CENTRIFUGAL PUMPS

A **centrifugal pump** is a rotodynamic pump that uses a rotating impeller to increase the pressure of a fluid. Centrifugal pumps are commonly used to move liquids through a piping system. The fluid enters the pump impeller along or near to the rotating axis and is accelerated by the impeller, flowing radially outward into a diffuser or volute chamber (casing), from where it exits into the downstream piping system. Centrifugal pumps are used for large discharge through smaller heads.

CENTRIFUGAL PUMPS

Modern process plants use powerful centrifugal pumps, primarily because of the following factors :

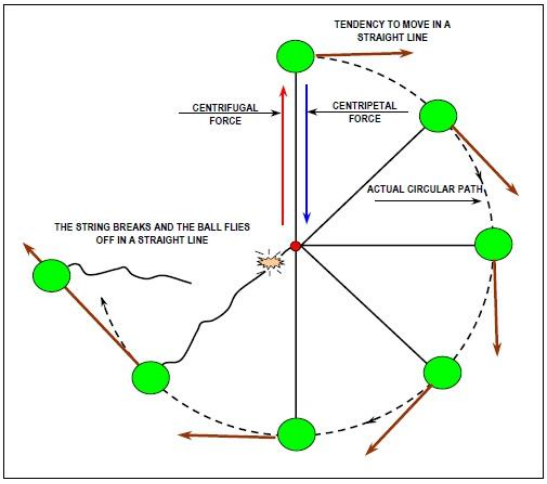
1. The low initial cost.
2. Low maintenance costs.
3. Simple in operation.
4. Ability to operate under a wide variety of conditions.
5. Give a smooth, continuous flow, free from pulsation.

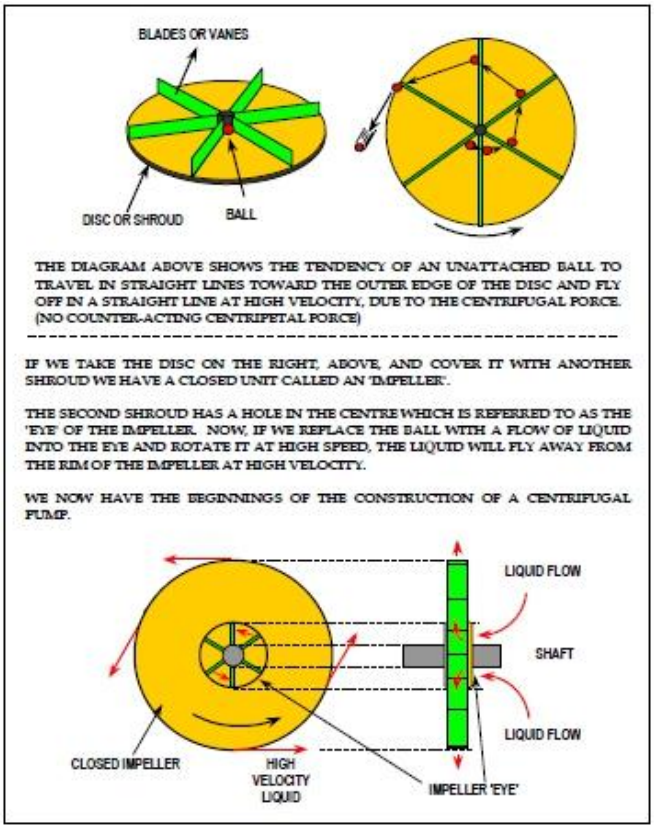
CENTRIFUGAL FORCE

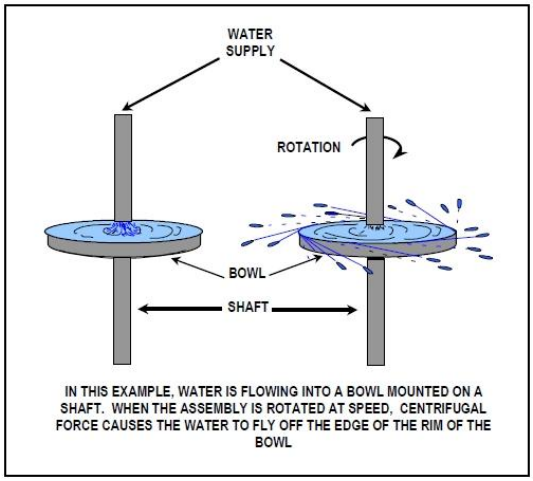
The word, ' centrifugal ' is derived from the latin language and is formed from two words 'centri' meaning 'centre' and 'fugal' meaning 'to fly away from'.

Centrifugal - 'to fly away from the centre'.

This is the force developed due to the rotation of a body - solid, liquid or gas. The force of rotation causes a body, or a fluid, to move away from the centre of rotation.







Parts of a Centrifugal Pump

A centrifugal pump is built up of two main parts:

1. THE ROTOR (or Rotating Element).
2. THE CASING (or Housing or Body).

The Rotor

One of the greatest advantages of a centrifugal pump is that it has very few moving parts which minimises mechanical problems and energy losses due to friction.
Other than the bearings, (and of course the driver), the only moving part in a centrifugal pump is the Rotor.
The Rotor (Rotating Element), is made up of the following main components :

1. THE IMPELLER(S) -Often called the 'Wheel(s)'. (In the centre of an impeller, is the 'EYE' which receives the inlet flow of liquid into the 'Vanes' of the impeller).
2. THE SHAFT -The impeller(s) is/are mounted on the shaft and enclosed by a casing.

The Impellers

These consist of wheel shaped elements containing 'Curved Vanes' at the centre of which is the liquid inlet called the 'EYE' of the impeller.

The wheel(s) is/are mounted on the shaft, (together called 'the Rotating Element' which is rotated at high speed. The liquid is thrown off the outer edge of the vanes, and more liquid flows into the eye to take its place. The speed of rotation of the wheel imparts kinetic energy to the liquid in the form of velocity which will be converted to pressure (potential) energy.

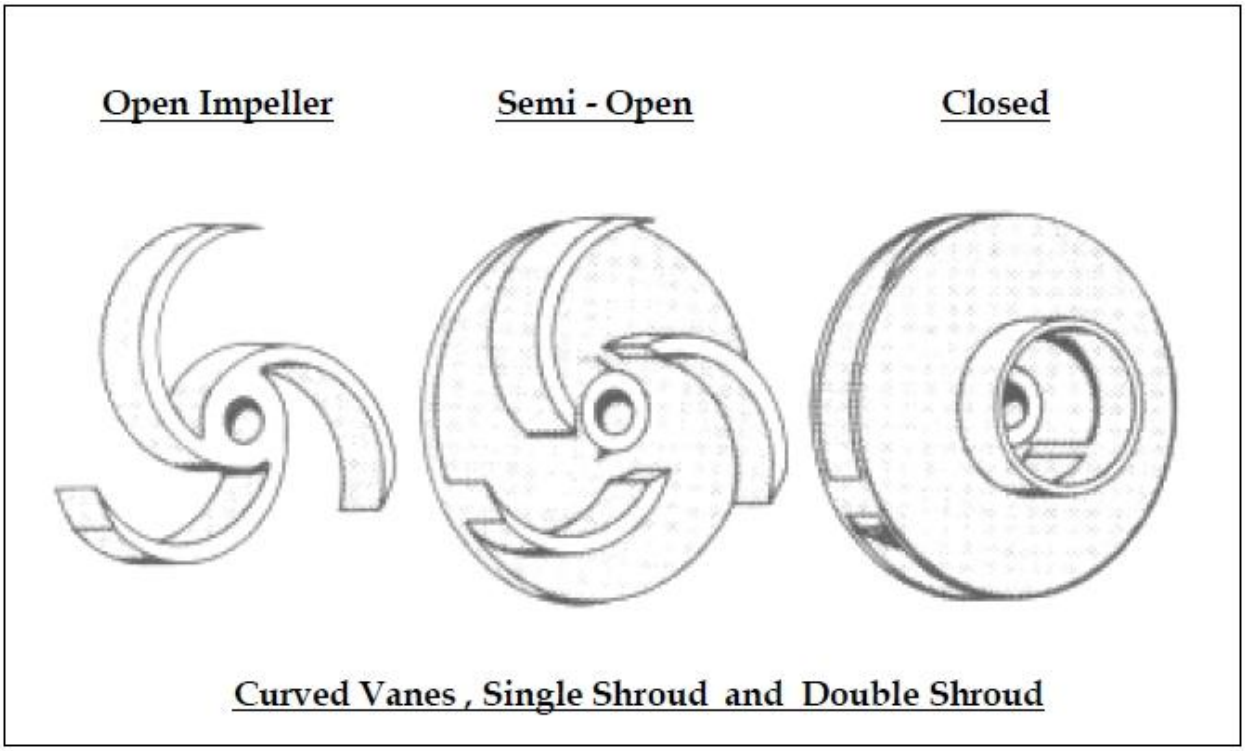
There are various types of impeller depending on the duty to be performed by the pump.

1. The Open Impeller : This type consists of vanes attached to a central hub with no side wall or 'shroud'. It is used for pumping highly contaminated slurry type liquids.
2. Semi-Open Impeller : This type has the vanes attached to a wall or shroud on one side. It is used mainly for lightly contaminated and abrasive liquids and slurries.
3. Closed Impeller : This impeller has the vanes enclosed on both sides by a shroud and is the most efficient impeller, used for clean or very slightly contaminated liquids. Impellers can also be

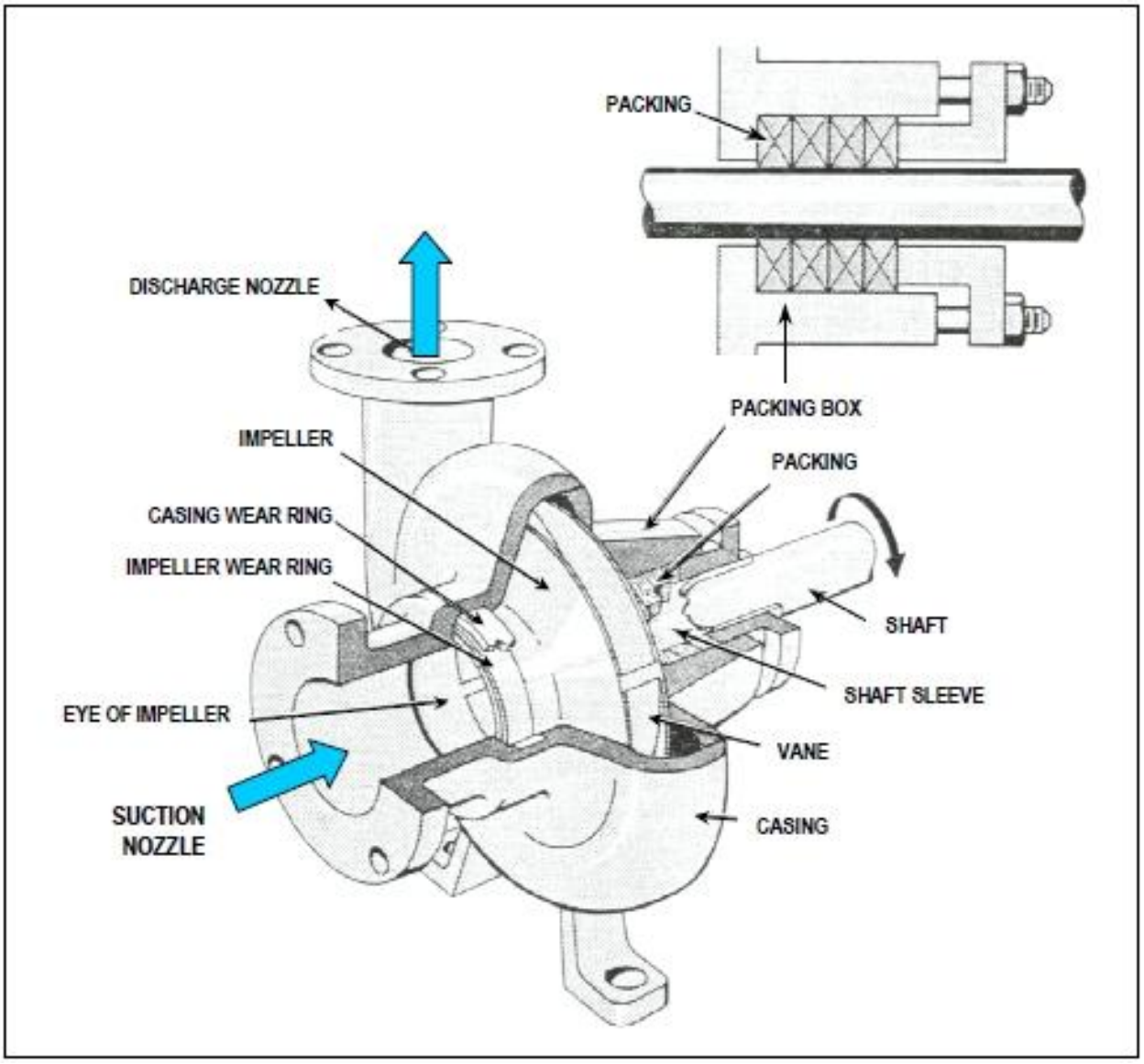
classified according to the vane curvature - i.e. 'Backward' curve used for high flow rate. 'Forward' curve for high liquid head and 'Straight' for either service.

Types of Impeller

High power, high volume pumps are fitted with more than one impeller. This type is called a 'Multi-stage' pump and is actually a series of pumps mounted on the shaft within a single casing. The liquid leaving each impeller rim, is fed into the eye of the next wheel. In this way, the pressure is built up in stages through the pump. The more stages, the higher the discharge pressure. As liquids cannot be compressed and therefore no change in volume takes place, the impellers of a multi-stage pump are all the same size – (unlike those of a compressor). How the liquid is passed from stage to stage is discussed later in the notes on the casing.



Curved Vanes , Single Shroud and Double Shroud



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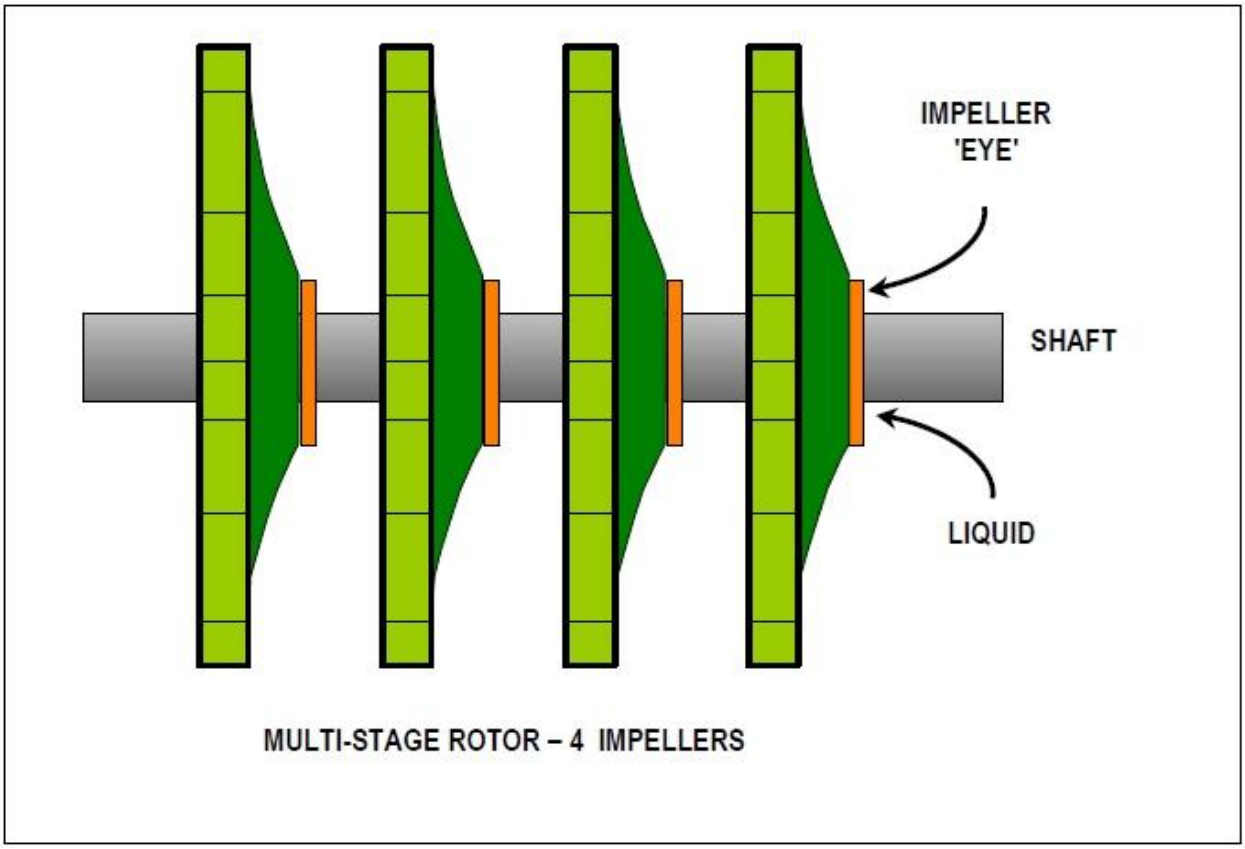

The Shaft

The Impeller(s) are mounted on this part of the pump which is then referred to as the 'Rotor' or rotating element which is coupled (connected) to the pump driver. The driver imparts the rotation to the rotor that is housed in the casing, supported by the bearings.

The shaft, due to the high speed of rotation, will tend to move :-

- Radially -movement across the shaft (Vibration) and,
- Axially -movement along the shaft (Thrust).

In order to minimise and control these movements, bearings are fitted (as discussed earlier).

Source : http://nprcet.org/e%20content/mech/FMM.pdf