THE DE LAVAL STEAM TURBINE

Dr. De Laval
Born 1845.

The De Laval Steam Turbine—the invention of Dr. Gustaf De Laval, of Stockholm, Sweden, is the chief representative of the type known as the "impact" or "velocity" turbine. Invented in 1888, it has been in successful service in Europe and the United States for upwards of thirteen years, hence has had the thorough test of time; and, by careful correction of defects developed in trial, and wise economy in mechanical details, has attained to a high degree of perfection in construction, and efficiency as a prime mover—especially for small powers. Designed originally many years ago to drive centrifugal cream separators, it has been developed and applied effectively to a large variety of apparatus—direct and alternating current generators, centrifugal pumps, pressure blowers, spinning mills, etc.

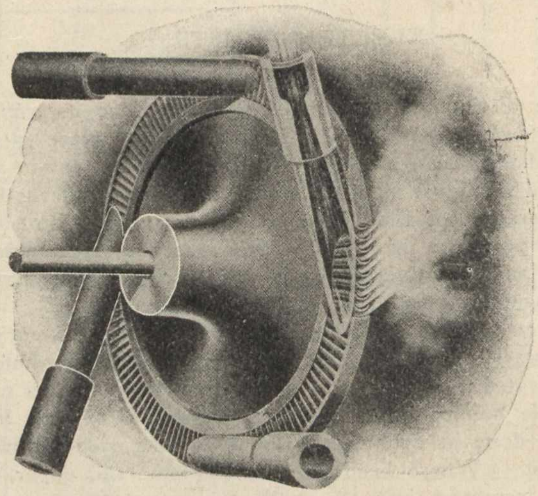

Fig. 1.
Wheel and Nozzles.

The essential difference between the De Laval "velocity" and Parsons "*pressure*" type of steam turbine is, that the former has only one ring of rotating vanes as shown in Figs. 1 and 5, whereas the latter may have as many as eighty rows; with 30,000 vanes in an engine of large magnitude.

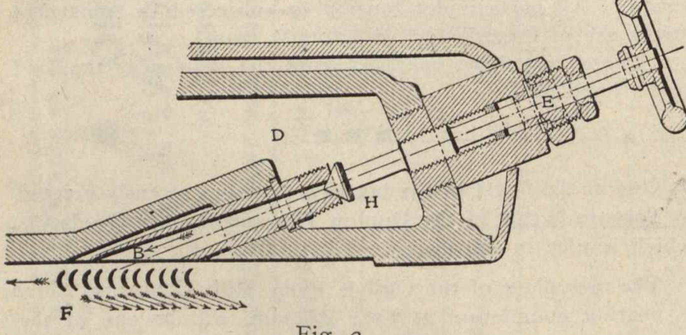

Fig. 2.
Sectional Nozzle and Valve.

Figs. 2 and 3 show in detail the single rotating disc and steam nozzles. The nozzles are conical, having their larger diameter at the exit, and are so designed that steam is expanded in the nozzle from boiler pressure down to that of the condenser, or, in the case of a non-condensing turbine, down to the atmospheric pressure, before impinging on the moving vanes. The work done by the steam during this expansion is taken up in giving kinetic energy to the steam; and in the case of a nozzle delivering steam at a pressure of 200 lbs. per square inch into a vacuum of 28 inches of mercury, The velocity of efflux is 4,130 feet per second.

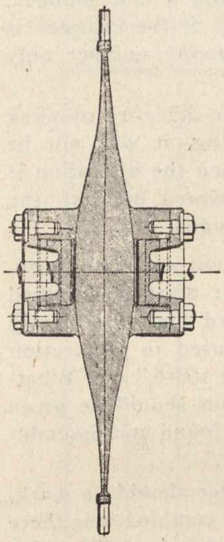

Fig. 3.
Section Turbine Wheel.

The angle between the nozzle and the plane of rotation of the wheel is 20°, and to obtain the maximum efficiency, the peripheral speed of the turbine disc should be 47% of the velocity of the steam jet. The energy absorbed by the turbine is then theoretically 88% of the kinetic energy of the steam. Owing to the limited strength of the materials of construction, it is at present unsafe to give the wheel a peripheral speed of more than 1,380 ft. per second. This is obtained in the 300 HP. turbine by giving the disc of 30 inches diameter, a velocity of 10,600 revolutions per minute. There are no guide vanes, since the steam is only passed once through the wheel, and as ample clearance is allowed between the fixed nozzles and the moving vanes, there is no chance of any rubbing taking place. Setting of the turbine disc at these high speeds is permitted by the simple device of mounting the disc on a shaft of small diameter—the diameter of the shaft for a 300 HP. turbine is only 1 5-16 inches, rotating in bearings adjustable, which are at a good distance apart. The flexible shaft has, therefore,

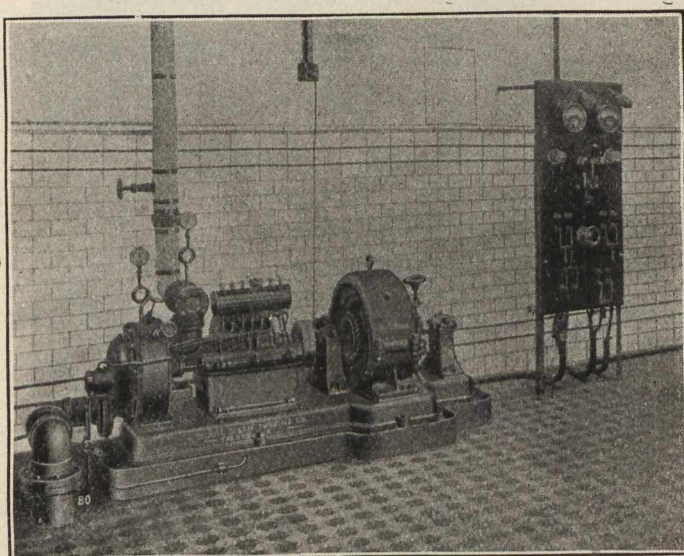

Fig. 4.
Thirty HP.Generating Set in Power Plant for Lighting the Sign on Roof of Building.

considerable play, and allows the rotating wheel to revolve on its true axis, as distinguished from its mechanical axis; and permits the centre of gravity of the rotor to take up its natural position when rotating. The wheel is made as a solid disc, to the circumference of which the buckets are dove-tailed, each bucket being separately fixed.

The disc is so proportioned as to be weakest near the circumference, so that, should rupture take place through an abnormal increase in the centrifugal stress, the buckets will be thrown off without doing serious damage, and will thus relieve the main body of the wheel. The rotor shaft is connected to a parallel second motion shaft by means of spiral gear wheels, giving a reduction in velocity of 10 to 1. Governing is performed by means of a centrifugal governor, which acts by completely cutting off steam from one or more of the steam nozzles, the remaining nozzles being unaffected. The velocity of efflux of steam from the working nozzles is