Unit II

- **Direction Control Valve**
- **Shuttle Valve**
- **Check Valve**

VALVES

- The pressure energy is fed to the actuator through a number of control blocks called *valves.*
- Valve is nothing but a device which is necessary to control the oil energy
- Basically valves are expected to control
- Blocking or stopping of flow
- Direction of flow (Directional control valve –DCV)
- Pressure of flow media (Pressure control valve –PCV)
- Flow quantity (Flow control valve –FCV)

DIRECTIONAL CONTROL VALVES

- **Directional control valves** are one of the most fundamental parts in hydraulic machinery as well and pneumatic machinery.
- They allow fluid flow into different paths from one or more sources.
- They usually consist of a spool inside a cylinder which is mechanically or electrically controlled.
- The movement of the spool restricts or permits the flow, thus it controls the fluid flow.

Directional control valves can be classified according to-

- Number of ports
- Number of positions
- Actuating methods

  Manually Operated

  Mechanically Operated

  Hydraulically Operated

  Solenoid Operated

Type of spool.

sliding and rotary

Specification

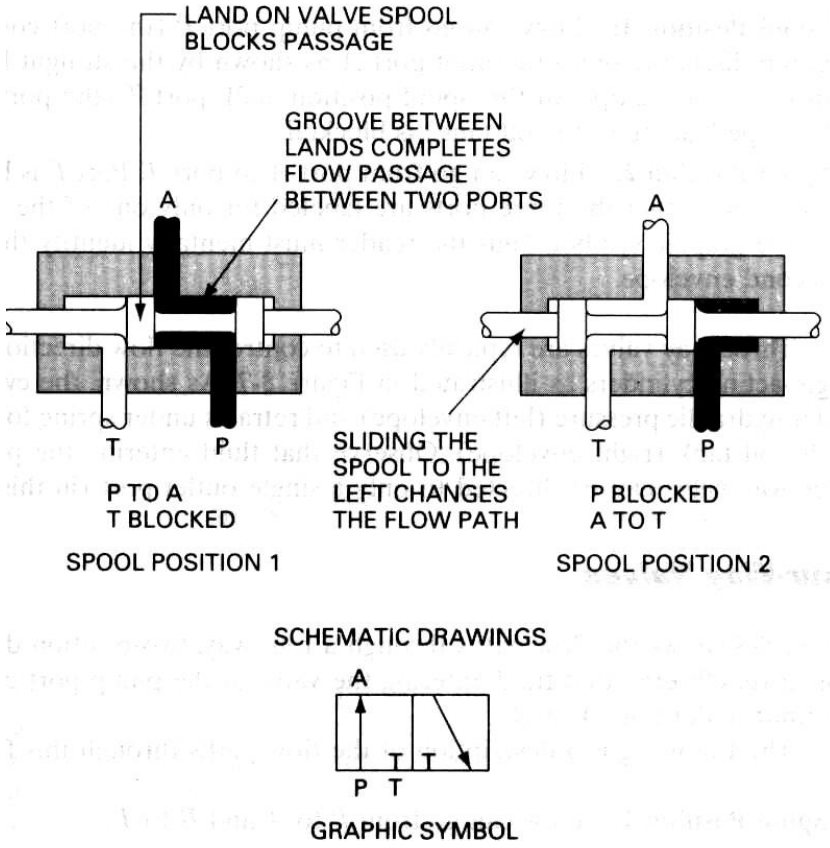
- It can be represented in general form as $\mathbf{n_p/n_s}$,

  where $\mathbf{n_p}$ is the number of ports connected to the direction control valve and

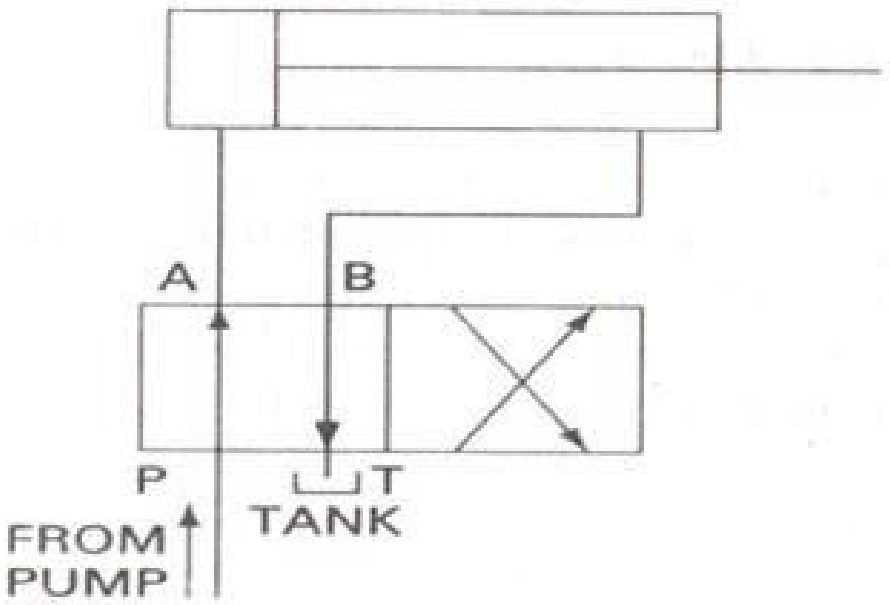
  $\mathbf{n_s}$ the number of switching positions.

DIRECTIONAL CONTROL VALVES

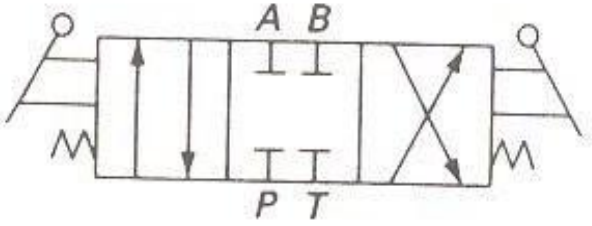
- Spool is a cylindrical member that has large-diameter lands machined to slide in a very close-fitting bore of the valve body.
- The radial clearance is usually less than 0.001 in. The grooves between the lands provide the flow passages between ports.
- The flow can go through the valve in *four* unique ways depending on the spool position.
  - *Spool position 1:* Flow can go from *P* to *A* and *B* to *T.*
  - *Spool position 2:* Flow can go from *A* to *T* and *P* to *B.*

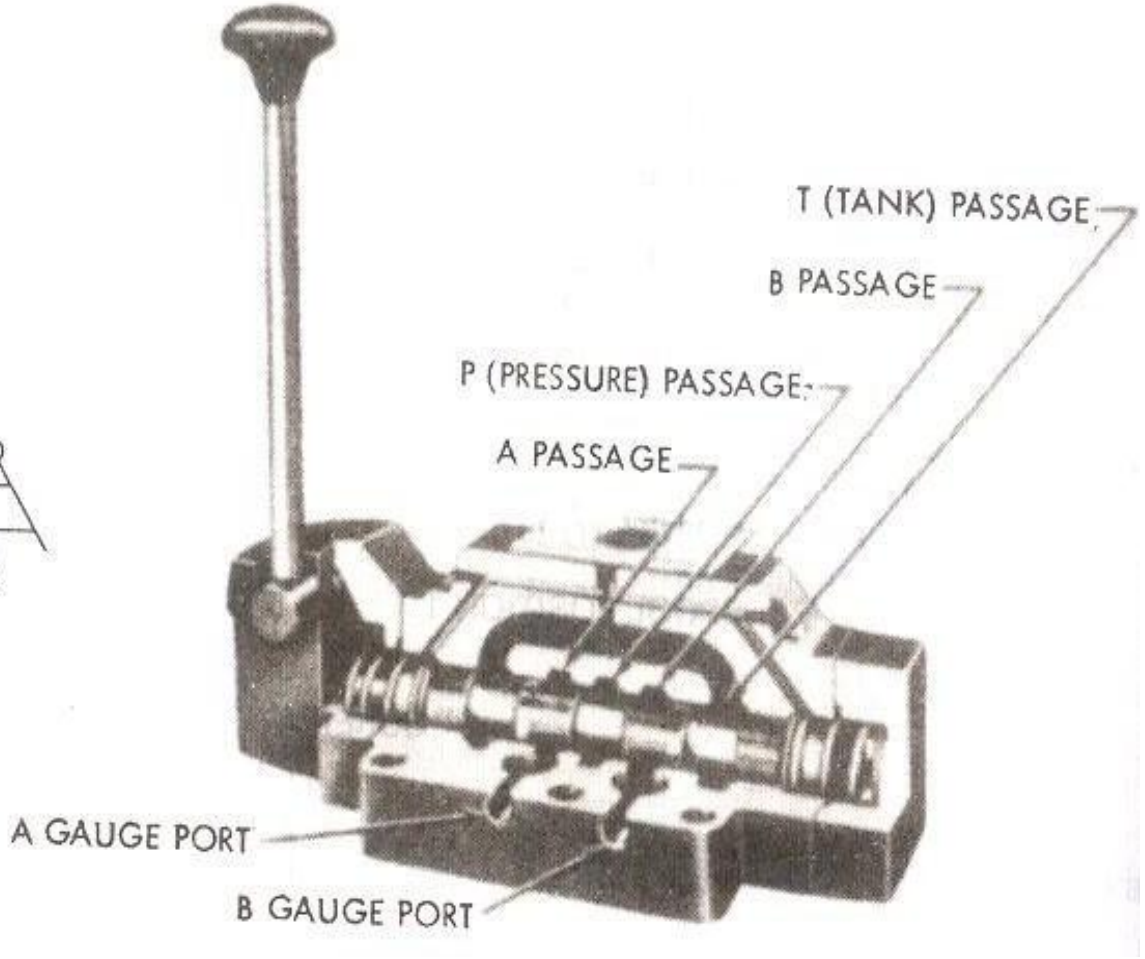


- 4 x 2 way valve used to move double acting cylinder
- Position I
  - P to A
  - B to T
- Position I
  - P to B
  - A to T

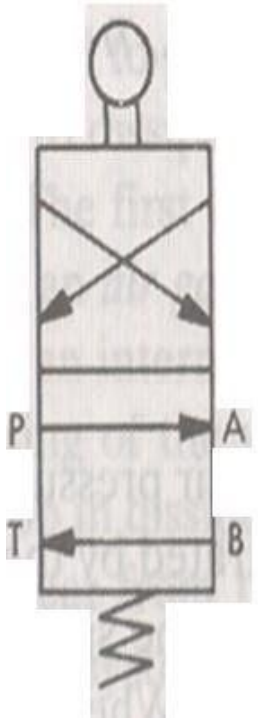


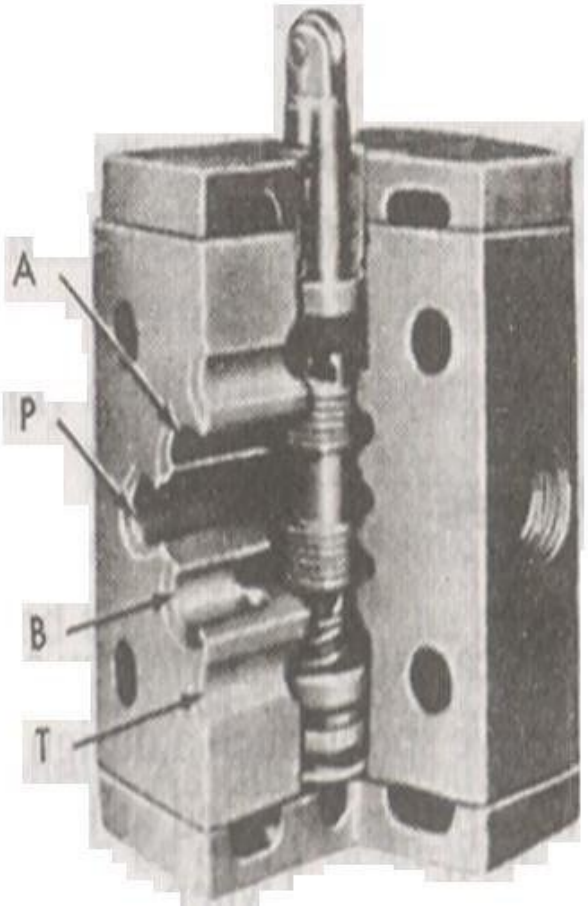
Manually actuated DCV





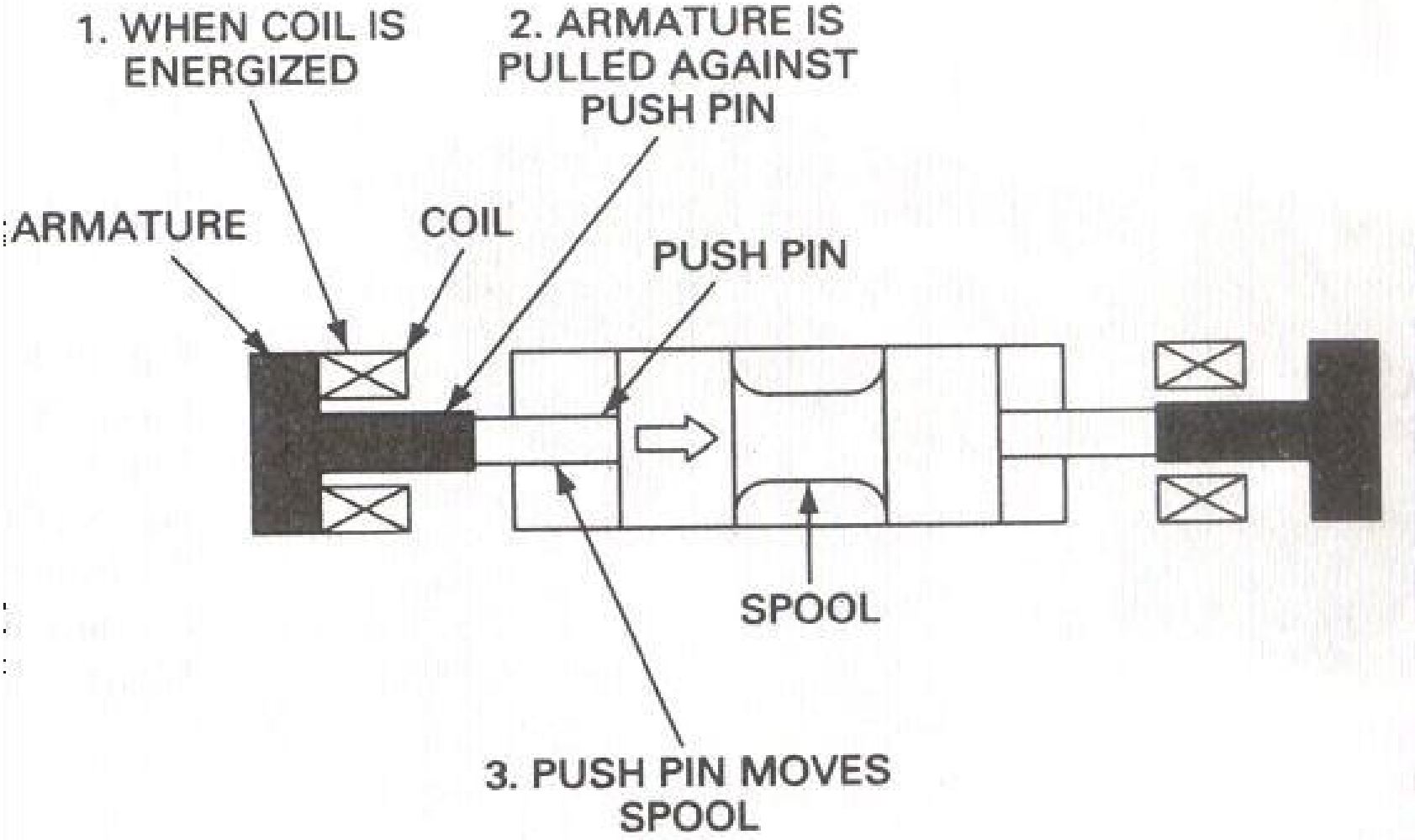
Mechanically actuated DCV





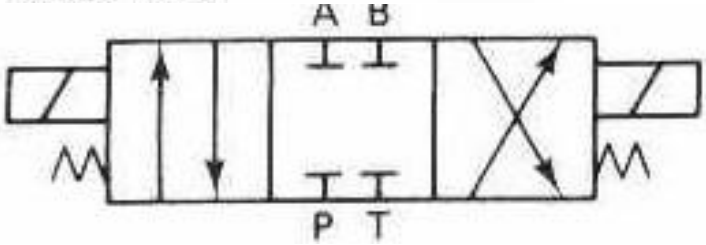
- Four-way spring offset valve mechanically actuated.
- The spool end containing a roller that is typically actuated by a cam-type mechanism.
- The basic graphical symbol is the same but that actuation is depicted as being mechanical rather than manual.

Solenoid actuated DCV

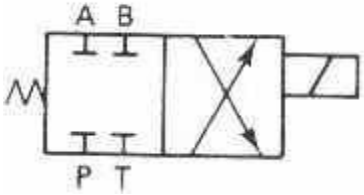


- It has a wet armature solenoid, which means that the plunger or armature of the solenoid moves in a tube that is open to the tank cavity of the valve.
- The fluid around the armature serves to cool it and cushion its stroke without appreciably affecting response time.
- There are no seals around this armature to wear or restrict its movement.
- This allows all the power developed by the solenoid to be transmitted to the valve spool without having to overcome seal friction.
- Impact loads, which frequently cause premature solenoid failure, are eliminated with this construction.

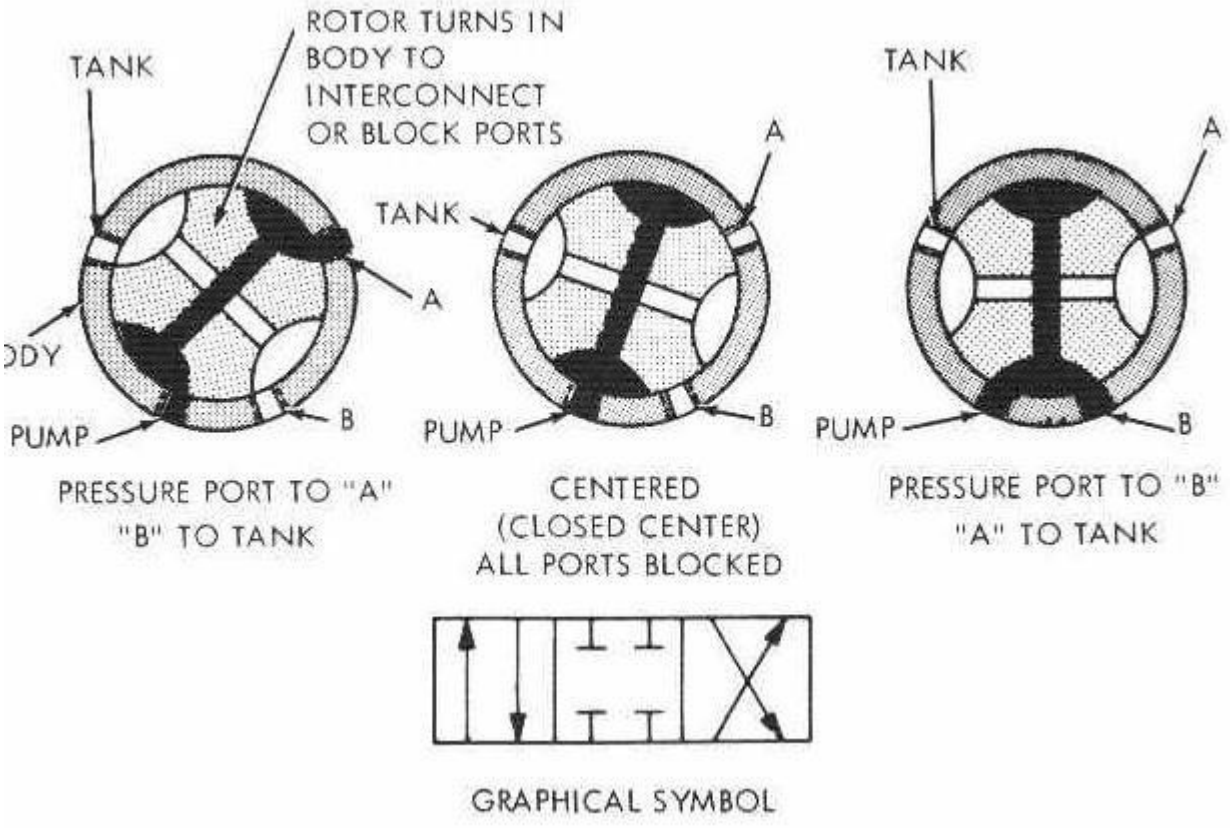
solenoid-actuated, four-way, three-position, spring-centered directional control valve.



Single solenoid-actuated, four-way, two-position, spring-offset directional control valve.



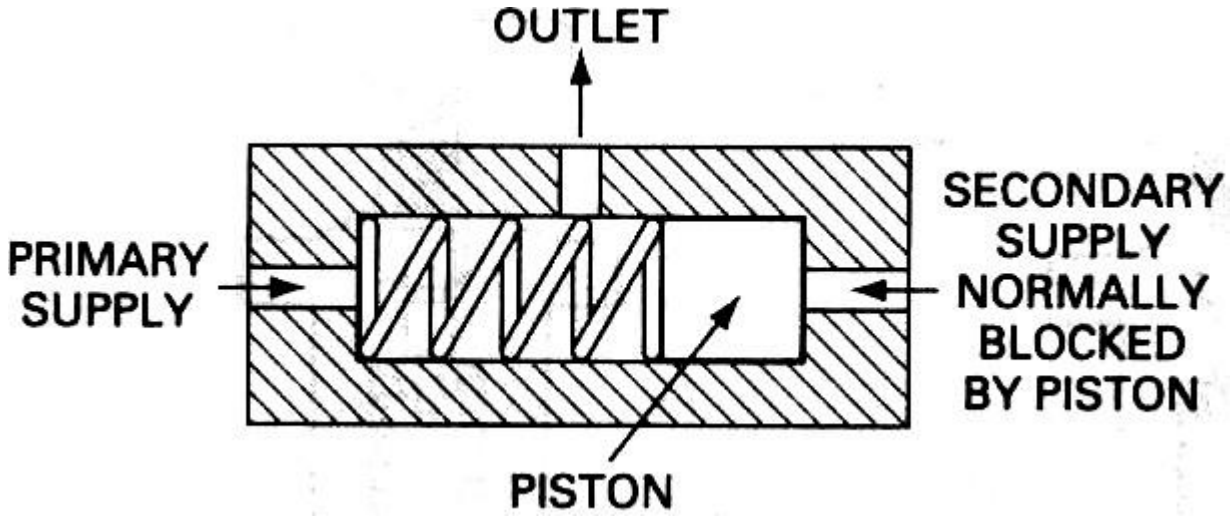
Rotary 4-way valve

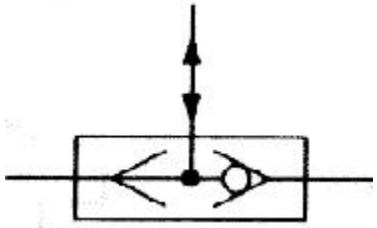


- The gradual overlapping of the round flow passages produces a smooth shearing action, which results in a low handle load and no sudden surges.
- There is no external leakage because of a static seal on a rotating shaft (not reciprocating and not under pressure).
- The high-pressure regions arc confined to flow passages.
- This type of valve can take higher velocities and more flow than a spool valve of the same pipe size.
- Manually operated, solenoid and air pilot-actuated models are available. These valves can be obtained in a variety of three-way and four-way. two- and three- position flow path configurations

Shuttle valve

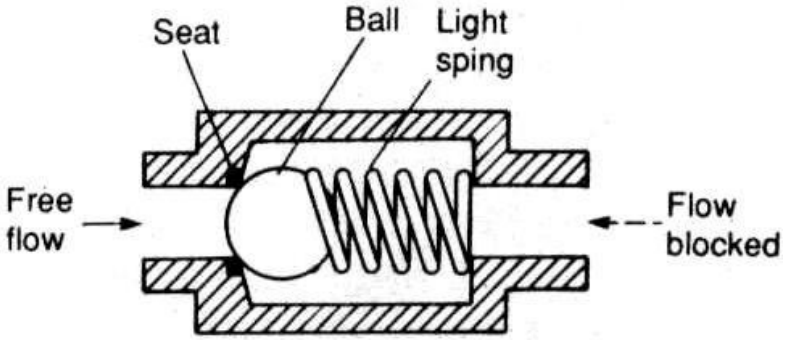
- A **shuttle valve** is a type of valve which allows fluid to flow through it from one of two sources.
- Generally a shuttle valve is used in pneumatic systems, although sometimes it will be found in hydraulic systems.

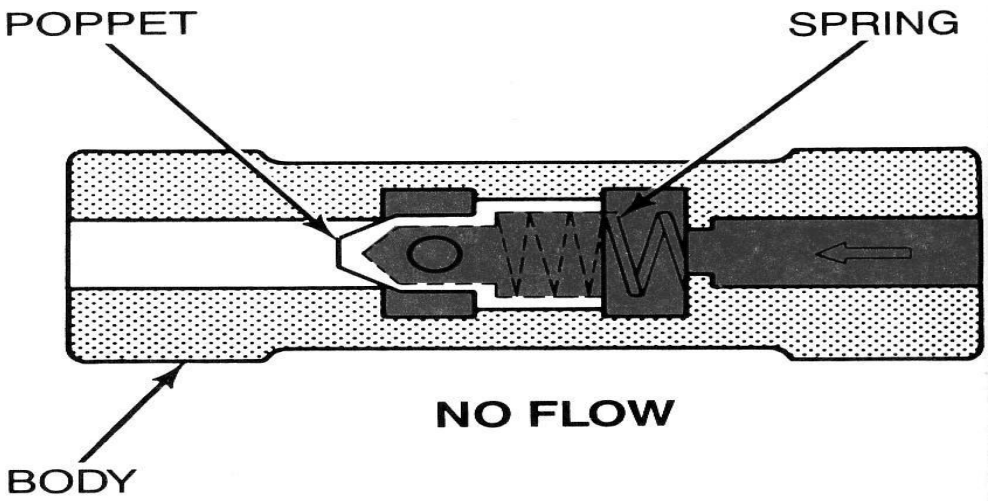


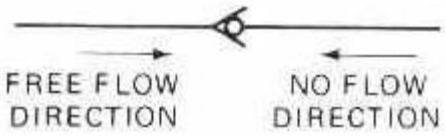


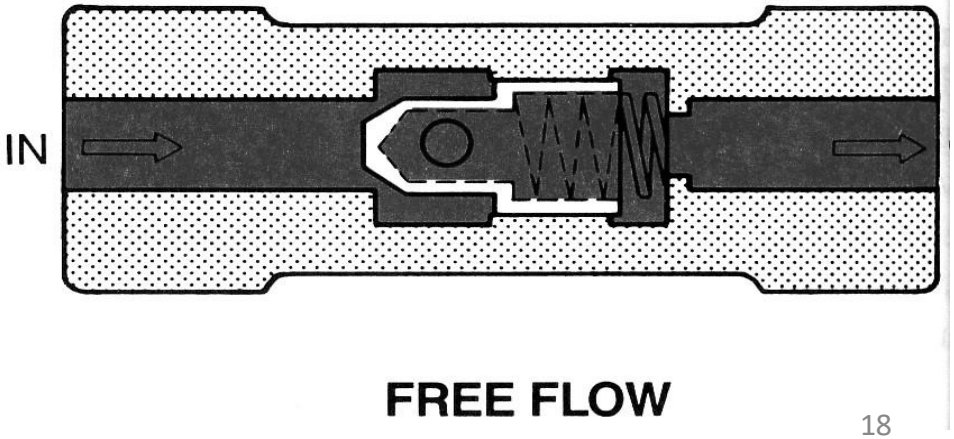
- A shuttle valve is another type of directional control valve.
- It permits a system to operate from either of two fluid power sources.
- One application is for safety in the event that the main pump can no longer provide hydraulic power to operate emergency devices.
- The shuttle valve will shift to allow fluid to flow from a secondary backup pump

Check Valve


Seat
Ball
Light sping
Free flow
Flow blocked

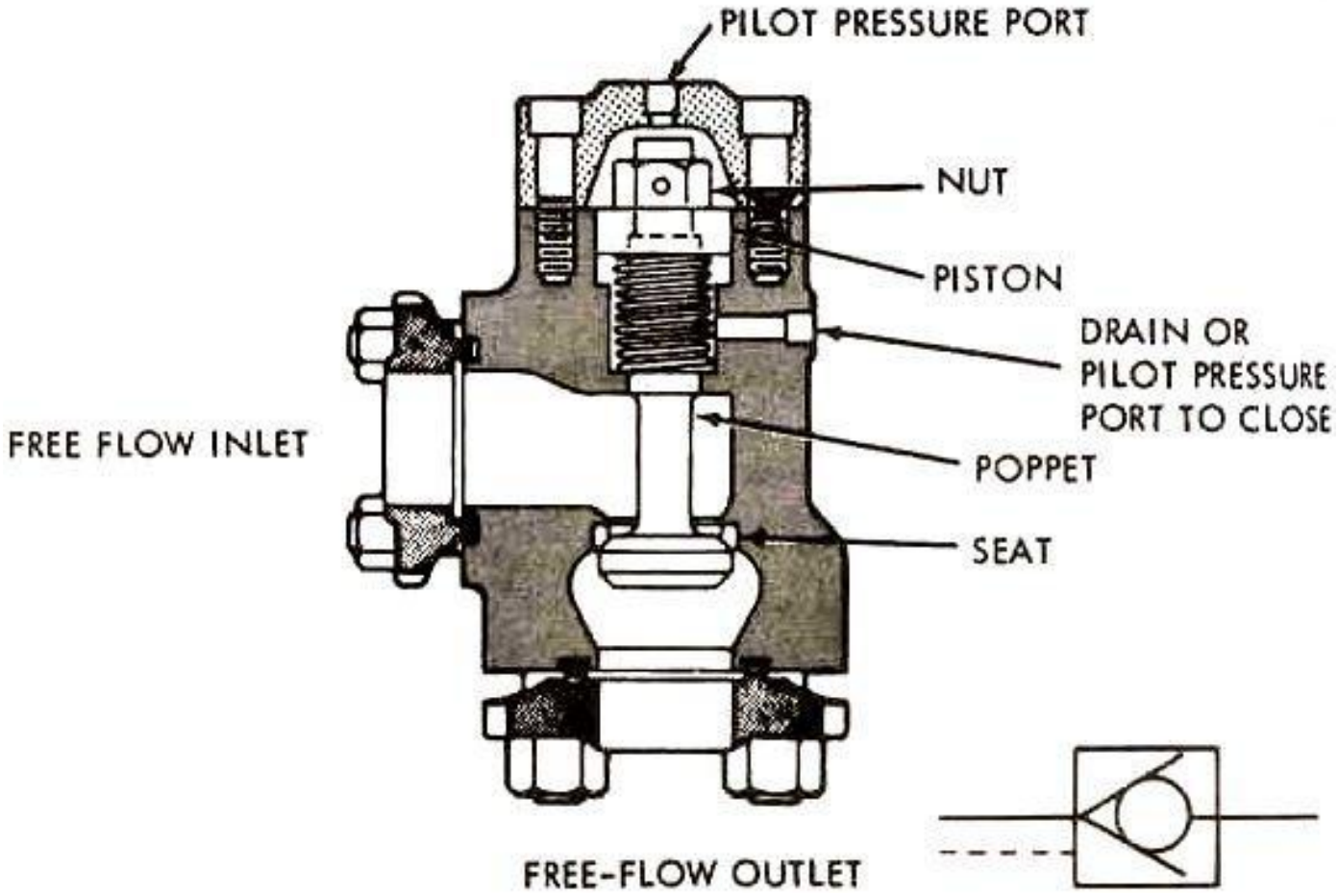

POPPET
SPRING
NO FLOW
BODY


FREE FLOW DIRECTION
NO FLOW DIRECTION


IN
FREE FLOW

- A light spring holds the poppet in the closed position.
- In the free-flow direction, the fluid pressure overcomes the spring force at about 5 psi.
- If flow is attempted in the opposite direction, the fluid pressure pushes the poppet (along with the spring force) in the closed position.
- Therefore, no flow is permitted. The higher the pressure, the greater will be the force pushing the poppet against its seat.
- Thus, increased pressure will not result in any tendency to allow flow in the no-flow direction.

Pilot operated check valve



- Pilot check valves are frequently used for locking hydraulic cylinders in position.
- Additional types of directional control valves are the two-way and four-way valves used to direct inlet flow to either of two outlet ports.
- Flow entering at the pump port *P* (this is the port that is connected to the pump discharge line) can be directed to either the outlet port *A* or *B.*
- Most directional control valves use a sliding spool to change the path of flow through the valve.

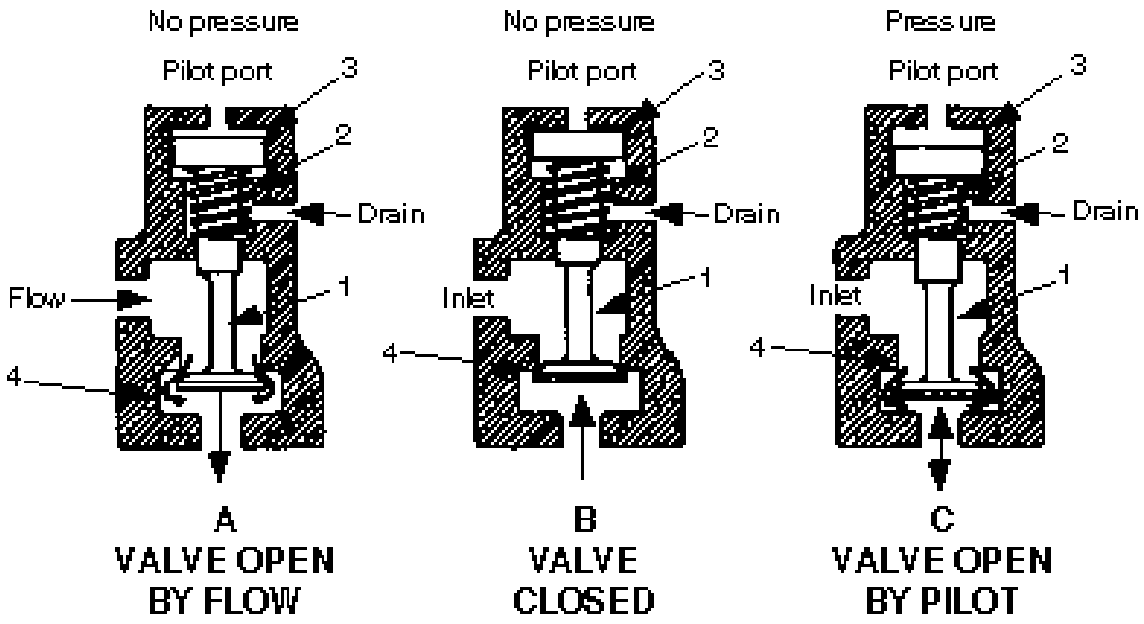
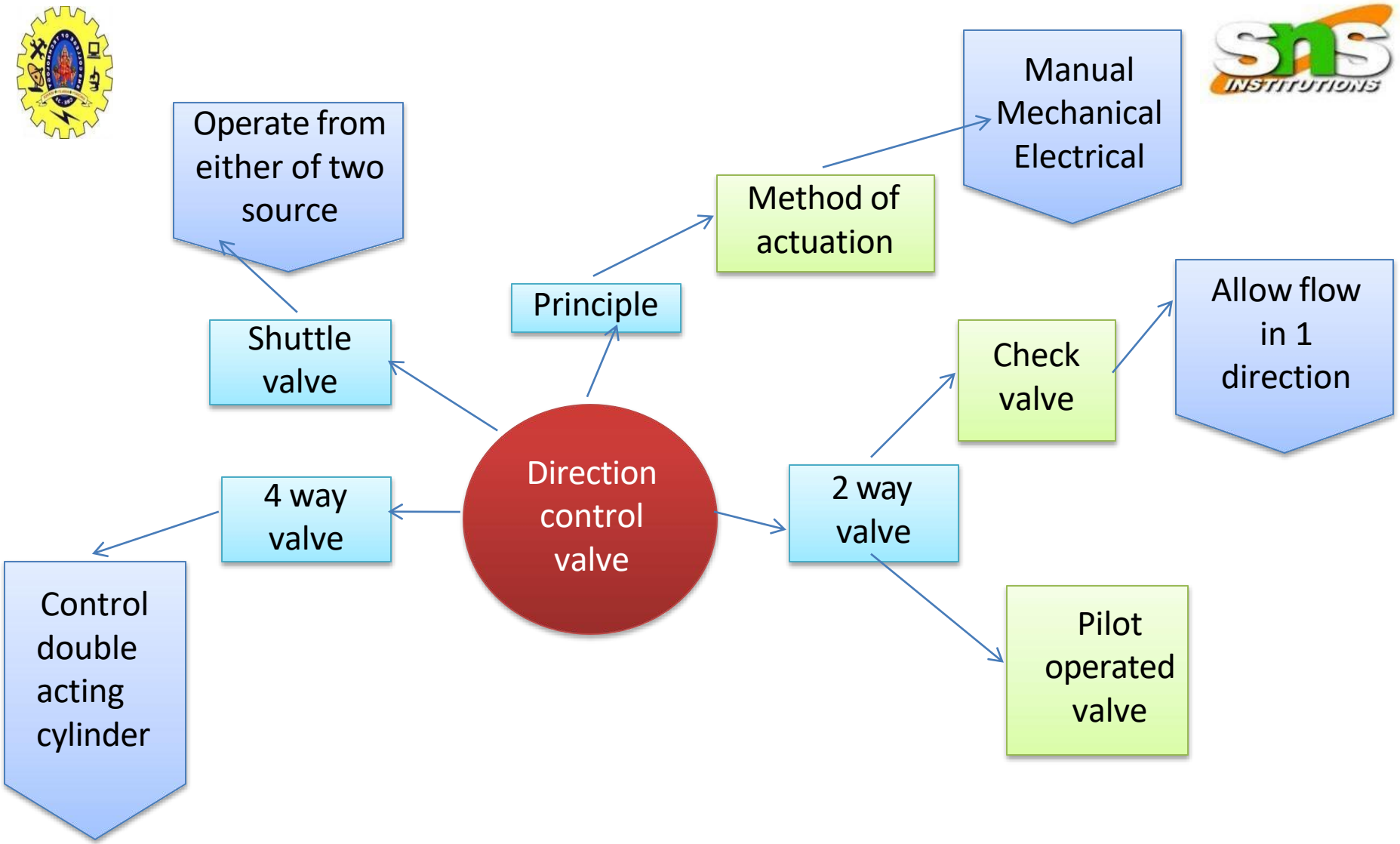


Figure 5-20. Pilot-operated check valve, second type

Questions

1. What are control valves?
2. What are the three important parameters that should be controlled in hydraulic system?
3. What is the function of Direction Control Valve?
4. What is the function of Shuttle valve?
5. Where the check valve is used?


Direction control valve
Principle
Shuttle valve
Operate from either of two source
Method of actuation
Manual
Mechanical
Electrical
4 way valve
Control double acting cylinder
2 way valve
Check valve
Allow flow in 1 direction
Pilot operated valve

Summary

- DCV allow fluid flow into different paths from one or more sources.
- They usually consist of a spool inside a cylinder which is mechanically or electrically controlled.
- The movement of the spool restricts or permits the flow, thus it controls the fluid flow.
- This is the cumulative count of all the entry and the exit passages for oil that the valve has.
- Flow paths can be selectedby either external or internal actuation.
- Internally actuated Directional Control Valves are limited to check valves.
- External actuations can be by manual means (levers, buttons or foot pedals), mechanical actuators (such as cams, rollers, plungers/tracers or springs), electrical methods (either solenoids or electrical motors that get their signals from limit switches, push buttons or PLC controls) or by the application or release or hydraulic or pneumatic pressure.
- Shuttle valve used to allow high pressure flow
- Check valve used to allow the flow in any one direction.

MCQ

1. A plain check valve can be used as:
    A. pilot-operated relief valves
    B. direct-acting relief valves
    C. either type relief valve
2. A 4-way valve has:
    A. two working ports
    B. three working ports
    C. four working ports
3. A Series bar manifold can have up to:
    A. one station.
    B. two stations.
    C. three stations.
4. Stroke limiters on the working spool of a solenoid pilot operated valve can:
    A. slow spool travel.
    B. speed up spool travel
    C. control actuator speed.
5. Direct solenoid operated valves:
    A. are only DC current activated.
    B. are only AC current activated.
    C. operate off either AC or DC current

Answer

1. A plain check valve can be used as:
   A. pilot-operated relief valves
   B. direct-acting relief valves
   C. either type relief valve
2. A 4-way valve has:
   A. two working ports
   B. three working ports
   C. four working ports
3. A Series bar manifold can have up to:
   A. one station.
   B. two stations.
   C. three stations.
4. Stroke limiters on the working spool of a solenoid pilot operated valve can:
   A. slow spool travel.
   B. speed up spool travel
   C. control actuator speed.
5. Direct solenoid operated valves:
   A. are only DC current activated.
   B. are only AC current activated.
   C. operate off either AC or DC current

Higher Order Question

- Identify the usage of DCV in the following application.