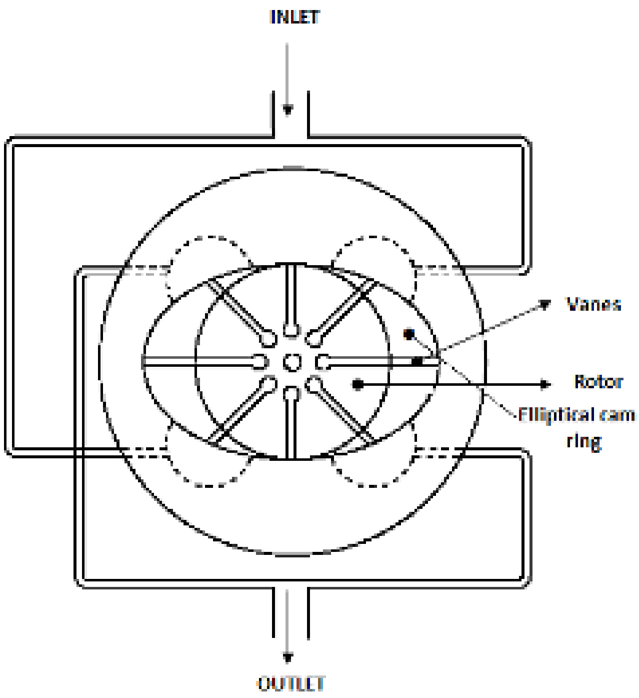
BALANCED VANE PUMP:



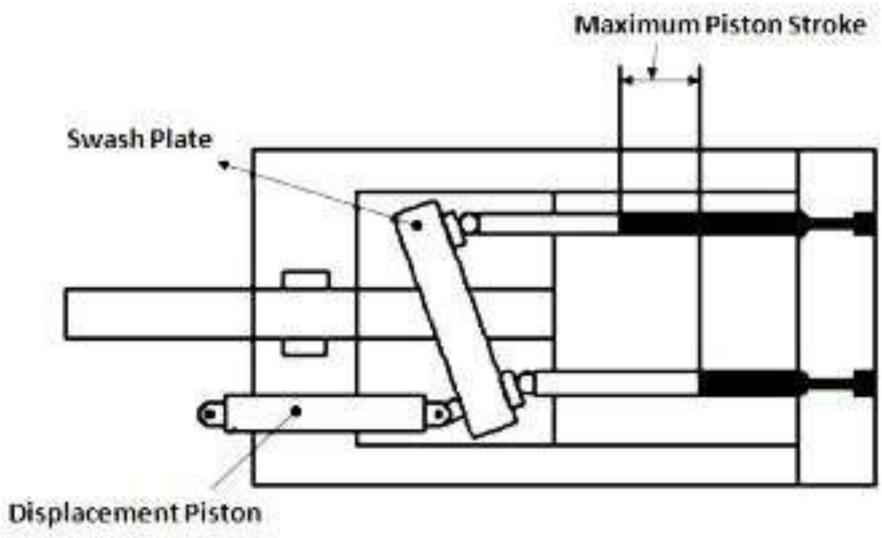
The constructional features of a balanced vane pump is as shown in the fig. The rotor and the casing are on the same centre line. Vanes are provided in the slots of the rotor. There are two inlet and outlet chambers around the elliptical cam ring surface. The inlet and outlet chambers are positioned diagonally opposite to each other. The cam ring is elliptical in shape, so that the vanes stroke twice per revolution of the pump shaft. Thus the volume increase and decrease at the inlet and outlet chambers also occur twice per revolution. In fact, the inlet and outlet ports are connected to a common inlet and outlet within the pump housing. In operation, due to the elliptical shape of the cam ring, the oil suction at the inlets and the pumping at the outlets occurs simultaneously. This situation results in equal pressure on the opposite sides of the pump shaft, and the net force acting on bearing will be zero. Thus, it is termed the balanced vane pump.

PISTON PUMPS:

Piston pumps are of following types

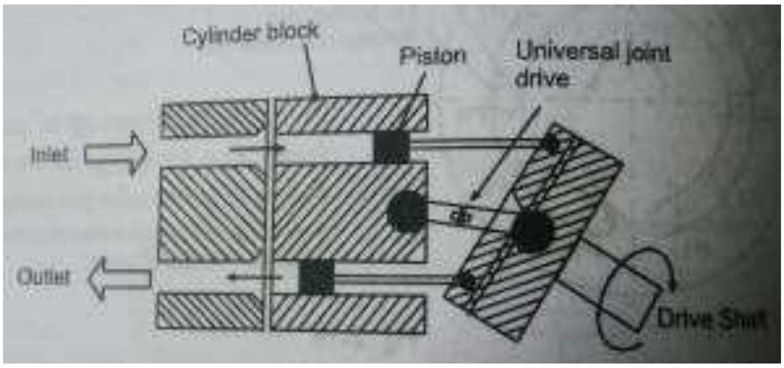
1. **Axial Piston Pump**
   - Swash plate type piston pump
   - Bent axis type piston pump
2. **Radial Piston Pump**

SWASH PLATE TYPE PISTON PUMP:



In this type, the cylinder block and drive shaft are located on the same center line. The pistons are connected to a shoe plate that bears against an angled swash plate. As the cylinder rotates, the pistons reciprocate because the piston shoes follow the angled surface of the swash plate. The outlet and inlet ports are located in the valve plate so that the pistons pass the inlet as they are being pulled out and pass the outlet as they are being forced back in. This type of pump can also be designed to have a variable displacement capability.

BENT AXIS TYPE PISTON PUMP:



In constryction it consists of a cylinder block with arrayed cylindrical openings, housing, pistons and drive shaft. The housing design is such that it creates an offset angle between the centreline of the drive shaft and the centre line of the cylinder block. The pistons are connected to the drive plate with ball and socket joints. The drive plate and the cylinder block are connected with an universal joint, so that the motion is transmitted through the bent axis. The bent axis of the drive shaft leads to the reciprocatory motion of the pistons in the cylinder block. The housing end at the cylinder block is sealed with an end cap, having inlet and outlet ports with feed grooves.

PUMP PERFORMANCE:

The performance of a pump is a function of the precision of its manufacture. An ideal pump is one having zero clearance between all mating parts. Since this is not possible, working clearances should be as small as possible while maintaining proper oil films for lubrication between rubbing parts. The performance of a pump is determined by the following efficiencies:

1) **Volumetric efficiency (η_v):** It is the ratio of actual flow rate of the pump to the theoretical flow rate of the pump.

$$\eta_v = \frac{\text{Actual flow rate}}{\text{Theoretical flow rate}} \times 100$$
$$= \frac{Q_A}{Q_T} \times 100$$

2) **Mechanical Efficiency (η_m):** It refers to the efficiency of the pump due to energy losses other than due to leakages.

$$\eta_m = \frac{\text{Pump output power (no leakage condition)}}{\text{Actual power input to pump}} \times 100$$
$$= \frac{P \times Q_T}{2\pi NT} \times 100$$

Where, P = Pump discharge pressure, Pa

QT = Theoretical flow rate, m3/s

T = Torque input to pump, N.m

N = Pump speed, rps

3) **Overall Efficiency (η_o):** Overall efficiency refers to the overall performance of the pump considering possible losses including the leakage loss, friction loss, etc. it is given by the relation:

$$\eta_o = \frac{\text{Actual power output by pump}}{\text{Actual power input to pump}} \times 100$$

It can also be given by,

$$\eta_o = \frac{\eta_v \times \eta_m}{100}$$

$$\eta_o = \frac{P \times Q_A}{2\pi NT} \times 100$$

PUMP SELECTION FACTORS:

The main parameters affecting the selection of a particular type of pump are as follows:

1) Maximum operating pressure.
2) Maximum delivery.
3) Type of control.
4) Pump drive speed.
5) Type of fluid.
6) Pump contamination tolerance.
7) Pump noise.
8) Size and weight of a pump.
9) Pump efficiency.
10) Cost.
11) Availability and interchangeability.
12) Maintenance and Spares.

ACCUMULATORS:

A hydraulic accumulator is a device that stores the potential energy of an incompressible fluid held under pressure by an external source. The stored potential energy in the accumulator is a quick secondary source of fluid power capable of doing useful work.

CLASSIFICATION OF HYDRAULIC ACCUMULATORS:

1) Weight loaded or gravity accumulator
2) Spring-loaded accumulator
3) Gas-loaded accumulator
   a) Non-seperator type

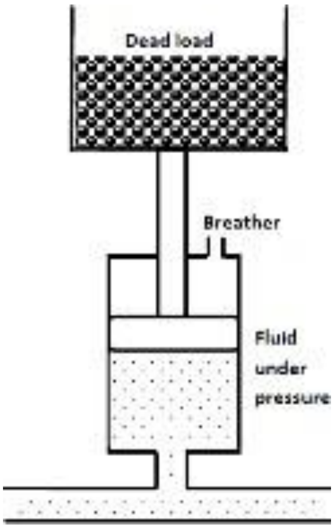
b) Seperator type

i) Piston type

ii) Diaphragm type

iii) Bladder type

WEIGHT LOADED OR GRAVITY ACCUMULATOR:



It is a vertically mounted cylinder with a large weight. When the hydraulic fluid is pumped into it, the weight is raised. The weight applies a force on the piston that generates a pressure on the fluid side of piston. The advantage of this type of accumulator over other types is that it applies a constant pressure on the fluid throughout its range of motion. The main disadvantage is its extremely large size and heavy weight. This makes it unsuitable for mobile application.

SPRING LOADED ACCUMULATOR: