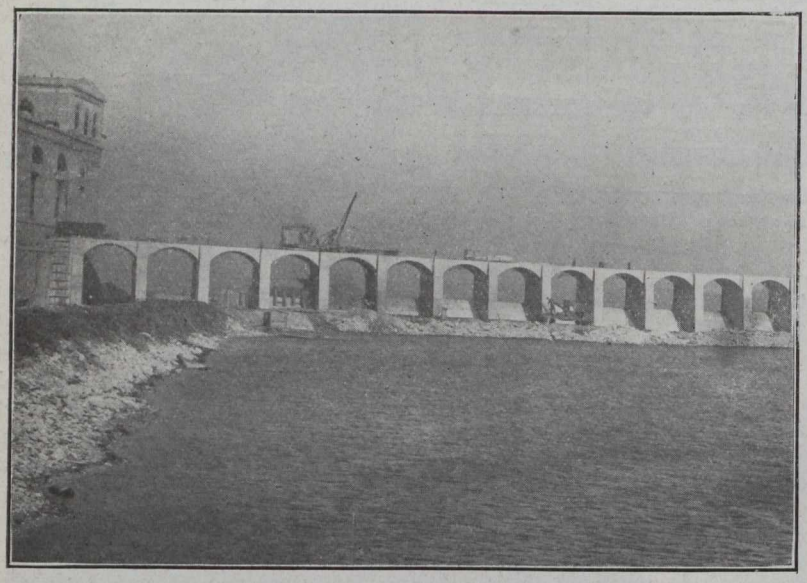
forms were hinged and arranged to be removed after the concrete set without wedges, blocking, or shores. The mixing plant was placed to deliver in the axis of the dam at the eastern end. Three standard gauge railroad tracks on top of the dam carried the concrete from the mixers in one and a half-yard buckets to the forms at the end of the dam in



Junction of the Dam and the Power House, Showing Some Spillways on Top of which go the Steel Gates.

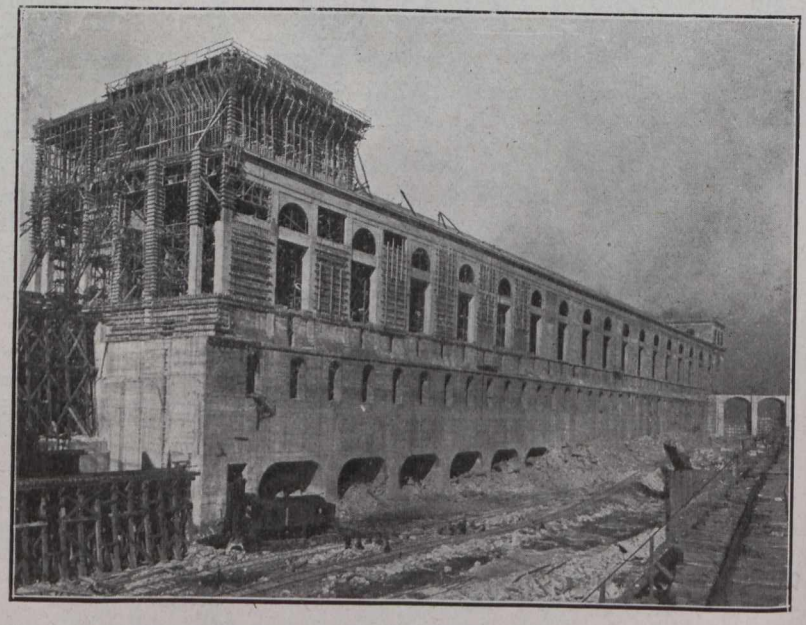
process of construction. There was a cantilever traveler with its cantilever arm 150 feet long extending out over the forms, which picked up the buckets from the cars and dumped them in place. This cantilever traveling crane had a main frame 25 feet by 90 feet, mounted on six heavy steel wheels which ran on a track of 25-foot gauge and 100-pound rails, spanning the three tracks used for hauling the concrete. This cantilever traveler, after its work on this dam was done, was sold to a Canadian company for use on the St. Lawrence.

The spillways were built with side dump cars pouring the concrete into conveyers which carried to the forms below, after the main structure of the dam was completed. Temperature variation of volume inducing cracking was provided against by strips of tar paper inserted in every pier and arch.

The power house is set near the Iowa shore almost parallel with the river, with the forebay between it and the Iowa bank, a curve in the river increasing the width of the upper end of the forebay. The substructure, 132 feet 10 inches by 1,718 feet and 70 feet high, was set about 25 feet into the river bottom, the tail race being excavated to the same depth on the eastern side of the power house. It is monolithic concrete in continuation of the dam at one end and the lock and other adjuncts at the other end. It was cast in wooden forms, an area of about thirty-five acres being unwatered in the river for the construction plant there. It contains thirty power units and four exciter-auxiliary units. Gantry cranes were used as concrete conveyers from the trains to the forms. Each turbine is placed in a scroll case 22 feet high and 39 feet in diameter, entered through four intakes so curved and choked as to deliver the water to the turbine runner with equal velocities at every point on the circumference of the wheel. The draft tube of each unit is circular, 18 feet in diameter at the top, and curves down into the tail-race, the lower end being an opening in the superstructure, two semicircles with tangent top and bottom, 22 feet 8 inches in vertical diameter and 40 feet 2 inches in horizontal width. The bottom of the draft tube is at the bottom of the tail race about 25 feet below the river bed. The water velocity at the upper end of the draft tube will be 14 feet per second, and at the exit 4 feet per second.

The turbine here presented the problem of a head of 32 feet with large volume of water and low rotation. As finally worked out, the answer is a turbine of original design, Francis type, of 57.7 r.p.m., efficiency of 86 per cent. by Holyoke test, and a little over 10,000 h.p. on the shaft. The runner has twenty buckets and weighs about 130,000 pounds, is 16 feet 6 inches in diameter and 11 feet 3 inches high. The shaft, with the turbine below and the revolving field of the generator above, is 25 inches in diameter. The weight is supported on one thrust bearing set high in the turbine pit, out of the water, and easily accessible, the top of a cone resting on the foundation ring of the pit liner. The latter is a steel cylinder imbedded in the concrete with rings at top and bottom weighing 100,000 pounds each. The weight on the thrust bearing is 550,000 pounds, and the lubrication is by forced oil with immersed roller bearing in reserve. It is believed that this installation has high dependability as well as satisfactory efficiency. The guide vanes of the regulator are connected to the compression cylinder by levers, rocker rings and cranks. Strainers are placed on buttresses projecting between intakes in front of which an arch for each unit marks the forebay side of the power house substructure.

The architecture of the superstructure is adapted to the electric machinery content, and the walls are of reinforced concrete and the roof trussed. The superstructure from gen-



The Lower Side of Part of the Power House, Showing Parts of Lower Ends of Draft Tubes with Exits into the Tail Race Excavated into the Bottom of the Mississippi.

erator floor to roof pinnacle is 107 feet 6 inches, making the total height of the power house 177 feet 6 inches from bottom of draft tubes to pinnacle.

The generators are rated at 9,000 k.v.a., 11,000 volts, three-phase, 25-cycle, with a full load efficiency of 96.3 per cent. and a regulation of 13 per cent. at unity power factor. Each armature is 30 feet 9 inches in diameter, and each gen-