CHAPTER – 5

ACCESSORIES OF HYDRAULIC &PNEUMATIC CIRCUITS

Government Polytechnic, Balangir
Department of Automobile Engineering
Sem-4th
Subject -Hydraulic & Pneumatic Control

5.1 Filters

- Hydraulic Filters
- Pneumatic Filters (Air filters)

Hydraulic Filters

- The hydraulic system works best when the fluid is free from impurities & other foreign matter.
- The fluid filters are used to remove the smallest particles of foreign matter from fluid.
- The filters used to clean the oil for the hydraulic system are termed as hydraulic filters.

Types of Hydraulic Filters

There are four basic types of filters used in the hydraulic systems

- Mechanical
- Absorbent
- Adsorbent
- Magnetic

Filters are further classified as

- Full flow filters
- Proportional type filters

Mechanical filters

- These contains fine wire mesh closely stocked metal disc or cloth in the form of bag.
- They remove the coarse contaminants such as dirt, dust, grit & metallic particles.
- But these can not remove oil soluble & fine contaminants.

Absorbent filters

- These contains material such as cotton waste, paper, wood pulp, cloth, asbestos.
- They will filter out by mechanical absorption of coarser particles as well as fine insolubles.
- But they do not remove oil soluble oxidation products.

Adsorbent filters

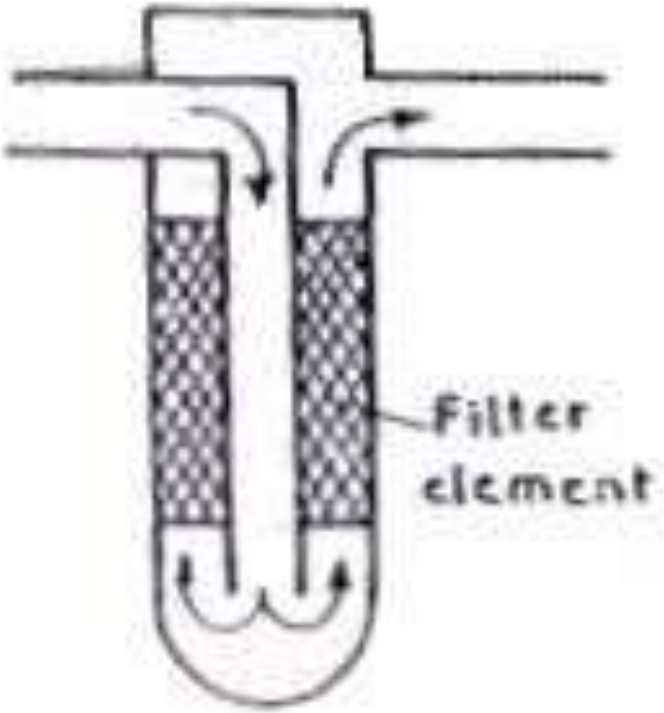
- These contains materials such as fuller’s earth, charcoal, activated clay, chemically treated paper or waste.
- It removes both coarser & fine particles.
- It also removes insoluble sludges & oil soluble contaminants.

Magnetic filters

- These use stake of magnetized soft steel grids to remove the ferrous particles flowing through fluid by magnetism.

Full flow filters

- In this all the fluid passes through filter.
- It consist of cylindrical filter element fitted in a body.
- The fluid enters through the inlet & moves to outer side of filter element.
- Then it passes through filter element to inner side where it is connected to outlet of the filter.



Full flow filters

- This filter offers excessive resistance to flow as fluid becomes dirty.
- To avoid this resistance, a spring loaded check valve is provided, that opens if pressure becomes excessive.

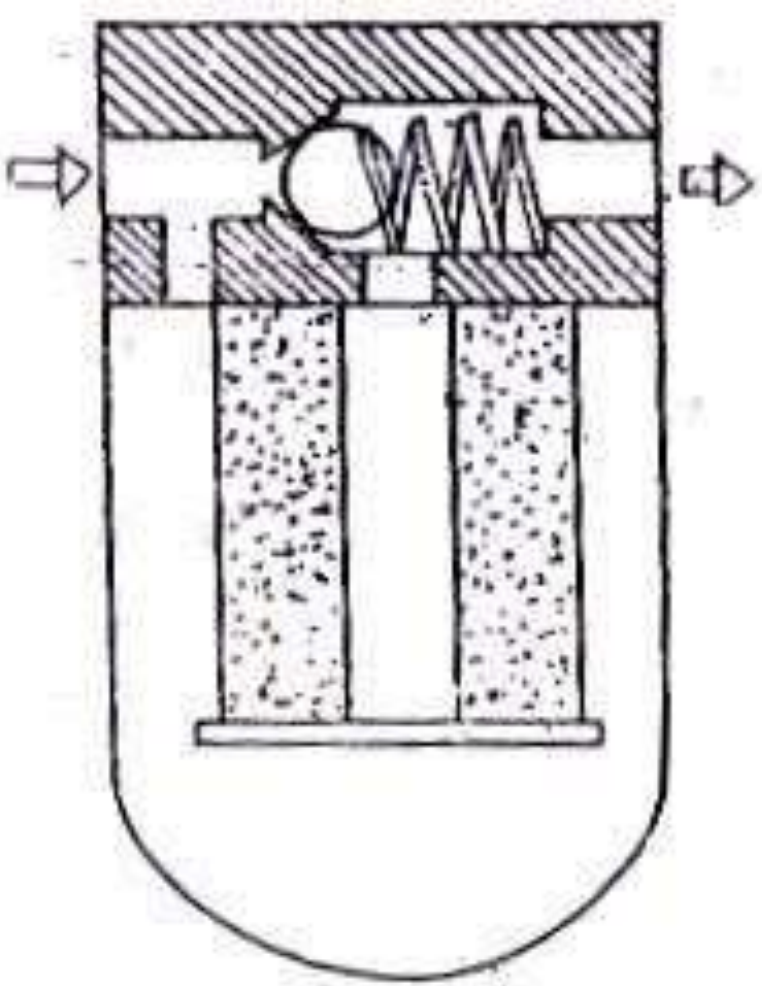


Fig. 15.8

Proportional filter

- Fig. shows proportional type of filter in which only a portion of fluid passes through the filter.
- It operates on the principle of venturi.
- The venturi throat causes a pressure drop because it is smaller in diameter than the fluid piping

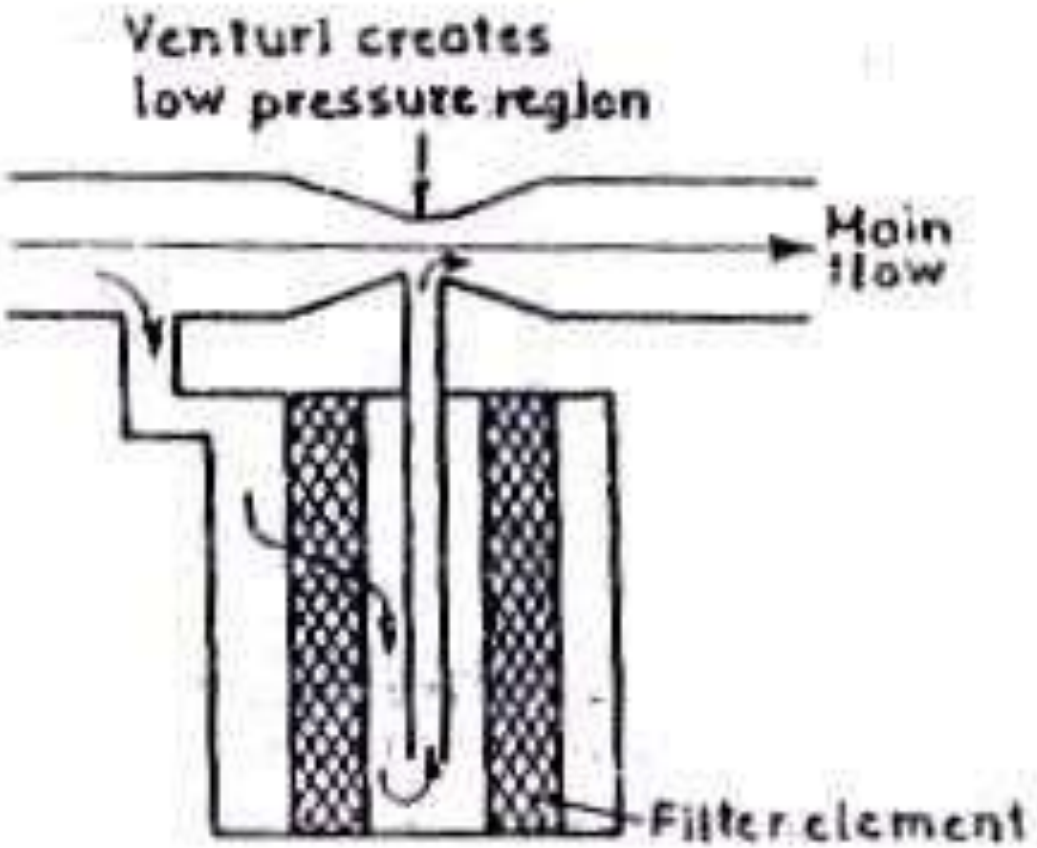


Fig. 15.7

Proportional filter

- This decrease in pressure causes a fluid to flow through filter element & up into the venturi throat where pressure is lowest.
- The disadvantage is that harmful abrasive solids can circulated through the system until they are trapped.

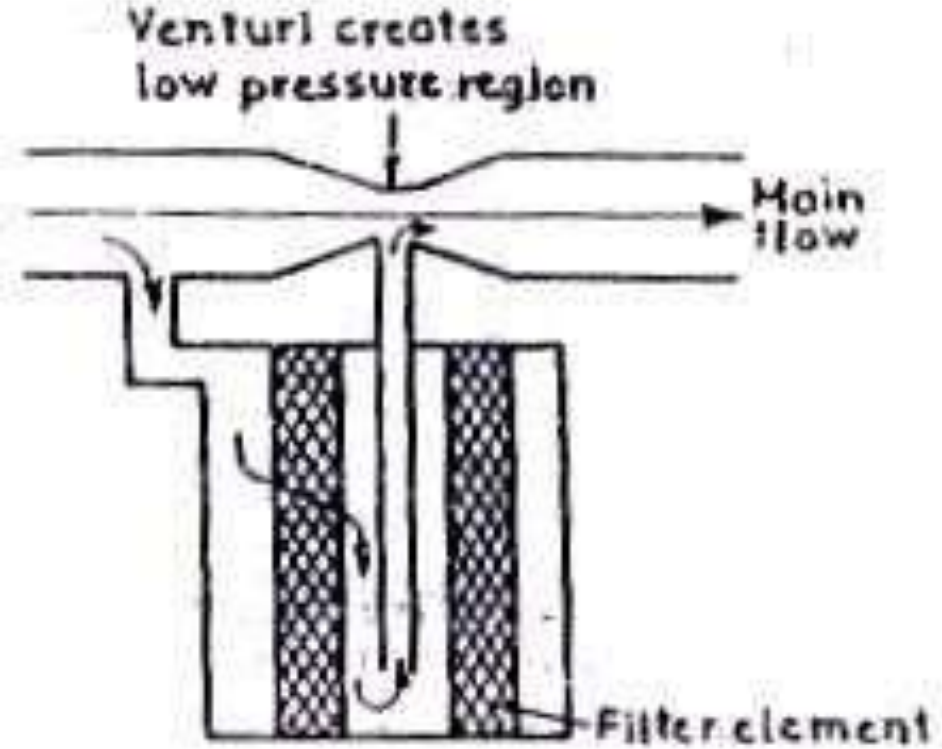


Fig. 15.7

Pneumatic Filters (Air Filter)

- Air filters are used to remove foreign matter from a air.
- The foreign matter may be removed by centrifuge or cyclone action.
- The material for the filter elements are porous metal, porous stone, felt, resin-impregnated paper, wool fiber.

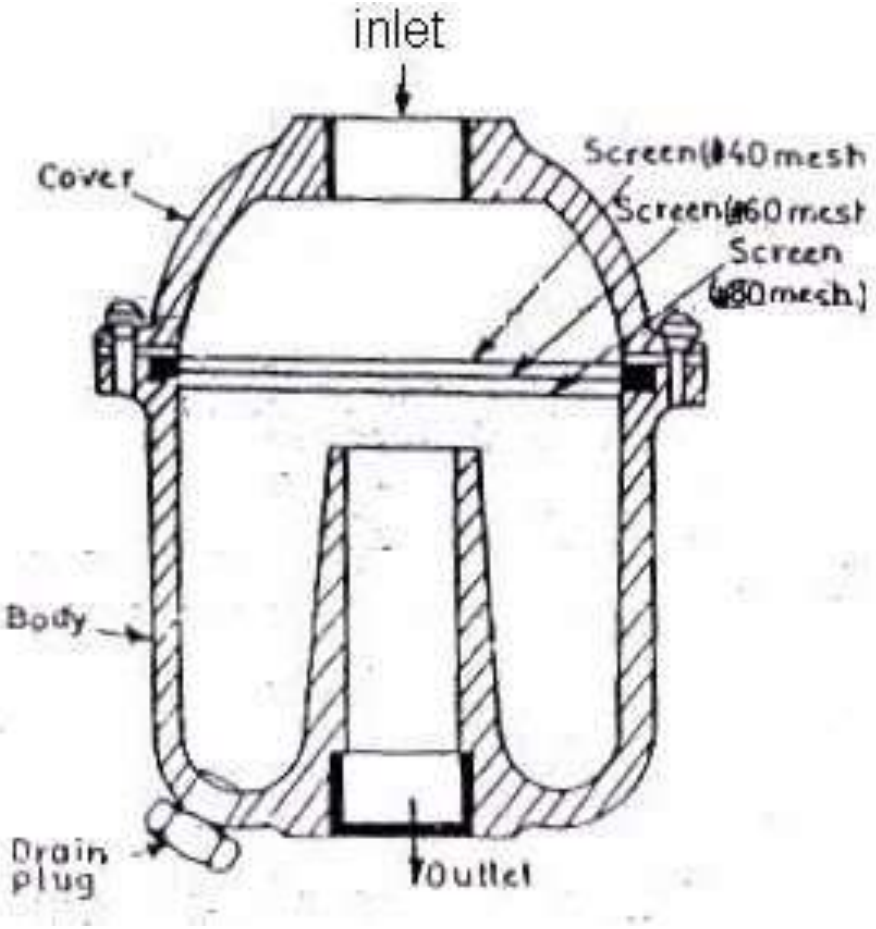
Types of air filters

There are three types of air filters

- Screen type
- Mechanical type
- Cyclone type

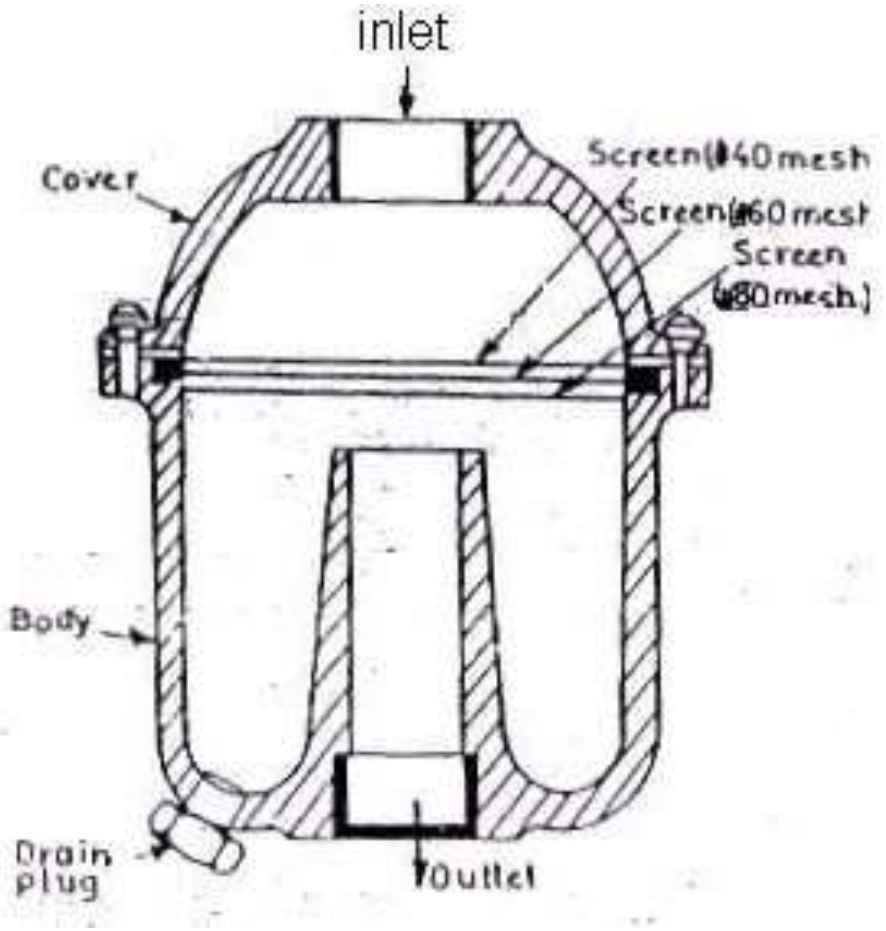
Screen type

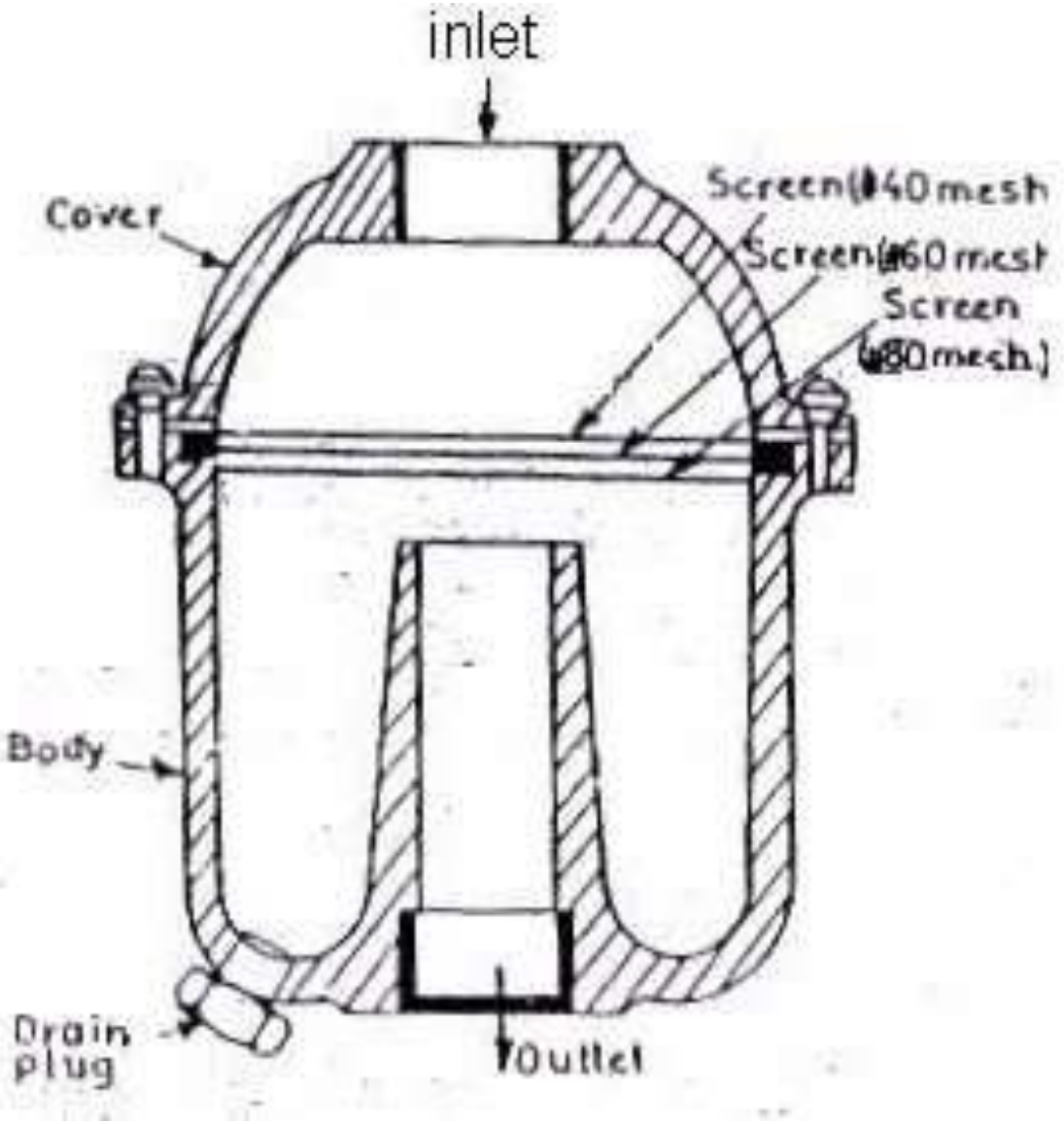
- It consist of a metal body in which different mesh screens are kept between inlet and outlet.
- Here air enters the filter through the inlet & flows through filter element.



Screen type

- The filter material is screen where foreign matter is separated from air & then clean air is passed through the outlet of the filter.




inlet
Cover
Screen(#40 mesh
Screen(#60 mesh
Screen
(#80 mesh)
Body
Drain
plug
Outlet

Mechanical type filter

- In mechanical filter the air enters the filter at the bottom & then passes through the body of filter, while passing it rotates the rotor mounted in a filter at high speed.

- Due to this action, the foreign particles, which are heavier than that of air are thrown against the wall of the body by centrifugal force.

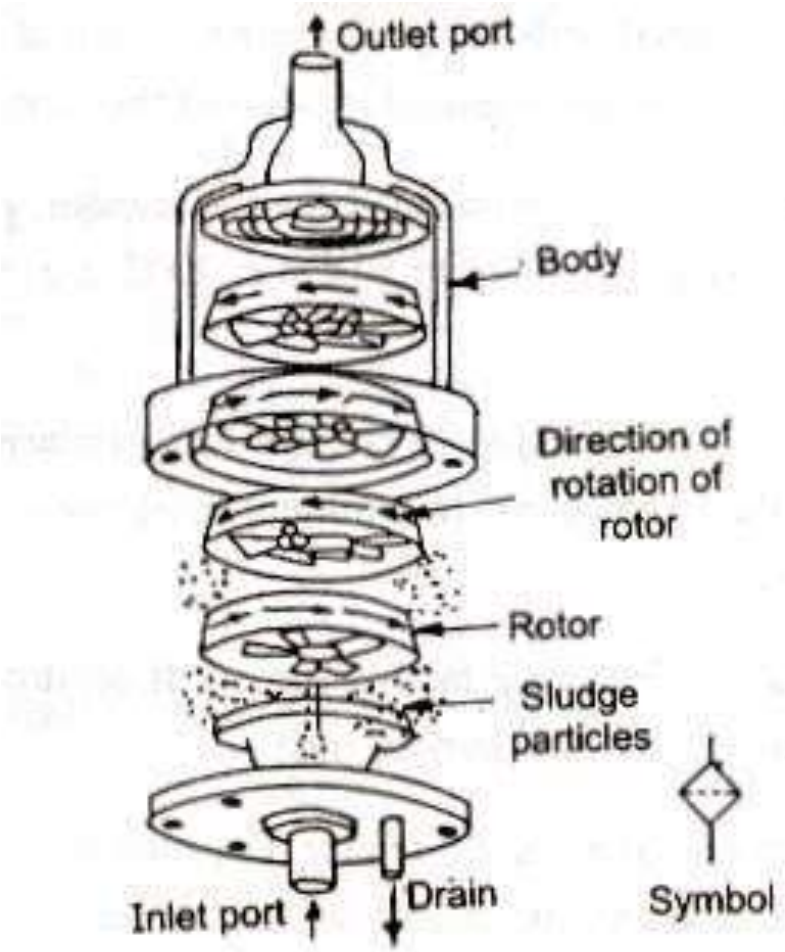


Fig. 11.8 : Mechanical type filter

Mechanical type filter

- The foreign particles then fall downward at the bottom of the body & can be removed from the drain plug.
- All the four rotors are arranged in such a way that the rotation is opposite in alternate rotors.
- As the air stream passes from one rotor to another, the sudden reversal of air stream provides a cleaning action for removing the foreign materials.

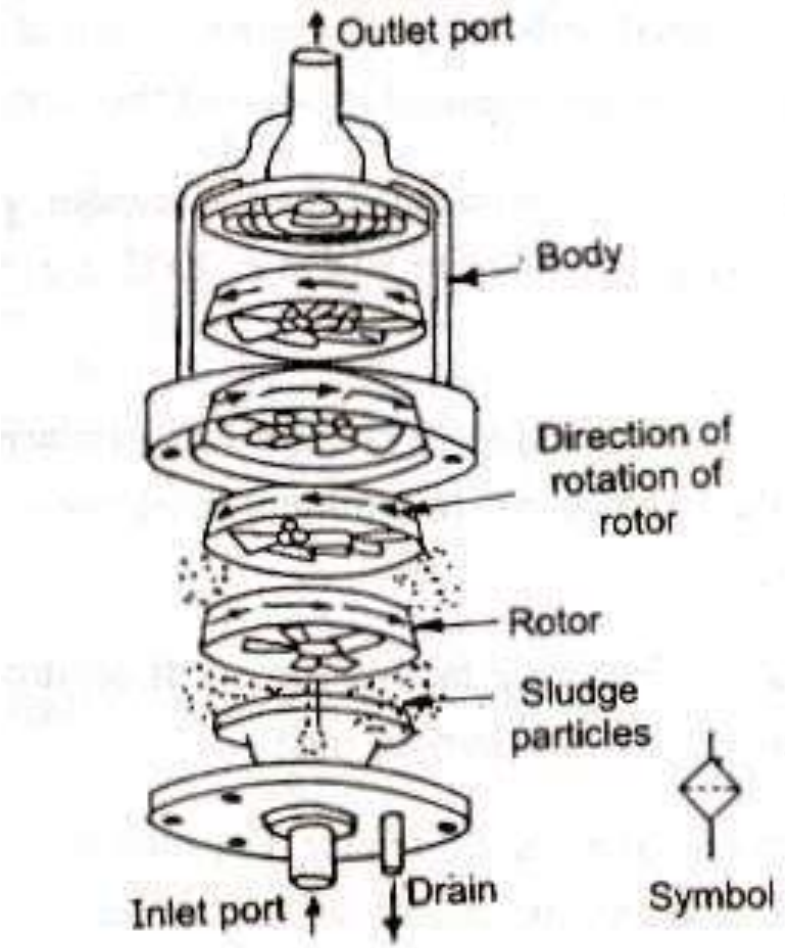


Fig. 11.8 : Mechanical type filter

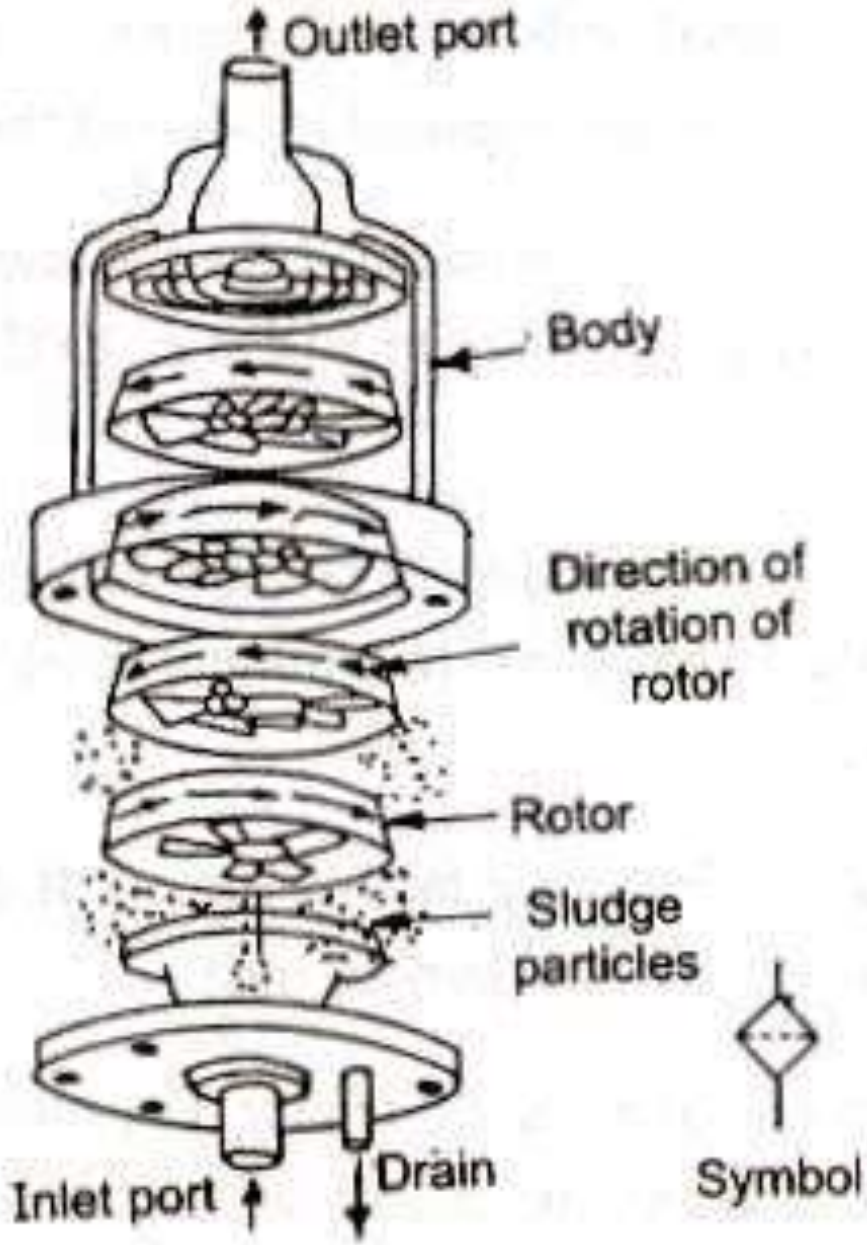


Fig. 11.8 : Mechanical type filter

- **Cyclone type filter:**
- it is used for gaseous fluids.
- It has deflector plate which makes the gas to swirl around the filter element.
- Due to this large particles will be thrown against the walls of the bowl by centrifugal force and collects at the bottom of the bowl.
- The smaller particles are removed by filter element.

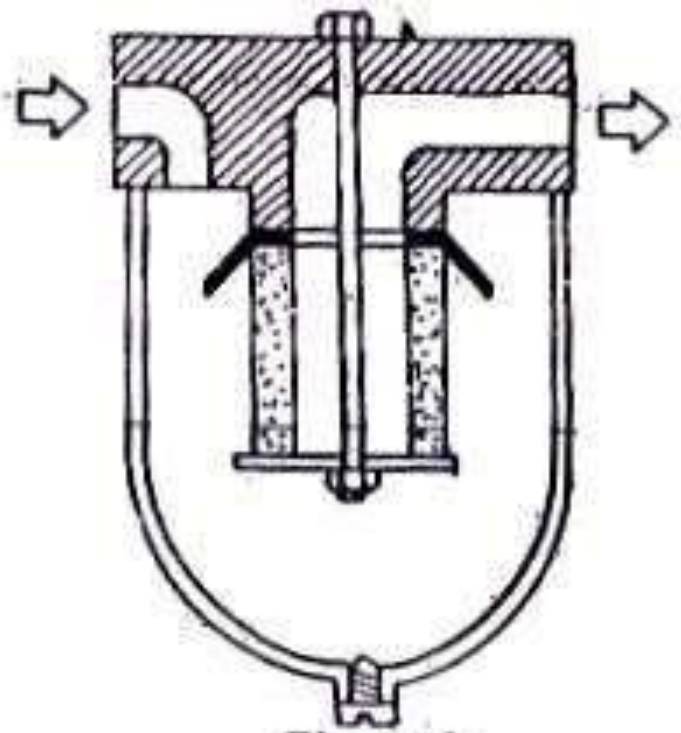


Fig. 15.9

Indicator Type Filter :

5.2 Hoses & Connectors

- Requirement of hoses and hose fittings:

1. It should be flexible sufficiently
2. It should be able to work with maximum system pressure
3. It should be provided with proper end fitting
4. It should be oil & weather resistant
5. While assembling, care should be taken to avoid sharp bends, twists, & tension in the hose.
6. Care should be taken while installation regarding the permissible limits of temperature which the hose can withstand.

5.2 Hoses & Connectors

Flexible hoses

- Hose provide flexible connection for linking two relatively moving machine components.
- They are made of nylon, PVC, flexible metallic tubes, elastometric or rubber tube of reinforced construction.

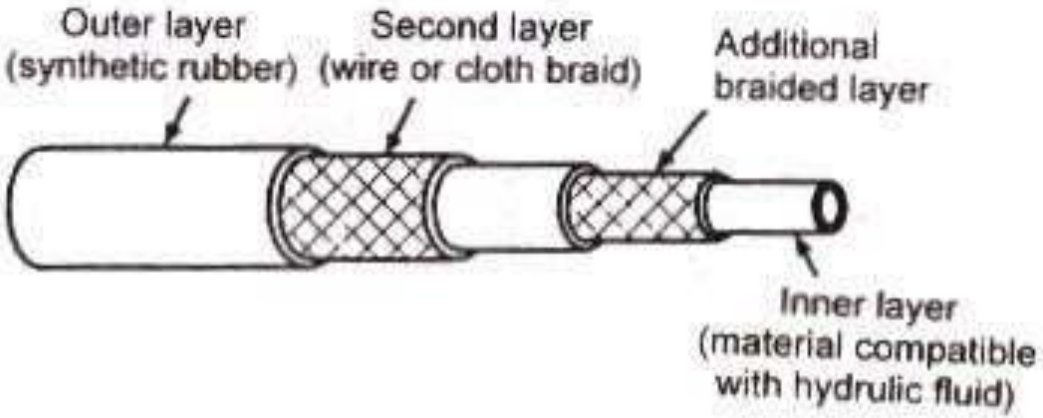


Fig. 6.7 : Various layers in a hose

- A flexible hose has multilayer cross-section.
- The main conductor is made up of a material which is compatible with the fluid to be transmitted.
- On outside, it is covered with alternate layers of braided fabric or wire & layer of synthetic rubber.

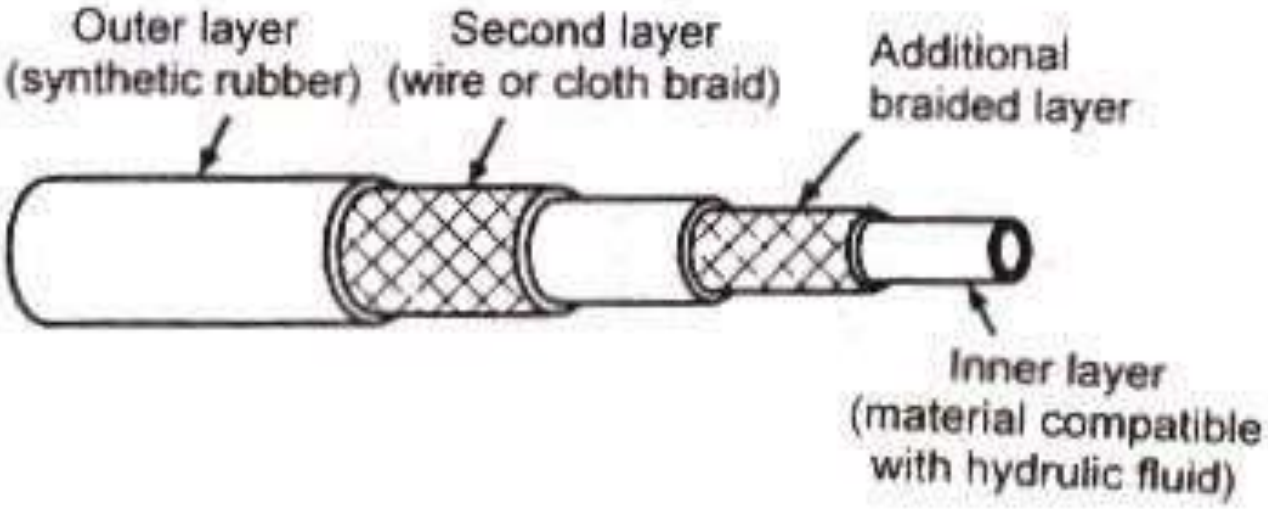


Fig. 6.7 : Various layers in a hose

- Thus a hose has minimum three layers that of inner tube, braided and outside elastomer.
- The number of layers can be increased depends on the pressure to be handled.
- The braided layer of fabric or wire gives the required strength to withstand the pressure.

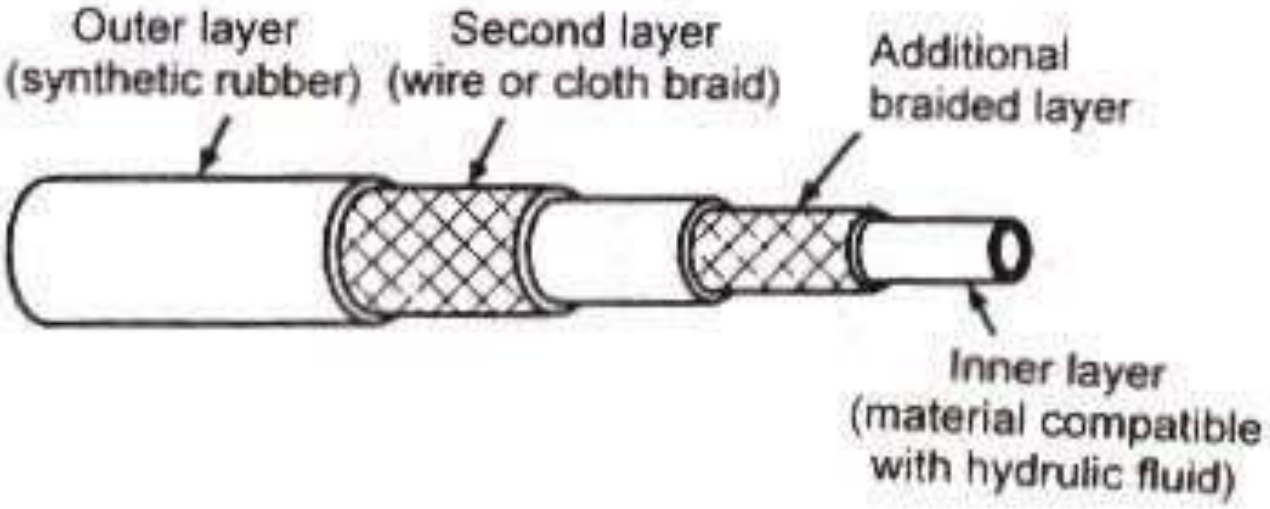


Fig. 6.7 : Various layers in a hose

- While the layer of synthetic rubber protects the braided layer from corrosion & wear.
- Hoses are used in industrial installation due to ease in installation & its characteristics of absorbing pressure shock and machine vibrations.
- It required less skill for pipe plumbing, but cost of hose is higher.

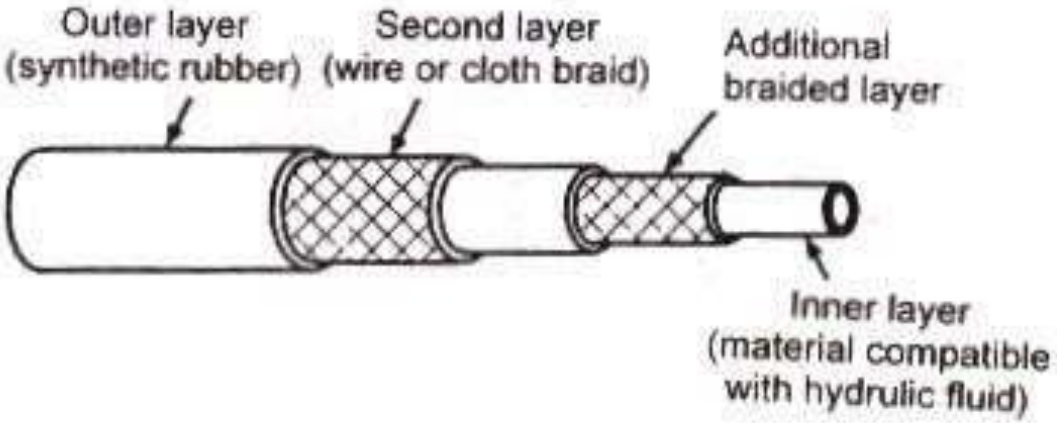


Fig. 6.7 : Various layers in a hose

Hose Connectors / fittings

1. **Permanently attached end fitting:**

These may be straight fitting, 45^0 elbow fitting or 90^0 elbow fitting.

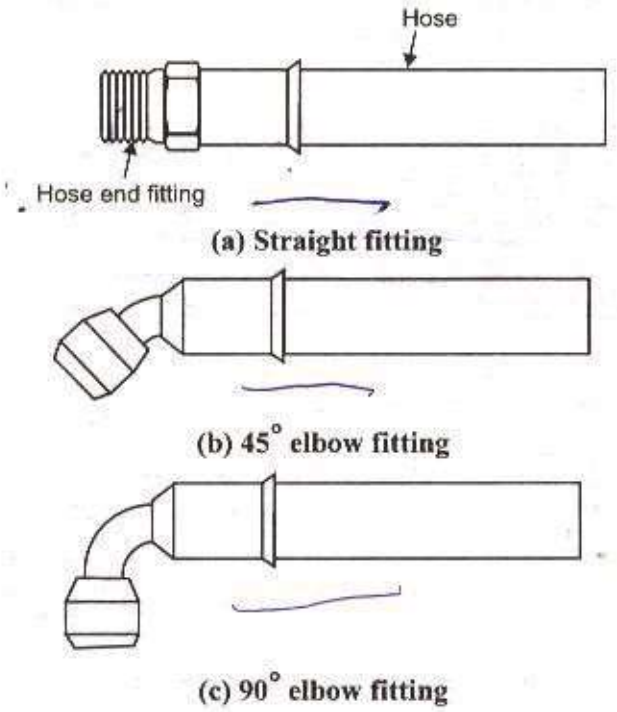
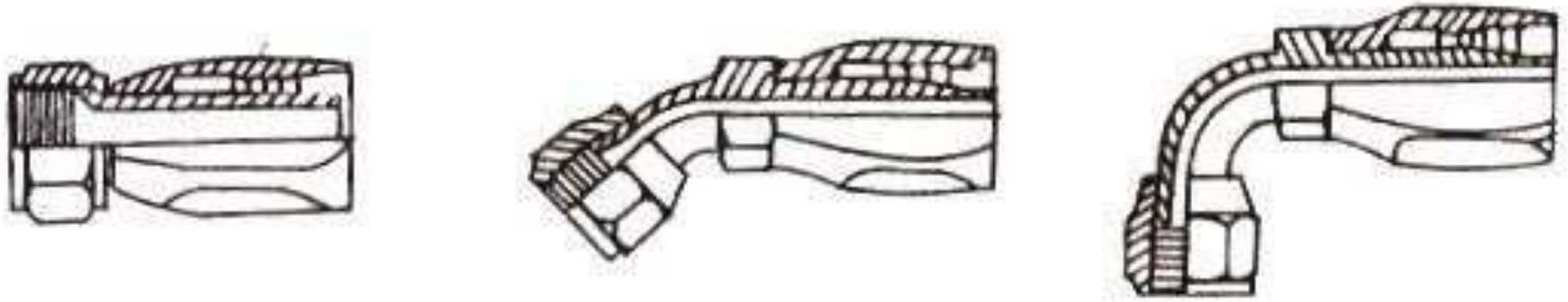


Fig. 6.8 : Permanently attached end fittings for flexible hose

2. Reusable type end fittings:

These are straight fitting, 45^0 elbow fitting or 90^0 elbow fitting.

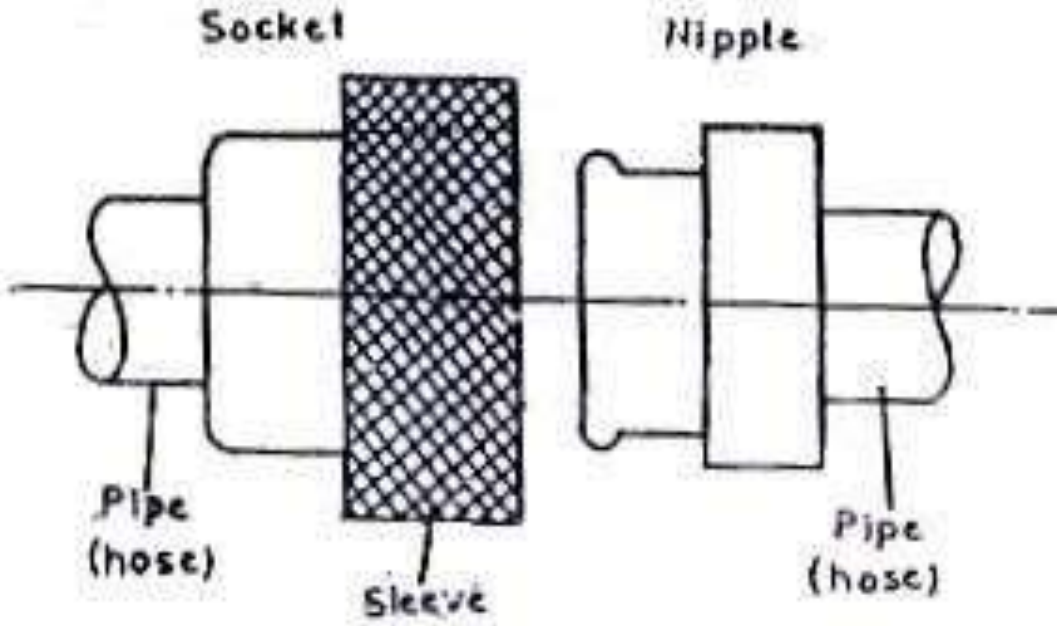


(a) Straight fitting (b) 45° elbow fitting (c) 90° elbow fitting

Fig. 6.9 : Reusable type end fittings for flexible hose

3. Quick disconnect couplings:

- Some application require frequent connecting & disconnecting of fluid supply components.
- This requirement is fulfilled by a specially designed connector known as Quick disconnecting coupling.



- It permits assembly & disassembly of hose in seconds without need of any special tooling.
- The quick disconnect coupling is provided with suitable seals to prevent loss of fluid when two halves are being connected.
- It is also provided with suitable check valves to prevent loss when hoses are disconnected.

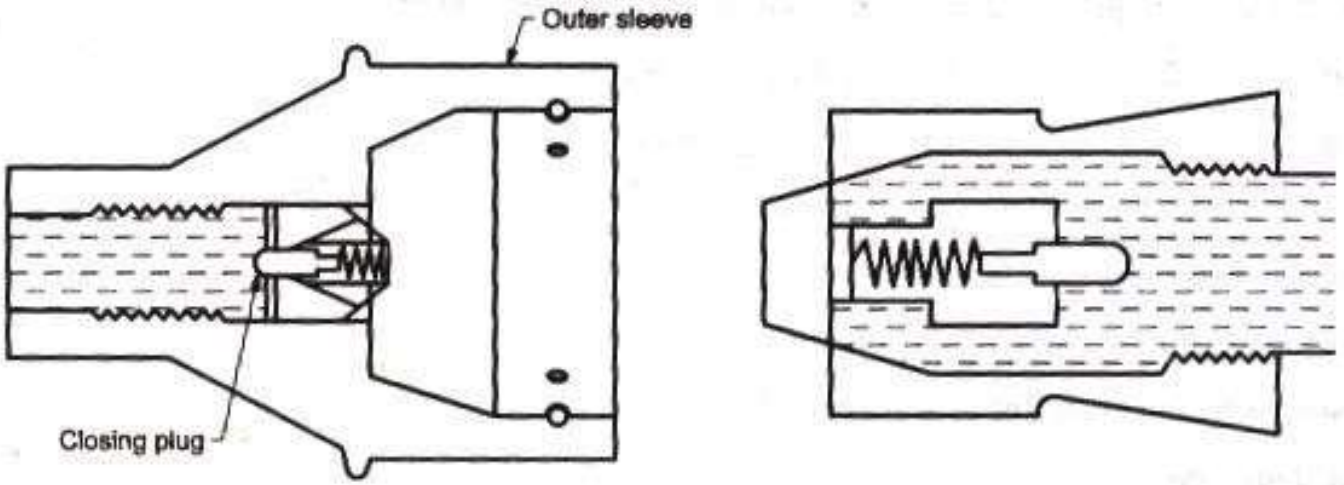


Fig. 5.39 : Quick action coupling

- When the two ports of the coupling are connected the check valve unseated to allow the fluid flow.
- The two parts are held together by a locking device.
- The locking device is so constructed that a single mechanical movement will unlock the unit & allow the two halves to be parted.

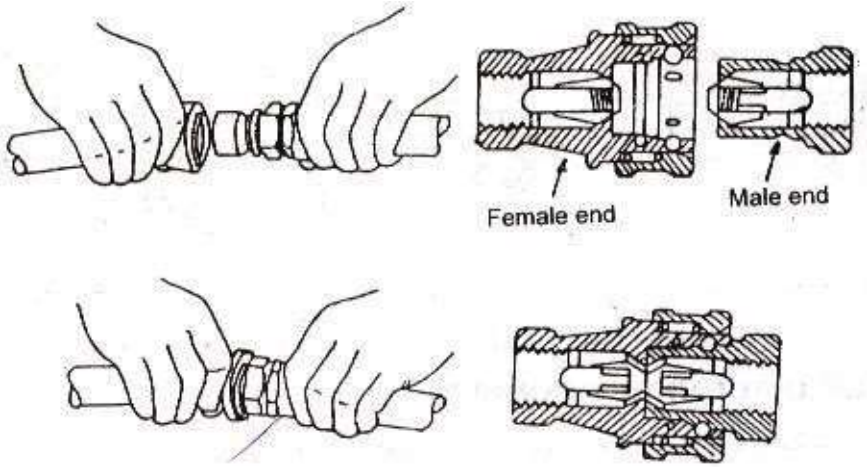


Fig. 6.10 : Quick disconnect coupling

Types of quick disconnect coupling

1. One way shut-off:

- In this type check valve is fitted in female part of coupling which prevents the loss of fluid from the fluid source.
- The other part does not consist of check valve which leaves the actuator components unloaded.
- This cause other side gets contaminated with foreign particles.

2. Two way shut-off

- In this type check valves are provided at both the ends of the coupling.
- This prevents the loss of fluid when two parts are disconnected also it prevents contamination due to foreign matter.
- These couplings are used in earth moving equipments, agricultural machines & portable air tools

Seals & Gaskets

- Seals are used to minimize the leakage which in turn prevents the loss of power & reduced efficiency.
- Thereby preventing complete failure of components such as pumps or valves.
- Seals prevents excessive internal and external leakage and keep the system out of contamination.

- Seal is a component made up of some flexible material when placed at the probable location of leakage, it gets deformed to fill the clearance and thus prevents the leakage of hydraulic oil.

Classification of Seals

- **On the basis of elimination of leakage**

A) Positive seals

B) Non-positive seals

- **Positive seals:-** these seals completely stop the leakage. They are primarily used to prevent external leakage.

Ex. Washer used between valve and valve seat.

- **Non-positive seals:-** these are used to prevent any excessive leakage, at the same time they are designed to permit a small amount of leakage.

Ex. Piston rings do not allow the oil to flow from one side of piston to the other at the same time they provide little clearance for formation of lubricating film between cylinder and piston.

- **On the basis of relative motion between the parts sealed**

Static seal

Dynamic seal

- **Static seals:-** The seals used between the mating parts that do not move relative to each other are termed as static seals.

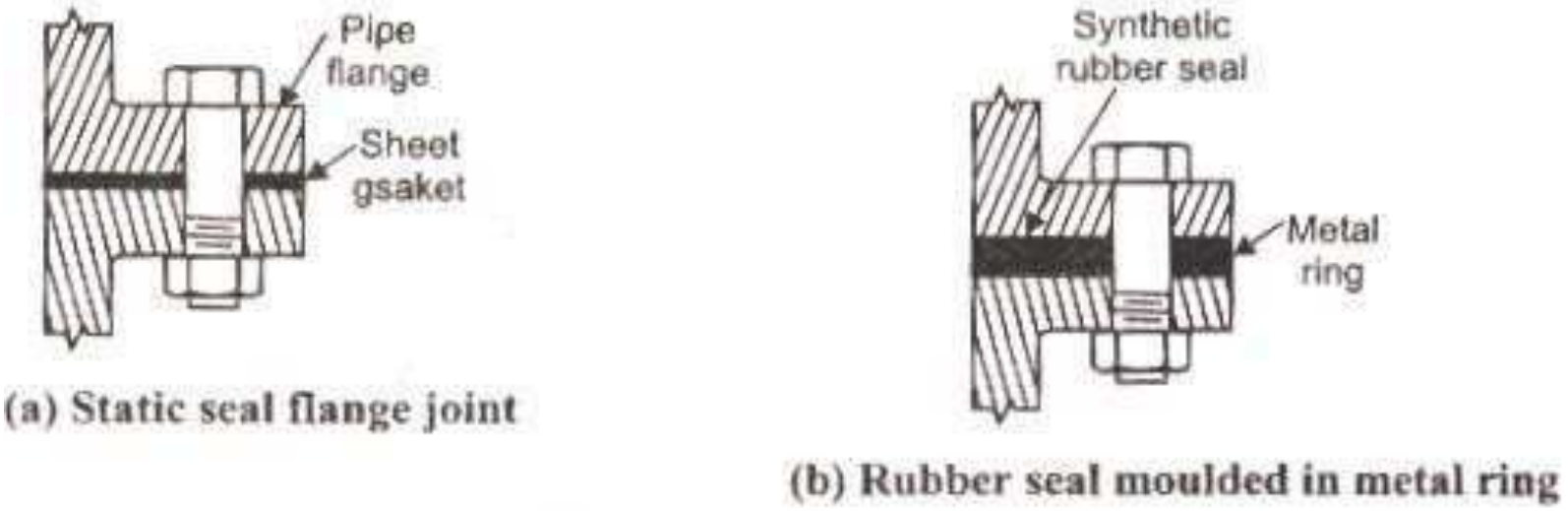
  These seals are compressed between two rigidly connected parts.

These seals makes leak proof joint because of pressure applied in tightening the bolts.

Under pressure the seal material flows and fills the irregularities in the surface making the joint leak-proof.

- A static seal may often termed as gasket and is usually cut from compressible flat sheet material like **paper, cork, rubber or asbestos**. The thickness is ranging from 0.25 mm to 3 mm.

- Figure shows static flange joint and rubber seal moulded in metal ring



(a) Static seal flange joint

(b) Rubber seal moulded in metal ring

Fig. 6.14 : Static seals

- O-ring static seal is the simple and most versatile seal used for static applications. The O-ring can be made circular, rectangular or U-ring in cross-section as shown in fig.

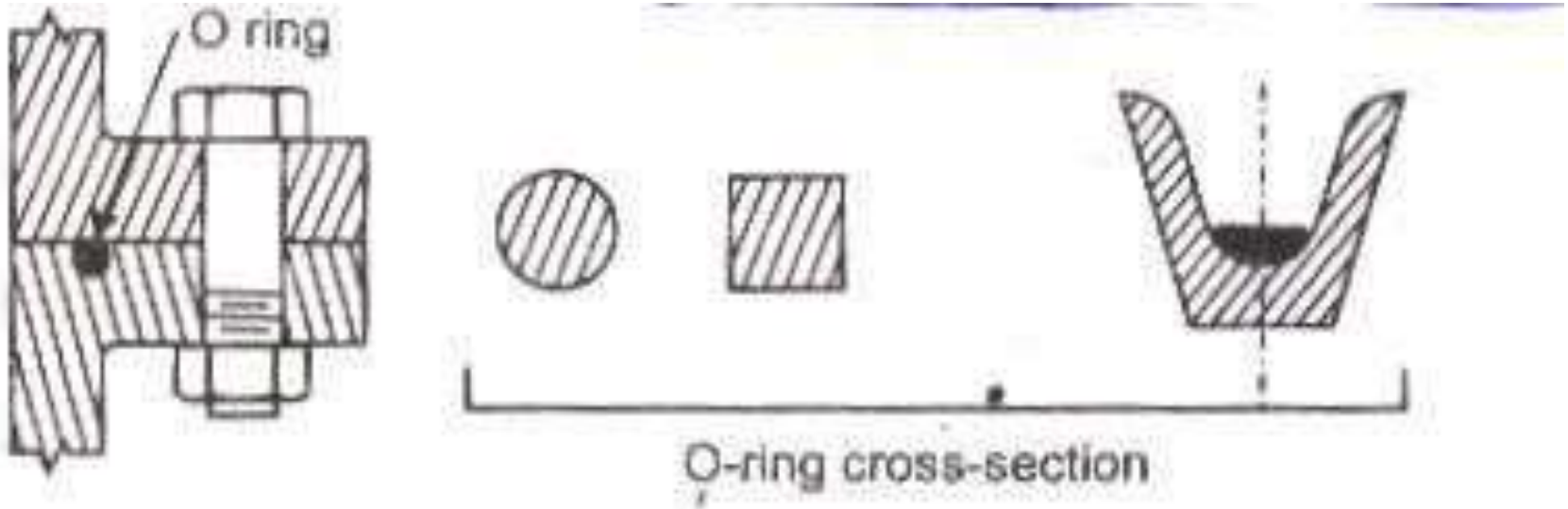


Fig. 6.15 : O-ring static seal

- Dynamic seals:-
- The seal between the mating parts that move relative to each other is called as dynamic seals
- These seals are subjected to wear as one of the mating part rubs against the seal
- These seals prevents leakage around a moving component
- Ex. Piston rings, O- rings on rotating and reciprocating shafts

- Types of dynamic seals
- O-ring
- Lipped seals
- Piston cup packing
- Piston rings
- Wiper rings

- O-ring :-

It is moulded synthetic rubber seal that has round cross-section in free state.

It can be used for static as well as dynamic conditions.

It gives effective sealing strength through a wide range of pressures, temperatures and movements.

It provides sealing pressure in both directions as well low running friction on moving parts.

It is installed in an annular groove formed into one of the mating parts.

When the pressure is applied, the O-ring is forced against the third surface to create a positive seal. Hence it is capable of sealing against high pressures.

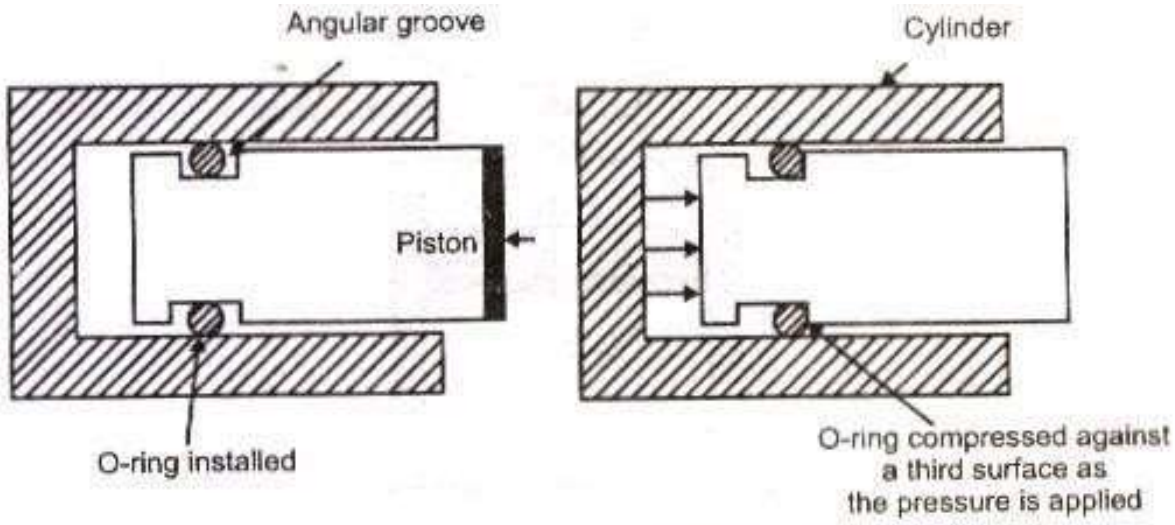


Fig. 6.16 : Operation of 'O' ring

- Lipped seals:

These are used in all types of reciprocating motion applications.

The U-type of seal is pressure driven against the mating moving face and the supporting walls of its recess.

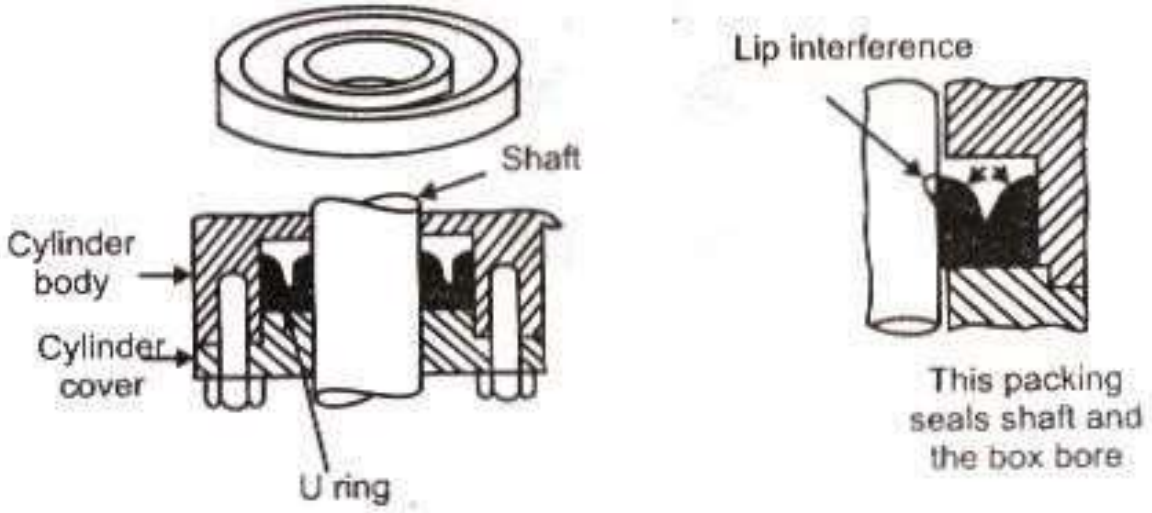


Fig. 6.17 : U-ring seal for cylinder and shaft

- Piston cup packing:

These are designed for pistons in the reciprocating pump and power cylinders.

These are simple and installed quickly.

In this there is full pressure at lip and decreasing to zero at the base.

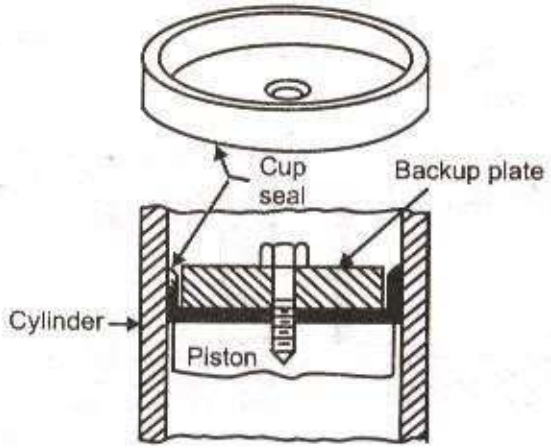


Fig. 6.18 : Piston cup packings

The wall of cylinder supports the pressure at the cup's top.

For lower pressures and shock loads an expander is placed inside the expander packing to force lip against wall.

Ex. Pistons, plungers, rams for sealing reciprocating motion. In wheel cylinder.

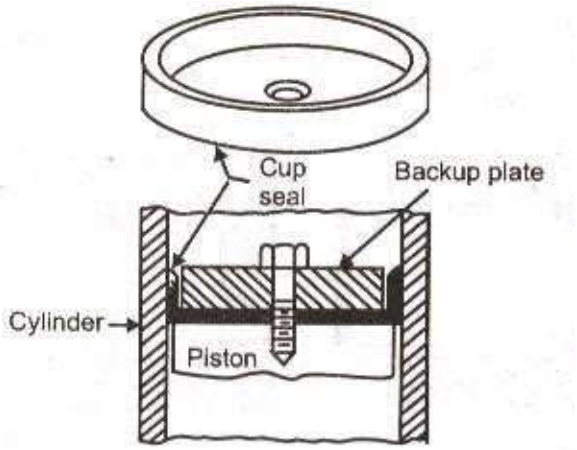


Fig. 6.18 : Piston cup packings

- Piston rings:- these are endless, bevel-cut, butt-cut and step-cut. The piston rings are installed in a groove cut in piston to prevent leakage of fluid past the cylinder.

- Piston rod wiper rings:

These rings are used to prevent foreign abrasive or corrosive material from entering into a cylinder. The wiper ring moulded from a synthetic rubber which is stiff enough to wipe all dust of dirt on the piston rod.

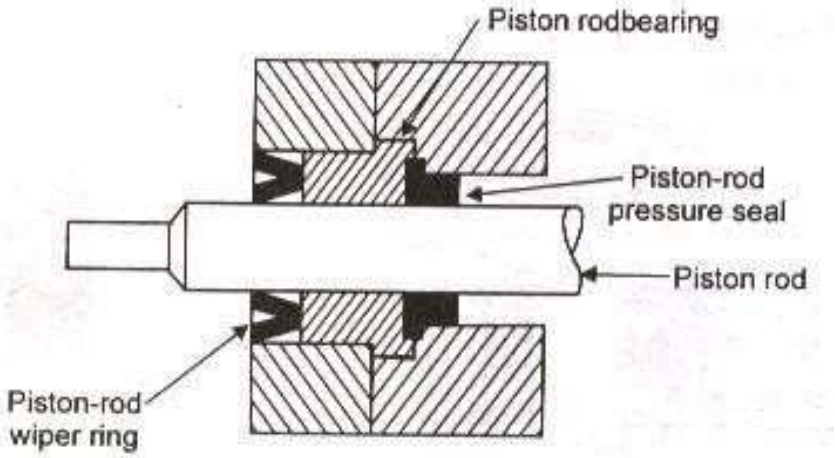
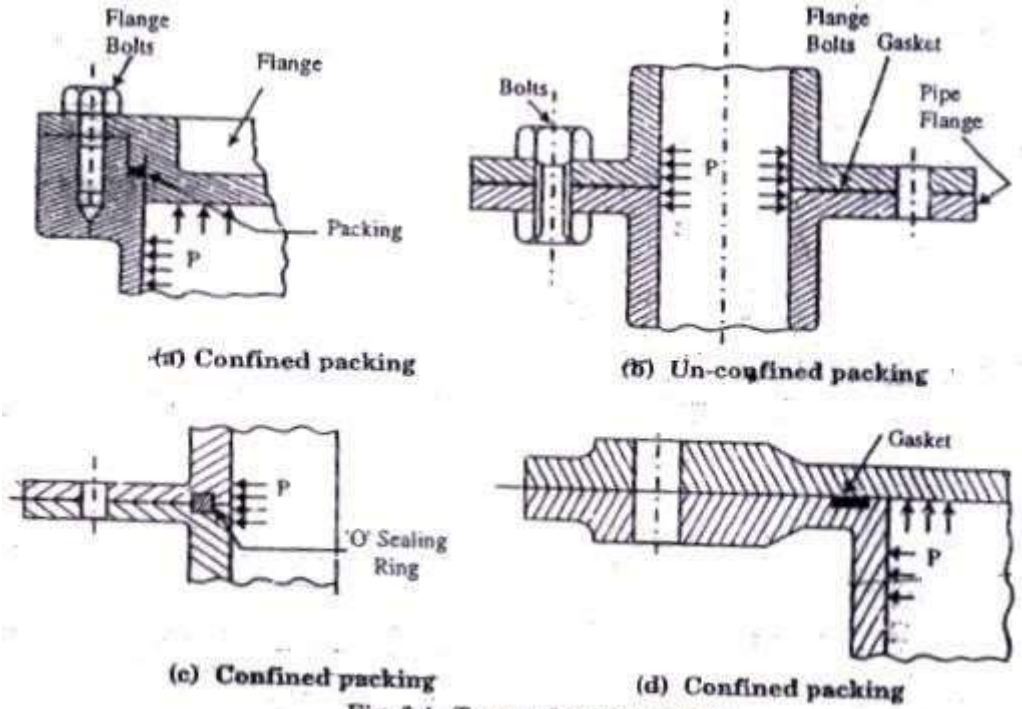


Fig. 6.19 : Piston rod wiper ring



(a) Confined packing

(b) Un-confined packing

(c) Confined packing

(d) Confined packing

Fig. 6.4 : Types of static gaskets

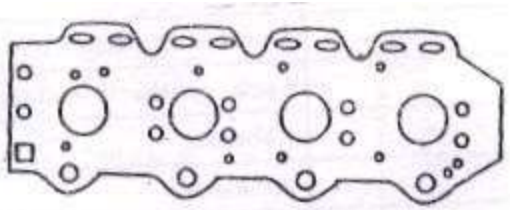


Fig. 6.2 : A typical cylinder head gasket

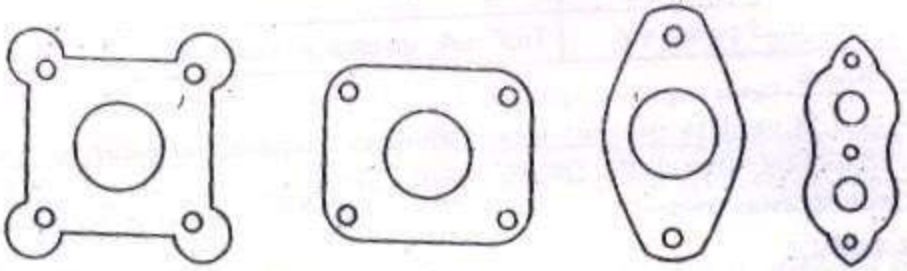
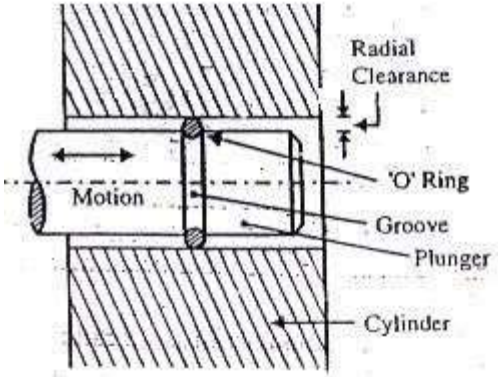
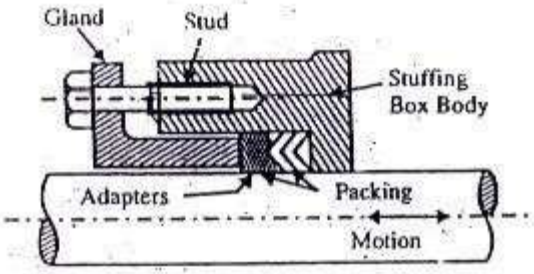


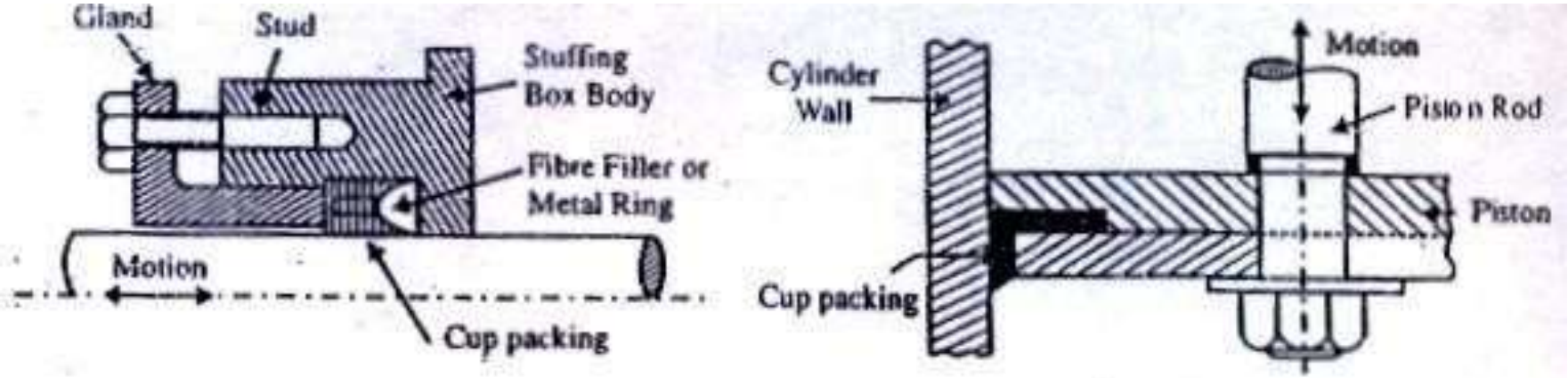
Fig. 6.3 : Shapes of some gaskets used in automobile



(a) 'O' ring seal gland



(b) V-ring packing



(c) U-cup packing

(d) Cup packing

Fig. 6.5 : Type of reciprocating seals

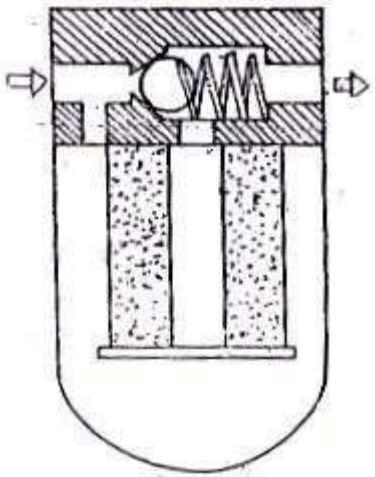


Fig. 15.8

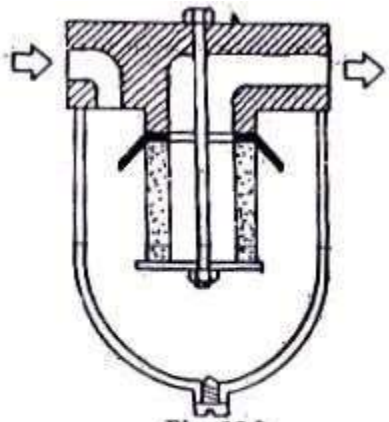


Fig. 15.9

Indicator Type Filter :

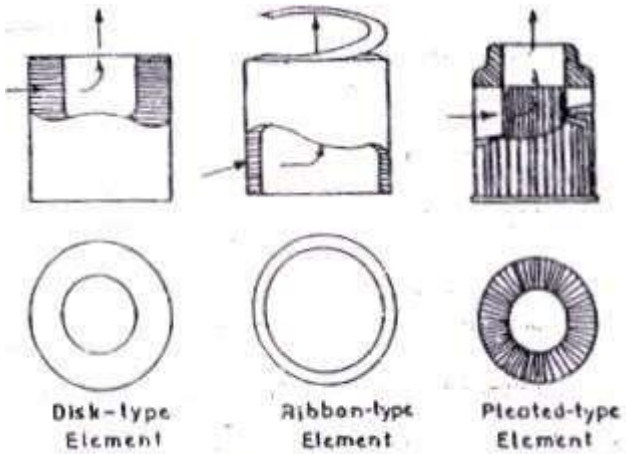
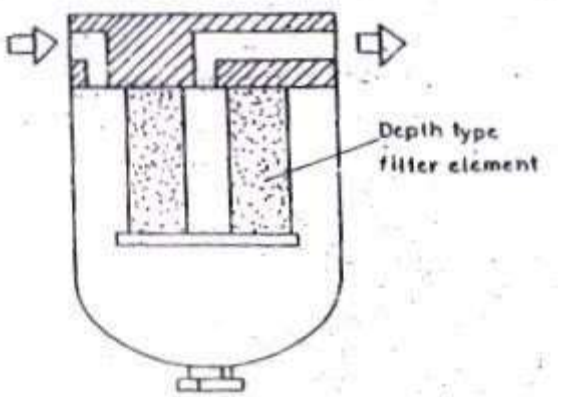
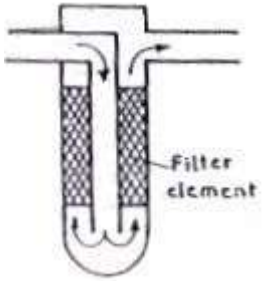
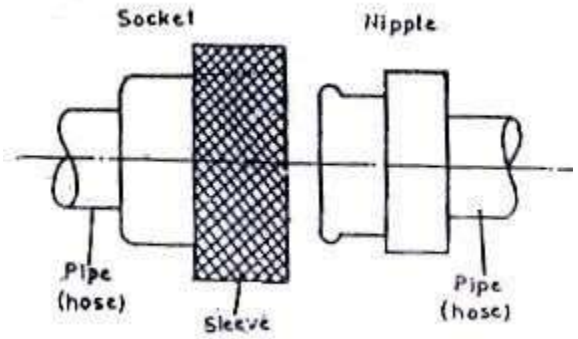
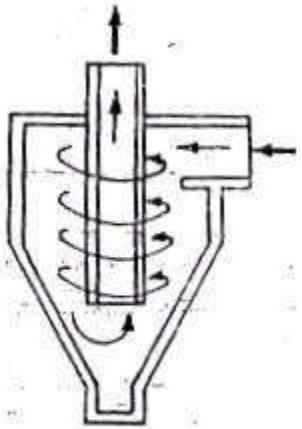

Disk-type
Element
Ribbon-type
Element
Pleated-type
Element

Fig. 15.4


Depth type
filter element


Filter
element


Socket
Nipple
Pipe
(hose)
Sleeve
Pipe
(hose)



Cyclone type dust separator

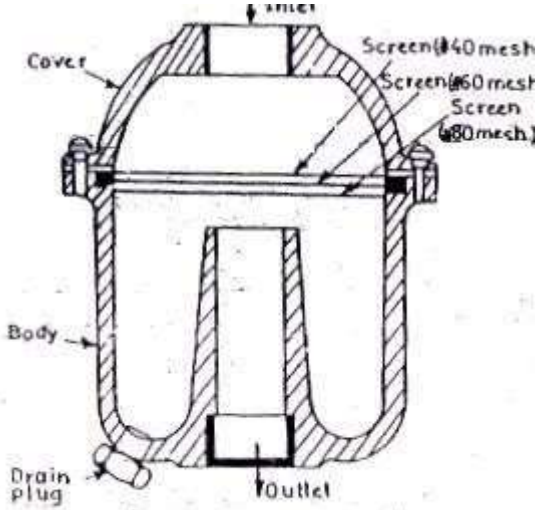

Cover
Screen (40 mesh
Screen (60 mesh
Screen
(80 mesh)
Body
Drain
plug
Outlet

Fig. 15.3