passenger journey 69 miles. The average freight train consisted of 311 tons, and the average haul was 211 miles. The average passenger journey and average freight haul in Canada are the longest in the world.

The gross earnings for 1910 were $175,956,217, a gain of $28,899,881 over 1909, or 19.9 per cent. Operating expenses amounted to $120,405,440, an increase of $15,805,356. The net earnings were $53,550,777, or 32.3 per cent. better than for preceding years.

Railway fatalities numbered 615, and 2,139 were injured. Of these, 524 were killed and 1,441 injured from the movement of trains. The killed included 60 passengers and 214 employees. One passenger in every 598,243 was killed, and one in every 132,943 injured. One trainman in every 199 was killed, and one in every 33 injured.. In 1909 there were 36 passengers killed and 281 injured. The accidents at highway crossings during the year resulted in 63 persons being killed and 61 injured.

The 123,768 employees involved a wages and salary bill of $67,167,793, as compared with $63,216,662 in 1909. In addition, 16,709 employees were engaged in outside operations at a cost of $5,169,923. The wages bill for all railways four years ago amounted to $58,719,493.

The mileage for electric railways grew from 989 in 1909 to 1,049 in 1910. Capital liability increased from $91,604,989 to $102,044,979. Gross earnings reached $17,100,789, a betterment of $2,275,853. Net earnings amounted to $5,383,276, after making a deduction of $2,953,759 for taxes, interest on funded debt, etc. The electric railways of Canada carried 360,964,876 passengers in 1910 and 853,294 tons of freight. The employees numbered 11,390, and the wage bill was $6,316,777.

Accidents led to the death of 95 persons and the injury of 2,538.

ADVANTAGES, OPERATING CONDITIONS AND APPLICATIONS OF SMALL EXHAUST STEAM TURBINES.

A. Eugene Michel.

Increasing the power of a plant where the requirements have outgrown its original capacity, but are not great enough to justify scrapping the old and replacing with new units is a trying problem that is often made easy by means of the exhaust steam turbine. This is well illustrated, for instance, in a mill deriving its power from a simple non-condensing engine and in which the addition of machinery from time to time has increased the load on the engine beyond a practical limit. The owner can secure more power in three different ways:

First—He can install a larger or additional engine which is an expensive proposition at best, requiring additional boiler capacity, perhaps involving expense for enlarging the buildings, and increasing labor and upkeep costs materially. Seldom can over 20 per cent. of the new expenditure be netted from the sale of the old apparatus, taking into consideration the installation costs, etc. Further, the power needs, unless the increase is large, do not usually warrant big expenditure.

Second—More power may be secured by running the old engine condensing, but a condensing engine either simple or compound and even when operating at the most economical point of cut off and otherwise under the best conditions can hardly deliver 20 to 25% more power than when running non-condensing. The increase obtainable and practical will hardly be greater with a compound than with a simple engine and in either case the change may subject the engine to a constant load, greater than that for which it was designed. Where this is true the overload is in time bound to prove injurious and the economy improvement and power increase are partially counterbalanced by deterioration of the unit.

The Third Method—that of changing the engine to condensing and utilizing the additional range of pressure drop to drive an exhaust steam turbine—is far more logical. In this way it is possible not only to almost double the amount of power previously secured from the engine, but this is done without increasing the duty on the engine and without using more steam than before. Such an installation is illustrated in Figure 1. The initial cost of the turbine and condenser per horsepower is less than for additional boiler and engine capacity, but there is not the compulsion to buy more than may be required.

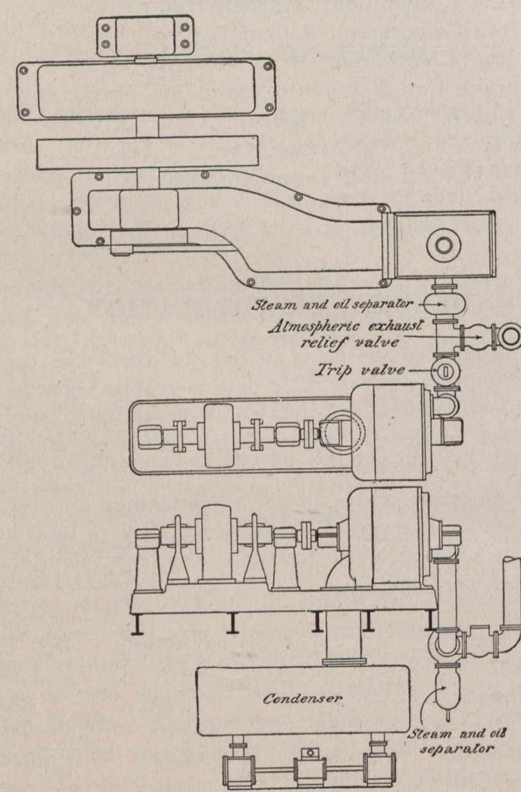

Fig. 1.—Plan and elevation of Kerr Exhaust Turbine Generator Installation, showing connections and relative proportion of the parts. Horsepower on engine, 300; horsepower on turbine, 200.

The Kerr Exhaust Turbine operates with any steam pressure above 2 lb. gauge at its inlet and exhausts into a vacuum of from 24 to 28 inches, utilizing exhaust from main engine, pumps, air compressors, etc.

The installation of such an exhaust turbine improves the economy most and offers the greatest capacity increase where the turbine and a suitable condenser are added to a simple non-condensing engine. For the smaller sizes the ordinary jet codenser maintaining 24 to 26 inches vacuum may be used with satisfaction. In larger units condensing apparatus maintaining higher vacuum is justified. A substantial improvement in economy and increase in capacity also result from the addition of an exhaust turbine to a simple condensing engine and from the addition of turbine and condenser to a compound non-condensing engine. The exhaust turbine can also be utilized to advantage with compound or even triple expansion engines where increased capacity is important.