bubbling spring is called Source de l''Orbe—and thence down to Lake Neuchatel the river flows through a deep and beautifully wooded valley, sufficiently picturesque with its cascades and waterfalls, to attract thousands of summer visitors. This is now one of the tourist points on the new Paris-Simplon-Milan line.

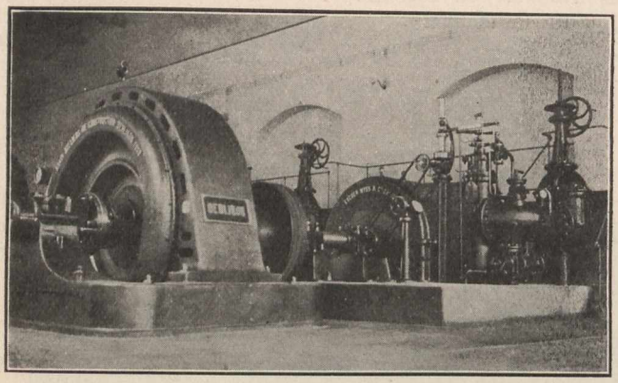

Fig. 6.—Vallorbe: 1,000 H. P. Power Unit.

In the autumn of 1901 the "Compagnie Vandoise des forces motrices des lacs de Joux et de l'Orbe" was formed to develop, generate and distribute electrical energy in the Canton and, as the first of their enterprises, commenced in 1902 the construction of a hydro-electric plant near the "source" called the La Dernier station. This station and its local distributing system were put into operation in 1904, and was soon followed by a second plant, 10 miles lower down on the river, at the city of Orbe, the latter called the Montcherand station. These two plants when entirely completed will deliver for sale about 11,000 H.P., which they consider will be a minimum continuous output. The region in which this is sold is quite large and may be said to comprise all that south-western portion of Switzerland lying between Lakes Geneva and Neuchatel (excluding Geneva and district).

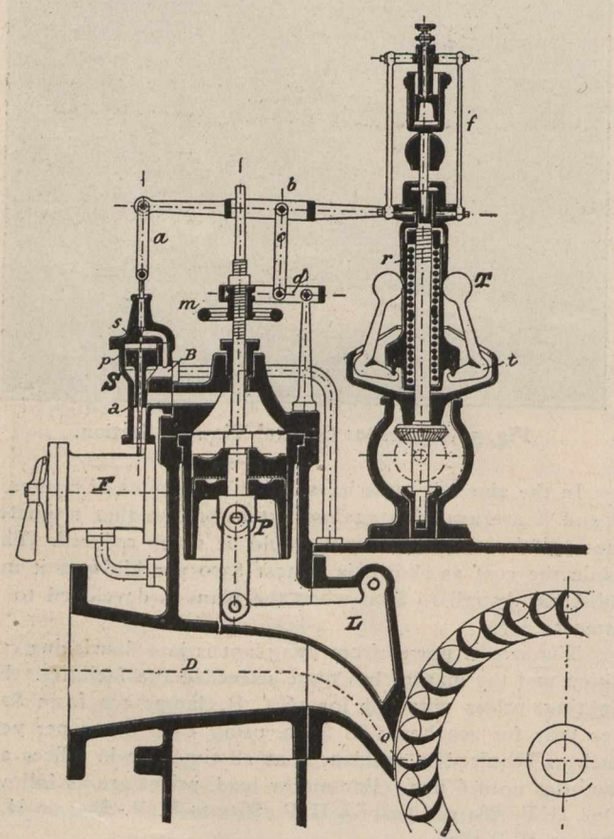

Fig. 7.—Vallorbe: Section Through Hydraulic Governor.

The Vallorbe plant has been in operation since 1904 with five units: space and connections are arranged, however, for three more, while ultimate extensions will provide for a total of about 12 units if sufficient water can be secured. The present output of this plant is 5,000 H.P.

Hydraulically this development is most remarkable, owing to the nature of the water supply. Lakes de Joux and Brenet have six and seven surface outlets respectively, but the main discharge is the subterranean river which forms the Orbe. In order to get sufficient water then, all the small surface outlets were dammed, and the lakes were formed into a huge reservoir in which the concessions permitted the fluctuation of the level within limits of 12'-0", artificially controlled. At certain periods of the year these lakes have regularly risen a number of feet, according to a law determined by observations extending over many years. This increase is now partially secured by the new works, and is held up for power purposes. The subterranean flow, however, still proceeds. Hence the development presents the unique feature of being dependent entirely on storage water or such as can be stolen from the natural outlet. Probably when some ingenious Swiss engineer obtains a means of plugging the outlets in the bed of the lake, or can find and tunnel into the subterranean rivers and dam them, the present plant will be developed to much larger proportions.

The water taken at the intake in the lake, after passing racks and gates, is carried by means of a rectangular concrete lined tunnel to a point on the lower hillside, where a forebay and head house are located. The tunnel conduit is 6'6" wide, 7'-0" high and about 8,700'-0" long on a slope of 3%.

In Fig. No. 5 the forebay works can be seen high up the mountain side. Water issuing from the tunnel first passes a course rack, enters a chamber having an overflow weir with

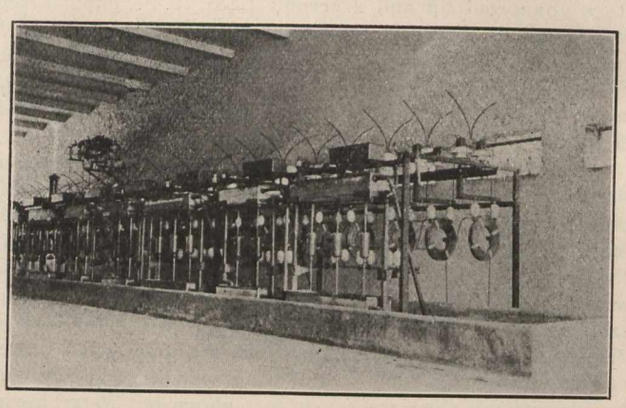

Fig. 8.—Vallorbe: Water Resistance Lightning Arrester.

adjustable crest, then passes through a fine rack and enters a second chamber at right angles to the line of flow, thence passing head gates, enters the penstocks. Overflow water spills into a large chamber from which steel pipes carry it down the slope. In the illustration the latter, two in number, are on the left, and the single penstock leads toward the right, passing into the rear of the station parallel with the long axis. The penstock varies in diameter from 48" at the top to 40" at the station, the respective thicknesses of plates being 5-16" and 13-16", while the distributor portion within the building is 1". The total length of penstock is about 2,000'-0", with a maximum slope of 77%; it is carried on concrete piers with heavy anchorages and there are four expansion joints.

The two spill pipes are about 2,400'-0" long, about 3'-0" diameter, 7-16" plate, and with rivets counter sunk on inside. These have several expansion joints and automatic air entry valves. They discharge water into the river below the power house.

In a plain concrete building are now installed five 1,000 H.P. units and two exciters operating under a head of 770'-0". These units (see Fig. 6) are contained in a room 160'-0" long and 40'-0" wide, while in a central wing are located the busses, switches, switchboards and arresters.

The water wheels are by Escher Wyss & Co., and are very similar to the 500 H.P. units in the Kubel plant, having single nozzles with one runner. A feature of this wheel is its automatic hydraulic regulator, an illustration of which is given (Fig. 7) showing governor and link connection. In plants of this pressure, European builders are using filtered water from the penstock instead of oil as the medium. This involves a mechanical filter on the governor to insure clean