trance, shown in foreground of Fig. No. 1. The screens are parallel to the canal, 110'-0" long on the face and in 8'-0" minimum depth of water, with 1" spaces. Water, after passing through the screens, is controlled by 2 sluices in each bay, and flows into a pit 18'-0" deep, from which the penstock carries it to the station. Surplus water passes automatically over the weir and down a spillway consisting of a flight of six gigantic steps, leading to the tail races, see on left of Fig. 2, which shows exterior of station.

The penstocks, 6'-6" diameter, pass down to the power house on a slope of about 30 degrees, leading

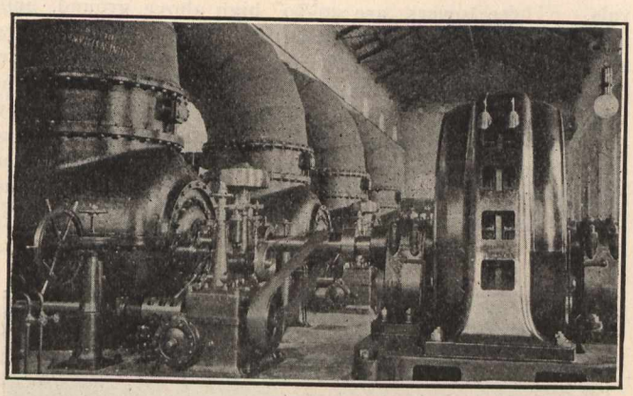

Fig. 4.—Vigevano, Hydraulic Unit with Governor.

through the rear wall above the turbines, and turn down vertically to the tops of the wheel cases. Special provision is made against expansion thrust by placing large abutments outside the wall in which to anchor the pipes. After passing through the turbines, the water is carried through tail pits consisting of arched races in the foundations; it is to be noted that here, as everywhere in European plants, provision is made for closing off each pit from the main tail race for repairs, so that each may be isolated.

As a generating station, the arrangement at this plant is ideal, and, upon entering, the visitor is impressed with the convenient and roomy arrangement. (See Fig. 3.) The turbine and generator units, five in number, are arranged abreast in a long hall, the two exciter units being at one end. At the same end is the switchboard, mounted on, and under, a floor, which is 6'-0" above the main floor; the whole hall is about 340'-00" x 40'-0". Alongside the gallery is an enlarged wing, shown on the right of Fig. 2, containing all switching and transforming apparatus, the arrangement of which in convenient sequence, roomy spacing and isolation is very clever. In the introduction of these features the European practice in design within the past two years is quite marked.

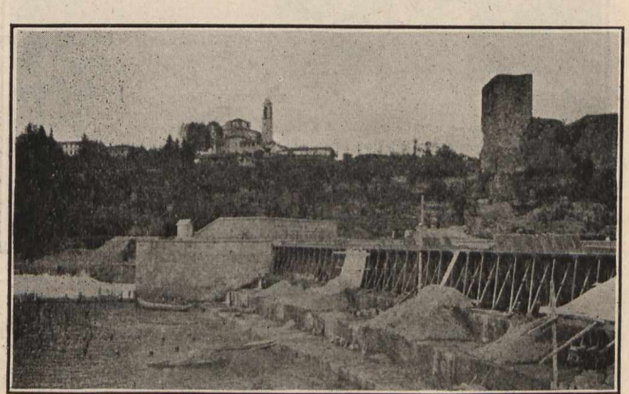

Fig. 5.—Trezzo, Dam with Collapsible Crest.

The turbines are by Riva Monneret & Company, Milan, four units being installed at the time of the writer's visit on February 6th, 1906, and one being still in the shops. The type is horizontal shaft double Francis inward discharge, into a draft chest: the cases are exposed and form the termination of the penstocks. See Fig. 4 for details. Each turbine unit works under a head of 61'-0", developing 1,400 H.P., using 270 cubic ft. of water per second. The governors are of a special oil type, recently perfected by the turbine makers, sensitive and very powerful for their size; the writer looked at the governors, especially to discover periodic hunting while the station was running in parallel with a steam plant at Milan, but could see no injurious irregularities. The generators by Gadda & Company, Milan, are directly connected, 3-phase, wound to 2,750 volts at 42 cycles.

Switch gear is fitted with table type instruments and distant control apparatus, so that the operators can at once see both instruments and machines. Current is stepped up to 25,000 volts and the transmission lines, comprising two circuits of 7MM. wires are carried in steel towers spaced 350'-0" apart.

The power from this station is used in outlying towns to the north and west of Milan, as well as in the city, and the loads and prices are about the same as those indicated in the previous paper, in the same locality.

Trezzo On the Adda.

The Trezzo plant, used in conjunction with the Paderno station, introduces entirely new features in the Milan hydraulic types. The Adda River at this point (5 miles below Paderno) makes a horseshoe bend around a rocky hill and at the same time has a rapid fall. The power project consisted of damming the river at the crown of the bend, and placing a power house alongside the rock cliff, discharging the water from the tail races through tunnels, under the hill, to the river below. The low head thus obtained only 24'-0", required vertical shaft type of units, with low speeds and a corresponding large volume of water, with many units.

The construction of the dam was a very delicate operation, owing to the rise, and peculiar violence of the river

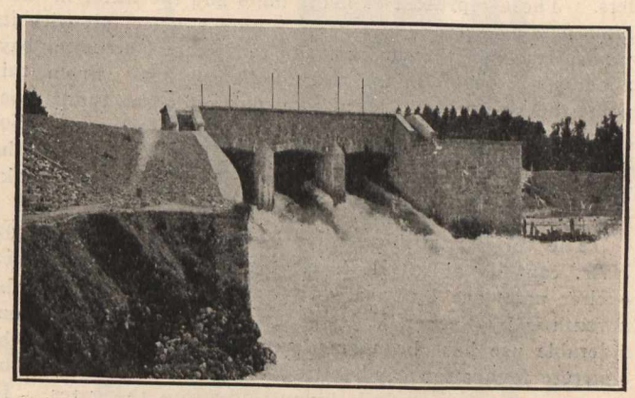

Fig. 6.—Trezzo, Spillway Sluices.

after rains in the mountains, 30 miles distant. The foundations of the whole structure are of concrete, laid on the rock river bed, and, in the main portion, consist of large terraced courses of monolithic concrete, over which the water can discharge in high seasons. The upper part of this work consists of an adjustable crest formed by structural steel bents, provided with removable wooden sheeting and planking capable of raising the water to an elevation about 10'-0" higher than the permanent concrete crest, thus forming a huge flash board system.

This is shown in Fig. 5, from a photo taken on the writer's visit, May 24th—after the plant had been running about six weeks. At the opposite (down stream) end of the dam, a set of three spillway sluices is located (see Fig. 6), having vertical sliding gates operated by hand, permitting water to pass beneath; about 2,000 cubic feet per second was passing through at the time the photo was taken. In the foreground will be noticed a cave-in of the rip-rap retaining wall. While not discernible in the illustration, it is interesting to note that repairs to this were under way by means of a new system, recently introduced in France, of making bags or cylindrical nets of galvanized iron wire fence netting, filling these with stones and small boulders, and rolling or placing them in a suitable position to form a new wall.

Against the high cliff of the river, in the horseshoe, the power house was constructed, having its face parallel to the river flow opposite, yet almost square against the