DEPARTMENT OF MECHANICAL ENGINEERING

LAB MANUAL

SUBJECT: INDUSTRIAL AUTOMATION & ROBOTICS

B.TECH- 5th Semester BRANCH: - ME

KCT COLLEGE OF ENGG & TECH, FATEHGARH

Punjab Technical University

LIST OF PRACTICALS

Sr. No.	Name of Experiment
1	Design and assembly of hydraulic/pneumatic circuit.
2	Study of power steering mechanism using cut piece model.
3	Study of reciprocating movement of double acting cylinder using pneumatic direction control valves.
4	Use of direction control valve and pressure control valves clamping devices for jig and fixture.
5	Study of robotic arm and its configuration.
6	Study of robotic end effectors.
7	Study of different types of hydraulic and pneumatic valves.

PRACTICAL NO. 01

AIM: - DESIGN AND ASSEMBLY OF HYDRAULIC/PNEUMATIC CIRCUIT.

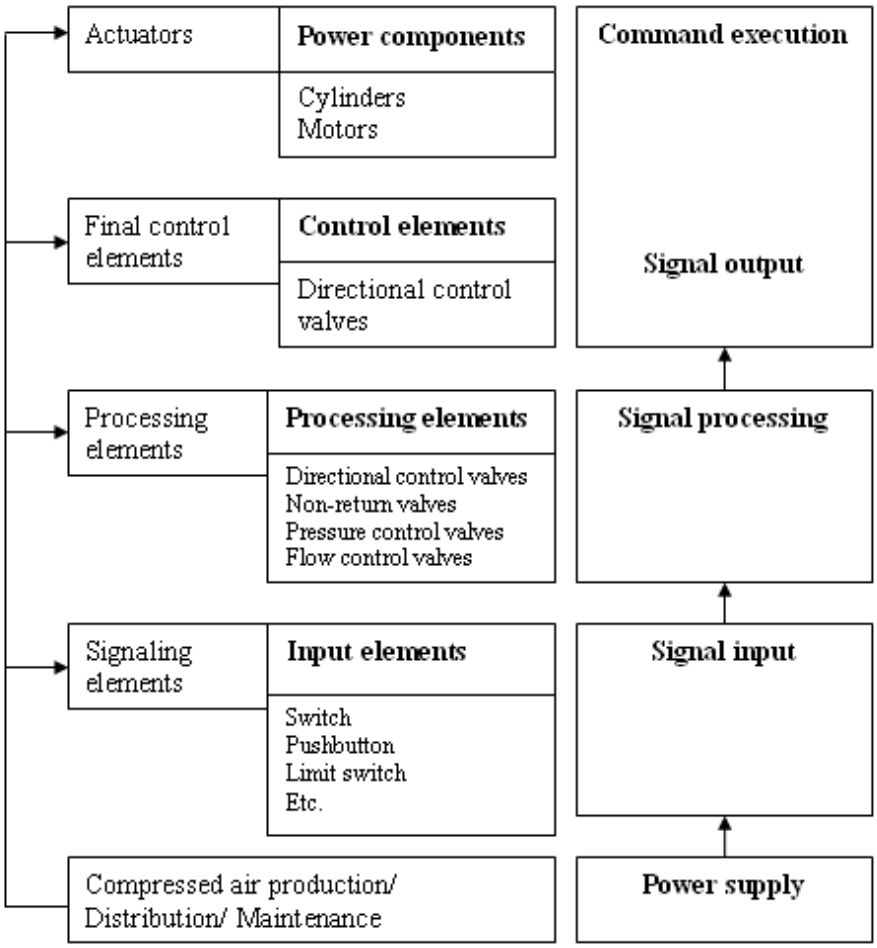
THEORY: -

1.1 INTRODUCTION

The circuit is defined as a pictorial representation of the working of a system using symbols. The hydraulic/pneumatic circuit must essentially include the symbols of the following:

- Power/Pressure source
- Reservoir(In Hydraulic Systems)
- Fluid lines
- Filter
- Lubricator (In pneumatic system)
- Pressure Regulator(For example Relief Valve)
- Direction Control Valves
- Flow Control valves (If speed regulation is desired)
- Special Purpose valves(if required)
- Actuators etc.

The circuit must be a closed in case of hydraulic where incompressible oil is used as an actuating fluid. The circuit must ensure the proper working of the actuators along with a control strategy. The safety aspect must also be taken into consideration. The system should function in a logical manner. The design must be as simple as possible and the logic should be apparently clear. Proper connections must be ensured before releasing the fluid under pressure from the source into the system.



1.2 PROBLEM

To control a double acting pneumatic cylinder in such a way that during the return stroke the speed of the piston shall be adjusted. There is no stopping of the piston rod in between the terminal points.

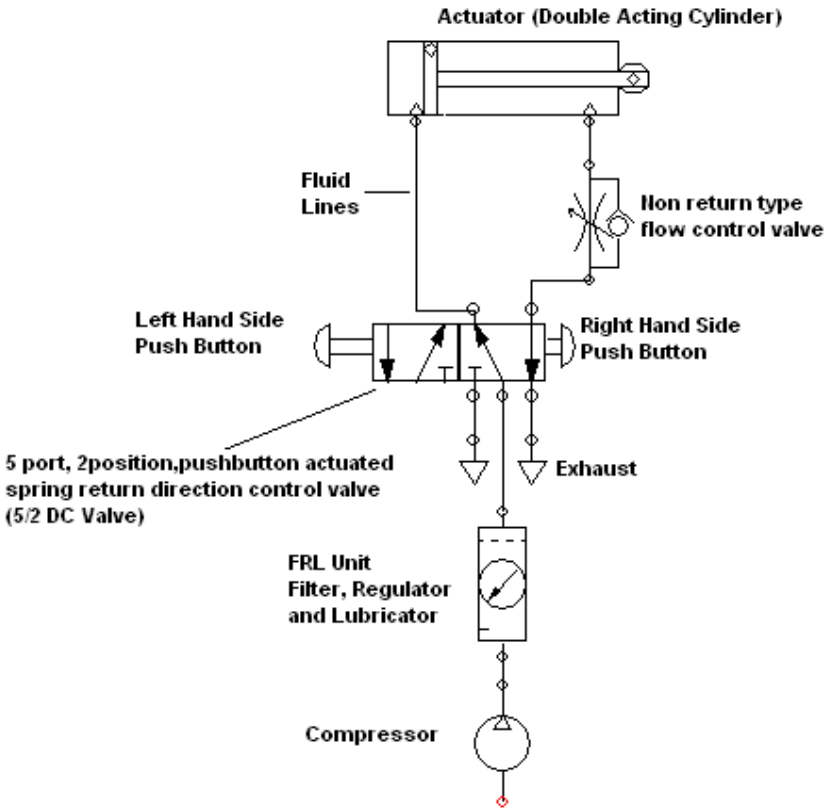
(The piston rod of a double-acting pneumatic cylinder extracts if right hand side push button of the 5/2 DC valve is pressed and the cylinder should retract when the left hand side push button of the DC valve is pressed. Also there should be a provision for speed control of cylinder during the return stroke)

1.3 SOLUTION

To design a circuit, we shall be making use of symbols of various components. First of all compressor is used as a power/pressure source as the problem refers to a pneumatic system. Then the air coming out of the compressor needs to be conditioned. For the same a FRL unit is put in the pressure line of the compressor. As we know that

we have to control a double acting cylinder which doesn't have to stop in between so we chose a 5 port,2 position pushbutton actuated, spring return direction control valve. We have to provide an adjustable speed control during the retracting motion of the cylinder, so a non return type adjustable flow control valve is put in between the actuator and the DC valve so as to ensure a *throttling in* speed control of cylinder.

1.4 PNEUMATIC CIRCUIT FOR THE PROBLEM



1.5 THINGS TO REMEMBER

- Physical arrangement of the elements is ignored.
- Draw the cylinders and directional control valves horizontally wherever possible.
- The energy flow within the circuit moves from the bottom to the top.
- Energy source can be shown in simplified form.
- Show elements in the initial position of the control. Identify actuated elements by a cam.
- Draw pipelines straight without cross-over wherever possible.

PRACTICAL NO. 02

AIM: - STUDY OF POWER STEERING MECHANISM USING CUT PIECE MODEL.

THEORY

2.1 INTRODUCTION

A power steering is a modified steering system in which the human effort is supplemented with the external agency which is required for steering the wheels. There are two main parts to the power steering system: the pump and the steering gear. In most cases, the pump is attached to the front of the engine and driven by the accessory drive belt. The fluid reservoir (where you add fluid) is usually located on the pump. The pump should be sized to deliver sufficient fluid pressure at idle. As the pump spins faster as engine speed increases, a pressure relief valve is used to keep the pressure at the desired levels. In some cases, the engine driven pump may be replaced by an electric pump (therefore there won't be a belt running to the pump).

There are two major types of steering gears used:

1. Rack and pinion
2. Recirculating ball type

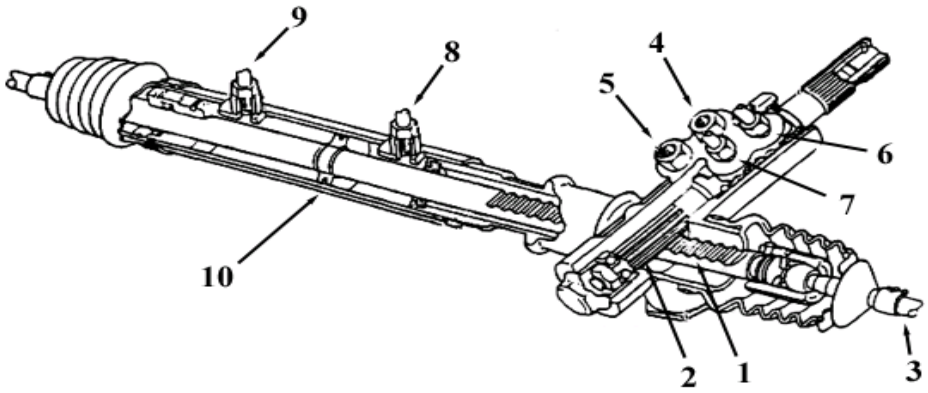


Figure 2.1: Cut-away view of a power assists rack and pinion

2.2 WORKING

The pinion (2) is attached to the steering shaft which is attached to the steering wheel. Thus, as the steering wheel is turned, the teeth in the pinion mesh with the rack (1) and slides the rack left and right. The rack is attached to the tie rods (3) which in turn attach to the knuckle (not shown) and tire. That's manual steering with a rack and pinion.

In the power assist system, fluid from the pump (high pressure side) enters the steering gear at (4) and returns (low pressure side) at (5). A valve system inside the gear box directs fluid out at (6) and (7) which re-enters the gearbox at (8) and (9). This pressurized fluid acts on the power piston (10) to assist steering. Thus, if the driver is turning right, additional fluid is directed to the right side of the piston, which helps move the rack and therefore steer the tires.

Fluid is directed to either the right or left sides by means of a rotary valve and torsion bar. Through this mechanism, the fluid pressure (and thus the amount of "assist") is proportional to the torque due to steering effort, and not the direction that the wheels are turned. In other words, it is possible for the system to help you turn left, even if the steering wheel is right of center. Here is a sketch of the rotary valve. Only one quarter is shown (it's symmetrical).

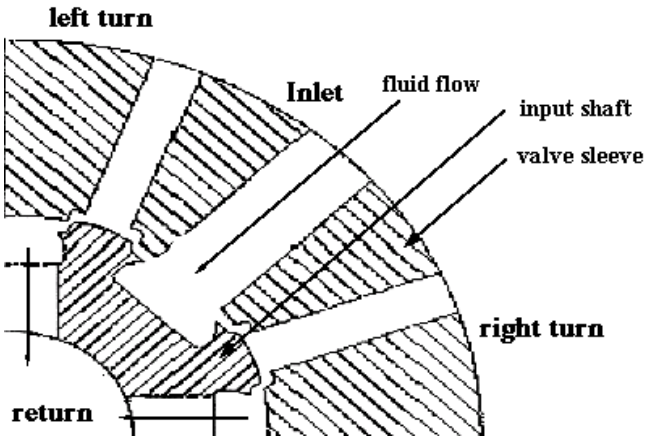


Figure 2.2: Sketch of one quarter of the rotary valve during left turn

The various positions of rotary control valve is shown in this figure give below:

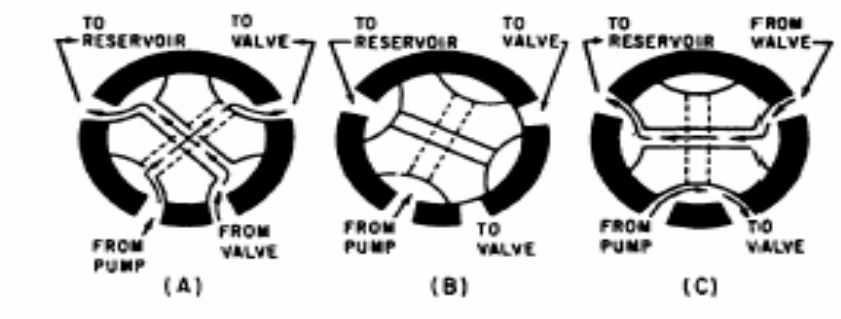


Figure 2.3

The torsion bar (a torsional spring) connects the steering shaft to the pinion. As stated at autoshop-online.com, "When the steering wheel is turned, resistance is created by the weight of the car and tire-to-road friction, causing a torsion bar in the rotary valve to deflect. This changes the position of the valve spool and sleeve, thereby directing fluid under pressure to the proper end of the power cylinder."Here's another sketch of the rotary valve in a hard right turn.

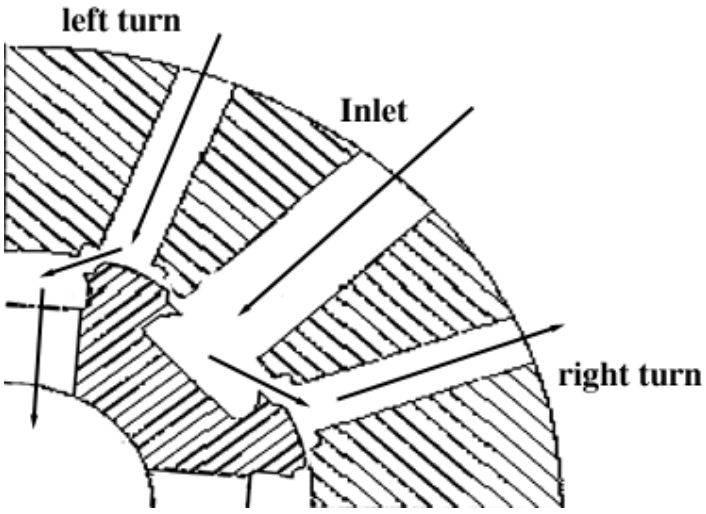


Figure 2.4: Sketch of one quarter of the rotary valve during right turn

As you can see, as the torsion bar twists, it changes the alignment between the input shaft and valve sleeve, delivering more pressure to one side, and less to the other.

2.3 OPERATION:

Figure below shows an automotive power steering example of a mechanical-hydraulic servo system (closed loop system). Operation is as follows:

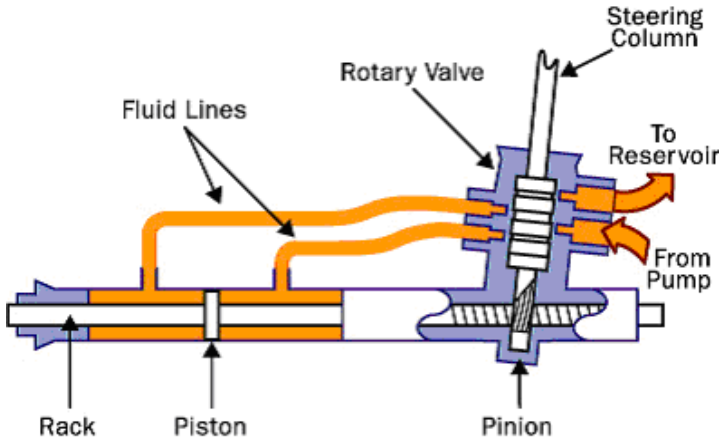


Figure 2.5 Automotive power steering system

1. The input turn of spool of rotary valve is achieved by turning of the steering wheel.
2. This moves the valve sleeve, which ports oil to the actuator (steering cylinder).
3. The piston rod moves the wheels via the steering linkage.
4. The valve spool is attached to the linkage and thus moves with it.
5. When the valve spool has moved far enough, it cuts off oil flow to the cylinder. This stops the motion of this actuator.
6. Additional motion of the steering wheel is required to cause further motion of the output wheels.

PRACTICAL NO. 03

AIM: - STUDY OF RECIPROCATING MOVEMENT OF DOUBLE ACTING CYLINDER USING PNEUMATIC DIRECTION CONTROL VALVES.

THEORY: -

3.1 INTRODUCTION

A double acting cylinder is to advance when a push button is operated. Upon release of the push button the cylinder is to retract. The cylinder is 250 mm in diameter and consumes a large volume of air. Draw the circuit diagram for the problem. Designate the valves and indicate the numbering system for the connections.

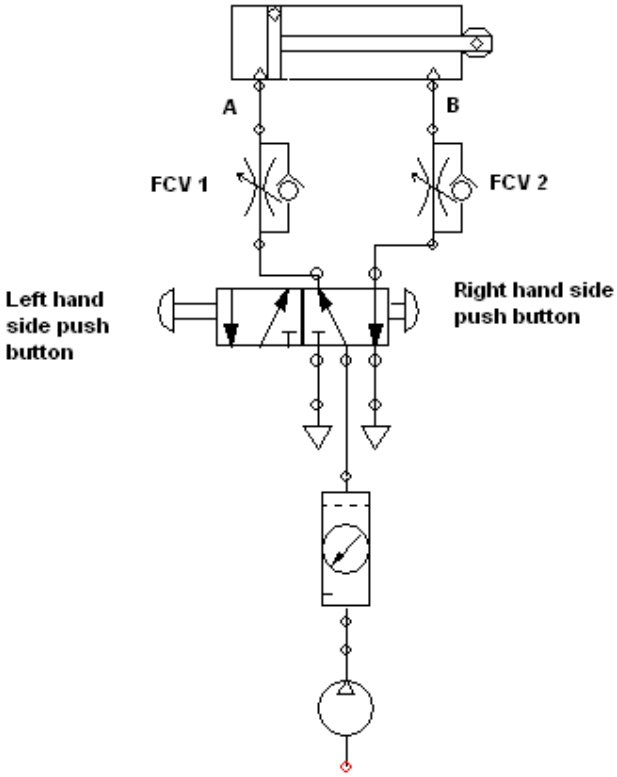
For controlling cylinders at high speed or of large diameter, the air flow required determines that a large size control valve should be used. The operating force to actuate the valve may be relatively large and in this case indirect control is preferable.

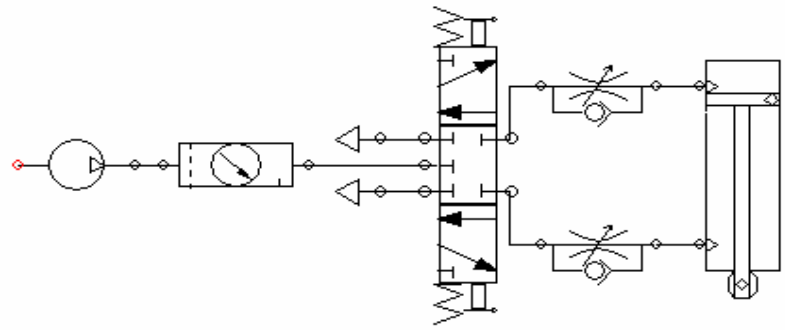
A 4/2-way or 5/2-way direction control valve controls the double acting cylinder if the piston is not to be stopped in between and 4/3 way or 5/3 way direction control valve controls the cylinder in which the piston can be stopped anywhere required.

A signal is generated or reset on the valve, if a push button actuator is pressed or released. The circuit includes:

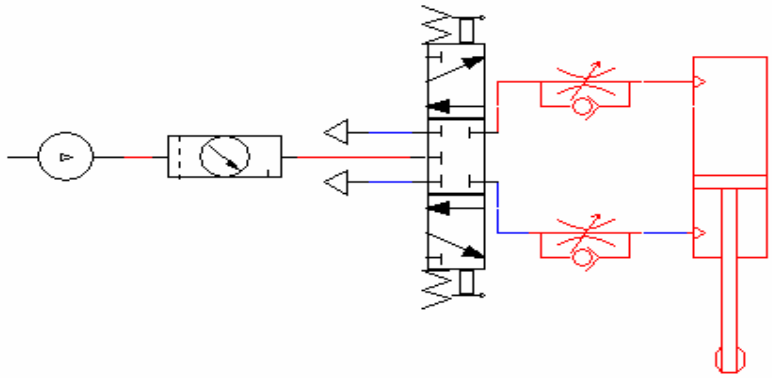
- Supply air source(Compressor)
- Air connections among supply,
- FRL Unit for conditioning of air
- Double acting cylinder
- 4/2-way/5/2-way/4/3-way/5/3-way directional control valve: push button and lever for operation and spring for return force
- Adjustable Non return flow control valves for speed control(throttling out)
- Fluid Lines

3.2 Basic Pneumatic Circuit with a 5/2 DC valve.

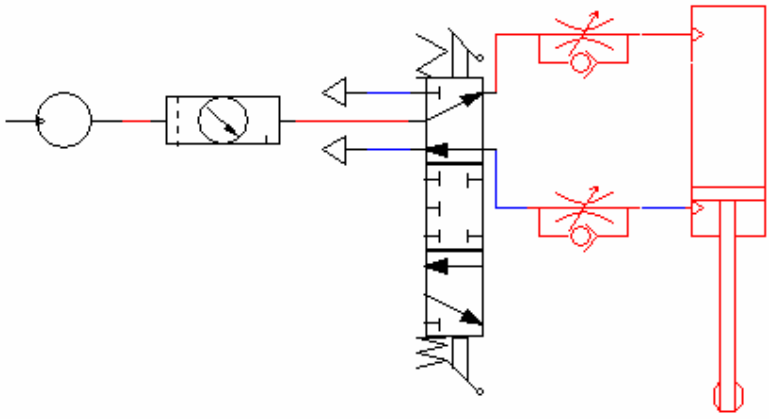




System using 5/3 DC valve with no actuation and the piston is in its initial position (Retracted)



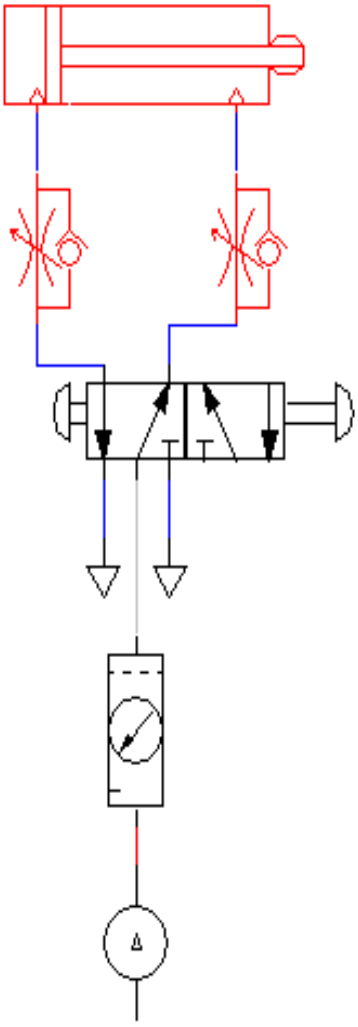
System using 5/3 DC valve with actuation released when the piston is at the middle



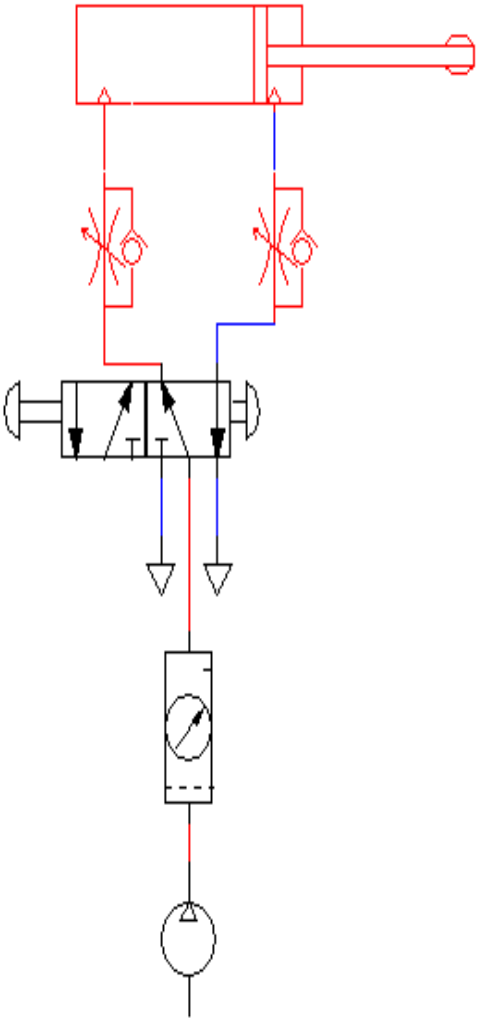
System using 5/3 DC valve with actuation selected and the piston is at the extracted position.

Double acting Cylinder control using a 5/2 DC Valve with push button actuation on one side

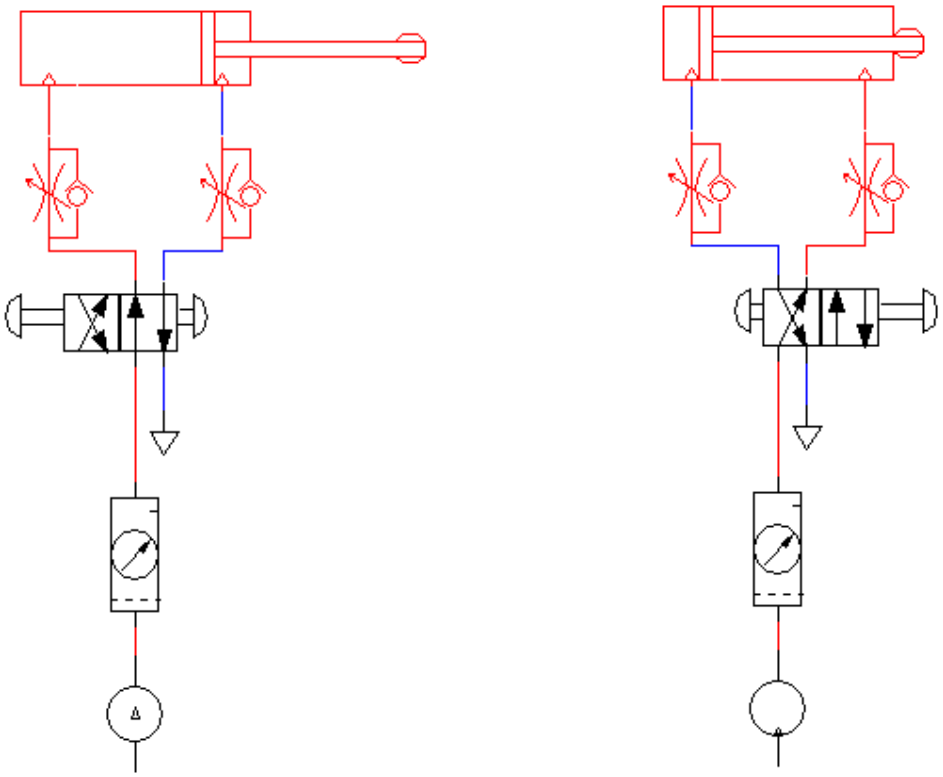
Double acting Cylinder control using a 5/2 DC Valve with push button actuation on other side and piston in extracted position



Double acting Cylinder control using a 4/2 DC Valve with push button actuation on one side



Double acting Cylinder control using a 4/2 DC Valve with push button actuation on other side and piston in extracted position



3.3 PRECAUTIONS

- Draw the cylinders and directional control valves horizontally wherever possible.
- The energy flow within the circuit moves from the bottom to the top.
- Show elements in the initial position of the control. Identify actuated elements by a cam.
- Draw pipelines straight without cross-over wherever possible.

PRACTICAL NO. 04

AIM: - USE OF DIRECTION CONTROL VALVE AND PRESSURE CONTROL VALVES CLAMPING DEVICES FOR JIG AND FIXTURE.

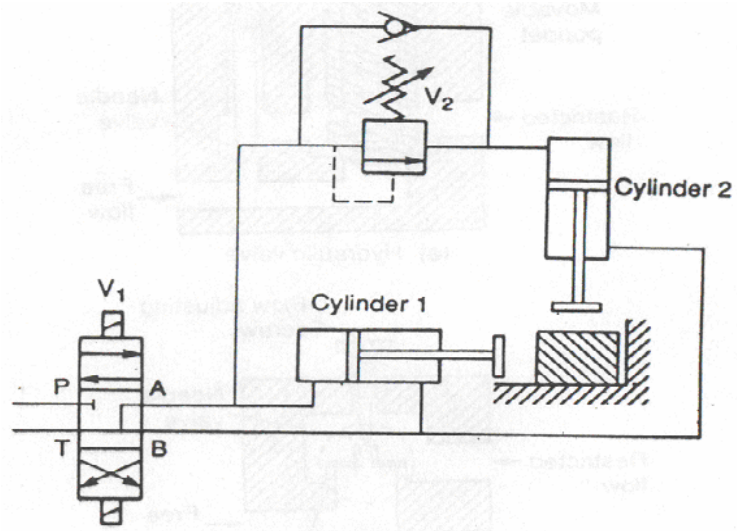
THEORY: -

4.1 PROBLEM

A plastic cubical component is embossed using a die driven by a double-acting cylinder 2. The die is to advance and emboss the plastic component only after clamping. The cylinder 1 is to be used for clamping. The cylinder 2 must operate in a sequential way only when the cylinder 1 has caught hold of the plastic piece. The embossing pressure or working pressure of the cylinder 2 must is to be adjustable.

4.2 SOLUTION

This problem can very easily be tackled by using a sequence valve as shown in the given figure If the piston rod is not in its initial position, the must be reset by operating the manual override on the 5/2-way double pilot valve.



27 Sequence valve

All valves are unactuated in the initial position, pressure is applied at the piston rod side of the cylinder and the piston rod remains in the retracted state. Circuit diagram for solution to this problem is shown in figure 4.1 below. The circuit includes:

- Double acting cylinder
- 5/2-way double pilot directional control valve
- Pressure sequence valve
- 3/2-way push button operated spring return DC valve
- Supply air source
- Air connections among supply, DC valve and cylinder

4.3 PRECAUTIONS

The response pressure set on the pressure sequence valve must be lower than the system pressure in order to ensure reliable switching.

PRACTICAL NO. 05

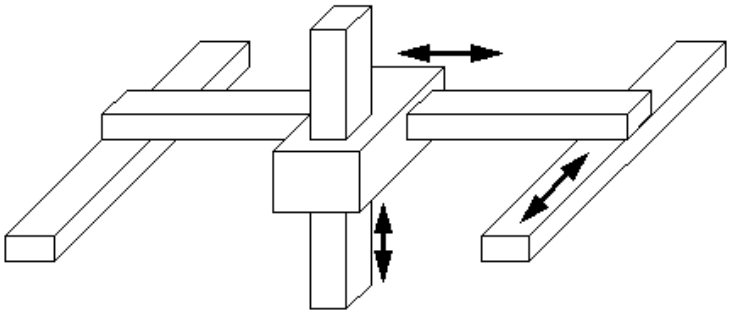
AIM: - STUDY OF ROBOTIC ARM AND ITS CONFIGURATION.

THEORY: -

There are in general 5 basic configurations namely

1. Cartesian
2. Spherical
3. Cylinderical
4. Jointed Arm
5. SCARA

5.1 CARTESIAN CONFIGURATION



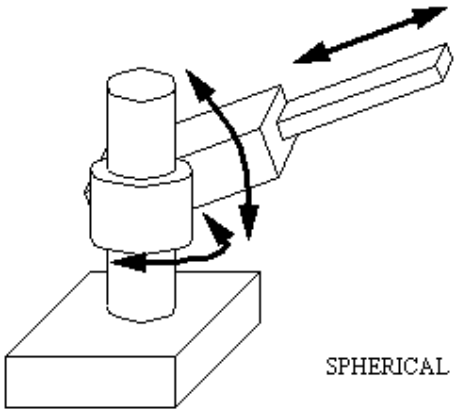
CARTESIAN/RECTILINEAR/GANTRY

Cartesian/Rectilinear/Gantry - Positioning is done in the workspace with prismatic joints. This configuration is well used when a large workspace must be covered, or when consistent accuracy is expected from the robot. It is a PPP configuration & is used for pick and place work, application of sealant, assembly operations, handling machine tools and arc welding. It's a robot whose arm has three prismatic joints, whose axes are coincident with a Cartesian coordinator.

5.2 SPHERICAL CONFIGURATION

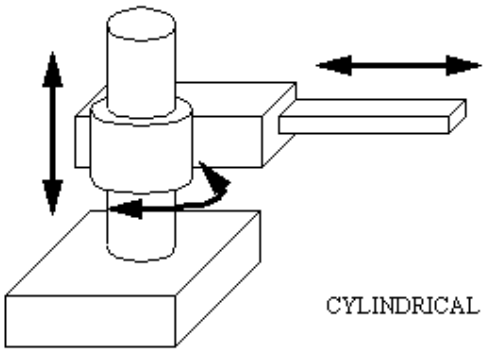
Spherical - Two revolute joints and one prismatic joint allow the robot to point in many directions, and then reach out some radial distance It is a RRP configuration & is used for handling at machine tools spot welding,

die-casting, fettling machines, gas welding and arc welding.



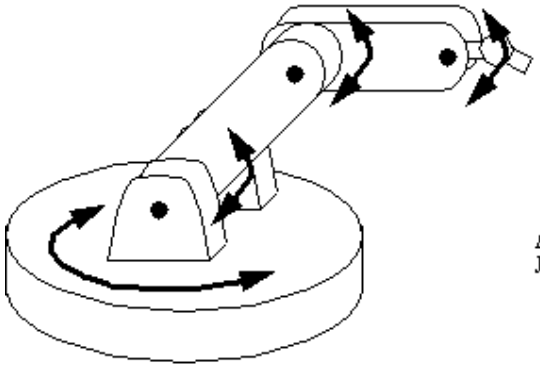
It's a robot whose axes form a polar coordinate system.

5.3 CYLINDERICAL CONFIGURATION



Cylindrical - The robot has a revolute motion about a base, a prismatic joint for height, and a prismatic joint for radius. This robot is well suited to round workspaces. It is a RPP configuration & is used for assembly operations, handling at machine tools, spot welding, and handling at die-casting machines. It's a robot whose axes form a cylindrical coordinate system.

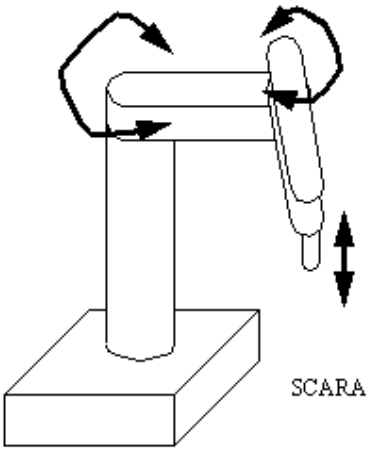
5.4 JOINTED ARM CONFIGURATION



ARTICULATED/REVOLUTE/
JOINTED SPHERICAL

Articulated/Jointed Spherical/Revolute - The robot uses 3 revolute joints to position the robot. Generally the work volume is spherical. This robot most resembles the human arm, with a waist, shoulder, elbow, and wrist. This configuration is RRR configuration & is useful for pick & Place operations. It has got the flexibility to handle the object beneath or above the arm.

5.5 SELECTIVE COMPLIANCE ARTICULATED ROBOTIC ARM (SCARA)

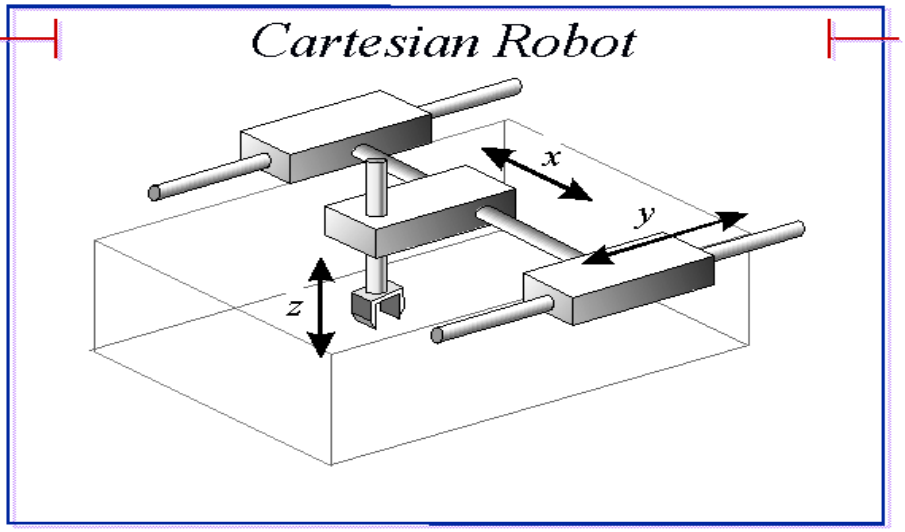


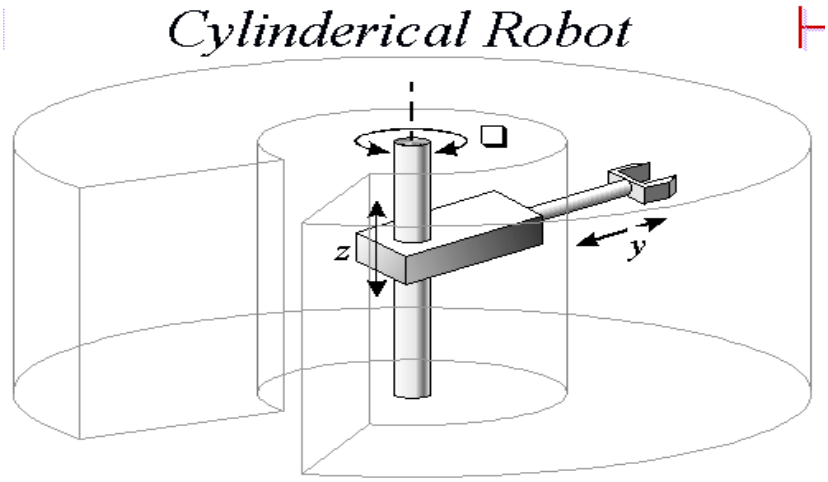
SCARA

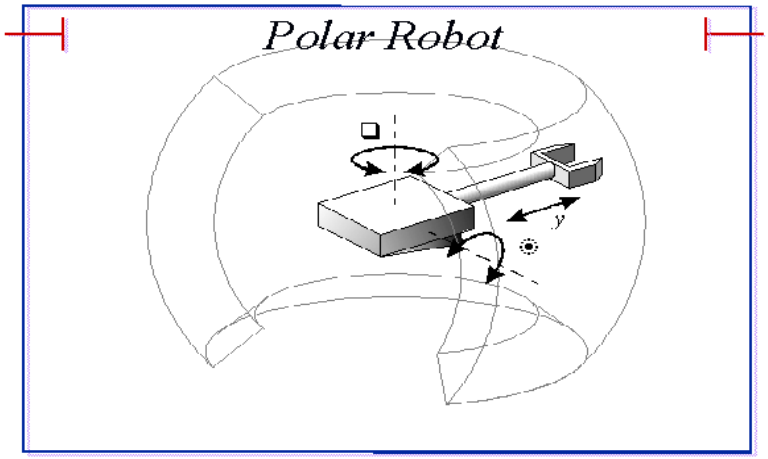
This robot conforms to cylindrical coordinates, but the radius and rotation is obtained by a two planar links with revolute joints. It is a RRP configuration & is used for pick and place work, application of sealant, assembly operations and handling machine tools. It's a robot which has two parallel rotary joints to provide compliance in a plane

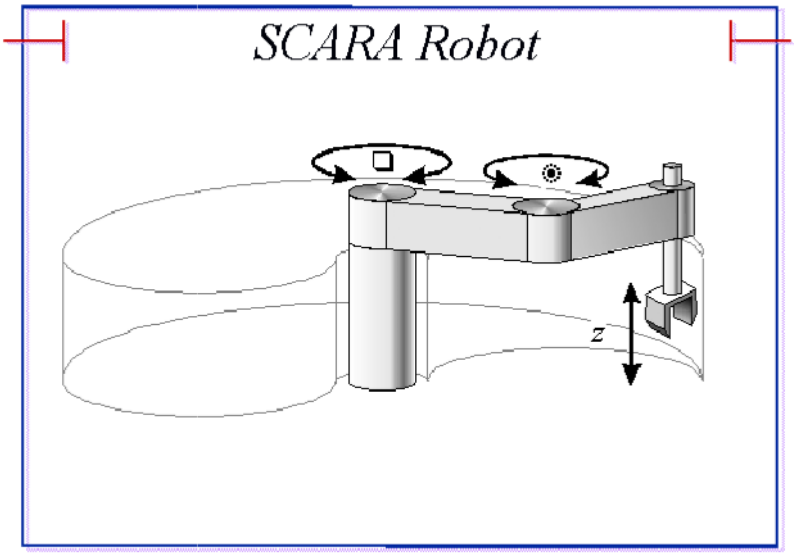
5.6 WORK VOLUMES

Work Volume is defined as the 3 Dimensional Space around the arm where it can reach again & again with a desired accuracy & precision.






Polar Robot
y


SCARA Robot
z

S.NO	Configuration	Joints Type	Advantages /Disadvantages
1	Cartesian	PPP	Advantages 1. Linear motion in 3 dimensions 2. Simple Kinematic Model 3. Rigid Structure 4. Easy to visualize 5. Compatible With pneumatics Disadvantages 1. Requires a large volume 2. Workspace is smaller than robot volume. 3. Unable to reach areas under objects 4. Guiding surfaces are required **5.** Must be covered to prevent ingress of dust
2	Cylinderical	**RPP**	Advantages 1. Simple Kinematic Model 2. Easy to visualize 3. Good access to cavities & machine openings 4. very powerful with hydraulic drives Disadvantages 1. Restricted work space 2. Prismatic guide difficult to seal **3.** Back of robot can overlap work volume.
3	Spherical	**RRP**	Advantages 1. Covers a large volme from a central support. 2. Can bend down to pick up fallen objects. Disadvantages 1. Complex Kinematic model **2.** Difficult to visualize
4	Jointed Arm	**RRR**	Advantages 1. Maximum Flexibility 2. Covers a large work space compared to work volume 3. Revolute joints are easy to seal 4. Suits electric drives 5. Can reach over & under objects Disadvantages 1. Complex Kinematic model 2. Difficult to visualize 3. Control of linear motion is difficult **4.** Structure not very rigid

PRACTICAL NO. 06

AIM: - STUDY OF ROBOTIC END EFFECTORS.

THEORY: -

6.1 INTRODUCTION

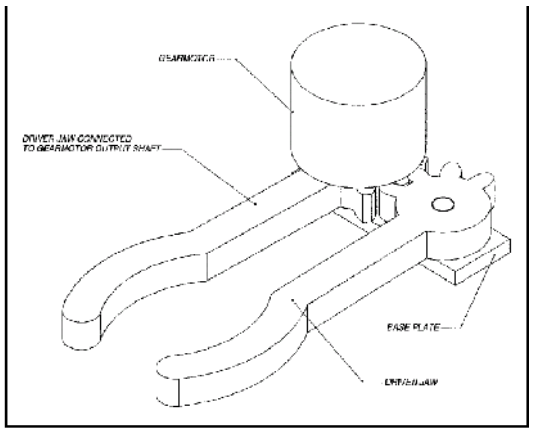
The end of the manipulator is the part the user or robot uses to affect something in the environment. For this reason it is commonly called an end-effector, but it is also called a gripper since that is a very common task for it to perform when mounted on a robot. It is often used to pick up dangerous or suspicious items for the robot to carry, some can turn doorknobs, and others are designed to carry only very specific things like cans. Closing too tightly on an object and crushing it is a major problem with autonomous grippers. There must be some way to tell how hard is enough to hold the object without dropping it or crushing it. Even for semi-autonomous robots where a human controls the manipulator, using the gripper effectively is often difficult. For these reasons, gripper design requires as much knowledge as possible of the range of items the gripper will be expected to handle. Their mass, size, shape, and strength, etc. all must be taken into account. Some objects require grippers that have many jaws, but in most cases, grippers have only two jaws and those will be shown here.

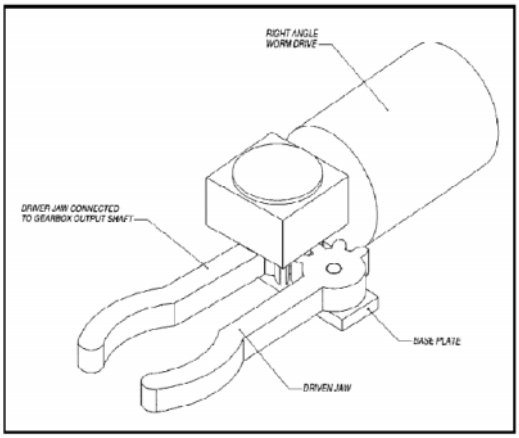
6.2 Types of Grippers

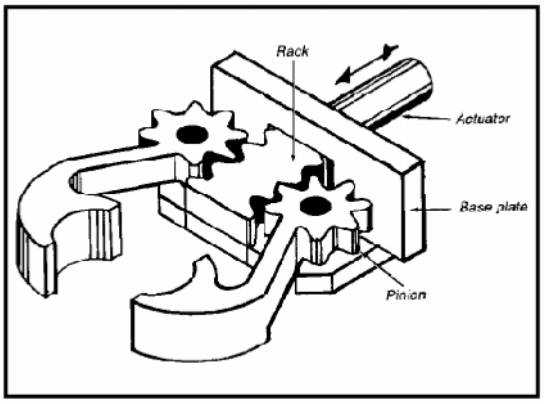
1. Mechanical grippers
2. Collet grippers
3. Vacuum grippers
4. Fragile-object grippers
5. Magnetic grippers
6. Expandable grippers

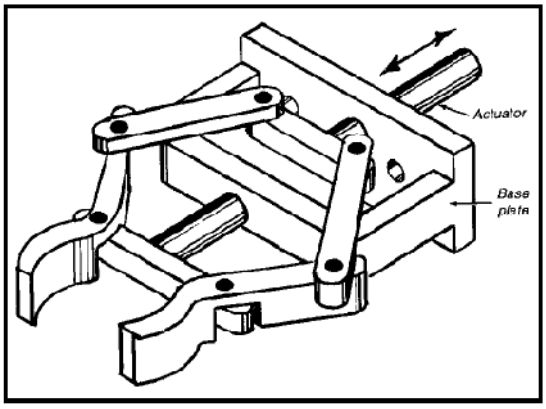
MECHANICAL GRIPPERS

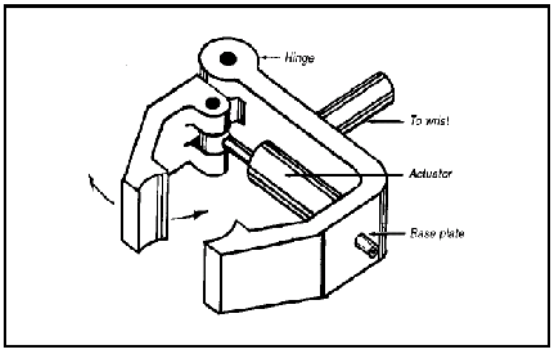
Mechanical grippers are the most common grippers available. They make use of levers, gears, springs etc to hold objects. They can be angular or parallel

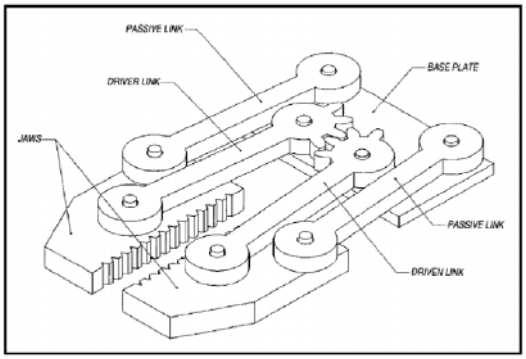


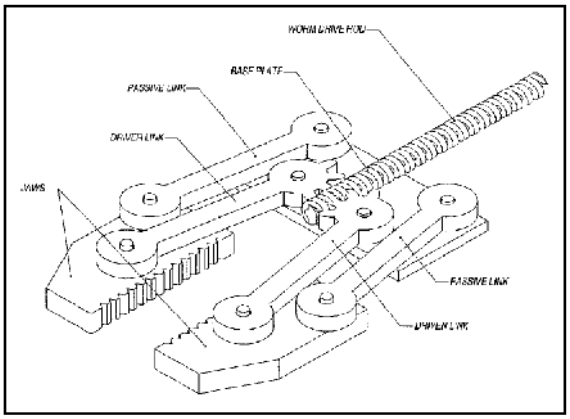


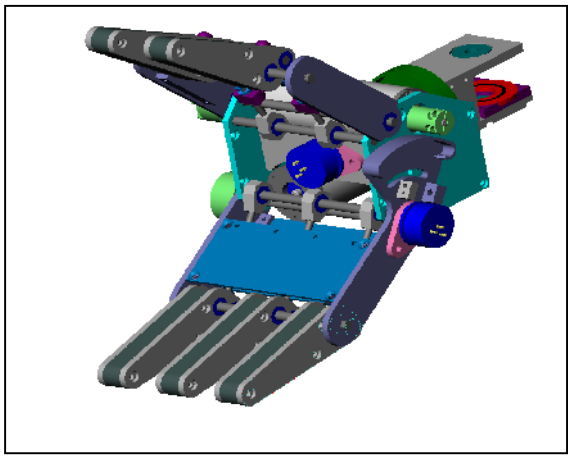


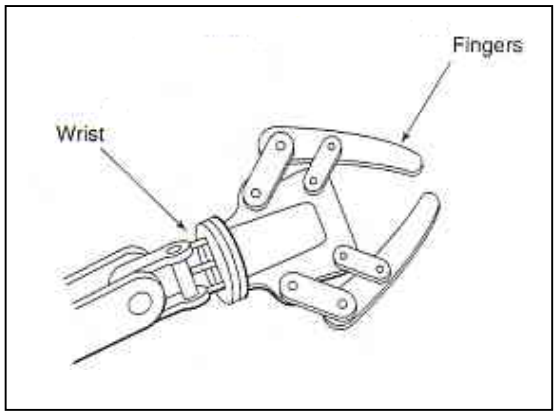


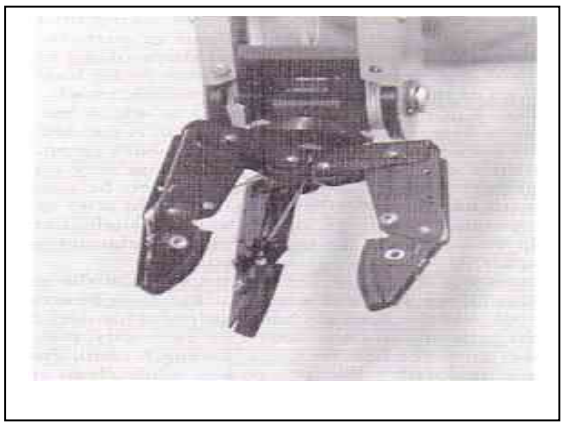








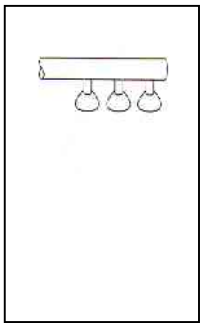




COLLET GRIPPERS

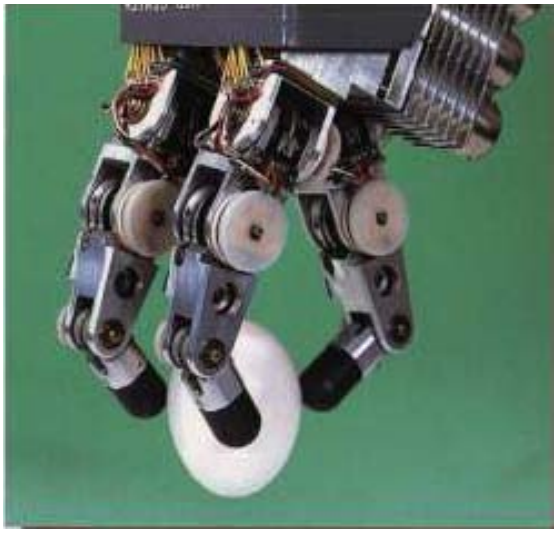
Collet grippers are used to pick and place cylindrical parts that are uniform in size. They are particularly used where the end tooling is required for machining operations etc.360° of clamping contact is achieved in such grippers and round, square or hexagonal shapes can be accommodated.

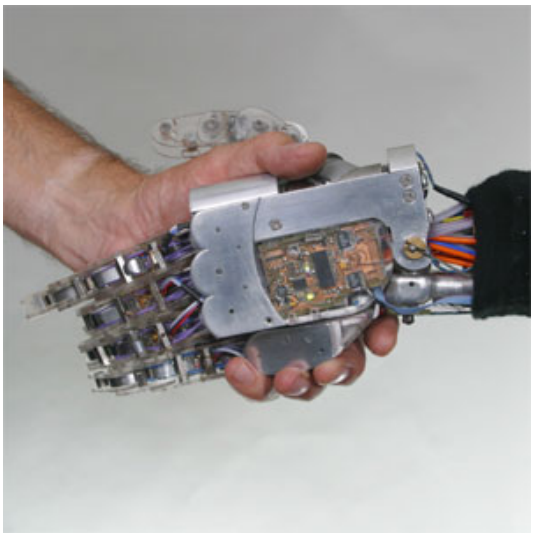
VACUUM GRIPPERS



Vacuum grippers make use of negative pressure to hold the things. Smooth surface can be handled using such grippers. They utilizes suction cups made of natural or synthetic rubber. Number of grippers (cups) determines the size and weight of object to be grasped Handling of fragile parts. Positioning of parts not as critical as with other grippers

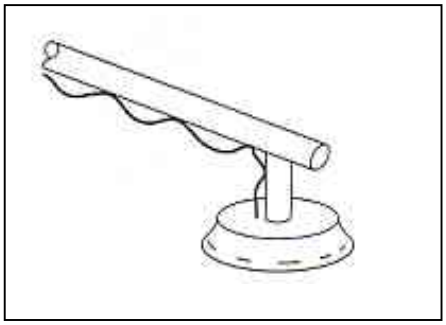
FRAGILE-OBJECT GRIPPERS





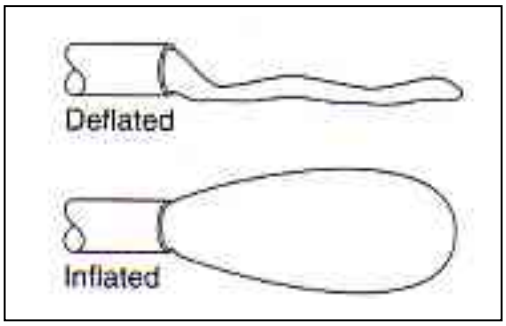
Fragile grippers have got cushioning in their grips along with they are provided with force control system on the grips in the form of load cells or adjustable pressure control so that the object of interest is gripped properly without damage. These grippers are used to handle sophisticated, delicate and prone to fracture objects in which the amount of compliance required is controllable and which plays a great role.

MAGNETIC GRIPPERS



These grippers work on the principle of magnetic effect either from a Electromagnet or permanent magnet. If permanent magnet is used, there needs to be some stripping device to separate part from gripper. Ferrous parts, easier to handle if surface is smooth and clean. Support grippers. Crane-type manipulators have support grippers, e.g. hooks, scoops etc. The main problem is that objects have a tendency to topple over or fall with quick movements. The wire as shown carries the electric supply which makes an scoop or hook as electromagnet thereby attracting the ferrous material.

EXPANDABLE GRIPPERS



These grippers are made up of hollow rubber envelope which expands when pressurized to grasp object. Such grippers are employed where evenly distributed pressure on surface is required for gripping. There are two types of expandable grippers: interior or exterior grasping.

PRACTICAL NO. 07

AIM: - STUDY OF DIFFERENT TYPES OF HYDRAULIC AND PNEUMATIC VALVES.

THEORY: -

7.1 INTRODUCTION

The function of valves is to control the pressure or flow rate of pressure media. The principle of operation of most valves is the same. A valve is a variable area orifice where the orifice area may be controlled by conditions in a circuit, for example a pressure relief valve operates without operator intervention. Alternatively the orifice area may be controlled by an operator as in a directional control valve. Valves are used in hydraulic & pneumatic systems to control the operation of the actuators. Valves regulate pressure by creating special pressure conditions and by controlling how much oil will flow in portions of a circuit and where it will go. The three categories of hydraulic valves are pressure-control, flow- (volume-) control, and directional-control. Some valves have multiple functions, placing them into more than one category. Valves are rated by their size, pressure capabilities, and pressure drop/flow. Depending upon design, these can be divided into following categories:

Direction control valves

Flow control valves

Pressure control valves

Special Purpose Valves

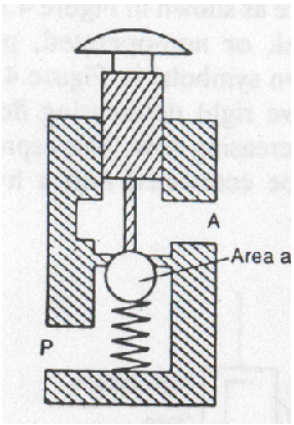
Logic Valve

Servo Valves

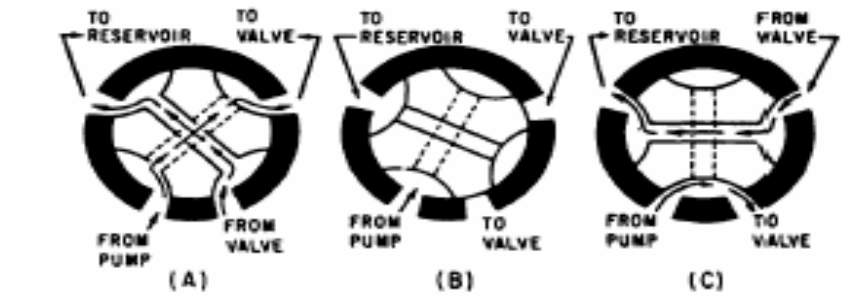
7.2 DIRECTION CONTROL VALVES

Directional-control valves also control flow direction. However, they vary considerably in physical characteristics and operation. Directional-control valves may also be classified according to the method used to actuate the valve element. A poppet-type valve is usually hydraulically operated. A rotary-spool type may be manually (lever or plunger action), mechanically (cam or trip action), or electrically (solenoid action) operated. A sliding-spool type may be manually, mechanically, electrically, or hydraulically operated, or it may be operated in combination. The valves maybe a

1. Poppet type, in which a piston or ball moves on and off a seat. It consists primarily of a movable poppet that closes against a valve seat. Pressure from the inlet tends to hold the valve tightly closed. A slight force applied to the poppet stem opens the poppet. The action is similar to the valves of an automobile engine. The poppet stem usually has an O-ring seal to prevent leakage. In some valves, the pop-petsare held in the seated position by springs. The number of poppets in a valve depends on the purpose of the valve.



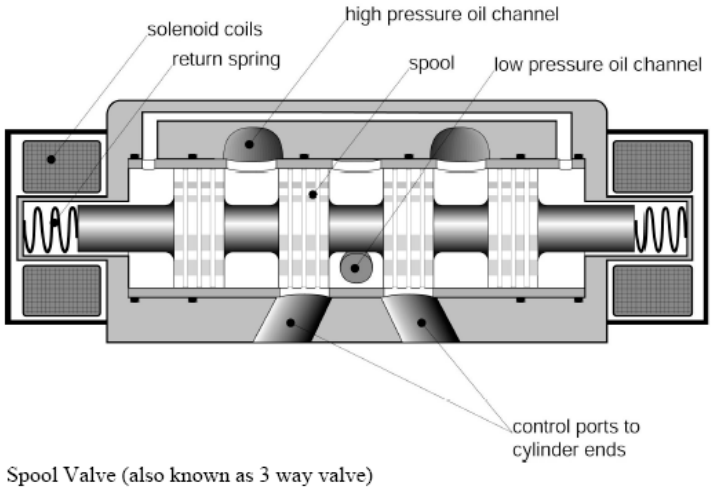
2. Rotary Spool Control type, in which a spool rotates about its axis and the angular displacement of the spool, controls the flow of fluid from one



port to another. It is therefore used in hydraulic power steering of automobiles in which direction of rotation of the steering wheel determines the steering direction of the wheels.

3. Sliding Spool Valve is simplest form of spool is a series of small cylindrical drums on a shaft. Each drum may be called a land. The minimum number of lands in a spool valve is two, but four are often used in more expensive valves, such as the proportional type, to achieve more accurate guidance. The valve body has grooves machined in the bore. The edges of the spool lands and the grooves in the bore are machined to a vanishing small radius, so the cylindrical

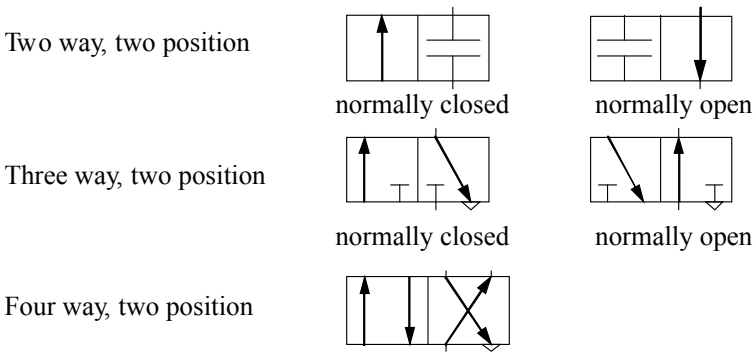
ring orifice that is formed by the displacement of the spool on the bore has sharp edges. Spool valves, however, require good maintenance.



Spool Valve (also known as 3 way valve)

Sliding-spool type, in which a spool slides axially in a bore. In this type, a spool is often classified according to the flow conditions created when it is in the normal or neutral position. A closed-center spool blocks all valve ports from each other when in the normal position. In an open-center spool, all valve ports are open to each other when the spool is in the normal position. .

Directional-control valves may also be classified according to the number of positions of the valve elements or the total number of flow paths provided in the extreme position.



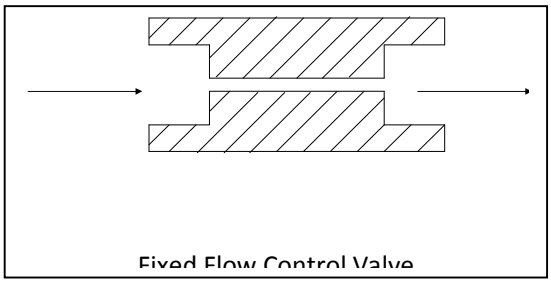
For example, a three-position, four-way valve has two extreme positions and a center or neutral position. In each of the two extreme positions, there are two flow paths, making a total of four flow paths or four way or four ports.

7.3 FLOW CONTROL VALVES

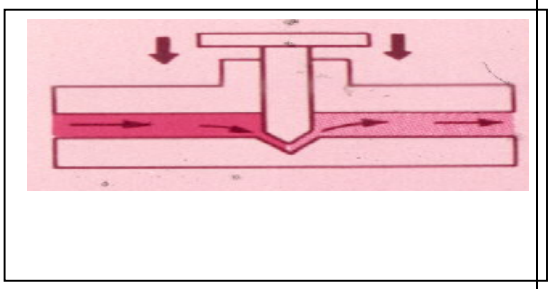
The purpose of flow control in a hydraulic system is to regulate speed of the system. The control the speed of an actuator is carried out by regulating the flow rate of the fluid passing through it. Flow rate also determines rate of energy transfer at any given pressure. The two are related in that the actuator force multiplied by the distance through which it moves (stroke) equals the work done on the load. The energy transferred must also equal the work done. Actuator speed determines the rate of energy transfer (i.e., horsepower), and speed is thus a function of flow rate.

The flow control valves are of two types:

- Fixed flow control valves
- Variable flow control valves

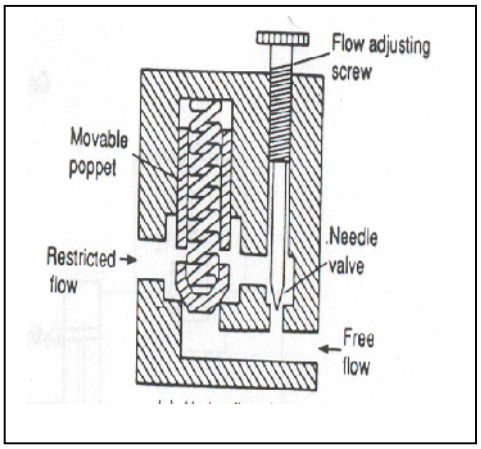


Fixed Flow Control Valve



In fixed flow control types of valves the amount of fluid passing through it remains fixed whereas in the variable flow control valves there is a provision of controlling the flow of fluid passing through it.

One more type of flow control valve is Restricted Flow Control Valve. In this valve the in one direction the flow is free to move and in the other direction the flow can be controlled. These are widely used in controlling the speed of various actuators.

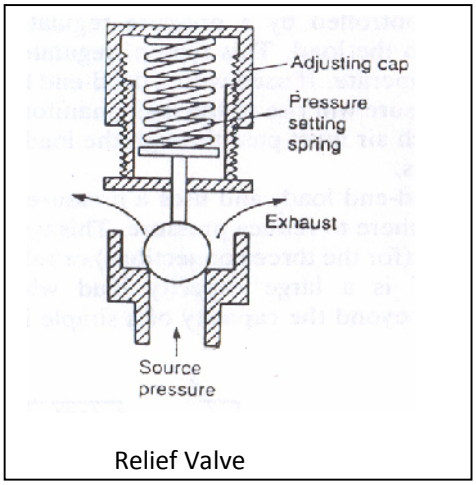


7.4 PRESSURE CONTROL VALVES:

A pressure-control valve may limit or regulate pressure, create a particular pressure condition required for control, or cause actuators to operate in a specific order. All pure pressure-control valves operate in a condition approaching hydraulic balance. Usually the balance is very simple: pressure is effective on one side or end of a ball, poppet, or spool and is opposed by a spring. In operation, a valve takes a position where hydraulic pressure balances a spring force. Since spring force varies with compression, distance and pressure also can vary. Pressure-control valves are said to be infinite positioning. This means that they can take a position anywhere between two finite flow conditions, which changes a large volume of flow to a small volume, or pass no flow.

Most pressure-control valves are classified as normally closed. This means that flow to a valve's inlet port is blocked from an outlet port until there is enough pressure to cause an unbalanced operation. In normally open valves, free flow occurs through the valves until they begin to operate in balance. Flow is partially restricted or cut off. Pressure override is a characteristic of normally closed-pressure controls when they are operating in balance. Because the force of a compression spring increases as it lowers, pressure when the valves first crack is less than when they are passing a large volume or full flow. The difference between a full flow and cracking pressure is called override.

The simplest example of a pressure control valve is relief valve. The relief valve is used to release the extra pressure if mounted in the system against the set pressure. It works on the principle of counterbalance of forces. The tension in the controlling spring is adjusted against the pressure of the fluid acting in the system. If the force exerted due to pressure is more than the spring tension then the extra pressure is relieved to the atmosphere.

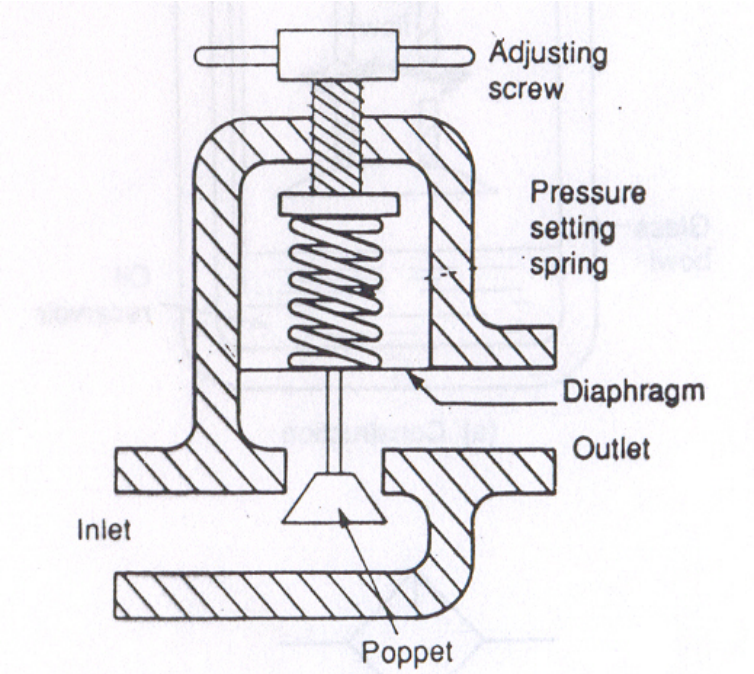


Relief Valve

Relief valves come in two forms. In the direct acting type, the pressure to be relieved acts directly on the fluid regulating element. This type is commonly employed in systems with relatively low flow rates. Where high flow rates must be passed, a pilot operated type is commonly employed. In this type the pressure to be controlled acts

on a pilot. As soon as this pilot allows flow, the pressure difference across the main regulating element becomes large enough to provide a force that causes the valve to open rapidly because the spring controlling the main element is light.

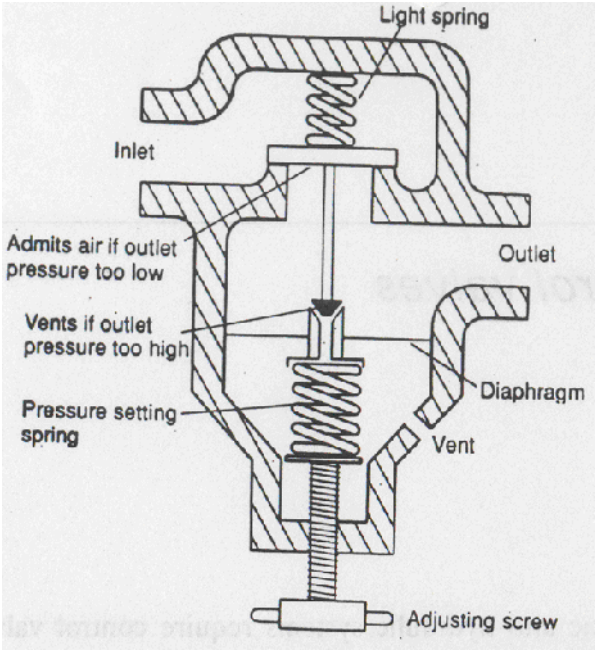
NON RELIEVING TYPE PRESSURE CONTROL VALVE



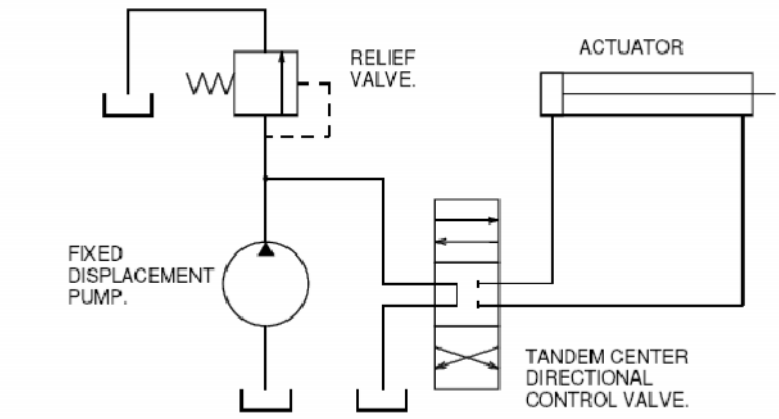
In non relieving type pressure control system the system pressure acts on a diaphragm which is resting on a spring whose tension can be adjusted. As the pressure in the system is less than the spring tension and the system pressure, the poppet will move down and allow more fluid to enter from the pressure line and if the system pressure is low the diaphragm will move up causing the poppet to close on the seat thereby restricting the flow of fluid from the source into the system. In this way the pressure is regulated without relieving the fluid to move out of the system.

RELIEVING TYPE PRESSURE CONTROL VALVE

In this type of pressure regulating device there is an arrangement of vent through which if somehow an extra pressure is maintained in the system, then that can be relieved.

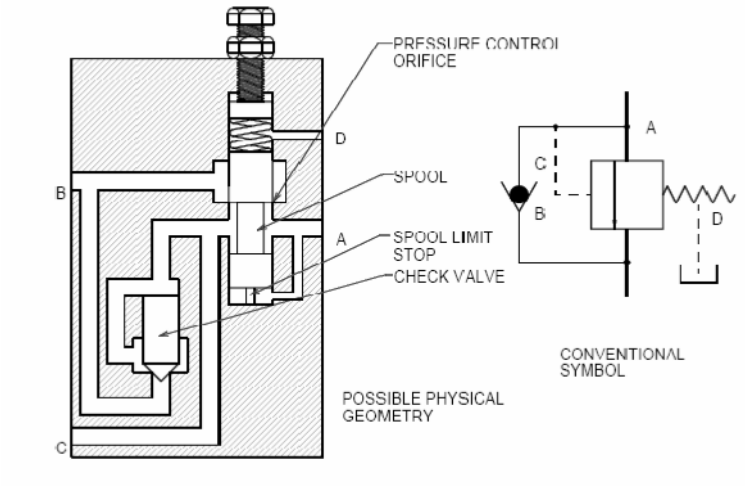


These pressure regulating devices are employed where there is high pressure to deal with and the excessive pressure can be allowed to go back into the reservoir or to be liberated.These pressure regulating devices are provided in the high pressure line between the source and the direction control valves as shown in the figure given below.



Pressure protection of a system with a relief valve.

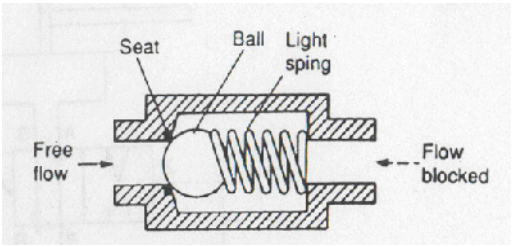
PRESSURE SEQUENCING VALVE

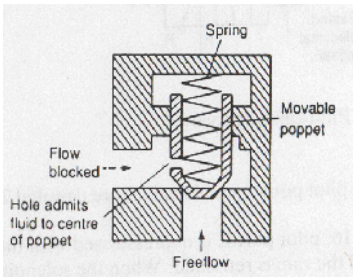


It is often necessary for two actions to take place sequentially. For example, in a machining operation the work piece may be clamped by one actuator and after the clamping action is completed a drill head may be moved by another actuator. At the end of clamping, the actuator extension is blocked and the pressure will rise. This pressure rise can be sensed by a sequencing valve and the flow diverted to a secondary circuit. A sequencing valve is a special application of a direct action relief valve (Figure 7.17). The pressure differential across the fluid control element is between the primary circuit pressure and the reservoir.

7.5 SPECIAL PURPOSE VALVES

CHECK VALVE



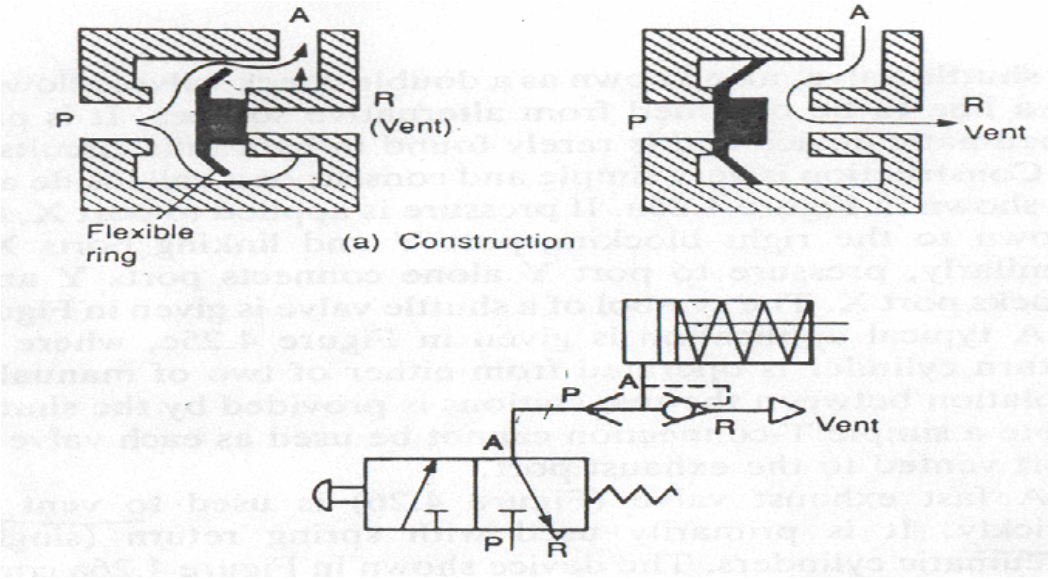


The check valve in the system is to check the direction of fluid flow in the reverse

direction. This is also called as unidirectional valve as it allows the flow only in on direction

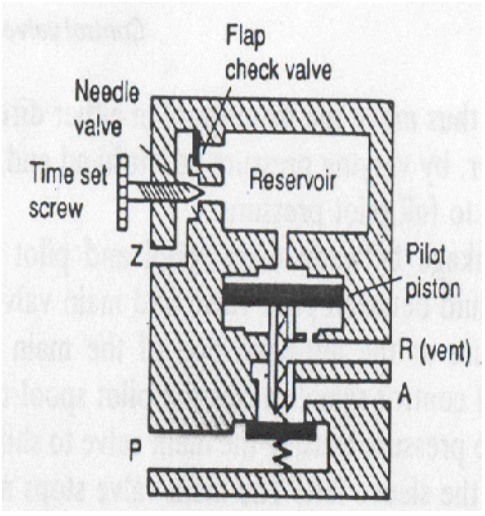
QUICK EXHAUST VALVE

This valve is used when the used air is removed from the actuator in a very short time. In this valve the fluid is allowed to come from a constricted opening from P due to a flexible ring but is allowed to escape from a bigger opening R and thereby venting the fluid from the system in a very small time. To make the unproductive strokes faster such valves are used which can help in reducing the cycle time.



TIME DELAY VALVE

Time delay valve is a valve in which there is an arrangement of three ports. One port is for pressure supply and the other one the output port. The third one is the trigger port and when the pilot pressure is applied on this trigger port, the delay starts .This delay can be adjusted by the movement of the set screw of needle valve. As the delay period is over the pressure line gets connected to the output line.



Time Delay Valve

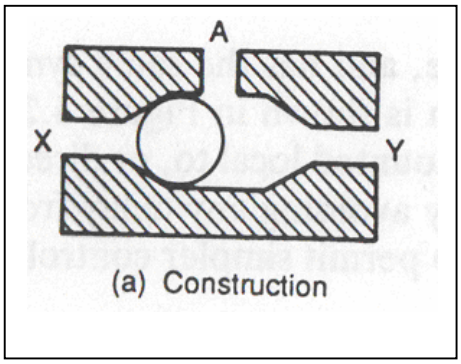
7.6 LOGIC VALVES

Logic valves are those valves which work on the principle of gates.

1 Shuttle Valve/ OR Gate:

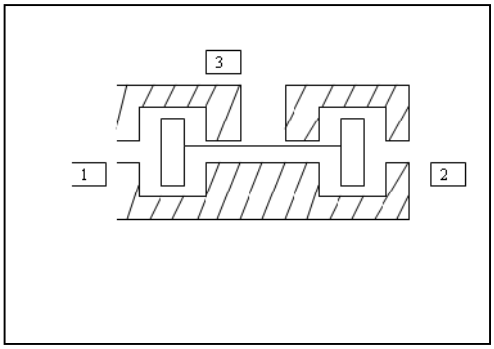
This valve acts like a or gate. Here there are two inputs X & Y and one output A.

When there is supply or input at any of X or Y or both the output can be collected from port A based on OR Logic



2 Twin Pressure Valve/AND Gate:

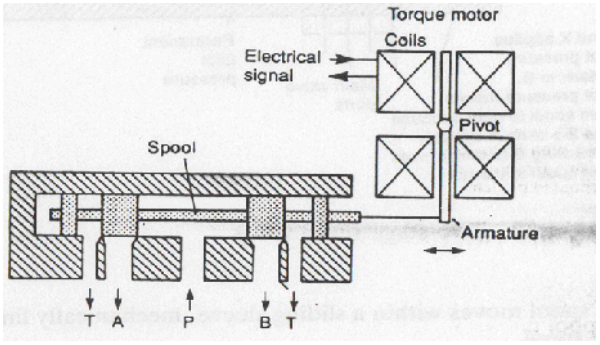
This valve acts like a AND gate. Here there are two inputs X & Y and one output A. When there is supply on both inputs then only the output can be collected from port A based on AND Logic. In this valve 1 and 2 are inputs and 3 is output. Output only occurs when there is an and preposition between the inputs



7.7 SERVO VALVES

These are infinite position valve which gives their output on the basis of a feedback signal from the system

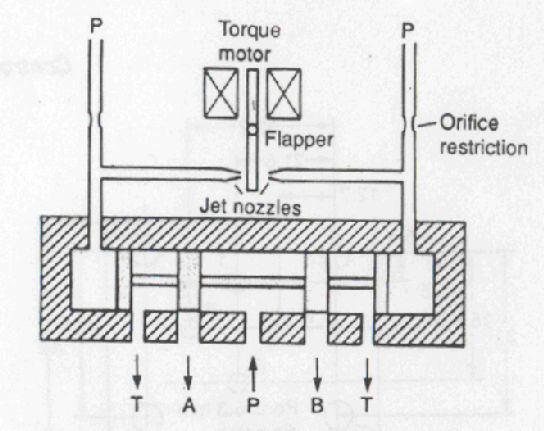
1. Angular displacement Servo Valve



Servo name is associated with the feedback. The spool movement is connected to a angular displacement measuring system which calibrates it in an electrical

signal. The movement of the servo can be controlled using the feedback electrical signal.

2 Jet Flapper Servo Valve



In jet flapper servo valve when the flapper is in the centre the spool is at normal mean position. As there is some variation then the flapper closes the opening of the jet nozzles restricting the release of fluid and a differential pressure is created at the ends of the spool valve. This differential pressure acts on the spool valve and is responsible for the actuation of the spool thereby controlling the fluid.