

PART - B

UNIT – 7

DIRECTION CONTROL VALVES

DIRECTION CONTROL VALVES

- Direction control valves are mainly used to change the direction of flow path of working medium or signal medium. They are used for admitting or exhausting working medium to the cylinder or from the cylinder for actuation of the cylinder.

DIRECTION CONTROL VALVES

 Direction control valves are designated as per the following functions.

- Number of ports on the valves
- Number of switching positions
- Method of actuation
- Method of reset
- Design and constructional features

Symbolic Representation of Directional Control Valves

Each Square represents a switching position



Number of Squares represents number of switching positions



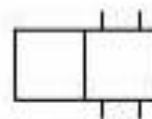
Lines indicates the arrow path.
Arrows indicates the direction



Shut off positions are indicated by lines drawn at right angles



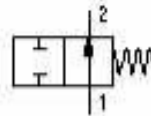
Connections to the valves are indicated by short lines drawn outside the boxes



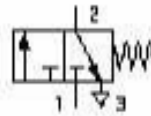
Symbolic Representation of Directional Control Valves

Number of ports
Number of positions

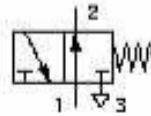
2/2 Way Directional Control Valves Normally Open



3/2 Way Directional Control Valves Normally Closed

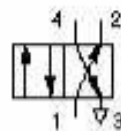


3/2 Way Directional Control Valves Normally Open

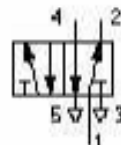


Number of ports
Number of positions

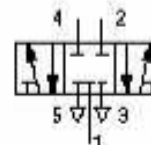
4/2 Way Valve



5/2 Way Valve

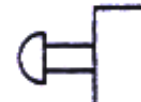


5/3 Way Valve ,
Mid Position Closed



Symbolic Representation of Directional Control Valves

PUSH BUTTON OPERATED VALVE



PEDAL OPERATED VALVE



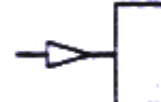
SPRING RESET



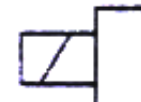
ROLLER LEVER OPERATED LIMIT SWITCH



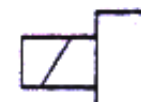
PILOT OPERATED VALVE



SOLENIOD ACTUATED VALVE



SOLENIOD ACTUATION AND RESET



PILOT ASSISTED SOLENIOD ACTUATION AND RESET WITH MANUAL OVER RIDE



SOLENIOD ACTUATION AND SPRING RESET



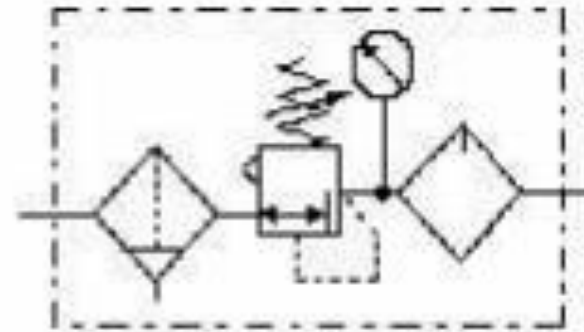
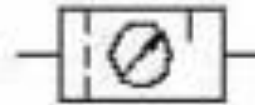
Fig. Method of Actuation and Reset of Directional Control Valves

Symbolic Representation of Directional Control Valves

Pressure Source



Air Service Unit



Symbols for Energy Elements

Port marking of direction control valve

As per IS 1219

- Supply Port A
- Exhaust Ports R & S
- Out put Pots A & B
- Pilot Port [Set] Z
- Pilot Port [Reset] Y

As per IS 5599

- Supply Port 1
- Exhaust Ports 3 & 5
- Out put Ports 2 & 4
- Pilot Port [Set] 14
- Pilot Port [Reset] 12

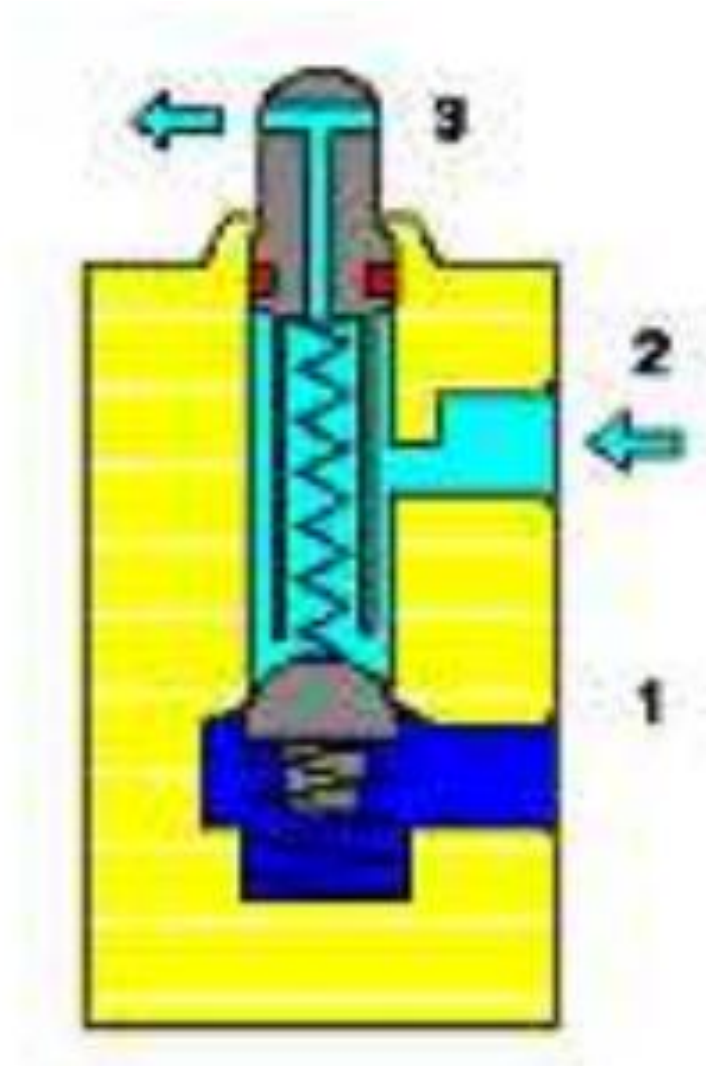
Design and construction features of DC valve

- Poppet type of valves
 - Ball seat type (Pneumatic/Solenoid actuation)
 - Disc seat type (Pneumatic/Solenoid actuation)
- Slid valves (Pneumatic/Solenoid actuation)
- Suspended disc type of valve (Pneumatic/Solenoid actuation)
- Plate of valve (manual actuation)

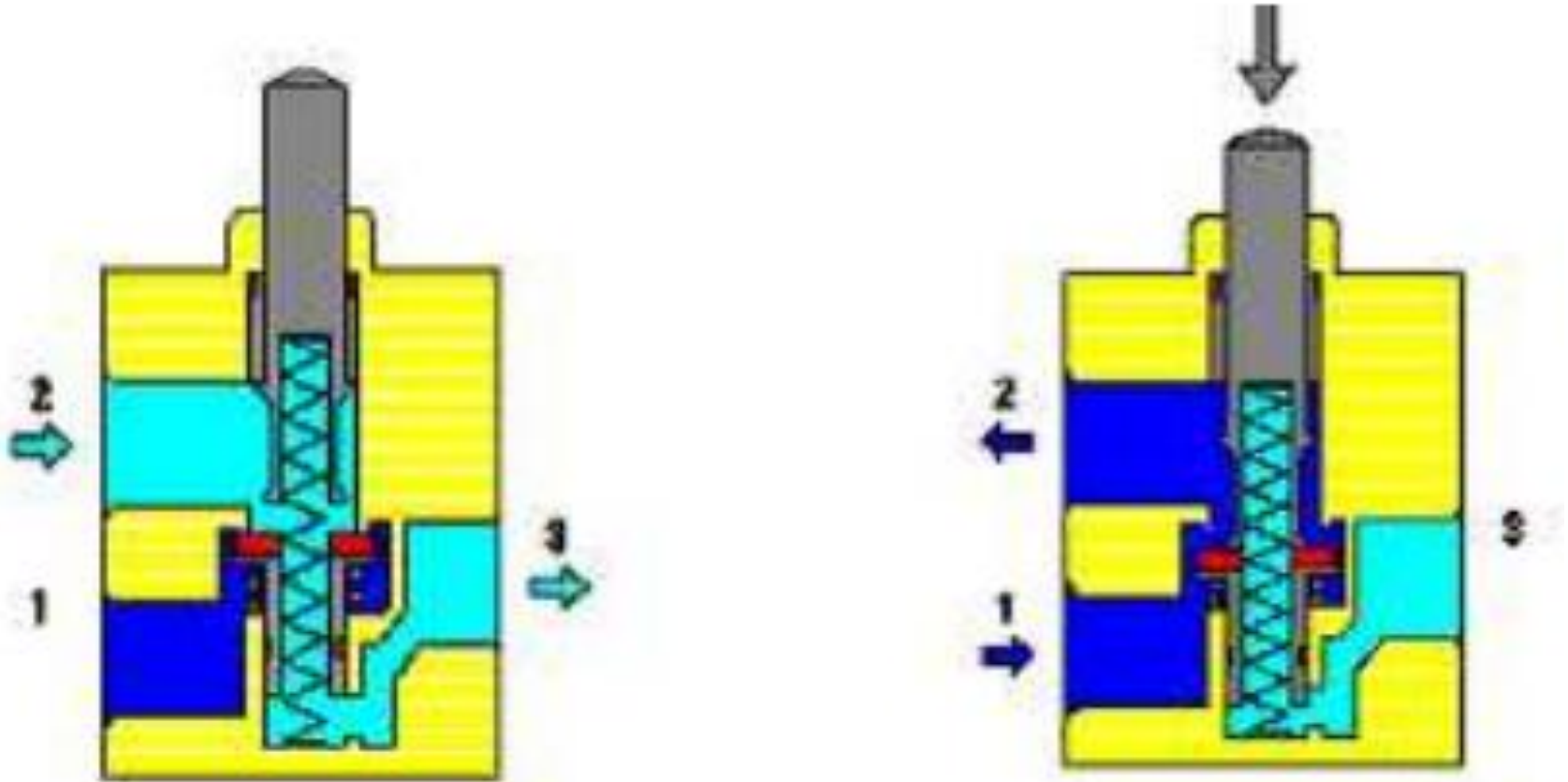
Selection criteria of D.C valve

- Actuation force
- Leak tightness
- Ease of servicing
- Sensitive to contamination by dirt
- Travel length of valve stem
- Size
- Cost

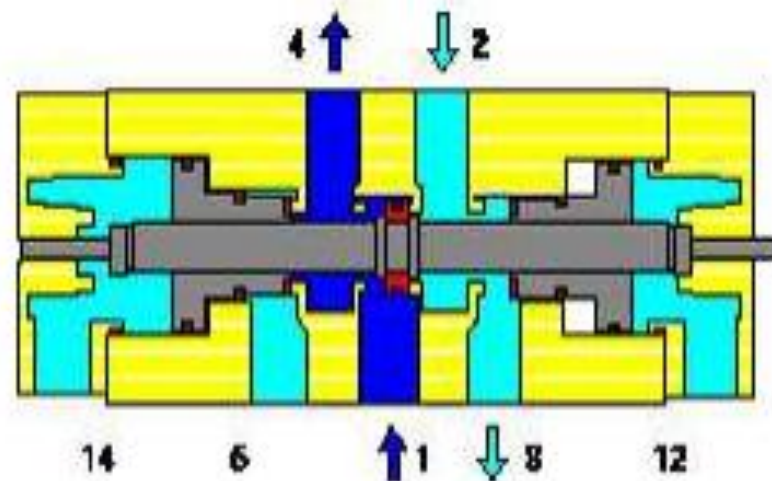
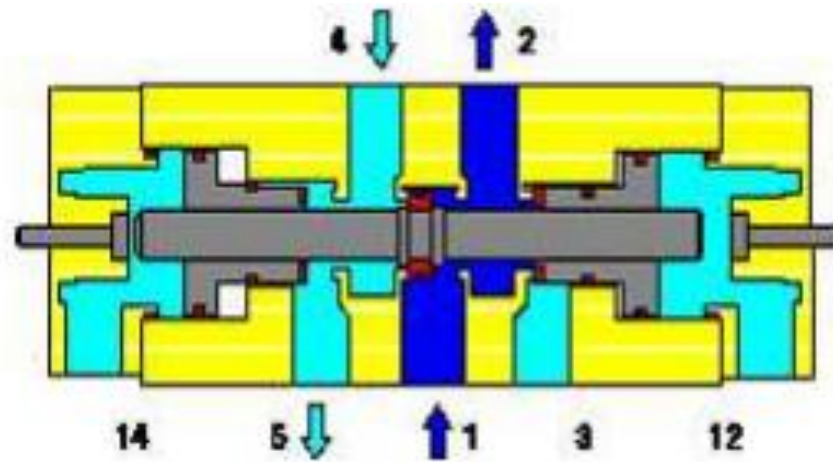
3/2 way ball seat type D.C valve



3/2 way disc seat valve (normally closed)



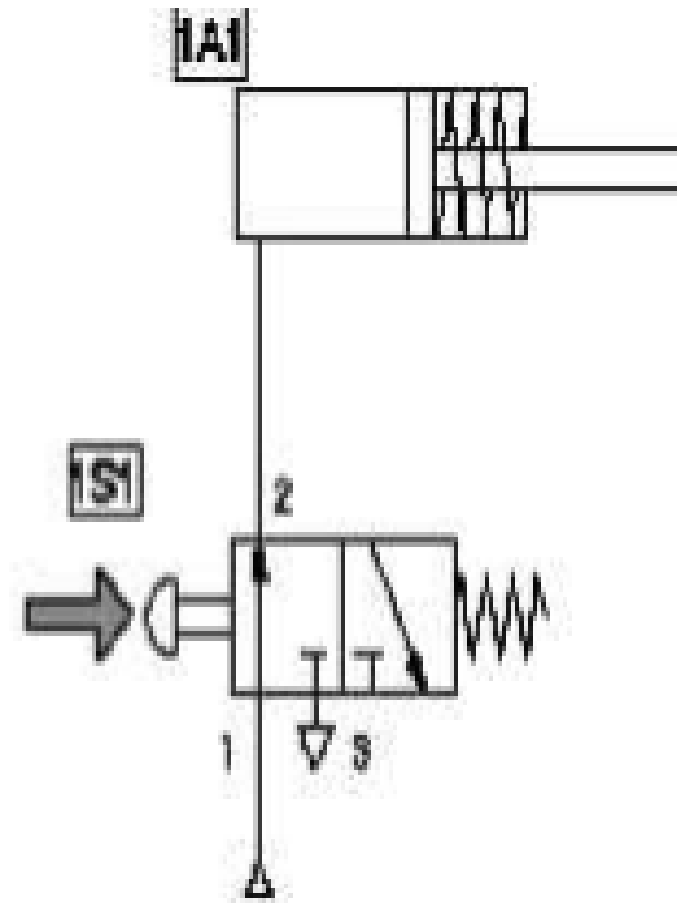
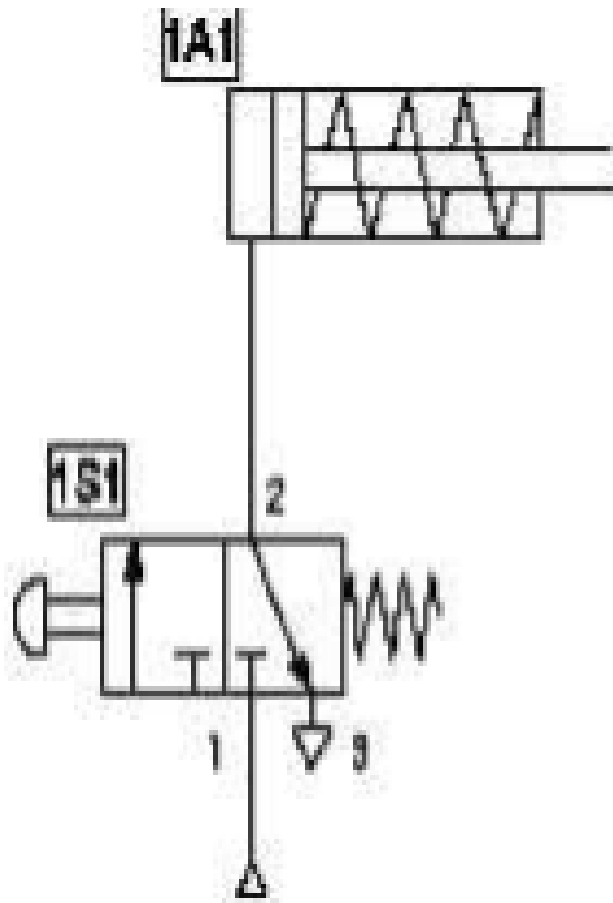
5/2 way suspended disc seat type valve (normally closed)



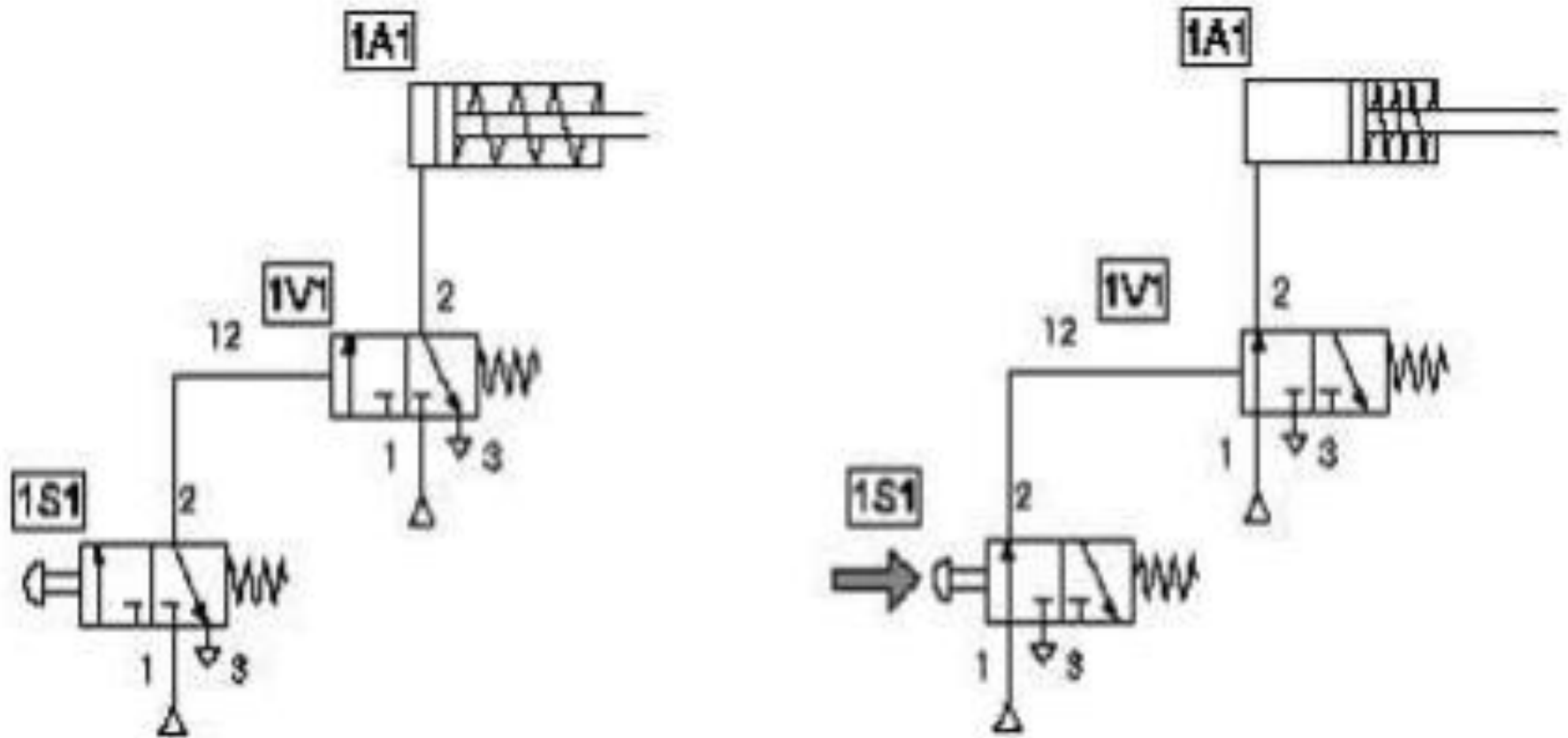
Controlling of pneumatic cylinders

- Pneumatic cylinders can be controlled by following methods.
 - Direct control of single or double acting cylinder
 - Indirect control of cylinder with single pilot control valve
 - Indirect control of cylinder with double piloted control valve

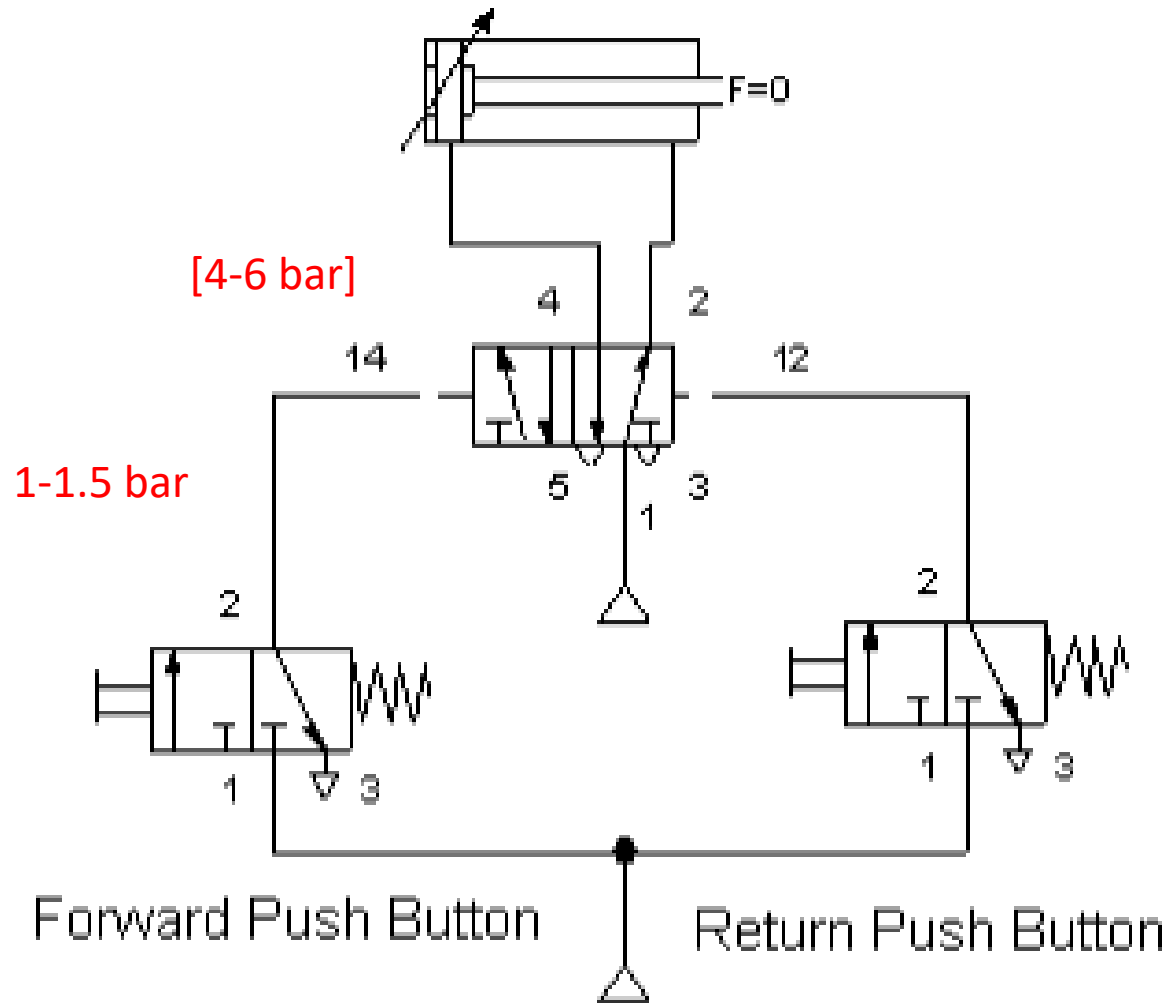
Direct control of single acting cylinder



Indirect control of single acting cylinder with single piloted final control valve



Indirect control of cylinder with double piloted final control valve

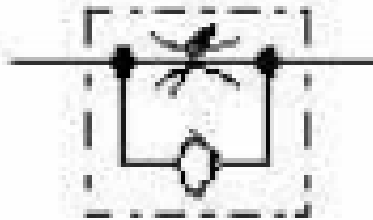


Speed control of cylinders

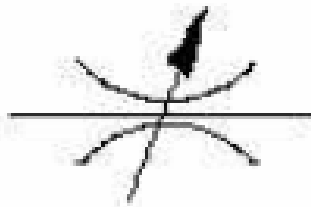
- It is always necessary to reduce the speed of cylinder from maximum speed based on application.
- Speed control of pneumatic cylinder can be conveniently achieved by regulating the flow rate supply or exhaust air.
- The volume flow rate of air can be controlled by using flow control valves which can be either two way or one way flow control valve.

Flow control valves

- One way flow control valve

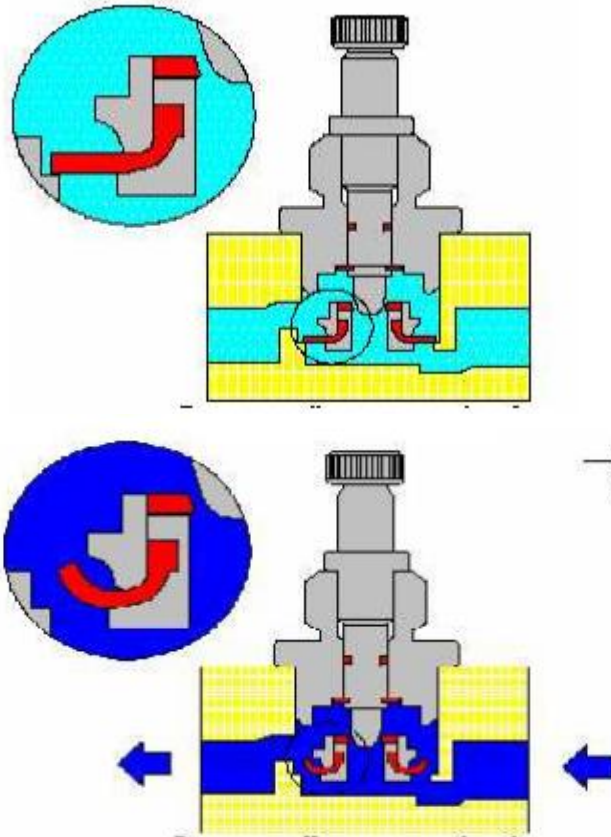


- Two way flow control valve



One way flow control valve

- It is also called as throttle relief valve



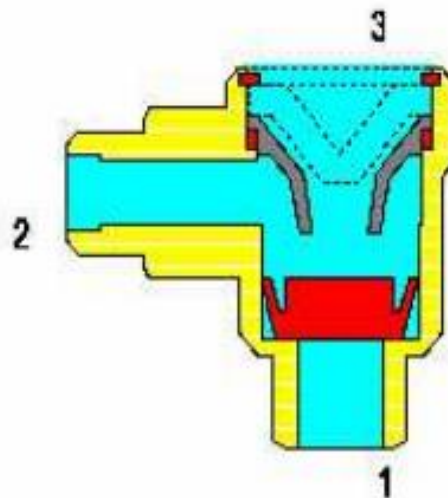
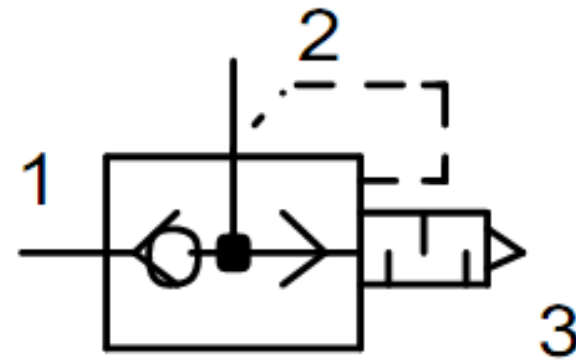
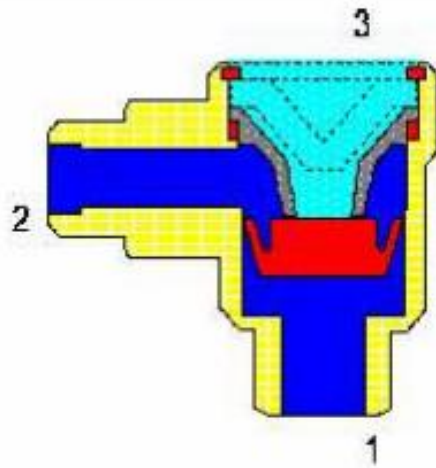
Slip stick effect

There is a limitation in achieving smooth movement of cylinder with low speed setting of flow control valve. This results in jerky motion of piston which is called as the stick slip effect

When the flow control valve is set for low flow rates, it takes considerable time for the supply air to build up to the required pressure [corresponding to the load]

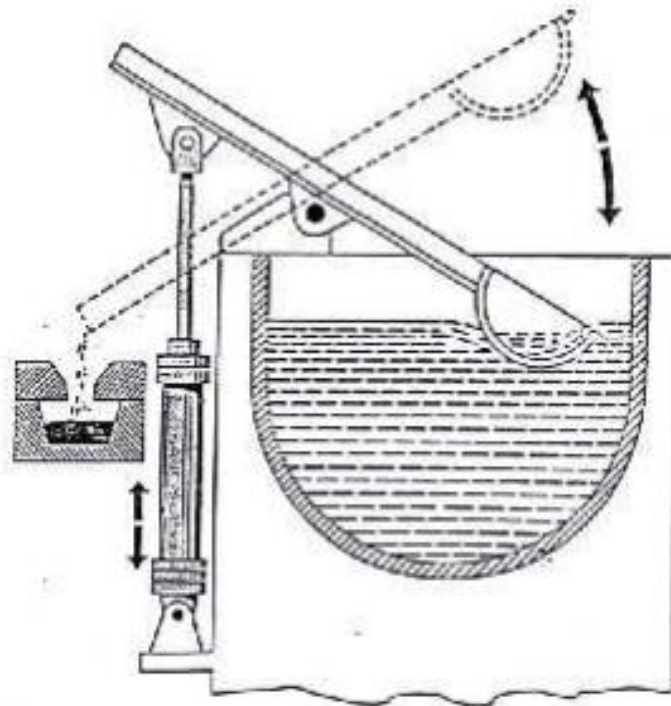
behind the piston. Every time this pressure is reached, the piston jerks in the direction of motion which results in increase in cylinder volume. This further results in drop in pressure in the cylinder and the piston momentarily halts until the pressure build up takes place. This intermittent motion is called as the Stick Slip Effect

Quick exhaust valve



Exercise

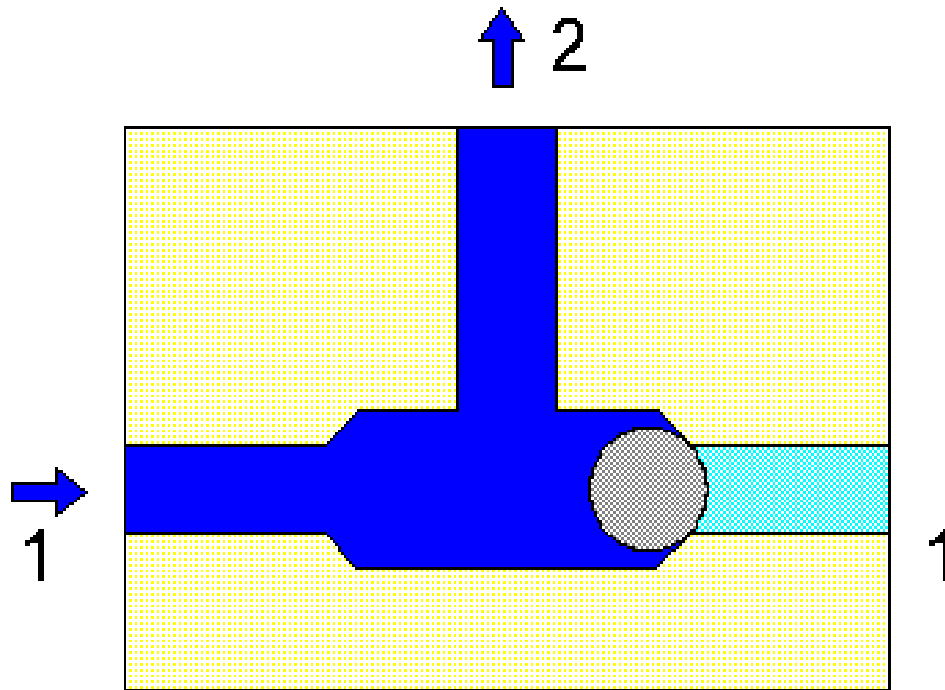
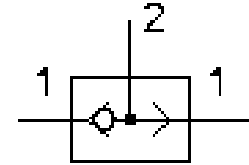
Liquid metal is drawn from a smelting crucible by a casting ladle and cast in moulds. The raising and lowering of the ladle is controlled by separate manual push buttons. The raising and lowering speed is separately adjustable. Design a Pneumatic control circuit for this application



Signal processing elements

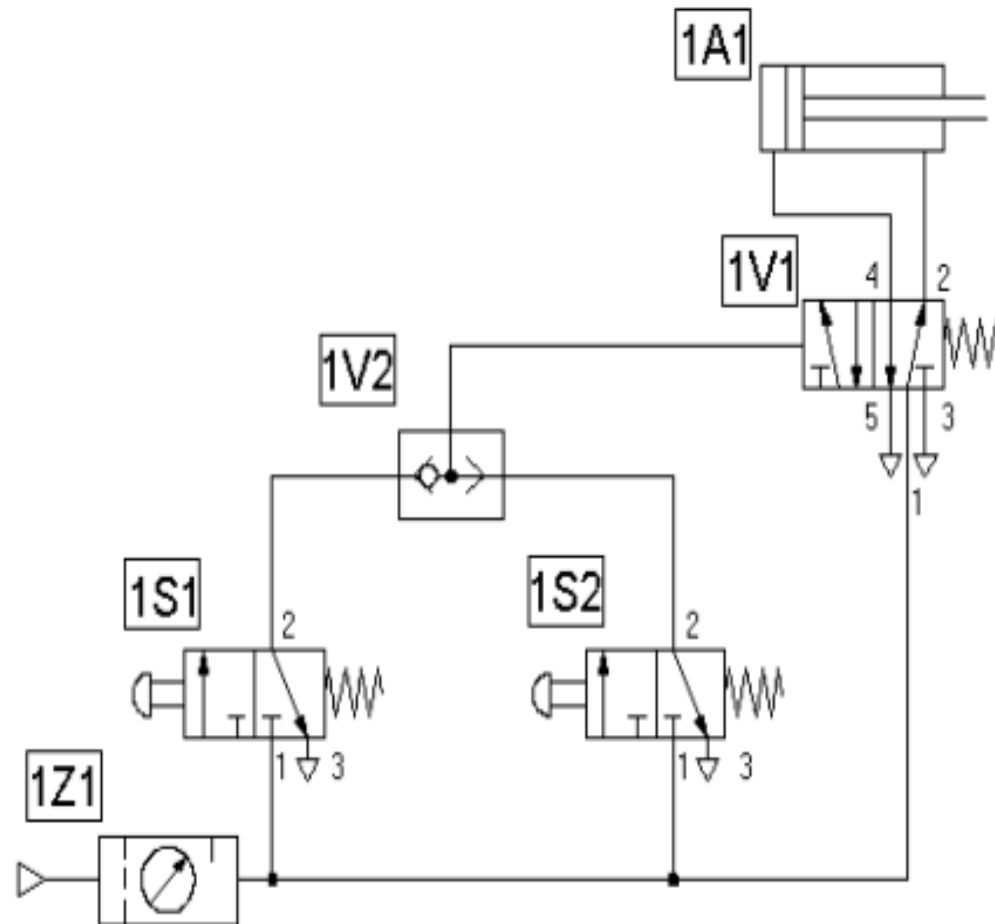
- To meet the requirements of various conditions in pneumatic applications, signal processing devices are often used. The following gates or valves are used depending on required conditions.
 - OR Gate – Shuttle Valve – Used to select one of the two input signals
 - AND Gate- Two Pressure Valve- To combine two input signals i.e to satisfy two conditions at the same time
 - NOT Gate- 3/2 way, normally open, pilot operated Directional Control Valve- Used to negate the function

Shuttle Valve as OR Gate



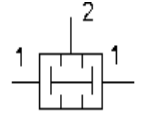
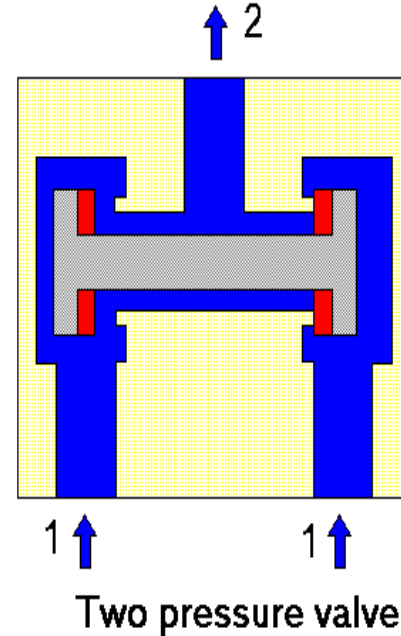
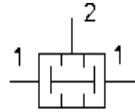
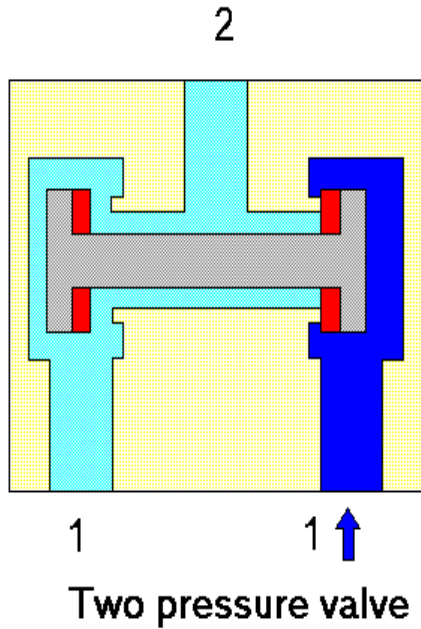
Shuttle valve

Shuttle valve as OR Gate



Circuit diagram: Shuttle valve

Twin pressure valve as AND Gate



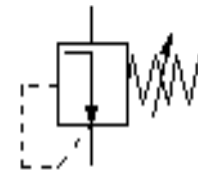
Pressure and time dependent valves

■ Pressure Dependent Valves

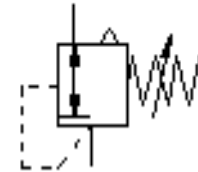
- The following Pressure Dependent Controls are often used in Pneumatic applications
 - Pressure Sequence Valve
 - Pressure Relief Valve
 - Pressure Regulator

Pressure Sequence Valves

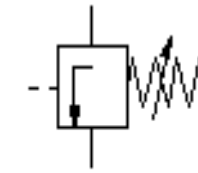
Adjustable pressure regulating valve
Non-relieving type



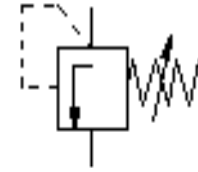
Adjustable pressure regulating valve
relieving type (overloads are vented)



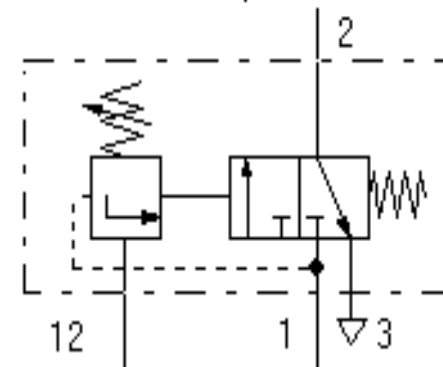
Sequence valve
external source



Sequence valve
in-line



Sequence valve
combination

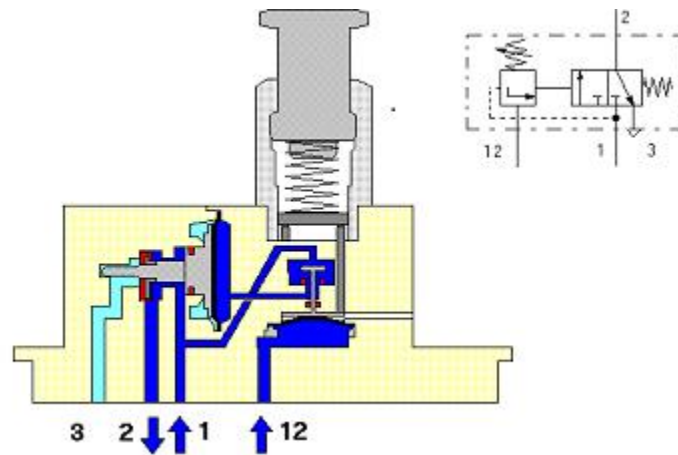
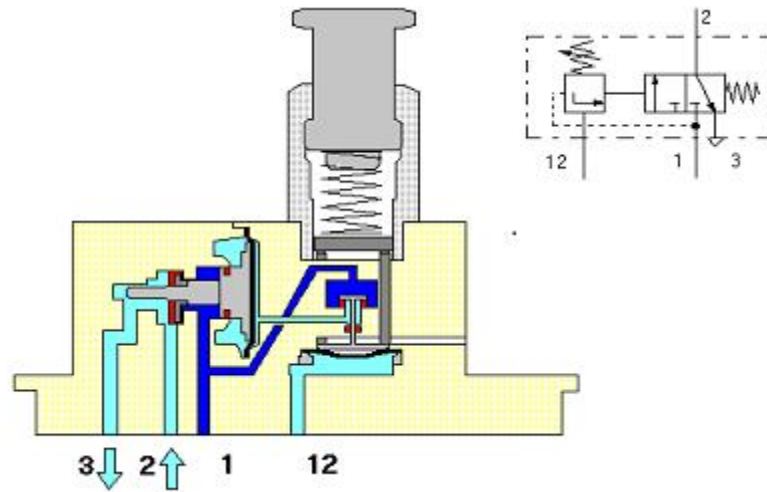


Pressure control valves

Pressure Sequence Valve

- Pressure Sequence valve is essentially a switch on or off valve
- Sequence Valve generates a pneumatic signal if the sensing pressure [signal input] is more than the desired set pressure
- This generated out put signal is used to control the movement of cylinder by using it as a set signal or reset signal to the final control valve to obtain forward or return motion respectively
- Used for applications such as bonding cylinders, clamping cylinder etc. to ensure desired minimum pressure in the cylinder
- This is a combination valve, having two sections. One of the section is a 3/2 directional control and the other a pressure control valve

Pressure Sequence Valve



Pneumatic Timers

- Pneumatic Timers are used to create time delay of signals in pilot operated circuits.
- Available as Normally Closed Timers and Normally Open Timers.
- Usually Pneumatic timers are on Delay Timers
- Delay of signals is very commonly experienced in applications such as Bonding of two pieces.
- Normally Open Pneumatic Timer are also used in signal elimination
- Normally Open Pneumatic Timers are used as safety device in Two Hand Blocks