fully studied. The whole mass, consisting of some 25,000 cubic yards of material, was made of concrete, laid in cement, in order to minimize shrinkage; and the laying of concrete was not unduly hurried. In addition, an envelope of three thicknesses of tarred felt was interposed in the concrete forming the waterway at a distance of 12 inches back from the entire wetted surface. Except a few minor

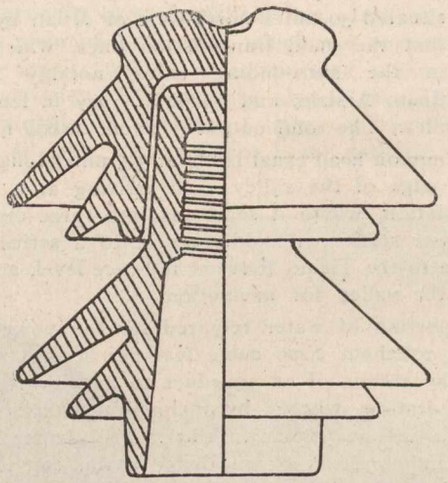

Fig. 5.—Paderno: Standard Line Insulator.

cracks, hard to detect by the eye, this work appears to be perfectly sound and tight. Fig. 6, side elevation of the aqueduct, shows the general character of the structure, and is from a photograph taken by the writer at the only point where a crack was plainly visible, as may be noticed by the traces of plaster caulking above the crown of the arch;

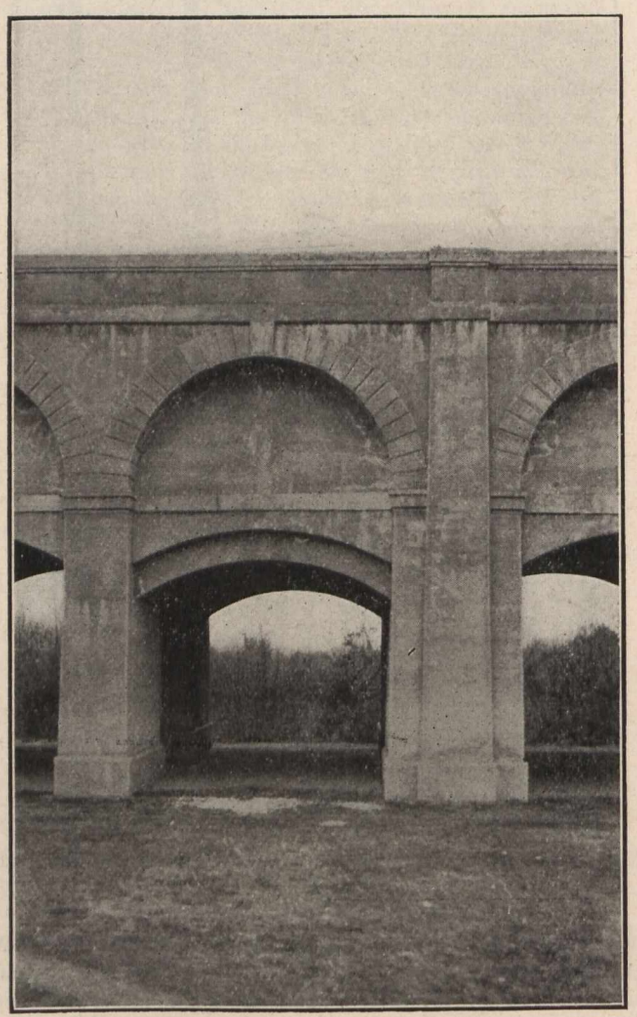

Fig. 6.—Vizzola: Side Elevation of Aqeduct.

this, too, was on a cold February day (1906), with the thermometer at freezing point.

The forebay structure is of the same character and general design as the aqueduct, having on the one side the screen and gate-house, over the entrances to the penstocks, and on the other, an over-flow regulating weir, permitting spill of surplus water into a basin, which in turn discharges into the lower river level alongside the three canal locks above referred to. This is shown in Fig. 7, the generating station being on the opposite side of the gate-house, below the hill. The over-flow weir is 300 feet long, and, at a lower level, are also three sluice-gates for additional discharge. Twelve bays, each with a submerged arch opening, protected by screens, and capable of being closed by vertical sluice-gates, operated by either electrical or hand power, lead to the twelve penstocks. Ten penstocks for power units are 6 feet, 6 inches in diameter; and two for the exciter units are 3 feet; all are 150 feet long to inside of station wall.

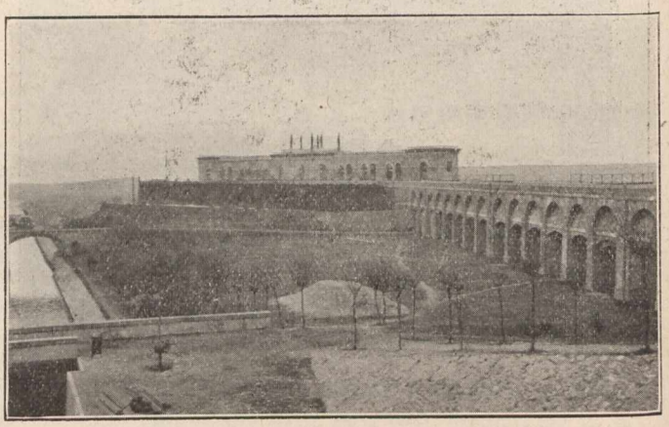

Fig. 7.—Vizzola: Aqueduct, Receiving Basin and Gate-house.

The generating station (see Fig. 8) is a massive but plain building of concrete and stone, and the tail-race (on the right) excavated along its front leads to the low-level navigation canal. The power installation consists of ten 2,100 H.P. turbines, connected directly with horizontal shafts to 1,500 kw. alternators, together with two separately driven exciters. Under high and low conditions of river, the working head varies from 80 to 94 feet, respectively; with the normal at 92 feet. Of the 10 turbines, 8 are built by Riva, Monneret & Co., of Milan, and 2 by Voith, of Heidenheim, Germany. Both types are similar, with double runners and distributors, actuated by balanced gate-rings connected to swivel gates. The governors are water pressure type. The generators are by Schuckert, of Nurem-

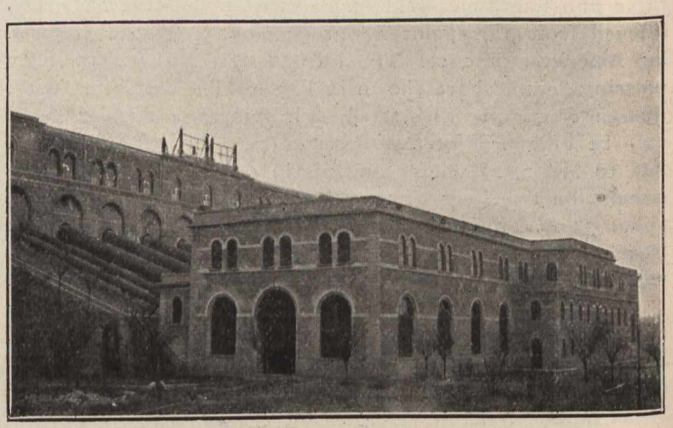

Fig. 8.—Vizzola: Generating Station.

burg, revolving field, three-phase, at 187 r.p.m., wound to 11,000 volts at 50 cycles; they work directly on the lines without step-up transformers.

Each large centre of distribution has its own separate transmission line from the generating station, which, while expensive, has proved most satisfactory in convenience of operation, continuity and safety. Lighting current lines are also separate from the power lines. Nearly all the main lines have steel towers, with triple porcelain insulators.

The prices obtained by this company in the widely separated centres of consumption are based on a flat rate, and on a 24-hour day, average about $31 per H.P. year, with a minimum of $23 and a maximum of $44, depending on distance. The price of coal is about the same as in the city of Milan.