

The Chicago, Milwaukee and St. Paul Railway

TO PUGET SOUND
THE
**CHICAGO
MILWAUKEE**
AND **ST. PAUL**
RAILWAY
ELECTRIFIED



The Largest and Most Powerful
High-Speed Passenger Locomotive

Built jointly by the
Baldwin Locomotive Works
and
Westinghouse Electric & Mfg. Company

The Milwaukee Electrification



Of the boldness and vision of the management of the Chicago, Milwaukee & St. Paul Railroad, this noteworthy electrification owes its accomplishment. The harnessing of the nation's resources in the development of the Montana Power Company, which serves an area equal to that of a small nation, has been remarkable. The availability and reliability of this power at a favorable price, coupled with the certainty with which the service of electrical apparatus could be determined, led to the decision for the electrification of this great stretch of railroad, far surpassing the scope of any previous railroad electrification project.

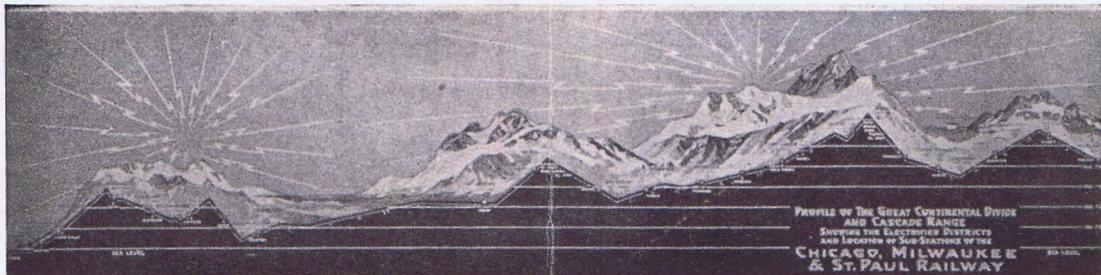
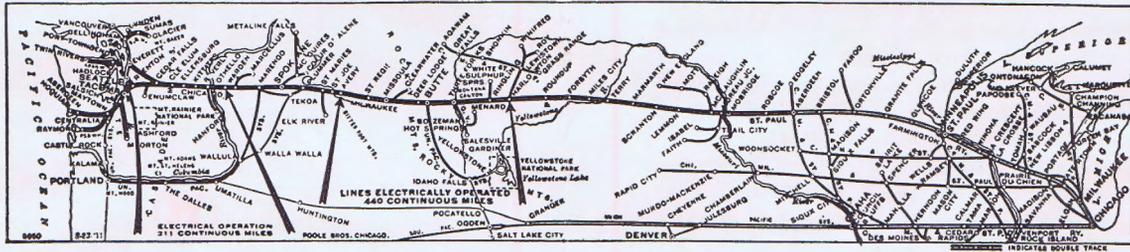
The initial electrification included the conversion of four steam engine divisions extending from Harlowton, Montana to Avery, Idaho, a distance of 440 miles. Electric service over part of these divisions began in December 1915, steam engines being entirely superseded about a year later. At this time there were 42 main line freight and passenger locomotives and two switching locomotives in operation, the former handling in 1918 an amount of traffic which would have required about 120 steam locomotives of the various types displaced.

This part of the electrification crosses three mountain ranges and includes many long grades, the most difficult of which is two percent and 21 miles long. The longest grade is one percent for 49 miles, ascending the west slope of the Belt Mountains. There are 36 tunnels in this electrified zone, the longest being the St. Paul Pass Tunnel, over 1½ miles in length, piercing the ridge of the Bitter Root Mountains.

Upon the completion of the electrification of the Rocky Mountain and Missoula divisions electrification was begun on an additional 211 miles of main line comprising the Coast Division, which extends from Othello, Wash. to Seattle and Tacoma, crossing the Saddle and Cascade Mountains. Electric passenger service on this division was started in March 1920.

The Coast Division also includes many severe grades and a number of tunnels. Westbound there is a 17 mile, 2.2 percent grade and eastbound a 20 mile, 1.74 percent grade.

(Continued on last page)



Map and Profile of Electrified Zones on Chicago, Milwaukee and St. Paul Railway

(Continued from first page)

Electrification has entirely eliminated congestion of freight traffic by increasing both the weight and speed of trains. Freight trains of 3,000 tons trailing load are handled eastward over a 1.66 percent grade and 2200 tons westward over a 2 percent grade with one locomotive and one helper. The passenger locomotives haul a train of 960 tons, or 12 all-steel cars, over the entire profile without a helper. Under electrical operation the locomotives, instead of being changed at the end of each 110 mile engine division remain in service over the entire 440 miles with only a light inspection at each end.

There is a marked economy in this electrification. The 61 electric locomotives have released for service elsewhere on the system, 162 steam engines and effect an annual saving of 265,000 tons of coal and 35,000,000 gallons of fuel oil. Regeneration is another important feature both from the standpoint of economy and also from that of safety. On long sustained down grades the motors become generators which absorb the energy of the descending train and convert it into electricity, which is returned to the trolley for the use of other trains ascending grades. The electrical energy thus recovered is from 30 to 40 percent of the amount used on the corresponding up grade and the total amount recovered is 12 percent of the total consumption on the entire line.

In addition to locomotives the Westinghouse Company furnished substation equipment which incorporated advances over previous installations. Notable among these is the power indicating and limiting apparatus which makes it possible for the Railway Company to hold its maximum power demand to a minimum consistent with the most economical and efficient operation of its trains.

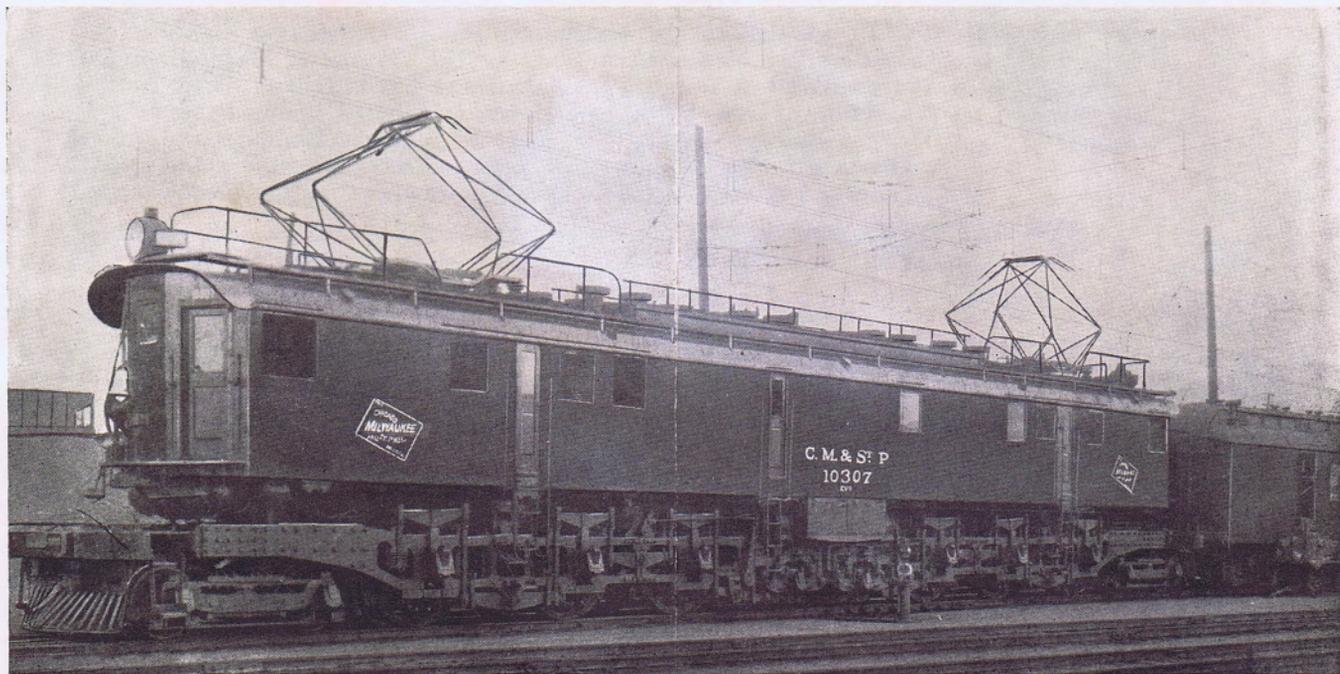
After this electrification had been in operation a sufficient time to show results the Vice President of the Milwaukee, in charge of electrification said:

“Our electrification has been tested by the worst winter in the memory of modern railroaders. There were times when every steam locomotive in the Rocky Mountain district was frozen, but the electric locomotive went right along. Electrification has in every way exceeded our expectations. This is so, not only as respects tonnage and mileage made, but also the regularity of operation”.



Westinghouse Electric & Manufacturing Co.
East Pittsburgh, Pa.

The Mighty Baldwin - Westinghouse Locomotive



300-Ton, 3,000-Volt Direct-Current Motive Power Unit for Passenger Service

(Road Nos. 10300*—10309)

Total weight of unit	600,000 lb.	Length overall (between pulling faces of coupler knuckles)	88 ft., 7 in.
Classification of wheels	2-C-1+1-C-2	Width overall	11 ft., 0 $\frac{1}{4}$ in.
Weight on drivers	378,000 lb.	Height from rail to locked position of pantagraph	17 ft., 0 in.
Number of driving axles	6	Diameter of driving wheels	68 in.
Number of idle truck axles	6	Diameter of idle truck wheels	36 in.
Total weight on idle trucks	222,000 lb.	Voltage and type of conductor	3,000 volt d-c. overhead
Capacity at one hour rating	4,680 hp.	Number and type of motors6 twin 348
Starting tractive effort at 25% adhesion	94,500 lb.	Method of drive	Geared quill
Max. starting tractive effort at 40.4% adhesion (limited by motors)	153,000 lb.	Gear ratio*	24:89
Tractive effort-hourly rating	66,000 lb.	Type of control	Electro-pneumatic (HBF)
Speed—hourly rating	26.7 mph.	Number of this type of unit in service	10
Tractive effort—continuous rating	40,800 lb.	Year placed in service	1920
Speed—continuous rating	31.2 mph.	Route miles electrified	660
Maximum speed	65 mph.	Track miles electrified	878
Total wheel base	79 ft., 10 in.		
Rigid wheel base	16 ft., 9 in.		

*Locomotive 10300 is geared for freight service 31:92 which changes the tractive effort and speed.



World Wide Electrification

Around the World with Westinghouse

In addition to the locomotives which Westinghouse furnished for the Milwaukee electrification and for the Boston & Maine Railroad; Detroit, Toledo & Ironton Railroad; Grand Trunk Railway; Great Northern Railway; New York, New Haven & Hartford Railroad; Norfolk & Western Railway; Pennsylvania Railroad; Virginian Railway and 47 other railroads in the United States, Westinghouse electric locomotives and multiple-unit cars are also in daily service in 9 countries, not including Canada.



IN THE NETHERLANDS, 35 Westinghouse equipped multiple-unit cars are being used for the extension of high-speed inter-city service on the Netherland State Railways.



IN FRANCE, the Paris-Orleans Railway has 120 locomotives, equipped with Westinghouse Unit Switch control, the only large amount of equipment purchased outside of France.



IN SPAIN, El Norte Railway has six locomotives equipped with Westinghouse motors and control, and control for 17 multiple-unit cars.



IN ITALY, the Italian State Railway has in service 196 Westinghouse locomotives operating larger trains at higher speeds than was possible with steam equipment.



IN JAPAN, the Chichibu Railway has five Baldwin-Westinghouse locomotives and ten Westinghouse multiple-unit cars; the Imperial Government Railways has ten Baldwin-Westinghouse locomotives; the Mushashino Railway has three Baldwin-Westinghouse locomotives and seven Westinghouse multiple-unit cars; the Shinano Railway has two Baldwin-Westinghouse locomotives and four Westinghouse multiple-unit cars; and the Yoshino Railway has eight Westinghouse multiple-unit cars.



IN JAVA, two Westinghouse equipped locomotives and five Westinghouse multiple-unit cars operate by electricity generated in hydro-electro plants.



IN CHILE, 39 Baldwin-Westinghouse electric locomotives on the Chilean State Railways haul 35 percent heavier trains up steep grades in 20 percent less time than was possible with the former steam locomotives.



IN ARGENTINA, the Buenos Aires Western Railway is using two Baldwin-Westinghouse locomotives to handle the heavy transfer traffic between the steamship docks and the Terminal.



IN BRAZIL, 13 Baldwin-Westinghouse locomotives on the Paulista Railroad are helping to conserve natural resources and save high costs of imported coal by utilizing energy generated by water power.