

Centrifugal pump is a hydraulic machine which converts mechanical energy into hydraulic energy (i.e. pressure energy) by the use of centrifugal force acting on the fluid. The flow of liquid takes place in radial outward direction which is reverse of the inward radial flow [reaction turbine](#). It is used in different areas where fluid is needed to be raised from low level to high level.

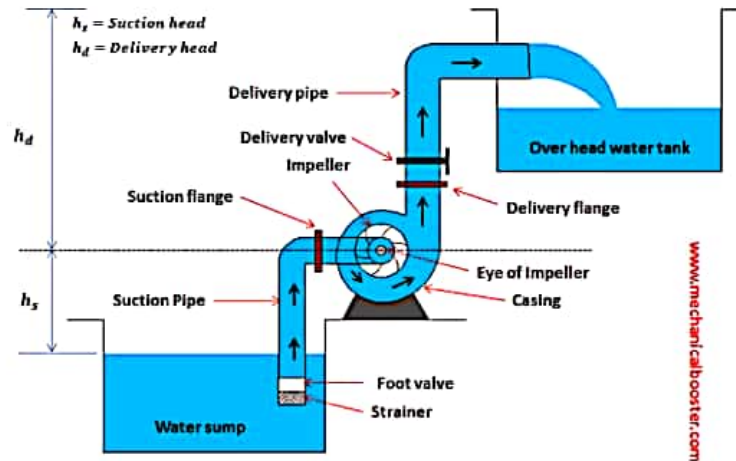
Working Principle

It works on the principle of forced vortex flow. The forced vortex flow means when a certain mass of fluid or liquid is allowed to rotate by an external torque then there is a rise in pressure head of the rotating liquid takes place. This rise in pressure head is used to deliver water from one location to another. It is centrifugal force acting on the fluid that makes it to flow within the casing.

The rise in the pressure head of the rotating liquid at any point is directly proportional to the square of the tangential velocity of the rotating liquid.

Main Parts

The various main parts of a centrifugal pump are:



Centrifugal Pump Working

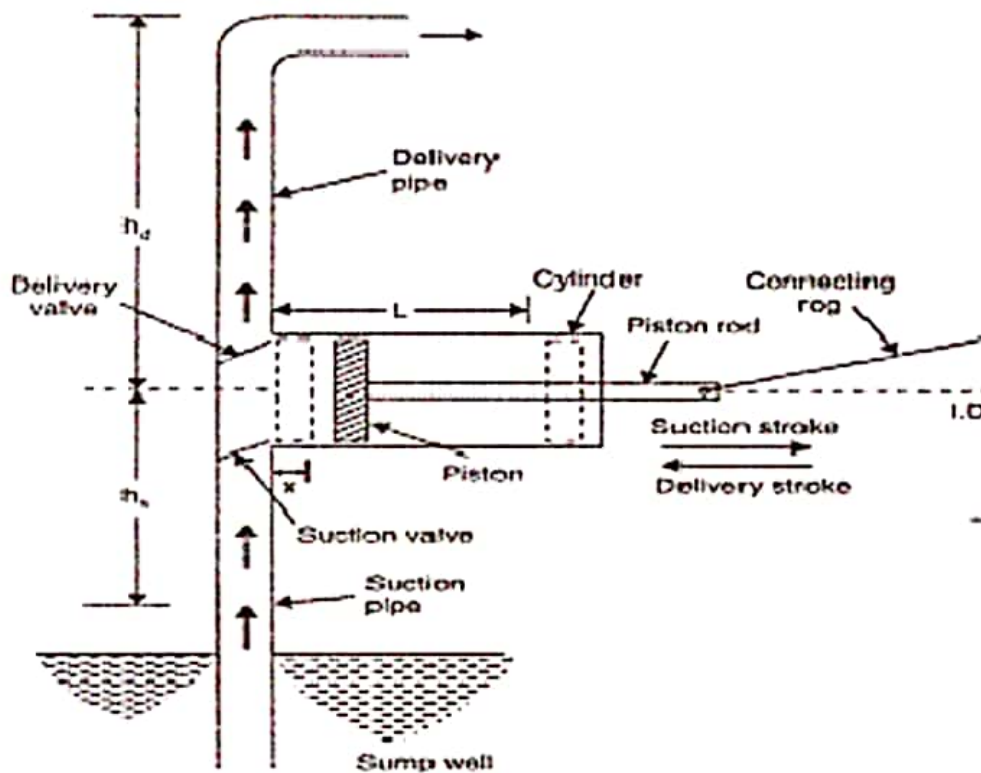
1. Impeller
2. Casing
3. Suction pipe with a foot valve and strainer
4. Delivery pipe

Let's discuss about each one of them one by one

1. Impeller

It is the rotating part of the pump. The impeller is mounted on a shaft and the shaft of impeller is again connected with the shaft of an electric motor. It is rotated by the motor and consists of series of backward curved blades.

DIAGRAM:



CONSTRUCTION DETAILS OF A RECIPROCATING PUMP:

Components of reciprocating pumps:-

- Piston or plunger: – a piston or plunger that reciprocates in a closely fitted cylinder.
- Crank and Connecting rod: – crank and connecting rod mechanism operated by a power source. Power source gives rotary motion to crank. With the help of connecting rod we translate reciprocating motion to piston in the cylinder.
- Suction pipe: – one end of suction pipe remains dip in the liquid and other end attached to the inlet of the cylinder.
- Delivery pipe: – one end of delivery pipe attached with delivery part and other end at discharge point.
- Suction and Delivery valve: – suction and delivery valves are provided at the suction end and delivery end respectively. These valves are non-return valves.

WORKING OF RECIPROCATING PUMP

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Operation of reciprocating motion is done by the power source (i.e. electric motor or i.c engine, etc). Power source gives rotary motion to crank; with the help of connecting rod we translate reciprocating motion to piston in the cylinder (i.e. intermediate link between connecting rod and piston). When crank moves from inner dead centre to outer dead centre vacuum will create in the cylinder. When piston moves outer dead centre to inner dead centre and piston force the water at outlet or delivery valve.

EXPRESSION FOR DISCHARGE OF THE PUMP:-

$$Q = \frac{ALN}{60}$$

Where: –

Q: – discharge in m³/sec

A: – cross-section of piston or cylinder in m²

L: – length of stroke in meter

N: – speed of crank in r.p.m

2. Casing

It is an air tight passage which surrounds the impeller. The design of the casing is done in such a way that it is capable of converting the kinetic energy of the water discharging from the outlet of the impeller into pressure energy before it leaves the casing and enters into the delivery pipe.

Commonly three types of casing are used in centrifugal pump and these are

(i). Volute Casing: It is a spiral type of casing in which the area of flow increases gradually. The increase in area of flow decreases the velocity and increases the pressure of the liquid that flows through the casing. The volute casing is shown in figure above:

(ii). Vortex Casing: In vortex casing, a circular chamber is introduced in between the impeller and casing. This is done in order to prevent the loss of energy due to formation of eddies. The efficiency of the vortex casing is more than that of the volute casing.

(iii). Casing with Guide Blades: In this casing, the impeller is surrounded by series of guide blades. The guide blades are mounted on a ring which is called as diffuser. The design of the guide vanes are kept as such that the water which is leaving the impeller enters the guides without shock. The area of the guide vanes increases; this helps to decrease the velocity of the liquid and increases its pressure. After guide vanes, water passes through the surrounding casing. In most of the cases, the casing remains concentric with the impeller.

3. Suction Pipe with Foot Valve and Strainer

A pipe whose one end is connected with the inlet of the impeller and the other end is dipped into the sump of water is called suction pipe. The suction pipe consists of a foot valve and strainer at its lower end. The foot valve is a one way valve that opens in the upward direction. The strainer is used to filter the unwanted particle present in the water to prevent the centrifugal pump from blockage.

4. Delivery Pipe

It is a pipe whose one end is connected to the outlet of the pump and other end is connected to the required height where water is to be delivered.

Working

- As the electric motor starts rotating, it also rotates the impeller. The rotation of the impeller creates suction at the suction pipe. Due to suction created the water from the sump starts coming to the casing through the eye of the impeller.
- From the eye of the impeller, due to the centrifugal force acting on the water, the water starts moving radially outward and towards the outer of casing.
- Since the impeller is rotating at high velocity it also rotates the water around it in the casing. The area of the casing increasing gradually in the direction of rotation, so the velocity of the water keeps on decreasing and the pressure increases, at the outlet of the pump, the pressure is maximum.
- Now form the outlet of the pump, the water goes to its desired location through delivery pipe.