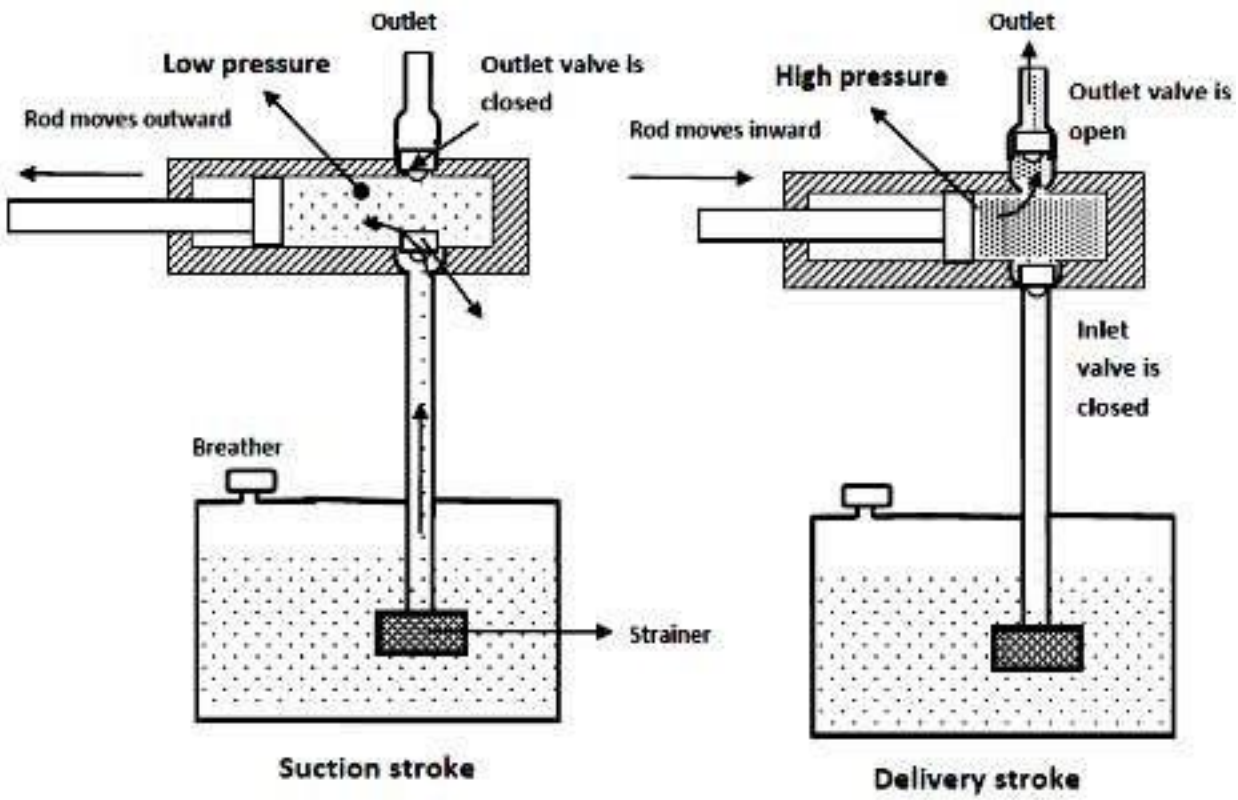
PUMPING THEORY OF POSITIVE DISPLACEMENT PUMPS:

Pumps operate on the principle whereby a partial vaccum is created at the pump inlet due to the internal operation of the pump. This allows atmospheric pressure to push the fluid out of oil tank (reservoir) and into the pump intake. The pump then mechanically pushes the fluid out the discharge line. This action can be best described by reference to a simple piston pump shown in Fig.



1. As the piston moves to the left, a partial vacuum is created in the pump chamber that holds the outlet valve in place against its seat and induces flow from the reservoir that is at a higher (atmospheric) pressure. As this flow is produced, the inlet valve is temporarily displaced by the force of fluid, permitting the flow into the pump chamber (suction stroke).

2. When the piston moves to the right, the resistance at the valves causes an immediate increase in the pressure that forces the inlet valve against its seat and opens the outlet valve thereby permitting the fluid to flow into the system. If the outlet port opens directly to the atmosphere, the only pressure developed is the one required to open the outlet valve (delivery stroke).

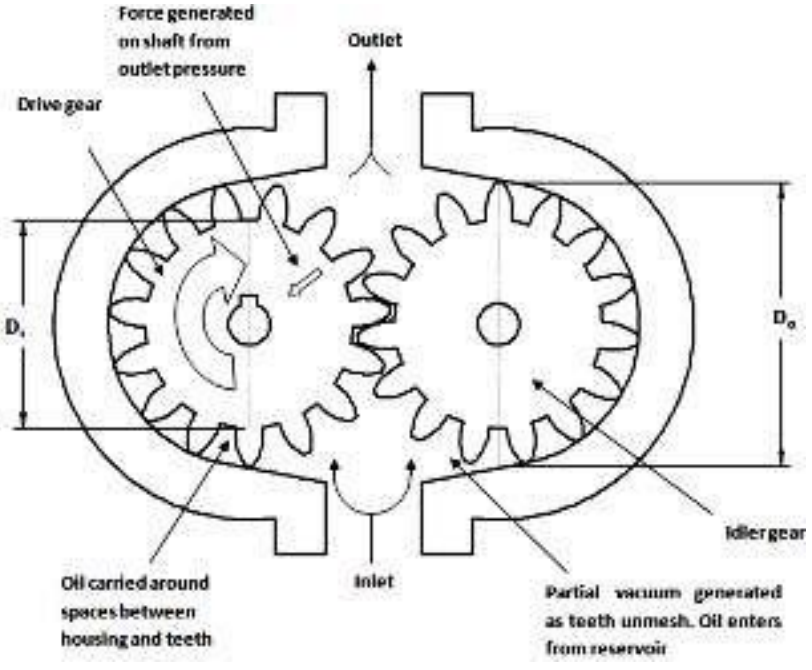
CLASSIFICATION OF POSITIVE DISPLACEMENT PUMPS:

1. **Gear Pumps**
   - External Gear pump
   - Internal Gear pump
2. **Vane Pumps**
   - Balanced vane pump
   - Unbalanced vane pump
3. **Piston Pumps**
   - Axial type
   - Radial type

GEAR PUMPS:

Gear pumps are less expensive but limited to low pressures. It is noisy in operation than either vane or piston pumps. Gear pumps are invariably of fixed displacement type, which means that the amount of fluid displaced for each revolution of the drive shaft is theoretically constant.

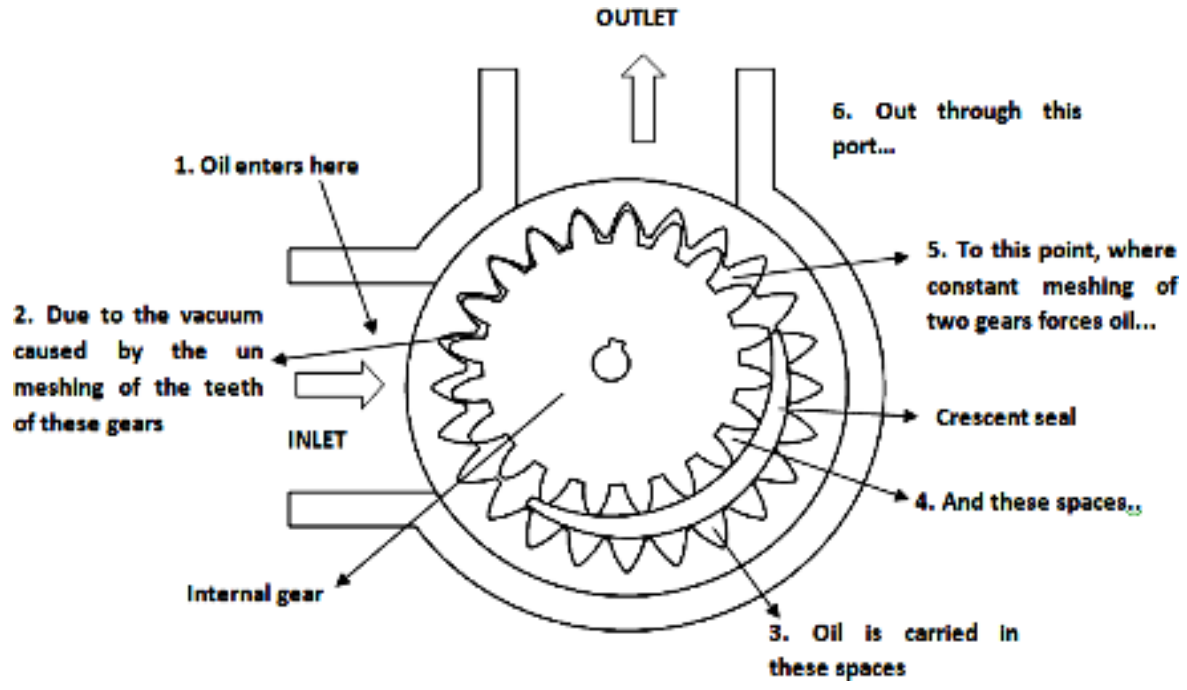
EXTERNAL GEAR PUMPS:



External gear pumps are the most popular hydraulic pumps in low-pressure ranges due to their long operating life, high efficiency and low cost. They are generally used in a simple machine. The external gear pump consists of a pump housing in which a pair of precisely machined meshing gears runs with minimal radial and axial clearance. One of the gears, called a driver, is driven by a prime mover. The driver drives another gear called a follower. As the teeth of the two gears separate, the fluid from the pump inlet gets trapped between the rotating gear cavities and pump housing. The trapped fluid is then carried around the periphery of the pump casing and delivered to outlet port. The teeth of precisely meshed gears provide almost a perfect seal between the pump inlet and the pump outlet.

INTERNAL GEAR PUMPS:

Internal Gear Pumps consist of two gears: An external gear and an internal gear. The crescent placed in between these acts as a seal between the suction and discharge. When a pump operates, the internal gear drives the external gear and both gears rotate in the same direction. The fluid fills the cavities formed by the rotating teeth and the stationary crescent. Both the gears transport the fluid through the pump. The crescent seals the low-pressure pump inlet from the high-pressure pump outlet. These pumps have a higher pressure capability than external gear pumps.



ADVANTAGES OF GEAR PUMPS:

1.They are self-priming.

2.They give constant delivery for a given speed.

3. They are compact and light in weight.

DISADVANTAGES OF GEAR PUMPS:

1. The liquid to be pumped must be clean, otherwise it will damage pump.

2. Variable speed drives are required to change the delivery.

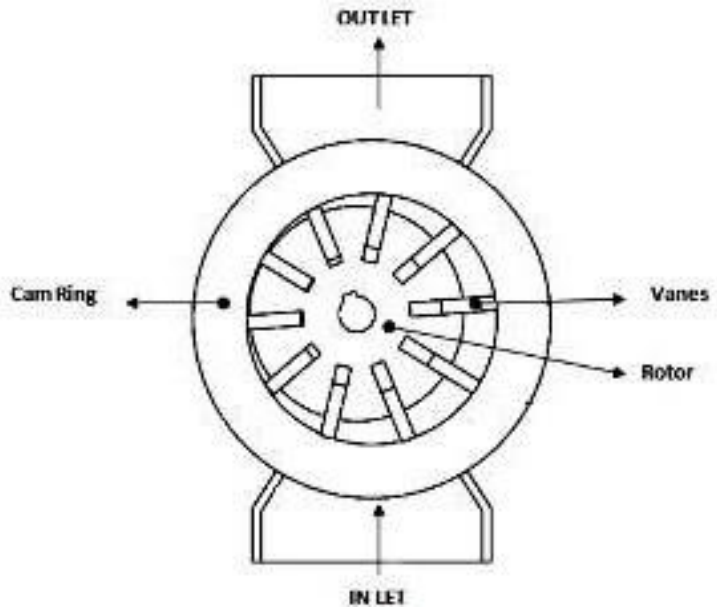
3. If they run dry, parts can be damaged because the fluid to be pumped is used as lubricant.

VANE PUMPS:

Vane Pumps are classified into

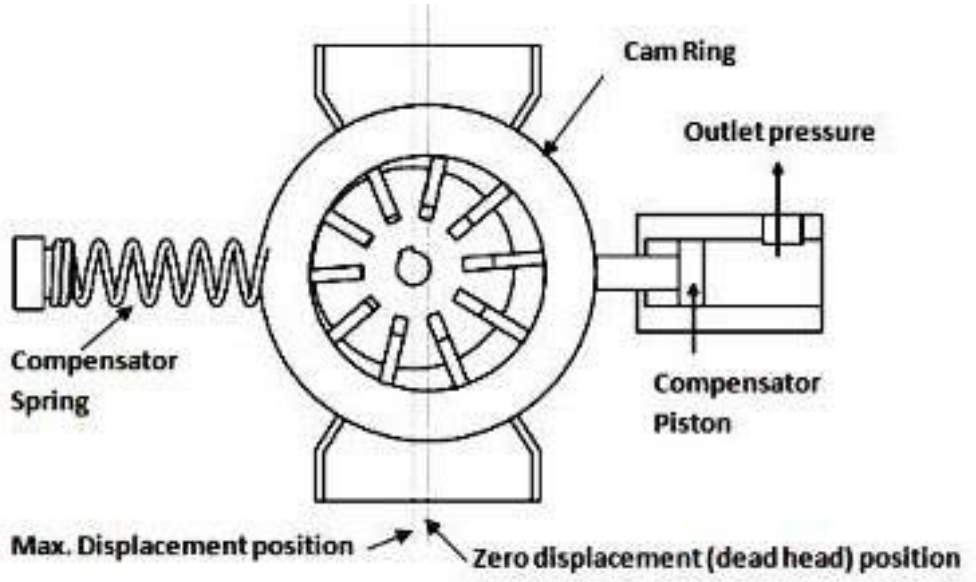
1. **Unbalanced vane pump**
   - Fixed displacement type
   - Pressure compensated variable displacement type
2. **Balanced vane pump**

UNBALANCED FIXED DISPLACEMENT VANE PUMP:



The main components of the pump are the cam surface and the rotor. The rotor contains radial slots splined to drive shaft. The rotor rotates inside the cam ring. Each radial slot contains a vane, which is free to slide in or out of the slots due to centrifugal force. The cam ring axis is offset to the drive shaft axis. When the rotor rotates, the centrifugal force pushes the vanes out against the surface of the cam ring. The vanes divide the space between the rotor and the cam ring into a series of small chambers. During the first half of the rotor rotation, the volume of these chambers increases, thereby causing a reduction of pressure. This is the suction process, which causes the fluid to flow through the inlet port. During the second half of rotor rotation, the cam ring pushes the vanes back into the slots and the trapped volume is reduced. This positively ejects the trapped fluid through the outlet port. The delivery rate of the pump depends on the eccentricity of the rotor with respect to the cam ring.

UNBALANCED PRESSURE COMPENSATED VARIABLE DISPLACEMENT VANE PUMP:



Variable displacement feature can be brought into vane pumps by varying eccentricity between the rotor and the cam ring. Here in this pump, the stator ring is held against a spring loaded piston. The system pressure acts directly through a hydraulic piston on the right side. This forces the cam ring against a spring-loaded piston on the left side. If the discharge pressure is large enough, it overcomes the compensated spring force and shifts the cam ring to the left. This reduces the eccentricity and decreases the flow. If the pressure continues to increase, there is no eccentricity and pump flow becomes zero.