UNIT II

HYDRAULIC ACTUATORS AND CONTROL COMPONENTS

PART-A

1. What is a telescopic Cylinder? Nov/Dec2011

Telescopic cylinders are a special design of a hydraulic cylinder or pneumatic cylinder as well as pulley system which provide an exceptionally long output travel from a very compact retracted length. Some pneumatic telescoping units are manufactured with retracted lengths of under 15% of overall extended unit length.

2. What is the function of unloading valve and sequence valve? Nov/Dec 2012

a) The unloading valve is useful to control the amount of flow at any given time in systems having more than one fixed delivery pump.

b) When the operation of two cylinders is required to be performed in Sequence, the sequence valve is used

3. **Differentiate double rod and tandem cylinder May/June2013**

Tandem cylinders consist of two cylinders in one housing. They have four ports and the back cylinder is single-rod end while the front cylinder is double-rod end. Because the front cylinder is double-rod end, it has equal areas and volumes on both sides of the piston

4. **Mention advantages of air motor over electric motor. May/ June 2013**

The greatest advantage of an air motor vs electrical motor is the torque. An air motor allows you to adjust the torque output depending on your needs. Air motors feature a dynamically generated torque load. Electric motors get their power, either, from an Alternating Current (AC) or Direct Current (DC) motor.

5. What is chattering in pressure valve? May/June 2014

Chattering is the rapid opening and closing of a pressure- relief valve. The resulting vibration may cause misalignment, valve seat damage, and, if prolonged, mechanical failure of valve internals and associated piping.

6. List the three types proportional control valve May/June 2012

i) Solenoid Operated Proportional Relief Valve.

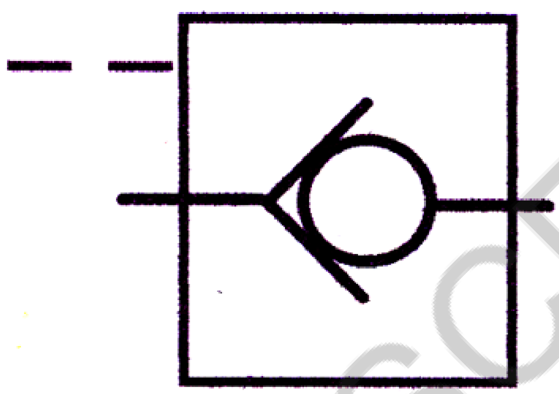
ii) Solenoid Operated Proportional Relief Valve.

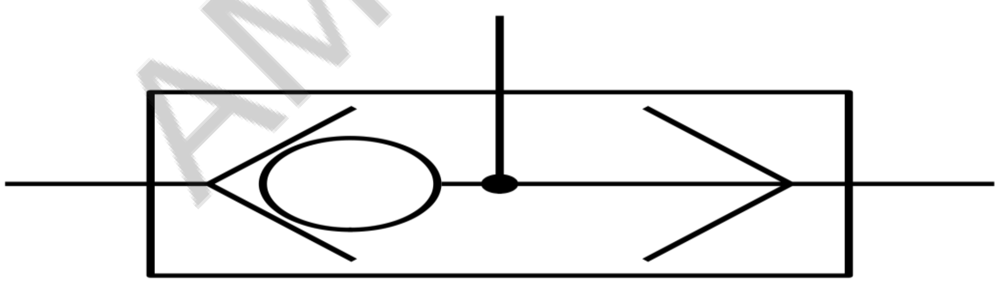
iii) Direct Operated Type Solenoid Operated Proportional Throttle Valve.

7. What is tandem cylinder? April/May 2015

It design has two cylinders mounted in line with pistons connected by a common piston rod. These cylinders provide increased output force when the bore size of a cylinder is limited. But the length of the cylinder is more than a standard cylinder and also requires a larger flow rate to achieve a speed because flow must go to both pistons.

8. Draw the ANSI symbol for Pilot operated check valve and Shuttle valve (April/May2008)





9. **When is lobe pump is preferred? (Nov/Dec 2009)**

A lobe pump itself does not compress the material it pumps. Lobe pumps are frequently used in food applications because they handle solids without damaging the product. Particle size pumped can be much larger in lobe pumps than in other positive displacement types

Rotary lobe pumps are non-contacting and have large pumping chambers, allowing them to handle solids such as cherries or olives without damage. They are also used to handle slurries, pastes, and a wide variety of other liquid.

10. Why is end cushioning provided in hydraulic cylinder operation? (Nov/Dec 2009)

Cushioning of some sort normally is required to decelerate a cylinder's piston before it strikes the end cap. Reducing the piston velocity as it approaches the end cap lowers the stresses on cylinder components and reduces vibration transmitted to the machine structure.

11. What is pressure compensated flow control? (April/May2010)

A pressure-compensated flow control valve has a fixed throttling flow at all pressures. The two-way pressure-compensated flow control valve is also called a series valve. The pressure reducing valve and the smothering of this valve are placed in series with each other.

12. How does a servo valve difference from proportional valve (April/May 2010)

Servo valve — any continuously variable, electrically modulated, directional control valve with less than 3% center overlaps.

Proportional valve — any continuously variable, electrically modulated, directional control valve with more than 3% center overlaps.

13. How do you classify directional control valve? (Nov/Dec 2005)

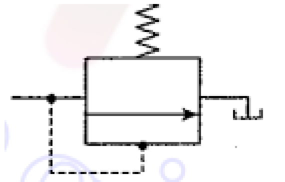
Based on the number of ports present, the DCVs are classified as :

(*i*) Two way valves,

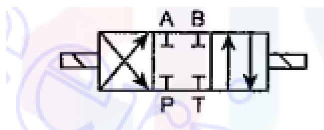
(*ii*) Three way valves, and

(*iii*) Four way valves.

14. Draw the symbol of pressure relief valve (Nov/Dec 2005)



15. Give the hydraulic symbol for ¾ closed centre solenoid DCV (May/June 2006)



16. What is the difference between pilot operated and direct operated pressure relief valve (May/June 2006)

Direct operated pressure relief valves are used where the flow rate and the system pressure are reasonably smaller or there is not much variation in system pressure or flow rate. Whereas for a larger flow rate and higher pressure, pilot operated pressure relief valves are used. The great advantage of pilot valve is that it can be kept spatially separated from the main valve.

17. Difference between pressure control valve and pressure relief valve (Nov/Dec 2006)

Pressure control valve controls the fluid pressure in a system whereas pressure relief valve protects a system from excessive fluid pressure over and above the design pressure limit.

18. write the function of solenoid valve(Nov/Dec 2006)

A solenoid is an electromagnetic mechanical transducer that converts an electrical signal into a mechanical output force. It provides a push or pull force to remotely operate fluid

19.define pressure over ride in pressure control valve (Nov/Dec 2006)

The pressure at which the valve that opens is called the cracking pressure. The cracking and closing pressure of the control valve is not same. Moreover in most cases, the valve poppet cracks at a pressure lower than the adjusted pressure but the valve closes at a lower pressure than at which it cracks. This phenomenon is known as pressure override.

20. What is the control function of different valves in hydraulic system (Nov/Dec 2007)

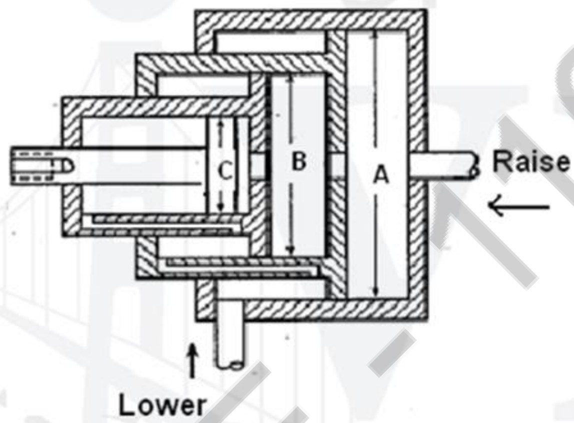
1. ***Directional control values:*** To control the direction of flow by which the direction of actuator is controlled.
2. ***Pressure control values:*** To control the pressure of the fluid in the circuit by which the force exerted by actuator is controlled.
3. ***Flow control values:*** To control the flowrate of fluid in the circuit by which the speed of the actuator is controlled.

PART-B

UNIT-II

1. i) Explain with neat sketch, the principle and operation of telescopic cylinder (April/May 2008)

They are used where long work strokes are needed. A telescoping cylinder provides a relatively long working stroke for an overall reduced length by employing several pistons which telescope into each other.



Since the diameter A of the ram is relatively large, this ram produces a large force for the beginning of the lift of the load. When ram A reaches the end of the stroke, ram B begins to move. Now ram B provides the required smaller force to continue raising the load. When ram B reaches the end of its stroke, then ram C moves outwards to complete the lifting operation. These three rams can be retracted by gravity acting on the load or by pressurized fluid acting on the lip of each ram.

ii) With respect the hydraulic motors. Define the terms Volumetric, Mechanical and Overall efficiency (April/May 2008)

6.14. HYDRAULIC MOTOR PERFORMANCE

Like in hydraulic pumps, the performance of hydraulic motor is also evaluated by using volumetric, mechanical, and overall efficiencies.

6.14.1. Volumetric Efficiency (η_{vol})

The volumetric efficiency of a hydraulic motor is the inverse of that for a pump. Mathematically,

$$\eta_{vol} = \frac{\text{Theoretical flow rate motor should consume}}{\text{Actual flow rate consumed by motor}} \times 100 = \frac{Q_T}{Q_A} \times 100 \quad \ldots (6.11)$$

6.14.2. Mechanical Efficiency (η_{mech})

The mechanical efficiency of a hydraulic motor is the inverse of that for a pump. Mathematically,

$$\eta_{mech} = \frac{\text{Actual torque delivered by motor}}{\text{Torque motor should theoretically deliver}} \times 100 = \frac{T_A}{T_T} \times 100 \quad \ldots (6.12)$$

where $T_A = \dfrac{\text{Actual power delivered by motor (watts)}}{\text{Angular speed of motor shaft (rad/s)}} = \dfrac{P}{\omega}$, and

$$T_T = \frac{V_D\,(m^3/rev) \times P\,(N/m^2)}{2\pi} \quad \ldots (6.13)$$

6.14.3. Overall Efficiency (η_0)

The overall efficiency of the hydraulic motor is the product of the volumetric and mechanical efficiencies. Mathematically,

$$\eta_0 = \eta_{vol} \times \eta_{mech} \quad \ldots (6.14)$$

Combining equations (6.11), (6.12), (6.13), and (6.14), we get

$$\eta_0 = \frac{T_A\,(N\text{-}m) \times \omega\,(rad/s)}{P\,(N/m^2) \times Q_A\,(m^3/s)} \times 100 \quad \ldots (6.15)$$

Note The actual power delivered to a motor by the fluid is called by the term ***'hydraulic power'***. Similarly, the actual power delivered to a load by a motor via a rotating shaft is called ***'brake power'***.

2. Explain the sequencing of two double acting cylinders with a neat sketch. (April/May 2008)

Fig.6.4 illustrates the arrangement of a typical telescoping type cylinder having three rams.

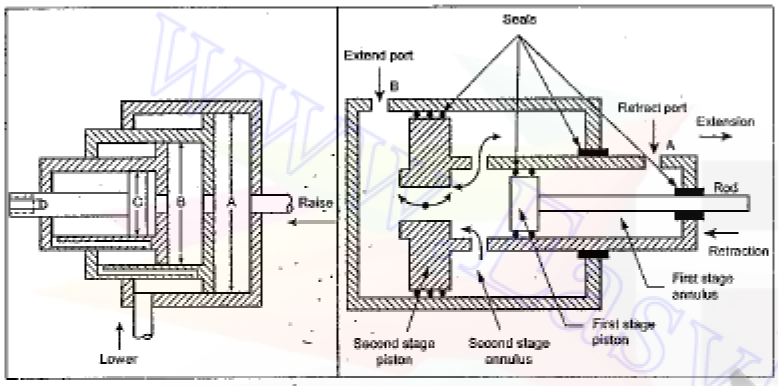


Fig. 6.4. Telescoping cylinder

Fig. 6.5. Operation of a two-stage double-acting telescopic cylinder

Since the diameter A of the ram is relatively large, this ram produces a large force for the beginning of the lift of the load.† When ram A reaches the end of the stroke, ram B begins to move. Now ram B provides the required smaller force to continue raising the load. When ram B reaches the end of its stroke, then ram C moves outwards to complete the lifting operation. These three rams can be retracted by gravity acting on the load or by pressurized fluid acting on the lip of each ram.

6.6.3. Working of a Two-Stage Double-Acting Telescopic Cylinder

Fig.6.5 illustrate the operation of a typical two-stage double-acting telescopic cylinder.

Retraction stroke : During the retraction stroke, the fluid is fed into the first-stage annulus via retract port A. Therefore the first stage piston is forced to the left until it uncovers the fluid ports connecting this with the second stage annulus. This, in turn, moves the larger piston to the left until both the pistons are fully retracted into the body of the cylinder.

Extension stroke : During the extension stroke, the fluid is fed through the extend port B. Now the fluid forces both pistons to the right until the cylinder is fully extended.

As could be seen from Fig.6.5 that many seals are provided for preventing any possible fluid leakages.

3. With a neat sketch describe the construction and operation of a pressure compensated flow control valve (April/May 2008)

The construction and operation of a typical pressure-compensated flow control valve is illustrated in Fig.7.24.

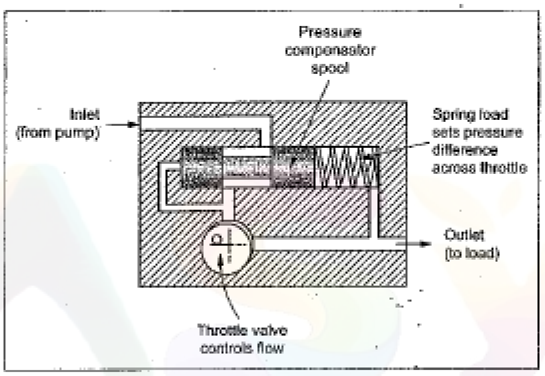


Fig. 7.24. Pressure-compensated flow control valve

The valve actually has two main parts arranged in series. They are :

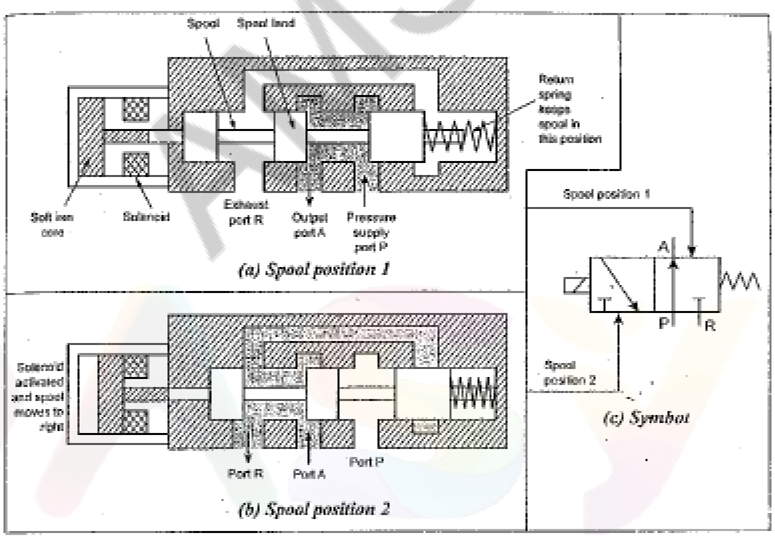
1. Throttle valves : Similar to a needle valve, the throttle valve has an orifice whose area can be adjusted by an external knob setting. This throttle valve setting determines the flow rate is to be controlled.

2. Pressure compensator : The pressure compensator spool controls the size of the inlet orifice and maintains a constant pressure drop across the throttle valve.

As inlet pressure increases and overcomes the spring force, the pressure compensator spool closes the inlet passage. It blocks off all flow in excess of the throttle setting. As a result, the valve permits the fluid flow only to the amount for which the throttle is already set.

When the fluid passes through the throttle valve, the pressure builds up in the spring side of the compensator. This pressure drop produces a rapid compensation in the form of spool motion. This spool adjustment causes the pressure drop to return quickly to its original valve, thus maintaining constant flow.

4. Discuss the construction and working of a solenoid-actuated valve (Nov/Dec 2009)



(a) Spool position 1

(b) Spool position 2

(c) Symbol

Fig. 7.11. Construction and operation of a solenoid-actuated 3/2 valve

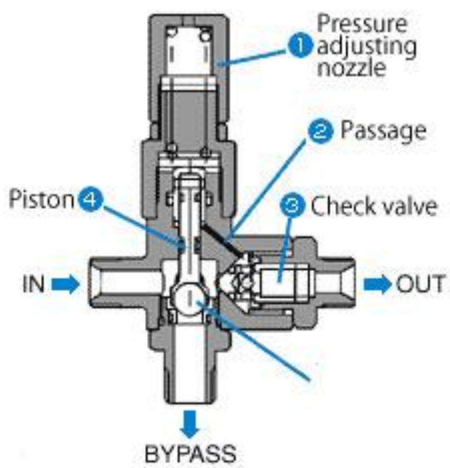
As shown in Fig.7.11(*a*) and (*b*), the valve is actuated by a current passing through a solenoid and, returned to its original position by a spring. The spool slides over the finely finished valve bore inside the valve housing.

Spool position 1 : In the original or neutral position of the spool, (Fig.7.11(*a*)), the pressurized fluid flows from port P to port A to move the actuator, the exhaust port (R) remaining closed.

Spool position 2 : When the solenoid is activated (Fig.7.11(*b*)), the spool moves to the extreme left. In the extreme spool position, the fluid from port P gets closed and hence the fluid is permitted to flow from port A to port R.

Thus the valve alternately connects and disconnects fluid supply to the cylinder by the sliding spool.

5. Discuss the functioning of an unloading valve with a diagram (Nov/Dec 2009)



Unloading valves are pressure-control devices that are used to dump excess fluid to tank at little or no pressure. A common application is in hi-lo pump circuits where two pumps move an actuator at high speed and low pressure, the circuit then shifts to a single pump providing high pressure to perform work.

the construction of a direct-acting unloading valve. The valve consists of a spool held in the closed position by a spring. The spool blocks flow from the inlet to the tank port under normal conditions. When high-pressure fluid from the pump enters at the external-pilot port, it exerts force against the pilot piston. (The small-diameter pilot piston allows the use of a long, low-force spring.) When system pressure increases to the spring setting, fluid bypasses to tank (as a relief valve would function). When pressure goes above the spring setting, the spool opens fully to dump excess fluid to tank at little or no pressure.

A pilot-operated unloading valve has less pressure override than its direct-acting counterpart does, so it will not dump part of the flow prematurely. It also will go from no flow to maximum flow quickly, thus using all the flow from the high-volume pump flow for a longer period, and rapidly dropping horsepower draw from the high-volume pump.

In a pilot-operated unloading valve, the unloading spool receives a signal through the remote-pilot port when pressure in the working circuit goes above its setting. At the same time, pressure on the spring-loaded ball in the pilot section starts to open it. Pressure drop on the front side of the unloading spool lowers back force and pilot pressure from the high-pressure circuit forces the spring-loaded ball completely off its seat. Now there is more flow going to tank than the control orifice can keep up with. The main poppet opens at approximately 20 psi. Now, all high-volume pump flow can go to tank at little or no pressure drop and all horsepower can go to the low volume pump to do the work. When pressure falls approximately 15% below the pressure set in the pilot section, the spring-loaded ball closes and pushes the unloading spool back for the next cycle.

6. With a neat sketch, explain the construction and cushioning mechanism in cylinder (Apr/May 2010) (May/June2012), (May/June2014)(April/May2010)

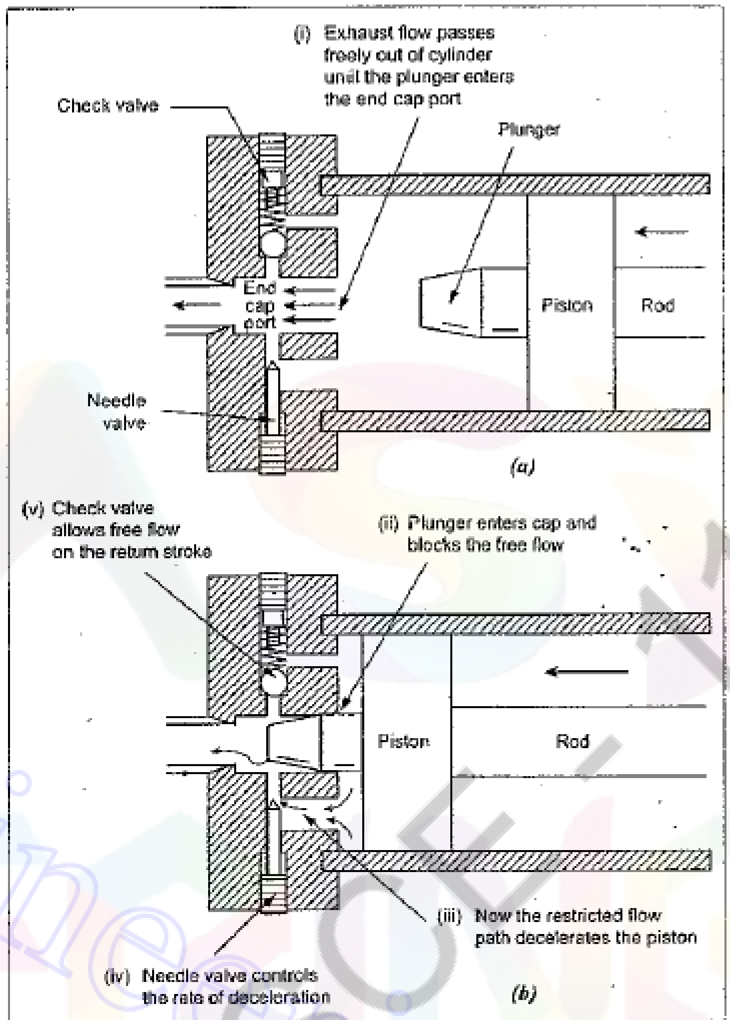
6.5.1. What is Meant by Cylinder Cushion ?

When the pressurised fluid is allowed to enter inside the cylinder, the piston accelerate and travels in the cylinder barrel. If the piston is allowed to travel at the same speed till th end of the stroke, it will hit the end cap with a great impact. To avoid this impact, the pistor needs to decelerate at the end of the travel. The arrangement made at the end caps to achiev the same is called 'cylinder cushion'.

6.5.2. Construction and Operation

A typical cylinder cushioning arrangement is illustrated in Fig.6.3. Figs.6.3(*a*) and (*b* show the position of the piston at the start and of the cushioning action, respectively.

As the piston approaches the end of its stroke, the plunger enters the end cap port and thu blocks the free flow. Now the fluid is trapped between the piston and the end cap. This fluic can escape only by passing through the adjustable restrictor, as shown in Fig.6.3(*b*). Thi fluid flow through the restricted flow path causes the piston to decelerate. The rate o deceleration of the piston can be controlled by the adjustable needle valve. A non-return o check valve is provided to allow free flow of fluid to the cylinder quickly during the returr stroke.


(i) Exhaust flow passes freely out of cylinder until the plunger enters the end cap port
Check valve
Plunger
End cap port
Piston
Rod
Needle valve
(a)
(v) Check valve allows free flow on the return stroke
(ii) Plunger enters cap and blocks the free flow
Piston
Rod
(iii) Now the restricted flow path decelerates the piston
(iv) Needle valve controls the rate of deceleration
(b)

7. Explain the construction of pressure relief valve with neat sketch May/June 2012

7.14. SIMPLE (OR DIRECT ACTING) PRESSURE RELIEF VALVE

7.14.1. Construction and Operation

The construction and operation of a simple poppet (ball)-type direct-acting pressure valve is illustrated in Fig.7.16(*a*). It has one inlet port which is normally closed under the influence of spring force. An adjustable spring load provides the pressure setting of the relief valve.

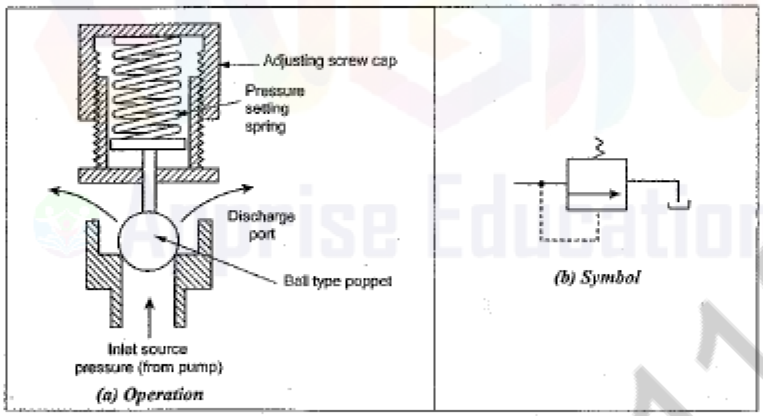


Fig. 7.16. Simple pressure relief valve

When the inlet pressure overcomes the force exerted by the spring, the valve opens and vents to the atmosphere or back to the sump. Thus the relief valve protects the other elements in the system from excessive pressure by diverting the excess fluid to the sump or atmosphere when the system pressure tends to exceed the preset level.

The direct-acting type of relief valves have a ball, poppet or a sliding spool working against a spring. As the inlet pressure decreases, the valve closes again. The adjusting screw cap is used to adjust the pressure limit and to vary the spring force.

7.14.2. Graphic Symbol

Fig.7.16(*b*) represents the graphic symbol of simple relief valve.

7.14.3. Application of Simple Relief Valves

The direct-acting pressure relief valves are used where the flow rate and the system pressure are low.

7.14.4. Limitation of Simple Relief Valves

When the required system pressure is high, a heavier spring is required. Because of the use of heavier spring, the problem of valve chatter or pressure fluctuations are very common.

8. Explain the operation of a check valve with a neat sketch (Nov/Dec 2011)

7.7. CHECK VALVES (OR TWO WAY VALVES)

7.7.1. Introduction

- ✓ Check valves are the most commonly used and the simplest type of directional control valves.
- ✓ The check valve is a ***two-way valve*** because it contains two ports. Also *a check valve is analogous to a diode in electric circuits.*
- ✓ ***Functions :*** The check valves are used :
  - (*i*) to allow free flow in only one direction, and
  - (*ii*) to prevent any flow in the other direction.
- ✓ Since check valves block the reverse flow of the fluid, they are also known as ***non-return valves.***
- ✓ The symbolic representation of a check valve, shown in Fig.7.4, illustrates its function clearly.

7.7.2. Types of Check Valves

Check valves are of several types. But the two important types of check valves are :

1. Poppet-type check valves, and
2. Pilot-operated type check valves.

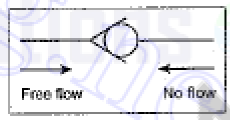


Fig. 7.4. Symbolic representation of a check valve

7.7.3. Poppet-Type (or Simple) Check Valves

7.7.3.1. Construction and Operation

The construction and operation of a typical poppet type check valve is illustrated in Fig.7.5. Normally a spring holds the poppet in the closed position.

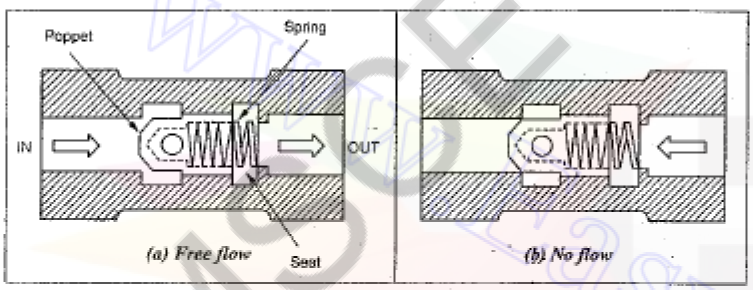


Fig. 7.5. Construction and operation of a poppet-type check valve

When flow is in the normal direction, the liquid pressure acts against the spring tension to hold the poppet offset the seat. When the liquid pressure overcomes the spring force, as shown in Fig.7.5(*a*), the valve allows the free flow. When flow stops, the spring seats the poppet and liquid cannot pass in the reverse direction.

Instead, if flow is attempted in the opposite direction as shown in Fig.7.5(*b*), the liquid pressure along with the spring force pushes the poppet in the closed position. Hence no flow is permitted in opposite direction.

7.7.3.2. Applications of Simple Check Valves

Usually poppet type check valves are used to provide the pilot pressure to operate larger valves.

7.7.4. Pilot-Operated Check Valves

The piloted operated check valve allows free fluid flow in one direction, but reversed flow depends upon the pilot actuation. That means, this type check valve also allows the reverse flow, provided pilot pressure is applied at the pilot pressure port of the valve to overcome the spring force of the poppet.

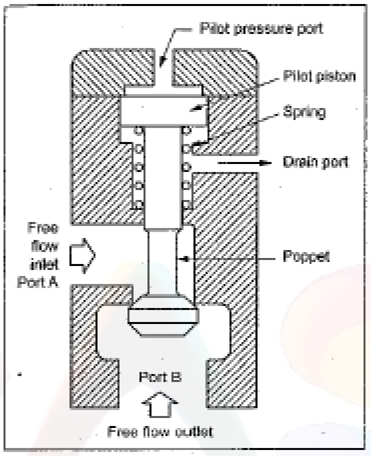


Fig. 7.6. Pilot-operated check valve

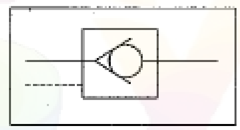


Fig. 7.7. Symbolic representation of a pilot-operated check valve

In order to permit the fluid flow in the reverse direction *i.e.*, from port B to port A, a pilot pressure is applied through the pilot pressure port. The pilot pressure pushes the pilot piston and the poppet down. Thus the fluid flow in the reverse direction is also obtained. The purpose of the drain port in the circuit is to prevent oil from creating a pressure buildup on the bottom of the pilot piston.

7.7.4.2. Graphical Symbol

Fig.7.7 shows the symbolic representation of a pilot-operated check valve. In Fig.7.7, the dashed line presents the pilot pressure line.

7.7.4.3. Applications of Pilot-Operated Check Valves

The pilot-operated check valves are widely used to hydraulically lock the cylinders such as in a hydraulic jack.

9. Explain the working of a pilot operated pressure relief valve with neat sketch (Nov/Dec2012)

7.15. COMPOUND (OR PILOT-OPERATED) PRESSURE RELIEF VALVE

7.15.1. Introduction

The compound pressure relief valve overcomes the problem of direct-acting pressure relief valve. Thus these relief valves can be employed for a larger flow rate and higher system pressure. These valves are built in two stages.

7.15.2. Construction and Operation

The construction of a typical sliding-spool type pilot-operated pressure relief valve is illustrated in Fig.7.17.

This compound relief valve operates in two stages :

Stage 1 : The first stage is the same as direct-acting type. As in the direct-acting type, the movable main poppet allows fluid to escape to the reservoir when the system pressure exceeds the setting of the valve. This first stage is shown on the right side of the valve. The main poppet is retained to its seal by a light spring.

Stage 2 : The second stage, also known as ***pilot stage,*** is located on the left side of the valve. It contains a pilot valve poppet (also known as control poppet) which is held against a seat by an adjustable strong spring. The pressure limit can be adjusted by using an adjustment screw.

The inlet system pressure acts on both sides of the main poppet because of the small orifice shown in Fig.7.17. The fluid passes from the inlet port through the orifice to a control chamber where it acts on the main poppet to add to the spring force. The system pressure also acts on the pilot poppet as shown in Fig.7.17.

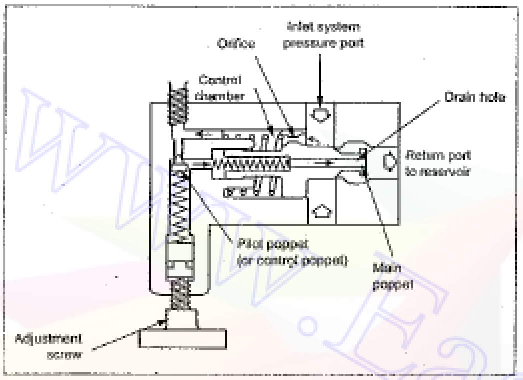


Fig. 7.17. Pilot-operated pressure-relief valve

When the system pressure exceeds the setting pressure of the main poppet, the poppet is pushed from its seat towards left. This forces the pressurised fluid on the left side to escape through the centrally drilled drain hole of the main poppet. This limits the pressure on the control chamber side. Due to the restricted flow through the orifice, the fluid cannot enter into the control chamber as quickly as the fluid leaves through the drain hole. Because of this, the pressure on the right side exceeds that on the left and the main poppet moves to the left. Thus it permits the fluid flow directly to the reservoir tank from the inlet port. When the pressure falls below the setting pressure, the main poppet retracts back to its original position again.

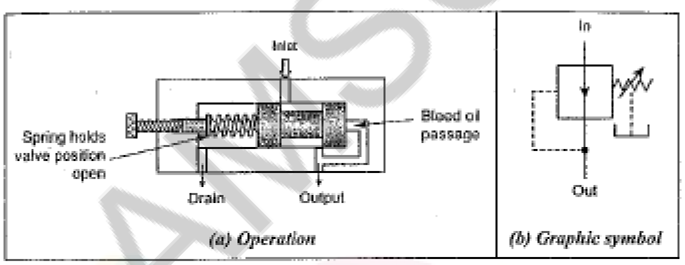
10. Write the short notes on (May/June2012)

i) Direct acting pressure reducing valve

7.17. DIRECT ACTING PRESSURE REDUCING VALVE

7.17.1. Construction and Operation

The construction and operation of a direct-acting pressure reducing valve is illustrated in Fig.7.18(*a*). It has a spring loaded spool to control the downstream (outlet) pressure.



(a) Operation *(b) Graphic symbol*

Fig. 7.18. Pressure reducing valve

When the main supply pressure is below the valve setting pressure, fluid will flow freely from the inlet to the outlet. It can be noted from Fig.7.18 that an internal connection from the outlet passage transmits the outlet pressure to the spool end opposite the spring.

When the downstream (outlet) pressure increases to the valve setting pressure, the spool moves to the left to partly block the outlet port. During this period, only enough flow is passed to the outlet to maintain the preset pressure.

If the valve closes completely, leakage could cause the spool pressure to build up. In order to avoid this, a continuous bleed to the tank is permitted to keep the valve slightly open. A separate drain passage is provided to drain this fluid to the tank.

ii) Pilot operated sequence valve

7.19. SEQUENCE VAVLES

7.19.1. What are Sequence Valves

- ✓ *The sequence valves are used to control the fluid flow to ensure several operations in a particular order of priority in the system.*
- ✓ The sequence valves are another type of pressure control valves, which are also extensively used in hydraulic systems.
- ✓ These valves permit several operations to be completed in a sequential order, *i.e.*, one after another. For example, a pressure sequence valve used in a clamping and drilling circuit will permit the clamping operation to take place first and then the drilling operation is accomplished.
- ✓ The sequence valves are set to specific pressure levels so as to ensure the priorities of function.

7.19.1.1. Types of Sequence Valves

Sequence valves are basically relief valves with minor modifications and may be either of the direct-acting or compound type.

7.19.2. Pilot-Operated (or Compound) Sequence Valve

The construction and operation of a typical pilot-operated sequence valve is illustrated in Fig.7.19(*a*).

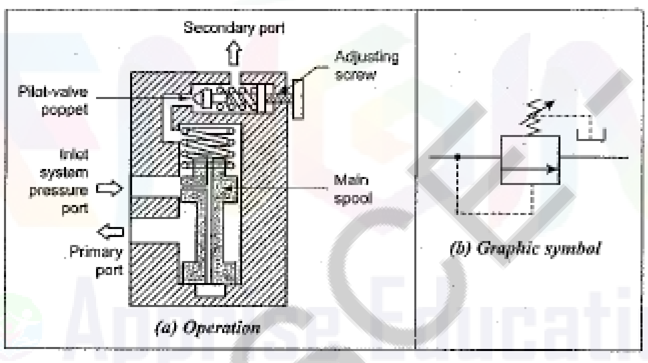


Fig. 7.19. Pilot operated sequence valve

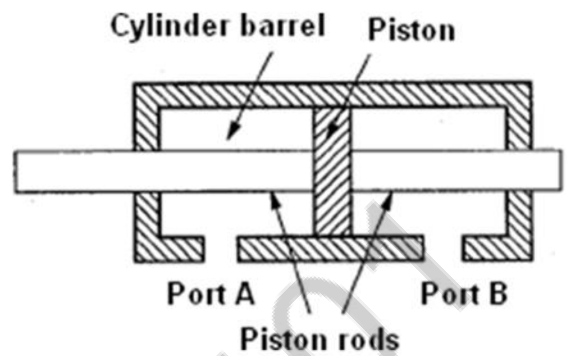
When the system inlet pressure is within the preset valve pressure, the valve allows the fluid freely through the primary port to operate the first phase. When the system inlet pressure exceeds the preset valve pressure, the valve spool moves up. As the spool lifts, flow is diverted to the secondary port to operate the second phase.

The required sequential pressure can be adjusted with the help of the adjusting screw.

11. Explain any three types of cylinders used in hydraulics with neat sketch (April/May2008)

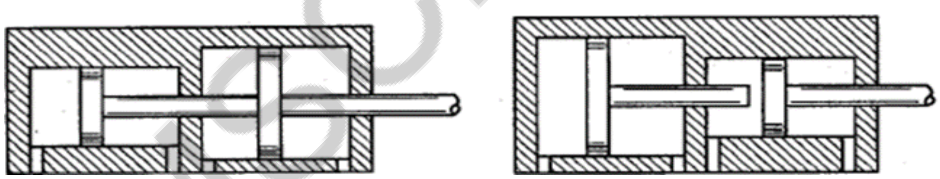
DOUBLE ROD CYLINDER:

It is a cylinder with single piston and a piston rod extending from each end. This cylinder allows work to be performed at either or both ends. It may be desirable where operating speed and return



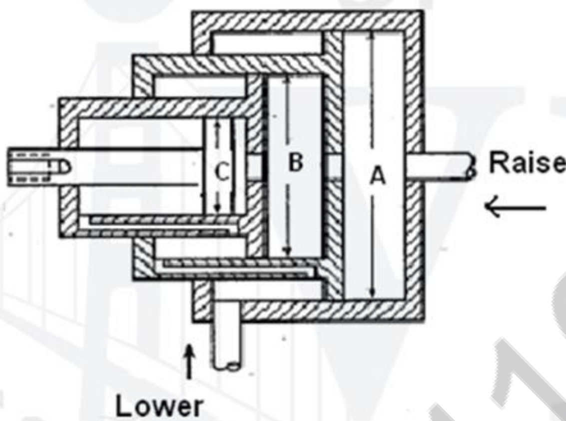
TANDEM CYLINDER:

It design has two cylinders mounted in line with pistons connected by a common piston rod. These cylinders provide increased output force when the bore size of a cylinder is limited. But the length of the cylinder is more than a standard cylinder and also requires a larger flow rate to achieve a speed because flow must go to both pistons.



TELESCOPIC CYLINDER

They are used where long work strokes are needed. A telescoping cylinder provides a relatively long working stroke for an overall reduced length by employing several pistons which telescope into each other.



Since the diameter A of the ram is relatively large, this ram produces a large force for the beginning of the lift of the load. When ram A reaches the end of the stroke, ram B begins to move. Now ram B provides the required smaller force to continue raising the load. When ram B reaches the end of its stroke, then ram C moves outwards to complete the lifting operation. These three rams can be retracted by gravity acting on the load or by pressurized fluid acting on the lip of each ram.

12. Discuss the working of gear motor with neat sketch (May/June 2014)

6.10. GEAR MOTORS

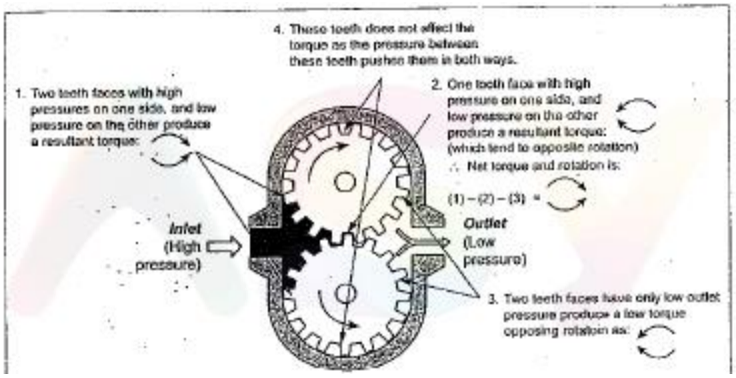
6.10.1. Introduction

Like gear pumps, gear motors are fixed displacement devices. Also, gear motors can be classified as external or internal gear units. External gear motors include the gear-on-gear units such as the spur gear motor. Internal gear motors include the crescent seal types and the gerotor type unit.

6.10.2. Construction and Operation

Fig.6.9 illustrates the operation of a gear motor. In this type, both the gear wheels are driven and one of the gear wheel has an extended shaft to provide output torque.

In the gear motor, rotary motion is produced by the unbalanced hydraulic forces on the gear teeth. The hydraulic imbalance in a gear motor is caused by gear teeth unmeshing. As gear teeth unmesh, all teeth subjected to system pressure are hydraulically balanced, except for one side of one tooth on one gear. This imbalance of force on gears, as shown in Fig.6.9, develops the torque. It should be noted that the larger the gear tooth or higher the pressure, more is the torque produced.


4. These teeth does not affect the torque as the pressure between these teeth pushes them in both ways.
1. Two teeth faces with high pressures on one side, and low pressure on the other produce a resultant torque:
2. One teeth face with high pressure on one side, and low pressure on the other produce a resultant torque: (which tend to opposite rotation)
∴ Net torque and rotation is:
(1) – (2) – (3) =
Inlet (High pressure)
Outlet (Low pressure)
3. Two teeth faces have only low outlet pressure produce a low torque opposing rotatoin as: