

# Western Maryland Uses Shay Locomotive On Heavy Grades in Mining District

**Lima-built unit weighing 324,000 lb. on drivers with a tractive force of 59,740 lb. designed for grades of 7 to 10 per cent and maximum curvature of 22 degrees**

**T**HE Western Maryland has recently placed in service a Class 150-3 Shay geared locomotive, having a tractive force of 59,740 lb. This new locomotive was designed and built by the Lima Locomotive Works and replaces other Lima-built Shay locomotives that have been in service for a number of years. It is used on a coal mining branch that connects with the Western Maryland near Chaffee, W. Va., between Cumberland, Md., and Elkins, W. Va., and is located on the headwaters of the Potomac river. The branch, originally a narrow gage, was built in 1904 by the Three Forks Coal and Coke Company and was converted into a standard gage in 1912. The Western Maryland acquired the branch line in 1929 and has operated it since that time.

The new Shay locomotive is designed for regular operation on seven per cent grades, with occasional stretches up to 10 per cent and a maximum curvature of 22 deg. The locomotive can handle trailing loads of 5,560 tons on level, tangent track at 10 m.p.h. and 156 tons on a 7 per cent grade at the same speed.

## The Boiler

Conventional design and construction characterizes the boiler of this locomotive. It is a two-ring extended wagon top type, 28 ft. 3 in. long overall. The first of the two shell rings is 62 $\frac{3}{8}$  in. outside diameter at the front tube sheet and tapers to 80 in. at the second-ring circumferential seam. The barrel plates are  $\frac{3}{4}$  in. thick and the longitudinal seams are the triple-riveted butt type with the barrel plate seam welded. The dome, 29 in. inside diameter, is located on the second ring.

For regular operation on seven per cent grades, the fireboxes are built with a 30-in. space between crown and roof. Double water glasses are used with the low reading 3 $\frac{1}{2}$  in. above the highest point of the crown and the high reading 21 in. above that point.

The firebox is built without a combustion chamber and is 114 in. long by 61 $\frac{1}{4}$  in. wide inside. The side and roof sheets, as well as the furnace crown and side sheets, are each one piece and the firebox seams are riveted. The furnace door sheet and back head are welded at the door ring.

Flannery flexible staybolts are used

in the firebox breaking zones and the outside row of throat sheet stays. Several rows of Flannery rigid hollow stays are used in the area above the mud ring and fire line. Three 3-in. arch tubes support the Security brick arch. Bituminous coal is hand fed through a Franklin No. 8A firedoor.

The boiler is equipped with two Sellers No. 10 $\frac{1}{2}$  injectors having a combined capacity of 7,900 gallons per hour, Type A superheaters, 2-in. Okadee

blow-off cocks, and two 3-in. Ashton safety valves.

The main steam pipe from the header to the engine cylinders is located outside the boiler on the right side and is of cast iron with ball joints. The throttle dry pipe is similarly equipped. The engine exhaust pipe is located next to the boiler on the right side and enters the smokebox on the bottom center line.

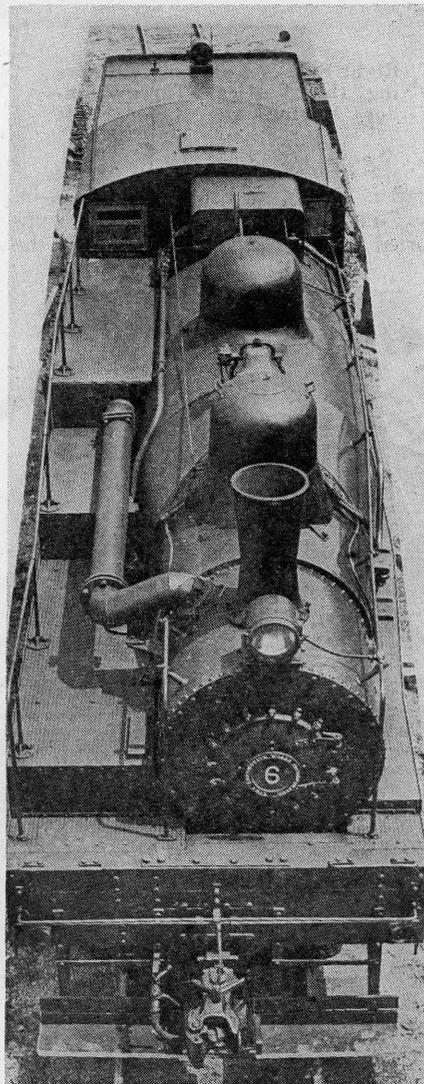
## Frames and Machinery

The main locomotive frame is a girder type assembly fabricated, by riveting, of plate and angles. The top rail is a 6-in. by 8-in. by 1-in. angle and the bottom rail is built up of two 6-in. by 6-in. by 1-in. angles with a 1-in. cover plate. The vertical web is  $\frac{3}{4}$ -in. plate on the right frame and  $\frac{5}{8}$  in. on the left frame. The side frame rails are tied together by the bumper and foot plate crossies as well as cross members at the front truck bolster and at the front of the firebox. Brackets for runboards, air compressor and air reservoirs are bolted to the frame. The center line of the boiler is located 14 $\frac{3}{4}$  in. to the left of the center of the track rails. This compensates for the machinery location on the right side of the locomotive.

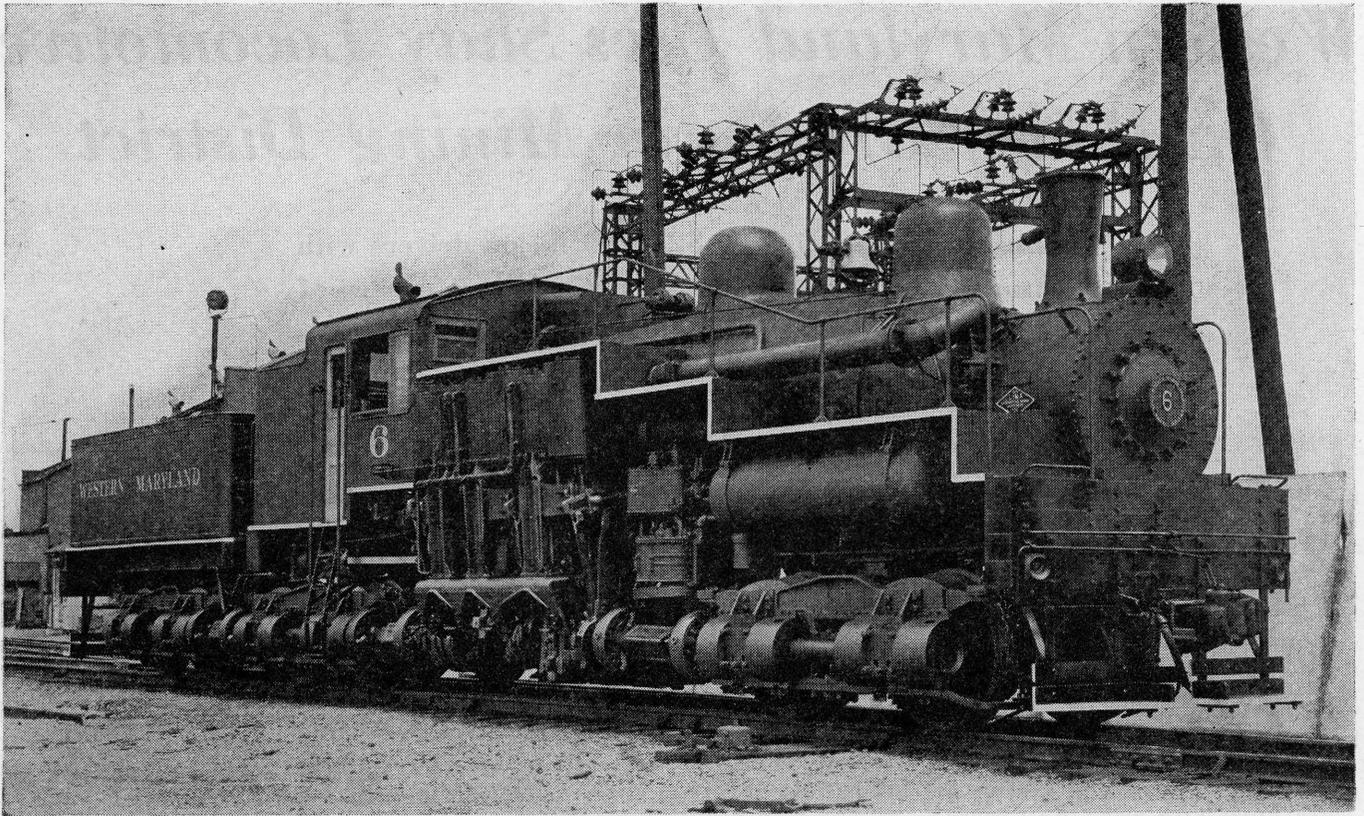
The machinery and running gear consists of a three-cylinder, single-expansion engine located on the right side immediately ahead of the cab. Directly connected to the engine crank shaft is a line shaft assembly which transmits power to three four-wheel trucks, alike in essential details and dimensions. Two of the trucks are located under the locomotive, on centers of 29 ft. 6 in., and one under the tender 13 ft. 10 in. back of the center of the rear engine truck.

## The Three-Cylinder Engine

The engine is a vertical three-cylinder single-expansion unit with piston valves and Stephenson valve gear. The cylinders are 17 in. bore and 18 in. stroke. Steam distribution is effected by 9 in. piston valves operating in bushings with a 4 $\frac{3}{4}$ -in. maximum travel. The valve gear is controlled by an Alco Type G power reverse gear through double reverse cranks located in planes at right angles to each other. The reverse shaft bearings are embodied in the vertical engine frames.



The Boiler is 14 $\frac{3}{4}$  in. Off Center



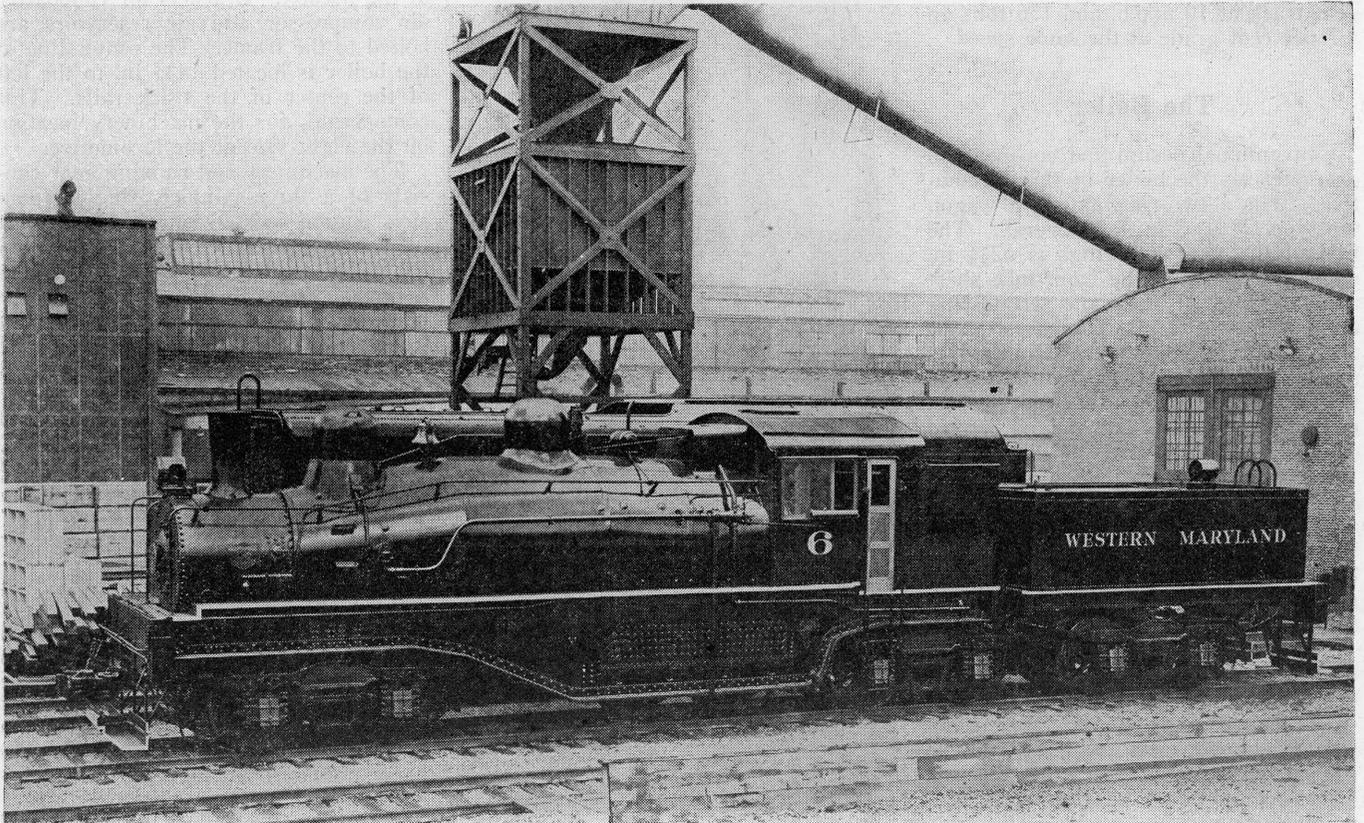
**Right Side of Locomotive Showing the Vertical Three-Cylinder Engine and Line Shaft**

The pistons are cast iron with  $3\frac{1}{2}$ -in. hammered-steel rods secured by a taper fit to cast-steel crossheads operating in cast-iron guides in the engine frame. The forged connecting rods have brasses with two babbitt strips in each half and are adjustable at both crosshead and crank shaft ends. The crank

shaft is  $7\frac{1}{4}$  in. in diameter with  $7\frac{1}{4}$ -in. by 7-in. journals. The shaft is supported by four main bearings in the

bed plate with removable bearing caps and brass bearings.

The backbone of the engine assembly is a steel bed casting to which three separate vertical engine frames containing the crosshead guides are bolted. The lower ends of these vertical frames are flanged to form the pads of the bed con-



**The Left Side Has a Clean Cut Appearance—the Frame Construction Is Visible**

nection and the upper ends are flanged for the cylinder connection.

On each vertical engine frame is a cast-steel valve-motion support containing the valve crosshead guide. These valve-motion supports are bolted to the side members of the vertical engine frames and act as strength members.

The cylinders and piston-valve chambers are cast as integral units and may be removed separately from the vertical engine frames. Both the engine bed plate and vertical frames are rigidly bolted to the locomotive girder frame at the top and bottom frame rails.

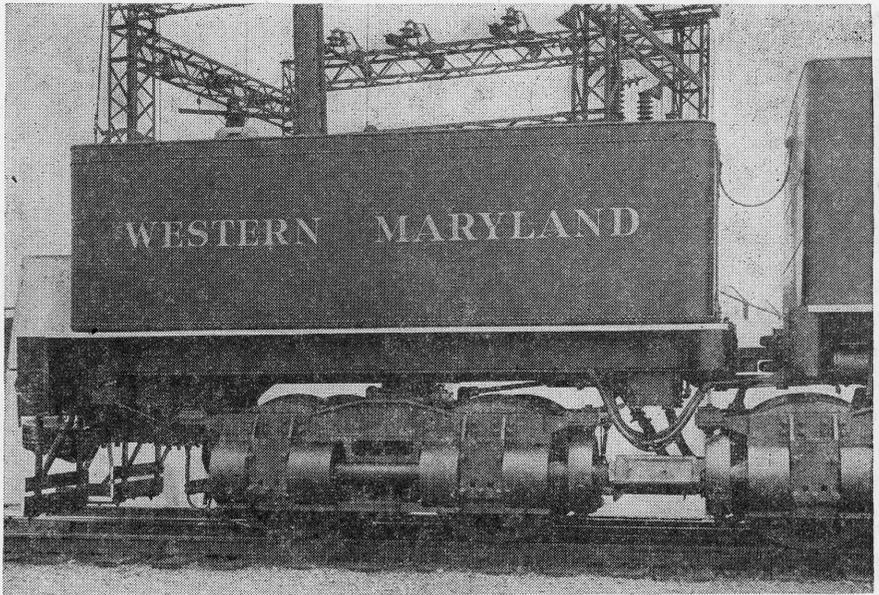
The line shaft which transmits power to the trucks has three pairs of universal couplings; one pair between the tender and rear engine truck; one pair between the rear engine truck and the rear of the engine crank shaft, and one pair between the front of the engine crank shaft and the front engine truck. Each coupling consists of two forked ends, or horns, forming a universal joint. The horn ends operate in bushings in the coupler ring. Removable cellars containing oil fittings are used at the four horn ends. Slip joints of square cross section, between each pair of couplings, permit truck swing adequate to negotiate 22-deg. curves. The horn couplings are cast steel, shrunk on and keyed.

### Trucks and Drive Mechanism

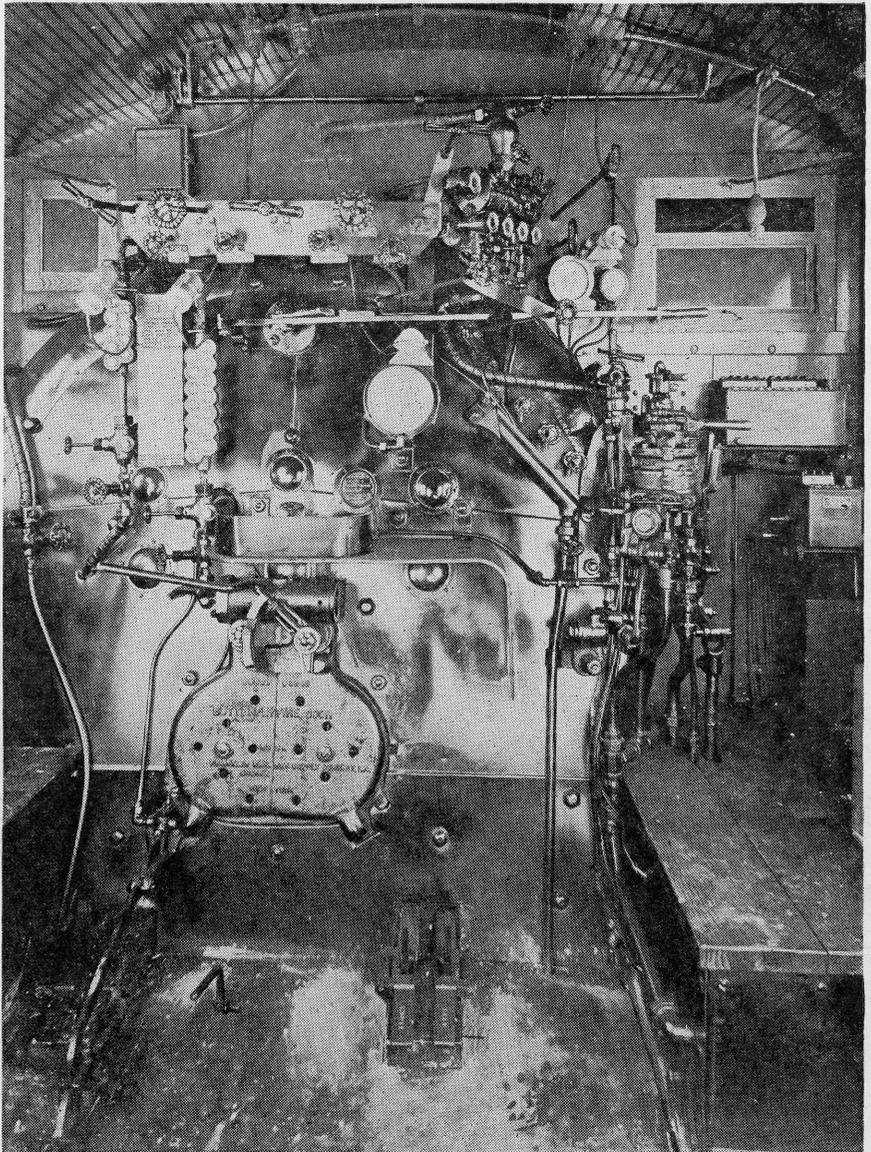
The three four-wheel trucks have cast-steel side members and forged truck-box binders. At each truck there are body and truck holsters consisting of a pair of 12-in. 40-lb. channels with 1½-in. cover plates. Coil springs, 36 in number, between the holsters, carry the load.

Six of the 12 truck wheels, on the right side, have cast-steel wheel centers of special design to accommodate the rim of the drive gear on the outside of the wheel and with lugs cast on the inside to prevent shearing the gear holding bolts in case of derailment. Steel tires are shrunk onto the wheel centers. The six left-side wheels are rolled steel. All wheels are 48 in. diameter and are mounted on carbon steel axles with 8½-in. by 10-in. journals running in oil-lubricated bronze-bearing truck boxes. The truck boxes on the right side are a special design which incorporates both the journal bearings for the axles and the bearings for the pinion, or line shaft. These are at right angles to each other. The line shaft bearings are 6½ in. by 14 in. The pinions are located ahead of each axle and are keyed to the line shaft. The gear ratio is 2.45 to 1 with 20 teeth on the pinion and 49 teeth on the gear. The maximum locomotive speed is 22 m.p.h. at a maximum engine speed of 377 r.p.m.

The cab is the vestibule type, of riveted construction. The cab and the coal space, having a capacity of nine tons, are built as a unit and are 6 ft. 10¼ in. long. There is approximately 5½ ft. between the fire-door and coal gates. The cab width is 119 in.



The Tender Tank Is Supported at Two Points—the Truck and the Hinge Connection to the Engine



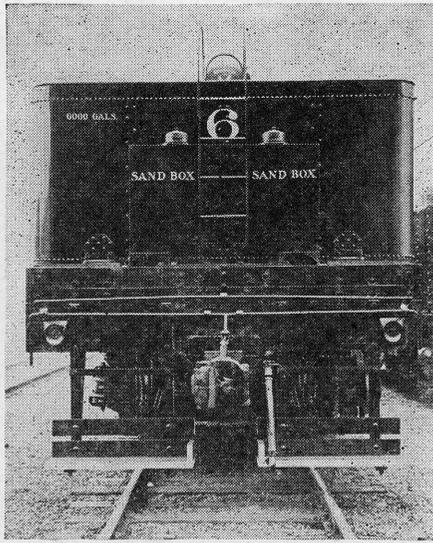
The Cab Affords Plenty of Working Room and Is of the Vestibule Type

### Partial List of Materials and Equipment on the Western Maryland Shay Locomotives

Firedoor .....	Franklin Railway Supply Co., Inc., New York.
Couplers .....	W. H. Miner, Inc., Chicago.
Brake equipment..	Westinghouse Air Brake Co., Wilmerding, Pa.
Gage cocks; lubricators; whistle	Nathan Manufacturing Co., New York.
Blow-off cock ....	The Okadee Co., Chicago.
Steam gage .....	Ashcroft Gauge Div., Manning, Maxwell, & Moore, Inc., Bridgeport 2, Conn.
Safety valves ...	Ashton Valve Co., Boston, Mass.
Water glass .....	Hanlon Drifting Valve Co., Boston, Mass.
Power reverse gear	American Locomotive Co., New York.
Lubrication .....	Manzel Bros. Co., Buffalo 10, N. Y.
Superheater .....	The Superheater Co., New York.
Brick arch .....	American Arch Co., Inc., New York.
Staybolts .....	Flannery Bolt Co., Bridgeville, Pa.
Injectors and checks .....	Wm. Sellers & Co., Inc., Philadelphia, Pa.
Headlight; generator .....	The Pyle-National Co., Chicago.
Bell ringer .....	U. S. Metallic Packing Co., Philadelphia, Pa.

Lubrication is effected by means of two Manzel oil pumps, one a three-feed unit for the engine steam chests and the other a 10-feed unit for the engine guides and bearings. A Nathan four-feed, four-pint automatic sight-feed oiler is located in the cab.

The locomotive is equipped with Westinghouse Schedule ET-6 air brakes having a single 8½-in. cross compound compressor and one 24½-in. by 102-in. main reservoir located under the runboards on the right side.



The Rear of the Tender

The tender tank is mounted on a structural frame having sills 12 in. deep. The rectangular tank is 17 ft. 0¾ in. long, 60 in. deep and 125½ in. wide; it has a capacity of 6,000 gal. The tank is built with 3/16-in. side sheets and ¼-in. bottom sheets.

The tender is supported on a single four-wheel truck and stability is maintained by a hinge connection between engine and tender consisting of a double jaw casting on the rear of the engine frame into which a rigid bar, riveted to the tender frame, and a conventional drawbar are inserted. A drawbar pin

### General Dimensions and Weights of the Western Maryland Shay Type Locomotives

Builder .....	Lima Locomotive works
Type of locomotive .....	Shay geared
Road number .....	6
Service .....	Freight
Rated tractive force, engine, 85 per cent, lb. ....	59,740
Weights in working order, lb.:	
On drivers .....	324,000
Total engine and tender .....	324,000
Wheel bases, ft.-in.:	
Driving .....	49-0
Engine, total .....	35-2
Engine and tender, total .....	49-0
Truck wheel base, rigid .....	5-8
Driving wheels, diameter outside, tires, in. ....	48
Cylinders, number, diameter and stroke, in. ....	(3) 17 x 18
Valve gear, type .....	Stephenson
Valves, piston type, size, in. ....	9
Maximum travel, in. ....	4¾
Boiler:	
Steam pressure, lb. ....	200
Diameter, first ring, outside, in. ....	62¾
Firebox length, in. ....	114
Firebox width, in. ....	61½
Arch tubes, number and diameter, in. ....	(3) 3
Tubes, number and diameter, in. ....	156-2
Flues, number and diameter, in. ....	28-5¾
Length over tube sheets, ft.-in. ....	13-6
Fuel .....	Bituminous
Grate area, sq. ft. ....	48.5
Heating surfaces, sq. ft.:	
Firebox and arch tubes .....	226
Firebox total .....	226
Tubes and flues .....	1,623
Evaporative, total .....	1,849
Superheating .....	429
Combined evap. and superheat. ....	2,278
Tender:	
Style .....	Rectangular
Water capacity, gal. ....	6,000
Fuel capacity, tons .....	9

in the engine frame casting passes through both bars. The inner surface contours of both the male bar casting and the engine frame casting are such as to allow for considerable movement between engine and tender on vertical curves.

