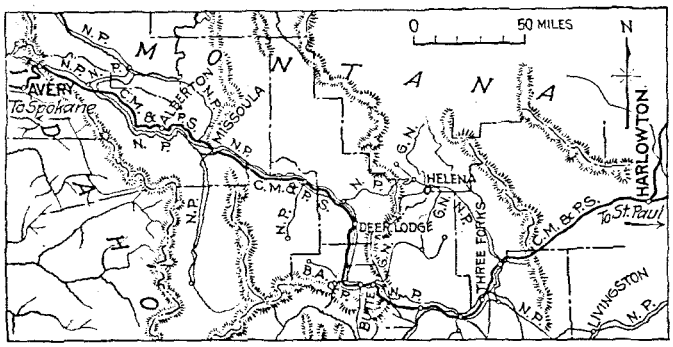
Electric Traction on the Chicago, Milwaukee & St. Paul Ry.*

The plans for the substitution of electric traction for steam on certain mountain divisions of the Puget Sound line of the Chicago, Milwaukee & St. Paul Ry. have been completed and contracts let as has been previously announced in these columns.† The initial change is on two



ROCKY MOUNTAIN DIVISIONS OF THE CHICAGO, MILWAUKEE & ST. PAUL RY.

engine divisions comprising 113 miles of main line between Three Forks and Deer Lodge, Mont.; this is the first step toward a pending change on two more engine divisions which will extend the system from Harlowton, Mont., to Avery, Idaho, some 440 miles of line with a total of 650 miles of track. Besides this it is expected that, if the operating results of the initial installation are as satisfactory as anticipated, the system will be extended to the Pacific Coast, giving 850 miles of line. The change, from the start, will require the exchange of locomotives only at points where steam units would ordinarily be shifted, so that there will be no useless duplication of equipment or loss of efficient operation through short runs, etc. It is reported that the change is made by the officials of this road purely on economic grounds and in hope of such superior operating results as to return an attractive profit on the investment required.

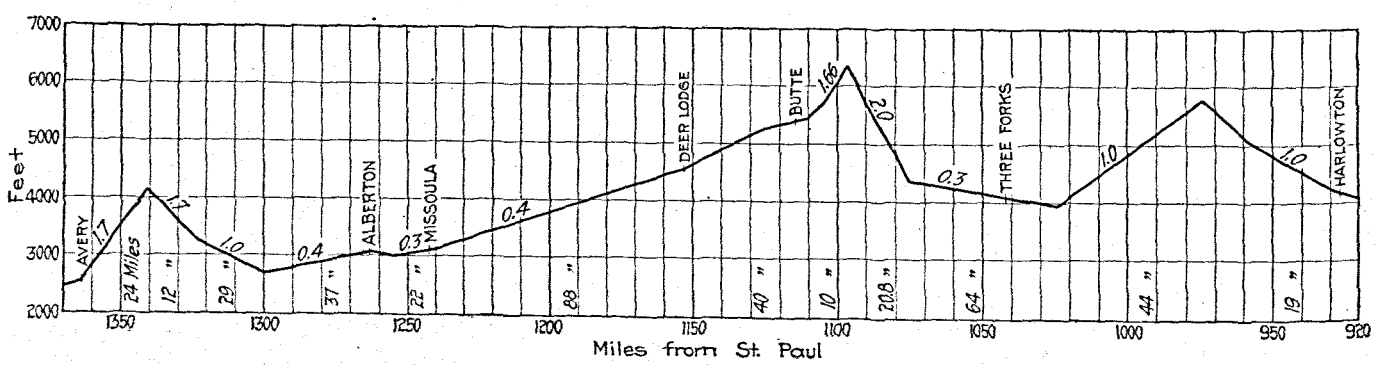
POWER SUPPLY

The railroad will not generate its own electric current; it has contracted with the Montana Power Co. for an adequate supply. This company has a transmission network connecting a number of hydraulic plants and one steam station, and it has plans for several more developments. A price of 0.536c. per kw.-hr. is given the railway, but based on 60% load factor. Such a high utilization of capacity can be secured by adjusting train schedules.

The first 113 miles equipped will have four substations, with step-down transformers and motor-generator sets converting from 100,000 volts, 60-cycle three-phase, to 3000 volts direct current. This is the first use of such high-potential direct current, exceeding by 600 volts the somewhat similar installation on the near-by Butte, Anaconda & Pacific Ry. (see ENGINEERING NEWS, Aug. 15, 1912; June 26, 1913; Mar. 19, Apr. 2 and June 25, 1914). Each motor-generator set will have a 2300-volt synchronous motor, two 1500-volt direct-current generators (connected permanently in series) and a single exciter on the same shaft supplying the fields of all three machines. To insure good commutation at overloads, the generators have commutating poles and compensating pole-face windings. The motors will be used super-excited at heavy loads so as to draw "leading current" and regulate the transmission-line voltage better.

The substations are from 27 to 42 miles apart. In addition to the transmission lines of the power company, a tie line will be run by the railway company from the first to the fourth station largely along the right-of-way. This will result in each substation being fed with power from two directions to reduce the probability of interruption. The stations at each end of the line will have two 2000-kw. units. The two in the middle will have three 1500-kw. units.

For the distribution of current to locomotives, an overhead trolley will be used. Two No. 0000 wires will be suspended, parallel and in the same horizontal plane, from a steel catenary supported on wooden poles by brackets, wherever track alignment permits, and by cross-spans on sharper curves and in yards. Steel poles will be used only where the spans are so long as to exceed the possibilities of wood construction. The hangers from the messenger cable will connect alternately to one and the other of the two parallel No. 0000 wires. It has been found by experiment that this gives additional flexibility and permits collection, without sparking, of very heavy currents at low speeds or moderate currents at very high speed, and is thus adapted to both heavy grades and high-speed stretches of the line.



PROFILE OF ROCKY MOUNTAIN DIVISIONS; CHICAGO, MILWAUKEE & ST. PAUL RY.

LOCOMOTIVES

At first, there will be nine freight and three passenger locomotives, each weighing approximately 260 tons and similar in all respects except that the gear ratio of the passenger locomotives will permit of the operation of 800-ton trains at 60 miles per hour, and will carry an oil-fired steam boiler for heating the cars. All electrical and me-

*From information supplied by the General Electric Co., Schenectady, N. Y.

†"Engineering News," Jan. 16 and Dec. 25, 1913, pp. 132 and 1331; Feb. 12, 1914, p. 371.

chanical parts of the two types of locomotives will be interchangeable to reduce cost of operation and maintenance.

The main frame, which will carry all the traction and buffer stresses of the locomotive, is in four parts, articulated. The two end sections carry extensions which hold the small leading trucks. There is 30 tons weight on each guide truck. The cab is divided into two similar sections; at the outer end of each is a compartment for the engineman, the remainder being occupied by control equipment, train heater, air-brake apparatus, etc. Owing to the unusual height of trolley wires (25 ft. above rail), the pantograph bases have to be elevated about 5 ft. above the cab roof.

Each driving axle is twin-geared to a 1500-volt motor rated to give 430 hp. for one hour, or 375 hp. continuously. The locomotive thus has a one-hour rating of 3440 hp., and a continuous rating of 3000 hp., which makes it the most powerful type yet developed. The drawbar pull at starting approximates 120,000 lb., with 30% coefficient of adhesion. The motors are connected two in series permanently, the four groups being handled in the usual series and parallel combinations. The motors have commutating poles and openings for forced ventilation which is supplied by a motor-driven blower in the cab.

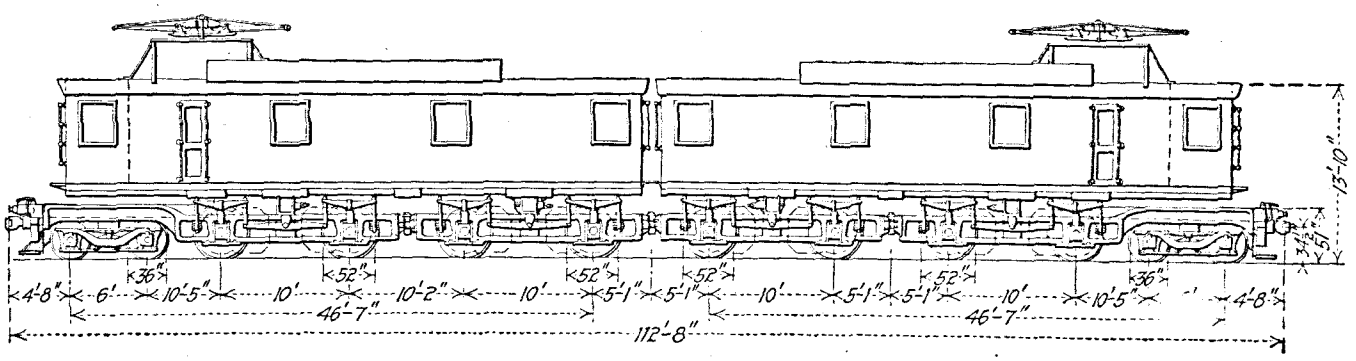
The freight locomotives are designed to haul a 2500-ton trailing load at 16 miles per hour on gradients up to 1%. The same trainload will be carried unbroken over the 1.66% and 2% ruling grades on the west and east slopes of the Rocky Mountain Divide by the help of a second locomotive acting as pusher.

One of the most interesting parts of the locomotive equipment is the control which is arranged for regenerative electric braking on down grade. This scheme has not before been employed with such motors and on such a scale. Track provision is being made at Donald, the summit of the Rocky Mountain grade, so that the pusher locomotive may run around the train to the head; then the entire train on the down grade will be under compression and held back by the two locomotives under the control of the engineman in the leading unit. It is expected that the locomotives will develop sufficient regenerative-braking capacity to hold back the entire train to proper speed on down grade without use of the air brakes, which then may be needed only in emergency and for stopping the train. This, besides giving a duplicate braking system and greater safety of operation, should reduce breakdowns, wheel and track wear, maintenance costs, etc.

When the entire line of four engine divisions is converted from steam to electric traction, it is proposed to combine them into two locomotive divisions of approximately 220 miles length, changing crews, however, at the present division points. This will be possible since the electric locomotives will need inspection only after a run of some 2000 miles and require no stops for taking on coal or water, or for cleaning.

Organization

This work on the Chicago, Milwaukee & St. Paul is under the direction of C. A. Goodnow, Assistant to the President, and in charge of construction. The field work is under the supervision of R. Beeuwkes, Electrical Engineer of the railway. Contracts for the electrical equipment have been placed with the General Electric Co., of Schenectady.



Direct-Current Locomotive; Chicago, Milwaukee & St. Paul Ry.

Fire Protection for the Panama-Pacific Fair Buildings

The central fire- and police-alarm system for protecting the buildings of the Panama-Pacific International Exposition at San Francisco has been installed in part. The system comprises a central office and full automatic equipment consisting of a 12-circuit switchboard, an 8-circuit automatic repeater with four local engine-house circuits, a signal-wheel transmitter for transmitting still and special alarms, a punching register, take-up reels and an automatic time stamp for recording the exact time when an alarm comes in. The stamp is controlled by a self-winding electric clock. All testing of lines and batteries and the battery charging are controlled from the main switchboard.

The fire-protection system is described by the official organ of the American Society for Fire Prevention as follows:

There are 102 fire-alarm boxes installed throughout the grounds and buildings. These boxes are absolutely noninterfering and successive, and so constructed that nine boxes may be pulled simultaneously and all of them will register in succession their respective signals.

Each of the three engine houses on the grounds is equipped with an ornamental pressed-steel panel on which are mounted a 12-inch electro-mechanical gong, punch register, tapper bell, take-up reel and an automatic switch which turns on the lights in the engine house on the first stroke of the alarm; these lights are automatically turned off by the switch at a predetermined time after the fire apparatus has left the house.

z There is a similar set of apparatus in the headquarters of the Exposition military guards in the Service Building.

There will be 102, seven-call combination police telephone and signal boxes. These, together with the fire-alarm boxes, are mounted on ornamental iron pedestals, surmounted by a red globe on which is etched "Fire Alarm" in white letters. By means of a signal-wheel transmitter, operated by an electric motor in the central office, code signals will be flashed on these lamps at night to notify the guards that their services are required.