THE 1500-VOLT ELECTRIFICATION OF THE CHICAGO, MILWAUKEE & ST. PAUL RAILWAY

By W. D. Bearce

Railway and Traction Engineering Department, General Electric Company

The author gives a brief description of the 1500-volt electrification of the terminal line at Great Falls, Montana, which will in all probability ultimately make connection with the 3000-volt installation of the Chicago, Milwaukee & St. Paul Railway. The most interesting features of the substation and locomotive equipment and the overhead line construction are described.—Editor.

GREAT FALLS TERMINAL

As a forerunner of the 3000-volt main line electrification, the Chicago, Milwaukee & St. Paul Railway has recently begun electrical operation of the terminal line in the city of Great Falls, Montana. This city is at present the terminal of the new 138-mile feeder line from Lewistown, Montana, connecting with the main line transcontinental division at Harlowton, the eastern terminus of the 3000-volt electrification now under construction. The Great Falls terminal yards are located in the center of the city and are connected by a cross-town line about four miles in length, known as the Valeria Way Line. There are about three miles of additional electrified trackage, making a total of seven miles. The terminal buildings include a large freight house, round house, power plant and passenger station.

The tracks connecting the Falls Yards and the Terminal Yard pass through the business part of the city and it is expected that considerable benefit will be derived from the elimination of steam locomotive smoke from the center of the city as well as a reduction in the cost of train haulage. The traffic includes the transfer of both freight and passenger trains from the Falls Yards to the terminal station as well as switching service in the terminals.

The electrical equipment is of sufficient capacity to take care of 580-ton freight trains operating at about 9½ m.p.h. on the maximum grades of 0.65 per cent. Electric power is supplied by the Great Falls Power Company from the hydro-electric plant at Rainbow Falls, about six miles from the substation. Energy is transmitted at 6600 volts, three-phase, 60 cycles, as generated at the power station.

Substation

The substation equipment is located in the power station operated by the railway company for heating the terminal buildings and includes a two-unit synchronous motor-generator set with a two-panel switchboard for controlling the alternating and direct-current units. The motor is rated 435 kv-a. (0.8 power-factor), 6600 volts, and operates at 900 r.p.m. Provision is made for starting as an induction motor through a compensator which is operated from the alternating-current panel. The generator is of the commutating pole type, rated 300 kw. at 1500 volts. The set is capable of carrying 200 per cent overload or 900 kw. momentarily. Excitation for the a-c. motor fields and for the shunt fields of the d-c. generator is furnished by a 10-kw., 125-volt direct connected exciter.

The switchboard consists of two natural black slate panels, one controlling the synchronous motor and the other the direct-current generator and feeder. The d-c. panel is of the standard 1500-volt type and carries a remote control, hand-operated switch and circuit breaker mounted between slate barriers at the top of the panel. The motor

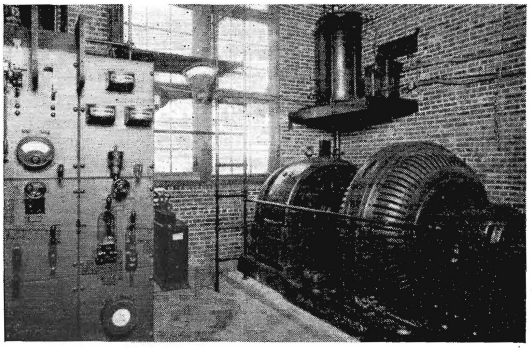

Fig. 1. Part of the 1500-volt Substation Equipment for the Great Falls Electrification of the C. M. & St. P. Ry.

panel contains the usual instruments and starting and operating switches for controlling the motor. An aluminum cell lightning arrester is also installed in the station for protection against electrical storms.

Locomotive

All trains are handled by a standard 50-ton electric locomotive of the steeple cab type designed for slow speed freight and switching service. The running gear consists of two swivel equalized trucks carried on semi-elliptic equalizer springs. The driving wheels are of solid rolled steel, 36 inches in diameter.

The motor equipment includes four GE-207, 750-volt, box frame commutating pole motors insulated for 1500 volts. Each motor has a normal one-hour rating of 79 h.p. at 750 volts, and two motors are connected permanently in series. All motors are ventilated by a blower direct connected to the dynamotor in the cab of the locomotive. The gear reduction is 64/17.

The control equipment is Sprague-General Electric type M, arranged for operation from either end of the cab. There are 10 steps with the motors in series and seven steps in series parallel. Control current for the operation of contactors, lighting and other auxiliary circuits is furnished by a 1500/600-volt dynamotor. A multivane fan carried on an extension of the shaft furnishes air for ventilating the motors.

The current collector is a sliding pantograph similar to that being installed on the main line 3000-volt locomotives. The slide is

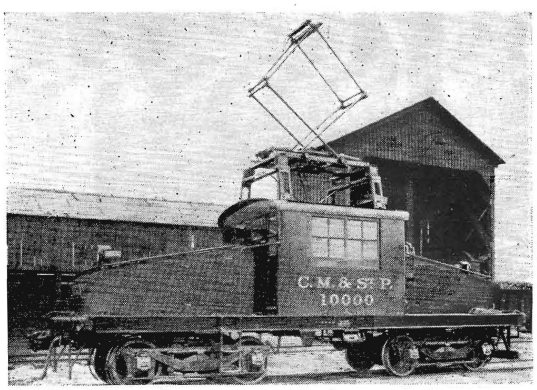

Fig. 2. 1500-volt, 50-ton Locomotive on the Great Falls Electrification

lifted into position by air pressure and is held against the wire by steel coil springs. Provision is made for operating at trolley heights varying from 17 to 25½ ft. above the top of the rail.

Compressed air for operating air brakes, whistles and sanders is supplied by two 1500-volt motor-driven air compressors. Each of these units has a displacement of 27 cu. ft. of air per minute at 90 lb. pressure.

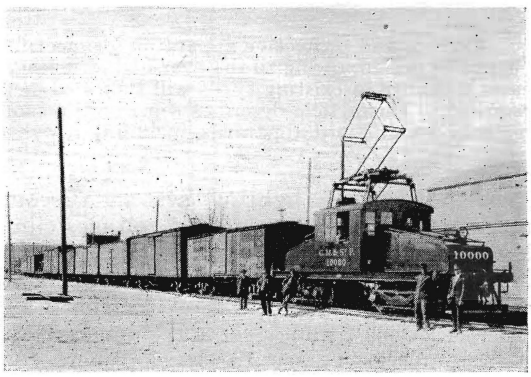

Fig. 3. Locomotive shown in Fig. 2 hauling freight train

The compressors are located in the cab of the locomotive convenient for inspection.

A headlight is mounted on each end of the locomotive provided with a concentrated filament type Mazda lamp of about 100 c-p.

As a safety precaution no trolley wire is installed inside of the round house. A connection is made in the cab of the locomotive for applying power to the locomotive through a length of special flexible cable insulated for 2400 volts. A double-throw switch in the locomotive cab allows connection to be made either to the trolley or cable circuit.

Line Construction

The overhead line construction is of the catenary type similar in a general way to that installed on the Butte, Anaconda & Pacific, 2400-volt railroad. Both span and bracket construction are used, depending upon local conditions. Poles are spaced approximately 150 ft. apart on tangent track supporting a 4/0 grooved trolley from a three-point suspension. There is no feeder copper installed.

The work was done by the Electrification Department of the Chicago, Milwaukee & St. Paul Railway, R. Beeuwkes, engineer in charge, under direction of Mr. C. A. Goodnow, assistant to the President. All of the electrical apparatus including locomotive, substation equipment and line material was furnished by the General Electric Company.