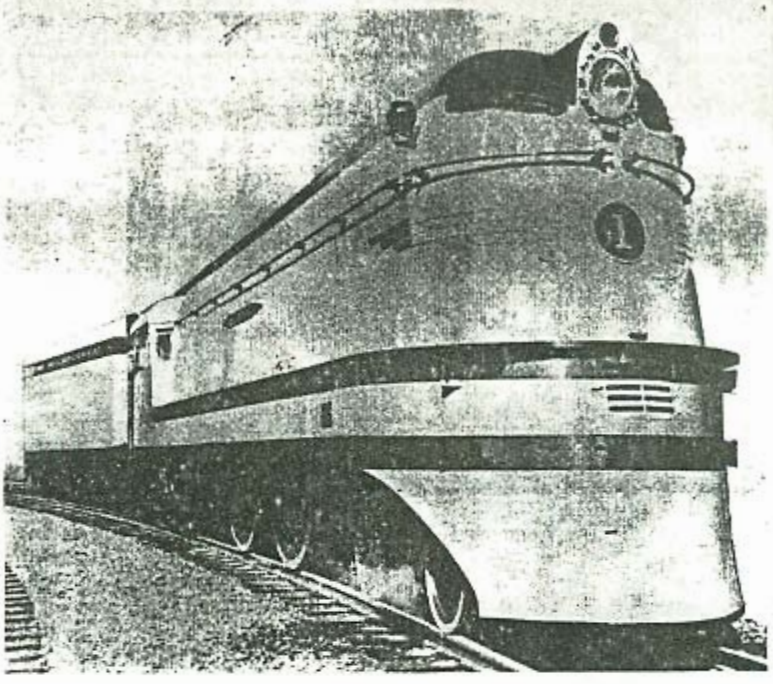
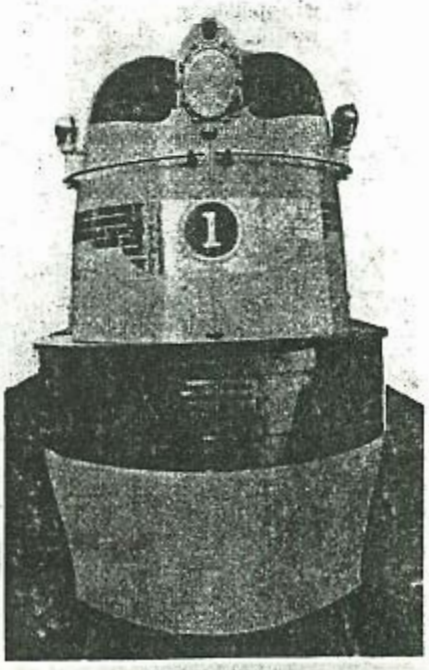
Milwaukee Buys Steam Locomotives for Fast Schedules

Built by the American Locomotive Company for smooth operation at high speeds and styled for public appeal—To operate the "Hiawatha", a fast day train soon to go into service on a six-and-one-half-hour schedule for 410 miles between Chicago and the Twin Cities



ON April 30, in the presence of Governor Herbert H. Lehman of New York and a party of railway and railway supply company officers, William C. Dickerman, president of the American Locomotive Company, officially delivered to H. A. Scandrett, president of the Chicago, Milwaukee, St. Paul & Pacific, the first of two new streamlined high-speed passenger locomotives. They are the motive power for the fast day-train service to be inaugurated on or about May 29 by that road between Chicago and the Twin Cities. This train, to be known as the "Hiawatha," will operate on schedules of six and one-half hours for the 410 miles with five intermediate stops in each direction—an average speed from start to stop of 63.1 m.p.h. and an average running speed of 66 m.p.h.

Among the numerous interesting features of these locomotives none is more striking than their exterior appearance. This arises not alone from the complete shrouding of the boiler and the skirting which partially conceals the running gear and motion work, but from the bold use of color and the skillful ornamentation. The finish includes black, gray, orange yellow, maroon and brown, with lettering in gold leaf and the conventionalized Indian headdress on the shrouding front in polished chromium.



In arranging the shrouding and skirting to permit ready access to all concealed apparatus great care and no small amount of ingenuity were exercised to keep the exterior surfaces free from projecting bolt heads and nuts. One or two inconspicuous handles, in most cases, is all that can be seen of a hinged door and no tools are required to unlatch and open the doors.

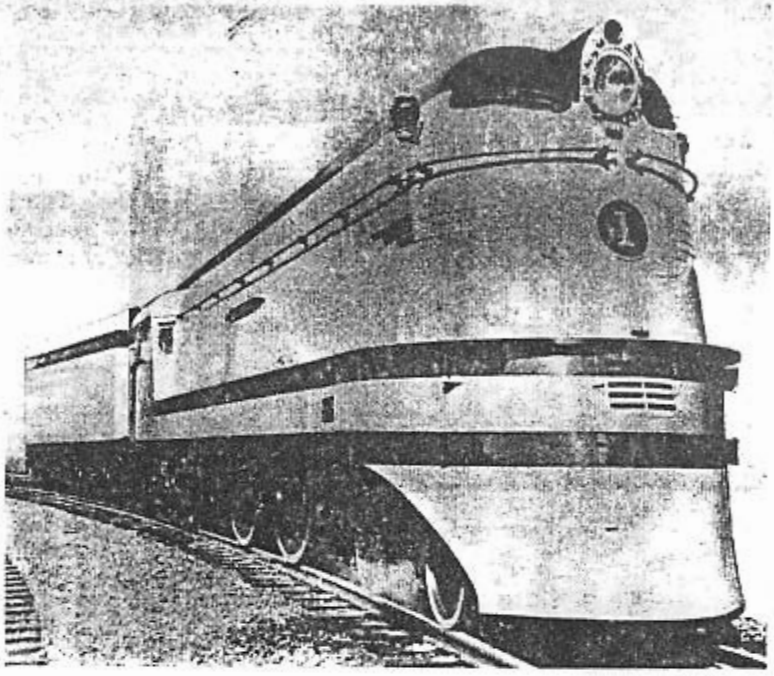
The locomotives are of the 4-4-2 wheel arrangement with large drivers and ample boiler capacity to handle trains of six cars, weighing about 340 tons behind the tender, at speeds in excess of 90 m.p.h. on level, tangent track for extended periods. The boiler has a total evaporating heating surface of 3,245 sq. ft. and 1,029 sq. ft. of superheating surface and is equipped to burn oil. The total weight of the engine is 280,000 lb., of which 140,000 lb. is on the drivers. The boiler carries 300 lb. per sq. in. working pressure. With cylinders 19 in. by 28 in. and 84-in. driving wheels, the tractive force rating is 30,700 lb. There is no booster.

The boiler is a straight-forward design embodying a conventional stayed firebox and fire-tube shell. The barrel is rolled in two courses

RY AGE MAY 11, 1935

Milwaukee Buys Steam Locomotives for Fast Schedules

Built by the American Locomotive Company for smooth operation at high speeds and styled for public appeal—To operate the "Hiawatha", a fast day train soon to go into service on a six-and-one-half-hour schedule for 410 miles between Chicago and the Twin Cities



ON April 30, in the presence of Governor Herbert H. Lehman of New York and a party of railway and railway supply company officers, William C. Dickerman, president of the American Locomotive Company, officially delivered to H. A. Scandrett, president of the Chicago, Milwaukee, St. Paul & Pacific, the first of two new streamlined high-speed passenger locomotives. They are the motive power for the fast day-train service to be inaugurated on or about May 29 by that road between Chicago and the Twin Cities. This train, to be known as the "Hiawatha," will operate on schedules of six and one-half hours for the 410 miles with five intermediate stops in each direction—an average speed from start to stop of 63.1 m.p.h. and an average running speed of 66 m.p.h.

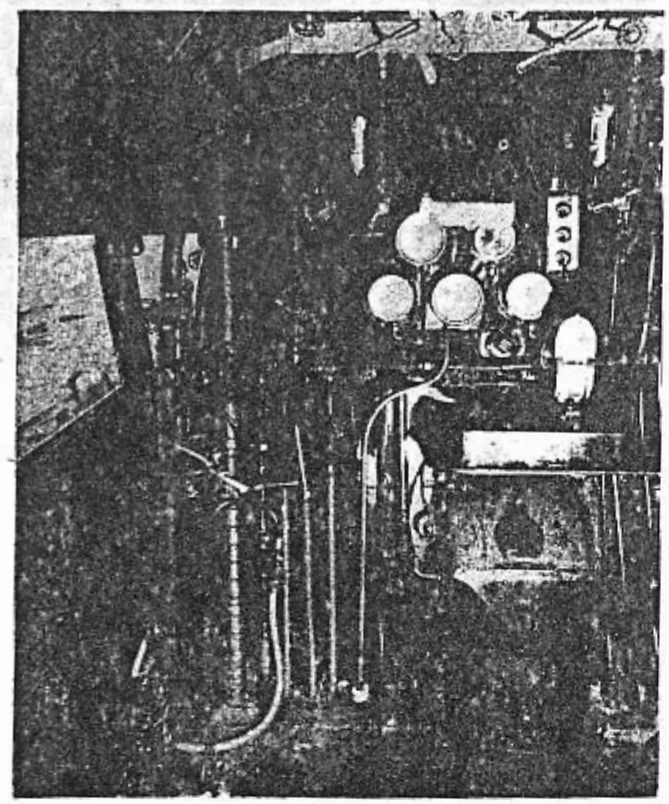
Among the numerous interesting features of these locomotives none is more striking than their exterior appearance. This arises not alone from the complete shrouding of the boiler and the skirting which partially conceals the running gear and motion work, but from the bold use of color and the skillful ornamentation. The finish includes black, gray, orange yellow, maroon and brown, with lettering in gold leaf and the conventionalized Indian headdress on the shrouding front in polished chromium.

In arranging the shrouding and skirting to permit ready access to all concealed apparatus great care and no small amount of ingenuity were exercised to keep the exterior surfaces free from projecting bolt heads and nuts. One or two inconspicuous handles, in most cases, is all that can be seen of a hinged door and no tools are required to unlatch and open the doors.

The locomotives are of the 4-4-2 wheel arrangement with large drivers and ample boiler capacity to handle trains of six cars, weighing about 340 tons behind the tender, at speeds in excess of 90 m.p.h. on level, tangent track for extended periods. The boiler has a total evaporating heating surface of 3,245 sq. ft. and 1,029 sq. ft. of superheating surface and is equipped to burn oil. The total weight of the engine is 280,000 lb., of which 140,000 lb. is on the drivers. The boiler carries 300 lb. per sq. in. working pressure. With cylinders 19 in. by 28 in. and 84-in. driving wheels, the tractive force rating is 30,700 lb. There is no booster.

The boiler is a straight-forward design embodying a conventional stayed firebox and fire-tube shell. The barrel is rolled in two courses

RR AGE MAY 11, 1935

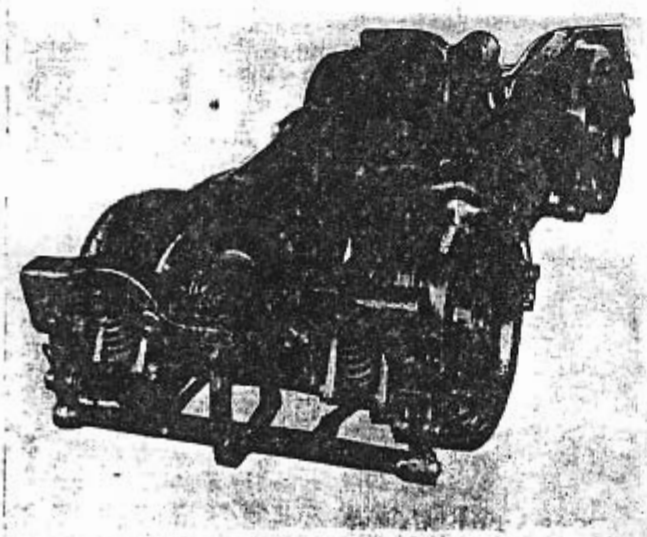


The Fireman's Side of the Cab

and the dome is located on the forward course, 7 ft. back from the front tube sheet.

The firebox sheets are of Lukens firebox steel built up on a solid cast-steel mud ring and stayed with Lewis Special staybolt iron. The stays are 1 in., $1\frac{1}{16}$ in. and $1\frac{1}{8}$ in. in diameter and include a liberal application of flexible stays at the breakage zones. The boiler-shell courses, including the welt strips and the firebox wrapper sheets, are of silicon-manganese steel. The second and larger shell course, which is 80 in. in diameter outside, is rolled from plate $\frac{27}{32}$ in. in thickness, while the front course is $\frac{13}{16}$ in. in thickness.

The firebox is of welded construction throughout. Welding is also used for 12 in. from the ends along the longitudinal shell seams and the edges of the wrapper sheets are welded at all corners 12 in. up from the bottom of the mud ring. Both the firebox and wrapper sheets are also seal-welded to the mud ring behind obstructions which would make access for calking difficult.



The Engine Truck

Frames and Running Gear

The locomotive is assembled on a cast-steel bed, of which the cylinders, back cylinder heads, saddle and main reservoir are an integral part. Provision is made for the support of the running boards on the bed casting, either directly or from waist sheet and other bed-casting connections. The shrouding and skirting are, in turn, supported from the running boards. In front of the cylinders the casting includes suitable brackets for the air pump, turbo-generator and bell. There is no bumper beam. The bed terminates at the front in a deep vertical bolting face, to which are attached the front coupler pocket and the pilot or nose structure of the shrouding.

The boiler is supported on sliding shoes at both the front and back ends of the firebox. Between the driving wheels and at the guide yoke are waist sheets which have sliding fits on the boiler shell.

The driving wheels have Boxpok cast-steel centers which are mounted on hollow-bored axles. The journal boxes are fitted with SKF roller bearings. The engine truck is the Commonwealth four-wheel type, with inside journals. The trailing truck is the Commonwealth Delta type with a single axle. SKF bearings are applied on the hollow-bored axles of the engine truck and the trailing truck has an American Steel Foundries roller-bearing axle assembly fitted with Timken roller bearings.

In the design of the rods and motion work weight reduction was an important consideration. The drive is through Tandem main rods, with the cylinders spread

The Six-Wheel Tender Truck

78 in. between centers. The rods are of high-tensile nickel steel and are light I-sections. For stiffness the parallel rod is fish-belly in form. The eccentric rod and crank are also channeled to keep down the weight on the main crank pins. The counterbalancing of the locomotive is such that the dynamic augment at the rail at a speed of 100 m.p.h. is 10,800 lb. The total reciprocating weights on one side of the locomotive amount to 1,003 lb., of which one-third are balanced. The low dynamic augment is due in part to the care in design to keep the weights of reciprocating parts as low as possible, and also to the greatly reduced overhang of the pin-borne weights due to the relatively narrow cylinder spread.

The crank-pin bearings are bronze-floating bushings inside of Hunt-Spiller gun iron bushings, pressed in the rods at the rear pins and in the steel articulating bushings of the rods at the front pins. The crank pins are of carbon steel, hollow bored.

The pistons are light Z-sections, open-hearth-steel forgings fitted with Hunt-Spiller Duplex packing. Bronze wearing faces are provided at the bottom. The crossheads and guides are of the Dean three-bar type. The Diamond-Crescent rod packing is suitable for steam temperatures of 750 deg. F.

The locomotive suspension is of the customary three-point type. In addition to the main driving and trailing-truck springs, each side suspension includes two coil cushioning springs, one lever-connected to the front driving-spring hanger and the other interposed directly between the end of the rear trailer-spring hanger and the Delta frame. The driving springs have a slight reverse camber.

The locomotive is fitted with Walschaert valve motion and 10-in. piston valves which have a maximum travel of 6½ in. An American multiple throttle is fitted in the type A superheater header. The latter is connected to the valve chambers by the usual outside steam pipes and Flextite casings. The Alco reverse gear is located at the side of the firebox, behind the skirting below the running board, and is supported directly from the engine bed.

The cylinder and valve chambers are lubricated by a Nathan DV-4 24 pint forced-feed lubricator. The valve motion, rods, spring rigging and brake work are fitted for Alemite lubrication throughout.

The Front End

An unusual feature of the front end is the exclusion of the volume in front of the diaphragm and above the table plate from the smokebox proper. The table plate extends forward to the smoke-box front. In it is an opening to which the bottom of the stack extension is fitted. Since the fuel is oil, no front-end screen is needed. The exhaust nozzle is relatively low in the front end. The Goodfellow tip stands 19⅞ in. from the bottom of the smoke arch and is 12⅛ in. below the bottom of the stack extension and the table plate.

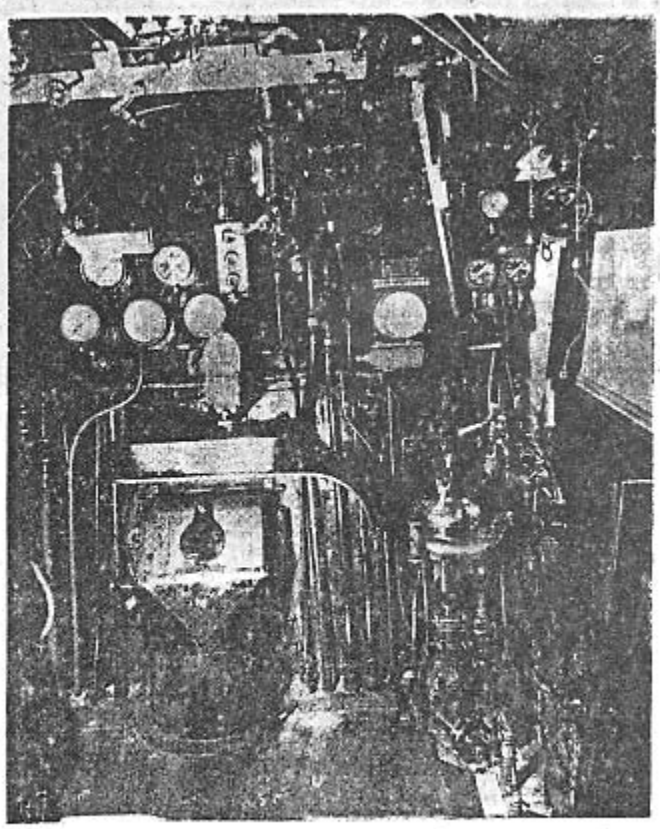
Advantage has been taken of the fact that the smoke stack is concealed to use it as a support for the shrouding. Bolting lugs have been cast on it, both in front and at the rear. A vertical passage of circular section which extends up to the top of the stack also forms an integral part of the casting at the rear. This is provided with a suitable connecting flange at the base and serves as an exhaust pipe for the feedwater pump and the turbo-generator. The moisture from these exhausts is thus kept out of the smokebox. The air-pump exhaust is piped into the main exhaust passage in the cylinder saddle.

The entire front end is lagged and jacketed to keep down the temperature inside the shrouding. The smokebox front is swung on Okadee hinges.

The Brakes

One of the outstanding developments embodied in these locomotives is the foundation brake, designed by the American Brake Company. This is particularly adapted to the dissipation of the large amount of energy stored in the locomotive when moving at speeds of 90 m.p.h. and upward. Clasp brakes are applied on every wheel under the locomotive. On the engine truck there are two brake cylinders, one of which applies the brake shoes against the front and the other against the rear of all wheels. To steady the truck frame against the tilting action of the brake application the ends of the equalizers are extended beyond their bearings on the tops of the journal boxes and support seats for coil cushioning springs under the four corners of the engine-truck frame.

The driver brakes are operated by three cylinders. The front brake shoes on all four driving wheels are applied by a single cylinder through mechanical equalization. The rear shoes on each side of the locomotive have separate cylinders, the equalization between the two sides of the locomotive being effected pneumatically.



Right Side of the Cab

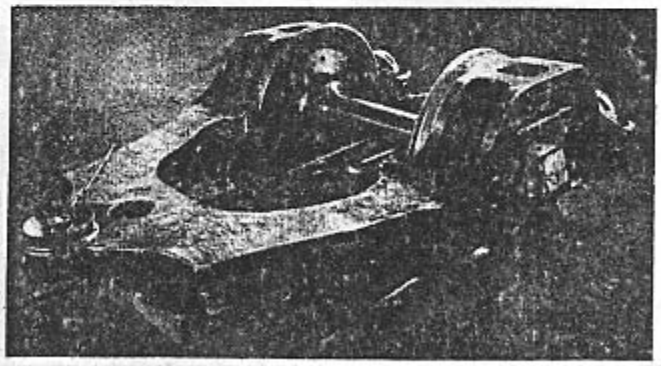
One brake cylinder applies all four shoes on the trailing-truck wheels.

The braking ratios of the three brake systems are, respectively, 45 per cent for the engine truck, 60 per cent for the trailing truck and 78 per cent for the driving wheels, based on 50 lb. brake-cylinder pressure.

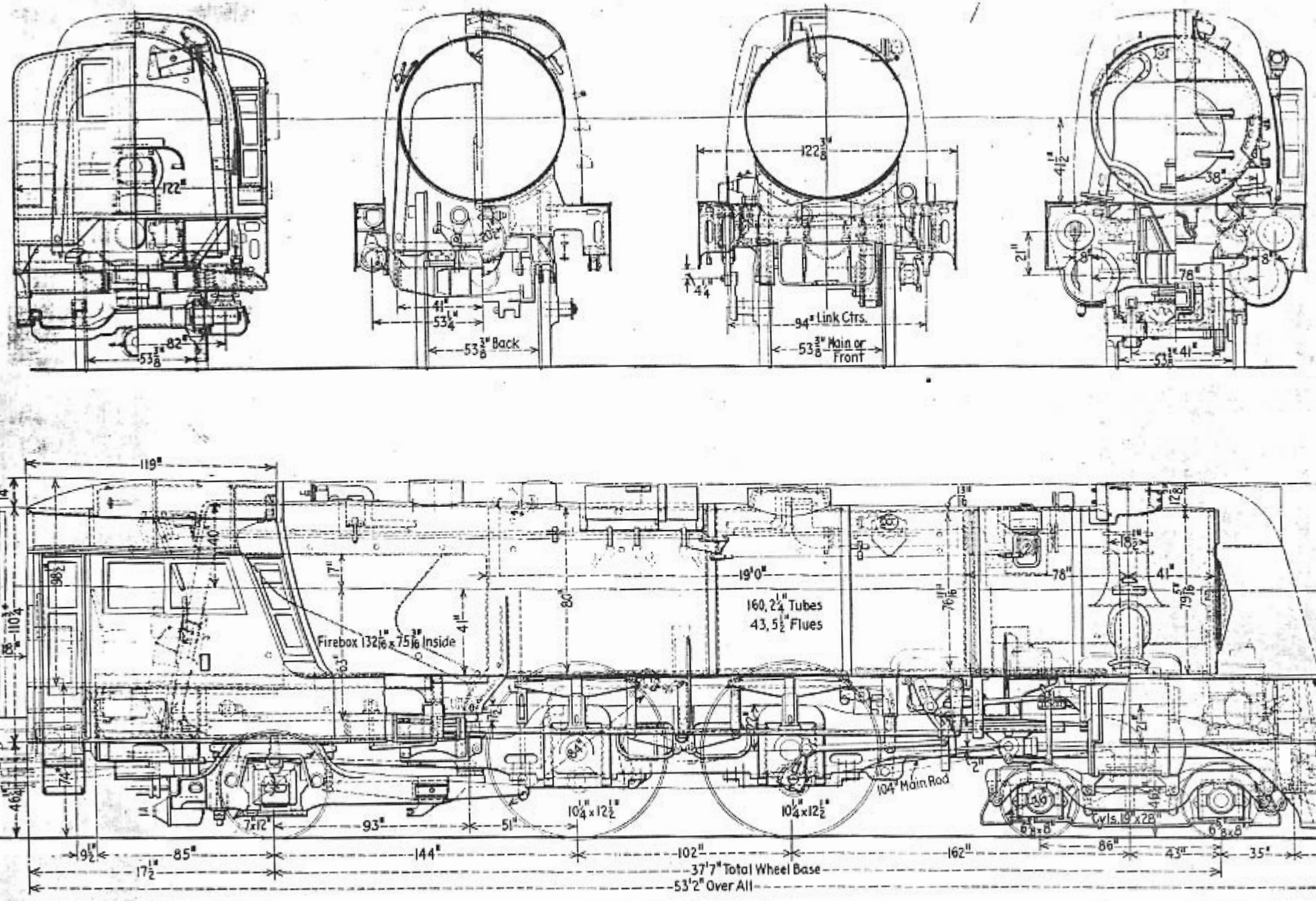
The locomotives are fitted with the Westinghouse No. 8ET air-brake equipment and one 8½-in. cross-compound air compressor. The main reservoir, which is a part of the backbone of the engine bed, is divided into three compartments. Between the air compressor and the first compartment of the reservoir and between the first and second compartments are radiator-pipe connections. The rear compartment, which is small, is connected to the second by a cored passage near the top of the dividing wall and serves as a final moisture settling chamber before the compressed air is drawn into the brake system.

The Shrouding

The shrouding completely encloses the boiler and all apparatus customarily suspended from the boiler or mounted on the locomotive bed. Extending down to



The Trailer Truck



Elevation and Cross-Sections of the Chicago, Milwaukee, St. Paul & Pacific High-Speed Streamlined Locomotive

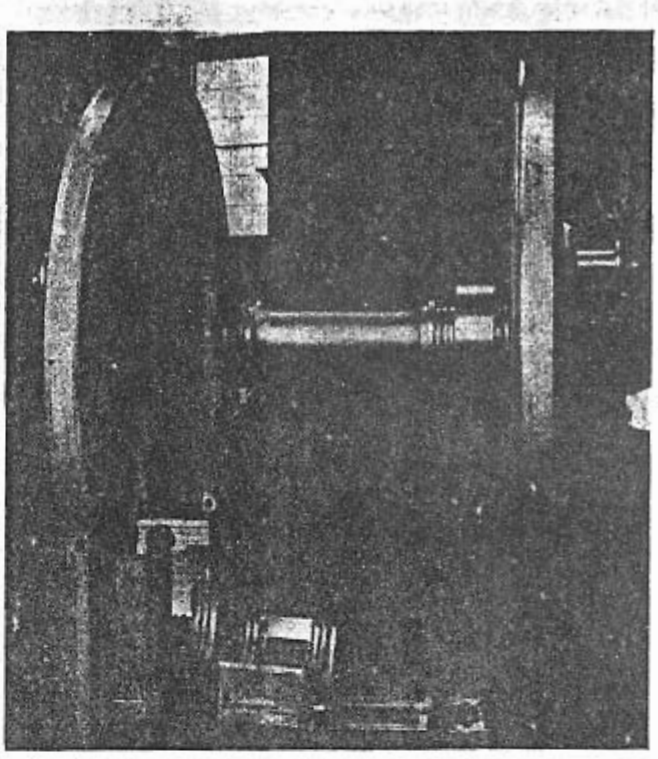
the running board, it is built of No. 16 gage material—Toncan steel for the doors ahead of the smokebox and Republic double-strength steel for the remainder. The sheets are carried on a frame consisting of angle carlines which are supported from the running boards and centered by means of swivel connections to studs on top of the boiler. The shrouding is fitted with doors opposite all washout plugs, sand traps, boiler checks, etc. The entire front is enclosed in swinging doors, the opening of which facilitates access to the front end and the equipment mounted below the front end on the engine bed. Grilles at the top of the front of the shrouding admit air to a duct which has an outlet behind the stack where it serves as a smoke lifter.

Among the interesting details of the shrouding are folding steps in the sides which can be let down when access to the sand box or cab turret is desired. The classification lamps are supported on top of the upper hinges of the front shrouding doors and these hinges have been designed so that the wiring is carried through them to the interior of the jacket. The handrail columns are fitted with simple spring latches, by means of which the handrail is securely locked in the columns. Each is unlocked by push button and opened by spring torsion. Closing the latches automatically locks them in place. An entire side section of the handrail can thus be removed and replaced in a few minutes without the use of tools.

The lower section at the front end of the shrouding serves as a pilot. This is a stiff, welded structure of plates and angles which extends below the bottom of the front-end shrouding doors. A panel on the center of the pilot conceals the coupler when it is not in use. The coupler is hinged in its pocket to swing upward and, when its use is required, on removal of the panel, it can be swung down horizontally. Train-brake and air-signal lines are carried to the front of the locomotive, where they terminate inside the shrouding with standard cut-out cocks. When not in use the air hose are removed and carried in the tool box.

Skirting is supported from the outer edge of the running board and extends down about 33 in. This conceals the reverse gear, the boiler feed pump, the spring rigging and most of the valve motion, and forms an unbroken line from the rear of the pilot wing to the rear of the tender.

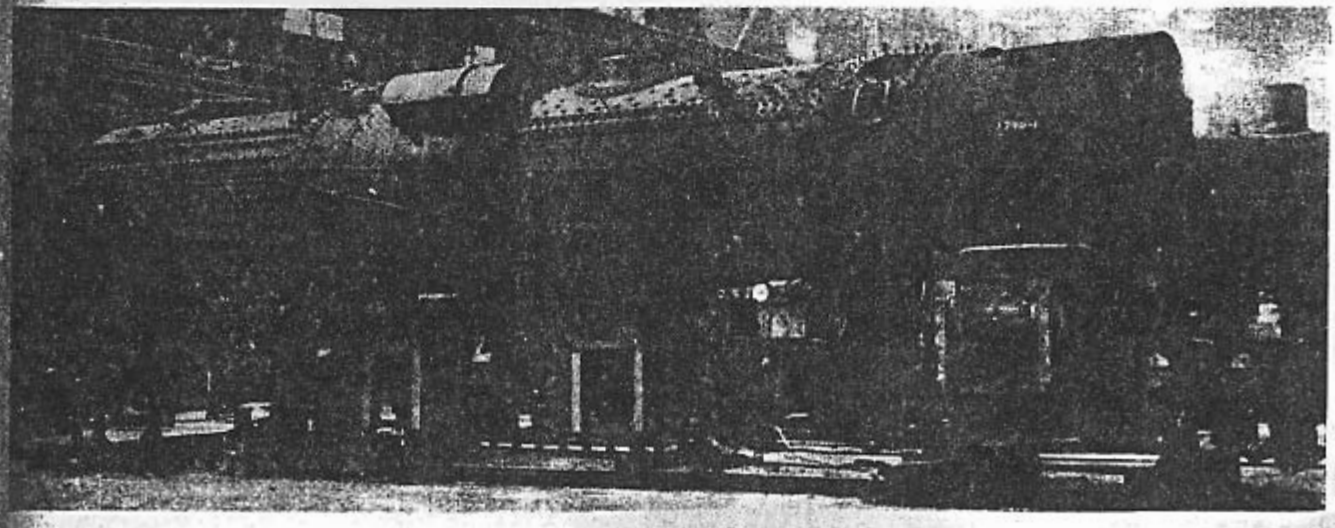
Since the locomotive and tender are built for oil-burning service only, there was no need for access to the tender through the arch at the rear of the cab. The back of the cab has, therefore, been completely enclosed and side doors are provided back of the engineman's and fireman's seats. The cab is of welded construction throughout and is provided with one thickness of hair insulation between the outside sheets and the inside wood lining. The engineman's and fireman's seats are Gustin-Bacon type with Spongex cushions. Two auxiliary drop seats are also provided and are fitted with the same type of cushions. The cabs are fitted with Prime clear-vision windows.



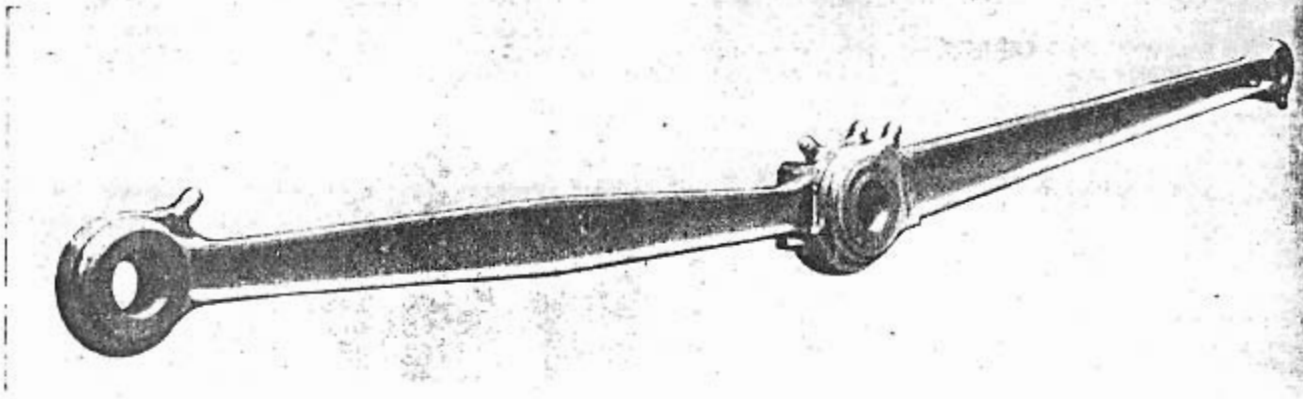
The Driving Wheels and SKF Roller-Bearing Journal Boxes

Because of the inaccessibility of the tender while the locomotive is running, the cab is fitted with water- and oil-level indicators, accompanying which is a calibration chart showing the gallons per inch of fuel and water heights. With these gages is also a dial type pyrometer which shows the temperature of the fuel oil in the tank.

There are two steam turrets. That for superheated steam is located on the smokebox near the superheater



The Boiler Mounted on the Engine Bed



The Tandem Rods

header and supplies steam for the air pump, the turbo-generator, the blower line, the oil burner and the cylinder cocks. The saturated-steam turret is placed in the conventional location just ahead of the cab and supplies the injector, steam heat for the train and cab, the power reverse gear, the feedwater pump and the lubricator heater. The locomotive is equipped with a Loco Recorder, reading up to 120 m.p.h., and with Union Coded continuous cab signals.

The headlight is the Pyle-National submerged type with a 14-in. glass reflector, arranged to swing out. The special oval front goggle is mounted in an aluminum frame. The locomotive has a Leslie Tyfon whistle fitted for operation by air or steam. The single horn is enclosed within the cowling immediately above the headlight. Brewster-White remote-control type sanders are applied. The control valves are located at the sand traps with direct air connections from the main reservoir and a pneumatic operating valve in the cab. This arrangement is designed to provide a flow of sand immediately on the operation of the cab valve.

The Tender

The tender is rectangular and is built up by welding upon a General Steel Castings water-bottom frame. It is designed to be used in oil-burning service only, and the fuel tank is built in integrally. The hot-water compartment of the Wilson water conditioner is located on the left side of the water tank at the front and receives exhaust steam from the back end of the exhaust ports through pipes which are carried between the frames and under the draft pan to the tender. The feed pump is located on the left side under the cab.

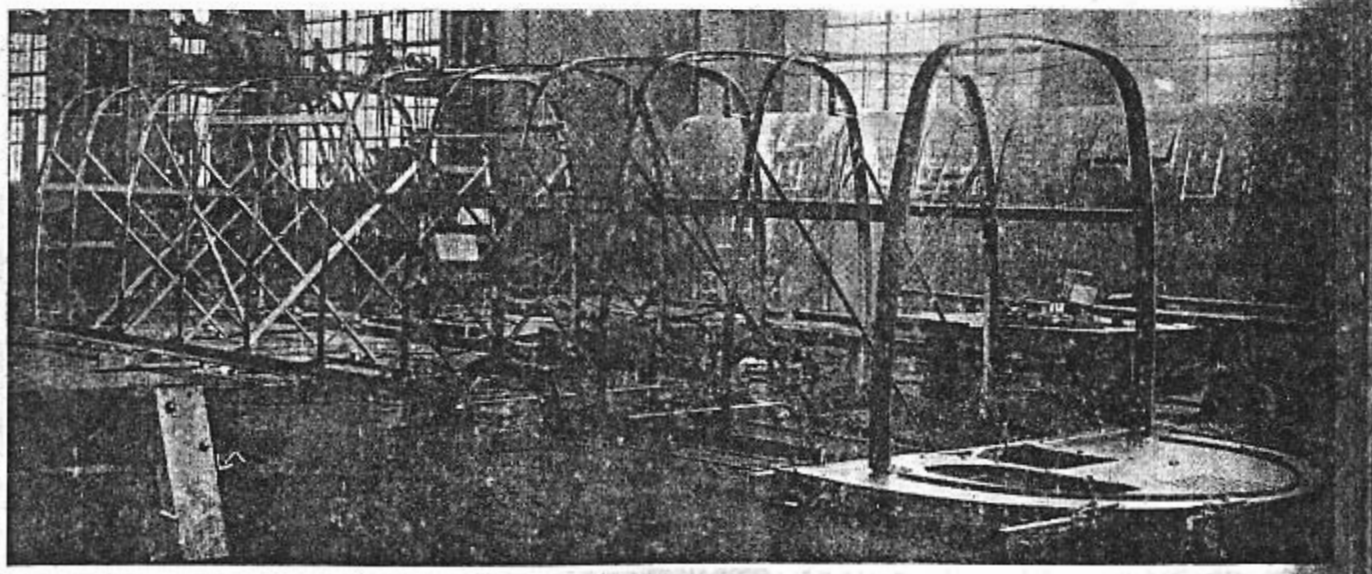
The top of the tank is shrouded to conform with the contour of the roofs of the new passenger cars with which these locomotives will be operated. A single opening in this shrouding provides access to both the water and oil-filling holes. The rear end of the tender is fitted with a dummy vestibule connection.

The tender is carried on five axles. Both the four-wheel and the six-wheel trucks are of General Steel Castings construction fitted with American Steel Foundries roller-bearing wheel-and-axle units having Timken bearings. Davis cast-steel wheels are applied. Both trucks are equipped with Simplex unit type clasp brakes.

The locomotives are fitted with the Franklin Radial buffer and Unit engine and tender drawbar. Miner A-94-XB draft gear is installed at the rear end of the tender. Barco steam, air and oil connections are applied between the engine and tender, with hose connections for water. Barco brake-cylinder connections are also used on the engine, trailer and tender trucks.

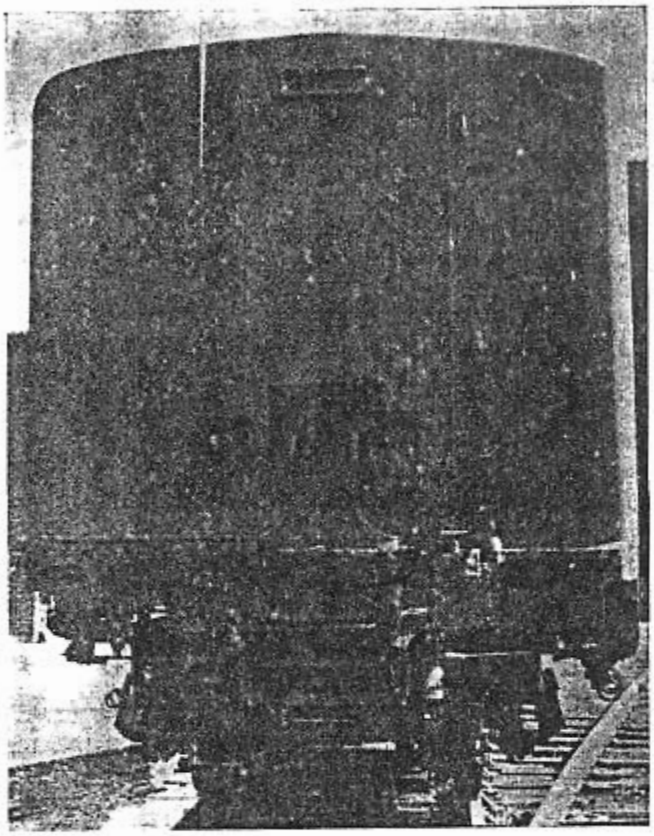
Partial List of Specialties on the Chicago, Milwaukee, St. Paul & Pacific High-Speed Passenger Locomotives

Builder	American Locomotive Co.
Alemite fittings	W. S. Wilson Corp.
Bearings, side—tender truck	Standard Car Truck Co.
Bearing, roller, wheel and axle assembly, with Timken bearings—tender and trailer trucks	American Steel Foundries

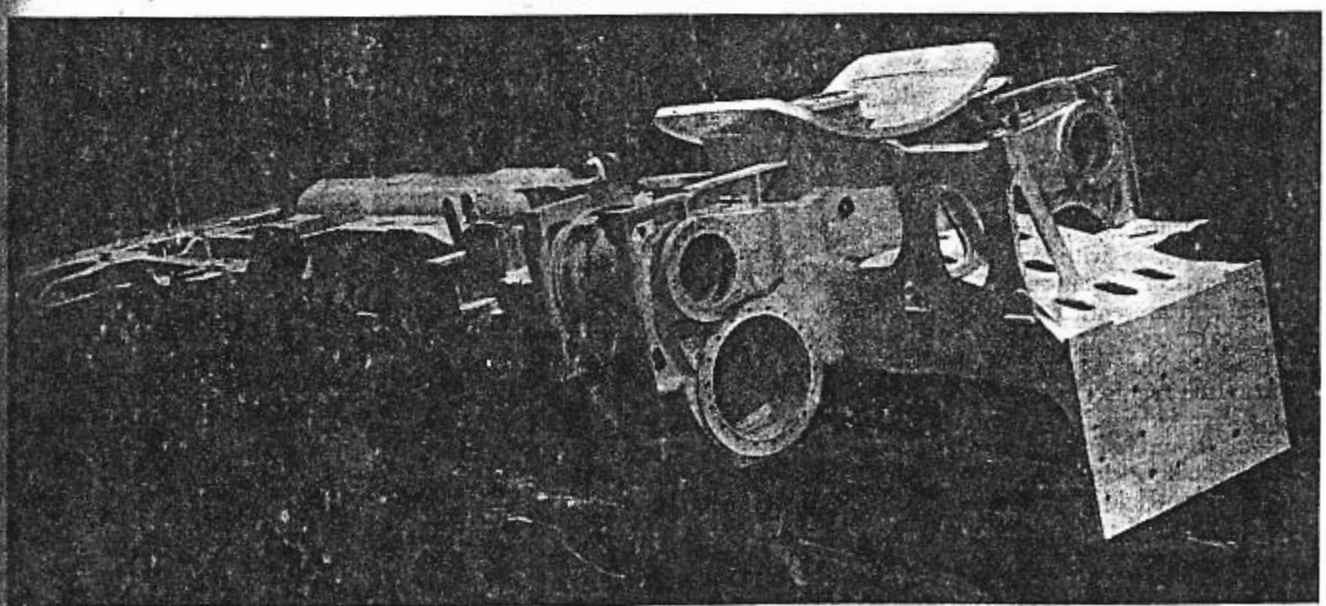


The Shrouding Frame

Bearings, roller—main and back driving boxes and engine trucks	SKF Industries, Inc.
Bell ringer	Vilter Railway Equipment Co.
Blow-off cocks	Wilson Engineering Corp.
Boiler tubes and flues	Globe Steel Tubes Co.
Brakes, Simplex unit-type, clasp, tender	American Steel Foundries
Brakes, foundation	American Brake Co.
Brakes, operating	Westinghouse Air Brake Co.
Brake shoes, tender	American Brake Shoe & Foundry Co.
Buffer, radial	Franklin Railway Supply Co.
Bushings, cylinder, valve chamber and side rod	Hunt-Spiller Mfg. Co.
Bushing, main-rod back-end	Camden Forge Co.
Cab insulating material	American Hair & Felt Co.
Cab seats	Gustin-Bacon Manufacturing Co.
Cab signals	Union Switch & Signal Co.
Cab windows, clear vision	Prime Manufacturing Co.
Cable	General Cable Corp.
Castings—engine bed; Boxpok driving-wheel centers; tender frames; engine-, trailing- and tender-truck frames	General Steel Castings Corp.
Couplers	Buckeye Steel Castings Co.
Crosshead shoes	Ampco Metal, Inc.
Crossheads, steel	Adirondacks Steel Foundry Corp.
Cylinder cocks	Prime Manufacturing Co.
Drawbar, Unit safety	Franklin Railway Supply Co.
Draft gears, tender	W. H. Miner, Inc.
Drypipe, Lap welded iron	Reading Iron Co.
Firebrick	American Arch Co.
Flexible joints, steam air and oil between engine and tender, and for brake cylinder connections on engine, tender and trailer trucks	Barco Manufacturing Co.
Gages, steam heat	Ashton Valve Co.
Grease guns (Alemite)	Prime Manufacturing Co.
Headlight and generator, and cab lamps	Pyle-National Co.
Insulated wire	Kerite Insulated Wire & Cable Co.
Joints, Universal	Prime Manufacturing Co.
Lagging, magnesia; steam pipe covering (Insutape)	Union Asbestos & Rubber Co.
Lamps, classification and marker	Adams & Westlake Co.
Low-water alarm	Barco Manufacturing Co.
Lubricators, cylinders and air pumps	Nathan Manufacturing Co.
Oil burner; oil tank heater; oil-burner valves; water-gage drain valves; water-column drain valves; sludge-remover drain valves; safety valves; injector and checks; back-pressure steam gage; dial thermometer; water-level indicator; oil-level indicator	Consolidated Ashcroft Hancock Co.
Packing, piston and piston valve	Hunt-Spiller Mfg. Co.
Packing, piston rod and valve stem (Diamond-Crescent)	T-Z Railway Equipment Co.
Packing, throttle air joint	Pilot Packing Co.
Pistons, forged steel	Carnegie Steel Co.
Rerailers	Aldon Co.
Rod bushings, bronze	Magnus Co.
Running boards, Diamondette steel	Alan Wood Steel Co.
Sanders (B-W)	Morris B. Brewster Co.
Sludge removers	Wilson Engineering Corp.
Smokebox hinges	Okadee Co.
Speed recorder	Valve Pilot Corp.
Springs	American Locomotive Co., Ry. Steel-Spring Div.
Staybolt iron (Lewis Special)	Jos. T. Ryerson & Son
Steel, boiler	Lukens Steel Co.
Steel castings, miscellaneous	American Steel Foundries
Steel plates, for tank and cab	Bethlehem Steel Co.
Steel sheets for shrouding (Double strength, hot rolled)	Republic Steel Corp.
Steel sheets, jacket and cylinder casing	American Sheet & Tin Plate Co.
Superheater (Type A)	Superheater Co.
Syphons	Locomotive Firebox Co.
Throttles, multiple	American Throttle Co.
Truck boxes, tender	Symington Co.
Tubing, copper	Chase Brass & Copper Co.
Valves, couplings, tees—Miscellaneous	Crane Co.
Valves, exhaust, drain and tank	T-Z Railway Equipment Co.
Valves, low-water alarm and globe	Walworth Co.
Valves, steam heat	Vapor Car Heating Co.
Washout plugs	T-Z Railway Equipment Co.
Water conditioner	Wilson Engineering Corp.
Wheels, engine truck	Edgewater Steel Co.
Wheels, tender truck	American Steel Foundries



The Front End of the Tender



The Engine Bed Includes Cylinders, Back Cylinder Heads and Main Reservoir