
BALDWIN
LOCOMOTIVES

# Class S-2 Locomotives for The Milwaukee Road

*Results Obtained With 30 Locomotives Built in 1937, Led to the Purchase of 10 Duplicate Units*

THE Chicago, Milwaukee, St. Paul and Pacific Railroad, early in 1938, placed in service a group of 30 locomotives of the 4-8-4 type, Class S-2, built by The Baldwin Locomotive Works.

The Class S-2 locomotives were especially designed for freight service between Bensenville, in the Chicago district, and Council Bluffs, Iowa; and also between Bensenville and the Twin Cities. However, with ample boiler capacity and driving wheels 74 inches in diameter, these locomotives have proved as efficient in heavy passenger service as in fast freight.

In freight service, these locomotives, due to their greatly increased power, were able to replace 55 Mikado (2-8-2) type locomotives which in turn were reassigned to other districts, finally resulting in the scrapping of 17 units and placing 54 in reserve.

In passenger service, the locomotives were assigned to the run between Minneapolis, Minnesota, and Harlowtown, Montana, a distance of 914 miles. On this run, which is made without changing engines en route, one Class S-2 locomotive is capable of handling 18 cars on the *Olympian's* schedule, whereas the heaviest power previously used could handle not more than 12 cars.

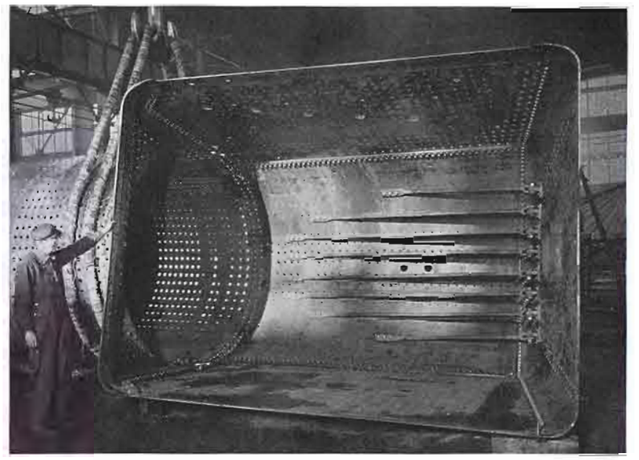
During the month of March, 1938, three of the locomotives in passenger service, on the Minneapolis, Harlowtown run, made a total of 55,083 miles; an average of 18,361 miles per locomotive.

*One of the New Class S-2 Locomotives Built by Baldwin Early in 1940 for The Milwaukee Road.*

| | | | |
|---|---|---|---|
| Cylinders ..... 26" x 32" | Tubes—Diameter 3¾" & 2¼" | Wheel base— | Weight— |
| Drivers, diameter .....74" | Number 3¾",201; 2¼",66 | Driving .... .. .. 19' 3" | Total engine ...493,550 lb. |
| Boiler, diameter .....92" | Length ..... ....21' 0" | Rigid .....12' 10" | Total tender |
| Steam pressure .....285 lb. | Grate area .....106 sq. ft. | Total engine .....47' 4" | (⅔ c. & w.)..323,000 lb. |
| Firebox, length .....150" | Water heating surface .....5,467 sq. ft. | Total engine and tender .....96' 0½" | Tank capacity. 20,000 U. S. gal. |
| Firebox, width .....102¼" | Superheating surface .....2,336 sq. ft. | Weight on drivers. 289,147 lb. | Fuel capacity .....25 tons |
| | | | Tractive force .....70,800 lb. |







*Outer Shell of the Boiler Back-End, Prior to Installation of the Mud Ring and Firebox Sheets.*

One of the locomotives covered 19,282 miles during the month.

Proof of the success of the Class S-2 is found in the fact that The Milwaukee Road ordered from Baldwin ten additional locomotives, differing from the first lot in minor details only. Delivery of this new power was completed in May, 1940.

### *New Class S-2 Locomotives*

The new locomotives follow the original 1937 design very closely and take the same classification, S-2. They bear road numbers 231 to 240 inclusive. The general specifications for these locomotives are given with the accompanying illustration. The equipment includes General Steel Castings cast-steel locomotive bed with cylinders cast integral.

### *The Boiler*

The boiler is conical in design with a maximum diameter of 100 inches at the third course. The barrel courses, welt strips and the roof and side wrapper sheets are of silico-manganese steel. The joints between all the sheets of the firebox and the 72-inch combustion chamber are butt welded. Door flanges are welded in the back head and door sheet. After the firebox seams were welded on the fire side, they were chipped out on the water side with a round-nose tool and then built up. Seal welding is applied to the edges of the wrapper sheet and throat sheet where they join the third course of the boiler. Similar welding is applied where the wrapper sheet joins the back head, and for a distance of 20 inches up from the mud ring at the front edge of the wrapper sheet. The bottom edges of both firebox and wrapper sheets are welded for a short distance each way from the corners of the mud ring.

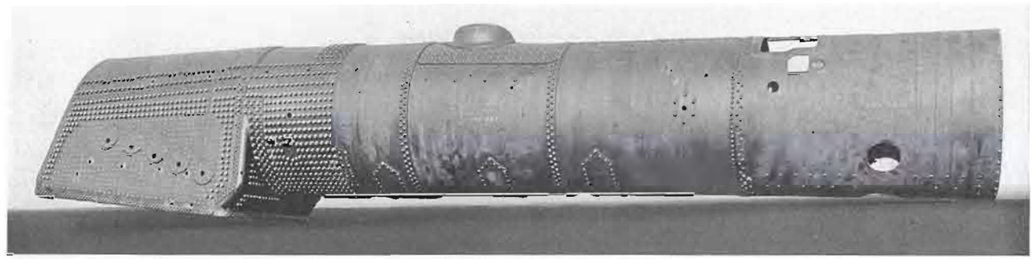
Five American Arch Company's water circulators are applied in the firebox and one similar unit in the combustion chamber.

Flexible staybolts are applied to all except two rows in the throat sheet while the combustion chamber has a complete installation. Flexibles are applied to four top horizontal rows and the two front and two back vertical rows in the sides of the firebox. Similar stays are applied to the two outside rows around the back head. The first six rows of crown stays back from the tube sheet are expansion stays.

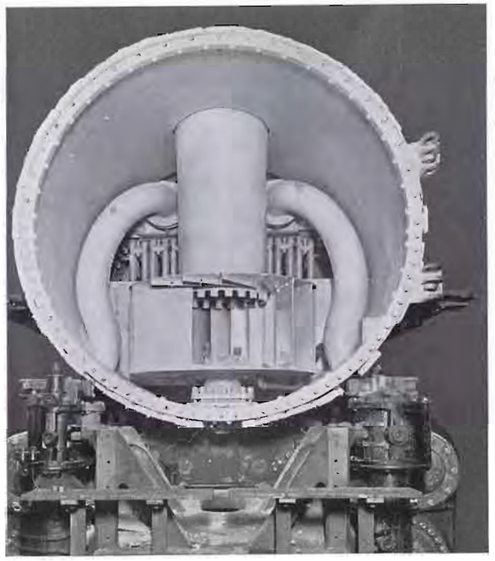
The boiled is fired by means of a modified Type "B" du Pont Simplex stoker.

A modified Type "E" superheater is applied and the header incorporates the American Multiple throttle.

An Anderson open type spark arrester is applied



*Complete Boiler of a Class S-2 Locomotive Showing Installation of Flexible Staybolts in the Combustion Chamber and Firebox.*



*The Anderson Open Type Spark Arrester as Applied in the Smokebox of a Class S-2 Locomotive.*

in the smokebox between the top of the exhaust nozzle and the bottom of the stack extension. It consists of a box-like arrangement, the sides and front of which are fitted with louvers to set up an effective baffling action in the path of the cinders. This device takes the place of the netting and baffle plates usually installed in the smokebox.

### *Bed and Running Gear*

The locomotive bed, in addition to integral cylinders, includes in one casting the back cylinder heads, main air reservoirs, also brackets for air compressors, headlight generator, hot water feed pump and reverse gear. The casting also includes the guide yoke crosstie, valve motion crosstie and bolting lugs for cab bracket supports and waist sheets.

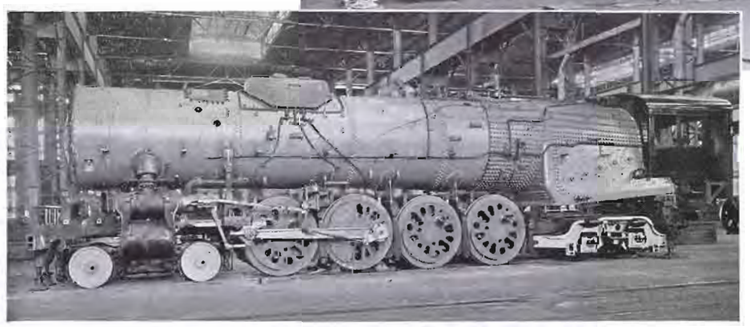
The pilot consists of a cast-steel frame to which steel plate is welded. The coupler is made so that it can be folded back when not in use. A steel plate closes the coupler opening in the pilot so that it presents a smooth unbroken surface.

The driving wheels have Boxpok cast-steel centers made by Standard Steel Works Division, which company also produced the driving axles, front engine truck wheels and axles, trailer truck and tender truck axles, and the steel-tired wheels at the rear of the trailer truck. Miscellaneous steel forgings and castings also came from Standard.

Driving axles and front truck axles are fitted with Timken roller bearings, while the trailer truck and tender trucks are equipped with American Steel Foundries Roller Bearing Units. This makes a complete installation of roller bearings on all engine and tender wheels.

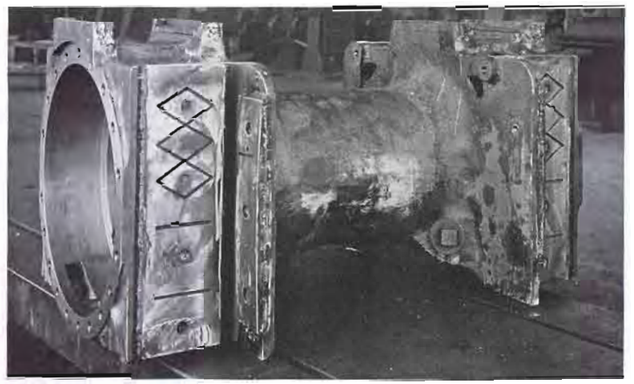
The engine truck is the General Steel Castings four-wheel equalized type with inside bearings. The wheels are 36 inches in diameter and are

*One-Piece, Cast-Steel Locomotive Bed With Cylinders, Back Cylinder Heads, Air Reservoirs, and Other Parts Cast Integral.*



*A Class S-2 Locomotive Takes Shape in the Baldwin Erecting Shop.*





*One-Piece Housing of the Timken Roller Bearings Applied to the Driving Axles.*

mounted on hollow-bored axles. These trucks are fitted with the constant-resistance centering device.

The Commonwealth Delta type four-wheel trailer trucks have front wheels 38 inches in diameter, while the rear wheels have a diameter of 44 inches. Both axles are provided with ½-inch lateral movement.

The main and side rods are of low-carbon nickel steel. There is a complete installation of floating bushings on the crank pins with Hunt-Spiller fixed bushings in the rods. The front end of the main rod has 1/16-inch lateral play in the crosshead. The knuckle pins are of nickel steel.

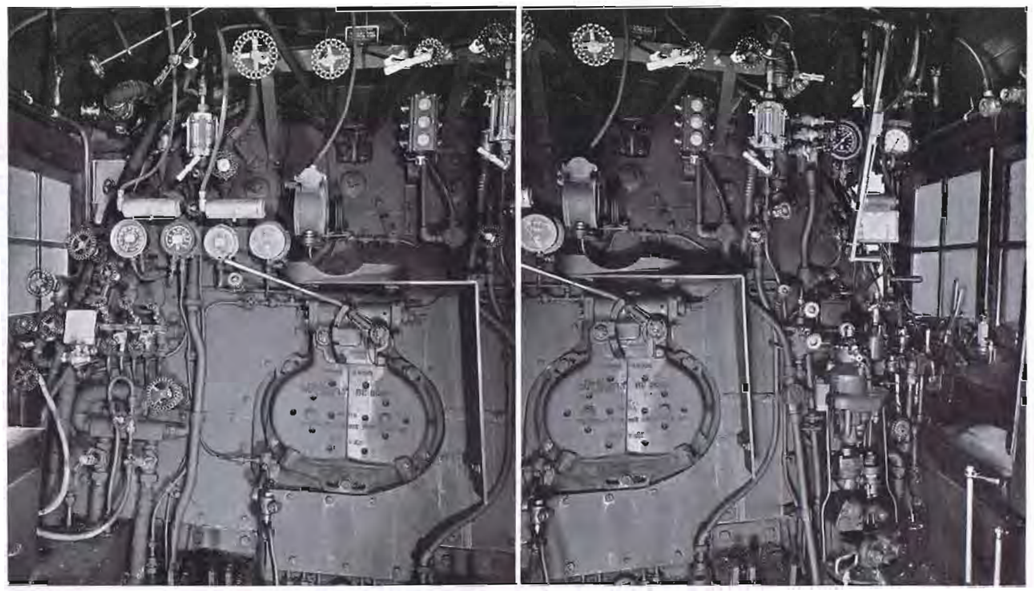
Valve motion is the Walschaerts type with a valve travel of 7½ inches. Baldwin power reverse gear is applied to five of the locomotives while the remaining five have the Alco reverse gear.

### *Cabs and Accessories*

The cabs are of the vestibule type, made of steel with wood lining and insulated sides, roof and floor. In addition to seats for the engineman and fireman, drop seats are provided against the rear wall of the cab for the use of the brakeman. Shatterproof glass and windshield wipers increase the safety and visibility.

Brakes are No. 8ET Westinghouse with two 8½-inch cross-compound compressors. The driving wheels are fitted with long brake shoes. Both the engine truck and trailer truck wheels have clasp brakes.

Other items of equipment include Wilson feedwater heater, Manning, Maxwell & Moore injectors, Superior flue blower, Wilson sludge remover, Franklin Butterfly firedoor, Waugh Firebar grates,



*Two Views of the Back Head of a Class S-2 Locomotive Showing the Gauges and Controls on Both Sides of the Cab.*

and Barco low-water alarm. The locomotives and tenders have an extensive installation of Alemite fittings on connecting rods, valve motion, brake rigging, spring rigging, truck pedestals and numerous other wearing surfaces.

### *Tender*

The tender underframe is General Steel Castings water-bottom type in which the sump for the Wilson feedwater heater is cast integral. The 20,000-gallon capacity tank is of welded construction throughout. Each tender has a fuel capacity of 25 tons.

Tender trucks are General Steel Castings six-wheel trucks with 38-inch diameter wheels. American Steel Foundries Simplex unit-cylinder clasp brakes, with one cylinder per truck, are applied to each wheel.

### *Counterbalance*

All revolving weights are counterbalanced and those in the main wheels are cross-counterbalanced, but a departure was made from the generally accepted method of balancing.

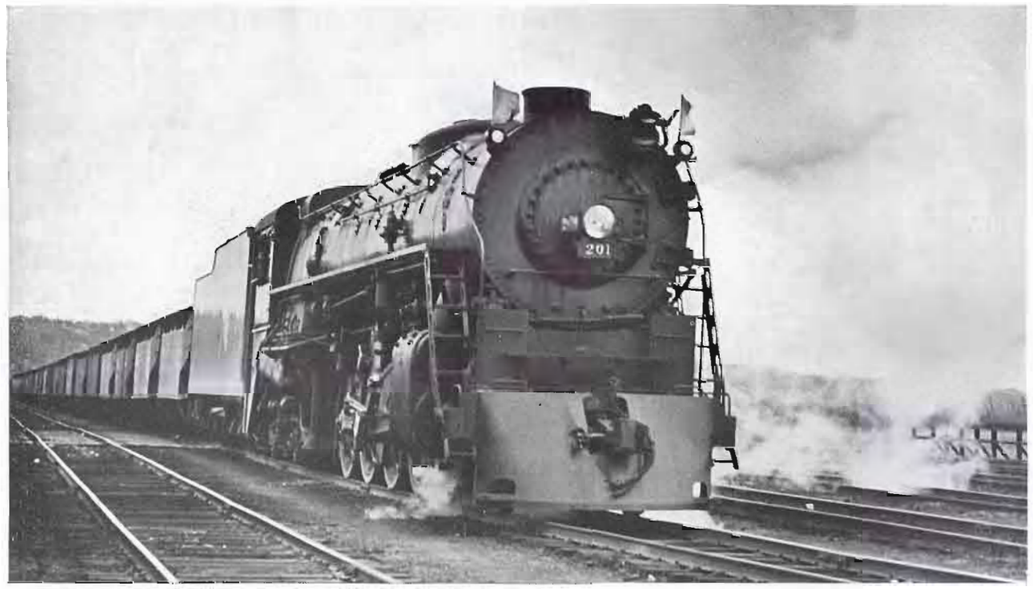
Instead of compensating for a percentage of the reciprocating weights, which has been the practice in the past, the portion of the reciprocating weight which could remain unbalanced in relation to the total weight of the locomotive was used as a basis for determining the amount of reciprocating balance.

For these locomotives 3.52 pounds of reciprocating weight per 1000 pounds of the total weight of locomotives were left unbalanced. The total weight of reciprocating parts on each side is 2,309 pounds, of which 1,739 pounds remain unbalanced. The remaining 570 pounds were distributed as follows: 120 pounds in the main wheel; 150 pounds in each of the front, intermediate and back wheels.

Less overbalance is placed in the main wheel than in the other coupled wheels to compensate for the vertical component of the horizontal inertia forces of the reciprocating parts and the piston load, brought about by the angularity of the main rod.

The revolving and reciprocating portions of the main rod are based on the center of percussion, rather than the center of gravity method, the center of percussion being determined by actually swinging the rod as a pendulum about the center of the crosshead pin.

The dynamic augment at diameter speed due to the above overbalance in the front, back and intermediate wheels is 7,700 pounds and for the main wheels 6,160 pounds.



*One of Thirty Class S-2 Locomotives Built by Baldwin in 1937, in Freight Service on The Milwaukee Road.*