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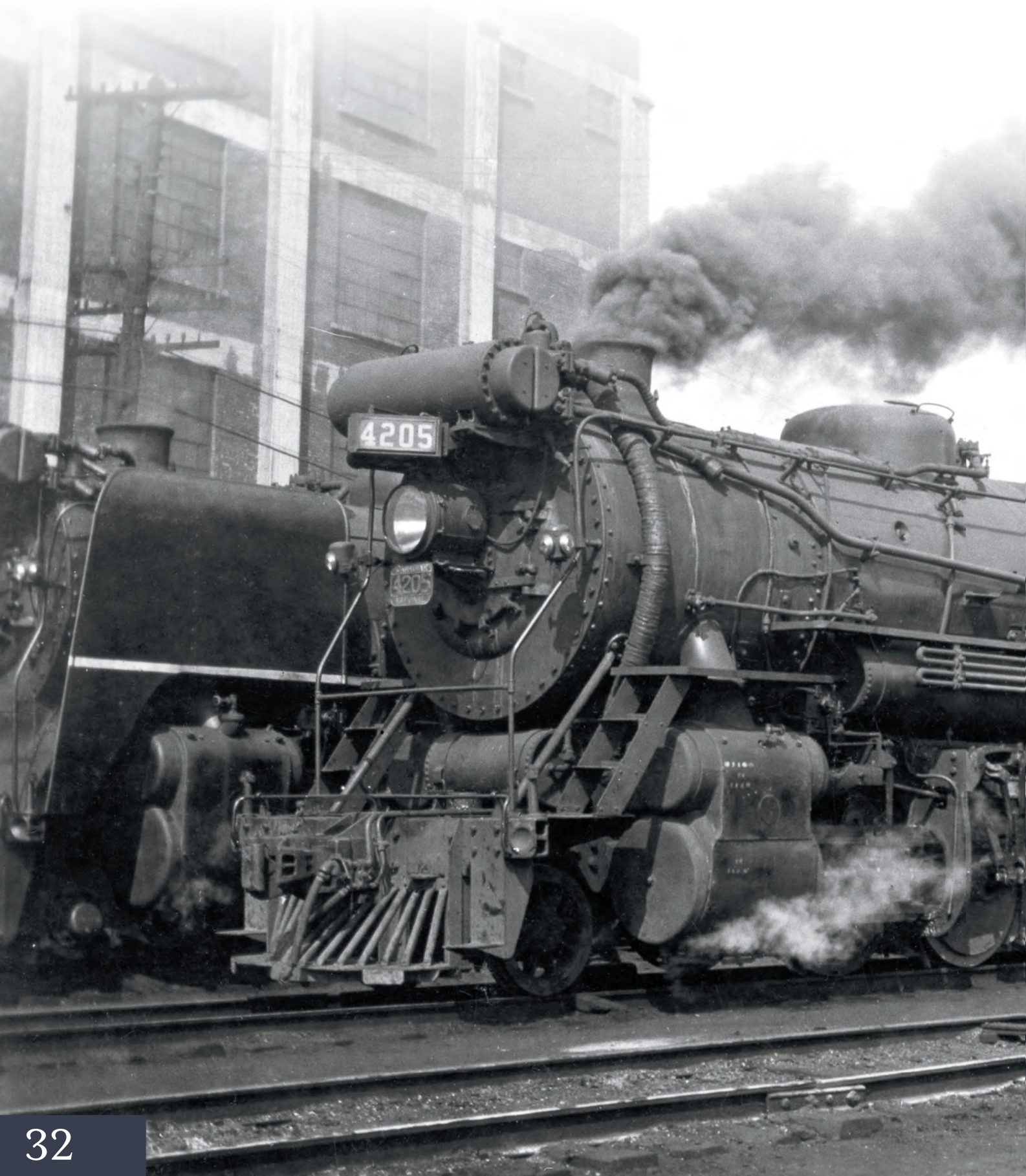
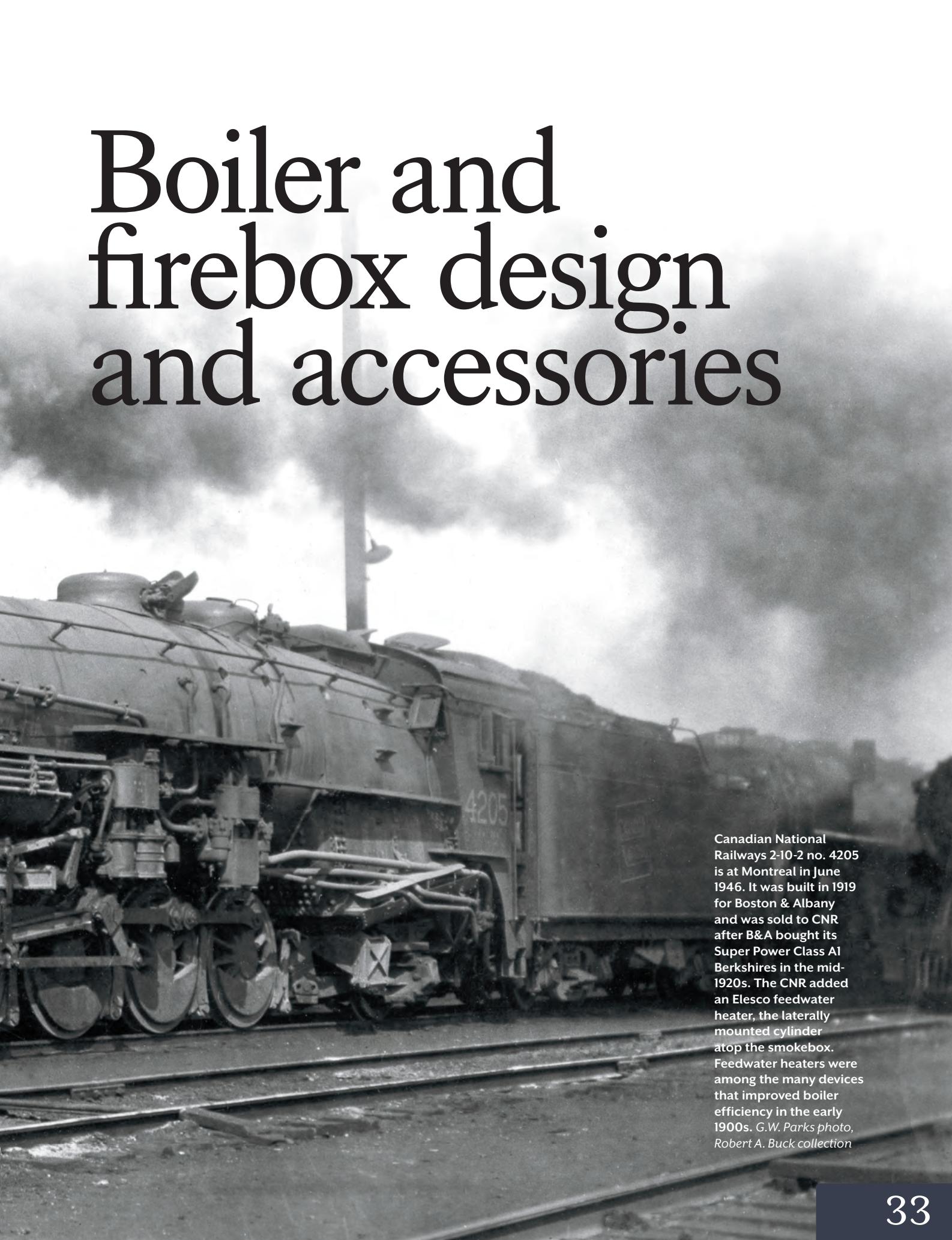
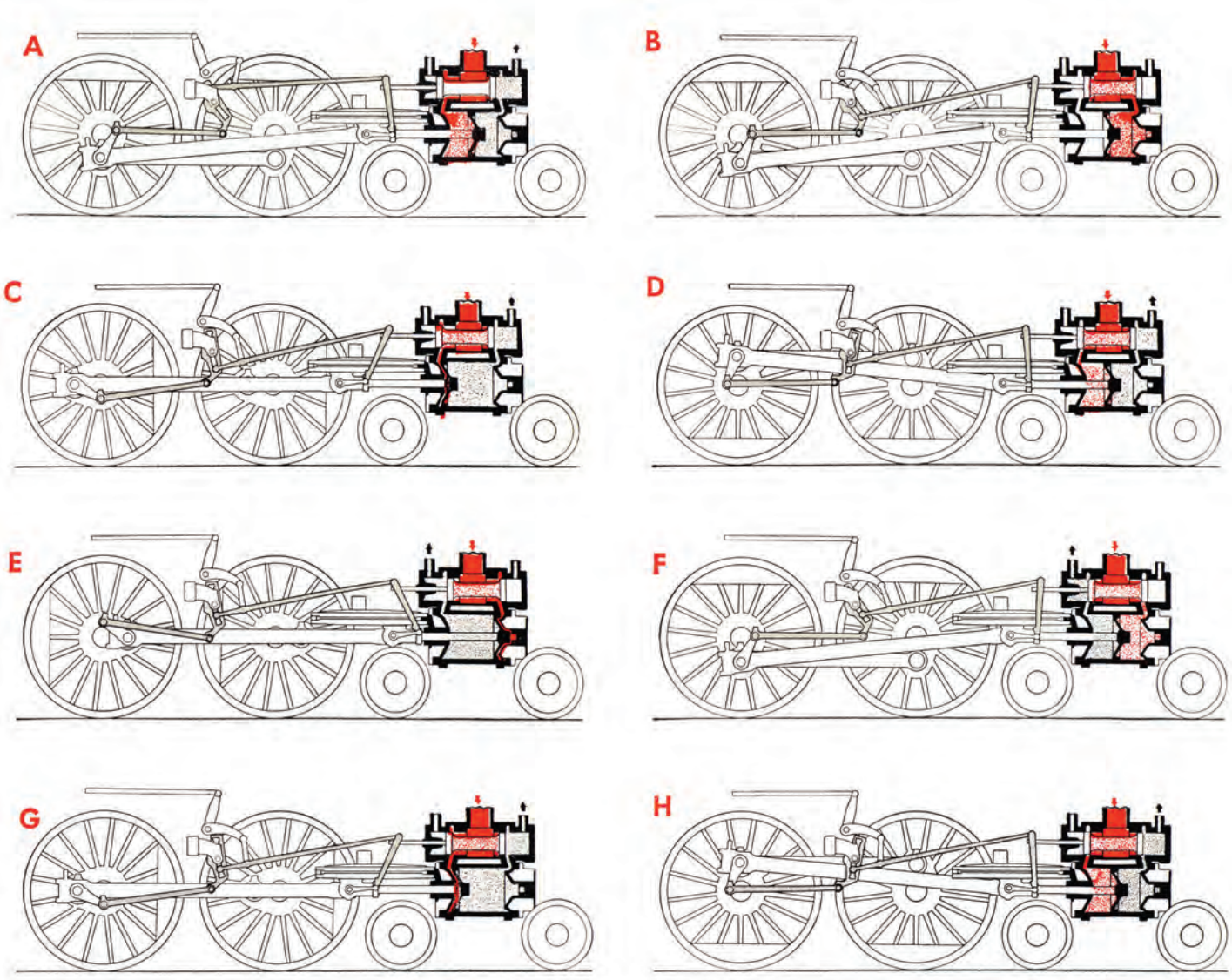

4205

Boiler and firebox design and accessories



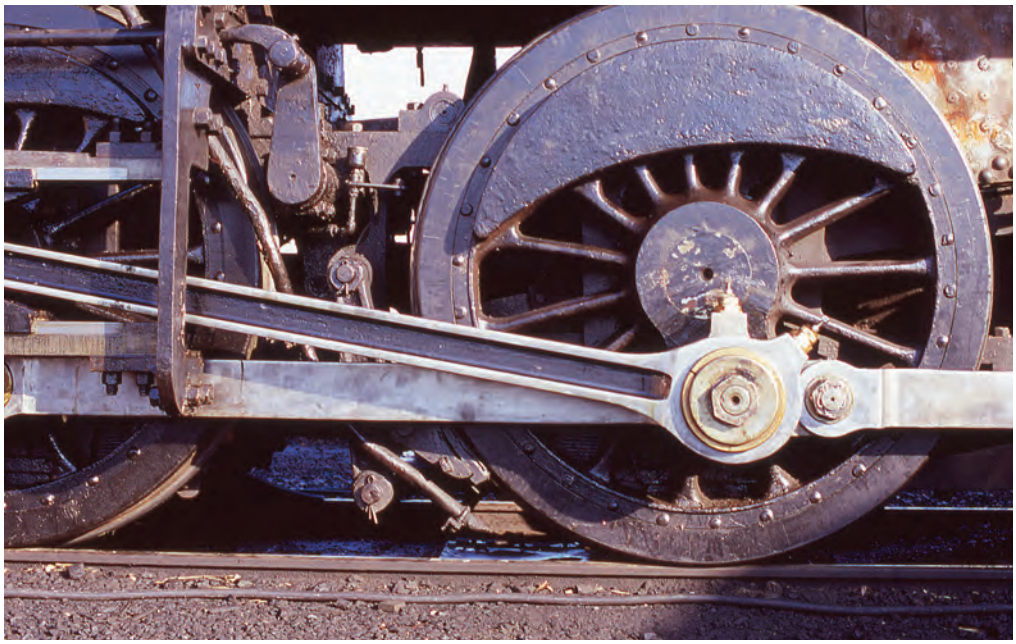
Canadian National Railways 2-10-2 no. 4205 is at Montreal in June 1946. It was built in 1919 for Boston & Albany and was sold to CNR after B&A bought its Super Power Class A1 Berkshires in the mid-1920s. The CNR added an Elesco feedwater heater, the laterally mounted cylinder atop the smokebox. Feedwater heaters were among the many devices that improved boiler efficiency in the early 1900s. *G.W. Parks photo, Robert A. Buck collection*



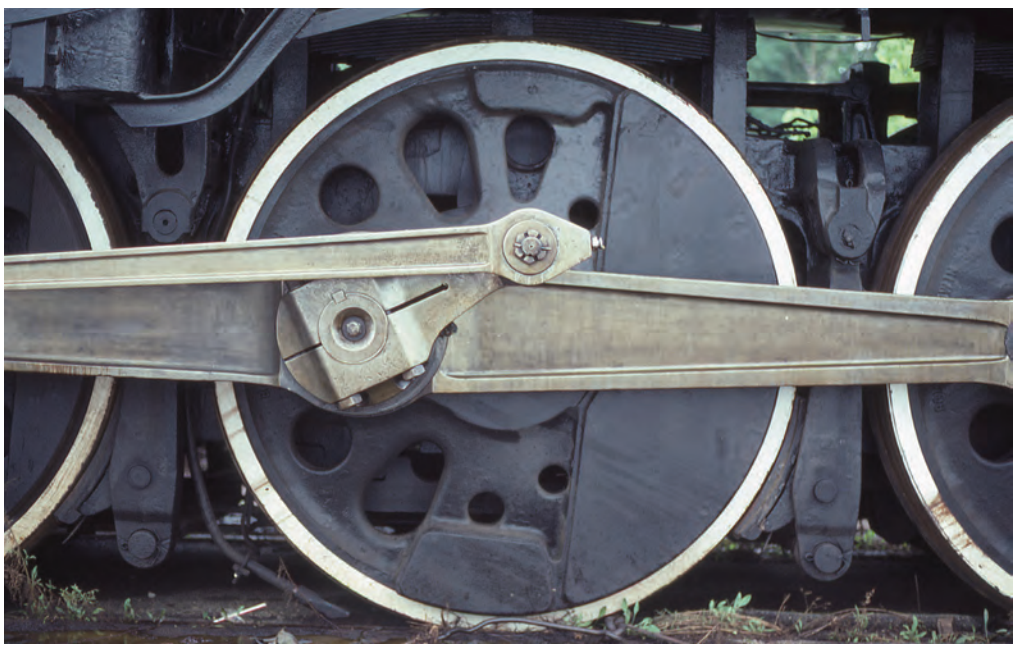
Valve and cylinder operation

This series of drawings shows how link motion and valve movement regulates steam admission to the piston. Red is incoming steam from the dry pipe; gray is spent steam to be exhausted. (The drawings show Walschaerts valve gear; others provide similar valve/piston motion.)

View A shows valve gear with the radius rod lifted for reverse motion. In B and C, the radius rod is fully down for maximum power at full cutoff. Views D to H show a complete motion cycle for forward movement (at about 50 percent cutoff).



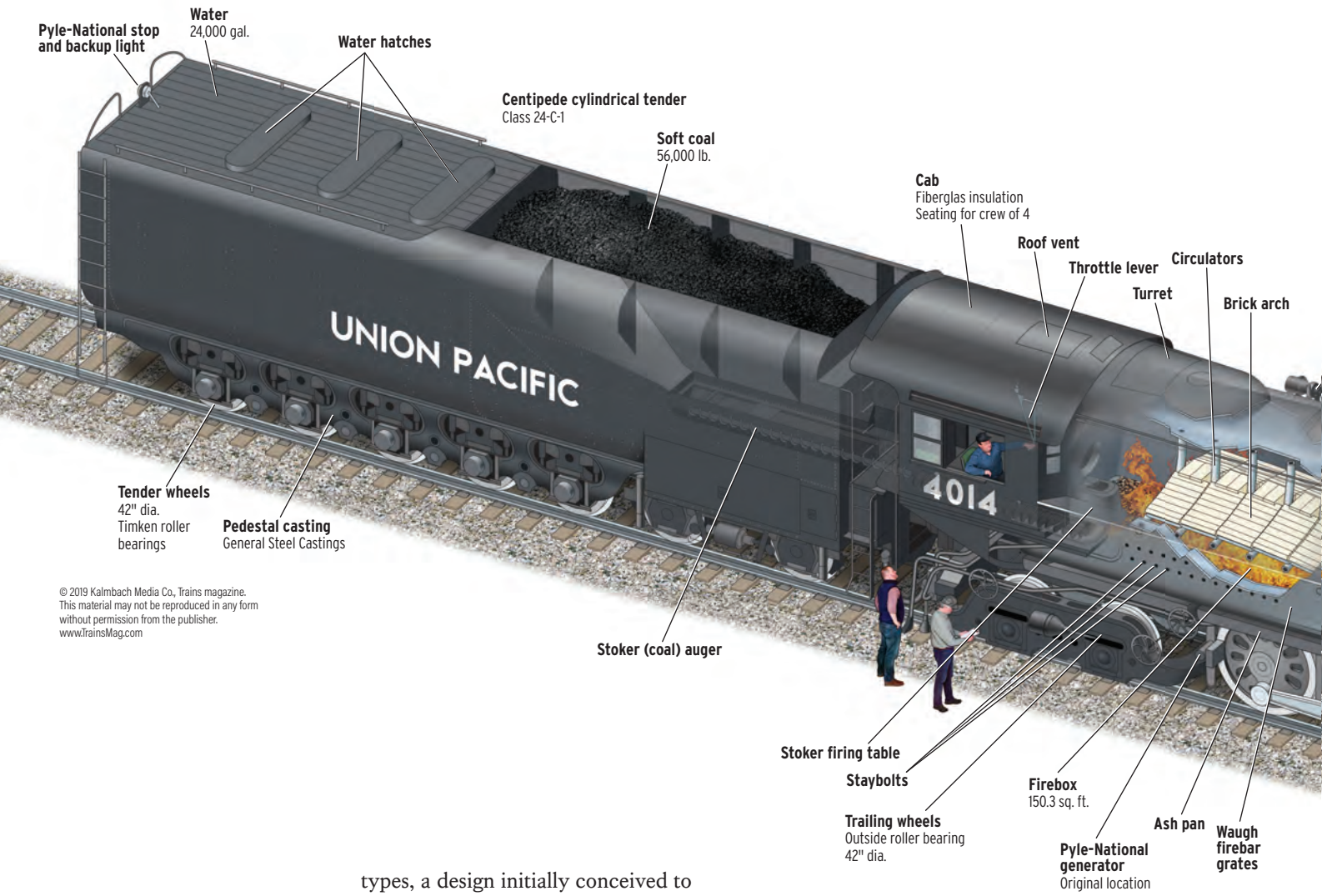
Strasburg no. 89 is a 2-6-0 built in 1919 by the Canadian Locomotive Company for Grand Trunk Railway. This view shows its 63" driving wheels. Note that the main driver's counterweight is 180 degrees opposite the position of the crank pin. *Brian Solomon*



Reading class T-1 4-8-4 no. 2100 is equipped with Boxpok driving wheels. These feature box-section spokes and wheel rims in place of conventional spokes, allowing for better counterbalance to reduce the effects of dynamic augment at the rail. Note the tapered rod. *Chris Bost*

be spotted by its oval-shaped openings, which have smooth transitions (no lips or raised edges). The original Type A design had larger but fewer openings; the later Type B wheels had smaller but more openings.

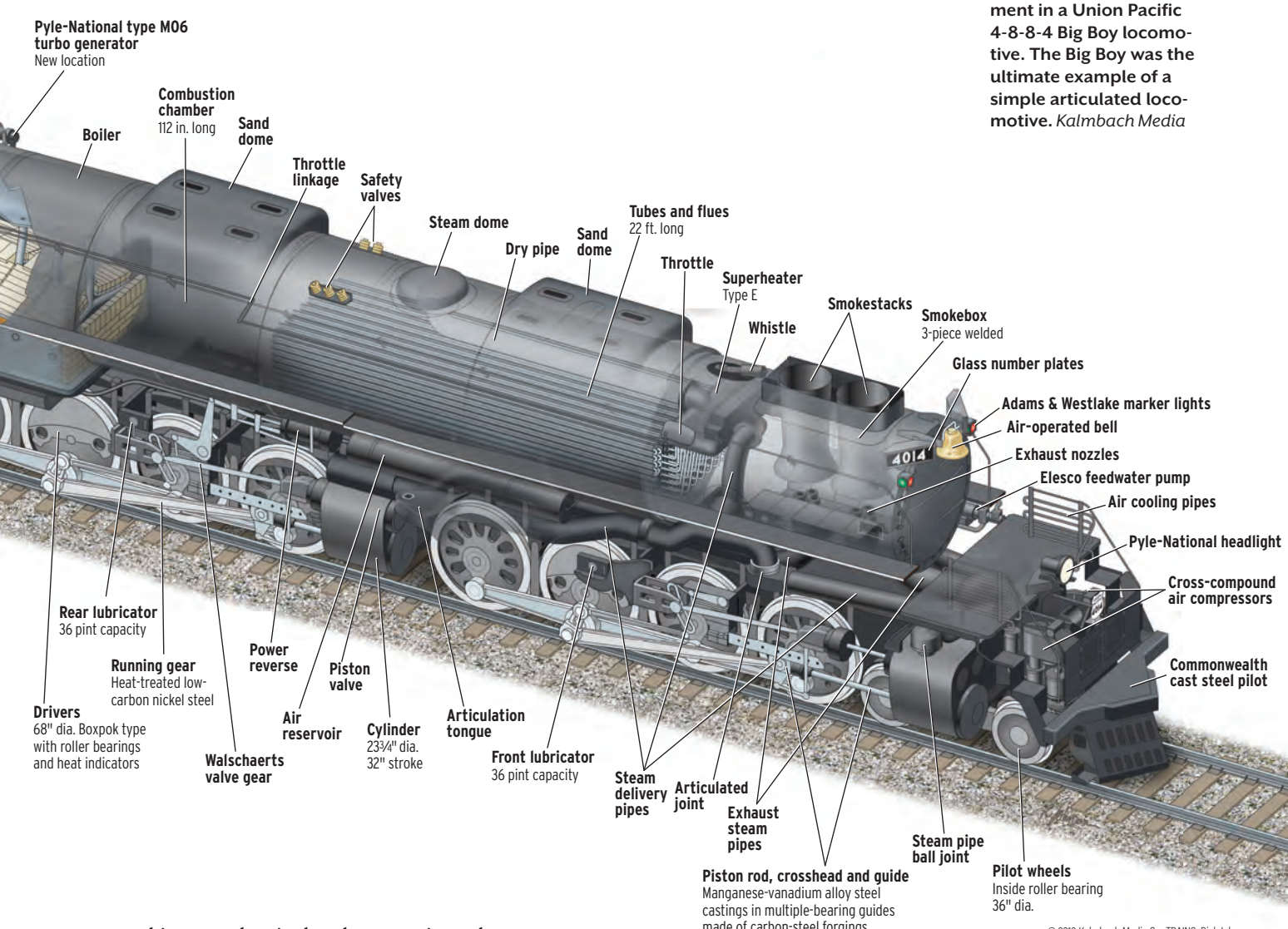
Baldwin developed its own modern drive wheel design that it called the Baldwin Disc Wheel, which according to a period advertisement was cast from high-tensile steel using a pattern that featured a single arched disc section. This was merged with hollow triangular sections at the rim and hub that aimed at providing uniform support to all points of the rim. Baldwin boasted that this reduced dynamic augment by as much as 75 percent. They can be spotted by their oval (or "egg-shaped") openings with raised edges around the driver, with the face of the wheel inset between the holes.



types, a design initially conceived to burn low-yield lignite as fuel. The NP's Yellowstones were the world's largest locomotives until Union Pacific's 4-8-8-4 Big Boy of 1941 and Chesapeake & Ohio's slightly heavier 2-6-6-6 Alleghany emerged in 1942.

Among the notable simple articulateds were Southern Pacific's later development of the Cab-Forward arrangement, first ordered in a simple articulated configuration in 1928. These 4-8-8-2s characterized the railroad's heavy mountain power for the next two decades. The railroad's final 4-8-8-2, no. 4294, was built by Baldwin in 1944, and it is preserved at the California State Railroad Museum in Sacramento.

The advantages offered by the simple articulated encouraged some railroads to rebuild older Mallet compounds as simple locomotives. Then, in the mid-1930s, several railroads ordered relatively fast articulated locomotives. These didn't set records for weight or size, but were remarkable machines. Norfolk & Western perfected the 2-6-6-4 type for fast freight, while in a similar effort, Union Pacific and Alco jointly developed the 4-6-6-4 Challenger, which proved to be the most widely adopted simple articulated type. The Challenger blended several technological advances with existing articulated design to produce a large locomotive that was comparatively flexible and fit clearances on most main lines. Application of a four-wheel leading truck improved the front-end stability of the articulated forward engine while better distributing the weight between the forward and rear engines. The locomotive's well-engineered suspension



This three-dimensional cutaway view shows the arrangement of equipment in a Union Pacific 4-8-8-4 Big Boy locomotive. The Big Boy was the ultimate example of a simple articulated locomotive. *Kalmbach Media*

and improved articulated connections also aided faster speeds, and the engines pulled passenger trains as well as freight—they were capable of working up to 80 mph, although speeds of 70 mph were more practical.

The UP's massive Big Boy of 1941 essentially expanded the Challenger type with the two additional sets of drivers, one each on the rear and forward engines, along with a corresponding increase in boiler capacity. The locomotive's unusually large size and long wheelbase restricted its operating area, but it proved itself in heavy freight service, mainly hauling freight on UP's Sherman Hill in Wyoming.

Further steam development of articulated designs essentially ended by the close of World War II in 1945, with dieselization well underway.