4,000 feet or more per second must be employed. This velocity can, of course, be regulated by the form of nozzle. But for economical working, as large a proportion as possible of the heat energy of the steam must be changed into the kinetic energy of the gas, the velocity of which, since it has a large specific volume, must be very high. It is stated above that for maximum efficiency the velocity of the vane should be one-half the velocity of the impinging jet. But a vane velocity of 2,000 feet per second would, of course, cause such centrifugal forces in the turbine wheel as no known material could safely bear. Turbines, with a single row of vanes using high pressure steam, must consequently run at a speed lower than the most efficient—a peripheral velocity of 1,000 feet per second being about the limit. The introduction of many rows of moving and stationary vanes at once overcomes this difficulty. The steam loses some of its velocity at each row, and so, on this principle, turbines have been made that run efficiently at speeds not much in excess of those of some high-speed reciprocating engines.

Figure 1 shows the working parts of a De Laval turbine, and Figure 2 is a sectional plan of the same. The steam enters the nozzle from the chamber D, where it is completely expanded, passes through the turbine bucket F to the exhaust chamber G. The important features are the diverging nozzle referred to above, the fact that there may be considerable clearance between the wheel, casing and nozzle, the flexible turbine shaft with its flexible bearing, the turbine wheel, made of forged nickle steel of increasing thickness from the periphery to the centre to resist centrifugal force ; above all, the high velocity of the turbine wheel, and the gear wheels required to reduce this velocity usually in the ratio of about ten to one. It is interesting to notice in passing some of the forces acting on this turbine. Suppose in a 10 H.P. turbine the speed of the turbine shaft is 24,000 revolutions per minute and the diameter of the turbine wheel 4.8 inches, the torque on the flexible spindle will be about 26 lbs. inches, and the total tooth pressure approximately 50 lbs.

Figure 3 shows a longitudinal section of the Parsons turbine, as manufactured by the Westinghouse Machine Company. In this the steam enters at A, passes through the stationary to the rotating blades through the high pressure, intermediate and low pressure cylinders, exhausting at B. As stated above, because of the many rows of stationary and rotating vanes and the reduction of speed with each pair of vanes, the speed of the Parson turbine can, by multiplying the vanes, be reduced to almost any amount. The end,