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# Hydraulic Pumps

## HYDRAULIC PUMPS

- A **pump** is a device used to transfer fluids from lower elevation to higher elevation.
- The hydraulic machines which convert the mechanical energy into hydraulic energy are called pumps.
- The hydraulic energy is in the form of pressure energy. This pressure energy is converted into potential energy, as the liquid is lifted from a lower level to a higher level.

**Uses of Pumps:** Used for irrigation purposes and in chemical industries, petroleum industries, etc. Used to feed the water into the boiler (called Feed Water Pump) in power plants. Used to circulate water in the condenser (called Condensate Pump) Used to remove the condensed steam from the condenser (called Condensate extraction Pump) Used to transfer the oil from the reservoir to its proper place in I.C. Engines. Used to force the lubricating oil into the moving or rotating parts of I.C. Engines.

## **CLASSIFICATION OF PUMPS**

Pumps are broadly classified into Positive- displacement pumps

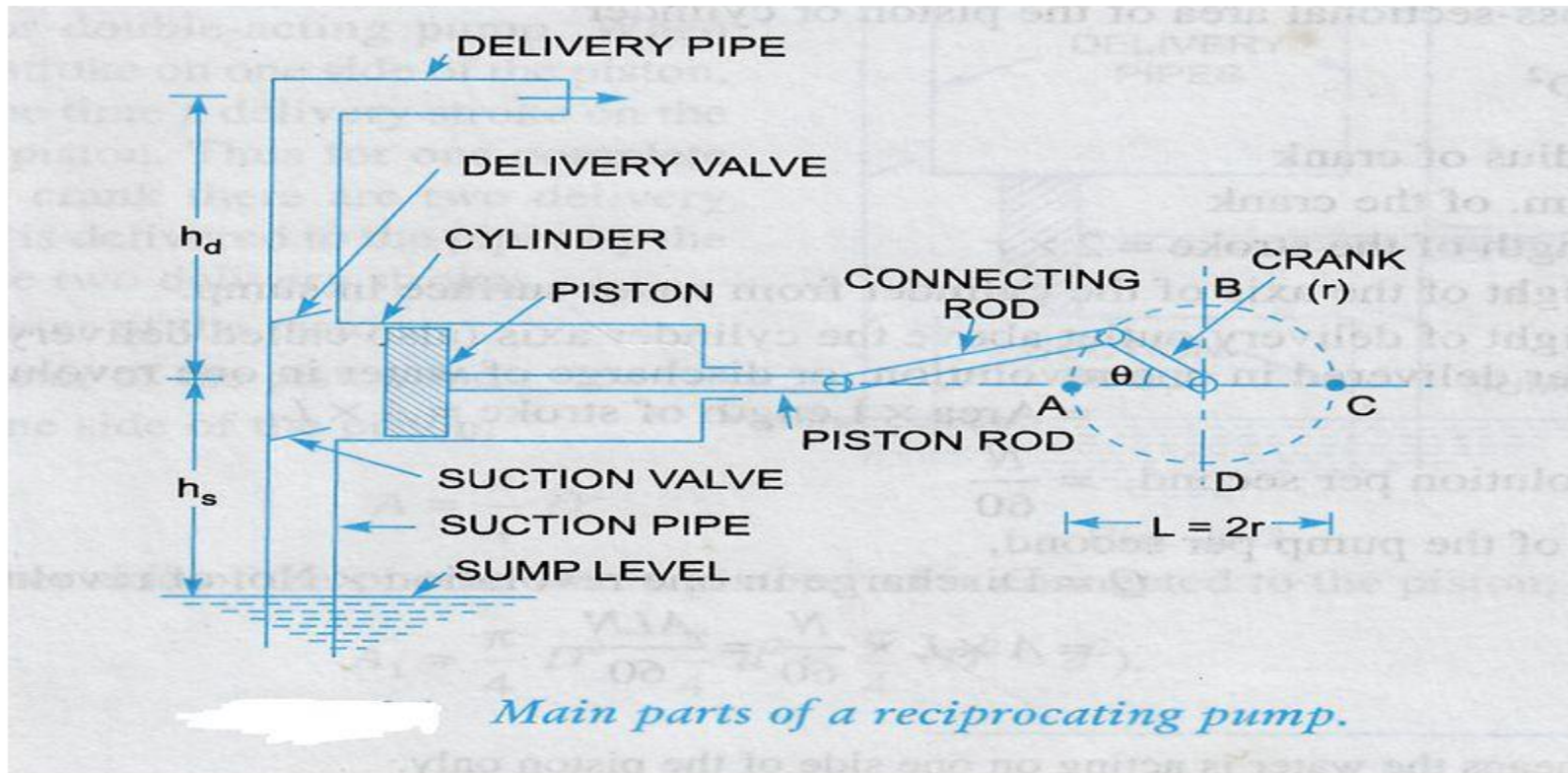
Rotodynamic pumps Positive- displacement pumps: They make a fluid move by trapping a fixed amount and displacing the trapped volume into the discharge pipe. Discharge is directly proportional to speed. Eg : Reciprocating pump, Vane pump, Gear pump

Rotodynamic pumps: It is a machine in which energy is continuously imparted to the pumped fluid by means of a rotor and thus fluid is raised to higher elevation. Eg: Centrifugal pump



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# RECIPROCATING PUMP



**During the motion of piston from left to right a partial vacuum created inside the cylinder.**

Because of this low pressure water will rise from well through suction tube and fill the cylinder by forcing to open the suction valve. This operation is known as suction stroke.(motion of piston from left to right).In this stroke crank rotates  $\theta=0^\circ$  to  $\theta=180^\circ$ . Also delivery valve will be closed and suction valve will be open during this stroke.

**When the crank rotates from  $\theta=180^\circ$  to  $\theta=360^\circ$  piston moves inwardly from position right to left.**

Now piston exerts pressure on the liquid and due to which suction valve closes and delivery valve opens. The liquid is then forced up through delivery pipe. This stroke is known as delivery stroke. Now the pump has completed one cycle. The same cycle repeated as the crank rotates.

**Crank is rotated by means of an electric motor**

Movement of piston is obtained by connecting it to the crank by using a connecting rod. Suction and delivery valves are one way or non return valve

# Discharge through a reciprocating pump

**Discharge Through a Reciprocating Pump.** Consider a single\* acting reciprocating pump as shown in Fig.

Let  $D$  = Diameter of the cylinder

$A$  = Cross-sectional area of the piston or cylinder

$$= \frac{\pi}{4} D^2$$

$r$  = Radius of crank

$N$  = r.p.m. of the crank

$L$  = Length of the stroke =  $2 \times r$

$h_s$  = Height of the axis of the cylinder from water surface in sump.

$h_d$  = Height of delivery outlet above the cylinder axis (also called delivery head)

Volume of water delivered in one revolution or discharge of water in one revolution

$$= \text{Area} \times \text{Length of stroke} = A \times L$$

Number of revolution per second, =  $\frac{N}{60}$

$\therefore$  Discharge of the pump per second,

$Q$  = Discharge in one revolution  $\times$  No. of revolution per second

$$= A \times L \times \frac{N}{60} = \frac{ALN}{60}$$

**Centrifugal pumps:** A centrifugal pump is a rotodynamic pump that converts mechanical energy to hydraulic pressure energy. It uses a rotating impeller to increase the pressure of a fluid. The fluid enters the pump impeller along or near to the rotating axis and is accelerated by the impeller, flowing radially outward

**COMPONENTS Impeller-** it is a wheel or rotor which is provided with a series of backward curved blades or vanes. It is mounted on a shaft which is coupled to an electric motor. Volute casing- it is an air tight chamber which surrounds the impeller. Suction pipe- it is a pipe which connected to the inlet of pump. The other end is dips into water in a sump or well. Foot valve and strainer are connected to it.

Delivery pipe- it is a pipe which connected to the outlet of pump and it delivers the water into the required height. Delivery valve- controls the flow from pump to delivery pipe

**WORKING The first step is priming.**

Priming is the process of filling the water in suction pipe, casing and portion of delivery pipe up to delivery valve. So that all air from this portion is driven out. Pressure generated in a pump impeller is directly proportional to the density of fluid that is in contact with impeller. So if air is there, only negligible pressure would produced with the result that no liquid will be lifted up.

## **Classification of Hydraulic Turbines: working principle**

**Impulse Turbine:** The pressure of liquid does not change while flowing through the rotor of the machine. Pressure change occur only in the nozzles of the machine. Eg : Pelton Turbine.

The energy to rotate an impulse turbine is derived from the kinetic energy of the fluid flowing through the nozzles.

## **Classification of Hydraulic Turbines: working principle**

**Reaction Turbine:** The pressure of liquid changes while it flows through the rotor of the machine. The change in fluid velocity and reduction in its pressure causes a reaction on the turbine blades. Eg: Francis and Kaplan Turbines





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**After the pump is primed, electric motor started to rotate the impeller.**

Due to rotation impeller rotation, produces a vortex which imparts a centrifugal head to liquid. Then the liquid starts to flow in an outward radial direction thereby leaving the vanes of impeller. At the centre of impeller a partial vacuum is created , causes the liquid from sump or well to rush through suction pipe to the eye of impeller.