The tunnel terminates in a forebay formed in the cliff by excavation and heavy masonry walls, provided with an adjustable weir and spill, and with separate screens and sluice gates to each penstock. The penstocks—five in number, with provision for two more—are 7 ft. diameter, and are fitted with 4 ft. diameter visers below the sluice gates. See Fig 2, in which may be also noticed a light suspension bridge crossing the river at this point.

The generating station is a heavy stone structure, equipped with five units, each of about 1,200 horse-power electrical output, with horizontal shaft, direct connected, at 250 R.P.M. The turbines are double "American" type, built by Piccard Pictet & Co., of Geneva, and are fitted with oil pressure governors, which appear to give good regulation. The generators are by Schneider & Co., of Creusot, 3 phase —the latter being 15,000 volts. Three original units installed in 1901 were formerly wound to 26,000 volts, and intended to operate directly on the line without transformers; but these were found unsatisfactory, hence were rebuilt for 15,000 volts. The transformers are 15,000 to 26,000 volts, air cooled. The interior of the station is shown in Fig. 3.

The transmission line is interesting from the fact that the portion nearer to Grenoble is used jointly by this and another company (Champ Station, described below). The line from Avignonet to Grenoble consists of three circuits carried on iron poles. The towers for the joint transmission line shown on the right hand of Fig 4, are about 40 ft. high above ground, and carry six cicuits of 26,000 volts. These towers are set 6 ft. in the ground in concrete, the cross arms are wood, 10 ft. long, set in an iron framework, and each tower costs, complete, $100. At the junction with the second company, about 8 miles above Grenoble, a special structure (Fig. 4) is erected, and similar ones are also used in the city. Each company has its respective side and interconnecting and sectional switches. The two companies work in harmony, one using the other's wires at times for repair on the other side of the tower.

The snow seen in the accompanying pictures, while common, is unusual to such an extent in this locality. There is no trouble from floating or frazil ice, however, in any of the power plants in the vicinity of Grenoble.

Champ Station, Drac River.

The Champ Station is situated near a village of the same name, and is about 8 miles above Grenoble, at the junction of the Romanche River. It is owned and operated by the Fure and Morge Co., of Grenoble, and under normal conditions of river has an output of about 6,000 horse-power, which is used for miscellaneous factory power in and near Grenoble. There are upwards of 70 works now connected through about 15 receiving stations. It was first operated in 1902.

The general scheme is quite different from the plant at Avignonet, owing to the nature of the river at this point, which is shallow and flows through a gravel bottom in a wide valley. The intake works are situated about 3 miles up stream and the water is conveyed to the generating station by means of a flume laid underground; the station stands in the flat bed of the valley and the water is discharged through a short canal into the river channel near by.

The intake consists of a submerged dam at right angles to the stream, terminating near the shore, in an intake set parallel to the stream, consisting of submerged arches provided with gratings and sluices. Special precautions were required in this respect to prevent entrance of debris, gravel and stones, of which the river carries considerable. Behind the intake is a headbay 1,900 feet long, acting as a settling basin and provided with over-flows having adjustable crests. At the end is a bell-mouthed entrance to the flume, fitted with a gate having an air inlet behind.

This flume is a most interesting work, about 14,000 feet long, 10 ft. 8 in. interior diameter, laid on a grade to conform to the slope of the river, partly in trench cut, and then filled over with gravel and earth. Its carrying capacity is figured at about 800 cubic ft. per second at a speed of 10 ft. per second. The upper 6,000 ft. being under light pressure,is of concrete reinforced with steel rods. The girth rods, a few inches apart, vary from ½ to 1 in. diameter, and the longitudinal ones from ¼ to ½ in. The whole thickness of shell varies from about ⅞ to 1¼ in. The remainder of the flume is of steel plate from ⅜ to ⅝ in. thick, and the structure throughout rests on a concrete foundation about 12 in. thick. There are three air shafts or visers carried above the head level about 4 ft. diameter along the length to provide against entrained air or collapse when emptying. The most interesting feature of this flume is the terminal air shaft at the generating station, which consists of a vertical prolongation of the steel flume after the penstocks are taken off leading to the turbines. The vertical shaft converges from the 10 ft. diameter to about 5 ft. at the top, a total height above tail water of about 140 ft. The top terminates in an open chamber drained by three down pipes 18-in. diameter leading to outlets in the tail race. The water stands up to about 116 ft. above tail level when the plant is not operating, but when running full load this becomes 100 ft., which is the working head, the difference being friction and entry losses

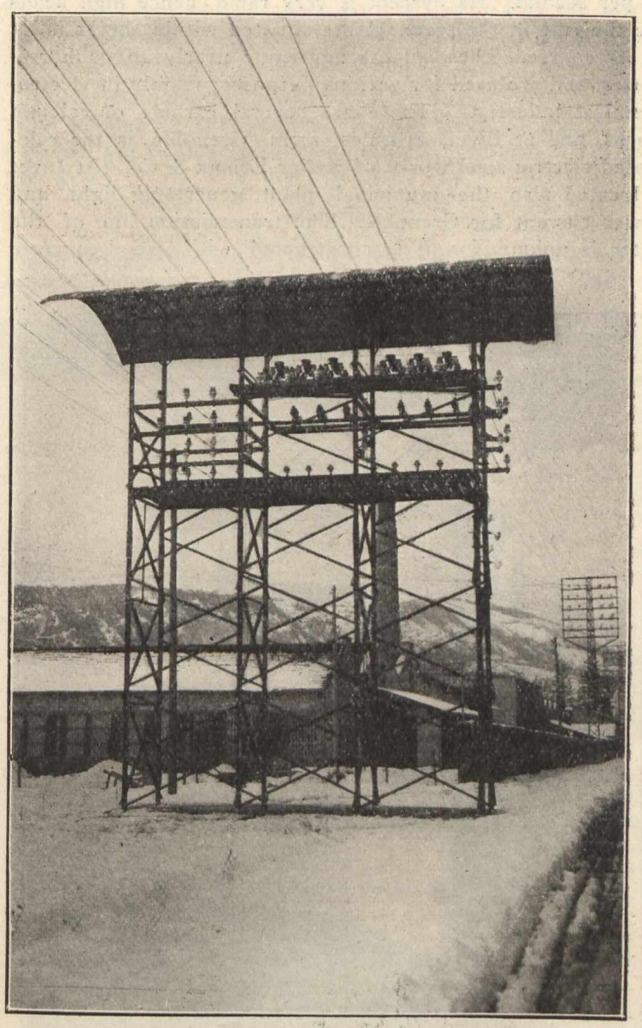

Fig. 4.—Junction Tower, Transmission Line.

Referring to Fig. 5, showing the stand pipe relief, a scaffold for repairs will be seen. It may be interesting to note that about three weeks before the winter's visit on February 13th, 1906, the upper part of the pipe collapsed from a singular cause. A few days of cold weather caused ice to form near the top with the water at a high level. Subsequently, when the water lowered suddenly, a vacuum was formed resulting in the crushing of the thin steel shell for about 20 ft. from the top. While this accident might happen in Canada, it is considered as a very unusual occurrence here.

The turbines, five in number are supplied by short horizontal penstocks connecting with the main flume, fitted with butterfly valves. They were built by Neyret-Brenier & Co., Grenoble, and are single wheels on horizontal shafts with cylinder gates, operating at 300 R.P.M. giving 1,500 horse-power. Though several wheels are fitted with simple governors they are regulated by hand, and appear to be fairly