LECTURE 30 to 31– ACCESSORIES USED IN FLUID POWER SYSTEMS

FREQUENTLY ASKED QUESTIONS

1. Explain the two types of the leakages in hydraulic system. In what way do they affect the performance of a fluid system?

Leakage in hydraulic system can be classified as

1. Internal Leakage
2. External leakage

Internal leakage increases the clearances between mating parts due to wear. If the entire system leakage becomes large enough, the actuators will not operate properly.

External leakage represents a loss of fluid from the system. It is unsightly and represents a safety hazard. Improper assembly of pipe fittings is the most common cause of external leakage.

2. What is a seal and what are their functions

Seals are used in hydraulic systems to prevent excessive internal and external leakage and to keep out contamination. Functions are

- Prevent leakage – both internal and external
- Prevent the dust & other particles entering into the system
- Maintain pressure
- Enhance the service life & reliability of the hydraulic system.

3.How are hydraulic seals classified? What is meant by positive sealing and non positivesealing?

Classification of hydraulic seals

1. Hydraulic seals can be classified according to the method of sealing as

   a. Positive Sealing

   b. Non-positive sealing

2. Hydraulic seals can be classified according to the relative motion exist between the seals and other pars as

   a. Static seal

   b. Dynamic seal

3. Hydraulic seals may be classified according to geometrical cross section as

   a. O-Ring seal

   b. V-Ring & U-ring seal

   c. T-ring seal

   d. Piston cup packings

   e.Piston rings

   f.Wiper rings

A positive seal prevents even a minute amount of oil from getting past. Positive seals do not allow any leakage whatsoever (external or internal). A non-positive seal allows a small amount of internal leakage, such as the clearance of the piston to provide a lubrication film.

4. Distinguish between static seal and dynamics seal

Static Seal: Static seals are used between mating parts that do not move relative to one another. Typical examples are flange gaskets and seals, o-rings, etc. These are relatively simple. They are essentially non-wearing and usually trouble free if assembled properly.

Dynamic Seals: There are assembled between mating parts that move relative to each other. Hence dynamic seals are subject to wear because one of the mating parts rub against the seal.

5. How are seals classified based on geometrical cross section?

Hydraulic seals may be classified according to geometrical cross section as

a. O-Ring seal

b. V-Ring & U-ring seal

c. T-ring seal

d. Piston cup packings

e.Piston rings

f.Wiper rings

6. Explain the different types of sealing materials commonly used

Natural rubber is rarely used as a seal material because it swells and deteriorates with time in the presence of oil. In contrast, synthetic rubber materials are compatible with most oils. The most common types of materials used for seals are leather, Buna-N, silicone, neoprene, tetrafluoroethylene, viton and of course, metals.

- Leather. This material is rugged and inexpensive. However, it tends to squeal when dry and cannot operate above 90℃, which is inadequate for many hydraulic systems. Leather does not operate well at cold temperatures to about -50℃.
- Buna-N. This material is rugged and inexpensive and wears well. It has a rather wide operating temperature range (-45℃ to 110℃) during which it maintains its good sealing characteristics.
- Silicone. This elastomer has an extremely wide temperature range (-65℃to 232℃)Hence, it is widely used for rotating shaft seals and static seals where a wide operating temperature is expected. Silicone is not used for reciprocating seal applications because it has low tear resistance.
- Neoprene. This material has a temperature range of 50℃ to 120℃ F. It is unsuitable above 120℃because it has a tendency to vulcanize.
- Tetrafluoroethylene. This material is the most widely used plastic for seals of hydraulic systems. It is a tough, chemically inert, waxy solid, which can be processed only by compacting and sintering. It has excellent resistance to chemical breakdown up to temperatures of 370℃. It also has an extremely low coefficient of friction. One major drawback is its tendency to flow under pressure, forming thin, feathery films. This tendency to flow can be greatly reduced by the use of filler materials such as graphite, metal wires, glass fibers and asbestos.
- Viton. This material contains about 65% fluorine. It has become almost a standard material for elastomer-type seals for use at elevated temperatures up to 240℃Its minimum operating temperature is 28℃.

7.What are the primary and secondary functions of a reservoirsystem

The function of a fluid reservoir in a power hydraulic system are the following

- To provide a chamber in which any change in volume of fluid in the hydraulic circuit can be accommodated. When the cylinder extend there is an increased volume of fluid in the circuit and consequently there is a decrease in the reservoir level.
- It provide a filling point for the system.
- The reservoir serves as a storage space for the hydraulic fluid used in the system.
- The reservoir also uses as the location where the fluid is conditioned.
- To provide a volume of fluid which is relatively stationery to allow entrained air to separate out and heavy contaminants to settle. The reservoir is where sludge, water and metal slips settle
- The reservoir is a place where the entrained air picked up by the oil is allowed to escape.
- The dissipation of heat is accomplished by a properly designed reservoir. It provides a radiating and convective surface to allow the fluid to cool.

8. Explain the important elements of a reservoir system and explain the function of each

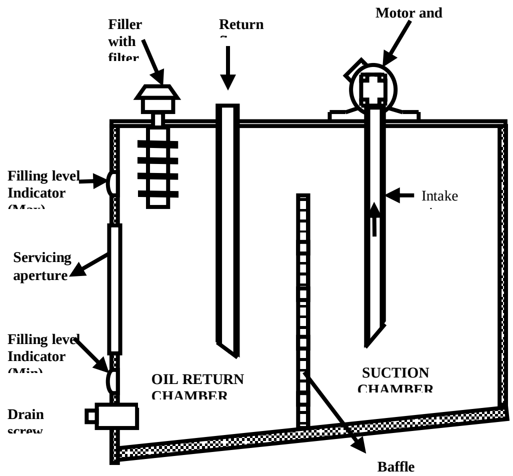
Elements of a reservoir are as follows

Filler Cap (Breather Cap)

It should be air tight when closed, but may contain the air vent which filters air entering the reservoir to provide a gravity push for proper oil flow.

Oil Level Gauge

It shows the level of oil in the reservoir without having to open the reservoir



Hydraulic Reservoir

Baffle Plate

It is located lengthwise through the centre of the tank and is 2/3 the height of the oil leve. It is used to separate the outlet to pump from the return line. This ensures a circuitous flow instead of the same fluid being recirculated. The baffle prevents local turbulence in the tank, allows foreign material to settle, get rid of entrapped air and increase heat dissipation.

Suction and Return Lines

They are designed to enter the reservoir at points where air turbulence are least. They can enter the reservoir at the top or at the sides, but their ends should be near the bottom of the tank. If the return line is above the oil level, the returning oil can foam and draw in air.

Intake Filter

It is usually a screen that is attached to the suction pipe to filter the hydraulic oil.

Drain Plug

It allows all oil to be drained from the reservoir. Some drain plugs are magnetic to help remove metal chips from the oil.

Strainers and Filters

Strainers and filters are designed to remove foreign particles from the hydraulic fluid. Strainers and filters are discussed later in detail.

9. What is a filter and How are filters classified?

Filter is a device whose primary function is the retention, by some fine porous medium, of insoluble contaminants from the fluid. Fluid flow has to follow a winding path and through the element.Filters are used to pick up smaller contaminant particles because they are able to accumulate them better than a strainer.

Types of Filters

A). Filters may be classified according to the filtering methods as

i. Mechanical Filters
ii. Absorption Filters
iii. Adsorbent Filters

i) **Mechanical filters**: This type normally contains a metal or cloth screen or a series of metal disks separated by thin spacers. Mechanical filters are capable of removing only relatively coarse particles from the fluid.

ii) **Absorption filters**: These filters are porous & permeable materials such as paper, wood pulp, diatomaceous earth, cloth, cellulose and asbestos. Paper filters are impregnated with a resin to provide added strength. In this type of filter, the particles are actually absorbed as the fluid permeates the material. Hence these filters are used for extremely small particle filtration.

iii) **Adsorbent filters**: Adsorption is a surface phenomenon and refers to the tendency of particles to cling to the surface of the filters. Thus the capacity of such a filter depends on the amount of surface area available. Adsorbent materials used include activated clay and chemically treated paper.

B).Filters may be classified according to the size of pores in the material as

i. Surface filters
ii. In depth filters

i) Surface filters: These are nothing but simple screens used to clean oil passing through their pores. The screen thickness is very thin and dirty unwanted particles are collected at the top surface of the screen when the oil passes. e.g. Strainer

ii) Depth filters: These contain thick walled filter medium through which the oil is made to flow & the undesirable foreign particles are retained. Much finer particles are arrested and the capacity is much higher than surface filters.

C).Filters are classified according to the location of filters as

i. Intake or inline filter
ii. Pressure line filter
iii. Return line filter

10. What are surface and depth filters

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11. What are the important locations of filters? Explain the advantages and disadvantages of each locationC).Filters are classified according to the location of filters as

i. Intake or inline filter
ii. Pressure line filter
iii. Return line filter

i) **Inline filter (suction strainer):** These are provided first before the pump to protect the pump against contaminations in the oil. These filters are designed to give a low pressure drop. Otherwise the pump will not be able to draw the fluid from the tank. To achieve low pressure drop across the filters, a coarse mesh is used. These filters cannot filter out small particles.

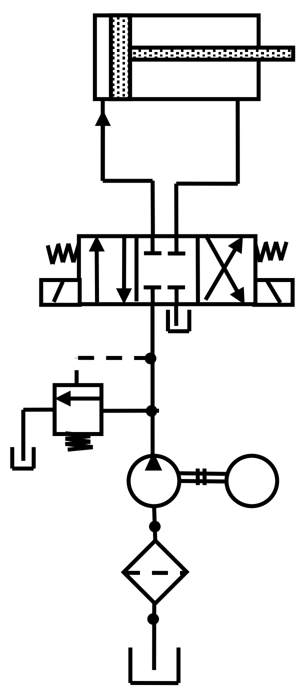

Figure 20.8 Suction filter

Advantages

1.A suction filter protects the pump from dirt in the reservoir. Since the suction filter is outside the reservoir, an indicator telling when the filter element is dirty can be used.

2. The filter element can be serviced without dismantling the suction line or reservoir. (Easy to maintain)

Disadvantages

A suction filter may starve the pump if not sized properly

ii) **Pressure line filters (High pressure filter):** These are placed immediately after the pump to protect valves and actuators and can be finer & smaller mesh. They should be able to withstand the full system pressure. Most filters are pressure line filters.

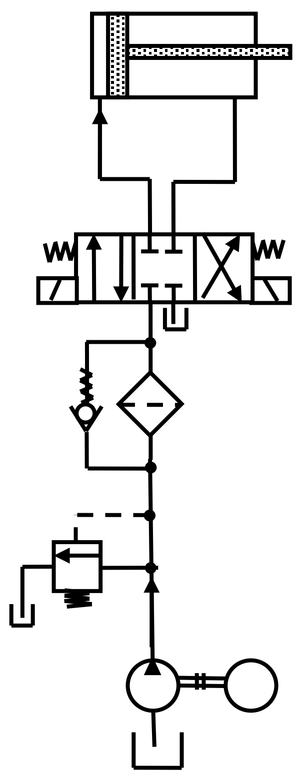

Figure 20.9 Pressure filter

Advantages

1.A pressure filter can filter very fine contaminant since the system pressure is available to push the fluid through the element

2. A pressure filter can protect a specific component from the harm of deteriorating particles generated from an upstream component

Disadvantages

1.The housing of a pressure filter must be designed for high pressure because it is operating at full system pressure. This makes the filter expensive.

2. If pressure differential and fluid velocity are high enough, dirt can be pushed through the element or the element may tear or collapse.

Return line filters (Low pressure filters): These filters filter the oil returning from the pressure relief valve or form the system i.e. actuator to tank. It is generally placed just before the tank. They may have a relatively high pressure drop & hence can be fine mesh. These filters have to withstand low pressure only and also protect the tank & pump from contamination.

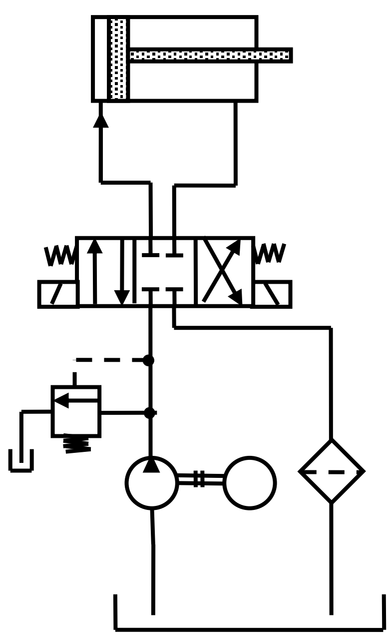

Figure 20.10 Return line filter

Advantages

1.A return line filter catches the dirt in the system before it enters the reservoir
2.The filter housing does not operate under full system pressure and is therefore less expensive than a pressure filter

Disadvantages

1. There is no direct protection for circuit components.
2. In return line full flow filters, flow surges from discharging cylinders, actuators and accumulators must be considered when sizing.

12. Why the temperature of the working fluid should be properly maintained

Heat is generated in hydraulic systems because no component can operate at 100% efficiency. Significant sources of heat include the pump, pressure relief valves and flow control valves. Heat can cause the hydraulic fluid temperature to exceed its normal operating range of 35 ℃ to 70 ℃. Excessive temperature hastens oxidation of the hydraulic oil and causes it to become too thin. This promotes deterioration of seals and packing and accelerates wear between closely fitting parts of hydraulic components of valves, pumps and actuators.