MODULE-3 : Hydraulic Valves (General)

LECTURE- 9 : Hydraulic Circuits & Valves

Introduction:

Using a pressure control or flow control valve, or using a set of valves various possible hydraulic circuits can be constructed. Some exemplary circuits are discussed below.

Venting System (Fig.- 3.9-1)

Remote control in pilot operated pressure relief valve i.e., PoPRV (See Fig.- 3.6-3) is used to vent the system i.e., to unload the pump at its idle running condition.

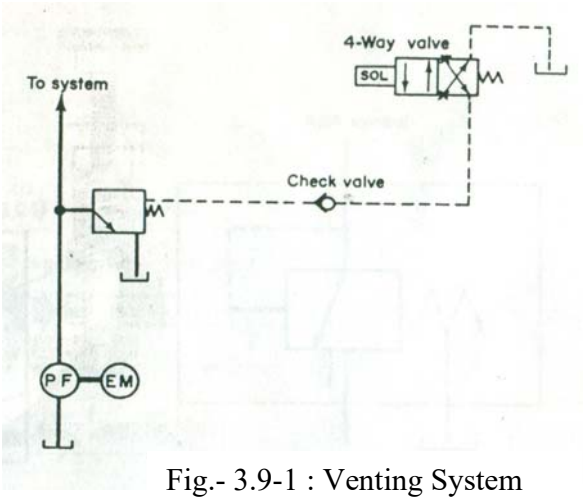


Fig.- 3.9-1 : Venting System

Sequence Circuit (Fig. 3.9-2)

Using a modified PRV sequence valve is made. The sequence circuit diverts the flow in multiple systems in the same circuit, in sequences governed by the sequence valve. In the shown example first cylinder A is operated. Next when the pressure is reached further to the set pressure of sequence valve opens. Cylinder B is activated when the required pressure reached. Note that during the operation of cylinder B the cylinder A remains at its extended position. In return stroke when the dc valve is set in opposite phase the pistons in both cylinders contract in sequence depending on respective pressure requires in the return stroke.

Sequence Circuit

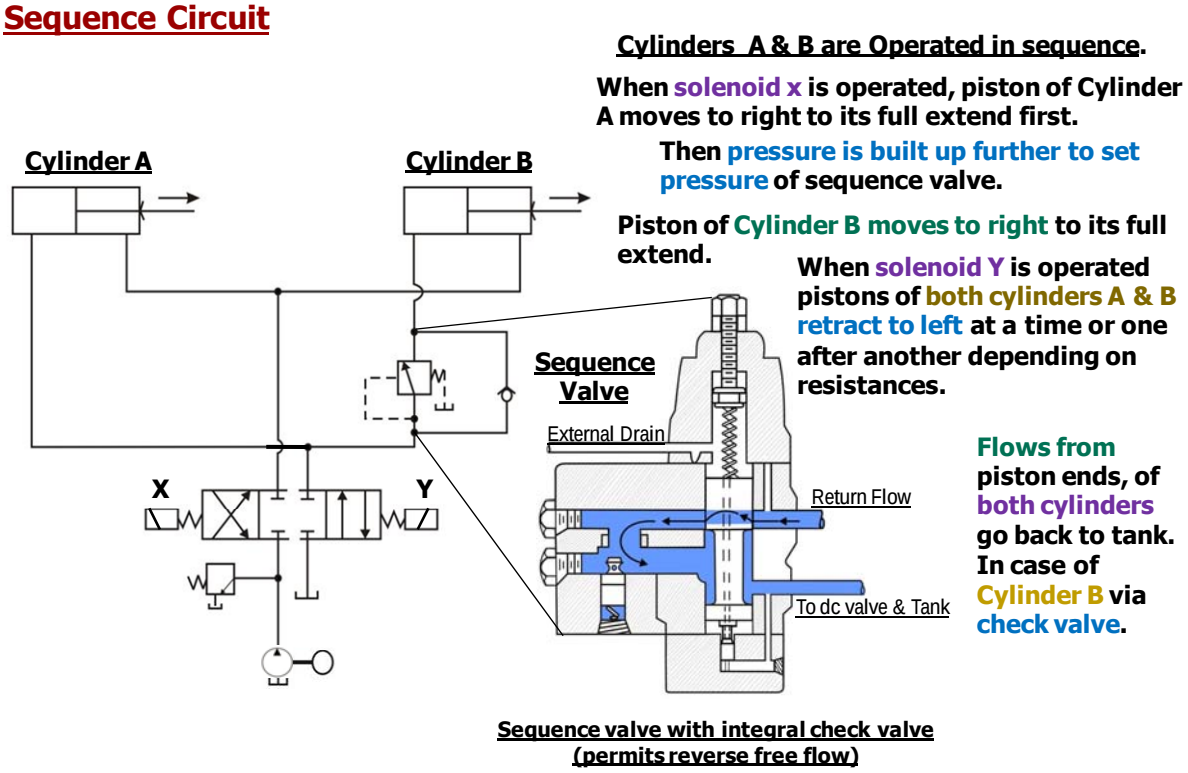


Fig.- 3.9-2 : Sequence Circuit.

Referring to Fig. 3.6-4(a), the sequence valve, can be externally piloted. Plug (Int P) is used to activate external pilot. Note that for internal piloting the plug (Int P) is to be removed and a plug is inserted at XP port. Also all sequence valves are externally drained through XD port. This is to avoid back pressure during operation. In a carefully designed valve internal draining is also possible by removing Int D plug while XD is plugged.

An integrated check valve can be accommodated as shown in Fig. 3.6-4(b). A significant difference in the valve as shown Fig. 3.6-4(c), which as the Auxiliary external pilot is directly exposed to the bottom of larger section of mail spool. Contrary to the other two this gives dual control.

In another application of sequence valve is often called as 'counter balance system', where the valve is also called as counter balance valve. It maintains resistance against flow in one direction where as allows free flow in other direction. It is usually placed at the rod end side of a double acting actuator. It prevents free fall of the load i.e., uncontrolled movement of load towards

the gravity. Such a valve even made sensitive to the amount of flow rate. The valve is then called 'slow down valve' (feature is not shown).

Counter Balance Circuit (Fig.- 3.9-3)

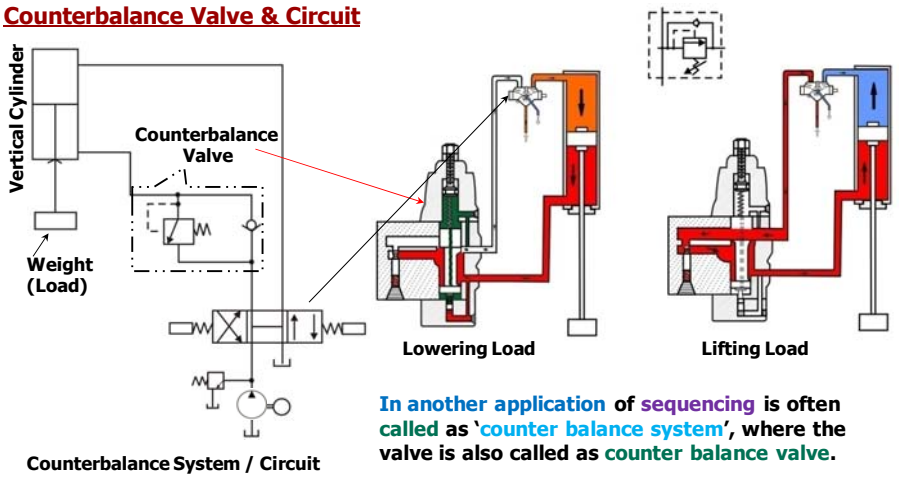


Fig.- 3.9-3 : Counter Balance System.

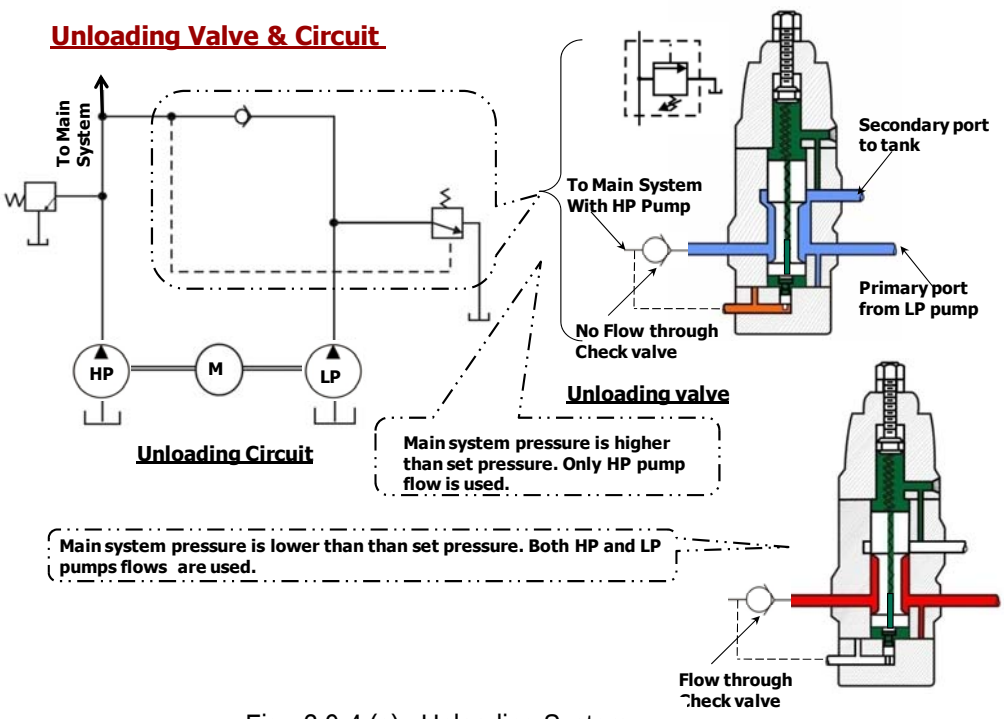
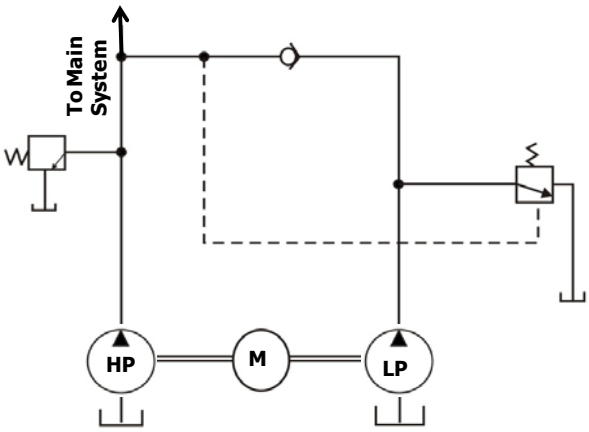


Fig.- 3.9-4 (a) : Unloading System.

Unloading Circuit (contd...)



Unloading Circuit

In brief.

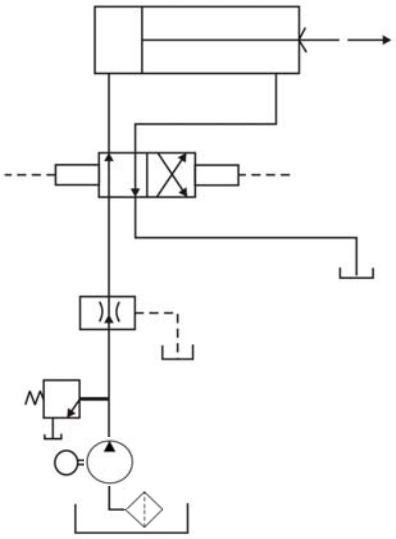
- **An unloading valve is also another version of a sequence valve.**
- **It allows the pressure to build up to a value determined by a pressure setting.**
- **It is two-way valve generally used to by-pass part of the circuit back to tank at very low pressures.**
- **The internal draining occurs. Double pump system as shown in figure is an example of unloading valve.**
- **Using the same power two outputs are mixed up at low pressures.**
- **At high pressure only the flow of one pump is used by the system where as the flow of other pump is diverted to tank at a nominal pressure.**

Fig.- 3.9-4 (b) : Unloading System.

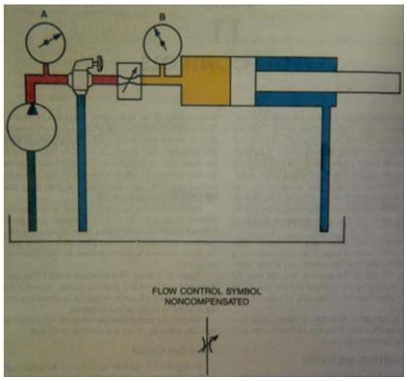
Circuits using flow control valves (Contd...)

Flow Control valves are used in three basic ways in circuit design.

Meter-in-Control



Meter-in-Control
In both directions



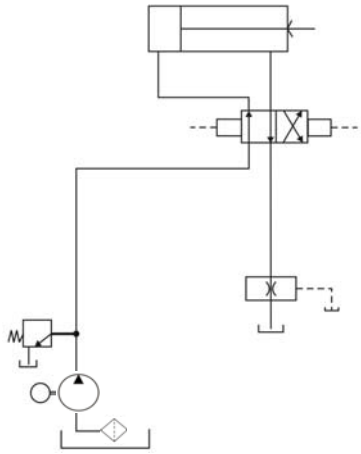
The flow of the fluid can be controlled as it enters the cylinder or motor making it a meter - in –application.

Example- operation of a grinding table or a welding table.

Fig.- 3.9-5 : Meter-in-Control (In both directions).

Circuits using flow control valves (Contd...)

Meter-out-Control



Meter-out-Control
In both directions

Control of the fluid as it leaves the cylinder is known as a meter-out control .

It is widely used in machine tools often as a quick return mechanism.

Also, it is commonly used on drills.

When the drill point is about to break through it tends to drag, but metering the fluid out of the cylinder prevents the drill from a fast break through of the material being drilled.

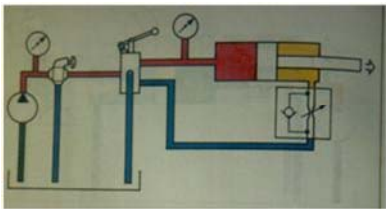
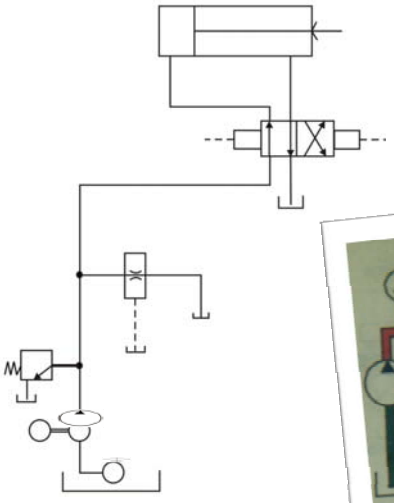


Fig.- 3.9-6 : Meter-out-Control (In both directions).

Circuits using flow control valves (Contd...)

Bleed-Off-Control



Bleed-off-Control
In both directions

Diverting the flow of fluid to the tank is known as the bleed-off function. Used in planer table or broaching. However, applications are limited.

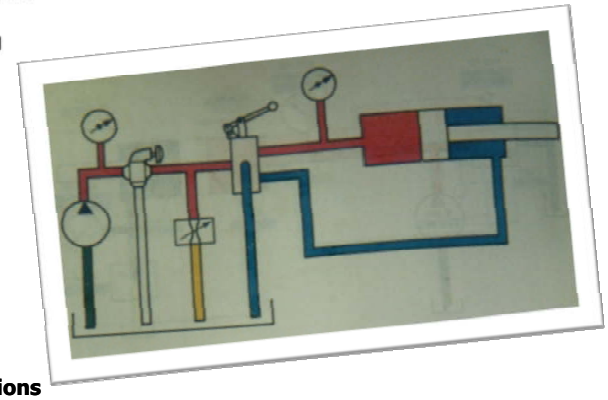


Fig.- 3.9-7: Bleed-off-Control (In both directions).

Unloading Circuit (Fig.- 3.9-4)

An unloading valve is also another version of a sequence valve. It allows the pressure to build up to a value determined by a pressure setting. It is two-way valve generally used to by-pass part of the circuit back to tank at very low pressures. The internal draining occurs. Double pump system as shown in figure is an example of unloading valve. Using the same power two outputs are mixed up at low pressures. At high pressure only the flow of one pump is used by the system where as the flow of other pump is diverted to tank at a nominal pressure.

Circuits using flow control valves:

Flow Control valves are used in three basic ways in circuit design.

(i) The flow of the fluid can be controlled as it enters the cylinder or motor making it a meter - in – application (Fig.-3.9-5). Application examples- operation of a grinding table or a welding table.

(ii) Control of the fluid as it leaves the cylinder is known as a meter-out control (Fig.-3.9-6). It is widely used in machine tools often as a quick return mechanism. Also, it is commonly used on drills such that when the drill point is about to break through it tends to drag, but metering the fluid out of the cylinder presents the drill from a fast break through of the material being drilled.

(iii) Diverting the flow of fluid to the tank is known as the bleed-off function (Fig.-3.9-7). Used in planer table or broaching. However, applications are limited.

Summary

The circuits shown in this section are only few application examples of pressure and flow control valves. Hydraulic circuits are also discussed in other sections explaining the various operational requirements.

Bibliography:

1. J. Korn (Editor) : Hydrostatic Transmission Systems, Intertext Books. London, (ISBN 0 7002 0080 0), 1969.