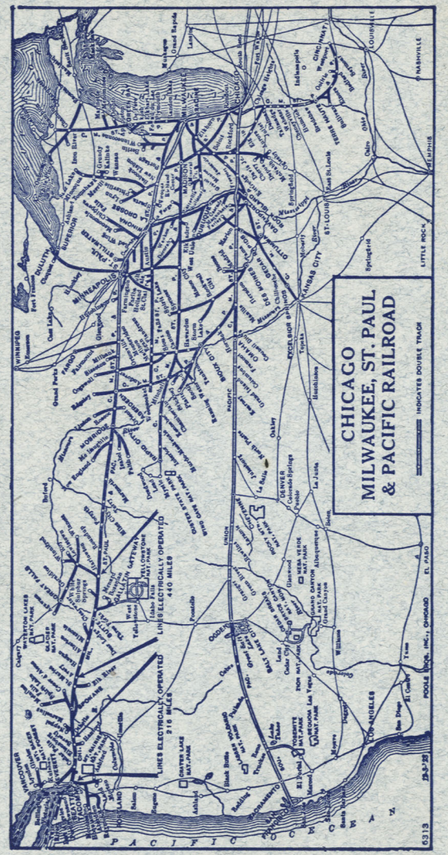


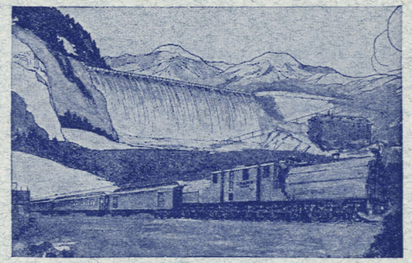
100M-5-24-33 THE GUNTHORP-WARREN PRINTING COMPANY, 210 WEST JACKSON, CHICAGO

Sparks

from

The MILWAUKEE ROAD

Electrification Exhibit

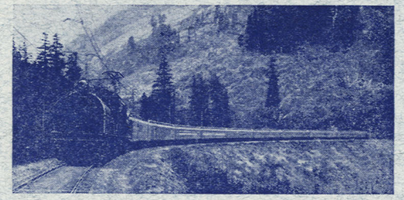


CHICAGO MILWAUKEE ST. PAUL AND PACIFIC

A CENTURY *of* PROGRESS

Chicago

May 27 - Nov. 1, 1933



The Olympian in the Cascades

OVER THE ROCKIES TO THE SEA BY THE POWER OF "WHITE COAL"

The Chicago, Milwaukee, St. Paul and Pacific Railroad today owns and operates America's Longest Electrified Railroad.

Stretching for 656 miles, over four of America's greatest mountain ranges, it represents nine times as much electrification as all other transcontinental lines combined and its first stretch—440 miles from Harlowton, Mont., to Avery, Idaho—constitutes the **longest continuous electrified ride in the world.**

From all parts of the world, men who have spent a lifetime in the study of transportation, have come to these very mountain barriers to see for themselves how great a thing man has accomplished.

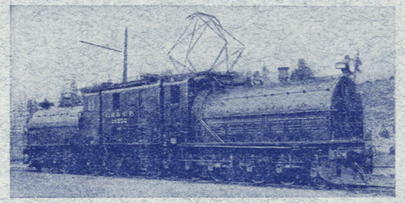
You view here today, at A Century of Progress Exhibit, an integral part of this triumph of science. This giant locomotive, known as the Bi-polar Gearless type, is one of several used in hauling "The Olympian," America's Queen of Transcontinental Trains, across the Cascade mountains. Other types, mainly the Quill type, are used in the zone embracing the Belt, Rocky and Bitter Root mountains, and in freight service in the Cascades.

SMOOTHER, SURER and SWIFTER

The ease and dispatch with which trains have been handled by electric power since The Milwaukee Road pioneered in its use, demonstrates that it is more reliable, more expeditious and more economical than steam in the movement of traffic in mountain districts. As the locomotive on exhibition is a passenger locomotive, the comments in this leaflet are for the most part confined to application of electric power to The Olympian, although its advantages are equally applicable to freight traffic.

The Olympian is started, operated, and brought to a stop, both up and down mountain grades, with a precision and nicety that only the mobility of electric power and the great size and capacity of the electric motor can supply.

How electric power and the electric locomotive have revolutionized passenger service is evident to every traveler. Where previously an otherwise faultless journey was marred by smoke and cinders from the steam locomotive laboring up mountain grades or steaming through mountain tunnels, by the jerking and jarring incident to starting and the application and release of the air-brake on steep gradients and sharp curves, the electric locomotive now picks up its load and The Olympian moves immaculately over the rails with scarce a perceptible motion. Gliding is the word that best describes its even speed. As it is brought to a stop, the thousand ton train is eased down to a standstill by the even application of the current, and in starting again, the passenger is often surprised to find himself under way, so smooth is the application of power.



Bi-Polar Type Locomotive

"WHITE COAL"

The source of this compelling current is in the mountain rivers, some of them as far distant as 200 miles from the rails over which you ride. These rivers are fed full with the waters of lakes and springs and with the melting snows of mountains that reach their summits into altitudes of almost perpetual winter. There the rivers leap and plunge down rocky cataracts, their maddened waters momentarily impounded and the full head of their imprisoned force is turned against the giant wheels of dynamos that generate electric power.

This current, generated at plants of several water-power companies, is carried along high-tension wires to twenty-two sub-stations on the main line of The Milwaukee Road throughout the Belt, the Rocky, the Bitter Root and the Cascade ranges.

As it comes down to the sub-stations at 100,000 volts a. c. it is far in excess of any normal requirements, and too strong for direct application. So, through the medium of oil switches, it is reduced to 3,000 volts d. c. It passes out on feeder wires to the trolley suspended from poles along the track. From this trolley the power is taken down to the

driving wheels of the locomotive through that claw-like arrangement, called the pantograph, that you see on top of the locomotive exhibited here. In transit it passes through various control devices before it reaches the motor itself. When introduced into the motor, the motor shaft is caused to revolve and it is this action which propels the locomotive.

CAPABLE OF 3500 HORSEPOWER

The locomotive which features this exhibit is called the Bi-Polar Gearless. It is equipped with twelve of these motors and is capable of developing 3200 h. p. continuously or 3500 h. p. for a one-hour period. Each motor is mounted directly on the driving axle, the axle itself forming the shaft of the motor. This method does away entirely with the usual gears such as are found on street cars.

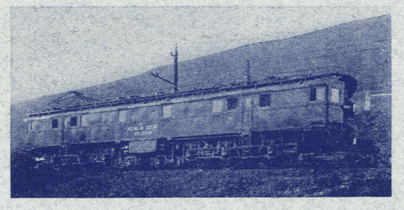
An interesting feature of the locomotive is the means by which it is controlled. The locomotives are operated by many of the same men who formerly ran the steam engines. Therefore, so far as possible, the control arrangement was made to duplicate the arrangement commonly found on a steam locomotive. Also, as it would produce a dangerous condition to have the 3,000 volts in the engineer's cab, all the switches that are in contact with this high voltage are operated by compressed air or low voltage electro magnets.

The Engineer handles only the air control or low voltage switches. The high voltage circuits are all confined in a separate compartment. No one is permitted to enter this compartment while the pantograph is in contact with the trolley.

REGENERATIVE BRAKING

A very important feature of this locomotive is the so-called regenerative braking whereby energy is reversed on the descending grades. This is accomplished by reversing the usual function of the electric motors, thus utilizing the momentum of the train to drive them as generators. On the long sustained grades, encountered in crossing the several mountain ranges, great skill is required to handle the heavy freight or high-speed passenger trains with the usual air brakes. To control a 3500-ton train traveling at a rate of 17 miles per hour on a 2 per cent grade, 6700 h. p. must be dissipated. Is it surprising then that brake shoes sometimes become red hot?

With the electric locomotive the air brakes are used only in emergency or in bringing the train to a full stop and the energy that would otherwise be wasted in heating the brake shoes is converted into electricity and returned to the power plant. Not only is this a big saving but it also contributes greatly to the comfort of the traveler. The grinding and jerking often encountered with the use of the air brake is eliminated and the train descends with a smoothness that is remarkable. From 40 to 60 per cent of the energy that was required to pull the train up the mountain is recovered in making the descent. About 12 per cent of the entire amount drawn from the power plant is later returned or in effect merely borrowed.



Quill Type Locomotive

656 MILES ELECTRIFIED

The first section of electrified travel encountered en route westward is at Harlowton, Mont., where the line extends to Avery, Idaho, a distance of 440 miles. In this section the railroad crosses the Belt Mountains, the main range of the Rockies, and the Bitter Root Mountains, where the severe winter weather makes operation under steam power very difficult. Scenically, this entire region is one vast expanse of rugged grandeur. The towering mountains, the colored walls of the canyons and winding, tangled, rocky streams create a vista both magnificent and inspiring.

In 1918, after two years of test, the results of the electrification were so satisfactory that a second electrification zone was authorized. This includes the extreme west end of the main line of The Milwaukee Road between Othello and Seattle-Tacoma, Washington, over the Cascades, a distance of 216 miles, where heavy grades and severe winters prevail. This total of 656 miles is by far America's Longest Electrified Railroad.

If you ever travel over these two electrified stretches you will readily see how electric power and the electric locomotive have revolutionized passenger service. There is, of course, the complete absence of smoke, soot and cinders; tunnels through the mountains are clean and fumeless. In the summer, open observation cars are an enjoyable part of The Olympian's regular equipment. The combination of these cars and electrical operation makes it possible for the passengers to enjoy full-vision views along the scenically supreme trail of The Olympian.

Other advantages are increased operating ease and economy, reduced wear on rails and equipment, maximum of cold weather safety and for the most part trouble-free handling of traffic in districts that normally present tremendous operating difficulties.

SPARKS FROM THE LOCOMOTIVE ON EXHIBIT

Class	Passenger
Type of Drive	Bi-Polar Gearless
Number in use	5
Length over all	76 feet
Total wheel base	67 feet
Rigid wheel base	13 ft. 9 in.
Total weight	521,200 lbs.
Weight on Drivers	457,800 lbs.
Per cent of weight on driver	87.8%
Average weight per driving axle	38,150 lbs.
Diameter of driving wheel	44 in.
Diameter of guiding wheel	36 in.
Number of driving motors	12
Continuous rating-total output	3,200 h. p.
Hourly rating-total output	3,500 h. p.
Tractive effort available at starting	114,450 lbs.

Throughout the entire electrification system of 656 miles, 23,239,208 pounds of copper is used in the different facilities involved.

First! Again and Again—

THE MILWAUKEE ROAD

First and only road to operate over its own rails all the way from Chicago to the North Pacific Coast

First line between Chicago and the Twin Cities—the only double-tracked route

First to adopt roller bearings for through passenger trains

First to operate all-steel trains between Chicago and the Twin Cities; between Chicago and Seattle-Tacoma

First to use open observation cars on transcontinental trains

First to use steam heat and electric lights on trains between Chicago and the Twin Cities

First to operate long distance trains by electric power

First to use electric refrigeration in dining cars

FAMOUS TRAINS

The OLYMPIAN—
Chicago—Butte-Spokane-Seattle-Tacoma

THE PIONEER LIMITED—
Chicago-Milwaukee—St. Paul-Minneapolis

THE SOUTHWEST LIMITED—
Chicago-Milwaukee — Cedar Rapids—Excelsior Springs-Kansas City

THE ARROW—Chicago-Milwaukee—Des Moines-Omaha-Sioux City

THE COPPER COUNTRY LIMITED—
Chicago-Milwaukee—Iron River-Calumet

THE SIOUX—Chicago—Mason City-Sioux Falls—Mitchell-Black Hills

THE FISHERMAN—
Chicago-Milwaukee—Minocqua-Star Lake

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