CHAPTER - 6

HYDRO PNEUMATIC SYSTEMS &CIRCUITS

By Prof. S.P.Chaphalkar

6.1 Comparison of Hydraulic & Pneumatic Circuits

Hydraulic Circuits	Pneumatic Circuits
1. Working fluid used is oil	1. Working fluid used is air
2. The operation is complicated	2.The operation is simple
3. The operation is quiet	3. The operation is noisy
4. To pressurized the oil, pump is necessary	4. Air compressor is necessary
5. It require return lines, hence the circuit is complicated	5. No return lines are required, hence circuit is simple
6. Speed is limited	6. Very high speed can be possible
7. There is possibility of fire hazards when working with higher temperatures.	7. It is safe in volatile atmosphere.

6.1 Comparison of Hydraulic & Pneumatic Circuits

Hydraulic Circuits	Pneumatic Circuits
8. Its operating pressure can be lower to very high	8. Its operating pressure is limited to 6 bar
9. In this the system rigidity is good	9. In this system rigidity is poor
10. It has simple maintenance	10. It also has simple maintenance
11. It requires moderate operating cost	11. It requires very low operating cost
12. Overall cost is higher	12. Overall cost is lower
13. It is very much suitable where long strokes are required	13. It is not suitable for long strokes
14. It is suitable for feed movements of machine tools. Stroke control is easy and is very precise	14. It is not suitable for feed movements. Stroke control is easy, but fluctuations cannot be avoidable.

6.1 Comparison of Hydraulic & Pneumatic Circuits

Hydraulic Circuits	Pneumatic Circuits
15. Applications: Automatic lathe Drilling machines Grinding machines Shaping machines Crushers Fork lift trucks Dumpers Truck loaders Bulldozers Hydraulic press	15. Applications: Automatic machines for holding, gripping, feeding, bottling, wrapping, packaging etc. Clamping jigs & fixtures Wire feeding For raw material feeding For hoist, Lift, Cranes For furnace operations For power tools For mining boring, shoveling Automatic tillers For press tools

Hydraulic Circuits

- A hydraulic circuit is a group of components arranged in such a way that they will perform a useful task.
- The elements of hydraulic circuit are pumps, actuators, control valves, pipe & pipe fittings, reservoir, accumulator, filter and strainer
- These components are arranged in various ways to obtain a desired output from the circuit.

Hydraulic Circuits

- While designing any hydraulic circuit the following points should be considered.

1. Performance of desired function
2. Efficiency of operation
3. Safety of operation
4. How much force is needed?
5. How fast circuit should function (actuating speed)?
6. Control desired – manual, mechanical, electrical, pilot.
7. Input energy source
8. Life of system desired.

Hydraulic power unit

- The hydraulic power unit consist of pump, filter, reservoir, pressure gauge, pressure relief valve, electric motor, shut-off valve, pipe and pipe fittings.
- In this power unit pump is driven by electric motor, oil rushes from reservoir via filter and deliver at higher pressure at its outlet.
- To set maximum pressure in the system, a pressure relief valve is connected which gets open when pressure in the system is above set value.
- The shut-off valve is opened to read the pressure gauge reading.

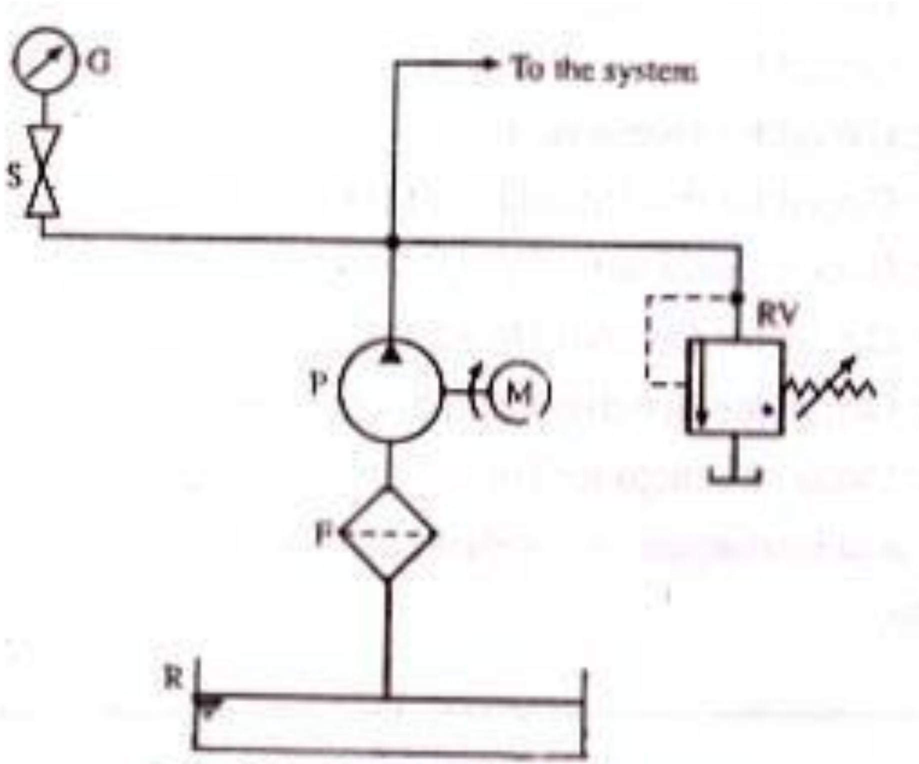


Fig. 7.1 : Hydraulic power unit

Flow control circuits

- When a constant delivery pump is used to deliver a constant volume of fluid to the circuit, then the speed or feed control should be provided with metering valves.
- To ensure proper feed and speed of an actuator, the flow control valves may be used in the circuits.
- There are following methods to control flow

1. Meter-in control circuit
2. Meter-out control circuit
3. Bleed-off control circuit

Meter-in control circuit

- Fig. shows the meter-in circuit.
- In this flow control valve is connected between the D.C valve and blind end of the cylinder.
- Here metered fluid enters the cylinder which controls the speed and feed of the piston.
- When D.C. valve is manually shifted to right side the flow from pump passes through the compensated flow control valve into blind end of cylinder and the exhaust fluid is directed freely to the reservoir.

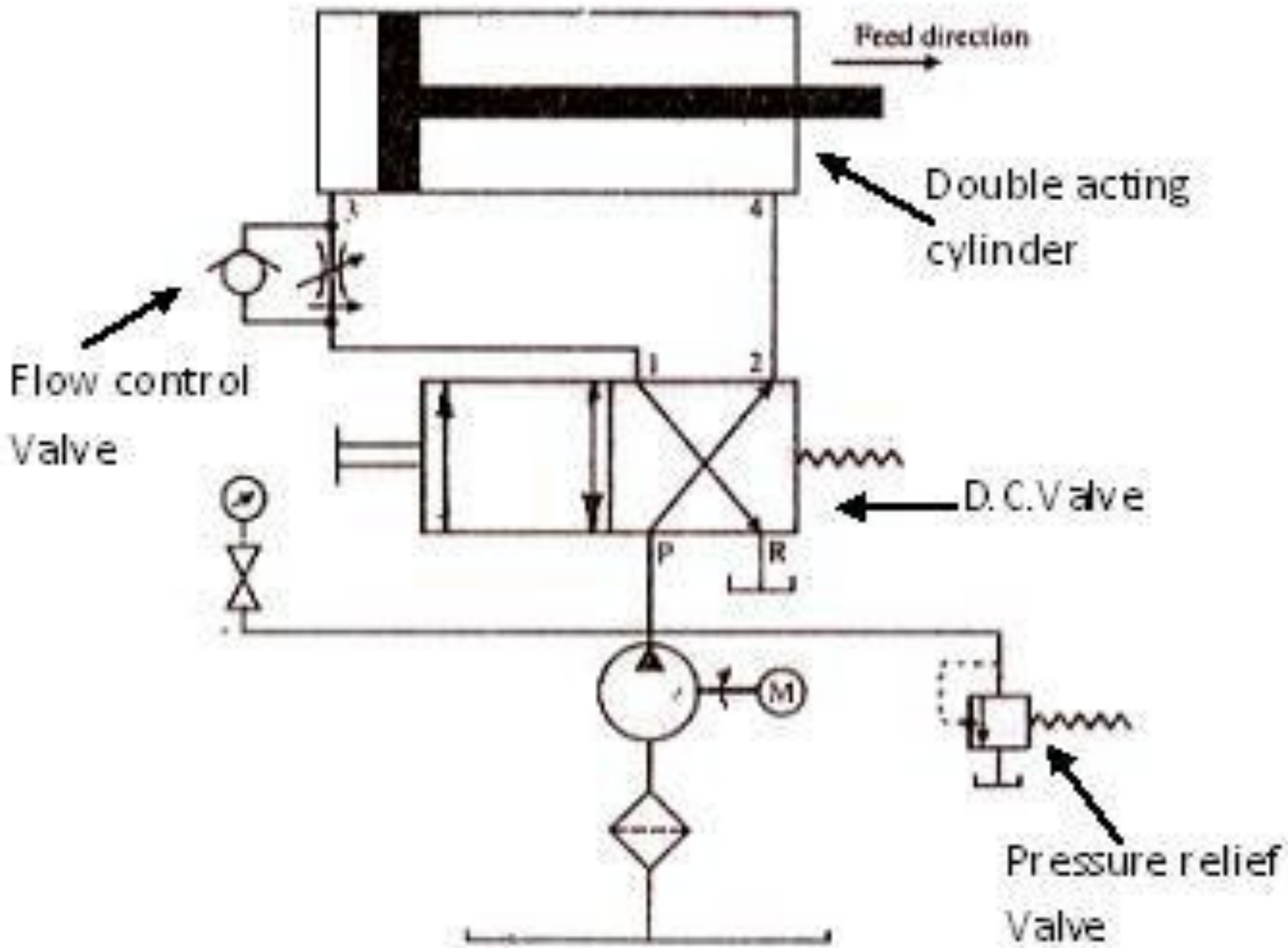


Fig. 7.3 : Meter-in hydraulic circuit

- When the force on D.C. valve is released, it permits the spool to return due to valve spring and the pump flow is directed to the rod end of the cylinder.
- The fluid from blind end of the cylinder will pass through the integral check valve in the flow control mechanism and the piston can be retracted rapidly to its initial position.
- Flow during retraction is not controlled (i.e. Free flow)
- This method is used when the load characteristics are constant and positive. Hence they are used in surface grinder & milling m/c.
- Also in Shaper planner slotter due to quick return.

Meter-out speed control circuit

- Fig. shows meter-out speed control circuit.
- In this flow control valve is located between D.C. valve and rod end of cylinder in such a way that the fluid is metered as it leaves the cylinder.
- When D.C. valve is manually shifted to right side the flow from pump passes to blind end of cylinder and the exhaust fluid is directed through flow control valve to the reservoir. Due to this the movement of piston is regulated as fluid has restriction on rod end side. Thus piston moves slowly.

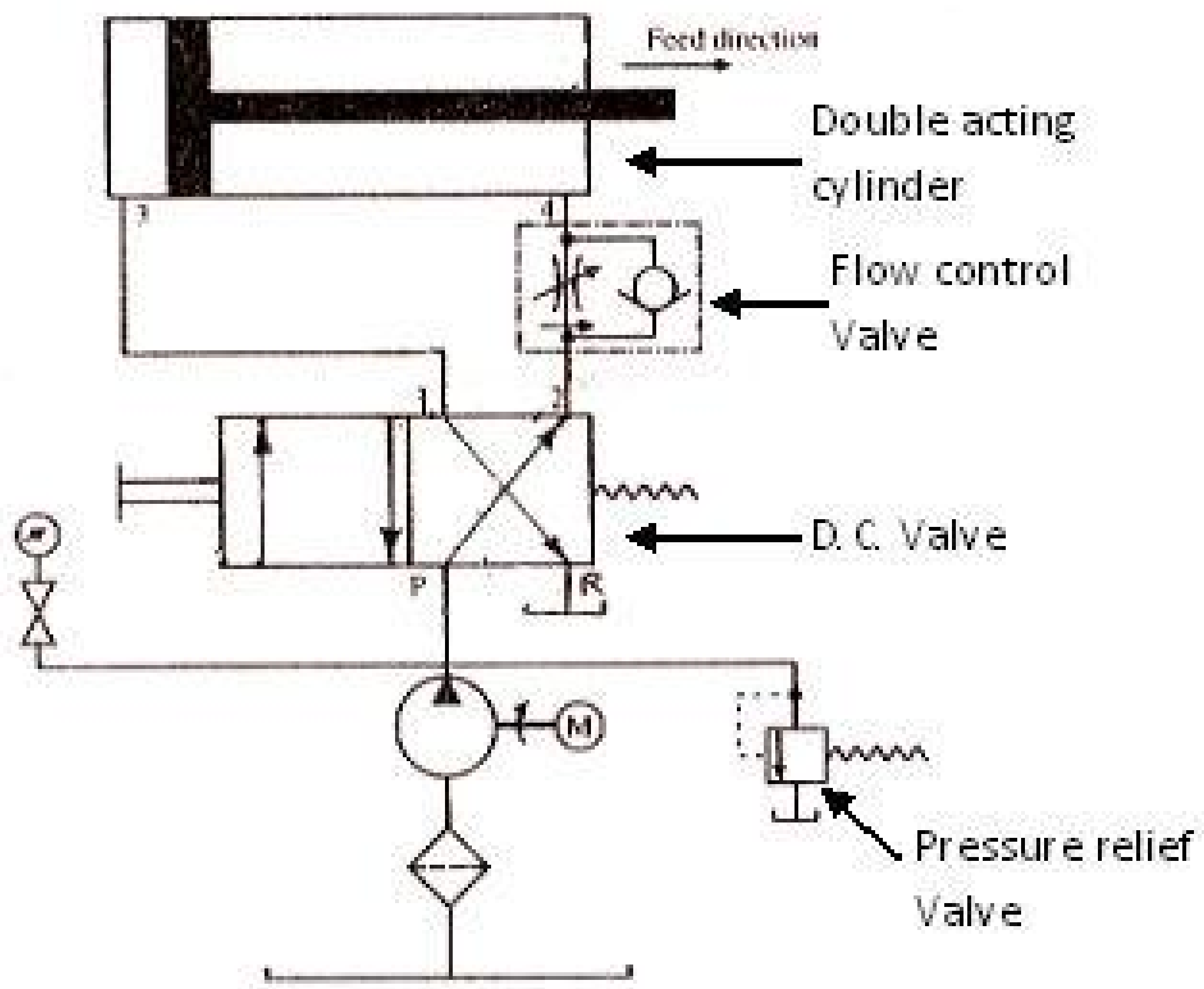


Fig. 7.4 : Meter-out speed control hydraulic circuit

- When the force on D.C. valve is released, it permits the spool to return due to valve spring and the pump flow is directed to the rod end of the cylinder through integral check valve in the flow control mechanism.
- The fluid from blind end will flow to D.C. valve as there is no restriction and the piston can be retracted rapidly to its initial position.
- Flow during retraction is not controlled (i.e. Free flow)
- This method is used where free falling load or overhauling load tends to go out of control.
- They are used in operations like drilling, boring, reaming. Shaper planner slotter due to quick return.

Bleed-off control circuit

- This is basic speed control circuit in which the flow control valve is used to divert the fluid to the reservoir.
- Fig. shows bleed-off control circuit.
- In this flow control valve is connected in the pressure line so that the speed control may be in both directions of cylinder travel.
- These circuits are suitable for broaching machines, shaping and planning machines.
- The bleed-off control circuits may be used in hydraulic motor brake circuit and concrete mixtures on the truck.

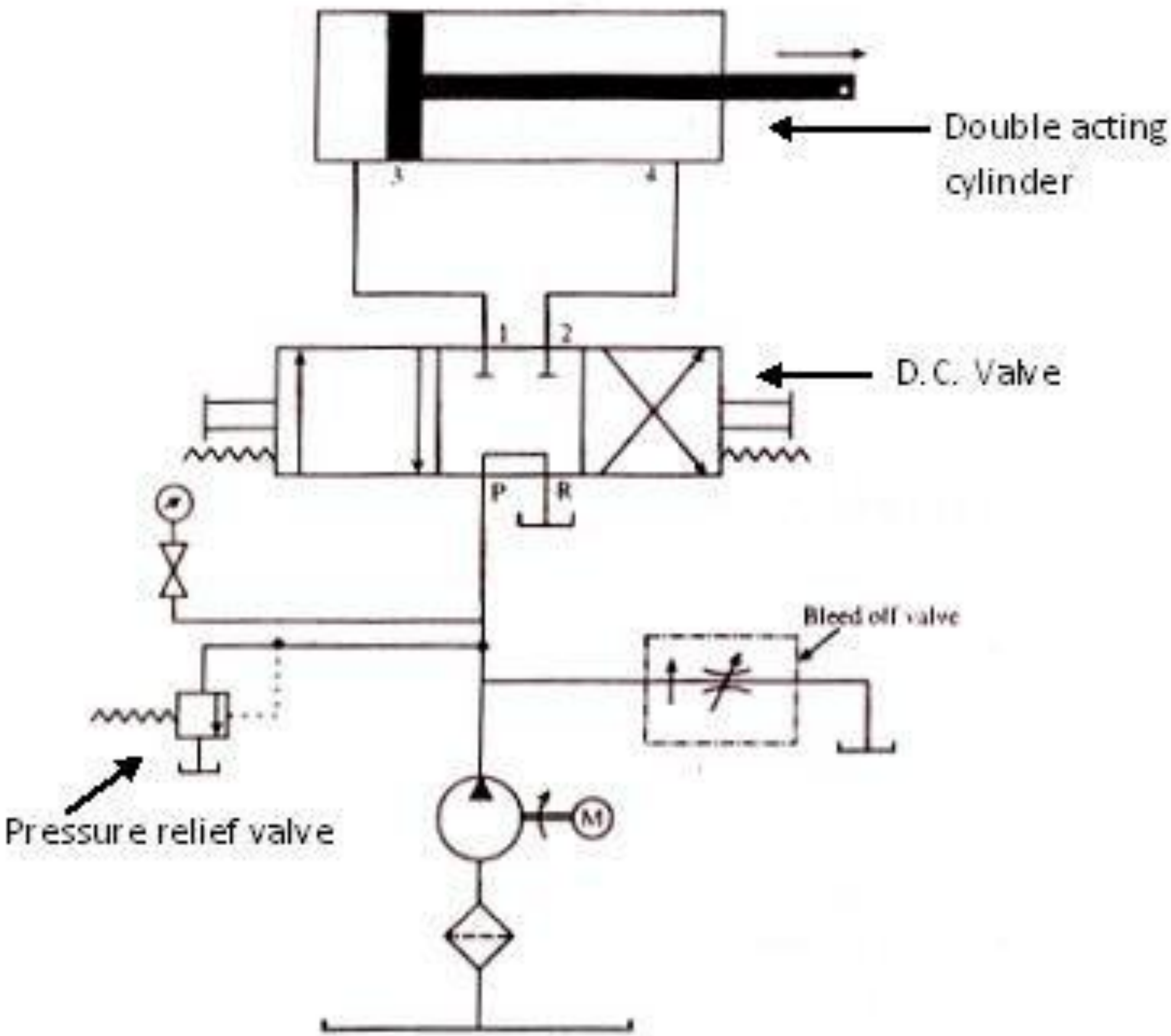


Fig. 7.6 : Bleed-off speed control hydraulic circuit

Sequence circuit

- In this sequence valve is provided to do the operations sequentially.
- Fig. shows the use of two sequence valve in hydraulic circuit for controlling two operations performed in the sequence in both directions.
- It consist of hydraulic power unit, two sequence valves A & B with integral check valve, two double acting cylinders P & Q, and D.C. valve
- When D.C. valve is shifted to left envelop mode, the oil from pump enters the cylinder ‘P’ through line 1-3, causing the piston in cylinder ‘P’ to extend fully.

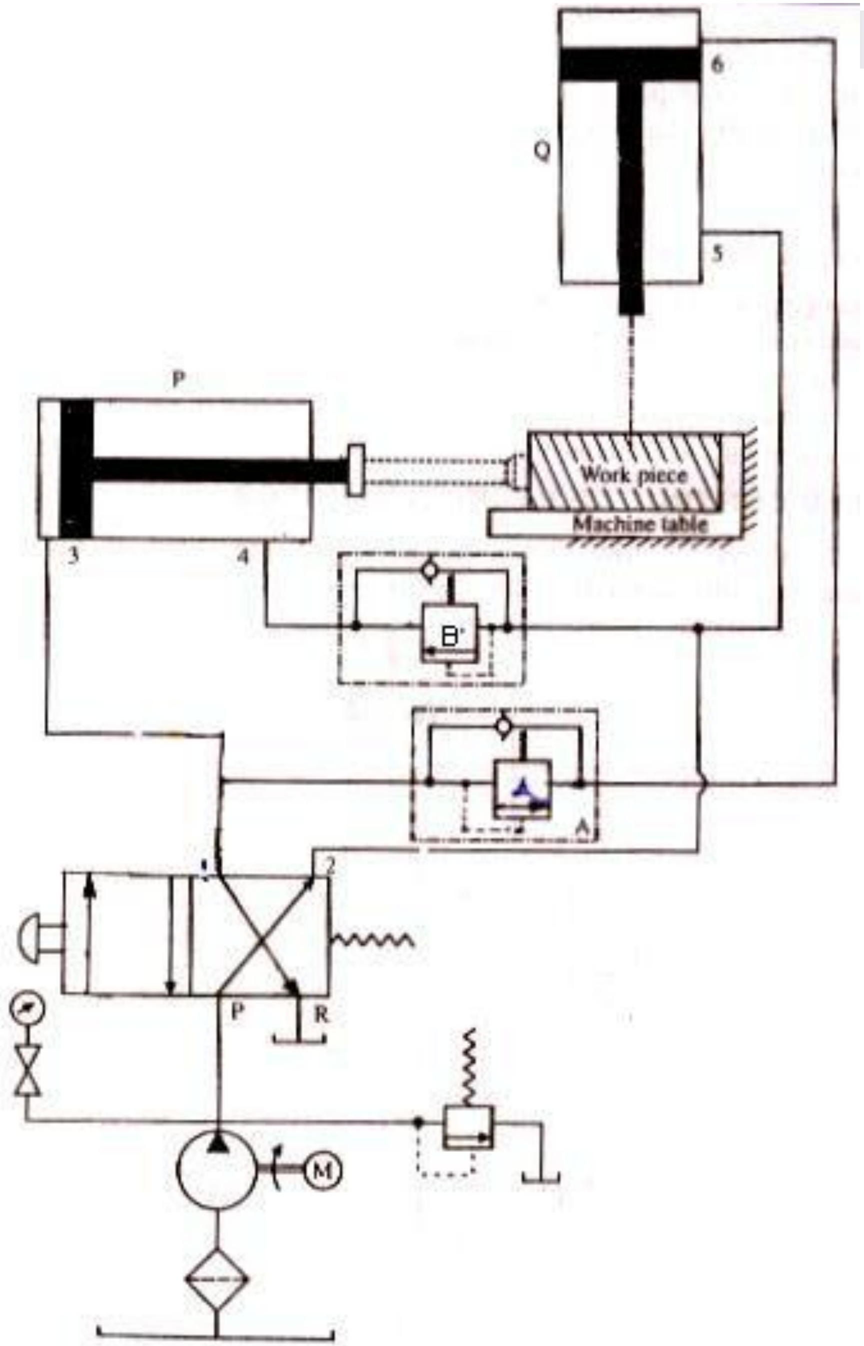


Fig. 7.10 : Sequence circuit

- The oil from rod end of cylinder passes from port 4 via check valve of the sequence valve ‘B’ to port 2 of the D.C. valve and exhausted to the reservoir.
- As the piston in the cylinder ‘P’ extends completely, the pressure in line 1-3 rises which causes the sequence valve ‘A’ to open.
- Then the oil from pump enters the blind end of cylinder ‘Q’ through the line 1-6, which cause the piston in cylinder ‘Q’ to extend completely.
- The oil from rod end of cylinder ‘Q’ is discharged into the reservoir via line 5-2 through D.C. valve.

- When the D.C. valve is released, the oil from pump enters into the rod end of cylinder ‘Q’ via line 2-5 causing the piston in the cylinder ‘Q’ to retract completely and oil from side of the cylinder is directed to return into the reservoir through check valve of sequence valve ‘A’ via line 6-1.
- As the piston in cylinder ‘Q’ retracts completely, the pressure in the line 2-6 is increased.
- The pressure rise in the line 2-6 causes the sequence valve ‘B’ to open, allowing the flow from pump to enter rod end of cylinder ‘P’ through port 4.

- It causes the piston in cylinder ‘P’ to retracts completely.
- The oil from blind end of cylinder ‘P’ is discharged out to reservoir via line 3-1 through D.C. valve.
- Thus the extension and retraction of pistons in both the cylinders are performed in sequence.
- The circuit is suitable for clamping and declamping of work piece and punching or drilling operations simultaneously.

Application of Hydraulic circuits

- Hydraulic circuit for Milling M/c
- Hydraulic circuit for Shaper M/c
- Hydraulic circuit for Surface grinder
- Hydraulic circuit for Hydraulic Press
- Hydraulic Power Steering
- Reaction piston type hydraulic steering system
- Hydraulic circuit of Dumpers
- Hydraulic circuit of Excavators

Hydraulic circuit for Milling M/c

- fig. Shows the hydraulic circuit for reciprocation of milling machine table using limit switch.
- It consist of hydraulic power unit, solenoid actuated D.C. valve to alter the direction of piston stroke of double acting cylinder.
- To obtain a smooth, equal speed and feed in both direction of machine table travel a flow control valve is placed in tank line.
- Here limit switch LS-1 and LS -2 are used to energize the solenoid.

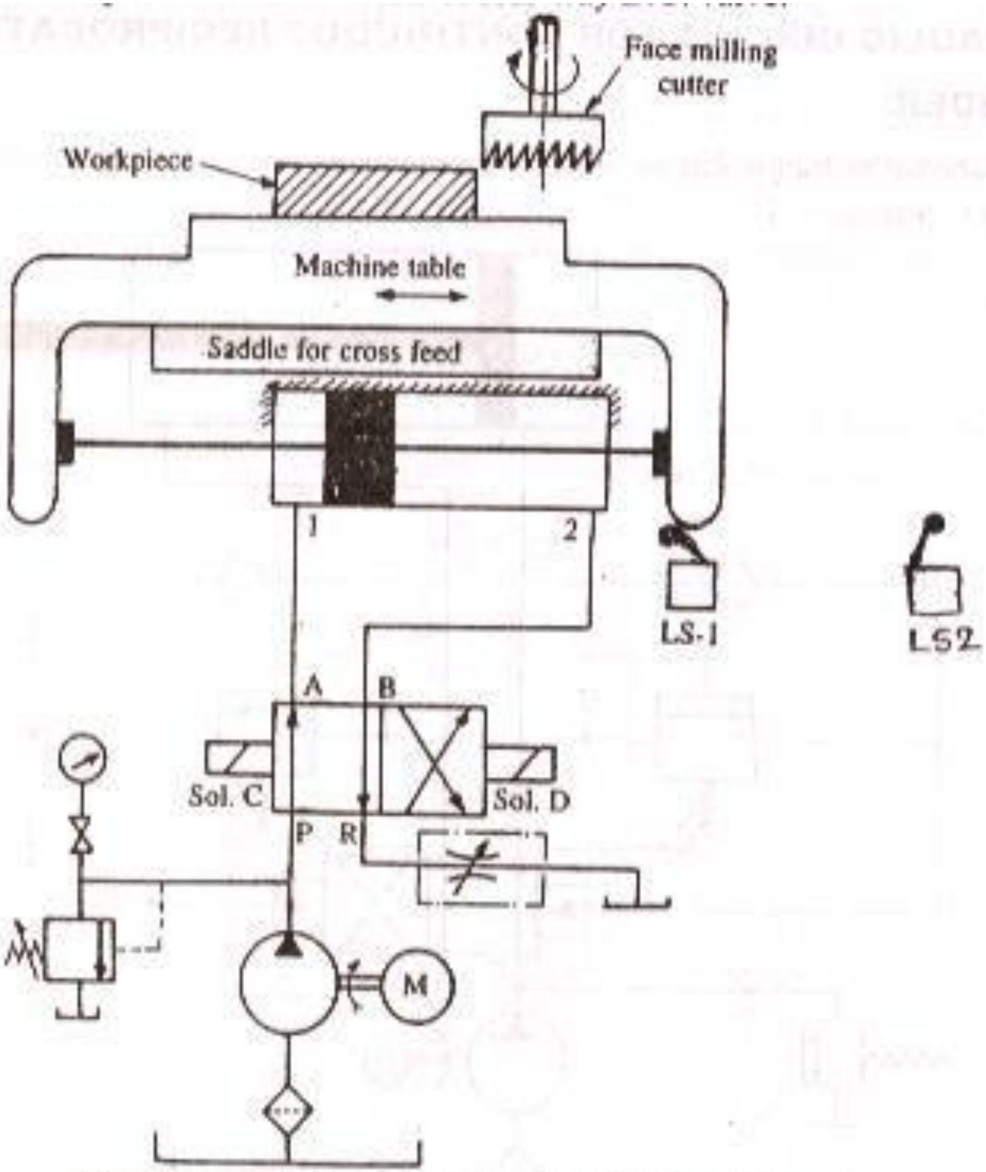
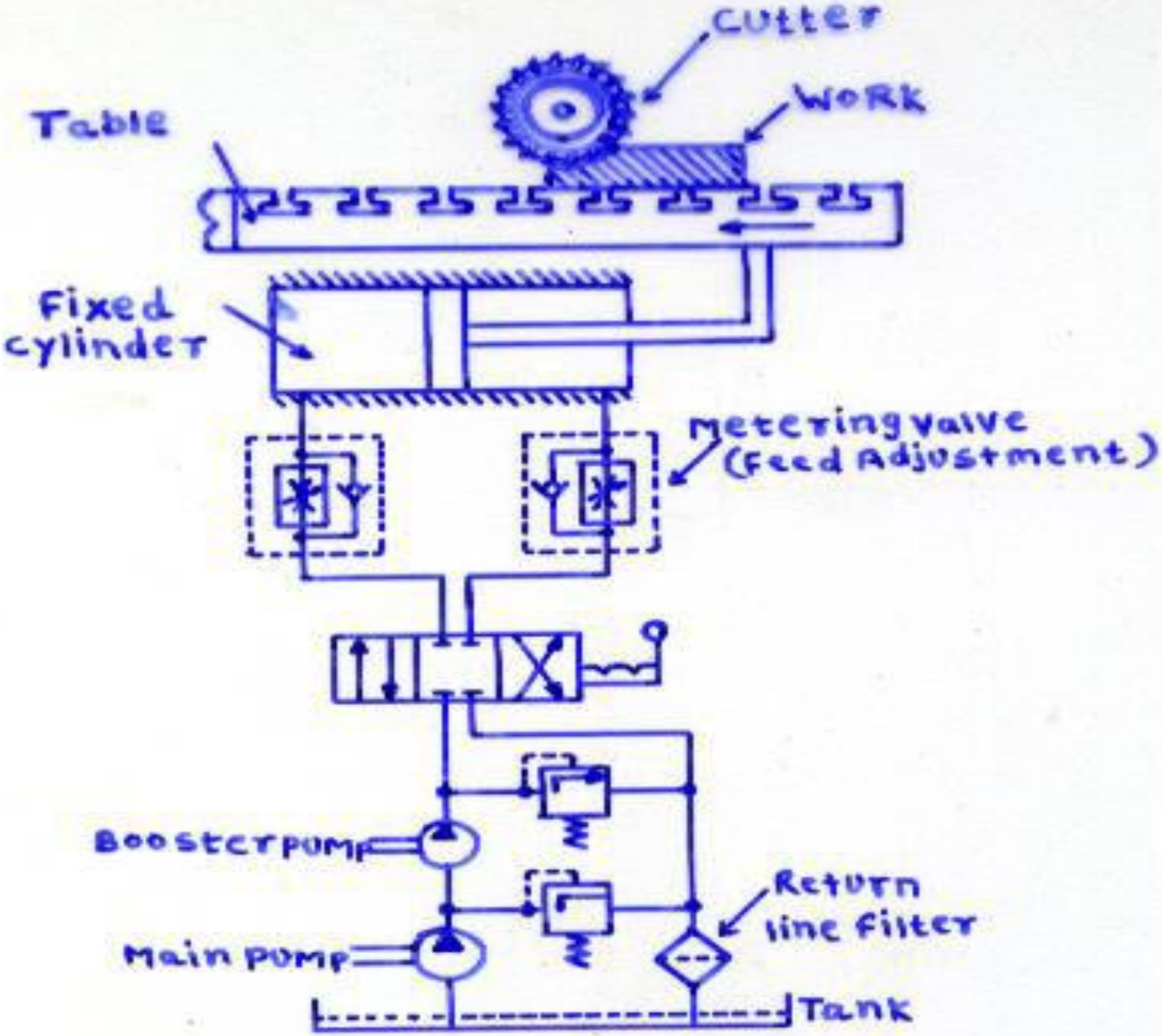


Fig. 7.13 : Hydraulic circuit for milling machine

- Initially consider that the limit switch LS-1 is depressed by machine table which energizes the solenoid C causing D.C. valve to shift in left envelop mode.
- The oil from pump port ‘P’ enters the cylinder port 1 via line P-A-1 causing machine table to move forward and the oil from other side of piston is return to reservoir through flow control valve
- At the end of forward stroke the limit switch LS-2 is depressed causing solenoid D to energized.
- This causes D.C. valve to shift in right envelop mode.

- Then the oil from pump P enters cylinder port 2 causing the piston to perform return stroke.
- The oil from port 1 returns to reservoir via flow control valve.
- This cycle is repeated causing milling m/c to perform cutting action.
- The length & position of stroke can be adjusted by shifting the position of limiting switches



Hydraulic circuit for Miling machines.

Hydraulic circuit for Shaper M/c

- Fig shows the hydraulic circuit for operation of shaper.
- Here meter- out circuit is used.
- It consists of hydraulic power unit which delivers the oil at constant pressure.
- A double acting cylinder is used to reciprocate the ram
- A pivot actuated D.C. valve is used to alter the direction of stroke of the piston
- When spool is in right envelop mode, the oil from port P enters the blind end of cylinder causing the ram to move forward.

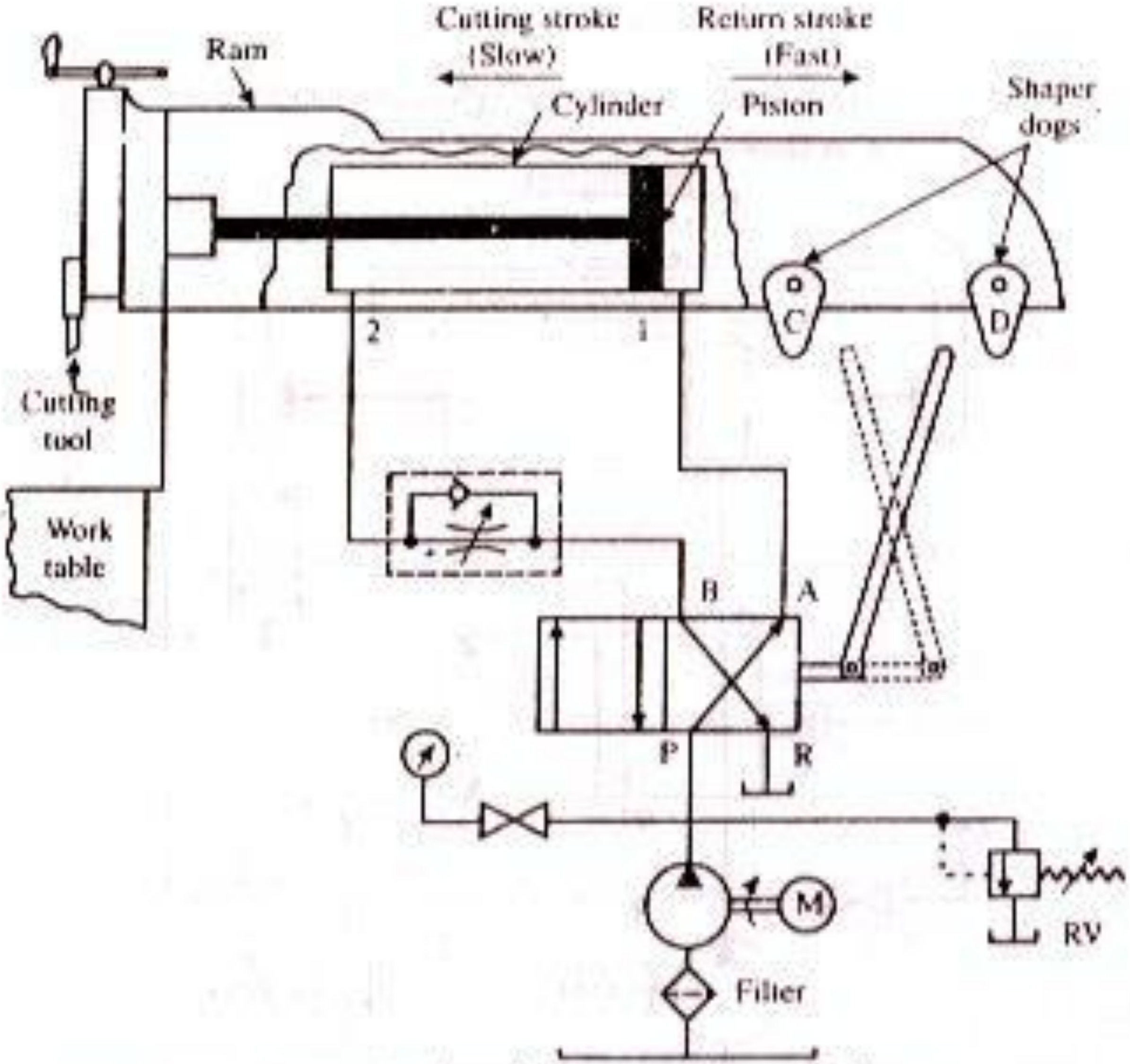


Fig. 7.14 : Hydraulic circuit for operation of shaper

- The oil from other side of piston is discharged through flow control valve into reservoir. Here quantity of liquid is controlled while going out hence circuit is meter-out.
- The cutting speed can be changed by controlling the flow control valve.
- At the end of forward stroke, the ram hits the pivoted lever of D.C. valve shifting the valve into left envelop mode.
- Thus the oil from pump enters the rod end of the cylinder through check valve causing the ram to perform the return stroke.
- The oil from blind end returns to reservoir, as there is no restriction the return is quick.

Hydraulic circuit for Surface grinder

- Fig. shows the hydraulic circuit for reciprocating the machine table for surface grinder.
- The circuit consist of a hydraulic power unit, which delivers oil under pressure.
- It uses pilot operated D.C. valve to alter the direction of stroke of piston in a double acting cylinder.
- It also consist of two roller actuated three way D.C. valve V1 & V2 to actuate pilot operated four way D.C. valve

- The flow control valve is placed in return line to tank which provides smooth and equal speed and feed in both direction of table travel.
- When valve V1 is depressed by table, the oil from pump flows through V1 and is supplied to pilot spool E which puts the D.C. valve in left envelop mode
- Then the oil from pump enters the cylinder through port 1 causing the table to move forward and oil from other side is delivered to reservoir through flow control valve.

- At the end of stroke it depress valve V2 , the oil from pilot line operates spool F to put D.C. valve in right envelop mode.
- Thus oil from pump enters the cylinder port 2 causing machine table to return and the oil from other side of piston is delivered to reservoir through flow control valve.

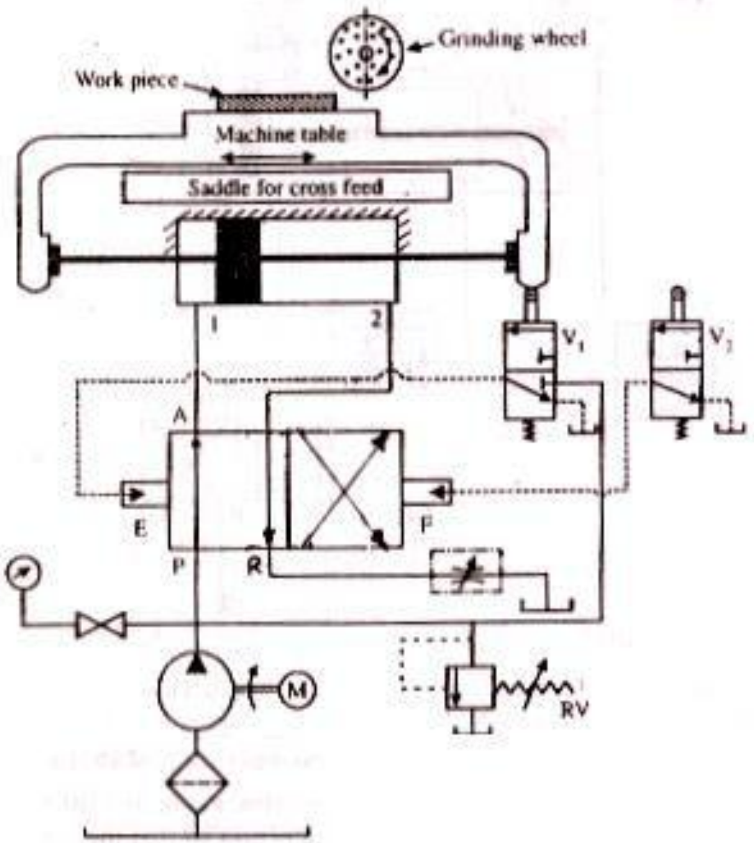
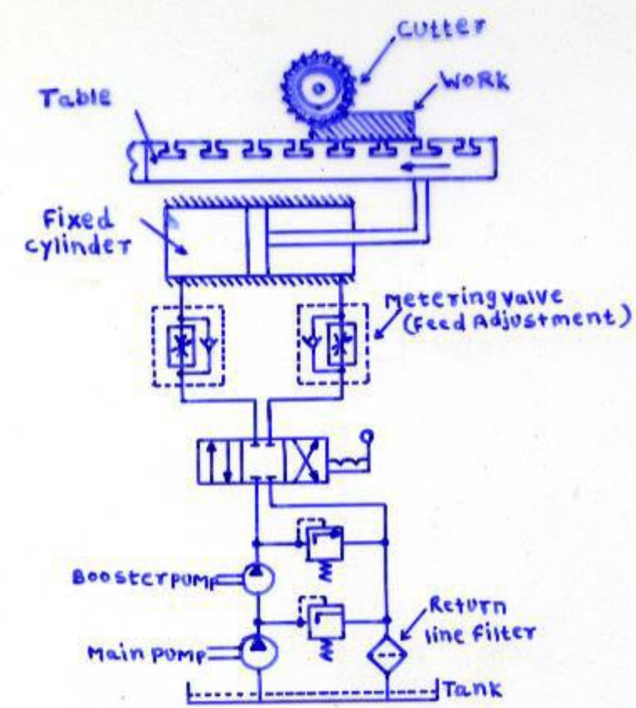


Fig. 7.15 : Hydraulic circuit for surface grinder



Hydraulic circuit For Miling machines.

Hydraulic circuit for Hydraulic Press

- Fig. shows the hydraulic circuit for the operation of hydraulic press.
- It consist of manually operated D.C. Valve
- A press operation requires an accurate movement rate of piston so that the metal flows smoothly without tearing or cracking
- Thus it is necessary to meter the fluid into the blank end of the cylinder. Here meter-in circuit is used
- Therefore flow control valve is located in the feed line B-1 on the actuator so that one stroke is to be speed controlled and check valve permits the rapid retraction.

- When spool of D.C. valve is in left envelop mode, the metered quantity of oil from pump enters the blank end of cylinder via flow control valve causing forward stroke.
- The oil from rod end is discharged out into the reservoir via line 2-A-R. during this stroke operation is done on workpiece
- When the spool is shifted to right envelop mode the pump supplies the fluid to rod end of cylinder and the fluid from blank end returns back to reservoir through check valve causing quick retraction of cylinder.
- When spool is in neutral position the operator unloads the object and load another object. In this position pump delivery is directed to reservoir.
- The hydraulic presses are slower and more powerful and adapted for pressing, forming and bending operations.
- These are also employed for fabrication of heavy forgings

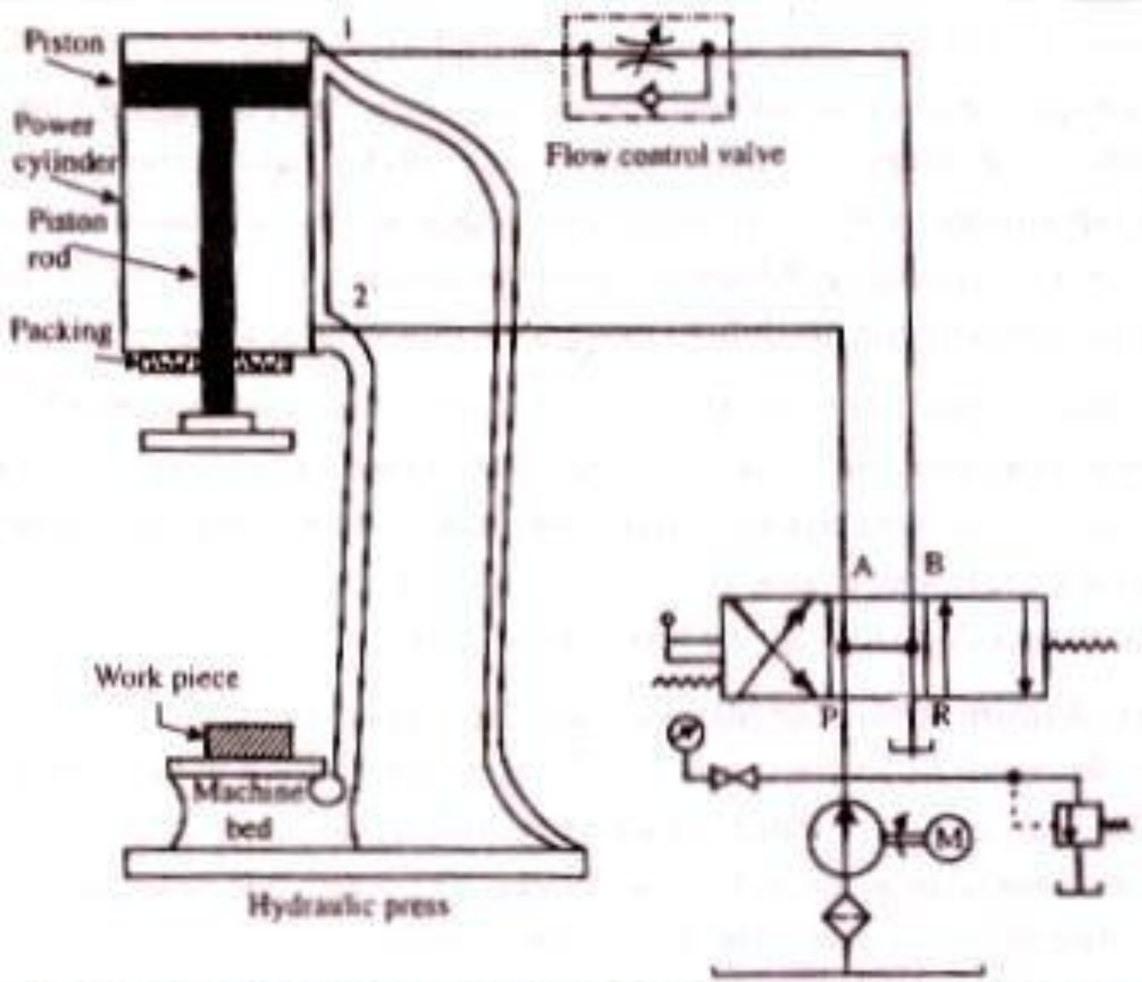


Fig. 7.16 : Hydraulic circuit for the operation of hydraulic press

Hydraulic Power Steering

- This is used to reduce the turning effort required to steer the wheels.
- It consist of hydraulic pump, gear box, rotary spool type D.C. valve and hoses.
- The steering wheel is connected to the one end of rotary spool valve while at other end of valve worm is connected.
- The worm rotates the nut making the sector to turn which turns the road wheels at angle.
- When driver turns the steering wheel, the spool valve turns directing the pressurised oil from pump to appropriate side of the nut applying the effort on that side.
- This helps in reducing the effort of driver.

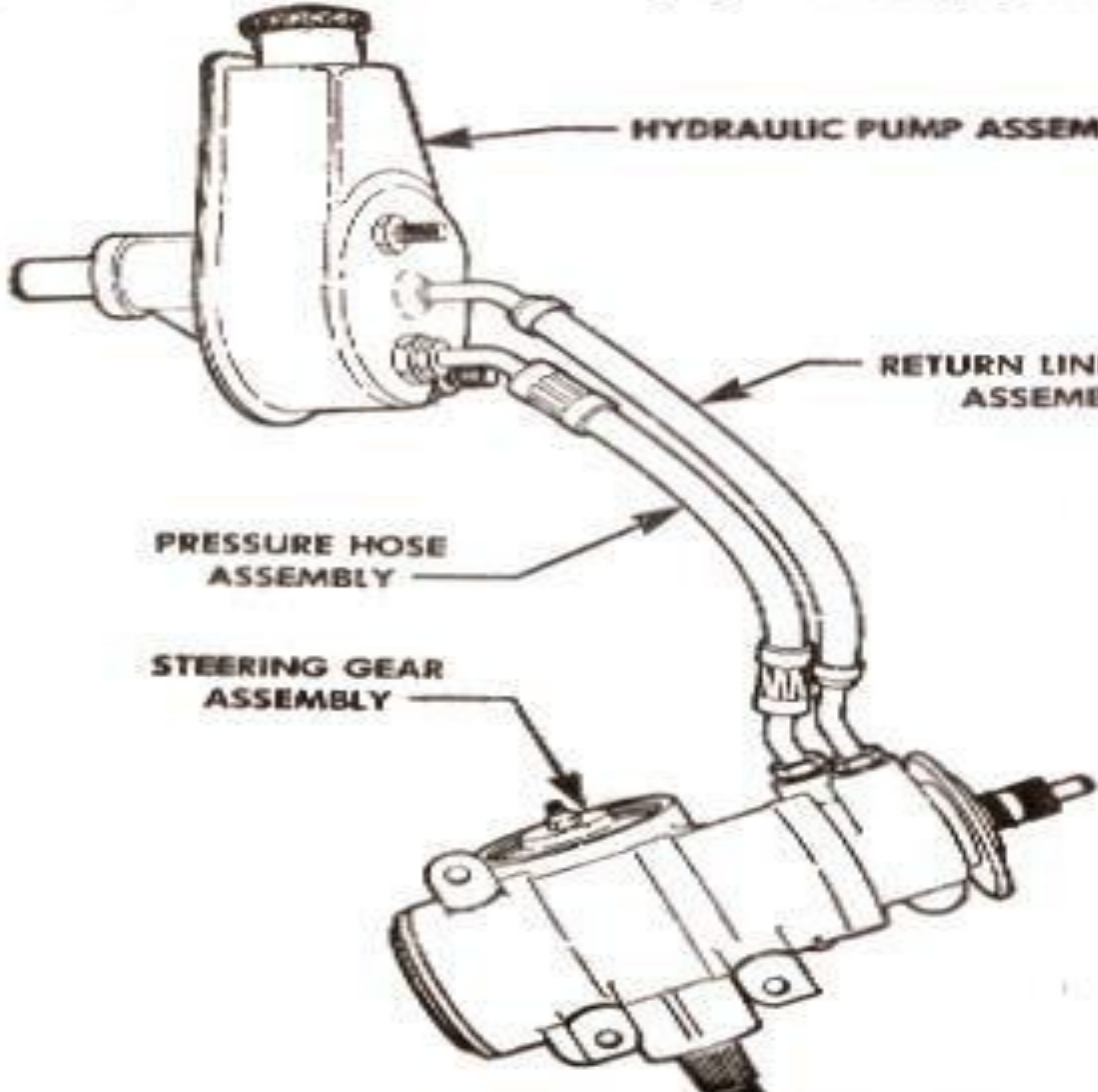


Fig. 8.56. Layout of an integral power steering system.

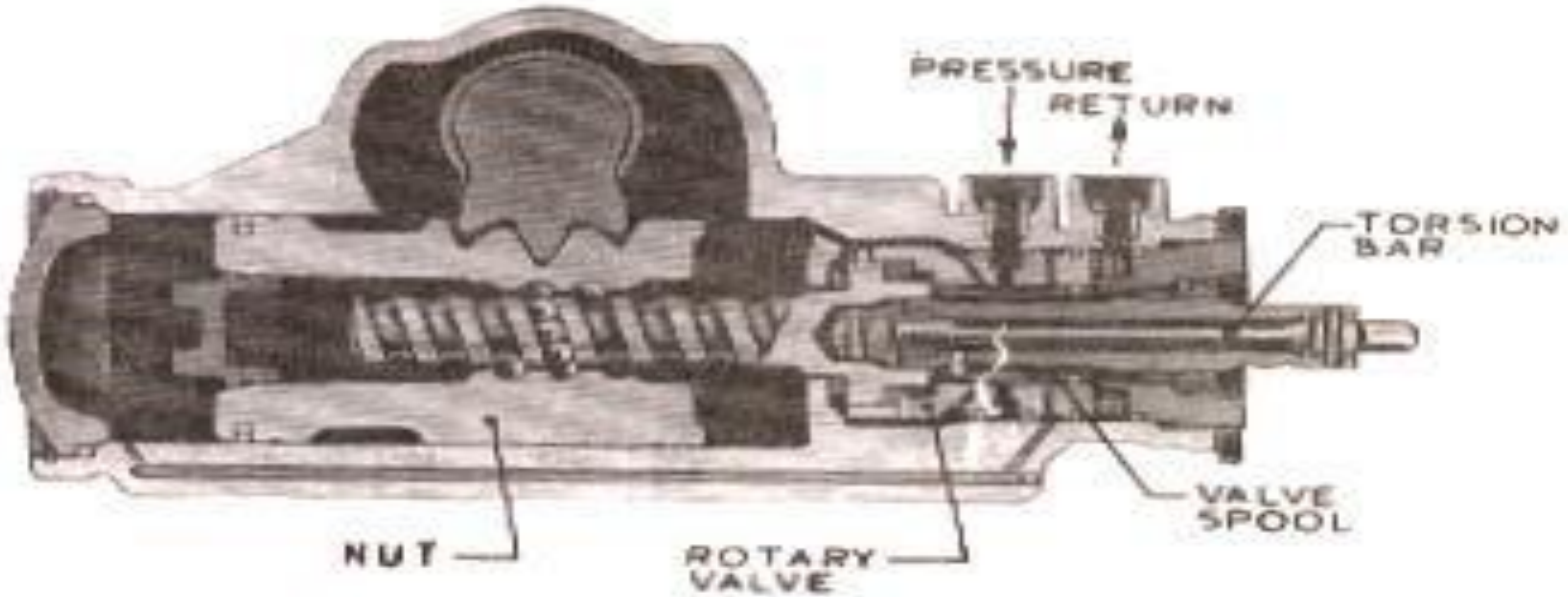


Fig. 8.57. Rotary valve power steering gear
(Courtesy—Saginaw Steering Gear Division, U.S.A.)

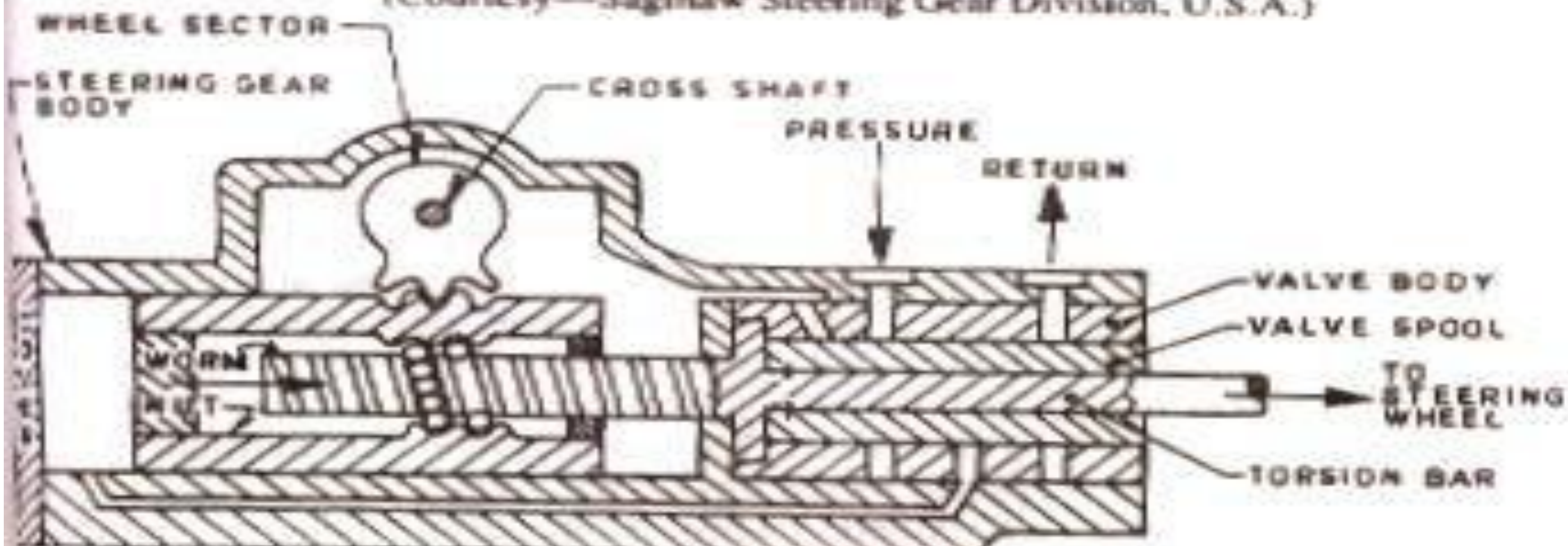


Fig. 8.58. Rotary valve type power steering gear.

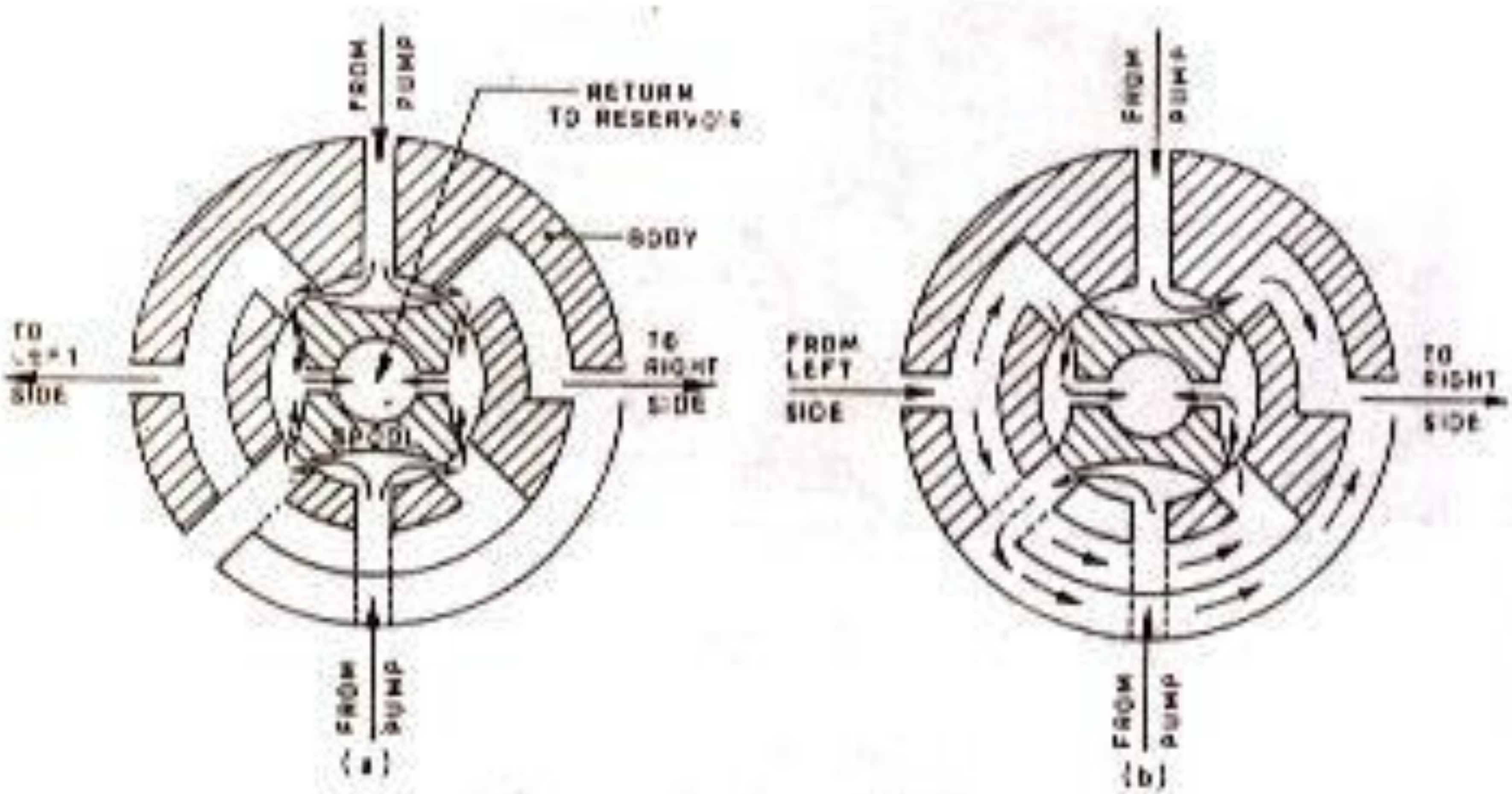


Fig. 8.59. Diagram showing action of a rotary valve (*a*) steering in neutral (*b*) steering in action to turn right.

Reaction piston type hydraulic steering system

- It consist of piston connected to chassis, a moving cylinder, ball joint connected to drop arm and sliding spool valve
- The spool valve is operated by ball joint.
- When the steering wheel is moved to right, the ball joint connected to the drop arm moves the spool valve to right against spring pressure. This allows hydraulic pressure to pass to the rear of the piston.
- As piston is stationary the pressurized fluid react against the piston and push the cylinder to the right.
- The fluid from front of piston is returned to the reservoir.
- Thus it helps in reducing the effort applied by driver.

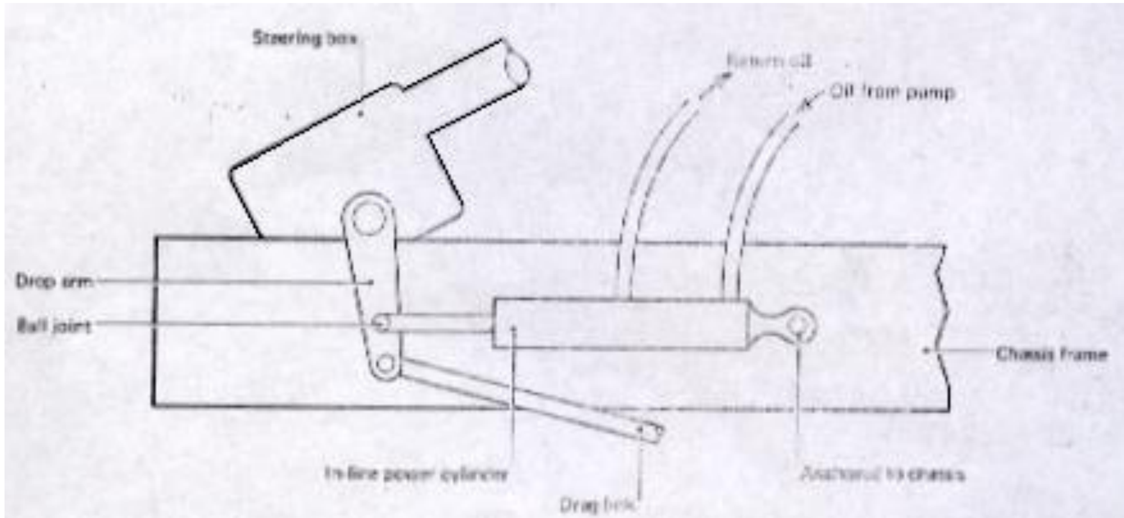
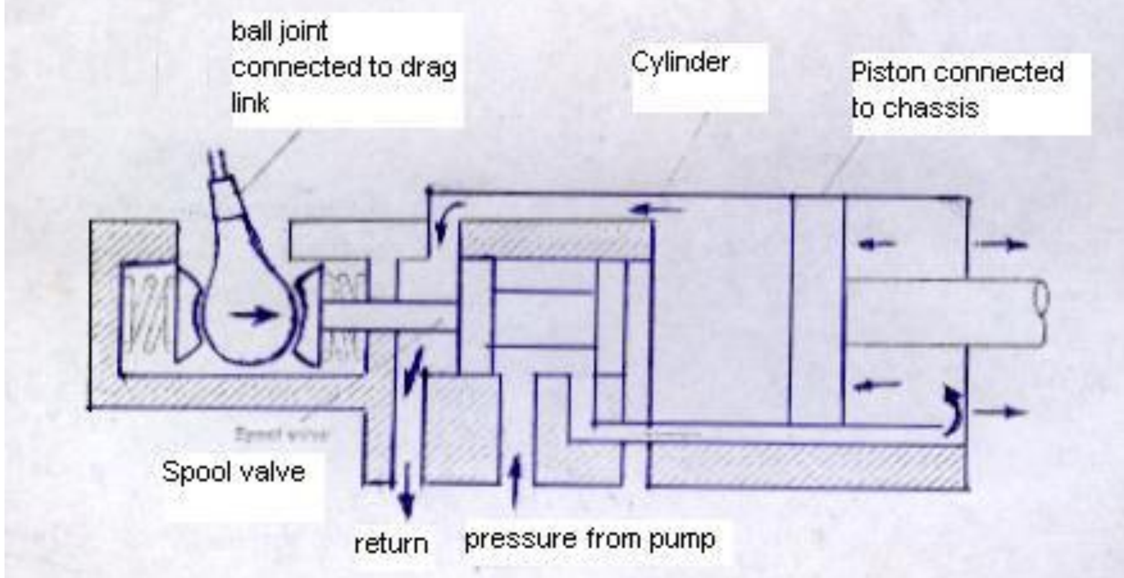


Figure 278(a) *Connection of in-line booster*



The most common arrangement of hydraulic brakes for passenger vehicles, motorcycles, scooters, and mopeds, consists of the following:

Brake pedal or lever

A pushrod (also called an *actuating rod*)

A master cylinder assembly containing a piston assembly (made up of either one or two pistons, a return spring, a series of gaskets/ O-rings and a fluid reservoir)

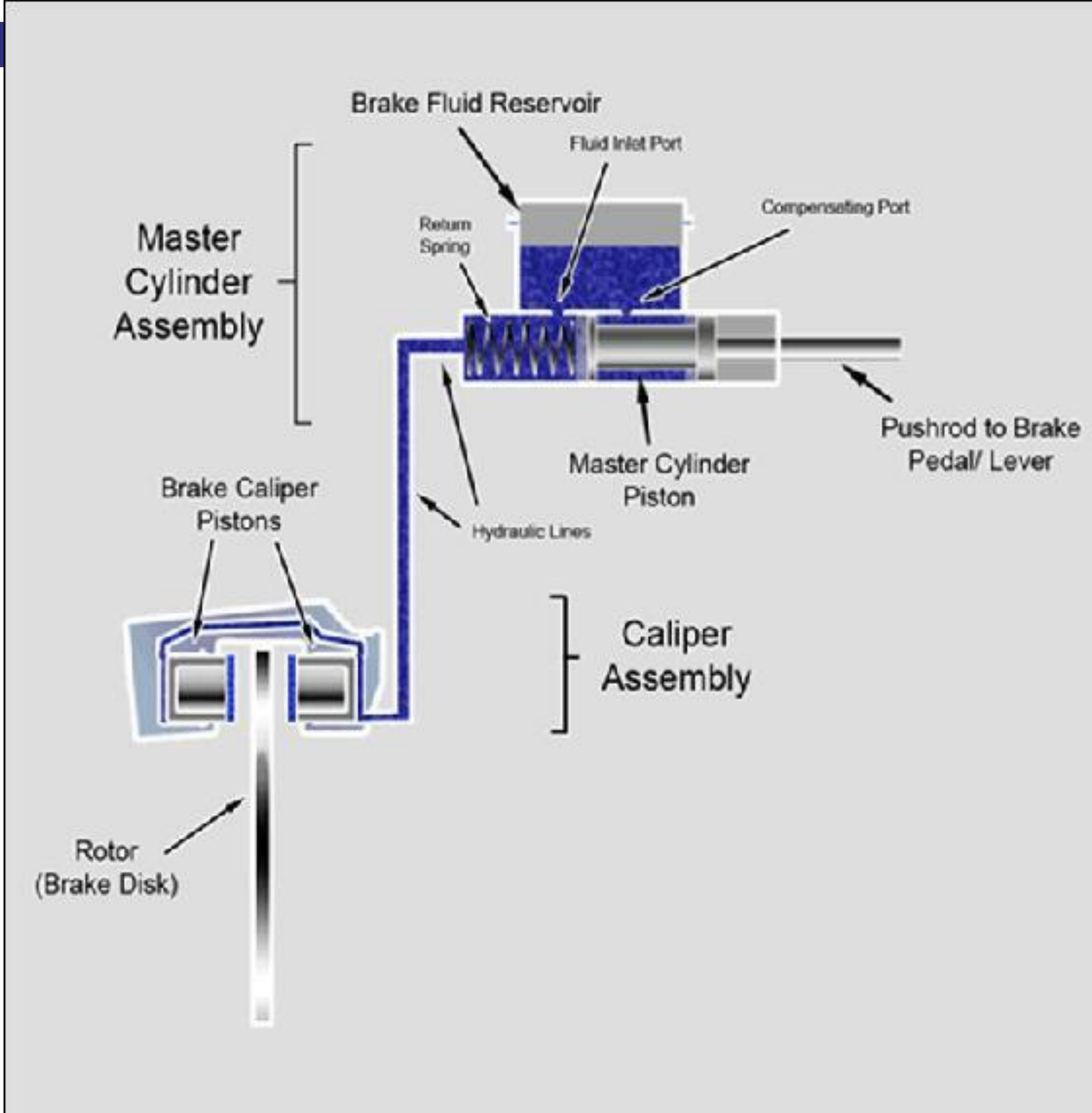
Reinforced hydraulic lines

Brake caliper assembly usually consisting of one or two hollow aluminum or chrome-plated steel pistons (called *caliper pistons*), a set of thermally conductive brake pads and a rotor (also called a *brake disc*) or drum attached to an axle.

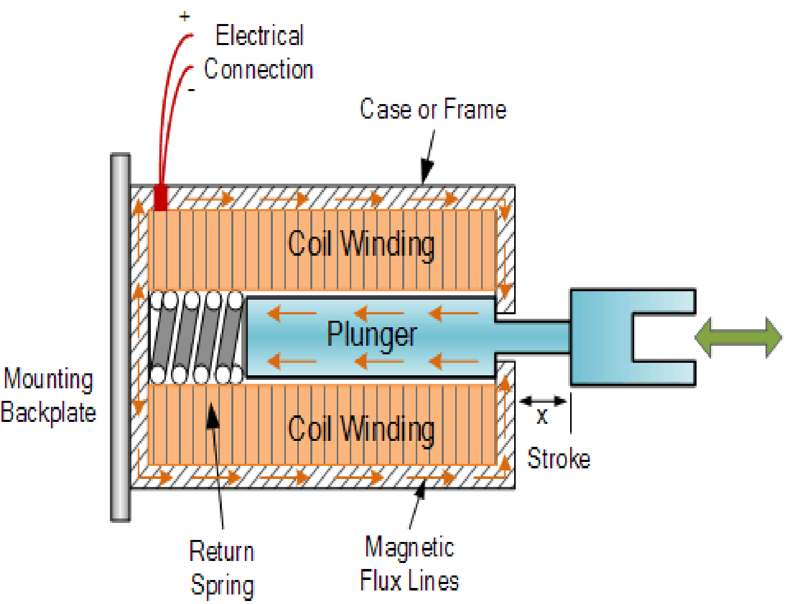
The system is usually filled with a glycol-ether based brake fluid (other fluids may also be used).

At one time, passenger vehicles commonly employed drum brakes on all four wheels. Later, disc brakes were used for the front and drum brakes for the rear. However disc brakes have shown better heat dissipation and greater resistance to 'fading' and are therefore generally safer than drum brakes. So four-wheel disc brakes have become increasingly popular, replacing drums on all but the most basic vehicles. Many two-wheel vehicle designs, however, continue to employ a drum brake for the rear wheel.

The following description uses the terminology for and configuration of a simple disc brake.


Brake Fluid Reservoir
Fluid Inlet Port
Compensating Port
Return Spring
Master Cylinder Assembly
Pushrod to Brake Pedal/ Lever
Master Cylinder Piston
Hydraulic Lines
Brake Caliper Pistons
Caliper Assembly
Rotor (Brake Disk)

Introduction to Electo-hydraulic system



- ❑A solenoid valve is a type of valve that uses an electrical current to actuate or shift a spool or cartridge consisting of a solenoid coil and tube assembly.

  Basically, this valve type uses an electric current to shift a pin to perform simple A/B tasks such as open/close valve spools.

  The designation "solenoid" means that the valve operation is electrical not manual.

- ❑ Maybe the easiest way to describe a solenoid valve is by thinking about an automatic car lock. The electric current get triggered, the pin gets pushed up and the doors are unlocked. A reverse current gets triggered, the pin gets pushed down, and the doors are locked.

A **solenoid valve** is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid: in the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold.

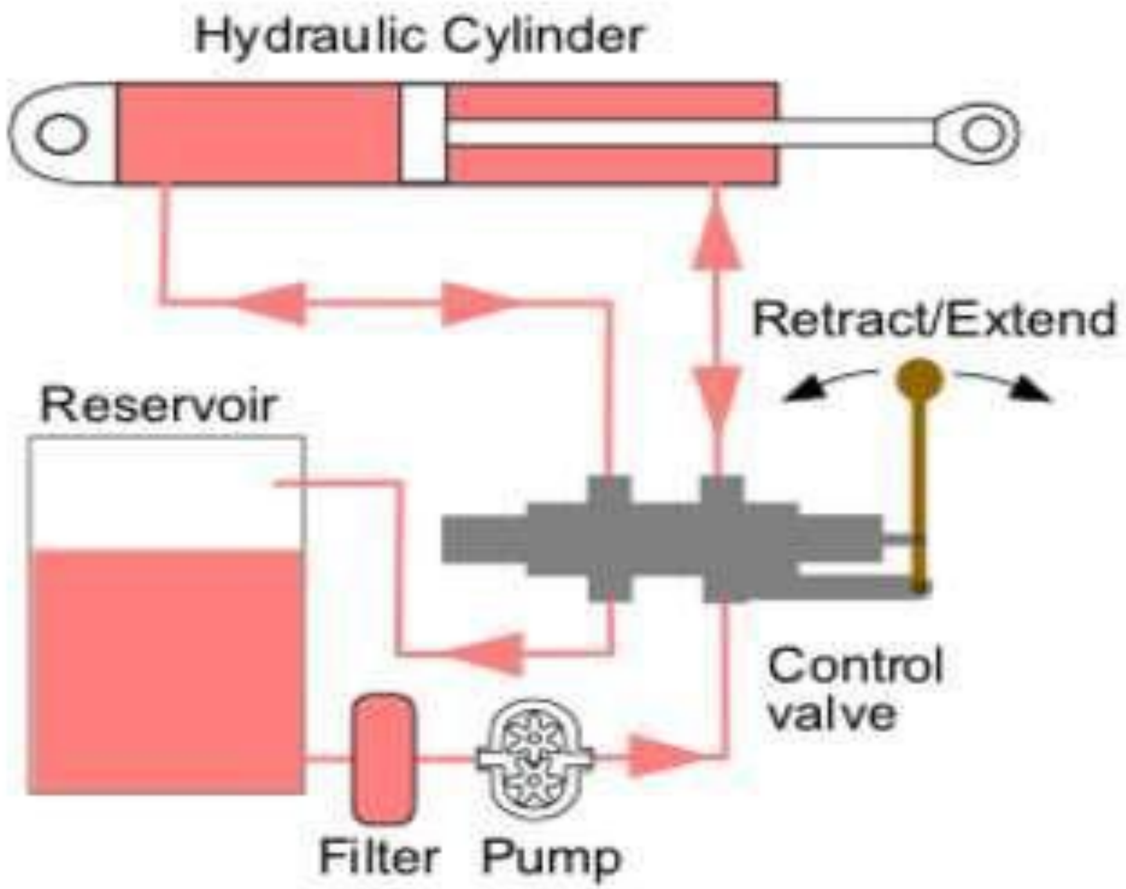
Solenoid valves are the most frequently used control elements in fluidics.
Their tasks are to shut off, release, dose, distribute or mix fluids.
They are found in many application areas.

Advantageous of Solenoids

fast and safe switching,
high reliability, long service life,
good medium compatibility of the materials used,
Low control power and
compact design.
·

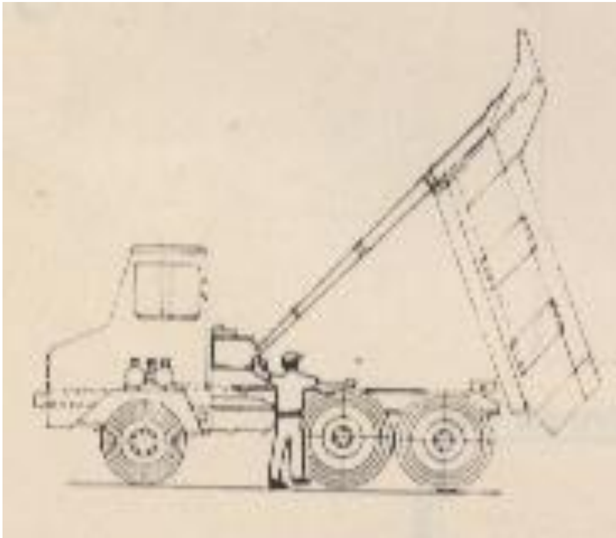
Compact Ergonomic Design.

- User Friendly, Self Explanatory Systems.
- Leak proof Safety Measures, sturdy piping & Robust Construction.
- Training Manuals mimic Charts for Operation Ease.
- M.S. powder coated cubical plant with standard Instrument Mountings.
- Inbuilt Safety Measures to avoid improper usag

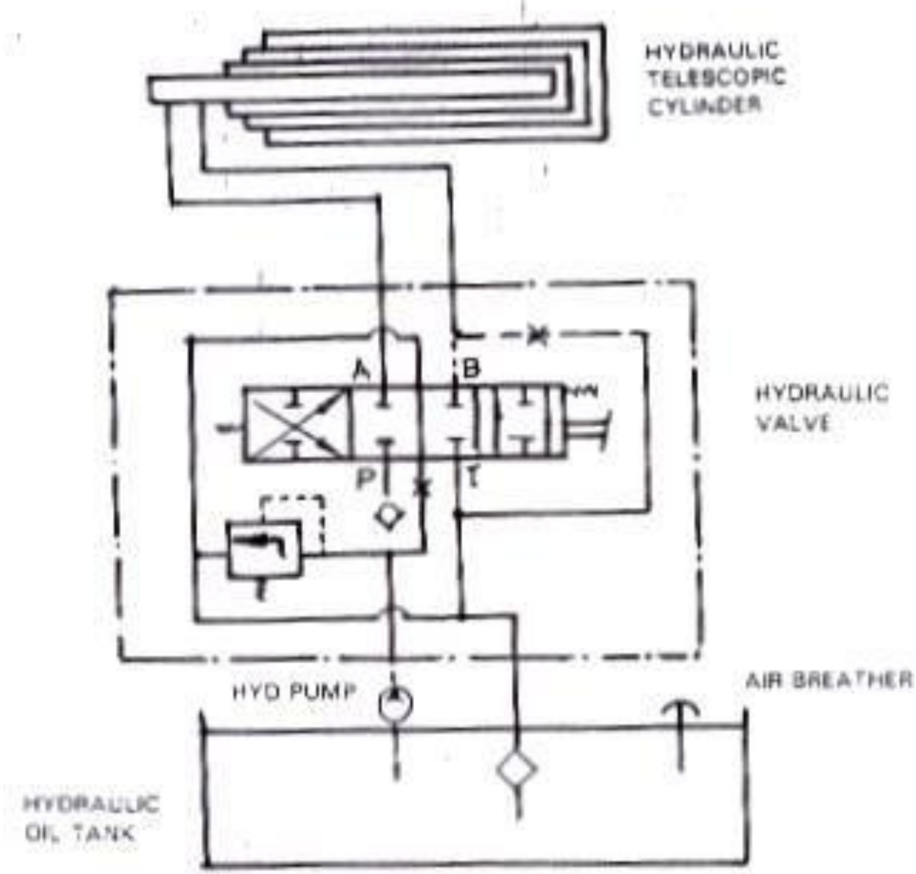

Hydraulic Cylinder
Retract/Extend
Reservoir
Control
valve
Filter
Pump

Hydraulic circuit of Dumpers:

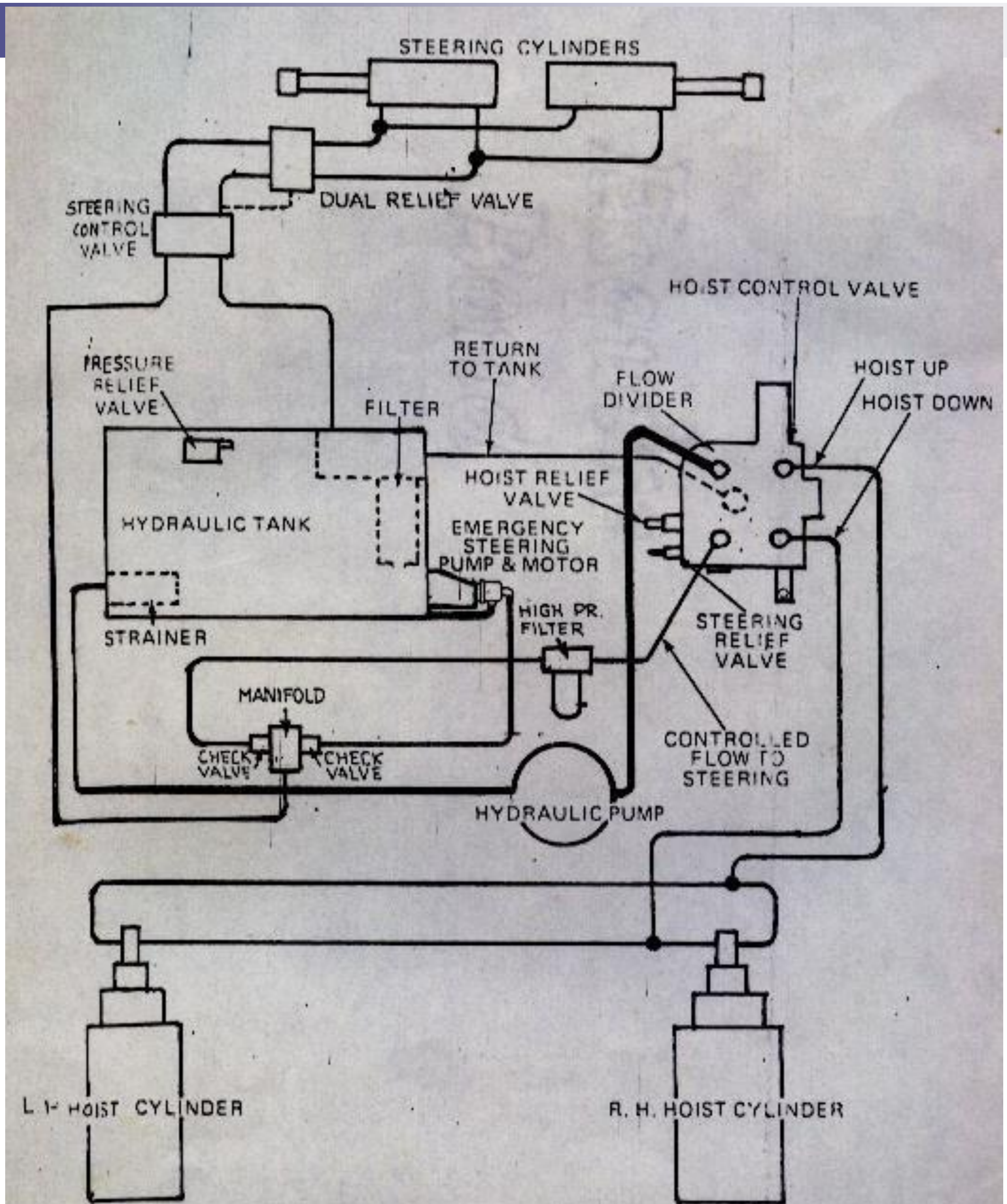
- Dumpers are used in mining sector for transporting material with in the area of mines.
- In some dumpers tipping system and steering system is hydraulically operated.
- The basic components are
- Hydraulic fluid tank
- Spool valve
- Relief valve
- 3-stage hydraulic cylinder
- Hydraulic gear pump



HYDRAULIC CIRCUIT



HYARAULIC CIRCUIT OF ALRD - 20



Hydraulic Circuit
(Emergency Steering pump and motor are shown inside the tank)

- Working: The fluid from reservoir is sucked by pump. It is pressurized and send to the spool valve. A relief valve is provided in circuit to keep pressure constant. If the spool valve is in neutral position, the tipping system is not operating, the flow goes to reservoir through the filter.
- If the spool valve is in forward position the flow goes to the tipping cylinders thus extending the cylinders and tipping operation is carried out. If the spool valve is in reverse position the flow of oil in the top end of tipping cylinder and bottom end is connected to reservoir there by contracting tipping cylinders.

Hydraulic circuit of excavators

- Excavators are used in various industries like construction, agricultural, mining & irrigation department.
- In excavators all the operation such as boom, bucket, stick, swing & travel are done hydraulically.
- The fig. shows the hydraulic circuit for boom, bucket & stick of excavators
- A fluid from reservoir is pumped to a six chambers which further supplies to various operating systems.

AUTO LEVELING SYSTEM

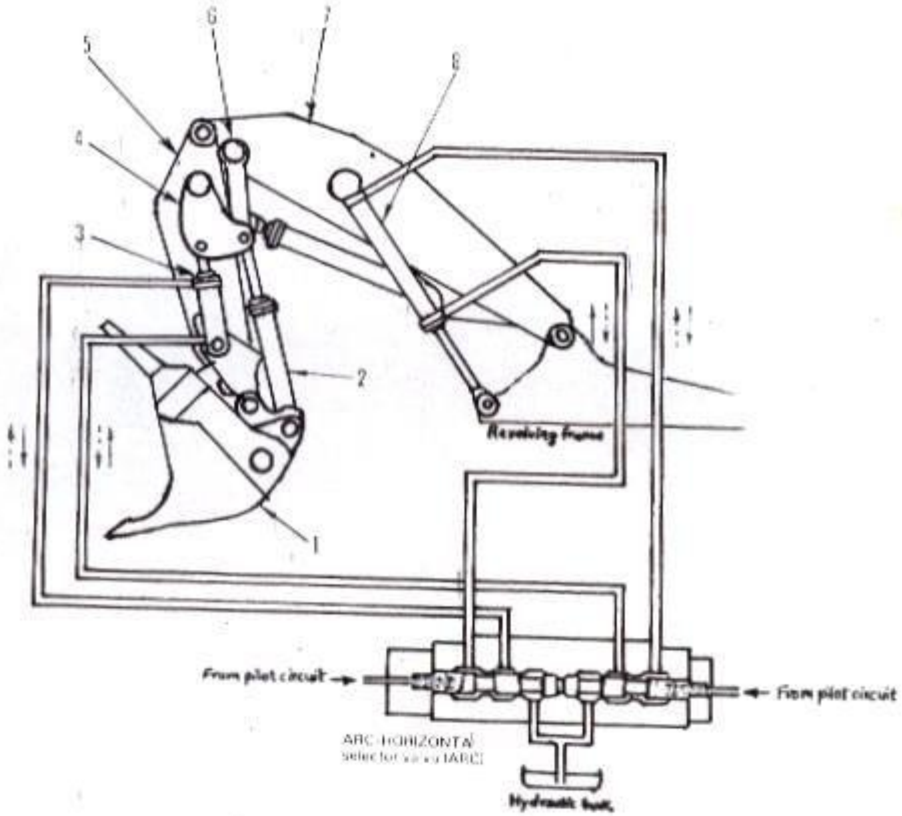
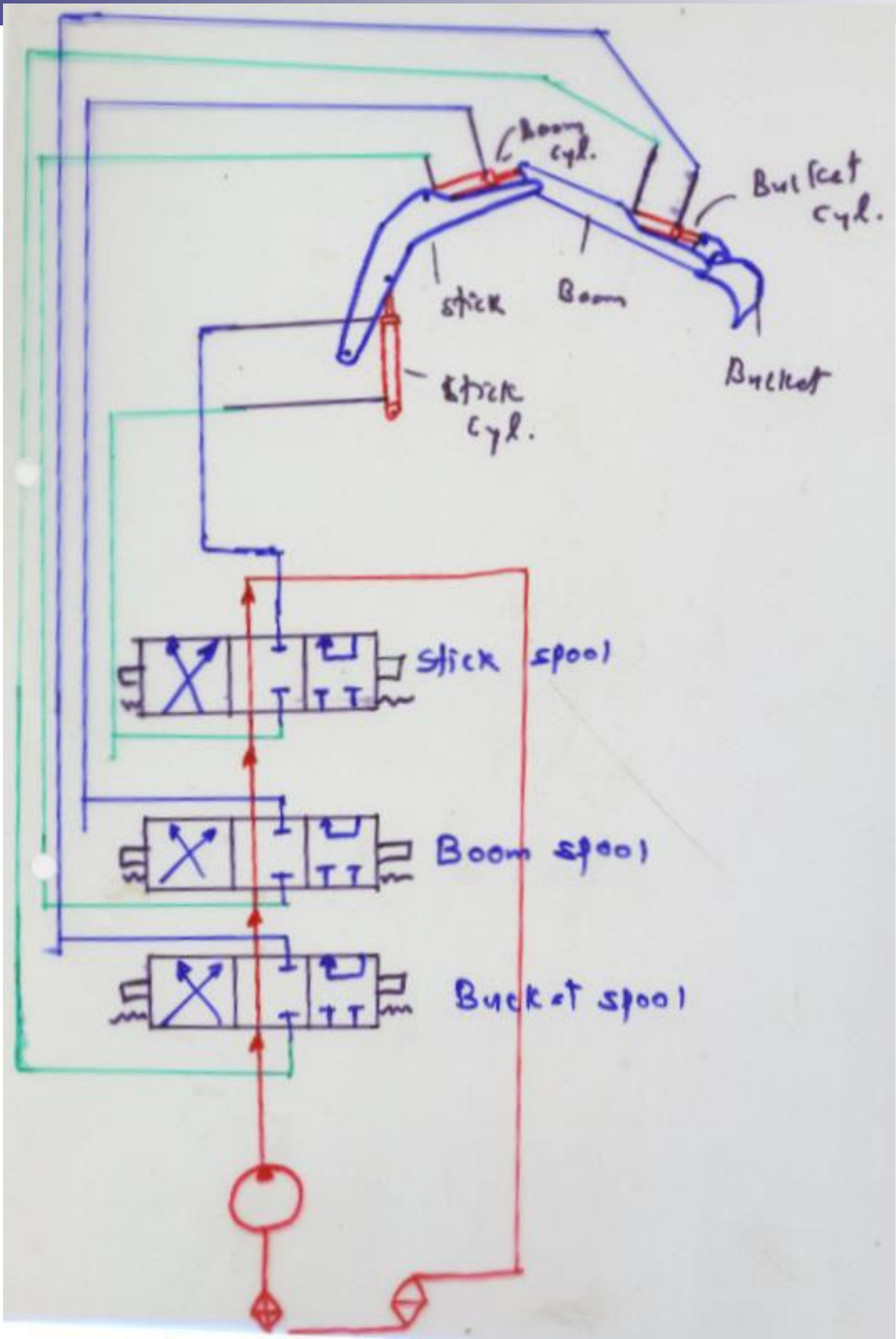


Fig. 28. AUTOLEVELING SYSTEM

1. Bucket
2. Bucket cylinder
3. Compensating link
4. Front link
5. Arm
6. Rear link.
7. Boom
8. Boom cylinder


Boom cyl.
Bucket cyl.
stick
Boom
Bucket
stick cyl.
Stick spool
Boom spool
Bucket spool

Hydraulic circuit of excavators

- Flow from chamber 1 goes to spool valve that operates the boom.
- The spool valve of boom is operated by joy stick situated on the dash board.
- As spool is moved it supplies the fluid in appropriate side thereby extending or contracting the boom cylinder and boom rises up or down.
- The fluid from chamber 1 also goes to operate spool of bucket.

Simple Pneumatic Circuits

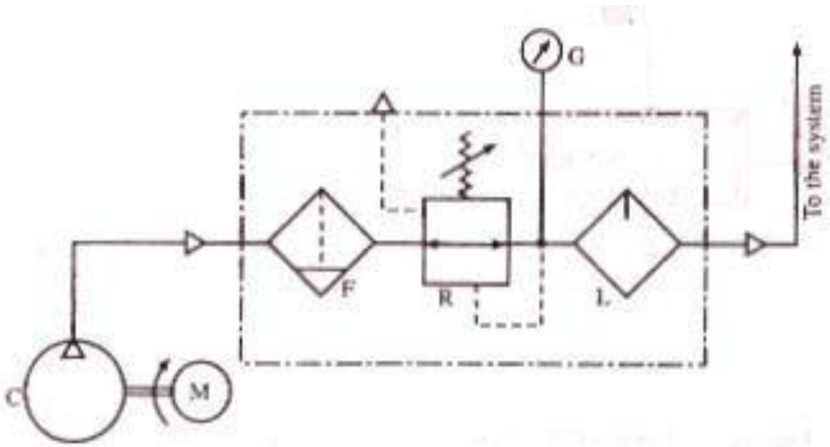
- A Pneumatic circuit is a group of components arranged in such a way that they will perform a useful task.
- The elements of pneumatic circuit are air compressor, actuators, control valves, tubes & tube fittings, FRL unit (filter, regulator & lubricator).
- These components are arranged in various ways to obtain a desired output from the circuit.

- While designing any pneumatic circuit the following points should be considered.

1. Performance of desired function
2. Efficiency of operation
3. Safety of operation
4. How much force is needed?
5. How fast circuit should function (actuating speed)?
6. Control desired – manual, mechanical, electrical, pilot.
7. Input energy source
8. Life of system desired.

Pneumatic power unit

- Fig shows the circuit for pneumatic power unit.
- In this air compressor compresses the air which is then stored in the receiver. This air is further pass in the system through FRL unit.
- The FRL unit filter the air, it regulates the pressure in the system and it lubricates the air.



G - Pressure gauge, R - Regulator, F - Filter, M - Electric motor,
RV - Pressure relief valve, C - Air compressor

Fig. 12.1 : Pneumatic power unit

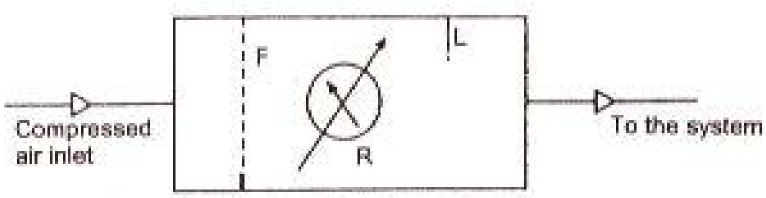


Fig. 12.2 : Simplified pneumatic power unit

Speed control circuits

Meter-in speed control pneumatic circuit:

- Fig shows the speed control pneumatic circuit
- It consist of manually operated D.C. valve, a flow control valve.
- A flow control valve is placed in the pressure line such that the air flow rate is regulated as the air enters the blank end of double acting cylinder to perform forward stroke.
- When the spool is shifted to its left envelop mode the air from FRL unit is directed to enter the blank end of cylinder through flow control valve where the air flow rate is controlled to control the forward stroke of piston in the cylinder.

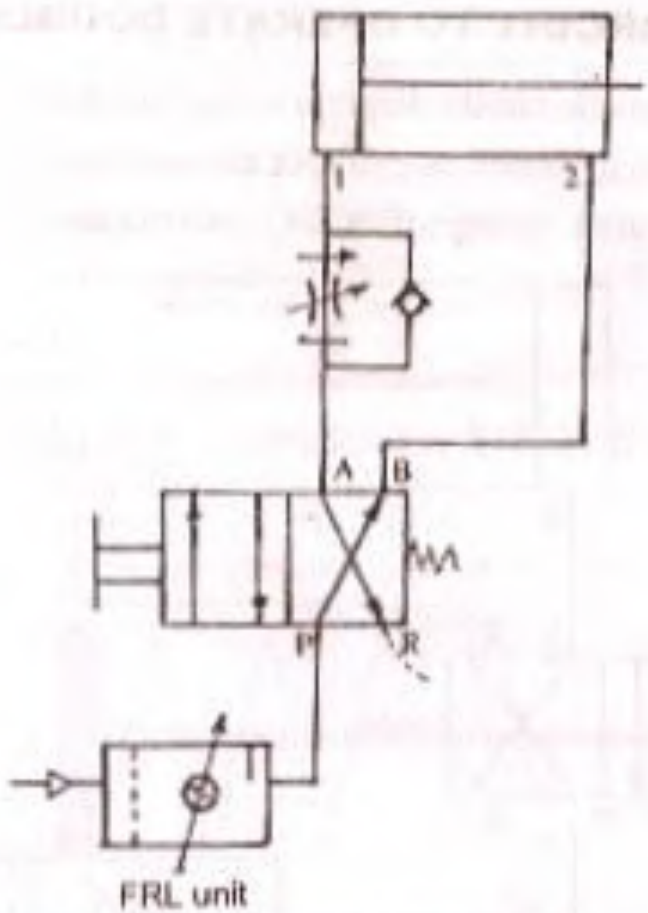


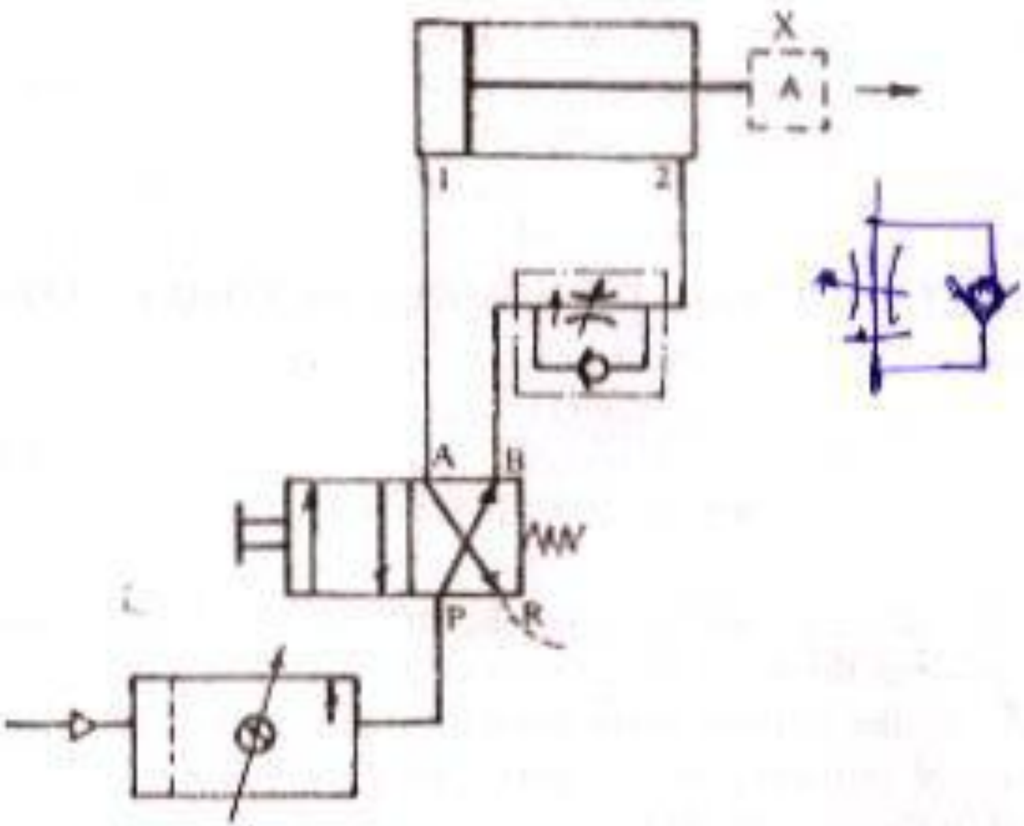
Fig. 12.5 : Pneumatic circuit used for meter-in applications

Meter-in speed control pneumatic circuit:

- The air from the other side of piston is discharged out into the atmosphere.
- When the spool is shifted to right envelop mode the air enters the rod end of cylinder and acts on piston to perform return stroke quickly. The air from other side of piston discharged out freely into the atmosphere through the check valve

Meter-out speed control pneumatic circuit:

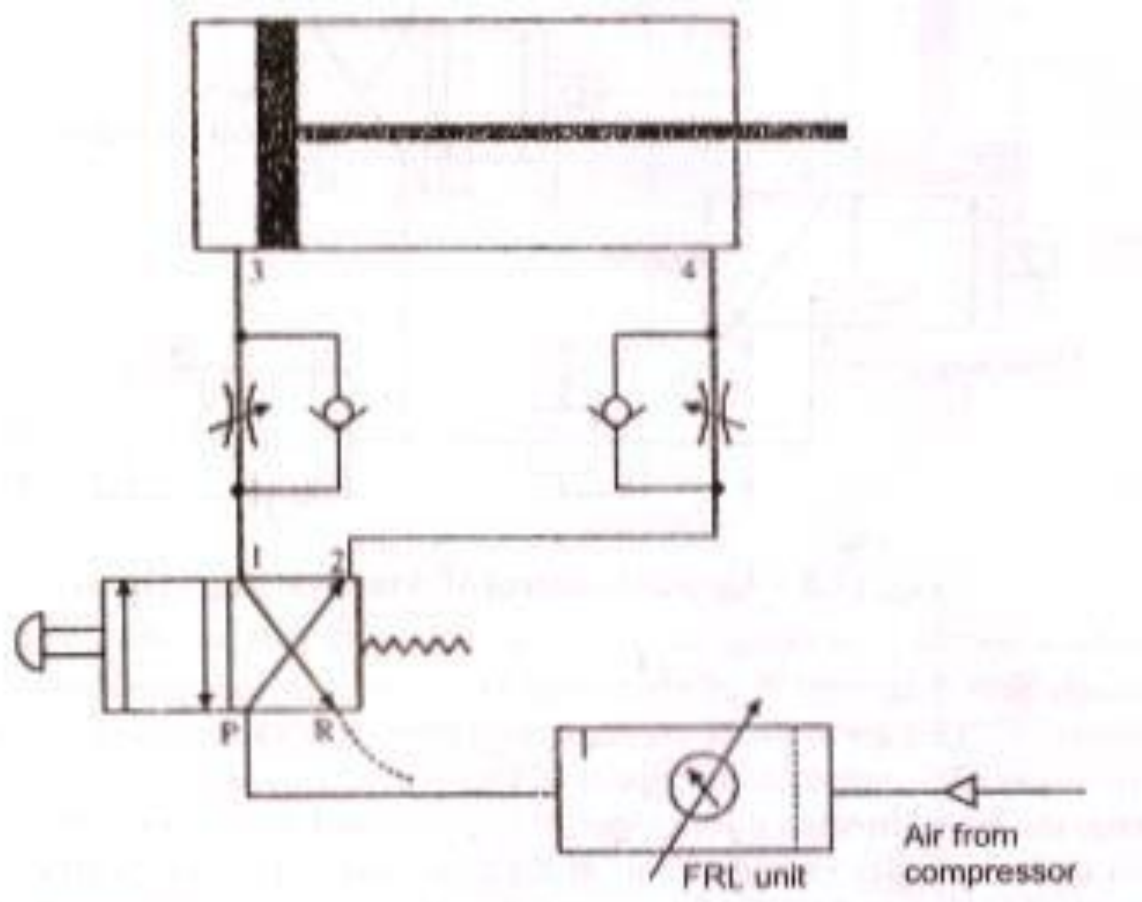
- It uses the flow control valve to control the rate of piston movement on the outstroke of machine
- It consist of pneumatic power unit, manually operated D.C. valve, flow control valve
- When spool is in its left envelop mode the air from FRL unit enters the blind end of cylinder and acts on the piston to perform forward stroke.
- The air from other end of cylinder is allowed to pass through a flow control valve to regulate the outstroke speed of piston.
- When the spool is in right envelop mode the piston retracts quickly.



Pneumatic circuit to control rate of piston movement on out stroke of the machine

Pneumatic circuit to control the speed of double acting cylinder:

- Fig shows the pneumatic circuit to control the speed of double acting cylinder.
- Here two flow control valves are placed in the incoming lines of double acting cylinder. And is placed in meter-out circuit.
- The check valve and flow control valves are placed in such a manner that the air flows freely into the cylinder through the check valve in both position of a four way D.C. valve.
- But the air from the cylinder has to pass only through the flow control valve in both position of D.C.Valve.
- In this both the piston extension or retraction speed can be controlled by flow control valve.



. 12.7 : Pneumatic circuit of control speed of double acting cylinder

Sequence circuit

- Fig shows the pneumatic circuit using one sequence valve to control the two operations performed in proper sequence in one direction only.
- It consist of pneumatic power unit, D.C. valve, sequence valve and two double acting cylinders.
- When spool is shifted to right side, then the D.C. valve is in its left envelop mode so that the compressed air from pneumatic power unit is directed to enter into the blind end of cylinder ‘P’
- Then the piston in the cylinder P extends which moves the object placed at position X to position Y.

ters.

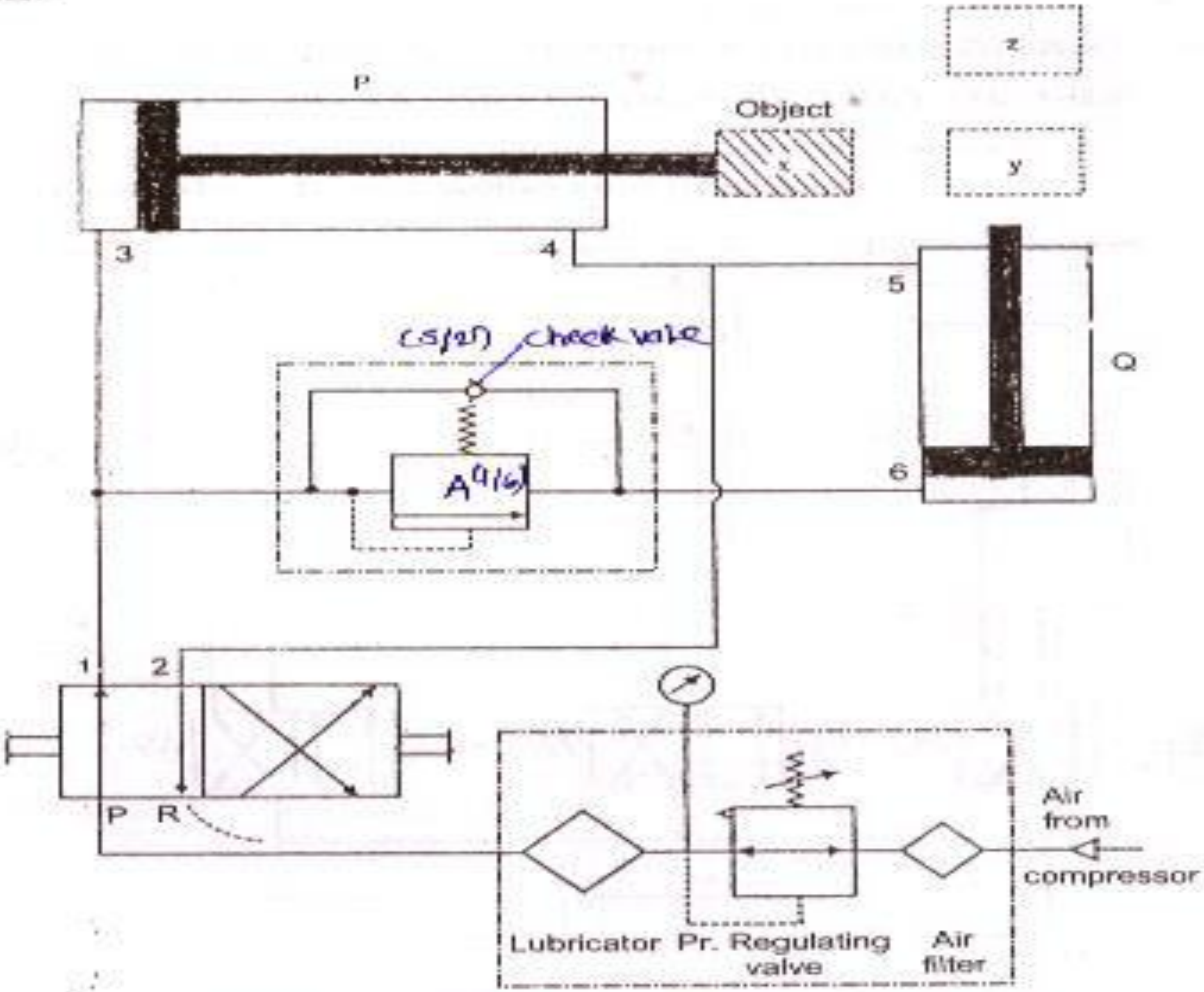


Fig. 12.9 : Pneumatic circuit using a sequence valve

- The piston in cylinder P extended completely, due to this the pressure in line 1-3 builds up causing the sequence valve A to open.
- This allows the flow of compressed air to enter the blind end of cylinder Q via line 1-6.
- Thus the piston in the cylinder Q extends, which moves the object at position Y to position Z.
- The air from the rod end of cylinder is exhausted into the atmosphere
- As the spool is shifted to left side, then the D.C. valve is in its right envelop mode.
- The compressed air from power unit is directed to enter the rod end of both cylinders, causing the cylinder to retract fully.

- The air from blind end is exhausted to atmosphere via check valve. Thus the piston in both the cylinders retracted at the same time.
- Then the cycle is repeated again.

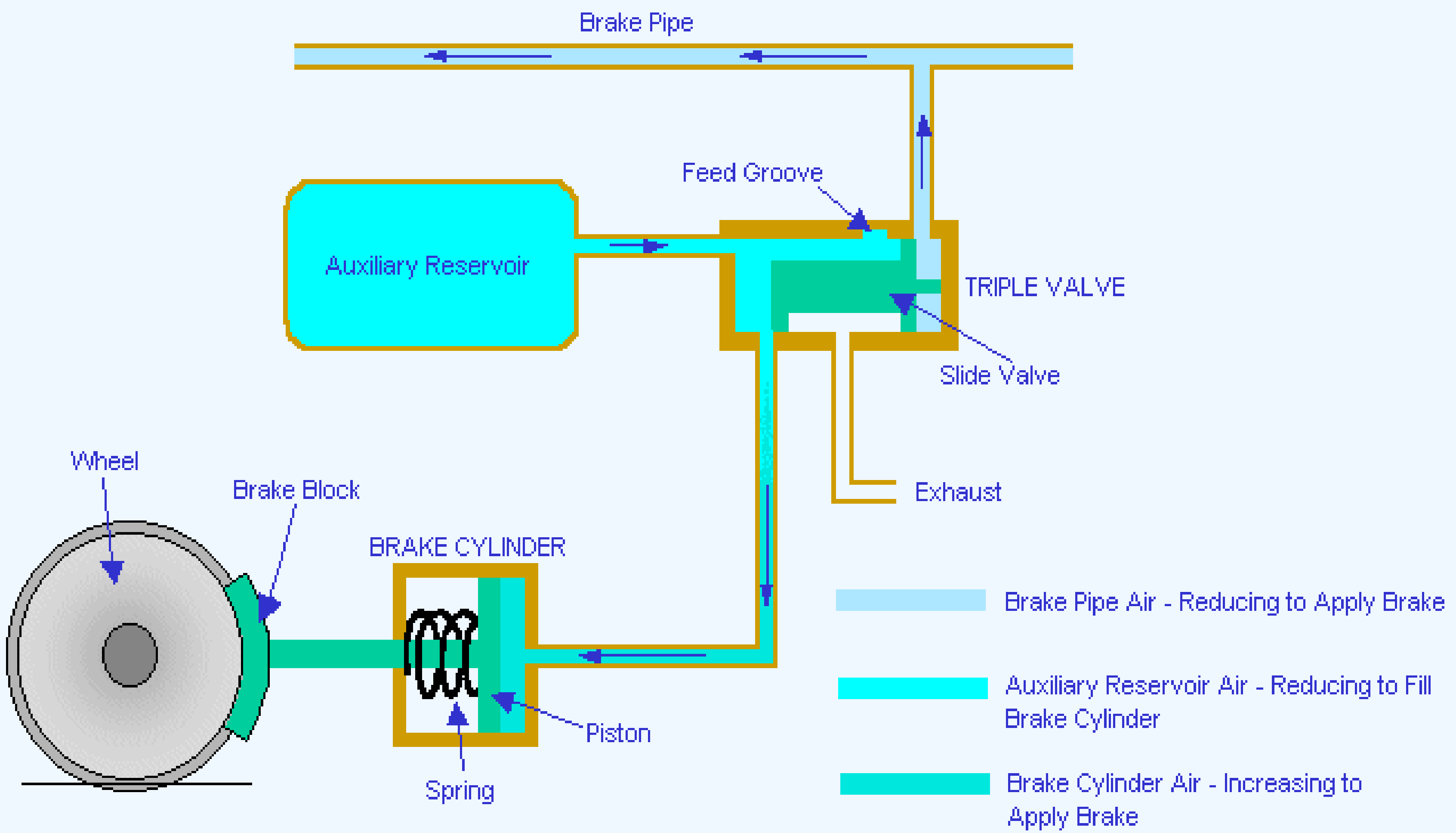
Application of Pneumatic circuit:

- Pneumatic systems are used in various power operated devices like chucks, mandrels, vice, jig & special holding fixtures
- A pneumatic power tool are the mean of converting air power to mechanical power. They work on percussive or rotary motion.

Application of Pneumatic circuit:

- In percussion tools, the piston oscillates rapidly to and fro, striking the tool on the outward stroke and air cushioned on the inward stroke towards the hand to relieve the operator from shocks. The oscillations may be up to 2000 per min. ex. Hammers, Rivetters, Picks, Concrete breakers.

- Rotary pneumatic tools consist of vane type rotar which is rotated by compressed air and this rotary motion is transmitted to the tool. Ex. Pneumatic drills, grinders, die grinders.



Schematic Diagram of Air Brake System on Vehicle in Application Position

- Air brakes are used in trucks, buses, trailers, and semi-trailers.

- George Westinghouse first developed air brakes for use in railway service. He patented a safe air brake on March 5, 1872. Originally designed and built for use on railroad train application, air brakes remain the exclusive systems in widespread use.

- Westinghouse made numerous alterations to improve his air pressured brake invention, which led to various forms of the automatic brake and the subsequent use on heavier road vehicles.

- The air compressor is driven off of engine either by crankshaft pulley via a belt or directly off of the engine timing gears. It is lubricated and cooled by the engine lubrication and cooling systems.

- Compressed air is first routed through a cooling coil and into an air dryer which removes moisture and oil impurities .

- Air brake system may include a pressure regulator, safety valve and a smaller purge reservoir. As an alternative to the air dryer, the supply system can be equipped with an anti freeze device and oil separator.

- The compressed air is then stored in a reservoir (also called a wet tank) from which it is then distributed via a four way protection valve into the front and rear brake circuit air reservoir, a parking brake reservoir and an auxiliary air supply distribution point.

- The system also includes various check, pressure limiting, drain and safety valves.

Safety

Since air is readily available for free everywhere on the surface of earth, this significantly reduces the chance of brake failure due to leaks in the braking system.

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Reliability

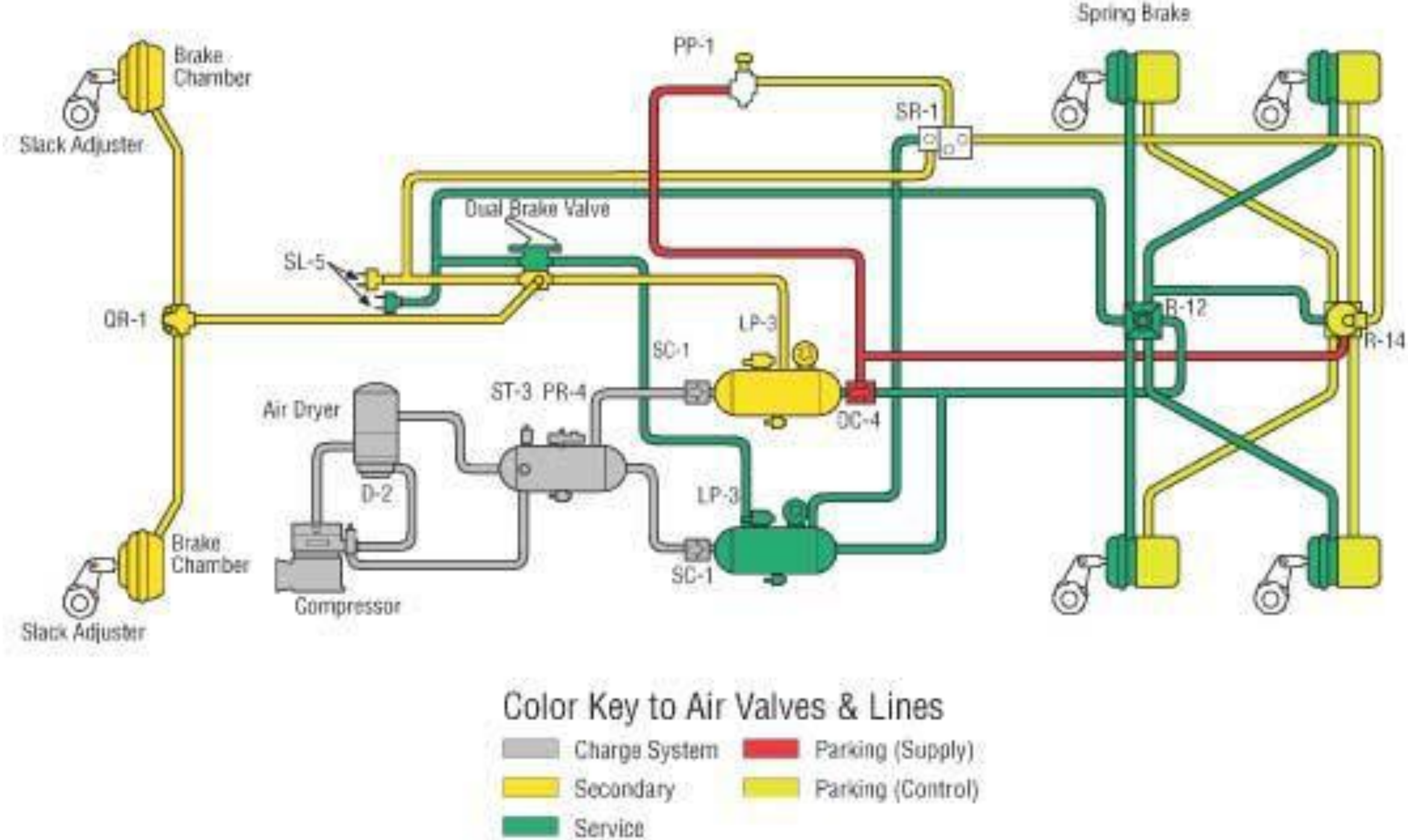
When the vehicle is started, the compression begins and the brakes are released when the vehicle is put to motion. Thus, if there is a leak or even if the compression Mechanism completely fails, the brakes revert back to their default, activated position and the vehicle is brought to rest.

Cost Effectiveness

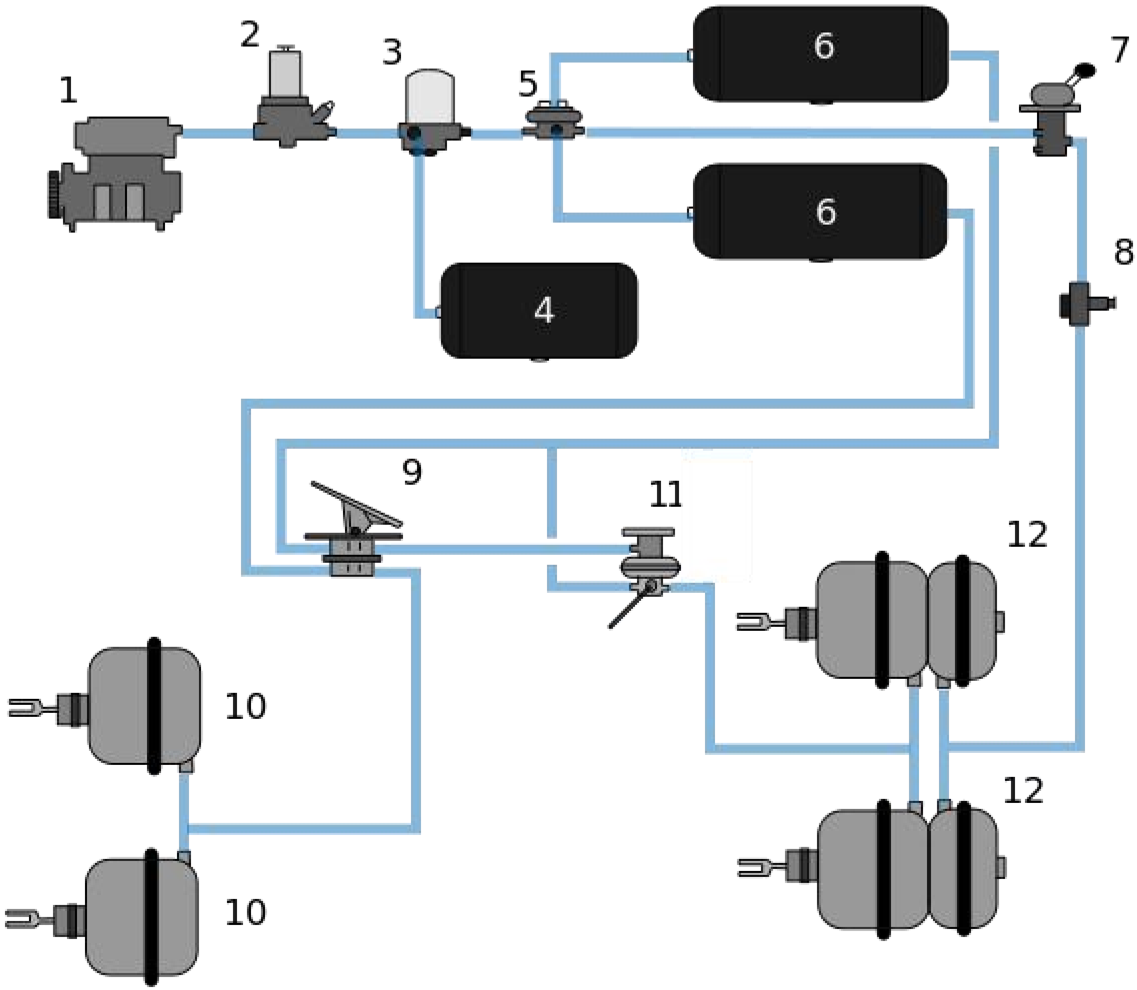
Air on the other hand, is freely available. Minor leaks do not result in brake failures.

Air line couplings are easier to attach and detach than hydraulic lines; there is no danger of letting air into hydraulic fluid. So air brake circuits of trailers can be attached and removed easily by operators with little training.

Air not only serves as a fluid for transmission of force, but also stores potential energy. So it can serve to control the force applied. Air brake systems include an air tank that stores sufficient energy to stop the vehicle if the compressor fails.



Spring Brake
PP-1
Brake Chamber
Slack Adjuster
SR-1
Dual Brake Valve
SL-5
QR-1
R-12
R-14
LP-3
SC-1
Air Dryer
ST-3
PR-4
DC-4
D-2
LP-3
Brake Chamber
SC-1
Compressor
Slack Adjuster
Color Key to Air Valves & Lines
Charge System
Parking (Supply)
Secondary
Parking (Control)
Service



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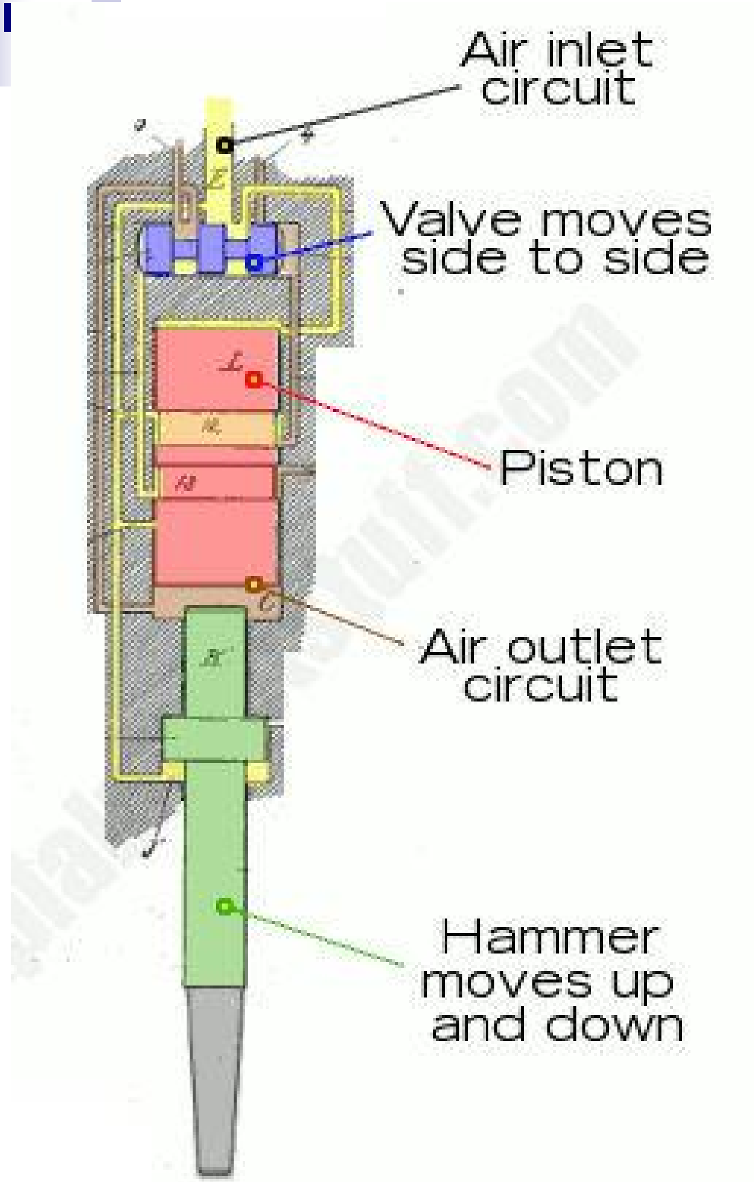
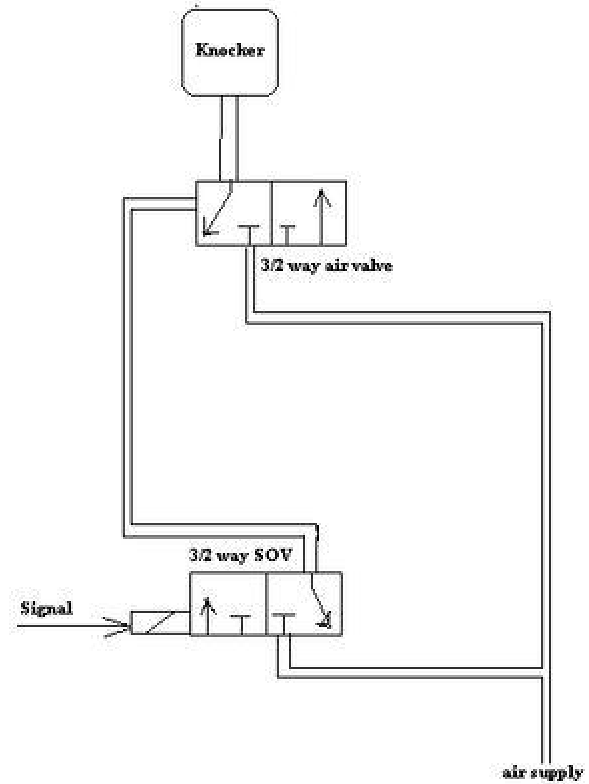
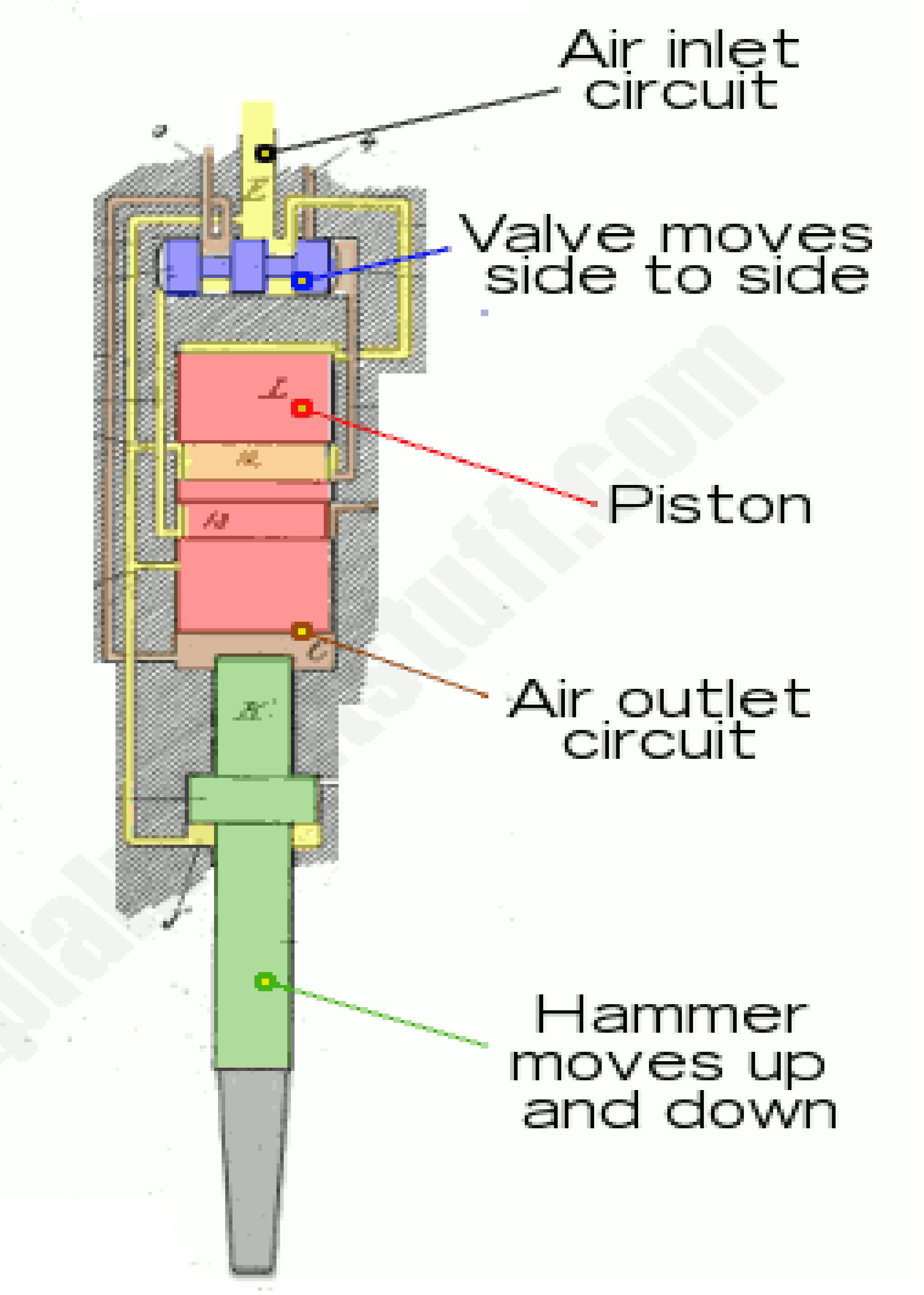

Air inlet circuit
Valve moves side to side
Piston
Air outlet circuit
Hammer moves up and down


Knocker
3/2 way air valve
3/2 way SOV
Signal
air supply


Air inlet circuit
Valve moves side to side
Piston
Air outlet circuit
Hammer moves up and down

Introduction

- Air hammers/pneumatic hammers o/ power hammers, were invented in 1890, and patented in January of 1894 by Charles Brady King.

- These hammers use compressed air to help aid craftsman to hammer, **score** and perish (smooth) a workpiece that would take hours, if not days, to produce manually.

- Air hammers range in size and price greatly. Hand-held models can be bought from around $20 to larger desk size models that can cost up to $20,000.

Piston

- Air hammers use a **piston** to work. The piston is the only moving part to an air hammer.
  The piston moves very rapidly back and forth from the air pressure of the compressor.

- Air is pushed into the central cylinder forcing the tip attachment forward with great power and velocity. A cyclical valve then reverses the air flow, forcing the tip attachment into the back of the cylinder. This cycle is repeated thousands of times per minute.

- Air hammers use air compression to work. Air compressors are large tanks of air with motors attached. Hand-held models of air hammers use tubes connected to an air tank. The motor fills the tank with air that is pressurized. This pressurized air travels through the tube to the air hammer, thus making the air hammer operational.

- Each air hammer varies on the size of compressor it needs to perform. Smaller air hammers need smaller compressors while larger models need larger compressors.

Applications

- The difference in size of air hammers to air compressors vary according to the cubic feet per minute, or PSI required for the specific air hammer model being used.

  - Since different bits can be used in air hammers, a craftsman can find several purposes for the tool.

  - Different bits can be acquired to do jobs such as cutting steel, cutting metal, drilling holes, decorative and ornamental purposes.

  - Contractors can also use these tools for demolition projects, take out mortar, or removing rivets. Safety

Precautions

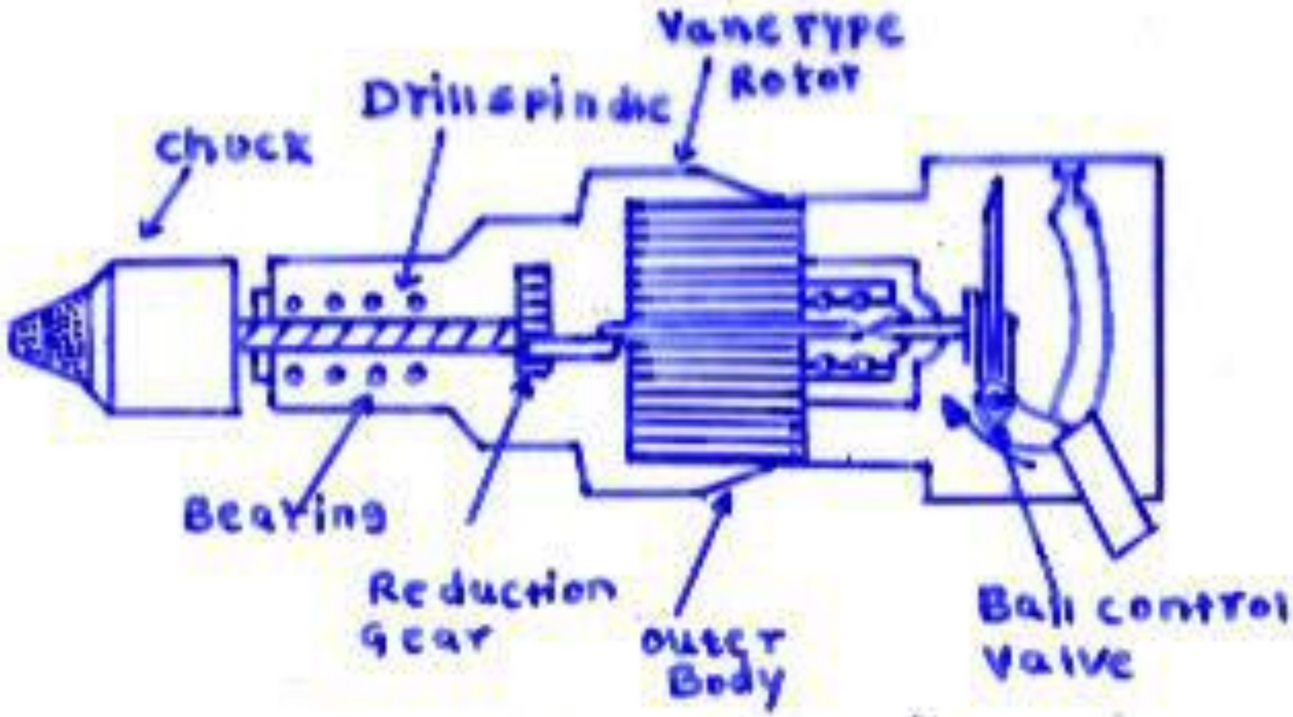
- Air hammers are very powerful **tools** which can cause great injury if safety precautions are not taken.

- Wear the proper safety equipment such as safety glasses and ear plugs. Craftsman should always make sure the air hammer is unplugged when changing the various tips, or bits.

- Finally, when working with an air hammer, a craftsman should always be aware of the positioning of the tool due to the extreme powerful nature that can cause the tool to jump when operated.

Pneumatic drill:-

- Fig shows small light duty pneumatic drill.
- It works on compressed air at 5.5 bar.
- The quantity of air is controlled by ball valve which is pressed by hand lever mechanism incorporated in the handle.
- When the lever is pressed air is supplied to the air motor and when it is released the air supply is cut off.
- The high pressure air is supplied to the air motor through control valve.
- The air motor consists of vane type rotor.



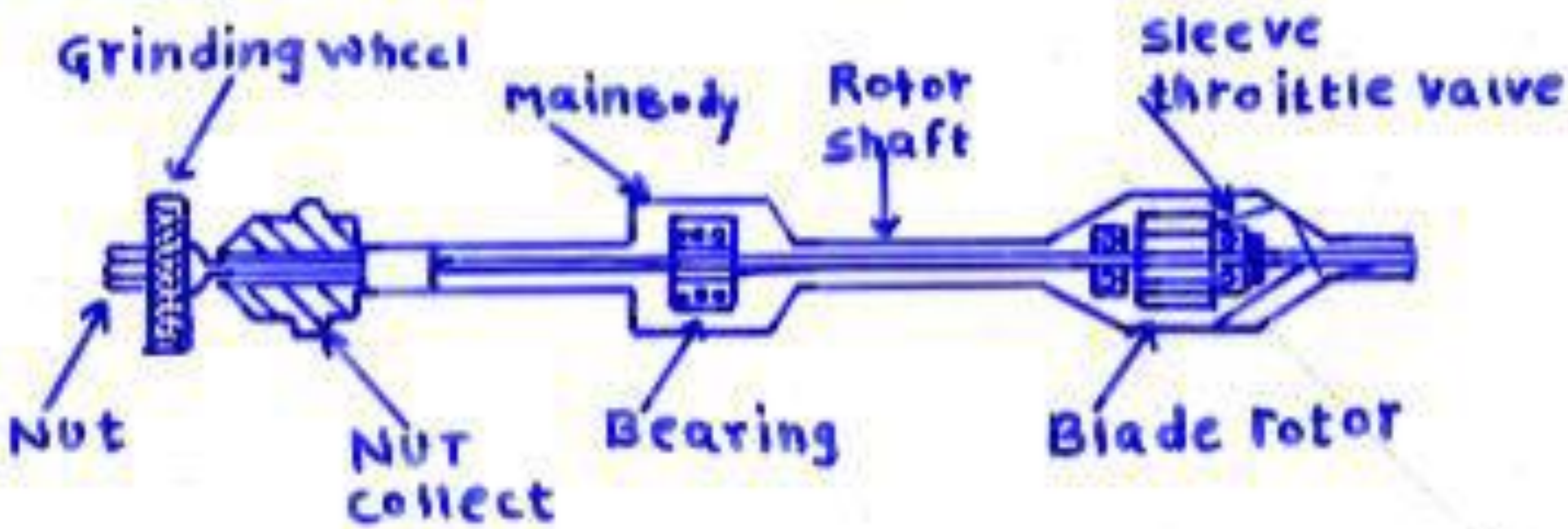
Pneumatic Drill

Pneumatic drill:-

- The air flows over the vanes axially and rotate the shaft of air motor.
- After doing work of rotation, air is exhausted into the atmosphere.
- It is used for wood boring, light drilling, drilling holes in steel plates for riveting. Here drill size is up to 2.5 mm.

Pneumatic grinder:-

- It works on compressed air at 5.5 bar.
- It consist of hose, throttle valve, bearing vane type rotor, rotor case and rotor shaft which are enclosed in a body of the grinder.
- The rotor shaft projects outwards of the body at the end of which a grinding wheel is mounted.
- The compressed air is supplied to grinder from a compressor.
- As air passes over the rotor blades it rotates the shaft and hence the grinding wheel. After doing work air is exhausted through the ports to atmosphere.



PNEUMATIC Grinder

Pneumatic grinder:-

- The speed of grinder is constant, it is about 14500 to 15000 rpm.
- The grinders are used in die shop for delicate work.
- They are also used for grinding ornamental scroll work for finishing metal pattern, trimming of casting, polishing and filling of various jobs.

Low cost Automation:-

- Pneumatics is a pacemaker of low cost automation.
- It helps in simplification of the technical outlay for special machinery and auxillary equipment, with limitations naturally being set by application criteria Ex. Force, thrust, travel, time etc.
- The relatively small capital expenditure creates a basis for building a special type machine, fixture or auxillary unit for a given shaping operation even when only small runs or a few of the parts are to be produced.