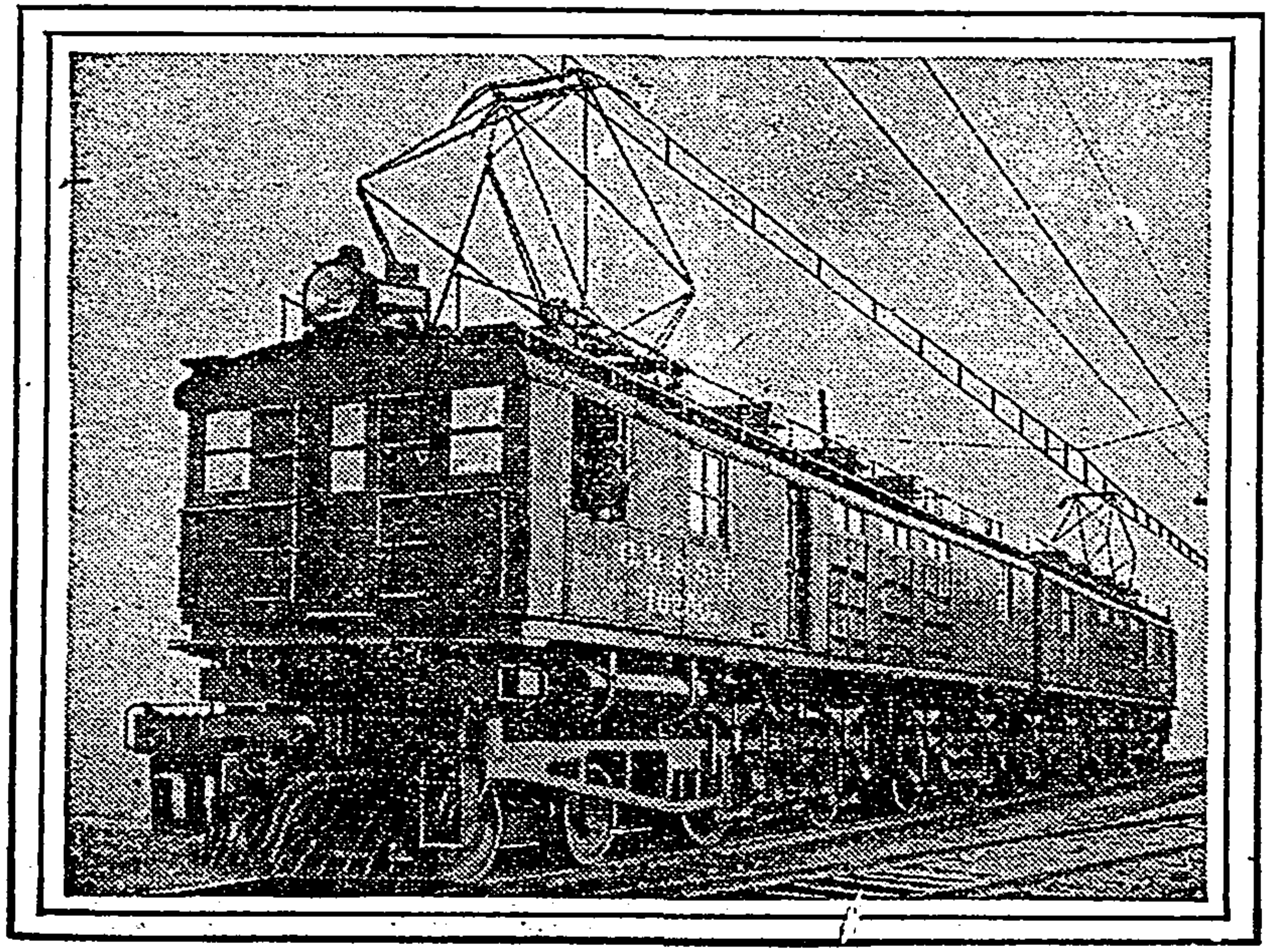
Electric Trains Over the Rocky Mountains

Chicago, Milwaukee & St. Paul Railway Has Just Opened the First Section of Line That Marks an Epoch in Transportation

EVEN the non-technical traveler understands and appreciates that the diminution of noise is one of the notable advantages secured by electric operation of a railroad—that and the elimination of fiery cinders and sable smoke. Only a few Americans, comparatively speaking, have had the opportunity to compare the new with the old system of railroad transportation. The traveling public has, however, dreamed of the time when the clean, swift electric traction with which New York is familiar in its suburban service shall have been extended to cover all railroad operation. With the announcement by the Chicago, Milwaukee & St. Paul Railway that its task of electrifying 440 miles of track across the Great Continental Divide, is nearly completed comes the assertion that it is justly compared in importance with the first journey of a locomotive.

There may now be raised the question, Has the doom of the steam locomotive been sounded? In 1898 there were just fifty-eight automobiles in the United States. Less than a hundred years ago it was feared that a great part of the region through which these electric trains will thunder at sixty miles an hour would form a lawless interval between the abodes of civilized man like the wastes of the ocean or the deserts of Arabia. We are heirs of evolution.

"Nobody can doubt that electrification is a great problem," said a well-known steam railroad man the other day, "nor can one doubt that it is coming. As a steam railroad man I should hesitate to predict that it will not come into general use in the future."



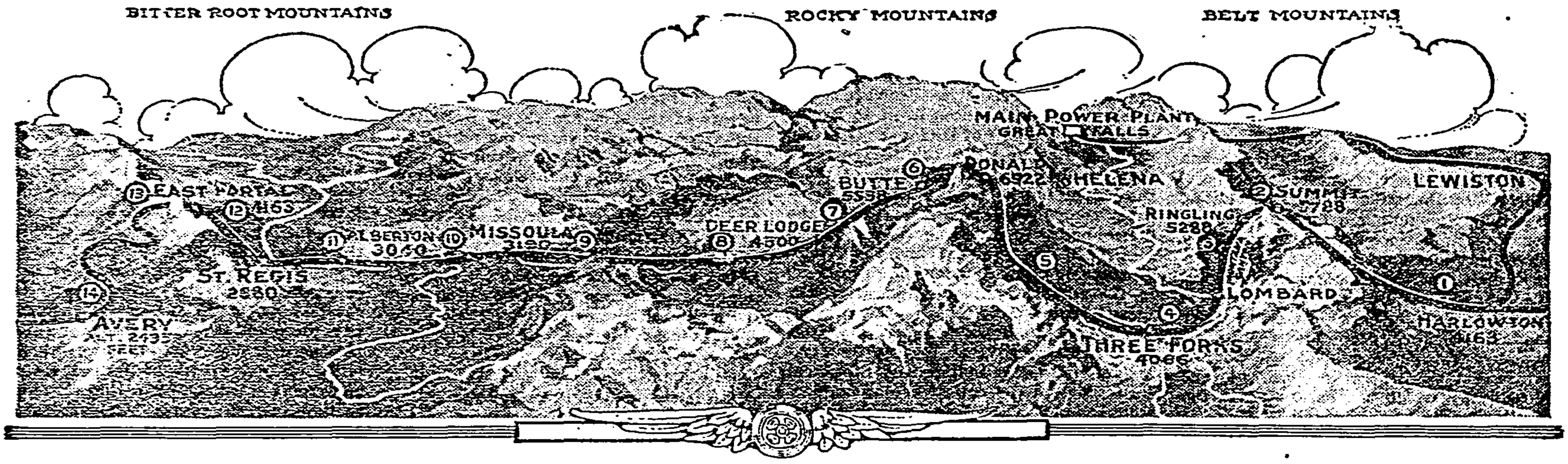
The Most Powerful Electric Locomotive in the World.

During the development of the science of electrical engineering the steam railroad men have not been idle in locomotive design by any means. They have passed from the old type of locomotive to the Mogul, then to the ten-wheeler or Decapod; then to the Mikado, and, finally, to the Pacific and Mallet type. So the steam designers have been just as alert, say the experts, as the electric designers, and the problem now is the relative efficiency of steam and electric locomotives.

Will electrification pay? Is it an economical possibility? Just think of scrapping all those useful, smoky locomotives that cost so much money! It is a tremendous problem, and yet well-informed railroad men assert that in the course of time the railroads—passenger, freight, and suburban service—will all be operated by electricity. Although, they add, it may be a hundred years to the time of the fruition of these hopes of today.

Some time ago the Chicago, Milwaukee & St. Paul officials decided to electrify four engine divisions of its Puget Sound lines, extending from Harlowton, Mon., to Avery, Idaho, a total distance of about

The New York Times
Published: April 23, 1916



Electrified District and Substations (Shown by Numbers) on Chicago, Milwaukee & St. Paul Railroad.

440 miles, aggregating about 650 miles of track including yards and sidings. One hundred and fifteen miles, from Three Forks to Deer Lodge, are now in actual operation. This work is under the direction of C. A. Goodnow, assistant to the President and in charge of construction.

"This project," said Mr. Goodnow, in describing the new line, "is of special interest because it provides for the electrification of four entire engine districts and also because this work is being done to effect economies in operation on a single track line of moderate traffic and not to overcome congestion on a busy line now working to its capacity or to eliminate the smoke nuisance.

"From Harlowton to the coast the railway crosses four mountain ranges—the Belt Mountains at an elevation of 5,768 feet, the Rocky Mountains at a height of 6,350 feet, the Bitter Root Mountains at an altitude of 4,200 feet, and the Cascade Mountains at an elevation of 3,010 feet. There are several tunnels, the longest of which is the St. Paul Pass tunnel at the summit of the Bitter Root Mountains, 9,000 feet long. The maximum grade west-bound is 2 per cent. for 20.8 miles on the Eastern slope of the Rocky Mountains, while the maximum grade east-bound is 1.7 per cent. for 24 miles approaching the St. Paul Pass tunnel.

"The hardest problem of this nature is presented by the continuous 1 per cent. grade for 44 miles, ascending the western slope of the Belt Mountains, involving as it does the necessity for special precautions to avoid overheating the motors while working at their maximum capacities for this long period of time.

"Several important economies are expected from the electrification of this line. In the first place, this is the first time an entire engine district has been electrified, permitting the complete substitution of electric for steam locomotives between the terminals. In other installations throughout the country only a portion of a division has been electrified, resulting simply in a shortening of the steam operated engine district."

Each steam locomotive is a power generating plant in itself, while the electric locomotive merely utilizes energy which is generated at certain central power houses or stations. Engineers say that even under the best conditions the steam locomotive cannot produce power with anything like the economy of a stationary plant, but while thus relatively wasteful, these locomotives can be called into service as they are needed, and can be retired to the roundhouse after their duty is discharged. Each steam locomotive engineer is concerned only with a single problem. The central plants, on the other hand, supply motive energy for a large number of electric locomotives, and must be run continuously whether the drain be merely the average or the maximum. Again, should the power plant fail the whole section may be brought to a standstill.

Such gradients as those on the line of the Chicago, Milwaukee & St. Paul Railway are said to be especially difficult for the steam locomotive in Winter weather, when the loss of heat by radiation is great and much attention is necessary at every division point. The electric locomotive, it is maintained, excels in cold weather. Low temperatures keep its motors cool, it suffers no lessening of speed or tractive power, and it can drive through snowdrifts in which a steam locomotive is helplessly stalled. These considerations, to which were added others, such as the absence of smoke, the elimination of fuel trains, coal and water stations and ash dumping, led to the decision on the part of the Chicago, Milwaukee & St. Paul officials to spend $12,000,000 in electrifying the mountain divisions of that road.

The electric passenger locomotives on the Chicago, Milwaukee & St. Paul Railway, according to an announcement made by the company, are designed to haul 800-ton passenger trains at a speed of sixty miles an hour on the level or thirty-five miles an hour on a 1 per cent. grade, and are equipped with oil-feed steam-heating outfits for heating the train. The freight locomotives are designed to haul a 2,500-ton trailing load on all gradients up to 1 per cent. at a speed of approximately sixteen miles an hour, and this same trainload unbroken over 2 per cent. ruling grades on the west and east slopes of the Rocky Mountain Divide with the help of a second similar freight locomotive acting as a pusher.

A big steam locomotive costs less than a large electric locomotive, but because of the nature of the mechanical movements of the latter its upkeep is said to be only about half as costly as that of the steam engine, while its drawing power is relatively higher for any fixed measure of effort. The electric locomotive is far more responsive to a sudden or excess demand than the steam engine. In a word, its advocates say it is almost like a good horse in the way it will exert itself to draw an overload or to overcome a momentary difficulty. Certain electric locomotives of the New York Central were designed to pull a train of 550 tons, including the locomotive's own weight, and it was the intention to employ two locomotives on heavier trains. Yet a single electric locomotive has frequently drawn 800-ton trains consisting of from twelve to fourteen Pullman cars.

Electric locomotives of the Chicago, Milwaukee & St. Paul Railway weigh as much as 284 tons and cost as much as $112,000 each. Where the wood-burning locomotive of fifty years ago had a tractive power of 5,000 pounds and the present-day Mallet steam locomotive has a tractive power of 76,200 pounds, these electric engines, 112 feet and 8 inches long, have a tractive power of 85,000 pounds.

The valuable feature of regenerative braking in such a system is emphasized by the experts. By regenerative braking it is possible to make the electric motor produce power, instead of using it, on down grades. This produced power can be turned into the trolley wire, says one authority, to assist other trains and reduce the amount of purchased electric current. When the crest of a grade has been reached the helper locomotive is brought to the front of the train and coupled with the forward locomotive, both being operated as one. The train is then controlled by regenerative braking as it rolls down the slope. In this way from one-quarter to a half of power—from 25 to 52 per cent.—is recovered and turned back into the trolley wire, where it is available for other trains toiling upward at other points on the road.

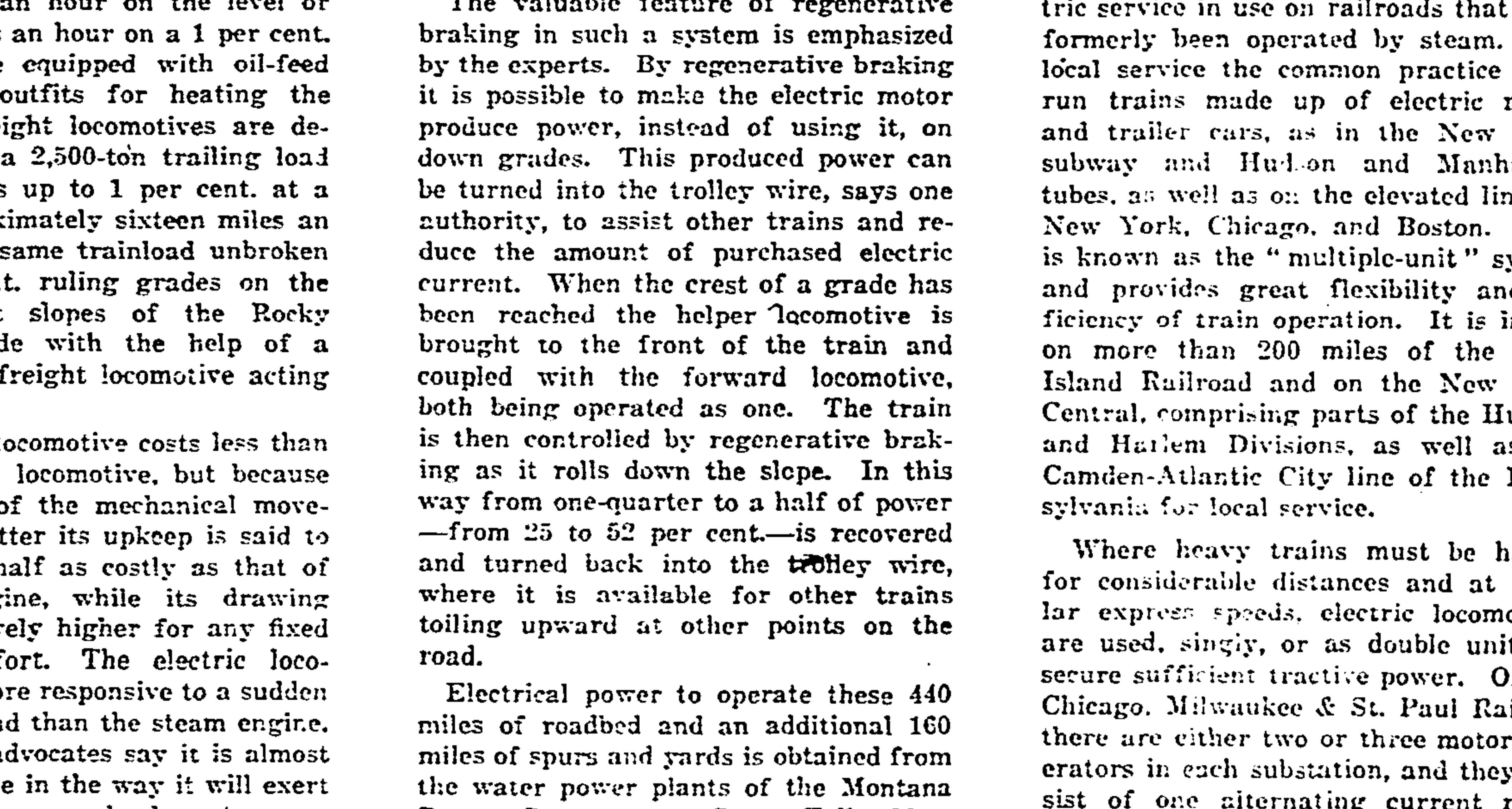
Electrical power to operate these 440 miles of roadbed and an additional 160 miles of spurs and yards is obtained from the water power plants of the Montana Power Company at Great Falls, Mon. It is delivered to fourteen substations along the route of the railway. The substations receive an alternating current of 100,000 volts. It has to be delivered to locomotives in direct current of 3,000 volts.

The 100,000 volt alternating current is received through oil switches, is conveyed to the high tension current distributer made up of three lines of copper tubing, and there forms the source of power for the substation. From the distributer, the current is conducted through other oil switches to the transformers. These it enters at 100,000 volts and leaves at 2,300 volts. It then goes through switches to the motor generator sets and supplies the power employed to operate them.

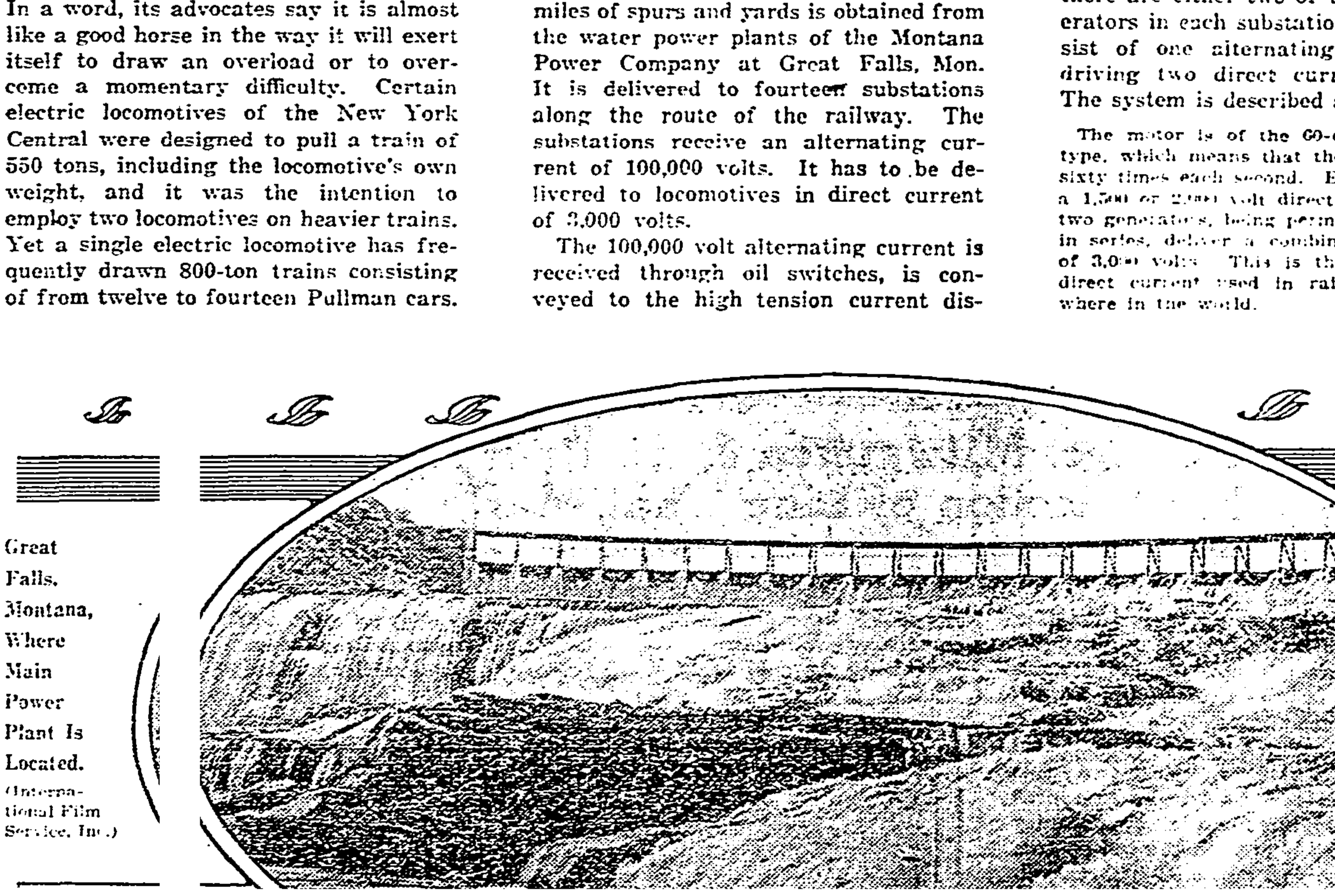
There are two general classes of electric service in use on railroads that have formerly been operated by steam. For local service the common practice is to run trains made up of electric motor and trailer cars, as in the New York subway and Hudson and Manhattan tubes, as well as on the elevated lines of New York, Chicago, and Boston. This is known as the "multiple-unit" system and provides great flexibility and efficiency of train operation. It is in use on more than 200 miles of the Long Island Railroad and on the New York Central, comprising parts of the Hudson and Harlem Divisions, as well as the Camden-Atlantic City line of the Pennsylvania for local service.

Where heavy trains must be hauled for considerable distances and at regular express speeds, electric locomotives are used, singly, or as double units, to secure sufficient tractive power. On the Chicago, Milwaukee & St. Paul Railway there are either two or three motor generators in each substation, and they consist of one alternating current motor driving two direct current generators. The system is described as follows:

The motor is of the 60-cycle synchronous type, which means that the current changes sixty times each second. Each set generates a 1,500 or 2,000 volt direct current, and the two generators, being permanently connected in series, deliver a combined direct current of 3,000 volts. This is the highest voltage direct current used in railroad work anywhere in the world.



Great Falls, Montana, Where Main Power Plant Is Located. (International Film Service, Inc.)



"Olympian" Crossing the Continental Divide. (International Film Service, Inc.)