the stator winding The armature slots are nearly closed, and are arranged slanting to the direction of the axis.

Regulation of the motor speed is effected by altering the supply pressure by means of contractor switches, which are connected up to tappings of the power and exciter transformers, and are actuated by the controlling current. The controlling current is derived from a special (300-volt) coil of the power transformer.

Each of the two controllers has two separate switch-drums, one of which operates the contactor switch of the power transformer, and serves to regulate the power consumption, whereas the other operates the exciter switches, thus controlling excitation. The exciter drum moves the reverser into its proper position in a preliminary stage to "forward" and "backward" respectively. Each of the two switch-drums is entirely self-contained, so that any position of one can be combined with any position of the other, thus obtaining a minimum k.v.a. consumption for each speed of the motor.

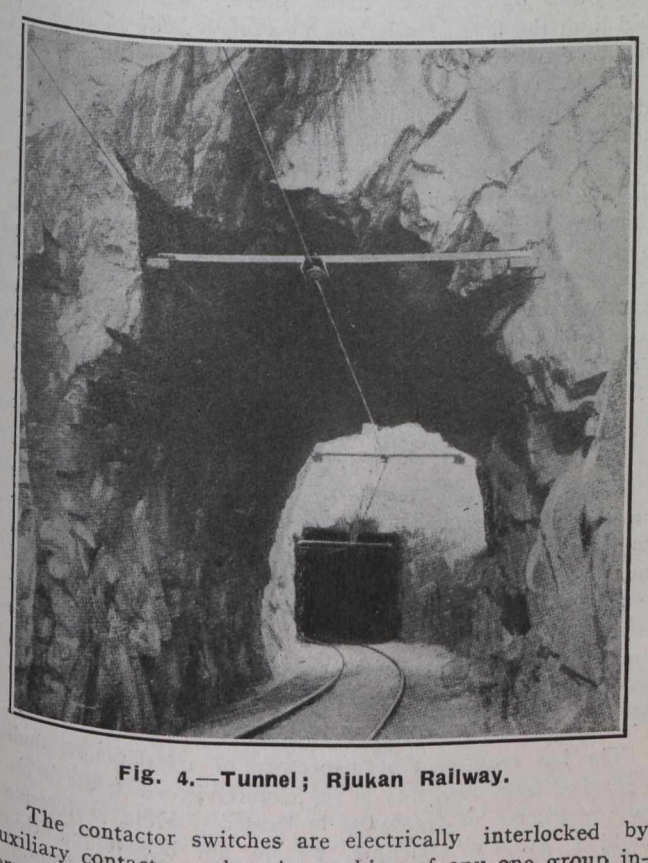

Fig. 4.—Tunnel; Rjukan Railway.

The contactor switches are electrically interlocked by auxiliary contacts so that the working of any one group interrupts all the remaining switch coils.

Provision is made for two locomotives to be joined up in multiple connection for hauling train weights of up to 250 tons. This arrangement allows both locomotives to be controlled by a single driver. The conductors for the motor-compressor and the lighting and heating of the locomotives are connected up to the same switchboard with the controller circuit and are fitted with hand switches. All these circuits are fed from the 300-volt controller coil, which has a 19-volt tapping for the lighting circuit. The motor-compressor, which supplies compressed-air for the Westinghouse and Henry brakes as well as for actuating the current collectors, sanders and signal whistles, is thrown into and out of circuit automatically.

Each of the radiators provided for heating the locomotives has an output of 1 kw. Heating sockets are provided at the ends of the locomotives for heating the train, which are connected up to the cars by coupling cables.

The Rjukan Railway.—This is the first standard gauge electric railway in the South of Norway to be installed on the single-phase system. It comprises two sections separated by the Tinn Lake, the northern section (from Saaheim to the Tinn Lake) being the Vestfjorddals Railway, 16 km. in length, and the southern section, about 30 km. long, the Tinnos Railway, running from Tinnoset to Notodden, along the Hitterdals Lake. A ferry across the Tinn Lake will connect the two sections.

The Rjukan Railway is mainly intended for the transport of artificial saltpetre manufactured in Saaheim, to Notodden. Trains with a maximum trailer weight of 290 tons are drawn on the section from Notodden to Lilleherred, which has a constant gradient of about 2.7 per cent. by two locomotives, and on the remaining sections by a single locomotive.

The rolling stock comprises three four-axle, and two two-axle locomotives. The former have two bogie trucks, and are fitted with four alternating-current motors, each having an hourly rating of 125 h.p., and weighing approximately 46 tons. The two-axle locomotives have two motors of the same size, and weigh about 23 tons. The locomotives are constructed for a line pressure of 10,000 to 11,000 volts, 15 to 16 cycles, and are designed for contactor control.

The track equipment consists of a single catenary suspension overhead contact line, the distance between the poles being about 60 metres. On some sections bracket suspension is used, while on others cross-suspension is employed. We illustrate the form of suspension adopted for the overhead line in a tunnel.

The power supply is derived from a separate converter station for each section of the line, only 50 cycles, three-phase current at a pressure of 10,000 to 11,000 volts being available; the converter station feeding the northern section is situated at Vestfjorddalen, and contains two converter sets. Each of these comprises a three-phase transformer which steps down the pressure from 10,000 to 5,000 volts, and feeds an asynchronous motor driving an alternating-current generator with an output of 400 k.v.a., which supplies the line. The converter station receives its energy from the Rjukan power station, which is about 5 km. distant.

The southern section is fed from the Svaelgfos converter station, which is situated in the same building as the power station and consists of three converter sets similar to those above described.

MUNICIPAL OWNERSHIP SUCCEEDS.

Municipal ownership of public utilities in Edmonton resulted in a net surplus of more than $60,000 during the twelve months ended October 31st, 1912, according to the annual report of City Auditor Richardson, submitted to the council at its last meeting. The report shows the city has assets valued at $15,982,205, the assets in cash totalling $642,095. There was a net deficit of $10,033, due to over expenditures. There is $2,021,162 in unexpended debenture funds on hand, against which there is an allowance of $600,000 for the city's share of street-paving and sewer construction. Debentures authorized and unsold amount to $1,267,260. The principal surpluses for the year are given as follows: Electric light and power, $85,656.75; power house, $13,311.60; telephone department, $4,324.63 The deficits, largely as the result of over-expenditures for construction and betterment, are: Street railway, $32,549; water department, $3,064; stores and works department, $8,618.