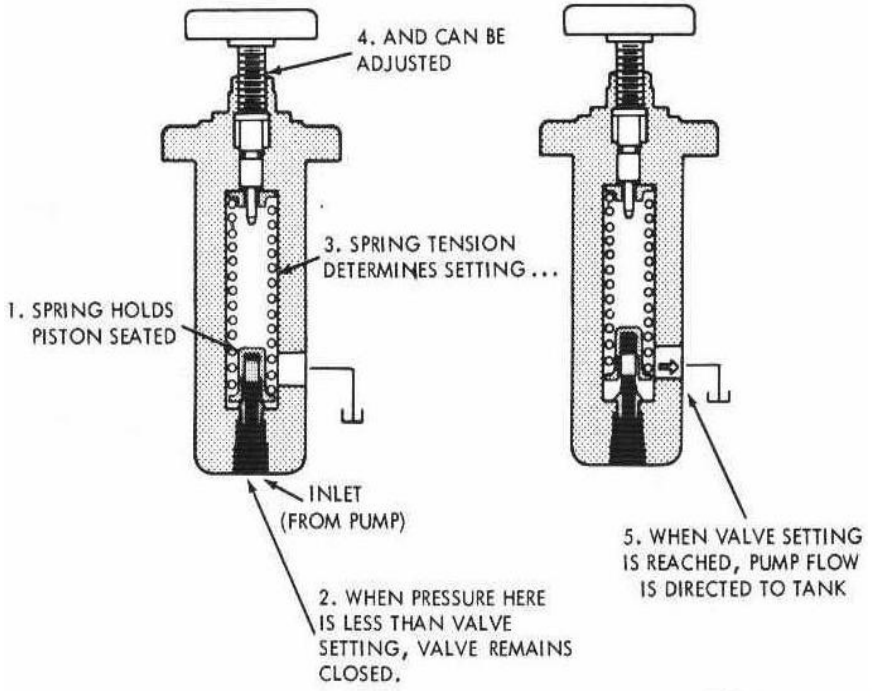
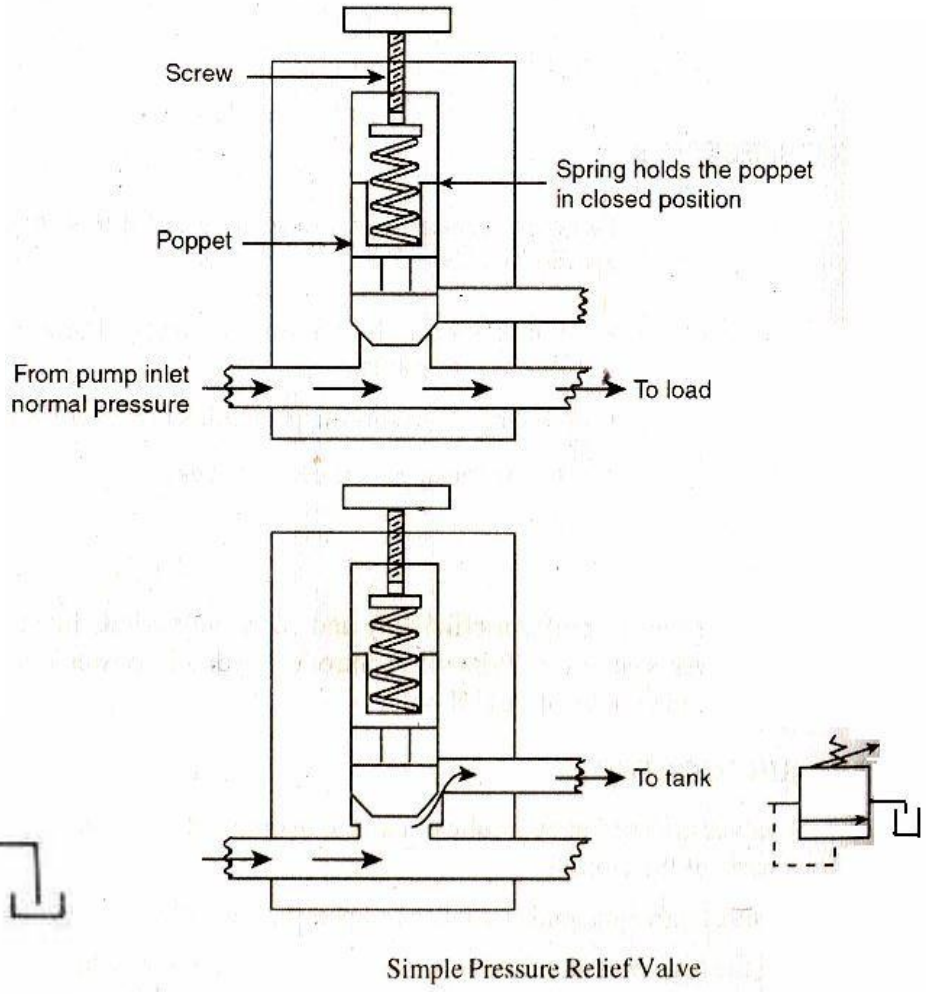
Unit II

Pressure Control Valves

- **Pressure relief valve**
- **Pressure reducing valve**
- **Unloading Valve**
- **Sequence valve**
- **Counterbalance valve**

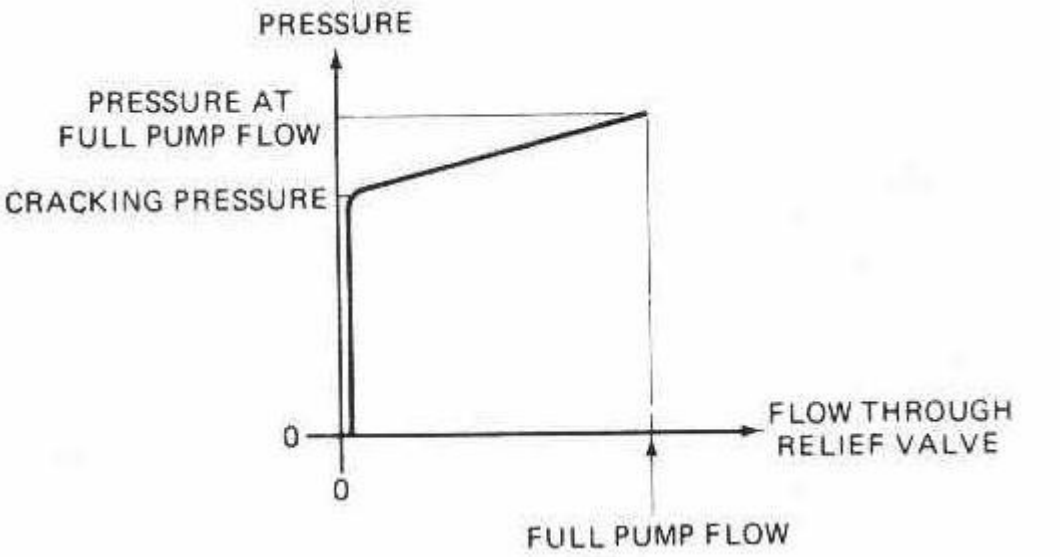
Pressure relief valve

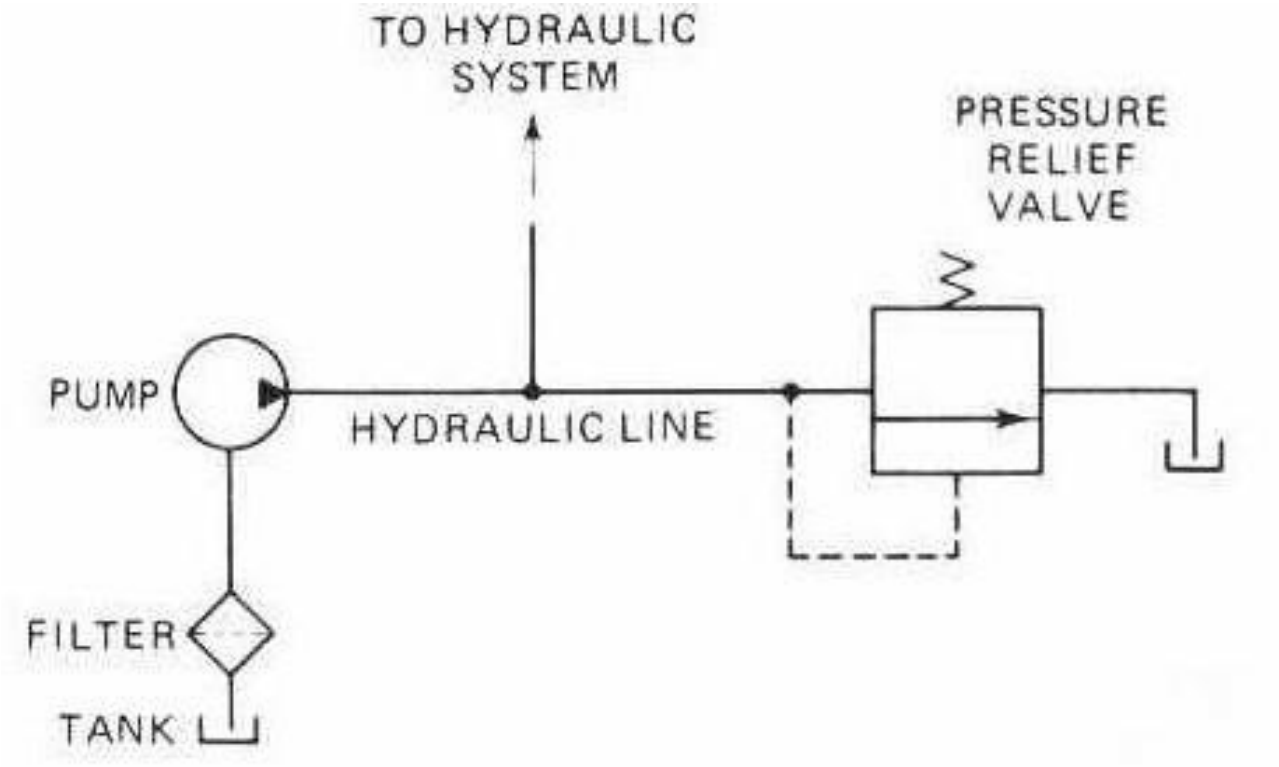




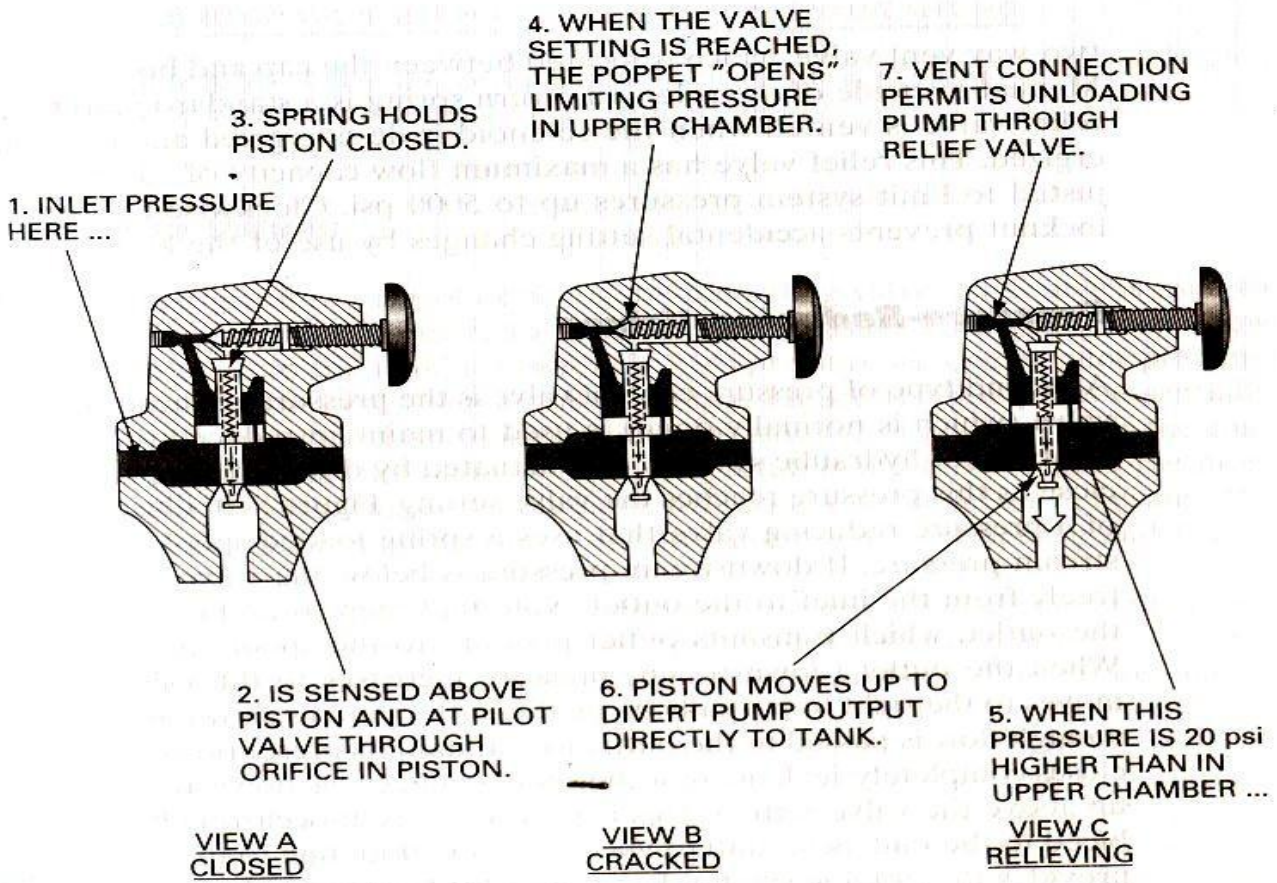
- It is a normally closed valve whose function is to limit the pressure to a specified maximum value by diverting pump flow back to the tank.
- When the system pressure reaches a high enough value, the poppet is forced off its seat.
- This permits flow through the outlet to the tank as long as this high pressure level is maintained.
- Notice the external adjusting screw, which varies the spring force and, thus, the pressure at which the valve begins to open (cracking pressure).
- The poppet must open sufficiently to allow full pump flow.
- The pressure that exists at full pump flow can be substantially greater than the cracking pressure.
- The pressure at full pump flow is the pressure level that is specified when referring to the pressure setting of the relief valve.
- It is the maximum pressure level permitted by the relief valve.

Pressure Vs Flow




TO HYDRAULIC SYSTEM
PRESSURE RELIEF VALVE
PUMP
HYDRAULIC LINE
FILTER
TANK

Compound pressure relief valve

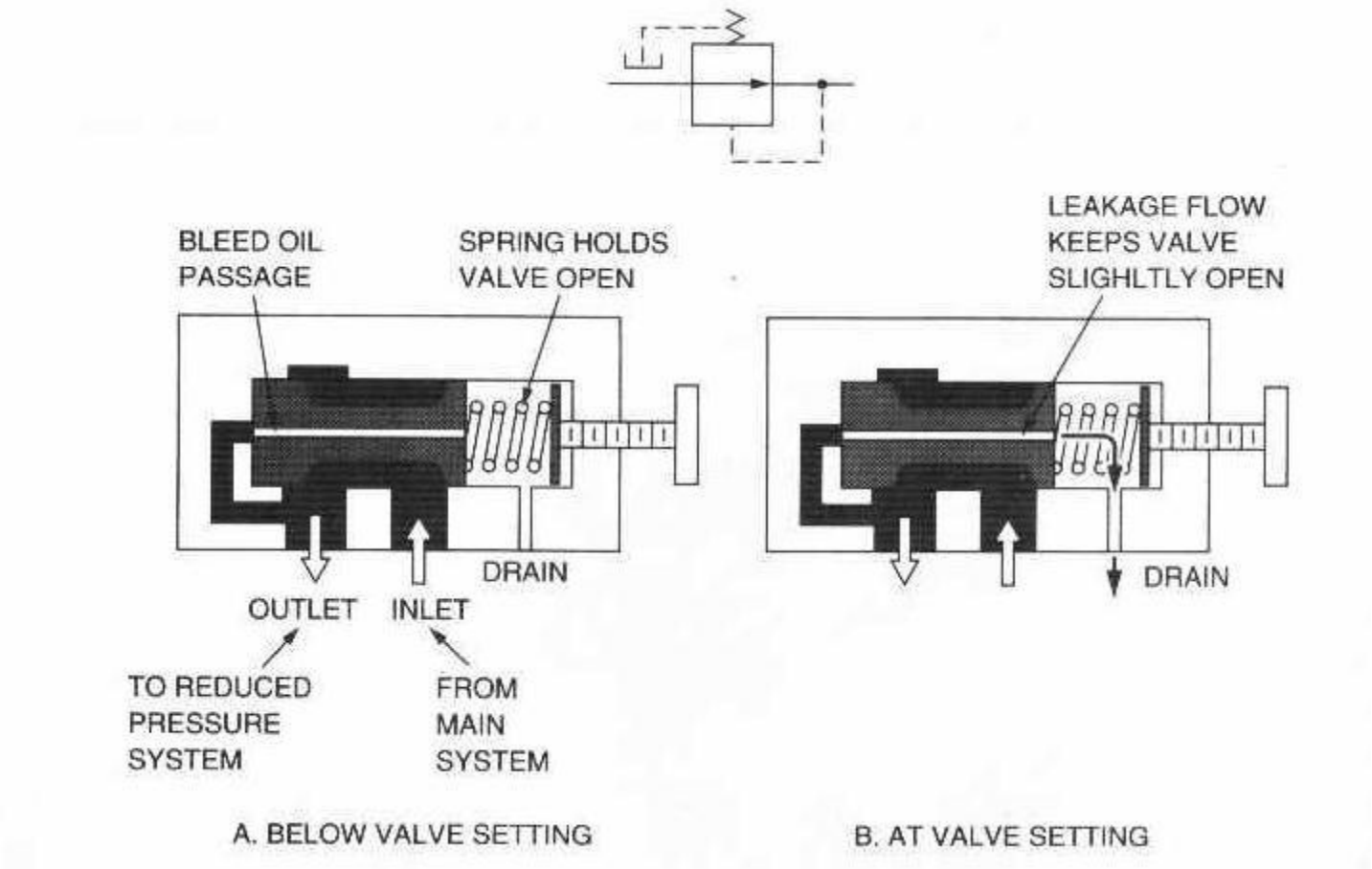


A compound pressure relief valve is one that operates in two stages.

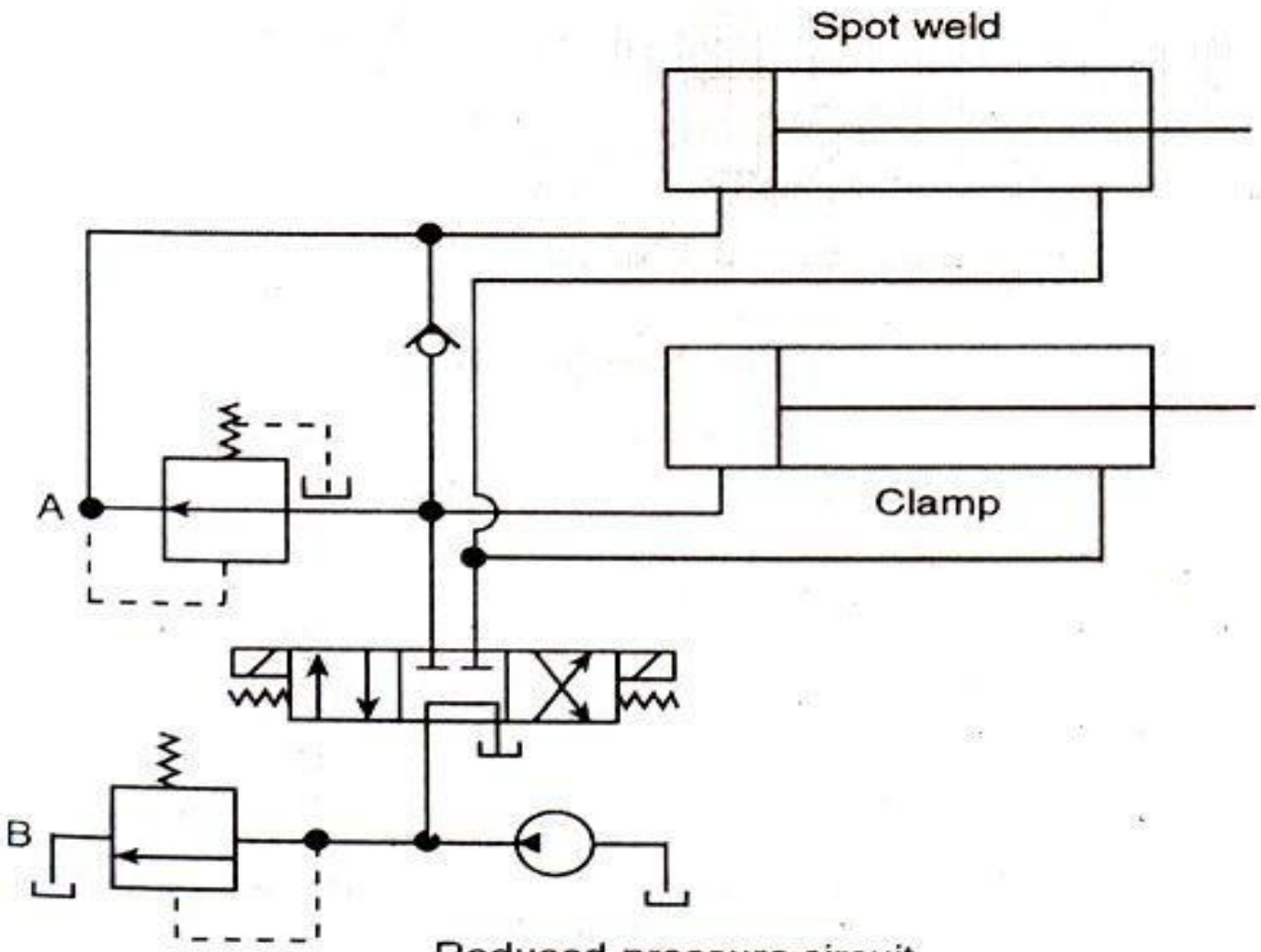
- The pilot stage is located in the upper valve body and contains a pressure-limiting poppet that is held against a seat by an adjustable spring.
- The lower body contains the port connections.
- Diversion of the full pump flow is accomplished by the balanced piston in the lower body.
- In normal operation, the balanced piston is in hydraulic balance.
- Pressure at the inlet port acts under the piston and also on its top because an orifice is drilled through the large land.
- For pressures less than the valve setting, the piston is held on its scat by a light spring.

- As soon as pressure reaches the setting of the adjustable spring, the poppet is forced off its seat.
- This limits the pressure in the upper chamber. The restricted flow through the orifice and into the upper chamber results in an increase in pressure in the lower chamber.
- This causes an unbalance in hydraulic forces. which tends to raise the piston off its seat.
- When the pressure difference between the upper and lower chambers reaches approximately 20 psi.
- The large piston lifts off its seat to permit flow directly to the tank.
- If the flow increases through the valve, the piston lifts further off its seat.
- However, this compresses only the light spring, and hence very little override occurs.

Pressure Reducing Valve

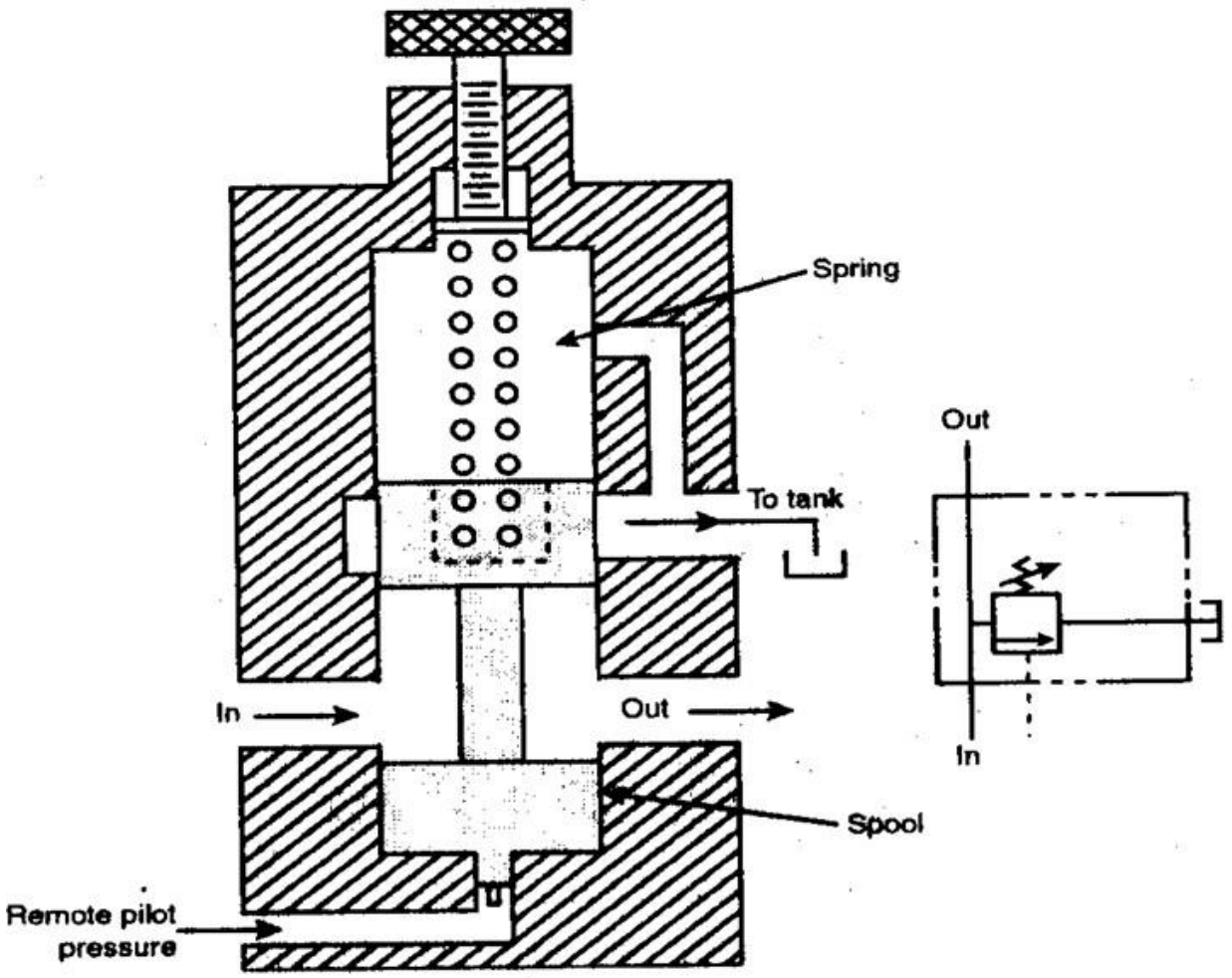


- This type of valve (which is normally open) is used to maintain reduced pressures in specified locations of hydraulic systems.
- It is actuated by downstream pressure and tends to close as this pressure reaches the valve setting.
- It uses a spring-loaded spool to control the downstream pressure.
- If downstream pressure is below the valve setting, fluid will flow freely from the inlet to the outlet.
- 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.

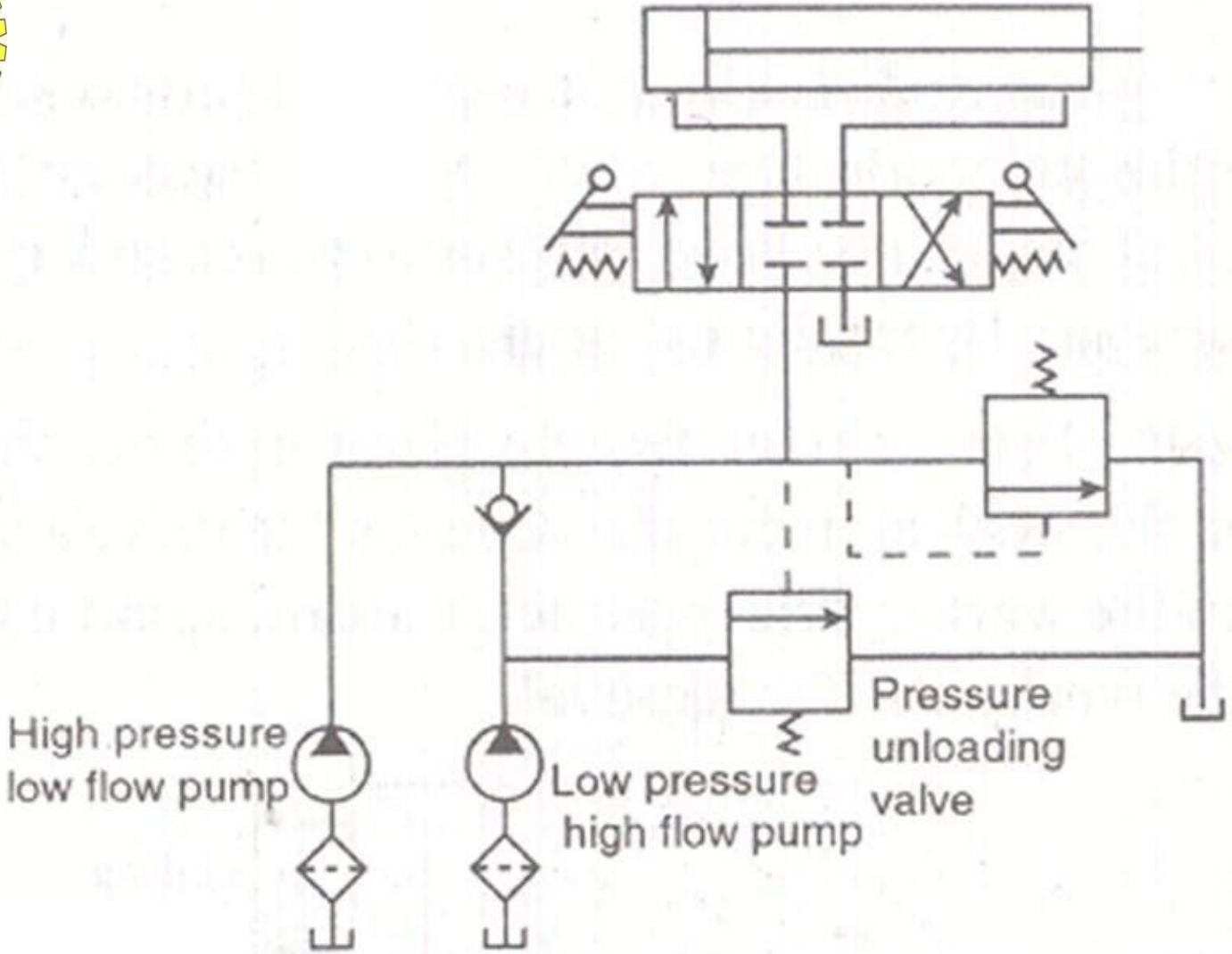


Reduced-pressure circuit

Unloading Valve

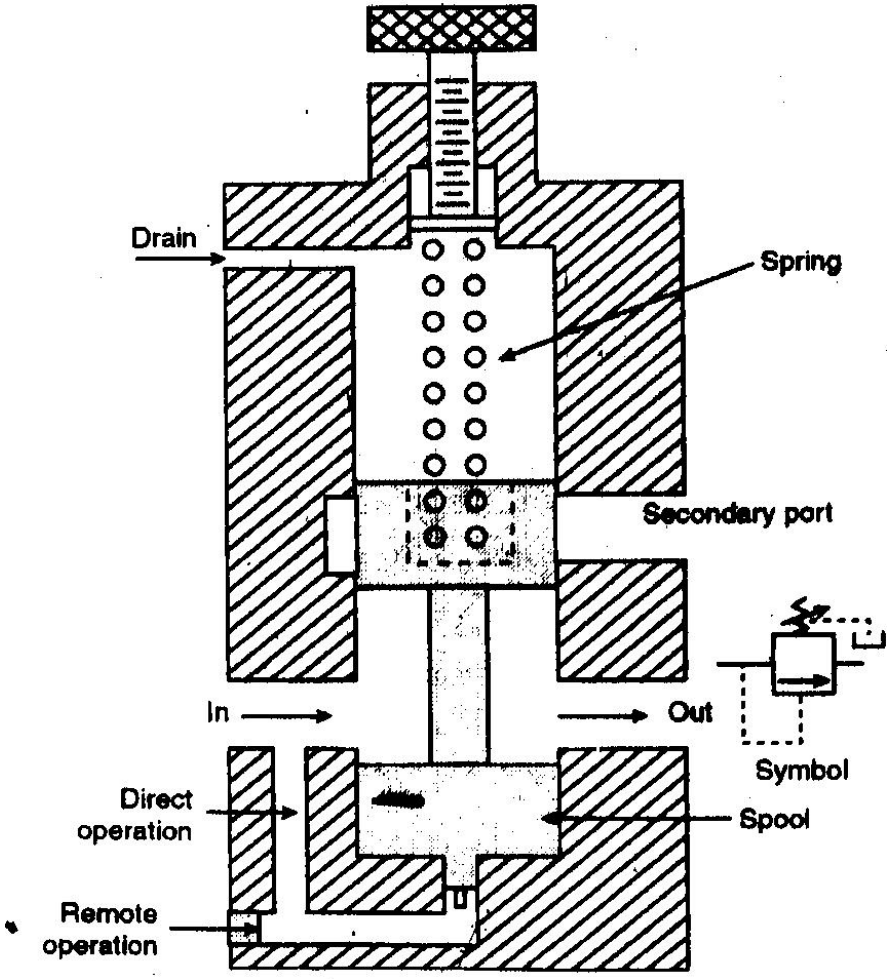


- The high-flow poppet is controlled by the spring- loaded ball and the pressure applied to port .
- Flow entering at port *A* is blocked by the poppet at low pressures.
- The pressure signal from *A* passes through the orifice in the main poppet to the topside area and on to the ball.
- There is no flow through these sections of the valve until the pressure rises to the maximum permitted by the adjustably set spring-loaded ball.
- When that occurs, the poppet lifts and flow goes from port *A* to port *B,* which is typically connected to the tank

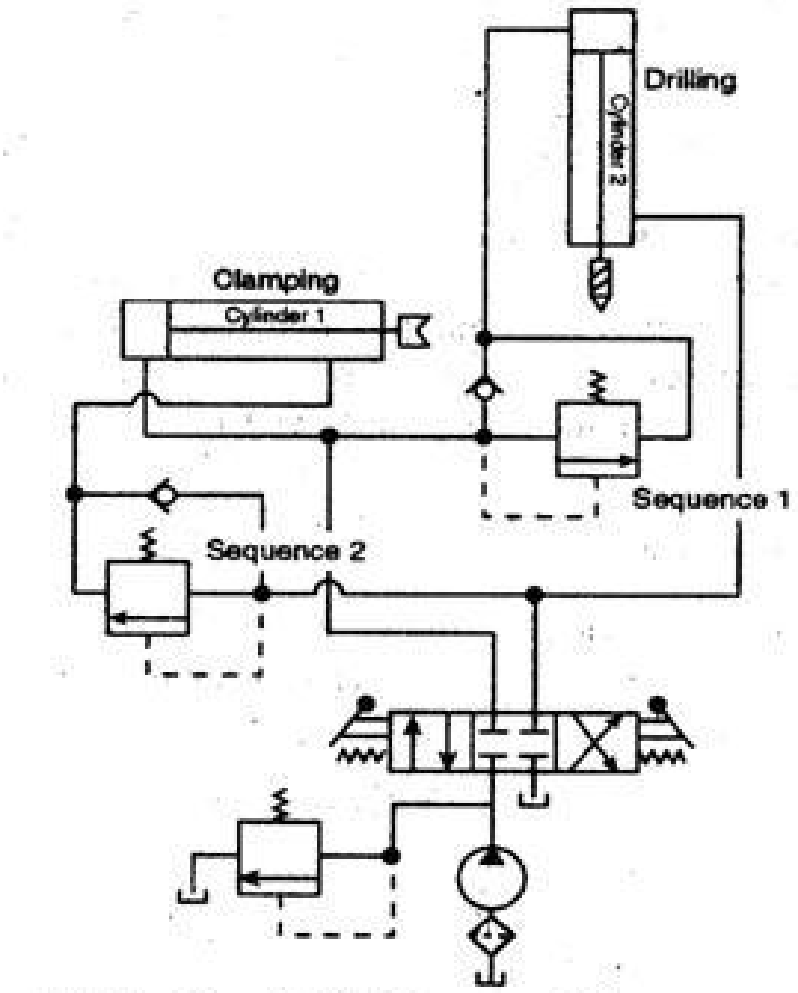


High-Low Circuit Using Unloading Valve

Sequence Valve

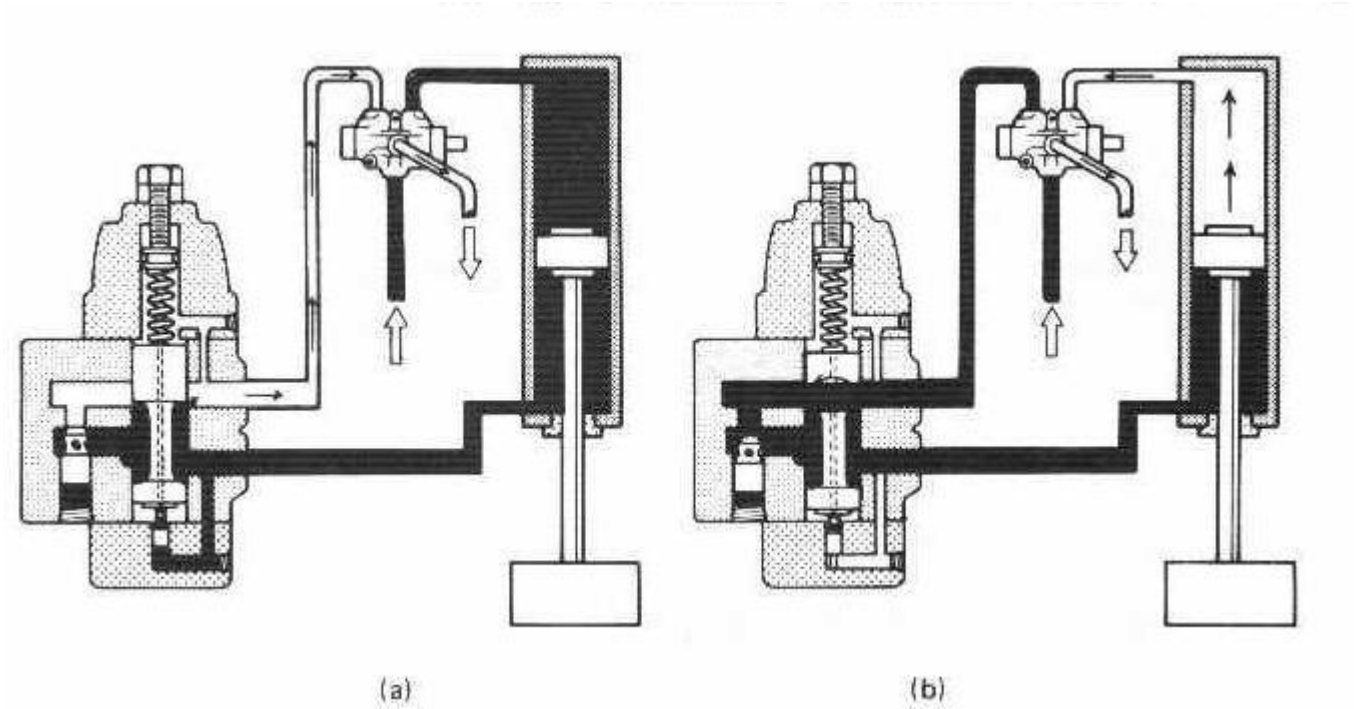


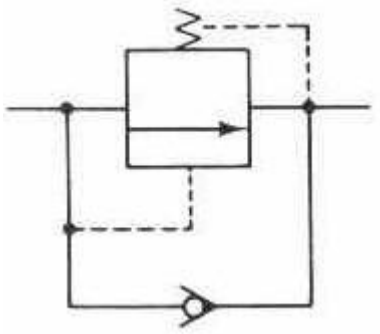
- After the components connected to port *A* have reached the adjusted pressure of the sequence valve, it passes fluid through port *B* to do additional work in a different portion of the system.
- The high-flow poppet of the sequence valve is controlled by the spring-loaded cone. Flow entering at port *A* is blocked by the poppet at low pressures.
- The pressure signal at *A* passes through orifices to the topside of the poppet and to the cone.
- There is no flow through these sections until the pressure rises at *A* to the maximum permitted by the adjustably set spring-loaded cone.
- When the pressure at *A* reaches that value, the main poppet lifts.



Drilling Circuit Using Sequence Valve

Counter balance valve

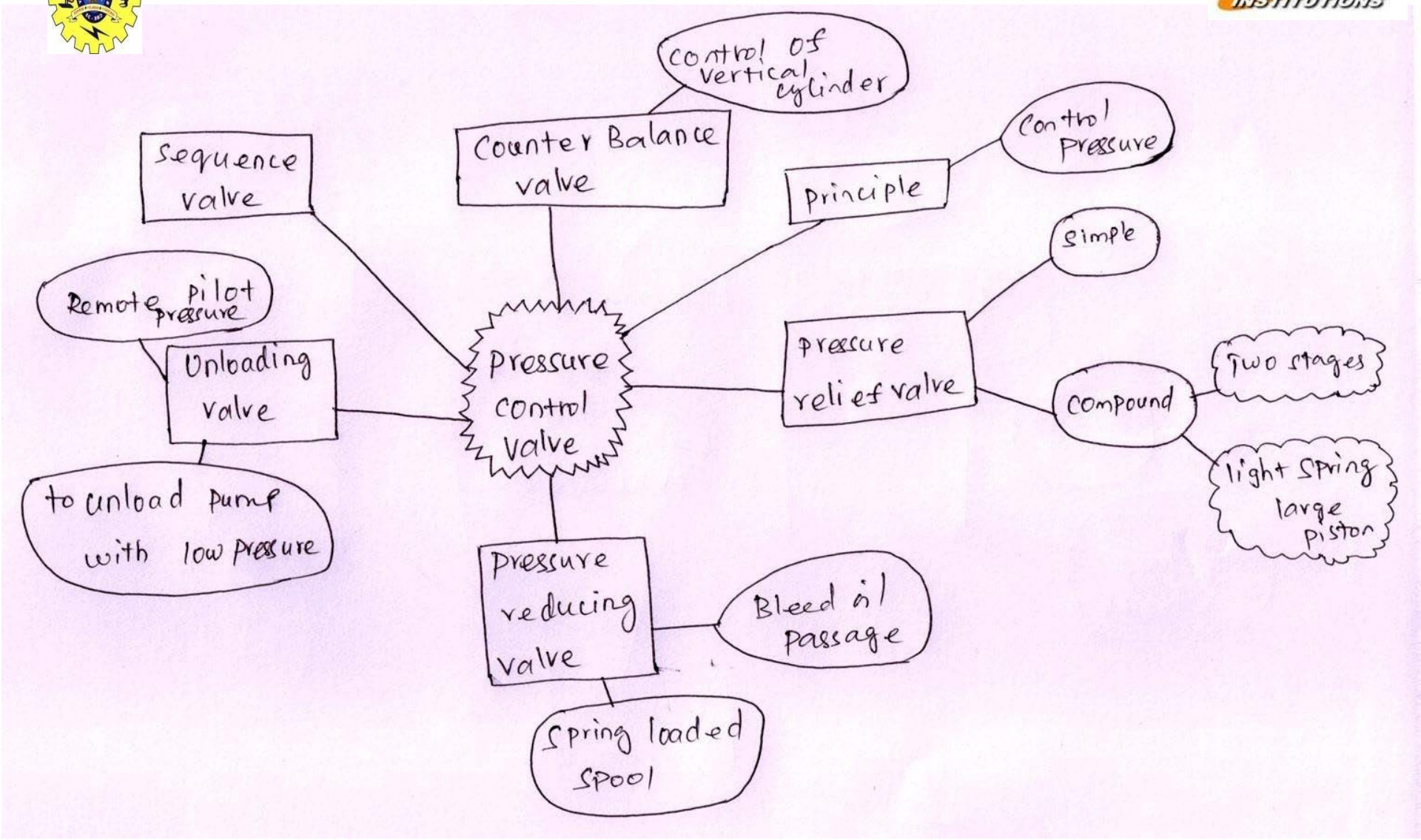




- The purpose of a counterbalance valve is to maintain control of a vertical cylinder to prevent it from descending due to gravity.
- The primary port of this valve is connected to the bottom of the cylinder, and the secondary port is connected to a directional control valve (DCV).
- The pressure setting of the counterbalance valve is somewhat higher than is necessary to prevent the cylinder load from falling.
- When pump flow is directed (via the DCV) to the top of the cylinder, the cylinder piston is pushed downward.
- This causes pressure at the primary port to increase to raise the spool. This opens a flow path for discharge through the secondary port to the DCV and back to the tank.
- When raising the cylinder an integral check valve opens to allow free flow for retracting the cylinder.

Questions

1. What are pressure control valves?
2. Why pressure relief valve is used in hydraulics system?
3. What is the purpose of pressure reducing valve?
4. What is the function of unloading valves?
5. What is the application of counter balance valve?


control of vertical cylinder
Counter Balance valve
Sequence valve
Principle
Control Pressure
Simple
Remote pilot pressure
Unloading valve
Pressure control valve
Pressure relief valve
Compound
Two stages
light Spring large piston
to unload pump with low Pressure
Pressure reducing valve
Bleed oil passage
Spring loaded spool

Summary

Pressure control valves include relief, reducing, sequence, counterbalance, and unloading.

- All of these are normally closed valves, except for reducing valves, which are normally open.
- Pressure reducing valve maintains a prescribed reduced pressure at its oultlet regardless of the valve inlet pressure
- Sequence valve directs flow to more than one portion of circuit
- Unloading valve allows pressure to build up to an adjustable setting.
- Counter balance valve permits free flow in one direction.

MCQ

1. Direct acting relief valves have_____response than/as a pilot operated relief valve.
    A. slower
    B. same
    C. Faster
2. Pilot operated relief valves have_____pressure override than/as a direct acting relief valve.
    A. more
    B. less
    C. the same
3. Solenoid operated relief valves can be made from:
    A. direct acting relief valves.
    B. pilot operated relief valves.
    C. either type relief valve.
4. A vent port is found on:
    A. pilot operated relief valves.
    B. direct acting relief valves.
    C. either type relief valve.
5. Solenoid operated relief valves can be used:
    A. on the case drain of a pump.
    B. on the tank line of a pump.
    C. to unload the pressure port of a pump.

Answer

1. Direct acting relief valves have_____response than/as a pilot operated relief valve.
    A. slower
    B. same
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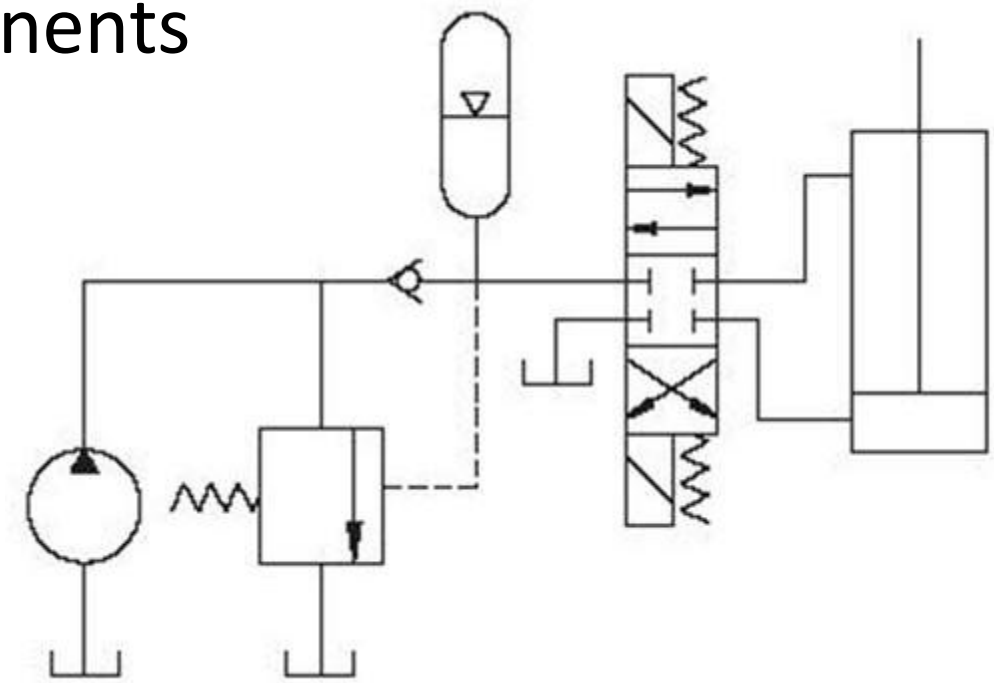
Higher Order Question

- Identify the use of unloading and other components



Circuit illustrating use of unloading valve to unload pump at low pressure between cycles of cylinder.