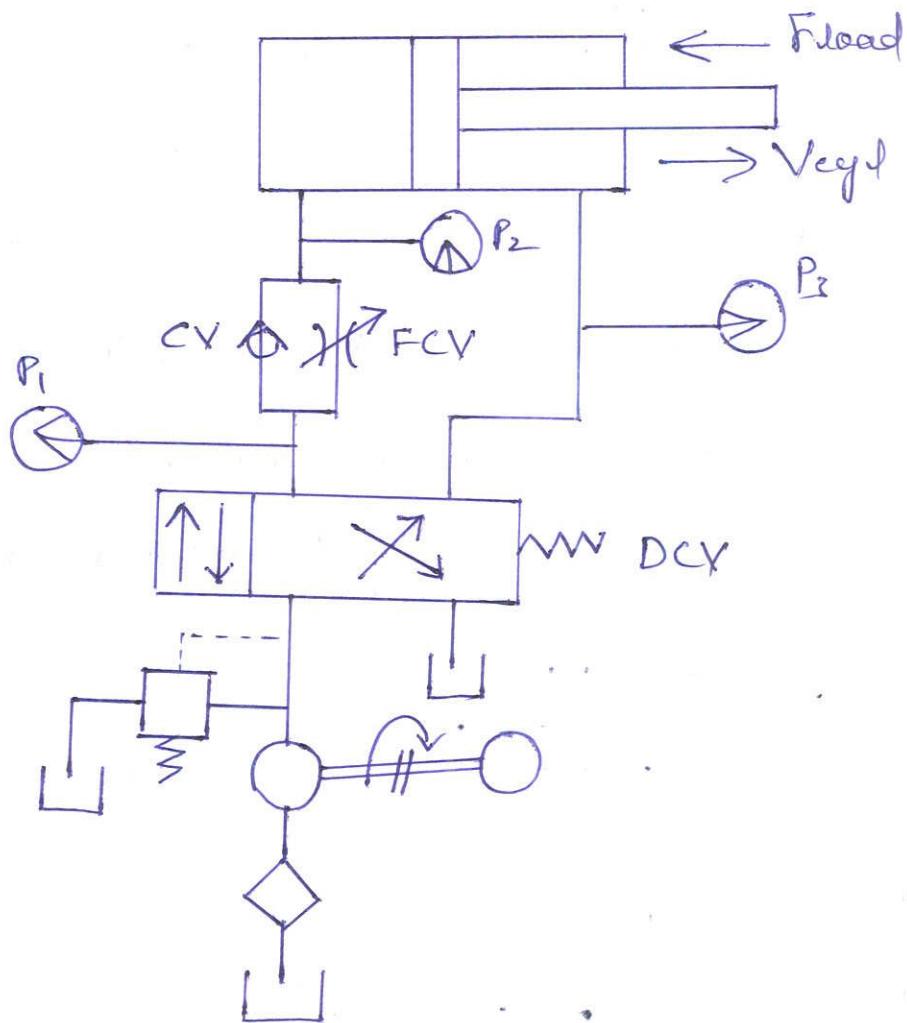


\* Speed Control of cylinder:

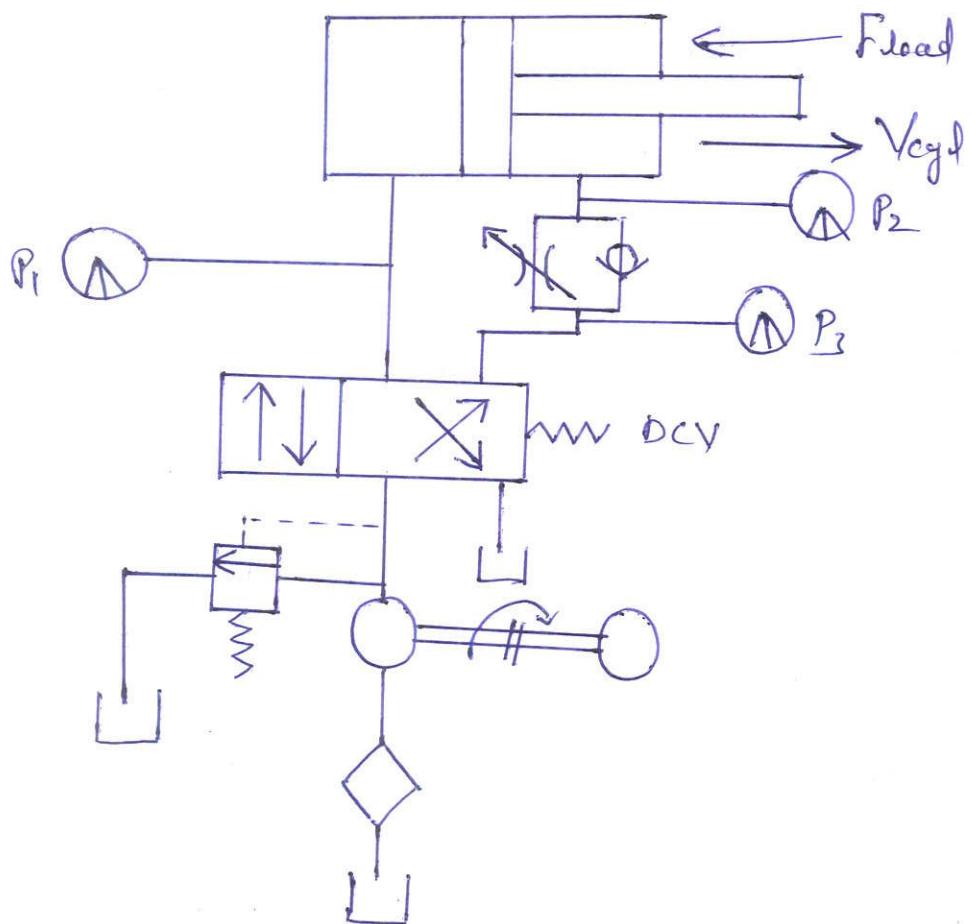
→ Meter in Circuit:

Speed control during a work stroke can be accomplished by regulating flow to the cylinder. The check valve allows free reverse flow when the cylinder retracts. It normally gives finer speed control than a meter-out circuit.



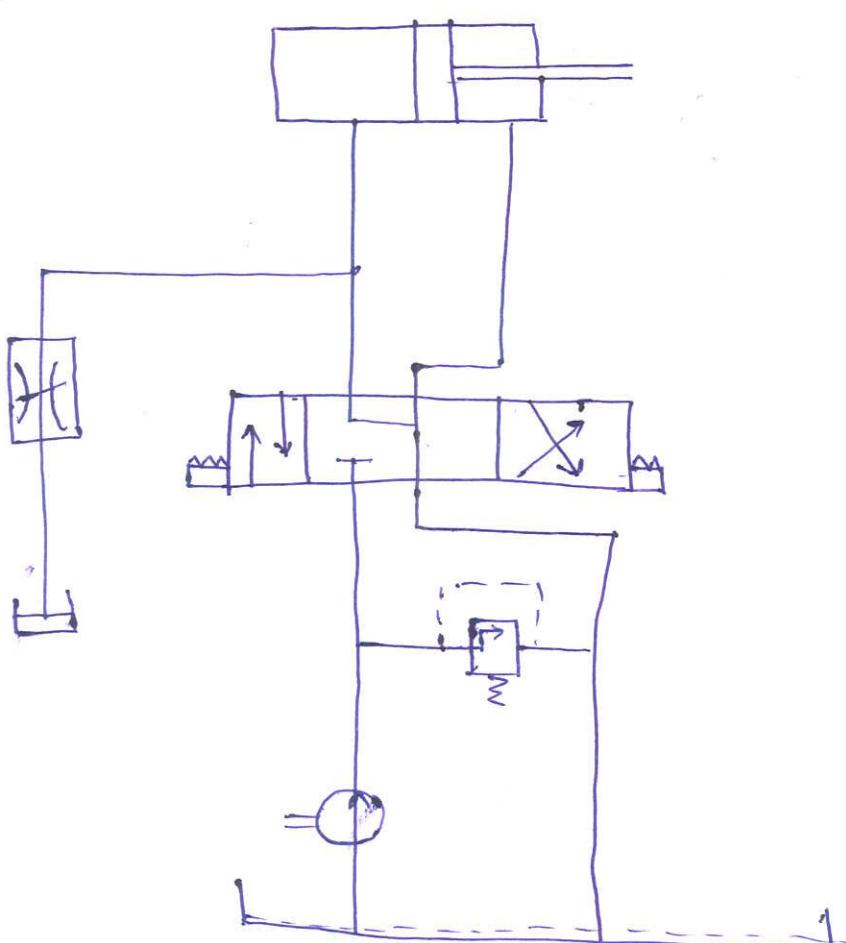
→ Meter out Circuit:

Regulating flow from the cylinder is another way to control speed. This circuit maintains a constant back pressure during both extension and prevents "bumping" if the load drops quickly (or) reverse.



### \*Bleed-off Circuits:

Flow to the cylinder is regulated by metering part of the pump flow to tank. This circuit is more efficient than meter-in (or) meter-out, as pump output is only high enough to overcome resistance. However it does not compensate for pump slip.



## \* Fail-Safe Circuits?

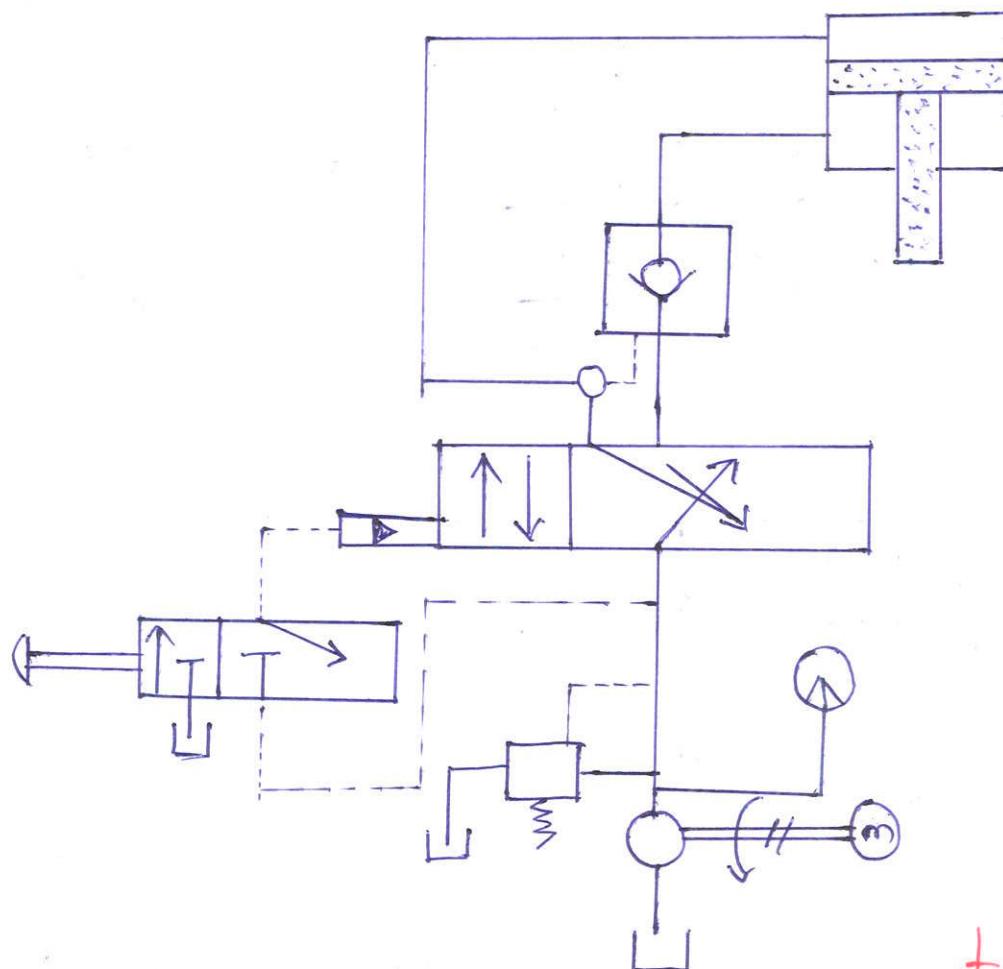
Fail-Safe Circuits were those designed to prevent injury to the operator or damage to the equipment. In general, they prevent the system from accidentally falling on an operator and also prevent overloading of the system. In following sections we shall discuss two fail-safe circuits.

(i) Protection from inadvertent extension.

(ii) fail-safe overloaded protection.

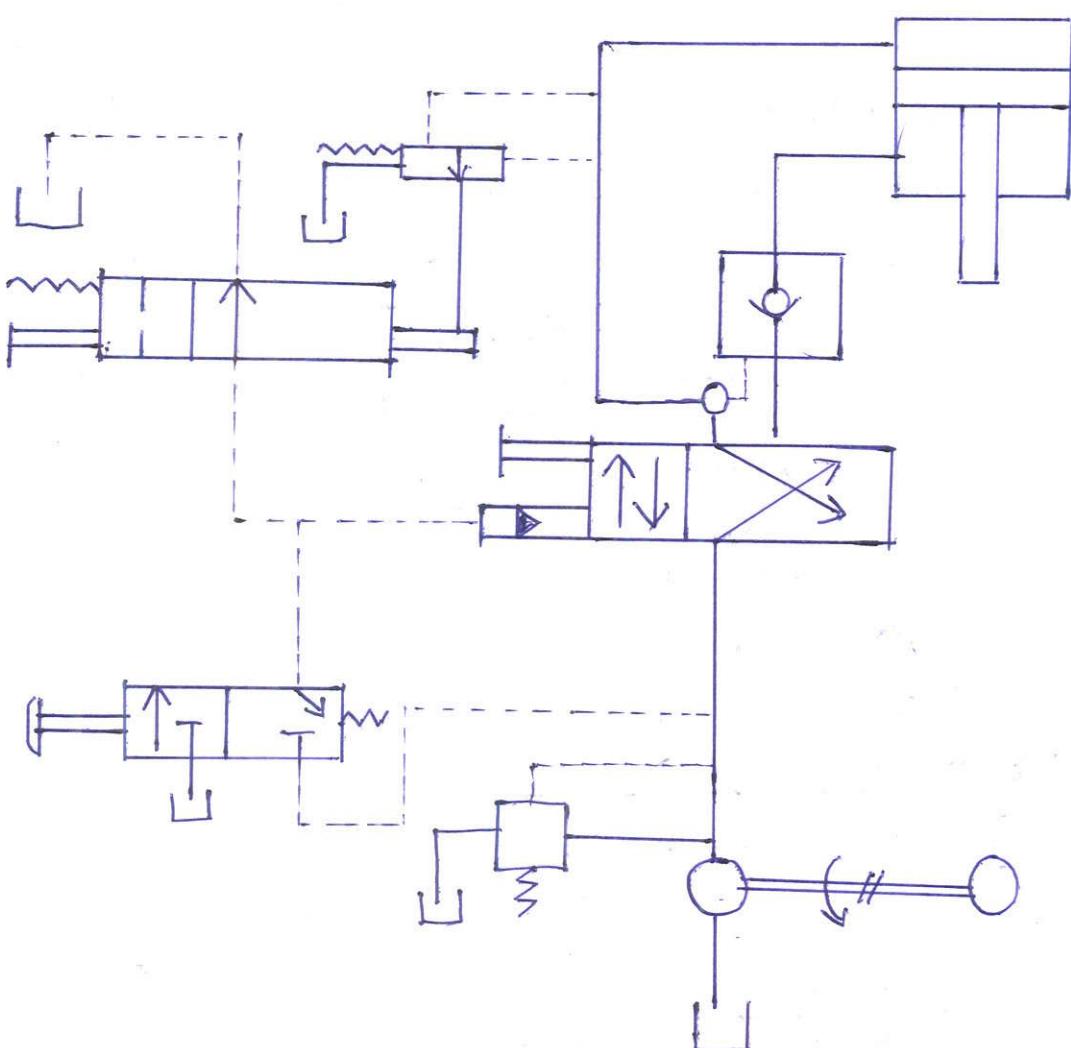
(i) protection from inadvertent cylinder extension:

Below fig shows fail-safe circuit that is designed to prevent the cylinder from accidentally falling in the event when a hydraulic line ruptures or a person inadvertently operates the manual override on the pilot-actuated DCV when the pump is not working. To lower the cylinder, pilot pressure from the blank end of piston must pilot open the check valve to allow oil to return through the DCV to the tank. This happens when the pump operates. The pilot-operated DCV allows free flow in the opposite direction to raise the cylinder when this DCV returns to its off mode.



(ii) fail-Safe Systems with overloaded protection:

Below figu Shows a fail-safe system that provides overloaded protection for system Components. The DCV  $V_1$  is controlled by the push-button three-way valve  $V_2$ . When the overloaded valve  $V_3$  is its Spring offset mode, it drains the pilot line of valve  $V_4$  pilot actuates overloaded valve  $V_5$ . This drains the pilot line of valve  $V_1$ , causing it to return to its spring offset mode. If a person then operates the push-button valve  $V_2$  nothing happens unless overload valve  $V_3$  is manually shifted into its blocked-port Configuration. Thus, the System Components were protected against excessive pressure due to an excessive cylinder load during its extension state.



**Compressor** - An air Compressor is a Specific type of gas Compressor.

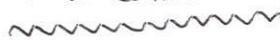
**Regulator & gauges** - They let the Computer System or operator to regulate and check the PSI of the air inside the Compressor.

**Accumulator or Buffer Tank**: These tanks help in preventing irregular airflow surges in the actuators, allowing the compressor cycle to maximise its shutoff timing.

**Feed lines** - These are hoses that move the pressurised air through the pneumatic system.

**Actuators** - These are the Components of the pneumatic system that do the hard work.

\* **Pressure Control Valves**:



⇒ **Counter Balance Valve**:



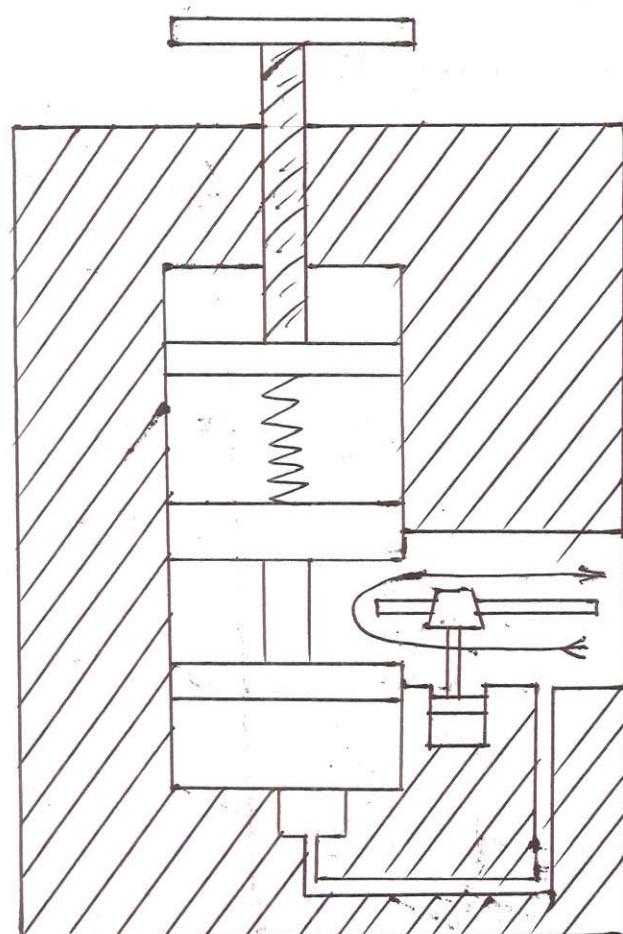
Schematic diagram of Counterbalance valve is shown in below fig. These normally closed valves are primarily used to prevent a load from accelerating uncontrollably. This situation can occur in vertical cylinders in which the load is a weight. This can damage the load or even the cylinder itself when the load is stopped quickly at the end of the travel.

Valve's primary port is connected to the cylinder rod end and the secondary port to the directional control valve. The pressure setting is slightly higher than that required to keep the load from free-falling. As the load is raised, the integral check valve opens to allow the cylinder to retract freely.

If it is necessary to relieve back pressure at the cylinder and increase the force at the bottom of the stroke, the Counterbalance Valve can be operated remotely.

Counterbalance valves are usually drained internally. Graphic symbol of a pressure - unit 4, Pg - 5/19

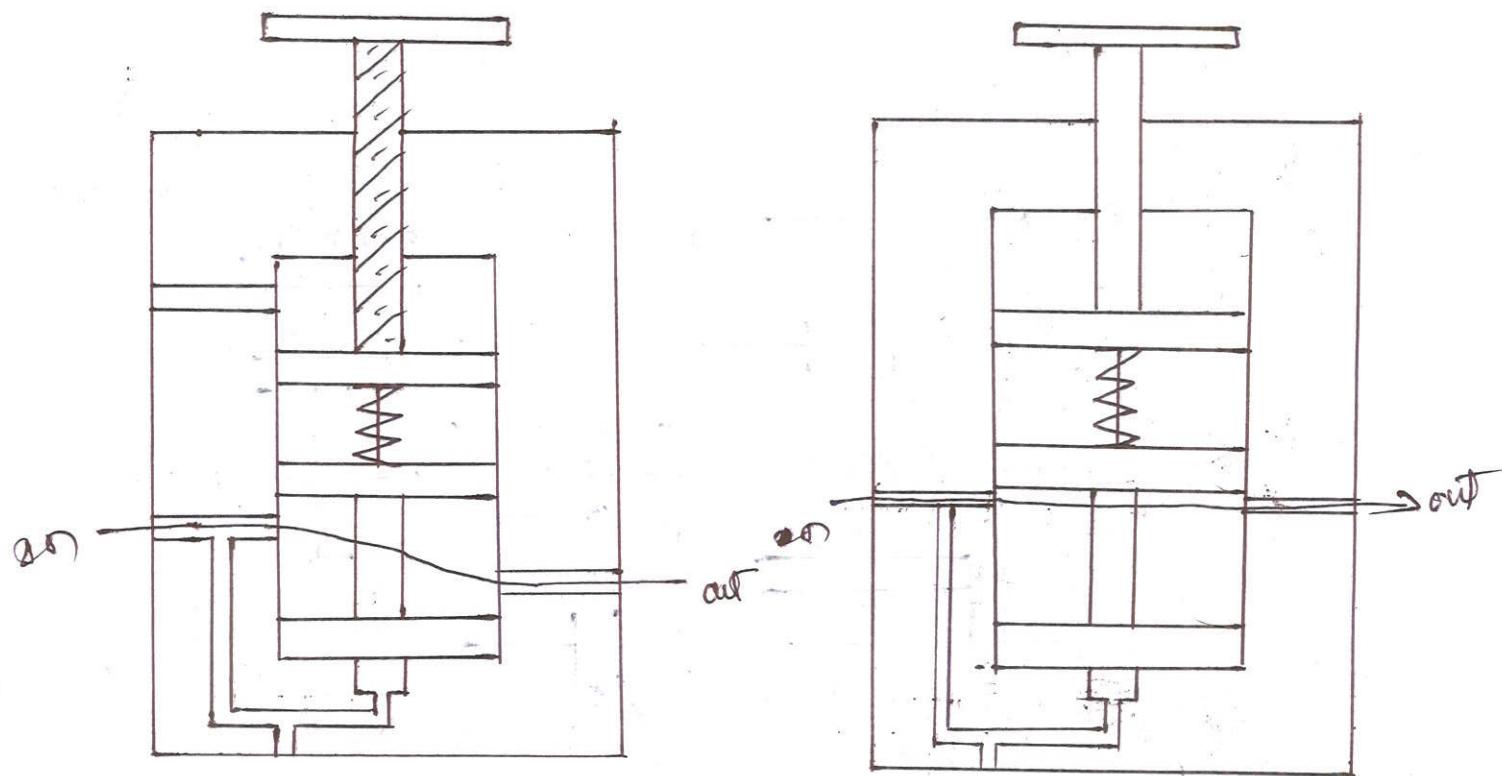
— Reducing Valve is shown in below fig. When the cylinder extends, the valve must open and its secondary port should be connected to the reservoir. When the cylinder retracts, it matters little that load pressure is felt in the drain passage because the check valve bypasses the valve's spool.



### \*Pressure Sequence Valve:-

..... o .....

A Sequence Valve is a pressure-control valve that is used to force two actuators to operate in sequence. They are similar to pressure-relief valves. Schematic diagram of Sequence Valve allows flow to a branch circuit, when a preset pressure is reached. The check valve to be bypassed in the reverse direction. The Component enclosure line indicates that the check valve is an integral part of the component. The Sequence Valve has an external drain line; therefore, a line must be connected from the Sequence Valve's drain port to the tank. The symbol for a Sequence Valve is shown in fig. no.



### \*Application of a Sequence Valve:-

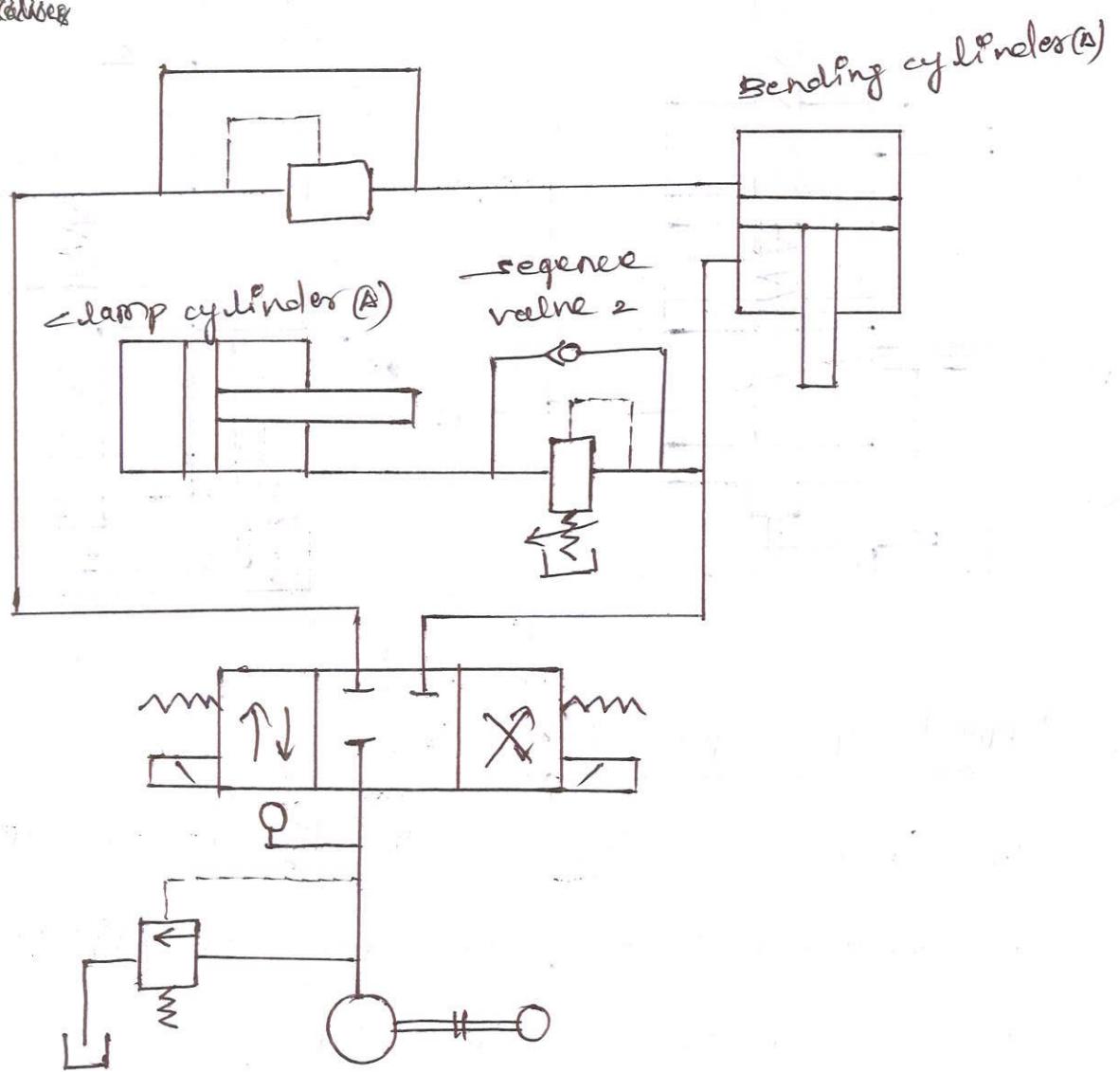
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The hydraulic circuit shown in the fig. is an example of an application of Sequence Valve in which a clamp cylinder extends first to hold a workpiece and then a second cylinder extends to bend the workpiece in the desire shape. In this circuit, two cylinders are connected in parallel. Without the Sequence Valve, these cylinders would extend together as they are both unloaded. In order for this circuit to function properly, the clamp cylinder must extend completely before the bending cylinder begins to extend. The Sequence Valve accomplishes this. Unit 4, Pg - 7/19

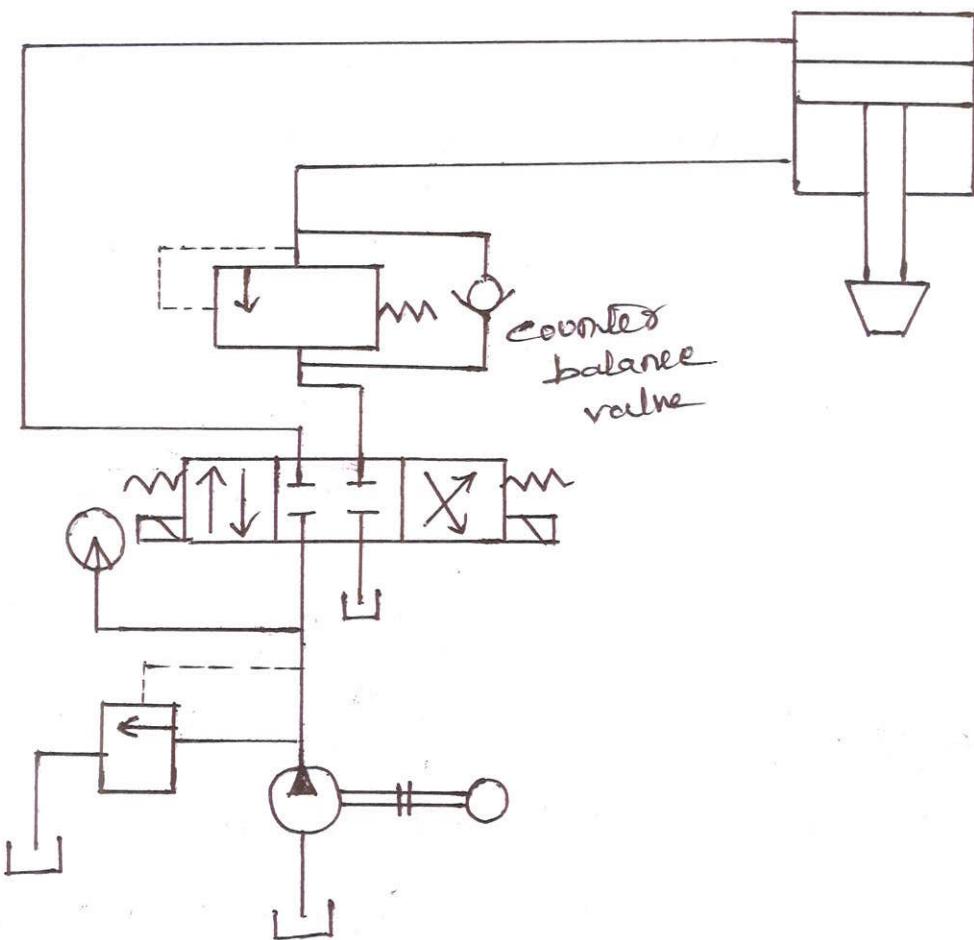
This is by not allowing flow into the bending cylinder branch of circuit until the clamp cylinder has reached the end of its stroke. When the clamp cylinder extends completely, the pressure rises and opens the sequence valve, thus allowing the bending cylinder to extend. The sequence valve must be set high enough so that it opens only after the complete extension of the clamp cylinder.

During the retraction of cylinders, the check valve allows the sequence valve to be bypassed. The sequence valve has no effect on the circuit in this situation. Both cylinders retract together because both are unloaded and split the pump flow.

\* Cut-off valve



\* Application of a Counterbalance Valve :-



Counterbalance valves are commonly used to counterbalance a weight or external force or counteract a weight such as a platen or a press and keep it from freefalling. Fig. above illustrates the use of a Counterbalance or back-pressure valve to keep a vertically mounted cylinder in the upward position while the pump idles, that is, when the DCV is in its center position.

During the downward movement of the cylinder, the Counterbalance valve is set to open at slightly above the pressure required to hold the piston up. The control signal for the Counterbalance valve can be obtained from the blank end or rod end of the cylinder.

If derived from the rod end, the pressure setting of the Counterbalance valve equals the ratio of the load to the annulus area of the piston. If derived from the blank end, the pressure setting equals the ratio of load to the area of piston. This pressure is less and hence usually it has to be derived blank end. The directional control valve unloads the pump.

\* Source of pilot pressure in Counterbalance Valves:-

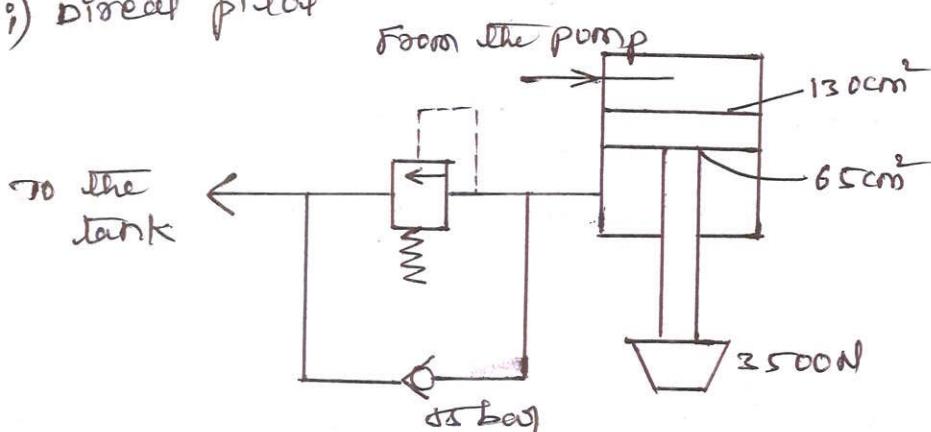
When a Counterbalance Valve is used in large vehicles, it may be important to analyze the source of pilot operating pressure. Fig. below shows a comparison between direct pilot and remote pilot operation.

Through the application of Pascal's law we have,

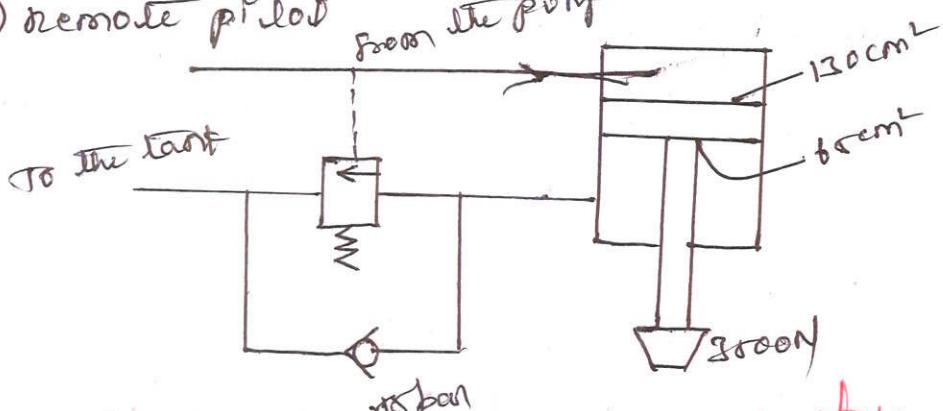
$$P = \frac{\text{Force}}{\text{Area}} = \frac{35000}{65 \times 10^{-4}} \approx 55 \text{ bar}$$

If the pilot pressure is taken directly, then the Counterbalance Valve operates at about 55 bar or slightly higher because of inertia and friction. In the other case where the remote pilot pressure is taken from the pressure line at the top of the cylinder, a choice of operating pressure can be made for the valve. A Counterbalance valve is normally a closed valve and remains closed until acted upon by the remote pilot pressure source. Therefore, a much lower spring force can be selected to allow the valve to operate at a lesser pilot pressure. It should also be noted that the press load cannot move downward unless flow from the pump is directed into the top of the cylinder, which is a normal function of the machine.

i) Direct pilot



ii) Remote pilot



## \* Accessories in fluid power systems:

- Fan Blades and Propellers - used to convey power from motor to air movement
- Hydraulic and Pneumatic Testing Services.
- Hydraulic Seals and Pneumatic Seals
- Manifolds & manifold Systems
- Pressure Intensifiers & Boosters
- Quick Couplers
- Rodless cylinders
- Rotary Unions
- Swivel Joints.

## \* Filtration System:

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Filtration is essential to prevent damage from solid particles like dust and dirt.

Solid particles like dust traveling through a system can score and abrade surfaces, enlarge critical clearances, promote internal leakage and, in hydraulics, even acts as catalyst to chemically break down the fluid.

### \* Importance of filter:

→ Use and wear of the components, poor plumbing, and contamination brought in with new fluid are just a few of the possibilities.

→ This is why no fluid power system can be complete without the use of a filter.

→ Hydraulic filters keep the hydraulic fluid contaminant free.

## \* Maintenance of Systems:

→ Lack of maintenance of hydraulic systems is the leading cause of component and system failure yet most maintenance personnel don't understand proper maintenance technique of a hydraulic system.

\* A list of preventive maintenance Task for a hydraulic system could be:

1. Change the (Could be the return or pressure filter) hydraulic filter.
2. Obtain a hydraulic fluid sample.
3. Filter hydraulic fluid
4. Check hydraulic actuators.
5. Clean the inside of a hydraulic reservoir.
6. Clean the outside of a hydraulic reservoir.
7. Check and record hydraulic pressure.
8. Check and record pump flow.
9. Check & record temperature on the main pump motor.
10. Check machine cycle time and record.

## \* Components of Pneumatic System:-

→ All Pneumatic systems use compressed air to operate and move parts or actuators actuators.

→ These systems like pneumatic valves range from simple air-driven pistons to multiple actuators mining operations.

→ Here are the common parts of Pneumatic System:

Check Valve - The let the compressed air gather in the buffer tanks, but prevent backflow into the compressor tank.

## \* Cartridge Valves :-

Cartridge Valves consist of a valve shell that can be mounted in a standard recess in a valve block or manifold. The machine manufacturers does not have to worry about tolerances of moving Spools and Poppets because these are taken care by the hydraulic valve manufacturer. This is very advantageous for batch production and modularized packages & integrated circuits. Cartridge Valves eliminate expensive and potentially leaking pipework and connectors. Cartridge Valves can be used as follows.

1. Leak-proof direction Control Valve.
2. Check Valve to obtain unidirectional flow.
3. Throttle Valve to control and limit the rate of flow.

The Valve shell or body has two main ports (A and B) that are connected or separated by a poppet or a spool. The poppet-type Cartridge Valve is basically a check valve that can be pilot operated in a no. of ways, whereas the Spool-type Cartridge Valve is used as a variable restrictor that is either normally open or closed by the action of the control or vice versa. The actions of the two types of Cartridge Valves are completely different.



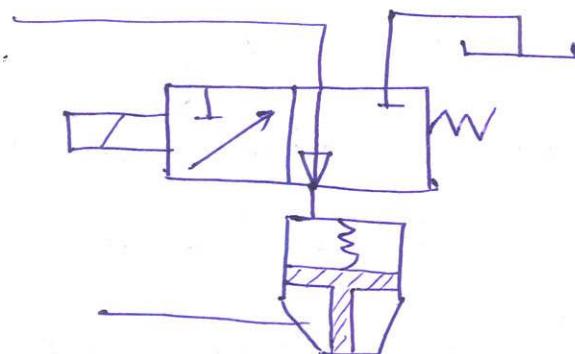
- \* Development of single and multiple actuators and cylinders:
- \* Pneumatic cylinders can be directly controlled by actuation of final directional control valve.
- \* These valves can be controlled manually or electrically. This circuit can be used for small cylinders as well as cylinders which operate at low speeds where the flow rate requirements are less.
- \* Multiple actuators cylinders:
 

most of the practical pneumatic systems involve the use of multiple actuators. Cylinders, semi-rotary actuators, etc which when operating in specified sequences carry out the desired control tasks. Double-pilot directional control (DC) valves are used as final control elements to control the forward and return strokes of the actuators.
- \* logic valves within the control circuit:
 

The signal processing in the pneumatic takes place within the control circuit via logic valves. In this case, any complex logic function can be installed. The three

## ~~•~~ logic functions - "OR-AND-NOT"

- \* logic-AND-valve or two pressure valve or  
~~~~~ ~~~~~ ~~~~~ ~~~~~ ~~~~~
- \* At the output of logic circuit, the operating pressure will only be connected through when both inputs are supplied with pressure.
- \* with different input pressure, the side with the higher pressure closes the valve and the side with the low pressure is directed to the output. This switching remains also when the both inputs get now the same high pressure.

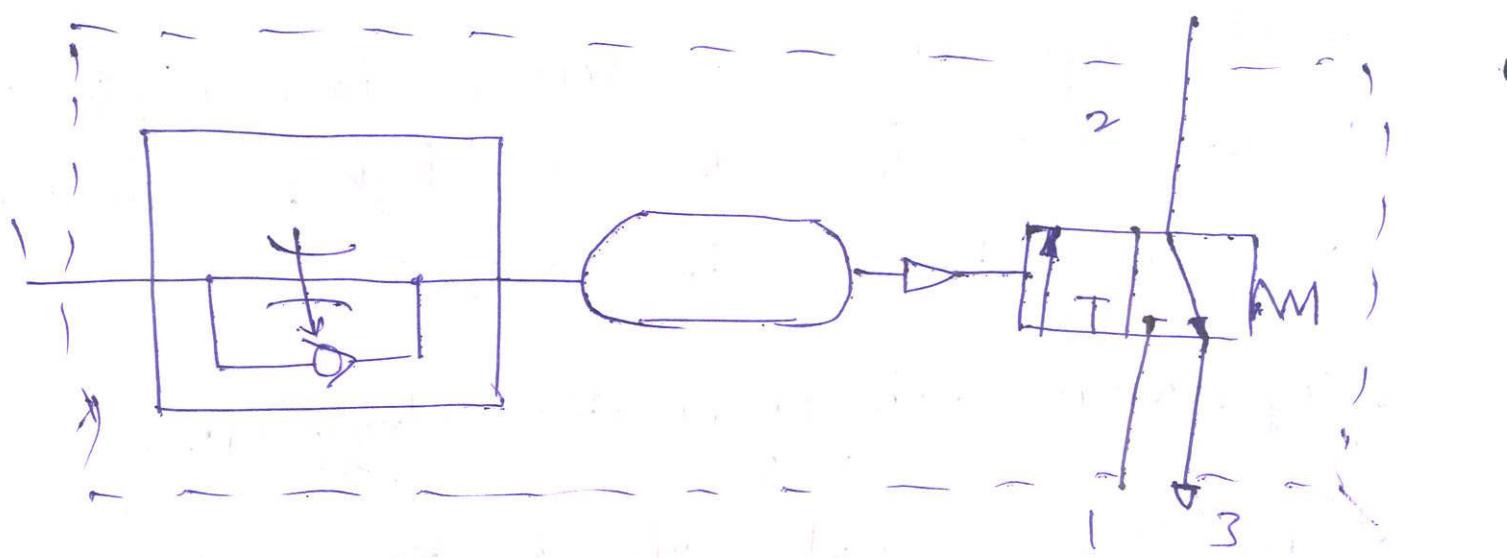


- \* logic OR-valve or shuttle valve !  
~~~~~ ~~~~~ ~~~~~ ~~~~~ ~~~~~

At the output 2 of this valve the operating pressure is switched through as one of the inputs 1 or 2 are applied to the operated pressure.

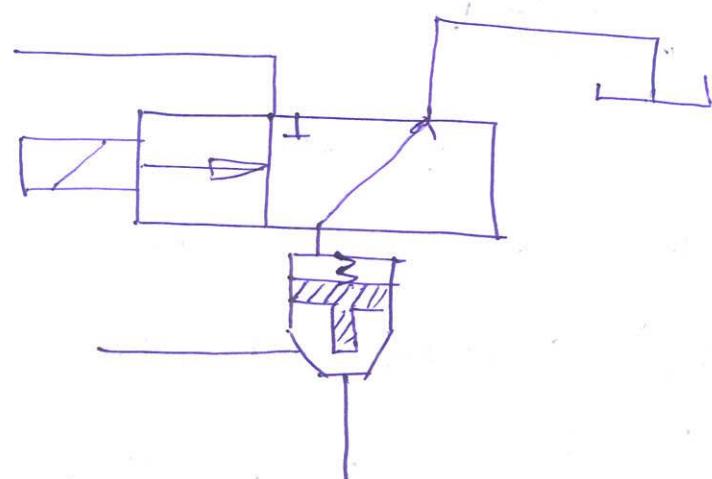
## \* Time delay valve ↴

Time delay valve function in certain applications like machining or press operation it is necessary that certain operation be delayed by some fraction even after pressing valve.

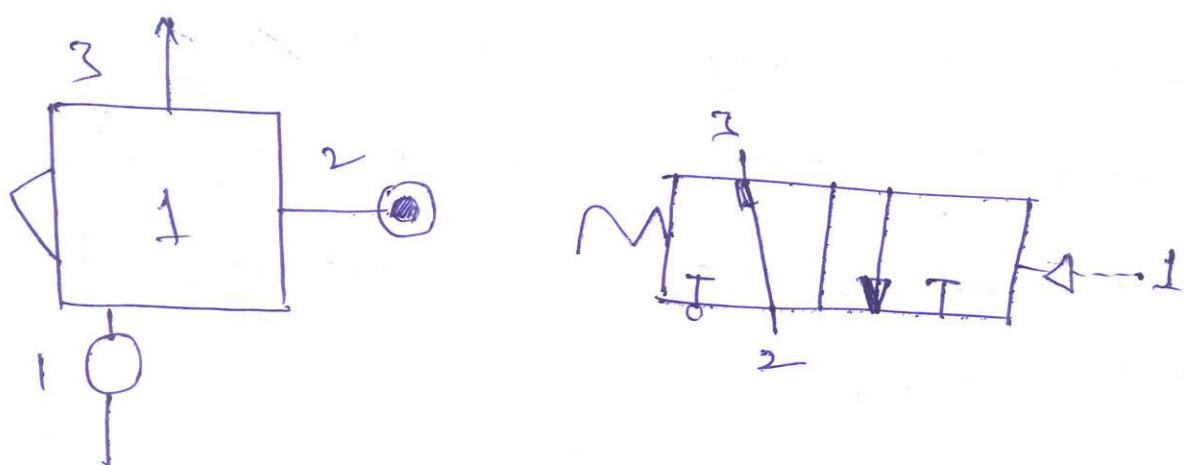


Time delay valve is a combination valve used to set the operating time as per the requirement. The time delay can be increased or decreased by adjusting the flow through the non-return flow control valve. The change in variability increases or decreases the time taken to fill and pilot activates the direction control valve.

\* Time delay valve is a combination of a pneumatic actuated 3/2 direction control valve.



- \* The logic OR valve applies to a double check valve, which forwards the higher pressure at the entrance to the exit.
- \* logic NOT with pneumatic elements! -
- \* In this example the function NOT is realized by means of a pneumatic NO' - Pushbutton. The logic here is if the button is not pressed but way valve is activated and the cylinder extended.



- \* Exhaust and supply air throttling
- \* Exhaust air throttling:
  - + supply air flows freely to the cylinder through the bypass passage of the non return valve.
- \* the supply air does not undergo any throttling.
- \* Exhaust air leaving the cylinder as to undergo no throttling as the non return valve is closed in the returned direction.
- \* the piston is loaded between the two causes of air exhaust throttling.
- \* the exhaust throttling should always be used for double acting cylinder
- \* not suitable for small volume cylinder and cylinders with short strokes as effective pressure cannot built up sufficiently.

\* Supply air throttling:

- \* Supply air entering the cylinder through either of the working ports undergoes throttling as the non return valve is closed in the direction of flow.
- \* During exhaust the compressed air leaving the cylinder is bypassed through the non return valve and escapes freely as it does not undergo throttling.
- \* Supply air throttling is used for single acting cylinder and small volume cylinder.