engine or that the boiler does not steam as it should. We cannot give maximum working pressure from particulars sent, but would say that 30 lbs. is quite safe. Are the valves of the engine set properly, is the piston properly packed, and is the boiler entirely free from leaks? We regret being unable to post you this reply as you did not give sufficiently full address.

F. P. Spicer (late of "Woodbank").—Will you please send us your present address?

H. W. S. (Herne Hill).—Write to Messrs. S. Holmes and Co., Bradford, and state your requirements.

C. H. B. (Wrexham).—Articles and particulars relating to the construction of automatic cut-outs appeared in our issues for February 15th, February 22nd, and April 5th (1906).

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

How to Address Letters.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to The Editor, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to The Advertisement Manager, "The Model Engineer," 26–29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

Sole Agents for United States, Canada, and Mexico: Spon and Chamberlain, 123, Liberty Street, New York, U.S.A., to whom all subscriptions from these countries should be addressed.

Contents.

[*The asterisk (*) denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

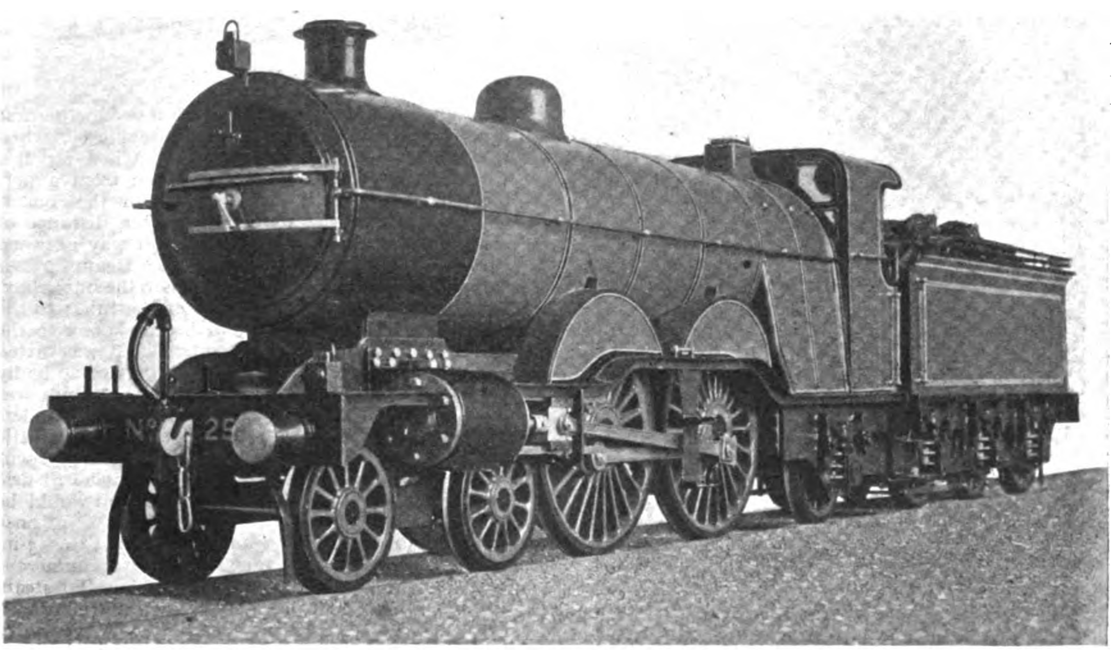
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL. A.I.MECH.E.

VOL. XVIII. No. 366. APRIL 30, 1908. PUBLISHED WEEKLY

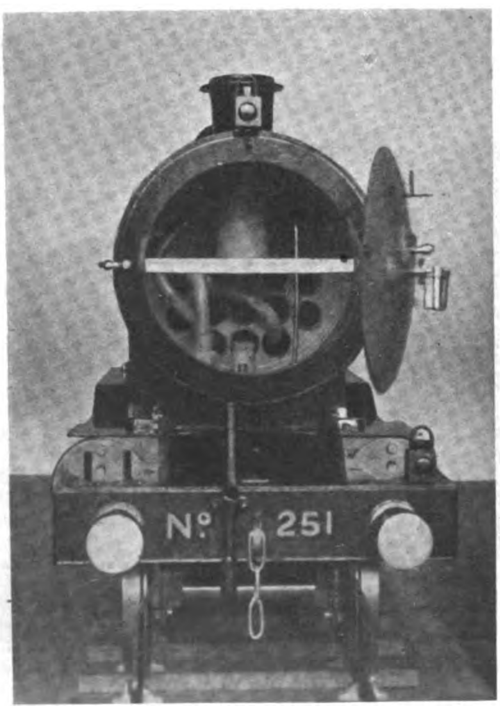
A ¾-in. Scale Model G.N.R. "Atlantic" Type Locomotive.

By A. KIRKBY.

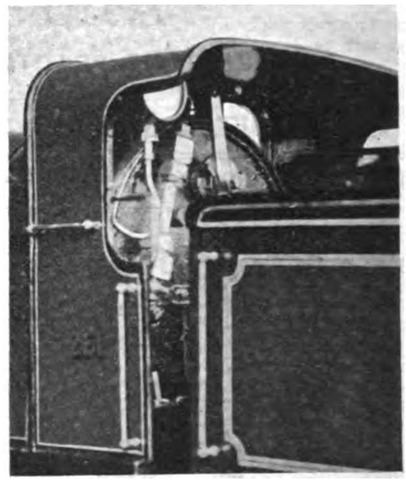


MR. A. KIRKBY'S MODEL G.N.R. "ATLANTIC" TYPE LOCOMOTIVE.

In building the model illustrated herewith, I was anxious to make as powerful an engine as I could without going away from the general outline of the prototype. My ambition was to ride behind the tender, and although I could do this with my No. 3, illustrated in THE MODEL ENGINEER, of February 22nd, 1906, it was very slow work as the model was very light and the wheels would skid round at times without the engine making any progress. The cylinders in the present model are 1 in. × 1½ ins., and I was rather doubtful when I had half completed the boiler as to whether it would supply enough steam, as I had originally intended to fit a 4-in. Primus burner. I was informed by a friend that the manufacturer had given up making this size, so I had to resort to the 3-in., and by pinching in the sides so as to throw the flames across the wide firebox, very satisfactory results have been obtained. On a temporary (very uneven) track laid down in the garden, the engine under steam has pulled 203 lbs. behind the tenders on a rising gradient. I was unable to find out exactly what this gradient was, but a little start at the top would send you down to the bottom. The track was 42 ft. long, and the engine started at a steam pressure of 50 lbs. to the square inch. At the end of this distance the gauge registered 47 lbs., although the wheels had been skidding a good deal. Another trial was made with 15½ stone behind the tender, but although I had as much weight as I could get on the drivers, the wheels would slip round without the engine moving. Doubtless on a level track it would have pulled this weight along. However, I only weigh 10 stone and my ambition has been fulfilled, as it will pull me up the hill at a good speed with 45 lbs. pressure. The boiler is 17½ ins. long by 4¼ ins. outside diameter, and is made from solid drawn copper tube 1-16th in. thick. This was split and hammered out to shape at the firebox end. There are thirteen tubes ½-in. inside diameter. These were screwed into the firebox end, 32 threads to the inch, and expanded at the smokebox end. The firebox has gunmetal castings for the back and front, the back one having the fire ring cast on and a piece of sheet copper 1-16th in. thick was screwed on to these to form the top and sides. The boiler and firebox are screwed throughout with No. 8 B.A. taper head brass screws. I have always found this plan of screwing satisfactory, and it is done without much noise, which is a consideration; the only hammering necessary being the knocking together of the two pieces you are screwing so as to make a tight joint. Before screwing together, all joints should be well tinned with solder and finally sweated with soft solder. This is in place of caulking, the solder filling in any small crevices. The firebox is stayed throughout with ⅛-in. brass screws, fitted with nuts inside, and the boiler with two 3-16ths in. stays running from end to end 1 in. from the top. When completed it was put under water test and the first drop to escape was through the regulator, when the needle of the pressure gauge touched 140 lbs. to the square inch. Steam is taken from a perforated pipe placed at the top of the boiler, the perforated holes extending over a distance of 4 ins. These holes are situated half way between the smokebox and firebox. The steam passes through the regulator, and is taken to the smokebox. From here it is led through one of the tubes to the firebox and returned through the smokebox to the cylinders. At first a coil superheater was fitted in the smokebox, but the cylinders primed so badly that this had to be discarded, and the steam was tried taken direct from the boiler to the cylinders but it was still very wet, although certainly a little better. A considerable length of time was spent in solving the steam problem as the model at first would hardly move itself along. Steam would be turned on at 50 lbs. and would drop almost at once to about 30 lbs. and I began to think that this 3-in. lamp was not large enough, but after numerous experiments the above plan of passing the steam through the firebox was adopted and has proved very satisfactory, as the steam is now very dry and the boiler uses much less water. The boiler is fitted with steam pressure and water gauges, blower, check valve and drain cock, and is covered with asbestos underneath the outer casing. A general idea of the smokebox arrangements may be gathered from the illustration. Unfortunately, the door moved a little during the process of photographing. The crossbar and funnel extension are detachable so that the fittings may be got at easily.



View showing Interior of Smokebox.



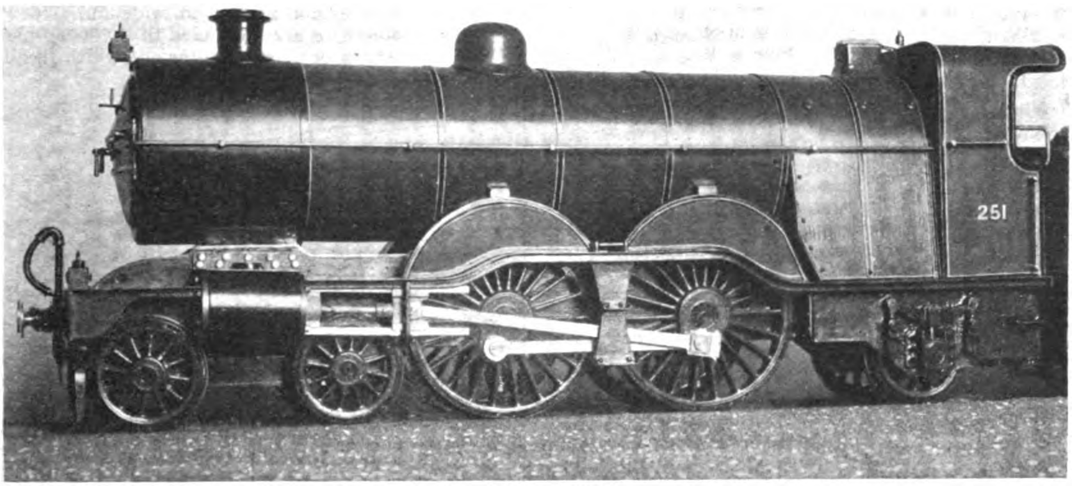
Cab View.

The cylinders are fitted with piston rings and are very satisfactory, the compression being very good. Steam ports are 3-32nds in. × ½ in., and exhaust ports 3-16ths in. × ½ in., lap 1-32nd in. and lead

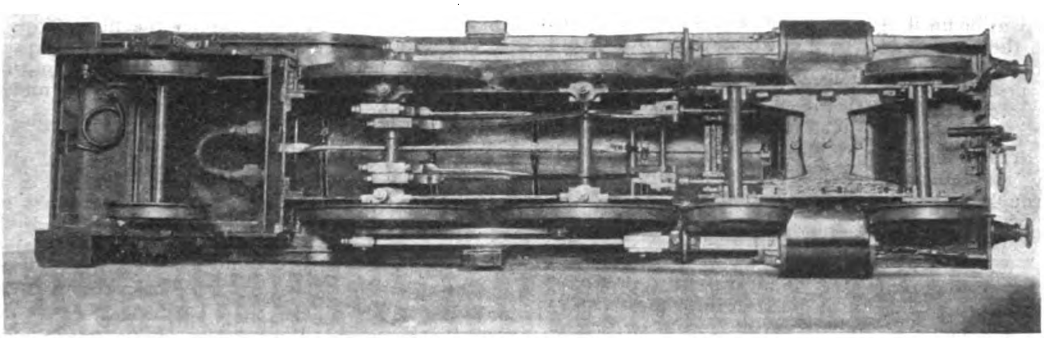
1-16th in. Stephenson's link motion is employed, with the links placed in front of the leading pair of coupled wheels, the reversing being operated by a lever in the cab.

Great care was taken with the eccentrics in getting them all exactly the same length, and as I had no dividers large enough to mark them off the following plan was resorted to. A piece of brass was turned down in the self-centreing chuck on the lathe to the size of the hole in the eccentric straps, and the strap with rod attached fitted on to this. A scriber was then fixed in the slide-rest and adjusted to the correct length. The rods were then marked off on both sides to ensure the holes being drilled at right angles. This little bit of trouble has more than paid for itself, as the beats of the exhaust are perfectly even. Sheet brass has been used in the construction wherever possible, excepting the main frames of the engine, which are 3-32nds in. steel, brass being very much easier to work although it is a little more expensive. The wheels are cast iron and are fitted with ⅜ in. steel axles. These run in ½ in. brass bearings; spiral springs have been used throughout, the laminated ones being dummies.

I have had great trouble at times in starting a Primus burner out in the open, especially on a windy day, and have very often had to take it into the house, start it there, and when alight bring it back to the engine and place it in position; but it was foreseen that considerable difficulty would be experienced in doing this with the present one, owing to the axle of the trailing pair of wheels being in the way. I have therefore made the rear outside frame and trailing wheels detachable, so that the lamp may easily be placed in position and the engine lifted on. The rear of the engine is strengthened with two ¼-in. square steel bars



Side View of ¾-in. Scale Model G.N.R. "Atlantic" Type Locomotive.



Underside View of Engine.

running from the cross-piece at the end of the main frames to the back buffer plate. The tender is fitted with a horizontal pump, which I find much easier to work than the vertical pattern, and at the same time it does not strain the spring when pumping. The leading dimensions are as follows:

- Cylinders, diameter, 1 in.
- Piston stroke, 1½ ins.
- Coupled wheels, diameter, 5 ins.
- Bogie and trailing wheels, diameter 2¾ ins.
- Heating surface: Tubes, 26 sq. ins.; firebox, 52 sq. ins.
- Total, 312 sq. ins.
- Working pressure, 50 lbs. per sq. in.
- Weight of engine in working order, 50½ lbs.
- Weight of tender in working order, 22 lbs.
- Total, 72½ lbs.

When the engine had completed her trials, which lasted about nine months, she was taken to pieces and all parts finished off. It was found on cleaning the boiler that the firebox and tubes were coated with a thick layer of soot owing to the lamp working badly at times, and it seems marvellous how such a pressure had been maintained. It had never occurred to me to clean them out, as there seemed to be nothing lacking in the way of steam raising. All parts to be painted were first washed in hot soda water to remove all grease, then given two coats of lead colour paint and finally three coats of finishing enamel; each coat being gently rubbed down with fine glass-paper. I find that on flat surfaces it is best to put the enamel on thickly to get an even surface and allow to dry thoroughly. The time required will depend on the weather. The lining has been done with a compass pen, this way being very much easier than using a lining brush unless you have had considerable practice. The main thing to be careful about is to get the paint the right thickness, so that it just flows through the pen when drawn along the surface. To do this, procure a penny tin of enamel and thin down with turpentine until the best results are obtained. After use, the tin may be closed down and kept for future occasions. The other end of the compasses may be used as a guide when the line to be drawn runs horizontally with the edge of the metal.

In conclusion, I have to thank THE MODEL ENGINEER for its many good words of advice, as all my mechanical knowledge has been obtained through its pages and publications.

AN automatic water finder recently produced is a scientific development of the divining-rod. The new appliance is stated, as the result of several tests in the hands of well-known engineers, to be infallible in its action. A contemporary states that the device comprises a small magnetic needle, similar to that of the mariner's compass, mounted in a small box which is carried on a tripod. When it is put in operation, the presence of subterranean sources of water is immediately betrayed by the violent agitation of the needle, the oscillation in some cases being as much as 150 degs. Unlike the old-fashioned divining-rod, the appliance is not affected by other influences than those of water, which consequently renders it absolutely reliable in its action. Should no water be existent the needle remains absolutely stationary.

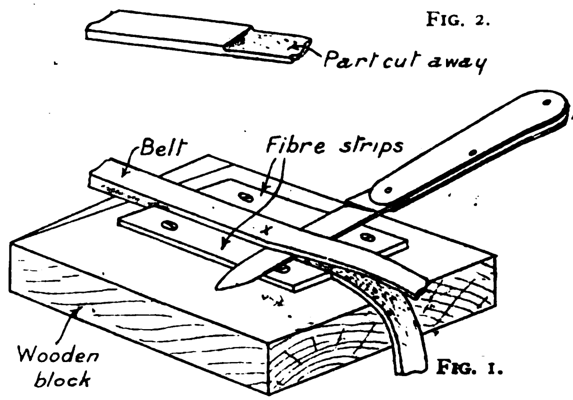
Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "WORKSHOP" on the envelope.]

Cutting Leather Belts.

By "PULLEY."

Having occasion to cut a small belt 3-32nds in. thick down to 1-32nd in., I tried the following simple method: Two strips of fibre are cut about 3 ins. long and about ½ in. wide and 1-16th in. thick; both strips are then fixed to a wooden block, leaving a space between of sufficient width to allow

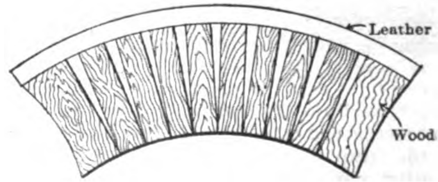


SHOWING A METHOD OF CUTTING A LEATHER BELT.

the belt to be cut to slip easily between. Then, with a sharp knife, cut a short layer off to begin with (Fig. 2); then place belt on the wood and keep knife pressed firmly down on the fibre strips and cut with a sawing motion, keeping the belt pressed down by left hand on the part marked X in Fig. 1, and the resultant belt will be quite even and flat. I think the sketch will make all clear.

A Sandpaper Block.

A contributor to the *American Machinist* gives the following hint for making a universal sandpaper or emery-cloth block. It is made by glueing



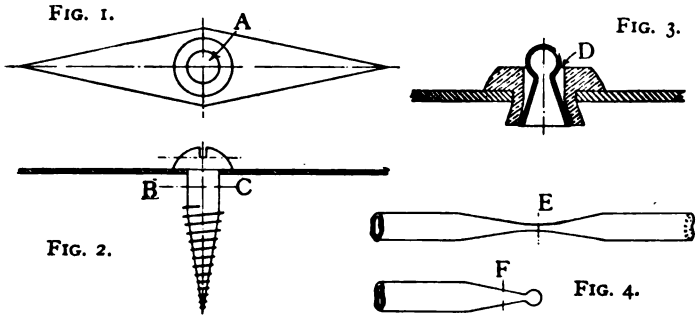
A SANDPAPER BLOCK.

a piece of leather to a block of wood of suitable size and then slitting with a saw, leaving lands a quarter of an inch wide. It fits concave, convex or flat surfaces and is a very handy block and easily made.

A Simple Bearing for Small Magnetic Needles.

By G. R. Atkins.

Make a needle out of a steel watch spring, and, having softened it, drill a hole A (Fig. 1) through it. Now take a brass button-headed wood screw or a copper rivet of the diameter of hole A, and file it down till the nick vanishes; pass the shank through the hole in needle and cut in two at the dotted lines B C (Fig. 2). Now drill a hole D through the centre of brass head, and with a punch driven into hole, swell out the lower end of screw so as to firmly grip the needle on both sides (Fig. 3).



Details of Bearing for Small Magnetic Needles.

The whole must next be hardened by wrapping in a tin case and heating in a fire or gas jet to a red heat, when it is dropped into cold water or oil. The tin case prevents the steel from burning, and can also be adopted to soften the needle. Finally, the needle must be magnetised by magnet, battery, or dynamo. The bearing itself must now be made. Take a piece of ¼-in. glass tubing and draw it out thin, then break off at the dotted lines E (Fig. 4), and seal up as finely as possible, immediately blowing a tiny bulb slightly smaller than the hole D (Fig. 3). The glass will now have the appearance shown at F (Fig. 4), and must be carefully snapped at the dotted lines. If you are lucky enough to complete the bulb, as in Fig. 3, the fixing will be easy, needing only a little cement; but if it will not hold naturally, the glass must be bedded round with cement and adjusted carefully, so as to stand upright. If the bulb is at all dirty, it is best cleaned out by holding under a fine jet made by partly stopping up a water tap with the finger and then drying out with cotton. If done properly, the final result should be well worth the trouble of making, both in appearance and working.

A Handy Charging Plug.

By "A Dabbler."

The cord-gripping portion of an Ediswan electric lampholder is removed, and in its place the following arrangement is fitted: A piece of metal tube A, ¾ in. external diameter by 1¾ ins. long; in my case a portion of stem of cycle handle-bar (the sketch is not to scale) has a ring of wire B, about 20 gauge, soldered round one end. A 3-16ths-in. hole is drilled in side of tube, as at C, the edges of holes being smoothed as well as possible. A disc of vulcanised fibre D, ⅛ in. thick, is fitted tightly into upper end of A, and on its outer surface two pieces of sheet brass are riveted, in shape and position as the brass pieces of an electric lamp top. The screwed coupling ring of lampholder is slipped on A, being prevented from coming off by B. Two brass pins E E are screwed or soldered into A, similar in position to pins in electric lamp top. A piece of flexible electric light cord G, about 2 ins. long, has one end passed through a hole in D and soldered to one brass piece. The ends, a convenient length of twin flexible cord, say 2 yds., are passed through C—one end H is passed through another hole in D and soldered to other brass piece, the other end, I, is left about 1¼ ins. long and brought out of A, as shown. The space inside A is then filled up with plaster-of-Paris made to a thick cream and allowed to set. Over the lower ends of G and H is passed a fibre washer 1 in. diameter by ¼ in. thick and a ⅜-in. hole. These wires are bared and attached by the screws to brass plates in the porcelain plug K of lampholder, carrying the spring buffers which make contact with lamp. The coupling ring is then screwed on to L and the plug is complete. For use, a lamp is removed from its holder and plug inserted in its place, and the lamp—or any lamp passing a suitable current to charge the accumulator—is put in the ordinary manner in L; the outer ends of twin cable are tested for polarity and connected to accumulator, etc., and charging commenced. The polarity having been found (a simple method being to dip both wires in some accumulator acid, the — pole being denoted by bubbling the *most*), the position of A in lampholder should be marked and a corresponding mark made on plug, and the wires also marked, say by attaching to the + one a little piece of sheet metal cut in the form of a cross; this will ensure the correct polarity when connecting up in future. This charging plug will be found more convenient than the usual charging board, being more compact, self-contained, and the lamp used for the resistance being in its ordinary place, its illumination can be utilised to best advantage and accumulator charging carried on at the same time. A certain dimming of the light naturally occurs, due to the resistance of accumulator in the circuit, but in the majority of cases this would not matter.

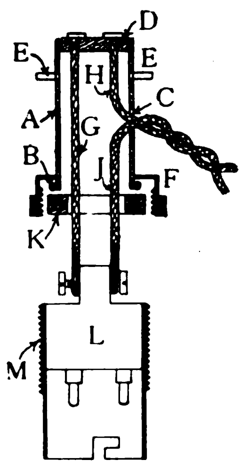


Diagram of Charging Plug.

Alzen is the name given to a new metal, which is composed of two parts of aluminium and one part of zinc. It is said to equal cast iron in strength, but it is much more elastic. Alzen is superior because it does not rust, and takes a high polish.

For the Bookshelf.

[*Any book reviewed under this heading may be obtained from* The Model Engineer *Book Department, 26–29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.*]

Motor Cycling. By G. C. Ransome. London: Guilbert Pitman. Price 1s. net; postage 2d.

The book before us is divided into seven chapters, dealing respectively with the Mechanism of the motor cycle; Ignition; Carburation; Transmission; Driving; Unsatisfactory working; and Passenger attachments; including a few brief notes entitled "The Motor and the Law." The early chapters on the mechanism and ignition of motors may be commended to those who have not yet had any practical experience with the running of such engines; but, at the same time, we think that the elemental explanations given of how a motor engine works are wholly unnecessary considering the large amount of material which has already been published dealing with the same subject. We note that in the chapter on Ignition the author gives it as his opinion that the high-tension magneto system has come to stop. We are inclined to think that the low-tension magneto has still many years of prosperity before it, and we cannot altogether agree with the author on this point. However, for those interested in the subject, and for, perhaps, the prospective buyer, the book will make interesting reading, as it gives a fairly good idea of the various points to look out for when purchasing, and also acquaints him with the various forms and types of machines which are on the market, and being used, at the present day.

Systems of Electric Ignition for Motor-cars. By Douglas Leecham. London: *The Car Illustrated*, Ltd. Price 1s. 6d. net; postage 3d.

In the above book we appear to have a careful compilation of the series of articles which appeared recently in *The Car*. The author tells us that they have been carefully revised and extended, both as regard to matter and illustrations. A large portion of the book is devoted to descriptions of magneto systems of ignition, which are so strongly in evidence now-a-days. In order to make the book interesting and understandable to the non-technical reader, the first chapter is devoted to the explanation of elementary electrical matters which are clearly written and put together in an interesting manner. The various systems described are as fully dealt with as need be, and it may be said that the contents are as up-to-date as they possibly could be. It is a book which the owner of any motor-car would be glad to have, and which would tell him practically all he needs to know about the various systems of ignition, and about any that he is likely to meet with in motor-car practice.

Recent Developments in Aerial Navigation.

The successful flight accomplished by Mr. Farman on his No. 1 machine, at Issy on March 21st, will make the accompanying pictures of unusual interest. The top picture on the opposite page shows a broadside view of the machine in flight, and the lower view is a snapshot showing the front of the machine on its voyage through the air. On the occasion above mentioned Mr. Farman, in the presence of the Aero Club Committee, made the following record: Two posts, 550 yds. apart, were erected, and outside these the Farman aeroplane circled twice in succession. The official distance is given as 2004·8 metres, and the official time as 3 mins. 31 secs.; it is estimated, however, that Mr. Farman must have flown over 4 kiloms. from start to finish. Mr. Farman will only be entitled to the new Michelin Prize provided that this achievement remains unbeaten for the remainder of the current year. At the present moment he does not gain any trophy.

Up to the time of this event, no flying machine had carried more than one man. M. Delagrange being present with his machine, invited Mr. Farman to mount behind him, and for about 300 yds. the two men flew together on a machine heavier than air.

In Fig. 1 we reproduce a photograph of Santos Dumont's No. 16—the "Dirigible Mixte," the new combined aeroplane-airship. There are two hori-

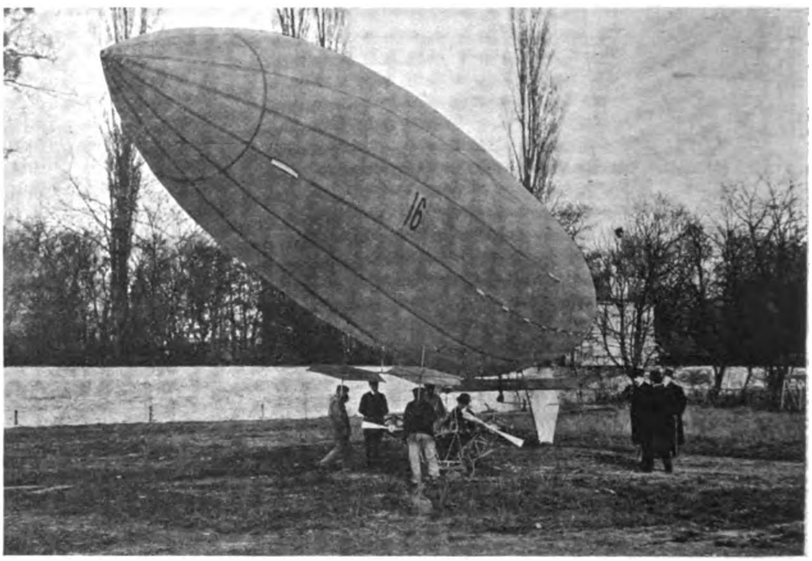
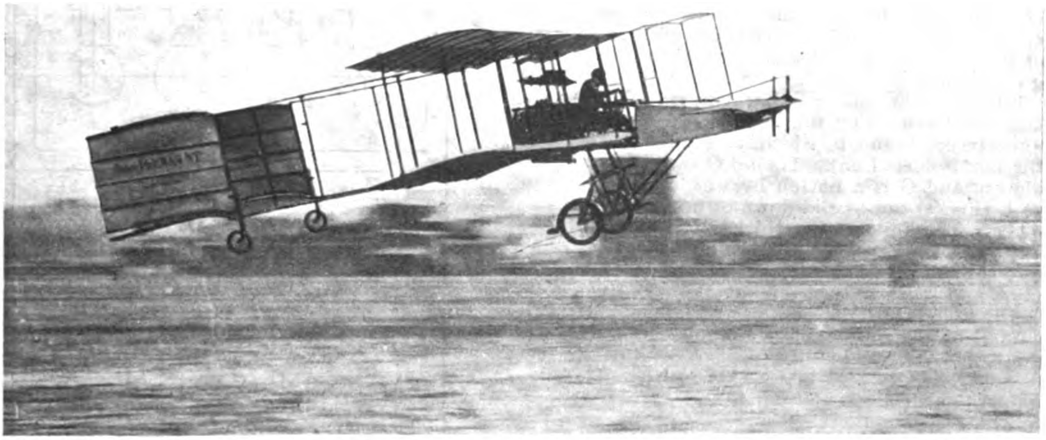
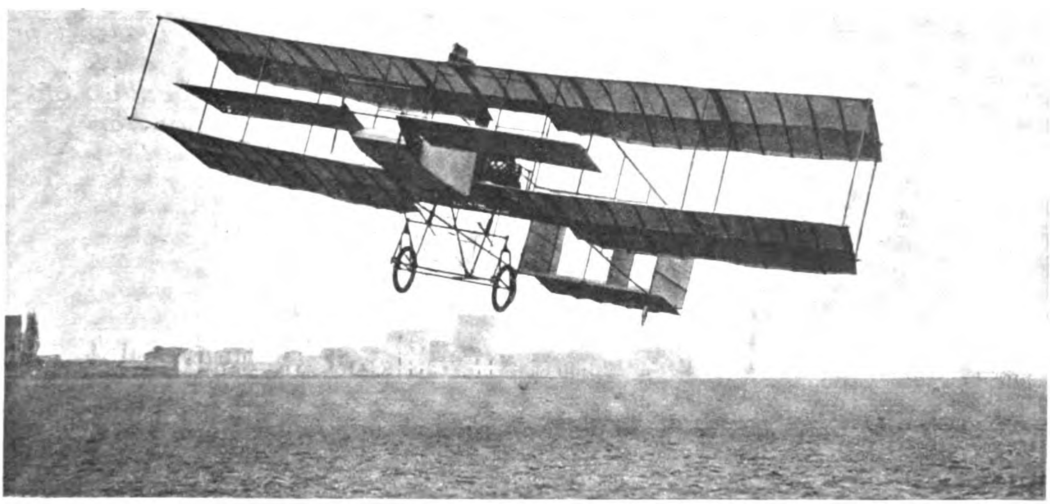


Fig. 1.—Santos Dumont's "Dirigible Mixte."

zontal twin-cylinder engines developing 6 h.-p. each, and each driving direct a two-bladed tractor screw. The various aeroplane surfaces can be

AN AERONAUTICAL "LEVEL."—An illustration recently appeared in the *Auto-motor Journal* of a device constructed by a reader for use as a





TWO VIEWS OF THE FARMAN NO. 1 AEROPLANE.

seen beneath the gas vessel, and the framework is beneath the aeroplane. The envelope has a capacity of 500 cubic metres. It is reported that the preliminary trials recently were not very successful.

level on balloons and flying machines. It consists of a globule of mercury in a shallow dish which is calibrated by concentric circles denoting the degrees of "tilt."

How to Make a Trick Lock.

By Mark Dawson.

Some time ago someone asked how to make a lock which would only open when a certain combination of letters had been chosen (the said letters being, of course, attached to the mechanism which works the lock). The lock which I have sketched is on the same principle. This lock can be fitted to any kind of box and, if well-made, is very difficult to open by anyone not knowing where to place the hands of the sham clocks A and B (Fig. 1). The box which I have is intended to be a snuff box. It is made of sheet brass, being 3 ins. long by 1⅞ ins. wide by about ½ in. deep. The lid of the box (on the inside of which is fixed the mechanism for working the lock) is fitted between the two pieces L and P, which, as shown, are part of the box (soldered on). The lid Q is hinged to P as shown, and G is a button by which the sliding piece E (Fig. 2) can be slid down or up, as the case may be. The button G, which is fixed to the sliding piece E—as will be seen from the drawing—cannot slide down when the box is shut, unless the pieces C and D are so turned as to allow the spigots H and K to pass into the slots 1 and 2, which allows the lip N of the sliding piece E to clear the edge of the top of the box L. E is a piece of 1-16th in. brass sheet, and is kept in position by the sliders L and M, which are soldered on, and also by the rivet which fastens the button G to it. This rivet must be made just a working fit. C and D are made out of a piece of 1-16th in. brass, the slots 1 and 2 being filed out to exactly fit the spigots H and K, on the sliding piece E. The button G is just a piece of ⅛-in. brass, turned up into the shape shown, small grooves being cut round it when turning in the lathe, for fancy appearance.

When the mechanism on the back of the lid is finished, and the position of the hands of the clock which will allow the box to open has been noted, a thin piece of tin can be soldered over the mechanism, to keep it clean. It will be seen that there is only one position of the hands of the clock which will allow of the sliding piece E to move. This position can, of course, be made anything the makers desire.

A lock which is fitted to a desk is shown in Fig. 3. There are four sham clock faces on this desk. Two for the "minutes" and "hours," and two for the "seconds." The mechanism is the same as before, only there are four spigots instead of two. If one makes the box as it is shown, they might place a dummy sham clock face in the lower position. The clock A need not be connected to the mechanism of the lock at all, but would serve to baffle anyone who is trying to open it.

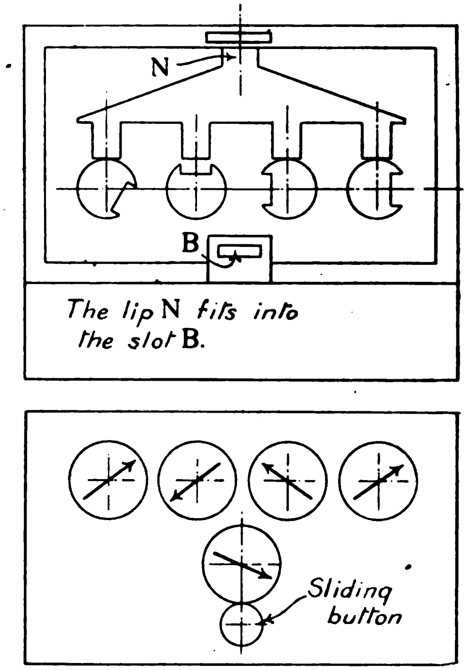


Fig. 3.—Arrangement of a Four-dial Lock.

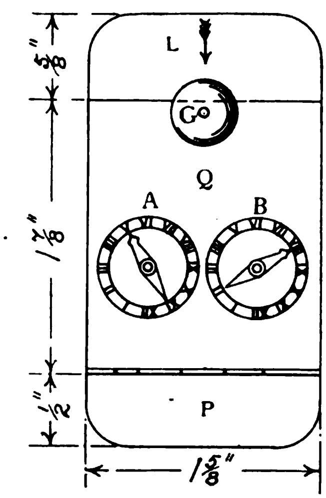


Fig. 1.—Exterior of Box.

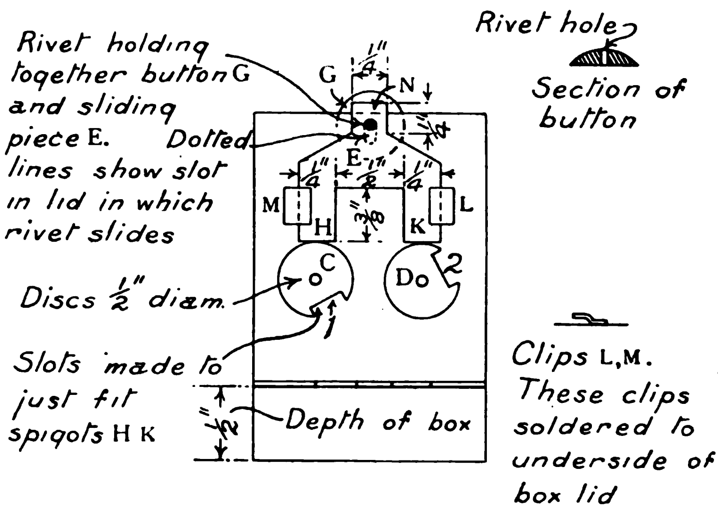


Fig. 2.—Showing Arrangement of Lock.

How It is Done.

[For insertion under this heading, the Editor invites readers to submit practical articles describing actual workshop methods. Accepted contributions will be paid for on publication, if desired, according to merit.]

Elementary Smiths' Work.

By C. W. Fraser.

(Continued from page 395.)

HAVING given a few elementary examples as a guide to what may be done in the way of single handed forge work, we may now turn to pipe bending. We shall consider both brass and copper pipe, as well as iron, as they are all used in engine

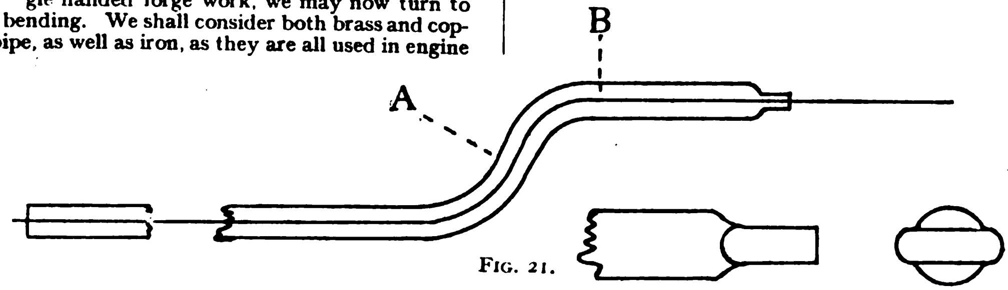


FIG. 21.

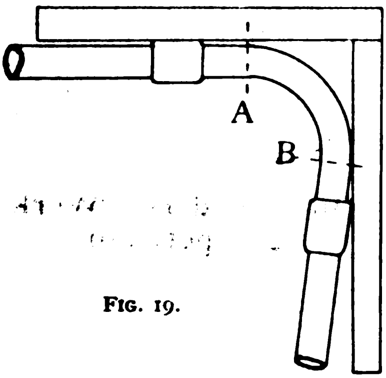


FIG. 19.

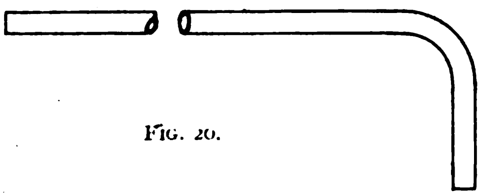


FIG. 20.

work. Small bore pipe (up to ½ in.) in brass or copper, should be well annealed by heating to a dull red and plunging into water. It can then be bent with the fingers as required. Larger sizes should be well annealed and then filled with lead or resin. Whichever is used, it should be poured in, in a fine stream, and as hot as possible, to avoid forming air bubbles. When cold it may be bent as though it were a solid bar. Brass pipe is best filled with resin, copper with lead. Iron pipe, such as steam or gas barrel, from ½ in. to 3 ins., requires no filling whatever. As the latter size scarcely comes within the amateur's reach, we will consider nothing larger than 1 in. Fig. 19 shows an ordinary shop bought ¾-in. steam bend, which is found to be "under square," as shown. To correct this, screw a couple of short pieces of pipe in each end, and heat the parts A B to a red heat, and pull out gently with the hands till square. A large stock square should be used for this work, or, failing that, a rough one can be made from two pieces of straight wood, such as a slate batten.

Fig. 20 shows a right-angle bend in a long piece of barrel. To make this, chalk the pipe approximately where you require the bend, and heat at that spot to a dull red. Hold the short end in the vice, and pull the long end round exactly as if it were solid iron. Pull it round slowly, but firmly and evenly, and do not snatch or hurry it, and if properly done, the result should satisfy the most fastidious engineer. If it is found that the pipe tends to flatten at the bend, take it out of the vice, heat up again, and very gently squeeze the sides of the bend in the vice. Do not overdo this, or the shape of the bend is spoiled. In heating pipe it should be turned round in the fire so as to heat it equally all round. This applies especially to the larger sizes. When finished pipe bends should be rubbed over with an old file while hot, to remove scale and dirt.

Fig. 21 shows an exhaust pipe as used on

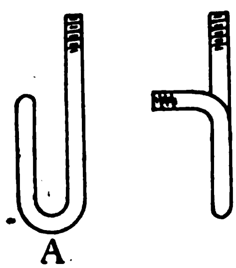


FIG. 22.

motor-cars. It is a fair example of a double bend. It should be set out full size on a piece of board, and a thin wire template made from the drawing, as shown by the solid centre line. It is as well to allow a few inches of pipe over the length required, and cut it off afterwards. Weldless steel tube is the correct thing to make these exhaust pipes of, and as it is thin it will require careful handling. Mark off the distance A B, and heat to a nice even dull red heat. Hold one end in the vice, and pull the other round very gently till the required curvature is obtained. To ascertain this, the wire template is tried on quickly, or, better still, held just above the job by an assistant. Some slight experience is necessary to work exactly to the template, but in this case, so long as the centre line comes right, the exact curve is of no moment. The second bend is, of course, only a repetition of the first. The flattened end helps to reduce the noise of the exhaust somewhat, and is produced by simply heating the end and squeezing it up in the vice, having previously inserted a piece of ⅛-in. thick iron in the pipe to squeeze on to. This hint may be useful to small gas engine users.

Fig. 22 shows a syphon for a steam pressure gauge. It is made from ¼-in. barrel, and the bend A should be made first. It will be found that two or three heats are required to make a nice bend, but if it should flatten, the sides can be gently squeezed in the vice. The remaining bend presents no difficulty.

The one or two examples shown may serve to indicate that there is nothing difficult about ordinary pipe work, but a word of caution may be added. Do not, on reading these hints, try and alter the drop or shape of your cycle handle-bars or similar goods. These thin steel goods are bent on machines designed for the job, by experts, and the result of amateur alterations is failure in almost every case.

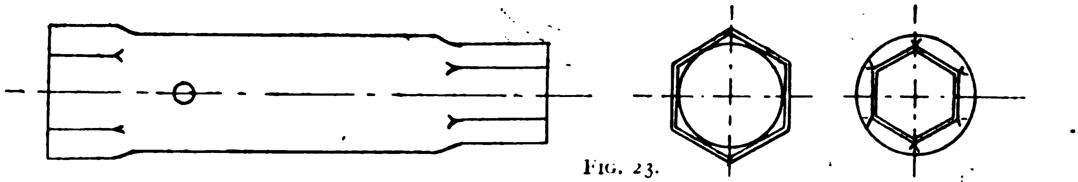
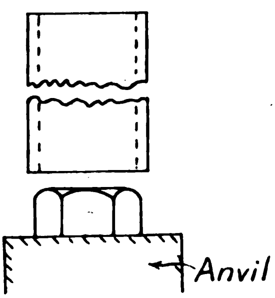


FIG. 23.



Instructions for the performance of a few odd jobs requiring the use of the forge, and of use to mechanics, will now be given :—

To case-harden small articles in steel and wrought iron, such as motor valve tappets, cams, pins, etc.—Heat them up to a very dull red (not enough to scale them), and roll them in some powdered yellow prussiate of potash. Do not shake any of the potash off, but place the job back in the fire and heat up again *slowly*. When all the potash has dissolved, repeat the operation twice more, and after the third heating up, take them off the fire, and plunge at once into clean cold water. If properly done it will resist a file, but, of course, the hardened surface is only skin deep.

To make box spanners for motor work, etc.—Procure a piece of steel tube a little smaller in internal diameter than the size of the nut for which the spanner is wanted. Heat one end of the tube and drive it over a spare nut. Tap the sides up afterwards to loosen the nut. Fig. 23 shows the method of making and also a finished spanner, one end being driven over a nut, and the other closed down to make a smaller size.

Finally, although brass casting is not smith's work, a forge makes an ideal thing to melt brass on in small quantities. Blow up a good clear fire, put a few lumps of hard coke in the bottom, and stand the crucible on them. Pack round with small lumps of coke. Do not blow up too sharply, or you may crack the pot, especially if it is a new one.

In conclusion, it is as well to remember that forge work requires a certain amount of practice before perfection is attained. Use proper fuel, and do not expect good results from using large lumps of ordinary house coal, etc. Learn to keep your fire as small and as hot as possible consistent with the job in hand. Slight burns from bits of hot scale, etc., should be let alone, and not treated with oil, etc. They are a trifle painful, but experience will teach how to avoid them. After working for an hour or so a lump of slag, or "clinker" as it is called, will form in the bottom of the fire. This should be removed, and the fire made up with fresh coal. Coal should always be wetted before being put on the fire. Small coke is used dry.

It is hoped that the few elementary examples given may serve to show the great advantage to be gained from even a slight knowledge of smithing, and that they may be of service to those readers who desire to go in for work of a more practical nature than the polished brass models of the toy shop order.

Our Readers' Work Competition.

TO encourage readers to send us accounts of their work, we offer to send any tool, book, or other desired article supplied by any of our advertisers, to the value of 6s. 6d., to any reader who sends us for insertion in THE MODEL ENGINEER a sufficiently good photograph and description of any model, tool, mechanical or electrical apparatus that he has made, and which has not been already illustrated in our pages. Entries should be accompanied by a separate letter giving the title of the article, and stating exactly what is required as a prize in the event of acceptance. When tools or apparatus are desired, the page and number of article in the firm's catalogue from which it can be obtained should be stated, if possible. It is understood, of course, that we do not promise to accept everything that is sent in, and examples of work submitted must show some degree of originality or usefulness. Ordinary every-day tools or models merely made up from purchased castings are not required. The article should be written *on one side of the paper only*, with the name and address of the sender on the back. The photographs and separate sketches enclosed with the contribution should similarly bear the name and address of the sender, otherwise delay may arise in the awarding of the prizes. It is essential in this, as in our other competitions, that the copyright of the photographs must be the property of the senders, and the covering letter should contain a declaration to this effect. The competition will close on June 30th, 1908.

Design for a Small Power Three-throw Deep Well Pump.

To Work in Conjunction with the "M.E." Windmill.

By "Engineer."

In bringing this design for a model or small power deep well pump before model engineers, the designer has three points in view—first, it is a new departure in model work; second, it is a useful size; third, it is not difficult to make, and no beginner need fight shy of it. The pump should appeal especially to makers of the windmill described in Vol. XVI, as—geared suitably and driven by a three-throw crank—it would pump water to a height of 100 ft. with ease. Of course, the pump may be driven by any other means, such as manual power or by belt.

To find the horse-power required to lift water to a certain height, the following formula is used: Multiply number of gallons per minute by 10 (weight in pounds of 1 gallon), and this result by *total* number of feet water is to be raised. Result is power in foot-pounds. Divide by 33,000 = theoretical horse-power required. Liberal allowance for slip and friction is to be added.

The pump shown in the accompanying drawings will raise 90 gallons per hour at thirty strokes per minute, which is the usual speed for large pumps of this class.

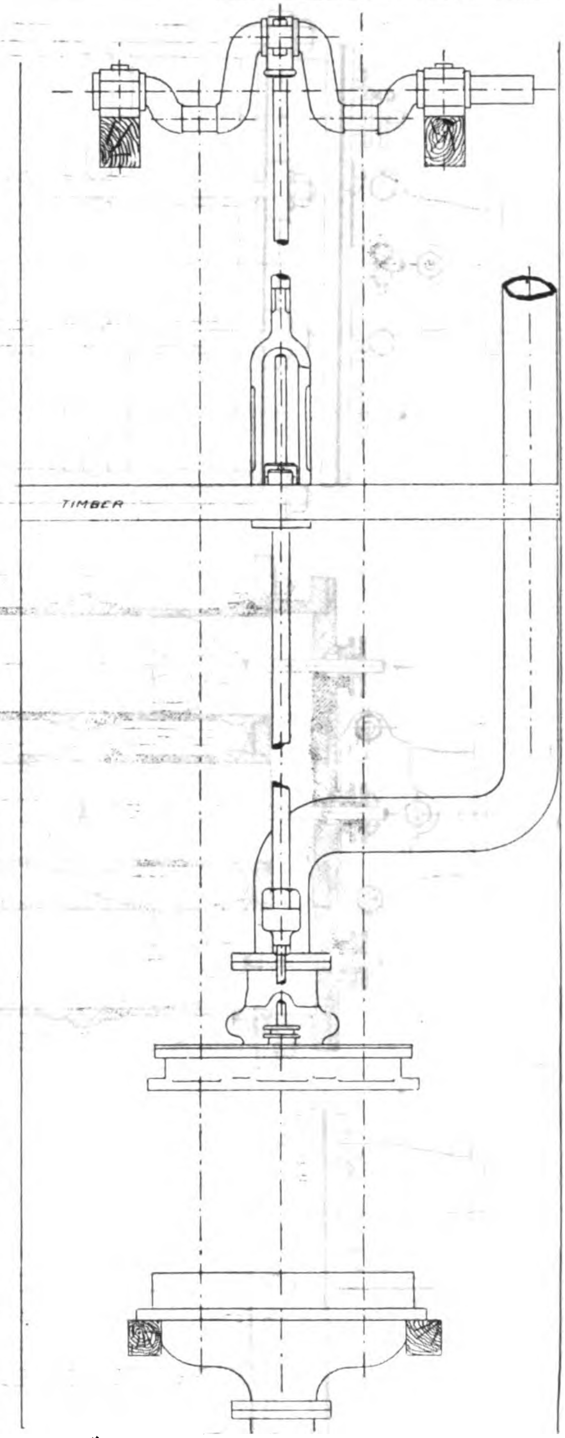
To turn to the drawing. This is practically self-explanatory, but perhaps if each part is described it will help intending builders.

The tail-piece of cast iron is faced on top and bottom of flange, a suitable amount being added to the pattern. The four foundations and six holding-down bolt holes had better be drilled in, as, if they are cored, it means a lot of finger-prints and coreboxes to suit.

The valve box (gun-metal) is machined on top, bottom, and front. The valve seats are faced—and, if the maker likes, skimmed in the bore—at the same time as the top is bored for the barrel. It will be noticed that there are bosses cast inside to take the studs which secure the valve doors. Care should be taken not to drill through into the body of casting. The doors may be in cast iron, the studs steel, and the nuts gun-metal, to prevent corrosion when pump is in the well. The doors do not require machinery, as a water-tight joint is made with the jointing material, which is oil-dressed leather or indiarubber sheet 1-16th in. thick. All joints are the same except the cover; those will be referred to again.

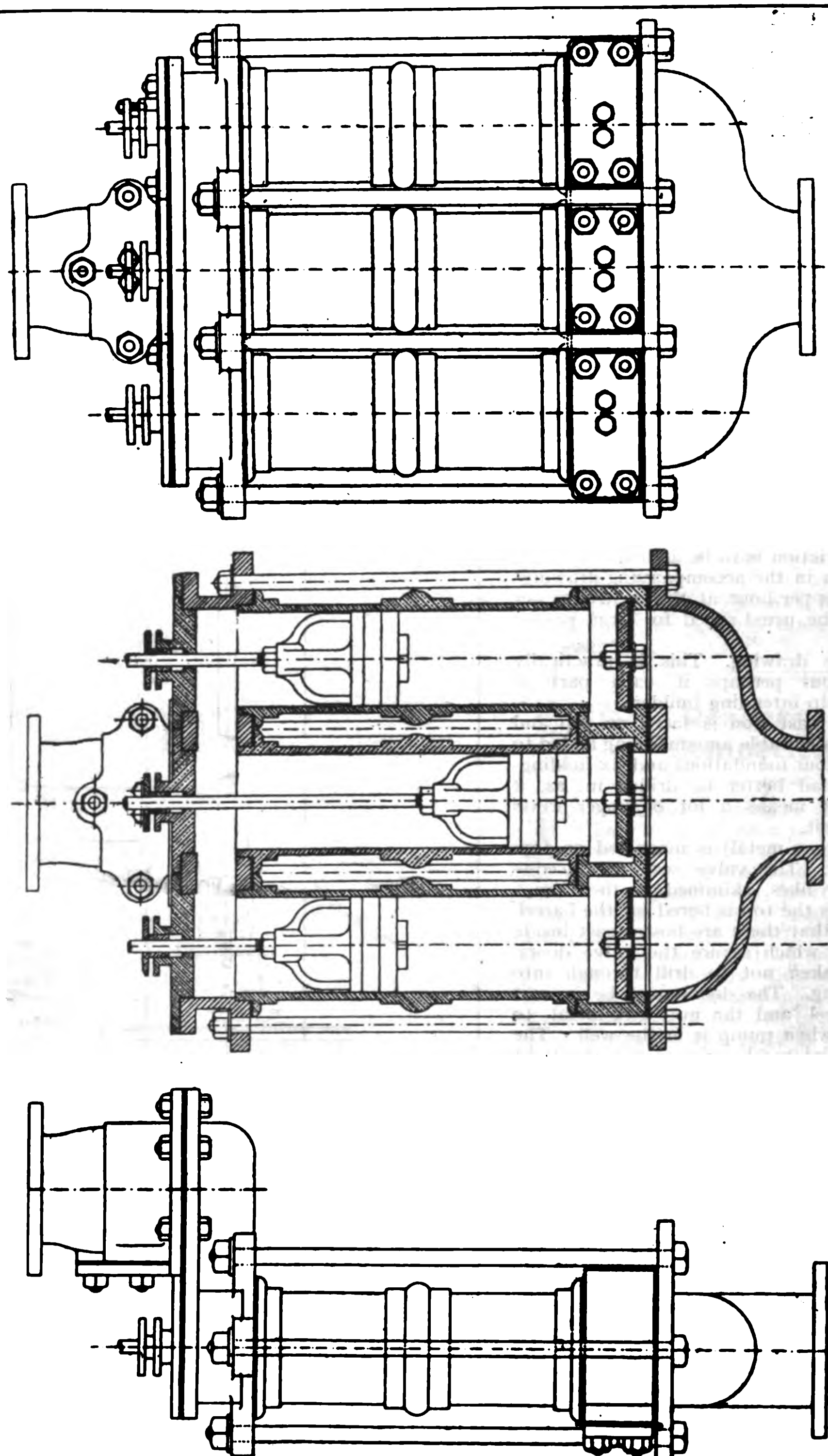
The barrel (gun-metal) requires no explanation, except that it is machined all over and the outside polished and lacquered. A 7-16ths-in. rod is fixed—driven in—to the bottom to prevent bucket going too far down when being adjusted. The covers and stuffing-boxes should be finished in the same way, as the lacquer in conjunction with grey paint, which the other parts are finished with, gives a very good finish to the pump. The bolts are coloured black.

The bucket is very simple, yet efficient. The lift of the valve is regulated by the bucket-rod, adjusted by the locknut, and should be set for a shade over 3-16ths in. To prevent the end of the rod from getting burred, a piece of lignum vitæ or indiarubber is placed in the recess in the



General Arrangement of Pump.

(*Scale*: 3-16*ths-in.* = 1 *inch.*)



FRONT ELEVATION.

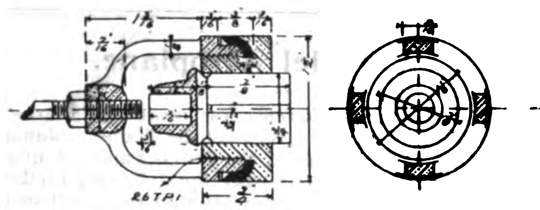
SECTIONAL ELEVATION.

SIDE ELEVATION.

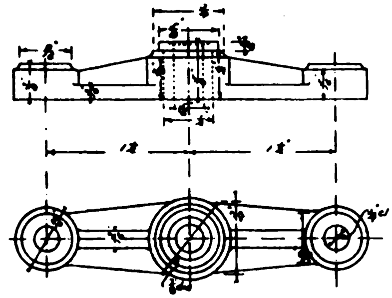
DESIGN FOR A SMALL POWER THREE-THROW DEEP WELL PUMP.

(Scale: One-third full size.)

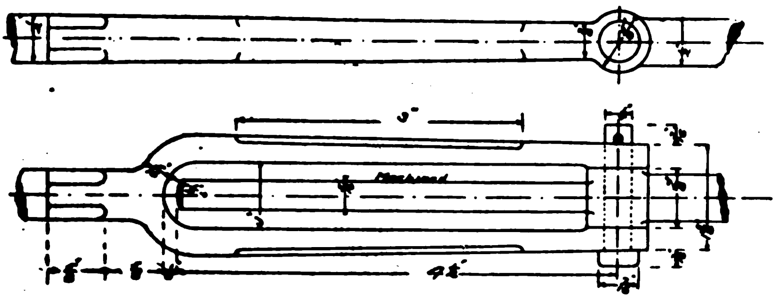
[*For description* *see pages* 419-422.



BUCKET, GUN-METAL. *(Half full size.)*

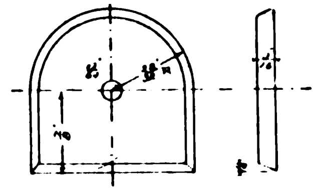


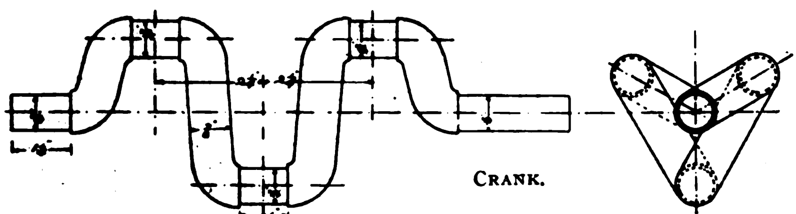
GUIDE.



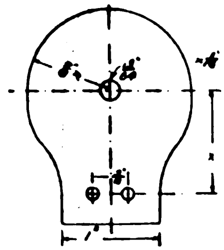
SLING.

CLACK PIECE: BRASS.

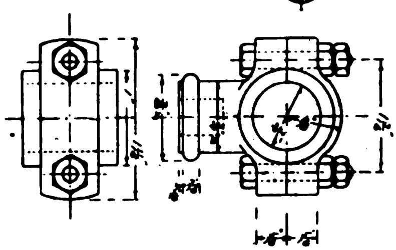




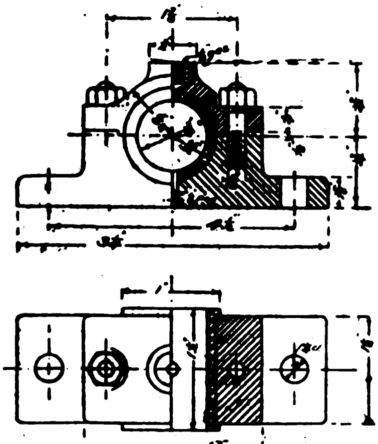
CRANK.



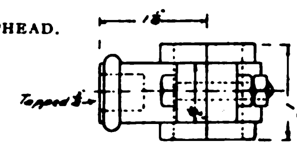
OIL DRESSED LEATHER.



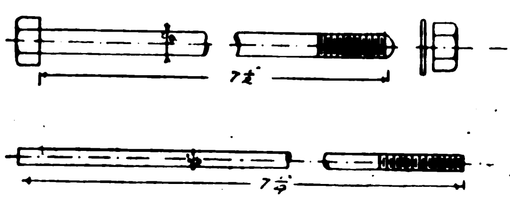
STRAPHEAD.



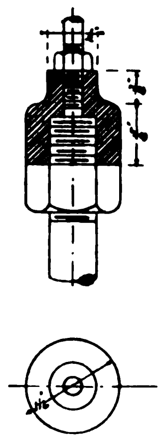
BEARING.



HOLDING-DOWN BOLT.



BUCKET ROD.



CONNECTION.

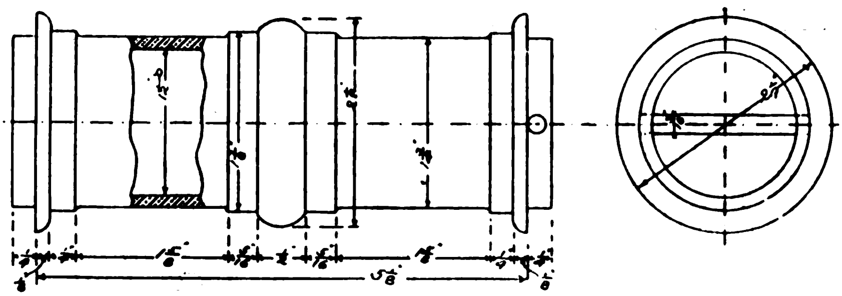
DETAILS OF SMALL POWER THREE-THROW DEEP WELL PUMP.

(Scale: Half full size.)

top of the valve. An improvement in the valve would be to make the wings on an angle, thus giving the valve a rotary movement each up-stroke and keeping the valve face from being unevenly worn. The angle found to give best results is 2½ ins. in 1 ft. But this is a refinement which the maker can please himself whether he adopt or not.

The bucket-rod is 3-16ths in. diameter, of steel. The safe loading strain of a 3-16ths-in. steel bolt (which the bucket rod practically is in theory) is 56 lbs. per sq. in., and the weight of 100 ft. of water is 44 lbs. per sq. in., so it will be seen that it is not advisable to lift much more than 100 ft.

German silver would be better than steel, as it is rustless; but, better than all, is "Silvo," a new rustless steel now on the market. If any maker does not know the name of the firm who makes it, the writer would be pleased to tell him if he cares to write to him through the Editor; but refrains from publishing the name here on well-known principles.



GUN-METAL PUMP BARREL. (*Half size.*)

Coming to the top piece. This is cast iron, faced top, bottom, and bored for barrels and covers. The outlet to delivery chamber is cored only. The stud holes will want careful drilling, in order not to break through to the wall. The flange is made ¼ in. thick to allow this, so if the holes are 3-16ths in. deep, and tapped to the bottom, this will be sufficient thread for safety.

The best plan with the holding-down bolts is to lay the top piece on the top of the tail and mark off the holes. This will make all the bolts vertical, as nothing would spoil the effect of a good job more than to see one bolt leaning one way and another another.

Care should be taken to see that in boring the holes for the barrels, the holes for the covers are bored at the same time, to get perfect alignment. The centres are exactly the same as the valve box.

The covers (gun-metal)—which should be finished before the top piece—are machined all over, and, as previously stated, are lacquered. It will be found that the two outside covers will require one flat and the middle cover two, filing on their circumference in order to allow them to bed on the top piece.

The best method to get them to fit would be to turn them to the right diameter; then, when the top piece is bored, mark off the amount of flat to be filed. Make them all three fit snugly, drill the 3-16ths-in. clearance holes, replace on top piece, and mark off the tapping holes in the latter.

(*To be continued.*)

A Model Aeroplane.

IN our last issue reference was made to "Clarke's Flyers" in the "News of the Trade" column. Mr. T. W. K. Clarke, the designer and patentee, has kindly favoured us with the following further interesting notes. We may say that this gentleman has carried out experiments on a much larger scale; his machine having main aeroplanes 39 ft. and 31 ft. long by 63 ins. wide, the surfaces being curved with the concave side underneath. He made some interesting trials on the Fox Hills, near Aldershot, ascending in the machine to a considerable height, but using three guy ropes to maintain connection with the ground, the machine being, therefore, used practically as a kite. Regarding his small models, Mr. Clarke says:—

The particular design of the flying machine known as Clarke's Flyers was the outcome of attempts by the writer to obtain an experimental aeroplane machine of high efficiency, and to be strong. The writer recognised that in order that any such machine shall pass through the ordeal of the preliminary trials for getting the best positions for the surfaces, weights, etc., and to be capable of being used for a consecutive series of experiments, it must be practically unbreakable, and the various parts must be simple and renewable. Lightness was considered of secondary importance, extra weight being only a matter of higher speed, and at the same time giving greater stability.

The type of machine chosen was—for simplicity—the so-called single deck type, with a small single subsidiary plane in front tilted up at a small positive angle to the back plane, an arrangement which the writer believes is novel, and is certainly very efficient. The frame consists of a lenticular or double bow-shaped frame of American elm with hardwood ends. This gives a frame at once tough, simple, and with considerable elasticity. It also forms an excellent medium for carrying the motive power, which consists of that simplest of all motors, a skein of twisted elastic, slung between a hook on the forward end of the frame and the hooked end of the propeller spindle.

The surfaces are made from wooden laths, bent hollow on the underside in the direction of their length, *i.e.*, their narrow dimension, and bent up at an angle at their centre, called the dihedral angle.

The main surface in the machine, with which most of the experimental work was done, was 4½ ins. long in the centre, tapering to 1½ ins. at the tips, while it was 5 ft. broad, giving a ratio of 20 to 1 between the breadth and average width, and was made from a special spruce, the thicker edge being in front. The front surface was similar, but of about one-third or one-quarter the area.

All connections, *i.e.*, between surfaces and frame, and propeller and spindle, are of a spring and friction grip nature. This serves three useful purposes :—

(1) The surfaces (or propeller) slip or yield when any part of the machine strikes the ground heavily ; otherwise the inertia of the surfaces would cause them to break away from any fixings.

(2) The surfaces can be adjusted in any direction.

(3) The surfaces (or propeller) can be changed.

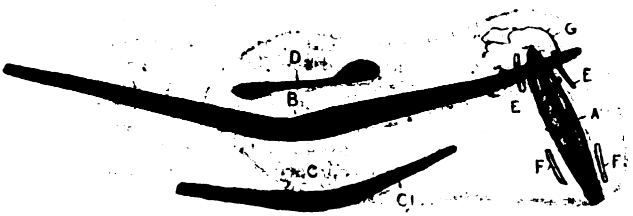


FIG. 1.—THE PARTS READY FOR ASSEMBLING.

For use in experimenting there were a set of frames with blocks of varying slopes on them for giving various tilts to the front surface relative to the back; sets of surfaces of different shapes, such as —

areas, weights, and hollowness; propellers of varying area and pitch, and skeins of elastic of varying amount ; each of the above was lettered and classified. Thus it was possible to vary different elements of the machine independently, and so try to obtain the best combination.

An interesting point about the propellers was that the tendency was to make the area too large and the pitch too small. In most cases the best propellers were those having a pitch angle greater than 45°.

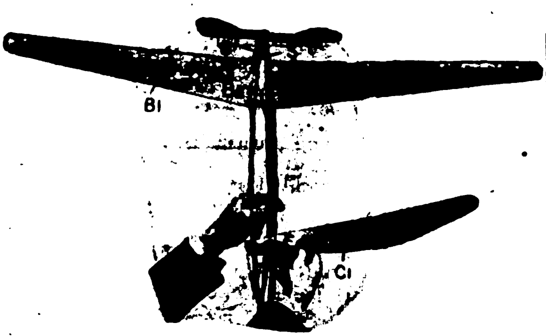


FIG. 2.—FITTING TOGETHER.

An entry for a flight on September 24th thus read :—

Head wind.	Front surf.	Back surf.	Frame.	Propeller.	Long. Position. Back surf.	Long. Position. Front surf.	Lateral Position. Back surf.	Lateral Position. Front surf.	Windings.	Elastic.	Torque (max.).	Thrust.	Distance.	Count.	Secs.	Revolutions.	Direction.	Remarks.
+3m.p.h.	F1	/1	F	1	9"	24"	¼"	½"	190	12×⅛	6×6		486	'60	13	196	R	

Under elastic, 12 × ⅛, means 12 strands of ⅛ in. square.

Under torque (max.), 6 × 6, means 36 oz.-ins. when full wound.

The thrust works out by calculation almost identical with that found by experiment. In the above it will be about 5 to 6 ozs. (max.). The distance was 486 ft. This was one of the best. The best recorded, a day or two later, was 501 ft. on ground falling away 1 in 19. The revolutions (196) of the screw were 6 more than the windings, *i.e.*, after running out and gliding it overwound 6 turns.

Multiplying the pitch of the propellers by the revolutions gives the distance that would be travelled if there were no slip; the difference between this and the actual distance gives the actual slip, and in the above case the slip worked out at $13\frac{1}{2}$ per cent., but the gliding at the end of course should not be counted. In cases where there has been no gliding (*i.e.*, revolutions less than windings) the slip has been less than 25 per cent., which is quite good.

The time was taken by counting as fast as possible, and then checking against a watch.

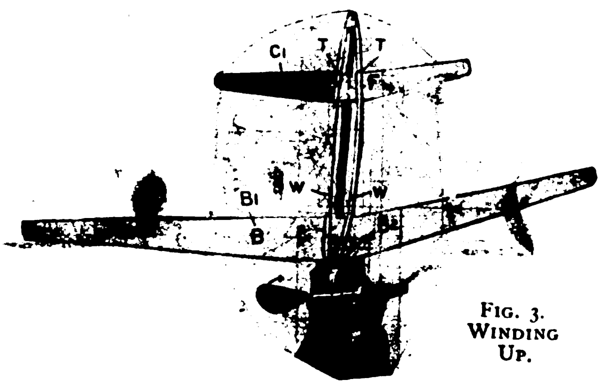


FIG. 3. WINDING UP.

The above model had $1\frac{1}{2}$ sq. ft. area, weighed $1\frac{1}{2}$ lbs., and travelled (as was expected) at 25 miles per hour, *i.e.*, 37 ft. per second. The models made since have been lighter, which makes them easier to launch, but they cannot be made to go so straight.

Model A is copied from the above, and when in trim should go over 400 ft.

Model B is rather flimsy, and should go about 320 ft.

Model C is very strong, and should go about 250 ft.

Model D is very light, and should go about 90 ft.

The writer has made some experiments with twin-screw machines, which show very good promise.

It will be seen that in the above models wood enters very largely, and in this respect it may be noted that weight for weight, properly selected wood is stronger than any of the metals. Its bulk also gives it what is almost more important, viz., local stiffness against bruising and damage.

THE Italian State Railway, after experiments, has decided to employ sleepers of reinforced concrete, and a first lot of 300,000 of such sleepers has been ordered.

The Design and Construction of Ball Bearings.

By "ZODIAC."

(*Continued from page 402.*)

IT will be obvious to the reader that unless the balls are accurately made, they will not share the load equally. If one ball is slightly larger than the rest, it will take practically all the load, and be very liable to be broken. Messrs. Hoffman guarantee that their balls are accurately ground to 1-10,000th in., both as to spherity and to size. This firm, and also Messrs. Ludw. Loewe make a ball bearing very similar to that shown in Fig. 27, these being very suitable for workshop shafting, as they are easily supported by simple plummer blocks. If the inner rings are simply a good sliding fit on the shafts, the races will adjust themselves and thus prevent the bearings binding. One bearing must have the inner ring locked on the shaft, so as to take any slight end-thrust. These bearings cost from 3s. each, so they are quite cheap. There is apt to be trouble in making the joints of the end covers oil-tight unless a thin sheet-lead packing-ring is used between the oil or dust-caps and the hanger or plummer block body.

The table showing the power that various sized shafting will transmit will be found useful in arranging workshop drives. It will be noted that the horse-power transmitted varies directly as the speed and as the cube of the diameter, so that a 2-in. shaft will transmit eight times the horse-power of a 1-in. shaft. For wrought-iron shafting 70 per cent. of the values given in the table should be taken. If the shafts are used as prime movers, *i.e.*, engine or motor, they should not be rated to carry more than 70 per cent. of the power stated. The length in feet between the bearings should not exceed that given by the formulæ :—

$$L = 4{\cdot}8 \sqrt[3]{\text{shaft diameter in inches.}}$$

assuming an ordinary proportion of pulleys. Thus, for a 1-in. shaft the distance apart of the bearings should not exceed 4·8 feet, or say 57 ins, and for a 2-in. shaft 6 ft., the cube root of 2 being approximately 1·26. Model engineers are very apt to place their shaft bearings much too wide apart ; if care is not given to this point, the bearings will be sure to bind.

Fig. 28 shows a design of thrust bearing suitable for a boat that is only required to go "ahead" and not "astern." The disc C is of tool steel carefully ground true after hardening. The thrust-ring R can be a standard cycle head-ring, and is fitted in the conical seating of the casting S, which is fixed to the boat by the lugs P. By adopting the design shown, any slight want of alignment between the shaft centre and the thrust ring centre does not affect the bearing, as would be the case if two grooved rings were used. This design, with the addition of an oil-splash guard, will be found very suitable for the tail-end of any lathe headstock, and is much more satisfactory than the usual V-shaped thrust-point. If the headstock has only one front bearing and a back V-centre, so that the V-centre has to take part of the belt pull as well as the end thrust, then the thrust ring may be fitted so that it is stationary, and the lathe pulley forms the equivalent of the part marked C.

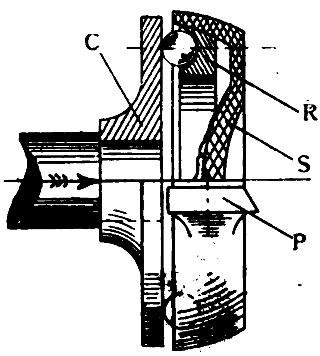


FIG. 28.—SIMPLE BALL BEARING THRUST BLOCK FOR BOAT OR LATHE.

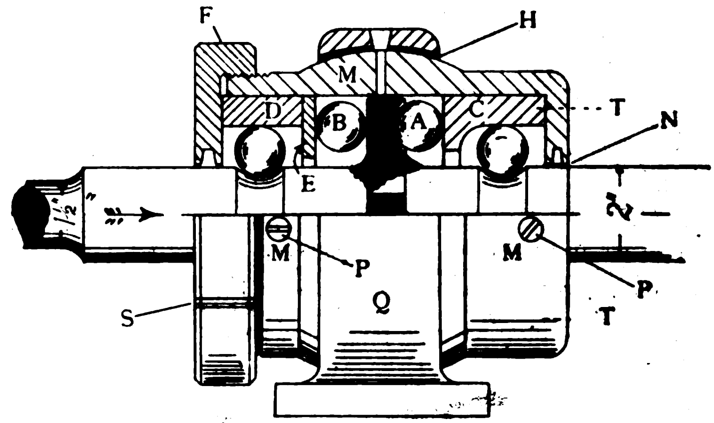


FIG. 29.—BALL BEARING THRUST BLOCK FOR BOAT.

Fig. 29 shows a thrust bearing designed for a boat motor running at nearly 700 r.p.m. The balls A take the "ahead" thrust, and are centred by reason of the shaft collar being hollowed out, as shown. The B balls are only under load when going "astern," and hence a plain flat race is adopted ; centrifugal force would tend to make them fly out and rub along the shell M ; but, as the pressure is slight, the friction from this cause would be very little ; a ball cage could be used, if desired. Two designs of ball race collars are shown, the D E race being easier to make than the C race. The races are prevented from turning in the outer shell M by the screw studs P P. Three tapped holes, spaced 120 degs. apart on the pitch-circle T T, allow of the races being forced out by means of screws, when desired. The bearing shell M is supported by the pedestal Q, and has a spherical white-metal lined seating H, so that the bearing can set itself and thus equalise the thrust on the balls. F is the locking-ring, grooved at S so as to take a circular key. The clearance N should not exceed 0·01 in., so as to prevent oil creeping along the shaft. It is quite possible to build up a very similar design by using standard Hoffman or Loewe ball bearings, thus saving a considerable amount of accurate grinding work. A ball-bearing thrust-block will well repay for the trouble of fitting, especially in the case of small boats.

The table giving the pitch-circle diameters for various numbers of balls will be found useful in designing special bearings.

TABLE GIVING DIAMETER OF BALL PITCH-CIRCLE FOR 1-IN. BALLS.

No. of Balls.	Diam. of Pitch-circle.	No. of Balls.	Diam. of Pitch-circle.
6	2·000	18	5·758
7	2·310	19	6·075
8	2·612	20	6·394
9	2·923	21	6·710
10	3·236	22	7·027
11	3·548	23	7·345
12	3·864	24	7·662
13	4·179	25	7·978
14	4·494	26	8·296
15	4·810	27	8·615
16	5·125	28	8·934
17	5·440	30	9·566

To find the pitch-circle diameter for balls other than 1 in. in diameter, multiply the above by the diameter of the ball; thus, six ½-in. balls require a pitch-circle of 1 in. diameter. Clearance between adjacent balls should be 0·005 in.

TABLE SHOWING POWER TRANSMITTED BY STEEL SHAFTING.

	Diameter of Shafting in inches.					
	1"	1½	1¾	2"	2¼	2½
R.p.m.	Horse-power they will transmit.					
50	1·0	3·3	5·3	8·0	10·9	15·6
60	1·2	4·0	6·4	9·6	13·1	18·8
70	1·4	4·7	7·5	11·2	15·2	21·9
80	1·6	5·4	8·5	12·8	17·4	25·0
90	1·8	6·0	9·6	14·4	19·6	28·1
100	2·0	6·7	10·7	16·0	21·8	31·2
110	2·2	7·4	11·8	17·6	23·9	34·4
120	2·4	8·1	12·9	19·2	26·1	37·5
130	2·6	8·7	13·9	20·8	28·3	40·6
140	2·8	9·4	15·0	22·4	30·5	—
150	3·0	10·1	16·1	24·0	32·6	—
160	3·2	10·8	17·1	25·6	34·8	—
170	3·4	11·5	18·2	27·2	37·0	—
180	3·6	12·2	19·3	28·8	39·2	—
190	3·8	12·8	20·4	30·4	41·3	—
200	4·0	13·5	21·4	32·0	43·5	—
225	4·5	15·2	24·1	36·0	—	—
250	5·0	16·9	26·8	40·0	—	—
275	5·5	18·6	29·5	44·0	—	—
300	6·0	20·3	32·2	48·0	—	—
325	6·5	21·9	34·8	52·0	—	—
350	7·0	23·6	37·5	56·0	—	—
375	7·5	25·3	40·2	60·0	—	—
400	8·0	27·0	42·9	64·0	—	—
425	8·5	28·7	45·6	68·0	—	—
450	9·0	30·4	48·2	72·0	—	—
475	9·5	32·1	50·9	76·0	—	—
500	10·0	33·7	53·6	80·0	—	—

A few remarks as to the adjustment and care of ball bearings will conclude this article.

(*To be continued.*)

Practical Letters from Our Readers.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily for publication.*]

Petrol or Oil Motor for 14-ft. Boat.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—In answer to your correspondent's letter in your issue of March 26th, 1908, under "Practical Letters from Readers," regarding a suitable petrol or oil motor for a 14-ft. L.O.A. boat, I have had considerable experience with oil and petrol motors installed in just such a boat as he describes, for the purpose of fishing on sea, river, and lake; and having used mine almost daily for six months every year for four years, I may be held to be in a position to give advice in the right direction as to reliability. Some motors are in no way fit for boat propulsion, being adapted car or other type of petrol motors. These are sold at a very low figure, and advertised as complete equipments, and certainly catch people simply on that score. The boat I have is a Clincher built, teak-fitted stout boat, 14 ft. L.O.A. by 5-ft. beam. She is decked forward as a turtle-deck, which would not perhaps be necessary for a lake boat; but the main reason of this was for stowage of petrol tank forward under cover, which is the best place for it.

To come to the main point. *The Motor*: For two years I had a two-cylinder 3 to 4 h.-p. engine, 700 r.p.m., very economical, made by a well-known maker. This was worked by a blowlamp and hot tube. Having run some 2,000 miles, under all conditions, I condemn it wholesale, and say that anyone going in for a paraffin motor in a boat is laying in for himself an endless period of trouble and repairing, due to constant breaking down. I always did my own repairing while in the boat, carrying a small workshop of tools and spares; yet I repeat emphatically, "don't" ever have an oil engine, or, rather, paraffin engine, solely worked by a hot tube. A paraffin motor with hot tube is absolutely *unapproachable* for a very long while before allowing anyone to touch it. A petrol motor is much less expensive, as a rule, in first cost, clean in working, no abominable smell of burnt paraffin, to say nothing of an everlasting smell in the boat of paraffin oil, which appears to crawl on to everything. There is really no point in favour of paraffin excepting the economy, and, as regards safety, I am of opinion that with ordinary care petrol is a great deal safer. A paraffin hot-tube motor is, owing to the erratic behaviour of the blowlamps, apt to cause conflagration, unless constant and utmost vigilance is given to it. I sold my paraffin motor, and it was relegated to sawing wood, which work it has done, I hear, admirably. I then considered every suitable motor on the market, and had an experience personally in handling some of the best. I came to the conclusion that, for reliability and entire freedom from trouble, and greatest efficiency for horse-power and perfect ease in taking apart (which can be done in five minutes), together with a minimum of upkeep in the repair line, there is not one in any way to be compared to the "Seal" motor. This firm is very well known, have had upwards of thirty years' experience, and have got the highest awards for reliability, gold medals for non-stop runs at sea in small boats of about the same size as the one considered, with engine of 3 to 4 h.-p. The motor I purchased was, by comparison, somewhat expensive to others; but it had so many points that I am thoroughly glad I decided in its favour. The horse-power of mine was guaranteed 3 b.h.-p., but it works up to 4 easily. For river or lake work I run easily 6 miles an hour. The engine is absolutely safe, and is entirely free from the liability to flooding of carburettor which many types are subject to, and also from the liability to internal explosions of a violent nature, which nearly all the two-stroke motors are apt to have in the crank cases. The two-stroke motors of the American origin I again condemn, as giving incessant worry. The electrical arrangements are of bad design, and being of the low-tension type, as a rule break down at very inopportune moments. Some are fitted with high tension—more so lately, but this kind of engine is very tricky, takes a long time to learn to work efficiently, and is expensive in petrol. *Don't have a two-stroke engine.*

Referring to the "Seal." The points are as follows: Petrol automatically drawn in and adjusted according to speed of engine; impossibility of back-firing and any harm arising. The valve for petrol is absolute simplicity, and can be got at at once. The air in "Seal" is also automatically adjusted, and so is the firing. It can only fire at the right time, and this simplifies the overhauling and assembling of parts at any time. It is all marked and carefully numbered, etc., so that even a novice can master the engine very soon. The crankshaft is made of steel of solid proportions, and balanced, and so is the flywheel. One notable point about the "Seal" engine is that it is virtually built in exactly the opposite way to all others, the cylinder having its compression end downwards, and so bringing all the weight to the lowest part, *i.e.*, the keel. Consequently, it is the most compact engine known. The cooling is automatic, no pump required, which takes away some of the horse-power in all other engines. The water enters at side of keel through a scoop, and passes below water on the starboard side. This gives no trouble, and never gets obstructed. The lid of the cylinder, with bearings, comes off in five minutes, when piston, crankshaft, etc., and interior of cylinder can at once be inspected.

In the "Seal" there are no two-to-one cogwheels; this is a thing to be avoided in all boat motors. Sometimes, through back-fires a tooth of a cogwheel breaks off, which it has done in my experience, and you are properly "done." The "Seal" method is worked most cleverly from the shaft, and the angular velocity is greater in consequence and gives greater efficiency. I have found, after running nearly 4,000 miles, that I have had no repairs of any kind to the motor whatever, and no adjustments to the valves or springs, and apparently am not likely to for some time. I am about to instal my engine again in my boat for the season, and have no trouble whatever in fitting out every year. I take engine out for winter months and look after it indoors; with a new coat of paint, it is ready to put in again. An ordinary boatman gives me help, and I fix it up entirely without outside assistance. The engine is so light that it can be, when stripped, brought on a man's back with ease. There is scarcely a part in the engine which could not be repaired by any ordinary mechanic at any time, and parts being standardised can be sent for and replaced easily, if ever required. The whole engine occupies only 15 ins. square and some 10 ins. in height off the fore-and-aft stretchers. These engines are made by Seal & Co., 3 b.h.-p. single cylinder, as follows:—

(1) For *petrol* electric ignition. High tension. Accumulator or dry batteries.

(2) For *petrol*: to start in five minutes, and then use paraffin. Electric ignition as above; but when working some ten minutes electricity is switched off and motor runs by its own explosions. In this case, of course, *petrol* could be used entirely.

(3) Lamp ignition with tube, and bulb times ignition (their own patent). High compression, lamp starts engine, and bulb keeps engine working. This with paraffin, of course.

N.B.—A combination of these can be had, whichever is desired.

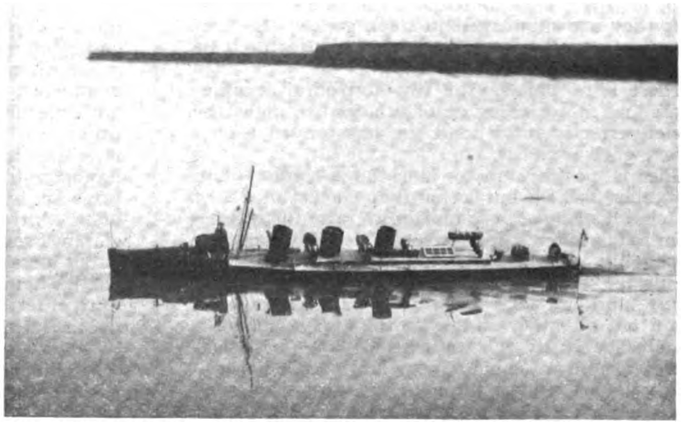
In my engine I have electric ignition with accumulator and coil. Petrol tank holds 6 gallons (forward), and I can work entirely on petrol, if desired; at any time I can change to paraffin by bi-unial tap. One paraffin tank holds 4 gallons; port and starboard under gunwale. These tanks enable me to run for some 150 miles a day. I made the tanks to design of my own. In case of breakdown, which is not likely with two accumulators, I can light up my blowlamp, heat tube for five minutes, and again work on paraffin, so can fight against a combination of bad luck. I did not pay any more for this. The engine was fitted with it, but I am of opinion, from experience of their later types, that the bulb ignition is a splendid thing, saving electricity when once started, and using petrol at first. They have also this year brought out many great improvements as regards exhaust regulation, so that almost perfection has been arrived at.

As your correspondent would be using motor for moving about on lake, to take up new places for fishing, etc., it is essential that the exhaust should be minimised so as not to disturb the fish. It is a curious fact (little known) that an exhaust into the air is more disturbing to fish than even the revolution of the screw. It seems as if the sound were conveyed through the water. Finding this to be the case, I exhaust under water, and in my boat there is no noise at all: she simply glides along, and when at moderate speed no disturbance occurs in any way, so much so that even when running at top speed, all my friends have scarcely believed it to be a motor boat.

Having given you a very lengthy discourse on the *pros* and *cons* of motors, I must now conclude, hoping I may have rendered your correspondent a service and put him on the right track to get a motor which will give no trouble. As I said before, the price of "Seal" motors is high, but is it not as well to pay slightly more and have the best? When I bought mine the list price was £54 all complete for 3 b.h.-p. motor. Seal & Co. tell me they now sell the same engine for £42—£12 *less* this year. Now this is most reasonable, and compares in price with the best types on the market. I fancy they might be open to the instalment system, and, again, you could, by advertising for a "Seal" motor, get one second-hand, as good as new, for they last so much better than any others, owing to splendid metal and manufacture. Again, I shall be very happy to give any further details as to fitting or engine I can, if he will write to me. The Seal Motor Company will forward their list and catalogue, which fully describes and illustrates their motors and their special reversible screw and shaft, also their latest types. If he should care to do so, I am sure they will give him the greatest possible assistance in their power, together with the utmost courtesy I have ever found from any firm. Dry batteries can be used, and preferably to accumulators where any difficulty exists in charging them. They are very reasonable in cost, and six at most would be required. They last a whole season, *i.e.*, six months or more.—Yours, etc.,

A. Norgate.

Cornwall.



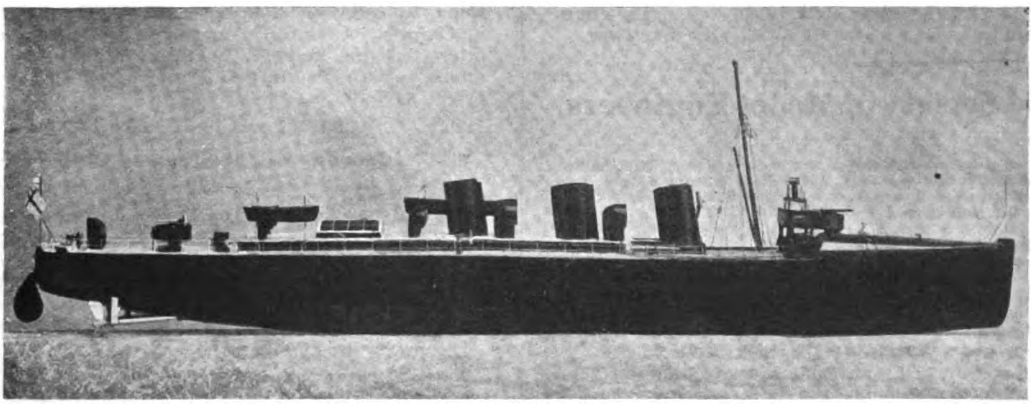
A Sea-going Model T. B. D.

To the Editor of *The Model Engineer*.

Dear Sir,—The enclosed are two photographs of a model T.B.D. that I have recently completed. This model is built as close to scale as possible; the dimensions, etc., are:—Length, 60 ins.; beam, 5¾ ins.; depth, 4¾ ins.; draught, 2 ins.; (forward); draught, 2½ ins. (aft); total weight in running order, 21 lbs.

All guns, torpedo tubes and ventilators revolve and are removable. Engine room skylights, band stand, parts of bridge, shelter, etc., are built up of celluloid. Stanchions are stout steel pins; rails, fine copper wire soldered to pins and painted. The two patent stockless anchors and cable were bought. Deck is of aluminium, boat davits of thick brass wire fitted with blocks, etc.

The armament consists of scale models of Q.F.s: one 12-pounder mounted on the bridge; five 6-pounders—two under the bridge, two nearly amidships, and one on a raised platform aft, commonly called the "Band stand"; also three Whitehead torpedo tubes.



Mr. C. E. Stewart's Model T.B.D.

The hull is built up on the "bread and butter" plan, the deck fittings are odds and ends of various descriptions, dummy funnels are of cardboard, escape pipes are very thin brass tubing from old fishing-rod joints, whistle and syren, valve parts from a pneumatic tyre, four small ventilators are old tobacco pipes, four large ventilators I had cast in aluminium from my own pattern, the 6-pounder Q.F. mountings are ·303 cartridge cases cut down, the guns I turned and bored, they are all of gun-metal, the 12-pounder only is fitted with a breech.

The propelling machinery consists of a four-pole motor and two six-volt, 8 ampere-hour accumulators, the motor taking 12 volts at about 2½ amps. when running at full power. For starting up there is a resistance coil placed in the forward funnel which only passes about ¾ amp.; the starting switch is on a bridge and is worked by moving the 12-pounders Q.F. to "Port" for about half speed through the resistance, to "Starboard" for full speed ahead; there is no reverse. The motor drives a pair of 3 in. diameter propellers through gearing (reduction

3 to 1) motor running at approximate 3,200 revolutions, per minute, propellers at 1,066 revolutions per minute *in the water.*

There is a little cavitation at full speed which is as near as possible, with accumulators fully charged and in a smooth sea, 5½ miles per hour. There are no stern glands proper, the propeller shafts are just slack in their tubes, and where the tubes enter the boat they are submerged in thick grease, the boat can run for quite 20 minutes before water need be removed.

There is no ballast, the two horizontal accumulators and motor being quite sufficient to make the model perfectly stable, and she has proved herself a very good sea-boat.

She is possibly more like the *Albatross* than any other T.B.D., but is hardly a correct model of any class, as I have been obliged to raise the engine-room hatch about ⅜-in. above the deck to make her thoroughly seaworthy. The raised platform on the bridge carrying a searchlight is fitted to H.M.S. *Crane* and all the *River* class destroyers. It was fitted as rather adding to the appearance of a model; she is, by the way, fitted with port, starboard, masthead, engine room and search lights—all 4-volt pea lamps: the lighting switch is worked from the bridge.

Altogether this model has taken about 12 months to complete, working in spare time. Many small deck fittings and ventilators found in a T.B.D. are left out, as, if fitted, they would make her awkward to handle.

She is, like her big sisters, rather "damp" in a seaway and a beggar to roll; however, this rather adds to the effect and amuses her builder, who is generally fairly "handy" in a rowing boat. On her trial trip I stayed on shore and had to watch her ram a large sailing boat and founder! She was ultimately recovered with a very long boathook, not much the worse for her wetting.—Yours faithfully, C. E. STEWART.

The Society of Model Engineers.

[*Reports of meetings should be sent to the offices of* THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.*]

London.

A VERY pleasant and interesting visit was, on Saturday, April 11th, made by a party of twenty-eight members to the paper mills of Messrs. John Dickinson & Co., Ltd., at Croxley Green, near Watford. The party left Euston by the 1.45 train, and on reaching Watford walked the 2½ miles to the mills through a pretty country, arriving at the mill at 3 o'clock. Here the guides, in the persons of Messrs. H. Howden Webb, Barton-Smith, jun., and another of the staff, met the party, which, having divided in three, commenced a tour of the many sections of the extensive mill premises. Work being in progress, the various operations necessary to produce the high-class writing and process papers for which the firm is noted were seen and explained, and the production of paper pulp from rags, esparto grass, and wood was watched, in its many and varied stages, with great interest, from the time of the arrival of the raw material by canal barge and rail to its delivery to the hopper of the paper-making machine, and from its emergence thence as paper through the numerous processes of flattening, glazing, super-glazing, cutting and packing, to the warehouse.

The power plant for the driving of the large number of different machines and for electric lighting comprises some very interesting items, particularly two recently-installed Parsons turbines direct-coupled to 750 kw. alternators supplying energy at a pressure of 440 volts and running at 3,000 r.p.m. There are also three sets of tandem compound condensing horizontal engines by Pollit and Wigzell—one giving 700 h.-p. nominal and the other two 550 and 650 h.-p., respectively. These were particularly handsome and massive engines, having a stroke of 6 ft. Steam is supplied at 150 lbs. pressure by a battery of nineteen Cornish type boilers fitted with automatic stokers. The mill employs several hundred hands, and the output of paper possible is 190 tons per week. The three parties having united after a tour lasting 2½ hours, were entertained by the firm to a very substantial tea in the spacious dining-hall attached to the mill, to which everyone present did full justice. At the close the Secretary moved that a specially hearty vote of thanks be accorded Messrs. Dickinson for their kindness in receiving and entertaining the members, and to the three guides for their untiring energy in answering the innumerable questions of the members and their lucid explanations of the many processes necessary to the making of a sheet of first-class writing paper. The vote was given with much enthusiasm. Mr. H. Howden Webb having briefly replied, the party returned to London by the 7.30 train.—HERBERT G. RIDDLE, Secretary, 37, Minard Road, Hither Green, S.E.

TO READERS IN OXFORD.—It is desired by some to establish a society of model engineers in Oxford. An intimation is given to all readers interested and resident in that district to communicate with Mr. THOS. E. FOORT, 47, Corn Market Street, Oxford.

Glasgow Model Steamer Club.

THE above club has recently been formed, and its members will be pleased to welcome any new comers who are interested in the sport. Mr. Samuel Russell is the president. The Hon. Secretary, Mr. A. C. Gaffikin, 725, Hawthorn Street, Springburn Road, Glasgow, will be pleased to reply to all communications respecting the club.

FROM time to time one hears of curious causes for the stoppage of motors. An addition to the list is contributed by Mr. Stephen Cliff, of Leeds, to the *Auto-motor Journal*, who relates a strange experience which occurred while driving his six-cylinder Napier last autumn. Suddenly, whilst going at full speed, the petrol supply failed, and on investigating it was found that an ant had by some means got into the petrol, been carried along the pipes, and eventually stuck fast in the spray nipple. Mr. Cliff thinks the fact that it stopped a 40 h.-p. Napier proves that the ant is the strongest animal in the world for its size.

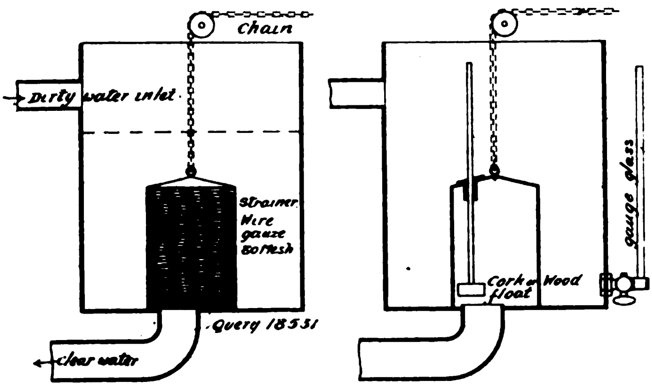
Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[18,531] **Device for Indicating Water Levels in Tanks.** E. H. R. (North Wales) writes: Can you tell me how to weld cast steel bars together? The bars are about 1½ ins. diameter. I have the use of a blacksmith's forge, if that would do. I am making a water strainer (as sketch), and want to fit an indicator to the central part to tell me the difference of pressure between inner and outer water before raising to clean, and would be much obliged if you could give me some simple plan of making indicator.



Heat to a white heat and beat together. We suggest a water level gauge or tube, and in the strainer a float, as shown in sketch above. This idea could easily be made mechanically perfect.

[18,973] **Failure of Daniell Cells.** T. S. (Dobcross) writes: I am thinking of having a small electric light in the passage to use when answering the door at night. I got your book on "Electric Batteries," price 6d., and decided to make a battery of four Daniell cells, as described in the book. I have four porous pots made out of old Leclanché cells and four zinc rods. I washed and cleaned them well, and got four copper plates, 6½ ins. by 1½ ins. and 1-16th in. thick. I have jam jars for the sulphuric acid (1 part acid to 12 parts water) for each cell. I dissolved ½ lb. copper sulphate in 40 ozs. of water for porous pots. I connected up in series, but got no result. It made a little spark when connected to two carbon pencils. In three days it would make a small 4-volt lamp red hot, but I could not get any better result. In two days after the zinc rods were completely eaten away. I got four new ones, but they were partly eaten in one night, so I have taken them out of the solution till I have received a reply from you. In the bottom of the outer jar I found the material, of which I enclose a sample. Can you tell me what it is? Also why the zinc wastes so soon, and why I get no result from the battery? I have followed the instructions out as near as possible.

We think the sole cause of your trouble is due to the porous pots not being clean in the first place. The action of a Daniell cell depends upon the inter-mixing of the two solutions, and this is evidently prevented in your case by using the old porous pots from the Leclanché batteries. If you obtain new porous pots and start afresh the new electrolyte as per the instructions given in handbook, we think you will obtain very good results. Another point which is worth mentioning is that the copper solution should always be kept more saturated—that is, some copper sulphate crystals should be kept in the solution undissolved, as described in Chapter IV of our handbook. You should also ascertain that the lamp you are using is suitable for the batteries; that is, see that it does not take too much current, and also that it is a 4-volt lamp and not a 6-volt. Another way out of the difficulty would be to add one or two more Daniell cells to those you already have and connect the whole lot up in series. This would give you a higher voltage which would probably light your present lamp quite effectively. The sample of deposit you sent appears to be a mixture of manganese dioxide, probably some crushed carbon, which is gradually being washed out of the old porous pots you have been using.

[19,577] **Calculating Approximate Charging Rate for Accumulators.** H. B. (Grange-over-Sands) writes: I will be greatly obliged if you would answer the following. What should the volt- and ampere-meter register when charging twenty-two accumulators, five plates in each cell, measuring 7½ ins. by 5½ ins., so as to charge them in the least time? I have been charging these cells by dynamo and water wheel. I run the dynamo to proper speed (slightly over ·56 volts), as the cells are 130 yards from dynamo. After charging for one hour or so, I went to look, and voltmeter was registering 30 and ampere-meter 7. I ran the dynamo to proper voltage, but the amperes went up also to 12. Would you kindly say where I am wrong, as I cannot keep it within limits. You speak in your book—"Small Accumulators, page 35—about supplying a heavy current at a given voltage. Would you enlighten me how this can be worked at will? I have no resistance in circuit with cells, as I thought I should not require any. Would you kindly say what has been the reason of field-coils charring; the volts were low and amperes high when I found this.

The charging rate for your cells should not exceed 5 to 6 amps. per sq. ft. of positive plate surface. Calculating the size of plate surface, counting both sides of the positive plates, in your case it will be 7 × 5 × 2 × 5—350, hence the charging rate may be approximately 12 amps. You should run your dynamo at such a speed that it will give a flow of 12 amps. when the cells are put in series with it. An ammeter should be used to ascertain exactly what current is flowing through the cells, as this is the only conclusive way of ascertaining what the charging rate is. The voltage is a secondary consideration, and so long as it is able to send 12 amps. through the accumulators that is all you require.

[19,056A] **Electricians at Sea.** R. V. J. (Peckham) writes: Will you kindly answer me the following questions:—(1) What power water motor will be required to drive a 10-volt 5-amp. dynamo? There is not much pressure at the water tap. (2) I desire to become an electrical engineer. I am nearly 18 years of age. As father cannot apprentice me, and I think I am too old to start in any electrical works, could I get with the electricians on board a liner, being fond of the sea? I am very handy with tools and know a little about electricity. I could study in my spare time. Will you recommend a few books suitable for me?

You will find a useful series of articles commencing in Vol. VII on "How to Become an Electrical Engineer." We do not think it probable that you would get an electrician's job at sea, because, as a rule, the fourth engineer takes charge of the electrical work on most ocean-going seaships, and on the very large liners fully qualified electricians only are taken. You might get taken on by a firm of electricians, and in this way gain some practical experience; but in order to secure such a position, you would have to make personal enquiries, either by calling upon or writing to such firms you happen to know of or see. We enclose a book list and have marked a few books which we think will be useful. *Re* water motor, you will require one capable of developing approximately ⅛ h.-p. Various particulars of small water motors have been given in these columns recently, to which we beg to refer you.

[19,056] **Bichromate Cells for Lighting Lamps.** J. F. (Southampton) writes: Would you kindly answer the following questions concerning the non-polarising bichromate battery described on page 45 of "Electric Batteries"? (1) Will three cells light a 4-volt lamp; if not, how many? (2) It states it will give a constant current for about half a week. Does that mean—supposing the lamp to be in use a quarter of an hour a day—it will require re-charging at the end of half a week, or will it last a corresponding time longer? (3) How should I obtain the sulphuric acid of the required quality, viz., specific gravity 1·84?

If you have read the query columns for the last few months, you would have come across various Query Replies on these subjects. As it is, we advise you to look up back numbers and also to study some elementary books on electricity and magnetism. To reply to your queries—(1) Three bichromate cells will give 6 volts when connected in series, hence a 6-volt lamp should be used with them, otherwise the lamp would probably burn out very quickly. (2) The time the cell will last depends upon the rate the current is taken from it. The cell would probably last several weeks if you only used it for a quarter of an hour or so every day. Remember that the zinc must be removed when the cell is not in use. (3) You should use a hydrometer to ascertain the specific gravity of the sulphuric acid. These instruments can be obtained from any of our electrical advertisers for 1s. or so.

[19,057] **Resistance Frame for Lamps.** E. P. (Manchester) writes: I wish to ask your advice as to how I would construct a resistance coil. I have got a frame, but I do not know what particular wire I must use on it. I want the coil to carry from 15 to 20 volts without undue heating. The coil is for a lamp burning in series with another lamp, both taking 5 amps. on a 200-volt circuit. I beg to ask whether 1/18 German silver would do.

Your query is not clearly stated. If you require to reduce the 200-volt supply so that a maximum of 5 amps. will not be exceeded, you must use 40 ohms resistance, 1½ lbs. of No. 20 S.W.G. German silver wire will give you this resistance, which can be used in series with your lamps and then cut out as required. No. 20 S.W.G is the smallest wire which will carry 5 amps. without overheating.

[19,061] **Model Electric Canal Boat.** A. E. (Woolwich) writes: I am working out a design of an electrically propelled canal boat (model), 1 ft. in length, worked by a trolley from an overhead wire—same system as an electric car. Not being a practical electrician, I am at a loss how to get the current. This is what I have done, as shown in the rough sketch (not reproduced). It is the overhead wire that puzzles me. The motor is a "Pet" type, and works well.

We cannot quite follow your sketch of connections, but the circuit should be as follows: From the positive pole of battery to the positive brush on motor, from the negative brush on motor to the negative trolley wire, which is connected to the negative pole of the battery. Thus you will need duplicate trolley wires, as there is no satisfactory way of making an earth return, such as is used in tramcar work. If you are using either salt water or water made slightly acid for your model to float in, you could connect the negative wire from your motor to the hull of the boat, and thus place it in communication with the water. We should be glad to have a description, with photographs, of your model should it prove a success.

[18,599] **Small Dynamo Failure.** J. D. (Darwen) writes: The dynamo sketch enclosed I bought second-hand, and on running same at from 2,500 to 3,000 per minute the only output was a faint glow on being shorted. I think it is short of wire on field, and I cannot put more on, so I am intending winding it with fine gauge. The armature is a twenty-four section drum (plain), 2 9-16ths ins. diameter by 3 ins. long; commutator, twelve segments. It is beautifully wound, and I do not wish to take wire off if I can avoid it. Above dimensions are over wire (sample same enclosed). I have tried insulation, and it is correct. Please say—Do you think it will work as a dynamo if fields are wound with finer wire? What gauge of wire should I put on field and how much? Would it be better to get new field-magnet? What should I expect to get out of a dynamo of above dimensions?

You would not get your machine to excite properly when you tried it owing to the fact that you short-circuited the armature windings, thus practically no current would be flowing in the field-magnets, as the short-circuited path you gave it would take all the available current. If you run your machine with a higher resistance in the armature circuit, you will probably find that the machine will build up and you will get it to generate at its normal voltage without further trouble. As far as we can say from the dimensions given; your machine should give approximately 150 watts output, but this can only be found accurately by actual trial. The samples of wire you enclosed are No. 18 and No. 29 S.W.G. respectively.

[19,046] **Small Lighting Plant.** H. O. (Chichester) writes: As an interested reader of your valuable journal I shall feel extremely obliged if you will advise me on the following—I wish to instal a small electric lighting plant for a private house; average size of rooms, 14 ft. by 14 ft. What I want to know is—(1) The size dynamo which a ½ h.-p. engine will easily drive? (2) The number of lamps the dynamo will light? (3) Will a volt and ammeter be necessary, also a fusebox? If you could give me a diagram of the installation, showing connections for lamps, etc., complete, I shall be very glad. (4) As two of the lamps are only required occasionally, will a resistance equal to the current consumption of the lamps have to be switched on when lamps are not required? (5) What weight travelling crane will a slide-valve cylinder (½-in. bore, ¾-in. stroke) easily drive with a boiler pressure of 20 lbs.?

(1) A ½ h.-p. engine would drive a 250-watt dynamo comfortably? (2) Reckoning 3 watts per candle-power, such a dynamo would light a lamp giving 83 c.-p. or its equivalent in a smaller number of lamps. (3) A volt and ammeter would not be absolutely necessary, but would be very useful on such a job. The same applies to a fuse. Various diagrams have been given from time to time showing simple wiring connections, and we think you will get all you require from these. You could also refer to our Handbook, "Electric Lighting for Amateurs," 7d. post free, also "Private House Electric Lighting," 1s. 3d. post free. (4) When the lamps are not required, all you have to do is to switch them off, when the dynamo will continue to run on no load as there will be no current flowing in the circuit. (5) Your enquiry *re* travelling crane is rather vague. A suitable boiler for the engine would be as Fig. 10 in the revised edition of "Model Boiler Making."

[19,029] **Boiler for 1½-in. by 1½-in. Engine.** R. T. (Olton) writes: I have a double-acting oscillating cylinder (1½-in. bore, 1½-in. stroke). (1) What size boiler of the same type as that on page 24 of the book, "Model Boiler Making," will be required? (2) What size dynamo would it drive?

You will require a boiler not less than 8 ins. diameter by 14 ins. high, containing twenty tubes ½ in. diameter. See page 32, Fig. 9c, of "Model Boiler Making," revised edition. The engine should be capable of driving a 10- or 15-watt machine. You can use the intensive burners for this boiler, which can be obtained from Messrs. Bassett-Lowke & Co., of Northampton. Oil is used as fuel.

[18,817] **Working Coil for Alternating Current.** A. H. (Tunbridge Wells) writes: May I venture to ask you to answer the following questions for me? At the above institution there is an *X*-ray apparatus which consists of a 14-in. spark coil, ammeter, and voltmeter (reading up to 16 volts), a break of the mercury jet type, and accumulators having a voltage of sixteen. I should like, if possible, to run it off the lighting circuit, which is 220 volts 70 cycles per second. If I transform down to 16 volts, would it be possible, and safe and effectual, to run that current straight into the primary and condenser without using the break at all. If the above is possible, would you give me particulars of a transformer down to 16 volts 10 amps., etc.?

It is necessary to use a break of some kind. If you merely supply alternating current to the primary of the coil, you will obtain alternating current at the secondary terminals. This would be useless for *X*-ray purposes. You will find particulars of a break for use with alternating current on page 208 of The Model Engineer of February 28th (1907), made by Messrs. Gouffe and sold by the Medical Supply Association, of 228, Gray's Inn Road, London, W.C. You would probably have to transform down to a lower voltage or have the coil primary rewound.

[19,033] **Small Dynamo Windings.** D. R. (Llanbradach) writes: I have a small dynamo, with Siemens' H armature. I have rewound the field with No. 22 D.C.C. and 10 ozs. weight, exactly as it came off. Instead of having a Siemens' H armature, I want to have a drum armature, say eight or ten slots. The armature tunnel is 1⅞ ins. diameter and 1½ ins. long. What size wire would I want to wind the same, and also what voltage would I get, going at 500 r.p.m.?

You can use a drum armature for your machine, and it should be wound with 4½ ozs. No. 22 S.W.G., and the field-magnets with 2 lbs. No. 23 S.W.G. The machine will have to run at very much more than 500 r.p.m.; 2,800 or 2,900 would be nearer the mark.

[18,523] **Hot Wire Voltmeter.** F. J. F. (Harrow). In further reply to your previous query (No. 18,523) in recent issue we may say that the firm of W. T. Goolden & Co. were well known in the early days of the electric lighting industry some twenty years ago, but they are not now in existence as a separate firm. The instrument department of the business was acquired by Messrs. Evershed & Vignoles, Ltd., Acton Lane Works, Chiswick, London, S.W., who now carry it on. You might enquire of them, and no doubt they will give you any information they can respecting the instrument. These voltmeters were well known: the inventor was Major Cardew. If you try to dispose of it by private advertisement, describe it as a Cardew voltmeter (hot-wire) by Messrs. W. T. Goolden & Co. As far as we can see, it is one of these instruments, and should be suitable for use with either continuous or alternating currents.

[19,044] **Sources of Supply for Coil Work.** A. J. S. (Molesey) writes: (1) I wish to get a current of 9 amps. 10 volts for a coil which I want to use for radiography, so I wish to keep current on for a length of time. If I use accumulators, what size is best for me? I have a lighting circuit in the house 250 volts 5 amps. Could I charge the accumulators from this circuit? Also, could I put the 250 volts, with lamps, in circuit direct into the coil; if so, how? (The coil gives a 6-in. spark.) (2) How could I earth a medical or small coil so as to give a shock with one connection? I have seen this experiment done, but do not know how it was connected up. I got a shock by only shaking hands with a friend. (3) Are bichromate batteries any good for long runs, with coils, and should a resistance be used in series with them? Would a 4-pint cell give me 2 amps.?

(1) You can use accumulators for this purpose. Each cell must be at least 20 amp.-hour size and capable of discharging at 5-amp rate. To obtain 10 volts, five such cells must be coupled in series. You could also run your coil from the supply mains by inserting either lamps or other form of resistance of such size as will give you a possible flow of current of 5 or 6 amps. (2) To earth your secondary, you need only to take a wire to any available piece of metal, such as a pipe in connection with earth. (3) Bichromate cells can be used for coil work, but they must be of a large size. Four-pint cells, ten in number, coupled in series, would be capable of discharging at 2-amp. rate.

[19,303] **Exhausting Geissler Tubes.** A. N. K. (Highgate) writes: Can you tell me what degree of vacuum exists in Tesla tubes? Would it be high or low? If possible, I should like it given in terms of mercury.

Do you mean "Geissler" tubes? As far as we are aware, the tubes generally used as vacuum tubes for experiments with electrical discharge are exhausted to about half a millimetre of mercury.

[19,583] **Testing Boilers.** F. C. (Melton Mowbray) writes: Please can you tell me if a model boiler can be tested with air-pressure from a triple motor-pump for inflating tyres, and, if so, what pressure should a bronze boiler, with shell about 1-12th in. thick, be worked?

Yes, this pump could be used for testing the boiler, but the latter will have to be pumped up through a non-return valve. Particulars of pressures for various types and sizes of boilers are given in our Handbook, "Model Boiler Making," 7d. post free. A useful method of testing boilers was given by Mr. Ferreira in his recent lecture before the Society of Model Engineers (see Feb. 6th, 1908, issue of THE MODEL ENGINEER), simply filling the boiler completely with water, and then gently heating it so as to cause expansion, the amount of heat applied determining the pressure that it will be subjected to. The pressure generated is read off from the pressure gauge fixed to the boiler in the usual way.

[19,584] **Frictional Electricity.** H. T. (Erith) writes: I would be greatly obliged if you would answer me the following query. A friend of mine told me that electricity is produced by taking steam from a boiler and passing it through a wooden nozzle, and the electricity is gathered up by means of prongs (like a rake). Could you give me details by a sketch of this plan of producing electricity. Would a boiler 10 ins. long by 4 ins. diameter be any good, and would the process be any good for ringing bells, etc.?

It is true that electricity can be generated in this way, but it is in no sense a practical method to adopt. You cannot do better than use a few Leclanché cells, if you want to fix up a set of electric bells. Our handbook, "Electric Bells and Alarms," and also "Electric Batteries," would probably interest you. See *Engineer-in-Charge*, June issue, 1907, page 83, Problem No. 27; also solution to same in July, 1907, issue. Copies can be had from this office, 3½d. each post free.

[19,526] **Electric Lighting Plant Failure.** H. C. S. (Southsea) writes: Thanking you for past help, I should be obliged if you would help me on the following. I have recently fitted up a small electric plant, but have so far met with little success. The plant consists of a twin-cylinder marine engine, 1 in. bore by ⅞-in. stroke (Stuart Turner), fitted with 6¼ in. diameter flywheel, and driven with a V.C.F. boiler (9 by 18), no cross-tubes, and single riveted, and of ⅛-in. mild steel. The dynamo I purchased from Messrs. Avery, and is a 10-volt 3-amp. size of their "Ironclad" type, with 1-in. pulley. I have fitted four 8-volt Osram lamps in parallel, but can only get them to glow slightly, and the pressure in boiler I have maintained at 45 lbs. Can you tell me what is wrong? With a large boiler could I hope for better results?

You do not mention speed, nor whether the boiler maintains its pressure when driving dynamo at full load. We should, however, recommend a boiler of somewhat larger dimensions than yours. For ordinary work under natural draught a vertical centre flue boiler should be about 14 ins. diameter and 24 ins. high. The height of firebox 12 ins. For forced draught a boiler 11½ ins. by 24 ins. high would do. Another reason why dynamo may fail to give its rated output is that the speed may not be sufficiently high; for a small machine such as yours, speed should not be less than 2,800 r.p.m.

[19,530] **Pasting Negative Plates of Accumulators.** H. L. (Bridgetown) writes: Could you advise me kindly on the following queries—(1) I have been making a small accumulator from instructions in Handbook No. 1, but have not succeeded in getting my negative plates correct. I put some strips of zinc into a strong solution of lead acetate, and the precipitate of lead formed was so tough and firm that I could not paste same in the grids of the plate. It was just like ordinary lead. Can you correct me? (2) Will litharge and sulphuric acid (dilute) not do for negative plates as well? (3) From whom can I purchase glass tubing suitable for blowing small lamps? (4) Which firm keeps No. 46 platinum wire? (5) Can you advise a good adhesive for sticking celluloid for accumulators to stand the acid?

We know that considerable pressure is required to force the crystals formed into the lead grids, but you would find the process a success if you could get the grids filled up as stated in the handbook; however, if you cannot get over that process, you can make your negative plates in the ordinary way by using a paste made of litharge and sulphuric acid, filling the plates in the usual way. *Re* glass tubes, Messrs. Whitneys, of 117, City Road, London, E.C., would supply you, or Messrs. Townson & Mercer, 89, Bishopsgate Street, London, E.C. Both the above firms would also supply platinum wire. Amyl acetate is used for joining celluloid.

[18,686] **Solders and Brazing.** R. H. C. (Dulwich) writes: I should be very much obliged if you could answer me the following questions:—(1) Which is the best material for model steam boilers—brass or copper? (2) Is there any objection in having some parts brass and others copper, in brazing or otherwise? (3) What are the melting points of soft-solder, silver-solder, and brass brazing spelter? (4) Can brass be brazed with some brass alloy in the form of a stick; if so, what should I ask for and where can it be obtained?

(1) Copper; only use brass where castings open up some advantages or are necessary, and where the tubes have to be screwed into the plates. (2) All copper is better, but if silver-solder is used, there is much less risk of fusing (or "burning") the brass portions All the best commercially made small boilers are silver-soldered, and not brazed. (3) Soft-solders—melting points, 250° to 482° F.; silver-solders—melting points, 1,300° to 1,600° F.; brazing spelters—melting points, 1,600 to 1,900° F. (4) We do not advise amateurs brazing brass and copper work. Silver-solder can be obtained in sheet, and may be cut up into strips. Brazing spelter is also supplied in strip form.

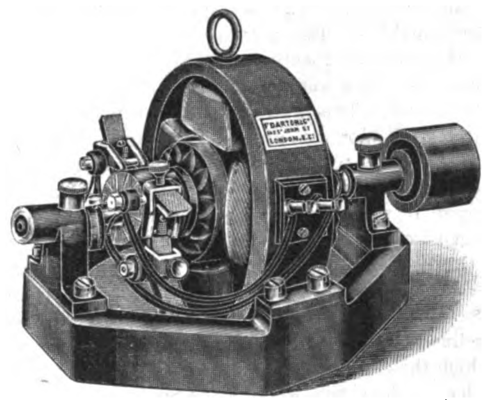
The News of the Trade.

[*The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.*]

* *Reviews distinguished by the asterisk have been based on actual Editorial Inspection of the goods noticed.*

*A Model Four-pole Traction Type Dynamo.

Those of our readers who are engaged in the laying down of model electrical railway or tramway systems will be interested in the four-pole traction type dynamo recently introduced by Messrs. F. Darton & Co., 142, St. John Street, Clerkenwell, London, E.C., and shown in the illustration herewith. This is a thoroughly well designed machine, and bears a close resemblance to the modern power generators used in electric tramway systems. The field-magnet is a one-piece casting, circular in form, with four inward projecting pole-pieces. The tunnel is bored to clear the armature. The base is a massive casting, machined on the sole, and on the faces for the bearings, and the field-magnet steps. The bearings are very rigid, and are fitted with ample lubricating arrangements. The



F. DARTON & CO.'S MODEL FOUR-POLE TRACTION TYPE DYNAMO.

smaller sizes are fitted with inverted grease cups, which hold sufficient lubricant for a ten hours run, while the larger sizes have self-oiling bearings which will run for six months without changing the oil. Both the field and armature coils are former-wound. The commutator is built up of hard phosphor-bronze, insulated with mica, and mounted on a cored steel sleeve. An original design of brush gear is fitted, having a side adjustment, to enable brushes to be set centrally on the commutator, and the tension to be adjusted by one screw only. Altogether, these machines are designed to stand long runs of hard work, and seem well adapted for this purpose. They are at present made in two sizes, with outputs of 10 volts 3 amps., and 10 volts 10 amps. respectively.

* Handy for Electricians.

We have received from Messrs. T. A. Mackereth & Co., 10, Meersbrook Bank Road, Sheffield, a combination tool which will appeal to our readers interested in practical electrical work as a very serviceable article, known as the "Handy" pocket-knife and screwdriver. The blades are encased in an insulated handle, stated to withstand a pressure of 800 volts. The knife blade or screwdriver, as required, are extended for use by simply releasing a spring fitting at one end of the handle, which also holds the tool firmly when in use. The tool is not over-bulky, being, when closed, the length of an ordinary pocket-knife and about ½ in. square. Price and further particulars can be obtained of the manufacturers as above.

The Editor's Page.

We have received an interesting letter from the Hon. Secretary of the Cape Town Society of Model Engineers, from which we are pleased to note that this body is in a flourishing condition and doing useful work. The following extract from our correspondent's letter speaks for itself :—" Although the Society was only formed in August last we have now a membership of between thirty and forty, which is, I think, a very satisfactory result, bearing in mind that in the Colonies model engineers labour under many difficulties compared with your home readers. The Society is controlled by a president, two vice-presidents (one honorary), a secretary and treasurer, and a committee of five members. By the courtesy of the Town Council of Cape Town, the Society is allowed the use of one of the committee rooms in the old Town House for holding its meetings, which take place on the second Wednesday in every month. The committee arrange the subjects for discussion two months in advance, which gives members an opportunity of preparing their subject. Our usual procedure is to devote the first half-hour at the monthly meetings to formal business, which occupies only a very few minutes, and to questions for advice. This half-hour always proves a very interesting portion of the meeting, as members who have met with difficulties in their workshops are at liberty to explain them with the aid of a blackboard if necessary, and those present volunteer suggestions as to the best means of overcoming them. I think all societies might copy this with advantage, as it encourages bashful members to get on their feet and air their views,. too many members being inclined to hide their light under a bushel—a practice which the committee have to fight against, otherwise it leaves the active work of the Society in the hands of a few. At the end of the half-hour the member who is delivering the lecture decided upon for the meeting is allowed about three-quarters of an hour for his subject, the remainder of the evening being devoted to discussion thereon. Occasionally the monthly meeting is held at the workshop of one of the members, when advantage is taken to give a practical demonstration on some branch of workshop practice, such as brazing, silver soldering, forging, moulding, etc. During last December and January the Society held an exhibition of models, tools, apparatus, etc., made by its members. The exhibit was shown in one of the shop windows of a large shop in Cape Town and attracted large numbers of people. You will recollect that you drew attention in your columns some months ago to the formation of the Society, and mentioned that I (the Secretary) would be very pleased to have catalogues from manufacturers and others catering for model engineers' requirements, for the information of members; but I regret to say only *one* firm was enterprising enough to forward a catalogue Model engineers in the Colonies have to obtain most of their requirements from home, and one would think that firms would be only too glad to obtain a share of the business. I frequently get inquiries from members for a catalogue from a particular firm. It is quite true that a person has only to write home and send the requisite stamps, and he can get any catalogue he requires; but this means that six or seven weeks (in the case of Cape Colony) elapse before you receive the catalogue, and then another two months probably to get the articles you require, so that members get in the habit of doing without the things or giving up the job and doing something which can be done without sending home for the parts or castings. I should be glad if you could draw attention to the matter again in your columns, when I trust that some of the firms will prove a little more enterprising." The Hon. Secretary of this Society is Mr. S. E. Anderson, Chester House, Rondebosch, Cape Town, and he will be pleased to hear from local readers of The Model Engineer who may not yet have become members, and also from firms at home who would like to have their catalogues consulted at the meetings.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE

Model Engineer

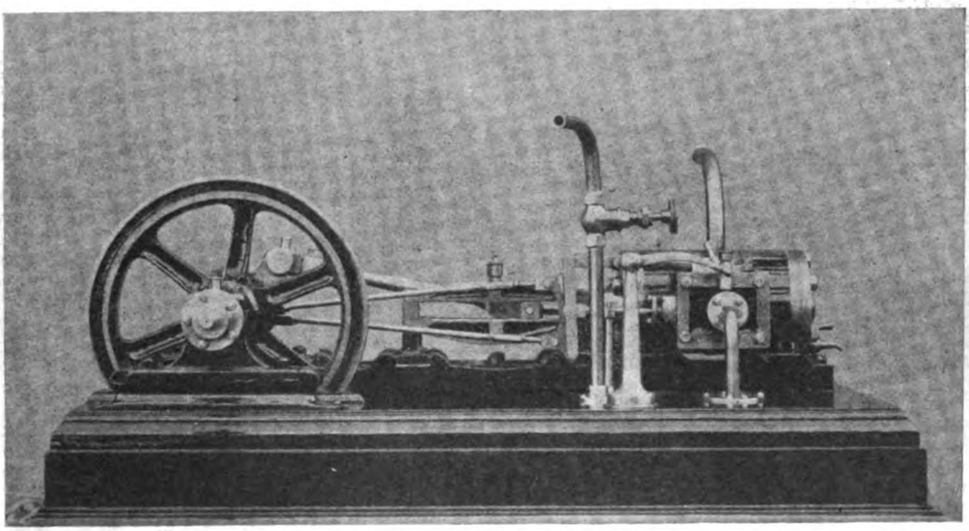
And Electrician.

A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 367. MAY 7, 1908. PUBLISHED WEEKLY.

A Model Horizontal Reversing Steam Engine.



A MODEL HORIZONTAL REVERSING STEAM ENGINE BUILT BY W. AND J. McLEAN.

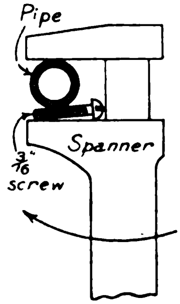
HEREWITH is illustrated the work of two brothers—W. and J. McLean, during their apprenticeship—readers of THE MODEL ENGINEER, and residing at Kilmarnock, N.B. Following are a few of the dimensions and particulars of the engine:—The soleplate is of cast iron, 18 ins. long; cylinder is also of cast iron, 2-in. bore by 3½-in. stroke. The piston head is fitted with two rings. The piston-rod is 5-16ths in. diameter, connecting-rod is of the barrel type, 7-16ths in. diameter at centre, tapering to 5-16ths in. at ends. It is also fitted at both ends with straps having gibs and cotters to take up any wear. The crank-pin is ⅜ in. diameter, crankshaft ⅝ in. diameter, having flywheel 8 ins. diameter by 1 in. broad. End of shaft is fitted with a coupling having six bolts, ⅛ in. diameter. The eccentric pulleys are turned out of the solid, the straps being of brass. The rods are made of 3-16ths in. steel wire, having nuts at end, right and left-hand screws for regulating slide-valve, the spindle of which is ⅛ in. diam., having also a steadying column—as can be seen in photograph. The upright pipe is for attaching to boiler, it being of 5-16ths in. copper tube, and fitted with stop valve. The cylinder is jacketed, and has two brass tie straps. It is mounted on a neatly finished oak stand. Under steam, with a pressure of 35 lbs. per sq. in., the engine has attained a speed of 250 r.p.m.

Workshop Notes and Notions.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume if desired, but the full name and address of the sender MUST *invariably be attached, though not necessarily for publication.]*

A Makeshift Pipe Wrench.

By "H3."

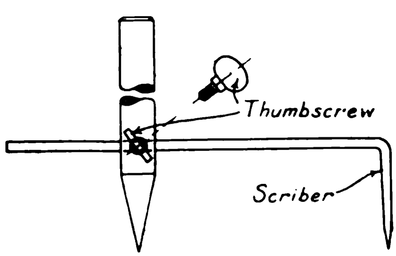


A good substitute for a pipe wrench for small pipes up to ½ in. is made by placing a 3-16ths-in. stove screw between the pipe to be turned and the fixed jaw of an adjustable spanner, as is shown in the sketch.

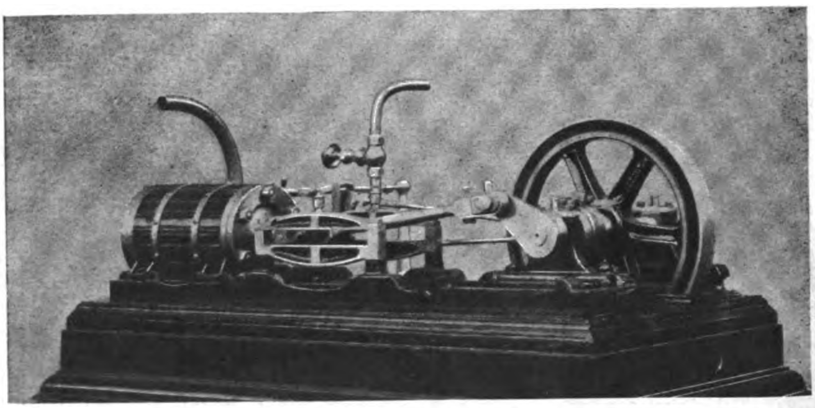
A Useful Centre-Punch.

By C. W. Brumhill.

A centre-punch of novel form, which will prove itself very useful in boiler-making and in work where a number of holes are to be marked out at an equal distance apart, is explained in the sketch below. Although very simple, it is much handier and quicker than dividers. The points of the punch and scriber should be set at required distance and after making the first indention, put the scriber point into it and make another, and so on. To avoid the scriber slipping, a small locknut should be inserted between the setscrew and punch.



A Centre Punch.

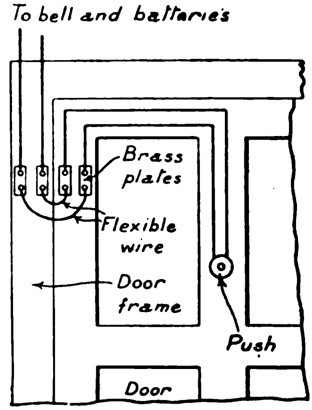


Another View of Engine described on the Front Page.

A Useful Wiring Hint.

By W. Dobbins.

A simple way to avoid the breaking of wires where the push for an electric bell is placed in the centre of door is shown in the sketch herewith. All that is needed being four brass plates 1 in. by ¼ in. by 1-16th in., eight small round-headed brass wood screws and washers, and two pieces of flexible wire, as used for electric lighting. The sketch shows clearly the idea.

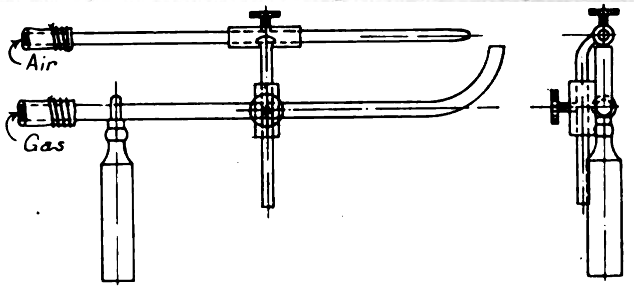


Door Bell Wiring.

Adjustable Blowpipe for Gas.

By A. Linton.

The chief feature of this device is that the blowpipe is kept at the same distance from the gas jet throughout an operation of soldering, or whatever one may be doing. Also, the gas jet and blowpipe being fastened to one handle, one is able to guide the flame to any desired position while applying solder or holding the article with the other hand. I think the sketch explains itself. I might say that the whole tool is made of brass, soft-soldered where necessary. The one I made was supplied with air from the mouth, but bellows would be better.



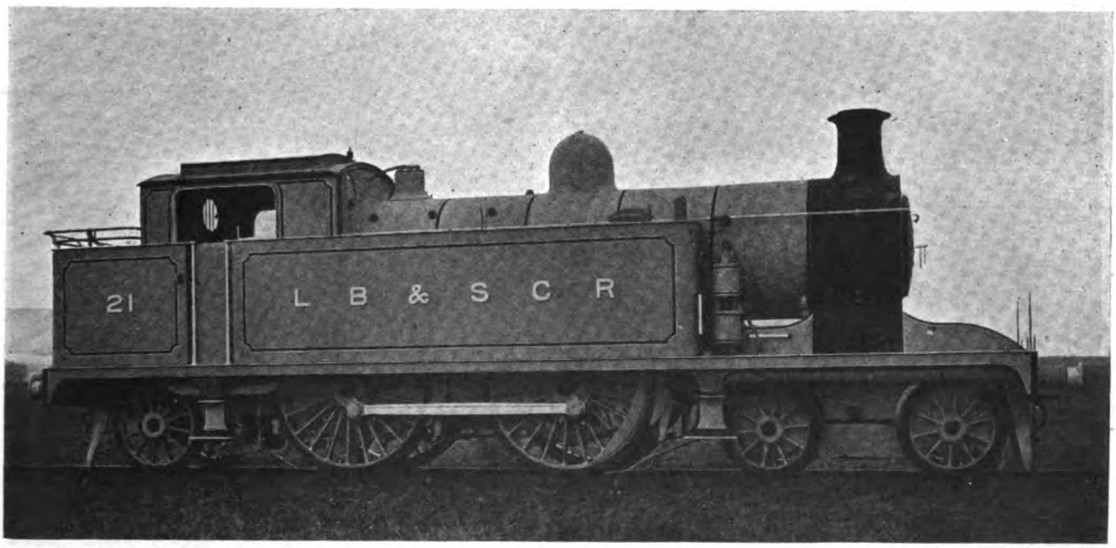
An Adjustable Blowpipe for Gas.

Locomotive Notes.

By Chas. S. Lake, A.M.I.Mech.E.

Express Tank Locomotive for the Brighton Railway.

The London, Tilbury, and Southend Railway has been demonstrating for years what can be done in the way of running heavy and fast passenger trains over limited distances by the aid of large tank locomotives, which, in reality, are the equal in most respects to express engines, except for the tender, and now the locomotive superintendent of the London, Brighton & South Coast Railway, Mr. D. Earle Marsh, has introduced a design of tank engine which is virtually one of Mr. Billinton's "Canada" class (4—4—0 with tender) locomotives, but all comprised on the one framing. Mr. Marsh has kindly provided a photograph of the engine, and from this the illustration has been reproduced. The coupled wheels are just large enough in diameter to give the engine the distinction of having the largest driving wheels yet applied to a modern tank locomotive. They are 6 ft. 9 ins., as against 6 ft. 8½ ins. of the 4—4—2 tank engines of the Great Western Railway, a fact hardly worth mentioning except that it does just effect the distinction above mentioned. The L.B. & S.C. Railway is especially suited well for the purpose of employing large tank engines, such as this one. During the summer months a very frequent service is maintained between London and Brighton, and a large proportion of this can be quite as well handled by powerful tanks as by their heavier and larger contemporaries fitted with tenders. Perusal of the dimensions of the new engine show it to be, as before stated, almost a replica in all important respects of the 4—4—0 tender engines used for main line work on the same railway. The cylinders are 19 ins. diameter by 26-in. stroke, bogie wheels 3 ft. 6 ins. in diameter, coupled wheels 6 ft. 9 ins., and trailing radial wheels 4 ft. The bogie wheelbase is 6 ft. 3 ins., and coupled wheelbase 8 ft. 9 ins., while the total wheelbase amounts to 30 ft. 11 ins. The boiler is 10 ft. 10 ins. long by 4 ft. 10 ins. diameter. The barrel contains 325 tubes, each 1⅝ ins. diameter. These provide a heating surface of 1,449 sq. ft., and the firebox adds 126 sq. ft., making the total 1,623 sq. ft. The grate area is 24 sq. ft., and the steam pressure 180 lbs. per sq. in. The boiler stands with its centre 8 ft. 4 ins. above the level of the rails. The tanks carry 2,110 gallons of water, and the coal supply is 3 tons. With the engine in full working order, the adhesion weight is 38 tons, and the total weight 73 tons.



4—4—2 Type Express Tank Engine for the L.B. & S.C. Railway.

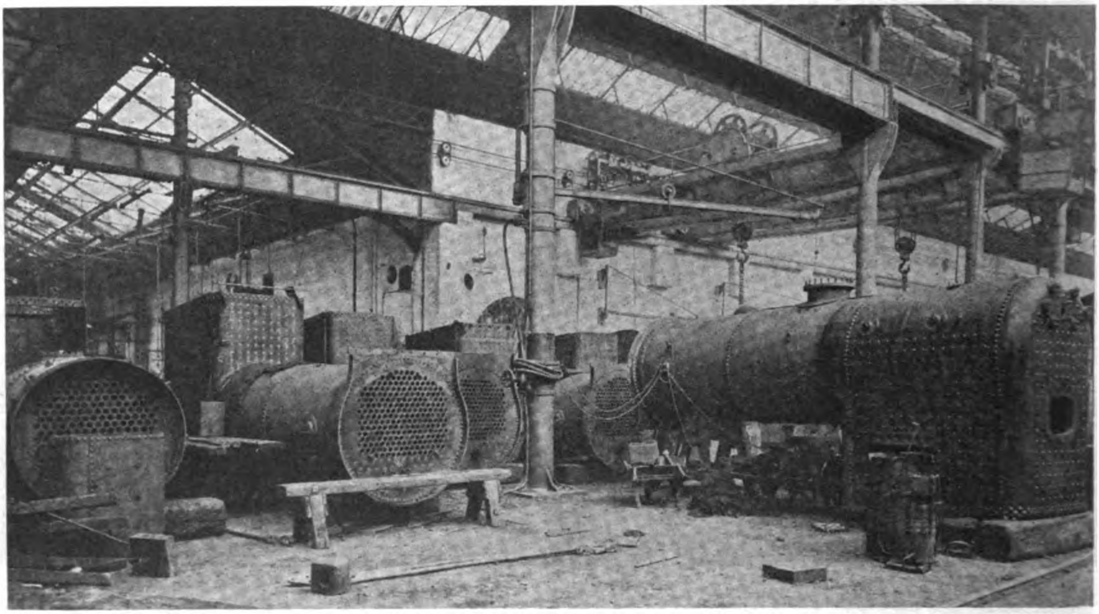
The New Great Northern Compound.

The new four-cylinder compound express locomotive recently turned out of the Doncaster Works of the Great Northern Railway, and numbered 1,421, resembles very closely, so far as outward appearances are concerned, its predecessor—No. 292—built at the same works in 1905. The details of construction, however, show on examination that differences exist in several particulars. As before, the cylinders are placed in line across the centre of the bogie, with the high-pressure inside and the low-pressure outside the frames, the outside cylinders driving the second coupled wheels and the inside ones the crank-axle of the first pair. Walschaerts valve gear is used both for the inside and outside cylinders, whereas in No. 292 Stephenson link motion actuated the valves for the high-pressure cylinders. The low-pressure cylinders are larger than in the previous case, viz., 18 ins. diameter by 26-in. stroke, as compared with 16 ins. by 26 ins. The boiler has also been modified somewhat, the smokebox extension being to the rear, and not in advance, of the chimney.

A reduction in the length between tube-plates has by this means been effected, the dimension now being 14 ft. 6 ins., against the 16 ft. formerly obtaining. The crank-axle is of special design, having as its distinctive feature the prolongation of the inner crank webs, which are bolted together at the end of the extension thus formed by four turned bolts and nuts. The total heating surface is less than in No. 292, and the simple "Atlantics" of the G.N.R., this resulting, of course, from the shortening of the tubes. It is now 2352·8 sq. ft., whilst in the other engines it amounts to 2,500 sq. ft. The grate area remains the same, as do also several other important characteristics.

The Boiler Shop at St. Rollox.

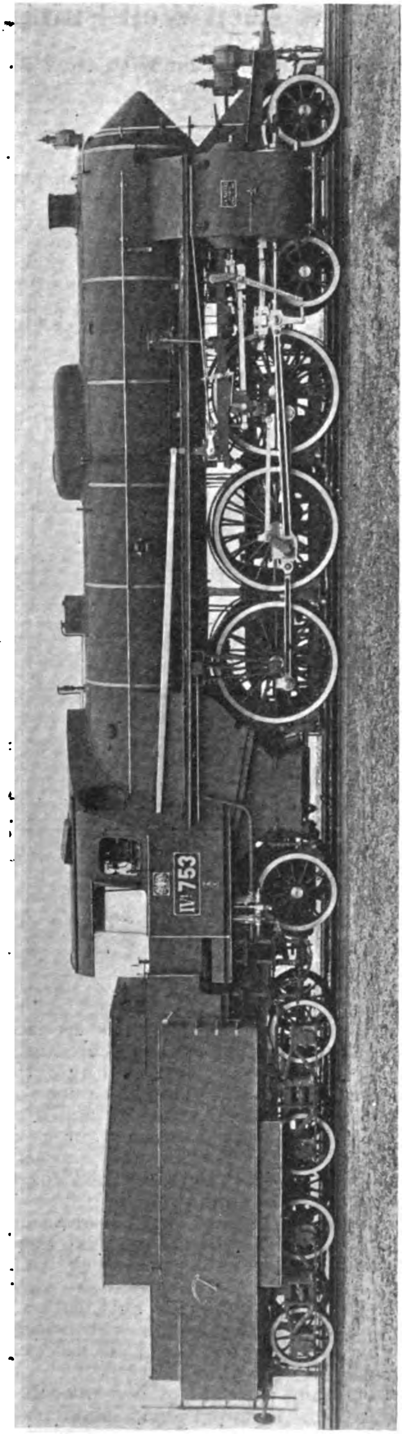
The illustration on this page presents a fair idea of the appearance of part of the boiler shop at the St. Rollox Works of the Caledonian Railway, Springburn, Glasgow. The shop is 377 ft. long by 97 ft. wide, and is replete with all the necessary plant and fixtures for manufacturing the largest locomotive boilers fitted to Caledonian Railway locomotives. There are two 20-ton overhead travelling cranes, and one of 5 tons, also several hydraulic cranes, two sets of horizontal plate-bending rolls, hydraulic portable riveting machines, pneumatic drilling and tapping machines, and a host of other and equally up-to-date appliances both fixed and portable. The hydraulic power used in the boiler shop and other departments of the works is produced by a pumping engine and steam accumulator placed near the boiler shop, the hydraulic pressure employed being 800 lbs. per sq. in.



Part of the Boiler Shop: St. Rollox Works, Caledonian Railway.

The First German "Pacific."

The credit of having first introduced the "Pacific" (or 4—6—2) type of locomotive into Europe belongs to France, and England and Germany have about tied for second place. In each of the three cases the design provides four cylinders; but, as might be expected, the English locomotive differs from its contemporaries in that it is a simple, while they are compounds. The German engine is, by courtesy of the builder, J. A. Maffei, of Munich, illustrated herewith. It is in every respect a remarkable production. As regards size, it easily eclipses both the Paris-Orleans "Pacific" and the "Great Bear" of the G.W.R.; and, secondly, it establishes a precedent in an important feature of construction. The four cylinders—which are placed in line below the smokebox—all drive the middle, and not the leading, pair of coupled wheels, as has hitherto been standard practice on the Baden State Railways, for which this new engine has been built. An alternative would have been to drive the leading coupled axle by the inside cylinders and the second ones by the outside cylinders, but this plan has not been followed. The arrangement used necessitates inclining the inside cylinders, which are the high-pressure, somewhat sharply, in order that the slide-bars, etc., may clear the front axle, and, although some engineers object to doing this, there is nothing against it in the way of practical disadvantage. There are only two valve gears in this engine for operating the slide-valves. These gears, which are of the Heusinger pattern, are driven off return cranks outside the wheels, and the inside valves, viz., those for the high-pressure cylinders take motion from the outside gear through a rocking-shaft and combining lever. The American type of bar framing is used, except at the front end, where the cylinders are attached, and here plate-frames are used. Wheel splashers are conspicuous by their absence, the only covering provided being a plate hooped over the top of each coupled wheel, and there is, of course, the running board extending the full length of the boiler above the



The First German "Pacific" Type Locomotive. *(Built by J. A. Maffei, Munich.)*

wheels. The boiler is of immense proportions, and contains a Schmidt smoke-tube superheater. The dome is encased together with the sandbox, and the only other mountings are the safety valves and whistle. The smokebox door is cone shape, and the front of the cab takes the form of a prow, these combined features tending to lessen the retarding effects of wind-pressure. All the wheels of the engine and also those of the tender are fitted with brake blocks. The tender is somewhat unusual in design. It is planned to carry a large supply of water and coal without requiring a long wheelbase, and is provided therefore with a raised tank, standing almost as high as the top of the cab. The bogies have diamond-pattern frames, similar in design to those commonly employed on American railways.

The principal dimensions are as follows :—

Cylinders—diameter : H.-P., 17 ins. ; L.-P., 26 ins. ; piston strokes, 24½ and 26½ ins.

Wheels—diameter : Bogie, 3 ft. 3 ins. ; coupled, 6 ft. ; trailing, radial, 4 ft.

Wheelbase : Coupled, 13 ft. ; total engine, 37 ft. 4 ins.

Total heating surface, 2,408 sq. ft.

Grate area, 48 sq. ft.

The tender carries 4,402 gallons of water and 6½ tons of coal. In working order, the weights are : Engine, 88 tons ; tender, 48·5 tons : total weight, 136½ tons.

A correspondent enquires whether the writer is aware that on the Glasgow and South-Western Railway " a 4—4—0 express passenger locomotive has been built which differs from the others of the same pattern by having outside cylinders." The correspondent states that he saw this engine from the windows of a corridor coach whilst passing Kilmarnock recently, and would be glad to have a list of its principal dimensions. Presumably the engine was No. 11, the four-cylinder simple built some years ago, as that is the only one of the 4—4—0 type on the G. & S.W. to have outside cylinders and modern characteristics. The dimensions of the engine have already appeared in many of the technical journals.

For the Bookshelf.

[Any book reviewed under this heading may be obtained from The Model Engineer *Book Department, 26–29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.]*

The Motor-car and Its Engine. By John Batey. London : Fisher Unwin. Price 5s. ; net ; postage 2d.

In a book of some 254 pages the author has contrived to get a very large amount of data and practical information based on results which have been arrived at through actual practice. The book deals with the source of power—that is, petrol—its nature, composition, and so on ; the volumes of gases and the effect of temperature on volume, and carburation attained by means of various methods. Chapter VI deals with the motor engine and Chapter VII with adiabatic compression and expansion. Chapter VIII deals with the application of the various principles involved in engine design and running, and includes a new adiabatic table. The Time Value of 1 lb. of petrol, and various matters connected with combustion are referred to in Chapter IX. The remaining chapters are as follows:—Heat transmissions as effects and losses; Deferred and compressed heat; Probable temperature after combustion; Radiant heat theory; Motor engine conditions; Theory and practice; The net work of expansion; Economic conditions for car engines; Influence of design; Inlet and exhaust valves; Crankshafts and bearing; Balancing engines; Flywheels; Effects of reciprocating parts, etc. To the motor-car engineer perhaps more than to the user of motor-cars, the book should appeal very strongly, as it deals with the various matters involved in engine design from a practical standpoint, and if every argument advanced is not absolutely sound, it at least opens up a wide subject for discussion, which would naturally lead to better practical results in the future.

SKETCHES OF ENGINE AND MACHINE DETAILS. By Wallace Bentley, M. I. M. E. Halifax: The Bentley Publishing Company. Price, 2s. 6d. net; post free, 2s. 9d. Price abroad, 3s. net.

The popularity of this work amongst draughtsmen, technical school teachers, and others, has resulted in the production of a fourth edition, in which has been included, with the already numerous samples of machine drawing, nearly twenty pages of new drawings, representing the most modern engineering practice. Amongst these additions may be mentioned Hoffmann's patent ball bearings, friction clutches, some oil engine details, and driving headstock for a large lathe. It is a pity, however, that, presumably for reasons of space, the drawings of the headstock have been reduced to so small a scale. Other new things are speed gear box for motor omnibus, Parson's steam turbine, safety valves, etc. We are not surprised to know that the work is considered as one of the best text-books for the use of students attending machine construction and drawing classes.

THE METRIC AND BRITISH SYSTEMS OF WEIGHTS, MEASURES AND COINAGE. By F. Mollur Perkin, Ph.D. London: Whittaker & Co. Price, 1s. 6d. net; post free, 1s. 9d.

Some strong reasons in favour of the adoption of the metric system are given in the introdution to this work; but the primary object of the author is to supply a book suitable for students of chemistry, physics, engineering, or general elementary science. Chapters on measurements of area, length, weight, volume, specific gravities, temperature measurements, money, etc., are included. One worked out example in each case is given, other examples are left for the student to work out for himself. A number of helpful diagrams are included.

Design for a Small Power Three-Throw Deep Well Pump.

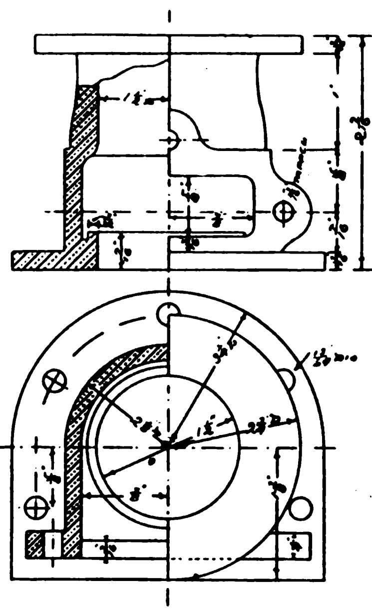
To Work in Conjunction with the "M.E." Windmill.

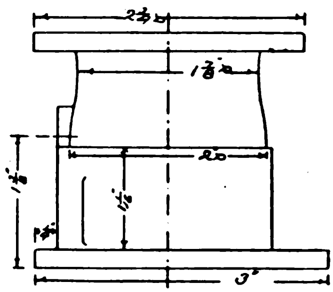
By "ENGINEER."

(*Continued from page* 422.)

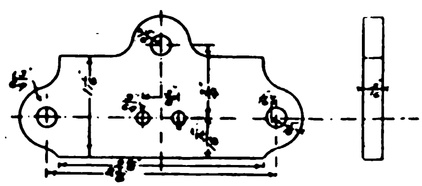
In the general arrangement 1-16th-in. jointing is shown to harmonise with the other jointing, but the writer thinks that two or three thicknesses of brown paper would be sufficient.

The delivery chamber is drawn gun-metal; but if this is objected to on the score of expense, cast iron may be used, in which case a gun-metal bush should be driven in to make a valve seat.





DELIVERY CHAMBER.



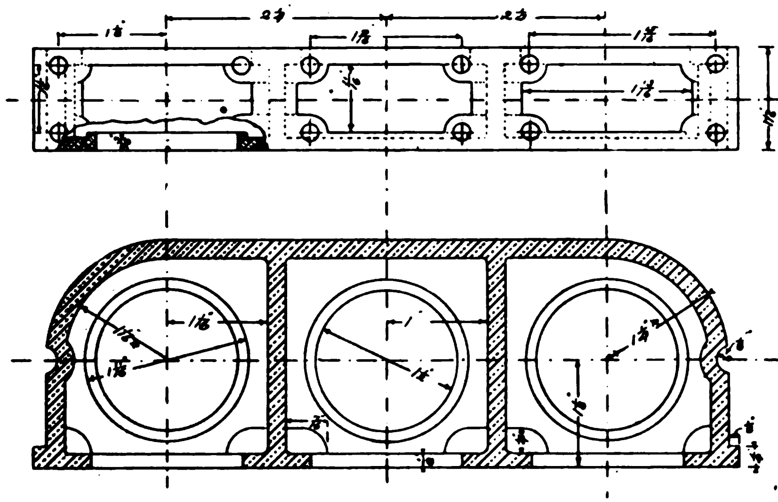
(*Cast iron cap.*)

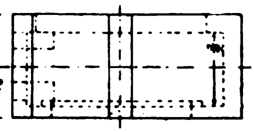
The two flanges and the valve door are faced, also the valve seat. The chamber is secured to the top-piece by 3-16ths-in. steel bolts and nuts, the valve door by steel studs and gun-metal nuts.

All the valves (four) are alike, and are of the well-known clack type, consisting of a valve of 1-16th-in. oil-dressed leather, with a brass weight on the top, the two being fastened together by 3-16ths-in. brass bolts and nut.

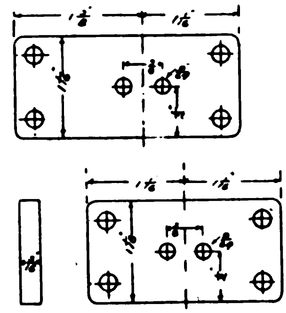
The dimensions marked X on the drawing of the leather (p. 421) is 1 7-16ths ins., but may vary a little. Therefore, the maker is recommended to fit valve together—the leather is secured to valve door by two ⅛-in. brass bolts and nuts, with a washer—and to try the valve on its seat before finally assembling the pump. Then, if necessary, the holes may be slotted till correct.

The top frame consists of two wooden bearers, on which are mounted four plummer blocks. These bearings, of cast iron bushed with gun-metal, are very simple yet strong, and will offer no difficulties to the pattern-maker.



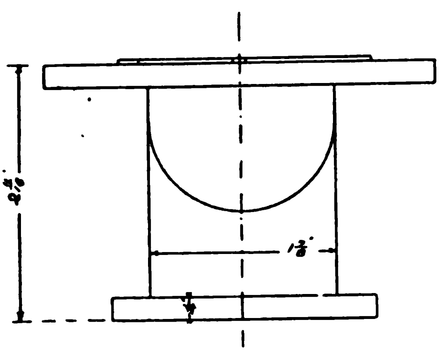


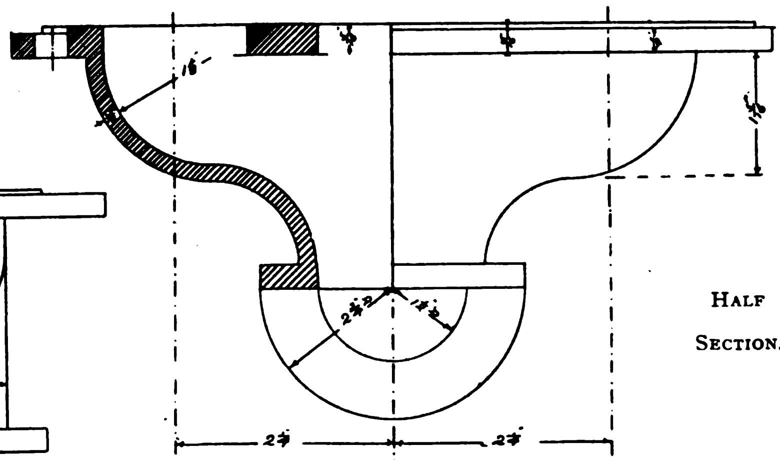
Gun-metal Valve Box. (*Half scale.*)



Covers (Cast Iron).

End Elevation.



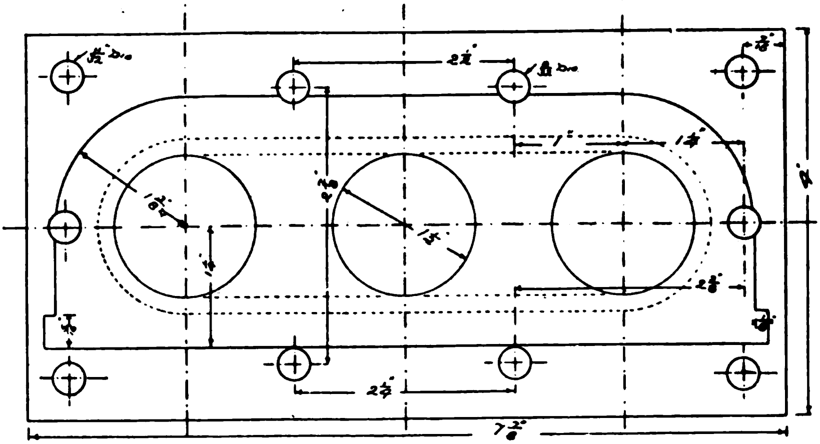


Half Section.

Plan

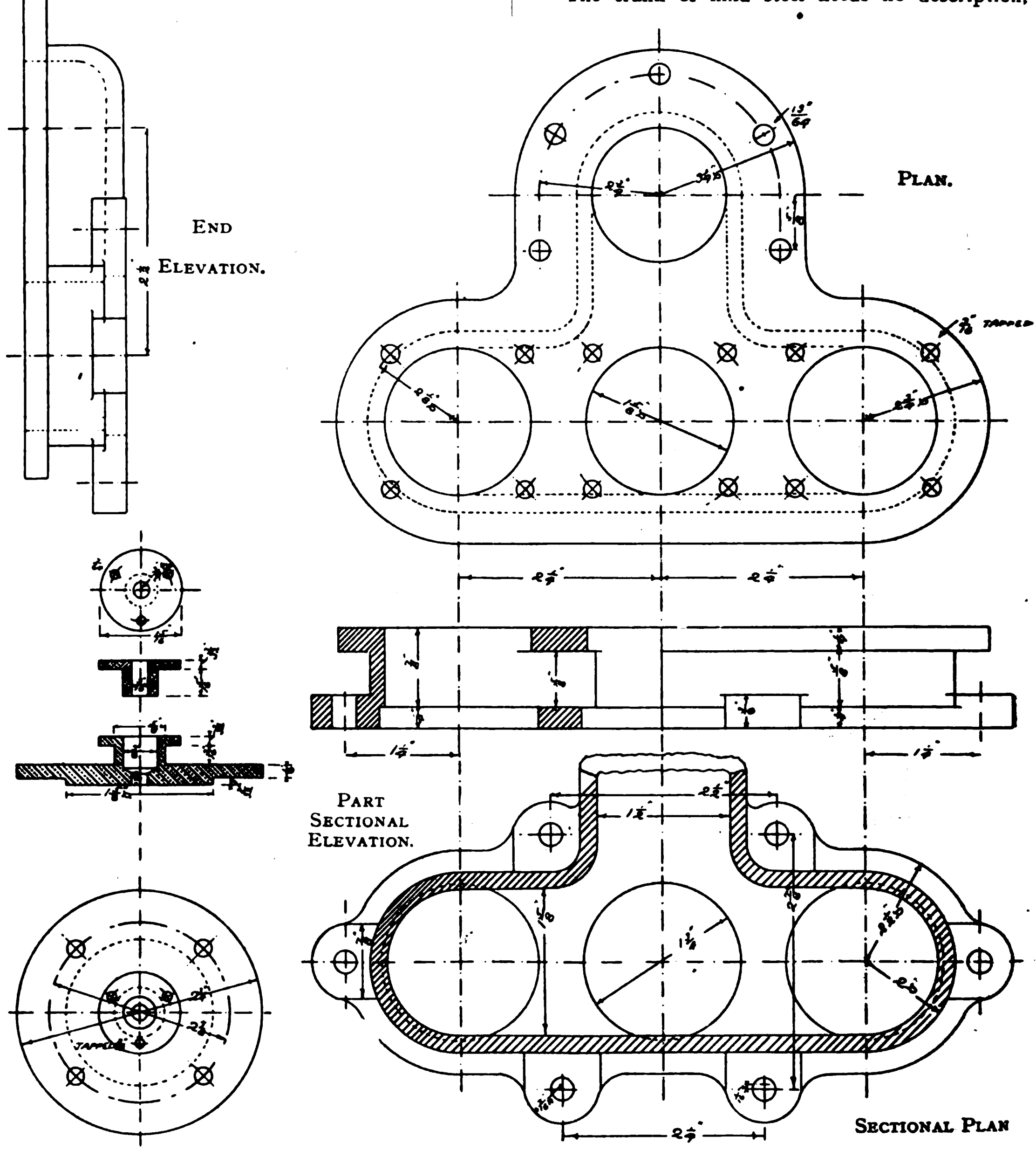
Tail Piece.

(*Half size.*)



DETAILS OF SMALL POWER THREE-THROW DEEP WELL PUMP.

It is impossible to give a drawing of the frame complete—except a front view in the general



Cover: Gun-metal. (*Half size.*) Top Part of Pump Casing: Cast Iron. (*Half scale.*)

. DETAILS OF SMALL POWER THREE-THROW DEEP WELL PUMP.

arrangement of the well—as the distance between centres of crank and countershaft will depend on the gearwheels. For the same reason no length is given on gearwheel end of crank.

The countershaft may be driven by fast and loose pulleys or coupled to the horizontal shaft from a windmill, such as described in The Model Engineer, Vol. XVI.

The crank of mild steel needs no description, neither the strap heads of gun-metal. It will be noticed that the well rod increases in diameter from the strap head to the sling from $\frac{3}{8}$ in. to $\frac{1}{2}$ in.

Three feet between the centre of crank to centre of guides would be very suitable for this size pump, but will, of course, depend on circumstances, and will vary with each well, the only fixed dimensions being not more than 20 ft. of suction, *i.e.*, the pump must be fixed within 20 ft. of the water.

The slings are forged from mild steel and left black, except the guide-rod, which is turned to 5-16ths diameter. This works up and down the guide (cast iron bushed with gun-metal), thus changing the rotary movement of the crank to the vertical movement for the pump.

The connection between the well-rod (of ½-in. wrought iron) to the pump-rod is shown very clearly in the drawing, any slight adjustment being made with the nuts.

This pump, although designed for well work, may be used for any other purpose and will well repay the maker for the time spent on it.

A Small Electric Lighting Plant.

By H. Wood.

THE small steam plant for electric lighting purposes which I have erected having proved satisfactory, the brief description herewith may be of interest to many readers. The vertical boiler is 16½ ins. high by 7¾ ins. diameter; plates, ⅛ in. thick; rivets, 5-16ths in., having a central flue 1¼ ins. diameter opening into a 2 ins. diameter chimney.

The boiler is fitted with a safety valve, and a wheel valve for regulating. A damper is fitted, which serves as well as governors to engine. Pressure gauge registers 80 lbs., and working pressure is 40 lbs. A good force-pump is fitted, which works from shaft of engine, and has cocks to regulate the supply of water, which is superheated.

The water tank, which was made from a 6-gallon (about) paint drum, has glass gauge, and when water is turned on, the pressure alone fills the boiler. The boiler is fired with coal and coke in equal proportions. Exhaust pipe is directed up chimney and burns fire white hot.

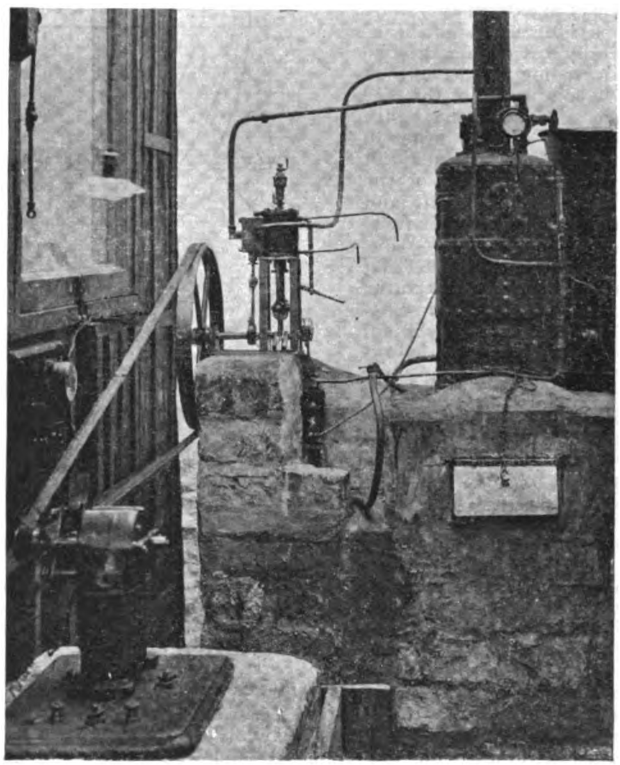
The bore of cylinder is 1¼ ins.; stroke of piston, 1¾ ins. A rather large lubricator was fitted to cylinder, as it was found more effective. It is fitted with two cocks, one of which, when set to a mark, regulates the flow of oil to efficiently lubricate the cylinder for about two hours. The connecting-rod, which is marine type, is made of forged mild steel, 2½-in. centres. Piston-rod and guides are ¼-in. diameter. Valve travel, ⅜ in., on lap or lead. Steam ports, ⅛ in. by ⅝ in., and exhaust ports, ¼ in. by ⅝ in. The crankshaft, ½ in. diameter, of mild steel, is double webbed, ⅜-in. journals. The bearings for the shaft are gun-metal, ⅜ in. thick; bedplate of engine is ⅜-in. mild steel. The steam pipe of cylinder is copper, 5-16ths in. inside diameter, and exhaust pipe ¼ in. diameter. The height over all of engine is 12½ ins.

I have fitted a pipe to boiler, to conduct the waste steam, when there is too much pressure, to bottom of water tank, where it is condensed. I might add that the boiler can be filled with water very rapidly by this pipe in the following manner:—I let the steam out of the boiler, when I have ceased running, and close all the outlets. When the boiler has cooled the resulting vacuum draws in sufficient water for the next run.

The boiler is tested by the force pump to a pressure of 80 lbs. Previous to the testing a fire is lit to raise about 15 lbs. of steam, to prevent leakage of water.

The plant has been run five hours without a stop, and during that time about two pails of coal and coke mixed and about 3½ pails of water were used.

The dynamo is an 8-volt machine, giving 3,000 r.p.m., lighting the engine shed very well with four 4-volt lamps. Occasionally a wire is run into the house from shed for lighting an extra lamp. The dynamo is an overtype with tripolar armature, with gun-metal bearings and brush rocker. The switchboard is fitted with voltmeter and switches for cutting out lights. The mahogany board on which dynamo is fixed has two guiding slots and two adjusting screws. The driving belt is oil-dressed leather, width ¾ in., thickness 1-16th in.



Mr. H. Wood's Small Electric Light Plant.

The Cunard Company announces officially that the *Mauretania's* speed from New York to Queenstown on its recent voyage was 24·08 knots.

A gas-holder for 3,000,000 cub. ft. which is being erected at Redburgh, Newcastle, will be, it is stated, the largest spiral-guided holder yet built.

The Metre Launch "Hermes."

By Thos. Dysart.

The following notes on the design, etc., of the above-named boat, together with the accompanying drawings, will perhaps be of interest to those readers who include model marine engineering in their hobbies.

In general appearance my boat* is certainly not handsome, the hull being really completed to accommodate an engine and boiler I had made during the earlier part of last year, and for which I had no other use.

Reference to the drawings will clearly show that she is not to be regarded as a typical speed boat, her lines being too bluff, although she has proved herself rather fast, having captured the Bronze Medal (in her class) awarded by The Model Engineer in last year's Speed Boat Competition; the *Hermes* averaging on that occasion a speed of 6·52 miles an hour. The first heat of 100 yds. was accomplished in 28 seconds (7·3 miles an hour), but owing to the very boisterous weather prevailing at the time, coupled with the fact that she is an extremely "wet" boat, the speed got beautifully less during the two succeeding heats, and on the completion of the race she arrived home with about 3 qrts. of water in her (and consequently all round the bottom of the boiler), the lamp out, and a drop in the steam pressure from about 100 lbs. to 60 lbs.! The steering also was very erratic, owing to the rudder somehow having got shifted, so the aid of a fellow-member's walking-stick was constantly being called into requisition. Naturally, these deflections from a straight course did not enhance her speed!

On other occasions, however, my boat has done a good 7½ miles an hour; but the great trouble is to keep her dry, and this in spite of the very high coaming which the writer found necessary to erect on her deck after the first trial run.

Turning to the hull, the lines, sections, etc., will be apparent to those readers familiar in the slightest degree with similar drawings. The hull itself is made of three-cross tinplate in ten *vertical* sections; the stern, however, being carved out of a piece of common deal plank. This latter was first roughly sawn and planed to shape; then the aftermost edges of the section at X were screwed on to it with some fine screws, and it was afterwards trimmed off and finished, following the general contour of the deck and body lines. A stout batten runs right round the deck line inside the hull, and not only tends to strengthen and preserve the shape of the latter, but comes in useful when putting on the deck. This is of 5-16ths-in. red pine, having the necessary hatchways, etc., sawn out and trimmed before finally screwing it on to the batten just mentioned.* The midship portion of the deck is left open, so as to see the pressure gauge and get at the filler; the latter, in this instance, being the collar of the safety valve, which is unscrewed for this purpose. A slight superstructure, screwed on to the main coaming, encloses the midship portion of the deck just referred to, and at each end of this is soldered a couple of very small brass hinges, which, in turn, are soldered to two hatches made of tinplate, cut to just fit the outside of the main coaming. The high "breakwater" at each end of the boat is simply a semicircular piece of tinplate, bent to the required shape and screwed to deck and main coaming. They were found to be absolutely necessary—the "forra'd" one for obvious reasons, the other to prevent the water from coming in over the stern, which inevitably happened whenever the boat was stopped.

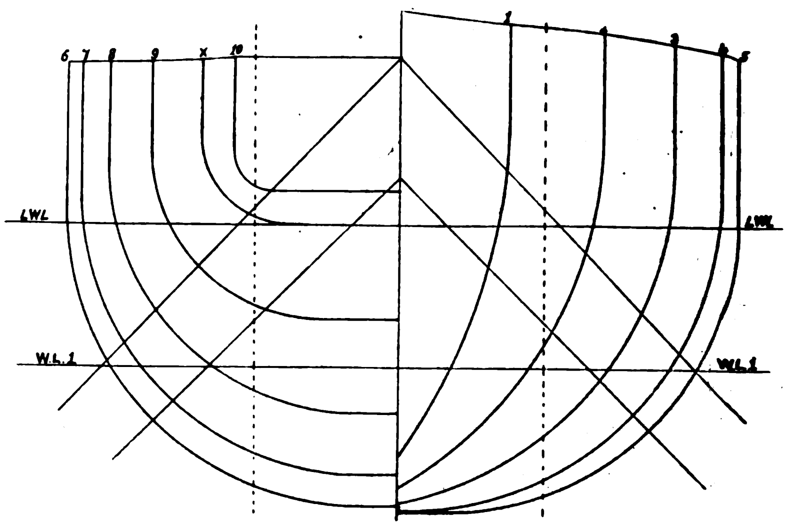


Fig. 1.—Body Plan.

It will be noticed that the boat has a fin keel, made of tinplate. This not only acts as a bracket for the propeller tube, but also tends to preserve a straight course.

The propeller tube is of brass, 5-16ths in. outside diameter. There is no gland, only a bush at each end drilled 5-32nds in. to take the shaft. Melted tallow poured down the propeller tube makes the whole thing perfectly water-tight, and seemingly there is much less friction with this method than would be met with were the ordinary gland, etc., adopted.

The rudder is made from a piece of 22 gauge hard-rolled brass, and is soldered on to a short length of ⅛-in. brass rod, which is a good fit inside of a 3-16ths in. outside diameter brass tube. This

* A photograph of this boat was reproduced on page 265 of March 19th issue.

* A coaming of the same material, ⅜ in. deep, runs round the deck for almost the whole length.

MR. THOS. DYSART'S METRE LAUNCH, "HERMES."

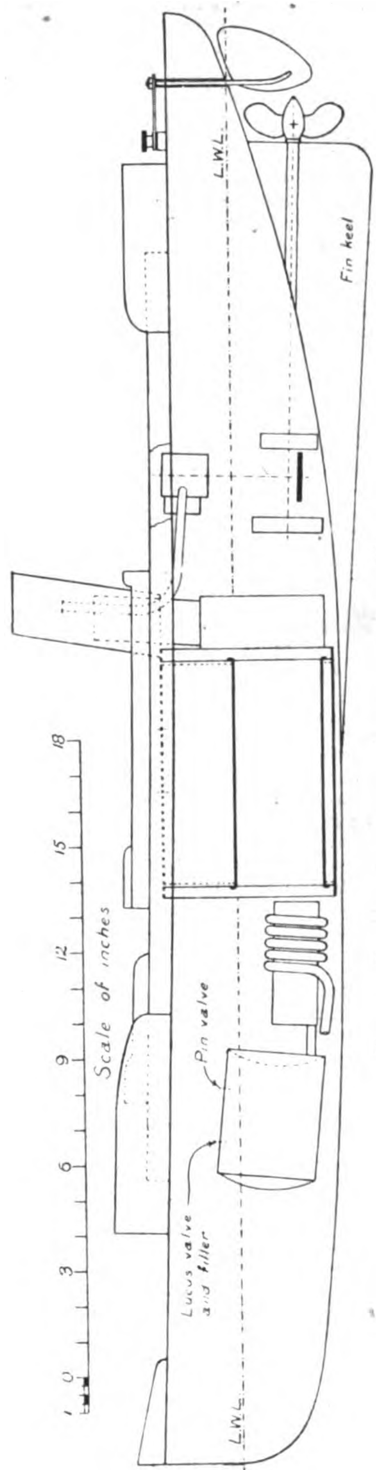


FIG. 4.—ELEVATION SHOWING ARRANGEMENT OF MACHINERY.

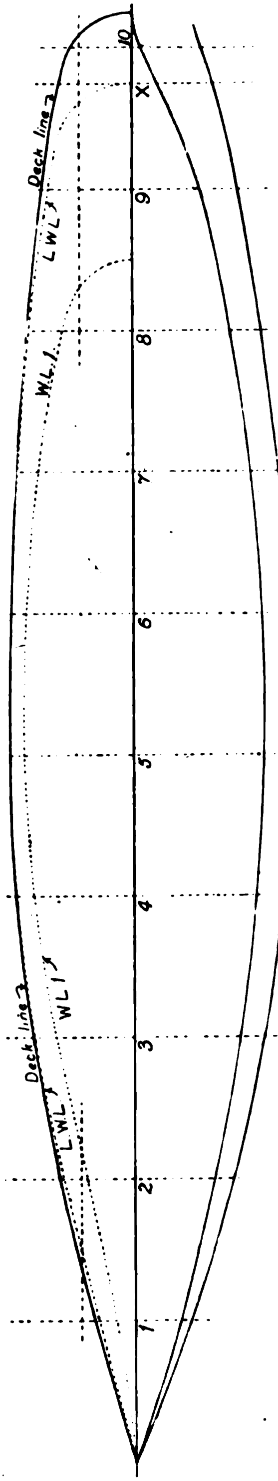


FIG. 3.—HALF BREADTH PLAN.

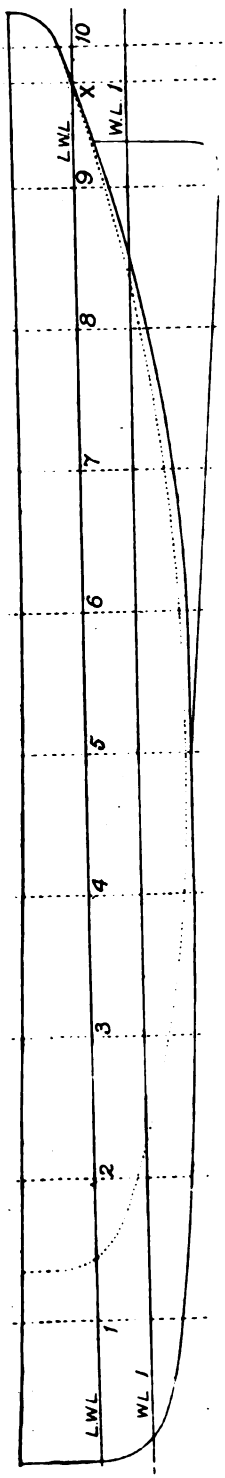


FIG. 2.—SHEER PLAN.

latter, as seen from the drawing, passes right through the boat and is soldered to the hull at the bottom end. The other end is attached to the wooden deck by means of a piece of stout tinplate (to which it is soldered) and four small wood screws. The head of the ⅛-in. rudder post is screwed 3-32nds in., and after the tiller is put on a small nut keeps the latter from shifting. The tiller is carried forward a short distance (1⅝ ins. centres), where it is secured upon a small radius-bar by a washer and clamping-down nut; in this instance, the latter being got from an old dry cell terminal.

The total dimensions of the hull are: Length over all, 3 ft. 5 ins.; length on water-line (to section X), 3 ft. 3 ins.; beam and draught (at section 5), 7 ins. and 3 ins. respectively.

The total weight of the boat in running order, with full supply of water and fuel, is no less than 17 lbs.! Of this, however, 2 lbs. of lead ballast must be taken into account.

The Engine.—Having designed this, the patterns for the cylinder and flywheels were made, and these are the only castings (gun-metal) in the engine, the remainder being made from rod and scrap.

The dimensions are: Bore, ¾ in.; stroke, ⅝ in.; steam ports, 1-16th in. (full) by 5-16ths in.; exhaust port, ⅛ in. by 5-16ths in. The total height is 4 9-16ths ins.; weight (complete), 1 lb. 5 ozs.

The ports are a great deal larger than theoretically necessary, and to this fact no doubt a large amount of the engine's success is due. The writer believes in large ports, especially in the smaller size models.

Regarding construction, the valve chest is made separate from the cylinder. After the valve face has been surfaced and the ports drilled and cut, the valve chest is temporarily secured by two 1-16th-in. screws let into a recess so that their heads are below the top surface of the latter. By this arrangement the valve can be accurately set. After this is done the valve chest and cover can be secured in position together by the four 3-32nds-in. screws provided.

The cylinder is supported by two ¼-in. diameter steel rods, which also act as guide-bars for the guides.

The crosshead and guides are of rather novel construction, but they were made so simply to suit the material in hand. Having first screwed the 5-32nds-in. piston-rod ⅛ in. at each end (one end for piston), a piece of ¼-in. square-section brass rod (⅝ in. long) was centred, drilled, tapped, and screwed on to the other end of the piston-rod. This latter was then placed in the self-centreing chuck and the bottom of the piece of brass rod surfaced. A piece of brass rod 5-16ths in. by ¼ in. by 1¼ ins. long was then cut, filed, and faced up carefully. A 5-32nds-in. hole having been drilled for the crosshead pin, it was then marked off, so that its centre coincided exactly with that of the piece already on the piston-rod. This having been done, the two were sweated together, care being taken that they did not shift during this process. The centres for the two 3-32nds-in. bolts were then marked off, the holes drilled and tapped, and the two bolts inserted, firmly securing the two pieces together. The job was then put aside and a piece of ⅜-in. hexagon brass rod to form the guides was put in the chuck, drilled, and bored a nice sliding fit on the two ¼ in. steel columns. After a little being turned off, for the sake of lightness and appearance (as shown in the drawing), the finished guide was then parted off and the other taken in hand and completed. The piston-rod (piston end) was then passed through stuffing-box and gland, the piston screwed on, packed, and inserted in cylinder, and the bottom cover, soleplate, and columns all put together and bolted into position. It was then found that the guides (one on each column) and the crosshead fitted each other exactly, so a good fillet of solder was applied, firmly securing the guides to crosshead. This construction may appear somewhat heavy, but it answers the purpose and is strong.

When erecting, care must be taken that the three 3-32nds-in. bolts used for tightening the cylinder gland do not come in line with the heads of those two used for the crosshead, as otherwise there is not sufficient clearance.

The gland and stuffing-box on valve chest are screwed and tapped ¼ in., twenty-six threads to the inch.

The piston is 5-16ths in. deep and provides for plenty of packing. That on my engine is quite tight, although it has never been renewed. Indeed, it is a pleasure to feel the suction when turning the engine backwards by hand. The writer generally uses good soft darning-cotton for packing, well soaked in motor cylinder oil before being wound on piston, and has no fault to find with it, although this engine has been worked at 115 lbs. pressure, with highly superheated steam.

A small lubricator is placed on top of valve chest.

The crankshaft is built up. A piece of iron ½ in. by 3-16ths in. and about 5 ins. long was cut with the hacksaw and provided the webs. These were faced up roughly, sweated together, and the centres for shaft and crank-pin marked off. They were then drilled ¼ in. and 3-16ths in. for shaft and crank-pin respectively, unsweated, and the requisite lengths of mild steel rod of the above diameters driven in, pinned, and the joints well soldered. Afterwards the whole job was trued up and cleaned. So far the writer has found this method prove quite strong enough, although the engine has done some very hard work, running light, the revolutions being fully 3,000 per minute.

(To be continued.)

A SMART PIECE OF WORK.—To provide siding connection into the grounds of the Franco-British Exhibition from the West London Line, it was necessary to erect a signal-box, containing a new frame of forty-seven levers, to control the junction and the signals of the Uxbridge Road Goods Depot. The order was given on February 20th, and the whole of the work was completed on March 21st.—*G.W.R. Mag.*

THE April number of the *Illuminating Engineer* contains, among other items, articles under the following headings: "The Development of the Electrical Metal Filament Glow Lamp," "Electricity *v.* Gas for Illuminating Purposes," "Illumination—its Distribution and Measurement," "The Jandus Regenerative Arc Lamp," and "A New Form of Photometer (for the comparison of sources of light which differ in colour)."

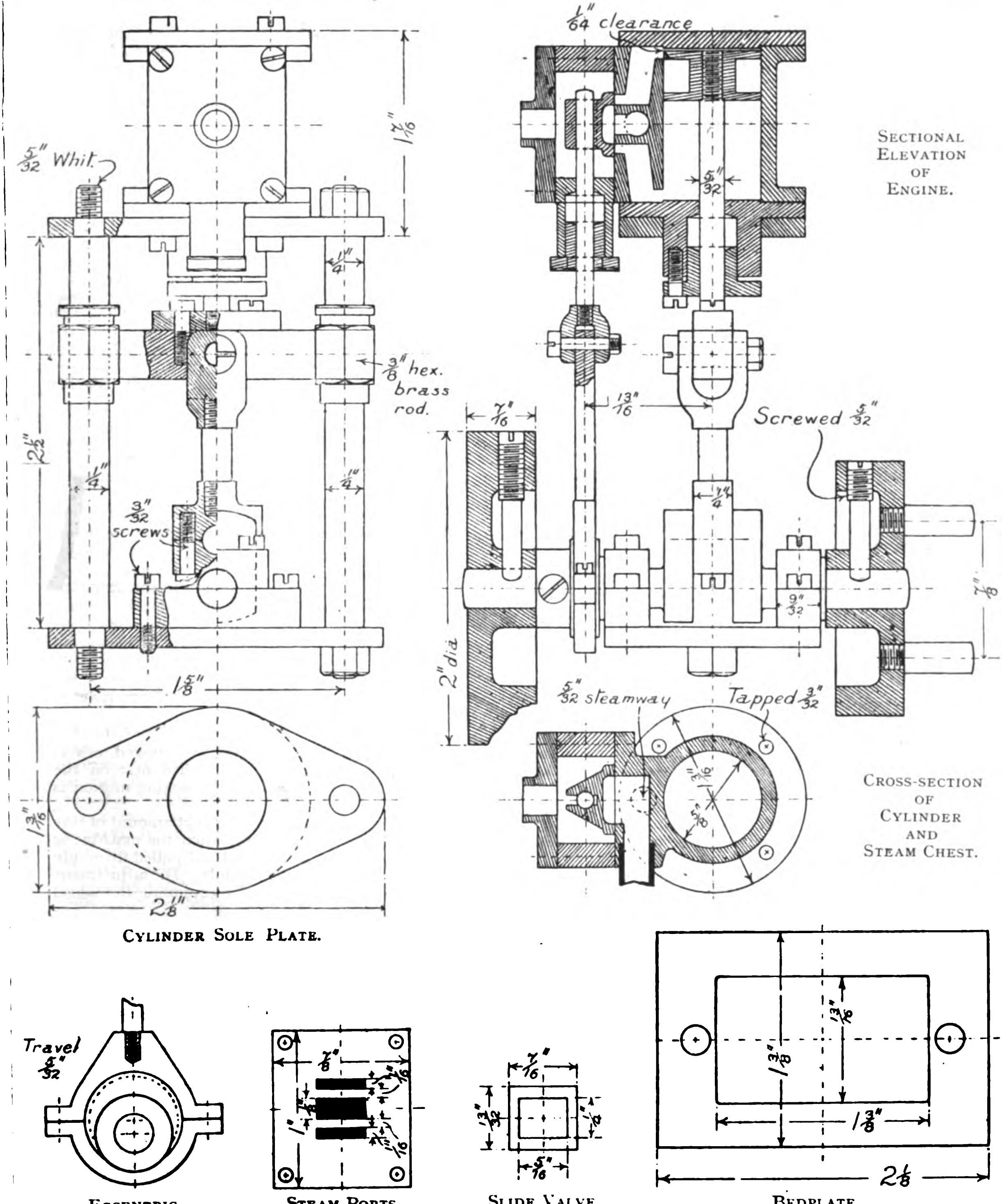


Fig. 5.—Details of Single-cylinder Marine Engine for the Metre Boat, "Hermes."

The Design and Construction of Ball Bearings.

By "ZODIAC."

(*Continued from page* 425).

No joint is as a rule permissible in the cone or the outer race of a ball bearing, as no matter how accurately the joint be machined and ground, the balls will bump over it in just the same manner that a railway carriage wheel bumps in passing a joint in the rail. The ball race being dead-hard is exceedingly brittle, so that the balls readily chip pieces off the edge of the bearing joint, this resulting in the bearing being rapidly ground to bits. The comparatively heavy pressure (per unit of area) of the balls is bound to slightly press one edge of the joint below the other, thus tending to chip the raised edge.

There is one design of bearing on the market where a small sector is cut out of the bearing so that by removing this gap-piece the balls can be introduced. The bearing is of the type shown in Fig. 7B and Fig. 27, but owing to the gap-piece the whole race can be filled with balls so that no cage or ball retainer is employed. Thus it is possible to get double the number of balls into the bearing as compared with the bearing shown in Fig. 27. In order to avoid the joint being chipped as mentioned above, the joint is arranged at that portion where the balls are not under load. Thus in Fig. 25 the joint would be at the bottom of the ring, while in Fig. 26 the joint would be at the top of the ring. If this point is not carefully attended to, the joint gets chipped and the bearing rapidly grinds itself away. Further, unless the gap piece is very accurately replaced, care being taken to see that not the slightest trace of dirt gets between the faces, the running of the bearing will be impaired.

A ball bearing should never be hammered, as the balls being very brittle will be cracked, if not actually broken. In removing a cycle crank cotter pin, for instance, a *large* hammer should always be held under the crank when knocking out the cotter pin so as to relieve the balls from the effect of the blow. It is far preferable to use a cotter pin extractor, costing 3s., as the hammering generally damages the cotter pin thread.

Fig. 30 shows an excellent method of easily removing a cycle crank cotter pin without the use of a hammer. The top end of the cotter is threaded as shown, so that it can readily be extracted by means of a spare nut carried in the tool bag.

The thread just reaches below the top face of the crank; either a ⅜-in. Whitworth thread (16 threads per inch) or a standard ⅜-in. cycle thread (26 threads per inch) can be used. A standard cycle thread has the advantage that the rider is always sure of having a nut with him, viz., the back hub axle nut (see table of standard cycle threads); on the other hand, being a finer thread it is much more easily stripped than a Whitworth thread. The weight of a ⅜-in. nut is only a quarter of an ounce (3 new penny pieces weigh exactly one ounce) so an extra nut in the tool bag is of no moment.

This improvement is very handy indeed, especially when a bent crank has to be removed on the roadside, which usually happens by the "law of cussedness" a good few miles from any town or village. The threads are easily cut by a "Pratt Whitney" or other form of taper die, or, of course, they can be cut on the lathe. In some instances there is not sufficient room between cotter pin and chain wheel to turn a ⅜-in. nut round; in such cases a tapped steel tube must be used for extracting instead of the nut. A couple of holes in the top of the tube will allow of its being turned by means of a "tommy pin."

All ball bearings should be an easy fit, a slight amount of shake or side play being allowed when assembled as a rule. No ball bearing should ever be assembled by force or needless friction and wear will result. Thrust collars on shafts should not be too tight a fit or expansion will cause trouble, 0·01" play should be allowed. In the case of a cycle, the head bearing should have no side shake at all, being carefully tightened up until all side shake is removed; otherwise the balls will wear the ball race oval. This however does not imply that the adjusting clip must be forced down so tight as to prevent the steering head moving freely to and fro. In the case of the crank-bracket bearing

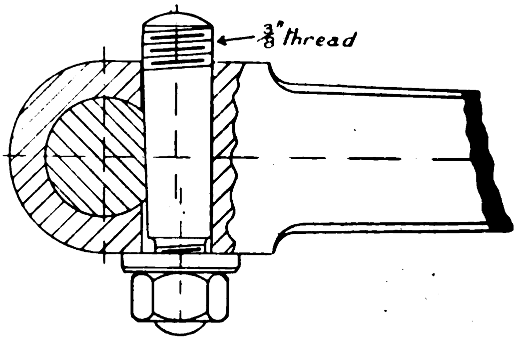


FIG. 30.—COTTER PIN SCREWED TO FACILITATE EXTRACTING.

side play should be *almost* entirely removed, otherwise owing to pressure being applied first on the one side and then on the other, a rocking motion is set up.

In the case of the wheels, a distinct amount of side play must be allowed so that when the machine is firmly held and the rim grasped and pulled from side to side a slight shake is perceptible. The adjustment of a bearing cannot be tested by spinning the wheel round rapidly.

The proper way is to set the wheel slowly in motion and note how it stops. If it stop "dead," the bearing is too tight: the wheel should swing backwards and forwards for some time before coming to rest.

A good bearing should run at least 2,000 miles without requiring adjustment unless the cycle is brand new, when a very slight adjustment is sometimes required after the first 150 to 200 miles. It is then also advisable to thoroughly clean the bearing with paraffin so as to remove any small particles of plating which may have chipped off the edge of the hubs and got into the ball race. Most bearings get too much adjusting or rather "tampering" with The very best cycle will run "hard" or "heavily" if too tightly adjusted.

Lubrication does not play so important a part as regards reduction of friction in the ball bearing as it does in the ordinary bearing, owing to sliding friction being almost absent in the ball-bearing.

On the other hand the lubricant assists the balls in distributing the load.

For instance, in a three-point bearing such as Fig. 11, a microscopic reduction in size of one ball would result in this ball tumbling idly about and taking no load, were it not for the film of oil. The oil also tends to keep out dust, especially if a thick oil is used. Theoretically, large sized balls introduce less friction than small balls as they do not sink so far into the surface of the ball race, just in the same way that a large cart wheel runs more easily than a small cart wheel, especially on soft ground. Of course, in practice the amount by which the balls sink into the surface of the ball race is quite minute, so that the difference in friction is hardly measurable. Lubrication has also a very deadening effect on the noise, tending to cause the bearings to run quietly, by acting as a cushion between the balls, as already pointed out in connection with Figs. 25 and 26. The centrifugal force of the balls at high speeds is fairly considerable, so that it is necessary for the ball cages of high speed thrust bearings to be well lubricated so as to reduce friction between the rotating ball and the cage. Obviously, the higher the speed the greater the pressure of the ball on its cage; the centrifugal force (in lbs.) of a ball being found by the formula,

$$\text{Centrifugal force (in lbs.)} = \frac{W \times r \times n^2}{2{,}936}$$

W being the weight of the ball in pounds, r the radius of its circular path, and n the speed in revolutions per minute. The radius r being expressed in feet.

For cleaning out ball bearings so as to remove dirt and old oil, a thorough injection of paraffin by means of a syringe is most effective, only care must be taken to see that the paraffin is all drained out of the bearing afterwards, as the lubricating properties of paraffin are practically nil. To readily get rid of the paraffin it is as well to inject petrol afterwards, the petrol readily evaporating out of the bearing in a very short time. Of course, this must be done out in the open air, as petrol vapour is explosive. A good cleaning twice a year is enough for either a motor cycle or an ordinary cycle bearing if a good thick oil be used for lubricating. Neither benzine, petroleum nor paraffin should be used on a bearing for clearing unless it can be all thoroughly drained out afterwards. Needless to say, after cleaning and draining the bearings thoroughly, a good ample supply of oil should be given. If thick oil is used, one oiling will last at least 500 miles.

TABLE OF STANDARD CYCLE THREADS.

[A. & C. E. Inst. Standard] used for Cups, Cones, etc.

Sizes Ins.	Outside Diam.	Parts on which Thread is used.	Threads Per In.
5-16	·3125	Front hub axles, seat and head pins, saddle clip, bolts	26
⅜	·3750	Back hub axles	26
9-16	·5625	Pedal pins, right and left hand ..	20
·9675	·9675	Steering column	30
1	1·0000	" "	26
1·29	1·2900	Hub lock ring, left hand	24
1·37	1·3700	Hub chain wheel	24
1 7-16	1·4375	Large hub lock rings	24
1½	1·5000	Large chain wheels	24

Number of Balls usually required for Cycle Bearings :—

Steering head, 30 each top and bottom, size ¼".

Crank bracket, 11 each side, ¼"; or 9 each side, 5-16ths in.

Pedals, 14 crank end 11 outer end, ⅛"; or 10 crank end 9 outer end, 3-16ths in.

Hubs (front), 10 or 9 each side, 3-16ths in. or ¼".

Hubs (back), 9 each side, ¼".

(To be concluded.)

How it is Done.

[For insertion under this heading, the Editor invites readers to submit practical articles describing actual workshop methods. Accepted contributions will be paid for on publication, if desired, according to merit.]

Boring a Cylinder.

(Continued from page 271.)

By H. MUNCASTER, A.M.I.Mech.E.

WORK generally becomes very much more difficult as the appliances for doing it become more limited or more unsuitable, and taxes the ingenuity and resourcefulness of the workman in a greater degree, demanding the exercise of patience as well as a largely increased expenditure of time. Given suitable tools, almost any operation in an engineering shop is a very simple matter; but if no adequate appliances are available such operations are extremely difficult, if not impossible.

In the early days of the steam engine, cylinders were, for lack of means, not bored, but were cast to as nearly the size as possible, and trued by the use of pieces of sandstone or by some process of erosion whereby the unevenness might be modified. In an old book in the writer's possession, speaking of a cylinder, the reader is assured that "an error of 1-16th of an inch from a truly cylindrical form is not detected in the internal surface of the cylinder," which was considered an excedingly good job. It may be explained that it was then necessary to "seal" the piston by means of a stream of *cold* water running on to the upper surface of it.

Generally speaking, if the amateur has not access to a lathe of some sort, it is not worth his while to attempt the boring of a cylinder. And we shall assume in this article that he is possessed of a lathe having a faceplate and a loose headstock, with a screw-sleeve that is fairly lineable with the fixed headstock. Such a tool is now-a-days so easily and cheaply obtained that every serious worker owes it to himself to possess one.

Two methods have already been described in these articles—in the one case the cylinder was fixed to a saddle moving in a direction parallel to the axis of the boring bar, and the latter rotated so that the cutter was kept moving in the same plane; in the other case the cylinder was rotated and the cutter was arranged to travel in a straight line parallel to the axis of the cylinder. A third method now very commonly employed for large cylinders is where the work is fixed to a table or bedplate and the boring bar either moved along to give the feed as the bar rotates, or is fitted with a sleeve carrying the cutting tool, this sleeve travelling along the bar as the boring proceeds. However, as either of these methods involves some complications in apparatus, we shall not further consider them in these articles.

To bore the last of the cylinders previously referred to we decided to use no appliances that might not be available to any beginner in possession of a lathe and a few tools; the lathe having a back centre adjustable by a hand-wheel operating a screw, but not fitted with back-gear or slide-rest.

From a bar of $\frac{5}{8}$-in. octagon tool steel a piece was cut off about 15 ins. in length. The ends of this (Fig. 16) were carefully squared and a hole drilled into one end about $\frac{1}{4}$ in. deep and 3-16ths in. diameter. About $\frac{3}{8}$ in. from the other end a 3-16ths-in. hole was drilled to take the cutting tool, and a $\frac{1}{4}$-in, tapping hole drilled and tapped for taking a small screw to hold the cutter. A length of about 4 ins. from the end, the bottom face of the octagon, and a similar strip along the back face were filed up true. These are intended to lay against the rest so as to guide the bar in a truly parallel line. A piece of 1 in. by $\frac{1}{4}$-in. flat bar was obtained, shaped and drilled, as shown in Fig. 17.

A short length of angle iron which had been in use for clamping small articles to the faceplate was requisitioned to hold the above-mentioned, the hole in Fig. 17 being drilled to suit this, and the two pieces fitted up to make an adjustable rest, as shown in Fig. 18.

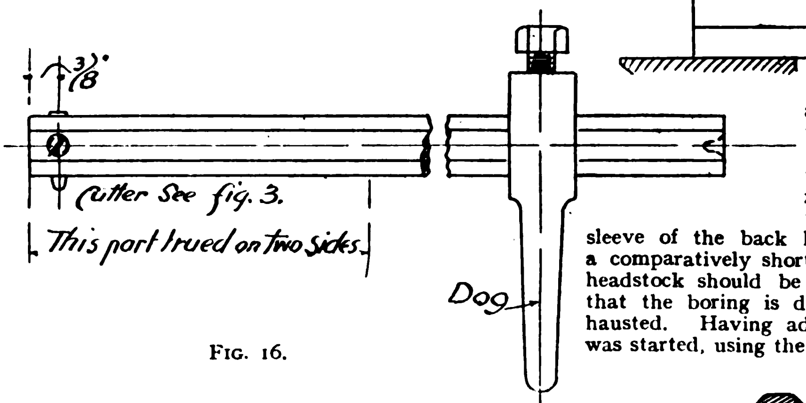


FIG. 16.

The boring bar was put between the lathe centres and the rest adjusted to bear against the two sides that had been filed true.

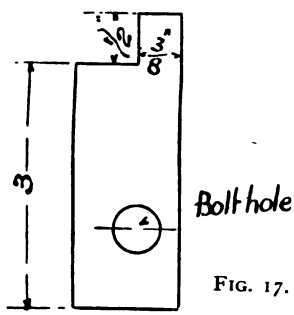


FIG. 17.

The cylinder was now mounted on the faceplate in a similar manner to that shown in Fig. 9 (page 270). A lathe carrier dog was fixed to the bar and a woodturning rest to the lathe bed, the object being to prevent the bar from turning. The whole arrangement being as shown in Figs. 19 and 20.

Two pieces of light chain were found, and one piece hung over the bar close to the right-hand side of the angle-iron, and about 50 lbs. of iron attached to act as a weight to keep the bar hard down on the support. As the chain hangs over the back of the lathe bed the pull of the weight keeps the bar against the support in both a horizontal and a vertical direction. The other piece of chain was attached to the dog on the bar, hung over the wing-nut on the loose headstock, and down by the back of the lathe bed, a weight of about 50 lbs. of odds and ends being suspended; the object of the weight being to keep the bar hard up against the back centre and not only prevent the bar from slipping off, but

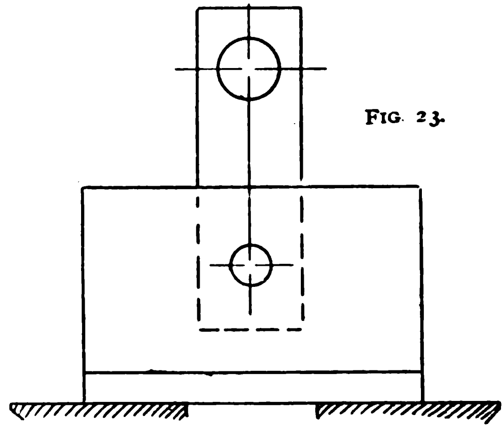


FIG. 23.

also to take up any slack in the screw of the poppet head.

It may be pointed out here that the depth to be bored is limited by the length of travel that is possible on the sleeve of the back headstock; and where only a comparatively short cylinder is to be bored the headstock should be brought up to the bar so that the boring is done before the screw is exhausted. Having adjusted the cutter, the lathe was started, using the slowest speed available without the use of the back-gear, and the feed gradually supplied by turning the hand-wheel, the amount being about $\frac{1}{2}$ in. on the periphery of the wheel at a time, and the advance made on every other stroke of the footboard. The work proceeding very satisfactorily, two cuts were taken, and the bore tested with the callipers to see if it was parallel, as it was recognised that if the supports for the

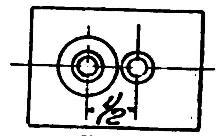


FIG. 21.

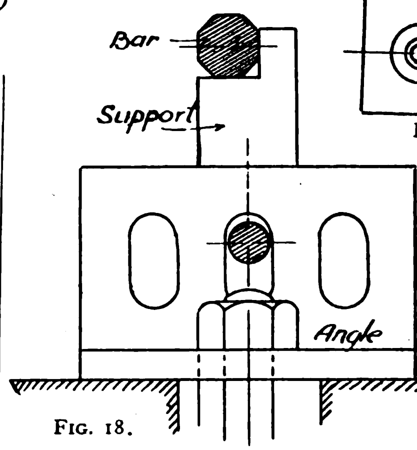


FIG. 18.

bar were not exactly in the right place the bore would be tapered and the supports require re-adjusting, any error being aggravated by using a shorter bar.

a larger cylinder (a 2 ins. diameter cylinder) was set on the faceplate and a modification of the bar made to suit.

The end of the bar next to the back centre was filed to fit a $\frac{3}{8}$ in. diameter hole in a piece of $3\frac{1}{2}$-in. by $\frac{3}{8}$-in. flat bar, as shown in Fig. 21, the support near the work being moved forward a similar

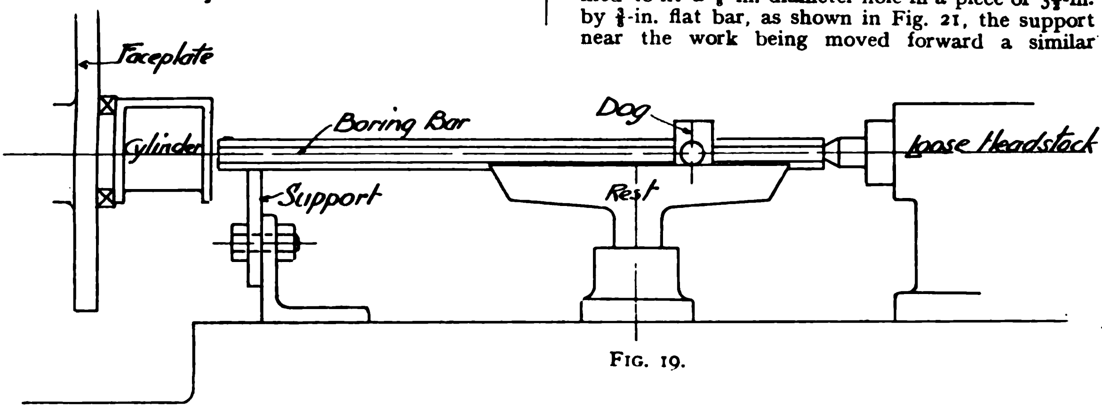


FIG. 19.

FIG. 20.

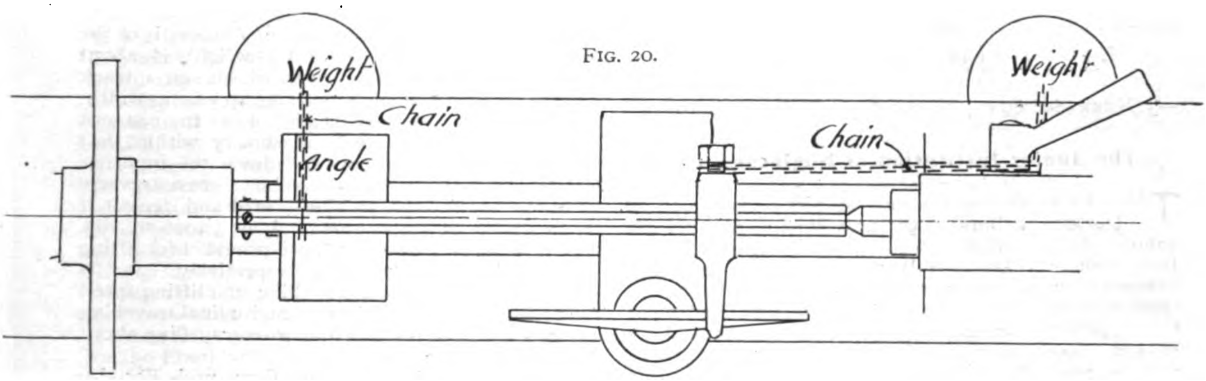
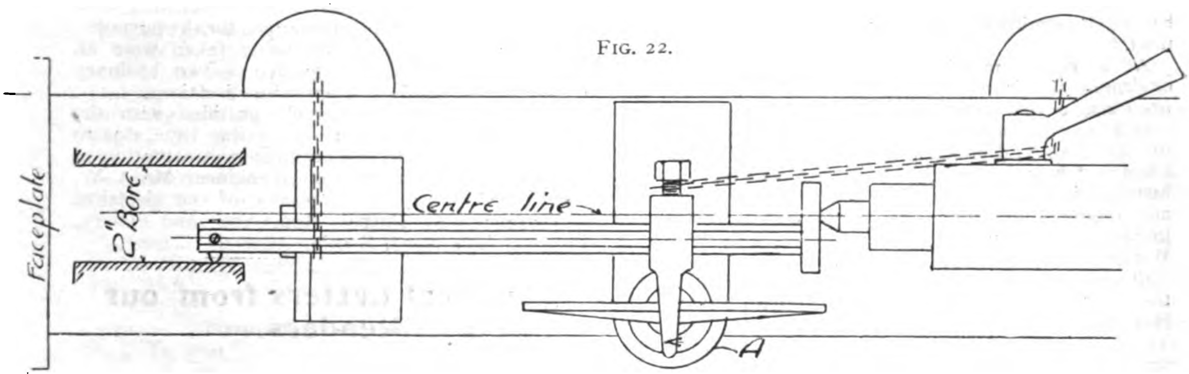


FIG. 22.



The testing showed the bore to be practically parallel, whereupon the cutter was set again and a final cut taken, boring the cylinder to a diameter of 1 in., the work proving quite satisfactory and apparently equal to that done by the aid of the slide-rest and screw-cutting gear, although the amount of labour and attention were considerably more, the most difficult thing being the keeping of the feed quite regular.

To test the suitability of this method for boring, amount. The arrangement shown in plan (Fig. 22) was the result. The lathe was started without the back-gear, but as the speed was too high for a cast-iron cylinder (a brass cylinder may have been bored comfortably), it was thought desirable to put in the back-gear of the headstock, after which the work proceeded with the utmost satisfaction. During the operation the hand was pressed on the dog to hold it down to the rest at A, lest there might be a possibility of the tool chattering.

Judging from the writer's experience, no handy amateur need stick at the boring of a cylinder of a size anywhere in the range of model making: such a rig as last described can readily be set up and is easily worked. There may be several modifications, as, for instance, if the boring bar be round and true, the support shown in Fig. 23 may have a round hole in which the bar would be a good fit, and so dispense with the chain and weight. The end of the bar could be made to fit the spindle of the loose headstock in place of the back centre. Both of these may be considered refinements on the somewhat rough-and-ready methods shown.

Glasgow (Langside District), Queen's Park, Model Yacht Club.

A CLUB named as above has now been formed in connection with Camphill Model Yacht Pond, and handsome premises secured from the Corporation for use as a club house. Season: April to October; opening cruise was held April 25th. New members will be made welcome. The club has adopted the new rating rule:—

$$\frac{L + B + \cdot 75G + 4d + \cdot 5\sqrt{SA}}{2\cdot 1} = \text{Rating.}$$

—J. KERR (Secretary), 14, Strathyre Street, Glasgow.

The Junior Institution of Engineers.

THROUGH the munificence of Mrs. Frank R. Durham, a bursary of the value of £25 per annum—to be called after the Chairman of the Institution, the Durham Bursary—is about to be announced to the members and associates, of whom those between the age of 20 and 22 will be eligible to compete by writing a thesis on some technical subject chosen by the candidate. The first award will be made in October, and competing theses must be in the hands of the Secretary at 39, Victoria Street, Westminster, not later than September 1st next.

At a recent meeting of this Institution the chairman, Mr. Frank R. Durham, Assoc.M.Inst.C.E., presiding, a very interesting paper on "Automatic Fire Extinction as applied to Factories," was read by Mr. Geo. T. Bullock (vice-chairman), A.I.E.E., Chief Surveyor to the Union Assurance Society. The history of the subject was first lightly touched upon and reference was made to the type of sprinklers known as the Parwalee, Vulcan, the early Grinnell, Witter, Draper-Hetherington, Walworth, Titan, Galloway, Mayall, and Hudson; whilst those of the modern types—the Grinnell, Witter, Titan, Hoffman, etc.—were subsequently dealt with. The essential conditions of a successful installation were fully described, and the points of buildings where special protection was needed were enumerated. Questions relating to water supplies were entered into, including town mains, elevated gravity tank, private reserve, pressure tanks, pumps, and automatic injector apparatus. Considerations relating to the spacing of sprinklers were introduced. Areas of supply and distribution pipes, valve connections (both of the wet and dry type systems), pressure gauges, alarm gongs, and other important branches of the subject were treated, and, in conclusion, the author gave some valuable statistics showing the effect of automatic fire-extinguishing apparatus in actual operation. The paper was excellently illustrated in the text, and a number of specimens of sprinklers were exhibited. An animated discussion ensued, in which Messrs. J. H. Pearson, C. W. Pettit, G. C. Allingham, Jas. Spiller, J. O'Brien, B. E. D. Kilburn, F. D. G. Napier, A. W. Marshall, Jas. Sheppard, A. J. Simpson, J. W. Johnston, L. T. Healy, J. W. Nisbet, R. H. Parsons, L. F. de Peyrecave, and Ridley took part, and the proceedings closed with a vote of thanks to the author.

Liverpool and District Electrical Association.

THE members of the above association, on the kind permission of Mr. G. Hughes, chief mechanical engineer to the Lancashire and Yorkshire Railway, paid a visit to the fine new electric double cantilever crane, recently erected in that Company's North Mersey goods station, Bootle, on Saturday, April 11th.

It is constructed by Messrs. C. & A. Musker, of Tuebrook, the electrical equipment being supplied by Messrs. Dick, Kerr & Co.

The crane, which has cost about £10,000, is of the cantilever type, and the total weight is about 150 tons; it runs on fourteen wheels, on a track of about 540 yds. long, and about 10 yds. in width, and having a clearance height of 30 ft., can not only lift and stack goods to shortly within that height, but can move up and down the immense goods yard with ease, and having a cross traverse of about 172 ft., can pick up a load and deposit it at any point within an area of about 31,000 sq. yds. Two motors of 90 h.-p. each are provided for lifting and longitudinal travelling respectively, and a 25 h.-p. motor for cross travelling, the lifting speed being about 90 ft. per minute, longitudinal travelling about 400 ft. per minute, and cross travelling about 600 ft. per minute.

Current is obtained from the Company's Formby Power Station, a portion of the electrified line, which is running near, being tapped for the purpose; direct current at 600 volts being taken from an overhead conductor, by means of two ordinary trolley poles, trailing in opposite directions.

The party were exceedingly gratified with the visit, having spent a most interesting time, due in no small measure to the kindness and attention of the Company's local mechanical engineer, Mr. A. W. Cunliffe, also Inspector Roberts, of the electrical department.—S. FRITH, Hon. Sec. and Treas., 77, St. John's Road, Bootle.

Practical Letters from our Readers.

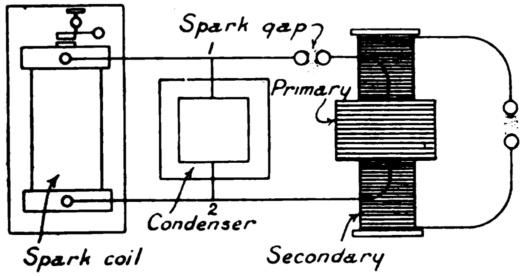
[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume if desired, but the full name and address of the sender MUST *invariably be attached, though not necessarily for publication.]*

Tesla Coil.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I send a simple diagram of connections for Tesla coil, from which I think Mr. Thompson will be able to grasp the theory of working. The condenser—a Franklin's pane—is a sheet of tinfoil pasted on each side of a sheet of glass.

In diagram the top sheet is connected to No. 1, and the bottom to No. 2. When the spark coil is started to work, the condenser becomes charged—one sheet with negative and the other with positive electricity—till it is strong enough to spark across the gap, when positive and negative meet. Now, if only one spark passes the gap, it is not the simple



little spark one may think, but a succession of sparks all in one, negative and positive alternately, as when the condenser discharges it charges itself again by induction in an opposite polarity. This it will do many times in succession, but each time becoming weaker, and this takes place in a very small fraction of a second. But if the spark coil be kept working continuously, thus causing a continuous unbroken spark at the gap, the oscillations may be 100,000,000 per second, which go surging round the primary, thus causing an induced current in the secondary coil, an alternating current of high voltage.

To get the condenser in the base of coil it had to be cut up in many sheets of tinfoil and glass. If you will notice plan of condenser shown in THE MODEL ENGINEER, you will find nine sheets of tinfoil connected to one wire and nine to the other. These really represent the two sheets on each side of the Franklin's pane. There is a great advantage in having the condenser in the base of coil, as it is protected against the moisture condensing on the glass by every change of temperature.

There is only one layer of wire on the coil described, though I think it would be worth the time making the experiment of adding more, having carefully insulated each layer with dry blotting-paper. In this case there would be no need for the bell wire up the centre ot coil, as the wire could be started at one side and finished at the other. Hoping these few remarks will explain matters.—Yours truly. FREDK. T. WEBB.

[Several correspondents having asked for these particulars, Mr. Webb has kindly complied.—ED., *M.E.*]

Naming of Locomotives.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—With reference to Query 18,593 and your reply in issue of January 30th, 1908, *re* the naming of G.C.R. locomotives, I may say that in addition to the instance you have given of the 4—6—0 type, named "Immingham," the following are running: "Atlantic (4—4—2) type, "Sir William Pollitt," "Lady Henderson," "King Edward VII"; 4—4—0 type, "Sir Alexander" (1,014), "Queen Alexandra." The latter has been fitted with a large boiler of the "Atlantic" type. Hoping this will interest "H. N." (Aston).—Yours faithfully, H. E. SMITH.

Re Hot Water Supply System.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—*Re* the query of "W. G." (Vauxhall), there are three faults in his hot water system:

(1) The cylinder is fixed too high.
(2) Bath branch is taken from wrong place.
(3) The hot pipe is too low in boiler.

The cylinder should be fixed as near boiler as possible, and all branches should be taken from expansion pipe, and not from the circulation, as shown in sketch. If he alters this branch in the existing arrangement without lowering the cylinder, he will find that there will be a very poor flow of water from bath tap, and it will take some time

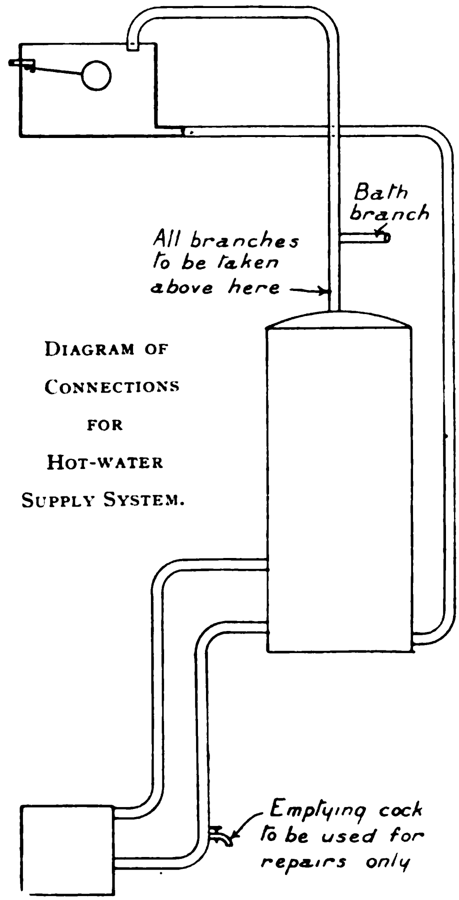


DIAGRAM OF CONNECTIONS FOR HOT-WATER SUPPLY SYSTEM.

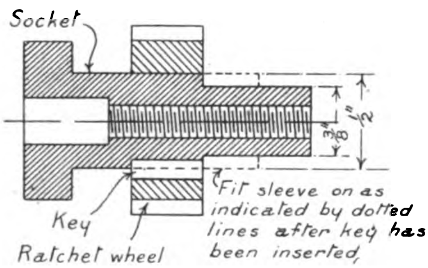
before enough water can be had for a bath. The flow pipe, where it enters boiler, is much too low and should be taken out as near the top of boiler as possible. As it is at present, the boiler will never be full of water, as the air cannot escape after the water reaches the level of the top pipe, and, should there be a manhole in top of boiler it will be found impossible to keep it watertight as the fire will burn out the packing in a very short time. The air will also cause a rumbling noise in boiler when working, whereas it should work quite noiselessly. I have enclosed sketch showing how connections should be made, which I think will explain how the whole system should be fixed.

If "W. G." will forward me his address, I will explain to him more fully the working of this system of water heating. He will then understand why he cannot get enough hot water as at present fixed.—Yours truly, "PLUMBER."

Re Fitting a Ratchet.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I am thinking of making the ratchet shown on page 146, February 13th, but I do not understand how the ratchet wheel is keyed on to the spindle. It seems to me that if you fit the key on spindle, you will not be able to get it into position, unless you cut a slot in side of bearing hole, which I do not think would be very good



practice. The only way I can see will be to make the back part of spindle smaller, as in sketch, but then I could not use the design of feed-screw, as the screw would be too weak.—Yours truly,

H. PALMER.

[We do not quite see the point you raise with regard to the key of the ratchet, and we think the best plan would be to reduce the outside diam. of the spindle, so that you would get a true bearing at each end, without necessitating cutting a slot for the entrance of the key.—ED., *M.E.*]

Re Experiments with Primary Batteries.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I am very much disappointed at finding this series concluded without reference to Jablochkoff's carbon-nitrate of potassium, iron primary battery. I believe I am correct in saying that this generator is entirely ignored both by writers of articles on electric generators and also writers of text-books.

I cannot understand why this should be so. Surely the fact that carbon (coke) may be consumed in a battery in place of zinc, with an electrolyte of fused saltpetre, is, to say the least, interesting, and I believe if it was brought to notice a number of experimenters would turn their attention to it, the result being, probably, a useful, simple, and cheap generator of electricity.

Writers are never tired of stating that "if we could generate electricity direct from the fuel, it would revolutionise, etc.," but with this battery we actually have the means of doing so; yet it is ignored.

Anyone wishing to do so could afford the cost of experimenting with it. Short ends or broken arc lamp carbons can be obtained almost for the asking; saltpetre can be purchased at any oilshop for about 4d. per lb. The necessary iron cells can be made from gas caps—any size from ½ to 1 in. can be obtained from any ironmonger for a few pence each, and it would be little trouble to suspend a series of these over an ordinary gas-ring by means of clips supported by a wooden (or other insulating material) ring. I hope you will induce the writer of the articles to append a chapter or two on this battery, giving as exhaustive an account of it as possible. I think it is far in advance of any thermopile.—Yours obediently, A. GREEN.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26-29, Poppin's Court, Fleet Street, London, E.C.]*

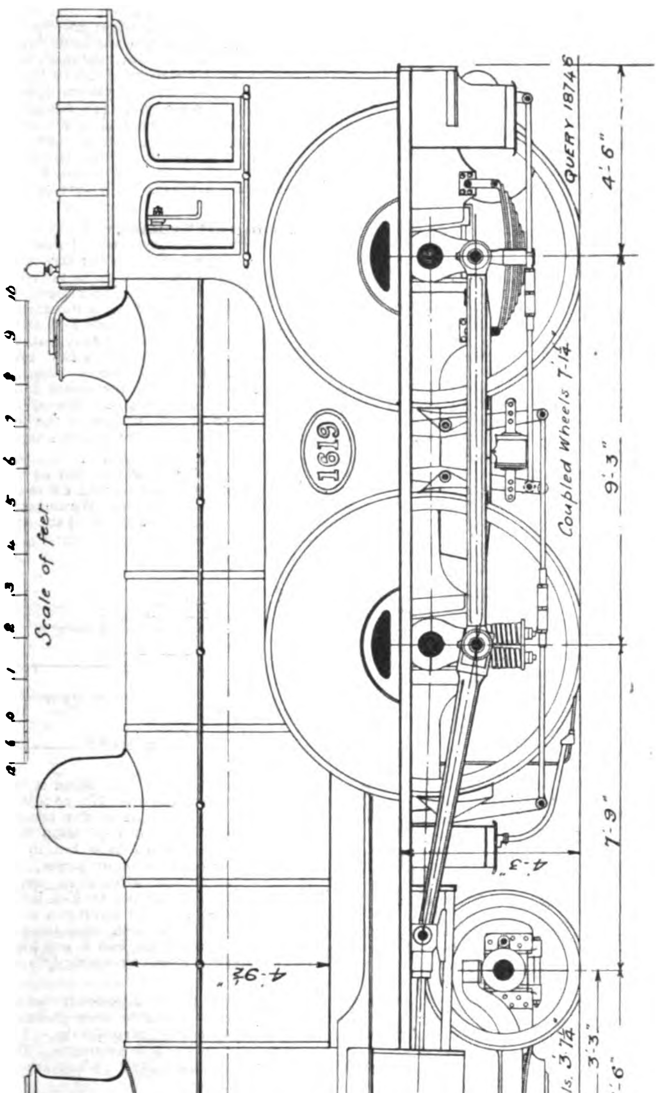
The following are selected from the Queries which have been replied to recently:—

[19,493] **Electric Light Installation.** J. E. W. (Denton) writes: Would you kindly explain to me the following query? How many ordinary 16 c.-p. incandescent lamps the dynamo of the following capacity should supply, also the method of ascertaining the capacity of any dynamo? It is a two-pole dynamo by Paterson & Cooper, of London, to run at 300 r.p.m. 35 amps. and 100 volts, that is, according to the makers' specification-plate fixed on the machine, and has gauze wire brushes. It is now run at 240 r.p.m. 100 volts, and indicates 25 amps. I do not think it would run to 300 r.p.m., as it is driven directly by steam engine, which is run almost at its full capacity now. It at present supplies forty-five 16 c.-p. lamps, and sparks a good deal when running at full load, which I should be pleased if you could advise me how to prevent. What width should the brushes be, and what is meant by leading brushes? and which is the best method of setting and trimming them, and whether a little vaseline is any advantage, smeared on the commutator? I may say the dynamo is 9 years old, but in very good condition.

Assuming the 16 c.-p. lamps take 60 watts per lamp, your machine should generate sufficient current to supply fifty-eight or sixty such lamps—that is, working on the basis of 35 amps. at 100 volts. You may reckon approximately 3 watts per candle-power is required for ordinary incandescent lamps; from this you can calculate the current required for any number of lamps. We recommend you to obtain "Dynamo and Motor Attendants, and their Machines," by Frank Broadbent, price 1s. 9d. post free, which will give you complete information on the running of dynamos and motors.

[18,461] **Steam Turbine.** A. J. M. (Port Talbot) writes: Will you kindly help me in the few following questions. I have just finished the hull of a model of the *Lucania* of the Cunard Line, which is 6 ft. 3 ins. long, 9-in. beam, and 7 ins. deep. I intend fitting her with turbines. The hull is fitted with twin-screws each 3 ins. diameter, three blades each. Would the turbine on page 43 of "Model Steam Turbines" be strong enough, one on each shaft, or would you advise me to make one larger turbine geared to drive both shafts? The boiler which I am making is solid-drawn copper, 12 ins. long, 6 ins. diameter, with two 2-in. flues, with few cross tubes and return tubes, to work on 60 lbs. pressure, to be fired with blowlamp (two burners). Would this boiler drive the above-mentioned turbine? I do not want a great speed out of the boat, say, 3½ to 4 miles per hour. She has fine lines, but is rather heavy to expect a great speed, as I have made the whole hull out of wire and strip sheet tin.

The whole question turns on the boiler capacity. The turbine will require 1 cub. in. of water evaporated per minute, so that a larger turbine would only be admissible if this figure is exceeded. Your boiler, according to the dimensions you give, will barely do this, and we do not therefore recommend the adoption of turbines to drive the boat.



OUTLINE OF N.E.R. THREE-CYLINDER "SMITH" COMPOUND LOCOMOTIVE, NO. 1,619.
(Scale: 7-32nds in. to the foot; half size for 2 in. gauge model.)

[19,170] **Indicated Horse-power of Steam Engines.** W. W. (Clapham Common), S.W.) writes: Would you kindly oblige me by giving me a formula how to find the indicated horse-power of a steam engine?

This is obtained by means of an indicator diagram, from which is measured the mean effective pressure on the piston of the engine. The formula is—

$$\frac{PLAN}{33,000}$$

If you read up back numbers, you wil find many query replies on this subject which will give full information on the subject. For more detailed information you should study some text-books, such as "Indicator Diagrams," by Pullin.

[18,746] **N.E.R. (No. 1,619), "Smith" Compound Locomotive.** E. A. (Bishop Auckland) writes: I am making a ½-in. scale model of No. 1,619 North-Eastern four-coupled bogie express engine, and should be very gratified if you could oblige me with dimensions of same. If possible, would you send me a sketch of engine?

In further reply to your request, we now give a drawing of No. 1,619. We cannot insert to half size for ½-in. scale model, but reproduce it as large as possible, and include a scale of feet and the leading dimensions figured in feet and inches. You will find a design, as already mentioned, for a N.E.R. ½-in. scale model in Greenly's book, "The Model Locomotive: Its Design and Construction." In this design various modifications are introduced in the matter of wheel sizes to enable the locomotive to traverse sharp curves.

[19,293] **Blowlamp for Boiler.** R. L. (Leeds) writes: I should be glad if you would tell me what you consider the most suitable blowlamp for boiler. I have designed it for the 2-in. by 3-in. steam engine you kindly inserted in Vol. XVII, No. 388. I also want the boiler to steam a 1½-in. H.-P. 2½-in. L.-P. by 1½-in. stroke compound. The boiler has fifty weldless steel tubes (7-16ths in. inside diameter by 1 ft. long); diameter of boiler, 8¾ ins.

Although in the matter of heating surface the boiler would appear to be sufficiently powerful for light loads, we think that the boiler is much too small to satisfactorily drive a compound engine of the size mentioned. However, if the steam is supplied dry or slightly superheated, it should run the engine at a slow speed. Do not attempt to speed the engine so that it runs at high speed and a low pressure. If you do, the L.-P. cylinder may be doing negative work; therefore, it will be better to adjust the load and speed so that the pressure in the H.-P steam chest is maintained at anything above 60 lbs. When it is coupled to the simple engine, you may let the engine run as fast as it will, and wiredraw the steam by only using a very small hole in the inlet of the steam pipe (at the boiler end). The wiredrawing of the steam is essential to prevent priming. The feed regulation must be as perfect as possible. We would advise the use of a 4-burner "Vesuvius" stove. We shall be pleased to have particulars of the performances of the boiler when you have tried it in conjunction with the two engines mentioned under various loads and also running light.

[19,508] **Gas Engine for Lathe and Chaff-cutter.** W. H. P. (Cowbridge) writes: I should like to take advantage of your Query Department, in asking you to inform me what powered gas engine would be necessary to drive a 6-in. back-geared screw-cutting lathe. Also power required for a chaff-cutting machine? Also power required to work the lathe and chaff-cutter together?

For a 6-in. back-gear lathe you will often require as much as 2 h.-p. for heavy work. For a chaff-cutter anything can be used from 1 b.h.-p. upwards, according to the size of the machine and the speed at which it is run. We cannot say more definitely, as you do not say what the size of the chaff-cutter is. The makers would give you the maximum power required, and in ordering your engine it is always safe to add 25 per cent. to the power the makers say is required to do the work.

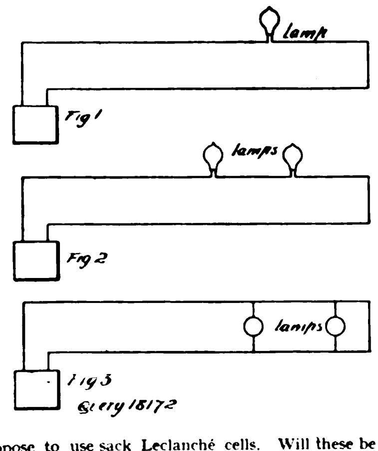
[19,509] **Accumulators for Driving Motor.** A. P. B. (Truro) writes: I should be glad if you would answer me the following questions—I have a motor taking 3 amps. at 4 volts. Would an ordinary 4-volt 5-amp. accumulator drive it? Would I have to get any special one to discharge at 3 amps.? If so, what is the smallest one I can get? As I only want to run motor for an hour at a time, I do not want a large accumulator if I can help it.

To drive motor an accumulator capable of discharging continuously at 3 amps. will be required. You do not say whether your accumulator is a 5 amp.-hour one, or one capable of discharging at 5 amps. Reckon 15 amp.-hours per sq. ft. of positive plate surface, and the maximum discharge rate for an ordinary accumulator should not exceed 4 or 5 amps. per sq. ft. of positive plate surface. Any of our electrical advertisers would quote you a price for a suitable accumulator on application. You should state, when ordering, that it is required to discharge it at the rate of 3 amps.

[19,566] **Capacity of Accumulators.** J. S. P. (Glasgow) writes: I would be pleased if you would answer me the following—I have accumulators (2-volt), four + and four — plates, 4½ ins. by 3½ ins. Am I right in saying they are 20 amps.? One of the terminals is always covered with a brown paste, viz., the + one. The pitch comes away from same terminal, even if I fill it up. I get them charged at the charging station here, and the man tells me they are always fully charged, as they are with him for a full week, but on connecting them to a ½-in. spark or two to 2 4-volt Osram lamps I can only get about two or three hours' use.

The total area of positive plate surface in your cell equals 4·5 multiplied by 3·5 by 2 by 4—126, which, counting 15 amp.-hours per sq. ft. of + plate surface, gives you a capacity of approximately 12 amp.-hours. The brown paste forming at the + terminals is probably due to electrolysis. The correct way to mount the terminal on the accumulator is to fetch the lead lug well outside the filling-in, whether it is pitch or other material, and then to solder or fasten by means of a clamping screw, whichever is most convenient. Very often soldering your connections inside where the acid will attack the metal causes the action you describe, therefore every care should be taken to prevent any other metal but the lead of the accumulator grids coming into contact with the sulphuric acid in the cells.

[18,172] **Small Electric Light Installation.** J. B. (Patrickswell) writes: I wish to instal a small intermittent installation of electric light of about four 4 c.-p. lamps, several of which may have to be alight simultaneously. The lights will be about 20 ft. of wire apart. Will you please reply to the following questions?

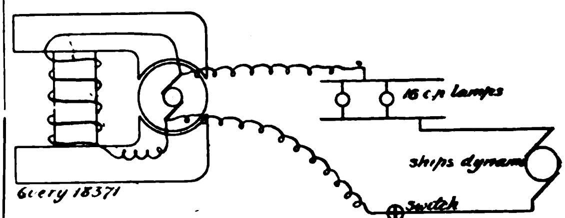


(1) I propose to use sack Leclanché cells. Will these be suitable, and how many and what size would be required? (2) What size wiring should I use? (3) Would Osram or Nernst lamps be the most suitable? (4) I conclude lamps should be wired in parallel in the circuit? (5) On putting in an installation, what are the principles involved in settling voltage required? Do you go by the length of wiring or number or candle-power of lamps, or what? (6) Would the above diagram be correct as regards volts, amps., and ohms in the circuit, if E.M.F. of battery is 10 volts and resistance of each lamp is 10 ohms (neglecting all resistance except that of the actual lamps): Fig. 1, One lamp, E.M.F., 10; R,10; C, 1. Fig. 2, Two lamps in series—E. M.F., 10; R, 20; C, ½ (through each lamp). Fig. 3, Two lamps in parallel—E.M.F., 10; R, 5; C, 2 (1 through each lamp).

(1) Leclanché cells are not suitable unless light is only on for a minute or so at a time, with considerable intervals in between and flow of current very small. You will find information in our handbook (No. 3) on electric batteries, or you might try the one described in THE MODEL ENGINEER for April 9th and 16th (1903). (2) Assuming that the lamps are arranged in parallel, the main wires should be No. 18 gauge; branch wires for each lamp can be No. 20 gauge, or you can use No. 18 throughout. (3) Osram lamps; Nernst are not made for so small a candle-power. (4) Yes, wired in parallel. (5) In this case the voltage is determined by the lamps obtainable and convenient arrangement of battery. You will probably find 8 volts convenient. Ascertain first what lamps are procurable, and then make battery to suit. There should be a slight excess of voltage to allow for loss in wires. (6) Your diagrams and figures are correct.

[18,371] **Motor for Fan, 500-watt Dynamo.** A. D. (at sea) writes: I am in this new ship, fitted with a dynamo. I now find your MODEL ENGINEER more interesting still. I went through a short course of electricity by correspondence, and now in my spare time I wish to construct a small motor to drive a fan for use in my engine-room, but later on I would like to run it as a dynamo at home for ten or twelve 16 c.-p. lamps. What size should I construct the motor to answer both purposes? I would naturally run the motor with the current from our dynamo, which is a 4 B.V. type, 65 volts 68 amps., 300 revolutions. We use it for a projector as well as for ship lighting, and when I make the motor I will make it as near as possible a model of our dynamo. Would you kindly tell me what size wire I should have on each of the four magnets and also armature to give the motor the power I would require from it?

A fairly small motor would do to drive your fan, but as you require a machine that can be used to generate current for ten or twelve 16 c.-p. lamps, you will need a big machine. We therefore advise you to begin by building a small 20-watt motor of the type



shown in "Small Dynamos and Motors" (Fig. 5). Wind it with 2 ozs. No.26 S.W.G. c.c. wire on armature, and 1 lb. No. 26 S.W.G. c.c. wire on field-magnet, and connect in shunt to the brushes. Then run the motor in series with one 16 c.-p lamp from the ship's dynamo, as shown. You can easily fit a fan to the end of motor spindle. If you find you require more power, then add another lamp in parallel with the one already in use, as shown on sketch. For lighting your ten or twelve 16 c.-p. lamps, you will need at least a 500-watt dynamo, and we think you would do well to try your hand at the smaller machine first. The 500-watt machine, as Fig. 12 in handbook, is a good type, and if you follow the directions and details therein given, you will have little difficulty in the matter.

[19,491] **Draughtsmen.** J. W. J. (Huddersfield) writes: I wish to become a draughtsman, and should be very pleased if you could advise me as to what course I shall have to take. I am 17½ years of age, and have passed the first year in geometry. Shall I have to commence in drawing office at once? What are the salaries?

To answer your enquiry fully we should have to know the full circumstances of the case. Draughtsmen usually begin their career as tracers in the drawing office of some engineering firm; but, in order to become more than merely tracers, it is necessary, or at least advantageous, to have a good knowledge of engineering, which will enable you to understand exactly what it is you are drawing. You could attend evening classes or take a course of correspondence instruction, which would assist you a good deal, but, as a rule, actual experience in a drawing office and continual practice are the two essentials to real progress. As regards salaries, these vary enormously, and depend entirely upon the capabilities of the party in question. Tracers get anything from 15s. to 30s. a week, whereas chief draughtsmen often get as much as £5 to £8 a week.

[19,505] **Running Motor as Generator; Power for Same.** G. D. (Newcastle) writes: Will you kindly answer for me the following questions, if not too numerous? I have bought (cheap) one bipolar Crocker-Wheeler motor. It has been used for lift work; its output is 150 volts 3·5 amps. at 950 r.p.m., and is 1 h.-p. Can I use it as a generator? and can I alter the connections of the windings and so raise the amperes; if so, how shall I do same? I have also an engine (horizontal), 4-in. bore, 5-in. stroke, with 30-in. flywheel. Will this do to drive generator; or, would it be cheaper to buy gas engine, as I have no boiler?

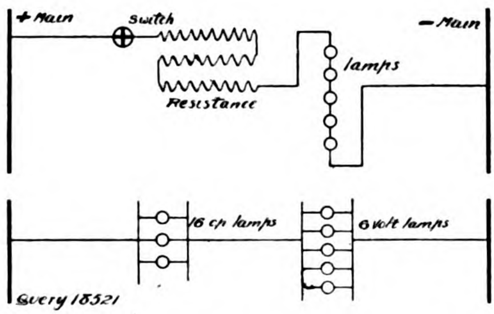
We cannot say that your machine will work as a generator satisfactorily, but you could give it a trial run and see what output you get. You will need approximately 1 b.h.-p. to drive it. Your steam engine, if supplied with ample steam, would do the work comfortably, but it would come cheaper to install a small gas engine as you suggest. The latter would, of course, take practically no looking after, as would the steam engine and boiler.

[18,746] **Preparation of Scale Drawings of N.E.R. Locomotive (No. 1,619).** E. W. (Bishop Auckland) writes: In accordance with your conditions, I wrote you some few weeks ago, asking if you could give me a scale drawing of North-Eastern engine (No. 1,619). I was rather surprised at not hearing from you, or at least seeing a reply to my query in a subsequent issue of your interesting journal. I should be obliged therefore if you would let me know by return if you can help me or not, as, if not, I shall have to try elsewhere.

We have a drawing in hand which will be published as soon as space permits. We do not guarantee to supply readers with drawings free of charge, but where general interest is likely to result we obtain the necessary particulars and prepare drawings for publication in our journal. We have a scale sketch of No. 1,619 N.E.R. now in the press, but if you are urgently wanting particulars of the engine for model purposes, and cannot await above, you will find a $\frac{1}{2}$-in. scale design in "The Model Locomotive," by Greenly, price 6s. 5d., post free from this office. The drawing we shall publish will be of the actual engine, with all details included in it, so that you can make what modifications you please. We recommend you the above book to help you in this direction, as well as a general guide. See Plate II for N.E.R. design.

[18,521] **Lighting Small Lamps from Supply Mains.** E. W. S. (Bath) writes: I want to light up five 6-volt lamps. They will all be burning at the same time, and I want to use the electric light main for this purpose. It is 220 volt (direct). Will you kindly tell me how best to effect this? What will be the best resistance, etc., and the connections necessary?

You do not state the current required by your lamps. The



necessary resistance cannot be calculated without this data. Assuming them to take about $\frac{1}{2}$ amp., you will need approximately 440 ohms; $\frac{1}{4}$ lb. No. 30 German silver wire will give you this. The connections will be as sketch. A simpler way would be to connect your 6-volt lamps in parallel, and this group in series with some 220-volt 16 c.-p. lamps. See diagram above.

[19,362] **Small Gas Engine Trouble.** E. J. W. (Walthamstow) writes: I have bought a small water-cooled gas engine from an engineering firm in Staffordshire, $1\frac{1}{2}$-in. bore, 3-in. stroke, and should feel much obliged if you can answer me a few questions concerning it. (1) Do you think $\frac{3}{4}$-in. is enough compression space compared with length of stroke and size of piston? I cannot time explosion right by tube—the charge always fires when the charge is about half compressed. I have regulated mixture, but to no effect, as there is no timing valve. I have decided to use electric ignition, as being capable of more adjustment. I have a sparking plug in my possession that I intend to use if possible. (2) Would you advise a small magneto or a coil? I do not want to go to too much expense. (3) Where could I obtain a magneto or coil for this purpose, and about what price? (4) Would a non-trembler coil be of any use? (5) Where could I have a new piston turned, as the makers have made this one quite 1-64th in. loose, and most of the compression leaks away, unless I keep the cylinder flooded with oil. Could you name a London firm who would do this cheaply and quickly and make it a fit? I could get casting myself, if I make up old one as pattern.

You do not state whether the engine has ever run properly or whether it has developed the defect you speak of since you got it. You might try increasing the compression by screwing on a thin plate of metal to the back end of the piston. The early firing, we think, could be overcome by the proper adjustment of the gas and air supply, and certainly no timing valve is needed on such a small engine. Electric ignition would also be a decided improvement, but the magneto would be almost as large as the engine, so that you should not adopt that. Any of our advertisers could supply you with a coil for spark ignition. A useful method is illustrated and described in March 29th issue, 1906. Of course, if your piston is leaking badly, this would account in a great measure for unsatisfactory working. If you had a new casting made W. H. Dearden and Co., 119, Dorset Road, Clapham Road, S.W., would turn it up to a proper fit for you at a very reasonable price. You should, remember, however, that increasing the compression will not tend to remedy the early firing.

[19,365] **Dynamo for Driving Motors.** H. B. M. (Natal) writes: I have a small Empire dynamo, price 15s., 10 volts at 3,000 r.p.m., shunt-wound, with Siemens' H-armature. Also a couple of small motors, about 4 volts 1 amp. each. One is the Ajax type (7s.), and both are series-wound. The makers of the dynamo state that it will easily drive the motors, either separately or together; but I have been unable to get it to work either motor at all, although it lights four 8-volt lamps well. The motors both run well from 4-volt bichromate battery. I have tried running the dynamo at 4 to 6 volts only; also at full voltage, with resistance in circuit; and also with resistance in motor-field coil only; also connecting motor in shunt, but in no way can I get the motors to work from the dynamo current. I shall be obliged if you can tell me why this is, and how I can get the motors to work with the dynamo.

We advise you to obtain a small ammeter and also a voltmeter, although the latter is not essential. Run your dynamo up to speed, and find out exactly what current it is giving when one or both of the motors are placed in series with it. By noting exactly what current the dynamo is giving, you will be able to judge what is happening and whether the voltage of the dynamo is sufficiently high to force current through the motors. Unless you use measuring instruments and find out *conclusively* what the dynamo is giving, you will never get near to a satisfactory solution of your difficulty.

[19,369] **Small Lighting Plant.** W. B. (Hexham) writes: (1) What candle power would it take to light a kitchen—17 ft. by $10\frac{1}{2}$ ft. floor space? (2) What would be the best kind of dynamo to use for lighting above? I would like the voltage to be as low as possible, if it would be just as efficient. (3) I would like to drive above dynamo with a water motor off ordinary house tap. Please give particulars of one suitable. *Re* water motor in February 27th (1908) issue. If I were going to make one of the same dimensions, I would be getting all the parts cast—case, wheel, buckets, etc. Are the buckets shown of the best pattern, or is there a better style for casting? (4) How would you suggest to get the necessary speed for dynamo, if the water motors were too slow? (5) What would be the output of a suitable dynamo, using Osram lamps, to light above kitchen? (6) Am I right in thinking that 50 volts 1 amp., 25 volts 2 amps., 10 volts 5 amps., and 5 volts 10 amps. dynamos are all able to light one 16 c.-p. lamp, and that all above are 50-watt machines? (7) Please explain how to tell if a machine is a dynamo or motor. (8) What gauge wire leads will be required for above dynamo?

(1) Two 8 c.-p. lamps should supply a very good light. (2) We should recommend a dynamo of about 150-watt output of the Manchester type. You can have it wound for any voltage you like. (3) We should recommend a small gas or oil engine in preference to a water motor, if you require the dynamo for any appreciable work. (4) The water motor in February 27th issue would hardly be large enough for your purpose. You will require at least a $\frac{1}{4}$ h.-p. motor, such as described in December 15th issue of Vol. V. (5 and 6) A 50-watt dynamo would hardly be large enough, although it would light a fair number of Osram lamps. It might possibly give you a sufficient light. It all depends upon how much light you want. (7) Many machines can be run either as dynamos or motors. A dynamo has forward lead given to the brushes when it is running on load, whilst a motor has backward lead. (8) You can tell what gauge wire is required for the leads of your machine by reference to any wire table. Much depends upon what windings the machine has and whether it is wound for high or low voltage.

[19,469] **Faulty Dynamo.** R. B. V. (Coventry) writes: I have a Manchester type dynamo, ring armature 5 ins. diameter by 4 ins. long, 10 slots, and 10-part commutator, wound with 3 lbs. No. 20 S.W.G. I cannot use it, as it sparks abnormally at any load. 4 amps. at 40 volts is the most I have taken. Sparking apparently due to bad design of armature? Would you advise a new armature? If so, should it be a drum, with twenty or twenty-four sections, or a smooth ring, twenty or twenty-four sections? What gauge wire? I think 18 might be used, as it gives now over 50 volts at 1,500 r.p.m. I think it should do 10 amps. at 50 volts if the sparking could be got rid of.

You can only tell by actual trial whether the sparking is due to faulty design or to want of proper regulation and adjustment of the brushes, etc. We should say, however, that the windings are correct for the output the dynamo is intended to give. Perhaps if you sent the machine to some of our advertisers, such as Messrs. Thompson & Co., 28, Deptford Bridge, Greenwich, S. E., or Mr. A. H. Avery, Fulmen Works, Tunbridge Wells, they would make a thorough test of the machine for you and issue a report for a small fee. We think that is your best course to adopt before having the armature completely re-wound.

The Editor's Page.

MR. W. PENTNEY, of Derby, informs us that the successful number in the recent draw for the model locomotive was 2,170. He adds that he received no less than 197 applications for post-cards from readers of THE MODEL ENGINEER, these coming from all parts of the country. The proceeds of the draw will be sent to the Orphan Fund at the head office of the Amalgamated Society of Railway Servants, 72, Acton Street, Gray's Inn Road, London, W.C., and will be duly acknowledged in the next annual report, which can be obtained gratis from the head office or any of the branches of the Society. Mr. Pentney still holds the postal order for 6d. which one of our readers from Chelmsford sent without giving his name and address, and will return this to the owner on application.

* * *

The following interesting letter from a former Colonial reader, now settled in this country, speaks for itself: "I feel bound to write and thank you for the great service you have rendered me through your excellent paper, of which I have been a reader for some years now. I am an Australian, belonging to Luckhardt, Sydney, N.S.W. It was always my ambition to become an engineer, but having to do for myself I was never able, as you know that the wages of an apprentice are not sufficient to keep a chap. I used to work in a sawmill in Sydney, and can say, without boasting, that I got on well there, but I never lost sight of my ambition. I attended the Sydney Technical College at night for some time before I left Sydney. In reading one of THE MODEL ENGINEERS, I saw the account of Messrs. ——'s apprentice scheme. I thought the matter over, and came to the conclusion that if I could get in there, with the wages they pay and my own savings, I could manage to pull through. So I wrote and asked for a position, and in due course I received a reply, stating, if I cared to come over, they would give me an opportunity. I came straight away. I have just finished my probation. Of course, it is needless to say how much I like the work, and I owe it all to your splendid paper. I have just turned 22; it is a bit late in life to start afresh, but better late than never."

Answers to Correspondents.

G. D. T. (Bombay).—Thank you for your letter. We will try and publish an article on the subject you mention. We are always glad to have suggestions of this kind. Vol. I of THE MODEL ENGINEER has been out of print for some years, and is now very scarce. You might secure a copy by advertising in our Private Sale Column.

J. H. A. (Islington, N.).—We have communicated your request to our contributor. An article is already in hand describing the fittings.

W. A. KIRKLAND (Lurgan).—Write to any of our advertisers who supply materials for model work. We cannot put you in communication with our contributor, unless you send a stamped envelope for the purpose.

W. DEAN (Pendleton).—The accumulator would probably drive the motor very well. You do not mention what voltage motor is wound for, but if you find one accumulator insufficient, you could always add another and couple it either in series or in parallel. Whether the motor will take a higher voltage and less current or a lower voltage and greater current will be found by actual trial. If you find the accumulator becomes polarised, that is, exhausted very quickly, it tends to show that the motor is taking more current than the accumulator can give: therefore two such accumulators should be coupled in parallel—that is, positive to positive and negative to negative—and then connected to the motor as though you were using one single accumulator. Kindly comply with our rules in future, and give full address.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

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All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

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Model Engineer

And Electrician.

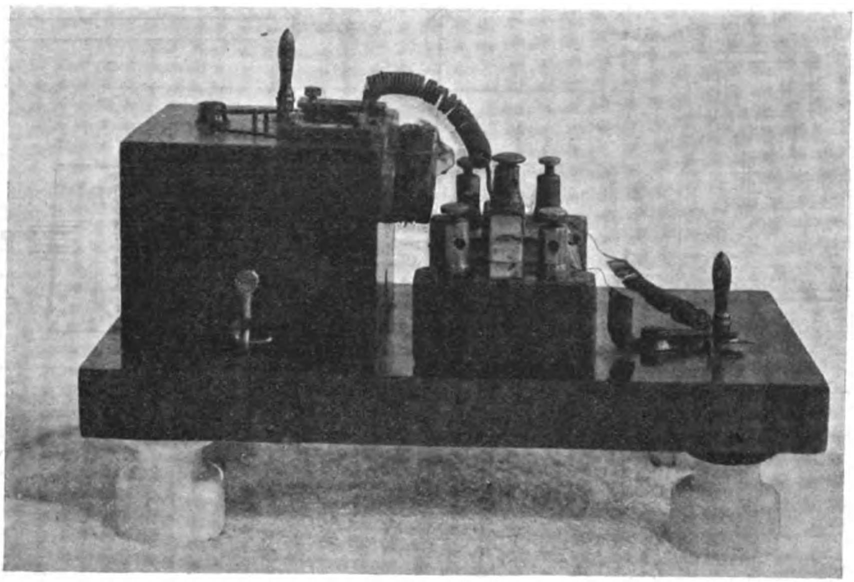
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL. A.I.MECH.E.

VOL. XVIII. No. 368. MAY 14, 1908. PUBLISHED WEEKLY

Electrolytic Detector for Wireless Telegraphy.

By F. E. BORNHARDT.



MR. F. E. BORNHARDT'S ELECTROLYTIC DETECTOR FOR WIRELESS TELEGRAPHY.

THE interesting wave detector which I am going to describe in the following article has, so far as I know, not been alluded to in THE MODEL ENGINEER, and a description of how to make one may be of interest to the readers of this article, certainly to those who possess a wireless telegraph installation or who are interested in wireless telegraphy.

This wave indicator is the so-called "electrolytical detector," the reverse of the Wehnelt break, which is known to all electrical readers. The principle on which it works is quite different to all the other detectors, and has up till now not been perfectly explained. It was discovered by Schloemilch in the year 1903.

If we have a small polarisation cell, with diluted acid as liquid and two electrodes out of platinum or gold, this cell will have a certain maximum of polarisation. If we now take a battery the E.M.F. of which is just a little higher than the polarising maximum of cell, a weak decomposition of the acid will take place; the one electrode of cell will give off oxygen, and the other electrode hydrogen gas, and a small current will pass through the cell. If we now make the electrode which gives off oxygen gas very small, we will find that the gassing in the cell and the very small current passing through are distinctly influenced by electric waves falling upon the cell. As soon as a wave impulse reaches the cell the small current passing gets stronger and a lively gassing takes place at the small oxygen electrode ; all this happens instantaneously at each impulse. The reason of this phenomenon has not yet been explained, but it seems that a small resistance between positive electrode and acid gets removed, the same as in a filings coherer after the Marconi system. We see that with such a cell we have an excellent wave detector—an electrolytical detector.

Fig. 1 shows the detector — a small crucible A out of glass or vulcanite, filled with sulphuric acid S (1 : 10 vol.). A thick platinum wire N is immersed into the acid, and a very thin platinum wire P (Wallastone wire) 1-1,000th mm. diameter, molten into a capillary tube and the end ground down to a fine point, protruding only 1-100th mm. out of the glass ; this wire will be anode. The manner in which a cell like this is connected to the receiving apparatus is shown in Fig. 2.

The electrolytical cell is C. A battery B is not connected directly to the cell C, but closed

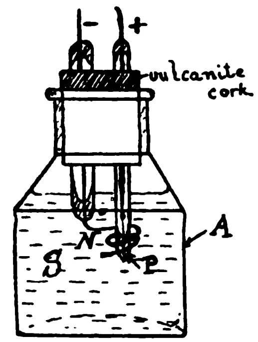


Fig. 1.—Detector.

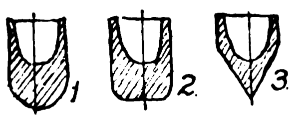


Fig. 6.

through the resistance R, from which current is branched off by means of a small sliding contact Z. The positive electrode of the cell C is connected with the air-wire A through the sliding contact *d* on the self-induction coil S, which, together with the variable condenser (or better capacity) K are used for tuning the whole system. T is the telephone or relay, which is in circuit with the cell. The wave impulses received will be heard as a crackling in the telephone ; each spark can be heard. This electrolytical detector works very exactly when the positive electrode is very small, and is free from all the faults of other detectors. With a telephone as receiver, the cell is at least three times as sensitive as the best filings coherer. This cell is partly used in the receiving stations of the "Gesellschaft für Drähtlose Telegraphie," Telefunken, in Germany.

The photograph shows the apparatus I have made ; Figs. 3 and 4 the sketch of arrangement. The cell is contained in the square box next to which is the resistance, from which the current for the cell and telephone or relay gets branched off by the slide contact P (Fig. 3). The bar on which P slides along is celluloid (vulcanite would be better), and screwed down through the slate block into the wood by two long brass screws. The block on to which the resistance wire is wound is slate. It should be turned in the lathe, and then a thread cut into the space on which the wire is to be wound. The resistance wire should be German silver wire, No. 26 (about thirty turns to the inch). Having wound the wire into the threads previously cut, secure the two last turns at each end by soldering them together ; it will prevent wire slipping. It is advisable to perfectly dry the slate block now in an oven, and then, when still hot, soak in paraffin wax. Bore all holes needed, and fix terminals into the slate by means of molten sulphur. The springs of the sliding contact should press fairly hard on to the wire, so as to ensure perfect contact.

Now we come to the cell proper. We need a small glass bottle—a small Indian ink bottle will

Fig. 5.

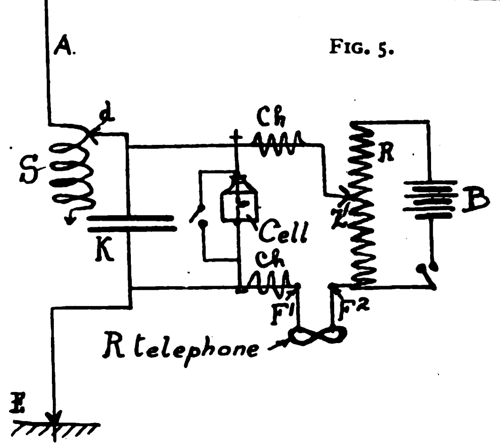
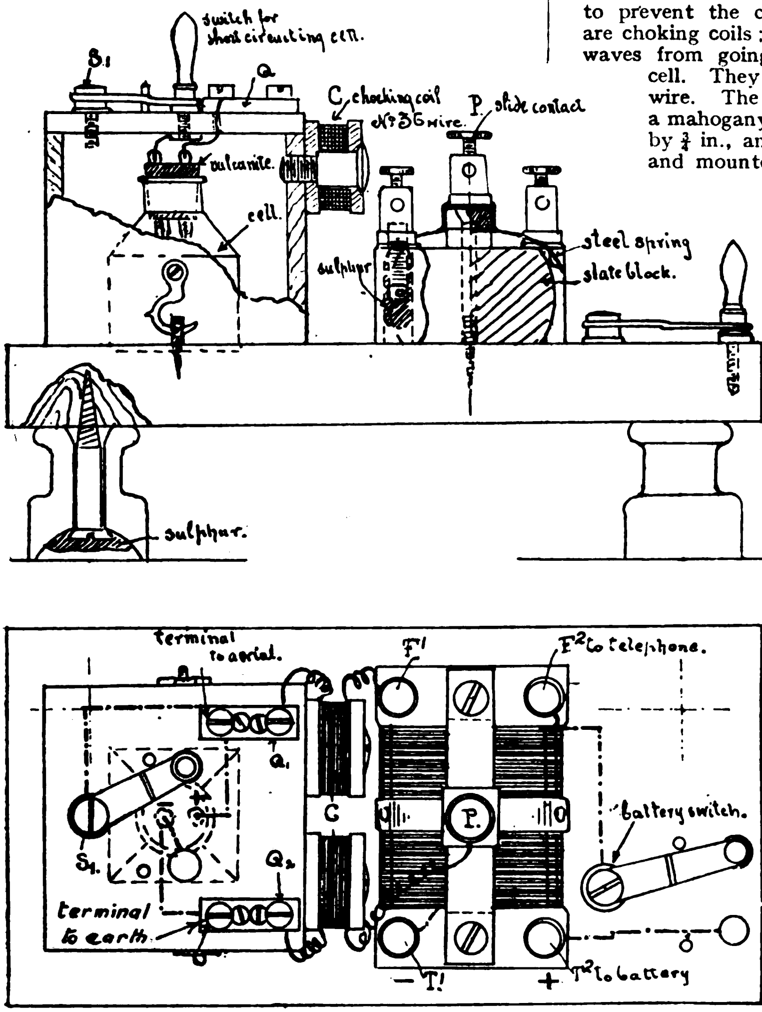


Fig. 2.—Diagram of Connections.

answer the purpose excellently. Then we need a piece of No. 32 platinum wire for the cathode. The wire should be sealed into a small glass tube, an inch sticking out both ends. The glass tube is to ensure perfect insulation when passing through stopper of bottle.

Now we come to the main part in the whole apparatus—to the fine wire for the anode. The finest possible platinum wire should be used ; this is an article which is extremely difficult to obtain and fairly expensive for the amount you get, but a length of an inch will do for two points at least. The way of drawing this fine wire—called Wallastone wire—entails a lot of work, and cannot be done by the amateur. First, a thin platinum wire is taken and thickly coated with silver. Then this silver wire, with the platinum core, is drawn very fine and the silver dissolved in nitric acid, leaving the thin platinum wire ; it sounds simple, but it isn't. If this specially drawn wire cannot be got, there is a very fine wire (platinum, of course) stocked by larger opticians, who employ it for the crosses in telescopes, etc., which will answer the purpose excellently. (The first wire I ever used for my point was from one of those gaslighters with the thin wires and a small piece of platinum sponge; this worked well, although not very sensitive). Having got the wire (the thinner the



Figs. 3 and 4.—Electrolytic Receiver for Wireless Telegraphy. (*Half full size.*)

better), melt it into a small glass tube and keep the molten glass point soft for a few minutes; this will make the small air bubbles which settle round the platinum disappear. When everything has cooled, the wire should be ground down flush with the glass (see Fig. 6, No. 2). Take a magnifying glass and see that no air-bubbles or cracks are round the platinum on the ground surface. After this, grind the glass to a fine point (Fig. 6, No. 3) on an oilstone, with plenty of oil; again examine with a magnifying glass and see that everything round the platinum is smooth and goes to a fine point. If everything is in order, the point is ready for use. Slip the tube through the stopper into the bottle which was previously filled with diluted sulphuric acid and make connections with terminals Q^1 Q_2 by soldering.

The switch S_2 (Figs. 3 and 4) on the lid of the box (which is mahogany soaked in boiling paraffin) is for short-circuiting the cell when transmitting, to prevent the cell from getting damaged. C C are choking coils; they are to prevent the electric waves from going to earth without passing the cell. They are wound with No. 36 copper wire. The whole apparatus is mounted on a mahogany board measuring ·4 ins. by 8 ins. by ¾ in., and is soaked in paraffin, polished, and mounted on four porcelain insulators.

The connections are very simple and can be seen in sketches (Figs. 2 and 4). Having made all the connections, we can start testing the apparatus. First of all, leave alone the aerials and make a small tester by taking a vulcanite rod (Fig. 5) 6 ins. long and 5-16ths in. diameter; round the ends off and polish them, and into one end insert a piece of ⅛-in. brass wire, leaving out an end about 1 in. long; round off the top and polish the whole wire (see Fig. 5). (This is an excellent little apparatus for testing receiving apparatuses. Rub it on a piece of flannel or on your coat sleeve, and touch a piece of metal anywhere near the receiver; then a well-made filings receiver should respond with a sharp rap, which can be repeated about ten times without having to rub again.)

We now connect a battery to the terminals T_1 T_2 (Fig. 4), and to F_1 and F_2 a telephone receiver, and by means of the slide-contact P we can switch in more current into the telephone circuit, till a distinct gassing is heard in the telephone; now move back the slide-contact till the gassing leaves off, and reverse the current for a few seconds. Having switched the current in the right direction again, the first trial can be made. Rub the vulcanite rod and touch any piece of metal near the receiver; each time a sharp click should be heard in the telephone receiver, showing that everything is in order.

The receiver can now be connected with the antennæ by means of the terminals Q_1 Q_2. It is best to connect the air-wire with the anode of the cell; it gives the best results.

The battery power for this receiver can only be ascertained by trial, as it depends largely upon the amount of wire on resistance and choking coils; it also differs if relay or telephone receivers are used. It can vary between 4 and 12 volts; the batteries out of an electric pocket lamp do excellently if the resistance of wire is high enough. A sensitive relay will work well with this receiver, but a telephone receiver is preferable, as the signs received can be read with the telephone lying on the table.

The results with this cell are the best I have had with any receiver up till now, and I can recommend a trial, as the apparatus is not difficult to make.

If anything should not be clearly explained, or if any reader needs more particulars, I should be pleased to answer through THE MODEL ENGINEER. I hope in another article to be able to describe some other receivers and tuning apparatuses I have made for my wireless telegraphy station, and the results I have had with them.

Our Readers' Work Competition.

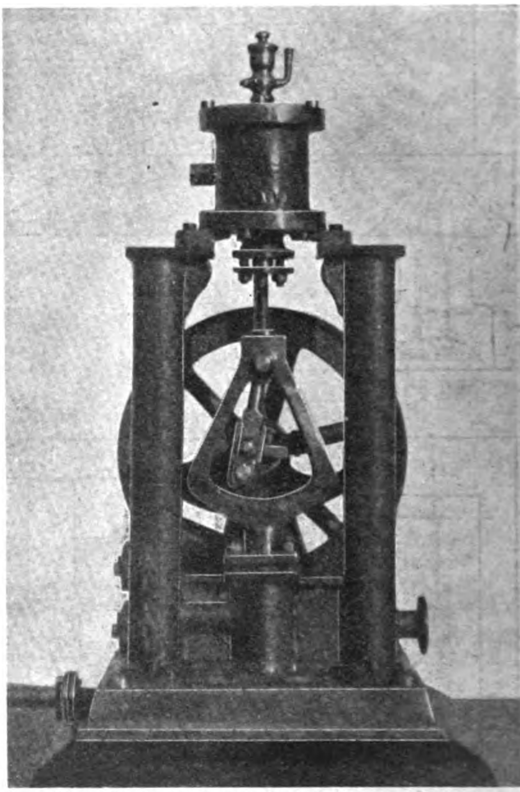
TO encourage readers to send us accounts of their work, we offer to send any tool, book, or other desired article supplied by any of our advertisers, to the value of 6s. 6d., to any reader who sends us for insertion in THE MODEL ENGINEER a sufficiently good photograph and description of any model, tool, mechanical or electrical apparatus that he has made, and which has not been already illustrated in our pages. Entries should be accompanied by a separate letter giving the title of the article, and stating exactly what is required as a prize in the event of acceptance. When tools or apparatus are desired, the page and number of article in the firm's catalogue from which it can be obtained should be stated, if possible. It is understood, of course, that we do not promise to accept everything that is sent in, and examples of work submitted must show some degree of originality or usefulness. Ordinary everyday tools or models merely made up from purchased castings are not required. The article should be written *on one side of the paper only*, with the name and address of the sender on the back. The photographs and separate sketches enclosed with the contribution should similarly bear the name and address of the sender, otherwise delay may arise in the awarding of the prizes. It is essential in this, as in our other competitions, that the copyright of the photographs must be the property of the senders, and the covering letter should contain a declaration to this effect. The competition will close on June 30th, 1908.

A Model Force Pump.

By T. C. LEWIS.

THE photograph given herewith is of a model force pump which I have made. The description of the model is as follows:—The cylinder is 1¼-in. bore, 1¼-in. stroke; travel of valve, ¼ in.; steam ports, 1-16th in. by 7-32nds in. Exhaust port, ⅛ in. by 7-32nds in. It is made nearly all of brass. The flanges of the cylinder are made of ⅛-in. sheet brass. The body of cylinder is made from brass tubing 3-32nds in. thick, the flanges being a good fit riveted over a little and then soldered. There are five screws, ⅛ in. diameter, in each end of cylinder. The quadrant and ram is brass, and cast in one piece. The slots in each side of quadrant were cut in after it was cast, which allow room for the gib and cotter to work.

The connecting-rod is of iron and made with an eye at one end and with strap brasses, gib and cotter at the other, and set screw to hold cotter after adjustment. The ram is ¾ in. diameter, and the gland is fitted with four ⅛-in. studs and nuts. There are two columns made from ¾-in. brass tubing, each fitted with flanges at each end, which are soldered on; the left hand one is fitted with two valves, and valve seats were made a driving fit into the column, and then the openings were made to the valves, which are ⅜-in. diameter, and lift ⅛ in., and a pipe connects the two columns at the back to carry the water to the delivery pipe in the right-hand column. Crankshaft is 9-32nds in. diameter, and crank-pin is



MR. T. C. LEWIS'S MODEL FORCE PUMP.

5-32nds in. diameter, and is made of mild steel. Eccentric is brass, and rod is of iron, and valve spindle is of iron. A bracket is attached to the columns; also an A-shaped standard to carry the crankshaft. The flywheel is cast iron 4½ ins. diameter. Bedplate is made of brass sheet, 3-32nds in. thick, and is 5¼ ins. by 4½ ins.; the sides are fastened on with cramps inside and soldered together and then polished. The small oil cup on the top of cylinder is hollowed out in the top part, and the top screws on, so that oil can be put in when the model is at work. The model is screwed on to a mahogany base, and is 6¾ ins. by 6 ins.; the height is 10 ins. to top of cylinder, and oil cup is 1 in. high.

Engineering Drawing for Beginners.

By H. Muncaster, A.M.I.Mech.E.

(*Continued from page* 328.)

GENERALLY speaking, isometrical projection is only suitable where the objects represented are bounded by lines that are parallel to one of the edges of a cube whose diagonal is perpendicular to the plane of projection. There are cases, however, where, while the greater portion of the work fulfils these conditions, a few details hardly conform to them. In such cases all the necessary points to determine the figure may be found by referring to the edges of one of the faces of a cube.

Suppose *a b c d* (Fig. 99) be the orthographic plan of a cube on the face of which is a polygon 1, 2, 3, 4, 5, which is required to be drawn in isometrical projection. Extend the line 1, 2 to cut the edge of the face at *f* on *a b* and the line 1, 5 to *e*; in a like manner extend 3, 4 and 4, 5 to cut the edges at *h* and *i*. The points *e f g h i*, also 3 and 2, may then be measured off and transferred to the isometrical view (Fig. 100) along the lines *a b c d*, etc.; the lines 2 *f* and 5 *e* drawn to intersect so as to determine the point 1, the point 4 being similarly found and the figure completed.

The foregoing proposition will suggest a very extensve application of this method of projection. Fig. 101 gives a further example, showing how radial lines may be projected by means of a square. The points *e f g h*, etc., having been found by extending the radials, may be transferred to the isometrical view (Fig. 102). This will give in outline a method of projecting a wheel, in which the edges of the spokes may or may not be parallel to the radials.

Before leaving the subject of isometrical projection an example is given of a drawing of a crankshaft and eccentric (Fig. 103). A few of the construction lines have been inked in to show how the work is set out. The centre line *a b* is drawn at an angle of 30° from the horizontal. Measuring from *a*, the distance from the end of the shaft to the face of the crank web is marked off at *c*, also the throw of the crank *c j* directly from the scale, also the running dimensions *j m*, *j k*, *p r*, etc. The edge of the crank web at *k* is part of a circle of a radius equal to *c k*, showing as part of an ellipse. Set off *k d* equal to *c k* on a line drawn 30° from the horizontal; join *c d*. The required ellipse will have its axis on *c d*, and will have the line *d k* tangent at *k*. Set off *m e* equal to *j e*; the curve at *m* will have the same relation to *j e* and *m e* as that arc has to *c d* and *k d*. Both of these curves may be determined by the methods of drawing ellipses already described. The remaining portions of the crank will be readily drawn. To find the position of the eccentric, set off *o* at a distance from *a* equal to the distance from the end of the shaft to the face of the eccentric sheave; set off *o x* equal to the cosine and *x y* equal to the sine of the *angle of advance* of the eccentric for the radius *o y*. This will determine the point *y*, through which draw the vertical line *z v*; set off *y z* and *y v* each equal to half the diameter of the eccentric. Through *z* draw *g s* at an angle of 30° from the horizontal, *z g* and *z s* being each equal to *y z*. Complete the parallelogram *g s t u* and draw the ellipse representing the face of the eccentric sheave. The other parts will be similarly set out and drawn. With regard to the curve at *f*, this will not really show as a line, on account of the fillet occurring there. The same may be said of the crank-pin.

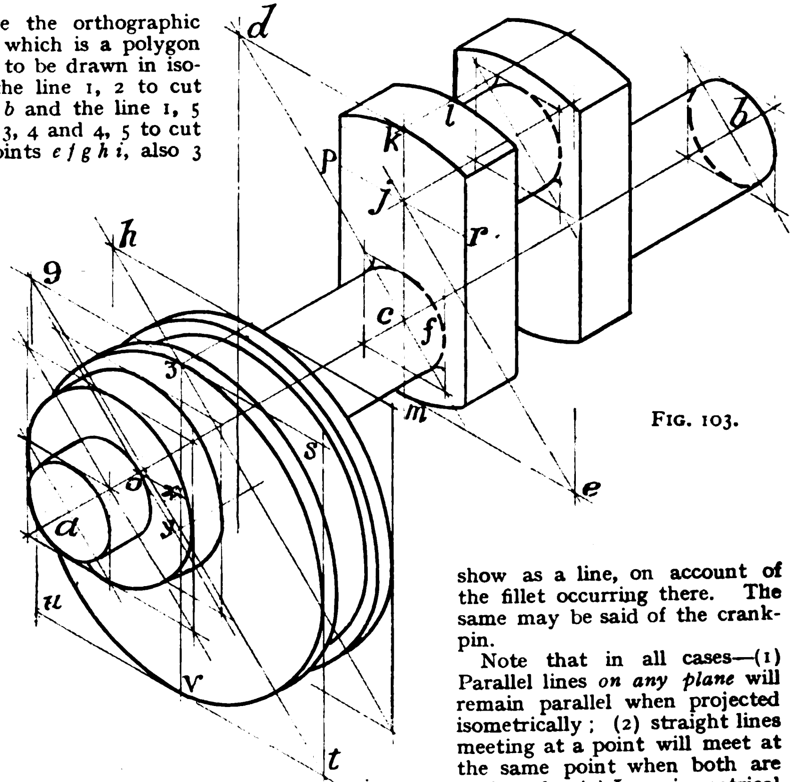


Fig. 103.

Note that in all cases—(1) Parallel lines *on any plane* will remain parallel when projected isometrically; (2) straight lines meeting at a point will meet at the same point when both are projected. (3) In an isometrical cube the diagonals across any face are as 1 to ·57753, and in every plane parallel to one of the faces a circle will be represented by an oval having its major and minor axes in the same proportion (4) Vertical lines will always be represented by vertical lines. (5) Circles that are concentric and on the same plane will be represented by ovals having their major and minor axes on lines common to both.

In setting out toothed wheels the shape of the teeth is the first matter demanding attention. The most casual observer may notice that the shape of the tooth alters, not only with the pitch, but also with the size of the wheel, that is, two wheels gearing into each other, if of different size, will have teeth of different shape.

The theory of the form of teeth is rather beyond the scope of these papers; it may suffice to point out that the teeth must be of such a shape that while the working faces of the teeth are in contact the relative angular velocities of the wheels must be constant. The usual form of tooth is the epicycloidal.

Suppose the curve *a b* (Fig. 104) represents a portion of the periphery of a wheel having a smooth edge; if we roll another wheel, as *c*, on the edge of the first wheel, any point in the periphery of the second wheel will describe an epicycloid. Take *x* as being the point of contact. If we move the wheel to the position *d*, the point that was in contact at *x* having moved to *y*, describing the curve shown by the dotted line, this curve is no

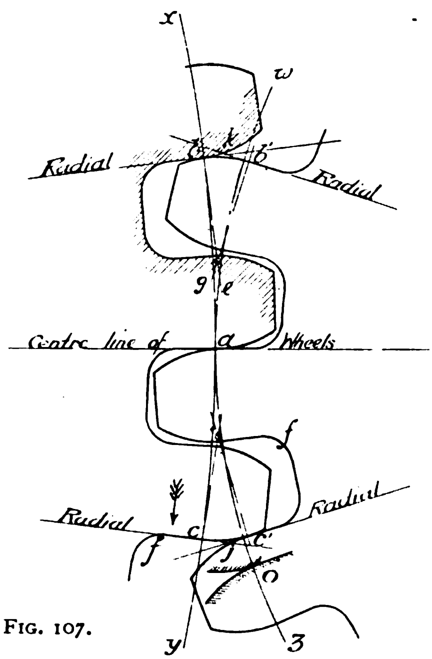


FIG. 107.

part of a circle or of an ellipse, but of a species of curve of which there are three forms—(*a*) the epicycloid (shown in Fig. 104), (*b*) the cycloid where *a b* would be a straight line, (*c*) hypocloid where *a b* would be an internal segment.

Let *a b* (Fig. 105) be a curve of the same diameter as *a b*, where we can roll the wheel on the *internal* side of the curve. We begin by placing the wheels in contact at *x* and rolling the smaller wheel from the position *c* to that at *d*, the point first touching at *x* having moved along, as shown by the dotted line, to *z*.

If *a b* be the pitch line of a spur wheel *x y* (Fig. 104) would be the shape of the tooth above the pitch line, and *x y* (Fig. 105) the shape below the line. If the rolling circle be half the diameter of the fixed circle, the hypocloid would be represented by a straight line, as shown in Fig. 106, where three positions are given for the smaller circle at *c*, *d*, and *e*, the relative position of the point being at *x*, *y*, and *z*, on a straight line equal to the diameter of the larger circle.

A radial line through the point of contact, *x*, as

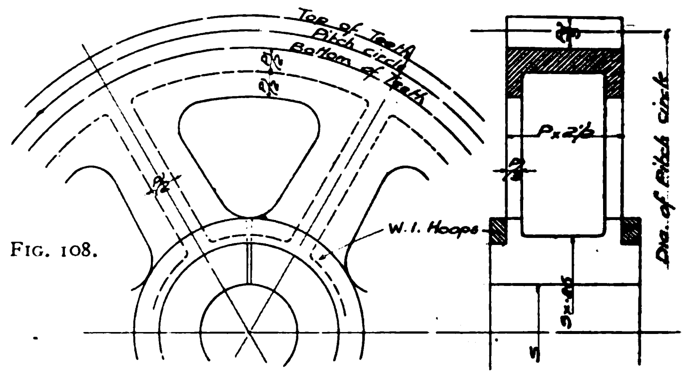


FIG. 108.

in Fig. 105, will be tangent to *both* curves. There are several methods of setting out by means of arcs drawn by the compasses, the shape, with varying degrees of inaccuracy, of epicycloidal teeth, which are generally unsatisfactory. The writer strongly recommends the radial form of tooth, as being easily set off, and, what is of more importance, extremely quiet in working.

As will be evident by referring to Fig. 106, a tooth having the root defined by a radial may be considered as having this described by a rolling circle of half the diameter of the pitch circle.

The proportions of teeth adopted by the writer,

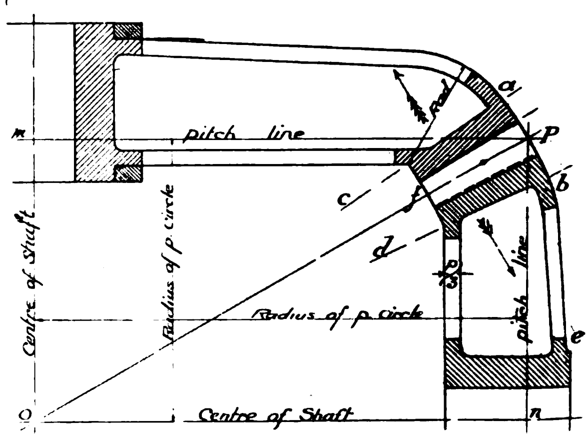


FIG. 109.

and used with success for many years, are given in the following table:—

Total depth of tooth	=pitch	× ·70
Above pitch line	= „	× ·33
Below pitch line	= „	× ·37
Thickness on pitch line	= „	× ·48
Space on pitch line	= „	× ·52
Width of teeth	= „	× 2· to 3·
Thickness of rim	= „	× ·45 to ·5.
Radius of fillet at root	= „	× ·15

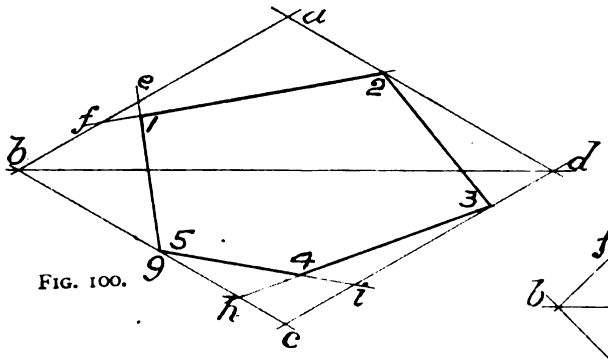


FIG. 100.

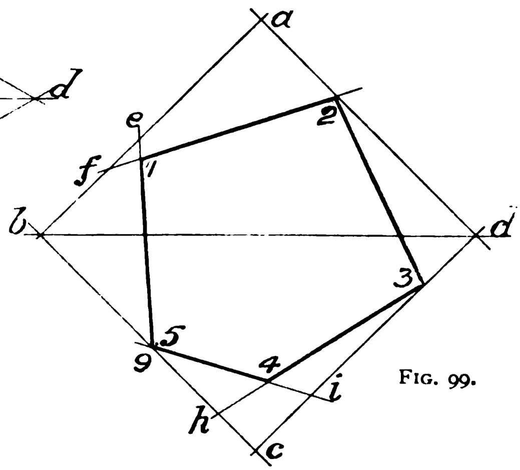
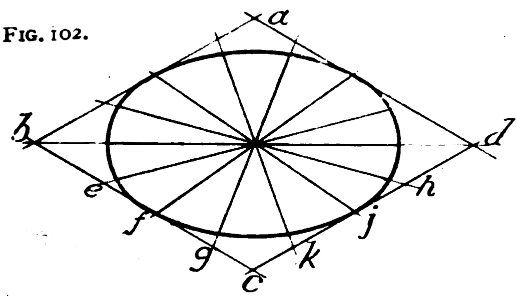


FIG. 99.

FIG. 102.



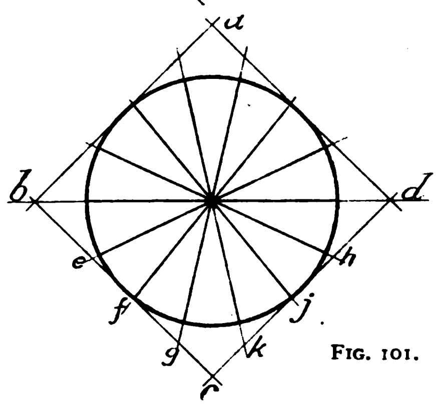


FIG. 101.

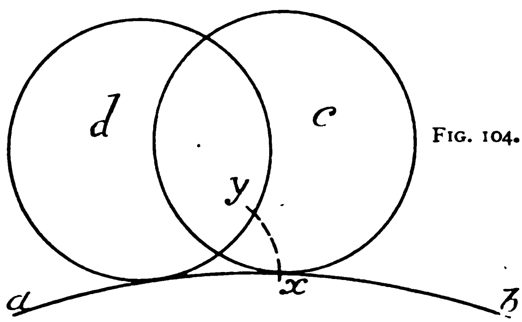


FIG. 104.

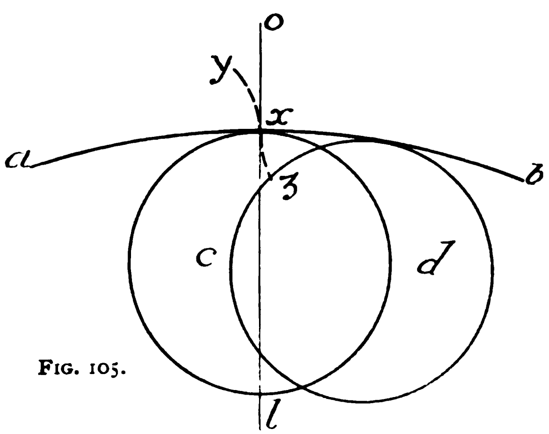


FIG. 105.

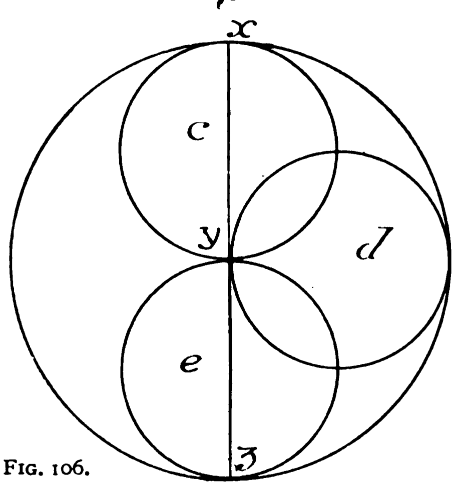


FIG. 106.

ENGINEERING DRAWING FOR BEGINNERS.

These are for cast gear; for cut gear the clearance may be rather less.

Fig. 107 shows the writer's method of setting off the radial teeth. Let $x\,y$ and $w\,z$ be the respective pitch circles. Draw through a a straight line radial to each wheel. Set off the pitch $a\,b$ and $a\,c$ on both circles, and draw radials through each point; from k, where the radials cross, set off $k\,b$ equal to $k\,b$; from b and b' draw $b\,e$ and $b'\,g$ lines perpendicular to the radial. Where these lines cross as a centre, describe the arc $b\,b'$; this will be the radius of the top of all the teeth of the smaller wheel. Set off $c'\,j'$ equal to $c\,j$; from c and c' draw lines perpendicular to the radials where these lines cross. As a centre describe the arc $c\,c'$. This will give the radius of all the top parts of the teeth of the larger wheel. Draw the circles for the bottom and tops of the teeth in each wheel (as in Fig. 108), and complete a few teeth, as shown. A substantial fillet may be shown at f equal at least to one-seventh of the pitch. The hatched portion at o shows the position of the teeth just before leaving the contact.

Fig. 108 shows the method of setting out a wheel for the pattern shop. The body of this wheel would, in moulding, be strickled in the sand and six cores made to the dimensions given, which would be required *in inches*, and not in terms of the pitch, as shown. It is usual to put iron plates into the boss to divide the wheel there, as shown, so that in cooling, after being cast, the wheel is not distorted or cracked by unequal contraction. The boss is afterwards hooped by wrought-iron hoops shrunk on.

Fig. 109 shows the method of setting out bevel and mitre wheels. The centre lines of the shaft intersect at o. Set off $o\,m$ and $o\,n$ equal to the radii of the pitch circles of the required wheels; draw $m\,P$ parallel to $o\,n$ and $n\,P$ parallel to $o\,m$; with $o\,P$ as radius, from the centre o draw $a\,b$. Set off on $a\,b$ the depth of the teeth above and below the line and the thickness of the run according to the figures given in the preceding table, also the width of the tooth $P\,f$. Draw $a\,c$ and $b\,d$ radial to the point o; with radius $o\,f$, draw the inside edges of the teeth, determined by the lines $a\,c$ and $b\,d$. The remaining parts will be easily understood by referring to the sketch. As there is a certain amount of thrust in the direction shown by the arrows, it is good practice to make the arms taper so as to be wider at e than on the face of the teeth.

(To be continued.)

Engineering Works and Accessories for Model Railways.

By E. W. Twining.

(Continued from page 254.)

In my last contribution I dealt with viaducts, giving as an example one of large dimensions, and explained that structures of this class, as a rule, are never of a very elaborate or proto-architectural type. For that reason I shall allow that one design to suffice.

Viaducts are built of all sizes and lengths, but, roughly, they may be divided into two groups, viz., large and small. The large variety being found bridging deep valleys where the nature of the physical features of the country prevents the adoption of embankments, or where such would be too costly. Small viaducts are generally employed in towns where, of course, embankments are also impossible. As the railway in such cases is carried at no great height above the street level, the piers are low and the spans likewise short.

Of this class I have selected a very fine example in the city of Bath; the Great Western Railway is carried by this through the southern part of the town, and, owing to the line crossing two important thoroughfares close to the point at which they unite at the end of the "Old Bridge," over the river, a very peculiar piece of viaduct construction was necessary. The two roads referred to unite at a very great angle, and acute skew arches had to be resorted to.

There are two main arches—one to each of the roads, which span the carriageway only, and each of these is flanked by two other smaller ones, through which the footways pass. The space under the viaduct between the roads is used as offices.

The style of this portion of the work is most

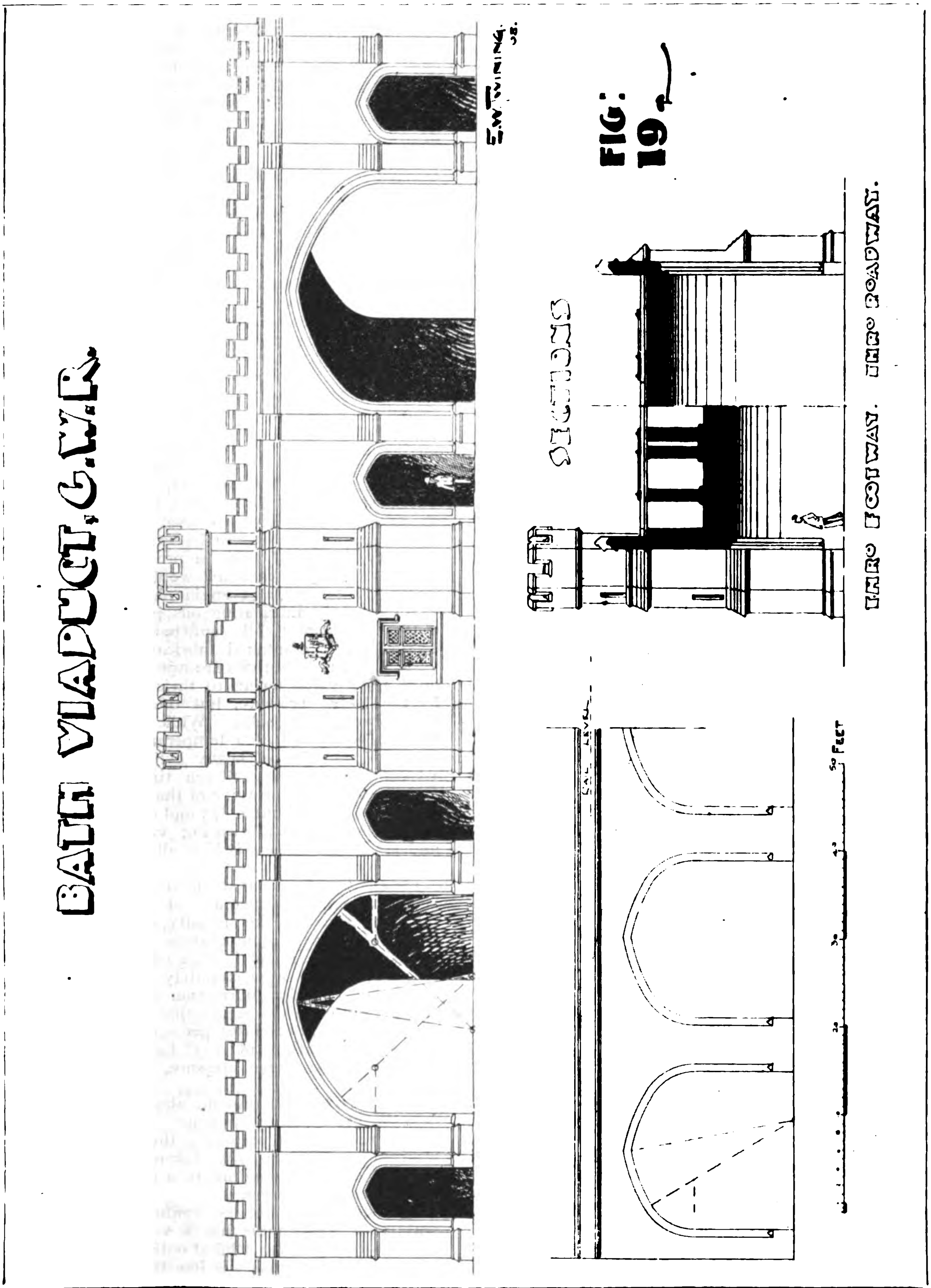
Fig. 19a.—View of Bath Viaduct, G.W.R.

elaborate, indeed, it may be safely said that there is no other such piece of work to be found, uniting as it does, extraordinary construction with chaste and correct architectural design.

The elevation at the top of Fig. 19 will convey an idea of its appearance. This portion is the only elaborate part; the remainder is more or less as shown at the lower left-hand side of the drawing. I say "more or less," because the spans and pier thicknesses vary greatly, as does, in a lesser degree, the general height above ground level. However, the sketch may very well be followed for modelling purposes.

The total length of the viaduct is 306 ft. 4 ins., and there are altogether five arches—all of the pointed segmental form.

Fig. 19a is a photograph of the special portion; though not a good print, it may give some assistance in forming a proper conception of the work. The view, both in this and in the drawing, represents the northern face, and viewing the viaduct


BATH VIADUCT, G.W.R.
E.W. TWINING.
FIG: 19
SECTIONS
THRO' FOOTWAY. THRO' ROADWAY.
RAIL LEVEL
50 FEET

thus, there are to the left or eastern side of the special portion over the diverging road four of the plain arches; the remainder lie to the west side.

The whole viaduct is built of Bath stone in the late Tudor Gothic style, sometimes termed Elizabethan.

I fear that few readers will think of building this fine structure for a railway out of doors by the method I intend to give later; the labour involved would be too great, although the design is a practicable one. The design should, however, be useful to those who contemplate an elaborate small-scale indoor track, such as an electrically equipped one, in which case the structural work would all be of wood, or wood faced with cardboard.

(*To be continued.*)

The Design and Construction of Ball Bearings.

By "Zodiac."

(*Concluded from page* 447).

HENCE with thick oil, the cyclist need not trouble to carry an oil-can, thus saving a messy tool bag due to the oil-can leaking. For cycle bearings nothing can equal a good thick cylinder oil, provided it is free from acid and does not have any tendency to oxidize and become gummy.

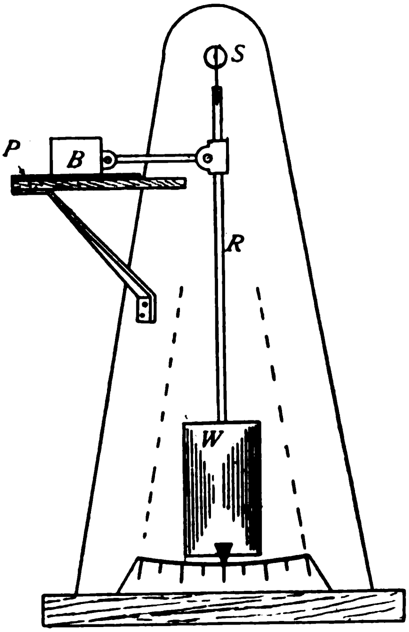


Fig. 31.—Simple Form of Bailey's Pendulum Oil Tester.

A drop of oil left for some hours on a brightly polished copper plate, will soon show if any acid is present. For information on oil testing, the reader should refer back to an article on lubrication in The Model Engineer, March 26th, 1903, by Mr. C. F. Townsend, which is most interesting.

The simple oil tester shown in Fig. 31, may be of interest to those readers wishing to actually test oils. The heavy pendulum W, with its rod R, is suspended from S in the same manner as an ordinary clock pendulum. In swinging to and fro the pendulum drives the block of brass backwards (B) and forwards on the horizontal brass plate P, by means of the connecting link, as shown in the drawing.

A single drop of the oil to be tested is placed on the plate and the block B lowered on to the oil. The pendulum is then deflected to the end of the graduated arc and released, the number of swings it makes before coming to rest being taken as a measure of the lubricating value of the oil. If the test is repeated at the end of three or four days an indication is obtained of the tendency of the oil to oxidize and become gummy; of course, the oil must meanwhile be protected from dust. An alternative "gumming test" is to heat a sample of the oil for, say, one or two hours to about 200° Fah., allow it to cool and then re-test. If the pendulum now comes to rest quicker than before, the oil will gum badly and should be rejected.

The apparatus is exceedingly simple and easily made and is very effective. The weight W should be at least 8 lbs. or 10 lbs. and the length of the pendulum between 4 ft. and 5 ft.

The weight of the brass block B should be varied so as to give somewhere near the pressure per square inch that the actual bearing for which the oil is intended will have in practice. Obviously a light sewing machine oil would not be suitable for lubricating, say, a gas engine shaft, and *vice versa*.

Some of the lubricating oils put up in tins for cyclists' use are totally unfitted for the purpose, especially the combined lubricating and burning variety. Such thin oils are not only of very little lubricating value owing to their being forced out by the heavy pressure, but they do not deaden the noise of the balls. While the viscosity, or body, of sperm oil at a temperature of 70° Fah. is 100, the viscosity of heavy cylinder oil is about 1,500, that is to say fifteen times as great, although the specific gravity of the two oils is almost the same, viz., about 0·875 and 0·890 respectively. The difference in lubricating value for bearings under heavy pressure (which all ball bearings are) is therefore considerable.

For the benefit of our steam engine friends it may be remarked that increase of temperature considerably decreases the viscosity, or body, of an oil; for instance, at a temperature of 120° Fah. the viscosity of sperm oil is reduced to 45 degs., that of cylinder oil to approximately 700 degs. Hence, for engine cylinder lubrication the light machine oils are quite useless seeing that a steam pressure of only 10 lbs. (absolute) per square inch already has a temperature of 193° Fah., and 100 lbs., equal 85·3 lbs. gauge pressure, a temperature of 328° Fah.

Note.—To find the pressure above the atmosphere *i.e.*, the steam gauge pressure, deduct 14·70 lbs. from the absolute pressure; the pressure of the atmosphere being usually taken as 14·7 lbs. per square inch, corresponding to a barometer reading of 29·9 inches of mercury.

Viscosity must not be confused with specific gravity, a wax candle has a very high viscosity indeed—in fact, it is a solid at ordinary temperatures —yet its specific gravity is less than that of water. Thick oil and tar are even better illustrations of the above point. Specific gravity of oils is not of much importance from the lubricating point of view, viscosity being a much more important property.

A handy way of measuring the diameter of a ball is to place it between the jaws of a cycle spanner, screw up tight, and then measure the distance between the spanner jaws. If the spanner is in good trim and not burred on its jaw faces, this will be found very handy and accurate, especially if a pair of calipers are not to hand.

A small circular plate ball gauge with holes accurately reamered out to, say, ⅛, 5-32nds, 3-16ths, 7-32nds, ¼, 5-16ths, 11-32nds and ⅜ in. is easily made and a very handy workshop tool, as the difference between, say, a ⅛ and 5-32nds in. ball is not readily seen at a glance. Such a gauge is not intended to check the accuracy of the balls, but merely to prevent mistakes being made in the sizes.

As a matter of fact, a complete range of balls from 1-16th up to 4 ins. (50 sizes in all) form a set of very accurate and fairly cheap standard gauges for workshop use in general. The cost of such sets is 1-16th to ½ in. (14 sizes), about eighteen pence; 9-16ths to 1¼ in., 12 sizes, costing about four or five shillings. Of course the larger sized balls come rather expensive, 4-in. balls costing about seventeen shillings apiece.

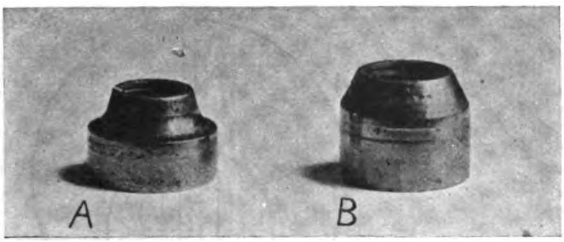


Fig. 32.—Photograph Showing Wear of Cycle Cones.

Fig. 32 shows the wear of two front cycle cones run under practically equal conditions as regards load, etc. Cone A is that of a first-class maker, and after over 30,000 miles the suface is still intact. Cone B is from a four-guinea cycle and, as seen in the photograph, the surface is deeply pitted after only 5,000 miles, the cone being quite worn out.

In conclusion, a final hint may be useful for the sake of those readers who have old machines in which both pedal pins are threaded with a right-hand thread. In such cases the left pedal is liable to unscrew in spite of locking devices. Such faulty pedals can be remedied by being well warmed up, smeared with Prout's elastic glue, and then tightly screwed home into the heated crank. This treatment will effectively prevent the pin unscrewing, and if the pin has to be unscrewed at any time the crank end will have to be warmed up first.

According to *Power* an electric generator in a smelting plant at West Jordan, Utah, is said to have been in constant operation twenty-four hours a day for nearly four years and a half, with a single interruption, which was due to a broken pulley.

The Metre Launch, "Hermes."

By Thos. Dysart.

(*Continued from page* 444.)

The Boiler.—This is 7 ins. long over all by 4⅞ ins. outside diameter. The total heating surface is about 103 sq. ins. The shell is of a special quality mandrel-drawn *brazed* brass tube, 19 gauge, and designated by the well-known firm in Clerkenwell, where it was bought, as "Day's Best London Brazed Tube." Considering that *brazed* tube is generally deemed too risky to employ in model boiler making (weight being an important desideratum), this information may perhaps be of use to some readers. The boiler has been tested to 220 lbs. water pressure and to 120 lbs. steam (the limit of my pressure gauge), and, as the pressure when the boat is running at top speed is anything from 90 lbs. to blowing-off pressure at 110 lbs., personally, I think where weight is a consideration good *brazed* tube may be used for the *shell*. However, the intending user must act upon his own responsibility when deciding this point.

The furnace is of best quality mandrel-drawn seamless *brass* tube, 2 9-16ths ins. outside diameter, 20 gauge. The water tubes (twenty-three in all) are 5-16ths in. outside diameter, solid-drawn *copper*, 20 gauge.

As to construction, the ends, which are simply two plain discs of hard-rolled brass 3-32nds in. thick, were turned a good tight fit, both for the shell and to take the furnace tube. One having been fixed into position in the shell and well sweated from the inside, the furnace tube with the water-tubes already silver-soldered in was driven into the other end. After being sweated together, they were inserted in their respective places, the one into the end already in position, and the remaining end into the shell, where it was sweated. A piece of strip brass ¼ in. by 1-16th in. was then used to form flanges for each end, and secured to shell by 3-32nds-in. brass rivets (about ½-in. pitch). The ends of the furnace tube, previously annealed, were then turned over about 5-32nds in., getting them quite flat and well fitting on the ends. A blowlamp, with some best blowpipe solder, was next brought to work, and the whole job—ends, flanges, and ends of furnace—thoroughly re-sweated, the result being a completely steam- and water-tight boiler.

This method of construction, whilst admittedly not orthodox, will doubtless appeal to many, as there is no troublesome flanging, etc., to be done, and turning the ends in the lathe is very easy.

Considering that most of us are cautioned against using soft solder in conjunction with steam pressures above 50 lbs. to 60 lbs., this boiler may prove somewhat of a revelation. Of course, a good tight driving fit must be made of the ends, and good solder used as a caulking only, the writer not wishing to convey the idea that soft solder used with higher pressures would prevent the inevitable results of poor workmanship.

Steam is taken from the top of the boiler through an anti-priming arrangement of the writer's design. This simply consists of a piece of ⅜-in. hexagon brass rod 1 3-16ths ins. long, reduced to and screwed (twenty-six threads to inch) 5-16ths in. for a distance of ⅜ in.; this portion is to screw into boiler, where it is afterwards well sweated in. Before this latter operation, however, a 9-64ths-in. hole is drilled up for a distance of 1⅛ ins. The open end is then tapped 5-32nds in. for about ⅛ in., and a plug of brass rod, screwed to correspond, is inserted. Six 1-16th in. diameter holes are then drilled radially through that portion which screws into boiler, and this completes the steam connection. This arrangement, besides slightly wire-drawing the steam, proves highly anti-priming. The finished article has one face tapped 3-16ths in. for steam pipe and another tapped ⅛ in. for the pressure gauge syphon. After screwing it into boiler top, and *before* sweating it in, see that the face with the 3-16ths-in. hole for steam pipe is in line with the boiler lengthwise and in the direction of the firing (front) end. The steam pipe (3-16ths in. outside diameter) is of *steel*, this metal being deemed advisable from past experience, as, scored, owing to the excessive superheat, that is, if brass or gun-metal is used in the construction. The method adopted by the writer for gauging the temperature of the superheated steam he employs is as follows: after coupling the steam pipe on to valve chest cover, a little soft solder is applied to the joint. If the steam is *too* hot it will melt the solder. If just what is deemed hot enough, he knows by the particular colour the brass assumes.

A small steam cock (to take ⅛ in. outside diameter solid-drawn copper pipe) is screwed into front end of boiler. This is for the blast in the smokebox, which is essential in a boiler of this type. After leaving the steam cock the pipe passes down front of boiler into the furnace, and then right through at the side of the latter into smokebox, where it is bent up (clear of the superheater) centrally in position. The nozzle has a small hole of about

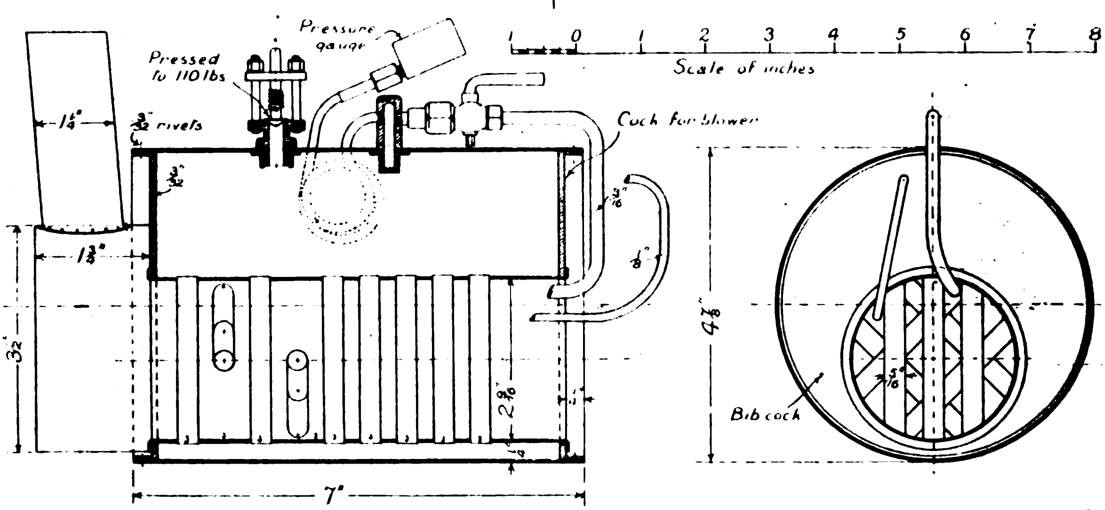


FIG. 5.—THE BOILER OF METRE BOAT, "HERMES."

after entering the furnace, there are two coils of it in front of the water tubes, afterwards passing right through the furnace into smokebox, where it is connected by a union to a length of 3-16ths in. diameter solid-drawn copper pipe. This latter is coiled once and then passes out of the top of smokebox to engine; not direct, however, as the steam is very highly superheated, but a little extra length of pipe is allowed, so that, after emerging from smokebox, it passes right round the cylinder and then is coupled on to valve chest cover at the front of the engine. This allows the steam to cool off a little before entering the cylinder, otherwise the very hot steam would score the sliding surfaces.

What the extra efficiency derived from this method of superheating is the writer cannot determine, but there can be no gainsaying the fact that it is of great benefit, especially to a small plant. That portion of the steam pipe which is coiled inside the furnace gets quite red hot whilst raising steam, and, even after steam appears the colour of the coils is a dull red. The great thing, however, is to find the right length of steam pipe to be exposed to the heat, otherwise there will be great danger of the cylinder, etc., being badly 1-32nd in. diameter, and was made from ⅜-in. hexagon brass rod. A trial or two will determine the best position of the blast. Very little steam is required for same.

The smokebox was made out of an old molasses tin, and the removable cover (the lid) comes in very handy when the smokebox is opened for inspection.

The boiler holds sufficient water for one quarter of an hour's steaming at top speed.

The Lamp.—The tank of this is 2¾ ins. diameter by 3½ ins. long, and is made out of stout tinplate lap-seamed and well sweated. The ends are dished to withstand the pressure. The vaporiser is composed of ¼ in. outside diameter solid-drawn copper tube, 20 gauge, well annealed before bending. The supply end is brought back from the front of the coil the required length and then turned over closed with the hammer, and the joint soldered. That portion of the vaporiser (about 2¼ ins. long) is then firmly fixed to the under side of the tank with soft solder. A hole ⅛ in. diameter is then drilled into it to take the small feed pipe which comes down from the pin valve at the front end of the tank. A little solder, judiciously applied, completes the connection. The other end of the coil is turned backwards and then straight across the diameter of the coil. A piece of ⅜-in. hexagon brass rod is tapped ¼ in. to take the coil, and again is tapped 5-32nds in. on one of its faces for the nipple. The latter has a very fine hole in it, about 70 gauge, which was made with a fine sewing-needle.

The burner tube consists of a piece of tinplate cut to dimensions, rolled into shape, and twisted tightly into the bore of the coil the required distance. At the nipple end, having previously been slotted radially for this purpose, it is coned down to about 9-16ths in. bore, and just encloses the nipple. This ensures the proper air supply. The total dimensions of lamp are: Length over all, 8¼ ins.; bore of vaporiser, 1¼ ins.; length of burner tube, 3½ ins.; distance from nipple to end of burner tube, 3¾ ins.; weight, 1 lb. 3 ozs. with full charge of benzoline. The flame at full power is about 8 ins. long and intensely hot.

The Propeller.—This is 2¾ ins. diameter and 7¼ ins. pitch. The boss, which is 9-16ths in. diameter by 1 3-16ths ins. long, is made out of brass rod. A piece of this was marked off accurately for the angles and depths to take the two blades. A fine hacksaw cut the slots, care being taken to cut exactly to the lines marked. A 5-32nds-in. hole for the shaft was then drilled up in the lathe for a distance of ¾ in., the boss turned to shape, and parted off. The blades are of six-cross (about 1-32nd in.) tinplate, which material the writer finds answers admirably, it being light, yet strong. The blades were both cut from a cardboard template, placed in the vice and filed up together to shape. Whilst still there they were twisted approximately to the desired angles (using cardboard templates). They were then taken out of the vice, inserted in the boss, and well sweated in, a good fillet of solder being left, which was afterwards nicely filed to the general shape. There is a slight curvature on the blades, and this was got at the same time as the correct angles by hammering the blades on the round top of the vice. A little practice and patience are required to obtain the best results. After getting the blades seemingly right, the propeller was then mounted on a length

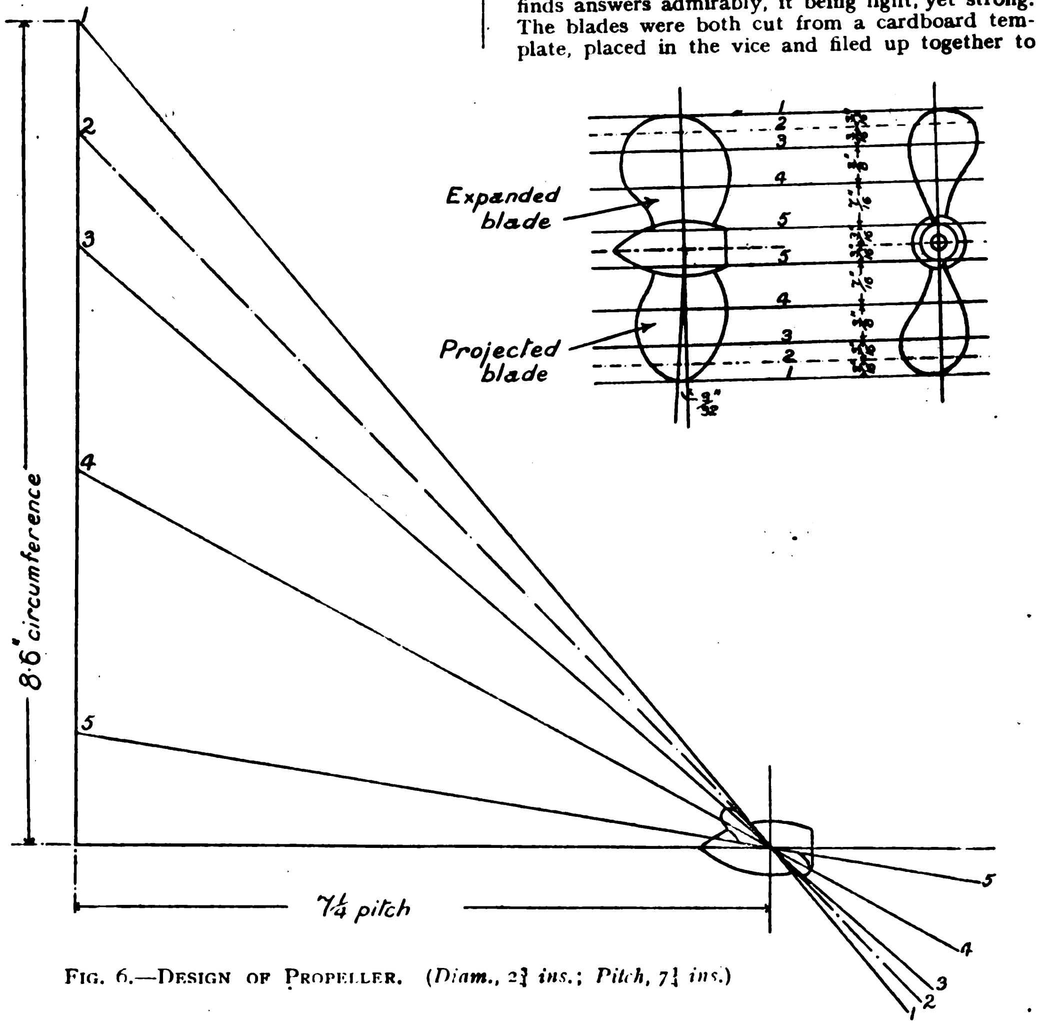


Fig. 6.—Design of Propeller. (*Diam., 2¾ ins.; Pitch, 7¼ ins.*)

of 5-32nds-in. steel rod, placed in the chuck, and revolved slowly, testing the various angles by cardboard templates and a straight-edge placed in the slide-rest. Satisfied with the results, the blades were then finished off with fine files and emery cloth. A ⅛-in. setscrew secures the propeller on to the shaft, a small flat being filed on the latter for that purpose.

Too much care and labour cannot be expended upon a properly designed propeller, which, in the writer's opinion, is one of the chief factors for speed; if not *the* chief, assuming, of course, fair design and workmanship in the other component parts of a boat.

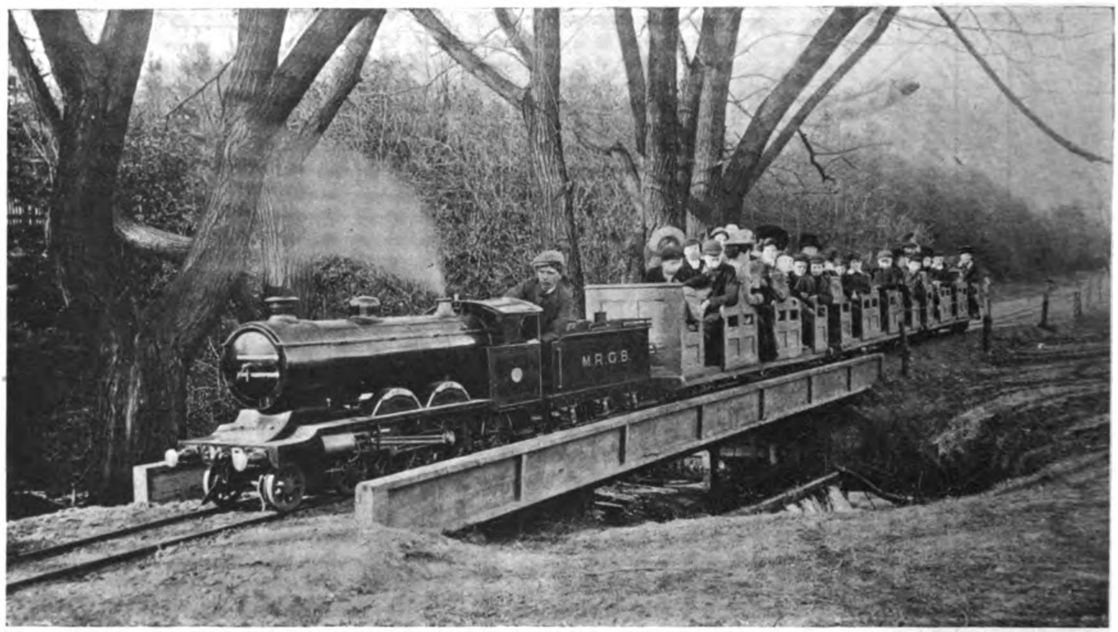
In concluding this somewhat lengthy description the writer hopes that the same may prove of benefit to those who intend going in for a metre speed boat, as, reading between the lines, a great deal of valuable information for future results can be readily deduced. Eight-and-a-half miles an hour is quite feasible for a metre speed boat, and the writer looks forward to accomplishing this speed himself in this year's Speed Boat Competition.

LEEDS MODEL YACHT CLUB.—Mr. Ernest North, assistant secretary of this club, reports an interesting series of races held during the past year, and further states that the club is in a satisfactory financial position, and has a membership of twenty-five. The fleet comprises some thirty boats, the majority of which are new and of modern type. The absence of a suitable lake is severely handicapping the club, but hopes are entertained that the Corporation of Leeds may see their way to finish the lake at Kirkstall, which, when full of water, is an ideal pond for model yachting.

Model Railways.

XX.—Sutton Coldfield Miniature Railway.

OWING to the increase in the traffic on this line and the desire to be well able to cope with any sudden influx of passengers, the directors of the Miniature Railways of Great Britain, Ltd., have withdrawn the 2-in. scale engine "Nipper," and have increased the gauge of the rails to 15 ins. A new locomotive of the "Little Giant" class has just been built at the works of Messrs. W. J. Bassett-Lowke & Co., Northampton, for the railway, and it commenced to work at the Easter holidays. The engine is of the standard type, and is named "Mighty Atom." The only important difference which Mr. H. Greenly, the engineer to the Company, has introduced into the design is in the matter of the big end of the connecting-rod and the brakes. The big ends are now arranged with adjustable brasses in place of the solid bushes originally designed for the "Little Giant," and which followed the recent practice on the G.W.R.



THE SUTTON COLDFIELD MINIATURE RAILWAY.

The boiler has been stayed for a pressure of 125 lbs. instead of 110 lbs., as it is found that the engine can easily maintain the higher pressure under all conditions. The diameter over the boiler to the lagging has been slightly increased and the chimney lowered to an extent of ¼ in., which gives the model a somewhat more imposing appearance.

The other important feature is in the arrangement of the brake-blocks. Instead of these being applied to the rear side of the driving and coupled wheels, the brake rigging is arranged so that the two blocks grip only the driving wheels, the pressure of the blocks being equalised in the orthodox manner by levers placed in the crossbar. This method of arranging the rigging is intended to prevent the undue wear on the hornblocks and axle-boxes which takes place in an engine which is constantly being stopped and started, where the blocks are fitted to only one side of the wheel. The engine is painted standard Midland red and bears the letters "M.R." on the buffer-beam and "M.R.G.B." on the side panels of the tender.

The line at Sutton Coldfield is being laid with a loop at each end, so that the engine may run round the train, and thus it will not be necessary to push the coaches back in front of the engine on the return journey. So that the driver can perform the shunting operations without leaving the footplate, the points to the loop-lines will be self-acting and automatic couplings will be used on the engine and carriages.

Readers in the Birmingham district who have not seen one of these engines should avail themselves of the opportunity during the present summer. As the accompanying photograph shows, the line is a very picturesque one, and is well worth a visit. After the Easter Holidays the traffic does not resume until Whitsun.

Some Notes on Fitting Up a Small Oil Engine.

By E. W. F.

SOME few months ago the writer purchased from a private advertiser in THE MODEL ENGINEER a set of horizontal water-cooled oil engine castings of 2-in. bore and about 3-in. stroke. It is only fair to all concerned to state that they were exactly as turned out by the makers, and they had done the following work on them: bored cylinder, faced cover, drilled flywheels, partly turned the crank, and rough-drilled and fitted main brasses, and a few other jobs. Working drawings of a sort were also supplied, but these can

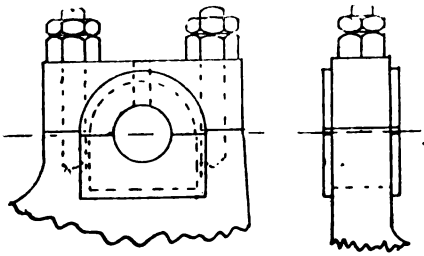


FIG. 1.

be ignored by any reader possessing the most elementary knowledge of small petrol motors. Taking the heavy work first, the brasses supplied were far too small for a ⅝-in. shaft, and the shaft was too small and weak to allow of turning ½-in. journals on it. The steps for the brasses were filed out as large as the distance between the studs would allow, and new brasses were fitted and a proper cap put over them. Fig. 1 shows the altered bearing complete. Turning the crank-pin was an awkward job, but was got over by fitting temporary arms on the shaft ends, as explained in back numbers of THE MODEL ENGINEER.

The keyways were cut by using an ⅛-in. parting tool laid on its side in the slide-rest and the saddle racked backwards and forwards by hand like a planer head. Turning the flywheels calls for no special skill. The connection-rod was found to give about 1 in. too much compression space, so it was discarded, and a new mild steel forging obtained of the correct length.

The gudgeon pin end calls for no remark, and Fig. 2 shows plainly the construction of the big end.

The piston had a 14-in. bastard file finish on it, and no grooves, so it was carefully chucked and three 3-16ths-in. grooves and an oil groove put in.

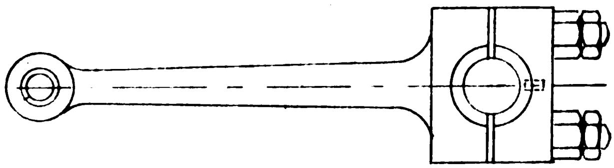


FIG. 2.

A set of rings was turned and fitted, and the joints kept 120° apart.

Inspection of the half-time wheels showed that they were of too coarse a pitch, and two of the teeth were cast solid. A pair of blanks were turned, the large in iron and the small in gunmetal. The diameter is not particular, but in the present case 36 and 72 teeth were cut on the small and large wheels respectively. The large wheel carries the exhaust cam, and a detail drawing showing the cam and its method of fixing is shown at Fig. 3.

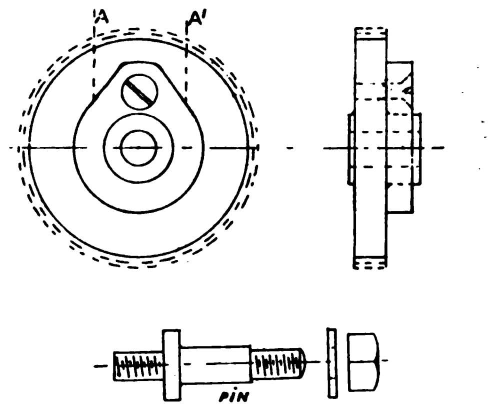


FIG 3.

In filing up the cam (which should be of tool steel) remember that it is the part between lines A and A′ that is the operative portion. The drawings sent with the castings showed a simple crank-pin screwed in the half-time wheel, and a connecting-rod actuating a bell crank lever, which in turn worked the exhaust valve. This method has one thing in common with anyone who may fit it and expect it to work successfully on a high-speed engine—simplicity. The new exhaust valve lever is shown at Fig. 4, and it was forged from mild steel. It is hung on a pin screwed in the end web of the engine bed, and can be bent to shape so that the roller bears on the exhaust cam, while the other end clears the exhaust valve stem by about 1-64th in. With a view to silence, the writer fitted an adjustable steel cup fitted with a hard rubber bush on the end of the lever, but as it is not absolutely necessary the drawing of it is omitted.

We now come to the valves and combustion

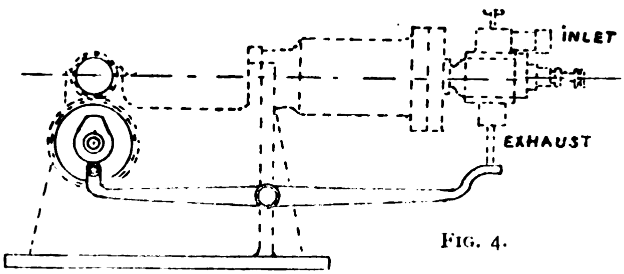
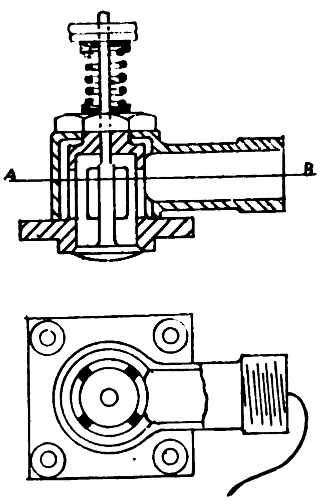


Fig. 4.

chamber. The valves sent with the castings were scrapped, and two old nickel steel cycle motor valves were turned down to suit the job. The exhaust valve calls for no special remark, but the inlet was altered somewhat from the makers' drawings. They show an exceedingly simple arrangement, consisting of a small pipe coming out over the inlet valve and with a little cup on the other end. It is delightfully simple (on paper), and conjures up visions of the maker standing over the

Sectional Elevation.

Section on Line A B.



To carburettor.

Fig. 5.

engine pouring small doses of petrol in that cup while a friend does the hand blister act known to chauffeurs as "winding her up." The arrangement shown at Fig. 5 will be found to answer well. A good carburettor should be used, and electric ignition. The make-and-break was arranged to work from the large half-time wheel; but the arrangement is not shown, as it had some defects, and is being improved upon. As space between the wheel and the bed is limited, the writer advises a separate wheel of 72 teeth, to be fitted and fixed to any convenient part of the bed, and an ordinary wipe contact, as fitted to motor-cycles, be fitted thereon. Provision should also be made for sparking advance.

Fit a good sight-feed drop lubricator over the cylinder and large oil holes to all bearings.

Now note: Many a good engine is blamed because it will not start up when turned over by hand, and here is a good method of starting these single cylinder small engines. Rig up a simple valve lift (a piece of string tied round the valve lever will do), and belt the engine up to your lathe wheel, or even a true grindstone if you have nothing better. Use fresh petrol; see all electrical connections are clean, and your battery well up to 4 volts; plug points clean and throttle open wide and spark retarded. All being well, lift the valve, get up a good speed on the engine, switch on your coil and drop the valve smartly, and the engine should run. Do *not* turn on the cooling water till the engine has done a few hundred revolutions. Final adjustments of the carburettor, sparking lever, and throttle, can be made while the engine is running. Nothing has been said here about valve timing, etc., as that is simply and well explained in The Model Engineer handbook.

Finally, if you are a London reader, bring your engine to one of the meetings of the Society of Model Engineers and let someone else enjoy a sight of it besides yourself.

Finishing Model Engines.*

By Rev. J. Shores.

The question of finish is one of great importance in all good model engine work. In the first place, because it gives smoothness to all running parts, and secondly, because it adds so very much to the appearance of the model. How can this object be attained? The writer offers, as an amateur, suggestions which have been well tried by himself, and proved to give very satisfactory and pleasing results.

Assuming that all turning, boring and fitting have been done, the next work to be taken in hand is that of polishing.

Polishing Steel.—First remove all file or tool marks. With all circular parts this can be done in the lathe by fine files and emery cloth. With flat parts, hand work is necessary. In filing flat surfaces, draw the file towards the manipulator and push away from him by even strokes. Care must be taken not to use rough files, or deep scratches will be made. First, a fairly fine ordinary file should be used, and a finish made with a "dead smooth" file (as supplied by engineers' tool dealers for the purpose of polishing). Then follows the use of emery cloth. This must be the best blue cloth as used by engineers, and never the common kind supplied to women for cleaning fire irons. Never use a very coarse emery as it leaves scratches which require much erasing. Begin with medium blue cloth and finish with the very finest. After the "dead smooth" file has been used, no *deep* scratches will be visible. At least three grades of emery cloth should always be used—medium, finer, very finest obtainable. It will astonish the beginner to find

* A prize of two guineas has been awarded for this article in the recent Competition (No. 43).

what a good finish the finest emery sheet will give him, but he may advance even a little beyond this by using Oakey's knife polish on a piece of cloth.

A steel burnisher is made from hard steel into a tool usually fish-belly shaped and varying in length from 6 ins. to 12 or 14 ins. This tool must itself be harder than the material to be polished, and must be quite free from any scratches. The steel burnisher is used in a similar manner to the file when "draw-filing." The burnisher gives a very glossy finish; but with the process of filing and emery cloth finish described, it is scarcely necessary to use a burnisher on steel.

Cast Iron Polishing.—This material is more difficult to finish well than steel. Coarse emery cloth tears into it. Fine emery needs to be used carefully. In polishing flywheels in the lathe it is very difficult to remove all marks. If the wheel is run at any considerable speed, files and emery simply tear into the material. The writer has tried many experiments on revolving cast iron in the lathe, and has at last succeeded in obtaining a fine polish on cast iron by discarding the file and using a piece of very fine stone, or emery stone. A circular emery wheel, if very fine, will answer the purpose well. Hold the flat side against the revolving surface. This removes scratches wonderfully. Then use fine emery sheets, and finish with the finest as in polishing steel.

Cast Metal Polishing.—Here again the stone may be used, if with care, on revolving work. When emery cloth is used it is an advantage to pour oil on the emery to prevent it tearing in to the work. Finish as cast iron.

Brass and Gunmetal Polishing.—These are much easier to polish, whether in the lathe or on flat and irregular surfaces. Coarse files should never be used, nor coarse emery sheets. Use fine files and the "dead smooth" file, and then fine and finest emery. Finally, a very brilliant polish may be got on revolving work by pouring Globe or other liquid polish on to a cloth and holding it against the work. Paste polish will, of course, do as well.

In polishing *flat* and *irregular* brass and-gunmetal *surfaces* a good finish can only be obtained by the use of the brass finisher's machine. This need not alarm any amateur, for it is very easy for him to make for himself a brass finisher's set and to get a result equal to that of the brass finisher himself. Obtain a few yards of calico and cut from it about 50 or 60 circles, 7 or 8 ins. diameter. Then lay them all evenly together, and cut two circles of stout leather about 3 ins. diameter. Lay one piece of leather on each side of the calico, having got the centre as near as possible, and nail right through the first leather, and through the calico into and through the leather at the other side, turning the nail points by hammering on the anvil. Then make another "buff" of swan'sdown calico for finishing, and nail together in the same way. Now turn a piece of steel shaft and get it taper screwed at one end, so that the leather of the polishers will screw on to it. Then put a small pulley at one end or, better still in the middle of the shaft, make a stand to carry a flywheel and under shaft with pedal and run the polisher about 1,200 to 1,500 revolutions per minute. The buffer may be fixed by bearings on to the end of the lathe bed and driven from a separate flywheel at the end of the crankshaft. The result will simply astonish the beginner. His finish need now be second to none. The work is, of course, held against the revolving calico wheel and a little stiff paste (to be had from engineers' stores) first applied to the revolving calico. To finish, use the swan'sdown wheel without paste. The high velocity of the calico wheels produces a finish which cannot be obtained by any hand polishing and in less than a quarter of the time. It must be remembered that this is only a polishing process. It is useless to begin buffing until *all* file and emery marks are removed. The "buffer" is to obtain a smooth, glossy brilliant surface, and to remove the last faint scratches—not deep ones.

Polishing Copper.—Proceed as with brass. Anything too large for holding to the polishing machine as, for instance a boiler shell, is first polished by "draw-filing" and emery cloth. This will leave a dull surface very discouraging to the beginner, no matter how free the surface has been made from scratch marks. The only way to get a brilliant polish is now to use the burnisher. Apply water constantly as the burnisher is being used. The result will be all that can be desired, providing that all file marks were erased before the burnisher used. Remember the burnisher is only to give a brillant finish and not to remove deep file marks.

Polishing Flat Surfaces.—In polishing the sides of bearings or the sides of eccentric straps or any flat surface which is not too large, a very useful aid to this end is to turn a wooden disc about 8 ins. diameter, and about 1 in. wide. Then cut two circles of emery cloth and stick one on each side of the disc, using glue. Hold the article against the flat side of the disc as it revolves on the spindle. This not only removes file marks quickly, but it serves to make flat surfaces very square and even. The surfaces of hexagon nuts can be polished by this means.

The disc may be fitted to one end of the calico polisher shaft, and the polisher at the other end. The old fashioned leather wheel is of such little use as not to be worth making. By having double nuts at the polisher shaft end the emery wheel may be used in the place in which the disc is used. Thus one spindle with pulley in the middle will serve the purpose of two polishing wheels (calico) a wooden disc with emery sheets, and an emery grinder.

In assembling a highly finished model, care should be taken not to scratch or damage nuts by pliers or other unsuitable tools.

Painting Models.—Castings to be painted should be filed or ground as smooth as possible. Any deep holes which cannot be filed out should be filled up by a filling paste mixed with gold size. This may be obtained from any engineer's stores. The "filling" is plastered on and allowed to dry hard, then it may be filed with a fine file and rubbed with emery cloth. A dead coloured paint is used by coach painters, and rubbed down with powdered pumice stone after each coat and finally varnished three to five times over with varnish at about 20s. a gallon or more. But the amateur will probably obtain better results by using Aspinall's enamel, thinning it with turpentine and applying two or three thin coats with a flat camel-hair brush. The brush must be very clean. The least grit or dust is fatal to good work. As to lining, the only good advice to the amateur is "don't." It is impossible to line well without constant practice. But it is possible with good enamel, thinly applied, to obtain very good results. Then it is easy to get the carriage painter to add a few lines in very little time. Aspinall's enamel should be varnished with best carriage varnish.

Lacquering.—This may now be done cold with a preparation to be obtained from the Liverpool Castings Co., and others. After the brass or copper is highly finished apply the lacquer with a fine, clean camel-hair brush. The result will be quite satisfactory.

Mounting Models.—In cases where a cast bed is not used, a very nice bed may be made by cutting a block of common wood to the size required, and then obtaining some oak, mahogany or other kind of picture-frame moulding, mitreing it and fixing it to the block. Or a solid block may be machined at a saw mill to any design and French polished. A block of white or coloured marble makes a nice bed for a model.

In putting a model into a glass case it is important to remember to raise it sufficiently high from the bottom of the case to allow the whole model to be in view when the case is on.

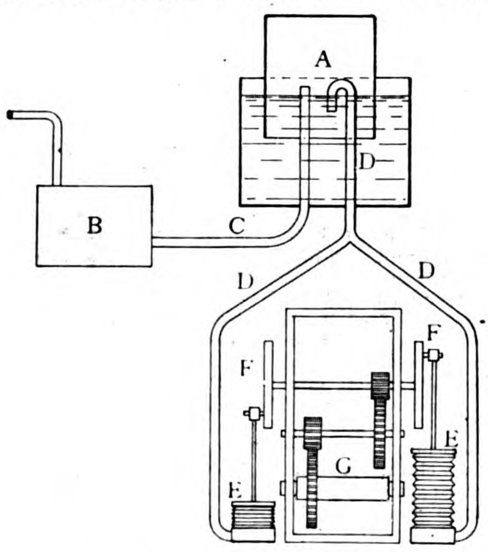
Practical Letters from Our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume if desired, but the full name and address of the sender MUST *invariably be attached, though not necessarily for publication.]*

Petrol Gas Plant.

To the Editor of *The Model Engineer.*

Dear Sir,—I am building a petrol gas plant, and wish to use two pairs of bellows, to be driven by a



A, Air holder; B, Carburettor; C, Air pipe from holder to carburettor; D, Air pipes from bellows to holder; E, Bellows; F, Faceplates to pin to drive bellows crank; G, Roller to carry wire rope.

falling weight. I enclose you rough sketch. Would you please advise me if this power would be suitable? I have heard of one system that is driven by falling weights.

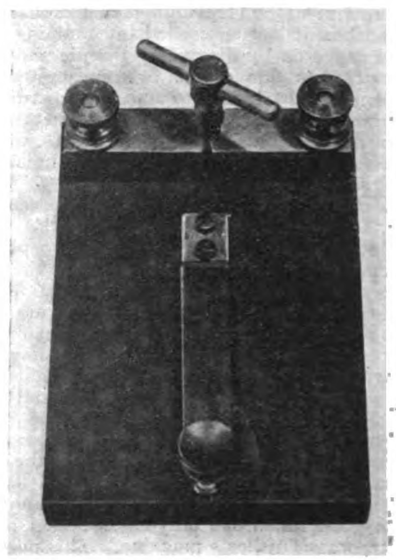
You will notice that I propose to have a water seal to stop the air from returning, and again I purpose making it automatic, so that when the air holder is full, the motor is stopped until it is nearly empty. If you think bellows will not do, perhaps one of your numerous readers could give me an idea. I do not want to use a hot air engine if it can be avoided, as I have plenty of room for a falling weight. I might add I should only require two lights as a rule burning at one time, which would be, say, 8 to 10 ft. of gas per hour. Any information you can give me will be much appreciated.—Yours truly,

"Gas Plant."

A Combined Tapping and Plug Key.

To the Editor of *The Model Engineer.*

Dear Sir,—I am enclosing herewith a photograph of a useful electrical combined tapping and



A Tapping and Plug Key.

plug key which I designed some time ago and which I thought would interest readers of your ever-welcome Model Engineer. The two instruments being on the same base facilitates all sectional experimental work. Thus, when circuit is connected up to the two binding screws and the plug withdrawn, the instrument is then used as a tapping key. The insertion of the plug, of course, at once shorts it. We have now many in use in the Physics Laboratory which is sufficient recommendation, perhaps, for it to be more extensively known.—Yours truly, H. B. Williams.

The University, Birmingham.

A Simple Electrical Resistance.

To the Editor of *The Model Engineer.*

Dear Sir,—I do not know whether the following is at all new; if it is, it may interest some of your readers.

I have at various times required to use resistance in electrical circuit in connection with model electric motors which I ran from lighting circuit and dynamos, and being unable to obtain suitable resistance wire locally, and not wishing to incur the expense of necessary lamps and holders, I tried using ordinary common lead pencils as resistance. I cut each end of the pencils so as to leave about ¼ in. of the lead protruding. Then I connected the pencils by means of wire wound on to these ends of lead, either in series or parallel or series-parallel, according to the amount of resistance desired and current required. I have no voltmeter or ammeter, so I am unable to say how much current one passes or what resistance it affords. So far I have merely arranged my pencils by experiment, connecting them in various ways until I got the best results.

Those who have meters will have no difficulty, and any who try using pencils will find them compact, and they form a very effective and cheap resistance. Of course, they heat up to a certain extent, but I have never found that any drawback.—Yours truly,

HORACE B. MORCOM.

Natal, South Africa.

Two Electrically Driven Models.

To the Editor of *The Model Engineer*.

DEAR SIR,—I have enclosed photograph of a model motor-car, built by myself. It is 2 ft. in length and weighs, when in full running order, 10½ lbs. The motive power is electricity. Three 2-volt accumulators are carried on car—two under back seat and one in bonnet by side of the electric motor. The motor drives by leather band on to a flywheel (underneath car), to which is attached a friction leather-faced clutch. Then through cog-wheels, reducing about 8 to 1, and from that by chain drive to back axle, again reducing, which allows the motor to travel at a high speed. One back wheel only is a solid fixture to back axle, as I was unable to make a satisfactory differential gear. The motor or engine is started by turning the handle in front of bonnet, which acts as a switch; the clutch is thrown out by depressing a foot-pedal, and *vice versa*. Reversing is also obtained by depressing another foot-pedal, which operates a reversing switch in the electric current. Three speeds are obtained by moving a lever at the side of driver's seat, which connects up the accumulators in series. When on full speed, the car travels at a good walking pace. Another side lever works two band brakes, one on each side of the rear wheels. The steering of the front wheels is worked very similarly to the usual style. The lamps contain small electric bulbs, which give a very good light. The wheels are fitted with solid rubber tyres, and the body of car is balanced on springs. The model is built entirely of odd scraps, sheet zinc, and wood. All metal parts are painted with aluminium paint; the wheels, mudguards, body, etc., are painted with red enamel, which gives a very good finish.

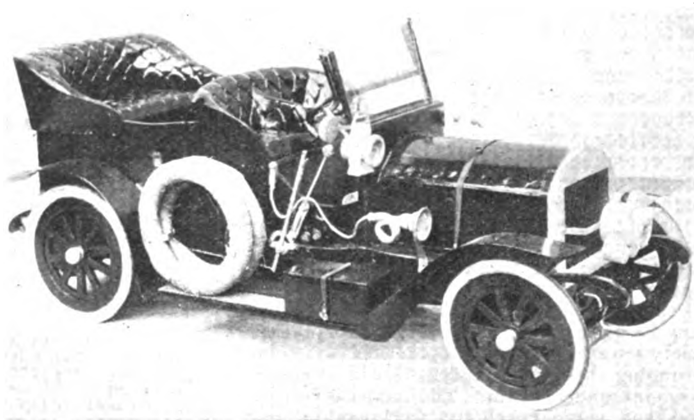


FIG. 2.—AN ELECTRICALLY DRIVEN MODEL MOTOR CAR.

I have also enclosed another photograph of a model motor-boat, built by myself. It is 2 ft. 8 ins. in length, and weighs, when in full working order, 7 lbs. It is electrically driven, the motor being geared down about 3 to 1. The accumulator weighs 2 lbs. The hull is built of one piece of sheet zinc, stretched over a wooden framework. It is painted white and dark red, and travels at a fair speed.—Yours, etc.,

E. C. WILKINS.

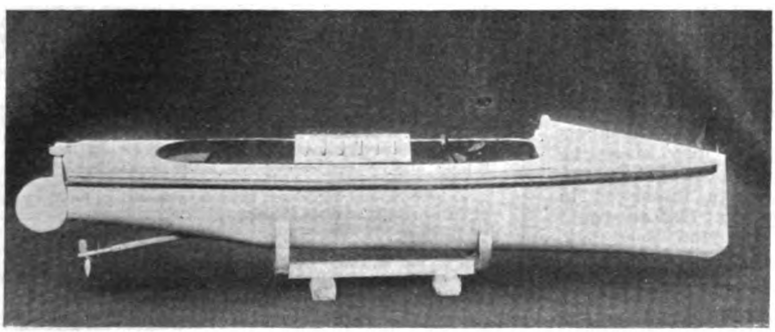


FIG. 1.—MODEL ELECTRIC MOTOR BOAT.

THE Junior Institution of Engineers will, on Saturday afternoon, May 16th, at 3 p.m., visit Southwark and Bermondsey Storm Relief Works.

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of The Model Engineer *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

An ordinary meeting of the Society was held on Wednesday, April 29th, at the Cripplegate Institute, Golden Lane, E.C., Mr. Solomon taking the chair, and 106 members and a few visitors being present. The minutes of the previous meeting having been read and signed, and two new members elected and other formal announcements made, the business part of the evening concluded, the rest of the evening being spent in watching the various practical demonstrations in progress. Mr. Hildersley kept a large audience greatly interested in the operations of ball turning, wheel cutting, and screw chasing. Mr. Fraser demonstrated with a small milling and grinding attachment of his own construction; and Mr. Arthur Drummond had a great point of attraction in Drummond Bros.' new model-makers' lathe, explaining its construction and various capabilities. The Society's track was also in operation, Mr. John Baird running his four-coupled North Eastern express engine under steam. The model is a ½-in. scale one, and worked well, its workmanlike and handsome appearance being much commented upon. The meeting terminated at 10 p.m.

Future Meeting.—Saturday, May 23rd, at the Cavendish Rooms, Mortimer Street, W., the Ninth Annual Conversazione and Biennial Model-making Competition will be held. Members are informed that the last day for sending in competition entries has been extended to Thursday, May 14th; entries received by the Secretary later than the first post on Friday, May 15th, will be disqualified.—Herbert G. Riddle, Secretary, 37, Minard Road, Hither Green, S.E.

Provincial Society.

Oxford.—At a well-attended meeting of model engineers, held on Wednesday, April 22nd, it was unanimously decided to form an Oxford Society. O. L. Bickford, Esq., was elected president, H. F. Galpin, Esq., jun., hon treasurer, and T. E. Foort, of 47, Corn Market Street, hon. secretary. Weekly meetings have been arranged for the present. Efforts are being made to enrol as many members as possible, so that the Society may start the next season with well-attended meetings and an interesting programme. Gentlemen interested in model engineering residing in or near Oxford would do well to communicate with the Hon. Secretary, who will be pleased to give full particulars for joining the Society.

The Liverpool and District Electrical Association will pay a visit to Bootle Cold Stores on Saturday, May 16th, at 3 p.m.—S. Frith, Hon. Sec., 77, St. John's Road, Bootle.

Novel Effect of Lightning.—A log of mahogany which has been sawn through at Belfast, was found to contain right though its thickness, a very clearly defined "photograph" of a small deer and a larger animal, running. The "photograph" was probably (says *Electricity*,) transmitted by lightning during a storm. Every plank of the log. right through, shows the images clearly.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name must *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* The Model Engineer, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[19,163] **About Accumulator Plates.** S. R. (Islandbawn) writes: (1) How is it when an accumulator is charging, the resistance lamp burns as bright as if connected to the wire direct, instead of passing through accumulator somehow? I could not understand it, so I tried, for experiment, connecting one 16 c.-p. lamp (100-volt) in series with the voltmeter. This only reduced voltage about 5 volts, so I put one 32 c.-p. 100-volt lamp in series on the other wire; the two only reduced voltage about 15 volts. (2) The dynamo is 100 volts compound-wound lighting dynamo. Is this suitable for charging accumulators? There have been some accumulators charged here, but they were not very successful. (3) I tried for experiment making an accumulator by bending sheet lead in the form of a pipe, punching it with small holes and filling the interior with red lead; the plates were about 4 ins. long and 1 in. diameter. Would this be any better plan for holding the paste, as you can get twice or three times as much paste in, or is it only the outside surface that counts in accumulators? Of course, I made both plates alike, and just attached the wires of dynamo to plates which I had in glass bottles (two in each bottle); when they were gassing freely I disconnected and tried a 4-volt Osram lamp, which takes 1 amp. It only lighted for about thirty minutes. Is this too rapid a discharge for such plates? I have made another small accumulator, as described in your handbook, and I want to make sure of the charging before I spoil it.

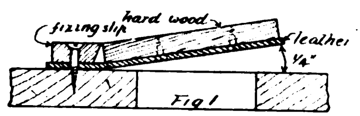
(1) The resistance of your accumulator is so small compared to the resistance of the lamp connected in series with it that the drop in volts through the current passing through the accumulator is bound to be very small. A 32 c.-p. lamp will take twice the current a 16 c.-p. lamp takes. (2) You can charge your accumulator on a compound-wound dynamo quite satisfactorily. The main thing is to connect a sufficient number of lamps or an equivalent resistance in series with your accumulator to pass the required current. Of course, the maximum charging rate of the accumulator should not be exceeded. If you read up recent query replies on this subject, you will find much to enlighten you. (3) Your plan for holding the paste is a very good one if it were not for the fact that the surface area of the accumulator plates is an important factor. By having a larger area, the forming of the plate is completed more quickly, and, moreover, there is more surface for the passage of the current from plate to plate, this tending to reduce the internal resistance of the cells very considerably. The charging rate should not exceed 6 amps. per sq. ft. of positive plate surface for flat plate cells of the ordinary pattern. Your plates would stand a much heavier rate of discharge as well as charge, and would not buckle so readily as flat plates.

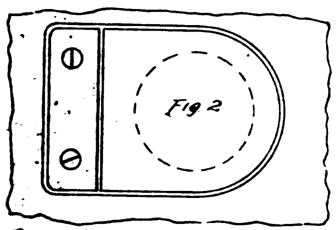
[19,370] **Small Accumulator Charging and Lighting Set.** R. V. M. (Londonderry) writes: Would you kindly recommend the most suitable type of engine to employ for driving a 60-watt dynamo for accumulator charging and Osram lighting? It is essential that the set be capable of running for long periods without much attention, and as it will be run in room of dwelling-house, used as workshop, it is desirable that it be as vibrationless and quiet, and also as compact as possible. A supply of town gas is available, but it would be advantageous to be able, if necessary, to use oil as an alternative. Please give your opinion regarding the suitability of the following types of engines under above conditions, and state where suitable castings of same may be procured and horse-power recommended—(1) Slow speed (about 500 r.p.m.) horizontal type gas engine, belted to dynamo; (2) high-speed enclosed type gas engine, direct-coupled to dynamo; (3) high-speed hot-air engine.

The choice of a suitable engine for your lighting plant is more or less a personal matter, and there is not much to choose between the various types on the market. We should, however, recommend gas in preference to steam or oil, and you should obtain an engine amply large enough for the power it has to develop. A good horizontal gas engine is supplied by Messrs. Stuart Turner, Ltd., Shiplake, Henley-on-Thames. We do not know that there is an enclosed type of engine manufactured on so small a scale, and, lastly, a hot-air engine of the power required would be quite out of the question, owing to its bulk.

[18,406] **Foot Bellows for Working Engine.** C. H. E. (Oldham) writes: I have constructed a model cardboard beam engine with cylinder 1 3-6ths-in. bore and 2-in. stroke, to be driven by air. I shall therefore esteem it a great favour if you will send me instructions how to make a pair of double-blast bellows to drive same. I want to work them with a foot pedal, so that I can have them under the table, and shall connect by a piece of rubber tubing to the engine. It is quite easy to blow the engine round with the mouth.

So long as a good reservoir in the shape of a net-protected rubber bladder is provided there will be no need for a double-blast bellows. An ordinary foot blowpipe bellows will suffice with the bladder on the top. We suggest that you obtain an ordinary pair of bellows (largest size obtainable) and adapt the nozzle to suit the delivery pipe you wish to use. Screw the bellows to two blocks or battens, so that when the bellows are placed on the floor the air can get to the inlet valve. Drill a 1½-in. hole in the opposite side to the inlet valve. This should be covered with a flap valve made of wood, with a leather face and hinge. (See Fig. 2. below. The space





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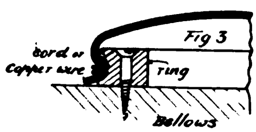
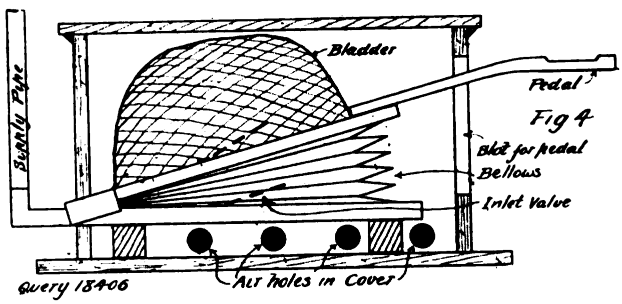


between the fixing slip and the wooden portion of the valve should so be arranged that while perfect freedom of movement is allowed, the lift is limited to, say, ¼ in. The valve will then not become displaced if the bellows are moved about and possibly inverted. There are several methods of fixing the rubber bladder. A ring of wood (as large as the area of the side of the bellows will allow) may be turned up to the section shown in Fig. 3, and the sheet rubber which forms the flexible reservoir may be wired or corded into this groove, like a cover to a pot of jam. Other forms of clip rings are in use, but the above is a simple device. If no means of turning wooden ring are available, then the section may be planed up in the straight length and, a large number of sawcuts being made from the inside, the wood may be "bent" into a circle and glued and screwed down to the side of the bellows. A net should then be fitted over the bladder to prevent it bursting when strained to its fullest capacity. To give the whole arrangement a neat finish a cover may be provided for the bellows with a slot for the pedal. This cover must, of course, have holes to allow the air to enter the bellows. These holes may be covered with gauze (40 mesh), fastened on the inside of the cover to keep out dirt and dust.

[19,347] **Electrical Engineering as a Profession.** F. C. S. (Kingsland) writes: I have only lately become a reader of your interesting paper, and seeing what an interest you appear to place in your readers, I am going to ask you for a little advice. I am at present by trade a tailor's shop assistant, a married man earning £1 per week. But, while I have been at the trade for eight years, I have never liked it, always having a hankering after electricity or engineering. I have, through small knowledge I have picked up, been able to keep all switches, lamps, etc., in order for my employer for the past two years, and have quite lately done a small job, running about 40 ft. of new casing and wiring and fitting new switches, a fan, and re-wiring the old fittings. So what I want to know is—Can I in any way whatever (as I am naturally mechanical and quick at learning such things) get into a place to learn something of the trade, and at the same time manage to earn at least what I am getting now, viz., £1 weekly. I can assure you I would be willing to work hard, but I would do anything in reason to get into the trade I wished for since I started work. I am only twenty-four, so there is plenty of time to learn.

As you say you feel yourself particularly well adapted for engineering work, we think your best course would be to endeavour to obtain a post in some small engineering works in any capacity that offers. You would probably have to begin very low down the ladder, and be prepared to do practically labourer's work. That, however, would be the only way by which you could possibly gain any experience, unless you were prepared to work for nothing or possibly pay some premium. We think, however, it is only fair to remind you that the electrical engineering trades are already overcrowded, and that unless you manage to get to the top of the tree it involves very hard work for very small remuneration.

[19,165] **Miscellany.** W. D. G. (Oldham) writes: Will you kindly answer the following for me? (1) Having a 4-volt 10 amp.-hour accumulator (Prested make), now I want to use it to drive a model tramway with motors, that is, 4 volts and 3½ amps. Now, will it take 3½ amps. each hour to drive it with this accumulator? (2) As per your Handbook, "Electric Lighting," where it states charging pocket accumulator by four Leclanché cells, could I charge the above



Bellows for Working a Cardboard Model Engine.

the same, or to put the Leclanché cells when not using it would it do it harm? (3) Not wanting to use it for three or four months, what is the best thing to do with it to stop it from spoiling? (4) Can I use this accumulator for any lamp that is 4 volts? (5) Is there any means of keeping an accumulator charged by the aid of the trams when in motion? (6) The trolley-pole wheel—how does it make the connection? Does it travel down each side of the pole? (7) Is each side of pole brass to the bottom of spring, but, of course, insulated from the public?

Your first query is not very clear. Your best plan is to find by trial what current your motor takes at full load, and then obtain an accumulator sufficiently large to drive it properly. A 10 amp.-hour cell should not be allowed to discharge at more than 3 amps. (2) You can charge the accumulator by means of Leclanché cells, but it is a very slow process. To do so, the Leclanché cells should be arranged in series to give a slightly higher voltage than the accumulators being charged, and the charging might be allowed to go on continually whenever the accumulator is not required for other work. Charging at a very slow rate will do the accumulator good rather than harm. (3) To dismantle the accumulator, it should be completely discharged and the plates taken out and washed in dilute sulphuric acid and then in clean water, then dried and put away. (4) Provided the lamp you intend to use does not take more current than the accumulator can supply. (5) There is really no satisfactory way of doing this. (6) A conductor of a suitable gauge of wire is connected to the trolley pole head, and conveys the current to the motor in this way. (7) See above.

[19,437] **Size of Gas Engine Valves.** H. F. K. (Portsmouth) writes: Please could you tell me what compression I should require for a gas engine 2-in. bore, 1½-in. throw of crank, and what lift to give air, gas, and exhaust, also diameter? Crank pin is ½ in. diameter.

These dimensions cannot be definitely settled without going fully into the design of such an engine, but the approximate sizes for the parts mentioned would be: air and exhaust valves, 1-in. diameter; gas valve, ¾ in. diameter, and compression space should be equal to one quarter of the total volume of cylinder.

[19,042] **Single-acting High-speed Engine.** G. H. (London) writes: In the early numbers of THE MODEL ENGINEER an article appeared on a single-acting high-speed engine, made by Mr. Spicer. Could you tell me the exact number of this and where I could get it.? (2) I have a casting of a cylinder (single-action), with valve chest cast on. It is to be bored out to 1¼ ins., and valve chest to ⅝ in. Could I bore it with a ratchet brace and bit, to suit, as I have no lathe? Would a 3-16ths-in. hole do for port, as I have to drill through valve chest and then plug hole up, as in sketch? What size steam pipe do I want?

(1) You will find full particulars of Mr. Spicer's single-acting engine in the first volume of our journal (May issue, 1898). You will have some difficulty in getting a copy, but you would do well to try our "Wanted" advertisement columns. (2) We think that you are ill-advised to arrange the steam inlet below the valve, as you will have to pack the valve spindle; by arranging it in the opposite way, you would avoid this. A single hole is not

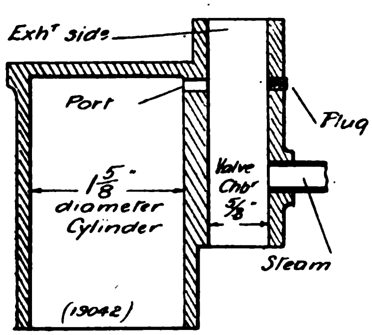


FIG. 1.—CYLINDER CASTING.

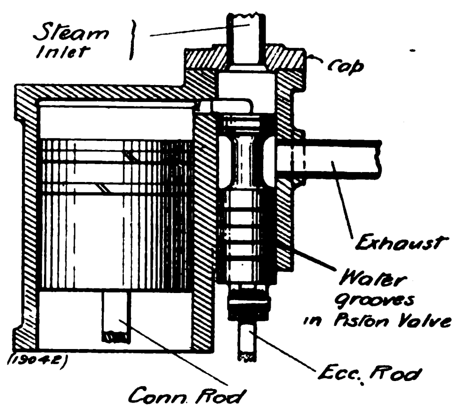


FIG. 2.—COMPLETE CYLINDER.

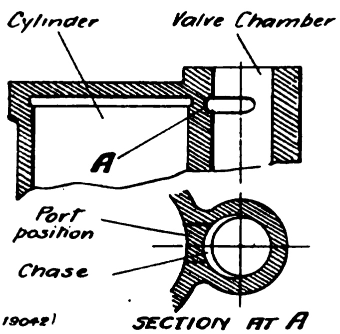


FIG. 3.—CUTTING CHASE IN VALVE CHAMBER.

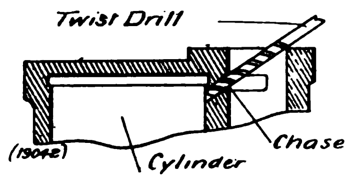


FIG. 4.—DRILLING PORTS.

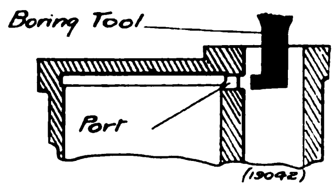


FIG. 5.—FINISHING CHASE.

enough, and we would have advised you to core the small port between the cylinder and the valve chamber. By first cutting a small chase in the valve cylinder (setting the work eccentric in the lathe) with a round-nosed boring tool, as at A (Fig. 3), the port may be drilled in two or three places, as shown at Fig. 4. Of course, coring the port is to be preferred, but, in any case, the eccentric chase will be advisable to provide a good "cutting off" edge for the piston valve. This may be finished with a square-nosed tool, as at Fig. 5. The chase should not be turned so that it appears all round the wall of the chamber, as the back of the piston valve is better supported by the wall of the chamber. To obtain best results in boring the cylinder, a hole should be cored in the end about 1 in. diameter, so that a boring bar may be used. The piston should be as light as possible, and the unbalanced reciprocating forces reduced to a minimum. The port, if cored, should be about 5-32nds in. by ⅝ in. long, for high-speed work. The steam pipe should be ⅛ in. diameter.

[19,488] **Difficulty in Driving Small Lifting Plant.** G. B. W. (Malvern) writes: I should be greatly obliged if you would answer the following queries. I have a 20-amp.-hour 4-volt accumulator in celluloid case, and I use same for working by (learning lessons) in my study, using a 4 c.-p. Osram lamp. The lamp will not keep at the same brilliancy for one minute on end, but will get somewhat dull by going down in "jerks" and then all of a sudden will attain its usual brilliancy again, which only lasts for about 10 seconds, before it begins to decrease in brilliancy. Is this the fault of jerky charging? I get it charged at our workshop, where there is an excellent charging plant; but, of course, the dynamo may be in fault. The plates of accumulator are good, and in good condition, and are made by the Premier Company, Birmingham. I am sure you will make me clear about it. (2) I use a 10-volt 3-amp. dynamo at home for charging purposes, and I have plenty of power. My great trouble is to get a satisfactory belt. As the shafting is fairly high up I want a belt 18 ft. long. What is the best belting to use? I have a V and a flat (bevelled) pulley, both of brass, the flat one being 1 in. in width, and both being 1 in. in diameter. I did away with the V pulley because blind cord was the only thing I could get to satisfactorily drive it; it used to get slack, and, as there was no weight in it, it naturally slipped. With the flat pulley I have tried numerous belts, the first a seamless leather, ⅜ in. wide. Of course, as there were four joins in it, the ammeter jumped from ½ to 4 amps., and so I couldn't tell how much I was putting through my accumulators. Then I tried thick braid without success. Next I got some stout lamp wick, but it has not the gripping power of leather, and won't keep on the dynamo pulley without guides, and after about an hour's running it slips considerably, which is very annoying if you want to run it for a morning while you are away. Can you suggest something that will suit me, or can I treat the lamp wick with any preparation to make it "tacky"?

We suspect you have some faulty connections either between the plates of your cell and the terminals or else in some of the leads between the lamp and the cells. Uneven charging would never manifest itself in this way when the cell is being discharged. Any of our advertisers supplying engineering stores would give you a good belt. For your purpose a thin raw hide would be most suitable. You should use some preparation for your belt which will make it drive evenly. Christopher, of Clerkenwell Road, London, E.C., would supply you with a tin of suitable dressing. This applied to a thin leather belt with a carefully made joint should answer your purpose quite well.

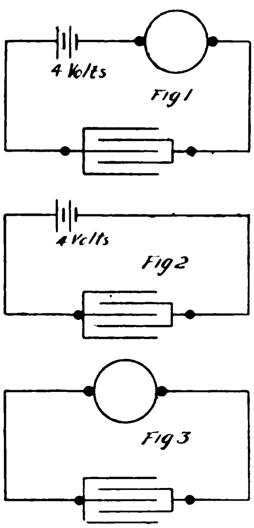
[19,544] **Accumulators.** J. R. M. (Nottingham) writes: Would you please mind answering me these questions? I am wanting to make a 4-volt 32-amp.-hour accumulator, and I have your book, but it does not give the size for a larger accumulator (4 volts) than 1½ amp.-hours. Would plates 8 ins. by 6¼ ins. by 3-16ths in., having one of + and — to each cell (two cells), give 32 amp.-hours; if not, could you please give me the size, number of plates to each cell, and also the arrangement of each cell? Also, does it matter if the plates are collected in one cell (the 4 volts) without any partition, or must you have a separate cell to each 2 volts? How could I connect the plates so as to have one more — plate than + plates?

If you would read up recent queries in these columns, you would find full information on all the points you ask. You can use one positive plate to each cell; the size of the plate determines the capacity of the cell. The latter may be reckoned on a basis of 15 amp.-hour capacity per sq. ft. of positive plate surface, that is, counting both sides of the plate. You will never get more than 2 volts from one cell of accumulator, even if the plates number

100—that is to say, the size of the cell does not determine the voltage. One cell always gives approximately 2 volts, and if there is even the slightest leakage between one cell and another, you will find the voltage immediately comes down to the level of that of one cell. The two negative plates of one cell are connected together by a lead strip. One terminal of the cell is then connected to the two negative plates, the other terminal being connected to the positive plate. We trust these details will put you right.

[18,541] **About Condensers.** A. S. (Hampstead) writes: Will you kindly oblige by answering the following query? I am constructing a condenser, the size of the tinfoils are 3 ins. by 2½ ins., consisting of about sixty layers. I enclose specimen of the di-electric used. The di-electric is ½ in. larger than the foil all round the edges. If I pass a current through condenser, as Fig. 1, ought I to get a deflection on the galvanometer if the insulation is perfect? If the condenser is charged by a battery (Fig. 2), then disconnected and a galvanometer inserted in its place (Fig. 3), should a momentary deflection be observed? Is there any other way to test a condenser? I have constructed half the condenser at present, but by testing same as above (Fig. 1) I do not get any deflection on galvanometer, and also, as per Figs. 2 and 3, using galvanometers having ·2-1 watts and 100 watts respectively, I get no momentary kick. About what capacity would the above condenser be when completed?

Yes, you should obtain a deflection, as electricity is transferred from one side of the condenser to the other. Conversely, a deflection in the opposite direction should be obtained when the charged condenser is connected to the galvanometer, as in your Fig. 3. Your galvanometer is perhaps not sufficiently sensitive, or you are losing the charge by surface leakage in some way or other. Galvanometer should be of high-resistance type; coils, say 5,000 ohms resistance. The insulation of everything connected to the condenser should be very good. The capacity of a condenser will vary according to the kind of material used to separate the sheets of tinfoil and its thickness. If you use a single thickness of the



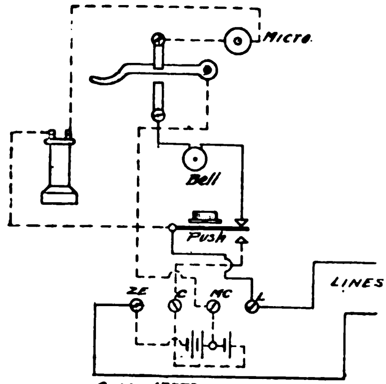
Query 18541

sample paper, the capacity may be about ·026 microfarad, but as two thicknesses should always be used to guard against pin holes, with the same paper the capacity would be then ·013 microfarad approximately. These figures are quite a rough estimate. We advise you to make the margin of paper quite ½ in. beyond the foil, or even more than this.

[19,534] **Silver-Plating.** H. M. (Newark) writes: I wish to plate the polished parts on some small castings that I have. What quantity of chemicals for the bath shall I want, also how many Daniell cells? About how long would the work want to be in the bath; what should I cleanse the work with; about what size the silver plate should be, and does it wear away very quickly?

You will find a useful article on silver-plating in our issue for August 23, September 20, October 4 and 25, 1906, Vol. xv. Some other particulars on various kinds of plating work are given in "The Electro Plater's Handbook," by Bonney, price 3s. 9d. post free, which we strongly recommend you to obtain. If you only require a very small amount of plating done, it would pay you to send your castings to some electricians to have them plated, such as Messrs. Whitneys, 117, City Road, London, E.C.

[18,373] **Telephone Connections.** W. P. (Glasgow) writes: Will you please send me a sketch or tell me how to wire up a telephone apparatus? I have transmitter, receiver, bell, and push switch on door of casing, taking wires inside to connect. The receiver hook carries current and makes contact with two brass



Query 18373

DIAGRAM OF TELEPHONE CONNECTIONS.

spring strips. The bottom strip connects to one bell terminal and top strip to one receiver terminal. There is no induction coil. Your handbook on "Telephones" does not show a circuit like mine; the simple circuit it shows has no microphones in it. I should be glad if you will show me inside connections and line (no earth).

We reproduce diagram above.

[19,562] **Converting from Tube to Electric Ignition.** W. H. B. (Pembroke Dock) writes: I should be glad if you would let me have answers to the following: I have a 2 h.-p. gas engine which has tube ignition; as this takes a considerable amount of gas to heat the tube and keep it at white heat, would you advise me to put electric ignition to it? I use it in connection with a dynamo for lighting purposes, so that I would always have plenty of electricity at hand. To start it, I thought of using a small accumulator, and then switch on the power from the dynamo; the power of the dynamo is 65 volts 25 amps. As I have not time to do the work if much is involved, please let me know what firms undertake this work. The engine works on the Otto cycle principle.

The quantity of gas consumed by the ignition burner is comparatively small, and we doubt very much whether the conversion to electric ignition would be worth your while. The best people to do the job for you would be the makers of the engine. Failing this, any local engineers in the gas engine or motor line of business would do the job for you. Personally, provided the engine runs satisfactorily with tube ignition, we should be inclined to leave it at that.

New Catalogues and Lists.

Archibald J. Wright, Ltd., Leyton Green Road, London, S.E.—The monthly price list of automobile electrical accessories and electrical instruments comprises particulars of ignition accumulators, terminals, plates, celluloid cases, charging batteries and dynamos, ignition coils, sparking plugs, pocket voltmeters, ammeters, etc. Readers desirous of purchasing such apparatus should apply for this list, which will be sent post free.

W. E. Burnand & Co., Chippinghouse Works, Heeley, Sheffield.—We have received from this firm a pamphlet setting forth the advantages of their high efficiency transformers for metallic filament lamps, and containing a full list of prices.

Boulton & Paul, Ltd., Rose Lane Works, Norwich.—With the coming of summer some, at least, of our readers are contemplating the purchase of some kind of pleasure craft for the river or sea. We have received an interesting catalogue, giving prices and particulars of steel boats of various sizes and types, also including suitable petrol engines for driving same. Those who are interested should write to the above firm stating their requirements.

H. Wheeler & Co., 25, Station Road, Walthamstow.—We have received a price list of small appliances that model makers cannot well dispense with, such as an assortment of taps, tap wrenches, stocks and dies, screw plates, micrometers, etc. The sizes in which these are listed cover the requirements of most amateurs, and readers should send for the list, which will be forwarded upon application.

The Editor's Page.

WE would ask those readers who intend competing in the "Readers' Work" Competition to first compare the photographs and particulars they propose sending with the various models which are described in our pages. If they feel that their photographs are as good, and their model as interesting, as one or other of the items we have already published, it should be worth their while to send them along, for they will have a fair chance of acceptance. But if, on the other hand, they feel that their work, however satisfactory and interesting to themselves, is not so good as that of other readers whose contributions are reproduced in these columns, they should abstain from competing, for they have little chance of securing a prize. We regret to have to return a number of entries which in themselves are highly creditable as early efforts in model making, but which are not up to our standard of publication or are not of sufficient interest to our readers. Sometimes we have to decline a good photograph and good description because the model illustrated is of a very ordinary kind, or because we have published something very similar before. We make these observations, not with any view of discouraging readers from competing, if they have good things to send, because these are always welcome; but we wish would-be competitors to be saved from the trouble and disappointment of sending unsuitable items.

Answers to Correspondents.

H. H. B. (Portsmouth).—We will endeavour to publish a drawing in the near future.

J. L. B. (Wigan).—You would find it much cheaper to purchase a small forge from some manufacturer. Messrs. C. W. Burton Griffiths & Co., Ludgate Square, London, E.C., would send you quotation for what you require, on application.

Geo. S. R. (Newcastle-on-Tyne).—We regret that this is beyond the scope of our Query Columns. It would cost you something over £5, probably, to prepare a design.

E. S. (Montreal).—Thanks for your letter *re* Caledonian castings. We think we have been able to satisfy all enquiries; but if we hear of anybody on your side wanting a set, we will put them into communication with you.

W. T. (Inglewood, Australia).—Thanks for your letter. The book and back numbers have been forwarded. Shall be very pleased to have photographs and particulars of the models and apparatus you have made.

H. N. (Lowestoft).—Description of paraffin blowlamp will be found in our issue for May 21st, 1903. As far as we know, the pedrail system of traction has not progressed greatly during recent years, and the only information we have was that given in our issues for January 26th (1905) and September 14th (1905).

W. H. (London, W.).—We have no further particulars than those you refer to.

S. C. L. (Sunderland).—We do not think any patent agent would finance your invention, but we suggest that you try and get some friend to help you in return for a share in the patent.

A. R. (Aberdeen).—We thank you for your letter.

A. D. (Luton).—A reply to your inquiry is awaiting you; and, if you will comply with our rules, and send your name and address, it will be forwarded at once.

E. W. M. (Tunbridge Wells).—We have to thank you for your instructive letter. Many others have been received on the subject.

G. E. (Darlington).—Your photographs and description will be published as soon as we can find space.

A. G. (Chicago).—We thank you for the photograph and description of your work; but regret we cannot see our way to accept same for publication.

"Porpuss" (Manchester).—The "Porpuss" is an amusing little animal, having a great antipathy to its natural enemy the "free-ad-cuss." Its strong imaginative faculties, however, occasionally obscure its vision and lead it to attack by mistake the harmless and useful "wat-i-no," which belongs to a totally different species.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

How to Address Letters.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to The Editor, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to The Advertisement Manager, "The Model Engineer," 26–29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk (*) denotes that the subject is illustrated.*]

THE
Model Engineer
And Electrician.
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 369. MAY 21, 1908. PUBLISHED WEEKLY.

A Model G.N.R. Brake Van.

By C. GEORGE HARRISON.

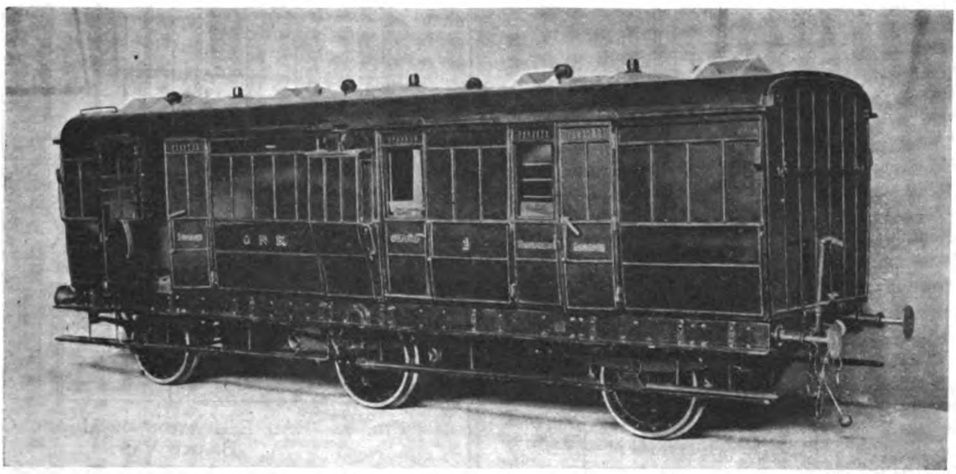


FIG. 1.—GENERAL VIEW OF MODEL G.N.R. BRAKE VAN.

THE following is a description of a model Great Northern Railway brake van, partly made by me some years ago to a scale of 1 in. to a foot. Having always taken a great interest in railways since a boy, and admiring the Great Northern engines and carriage stock more than those of any other line, it was naturally chosen for the prototype of my model. As my brother was building an inch scale locomotive, it was decided to make a carriage, so that we should have a train to work on a model line we proposed laying down, about 400 ft. in length, with stations, correctly signalled; the line was staked out, levelled, and one of the terminal stations started. A six-wheeled third five-compartment carriage was started, for which the necessary dimensions were obtained as required, but no drawings were made.

My first frame, being neither dovetailed together nor fitted with any diagonals, was not a success, as the six cross-pieces did not make a sufficiently accurate and firm job of it. The buffer heads were brass castings, with steel rods screwed into them, and were then turned up in the lathe. The wheels were cast iron, and were first bored out taper in the faceplate and then the axles were also turned taper for a driving fit; but, on putting them in the lathe to turn the treads of wheels, they worked loose, the cast iron being very hard, so they were drilled and tapped and screwed on to the steel axle, and this method was found very satisfactory. The axle-boxes were brass castings, drilled and faced up in the lathe, and had the grooves filed in them to slide in the axle-guards. The axle-guards were filed up from brass castings, and all screwed to the inside of the sole bars, horn stays being fitted and secured with 3-64th-ins. bolts and nuts. To

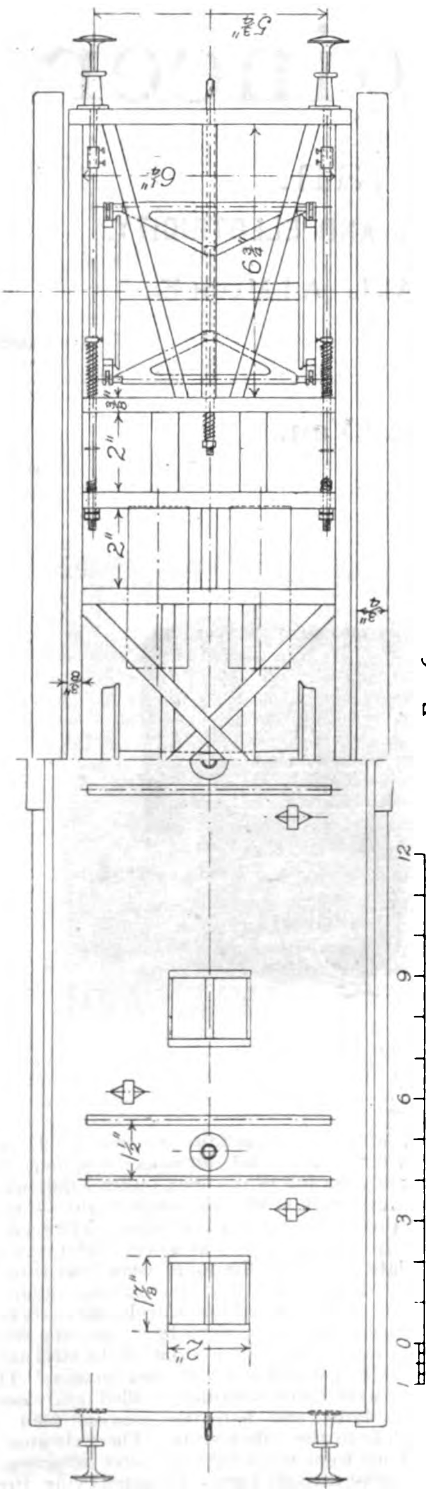


Fig. 6.

Half Plan of Under-frame.

Half Plan of Top.

Scale of inches

(For General Arrangement Drawings, see pages 492–493.)

make the springs, six forgings were procured for the top plates, filing them up to size and drilling the ends to take bolts, the rest of the plates being made from clock spring packed with distance-pieces of brass, as shown in The Model Engineer, with a bolt through the centre to keep them in position, and tapped into the axle-box. They looked very clumsy, as on a carriage the springs are more conspicuous, being outside the wheels, and are a greater length than those fitted on engines, which are usually behind the wheels and not seen. Having got so far with the model, the conclusion was come to that it could be greatly improved, as the wheels and axle-boxes were made from patterns not strictly to the G.N. type, and did not look real enough when fitted up.

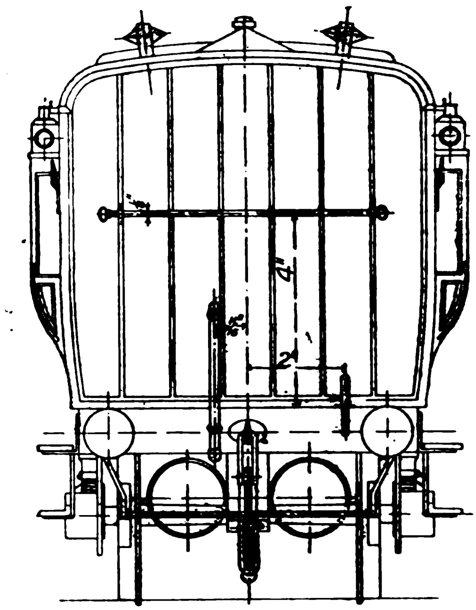


Fig. 7.—End Elevation of Model G.N.R. Brake Van.

It was then decided to build the carriage correctly to scale in every detail, and spare no time or expense to make the model as complete as possible, placing the axle-guards for the centre wheels outside the sole bars (as is the practice on the G.N.R. six-wheeled stock), fitting brake gear. Thinking the upholstering of five compartments would be very difficult to be made to look realistic, we finally settled to make a model of a guard's van.

First, a complete drawing was made, every dimension having to be taken from a van in the siding, and this necessitated going underneath to measure the brake gear, also on the roof for lamps, etc., and I was greatly indebted to Inspector Shankland, at Westgate Station, for assisting me to take these dimensions, and it is surprising what a number are required when a drawing is made showing every detail; but it is well worth the trouble. The new frame was made at a cabinet-maker's, and it was an exact copy of the prototype, having upwards of thirty pieces dovetailed together.

At this stage of the work, not having much spare time and deciding to have a much more elaborate model, the work of making and fitting in new wheels and axle-boxes was put out. The centre axles being shorter, allowed about ⅛ in. side play, this enabling the van to travel round sharp curves, and being a simpler plan in the model than allowing the boxes to slide laterally in the axle-guards, as is done in actual practice. It was found that the model would travel round a curve of 15-ft. radius, but when screw-coupled to an engine it would not travel round a curve much under 24-ft. radius without buffer-locking.

The laminated springs were brass castings with lines scored on them to imitate each plate, and a small spiral spring concealed in the buckle, this giving a much better appearance than the clock springs. New buffers were then fitted in the following way: steel forgings were procured of the head and rod (long enough to go through the end of the frame and were joined to a 3-16ths-in. brass rod by means of a small brass collar and set-screws. A weak spring was fitted to take the first shock of the buffer on being struck, and a pin acted against a very strong spring on the buffer, going in to within about 1-16th in. of the guide. The collar that presses against the first spring can be adjusted by means of a setscrew, and this will be clearly understood on reference to the plan shown at Fig. 6.

The footboards are of brass, and the lower ones have pieces hinged to allow the axle-box front covers to be removed for oiling, and the hangers are of steel screwed to the frame and footboards. To further improve the appearance of the wheels, brass plates were turned to fit over the boss, and No. 1 brass screws were driven in and also round the inside of the tyre to represent the actual bolts in the real wheel, and the sole bars were studded with screws, which can be plainly seen in the photographs.

(To be continued.)

Workshop Notes and Notions.

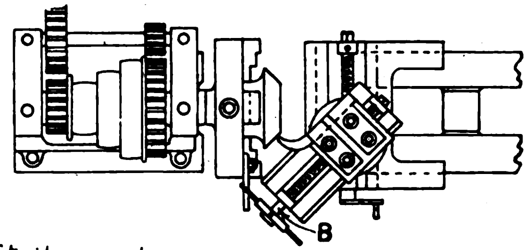
[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "WORKSHOP" *on the envelope.]*

A Self-feed Attachment for Slide-rest.

By J. H. P. BOLDERO.

When turning any cone or angular surface, such as the face of a bevel or mitre wheel, the continual turning of the small handle of the slide-rest, especially when a fine cut is on, becomes very tiring to the fingers. The sketches show an attachment adopted to give the tool automatic feed when doing this or similar work on a gap-bed lathe. Fig. 1 gives a good idea of the general arrangement. In this case the rest is set at an angle of 45 degs. An ordinary four-jaw chuck (Fig. 2) has attached to it a striker; this is made out of a piece of ⅜-in. or ½-in. square iron bent into the form of a long U about 8 ins. or 9 ins. in length. Here I might say the dimensions given are intended as a guide only; each attachment should be made to suit the size of lathe with which it is to be used. The disc (Fig. 3) is turned out of wrought iron, having a diameter of 4 ins. or 5 ins. and a thickness of ⅝ in., having a boss on one side ⅝ in. deep and 1½ ins. wide; a hole should be drilled through the centre A and filed out square to fit the slide-rest spindle B. Round the circumference of this disc six 5-16ths-in.

FIG. 1.



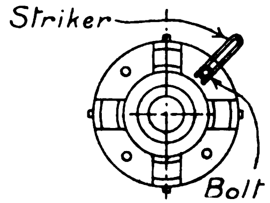


FIG. 2.

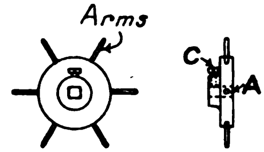


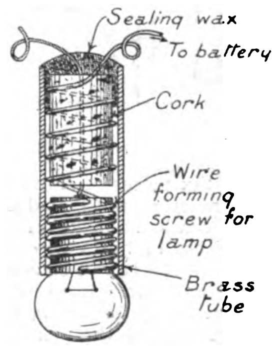
FIG. 3.

or ⅜-in. tapping holes should be drilled at equal distances apart, also one through the boss at C (Fig. 3) to take a small setscrew with which to fasten disc on square of slide-rest spindle. Having tapped these holes, procure six pieces of 5-16ths-in. or ⅜-in. round iron about 3 ins. or 4 ins. long, threaded at one end and slightly rounded at the other; screw these into position to form the arms (Fig. 3). Now mount as shown in Fig. 1, and the attachment is ready for use and will be found to well repay the time and trouble expended upon it.

Holder for Pocket Lamp Bulbs.

By IAN R. FRAZER.

Pocket lamp bulbs give a very good light and are much cheaper and take less current than ordinary lamps of the same voltage. The only difficulty is that you have to make holders for them. The holder described below makes a very neat one, resembling an arc lamp. When placed on suitable posts they make a very useful and realistic acquisition for model stations and shunting yards. Take a piece of brass tubing about 1 in. or 1¼ ins. long, and slightly broader than the diameter of the screw on the bulb. Cut a piece of cork that will slip into



the tube, and is about half the length of it, into two, and lay a wire down the middle to connect with the middle terminal of lamp. Then make a screw for lamp to screw into by winding a piece of fairly stiff wire round the screw on the lamp, and continue winding round the cork, and leave an inch or two for connection to battery. Now put the cork into tube. Lastly, fill the top with sealing-wax and give the holder a coat of black paint.

Keeping a Central Leading Screw Clean.

By Captain A. H. Norgate.

All possessors of a screw-cutting lathe with a central leading screw will be glad to know of a device that will keep the screw free from all metal and wood shavings and save them many an hour's careful cleaning. Although the central lead screw has advantages over the frontal, there is no doubt that it is very exposed and is not easy to clean. Having a Drummond 3½-in. lathe, I thought out a method which I now describe, and if the measurements are accurately taken, will give great satisfaction. The device consists of two attachments to the saddle, one of which is also fastened to the tailstock. Fig. 1 of the bed of the lathe will make this clear. The guard on the left of the saddle consists of a strip of very thin American cloth of a very flexible nature, such as used for book covers. This has cemented on its prepared surface seven strips of sheet zinc cut accurately to size given. These strips must be attached with quick-drying varnish such as used for negatives, or what is far better, by using Crane's Zapon Enamel for lacquering. After freely coating the plates, they are placed in position, ⅛ in. apart exactly, then pressed down with a flat iron, heated so that it can be borne on the hand, when they will

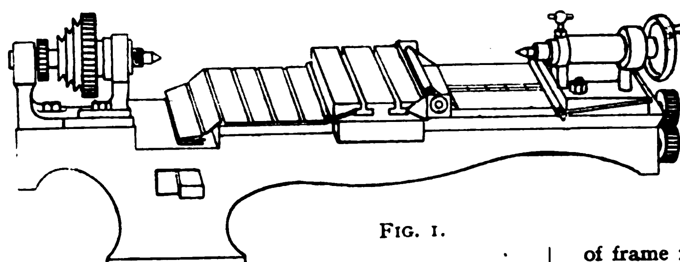


Fig. 1.

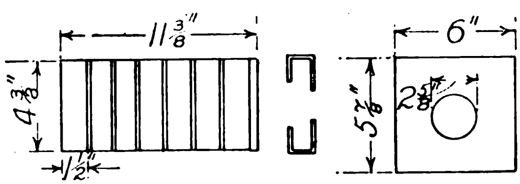


Fig. 2.

be found to be firmly fixed. Six pieces of zinc are cut exactly alike, but the one nearest the saddle must be ¼ in. wider, so that it can be lapped over to form a tube to take bent pieces of brass wire of 1-12th in. diameter or thereabouts. It will be seen that by means of two U-shaped wires it can be fastened on to the saddle, using the T-slots in it, and taken off in a moment. When the self-act feed is in use it works very prettily, folding itself most compactly in the gap and unfolding in a regular manner, and is not in the way in the least. In moving towards the mandrel it throws off all chips, etc., on to the tray. In Fig. 2 the dimensions will be seen clearly. It was impossible to provide such a device on the right of the saddle, as there is nowhere for it to pack up, and further, the saddle is often required close up to the tailstock. For this I constructed a sort of roller blind, the end of which being fastened with brass wire to the bed of tail-

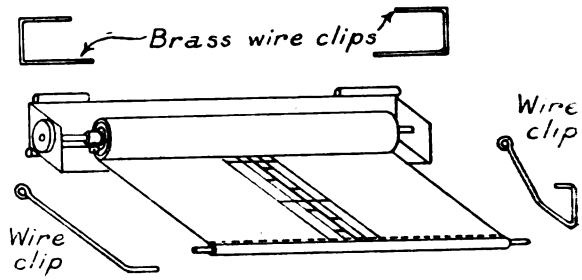


Fig. 4.

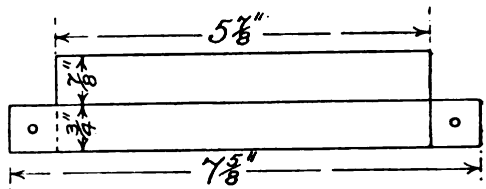


Fig. 3.

stock unrolls as the saddle moves towards mandrel and winds back again. A zinc guard for top of saddle with dimensions is also shown at Fig. 2.

This attachment requires very careful making to work efficiently and to be accurate. The frame of the roller is made of brass sheet 1-16th in. thick, cut to shape of Fig. 3, the ends turned up to form bearings for roller. The wider portion is bent up to form back of frame for attachment. The blind or guard is cut out of white American cloth similar to the other device and the same dimensions. The roller consists of a brass tube, ¾ in. outside diameter, and of length shown, with the two bushings one at each end. The spindle consists of ⅛-in. brass tube, outside diameter. This fits tightly into the bushings at each end of the larger tube. The bushings are drilled pieces of brass rod 3-16ths in. in length, and ¾ in. diameter, the same as outer tube. These bushings are soldered neatly to ends of the roller. One bushing must be tapped for a 1-16th-in. screw as a setscrew to prevent roller moving independent of spindle and yet enable the spring to be compressed and blind rolled up at any time if the spring should get weak. The drum is taken from an old watch, to be bought cheaply. This drum is, with its arbor, soldered on to the spindle firmly and accurately. In taking the drum out of a watch, it is important to see which way the spring winds up, as they appear to vary in this particular. The winding arbor is sometimes plain shouldered; at others it is squared. This shoulder must be soldered into the 1-16th-in. tube. When first removed from the watch, take snap disc out and inspect the spring and see for certain which way the arbor winds—unless this is done the mainspring is easily snapped. Mark with an arrow on inside or outside of drum, and there will be no mistake. If the drum winds up right-handed, it must be secured to frame as shown in sketch, and *vice versa*. The blind must be sewn securely on to the roller and on to a French nail cut down to 5 ins. in length. The whole can now be assembled, the drum placed in best position, when a drop of solder will secure it to frame. Wind up blind, fasten setscrew, and if proper place has been found, the blind will act well. Four pieces of 1/8-in. tube are soldered at top and bottom of frame for securing it to saddle with bent wire. Two pieces of brass wire fasten end of blind to bed of tailstock. The scraper and measurer is made of sheet zinc and slips on to the spindle, and is easily removable. The bottom edge has a 1/4 in. wide strip of velvet cemented underneath to catch shavings. Mark the blind accurately in inches and divisions of an inch, and you have the whole complete. Do not over-compress the spring. Follow up with tailstock.

Our Readers' Work Competition.

TO encourage readers to send us accounts of their work, we offer to send any tool, book, or other desired article supplied by any of our advertisers, to the value of 6s. 6d., to any reader who sends us for insertion in THE MODEL ENGINEER a sufficiently good photograph and description of any model, tool, mechanical or electrical apparatus that he has made, and which has not been already illustrated in our pages. Entries should be accompanied by a separate letter giving the title of the article, and stating exactly what is required as a prize in the event of acceptance. When tools or apparatus are desired, the page and number of article in the firm's catalogue from which it can be obtained should be stated, if possible. It is understood, of course, that we do not promise to accept everything that is sent in, and examples of work submitted must show some degree of originality or usefulness. Ordinary everyday tools or models merely made up from purchased castings are not required. The article should be written *on one side of the paper only* with the name and address of the sender on the back. The photographs and separate sketches enclosed with the contribution should similarly bear the name and address of the sender, otherwise delay may arise in the awarding of the prizes. It is essential in this, as in our other competitions, that the copyright of the photographs must be the property of the senders, and the covering letter should contain a declaration to this effect. The competition will close on June 30th, 1908.

LIVERPOOL DOCK EXTENSION.—Three new docks are to be built at Liverpool at an estimated expenditure of over £3,000,000 during the next five or six years. They will have a depth of 40 ft. of water over the sill at high-water neap tides, and will take vessels having a length of 1,100 ft. Although the *Lusitania* and the *Mauretania* are the largest vessels afloat at the present time, they are to be eclipsed in point of size, although not in speed, by vessels which are to be built for the White Star Line.

The Construction and Repairing of Motor Bicycles.

By "SREGOR."

(*Continued from page* 115.)

AS mentioned in my remarks on the construction of the roller bearing, the success of these depends, in addition to the correct design, on the quality of the workmanship. For example, the rollers must be of exactly the same size, and truly parallel, or, assuming one roller working in a bearing whose diameter is larger than the rest, this will cause a slight lift to the shaft, and set up a knock, besides throwing all the weight on this roller in a varying degree. The same obviously applies to the ball bearing, and, fortunately, the manufacture of balls is a speciality of high-class work, executed by special machines, and guaranteeing practically absolute accuracy. The ball bearing is undoubtedly

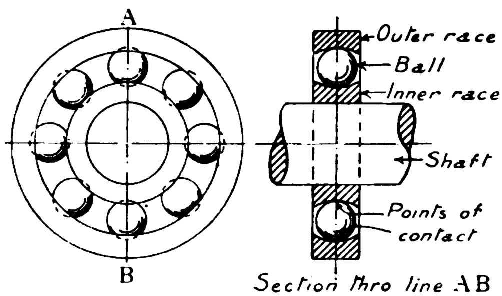


FIG. 89.

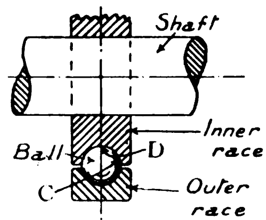


FIG. 90.

much more universally used in motor-car construction than the roller bearing. The design and construction of a ball bearing will vary according to the duty it has to perform. The ordinary bearing, as applied to carry a revolving shaft, is that shown in Fig. 89. As will be seen, the ball only takes a point bearing—that is, the radius of the race is larger than the radius of the ball. The apparent objection to this would appear to be throwing all the weight of the load on a very small bearing surface of the ball; whereas, by making the race the same radius as the ball, and allowing a much greater bearing contact, a better result would be attained; but, on following carefully the rolling action of the ball, it will be observed that the greater portion of the bearing surface takes a rubbing action, as the ball revolves. This is greatest at the centre, where indicated at C in Fig. 90, decreasing to a minimum at the point D. Hence the reason for making a ball race with larger radius than the ball. It is most apparent that the rubbing action is to be avoided in any running bearing, but for purposes where a ball bearing is used to carry large weight, and receives only a slight revolving action, then the bearing with the ball fitting the race can be applied, with these advantages: that the pressure is spread over a much larger surface of the race, and the bearing is more rigid, and more conducive to absorb any shocks. This type of bearing is suitable for the steering heads of the steering axle of a car, as shown in Fig. 91, the amount of movement this is subjected to being very slight. One design of ball race for a revolving bearing, as fitted to the hubs of a car, etc., is shown in Fig. 92, and is what may be termed a non-adjustable bearing. Another design is that shown in Fig. 93, which is commonly used for the bearing of the bicycle hubs, etc. The race, which is of cone shape, is mounted

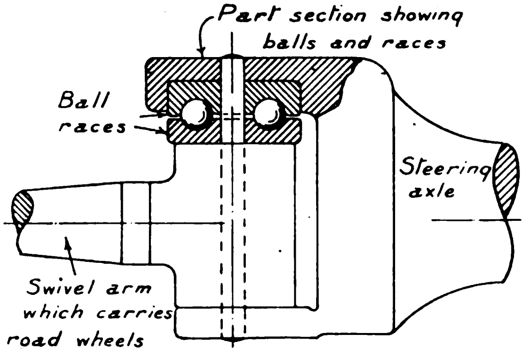


FIG. 91.

on a fine-pitch thread, which serves to adjust the bearing. This design has the following advantage over the type shown in Fig. 94: that any slight error made in the diameter (as shown in Fig. 93, at B) can be readily compensated by adjusting up the cone until the ball is a running fit, whereas the inner and outer races of Fig. 92 must be ground most carefully to exact size. Another feature of Fig. 93 is the fact that it takes the side thrust

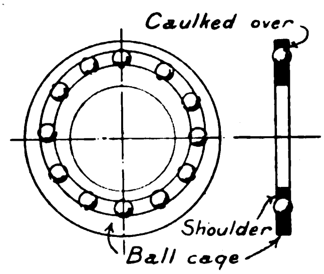


FIG 94.

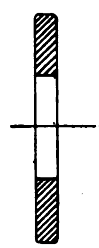


FIG. 95.

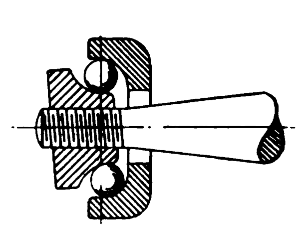


FIG. 96.

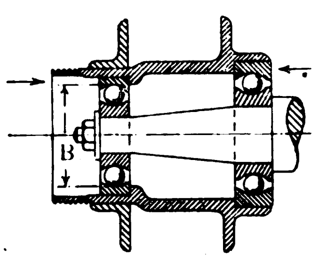


FIG. 92.

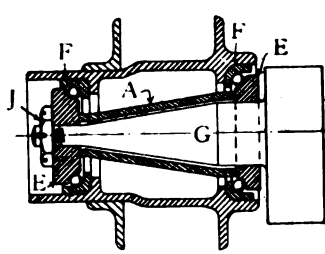


FIG. 93.

more directly than Fig. 92, which has a tendency to lock the ball, or burst the race; which, however, can be overcome by fitting a plain side-thrust ball bearing, as shown in Fig. 94. This consists of a plain disc, into which the balls are located a loose fit. The path of the balls, or pitch circle, is eccentric, as shown in Fig. 94. which ensures a distribution of the wear on the thrust plate or washer, Fig. 95. The ring which contains the balls is generally termed the ball cage, and should be drilled only part way through, as indicated in Fig. 94, the radius shoulder preventing the ball from falling through, after which the ball is inserted and the other side caulked over with a suitable punch, but leaving the ball quite free to revolve. The thickness of the cage must be less than the diameter of the ball, to ensure that the pressure comes on the balls and not on the cage. This type of ball thrust is extensively used for taking up thrust in various parts of the motor-car. Referring to the ball race shown in Fig. 93, it is advisable to design the adjusting cone E with a plain hole, and to be a sliding fit on the spindle, which ensures the cone faces being true with the spindle. The screwed race is somewhat difficult to make a good fit, and maintain the same, owing to the fact that, provided the screw is a good fit when soft, it has a tendency to swell, and alter its shape, in the hardening process. Of course, provided the screw is a good fit, and the race ground true on a good fitting screwed mandrel, the result is good, but, as mentioned above, there are the possibilities, under ordinary manufacturing conditions, of not attaining this desired effect, and a slight slackness of fit will pitch the race out of square, as shown in Fig. 96 (which is exaggerated). The practice, when this type of ball bearing is used, varies under different conditions, as to the tendency in which the cone race would travel (caused by the friction of the hub which it carried) in the event of the locking arrangement becoming loose. The practice adopted by the cycle maker is to design the direction of the screw—that is, whether right-hand or left-hand—so that the cone will have a tendency to screw away from the balls, and so loosen the bearing, in which case the rider of the machine would soon detect what had happened without effecting any serious result, as the forks of the machine would prevent the race unscrewing too far. But in the event of the design allowing a tendency for the cone to tighten on to the balls, the result would be to tend to lock the bearing, and some serious acidents have been experienced owing to this, especially in the earlier days of the safety bicycle. Now, comparing these results to those of a bearing, say, of the front wheel of a car, in this case the wheel tends to drop off the spindle; or, if designed to tend to lock the bearing, the same serious effect happens as in the case of the bicycle hub. So that the ideal bearing for the car hub is one that will prevent the possibilities of the bearing either locking or falling off the spindle, should the locking arrangement be defective. A design to this end is that shown in Fig. 93, in which G is the spindle or arm which carries the ball bearing cones E and F, on which the hub revolves. Between the two cones E, E, and over the diameter of the spindle G is a distance sleeve H, which must be made to exact length, so that the lock-nut J can be screwed up perfectly tight, which locks the two adjusting cones, and at the same time allows the balls to revolve freely. This distance piece effectually prevents the cones from tightening. The direction of the thread should be to tend to tighten the cone, which will be left-hand thread for left wheel, and right-hand thread for right-hand axle.

Comparing the two designs of ball bearing, Figs. 92 and 93, from my remarks above (*i.e.*, comparing the two types especially as being applied to the front hub of a car, which bearing receives very considerable rough usage, and direct and side shocks, as the wheels are passing over rough obstacles in its travels on the roads), it is apparent that the bearing is not designed to stand against side shocks as indicated by the arrows, to the same degree as the cone bearing, Fig. 93, in this design. As shown, the cone race offers a substantial side thrust, in addition to providing a revolving bearing, and can be readily adjusted by means of the screw. My remarks above, *re* the screwed cone, are intended to apply only to the larger size bearing as used on the car, and not the smaller design as used on the bicycle and motor cycle, which are more readily made a good screwing fit under ordinary conditions.

Up to the present, one of the few details that have not been mentioned in this series is the exhaust arrangement. Having obtained a good mechanical design throughout for the details of the engine, to obtain the best efficiency from the same, a correct size and good design of carburettor must be used, and in co-operation with this detail, the exhausting arrangement must be such as to ensure the exploded or spent gases getting freely and effectively away, otherwise the good effect of a suitable carburettor will be sacrificed in consequence. The cylinder head, or combustion chamber, designed with the least amount of restrictions and recesses, lends itself best to effect a quick and clean exhaust. The outlet connections and pipes must be as large as practicable. A good fault is to have them on the larger rather than the small side of what most makers consider the correct size. In the early days of the petrol engine construction it was the accepted practice to make the area of the exhaust valve a percentage larger, than the area of the inlet valve to effect this, and if the inlet diameter is, say, 1 in., the exhaust would be 1¼ ins. to 1½ ins. diameter, while of recent years there has been an almost universal application in design to make the two valves of exactly the same dimensions, keeping both, of course, sufficiently large to cope with the volume. The idea of making the valves in duplicate (speaking of mechanically operated valves, of course) is to minimise the number of different parts, which is a great advantage, both to the user and the manufacturer of the motor. This practice is, of course, more beneficial in the case of cars which carry eight or twelve valves in the complete engine at once. From the user's standpoint, he has only one size of valve to carry as spares, and for the manufacturer it means one type to make, so that the same tools do for both types, and the same tools and jigs for the seats in the cylinder casting. Speaking again of the principles which should govern the designer upon fixing a relative size for each valve, and taking due consideration for the fact of the desire to effect a quick exhaust of the burnt gases, it must be remembered that there is a great difference between the velocity of the charge entering the cylinder and when it escapes. The entering charge depends upon the speed of the piston and efficiency of the vacuum caused by it. But as soon as the charge is exploded the pressure and expansion of the gas has increased, which attains its maximum pressure the instant it explodes, decreasing as the piston moves outward on its stroke. As soon as the exhaust valves open, the gases readily escape in the form of a flame, as will be readily observed when the exhaust pipe is removed from engines. In addition to the high pressure of the exhausting gases, their escape is accelerated by the piston on its return stroke, known as the scavenging stroke, so that an equal area valve should readily allow efficiency for the exhaust. Besides the pressure, the burnt gases are of high temperature. It is the effect of this temperature, coupled with the velocity, that causes the report upon coming in contact with the atmosphere. This is not quite universally known amongst the amateur motorists, and when the construction of the exhaust box has been under consideration, more attention has been given to the baffling of the escape of the gases through the box than to effect a reduction in the temperature. The ideal exhaust box, I think, and taken from a practical standpoint, is one which gradually baffles the pressure, and finally distributes the gases over a large cooling surface. Of course, elaborate arrangements may be readily devised to effect this, such as a water-cooled box, but this becomes impracticable, not but what it can easily be arranged, but a good enough effect can be obtained without entailing such an extra and costly addition even in the most up-to-date motor-car.

In the next article I shall show some designs of exhaust boxes illustrating the above remarks.

(*To be continued.*)

The Navy and Oil Fuel.—It is stated that "during the year oil-burning appliances, as auxiliary to coal, have been completed and tried in the armoured cruisers *Cochrane*, *Achilles*, *Natal*, and *Warrior*, with satisfactory results. The first group of twelve torpedo boats fitted to burn oil only still continues to give satisfactory results on service. All armoured vessels now under construction are being provided with arrangements for burning oil in conjunction with coal, and all torpedo craft for burning oil only. The four new destroyers of the *Mohawk* class, which have carried out their full speed trials, used oil fuel only, and their installations have proved satisfactory. Installations in the *Majestic*, *Cæsar*, *Magnificent*, and *Victorious* to burn oil and coal together are being completed. Special arrangements have been made in the instructional classes at Portsmouth and in the fleet with the object of increasing the rate of instruction in this subject, and are proving satisfactory."

Patterns for Screw Propellers.

By T. D. GARSCADDEN.

NO one perusing THE MODEL ENGINEER week after week can avoid being struck by the marvellous ingenuity and skill displayed in the making of the hulls and engines of model steamers. That point will be readily granted, but

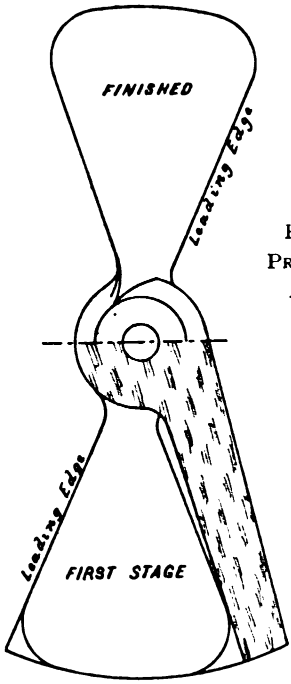


FIG. 4. PROJECTED AREAS.

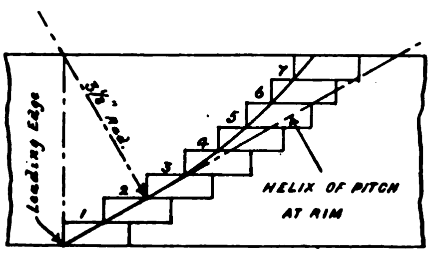


FIG. 1.—STRIKING-OUT PITCH.

it has been borne in upon the writer as a regrettable fact that, as a rule, they do not pursue their aims to the propeller end in the same scientific manner, out leave that most important adjunct to be formed by means which savour of a guessing competition. The result is that that end is frequently a bitter one, with the consciousness of defeat in the matter of speed, and an utter helplessness to take the engineer's usual lessons from failures, because of the trial and error methods which are distasteful to all good craftsmen.

Of course, I agree that propeller design is still largely experimental, and I am afraid must ever be so (as witness the trouble with H.M.S. *Dreadnought*, and many other new ships), owing to paucity of data to go upon; but at least the designer knows the exact lines of a screw that has failed, and this knowledge, coupled with his theory (begotten of experience and instinct) shows him the direction towards success.

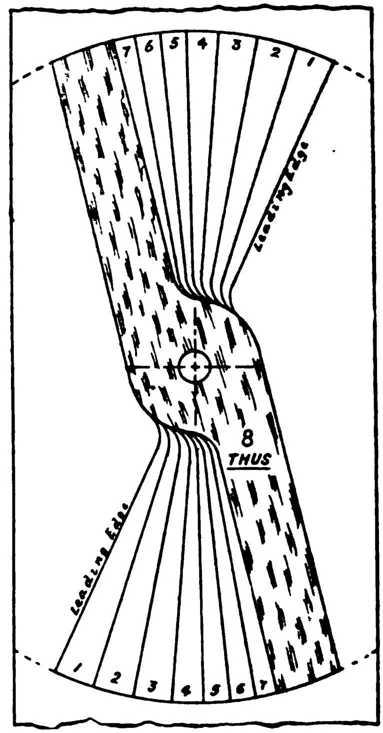


FIG. 2. PATTERN BUILT UP.

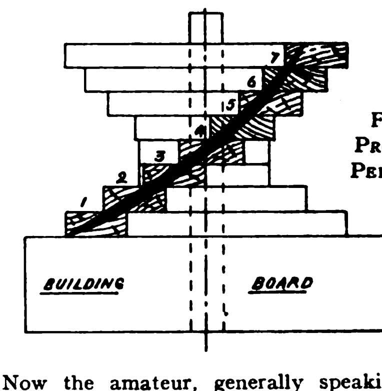


FIG. 3. PROJECTED PERIPHERY.

Now the amateur, generally speaking, cannot avail himself of this help from his more or less rule-of-thumb-made, built-up propeller. Nor is he in better case, but worse, if he has fitted his boat with a ready-made cast one. The futility of the latter becomes manifest when it is known that it is now a generally accepted fact among authorities that *every* steamer ought to have *her own special design* of propeller.

In the yard in which the writer received his training, two sister ships were laid down side by side.

Mostly from obvious economical reasons, but partly for research purposes, everything for engines and hulls was made in duplicate. At the trials, when finished, one vessel slightly exceeded the scheduled speed, but her sister fell short by nearly a knot per hour, and it took the third experimental propeller to bring her up to the other.

Now, it is the purpose of this article to help model steamer builders to make their screws accurately on their own pre-determined likely lines that will lead to the maximum speed exerted by their well-made engines, and so reap the reward of their skill.

Into the vast controversial field of relative diameters, pitches, blade-areas, shapes, immersions, etc., I do not propose to enter, having had some. Few come out of that field unscathed, a fact easily realisable by observing the hosts of patents taken out for screw propellers, and each one swearing by his own.

I would like, however, to call the amateur's attention to two excellent articles on "Screw

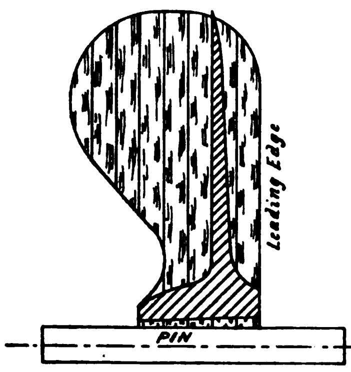


Fig. 7.—Fore and Aft View.

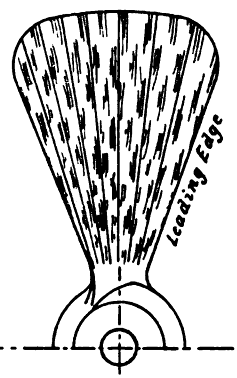


Fig. 6.—Projected Area of Blade.

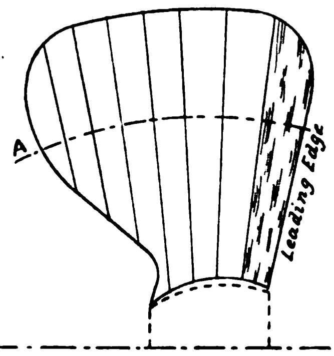


Fig. 5.—Expanded Area of Blade.

Propellers for Model Steamers" which appeared in The Model Engineer issues for March 19th and April 2nd, 1903. The study of these will greatly assist the amateur in determining the most likely diameter, pitch, and form of screw to suit the power and revolutions of his engine and form of boat.

I may venture, however, to say something in favour of the design given in the object lesson herewith, in so far as it is thought to be a good starting point for experimenting in this most fascinating study. To suit model conditions, it is to a slightly modified scale of a screw the writer designed and made (by the methods shown) for a small steam yacht which had been a somewhat slow boat hitherto. After taking the various governing factors into consideration, I designed one with two blades on the lines here given, and the resulting increase of speed was most surprising. A look at the diagram (Fig. 9) will help the reader to understand my reasoning in regard to design.

Positive slip being the indeterminate factor which reduces speed efficiency so much in model propellers, this is the evil tackled here, as it was in the yacht.

Ignoring other disturbing influences for the time being, it will be conceded that, at the leading edge of impact, and for a variable distance up, according to suitability of even pitch to governing factors, the blade is practically working in a solid material. As the blade continues to progress, but with its work to do forward, the water begins to "give" in obedience to the law of disturbed bodies moving along the line of least resistance. It is this elliptical line which is sought to be met by the circular line of progressing blade, which latter becomes elliptical in its action, so giving the same amount of "grip" to the following edge as to the leading.

In short, my contention is that the leading edge of the blade makes the pace, and the following edge keeps it, or, in other words, that it negatives positive slip, if I may be allowed the phrase.

By the way, the term "negative slip" is used to denote the *increase* in speed over and above what the propeller would allow if working in a solid substance. This high degree of efficiency is sometimes attained, though not often, by "real" vessels, but I make bold to say has never been reached in amateurs' models. Instead, I shall be within the mark if I place the average loss by positive slip in the latter at 40 per cent., thus showing the vast field for improvement, and justifying me in pointing out methods whereby this great waste of power may be reduced.

In this connection it may not be uninstructive to explain how negative slip comes about. The propeller does not work in still water, as the passage of the ship forward causes the "wake," a column of water progressing in the same direction as the vessel. Considering this alone, it will be seen that this motion tends to make the propeller beat its own pitch relatively to still water. This action is more or less modified, however, by positive slip, and also the fact that the revolving propeller, by its own action, causes a reduction of pressure fore of it. This reduction of pressure on the after part of the hull is exactly equivalent to an increase of resistance in front.

It is impossible to mathematically estimate the various causes which produce these effects, though sometimes, by a happy hit, but far more frequently by experiment in an intelligent direction, the gain due to the wake thrust aft overcomes the loss due to increased resistance fore.

The points to be borne in mind while studying for the desirable result of negative slip, in order of importance, are :—Lines of hull, diameter of screw, pitch, revolutions, total area of blades, and shape of same.

The reader will note the absence of engine power from the last sentence. This is to point out that one may have attained above results and yet fall short of his reward in speed through not having developed the full power of his engines, but when he has reached that point, he is not far from the goal, and will be able to see the direction there clearly.

I have another argument in favour of my design. If it be granted that the circular curve on the thrust side of revolving blade equals the elliptical curve of greatest longitudinal resistance at right angles to shaft line, the claim is also established that the back of the blade furnishes the line of least resistance to the broken water of the race, which would otherwise be whole water acting as a deterrent against the speed of the vessel.

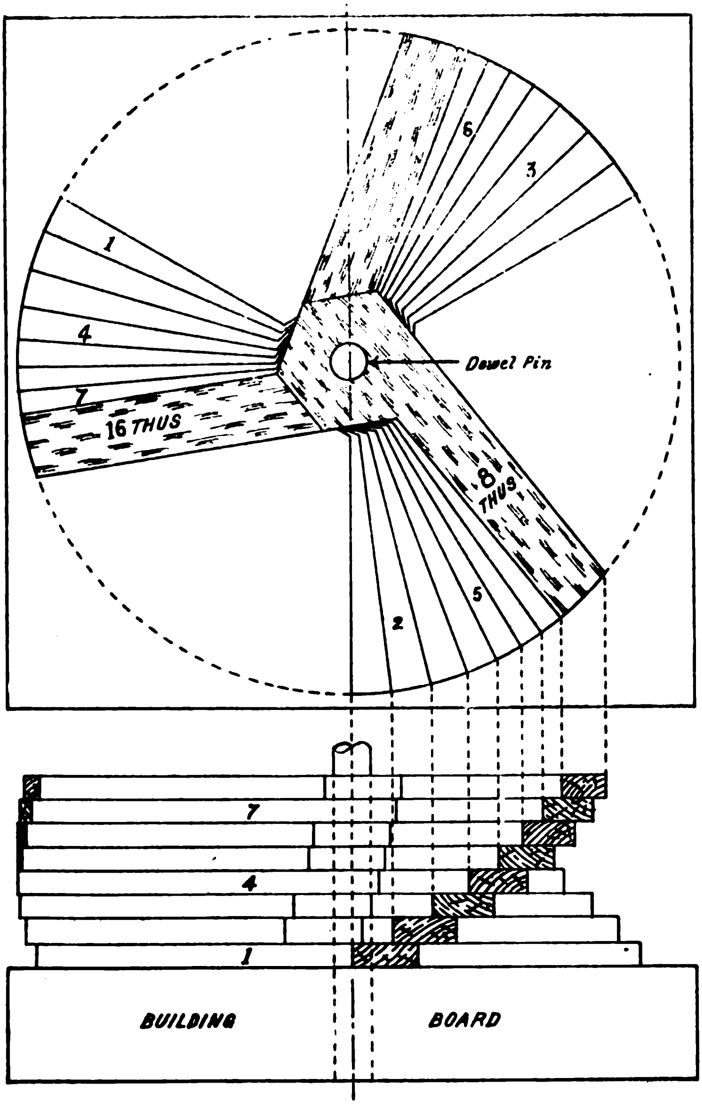


FIG. 8.—BUILDING A THREE-BLADED SCREW.

Assuming that the diameter and pitch of the proposed propeller have been determined, let us now turn to the actual making of the pattern, on whatever lines projected. For the purpose of the lesson, however, let us suppose that we are making a propeller to the dimensions laid down, viz :—

Diameter, 3½ ins.
Pitch, 6¼ ins.
Right-handed.
Two blades.
No drop.

The drawings are produced full size, so that the other particulars can be taken from them.

Draw the helix of the pitch at rim on a piece of drawing paper, as in Fig. 1, and then draw the lines representing thickness of building courses ⅛ in. apart. The curve has its centre in the normal to the arrowhead at corner 2, and the radius is half the pitch in this case, but this is not by any means to be taken as a constant relation.

Next place the end sections of building pieces with the thrust edge at junction of pitch line with its corresponding parallel line. These junctions indicate the distances at ends at which each successive piece of wood is placed in its graduated spiral course upwards (see Figs. 2 and 3).

Now plane a piece of wood quite flat for building on, and in the centre bore a hole for wood or metal pin, taking care to bore at right angles to board. The best way to ensure this is to produce the centre on both top and bottom, and bore half-way through from each. It is preferable to use a centre-bit for this, and to use the same bit for the building pieces right through.

After fitting in the pin fairly tight, cut out eight pieces of nice straight-grained, dry, yellow pine, ⅛ in. thick, as in Fig. 2. You need only use care to pare the thrust edges neatly, as these junction edges guide you subsequently to pare to a true radial form of the working face. My method, and one which I recommend, is to cut one piece of wood sufficiently thick for all the pieces required, plus ample allowance for sawing between. I then plane bottom true, square one side, gauge, and plane parallel to the greatest width, and then draw off profile on both top and bottom. Next I bore the hole carefully half-way through from top to bottom, then cut out profile, after which it is an easy matter slitting up into the thicknesses.

Having done this, pass the first one over the pin on to board; it need not be fastened down. Next, on the top of ends of No. 1 mark off the position of No. 2, and fasten same down with good glue, made very hot, and used fairly thin. Let it remain under pressure for a little while until it is partly set, and repeat the process until it is all built up. To keep each layer under pressure for some time, a perfectly flat piece of wood, with a larger hole through it than the bottom board, may be used, and the weight placed directly over the centre if the wood is of sufficient thickness to cover pin. When the

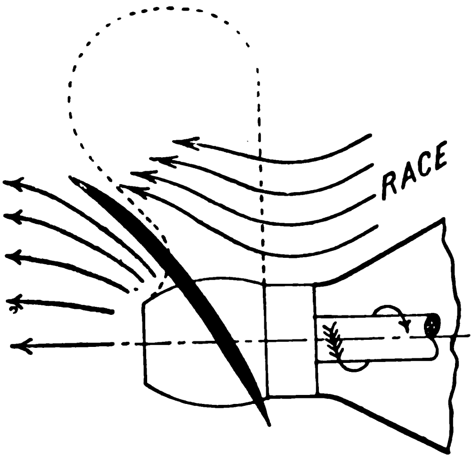


Fig. 9.—Diagram.

building is completed, leave it all under pressure for at least twenty hours.

When thoroughly set, finish the thrust faces by paring away the projecting steps clean down to the corners (Fig. 4, First Stage), when it is to be hoped that not even the joints will then be seen. A keen, flat gouge is best for this purpose. Now cut out a paper template of the expanded area (Fig. 5) and, with leading edge held to leading edge, draw off, as in Fig. 4. Cut away to profile, and at the same time cut down the boss to the required thickness.

Next, the blades have to be cut down to thickness, or rather thinness, and form the barrel, and fillets at roots of blades at the same time, using gouges at first, finishing with a sharp knife.

Three-Bladed Propeller. — Just here let me strongly advocate the adoption of propellers with two blades *only* for model steamers. The objections to these in a large ship on account of want of balance in a sea-way do not here apply, as model steamers' screws are always well immersed (too well sometimes, judging by the angles), and they run in comparatively smooth water.

The undoubted high degree of efficiency possessed by two-bladed propellers is largely due to non-interference between the blades under certain favourable conditions. These favourable conditions are always present in the performances of a well-made model steamer, and it behoves the amateur to take advantage of every well-established fact in connection with his hobby. I know the idea lingers in the minds of some that there must be a lack of balance even under deep immersion, but the following case, within the experience of the writer, effectually disproves this theory.

During the whole of a smooth passage it was noticed that the engines ran a little faster than usual, and the cause was not discovered until the vessel was slipped for other repairs, when it was found that one of the blades of the propeller (a *three*-bladed one) had broken short off at the boss. There had been no knocking or irregularity of revolution, and the speed was as usual. Loss of area increased the number of revolutions, and so kept up the speed, but, of course, at the cost of increased friction.

However, if the reader wishes to make one, the procedure is only a slight variation of the instructions given for the two-bladed one, and that only at the commencement.

The drawing, Fig. 8, is self-explanatory, and the reader will see the dodge of "knitting" to maintain the strength. Supposing we began with No. 1 segment as a hexagon-ended one, we should place the next one of the same kind in the position No. 2 in the second course, and so on, as per numbers marked. Before boreing the pinhole in the building board, draw the diameter of the propeller on it, and divide the circle into three. From the three points draw radial lines, which will represent the "leading edges" of blades, and from which you start building. Fig. 6 shows the projected area of blade from an aft point of view, while Fig. 7 does the same for the fore and aft appearance.

By keeping the centre pin long enough at the start, any departure desired by the student from the lines given in example can be made by using the pin just as a centre bar is used in the foundry in striking up large propellers, with the desired template swinging round same.

In building the pattern, by forming the alternate courses out of different coloured woods, a very

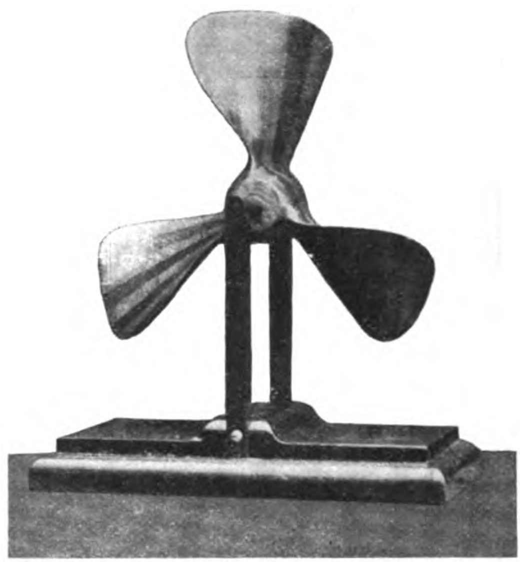
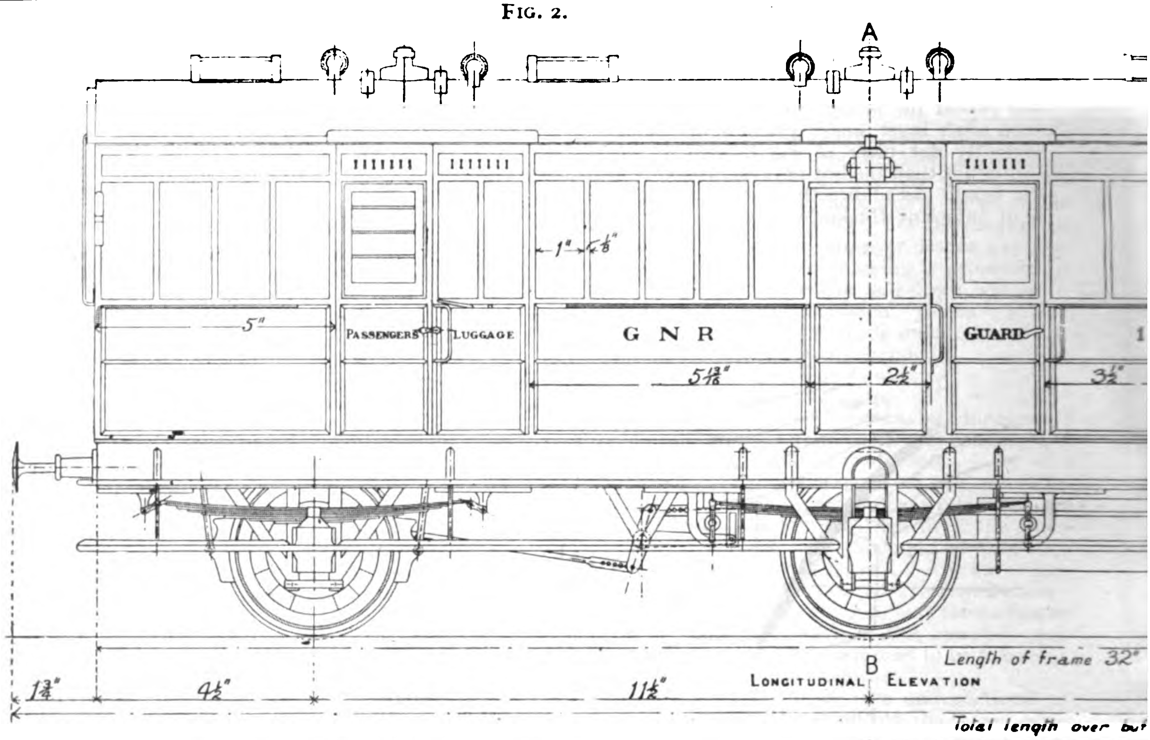


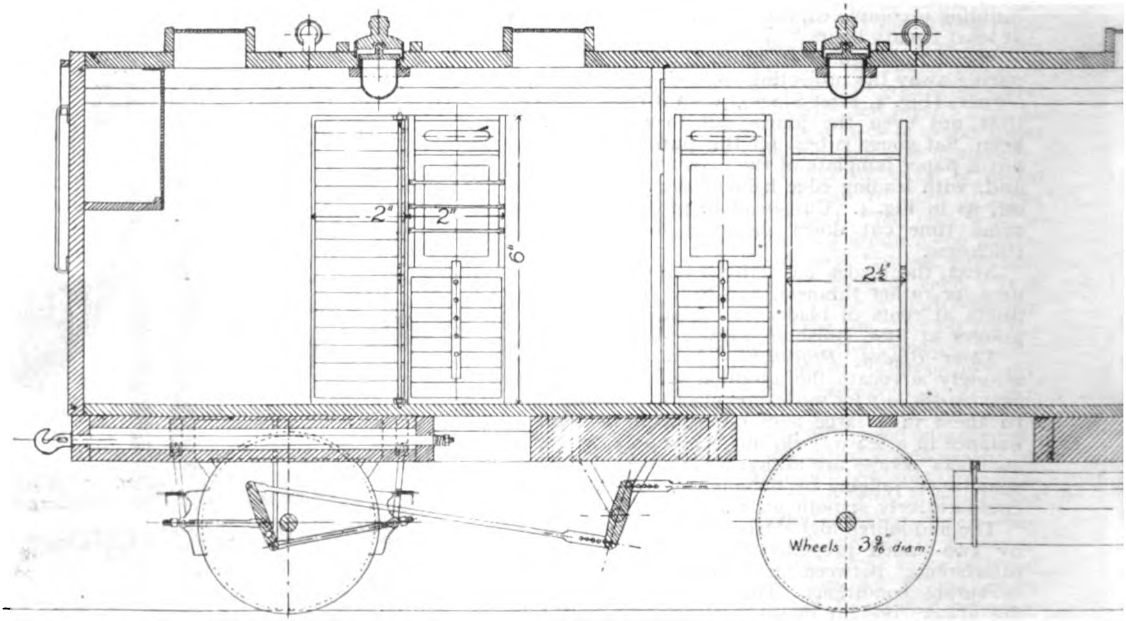
Fig. 10.—Screw Pattern mounted as a Model.

pretty effect is produced, which renders it a most appropriate and ornamental trophy of the student's chase after truth, and a model in itself, which will be found invaluable in the next effort by providing a study of the radial lines made prominent.

Fig. 10 is from a photograph of such a screw pattern mounted as a model.

FIG. 2.





LONGITUDINAL SECTION

FIG. 3.

A 1-IN. SCALE MODEL GREAT

By C. GR

For description]

(*Scale : One*

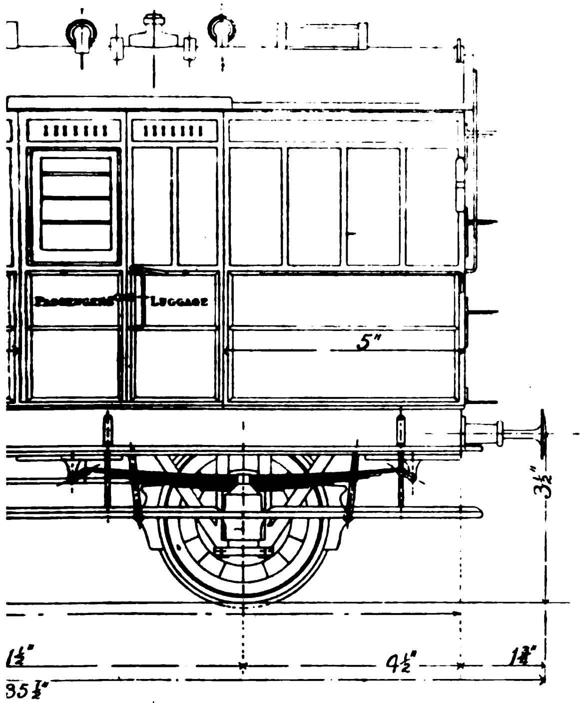
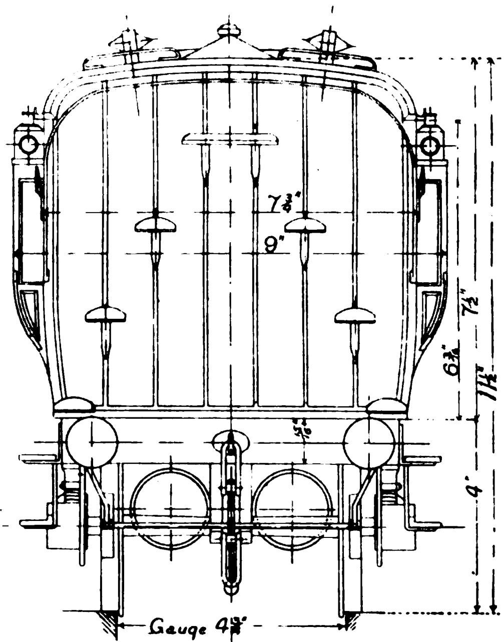
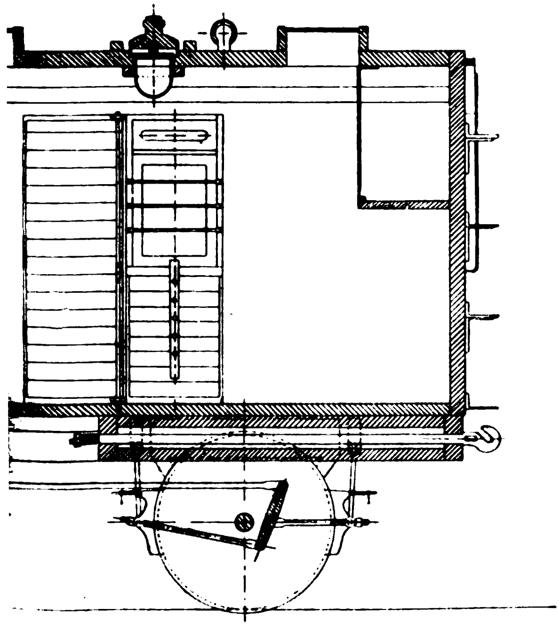
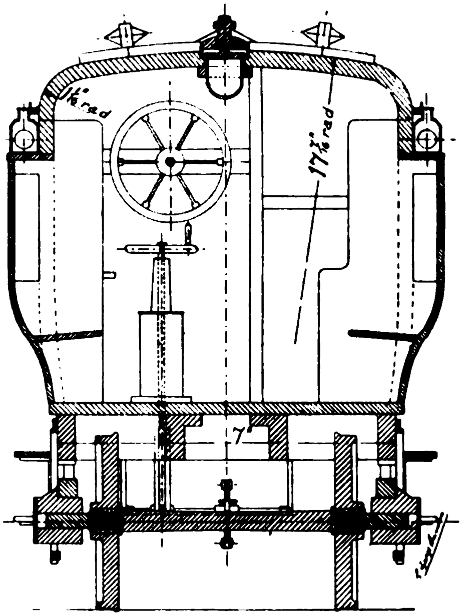


Fig. 4.



End Elevation





Section through AB

Fig. 5.

THERN RAILWAY BRAKE VAN.

Harrison.

ter full size.)

[see page 481.

Locomotive Notes.

By Chas. S. Lake, A.M.I.Mech.E.

The New North-Eastern Railway Tank Locomotive.

The new tank locomotive of the North Eastern Railway, with 4—6—0 wheel arrangement, is at present in the shops at Gateshead undergoing modification. When it reappears it will be found that the extended smokebox at first fitted has been replaced by another of the standard pattern. The writer has received from Mr. Wilson Worsdell, Chief Mechanical Engineer of the N.E. Railway, a promise to the effect that when the engine is again ready for service and has been photographed in its altered condition a copy of the photograph will be sent. This will in due course be reproduced in The Model Engineer, and a full list of dimensions will also be given. For the time being, therefore, further particulars must be withheld.

Locomotive Work at Easter.

Communications of an interesting character have been received from several correspondents giving particulars of observations made of the locomotive work performed on both ordinary and holiday trains during the Easter holidays. The miserable climatic conditions militated very strongly against the railway companies in the matter of traffic volume, but on the Thursday evening, the 16th ult., some exceptionally heavy trains would appear to have left the various London termini and some remarkable performances are to be credited to the engines which hauled them. One correspondent states that he left King's Cross for Scotland by a "special" excursion train made up of thirteen heavy corridor vehicles, the majority of which were filled, and he estimates the total weight behind tender at about 370 tons, which is probably not far wide of the mark. If anything, it would be rather under than above the actual load; but as the type of vehicle is not stated, it is impossible to form a true estimate. In any case the load was hauled by one of the later Atlantic type engines belonging to the 251 class to Grantham (105½ miles) in 2 hrs. 3 minutes, although several slight and one rather severe slackenings of speed occurred *en route*. Another correspondent states that he left London by the Sheffield Special of the Great Central Railway on the day preceding Good Friday, and noted a very good performance on the part of the 4—4—2 type engine which drew the train. The load was considerably greater than usual, consisting of eight 8-wheeled, and one 12-wheeled vehicles, and a very fast run was made over the Quainton Road-Leicester section; while between the latter place and Nottingham and from there on to Sheffield the running was at all times noticeable for its swiftness. The Marylebone-Leicester length of 103 miles occupied 1 hr. 53 minutes and the total distance to Sheffield, viz. 164¾ miles, was covered in two minutes under the three hours.

On the same day the writer returned from Manchester by Great Central route, leaving London Road station by the 2.15 p.m. restaurant car train due at Marylebone at 6.35 p.m. On this occasion the run was very punctually performed, the train leaving all stopping points practically to schedule time. The 103 miles (Leicester to London) were covered in precisely 1 hour 54 minutes.

New Six-coupled, Bogie Express Locomotives.

Both the Great Western and North-Eastern Railways are having their stock of 4—6—0 type express engines increased by the building at Swindon and Gateshead Works, respectively, of fresh locomotives belonging to this class. Those for the first-named railway are practically reproductions of the "Star" design, but with superheater boilers and the modified pattern of bogie fitted to Pacific engines; while the North-Eastern locomotives are similar to the first engines of that type introduced on that line and classified as series "S." It is instructive to witness this further application of a type of locomotive about the desirability of employing which there is some difference of opinion in well-informed engineering quarters. When the 4—6—0 type of locomotive first made its appearance in England (and this was on the North-Eastern Railway, by the way) there were those who said that six-coupled driving wheels would never do for express passenger work, but the type has proved uniformly successful nevertheless wherever tried. Now, after extended trial, several of the leading British railways employ it, and, as we see, the number of such engines is constantly increasing.

The Paint Shop in a German Locomotive Works.

The Berliner Maschinenbau Actiengesellschaft is one of the leading locomotive building concerns in Germany, and when, about two years ago, restrictions of space at their works, situated in a congested quarter of Berlin, forced them to seek new quarters, they established commodious premises at Wildau on the outskirts of the city, which have been equipped with all that is latest in machine tool and other plant. One of the last departments to be started up for work was the paint shop, of which an illustration is given opposite. Although not one of the larger departments, it is nevertheless one of the most completely equipped for its purpose. There are six engine pits and over these a large amount of finishing as well as paint work is carried out. A fitter's bench with vices, etc., runs along one side of the building, and here a certain amount of what may be termed final fitting up is done, consisting mostly of the addition to the engines of small parts such as taps, cocks, and various handles.

At the time of the photograph reproduced herewith being taken the shop was full of locomotives, some of which were 4—6—0 type compounds for the Shantung Railway, China, while others were for a Russian railway. It was in these works that the very large and powerful ten-coupled tank engines and the 4—6—0 express locomotives for the Prussian State Railway fitted with Schmidt superheaters, and which were tested over a considerable period under official auspices, were built, and this fact brought the works into additional prominence.

The Shrewsbury Accident Report.

Considerable indignation was aroused in locomotive enginemen's circles by the statement contained in Colonel Yorke's report on the Shrewsbury railway disaster to the effect that evidence existed to show that the driver and fireman were asleep on the footplate. Meetings have been held to protest against this suggestion, and the contention is put forward that the fact of the engine being reversed disposed of any question of this sort, and that to make such a statement was only theorising, or something worse. It is easy to understand that suggestions of the kind which have given so much offence on this occasion are very unpalatable to the responsible body of men who run our locomotives; and while there is no one presumably who would be prepared to attribute to Colonel Yorke anything but a real desire to clear up the mystery which surrounds the regrettable occurrence, it seems to be a great pity that, without direct evidence to go upon, anything should have been embodied in the report which, while impossible of substantiation beyond any doubt, should have given rise to so much unpleasant controversy, to say nothing about the opportunity held out to the lay press to enlarge upon what are only imaginary dangers. No one who has done any great amount of footplate riding will believe that there is anything for the public to fear from the likelihood of enginemen giving way to sleep while on duty. It is too apparent to them, whatever those may think who judge these matters from outside, that the conditions under which drivers and firemen of express trains work are such as to induce constant wakefulness and not the opposite.

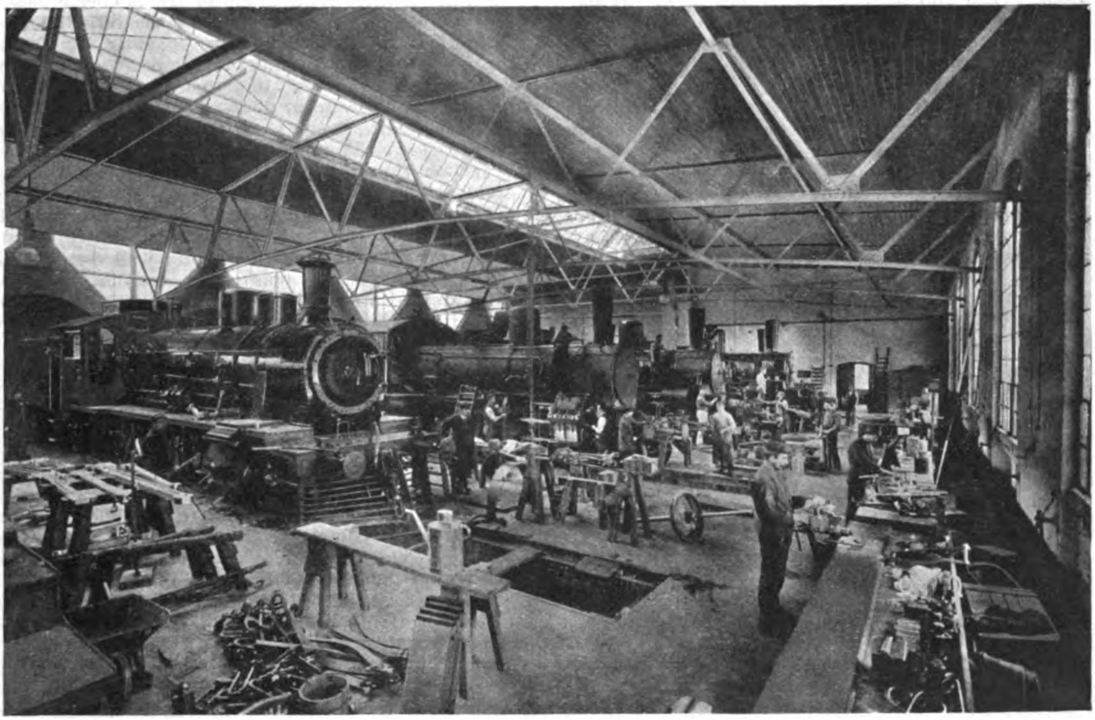
Accidents on Miniature Railways.

By Arthur W. Line.

Even the miniature railway is not exempt from accidents. Derailments are quite common, and are generally due to taking a curve, switch, or unsafe spot at too high a speed, or to obstructions on the track dropped by careless persons.

The miniature railway at Venice, California, has its full quota of accidents. It has a trackage of 2 miles, including sharp curves, steep grades, five bridges, and numerous switches. The writer was recently a passenger when a derailment occurred at a trailing switch immediately followed by a trestle bridge over a canal. The pony truck jumped, but was held by the bridge guard rail. The engineer stopped, looked at the trouble, and calmly ran the train on until the locomotive was clear of the bridge. A crowbar carried on the train soon replaced the truck. The value of a guard rail on bridges was very forcibly demonstrated, as the pony ploughed off sideways into the ballast immediately after clearing the guard rails.

This railway had also two cases of trains parting when coming over the crest of a hill last May. In each case the train was heavily loaded, and consisted of two locomotives and eight twelve-seat



Paint Shop and Finishing Department: Berlin Machine Co.'s Locomotive Works.

passenger cars, and a collision occurred between the head and rear portions of the train at the foot of the grade. In only one case was anyone hurt—that of a woman who tried to get off and was thrown to the ground when the rear car struck. The brakes being "straight air," were useless when the train line parted, and as the electric bell cords were disconnected, the conductor could not signal to the engineers to pull out of the way of the rear portion of the train.

On the same day one of the engineers was badly burned by the explosion of an acetylene generator carried on the tender to feed the headlight, markers, and cablight.

About two years ago a lady passenger riding on the Long Beach and Asbury Park Railway, California, leaned too far out on a curve, and overturned a car into a sandbank, causing no injuries, however, except to her dignity.

Quite recently a wreck occurred on the miniature railway at Forest Park, Kansas City, Missouri. All the train except the locomotive went over an embankment. Two adult passengers leaned too far out and caused the coaches to turn over. Half a dozen children who were on the train escaped injury. The engineer kept the locomotive from leaving the track by jumping to one side and holding it on.

For the Bookshelf.

[Any book reviewed under this heading may be obtained from THE MODEL ENGINEER *Book Department, 26–29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.]*

MODERN POWER GENERATORS. By James Weir French, B.Sc., with an Introduction by Prof. Archibald Barr, D.Sc., M.Inst.C.E. London: The Gresham Publishing Company, 34B, Southampton Street, Strand, W.C. In two volumes with eleven composite sectional models. Price £2 2s.

This elaborately produced and handsome pair of volumes deal with the subject of the production of power by steam, electricity, and gas, and the principal applications of that power to the requirements of modern life. This is a large subject, full of variety, but of great interest and importance to practically every member of the community. Even if we are not engineers, the clothes we wear, the houses we live in, the trains, trams, and ships we travel by, and even much of the food we eat, all involve in their manufacture the use of power, and it behoves every one who takes an intelligent interest in life to have at least some understanding of the methods by which power is produced and utilised. To the engineering student, and to the practising engineer, the subject is, of course, all-important, and for these, as well as for the non-technical reader, the volumes under review possess a special value. The ordinary member of the public will find in their pages clearly-written and easily understood descriptions of all the principal types of modern power generators, which, without any previous engineering knowledge, he may follow with much interest and instruction. On the other hand, to the professional man, who is usually a specialist, the value of the work lies in the fact that it gives him an excellent survey of nearly the whole of the power-production problem, and enables him to readily refer to or familiarise himself with the details of those types of generators which lie without the usual run of his professional work. In the first volume we find four sections, dealing with "Steam Generators," "The Steam Engine," "The Steam Locomotive," and "Continuous Railway Brakes," while in the second volume the subjects dealt with are "Electrical Generators and Motors," "Gas and Oil Engines," and "The Motor-car." These headings give a good idea of the general scheme of the book, and show that it is fairly complete in its scope; but we regret to note that water and wind motors, two very important types of power-producers in their special fields of application, have not been included in the contents. Neither of these types of motor are, of course, power generators in the strict sense of the term, as they merely change power already provided by Nature in one form into another form more convenient to the purpose of man, but then the same remark applies to every form of so-called power generator. However, with these exceptions, the subject of power generation and application is well covered, and some excellent types of modern practice in generator design and construction have been chosen for description. On the illustrative side the volumes are exceptionally strong. The numerous explanatory diagrams and working drawings are thoroughly well done, while the printing of the many photographic reproductions leaves nothing to be desired. The most noteworthy feature among the illustrations, however, is the extensive use of composite sectional models to explain the details of the various types of generators. These are printed on thin card, and show anatomically the whole of the constructive features of the particular appliances they illustrate. There are eleven of these models altogether, and they illustrate respectively a Babcock & Wilcox water-tube boiler, a horizontal steam engine, a Riedler-Curtis steam turbine, a locomotive, a Westinghouse quick-acting compressed air brake, a continuous current electric motor, a squirrel cage three-phase induction motor, an Otto gas engine, a Priestman oil engine, a Diesel engine, and an automobile. The use of these models is an excellent aid to the study of their respective subjects, and we have no doubt they will be highly appreciated by the purchasers of these volumes. The style of production of the volumes is thoroughly good, and as a whole the work may be strongly recommended. Although, by reason of its special character, it is an expensive book to purchase, the publishers have made arrangements by which it can be obtained on the easy payment system. Particulars of this, together with an illustrated prospectus, may be obtained by any of our readers from the Gresham Publishing Company.

FOWLER'S ELECTRICAL ENGINEER'S POCKET BOOK, 1908. Manchester: Scientific Publishing Company. Price, 1s. 6d. net; post free, 1s. 9d. Superior binding, 2s. 6d. net; post free, 2s. 9d.

In the last annual revision of this book, we are glad to notice that advantage has been taken of the opportunity to re-arrange the contents in sections, making it a far more convenient work of reference. The continual advancement of all branches of electrical engineering naturally increases the demand for space in such a pocket book as this, and to meet this demand the more strictly mechanical features of the subject have been transferred to the companion volume, which has already been reviewed in these pages—"Fowler's Mechanical Engineer's Pocket Book." The new additions include information on polyphase motors, electric power transmission, traction, and dynamos and motors.

Practical Letters from Our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily for publication.]*

Re Wireless Telegraphy Apparatus.

To the Editor of *The Model Engineer.*

Dear Sir,—*Re* Mr. Delves-Broughton's notes on "Wireless Telegraphy Apparatus," Mr. Delves-Broughton seems to be under a slight misapprehension with regard to page 72 of my handbook on "Wireless Telegraphy," where he says that I apparently advocate breaking alternating currents on the summit of each half-wave. He goes on to say that he obtained "infinitely better results when using one break only in each alternation, using the unbroken wave below the zero line simply to demagnetise the core of the coil and obliterate any residual magnetism remaining from the previous alternation."

My actual words are: "Each half-wave of the current charges the aerial in the opposite direction to that preceding it, and the discharge should occur as nearly as possible at the moment when the potential is at a maximum."

By this I only meant to imply that the ideal moment for the occurrence of the spark is when the aerial-potential is greatest. If the gap length is adjusted so that the spark only occurs when the potential is greatest, the action is irregular and the spark misses fire frequently. For this reason the gap is shortened so that the spark occurs shortly before the point of highest potential, the crest of the wave being used as an additional supply of energy to ensure regularity of discharge. The shorter the gap is made, the earlier the discharge will occur on the rising curve of potential, and the weaker the discharge will be; also the more tendency there will be for the remaining portion of the curve to produce a non-oscillating or quiet arc between the discharge balls.

Therefore, the discharge must occur as late on the rising curve as is compatible with regularity in the stream of sparks.

I did not advocate breaking the circuit at all at any point. If matters are properly adjusted, the spark occurs *automatically* near the crest of each half-wave.

Possibly the improvement found by Mr. Delves-Broughton to result from cutting half of the wave off is partly due to the decrease in the tendency to arcing, for this tendency increases considerably with the rapidity of sequence of the sparks. However this may be, the complication of any arrangement for breaking the circuit at any point is not necessary in ordinary commercial practice. Results of the most admirable kind as regards regularity, power, spark syntony, and high efficiency can be and are obtained simply by connecting to the aerial the secondary of a high voltage transformer supplied direct from the slip-rings of an alternator without any additional device.

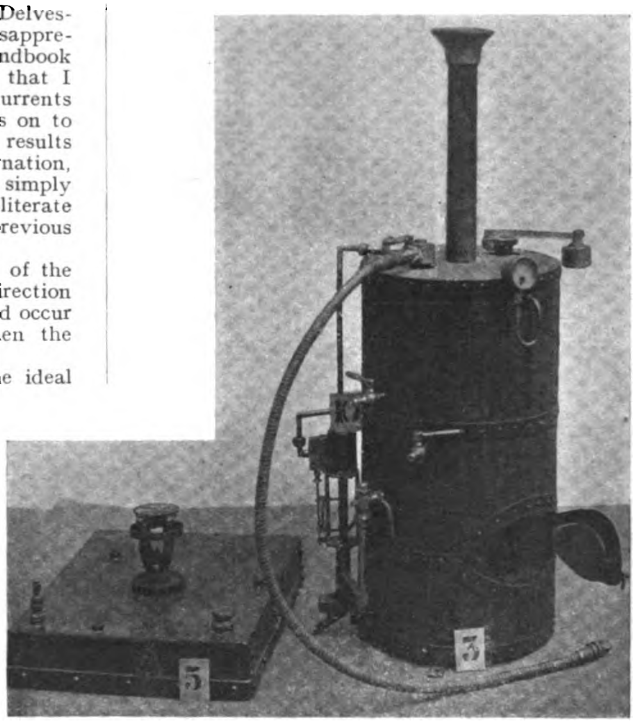
Mr. Delves-Broughton's alternator is very interesting, and the arrangement certainly has advantages, as, for instance, the sudden stoppage of power shortly after the spark occurs; this must still further tend to decrease arcing.—Yours truly,

R. P. Howgrave-Graham.

A South African Reader's Models.

To the Editor of *The Model Engineer.*

Dear Sir,—The accompanying photographs and the following brief description of some models that I have made may be considered of sufficient interest for insertion in the pages of The Model Engineer.



Mr. F. N. Hobern's Model Vertical Boiler.

The models were built up from castings and scrap metal, and represent about five years' spare time, working at odd hours at long intervals when the spirit moved me.

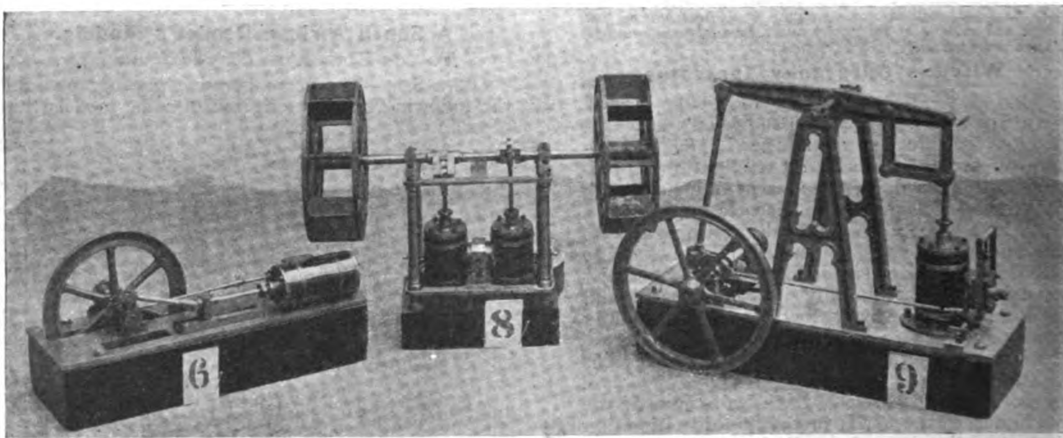
The set of castings for No. 1 engine was purchased about a dozen years ago from a London firm long since out of the trade. The engine has been made over and over again, so that of the original set the cylinder only remains. It is a 1-in. by 1-in. vertical, with slide-valve, and my first attempt at model-making. The cylinder is covered with asbestos, held in position by mahogany lagging bent to shape under steam and fastened with two copper bands.

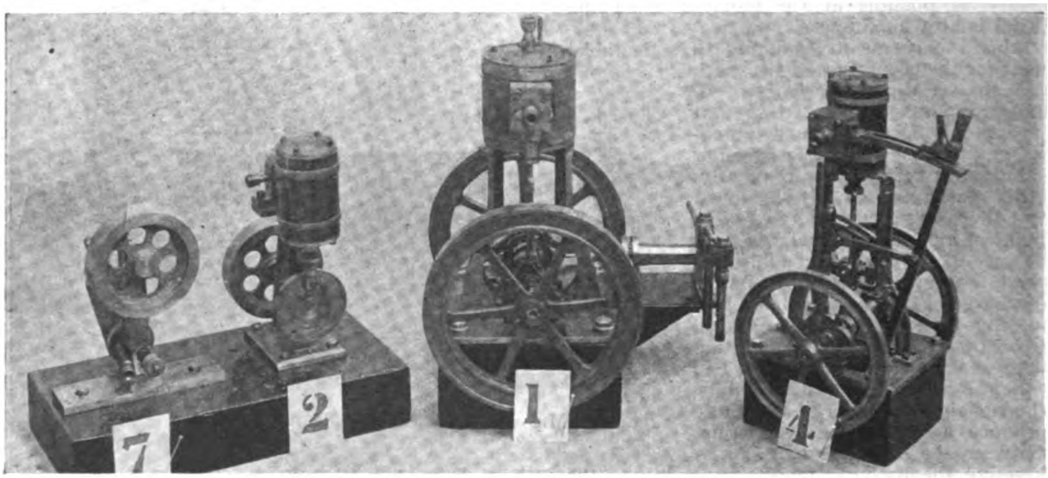
The force pump (¼-in. by ¼-in.) is a much later addition.

It may be nere stated that the cylinders of the other engines are also covered with asbestos and lagged with ferrotype plate, held in position by Muntz metal bands turned from the solid and made a tight fit. Ferrotype plate was used on account of the ease with which it can be worked; it looks well, and so far it has stood the heat of the steam without peeling.

flue and three cross tubes, and there is water space all round. It is adapted to take a gas-ring as well as solid fuel. The Primus burner (2 ins. by 7½ ins. by 10 ins.) does not keep up a good head of steam, it is therefore seldom used.

I have just completed a pump (¾-in. by 1-in. with a ¼-in. plunger) for the feed-water, on the tappet valve system; the material used in the construction came from the scrap heap. Castings for Nos. 2, 4, 6, 8, and 9 sets were ordered from an





A GROUP OF MODEL STEAM ENGINES MADE BY MR. F. N. HOBERN, SOUTH AFRICA.

The engines are bolted to cast-iron beds of sufficient weight to prevent the models from moving about under steam, as they are not balanced.

The boiler is of sheet copper, 1-16th in. thick, riveted lap joint, and well sweated. The inner shell is slightly taper and stayed to the outer one. Provision is made for additional steam pipes without cutting into the boiler; it is provided with all the usual fittings, and was tested to over 70 lbs. hydraulic pressure without leaking. The working pressure is limited to 30 lbs. The boiler (6 ins. by 12 ins.) is lagged with walnut, with four copper bands and brass screws. It has a central

English firm who advertise largely in THE MODEL ENGINEER. After waiting for a very long time the castings turned up, but unfortunately did not correspond with what was ordered. As half a loaf was better than none at all, they were retained and worked up to what they could be.

Most of the screws used on the models are made from French wire nails. The steam pipe union fits all the steam chests. At present only one engine at a time can be under steam, but it is intended shortly to fit branches to the main steam pipe so that one or all the engines may be run at the same time.

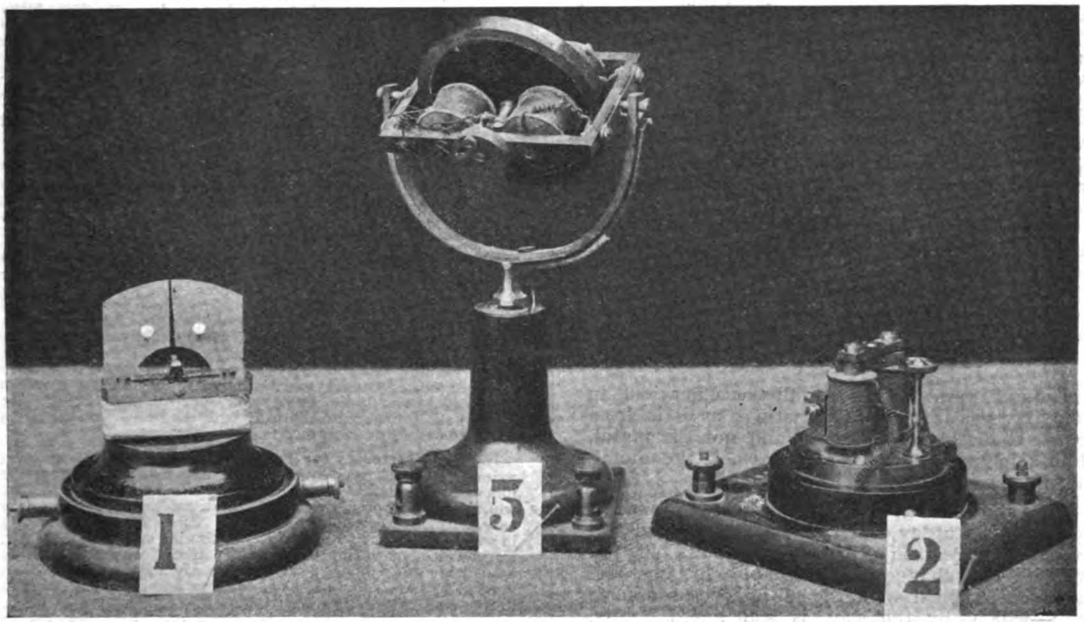
No. 2 is a double action oscillating ⅜-in. by 1-in.; No. 4 a vertical slide-valve ⅜-in. by 1¼-in., with link reversing motion; No. 6 a horizontal slide-valve, ⅜-in. by 1¼-in., slipper guide; No. 7 a single-action oscillating, ½-in. by 1-in., scrap material; No. 8 a double-action oscillating paddle wheel engine, ⅜-in. by 1-in; No. 9 a beam engine, double action, slide-valve, ¾-in. by 1½-in.

In the electrical branch of models I have made a simple detector or galvanometer, shown at No. 1, below; No. 2 is a relay of the telephone pattern. No. 5 is an electrical gyroscope, the flywheel of which is the original supplied with the No. 1 steam engine. This scientific toy was not built to any particular design; its performance under 6 volts through the four coils in multiple series is most satisfactory.

The construction of most of the models has already been described in The Model Engineer by other amateurs; it will, therefore, be a waste of valuable space to repeat the process; suffice it to say that the various models were adjusted to work with the least possible expenditure of power. The machining of the several parts was done on a 3½-in. screw-cutting lathe, to which an overhead is being fitted to enable me to cut the gear wheels of two model petrol engines now in hand. I have also in hand a small locomotive, and hope some day to try my hand at a scale model of a G.C.R. locomotive.—Yours truly,

Port Elizabeth, South Africa. F. N. Hobern.

[Other photographs were received, but we have only reproduced the most interesting for reasons of space.—Ed., *M.E. & E.*]



Some of Mr. F. N. Hobern's Electrical Models.

Boilers for Steam Omnibus.

To the Editor of *The Model Engineer.*

Dear Sir,—I was looking through my Model Engineer recently and I saw in February 27th, 1908, issue, that "R. B. W." asked what boilers are used on Clarkson's steam 'bus. I think I can supply some information if I am not too late. The boilers now used are water-tube type resembling in shape a Chinaman's hat. I believe about a dozen coils are placed on top of each other and connected up. Steel tubes of 1 in. diameter are used, the working pressure being, I believe, 450 lbs. I cannot be quite certain this is correct, but when I worked with that firm a friend also working there told me this was so. Hoping this will be useful to "R. W. B."—Yours, etc.,

Burnham-on-Crouch. Frank Harris.

Tinning Carbon Brushes.

To the Editor of *The Model Engineer.*

Dear Sir,—I wish to be able to solder some brass terminals to carbon brushes which I have, but do not know the best method to adopt to tin the carbon in order to make the terminals take. Possibly some of your readers have performed similar jobs to this and could give me the benefit of their experiments. I have also some carbon brushes for small electric motors, which are not finished off in the usual manner—that is, they are not copper coated. I should like to know how the copper coating or covering is applied, assuming that the skin covering is copper.—Yours faithfully,

Liverpool. J. Woods.

A New Process of Photography.

SOME remarkable photographs are now being shown in London. They are produced by a process invented by a well-known photographic expert, Mr. Welborne Piper. An ordinary photograph is made and then treated with a solution which apparently removes the picture, leaving the photograph like a sheet of white paper. But the picture is now restored by applying oil-colour with a brush, in doing which the photographer can work wonders with his subject. He can convert a poor snapshot into a work of art. He can leave out a figure, or building, or add effects which did not exist at the time he took the photograph. In short, by the new process the camera simply draws the picture for him: the rest is done when he "pigments" his print. The process requires no dark room and anyone can work it. Although invented only a few months ago, it has already caused a revolution in the methods of amateur photographers.

The present Exhibition includes seventy-two examples of the process from negatives of German scenes made by George E. Brown, editor of the *British Journal of Photography*. The "pigmenting" has been done by Mr. F. C. Tilney, a well-known artist and illustrator.

The Exhibition will remain open until May 27th, at 24, Wellington Street, Strand, and is free to the public.

HYDROFLUORIC acid is equally as efficacious in removing sand from brass castings as it is from iron. It dissolves the sand, and not the metal, while sulphuric or other acids attack the metal, and not the sand.

LIVERPOOL AND DISTRICT ELECTRICAL ASSOCIATION.—On Saturday, May 2nd, a large party paid a visit to the Pearson & Knowles' Coppull Collieries. After all had changed into suitable clothing, and had been supplied with the all-important miner's lamp—which, by the way, is sealed and lighted electrically—the party divided into two portions, one going down No. 1 shaft and the other down No. 2 shaft. On arrival down below, instead of the inky darkness which was expected, it was found that the main passages were all well illuminated with electric light, and were in better condition for walking than many of the roads in the suburban districts of Liverpool. Much interest was shown in the haulage plant, the haulage being performed by an endless wire rope driven by a pair of 18-in. cylinder engines (3-ft. stroke). The party proceeded right to the site of working operations. The mines are ventilated by a Walker indestructible fan, 22 ft. diameter and 2 ft. wide, with a double inlet, and, judging by the experience of the visitors, the ventilation is excellent. On coming to the surface again, an inspection was made of the boiler-house, containing eight Lancashire boilers 30 ft. by 8 ft., 100 lbs. pressure, the winding engines, screening plant, electric plant for light and power, and the workshops, etc. The party were then thoughtfully provided with tea, after which a vote of thanks was proposed to Mr. J. S. Harmood Banner and his able manager, Mr. Lowe, and staff, for the very kindly way in which the Association had been received and entertained.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[19,688] **Telephone Engineering.** R. W. S. (Dublin) writes: I should like your opinion as to what the prospects in telephone engineering are, and whether, after serving time to it, I should be eligible for an appointment in a power station? Also what time is it necessary to serve?

The prospects of telephone engineering are much the same as for other forms of electrical engineering. The question of appointment after you have served sufficient time at the works to gain considerable experience would depend entirely upon your ability and other circumstances of which we know nothing. Your best plan would be to keep your eye upon the advertisement columns in the trade journals, such as *The Electrical Review*, *The Electrical Times*, etc. The time you would have to serve would also depend upon your qualifications at the time you started in the business, and upon the progress you made during your apprenticeship. This point would have to be settled mutually with the people you made the appointment with. More than this we cannot say.

[19,690] **Batteries for Lighting.** T. H. W. (Cambridge) writes: I will be very much obliged if you will answer me the following questions:—I have three sack Leclanché batteries, which I bought from the Economic Electrical Supply, and find they only half light a 4-volt 4 c.-p. Osram. Can you suggest any way in which I can increase the light, and also the amperage? If not, can you recommend any home-made batteries capable of lighting a 4-volt 4 c.-p. Osram for a short period, say about a quarter of an hour to half an hour, as I have not seen any of that description in your book on "Electric Batteries."

These batteries are only suitable for lighting lamps which take a very small current. You can overcome the difficulty by using more cells and coupling them up to give the required voltage, but in sets of two in parallel, three such sets in series.

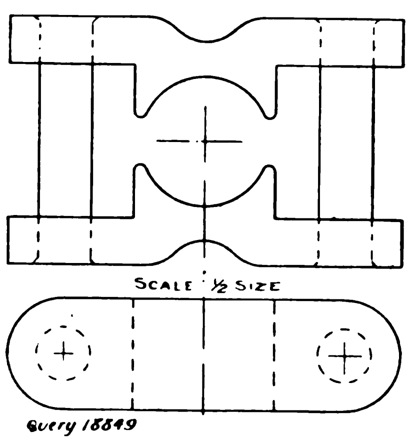
[19,691] **Burst Gas Bag of Small Gas Engine.** T. W. (Oldham) writes: I have a gas engine, 2-in. bore 4-in. stroke, 730 r.p.m., with governor, gas valve, and electric ignition. I purchased it some time ago through an advertisement in THE MODEL ENGINEER. There was no gas bag with it, so I first got two football bladders and connected them in parallel. The engine soon exploded these, however. I then made a tin box, 12 ins. diameter, 2½ ins. deep, and covered the top with rubber cut from the bladders; this is also soon exploded. The engine runs well without bag, but will not allow any lights in the house to keep in, and as I want to run it sometimes in the evening, this is a serious disadvantage. What I wish to know is, is the tin box large enough? If not, will you give me dimensions for a suitable gas bag? Is it necessary for the bag to be all rubber?

If your engine had been running properly, it would not behave in the manner stated. The gas bag should never be subjected to pressure from the engine, and the fault appears to be that the gas valve is kept open for far too great a portion of the stroke, thus allowing the pressure generated by the explosion in the cylinder to leak past the open valve and do the damage referred to in the gas bag. An anti-fluctuator would be a great advantage in your case, and would minimise the trouble due to the engine sucking the other lights in the house out. It might be an advantage to use larger pipes to supply the engine, but the size of supply pipes depends to a great extent upon the pressure in the gas mains, and no fixed rule can be given. If you study the chapter on cams and valve settings in our handbook, "Gas and Oil Engines," you will find the question fully explained, and will be able to set your valves in the proper manner. Should you have any further difficulty after this we should be pleased to assist you if you will write us again.

[19,533] **Small Electric Lighting Plant.** T. W. C. (South Kensington) writes: Being a reader of your valuable paper, I write to ask if you would be good enough to assist me on the following subject—I am thinking of lighting two passages in a country house with small electric lamps. I should require six Osram lamps—four of 6 c.-p. and two of 4 c.-p., and am not quite sure what power dynamo I should require. I believe a 6-volt Osram takes about 1 amp. Would it be best to run the lamps direct from the dynamo (which would be in the cellar), or to have accumulators which could be charged from the dynamo and use one for each lamp? Also, can you tell me what power oil engine I should require to drive the dynamo, and if small oil engines can be left running for several hours with little or no attention?

You will require a total supply of, approximately, 60 watts to supply your lamps, therefore a dynamo of this output would be required. To drive this an engine giving at least ¼ h.-p. would be needed. An oil engine would be very suitable, but from whichever firm you make your purchase, we strongly recommend you to obtain a guarantee in writing as to the brake horse-power of the engine, as we believe there are several makes on the market at present which are not as reliable as they might be. The voltage of the dynamo should correspond with that of the lamps you intend using; thus, for 10-volt lamps, the dynamo should have an output of 6 amps. at 10 volts.

[18,849] **Manchester Dynamo Windings.** R. S. T. (Bowes Park) writes: I should be much obliged if you would be kind enough to answer the following: (1) I have a dynamo (Manchester type—see sketch), and should like to know what size and how much wire to wind armature and fields with. (2) What would be the output? (3) Could I charge accumulators with it?



MANCHESTER TYPE FIELD-MAGNETS.

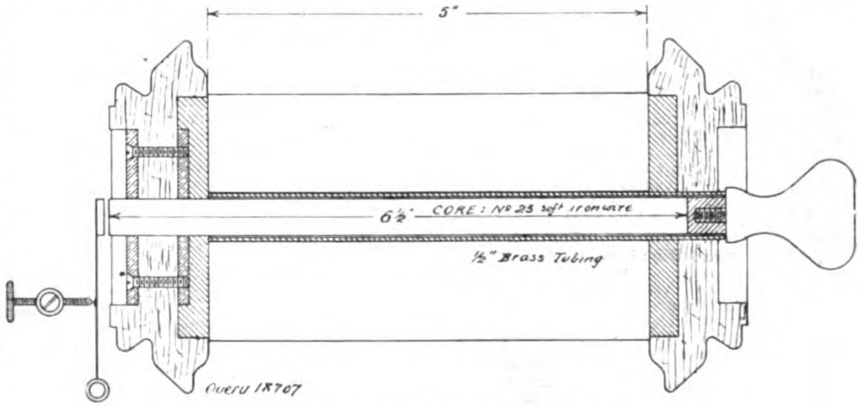
(1) Wind armature with 1½ ozs. No. 24 S.W.G., and field-magnets with 7½ ozs. of same gauge; connect in shunt. (2 and 3) You could charge accumulators with this machine, output of which would be 10 volts 1 amp.

[19,435] **Working Engraving Machine from Battery.** J. P. (Cardiff) writes: Will you kindly answer me the following. I have a 6-volt accumulator that I use for an engraving machine, but I find four volts are plenty. How can I make a resistance so that only 4 volts will be used? Please state if a lamp or wire would be the best.

Use one or two yards of No. 28 S.W.G. iron wire and connect this in series with the accumulator and the engraving machine. If you find that the voltage is still too high and appears to drive the machine too vigorously, add more wire resistance. If the reverse is the case, cut out some of the resistance.

[18,707] **Induction Coil Windings.** G. W. A. (Wallsend) writes: As a reader of THE MODEL ENGINEER I should be greatly obliged if you could assist me in the following. Could you please tell me from the enclosed sketch, the gauges, quantity, etc., of the wire I would require to wind primary and secondary coils.

Your coil should be wound with 7 ozs. No. 16 S.W.G. on the primary, and for the secondary use about 20 ozs. of No. 36 S.W.G. Further particulars relating to the construction of such a coil will be found in our handbook, "Induction Coils," 7d. post free.



SECTION THROUGH INDUCTION COIL.

[19,557] **Converting Gas Engine to Run on Petrol.** E. S. B. (Buxton) writes: Will you kindly inform me if, when converting a, say, 1 h.-p. gas engine to run on petrol, the compression space has to be altered? I am under the impression that the explosion of petrol and air is more violent than coal-gas and air, and therefore tends to make the engine run unsteadily, unless the compression is lowered. Would not a 1 h.-p. engine, when running on petrol, develop more than 1 h.-p., and has anyone ever made an electric governor, working on the solenoid principle, to cut off the gas? I am very desirous of running direct off the dynamo, and not use accumulators, but it will all depend on the governor.

When a gas engine is converted to run on petrol, it is sometimes found that a slightly greater horse-power is generated; thus, in a 5 h.-p. engine, you might possibly get 5·25 to 5·5 with petrol under certain conditions, but this is not invariably the case. With a proper mixture the explosion of air and petrol vapour is not more violent than a proper mixture of gas and air, and, as a rule, there is no need to reduce the compression, except in the case of such gas engines in which very high initial compression is employed. We do not know of a satisfactory electrical governor for gas engines, and do not think there is one on the market. A good mechanical governor on the engine, with sufficiently heavy flywheels, together with a flywheel on the dynamo, generally gives quite satisfactory results. The engine should, if possible, have its mixture regulated, so that it fires on normal load nearly every time. We are presuming it is governed on the hit-and-miss principle. It is sometimes found advisable to dispense with the mixing bush when petrol is used. From tests which we have carried out at various times we found that it was conducive to more regular firing to admit the petrol vapour through a fairly large port, and not to attempt to mix it mechanically by passing it through a mixing device comprising a number of small holes, through which air was drawn in with the petrol vapour. See "Gas and Oil Engines," by Runciman.

[19,721] **Accumulators.** E. K. (New York) writes: As I am a subscriber to THE MODEL ENGINEER, kindly give me advice. I have been practising on a small storage battery, and can't succeed. After charging it with 4 volts., I notice that a few hours standing not in use it loses its current so that only 1 volt is left. I use soft lead plates. I have heard I must use prepared lead. What does that mean, and is that the fault? and kindly tell me just how to use it and particulars.

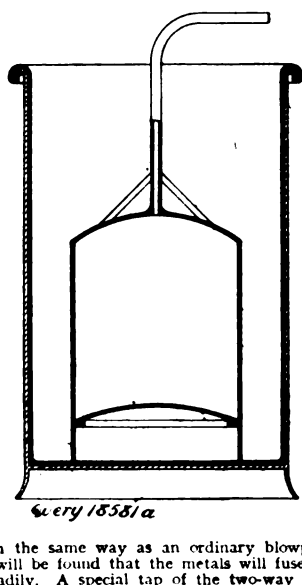
The fault is due to one of several likely causes. First of all the cell may not have yet been completely charged, in which case its voltage would soon run down to the figure you mention after it has been standing a short time. Secondly, there may be a leakage to earth which allows it to run down very quickly. It is not clear whether you use solid lead plates or pasted plates. The former require very much more forming before the cell will attain an appreciable capacity: the latter are much more readily and quickly formed. Our handbook, "Small Accumulators," 7d. post free, would assist you considerably, and you should also read the recent query replies on this subject in back numbers of this journal.

[19,335] **Trouble with Accumulator Plates.** F. W. M. (Ilford) writes: My query differs somewhat from the answers given to No. 18,954 and No. 18,882 recently. (1) I have apparently managed to make negative plates satisfactorily with litharge and sulphuric acid diluted with equal quantity of water. After giving them a full charge I took a negative plate out, and as it dried it became exceedingly hot and steamed, this lasting two or three hours. Is anything wrong? (2) On charging the positive plates made as directed in your book, they have turned almost black, and there is now a coating of dull grey or whitish film on the surface which is very firm, although they were the usual brown colour when first put in to charge. A smaller plate tried as an experiment retained its dark brown colour. Can you explain what is the matter?

If your negative plate had been thoroughly discharged before you took it out of the cell it would not have become heated in the way you describe. Beyond this we do not think any harm will have been done. With regard to the positive plate, the coating formed upon its surface may possibly be a sulphate, but we cannot say exactly from your description. The fact that the small plate you used to experiment with remained in good condition after the test rather points to the fact that the quality of the materials used varies somewhat. We can only advise you to make one or two more trials and note carefully what happens each time with given materials.

[18,581A] **Lead Burning.** D. V. J. (Deansgate) writes: In reference to last reply, for which I thank you, but which is of no use to me, as I could not get the soldering iron into the work, and as it is something which I desire to keep private, I should be obliged if you would give me particulars of lead burning with the hydrogen flame and blowpipe. I have seen it done with a large lead bucket containing water and some kind of acid. Is this the hydrogen system? Your reply will greatly oblige.

Re your further enquiry on lead burning, the apparatus usually employed consists of an appliance capable of generating hydrogen gas, also a pump or bellows of some description for blowing air along a pipe to mix with the hydrogen. The hydrogen may be generated by the action of sulphuric acid on zinc. We append herewith a sketch of the apparatus which is generally used for generating this gas, and it should be borne in mind that when hydrogen is mixed with air in certain proportions it forms a highly explosive mixture, hence on no account should gas be tested by applying a light to the outlet nozzle. The usual way to test the gas is to hold a small testing tube over the nozzle for a few moments, and then, still keeping the test tube inverted, remove it some distance from the nozzle and apply light. If the mixture is explosive, a small explosion will occur in the test tube; if, on the other hand, pure hydrogen is present, it will burn slowly and quietly until the tube is emptied. When all the arrangements are made for the supply of gas and air, the jet is directed upon the work in hand



HYDROGEN GAS GENERATOR FOR LEAD BURNING.

in much the same way as an ordinary blowpipe flame is used, and it will be found that the metals will fuse and flow together very readily. A special tap of the two-way pattern is required to supply the nozzle with the proper mixture of air and hydrogen, but this may be obtained from any large chemist's, such as Messrs. Townsen & Mercer, of Bishopsgate Street Within, London, E.C. For fuller particulars and details of such work we must refer you to "The Practical Plumber's Work," price 2s. 2d. post free, as it would take considerable space and time to go fully into the matter in these columns.

[19,421] **Civil Engineering.** C. I P. (Brockley) writes: I should feel obliged if you could tell me how to engage in civil engineering. The long article on "Mechanical Engineering" you published recently was excellent, and I should like to see something similar about civil engineering. I have already served three years in the shops and drawing office of a well-known mechanical engineering firm, but wish to take up with civil engineering. Would there be a heavy premium to pay on going (as a pupil) to a civil engineering firm, such as Sir John Jackson, or S. Pearson & Co.?

If you refer to our query reply on civil engineering as a profession in our issue for March 12th, we think you will get some useful information on how to proceed in the matter.

[18,833] **Armature Winding Diagram.** H. P. (Torquay writes: I thank you for your reply to Query as to winding sixteen-cog drum in eight sections, but cannot trace the similarity between

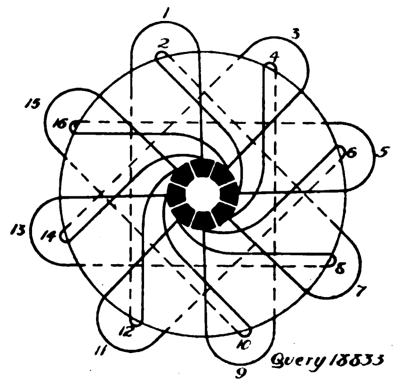


DIAGRAM OF ARMATURE WINDING.

this and twenty-four cog into twelve sections, referred to by you. Will you please fill in the winding and connection on enclosed tracing of stamping?

We append diagram of windings for your armature herewith.

[19,730] **Initial Pressure in Motor Cylinders; Water Motors.** E. W. (Kelvinside) writes: I will be glad if you can help me on the following points:—What is pressure (approximately) on completion of compression stroke in, say, a 3½ to 5 h.-p. bicycle motor on, or at moment after, explosion? What size of wheel, size of jet, and discharge of water are required to give 3½ to 4 h.-p. for water motor at 150 lbs. pressure per square inch? I have looked through back MODEL ENGINEERS, but cannot work out formulas given therein.

Re compression of bicycle motor, the compression before explosion varies in different makes, a very common figure being 60 to 70 lbs. After explosion pressure may have an initial value of anything from 140 to 280 lbs. per square inch. *Re* water motor, to get 3½ to 4 h.-p. from 150 lbs. pressure you will need a jet ⅜ in., which will consume approximately 7 cub. ft. of water per minute. Diameter of wheel may be 15 ins., which would give the horse-power mentioned at about 1,200 r.p.m.

[19,704] **Rewinding Dynamo.** P. N. B. (Bristol) writes: I have the parts of a 150-watt dynamo, which is partly finished. The fields are wound with 8 lbs. 21 S.W.G. (4 lbs. on each limb). The armature is a cogged drum, 3½ ins. diameter and 3 ins. long, with 20 cogs. I want to know quantity and gauge of wire to put on the armature to balance that on the fields and give the highest possible voltage. I want to get 45 to 50 volts, if possible, but I am told the wire on the fields is too coarse for this. The 4 lbs. on each limb of the fields increases the diameter from 1½ to 3¼ ins. Is that too much wire, the cores being wrought iron? Will this wire on the fields give me 50 volts with suitable wire on the armature? If not, what voltage will it give, and what alterations shall I have to make to get 50 volts? I want it to be shunt wound.

We are afraid you will have to use a finer gauge wire on armature if you require 45 to 50 volts. The field winding is too coarse a gauge for a shunt winding and too fine for a series, so you will have to choose between two alternatives. (1) Rewind fields with No. 24 S.W.G. and armature with No. 23 S.W.G. (2) Leave fields as they are and wind armature with No. 20 S.W.G. This would give you approximately 20 volts, although this figure might be exceeded by increasing the speed considerably.

[19,706] **Choice of Dynamo for Lighting; and Power for Running Same.** "JEWELLER" writes: (1) Is there any advantage, if so, in what way, in having a dynamo, of 30 volts 5 amps. in preference to one of 5 volts 30 amps.? Would they both light the same number of candle-power lamps? I want to make a dynamo for lighting as well as electro-plating, and for the

latter a low voltage is essential; if this would not answer, would it be possible to have two armatures with different windings to fit in the same field-magnet? (2) Is there any way of reducing the voltage of a dynamo without reducing the ampereage by resistance wire or otherwise? (3) Would a ¼ b.h.-p. water motor listed to give 1,250 r.p.m. drive a ¼ h.-p. dynamo which has a certain output at 2,200 r.p.m., at the correct speed, by using a transmission pulley, or would this necessitate increased power?

(1) The disadvantage of using a low voltage large current dynamo for lighting work is in consequence of having to use very large wires for supplying the lamps. The heavier the current flowing, the larger the leads must be. Further, lamps are not usually made to run on a low voltage supply when any appreciable candle-power is required, and you would therefore probably have some difficulty in obtaining suitable lamps for your purpose, if you only use 5 volts pressure. It is possible sometimes to have two armatures for one machine; for the high voltage machine the field windings are connected in shunt, and for the low voltage machine the same windings on the fields are used, but the coils on each pole-piece are connected in parallel with each other and in shunt to the brushes. The limit between the two voltages employed is not very great. (2) The voltage can be reduced by reducing the speed of the armature, but the current given in such case could only be maintained provided the resistance of the circuit was lowered in proportion to the reduction in voltage. By inserting a resistance in any circuit you reduce the current flowing. (3) A ¼ b.h.-p. water motor would drive a ¼ b.h.-p. dynamo, but the latter would not, of course, develop a full ¼ h.-p. Probably 30 to 40 per cent. would be lost due to the inefficiency of the dynamo.

[19,659] **Tesla Coils.** P. F. L. (Burnley) writes: Will you kindly explain the principles and theoretical differences between a Tesla coil and an ordinary induction coil?

You will find a full description of Tesla coils and their working in our issues for February 4th, March 3rd, May 19th, June 9th, August 4th, and 25th, October 27th, and November 24th, 1904.

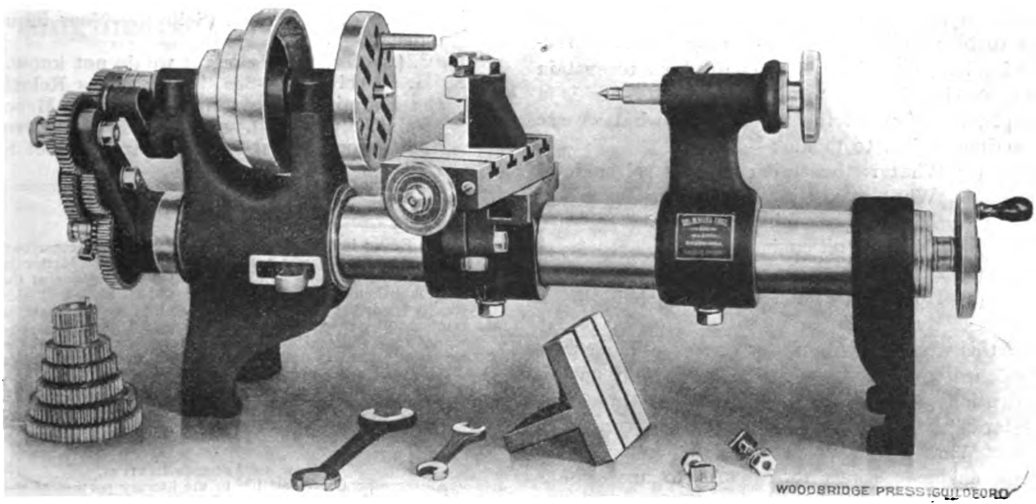
The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

* *Reviews distinguished by an asterisk have been based on actual Editorial Inspection of the goods noticed.*

* The New Drummond Lathe for Model Makers.

When Messrs. Drummond Bros., Ltd., of Ryde's Hill, near Guildford, announced their intention of putting a model maker's £5 screw-cutting lathe on the market, it was confidently expected that something worthy of their high reputation for accurate and well-designed tools would be the result. No one who has seen one of the new lathes will deny that this expectation has been amply fulfilled, for the tool is a production of quite exceptional merit and value. Its most striking feature perhaps is the use of a bed of circular section, with a revolving slide-rest. This possesses a double merit—firstly, in enabling the greatest accuracy to be provided at a minimum of manufacturing cost; and, secondly, in affording the many advantages of tool and work adjustment which the revolving slide-rest and work table permits. The lead-screw, for screw-cutting and self-acting, passes through the centre of the hollow bed, thus being out of the way of chips and dirt. It is put in and out of gear by means of a clutch in the base of the fast headstock. The gear wheels, which are all machine cut, are arranged on studs on a revolving quadrant in the ordinary way, and an extra stud and secondary quadrant are provided to facilitate the cutting of left-hand threads, or to give a reversed self-acting feed. The bed being ground with great precision in an elaborate grinding machine, and the headstock being bored in specially made chucks in the highest class boring lathes, extreme accuracy of alignment of the lathe centres is assured, while the diameter of the bed, and the disposition of the metal in the headstocks, gives great rigidity. The circular slide-rest, with its slotted table, and the slotted angleplate which fits thereon, make this lathe unusually efficient and adaptable as a milling machine, and the variety of work to which it lends itself is remarkable. The lathe mandrel is of steel, and runs in the best hard gun-metal bearings. It is 1 in. in diameter in the bearings, and is ground dead true after turning. The mandrel nose is ¾-in. Whitworth and is bored to No. 1 Morse standard taper. There is no back-gear to the lathe, but the driving pulleys on the mandrel are of large size for a flat strap, and sufficient power is obtainable for all the usual run of model work. A suitable foot driving gear, specially designed for this lathe, or a suitable countershaft for power, may be obtained at a moderate extra cost. The length of the lathe over all is 2 ft. 11 ins.; the length between centres, 12 ins.; the height of centres, 4 ins.; the diameter of work admitted over saddle is 6 ins.; and the approximate total weight is 145 lbs. We confidently predict a large sale for this splendid tool, both amongst model engineers, for whom it has been principally designed, and also amongst manufacturing firms who have uses for small accurate lathes. A full descriptive booklet may be had on application from the makers at the above address.



THE NEW "DRUMMOND" LATHE

A Stock-taking Sale.

We have before us a stock-taking clearance list which Messrs. W. J. Bassett-Lowke & Co., Northampton, have just issued. We note a reduction in the price of the ½-in. scale N.E.R. express engine, also in the model L.N.W.R. signal gantry. Amongst the surplus goods are clockwork, steam, and electric model locomotives, sundry rolling-stock and accessories. A list of soiled and second-hand goods is also included.

The Editor's Page.

THE members of our staff who deal with the queries sent in to our Postal Reply Department are animated by the most friendly of feelings toward the aspiring amateur, and are most patient and obliging in their efforts to enlighten the scientific darkness with which he occasionally finds himself surrounded. But, willing and expert as they are, they occasionally become confronted with a request for information which from its magnificence rather than its abstruseness, reduces them to a state of helpless collapse. In such cases the usual procedure is to gently insert the offending epistle among the more innocent papers on the editorial desk, so that in due course it discloses its deadly self about the time this particular column has to be prepared for the ensuing issue. Fortunately, long experience has enabled us to sustain such shocks without fatal results, but here is a sample, before us at the moment, of what we are sometimes asked to tackle :—

(1) What is the action of a petrol engine ? What makes it work ?
Ditto a gas engine ?
Ditto an oil engine ?
(2) Ditto an electric motor ?
(3) How is electricity generated in a dynamo ?

As if this were not enough for one dose, our correspondent goes on to enquire: "Why is there not an Institution for Amateur Electricians in Manchester ?" and by way of a P.S. he concludes with "What is the cheapest I could get a set of petrol engine castings for ?" As to answer our correspondent's first three questions with any degree of satisfaction would occupy a whole issue of THE MODEL ENGINEER he will pardon us, we hope, for declining such a task; but we will put him on the right track by referring him to our handbooks—"Petrol Motors Simply Explained," "Gas and Oil Engines Simply Explained," and "Electrical Apparatus Simply Explained," which will, we think, tell him what he wishes to know. We would also refer him to the "How It Works" series in Vols. XIV and XV of THE MODEL ENGINEER, where he will find most excellent explanations of the action of a dynamo and an electric motor. The absence of an electrical society for amateurs in the particular city referred to is possibly due to a lack of enterprise on the part of the amateur electricians in that district, while the question of the price of the cheapest petrol motor castings can be settled by reference to some of the advertisers of this journal. We hope our correspondent will not feel discouraged by the prominence given to this his first request for information through our Query Department, especially as we have purposely refrained from disclosing his name. He, and perhaps some other readers, may however take the hint that a good deal of time and trouble may be saved if a querist will first consider whether he cannot easily find out for himself what he wants to know through channels which are already wide open to him.

Answers to Correspondents.

W. E. H. (Newcastle, N.S.W.).—Thank you for your appreciative letter. Pleased to hear from you at any time.

F. A. F. (Bath).—Glad to hear of your successful effort with the petrol engine, and to know that you have found such a good friend in Mr. Membery, the local tool merchant. Other readers in your neighbourhood will be pleased to hear of his willingness to give them similar assistance with their work, and will no doubt make his acquaintance.

DEAN & Co. per W. G. (Selby).—Your inquiry is indecipherable.

H. C. (Ashford).—We regret we do not know.

A. H. (Woolwich).—See "Regulations Relating to the Examination of Engineers in the Mercantile Marine," price 7d. post free from Eyre and Spottiswoode, East Harding Street, Fleet Street, E.C.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 26–29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE
Model Engineer
And Electrician.
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 370. MAY 28, 1908. PUBLISHED WEEKLY

Engineering Works and Accessories for Model Railways.

By E. W. TWINING.

(*Continued from page* 254).

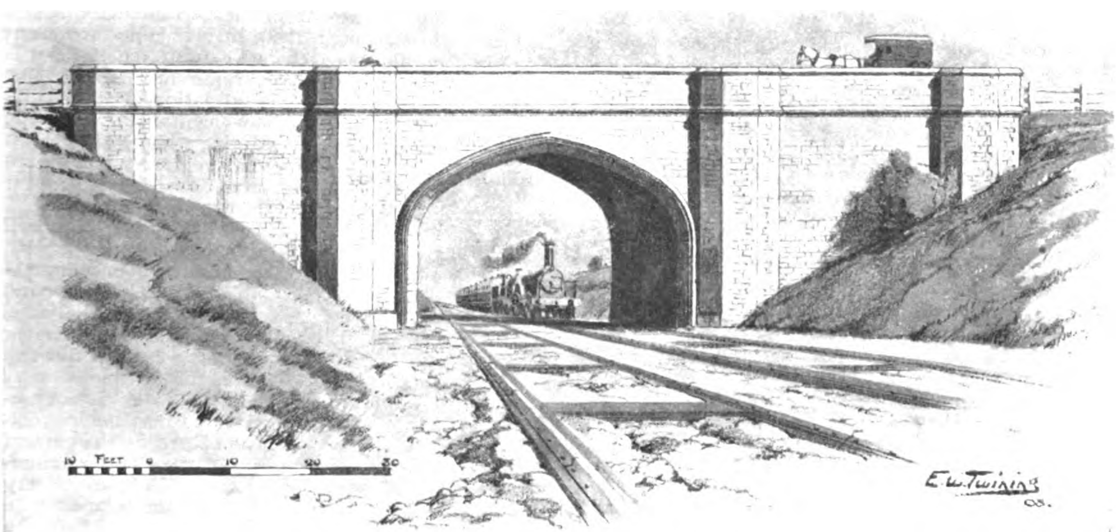

FIG. 20.—GOTHIC OVERBRIDGE AT KEYNSHAM, G.W. RAILWAY.

PASSING from the large form of arched structures we now come to bridges of somewhat lesser importance from an engineering point of view. Of bridges in general, in connection with railway work there are two classes: these are termed "overbridges" and "underbridges." The former are for conducting roadways or footways over the line, and the latter for carrying the railway over rivers and roads.

Of the first class, the subject of the accompanying illustrations may be taken as a good example. It crosses the Great Western main line, immediately west of the Keynsham Station, between Bath and Bristol. Nearly all the bridges, both over and under the line, between these cities are in the Gothic style, but this one at Keynsham has the reputation of being the most beautiful. It is not very elaborate as regards detail, but it is certainly chaste and neat in design.

Fig. 20 is an elevation, and Fig. 21 a plan of the bridge. From these it will be seen that it has an oblique arch, the amount of the skew being sufficient to make about two feet difference between the clear width between the walls—which measurement is

20 ft.—and the length of the span, which is about 33 ft.

I have thought it advisable, in order to shew the obliquity more clearly, to append a perspective sketch in Fig. 22. In this drawing are also included details of the mouldings; that shewn at A is a section of the top of the parapet, and at B is the string course, which is continued around the semi-octagonal buttresses. At C is shewn a cross-section of the moulding and chamfer around the outer voussoirs of the arch.

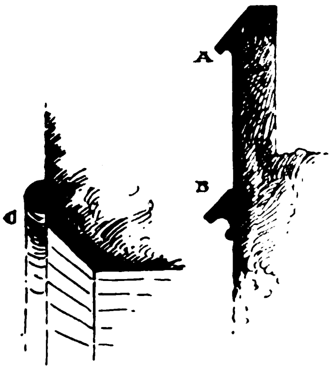

FIG. 22.

It will be noticed that in most of the drawings of works on the Great Western Railway, I have depicted the old broad gauge track, consisting of "bridge" pattern rails laid on longitudinal baulk sleepers: this has been done partly in order to shew a reason for the great width of the line, viz. 30 ft. The present standard gauge tracks have their outer rails laid where the corresponding rails were placed in the broad gauge days; the consequence of this is that what is known as the "six-foot way" on other lines is something like 10 ft. wide on the Great Western portions, which were at one time broad gauge.

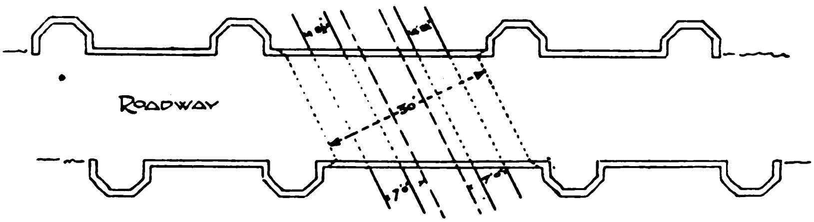

FIG. 21.—PLAN OF SKEWBRIDGE AT KEYNSHAM, G.W. RAILWAY.

In Fig. 21, the broad and standard gauge tracks are shewn.

(*To be continued.*)

PACKING PUMP PISTON-ROD.—A piece of new leather shoelace gives excellent results for packing a pump piston-rod, and for pumping cool water it is hard to beat, says a contributor to *Popular Mechanics.*

Small Dynamo and Motor Testing.*

By BARTON MOTT.

THIS article is intended to give in a short space a general plan of operations for testing small dynamos and motors. With most small models it is not practicable to test them in the same way as one would a large machine. The principal objects in view in the testing of a small machine, say up to ¼ h.-p., are to observe the behaviour, with regard to sparking, overheating, etc., while running at full load, and to find the energy required to enable it to give the best results. For this purpose the machine is tried under various conditions in a place where adjustment and alterations can easily be made.

Firstly, during construction, every coil should be tested by means of a battery and galvanometer just as soon as it is wound, in order to make sure that the winding has not broken anywhere, as sometimes happens with old wire, and to see that the coil is properly insulated from the core. A battery of about six cells will prove very useful for these tests. Fig. 1 shows the connections for testing a section of the armature winding. If the wire has not broken, the galvanometer needle will jump to one side every time the circuit through the winding is closed. The test for leakage is made by joining the wire from the galvanometer to one end of the winding; then, if there is no movement of the needle, when the wire from the battery is touched, to the core or frame of the machine, there is no leakage. The insulation of that winding is correct. Slight movements of the needle during this leakage test may be the result of dampness, caused by the spirit in the varnish.

In the case of small dynamos, where the field winding is not on a detachable bobbin, but is wound directly on to the core, it is advisable, whenever sending a current through it, as in the conductivity test, to make the connections so that the magnetism caused by the current will be of the correct polarity. The commutator should also be tested with the battery and galvanometer to prove that the segments do not make contact with each other. When the armature is finished, and each section has been tested, the total resistance should be measured. If the brushes are clean and making good contact with the commutator, their resistance will be practically nothing, so the armature resistance may be measured from brush to brush by means of a Wheatstone Bridge, or by using a galvanometer, as described in THE MODEL ENGINEER Handbook (No. 24). The resistance of the field should also be measured. Fig. 2 shows how to find the resistance by means of a slide wire bridge.

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* A prize of two guineas was awarded for this article in the recent Competition (No. 44).

R is a known resistance, X the unknown. The end of wire P is moved along the slide wire W W until there is no deflection of the needle, when the resistance

$$X = \frac{l_1}{l_2} R$$

The first step in testing a finished machine is to see that it is firmly screwed down, that the bearings are oiled, the belt even and not too tight, the brushes making good contact, and that all electrical connections are well made. The field-magnets should be tested with a magnetic needle to see that they have the correct polarity, or at least that they are not both the same. If it

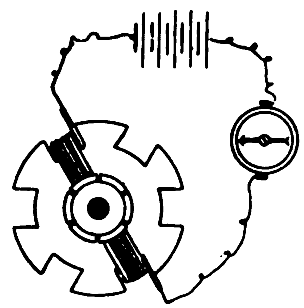

Fig. 1. Testing Armature Winding.

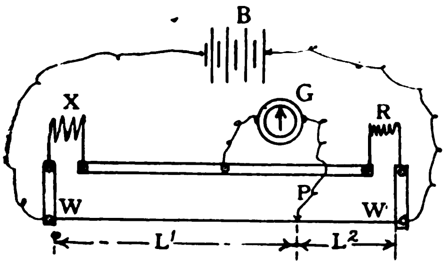

Fig. 2.—Measuring Resistance by Slide Wire Bridge.

is found that the poles are of like polarity, the field-magnet should be re-magnetised correctly by means of a powerful battery.

A test card should be made out on which the type of machine, date of test, speed, volts, amps., etc., and all conditions and results obtained should be recorded.

In testing a dynamo some arrangement must be made for absorbing the current generated, such as an adjustable wire or liquid resistance. Wire is to be preferred, as, owing to electrolysis, small liquid resistances are inconstant and are difficult to adjust. A voltmeter should be connected across the brushes and an ampere-meter in series with the resistance. A starting switch should be provided, and the machine run up to speed before closing the circuit. The resistance is then regulated until the meters show that it is working at full load. It should be kept running at least thirty minutes, and the voltage, amperes, and speed recorded every five minutes. This is the time when faults will be noticed. If the dynamo fails to generate at all, although the connections, etc., are correct, the direction of rotation should be reversed or the position of the brushes altered.

The brushes should have a forward lead with a dynamo, backward with a motor. Sparking at the commutator may be due to many causes, such as wrong connections or short circuits in the armature, rough commutator, brushes in the wrong place, or too great a load. The armatures of many small machines will cause a certain amount of sparking because of the difficulty in getting each section wound with an equal amount of wire. Overheating of the windings is usually caused by overloading the machine.

With small shunt machines it is not usually possible to regulate the current in the field winding. It is, however, an interesting experiment to excite the field winding with an independent current by means of the battery, and see the effect of running the armature with various field strengths and at various speeds. If the air-gap of a dynamo is large, this experiment will show if any improvement could be made by altering the field winding.

Testing for Horse-power and Efficiency.—The amount of power that a machine develops, can in the case of a dynamo, be read in watts from the volt- and ampere-meters (watts = volts × amperes);

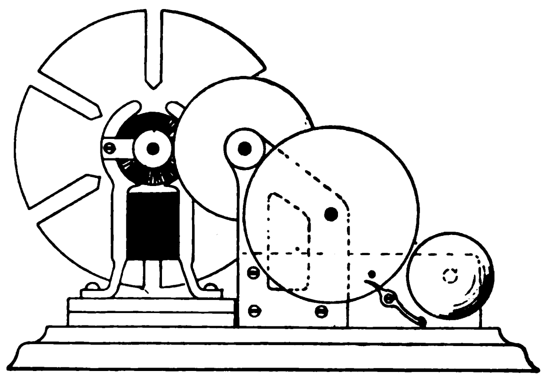

Fig. 3.—Auxiliary Speed Counter.

in the case of a motor determined by means of a prony brake. The efficiency of a machine is the ratio of the power produced to the power consumed.

To take the case of a dynamo first. The efficiency equals the electrical output divided by the mechanical input, both powers expressed in watts. For example, 1 h.-p. = 746 watts. So in a case where a dynamo takes $\frac{1}{6}$ h.-p., to make it generate 60 watts the efficiency would be

$$\frac{60}{\frac{1}{6} \times 746} = \cdot 48, \text{ that is, 48 per cent.}$$

To read the electrical output of a dynamo is easy enough, but, unless it is driven by an electrical motor, to determine the energy that is absorbed in driving it is a more serious matter. It may be roughly found by an indirect method, as follows: The energy consumed by a dynamo must equal the energy that it delivers plus the energy lost in the machine. The losses will be electrical and mechanical. The chief electrical losses are due to the resistance in the armature and field-windings. These resistances should be measured, as has already been described, while the machine is hot—just after running. Having found these resistances, the watts lost in each way may be determined thus: Let the total loss in the armature and field winding be expressed in watts = W.

In a series machine $W = C^2 (R_a + R_f)$.

In a shunt machine $W = C_a^2 R_a + C_f^2 R_f$.

In these formulas R_a = the resistance of the armature.

R_f = the resistance of the field.

C = the total current.

C_f = the current in the field = $\frac{\text{voltage}}{R_f}$

C_a = the current in the armature = $C - C_f$.

It has been found by experiment that all other losses in most small machines can be fairly well accounted for by reckoning them as equal to 25 per cent. of the total output. So we now get the input by adding the watts lost in the field and armature plus 25 per cent. of the output plus the total output. Another way of finding the input would be to make careful note of the exact conditions, pressure, speed, etc., under which the driving engine is running when working the dynamo, and then to replace the dynamo with a prony brake and adjust it until the engine is running under those same conditions again. A more direct method would be by means of a transmission dynamometer. There is another direct way which is particularly suitable for small dynamos, namely, the balance method, as described at the end of this article.

In the case of the motor the input is electrical and the output mechanical. This time it is the input that can be read from the volt and amperemeters. The output or horse-power is measured by means of a prony brake, and a speed recorder or some arrangement of gearing to enable the revolutions per minute to be counted by sight. With a dynamo the speed can be calculated from that of the driving engine, allowing 5 per cent. for belt slip. Sometimes, with very small machines, it is difficult to find the speed by these methods. In such cases an auxiliary motor may be used, the speed of which is shown by a counter or by gearing. This motor has a disc with slots cut radially in it mounted on its shaft. Another disc the same size, with the same number of slots, is mounted on the shaft of the machine being tested. The two machines are placed in line and the speed of the auxiliary one regulated until both discs appear to be standing still. The speeds of both machines are then alike. Fig. 3 is an illustration of a toy motor rigged up as an auxiliary speed counter. Almost any cheap little motor supplied with current from the battery will do for this. An adjustable wire resistance must be provided in order to regulate the speed. The slotted disc—which may be made of cardboard—can be put on to the same end of the shaft as is the gearing. The sizes of the gear wheels in number of teeth are—fifteen on the armature shaft, seventy-five and fifteen on the intermediate, and ninety on the countershaft. Any wheels having about the same ratio would do. The last wheel has a small pin inserted in one side, which rings the bell for every thirty revolutions of the armature shaft.

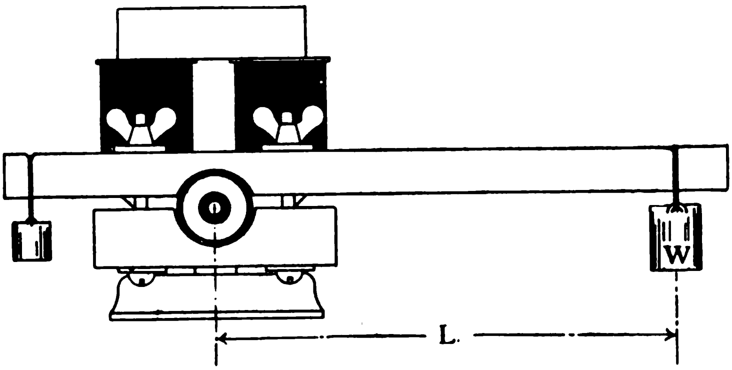

Fig. 4.—A Simple Wooden Brake.

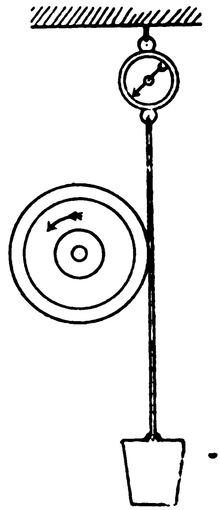

Fig. 5.—Spring Balance Brake.

Two simple prony brakes are illustrated here. The one shown in Fig. 4 consists of two wooden blocks, which are clamped on to the motor pulley by means of two bolts. The small weight on the left is to counterbalance the longer arm, and should be adjusted until the brake is perfectly balanced on the pulley. This is most important. When the perfect balance is obtained, the two bolts must be tightened until the brake begins to clamp the pulley. When the pulley revolves and the nuts are tightened, a weight, W, must be added. This weight is increased in order to keep the brake balanced horizontally. The pulley should be well lubricated with grease or soap. The horse-power = ·0001904 times the revolutions per minute, times the distance L in feet, times the weight W in pounds. Fig. 5 shows another type, using a spring balance. The weight may consist of shot or sand. W is the direct reading of the spring balance.

With this type the horse-power = $\frac{2\pi r \text{ (r.p.m.)}}{33{,}000} \times W$.

The torque of a motor is its turning effort.

It is equal to the belt pull in pounds multiplied by the pulley radius in feet.

$$\text{Torque in ft.-lbs.} = \frac{\text{H.P.}}{(\text{r.p.m.}) \cdot 00019}$$

It may be measured directly by means of the prony brake, by first loading the arm with a weight and clamping the brake on to the pulley fairly tightly, then gradually increasing the current supply to the motor until the pulley just begins to turn.

The efficiency of a motor is found by dividing the power developed, expressed in watts, by the number of watts that it is consuming.

An interesting method for measuring the power absorbed by a small machine is that in which the magnetic field is used as the brake. The machine to be tested is put between centres—in the lathe for example, a centre in each end of the armature shaft. The frame of the machine now has to be balanced with weights, as in the prony brake. The best way to do this is to fasten a bar of wood on to the top of the frame, on which weights can be arranged to obtain the proper balance. It measures the horse-power exactly as does a prony brake.

By the time the energetic reader has submitted his motor to the above tests he will very likely have discovered one or two more special experiments which in his particular case are worth while making, such as, in the case of a shunt motor, the overload capacity or the speed variation—that is, the difference in speed between no load and full load. A series-wound motor should never be allowed to run at full speed when unloaded.

The additional interest that a model provides to its owner when he thoroughly understands it well repays the trouble taken in carrying out these simple tests

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OILING bronze plungers of large outside-packed plunger pumps, such as are used for elevator or other high-pressure service, has been found in recent practice at a large industrial power plant at Baltimore, Md., to be of advantage not only in lessening the usual surface wear on the plungers from the packing, but also, by the material reduction of friction load, in increasing the sensitiveness in response to the automatic governor. The oil is fed to the top side of each pump plunger by a simple oil cup set for a very slow feed.

AN interesting phenomenon—viz., that an alloy of iron, and cerium, lanthanium, or any other of the rare earths (as used in manufacturing incandescent gas mantles), will create luminous sparks on being struck with some metal tool such as a knife-edge, a file, or the like—has been recently discovered by Mr. Auer von Welsbach. The shower of sparks given off at a point of impact is sufficient to ignite not only gas, but even a cotton wick saturated with alcohol, and it is possible to utilise these iron alloys for igniting all sorts of explosives. The behaviour of these alloys has been found to vary according to their percentage of iron, the sparking reaching a maximum with a content of 30 per cent.

Model Rolling-stock Notes.

By HENRY GREENLY.

L.N.W.R. WAGONS AND THE NEW STYLE OF LETTERING.

TRAVELLING up and down the southern division of the North-Western Railway I have lately noticed that this Company has

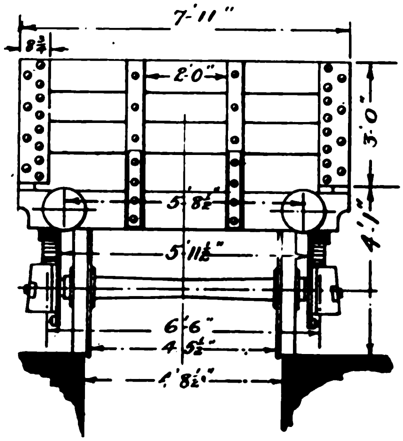


FIG. 2. END VIEW OF L.N.W.R. WAGON.

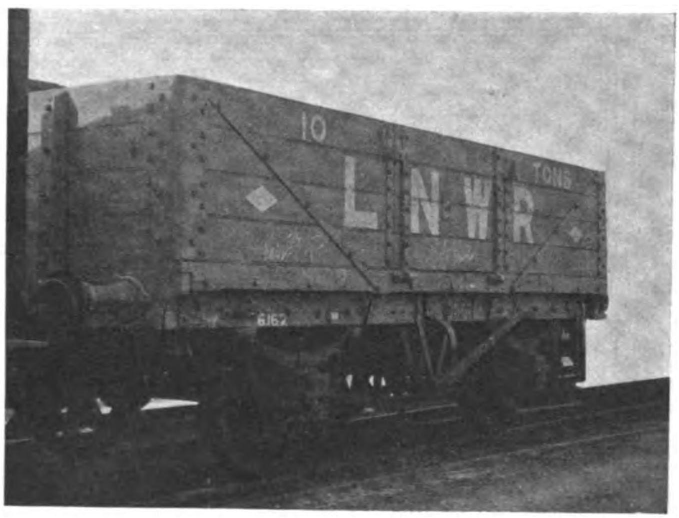


FIG. 3.—NEW L.N.W.R. STANDARD 10-TON GOODS TRUCK WITH SIDE DOORS ONLY.

fallen into line with most others in seeking, among other things, to advertise their routes by lettering the wagon stock, in an unmistakable way with the initials of the railway. On making official enquiries I find that this is no mere experiment, but is now the standard practice, and all wagons and goods brake vans going in for repainting, as well as new stock, will in future bear in large white letters "L.N.W.R.," in addition to the white diamonds which previously were the distinguishing mark of North-Western freight vehicles.

The above interesting development reminded me of the fact that my long-standing promise to give drawings and details of various types of carriage and wagon stock still remained unfulfilled, and I have made this more or less an excuse for commencing the subject. I have now a large amount of information collected, to which I am adding daily, and, with the Editor's permission, will submit articles from time to time on the subject of model wagon and carriage building.

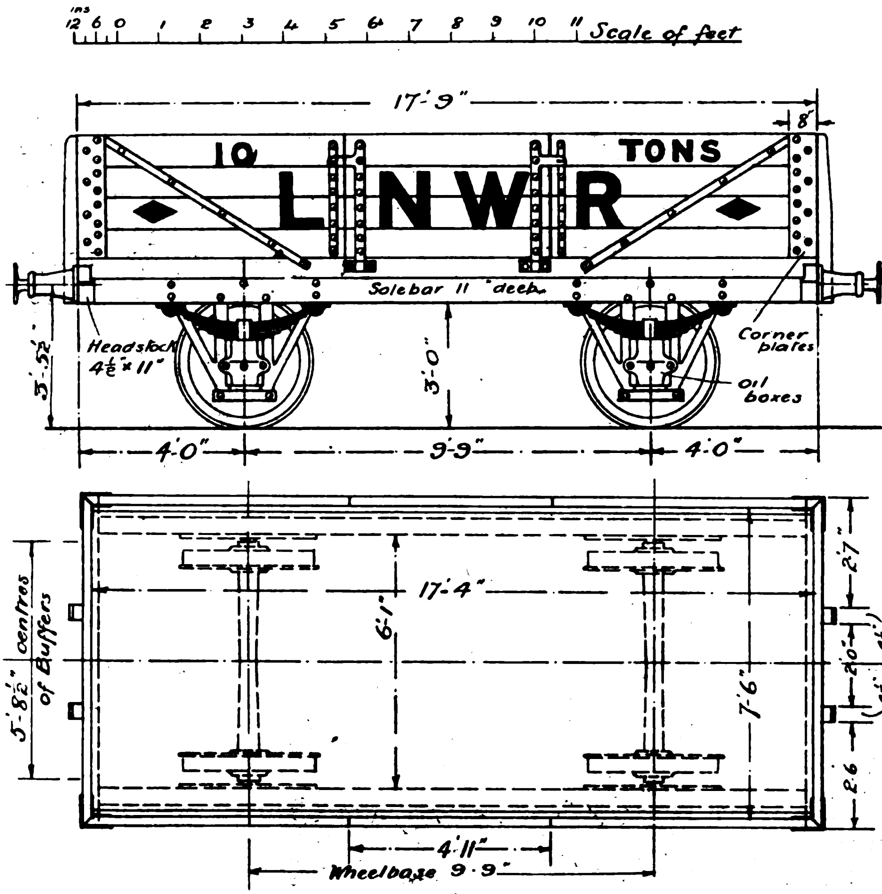


FIG. 1.—SIDE ELEVATION AND PLAN OF L.N.W.R. 10-TON GOODS TRUCK.

(*Drawing half full size for 7-16ths-in. scale model.*)

As most readers know, wagons are owned by private firms as well as by the various railway companies operating in this country, and that there exists certain standard specifications of construction to which builders of private wagons must conform before the trucks will be passed as fit to run over the standard gauge railways whose traffic is cleared by that well-known, but little understood institution—the Railway Clearing House. Therefore, while there are minor differences in the construction of ordinary open wagons, the same general design is carried out in almost all of them, and in matters of wheelbase and over-all lengths, heights, and widths certain limits are absolute.

Some railway companies, however, adopt slightly different proportions to those of the standard private owners' wagon, notably the L.N.W. Railway, and as the chief object of this particular article is to show the new style of lettering used on this Company's trucks, a drawing of the 10-ton standard open goods wagon is included herewith, together with a photograph of one I was able to take measurements from at a local station. A detail photograph is also reproduced which shows more particularly the arrangement of springs, axle-boxes, and axle guards (or W irons), used on trucks having the wooden underframe. Furthermore, this photograph illustrates the peculiar method of finishing the ends of the headstock (buffer beam) adopted by this Company.

As I shall show in a detailed manner in a future article, the 10-ton private owners' wagon has a body 15 ft. long by anything from 3 ft. 5 ins. to 3 ft. 10 ins. depth inside, whereas the L.N.W.R. standard 10-ton vehicle is longer and less deep—measuring 17 ft. 9 ins. long outside by 3 ft. high inside (from the flooring). The widths being the same, it will be seen that the cubic capacity is about equal.

In the matter of the wheelbase the standard Railway Clearing House specification for open wagons of 8, 10, and 12 tons' capacity says: "The wheelbase must not be less than 8 ft. or more than 9 ft."; but the L.N.W.R. Company do not consider that "what's sauce for the goose is sauce for the gander," and therefore make their 10-ton wagons with a 9-ft. 9-in. wheelbase.

The side door in L.N.W.R. 10-ton wagons extends right to the top, like it does in the standard private owners' 7- and 8-ton trucks, and therefore differs somewhat from the usual 10-ton wagons, which have one or two fixed planks over the top of the door, the opening being simply a hole in the side. Two forms of oil-boxes are in general use—the older grease-boxes, which are distinguishable by the lifting lid on the top, being gradually displaced by the more up-to-date padded oil axle-boxes, which are shown in the drawing and photographs herewith. The oil axle-boxes, it will be noticed, have a loose front, which is fixed by two studs. For model purposes, the grease-box is the easiest type to make, and where models are small there is no reason why they should not be used as a standard. In larger models, however, the more detail that can be introduced the better the effect, and the standard oil-boxes, with the hexagon-headed screws to represent the nuts of the fixing studs of the cap and the centre oiling screw plug, may be added with advantage.

Another point of difference in L.N.W.R. wagons is the absence of the plates outside the solebar (the main longitudinal timber of the underframe), which are noticeable on the private owners' and most other Companies' wagons (see detail photograph of M.R. wagon, Fig. 5, herewith). These plates are really washer-plates, and are used to prevent the heads of the bolts or nuts which fix the axle-guards (W irons) to the sole-bars from digging in and damaging the wood. The practice on the L.N.W. Rly. in the 10-ton wagons is to have a flitchplate of ⅜-in. steel covering the whole outside surface of the sole bar, and therefore such plates are unnecessary. Where the flitchplate is not used (as on the 7-ton wagons) the bolts are provided with sunk washers under the nuts to relieve the fibres of the wood from crushing in.

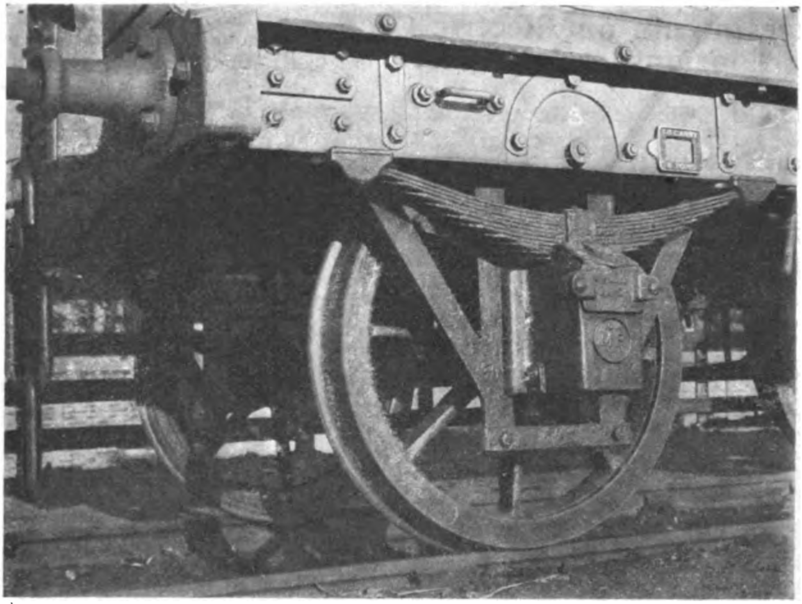


Fig. 5.—Detail View of M.R. Goods Truck, showing Washer Plates used on outside of Sole Bars for Axle-guard Bolts.

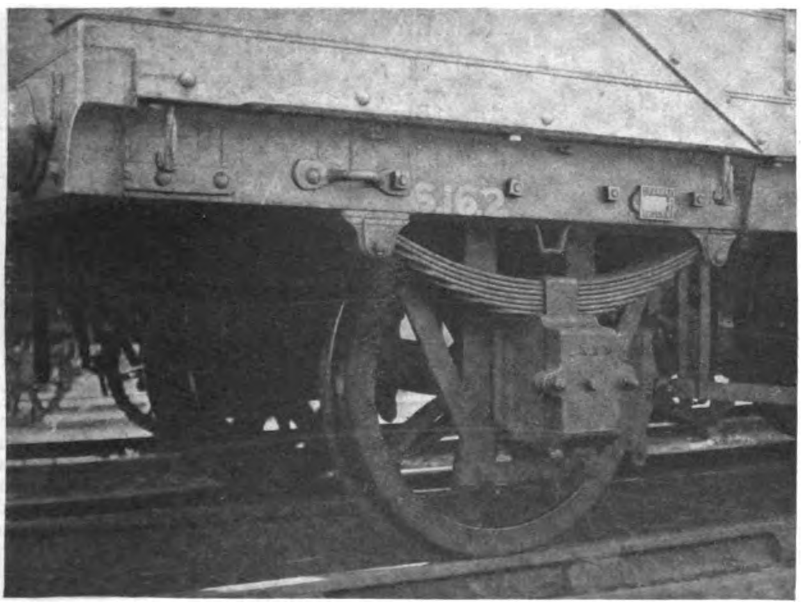


Fig. 4.—Detail Photograph of L.N.W.R. Teuton Truck, showing Oil Axle-boxes and shaped end of Buffer Plank.

North-Western trucks are painted in a rather dark lead colour all over, the ironwork not being picked out in any other tint. The wheels and ironwork below the sole-bars are painted black, and the initial letters "L. N. W. R."—which are 16 ins. high on the actual 10-ton truck—are in white. The white diamonds measure 11 ins. by 5½ ins., and the letters stating registered weight "10 tons" are 6 ins. high. The small wagon number-plates on the sole bar are 13½ ins. by 6½ ins., and have 2-in. raised letters and figures and a raised border.

(To be continued.)

Experiments on Electric Oscillations and Waves.

By R. P. Howgrave-Graham, A.M.I.E.E.

Further Illustrations of Discharge Experiments.

(Continued from page 347, Vol. XVII.)

IN the issue of February 22nd, 1906, two interesting experiments were briefly described without illustrations. The first of these shows the remarkable disruptive and heating power of the high-voltage, high-frequency discharge.

The effect is made more striking if a couple of holes are first drilled through the wood, as shown in the photograph (Fig. 58).

Almost the whole of the discharge—which, in this illustration appears to be passing over the surface of the wood—is really within its substance, and its evident tendency to go in a straight line, so as to follow the grain of the wood, is an interesting feature when compared with the wavy track followed in air.

On the right of the photograph we see a spark which has come out from the discharge point into the air in front of the coil, and then has entered the wood at the hole. This and the two thin wavy sparks which have run downwards and entered at points near the bottom edge are the only portions of the discharge which are not below the surface.

Very shortly after the commencement of the discharge one or other of the tracks gets slightly

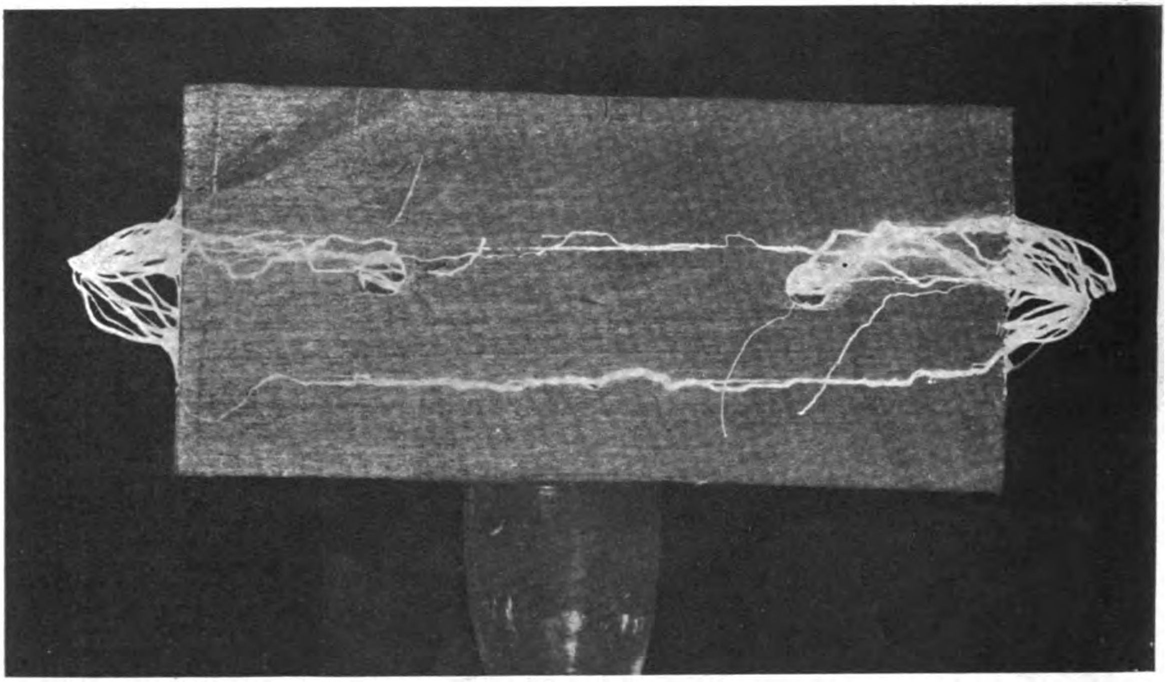


Fig. 58.—Discharge passing through Wood. *(Exposure about ½ sec.)*

A piece of ordinary deal 8 ins. or 9 ins. long, about 3 ins. wide, and about ½ in. thick, is insulated by standing it on a wineglass or other suitable support, and the discharge points are brought to a distance of about ¾ in. from the ends.

When the discharge is started, sparks pass through the wood from end to end, apparently meeting with little more opposition than is offered by an air-space of the same length; the light of these sparks shines through the wood with a curious red glow, and if they find a path near the surface the wood is often rent and splintered so freely as to produce small tufts of a substance almost resembling cotton-wool; this calls to mind the disruptive effects of lightning on trees, etc.

charred, and the hot gases from the decomposed wood afford a good conducting path; then the whole of the discharge chooses this track, the result being a rapid increase in the evolution of heat and in the decomposition of the wood, the latter eventually becoming so rapid that the gases escape and burn as vigorous flames at the places of entry of the spark.

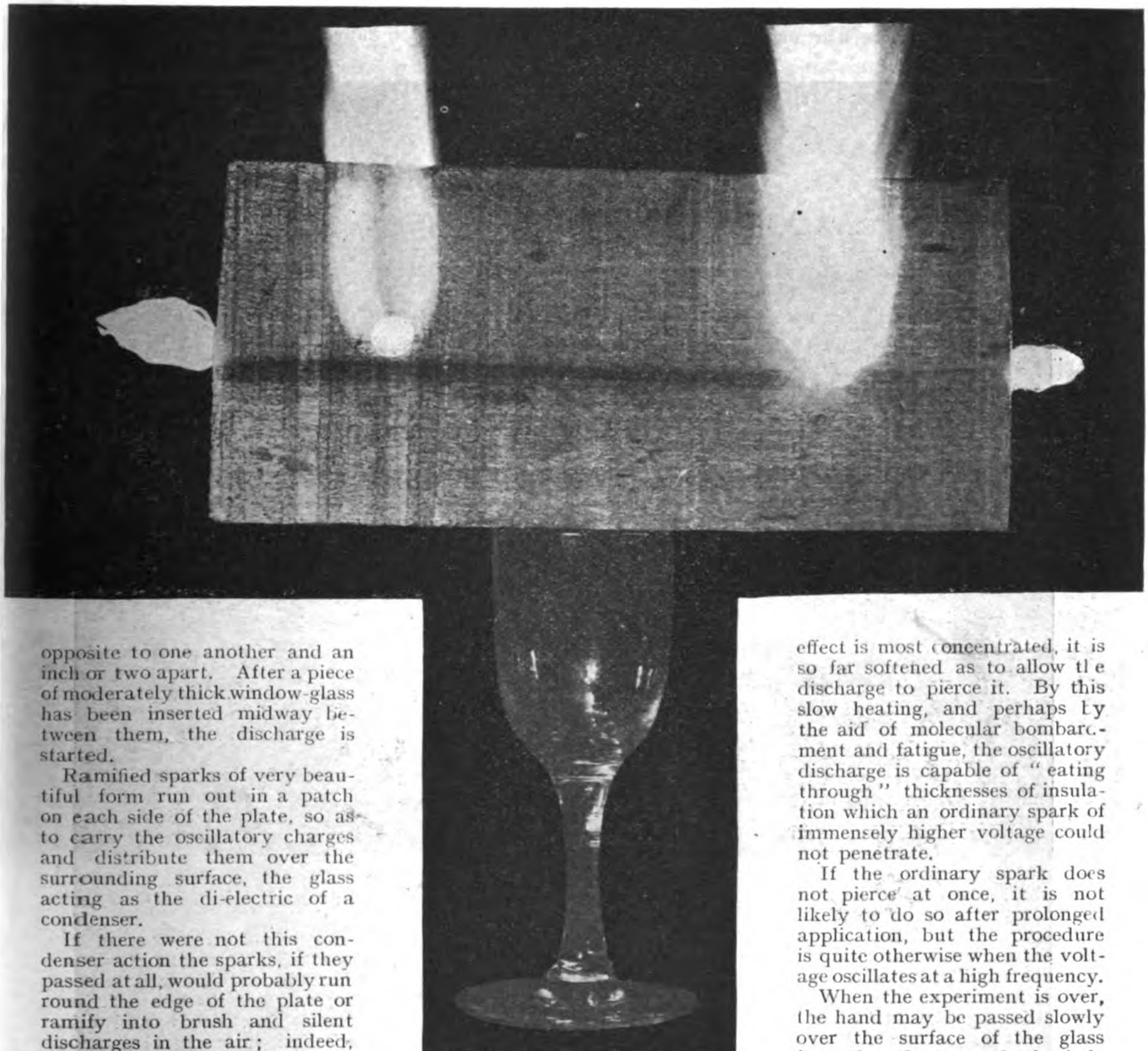
The photograph (Fig. 59) was taken when the flames rose upwards from the holes in the wood; the discharge crossed these holes, and they received gas from two directions, but later on there was sufficient evolved to cause flames at the ends also. In a very short time the track of the sparks is so far carbonised that it becomes a comparatively good conductor and allows the discharge to pass quietly; consequently, the jets decrease in size and eventually almost disappear.

The remaining photograph (Fig. 60) illustrates an experiment described in the same issue as the last. A pair of wires, attached to the secondary of the Tesla coil, are bent so that their ends are opposite to one another and an inch or two apart. After a piece of moderately thick window-glass has been inserted midway between them, the discharge is started.

Ramified sparks of very beautiful form run out in a patch on each side of the plate, so as to carry the oscillatory charges and distribute them over the surrounding surface, the glass acting as the di-electric of a condenser.

If there were not this condenser action the sparks, if they passed at all, would probably run round the edge of the plate or ramify into brush and silent discharges in the air; indeed, this is what would happen were the discharge that of an ordinary induction coil.

FIG. 59.—SHOWING WOOD IN FLAMES AFTER PASSAGE OF DISCHARGE FOR LESS THAN ½ MINUTE.



As it is, there is an enormous transfer of energy across the di-electric, and the violet branches of light over its surface are the feeders which carry the energy to be distributed as lines of static strain in the glass.

The thicker the glass is the less displacement will a given area of it experience, and therefore the less will be the charge which will oscillate in that area when a given voltage is applied. From this it follows that thickening the glass causes wider ramification and a larger area of luminosity. The di-electric "frictional" hysteresis heats the glass considerably, until at the centre, where the effect is most concentrated, it is so far softened as to allow the discharge to pierce it. By this slow heating, and perhaps by the aid of molecular bombardment and fatigue, the oscillatory discharge is capable of "eating through" thicknesses of insulation which an ordinary spark of immensely higher voltage could not penetrate.

If the ordinary spark does not pierce at once, it is not likely to do so after prolonged application, but the procedure is quite otherwise when the voltage oscillates at a high frequency.

When the experiment is over, the hand may be passed slowly over the surface of the glass from the edge towards the hole made by the spark in the centre. A curiously regular rise of temperature will be experienced up to the hole where the most violent effects have been; here the glass is far too hot to touch.

The photograph (Fig. 60) was taken with an exposure of about ¼ second. It must be borne in mind that as it was taken looking at right angles to the surface of a sheet of glass, the discharge on both sides is visible.

(*To be continued.*)

THE *Engineer* says: "An International Road Congress will be held at Paris this year, under Government auspices, to consider the construction of roads and their adaptation to the different new means of locomotion. This Congress, to which the Governments of other nations have been officially invited to send representatives, will open on Oct. 11th, and continue in session for seven days. An excursion during the session has been arranged for delegates to visit Nice, enabling them to inspect the specially constructed roads in that district, and those now in course of construction, which are being built especially to suit motor car requirements."

Workshop Notes and Notions.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily for publication.]*

A Method of Turning Eccentric Sheaves.

By "BIM."

Having a number of eccentric sheaves, with varying throws, to turn up, I devised the following method. It so happened that each sheave was to fit on a $\frac{3}{8}$-in. spindle and was to be secured in place by a setscrew passing through a boss on the sheave.

Referring to Figs. 1 and 2: the body *a* is of hard brass, and the arm *b* of tool steel. The castings *a*

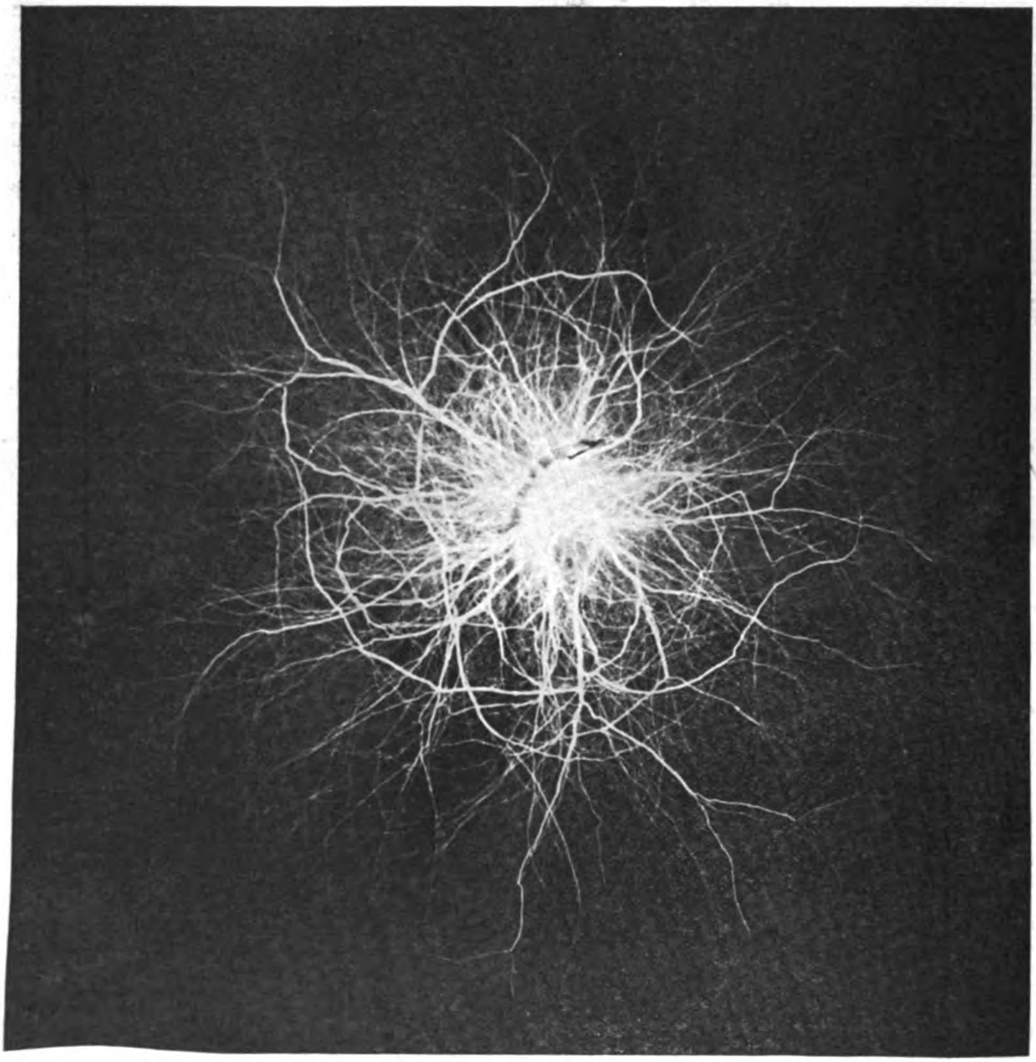
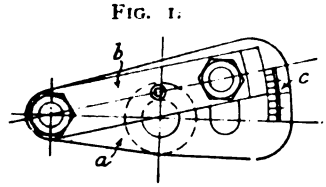


FIG. 60.—DISCHARGE SPREADING OVER GLASS PLATE. (*Exposure about* $\frac{1}{4}$ *second.*)

were first taken in hand, and the bosses drilled and reamered out to ⅜ in. diameter. A piece of silver-steel was then placed between the centres in the lathe and turned down to ⅜ in. to act as a mandrel. The brass bodies were placed on the ends as nearly as possible in similar positions, a hole drilled through each boss and the mandrel, and ⅛-in. taper pins fitted. The mandrel then had a small flat filed on it (to take the nose of the setscrew by which the sheaves were held in position while being machined), and was hardened and tested for straightness. The bodies were then placed in position and faced. After facing, a line was scribed on the face of each body 1¼ ins. from the centre, while between the centres. The mandrel was then taken out of the lathe and another line scribed on the face of the bodies, the mandrel being supported in vee blocks. Care was taken that the lines should be parallel and pass through the centre of the mandrel.

The intersections of these straight lines with those scribed on the faces, while the work was between the centres, gave the points A and B

FIG. 1.



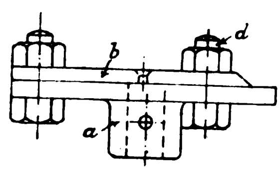


FIG. 2.

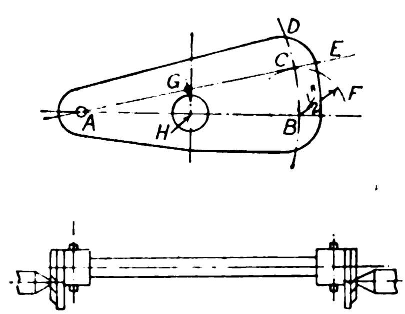


FIG. 3.

(Fig. 3). A is the point round which the arm *b* swings, and B is one end of the scale *c* (Fig. 1). These points were lightly centre-marked to preserve them.

The scale was next constructed on each body as follows:—Referring to Fig. 3, with centre A and radius AB, describe the arc BD. Set the compasses to ½-in. radius and with centre B describe the arc CF, cutting BD in C (this gives the farthest point on the scale), strike further arcs from centre B, similar to CF, reducing the radius each time by 1-16th in. Through the points thus located on the arc BD, draw lines similar to ACE, and by producing these appropriate distances beyond BD, form a scale as *c*, Fig. 1. The corresponding points on BD were located on both bodies with one setting of the compasses, thus ensuring that the scales should be absolutely identical. Holes were then drilled through points A and reamered out to ¼ in. diameter, care being taken that the centres of the holes should come on the centre line AB and at the intersection of the lines forming the scales. The bolts passing through these holes should be very carefully made to fit.

Flat pieces of tool steel, ½ in. by 3-16ths in. by 2½ ins. long, were then taken for the arms, and a line scribed down the centre of each. A point was marked off 2¼ ins. from one edge and the edge shaped to a radius of 2¼ ins. struck from the point. The edge was then bevelled and the centre line continued down the bevelled portion. Another point, exactly 1⅛ ins. from the first point, and from the bevelled edge, was then located on the centre line, a small hole drilled and countersunk to 60 degs. (to take the lathe centres), a ¼-in. hole was then drilled through the first points located. The greatest care must be taken to get both holes on the centre line and to get the centre hole 1⅛ ins. from the centre of the ¼-in. hole and from the bevelled edge. The holes for the tightening bolts *d* (¼ in. diameter) were drilled in any convenient position so that the bolt heads would clear the bosses on the undersides of the bodies, and curved slots were cut to correspond in the bodies. The arms were then hardened and tested for flatness. In using, one body is fixed on to the mandrel, the work is slipped on and clamped in place with a setscrew bedding on to the flat filed on the mandrel for the purpose, the other body is placed in position and the pins lightly driven home. The arms are then set to corresponding graduations on the scales to give the amount of eccentricity required, and the whole mounted between the lathe centres for work to be proceeded with.

The principle of the apparatus is as follows:—In Fig. 3 the triangles AHG and ABC are similar, and AG = ½ AC; therefore, GH (the distance of the centre into which the lathe centre fits from the centre of the mandrel, and consequently of the work) = ½ BC. If, therefore, it is required to turn up an eccentric sheave having a 3-16ths in. throw, set the arms to the 3-16ths in. graduations, and this will throw the centres G exactly 3-32nds in. away from the centre of the mandrel.

It is important that all the graduations of the scales should be struck from B, and not stepped out in 1-16ths along the line BD, as the curvature of BD will effect the accuracy of the scale. The method of marking out described also has the advantage that there is no cumulative error, and each graduation stands on its own merits as regards accuracy.

An Emery Wheel and Tool Rest.

By C. A. WILLHOMES.

The accompanying illustration shows how an emery wheel and tool-rest can be fixed up in an efficient way without the trouble of casting and boring. It well repays the little trouble necessary, and forms a very useful adjunct to a workshop. The standard is made up of a gas-pipeflange, short length of barrel, and a T-piece. Holes are drilled through the flange to fix to the bench, and a ⅜-in hole drilled through the top of the T-piece, the use of which will be shown.

Next turn a spindle out of steel to suitable dimensions. To mount this, slip a washer up to the collar A, pass the spindle through the T-piece, and screw up a washer against the face B, adjust the spindle parallel to the bench and tighten the nut. Now pour anti-friction metal through the top hole mentioned above, having previously plugged the barrel C with clay. Remove spindle and drill a 1-16th-in. hole through the runner for lubricating.

An Emery Wheel Grinder.

Fig. 1.

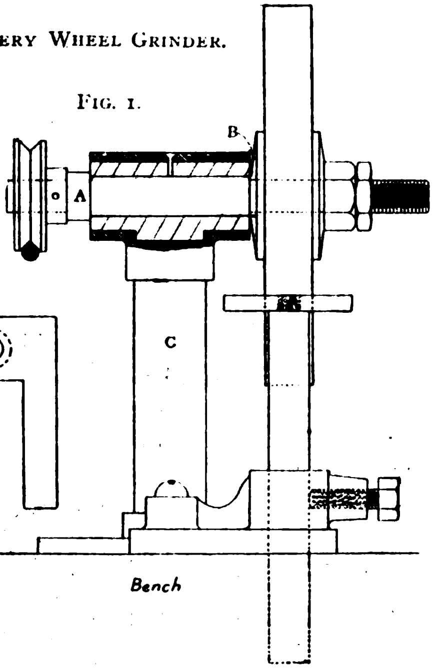
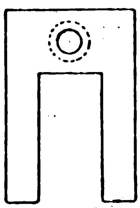


Fig. 2.



The pulley is next screwed into place, spindle replaced in bearings, and emery wheel, in our case 6 ins. by ¾ in., secured by flanges and lock nuts.

The tool-rest was made as follows:—A piece of steel was turned down to a sliding fit in the tool-rest of a Drummond lathe and reduced to ⅜ in., and tapped at its upper end. A piece of 3-16ths-in. sheet steel was cut to the shape shown in Fig. 2, and screwed on. The apparatus can be mounted at a convenient distance from the wheel, a hole being previously cut in the bench to receive the steel rod if it is found necessary to lower it.

A Dividing Apparatus for 3½-in. Drummond Lathe.

By C. A. Willhomes.

Wishing to space off some holes on several discs of metal, no division plate being available, the following plan was devised:—

A piece of ½-in. square steel was turned down as

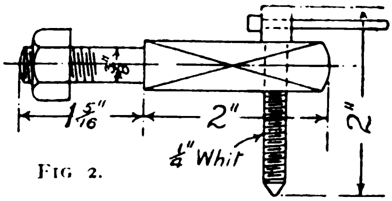


Fig. 2.

shown in the drawing. Next a hole was drilled at right angle and tapped ¼-in. Whitworth, 2¼-ins. from the end. A piece of ⅜-in. rod, 2½ ins. long, was next turned down and tapped to fit this, and a hole drilled through at one end to receive a lever. (See Fig. 2.)

To use the apparatus, screw it into the slot on the right-hand side of the headstock (Fig. 1), and mount a change wheel on the rear end of the

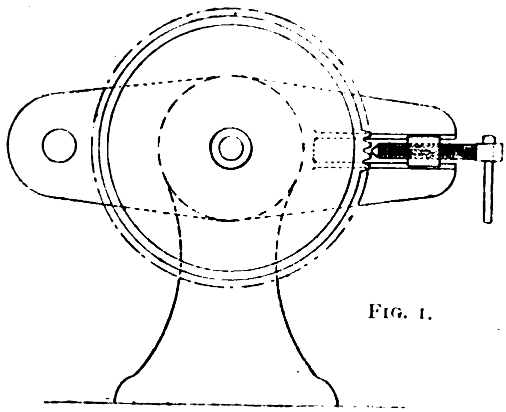


Fig. 1.

mandrel. Any change-wheel may be substituted, and their sub-division used. About 2½ turns of the spacer locks the mandrel, and the job can be drilled from the slide rest. Fig. 3 shows the drilling head made for this purpose. A is a piece of gun-metal squared up and screwed into the tool-box of the

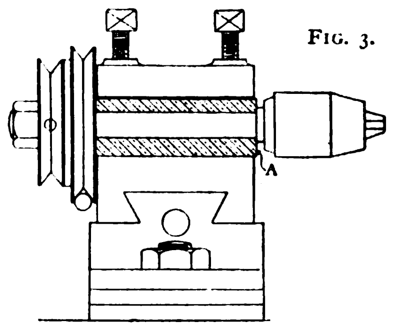


Fig. 3.

lathe parallel to the lathe bed. This is then drilled ⅜ in. with a twist drill in a self-centreing chuck. This ensures the hole being true with the "centres"; the reason for this will be described later. A spindle as shown in Fig. 4 is turned up and tapped to take the chuck from a Millers Falls hand-drill, the spindle put in the gun-metal block, and a two-speed cone screwed on.

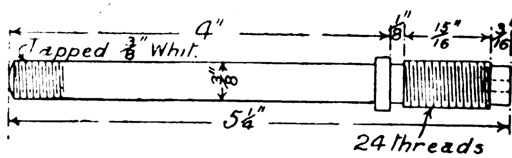


Fig. 4.

To set the drill at right angles to the job unscrew the chuck and mount the apparatus between centres. Set the slide-rest at right angles to the bed and screw it in under the gun-metal block. It will be found necessary to pack the tool-box about ¼ in. When the gun-metal block is well in the tool-box tighten set screws, run back poppet and saddle, run out slide-rest to required amount, and feed up with lead screw.

A Model G.N.R. Brake Van.

By C. George Harrison.

(*Continued from page 483.*)

THE brake rigging is an exact copy of the rigging employed on the G.N.R., the end wheels having a block on either side and being drawn together by a small lever hung from a bracket fixed to the frame behind the axle, and these connected to a lever on a shaft near the centre of the frame, which also has a lever for the screw-brake and one for the vacuum piston-rod (the latter not being fitted). The shaft and the three levers were made from one brass casting, the shaft being turned and the levers faced in the lathe, the ends being shouldered down to go into the brackets. The screw-brake can be worked by putting the hand in the guard's door, and the shape of brake casting and wheel is clearly shown on the cross-section. To the centre lever is attached a link, and on the top of this is soldered a nut into which the rod passing through the brake casting works, and on being turned draws the link up and applies the brake. It will be noticed that in the link a slot is filed, the reason for this being to allow the vacuum brake to work independently. The studs, springs, and adjusting handle for keeping the top of the brake blocks from rubbing the wheels were so small that they had to be made by a watchmaker. The gas cylinders are made of wood and fixed to the frame with half-round wire, secured by small screws.

Photograph Fig. 2 shows springs and wheels very clearly, and the window of the guard's door partly down.

Photograph Fig. 2 shows one of the double doors open, the dummy gas gauge, and the bolts on side of the frame.

Photograph Fig. 1 is an end view of the coach showing the vacuum pipe, screw coupling, side chains, and rod for turning on the gas, which in this model works the switch for the electric lamps fitted.

Having seen the railway post-office van built by Mr. J. Upton for Colonel Harvey, I decided to let him build the body for this new under-frame, and he describes his work as follows :

The original idea for the body of the van was that it should be built up of teak, varnished, and finished strictly in accordance with the G.N.R. practice ; but, on further consideration, this was abandoned on account of the difficulty of working this wood on such a small scale, and also on account of the natural grain of the wood, which would have tended to destroy the sense of proportion, which was the principal end in view throughout the building of this model. And with this view, time, trouble, and expense were subordinated to the one idea of producing a model coach which could hold its own alongside of the splendid specimens of locomotives, etc., turned out from time to time by members of the S.M.E. And those who inspected the model at the recent Conversazione are in a position to judge how far that idea was accomplished.

The one departure from truth was in the electric lighting, this being a necessity on account of the size of the van precluding the use of gas. Apart from this, the interior, as well as the exterior, fitments were faithfully reproduced according to the original *motif*. Some five or six varieties of wood had to be worked in to surmount the various difficulties, as they were encountered, a brief description of which may interest model woodworkers.

The floor, sides, and ends were of whitewood. The roof was of lemon pine—a variety of pine which possesses the virtue of stopping where it is put after bending, a very necessary factor in a long model, where there is a tendency to twist laterally. The inside standards and roof ribs were of ash, carefully sawn to shape (of course, lengthways of the grain) ; these were mortised and tenoned—the standards into the floor and the roof

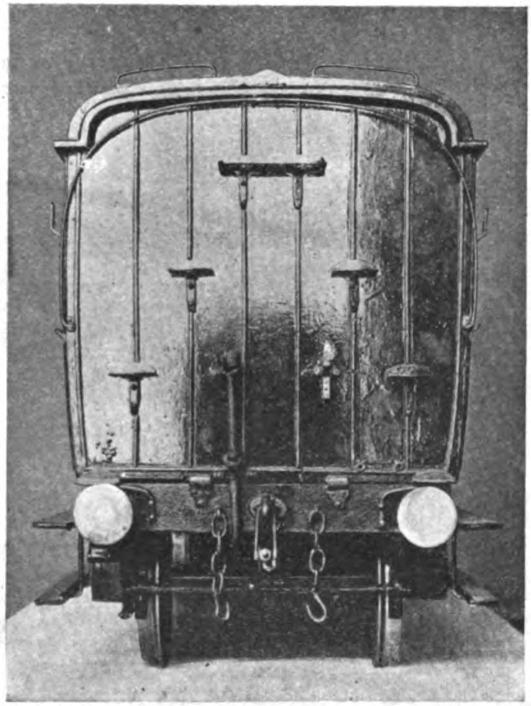


Fig. 1.—End View of G.N.R. Brake Van.

ribs into top of standards—a delicate job, but very necessary, as there was only one half partition in the van to help support the roof and sides, which were considerably weakened by the large door spaces, reaching from floor to roof. This partition was of mahogany, and to it was fixed the communication cord wheel, pigeon holes, lockers, etc., usual with this type of van. In front of this was fixed the hand-brake standard. The slabs on the floor of the van brought into use some old picture-backing ; this was planed up smooth and slit to the required width by means of the cutting gauge ; these fastened to floor with pin points.

The whole of the internal fittings, of course, had to be fixed before the roof was put on. This roof business was rather a difficult job, the edge of the roof being quite flush with the sides, a very different matter to the simpler overlapping roof.

The bend was too sharp to be tackled by the usual method of heat bending, so it had to be built of long strips, planed up in dovetail section and pinned to roof ribs. In this way the sharp corner was negotiated and the centre of roof put on in one piece; the whole was then carefully planed, and canvas glued on the outside to prevent any warping. The spaces in the roof for skylights and lamps were cut out before fixing. At the junction of roof and sides was fixed a cornice moulding, running round the van and following the sweep of roof at the ends.

The guard's "look-outs" at the sides was another matter requiring resource and patience. The simpler plan would have been to have made these in metal, but as the idea throughout was the testing the possibilities of wood in model building, wood it had to be. The sides of these "look-outs" were of mahogany, and were carried through to the inside, where they formed the supports for the guard's seat. The fronts were made of a very soft but tough birch, planed down to 3-32nds in., and after boiling for an hour was persuaded to take the awkward bends noticeable in the photographs. These were pinned to sides with very fine pin points; both inside and out were at once canvas glued to preserve the shape and prevent splitting when drying.

The doors were a considerable item in this model. These were framed and panelled, as in the real article. The framing was of ash, and there being twenty of the uprights to make, a pattern was made in zinc and the wood marked out from this, thus saving a lot of measuring and ensuring accuracy. The panels were of birch—very thin, and pinned down to the door pillars at both sides, thus leaving the bottom of door hollow for the glass frames to slide up and down.

The window-frames were of mahogany, planed down to 3-32nds in. The space for glass had to be fretsawn out and the glass pressed in a hand-tight fit, as there was no chance of mitreing or halving so thin a material; locks and handles to these doors were also to scale, involving some trick soldering and some very delicate mortising.

The doors were hung with three hinges, the lower one being a "flying" hinge, to compensate for the inward sweep of the door when opening. I think the most tedious part of the whole job was the hanging of the doors, it being very difficult to keep them flush with the sides.

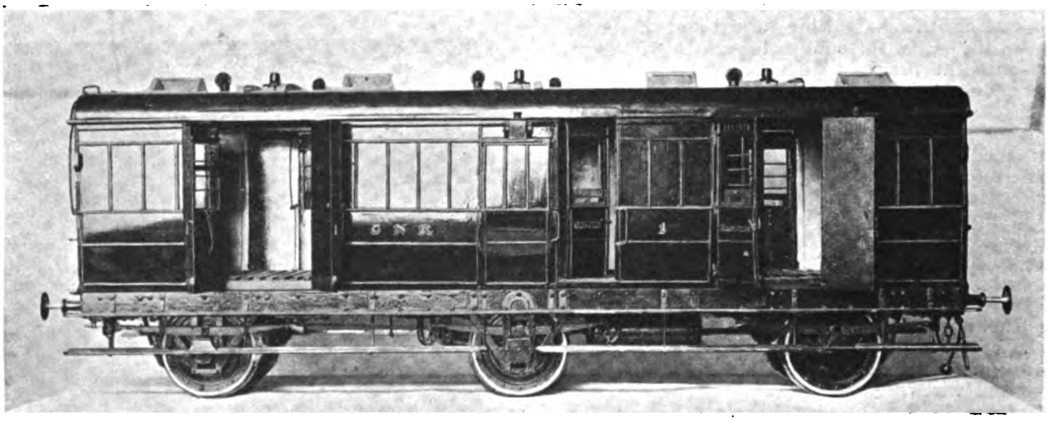


FIG. 2.—SIDE ELEVATION OF G.N.R. BRAKE VAN.

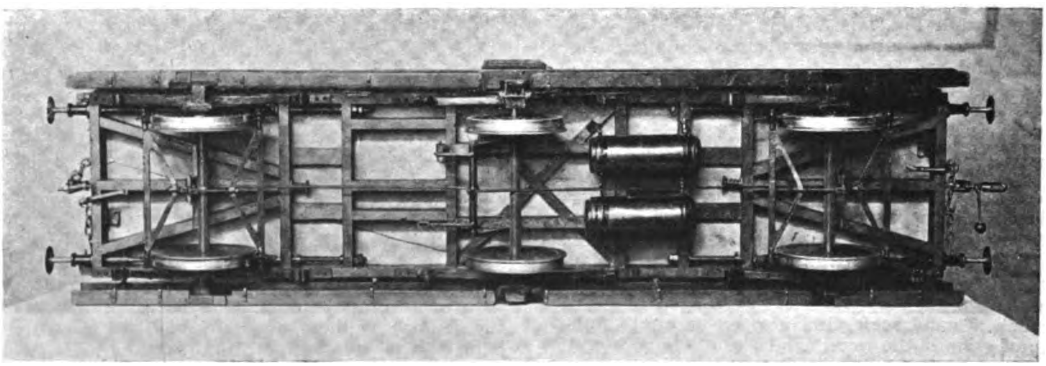


FIG. 3.—INVERTED PLAN OF G.N.R. BRAKE VAN.

Before fixing the beading, the whole of the body was "filled-up." This is a technical process in the painting, its purpose being to give a perfectly level and smooth surface over all. The painting was then forwarded as far as the buff ground colour. It will be remembered that the purpose was to imitate as nearly as possible the polished teak of the G.N.R. The beadings were hand-made, the method being as follows: a length of pine of fine and straight grain was planed down to the exact "width" of the beads—3-32nds in. and ⅛ in. The small beading plane was then run along the edge to give the requisite roundness and the cutting gauge set to the "thickness" of the bead, and one cut on each side of the strip was sufficient to slit off the length of bead, a rub with the file on the flat side finishing it off. These beadings were fixed to the body with the points of filliput or dolls' pins, about ⅛ in. being cut off the pin, larger pins than these would split such fine beading.

The bead fixed and the panels formed thereby, the whole of the body was then treated with the graining colour. By following this method, each panel could be separately dealt with and the varying shades of the wood imitated to a degree, the result being very effective and realistic. The graining was done by means of small pieces of an ordinary small-toothed comb, and softened down with a large camel's-hair brush. When dry, the body was given a thin coat of varnish, allowed to harden, and flatted in the usual way with pumice-dust and water. The gold lining was then put on, gold leaf being used, the lines being made with a compass pen charged with gold size. The final coat of varnish was then given. In all, this model received at least twelve coats of colour, filling, and varnish.

Mention may be made of the lighting of this van. Six small pea lamps were used, three roof lamps for lighting interior, two deck lamps, and tail lamp. The roof lamps were made to scale, and were removable; the outside top cast in type metal. Small recesses were cut on opposite sides and plugged with fibre, the wires from lamps passed through this, and fastened to two short pieces of copper wire driven into the fibre These, resting on the terminal ends of the "live" wire in the roof, formed the contact. The body of lamp was of thin brass tube, fitting easily on to the lamp top; the base of lamp formed with the ends of glass test-tubes. These lamps were wired in parallel, so that any one lamp could be removed without affecting the rest. The whole being switched on and off by means of the gas-cock handle at end of van, being converted for the purpose into a switch, without alteration of its standard proportions.

The steps on back of van, lamp brackets, etc., were built of brass and fixed to body with stout pins—the "head" ends this time, some old sticky varnish being used to assist in the fixing; it is astonishing what a hold this method of fixing has for these very frail fittings.

Some very microscopic drilling had to be worried through at times—the hand-rails on side of van, about 20 gauge. To flatten ends of these and drill pin holes patience and good eyesight were required; but we were on our trial for realism, and not being hampered by the various difficulties that confront the locomotive or other engine builder, we were able to attain our ends to a nearer degree, our limit being the natural difficulties of the wood and our own incompetence.

For the Bookshelf.

[Any book reviewed under this heading may be obtained from THE MODEL ENGINEER *Book Department,* 26–29, *Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.]*

THE STEAM TURBINE. By Robert M. Neilson. Fourth edition, revised and enlarged. London: Longmans, Green & Co. 15s. net, postage 6d.

This is the fourth edition of a book which has the distinction of being the first English text-book on steam turbines, and if not the first, very nearly so, of the long list of books now published on this subject.

Commencing with some fundamental notes and definitions, a brief history of the subject is next given, followed by a useful chapter on the kinetic energy of steam. An analysis of turbine types is then given, and the effects of speeds and angles on vanes of efficiencies dealt with. The succeeding chapters, copiously illustrated by photographs and line drawings, describe the different types of machine, as made by British and Continental manufacturers. Low-pressure steam turbines, the effects of steam pressure, superheat, and degree of vacuum on consumption are fully treated, the book concluding with a chapter on marine propulsion. Appendix I is devoted to steam tables, English and metric; while Appendix II is a list of British patents from earliest records up to the end of 1905.

At this time of day the production of a book on steam turbines on original lines is out of the question. The greater portion of the relatively enormous number of books on this subject which have been published overlap one another very largely. Mr. Neilson's aim, as set out in his preface, is to make the subject intelligible to the average engineer with fair but inextensive scientific training. In this we think he has succeeded, and while his book lacks the profundity and completeness—sometimes tiresomely so—of the German school of writers founded by Dr. Stodola, his treatment is sound, and the engineer approaching the subject for the first time will find the book of considerable value.

The preface to the first edition is dated June, 1902, and since this time we have seen an enormous expansion in the use of the steam turbine, the number of people engaged in its manufacture, and the literature of the subject. So varied and complex are the details of the steam turbine, that on the Continent at least two periodicals are devoted to its interests alone.

TELEGRAPHIC SYSTEMS AND OTHER NOTES. By A. Crotch. London: Chas. Griffin & Co. 5s. net, postage 4d.

This, the most recent publication on the subject of telegraphy, is the work of one of the Post Office engineers. The telegraph systems dealt with comprise the well-known Morse and Wheatstone apparatus and the two or three type-printing systems at present experimentally in use in the British Post Office. The first chapter deals with various types of primary battery, and concludes with an elementary description of secondary cells. The second chapter, headed "Universal Battery Working," deals for the most part with the circuit alterations when working with a Universal battery, as compared with those required with separate or individual batteries. Following this is an excellent chapter on duplex working. Chapter IV is devoted to duplex and quadruplex working, and is admirable for the series of diagrams representing the current distribution for various key combinations on a quadruplex circuit. An ingenious and original diagram is also given illustrating the "split signals" on the B side of a quad circuit when the A key is worked. The chapter on automatic telegraphy is, we think, the best that has ever appeared in an English text-book. It is curious to note that although the Wheatstone automatic system has reached its highest development in the British Postal Service, the fullest detailed descriptions of the mechanical portions of transmitter and perforator have, hitherto, been found in Continental text-books only. The detailed drawings and original diagrams relating to this system deserve the fullest praise, and, if for no other reason, the book should be in the hands of every aspiring technical telegraphist. We can only suggest to Mr. Crotch that when preparing a succeeding issue, he gives some details of the receiver. We do not agree with the treatment of the "shunted condenser," and think that one or two of the official diagrams might have been sacrificed to a more complete and accurate view of the matter. Multiplex telegraphy deals with the now obsolete—or nearly so—Delany system, the object of its inclusion evidently being to deal with the question of retardation and the combination of synchronous multiple systems with the duplex balance, the whole being introductory to the description of the Baudot system, which follows later.

The Hughes, Baudot, and Murray type-printers follow, the descriptions being fairly full and illustrated with good clear diagrams, drawings, and photographs. In this connection it may be pointed out that some of the illustrations to the Murray are very poorly done. This is all the more noticeable as those illustrating the Hughes are beautiful examples of the draughtsman's art. Succeeding chapters deal with instrument room wiring, circuit concentration, and intercommunication switching. These are all good, and could, with advantage, be extended. The chapter on repeaters is very well done, the explanatory skeleton diagrams being both original and well conceived. The photographs of different types of repeater which are inserted, although of little educational value, are, we think, a pleasing innovation. The chapter on submarine telegraphy is brief, but is up to date, dealing with curb transmitters, Brown's cable relay, and other matters.

The last chapter on wireless telegraphy is the most unsatisfactory in the book. We do not, in the least, see the use of describing coherers, aerials, or special systems until the reader has been given the conception of the composition of an electromagnetic wave, its generation, and propagation through space.

Generally, the book is satisfactory and well worth a position on a telegraph man's bookshelf. It is, perhaps, to be wished that the writer had dealt with his subject more on engineering lines and forgotten the existence of the official diagram book. Where he does get away from this, he shows plenty of originality, and has, evidently, some grasp of the art of teaching.

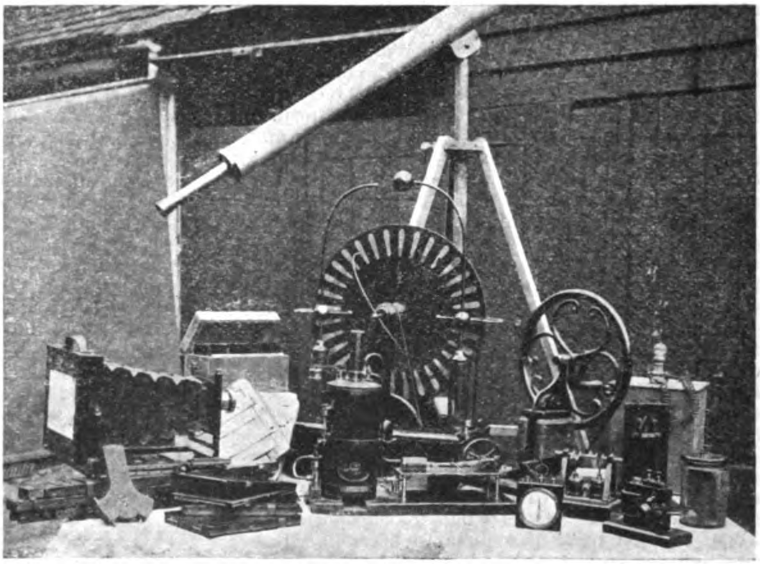
Practical Letters from Our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume if desired, but the full name and address of the sender MUST *invariably be attached though not necessarily for publication.]*

An Amateur's Work.

To the Editor of *The Model Engineer.*

Dear Sir,—The accompanying photograph is an illustration of the results of some years of model and apparatus making. It might perhaps be fairly called "a certificate of industry." It is not practicable to write a constructional article of the many items, but it will possibly be of interest to give some notes on points of interest in the making of the various articles.



"A Certificate of Industry."

Taking the centre object first—An 18-in. induction machine from Mr. Wimshurst's own design in polished mahogany. The brass work, polished and lacquered, supported by four glass jars, which also act as Leyden jars. Plates are of glass, and were cut by means of a glazier's diamond fixed in a wooden lath and pivoted by a wire nail in a flat block of wood. The whole were then placed on a small round-top table, and by walking round the table holding the block down on glass with left hand and pressing the diamond with the right, the circles were cut out. Places that were not cut through had to be carefully tapped with the handle of diamond just on the line where break was required. The holes in discs were ground out by means of copper tube, emery, and turps, using very light pressure. Tube may be driven by a bow or a hand-wheel rigged up. The tube must be supported in a somewhat rough rig-up (see small sketch).

The model engine in front of Wimshurst is ¾-in. bore, 1⅛-in. stroke. The boiler has internal firebox 3 ins. diameter, with two cross-tubes, and burns coal first rate. A point which is worth notice by model boiler makers is the lagging of boiler and cylinder. For instance, the amount of heat required before lagging was put on just kept steam up without running engine, the same amount of heat with lagging on runs engine at quite a fair rate, showing the large amount of heat lost by radiation. All rivets were made of copper wire, and the boiler has been tested up to 160 lbs. by feed-pump. The gauge glass fittings were made of ⅜-in. brass rod brazed and turned up, plugs fitted with small nuts, and handles bent out of solid.

The dynamo is a Siemens' shuttle armature, shunt-wound, and of 20 c.-p.

Then we have a pair of oscillating cylinders for paddle boat, ¾-in. bore and 1¼-in. stroke; a single-needle telegraph instrument and bottle battery, made from jam jar; and a small electro-motor for use with the above dynamo (design and data for wire were taken from Handbook No. 10, The Model Engineer series).

The box battery at the back has four sets of plates fixed to the top of box. The cells are in a tray, which is drawn up by means of a rod fixed in the centre of tray and passing through lid of box. When the rod is drawn up, a small catch is pushed forward by a spring and slips into a notch cut in the rod. When the light is done with, by just pulling catch out of notch the tray slides down to bottom of box.

The camera on left is half-plate, reversing and swing-back, rising front. Three double book-form dark slides, three-fold ash stand and top, also three printing frames and plate-boxes. One novel point about the printing frames is the method of holding the springs. They are cut out of hard spring brass ¾ in. wide. At one end a piece of small brass tube is soldered and a piece of wire passed through hole in tube. The ends of wire are then bent down to form a staple and driven into frame. At the other end of spring a slot is cut to take a small screw-eye, which is screwed into frame. When it is desired to clamp frame up, the spring is pressed down with thumb till screw-eye comes up through slot; the eye is then turned across slot. This method avoids all danger of shifting plate or paper, and is a great improvement over the ordinary smudging method.

The remaining articles are linesman's galvanometer, wound for intensity and quantity; and the astronomical telescope at the back. The achromatic object glass (2½ ins. diameter, 40-in. focus) shows the moons of Jupiter very plainly, Saturn's rings, and the mountains of the moon are a fine sight, when she is about four days old.

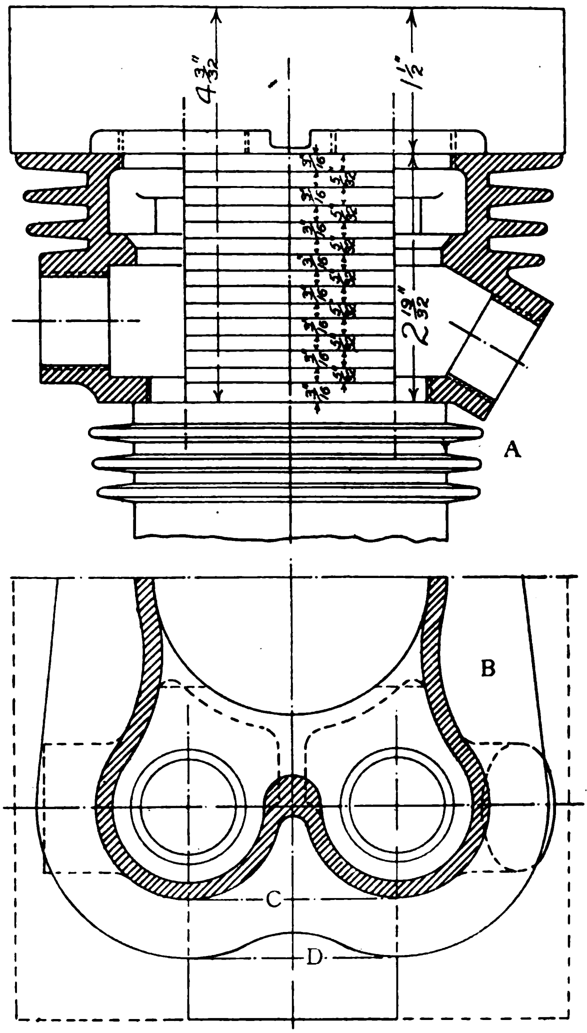
As showing what can be done, the whole of the brasswork of the above was either melted in a sheet-iron furnace and cast in wooden moulding-boxes, or was worked up out of sheet and rod and finished on a rough old lathe with wooden bed.—Yours truly,
J. Howlend.

Ashford, Kent.

Re Pattern for Mr. Hawley's Cycle Motor

To the Editor of *The Model Engineer*.

Dear Sir,—Is there not a mistake in the dimensions of the chamber corebox belonging to the pattern described in "Simple Lessons in Pattern



Pattern for Cycle Motor.

Making"? On page 513, Vol. IX, the length from the bottom of the print E at H to the top of the pattern is 3⅞ ins., while the length of the chamber corebox on page 541, Vol. IX, is 4 3-32nds in. Ought not these sizes to correspond?—Yours truly,
J. E. J.

To the Editor of *The Model Engineer.*

Dear Sir,—In reply to your correspondent, I may say the dimensions of the chamber corebox are quite correct, and should not be departed from. The print and corebox E have nothing to do with it really. The latter are to finish the contour of the chambers (outside) from centre to centre, as if cut out of the pattern they would not draw, undercutting the sand, as they would do.

I omitted to state, however, that the two thicknesses C and D, between the bottom of print E and bottom of chamber metal, should be carried across at right angles to parting line, as shown by chain dotted lines on the sectional plan B of the sketches on previous page.

A better way, but involving a slight departure from the original drawings of Mr. Hawley, is shown at A. Here, by making the recess pieces 5-32nds in. thick, instead of ⅛ in., I make the sum correspond with the dimensions to bottom of chamber metal, and conscience is soothed by the fact that this plan strengthens the thin ridges of sand. Of course, make the corebox E to suit, if you adopt the latter method.—Yours truly,

T. D. Garscadden

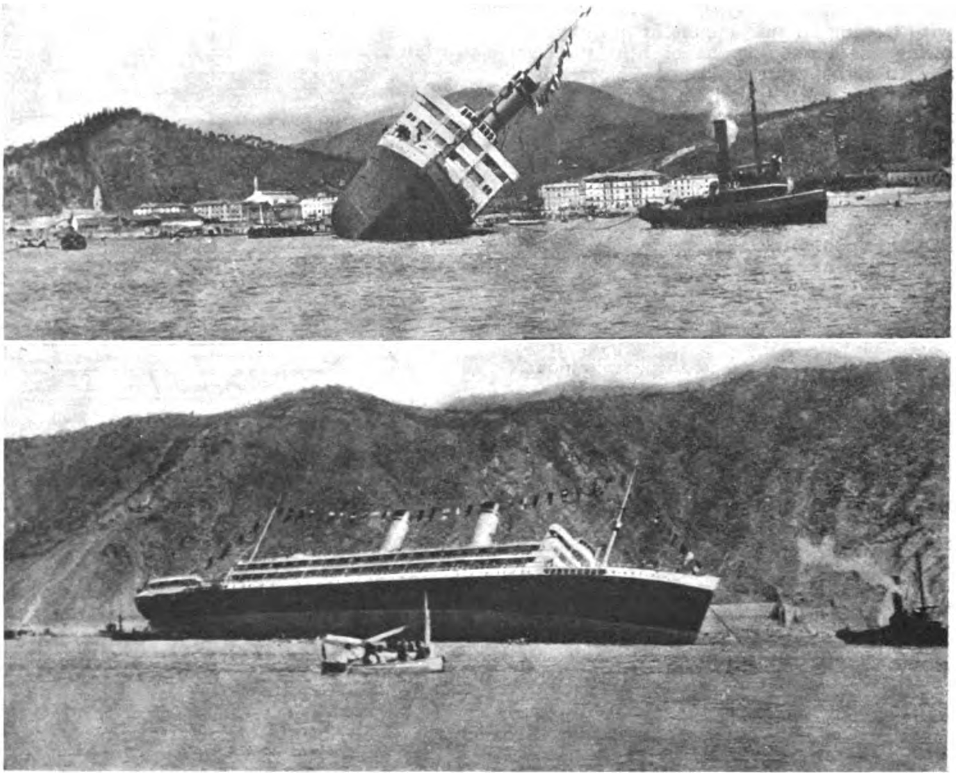
A Disastrous Launch in Italy.

To the Editor of *The Model Engineer.*

Dear Sir,—Being an old subscriber to your valuable and instructive paper, I have great pleasure in enclosing you some photographs showing a disastrous accident at the launch of the largest steamship ever built in Italy. This unfortunate catastrophe occurred at Riva Tugosa (not far from Spezzia), and the cause, as far as can be ascertained, was from being too much hampered with top-weight and not sufficiently ballasted to counteract this defect.

This magnificent vessel was built for the General Steam Navigation Company of Italy, and she was to carry passengers, mails, and cargo to South America. She was undoubtedly the *Mauretania* of Italy, and you will observe she was to be launched ready to run her speed trials that same afternoon.

The Insurance Company settled the matter with the shipbuilders by paying them £120,000—half the amount she was insured for, and the vessel as she lay. As this accident occurred some months ago, the vessel, through bad weather, has slipped into deeper water, so now it is a serious question for the builders. Her name was the *Principessa Jolanda*,



Accident at the Launch of the "Principessa Jolanda."

called after one of the daughters of the Royal Family.

At any time, if agreeable to your good self, I shall be very pleased to send you anything that may be of interest to yourself or my brother subscribers.—Faithfully yours, NORMAN ROBINSON.

Genoa

Stern Wheel River Steamer.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—Having decided to build a stern wheel steamer of the class used on African rivers, I should be much obliged if any of your readers could give me particulars of a similar boat which he has built. I propose to build one about 4 ft. long, with a beam of 1 ft. Hoping one of your readers may be able to help me, I remain, yours truly, ERNEST A. RENDELL.

The Wireless Transmission of Photographs.

A DEMONSTRATION of a new system for the wireless transmission of photographs was recently given at the Hotel Cecil, London, by Mr. Hans Knudsen. The following description is quoted from our contemporary, *The Engineer*:—

So far as the electrical part of the apparatus is concerned, this is practically identical with that used in the spark system of wireless telegraphy, an ordinary spark coil with its attending accessories, such as the aerial and so forth, being used. In carrying out the process a photograph is taken on a photographic plate, the gelatine being from three to four times thicker than that commonly used. The plate is screened; that is to say, a screen consisting of a glass plate with parallel lines on it is interposed between the lens of the camera and the plate. The plate having been developed, and before it is completely dried, iron dust is sprinkled upon it. It has been found with a plate of this kind that owing to the transparent and partly transparent parts of the plate drying more quickly relatively than the dark parts, the iron dust does not stick to the transparent and partly transparent parts to the same extent that it adheres to the dark and shaded parts, and that by lightly brushing the plate after the application of the dust, and when the former is about half dry, a picture, partly composed of iron dust, is obtained. The plate, having been prepared in this way, is then fastened to a small table on the transmitting instrument, with the film side upwards. This table, and consequently the plate fixed to it, is given a horizontal to-and-fro motion. similar to that of the table of a planing machine. A needle point attach d to a flat spring rests upon the surface of the plate, and this needle point is caused to travel slowly at right angles to the direction of the plate's motion. As the plate passes under the needle, it is evident, since some parts of the plate are covered with iron dust, while others are smooth, and since the needle is attached to a delicate spring, that the spring and needle are set in a state of vibration. The spring in vibrating makes and breaks the battery circuit of a spark coil, just as the spring attached to the armature of an electric bell makes and breaks the battery circuit. This sets up intermittent sparking in the spark-gap on the secondary side, and in this way etheric waves are produced at various intervals, as in wireless telegraphy, the vibrating needle and spring acting in a sense as the transmitting-key.

At the receiving end there is another small table and another vibrating needle, and this latter table has precisely the same movement as that at the transmitting end, the two tables moving in synchronism. The motion of the plate at the transmitting end is derived from clockwork, but that at the receiving end from an electric motor.

The method of synchronising is interesting. Every time the plate is about to start the stroke at the sending end, a fairly powerful spark is caused to be produced in the spark gap. The waves set up by this spark act upon an ordinary metal filing coherer at the receiving end, which completes an electric circuit, and by electro-magnetic means causes the running motor at the receiving end immediately to operate the table, and in this way the two tables are synchronised.

It may here be mentioned that the moving table at the receiving end carries a smoked-glass plate of the same dimensions as the plate at the sending end. Besides the coherer already referred to, which is used for synchronising the two tables, there is another special coherer which receives the intermittent waves which are transmitted by reason of the movements of the vibrating needle at the sending end. This coherer is connected in circuit with a battery and a small electro-magnet situated above the smoked plate, and as this circuit is alternately completed and broken by the coherer, the electro-magnet is magnetised and de-magnetised. The needle, which is attached to a delicate spring, is acted upon by this magnet, and so caused to vibrate on the smoked plate in unison with the needle at the transmitting end. This makes scratches on the smoked plate, these scratches reproducing the picture on the original photographic plate. The "scratched" plate is afterwards put on an ordinary photographic printing frame, and a print of it taken on sensitised paper.

We have not seen an actual photograph reproduced, but we have examined specimens of photographic prints which have been p inted from the smoked glass in the manner described, and these have shown fair results, taking into account the fact that Mr. Knudsen has only worked upon the apparatus for a period of three months. Perfection is not yet claimed, but Mr. Knudsen hopes shortly to remove the imperfections inseparable from new inventions. At the demonstration a picture was drawn upon a glass plate with seccotine, which was afterwards sprinkled with iron dust. This was placed on the table of the transmitting instrument, and reproduced on the smoked-glass plate in another room. The time taken to reproduce a photograph 5 ins. by 4 ins. on the smoked-glass plate is fifteen minutes.

A NEW process for protecting iron and steel articles from rust has recently been invented and patented by Mr. T. W. Coslett, of Birmingham. This consists in immersing the article in a hot phosphorised solution together with an iron compound. The surface of the iron is converted into a mixture of ferrous and ferric phosphates, and presents a pleasing dull-black appearance. The process makes the iron highly resistant to corrosion, and is being applied to all kinds of light engineering work, such as cycle frames, gun-barrels, stampings, and press work

The Society of Model Engineers.

[*Reports of meetings should be sent to the offices of* THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.*]

London.

A PARTY of the members (twenty-five in number) visited, on Wednesday, May 13th, the Electricity Generating Station, at Bankside, of the City of London Electric Lighting Company. Under the guidance of Mr. Fletcher, the engineer-in-charge, a very complete inspection of the very large plant was made. The Company, as its name implies, supplies current to the City of London for lighting, heating, and motor purposes, and the enormous and sudden fluctuations in load, caused by fog, etc., render necessary the use of some rather special machinery. The units for the production of continuous current are of 2,000 kw. capacity, driven by vertical compound steam engines fitted with Corliss trip valve gear. One of these huge machines was in process of dismantlement for overhaul, and a very good view was obtained by the members of the insides of the cylinders, pistons, etc. The alternating current is supplied by several sets of British Thomson-Houston alternators direct-coupled to high-speed Willans engines, Some of the older plant proved very interesting. and was specially uncovered for the members benefit; in particular, a large Ferranti alternator, having a disc armature of coiled copper ribbon placed edgewise round the circumference of a very large flywheel, and running between the poles of about eighty double electro-magnets. The boiler-house was visited and found to contain forty-eight Babcock & Wilcox boilers—some hand-fed, others having automatic stokers. The plant for straining and pumping the condenser cooling water taken from the River Thames was seen, and a complete tour of the numerous switchboards made. After thanks had been accorded Mr. Fletcher for his courteous attention and explanations, the party dispersed.—HERBERT G. RIDDLE, Secretary, 37, Minard Road, Hither Green, S.E.

Proposed Society of Model Engineers at Brecon.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—We should be glad if, through the medium of your much-appreciated columns, you would ask anyone sufficiently interested in model engineering work in this neighbourhood to aid in forming a Club, to communicate with the undersigned.

We, as enthusiasts, wish mainly to give an impetus to the pastime locally, and to, if possible, arrange speed boat competitions on one or other of our available sheets of water; also, when occasion offers, to exhibit models made in the district, and to encourage the efforts of amateurs, like ourselves, who are so thoroughly isolated from the "official" centres of model engineers.—We beg to remain, yours faithfully,

H. R. HOULSON,
A. J. HANDO.

The Elms Cottage,
Struet, Brecon, S. Wales.

Queries and Replies.

[*Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.*

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.*]

The following are selected from the Queries which have been replied to recently:—

[19,380] **12-in. Spark Coil Data.** J. W. B. (London) writes: Can you give me particulars and data for a 12-in. spark coil? I have a large amonnt of No. 36 S.W.G. wire and also some thicker wire of the gauge enclosed, and will be glad if you can give me the particulars I want.

The principal data for a 12-in. coil, according to the specification given by Mr. Hare in his book on "Large Induction Coils" is as follows:—The core made of wrought iron wire No. 22 S.W.G., 18 ins. long, 1 11-16ths in. diameter; weight, 7 lbs. 13 ozs. The primary consists of three layers of No. 14 S.W.G. (your gauge is too fine, being No. 16 S.W.G.) preferably silk-covered high conductivity copper wire. Total weight of primary is 5 lbs. 13 ozs.; total length, 286 ft. The resistance of the primary all in parallel is ·05 ohm, all in series ·452 ohm. The condenser consists of two portions, sizes of tin foils being 15½ ins. by 9 ins. Total number of foils, 82. Effective surface, approximately 32 sq. ft.; capacity, approximately ·39 microfarad. Insulation is two thicknesses of paraffined bank post paper. Secondary consists of a total weight of 19 lbs. 1 oz., composed of 17 lbs. of No. 36 S.W.G. and 2 lbs. 1 oz. No. 34 S.W.G. Total number of turns, 79,168; total length, approximately 17 miles; total resistance, 18,270 ohms. Mr. Hare's coil was composed of 96 sections insulated by one thickness of blotting-paper paraffined, increased to two thicknesses where the potential difference is greatest. The outside diameter of the secondary coil was 6½ ins. at the middle and gradually reduced to 5½ ins. at the ends. The inside diameter at the middle was 3½ ins., increasing to 4 ins. at the ends. We trust the above particulars will enable you to go ahead with your coil, although it is quite possible that considerable experimenting will be necessary in order to get the best possible results.

[19,407] **Overshot Water-Wheel.** A. B. (Usk) writes: I would be much obliged if you would answer in your "Correspondence" column of THE MODEL ENGINEER the following questions: What horse-power would a water-wheel of enclosed dimensions develop with a pretty good supply of water? I am thinking of making it out of sheet iron.

The power developed by such a wheel would be infinitesimal, and would depend upon the quantity of water flowing and its pressure. As from your sketch the stream appears to flow into the wheel without any head, there would be no other pressure to make use of than the difference in level between the top of the wheel and the bottom where the water would be discharged from the buckets. The pressure due on head of water equals approximately 1 lb. of pressure to every 2 ft. of head. We advise you to read the articles in Vol. IX on Pelton wheels, page 222. *Re* hot air engine, Messrs. Hardy & Padmore, Worcester Foundry, Worcester, would supply you with a reliable hot air engine.

[19,443] **Accumulators Required for Lighting Lamps.** A. C. (Southport) writes: Being a reader of THE MODEL ENGINEER for over five years, I should be glad if you would answer me the following questions. I have a dynamo 50 volts 20 amps. What power and sort of engine do you advise me to have to drive it? I wish to make a set of accumulators to suit the above. I should want 32 c.-p. for about four hours each night, and to charge the accumulators about twice a week. What size would you have? Is it the best way to fill accumulator plates with red lead and sulphuric acid and then form them for both negative and positive? Will you give me the addresses of some firms from whom I can get celluloid and accumulator plates

You will need at least a 2 b.h.-p. engine to drive your dynamo. To supply 32 c.-p. for about four hours each night throughout the week, and allowing that the cells are charged twice during that week gives you an equivalent power required of 32 c.-p. for fourteen hours. Each cell will have to be capable of supplying 2 amps. for 14 hours., that is 28 amp.-hour capacity. Using 50-volt lamps, 25 cells must be employed in series, each cell of 28 amp.-hour capacity. Reckoning 20 amp.-hour per sq. ft. of positive plate surface, each cell must contain approximately 1¼ sq. ft. of positive plate surface, therefore you will see that you will need a fairly large battery to cope with the work. Any of our advertisers would supply you with suitable accumulator plates, celluloid, etc. You might try Messrs. Whitneys, 117, City Road, London, E.C., or Messrs. T. W. Thompson & Co., 28, Deptford Bridge, Greenwich, London, S.E.

[19,023] **L.B.S.C.R "Atlantic" Locomotives.** P. S. (London) and H. N. (Aston) write: Would you kindly send an outline drawing of the new L.B. & S.C.R. "Atlantic" type locomotive, No. 38?

We do not supply our readers with outline drawings to any particular scale except through the Expert Service Department; but where the drawings are likely to be of general interest, and of actual use to other readers of this journal, we prepare same for publication and reproduce to the largest scale possible. We append an outline of these locomotives herewith. As will be noticed, the leading dimensions of the engines are exactly the same as the G.N.R. No. 251.

[19,396] **Reversing Switch for Motors.** T. V. N. (Tonbridge) writes: I enclose a sketch of a small motor which I want to know how to reverse so as to be able to gear same to a crane; I would be much obliged if you could tell me whether it is possible, and how.

To reverse your motor you must either send the current through the fields or the armature in an opposite direction—that is to say, the current in either fields or armature must be reversed, but not in both at the same time. A diagram showing connections of a reversing switch was given in our issue for April 16th, 1906, page 381.

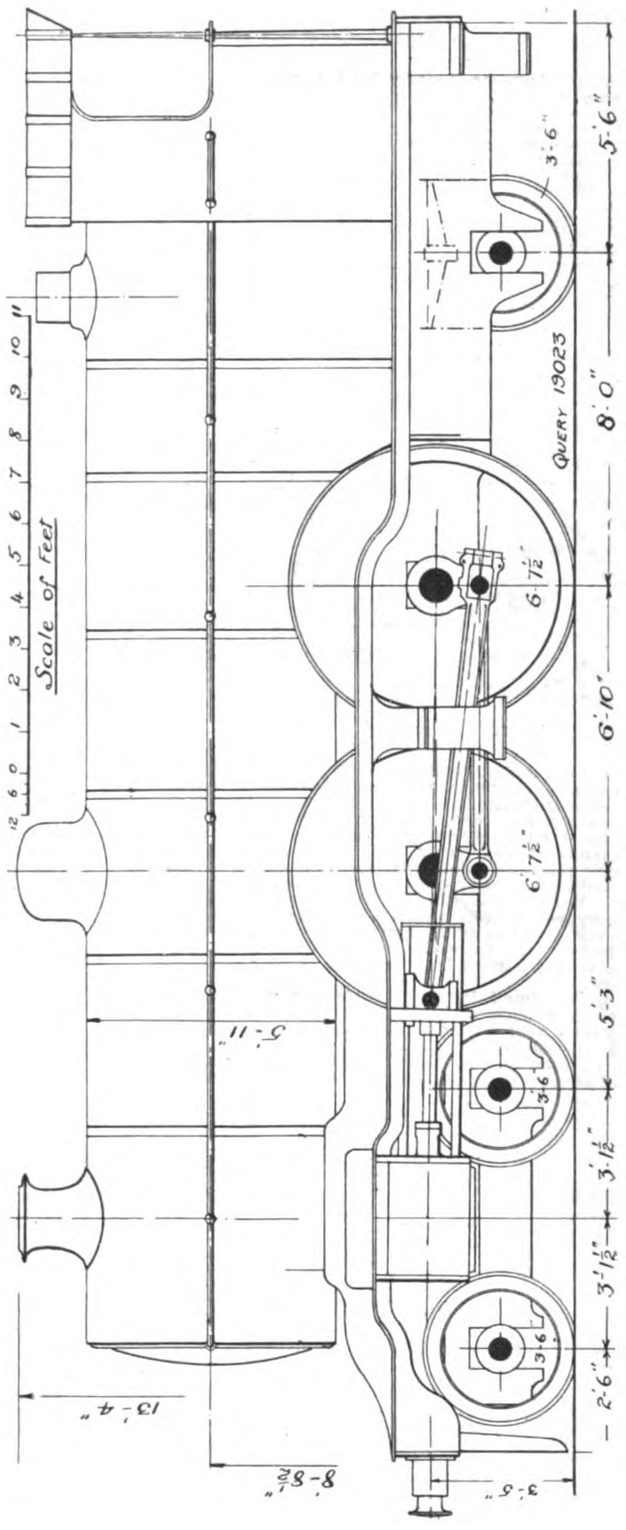
[19,394] **Dynamo Castings.** J. G. (Paisley) writes: As I intend building a 40-watt dynamo, as Fig. 14 of book, "Small Dynamos and Motors," I would be obliged if you could give me the name and address of some firm that would supply me with castings for same. Would I require to make the patterns for the casting? Please say if a good casting would require the armature tunnel finished off with a lathe, as I do not possess one.

Any of our advertisers would supply you. Try Messrs. Thompson and Co., 28, Deptford Bridge, Greenwich, S.E. The armature tunnel is more easily finished off by turning in a lathe, but if you can use your files fairly well you should have no difficulty in filing it out true with a suitable half-round file.

[18,949] **Charging Accumulators.** A. G. (Hartlepool) writes: I have had a board fixed up by an electrician for charging accumulators from the public supply (230 volts). I have four 16 c.-p. lamps and can use them either singly or together. Will you kindly tell me this: (1) Suppose I have my lamps arranged to charge an accumulator at the rate of ½ amp. per hour, at what rate am I charging if I connect another (or even two more) 4-volt accumulators in series? (2) When I want to charge several cells at once, which is the most economical way—in series or parallel? If the lamps I am using take ½ amp. per hour, am I charging at the same rate (viz., 1 amp. in two hours)? I have your book, but cannot find this information.

(1) The addition of another 4-volt accumulator in series with those you are already charging will not materially alter the charging rate per cell. (2) Charging from a high voltage supply you will find, as a general rule, it is more convenient to connect your accumulators in series. We are not clear as to what you want to know when you refer to your lamps using ½ amp. per hour. An ampere is the rate of flow of current, so that a lamp taking ½ amp. will always take current at that rate whether it is burning for half-an-hour or for five minutes. If it is burning for two hours, you do not say that the lamp is therefore taking 1 amp. We advise you to study some book on elementary electricity and magnetism, such as P. Maycock's "Electric Lighting and Power Distribution," 6s. 4d. post free.

[19,658] **Slip Eccentrics.** N. M. (Harrogate) writes: Would you kindly give me an outline of a slip eccentric? I have been advised to use one to a small locomotive I have made. Having never seen a slip eccentric, I should like you to give me an outline of one. There does not seem to be room for any other



Outline of L.B. & S.C.R. "Atlantic" Locomotive.

form of reversing, so the makers of the castings advise slip eccentric.

You will find a description with drawings of a slip eccentric in our issue for April 2nd last.

[18,702] **Pump for Mercury Jet Interrupter.** T. A. C. (Brockley) writes: Could you oblige me with a dimensioned drawing of a small centrifugal pump for a mercury jet interrupter for an induction coil? I give a sketch of the revolving part below. It is for an inch spark coil. Is this part suitable; if not, would you please give me a sketch of this part also?

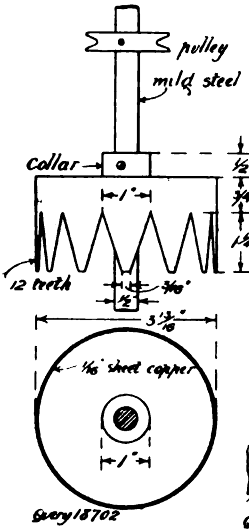


Fig. 1.

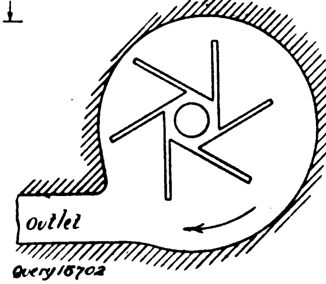
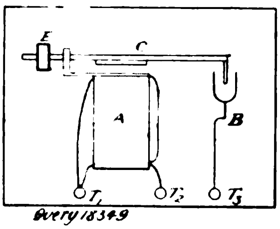


Fig. 2.

Fig. 2 gives a sketch of shape and size of vanes. We must leave you to arrange the thickness of casing and other details; the vanes can be made about ¼ in. in width. The pump is to be fixed in a horizontal position, with vanes direct-connected to your vertical spindle. For inlet make holes about 1 in. diameter, one at top and one in underside of the casing, concentric with the spindle. The pump is to be entirely submerged in the mercury. You can try outlet jets of various sizes, say 3-16ths in. diameter to start with. You may find too many teeth in your contact wheel; if so, try one with a less number. The pump must be made of iron or steel—not brass, as the mercury will attack the brass. We advise you to cut the pump spider out of solid iron. The tooth wheel must be insulated from spindle and provided with a rubbing contact.

[18,349] **Small Rotary Transformers; Windings for Automatic Cut-out.** S. F. H. (Plymouth) writes: I intend to make a small booster for charging a small 4-volt 25 amp.-hour accumulator. The dynamo is to be 5-volt 2-amp., as Fig. 11, page 18, of "Small Dynamos and Motors." The armatures are to be on one shaft and same diameter, viz.,

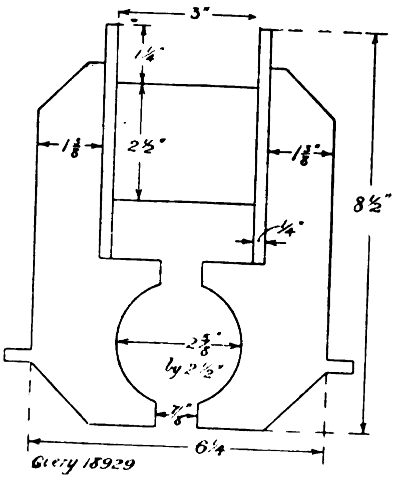


1½ ins. What I want to know is the width of magnet and armature of the motor, also size and quantity of wire for same. Voltage of supply for motor is 50. Could you tell me quantity and size of wire for series and shunt coils for a cut in and out for 18 volts 3 amps.? I have about 2 lbs. No. 17 and 1 lb. of No. 19 German that might do for the series coil. I have only a year's numbers of The Model Engineer, so cannot trace any design for same. Am I right in assuming current to flow in terminal 2 through shunt coil to T1, series coil in at T2 *via* coil C and B to T3? A, magnet coils; B, mercury cup; C, armature; E, balance weights.

We advise you to make both machines of the 20-watt size, because the motor machine must be of quite double the power of the generator machine. The generator will be working under full load, but will have a higher efficiency and regulate better than the smaller size working at full load. The appearance of the machine will also be improved. Winding for the motor machine to be—armature, No. 32 s.c.c. copper wire; field-magnet, No. 32 s.c.c. copper wire. Winding for the generator machine to be as given in the table, 20-watt size for 5 volts 4 amps. If you find that the generator voltage is too high, rewind the motor armature with No. 34 s.s.c. copper wire, or the generator armature with No. 21 or 22 gauge D.S.C. copper wire, if voltage is too low. Some adjustment of this sort will very likely be required. Quantities of wire will be approximately as table, page 49, of "Small Dynamos and Motors." Your idea of cut-out circuits is correct; the coils should be wound in the same direction. Either No. 17 or No. 19 wire may do for the series coils; it is a matter of trial. Use the No. 17 gauge for the series coils, and try some No. 32 s.s.c. copper wire for the shunt coils. The quantities and number of turns must be determined by yourself. You could obtain parts and particulars for an automatic cut-out from Mr. A. H. Avery, of Fulmen Works, Tunbridge Wells. Wind the shunt coils on first, and adjust the cut-out until the contact is pulled in when the dynamo volts rise to correct value; then wind on some series turns and connect them to a battery, so that the current flows in reverse direction, as it would do from the accumulator being charged. Adjust the number of turns so that the shunt winding is overpowered when, say, 2 amps. flow through the series coils; then make some trials with it in charging use.

[18,929] **Output of Electric Motor.** F. E. W. (Lincoln) writes: I have an eight-slot drum armature, 2½ ins. long and 2½ ins. diameter, wound in four sections, and four-way commutator with 66 turns of No. 20 D.C.C. wire in each slot—528 turns altogether; weight of wire is 1 lb. exactly. Now I have a field-magnet casting, as per sketch, and 6 lbs. of No. 20 S.C.C. I want to get 30 volts 5 amps. or thereabouts. Will you please tell me if wire is right—size and quantity; if not, please tell me what to get? Also, what horse-power would be required to drive dynamo when finished, and what it will take to drive as a motor?

Your machine will not give much more than 100 watts output. The field windings, we may say, appear to be rather in excess of



what is really required on such a machine; although, after all, the best plan to adopt in your case would be to run your machine with its present windings and find by actual trial and the use of ammeter and voltmeter exactly what you can get out of it. It is, of course, very inefficient to use heavier field windings than necessary, because once the field-magnets are magnetised to satiation point any current flowing in the fields in excess of this amount is pure waste of current. Power required to drive a 100-watt machine would be not less than ¼ h.-p. As a motor machine, of course, it will take rather more current than it will give out as a generator. Assuming that it generates 30 volts 5 amps. (which it will not), it would take perhaps 35 volts and 5½ amps. as a motor.

[19,793] **Resistances and their Uses.** W. F. M. (Highbury, N.) writes: Would you mind answering the following questions: I am making an 8-cell bichromate battery, using 3-lb. jam jars, and want to have a resistance. What wire and what length shall I want for 4 cells and 8 cells respectively? I want to have the coils in a wooden case, and would like to know if the wire will get too hot.

There is no difficulty about getting a resistance, but it is necessary to know what you want the resistance for, how much current it will have to allow to flow, etc. As a rule, it is not at all necessary to use resistance coils in conjunction with primary batteries, as by coupling up such cells in various ways you can get any voltage or power required.

[18,967] **Overtype Dynamo Windings.** B. B. (Broadbottom) writes: Being a constant reader of your two valuable journals, THE MODEL ENGINEER and *The Engineer-in-Charge*, I shall be very much obliged if you will answer me the following questions. I have a dynamo I want to wind. I want it to give 100 volts 10 amps. or more at 1,680 r.p.m. How much wire for armature, and gauge? How much wire for field-magnets, and gauge? How many amps. will it give? Armature, 3½ ins. diameter; 36 slots, 3-16ths in. by ½ in., 7½ ins. long; commutator, 18 segments; magnets, 7½ ins. long, built up from soft iron stampings.

The windings for your machine to give 100 volts 10 amps. will be: On the armature use No. 16 S.W.G., and get on as much wire as you can in the space provided; this will probably amount to 3½ lbs. For the field-magnets use 16 lbs. of No. 22 S.W.G. connected in the shunt to the brushes. The machine, we are afraid, will hardly give you 1,000-watt output, but run at a good speed, not less than 2,200 r.p.m., it should not fall far short of this figure.

[18,965] **About Small Dynamo Building.** H. T. (Cardiff) writes: I have purchased "Small Dynamos and Motors" and also "The A B C of Dynamo Design," but I should like to ask you one or two questions. (1) If I made an ironclad dynamo, 300 watts, similar to the 500-watt size described in Mr. Avery's book, would it be an advantage to use field-magnets and casing of wrought iron? Would it economise wire? Would it have any disadvantages besides being rather difficult to excite at starting? (2) I should like a dynamo which would give either 300 or 200 watts at same voltage (50 or 55). Is this possible? Could it be done by cutting out part of the field-magnet coils when running at 200 watts? For instance, I could wind it compound and design it for 300 watts and then cut out the series windings when working at 200. Of course, the armature could not be touched and would have to be wound for greater current. I suppose in this case the same speed would give the requisite voltage in either case? Could you say about what percentage of number of turns would have to be cut out? (3) Has the ironclad type much advantage over others—for instance, the Kapp? Mr. Avery seems to think it is the only kind worth consideration.

(1) As a rule, wrought iron for the field-magnets of such machines is preferable, although, as you say, in some cases it is rather more difficult to get the machine to excite at the start owing to the fact that there may be a very small amount of residual magnetism in the fields owing to their extreme softness. Good Swedish iron castings are almost as suitable and, at any rate, very excellent results may be obtained by machines made of good castings. (2) It is possible, assuming you have a 300-watt machine giving 50 volts, to run that same machine at any output you choose in watts. You appear to have lost sight of the fact that it is speed at which the machine is run which determines the voltage, but it is the resistance in the outer circuit and armature windings which determines the current that will flow, assuming the voltage, that is the speed, to remain the same. Thus, a 300-watt machine need not necessarily be always run at its full output or load. The 300 watts merely signifies that that is the full capacity of the machine beyond which it is not advisable to press it. If you cut out the series windings of a compound machine the effect would be to not only reduce the voltage somewhat, but would disable the machine from adjusting its own voltage automatically when working under heavy loads. When the load on a shunt wound machine is suddenly increased, the shunt field windings are strengthened by cutting out some of the field resistance which is usually in circuit, and inversely when the load is suddenly thrown off a shunt wound machine the voltage tends to rise, consequently a resistance must be inserted in the field windings. With a compound machine this hand regulation of the field strength is to a large extent obviated, hence a compound machine is particularly suitable for certain kinds of work where the load is constantly fluctuating. The ironclad type of machine is certainly a very good type to use for all ordinary purposes, although it is quite possible to have other types of machines which give equally good results. We suppose that it is quite possible that every maker has different views as to which is the best type of machine, and really no definite rule can be laid down either one way or the other.

[19,857] **Partial Failure of Dynamo to Build up.** A. J. W. (Rugby) writes: I have a small undertype dynamo which I cannot get to work, and any suggestions you could make I should be very grateful for. When purchased it had an H armature. I substituted this with an eight-slot drum, built of charcoal iron stampings, properly insulated from each other, and also from the winding. It is 1½ ins. long and 1½ ins. diameter. It is wound in four sections, with No. 24 D.C.C. wire. The field magnets are connected with an iron yoke, which is screwed on; they are of soft iron, and bolted to a brass bedplate; the bobbins are 2 ins. long and 1½ ins. diameter, wound same as armature. The insulation is quite good, and I have also tried reversing the polarity. The clearance between armature and tunnel is a bare 1-16th in. I think this must be the cause of it not building up. Would you advise covering the armature with soft iron wire to lessen the air gap, as recommended in your "Small Dynamos and Motors," which I think is an excellent little book?

The excessive air gap will largely contribute to the partial failure of the machine, and you could safely try winding the armature over with fine iron wire. To get the machine to build up you should make sure you have a fairly good resistance in the outer circuit, preferably about equal to that of the fields. If you have too low a resistance, you will not get any appreciable current shunted through the field windings and consequently the machine will refuse to pick up.

The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

** Reviews distinguished by an asterisk have been based on actual Editorial Inspection of the goods noticed.*

The Stuart Turner Model Making Competition.

Considerable interest was aroused amongst model engineers some months ago by a very handsome list of prizes put up for competition by Messrs. Stuart Turner, Ltd., of Shiplake. A good number of entries were received, and we quite anticipated that a fine show of work would be placed before us for adjudication. Unfortunately for the complete success of the competition, a number of the entrants for some reason or other did not reach the point of actually sending up their work for judgment, so that in the end the competing models were but few in number. These, however, were excellent in quality and showed how well the "Stuart" castings work up in the hands of the amateur. With the expert assistance of Mr. L. M. G. Ferreira, we carefully examined the models at the showrooms of Messrs. Rd. Melhuish, Ltd., and placed them in the following order:—(1) Mr. Bert. Graham's engine built from a No. 1 set of castings; (2) Capt. Craigie Norwell's engine built from a No. 5 set of castings; (3) Mr. A. E. Bennett's engine built from a No. 4 set of castings. The number of competing models in the various classes did not reach the minimum prescribed by the terms of the competition, so the competitors were not eligible for the prizes as originally offered. Messrs. Stuart Turner, Ltd., have, however, generously decided to mark their appreciation of the quality of the work by awarding a gold, silver, and bronze medal respectively to the three competitors whose names we have mentioned. We are asked by Messrs. Stuart Turner Ltd., to state that they are prepared to hold another competition if sufficient prospect of support is forthcoming, and they would be pleased to have a post-card from anyone interested giving his views, or to hear from any of the entrants for the last competition stating why they were unable to send up their models to be judged.

New Catalogues and Lists.

The Southwark Engineering and Model Works, 155 and 157, Southwark Bridge Road, London, S.E.—One of the best produced and most comprehensive catalogues of model locomotives we have yet seen has just been issued by this firm, who may be better known to many of our readers under the name of Messrs. Wright, Clark & Wallis. This firm appear to have fully recognised the remarkable variety of tastes and requirements which exist amongst model locomotive lovers, and they claim for the catalogue they have now issued that in it anyone may find at once the cost of a model of any British locomotive to scale, from 7-16ths in. to 1½ ins. inclusive, in no less than five different specifications. They state that it does not matter in the slightest to what particular railway the desired engine appertains, it being only a question of type and scale, the former referring to the arrangement of the wheels. The same claim applies to anyone requiring a model to his own designs. The five different specifications, or qualities, are carefully set out at the commencement of the book, which then proceeds with illustrations and principal dimensions of the various types. These include Caledonian, Midland, Brighton, Tilbury, Great Northern, Great Western, and North-Eastern engines, the photographs being from actual models built to one or other of the standard specifications in the list. We also note particulars of separate parts, such as inside slide-valve cylinders, crankshafts, boilers, and several well turned out models of passenger and goods rolling-stock. Sets of castings and parts for the 7-16ths in. scale, 2-in. gauge rolling-stock are listed, the carriage bodies being made up of aluminium castings, thus being quite easy to fit up and very strong when built. Several types of horizontal and vertical engines are also included. The main catalogue covers 72 large pages, and is beautifully printed on art paper, the cover being one of Mr. Twining's well-known artistic productions. There are also some supplementary sheets and price lists. The catalogue is one which will be found of great interest by all model locomotive enthusiasts. It is priced at 2s. post free.

The Editor's Page.

THE problem of perpetual motion has been a fascinating one for the mechanically-minded for all time, and technical education will probably never be sufficiently far-reaching in its effects to place this attractive subject finally on the shelf. The old adage of a little knowledge being a dangerous thing, is answerable for most of the persistent efforts on the part of sundry inventors to achieve the impossible; for the perpetual motion seeker usually has sufficient knowledge to know that certain mechanical powers produce certain results, but he has not sufficient knowledge to see that his mechanism cannot possibly produce all the results that he expects. The records of the Patent Offices of all countries contain numberless descriptions of devices which were designed to produce the impossible, and almost every engineer of experience must at some time or another have been asked for his opinion on some weird and wonderful construction for the manufacture of power. We ourselves frequently find the problem cropping up in our Query Department, and just lately there has been quite a little epidemic of perpetual motion schemes. One of the most usual ideas is that embodied in the following letter, which, by the way, is almost identical with another which reached us by the same post :—" I shall be glad to know if it is possible to connect up a dynamo and motor in such a manner that part of the current from the dynamo could be made to supply sufficient power to the motor for driving the dynamo? If so, please give sketch of the connections in next week's paper, and also state what percentage (approximately) of current would be used by the motor. The dynamo used would be a 30-volt 5-amp. one. The motor would be started from a primary battery, and as soon as the dynamo produced current the battery would be switched off and the motor switched on to the dynamo." Obviously such an arrangement, if successful, would solve the perpetual motion problem, but, unfortunately, it will not work. The reason is so simple that it ought not to be necessary to give it, but the fact that at least two of our readers are at the present moment in the dark, prompts us to explain. It is merely that any power machine, whether a steam engine, or a gas engine, or a motor, or a dynamo, or any combination of wheels and cranks and gearing, is bound to absorb a certain amount of the power put into it by the friction of its working parts, so that it can only give out less power than it receives. In a motor or dynamo certain other electrical losses occur, which need not be particularised, but the fact that the motor gives out less power than it receives, and the dynamo gives out less current than the equivalent of the power put into it, is quite sufficient to show that in the combination suggested by our correspondent the available power would rapidly become less and less until it disappeared altogether and the whole affair would stop. It is exactly as though one took two quart cans, each having a hole in the bottom; filled one of the cans with water, and then continually poured the water from one can into the other and back again. It is obvious that every time the water changed over some would leak away through one or other of the holes, until at the finish there would be none left. So with the power as it goes backward and forward from the motor to the dynamo and *vice versa*, a little leaks away in friction and other losses every time, until there is none left. The whole secret of the impossibility of perpetual motion lies in the fact that power cannot be created. It can only be converted from one form to another, and there is always a loss in the conversion.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

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HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

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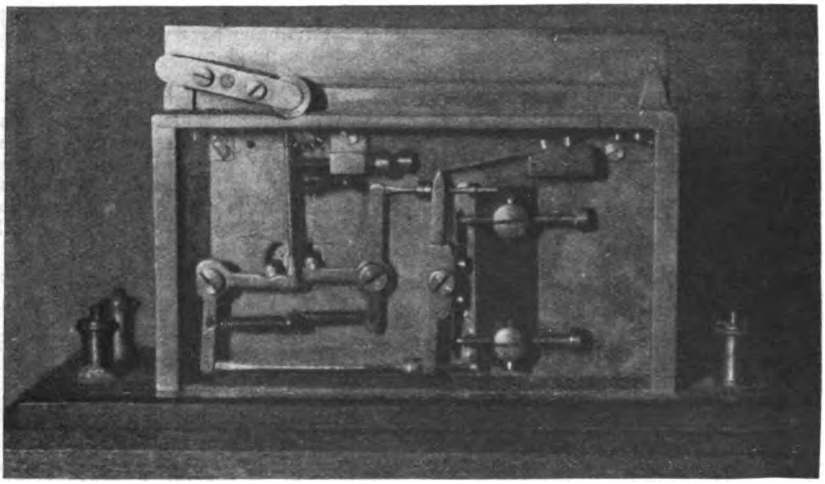
Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE
Model Engineer
And Electrician.
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.
EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.
VOL. XVIII. No. 371. JUNE 4, 1908. PUBLISHED WEEKLY.

A Model Telegraphic Transmitter.

By W. B. FERGUSON.



MR. W. B. FERGUSON'S AUTOMATIC TRANSMISSION APPARATUS.

THE photograph is of a model of the apparatus used by the Post Office and other telegraph services for automatic transmission of telegrams either for purposes of speed or repetition work, such as news messages sent to various towns. It is called the Wheatstone Automatic Transmitter. The messages are punched out (by means of an apparatus called a perforator) on a long slip or tape of paper, and this tape, when passed through the transmitter (which takes the place of the hand key) on a telegraph line, makes the necessary contacts and breaks for the reproduction of the signals on a Morse sounder, printer, or relay at the distant station.

This model was made by the writer some seven or eight years ago in spare time while serving as a learner in the Post Office, and took about a year of odd moments to complete. It was commenced with a view to obtain practice in sound reading (having no one at home who could manipulate the key to give such practice), but by the time it had reached the stage of completion the learner had also acquired proficiency, so that its services were rather belated.

Originally it was encased with mahogany and had a glass front cover slipped up from underneath. Lately, while travelling as a Marconi telegraphist on the Anchor liner *Caledonia*, a neat brass case was made for it, which slips over the apparatus like a jacket, and is fixed to the body of the machine by screws, the glass front being held in place by two brass beadings fixed by screws to the case.

The gearing inside is adapted from a "Bee" clock with a few pieces of scrap brass and steel rod thrown in. The pressure wheel for the tape is adjustable by means of a screw from the side of machine so that it just allows the paper to pass under it without any perceptible pressure on it.

The "key" portion of the transmitter is "platinumed" for both "marking" and spacing currents, but this spacing contact is usually connected to the home sounder for single current working. Four terminals are shown. One is a "dummy," the others are: (1) marking, (2) spacing or sounder, (3) line.

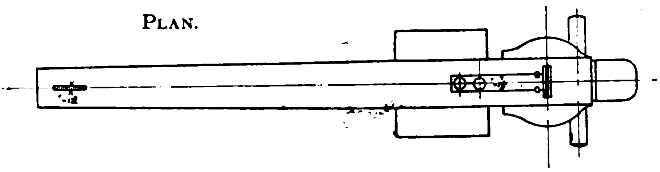
It has no driving mechanism so far, being simply turned by a handle at the back and by turning this at a very leisurely speed the rate of 25 to 30 words is obtained. Beyond this speed it is doubtful if the signals would be good from my model. They would, of course, be unreadable *on a sounder* above this speed even with the Post Office machines, and I have not tried it on the speed printers. Up to 30 words the signals from this model are perfect. It is much simplified from the machines in daily use and was made simply from studying the apparatus in the office and before I had read anything on the subject.

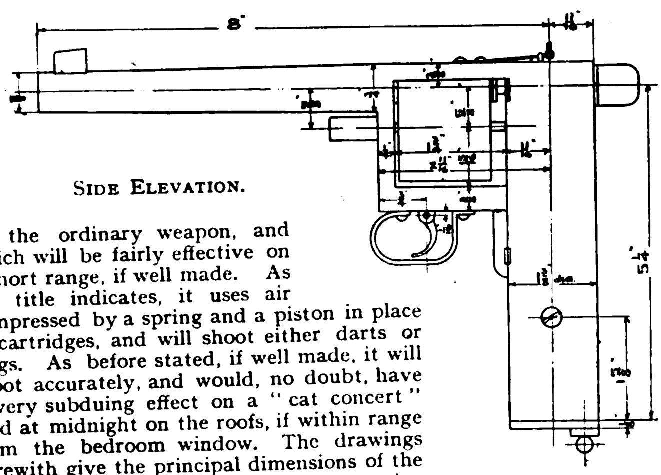
Design for an Air Revolver.

By W. Darling.

THE following is a description of an article which may be of interest to readers of THE MODEL ENGINEER who may have become tired of steam and electrical model making. The subject is a revolver, very similar in appearance

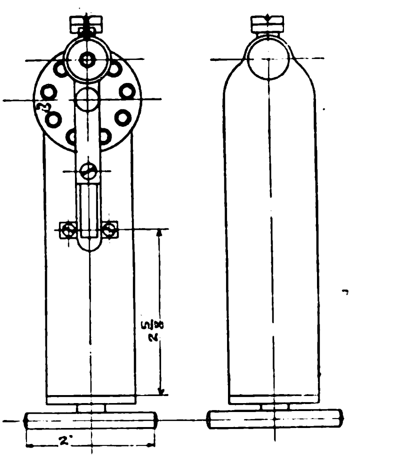
PLAN.





SIDE ELEVATION.

END ELEVATIONS.



to the ordinary weapon, and which will be fairly effective on a short range, if well made. As the title indicates, it uses air compressed by a spring and a piston in place of cartridges, and will shoot either darts or slugs. As before stated, if well made, it will shoot accurately, and would, no doubt, have a very subduing effect on a "cat concert" held at midnight on the roofs, if within range from the bedroom window. The drawings herewith give the principal dimensions of the various parts, and, if studied in conjunction with the description, no one who aspires to make the revolver should experience any difficulty.

As very few tools are necessary, it should be within reach of the majority of model engineers. The drawings being strictly to scale, every detail is proportionately correct, and anyone will be able to form an idea as to the appearance of the finished article. The screwing shown is "Whitworth" in all cases. This is, however, immaterial.

The first thing to do is to make a pattern of the body for a casting, which may be either in cast iron, aluminium, or soft yellow brass. I prefer the latter, as it is very easily worked and soldered. Although rather more expensive, I think, when finished and highly polished, or plated, it will have repaid a little extra outlay.

The pattern should present no difficulty to anyone possessing a lathe. It will also be advisable to have the magazine (Fig. 1) cast; this, of course, will mean another pattern. Having obtained a casting of the body of the revolver, the first thing to do will be to drill a ⅜-in. hole from the muzzle downwards, to about three-quarters of the total length; this done, drill from the opposite end until the two holes run into each other.

The reason why this method is adopted is this (even supposing a drill sufficiently long to pass through the total length was available): it is imperative that the steel tube (Fig. 2) should be central. The hole at the muzzle end being central, as is that at the butt end, the tube will also be so, the clearance allowing for any slight irregularity. The butt should be drilled next, and finished off with a reamer, if possible, in order to get it smooth inside; the space for the magazine should now be finished off. This done, get a piece of steel tube (Fig. 2) 3-16ths in. internal diameter by 5 11-16ths ins. long. In order to get this fixed centrally in position proceed as follows:—

Obtain a piece of straight steel rod 3-16ths in. diameter and about 9 ins. long; push this down the tube, and insert the whole into the body, placing the end of the tube flush with, and in the centre of, the muzzle; pack the space between with pieces of wire to hold it central. The end of the rod will now project beyond the butt end. This should also be packed central.

The clearance space between tube and the metal of the barrel must now be filled up with solder, and by holding the revolver muzzle downwards and heating it, the solder may be run in from the magazine space. Needless to say, the outside of the tube should be bright, and coated with a good soldering flux, in order that the solder may "take." When cool, the rod may be withdrawn. Next, mark off and drill a ⅛-in. hole through the centre

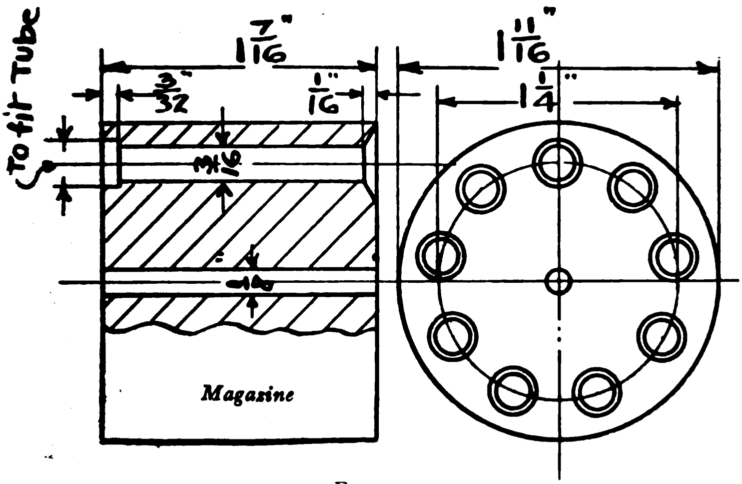
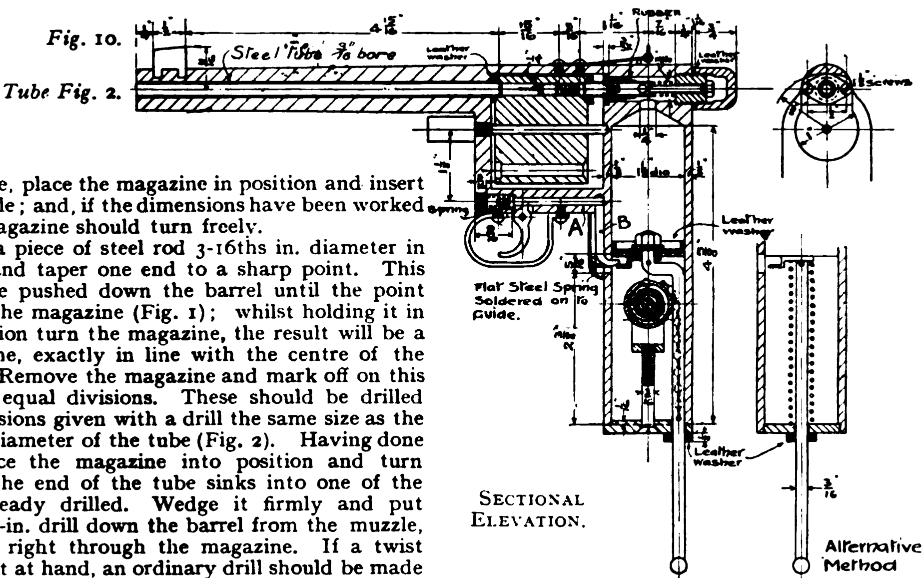


FIG. 1.

of the magazine (Fig. 1), after which it should be placed on a mandrel and turned down to dimensions given, taking very light cuts. The holes for the magazine spindle in the body should now be drilled and tapped, and the spindle (Fig. 3) turned.



SECTIONAL ELEVATION.

This done, place the magazine in position and insert the spindle; and, if the dimensions have been worked to, the magazine should turn freely.

Place a piece of steel rod 3-16ths in. diameter in a lathe and taper one end to a sharp point. This should be pushed down the barrel until the point touches the magazine (Fig. 1); whilst holding it in this position turn the magazine, the result will be a centre line, exactly in line with the centre of the barrel. Remove the magazine and mark off on this line nine equal divisions. These should be drilled to dimensions given with a drill the same size as the outside diameter of the tube (Fig. 2). Having done this, place the magazine into position and turn it until the end of the tube sinks into one of the holes already drilled. Wedge it firmly and put a 3-16ths-in. drill down the barrel from the muzzle, and drill right through the magazine. If a twist drill is not at hand, an ordinary drill should be made out of a piece of 3-16ths-in. tool steel. This method will ensure every hole being in line with the barrel, which is an important feature.

Having finished the magazine, the gland (Fig. 4) should be attended to. This is made up of a piece of tube similar to the barrel, with a brass washer soldered on to one end, and a piece of brass wire on to the other. On the brass washer is a leather washer held on by seccotine. It will be seen that the tube projects beyond the leather washer a little; the object of this is to prevent the leather being torn off when the magazine is rotated. When in the countersunk holes in the magazine the pressure due to the spring is entirely sustained by the leather washer, thus making it quite air-tight.

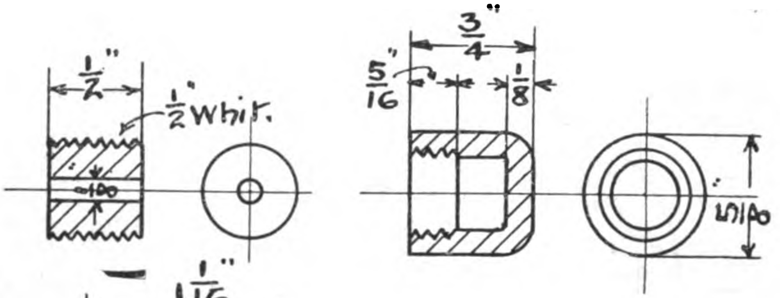
On referring to the sectional elevation, it will be seen that a rubber diaphragm intervenes between the gland tube and the revolver body at the butt end. This is a piece of rubber, such as is used for repairing punctures in bicycle tyres. A small hole is cut in a piece of this rubber and the tube (Fig. 4), well covered with seccotine, inserted. When dry, place the tube in position, screw on the cover (Fig. 5), and remove the superfluous rubber; next, insert the spiral spring into the opposite end, and, whilst holding the tube (Fig. 4), screw down the brass plug (Fig. 6), and the nut on to the tail of the gland tube. The object of the nut is to prevent the spring forcing the gland tube out and injuring the rubber when the magazine is removed.

The piston is actuated by a clock spring, enclosed in a brass drum (Fig. 7), similarly to that in some kinds of watches, the connection between the piston and drum being made by a piece of light steel chain, which is very flexible and strong. The drum rotates on a steel spindle (Fig. 8) held in a brass carrier (Fig. 9), the end of the spring being secured by a small rivet, and to the spindle in a manner similar to that adopted in clocks. The spindle is prevented from turning by the square end, which fits into a similar hole in the carrier (Fig. 9).

The reader will observe the long screw (3-16ths in. diameter) passing through the cover in the butt carrier (Fig. 9) is removed. A ⅛-in. hole is drilled in the drum, exactly in line with the tapped hole in the carrier, and, when about to remove the piston from the revolver, first withdraw the long screw and allow the cover to drop down; next pull out the piston-rod to position shown in sectional elevation, re-insert the screw, and screw it down until the end enters the ⅛-in. hole in the drum; the other screws may now be removed without any danger of the spring becoming uncoiled.

The sights should now be attended to. The fore-sight (Fig. 10) is made out of a piece of sheet steel or brass 1-16th in. thick and

FIG. 6.



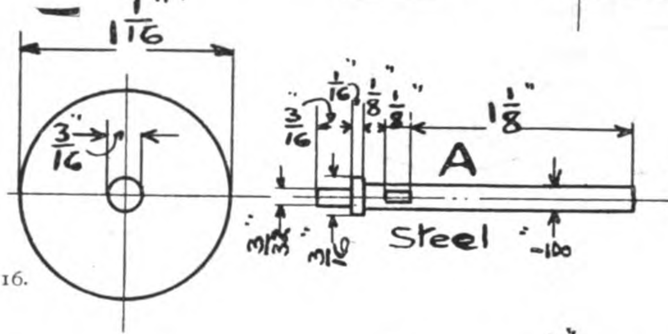


FIG. 16.

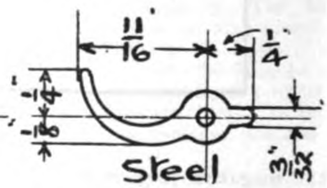


FIG. 18.

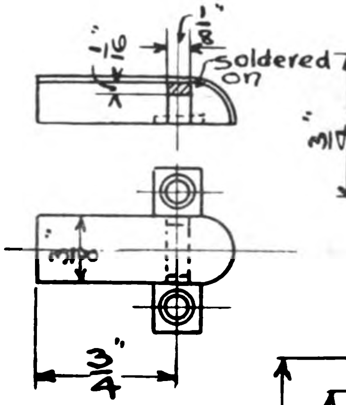


FIG. 17.

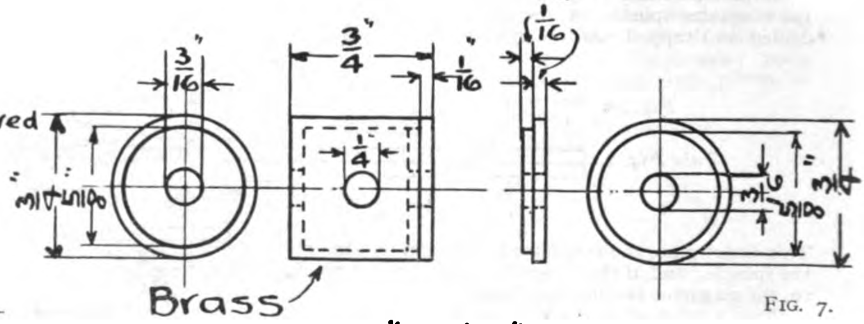


FIG. 7.

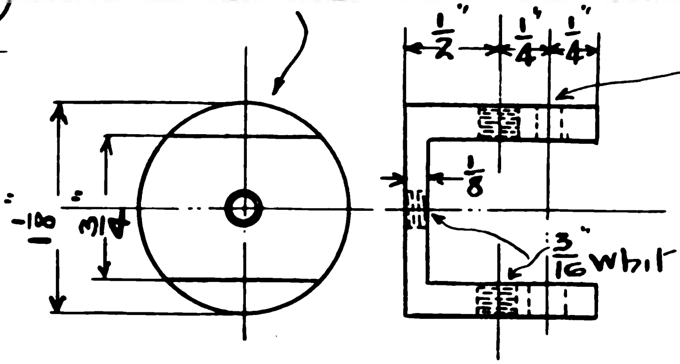


FIG. 9.

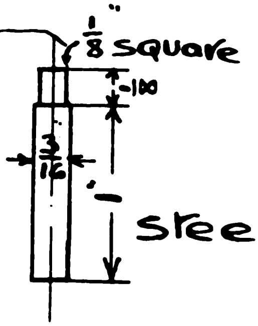


FIG. 8.

and screwed into the carrier; the purpose of this is twofold—one is as already explained, the other is to prevent the drum (Fig. 7) rotating when the soldered into two ⅛-in. holes in the barrel. The back-sight (Fig. 11) is made in such a manner as to be adjustable for vertical and lateral movement. One end of a piece of thin sheet steel ¼-in. wide is fastened to the revolver by means of two ⅛-in. screws. To the other end is soldered a piece of ⅛-in. tube (Fig. 12), with a sawcut in it, as shown. In this tube is placed a piece of steel (Fig. 11), filed to dimensions given and made a sliding fit, which will allow of lateral adjustment. A piece of wire (Fig. 13) is bent over at the ends to embrace the thin steel, and is also left a sliding fit, which will regulate the elevation. Having completed the description of the principal details, I will now explain the manner in which the revolver works. In the sectional elevation it is shown ready for firing. When the trigger is pulled it moves the ⅛-in. steel rod A along, until it is clear of the rod B, which, being left unsupported, also moves outwards and upwards, owing to the pressure on it from the piston. The movement con-

Fig. 11. Fig. 12. Fig. 13.

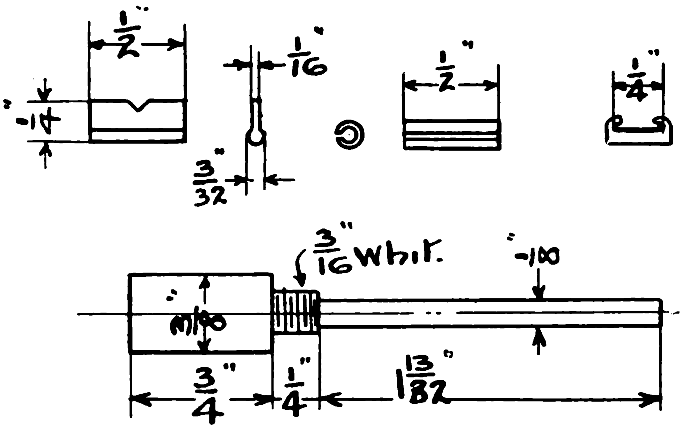
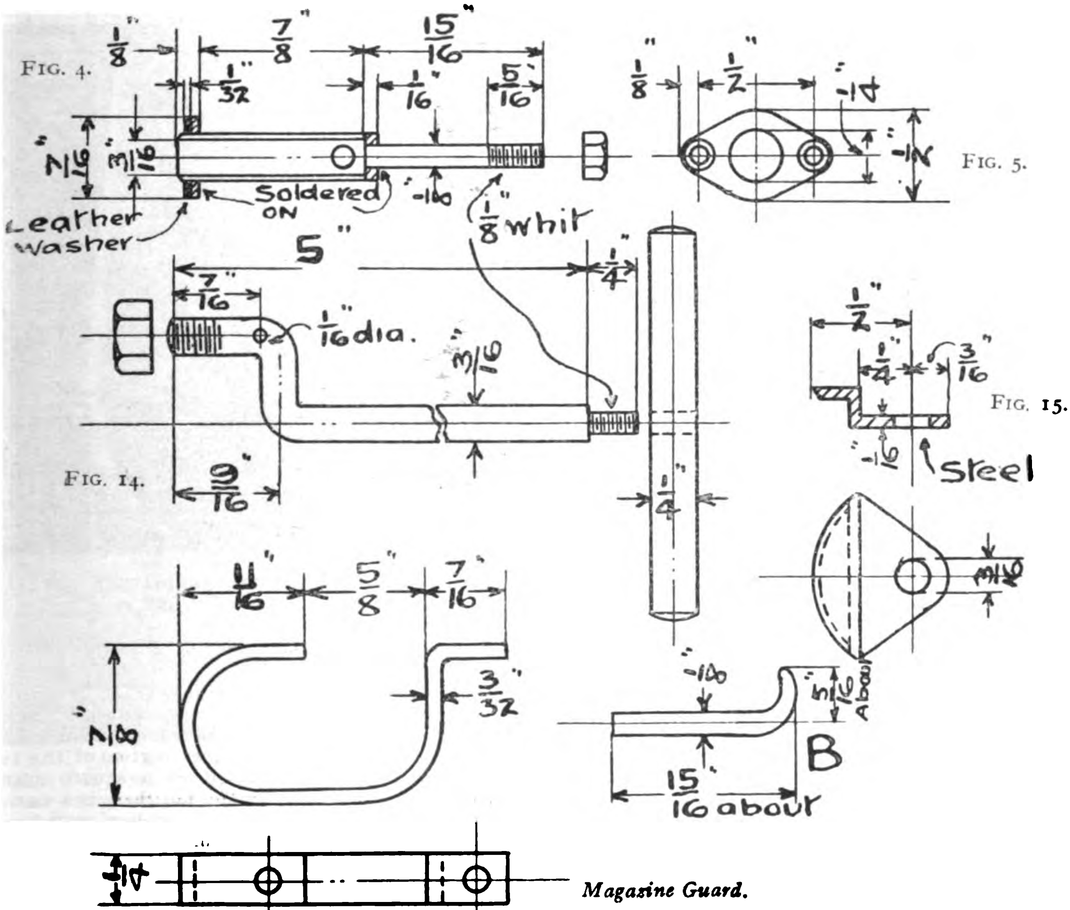


Fig. 3.



DETAILS OF DESIGN FOR AN AIR REVOLVER.

tinues until the piston is free. The chain is now coiled upon the drum, owing to the spring inside, and the piston is brought sharply to the end of the stroke; this, of course, compresses the air above it, and, to escape, must drive the dart (shown dotted) out of the barrel. To load again, first pull the piston outwards by the cross-piece on the piston-rod (Fig. 14), and as the rod B is lying in the same position as when after discharge, *i.e.*, the end of the hook B is just inside the cylinder, quite clear of the steel catch (Fig. 15), and as the steel washer (Fig. 16) comes along, it of course takes hold of B, carrying it with it. The rod comes in contact with the guide (Fig. 17), which forces it inwards, and when sufficient movement has taken place the rod A is forced under the end by the spiral spring, thus preventing B from returning. The magazine should now be turned on to the next hole, and the revolver is ready for the next shot. When the chambers are empty, remove the magazine and refill. After firing, the magazine should not be turned until the piston has been drawn back. The leather washer on the piston may be obtained from any cycle dealer, as it is similar to that used in inflators.

If the revolver works unsatisfactorily, another clock spring should be placed in the drum (Fig. 7), if there is room, and the piston should be well lubricated. The travel of the trigger (Fig. 18) before the release of the piston may be altered by filing the end of the rod A.

The reader will notice a thin flat spring pressing on the hooked end of rod B; this is to force the rod towards the magazine after firing, as, should it drop down towards the cover, the piston will not catch.

Now as regards the sighting; if the shots should be going low all that is necessary to do is to move the bent wire (Fig. 13) underneath the back-sight a little towards the muzzle. This will raise the sight and also the elevation of the shots on the target; if the elevation is correct, and the shots go to the right, move the sliding leaf (Fig. 11) in back-sight slightly to the left. There will be no difficulty in remembering that the revolver shoots to the side to which the sight is moved.

The reader will observe an alternative method of compressing the air, by means of a spiral spring. This, I think, is not so good as the other method, because the spring must be pressing down the piston with considerable force when at the end of the stroke in order to get the necessary air pressure on the dart or slug. The pressure required to compress a short spiral spring increases enormously when the limit of compression is nearly reached. This will mean a considerable increase in the pull required when the piston is about to "catch."

With the spring enclosed in the drum the pull required will be fairly constant. The reader should note that the spring shown in the alternative method is only diagrammatic, and must not be taken as a guide when selecting a spring. I fear that I must not trespass further on the Editor's space, so will finish by wishing all would-be gunsmiths the best of luck.

ACCORDING to the *Chemiker Zeitung* the production of calcium carbide in Argentina has increased from one ton to four tons a day since the year 1900. In that year a Cordoba factory first commenced its manufacture.

Experiments on Electric Oscillations and Waves.

By R. P. HOWGRAVE-GRAHAM, A.M.I.E.E.

(*Continued from page* 514.)

AMONG other experiments which have been described without photographs in previous issues is one which illustrates the production of heavy currents by means of a step-down transformer with a single-turn secondary of broad brass strip. On August 29th, 1907, a photograph was published showing the sparks obtained by short-circuiting the terminals of the transformer with an old file.

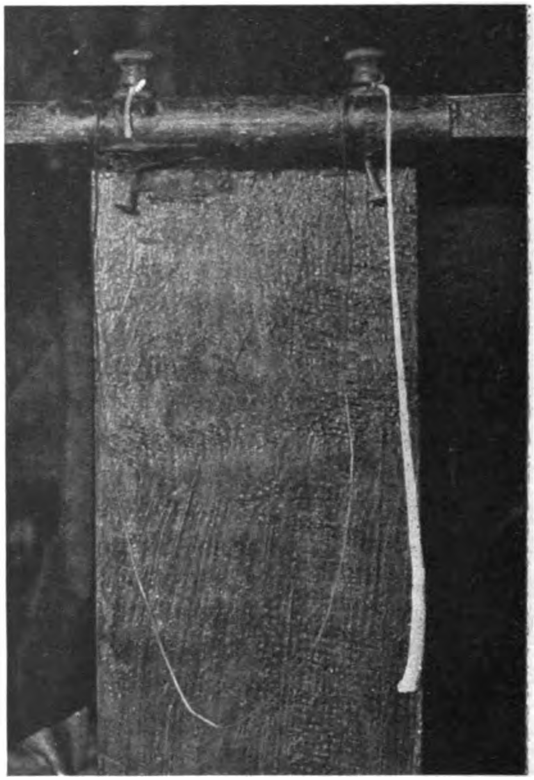


FIG. 62.—FUSED WIRE IMMEDIATELY AFTER RUPTURE. (*Half size.*)

The accompanying photographs (Figs. 61 and 62) show the fusing of an iron wire connected across the terminals so as to hang in a loop. The photograph (Fig. 61) shows the upper portion of the turn of strip, which is supported by a square frame. When the wire becomes white hot there is a curious appearance as though drops of molten metal were running downwards over its surface. Possibly there is a semi-flexible skin of oxide formed within which an actual flow or run of the metal can take place. Shortly after this effect is visible, the wire melts at some point and breaks the circuit. The above photograph (Fig. 62) shows the wire immediately after the rupture, with a globule of molten iron hanging on one of the broken ends. Part of the wire has dropped away. The photographs were taken with preliminary magnesium exposures and this is why the unfused wires are visible in both cases. The wire was about a foot in length. Good brush discharges can be obtained from the small piece of apparatus shown in Fig. 63. This consists of a brass ball into which a short length of brass rod is

The joints between brass and ebonite, ebonite and glass, or glass and wooden base may be secured with hot shellac, or better, with "electrician's" wax. Before attaching it to the insulating stem the ball is drilled in nine symmetrically arranged places, the tenth being occupied by the stem. Lengths of hard brass wire are soldered into the holes, after which the ball of bristles so produced may be painted if it is considered desirable.

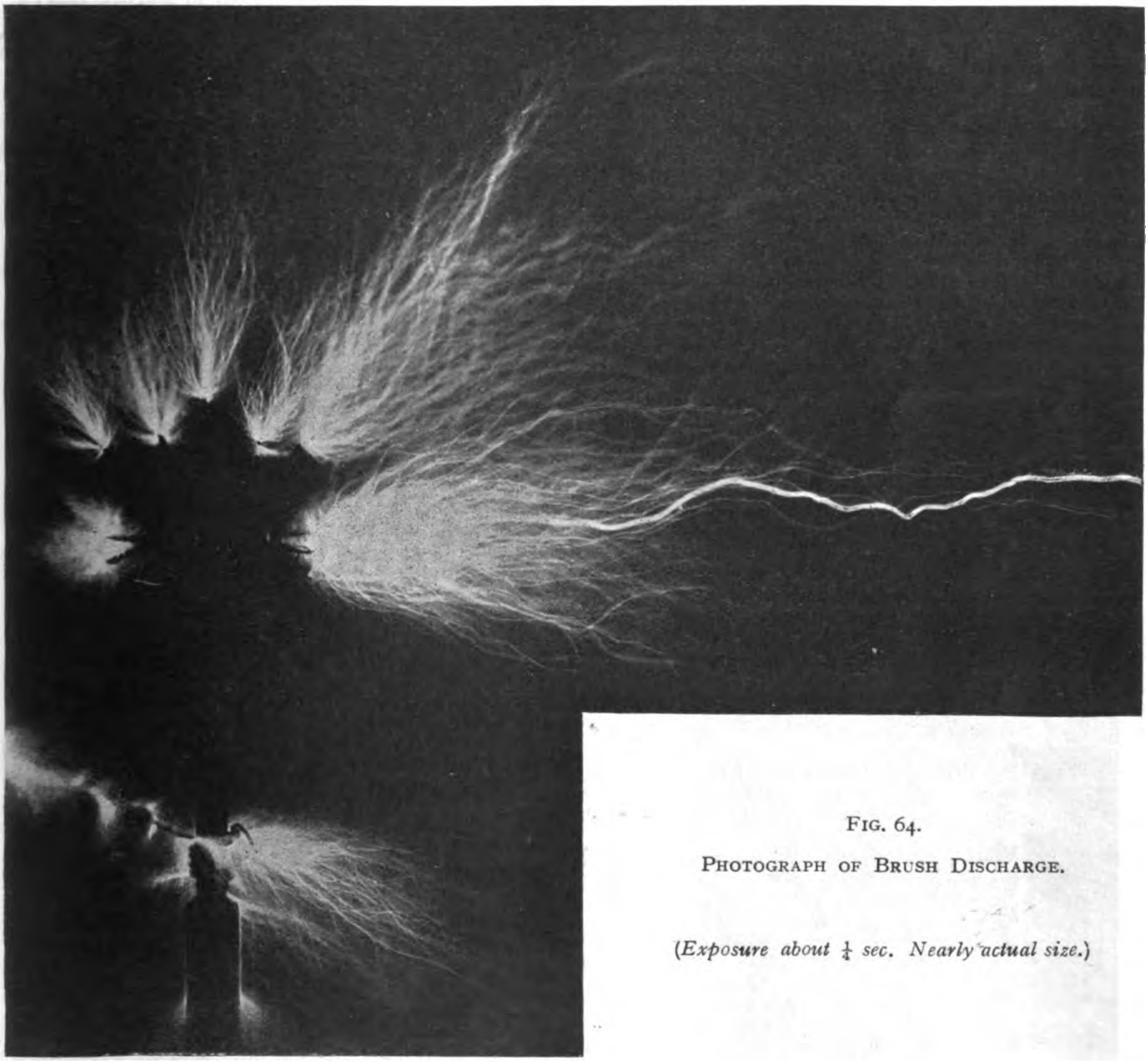


Fig. 64.

Photograph of Brush Discharge.

(Exposure about ¼ sec. Nearly actual size.)

screwed. A hook of wire is soldered to this rod, so as to make connection easy. The ball must be mounted on a very long stem of insulating material, which can be let into a wooden base so as to stand vertically. The insulating stem may be of stout glass tube, and the brass rod may be let into the end of the tube or may be adapted to it by a piece of ebonite rod turned and drilled to fit the glass tube and the brass rod.

The ball shown in the photograph was about ¾ in. in diameter, and the projecting length of the bristles was about ½ in.; but the reader is advised to make the ball considerably smaller, or even to try soldering the wires in a bunch and bending them back as required. When completed, this discharger may be connected to one terminal of the Tesla coil, while the other terminal is connected to a large insulated metal plate. If the ball stands isolated at some distance from the plate, a symmetrical sphere of brush discharge surrounds it, but if it is brought nearer to the plate the brush discharges concentrate very vigorously towards the plate, and occasionally there will be a direct spark. The

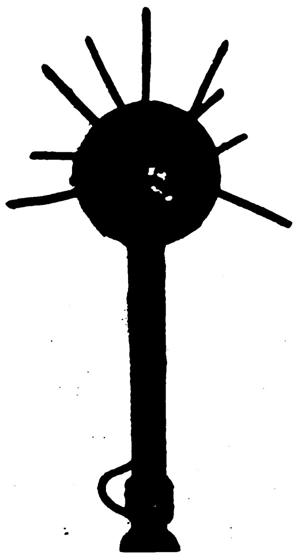


FIG. 63.—BALL WITH WIRE BRISTLES FOR PRODUCING BRUSH DISCHARGE.
(*Actual size.*)

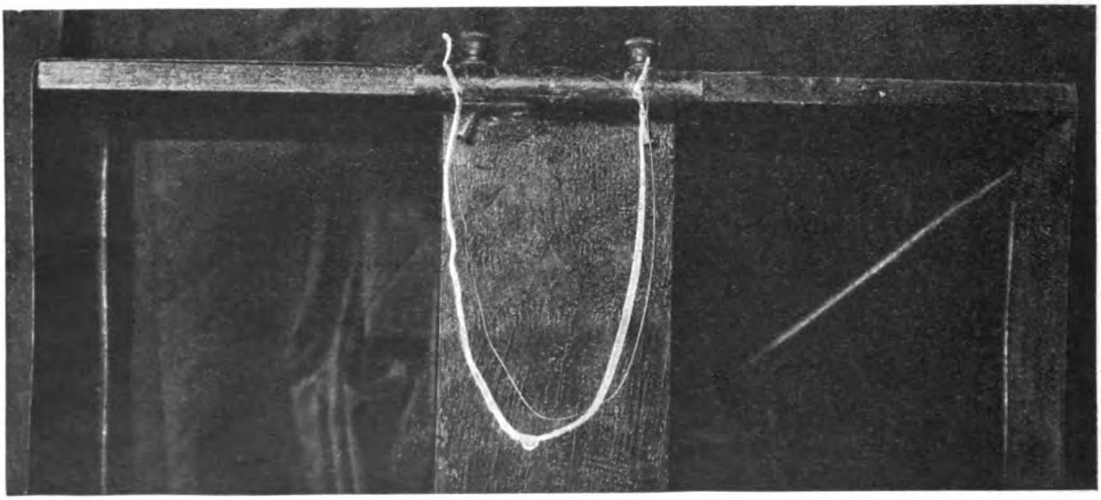


FIG. 61.—IRON WIRE FUSED BY CURRENT INDUCED IN A SINGLE TURN OF BRASS STRIP.
(*About one-third actual size.*)

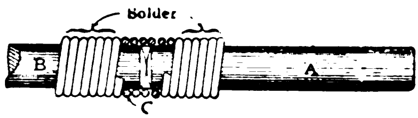
photograph (Fig. 64) had an exposure of about a quarter of a second and shows a direct spark among the brushes. As is usual with such photographs, it gives but a poor idea of the beauty and extent of the actual effects obtained, and fails to show the delicate streamers beyond the main brushes, while the brilliance and illumination of the latter are somewhat exaggerated. (See former articles.)

(*To be continued.*)

Flexible Drive for Small Drill or Boring Bar.

By H. D. BENNEY.

IT is sometimes desirable, when using a drill or boring bar, in cases where the bar is used in connection with guide bushings in a fixture, to provide a flexible drive in order to avoid any tendency to cramp the bar. The accompanying sketch shows a simple and inexpensive form of universal joint which has been used successfully by the writer for



driving small boring bars and drills, in cases where the fixture bushings have been more or less out of line with the driving spindle. It consists of the boring bar or drill B and the short shank A, the ends of each being slightly convex, as shown. The spring C is wound close, slipped over the joint, and soldered at each end. The spring should be wound so as to fit the cores, and in such direction as to cause it to have a tendency to close tighter on the cores from the resistance of the cut. The ends of the bar and shank being convex, the flexibility of the spring will readily permit of considerable deflection in the alignment of the bar and driving spindle.—*American Machinist.*

Wires for Electrical Apparatus

By A. W. M.

A SMALL difficulty which presents itself to the amateur maker of a dynamo, electric motor, or other piece of electric apparatus, is the technicalities in connection with wires for winding the coils or making the connections. He knows that "insulated" wire is required, but probably is quite in the dark as to the meaning of the term from a trade point of view. Probably also his acquaintance with wire has been limited to the copper wire as sold by local ironmongers for the old-fashioned mechanical bell work, and to the iron wire sold for garden purposes, etc. The purpose of this article is to assist such a novice with some practical information on the subject.

Wire used for the coils of electric apparatus has to convey a current of electricity throughout the winding and confine the flow to the body of the wire so that it cannot leak or escape until it has reached the end of the length which has been so wound up. If you wind a length of bare wire into a coil so that the turns touch those adjacent to them and connect the ends of the coil to a battery, the current will not be confined to the body of the wire throughout its length. It will go across from one turn to another finding the path of least resistance between the ends of the wire. The turns will be, in electricians' language, "short circuited," and the coil will not produce the electrical effect for which it was designed. To confine the flow to the body of the wire throughout its length it must be made "electricity tight," as a length of steam piping must be "steam tight" to confine the flow of steam to the length of piping. In fact, the wire must be surrounded throughout its length by some substance across which the flow of electricity cannot pass. There are a variety of such substances. All are non-metallic; air is included in the list. If an air space can be maintained around the wire throughout its length, it will be "electric tight." An example is a telegraph line wire, which is supported upon porcelain insulators at the poles, but is air-insulated throughout its length. Another example is a resistance coil of one layer stretched like a spring between insulators. It is impracticable to have the wire entirely air-insulated when wound into a coil consisting of more than one layer. A partial air-insulated method of winding coils is in use and illustrated by Fig. 1. The wire is wound so that each turn in a layer is separated from the next by an air space. Each layer is separated from the one beneath and on top of it by a sheet of paper or other similar insulating material. The turns must be wound with sufficient tension to keep them in place. Such a method is not economical of space. The more closely a given coil space can be filled with wire, the more efficient will be the coil. The most convenient and economical method is, therefore, to entirely cover the wire with some insulating substance so that the turns can be wound as close as possible to one another, the insulation preventing the metal from coming into contact. No air space between the turns is then necessary, and they may be wound on tight or slack as desired. The pioneer electricians were obliged to do their own wire covering, as no demand then existed for insulated wires, and early examples of electrical apparatus show the difficulty and trouble which these workers must have been put to in making the coils of their magnets and other appliances with which to conduct experiments. A coating of varnish would be excellent if it could be very flexible, and yet sufficiently hard to withstand the pressure between the turns of successive layers of wire in a coil. It would also have to stand a fairly high temperature without becoming soft or liquid, as all coils of wire used in electrical apparatus become more or less heated by the flow of current through the wire. Varnishes for which such qualities are claimed may be procured, but the usual trade insulated wires are covered (some makers use the term "lapped") with cotton, silk, indiarubber, or gutta-percha. Combinations of these coverings are used.

The wire in common use for armature and magnet coils is copper of a high degree of purity. It is measured for size by its diameter to a wire gauge, the sizes going by numbers. Three principal gauges are in use; in each the small numbers indicate the largest diameter wires. In English practice that now most referred to is the Legal Standard Gauge, sometimes referred to as the Standard Wire Gauge (also called Imperial), abbreviated to L.S.G. or S.W.G.; wires are usually made to this. Makers usually commence with No. 8, which is ·160 of an inch, or 4·064 millimetres in diameter, and is the largest which can be conveniently handled for small work, being rather more than ⅛ in. diameter. Large size wires do not bend easily, and require to be strained or hammered into place. This damages the insulation, and is to be avoided as much as possible. The smallest gauge advisable is No. 40, which is ·0048 or ·1219 millimetre in diameter. Smaller gauges are made, but should be avoided when possible, as the wire is fragile, and the proportion of space taken up by the insulation to copper becomes very pronounced. The numbers go consecutively 8, 9, 10, and so on; but even number sizes are, as a rule, more readily obtainable. Odd number sizes, however, are made, and, if not in stock, may be obtained to order, except perhaps in some of the sizes smaller than No. 28. It often happens that an odd number size is much more suitable for some particular winding than either of the even numbers, larger or smaller. If you are unable to obtain it from a dealer, you will probably be able to obtain it from an electric wire manufacturer direct. The other two wire gauges are the Birmingham (abbreviated B.W.G.), and the American Brown & Sharpe gauge. The three gauges do not correspond entirely. Some numbers are common to the three and of the same size, others differ. It is therefore necessary when ordering wire to specify the name of the gauge or to give the diameter. Continental electricians usually ignore gauges and specify the diameter of the wire in millimetres, thus No. 20 L.S.G. is ·914 millimetre; No. 8 B.W.G. is 4·191 millimetres. When ordering from an English maker or dealer, it is advisable to specify to L.S.G. It may happen, however, that a size in B.W.G. is more adapted for your purpose; in this case specify B.W.G. Then the question will arise as to whether you have obtained that which you have ordered. If you have a micrometer calliper you can check the size by measuring it and referring to a wire gauge table. Makers of wire usually publish a useful list giving the sizes of wires in gauge, inch and millimetre measurement. Such a table is convenient for reference if you are doing much electrical work; tables of wire gauge sizes are also usually included in engineering pocket-books. The measurements always refer to the bare wire.

Cotton and silk coverings are usually double or single, though for special purposes treble-covered wire is also made. Each covering consists of a lapping composed of a number of strands of the material wound side by side upon the wire by a machine. The lap thus forms a flat strip which is wound screw fashion upon the wire, as shown by Fig. 2, which represents a single-covered wire. A single covering is quite sufficient for some purposes, such as the field-magnet coils of small dynamos and motors, or the bobbins of electro-magnets for bells and similar apparatus. Single cotton-covered wire is known by the trade as "s.c.c." wire, and single silk-covered as "s.s.c." wire. A single-covering is not

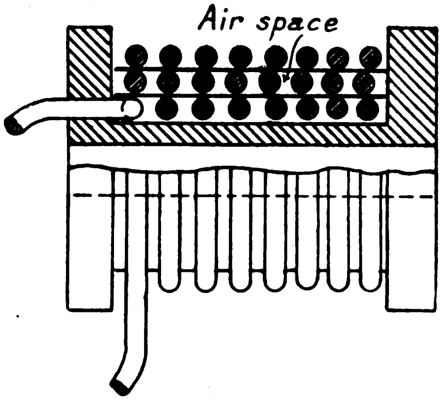


FIG. 1.

entirely satisfactory for such purposes as armature coils, where the wire has to be bent round comparatively sharp corners, or is liable to be pressed tightly into slots and under binding wires. The strands may open and disclose the surface of the wire. To prevent this a double covering is used, which, in addition, doubles the thickness of insulating material so that there will be four layers between adjacent wires instead of only two. The second covering consists of a similar lapping to the first, but wound on top of it in the opposite direction. Thus, if the first covering is right-handed screw fashion the second would be left-handed screw fashion. Fig. 3 shows a double covered wire. The two lappings thus lock one another and prevent sideways movement of the strands. Double cotton-covered wire is known as "D.C.C." wire, double silk-covered is known as "D.S.C." wire. The tendency for the strands to open increases with the diameter of the wire. All sizes larger than No. 18 gauge are preferably double covered for all purposes; if the covering is silk, it should preferably be double for sizes larger than No. 24 gauge.

If a further protection is required a third similar lapping is put on or the third covering may be braided on as Fig. 4. Wires covered thus would be specified as treble cotton or silk covered, or double cotton or silk covered and braided. Makers will cover wire to specified thicknesses of covering to special order. Ordinary cotton and silk covering of good make is usually about 3 to 3½ mils in thickness. The mil is equal to one-thousandth of an inch. Wire makers generally refer to the covering as so many mils in thickness. A single covering will therefore increase the diameter by approximately ·007 in., and double covering by approximately ·014 in. Wire for electrical purposes is sold by weight, and not by length; it is obtainable in small as well as large quantities. The approximate length per pound of any gauge is, however, known by the makers; so that if you cannot state the weight they can easily compute it if you state the length required.

Covered wire of rectangular section can be obtained as well as circular section. Generally it is not worth while going to the trouble of obtaining this, as circular section wire meets usual requirements. But occasion may occur when it is necessary to get as much copper as possible into a given winding space; rectangular section wire will then give an advantage over circular section. Or perhaps a circular section wire may be too stiff to bend convenien ly. The same sectional area can be obtained in the form of a thin flat section easily bending in one direction. When extreme flexibility is required, it is obtained by stranded wire. The wire is then composed of a number of very thin wires bunched together and covered with cotton or silk as before. For example, one size may be composed of 23 No. 40 gauge wires, or 112 No. 32 gauge, and so on. These flexible wires are convenient for heavy current armatures, connections from brushes to terminals, series coils for compound windings, ammeter bobbins, etc. As usually made they are double cotton-covered, or D.C.C., and braided.

The principal value of copper for electric wires is its low resistance and comparative cheapness. Pure silver has a slightly lower resistance, but is expensive. Low resistance is not always a desirable quality for wires used in electrical practice. On the contrary, a comparatively high resistance is required in wires used specially for the purpose of absorbing or choking back voltage. Iron wire is often used for this purpose; it is cheap and has a resistance according to quality about six to eight times that of copper. Another wire is that known as German silver, which is really a kind of brass (copper, zinc and nickel). It has a resistance of about 12½ times that of copper, and can be obtained bare or covered from electric wire makers. There are other kinds of brass alloy resistance wires made by various makers, the object being to obtain a material which has a higher resistance than German silver and as small a temperature coefficient as possible. That is, the resistance shall not increase by an appreciable amount if the temperature of the wire increases either by external heat or by the heating effect of the actual flow of current through the wire. For some purposes, such as a resistance to be used in series with an arc lamp or an electric motor, a moderate increase of resistance in the wire would not matter; but in the case of resistance coils used for electrical testing and measurement, an increase of resistance with any rise of temperature, or, conversely, decrease of resistance with fall of temperature, may be very objectionable. These special resistance wires are useful on account of their comparatively high resistance, which makes it possible to economise both in space and length of wire when making up resistance coils for regulating the speed of motors and similar purposes. Three well-known brass alloys are "Platinoid" (which is not platinum, but German silver and tungsten), "Eureka," and "Manganin." They are all made by Messrs. The London Electric Wire Company, Golden Lane, London, E.C. Platinoid has about 24 times the resistance of copper, Eureka 30 times, and Manganin 25 times that of copper. The temperature co-efficient of Eureka wire is practically nothing. Wires of a similar kind are made by other firms. Another class of resistance wires are made of steel alloy. They have a very high resistance, but are liable to be brittle in places. In spite of this, however, they are very useful. Several firms make them, each having its own peculiarities. "Beacon" resistance wire, made by Messrs. Brunton, of Musselburgh, Scotland, is a good example of the class.

The defects of manufacture which may be found in covered wires are: unevenness of the covering, bare places, joints in the wire, inaccuracy of gauge, and, in the case of copper, hardness as compared with first-class quality metal. In the best quality these defects will occasionally occur; they are more

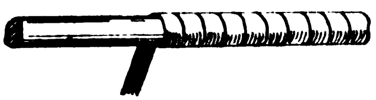


FIG. 2.

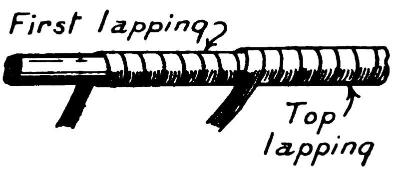


FIG. 3.

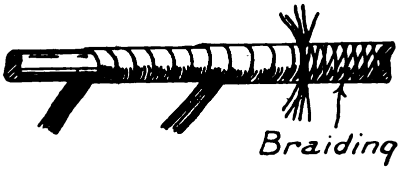


FIG. 4.

prevalent in the lower-priced wires; they should be looked for whenever likely to interfere with the work. Unevenness of covering means that the lapping will be thick in places, and lumps occur where the cotton or silk has come to an end or broken and a joint has been made. This may be troublesome for armature winding, and causes waste of space in magnet coils. Bare places means portions where the wire has moved faster through the machine than the normal rate, with the result that the turns of the covering do not lap over each other. The covering then appears as a distinct screw thread, the bare surface of the wire showing between the turns. Such places are liable to cause short circuits if the wire is wound into a coil, such as for a field-magnet, and should be covered with thin paper or other suitable material. Joints in the wire are bound to occur, as the wire must be drawn to finite lengths. If well-made—and they are made so by good makers—no trouble will be experienced. But if carelessly made they are liable to open perhaps after the wire has been wound into a coil and varnished and finished off. The heating of the coil due to the flow of current through it causes the wire to expand; the joint opens and breaks the circuit. Sometimes the joint closes again when the coil becomes cool, so that some trouble is caused before the reason of failure is discovered. If the copper is of inferior quality and hard, it springs when wound instead of lying easily in place; it is also liable to crack when wound into coils.

Covered wire for installation work is always of copper, and frequently coated with tin to prevent corrosion. The covering is usually a combined one, consisting of a sheath of indiarubber, over which is a lapping of prepared tape. Over this a protective covering of cotton or other similar material is braided and finally coated with an insulating compound. Both single and stranded wires are made; the latter is convenient where the wire has to be coiled or bent. Twin wire is also made, and consists of two single insulated wires placed side by side and covered with braiding, which is finally coated with insulating compound. Wires for use in damp situations are made with an outer covering of lead, and known as lead-sheathed wires. The lead covering is put on over the insulation by hydraulic pressure, so that the wire with its insulation is really enclosed in a seamless lead pipe. When wires are required to be flexible and yet protected from injury, an outer covering of phosphor bronze or steel wire is braided over the insulation. Such wires are known as "workshop flexible," or "armoured flexible." Flexible wires suitable for suspending lamps and making connections consist of a large number of exceedingly thin wires, usually No. 36, 38, or 40 gauge. The covering may consist of indiarubber lapped over with strands of cotton over which is a fancy covering of cotton or silk braided on. Various patterns and colours are made, so that the wire can be selected to suit fittings and decorations. This kind of wire is usually known as "flexible cord," and may be obtained single or twin, the latter consisting of two completely covered wires merely twisted together. Single wire is not usually kept in stock, and the demand is nearly always for twin wire, but it is easy to untwist the twin wire and thus obtain single cord.

When purchasing ordinary cotton or silk-lapped wire the low-priced wire is usually less closely covered than the higher-priced wire, and therefore more space is wasted by insulation. Some makers also seem to produce better covering in some gauges of wire than they do in others. When the quality of the wire is of some importance, and you are going to buy a fair amount, it is a good plan to ask for samples so that you can judge the covering, quality of wire, and gauge. For example, you may intend to buy a quantity of No. 40 gauge D.S.C. wire for induction coil making. One sample will be somewhat hard and springy and another nice and soft, each being equally well covered. The latter make will be easier to deal with when winding the coils.

IN connection with the project of forming a Pit Pony Society in the Midlands a meeting of Midland colliery managers was recently held, when the proposal was discussed and favourably received. A further meeting is to be held, when Mr. W. J. Wills, of Dodworth, Secretary of the Yorkshire Society for the Promotion of Kindness to Pit Ponies, will give an address.

An Electrical Engraving Machine.

By H. A. Stevenson.

THE following is a description of an electrical engraving machine, which I have just completed in my spare time. I first of all procured a piece of flat iron bar ¾ in. broad and 3-16ths in. thick and 10 ins. long; this can be obtained from any whitesmith. I then filed and papered it smooth, and scribed a fine line down the centre of the broad face with the scriber. The next process was to divide the bar up ready for drilling, as shown in diagram (Fig. 1). This I did with a pair of dividers, marking out the centre of each and centre-punching them; the next thing to be done is to get the bar drilled and bent. Not having the necessary tools at my disposal, I went to the local whitesmith, who has the drilling machine and forge required for the job. The square hole in the

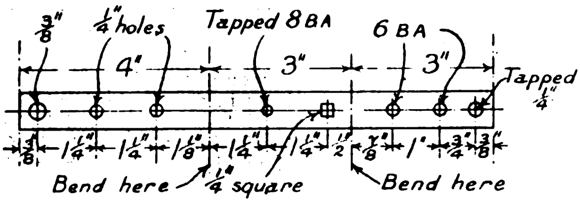


Fig. 1.—Frame before Bending.

bar was simply drilled out to quarter size, and then filed square to suit. The framework of the machine is now complete.

The arm B (Fig. 4) now claims our attention; it is made of a piece of brass 5¼ ins. by ¾ in. by ⅛ in. thick; ½ in. of this is bent over at one end and ¾ in. at the other. A slot is cut at each end to take the bearings T S (Fig. 4). A rivet is put in the brass arm each side of the slot in order to make the joint firm. A small hole is then drilled to take a piece of knitting needle, making it a tight fit for the bearings to run on.

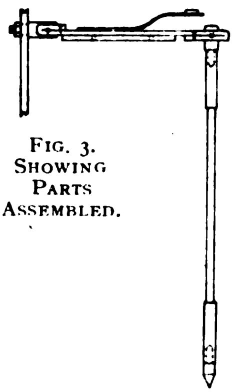


Fig. 3. Showing Parts Assembled.

The next thing to be done is to make the armature. This is composed of a small piece of soft iron 2½ ins. by ½ in. by ¼ in., and has two holes drilled in it to take 6 B.A. screws; one of these is ¾ in. away from the frame end, and the other 2½ ins. away. Two holes to correspond are drilled and tapped in such a position that the clear piece of armature on either side of the screws is opposite the cores. These holes will be approximately 1½ ins. and 3 ins. away from the frame end of the arm. The contact spring is 2¼ ins. long, and is made of a piece of fairly strong steel spring ½ in. wide. Two holes are drilled through this to take 6 B.A. cheese headed screws, 3-16ths in. and 5-16ths in. away from one end of the spring; the spring was then bent to shape, and two holes to correspond drilled and tapped 6 B.A., ¾ in. and 1¼ ins. away from the frame end of the arm; two 6 B.A. screws are then screwed through the spring into the arm.

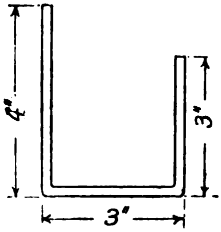


Fig. 2.—Frame bent to Shape.

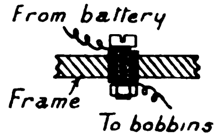


Fig. 8. Terminal Screw.

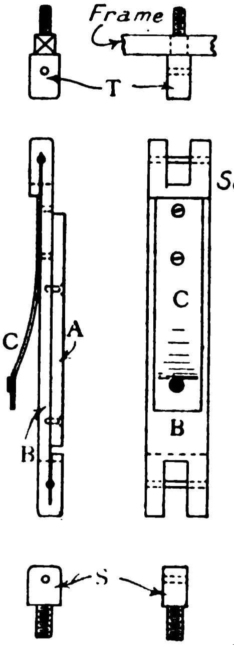


Fig. 4.—Armature, Contact Spring and Bearings.

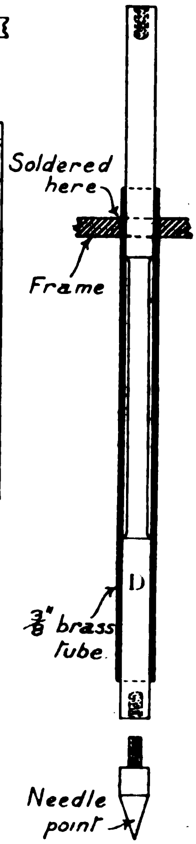
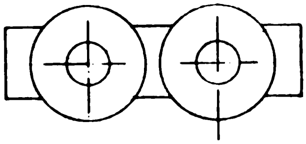


Fig. 5.—Needle Arm and Tube.

The bearing-pieces are next made. T in Fig. 4 is composed of a piece of brass 1 in. long by ¼ in. by 5-16ths in. The end is first rounded off and ¼ in. square is filed in it one ½ in. up, to fit the square hole in the frame. A thread is cut on the remaining part to allow the bearing to be clamped firmly on the frame, as Fig. 4. A hole is then drilled through the bearing when it is in position, and a knitting needle forced through afterwards and riveted each end. The other bearing is made of steel in the same way, except that there is not a square filed on it, so it is only ¾ in. long instead of 1 in. A piece of brass rod is next tapped 4 B.A. down each end, and is filed as Fig. 5, so that it is a tight fit for the ⅜-in. brass tube.

The next thing to do is to make the bobbins that slip over the cores. The four tops were first turned out of boxwood to 1 in., and holes drilled in them to make them fit over the paper tube, which I made into shape over the soft iron rod which I had procured for the cores. I then glued



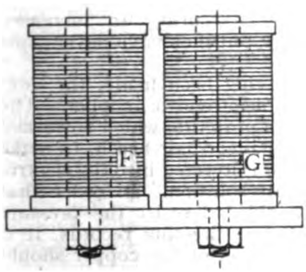


Fig. 6.—The Bobbins.

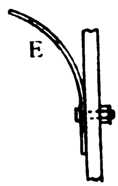


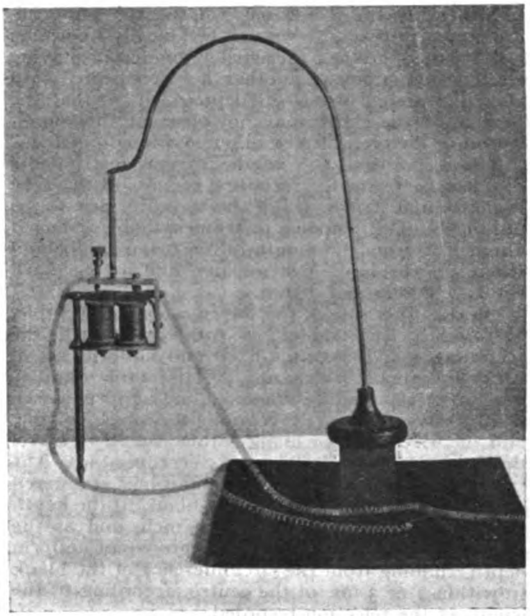
Fig. 7.—Spring.

the bobbin end on the paper tubes; while the glue was setting, I turned the cores to the shape required, as Fig. 6, and provided them with nuts. The bobbins now being dry, I commenced winding them. I wound on ¼ lb. No. 28 D.C.C. wire, which just filled the bobbins.

The spring next claims our attention. It is made of the same material as the contact spring, and has a slot cut ¾ in. from one end, which allows a 6 B.A. screw to pass along it freely. A terminal is then taken, and a small piece of German silver is then soldered on the quarter thread; the parts in Fig. 3 are then fixed together and screwed on to the frame. The spring E is then fixed to the frame, as Fig. 7, so it has just sufficient power to lift the armature, etc., up. The tube is then inserted in the frame and soldered, as Fig. 5. The contact-screw is now screwed in the frame, and a small piece of German silver is soldered on contact-spring where it touches.

Now for the connections. One end of the bobbin G is soldered on to the beginning of bobbin F; the remaining end of G is clamped underneath a screw, which is insulated from the frame, as Fig. 8, one battery wire being clamped on to the top. The other wire from F is clamped underneath lifting spring screw, as Fig. 7. The other battery wire being connected to the contact-screw, a needle is now required. This is made of best tool steel, as Fig. 5, and screws into the bearing-rod at the end outside the tube.

This machine will engrave any metal when run with four bichromate batteries. The full original directions are had from March 26th and April 2nd, 1903, issues of The Model Engineer; but, as I found it an advantage to alter mine in some respects, I give a full



Photograph of Finished Machine.

description of the machine as I made it. I have already got enough orders for engraving to pay for the cost of the machine, so if a model engineer wishes to make his hobby pay, I advise him to make an electrical engraving machine.

How a Gramophone Record is Made.

A very interesting paper on "The Gramophone and the Mechanical Recording and Reproduction of Musical Sounds" was recently read before the Royal Society of Arts by Mr. Lowell N. Reddie. The complete paper was published in the *Journal* of the Society for May 8th, and may be obtained from Messrs. George Bell and Sons, Portugal Street, W.C., price 6d. We give the following extract describing the method by which the records used on this popular instrument are produced:—

I will now deal with the series of operations which go to make up a finished disc record of the Berliner or gramophone type. The person who is making the record sings or plays immediately before the mouth of a horn or funnel, the object of the horn being to concentrate the energy of the sound-waves upon the recording diaphragm. At the narrow end of the horn is the recording sound-box and machine and its attendant expert. The artist is on one side of the screen and the machine on the other, for in all the recording laboratories of talking-machine manufacturers the secrets of the operation of recording are most carefully guarded. The making of a good record is not so simple a matter for the artist as might appear; he often has to make several trials before he learns just how to sing into the trumpet, how near to stand, etc. When singing loud high notes he must not come too near the mouth of the funnel, as otherwise the vibrations will be too powerful, and the result will be what is technically known as "shattering." When the artist is singing or playing to an accompaniment, another horn connected with the same sound-box is often provided, so that the person of the artist may not obstruct the sound-waves of the orchestra or other accompaniment.

The disposition, too, of the various instruments of an orchestra in the recording-room is of the very highest importance, if the best results are to be obtained. The wooden instruments are arranged about 4 ft. from the mouth of the trumpet—behind them are the brass instruments, and at the back the bass fiddles and drums.

On the other side of the screen a horizontal table, carrying a wax tablet, is rotated beneath the recording sound-box at a fixed and uniform speed, generally about 70 r.p.m. As the table rotates, it also travels laterally at a fixed and uniform speed, being carried on a revolving threaded spindle, and the wax tablet or blank is thus caused to travel slowly under the stationary recording-box. The sapphire cutting-point of the sound-box is lowered so as to enter the surface of the blank to the depth of about 3½ to 4-1000ths of an inch, and as the machine runs it cuts a fine spiral groove of uniform depth, running from the circumference of the blank to within 2 or 3 ins. of the centre, according to the length of the selection recorded.

The turn-table travels, as a rule, about 1-100th in. laterally for every revolution, so that the spiral cut comes round about 100 times in the width of 1 in. It will thus be evident that the lateral undulations of the sound-line must be minute in the extreme, as otherwise the lines would at points break into one another.

The recording blank is made of a soapy wax. Each laboratory has its own receipt for the composition of the blank, but, generally speaking, the compound is made up of stearine and paraffin. Many other substances have been suggested, amongst which may be mentioned barium sulphate, zinc white and stearine, ozokerit and paraffin.

The consistency of the blank material must be such that it is stiff enough to retain its shape when the sound-groove is cut in it, and at the same time it must not be so stiff as to offer any great resistance to the cutting-point. It must not chip nor flake, as otherwise the recording point will cut a groove with ragged sides, and this will increase the scratching sound made by the needle on subsequently reproducing. The best results are obtained by a tablet of such consistency that the cutting point detaches an unbroken shaving of wax.

The diameter of the recording blank varies, but the maximum diameter employed is about 12 ins. It will be clear that the size of the record cannot be increased beyond certain limits, when it is remembered that the blank is revolved at a uniform speed, and that consequently the outer portion of the blank is running past the recording point at a much higher speed than the inner portion. Thus, with a 12-in. disc, when the cutter is ½ in. from the edge, it will in one revolution describe a line on the record of a length approximately equal to the circumference of a circle of 11 ins. diameter—that is to say, 34·5 ins. By the time the recording point has worked in another 3 ins. towards the centre of the tablet, the length of its path over the wax will approximately equal the circumference of a circle of 5 ins. diameter, or 15·7 ins. The rate of revolution of the tablet being uniform, the sound-line at the edge of the tablet is accordingly being cut at more than twice the speed that it is cut at nearer the centre; and the speed at which the recording point can be made to cut the sound-groove satisfactorily can only be varied within certain limits. If the diameter of the tablet is increased, the outside speed will be too great for proper recording; and if the speed of the turn-table is correspondingly decreased, the ripples in the sound-line near the centre will be too close together and cramped; there will be too many vibrations per inch of sound line to allow of proper recording and reproduction. The obvious solution would be, of course, gradually to increase the speed of the turn-table as the recording point nears the centre of the blank, but there then arises the necessity of using mechanism for securing a corresponding gradual change of speed on the reproducing machine, in order to keep the selection in the proper key. Devices for securing an increased speed have been invented, but they have never come into general use.

The record in wax having been made, the next step is to produce a negative in copper. The wax tablet is dusted with graphite, which is worked into the grooves with a badger-hair brush, to make it electro-conductive, and is lowered into the electrolytic bath of copper salt solution. In order that this negative may be able to resist the pressure to which it is subjected in pressing records, it is necessary that the deposition of the copper should be thoroughly homogeneous. To this end, and also in order to hasten the process so that the blank may not be attacked by the solution, the blank is kept continuously in motion in the electrolytic bath. The process is continued until the copper shell is nearly ·9 of a millimetre in thickness. The negative thus formed may be termed the master negative, and from this master a few commercial samples of the record can be pressed by means of which the quality of the record can be tested. It is not, however, usual to press more than two or three records from this negative. Seeing that sometimes as many as 6,000 or more copies are sold of a single record, it is natural that the manufacturers should take steps to enable them to multiply copies without injuring their master negative or having it worn out, for it is not usual at this stage to obtain further negatives from the original wax record. They accordingly make duplicates of their master negative, by taking dubs or impresses of the master in a wax composition, from which in turn working matrices are made. Copper shells are obtained from these dubs in the same way as from the original wax tablet, but the metal is only deposited to the thickness of about ½ millimetre. The shells are made absolutely true and flat at the back, so that any irregularities caused in the electro-deposition may not be transferred in pressing to the front or face of the shell. They are then backed up or stiffened by a brass plate about 1-10th in. in thickness. The attachment of the backing plate and matrix is effected by sweating or soldering them together under pressure. The backing plate is supported on a heated table, a thin layer of solder is run over it, the shell is laid upon it and pressed firmly down, with an elastic protective cushion of asbestos, for example, placed over the face or recorded surface of the shell to prevent the sound-ridges in it from being injured. The matrix thus obtained is now nickel-plated on the recorded side so as to present a better wearing surface, and after polishing is ready for use in the pressing machine.

Attempts have been made to use a recording blank of conductive material, or containing sufficient conductive material to allow of omitting the subsequent graphiting or metallising of the blank; the objection to this procedure has always been that such substances offered too much resistance to the recording point.

The commercial record is pressed in a substance the essential qualities of which are that it should be hard at normal temperature, but capable of being softened and made plastic by heat. It must be tough and elastic enough not to be easily broken when pressed into discs of about 2½ mm. in thickness; it must be thoroughly homogeneous; and it must not be gritty in composition, as otherwise it will augment the scratch of the needle and wear off the point. Finally, the record must be so hard, when cold, that it will retain the contour of the sound-groove, even after it has been played a large number of times. Various substances and compounds have been used or suggested for making records—celluloid, glass, papier-maché, vulcanised rubber, casein, and shellac with an admixture of crocus powder. In nearly all the compounds actually used shellac is the principal ingredient.

The compound usually employed to-day is made up of shellac, wood charcoal, heavy spar (barium sulphate), and earthy colouring matter. Various animal and vegetable fibrous materials, such, for instance, as cotton flock, are added to give the record the required toughness. The several ingredients are first finely ground and then carefully measured and mixed according to formula. The mixture is put into a revolving drum, and the flock added. After being passed through a magnetic separator to remove any metallic particles, it is next mixed by heated rollers until a thoroughly homogeneous plastic mass is obtained. The mass is now passed through calender machines, which roll it out into thin sheets, and as it passes from the calender it is divided into sections, each section being about the requisite quantity for one record.

The records are pressed in hydraulic presses. The matrix is heated, and placed face upwards in a mould in the lower half of the press, being centred by a pin passing through the middle of it; the label for designating the selection is placed face downwards on the matrix, and on this is placed, in a warm, plastic state, the quantity of material required for one record. The press is operated, and the mass is immediately distributed all over the mould. Both halves of the press are furnished with cooling plates, through which a stream of water can be passed so that the pressing surfaces can be immediately cooled, and the record mass consequently hardens quickly and retains the impressions of the matrix. The record is removed, and its edges are trimmed up with emery wheels; for the record material is too hard to allow of any cutting instrument being used. The record is then ready for sale.

Modelling the Hydroplane.

By W. L. Blaney.

It is with a strange admixture of trepidation and confidence that I take up my pen to jot a few notes on the above interesting subject. Trepidation because of the disappointing results of models that have come under my notice (up till the time of writing) and in view of the celebrated failure to reach his expectations of that gifted and daring experimenter—M. Santos Dumont. But my confidence outweighs my misgivings, for have I not proofs that wonderful speeds have been accomplished with models, and that many years ago; so if readers will forgive my zeal, and patiently wade through the following disjointed notes, I will endeavour to set forth a few details of what has been already accomplished and advise with all due diffidence as to what may be done. Although the principle of the hydroplane is exceedingly simple, there is no doubt that the average non-technical mind regards these craft as very mysterious machines, this attitude being fostered by the many curious designs that different inventors have produced and to the aggravatingly inaccurate reports that have appeared in certain unmentionable daily papers. It is with the object of clearing away some of this vapour and inducing model engineers to experiment with model hydroplanes, that the writer has collected (with the kind assistance of his friends) the few notes here given.

To come to simplicities, we have only to examine any elementary text-book on mechanical principles, and there we shall find the invention of that famous philosopher Archimedes, known as the inclined plane.

In the sketch (Fig. 1) we have an inclined plane A fixed, and another inclined plane B being forced along in a horizontal direction, indicated by the arrow. The result is shown in Fig. 2, where B has risen in a vertical direction. This is exactly what takes place when a floating object with the under-water form of B is forced along in the same manner. The plane A is formed by the water falling in naturally to fit the submerged surface. When driven at a very slow speed we do not get the effect, because the water, being a yielding material, flows away from the oncoming plane; but, as the rate of motion is increased the water takes on the property of semi-solid matter, since its viscosity will not allow it to get out of the way in time. Hence we have the hydroplane:—an object with an inclined submerged surface which when driven through the water with sufficient force will rise partly out of that element, and by so doing has less resistance to meet with in its path of motion. This is the crux of the whole matter,

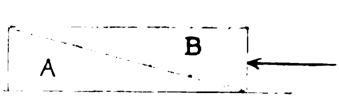


Fig. 1.

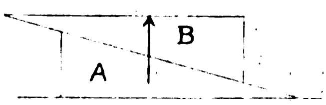


Fig. 2.

Firstly, then—What constitutes a hydroplane? It is an inclined plane or surface, not necessarily flat, which, when driven through the water with sufficient force will rise or sink, accordingly as the angle of inclination is directed up or down.

for while it has been shown that an orthodox shaped vessel requires a constantly increasing ratio of power to accelerate its speed, owing to the viscosity of the water increasing the resistance, the hydroplane does not need the same ratio, for its resistance decreases as the speed rises, this being brought about by the whole mass rising partly out of the water. Before dismissing this part, I must ask the reader to impress the fact upon his mind that although different inventors of hydroplanes have given wondrous and weird forms to the bodies of their creations, these said forms bear no relation to the principle involved, for they all depend for their anticipated or alleged speed upon the passage through the water of an inclined plane or planes.

Probably one of the most enthusiastic experimenters in the field of "hydroplanics" (if I may coin a word) is the celebrated Count de Lambert. It was in October, 1897, that a notice of one of his machines first appeared in *Engineering*. The writer cannot state whether this was the Count's first attempt; but it is evident that it was something like a success, for we are informed that he obtained a speed of 20 miles an hour with it. The particulars to hand are that the craft was of the catamaran type of body, approximately 20 ft. long and 10 ft. wide. There were four planes of a varying angle of inclination of 1 in 20 to 1 in 30. The arrangement was driven by a steam plant with a compound engine and tubular boiler; the propeller (in water), 22 ins. diameter by 30-in. pitch. The total weight of the machine was 600 lbs. This boat gradually rose to the surface of the water as the speed was increased, until at top speed only the back edges of the planes were immersed. The distinguished Count has made other machines since then, but it does not appear that he has met with the success he has deserved. His latest hydroplane is a weird contraption of laths and latticing, rectangular in plan, driven by an eight-cylinder "Antoinette" petrol motor, with an aerial propeller. The planes are arranged one behind the other, like the slats of a Venetian blind. It is scarcely relevant to the subject to open an argument on the relative efficiencies of air and water propellers, so that the writer would fain leave that in the hands of those whose experience of the two systems has been more extensive. It is an example, though, of the fallacies that are accepted by the public (through the tuition of non-technical journalism) that many think an aerial propeller to be an essential feature of the hydroplane. This, as explained, is nonsense.

Perhaps the most successful of modern hydroplanes is the little 11-ft. "glider"—"Ricochet Nautilus." This craft has already been illustrated in THE MODEL ENGINEER, although the underwater form was not then shown. A sketch plan is now given in Fig. 3. The most remarkable point about this boat is the comparatively low power used to obtain a high speed. It has been claimed that "Ricochet Nautilus" has reached a speed of 30 miles an hour, but this is not so. Twenty knots is nearer exactitude, and is quite sufficiently remarkable for a boat 11 ft. long and driven by a 9-12 h.-p. engine. It is worthy of note that our go-ahead cousins across the Atlantic have duplicated "Ricochet Nautilus" many times over, "water slipping" being quite the mode on the big rivers of the "other side." It would seem that old England is quite behind in the new manner of water locomotion and that inventors of hydroplanes were *non est* over here. But, stay! it is the writer's privilege to record that *the* inventor of the hydroplane was (according to the records of the English Patent Office) a reverend gentleman of the name of Charles Meade Ramus, of Playdon Rectory, who in the year 1873 obtained a speed that has not yet been beaten by any other craft made by man, and that was accomplished with a model 29½ ins. long! I have collected the following particulars of his experiments from a little monograph written

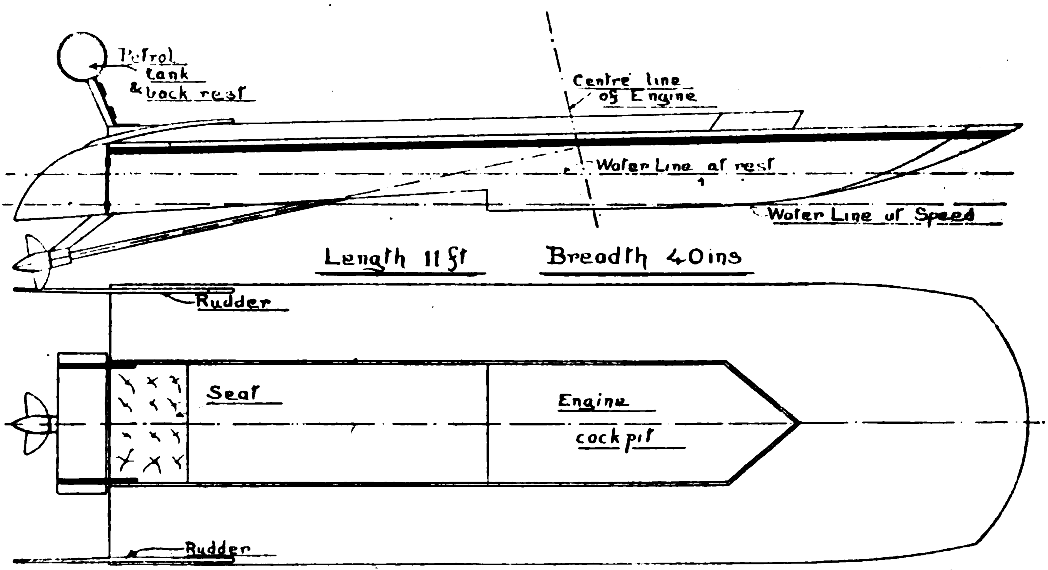


FIG. 3.—APPROXIMATE PLANS OF "RICOCHET NAUTILUS."

by himself, that can now be seen in the Patent Office library. The details and data of his work are so clearly and concisely set forth as to leave no doubt that the rev. gentleman was a conscientious and observing experimenter who has incidentally made it exceedingly easy for the writer to give directions to the readers of THE MODEL ENGINEER on "How to Break the Speed Boat Record." Let me hasten to explain at once that his models, which he calls "polyphensic ships," were propelled not by steam nor petrol, but rockets! and now I don't think I can do better than let the Rev. Ramus speak for himself. He says:—

"In December, 1873, I made some experiments with two models—one weighing 7 lbs., the other 3 lbs. 3 ozs. To each of these was attached a rocket containing 6 ozs. of rocket powder, which supplied the driving force by which the models were propelled. The rockets were attached to the hinder part of the decks and so placed that their orifices were slightly more elevated than their head, the line of propulsion being inclined downward about 2 degs. from the horizontal. The first experiments were made with the 7-lb. model. This was driven forward over the water 66 yds. in six seconds, the rocket by that time being completely discharged and the model brought to a state of rest. Average speed in this case 33 ft. per sec., or about 20 knots per hour; it may be assumed that its greatest speed could not have been less than 25 knots per hour. Second model, slightly different form; distance run, 105 yds. in three seconds at the rate of 63 knots per hour, a speed that will be allowed to far surpass anything ever obtained by any water-borne object before. In this case the model reached the end of the water before the rocket was discharged. (It is not stated what occurred then.) In rough water this same boat gave a speed of 40 knots. The motion of the models was from the beginning to the end of the course quite steady, so as to give them more the appearance of sliding over smooth ice than of passing over the surface of water. There was scarcely any water disturbance, though each model had a fixed rudder of thin sheet metal. There was no splash at starting, and at the end of the course the decks were unwetted. I have calculated, as exactly as possible, the power actually used to drive my models. Both were made of solid (?) fir wood. The first or larger model, 3 ft. 9 ins. long, 5¾ ins. broad, floated, when at rest, in 1¼ ins. of water. The slope of the three submerged inclines was 1 in 18. The second model was 20½ ins. long by 4¾ ins. broad, and drew ⅞ in. of water; slope of three inclines, 1 in 17.

"When drawn slowly over the water these models are found to offer a greater resistance than models of ordinary ships. This is evidently owing to the fact that at low rates of speed they carry a considerable quantity of water before them. This they continue to do until the equilibrium between the horizontal pressure of the inclines forward and the pressure of the water in a contrary direction is broken down. This action seems to take place suddenly, when the model at once rises in the water and passes over the hitherto obstructing masses of fluid. When the vessel is fairly lifted and the water passes freely beneath its bottom, it will continue to over-ride the water, which can no longer be removed in the brief time given for the vessel's passage. I believe the three-plane type to be the best. The rockets used to drive the models were found to have a propelling force not exceeding 3 lbs. at 7 knots; at 20 knots, 1 1-20th lbs., and at 63 knots only ¼ lb.—Rev. Chas. Meade Ramus, Playdon Rectory, March 26th, 1874."

There may be some who think these speeds are excessive, but there is little reason to doubt them. Anyone who has watched the flight of a skyrocket and pondered on the same will have no difficulty in understanding the speed of the Rev. Ramus's models, and to those who are still sceptical I would say—here are all the necessary data. It is a simple model to make. Go thou, and duplicate.

(To be continued.)

Workshop Notes and Notions.

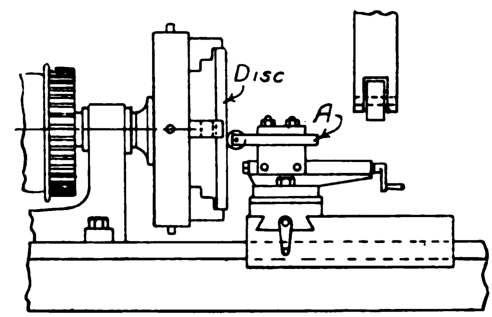
[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "WORKSHOP" on the envelope.]

A Handy Lathe Tool.

By P. BOLDERO.

The sketch shows an arrangement for trueing up any flat disc or plate in the lathe. The tool A consists of a piece of steel about ⅜ in. by 1⅜ ins., having a slot at one end to take a hardened steel roller 5-16ths in. by 1¼ ins. diameter. Fig. 2 is an enlarged view of the tool. To true up a disc, proceed as follows: Having placed the disc in the

FIG. 1. FIG. 2.



chuck and tightened the jaws slightly, set the work revolving; then bring the roller to bear with light pressure, and in a few revolutions the plate will be found to run true. This method is easier than chalking and then tapping with a hammer, and much quicker.

A Saw Gauge.

A very useful gauge for measuring the set of saw teeth is shown in the accompanying sketch, which is taken from *Popular Mechanics*. It consists of a small strip of hardwood, with one corner cut away as shown, and a small wood screw. The screw may be adjusted by means of a screwdriver until the head just touches the edge of the tooth, as shown. Then, by keeping the edge of the wood against the side of the saw and moving the screw

A SAW GAUGE.

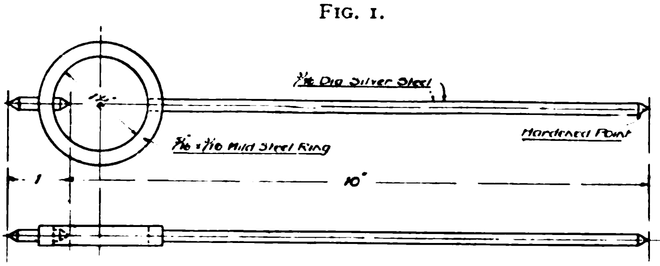
from one tooth to another, the teeth that are not set properly can be quickly found.

A Useful Centre Indicator.

By W. MUNCASTER.

A centre indicator will be found very useful when setting a job to the faceplate of the lathe, to be drilled or bored to a centre marked on the job. Fig. 1 shows an indicator which can be both cheaply and quickly made, the most difficult task being the making of the ring; but, as the size of this is not particular, anything somewhere near the size shown will do—in cast iron, brass, or mild steel. The ring shown was turned from a piece of heavy tube 1½-in. bore and 3-16ths in. thick. The pointers are of 3-16ths-in. silver steel, and are made a driving fit into the ring. Before fixing, the points were hardened. Fig. 2 shows the method of using. The job to be bored (A) is bolted to the lathe faceplate and marked with a centre "pop." Point *a* of the indicator is placed in this "pop," and *b* against the side of the arm *d*, which is made from an old lathe tool and held in the slide-rest, a small "pop" being made to take point *b*. The point *c* is left to work free. On starting the lathe any error at *a* will be exaggerated at *c*; in this case, ten times. The job A can now be adjusted till the point *c* has ceased to oscillate. On removing the indicator a hole can be first run through with a twist drill about ⅛ in. smaller than the required bore, and afterwards finish with a boring tool held in slide-rest. The method of gauging the work shown above is found more accurate than the usual practice by means of a scribing block of setting to a circle previously marked to show the required hole.

FIG. 1.



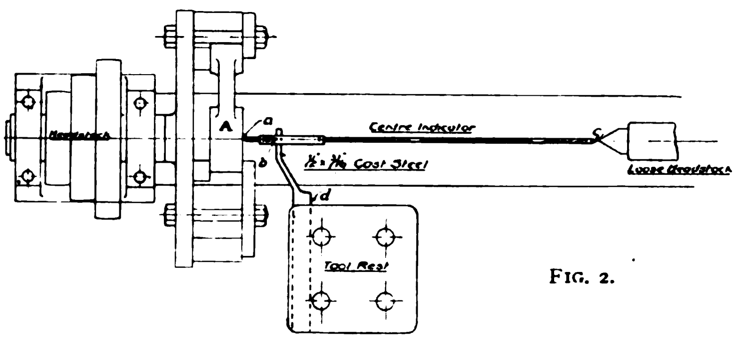


FIG. 2.

CENTRE INDICATOR. (*Scale: ⅓rd full size.*)

Practical Letters from Our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume if desired, but the full name and address of the sender MUST *invariably be attached, though not necessarily for publication.]*

Model Screw Propellers.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—The article on screw propeller design in your issue of the 21st inst. is most interesting, and I agree with Mr. Garscadden's remarks as to the horrible screws seen on many model (and larger) power boats.

I must say that the pattern making for a cast screw is very pretty, but I contend that an infinitely better job can be made by hard soldering thin sheet-brass blades into a suitably shaped boss.

We have made over thirty pairs for *Moraima*, and they are light, the blades are thin, they require little or no cleaning up, and, what is most important, they can (owing to the fact that the hard soldering leaves the blades soft) be bent many times for experimental trials.

I should be glad to hear what your contributor has to say as to the action of such a blade as he shows in throwing water out radially. All the best runs of *Moraima* have been made with screws having sickle-shaped blades; the tips seem to have a decided effect on the water astern. Our new boat has tandem screws, but the remarks apply much as for twin-screws.

The engine of *Moraima* having a practically constant power at a given speed makes it very easy to test the efficiency (or otherwise) of a given pair of screws, and if Mr. Garscadden has a pattern for a *pair* of the 3½-in. screws shown, we can easily see how their thrust compares with some of our 3½-in. built-up sickles.

A cast screw is the very last we should think of using.

The whole question of screw design is, in my

opinion, one of trial and error—at least, in models; but it is none the less fascinating, and I wish more of your readers would open their hearts on the subject.—Yours faithfully, W. H. Arkell.
London.

Wireless Telegraphy Apparatus.

To the Editor of *The Model Engineer.*

Dear Sir,—In answer to Mr. Howgrave-Graham's letter, I am sorry to say that I made the mistake as to his meaning about breaking the current on the summit of the alternations.

With the alternator that I experimented with—a Simplex dynamo with shuttle-wound armature—I could obtain no true spark at all, only a silent arc; but, on altering the construction as indicated, I obtained an inch spark with ease and great regularity.

It appeared to me that this was due to the sudden disappearance of the magnetic lines through the core of the induction coil on the interruption of the current, and that this sudden break in the current would cause an infinitely higher voltage in the secondary coil than the comparatively slow change of an alternating current from its + to — maximum.

I cannot pose as an authority on this matter, as I have had little experience beyond a few experiments which I have carried out for my own edification.—Yours faithfully,

V. W. Delves-Broughton.

Ball Bearings.

To the Editor of *The Model Engineer.*

Dear Sir,—Your exceedingly interesting article on the above should prove of great value to readers, especially cyclists, for this is a subject on which very little indeed has been published.

There was a cycle bearing actually on the market in which two sets of balls were used, one set for the "radial" and another set for the "axial" thrust. The high cost of production, however, swamped it, although its freedom from friction was remarkable. Would "Zodiac" briefly say what are the merits and disadvantages of disc and cone-adjusting bearings respectively? What is the object of using a ball form of cone as found on most continental machines? Surely this reduces the wearing surface to almost a point.

A useful tip when assembling ball bearings is to stick the balls in with heavy vaseline or Stauffer Grease. This often saves much time and temper.—Yours truly,

Camberwell, S.E. "Tangent."

The Whittington Floral, Horticultural and Industrial Society. — The annual exhibition arranged by this Society is to be held this year on August 25th, in the grounds of Whittington Grange. Besides an exhibition of flowers, fruits, and vegetables, a section is to be devoted to working models, woodwork, and drawing. Some valuable prizes are offered in this section for the best made model locomotive, steam, gas, or petrol engine. Further particulars and catalogue can be obtained from the secretary of the Industrial Section, Mr. W. Newton, Oakleigh, Old Whittington, near Chesterfield.

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of The Model Engineer *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

The ninth Annual Conversazione and Biennial Model Making Competition of the Society was held on Saturday, May 23rd, at the Cavendish Rooms, Mortimer Street, W., when, as usual, a gathering of several hundred people spent an enjoyable and interesting evening. The Committee having decided that the function was this year to be more in the nature of an exhibition of members' own work, only a few trade exhibitors were asked to exhibit. Messrs. Avery, of Tunbridge Wells, showed some of their new 5s. educational electrical models and also some larger 4-pole dynamos of very up-to-date design and construction. Messrs. Armstrong, of Twickenham, also exhibited several of their accumulators and other electrical apparatus. Mr. C. W. Franklin showed and demonstrated his new planing and shaping machine, which attracted considerable attention. The Northern Model Company had some small Great Northern engine parts and also cycle motor castings, and Messrs. Drummond's new model maker's lathe was a great centre of attraction. The Society's railway track was in full swing in the Lower Hall, Messrs. T. H. J. Bunt and W. Curtis running their electrically-driven L. & N.W.Rly. locomotives, and Mr. Steer his electric locomotive. Several other models were shown under steam in this Hall, the most notable being a horizontal engine of somewhat novel construction made by Mr. A. S. Lane, the cylinder being ⅞-in. bore by 1½-in. stroke, the valve gear being of the Corliss trip type, operated by cams worked by a revolving side shaft; the engine developed high speed and considerable power for its size.

The members' models entered in the competition were, of course, the main attraction, and worthily upheld the Society's reputation for having among its members some of the cleverest amateur engineers to be found in England. The Committee were fortunate in obtaining the services as judges of Messrs. J. W. Barber, M.I.M.E., and Percival Marshall, A.I.M.E., who, after a prolonged and careful scrutiny of the twenty models entered, awarded the medals and other prizes as follows:—The Society's gold medal (as first prize) to Mr. J. Chadwick Taylor for his fine exact scale model of the old locomotive "Agenoria." The silver medal (as second prize) to Mr. W. G. Corner for his ¾-in. scale Caledonian locomotive, the same gentleman taking the third prize for a model Babcock & Wilcox type water-tube boiler; while the fourth prize went to Mr. L. M. G. Ferreira for his compound undertype engine and boiler. Awards of half-a-guinea were gained by Mr. T. R. Welsman for a partly finished ¾-in. scale Caledonian locomotive, by Mr. H. R. Beckett for an undertype electric motor wound for 220 volts, by Mr. H. C. Waller for a vertical petrol engine, by Mr. H. A. S. George for ½-in. spark induction coil, by Mr. Hildersley for his compound microscope, and by Mr. B. G. Goodenough for a 1½-in. scale model of a Great Eastern Railway locomotive boiler.

The following received smaller awards:—Mr. R. W. Green for twist drill grinding machine, Mr. P. Blankenburg for ¾-in. scale Caledonian locomotive, Mr. H. Hildersley for an engine-turned box with trick lock, Mr. G. Norman for a model Hotchkiss gun, and Mr. W. G. Russell for a model London and South Western Railway locomotive.

Certificates of commendation were granted to—Mr. P. C. Simpson for a model horizontal steam engine, Mr. Geo. Dennant for a patented change speed gear, Mr. W. J. Hunt for an electrically-driven torpedo boat, and to Lieut.-Col. D. J. Gaisford for a vertical petrol engine.

The medals and other awards were subsequently presented to the successful competitors by Mr. J. W. Barber. Mr. Percival Marshall, in replying to a vote of thanks to the judges, proposed by the Chairman, congratulated the members on the excellent work shown, but strongly urged them to turn out models or apparatus showing greater originality in design or construction.

An important item in the evening's entertainment was a lecture by Mr. Alfred B. Harding, F.P.S., entitled "From Noise to Music," illustrated by slides and by many experiments illustrating the production of musical notes and otherwise.

A very interesting exhibition of microscopes and microscopic objects, arranged and presided over by Mr. E. A. Robins, attracted large numbers. Selections by Mr. Day's band and songs by Miss Blanche Askew, Mr. J. C. Callender, and others, were much appreciated.

Amongst other exhibits by members of the Society were the following:—Several very finely finished small motors (one with an armature only ¾ in. in diameter) by Messrs. R. A. and J. W. Allman, a ⅜-in. scale Midland Railway locomotive by Mr. Bennett, a steam winch for steamer by Mr. Dawson, milling and grinding appliances by Mr. Fraser, ½-in. scale Midland and Great Northern locomotives by Messrs. Delger and Harrison, a cross-Channel cargo boat by Mr. Maisey, a steam crane and model Porter governor by Mr. Riddle, a small horizontal engine by Mr. Picciotto, a very minute horizontal engine by Mr. Simpson, a side lever marine paddle engine, an early type of table engine and a beam engine by Mr. G. T. Tyas, and a North Eastern Railway locomotive by Mr. Livermore.

Presentation of a Model Medical Air-lock.—At Long Island City recently a model medical air-lock was presented by the workmen and staff of Messrs. S. Pearson & Son, Inc., engaged in the construction of the recently completed Pennsylvania East River Tunnels, to Mr. E. W. Moir, vice-president of Messrs. Pearson's Company. The model was made of brass to a scale of 1½ ins. to the foot, being about 2 ft. 6 ins. long and 9 ins. in diameter. It is complete in every way, being lit with electric light, and supplied with compressed air by a pump. Mr. Moir built, in 1890, the first air-lock ever used, and during the recent tunneling operations under the East River no less than six such medical locks have been in use, to the great relief of the staff employed in compressed air.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* The Model Engineer, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[19,381] **Model Engineering.** R. E. Y. (North Walsham) writes: I should be extremely obliged if you would kindly enlighten me on the following points. I contemplate building a ¾-in. scale electrically-driven model of a L.Y.R. 4—4—2 locomotive and tender (No. 1,400 class), 3½-in. gauge, to look as much like prototype as possible. (1) Could I use zinc or tinplate where sheet material would be used? Which would be cheaper? (2) What thicknesses of metal are advisable for main frames, footplates, and boiler? (3) What would be the best thickness for wheels, also of flanges and depth of flanges? (4) Would ⅛ in. be sufficient for total clearance, and what side-play should be allowed for wheels? (5) Could I use laminated springs; if so, could you give me dimensions? (6) I intend to use a four-pole motor, as described in The Model Engineer for June 15th (1902), page 271, but with a drum armature, as it must be self-starting. Would six or eight cogs do, and for how many sections must I wind? (7) Would the 40-watt size be powerful enough, or would you advise 50 watts, as I want to obtain as high a speed as possible, to be regulated from the switch-board? What ratio should I gear motor down to (belt drive, driving wheels 5 17-16ths ins.)? (8) What gauges and amount of wire should be used for a 20-volt circuit? (9) Are there any coloured plates of this engine published giving a good idea of the correct painting?

Your query involves replies covering the whole range of the subject, and therefore we recommend you to study the following for general information on the subject: "The Model Locomotive," by H. Greenly, 6s. 5d. post free; Pullen's "Steam Engineering," price 4s. 4d. post free; Model Engineer, from October last to end of February. (1) Tinplate takes solder well, and is generally used for model locomotive superstructures. (2) Main frames, 5-64ths-in. or 3-32nds-in. planished steel plate; footplates, 1-20th-in. planished steel plate; boiler barrel, mandrel brass tube. (3) See "The Model Locomotive." (4) See articles in The Model Engineer for October 3rd and 10th (1907). (5) Yes, see the above-mentioned books. Pullen's work contains a plate of the engine. (6) An eight-section winding. (7) We should use the 50-watt machine. See the recent articles for gearing and speed regulation. A belt drive is not suitable to so large a model. (8) See table of wire gauges in any electrical pocket-book. (9) Yes; apply—the *Railway Magazine* or the *Locomotive Magazine* publishing departments.

[19,737] **Peculiar Gas Engine Trouble.** F. V. K. (Wimbledon Park) writes: I have a gas engine of 3-in. bore by 6-in. stroke, which is to be used for electric lighting. It has a disc crank, and consequently only one flywheel, which I don't think can be heavy enough. As long as it can run at 400 to 500 r.p.m., it seems happy, but if I cut off the gas, or it is slowed down from any other cause, to about 200 to 300 r.p.m., it seems to suddenly lose all its power, and stops. It never labours or thumps as other gas engines do when over-loaded, but slows down to about 200 r.p.m., and then stops. I thought of making the flywheel somewhat heavier by weighting it with lead. About how much should a flywheel suitable for a 3-in. by 6-in. engine weigh? Mine goes about 40 lbs., is 18 ins. diameter, with a rim about 2 ins. by 1¼ ins. For reasons of economy, gas being 3s. 4d. per 1,000 cub. ft. over here, I wish to run my engine at 300 r.p.m. If you can help me at all in explaining this extraordinary behaviour, I shall be extremely obliged, as I could find nothing exactly like it in any of the back numbers of The Model Engineer, of which I have a file dating from 1899.

Your case seems to be rather a peculiar one, and it would have assisted us greatly had you described or given a sketch of the governing gear. It is quite a common occurrence for engines that are regulated, as far as ignition is concerned, to run at 500 r.p.m. to suffer from early firing when the speed is considerably reduced. The timing of the spark should be adjusted as the speed is reduced, or if tube ignition is employed, the flame should be raised so that the upper portion of the tube becomes heated instead of that portion nearer the combustion chamber. With proper governing mechanism you would not save anything in gas by altering the speed of the engine, provided it is equal to the load put upon it at the speeds at which you propose running it. The relative sizes of pulleys, namely, that on the engine shaft and that on the machine or line shaft which is driven from engine, are important factors, and their sizes should be fixed with due regard to the speed and power of the engine. If you would send us fuller particulars of engine with sketch if possible, and also state particulars as to what it is driving, sizes of pulleys, etc., we should be glad to go more fully into the matter with you.

[19,007] **Stationary Water-tube Boiler.** E. C. (West Ealing) writes: I enclose a rough sketch (Fig. 1) of a boiler I propose making to supply steam to a 1¼-in. bore by 1-in. stroke single-cylinder vertical engine, and I shall be glad to know whether the boiler will supply enough steam at 60 lbs. per sq. in. to drive the engine 1,000 revolutions. What size dynamo the engine, when working at that pressure and speed, will drive? The size of pump necessary to feed the boiler. If the boiler is not large enough, how much larger should I make it?

Presuming that everything is well made and the engine is of economical design, we think that the boiler would maintain the engine at a speed of about 400 revolutions and 60 lbs. per sq. in. pressure and drive a dynamo giving not more than 18 to 20 watts. Counting the whole of the barrel as heating surface, the total is 261. We, however, only reckon two-thirds of the barrel as providing effective heating surface. We should fit a pump with at least a 5-16ths-in. plunger and ½-in. stroke, and return any excess of water. The amended design will require a ⅜-in. plunger. You do not send sufficient particulars of the design of the end boxes for us to criticise the boiler properly. However, we do not think that the arrangement, as shown, is one which can altogether be recommended. What about staying the flat sides of the boxes? We would prefer the tubes to be built up in separate elements, as indicated on the drawing herewith (Fig. 2). To get over the objections of having to silver-solder so many joints in each "down" pipe or riser, we would recommend that five stout down tubes be used at each end, say ⅝ in. diameter and full 1-16th in. metal. These tubes may be of good brass or copper. Each tube, where the water tubes enter, may be slightly flattened (after annealing) in the vice, and holes 5-16ths in. diameter tapping should be drilled in the down tubes to suit the water tubes, which may be screwed forty threads per inch at each end. Four or five tubes may be used in each element, and to insert them in the down tubes the running joint method of attachment may be adopted, *i.e.* the tubes should be screwed farther into one down than necessary, and then screwed back again into the other tube (see Fig. 3). The joints may then be silver-soldered. The holes for the down tubes in the shell may be drilled zigzag (staggered) so that the boiler shell shall not be weakened to any extent (see plan, Fig. 2). These holes may be drilled ⅝ in., and the joints silver-soldered. The tubes, however, should not fit too easily, or the joints may move when the ends are being silver-soldered to the shell. In brazing or silver-soldering a large boiler a certain amount of skill and experience is essential, to say nothing of appliances, and there are many professionals who would have difficulty in managing such a job as the one now under consideration. Therefore, we suggest that the whole of the work may be done without brazing. Of course, more careful fitting will be required, and the feed-water arrangements will need more attention. The joints of the water-

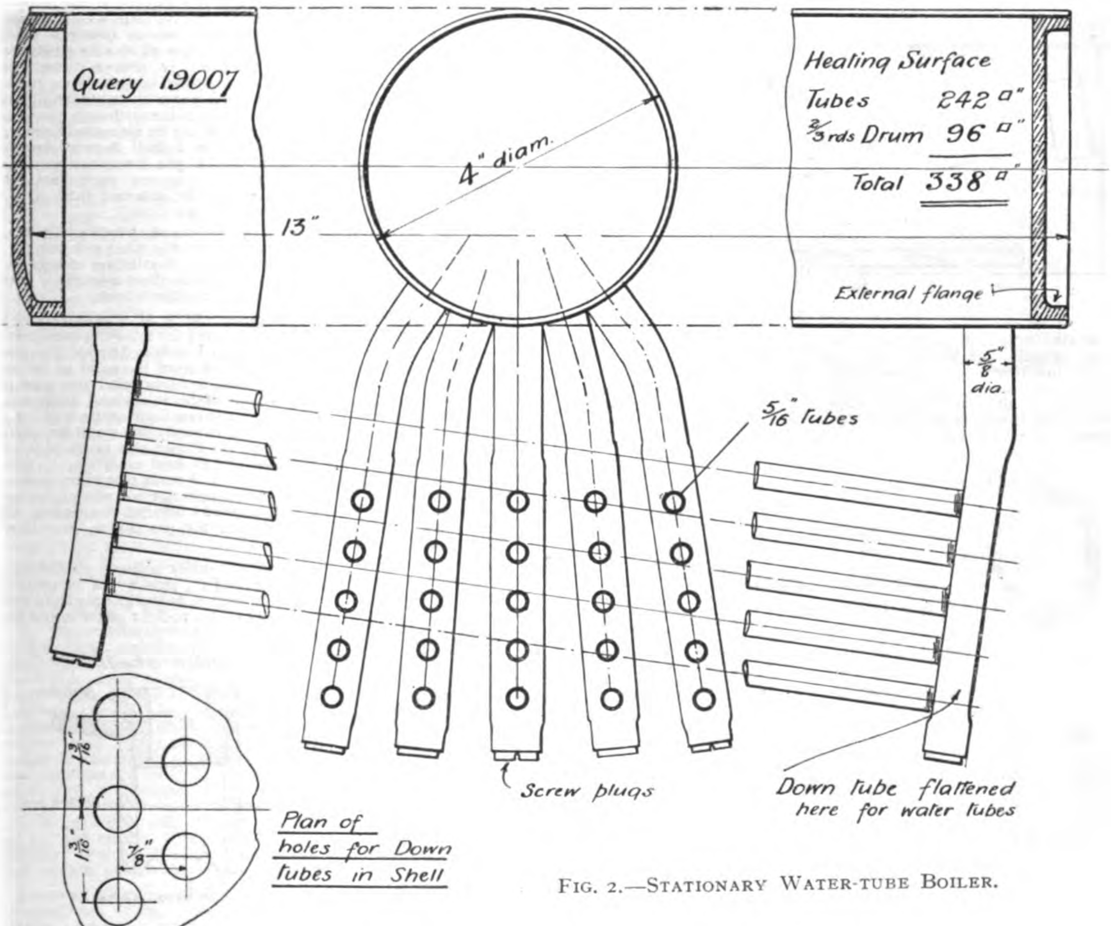


FIG. 2.—STATIONARY WATER-TUBE BOILER.

tubes and down tubes may be made more secure by using back nuts, as indicated on the detail drawing (Fig. 4), and the joints between the down tubes and the shell may be made by nipples, as shown in Fig. 5. The down tubes form a butt joint with the shell and the ends of the tubes should be carefully saddled to fit the barrel. When the elements are all in place the whole of the joints may be

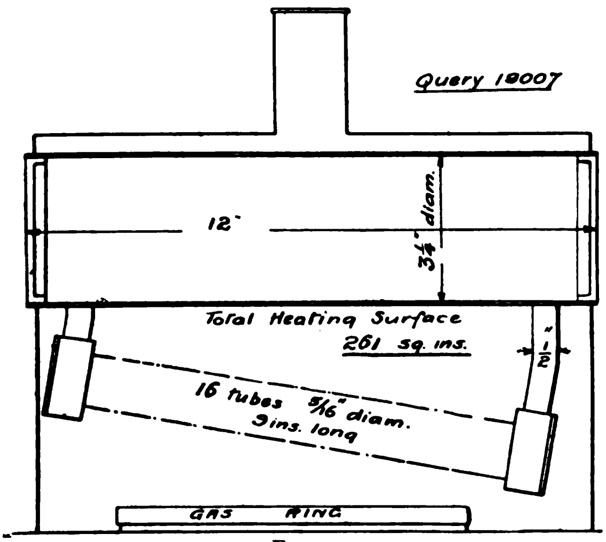


FIG. 1.

sweated with soft solder, as a caulking only, not as a means of strengthening the boiler. The ends may then be riveted in, one with the flange internally and the other (the end fixed last) with an external flange joint. (See Fig. 2.) The boiler may be at least 4 or 5 ins. diameter, and the down tube ⅝ in. or ¾ in. diameter, according to the size of the shell. The water tubes may be 5-16ths in. diameter, with five or six tubes in each element respectively. For

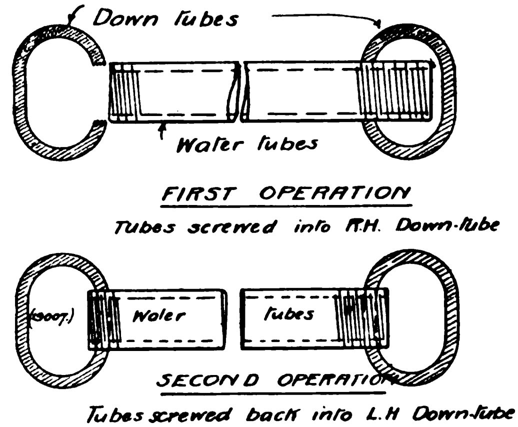


FIG. 3.

gas firing, where a considerable area of flame is possible, the down tubes should be spread out over as large a space as possible. The bottoms of the tubes should have screw plugs put in before the tubes are flattened. The effective heating surface, reckoning only two-thirds of the shell exposed to heated gas, will be 338 sq. ins., or 50 per cent. more than the other boiler.

[19,698] **Correspondence Tuition for Apprentices.** A. W. (Ely) writes: I am apprenticed to a small engineering firm in this neighbourhood for a period of five years, and as I wish to study theory of engineering, and there is no technical school convenient, I should be very much obliged if you could advise me as to the following:—(a) Do you recommend correspondence schools, or do you advise me to read up for myself? If you recommend the former, which institution would you take? I have noticed of late that there is a Correspondence School advertising in your valuable paper to which I have been a subscriber for nearly four years. I am speaking of the International Correspondence School. (b) Do you think this would be suitable? The branch I am interested in is steam engineering, and I should like to take up this subject thoroughly, as I have an idea that I should like to become an engineer in the Mercantile Marine. Could you let me know what the terms of this particular institute would be, and how long a complete course of lessons would last?

There is a certain advantage in taking a course of correspondence instruction which you do not obtain, however much you read up for yourself, in that a definite course of work is mapped out for you and you have a definite amount to get through with a certain degree of correctness. Particulars and the cost involved will be given to you on application at the institute you refer to. We think you would find a course of instruction of considerable value, provided you are obtaining practical experience concurrently with your theoretical training.

[19,732] **Ebonite Tubes.** C. H. K. (Knowle) writes: I beg leave to ask your assistance upon the following matters. Can you give me the address of a manufacturer or retailer that will supply me with an ebonite tube of the highest quality to fit a coil already finished? When at the Electrical Exhibition at Olympia three years ago, I saw a stand where the firm made all ebonite goods for coils, etc., but omitted to note the name or address; can you inform me what it was? I have already fitted to the coil two tubes —one waxed paper, the other alternate paper shellaced and thin mica. Both, however, immediately broke down, though the coil was only worked with 4 volts and was giving its estimated output, viz., 2-in. sparks. If you can assist me I shall be very deeply grateful. The firms advertising in THE MODEL ENGINEER seem to stock only certain sizes. Kindly give necessary particulars for building 12-in. coil, or say if same may be obtained from A. T. Hare's "The Construction of Large Induction Coils."

If you write to Messrs. Thompson & Co., 28, Deptford Bridge, Greenwich, London, S.E., and explain exactly what you require, we think they will be able to supply you. Particulars of a 12-in. spark coil were published in a recent issue in these columns. You will also get particulars of such a coil from Hare's book.

[19,736] **Installing Gas Engine.** W. P. H. (Upper Tooting) writes: Will you kindly oblige by answering the following questions. (1) I have a Stockport gas engine which I wish to fit up. The gas company will put me on 50 ft. of piping from the main to meter (which they also fix free). Now I wish to know what size pipe I ought to have to give an ample supply of gas to engine. Engine is 4½-in. bore, and distance of shaft centre to crank-pin centre is 3¼ ins., gas tap is screwed for ½ in., but this is surely too small for pipe from main. (2) What size meter? (3) Please give rough idea of b.h.-p. Engine is very substantial and in good condition. (4) It has a pendulum or inertia governor. If I want maximum power from engine, do I adjust her to run at highest speed when running light? (5) Where can I obtain a fairly detailed description of how to make a coil suitable to work the gas engine, including description of the system of contact?

A ¾-in pipe would be quite sufficient under ordinary conditions, but if the pressure is rather low, a 1-in. pipe would be better. You do not mention the stroke of the engine, but estimating from the diameter of cylinder, we should say that a 10-light meter would be

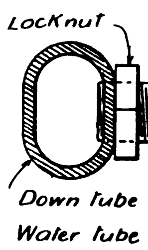


FIG. 4.

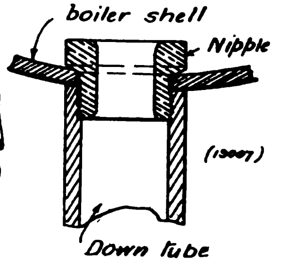


FIG. 5.

required. The b.h.-p. of engine would probably be about 1½ or 2. We advise you to obtain "Gas and Oil Engines," by Runciman, and study it carefully. It will give you a thorough knowledge of the working of small gas engines, and is particularly lucid in regard to governor mechanism and governing. You might also read the recent query replies in these columns on similar subjects, which you will find of great assistance. *Re* coil for gas engine, the ½-in. spark coil given in "Induction Coils" 7d. post free, would meet your requirements, although you would find it cheaper and more satisfactory to buy a reliable coil from any of our electrical advertisers. An illustrated description with diagrams showing connections was given in an article on the *M. E.* Gas Engine, in March 29th issue, 1906.

[19,638] **Model Steam Road Motor.** L. B. (London) writes: What shape boiler do you advise me to have, a horizontal oblong boiler or a vertical round boiler? Would a boiler about the size of a 7-gallon cistern do? Also what pressure would I require for the driving of the cart combined with the weight of one person in it. I thought of running a single centre flue through the boiler. Would I get sufficient pressure by having only a centre flue and no tubes? Would I get a fairly good speed (say six or seven miles per hour) by having a twin oscillating cylinder, about a 3-in. or 4-in. stroke to drive a double crank axle with a flywheel, fixing a belt or chain from the flywheel axle of the rear wheels? Do you advise me to have these cylinders or a single slide-valve cylinder?

We intend to deal with this subject in a future article. We answer your queries *in seriatim*. (1) The question of boiler design involves the whole design. We cannot say which would be better. (2) You do not measure boilers in this way, but by the heating surface and grate area they are provided with. (3) The pressure within limits is immaterial. The usual pressure would be between 40 and 80 lbs. A boiler a few inches high could be made to stand the pre-determined pressure, but would, of course, not supply the amount of steam required at that pressure. (4) A centre flue boiler would be useless for a proportionate model. See answer No. 3. (5) Oscillating cylinders are barred. This query involves main considerations of the design, and would take a draughtsman a week to answer properly.

[19,561] **Small Boiler for Lathe Driving.** S. P. (Birmingham) writes: Would a vertical boiler 9 ins. diameter, 18 ins. high, with 35 tubes ⅝ in. diameter, fired with gas, supply steam to a horizontal engine 2½ by 4½, running 100 r.p.m. at 50 lbs. pressure, driving a 3½-in. centre lathe? The above boiler would not have water space firebox. Heating surface, 800 sq. ins.

In the matter of heating surface the boiler is satisfactory, but we are afraid that it is rather small and would be apt to prime with such a large engine. You will, if you adhere to the design, have to take special precautions with regard to this point, and also to obtain a constant water supply. The boiler will require constant attention, which for lathe driving is an objectionable feature. We would prefer a very large boiler, either centre flue or with few tubes (for coal firing), or a generator with a much larger shell and the same or slightly larger tube heating surface than that provided by the proposed boiler, where gas or oil firing is intended.

[19,606] **Supply for Coil for Wireless Apparatus.** R. K. R. (Sutton, Surrey) writes: I should be extremely obliged if you would enlighten me upon the following: (1) I wish to set up a wireless telegraphy station to be in communication with another 35 miles away. As current is laid on in this house, 220 volts alternating, 50 ~, could I transform the voltage up by means of an ordinary transformer in order to obtain the required spark, and if so, would you kindly give me any particulars, *re* type of transformer, and should I require it to be artificially cooled? (2) If No. 1 is not suitable, would a Tesla coil (such as described in a recent number) be any good for wireless if connected up with a small coil? (3) I want to make a very sensitive relay; should I get one if I wind, say, two 3-in. bobbins with the finest wire procurable, No. 40, and consequently if I rewound the bobbins in a watch receiver with No. 40, should I get a more sensitive one? (4) Do you know of any book in which particulars are given *re* making of Morse inker?

(1) You could transform up the voltage by means of a special transformer very carefully insulated, preferably in oil. The secondary discharge is *dangerous*, and the whole construction must be very careful to avoid breakdown. A good spark coil could be used, but choking coils or resistances must be inserted to cut down the primary current. In either case the secondary discharge is a quiet flaming arc which only becomes a spark when connected to the aerial. Very great trouble with arcing will be encountered unless the aerial has a large capacity. This arcing greatly reduces the radiation and causes serious heating in the secondary coil. Great care must be exercised in handling the apparatus, as the discharge may be extremely dangerous. (2) We would *not* recommend you to use a Tesla coil. (3) For relays use the finest wire, say No. 40 or 42, and see Mr. Howgrave-Graham's book on "Wireless Telegraphy" (Percival Marshall & Co.). (4) We do not happen to have any book in mind which gives designs for a Morse inker.

[19,682] **Steam Electric Generating Plant.** W. R. (Sunderland) writes: I should be glad of advice on the following query. I have a small dynamo which, when driven from headstock on lathe, lights four 4-volt lamps easily. I have a copper boiler 5 ins. by 12 ins. centre flue, working at 30 lbs. pressure. What I want to know is if this boiler would be able to drive an engine to drive the above dynamo, and if so, what size engine would you advise. Or would you advise a larger boiler?

We estimate that under the very best conditions and with the aid of the induced draught obtained by turning the exhaust up the chimney, that the boiler would work at the pressure named a ¾ by 1¼ or ⅝ by ⅝ horizontal engine at 300 to 500 r.p.m., and just drive the dynamo. The boiler would, however, require constant attention. For dynamo driving the largest boiler possible will prove the best. You would not like to stand by a boiler 7 or 8 hours while the steam plant charged a 4-volt accumulator.

The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

Sutton Coldfield Park Miniature Railway.

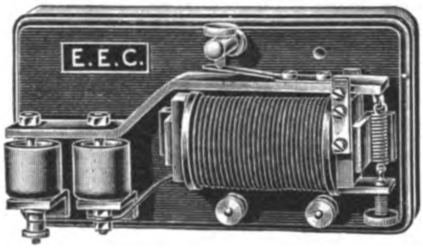
Our readers will be interested to learn that the alteration to the track having been completed, the railway, which was announced in a previous issue as not to be running until Whitsuntide, is now in full working order.

Sack Leclanché Batteries.

With reference to a recent reply to Query No. 19,690 on the subject of the use of Sack Leclanché cells for electric lighting, we are asked by the Universal Electric Supply Co., of Manchester, to state that their "Empire" Sack Battery, which is made with a secret mixing in the bags, will light Osram lamps perfectly well. We may say in this connection that we know from personal trial that the "Empire" Battery is an exceedingly efficient type of cell, and we have also seen a testimonial from a user to the effect that he has had three of these cells in use for ten months lighting a 4-volt "Osmi" lamp, with most satisfactory results. We are anxious to give credit where credit is due, and insert this reference to the merits of the "Empire" Cell with pleasure.

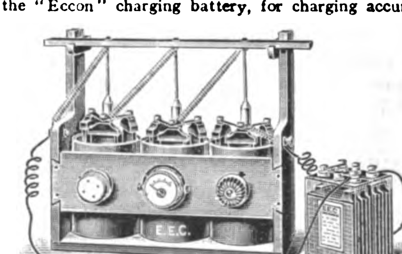
Economic Electricalities.

An exceedingly comprehensive list of electrical specialities has just been issued by the Economic Electric Co., Twickenham, London, S.W. It contains 100 closely printed and fully illustrated pages devoted to all the electrical requirements of the amateur.



THE "E.E.C." CUT-OUT FOR ACCUMULATOR CHARGING.

The goods listed include bells, telephones, batteries, dynamos, motors, small electric light fittings, accumulators, models, coils, boat and tramcar motors and gears, wireless telegraphy apparatus, measuring instruments, stampings, parts, wire, and tools. We show in the accompanying illustration one of the "E.E.C." special registered cut-outs for accumulator charging. These cut out the dynamo from the charging circuit as soon as the voltage of the machine falls to that of the cells. These are made in two types, suitable for various voltages from 4 to 100. We also illustrate the "Eccon" charging battery, for charging accumulators.



THE "ECCON" CHARGING BATTERY.

It is a two-fluid carbon-zinc battery, with special lifting arrangement for the zincs. This may be had with ammeter fitted as illustrated, or without. The battery gives 2 volts per cell, and is made with either 3, 4, 6, or 8 cells, as required. The catalogue is full of interesting items for amateur electricians, and has a specially designed artistic cover. A point which will be appreciated by Colonial readers is that post and freight rates to all British Colonies, and many other places abroad, are given. The list will be sent post free to any reader on application.

The Editor's Page.

WE have under consideration the holding of a Model Motor Boat Regatta during the month of July. The date proposed is Saturday, the 25th, the racing to take place in the afternoon and the various events to be open to all comers. Some classification will be made as regards motive power and length of boats, but events for steam, petrol, and electric models will be provided, and a handsome series of prizes put up for competition. The proprietor of the Wembley Park Pleasure Grounds has taken a great interest in this proposal, and in addition to offering the use of his lake for the races, has promised a substantial donation to the prize fund, including a magnificent silver cup for an inter-club competition. As many of our readers know, Wembley Park is only about fifteen minutes' journey from town, and the lovely surroundings of the lake, coupled with the many other attractions associated with the Pleasure Grounds, make it an ideal resort for an interesting and enjoyable afternoon outing. In order to enable us to settle the details of the various events, it is desirable that we should have some idea of the number of boats likely to be entered, and particulars of their types and sizes. We are anxious to arrange a programme which will give an interest to the private owner as well as to the expert club racer, and we shall be glad if all readers who would feel inclined to bring and run a model self-propelled boat of any kind on the date in question will send us a post-card, giving brief particulars of their boat. This will not constitute a definite entry for the Competition, but will merely be to enable us to arrange a suitable programme of events. We will ask for definite entries when this has been done. It is also proposed to hold an exhibition of model boats in one of the buildings of the Park on the same day, for which we should be glad to have the names of probable entries. Prizes would also be offered in this section. The nature of the water precludes races being arranged for sailing boats, but these would be welcomed for the exhibition. We should be glad if all those interested would write us as early as possible, as there is no time to be lost in making the final arrangements. We should appreciate any suggestion which readers may have to offer.

* * *

It is quite possible that amongst our many readers there are several who are interested in the subject of printing from an amateur point of view. Such may like to know that an Amateur Printers' Association has just been started, with Mr. E. H. Blakeney, of King's School, Ely, Cambs, as Hon. Secretary. We have given more than one article on the construction of a small printing press, and regard this craft as a highly interesting one for home practice.

Answers to Correspondents.

"NONSUCH" (Portland).—Thank you for your suggestion which shall have attention.

J. F. K. (Oldham).—Thanks for your interesting post-card. Hope you will enjoy your trip to London.

P. A. (Rondebosch).—We will try and keep you posted through our columns in any further monorail developments. Glad to hear your good opinion of THE MODEL ENGINEER.

T. P. (Atherstone).—Yes ; use litharge for negative, and red lead for positive plates.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

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HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

The asterisk (*) denotes that the subject is illustrated.

THE

Model Engineer

And Electrician.

A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 372. JUNE 11, 1908. PUBLISHED WEEKLY

A Model Torpedo-boat Destroyer.

By E. PORTEOUS.

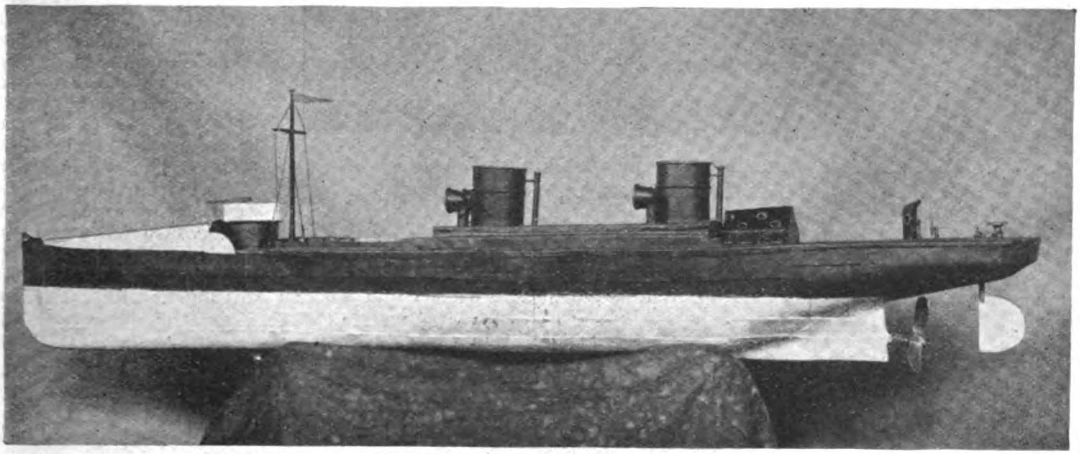


FIG. 1.—MR. E. PORTEOUS' MODEL T.B.D.

THE accompanying photographs illustrate a model torpedo-boat destroyer I have nearly finished. The boat is 4 ft. 7 ins. long, 5½ ins. beam, and 5½ ins. deep. I first got some 1-in. deals and screwed them together into a solid block, and got a friend to cut the hull out for a pattern. I then covered it with strong tin-like plating, and when I took the wood out I found it was strong enough without putting any ribs in. I made all the deck fittings, funnels, ventilators, screen, binnacle, wheel, conning-tower, gun, mast, etc., from scrap brass, tin, wire, etc. The boiler is made of 1-16th-in. copper; the ends are flanged and all seams are riveted and soldered. The furnace is made of 2-in. copper tube, with nine ⅜-in. water tubes. The size of the boiler is 3½ ins. by 9 ins., with a 3½-in. by 2½-in. steam dome. I tested the boiler to 100 lbs. by pumping water in with the hand-feed pump. Steam is raised with a paraffin blowlamp. I made the coil from ⅜-in. strong copper tube. The container is made of tin, and the pump is made out of an old inflator. I can raise 20 lbs. of steam in about ten minutes.

The engine is a double-acting trunk engine (1-in. stroke and 1½-in. bore). The trunk is made of ⅞-in. brass tube. The propeller is made of sheet brass soldered to a solid brass boss mounted on a ¼-in. shaft. The feed-pump is made of a piece of ½-in. brass tube, and other pieces of scrap brass with ball valves. I get about 4 miles an hour on 30 lbs. of steam. This is my first attempt at model steamer work, and I may say it works well. The boat has been sunk twice in collision, but it is none the worse for its experiences.

A First Attempt at Model Making.

By A. Kirkby.

As two of my model locomotives have already appeared in the pages of The Model Engineer, I thought it might be of interest to readers to know of my first attempt. The model

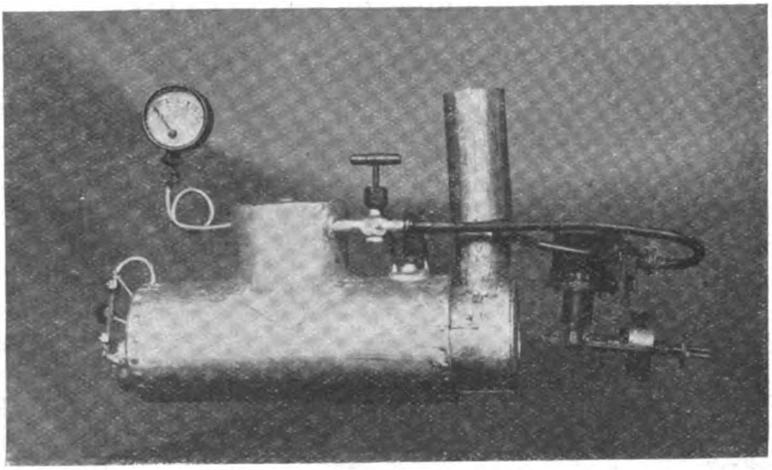
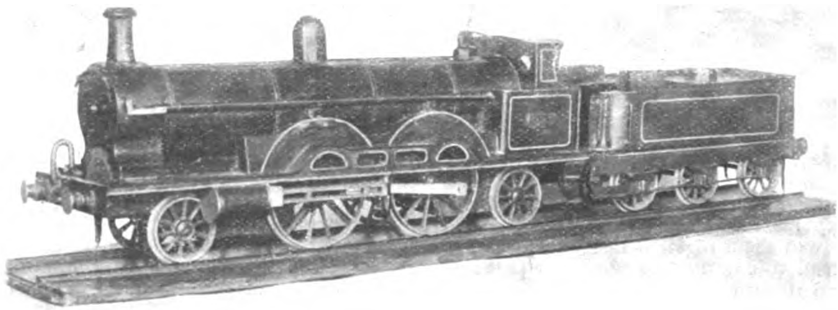


Fig. 2.—Engine and Boiler of Model T.B.D.

(For description see previous page.)

illustrated herewith was built in 1896 at a time when I knew practically nothing about metals. I had no idea in what form it was made up or how and



A "First Attempt" at Loco Building.

where it could be bought. Perhaps if I had been a little more in the know, I should have been able to supply some of the parts without so much trouble. My dimensions were obtained from a photograph which appeared in the *Locomotive Album*, and also from sundry visits to Euston Station, and is built to a scale of ⅜-in. to the foot. This size was decided upon as I had some old wheels by me which were about the right diameter, but were very poor specimens to what are put on the market at the present moment. I remember that I had to buy four more small ones to complete the set, for which I gave 1s. 9d. per pair, and then found that one or two of the spokes were built up of paint.

I had no intention of making a working model as I had never seen one so small. My sole ambition was to make something that looked like the original. I think I started with the boiler and was at a loss to know for some time how to construct it. I came across an old wooden rolling-pin, which I found—with bits of wood glued on to form the firebox, and a tin smokebox fitted to the other end—acted very well. The frames, cylinders, cab, and tender sides were all cut out of sheet tin with a pair of scissors and bent to the correct shape. The axles were made from nails, with the thread for screwing into the wheels filed on, for I had no screwing tackle in those days. The bearings were made from brass screw-eyes, the buffers from paper fasteners fitted with pieces of wood to form the correct shape. The hand rails and pipes along the sides of the boiler are steel and wooden knitting needles. The funnel, dome, safety valve, and tool boxes were cut out of wood with a penknife. It is painted and lined in L. & N.W.Rly. colours, and looked very well when completed, although when the photograph was taken it had been knocked about a good bit.

A Model Electrically Driven Launch.

By G. Rimmer.

THIS model was made with the intention of making a steamer; but as I had no lathe, I fitted it with an electric motor, the casting for the field-magnet being the only one I bought. The armature I made from scrap material in the following manner. First, I procured a piece of Δ-shaped iron 1¼ ins. long by ¾ in. on each face. I drilled a ¼-in. hole for the shaft and made three iron spindles and screwed them into the sides; then I screwed three pieces of ◘-shaped iron on to these, as shown in Fig. 2. The commutator was made in the usual manner—from boxwood and brass tubing, with copper brushes. The steering gear was made from the solid wheels of an old clock. The current is carried from the batteries to the switch through the brass ladders and railings, which are made from 1-16th-in. split pins driven into the deck and threaded with brass wire. The main switch is placed behind the funnel; there is also a reversing switch in the shape of a steering wheel on the bridge. The two lifeboats are not hung on davits, but fitted on stands under the

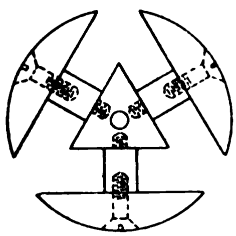


Fig. 2.
Built-up Armature.

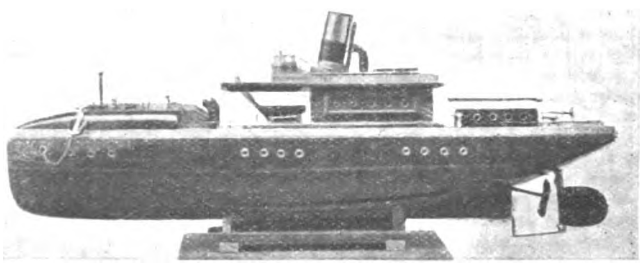


Fig. 1.—Electrically Driven Launch, by Mr. G. Rimmer.

extension of the upper deck. The hull is made from yellow pine, and painted black below the water-line and brown with gold lines above. The decks are French polished. The boat is 2 ft. 3 ins. long by 6 ins. wide by 10 ins. high. All fittings, including port holes, ventilators, etc., are of brass; a saloon is fitted between the two decks. She sails well above the water-line at a speed of about 5 miles per hour.

It is reported that recent experiments by the Danish Government with windmills for electric power generation for industrial and agricultural purposes have shown that those of the four-wing type give the most power for a given area. With a wind velocity of 20 ft. per second—13½ miles per hour—1 h.-p. may be developed on 65 sq. ft. of surface. With a velocity of 26 ft. the power is doubled.

The Construction and Repairing of Motor Bicycles.

By "Sregor."

(*Continued from page* 487.)

CONTINUING my remarks upon the exhaust of the motor, the position of the valve opening into the combustion chamber determines in a great degree the ease with which the exhausting

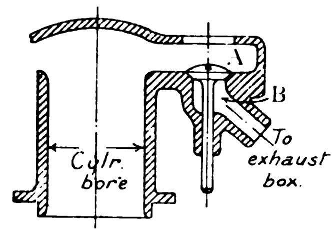


Fig. 97.

gases escape, so that the valve seat should be as close to the actual bore of cylinder as possible to ensure this result. In the accompanying sketches, Fig. 97 shows the position of exhaust valve most commonly found on petrol motors. This position facilitates the valves and tappets being in a vertical line, and has given satisfaction from a point of manufacture; but, undoubtedly, the gases do not so easily escape as in the design shown in Fig. 98, which shows the valve opening directly into the bore of the cylinder; obviously, this enables the gases to get away with the least restriction.

Referring to Fig. 97, it will be observed that the gases, after leaving the bore of cylinder, must enter the recess or pocket A, and then take a turn at right angles down through the valve opening B before entering the exhaust pipe. While it is the practice to baffle the escape of the gases through the exhaust-box to minimise the noise, it is very necessary for it to get clear away from the bore of cylinder, otherwise the incoming charge will be weakened by these burnt gases. From a mechanical point of view, the vertical operated valve has its advantages. As with the design (Fig. 98) there is a slight tendency for the valve stem and guide to wear oval. This, however, does not amount to much on such small valves generally found on the motor-car engine. This is usually compensated for by making the valve stem opening larger and thus providing a greater wearing surface, and drilling away the centre of stem—as shown in Fig. 99—and fitting a suitable

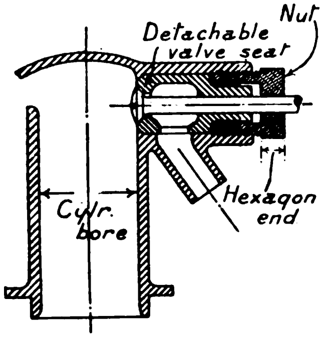


FIG. 98.

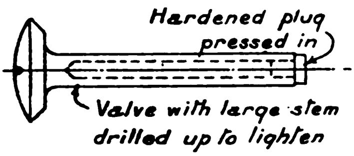


FIG. 99.

plug in the end to receive the blow of the valve mechanism.

After immediately leaving the valve, the pipe arrangement conducting the gases to the silencer should ensure an easy travel, and any sharp turn and restriction should be avoided, especially in the case of a multiple cylinder engine, such as four or six cylinders. Such an exhaust pipe as shown in Fig. 100 is detrimental to an easy exhaust. Here the force of the gases strike the sides of pipe and then continue along the pipes, meeting and restricting the passage of each other. This design of pipe becomes very hot in consequence.

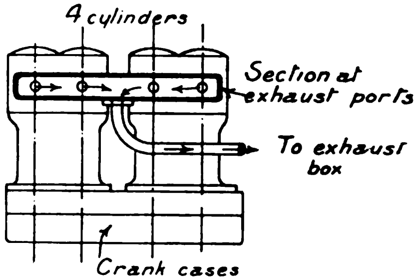


FIG. 100.

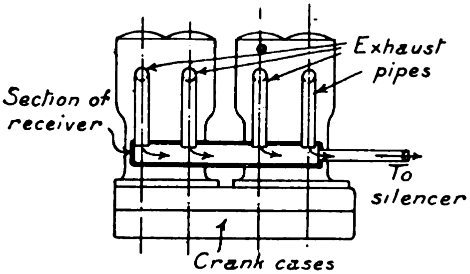


FIG. 101.

The design shown in Fig. 101 provides a straight lead away for the gases from each cylinder, and conveys them to a receiver of sufficient capacity to hold the gases without creating a back pressure. This, of course, in the case of the motor cycle would form the exhaust-box, but in the case of a car the gases should be conducted from this receiver along another pipe to the final silencer. Many forms and designs of these silencers may be found on the various makes of cars; but, as I mentioned previously, the construction of a silencer should be such that will effectively baffle and also reduce the temperature of the gases. A common form of silencer is such as shown in Fig. 102, which provides a form of baffling arrangement without any attempt at cooling the gases.

The design shown in Fig. 103 illustrates the points above mentioned. As will be seen, comparing the two designs, that Fig. 102 differs from Fig. 103 by having an extra liner around the first shell B. This, as shown, spreads the gases over a large surface. The outer casing being exposed to the air radiates the heat from the inner chamber, this being much more effective than in the design (Fig. 102), from the fact that the hot gases are concentrated around

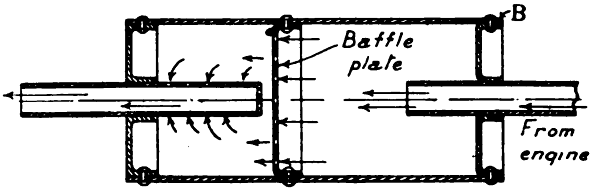


FIG. 102.

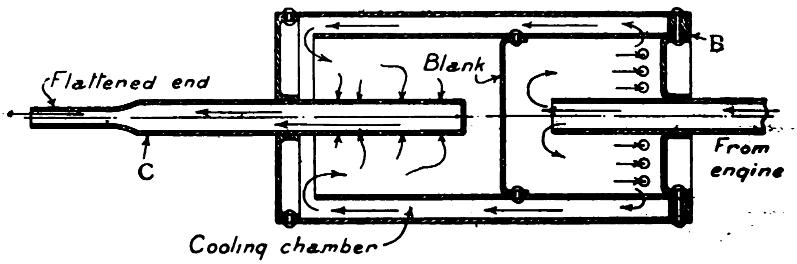


FIG. 103.

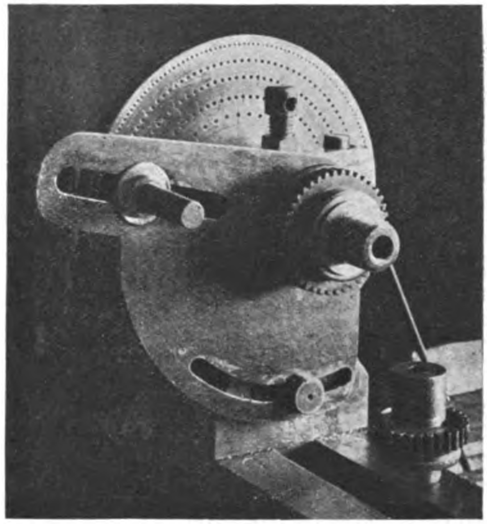
the narrow outer chamber and exposed to a larger surface before passing finally through the last pipes C into atmosphere. As previously mentioned, it is this cooling effect on the hot gases that reduces the report of the exhaust, it being a natural result that by reducing the temperature of the gases, the pressure of the said gases are simultaneously reduced also, so that the more perfect the cooling arrangement is of the cylinder, the quieter the exhaust of the motor will be. The end pipe C is somewhat flattened, which reduces the area of the pipes and checks the final exit of the gases, and provides a more gradual and constant flow of the gases. Needless to say, after ascertaining the efficiency of the silencer, the capacity of same must be such that will effectively pass the maximum amount of gases the motor is capable of passing without causing undue back pressure at the outlet of valves. Further comments will be made on the exhausting arrangements and details in the next article.

(To be continued.)

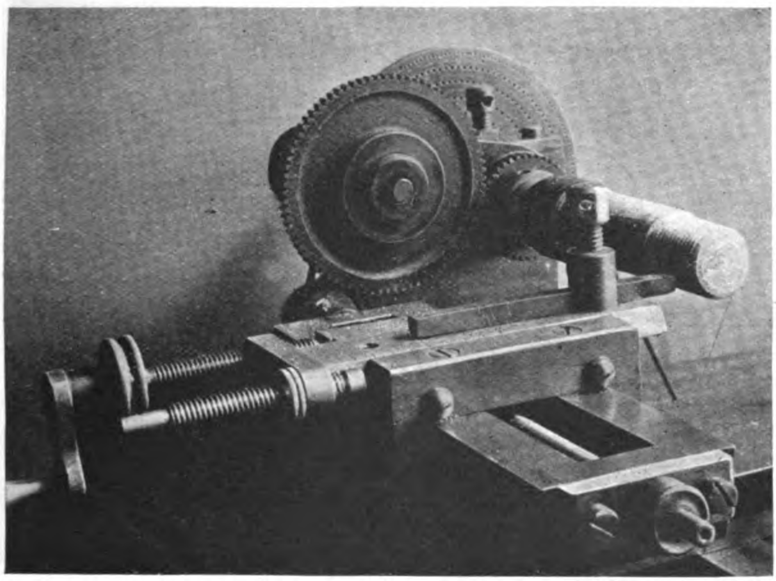
A Handy Screw-cutting Arrangement for the Lathe.

By H. Hildersley.

THE following gives particulars for making a screw-cutting attachment for the lathe. First make a chuck to fit mandrel, with a fac-simile of the mandrel nose, to carry the ordinary chucks. Turn the back part as small as possible in diameter consistent with strength, cut a thread about half-way along, and fit nut to clamp change wheels against a shoulder, which should be left on the chuck as shown at Fig. 1. Now make a similar collar to fit on the end of slide-rest screw where the handle goes on, fastening same with a setscrew (Fig. 2). Next we require a collar the same diameter as the others, but twice as long in the plain part, so that two wheels could be put on side by side if required ; a piece of steel wire should be screwed into each collar where the wheels go on (wire to be $\frac{1}{8}$ in. in thickness), to act as keys to prevent the wheels from slipping (Fig. 3). This collar should be bored with a $\frac{3}{8}$ in. hole, to be a running fit on steel pin (Fig. 4), which should be turned from $\frac{3}{4}$-in. steel, with a hole through one end to put a pin in to prevent the collar coming off ; the other end should have a flat filed on each side, and a screw and nut fitted to clamp it in slot without it turning round. Now make a plate of $\frac{1}{8}$ in. sheet iron, as shown at Fig. 5. The round hole should be made to fit over the bearing bush of the mandrel if it projects out ; if not, a flat ring should be soldered to a plate (Fig. 6), and screwed on the front of the headstock for the radial arm to fit on, so that it can move round in the arc of a circle, and be clamped in any position with a nut and screw, through the radial slot, as shown in front of the headstock (see photograph above).



Showing Method of Carrying Change Wheels.



General View of Screw-cutting Attachment.

For change wheels I got some cast-iron cut wheels off old sewing machines (they can often be got very cheap off old iron stalls), and made some out of boxwood the same pitch, as you cannot get them with any number of teeth. They run very well together, and do not make so much noise as all metal wheels do, and are quite strong enough if you make them about $\frac{3}{8}$ in. wide in the teeth, and are very easy to make if you have a division plate and vertical cutter frame, with a single tooth cutter. If you have not got the above I should advise you to make them. I think there has been an article on cutter frames in THE MODEL ENGINEER, so I shall not describe that to you.

My division plate I made as follows: cut a circle of brass, 5 ins. in diameter and 3-16ths in.

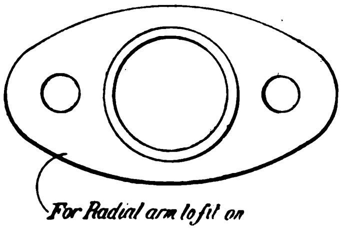
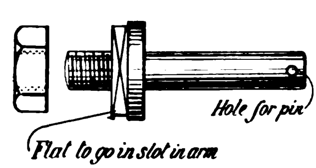


FIG. 6.

FIG. 4



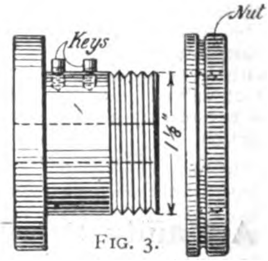


FIG. 3.

thick, and fit it over mandrel, against face of pulley, and fasten same on with four ⅛-in. screws; then strike five concentric circles about ⅜ in. apart

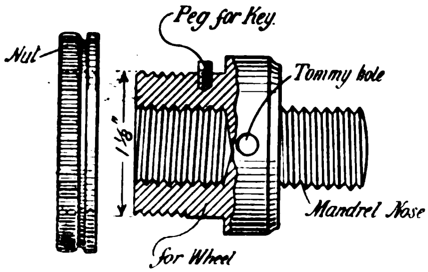


FIG. 1.

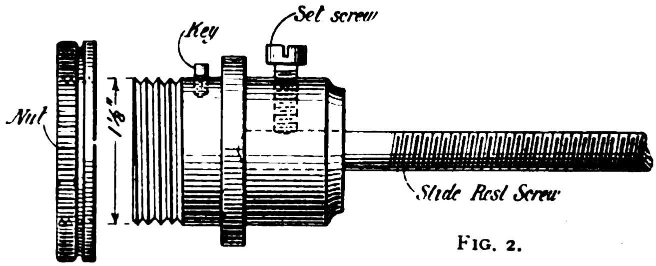


FIG. 2.

and divide them off into 42, first row inside, 78, 96, 112, and 180 on the outside; you first divide by a small number that will go into the number you want, and then sub-divide until you get what you want. For instance, No. 96 takes the radius of the circle, and mark off the circumference with dividers; it will go 6 times; then halve it, 12; again halve it, 48; again, 96. Then go over it with a sharp centre punch, and drill 1-32nd in. holes about ⅛ in. deep. It is easier to do than it looks, and is quite true enough for general work.

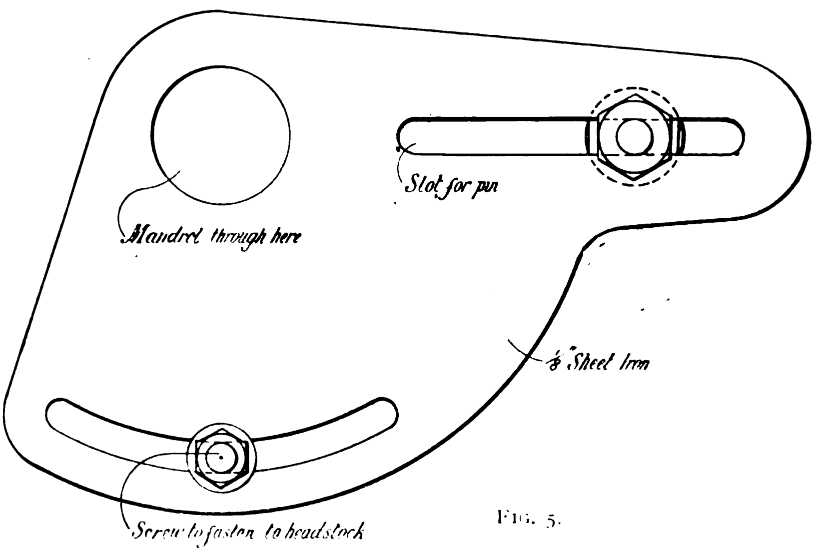
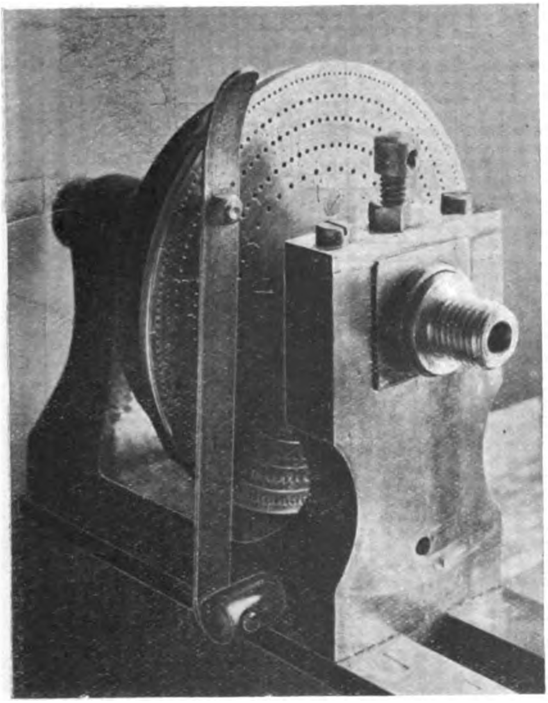


FIG. 5.

Now, to cut a screw. You arrange, as shown in photographs, screwing the radial arm against the headstock with one ⅛-in. screw, fixing it higher or lower according to the size wheels you are using; put on mandrel chuck a wheel with forty teeth, and one on the slide-rest screw the same; bring the slide-rest up and let them engage; they will cut a thread the same pitch as slide-rest screw, but will be left-handed if the slide screw is right-handed or *vice versa*. So you put a wheel on the pin in slot of radial arm and engage it between them, it will then cut the same direction as slide-rest screw. The number of teeth on this wheel does not matter so long as it is large enough to engage the two; if you put a wheel with eighty teeth on slide-rest you will cut a screw with twice the number of threads; or, put eighty on mandrel and forty on slide screw it will cut half the number, and so on according to the number of threads you want. On page 559 is a list of wheels to use with a slide-rest screw of sixteen threads to the inch :—

No. of Teeth in Mandrel.	Wheels on Lead Screw.	Threads Per Inch.
80 ..	30 ..	6
80 ..	40 ..	8
48 ..	30 ..	10
40 ..	30 ..	12
40 ..	32 ..	12·8
32 ..	30 ..	15
48 ..	48 ..	16
30 ..	32 ..	17
40 ..	48 ..	19·2



Showing Division Plate.

32 ..	40 ..	20
32 ..	48 ..	24
30 ..	48 ..	25·6
48 ..	80 ..	26·6
40 ..	80 ..	32
32 ..	80 ..	40
30 ..	80 ..	42·6

With six wheels only (80, 48, 48, 40, 32, and 30 teeth) 16 different threads can be cut.

Large New Power Station in Sweden.—The building of a large new power station in Lapland, North Sweden, is likely to be taken in hand during the forthcoming summer. The survey of the Norr and Söderfors Falls has been going on for some considerable time. It is proposed to build the power station close to the Brännland railway station, barely ten miles from the sea. The power available is estimated at 81,000 horse-power.

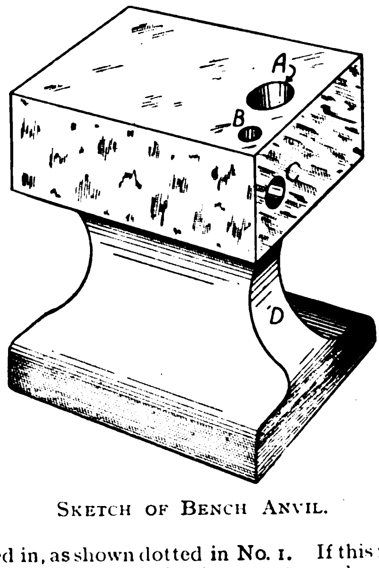
Workshop Notes and Notions.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume if desired, but the full name and address of the sender MUST *invariably be attached, though not necessarily for publication.]*

A Small Bench Anvil.

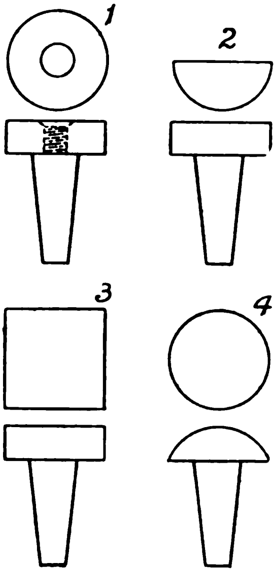
By Frank H. Jackson.

The sketch shows a small bench anvil made from a short piece of steel railroad rail. A suitable piece of rail can be easily obtained from the section foreman of any railroad. The material was first placed in a forge fire to anneal it, and then planed true on top, sides, and end. Then, with a hacksaw and files, the neb was cut out, as shown, so as to allow drilling the hole A clean through. This hole was reamed with a taper reamer from top, so as to hold securely the "stakes" (1, 2, 3, and 4). The hole A was drilled ⅜ in. The hole C was drilled (as shown) in end, so as to allow punchings, etc., that were forced through hole B to be removed. The hole B is about 3-32nds in. After the top part of anvil was trued up, so that the corners were exactly square, and polished, the top and edges were case-hardened by heating to a good red and sprinkling powdered yellow prussiate of potash, and when it was thoroughly melted, cooled off in cold water, which left it so hard a file will not touch it. The top and sides were then polished with emery paper. The "stakes" (1, 2, 3, 4) can be made of wrought iron, either turned up out of a solid piece or the top part drilled and a thread cut in, and the stem



Sketch of Bench Anvil.

screwed in, as shown dotted in No. 1. If this method is used, the top should be countersunk, so that the stem can be riveted, and the stem should have a shoulder, so the top can be very firmly secured to stem. The stem should be of such length as to allow the top to be about 1½ ins. from top of anvil (when in use), also extend through hole a little, so as to be easily removed by a light tap of a hammer. The shapes of "stakes" will be determined by the class of work to be done, and can be made to suit the work in hand. It is a good plan to case-harden the top part of the "stakes," so as to preserve their shapes and smooth surfaces. By cutting out a portion of the web, as



STAKES USED WITH BENCH ANVIL.

at D, it will allow some kinds of work to extend under top of anvil, which will be an advantage at times. My anvil is 3¼ ins. long by 2⅛ in. wide on top, and stands 4 ins. high; but the size will be determined by the size of the piece of rail used.

Cutting Piston Rings.

By E. H. ELLINGHAM.

While looking through some back numbers of your paper, I came across a query dealing

FIG. 1.

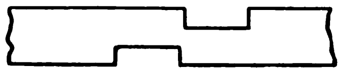


FIG. 2.

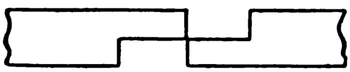
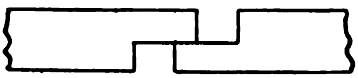


FIG. 3.



with piston rings (No. 19,128, March 26th). In this are some suggestions, all except one of which require small pieces of metal riveted on; as this is rather an awkward job, I thought that the following idea might be of use: Instead of the ring being cut, two notches are filed in it as in Fig. 1. These are increased until they break through into one another, as Fig. 2. When the ring is put into the cylinder it is pressed together and a steam-tight joint is formed, at the same time leaving plenty of spring, as Fig. 3.

[This method is, of course, well-known in engineering workshops, but it may be new to some of our readers.—ED., *M.E. & E.*]

A Model Balanced High-Speed Engine.

By HENRY GREENLY.

SOME three years ago I was commissioned to prepare drawings for a direct-coupled electric lighting engine, but as a model built to the 1903 undertype design was ultimately decided upon, the idea for the direct-coupled engine did not progress further than to a rough sketch

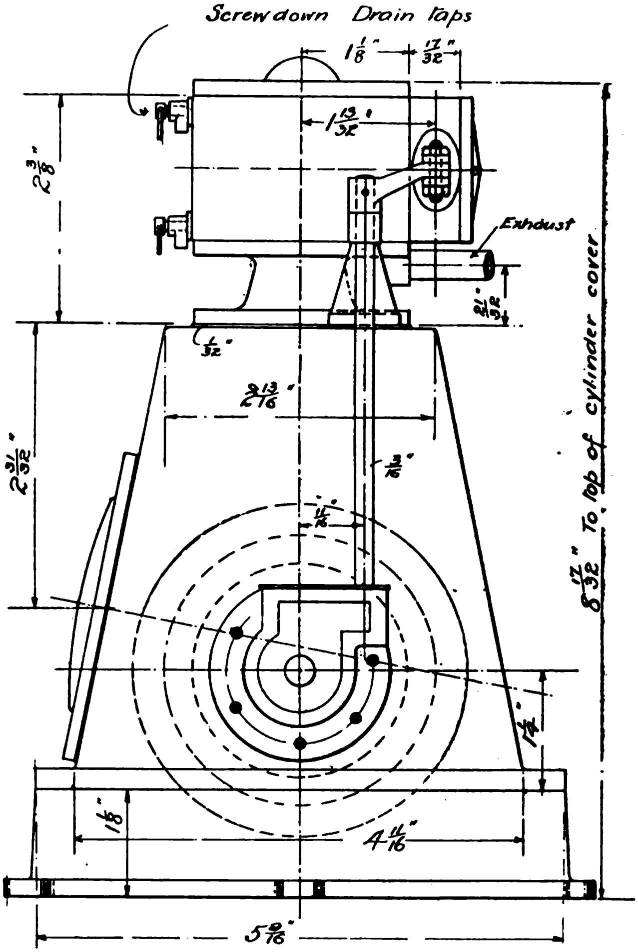


FIG. 1.—END VIEW SHOWING VALVE GEAR.

Although I may be accused of foisting old ideas on readers of THE MODEL ENGINEER in submitting complete drawings, I am relying on the belief that nothing of exactly similar character has appeared in these pages before. The model is called a balanced high-speed engine, and is entirely enclosed. The valve gear is of the cam type, as recently suggested by me for use in high-speed model steam launches.

The balance is not absolutely perfect, but is sufficiently good for speeds up to 3,000 r.p.m., which is all that is generally required. In all model single-cylinder engines it is extremely difficult to balance the reciprocating masses. As all readers know, reciprocating parts can only be properly balanced by equal and opposite reciprocating counterweights. In a single-cylinder engine

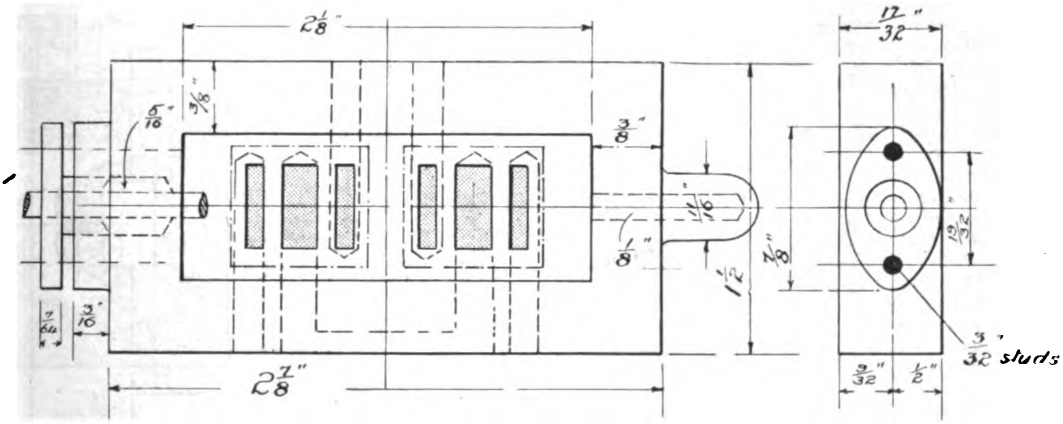


FIG. 3.—FULL-SIZE DETAIL OF VALVE CHEST, SHOWING PORTS AND STEAM PASSAGE.

it is comparatively easy to provide for the unbalanced revolving masses, such as the lower portion of the connecting-rod and crank-pin and webs by counterweights, either on the crank webs or

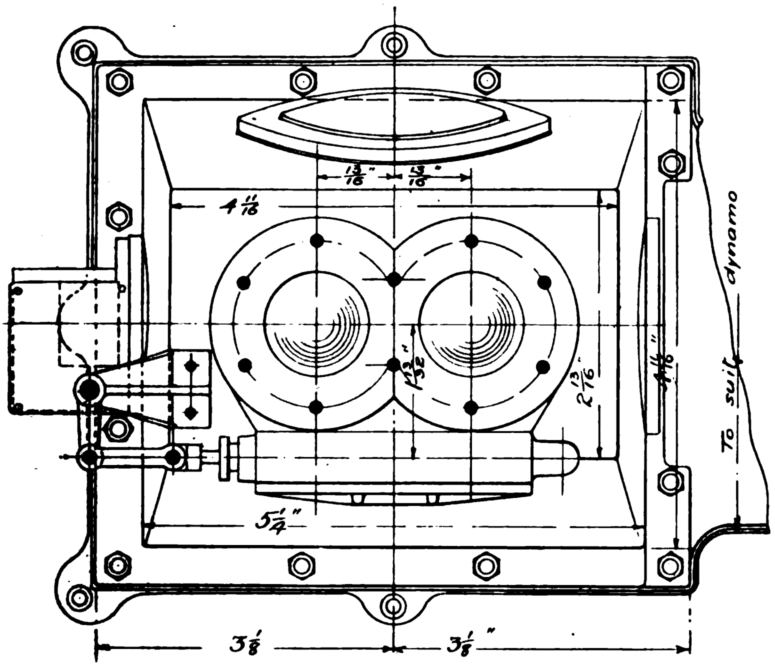


FIG. 2.—PLAN OF ENGINE.

in the flywheels. But what to do with the piston-rod and crosshead is another matter, as these portions, especially the piston, are proportionately heavier to those of an actual electric lighting engine.

The present design, it is submitted, gets over the difficulty, and while there is perhaps more work entailed in making a two-cylinder high-speed engine, I think I can show some saving in labour and in number of parts over an ordinary twin engine by the particular arrangement of valve gear employed. The cylinders are as close together as possible, and the disturbing effects of the moving reciprocating parts should be very small indeed.* An even better balance than that obtained with the arrangement shown in the general arrangement drawing may be obtained by using balanced cranks. The revolving weight masses would each be balanced separately, and the relative lateral positions of the cylinder would then be unimportant. However, this is not very essential, and I do not make it a strong point, experience with this type of engine having shown that speeds as high as likely to be required by the average model engineer may be obtained without undue vibration.

The engine, in general outline, is something like the well-known high-speed engines made by Messrs. W. H. Allen and Co., of Bedford. The crank case is entirely enclosed, and is shown fitting down, with an oil-tight joint on a sub-base which is extended to support a dynamo. This sub-base is not necessary, and may be substituted by a piece of 1-16th-in. plate and the engine secured to a wooden baseboard, where it is not intended for direct driving.

The valve gear is a cam gear, but this is not the only arrangement that can be employed for actuating

* To provide perfect balance the equal and opposite reciprocating masses should be concentric; this is, of course, impossible.

the valves. As in the Westinghouse engine, an eccentric working a bell crank may be used. The cam gear is, however, recommended, as giving an extremly rapid valve movement, the advantages of which are well known. The cam itself is also designed in such a way as not to necessitate any special milling apparatus. It can be done in any lathe having the usual slide-rest. The cam gear is covered to prevent the splashing of oil.

The valve chest is on the rear side of the cylinders, and contains two valves working in a horizontal direction on one spindle. The ports, as shown by the detail views, are placed vertically, and the passages running the same way as the ports make the path of the steam comparatively short, which is a desirable feature in a high-speed engine.

Fig. 3 shows the arrangement of the ports and indicates how nicely they seem to fit in with each other and to provide for the placing of the cranks at 180 degs. No awkward coring is required for the exhaust steam ; indeed, all passages can be drilled and the ports slotted by end mills in the lathe. Following the course of the steam, it will be seen that the ports being placed right- and left-handed, *i.e.*, with two steam ports to the top sides of the pistons in the centre, and the ports to the bottom on the outside, the steam either is directed to the top of the right-hand piston and to the under-side of the left-hand piston, or *vice versa*, at the opening of the ports, according to the position of the valve spindle at the moment of consideration.

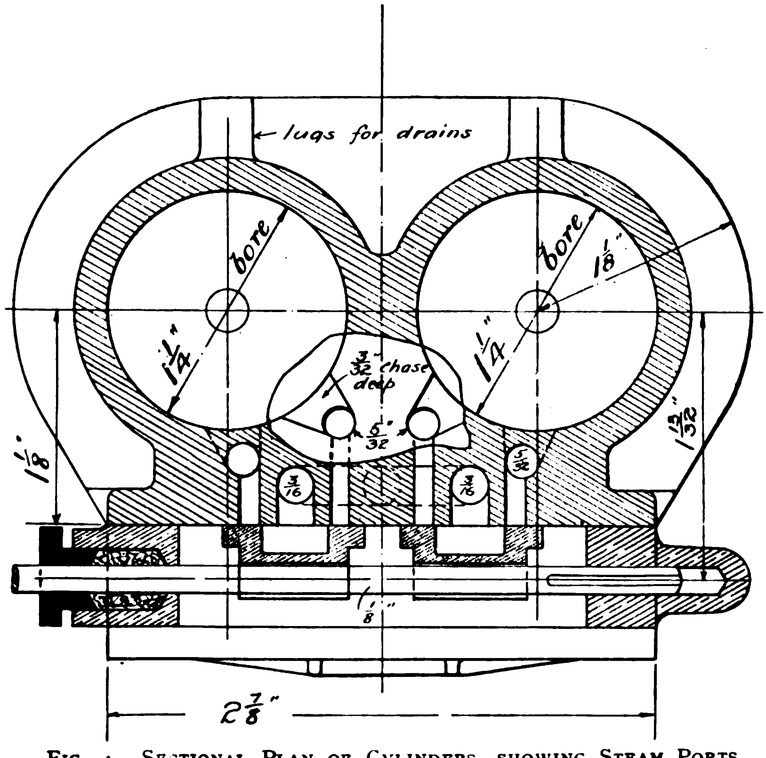


FIG. 4.—SECTIONAL PLAN OF CYLINDERS, SHOWING STEAM PORTS AND PASSAGES.

The connecting-rods are of the ordinary pattern, with adjustable big ends. The slides are solid with the crank case and are bored concentric with

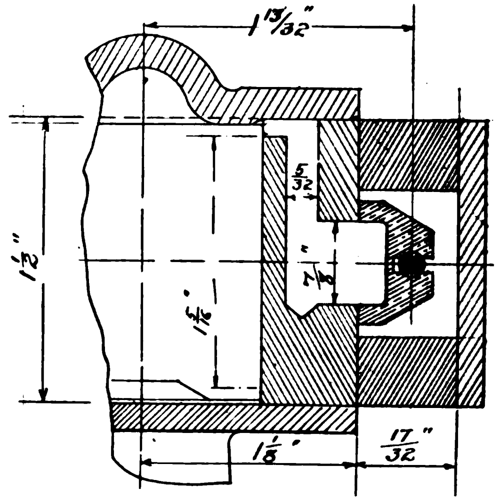


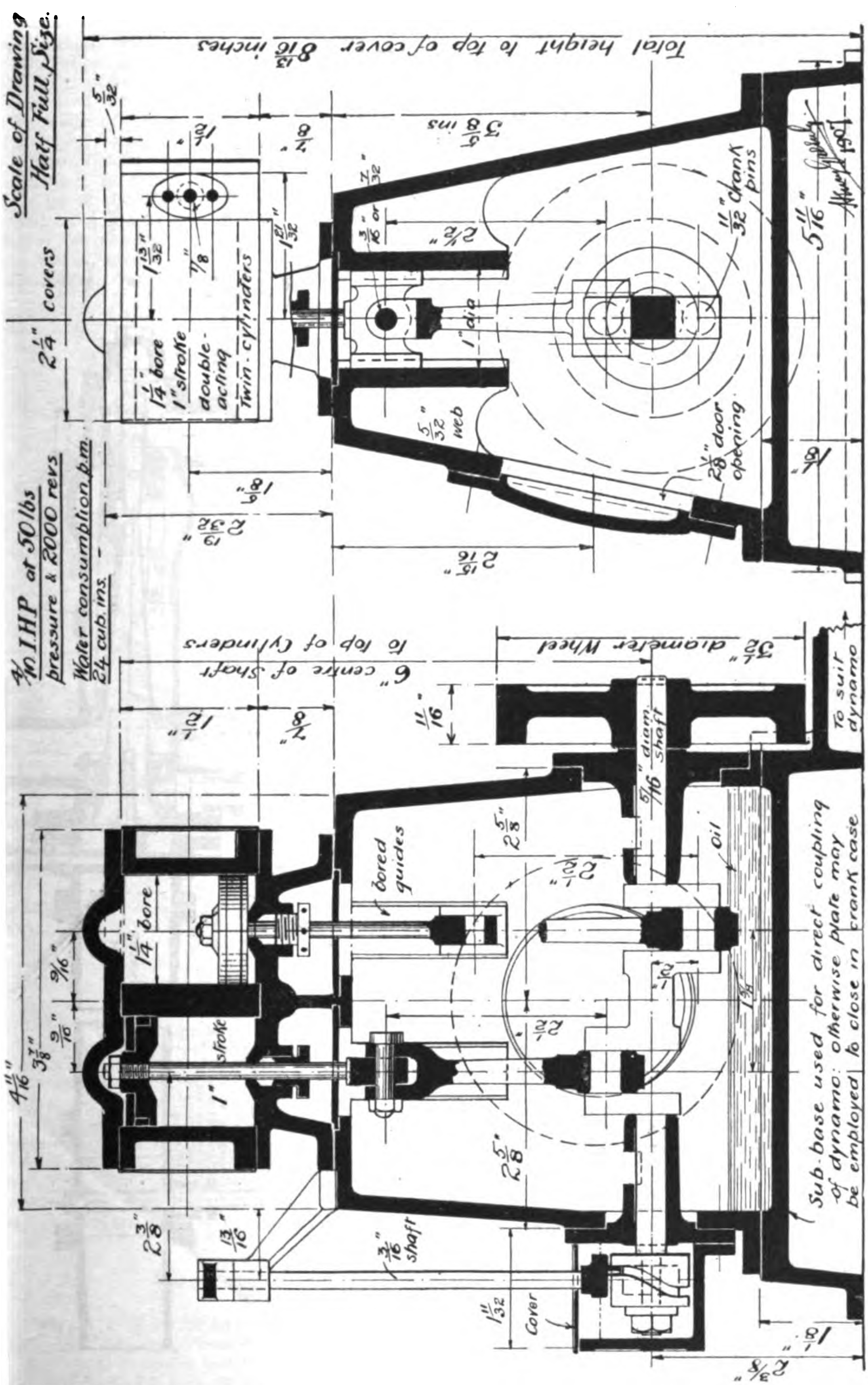
FIG. 5.—PART SECTIONAL ELEVATION OF CYLINDERS THROUGH CENTRE STEAM PORTS.

the cylinders. The crossheads have as large a bearing area as possible, weight of reciprocating parts in this particular engine not being a serious matter.

The pistons are intended to be fitted with a single spring ring, which may be of hard brass or bronze, a junk ring being used to facilitate its insertion in the groove in the piston.

The main bearings are long and each have a part cut away to allow of self-oiling. They are quite plain, and proposed to be made of cast iron in one piece with the covers. These covers fit over holes of different diameters, the opening at the flywheel end being sufficiently large to allow of the entry of the crankshaft, with or without counterbalance weights on the webs. The inspection door is more or less an ornamental feature, and may be embellished by the monogram of the builder of the model, if so desired.

The only objectionable feature in the whole design is the get-at-ability of the piston glands. This, however, must be passed over as inevitable in a model of a double-acting enclosed electric lighting engine. If the alignment of the cylinders piston-rod, and crosshead is good, and the piston glands are packed with a mixture of asbestos and Sichell's metallic packing (a sort of white-metal



A DESIGN FOR A MODEL BALANCED HIGH-SPEED STEAM ENGINE.

By Henry Greenly.

Scale of General Arrangement.] *[Half full size of model.*

shavings first introduced to me by Mr. P. E. Wedmeyer, an old reader of the paper), the glands should not want packing very frequently.

(To be continued.)

How It Works.

XV.—Exhaust Steam Injector for Locomotives.

By Chas. S. Lake, A.M.I.Mech.E.

THE principle of turning to useful account what would otherwise go to waste applies with equal, if not with greater, force where the steam consumption of locomotives is concerned than it does in other matters. With the simple, high-powered engines of the present day, working with high steam pressures, there must of necessity arise a large amount of waste, consisting of energy discharged into the atmosphere in the form of steam exhausted from the cylinders. A proportion of this steam, which, of course, contains a lot of unexpended power not absorbed in driving the locomotive itself, can very well be put to profitable use in other ways, among them being the heating of the carriages forming the train and the warming-up of the feed-water in the tender. Even after that has been done, however, there is still ample energy remaining for the performance of other useful purposes, and one of these is the operation of the injectors by exhaust steam. This has been found to lead to a marked economy, and several of the leading railways have of late years adopted the principle. The design and manufacture of this class of injector have received special attention from a leading firm of engineers in this country, *i.e.*, Messrs. Davies & Metcalfe, Ltd., whose device it is that is generally fitted whenever exhaust steam injectors are used. The idea of producing an injector which would work satisfactorily with exhaust steam only, appears to have resulted from the discovery that the Giffard injector, taking steam at a given pressure, developed in its delivery considerably greater pressure than that of the original steam, *e.g.*, an injector working with very cold water and steam at 60 lbs. pressure would force water against a pressure of 120 lbs. per sq. in. The initial difficulty to be overcome in making the exhaust steam injector a practical success was found to be in starting the injector, for, once started, an injector of very simple form with suitably proportioned nozzles would work satisfactorily. The difficulty was eventually overcome by the invention of the flap nozzle, a very ingenious contrivance which, while permitting a free discharge of steam through the combining nozzle, yet gave an absolutely continuous discharge cone to the moving water jet.

Of the accompanying drawings, Fig. 1 gives a general view in section of the complete Davies and Metcalfe apparatus. The exhaust steam injector itself consists of two parts, known as the exhaust portion and the supplementary portion, these being connected by a pipe through which the exhaust portion delivers to the supplementary one.

In addition, there is a grease separator and a throttle valve. The function of the grease separator and steam drier is to remove from the exhaust steam all particles of grease, dirt or condensed steam which may have been carried along with it. The

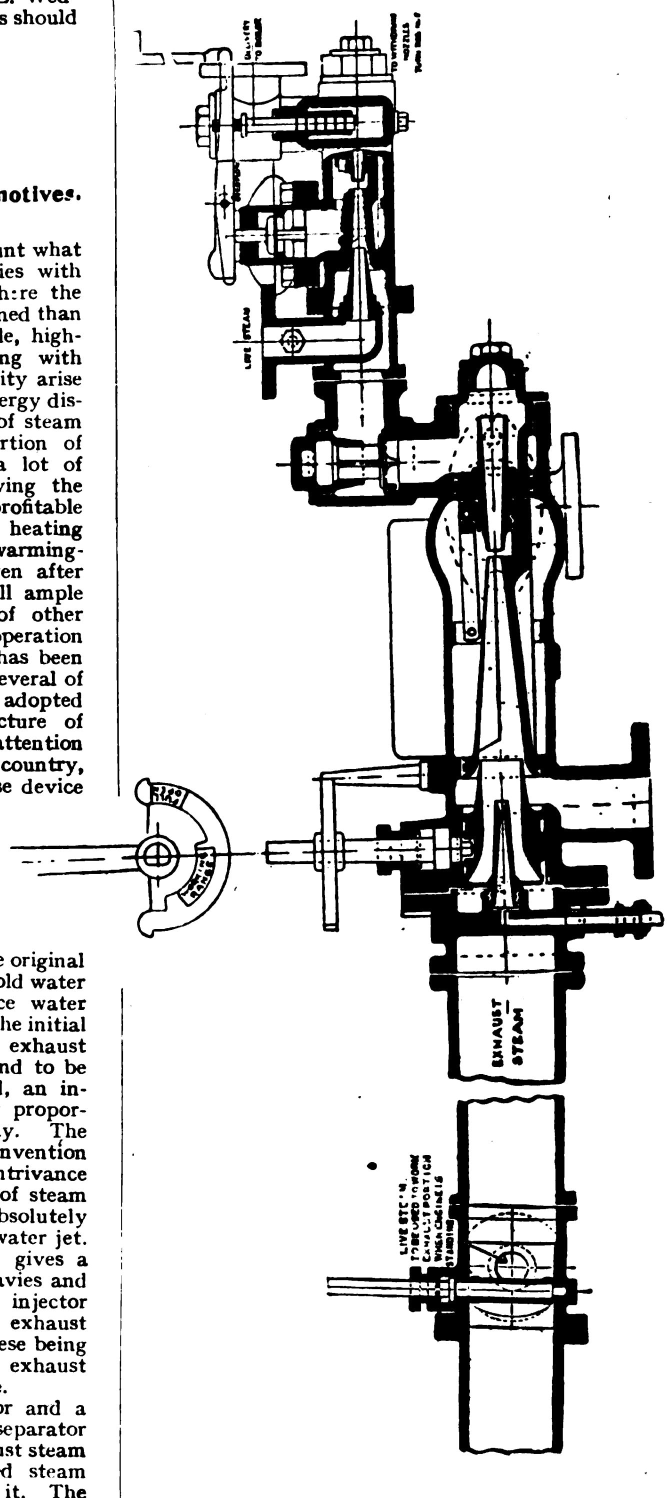


Fig. 1.—General Sectional View of Exhaust Steam Injector, by Messrs. Davies & Metcalfe, Ltd.

steam on entering the casing strikes against the baffle-plates contained therein, which deflect the suspended matter into the well below, whence they are discharged into a drain pipe through the automatic drip valve. The steam then passes through a perforated metal cylinder which is covered by a sleeve made of absorbent towelling, which further dries it and removes any impurities remaining in the steam before it passes to the throttle valve. This latter, of which an illustration is given in Fig. 2, is of the ordinary wing valve type, and is worked from the footplate. It is used to close the exhaust portion of the injector to exhaust steam when the injector is not required to feed the boiler. There is also coupled to the throttle valve casing a with it, its object being to create a vacuum in the exhaust nozzle, thus inducing a greater flow of exhaust steam from the blast pipe into the injector.

The water regulation of the injector is effected by moving the exhaust steam nozzle backwards or forwards. In this way the surrounding area between it and the mouth of the combining cone is varied, and consequently the volume of water flowing into the combining nozzle is regulated according to the quantity of water required. The movement is effected by an eccentric pin which is worked from the footplate. The exhaust portion is always fixed below the level of the water in the feed tank. The supplementary portion (Fig. 4) is

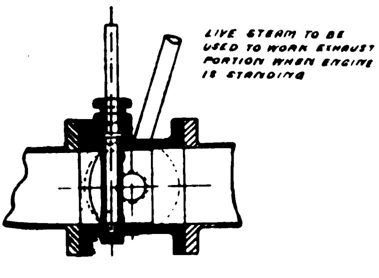


FIG 2.

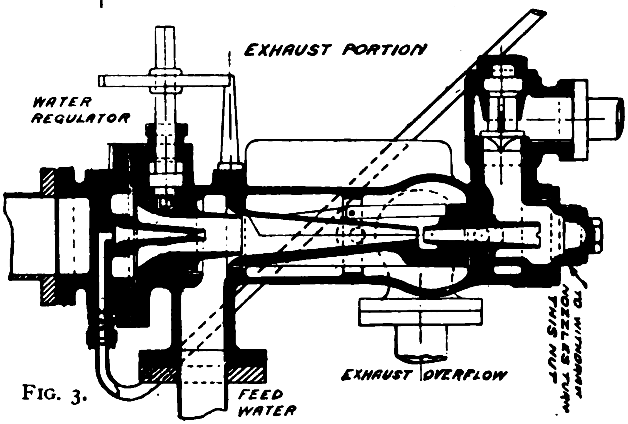
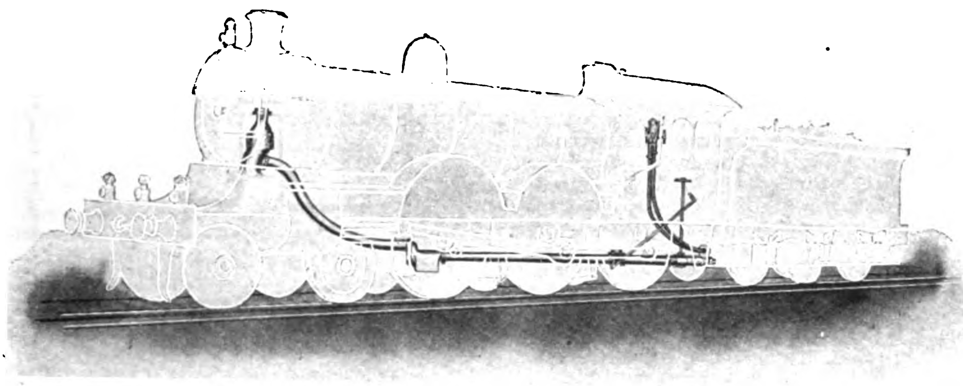


FIG. 3.

branch pipe which conducts live steam to the injector for use in working the exhaust portion when the regulator is shut and no exhaust steam therefore available. The exhaust portion of the injector is separately illustrated in Fig. 3. It really comprises in itself a complete exhaust injector consisting of the usual three nozzles or cones, viz., the steam, combining, and delivery nozzles. It simply a small live steam injector specially designed for handling extremely hot water. It is capable of working up to over 300 lbs. pressure, receiving feed-water at a temperature of 170° F. to 190° F. from the exhaust portion, and delivering the water to the boiler at a temperature of 280° F.

In designing the supplementary portion a serious



DIAGRAMMATIC VIEW SHOWING EXHAUST STEAM INJECTOR CONNECTIONS.

has steam feed-water overflow and delivery connections. The steam nozzle is of very large bore, and a very small diameter nozzle, known as the inducer, and supplied with live steam, is fixed concentrically problem was encountered in the necessity of employing a weighted overflow valve, which is rendered necessary by the high temperature at which the water is delivered to the boiler. This temperature, being well above boiling point, rendered it compulsory that the overflow valve of the supplementary portion should be weighted to a higher pressure than that corresponding to the temperature of the delivery water, otherwise the water would expand into steam and discharge through the overflow. At the same time the overflow valve must act automatically, so that if the continuity of the jet be broken in any way, as, by jarring in passing over points, sudden shocks, etc., the overflow valve must open and allow a free discharge until the injector restarts itself and restores the continuity of the jet.

This automatic action is accomplished immediately, and with practically no waste of water or steam, in an exceedingly simple manner by introducing a lever overflow valve in which a lever is pivoted on a fulcrum, on the injector casing, one end of the lever bearing against the top of the overflow valve, and the other end against the top of a small piston which is in communication with the delivery of the supplementary injector, the leverage being in favour of the small piston. The action of the overflow valve is briefly as follows :—When steam is turned on in the supplementary portion, and until steady working is obtained, the pressure under the overflow valve keeps it open and allows a free discharge into the overflow pipe. Directly the continuity of the jet is established, the pressure in the delivery, acting under the small piston, raises it, and so closes down the overflow valve and keeps it tight on its seating. If the jet breaks from any cause, the pressure on the piston is reduced, the overflow valve opens, and remains so until the injector restarts. The combining cone is fitted with the flap nozzle, to which passing reference has already been made, thus rendering it perfectly automatic. The combining cone is split longitudinally at its middle section up to a point near the steam nozzle, where the cross-section of the cone is sufficient to permit of a large and easy exit for the water or steam, the loose flap being hinged. The force of the steam striking against the hinged portion opens it, exposing a large area of discharge, and so enabling the steam to escape freely into the overflow pipe. As soon as the water is admitted and meets the steam, a partial vacuum is formed owing to the condensation of the steam, and then the hinged flap closes, and is held in that position for so long as the jet is continuous. Should the continuity of the jet be broken in any way, the pressure of the steam pushes open the hinged flap, and a free discharge is offered, and so on, until a vacuum is again formed and the continuity of the jet re-established.

The exhaust steam injector can be worked as a live steam one, if necessary, while the engine is stationary. For this purpose a small steam pipe is coupled to the throttle valve casing, live steam being introduced to take the place of that drawn in the ordinary way from the exhaust. The working conditions are exactly the same, and, indeed, the injector will work equally well in this way. Examination of the collective drawing, Fig. 5, shows that on opening the throttle valve, the exhaust steam leaving the blast pipe at a temperature of 212° F., passes through the grease separator, where it is dried and purified, and travels on through the throttle valve into the exhaust portion, and, flowing through the exhaust nozzle, meets the feed water at a temperature, say, of 50° F. Condensation immediately takes place, and a vacuum is formed, the combined jet of water and steam rushes forward through the combining nozzle and into the delivery nozzle, where the kinetic energy, due to the velocity of the jet of water and condensed steam, is changed into pressure energy, and leaves the exhaust portion at a temperature of about 180° F., and a pressure of 70 lbs. It is here that the economy claimed for the apparatus arises, for the

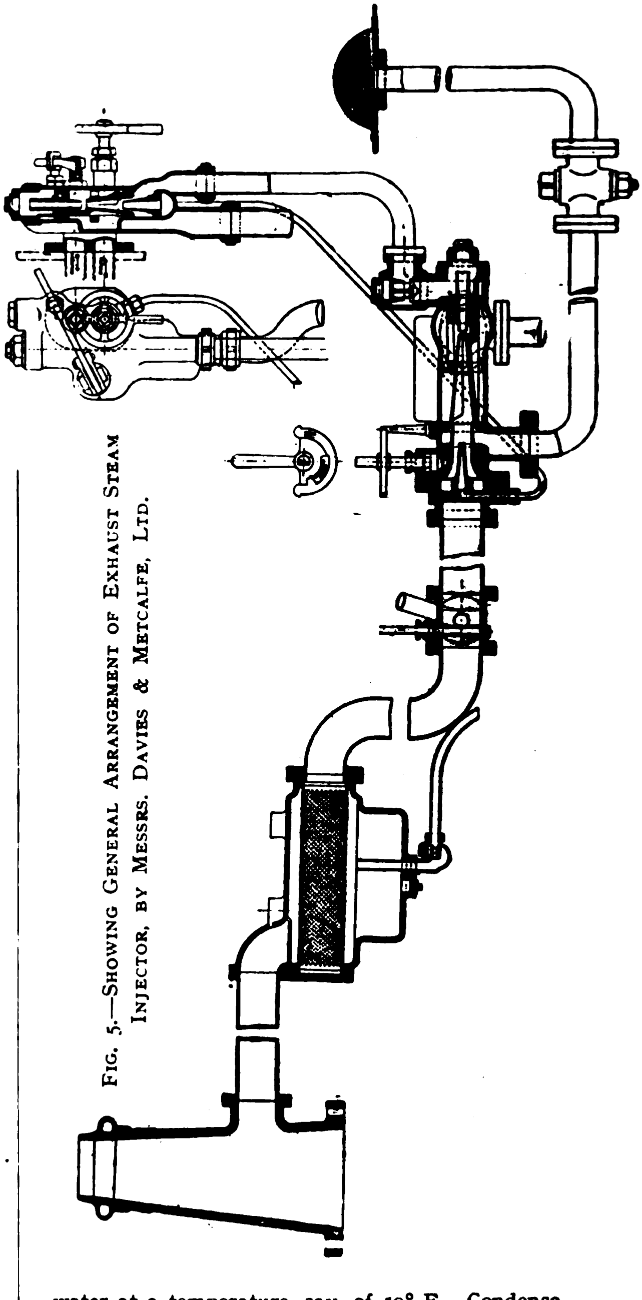


Fig. 5.—Showing General Arrangement of Exhaust Steam Injector, by Messrs. Davies & Metcalfe, Ltd.

feed-water is heated from 50° F. to 180° F., an increase in temperature of 130° F. This is done instantly, and in quantities sufficient to feed the boiler by the utilisation of the exhaust steam, which otherwise would, of course, have gone to waste. The water, at a temperature of 180° F., and a pressure of 70 lbs., is now delivered into the supplementary portion. Here it is met by a jet of live steam, which further heats it to a temperature of 280° F., and gives it sufficient pressure to force it into the boiler. Both portions of the injector are fitted with self-contained back-pressure valves.

The total quantity of live steam consumed by the complete apparatus is less than that used by an ordinary live steam injector of the same capacity, while the economy gained by its use is seen by noting the difference of temperature at which the

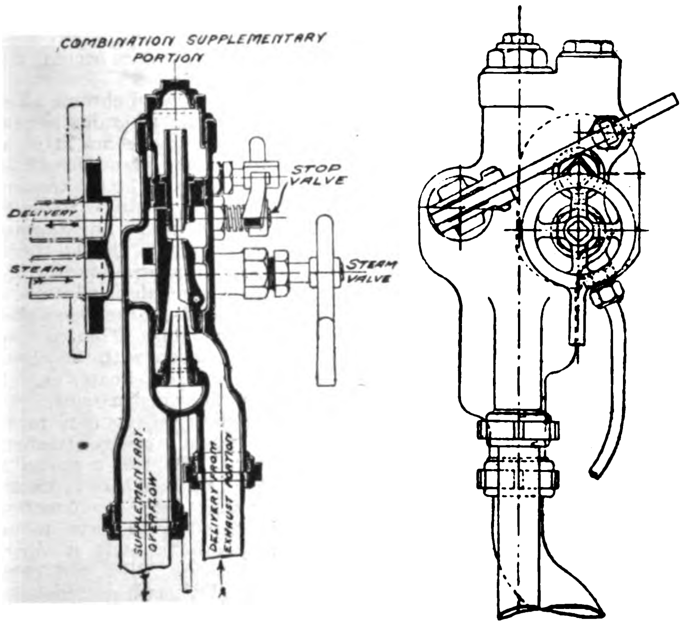


FIG. 4.

water is delivered into the boiler. This is as follows:—

Temperature of water delivered by exhaust steam injector	280° F.
Temperature of water delivered by live steam injector	160° F.

With the exhaust pattern of injector the driver can feed his boiler when running with a heavy load and in bad weather without reducing the boiler pressure. Under any climatic condition the exhaust injector can be worked when going up inclines without any practical reduction of the boiler pressure, whereas when the ordinary injector is used under the same conditions the pressure drops very quickly.

The writer has personally tested this injector of Messrs. Davies & Metcalfe, both at their works at Romiley, near Manchester, and under actual conditions of running on the footplates of locomotives, and has always found it do all that the makers claim for it.

Our Readers' Work Competition.

TO encourage readers to send us accounts of their work, we offer to send any tool, book, or other desired article supplied by any of our advertisers, to the value of 6s. 6d., to any reader who sends us for insertion in THE MODEL ENGINEER a sufficiently good photograph and description of any model, tool, mechanical or electrical apparatus that he has made, and which has not been already illustrated in our pages. Entries should be accompanied by a separate letter giving the title of the article, and stating exactly what is required as a prize in the event of acceptance. When tools or apparatus are desired, the page and number of article in the firm's catalogue from which it can be obtained should be stated, if possible. It is understood, of course, that we do not promise to accept everything that is sent in, and examples of work submitted must show some degree of originality or usefulness. Ordinary every-day tools or models merely made up from purchased castings are not required. The article should be written *on one side of the paper only*, with the name and address of the sender on the back. The photographs and separate sketches enclosed with the contrribution should similarly bear the name and address of the sender, otherwise delay may arise in the awarding of the prizes. It is essential in this, as in our other competitions, that the copyright of the photographs must be the property of the senders, and the covering letter should contain a declaration to this effect. The competition will close on June 30th, 1908.

GASOLINE ELECTRIC RAILWAY CAR.—A railway car with some interesting features has recently been erected in Philadelphia for the Strang Gas Electric Car Company. Some photographs were recently reproduced in *Engineering*, and below we quote a few of the particulars. The system is self-contained, consisting of a vertical gas engine (six cylinders, 10½ ins. by 9 ins.), with a direct-connected generator (85 kilowatts, 250 volts), electric transmission and control, direct electrical connection between generator and truck motors, and a storage battery. The generator furnishes all the necessary current for ordinary requirements. The storage battery takes care of the excess of normal demands, and is charged while the car is on down grades, coming to a stop, or standing still. The method of control is the "multiple-unit control," which enables the car to furnish current to other cars equipped with motors, to which it may be coupled. Sufficient gasoline is carried for a 200-mile journey, 6-10ths gallon per mile being consumed. A speed of 55 m.p.h. is attained, seats seventy-five passengers, and is capable of hauling three trailers, each containing the same number of persons. In the event of a breakdown the batteries will drive the car for 15 miles. The car measures 66 ft. over-all length.

Some Useful Dodges for Amateurs.

By V. W. Delves-Broughton.

Studs.

In making up small models it is often required to make studs to hold two parts of the machine together, and often a plain piece of wire screwed from end to end can be used, but in some cases, such as screwing the cover on to a cylinder where the flanges are comparatively thin, the hole has to be tapped right through, and it becomes impossible to fix a stud of the above description securely. In such cases it is desirable to use a properly formed stud screwed at each end with a plain piece in the centre, and I propose explaining how such studs can be made without fear of damaging the end first screwed when cutting the screw on the remaining end.

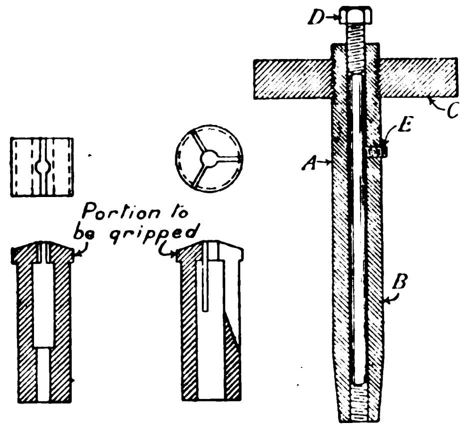


Fig. 1. Fig. 2. Fig. 3.

A, steel body; *B*, silver steel plug; *C*, brass crutch piece, screwed and soldered to *A*; *D*, set screw; *E*, grub screw engaging on flat filed in *B*.

For studs over ¼ in. no special precautions need be taken, but when it comes to making small studs down to 1-16th in. it becomes nearly impossible to hold the stud whilst cutting the screw on the second end without some special form of clamp. Such a clamp is shown in Fig. 1, the clamp in this instance being gripped in a vice. Fig. 2 shows an alternative design for a clamp for use in a self-centreing chuck.

In making a stud the wire is first held in the self-centreing chuck, one end is rounded off, and the thread cut for the required distance, finally being cut off to the right length. If the clamp shown in Fig. 2 is used the stud can be chucked in the clamp, rounded off, and screwed at the remaining end at one operation, otherwise the stud will have to be chucked in the self-centreing chuck, rounded off, then gripped in the cramp shown in Fig. 1, and screwed by hand.

Fig. 3 shows a convenient stud box for screwing studs into place, the studs being released by a slight turn of the set screw when the stud has been screwed home.

Glue Brushes.

Glue brushes are a constant source of trouble. Either they lose all their hairs, get burnt up, or disappear, so for some years I have used a piece of cane well hammered on the end till divided into fibres, which are combed out with a bit of broken hacksaw blade. The advantages of such a glue brush are (1) cheapness: ten costing 1d.; (2) the hairs cannot come undone; (3) if burnt, the end can be renewed in one minute by hammering out again. If a single cane is not wide enough, two or more may be tied or wired together.

Insoluble Glue.

Take 20 grains of chrome alum and dissolve it in a little water; melt 2 ozs. of glue in the usual manner, and before using stir in the chrome alum solution one drop at a time. This glue can be used for making joints in photograph dishes, boats built on the bread and butter principle, and a number of other uses. After use any glue that is left over should be thrown away, as should it once become dry it is impossible to re-dissolve it.

Glue loses a lot of its strength when chrome alum is added to it, and not more than 10 grains per oz. should be used, and the glue heated as little as possible. The solution of chrome alum should be made in sufficient water, as should it be too concentrated the mixture with the glue would be liable to form a stringy mass impossible to use. The amount of water used in dissolving the glue should therefore be kept down to a minimum to allow for the subsequent addition of the chrome alum solution.

Small articles can be moulded from the above glue in wax or other suitable moulds. Thin porous paper stuck together in many layers with the above glue can be used for light hulls of boats, etc., if efficiently strengthened with wooden ribs, etc. If paper boats are built the best process is to make a keelson with stem and sternpost properly attached, and to fix them to a board. On this a model is formed in clay, leaving the beam slightly in excess of that finally required to allow for the contraction of the paper. This contraction will have to be found from experience, as unfortunately it varies with each kind of paper used. Ribs and deck beams are bent in after the clay has been removed, a few copper pins being used to hold the ribs in position.

No hard and fast rule can be laid down for building a boat in this manner, but every builder must work to his own ideas. When finished and rubbed down the hull should be painted inside and out, when it will be found thoroughly watertight and unaffected by moisture. Again, thin paper or blotting-paper can be pulped and mixed with a sufficient quantity of this glue and moulded to any weird shape required, or in boat building pressed into crevices otherwise difficult to fill.

Unfortunately, this form of construction is not suitable for steamers, and I am afraid it would be difficult to join a bow and stern part formed in this material to a central part round the boilers, etc., formed of tin or other metal. I do not know if the interior could be sufficiently protected by a light lining of aluminium, but it might be tried, as I believe hulls can be built in paper lighter than in any other material. I have seen the hull of an old type cutter 42 ins. L.W.L., which, if I remember rightly, only weighed 28 ozs., but carried some 12 lbs. of lead, and sails in proportion.

(To be continued.)

Locomotive Notes.

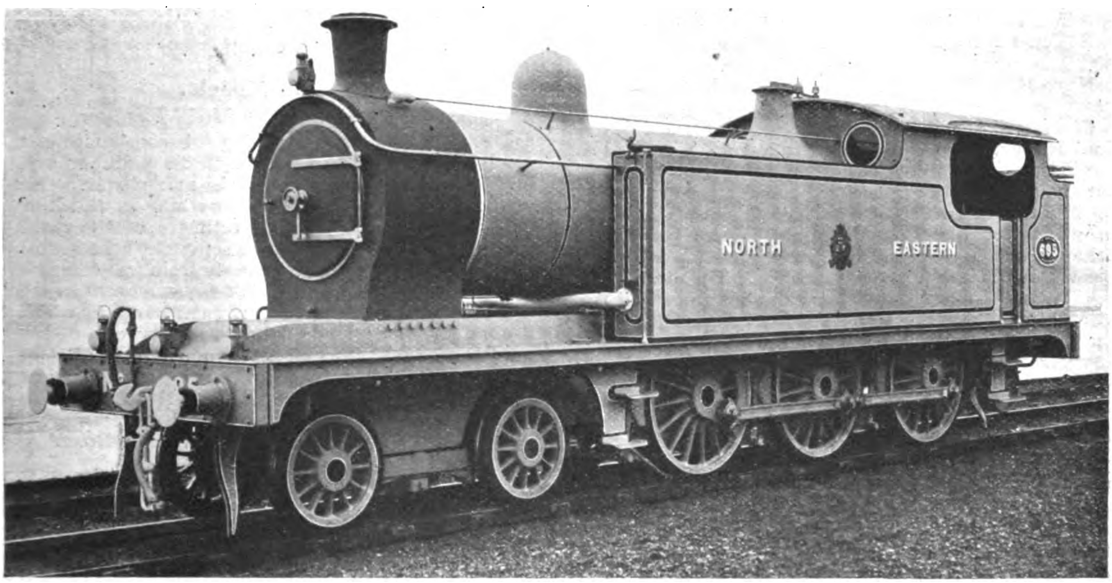
By Chas S. Lake, A.M.I.Mech.E.

The New N.E.R. Tank Engines.

As promised in a previous issue, further reference will now be made to the new type of tank locomotive recently introduced on the North-Eastern Railway, and of which ten have been built, or are in course of building, at the Gateshead Works. As the illustration, for which we are indebted to Mr. Wilson Worsdell, Chief Mechanical Engineer, shows, the design incorporates the 4—6—0 wheel arrangement with inside cylinders, and the dimensions throughout are such as to render the engine one of great power and general all-round utility. The locomotives of this class have been introduced principally for the purpose of dealing with the traffic in the most satisfactory manner. The new engines have 52 tons of adhesion, or, roughly, 75 per cent. more than the lighter four-coupled engines, while the cylinder and boiler capacities are also correspondingly larger. Not only is a greater adhesion weight obtained, but an increased ratio of grate area to heating surface is secured, thus affording an ample grate area and so enabling the blast pressure to be reduced and the rate of combustion per square foot of grate kept within reasonable limits.

The cylinders are inside the frames with piston valves underneath, the valve gear being Stephenson's link-motion connected to the leading coupled (crank) axle. The springs of the coupled wheels are fitted with equalising levers, bearing on hardened steel knife edges, and the bogie wheels have the customary inverted springs and equalising beams.

The first of these engines was fitted with a



New Type of North-Eastern Railway Tank Locomotive.

traffic on the Scarborough and Whitby section, a coast line abounding in gradients, some of which are both long and steep, and as the summer service over this portion of the railway is of an exceedingly heavy character and the popularity of the districts among tourists and holiday-makers is always increasing, a demand for a more powerful type of engine has arisen. The conditions are such that for permanent-way reasons it is desirable not to employ heavy tender engines, and at the same time the 0—4—4 tank locomotives ordinarily employed for branch line service on the North-Eastern Railway, and which have cylinders 18 ins. by 24 ins., coupled wheels 5 ft. diameter, and a total heating surface of 1,097 sq. ft., with 30½ tons of adhesion weight, are not of sufficient power to ensure reliability under the maximum service conditions, although at all normal times they deal with the smokebox of the extended type, but this has now been altered to one of normal proportions, while the succeeding engines are also being built with the ordinary pattern of smokebox. A regulating blast pipe and ash ejector is fitted, and the ashes are continually ejected in order that they may be prevented from accumulating in the bottom of the smokebox.

The engines are provided with Westinghouse brake appliances and also with hand brakes. Side tanks are fitted and the cab is of the most commodious description, especially for a tank engine.

Before being sent to the Scarborough and Whitby section to enter upon the regular duties for which they have been designed, the engines were put to work hauling goods trains in the Leeds district, whereon they proved very successful. In normal service they will have to haul, in the height of the tourist season, very heavy passenger trains over the tortuous climb culminating at the Peak summit, the gradient ruling at 1 in 40 for a considerable distance. Below are given some of the leading dimensions :—

Cylinders : Diameter, 19 ins. ; stroke, 26 ins.
Wheels—diameter : Bogie, 3 ft. 1¼ ins. ; coupled, 5 ft. 1¼ ins.
Wheelbase : Bogie, 6 ft. 6 ins. ; coupled, 12 ft. 6 ins. ; total wheelbase, 26 ft. 3 ins.
Boiler : Length of barrel, 11 ft. ; diameter, 4 ft. 9 ins. ; centre from rail level, 8 ft. 2 ins.
Number of tubes, 225.
Diameter of tubes, 1¾ ins.
Heating surface : Tubes, 1,182 sq. ft. ; firebox, 130 sq. ft. : total, 1,312 sq. ft.
Grate area, 23 sq. ft.
Working pressure, 170 lbs.
Weight on bogie wheels, 17 tons ; coupled, 52 tons : total weight (in working order), 69 tons.
The tanks carry 1,500 gallons of water and the fuel space accommodates 2½ tons of coal.

NEW RAIL MOTOR SYSTEM ON THE MIDLAND RAILWAY.

Commencing with the month of June the Midland Railway Company are introducing on several sections of their lines a new style of rail motor train, comprising a six-wheeled coupled tank engine set in between two bogie carriages so arranged that in whichever direction the train is running the driver occupies a special compartment adapted for his use at the end of the carriage. The fireman rides upon the footplate alone and his duty is to attend to the fire and to obey signals received from the driver's compartment. This system has been in vogue for some time, and has been found successful on the Great Northern Railway of Ireland, and an illustration of the train was given in THE MODEL ENGINEER at the time of its introduction. The Midland rail motors are taking the places of ordinary trains both on the northern and southern districts of the line.

RAILWAY ACCIDENTS AND THEIR PREVENTION.

In his report on the Chequerbent incline accident of the L. & N.W. Railway, Colonel Yorke recommends that where banking engines are employed for assisting trains on inclines the same should be coupled to the trains and the automatic brakes connected up, instead of as at present when the banking engine is not coupled to the train which it is assisting in any way. The accident occurred, in the instance referred to, by reason of the banking engine, a Webb four-cylinder compound of the 4—4—0 type, being allowed to fall away from the train it was pushing and the driver, perceiving this, put on steam to catch up again when, by an error of judgment, he allowed his engine to collide twice with the train in front, the result being that some of the vehicles were derailed and several passengers injured. If Colonel Yorke's suggestion is adopted, it will mean a very great deal of delay in carrying out operations, as the train will have to stop both before and after ascending the incline, *i.e.*, while the assisting engine is being attached and detached. Time will also be taken up in adjusting the automatic brake for use, so that wherever the train engine is at all powerful enough to climb the bank unassisted, no matter how difficult it may be to do so, it will be both cheaper and quicker to leave the banking engine out of the matter altogether. The particular accident which led to the suggestion is one which only occurs very infrequently. The practice of banking trains out of Euston, up the Camden incline, was in vogue for very many years, and an enormous mileage run under these conditions must have accumulated without serious accident. The plan has been resorted to and is being employed in all parts of the railway world; but if it is decreed that in future trains must stop twice wherever banking assistance is taken, it is certain that railways will discontinue to work on this system except where absolutely compelled.

Practical Letters from Our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached though not necessarily for publication.]*

Pond for Models.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I am thinking of constructing a small pond, about 6 ft. wide, 2 ft. deep, and 20 yds. long, for model power yachts and men-o'-war. Can any readers who have made anything of the kind give me any suggestions and estimate of the cost ? The soil is gravel and I have some old bricks, so I was proposing to make the bottom of concrete with brick sides.

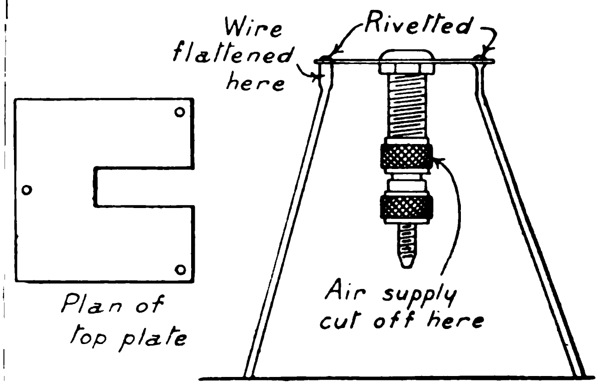
I also thought of making a small barge in which a child of 8 or 10 could be towed by one of the models. Would an electric motor boat be as powerful for this as a steamboat ? I think points on this subject would be of interest to others as well.—Yours truly,

Bromley. "MOTOR BOAT."

A Small Bunsen Burner for Soldering.

TO THE EDITOR OF *The Model Engineer.*

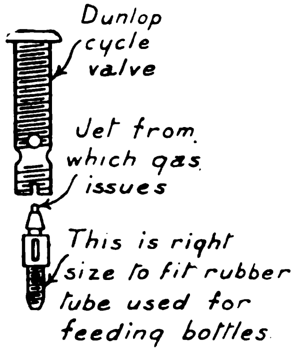
SIR,—The following is a description of a useful small Bunsen burner for soldering, which I made



recently out of a Dunlop cycle valve ; the diagram (not to scale) explains itself.

Two holes were drilled just beyond the groove which is found round the outside tube near the slotted end, of a size to admit sufficient air to make a perfect blue flame without any yellow "zone" (which would give soot), and the smaller tube to hold the valve-tube was cut off to ⅛ in. long and tapped gently together with a light hammer at the end to form a jet.

The top milled sleeve may be used to cut off

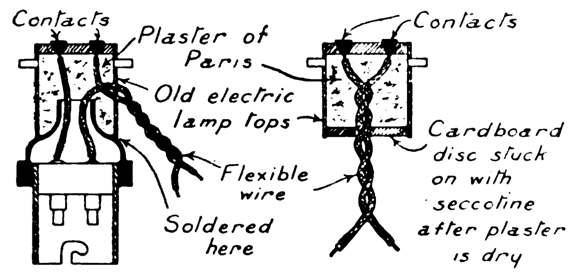


part of the air supply when necessary, and the hexagon nut to clamp the whole on to a stand made of a piece of brass or tinplate, with three wire legs and a slot cut as far as the middle the width of the main tube, to allow the burner to be slipped in easily. The legs may be bent so that the burner is in an inclined position, which is advantageous, as solder would otherwise fall down the tube and stop the jet. My burner gives a 5-in. flame, but the size of this is determined by the size of the jet. —Yours truly, W. N. Frampton.

A Handy Charging Plug.

To the Editor of *The Model Engineer*.

Dear Sir,—In The Model Engineer (April 30th, 1908) one of your correspondents, who signs himself "A Dabbler," has given a design for "A Handy Charging Plug." If he will excuse me saying so, it seems to me that he has gone to a lot of unnecessary trouble in making the adapter



part. I made one some time ago, using the top of an old electric lamp, as sketch, which saves the unnecessary work of preparing a piece of ⅞-in. tube and putting insulating washers, etc., on. I think the sketch will pretty well explain itself. Procure a top of an old electric lamp, clean out all plaster and glass; then solder your wires to the two top contacts; then clean it nicely and solder to lampholder, and connect up as sketch. Old lampholders also serve the purpose of making handy adapters—by cleaning them out as before and soldering the two ends of a flexible cord to the contacts, as sketch No. 2. I may say in conclusion, that another simple way of finding the polarity of wires is by dipping the two bare wires into some water, when at once bubbles will be seen escaping from the *negative* pole.—Faithfully yours,

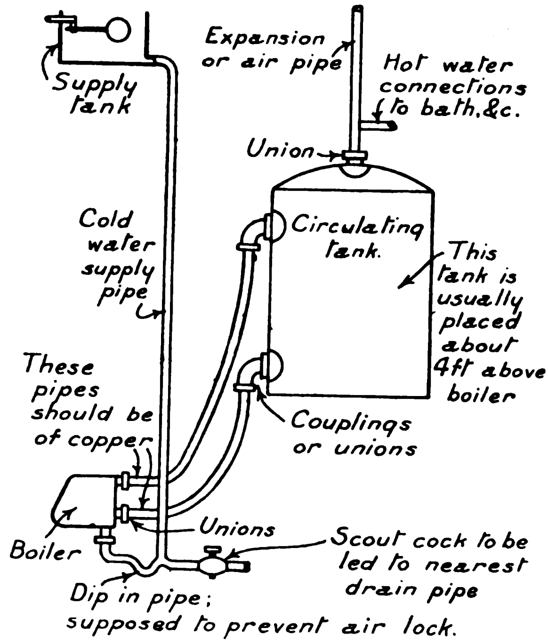
W. John Howes.

Hot Water Supply.

To the Editor of *The Model Engineer*.

Dear Sir,—*Re* "Plumber's" answer to "W. G.'s" query about hot water supply, I beg to point out that there are two wrong connections in his system.

(1) Hot water circulating pipe from boiler to tank should enter tank not more than 6 ins. from the top of same.



(2) Cold supply pipe should be to *boiler*, not circulating tank.

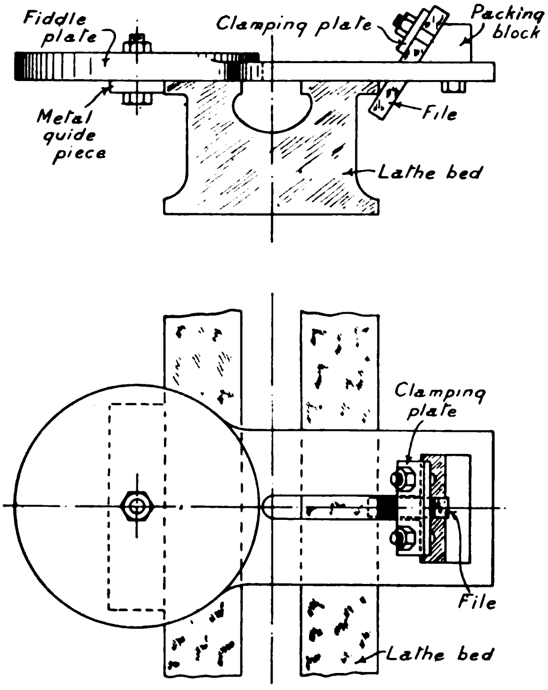
I append rough sketch of system as it would be fitted up by a practical man. "Plumber" says stop-cock shown on his sketch to be used for repairs "only." It should be used to scour out the whole system at least once in every twelve months. The sketch herewith is known as the high-pressure system as fitted to an ordinary kitchen range.—Yours truly,

Andrew A. Cumming.

Bevelling Lathe Bed to Receive S.C. Saddle.

To the Editor of *The Model Engineer*.

Dear Sir,—Having occasion recently to undercut a lathe bed to receive screw-cutting saddle, and not having many tools at my disposal, I adopted the following method: In the first place, the fiddle-plate of the slide-rest acted as "tool" holder, the tool being about 2 ins. of ⅜-in. square file, bolted at an angle of 60 degs. to the fiddle-plate (see sketch). To act as a guide, a strip of metal, bolted to the other end of fiddle-plate, was allowed to slide along the opposite edge of the lathe bed to the one being worked at. As the draw-filing proceeded, this guide



BEVELLING A LATHE BED.

was adjusted to suit until there was sufficient bevel. I may say this method was very successful as far as accuracy is concerned. The time taken to do a 30-in lathe bed was about five hours.—Yours, etc.,

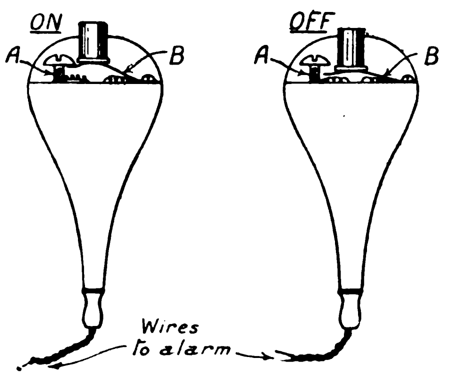
"NIL DESPERANDUM."

Push for Early Morning Alarm.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—Having made a small push for fitting to an electric alarm, I thought perhaps it might be of interest to some of your readers. The arrangement is for causing the alarm to start ringing each time its owner falls off to sleep again after it has once rung. It is an ordinary pear pattern push, with the small wood screw (*A*) screwed into same, so that the spring (*B*) touches the underside of the screw (*A*) when the push is out, and breaks contact when push is pressed in; so that when the alarm starts ringing its owner just presses the push (which is taken from alarm by a small length of flexible cord to the bed) and so stops same at once, but the moment he falls asleep again the push will naturally be released and so start bell ringing again, and so on until owner gets out of bed and switches off.—Yours truly,

E. W. SCARLETT.



A PUSH FOR EARLY MORNING ALARM.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

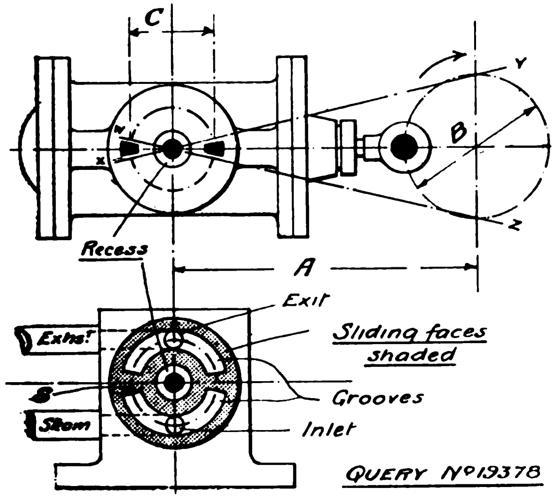
[19,869] **Mechanical and Electrical Aids for the Deaf.** H. J. S. (Stratford-upon-Avon) writes: I shall be much obliged if you will answer the enclosed queries, arising out of the article in THE MODEL ENGINEER, entitled "Mechanical, Electrical, and other Aids for the Deaf." (1) What type of microphone is the most suitable for use upon the apparatus described in the article "Mechanical, Electrical, and other Aids for the Deaf," and illustrated in Fig. 1 in that article? (2) Is the Hunnings' cone the best for this purpose? (3) How many microphones is it of any use employing, as, after a certain number, I presume no better results are attainable? (4) The person I am thinking of making up the apparatus for can just hear a little handbell (about 3 ins. across the mouth) when it is lightly rung about 15 ins. from her best ear. Do you consider she will be able to hear ordinary conversation in a room with the apparatus? (5) I am not quite clear upon the number of cells to be used in the battery; there are usually three cells in each flash-lamp battery. I should be much obliged if you will state the number of cells to be used and the voltage required.

Mr. Pike, the author of the article referred to, has kindly replied as follows: (1 and 2) The Hunnings type is best, but the General Electric Company's K15 transmitter is the best make that I have tried; price, 5s. or 5s. 6d. (3) The instrument figured in my article was or is a substitute for the "Acousticon." The largest size of latter carries six transmitters, and any person unable to hear with it will find any further experiment useless. (4) The patient mentioned by querist is probably almost as deaf as the writer; if so, it is improbable that she will hear *conversations.* That can only be determined by trial, but she will almost certainly hear music. I should certainly make trial with the K15, which is an exceptionally strong instrument. (5) The apparatus with four transmitters carried two or three of the small flashlamp batteries, and they were put in on account of their portability; a small accumulator would be better, say 4 volts 7 amps. The disadvantage of the flashlamp batteries is that there is so little current with the E.M.F. too high, *e.g.*, the nine small cells would be perhaps practically 12 volts and the current ¼ amp. Any further help in the matter of apparatus and so on will be gladly given.

[19,378] **Oscillating Cylinder Ports.** H. B. (Banbury) writes: Would you kindly give me a drawing of the steam way and the position of the ports of a double-action oscillating cylinder,

¾ in. bore, ⅞-in. stroke. I have enclosed coupon and stamped envelope for reply.

It is quite impossible for us to answer your query in definite terms. We can only indicate the method by which you will be able to set out the ports of your model. Three factors are required to be known. The distance between the port centre and crankshaft (see A in the sketch), the stroke (B), which we know, and the approximate centre of the ports (C). We only know B, and C of course depends on the design of the cylinder casting. Having settled these dimensions, then draw two lines X Y and W Z, and on the centre line scribe the outline of the port, the width of which



SETTING-OUT PORTS FOR OSCILLATING CYLINDERS.

should be just over half the width of the space. On the steam block the space S or portbar between the two grooves should be just a little wider than the steam port in the cylinder to provide a little lap and prevent leakage of steam to exhaust. Only the parts shaded should bear on each other. The rest must be recessed back. The direction of rotation may be reversed by changing over the exhaust and steam pipes.

[19,655] **Small Oil Engine Partial Failure.** W. B. C. (Matlock) writes: I have a small oil engine, 2 ins. by 3 ins., which I cannot get to work for more than about six explosions. The oil and air are by suction, the air vaporising the oil as it is drawn in. I have set the exhaust as your hand-book directs; it is worked by a lever. I enclose the working drawing sent by the firm (not reproduced). Would the ignition tube be better placed somewhere else—say, where I have marked it? The valves and piston are a splendid fit. With the connecting-rod sent out the piston was 1½ ins. from the back cover, but I have put a new connecting-rod in, an inch longer, as a friend advised, but it gives no better results. I have also tried it with a ¼-in. gas ignition tube with no success. I have had the tube a good heat with a powerful blowlamp.

It is difficult to say exactly what the trouble is due to, but most probably it is a question of adjustment, as these small engines frequently require a great deal of coaxing in order to get them to run properly. Provided you have got a good compression, that the valves are tight and seat properly on their seating, and that the ignition tube is kept sufficiently hot and the vaporiser at the correct temperature to vaporise all the oil that is taken to the cylinder, you should have no trouble in getting it to run properly. The tension on the air valve is the important factor, as this determines the total quantity of the explosive mixture taken into the cylinder. You might try the ignition tube in the position you suggest, provided there are no practical difficulties in the way. Some trouble is often caused by having such pockets as there are bound to be in your case with the ignition tube at the far end of the vaporiser casting. The effect is produced by the burnt gases being driven up into these pockets and recesses and preventing the subsequent charges of oil vapour from reaching the hot portion of the tube when the charge is compressed in the cylinder; the result, of course, is misfiring. Another point you might look after is to see that the exhaust passages are perfectly clear. The report of each explosion should be a sharp crack when the exhaust pipe is led out into the atmosphere close to the engine. More than this we cannot do for you without actually seeing the engine at work.

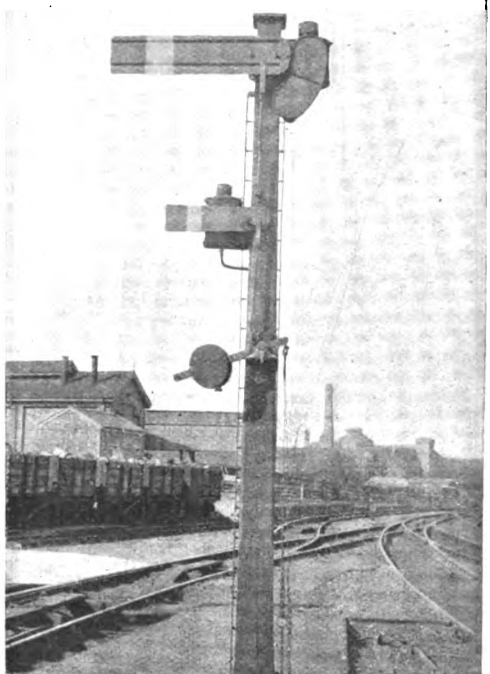
[19,868] **Electric Lighting Plant.** J. C. (Ayrshire) writes: I would be much obliged if you would answer the following questions. I am about to start a lighting plant, and I would like full particulars about the dynamo. What size and No. of wire, and so on, to light from sixteen to eighteen lamps of about 10 c.-p. I think 10 c.-p. is about the size of lamp that would do best for the ordinary house lighting. I have "The A B C of Dynamo Design" and a lot of THE MODEL ENGINEER. I suppose a water motor run off a 40-lb. supply would be out of the question for driving such a dynamo? What is the best and cheapest power for driving such a dynamo?

Presuming you want to light ten 10 c.-p. lamps, total power required will be 200 watts if high-efficiency Osram lamps are used, taking approximately 2 watts per c.-p. If ordinary lamps are used, the consumption may run up to 400 watts, in which case a 1½ b.h.-p. engine would be required. We strongly advise gas engine, or, failing this, a paraffin or petrol engine. On the other hand, a water motor with a good head of water would answer your purpose. Several of our advertisers could supply you with a reliable water motor if you stated the conditions under which it would have to be run. As regards wiring to lamps, you should consult our book "Private House Electric Lighting," and the current-carrying capacity of various size wires can be had from any wire table, such as that contained in our issue for January 1st, 1901, or any electrical pocket-book.

[19,401] **Boiler for 1 h.-p. Plant.** A. F. (Rotherham) writes: What size and type of boiler shall I require to effectually drive a 1 h.-p. horizontal high-speed steam engine (3-in. bore, 4-in. stroke)?

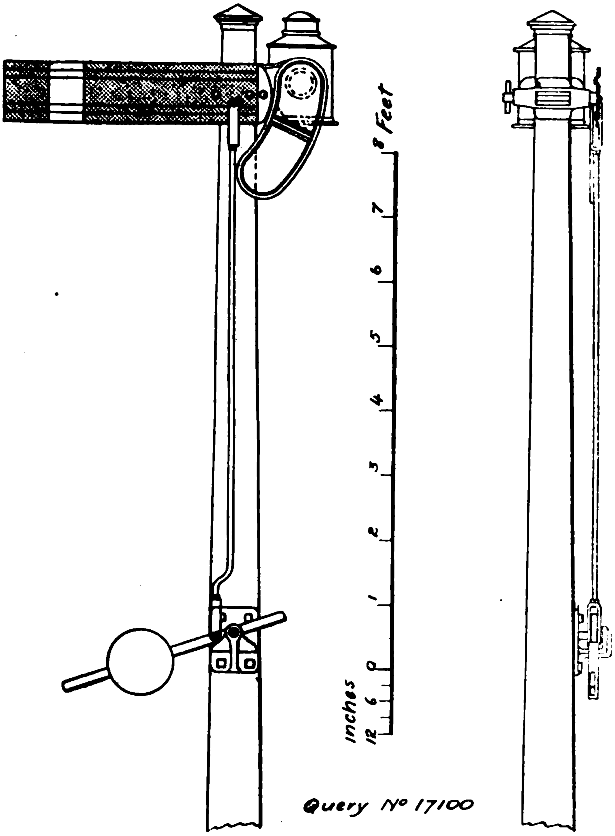
We presume there is no objection to the use of coal as fuel, and the best results will be obtained by using a vertical multi-tubular boiler. The boiler should be of ample size; with ordinary efficiency, the engine will consume about 35 cub. ins. of water per minute. This means a boiler with at least 3,500 sq. ins. of heating surface, and we recommend a boiler not less than 20 ins. diameter by 36 ins. high, with twenty tubes 1½ ins. diameter. The larger the boiler the less the attention it will require.

[17,100] **L.N.W.R. Signals.** L. G. H. (St. Albans) writes: Would you kindly send me a sketch of a L. & N.W.R. standard home signal? The length of post does not matter, as doubtless that varies. What I chiefly want is the length and width of arm and thickness of post at top and bottom.



L. & N.W.R. STARTING SIGNAL.

In reply to your query, we have made measurements of a L. & N.W.R. signal. We find there is a slight difference in the length of the arms (from the centre of the post). The signal shown in the photograph is a starting-signal, and if also provided with a small shunting or "calling-on" arm, just over half-way up the post. A starting signal was more conveniently measured and photographed, but the details, except the length of arms, are the same as other signals. The normal signal has thin corrugated steel arms 11½ ins. wide (official particulars say 11½ ins. wide at the root and 11¼ ins. at the tip), and ⅛ in. thick. The length from



L. & N.W.R. Standard Signal.

the centre of the post is 4 ft. 4 ins. average. The signal is pivoted on a pivot bracket fixed on the lamp side of the post. The counterbalance arm bracket is 9 ins. wide by 1 ft. deep; the projection depends on the number of arms. The arm is about 18 ins. from the centre of weight to centre of pivot; diameter of weight, 12 ins. by 2 ins. thick. The posts are 6 ins. square at the top, and about 1 ft. square at the bottom.

[19,867] **Accumulators and Lamps.** S. P. L. (Weybridge) writes: Since communicating with you *re* dynamo for lighting and charging accumulators on motor-car, on thinking it over, it seems an easier arrangement to light only from accumulators direct, and charge these by the dynamo. Will you kindly reply on the following points? I want to light five lamps (Osram). These and accumulators to be 4 volts, lamps 4 c.-p. (1) How long would a 60 amp.-hour accumulator light five 4 c.-p. Osram lamps in parallel on one charge? The maximum charging rate of above accumulator is 4·5 amps. I have bought from Stuart Turner a Simplex dynamo (30-watt). (2) If I wind this for 5 volts 6 amps., would this do for charging the above accumulator? If so, how can I reduce the amps. to about 4. I am going to put an Avery type cut-out in the circuit in case voltage of dynamo drops. I am keeping a volt and ammeter always in the circuit while dynamo is charging accumulators. (3) How am I to know when cell is fully charged; by testing accumulator with another voltmeter? I much regret troubling you on the same subject the second time, but I think this is the best way out of the problem.

A 4 c.-p. Osram lamp would take approximately 2 watts per c.-p., therefore five such lamps would require 40 watts. At 4 volts pressure you would have to discharge at the rate of 10 amps., which would be rather excessive for a 60 amp.-hour accumulator. Another way out of the difficulty would be to connect the lamps in groups of two in series and use 8-volt accumulators of the same capacity, thus discharging them at practically half the former rate. We believe we replied to the question of charging with 5-volt dynamo in our former reply. We should advise rather more than 5 volts pressure for charging 4-volt cells. Use an ammeter in circuit when charging, and regulate the speed of dynamo so that you get the required current flowing in the circuit. By increasing the speed the current flow will increase, other things remaining constant; and by reducing speed the voltage will fall, and consequently current flow will be somewhat diminished. Inserting resistance has the same effect as reducing the speed, and you can take your choice which method you adopt. The cell will begin to gas when it is fully charged. We trust these few notes, with the others previously sent, will help you over your difficulty.

[19,755] **Testing Petrol Motors.** E. M. L. (Newington) writes: Having been a regular reader of The Model Engineer for some years now, I wish to avail myself of your valuable help through the Queries column. Will you kindly answer me the following questions? I am constructing a four-cylinder model light petrol motor, and wish to know the horse-power generated. The four cylinders are 1 3-16ths-in. bore with 1½-in. stroke, and the motor is intended to run at 500 to 1,000 r.p.m. The amount of compression is ⅜ in. Is this high enough compression? Will ⅜-in. copper tube inside measurement do for inlet and exhaust pipes? What weight will flywheel want to be?

The only possible way of arriving at the actual horse-power is by making a test, using a brake in the manner described in our Handbook, "Gas and Oil Engines," by Runciman, 7d. post free. Weight of flywheel would vary with the diameter, but we should say a 6-lb. wheel of about 6 ins. diameter would meet your requirements.

[19,787] **Steam Engine Details.** A. S. (Tilehurst) writes: For some time past I have been working on a design for a tandem compound steam engine. I have the cylinder patterns nearly finished. High-pressure cylinder, 1½-in. bore; low-pressure cylinder, 2¼-in. bore; 2½ stroke. Total overhang, about 10 ins. All this is turned work, except the seating of guide on bed, and should be, when together, as firm as if in one piece. A displacement lubricator fixed on high-pressure cylinder, connected to steam pipe. Governor on low-pressure cylinder. Intended for a practical small power engine for domestic electric lighting for continuous running, with as little attention as possible, special attention to automatic lubrication and for hard wear. (1) Is the tandem design suitable for fairly quick running, say 300 to 500 r.p.m.? Is the excessive overhang likely to cause vibration? (1) Which is the best material for cylinders—cast iron or gun-metal? (2) How shall I lap out cylinders? I have the use of a screw-cutting lathe to bore them, but no other appliances. I cannot grind out inside surface, as in a recent article in The Model Engineer, and wrapping a piece of emery cloth round a stick and doing it that way seems to me rather rudimentary and not likely to be productive of first-class work. (3) Piston rod: I think a ⅜-in. steel rod turned down to 5-16ths in. forward of the low-pressure piston and to ¼ in. behind it would be suitable. But could you tell me any way of using a plain 5-16ths-in. rod for the purpose? (4) I propose using two rings on each piston. I am designing piston ½ in. thick. How wide should the rings be, and should they be in separate grooves? (5) Could you give me an idea of the size balance-weights on crank should be?

We cannot criticise your design so well as we might were the drawings for the model in front of us. Work the engine at least at 80 lbs. pressure. (1) If you place weights on the cranks you would be able to more or less counterbalance the revolving masses, and speeds up to 500 revs. would not matter. The reciprocating parts in a tandem are, however, comparatively heavy, and you may find vibration troublesome at the speeds contemplated. There is no satisfactory method of remedying this in the type of engine you have chosen, and therefore you must be prepared to run the engine slower rather than faster, than 300 r.p.m. on this account. If you have a boiler which will stand the pressure, this will not matter, as the pressure will rise slightly and the actual brake horse-power remain about the same. (1) Cast-iron, undoubtedly. (2) By a lead lap; a cylindrical piece of lead mounted on a mandrel between centres and charged with emery. (3) We hardly understand you. A 2¼-in. piston should be fitted with rings, and we recommend making the piston in two parts, secured by a nut. Unless you use a larger rod turned down to 5-16ths in., the threads being "plus" threads, we do not see how you can obtain a 5-16ths-in. rod throughout. (4) The pistons are rather narrow for an engine which is intended for hard work. The rings should be 5-32nds in. wide. We would recommend ¾-in. pistons at least. See the design for piston in the small undertype engine. (5) No, not without full particulars. We published a very complete article on this subject in our issues of August 8th and 15th, 1907. If you have plenty of water at a good pressure, we recommend the use of an ejector condenser.

[19,714] **Steam Gauges.** H. E. (Ashford) writes: I am desirous of trying some experiments with H.-P. steam, but cannot get a gauge high enough. A friend has offered me the loan of his hydraulic gauge, which registers up to 4,480 lbs.; that is much higher than I need. (1) If I had a syphon made for it, would the

hydraulic gauge answer for steam? (2) Would the syphon be best in copper or steel tube?

(1) Yes, but make it long enough, so that the gauge is kept cool (2) It does not matter so long as the metal is thick enough, as the syphon pipe should be comparatively cool, and its strength should not deteriorate perceptibly.

[19,021] **Running Small Lamps from Primary Cells.** G. E. M. (Bristol) writes: I shall be obliged if you can answer the following questions:—(1) How is it that with five of the non-polarising bichromate cells—as described in Chapter IV of Handbook No. 5—I can only light a 4-volt Osram for ten minutes at a time? The light then drops; connections all perfect and new solution. The light is lit through about 40 yds. No. 22 wire. How is it that the light drops so soon? These cells were made for simplicity, thinking the zincs could be left in, but these latter are dissolving rapidly. (2) What does the bag in an Empire cell contain? Would these cells be better for lighting than the bichromates? I want something that requires little or no attention. I was under the impression that Empire cells were really Leclanchés without a porous pot, but a friend of mine made some and the voltage dropped in about half a minute. (3) What size steam engine will efficiently drive a 10-watt dynamo? Also, what size boiler will supply enough steam for this? I would like a vertical boiler. Please state size of boiler and number of tubes, also size of firebox. Coal or coke would be preferred as fuel, with forced draught of compressed air. Please give me a rough sketch, if possible. (4) What is silver-solder? Where can it be obtained?

(1) The only thing that will cause the cells to run down at an unusually quick rate is if the lamp you are using is taking a greater current than the cells can supply. You should find out by means of an ammeter exactly what current your lamp is taking; you will then be in a position to say definitely whether the lamp or the cells are in fault. The zincs of bichromate cells should always be taken out when the battery is not being used. (2) These cells are practically sack Leclanchés, and the sack contains manganese dioxide and crushed carbon, surrounding the carbon plate. These are very good cells for continuous working at suitable rates of discharge. (3) If you will read recent query replies on this subject, you will get some information that will assist you. (4) See the article on silver-soldering in our issue of April 23rd, 1903. Any of our advertisers supplying engineering materials will supply you

[19,864] **The Engineering Profession.** W. G. B. (Dumbartonshire) writes: I am a third-year apprentice engineer, with ambitions above the ordinary run of fitters, having a fair technical training, but no influence. I should be very grateful for full particulars as to what fields of remunerative employment are open to me in any branch of the trade.

In reply to your enquiry, it is utterly impossible to say which branch of the trade there are openings in which you could fill. To begin with, we have no knowledge of your training, circumstances, or abilities, etc.; neither have we any particulars as to vacancies in the chief engineering firms' works throughout the country. The best we can suggest is that you read the recent articles on "How to Become a Mechanical Engineer." Further, when you have made more definite plans and settled which branch of the work you intend to work at seriously, you should study the advertisement columns of any of the large engineering trade papers, such as *Engineering*, *The Engineer*, etc. We regret we cannot give you any more definite information, but we think you will quite see that it is a matter for personal investigation and choice, and that we have no knowledge of the circumstances of the case.

[19,855] **Automatic Cut-outs for Charging Cells on Motor Cars.** S. P. L. (Walton-on-Thames) writes: I am making a 40-watt dynamo, drum armature, as per Fig. 5 in The Model Engineer handbook. I want to light five 4-volt 4 c.-p. lamps. Is the 40-watt size powerful enough for this work? I propose to adopt the winding given for 5 volts 8 amps. Will this be suitable for above, and also for charging 4-volt accumulator? I want to put the dynamo on a motor-car. It is to be driven off the engine. When lamps are not in use, I want to occasionally charge up the ignition accumulators on the car, and when they are fully charged, to automatically cut them out of the circuit. In case engine slows down whilst charging same, I can have a cut-out for the accumulators, but is it possible to arrange an automatic cut-out when they are fully charged to stop them being charged any more? Also, as a further detail, would it be possible to have a switch worked by a solenoid for switching on the accumulators to light the lamps when dynamo voltage drops too low, when engine is slowed down? I have all the back volumes of The Model Engineer, and I should be much obliged if you could refer me to any articles which would help me as to such automatic cut-outs.

Assuming the lamps to be efficient and not taking more than about 2 watts per c.-p., your 40-watt machine should drive enough to supply these lamps. We should advise slightly more than 5 volts for charging 4-volt cells. *Re* automatic cut-out, we can only suggest that you use one of Avery's, of Fulmen Works, Tunbridge Wells. Another automatic cut-out is described in April 5th, 1906, issue. We may say we do not favour the idea of introducing automatic mechanism such as you propose for motor-car work, as you would find it would take all your time looking after these auxiliaries.

[19,774] **Celluloid for Accumulator Cases.** G. C. (Aston) writes: Can you kindly inform me where to obtain celluloid for making small accumulators? Can you please tell me how to bend and joint same together? Must I ask for a certain gauge, or must I state the thickness?

Messrs. Whitneys, 117, City Road, London, E.C., would supply you. Amyl acetate is used for jointing celluloid. You could state the thickness required, either in fractions of an inch or as per S.W.G.

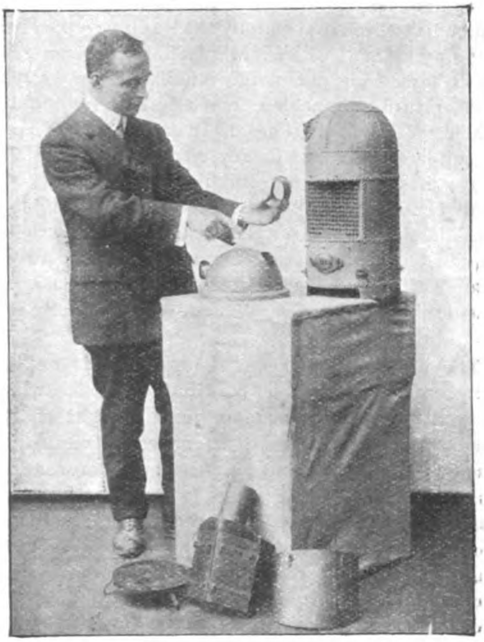
The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

** Reviews distinguished by an asterisk have been based on actual Editorial Inspection of the goods noticed.*

A Model Cochran Boiler.

An interesting example of the commercial uses of engineering models is shown in the accompanying photograph, which illustrates a model boiler built to the order of Messrs. Cochran & Co. (Annan), Limited, of Annan, N.B., for the purpose of demonstrating the constructional advantages of their well known steam boilers. This boiler takes to pieces so that all the various features of construction can be rapidly and effectively demonstrated; and in a pamphlet



Model Cochran Boiler with Smokebox removed.

recently published by the firm a series of interesting photographs are given, showing the arrangement of the several parts. Readers who would like to see the ingenious way in which this idea has been worked out should write to Messrs. Cochran (Annan), Limited, for a copy of the pamphlet.

Sack Cells for Electric Lighting.

With further reference to the subject of Query No. 19,690, Messrs. The Economic Electric Co., of Twickenham, write us that this querist no doubt had purchased one of their smallest size sack cells, which naturally would not do the work specified. They guarantee, however, that their No. 170 sack Leclanché cells will easily light a 4-volt 4 c.-p. Osram lamp for over thirty minutes, and regain their normal voltage in fifteen minutes. We have pleasure in giving publicity to this statement.

The Editor's Page.

ON the occasion of the distribution of prizes at the recent Conversazione of the London Society of Model Engineers, we ventured to make a few remarks on the subject of originality in model making which appear to have caused a little flutter in the hearts of some of the members. One of them, "P. S.," writes us as follows: "In reference to Mr. Marshall's excellent speech at the Conversazione and Model Competition, I must say that it has puzzled me greatly when he said: that to improve the model-making competition it would be better to have more original ideas. I think his words were: 'Brains coupled with handwork.' Now it seems to me that if one designs and constructs an engine of any type, and so finishes it that it is excellent in all details and accuracy, although it is a very fine model—it is a model of nothing, and I cannot see how it could excel any other model, made with the same detail and finish, which represents any later type of engine, be it stationary, locomotive, or marine, which have been designed by the leading engineers of the day. Or does Mr. Marshall mean one is to select something out of the usual run, say a model of a printing machine or a cigarette-making machine? or, again, does he mean that one is to design an engine with, say, a new kind of valve gear; if so, would not this latter come under the head of invention? I should be very grateful if Mr. Marshall would explain, for I have cherished an idea for constructing a model for some future competition, but I feel that it has now been quite put out."

* * *

The particular purport of our remarks on this occasion was to the effect that a model which showed some evidence of original thought on the part of the builder was a better piece of work than a model built from a purchased set of castings or published set of drawings, which merely represented the handicraft skill of the builder; and since the public now looked to the Society of Model Engineers to show them that which was best in the art of model making, the reputation of the Society required that at its public functions more models possessing some degree of originality should be shown. We do not wish in any way to decry the popular practice of fitting up purchased sets of castings, for with many amateurs this is the easiest and most convenient method of pursuing their hobby, and it affords a high degree of pleasure and personal satisfaction. But the expert member of the Society of Model Engineers should be capable of going a step beyond this and striking out on lines of his own. He need not necessarily be an inventor, nor need he seek distinction by making something which is only of interest by its being a freak. There is ample scope for original thought even in making models of well-known types of engines and machinery, and we would quote three excellent instances of the kind of originality we have in mind which were on view on the particular occasion referred to, viz.—Mr. J. C. Taylor's model of the old locomotive "Agenoria," which took the gold medal; Mr. Corner's model water-tube boiler, which took the bronze medal; and Mr. Lane's model horizontal engine, with trip valve gear, which was shown running under steam from a small water-tube boiler. Another original piece of work which will be well known to our readers may be instanced in Messrs. Arkell's petrol boat, the *Moraima*. Although Mr. Taylor's model was a scale reproduction of an actually existing engine, it involved considerable original thought in the conception of the idea, the collecting of the information necessary for its correct construction, and the scheming out of the best method of making the individual parts. We propose to have something further to say on this subject at a future meeting of the Society of Model Engineers, and so for the present will content ourselves with the foregoing observations, which, we trust, will be sufficient to show our correspondent the lines on which we think he might well proceed.

Answers to Correspondents.

J. S. DAWES (Wanganui, N.Z.).—Thank you for your letter; the volumes have been forwarded as desired. An excellent series of articles on "Milling in Small Lathes" appeared in Vols. VIII and IX, which can be supplied by our publishers.

Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

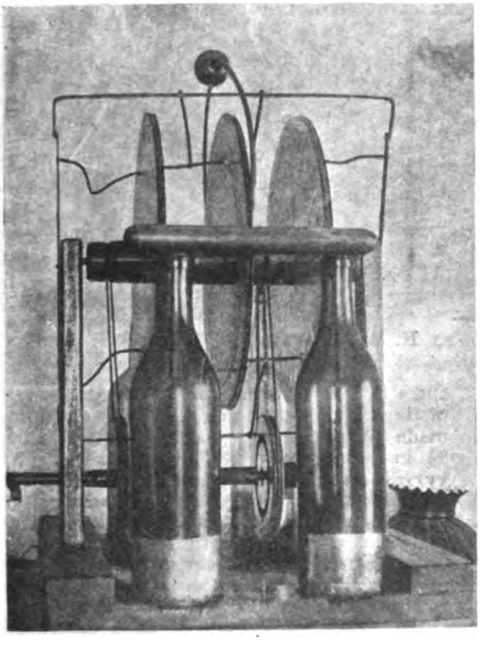
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

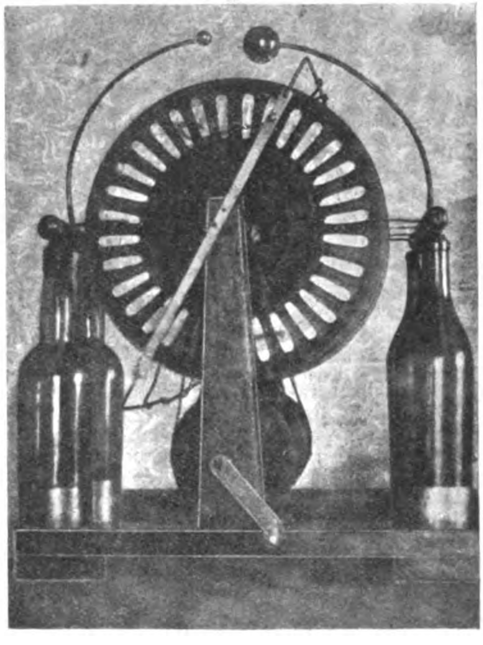
EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 373. JUNE 18, 1908. PUBLISHED WEEKLY.

A Six-Plate Wimshurst Machine.

By H. WEBSTER MOSS.





TWO VIEWS OF SIX-PLATE WIMSHURST MACHINE.

MANY amateurs are deterred from building a Wimshurst influence machine by the high prices charged for glass and ebonite plates and other parts. The following description of a machine built by me for *X*-ray and radio-telegraphy experiments, will, I think, render it clear that an efficient Wimshurst can be constructed at a very moderate cost.

As shown in the photograph, there are six plates. These are made of glass, 12 ins. diameter. Glass was chosen for the plate material, as it is, of course, much cheaper than ebonite, and the latter is very liable to warp in hot weather. Glass discs (15-oz. glass) of the above size may be obtained from any glass merchant for about 4d. each. These are then drilled. I have tried several methods for drilling the glass, and find the following about the best :—

On thick paper describe a circle of exactly the same diameter as the plate and mark the centre by a small circle ½ in. diameter. Place the plate upon this paper guide, and with the point of a fine rat-tail file go around the glass exactly over the little central circle. If the file point be slightly broken when it wears smooth, and the glass be lubricated from time to time with turpentine, a circular piece may be cut from the centre of the plate in a wonderfully short time.

The plates are cemented with glue to the wooden driving bosses. These were made by boring holes through two 6-in. by 2-in. pieces of mahogany, and bushing with ⅜-in. brass tube. The bosses were then turned up upon this tube, each 6-in. by 2-in. piece being parted centrally, as four bosses are required, the two central ones carrying two plates apiece. The spindle for the plates was turned to fit the bosses—from mild steel. Each plate has thirty-two sectors, 1½ ins. by ½ in., as the machine was intended to give a short, thick, and frequent spark. The Leyden jars are made from salad-oil bottles, cleaned and washed out with alcohol. When dry the bottles were coated to a height of 2½ ins. with tin foil, and filled with shot to the same height that the tinfoil extends outside.

The neutralising brushes were all mounted upon one frame, as can be seen from the photograph. The woodwork of the machine is of mahogany, although this is by no means necessary, as well seasoned pine will do quite as well. The glass plates (except the sectors) and Leyden jars, were coated with shellac varnish, to prevent the condensation of water vapour on the surfaces.

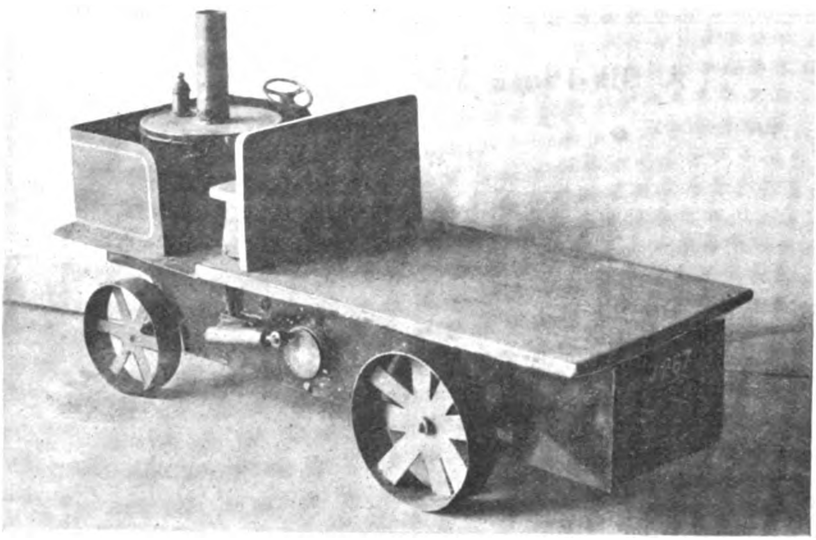
The machine gives an almost continuous 4-in. spark in fairly fine weather, and a 3-in. can be readily obtained under all conditions.

This Wimshurst, which is the second I have constructed, was built during the Easter Holidays, the total cost being well under 10s. I shall be pleased to give fuller particulars to any reader desirous of building this most useful form of influence machine.

A Small Steam Lorry.

By R. W. Chapman.

THIS photograph is of a model steam lorry which I made in a few hours at a cost of under half-a-crown. The items that were bought are as follows:—Two oscillating cylinders, 6d. each; one steam tap, 2d.; one safety valve, about 1s.; strip of tin, about 3d.: total, 2s. 5d., which, with the exception of the tin, were bought at Bassett-Lowke's. The two frames are of stout tin, 1 ft. long by 2 ins. wide. The driver's platform of tin is 4½ ins. by 5 ins. The seat and lorry top is made of cigar-box wood, the latter being about 8½ ins. long by 5 ins. by 3-16ths in. The coal bunk is a piece of tin, 9 ins. by 2 ins., bent to shape and soldered on to driver's platform. The boiler is made from half a cocoa tin, also soldered on to platform, and has one tube up centre and carried upwards to form chimney. The steering wheel is made from a small brass curtain ring soldered on to three flat spokes of tin.



A Small Steam Lorry, by R. W. Chapman.

The water tank (on the back of which is the registered number J 267) slides in at the back end between the frames, and is partly filled with methylated spirit which is carried along a brass tube underneath to the boiler. The front wheels are 2 ins. diameter by ½-in. tread, and are of tin, the spokes being cut out and then soldered into the rims. The driving wheels are made the same way (but the spokes are alternately bent in and out to give them a little more r alistic look) and are 2¾ ins. diameter by ⅝-in. tread. The transmission is by round rubber band from a small pulley on engine shaft to a large tin drum on shaft of driving wheels. It works very well and goes at quite a nice rate.

Elementary Ornamental Turning.

By T. Goldsworthy-Crump.

(*Continued from page 327.*)

FIG. 24 shows two examples of the cranked drill used in this way, and the centre upright in the ring stand shown in Fig. 25 was produced in a similar manner. Semi-circular hollows can be produced on the flat by this application of the drill spindle, which is often useful outside ornamental turning. In fact, many of the movements used in ornamental work can often be turned to great advantage in the construction of articles requiring exact and accurate fitting, and a little thought in this direction will sometimes save an extraordinary amount of time and labour.

At different times since these articles have been appearing the writer has been the recipient of letters from readers in many parts of this country—and from such distant places as India and Australia—asking for further information on particular points

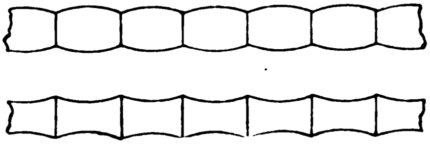


Fig. 24.

or a more detailed description than that given. As doubtless other readers have themselves felt that further elucidation would have been desirable, it is the intention to digress and reconsider the

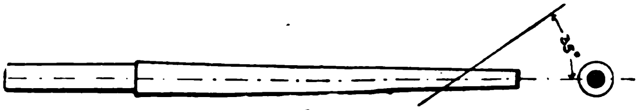


Fig. 26.

various items mentioned by correspondents. There seems to be a difficulty as to the manner the drills illustrated on pp. 563 and 564, Vol. XVII, are to be formed and sharpened. This may have arisen owing to the omission of a side view of a finished drill showing where the cutting edge is situated, Fig. 27. The extreme cutting edge must be even with the guide spot. The guide spot, of course, is obliterated in the final setting. For the purpose of sharpening and polishing the cutting edges of the hollow or bead tools brass taper mandrels should be turned up of such dimensions as to be applicable to the various sizes of semi-circles (Fig. 26). These mandrels should be run at a high speed between centres or held in a grip chuck. The mandrels are charged with fine emery, crocus or polishing paste, according to the degree of finish required. The hollow drill is applied at such position on the mandrel as agrees with its diameter, and held at an angle of 35 degs., as shown in Fig. 26. The flat surface of drill should be got up on a good oilstone or slip. Drills with straight edges are sharpened and set similar to an ordinary carpenter's chisel. Drills with a convex edge can be most conveniently set by the use of the holder shown in Figs. 28, 29, 30 and 31, as the edge can be applied to either oilstone or

Fig. 25.—Ring Stand.

polishing slab and the same angle maintained. Fig. 28 is a side view, Fig. 29 end view, Fig. 30 end view with extra leg in position; Fig. 31, leg with cylinder end. The block can be made of hard wood or brass, and is easily constructed. The angles, when found by trial, can be marked on the legs so that they can be adjusted and secured at once.

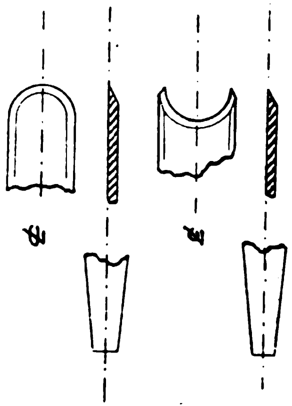


Fig. 27.

A sheet of plate glass makes an excellent polishing plate. A small quantity of abrasive or polishing paste is spread, and the tool and the holder applied, the latter being worked on the clear glass while the tool is in contact with the medium. By the use of the additional leg, Fig. 30, the angles of a drill such as No. 2 can be accurately worked up. After completing one edge the peg is inserted on the opposite side of block, thus maintaining the same angle for both edges. Fig. 31 shows a leg for use with square-ended drills.

With care it is possible to properly set drills with the usual oilstone slip and a final polish on the mandrel or slab, but, of course, the ability of the operator must decide which system to follow, as also the degree of accuracy and finish required.

Many questions have been asked as to division plates, drill-spindles, eccentric, vertical, and other cutting frames, ellipse, oval, and other chucks, and for details for their home manufacture. With the concurrence of our worthy editor, these are receiving consideration, and full details and drawings will appear shortly. The illustrations herewith show the simplest forms of a drill spindle and vertical cutter.

Next to the drill spindle, the vertical or universal cutter is an instrument of many applications. An example of the work produced by its aid is shown in Fig. 32 in the vertical fluting on the lower portion of jewel box. The instrument is constructed in various ways, but the general principle is the same. As its name implies, the cutter usually revolves on a vertical spindle, although cutting horizontally. It must be capable of vertical adjustment, so that the cutter may be set above, below, or at exact centre height. The ordinary cutters are made from flat steel of a size to fit the slot in the spindle and are filed to the required shape and hardened, ground, etc., in the same manner as the drills previously described. The vertical cutter is often used with a circular saw instead of cutter, for the purpose of accurately dividing turned or other work in any number of given parts where each portion has to be identical in contour and angle. An example of this application is shown in Fig. 33, which represents a way of producing moulding for fitting at a right-angle. Another use is for accurately slotting wood or metal chucks, also slotting screw-heads. The vertical cutter is most useful for all mouldings which are not undercut, and by its aid a large quantity can very quickly be produced. It is mostly used in ornamental work for the formation of flutes either on the cylinder, flat or concave surface. Two examples of its application on the cylinder are shown in Figs. 34 and 35, the former being straight bead-shaped flutes produced by traversing the cutter by the main slide and spacing by the division plate, while the latter shows a multiple spiral. This, of course, requires a screw-cutting lathe or an ornamental lathe fitted with spiral apparatus. The manner of procedure was as follows.—The blank having been centred and the ends turned to the required size and the

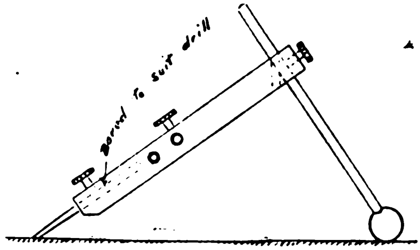


FIG. 28.

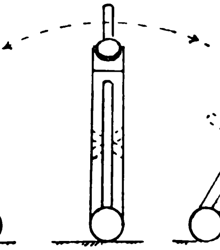


FIG. 29.

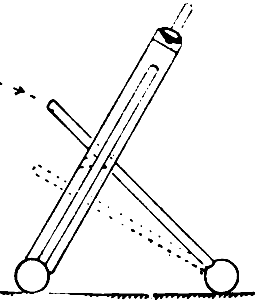


FIG. 30.

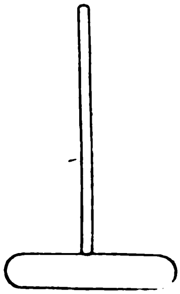
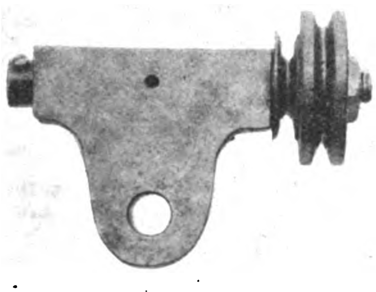


FIG. 31.


DRILL SPINDLE FOR DRUMMOND LATHE.

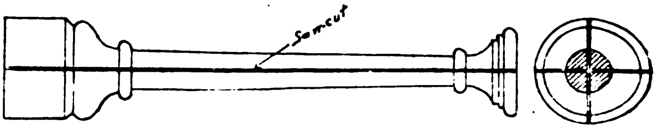
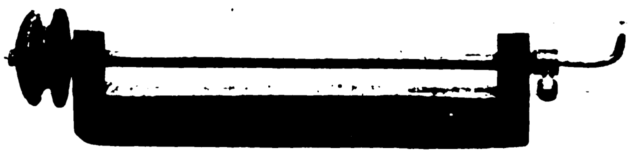
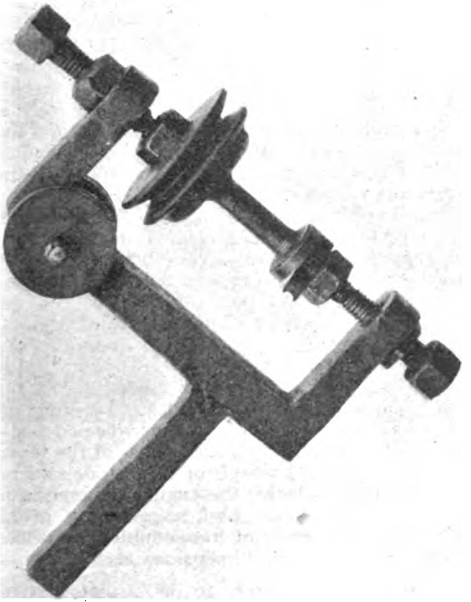


FIG. 33.


A SIMPLE DRILL SPINDLE.

centre portion turned parallel, the vertical cutter was properly adjusted to centre height, and a semi-circular cutter inserted and the overhead connected up. The change wheels employed were 105 on mandrel gearing with 20 on the intermediate shaft,



Simple Vertical Cutter.

this wheel being locked with a 65, which engaged with 20 on the lead screw, the latter having 8 T.P.I. per inch. As six flutes were required, it was necessary to arrange for these divisions on the headstock so that each flute should be equi-distant at the commencement of each cut. Everything being ready, the

Fig. 36.

amount of penetration was determined and the first cut proceeded with, the traverse and consequent revolving of the mandrel being obtained by hand from the main slide. The first cut being completed, the tool was brought out of cut and returned exactly to the starting point. The quadrant carrying the change wheels was then just disengaged and the mandrel revolved a sixth of a revolution and the wheels brought into mesh, when the second cut was proceeded with, these movements being repeated for each remaining flute. Fig. 36 shows the application of the same cutter on

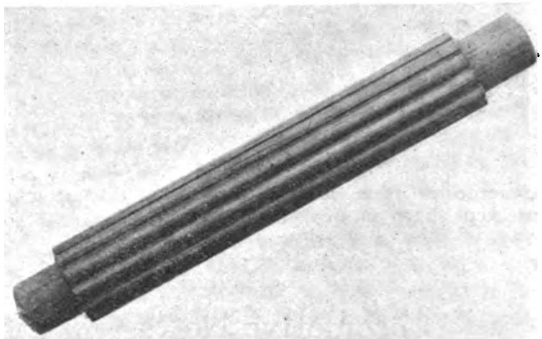


Fig. 34.

the concave surface, and its usefulness for this purpose is further shown in illustration on page 499, Vol. XVII.

The vertical cutter can be often employed on the ornamentation of the periphery of a circle with a pattern somewhat similar to that produced by a cranked drill or eccentric cutter, but with this difference—that the cutter is in a horizontal

Fig. 32.—A Jewel Box.

instead of a vertical plane. It is a tool that will appeal to the model engineer, as by its means spur wheels can be cut in brass, fibre, or wood.

The profile of the cutters is a counterpart to the pattern or cut required, and any shape can soon be filed up, care being taken to see that sufficient

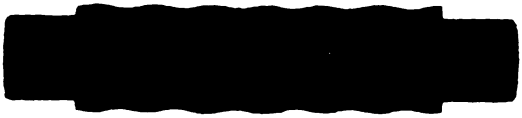


Fig. 35.

clearance is given everywhere, and that the cutters are kept sharp and driven as fast as possible.

(*To be continued.*)

Locomotive Notes.

By Chas. S. Lake, A.M.I.Mech.E.

British-built Locomotives for Service Abroad.

Locomotives of all types and sizes which have been constructed in this country are to be found in nearly every part of the world; and in many cases not only have the engines been built, but also designed here. The reputation enjoyed for excellence of design and workmanship held by British firms of locomotive builders is a far-reaching one, and there are many foreign railways which rely almost entirely upon this country for their locomotive supplies. South America has of late years especially provided one of the best markets for British-built locomotives, and among the railways which have taken large numbers of engines of large size and modern types is the Great Western of Argentine, which just recently has accepted delivery from Messrs. Robert Stephenson & Co., Ltd., of Darlington, of several "Consolidation" 2—6—0 type goods locomotives and also some tank engines of the 2—6—2 pattern.

In both cases the designs follow the specification of Mr. Chas. H. Fox, Consulting Engineer in London to the Argentine Great Western Railway. Both engines have outside cylinders and valve motion, the latter being of the Walschaerts' pattern. The heavy goods locomotive (Fig. 1) is fitted with a very powerful boiler, features in the design of which are the long Belpaire firebox and extended smokebox, the latter being provided with a spark-arresting device. The cylinders drive on the outside of the third pair of coupled wheels, with the slide-valves working on top. Extension piston and valve rods are fitted, and lubrication of the cylinders and valves has been given special attention. Indeed, it is a very important point that locomotives intended for use in South America should not only have all working parts arranged for ease of access, but that ample lubrication of those parts should be provided for. The springs of the coupled wheels are compensated by equalisers, in groups, the front truck being equalised with the leading and second coupled wheels, while the driving and trailing wheel springs bear the same relation to one another. The cab is of commodious and well-arranged design, and the tender is built for a large fuel-carrying capacity. It runs upon eight wheels, arranged as two four-wheeled bogies, with outside framing. All the wheels of the tender, and also the coupled wheels of the engine, are provided with brake blocks, the engine being equipped with steam and hand brakes. Sanding gear is applied at both ends of the coupled wheelbase. The engine has leading dimensions as follows:—

Cylinders: Diameter, 20 ins.; piston stroke, 26 ins.

Wheels—diameter: Bogie, 3 ft. 5 ins.; coupled, 4 ft. 7½ ins.

Fixed wheelbase, 16 ft. 0½ in.; total engine wheelbase, 24 ft. 7½ ins.

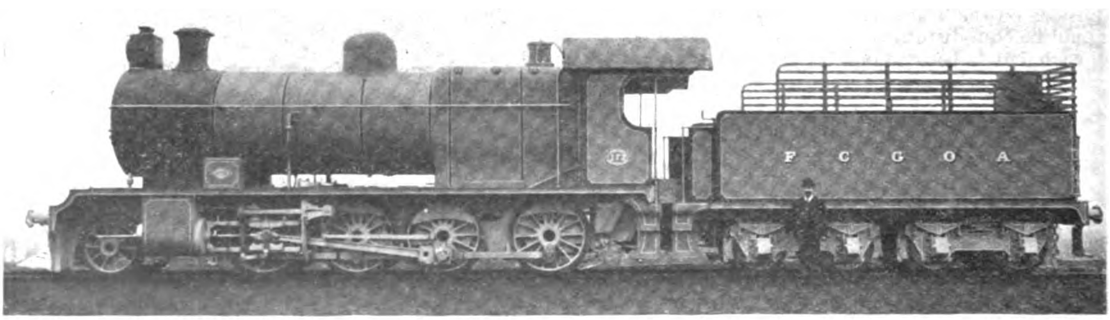


Fig. 1.—Heavy Compound Goods Locomotive: Argentine Great Western Railway.

Heating surface: Tubes, 2165·8 sq. ft.; firebox, 186 sq. ft.: total, 2,351·8 sq. ft.

Grate area, 35 sq. ft.

Working boiler pressure, 180 lbs.

Total weight (in working order), 71 tons 10 cwts.

The tender carries 4,500 gallons of water and 5 tons of coal; the capacity for wood is 480 cub. ft. Engine and tender (in working order) weight 135 tons.

The tank engine for the same railway—the Argentine Great Western—illustrated in the second reproduction, has three pairs of coupled wheels, of which the middle ones are the drivers, set in with the standard 4-ft. 8½-in. gauge. The tank engine has outside cylinders (17½ ins. diameter by 24-in. stroke), taking steam from a boiler which contains a total heating surface of 1393·1 sq. ft.,

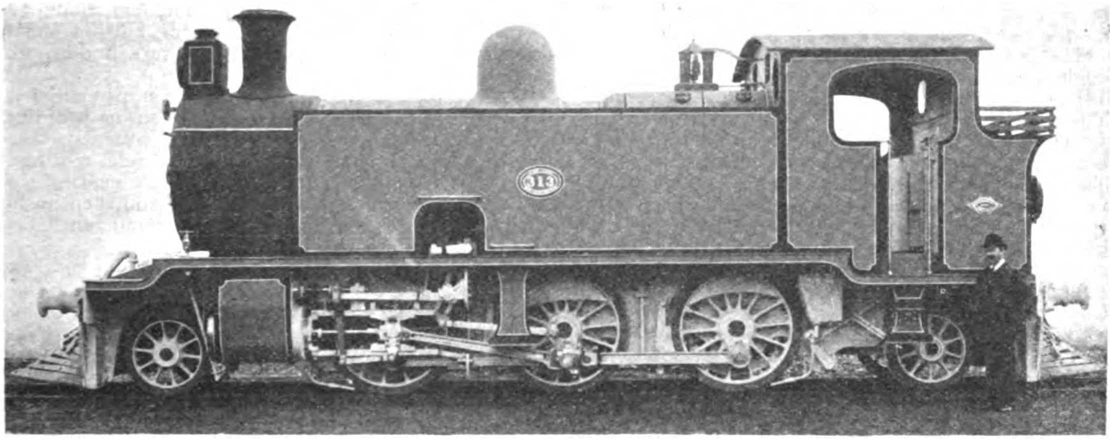


FIG. 2.—2—6—2 TYPE TANK ENGINE: ARGENTINE GREAT WESTERN RAILWAY.

between two pony trucks, thus combining ample facilities for adhesion weight being utilised and tractive power developed without sacrificing flexibility of wheelbase. The boiler is fitted with a Belpaire firebox and extension front end, and the design throughout, both in regard to details and features of general outline, follows what has now and has a grate area of 22·5 sq. ft. The working pressure is 180 lbs. per sq. in. The bogie wheels are 3 ft. diameter on tread, and the coupled wheels 4 ft. 6 ins.; the fixed wheelbase is 12 ft., and the total wheelbase 26 ft. 6 ins. The tank capacity is sufficient for 2,000 gallons of water, and a fuel space for 2¼ tons is provided. In full working

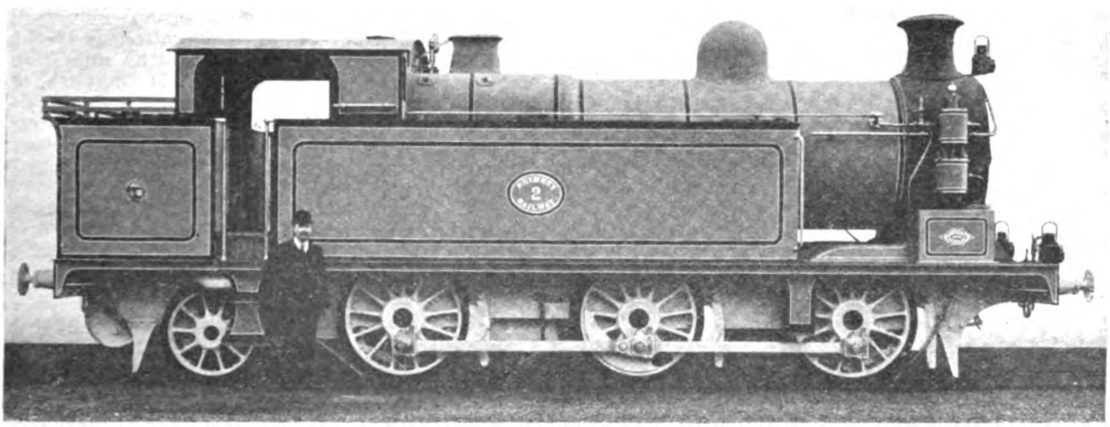


FIG. 3.—NEW RADIAL TANK LOCOMOTIVE: RHYMNEY RAILWAY.

come to be regarded as standard practice for Argentine G.W.R. locomotives. This railway has, in fact, acquired during the past few years a very modern and advanced locomotive equipment, most of which has been supplied from this country. It embraces many of the latest and most approved types of engines, and as the gauge of the railway is 5 ft. 6 ins., a greater amount of latitude is afforded the designer in selecting dimensions than is possible order the engine weighs 71 tons 4 cwts. The equipment includes steam sanding apparatus, vacuum brake appliances, and sight-feed lubricators.

NEW TANK LOCOMOTIVES FOR THE RHYMNEY RAILWAY.

The accompanying illustration shows one of the new type of tank locomotives recently supplied to the Rhymney Railway. The engines, which have been built to the designs of Mr. C. T. Hurry Riches, locomotive superintendent, are of the six-coupled radial or 0—6—2 type, with inside cylinders. They have been designed for hauling heavy trains both in passenger and mineral service, and are well adapted for this work, resembling in many respects the locomotives of the same type which have been used so successfully for many years on the neighbouring railway—the Taff Vale.

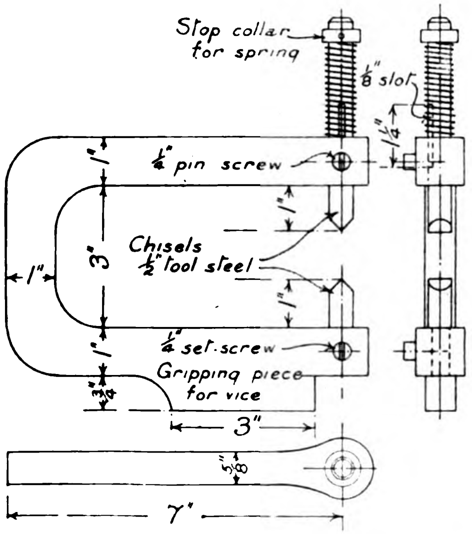
The leading dimensions which follow show the engines to be of powerful build. The cylinders are 18½ ins. in diameter, with a piston-stroke of 26 ins. The coupled wheels are 4 ft. 6 ins., and the radial wheels 3 ft. 6 ins. in diameter, the rigid wheelbase being 15 ft. 3 ins., and the total wheelbase 21 ft. 9 ins. The boiler is of the Belpaire pattern, and contains, in the tubes, 1,296 sq. ft. of heating surface, and in the firebox 123·5 sq. ft., or a total heating surface of 1,419·5 sq. ft. The grate area is 21·5 sq. ft., and the working pressure 175 lbs. per sq. in. The tanks have a water capacity of 1,740 gallons, while the bunker is designed to accommodate 3 tons of coal. In working order the engine weighs 67 tons, of which 54 tons are available for adhesion.

The engines are equipped with Westinghouse steam and hand-brake appliances. The engines were built by Messrs. Robert Stephenson & Co., Ltd., Darlington.

A Trimmer and Severance Tool for the Vice.

By John Heyes.

I HAVE named it thus, as the name seemed to fit its capabilities. As a trimmer, it could be used to cut off the surplus metal round the edges of a hole cut in sheet metal, and it could also be



used to cut metal rods of various sections. Many other uses could be found for it. In place of the bottom chisel a flat-faced piece could be inserted, if required. As will be seen from the drawings, the frame is a casting, with circular ends 1 in. diameter. These are centred and drilled accurately, to take the ½-in. tool steel chisels.

The bottom chisel is secured in position by a setscrew whilst the top chisel, being free to slide up and down, is prevented from rotating by means of a screw, the end of which has been turned down to fit without play in the slot. This pin should be case-hardened. The portion of the bottom chisel that fits in the frame should be turned down to ⅜ in.

The collar at the top end of the upper chisel is secured to the latter by a pin. The spring is of fine steel wire (about 22 or 24 S.W.G.), softened, then wound on a piece of ½-in. iron, made red hot, hardened, and then tempered blue by heating the iron rod on which it was hardened, and then pushing it into the spring, twisting it round, until the desired colour is obtained.

To use the tool, it should be secured in the vice by the gripping-piece, so that the part of the frame containing the bottom chisel rests on the vice. This precaution enables a solid blow to be struck without danger of breaking off the end of the casting.

It is hardly necessary to mention that the metal to be cut should be held at right angles to the chisels.

The Portsmouth Model Yacht Club.

A MEETING of the Portsmouth Model Yacht Club was held at the Highland Road Council School, on Wednesday evening, May 13th, the Commodore (Councillor Mark Gill, J.P.) occupying the chair. Mr. Clive Wilson (Hon. Secretary) apologised for the absence of several members who were out of town. The Commodore offered a prize to the Club for competition, and it was unanimously agreed to hold a special race for this prize. Letters were read from several influential local gentlemen, extending their patronage to the Club. It was also decided to hold an inter-Club race with another club outside the Borough of Portsmouth, the race to take place under the Club's 10-rater rule, home and away. During the afternoon the first race of the season was held, the boats being set going in a good breeze, which continued throughout the race. Mr. Coxon's *Saucy Sally* and Mr. Clive Wilson's *Florence* tied for first prize, with sixteen points each; Mr. Coxon securing first prize in the final. Mr. Tallack's *Sport* was third, with fourteen points; and Mr. E. J. Hablutzel's *Edna* fourth, with twelve points.

Liverpool and District Electrical Association.

THE members and friends of the above association paid a visit to Southport on Saturday, May 30th, the party leaving Exchange Station by the 2.30 p.m. express. On arrival at Southport they then journeyed by the 3.5 p.m. rail motor-car to Kew Gardens Station, and had a pleasant walk of about twenty minutes to the Southport Corporation Electricity Works, situated at Crowlands, when a most interesting inspection was made of the plant. This outing is expected to be followed by a visit to the Pacific Steam Navigation Company's steamer, *Orita*, on Saturday, June 27th.

Notes on Wireless Telegraphy Apparatus.

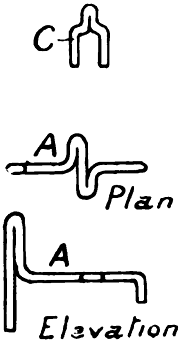
By V. W. Delves-Broughton.

(*Continued from page* 389.)

A Simple Potential Divider.

It is sometimes advisable to make up an experimental instrument in a rough and ready manner before spending a lot of time to make an elaborate piece of work which, after all, may not be suitable when completed. As an example of this, I propose describing a potential divider which took about one hour to make, and, as sometimes happens with the writer, was so successful that the proposed elaboration never came off!

First a piece of resistance wire 6 metres long, and having a total resistance of about 200 ohms, was taken and doubled in half, bared at both ends and in the centre, short lengths of No. 20 copper wire being soldered on at these points. One half was then doubled again and wound round a pencil and tied up with cotton in a tight coil, thus forming a non-inductive resistance.



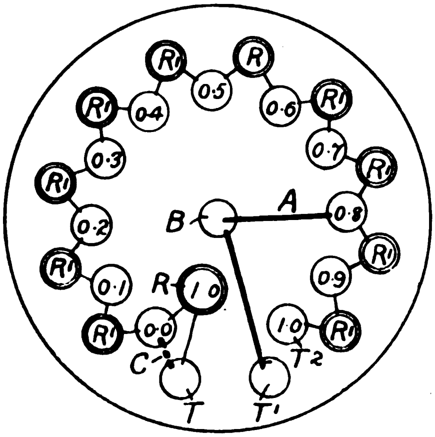


Diagram of a Simple Potential Divider.

Next, the other part was divided into ten equal parts, and small pieces of copper wire soldered on at each division mark, as above, and the intervening pieces of resistance wire coiled after being doubled and tied as explained. Next an empty 4-oz. Player's Navy-Cut tobacco tin was taken, and after removing the lid, was placed on a gas ring, turned very low, and paraffin wax melted in it till it was full. This was then allowed to cool and the box filled up as the wax contracted. And finally the wax was "struck off" flush with the top of the tin with a heated piece of square iron rod. Then two concentric circles were struck out on the wax and sub-divided as shown in the drawing, then holes were drilled with a centre-bit, driven at a high speed in the lathe, about 5-16ths in. diameter, by ⅜ in. deep. The large resistance had a somewhat deeper hole to accommodate it in the position shown in the drawing at R. The resistances were then each placed in its respective hole and hot paraffin wax run in till the hole was filled up and the wire entirely covered, only leaving the copper wire sticking out. The copper wires were then cut off and bent down so that their ends nearly reached the bottom of the holes in the inner circle.

The end of each copper wire was then touched with a little nitric acid, in which a little mercury had been dissolved to ensure thorough amalgamation, and the inner row of holes, the central hole B, and the holes T and T1 filled with mercury. The bridge pieces A and C are bent out of thick copper wire (10 or 12 gauge), as shown in Fig. 2. These also should be thoroughly amalgamated. In the drawing a larger circular tin is shown than the tobacco box I used, as I found it rather cramped.

The connecting wire from B to T1 is of No. 20 copper wire, held in place by two small staples formed out of copper wire, heated, and pushed into the wax.

In bedding the resistance coils in the wax a piece of stout wire heated in the gas-ring will be found a great assistance. In making up a divider on this principle, if intended for permanent use, it would be as well to thoroughly boil the resistance coils in wax before embedding them. Also it would be advisable to harden the wax by the addition of an equal quantity of clear resin.

To explain the action: the battery, which, for the sake of illustration, we will consider to give exactly 2 volts, is connected between T and T2. The coherer, relay, or moving coil instrument, choking coils, etc., are connected between T1 and T2. (It will thus be seen that a current will continuously flow through all the resistances, but as this resistance is considerable, the loss will be very slight.) Supposing the arm A to be in the position shown in the diagram, the current will be split in two, part flowing from T to T2 through the whole resistance, *i.e.*, a total of 2 R, and part from T1, through the resistance of 0—2 R to T2, the voltage between these points being 0—2 volt. If more than 1 volt is required, R is cut out by inserting the bridge piece C, when the difference of potential between each contact will be 0—2 volts instead of 0—1 when C is in place. It will thus be seen that practically any voltage can be obtained between 0 and 2 volts. The resistance of the external circuit should be greater than 200 ohms, however, or the potential difference will not hold good. It is advisable to use an accumulator, or at any rate a low-resistance battery with a potential divider, and if a primary cell is used it should be of the non-polarisable type.

Numerous other instruments can be made up expeditiously in much the same manner. Amateurs need not be ashamed of being seen with instruments made up in this manner as long as they do their business. The National Physical Laboratory at Teddington is full of such improvised appliances, and no one can say that the work done there leaves anything to be desired in the point of accuracy. Mercury contacts are better than any other system where perfect security is desired. The only other means of absolutely ensuring a perfect electrical contact is to solder the connections.

On one occasion a loose screw in a terminal cost me three hours to find out where the mistake was; but this was not quite so bad as a friend of mine who was engaged on some accurate research work, and after having spent some weeks in making observations on the deflection of a magnetic needle, found that these deflections were to a great part due to the fact that the steel frames of his spectacles had accidentally become magnetised.

When I made up this instrument I had some resistance wire, which was most useful, but have never been able to obtain it since. It was drawn to exact resistances per metre, not to gauge, thus it was sold with resistance of 33⅓ ohms (I believe this was the highest resistance made), 20 ohms, 16⅔ ohms, 10 ohms, and 5 ohms per metre run, and was sufficiently accurate for most practical purposes. I obtained this wire in a little instrument shop in Athens, Greece, and believe it was of French origin. It would be extremely useful if some enterprising firm would undertake to put similar wire on the market, as it saves a great deal of bother and time if you know exactly how much to measure off for a given resistance and have a definite measure without the complication of five or six places of decimals.

(*To be continued.*)

"WOLSELEY - SIDDELEY," the challenger for the British International Trophy, has been purchased by the Duke of Westminster.

A Model Balanced High-Speed Engine.

By H. GREENLY.

(*Continued from page* 564.)

THE first consideration of both pattern-maker and fitter will, of course, be the construction of the crank chamber. As shown in the general arrangement, the guides are cast solid with the case, and although I cannot lay claim to knowledge of the many ingenious devices adopted by pattern-makers and moulders to obtain castings of intricate objects, I do not think this particular

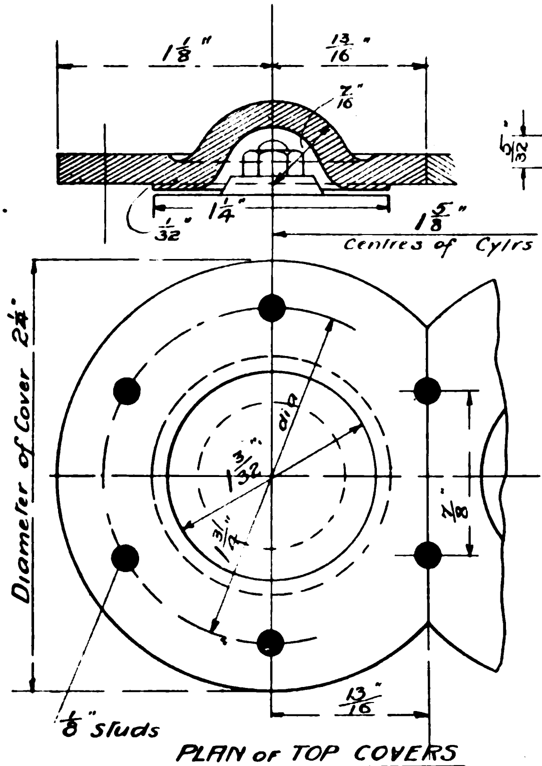


FIG. 9.—TOP CYLINDER COVERS.

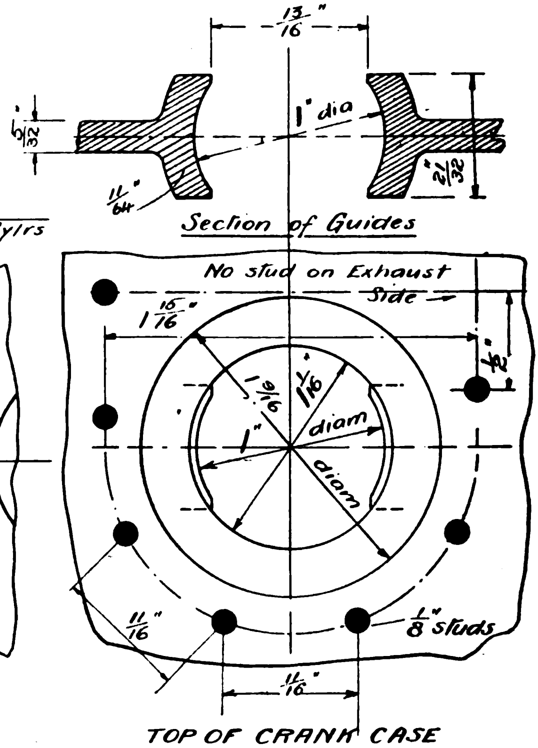


FIG. 7.—CRANK CASE AND GUIDES.

job involves anything of insuperable difficulty. The absence of any central bearing, usual in this type of engine, should certainly tend to reduce the complexity of the corebox for this important portiof thn oe engine. The section of the guides are shown to full size in Fig. 7. They are circular, and may be bored with a slide-rest tool, the crank case being fixed down on the faceplate. At the same time that this is being done, the 1 9-16ths in. diameter recess for the 1-20th-in. thick cover-plate may be turned in the top of the chamber. If the top surface has not been faced in a planer or shaper before setting up the casting on the faceplate, this surface must be dealt with during the above operations. In the drawing of the combined bottom cover and cylinder support (Fig. 8) spigots are shown engaging the recesses in the crank chamber. While these may be considered good practice by some, ensuring alignment, the accuracy of the work will ultimately depend on careful marking out, and not altogether upon the cylindrical fitting, like it would in the case of a single-cylinder engine. These spigots may therefore be dispensed with, and the bottom surface fitting on the crank case casting may be planed before the cylinder spigots and flanges are machined.

Fig. 8 shows the arrangement of the studs fixing the bottom cover down to the crank chamber, and on the right-hand side the arrangement of the cylinder studs. The presence of the exhaust connection entails an unsymmetrical arrangement in both cases, but the positions are quite clearly shown on this drawing and on Figs. 8, 9, and 10. The latter illustration shows the 3-32nds-in. stud which passes through the exhaust passage just inside the groove in the cylinder which connects the exhaust ports. The other studs for the top and bottom covers are arranged to miss the ports, with an ample margin in each case.

The top covers are separate, and are domed to clear the coned portion of the piston and the piston rod-nut, as shown in Fig. 9. The setting out of the studs is quite regular, the centre two studs being arranged to bear on one half of each cover. The holes for these may be drilled in

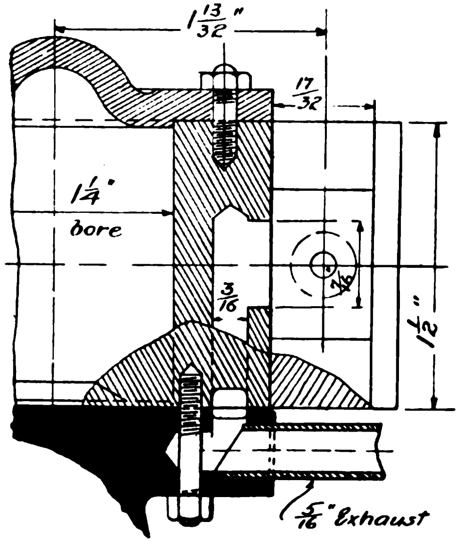


Fig. 10.—Section through Exhaust Port and through Pipe.

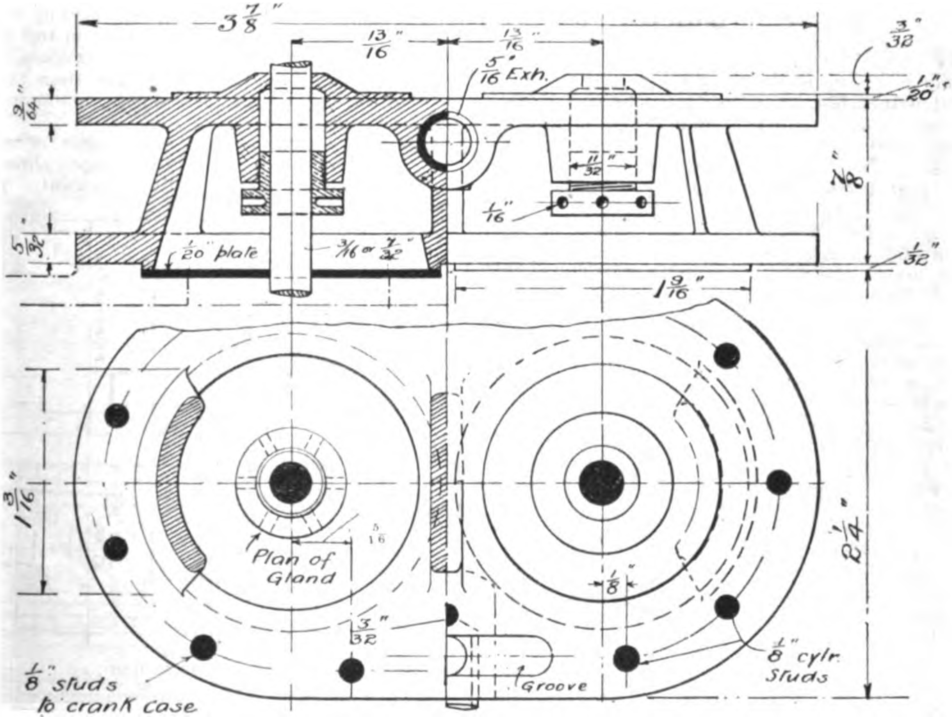


Fig. 8.—Bottom Cylinder Cover.

the covers before they are fitted together and the adjacent edges filed away to the centre-line line.

The crank chamber being faced up top and bottom, and the guides bored dead square with these faces, the casting may be set up on the boring table and holes for the combined bearings and end covers bored to their respective sizes. The facing strips upon which the flanges bed may be faced with a broad cutter at one cut; but if any doubt exists as to the advisability of this method, and if the lathe upon which the work has to be done will swing the casting, it may, after boring, be mounted on a hardwood mandrel, 1 1-16th in. diameter at one end and 1½ ins. at the other, and faced with side-cutting tool fixed in the slide-rest.

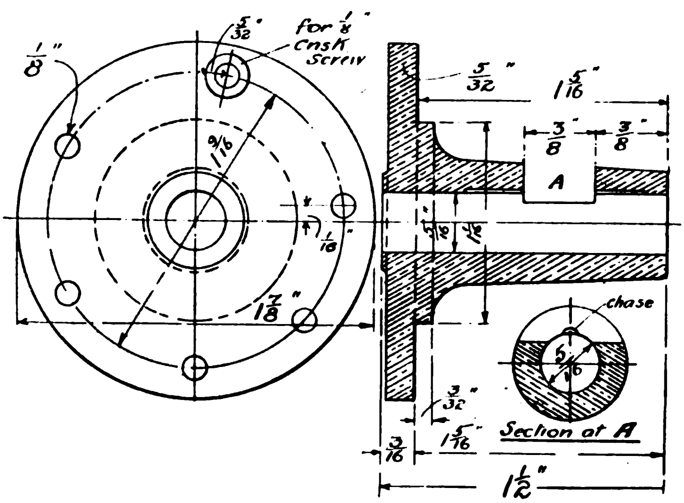


FIG. 11.—BEARING FOR VALVE GEAR END.

The bearings are quite plain, their great length doing away with the necessity of any adjusting devices. They may be cast in iron or gun-metal, cast iron giving good results if well oiled. To ensure sufficient lubrication, a slot marked A in Fig. 11 may be filed across the bearing so that about one-third of the journal for a distance of ⅜ in. is uncovered. A chase with a small round-nose chisel may be cut in the upper portion of the bore to meet the slot, as indicated in the drawings. Enough oil should then find its way into the bearing, by being splashed into the slot by the connecting-rod and cranks.

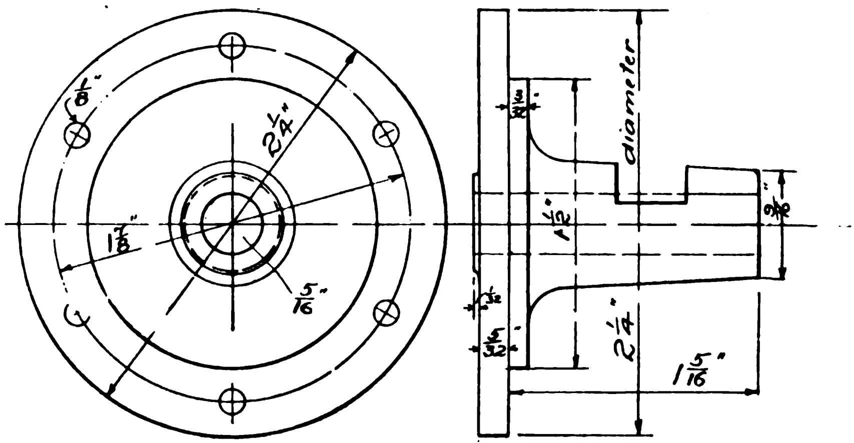


FIG. 12.—BEARING FOR FLYWHEEL END.

The inspection door is an ordinary cover casting, which may be turned and faced up to fit over the hole in the crank chamber, the facing strip of which may be cleaned up with a file. There is no need to rig up the casting to machine this joint, as accurate alignment is of no consequence. It may be made oil-tight by a piece of brown paper. To enhance the appearance of the engine the flange of the cover and the nuts may be polished bright.

The piston is designed to take a single ring. It may be solid, with a groove turned in the edge and the ring sprung once into the groove. The junk-ring arrangement shown in the drawings is, however, suggested as an improvement. The ring may be of brass, cast iron, or steel. If made of drawn tube, a brass ring will be found quite satisfactory. It may be turned to dimensions given on the drawing and then split diagonally, as shown, or the outside may be left 1¼ ins. by 1-32nd in. diameter, and the ring sawn with an ordinary thickness hack saw and the joint compressed and soldered up. The ring may then be placed on a mandrel (slightly eccentric) and the outside turned so that it just fits the cylinder. The solder point may then be heated and broken, and cleared with a saw or ward file, if necessary, and the builder will know that when the ring is in place and compressed it will fit the bore accurately, presuming all work is truly circular. The junk ring, it will be noted, fits over a spigot on the body of the piston, and therefore does not rely on the screws to keep it concentric. Both this and the main portion should be rough turned to the approximate finished size, and then fitted to the rod and skimmed up to dimensions, with the rod held in the self-centreing chuck or between centres. The piston-rod nut should not be larger than shown on the drawings, unless provision is made in turning up the top covers.

In deference to the practices of many model makers, the drawing of the piston shows it screwed on, the nut being really a locknut. This method of fixing is certainly a secure one; but if the final erection of the engine is considered, it will be seen that if the crosshead is fixed once for all, or if the piston-rod and the crosshead are made from one steel casting, as is often done, the piston must be removed to get it in place. With a screwed rod this would be all right if the shoulder were much larger, but as there is the possibility that the

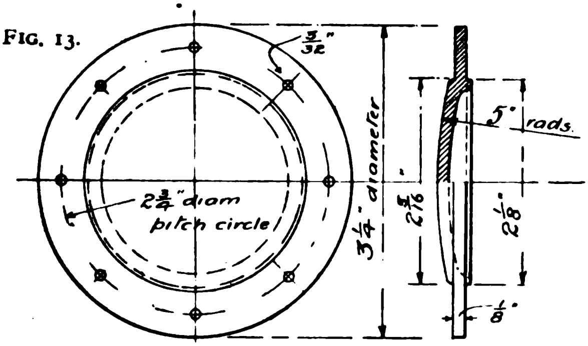


FIG. 13.

DETAILS OF BALANCED HIGH-SPEED ENGINES.

FIG. 13.—INSPECTION DOOR.

FIG. 14.—PISTONS AND PISTON RINGS.

FIG. 15.—PISTON-ROD AND CROSSHEAD.

FIG. 16.—CONNECTING RODS.

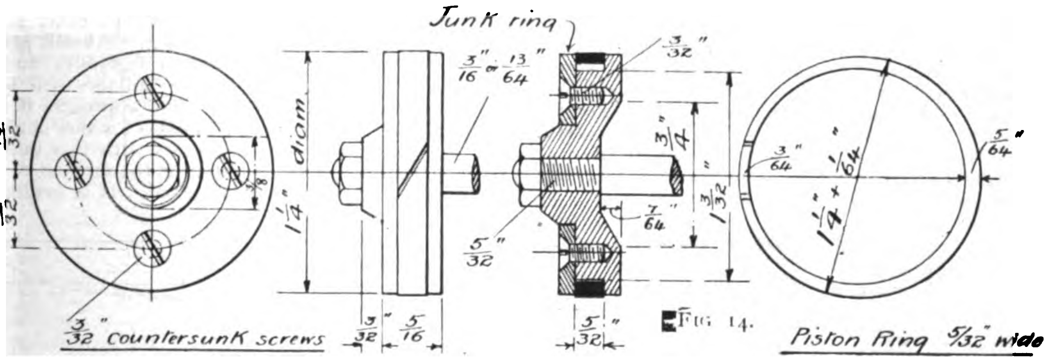


FIG. 14.

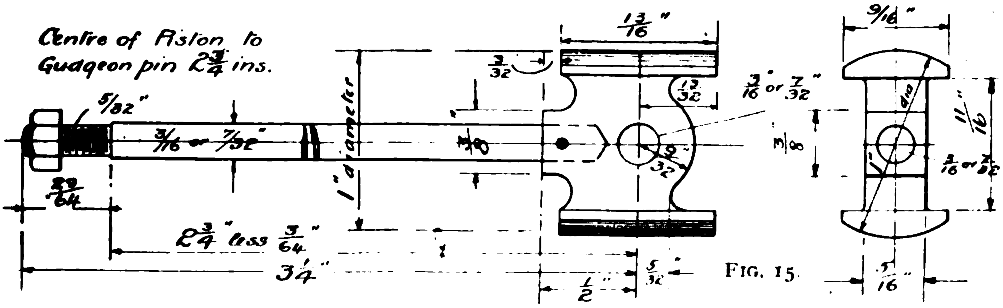


FIG. 15.

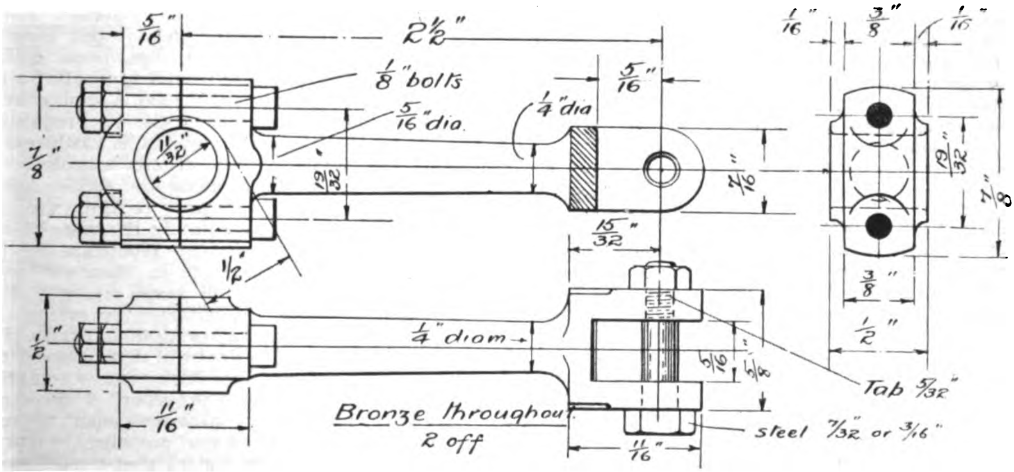


FIG. 16.

Piston cannot be removed and replaced without altering its alignment, the fitting of the piston on a plain, and not screwed, rod is worthy of consideration. When the engine is finally erected, the piston-rod may be slightly burred over the nut, or, better still, a 3-64ths-in. pin may be driven through both nut and rod to secure same from slacking off. The piston-rod, crosshead, and connecting-rod may then be fitted together and put in place from the bottom opening of the crank chamber.

The crosshead may be of cast mild steel, which I find wears very well indeed in conjunction with cast iron, or of gun-metal, and after being filed up to rough size may be drilled for the piston-rod. This should be fitted as well as possible, and the rod not shouldered, but arranged to bear on the bottom of the hole and pinned, as shown in the drawing. The rod, which should be centred at the piston end, may then be held in the chuck, and the crosshead turned to fit the bored guides. A centre-pop should be made in the crosshead, so that the whole of the work, the piston-rod, crosshead, and piston may be placed between lathe centres and finally trued up to size. A 7-32nds-in. piston-rod is recommended, and also a gudgeon pin of the same diameter.

The connecting-rod (Fig. 16) is of the ordinary marine type, and is intended to be made entirely of gun-metal or phosphor-bronze. The only point worth commenting on is the gudgeon pin. This should be tapped into one fork of the little end, so that the nut acts as a lock-nut. The body of the rod should be turned between centres before the top fork is filed out, this portion of the casting being made solid. The gudgeon pin may be of mild steel, potash-hardened, with advantage, or may be made out of a piece of tool steel.

(*To be continued.*)

A PATENT for a new system of railway fog signals has recently been granted to Messrs. Watson and Lettice, says the *Engineer*. The invention is purely mechanical. The apparatus is fixed on the locomotive or other part of the train suitable for the firing and discharging of detonators and the automatic replacing of the same. "Elbows" are placed at certain intervals beside the rails, which rise at the discretion of the signalman and engage the apparatus mentioned, which fires a detonator, thus giving the usual warning to the driver. The stopping and progress of a train is also regulated by the signalman.

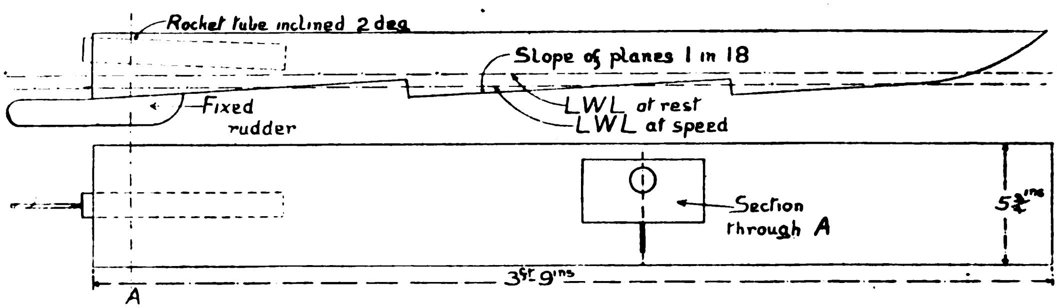
Modelling the Hydroplane.

By W. L. BLANEY.

(*Continued from page 545.*)

COMING down to present considerations, though we know that it is scarcely likely that the worthy Editor of THE MODEL ENGINEER will allow rockets in the Speed Competitions, but there is a wealth of data to be deduced from Ramus's experiments that will help the model engineer very considerably. Firstly, it may be taken for granted that a thrust power of 3 lbs. is not to be expected from any combination of machinery weighing only 3 or 4 lbs. (except rockets). But a model weighing 7 lbs. or so, all on, to give that amount of propulsive effort is by no means impossible by other agencies, although it provides a problem that will give considerable play to individual ingenuity to design such a plant. If intending builders will set this as their ideal, however, and approach it within near limits, they may still expect a very high speed in proportion to their success with this task.

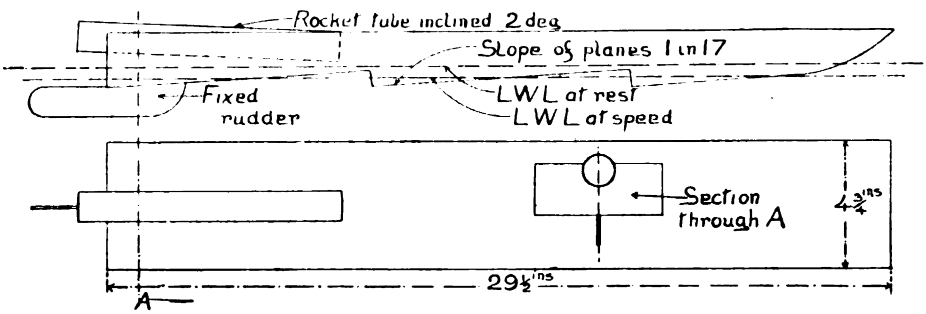
The second consideration is the method of applying this power, when obtained. It is evident that



THE REV. CHAS. MEADE RAMUS' MODEL HYDROPLANE, NO. 1.

with a propeller of 3 ins. or 4 ins. diameter, either the pitch or shaft speed (or both) would need to be excessive, so much so as to defeat its own ends by the wastage of power. The solution of this difficulty would appear to be to increase the diameter of the propeller indefinitely; but here another consideration arises. It has been conclusively proved that the best results can only be obtained when the thrust of propulsion is applied in a direction slightly opposite to the rise required in the boat. This seeming paradox is easily exemplified by the familiar trick of our schoolboy days of skating a flat stone along the surface of a pond. The stone must necessarily be thrown down upon the water, but immediately it strikes it rises and skips along in constant repetition of the first movement. The rockets in Ramus's models are inclined down for the same reason. The effect could, of course, be obtained by raking the shaft from aft to fore and allowing the propeller (?) to pull the craft, but it is doubtful if this would meet the case all ways. We have one alternative left, and that is the ariel propeller. I have said that I would not enter a controversy anent the respective merits of air and water propellers, so perhaps it will be sufficient to remark that recent experiments in the field of aeronautics (some of which have been illustrated in THE MODEL ENGINEER — No. 285, Vol. XVI)—have shown that a high degree of efficiency can be obtained from aerial propellers when they are made of the correct shape and form. The trial of different forms of model aerial screws should provide an endless source of interest to model hydroplaners and bring forth a clearer knowledge of their value. It will be seen from the sketch of "Ricochet Nautilus" that this craft apparently controverts this principle, since the propeller is raked aft very considerably. But it must be remembered that the helmsman in this case sits right aft—as far as he can get, and thus, by the application of his bodily weight, produces in some degree the effect of a downward thrust.

It will perhaps not be out of place to give a few hints on the making of a model hydroplane hull, as there are various little ways of saving weight that may not occur to all. It will be apparent, of course, by now that we must aim at reducing weight to the lowest limit, for the total weight will regulate the speed in a very much more noticeable proportion than occurs with orthodox hulls. Fig. 3, June 4th issue, to give them the maximum strength. The planes are best made from thin gauge aluminium sheet in one piece, worked up into the shape shown. This will be fixed on with very small brass screws (¼-in. Nettlefold, No. 1) spaced about 1 in. apart. Previous to screwing down, the edges of the wood should be evenly smeared with white lead, and no trouble from leaks need be feared. The heads of screws should, of course, be countersunk flush. It will be useless to expect these small screws to bury their heads themselves by just screwing up hard, so the hole in plate (pricked with an awl) should be rimered with a small rose bit held in a brace before inserting the screw. The deck can be made from the thinnest gauge aluminium sheet and fixed on in the same manner as the planes. The shape of the opening for the well will be regulated by the form of the machinery it is intended to fit, as will also the bearers for fixing the machinery to the hull. We have the cross-beams B B B B, which will do nicely if they happen to be in the right position; if not, they can be removed from the position shown and placed in a more suitable



THE REV. CHAS. MEADE RAMUS' MODEL "POLYPHENSIC SHIP," NO. 2.

shows a method of construction of a model hydroplane worked out to the same dimensions as Ramus's model (No. 1). It is an easy matter to design other sizes, since the surfaces are all flat and straight lines, allowing the displacement to be quickly measured. In spacing out the planes it is advisable to make them equi-distant along the length, and not to sink their highest edge below the surface a greater depth than one half the difference of measurement of depth between the highest and lowest edges of the planes. There is considerable latitude allowable in the relation of beam to length, so that if one requires to reduce the design of Ramus's No. 1 model to "metre" size, it is only necessary to increase the beam a shade to get the same displacement and plane area.

Coming now to the construction of the model under consideration, we can commence with the side planks, shown in Fig. 4. These may be cut from a piece of perfectly straight-grained yellow pine ¼ in. thick and trimmed to the shape shown. The cross-beams B B B B should be cut from the same material, and nicely squared up all the same length. They are then fixed in place with fine brass screws ⅜ in. long, the joints being anointed with a little medium thick hot glue. The knees K K K K are also cut from the same material and fixed in position in the same way. They are cut so that the grain runs diagonally across in order one, but with this method of construction they must not be removed altogether. A couple of coats of varnish applied warm to the woodwork will complete the hull. Such a hull will not exceed 1½ lbs. in weight, and will be amply strong enough for smooth water running, if carefully made. We thus have an allowance of 5½ lbs. for weight of machinery in order to sink the vessel to the designed waterline, and here I will leave the model engineer to rack his brains to get the utmost thrust out of a combination of power producing and using plant, that will come within this weight. It is not imperative to keep to this weight, and an extra pound or more would not annul the hydroplane's power of lifting, but unless the thrust was proportionately greater it would retard the speed. Neither is it to be expected that every model engineer will be able to produce a thrust power of 3 lbs. from the weight given, but this need not deter even the beginner from having a shot at such an interesting possibility. There is no other phase of model engineering that promises such a commensurate return for applied ingenuity and inventiveness, for the merest fraction of weight saved will show its effect in an increase of speed.

And now a word as to failures. I have seen many such, and the reasons for them can be easily traced. First, then, do not be tempted to disintegrate your model steamer and dump the plant (weighing anything up to a hundred weight) into a hastily made "herring box" (as I have heard them called) and expect to make a record. Find out your thrust power first. (It is easily done by holding the stern of the boat with a spring balance with power full on.) If the weight of the machinery is very much more disproportionate than the figures here given, give up the idea of breaking up your model steamer, and make a new plant for your hydroplane. Digest what has been written about the downward thrust. You will be disgusted to find that (if the screw is fitted and raked, as in an orthodox hull) the hydro will meekly hide its head beneath the waves.

Perhaps the writer may be allowed to close this article with a little criticism of that famous creation of M. Santos Dumont's, and here his trepidation returns. It seems a big task for a humble scribbler to dismember the work of such a famous and daring engineer, but there is a reason for all failures, partial or complete, so let us analyse. It will be remembered that M. Santos Dumont gallantly attempted to materialise his belief that a speed of 60 miles an hour could be obtained with his design of machine. The first thing to examine and dismiss is the motive power. There is no room for doubt that the Antoinette petrol motor fitted to this hydroplane is the lightest power-producing machine at present known to man.

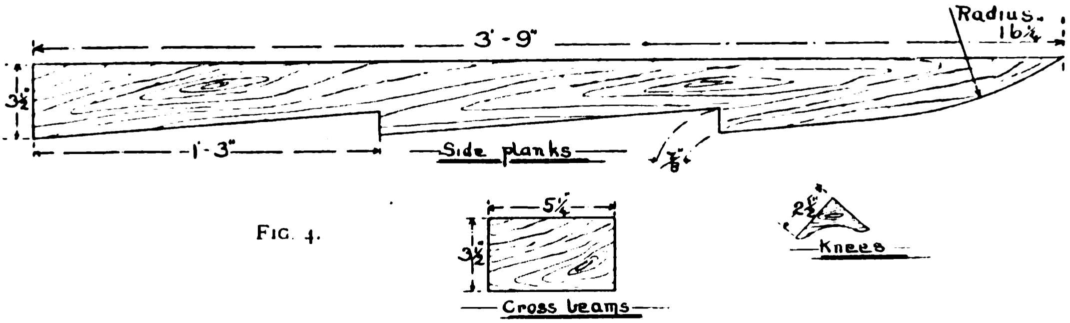


FIG. 4.

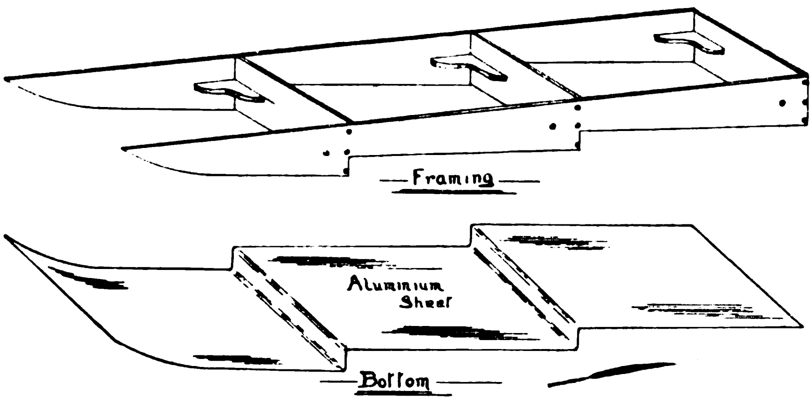


FIG. 5.—CONSTRUCTIONAL DETAILS FOR MODEL HYDROPLANE.

So M. Santos Dumont could not have done better there.

The method of applying the power, although novel, can be also dismissed as efficient, since the great experience of the designer with aerial screws would lead him to select the best type. It is possible that the position of the screw might have been improved, as besides being so high up as to render the machine unstable, it has the added disadvantage of "kicking against itself," so to speak, by driving a powerful current of air upon parts of the machine, which can only tend to retard the forward motion of the whole.

The body of the machine does not call for any comment, except that those three innocent torpedo-shaped floats have caused more scientific chaos among newspaper reporters than any other device of which the writer has ever heard. So we are left with only the planes to examine. There are two of these in Dumont's machine, the forward one being an extremely short, but wide, lath-like arrangement, with a section similar to a flat ground razor. The after plane is also very short, but not nearly so wide; and here the writer would respectfully point out that the gifted designer missed one little point. The greatest successes with hydroplanes have been made with machines having a relatively large plane area. The reason of this is that the hydroplane proper is aereoplanic as well. When it rises from the water at speed it also over-rides the air at the surface of the water, which is thus forced down and forms a cushion between hull and water. This accounts for the milky foam that is so noticeable a feature in the wake of boats of the " Ricochet Nautilus " type, and possibly the absence of this effect accounts for the disappointing results of M. Santos Dumont's machine.

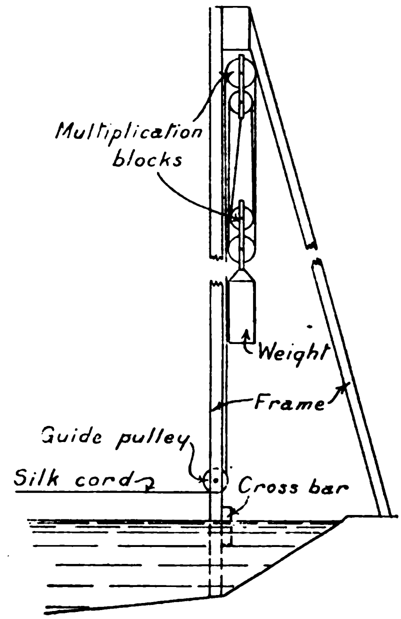
Some Useful Dodges for Amateurs.

By V. W. Delves-Broughton.

(*Continued from page 568.*)

Hull Design.

IN designing the hulls of large ships of a new type, numerous models are made in paraffin wax, and tried competitively one against another in large tanks; complicated dynamometers and traction devices being used to measure the relative power required to produce different speeds. Why should not the same method be used in designing our models? Surely it would be a simple matter to make one or two wax models, say quarter full size, and test their relative efficiencies before spending a lot of time and trouble over making the hulls for high-speed boats which, when constructed, often prove to be very far from right.



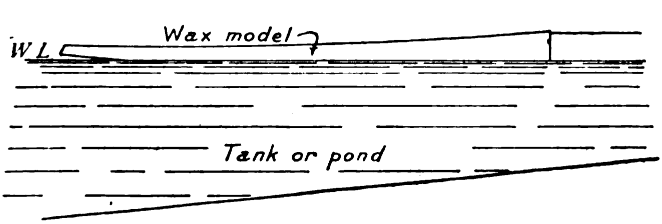


Fig. 1.—Diagram of Arrangement of Testing Tank for Model Boats.

The various conditions governing speed, size and power, are very complicated, but the following simple formulæ will give an approximation sufficiently accurate to be of great assistance in the final design :—

v = speed, p = power, d = displacement, l = length of model.

V = speed, P = power, D = displacement, L = length of ship.

Now the relations between p and P will vary as $l3$: L3 ; between d and D as $l3$: L3, and between v and V as l : L.

Or, supposing the small model to be a quarter the size of the large one, the power required would be about 1-43rd or 1-64th of that required for the large one. The displacement would also be in the same ratio, *i.e.*, 1-64th, and the speed about $\frac{1}{4}$ of the large one.

The above formulæ can be applied in the following manner, the requirements being a pond or tank some 20 ft. or more in length, well protected from wind (covered if possible), or an absolutely still day, and secondly, an apparatus shown in Fig. 1. To make my meaning clear, I shall describe how the formulæ could be definitely applied to a hypothetical case. Supposing it be proposed to construct a boat 54 ins. on the water-line, and to put an engine into it giving 20,000 ft.-lbs. per min. b.-p. The weight of this engine and boiler with all accessories being 14 lbs., and weight of the hull complete 5 lbs., the total displacement must be 19 lbs.

The first thing, of course, is to get out drawings that will fulfil the above conditions as to length and displacement. From this make a wax model half full size, 27 ins. long, and test it for displacement, which should be 2 lbs. 6 ozs. when drawing the designed depth of water. Naturally not more than this weight of wax can be used, but if we buy 3 lbs of paraffin wax candles, we shall have ample to allow for a certain amount of waste (price 4d. per lb.). Take a plank about 1 in. wider than the small model and 30 ins. long, to allow for counter overhang, etc., and, after carefully planing up, cover with a sheet of good drawing paper glued along the underside of the plank. On this paper set out the deck plan with cross lines at each point where a cross-section is shown in the drawings. Place a lump of well-worked clay in the middle of the deck plan to form a fairly large cavity in which shot can be placed to trim the vessel when being tried. This clay can easily be washed out under a tap when the wax model is finished. The wax should now be melted and poured over the plank and clay roughly conforming to the general lines of the boat. Finally the wax is modelled and scraped to the correct section, using templates to make the two sides alike and to transfer the drawing to the model. Of course, great care should be taken to make the model as smooth as possible, the final smoothing process being to rub down the wax with a fine cloth moistened with benzine.

As already stated, our large model is to be fitted with engines giving 20,000 ft.-lbs. per minute. Now, in trying our model we shall have no losses due to propeller slip or stern tube and thrust block friction, so we must make an allowance for these losses, say 25 per cent.*, so that the actual power helping to move our large model forward will be 15,000 ft.-lbs. per minute, so our small model should require $\frac{15,000}{8}$ ft.-lbs. or 1,877 ft.-lbs. per minute. We should therefore have to adjust the weights (see Fig. 1) till the travel of the boat in feet per minute, multiplied by the tension on the silk cord, resulted in the figure 1,877. Thus, supposing the wax model is found to give 4·4 ft., per second with a pull of 7·1 lbs. on the cord the power absorbed would be 4·4 × 7·1 × 60 = 1874·4 ft.-lbs. per minute, or about as near as we can get. The speed of the large model would therefore be 8·8 ft. per second, or about 6 miles per hour.

It will probably be found, however that the wax model will either throw up too much water at her bows or drag too much astern or commit some other fault to which craft are prone. If two or more types are to be tried it is advisable to test them on the same day, as the conditions obtaining are thus less liable to variation.

A satisfactory wax model having been found, the next process is to carefully cut it in sections round which a pencil can be drawn, giving a scale drawing, half size, without further trouble. Perhaps the most satisfactory manner of doing this is to cut away alternate sections entirely, using a sharp chisel for the process, care being taken not to remove too much at a time. In hot weather it may be advisable to place the model for some time in iced water to prevent its losing its shape whilst being cut.

(To be continued.)

New Locomotives for the Swedish State Railways.—The Board of the Swedish State Railways has refused all the tenders for locomotives recently sent in, the prices being considered too high. At the same time the Board has offered to contract for twenty new locomotives with the following firms:—The Motala Engineering Company and the firm of Nydquist and Holm, each five locomotives, Type A (the "Atlantic" type), at £4,080 each; the Wagon Manufactory, Falun, six locomotives, Type E, and the New Atlas Co., Stockholm, four locomotives, of the same type, at £3,660 each.

* Note this figure must not be blindly accepted, and is probably too low, according to some authorities amounting to 50 or 60 per cent.!

A Surface Indicator and Its Use.

By W. Muncaster.

ONE of the chief features of practical engineering is to work accurately. It is very easy to make an error which would not easily be detected by the eye and which would probably cause a great deal of inconvenience if left unaltered, especially in jig work or on machine parts which are required to be interchangeable. Work, whether turned, shaped, or milled, is not always accurate, often owing to a defect in the machine or carelessness in setting up for machining. It is therefore advisable to have sensitive instruments by which work can be tested. An instrument for this purpose is the surface indicator, which can be used for testing parallel surfaces from a surface-plate and also for setting turned surfaces in a lathe.

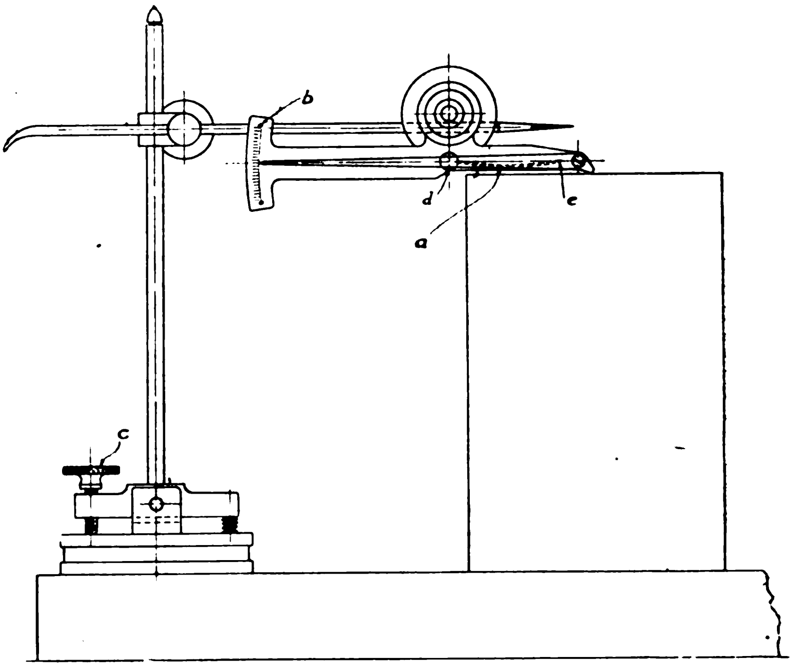
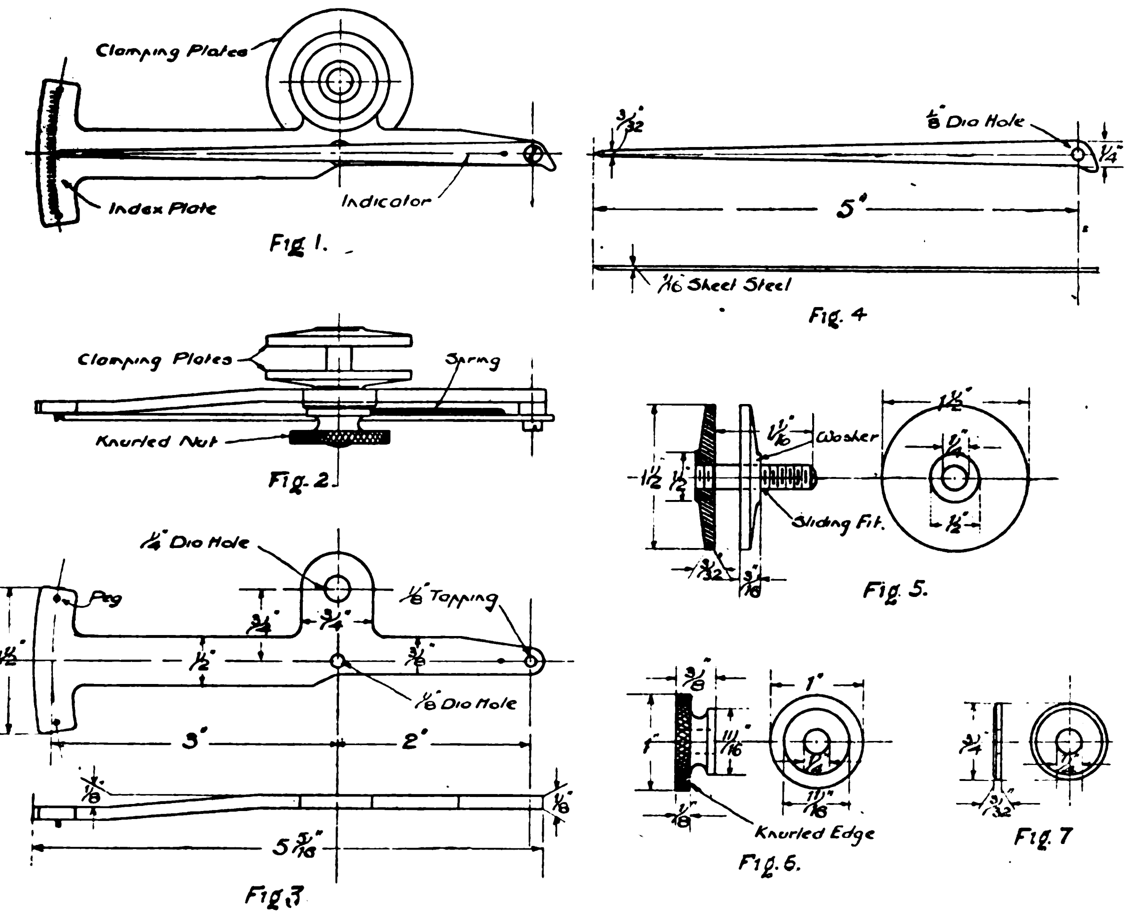


Fig. 8.—Method of Using the Surface Indicator.

A good form of indicator is shown in Figs. 1 and 2, which can be made from any sheet steel that may be handy. The only turning to be done is on the clamping-plates; the rest can be cut out with an ordinary flat chisel.

A piece of sheet steel $\frac{1}{8}$ in. thick, $5\frac{1}{2}$ ins. long by 2 ins., will make the index-plate. The plate should be marked off to dimensions given in Fig. 3. The corners at the base of the lug for clamping-plates and the T-end should be drilled, say $\frac{1}{8}$ in., and the remainder cut out roughly to shape with a flat chisel, leaving about 1-16th in. all round for filling. The plate can now be bent to throw the T-end $\frac{1}{8}$ in. forward, so that it will come close up to the pointer (Fig. 4). After polishing nicely, the T-end can be marked in this way—first warm the plate and rub a coating of bee's-wax on the portion to be marked, and, when cold, set a pair of dividers to make 5-in. radius and scribe a segment on the T, afterwards dividing the segment into intervals of 1-25th in. As the ratio between the two ends of the pointer from the pivot is 1 to 20, each interval on the segment will represent ·002 in. at the other end of pointer. The marks can now be burnt on by covering with nitric acid for about twenty minutes, on which a little salt should be sprinkled to assist corrosion.

The pointer or indicator is shown in Fig. 4. This would be made from 1-16th-in. sheet steel, from 20 gauge steel wire and fixed between the indicator and the index-plate; the one end of spring is placed in a notch on a small peg *d*, which is made a tight fit into the index-plate; the other end of the spring is bent through a small hole in the indicator at *e*. Now the spring *a* will keep the pointer up to the top of the T against peg *b*. By placing the block scriber in a position so that the end of indicator rests on the job to be tested, the indicator can be set with the adjustable screw *c* till the point comes to the centre. The block can then be moved over any part of the sur-



DETAILS OF SURFACE INDICATOR.

and a ⅛-in. diameter hole drilled 5 ins. from the indicating end; the other end will be ⅛ in. from centre of hole at an angle of 45 degs. Figs. 5, 6, and 7 show the clamping-plates nut for tightening, and washer, which would be made in a lathe. A winged nut may be used, if a knurling tool be not possessed, but a knurled nut would add more finish.

The method of using the indicator is shown in Fig. 8. Here it is attached to an ordinary scribing block. The scribing block has its base resting on a surface-plate, on which also the job to be tested is resting. The spring *a*, which is made face to be tested, and should it be higher or lower in any part it will be shown by the indicator, the amount reading either way from the centre.

The indicator can also be used in a lathe, as will be seen in Fig. 9. Here the indicator is fixed to a contrivance similar to a scribing block, which is held firmly in the tool-rest R in the same manner as an ordinary turning tool, and can be adjusted by the screw S after the indicator has been set on the top centre of job. It will be easy to locate the centre, by running the slide-rest in and out, whichever way is necessary. The job can now be set running and the indicator either kept stationary or traversed with the slide-rest, so as to test every part of the job, providing it is all

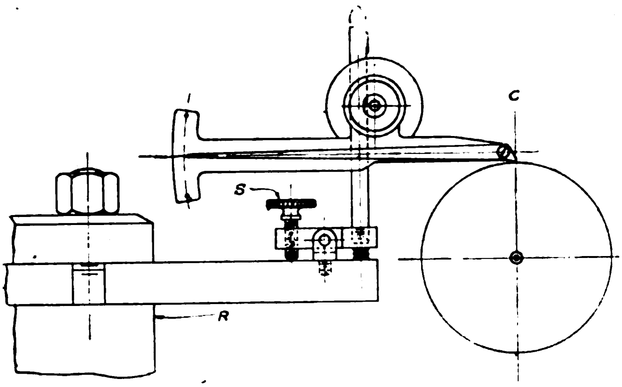


FIG. 9.

the same diameter. There are many other ways of using this indicator other than those shown here, and it would be well worth the trouble of making to those engaged on accurate work.

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

THE Annual Social Excursion in the form of a launch trip on the River Thames will take place on Saturday, June 27th. The steam launch, *Empress of India*, has been chartered, and will pick up the party at Caversham Lock, Reading, at about 2.20 and proceed down steam to Windsor, a distance of thirty miles, arriving there at 9.30. The loveliest portion of the river will thus be traversed, and an exceptionally enjoyable outing is promised. Members are reminded that all tickets must be accounted for not later than Monday, June 22nd, and as the party will be limited to the comfortable carrying capacity of the launch, those who have not yet done so should give early notification to the Secretary to prevent disappointment.—HERBERT G. RIDDLE, 37, Minard Road, Hither Green, S.E.

An American Motor-boat Club.

WE hear that arrangements are being made for the formation of a model motor-boat club in America, to be called the American Model Motor-boat Club. Model motor-boating has not, up to the present, seemed to appeal very strongly to those who would like to enter this branch of the sport, owing to the fact that while models con be operated by steam or electricity, suitable internal combustion motors have been difficult to procure. Model motor-boats have been popular in Paris for some time now, and a carnival is held each year on the lake of the Bois de Boulogne. A committee was appointed on May 22nd last to draw up a constitution and to arrange for the formal organisation of the club. It is said that the club will possibly hold one or more events this season, and also perhaps, a mid-winter event indoors, possibly at the Motor-boat Show. Those of our readers who are interested in model motor-boating in the States may apply for particulars of membership, etc., to H. E. BOUCHER, 91, Maiden Lane, New York City; HUGH S. GAMBEL, 314, Madison Avenue, New York; or CHARLES H. LARY, 177, Park Place, Brooklyn, N.Y.

Practical Letters from Our Readers,

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily for publication.]*

Ball Bearings.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—In the article dealing with ball bearings, which has recently appeared in your pages, I gathered that a thick oil, if anything, was slightly better for cycle bearings. Would I be right in using motor cylinder oil for *all my cycle bearings*? Would I be right in using the same oil in a Sturmey-Archer three-speed gear hub?—I am, yours truly, J. G. MONTEATH.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—In reply to "Tangent" the disc-adjusting bearings do not retain the oil quite so well as the cone-adjusting type; otherwise, there is very little to choose between the two types. The ball cone gives a truly circular ball-path, even when the spindle is bent, due to an accident or to a defective mudgard-stay end. In practice it appears to be satisfactory.—Yours truly, "ZODIAC."

Small Boosters.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—In your answer to Query 18,349, concerning a small booster, you advise exciting the generator with the current generated in the armature of that machine.

Would it not be more in accordance with modern practice to use the current from the mains to excite the dynamo field? This also would simplify matters somewhat, as both the motor and dynamo fields could be wound with the same wire.

The voltage of the dynamo with the field excited from the mains, using No. 32 wire, would probably be found rather high, but this is a fault on the right side, and can easily be corrected by a small variable resistance consisting of No. 34 bare German silver wire in series with the generator field.—Yours faithfully, V. W. DELVES-BROUGHTON.

Painting Water Lines on Model Craft.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I don't know if this tip is of any use to your readers or worth publication, but here it is.

For striking an exact colour line on model yachts which are one colour above and one below water line: first bring the model to a surface in white or light colour, then float her in a tank or bath, the water of which is stained with red ink or aniline dye. Having left her to get the water line stained on, remove carefully and allow to dry. Next get a supply of ordinary stamp edging and stick it all round the model fair with the water line thus found; then you can paint away with no fear of running over the edge. This method may be used for painting above or below a given line. Of course, the paper is washed off with warm water when done with.—Yours truly, E. M. MURPHY.

Model Screw Propellers.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I was deeply interested in Mr. Garscadden's contribution on above, and readers of THE MODEL ENGINEER have much to thank him for in the clear instructions he gives for the construction of what is, no doubt, a very efficient propeller. I think, however, with Mr. H. Arkell, that his design must have a radial or divergent action on the water, since there is nothing in the design to counteract centrifugal force.

I cannot, moreover, agree with his statement that a propeller can gain on its pitch or carry a boat further than its pitch by the revolutions. This would be contrary to all mathematical laws; rather, I think, the method of estimating the pitch must be wrong.

I, however, long ago adopted a more radical line of study of the propeller, as I hold that, if the helix be the true fundamental principle on which the ideal propeller depends, it cannot be improved by any fake; and if such fake really does improve it, some other geometrical figure and not the screw governs it. After a study on these lines for over thirty years with some practical experiments I think I can see where it may be found, and would be glad if Mr. Arkell would extend to me the offer of testing such, which he makes to Mr. Garscadden.

I may say that my discovery is an obscure development of the cone, and contains in itself those curves —variable with the pitch—which have been found by experiment to be most effective. Further, it would introduce a fixed principle for its design, not depending on individual opinion.—Yours faithfully,

JOHN MURPHY.

NEW USE FOR ELECTRIC HEATERS.—Electric heaters were recently put to a novel use for a shrink fit of a crank-pin into a crank disc on a 500 h.-p. cross-compound Russell engine. In replacing the old pin, a new pin, 6 ins. in diameter, with a taper of ⅛ in., was to be fitted into the crank disc 5 ins. thick. Owing to the undesirability of expanding the disc with blow torches, a number of heating units from General Electric 6 lbs. electric flat irons were grouped around an iron core and inserted into the 6-in. crank-pin hole, and sufficient current passed through the units to maintain them at white heat. After the heaters had been operated at this temperature for four hours, the disc had expanded sufficiently to allow the crank-pin to slip in place.—*Mechanical World.*

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor, THE MODEL ENGINEER, 26–29, Poppin's Court, Fleet Street, London, E.C.]

The following are selected from the Queries which have been replied to recently:—

[19,461] **Expansion Link.** F. C. H. (Weston) writes: I should be extremely obliged to you if you could explain to me the cause of the trouble which I have experienced with reversing gear shown on accompanying sketch, Fig. 1. When the die-block is in position marked A, and the engine is running, there is a movement of about 1-32nd in. on the weigh-shaft lever, and when in position B there is a movement of ⅛ in. If the weigh-shaft is held

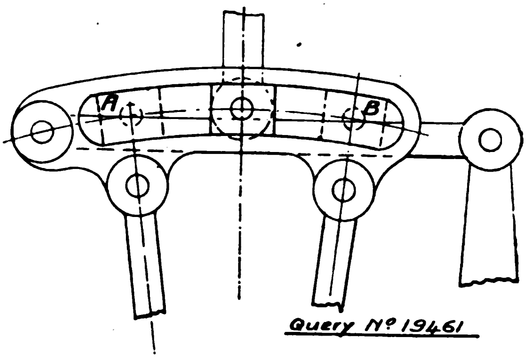


FIG. 1.

rigid the die-block moves and springs the valve-rod to which it is attached. I think the radius is correct and everything is a good fit, so that I cannot account for the movement in any way. I have also tried setting the eccentrics a little out of their correct position,

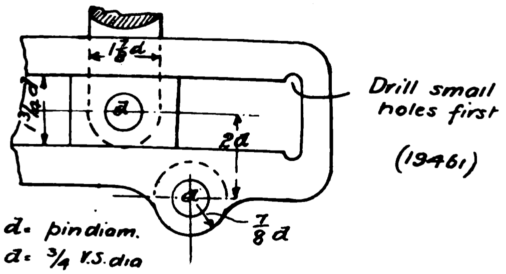


FIG. 2.—PROPORTIONS OF LINK.

but it does not seem to improve it at all. I have looked up reversing gears in Greenly's book on locomotives, and find it explains several troubles which may occur, but does not mention this particular one.

In reply to your query we may say that the trouble is due to insufficient clearance between the die and the end of the slot in the curved link. The slip of the block in this type of link is excessive, especially where the distance between the centre of the link and the eccentric-rod pin is considerable. You have also not followed the drawings showing this type of link given in the book mentioned. The ends of the slot should be shaped as shown in sketch, Fig. 2, herewith. This sketch gives the proportion of the link based on the diameter of the eccentric-rod and die-block pins. The diameter of the pins should not be less than three-quarters of the diameter of the valve spindle. The slip of the block cannot be calculated. The best thing is a cardboard or paper model. We recommend in your case to lessen the lap a shade, altering, of course

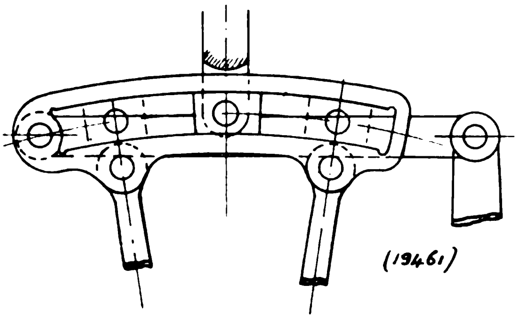
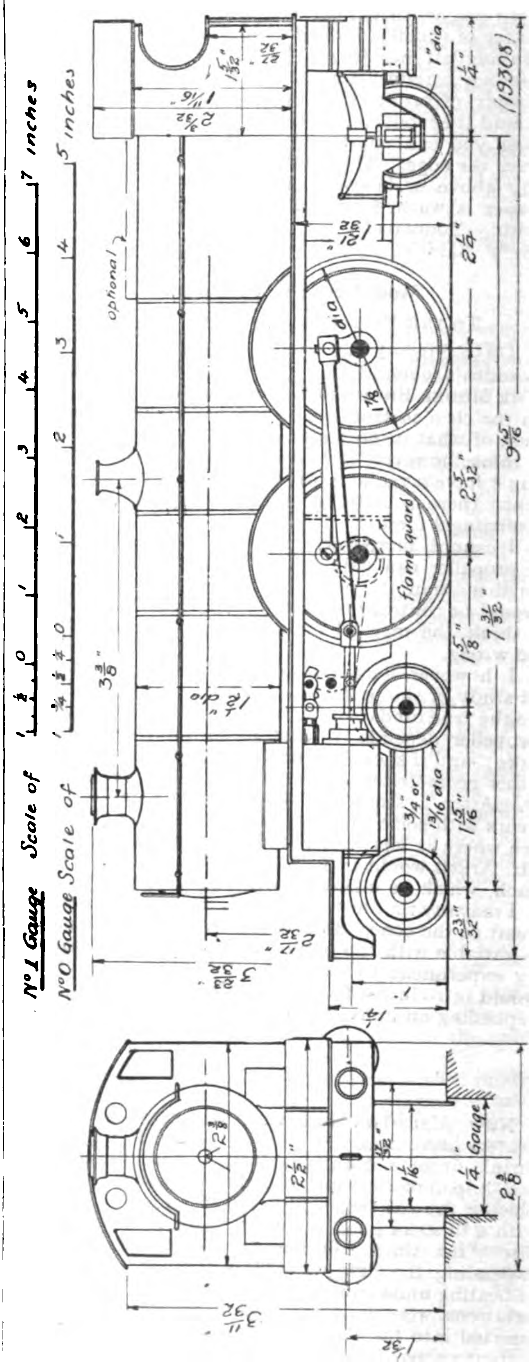


FIG. 3.—HOW WE WOULD HAVE MADE LINK.

the angle of advance of the eccentrics (otherwise do not touch the valve lap); to make the ends of the curved slot as square as possible, and to allow more clearance by reducing the length of the die-block. The movement of the reversing lever should be limited to the amount in which the die-block has ample clearance and does not spring the valve spindle weigh-shaft levers. This can be fixed by trial, holding the reversing lever in the hand, with the catch out of the sector plate, and turning the motion over in both back and fore gears. You will note in Greenly's book that the "specimen" links show ample end clearance. Fig. 3 indicates how we would have made the link; the diameter of the pins is the same as in yours, viz., ¼ in.

[19,308] **1½-in. Gauge Model Locomotive.** F. H. (Burnley) writes: I have a small 1½-in. gauge railway, and propose making an express locomotive for the same. Could you give me a sketch of an engine suitable for this gauge, with say two outside single-action oscillating cylinders, ½ in. bore by ¾ in. stroke, or one inside slide-valve cylinder? I have a piece of solid-drawn brass tubing, 1⅜ ins. diameter. Is this too large for boiler? Would you inform me what would be the smallest radius of curve the engine could safely take? Also I prefer internal firing, if this is at all possible in so small a model.

In attempting an express locomotive you are setting a difficult problem for both designer and builder. It would be comparatively easy to make a locomotive which has no pretentions to be a model of any particular type of express engine. And where tin rails are used and the curves are at all sharp (under 3 ft. radius) we recommend a model four- or six-wheeled tank locomotive or a nondescript type of tender engine with the smallest possible wheelbase. As the subject may be of interest to other readers, we submit a design for a model "Atlantic" express locomotive, which in the main follows the lines of the "Atlantic" engines on the G.W.R. (rebuilt "Albion" type). The boiler should be made of a piece of light tube (seamless), 1½-in. diameter, with brazed ends and two 3-16ths-in. water tubes, extending to within ½ or ¾ in. of the back of the smokebox. A frame-stretcher (marked "flame guard" on the drawings) should be used to protect the eccentrics which are on the coupled axle from the flame of the spirit lamp (four ⅜-in. diameter wicks). The Belpaire firebox is an optional addition, and may be built up of plates to fit over the firebox portion of the barrel. The cylinders may be the well-known "Perfecta" cylinders, as used on the "Black Prince" and "Pilot" type of ready-made model, and which can be obtained separately. These look much better than oscillating cylinders on a model express engine. The cylinders are provided with a self-contained reversing device, which should be arranged on top and to poke through the footplate. Two rods may then be coupled to the reverse disc and run along the top of the footplate. The radius of the curves should be not less than 8 or 7 ft., and the permanent way of drawn brass. The workmanship of the model will need to be of the very best. The trailing wheel may have at least ⅛ in. side play. The model would work more satisfactorily if made slightly larger to suit No. 1 or 1¾ in. gauge, and we include a scale of inches which will enable any reader to make the larger engine. If you desire excessively small radius curves, you must abandon all ideas of making a model of a modern express



MODEL 1½-IN. GAUGE EXPRESS LOCOMOTIVE (G.W.R. "ATLANTIC" TYPE).

engine. The two things are incompatible. Internal firing is out of the question. The bogie and trailing wheels may be made without spokes if you have any difficulty in getting satisfactory castings.

[18,889] **Model Yachtsmen.** A. C. G. (Glasgow) writes: Can you oblige me with particulars as to where I could purchase a good safe blowlamp for a model steamer 5 ft. long? Say about what price. Why do you have so little about model yachting and model steamers in your paper? Why do you not make up and print a list of all the model yacht clubs in the kingdom, with particulars about the clubs, sailing places, colours, and sizes? Why not add the canoeing recreation to your paper, with club list?

You could obtain a suitable burner from many of the firms advertising in this Journal. With regard to your suggestions concerning model yachting and steamers, etc., we may say that we are always pleased to make use of any information concerning club doings, etc., which our readers care to send us. It is well known that our pages are always open to our yachting friends, and, as we say, we should be very glad to publish any particulars which come to hand. If you are interested in the subject, perhaps you would bear these facts in mind and send along any interesting information you may have.

[19,873] **Model Steam Engine Details.** R. K. (Paisley) writes: I am making a marine engine with single-acting cylinders, $\frac{5}{8}$-in. by $\frac{1}{2}$-in. stroke. I should be greatly obliged if you could inform me as to the dimensions of steam ports and slide-valves (engine to run at a high speed)? Also what length of boiler (3 ins. diameter) with a single flue $1\frac{1}{4}$ ins. diameter, shall I require to drive four cylinders of the size given above (working pressure 15–25 lbs.)?

The steam ports should not be less than 5-16ths in. by 1-16th in. for steam and 5-16ths in. by $\frac{1}{8}$ in. exhaust. The slide-valves should be provided with about 1-20th-in. lap. The boiler should not be less than $7\frac{1}{2}$ ins. long. We would prefer a $1\frac{3}{4}$-in. diameter furnace and $3\frac{1}{2}$-in. diameter shell. The pressure is low and the cylinder capacity greater than normal, and therefore you require as large an amount of steam space and area of water as possible.

[19,799] **Gas Engine Water Jacket Joint.** J. T. (St. Ives) writes: As a regular reader of THE MODEL ENGINEER I should be glad if you could give me a method or tell me how to manage to stop water from coming between the water jacket and liner of cylinder. I have tried red lead and putty, but as soon as engine gets hot, and before red lead gets hard, it melts away. I have also tried iron cement, but it does not seem to stick on the protruding portion of cylinder. I have been running engine (1 h.-p.) now for six months without water, but it gets very hot. I use plenty of oil. I have tried caulking with chisel, but without success.

We are not clear whether the leakage is at the back or front end of your water jacket, or, rather, whether the liner is fixed with a rubber ring or not at the front end. If you refer to the coloured plate for January, 1906, issue, you will find a sectional drawing of a gas engine, showing clearly the method of making a water-tight joint at the mouth of a liner by means of a rubber ring inserted between cylinder and liner, in a groove. If the joint can be made between two metal surfaces, face to face, you cannot do better than use a coppered asbestos ring.

[19,798] **Repairing Celluloid Accumulator Cases.** A. F. (Portsea) writes: I should be very pleased if you could give me a little information. I have two 4-volt accumulators in celluloid cases, and in both the centre partition has broken away, and I should like to know what to stick them with. I may say that I have asked over twenty electrical fitters, with no success. The only promising answer was—write to the Editor of THE MODEL ENGINEER.

Amyl acetate can often be used to joint celluloid. It can be had from any good chemist or from any of our electrical advertisers. In your case we should recommend you to obtain some very thin pieces of celluloid and coat their surface with amyl acetate and patch the portion of the division-piece which has become cracked very carefully. We have no sketch of the breakage, so cannot advise you more definitely as to the probable results of the repair. We may say, however, that unless it is absolutely a tight joint, your cell will only give two volts instead of four, as it will in reality become a one-cell accumulator instead of, as hitherto, a two-cell one.

[19,777] **Speeds of Shafting, Pulleys, etc.** J. F. R. (Harrogate) writes: I should be greatly obliged to you if you would tell me how to calculate and arrive at different speeds for shafting, countershafts, etc.

Explanations of the methods of calculating various speeds of pulleys, countershafts, etc., were given in our issues for August 2nd and 9th, November 29th (1906), and May 30th (1907).

[19,455] **Model Turbine for 3-ft. Boat.** E. F. F. (Crouch End) writes: Would you kindly inform me which of the designs for a De Laval turbine given in your Handbook on "Model Steam Turbines" would be most suitable for a model steamer 3 ft. long, $3\frac{1}{2}$ ins. beam, and 4 ins. deep, and boiler for same?

The boiler shown in Fig. 8, page 17 of our Handbook would be suitable for the size of hull you give. This would not, however, give enough steam for a small turbine to be effective, we are afraid. If you wish to try the experiment, make the steam nozzle 0·02 in., and the diameter of the turbine wheel 3 ins. Use a coarse pitch small diameter propeller of sheet brass and a reduction gear of 40 : 1. The gear wheels should run in an oil bath, and must be of light construction. Old clock wheels might be tried.

[19,325] **Model Turbines.** W. P. (Liverpool) writes: Would you kindly answer the following questions? I am constructing a model turbine (De Laval type), diameter of wheel without blades 3 ins., with blades 4 ins., or slightly larger. (1) Is $\frac{1}{8}$ in. enough to sink blades in wheel? (2) Is $\frac{1}{4}$ in. enough of length of blade to allow for steam to act on? (3) Would you advise shrouding? I have your Handbook on "Model Turbines," but as I am not making mine according to any particular design I have no exact measurements to work by. I have forty-eight blades on wheel. (4) What diameter and length ought shaft to be, including part outside casing for pulley wheel? (5) If well made, about what horse-power ought it to develop? (6) What size boiler would comfortably drive it? (7) Would a thrust for end of shaft, as enclosed sketch, be practicable? (8) Could you also give me a suitable and simple design for a wipe-contact ignition for my gas engine, which I wrote to you about some time ago? I want it to work off the present 2 : 1 gear and as simple as I can have it, as my stock of tools is limited and I do not possess a lathe.

(1) Yes. (2) Yes. (3) Yes. You have all the particulars you ask for in our Handbook, which you say you possess. (5) Impossible to say, as you do not give size of steam nozzle. Why not design the turbine according to instructions given in the book? (7) Yes. (8) See March 29th, 1906, issue.

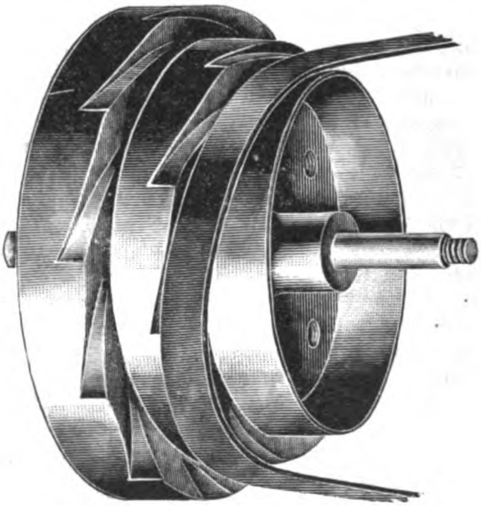
The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

* *Reviews distinguished by an asterisk have been based on actual Editorial Inspection of the goods noticed.*

* A New Variable Speed Gear.

Although the idea depicted in the accompanying illustration is put forward as a new variable speed gear, the novelty is not so much in varying the gear as the method of changing the belt from one speed to another on a coned belt pulley of the ordinary well-known type. It will be noted that the steps of the speed cone are provided with notches, which cause the belt to mount instantaneously to a higher or descend to a lower step of the pulley directly the fork of the striking gear is pushed over. The same



idea is also adapted to V-grooved cone pulleys, and we have seen a working model which demonstrates that the idea is quite a successful one in practice. The inventor is Mr. George Dennant, a member of the London Society of Model Engineers, and he is anxious to place the device on the market. He will be pleased to answer any enquiries on the subject, for which purpose letters should be addressed to him, care of Mr. E. Abbott, Bishop's House, Bishopsgate Street Without, London, E.C.

The Editor's Page.

BY kind permission of Mr. Arthur Drummond a visit of the Society of Model Engineers to the works of Messrs. Drummond Bros., Ltd., of Ryde's Hill, Guildford, is being arranged for Saturday, July 11th. It is proposed to leave Waterloo by the 2.28 p.m. train, and we are informed that permission to join the party is being extended to friends of the members of the Society and also to other readers of THE MODEL ENGINEER. Mr. H. W. Greenfield, of 87, Mortimer Street, Cavendish Square, W., is kindly undertaking the necessary arrangements, and as it is desirable to know beforehand the number of visitors who may be expected, he will be pleased to hear as early as possible from all readers of THE MODEL ENGINEER who would like to be included. Cheap railway tickets will probably be available, and full particulars of the arrangements will be sent to all those who reply at once to Mr. Greenfield in response to this intimation. A stamped addressed envelope should be enclosed.

* * *

The Annual Social Excursion of the Society of Model Engineers is due on Saturday, June 27th. and will take the form of a river trip on the steam launch, *The Empress of India*, from Caversham Lock down to Windsor. This journey includes some of the loveliest portions of the river, and, given fine weather, that most essential feature of all successful river functions, the outing promises to be one of the most enjoyable of the Society's annual gatherings.

* * *

Those of our London readers who have a military inclination in addition to scientific and mechanical tastes may be interested to know that recruits are required for the London Balloon Company of the new Territorial Forces. The obligations and conditions partake of the usual nature of Volunteer work, save that the duties will be in connection with the development of military ballooning and kite work, and the application of aeronautics to military requirements generally. We are informed that the Company will proceed to Aldershot this summer for training with the Army Ballooning School, but those who wish to join in this must make early application for enrolment. Particulars may be had from Mr. H. E. Holtorp, Drill Hall, Regency Street, Westminster, S.W., by post, or by personal application on Tuesday and Wednesday evenings from 6.30 to 8 p.m.

* * *

One of our readers, J. D. W. (Muswell Hill) sends the following advice *re* perpetual motion: "Before any man sets out to invent perpetual motion he is recommended to practice the trick of getting into a basket and lifting himself up by the handle. When he succeeds at that, he can go ahead with perpetual motion with some prospect of success."

* * *

We are glad to be able to report that considerable interest has been aroused by our proposal to hold a Model Motor Boat Regatta at Wembley Park, on July 25th. The two principal clubs in London—the Clapham Steam and Sailing Club and the Victoria Model Steamboat Club—have both taken up the matter with great enthusiasm and will be well represented in the various races. We have also had several letters from other readers promising to run their boats, including one from Mr. D. Scott, whose past successes in our Speed Boat Competitions are well known. The final arrangements for the afternoon are being completed, and will be announced in an early issue.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 26-29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

Sole Agents for United States, Canada, and Mexico: Spon and Chamberlain, 123, Liberty Street, New York, U.S.A., to whom all subscriptions from these countries should be addressed.

Contents.

[*The asterisk (*) denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XVIII. No. 374. JUNE 25, 1908. PUBLISHED WEEKLY

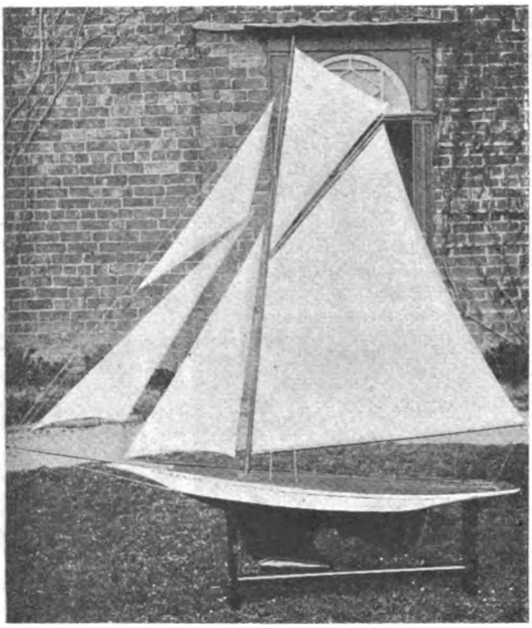
A 10-Rater Model Yacht.

By H. S. MORGAN.

THE following description of my model yacht *Molly*, which I successfully completed about 2½ years ago, will, I hope, be of interest to fellow readers.

The design is that of Mr. W. Paxton and will be found in No. 25 (January, 1900) of THE MODEL ENGINEER.

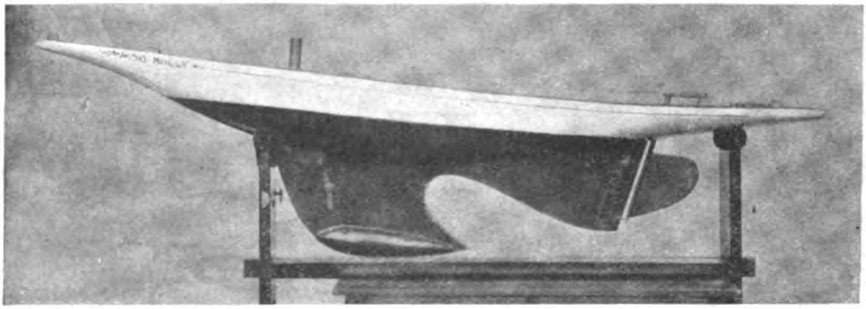
The hull is built on the "bread-and-butter" principle. I found this method of building extremely simple and straightforward. It is made up of four layers. The top layer above the water-line is 3½ ins. thick, and the three layers below the water-line are each 1 in. thick (Canary pine). The drawings were set off on these and were then shaped out with a bow saw as required. I then glued them together and clamped them and left her to set quite hard. The clamps were then released and I commenced cutting her into shape. This done, I wired her together, sinking the wires flush with the outside and twisting the ends over perforated zinc on the inside. These fastenings were placed about 3 ins. apart and high enough above and below the joint to prevent splitting.



MR. H. S. MORGAN'S MODEL YACHT.

The fin was next shaped and mortised into the body and strengthened by brass angle-plates. I then coated the inside well with paint and prepared the deck, which is made of a single piece of mahogany, lined to represent planks. I now made the lead keel and screwed it on and put her to float in the bath. I was pleased to find that she floated perfectly. I decided to paint her white and green, which looks very well. The deck fittings, which are as few as possible, are all of brass. The mast and spars are made from an old fishing-rod and answer very well, being strong and light. The sail plan I took from a design by Mr. Kitchingham in April 27th, 1905, issue.

I am very pleased with her, and she gives every indication of being a very fast boat, although as yet I have not tested her with advantage, owing to the lack of a good piece of water. I should be pleased to supply any readers



MR. MORGAN'S 10-RATER MODEL YACHT, "MOLLY."

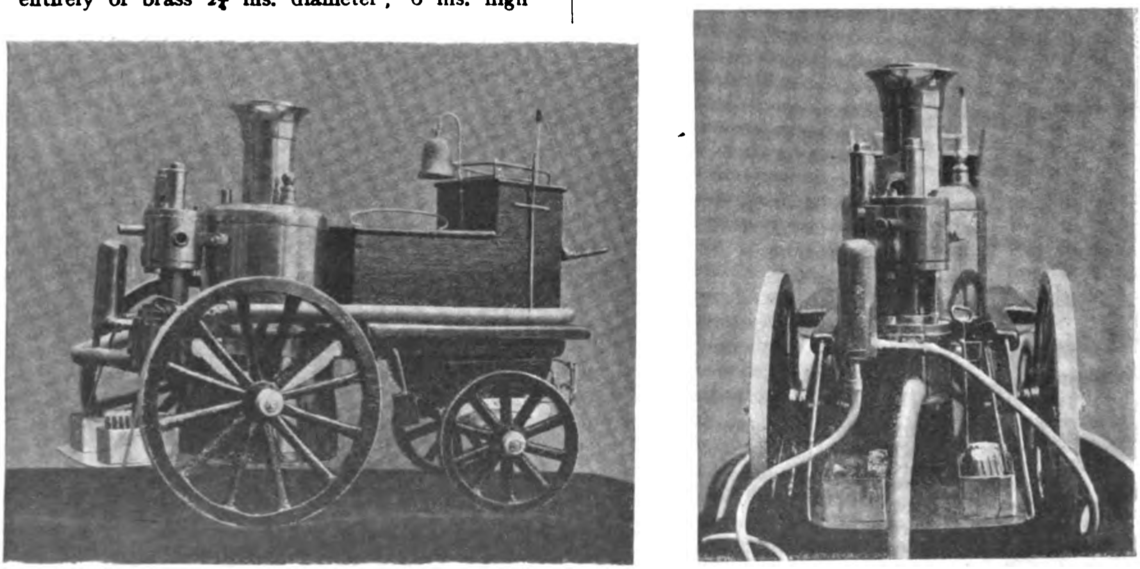
with further particulars at any time. The dimensions are as follows: L.O.A., 60 ins.; L.W.L., 36 ins.; beam, 11¾ ins.; draught, 5½ ins.; sail area, 1,664 sq. ins.

A Model Steam Fire Engine.

By G. HINSDON.

THE following is a short description of a steam fire engine which I have just finished. She has a single double-acting cylinder ½-in. bore by ⅝-in. stroke (which is fitted with piston valves), and works directly over the pump, which is ⅜-in. bore by ¼-in. stroke. The boiler is made entirely of brass 2¼ ins. diameter; 6 ins. high with water tubes and a central uptake. It is fired by a small spirit lamp, and easily maintains a full head of steam all the time, working pressure being about 10 lbs. per square inch.

At her trial she raised steam from "all cold" in 4 minutes, and the pump worked in 5 minutes, giving two deliveries, throwing jets to the height of 8 ft. and 4 ft. Her pumping capacity is about 1 pint in three minutes. The chief dimensions are: Length, 8½ ins.; breadth, 4¼ ins.; height, 7 ins. The wheels are oak—front, 2⅜ ins. diameter; back, 3⅞ ins. diameter. She carries 6 ft. of delivery hose in the body; two brakes act on the back wheels. There are also—coal bunkers, stoking iron, a copper suction strainer, and air-chamber, with pole and swaying-bars for horses. The hoses are india-rubber; suction, ¼ in. diameter, and delivery, ⅛ in. diameter.



TWO VIEWS OF MODEL STEAM FIRE ENGINE, BY G. HINSDON.

LEAD WOOL.—Shredded lead, or lead wool, may be used to joint lengths of pipes in place of the troublesome method of pouring molten lead inside the joint and caulking after it has cooled. Lead wool is made in strands, which are forced into the joint after the yarn has been put into pla e. Each layer should be firmly caulked as it is put in. Joints can be made under water or in the rain, and the pipes may lie in any position. Such work is impossible with the molten lead method.

Locomotive Notes.

By Chas. S. Lake, A.M.I.Mech.E.

New Compound Locomotives for the Western of France Railway.

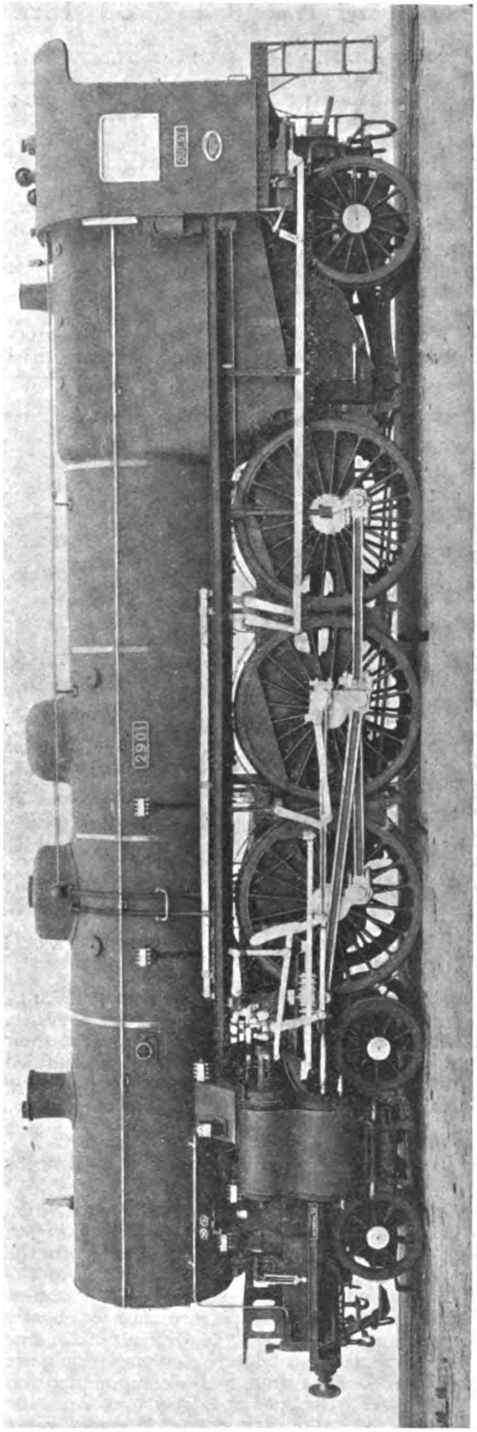
The Western of France Railway has just put into service two new types of four-cylinder compound locomotives, one of which is for express passenger traffic and the other for heavy suburban service. Both designs are illustrated herewith from photographs kindly supplied for the purpose by M. Sabouret, Chief Mechanical Engineer. The express engine, as will be seen, is of the 4—6—2 or "Pacific" type, and is of very large proportions. It has its H.-P. cylinders set between the frames ahead of the L.-P. ones, which are outside, the former driving the leading coupled wheels and the latter the intermediate wheels. The steam distribution valves are piston type throughout, and in each case the valve works above its cylinder, being actuated by Walschaerts' valve gear.

A very large boiler is fitted. The firebox is of the combined Belpaire and wide pattern, with sloping throat and back plates, and an unusually extended smokebox is provided. The rearmost pair of wheels, underneath the cab, are arranged as a Bissel truck, and the springs are equalised with those of the trailing coupled wheels, while a similar arrangement is adopted between the H.-P. and L.-P. driving wheel springs. The engine is equipped with air-sanding gear, the Westinghouse quick-acting brake, and Flamans' speed indicator and recorder. It has leading dimensions as follows:

Cylinders—diameter: H.-P., 16 ins.; L.-P., 26⅜ ins.; piston stroke, 25⅝ ins.
Wheels—diameter: Bogie, 3 ft. 2½ ins.; coupled wheels, 6 ft. 6 ins.; trailing wheels, 4 ft. 7½ ins.
Coupled wheelbase, 13 ft. 5½ ins.; total engine wheelbase, 35 ft. 3 ins.
Boiler tubes: No., 285; length, 19 ft. 8½ ins.
Heating surface: Tubes, 2,894 sq. ft.; firebox, 150 sq. ft.: total, 2,944 sq. ft.
Grate area, 43·04 sq. ft.
Weight on coupled wheels, 53 tons.
Weight of engine (in working order), 93 tons.

The tank engine, next illustrated, has its four cylinders arranged in line below the smokebox, and, in this case, the H.-P. cylinders are placed outside and the L.-P. between the frames, all four cylinders driving the middle pair of coupled wheels. Piston valves distribute steam to the H.-P. cylinders and balanced slide-valves are employed for the L.-P. ones, Walschaerts' gear being used throughout. The locomotive is supported at both ends by two-wheeled bogies, and the system of springing is such that the springs of each truck are equalised with those of the coupled wheels next to them. The boiler is fitted with the Belpaire type of firebox, and an extended smokebox, with ash ejector, is used. Air-operated sanding gear delivers sand on both sides of the driving wheels and also at each end of the coupled wheelbase. All the driver's handles, viz., the regulator handle, reversing screws, air-brake, air-sanding, and whistle handles are duplicated on the left-hand side of the engine.

The tank engines, a list of whose dimensions is given below, were built by the Société Alsacienne

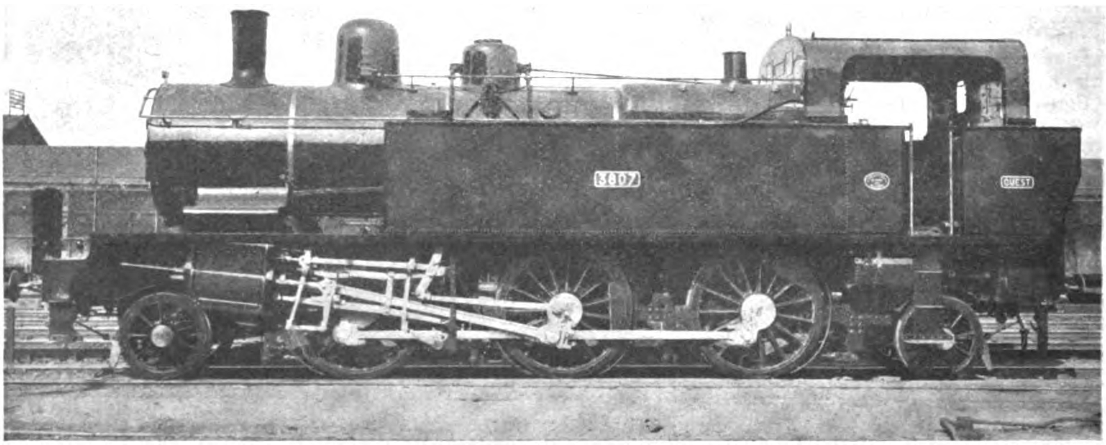


The New Four-cylinder Compound "Pacific" Type Locomotive: Western Railway of France.

de Constructions Mécaniques at Belfort, and the "Pacific" engines at the Sotteville Works of the Western Railway. Principal dimensions of the tank engines :—

Cylinders—H.-P., 13½ ins.; L.-P., 22 ins.; piston stroke, 24 ins.
Wheels—diameter: Truck, 3 ft. 2¼ ins.; coupled, 5 ft. 1½ ins.
Total wheelbase, 29 ft. 4 ins.
Boiler—mean diameter (outside), 4 ft. 10 ins.
Number of tubes, 117.
Heating surface: Tubes, 1,791 sq. ft.; firebox, 135·4 sq. ft.; total, 1926·4 sq. ft.
Grate area, 27 sq. ft.
Working pressure of boiler, 213 lbs.
Weight of engine (in working order), 74 tons.
Weight on coupled wheels, 50 tons.

The Western of France Railway does an enormous suburban passenger traffic around Paris, and of late years there has been some difficulty in maintaining the punctuality of the services. With these more powerful tank engines at their disposal, however, the Company will be enabled to provide a more frequent service of trains having a greater seating capacity.



NEW FOUR-CYLINDER COMPOUND TANK LOCOMOTIVE: WESTERN RAILWAY OF FRANCE.

NEW COMPOUND TANK LOCOMOTIVES—BUENOS AYRES AND ROSARIO RAILWAY.

The locomotive shown in the fifth illustration is one of several recently supplied by Messrs. Beyer, Peacock & Co., Ltd., of Gorton Foundry, to the Buenos Ayres and Rosario Railway. It is of the two-cylinder compound type, with side tanks, and is designed for the performance of heavy passenger train haulage on the difficult main line of the railway named. The cylinders, which are placed outside the frames, are compounded on the Worsdell-von-Borries-Lepage system, and the special form of intercepting and starting valve used for engines constructed on this principle is fitted in this case. The arrangement consists of two valves—one an intercepting and the other a starting valve, both of which are operated by steam and controlled by a single handle in the cab. When difficulty is experienced at starting, the driver, by pulling the handle referred to, opens the starting valve and brings into play a small piston, which, by its movement, admits steam to the intercepting valve chamber and closes the valve within it. This has the effect of cutting off communication between the receiver and the L.-P. cylinder and at the same time admitting a certain amount of boiler steam to the latter. The change from the use of boiler steam in the L.-P. cylinder to that of compound working is automatically effected after a few strokes of the piston by the pressure of the H.-P. exhaust in the receiver rising sufficiently to force the intercepting valve back into its normal position, thus closing the passage from the boiler to the L.-P. steam chest and opening up communication between the latter and the receiver again. The driver only has at his disposal facilities for starting the mechanism, the length of time during which it is in operation being governed by the action of the H.-P. exhaust in the manner described.

Steam is supplied to the cylinders by a boiler having a telescopic barrel 4 ft. 9⅝ ins. diameter (outside) at front by 12 ft. 2¾ ins. long. There are 241 tubes of 1⅞ ins. diameter, and the boiler is set with its centre 8 ft. 9 ins. above rail level. The firebox is of the Belpaire type, with interior firebox of copper, the outer shell measuring 7 ft. 5 ins. long (outside) by 4 ft. 4¾ ins. wide. The boiler is constructed of steel plates throughout, including the outer firebox shell, and is designed to carry a working pressure of 200 lbs. per sq. in. The valve gear is of the Stephenson link pattern, inside the frames, with eccentrics secured to the driving axle, viz., that of the intermediate coupled wheels. The leading end of the engine is supported by a four-wheeled bogie, and the trailing end by a pair of carrying wheels fitted with radial axle-boxes, the engine being thus classified as 4—6—2

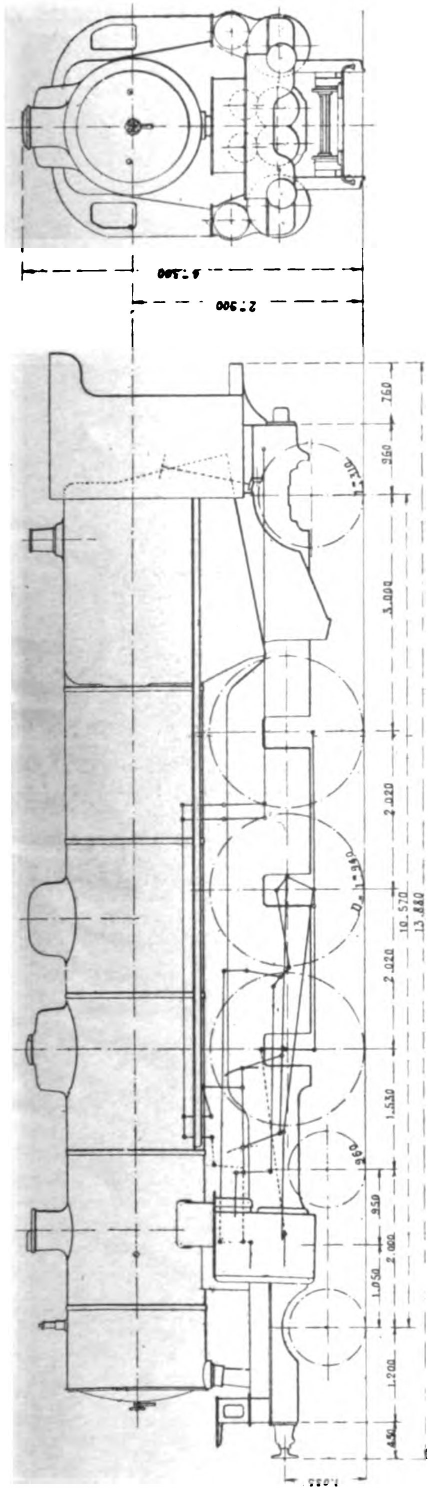


DIAGRAM OF WESTERN OF FRANCE RAILWAY EXPRESS LOCOMOTIVE.

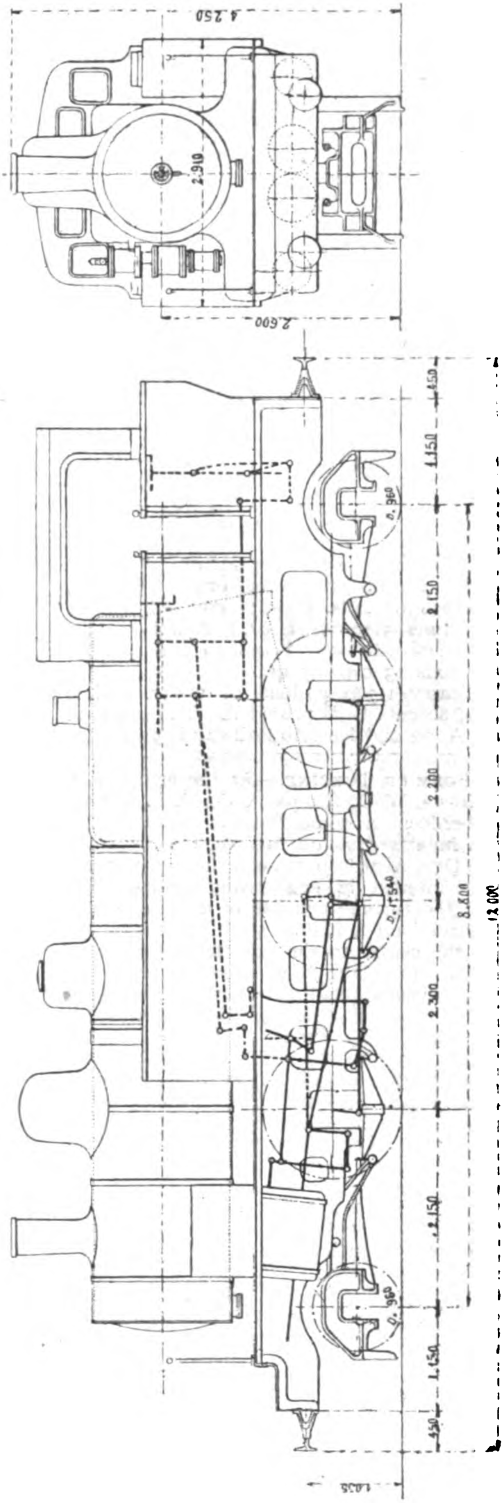


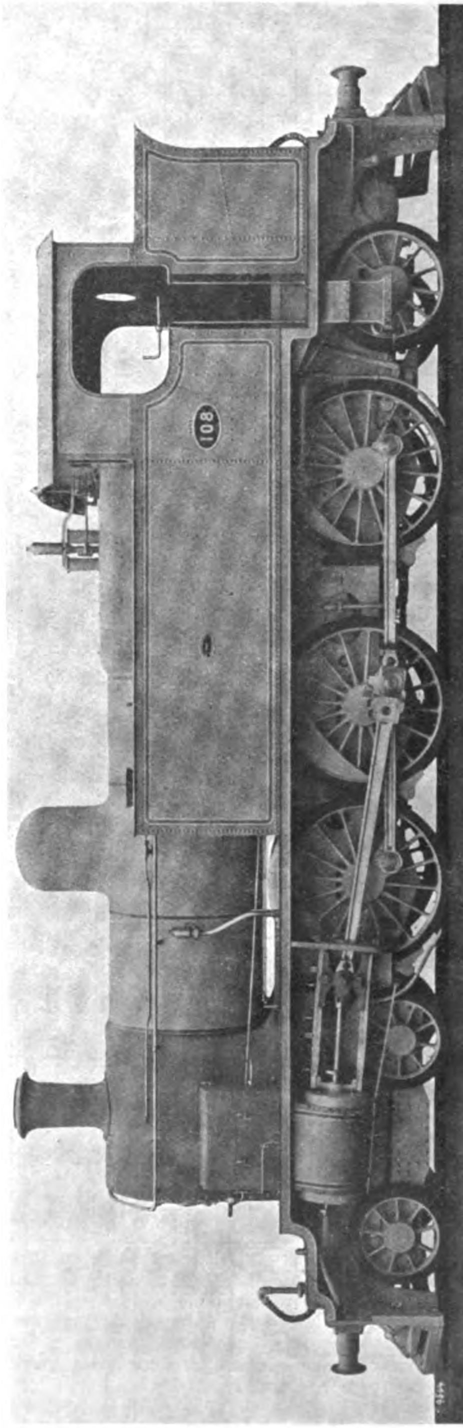
DIAGRAM OF WESTERN OF FRANCE RAILWAY COMPOUND TANK LOCOMOTIVE.

type. The springs of the radial wheels are connected by equalising gear with those of the trailing coupled wheels, and a similar system exists in respect of the driving and leading coupled wheel springs. The engine is equipped with the automatic vacuum brake and also steam and hand-brakes. Sanding gear is fitted and arranged for the delivery of sand in front of the leading wheels and at the rear of the trailing coupled wheels. The main frames are of steel plate, and the whole of the framing is on the inside of the wheels. Fenders or "cow-catchers" are fitted at both ends, in conjunction with side spring buffers and screw couplings.

The leading dimensions of these new and powerful locomotives are as follows:—

Cylinders—diameter: H.-P., 19 ins.; L.-P., 27½ ins.; stroke of pistons, 26 ins.
Wheels—diameter: Bogie, 3 ft. 4 ins.; coupled, 5 ft. 8 ins.; trailing (radial), 4 ft. 1 in.
Wheelbase: Coupled, 5 ft. 8 ins.; total, 31 ft. 3½ ins.
Boiler: Length, 12 ft. 2¾ ins.; diameter, outside front, 4 ft. 9¾ ins.
Heating surface: Tubes, 1496·5 sq. ft.; firebox, 135 sq. ft.: total, 1631·5 sq. ft.
Grate area, 25 sq. ft.
Boiler pressure, 200 lbs. per sq. in.
Weight on rails (working order): Bogie, 19 tons 10 cwts. 0 qr.; coupled wheels, 47 tons 5 cwts. 1 qr.; radial wheels, 14 tons 18 cwts. 2 qrs.; total weight, 82 tons 13 cwts. 3 qrs.

The tanks carry 1,500 gallons of water, and a fuel space of 82 cub. ft. is provided. The gauge of the Buenos Ayres and Rosario Railway is 5 ft. 6 ins.



New 4—6—2 Type Two-cylinder Compound Tank Engine: Buenos Ayres and Rosario Railway.

A New Form of Turbine.—At the engineering works of Messrs. W. M'Kinnon & Co., Ltd., Spring Garden, Aberdeen, a demonstration was recently given of an improved steam turbine, the invention of Mr. John Ogg, Aberdeen, which is likely to arouse considerable interest in engineering circles. The principle of the turbine consists of a metal wheel or disc mounted on a hollow shaft perforated by holes from the centre to the outside of the wheel radially. The holes are tapered from the centre outwards, and form expanding nozzles for the steam or fluid which is supplied through the hollow shaft. The steam, on issuing from the nozzles, strikes against blades fixed to the rim of the wheel at a suitable angle to the oncoming steam, causing them to revolve at a high velocity. One or more wheels may be mounted on the same shaft, and the blades of one or more wheels may be set for forward motion and others for reverse motion. A novel feature of this reversible turbine is that the steam issuing from the wheel or nozzles strikes the blade or blades which form part of the wheel, and thereby turns the whole round. At the same time the steam is playing continuously on the same blade and turning with it, so that the impulse is constantly the same if the steam pressure is kept up. Amongst other advantages claimed for the invention is that the turbine can be properly balanced; it has no dead centres; it can be reversed by shifting a valve; it has no eccentrics, cranks, or slide-valves; no rubbing parts except shaft bearings; needs no flywheel, the whole force of the steam can be utilised to stop as well as to start; it is simple, cheap, and occupies small space; its steam consumption per horse-power is economical.

A Model Balanced High-Speed Engine.

By H. Greenly.

(*Concluded from page 590.*)

THE crank-pins of this engine being placed at 180 degs. apart, the crankshaft can be conveniently made out of a piece of steel plate of approximately finished dimensions as regards thickness, no forging or twisting of cranks being necessary. The slab of steel, which may be 8 ins. long by 1⅝ ins. by ½ in. in the rough, should be marked out, drilled, chipped, and sawn out, so that the throw plates at the ends for turning the crank-pins are formed out of the solid and cut off afterwards.

Where balanced cranks are decided upon by the builder of the model, it is recommended that the counterweights be made separately and fixed to the webs. A much greater amount of work will be entailed by making a balanced crank out of the solid. The tool for turning the crank-pins will require a large amount of overhang, and, what is more important, the steel slab will have to be much heavier, unless a steel casting or a forging wrought closely to finished dimensions is obtained.

Fig. 18 shows in detail how the counterweights may be applied, the remainder of the crankshaft being made to the dimensions given in Fig. 17. The counterweights are extended as much as possible over the cheeks of the webs, and should be well fitted to the webs, the screw simply holding them in place. When fixed to the crankshaft webs the counterweights may have a finishing cut taken over them to ensure squareness with the rest of the work, the throw plates not being removed until after this is done. The tops of the webs will then be curved to the same radius as the counterweights.

The whole of the work to the crankshaft should be completed before the throw plates are cut off and the valve gear end turned down to 3-16ths in. diameter. The centre of the crankshaft, marked A in Fig. 17, may be left square or turned down to 7-16ths in. diameter, as desired. There is, however, no necessity to machine this part, so long as it is not badly out of balance.

The flywheel, shown in the detail, Fig. 19, and on the general arrangement drawing, is of the disc pattern, and is provided with a studded boss to receive a flexible cup coupling where the engine is intended for directly driving a dynamo, pump, or other high-speed machine. The cup is fitted to the armature shaft of the dynamo, and has six slots filed in it (with no sharp corners in the slots, of course) to take a continuous band of leather or textile fabric, the ends of which are fastened, as indicated, to the outside of the cup after the studs are put in place.

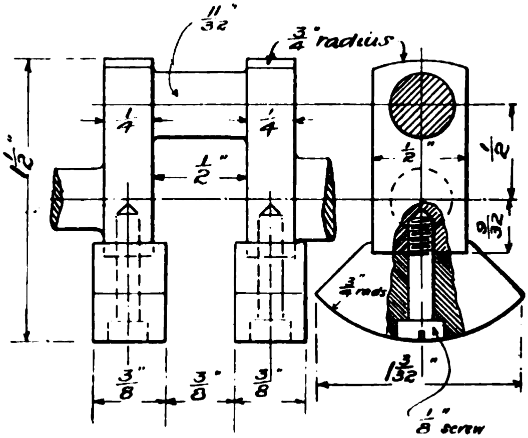


Fig. 18.

This coupling should look neat, and should also save the trouble of getting at least four bearings in absolute alignment, which is essential where the ordinary flanged coupling is employed.

In fitting the crankshaft, flywheel, and bearings it is important to note that end-play must not be allowed. The big ends should be free laterally on the crank-pins to prevent any twisting strains being given to the gudgeon pin, but no lateral movement must be present in the crankshaft, otherwise the setting of the valve gear may be seriously affected.

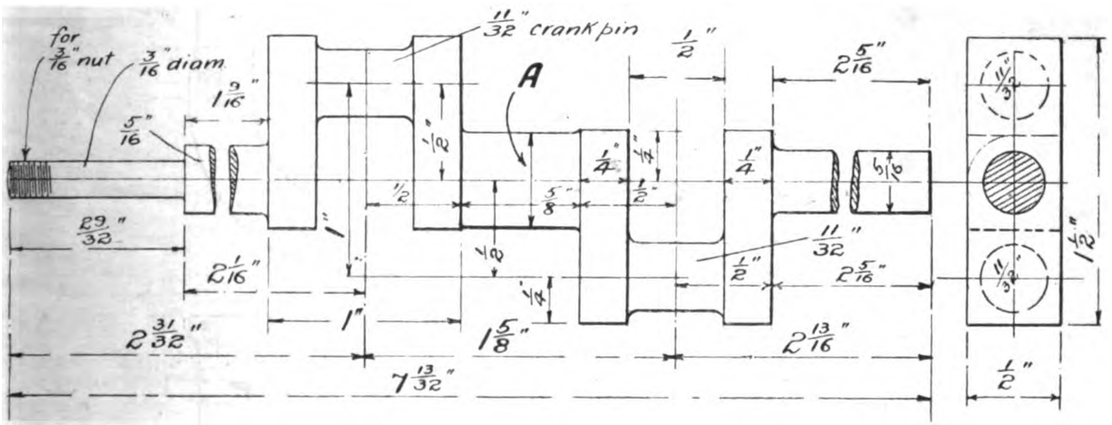


Fig. 17.—Crankshaft for High-speed Engine. (*Scale: Full size.*)

The cam box is fitted on to the flange of the bearings at the valve gear end, long studs being used to hold the two parts to the crank case, except at the top, where the bearings should be attached race and gives a partial turning movement backwards and forwards to the vertical valve shaft.

The shaft runs in a bearing bracket fixed to the top face of the crank case at its upper end, and has

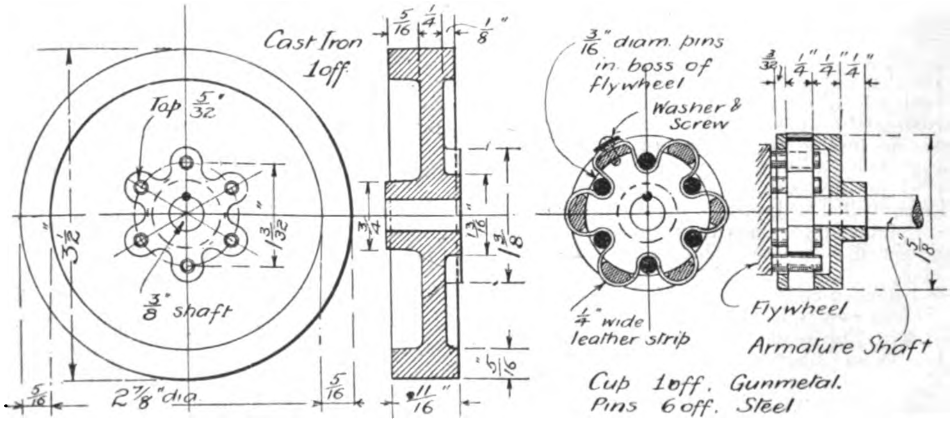


Fig. 19.—Disc Flywheel and Coupling. (*Scale: Half full size.*)

by a countersunk screw, as shown in Fig. 20 herewith.

The cam box, in addition to protecting the cam and preventing the oil from splashing about, also provides a footstep bearing for the vertical valve a crank arm set at 180 degs. to the lower one fitted to it. This crank is attached by a double link to the valve spindle crosshead, and thus actuates the valves. Details of the bracket, arm, and links are included in the accompanying Fig. 21.

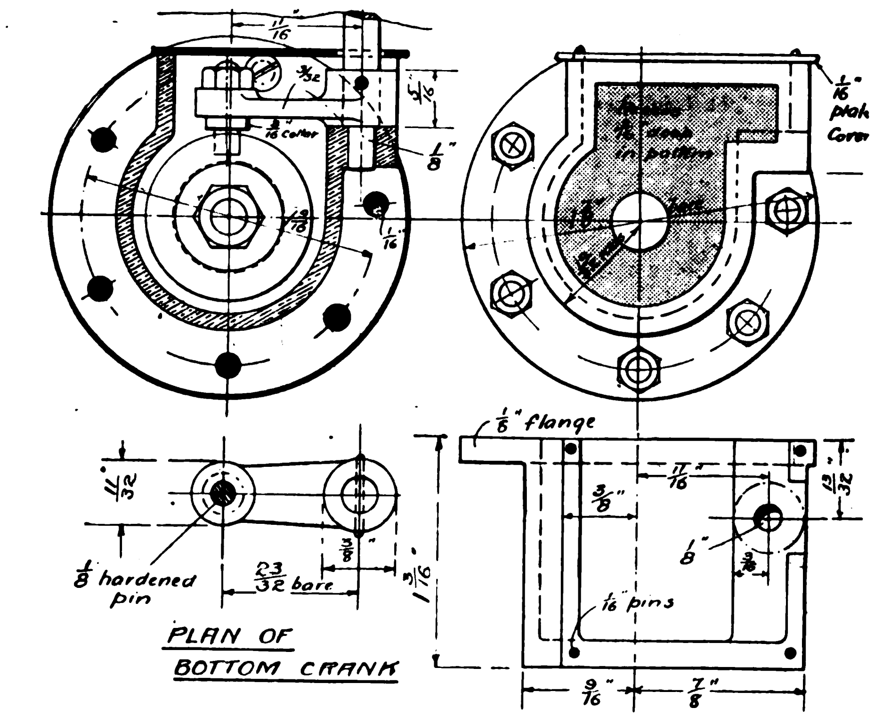


Fig. 20.

shaft. This shaft has fastened to it a gun-metal crank arm, into the end of which fits a hard steel stud. The lower end of this stud engages the cam

The cam box is arranged to be fitted with a loose lid of 1-16th or 1-20th-in. plate. This lid may be kept in place by four pins, one in each corner, fixed in the top of the cam box. The end of the cam box may be recessed in the pattern to give a better appearance, as shown in the drawing. The centre boxes may also be tapped for a screw and locknut, so that should any end-play occur in the crankshaft, this may be taken up at any subsequent cups whilst they are in the lathe. By placing two of the cups together with the distance-piece between a quick-acting cam is obtained. The distance-piece has no other work to do than maintain the correct distance apart of the cups, and may be of gun-metal. The cups may be made of mild steel

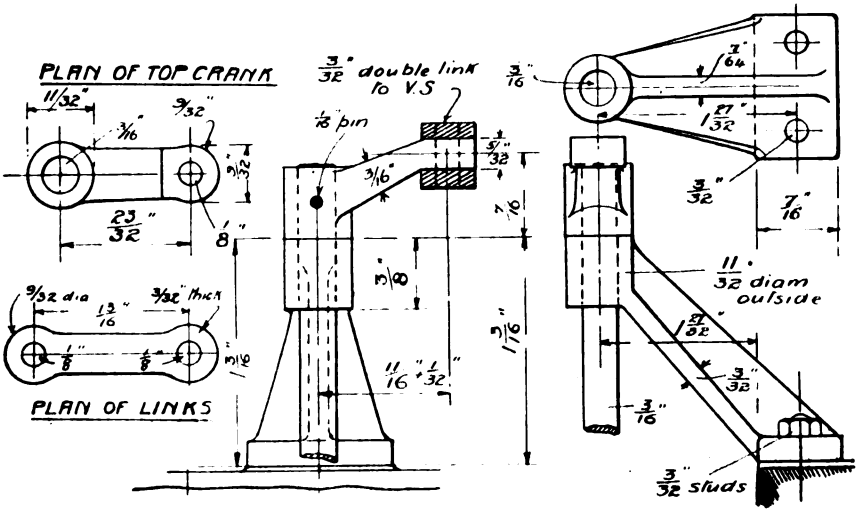


Fig. 21.—Details of Valve Gear. (*Full size.*)

time (as illustrated in Fig. 20*a*). This, however, is more or less of a refinement, and may be omitted.

The cam may be made in a variety of ways, depending on the appliances available. The usual method of cutting such cam races is to employ a copying spindle, which guides the milling cutter, and case-hardened with yellow prussiate of potash. The cam race need not fit the pin tightly, the chief point being to see that the working faces of the cam are smooth and regular.

The valves (see page 562 *ante*) are fixed to the spindle in the ordinary way by flatting the spindles

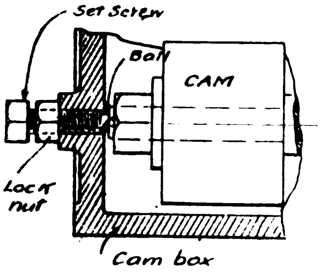


Fig 20*a*.

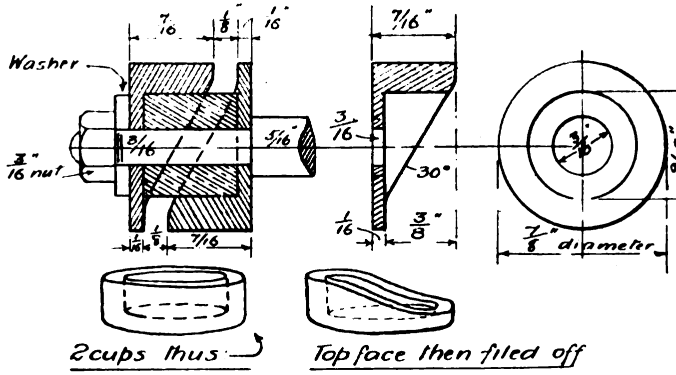


Fig. 22.—Simple Method of Making the Cam.

Tools of this description are not generally available in the amateur's workshop, and to save rigging up their equivalent, I suggest an arrangement which will not require anything but ordinary lathe tools.

Two cups are machined out of steel, as shown in Fig. 22, and a distance-piece is turned up to fit the cups. A gauge is made to the desired profile of the cam and the cups are filed to this gauge, guide marks being scribed on the outside of the and cutting a slot in the back of the valves. The lap of the valve should not be filed to finished size until the last thing, and care should be taken in trimming up the valves to obtain the simultaneous opening and closing of the port for each cylinder. When this is done, the equalising of the valve movement on each side of the centre should be attended to and adjustments made by either altering slightly the position of the crank arm on the top of the vertical valve shaft or, better still, by removing the bolt of the double connecting-links and screwing up or unscrewing the valve spindle crosshead.

The final timing of the valve should be left until there is an opportunity of testing the model under steam, and when satisfactory, and the model runs up to speed without knock or jar, means can be provided to pin or key the cam in the best position.

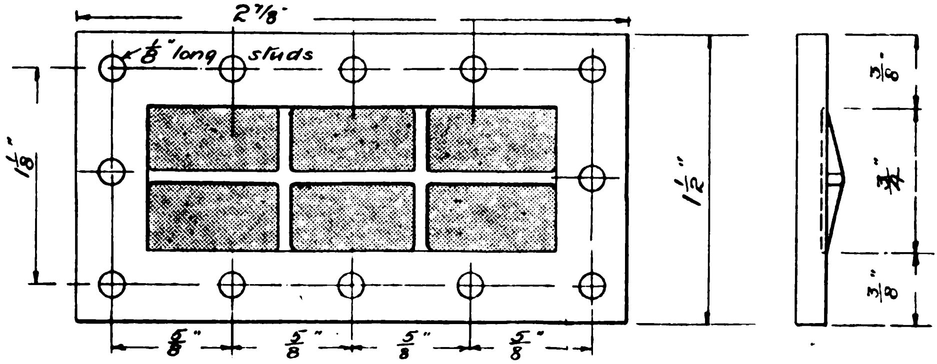


FIG. 23.—STEAM CHEST COVER. (*Shaded part recessed may be painted.*)

To accomplish this a hole for a 3-64ths-in. pin may be drilled through the washer and the three portions of the cam; this will tie these parts together, and then a keyway may be cut in the washer and a pin fixed in the shaft at the previously determined best position of the cam, to fit this keyway.

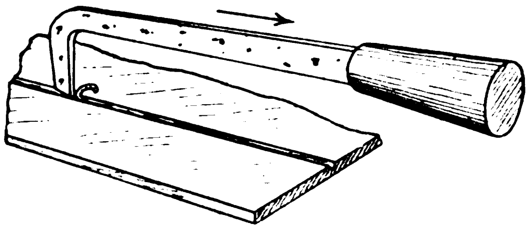
Notes on Working Ebonite and other Insulating Materials.

EBONITE is a black and somewhat brittle substance much used for insulating purposes in electrical apparatus. It is a manufactured product containing indiarubber, and is often called vulcanite. Several qualities are made, the cost varying according to quality; it is sold by weight. The high-priced quality is much lighter in weight, bulk for bulk, than that of low price, and is far superior as an insulator. It is always used for the better class of electrical instruments where high insulation is a matter of considerable importance. The cheaper quality serves very well for ordinary purposes, such as dynamo and motor work, switches, etc. Ebonite is made in sheets from about 1-20th in. thickness up to 2 ins.; in rods from about ¼ in. diameter up to 2 ins.; and in tubes of various thickness from about 5-32nds in. (outside diameter) up to 3 ins. It can be also moulded by the makers to special shapes.

Ebonite can be easily shaped by turning, sawing, drilling, etc., being somewhat of the character of hardwood in this respect. The surface left by tools or files is dull, but can be given a bright finish by a polishing process. For roughing down in the lathe, keen tools—such as used for wrought iron—will give good results. For finishing, the flat tools—such as used for brass or hardwood—are suitable; glass-paper can be used for finishing. Sheet ebonite can be cut to shape by means of a circular or straight saw, but if it is thin there is risk of splitting or cracking it. In this case use a knife or an L-shaped parting tool, as sketch. When drilling or turning ebonite tubes and collars, or any place where the thickness is much reduced, care is necessary: the ebonite is liable to crack and pieces to be split off by the pressure of the tool. A high speed should be used, as with wood. Ebonite is not a satisfactory material in which to tap holes for small screws. The screw thread crumbles away as dust, and though a sufficiently good cut can be made to hold a screw which is to be rarely removed, the thread soon pulls away if the screw is turned in and out of the hole repeatedly, as when making some adjustment. On this account it is advisable, whenever possible, to arrange holding-screws to clear through the ebonite and tap into metal at the far side. Ebonite may be softened for bending purposes by placing it in hot water, but, generally speaking, it should be kept away from heat on account of liability to warp. Sunlight acts upon the surface of ebonite and causes it to change from black to a yellow-green colour. To polish ebonite use first a fine grade of glass-paper, then smooth with Bath - brick dust, and finally polish with rotten-stone and paraffin.

Vulcanised fibre is a manufactured product containing indiarubber. It is a particular kind of material, and not vulcanite, though sometimes called so. For insulating qualities it is very much inferior to ebonite, and would be useless for purposes where a high grade of insulation is necessary and for which the best quality of ebonite is used. It is very useful, however, for low-voltage dynamos and motors and for ordinary switch and terminal work. Two kinds are made, hard and soft; the hard kind is the one to use for electrical purposes. Vulcanised fibre may be obtained in sheets of a thickness of 1-64th in. to 1¼ ins., and of red, grey, or black colour; also as square sticks, or round rods from ¼ in. to 1¼ ins. diameter, and tubes of various sizes up to 1½ ins. diameter: it can be made to special shapes, but not moulded. The black has a higher insulating property than the red or grey. The price differs very much, according to the form, that for rods and tubes being as high or higher than that of ebonite, but in sheets it is lower than the cheapest quality of ebonite; it is sold by weight.

Vulcanised fibre is very useful for many purposes where a material such as hardwood is applicable. It is very tough and does not split, can be cut by a saw, turned and drilled easily. The best way to cut pieces from the bulk is by means of a saw. For turning, use sharp angle tools, such as those for wrought iron, and high-speed hand tools, such as those used for hardwood or brass, can be used for finishing. A very good, smooth surface can be produced direct from the tool without the use of emery cloth. Flat surfaces can be filed and polished by means of fine emery cloth and oil, or with rag and oil alone, but only a moderate degree of polish is obtainable. A good screw thread can be produced in tapped holes, the material being better in this respect than ebonite, but the end of the screw should be round and entered carefully, as, if it crosses the thread the material will be torn away. Thin sheets may be bent to any extent without the necessity of softening it by heat. Vulcanised fibre is liable to absorb moisture;



Tool for Cutting Ebonite.

it should therefore not be used for insulating purposes where this property is likely to cause trouble; a coat of shellac varnish will very much improve it in this respect.

Ebonite and vulcanised fibre rods are moulded, and may not be quite circular, so that a margin should be allowed for turning up when ordering the size required. The cutting edge of the tool should be kept sharp, there is a decided grain in vulcanised fibre; if the tool is blunt, the material is liable to open.

Mica is another material exceedingly useful for electrical insulating purposes. It is a mineral, and remarkable for its extremely laminated character. A lump of mica is composed of an immense number of thin leaves, and may be easily split into these constituent parts. There are varieties of mica; that which is suitable for electrical insulation purposes being transparent and free from impurities. Leaves of the inferior kinds are covered with spots and streaks of a red and brown colour and should be avoided. Mica is sold by weight in bundles of pieces which have been trimmed to rectangular shape. The price varies very much, according to the shape and size. Small pieces are comparatively cheap, but the price increases rapidly with size. To be economical, you should therefore order the smallest dimension which will serve your purpose. The thickness scarcely enters into the question, dealers having to take it as it comes when sorting out the pieces and trimming it. As the leaves are smooth and flat, with even thickness, it is easy for the user to build them up to the dimension he requires or to split them if they are too thick. They are easily divided by pressure of the finger-nail. Mica is chiefly used for the insulation of commutators, pins of brush-holders, and switches, and between the winding and frame of dynamos and motors. The pieces may be cut to shape by means of a pair of scissors or a knife. The cutting edge of either should be kept very sharp, as the mica easily splits and flakes along the line of cut. Frequent grinding is necessary. Mica is hard, and tools used to cut it soon become dulled. It is incombustible and not affected by heat; it does not absorb moisture.

Notes on Wireless Telegraphy Apparatus.

By V. W. Delves-Broughton.

(*Continued from page 586.*)

Synchronised Aerials.

I WAS long deterred from experimenting or even seriously thinking about this branch of the subject, on account of the very meagre information published, combined with a sort of awe inspired by the very names of the scientists engaged upon this problem. One night recently, however, being unable to sleep, I turned the question over in my mind, and determined to try a few experiments with a view to investigating the possibility of carrying out tests on a very small scale, and at a trifling expense. As a matter of fact, my investigations did not cost me a penny, as I managed to work in materials and instruments which I had by me, and which would probably be found in the stores of any practical worker in wireless telegraphy.

If two aerials were constructed exactly on the same lines, and the upper and lower capacities of each aerial fixed at the same distance apart, the "period" of these two aerials should at first sight fulfil the necessary conditions to be in exact "tune" with one another, and this would be true if the aerials were suspended in open country by means of masts of similar design. If, however, the capacity-areas are hung on a house, especially if anywhere near any large masses of metal (lead flats, gutters or flashings, etc.), the capacity will be largely affected; and as in most amateur installations it is usual to hang the aerials in this manner (as described on page 615 *ante*), they will have to be tuned by a series of alternators on the "trial and error" system till the best results are obtained, the only guide to go upon being that the capacity-area nearest any large mass of metal will probably have the lowest capacity, all other conditions being equal.

If a pair of sending and receiving stations are to be fitted up, start with a pair of aerials suited to the least efficient coil, and then start experimenting, and if the tuning is found to be at fault, reduce the amount of wire in the netting at the end expected to have the greatest capacity, *i.e.*, that end where the capacity-areas are furthest removed from anything likely to affect it; or in the event of one of the coils being much more powerful than the other, place that coil at the end having the least capacity and add to the surface of the aerial netting.

The smaller the capacity, the higher will be the period. That is to say, that the number of oscillations per second, or any other given period of time, increases as the capacity of the aerials is diminished. This increase is exactly proportional to the capacity. I have found that two aerials work well together when one has directly half the capacity of the other much after the manner of the sympathetic resonance of tuning forks pitched at octave intervals.

Before proceeding to discuss the question further, I must point out that whatever waves are produced in a receiving aerial are damped almost instantaneously by the flow of the waves through the coherer if some precautions are not taken to prevent this action. (The isolation of the coil is unimportant, as, owing to the number of turns on the secondary, it acts as an enormous choking coil, capable of checking the oscillations entirely.) Therefore, a device shown diagrammatically in Fig. 1 is introduced between the aerial and the coherer, the wires leading from the aerial and coherer being attached to the two blocks carrying the brushes by suitable terminals. If then the wheel is made to revolve, contact will be made to the coherer momentarily when each tooth of the wheel comes in contact with the brush, the intervals of time, short as they are, between the teeth touching the brush, are still long enough to allow many hundreds of the waves to act on the aerial and produce an augmented surging of current up and down the aerial before it is put into communication with the coherer.

Mr. Howgrave-Graham refers to this appliance upper and lower capacities through a coherer, without the intervention of an interrupter, is shown. The waves produced in T S would be very much greater in proportion to those at the receiving aerials than sketched in the diagram, and the number at both transmitter and receiver aerials infinitely greater. On the lines A A sparks are produced, and between these lines a number of waves are produced in T S and received at T A, U T A, or D A. At T A, owing to the resonance of the aerial being in tune with T S, the waves will increase to a maximum, and then die away till the point B is reached, when, however, it will receive a fresh impulse from a fresh train of waves sent from T S, and, if the period between the sparks has not been too great, a certain amount of vibration will still continue in T A at B, and the second train of waves will leave even a greater amount of vibration when the third train arrives at B[1], and so on, till the amplitude reaches a maximum. This explains the advantage of a quick succession of sparks at the transmitter. At U T A it will be seen that the maximum is reached at the first reception of the first wave from T S, dying away till at C no vibration is taking place in the aerial.

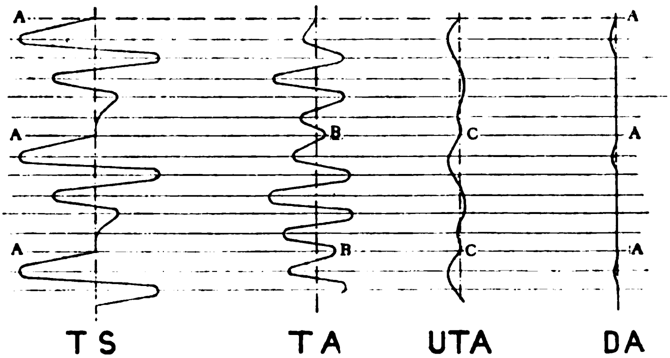


Fig. 2.

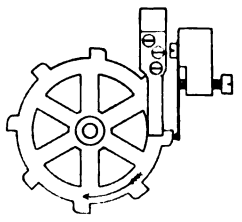


Fig. 1.

in his reference to the Poulsen system, but I believe that it is used in a modified form in every system in which tuning the aerials is attempted. At any rate, Captain Jackson used this in 1901.

This interrupter wheel must be driven sufficiently fast to prevent the coherer decohering during the interruptions or the relay will chatter and make irregular contacts, otherwise the slower it is run the better. In carrying out some experiments on a very small scale a spare mercury break was used, this when set to vibrate very quickly with a short stroke only just grazing the mercury, answered very well, but a properly made wheel would answer better, being more regular in its action, and giving a relatively longer interval between the contacts.

In Fig. 2, the surging action as set up by the spark is shown above T S (transmitting station), and the surging action set up by the resonance of a tuned aerial is shown above T A (tuned aerial), whilst the action on an untuned aerial is shown above U T A (un-tuned aerial).

Both the curves shown above T A and U T A are diagrams of the surging action when disconnected from the coherer; at D A (damped aerial) the effect produced by connecting the leads from the

If now either of these aerials is connected directly to a coherer, the neutralising effect of the two capacity-areas as already explained will reduce the wave to one single oscillation, as shown above D A, and that much reduced in amplitude. It will thus be understood why it is necessary to include an interrupter between the aerial and the coherer.

After each contact with the interrupter wheel the waves will be practically wiped out, but when it is remembered that, under the worst conditions, several hundred thousand are arriving every second, it will be seen that the aerial will be given sufficient time to produce a considerable augmentation of the amplitude of the waves during each interruption of the coherer circuit. If no interrupter is used in series with the coherer, all attempts at tuning must be abandoned, and it will then be found advisable to use the largest possible aerial for the receiving station; but if a station is used both for transmitting and receiving, the capacity of the aerial must be regulated to suit the coil. It is bad practice to have two aerials hung in very close proximity, as then the one would have a damping effect on the other, just like any other mass of metal, otherwise two independent aerials might be hung from the same mast and used, the smaller for transmitting, and the larger for receiving.

In tuning two aerials, it is practically impossible to directly measure the capacity with sufficient accuracy to be of any use. The electrical capacity of even a large aerial is so small that any comparative measurements would require the greatest exactitude to be of any use, and, as is well known, the measurement of capacity is one of the most difficult operations in practical electricity.

The period of an aerial is dependent on the formula

$$\omega' = 2\pi\sqrt{LK}$$

where ω = the period of one complete oscillation,
L = the co-efficient of self-induction,
and K = the co-efficient of capacity,
all these co-efficients being in C.G.S. units.

In the above formula the retardation, owing to the resistance of the leads to the capacity-areas, and the wire forming these networks themselves is neglected, which for all practical purposes is admissible, as these can always be made of sufficient cross section to render this a negligible quantity.

The complete formula is

$$\omega = 2\pi \frac{\sqrt{LK}}{\sqrt{1 - \frac{K}{4L}\omega^2}}$$

the letters representing the same constants, with the addition of ω, which represents the total resistance of the aerials.

The apparatus used in carrying out the experiments described in this article were of the roughest description, and it may interest readers of this paper to explain how they were carried out. The capacity-areas were made out of two hoops of iron wire formed out of four lengths of 12-gauge wire cut off to a length of 3 ft., and the ends butted together and soldered into small tin sockets. Diagonally across these hoops two copper wires were soldered, and where they intersected wires were attached to form lead to the coil or coherer.

One pair of these hoops were hung up at each end of a long room by means of thread boiled in wax, the lower ring being hung directly from the upper ring at a distance of 5 ft., and the upper ring hung from the ceiling. The receiver consisted of a Castelli coherer and telephone.

The coil was my great difficulty. I first tried a ½-in. ignition coil, using a separate break, but when the current was choked down sufficiently, the spark became very irregular. Then I tried a simple coil of about ½ lb. of No. 30 wire, using the spark caused by the "extra current" to excite the aerial, but this was again too irregular, so finally I made use of a medical coil provided with a condenser. This coil was of the sledge type, and I found it most convenient, as with the core pushed right in it would give a 3-16ths-in. spark, and this could be reduced as much as required by withdrawing the core.

At the receiving station, as already explained, a mercury break was used, to allow the vibrations in the aerial to accumulate before being allowed to act on the coherer.

By carefully reducing the spark so that it was only just sufficient to produce coherence at the receiving station it was found possible to disturb the synchronism of the aerials to such an extent that no messages were recorded by simply twisting 10 ins. of No. 20 wire into either of the aerials; this phenomenon being clearly shown with the aerials only 20 ft. apart.

The telephone circuit on each side of the coherer was isolated from the aerial by choking coils, consisting of about 500 turns of No. 24 wire.

In these experiments the capacity-areas were made in the manner described, so as to resemble the conditions obtaining in large installations as much as possible and at the same time to use materials to hand.

In making up special apparatus for these investigations I should advise the use of aerials about 3 ft. square, constructed as shown in Figs. 7 and 8, page 615 *ante*, and hung on light bamboo gallows about 10 to 12 ft. apart, and separated by a distance exceeding 100 yards on flat open ground clear from houses, trees, or other obstructions.

I should still use a sledge coil, but should construct this to give a maximum spark of ⅜ or ½ in. A more sensitive and reliable coherer than the Castelli should be used (probably one constructed on the Lodge-Muirhead principle would be the best), and the receiving appliances should be of a thoroughly reliable nature and thoroughly tested, otherwise results may be obtained which to a large extent depend on defects in the appliances.

It must be remembered that there are a great number of factors entering into the problem of receiving an aerial message, and because the waves fail to act on the coherer, it must not be considered as proved that it is owing to any one particular cause, unless it be found that interruption and transmission can be caused at will and be repeated as desired.

As an instance of how small an item will upset an installation working otherwise perfectly, I might mention that on one occasion, whilst experimenting with different gauge wires used as leads to the capacity-areas, all records suddenly ceased, and this was simply due to one of the leads having been shortened by forming it into a spiral of perhaps 50 turns wrapped round a pencil, this spiral subsequently being found to act as a most effective choking coil. On re-making the spiral by first doubling the wire and re-winding it as a non-inductive coil, the installation again worked satisfactorily.

In a previous article I advised the use of stranded wires in the construction of aerials and leads, but I have satisfactorily proved to my own mind that this is quite wrong. The twisting of the wires causes them to act more or less like a choking coil, and at the very high frequencies of the oscillations this has a considerable retarding effect. If therefore more than one wire is used, the wires should simply be bunched together or served over with string or other inert material without twisting. Leads can be conveniently formed by slipping the wires into tubular braid, which can be bought at any haberdasher's, but this is unnecessary if a single wire is used. Single wires heavily insulated with gutta-percha can be obtained for use where insulation is necessary, and, if not sufficiently thick, can be used in untwisted bunches of two or more.

It is with much diffidence that I bring this my last article on wireless telegraphy before my readers, as it enters more or less into theory, and as a simple self-taught electrician, I should leave these questions to people who have had the opportunities of thoroughly studying the question, and who have been in a better position than myself to learn what others are doing in this direction. I can, however, claim to be a thoroughly trained and competent observer, and as no one else has come forward to write on the subject, I submit this article more as an indication of what can be done by careful observation and deduction and the lines on which to work, than from the point of view that my results will have any practical value.

The Construction and Repairing of Motor Bicycles.

By "Sregor."

(*Continued from page* 557.)

The accompanying sketches show some details in the exhaust arrangements. Fig. 105 shows part of the cylinder with the exhaust outlet. A projection from the cylinder B is cast on to which the pipe is connected to conduct the

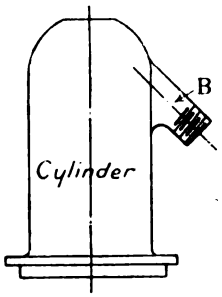


Fig. 105.

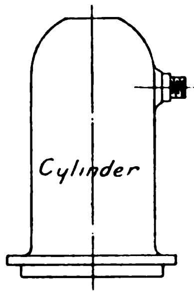


Fig. 106.

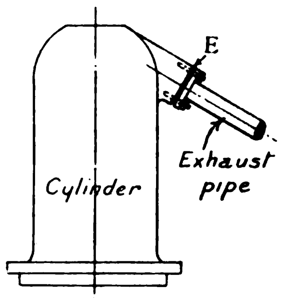


Fig. 108.

gases to exhaust hose. There are objections to this design, especially when considering the small fragile air-cooled motor cycle casting. Assuming the casting comes out perfect from the mould, it is common experience for such a projection, owing to the thinness of the metal, to be hard and brittle, which offers great possibilities of it getting broken in the machining operation, also affording difficulties in the screwing operation. These objections are avoided in the design shown in Fig. 106. In place of the projection B (Fig. 105) a boss is cast, slightly raised from sides of the cylinder; this can readily be drilled and tapped, into which is fitted a nipple, shown in Fig. 107, and which can conveniently be fitted, or removed, when required. It is advisable to make this fitting from brass, from the fact that the thread will not seize—a common experience when steel threads are used on exhaust pipes, owing to the heat. The opposite end of the nipple receives this end of exhaust pipe and forms a union connection. The joint is formed with the pipe by brazing a steel collar G and turned to fit D for the larger sizes of engines. The design shown in Fig. 108 is generally used, the faces E of the ports being machined to form a joint and receive the pipe flange G (Fig. 109) shown in detail. The face of this flange is recessed to a diameter and depth to receive the washer H. The washer must project above face of flange to receive the pressure from the studs when joint is screwed up. The washer consists of asbestos covered with sheet copper. Fig. 108 shows the joint assembled.

It is common practice now to utilise the pressure

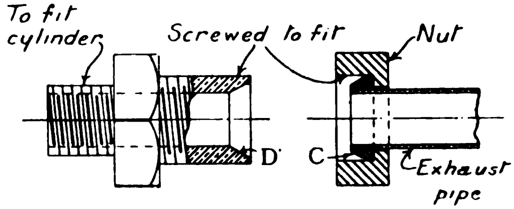


Fig. 107.

of the exhaust gases in the box to force the petrol from the tank to carburettor, also to force lubricating oil from tank to lubricator in car construction. It is advisable to so arrange that the acting pressure can be increased at will by the driver, so as to provide a greater flush of oil at convenient times, such as when the car is hill-climbing and the engine is running above its normal speed. This is accomplished by fitting a valve in the exhaust pipe and slightly closing it so as to induce more pressure. This has the objection of creating a back pressure and restricting the gases getting away readily from the cylinders. In the

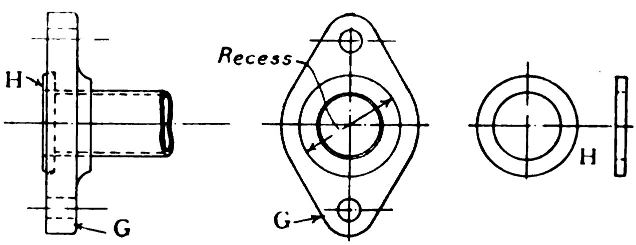


Fig. 109.

case of, say, a four-cylinder engine, the valve may be fitted in one of the branch pipes as shown in Fig. 110, so that any slight upsetting of the explosion caused by the back pressure will be confined to the one cylinder only, leaving the others working under regular conditions. When the exhaust receiving pipe is fitted fairly close to cylinders it is customary to arrange some means to compensate for the expansion of the metal caused by the heat of the gases. One arrangement to effect this is as shown in Fig. 111, which illustrates a sliding joint, the male and female parts J K being turned to a sliding fit. This design of joint has the disadvantage from a manufacturing standpoint that the two parts must be very accurately machined both from the flange joint to centre of pipe and the fit of the

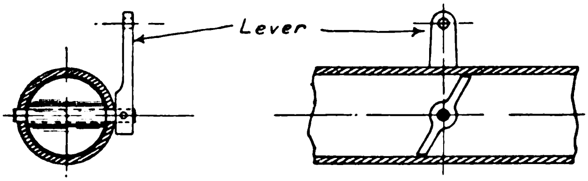


FIG. 110.

sliding joint; otherwise when the two pipes are screwed up, the sliding joint will get pinched and be robbed of its sliding propensities. Again, if any clearance is provided in the joint to allow for the above imperfection, the exhaust will leak through and cause an objectionable noise. The

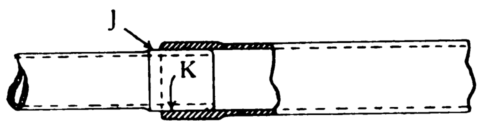


FIG. 111.

design shown in Fig. 112 is intended to meet the above requirements. The outline of the pipe can be the same as Fig. 111, the difference being the fitting of the flexible ring M, which is similar to an ordinary piston ring. The extra cost of fitting the ring will be compensated by the fact that the male and female parts can be much less accurately

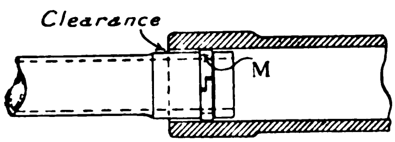


FIG. 112.

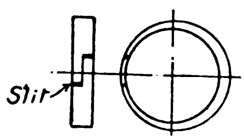


FIG. 113.

machined, but a reasonable amount of clearance must be provided to allow the ring M to definitely take a bearing and leave clearance between the face O. The type of joint ring should be such as shown in Fig. 113, which design provides practically a tight joint at the slit.

(*To be continued.*)

THE SWEDISH-GERMAN STEAM FERRY CONNECTION.—The Prussian Government has ordered the two German steam ferries for the Sassnitz-Trelleborg route from the Vulcan shipyard, in Stettin. The one ferry is to be ready by June 1st, 1909, but the firm thinks it will be ready by May 15th; the other has to be ready by June 15th.

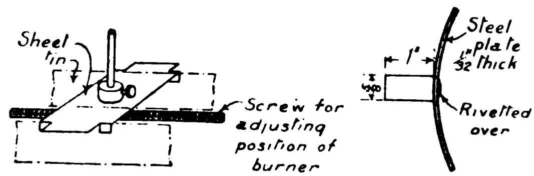
Practical Letters from Our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily for publication.]*

Electric Searchlight.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—In your reply to "H. B.'s" query recently you recommend an electric searchlight. As I have given considerable thought and time to the matter, and have always been very interested in the subject, I should like to recommend that instead of such an expensive apparatus an arrange-



ment which I have found to give good results might be considered.

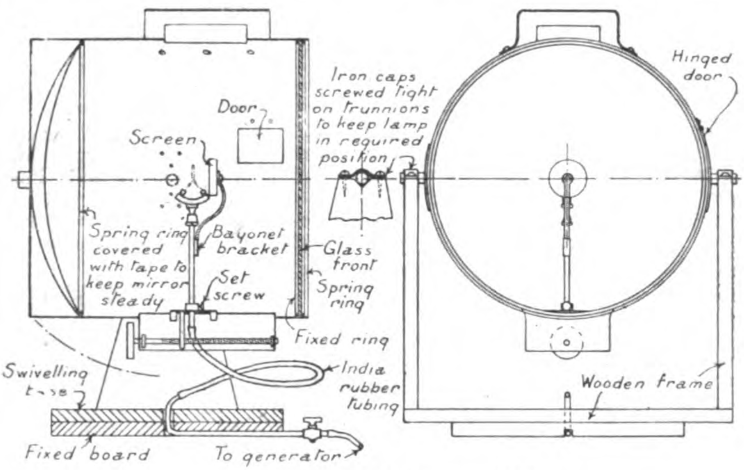
The illuminant is acetylene generated from a carbide-to-water generator, as Fig. 5 in your handbook on the subject. The generator is 7 ins. diameter and 14 ins. high, and has no guides nor sludge tank. The carbide chamber is closed by one of the patent stoppers used in small pickle bottles and a piece of thin sheet rubber about 1-16th in. thick. It is made of thin zinc and works perfectly; its cost is about 2s.

The projector consists of a 12-in. spherical glass mirror enclosed in a zinc body. The general design will be easily seen from the sketch. The mirror cost 2s. new. It is made, I believe, from spun glass, and is hollow like the baubles one sees for decorating Christmas trees, but of thicker glass. It is silvered on the inside and provided with a metal knob cemented on the back. Such mirrors are often seen placed behind incandescent gas lights in cycle shops, and shops which make a speciality of gas-lamp fittings. It requires careful handling, but once inside the projector it is quite satisfactory. If your correspondent has any difficulty in getting one, I think J. Yule, cycle maker, Manchester Road, Cubitt Town, Poplar, E., could help him.

The burner is a Bray's 28 litre "Elta" burner, using about 1 cub. ft. per hour; cost, 1s. The beam produced is fairly parallel, and even if a proper parabolic mirror were used, I don't think the result would be much better, because unless the source of light is very small, such as an arc, no mirror will produce a parallel beam.

I have a glass front, but do not use it unless the wind is high, as it absorbs a large amount of light. The spring ring holds the glass quite securely, and provides an easy means of removal for cleaning mirror, etc. There is a small door in the side of the projector for lighting up. And here a word of caution. Never put a light inside the lamp until it is certain that all the acetylene has been cleared out, otherwise an explosion may occur.

The small screen in front of the burner is to prevent the direct rays from spreading out in front,



MODEL ELECTRIC SEARCHLIGHT.

and thus spoiling the effect; the side next the flame is kept bright, and when looking at the light from in front the screen is hardly noticed. The screen is the lid of a small can 2 ins. diameter. The focussing gear is convenient, but the long screw is not necessary if some other means of securing the position of the flame is provided.

The whole is painted a dead black, and generator and projector cost together about 10s. Carbide is used at the rate of ¼ lb. per hour, which works out at 1d. per hour at 4d. per lb.

Finally, if there are any other points in which I could help "H. B." he can write me c/o the Editor, with this gentleman's kind permission, and I shall be happy to assist him further if I can.—Faithfully yours,

G. F. S.

A Centre Indicator.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—In reference to Mr. Muncaster's interesting letter in June 4th MODEL ENGINEER, on a "Centre Indicator," am I mistaken (no new experience!) in thinking that on the Drummond 3½-in. screw-cutting lathe, at any rate, equally accurate results may be obtained by putting the loose headstock immediately in front of the work as provisionally chucked and shifting the latter until the back-centre will find the "centre-pop"?

I have no experience of any other lathe, but I should imagine that this expedient would be available in most cases.—I am, yours faithfully,

"TIRO."

Hot Water Supply.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I notice in June 11th MODEL ENGINEER, Mr. Cummings' letter *re* my answer to W. G." some few weeks ago. I may say I did not intend my sketch to be taken as the proper way in which it should be done, "although it is the usual way of doing it in ordinary work," but only as the best way of getting hot water as "W. G." had it fixed, without altering the whole thing. Mr. Cummings says I have two wrong connections in my sketch. First, flow pipe from boiler is too low in cylinder: I agree with him on this point; but he should remember that "W. G.'s" cylinder had the holes in it in this position, and I did not know whether "W. G." could make a new hole higher up, and Mr. Cummings must allow it is rather a difficult job for an amateur if there is no manhole in cylinder. As for the actual working, it makes very little difference which of the two points flow pipe is connected to, the only advantage by connecting higher up is that hot water can be drawn a little quicker after fire is lighted. Secondly, he says that cold supply should be taken direct into boiler. I do not think he means this seriously, as a moment's thought will convince him of the folly of doing this. It has been tried many times and is always a failure, owing to the sudden contraction

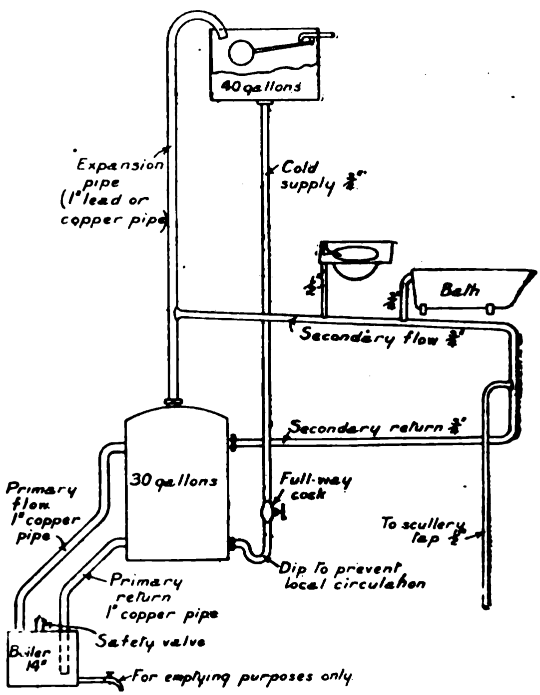


DIAGRAM OF HOT WATER SUPPLY.

of boiler when the cold water enters it. The boiler by this method is one minute hot and next quite cold, and, owing to the continual expansion and contraction, is bound to collapse; but when feed-pipe is connected to bottom of cylinder, the water is warmed before entering boiler and the contraction of boiler is not so sudden.

He also shows in his sketch a dip in feed-pipe *supposed* to prevent air lock. He does not say whether it will or not. The object of this dip is to prevent hot water working up feed-pipe to cold water cistern; or, in other words, to prevent what is known in the trade as "local circulating." This, however, it very rarely does, unless cold tank is fixed very near cylinder; and it is now a common thing for plumbers to connect feed-pipe direct without any dip, although this dip would always be shown in theory.

I have enclosed sketch of the correct way in which this system of hot water heating should be fixed, so that hot water can be obtained at any tap directly the tap is opened, showing primary and secondary flows and returns and the proper connections, also the smallest sizes of pipes to be used to expect good results, and if "W. G." cares to go to the expense of fitting his system as per my sketch (reproduced herewith), he will be perfectly satisfied with the result.—Yours faithfully,

"PLUMBER."

Coloured Plate of L. & Y.R. Loco No. 1421.

To the Editor of *The Model Engineer*.

Dear Sir,—In reply to "R. E. Y." (North Walsham), Query 19,381, may I state that he will find a good coloured plate of L. & Y.R. locomotive No. 1,421, 4—4—2 type, in the *Railway Magazine* for October, 1907? If he wants a larger one he can get it from the Railway Magazine Company, 30, Fetter Lane, Fleet Street, E.C., size 20 by 12 ins., price 6d. post free.—Yours truly,

"Locomotive."

Dirty Hands.

To the Editor of *The Model Engineer*.

Dear Sir,—Some months ago I noticed in your paper many letters from bank clerks, schoolmasters, and others who were model engineering enthusiasts, but were greatly inconvenienced by the important necessity of appearing with perfect hands. Many dodges and preparations were given as being efficient, but none would cleanse my hands after getting spirits of salts or sulphuric acid on them. Now, as I am a school teacher, this was a serious matter. However, a few weeks ago I found out a thoroughly efficient and very cheap cleanser for the dirtiest hands in the shape of "Cremo," a kind of washing powder to be obtained of most grocers, price 1½d. per packet. I can assure all engineers and others perfectly clean hands if they use this preparation instead of soap. Get about a tablespoonful in the palm of the hand and wet the other hand and use as a soap, rubbing every part. Rinse off the lather and all the dirt will be gone.—Yours truly,

J. W. C. Basnett.

The carrying of His Majesty's mails by petrol-driven vans is steadily increasing. A new service has just been started between London and Aylesbury. An 18 h.-p. Siddeley van is being used. It leaves Aylesbury at 7.30 each evening and arrives at Mount Pleasant just before midnight.

Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this Journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* The Model Engineer, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[19,875] **Launch Engine and Boiler.** A. W. B. (Billingshurst) writes: Would you please send me a sketch (also exact dimensions) of a compound engine to drive a launch 10 ft. long, 2 ft. 6 ins. beam, and 2 ft. 3 ins. deep, with two passengers, at a speed of about 12 miles an hour. Also send me dimensions of a steel boiler for above engine. Please state working pressure, also pressure to which boiler should be tested.

We can recommend a Stuart No. 3 compound engine, with cylinders 1½ ins. by 2¼ ins. by 1½ ins. To obtain 12 miles per hour, however, the boiler will have to be very powerful. We should not fit one with less than 2,000 sq. ins. of heating surface, and one which will stand at least 120 lbs. per sq. in. working pressure. A small locomotive type boiler, with wide firebox, would give good results and not be top-heavy. The barrel should be short; indeed, the whole design should be stumpy. We recommend one with 12-in. diameter barrel, 18 ins. long, with twenty-five to thirty tubes ½ in. diameter. The firebox may be 14 ins. wide at the bottom and about 12 ins. long. Plates should be 3-16ths in. thick and longitudinal seam double-riveted. Working pressure, 120 lbs. Test pressures—water, 200 lbs.; steam, 160 lbs.

[19,735] **Strength of Model Boiler.** B. C. H. (Burnt Ash) writes: Boiler Pressure. A locomotive type boiler, 2¼ ins. in diameter, 9 ins. long, is built of 1-16th in. (bare) seamless copper tube; it has ¼-in. gun-metal ends and five ⅜-in. (full) water tubes (no downcomer). One ⅛-in. nutted stay connects the ends. The whole is well fitted and silver-soldered. May a water test of 200 lbs. per sq. in. be applied with safety? If so, can a steam pressure of 150 lbs. on square inch be raised with confidence? If not, what should be the material and construction of a boiler of this size to carry the pressure named? The ⅜-in. diameter tubes are about 1-32nd in. thick.

Yes, quite safely. The ends are needlessly stout. They may be ⅛ in. full in thickness and not ¼ in., which makes the ⅛-in. stay superfluous. The shell may be 18 S.W.G. The bursting pressure of such a tube would be about—

$$\frac{\text{Strength of metal} \times \text{Thickness} \times 2}{\text{Diameter of tube.}} = \frac{20{,}000 \times 1}{2\tfrac{1}{4} \times 10} = \frac{2{,}000 \times 4}{9} =$$

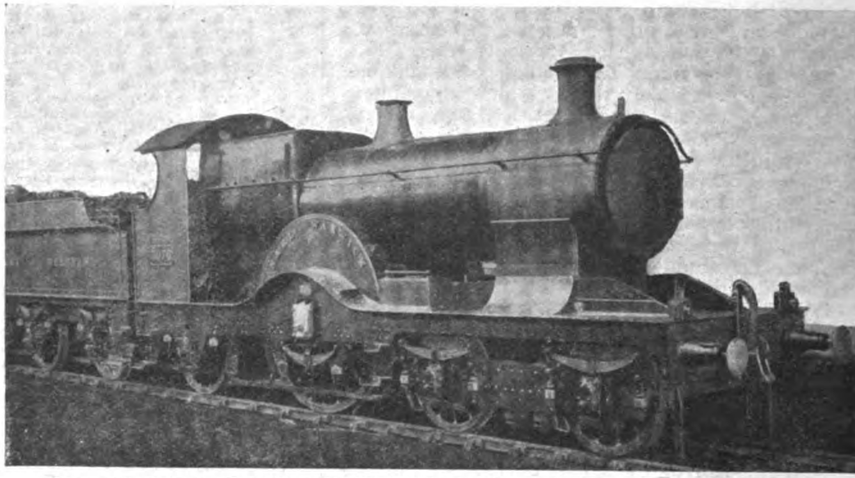
900 lbs. per square inch.

[19,712] **Elementary Electricity; Electric Motor Cars.** M.B. (Manchester) writes: I should be much obliged if you will kindly reply to the following queries:—(1) I have got twenty-five 4-volt. 10-amp. accumulators. If I connect them all together, will I get 100 volts 250 amps.? (2) Surmising that I do get 100 volts 250 amps., will that be powerful enough to drive an electric motor at a good speed and with sufficient force to work an electric motor-car to seat two persons, without the aid of petrol? (3) If not, what volts and amps. do I need, and how long will it take to charge it with a charging adaptor from the house supply of current? Salford electricity is 220 volts.

(1) When cells are connected in series the total voltage is the sum of their individual voltage; and cells connected in parallel the total current output is the sum of the output of each individual cell, the voltage remaining equal to that of one cell. We advise you to look up some elementary text-book such as "Electricity for Beginners," by Perrin Maycock, or Sylvanus P. Thompson's "Lessons in Electricity and Magnetism." (2) It is hardly practicable for you to construct an electric motor-car. Even firms doing this on a commercial basis, with any amount of capital, find the matter a very difficult one. You would also find it extremely costly. (3) It would cost you a large amount per week to buy current in sufficient quantities for charging accumulators capable of driving even a comparatively small car running 4 or 5 hours every day.

[19,813] **G.W.R Single Locomotive 3027 Class.** G. W. S. (Manchester) and others write: Kindly publish a drawing of the G.W.R. bogie singles with both the domed and Belpaire fireboxes.

The "Dean" 7 ft. 8 in. class of single express locomotive on the G.W.R. have had many phases since they first appeared. Some were originally built as 2—2—2 type broad convertible engines, and were, on the abandonment of the broad gauge in May, 1892, rebuilt for the narrow gauge. Some years later (about fourteen years ago) the "Wigmore Castle" 3,021 ran off the road in Box Tunnel, and was rebuilt with a leading bogie with outside frames, the cylinders being reduced from 20 ins. by 24 ins. to 19 ins. by 24 ins. Mr. Churchward has lately rebuilt several of the type with "Atbara" boilers, the "Worcester," 3,027, being the first. The engine shown in the photo is the "Earl of Warwick," 3,070, one of the later of Mr. Dean's singles, which, by the way, were built with bogies from the first. The "Nelson" is slightly different to the "Worcester." The boiler, judging from appearance, is about 3 ins. lower, and the old type of smokebox and chimney is retained. The Belpaire box, also, does not project so much above the barrel, and there are minor differences in heights of the cab. The two drawings are reproduced to the same scale. This type of engine holds brilliant records in the matter of speed, and ranks among the most handsome engines in the country.



PHOTOGRAPH OF REBUILT G.W.R. SINGLE LOCOMOTIVE, NO. 3,070 CLASS, "EARL OF WARWICK."

[19,450] **Steam Port Proportions.** J. S. (Dunfermline) writes: Would you kindly answer me the following queries? I am about to make a small steam engine and should like the cylinder to be 3-in. stroke and 1½-in. bore. (1) What size should steam ports and exhaust be? (2) What horse-power will this give me, and what pressure of steam would I need?

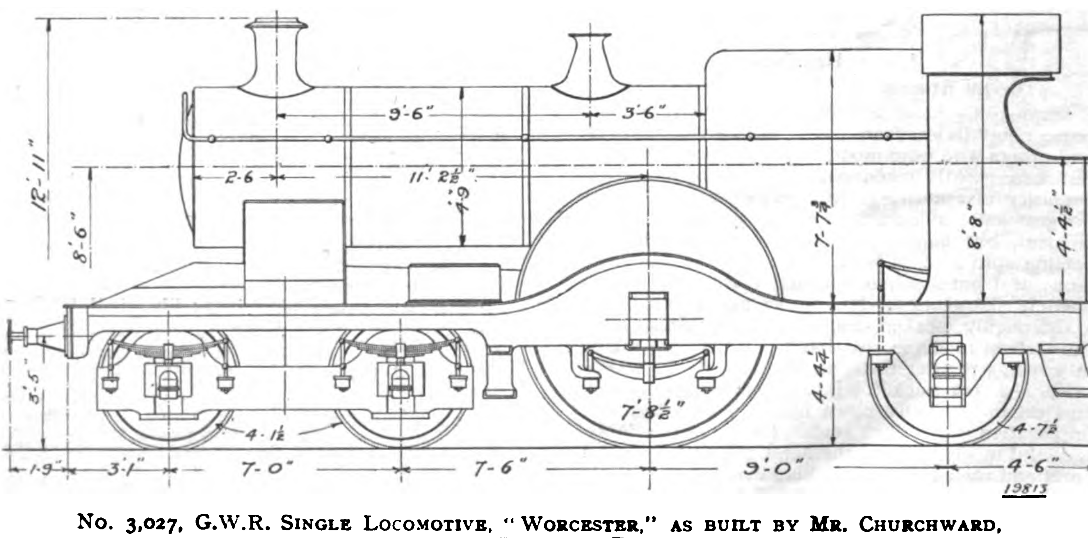
(1) Steam ports, ¾ by 3-16ths; exhaust ports, ¾ by ⅜: port bar, 3-16ths in. or 7-32nds in. (This is for moderate speeds.) (2) The horse-power will vary directly as the mean pressure of steam in the cylinders. At 50 lbs. pressure in the steam chest and 500 r.p.m. the indicated horse-power would be—

A × L — ¼ × 3-12ths — 7-16ths i.h.-p.

At 250 revolutions it would be half this.

[19,507] **Lagging Vertical Boiler.** H. G. B. (London) writes: I have a vertical copper boiler which I have lagged with sheet asbestos kept in position by strips of iron. This is not satisfactory and gets very knocked about and tears. What can you recommend? I notice large boilers are covered with a sort of cement (presumably asbestos cement). Can I make this, and will it stick to the boiler?

The only satisfactory method is to cover the boiler with a sheet-iron or steel "cleading." Planished steel of a blue colour can be obtained now at very reasonable prices in all thicknesses and looks very well. We do not recommend you to use any unprotected covering on a small boiler. It is exceedingly difficult to prevent it looking untidy.



NO. 3,027, G.W.R. SINGLE LOCOMOTIVE, "WORCESTER," AS BUILT BY MR. CHURCHWARD, WITH THE DOMELESS BOILER.

[19,740] **Electric Locomotives.** W. T. (Willesden Green) writes: Will you kindly furnish me with dimensions of Metropolitan electric locomotive (old Central London type)? Also gauge and quantity of wire for armature (1½ ins. by 1½ ins., eight-section drum) and field-magnet for above.

We have already published a drawing of the old C.L.R. locomotives (see issue of February 15th, 1902). We would point out that this type of locomotive does not permit of being used with rolling-stock of the ordinary standard dimensions, owing to the great difference in buffer levels, and if you have not commenced the model railway and are not building a miniature "Tube," you would do well to consider the merits of the Metropolitan Railway self-contained locomotives (see issue of July 25th, 1907). For windings of motor, see Handbook No. 10, "Small Dynamos and Motors," price 7d. post free.

[19,725] **Supply for Coils for Wireless Telegraphy Apparatus.** H. P. (Torquay) writes: I am much interested in Mr. Delves-Broughton's articles now appearing, also Mr. Howgrave-Graham's letter bearing on wireless telegraphy and the excitation of induction coils by means of alternating currents. I understand these gentlemen have used this current applied direct to coils without any form of break depending upon the resonance of the primary and secondary circuits. This particularly interests me, as I have lately made an alternator giving 5·8 amps. at 100 volts, frequency 114, and would like to also make a resonance coil to work off alternator. (1) Can you please give me specification for making such a coil? (2) Any information regarding the control and adjustment of above. Also whether these resonance coils allow of much alteration being made in the capacity of the secondary circuit, viz., could the coil be used on a plain aerial as well as a tuned one? (3) How is the coil brought into use for signalling purposes? Would it be brought into resonance by the short-circuiting of choking coils placed in the primary circuit?

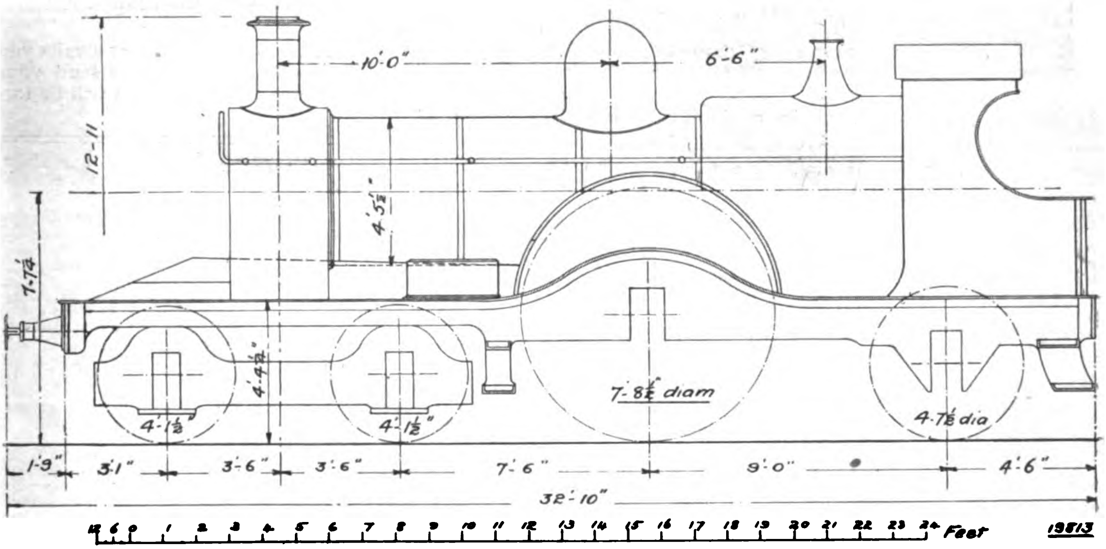
Yes, an alternating current can be applied directly to the induction coil for wireless telegraphy, but probably a choking coil will be required to regulate the primary current. The resonance between the primary and secondary circuits has nothing to do with the action of this apparatus. All that happens is—that as the alternating wave-form rises to its maximum value the aerial becomes charged until a point is reached at which the potential difference between the spark-balls is able to pierce the gap. Then there is a group of oscillations. Another group is formed when the alternation rises to a maximum in the opposite direction. It is clearly impossible to get resonance between the secondary of any ordinary transformer or induction coil and the very high-frequency combination which the aerial gives. The highest frequency usually met with in ordinary alternators is 100 cycles per second, and even if we use one specially designed at great trouble and expense to give a few thousand cycles per second, it cannot be made to resonate with an aerial with a natural frequency somewhere in the region of 1,000,000 per second. Your alternator would probably work all right for charging an aerial in the ordinary way, as described above, and an ordinary good spark-coil will transform the pressure to a high enough value. You *may* need a transformer to reduce primary voltage, instead of a choking coil, as you have only 5·8 amps. available. Signals are sent by making and breaking the primary circuit. The secondary discharge is dangerous.

[19,758] **Motor Cycle Fittings, etc.** W. A. (Grimsby) writes: Will you kindly answer me the following queries? (1) Where can I obtain ordinary and motor cycle spokes and rims, also dies for threading spokes? (2) Where to obtain B.S.A. motor cycle fittings? (3) Where to obtain book on cycle brazing, tyre vulcanising, etc.? (4) Where to obtain blowlamp for brazing?

Your best plan would be to purchase your fittings, etc., from some local cycle maker, then you can see exactly what you are getting. Or you could write to some of the manufacturers advertising in the cycle papers and ask for address of nearest agent. Any of our tool advertisers would supply you with suitable blowlamps for brazing. The under-mentioned books would also meet your requirements: "Cycle Building and Repairing," by Hasluck, price 1s. 2d. post free; "The Auto-Car Handbook," 1s. 9d. post free.

[19,751] **Lighting for Model House.** J. S. L. (Spondon) writes: Would you kindly, through the medium of your paper, advise me as to the method of carrying out the following plans? I am making a model of a house to a scale of 1 in. to a foot (which is to be used as a dolls' house for my children), and want it to be lighted by electric light and have a working lift. Not knowing much about electricity, I am not sure what cells or batteries and kind of wire I should require to keep, say four or six 4-volt pea lamps lighted. I intended to use the same cells or batteries to work the lift (not necessarily at the same time). I have a small electric motor which works the lift all right, attached to gear-wheels; but it takes three bichromate cells to work it, and then does not work for long at a time; the cells are rather rough, and the fluid is exposed to the air and quickly gets weak. My idea was to be able to light up about five lamps at once; then to switch off and work the lift, and perhaps one light, with the same cells. What can you recommend as to the cheapest and best method of working this? I have plenty of room in the roof of the house for any cells, but if fluids could be avoided it would be better. The furthest distance from the cells along which the current would have to travel to a lamp would be about 3 ft. 6 ins.

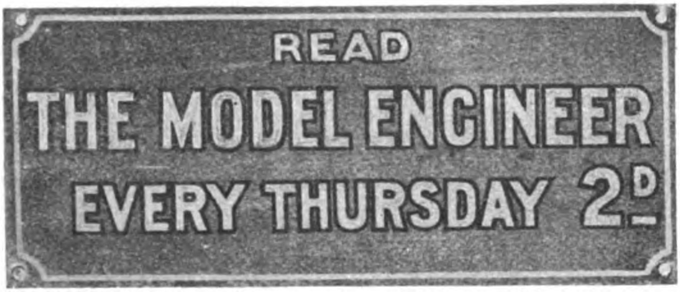
No. 20 S.W.G. wire will be suitable for all your connections. For the lamps we should suggest that you employ two or three good dry cells, which can be obtained from any of our electrical advertisers. The number to connect in series will depend upon the voltage your lamps take, but this point you can settle for yourself. Bichromate cells could then be used entirely for working the lift, and we do not think that you can improve upon this type of cell for simplicity and general convenience. The small lamps would, of course, be connected in parallel; otherwise, if they were in series, the number of dry cells required would increase beyond a convenient figure.



No. 3,027 Class 4—2—2 Type G.W.R. Single Express Locomotive, as built by Mr. Dean after "Box Tunnel" Accident.

The Editor's Page.

We show in the accompanying photograph a miniature advertisement plate of The Model Engineer suitable for fixing on the walls and stations of model railways, just as the ordinary daily papers are advertised on the big railway stations. These are neatly printed on the plate



in blue and silver, the exact size of the illustration, and look very effective. We shall be pleased to send any quantity up to eight, free to any model railway owner who will send us a stamped addressed envelope. Readers who would like one or two to put up in their workshops are also welcome to have them.

* * *

We shall commence next week the promised series of articles on a 3-in. scale model traction engine, the design being by Mr. Henry Greenly. The prototype has been carefully chosen as being both an excellent example of the best practice in this branch of engineering, and a type particularly suitable from the model maker's point of view. A model of this kind should prove very attractive to those readers who have a partiality for engine driving, but who have not the space to put down a track for a large scale model locomotive.

* * *

We are pleased to note that the Gordon-Wigan Prize of £50 for original chemical research has been awarded by the authorities of Cambridge University to Mr. Leonard A. Levy for his work entitled "Investigations on the Fluorescence of Platinocyanides." Mr. Levy will be remembered by many of our readers as the contributor of some interesting notes on "Radium" to these pages, and as the joint author, with Mr. Willis, of our handbook on the same subject.

* * *

A Society which deserves to be widely known amongst those interested in all branches of skilled craftsmanship is the National Institution of Apprenticeship. The function of this Institution is to promote the apprenticeship of suitable boys and girls to suitable trades, and its operations are conducted on a purely philanthropic basis, no charge being made for its services. It receives applications from boys and girls desirous of being apprenticed, selects those which are most suitable, and makes enquiries as to their respectability and fitness for the work. It invites applications from employers desiring apprentices, and selects a suitable boy or girl for trial. A very interesting collection of work done by apprentices who have been recommended by this Institution is to be seen at the Franco-British Exhibition. The Honorary Secretary will be glad to answer any enquiries addressed to—39, York Place, Baker Street, W.

Answers to Correspondents.

W. F. Miller.—A letter awaits you at this office. Please send your present address and it will be forwarded to you.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

How to Address Letters.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to The Editor, "The Model Engineer," 26—29, Poppin's Court Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to The Advertisement Manager, "The Model Engineer," 26-29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk (*) denotes that the subject is illustrated.*]