wasted (Art. 158). To avoid this, it is necessary to employ a machine in which some rotatory velocity is given to the water before entrance, in order that it may be possible to discharge it with no velocity except that which is absolutely required to pass it through the machine. Such a machine is called a *Turbine*, and it is described as "outward flow," "inward flow," or "parallel flow," according as the water during its passage through the machine diverges from, converges to, or moves parallel to the axis of rotation.*

Turbines are wheels, generally of small size compared with water wheels, driven chiefly by the impulse of the water. The water is allowed, before entering the moving part of the turbine, to acquire a considerable velocity; during its action on the turbine this velocity is diminished, and the impulse due to the change of momentum drives the turbine.

Roughly speaking, the fluid acts in a water-pressure engine directly by its pressure; in a water wheel chiefly by its weight causing a pressure, but in part by its kinetic energy, and in a turbine chiefly by its kinetic energy, which again causes a pressure.†

In the outward and inward flow turbines, the water enters and leaves the turbine in directions normal to the axis of rotation, and the paths of the molecules lie exactly or nearly in planes normal to the axis of rotation. In outward-flow turbines the general direction of flow is away from the axis, and in inward-flow turbines towards the axis. In parallel-flow turbines, the water enters and leaves the turbine in a direction parallel to the axis of rotation, and the paths of the molecules lie on cylindrical surfaces concentric with that axis.

There are many forms of outward-flow turbines, of which the best known was invented by Fourneyron, and is commonly known by his name. The inward-flow was invented by Prof. Jas. Thomson.

* Cotterill's App. Mechs., p. 506, † Ency. Brit., Vol. XII., p. 590.