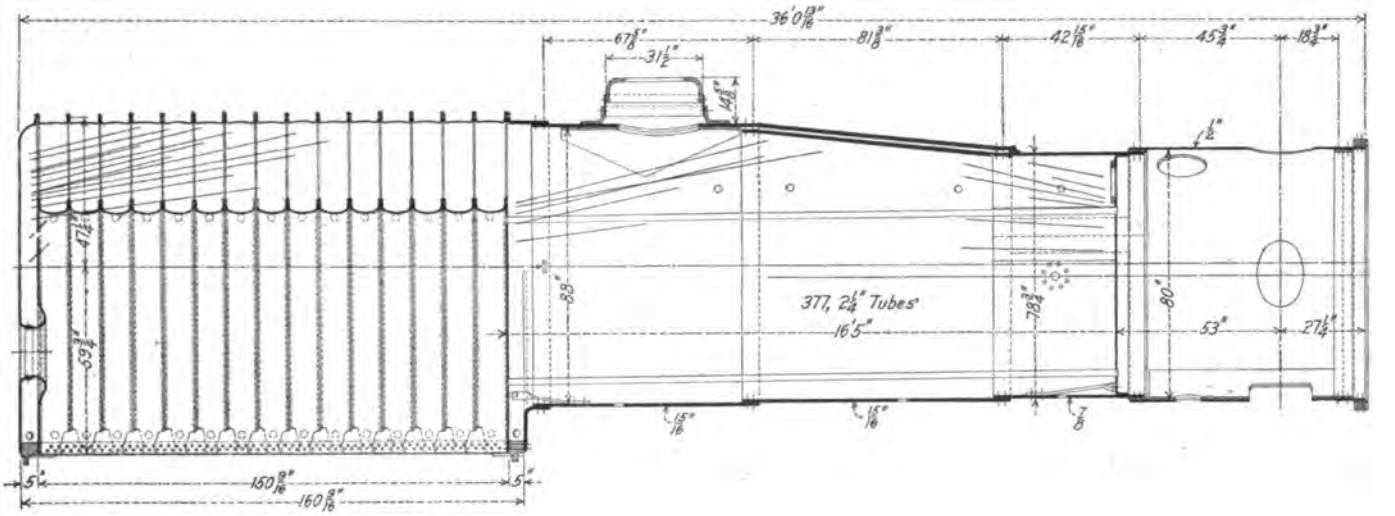

3000

MALLET LOCOMOTIVE WITH 20 DRIVERS FOR THE SANTA FE.

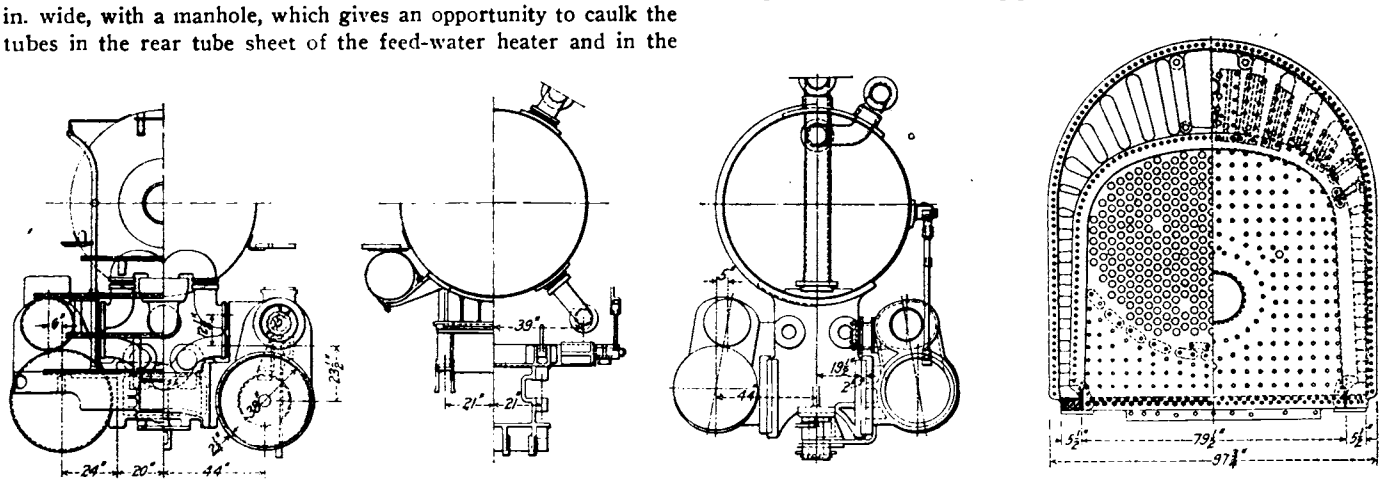
A brief article and a photographic view of a 2-10-10-2 type Mallet locomotive on the Santa Fe, was published in the *Railway Age Gazette* of April 14, page 908. These engines were rebuilt from Santa Fe type locomotives which were built at the Baldwin Works in 1902. The Santa Fe type locomotives weighed 287,000 lbs., and as single engines were probably the most powerful locomotives in the world, having a tractive effort of 62,800 lbs. Ten of them, which required new fireboxes, were selected for the conversion, and were fitted with new fireboxes of the Jacobs-Shupert type arranged for burning oil. The original low pressure cylinders were bushed from 32 in. to 28 in., and were used as high pressure cylinders of the Mallet locomotive.



Rear Section of Boiler for Santa Fe 2-10-10-2 Mallet Locomotive.

The front section of the Mallet, which was built by the Baldwin Locomotive Works, has a wheel arrangement similar to that of the rear unit, and low pressure cylinders 38 in. in diameter by 32 in. stroke. The front boiler section includes a feed water heater 106 in. long, located in the front portion next to the smoke-box. Back of the feed water heater is a narrow space 32 in. wide, with a manhole, which gives an opportunity to caulk the tubes in the rear tube sheet of the feed-water heater and in the front tube sheet of the reheater. The superheater is of the Buck-Jacobs type, consisting of a single drum, whose shell is integral with that of the boiler. The heads are riveted to this shell and support a set of horizontal tubes, which are welded in the heads by the oxy-acetylene blow pipe. An intermediate head divides the superheater into two sections, one for superheating the steam for the high pressure cylinders, and the other, a larger section, for reheating the exhaust from the high pressure cylinders before it passes to the low pressure cylinders. The front section of the boiler is attached to the smoke arch of the old section by a V-shaped ring joint. The articulated joint between the two sections of the frames is made with heavy steel castings, according to the usual practice of the Baldwin Locomotive Works in connection with Mallet locomotives. This is a simple rigid structure beneath the cylinder forming a large hinged pocket, which is partly shown in the drawing of the general plan of the engine.

The arrangement of the steam pipes is that developed by the Santa Fe in connection with their system of superheating and reheating. The steam passes from the dome of the rear section through the ordinary dry pipe, but the tee head is replaced by an elbow which connects to an outside steam pipe on top of the boiler. This leads to the high pressure superheater, and from the lower portion of this superheater there is another outside pipe which leads the steam to the high pressure cylinder. Exhaust from the high pressure cylinder passes through a long vertical pipe which extends to the upper shell of the smoke arch and connects with an elbow to another outside horizontal pipe on top of the boiler. This pipe leads to the reheater, and from here the steam passes by the usual pipe, with large ball and slip joints below the boiler and between the frames, to the low pressure cylinders. By this arrangement the steam pipe joints are all on the outside, where they are readily accessible for inspection and repairs. These joints are not subject to the intense heat which is liable to cause them to leak; when this leakage is in the smokebox or any of the smoke passages connected with the tubes it interferes with the draft of the engine. The

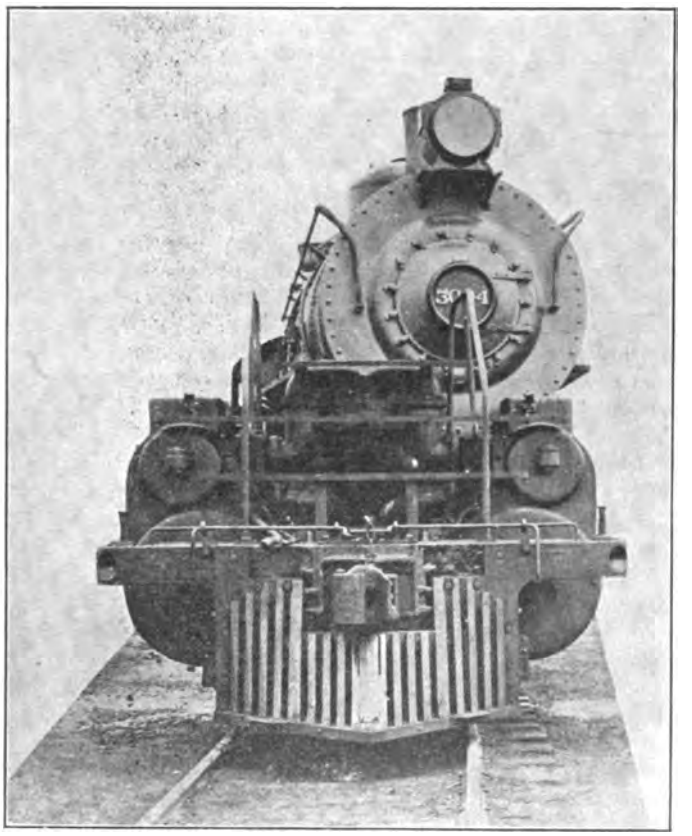


Cross-Sections Through the Santa Fe Mallet Locomotive and Its Boiler.

high pressure piston valve is 13 in. in diameter, and the low pressure, 15 in.; both are operated by the Walschaert valve gear. The feed water is delivered by two No. 12 non-lifting injectors, each capable of delivering 4,200 gal. of water per hour. There are two 8-in. Westinghouse cross-compound air pumps located on the left side of the engine and three main reservoirs having a combined capacity of 100,000 cu. in.

The tenders were designed and built by the Baldwin Locomotive Works especially for these Mallet engines, and on account of the unusual length the rear portion is tapered and the corners rounded to a large radius, so as to give a clear view to the engineer when backing up. The tender has a capacity of 12,000 gal. of water and 4,000 gal. of oil. It is mounted on two six-wheel trucks with cast steel frames, the design being quite similar to that used for passenger cars.

The principal novelty in this engine is its enormous size, and the fact that it is converted from the largest type of locomotive on a single set of drivers to the largest locomotive of the Mallet type. The principal features are the combination of designs developed by the Santa Fe and many of the details common to the Mallet locomotives as built at the Baldwin Locomotive



Santa Fe Mallet Locomotive on a Sharp Curve.

Works. Two of these locomotives have been in successful operation during the last three months west of Winslow, Ariz., and the total order of ten is being rapidly completed. The principal dimensions and ratios are as follows:

General Data.

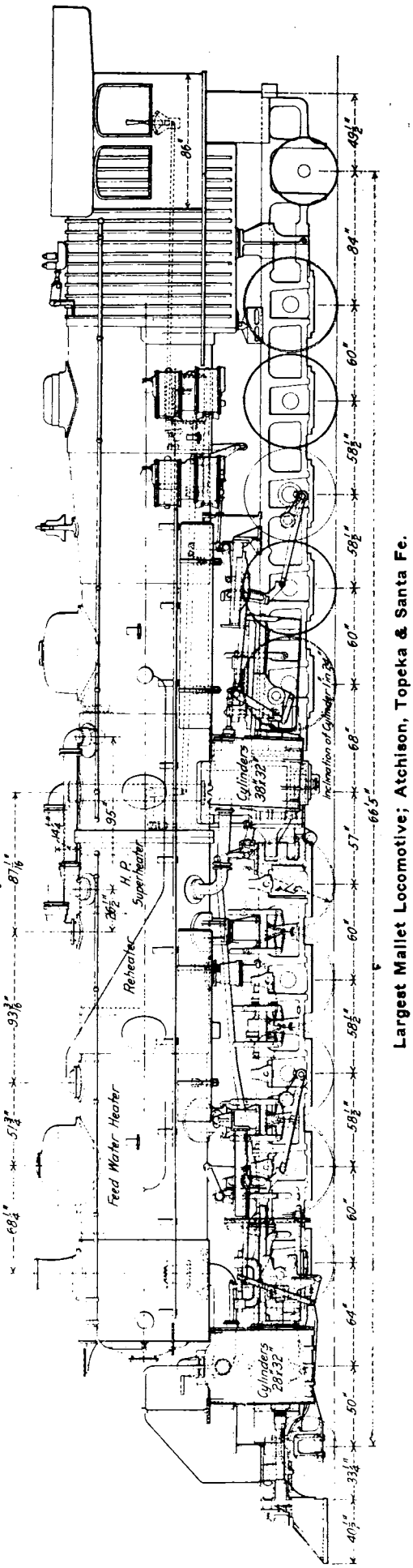
Type	2-10-10-2
Service	Freight
Fuel	Bit. coal and oil
Tractive effort	111,000 lbs.
Weight in working order	616,000 lbs.
Weight on drivers	550,000 lbs.
Weight of engine and tender in working order	850,000 lbs.
Wheel base, total	66 ft. 5 in.
Wheel base, engine and tender	108 ft. 1⅝ in.

Cylinders.

Kind	Compound
Diameter	28 in. and 38 in.
Stroke	32 in.

Valves.

Kind	Piston
Diameter	13 in. and 15 in.



Largest Mallet Locomotive; Atchison, Topeka & Santa Fe.

Wheels.

Driving, diameter over tire	57 in.
Driving journals, main, diameter	11 in. x 12 in.
Driving journals, others, diameter	10 in. x 12 in.
Engine truck journals	6½ in. x 10½ in.
Trailing truck journals	7½ in. x 11⅞ in.

Boiler.

Style	Ext. wagon top
Working pressure	225 lbs.
Firebox, width and length	78¾ in. x 149⅝ in.
Tubes, number and diameter	377—2¼ in.
Tubes, length	16. ft. 5 in.
Heating surface, tubes	3,625 sq. ft.
Heating surface, firebox	294.5 sq. ft.
Heating surface, feedwater heater	2,659.5 sq. ft.
Heating surface, total	6,579 sq. ft.
Heating surface, superheating	2,328 sq. ft.
Heating surface, total equivalent	8,907 sq. ft.
Grate area	81.9 sq. ft.

Ratios.

Total weight ÷ tractive effort	5.55
Weight on drivers ÷ tractive effort	4.95
Tractive effort × diameter drivers ÷ heating surface	.963
Tractive effort × diam. drivers ÷ equivalent htg. surf.	.710
Total heating surface ÷ grate area	80.4
Total equivalent heating surface ÷ grate area	109
Firebox heating surface ÷ total heating surface, per cent.	4.48
*Firebox heating surf. ÷ total equiv. htg. surf., per cent.	3.3
Weight on drivers ÷ total heating surface	83.6
Weight on drivers ÷ total equivalent heating surface	61.7
Total weight ÷ total heating surface	93.7
Total weight ÷ total equivalent heating surface	69.1
Volume both cylinders, cu. ft.	30.1
Total heating surface ÷ vol. cylinders	21.9
Total equiv. heating surface ÷ vol. cylinders	29.6
Grate area ÷ vol. cylinders	2.72

*Total equivalent heating surface equals total heating surface (6,579 sq. ft.) plus reheating and superheating surface.

TUNNEL VENTILATING PLANTS.

The Pennsylvania is installing a large ventilating plant in one of the tunnels under Baltimore. This tunnel is 4,963 ft. long and has a cross sectional area of 432 sq. ft. It was determined that it would require 450,000 cu. ft. of air per minute. This volume will drive a current of air through the tunnel with a velocity of 12 miles per hour, and will give a complete air change in 4¾ minutes.

Immediately over one of the portals is the fan room, the floor of which is 28 ft. above the tracks. In this room are two large electrically driven Sirocco fans, with fan wheels or impellers 12½ ft. in diameter. A division plate divides the breadth of these wheels into two equal sections and air is received from both sides. The air is discharged downward into the tunnel through a nozzle which lies close to the roof. This nozzle is flattened and curved to fit the tunnel arch, so that the air comes out through a slit along the arch extending from the springing line at each side. This draws in air from the portal on the principle of an injector. When a train is moving with the air current, the smoke is driven ahead of the engine; when moving against it, the smoke is blown back over the cab without bothering the engineman.

To discharge the volume of air required and to overcome the frictional resistance of the tunnel, the fan wheel must revolve at a speed of 104 r. p. m., which will require about 190 h. p. to drive it. Only one of these fans is intended to be run at a time, the other is held in reserve for use in case of accident.

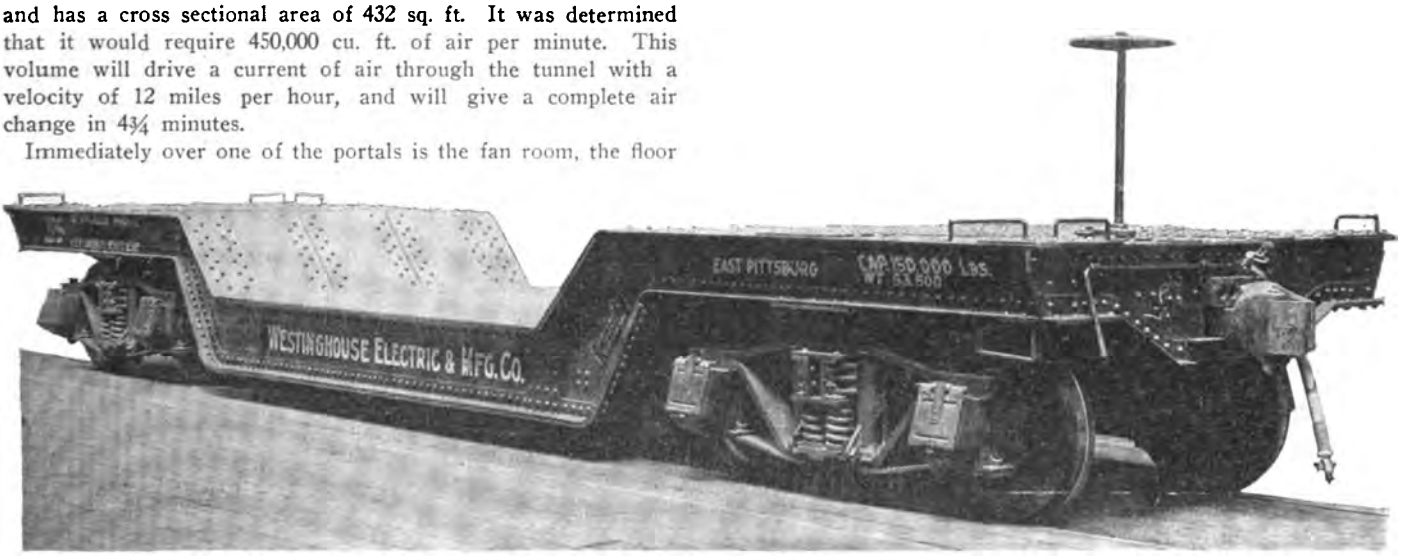
Charles S. Churchill, chief engineer of the Norfolk & Western, who designed the ventilating plants of the Gallitzin, the Big Bend and the Elkhorn tunnels of the Pennsylvania and the Norfolk & Western, also designed this plant. Previous to the installation of the ventilating plant at the Elkhorn tunnel at Coaldale, W. Va., on the Norfolk & Western, it required from 17 to 55 minutes to clear the tunnel of smoke, and during the four years immediately preceding the installation 26 men were asphyxiated. After the installation smoke appeared at the portal ahead before the engine appeared; and in less than a minute after the engine had passed out, the steam had vanished even from the roof, where it usually clings so persistently. The installation of this ventilating plant increased the maximum load of trains and resulted in a reduction of the number of trains necessary to carry a given load.

The Sirocco fan is made by the American Blower Company, Detroit, Mich.

FREIGHT CAR FOR SHIPPING TRANSFORMERS.

A special steel car with a portion of its floor at about the axle height was recently delivered to the Westinghouse Electric & Manufacturing Company by the Atlas Car & Manufacturing Company, Cleveland, Ohio. It was made so that heavy electric transformers may be shipped assembled and ready for installation and immediate use on arrival at their destination. The car will accommodate an oil insulated self-cooling transformer of 2,000 kva. capacity, which will stand 16 ft. above the top of the rail.

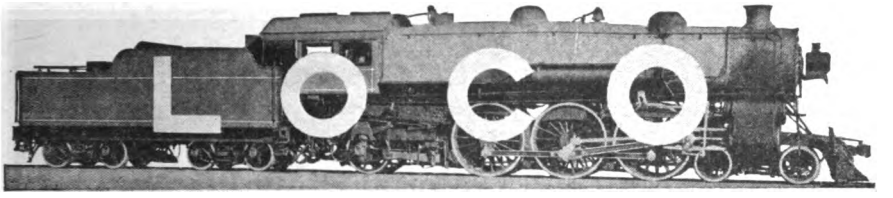
The car is entirely of steel, is 35 ft. 5 in. long, and has a capacity in the well of 150,000 lbs., or 75 tons. The surface of the floor in the well is but 2 ft. 2 in. above the top of the rails. The frame is of heavy built up steel girders. The trucks are of 205,000 lbs. capacity with 6 in. x 11 in. journals, 33 in. wheels, and M. C. B. springs of extra large capacity. The center plates are wrought steel and the boxes, brasses, etc., all conform to M. C. B. requirements for 205,000 lbs. capacity journals. Each car is equipped with Westinghouse air brakes, Westinghouse friction draft gear and M. C. B. automatic couplers. The car weighs 53,000 lbs.



Car of 250,000 lbs. Capacity for Shipping Transformers.

The committee of the Belgian Parliament to which was referred the estimates of the railway minister, has reported in favor of increasing both passenger and freight rates, which were long lower than elsewhere in Europe. The committee finds that the employees are insufficiently paid, and that the only way to get money to pay them what they earn is by raising the rates.


VIRGINIAN
802
VIRGINIAN
802



A TECHNICAL MAGAZINE

Vol. VII Schenectady, N. Y., February, 1917 No. 1

*Illustrated

PUBLISHED QUARTERLY BY LOCOMOTIVE CLUB.

R. J. FINCH, Editor H. W. BULL, Business Manager
A. S. McCORMICK, Ass't Editor J. W. KAMPER, Ass't Bus. Mgr.
Publication Offices: 4 Nott St., Schenectady, N. Y.
Postal Address, Box 992

Subscription: Per Year, 50 cents; Per Copy 15 cents

Entered as second-class matter, May 21, 1910, at the Post-Office at Schenectady, N. Y., under the Act of March 3, 1879.

The Virginian Mallets

The American Locomotive Company has contracted to furnish the Virginian Railroad with ten of the largest four cylinder engines ever built. In fact these will be the largest locomotives in the world, with possible exceptions of the triplex compounds built by the Baldwin Locomotive Company for the Erie and Virginia road. These new engines are scheduled for delivery in November, 1917.

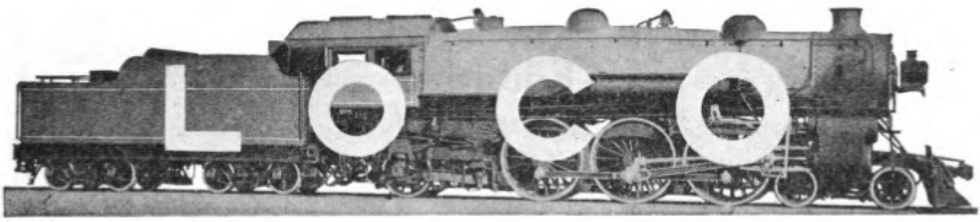
These engines are of the 2-10-10-2 type and have 30 inches by 32 inches high pressure and 48 inches by 32 inches low pressure cylinders. The total weight of this engine in working order will be 665,000 pounds, 600,000 being on the drivers and 65,000 on the two trucks. The tender will carry 13,000 gallon of water, 13 tons of coal and will weigh fully loaded about 210,000. This makes the weight of engine and tender 875,000.

The boiler will be 103⅛ inches inside diameter at the front and tapers to 118½ inches outside at the throat. The boiler will probably have 381–2¼ inch tubes, 70–5½ inch flues, 25 feet long. The heating surface of the tubes and flues will be approximately 8,090 square feet, and of the firebox and arch tubes 474 square feet, giving a total evaporating surface of 8,564 square feet.

The rigid wheel base of both front and back engines will be 19 feet 10 inches. The driving wheel base 50 feet, engine wheel base 64 feet 3 inches, wheel base ngine and tender 97 feet. The length of engine and tender overall will be approximately 106 feet 5 inches.

These engines will be equipped with the Mellin system of compounding, Schmidt Superheaters, Street Duplex Stokers and Gaines Arch.

The engines are to be built at the Schenectady plant of the Locomotive Company and the problem of shipping is a perplexing one. The boiler will have to be removed and shipped on two flat cars. This necessitates removing all the superstructure of the engines. On account of width limitations the low pressure cylinders, main rods and motion work will have to be removed.



A TECHNICAL MAGAZINE

Vol. IX. Schenectady, N. Y., May, 1918. No. 1

Illustrated

PUBLISHED QUARTERLY BY LOCOMOTIVE CLUB.

R. J. FINCH, Editor
A. S. McCORMICK, Ass't Editor
J. W. KAMPER, Business Manager
D. R. RUSSELL, Ass't Bus. Mgr.
Publication Offices: 4 Nott St., Schenectady, N. Y.
Postal Address, Box 992

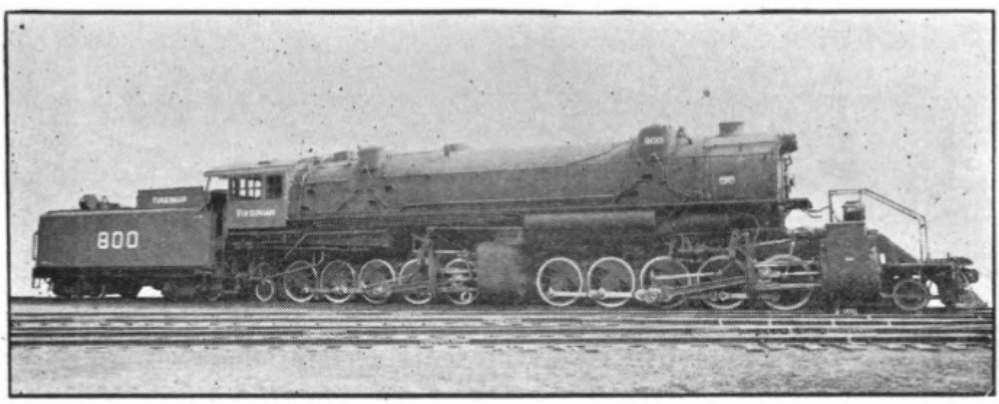
Subscription: Per Year, 50 cents; Per Copy 15 cents

Entered as second-class matter, May 21, 1910, at the Post-Office at Schenectady, N. Y., under the Act of March 3, 1879.

The Virginia Mallet

The first of the Mallet engines for the Virginian Railway, delivered to that company a short time ago, is worthy of the particular attention of anyone interested in locomotives or anyone interested in out-of-the-ordinary things.

The Virginian Railway extends from Deepwater through the Allegheny and Blue Ridge Mountains to Norfolk and the sea. It was built for heavy traffic; the largest part of its freight is coal, so its road-bed is well constructed and the steel of the heaviest. This road holds the distinction for the third time of owning the largest locomotive in the world. It followed closely after the B. & O. in adopting the Mallet as the best power for long trains

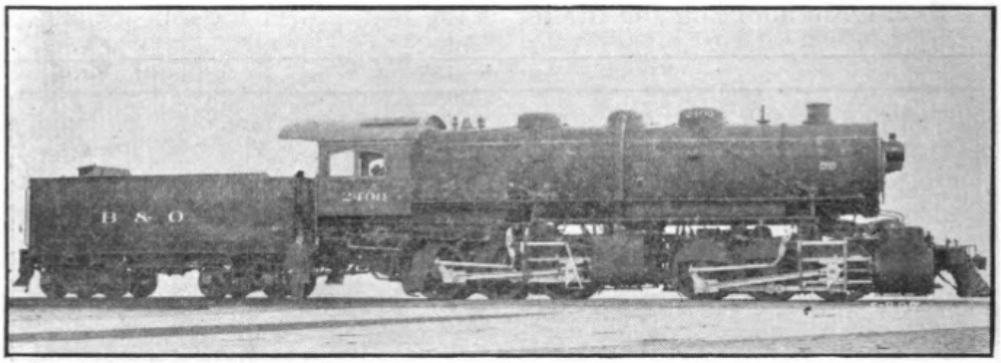


over steep grades, and in 1912 bought an engine of the 2882 type weighing 540,000 pounds and having a tractive effect of 115,000 pounds. This was the largest engine built up to that time. The Erie then brought out a triplex type engine with eight drivers under the tender, and for a short time held title to the largest engine, until the Virginian bought, in 1917, one of the same type but heavier, and took the title home again. Now they have purchased from the American Locomotive Company a Mallet of the 2-10-10-2 type which makes their title doubly secure.

These engines were designed for 18-degree curves. The engine and tender weighs 898,000 pounds—the engine alone 684,000 pounds—and the weight on drivers is 617,000 pounds. The total

wheel-base of engine and tender is 97 feet, total wheel-base of engine 64 feet, 3 inches, and total length over all of engine and tender is 106 feet, 10⅞ inches. The cylinders are 30 and 48 by 32; boiler pressure, 215 pounds, giving a tractive effort of 147,200 pounds working compound. Working as a simple engine in starting, etc., a tractive power of 176,600 pounds can be developed.

These figures may not mean much to some of our readers, but when it is explained that the above tractive power is nearly three times that of the average freight engine in service to-day it will give us some idea of the power. Or we can figure the tractive power in terms of cars to be hauled. The Virginian could haul 450 loaded 60-ton cars at a speed of 10 miles an hour on a level



track. This number of cars represents a train about 4¼ miles long. Think of having to stand on a crossing 26 minutes while a train like that went by!

Pity the poor automobilist in a hurry who, after waiting, say five minutes for the procession of gondolas to go by, gets impatient, waits five more and loses his temper; spends the next five searching his soul for sounds to tell how mad he is—after five more he runs out of language with which to do the occasion justice, and spends six more minutes in a state of inarticulate rage!

For the peace of mind of the automobilists and others it might be well to say that a train of this length would be impractical. A coupler has yet to be made which would stand the strain; but the power is there and the Virginian will haul with ease all the cars that can be safely coupled together.

The boiler is the extended wagon-top type, radially stayed,

and is 105½ inches O. D. at the front and 118½ inches O. D. at the throat. An automobile could easily be driven through this tube, and the firebox, which is 181 1/16 inches long, 108¼ inches wide and an average of 85⅜ inches deep, would make a fine bomb-proof garage.

The boiler is provided with 381 2¼-inch tubes and 70 5½-inch flues, and is equipped with a Schmidt superheater arrangement.

In the general equipment are also included a Street Duplex stoker, Woodard type trucks—both trailing and engine—and a Gaines arch. As it is a difficult matter to properly counterbalance an engine of this size, rods of nichrome steel were applied, which helped materially by reducing the weight to be counterbalanced.

In order to gain some idea of the size of the Virginian, it might be well to compare it with some other engine of the same type. For this purpose the B. & O. Mallet has been selected. This Mallet was built in 1904 by the Schenectady Works of the American Locomotive Company and was the first one to be used in this country. Incidentally, at the time of its building it was considered to be a "whopping big engine."

Weight on drivers—B. & O., 334,500; Virginian, 617,000.

Total weight of engine—B. & O., 334,500; Virginian, 684,000.

Total weight of engine and tender—B. & O., 473,800; Virginian, 898,300.

Wheel-base—driving—B. & O., 10 ft.; Virginian, 19 ft., 10 in.

Wheel-base—rigid—B. & O., 10 ft.; Virginian, 19 ft., 10 in.

Wheel-base—total, engine and tender—B. & O., 64 ft., 6¾ in.; Virginian, 97 ft.

Length over all—B. & O., 79 ft., 6½ in.; Virginian, 106 ft., 10⅞ in.

Greatest height—B. & O., 10 ft.; Virginian, 16 ft., 7½ in.

Greatest width—B. & O., 10 ft., 5 in.; Virginian, 12 ft.

Tractive power as a compound engine—B. & O., 71,500 lbs.; Virginian, 147,200 lbs.

Tractive power as a simple engine—Virginian, 176,600.

Cylinder diameter and stroke—B. & O., 20 and 32 x 32; Virginian, 30 and 48 x 32.

Diameter piston rod—B. & O., 3¾ in.; Virginian, 4¾ in.

Diameter driving wheels—B. & O., 56 in.; Virginian, 56 in.

Style boiler—B. & O., straight top; Virginian, extended wagon top.

Inside diameter first ring—B. & O., 82 in; Virginian, 103⅛ in.

Outside diameter largest course—B. & O., 88 in.; Virginian, 118½ in.

Boiler pressure—B. & O., 235 lbs.; Virginian, 215 lbs.

Fire-box length—B. & O., 108⅛ ft.; Virginian, 181 1/16 ft.

Fire-box width—B. & O. 96¼ in.; Virginian, 108¼ in.

Fire-box depth—B. & O., 80½ in. F., 72 in B.; Virginian, 98½ in. F., 72¼ in. B.

Combustion chamber length—Virginian, 36 1/16 inches.

Tubes, number and diameter—B. & O., 436 2¼-in.; Virginian, 381 2¼-in.

Flues, number and diameter—Virginian, 70 5½-in.

Heating surface, tubes—B. & O., 5366.3; Virginian, 5580.

Heating surface, flues—Virginian, 2510.

Heating surface, fire-box—B. & O., 219.4; Virginian, 437.5.

Heating surface, arch tubes—Virginian, 78.5.

Heating surface, total—B. & O., 5585.7; Virginian, 8606.

Grate area in square feet—B. & O., 72.2; Virginian, 108.7.

Tank capacity, water—B. & O., 7,000 gals.; Virginian, 13,000 gals.

Tank capacity, coal—B. & O., 15 tons; Virginian, 12 tons.

NEW YORK RAILROAD CLUB.

At the regular monthly meeting of the New York Railroad Club, held on February 15, a technical paper on the subject of the "Dynamic Augment—Need and Means of Reducing It," was presented by Mr. E. W. Strong of the American Vanadium Co., Pittsburgh, Pa. The paper contained much valuable data on the effect of the increased weight of the reciprocating parts of locomotives and the difficulty of counterbalancing the parts, and dwelt with convincing logic on the fact that in this age of heat-treated and alloy steels the designer has exceptional opportunities for reducing the weight of the parts. By using hollow-bored crank pins and piston rods, rolled steel or alloy and special cast-steel pistons, and by special care in the design of all details, a large percentage of saving can be effected in the weights of reciprocating parts.

TECHNICAL DEPARTMENT
Continued

New Hampshire, made in 1851, that they paid their president, Isaac Spalding, $1,000 per year; the superintendent, N. G. Upham, $2,000 per year; chief clerk, $800; his assistant, $340; passenger conductor, $600; engineer on passenger train, $2.25 per day, and on freight, $2.00 per day; brakemen and firemen, $1.25 per day, and the stockholders received a 10 per cent dividend.

Another incident of railway operation well worthy of consideration, at this time, was noted in 1881 taken from the history of the old Eastern Ohio Railroad, which was eight miles long. This road was built in 1874 and was owned by W. H. and C. B. Stevens. In building the road they embarrassed themselves financially and during the depression of business from 1874 to 1877 the two of them operated and managed the road, one acting as engineer and fireman and the other as conductor and brakeman and both of them handled freight and made all necessary repairs to the equipment as well as keeping up the road bed. In 1881 they were out of debt and had their road in good condition.

The great period of development started about 1880 and many improvements in power over the old standards and methods made their appearance and a large per cent of them were developed by men outside the railroad world. At the 1882 convention of the Master Car Builders Association, their committee which was appointed in 1876, made a report on automatic air brakes, reporting that the Reed train brake had been in operation for two years and its progress was satisfactory. It was further reported that the American Brake Company, was successfully operating a brake on 500 cars of the St. Louis & San Francisco Railroad. They also reported that the best stop made with automatic air brakes had been made on the B. & O. R. R. in 1881. The train on which this test was made consisted of 10 cars and weighed 25 tons. The speed at time of test being 46 and 6-10 miles per hour, requiring 16 seconds to stop and running a distance of 587 feet 8 inches, after application was made. Comparing the first locomotives that ran on rails on the American continent, the "Stourbridge Lion," which was brought from England by the Delaware & Hudson Canal Company in 1829, weighing 7 tons and being declared too heavy for the trestles, consequently, being laid away and dismantled, with the most powerful locomotives in service on this continent, those of the Mallets built by the American Locomotive Company for the Virginian Railroad, weighing 342 tons, will give you an idea of the development made.

VIRGINIAN MALLET LOCOMOTIVES

Ten Mallet locomotives having a tractive power of 147,200 pounds, working compound, and 176,600 pounds, working simple, are now in service on the Virginian Railway, having been built by the American Locomotive Company.

The authorities of the Virginian Railway have the problem of handling a constantly

increasing volume of traffic on an exceptionally difficult part of the system.

The portion of the line between Elmore and Clark's Gap on the Deepwater division, a distance of about fourteen miles, has a grade for the last eleven and one-half miles of 2.07 per cent, with maximum compensated curves of 12 degrees. For the first two and one-half miles the grade is 0.5 per cent. This fourteen miles is all single track and includes five tunnels, which compel the use of an absolute block. This is the crucial part of the entire system, as all the tonnage of the Virginian Railway passes over it. During the last eleven years Mallet locomotives have been employed in handling this traffic. The size and power of these locomotives have progressively advanced to keep pace with the growth in volume of traffic.

The first installment consisted of four engines of the 2-6-6-0 type with tractive power of 70,800 pounds. Next in sequence were eight of the same wheel arrangement but with a tractive power of 90,000 pounds. The third installment consisted of one engine of the 2-8-8-2 type with a tractive power of 100,800 pounds. The fourth lot was six engines of the 2-8-8-2 type with a tractive power of 115,000 pounds.

Up to the present time they purchased these 2-10-10-2 type engines, trains passing over the mountain section have operated by one 2-6-6-0 type Mallet road engine, with a tractive power of 90,000 pounds, at the head and two 2-8-8-2 Mallet pusher engines, with a tractive power of 115,000 pounds each behind. The maximum tractive power which can thus be applied to a train is 320,000 pounds, which enables them to handle 4,500 tons in 60 cars, having an average weight for car and load of 75 tons.

The traffic volume still growing, and as the track is single, and as it was not desired to increase the number of engines on any train above three, it was found necessary to put still larger locomotives into service. The enormous locomotives under discussion were developed in order to accomplish this result.

Upon receipt of these new engines, their trains are composed of one of the 2-8-8-2 Mallet engines, having a tractive power of 115,000 pounds, at the head and two of the new 2-10-10-2 Mallet engines, having a tractive power of 147,000 pounds, behind, giving a total tractive power for the train of 409,000 pounds. This train will have a tonnage of 5,850 tons, the equivalent of 78 cars having an average weight for car and load of 75 tons.

The 2-8-8-2 type Mallets which are used on the head end of the train were built by the American Locomotive Company in 1912 and 1913. At that time these engines were the most powerful locomotives in the world. The following comparison shows the extent in which these 2-8-8-2 type engines were exceeded in the new 2-10-10-2 type:

	2-8-8-2 type	2-10-10-2 type	% Increase
Total weight of engine.	540,000	684.000	26.6
Total weight, engine and tender, lbs.	752,000	898,300	19.5
Heating surface, sq. ft.	6,909	8,606	24.5
Superheating surface, sq. ft.	1,311	2,120	61.7
Tractive power, compounds, pounds	115,000	147,200	28.0
Tractive power, simple, pounds	138,000	176.600	28.0

Apart from the enormous weight and

power of the locomotive as a whole, some of the dimensions of the boiler are impressive as showing the extent with which all limits were exceeded in its design and construction. At the first course it is 105½ inches in diameter outside, while the outside diameter of the largest course is 112⅞ inches. The barrel is fitted with 381 tubes 2¼ inches in diameter, and 70 flues 5½ inches in diameter and 25 feet long. A combustion chamber 36 inches long is included. The firebox is 181 1/16 inches long and 108¼ inches wide. A total heating surface of 8,605 square feet and a superheating surface of 2,120 square feet are obtained.

The design as a whole follows the builder's ordinary practice, differing from previous designs only in modifications made necessary by the increased power.

These engines were built at Schenectady, N. Y., and the contract called for delivery completely erected and ready for service on Virginian Railway Company tracks. The shipping arrangement required considerable planning before the railroad carriers could be convinced that they could safely accept and move via their lines, locomotives of such size and weight.

In preparing for shipment of large locomotives it is first necessary to submit diagrams showing the estimated height and width clearance dimensions, and the distribution of weights on each axle to the operating or engineering department of each carrier over whose line it is intended to route the shipment in order to secure their agreement to handle the shipment when offered to their line. If some projection exceeds the carrier's clearance limitations, an effort is made to meet the objection by removing that part, if possible, and reapplying it on arrival at the destination. Or, if the weights are too heavy for some trestle or bridges via a natural route, an effort is made to find a way to ship via a detour route.

These large locomotives presented an unusual problem. It was impossible to ship them completely assembled and moving dead on their own wheels. After the consideration of many plans, it was finally decided to leave the boiler on the frames but trimmed of all outside parts and projections. The cab, low pressure cylinders, and other certain parts were removed and the remaining skeleton with tender were shipped on their own wheels. Each locomotive required one flat, one gondola and one box car to carry the lose and detached parts.

Authority was eventually secured for shipping in this manner, although under special operating instructions and via detour routes.

The full route used was as follows: New York Central Railroad, Schenectady to Newberry Junction; Pennsylvania Railroad via Columbia, Perryville, Newark, Del., Porter, Delmar and Cape Charles; float from Cape Charles to Port Norfolk, Va.; N. & P. B. L. Ry., Norfolk & Western and Virginian Railway to Princeton, W. Va.

The Norfolk & Western Railway was used only in the Norfolk district as the Norfolk & Portsmouth Belt Line Railway could not handle these engines direct to their point of connection with the Virginian Railway.

These engines could only be handled one at a time from Cape Charles to Nor-

folk as there was only one float—the latest one built—capable of handling the shipment under special instructions.

Each locomotive was accompanied by a messenger who had sleeping quarters fitted up in the cab which was loaded on a flat car.

Approximately two weeks has been the actual running time from Schenectady, N. Y., to Princeton, W. Va.

WHEN RAILROADS RULED
Continued

land. For a period of over thirty years, from 1868 to 1900, the public did not have a look-in in public affairs. Men were not selected for public office in either of the old parties until after railroad officials had given them their O. K.

Political freedom was as dead as a dodo. A man could not get a menial position in a county courthouse, a city hall, unless he was vouched for by a railroad boss, who was also usually a party boss.

THE STRUGGLE FOR FREEDOM

Trade unionists aroused public attention to these evils through their struggles in 1877, during their first big railroad strike in western Pennsylvania. Again and again great railroad strikes challenged public attention—in 1885 on the Gould roads of the southwest under the Knights of Labor; on the "Q" in 1888 under the Brotherhoods of Engineers and Firemen, and in the memorable national struggle of 1894 under Eugene Debs and the A. R. U.

Many other lesser struggles had come and gone, but these were the really effective explosions in the railroad world that caused a few big men in public life to shake themselves loose from railroad tyranny and fight for the public interest.

These were great men, and few Americans living today realize fully how much they owe to these pioneer progressive statesmen. Their names should be written in letters of gold. Chief among them were Larrabee, Dolliver, and Weaver of Iowa; William Chandler of New Hampshire; McAdoo of Tennessee; Van Sant of Minnesota; Peffer and "Sockless" Jerry Simpson of Kansas; Altgeld of Illinois; Pingree of Michigan; Sam Jones of Toledo, and Tom Johnson of Cleveland; Caldwell of the Federal courts, and our own "Battling Bob" La Follette of Wisconsin. These and a few other upstanding Americans have earned from the public a lasting debt of gratitude. They studied the problems, they listened to the grievances of railroad employes. They brought about the establishment of the Interstate Commerce Commission. They strengthened its authority. They aided labor in the enactment of safety laws. They encouraged public discussion and finally curbed the power of those who had made all men bow to their will.

Now the task is ours to maintain what has been gained. Insist that law and order shall prevail. Do not let upstarts like Atterbury, Gary and Morgan with the international banking conspirators dictate to the public nor to labor, nor to our executive administrators. In the language of the French at Verdun, let us shout the battle cry—"They Shall Not Pass!"