## TEN THOUSAND HORSE-POWER HIGH-PRESSURE TURBINES FOR THE BIASCHINA ELECTRIC POWER STATION.

The Biaschina electric power station near Bodio, Northern Italy, built by the A. G. Motor, utilizes the water of the River Tessin, with its tributaries, with a total head, between the Gotthard Railway stations of Lavorgo and Bodio, of 840 feet.

The water intake is located 500 feet down the valley from Lavorgo Station, on the right bank of the River Tessin, where the water is diverted by means of an overflow weir, built slantingly across the river. The water is then conducted to a special filtration reservoir, where it is cleared of any deposits of sand or other impurities; from here a closed canal of about 5½ miles length takes the water to the forebay, from which the water is led to the four turbines, each consuming at a head of 840 feet about 138 c.f.s.

The upper portion of the feeder conduit is in the form of a pressure tunnel, which at the point where the pressure reaches 260 lbs. per sq. in. is connected up to two separate steel pipe lines of about 67-in., inner diameter.

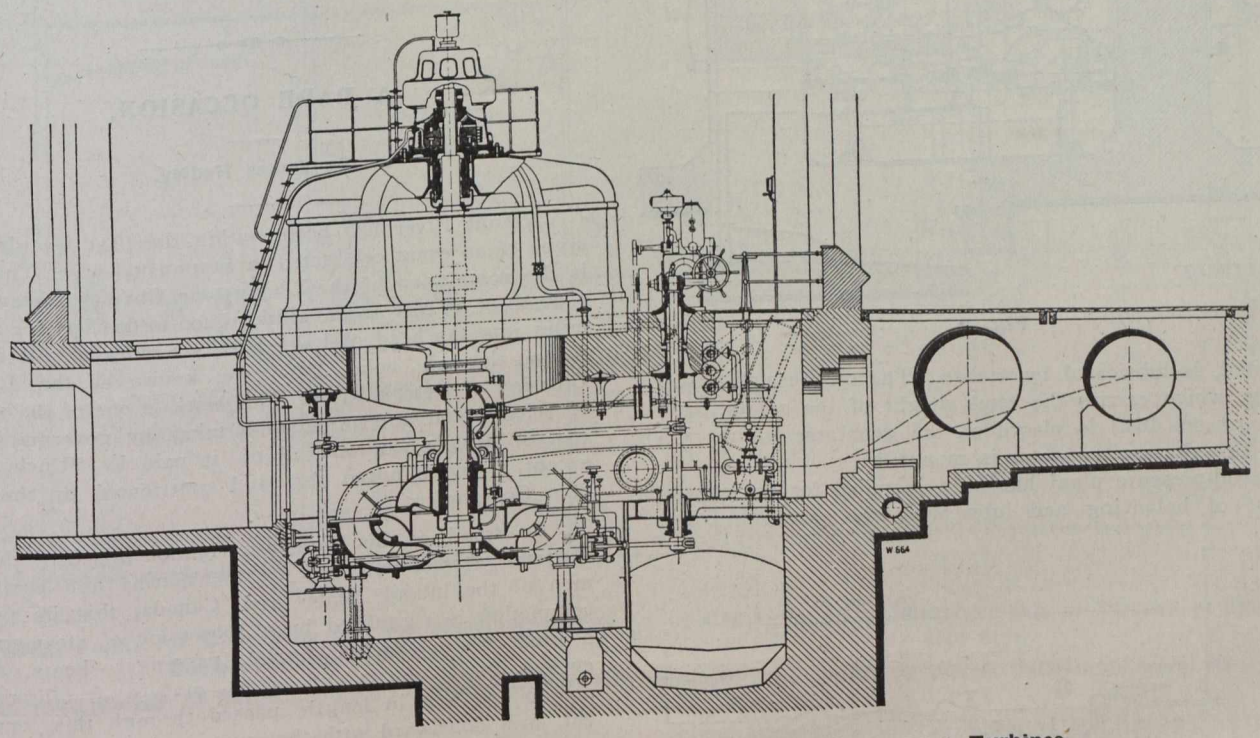

**Fig. 1—Longitudinal Section through 10,000 H.P. High-pressure Turbines.**

Each of the two pipe lines delivers the necessary amount of water required by two high-pressure impulse wheels, each capable of developing an output of 10,000 horse-power when running at 300 revolutions per minute. However, in accordance with the specifications, each of the wheels is designed so as to yield a maximum power, at full opening, of 12,000 horse-power.

For various reasons the vertical shaft arrangement was given the preference over the horizontal type, following recommendations made by Escher Wyss & Co., as similar turbines running on a vertical shaft designed and constructed by the same firm had given great satisfaction. The accompanying cuts show the general design of this type of turbine. The initial installation consists of three units with a total maximum output of 36,000 horse-power.

The two inlet pipes for each turbine are arranged symmetrically to the turbine axis, and are connected to the main pipe lines at an angle of 90°. The hydraulically operated gate-valves of 24-in. diameter are located inside the power-house, near the wall. These valves may be opened or closed from the machine house floor by a hand-wheel controlling an intermediate distributing valve, which directs the pressure water to the servomotor, or pressure cylinder, accordingly. In front of each valve an expansion piece is fitted in order that, in case of repairs, the valve may be quickly and safely removed.

The total power of 12,000 horse-power is developed by only one single runner wheel fitted with double pear-shaped buckets of cast-steel mounted around the circumference of the wheel. The water is discharged under full pressure of 840 feet through four needle nozzles, forming a circular solid jet, which again impinges upon the buckets of the runner. The nozzles from which the water is escaping with a velocity of 220 feet per second are most carefully designed and supported in such a way that the forces originating from the reaction of the water cause least possible vibration.

The governing mechanism for controlling units of this large capacity requires to be designed most carefully in order to safeguard the operation of the machines in cases of sudden changes of load. For this plant Escher Wyss & Co.'s patent Universal oil-pressure governors have been installed. Their oil-pressure pumps and speed pressure and speed pendulum are driven by belts off a transmission shaft situated underneath the power-house floor. The governor is usually operated by pressure oil, but each governor is also provided with a hand-wheel, so that the whole unit may be temporarily controlled by hand. The servomotor of the governor operates the vertical main regulating shaft, which latter, by means of a system of levers and rods, is connected up to the needle nozzles; the regulating needles are consequently controlled directly by the governor. These needles are so designed that they, in any position, are practically balanced, so that the capacity of the governor might be reduced, and also a most even working of same is obtained. The various pins and joints are provided with bearings on both ends, designed for grease lubrication, so that the wear and friction is reduced to a minimum. From the servomotor each nozzle can be adjusted according to the load under which it is to work, and it is also possible, if