A guide to diesel locomotive trucks

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RICHARD BALE REVIEWS TRUCKS FOUND ON DIESEL LOCOMOTIVES...

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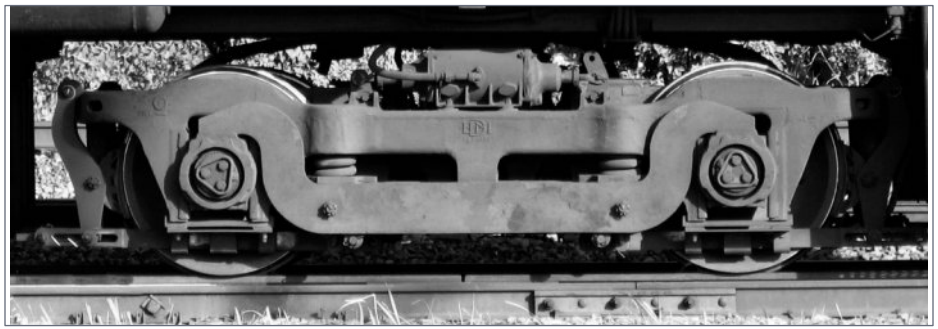
VIEW READER COMMENTS

PRIOR TO THE MID-1930S, experimental work began to develop rail cars and light locomotives powered by internal combustion engines driving an electric generator. They utilized trucks designed for trolleys and electric locomotives.

In 1924 a consortium of Alco, General Electric, and Ingersoll-Rand built the first standardized line of diesel-electric switch engines. The little switcher used a simple truck based on trolley technology of the period [4].

One of the first traction trucks that evolved into practical use on diesel-electric locomotives was a basic two-axle, two-motor truck developed by General Steel Casting in the 1920s. It got beefier over the years, but the basic plain-Jane design remained unchanged. Although never officially approved by AAR, the GSC Type A truck [1] is also known as an AAR Type A Truck.



1. This GSC Type A two-axle, two-motor truck was developed in the 1920s for electric locomotives. Spotting features include a pair of bulges that surround coil springs for the double dropped equalizers.

It was not until the mid-1930s, when EMC, predecessor to EMD, began work on its E series passenger locomotive, that an entirely new truck designed specifically for a diesel-electric locomotive appeared [19].

Over the years, the Type A truck was built with both plain and roller journal bearings. The original design had 40″ wheels on an 8′-wheelbase. Some later versions were extended to 9′-4″.

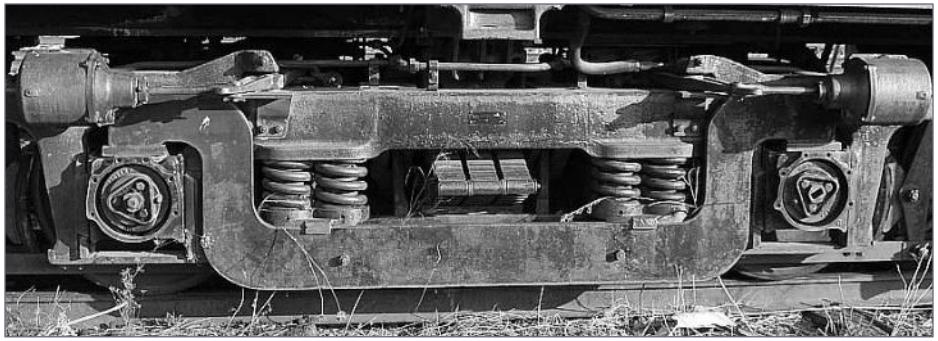
Among the early application of this truck on diesel locomotives was in 1936 on EMC's SC, SW, NC and NW light switch engines. Additional applications included Baldwin's VO and DS-series of switchers built from 1939 thru 1948.

In the 1940s and 50s Alco and EMC/EMD used the Type A truck on various industrial switchers. Fairbanks-Morse used this truck on its H-10 and H-12 light switchers built between 1944 and 1961. Montreal Locomotive Works used this truck on many of its S-series of yard and light switch engines.

After GSC's patents expired, Adirondack Iron & Steel Co. began supplying both raw castings and assembled versions of the Type A truck.

GSC introduced its Type B (aka AAR Type B) truck in 1941. It featured paired equalizer coil springs, swing motion, and triple-section elliptical bolster springs. EMC used an early version of this truck on its 1200hp Model TA cab unit built for Rock Island's Rocket in 1937 [2].

Alco used the GSC Type B truck on its FA cab units, B-B Century series locomotives, and RS and RSD-1 B-B road switchers. It proved to be a fundamentally sound design that was used into the early 1960s. A version of this truck with 42″ wheels on a 9′-10″ wheelbase was used on Baldwin's RF-16 Sharknose cab units introduced in 1950.



2. GSC introduced its Type B (aka AAR Type B) truck in 1941.

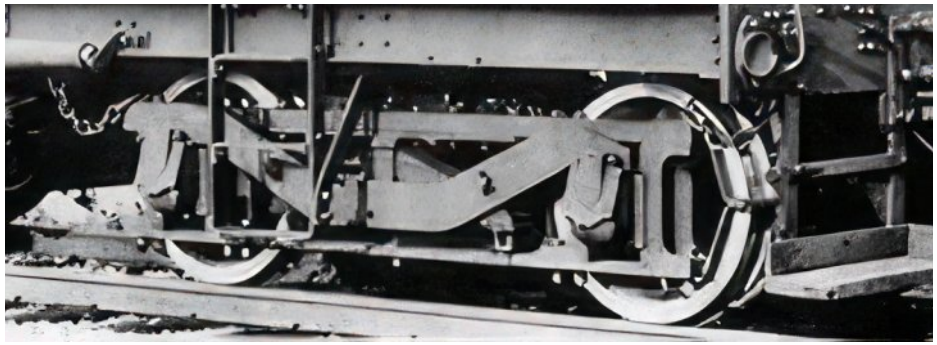
3. This three-axle two-motor A1A truck had a wheelbase of 15′-8″. In addition to its extended length, spotting features include goose-neck dropped equalizers with paired coil springs, and two-section elliptical bolster springs. Fairbanks-Morse used it to its Erie-built cab units in 1945. The truck made a more visible debut the following year when it appeared under Alco's highly publicized PA/PB passenger units. Variations over the years included wheel bases ranging from 7′-3″ to 9′-4″.

R. Bale

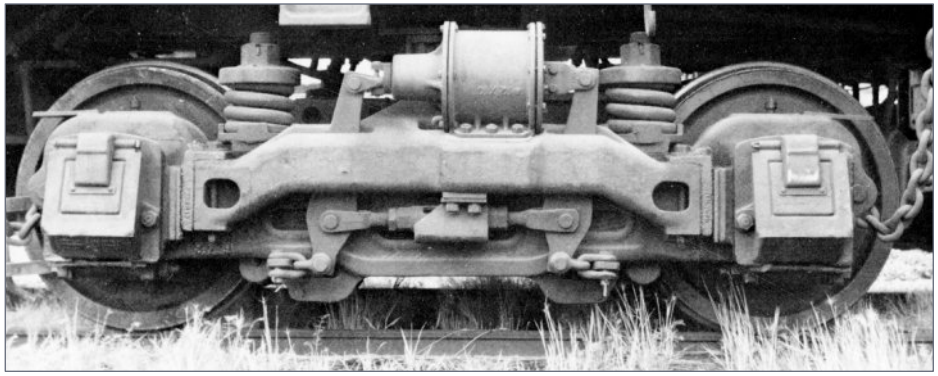
TRUCK MANUFACTURERS

The principal suppliers of castings for railroad trucks include General Steel Casting Corporation (GSC) established in 1928, it changed its name to General Steel Industries (GSI) in 1961; Adirondack Iron & Steel Co. (acquired by Rockwell in 1987), the Dominion Foundry & Steel Company, Hamilton, ON (Dofasco), now known as ArcelorMittal Dofasco, and Locomotive Finished Material Co. (LFM) of Atchison, Kansas. Identifying some trucks can be challenging since cast frames supplied by more than one foundry did not always look alike. For example see [29, 32 and 33]. Some locomotive builders had the ability to fabricate their own trucks by welding the frames from steel stock [26, 27, and 35].

ALCO LOCOMOTIVE TRUCKS



4. In 1924 Alco, General Electric, and Ingersoll-Rand combined their specialized capabilities to produce the first standardized line of diesel yard switchers. Over the next four years a total of 19 units were delivered with this fabricated truck having an outside equalizer.



5. Alco used this Blunt B-B truck on several early engines including a 60-tonner in 1931 and the S-2 and S-3 switchers introduced in 1940. The Blunt truck was an in-house design that had a reputation of performing well on rough track. It utilized 40″ wheels on an 8′ wheelbase. Note the beefy coil springs extending above the inside equalizers.

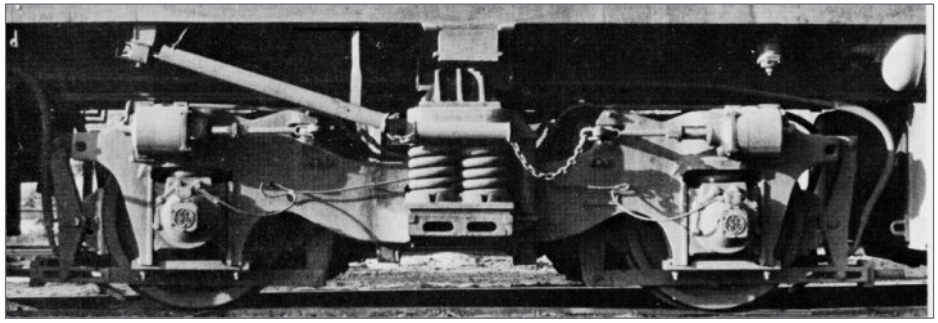
WHEEL SLIPPAGE

A critical factor in truck performance is wheel-to-rail adhesion. During periods of acceleration, high-horsepower locomotives suffer from wheel slippage. The torque generated by the axle-mounted motors tends to tip the truck, with the leading axle rising and the trailing axle digging in – the same as an automobile does when you stomp on the gas pedal.

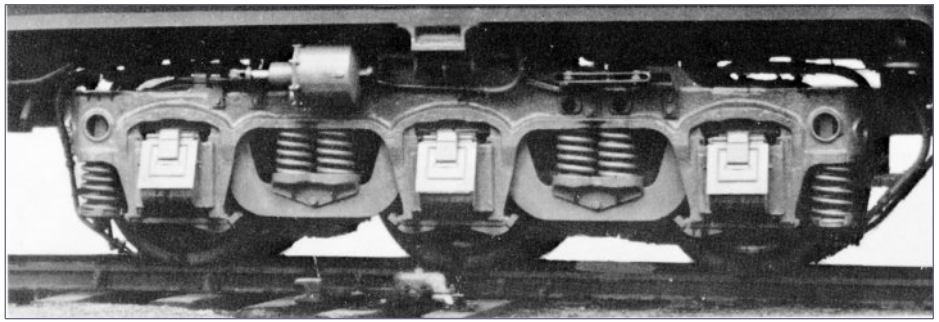
The tipping action puts less weight on the truck's leading wheels, which causes them to slip. Eliminating, or at least significantly reducing, wheel slippage involved, developing a way to spread weight on the entire truck rather than just through the center pin.

Addressing wheel slippage became a major issue that locomotive builders and operators could not ignore. Alco's answer to the problem came in 1947 with the introduction of a three-

motor high-adhesion truck [9]. EMD introduced its HT-B high-adhesion truck [17] and wheel-slip detection system in 1977. GE spread the weight on trucks with its Floating Bolster system [29] available in 1969.



6. In late 1965, Alco offered this high-adhesion two-axle truck on its Century series C415 center-cab heavy switcher. It was also used as an extra-fare option on Alco's high horsepower C430 road switchers introduced in 1966. Note the chain and chain-tubes for the hand-operated parking brake.



7. Alco used this A1A freight truck on its early DL-109 cab unit introduced in 1941. Note the plain bearing journals, inside drop equalizers, and secondary equalizer springs at both ends of the frame. This truck was also used on Alco's RSC-2 and -3 road switchers.

EQUALIZERS

Equalizers are steel levers that link axles together so that a jolt received by one wheelset is distributed to and partially absorbed by the other. Equalizers were standard on passenger trucks prior to the development of diesel locomotive.

Three forms of equalizers are used in powered trucks. A common design for two-axle trucks is a double drop equalizer with one inside the frame and one outside. The outside member can be seen resting on the top of the journal box [1 and 11].

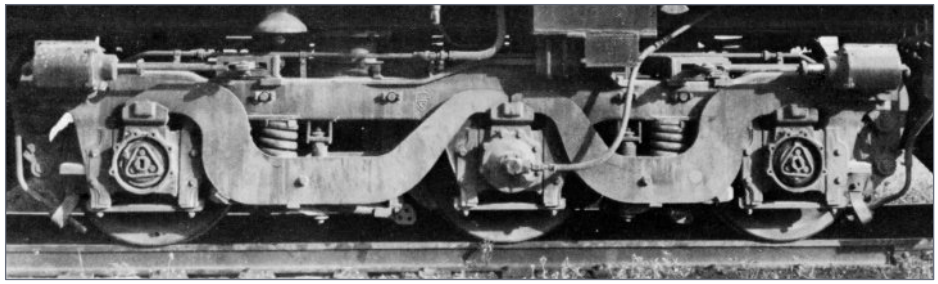
Trucks with single inside drop equalizers are relatively easy to spot [7, 25]. Drop or bottom equalizers on three-axle trucks usually consist of a pair of dog-leg members looped between the journals on each axle [3]. Straight equalizers are mounted internally and for modeling purposes are generally not visible [12].

As locomotives grew heavier, three-axle trucks were needed to help spread the weight on the rails. Among the earliest was an AAR approved A1A truck [3] with a wheelbase of 15' -2". It had a traction motor on the outer axles with the middle axle functioning as a weight-sharing idler.

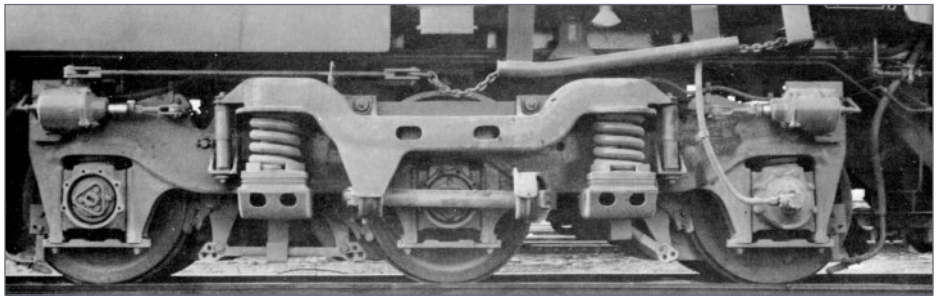
As the diesel industry proliferated, so did the variety of trucks. There was some commonality, but locomotive builders tended to favor particular truck designs. Distinctive proprietary models that are easily identified include Alco's two-axle Blunt truck [5], Baldwin's two-axle Batz truck [10], and EMD's two-axle Blomberg truck [14].

FLOATING BOLSTER

The three original trucks with floating bolsters – EMD's Flexicoil, Alco's Hi-Ad and GE's FB series – all functioned generally the same. EMD's Flexicoil [20A] has a coil secondary suspension



8. Alcos initial use of this three-motor truck with a 12′-6″ wheelbase and unequal axle spacing was on its RSD-4 and RSD-5 road switches demonstrated in 1951-52. Five years later Alco used this truck on its RSD-12 and -15 road switchers as well as on its high horsepower C-628 and C-630 locomotives. GE used a nearly identical looking truck on its U25C, U28C and U50C road switchers. In addition to the staggered axles, spotting features include massive double dropped gooseneck equalizers. MLW used a two-motor version of this truck on its RSC-13 road switcher introduced in 1955.



9. High horsepower locomotives suffered from wheel slippage, especially during periods of acceleration. Alco's answer to the problem came in 1947 with the introduction of this three-motor high-adhesion truck with a wheelbase of 13′ -7″. Of note is the uniquely shaped equalizer with the supporting coil springs located outside the truck frame. The equalizer has automotive–type shock absorbers at each end and a descending leg on the left that is tied to the truck frame by an anchor bolster. Alco locomotives with this Hi-Ad truck included the Century series C-636. This truck was available as an option on Alco's 3000hp C-630 road switcher.

between the truck frame and the bolster. Alco's three axle Hi-Ad truck is functionally like the EMD Flexicoil except the coil springs are mounted outside the truck frame.

In addition to conventional springs, GE's FB-3 floating bolster truck [32] utilized a secondary suspension system consisting of four stacks of rubber pads connected directly between the trucks and the locomotive under frame. Dofasco worked with GE in developing the truck. The truck was introduced in 1966 on the 3300hp U33C road switcher.

Bolster Anchor

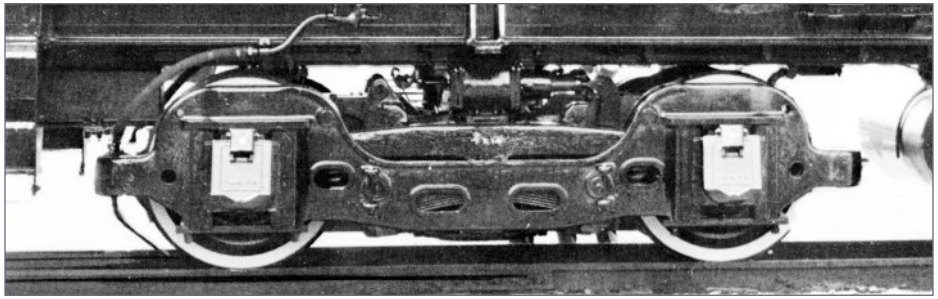
The bolster anchor, also known as a floating bolster, horizontal stabilizer or drag link, was developed by General Steel Casting Corporation in the very late 1930s for passenger car trucks. The bolster anchor is typically a heavy rod that ties the truck frame to the bolster [9].

The anchor permits the bolster to move vertically while keeping it square with the side frame of the truck. Shock and vibration are minimized by substantial rubber mounts on each end of the rod. Among the earliest applications of a bolster anchor on a diesel truck was in 1949 when Budd used the device on trucks for its RDC commuter cars [36].

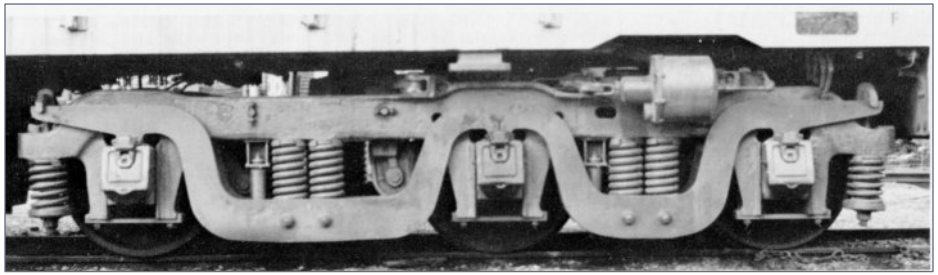
Swing Hangers

Swing hangers are U-shaped links that suspend the bolster spring from the truck frame. The swing hanger may be outside [14] or inside [23] the truck frame. The hanger allows the spring assembly to move from side to side, thus reducing the transfer of shock from sideways movement of the wheels to the body of the locomotive.

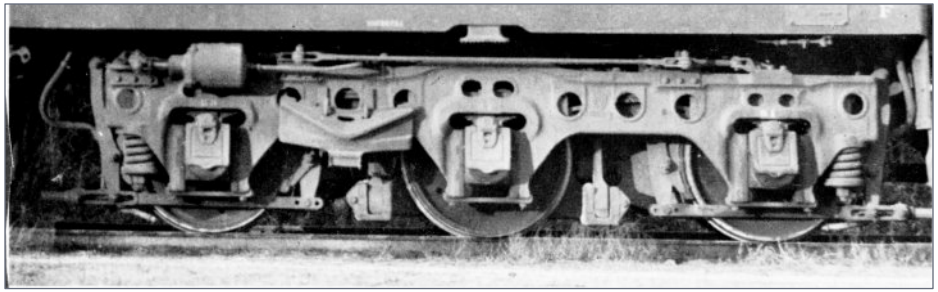
Baldwin Locomotive Trucks



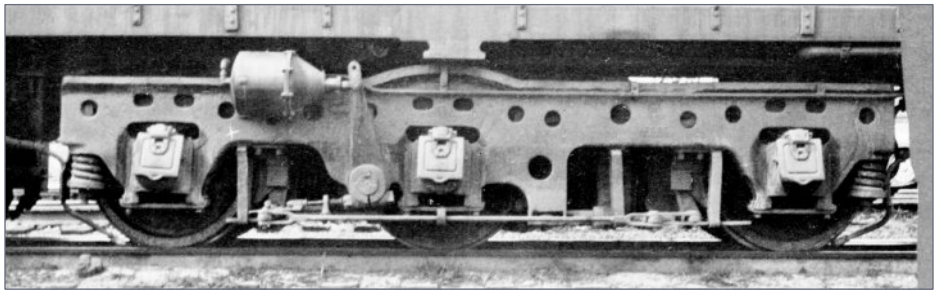
10. The Batz plain-bearing truck was a Santa Fe property licensed to Baldwin which used it on many of its B-B industrial and yard switchers built from the late 1930s into the mid-1950s. This included Baldwin's popular VO 660 and VO 1000 switchers introduced in 1939, and some units in the DS-4-4 series beginning in the post-war period.



11. Baldwin's RT-624 center-cab transfer units introduced in 1951 used this double drop equalizer truck, except they were equipped with roller bearings. Note the unequal axle spacing on this three-axle, three motor truck.

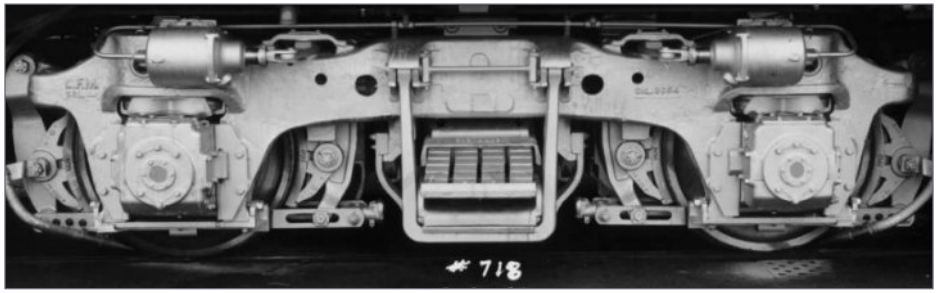


12. Baldwin used this A1A two-motor truck with unevenly spaced axles for its DRS-6-4-15 and AS-416 road switchers built between 1946 and 1955. Note the springs for the straight inside equalizer are visible at both ends of the cast truck frame. Baldwin continued to favor trucks with plain-bearing journals into the late 1950s.



13. This cast-frame truck with 42″ wheels and a 13′ wheelbase was used by Baldwin on the DT-6-6-20 mid-cab transfer units built in 1948. Lima used it on its 2500hp transfer locos cataloged in 1950. Note the uneven axle spacing, inside equalizers and plain-bearing journals.

EMD LOCOMOTIVE TRUCKS



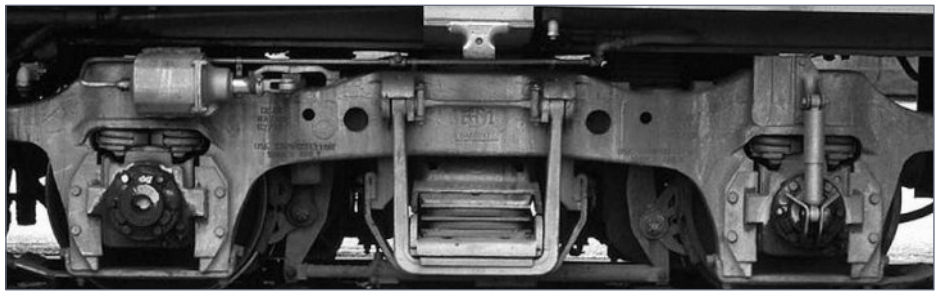
14. EMD's four-wheel two-motor Blomberg B truck was introduced in 1939 on the revolutionary FT freight diesel. The truck had a 9′ wheelbase and used 40″ wheels. The prominent U-shaped outside swing hanger supporting the elliptical bolster spring assembly helped mitigate sudden jolts and reduced crew fatigue. A pair of small coil springs were positioned above each journal box. This truck, and its variations, served as the principal truck on EMD B-B locomotives including all F and GP units, the MP15 and NW5 switch engines and the F40PH and F59 cowl units. EMD's Blomberg B was arguably the most successful two-axle, two-motor truck design of all time.

Martin Blomberg

EMC/EMD engineer Martin Blomberg incorporated swing hangers in his eminently successful four-wheel [14] and six-wheel diesel trucks.

Blomberg's three-axle A1A truck [19] was specifically designed for the E-series passenger diesel-electric locomotives that debuted in 1937. It featured outside U-shaped swing hangers on the two-section elliptical bolster springs and the visual absence of equalizers. A pair of small coil springs were positioned above each journal box. With minor changes, EMD continued to use this truck on new equipment as late as 1963.

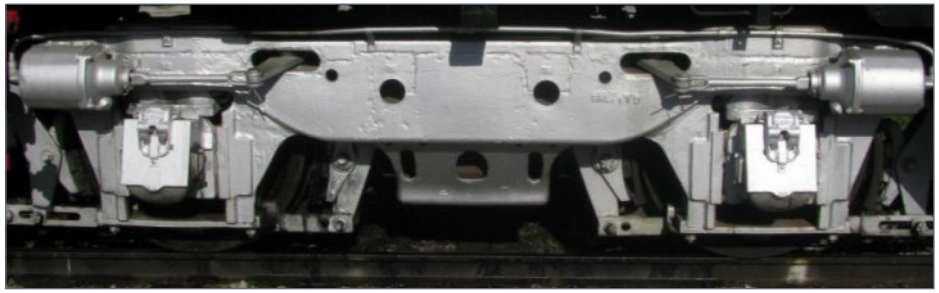
In 1939 Blomberg designed a four-wheel truck that also displayed a prominent U-shaped swing hanger. Known as the Blomberg B, the truck was first used on EMD's revolutionary FT series of diesel-electric freight locomotives. The Blomberg B continues to be seen on locomotives in the 2000s. ■



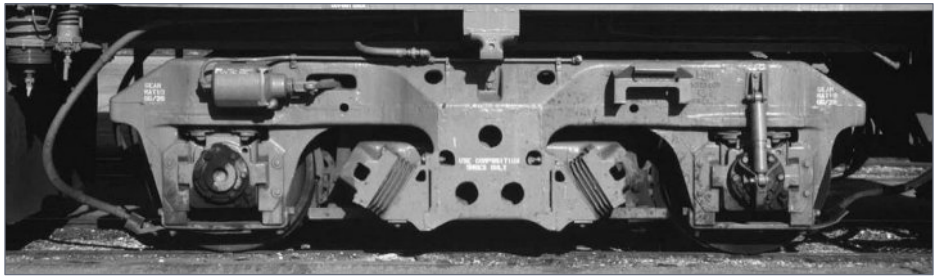
15. The Blomberg M (for modified) truck was introduced in 1972 on EMD GP40 locomotives. Modifications included replacing the elliptical bolster springs with rubber spring pads, which required a slightly shorter swing hanger. Additional changes include adding automotive-style shock absorbers and eliminating the outer brake shoes.

Journal bearings

The application of roller bearings on lightweight passenger cars was almost universal by the late 1930s, but some railroads continued to specify plain or solid-journal bearings on orders for new diesel locomotives well into the 1950s [11, 16].



16. This two-axle two-motor EMD Flexicoil truck had a wheelbase of just 8′. It was introduced in 1954 as an upgrade option on EMD's SW1200 switcher. Both plain- and roller-bearing versions were available.



17. EMD's HT-B truck (high-traction, two-axle, two-motor) was developed for the 3500hp GP40X road switcher built in 1977 for the Southern Pacific and Union Pacific railroads. After the initial production run, subsequent buyers specified the thoroughly proven Bloomberg M trucks [15] for their GP40X locomotives.

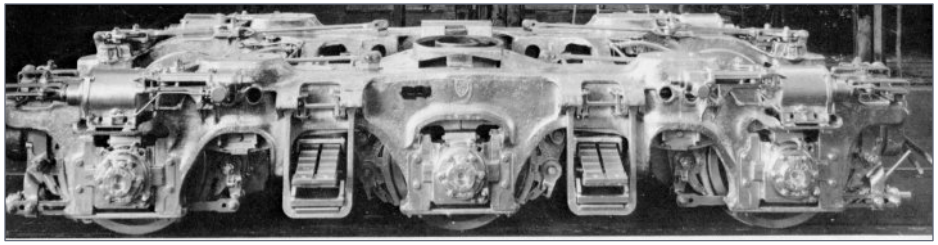
18. EMD first used this modern truck on the F125 commuter locomotives built from 2015 thru 2021 for the Southern California Metrolink. Note the paired coil bolster springs and the use of three automotive style shock absorbers.

SPRINGS AND SHOCK ABSORBERS

Bolster springs on diesel trucks usually consist of an assembly of elliptical springs of varying lengths. As the elliptical leaves flex against one another they tend to be self-dampening.

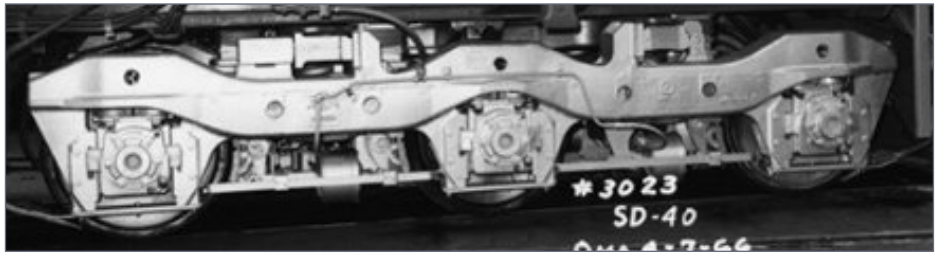
Equalizers were almost always fitted with coil springs, which need less space [7]. They provide a softer response, but they can be bouncy and develop harmonic vibrations. To help mitigate the bounce, coil springs require a damping device such as a second inner coil wound in the opposite direction.

Bolster assemblies utilizing coil springs were usually fitted with shock absorbers [18, 30A]. Monroe tubular hydraulic shock absorbers modified for use on railroads were introduced in 1938 [15, 29C].

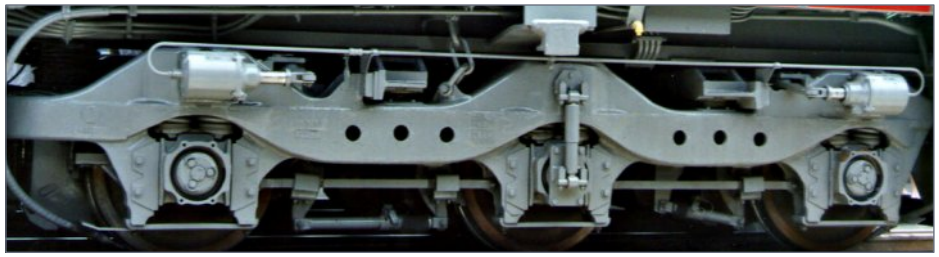


19. Engineer Martin Blomberg designed this two-motor A1A truck in 1937 for EMD's E-series passenger diesels. Distinguishing features include even axle spacing, outside U-shaped swing hangers on the two-section elliptical bolster spring assembly and the visual absence of equalizers. A pair of small coil springs were positioned above each journal box. The truck had a wheelbase of 14′-1″. A few were assembled with 36″ wheels, but most had 40″ wheels. EMD continued to use this truck on new equipment as late as 1963.

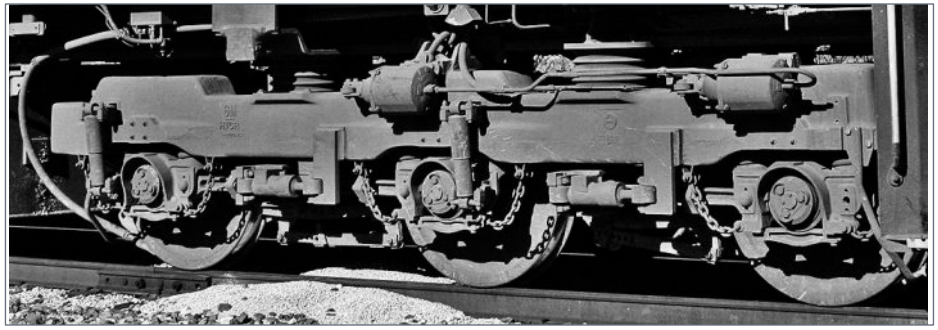
20a. EMD introduced the three-axle, three-motor Flexicoil C1 truck on its SD7 road switcher in 1952. It had 40″ wheel on a 13′-7″ wheelbase. A spotting feature of the original version had two "teeth" on the underside of the frame casting between each pairing of axles. Equalization of this tri-mount was handled by dual coil springs mounted above each journal. It was subsequently used on all EMD's SD series C-C road switchers.



20b. The “teeth” disappeared on latter versions of EMD’s Flexicoil truck as seen on this Union Pacific SD40. Placement of brake cylinders and single-shoe or clasp brakes also altered the appearance of the Flexicoil truck.



20c. In 1970 EMD introduced the Flexicoil HT-C, a high traction version of the popular Flexicoil truck. In addition to the three non-functioning holes in the casting, note how one end of the HT-C frame has been extended to support the third traction motor which is now outboard of that axle.



21. EMD’s self-steering HTCR-II three-axle, high-traction, radial guided truck was introduced on the SD70 in 1992. It was later available as an option on other third generation diesels including the SD75 and SD80. The HTCR-II was expensive and not without maintenance issues, prompting some of EMD’s customers to specify the less expensive Flexicoil truck [20C]. In 2003 EMD introduced the HTSC truck which was essentially an HTCR-II without the complex radial guided components.

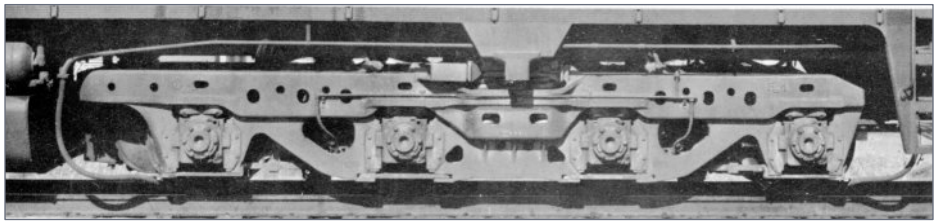
SELF-STEERING TRUCKS

Radial self-steering trucks allow the individual axles to align with curves. For non-radial trucks, the more axles in the assembly, the more difficult it is for the truck to negotiate a curve, due to friction between the wheel flange and the rail. On self-steering trucks, the wheel sets actively "steer" through curves which reduces wear of the flange and improves adhesion.

Introduced in 1992 on its SD70 series locomotives, EMDs self-steering high-adhesion HTCR truck [21], met with limited success because of high initial cost and the need for frequent maintenance. EMD introduced the simpler HTSC truck in 2003 which is basically an HTCR without the radial components.

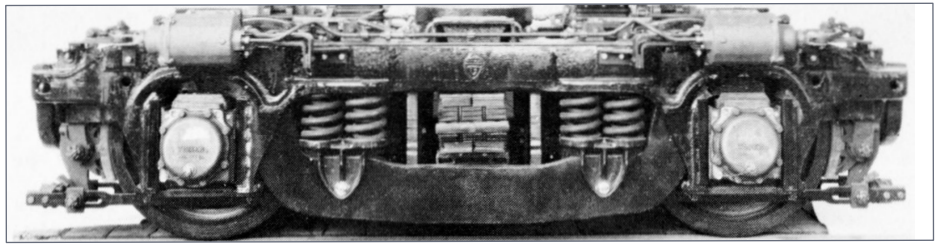
GE introduced their self-steering truck in 1995 [34] as a buyer option for the AC4400CW and later Evolution Series locomo-

tives. It suffered the same combined problems of high cost and high maintenance as EMD's HTCR, resulting in customers favoring GE's standard Hi-Ad truck [33] for both new and rebuilt locomotives.

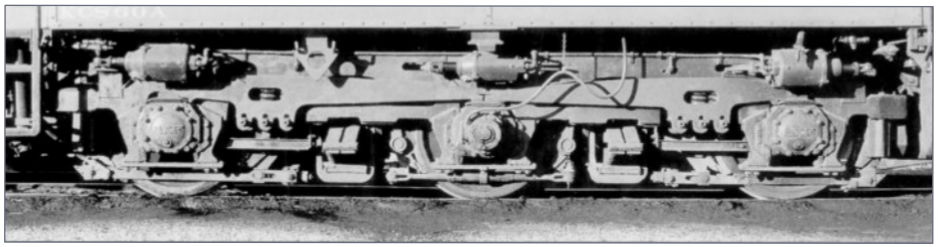


22. EMD's four-motor Flexicoil truck was developed for the 5000hp DD35 locomotive introduced in 1963. It was also used on the 6600hp DDA40X that was produced between 1969 and 1971. Its 17′-1″ wheelbase made it the largest truck built for a production locomotive. A less expensive approach was taken by GE, which simply bridged two of their modified Type B trucks [28] with a span bolster for its 5000hp U50. Alco did the same with AAR Type B trucks [2] for the three 5500hp C-855 units it built for the Union Pacific in 1964.

FAIRBANKS-MORSE LOCOMOTIVE TRUCKS



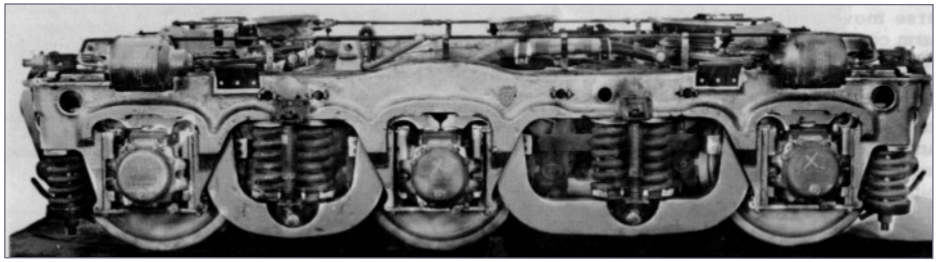
23. Fairbanks-Morse used this two-axle, two-motor truck on its H-16-44 road switcher introduced in 1950. It had a 9′-4″ wheelbase and a heavy single dropped equalizer supported by paired coil springs. Passenger versions of F-M's C-Liner series of locomotives introduced in 1949 had this truck up front but required a three-axle A1A truck [3] at the rear to support the steam generator.



24. This A1A two-motor truck with a 15′-5″ wheelbase was used on Fairbanks-Morse cab diesels introduced in 1945. The locomotives were identified as Erie-built because construction had been subcontracted to GE at its Erie PA facility. Since castings were in short supply during WWII, eleven of the first locomotives built were delivered with welded versions of this trucks that General Electric fabricated from stock steel. Subsequent production received A1A trucks [3].

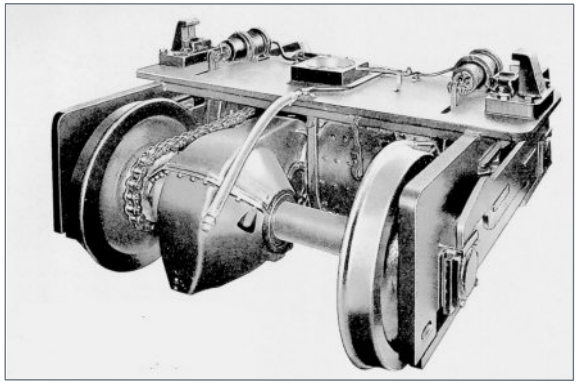
TRI-MOUNT TRUCKS

Instead of a regular bolster arrangement, tri-mount trucks have three mounting pads made up of a proprietary combination of rubber, springs and metal plates. Together the three mounting points hold the truck frame in the same plane as the frame of the locomotive. Details on a tri-mount trucks are not visible on a model.

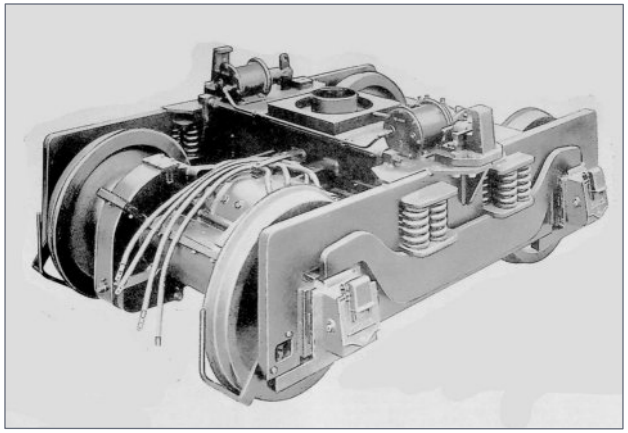


25. Fairbanks-Morse introduced its impressive Train Master series of locomotives in 1951 with the H-24-66 and H-16-66 [Baby Train Master). Some rode on a truck supplied by Baldwin [13], but most of the heavy road switchers were delivered with this proprietary C-C three-motor truck with uneven axle spacing. Secondary springs for the single dropped equalizers are visible at both ends of the cast frame. This Train Master truck had a wheelbase of 13′. Compare the single inside equalizers on this truck with the double drop equalizers on the truck in [11].

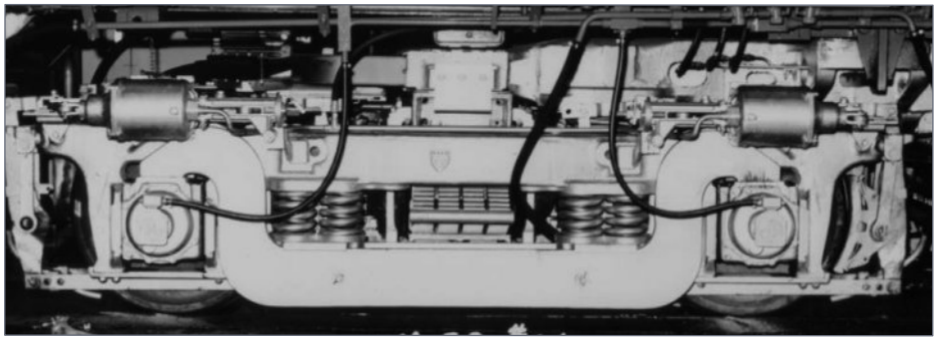
GE LOCOMOTIVE TRUCKS



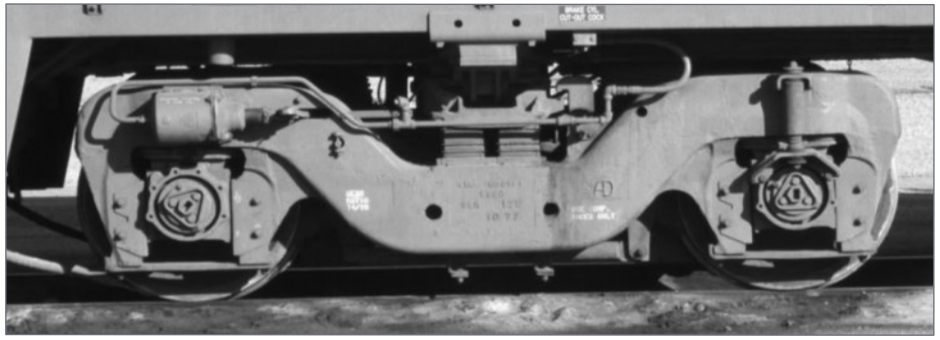
26. GE's 44 ton industrial switcher introduced in 1940 used this two-axle all-welded truck with 33″ wheels. The trucks had one axle motorized with the second axle connected by a chain drive. Note the small king pin center plate and the side bearings mounted on the ends of the slab bolster.



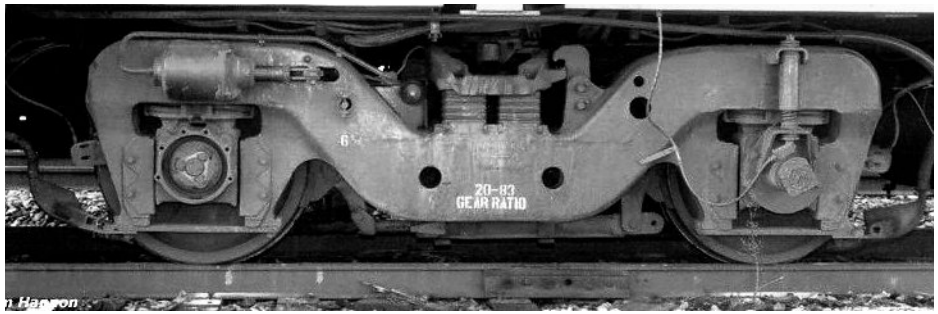
27. General Electrics industrial switchers rated from 50 to 95 tons used the same fabricated truck as in [26], however both axles carried traction motors. Note the dropped outside equalizer and pedestal tie bar below the plain bearing journal boxes.



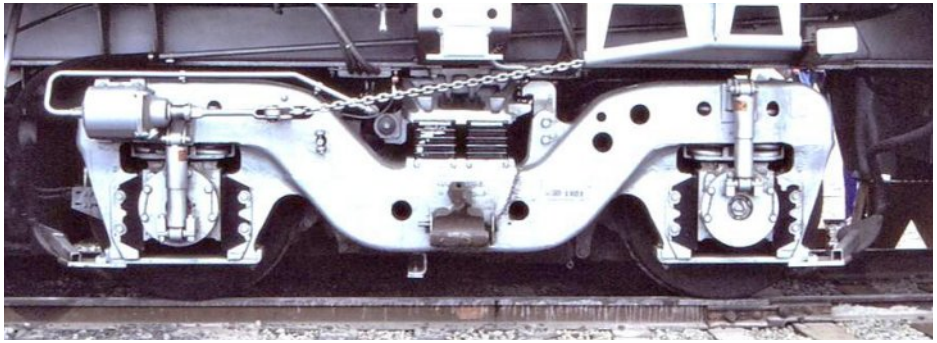
28. This is General Electric's beefed up, and slightly longer (9′-4″ wheelbase) version of the common GSC Type B truck [2]. The four-section elliptical bolster springs are suspended on inside swing hangers behind the double drop equalizer. GE used this truck on most of its B-B locomotives until the introduction of the Floating Bolster truck [29] in 1969.



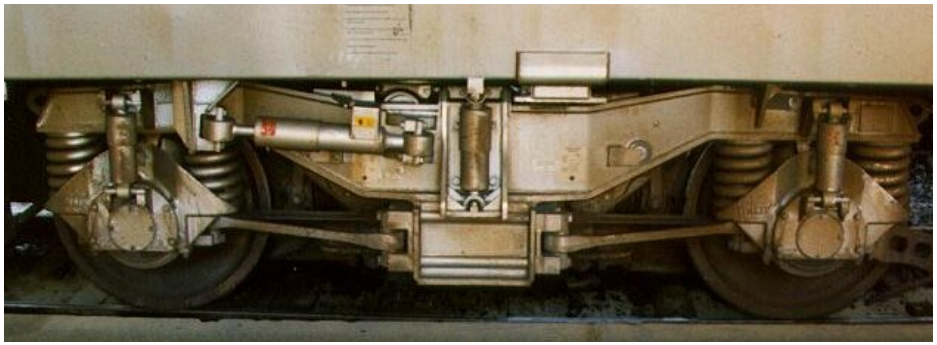
29a. GE introduced this FB-2 floating-bolster truck in 1969. The new design featured a bolster mounted on rubber and metal spring pads, which theoretically allowed the bolster to "float" over the truck frame. By 1972 the FB-2 truck was virtually a standard on all new GE B-B locomotives including the third-generation microprocessor-controlled U18B, most Dash 7 units, and the Dash 8-32BWH built for Amtrak in 1991. Castings for GE's FB-2 truck were supplied by at least two foundries. Those delivered by Adirondack are identified by two non-functional holes below the bolster and a single small hole to the left of the right axle.



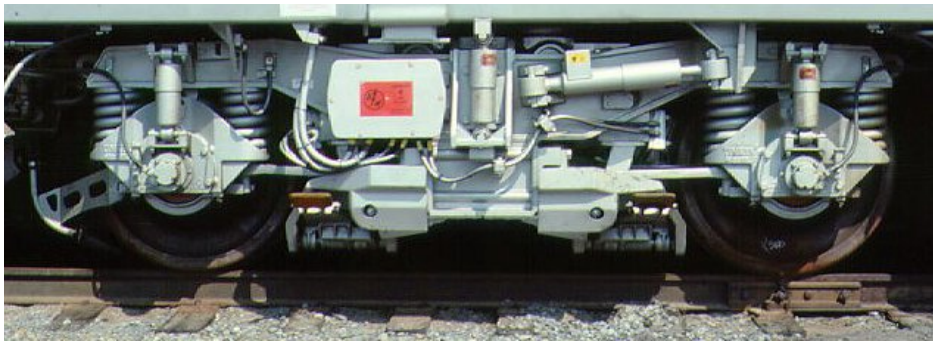
29b. GE FB-2 truck assembled from early Rockwell castings. Spotting features include slightly larger holes below the bolster and one additional large hole near the right wheel [29b].



29c. GE FB-2 truck assembled from later Rockwell castings. Note the additional holes in the cast frame, black pedestal liners, dual automotive-style shock absorbers and the taut chain from the hand-operated parking brake.



30a. GE applied this truck on its Genesis P40, P42 and P32 locomotives built for Amtrak beginning in 1992. The high-speed truck was designed and built for GE by Krupp-MaK, a German supplier of railroad products that has since been absorbed by Siemens Mobility.



30b. GE-Krupp truck with third-rail shoes for use on GE's P32AC-DM, (AC traction, Dual Mode) built for Northeast Corridor service. The shoes allow the P32AC-DM to switch over to electric only mode as it approaches the tunnels leading to New York's Penn Station.

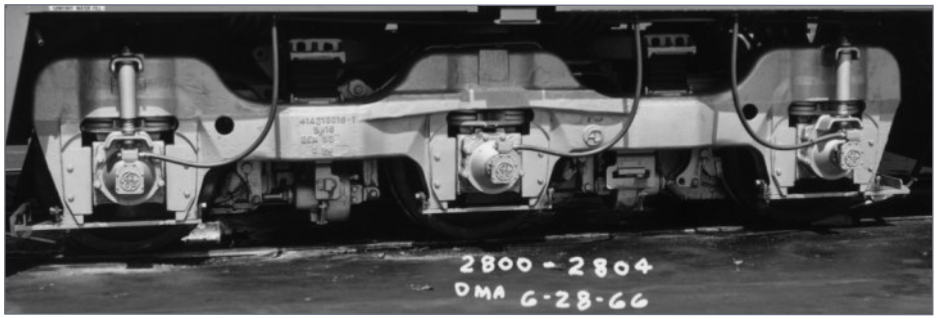
R. Bale

When locomotive and trucks don't match

Certain locomotive components, notably trucks, tend not to wear out as quickly as engines, generators, and other appliances. When buying new locomotives, it is not unusual for the customer to trade-in older locomotives and arrange for the trucks to be refurbished and used on the new purchase.

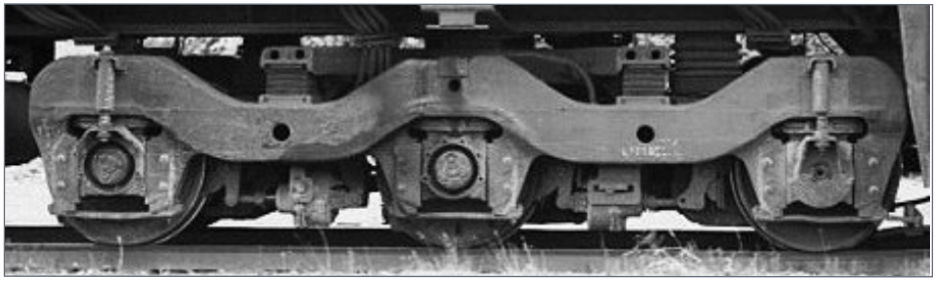
Occasionally this results in some unusual match-ups, such as EMD trucks under a new GE locomotive. EMDs smooth-riding Blomberg B was a favorite that appeared under a wide range of non-EMD two-axle locomotives.

VIEW READER COMMENTS

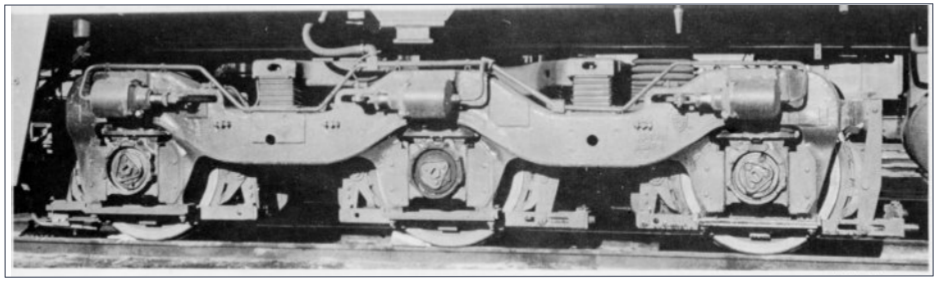


31. Adirondack supplied GE with the castings for this three-axle three-motor truck for five U28Cs ordered by the Union Pacific. Most other customers of the U28 series specified GE's FB-3 truck [32]. It was also used on U30CG cowl units built in 1967 for Santa Fe and some U36CG units built in the mid-1970s for the National Railway of Mexico. The spotting features on this truck are the protruding shelf above the center axle and the automotive-style shock absorbers above both outside axles.

32a. Identified as model FB-3, this floating-bolster truck first appeared in 1956 under GE's U30C. It continued to be used on C-C locomotives through the Dash 8 series. GE used castings made by both Adirondack and Rockwell. Spotting features of the Adirondack FB-3 frame include a boxy shape above the outer axles and two widely spaced non-functional holes in the casting.

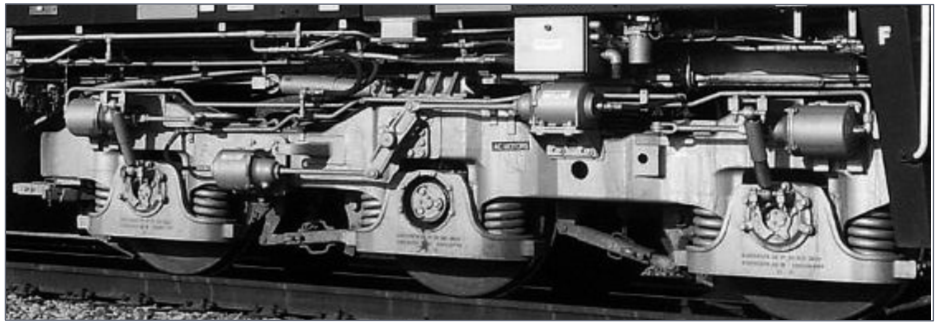


32b. The larger holes in Rockwell's version of GE's FB-3 truck are centered between the axles. A smaller hole is located above the middle axle.



32c. The installation of brake cylinders and rigging alters the appearance of all trucks including this FB-3. GE's FB-3 truck is similar in appearance to EMD's three-axle Flexicoil truck [20b] and shares the same 13′-7″ wheelbase.

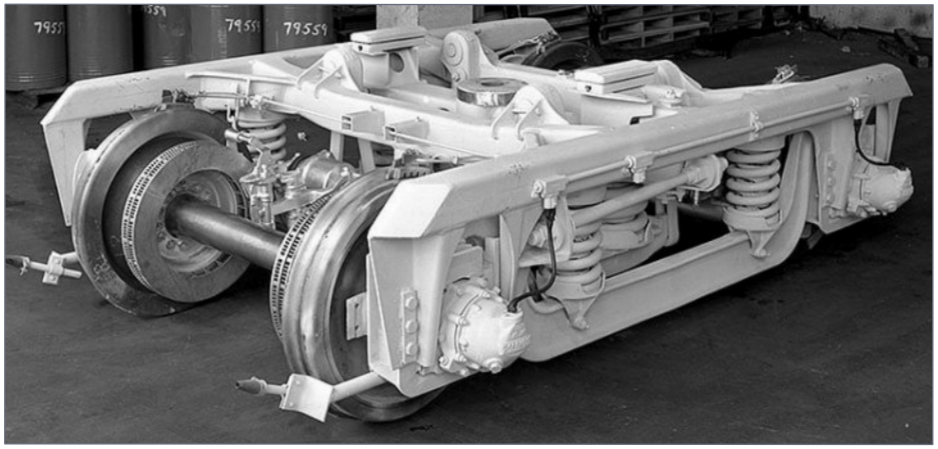
33a. GE's three-motor Hi-Ad (high adhesion) floating-bolster truck was introduced in November 1993 with the release of the microprocessor-controlled third-generation Dash 9-44 units. Subsequent applications include GE's ES44 series launched in 2003 and the ET44 series that followed in 2015. Dofasco worked with GE in developing this truck. In addition to conventional springs, the new truck had a secondary suspension system consisting of four stacks of rubber pads connected directly between the truck and the locomotive under frame.



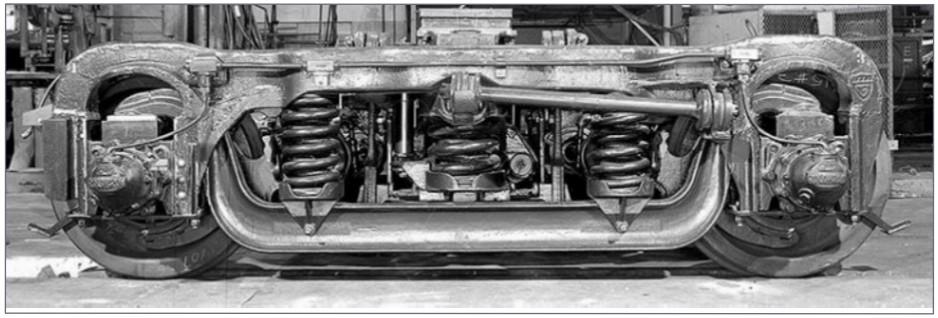
33b. This is a two-motor A1A version of GE's Hi-Ad CC truck [33a] modified for use on ES44C4 and ET44C4 units. The air cylinders and linkage mounted on the frame of the truck are part of the locomotive's computerized traction control system. In response to variations in grade, traction, or wheel slip, the computer adjusts the pressure in these cylinders to maintain sufficient adhesion, by varying the weight on the drive axles.

34. GE's self-steering truck was initially offered in the mid-1990s as a customer option on its AC4400CW and later Evolution Series locomotives. The revolutionary truck met with limited acceptance due to its relatively high initial cost and excessive maintenance requirement. Most subsequent customers opted for GE's standard Hi-Ad truck [33A] for new and rebuilt locomotives.

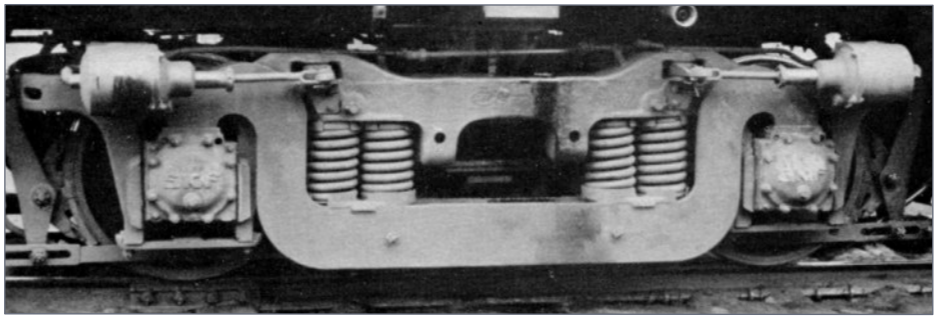
Miscellaneous Trucks



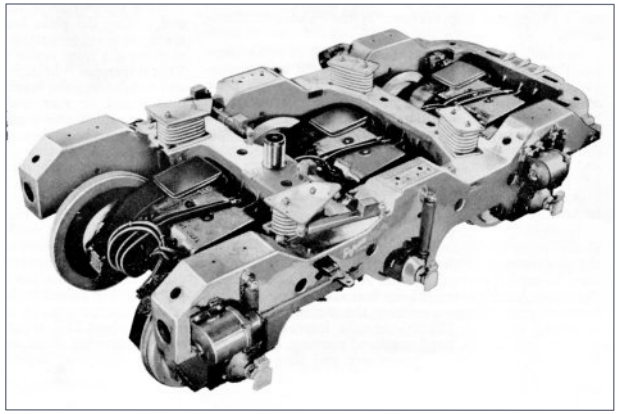
35. Budd used this two-axle one-motor truck with a fabricated frame on Phase 1 RDCs built between 1949 and 1955. Note the disc brakes, I-beam-shaped drop equalizer, and the use of an anchor bolster. It also used a hydraulic torque converter (aka transmission) instead of an electric motor.



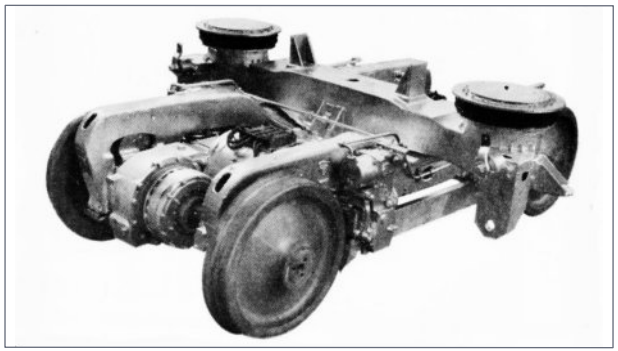
36. Phase 2 production of Budd RDCs, which began in 1956, used this two-axle one-motor truck with a cast frame. Its design was fundamentally the same as the original welded frame truck [35] used on Phase 1 RDCs.



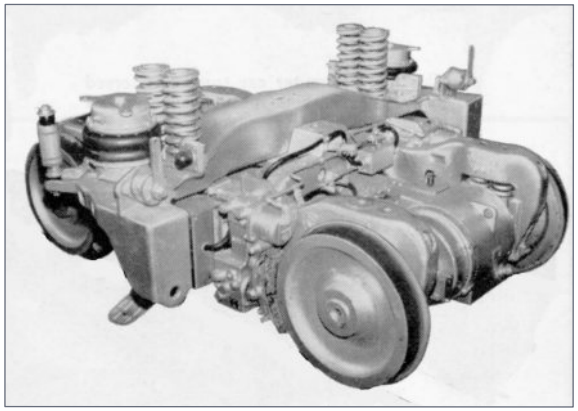
37. Inspired by a fundamental AAR Type B design, Dofsco developed and manufactured this equalized pedestal type truck which Montreal Locomotive Works used on its Century series locomotives. This Canada-only truck with a 9′ wheelbase was also used on RS-10, RS-18 and RS-23 switchers built by MLW.



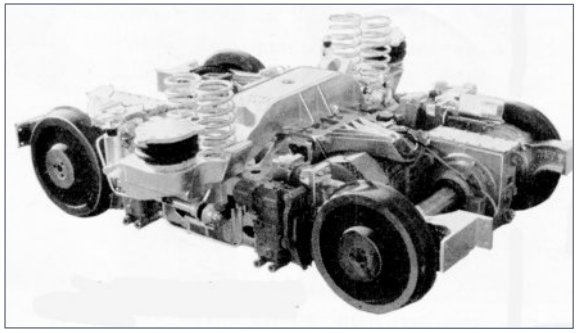
38. Dofosco high adhesion C-C truck used on MLW-Worthington M630 and M636 locomotives.



39. The General 70-series trucks introduced by GSI in the 1970s included a wide range of inside-frame, air-spring trucks for light rail and rapid transit applications.



40. GSI series 70 truck with third rail shoe. Note paired coil bolster springs.



41. A later version of GSI's General 70 truck featured improved braking.

42a. Siemens-Mobility SF4 two-axle two-motor truck.

42b. Siemens-Mobility SF4 truck under an ACS-64 Amtrak Cities Sprinter. The SF4 was also used on the ALC-42 and SC-44 Charger locomotives. Note the shock absorber linked to the body.

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