

# Mechanical Engineering Fundamentals

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# Mechanical Engineering Fundamentals

## (MEC103)

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# Content

- 1) Fundamental Concepts of Thermodynamics
- 2) Laws of Thermodynamics
- 3) Pressure and its Measurement
- 4) Heat Transfer
- 5) **Power Absorbing Devices**
- 6) Power Producing Devices
- 7) Principles of Design
- 8) Power Transmission Devices and Machine Elements

# Lecture No. - 4

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- Dynamic Pumps

# Power Absorbing Devices

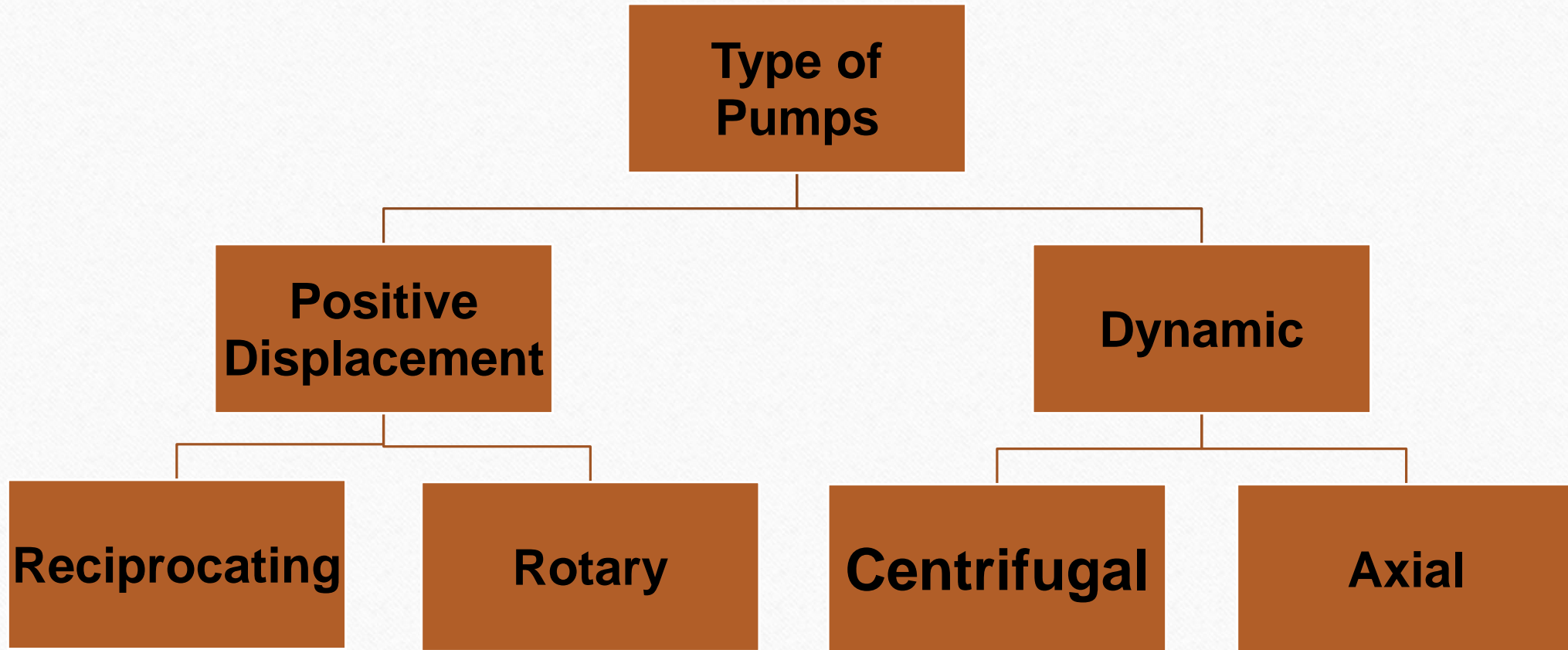
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The equipment's or devices that consume power for the working are called power absorbing devices.

Examples: Pumps, Compressor, Refrigerators etc.



# Classification of Pumps



# Positive Displacement vs Dynamic Pumps

S. No.	Parameter	Positive Displacement Pumps	Dynamic Pumps
1	Flow Rate	Low flow rate	High flow rate
2	Pressure	High	Moderate
3	Priming	Very Rarely	Always
4	Viscosity	Virtually No effect	Strong effect
5	Energy added to fluid	In positive displacement pumps, the energy is added periodically to the fluid.	In dynamic pumps, energy is added to the fluid continuously through the rotary motion of the blades.

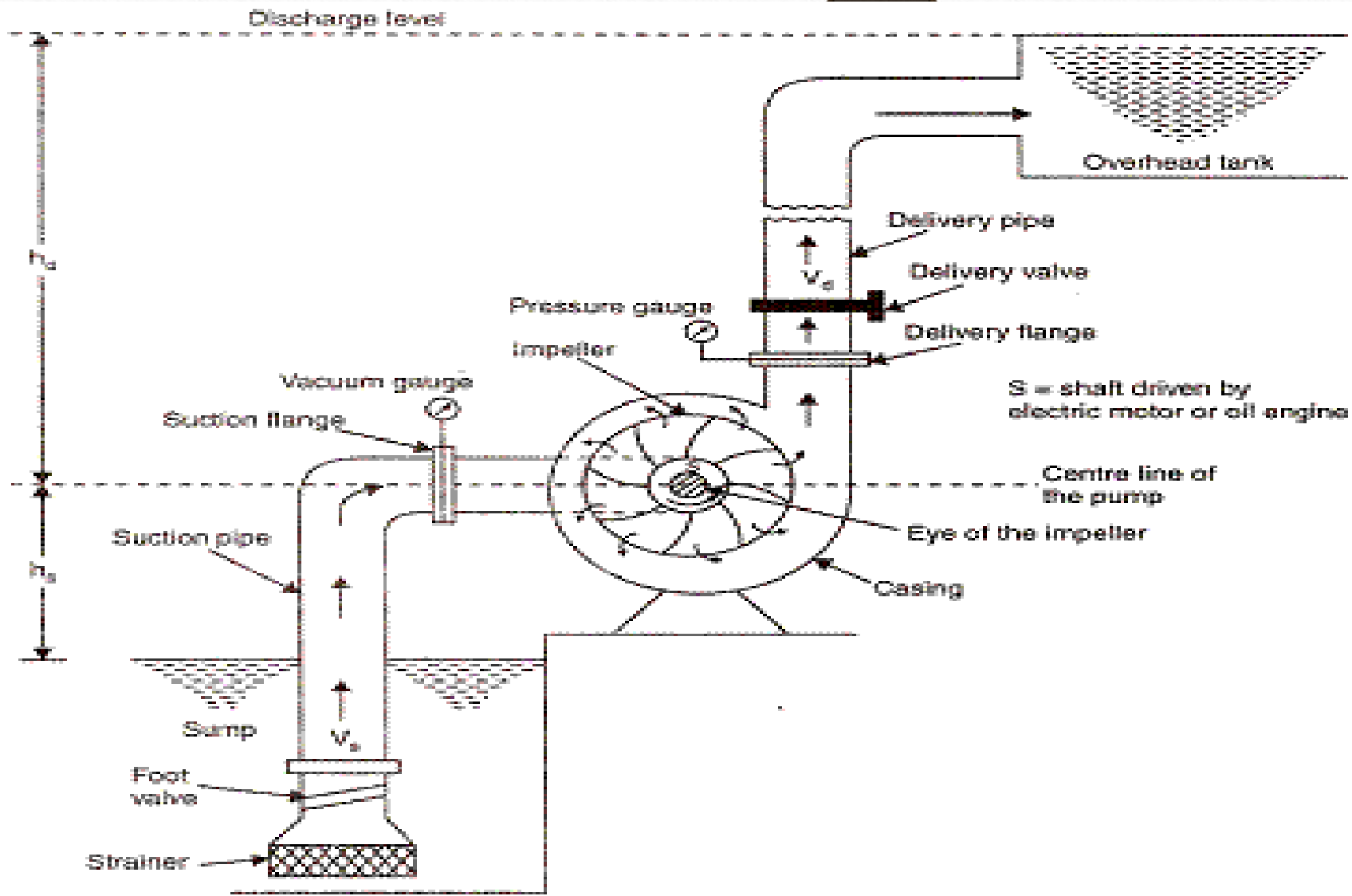
# Centrifugal Pump

- Centrifugal pump is a rotodynamic pump which is used where high discharge or flow rate is required.
- For the functioning of these pumps priming is required in their starting.
- It is suitable where high head is required i.e. it can lift the liquid to a high level.

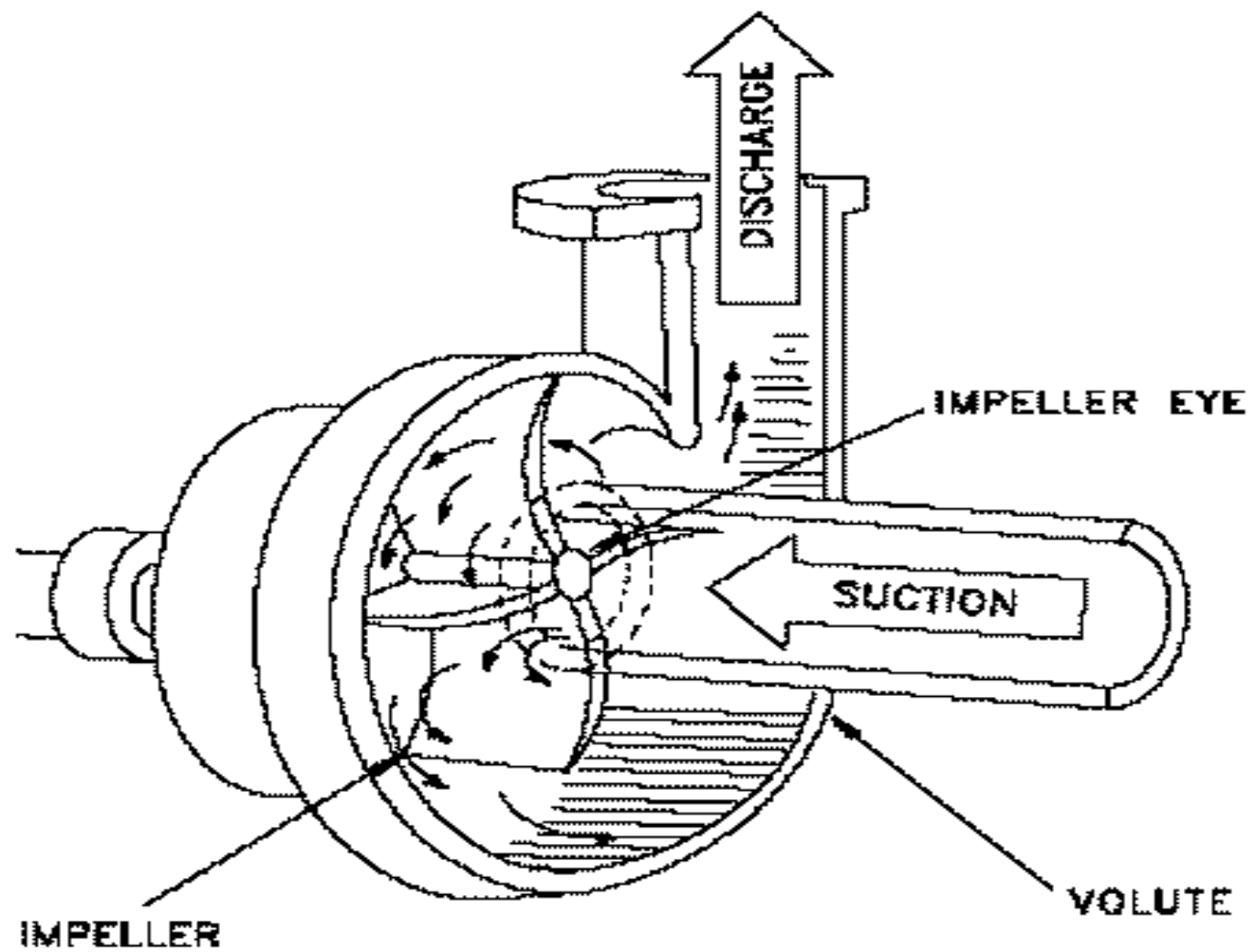


# Principle of Centrifugal Pump

Centrifugal Pump works on the principle of converting Mechanical energy into Pressure energy by means of centrifugal force acting on the fluid.



# Centrifugal Pump





# Main Components of Centrifugal Pump

Centrifugal pump has the following components:

- Stationary components
- Rotating components

**Stationary Components of the centrifugal pump are the following:**

## **1. Casing**

The casing is an **air tight passage** surrounding the pump impeller.

It is designed in such a way that **the kinetic energy of the water discharged** at the **outlet of the impeller** is **converted into pressure energy** before the water leaves the casing and enters the delivery pipe.

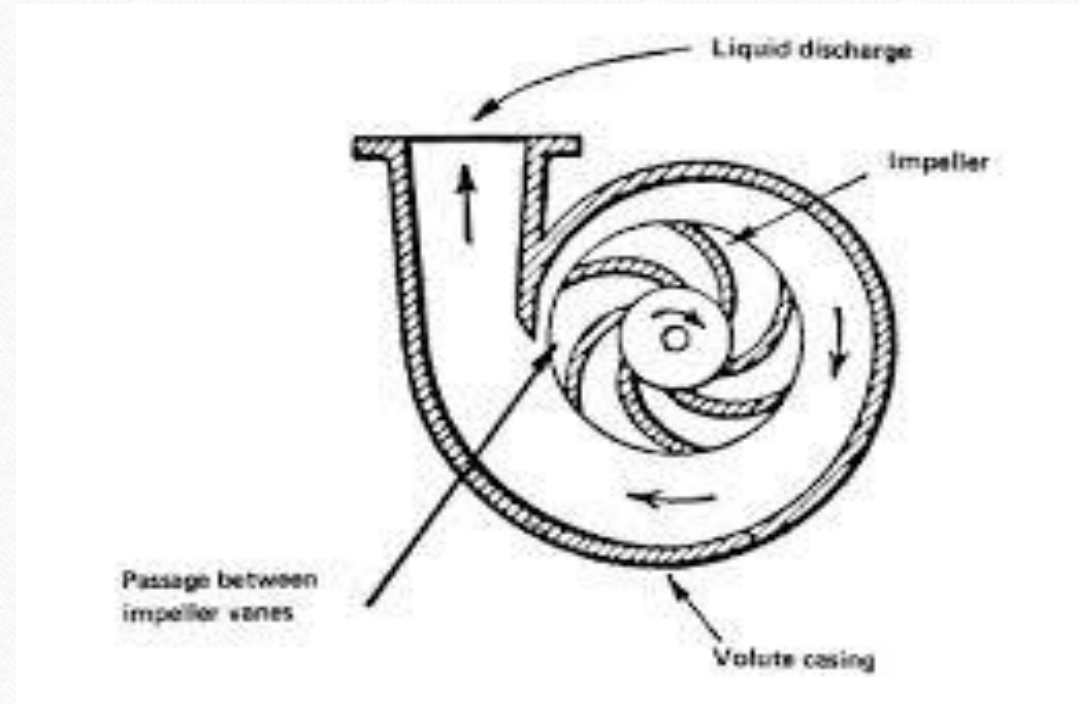
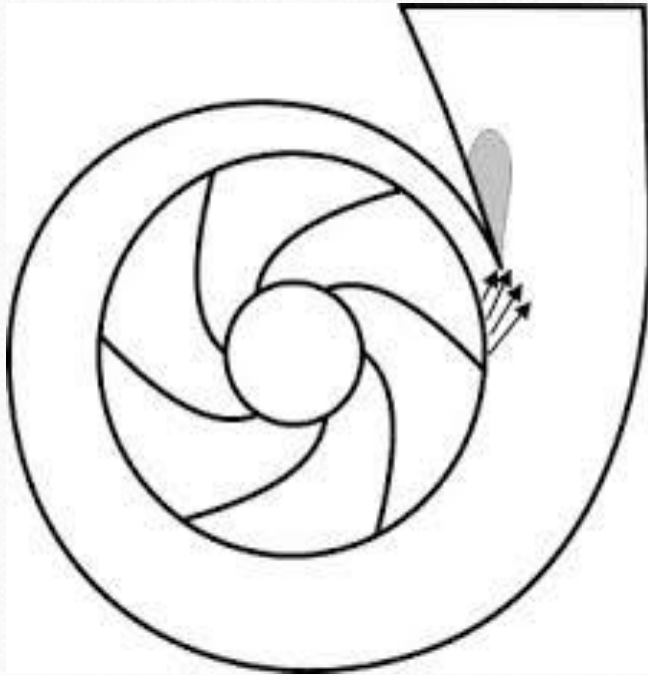
# Type of Casing

- The following three types of casings are commonly employed:
- Volute Casing or Spiral Casing
- Vortex Casing or Whirlpool Chamber
- Casing with guide blades

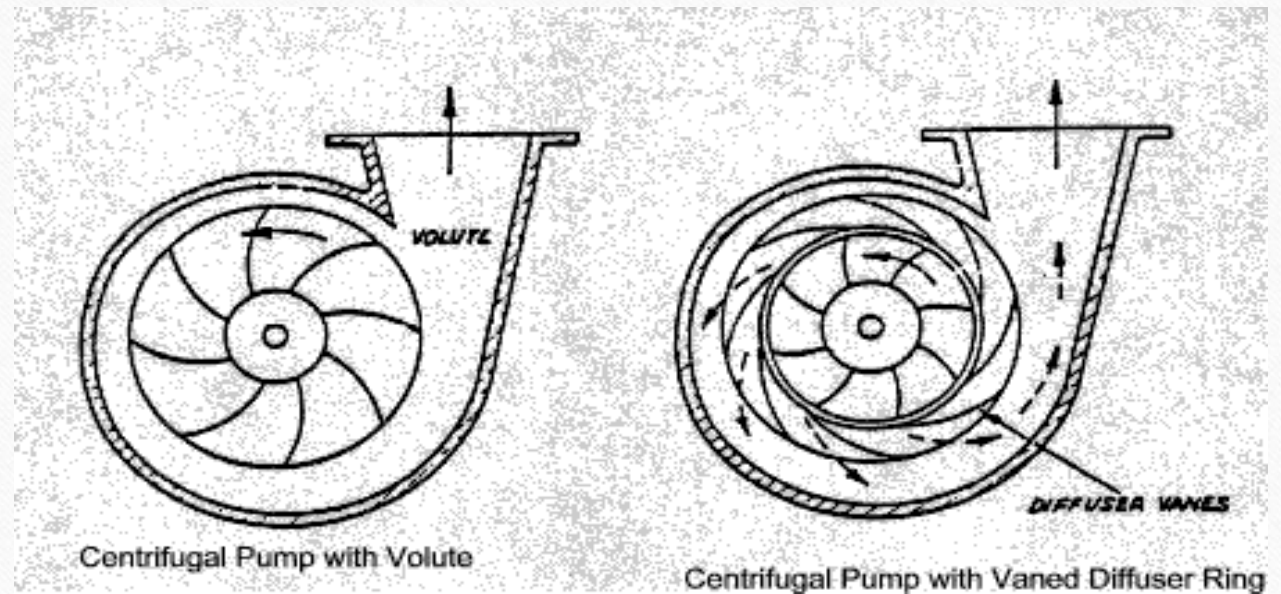
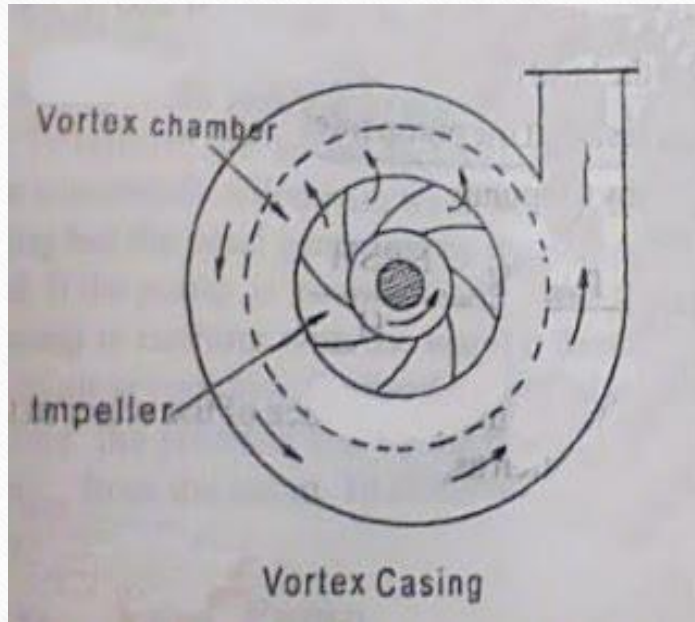
## **Volute Casing**

- Volute casing is of spiral type in which area of flow increases gradually.
- The increase in flow decreases the velocity of flow.
- The decrease in velocity increases the pressure of the liquid flowing through the casing, Thus K.E. is converted into P.E.





**Limitation of Volute Casing:** In this type of casing a considerable loss take place due to formation of eddies in the chamber.



**Vortex Casing** : Vortex casing is an improved form of volute casing in which a circular chamber is introduced between casing and the impeller.

This type of casing minimizes the loss of energy due to less formation of eddies and thus results in an increased efficiency.



**Casing with Guide Blades:** In this type of casing the impeller is surrounded by a series of guide blades mounted on a ring known as diffuser.

The guide blades are designed and arranged in such a way that the liquid from the impeller enters the guide blades without shock.

The liquid from guide blades then passes through the surrounding casing.



## 2. Suction pipe with Foot valve and Strainer

A pipe whose one end is connected to the inlet of the pump (meets at centre of the impeller commonly known as eye of pump) and other end dip into liquid in a sump is known as suction pipe. The pipe is made air tight so that there is no possibility of formation of air bubbles.

A foot valve **which is non-return valve or** one way valve is fitted at the **lower end of suction** pipe. It opens only in **upward direction**. It serves to fill the pump with liquid before it started, and **prevents back flow when** the pump is stopped.

Strainer is provided below the foot valve so as to **prevent the entry of foreign particles** into the pump.

These particles if carried into the pump would adversely affect its performance.

**3. Delivery pipe and Delivery valve:** A pipe whose one end is connected to the outlet of the pump and other end is involved in delivering the water at a required height is known as delivery pipe.

The diameter of delivery pipe is should be less than that of suction pipe. A regulating valve is called delivery valve is provided on the delivery pipe to regulate the supply of liquid.



# Rotating Components of the centrifugal pump are the following:

## 1. Impeller

It is the rotating part of the Centrifugal Pump.

It consist of series of backward curved vanes.

The impeller is mounted on shaft which is connected to the shaft of an electric motor.

it is of three types:

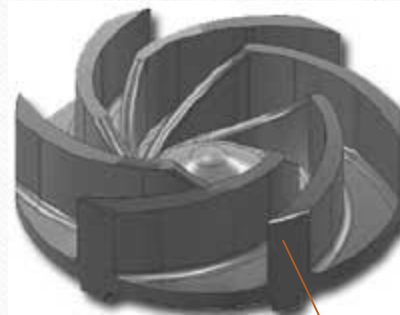
Open Type

Semi Open

Closed



Open



Semi-Open



Closed



# Impellers



**Open or No shrouds or Wall to enclose the vanes:** In open impeller, no plate is provided on either side i.e. vanes are open on both sides. These designs are preferred where pump has a very rough duty to perform such as a mixture of water sand, pebbles etc.

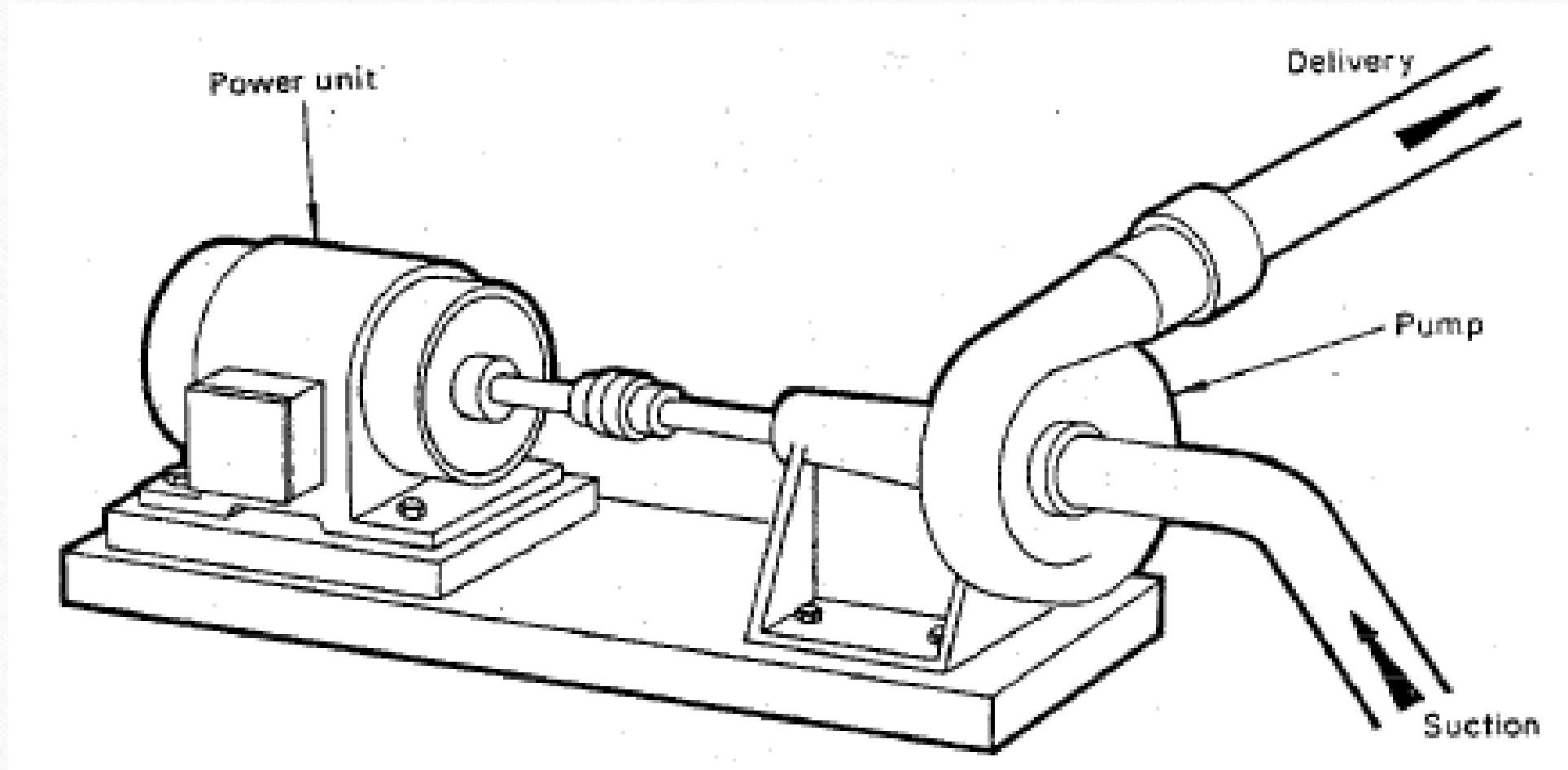
**Semi-open or Vortex type:** In semi open impellers, vanes are covered with plate only on back side. These designs are preferred to handle liquids containing fibrous material such as paper pulp, sewage water etc.

**Closed or Shrouds or Sidewall is enclosing the vanes:** In closed impellers, vanes are covered with shrouds or side plates on both sides, so that there is no slippage of liquid.

These are required to handle clear liquids such as water. The material of the impeller is selected according to the chemical properties of the liquid to be handled.



# Centrifugal Pump



# ADVANTAGES OF CENTRIFUGAL PUMPS

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- Maintenance costs are lower
- It has high output and high efficiency.
- It requires minimum space for installation as it is compact in design.
- It can be installed for high speed driving mechanism.
- The working is simple and there is no valve in the pump, hence it is reliable and durable.



# DISADVANTAGES OF CENTRIFUGAL PUMPS

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- The pump will not work, if the chamber is not full of water. So, the priming should always be done before starting the pump.
- The pump will not work if there is any leakage in the suction side.

<b>S. No</b>	<b>Reciprocating Pump</b>	<b>Centrifugal Pump</b>
1	It is a type of positive displacement pump where energy is added periodically.	It is a type of dynamic pump where energy is added continuously.
2	It gives pulsating and unsteady flow.	It gives even and smooth flow.
3	Initial cost is high.	Initial cost is low.
4	Occupy 6-8 times more space as compared to Centrifugal pump.	Occupy less area.
5	Priming is not required.	Priming is needed.
6	Installation is difficult.	Installation is easy.
7	Operates at low speed.	Operates at high speed.
8	It can be used for lifting less viscous liquids.	It can be used for lifting highly viscous liquids.
9	Maintenance cost is high.	Maintenance cost is low.
10	Gross weight is more.	Gross weight is less.



**THANK YOU**

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