

## Constructional detail of turbines

### 1. PELTON WHEEL OR TURBINE

Pelton wheel, named after an eminent engineer, is an impulse turbine wherein the flow is tangential to the runner and the available energy at the entrance is completely kinetic energy. Further, it is preferred at a very high head and low discharges with low specific speeds. The pressure available at the inlet and the outlet is atmospheric.

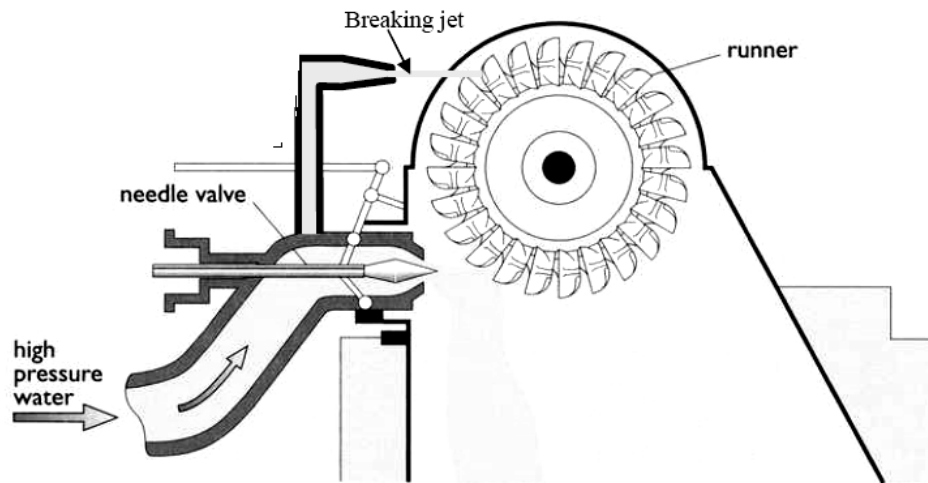


Fig. Pelton turbine

**The main components of a Pelton turbine are:**

#### **(i) Nozzle and flow regulating arrangement:**

Water is brought to the hydroelectric plant site through large penstocks at the end of which there will be a nozzle, which converts the pressure energy completely into kinetic energy. This will convert the liquid flow into a high-speed jet, which strikes the buckets or vanes mounted on the runner, which in-turn rotates the runner of the turbine.

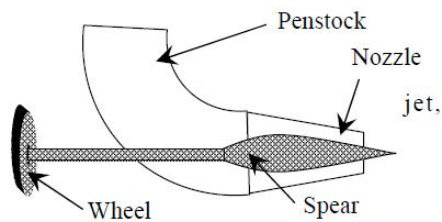


Fig. Spear arrangement

The amount of water striking the vanes is controlled by the forward and backward motion of the spear. As the water is flowing in the annular area between the annular area between the nozzle opening and the spear, the flow gets reduced as the spear moves forward and vice-versa.

**(ii) Runner with buckets:**

Runner is a circular disk mounted on a shaft on the periphery of which a number of buckets are fixed equally spaced as shown in Fig. The buckets are made of cast -iron cast -steel, bronze or stainless steel depending upon the head at the inlet of the turbine.

The water jet strikes the bucket on the splitter of the bucket and gets deflected through  $160-170^{\circ}$ .

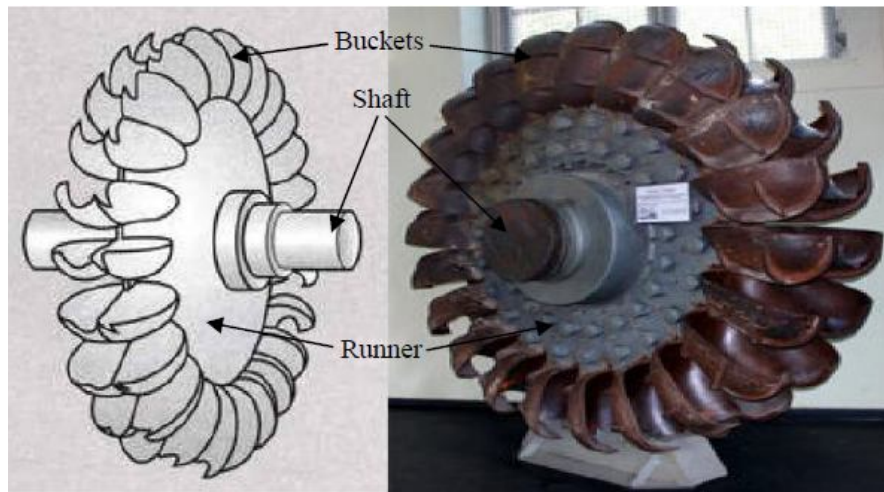


Fig. Pelton turbine runner with buckets

**(iii) Casing:**

It is made of cast -iron or fabricated steel plates. The main function of the casing is to prevent splashing of water and to discharge the water into tail race.

**(iv) Breaking jet:**

Even after the amount of water striking the buckets is completely stopped, the runner goes on rotating for a very long time due to inertia. To stop the runner in a short time, a small nozzle is provided which directs the jet of water on the back of bucket with which the rotation of the runner is reversed. This jet is called as breaking jet.

### **Constructional details of reaction turbine:-**

Reaction turbines are those turbines which operate under hydraulic pressure energy and part of kinetic energy. In this case, the water reacts with the vanes as it moves through the vanes and transfers its pressure energy to the vanes so that the vanes move in turn rotating the runner on which they are mounted.

The main types of reaction turbines are

1. **Radially outward flow reaction turbine:** This reaction turbine consist a cylindrical disc mounted on a shaft and provided with vanes around the perimeter. At inlet the water flows into the wheel at the centre and then glides through radially provided fixed guide vanes and then flows over the moving vanes. The function of the guide vanes is to direct or guide the water into the moving vanes in the correct direction and also regulate the amount of water striking the vanes. The water as it flows along the moving vanes will exert a thrust and hence a torque on the wheel thereby rotating the wheel. The water leaves the moving vanes at the outer edge. The wheel is enclosed by a water-tight casing. The water is then taken to draft tube.
2. **Radially inward flow reaction turbine:** The constitutional details of this turbine are similar to the outward flow turbine but for the fact that the guide vanes surround the moving vanes. This is preferred to the outward flow turbine as this turbine does not develop racing. The centrifugal force on the inward moving body of water decreases the relative velocity and thus the speed of the turbine can be controlled easily.
3. **Mixed flow reaction turbine:** This is a turbine wherein it is similar to inward flow reaction turbine except that when it leaves the moving vane, the direction of water is turned from radial at entry to axial at outlet. The rest of the parts and functioning is same as that of the inward flow reaction turbines.
4. **Axial flow reaction turbine:** This is a reaction turbine in which the water flows parallel to the axis of rotation. The shaft of the turbine may be either vertical or horizontal. The lower end of the shaft is made larger to form the **boss** or the **hub**. A number of vanes are fixed to the boss. When the vanes are composite with the boss the turbine is called **propeller turbine**. When the vanes are adjustable the turbine is called a **Kaplan turbine**.

### **The main component parts of a reaction turbine are:**

- (1) Casing, (2) Guide vanes (3) Runner with vanes (4) Draft tube

**Casing:** This is a tube of decreasing cross-sectional area with the axis of the tube being of geometric shape of volute or a spiral. The water first fills the casing and then enters the guide vanes from all sides radially inwards. The decreasing cross-sectional area helps the velocity of the entering water from all sides being kept equal. The geometric shape helps the entering water avoiding or preventing the creation of eddies.

**Guide vanes:** the function of guide vane is to direct liquid onto the runner vane and partial conversion of liquid pressure energy into kinetic energy.

**Runner with vanes:** The runner is mounted on a shaft and the blades are fixed on the runner at equal distances. The vanes are so shaped that the water reacting with the m will pass through them thereby passing their pressure energy to make it rotate the runner.

**Draft tube:** This is a divergent tube fixed at the end of the outlet of the turbine and the other end is submerged under the water level in the tail race.

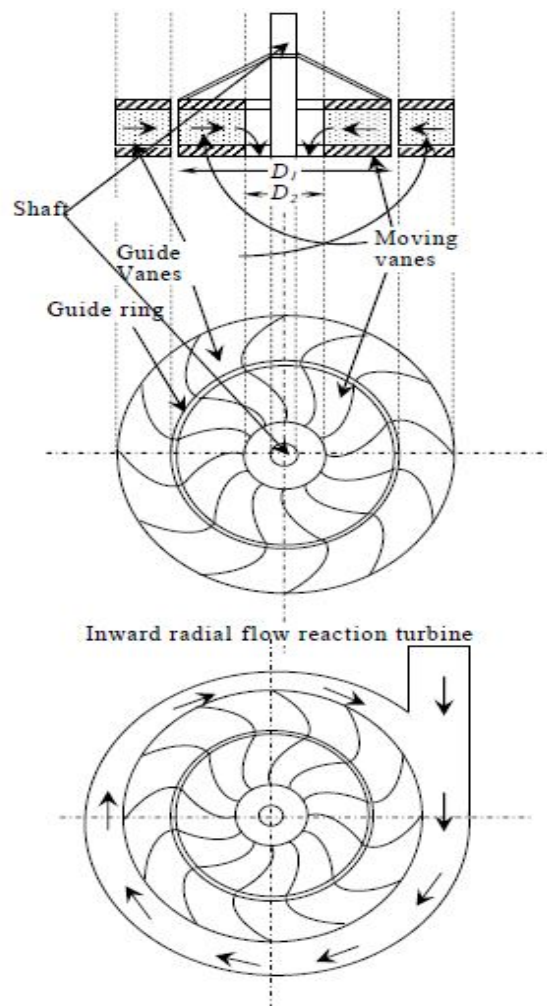


Fig. reaction turbine

- The liquid at outlet of turbine having large kinetic energy which will go waste if liquid is directly discharges into tail race so in order to utilize this energy, the outlet of turbine is connected to a draft tube which converts kinetic energy of liquid into pressure energy and create a negative pressure at turbine outlet therefore it increases net head on turbine. Due to which the turbine can installed above tail race without loss of head.
- It discharges liquid into tail race.

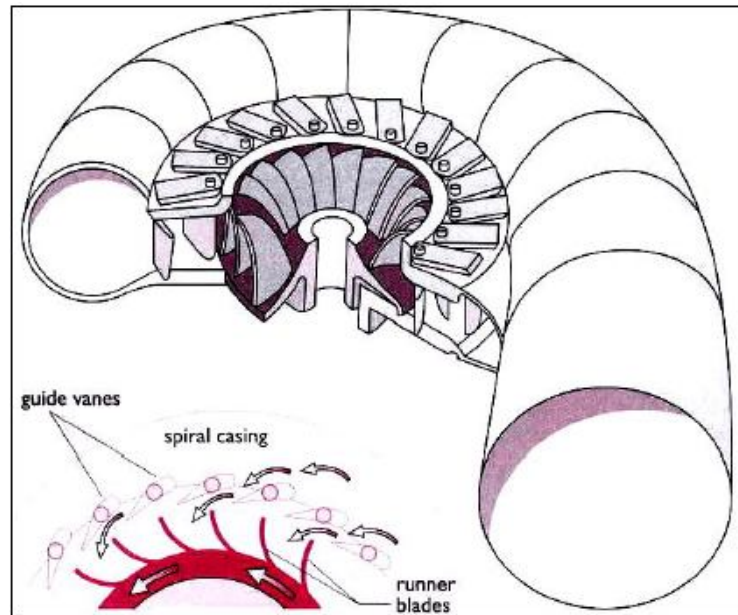


Fig. reaction turbine

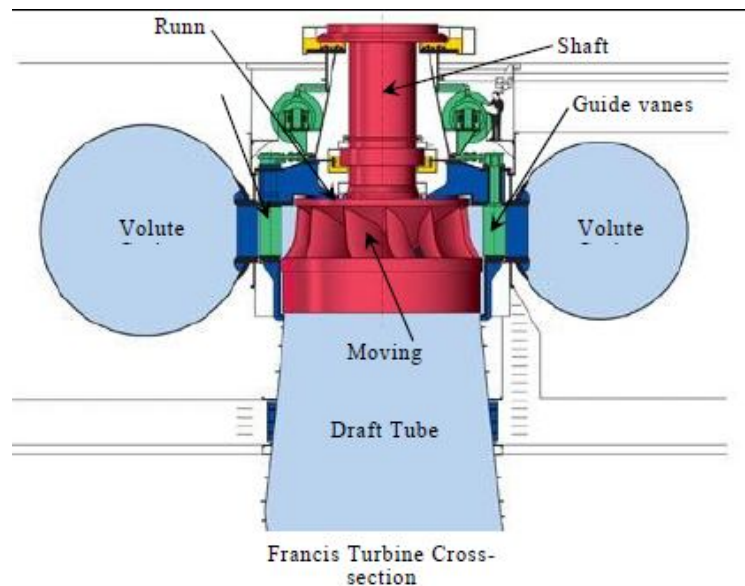


Fig. francis turbine