Unit - 2

subject - hydraulics & pneumatics

code - ME8694

YEAR/SEM : III rd / VI th sem

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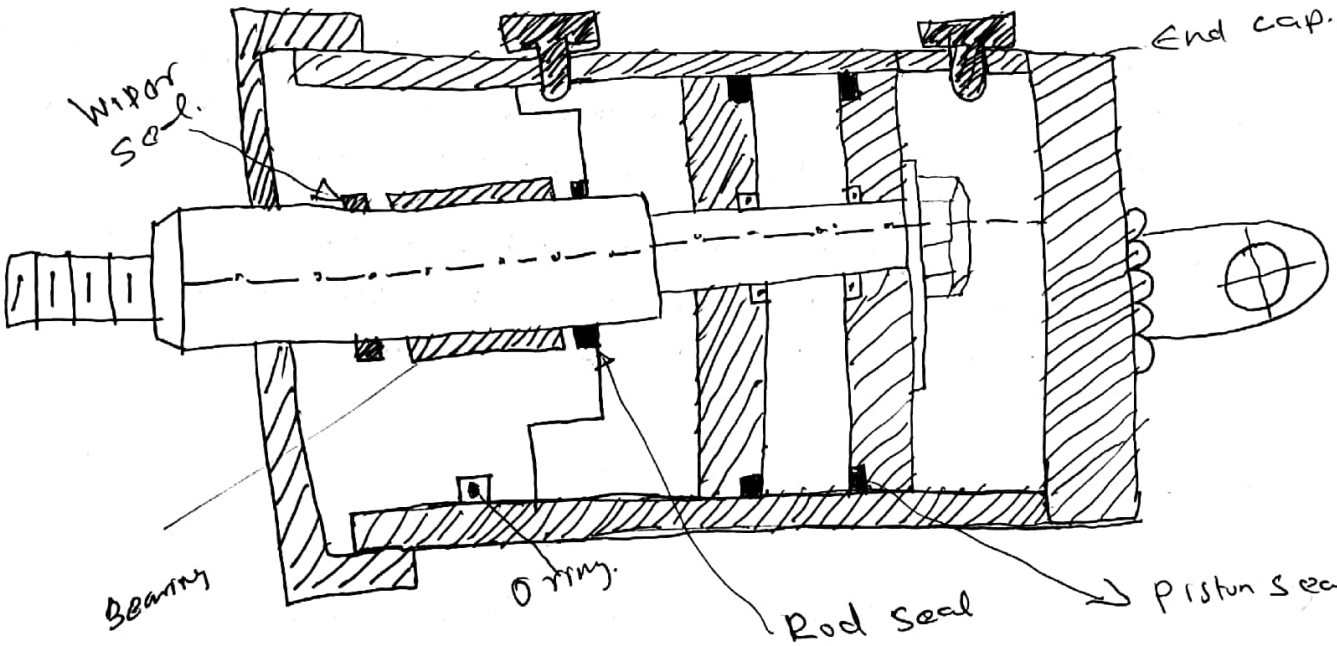
Unit - 2

Draw neat sketch and briefly explain double acting acting cylinders., cylinder cushioning.

A double acting cylinder is capable of delivering forces in both direction. The barrel is made of seamless steel tubing; honed to fine finish on the inside surface. The piston which is made of ductile iron contains U cup packing to seal the leakage between the piston and the barrel. The ports are located in the end caps which are secured to the barrel by the rods. The load at the piston rod at risk is taken by a rod bearing which is generally made of brass or bronze. A rod wiper is provided at the end. end of the neck to prevent foreign particles and dust from entering into the cylinder along with the piston rod.

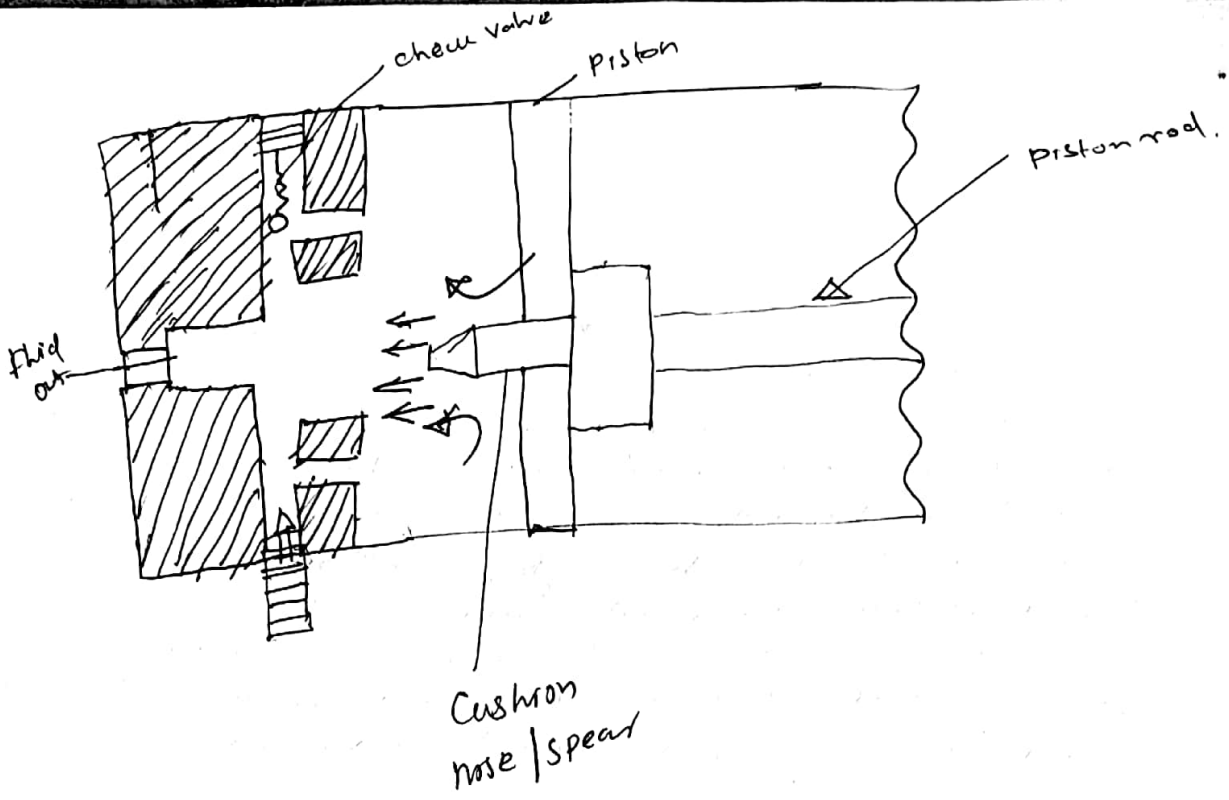


when the fluid from the pump enters the cylinder through port1 the piston moves forward and the fluid returns to the reservoir from the cylinder through port2. During the return stroke the fluid is allowed to enter the cylinder through port2 - and fluid from the other side of the piston goes back to the reservoir through port-1.

cylinder cushioning:

As long as the piston is moving in the middle range of the cylinder, nothing will hit the piston head. But due to the inertia. Forces of the moving parts at the end of the piston travel, the piston will hit the cylinder head at full speed.

(3)



To overcome this, the designer provide a cushioning arrangement by which the hydraulic cylinder can be slowly retarded or cushioned during the last portion of the stroke.

The figure shows the position of the piston at the start of the cushioning action. In this position, the fluid from the pump entire into the rod end of the cylinder.

(2) Briefly explain sequence valve and give suitable Application.

When the operation of two hydraulic cylinder is required to be performed in sequence by using a single direction valve, a special valve is required for the purpose and it is known as the sequence valve.

The sequence valve is to direct flow in a predetermined sequence, the sequence valve operates on the principle the when system pressure overcomes the spring setting the valve spool move up allowing flow to the secondary port that is connected with the second operating hydraulic cylinder

(3) In a meter in circuit a cylinder with 100mm bore diameter and 70 mm diameter is used to exert a forward thrust of 100 KN. with a velocity of 0.5 M/min. Neglect the pressure drop through the pipes and valves. If the pump flow is 20 l/min find

(a) pressure required at pump on extend.
(b) Flow through the flow control valve.
(c) Relief valve setting.
(d) Flow out of pressure relief valve.
+ System efficiency during extend.

Solution:

(a) Force needed during extend $F = 100 KN$

Pressure required at pump on extend $p = \frac{F}{A_p}$.

$$= \frac{100 \times 10^3}{\frac{\pi}{4} \times 0.1^2} = 127 \text{ bar}$$

(b) Velocity during extend. $V = 0.5 \text{ m/min}$.

$$Q = VAp$$

$$= 0.5 \times \frac{\pi}{4} \times 0.1^2$$

$$= 3.9 \times 10^{-3} \text{ m}^3/\text{min}$$

$$= 3.9 \text{ l/min}$$

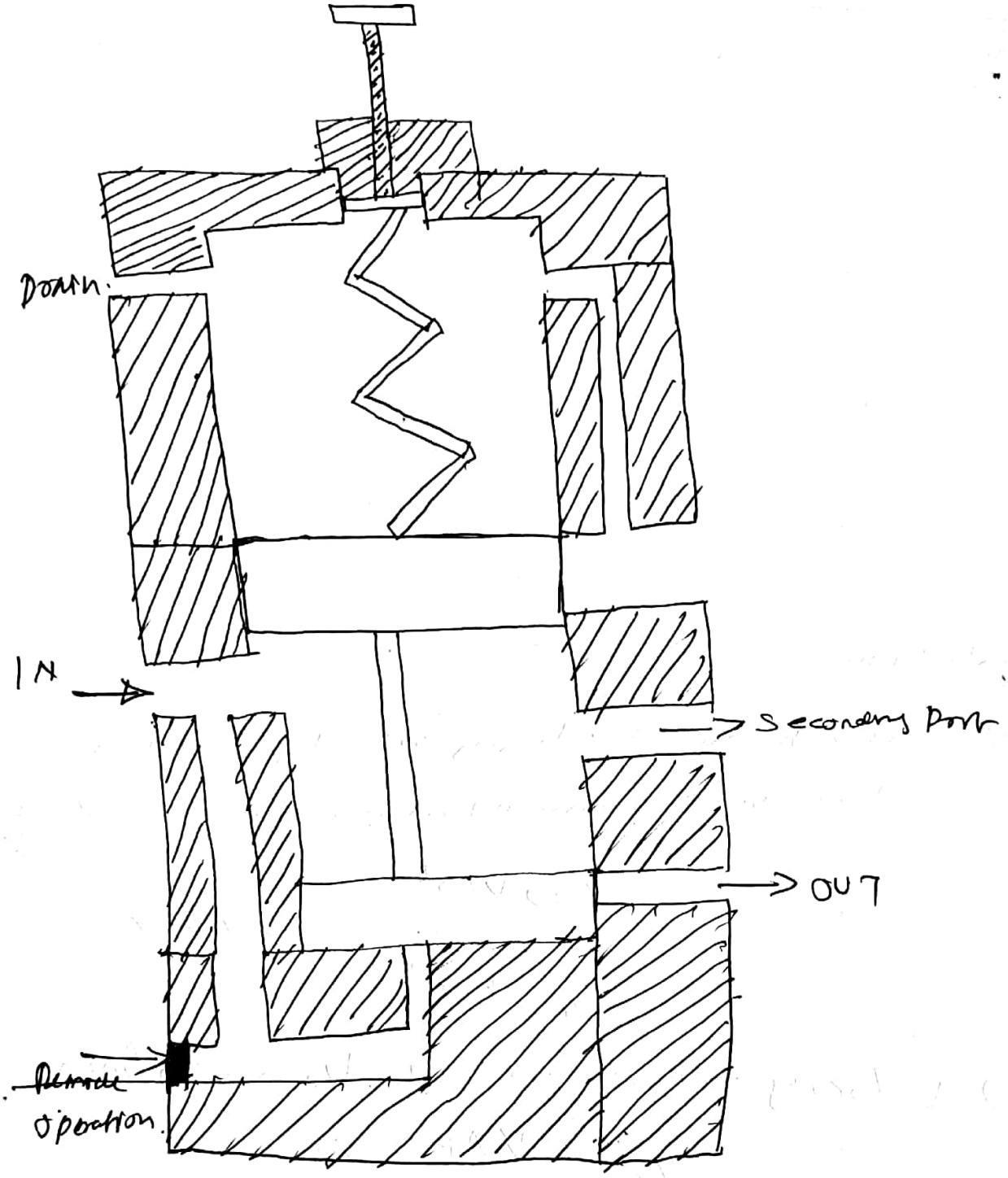
(c) Relief valve setting. $p = 127 \pm 10\% (127)$

$$= 140 \text{ bar}$$

(d) Flow out of pressure relief valve $= Q - q$

$$= 20 - 3.9$$

$$= 16.1 \text{ l/min}$$



Sequence valve

Application:

Drilling circuit using sequence valve

In this circuit first the clamp cylinder should extend and clamp the workpiece. Then the work cylinder should extend to drive a spindle to drill hole on the workpiece.

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$$Q = VA_p$$

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$$= 3.9 \times 10^{-3} m^3/min$$

$$= 3.9 l/min$$

(c) Relief valve setting. $p = 127 \pm 10\% (127)$

$$= 140 \text{ bar}$$

(d) Flow out of pressure relief valve $Q_1 = Q - q$

$$= 20 - 3.9$$

$$= 16.1 l/min$$

(3) = System efficiency $= \frac{P_1 Q_1}{P Q} \times 100$

$= \frac{127 \times 39}{140 \times 20} \times 100$

$= 17.6\%$.

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(4) A hydraulic cylinder has to move a table of weight 13 kN, speed of the cylinder is to be accelerated up to a velocity of 0.13 m/s in 0.5 sec and brought to a stop within a distance of 0.02m. If the coefficient of sliding friction is 0.15 and cylinder bore diameter as 50mm. calculate the surge pressure.

Solution:

Initial velocity $u = 0$ m/s

Final velocity $v = 0.13$ m/s

$$a = \frac{v-u}{t} = \frac{0.13-0}{0.5} = 0.26 \text{ m/s}^2$$

Force required to move the piston = dynamic force + frictional force.

$= \left[\frac{W}{g} \times a\right] + \mu . W$

$= \left[\frac{13000}{9.81} \times 0.26\right] + (0.15 \times 13000]$

$= 2294.5 N$

To overcome this force the pressure required in in hydraulic cylinder

$P_1 = \frac{2294.5}{\pi/4 \times (0.05)^2}$

$= 11.69 \times 10^5 \text{ N/m}^2$

11.69 bar.

From the equation for velocity acceleration and distance $V^2 - u^2 = 2as$

$$a = \frac{V^2 - u^2}{2s}$$

$$= \frac{0 - 0.13^2}{2 \times 0.02} = -0.4225 \ m/s^2$$

$$= \frac{13000}{9.81} \times 0.4225 + 13000 \times 0.15$$

$$= 2510 \ N.$$

Then pressure created by this opposing force

$$P_2 = \frac{2510}{\pi/4 \times (0.05)^2}$$

$$= 12.78 \times 10^5 \ N/m^2$$

$$= 12.78 \ bar.$$

The surge pressure $P_s = P_1 + P_2$

$$= 11.69 + 12.78$$

$$= 24.47 \ bar.$$

(5) Draw Neat sketch ANSI Hydraulic Symbols?

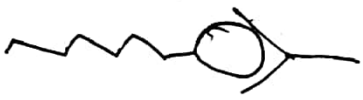
Fixed displacement Uni direction

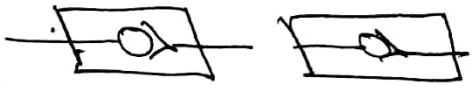
Fixed displacement Bi direction

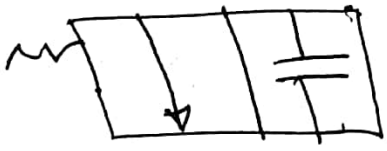
Variable displacement Unidirectional

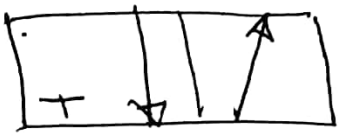
Variable displacement Bidirectional

- Check valve without spring 

Check valve with spring 

Pilot operated Check valve 

2/2 directional valve 

3/2 directional control valve 

4/3 directional control valve