

The car is provided with two master controllers of the single-handle drum type. Through this device the proper connections are made from the motor-generator set and storage battery to the control train line for operating the magnet valves of the switches in the proper sequence for the acceleration of the car. The supply wire leading from the storage battery switch to the master controller is connected to the "cutout" and "reset" receptacles and this renders the equipment inoperative without the control plug. The controller is provided with an automatic release and will not remain in any running position after the operator's hand has been removed. Moving the handle to the right will set the reverser in the proper position for forward movement of the car and moving it to the left *vice versa*. At the bottom of the master controller are the two push buttons for the operation of the pantograph. The master controller is shown in one of the illustrations.

The wires comprising the control train line are run in one cable throughout the entire length of the car and are connected between cars by jumpers when the car is to be operated in a train. One end of the jumper is permanently connected to the train line in the junction box at each end of the car and the other end is carried in dummy receptacles when not in use. The arrangement is shown in the cut on page 1209.

The car is provided with one switchboard panel located in a cabinet in the vestibule at the motor truck end and has the following apparatus mounted on it: One motor-generator switch, one battery switch, one governor switch, one control cutout switch, one limit relay cutout switch, one blower motor switch (fused), one compressor-motor switch (fused), three heater switches (fused), one automatic heat regulator, four lighting resistor units and fifteen fuses for lighting and auxiliary circuits.

DUST SCREEN USED IN VENTILATING INTAKE

The ventilating system for cooling the transformer, preventive coil and main motors is supplied from a blower. The runner for this blower is a 21½-in. single inlet wheel mounted on the shaft of the motor at the end opposite the commutator and enclosed in a steel casing. The motor is of the doubly fed type, supplied with current at 100 volts from taps on the main transformer, and runs continuously. The ventilating air is taken into the system from under the car body through a screening device, as shown herewith. That portion of the ventilating air required for the main motors is taken into the channel beam of the car body and carried forward to the motor intakes.

All of the car and headlight lamps are supplied with current at 30 volts through the various circuits, each of which is protected by a fuse mounted on the panel board. The current is obtained from the motor-generator set and storage battery, as before stated.

Under normal operation of the car at night the lighting system receives its energy from the motor generator, which is adjusted to give approximately the 45 volts required to float the storage battery on the system. The voltage is then reduced to the proper value for the lamps by means of resistance units inserted in the various circuits.

Whenever the motor circuit of the set is not energized, either due to the pantograph being lowered or to the power going off, the resistance units are automatically cut out of the circuits by the functioning of the battery disconnecting relay and the lights burn at the same

degree of brilliancy with current supplied from the battery. At the same time the battery is disconnected from the generator and prevented from feeding it and running it as a motor. The storage battery will supply the lighting system for approximately two hours.

The car has no power bus or lighting train line. Therefore the main motor and lighting circuits are independent of the corresponding circuits on other cars in multiple operation.

The Milwaukee Electrification*

Some of the Important Reasons for the Widespread Interest Which This Great Undertaking Has Awakened

BY F. H. SHEPARD

Director of Heavy Traction Westinghouse Electric & Manufacturing Company

THE most widely known section of railroad track in the world is the electrified section of the Chicago, Milwaukee & St. Paul Railway, now operating over four mountain ranges and crossing the backbone of the American continent. The eyes of the whole world are on it today, and for several important reasons.

It is the first electrification of any stretch of railroad of considerable length on which the operation is exclusively electric; that is, not combined with steam locomotive operation. It is also the first extensive railroad electrification to use hydro-electric power. Other considerations of importance are the great size and power of the locomotives, the use of regeneration on mountain grades, the first use of a 3,000-volt direct current and special provision for the most economical use of hydro-electric power.

The courage with which this undertaking was advanced is one of the amazing things in American railroad history. Electrifications already existing had been confined to comparatively short stretches of road where conditions obtaining due to terminal or grade congestion, tunnel operation or other local conditions had governed. In this case the determination to electrify followed the construction of a new transcontinental route, the underlying reason for the decision to electrify being undoubtedly the earnest desire to adopt the best in operation as a means to develop the best railroad. The availability of power supply at an attractive price from the great electric transmission network of the Montana Power Company was, of course, an important factor as well. But the chief consideration was that wherever electrification has supplanted steam more reliable and better operating conditions have been secured.

The present and potential distribution of power in the State of Montana had already made that State foremost in the use of electric power per capita. The utilization of water power is there seen carried to a high degree. Originating with the storage of the mountain run-off in the great Hebgen reservoir, adjacent to Yellowstone National Park, power is successively generated by plants located along the Madison and Missouri Rivers, the same water generating electric power seven times before its final release.

In this system, which includes the development on the course of the Columbia River, as well as minor water powers on the Yellowstone, there is already installed an aggregate of 300,000 hp., with undeveloped sites for

*Abstracted from extended article in the Milwaukee Employees' Magazine.

150,000 hp. additional. This is interconnected and distributed by 2,000 miles of high-voltage transmission line, much of which is 100,000-volt line, and serves jointly the mines, cities and railroads of the State.

The exclusion of steam locomotive service from the electrified line of the Milwaukee has secured the operation and maintenance of the electrical equipment in a most efficient manner. While a part of this is due to the skill with which the operation and maintenance of this apparatus is directed, a large part is also due to the zeal and interest of the operating forces. The engine men and maintenance forces have mastered the new power and the details of the electrical apparatus to an amazing degree.

Illinois Central Electrification Progress

**Making of Plans Only Work to Be Done This Year—
Construction of New Power Plant to
Handle I. C. Load Started**

THE Illinois Central Railroad does not contemplate doing any work in connection with the improvement of the Lake Front in Chicago this year. That is, no work will be done in the way of grading, filling, electrification or terminal station construction. The financial situation and other conditions are believed by the company to be so uncertain as to make it unwise for any railroad company to embark in enterprises necessitating the raising of money on any considerable scale at this time. The only actual work that will possibly be done this season is the subway for foot passengers from the Randolph Street station westward underneath Michigan Avenue. This tunnel is very urgently needed on account of the delay to patrons of the Illinois Central's suburban service in getting across Michigan Boulevard because of the constant stream, especially during the rush hour, of six rows of automobiles. Some studies are being made by a small organization in connection with the electrification project, but there may be no definite decision to report as to type of electrification systems, equipment, etc., perhaps for a number of months.

NEW GENERATING PLANT WILL BE READY

In preparation for carrying the load of the Illinois Central Railroad after this is electrified, and also for caring for the very large growth in its business to the south of Chicago, the Commonwealth Edison Company is planning to build a new 180,000-kw. power plant in the southeastern section of the city, which will be known as the Calumet Station. A 40-acre tract of land on the Calumet River, and located at 100th Street and Commercial Avenue, has been purchased as the site of the new plant. The new station will be laid out for six 30,000-kw. turbo generators, of which two will be put in as the initial installation. These two units have just been ordered, one from the General Electric Company and one from the Westinghouse Electric & Manufacturing Company. These will operate at 325 lb. steam pressure with 250 deg. superheat. There will be four Babcock & Wilcox boilers per turbine, each having 15,000 sq.ft. of heating surface and equipped with an economizer having 10,000 sq.ft. of heating surface. The order for the first eight boilers has also just been placed. It is expected that the station will be in operation in the fall of 1921.

Located close to the mouth of the Calumet River, the new power plant will have all Lake Michigan as a water supply. The situation is also favorable in regard to coal, for the Pan Handle Railroad circles the proposed station on the west side and the Chicago Outer Belt Railroad is adjacent to it on the south side. One of the features of the power plant will be the method of handling the coal supply and cinders to and from the boilers. Cars loaded with coal will enter at one end of the plant and the same cars will emerge from the other end loaded with cinders. The details of the station design are not as yet available.

This Calumet Station will make the fourth large generating plant operated by the Commonwealth Edison Company in supplying energy for all the local transportation companies and most of the power and light energy consumers of Chicago. The present three stations are the Fiske and Quarry Streets plants, located in the central part of the city, and the Northwest Station, located in the northwest section of the city. The new station will greatly reduce the line losses involved in supplying the southeast section of the city and provide necessary capacity for the growth of the many industries there.

The station will be well situated for supplying energy not only to the electrified Illinois Central Railroad but to numerous other roads running south and west and east from Chicago, when they later undertake electrification. The total capacity of the present three stations is 489,000 kw.

Chicago Hearing Concluded

AT THE concluding hearing before the Public Utilities Commission of Illinois, held in Chicago on May 26, on the financial situation of the public utility companies, George M. Reynolds, president of the Continental & Commercial National Bank, Chicago, testified that if public sentiment does not change from its traditional attitude against increases in utility rates it will only be a question of time until the utilities will be unable to function.

Mr. Reynolds said that would be a fatal blow to the development of the city. He also made the point that much could be done to improve the value of utilities securities if the commissions would be quick to recognize the justice of applications for increased rates. He declared that the fact that commissions have not met the changing financial and operating conditions in a prompt and business-like way has had much to do with the decline in the value of utility securities and in the market for them. There has been a tendency to assume that the present period of high prices is abnormal and that it would be unfair to set up rates which would pay a fair return on present operating costs.

Mr. Reynolds thought the fallacy of this view had now been pretty well established, nearly all economists agreeing that the low level of pre-war prices will probably never be reached again, or certainly not for a long time.

A liquid fuel which is being tried out in Great Britain and which is said to promise well is composed of a one-to-one mixture of coal dust and fuel oil. The coal dust is pulverized and treated with a small proportion of soap, fatty acids or other substances which will reduce its tendency to settle in the oil. The fuel has been given the name "Colloil."