Some Developments in the Electrical Industry During 1917

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This article constitutes our annual review of the activities of the electrical industry during the past year. Its scope, of course, increases with the growth of the industry, and while there is more to record on this occasion than on any previous one, there are yet many important developments of the year associated with war work that cannot be mentioned at this time for obvious reasons. Nevertheless, the advances in the industry that are outlined by Mr. Liston are unusual, and will be read with interest by all engineers. —Editor.

When, in the fullness of time, the complete story of the developments in the electrical industry for 1917 is told, it will constitute a record of which the entire electrical fraternity may well be proud; but, at present, for reasons which will be appreciated by every American engineer, many items of interest must of necessity be omitted from any review covering the accomplishments of the industry.

Despite this limitation there remains for analysis in this article an impressive array of improvements secured in many classes of apparatus, and, as well, a number of new appliances and applications of apparatus previously developed which can be classed as distinctly new.

The feature of overshadowing importance, however, was the enormous increase in the volume of production of standard apparatus to meet unprecedented demands for power station, railway, and industrial equipment. For certain types of apparatus which had long been in general use, this increase actually represented advances of several hundreds of per cent as compared with the maximum output of preceding years. In response to emergency demands, numerous machines of large capacity were manufactured with a rapidity which had never before been attempted.

While there were many notable additions to the existing equipment of electric railroads, hydro-electric stations, and the power and lighting systems of a great variety of industries, as well as extension of electric service into new fields, there were comparatively few instances in which the unit capacity of the apparatus supplied exceeded the maximum ratings previously established.

In view of the number and variety of subjects covered in this article and the limitations imposed by the space available, complete

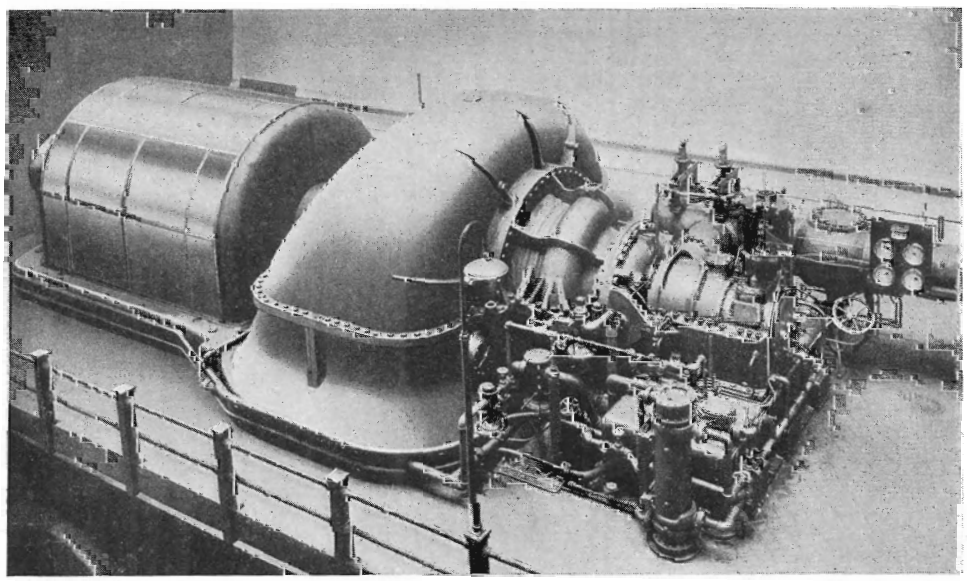

Fig. 1. 35,000-kw. Curtis Steam Turbo-generator Installed in Power Station of the Boston Elevated Co.

descriptive details cannot be given, and many items which would be of interest from an engineering standpoint have of necessity been omitted. The apparatus referred to, unless otherwise specified, is in every instance a product of the General Electric Company; but this does not invalidate the essential value of the cumulative effect of these references as a broad indication of the important tendencies in design, construction, and application throughout the manufacturing industry during the past year.

TURBINES

The pressing demands for turbines of all capacities necessitated the concentration of all efforts on the production of types of machines which were already developed and the postponement of development work which otherwise might have been undertaken.

A number of the large turbine-generator sets referred to in last year's review* by the author were shipped and are in operation. These sets consist in every case of a single turbine of single flow design connected to a single generator (see Figs. 1 and 2); and, in accordance with G-E turbine practice, they are designed to utilize efficiently the highest degrees of vacuum. It has often been pointed out that the volume of each pound of steam is almost twice as great at 29 inches as at 28 inches vacuum.

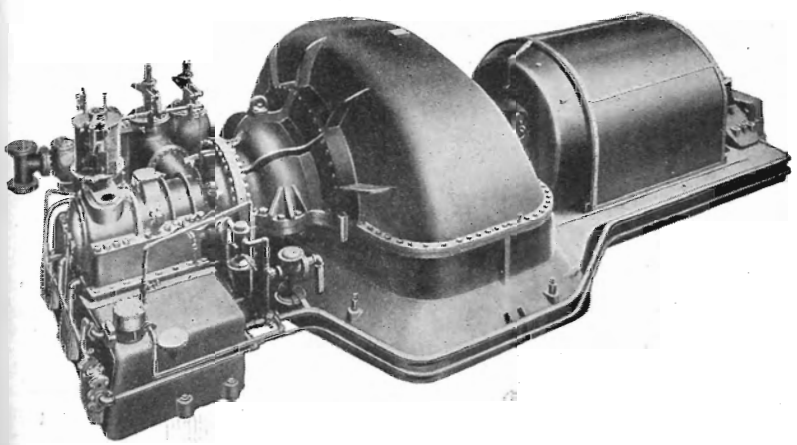

Fig. 2. 30,000-kw. 1800-r.p.m., 60-cycle Curtis Steam Turbo-generator

Geared turbine generator sets and geared sets for ship propulsion mentioned last year as new developments, have added another successful year to their record.

* General Electric Review, January, 1917.

ALTERNATING CURRENT MACHINES

There were no changes of importance in the design or maximum rating of this class of apparatus, but there was an exceptional expansion in the production of standard machines.

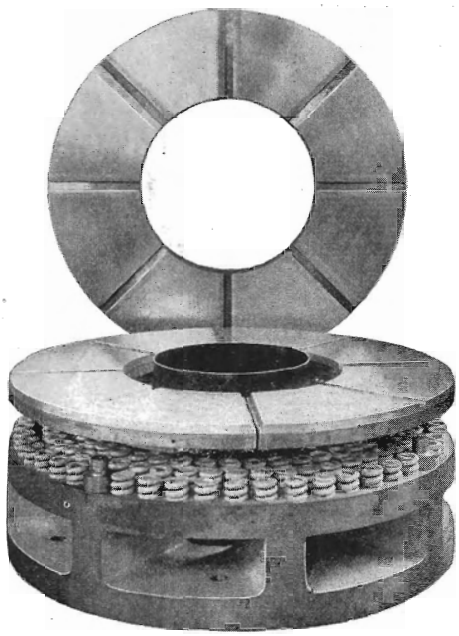

Fig. 3. Spring Supported Thrust-bearing Showing Rubbing Surface of Rotating Ring, Stationary Ring is Raised to Show Arrangement of Springs

The largest unit constructed was a horizontal shaft waterwheel driven generator rated at 20,000 kv-a., 6600 volts, 60 cycles, and operated at 360 r.p.m., or more than twice the speed of machines of the same class and kilowatt capacity previously built.

In low-speed machines there were two 10,000 kv-a., 6600-volt, 60-cycle vertical shaft waterwheel driven units operating at 55.6 r.p.m. These were supplied to the Cedar Rapids Mfg. and Power Co. of Quebec, and were similar to ten units previously installed by that company. They still represent the maximum of capacity development for machines of their class.

The spring-supported thrust bearing (Fig. 3) was developed by the General Electric Company to overcome certain difficulties

peak load demands on the steam power plant.

No operator is required for the hydro-electric station and the attendance is limited to periodic visits of inspection.

DIRECT-CURRENT MOTORS

The most important development of recent years, in direct-current motor design, was embodied in a complete new line of adjustable speed motors ranging from 2 h.p. to 125 h.p. in capacity.

By reference to Figs. 5 and 6 it will be seen that this new motor, which is known as Type RF, is provided with a distributed compensating winding embedded in slots in the main pole pieces, in addition to the commutating pole winding which had been previously accepted as the best practicable method of minimizing commutation troubles.

The use of this compensating winding practically prevents losses due to flux distortion, which, in previous commutating pole types, ran as high as 10 per cent, and the motor may be safely accelerated from low speed to high speed when connected to a

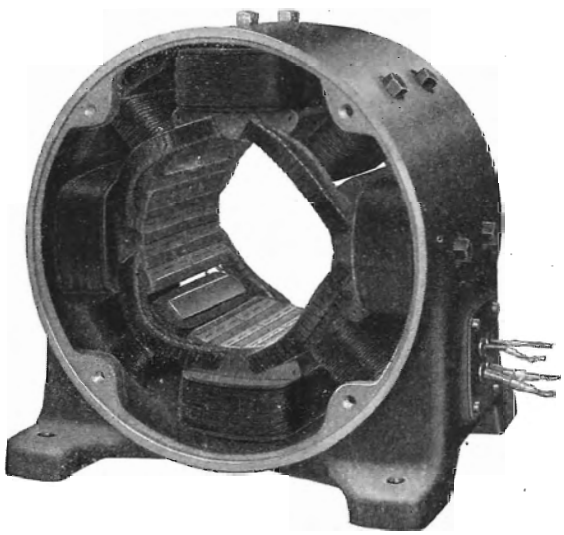

Fig. 6. Magnet Frame of RF Motor Showing Location and Arrangement of Coils

friction load by inserting the total field resistance in one step.

For ordinary operating conditions only a simple drum type controller is required, while for automatic service magnetic control of a very much simpler type than that necessary for the conventional commutating pole type of motor can be employed without sacrificing excellence of commutation.

ELECTRIC TRACTION

On account of the abnormal conditions due to the entrance of this country into the World War, the activities of the various large railroads looking to the electrification of heavy traffic and mountain grade sections were in most cases put aside pending the return of normal conditions. Railroads now operating electrical sections, however, placed orders for additional equipment and continue to add to their facilities as the traffic requirements dictate.

New York Central Railroad—Electric Division

During the year the New York Central Railroad placed in service ten additional 125-ton electric locomotives, which are duplicates of those furnished in 1914. These locomotives are of the high-speed passenger type, each equipped with eight bipolar gearless motors capable of handling trains between New York City and Albany in case the electrification should be extended.

Both the original type four-motor locomotives and the later eight-motor type (Fig. 7) continue to show remarkably low figures on locomotive maintenance, approximating since the beginning of service about 3½ cents per locomotive mile. This maintenance figure is probably not approached by any other electric locomotives of similar size now in service.

The suburban service on the electric division of the New York Central handled by multiple unit trains was augmented by eighteen motor-cars, each equipped with two GE-260 motors and Type "PC" control. This makes a total of forty multiple unit cars now using "PC" control on this system.

Canadian Northern Railway

During the early part of the year the Canadian Northern Railway placed in service on its Montreal terminal five of the six 83-ton, 2400-volt electric locomotives (Fig. 8) purchased for this electrification. While these locomotives have not been used to haul regular passenger and freight trains, they are in actual service hauling construction trains between the site of the new station and Cartierville, ten miles from the terminal, through the Mt. Royal Tunnel.

Fig. 7. Latest Type of Eight-motor New York Central Locomotive

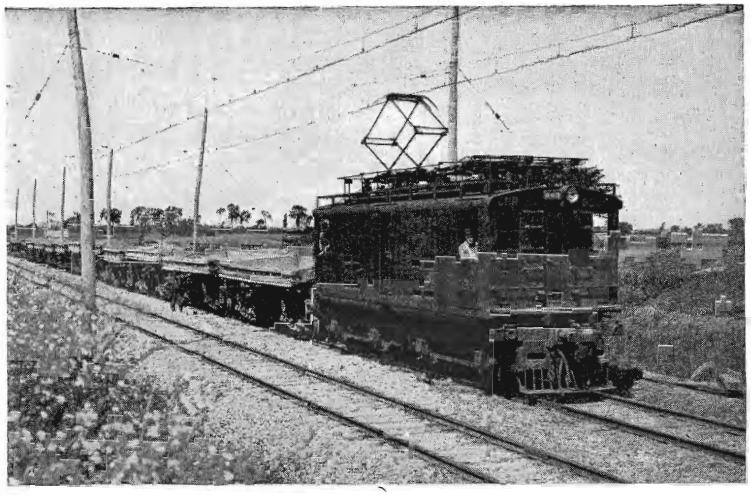

Fig. 8. 83-ton, 2400-volt, D-C. Locomotive Hauling Construction Train, Canadian Northern Terminal, Montreal, Canada

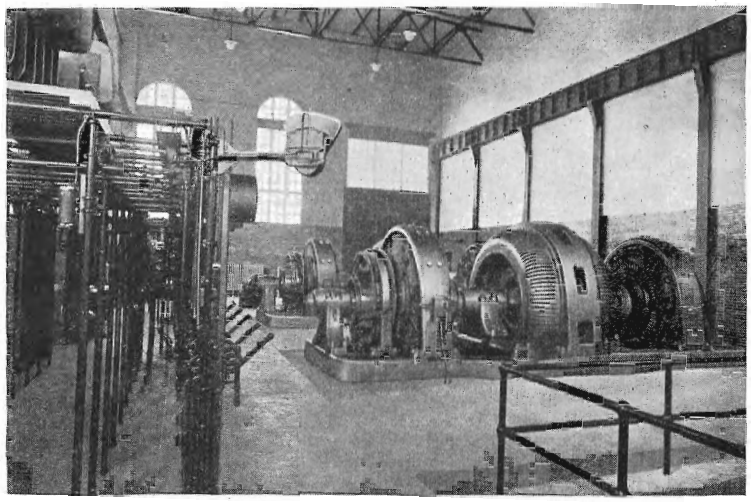

Fig. 9. Two 1500-kw., 2400-volt D-C. Motor-generator Sets in Montreal Sub-station, Canadian Northern Railway

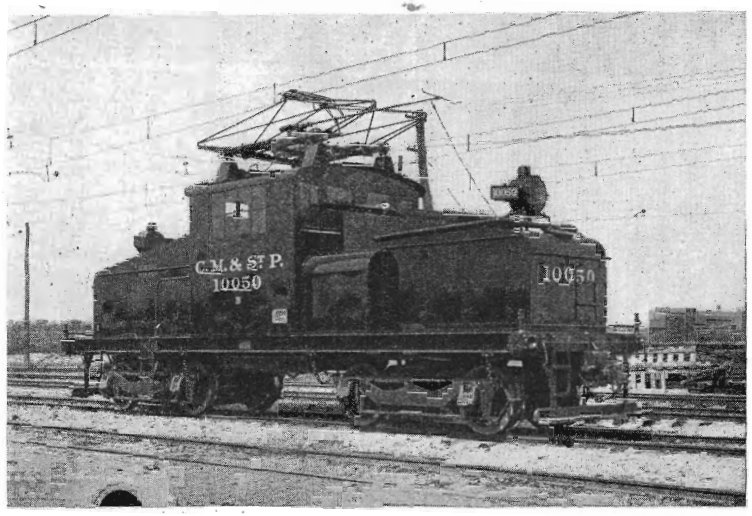

Fig. 10. Chicago, Milwaukee, & St. Paul Switching Locomotive

The substation, located at the portal of the 3-mile tunnel under Mt. Royal, was entirely completed, and contains two 3-unit, 2400-volt motor-generator sets with a capacity of 1500 kw. each (Fig. 9). Energy is purchased from the Montreal Light, Heat, and Power Company at 11,000 volts, 60 cycles, 3 phase, and transformed by these units to 2400 volts d.c. for the electric zone.

Chicago, Milwaukee & St. Paul Railway

The delivery of main line and switching locomotives and substation material for the 440-mile electrification of the Chicago, Milwaukee and St. Paul Railway was completed, and there are now in service on this line twenty-four standard freight locomotives each weighing 282 tons; twelve passenger locomotives of similar construction but geared for 60 m.p.h. on level track, weighing 300 tons each with heating equipment; and six freight locomotives equipped with heating equipment for emergency service on passenger trains, weighing approximately the same as the passenger locomotives. There are also two switching locomotives (Fig. 10) weighing 70 tons each, making a total of forty-four units delivered. In order to handle local passenger trains, two of the passenger locomotives have been separated into half units weighing about 150 tons each, so that the number of locomotives available for service is probably 46 instead of 44. Seven new substations on the Missoula Division were also placed in service, thus completing the most extensive steam road conversion in the world.

The Railway Company is rapidly completing the electrification of the Othello, Seattle, and Tacoma division of this main line, extending from Othello in the State of Washington to Seattle and Tacoma on the coast, a distance of 211 miles. Orders were placed with the General Electric Company for the equipment of five substations with apparatus which will be identical with that furnished on the Missoula Division. Five passenger locomotives of a new design, including bipolar gearless motors, are also under construction, and two switchers weighing 70 tons each which are duplicates of those now in service. Line material furnished by the General Electric Company for this section is now being shipped and the poles are set for a greater part of the distance.

* See article in November issue 1917 GENERAL ELECTRIC REVIEW, page 863.

*Automatic Substations**

There were in actual operation between twelve and fifteen automatic substations, and there are under construction in the Schenectady factory more than thirty additional automatic substation equipments ranging in capacity from 200 to 1500 kw.

Electric Locomotives

A number of locomotives ranging in size from thirty to eighty tons were ordered or put into service during the year mainly for switching and light freight service on city, suburban, and interurban railways. Most of these locomotives are of the steeple cab type equipped with four motors, all the weight being on the driving axles. Motor and control equipments have also been sold for locomotives constructed in railway company's shops. The Illinois Traction Company is now building six such locomotives, each weighing sixty tons and equipped with four GE-69 railway motors.

A good example of a standard steeple cab unit is the fifty-ton locomotive (Fig. 11) built for the Northern Ohio Traction and Light Company, which is equipped with four-type GE-257 railway motors and type M control. Two similar units are under construction for the Chicago, North Shore, and Milwaukee R.R. and one for the United States arsenal at Watervliet. Two eighty-ton locomotives with articulated trucks and four GE-69 motors are under construction for the Manufacturer's Railway of St. Louis for handling freight shipments for the Anheuser-Busch Brewing Company.

Car Equipments

The greatest activity in sales of equipment for city and suburban electric systems appeared in the sales of motors for small light-weight safety cars (Figs. 12 and 13). During the year nearly 1500 GE-258 motors were sold for this service, and approximately 900 GE-247 motors were also manufactured for light-weight equipments. Large orders for the above small motors included the following:

Transit Supply Company, 360 GE-258 motors for Twin City Lines.
Bay State Street Railway, 400 GE-247 motors.
New York State Railways, 100 GE-258 motors.
International Railway Co. of Buffalo, 200 GE-258 motors.
Philadelphia Rapid Transit Company, 200 GE-247 motors.

The commutating pole ventilated type railway motor known as the GE-249, rating