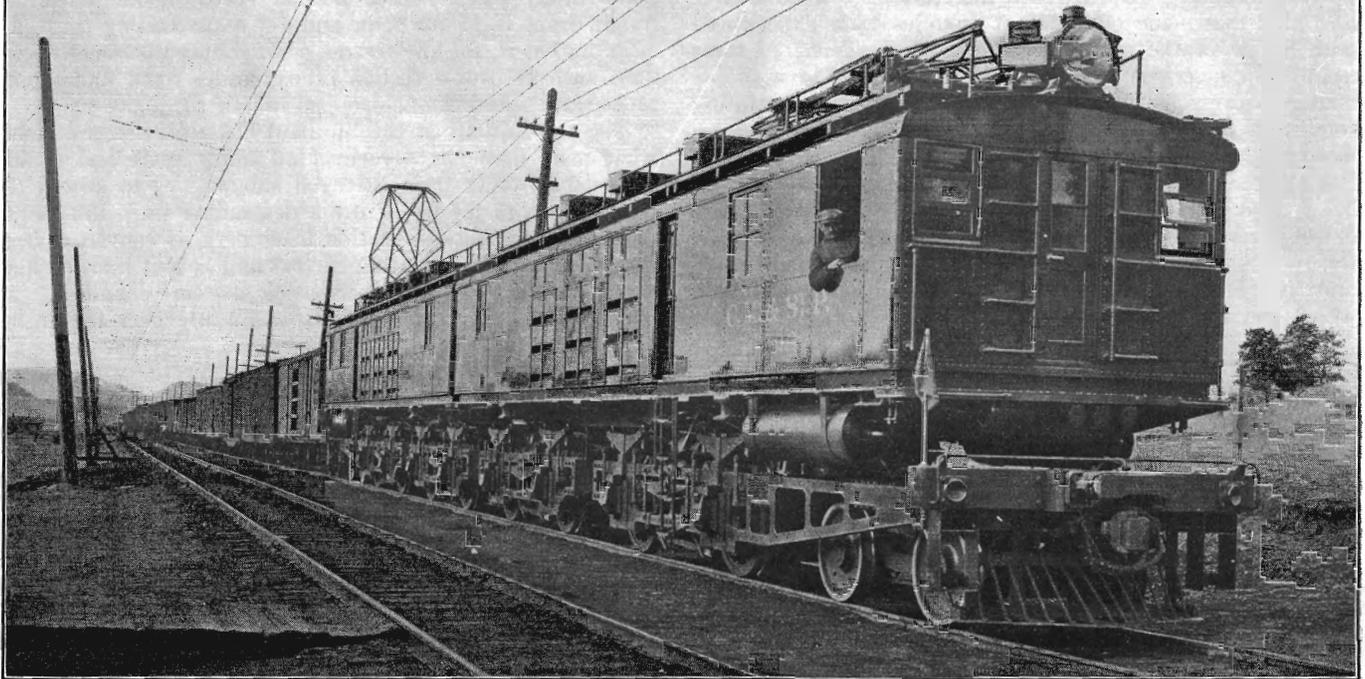


Operation of the St. Paul Electrification

Results Obtained on First Engine Division During the Past Four Months Have Been Entirely Satisfactory



A 1,650-Ton Freight Train Regenerating on a 2 Per Cent Grade at Grace, Mont.

SINCE December 9, 1915, when the Chicago, Milwaukee & St. Paul's crack transcontinental "Olympian" was taken from Butte, Mont., to Piedmont by an electric locomotive the first engine division of the electrified zone has been in continual electrical operation. Both the "Olympian" and the "Columbian" have been hauled by electric locomotives since the inauguration of electric service, but it was not until January that steam freight locomotives were entirely removed from the electrified division.

The electrification has, in every way, exceeded the expectation of both the railroad officers and the manufacturers of the equipment, and, considering that this installation is the first to use 3,000 volts direct current, the regularity of operation and the remarkable freedom from trouble with the locomotives and the catenary system has been extremely gratifying. It has been found that the contract capacity of the locomotive, which was 2,500 tons on a one per cent grade with one locomotive at a speed of approximately 15 miles an hour can easily be exceeded and as soon as the side tracks on the mountain division are made long enough to take care of the longer trains, it will probably be arranged to increase the train tonnage to 3,000 tons over the mountains, to 3,450 tons between Deer Lodge and the mountain and to 4,500 tons between the Bitter Root mountains and Deer Lodge, all with one locomotive, except that over the short heavier grades a helper will be used.

D. A. Goodnow, assistant to the president of the St. Paul, in charge of electrification, is reported in an interview as saying that the mileage of the electric trains for 24 hours is about 200 as against 114 by steam locomotives, that 24 steam locomotives—Mallets, and other heavy types—have been released with **only** one-fourth of the electrification in operation **and** that the work is being done faster and cheaper with the nine electric locomotives.

The question of hauling capacity of an electric loco-

motive is perhaps not thoroughly understood by the steam locomotive operator. His chief concern is to keep the steam locomotive hot and make steam, while the electric designer so proportions the motors that they will keep cool with the assigned tonnage.

The electric motor should not operate at much more than 125 degrees Fahrenheit above the surrounding air, as higher temperatures will cause an unduly rapid deterioration of the installation covering the copper conductors. Hence the somewhat baffling statement can be truly made that the electric locomotive will haul a greater tonnage in winter or cold weather than it will in summer, in this respect just the reverse of the performance of the steam locomotive.

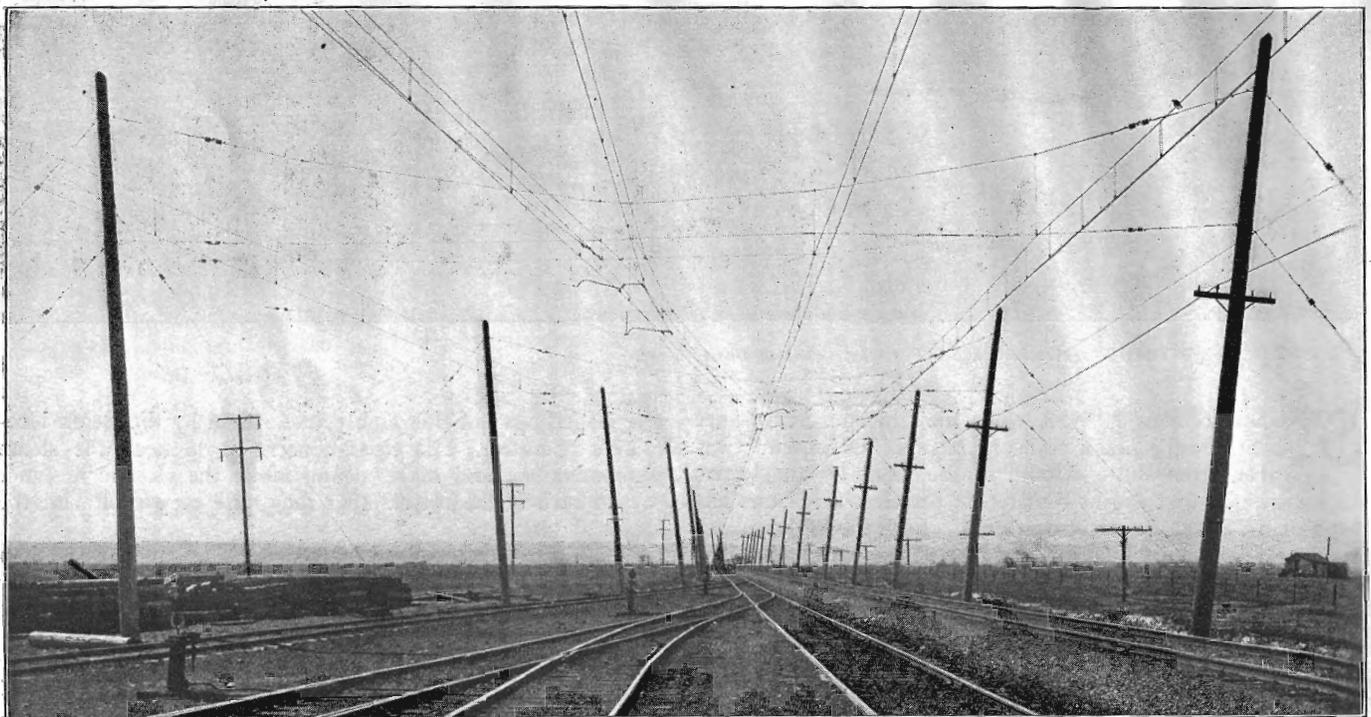
Another point in the hauling capacity of the electric locomotive is that for short periods of time it will haul anything up to the slipping point of its drivers. Normally the tractive power of the electric locomotive is approximately 16 per cent of the weight upon the drivers but for short periods it can exert 30 per cent and for one hour it can exert 20 per cent of this weight. Illustrating this; a 2,300-ton train, on the St. Paul, was being taken westbound from Piedmont up the 2 per cent grade with one locomotive at the head end and a helper at the rear end. The train broke in two leaving approximately 2,000 tons on the head end locomotive. Instead of cutting off the bad order car it was decided to proceed up grade to the next station and in this case one locomotive actually hauled 2,000 tons up a 2 per cent grade without a helper. As this machine is rated at only 1,250 tons the performance gives an idea of the tremendous overload which such a locomotive can haul for a short time. Continued operation at this heavy overload would, of course, result in the destruction of the installation of what is known among electrical men as "burning out of the motor."

The electric locomotives, and in fact all of the electric equipment on the St. Paul, has been given a severe test dur-

ing the past winter, which, because of the deep snow and the severe cold, was one of the worst in the history of Montana. It is reported that the electric operation, during this period, was conspicuous for its complete reliability and freedom from trouble. It is true that a regulator which is used in connection with the motor generator on the locomotive to supply low voltage current for lighting and control was not quite up to the capacity required and therefore gave some trouble and also that some other minor troubles were experienced with a few of the cam operated switches. None of these troubles were serious, however, and it proved to be a simple matter to overcome them. One of the surprising operating conditions met with was the frosting of the electric locomotives when they were taken into a steam locomotive roundhouse after operating in a temperature of from 20 to 30 below zero. It was found that frost and ice would collect on all parts of the electric locomotive in a surprisingly short time. This trouble, of course, would not be so noticeable and, in fact, would probably not occur in a roundhouse which did not house steam locomotives. For this reason

secured has also been demonstrated. When the motors are driven mechanically, as when a heavy train pushes a locomotive down grade, they act as a brake in converting this mechanical power into electricity which becomes available through the trolley system to haul other trains up grade. The same latitude in speed variation with electric locomotives is provided when braking as when operating up grade under power. The normal speed of an ascending freight train is 15 m. p. h. and for a descending train, 17 m. p. h., but if, for any reason, a lower speed becomes necessary, such as over a section of bad order track undergoing repairs, the speed can be dropped to half the above value.

The sub-stations in the St. Paul electrification are somewhat more than an average of 30 miles apart and should there be no other trains between sub-stations to absorb the power given to the trolley by a descending train this power passes through the sub-station machinery, is converted from direct current to alternating current and is sent into the high potential 100,000-volts distribution system connecting all sub-stations and becomes available for use over the entire



Line Construction in Switch Yards at Three Forks, Mont.

when the division is entirely electrically operated the trouble from frost should be eliminated.

A feature of especial interest in electrical operation of both passenger and freight trains on the St. Paul is the method of hauling these heavy trains when descending long mountain grades. It is a well-known fact that it requires the highest class of air-brake equipment and great skill in handling, to eliminate the danger of dropping a heavy freight or passenger train down a long sustained grade, when hauled by a steam locomotive and equipped with the usual automatic air brakes. Even on a two per cent down grade it frequently happens that brake shoes become red hot and wheel rims become greatly overheated, as practically all the potential energy stored in the train at the top of the mountain grade must be dissipated as heat in the brake shoes and wheels during the descent.

The St. Paul is the first to introduce electric braking with the direct current electric locomotive and it has proved not only entirely practical under the severe conditions appearing in regular service but the great operating benefit to be

440 miles of electrification. As a descending train will not give out quite as much power as it would absorb when ascending the same grade, there will always be a demand for power in excess of that given out by the descending train and this fact taken in connection with the large industrial load connected to the same hydraulic power system makes it possible to dump into the transmission system any amount of power which the descending train may give out.

Aside from the economies resulting from electric braking, which are a possible saving of some 50 per cent of the total power demand, the elimination of brake shoe and wheel wear and the easier operation on the track, particularly when rounding curves, the greatest advantage resulting from the use of electric brakes lies in the elimination of the difficulty attending the use of air brakes in holding back long heavy trains when descending mountain grades. The electric braking of the St. Paul electric locomotive entirely relieves the air brake except for the stopping of trains or for emergency use. There is, therefore, provided a duplicate braking system, each one capable of holding a train on a down grade

and there is thus offered a greater guarantee of safety in operation than would be possible with the use of the air brake alone.

It is an impressive and convincing demonstration to witness the operation of a 75-car train weighing 3,000 tons, between Deer Lodge and Harlowtown, a distance of 225 miles over the two mountain ranges, without the use of air brakes except when trains are required to stop. There is an entire absence of the grinding of brakes hitherto considered a necessary accompaniment of mountain railroading and all increased operating benefits are furthermore procured.

Since electric operation has been started on the St. Paul, the heavier trains are taken down the 20 mile 2 per cent grade (the heaviest one on the division) without air brakes, more steadily and smoothly than they were on the level and the attention to brake shoes and wheels and the stopping for inspection has been done away with entirely.

STORY OF ALI BABA AND THE FORTY RAILROAD COMMISSIONS

(A Fairy Tale)

By Blewett Lee

Once upon a time there lived in the Youessay two Railroads who were brothers, one named Cassim, and the other Ali Baba. Cassim had a large business in coal, iron and grain, and became one of the wealthiest and most considerable of Carriers. Ali Baba, on the other hand, had nothing but a local lumber traffic, and not much of that.

One day, when Ali Baba was soliciting lumber business and absolutely up a tree, he saw a tribe of horsemen coming toward him. They were all well mounted, each riding an Office, and with a sharp Order stuck through his belt, and their wallets were full of taxes, depots, fares, grade crossings, and other valuables. Ali Baba counted forty of these horsemen—there were really forty-eight, but they were so active and perpetually fighting that he always lost count when he came to forty. One, who seemed to be the captain of the band, was a long skinny person who wore the collar of the Association known as the Kornbellut Meetprodeusahs, one of the fiercest tribes of the Shippahs. He came up to a rock which stood in the way, and pronounced distinctly these words, in a language which Ali Baba remembered to have heard when he was a child, "State's Rights." As soon as the captain of the band had uttered these words, a door opened in the rock, and after he had made all his band enter before him, the captain entered and the door shut itself.

Ali Baba remained up the tree until the forty came out again, mounted their offices, and returned by the way they had come. When they had gone, Ali Baba descended to the front of the rock and pronounced the words, "State's Rights." The door instantly flew wide open.

Ali Baba was surprised to find a cavern well lighted and spacious, and filled with precious stores of Interstate Commerce. There were rich bales of silk stuff, brocade, and valuable carpeting, and every kind of treasure of art and handicraft. It was evident that there were incalculable riches inside the cave. He gathered together such as he was able to carry away, and by the use of the words, "State's Rights," he found his way out again and returned to the city.

The effect of Ali Baba's carrying Interstate Commerce from the cave was that he found himself in possession of a heap of gold. This was discovered by a crafty Accounting Officer in the service of his brother, Cassim. Cassim then threatened to denounce Ali Baba to the Commander of the Faithful, falsely, as being a member of a Trust or Combine, and so compass his ruin. Under this compulsion, Ali Baba told Cassim the secret of his wealth.

With this information Cassim also went to the cave and pronounced the words, "State's Rights." The door opened immediately and when he had entered, closed upon him. He found therein so much more riches than he imagined, and was so anxious to move the priceless Interstate Commerce which lay all about him, that he forgot the ancient and mysterious words he was to speak. Instead of saying "State's Rights," he said "National Sovereignty," "The Constitution," "United States," "Free Trade," "Simple Justice," "Square Deal," "Common Sense," and a great many other things which might have moved a door of stone, but it was to no purpose.

About noon the forty Commissions came to visit their cave. They saw in the distance the line which Cassim had made for the purpose of moving the Interstate Commerce, and were greatly alarmed. They dismounted and some of them went directly to the door with naked orders in their hands, and upon pronouncing the proper words, it opened. Cassim tried to escape, but the Commissions with their orders soon deprived him of his life.

The Commissions held a counsel and could not imagine how Cassim had gained entrance to their cave or discovered the treasures of Interstate Commerce there. They decided to cut Cassim's system into four quarters, to hang two on one side and two on the other, within the door of the cave, in order to terrify anyone else who might attempt to enter.

Cassim's stockholders were very uneasy when darkness approached and Cassim did not come back. They spent the night in tears, and when morning came they ran to Ali Baba in alarm. Ali Baba went at once to the cave, and when he pronounced the words, "State's Rights," the door opened and he was filled with horror at the dismal sight of his brother's four quarters. He entered the cave and took down the remains and carried them away with him, and in spite of his fears he also carried away some Interstate Commerce, selecting only the most valuable articles.

When he returned to his house, he consulted with his handmaid, Morgana, an intelligent slave, whom Ali Baba knew to be faithful and resourceful in the most difficult undertakings. At the advice of Morgana, an old cobbler by the name of Foarklosiah was brought in and sewed together the quarters of Cassim's system, so that he appeared to be reorganized, only there was no life in him.

Cassim had a great funeral and his body was followed to the grave not only by stockholders, but by many bondholders as well. There came also many holders of life insurance policies, and those who had savings bank deposits besides, and a great number of Shippahs who, now that Cassim was gone, found that they missed him very much.

When the forty Commissions found that Cassim's body had been removed, and that some Interstate Commerce had been moved also, they said amongst themselves, "It is evident that some railroad has been moving Interstate Commerce, and has made good its escape. He evidently must have been in league with the one we found here. Let us send one of our number to the City and ascertain if any railroad has lately died a strange death."

One of the Commissions, therefore, came to the City and accidentally fell upon Foarklosiah. The Commission saluted him, and had no difficulty in ascertaining from him that Foarklosiah had recently sewed a railroad up. Upon the Commission's insistence, Foarklosiah finally led the Commission to the house of Ali Baba. Having found the house, the Commission marked the taxes up high on Ali Baba's door with a piece of white chalk.

A little while after the Commission had gone, one of Ali Baba's servants discovered that the taxes had been marked up on the door, and so she made similar marks upon the doors of all the neighbors' houses.

Meanwhile the Commissions had armed themselves and in