Unit 6 Pneumatic Circuits

Marks Distribution for this Unit

Unit No	Unit Title	Teaching Hours	R Level	U Level	A Level	Total Marks
VI	Pneumatic Circuits	08	02	02	08	**12**

R-Remember, U-Understand,A-Apply
* Refer syllabus for details about Bloom's taxonomy

Syllabus content

6.1 Direct and indirect control of single acting and double acting air cylinders and motors
6.2 Speed control circuit cylinders and motors
6.3 Sequencing circuits, logic And/Or circuits, time delay circuit, Piston continuous back and forth.
6.4 Simple Hydro-Pneumatic applications
6.5 Simple Electro-Pneumatic Circuits
6.6 Remedies and Fault detection in pneumatic circuits
6.7 Maintenance of hydraulic and pneumatic system

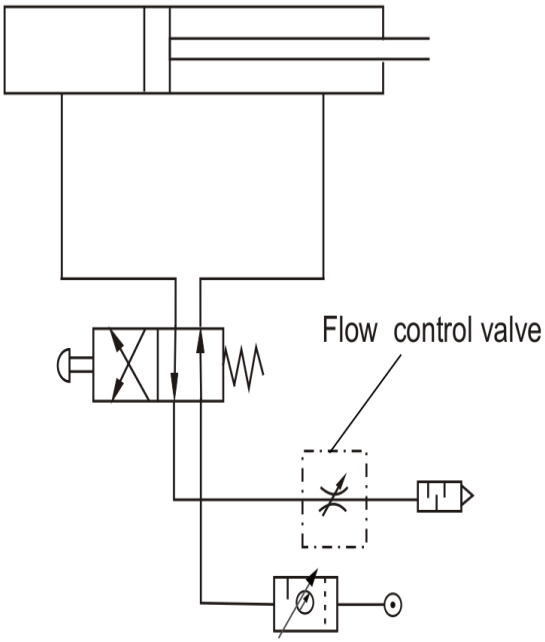
6.1 Direct and indirect control of single acting & double acting air cylinders motors

Q.1.What is a pneumatic circuit? How it differs from Hydraulic circuit ?

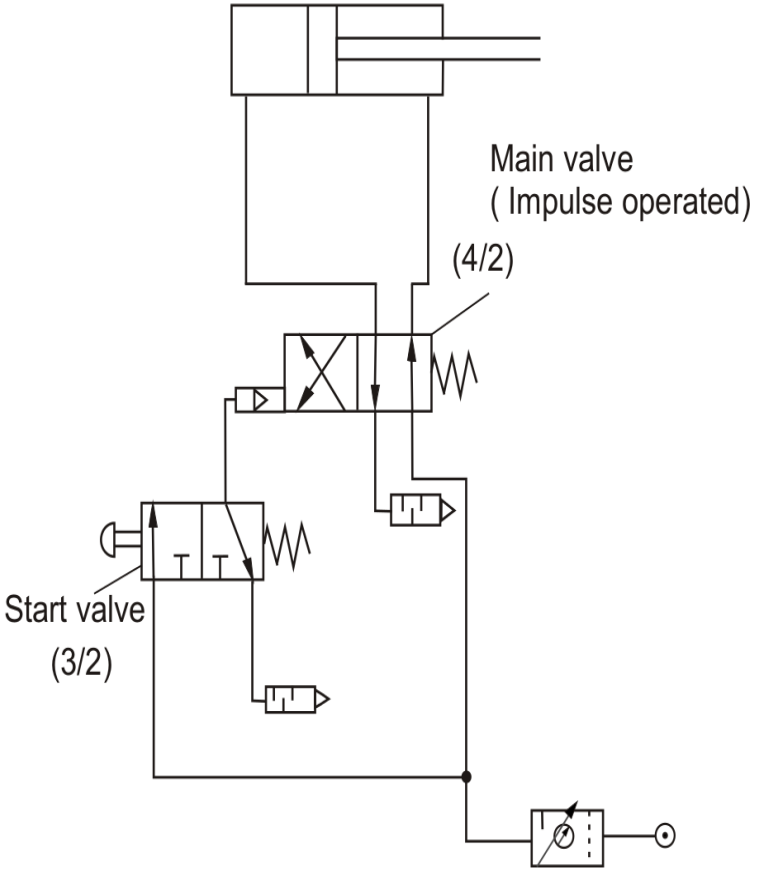
Ans : A pneumatic circuit may be defined as the graphic representation of the pneumatic components in a pneumatically operated machine.

Unlike in hydraulic circuit, the air is directly exhausted to the atmosphere in a pneumatic circuit, so there is no piping to return the working medium. Secondly in the hydraulic circuit diagrams as the source is compressed air, a compressor is not shown in the diagram.

Q.2. Draw the circuit diagram for speed control of double acting pneumatic cylinder.

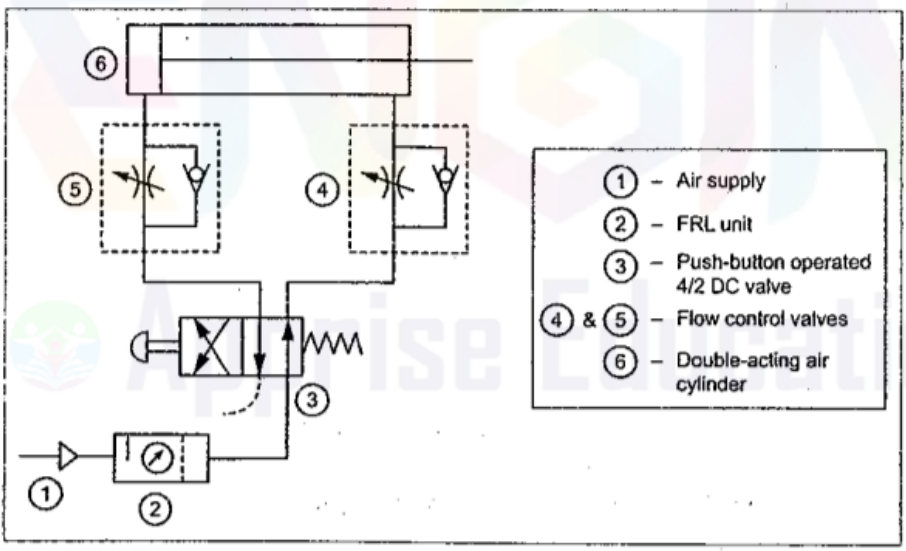


Q.3.Draw pilot operated DA cylinder circuit using 4 X 2 DC valve and 3 X 2 pilot valve. Or Draw pilot operated circuit for actuating a double acting cylinder



6.2 Speed control circuits

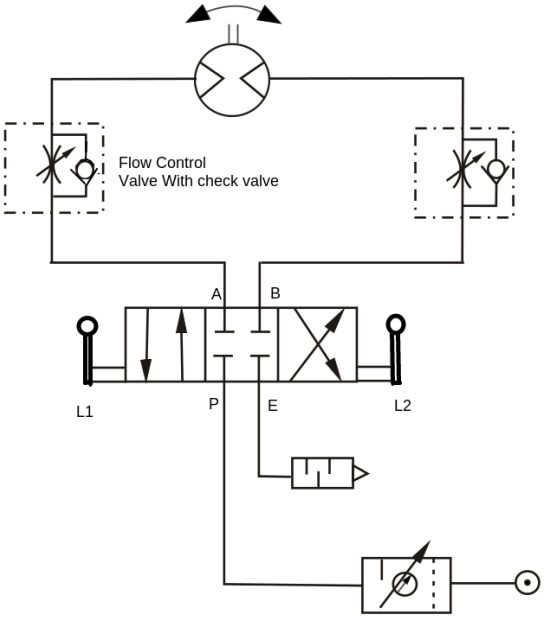
Q.4.Draw Pneumatic circuit for speed control of double acting cylinder with metering valves in both directions.



The above circuit uses a 4/2 manually operated dc valve to operate a double acting cylinder. Here two sets of metering valves with check valve are used which control the flow of air going to the cylinder.

The speed control is achieved by controlling the air coming out from the cylinder. In the diagram shown during the return stroke the air will pass through the check valve of the valve set 4 but air coming out from the piston head side passes through the metering valve and thus the speed control is achieved. The above circuit is meter out type.

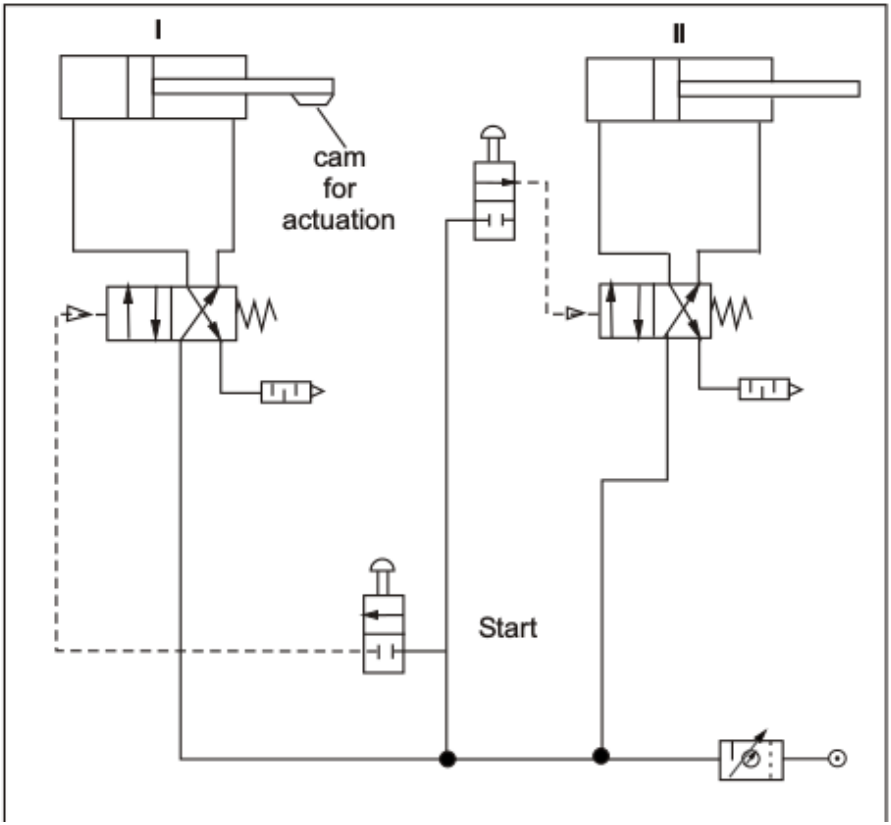
Q.5.Draw Pneumatic circuit for speed control of Bi-directional motor.



Bi-directional air motor rotates in clockwise as well as anti-clockwise direction. The speed of bidirectional motor is controlled as shown in fig. The speed control of motor by using variable two flow control valves having built-in check valve and 4x3 DC valve having zero position or central hold position with lever L1 and L2. When lever L1 is operated, port P will be connected to port A of air motor and motor will start rotating in clockwise direction. Its speed can be controlled by using variable flow control valve F1. Port B of motor will be connected to exhaust E and air in motor will be exhausted through port R via DC valve. When lever L2 is operated, pressure port P will be connected to port B of motor and naturally motor will start rotating in anticlockwise direction. Port A will be connected to port E and air in the motor will be exhausted through port E via DC valve.

6.3 Pneumatic circuits

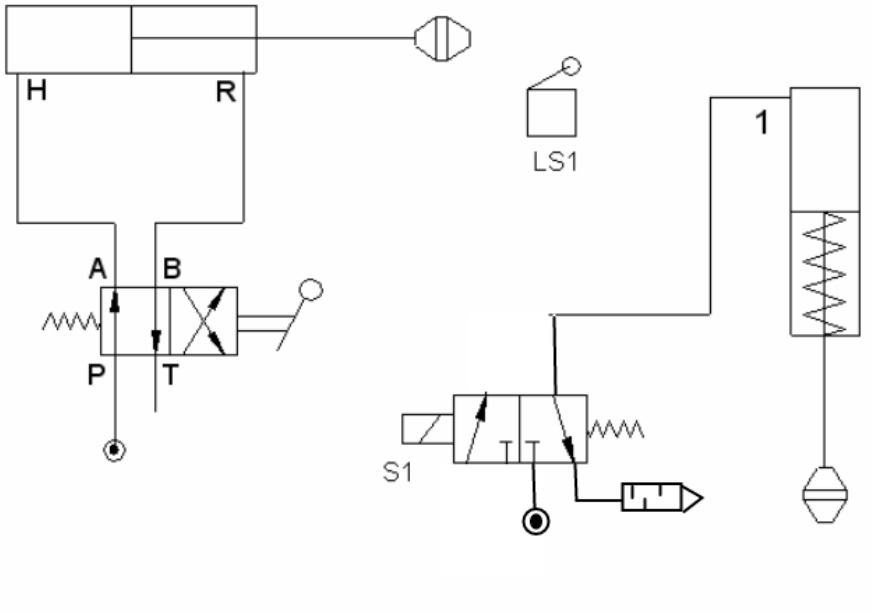
Q.6.Explain with sketch Pneumatic sequencing circuit.



The above circuit shows the position based sequencing of two DA cylinders with use of 2/2 dc valves for pilot operating 4/2 valves.

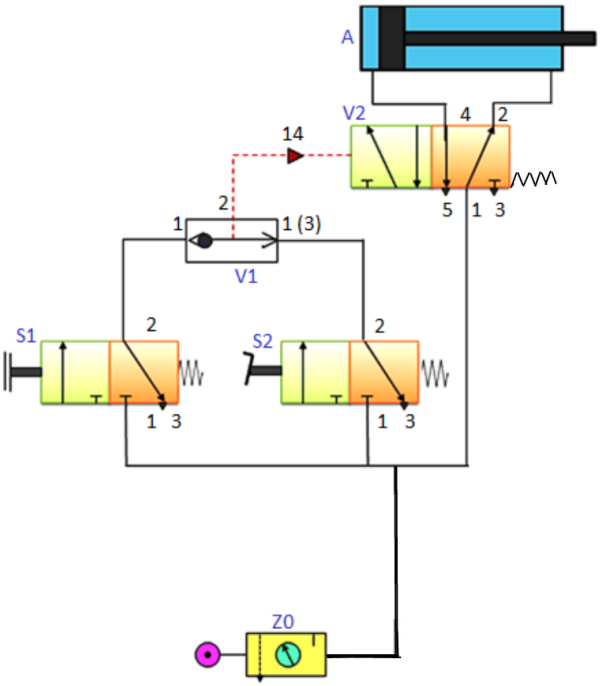
Sequencing using the limit switches

This is also a sequencing of two DA cylinder but this uses solenoid



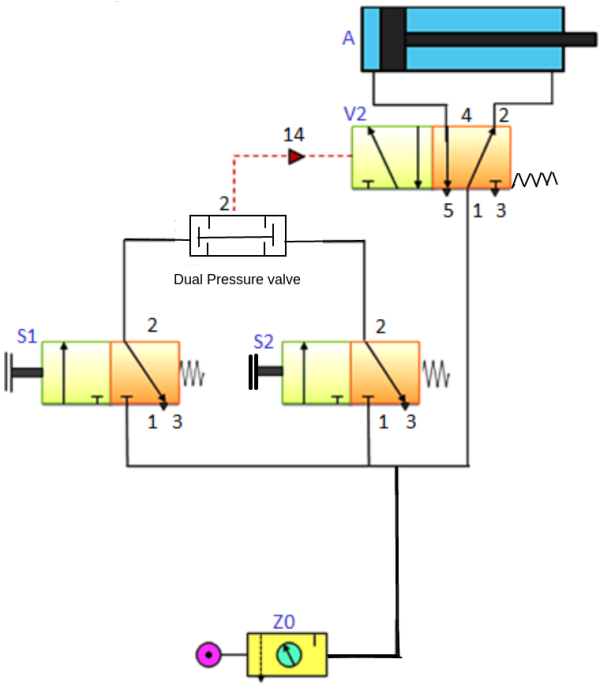
operated switch, which is triggered by a limit switch LS1. When the first cylinder reaches the limit it pushes the limit switch down thus providing current to solenoid switch S1, and there by shifting the dc valve. Due to shifting of dc valve the cylinder 2 starts moving down.

Q.7.Explain with sketch Pneumatic logic circuit “OR”



The above circuit represents the Pneumatic logic circuit 'OR', There are two 3/2 valves one is push button and another is pedal operated, the cylinder will be operated by pressing any one of them. That's why it is called OR circuit, means the DA cylinder will be actuated either by pressing pedal or push button. It uses a Shuttle valve which shifts depending upon the supply from either side. This provides pulse for the 5/2 pilot operated valve, which supplies air to the main cylinder.

Q.8.Explain with sketch Pneumatic logic circuit “AND”



The above circuit represents the Pneumatic logic circuit 'AND', There are two 3/2 valves , the cylinder will be operated only when both the valves are pressed. That's why it is called AND circuit, means the DA cylinder will be actuated only when both the push buttons are pressed. It uses a Twin Pressure valve which provides supply to main valve when there is air supply from both valves . This provides pulse for the 5/2 pilot operated valve, which supplies air to the main cylinder.

Q.9.Explain with sketch Pneumatic 'TIME DELAY' circuit.

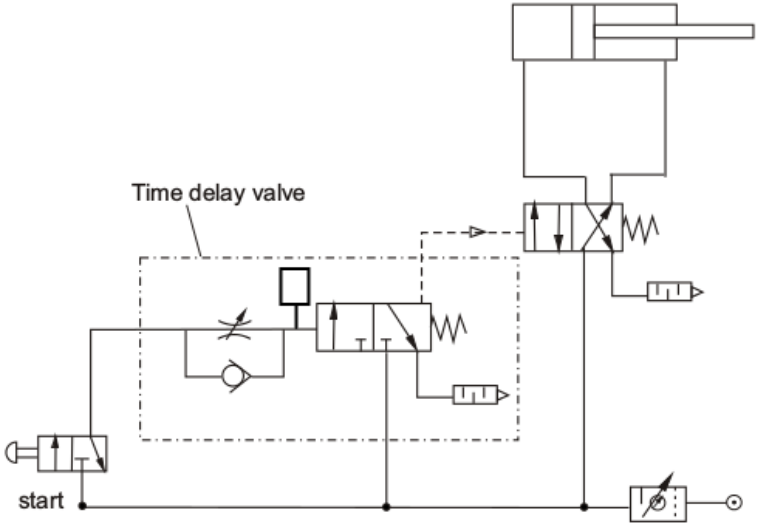
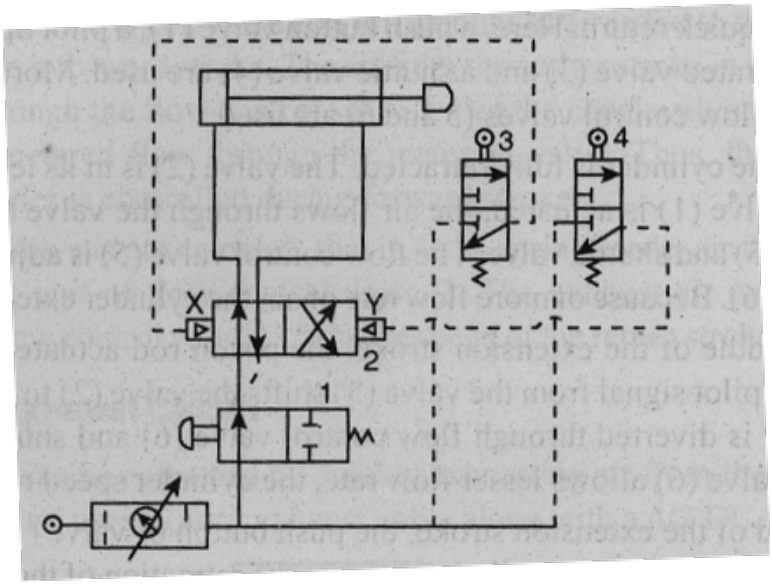


fig. 20.7 Time delay circuit

Time delay circuit as the name suggest is used to delay the effect of pushing button to some extent. In certain engineering applications, the impulse to the main valve is to be intendedly delayed by a pre-determined time for some operational or technical reasons. In such situations this valve is very useful.

As shown in circuit diagram it uses time delay valve which basically uses a metering valve and an accumulator which does not provide the impulse until the pressure is build up completely. Thus delaying the next operation after first button is pressed.

Q.10.Explain with sketch Pneumatic circuit for continuous back and forth motion of the piston automatically.



The figure shows a pilot-controlled automatic reciprocation circuit. When the tow way valve (1) is actuated, the cylinder will start reciprocating. Automatic cycling is achieved y using pilot air, directed alternatively through pilot air, directed alternatively through roller actuated three way valves (3 and 4) to shift the main control valve(2).

The main control valve(2) is in its left mode initially, by mechanically pressing the roller of valve 3, now the air enters the blank end of the cylinder and cylinder extends. At the end of extension, the pilot control valve (4) is tripped and air flows to the pilot chamber (Y) of the main control valve (2) . The valve (2) shifts to its right mode. Now cylinder starts retracting. At the end of retracting, the pilot valve(3) is tripped, causes the supply of air to X side of dc valve (2), shifting it to the left mode and cylinder starts extending.

6.4 Hydro-Pneumatic applications

A circuit which uses both hydraulic and pneumatic components is called Hydro-Pneumatic circuit. Hydraulic system provides higher force and better precision whereas pneumatic system provides easy control mechanisms. So sometimes using a combination is more effective than using the complete system.

Q.11. What is a hydropneumatic circuit? Where they are used?

In some applications, the hydraulic and pneumatic circuits are coupled to get best use of the advantages of both oil and air medium. This combination circuit is known as Hydropneumatic or Pneumohydraulic circuit.

Uses : It is used in the situation where quick action of air is desirable but high pressure/force of hydraulic system is required.

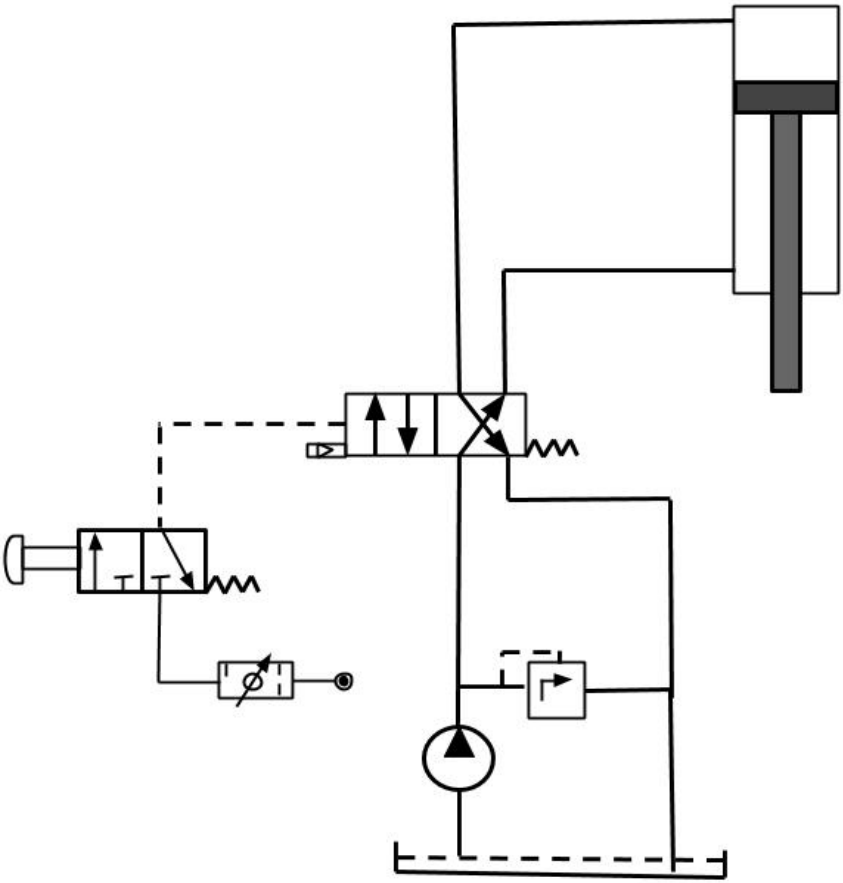
Q.12. A hydraulic press is operated by 4/2 spring returned pilot(air) operated dc valve. Draw Hydropneumatic circuit to operated the press using one 3/2 press button pneumatic valve.

Ans: As shown in circuit the main cylinder of press machine is operated by 4/2 spring returned valve which is operated by pneumatic pulse.

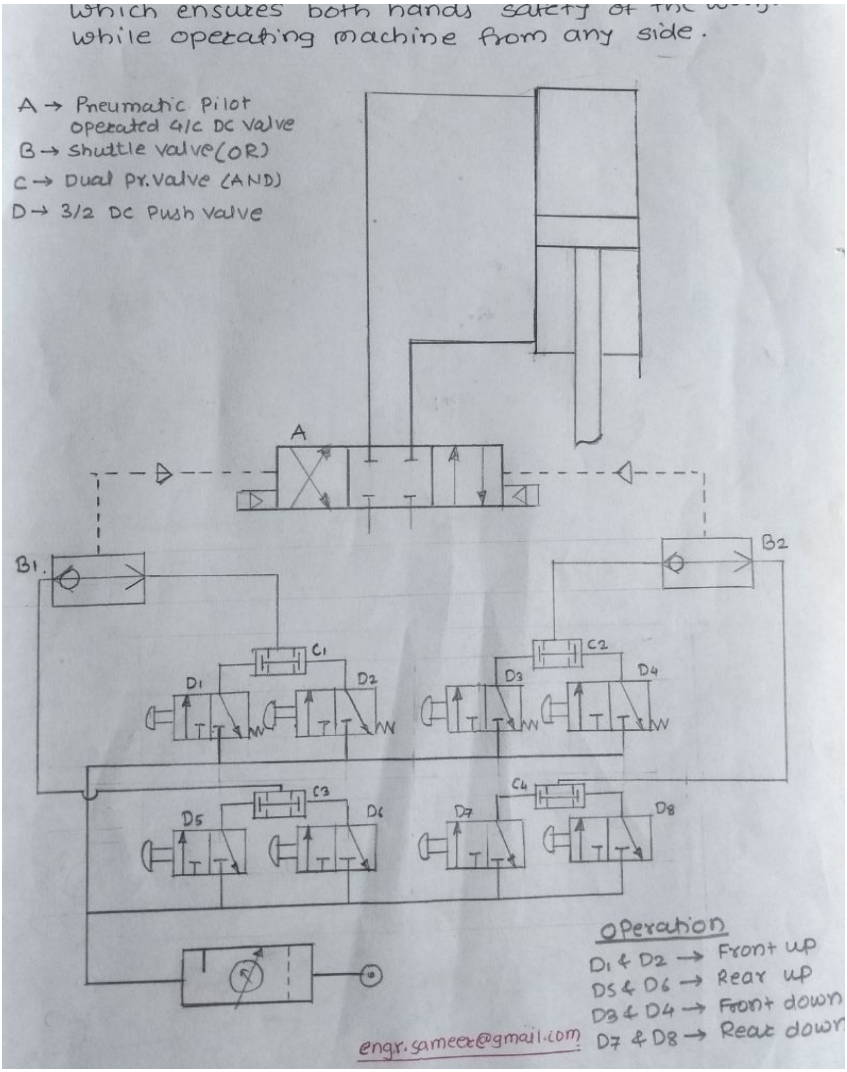
Pneumatic pulse is provided by pressing the press button which triggers the 3/2 dc valve. When the valve is pressed the compressed air moves to the 4/2 dc valve and shifts it towards the right side causing the oil flow to the top side of the hydraulic press piston.

As soon as the press button is released it causes the release of pressure on the 4/2 dc valve and spring of the 4/2 dc valve returns it to normal position, in normal position the pressurized oil is supplied to

bottom side of the cylinder, hence the piston moves in upward direction.

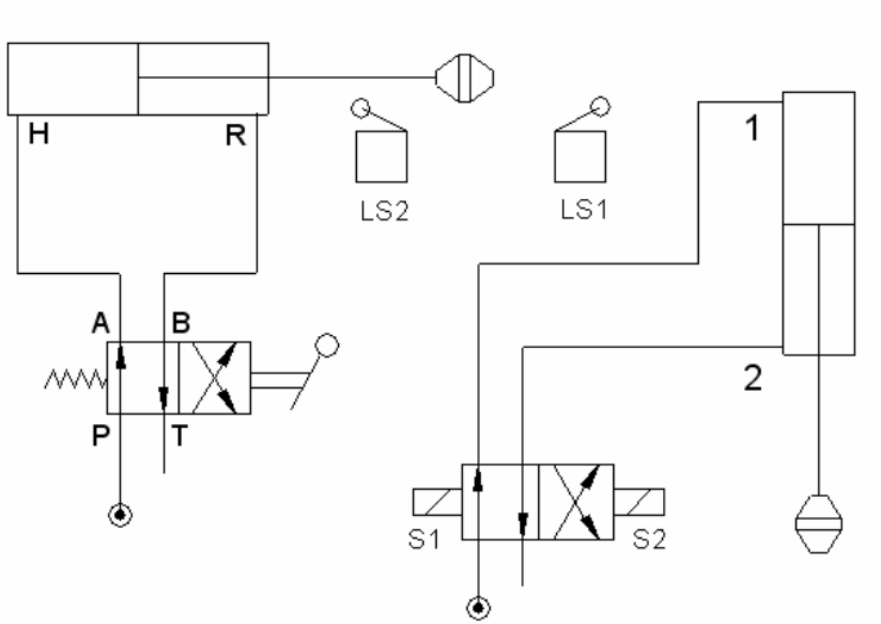


Q.13. A hydraulic press machine can be operated from both the sides. Draw a pneumatic circuit which ensures both hands safely of the worker while operating the machine from any side



6.5 Electro-Pneumatic circuits

A circuit which uses electric controls like solenoid valves for actuation of the direction control valves is called electro pneumatic circuit. Following example illustrates an electro-pneumatic circuit.



6.6 Remedies and fault detection in pneumatic circuits

Q.14. Enlist the common faults in Pneumatic system.

Ans : Following are the common fault in a pneumatic system
1. Unusual noise
2. Inadequate performance
3. Chatter and vibration
4. No piston movement or slow piston movement.
5. Erratic cylinder motion
6. Pressure drop in line
7. Buzz sound in solenoid valve
8. Air motor wont run or run with low speed
9. System getting excessively heated
10. Excessive pressure drop in the system.

Q.15. Enlist the common faults in Hydraulic system.

Ans : Following are the common fault in a Hydraulic system
1. Reduced speed of travel of piston
2. Increased noise and vibration in the system
3. Steep rise in oil temperature on starting the system
4. Non uniform or jerky motion of actuators
5. Oil leakage in the system
6. Loss of oil pressure
7. Frequent seal failure
8. Cavitation in pump leading to less or no supply from the pump

Q.16. List any four causes of Hydraulic system breakdown.

Ans : Following are the common cause of hydraulic system breakdown
1. Inadequate supply of oil in the reservoir
2. Clogged or dirty oil filters
3. Leaking seals
4. Loose inlet lines that cause the pump to take in air.
5. Sticky valves which do not move easily.

Q.17. List any four causes for pump making more noise.

Ans : Following are the possible causes for a pump making noise
1. Misalignment of pump and prime mover
2. Strainer not functioning properly or is clogged fully
3.Air is being entered in system
4. Pump being overloaded than its capacity.

6.7 Maintenance of hydraulic and pneumatic system

Maintenance of Hydraulic system

Most of the hydraulic systems are designed to have very minimum or no maintenance required during its use. But with the passage of time the seals worn out due to friction, pumps lose their efficiency, hose pipes lose their flexibility and oil goes on becoming unusable due to decomposition. So the hydraulic system needs to be repaired to restore it to the original state.

Maintenance is carried out at different levels such as routine checkups, weekly/monthly or Annual maintenance.

A. Operator tasks { Daily operation }

* Visual inspection of all components for leakage or damage
* Visual examination of fluid level in reservoir and fluid condition
*Visual check of operating pressure, filter conditions.
* Check for unusual sound and proper operation.

B. Periodic Maintenance (Weekly or monthly)

*Check fixing of all units
*Check pump noise level and pressure levels
*Check actuators for damage wear of seals etc.
*Check hose connections for leakages.

C. Annual Maintenance

* Empty fluid reservoir and check fluid condition.
* Clean reservoir internally and externally and examine for rust
* Examine electric motor
* Examine all hoses, pipe works and fittings for damage,wear and leakages.

* Check or replace filtering elements if required.
*Clean filter bowl
* Check all seals of pumps and cylinders and replace if required.

Maintenance of Pneumatic system

As compared to the hydraulic system pneumatic system is relatively less problematic and hence offer a more trouble free life. However the best system may also fail and hence it is necessary to carry out the preventive maintenance in addition to corrective maintenance.

Similar to Maintenance of hydraulic system this is also carried out at different levels and frequencies.

A. Operator tasks { Daily operation }

* Check condensate traps in air main lines.
* Detection and arrest of leakage of air in FRL unit.
* Drain out condensate from the filter.

B. Periodic Maintenance (Weekly or monthly)

* Check for air leakages in main line and other lines.
* Check pressure and pressure regulator setting.
* Check actuating handle of valves, solenoid valve and its connection.
* Check rpm, torque and vibration produced by the motor.

C. Annual Maintenance

* Change oil in lubricator after through cleaning the bowl of lubricator.
* Check springs and various actuator mechanism for intactness.
* Examine valves for any external damage or leakage of air.
* Replace air filters if required and test pressure regulator settings.
* Throughly check whole piping for leakage and mechanical damage.