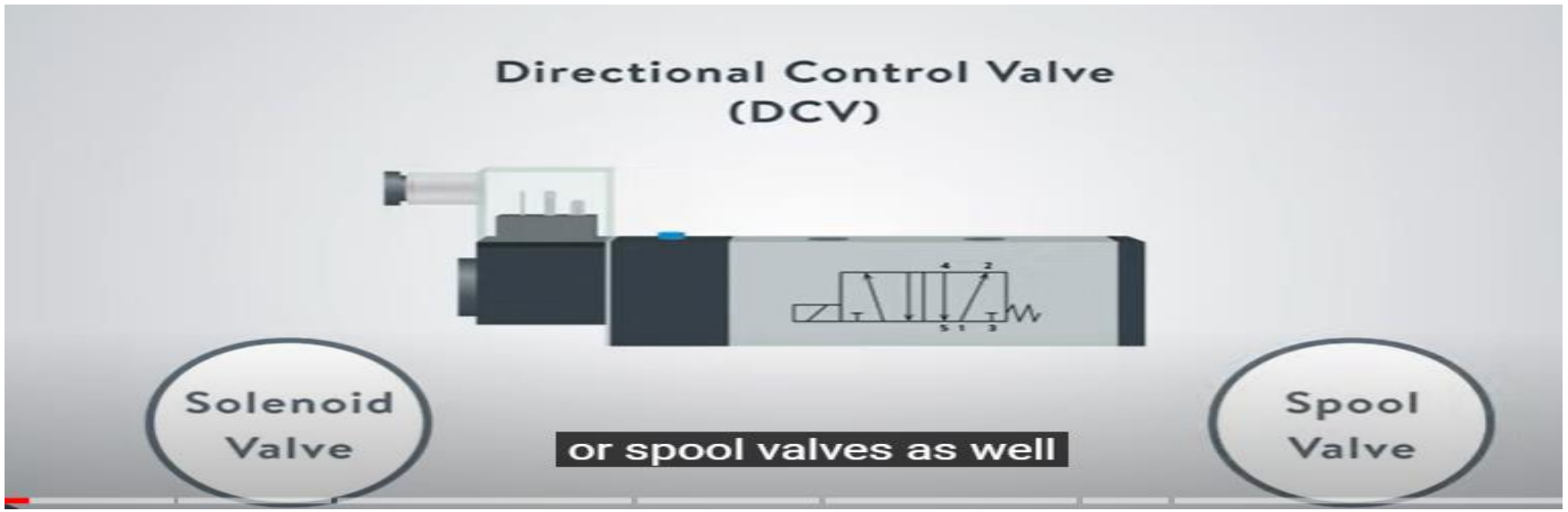
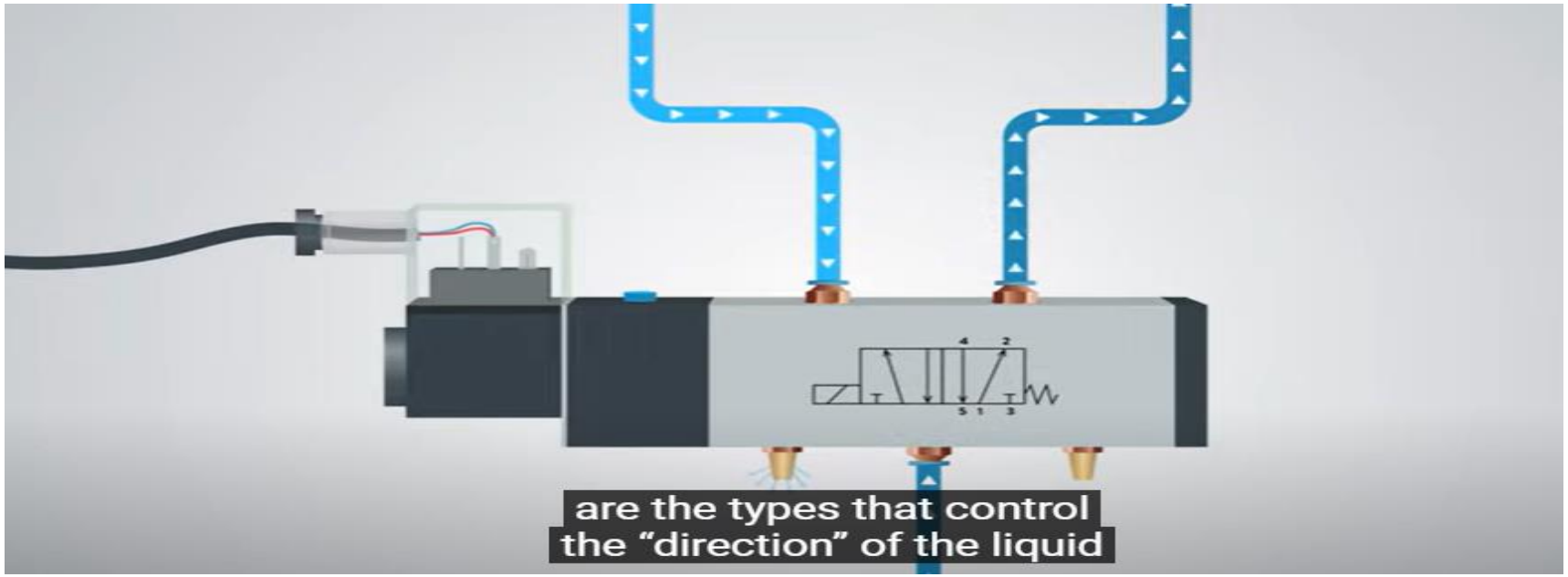
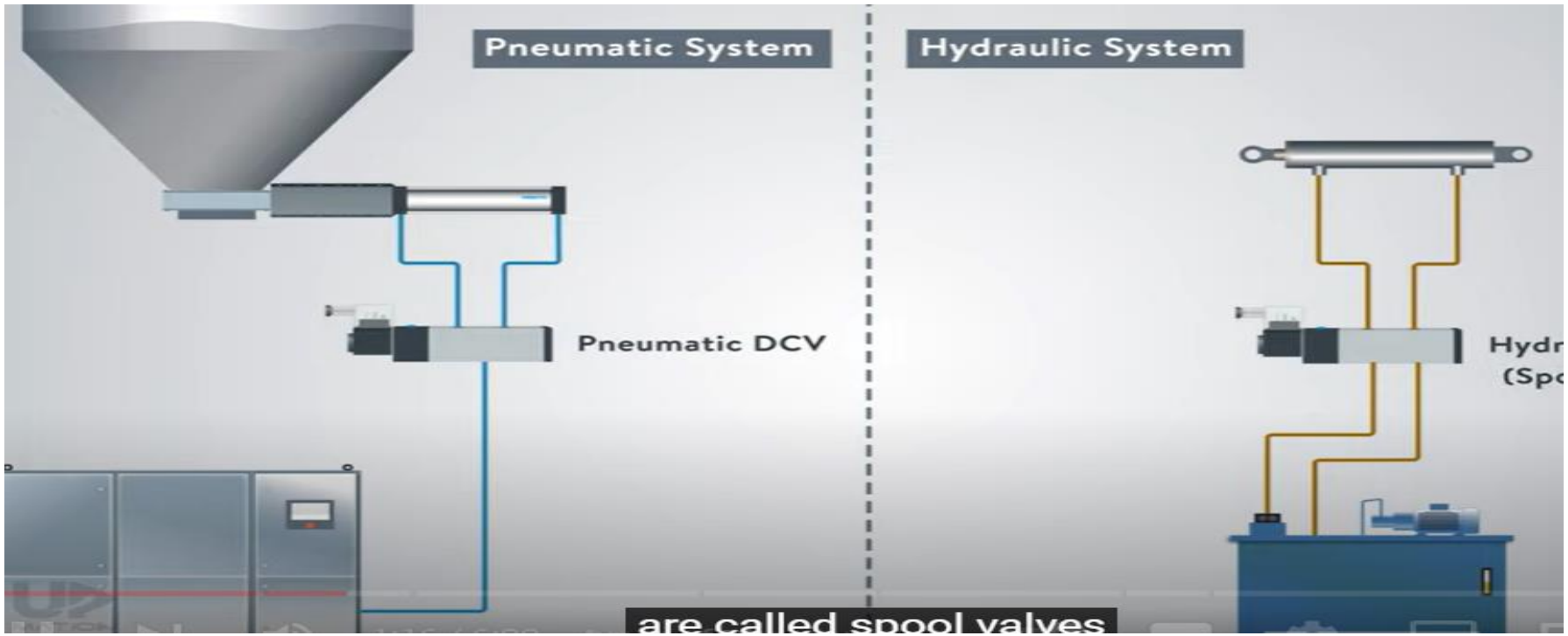
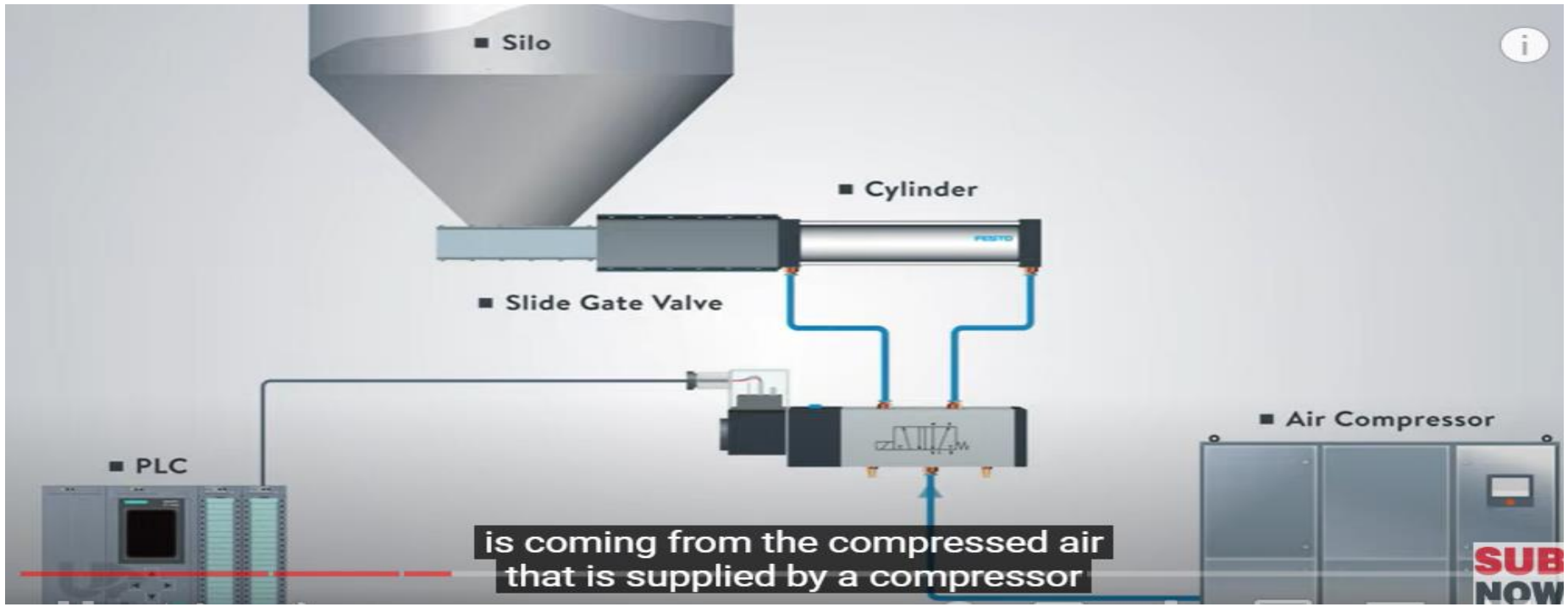
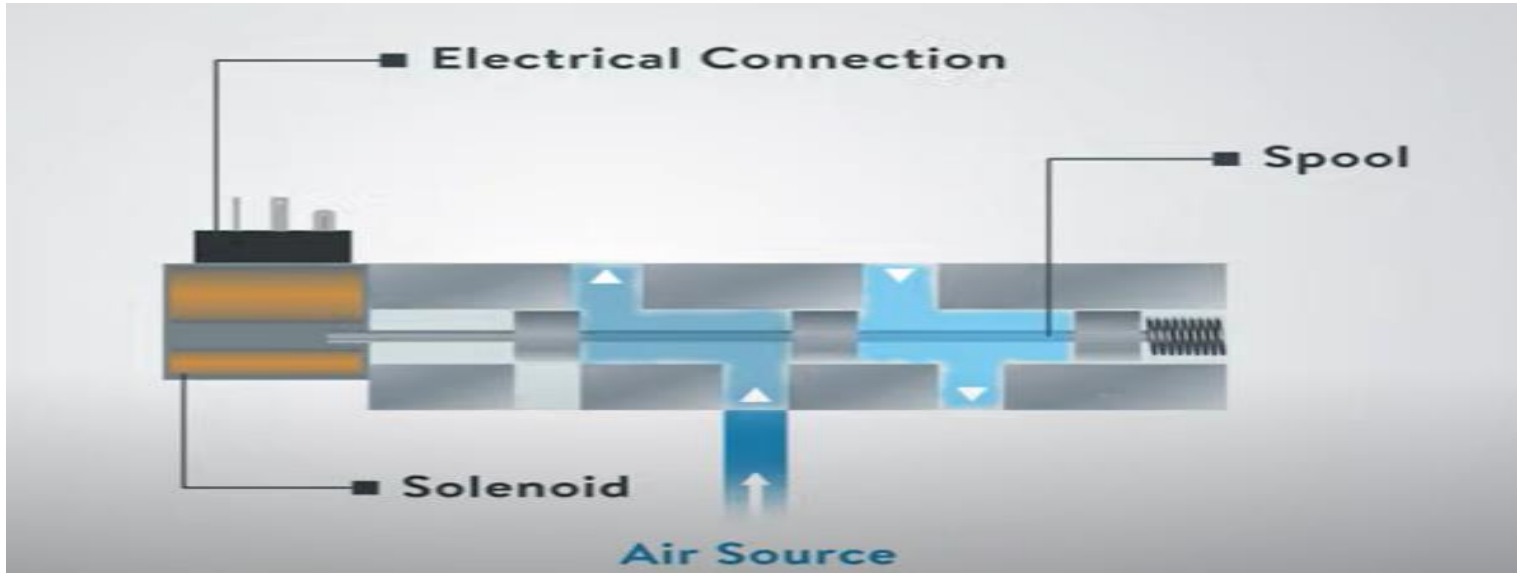
Direction control valve


Directional Control Valve
(DCV)
Solenoid Valve
or spool valves as well
Spool Valve


are the types that control
the “direction” of the liquid

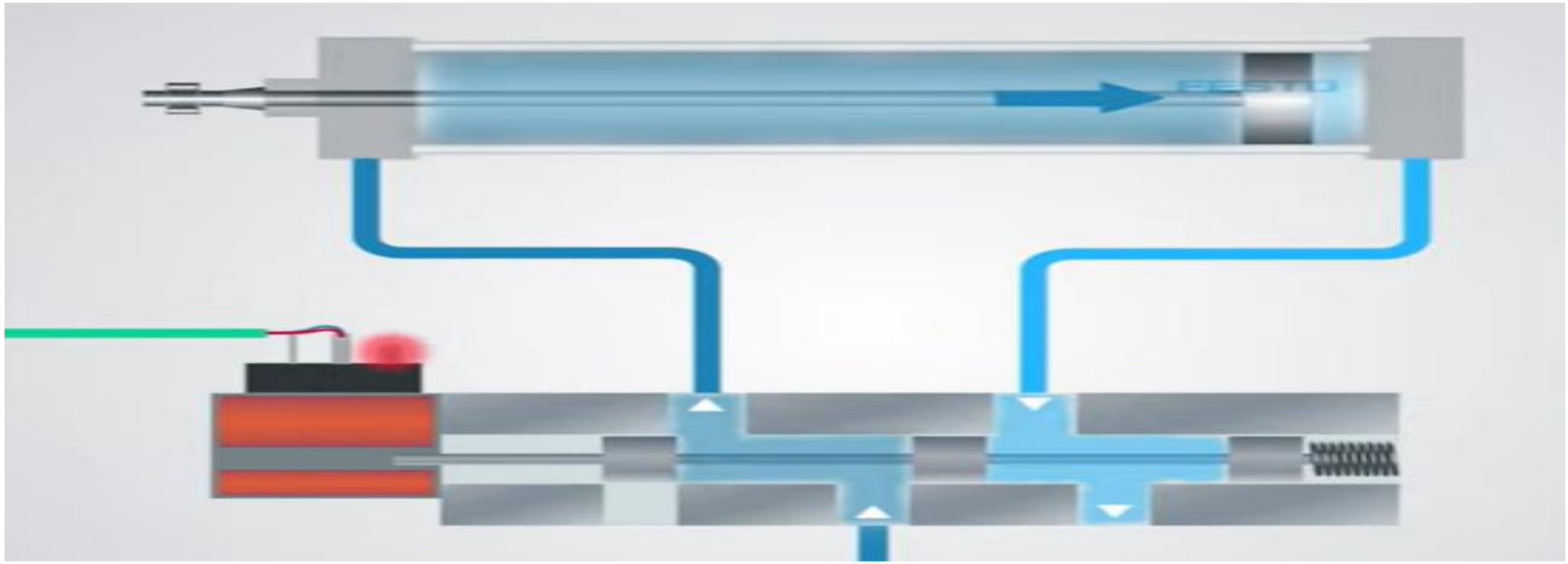

Pneumatic System
Hydraulic System
Pneumatic DCV
are called spool valves

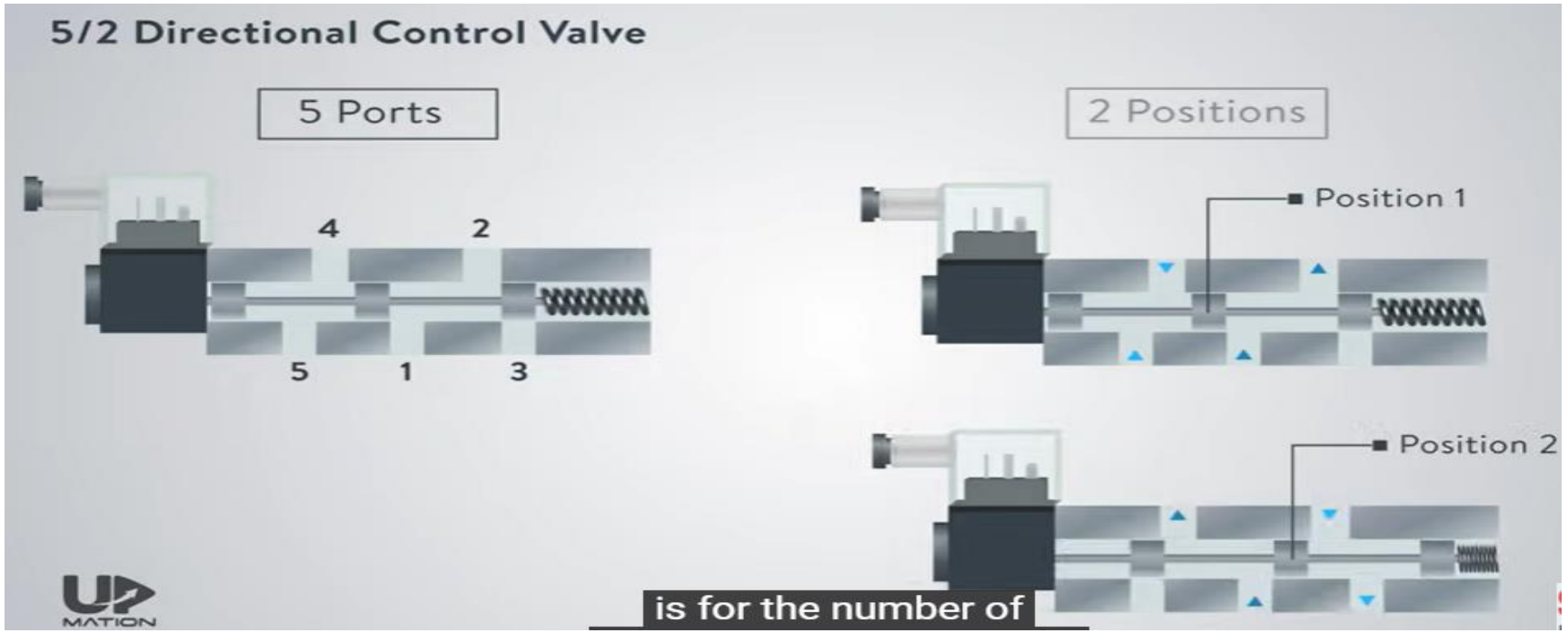

Silo
Cylinder
Slide Gate Valve
PLC
Air Compressor
is coming from the compressed air
that is supplied by a compressor

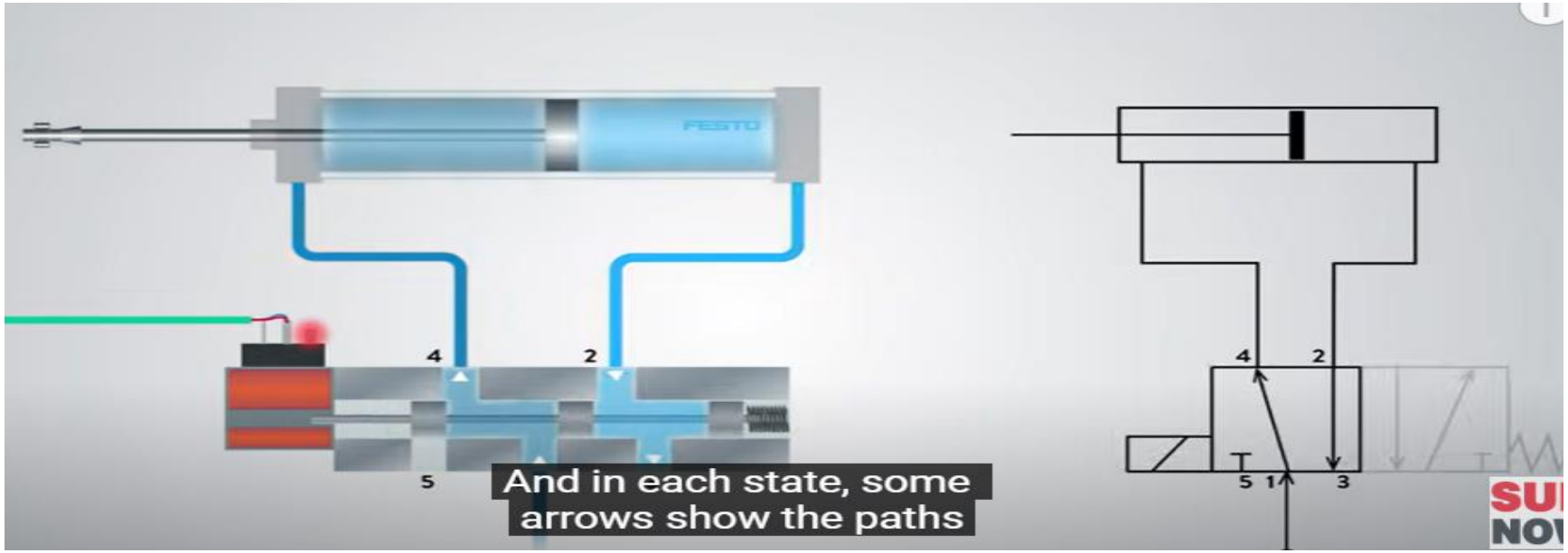

Electrical Connection
Spool
Solenoid
Air Source

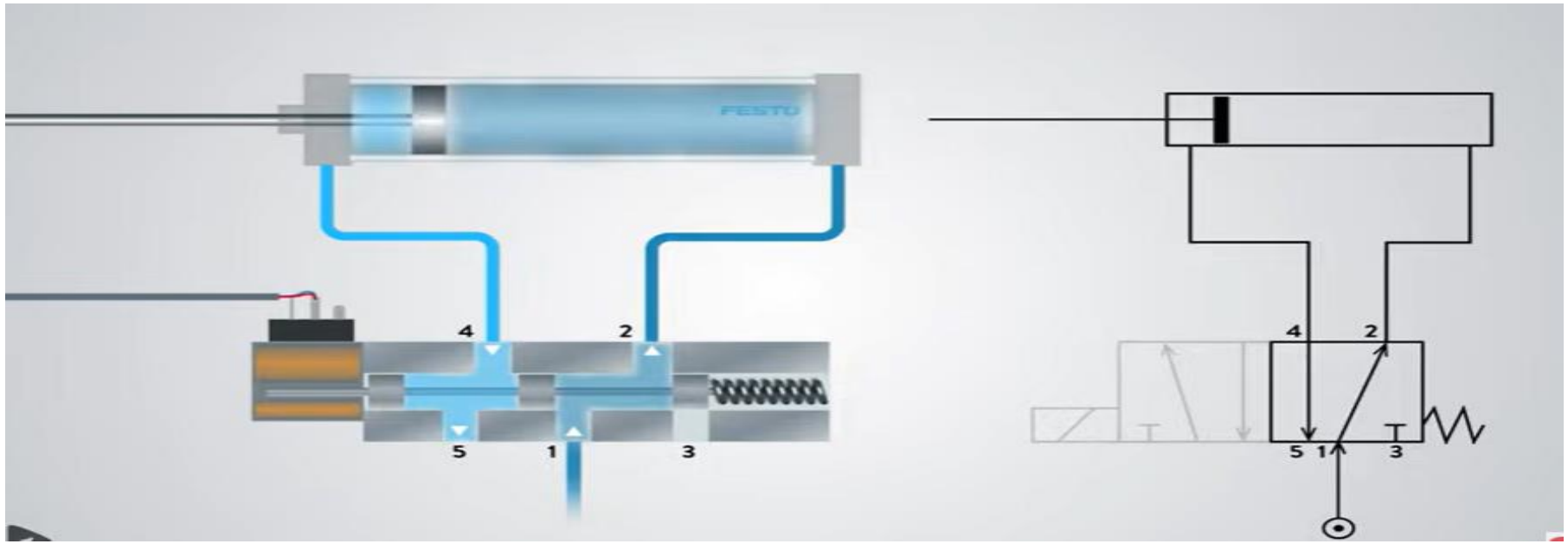
Rest position

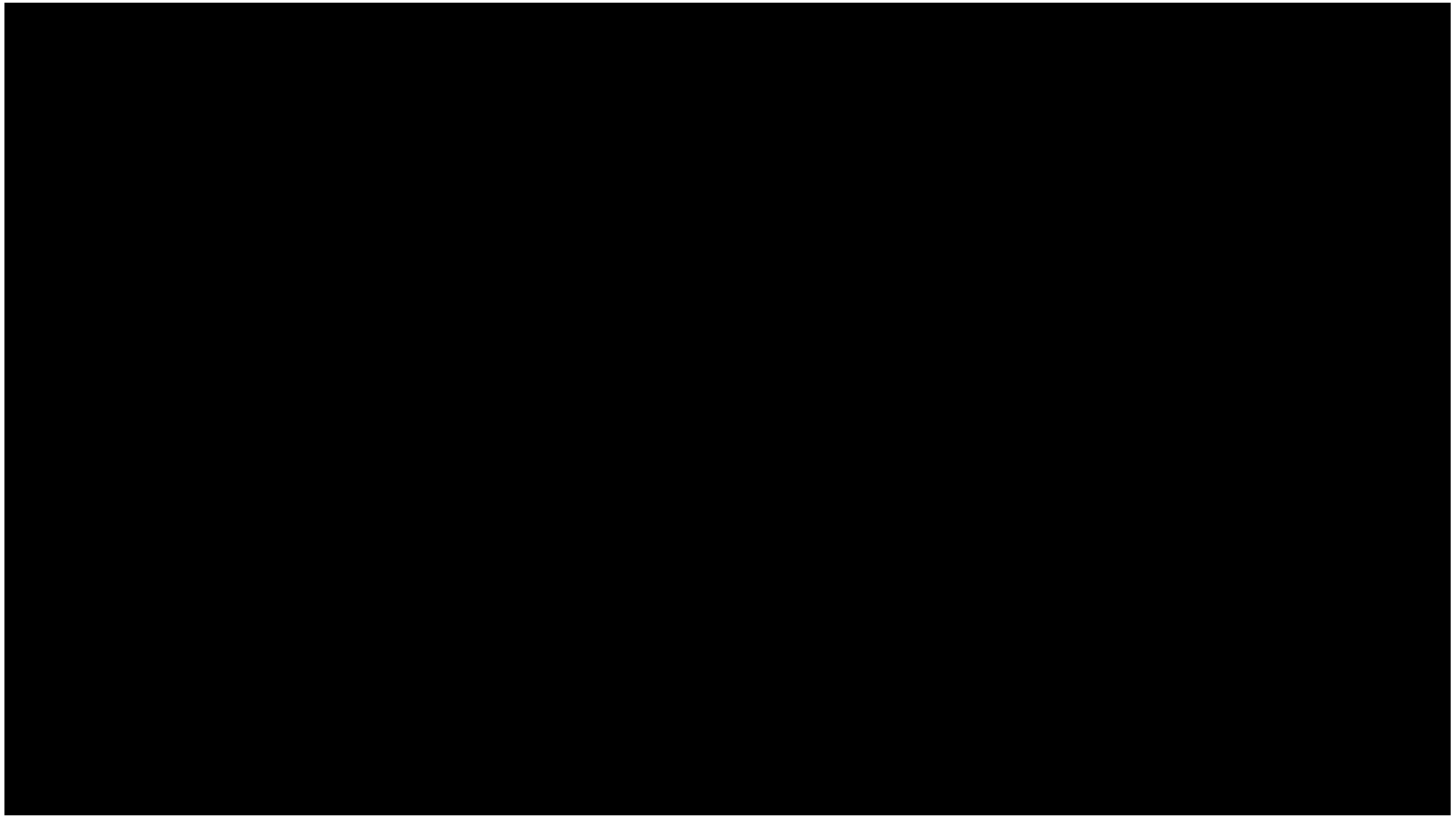
Expand



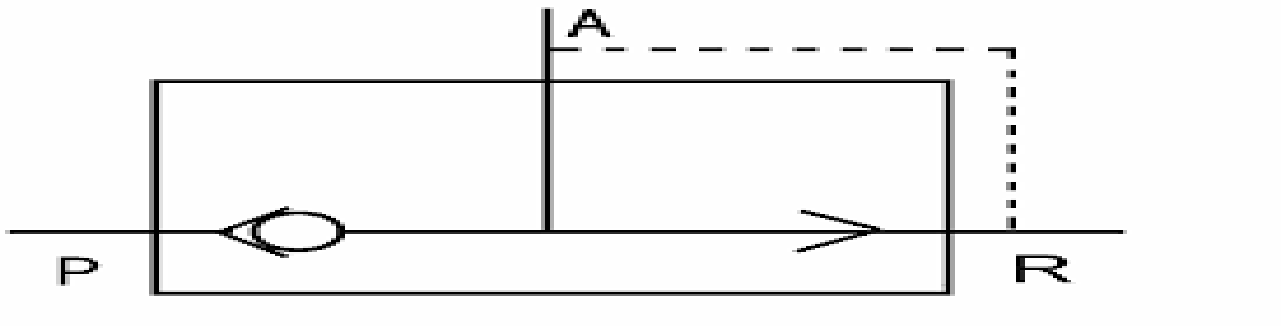

5/2 Directional Control Valve
5 Ports
2 Positions
4
2
5
1
3
Position 1
Position 2
UP MATION
is for the number of

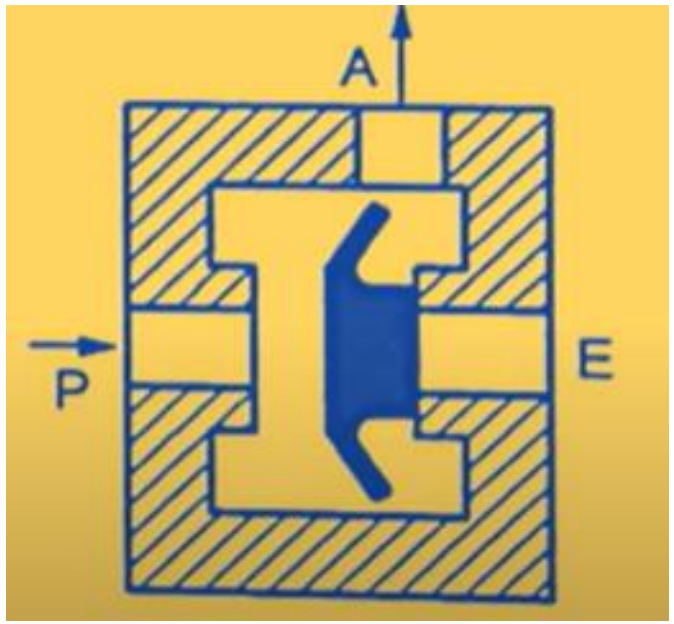

FESTO
4
2
5
And in each state, some
arrows show the paths
4
2
5
1
3

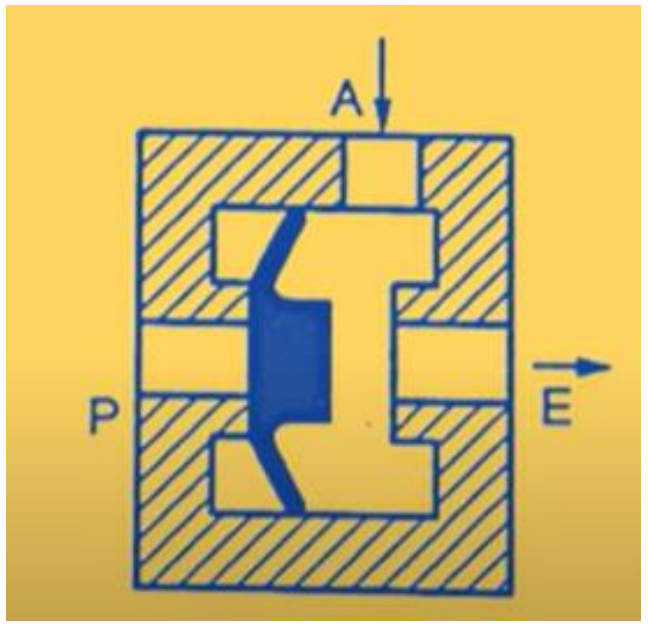

FESTO
4
2
5
1
3
4
2
5
1
3



Quick Exhaust Valve

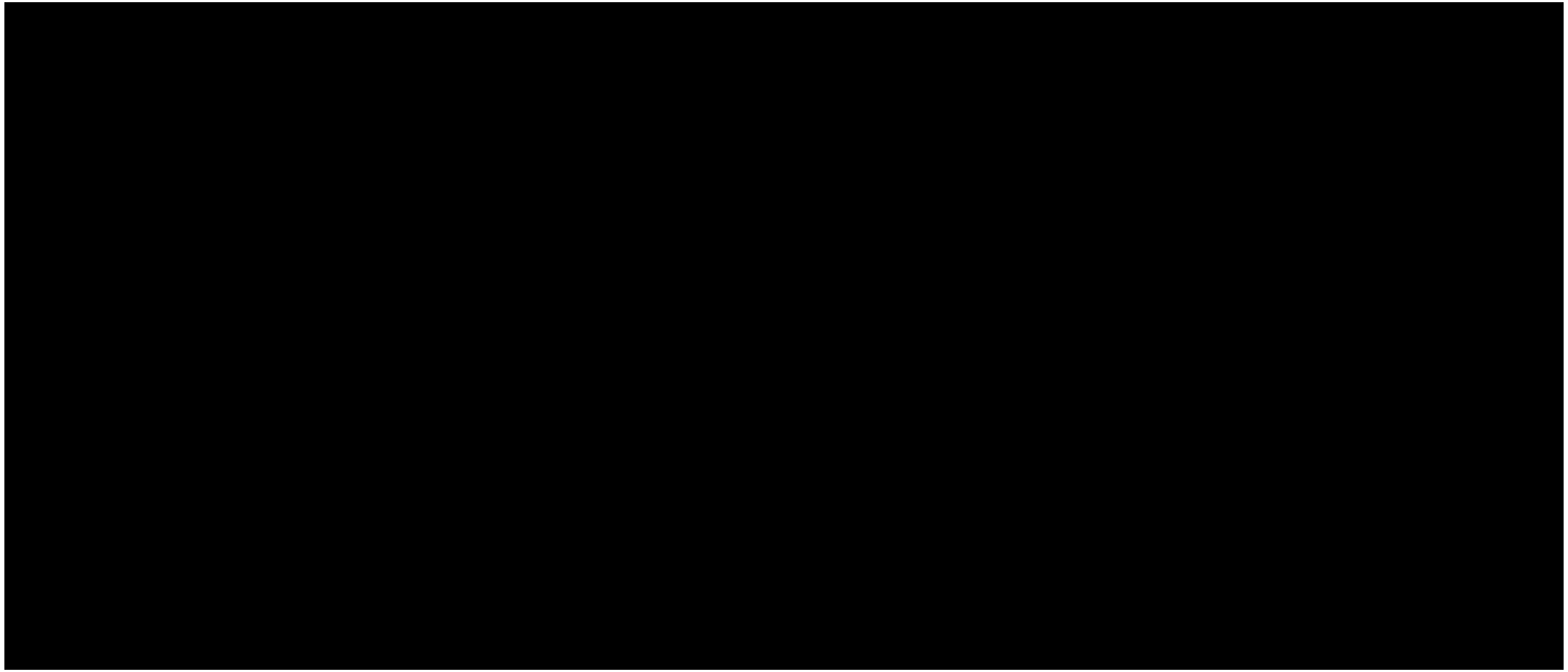



A
P
E


A
P
E

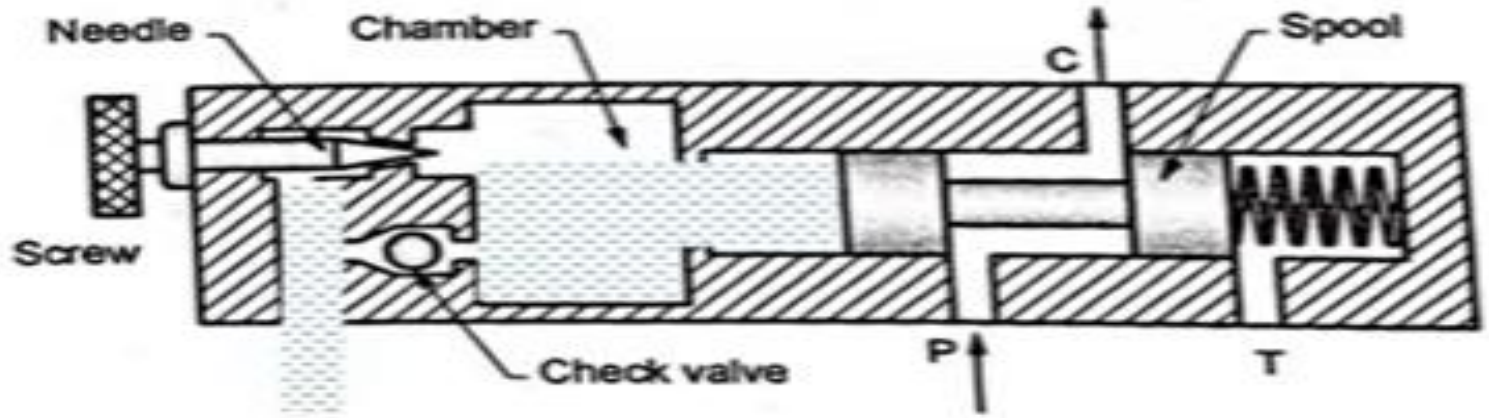
- This valve is specially used for pneumatic system
- During extension or retraction of the cylinder compressed air is supplied to one end and the air present in the other side of the piston is exhausted to atmosphere.
- Normally it has to take a long path to travel through piple and tubes to get exhausted through the exhaust port of the direction control valve.
- To avoid this quick exhaust valves are fitted to the cylinder ports.

- Quick exhaust valve will exhaust the air to atmosphere at cylinder outlet port itself and avoids the need to travel a long distance.
- Quick exhaust valve consists of a rubber seal inside the valve body, it has inlet port “P” cylinder port “A” and exhaust port “E”.
- When air is coming out from cylinder port A the rubber seal closes the inlet port P and opens the exhaust port E.
- When compressed air is supplied to inlet port P the rubber seal closes the exhaust port E and allow air to flow to cylinder port A.



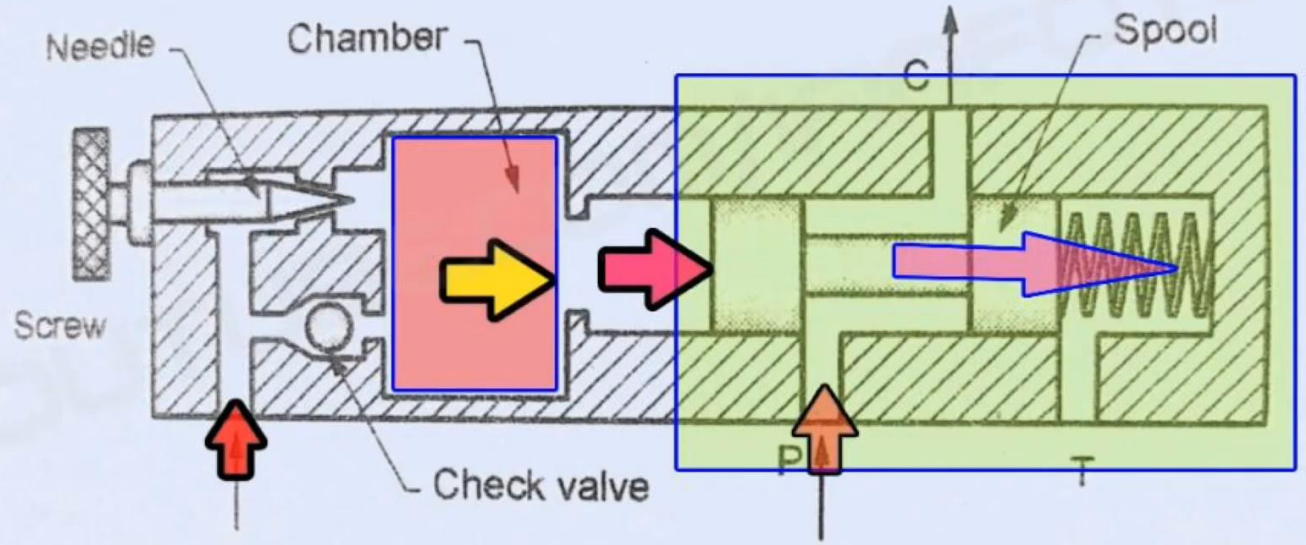
Time delay valve

- This valve is used to have required amount of time delay between two operations.
- It has an inbuilt reservoir, flow control, check valve and pilot operated 3/2 direction control valve.
- When the working fluid is admitted trough inlet port of this valve, it flows through check valve fills in the chamber and exerts force on the spool. Due to this the spool is pressed against the spring force, making the connection form port – P to port –C. the cylinder extends.


Needle
Chamber
C
Spool
Screw
Check valve
P
T

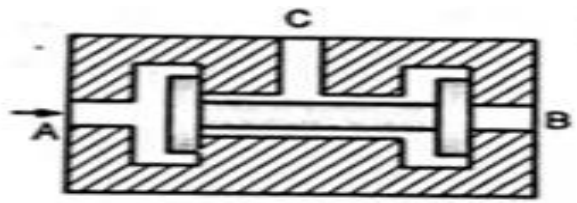
- When inlet port is open to working fluid reservoir working fluid flows through flow control valve slowly back to the reservoir. Pressure in chamber reduces slowly. Once the pressure becomes less then the spring force, the spool shifts back to make the connection between port C to port T cylinder retracts

Time Delay Valve



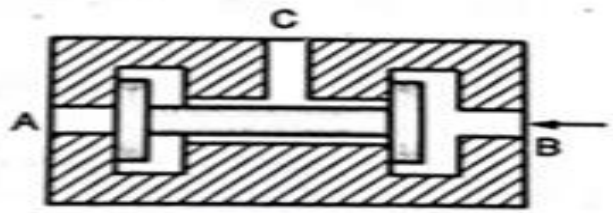
Twin Pressure valve

- A twin pressure valve has two inlet ports. A and B and one outlet port C.
- This valve has AND logic function.
- This valve consist of a spool inside the valve body. When working fluid is supplied from only one inlet port the spool closes the outlet. If fluid is supplied from both of inlet ports then only outlet port opens.
- AND logic is used in safety circuit ”two hand operation of press machine”



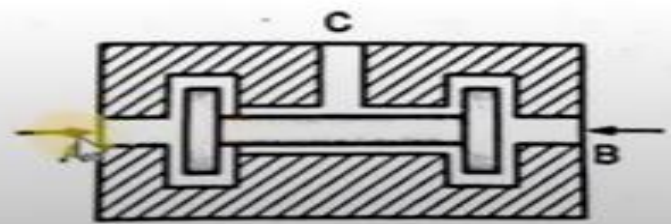
(a)

Input-A is present
no output at C



(b)

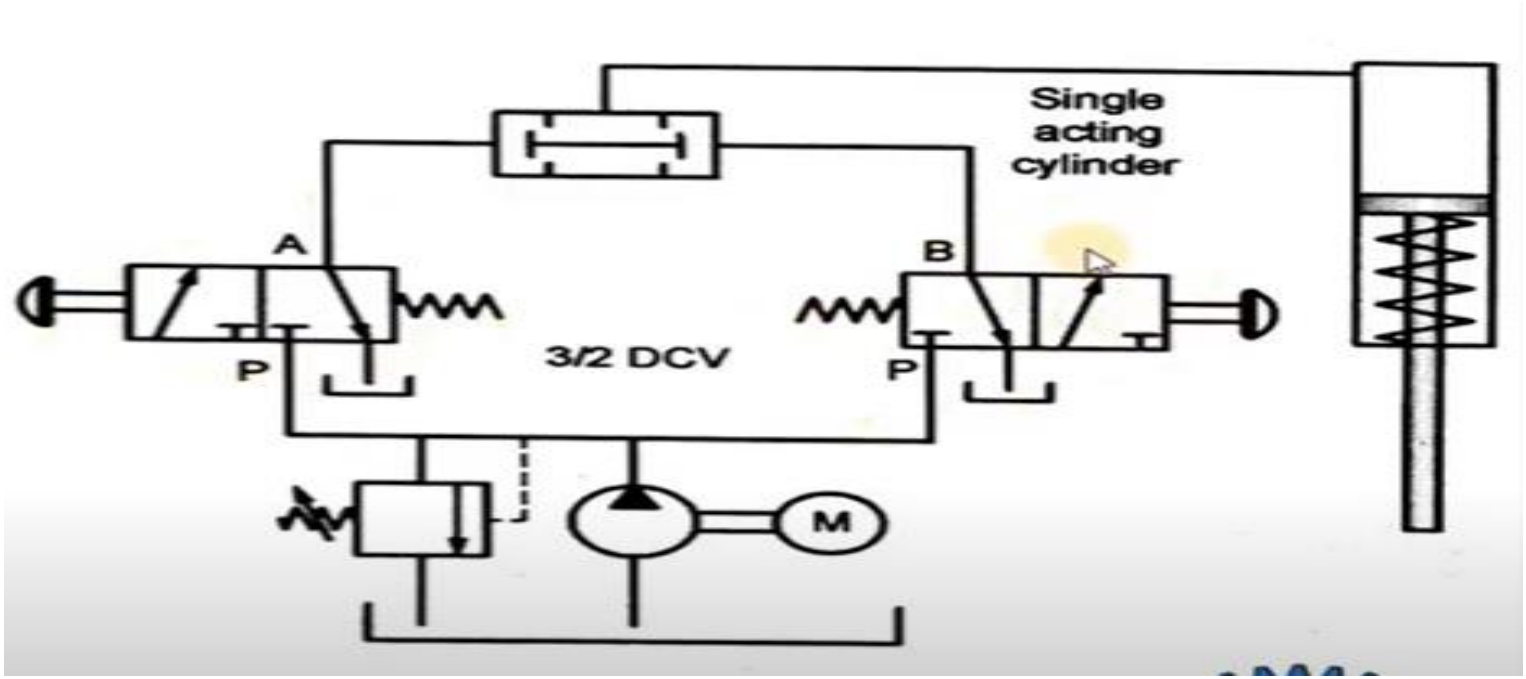
Input-B is present
no output at C



(c)

Both inputs A and
B are present.
hence, output at
C is present

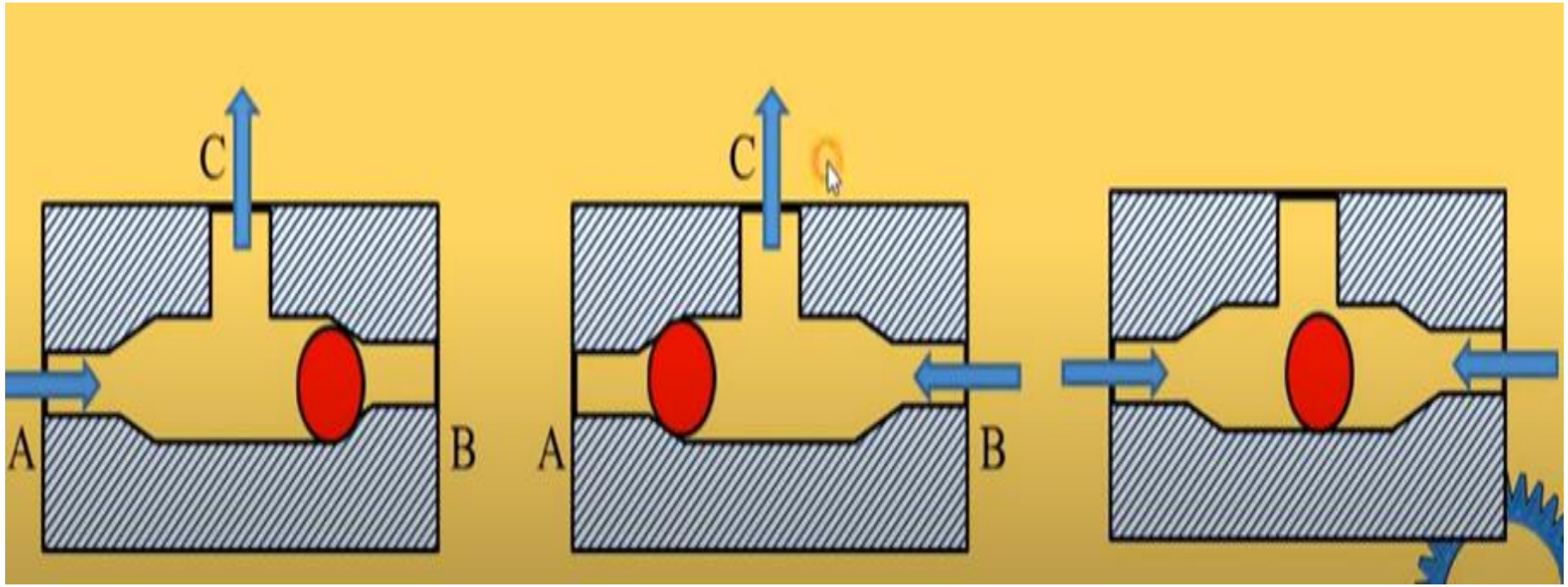
Application of twin pressure valve



Shuttle valve (OR logic valve)

- The circuit has two “puch button operated spring return type normally closed 3/2 direction control valves”, a single acting cylinder and a twin pressure valve.
- In normal position the single acting cylinder is in retracted position.
- If and only if the push buttons of both valves are pressed together then only the cylinder will extend.
- Such circuits are safety ciruits called “two hand operation circuits”

Shutter valve



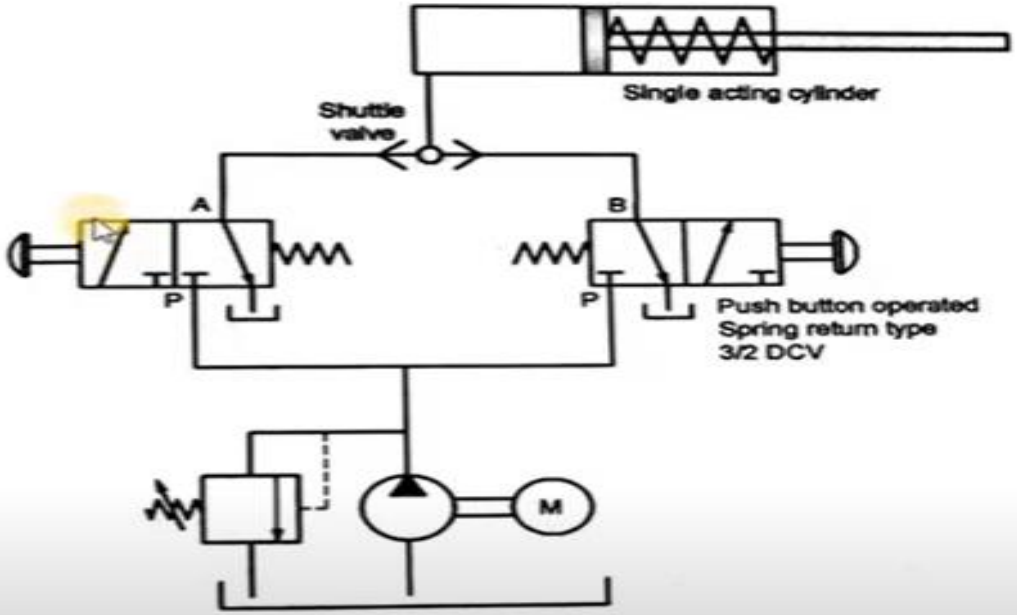
working

- It has inlet port A and B and one outlet port C
- It consist of a ball or poppet inside the valve body.
- When working fluid is supplied to any of two inlet ports inlet port A or inlet port B , the ball poppet closes the other inlet port and working fluid flows to cylinder port C

Input A	Input B	Output C
Yes	Yes	Yes
Yes	No	Yes
No	Yes	Yes
No	No	No

- Advantages
- Shuttle valve serves to isolate the failed supply line, If either of the dual supply ruptures or develop leakage,
- Direct connection to functional parts
- Disadvantage
- Used as a hot standby in sub-sea applications.
- Hydraulic cranes, excavators.
- Serve as a part of the braking system.

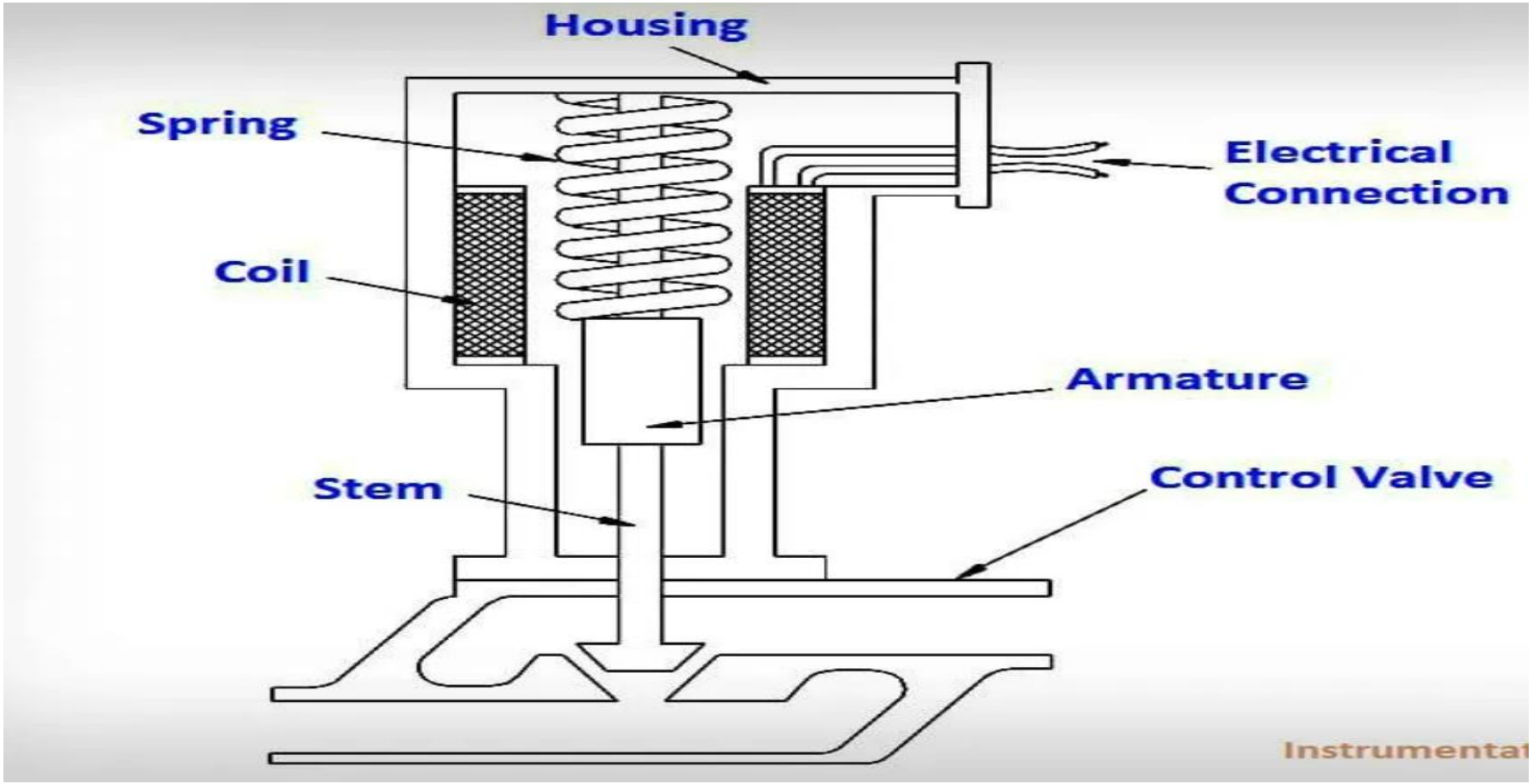
Application of shuttle valve (OR logic)



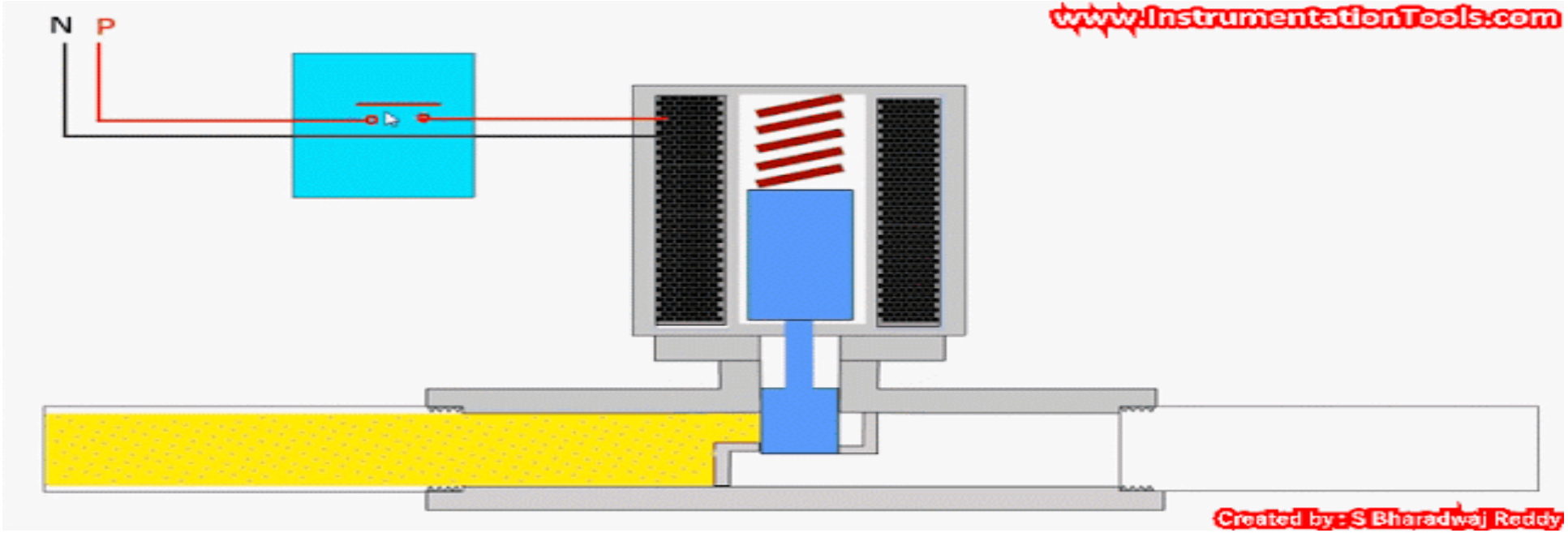
Truth Table

A	B	O/P
1	0	1
0	1	1
1	1	1
0	0	0

Solenoid valve

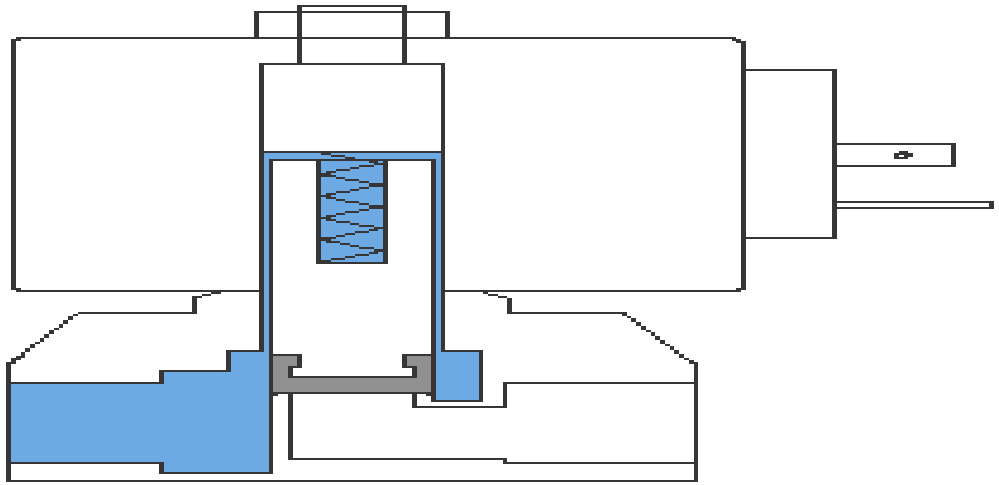


Working


N
P
www.InstrumentationTools.com
Created by : S Bharadwaj Reddy

- 1. The above shown animation is an example of normally closed solenoid operated valve.
- 2. When there is no supply voltage to SOV then it will be in Normally Closed co
- 3. When the Switch was closed then power will be passed through the Solenoid coil, then energizes the coil. The energized solenoid coil acts as magnet and lifts the core or plunger (Center Part of Solenoid) of the solenoid.
- 4. As the core or plunger of solenoid moves towards upsides, this movement creates a open flow.
- 5. When the Switch was opened .i.e. power supply is disconnected, then solenoid coil de-energizes and magnetic field also stopped. Then the plunger will be pushed back to its original position with the help of a spring, this movement stops the flow.

Direct acting, normally closed Solenoid Valve

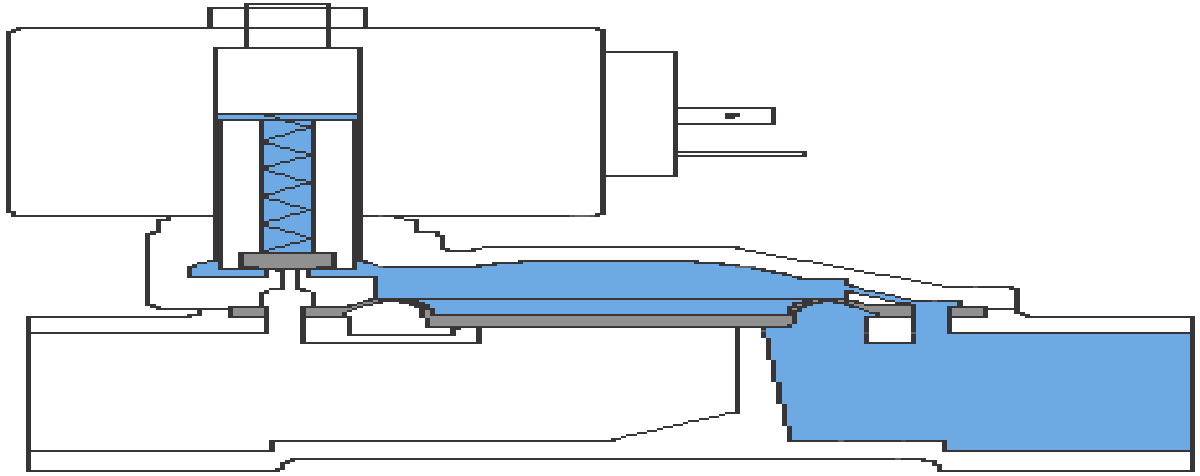


Main features

- The sealing element is directly connected to the core
- This type of valves does not need any differential pressure to open.
- The maximum pressure difference across the valve is limited by the magnetic force of the used coil and the seat diameter.
- This valve is commonly used for low flow volumes.

- **Solenoid valve is closed.**
- The coil is de-energized and the sealing element is pressed on the seat by the force of the spring and the medium.
- **Solenoid valve opens.**
- The coil is energized and the magnetic force lifts the core with the sealing element from the seat.
- **Solenoid valve closes.**
- The coil is de-energized and the sealing element is pressed on the seat by the force of the spring and the medium.

Diaphragm pilot operated solenoid valves with differential pressure normally closed (NC) – In direct



Main features

- The valve is sealed by the diaphragm.
- It utilizes the energy of the streaming fluid to open and close.
- This type of valves need for opening and closing minimal differential pressure know as “minimum working pressure”. This pressure varies from 0.1 to 1 bar, depending on the dimension of the valve.
- Same size of coil can be used for operation of valves with different dimensions, because the diameter of the pilot seat remains the same for different dimensions of valves
- The flow direction for the valve is given.

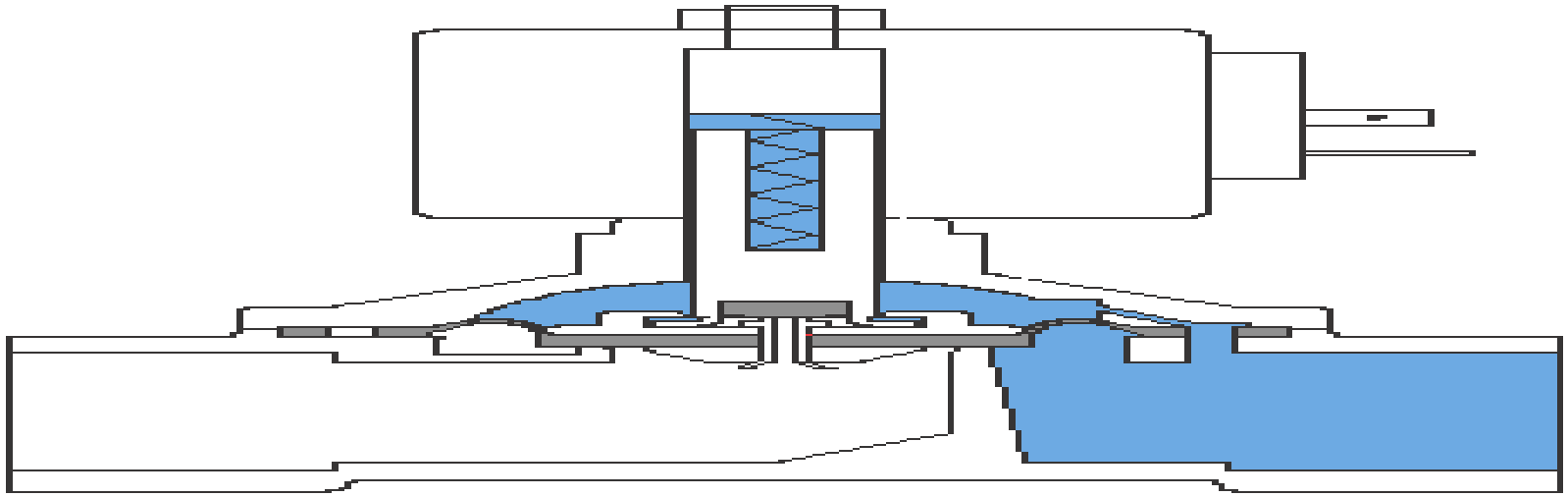
Solenoid valve is closed.

- The coil is de-energized and the core with the sealing element is pressed on the pilot seat with the force of internal spring supported by up-stream pressure.
- Up-stream pressure (higher then down-stream pressure) above the diaphragm presses it on the seat.
- Specific pressure difference known as “minimum working pressure” is needed to keep the valve tight.

Solenoid valve opens.

- The coil is energized
- The core with the sealing element is lifted from the pilot seat.
- The fluid from the upper part of diaphragm flows to the outlet trough the pilot seat and the pressure above the diaphragm equalizes with down-stream pressure on the outlet.
- This pressure ratio remains stable because less fluid can flow through the bleed orifice as can escape through the pilot seat.
- The opening force caused by the pressure difference between the upper and lower part of diaphragm lifts the diaphragm from the valve seat and keeps it open.

Diaphragm solenoid valves with forced lifting Example without differential pressure normally closed (NC)



Main features

- The valve is sealed by the diaphragm.
- It utilizes the energy of streaming fluid to open and close.
- These valves combine features of direct acting and pilot operated valves.
- No differential pressure is needed to operate the valve
- Same size of coil can be used for the operation of valves with different dimensions, because the diameter of pilot seat remains the same for different dimensions of valves
- The flow direction is given for the valve.

Solenoid valve is closed.

- The coil is de-energized and the core with the sealing element is pressed on the pilot seat with the force of internal spring supported by up-stream pressure.
- Up-stream pressure (higher then down-stream pressure) above the diaphragm presses it on the seat.
- In case of small or none differential pressure, the valve can be kept closed only by the force of spring.

The solenoid valves opens

- The core with the sealing element is lifted from the pilot seat.
- The fluid from the upper part of diaphragm flows to the outlet trough the pilot seat and the pressure above the diaphragm equalizes with down-stream pressure on the outlet.
- This pressure ratio remains stable because less fluid can flow through the bleed orifice as can escape through the pilot seat.
- The opening force caused by the pressure difference between the upper and lower part of diaphragm lifts the diaphragm from the valve seat and keeps it open.
- In case of small or none differential pressure. the valve is opened by the magnetic force, which lifts the core connected to the diaphragm by the mechanical coupling and opens the valve.