



UNIT III

PUMPS

Basic Civil and Mechanical Engineering

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PUMPS

- A pump is a machine which is used to raise or transfer the fluids.
- It is also used to maintain the constant flow rate or constant pressure.
- It is normally driven by an engine or a motor.
- Pumps are rated by the horse power.
- Important specifications for pump maximum discharge flow, maximum discharge pressure, inlet size and discharges size.



CLASSIFICATION OF PUMPS

- It is classified into positive displacement pumps and roto dynamic pumps.
- In **positive displacement pumps**, fluid is drawn or forced into a finite space and it is sealed.
- It is then forced out and the cycle is repeated.
- In **roto dynamic pumps**, centrifugal force is used to move the fluid into a pipe.



RECIPROCATING PUMPS

- It is a positive displacement pump
- It uses a piston and cylinder arrangement with suction and delivery valves integrated with the pump.
- It can be single acting and double acting
- There may be single or multi cylinders also.

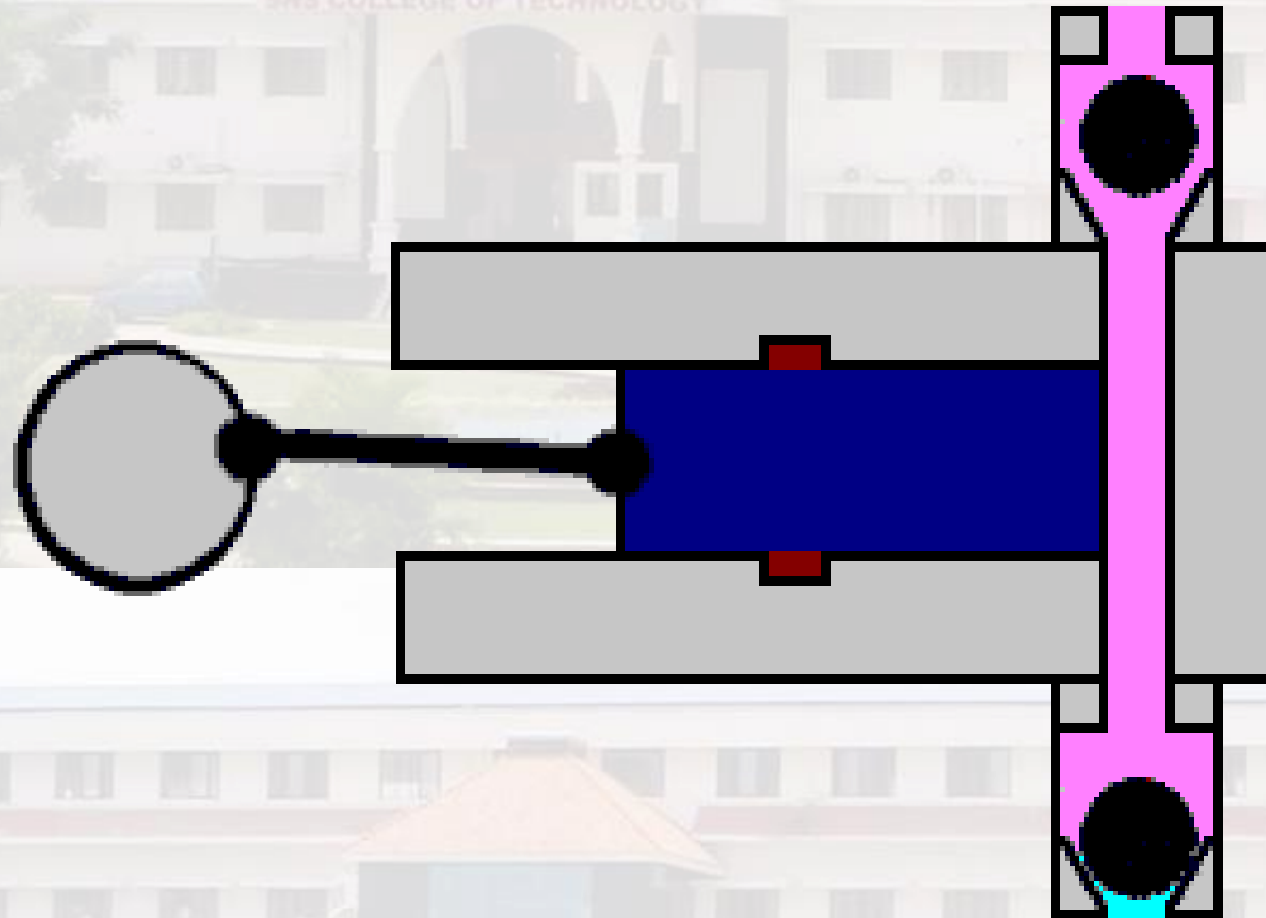


RECIPROCATING PUMPS

- It is a positive displacement pump
- It sucks and raises the liquid by actually displacing it with a piston/plunger that executes a reciprocating motion in a closely fitting cylinder.



WORKING OF SINGLE ACTING RECIPROCATING PUMP



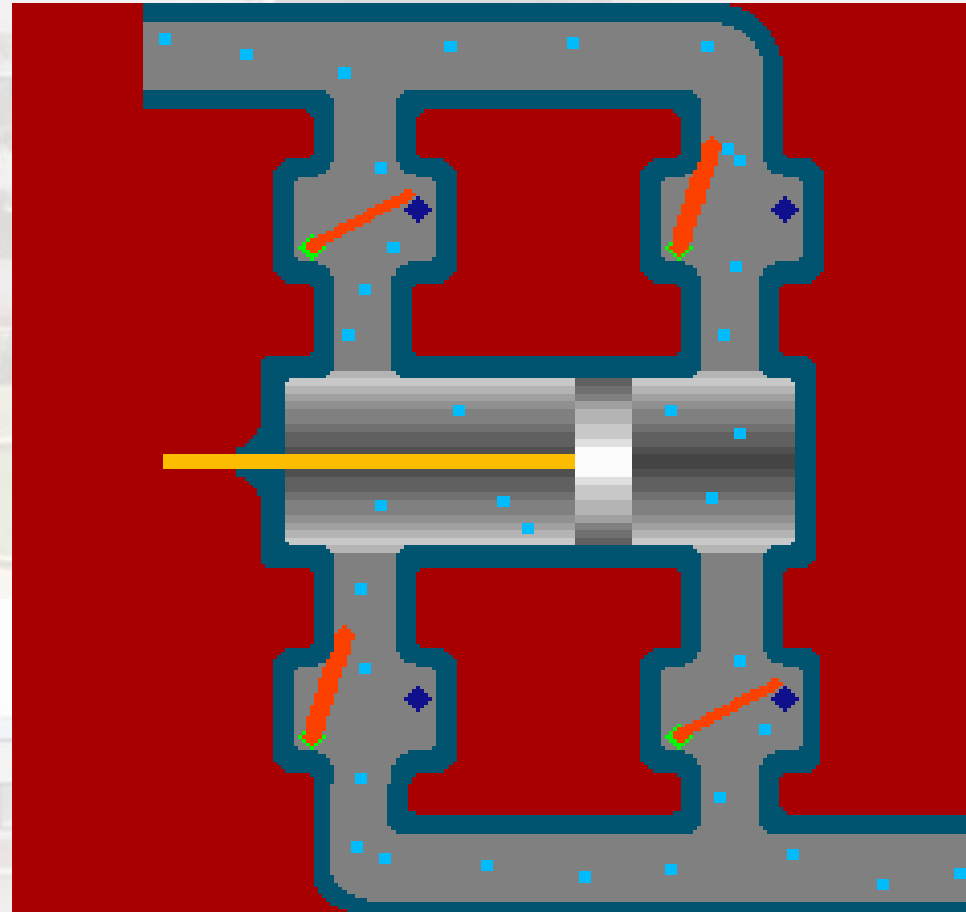


WORKING OF SINGLE ACTING RECIPROCATING PUMP

- During suction stroke the piston moves to the left, causing the inlet valve to open.
- Water is admitted into the cylinder through the inlet valve.
- During the discharge stroke the piston moves to the right closes the suction valve and opens the outlet valve.
- Through the outlet valve the volume of liquid moved out of the cylinder.



DOUBLE ACTING RECIPROCATING PUMP





DOUBLE ACTING RECIPROCATING PUMP

- Each cycle consists of two strokes.
- Both the strokes are effective, hence it is known as double acting pump
- Liquid is filled at one end and discharged at other end during forward stroke.
- During the return stroke, end of cylinder just emptied is filled and the end just filled is emptied.



AIR VESSELS

- **Air vessel** is a closed chamber containing compressed air in the upper part and liquid being pumped in the lower part.





PURPOSE OF USING AN AIR VESSEL

- To get continuous supply of liquid at a uniform rate.
- To save the power required to drive the pump (By using an air vessel the acceleration and friction heads are considerably reduced)
- To run the pump at much higher speed without any danger of separation.

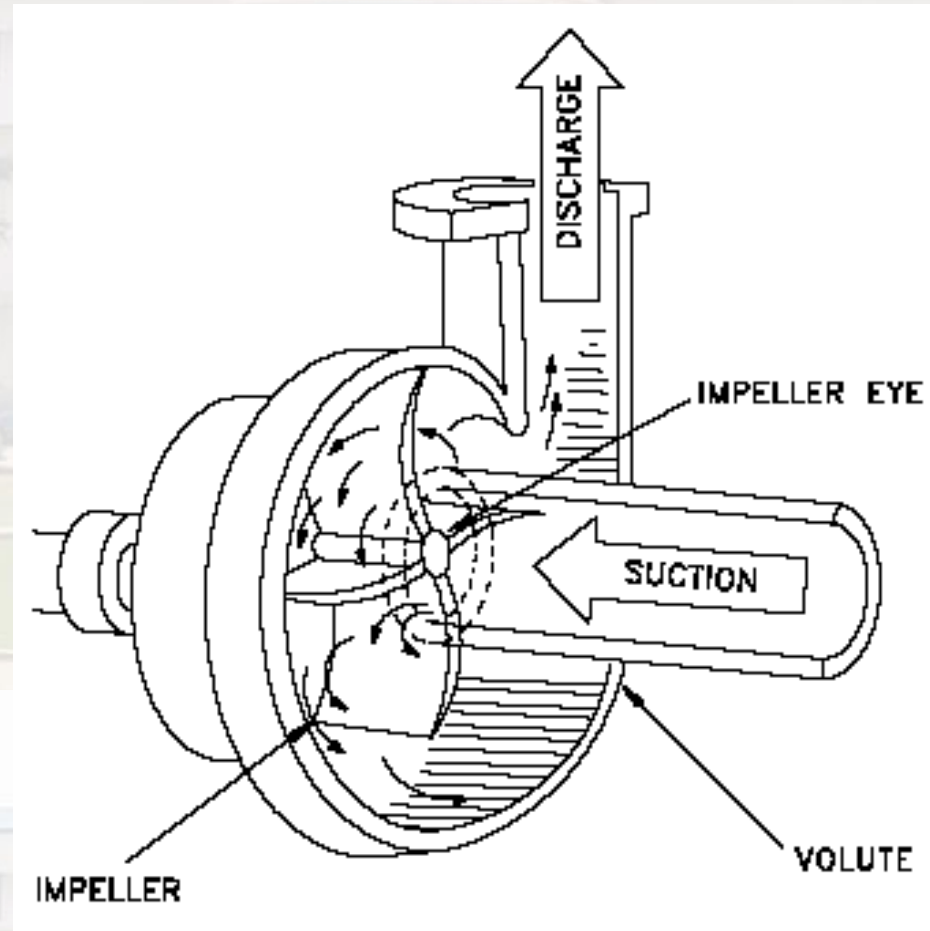


ADVANTAGES OF RECIPROCATING PUMP

- Relatively compact design
- High viscosity performance
- Ability to handle high differential pressure

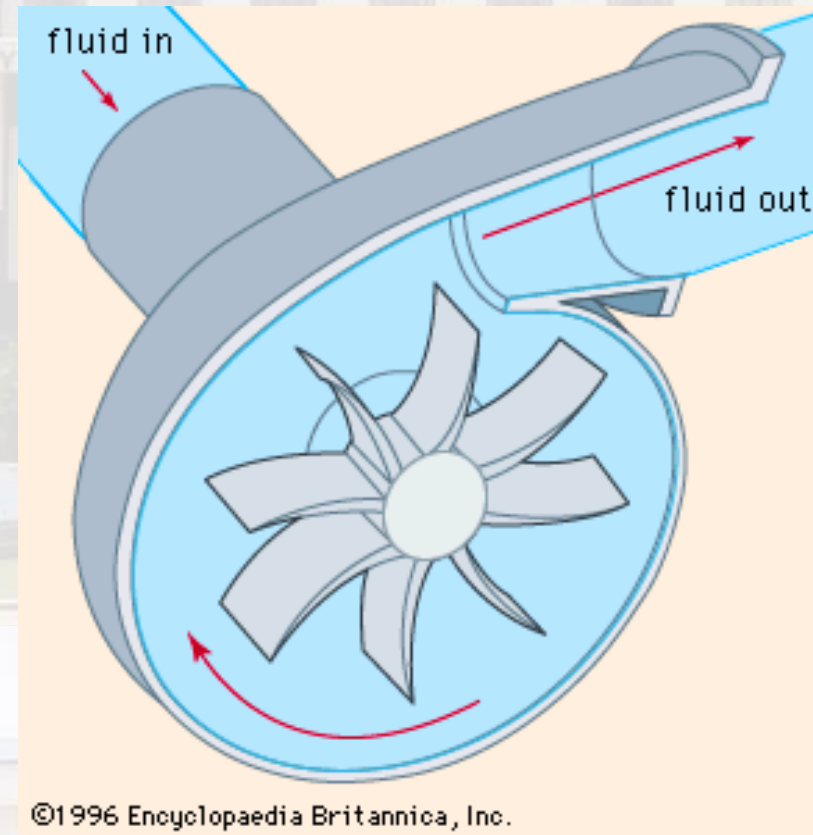
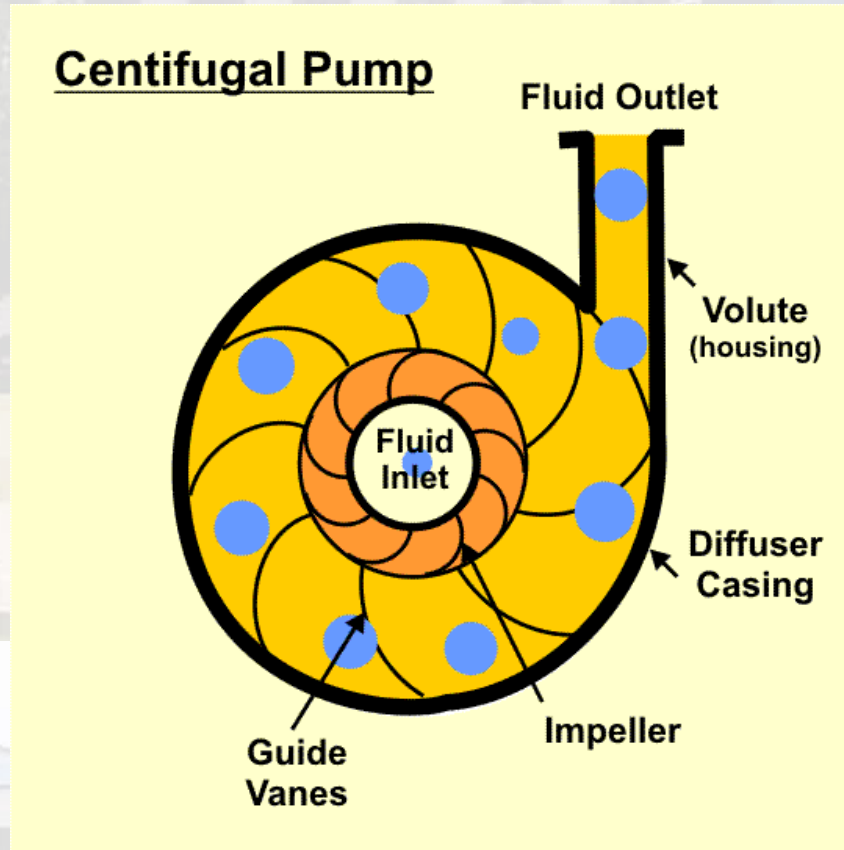


CENTRIFUGAL PUMPS





CENTRIFUGAL PUMP - WORKING





COMPONENTS OF CENTRIFUGAL PUMP

- A rotating component comprising of an impeller and a shaft.
- A stationery component comprising a volute (casing), suction and delivery pipe.



WORKING PRINCIPLE OF CENTRIFUGAL PUMP



Principle:

When a certain mass of fluid is rotated by an external source, it is thrown away from the central axis of rotation and a centrifugal head is impressed which enables it to rise to a higher level.

Working:

- The delivery valve is closed and the pump is primed, so that no air pocket is left.
- Keeping the delivery valve still closed the electric motor is started to rotate the impeller.
- The rotation of the impeller is gradually increased till the impeller rotates at its normal speed.
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WORKING PRINCIPLE OF CENTRIFUGAL PUMP

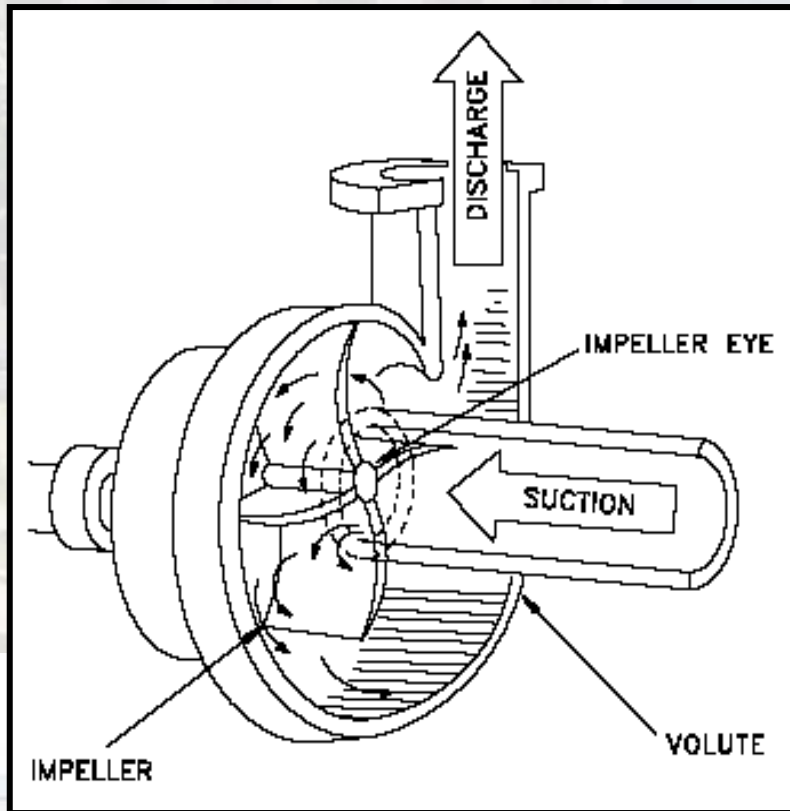


Working:

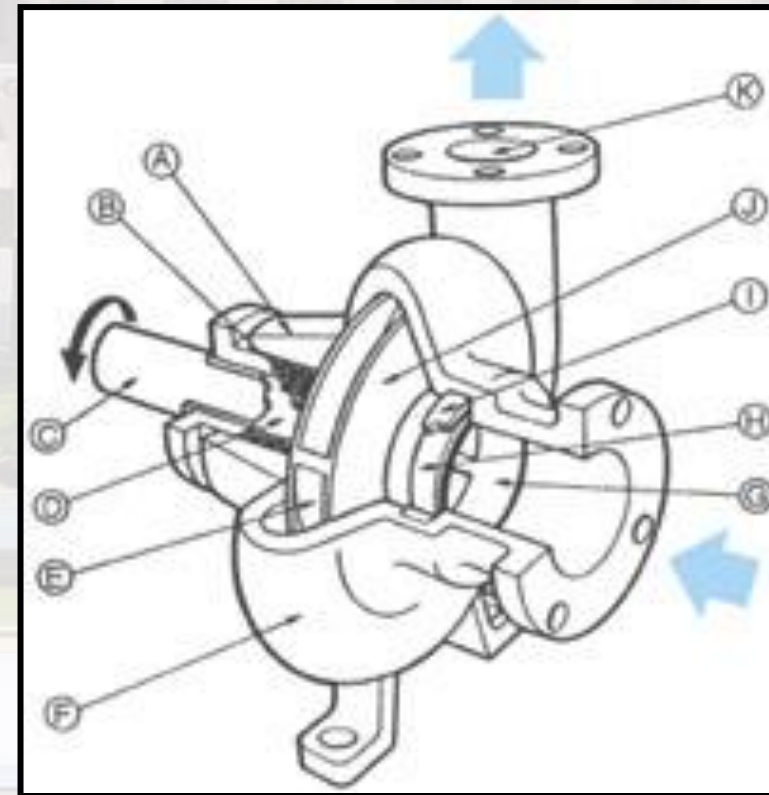
- After the impeller attains the normal speed the delivery valve is opened when the liquid is sucked continuously upto the suction pipe.
- It passes through the eye of the casing and enters the impeller at its centre
- The liquid is impelled out by the rotating vanes and it comes out at the outlet tips of the vanes into the casing.
- Due to the impeller action the pressure head as well as the velocity heads are increased.
- From the casing the liquid passes into the pipe and lifted to the required height.
- When pump is to be stopped the delivery valve is to be first closed, other wise there may be some backflow of water into the reservoir.



VOLUTE AND VORTEX CASING



Volute Casing



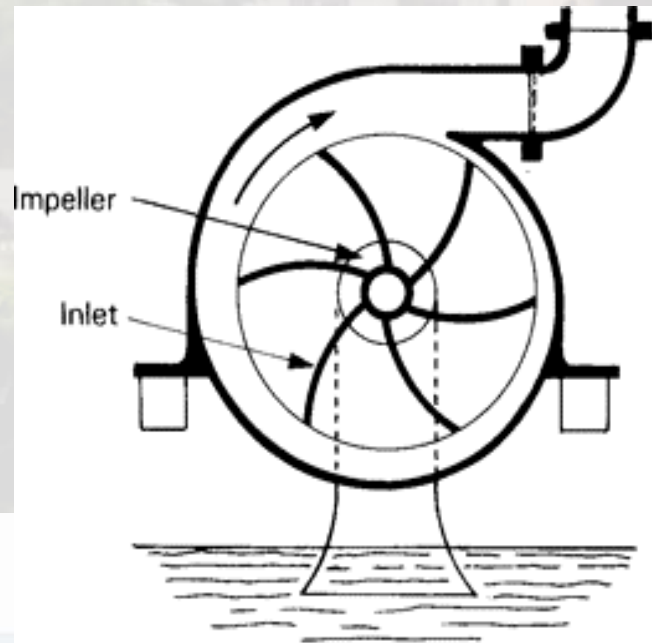
Vortex Casing



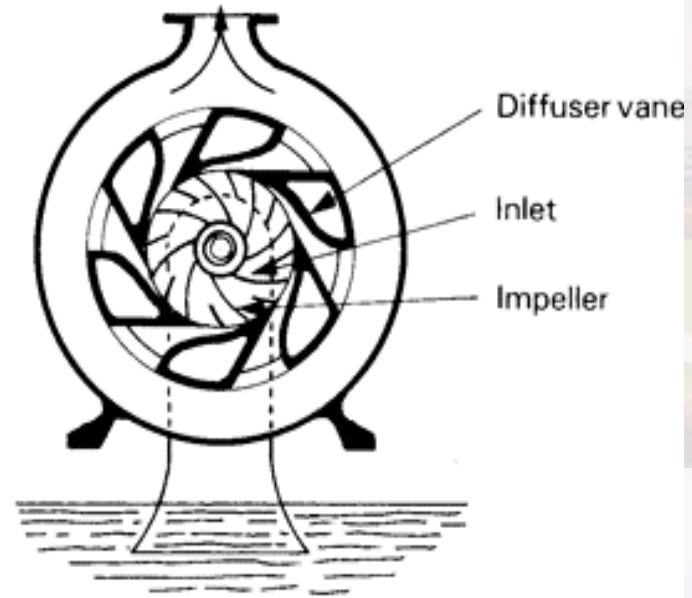
VOLUTE AND DIFFUSER CASING

Volute

Diffuser (guide Vane)



A. - Volute Centrifugal Pump.



B. - Turbine Centrifugal Pump.



VOLUTE AND DIFFUSER CASING



Volute Casing:

In this type of casing the area of flow gradually increases from the impeller outlet to the delivery pipe.

Vortex Casing:

If a circular chamber is provided between the impeller and volute chamber the casing is known as Vortex Chamber.

Diffuser C :

- The impeller is surrounded by a diffuser.
- The guide vanes are designed in such a way that the water from the impeller enters the guide vanes without shock.
- It reduces the vibration of the pump.
- Diffuser casing, the diffuser and the outer casing are stationery parts.



PRIMING OF A CENTRIFUGAL PUMP

- The operation of filling the suction pipe, casing and a portion of delivery pipe with the liquid to be raised, before starting the pump is known as **Priming**
- It is done to remove any air, gas or vapour from these parts of pump.
- If a Centrifugal pump is not primed before starting air pockets inside impeller may give rise to vortices and causes discontinuity of flow



LOSSES IN CENTRIFUGAL PUMP



Hydraulic Losses:

- Shock or eddy losses at the entrance to and exit from the impeller
- Losses due to friction in the impeller
- Friction and eddy losses in the guide vanes/diffuser and casing

Mechanical Losses:

- Losses due to disc friction between the impeller and the liquid which fills the clearance spaces between the impeller and casing
- Losses pertaining to friction of the main bearing and glands.



THANK YOU