ANJUMAN-I-ISLAMS
KALSEKAR TECHNICAL CAMPUS (AIKTC)

COURSE: APPLIED HYDRAULICS (CE

COURSE OUTECOME:

EXPLAIN THE WORKING AND FUNCTIONS OF CENTRIFUGAL PUMPS.

MODULE NO-05

CENTRIFUGAL PUMPS

INTRODUCTION:

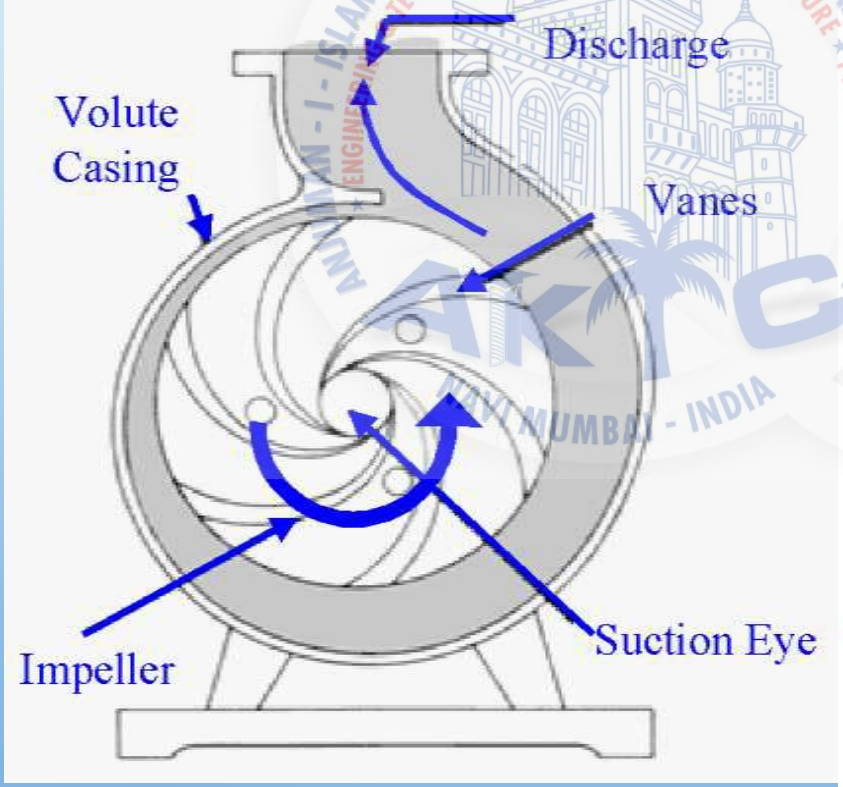
- It converts mechanical energy into hydraulic energy (pressure energy) by virtue of centrifugal force.
- Flow is in radial outward direction.
- It works on principle of forced vortex flow.
- Common uses include water, sewage, petroleum and petrochemical pumping.

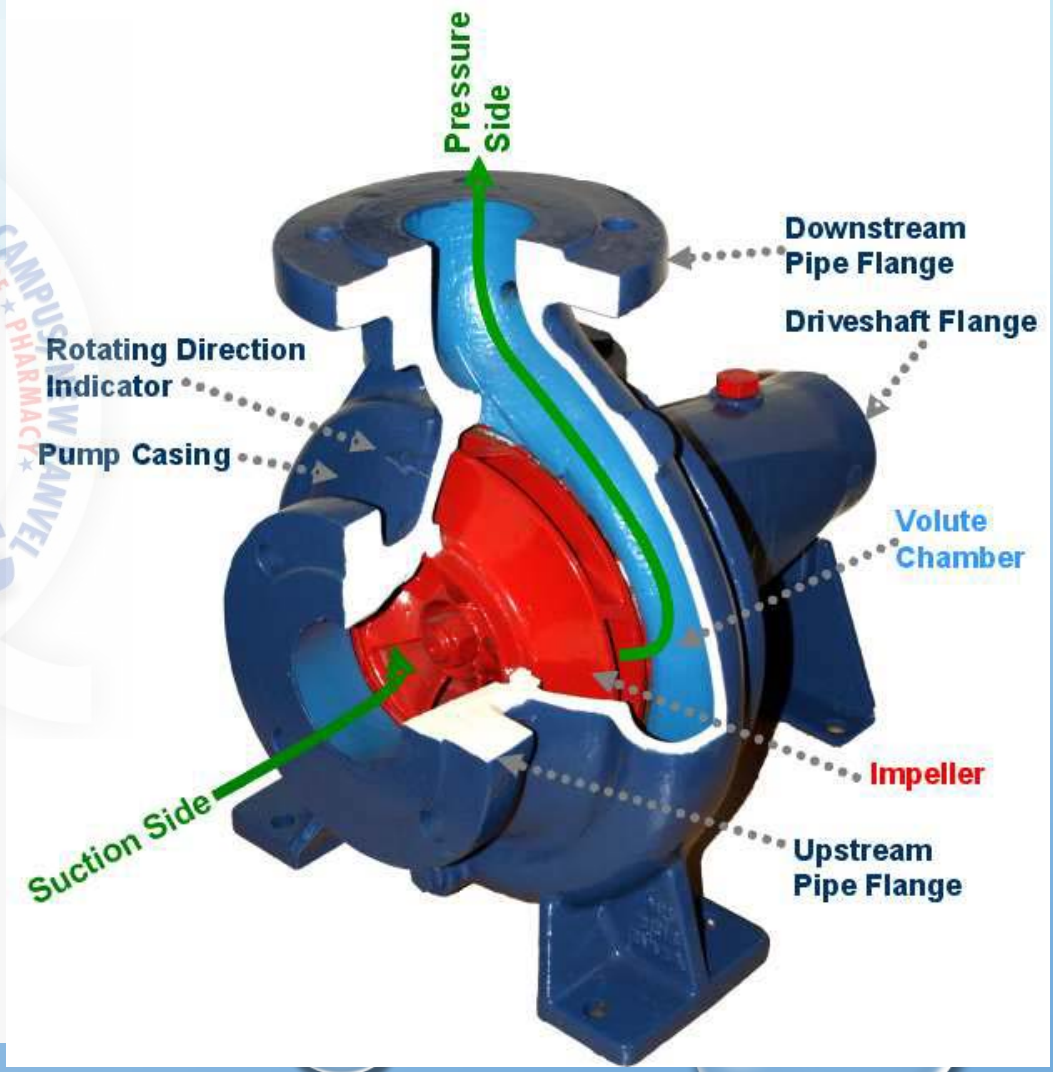
PRINCIPLE:

- It works on the principle of forced vortex flow means when a certain mass of fluid is rotated by external torque rise in pressure head takes place.
- Conversion of energy occur by virtue of two main parts of the pump:
  a) Impeller
  b) Casing.
- Impeller converts driver energy into the kinetic energy & diffuser converts the kinetic energy into pressure energy.

COMPONENTS:

- Impeller
- Casing
- Suction pipe
- Foot valve and strainer
- Delivery pipe





ROTATING COMPONENTS:

- A centrifugal pump has two main components:

I. A rotating component comprised of an impeller and a shaft.

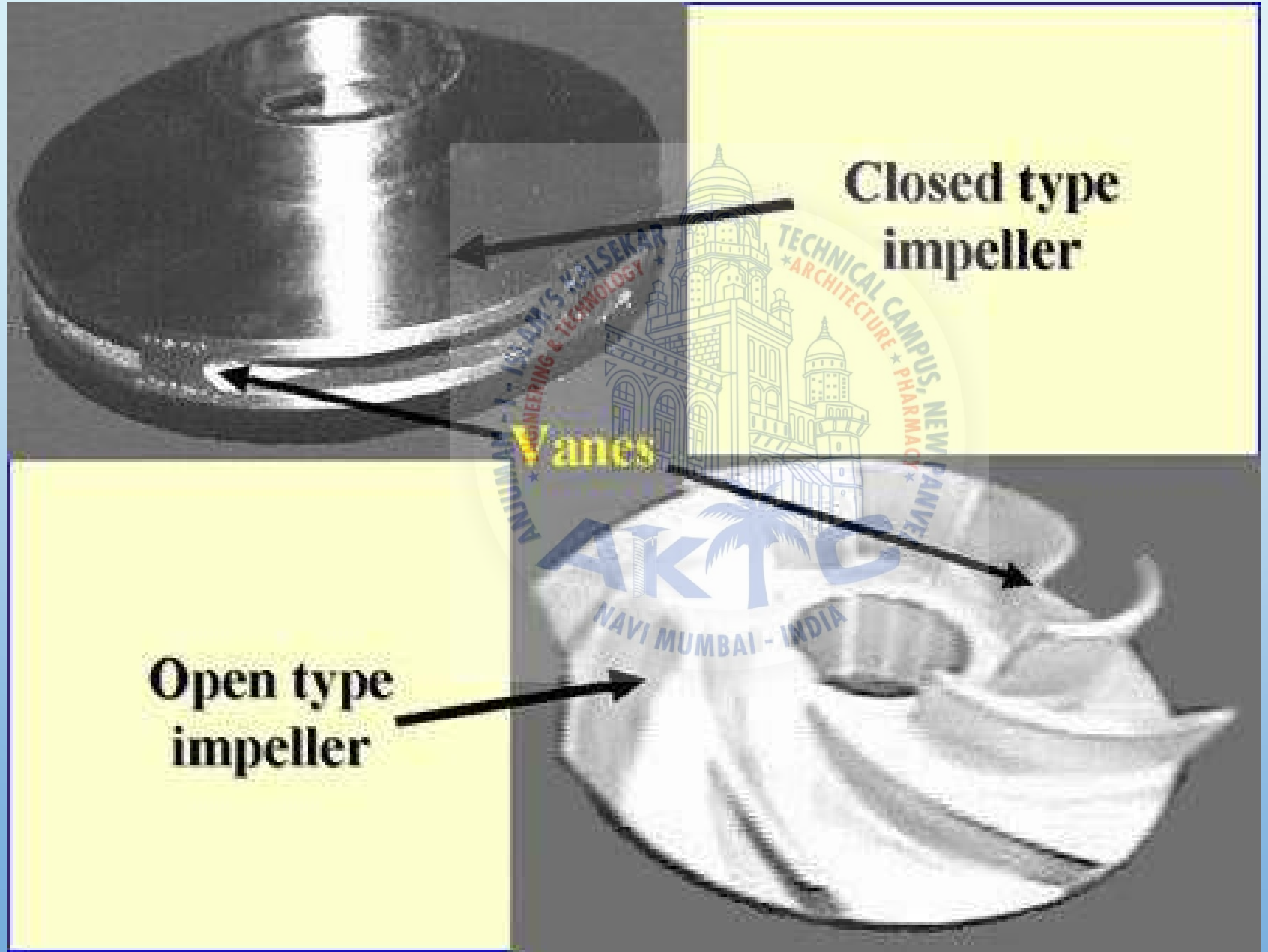
II. A stationary component comprised of a casing, casing cover, and bearings.

Impeller: The impeller is the main rotating part that provides the centrifugal acceleration to the fluid.

Shaft: Its purpose is to transmit the torques encountered when starting and during operation.

Supports the impeller & other rotating parts.

ROTATING COMPONENTS:



STATIONARY COMPONENTS:

- Casing: The main purpose of casing is to convert kinetic energy into pressure energy.
- Casings are generally of three types:

a) Volute : Used for higher head, eddy currents formed

b) Vortex : Eddy currents are reduced.

c) Circular : Used for lower head.

- A volute is a curved funnel increasing in area to the discharge port. As the area of the cross-section increases, the volute reduces the speed of the liquid and increases the pressure of the liquid.

STATIONARY COMPONENTS:

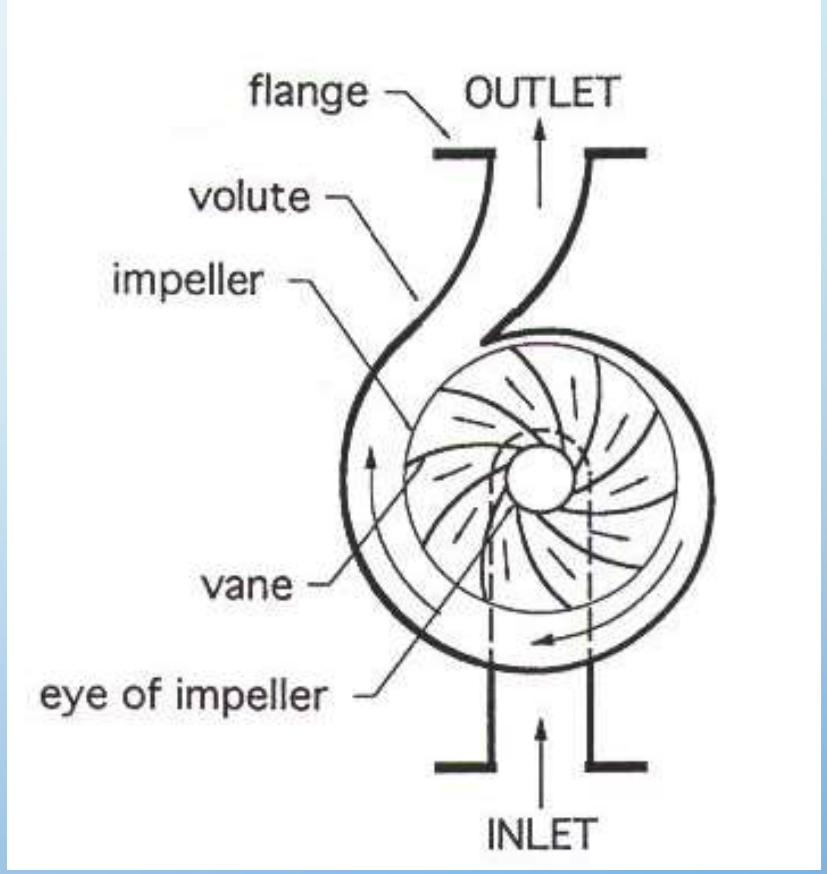
- Vortex Casing :A circular chamber is introduced between casing and impeller. Efficiency of pump is increased
- Circular casing have stationary diffusion vanes surrounding the impeller periphery that convert velocity energy to pressure energy.
- Conventionally, the diffusers are applied to multi-stage pumps.

PRIMING:

- It is the process of filling suction pipe, casing and delivery pipe upto delivery valve with water.
- Used to remove air from these parts.
- It is of 2 types:
  - a) Positive Priming:-The one which speeds up processing.
  - b) Negative Priming:-The one which slows down the processing.

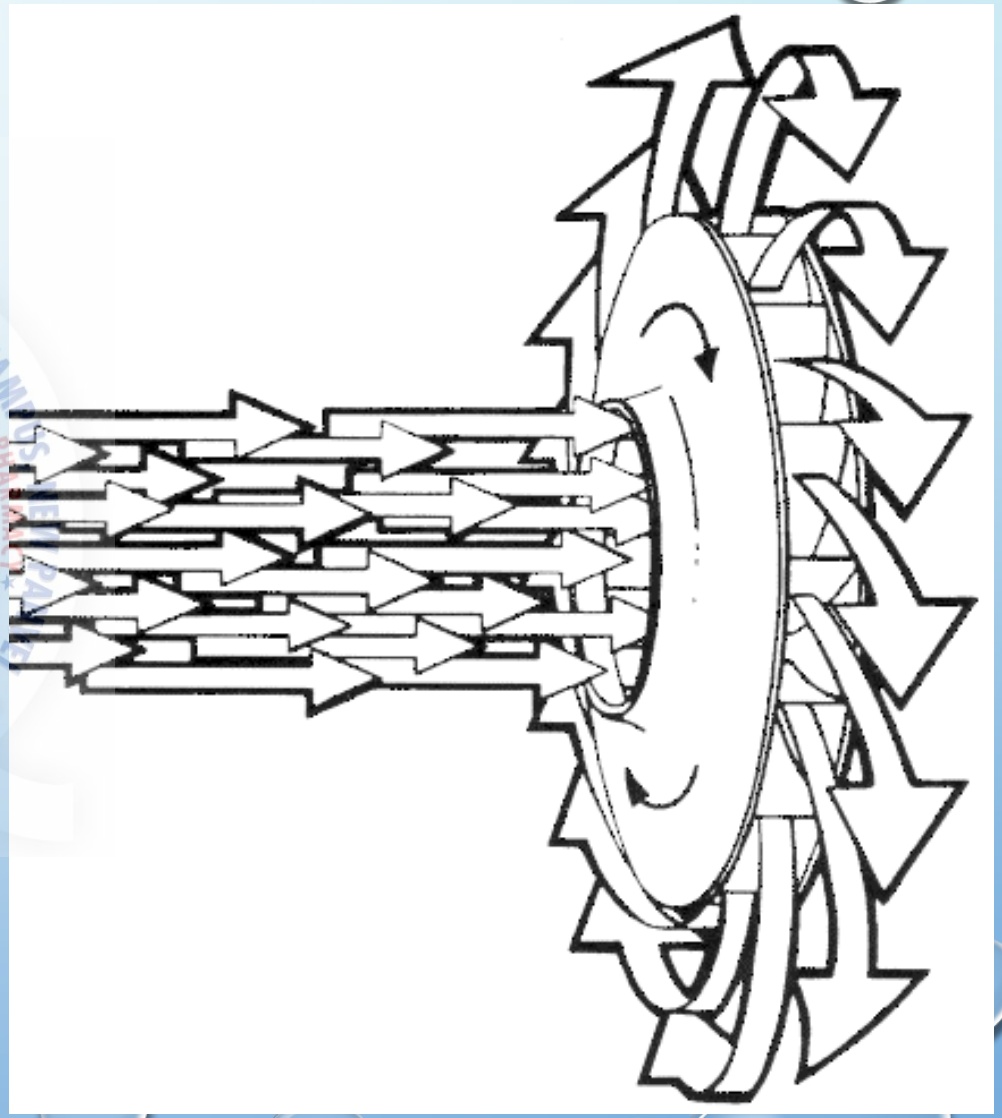
HOW DO THEY WORK?

- Liquid forced into impeller .
- Vanes pass kinetic energy to liquid: liquid rotates and leaves impeller
- Volute casing converts kinetic energy into pressure energy

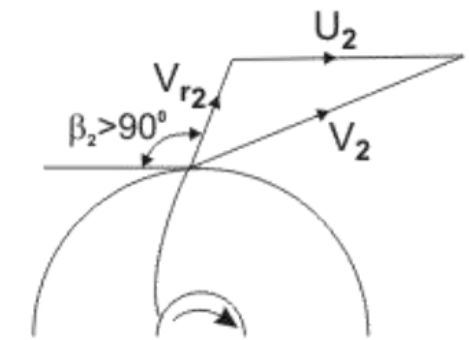


HOW DO THEY WORK?

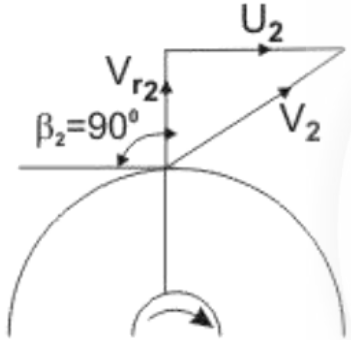
- It consists of an IMPELLER rotating within a casing.
- Liquid directed into the center of the rotating impeller is picked up by the impeller's vanes and accelerated to a higher velocity by the rotation of the impeller and discharged by centrifugal force into the casing .



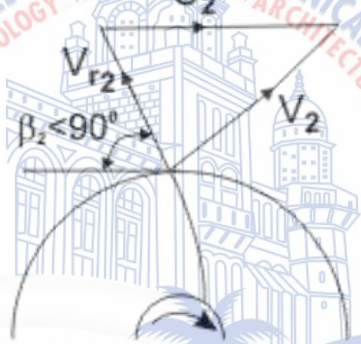
VELOCITY TRIANGLE:



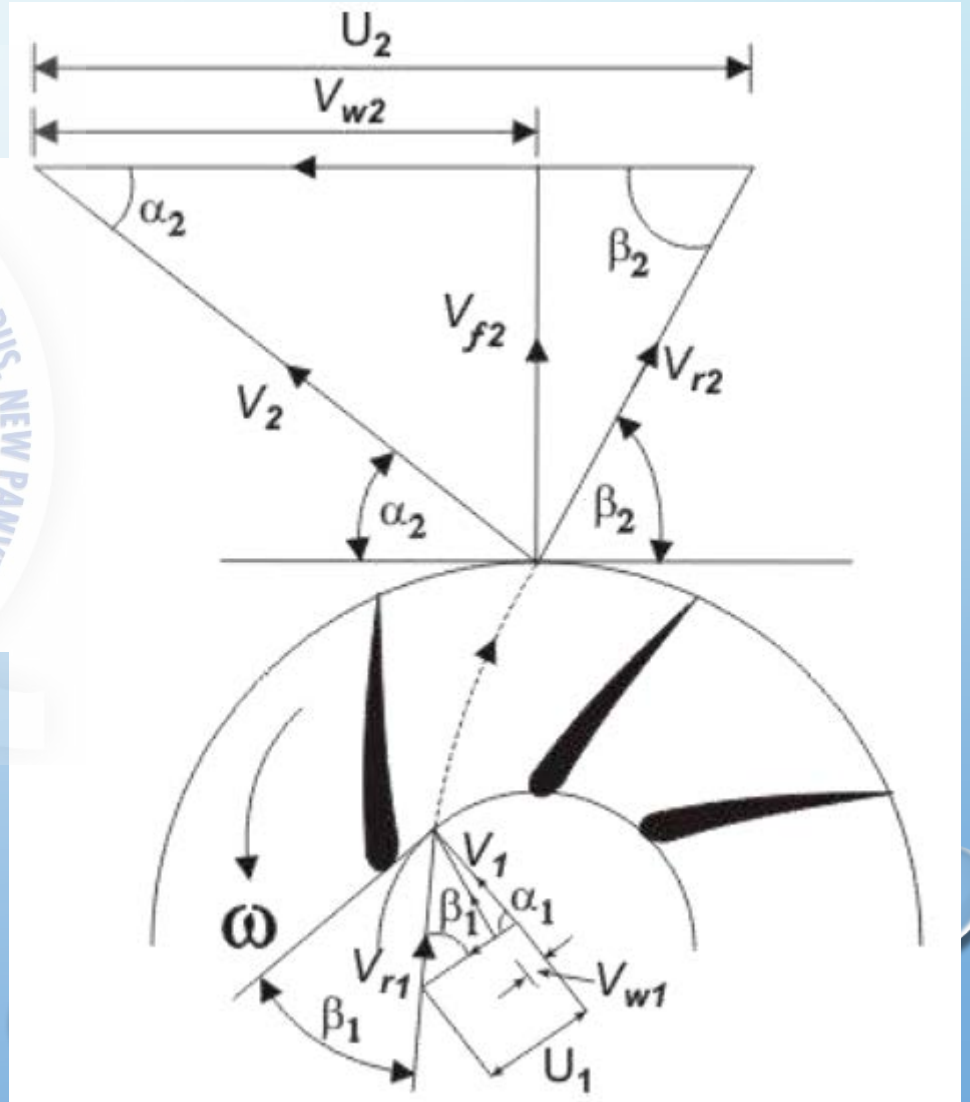
(a) Forward-facing vanes



(b) Radial vanes



(c) Backward-facing vanes



WORK DONE:

Work is done by the impeller on the water

$W=[Vw2U2-Vw1U1]/g$

where,

W=work done per unit wt. of water per sec.

Vw2=whirl component of absolute vel. of jet at outlet.

U2=tangential vel. of impeller at outlet.

Vw1=whirl component of absolute vel. of jet at inlet.

U1=tangential vel. of impeller at inlet.

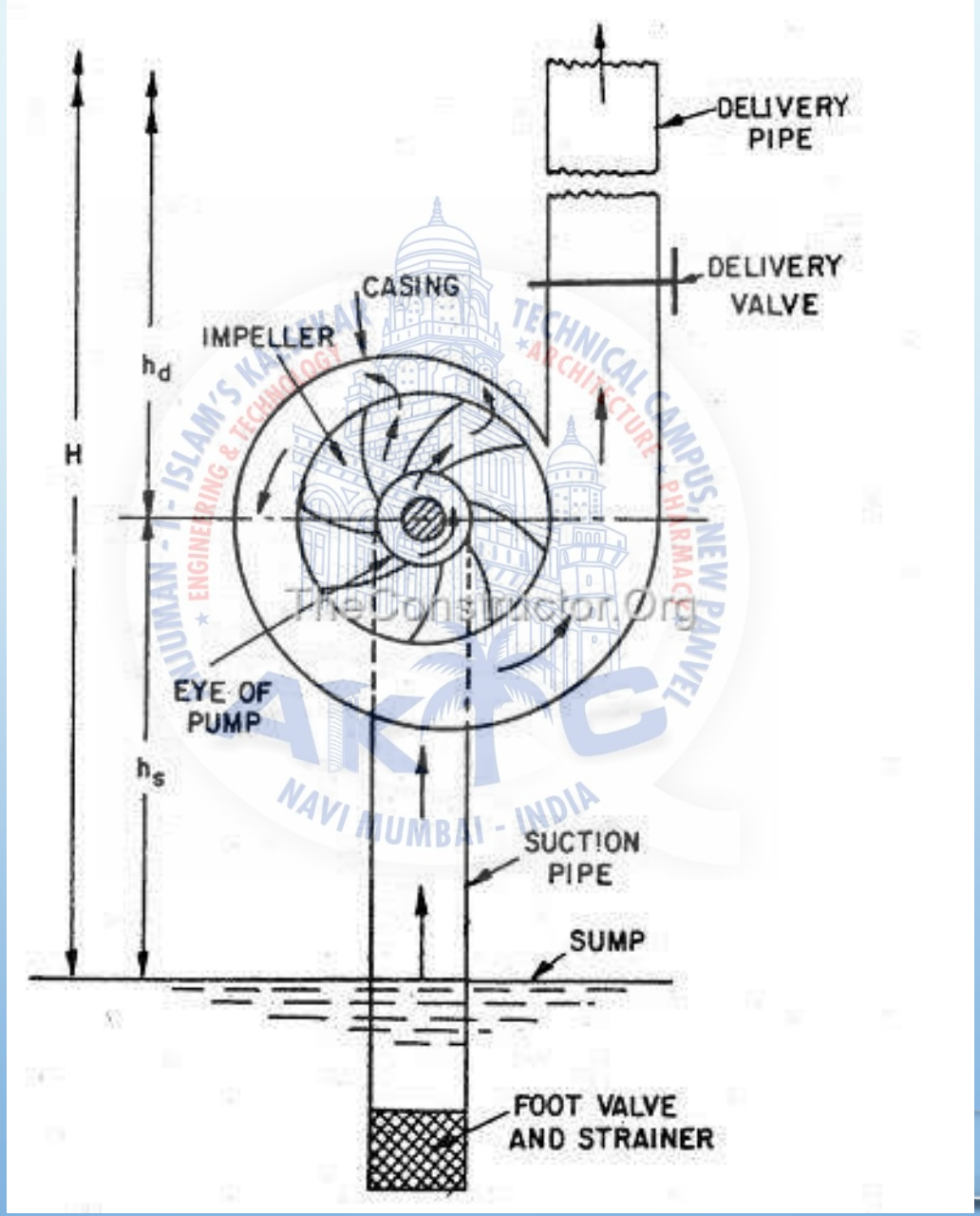
As water comes radially :

Guide blade angle at inlet $\alpha=900$

HEADS IN CENTRIFUGAL PUMP:

- Suction Head:- Vertical height of center line of centrifugal pump above the water surface to the pump from which water to be lifted.
- Delivery Head:- Vertical distance between center line of the pump and the water surface in the tank to which water is delivered.
- Static Head:- Sum of suction head and delivery head.
- Manometric Head:- The head against which a centrifugal pump has to work.
- Hm=hs+hd+hfs+hfd+(Vd*Vd)/2g

HEADS IN CENTRIFUGAL PUMP:



EFFICIENCIES:

Manometric efficiency:-The ratio of manometric head to the head imparted by impeller.

=Hm/(Vw2 u2/g)

Mechanical efficiency :-The ratio of power delivered by the impeller to the liquid to the power input to the shaft.

=(WVw2u2/g)/(power input to the pump shaft)

Overall Efficiency:-Ratio of power output of the pump to power input to the pump or shaft.

= wQHm/P

=WHm/P

CHARACTERISTICS CURVE:

These are required to predict the performance & behavior of pump working under different head, flow rate & speed.

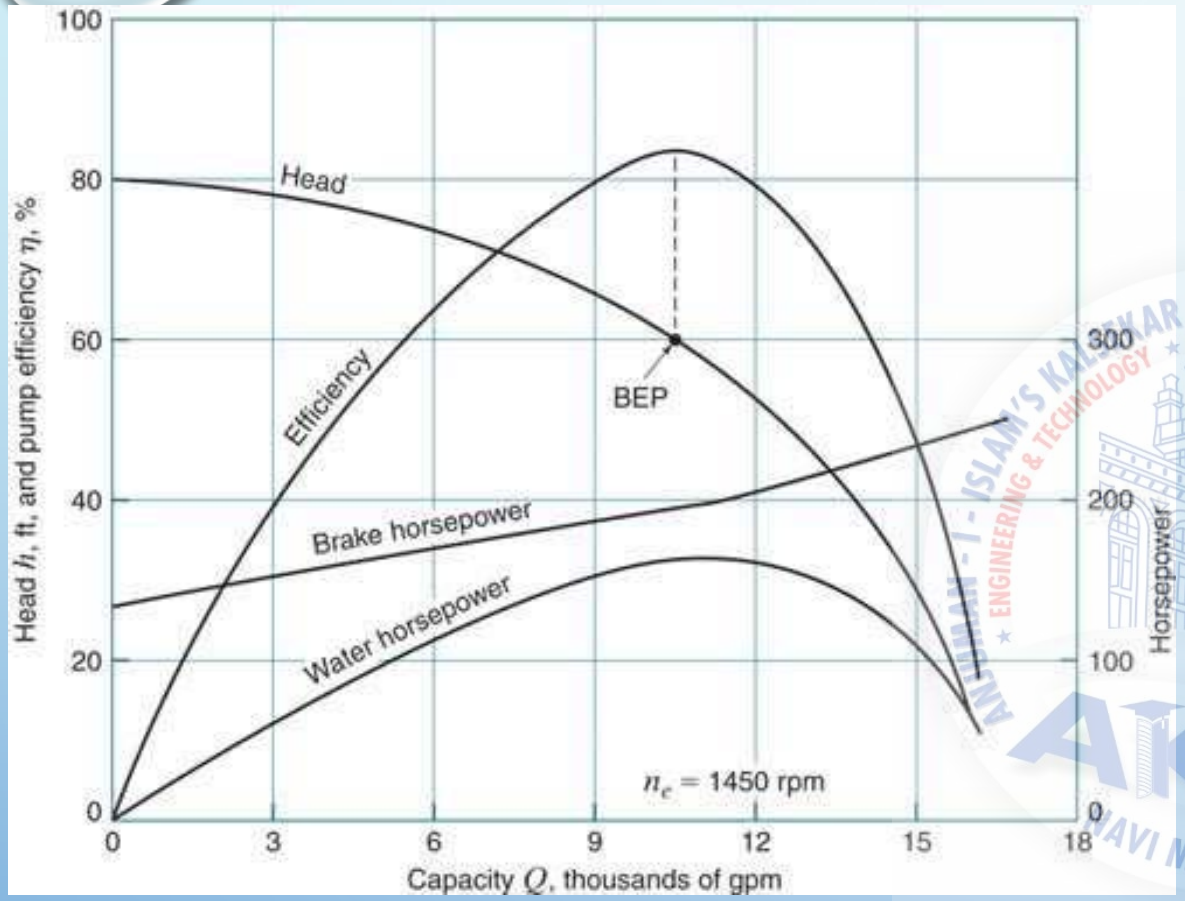
Following are the important curves:

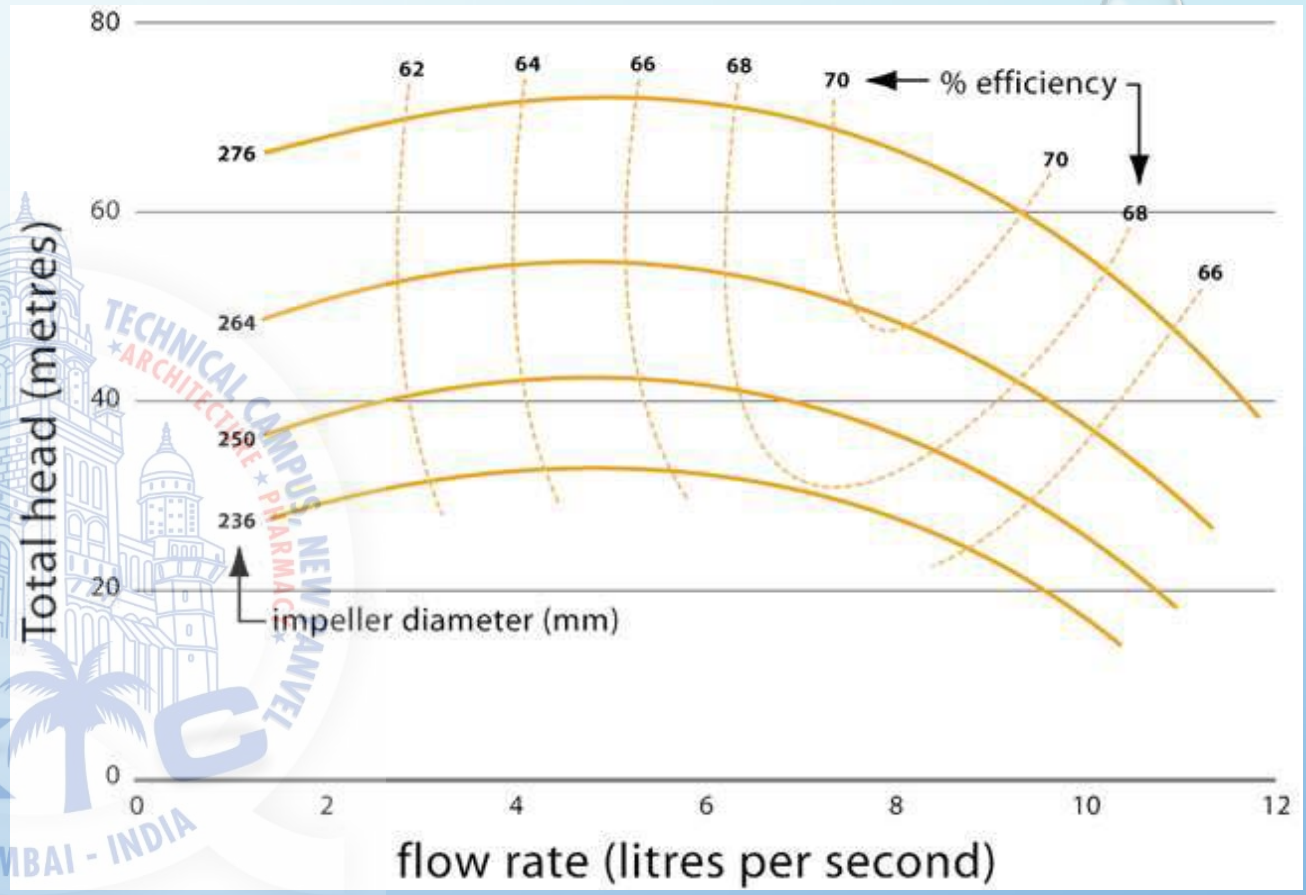
a) Main characteristic curve.

b) Operating characteristic curve.

c) Muschel or constant efficiency curve.

OPERATING CHARACTERISTICS CURVE:





NQ1/2/Hm 3/4=C

P/(D5N3)=C

η=ρQgH/S.P.

Constant efficiency curve

MULTI STAGE CENTRIFUGAL PUMP:

It consists of two or more impellers.

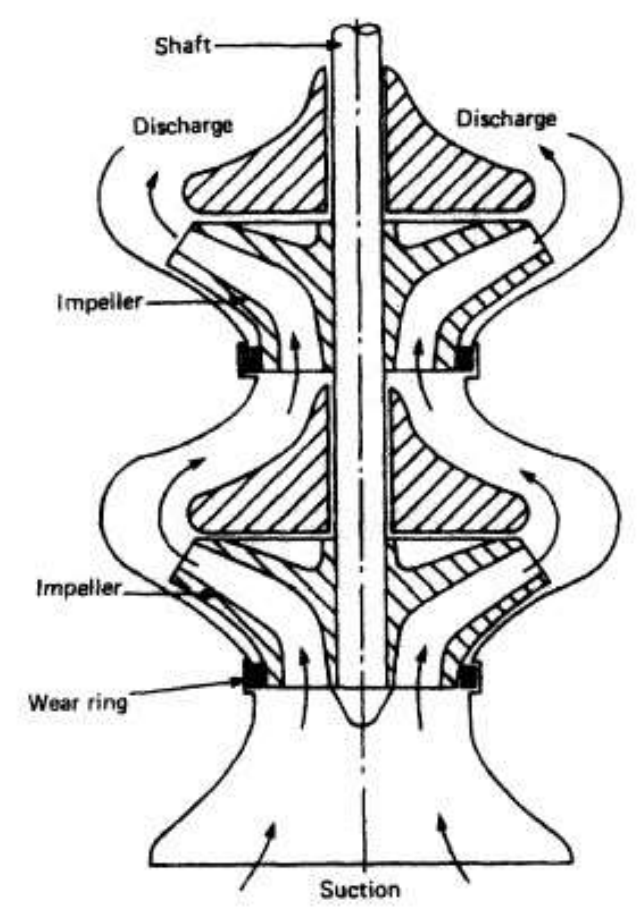
There are two types as follows:

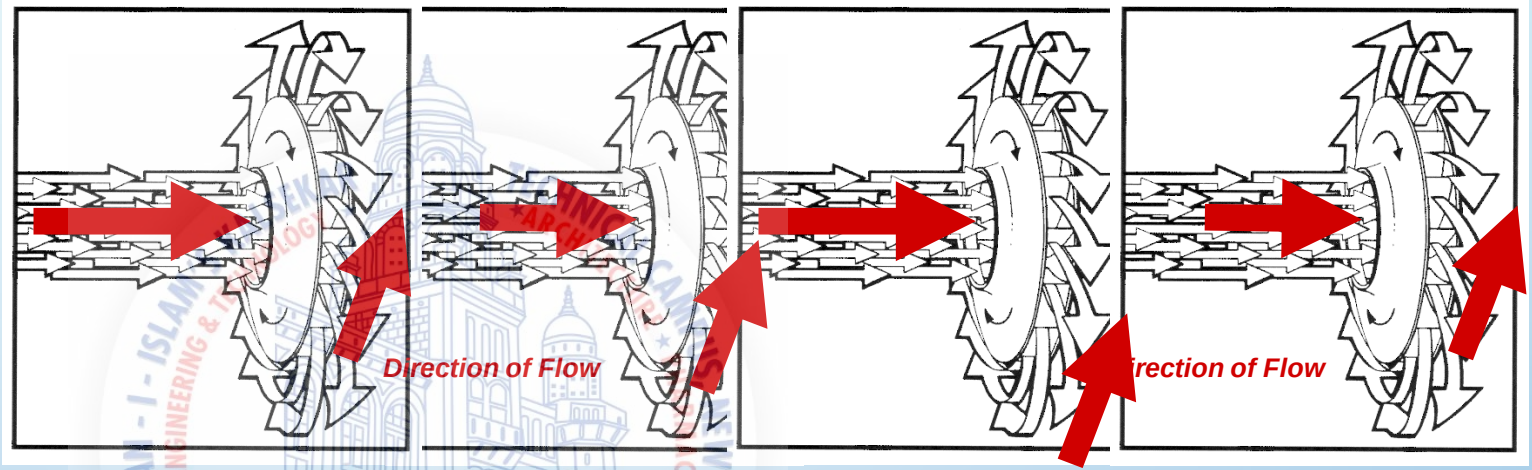
a) SERIES :To produce high head.

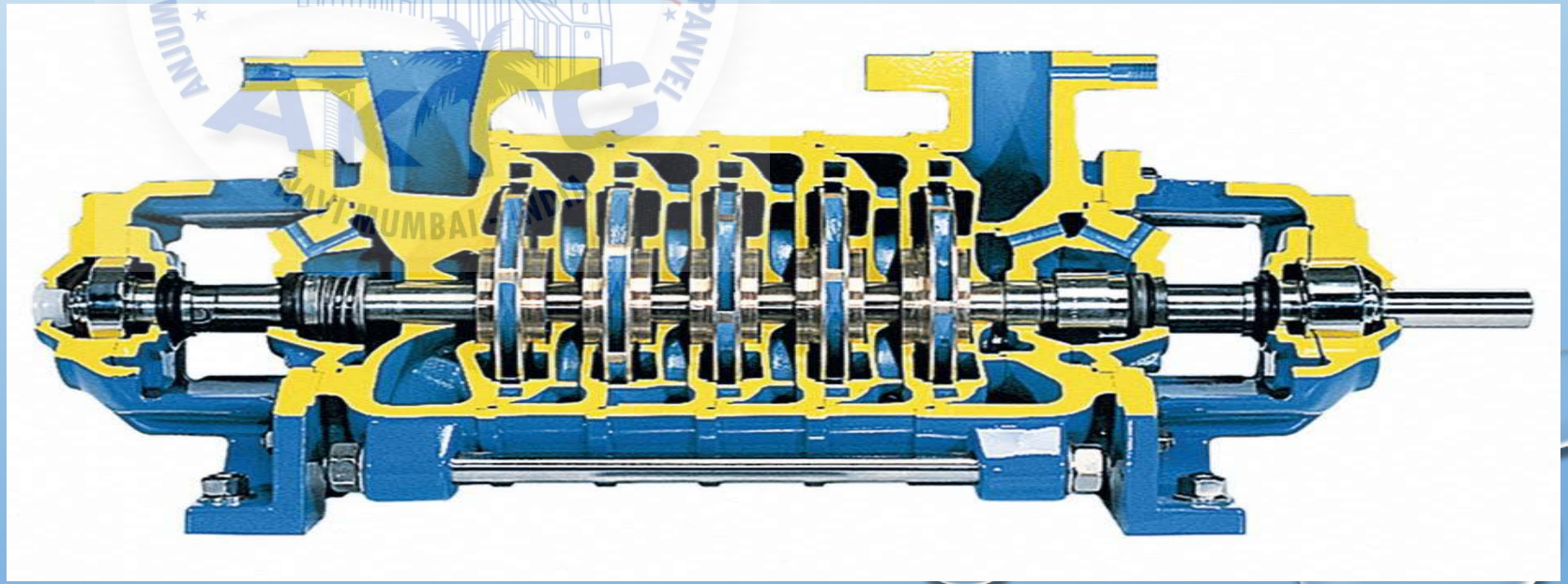
b) PARALLEL :To discharge large quantity of liquid.

MULTI STAGE CENTRIFUGAL PUMP:

Series combination for high head







MULTI STAGE CENTRIFUGAL PUMP:

Parallel combination for high discharge

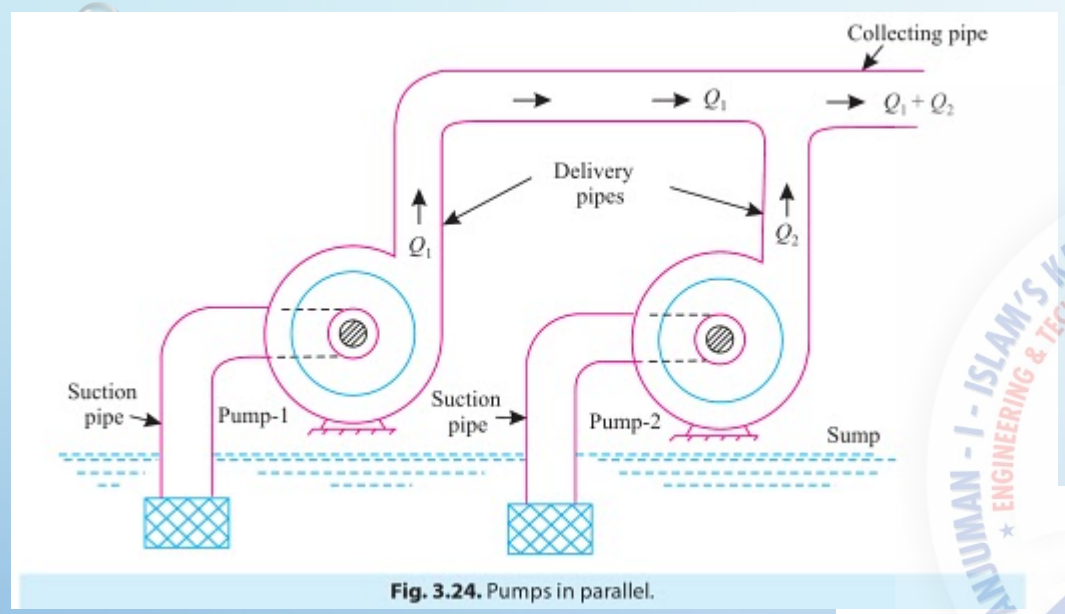


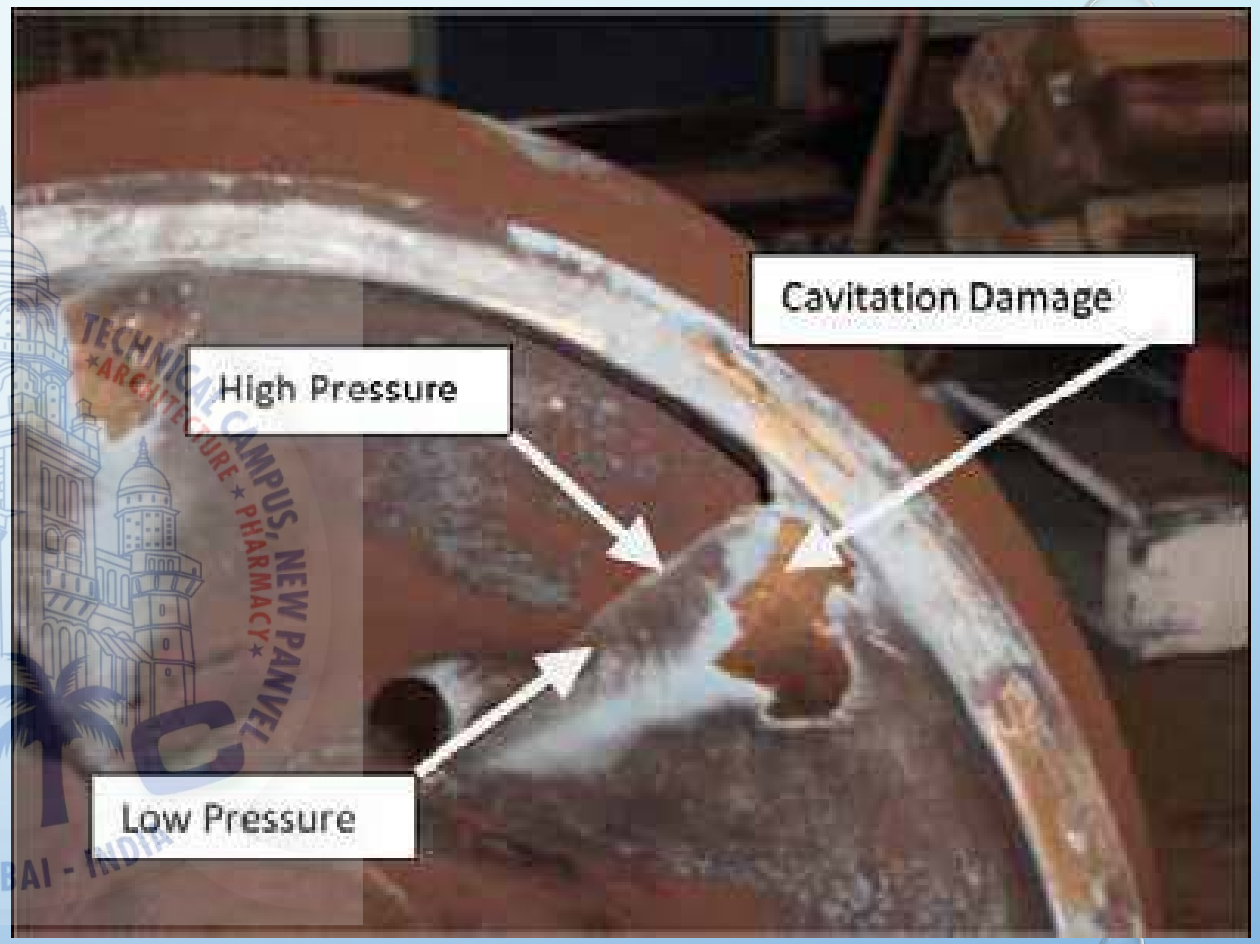
Fig. 3.24. Pumps in parallel.

CAVITATION :

It is a phenomena of formation of vapour bubble where the pressure falls below the vapour pressure of flowing liquid .

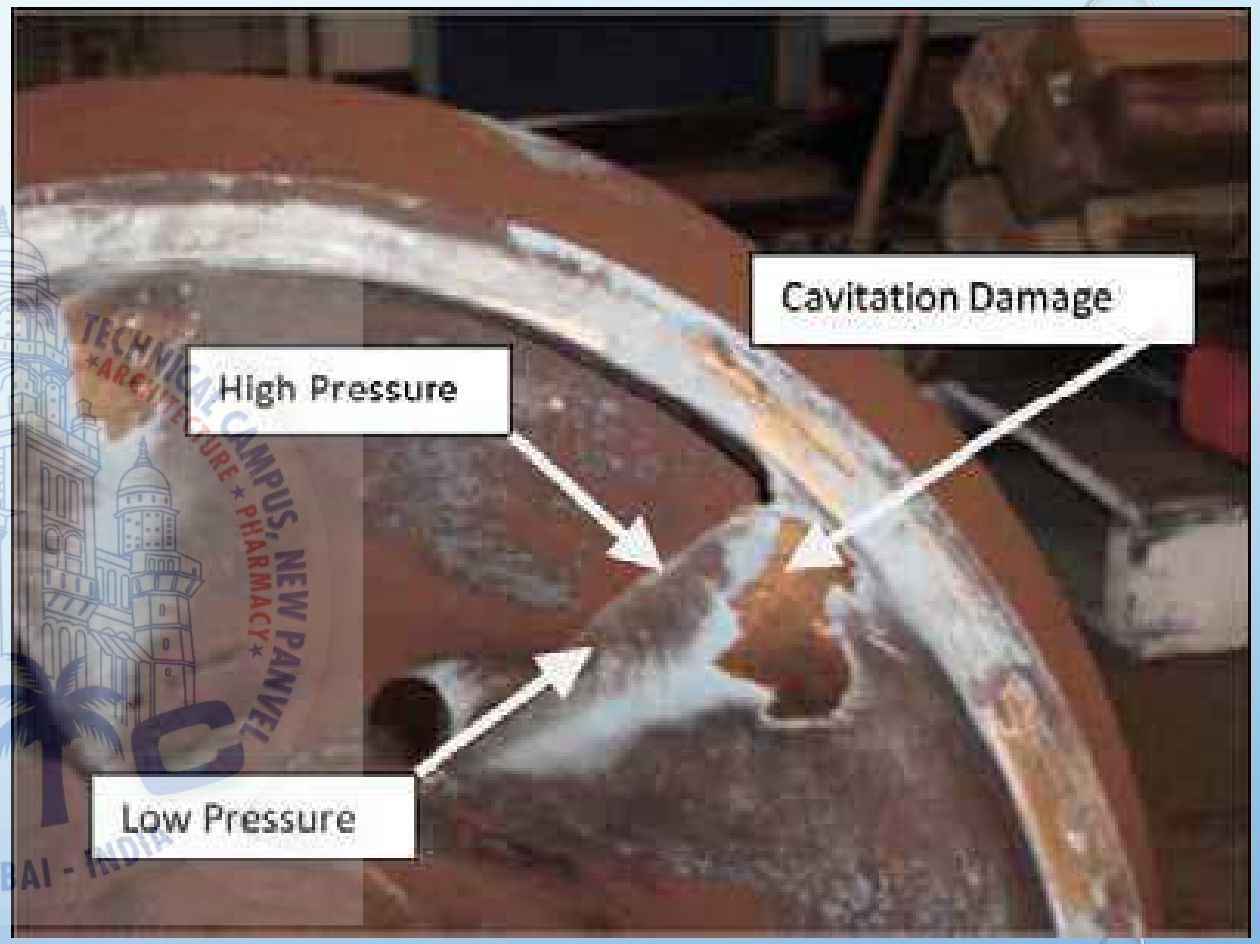
Collapsing of vapour bubble causes high pressure results in pitting action on metallic surface.

Erosion, noise & vibration are produced.



EFFECT OF CAVITATION:

Metallic surface are damaged & cavities are formed.
Efficiency of pump decreases.
Unwanted noise and vibrations are produced.



THANKS:

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Any Questions

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