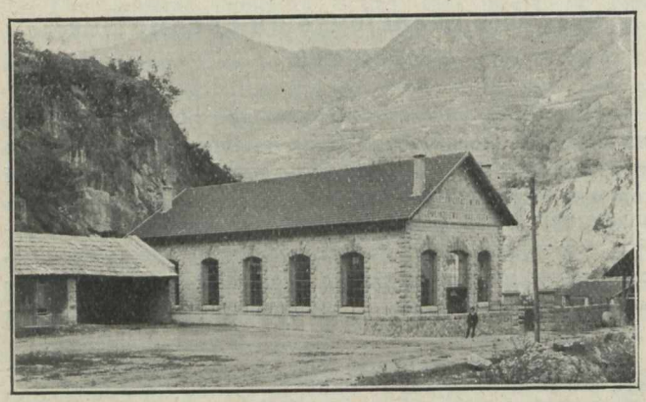
AN IMPORTANT POWER TRANSMISSION DEVELOPMENT IN AUSTRIA-HUNGARY.

By Frank C. Perkins.

One of the most interesting power plants in Austria-Hungary is the hydro-electric plant at Zwolfmalgreien in Tirol, which has a total capacity of 2,000 horse-power. This three-phase power and lighting installation was constructed by the Maschinenfabrik Oerlikon, of Oerlikon, near Zurick, Switzerland, the turbines being of the Leffel wheel type of Rasch design. The hydraulic work and cranes were installed by the Maschinenfabrik J. Ig. Rasch, of Dornbirn, Vorarlberg.

The current is transmitted by overhead and underground transmission lines, for both light and power from the Zwolfymalgreien Station to Bozen and Gries, at a pressure of 3,600 volts. The two overhead transmission lines each consists of three bare copper conductors 7 mm. in diameter, one group being utilized for the lighting current, and the other for the power current. The overhead lines are carried on wooden poles 15 meters in length, and 18 to 28 cm. in diameter at the top, the poles being placed 1.6 to 1.8 meters in the ground. The transmission line is installed along the



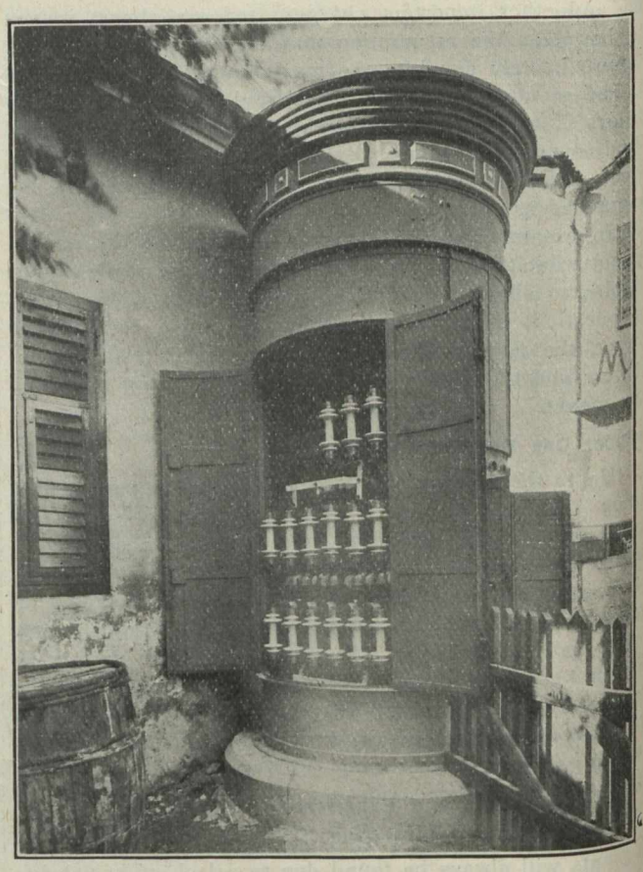
Power Station, Zwolfmalgreien.

left bank of the Eggenthalerbach, as far as Gansnerhof, where a high tension transformer tower is located, the line then crosses the stream passing along the right bank to Eisack, where a terminal tower is located. This tower contains the necessary connections and lighting arrestors for the junction of the overhead wires with the underground cables. The total length of the overhead lines is 800 meters, the weight of copper used being 1,700 kilograms, while the total length of the underground cable employed is 10090.2 meters, of which 5080.1 is a three conductor cable of 25 square millimeters section, and the remainder, which has a section of 15 square millimeters of copper for each of the three conductors is 1721.7 meters in length. These cables are insulated with paper, lead covered and iron armoured and are laid 700 mm. below the surface. The terminal tower is 6.75 meters high, of rectangular section 1.9 meters, the cement walls being 350 mm. in thickness, to various transformer houses in Bozen and Gries, where the current is transformed to lower voltages for the overhead distribution circuits.

On account of the necessity of providing drinking water for these towns, it was thought best to combine the water system with the power transmission plant, water for both being obtained from the same source.

The necessary water for the hydro-electric station is obtained from the Eggenthalerbach, which is reinforced by the waters of the Zangenbach and Welschnofenbach, and empties into the Eisack at Kardoun. The water supply for the electric station consists of 1,000 liters per second, the dam being located at a distance of 3.375 km. from the power house. The dam is 60 meters in length and 4.5 meters thick, and lies 516.1 meters above the sea level. The water is carried by means of a canal, 100 mm. wide and 2,500 mm. high, a distance of 3403.27 meters to the Wasserschloss, which is located on the side of the mountain above the power house, 511 meters above the sea level. At this point a steel pipe 416.4 meters in length conveys the water down to the power house, the net fall being 208 meters. This pipe is 5 mm. thick near the upper part, and 15 mm. thick near the power station, the diameter of the pipe being 900 mm., and it is constructed of 6 meter lengths, wrought iron being employed at the joints near the top and cast steel near the power house. The maximum discharge is 1.42 meters per second or the equivalent of 2,000 horse-power. The power station is located near Kardoun on the left bank of the Eggenthalerbach, about 700 meters from where the latter empties into the Eisack. The station has a floor area of 374.5 square meters, of which the turbine and generator room occupies 275 square meters, the switchboard room 35.4 square meters, and the workshop 29.55 square meters.

In the turbine and generator room are installed five units having a total output of 2,500 horse-power, an overhead travelling crane of 7.5 tons capacity being provided for handling the heavy parts in mounting and repairs. Four of the turbine sets are in use, the fifth being held in reserve in case of emergency. The station is lighted by a number of incandescent lamps, and three arc lamps in series using a current of 15 amperes.



Low Tension Side of Transformer House.

The turbines each develop 500 horse-power under a head of 208 meters, and use 226 liters of water per second. They operate at a speed of 500 revolutions per minute, and are direct connected to Oerlikon three-phase alternators, supplying currents of a frequency of 50 periods per second, and 36,000 volts with cos=.8. The turbines have an efficiency of 80 per cent., and the governors control of the speed within 3 per cent. at 50 per cent. change of load, and 6 per cent. at 100 per cent. change of load. Each set is provided with a flywheel weighing 3,250 pounds, measuring 1,450 mm. in diameter, and the turbines and generators are connected by means of flexible insulating couplings.

The bore of the armature of the three-phase generators is 1,400 mm., and the armature has 72 slots, with two slots per pole per phase and two sets of 18 coils. Each coil has 17 turns of two copper conductors having a section 4 mm. x 4.6 mm. The diameter of the field magnet is 1,390 mm. giving an air gap of 5 mm. on either side. The twelve field exciting coils have each 40 turns of copper strip 3 mm. x 33 mm., the insulation being .5 mm. in thickness between the strips. The exciters supply a current of 200 amperes each, and are supplied with twelve carbon brushes, measuring 24 mm. by 16 mm. The exciter for each alternator is mounted on the same shaft with the revolving field outside of the