Unit-V

Industrial Circuits and Maintenance of Fluid Power System.

Sequential circuit design for simple applications using.

* Cascade method,
* Step counter method.

Cascade method :-

The cascade method is simple to apply and results in reliable and easily understood circuits.

Steps involved :-

Step 1 :- Each cylinder is given a code letter and their sequence is determined.

For example A^+, B^+, A^-, B^- etc. '+' and '-' represent extension and retraction of the cylinder respectively.

Step 2 :- The sequence is split into minimum number of groups. No letter is repeated into any groups. Next the circuit is drawn up using the following steps.

Step 3 :- Each group is assigned a pressure manifold line which must be pressurised only while that particular group is active. So the number of pressure lines equals the number of groups.

Step 4 : selecting the valves.

a. Limit valves are denoted a_0, a_1, b_0, b_1 etc.

0 → actuated at the end of return stroke

1 → " " " " " forward stroke.

b. In order to pressurise the various manifold lines in the proper order, one or more group changing valves or cascade valves are employed.

The number of group valves always equals the number of groups minus one.

c. For each cylinder, a pilot operated dcv is selected. The number of cylinder acting valves equals the number of cylinders.

Step 5 : The valves are connected as follows. The output of each limit valve is connected to the pilot input corresponding to the next sequence step with one exception.

The limit valve corresponding to the last step of the given group is 'not' connected to the actuating valve of the next cylinder, but rather to the pilot line of a group changing valve so as to pressurise the manifold of the next group. This manifold line is then connected to the pilot line corresponding to the first step of the next group.

Example:-

Design a system in which cylinder A is used to clamp the workpiece; cylinder B is used to punching and cylinder C removes the workpiece from the station.

Step 1:-

a. cylinder A extends to clamp the work piece (A^+)

b. cylinder B extends to do the punching (B^+)

c. cylinder B retracts after punching (B^-)

d. cylinder A retracts to unclamp the work piece (A^-)

e. cylinder C extends to remove the work piece (C^+)

f. cylinder C retracts after removal of workpiece (C^-).

So the sequence is,

$$A^+, B^+, B^-, A^-, C^+, C^-$$

Step 2:- The sequence must be divided into three groups, since C^+ and C^- cannot be in the same group.

Group $\underbrace{A^+, B^+}_{I}$ $\underbrace{B^- A^- C^+}_{II}$ $\underbrace{C^-}_{III}$

The number of groups should be kept to a minimum, so the last group can be eliminated by assigning C^- to group 2

Group $\underbrace{C^-, A^+ B^+}_{I}$ $\underbrace{B^- A^- C^+}_{II}$

Step 3 :- The number of pressure lines equal to the no. of groups i.e., two (I and II).

Step 4 :- a. There are three cylinders and so the number limit switches equal to 6 ($3 \times 2 = 6$); i.e, a_0, a_1, b_0, b_1, c_0 and c_1.

a_1, b_1, c_0 – manifold line I

a_0, b_0, c_1 – manifold line II

b. Two groups, so one group value ($2-1=1$) is sufficient

The output ports of the group value are connected to the manifold lines.

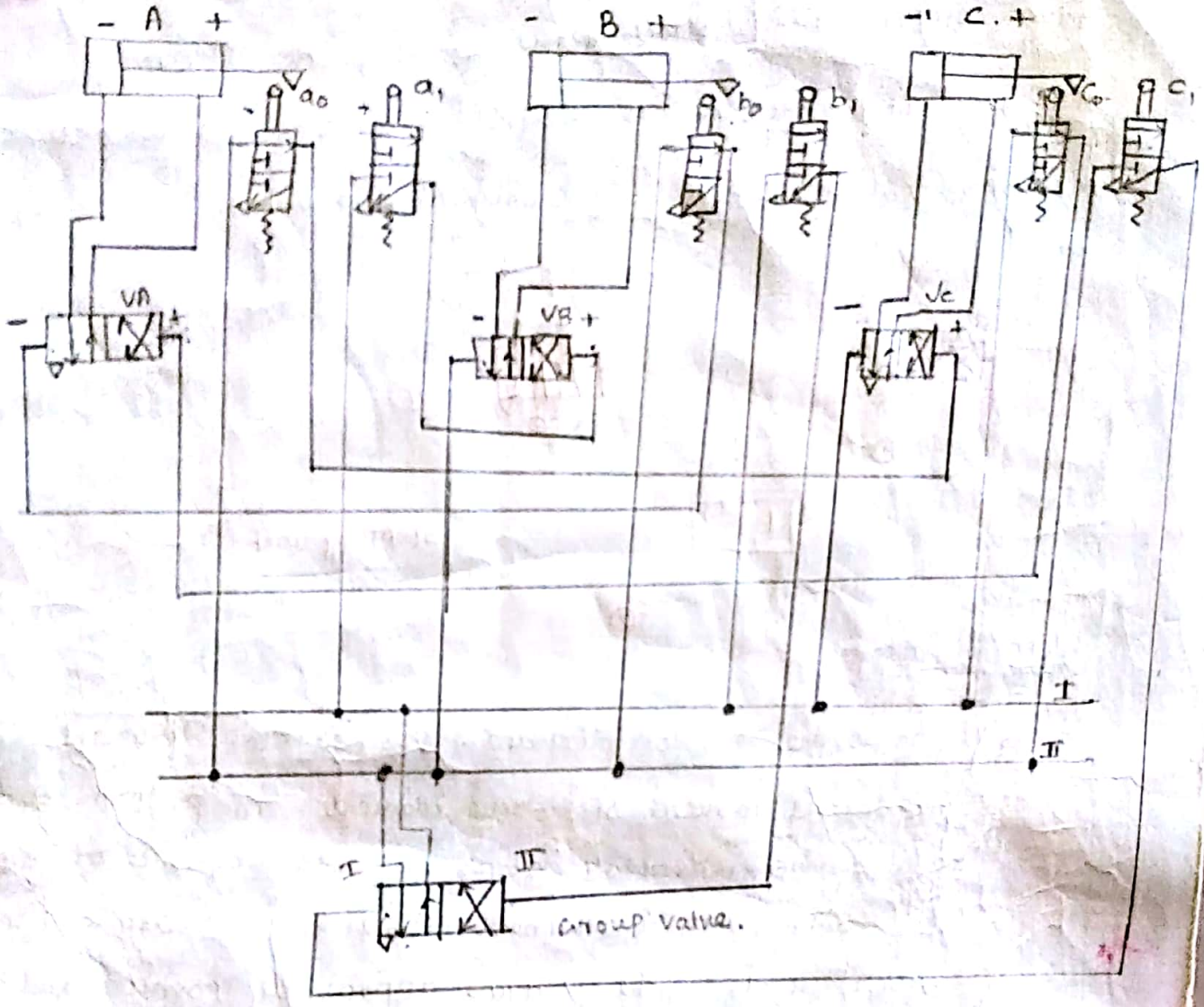
c. There are three cylinder actuating valves VA, VB, VC.

Step 5 :- a. The group value is in left hand position; Group I is Pressurised.

b. B^+ is the last step in Group I. In order to switch over to Group II, b_1 is connected to the pilot line II.

c. At the end of the retraction of cylinder B, the limit value b_0 is actuated.

d. The pressure from limit value c_1 is connected to the pilot line I of the group value.



Cascade circuit for $\underbrace{C^- A^+ B^+}_{I} \; \underbrace{B^- A^- C^+}_{II}$ (with c_0, a_1, b_1, b_0, a_0, c_1)

② Design a sequential circuit using cascade method for the following sequence $A^+ B^+ A^- B^-$.

Sol :- Group $\underbrace{A^+B^+}_{I} \quad \underbrace{A^-B^-}_{II}$

No. of Pressure lines = 2

Num. of limit valves = no. of cylinders x 2 = $2 \times 2 = 4$ (a_0, a_1, b_0, b_1)

no. of group valves = no. of groups - 1 = 2 - 1 = 1

no. of cylinder actuating valves = 2 (VA, VB).