rotary converter set of the same power, to act as a stand-by.

A single jet was chosen as the most suitable for the turbines, on account of the greater simplicity of the inlet pipes. Its diameter is about 3 inches, and it has a spouting velocity from the nozzle of 450 feet per second. It is evident that even the very best materials can only resist such a jet as this, if the latter impinges on the buckets without shock, and is deflected by them in a perfectly smooth and steady curve. Very special care was therefore

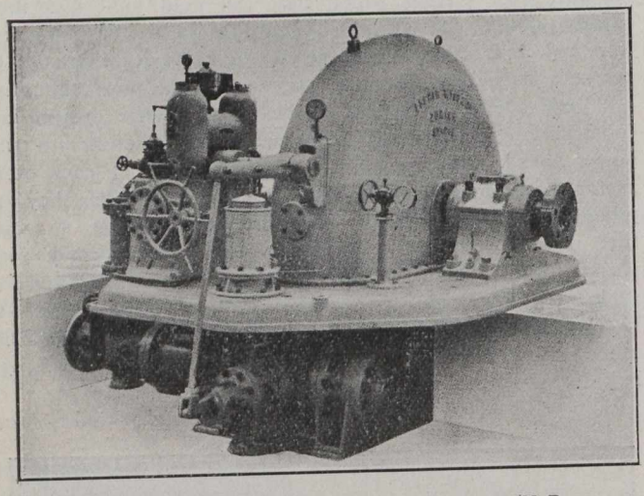

Fig. 3.—Generating Turbines of 6,500 H.P

necessary to safeguard the parts against rapid wear and to ensure a high efficiency. The question of regulation had also to receive close attention, so that no great rise of pressure should occur, on sudden variations of generator load, in a pipe line which was already highly stressed under normal conditions, and that there should at the same time be no waste of water to prejudice the yearly output of the station. It would have been an easy matter with this high fall to have built a wheel having a large number of revolutions and thus small dimensions and light weight. But the necessity in the case of providing for minimum wear and

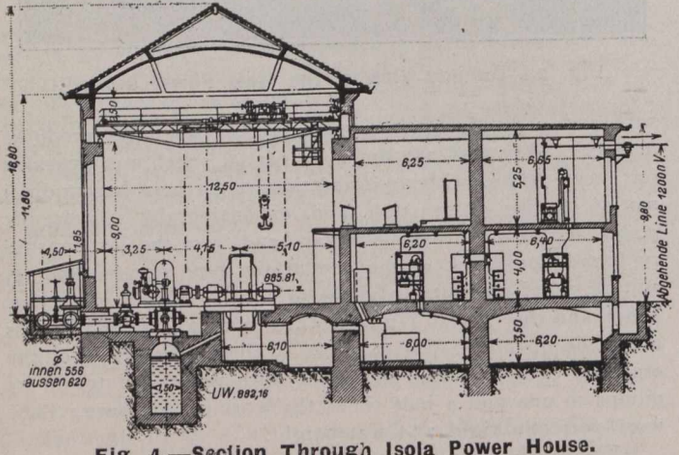

Fig. 4.—Section Through Isola Power House.

maximum efficiency required a wheel of large size; thus the comparatively slow speed of 420 revolutions per minute was selected. The runner has therefore an outside diameter of about 10 feet.

In order to obtain a large flywheel effect for the unit and therefore small moving velocities of the regulating mechanism, the turbine runner itself was built as a flywheel with a heavy rim. Although a rather longer time of closing is thus possible (5 to 6 seconds), yet this would be much too short to prevent serious rises of pressure in the pipe line, and another device has, therefore, to be provided, by which pipe line pressure oscillations could be avoided with certainty.

It was therefore determined to use a "deflecting nozzle" for the additional regulation required for the turbines of the Isola station, and this device will now be described. The supply of water flows from the distributing pipe to the turbine through a pipe of fourteen inches internal diameter, to which is connected a hydraulically operated sluice valve of specially heavy construction. The water then passes through a bend to a needle nozzle of circular cross section, from which it emerges as a cylindrical jet on the wheel.

A pear shaped needle which is movable along the axis of the nozzle regulates, in the usual manner, the area of the opening and the quantity of the water required for the load on the turbine. The whole inlet bend carrying the needle nozzle is movable about the axis of the inlet pipe, in which it is pivoted and jointed with double leather packing rings. By swinging this nozzle in the vertical plane, it is possible

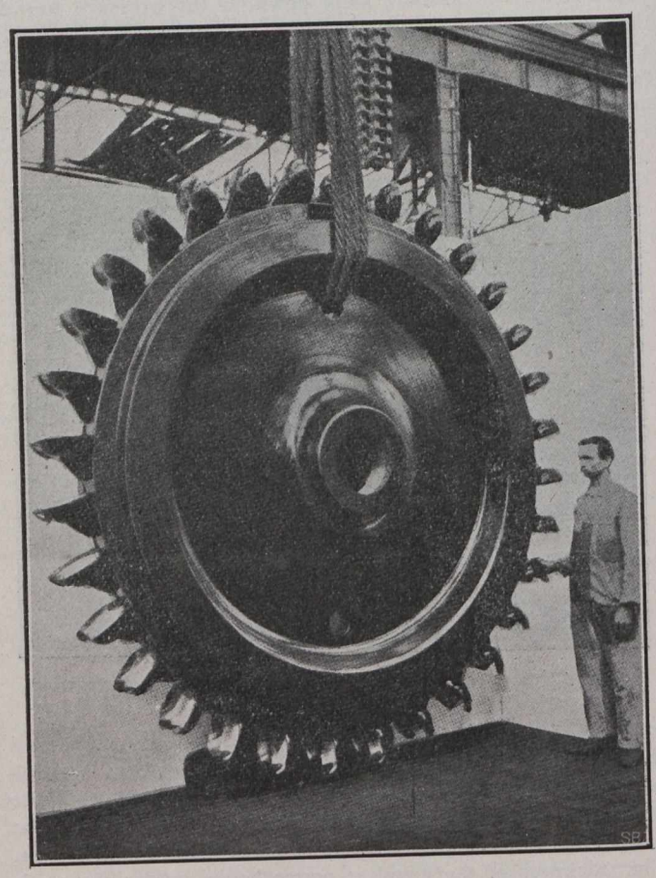

Fig. 5.— Runner of 6,500 H.P. Turbine.

to adjust the direction of the jet, so that it hits the buckets correctly at one end of its swing, but at the other misses the wheel entirely and shoots straight down into the tail race. The arrangement is known as a "deflecting nozzle", and it serves the same purpose as the pressure regulators with auxiliary outlets or with jet deflector, but has a considerable advantage over these in respect of durability of parts.

This patented deflecting nozzle, which is Zodel's design, is connected with the automatic governor in such a way that it swings out immediately any considerable reduction of turbine load occurs, without altering the setting of the needle and therefore without causing any shocks in the pipes.