Operating results are presented in the paper, and show that the performance of this apparatus fully comes up to expectations.

The authors point out that the reliability of the automatic control equipment is necessarily problematic, but it follows, in general features, principles which have had full trial in service for many years in controlling the voltage of generators in the form of the common Tirrill Regulator, and time can only decide its reliability in this service.

The motors are self-starting and at start, oil pressure is applied to the bearings to completely float the machine. The starting k.v.a. in service has been found to be about 1,200 k.v.a., or one-fifth of full load.

The authors point out that the term synchronous condenser, commonly applied to such machines, is a misnomer, giving the impression that the chief function of the machine is to supply leading current, while this represents but one-half of its use in service. The other and fully as important function is to supply lagging current. The use of the term "Synchronous Motor Reactor" is suggested in view of the common use of the term reactance as positive to represent inductive reactance, and negative to represent condensive reactance.

The second part of the paper relates to the predetermination of operation. Part III. gives the calculated and observed values. An appendix presents the equations and mathematical treatment.

The conclusion drawn by the authors is that while the use of the reactor to improve power factor at full load makes possible an increase of load with the same regulation of the line from no load to full load, the elimination of this regulation and the substitution of a constant difference of voltage between power house and terminal station by use of reactor to supply lagging current, and so lower power factor at light load, is desirable from the operating point of view, for the following reasons:—

1. Automatic compounding of the generating station voltage is done away with and constant voltage automatically controlled is substituted. Apparatus for the latter condition may be relied on.

2. Extreme overload capacity of lines in case of emergency, and control from the terminal station.

3. Telephoning between power house and terminal station is greatly reduced as the voltage of the distribution bus is controlled in the terminal station.

4. Voltage of the line is steady and arresters may be set closer with increased protection to insulators and apparatus. From this point of view it is important to arrange the switching so that the reactor is a part of the line unit in case automatic relays are used on the line oil switches.

5. Loads may be supplied at intermediate points on the line with steady voltage.

According to the report for 1914, of the Ottawa Light, Heat and Power Co., Limited, the unprecedented low water in the Ottawa River during last summer, fall and early part of the present winter necessitated the continuous operation of its steam auxiliary night and day since July last. They estimate that this abnormally low water has cost the Ottawa Electric Company over $50,000. The steam auxiliary of 8,000 h.p. which the company had provided for just such an emergency as has confronted it during the past year, made it possible to supply an uninterrupted service to all power and light patrons throughout the year.

COST OF HAULING OVER VARIOUS TYPES OF ROADS.*

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WHILE it has always been conceded that one of the main objects of building good roads was that of reducing draft and increasing hauling capacity, it has been a pretty difficult matter to prove to exactly what extent better roads cut down the cost of hauling. Tests have been made from time to time of the draft required for different loads over various types of roads, but in many cases the results were incomplete as to the conditions of the tests, or covered tests of short duration, which limited the general value of the work done. There is not even yet enough complete data available covering all types of roads under various conditions, but enough has been done to make possible reliable comparisons of many types. The United States Office of Public Roads is now making very extensive tests of road draft, which, when made public, will be of great value to road builders and interest to the public generally.

The horse is yet, and probably will be for some time, the chief factor for consideration in hauling on the country road. It being the main power producer, it will therefore be of interest to consider its capacity and limitations, as they have an important bearing on both road surface and grades. The average horse is generally considered to be able to develop about two-thirds the technical horsepower. It, however, has a large reserve draft capacity, beyond that of other traction producers, and can develop three horse-power for short periods of time, or 4½ times as much as under daily normal conditions under which the animal is expected to keep in good condition. The average horse will pull, under normal working conditions, about 1/10 of its weight at the ordinary walking speed, and can pull one-half its weight as a maximum draft for very short distances, though one-quarter the weight is considered as the ordinary maximum effort for longer periods. In recent U.S. road tests two horses developed, in four tests of an average of 250-foot haul, an average of 6.48 horse-power, or nearly 3¼ each, at an average speed of 3 miles per hour.

Road draft is commonly figured on a basis of the number of pounds required to haul one ton on the level. For example, if the draft on a high-class dirt road were said to be 80 lbs., and if the wagon weighed 1,500, and its load 3,000 lbs., or a gross load of 4,500 lbs., or 2¼ tons, the draft for this load under these conditions would be only 180 lbs.—a very easy load for the team.

The following is a table of drafts in pounds per ton on the level for different kinds of roads:—

Type of road.	Draft per ton.
Loose sand	280 to 350 lbs.
Gravel, ¾ inch loose top	300 "
Dry gravel road	258 "
Best gravel roads	60 to 100 "
Dirt	75 to 150 "
Hard dirt	106 "
Macadam	40 to 60 "
Asphalt	30 to 60 "

These are average figures which offer good comparison of the traction value of various roads. For loose sand, 300 lbs. may be taken as a very close average. The

* Given at the 1st College Short Course and Convention on Roads, March, 1915.