

LECTURE 18 AND 19

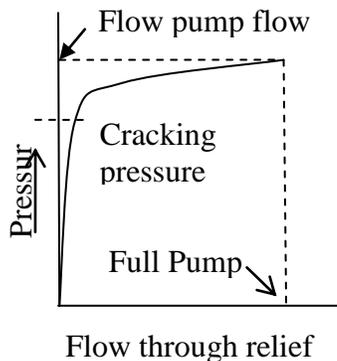
PRESSURE CONTROL VALVES

FREQUENTLY ASKED QUESTIONS

1. Deal with the function of the pressure control valves in hydraulic power systems

- Restricting maximum pressure in a system thereby ensuring safety using relief valve etc
- Reducing /regulating pressure in certain section of the circuit like pressure reducing valve
- Unloading system pressure using unloader valve
- Providing pressure control for sequential operation of actuators in a circuit e.g sequence valve
- Any other function accomplished by pressure control

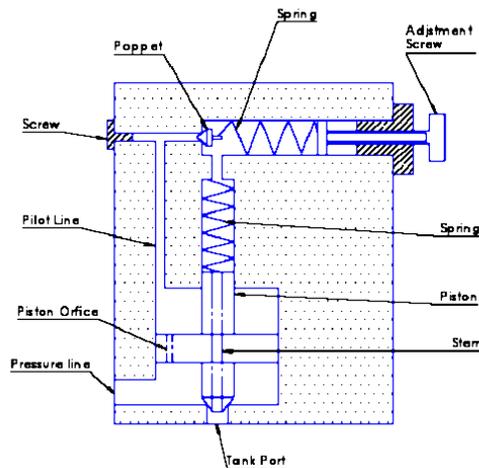
2. Discuss in detail the static characteristics of a direct operated relief valve, and explain how to reduce the override pressure.



If the hydraulic system does not accept any flow, then all the pump flow must return to the tank via the relief valve. The pressure relief valve provides protection against any overloads experienced by the actuators in the hydraulic system. Of course, a relief valve is not needed if a pressure compensated vane pump is used. Obviously one important function of a pressure relief valve is to limit the force or torque produced by hydraulic cylinders or motors.

The main advantage of direct-acting relief valves over pilot operated relief valves is that they respond very rapidly to pressure buildup. Any relief valve does not know there is a problem until pressure is very near or at its setting. Then it must open to relieve excess flow as quickly as possible to keep pressure overshoot low. Because there is only one moving part in a direct-acting relief valve, it can open rapidly, thus minimizing pressure spikes.

3. Draw schematically a pilot operated relief valve and explain its function



The pilot operated pressure relief valve has a pressure port that is connected to the pump line and the tank port is connected to tank. The pilot relief valve is a poppet type. The main relief valve consists of a piston and stem. The main relief piston has a orifice drilled through it. The piston has equal areas exposed to pressure on top and bottom and is in balanced condition due to equal force acting on the both sides. It will remain stationary in the closed position. The piston has a light bias spring to ensure that it will stay closed. When the pressure is less than that of relief valve setting, the pump flow goes to the system. If the pressure in the system become high enough , it will move the pilot poppet off its seat. A small amount of flow begins to go through the pilot line back to tank. Once flow begins through the piston orifice and pilot line, a pressure drop is induced across the piston due to restriction of the piston orifice. This pressure drop then causes the piston and stem to lift off its seat and the flow goes directly from the pressure port to tank.

4. Discuss the application of pilot operated relief valve

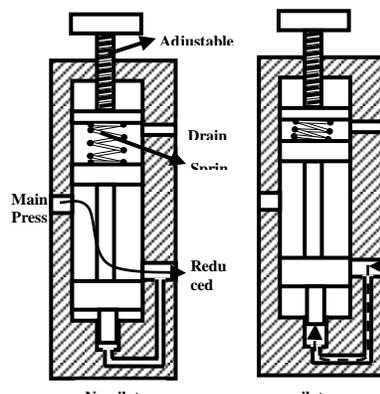
- It is used in counter balance application
- It is used in locked cylinder circuits

5. Discuss the principle of pressure reduction in fluid power systems

A second type of pressure reducing valve is pressure reducing valve. This type of valve (which is normally open) is used to maintain reduced pressures in specified locations of hydraulic systems. It is actuated by downstream pressure and tends to close as this pressure reaches the valve setting. See also question 6

6. Discuss briefly the operation of pilot operated pressure reducer

The pressure reducing valve uses a spring loaded spool to control the downstream pressure. If downstream pressure is below the valve setting, fluid will flow freely from the inlet to the outlet. Note that there is an internal passageway from the outlet, which transmits outlet pressure to the spool end opposite the spring. When the outlet (downstream) pressure increases to the valve setting, the spool moves to the right to partially block the outlet port. Just enough flow is passed to the outlet to maintain its preset pressure level. If the valve closes completely, leakage past the spool could cause downstream pressure to build up above the valve setting. This is prevented from occurring because a continuous bleed to the tank is permitted via a separate drain line to the tank.



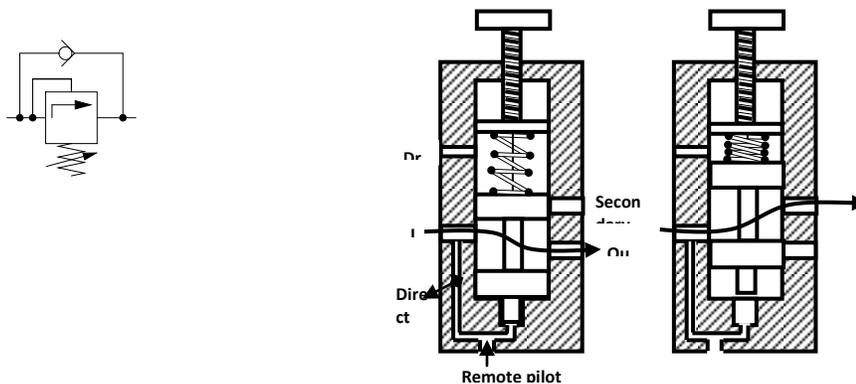
Reverse free flow through the valve is only possible if the pressure exceeds the valve setting, the valve will close, thus making reverse flow impossible. Therefore, pressure reducing valves are often equipped with a check valve for reverse free flow.

External forces acting onto a linear actuator will increase the pressure between the pressure reducing valve and the actuator. In some systems, it is therefore desirable to relieve excess fluid from the secondary system to the tank in order to maintain a constant downstream pressure, regardless of such external forces.

7. Explain the function of the direct operated sequence valve

A sequence valve is a pressure control valve that is used to force two actuators to be operated in sequence. They are similar to pressure relief valves. The symbol for sequence valve is as shown below.

Instead of sending flow back to tank, a sequence valve allows flow to a branch circuit, when a preset pressure is reached. The check valve allows the sequence valve to be bypassed in the reverse direction. The component enclosure line indicates that the check valve is an integral part of the component. The sequence valve has an external drain line; therefore a line must be connected from the sequence valve's drain port to the tank.



8. What are the difference between the relief valve and the sequence valve

A sequence valve is a pressure control valve that is used to force two actuators to be operated in sequence. They are similar to pressure relief valves. Instead of sending flow back to tank, a sequence valve allows flow to a branch circuit, when a preset pressure is reached.

9. Discuss the application of sequence valve used in hydraulic systems

Application of Sequence Valve

The following hydraulic circuit is an example of an application of a sequence valve in which a clamp cylinder extends first to hold a work piece, and then a second cylinder extends to bend the work piece in the desired shape.

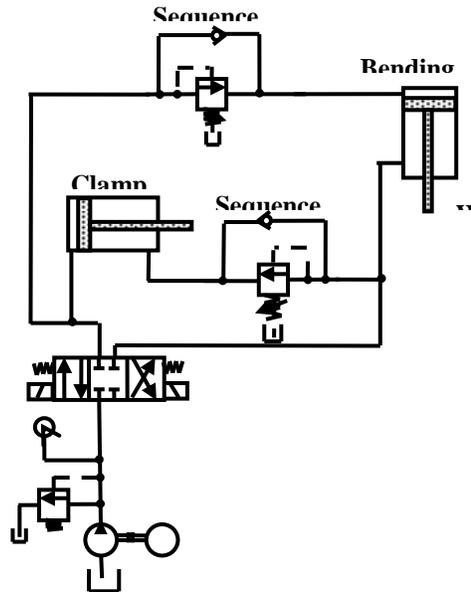


Figure 17 Application of sequence valve

In this circuit, two cylinders are connected in parallel. Without the sequence valve, these cylinders would extend together as they are both unloaded. In order for this circuit to function properly, the clamp cylinder must extend completely before the bending cylinder begins to extend. But by the application of sequence valve which does not allow flow into the bending cylinder branch of the circuit until the clamp cylinder extends completely. When the clamp cylinder extends completely, the pressure will rise and open the sequence valve. Thus, allowing the bending cylinder to extend. The sequence valve must be set enough so that it opens only after the clamp cylinder has extended completely.

During the retraction of cylinders, check valve allows sequence valve to be bypassed. The sequence valve has no effect on the circuit in this situation. Both cylinders will retract together because both are unloaded and will split the pump flow.

10. Name two applications of counter balance valve

- Used on counter balance application to prevent the load to run away like in counterbalance of vertical broaching machine
- Used in hydraulic press to prevent the load from running away

11. What is the function of a sequence valve?

When the operation of two cylinders is required to be performed in sequence the sequence valve is made use of.

12. What is the function of an unloading valve?

The unloading valve is useful to control the amount of flow at any given time in systems having more than one fixed delivery pump

13. How the unloading valve different from a pressure relief valve

Unloading valves are pressure-control devices that are used to dump excess fluid to tank at little or no pressure. Remote pilot signal is used to control. Where as in pressure relief valve pilot from system pressure controls the valve.

14. What is the function of pressure relief valve in fluid power systems?

Function of the pressure relief valve is to unload the pump in the event of extreme pressure in the circuit. When the set pressure is reached relief valve will send all the fluid back to the tank.

15. What is the advantage of using an unloading circuit, when feed and speed of a machine need to be varied?

- When high speed is required during air cutting, high flow pump can be used to get the rapid extension and cutting time is saved.
- When cutting is taking place (torque requirement is high), low flow pump can be used
- This circuit eliminates the necessity of having a very expensive high pressure, high flow pump.