GOVT CO-ED POLYTECHNIC

BYRON BAZAR, RAIPUR (C.G.)

LABMANUAL

Branch: Mechanical Engineering

Year&Semester:3rdYear/5th Semester

FLUID POWER ENGINEERING LAB

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EXPERIMENT NO. - 01

Aim- Study of Basic hydraulic circuit for the working of double acting cylinder and a hydraulic motor.

Apparatus: - Oil tank, filter, pump, manually operated, 4x3 D.C. valve, double acting cylinder, hoses, hydraulic motor

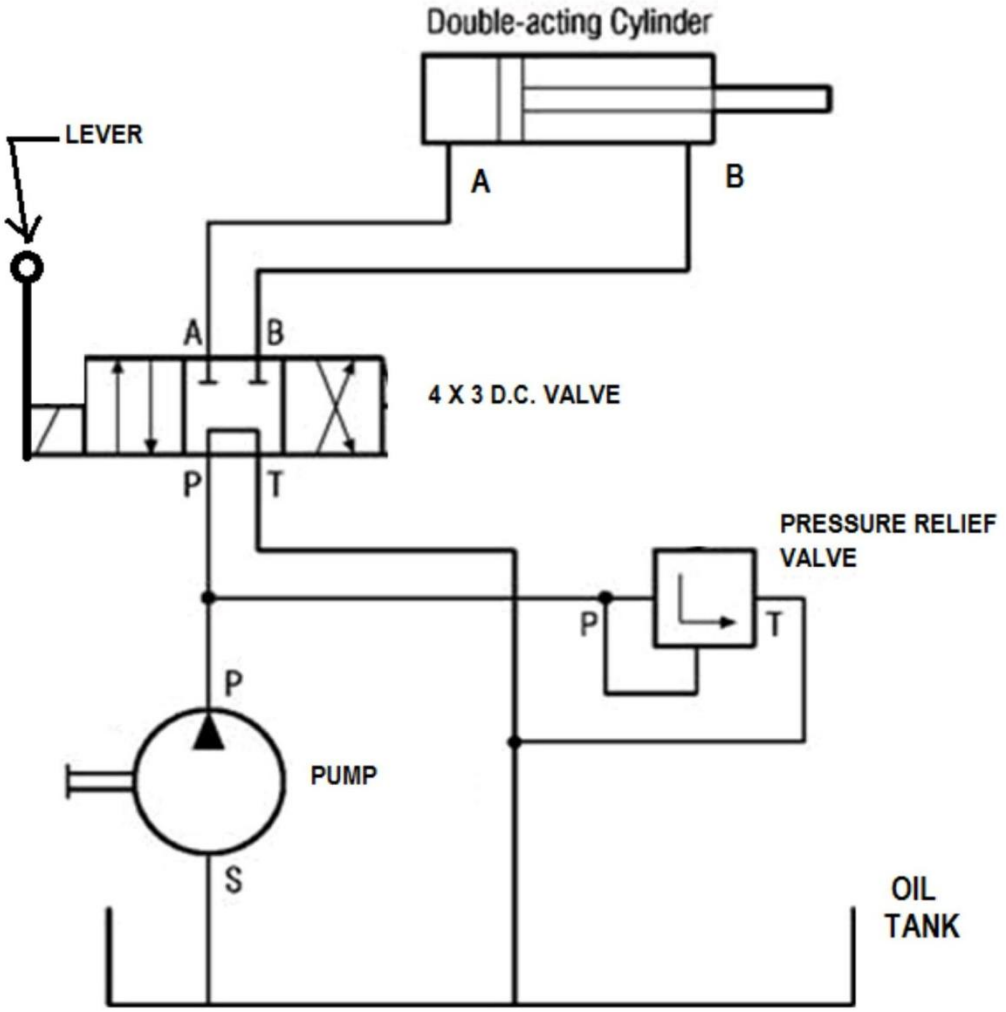


Fig- Basic hydraulic circuit for double acting cylinder

Theory

In this experiments we will see, how the pressure energy of oil converted in mechanical energy by using double acting cylinder, hydraulic motor.

The circuit diagram to control double-acting cylinder is shown in Fig. The control of a double-acting hydraulic cylinder is described as follows:

1 When the 4/3 valve is in its neutral position (tandem design), the cylinder is hydraulically locked and the pump is unloaded back to the tank.

2 When the 4/3 valve is actuated into the flow path, the cylinder is extended against its load as oil flows from port P through port A. Oil in the rod end of the cylinder is free to flow back to the tank through the four-way valve from port B through port T.

3 When the 4/3 valve is actuated into the right-envelope configuration, the cylinder retracts as oil flows from port P through port B. Oil in the blank end is returned to the tank via the flow path from port A to port T.

At the ends of the stroke, there is no system demand for oil. Thus, the pump flow goes through the relief valve at its pressure level setting unless the four-way valve is deactivated.

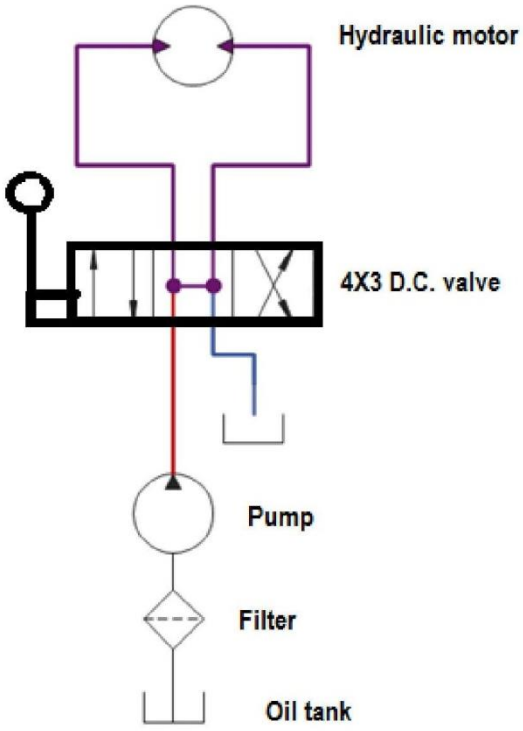


Fig- Working of double acting cylinder and hydraulic motor

Connections

1 When the 4/3 valve is in its neutral position (tandem design), the hydraulic motor is hydraulically locked and the pump is unloaded back to the tank.

2 When the 4/3 valve is actuated into the flow path, the hydraulic motor is rotates clockwise direction against its load as oil flows from port P through port A. Oil in the hydraulic motor is free to flow back to the tank through the four-way valve from port B through port T.

3 When the 4/3 valve is actuated into the right-envelope configuration, the motor rotates anticlockwise direction as oil flows from port P through port B. Oil in the blank end is returned to the tank via the flow path from port A to port T.
Hence we get rotary motion of hydraulic motor in form of mechanical energy

Procedure
1] Switch on the three phase connection given to Induction motor
2] Rotate pressure relief valve anticlockwise direction for two minutes
3] By observing the pressure gauge of pressure line adjust pressure between 12 to 15 kgf/cm²
4] Check oil level in tank to be full shown by indicator
5] Observe the reciprocating motion of double acting cylinder and hydraulic motor by varying the Pressure, using pressure knob.

6] Observe the rotary motion of hydraulic motor.

Observations- Observe the reciprocating motion of double acting cylinder and hydraulic motor by varying the Pressure, using pressure knob.

Applications - Used in for fitting of screw, assemble screwed parts

EXPERIMENT NO. - 02

Aim: To Study of Basic pneumatic circuit for the working of single and double acting cylinder

Apparatus: - Air tank, filter, compressor, junction box, manually operated, 2x3 D.C. valve single acting cylinder, double acting cylinder, pipes,

Circuit Diagram:

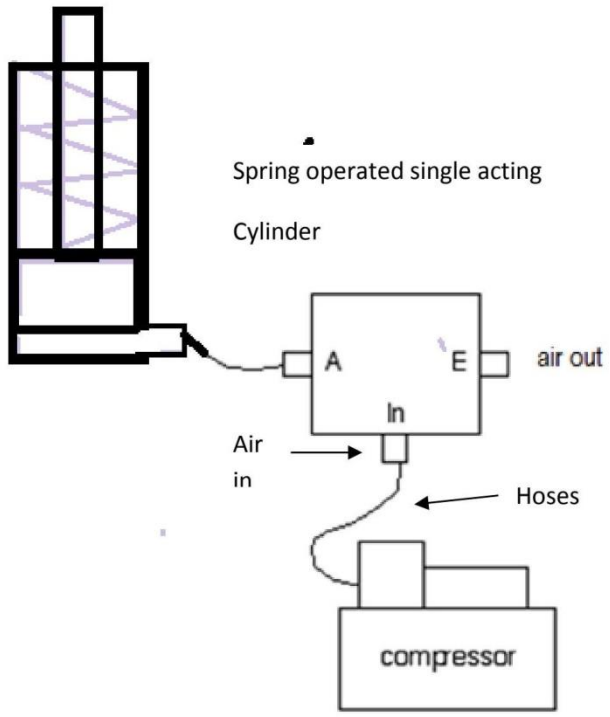
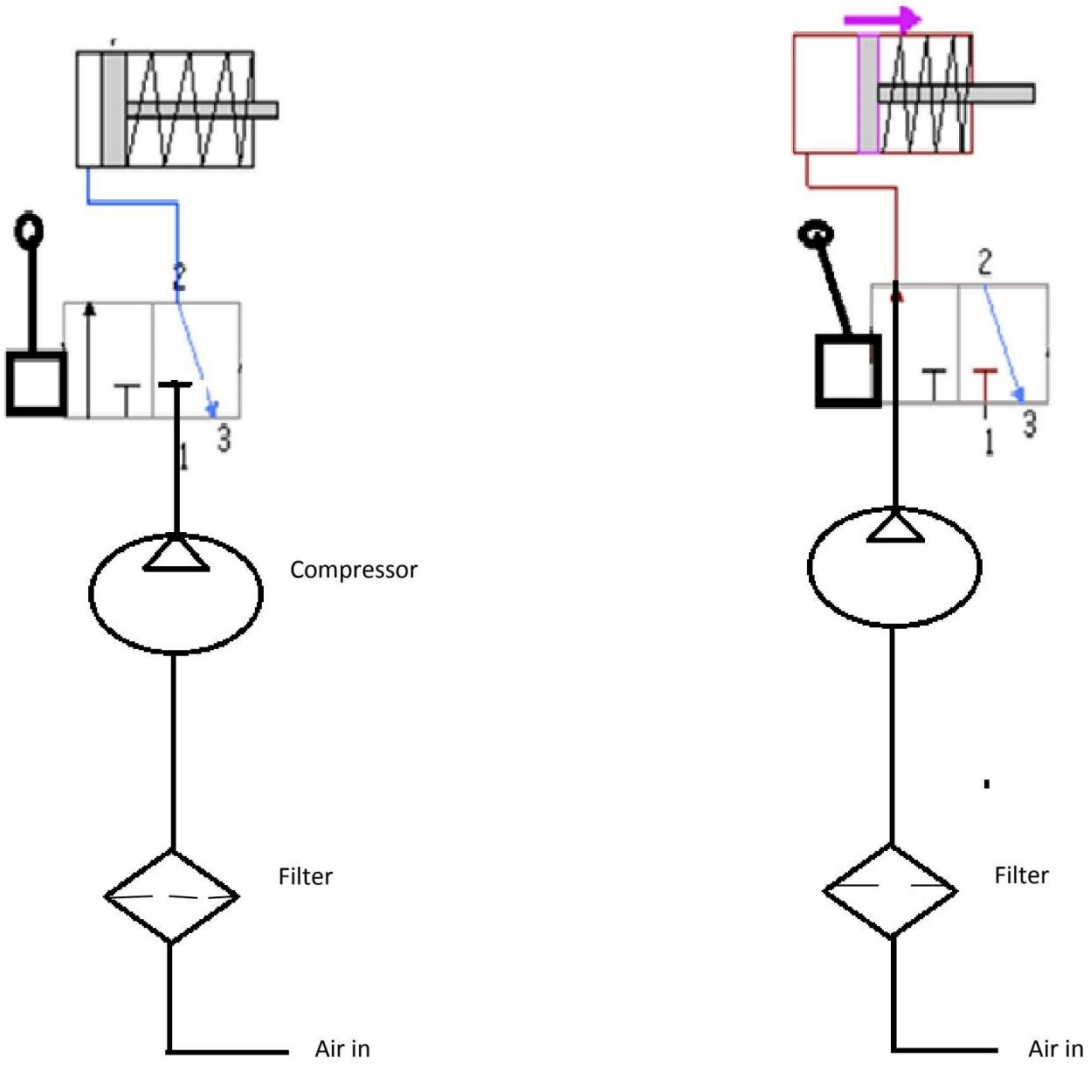


Fig – Schematic sketch Single acting pneumatic cylinder



A **Fig- Working of single acting cylinder operation** **B**

Theory

Connect all components as per above shown fig.high pressurized air enters in 3X2 Valve manually forward positions of lever air enters in cylinder,

When lever operated backward the air exhausted in surrounding through port E due to force of compressed spring

Forward motion-Due to pressurized air enters in cylinder.

Backward motion- spring pressure applied on area of piston surface

A] In fig**.** there is return movement of piston due to spring force. So air is delivered (exhausted) to atmosphere. Here 3x2 direction control valve is used. The air is exhausted to atmosphere through port 2 to 3.

B] In fig. there is forward movement of piston due to high pressure air. So air is entered to cylinder. And apply the force on piston surface Here 3x2 direction control valve is used. The air is entered in cylinder through port 1 to 2.

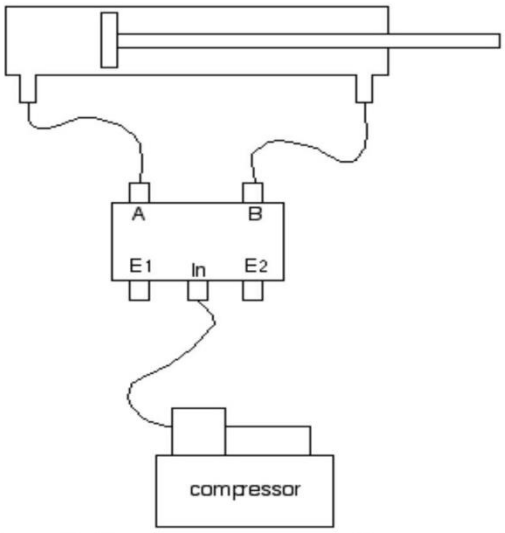
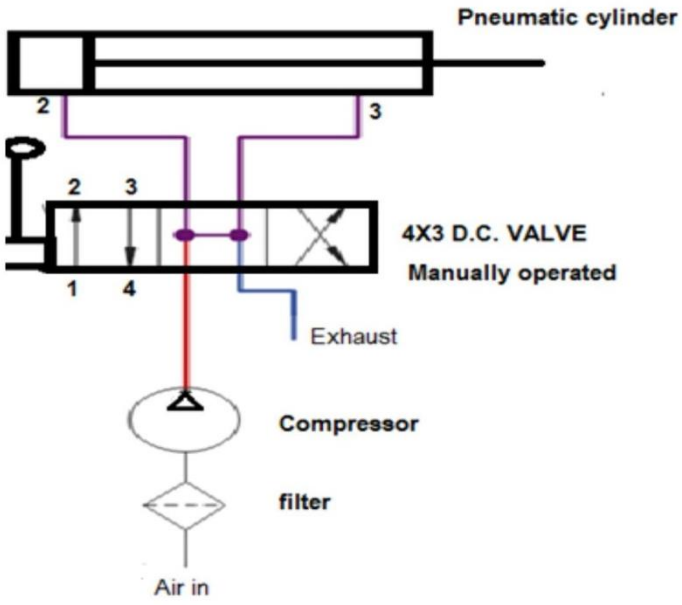


Fig. schematic diagram of double acting pneumatic cylinder



Figures show the working of double acting pneumatic cylinder

Theory:

In above pneumatic circuit we have used 4x3 D.C. valves. The valve is having four ports
Port 1 is connected to compressor
Port 3 is relieved to atmosphere through muffler.
Port 4 & 2 are connected to pneumatic cylinder
Forward position - At forward movement of piston, port 1is connected to port 4 and port 2 is connected to port 3
Retract position - At reverse movement of piston, port 1is connected to port 2 and port 4 is connected to port 3

Procedure

1] Switch on the compressor to store high pressure air.
2] Connect the pipes as per circuit shown above.
3] Connect air reservoir to junction box
4] Check pressure level in tank to be full shown by indicator
5] Observe the reciprocating motion of Single acting and double acting cylinder.
6] Observe the rotary motion of hydraulic motor.

Applications- used in industries for fitting the component of job.

EXPERIMENT NO.-03

Aim- Study of Speed control circuits. Different Metering methods Inlet & outlet flow control (meter-in& meter-out circuit)

Apparatus: - Air tank, filter, compressor, junction box, manually operated, 2x3 D.C. valve single acting cylinder, double acting cylinder, pipes,

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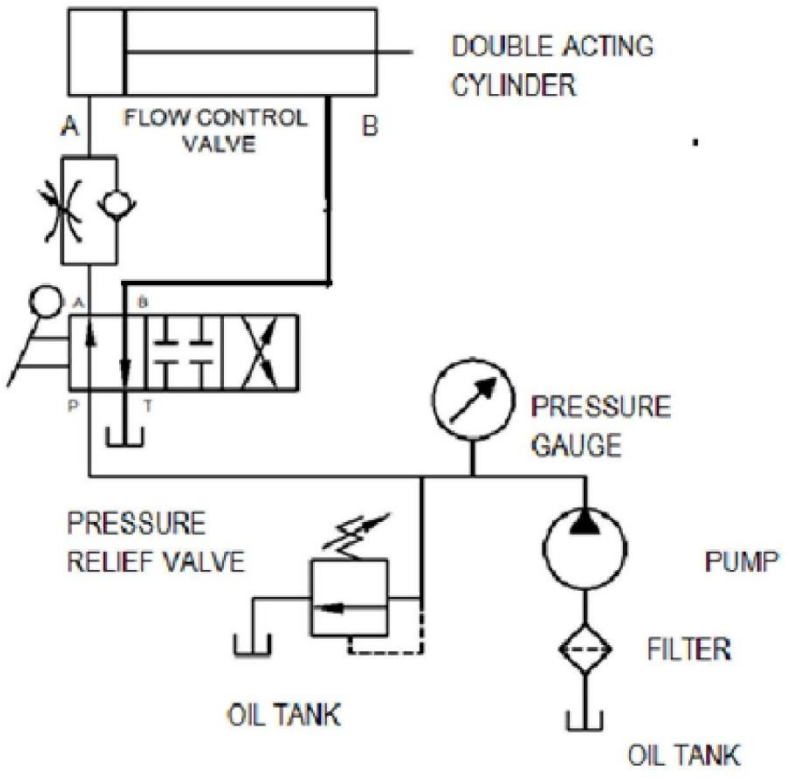


Fig Meter in speed control circuit

Components of Meter in hydraulic circuit- hydraulic cylinder,flow control check valve, 4X3 D.C. valve, pressure relief valve,oil tank, hoses for connections

Procedure

1] Switch on the three phase connection given to Induction motor
2] Rotate pressure relief valve anticlockwise direction for two minutes
3] By observing the pressure gauge of pressure line adjust pressure between 12 to 15 kgf/cm²
4] Check oil level in tank to be full shown by indicator

Theory:

The speed control of a hydraulic cylinder circuit can be done during the extension stroke using a flow-control valve (FCV). This is done on a meter-in circuit and meter-out circuit as shown in following figures.
When the Direction Control Valve is actuated, oil flows through the FCV to extend the cylinder. The extending speed of the cylinder depends on the FCV setting.

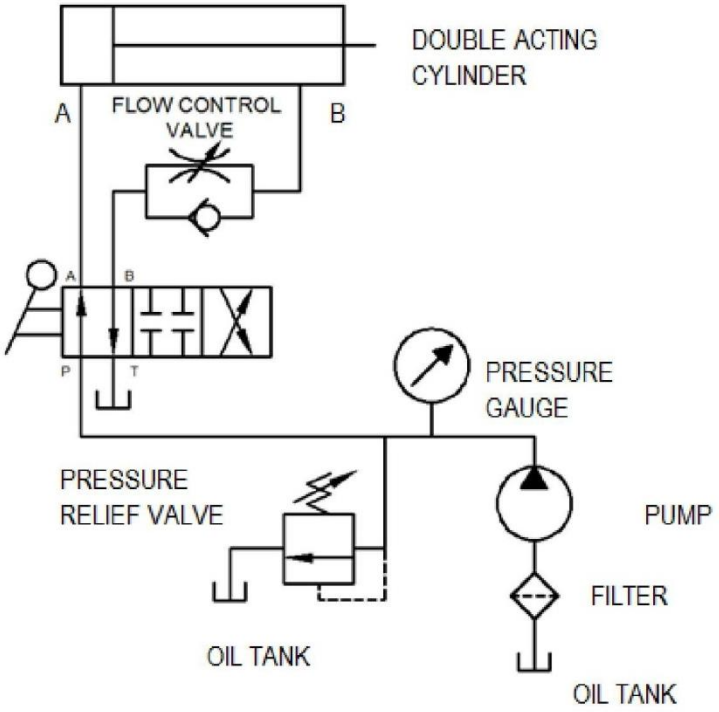


Fig - Meter out speed control circuit

When the DCV is deactivated, the cylinder retracts as oil from the cylinder passes through the check valve. Thus, the retraction speed of a cylinder is not controlled. Figure shows meter-out circuit; when DCV is actuated, oil flows through the rod end to retract the cylinder.

2 Meter-In Versus Meter-Out Flow-Control Valve Systems

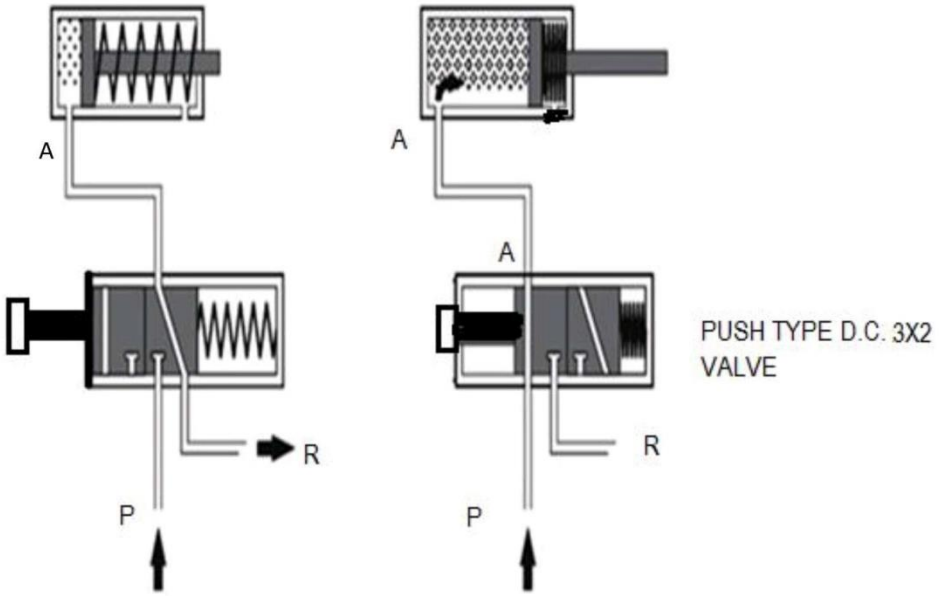
FCV is placed in the line leading to the inlet port of the cylinder. Thus, it is called the meter-in control of speed. Meter-in flow controls the oil flow rate into the cylinder meter-out flow control system is one in which the FCV is placed in the outlet line of the hydraulic cylinder. Thus, a meter-out flow control system controls the oil flow rate out of the cylinder. Meter-in systems are used primarily when the external load opposes the direction of motion of the hydraulic cylinder. When a load is pulled downward due to gravity, a meter-out system is preferred. If a meter-in system is used in this case, the load would drop by pulling the piston rod, even if the FCV is completely closed

One drawback of a meter-out system is the excessive pressure build-up in the rod end of the cylinder while it is extending. In addition, an excessive pressure in the rod end results in a large pressure drop

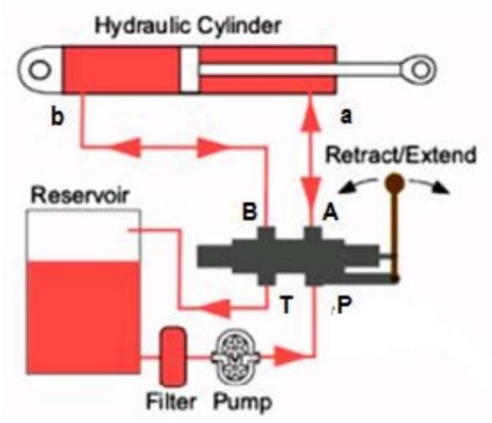
Applications- Used in shaper tool

EXPERIMENT NO. - 04

Aim- Study of Circuits for the Use of different direction control valves and valve actuation in single
And double acting cylinder, and multi actuation circuit.



A Fig- Schematic sketch of Directional control valve



Figures shows the working of Directional control valve

Procedure

1] Switch on the three phase connection given to Induction motor
2] Rotate pressure relief valve anticlockwise direction for two minutes
3] By observing the pressure gauge of pressure line adjust pressure between 12 to 15 kgf/cm²
4] Check oil level in tank to be full shown by indicator

Theory:

Schematic diagram shows manually operated hand lever D.C. Valve.
Extend- Right movement of lever
Retract – Left movement of lever

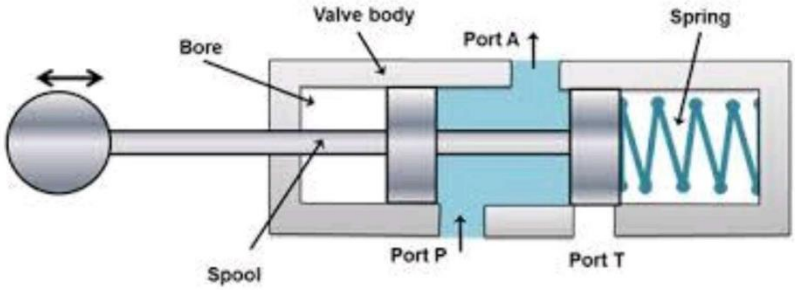


Fig-MANUALLY OPERATED 3X2 D.C. VALVE

Above fig. shows ball operated three ports two position valve. Here it consists of three ports named P, A & T. It consists of two positions. Above fig. shows normal position in which fluid is flowing port P to port A. When we press the lever towards right direction due to spool present in the valve it closes the flow between port P to port A. Now fluid flowing port A to port T. When we remove the force on lever due to spring force it will get its normal position. It is also called as 3x2 D.C. valves. It is used for working of single acting cylinder in hydraulic circuit.

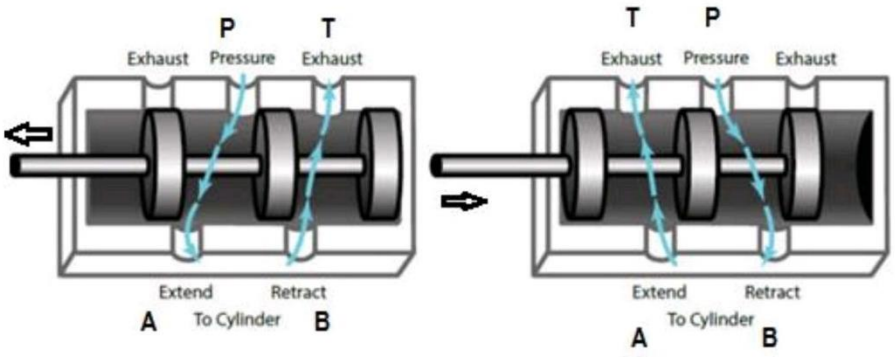


fig. spool type 5 X 2 valve

Above fig. shows 5x2 direction control valve .In above fig. five ports are shown named exhaust, pressure, exhaust, extend and retract. It consists of three spools in first fig. high pressure air is flowing from pressure port to extend port and retract port to exhaust port. This position is called extending position of piston in double acting pneumatic cylinder. In second fig. it shows retracting position of piston because when we operate the lever of valve the high pressure air is flowing pressure port to retract port and extend port to exhaust.

Applications- used in industries for automation in manufacturing

EXPERIMENT NO. – 05

Aim-Study of Hydraulic Counter-balancing circuit.

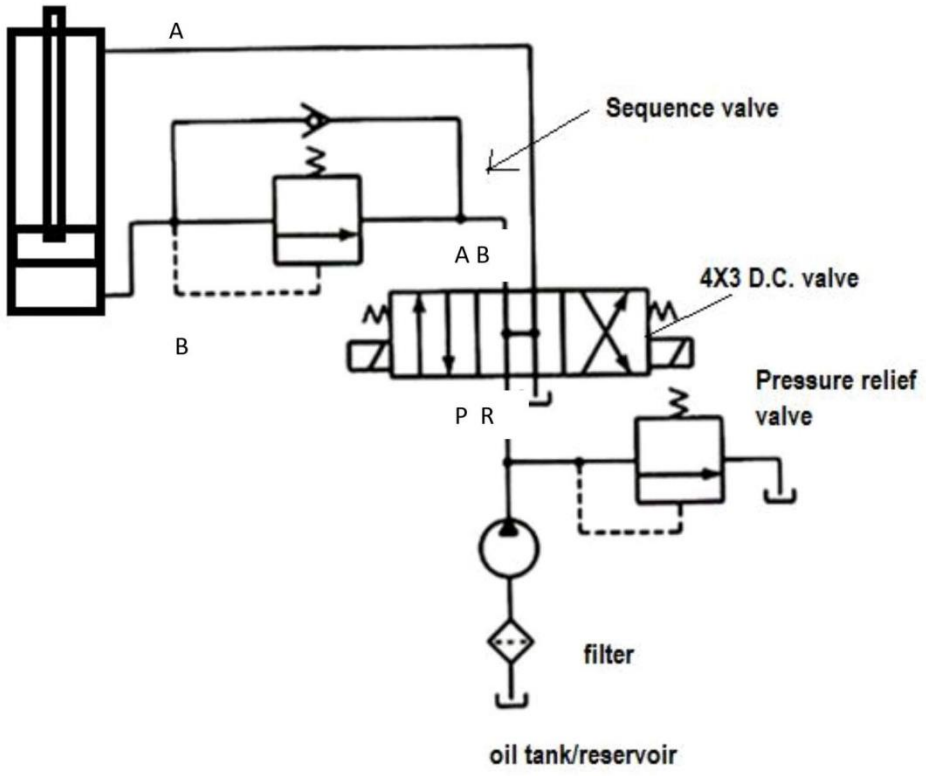
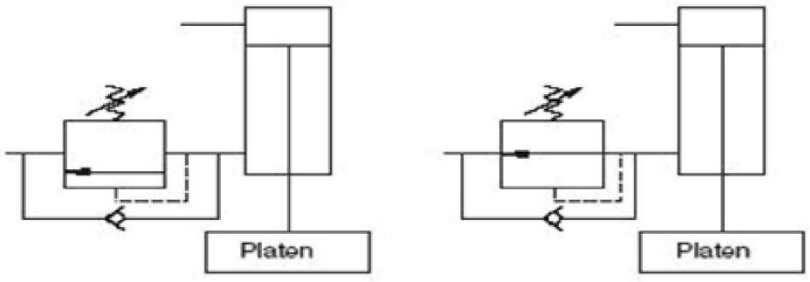


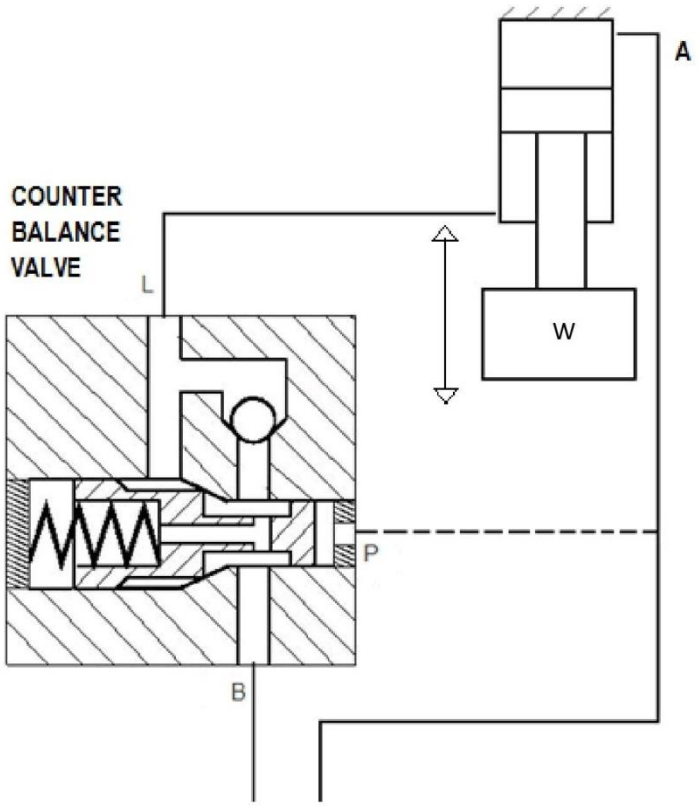
Fig –Working circuit of Counterbalance



Components required: hydraulic cylinder, direction control valve, pump, pressure relief valve, oil tank, Counter balance valve

Procedure

1] Switch on the three phase connection given to Induction motor
2] Rotate pressure relief valve anticlockwise direction for two minutes
3] By observing the pressure gauge of pressure line adjust pressure between 12 to 15 kgf/cm²
4] Check oil level in tank to be full shown by indicator



Theory:

A counterbalance valve is applied to create a back pressure or cushioning pressure on the underside of a vertically moving piston to prevent the suspended load from free falling because of gravity while it is still being lowered.

Valve Operation (Lowering)

The pressure setting on the counterbalance valve is set slightly higher than the pressure required preventing the load from free falling. Due to this back pressure in line A, the actuator piston must force down when the load is being lowered. This causes the pressure in line A to increase, which raises the spring-opposed spool, thus providing a flow path to discharge the exhaust flow from line A to the DCV and then to the tank. The spring-controlled discharge orifice maintains back pressure in line A during the entire downward piston stroke.

Valve Operation (Lifting)

As the valve is normally closed, flow in the reverse direction (from port B to port A) cannot occur without a reverse free-flow check valve. When the load is raised again, the internal check valve opens to permit flow for the retraction of the actuator.

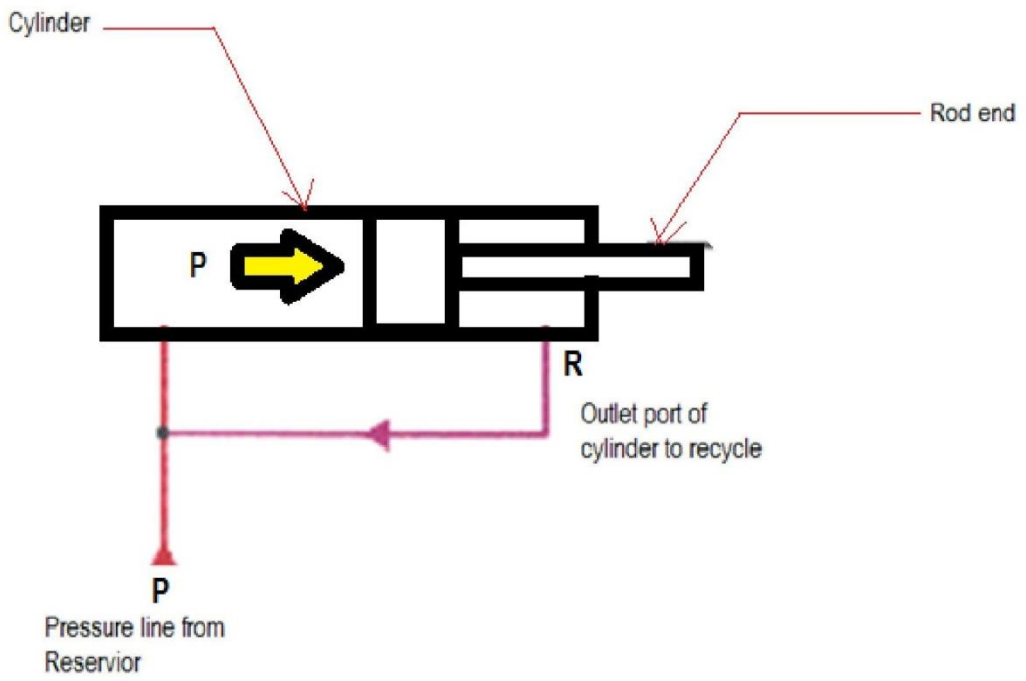
Valve Operation (Suspension)

When the valve is held in suspension, the valve remains closed. Therefore, its pressure setting must be slightly higher than the pressure caused by the load. Spool valves tend to leak internally under pressure.

This makes it advisable to use a pilot-operated check valve in addition to the counterbalance valve if a load must be held in suspension for a prolonged time.

EXPERIMENT NO. – 06

Aim – Study of Hydraulic or Pneumatic Regenerative circuit.



Components required: hydraulic cylinder, direction control valve, pump, pressure relief valve, oil tank

Figure shows basic concept of a regenerative circuit that is used to speed up the extending speed of a double-acting cylinder.

Procedure

1] Switch on the three phase connection given to Induction motor
2] Rotate pressure relief valve anticlockwise direction for two minutes
3] By observing the pressure gauge of pressure line adjust pressure between 12 to 15 kgf/cm²
4] Check oil level in tank to be full shown by indicator

Figure connection of a regenerative circuit

Theory:

Figure shows a regenerative circuit that is used to speed up the extending speed of a double-acting cylinder. The pipelines to both ends of the hydraulic cylinder are connected in parallel and one of the ports of the 4/3 valve is blocked by simply screwing a thread plug into the port opening. During retraction stroke, the 4/3 valve is configured to the right envelope. During this stroke, the pump flow bypasses the DCV and enters the rod end of the cylinder. Oil from the blank end then drains back to the tank through the DCV.

Applications- used in industries for saving energy required for machining operations.

EXPERIMENT NO. – 07

Aim - Study Hydraulic or Pneumatic Sequencing circuit.

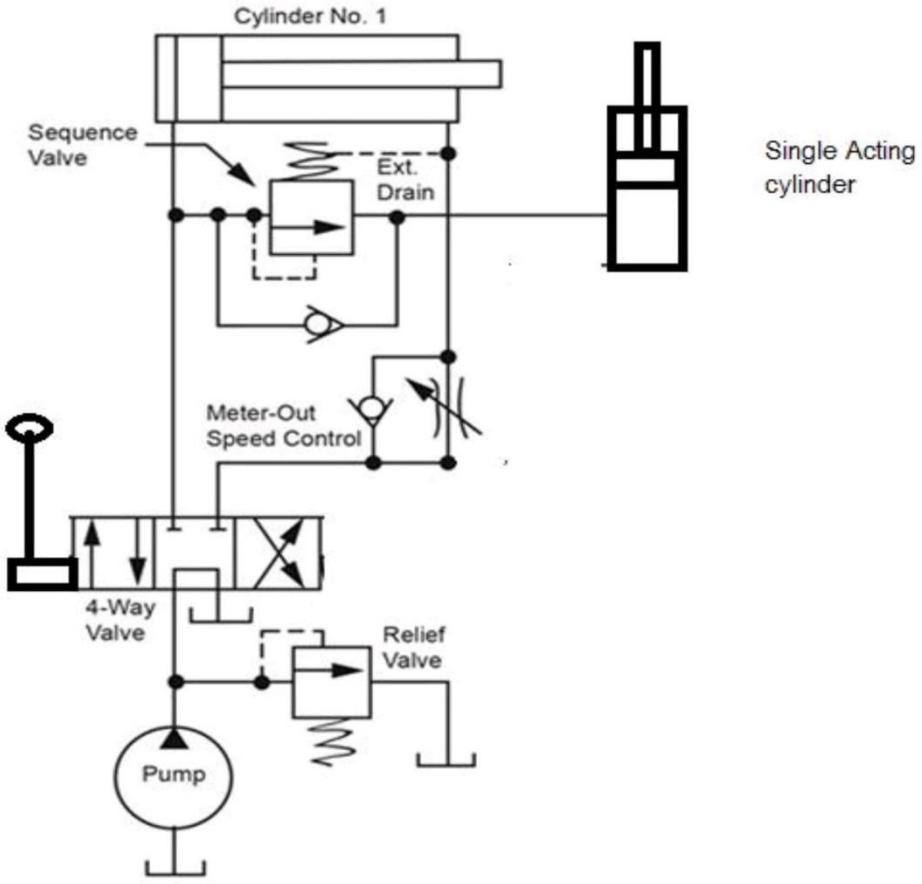


Fig. Working Sequencing circuit

Components required-

Hydraulic cylinders, pump, sequencing valve, 4X3 direction control valve

Hydraulic cylinders can be operated sequentially using a sequence valve.

Procedure

1] Switch on the three phase connection given to Induction motor
2] Rotate pressure relief valve anticlockwise direction for two minutes
3] By observing the pressure gauge of pressure line adjust pressure between 12 to 15 kgf/cm²
4] Check oil level in tank to be full shown by indicator

Theory:

Figure shows that two sequence valves are used to sequence the operation of two double-acting cylinders. When the DCV is actuated to its right-envelope mode, the bending cylinder (B) retracts fully and then the clamp cylinder (A) retracts.

This sequence of cylinder operation is controlled by sequence valves.

Application - This hydraulic circuit can be used in a production operation such as drilling. Cylinder A is used as a clamp cylinder and cylinder B as a drill cylinder. Cylinder A extends and clamps a work piece. Then cylinder B extends to drive a spindle to drill a hole. Cylinder B retracts the drill spindle and then cylinder A retracts to release the work piece for removal

EXPERIMENT NO.-08

Aim – Study of Hydraulic Unloading circuit.

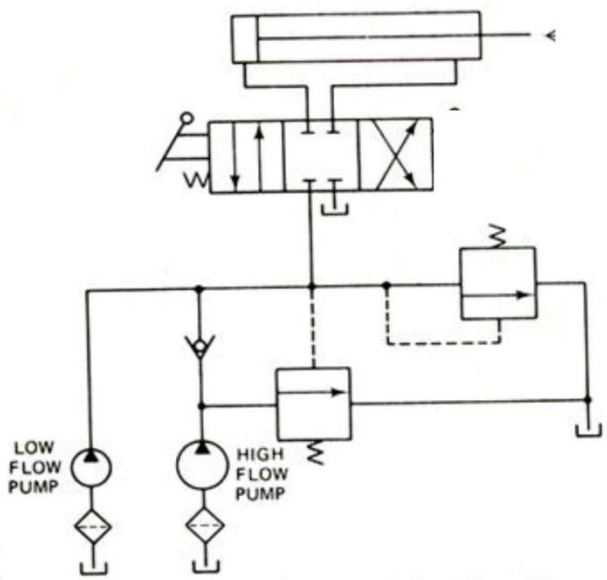


Figure shows a hydraulic circuit to unload a pump using an unloading valve

Components required: hydraulic cylinder, direction control valve, pump, pressure relief valve, oil tank, and unloading valve.

Procedure

1] Switch on the three phase connection given to Induction motor
2] Rotate pressure relief valve anticlockwise direction for two minutes
3] By observing the pressure gauge of pressure line adjust pressure between 12 to 15 kgf/cm²
4] Check oil level in tank to be full shown by indicator

Theory:

When the cylinder reaches the end of its extension stroke, the pressure of oil rises because the check valve keeps the high-pressure oil. Due to high-pressure oil in the pilot line of the unloading valve, it opens and unloads the pump pressure to the tank.

When the DCV is shifted to retract the cylinder, the motion of the piston reduces the pressure in the pilot line of the unloading valve. This resets the unloading valve until the cylinder is fully retracted. When this happens, the unloading valve unloads the pump due to high-pressure oil. Thus, the unloading valve unloads the pump at the ends of the extending and retraction strokes as well as in the spring-centered position of the DCV.

Application - This hydraulic circuit can be used in a production operation such as drilling. Cylinder A is used as a clamp cylinder and cylinder B as a drill cylinder.

EXPERIMENT NO. 09

Aim - Study of Circuit with cam operated pilot valves operating a pilot operated 4way direction control
Valve or proximity/ limit switches, solenoid operated 4way direction control valve for Auto reversing circuit.

Procedure
1] Switch on the three phase connection given to Induction motor
2] Rotate pressure relief valve anticlockwise direction for two minutes
3] By observing the pressure gauge of pressure line adjust pressure between 12 to 15 kgf/cm²
4] Check oil level in tank to be full shown by indicator

Theory:

Electro pneumatics is now commonly used in many areas of Industrial low cost automation. They are also used extensively in production, assembly, pharmaceutical, chemical and packaging systems. There is a significant change in controls systems. Relays have increasingly been replaced by the programmable logic controllers in order to meet the growing demand for more flexible automation

Electro-pneumatic control consists of electrical control systems operating pneumatic power systems. In this solenoid valves are used as interface between the electrical and pneumatic systems. Devices like limit switches and proximity sensors are used as feedback elements.

Electro Pneumatic control integrates pneumatic and electrical technologies, is more widely used for large applications. In Electro Pneumatics, the signal medium is the electrical signal either AC or DC source is used. Working medium is compressed air. Operating voltages from around 12 V to 220 Volts are often used. The final control valve is activated by solenoid actuation

In Electro pneumatic controls, mainly three important steps are involved:

- **Signal input devices** -Signal generation such as switches and contactor, Various types of contact and proximity sensors
- **Signal Processing** – Use of combination of Contactors of Relay or using Programmable Logic Controllers

Signal Out puts – Out puts obtained after processing are used for activation of solenoids,

1.2 SEVEN BASIC ELECTRICALDEVICES

Seven basic electrical devices commonly used in the control of fluid power systems are

1. Manually actuated push button switches
2. switches
3. Pressure switches
4. Solenoids
5. Relays
6. Timers
7. Temperature switches

Other devices used in electro pneumatics are

1. Proximity sensors
2. Electric counters

2 Limit switches

Any switch that is actuated due to the position of a fluid power component (usually a piston rod or hydraulic motor shaft or the position of load is termed as limit switch. The actuation of a limit switch provides an electrical signal that causes an appropriate system response.

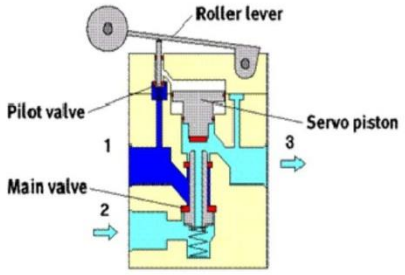


Fig Shows contact type limit switches

Limit switches perform the same function as push button switches. Push buttons are manually actuated whereas limit switches are mechanically actuated

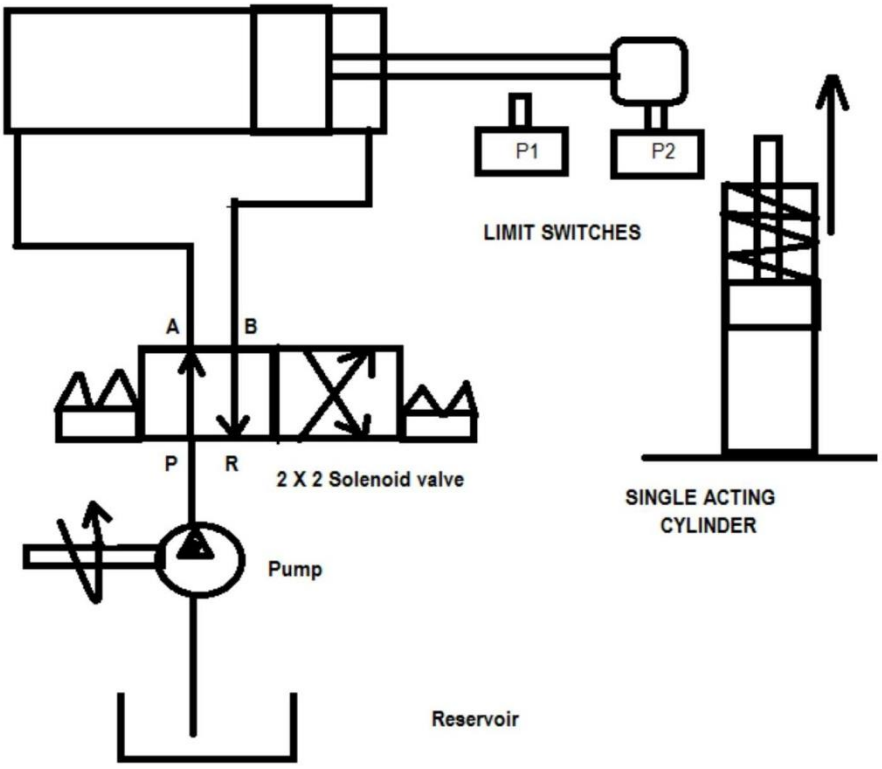
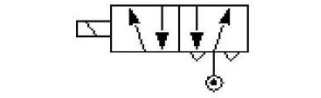
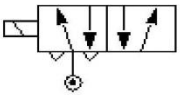
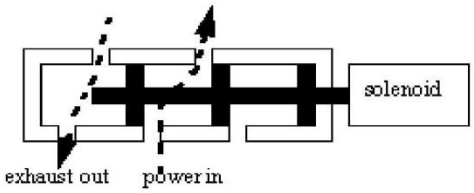


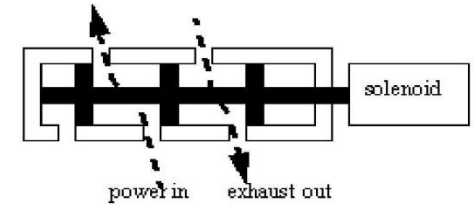
Fig- Working of Solenoid valve



The solenoid has two positions and when actuated will change the direction that fluid flows to the device. The symbols shown here are commonly used to represent this type of valve.







Application - This hydraulic circuit can be used in a production operation clamping, locating such as drilling. Cylinder A is used as a clamp cylinder and cylinder B as a drill cylinder.

EXPERIMENT NO. – 10

Aim- Study of hydraulics and Pneumatics circuit, based on the industrial application

Theory:

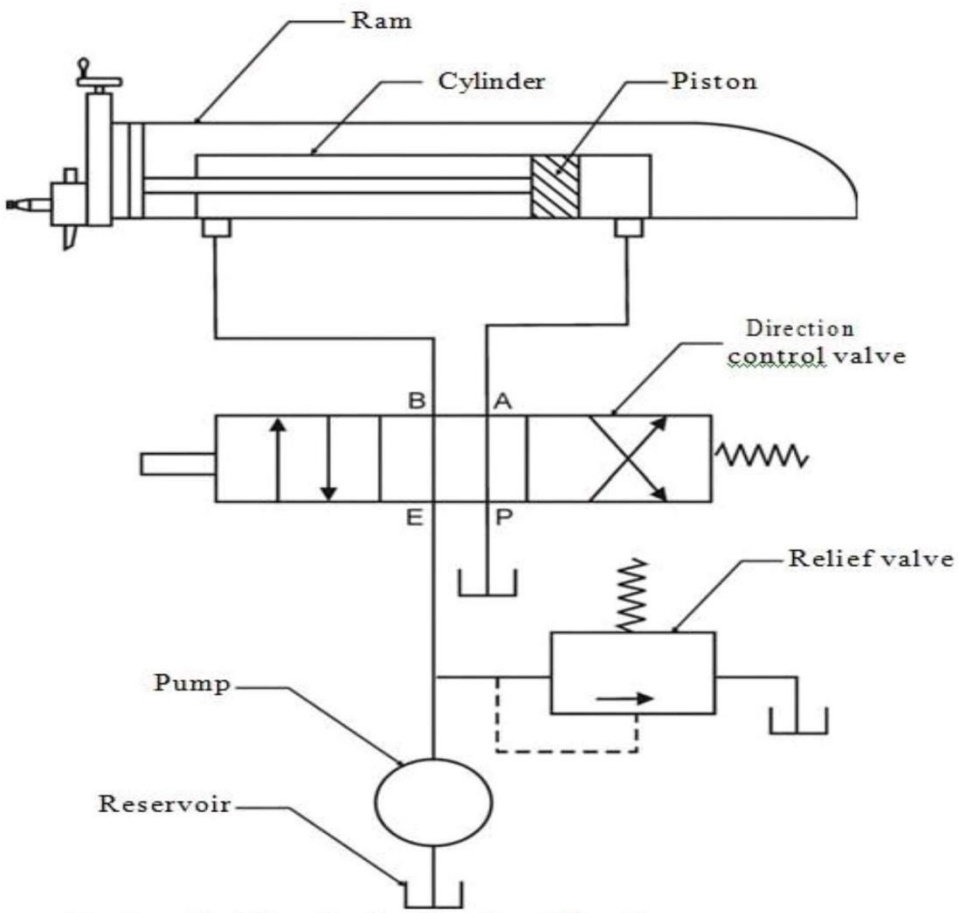
Hydraulic shaping machine

A shaping machine is also called shaper is mainly used for producing flat surfaces, which may be horizontal, vertical or inclined. Sometimes curved or irregular surfaces are also produced by shapers

In past years, Conventional mechanical shaper machine is used in industries. In this shaper machine gear arrangement is used to give liner motion to the machine tool towards to the work piece. The work piece mounts on a rigid, box shaped table in front of the machine. The height of table can be adjusted suitable to the work piece. In all shaper machine cutting stroke is controlled and return stroke is fast, this can be done by a mechanism which is named as 'whit worth quick return mechanism'. In conventional shaper machine stroke length can be adjusted by shaper dogs.

In modern era, whole mechanical shaper machine is replaced by hydraulic shaper machine due its ease operation and reliability In this modern shaper machine whole construction is same, but method of actuation is changed. The gear arrangement is totally replaced by a double acting hydraulic cylinder. Hydraulic cylinders are the device which uses hydraulic energy to achieve mechanical movement i.e. linear. A machine tool is used as per application

For example producing v slots v shape tool is used in this hydraulic shaper machine quick return is achieved by placing flow control valve and check valve in return line.



Hydraulic Circuit of a Shaping Machine

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The following component are used for hydraulic shaper machine

In which following parts are used.

Double acting cylinder
4/3 Direction control valve
Pressure relief valve
Filter
Gear pump
Hoses and fitting

Generally Meter out circuit is used for hydraulic shaper machine. Meter out circuit is as shown in fig below.

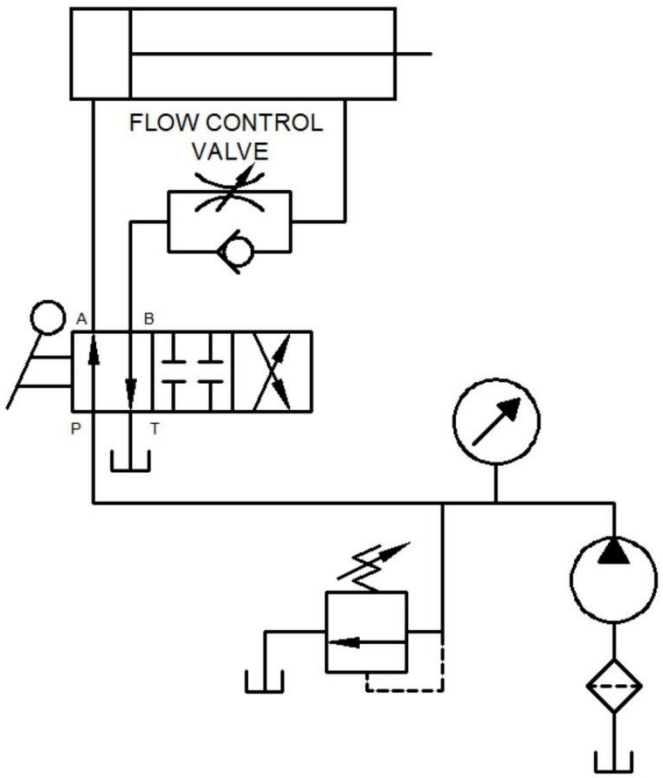

Fig. Meter out circuit for shaping machine

It consists of pneumatic cylinder, compressor, solenoid valve, electric control unit, forging hammer and table.

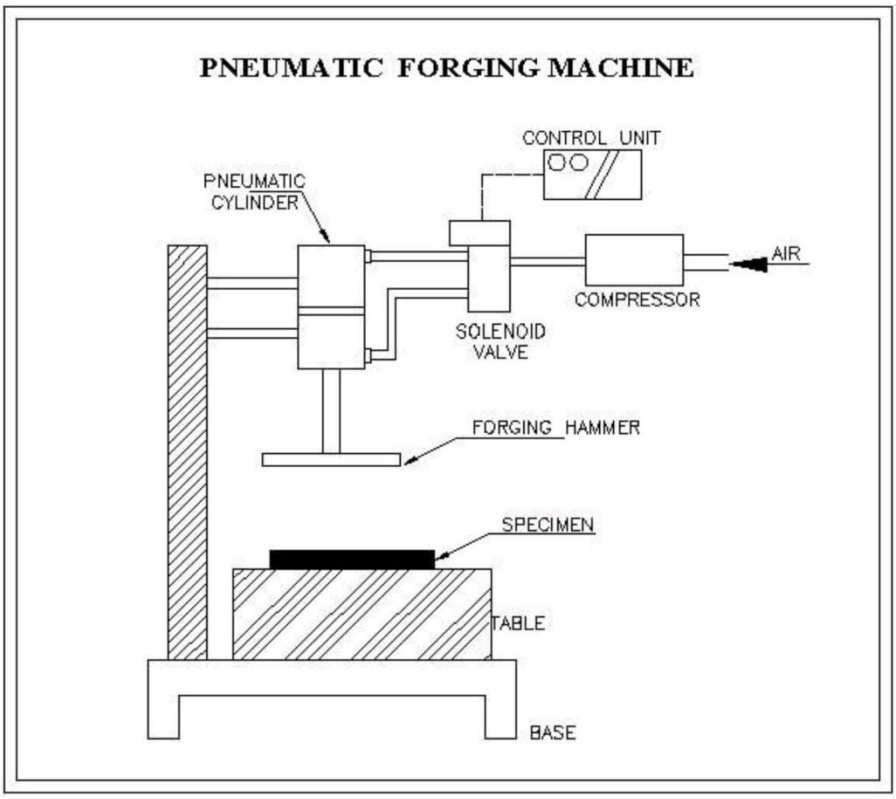

Fig. shows schematic block diagram of pneumatic forging machine.

Air is compressed by compressor, this high pressure air through direction control valve goes inside the pneumatic cylinder causing upward and downward movement of piston.