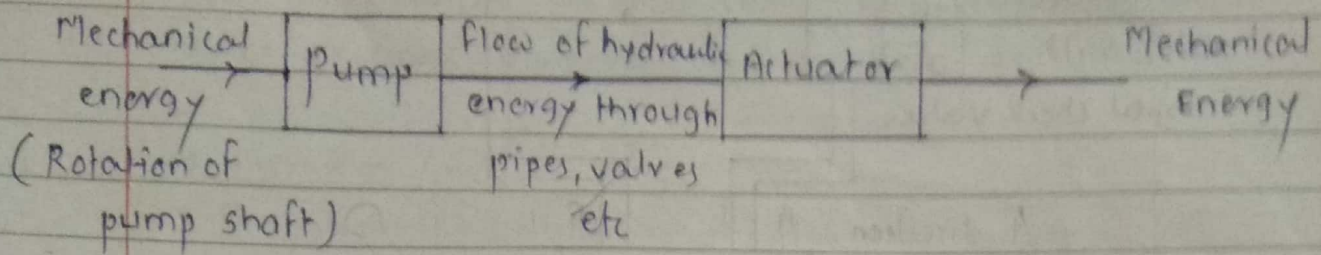


⊗ Basic Hydraulic System :-



- Basically, pump is a mechanical device which gives energy to the liquid.
- We can also define the pump is a mechanical device which
 - i) Makes the liquid flow
 - ii) will increase the pressure of liquid
 - iii) will lift the liquid from lower level to higher level.
- We know that; Hydraulic system is a power transmission system in which transmission of power takes place through the Hydraulic oil.
- Pump converts mechanical energy into hydraulic energy.
- Hydraulic oil carries this hydraulic energy from pump to actuator.
- Actuator convert that hydraulic energy into the mechanical energy.

⊗ Physical Components of Hydraulic System :-

Hydraulic system consists of following important physical components

- i) Oil Reservoir
- ii) Rotary Pump
- iii) Pressure Relief valve
- iv) Direction Control valve
- v) Flow control valve
- vi) Double acting cylinder
- vii) Pressure gauge
- viii) Filter

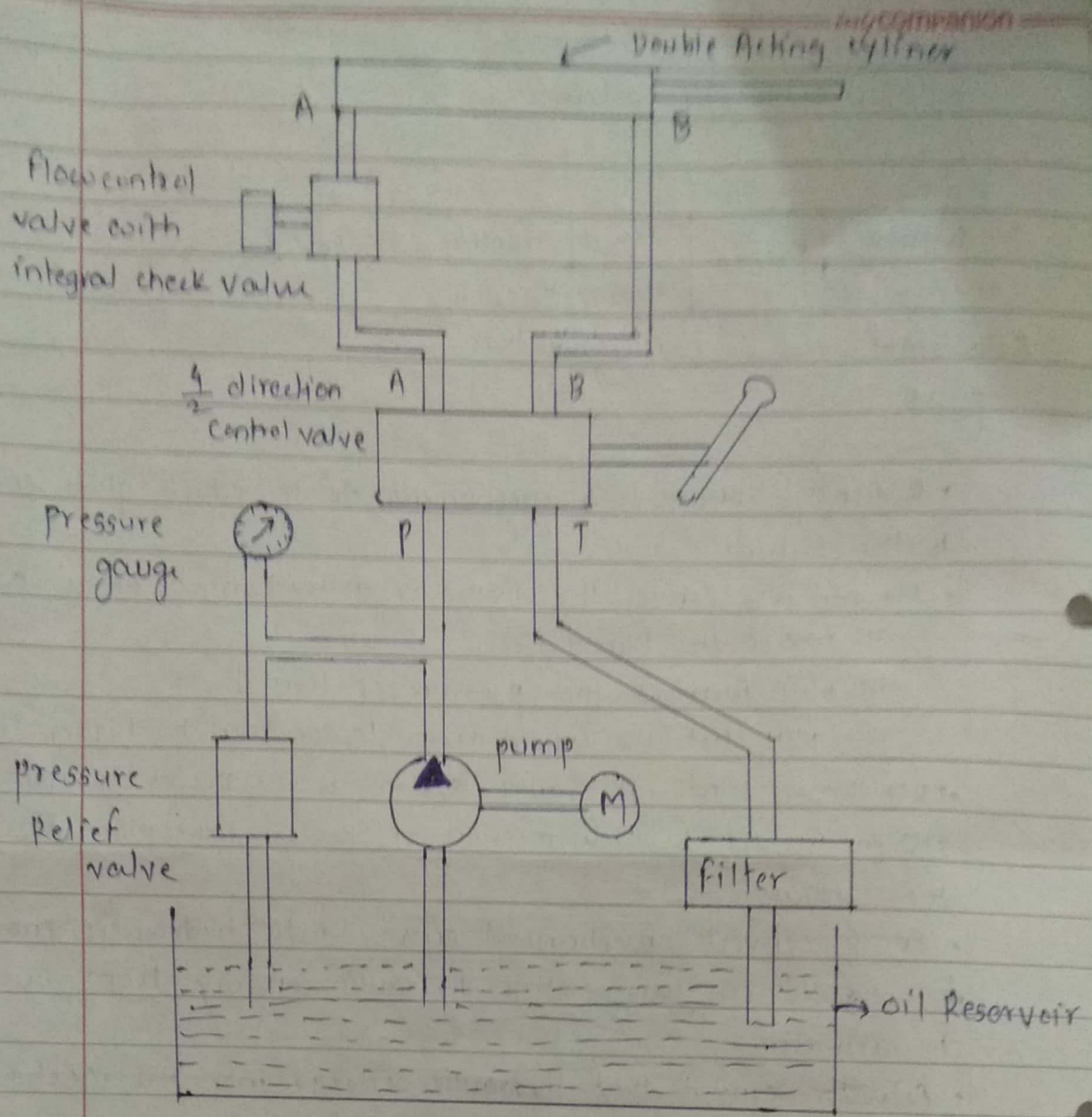


fig. Layout of general Hydraulic system.

i) oil Reservoir:

- Main function of oil reservoir is to store the sufficient amount of hydraulic oil in the system.
- It is also used to cool the hot return oil, also to separate the water from oil, also used to remove the air bubbles and provides the oil to the system with the help of pumps.

ii) Rotary pump:

- The function of Rotary pump is to pump the hydraulic oil to the hydraulic system/circuit.
- It converts mechanical energy into hydraulic energy (providing the oil throughout the system)

iii) Pressure relief valve:

- This valve is connected at the outlet of the pump.
- Its main function is to release the oil back to tank when pressure increases beyond preset value.

iv) Direction Control valve:

- It controls the direction of flow of hydraulic oil in the system.

v) Flow control valve

- It controls the rate of flow of hydraulic oil, by which speed of extension or retraction of actuator is controlled.

vi) Actuator:

- Basically actuator converts hydraulic energy into mechanical energy.
- It produces work. There are two types of actuator
 - i) Linear actuator
 - ii) Rotary actuator
- Linear actuator is called as cylinder & rotary actuator is called as motor.
- Cylinder develops force & motion.

$$\text{Force} = \text{pressure of oil} \times \text{Area of piston}$$

vii) Pressure gauge:

- It is important component of hydraulic system, It shows the pressure reading.

viii) Filter:

- Main function of filter is to remove the contaminants from the oil & to provide clean hydraulic oil to the system.

Q: Advn

① ② Q) What are the Advantages and limitations of Hydraulic system.

③ ④ Q) State and explain applications of Hydraulic system

⑤ Hydraulic pump:

positive displacement pump (PDP)

Negative displacement pump (NDP)

Reciprocating pump.

- i) Single acting pump
- ii) Double acting pump
- iii) Single stage pumps
- iv) Multi stage pumps
- v) Single cylinder pumps
- vi) Multi cylinder pumps.

Rotary pump.

① Gear pump

- i) External
- ii) Internal
- iii) Lobe
- iv) Gerotor
- v) Screw

② Vane pump

- i) Unbalanced
- ii) Balanced

③ Piston pump

- i) Axial piston pump
- ii) Radial piston pump

Centrifugal Pump

- ① ordinary
- ② Self priming
- ③ Jet pump

④ single & multi stage pump

Axial pump

④ Positive Displacement Pump (PDP)

- It is one type of pump whose displacement is positive
- The word 'positive' implies that, there will be definite amount of discharge
- Only such pumps can be used for Hydraulic system, because, hydraulic systems have to develop large amount of force, for which large amount of pressure is required, only PDP can deliver discharge under high pressure

⑤ Non Positive displacement Pump:

- In case of NPPD, the discharge does not remain constant,
- At high pressure pump cannot deliver the oil in other word, NPPD does not create large amount of pressure. Hence NPPD is not useful for Hydraulic system.

⑥ Disadvantages of Reciprocating pumps.

- Reciprocating pump has more no. of moving components like, piston, crank, connecting rod, valve etc.
- Due to this size is more, cost is more & maintenance cost is more
- Reciprocating pump has reciprocating parts
- Due to this, lots of vibration & noise is produced in the system,
- In this, due to fluctuating loads, pumps cannot be directly connected to motor shaft.
- For that, flywheel is required in order to uniform the fluctuating load.

⑦ Q. Difference b/w PDP & NPPD.

⑧ Q. What are the advantages of PDP

⑨ Q. What are the advantages of Rotary pump

⊗⊗ Rotary Pumps

- Rotary pumps are positive displacement pumps, having two or more rotating components.
- The discharge of rotary pump is smooth, continuous & not pulsating.
- The discharge of rotary pumps remains almost same irrespective of pressure.
- Rotary pump can give discharge at very high pressure.
- Very less vibration & noise is observed in ~~this~~ pump.
- Rotary pump have very less number of rotating/moving components & are less sensitive to contamination.

⊗⊗ Classification of Rotary pump

Classified into three categories

- 1) Gear pump
- 2) Vane pump
- 3) Piston pump

1) Gear pump:

i) External gear pump

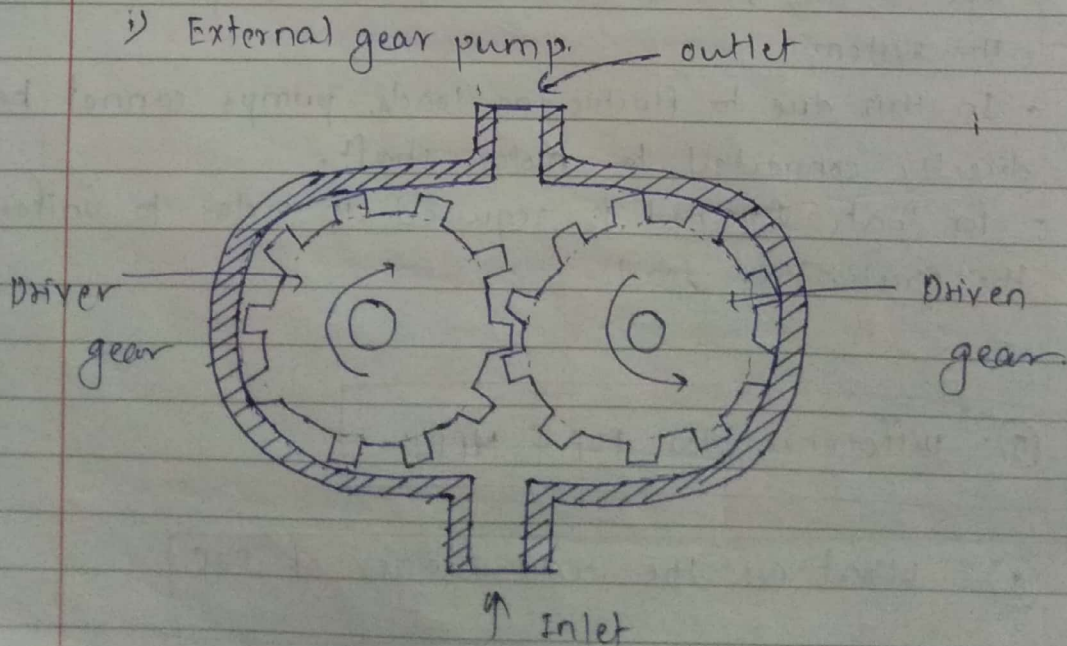
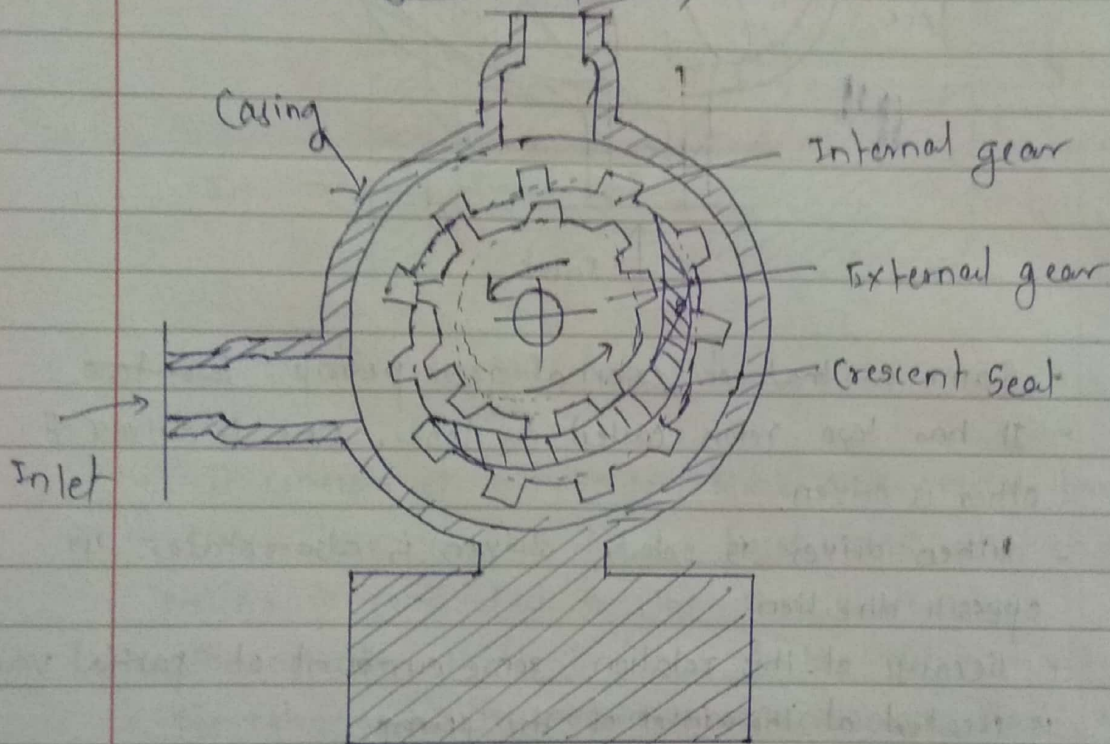


fig External gear pump

- It consists of two spur or helical gears which are meshed with each other and placed inside the casing.
- One is called a driver and other is driven.
- Both these gear gears rotate in opposite in direction.
- Because of rotation of these gears, some amount of partial vacuum is created at the inlet of the pump.
- Oil is entered the pump by atmospheric pressure.
- This oil is trapped in the pockets b/w teeth and this oil is then carried towards the outlet terminal. That shows the complete flow of liquid from inlet to outlet terminal.

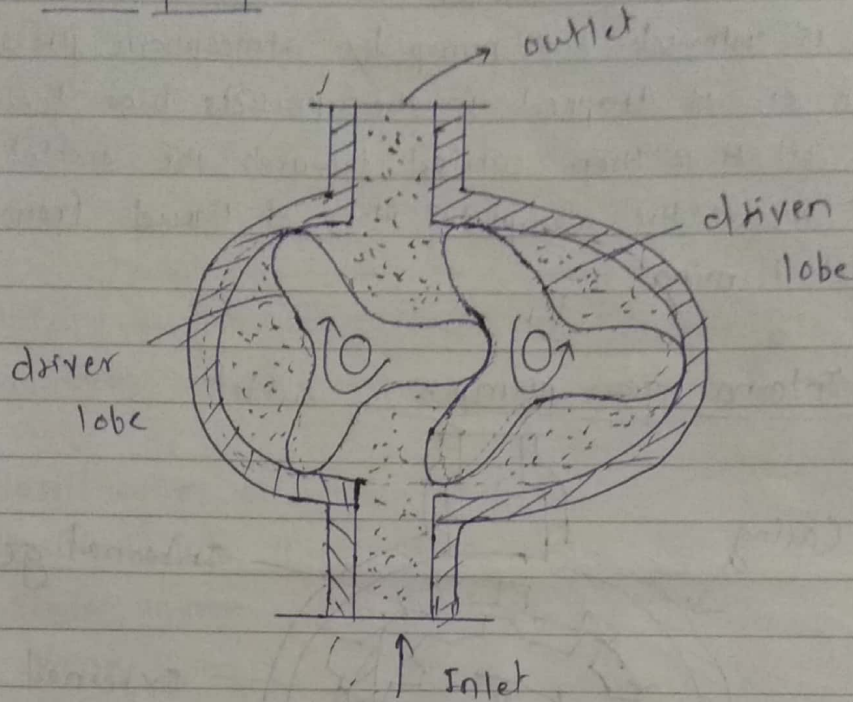
ii) Internal gear pump:



- It consists of two gears, internal one is having internal teeth and other is having external teeth.
- The external teeth is inside the internal gear.
- These two gears are meshed with each other.
- A crescent seal is provided b/w these two gears, which fills the gap b/w two gears.
- As gear rotates, teeth are comes out from the mesh & partial vacuum is created.

- from inlet terminal oil is entered and fills in the pocket b/w gear teeth and crescent seal. This oil is then carried towards the outlet terminal, i.e. there is complete flow of oil is done.

iii) Lobe pump:



- Same as that of external gear pump. ~~Two~~ two
- It has two rotors called as lobes. One is driver & other is driven.
- When driver is rotate, driven is also rotates in opposite direction.
- Because of this rotation, some amount of partial vacuum is created at the inlet of the pump.
- from inlet terminal oil is entered & ~~trap~~ trapped in its pockets and carried towards the outlet.

- | | |
|---|-----------------------|
| Q | Explain Ge-rotor pump |
| Q | Explain Screw pump |

⑤ Piston pump.

It is div

Two types of piston pump.

- i) Axial piston pump
- ii) Radial piston pump

① Axial piston pump:

i) Straight axis piston pump

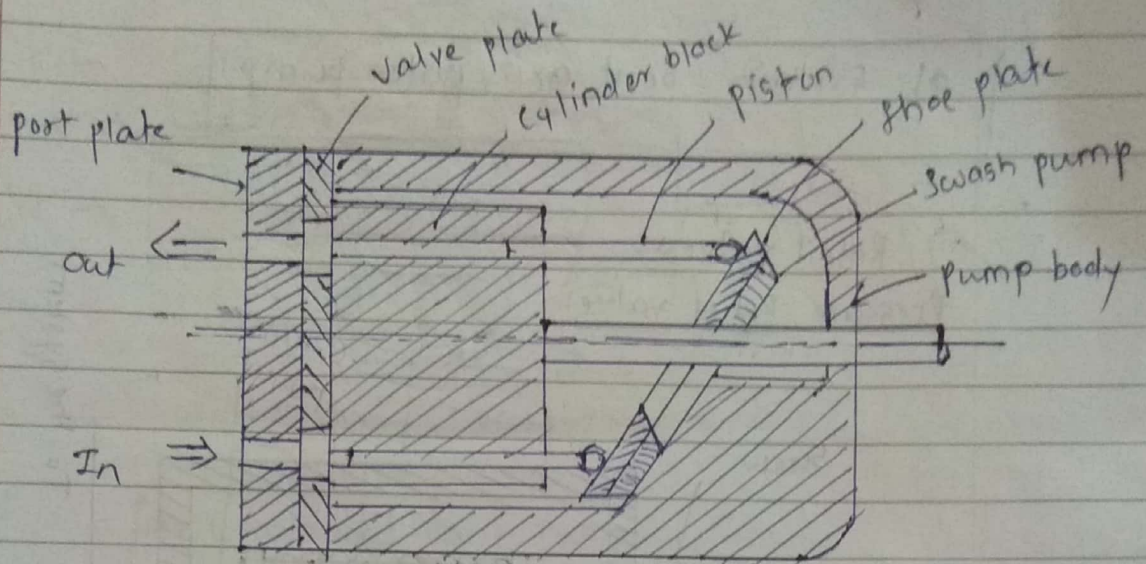


fig. Straight Axis piston pump.

- It consists of a cylinder block with axial bores.
- Pistons are inserted in the bores, and other end of pistons is connected to the shoe plate.
- The cylinder shaft is fitted to the drive shaft.
- The shoe plate is mounted on a swash plate, which is fixed at an angle to the axis of rotation.
- Cylinder block and the drive shaft have same axis of rotation which is as shown in fig.

operation:

- When the shaft is rotated, cylinder block is also rotates, the shoe plate is also rotate.
- Half rotation of the cylinder block causes ~~suck~~ suction of oil into a bore & next half rotation causes discharge.

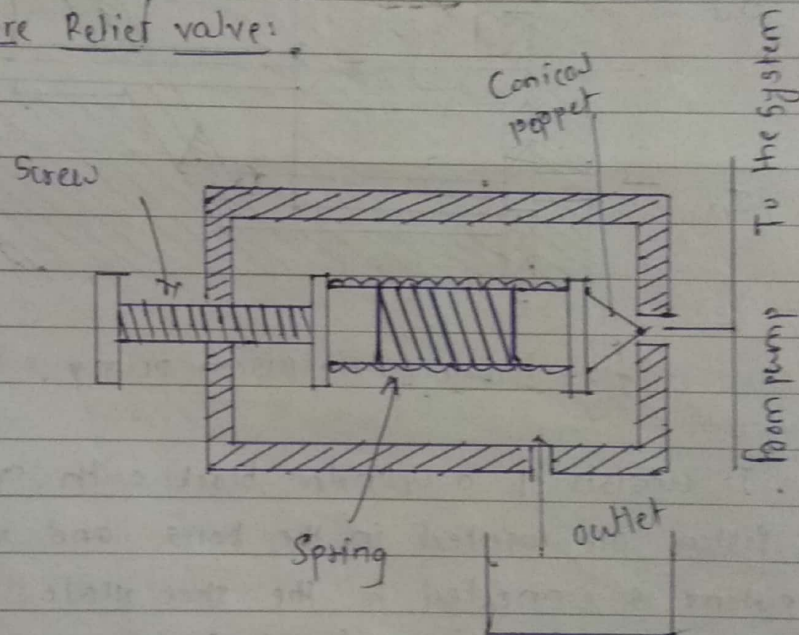
Function of swash plate:

- It is used to change the discharge of the pump.
- By changing the angle of swash plate, we can change the stroke length.
- When swash plate is perpendicular (90°) to the pump axis then at this position the discharge is zero.

Q1 Explain Bent axis piston pump.

⊗ Relief valve:

Pressure Relief valve:



- Relief valve consists of an adjusting screw, two supporting plates on either side of the spring and a conical poppet.
- When pressure at inlet increases above the preset limit, the conical poppet moves inside the valve against the spring force & it opens the door for working fluid to flow towards outlet.
- Here outlet of relief valve is connected to that of reservoir, so that working fluid flows to the reservoir tank.
- Flow of oil will stop when pressure decreases. (Conical poppet comes to its normal position)

② Vane Pump

Two types of vane pump.

- i) Unbalanced vane pump,
- ii) Balanced vane pump.

i) Unbalanced vane pump.

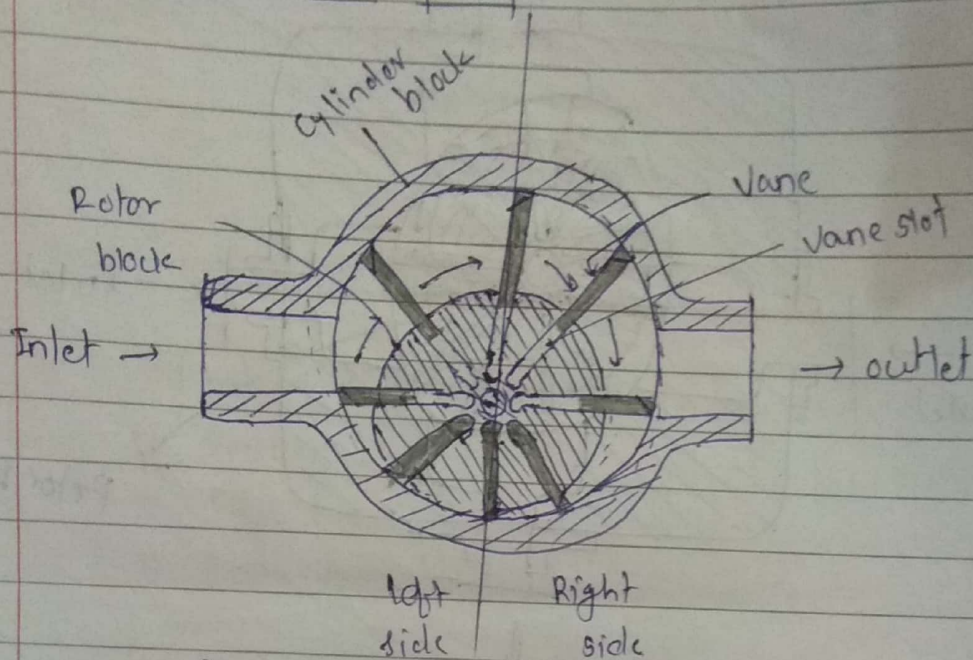


fig. Unbalanced Vane Pump.

- It is mounted
- It consists of a cylindrical rotor, which is mounted inside a circular casing.

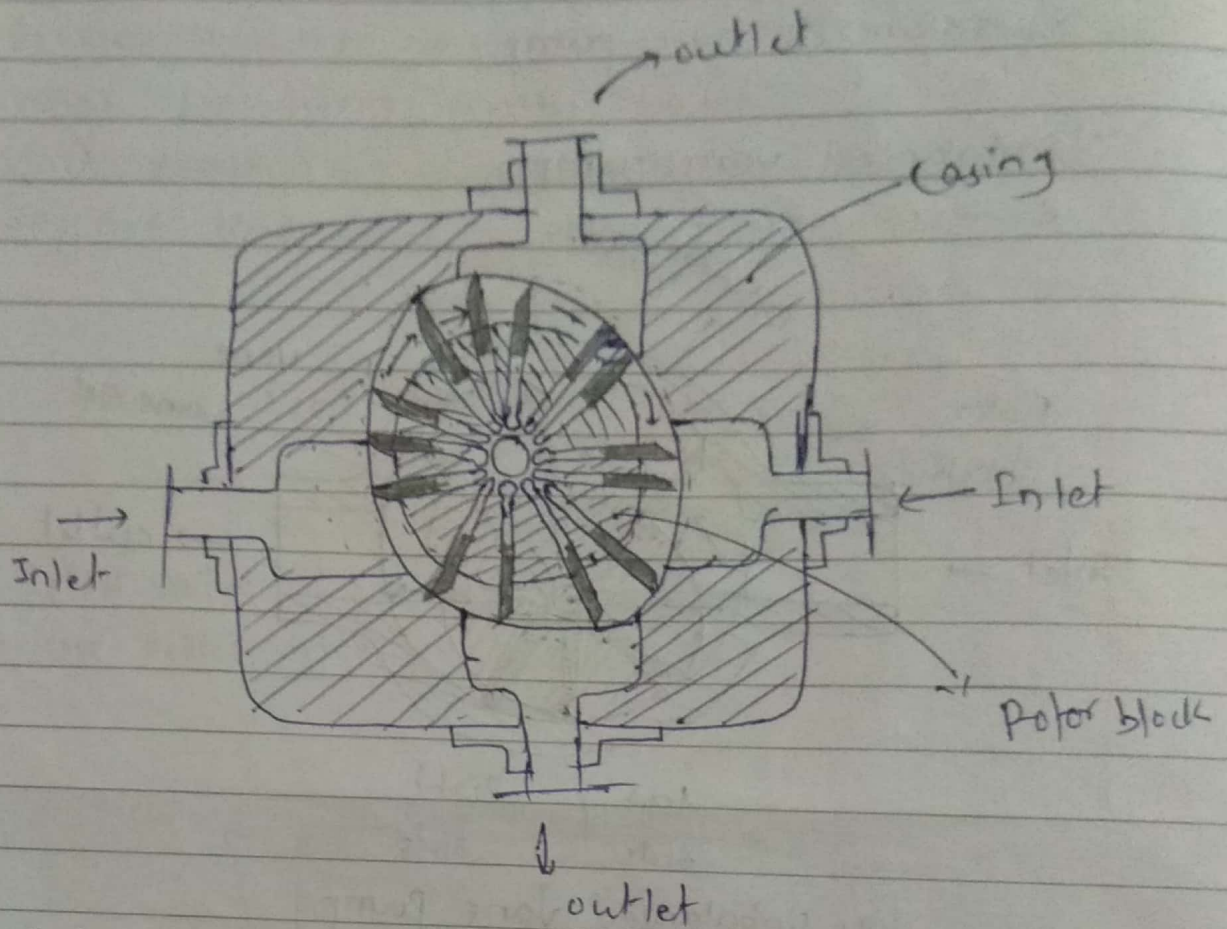
- Vanes are placed in radial slots of rotor, held against the casing by spring or hydraulic force.

operation : • As the rotor rotates, the size of pockets goes on increasing on left side and decreasing on right side.

- That is suction of oil at left side (inlet) and delivery of oil at right side (outlet).

- Hence there is complete flow of oil from inlet to outlet of the system.

ii) Balanced vane pump



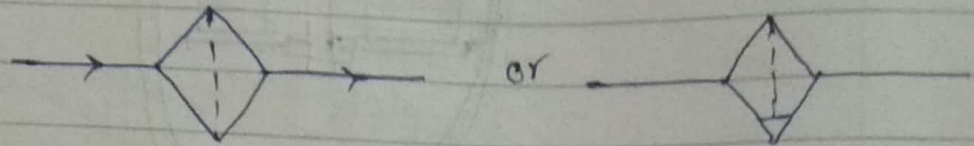
- Balanced vane pump consists of two inlet and two outlet terminals.
- Due to this, equal and opposite side thrusts get balanced.
- Hence it gives better service and longer life as compared with unbalanced vane pump.

operation :- As the rotor rotates, the size of the pockets goes on increasing on one side and goes on decreasing on the other side. Because of this, suction of oil at inlet and delivery of oil at outlet is possible. Hence complete flow of oil takes place from inlet to outlet terminal of system.

Filters in Hydraulic System:

- We know that, the main function of filter is that to remove the suspended solid contaminants from the oil & provides clean hydraulic oil to the system.

Symbol



Classification of filters:

A) classification According to function

- 1) Surface type
- 2) Edge type
- 3) Depth type

B) Classification According to construction

- 1) By-pass filter
- 2) Full flow filter
- 3) Proportional flow filter
- 4) Indicator type filter

1) Surface type filter / Screen filter

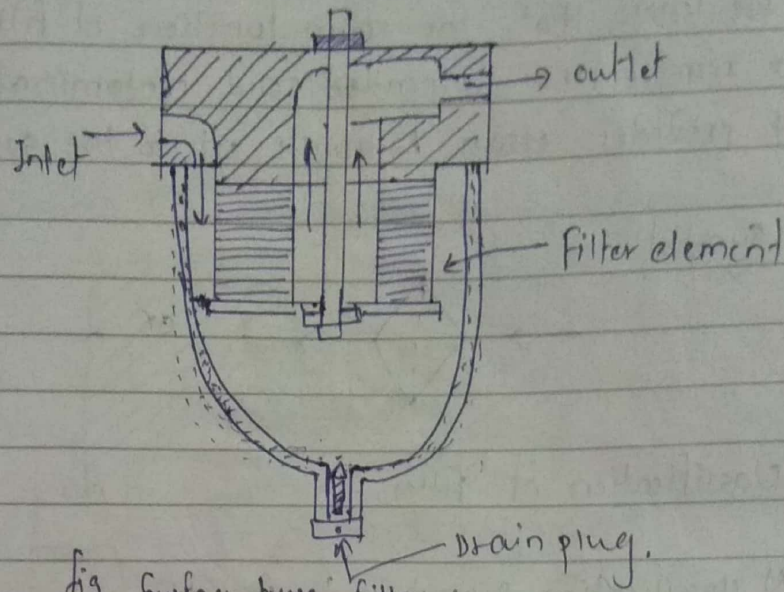


fig Surface type filter

- In this type of filter, the solid impurities are screened and retained on the surface of the filter.
- Basically filter elements are meshes of metal wires, woven cloths of metal wires etc. filter elements are placed parallel to each other.

2) Edge type filter

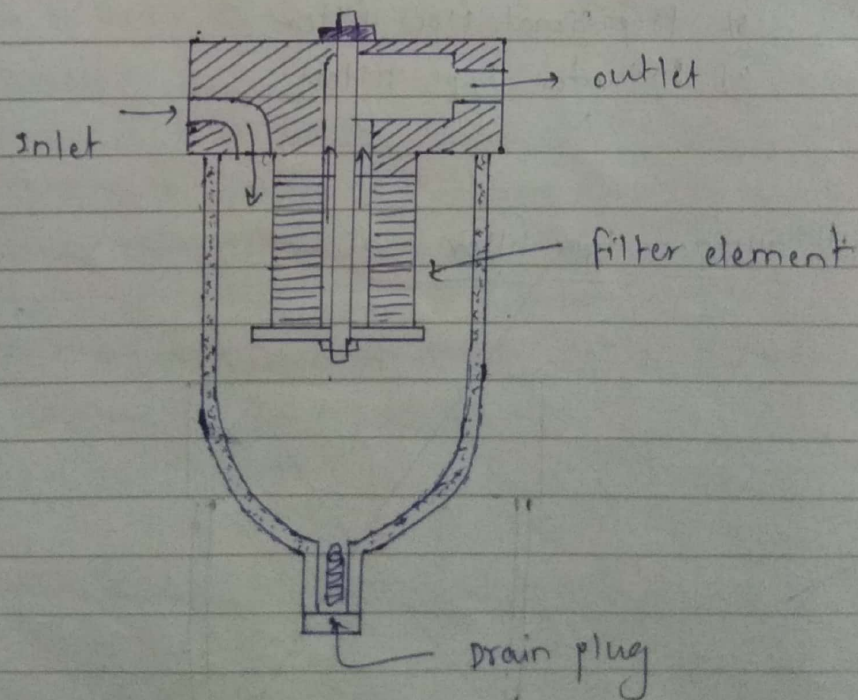
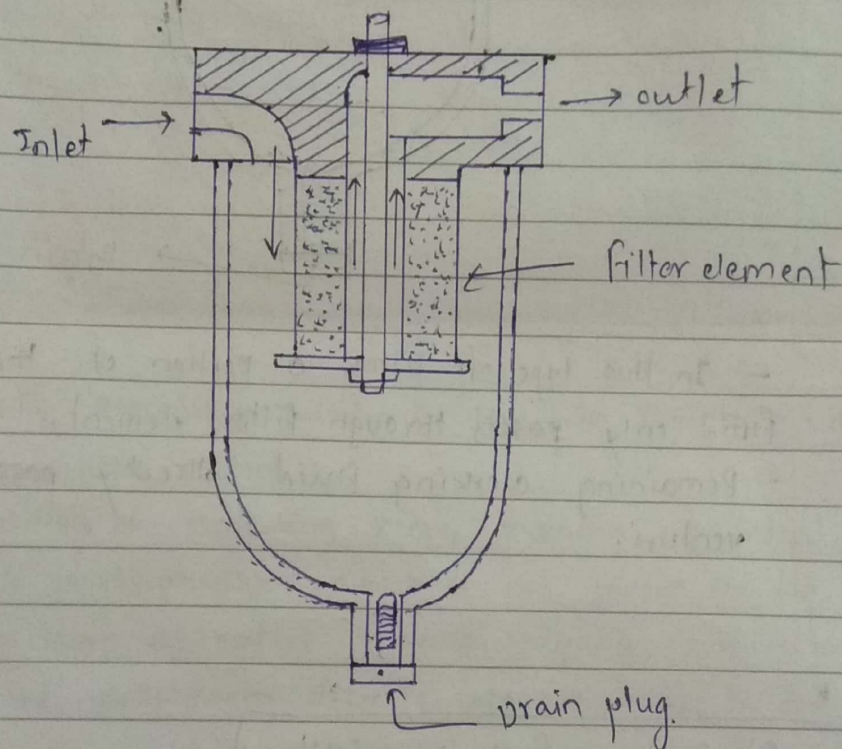


fig edge type filter

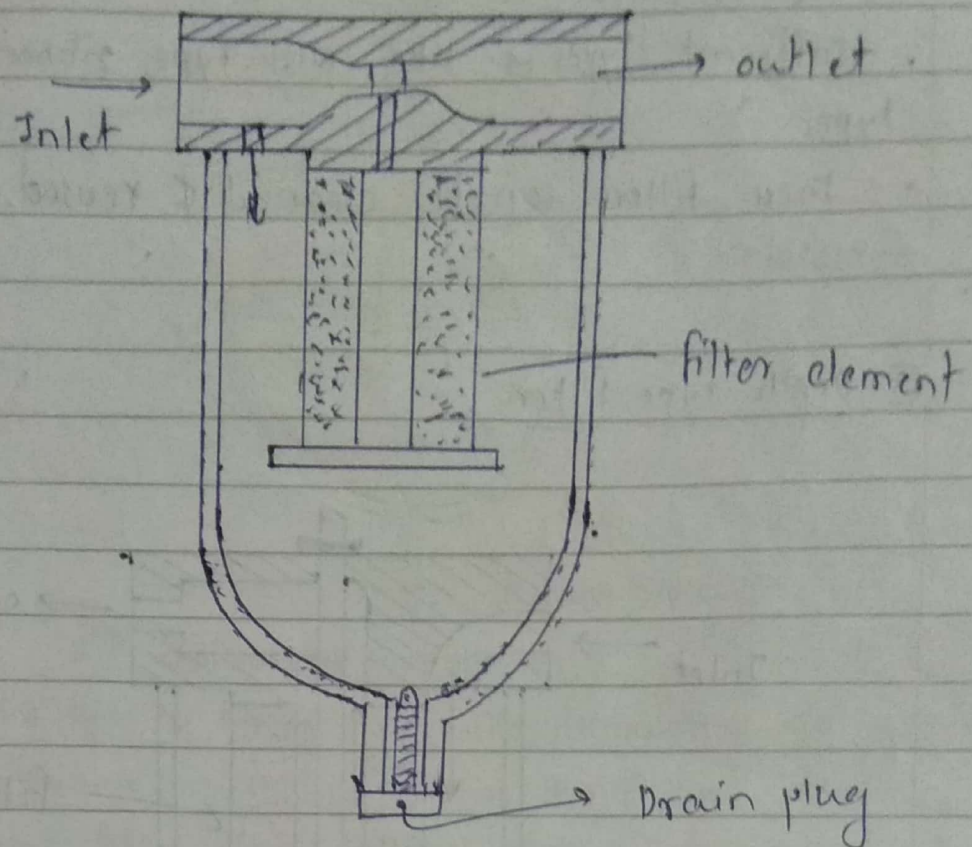
- In this type of filter, the solid impurities are trapped at the edges of the plates, which are arranged parallel to each other.
- Different types of like, disk type, ribbon type, plated type.
- These filters can be cleaned & reused.

③ Depth type filter



- In this, the solid impurities enter into the filter element to certain depth and trapped there.
- These are made of material like, sintered materials powder, sintered ceramic powder, natural & synthetic fibers etc.

① Proportional filter:



- In this type of filter, a portion of the working fluid only passes through filter element.
- Remaining working fluid directly passes through venturi.

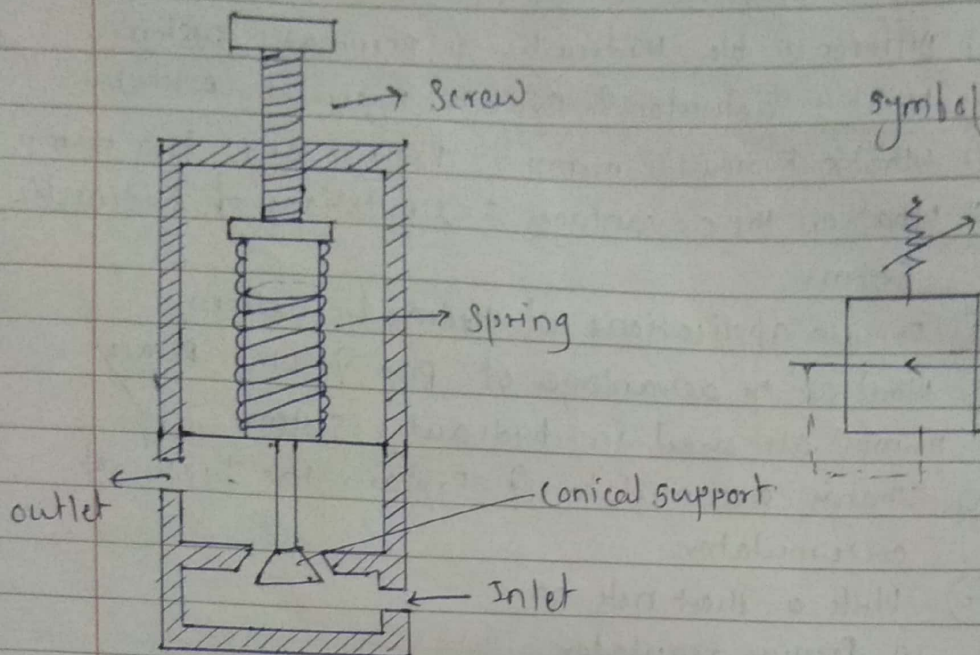
Q) Explain full flow filter

Q) Explain By-pass filter

⑧

② Pressure Regulator.

- It is also called as pressure reducing valve.



- Basically, pressure regulator is used to maintain the pressure in the system.
- It consists of adjusting screw, a spring, a conical poppet, fitted to a diaphragm which is as shown in fig.
- If pressure at outlet increases beyond certain level, then the diaphragm deflects upwards, due to this, conical poppet will also move upward to close the flow of working fluid.
- Once the pressure comes to normal position, the diaphragm deflects downward & conical poppet moves downward & it opens the passage for working fluid to flow.
- This valve is called as pressure reducing valve in hydraulic system & pressure regulator in pneumatic system.

② What is Accumulator? Explain the types of Accumulator

Assignment No. 2

- 1) Explain fluid power system
- 2) Explain physical components of Hydraulic system.
- 3) Difference b/w Hydraulic & pneumatic system.
- 4) What is actuator? Explain types of Actuator.
- 5) What is hydraulic pump? Explain any two pump.
- 6) What are the advantages & limitations of hydraulic system.
- 7) Explain applications of Hydraulic system.
- 8) What are the advantages of PDP? Why Rotary pumps are used in hydraulic systems.
- 9) What is accumulator? Explain the types of accumulator.
- 10) Write a short note on
 - i) Pressure regulator
 - ii) Relief valve
 - iii) Filter

Sensor:

A sensor converts a physical phenomenon into an electrical signal.

for eg.

thermocouple, RTD → Temperature

photo sensor → light

microphone → sound

strain gauge, piezoelectric transducer → Force & pressure

potentiometer, LVDT, optical encoder → position & displacement

Accelerometer → Acceleration

pH electrode → pH.

Digital Acq Data Acquisition System (DAS)

Sensor

A device which detects or measures a physical property & records, indicates or otherwise responds to it.

Actuator

An actuator is a component of a machine that is responsible for moving & controlling a mechanism or system.

for example opening a valve

Sensitivity -

A quality or condition of being sensitive

Accuracy

The quality or state of being correct or precise

Error: A measurement of the estimated difference b/w the observed or calculated value of a quantity and its true value