THE NEW 2,500 HORSE POWER TURBINES AT NIAGARA.

In our issues of March 6, 1897, and June 18 of this year, we give illustrated descriptions of the celebrated power house at Niagara. In the present issue we show a pair of Greyelin Jonval horizontal axis turbines which have lately been installed at the works of the Niagara Power and Manufacturing Company, by R. D. Wood & Co. of Philadelphia.

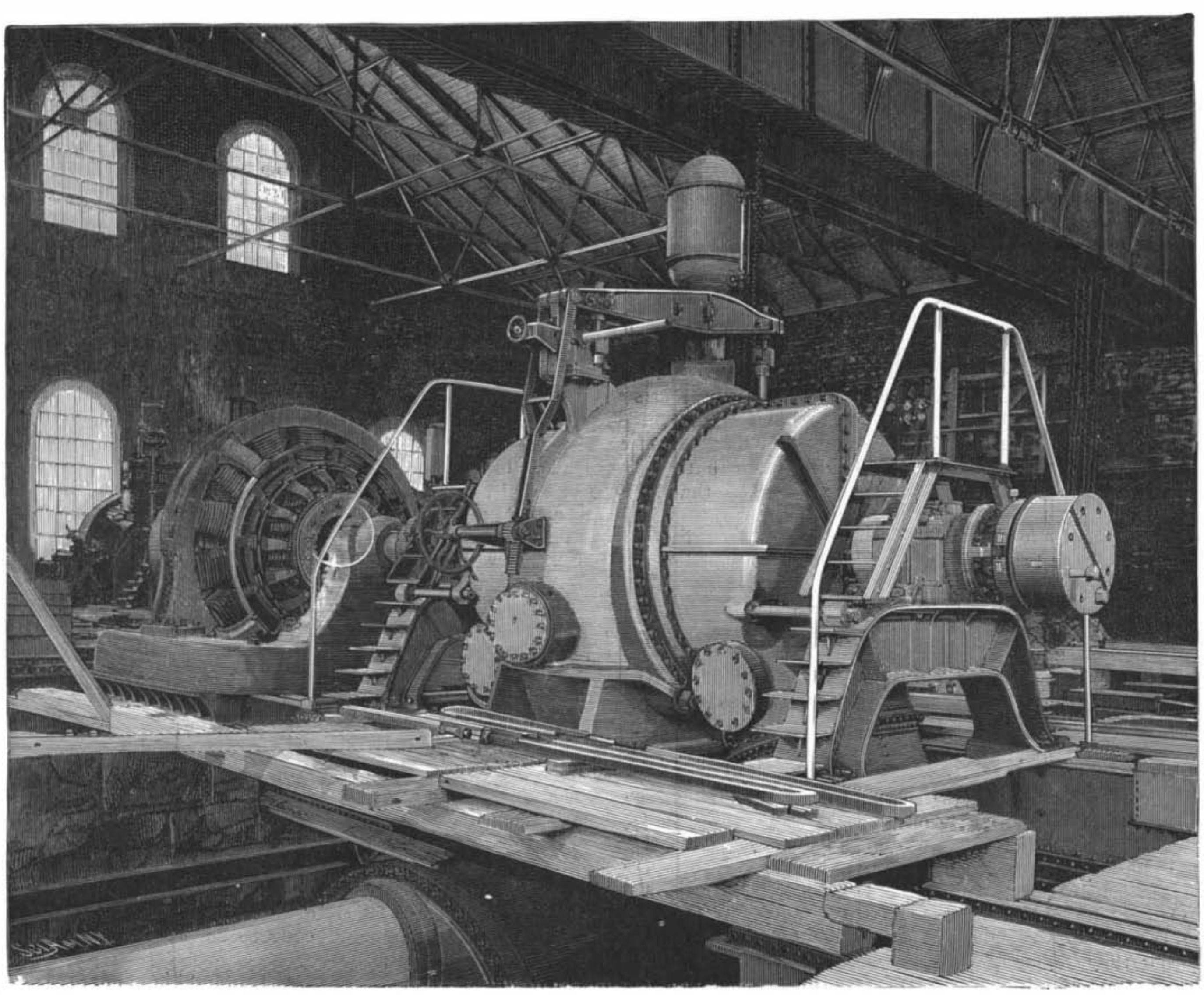
This pair of turbines forms part of a series of turbines composed of five pairs, each pair to be 2,500 horse power. They will be attached to a 13-foot diameter inlet tube, which tube directs the water from the top of the upper level of the fall to within 20 feet of the bottom of the fall, at which elevation a horizontal tube runs over the whole length of the wheel pit into which the spent waters are to be discharged. On the upper part of this horizontal tube are provided five openings on which slide gates of 60 inches diameter are attached. Each of these gates is acted upon by a hydraulic plunger operated by the pressure of the water.

The pair of turbines lately started is placed 24 feet above the lower level of the fall. The water, after acting on the blades of the turbine, is directed to two draught tubes, the extremities of which plunge into the tailrace water. This application of draught tubes in this case is specially desirable, as it enables the dynamos, which are directly attached to the extension of the turbine shaft, to be removed far above the tailrace water, thus escaping dampness.

The water is admitted to the central chamber, in which is placed a register gate controlled either by hand motion or by a governor for regular work. The water from the gates, which are placed opposite to each other, is admitted to the guide blades, which direct the water to the blades of the two revolving bronze wheels. These blades, with a view to high efficiency, are carefully designed and highly polished so as to reduce friction. The water leaving the two revolving wheels discharges into two draught tubes, the lower extremity of which plunges into the tailrace water. The whole structure rests on a framing of steel beams, secured by the side walls forming the tailrace. To prevent leakage of water, hydraulic grooves are provided both in the movable part and the stationary part.

The turbines are 70 inches mean diameter, of 36 blades, and each one has 142 square inches. They are secured on a horizontal axis of 11⅛ inches diameter in the middle, tapering down to 8 inches. The turbines make 250 revolutions per minute, and they are supported on self-oiling bearings of 30 inches length by 8 inches diameter, supported on stout stands resting on the steel framing above mentioned. Each end of the shaft is provided with thrust bearings, so as to neutralize any end pressure that may be caused by a temporary obstruction in one or the other of the turbines. The prolongations of both shafts are provided with couplings to which dynamos are directly connected. To-day, however, but one dynamo is in position, absorbing about 1,100 horse power.

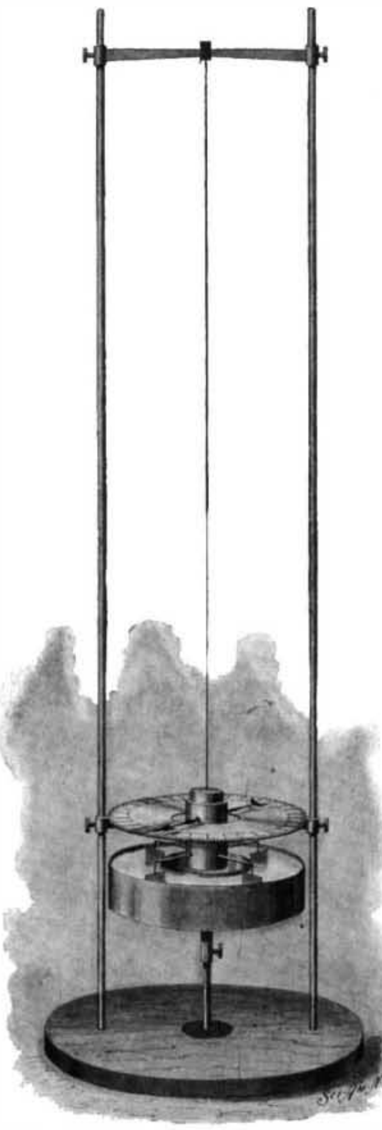
The placing of turbines in pairs on horizontal axes has within the last ten or fifteen years become a favorite mode of using water power, as, by placing the turbine shaft above the tailrace water, every part is made accessible. This mode of absorbing the power of hydraulic motors has become specially desirable, since the generators may be in many cases direct connected with the turbine shaft, thus saving any loss by the use of belting. Mr. E. Greyelin informs us that when, forty-four years ago, he placed two pairs of turbines on a horizontal axis, he little realized the advantages in the way of neutralizing the end pressure that would be secured by this method.



2,500 HORSE POWER TURBINES—NIAGARA POWER AND MANUFACTURING COMPANY.

A NEW VISCOSIMETER.

All who have given time to the subject of oil testing must have felt that many of the so-called standard tests were very unsatisfactory as compared with chemical tests in use in other fields to-day. This is no doubt due to the fact that it is almost impossible to duplicate many of these tests, especially those that come more under the domain of physical investigation rather than chemical.



A NEW TYPE OF VISCOSIMETER.

Foremost among this class of tests, and probably of more practical value than any other, is the determination of the viscosity of lubricating oils. But the value of this test has always been limited by the gross nature of the results obtained, and more especially since the recent investigations of Meyer and Slotte have shown that the apparatus which was formerly so much used and is still in somewhat extended use to-day, namely, the pipette, does not measure the viscosity at all, but that the result of all tests made with this instrument are influenced by the specific gravity of the sample.

Considering the nature of a correct test for viscosity, it should be kept in mind that viscosity has been defined as the resistance to flowing that any liquid or gas may possess. The frictional resistance which a fluid offers to change of shape or distortion of shape has been proved to be directly proportional to the length of time required to produce the change, or, in technical language, to the shearing per unit of time. Since shearing is the relative sliding of parallel planes without changing their mutual distances, and the tangential force per unit area of one of these planes is the measure of the frictional resistance of the fluid at the actual rate of shearing, then the quotient

$$\frac{\text{tangential force per unit area}}{\text{shear per unit time}}$$

is the measure of the quality of the fluid in virtue of which it resists distortion. It may correctly be called the coefficient of viscosity, or simply viscosity. The dimensions of this as given in the absolute system would be $\frac{M}{LT}$ and would determine the number of dynes per square centimeter necessary to produce unit shear per second.

The accompanying sketch shows a machine of the author's design for practically determining the viscosity of any liquid. The weight, including the pointers and paddles, of which latter there are four together with the wire, is exactly one kilogramme. Each paddle has an area of one square centimeter and is one millimeter thick. An adjustable scale graduated in degrees is shown just below the pointers. The pan is so arranged that it is adjustable in height, as shown by the pillar and screw. The wire from which the weight is suspended is one-tenth of a millimeter in diameter for light liquids and one millimeter in diameter for liquids of heavy viscosity, and in all cases one meter long. This wire is soldered into the standard at the top and into the center of the weight at the other extremity. The paddles stand at right angles to their adjacent neighbors as shown.

When ready for a test, the apparatus is in the position shown. The portion of the pan in which the paddles move is filled with the liquid to be tested and the pan raised until the liquid just covers the paddles. The weight is then brought to rest, thus showing that the wire is not subjected to any torsional strain. The weight is then moved until the pointers stand 180° from their original positions, and after being brought to rest are suddenly released. The elasticity of the wire now sets the weight in motion, and the number of degrees cut off in the first complete vibration is noted. This is then compared with the same angle determined with water at the same temperature. The subjoined table will give the actual viscosity for water at the several temperatures most commonly used.

The superiority of this method over the pipette procedure will be seen when it is known that with the pipette no difference in viscosity could be detected between water at 20° C. and petroleum naphtha at the same temperature. By this method, the following results were obtained: