

## MULTI-STAGE CENTRIFUGAL PUMPS

A multi-stage centrifugal pump is one which has two or more identical impellers mounted on the same shaft or on different shafts. The important functions performed by a multi-stage pump are:

1. To produce heads greater than that permissible with a single impeller, 'discharge remaining constant'. The task can be achieved by 'series arrangement' where in the impellers are mounted on the same shaft and enclosed in the same casing.
2. To discharge a large quantity of liquid, 'head remaining same'. This task is accomplished by 'parallel arrangement' wherein impellers are mounted on separate shafts.

### Pumps in Series

For obtaining a high head, a number of impellers are mounted in series or on the same shaft. Fig. 3.23 shows such an arrangement for a two-stage pump. The discharge from impeller-1 passes through a guided passage and enters the impeller-2. At the outlet of impeller-2, the pressure of water will be more than the pressure of water at outlet of impeller-1. Thus if more number of impellers are mounted on the same shaft the pressure at outlet will be increased further. If in each stage, the manometric head imposed on the liquid is  $H_{mano}$ , then for  $n$  identical impellers the total head developed will be;

$H_{total} = nH$ , however, the discharge passing through each impeller is same

The series arrangement is employed for delivering a relatively small quantity of liquid against very high heads.

The advantages of multi-stage pumps— impellers in series over single-stage pumps are as follows:

1. Less loss due to friction.
2. Reduced stresses.
3. Small slip leakage.
4. The number of stages may be so chosen that the pump speed suits the driving motor speed.
5. By proper arrangement of impellers a thrust can be eliminated.
6. Owing to lower specific speed of individual impellers a higher suction lift is possible.

### Pumps in Parallel

When a large quantity of liquid is required to be pumped against a relatively small head (which is impossible for a single pump to accomplish), two or more pumps are employed which are so arranged that each of these pumps working separately lifts the liquid from a common sump and delivers it to a common collecting pipe through which it is carried to required height. This arrangement is known as pumps in parallel (since each pump delivers the liquid against the same head). If  $Q$  is the discharge

capacity of one pump and there are  $n$  identical pumps (arranged in parallel) then total discharge will be,

$$Q_{\text{total}} = nQ$$

