Oil Hydraulics and Pneumatics
Prof. Somashekhar S
Department of Mechanical Engineering
Indian Institute of Technology, Madras

Part 3: Cascade method for stamping operation, Cascade method for drilling operation, Summary on cascade method of circuit design
Lecture - 79
Pneumatic Circuits: Design and Analysis of Multiple Actuators

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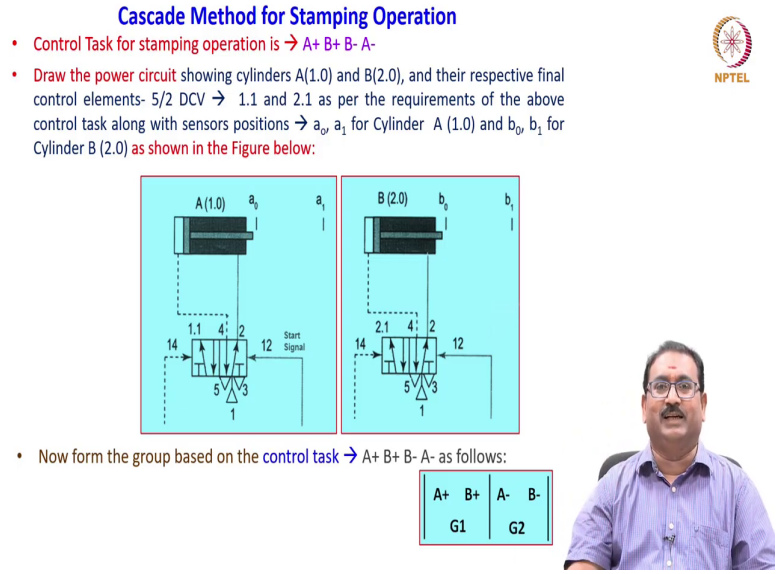

My name is Somashekhar, course faculty for this course. Now, I will show you the two important case only two problem because of the time limitations. The same thing is applicable to all the problem, understand very neatly here. Cascade method for stamping operation, you already know that correct.

Control task for stamping operation is A plus meaning what? Cylinder A extend brings the work bench beneath the cylinder B. Then what happen? Cylinder B will extend and starts the work space. Then what happen B minus meaning what? B will take at out cylinder will go, then A minus will go out.

This you know already correct friends? This quickly I will go the signal form A plus, B plus, B minus, A minus, this is a notational representation of the control task for the stamping operation. You have seen already in the previous slide. Now as usual the first step is same.

Draw the power circuit showing the cylinder A 1.0 and B 2.0, and their respective final control elements 5 by 2 DCV. As usual 1.1, 2.1 as per the requirements of the above control task along with the sensor position a 0 is a we have to monitor cylinder A's in the retracted position.

A 1 means we have to monitor after cylinder A extends then B will do activity know that is why we have to monitor the retracted position and extended position of the cylinder that is why we have to mention in the circuit a 0, a 1, b 0, b 1 correct like this. You already know this cylinder A, a 0 is a retracted position, a 1 is the extended position. These are the sensor position nothing but here I am using the valves; b 0, b 1 correct. This is a 5 by 2 valve you already know this 1.1 and 2.1.

Now, very important things, after drawing the power circuit, now from the group. Now what we will do now friends? Now, form the group based on the control task A plus B plus B minus A minus as follows. A plus B plus should be in one group; A minus B minus should be in the other group.

You will divide this in any fashion, but conflicting nature you have to avoid meaning you should not group the same cylinder is extending and retracting in the one group. Remember that is a very important case. This is a very simple case. I will divide like this G1 and G 2.

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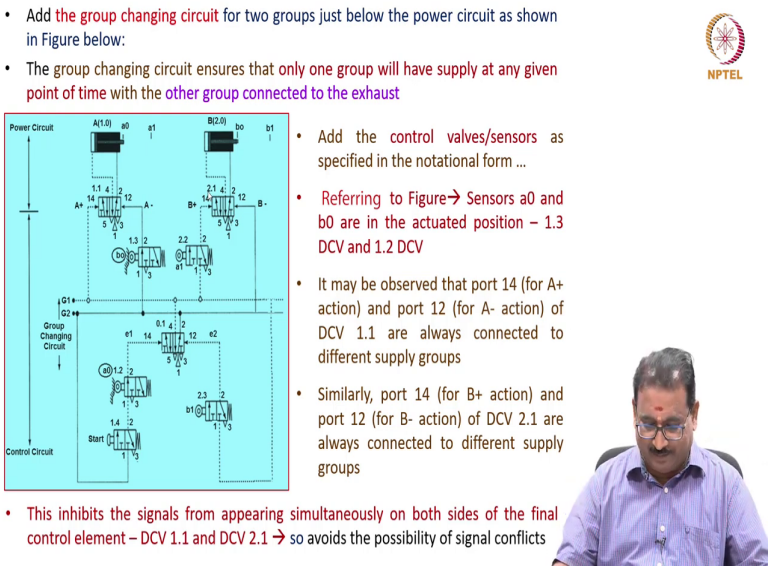

Add the group changing circuit for two groups just below the power circuit as shown in the figure below. You will see here. Now, we will see the top one is a power circuit. What is the power circuit? The main cylinder beneath that the final control element 5 by 2 DCV for A, pi by 2 DCV for the cylinder B.

This is known as power circuit. Beneath that full desired a control circuit in which it has the grouping group changing circuit. What is this group changing circuit? How we are divided G 1 and G 2? I am using the G 1 and G 2 group.

You will see here friends, the G 2 is always active. This is always it is called a null position. Power supply position which is always in the last group G 2. Now, as usual I have marked here a 0, a 1, b 0, b 1, then here b 0 we have to monitor as I have told you already because all

the operation will start it in the retracted position b 0. And a 0 see here, correct a 0 and b 0 are in the actuated position.

Then a 1, why it is a 1? Because after it will extend, how to draw? You will see. After it will extend, cylinder B should extend B plus should happen. After b 1 you will reach, here only you will see here it will come B minus should happen, b 1 you will see here. One more very important thing is the point 1 is a very important valve which will change from the G 1 to G 2 group.

Let us we will see these friends how this pneumatic circuit will work. The group changing circuit what I am drawn here ensures that only one group will have a supply at any given point of time whether G 1 is active or a G 2 is active with other group connected to the exhaust. Add the control valves or a sensors as specified in the notational form.

Referring to figure, sensor a 0 and b 0 are in the actuated position, a 0 and b 0 always the circuits will starts with retracted position of the cylinders. It may be observed that port 14, what for it is A plus action, port 12 for A minus action of DCV 1.1 always connected to different groups. Please remember how I will connect. It is in G 1 another group is in the G 2. Remember very important, the 14 is for A plus action should be; then A minus should be retracted position. How I grouped, same way you will connect here.

Similarly, the port 14 of 2.1 DCV for what it is, B plus. Similarly, for the port 12 for B minus both should be in the different group. How you grouped know? Same way, B plus should be in G 1, B minus should be in the other not B in the same group where to connect you will understand this friends.

This inhibits the signals from appearing simultaneously on both sides of the control elements 1.1 and 2.1. Because both are in the different group changing circuit G 1 and G 2. Here when you will do like this, if G 1 is active you no need to worry, the cylinders are extension and retractions are not in the same group. Remember that is a 1 of the important things you have to remember in the cascade methods.

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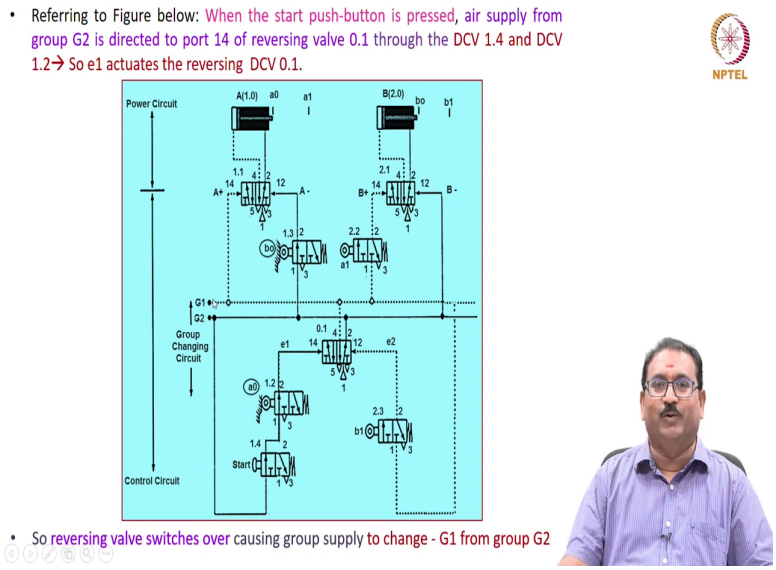

Referring to figure below, when the start push button is pressed, air supply from the G 2 is directed to port 14 of reversing valve 0.1 through the DCV 1.4 and DCV 1.2, so e 1 actuates the DCV 0.1. So, the reversing valve changes over causing the group supply to change to G 1 from G 2.

Why? Because when you will press this what it is a 0 is actuated. Then what happens? e 1 signal is active. If e 1 signal is active, what happen, it will changes the group changing circuit from G 2 to G 1, that is a beauty.

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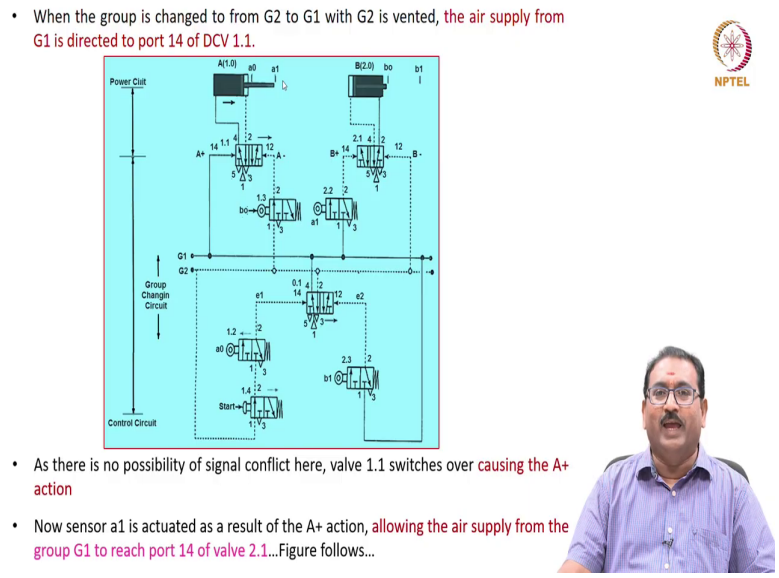

We will see now here. When the group is changed to from G 2 to G 1, what happen? G 2 is vented off; you remember G 2 is vented off. And the air supply from the G 1 is directed to the 14 of DCV 1.1. Then as there is no signal conflict, the valve 1.1 switch over causes the A plus action should be taken place because here there is no signal.

Now, the sensor a 1 is actuated as a result of A plus action, allowing the air supply from the group G 1 to reach 14, you will see when it will reaches a 1 this will actuate. When it will reaches this sensor, this valve will get actuates. What happen? The G 1 will send the energy to 2.1 through 14 like this.

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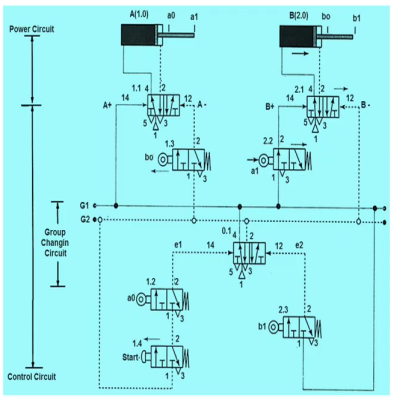

- As there is no possibility of signal conflict here, valve 2.1 switches over, causing the B+ action automatically
- Sensor b1 is actuated i.e. Valve 2.3 is actuated as a result of the B+ action, allowing the air supply from the group G1 to reach port 12 of reversing valve 0.1.
- As a result, the reversing valve switches over, causing the group supply to G2 from G1....(Next Fig)

You will see here how it is entering. After it is reaching, it will reaches 14 of 2.1 from the group G 1. So, there is no signal conflict here. Then what happen? B plus happens. As there is no possibility of signal conflict here, valve 2.1 switches over causing the B plus action automatically.

Sensor b 1 you will see now sensor b 1 is actuated meaning what it is, the valve the 2.3 actuates. What is this? e 2. When e 2 will come, again the group changing circuit will jump to the G 2, remember. As a result the reversing valve switches over causing the group supply to G 2 from G 1 like this.

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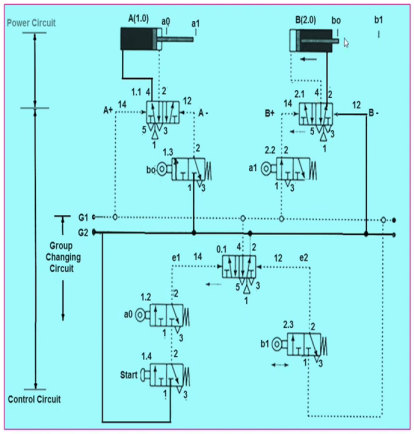
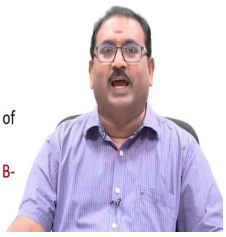


- As the group is change to G2, the air supply from group G2 is directed to port 12 of valve 2.1.
- As there is no possibility of signal conflict here, valve 2.1 switches over, causing the B- action automatically



See here now. Now, what happen here the then 12 of 2.1 receiving the signal. Then you will see here, this is cut off correct. This bottom a previous it is receiving G 1, now it is cut off because of the changeover. Then what happens? The B will retract very, very easily correct.

As the group is change to G 2, the air supply from the group G 2 is directed to the port 12 of the valve 2.1. As there is no signal conflict here, the valve 2.1 switches over causing the B minus 1 action automatically.

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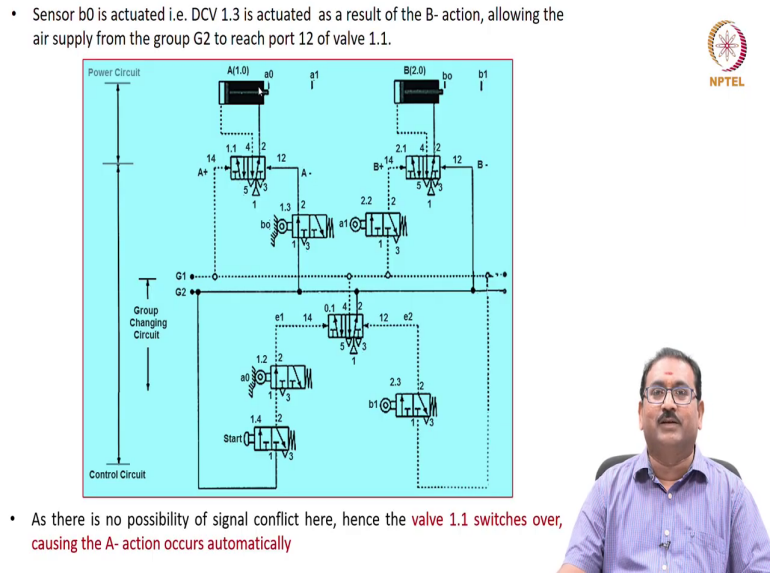

So, sensor b 0 is actuated meaning here you will see the DCV 1.3 is actuated as a result of B minus action, allowing the air supply from the group G 2 to reach the port 12 of valve 1.1. As there is no signal conflict here, hence the valve 1.1 switches over, causing A minus action occurs simultaneously.

See friends how it is. When I am grouping, the A plus B plus in G 1 group, A minus B minus in G 2 group, at any instant of time only one group is active. Based on this, you will never get the signal conflicts in the cascade method.

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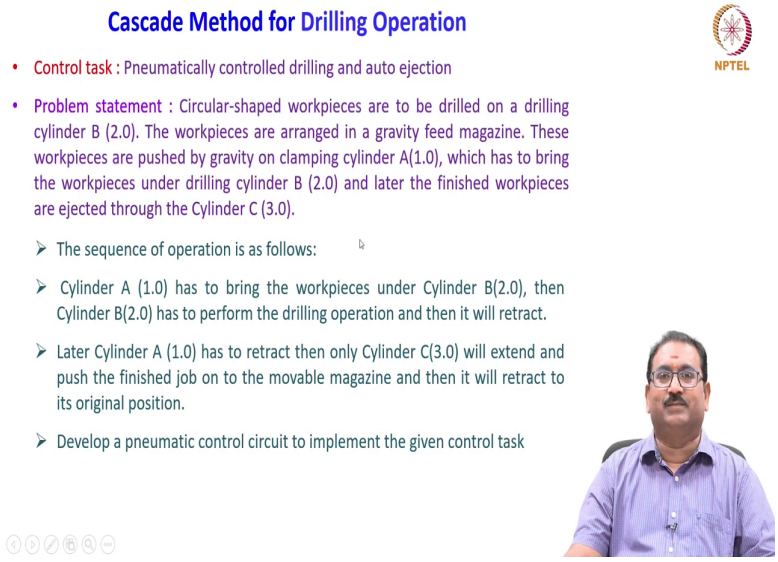

Now, let us we will see one more example very quickly drilling operations. Controlled task is pneumatically controlled drilling and auto ejection of the work pieces. Problem statement is like this. Circular shaped workpieces are to be drilled on a drilling cylinder B 2.0.

The work pieces are arranged in a gravity feed magazine. These work pieces are pushed by the gravity on a clamping cylinder A 1.0, which has to bring the work pieces under the drilling cylinder B 2.0. And later the finished work pieces are ejected through the cylinder C 3.0. Understand the problem statement, very important; three cylinders are there, cylinder A, B, C.

Now, the sequence of operations is as follows. Cylinder A 1.0 has to bring the work pieces under cylinder B 2.0, then the cylinder B has to perform the drilling operation, and then it will retract. Later A 1.0 has to retract, then only the cylinder C 3.0 will extend and pushes the

finished job on to the moveable magazine, and then it will retract to its original positions. This is a condition you have to follow. Develop a pneumatic circuit to implement the given task.

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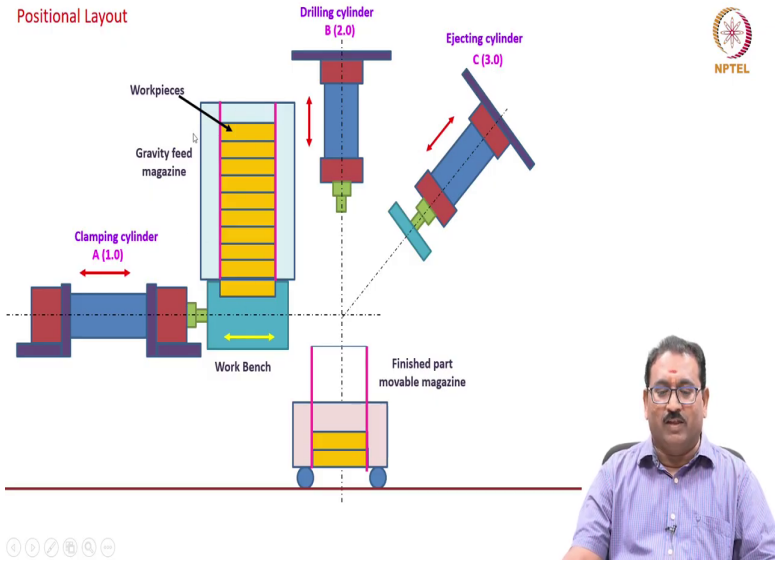

As usual you have to adopt any method. First I will show you the positional layout. How many cylinders are there? Friends, here now you will see there are three cylinders are there; one is a clamping cylinder A 1.0, another one is a drilling cylinder 2.0, another cylinder is ejecting cylinder 3.0.

Here it is a the gravity feed magazine which has a storage of work pieces. They will fall on to the work bench one by one. Then this clamping cylinder will push beneath the drilling cylinder. After operation is over drilling cylinder will take it out, then this cylinder will come out, then ejecting cylinder will push the finished job into the movable magazine. It will go.

This is a task given. You are to represent to understand clearly the positional layouts. You have seen already in the previous slide this.

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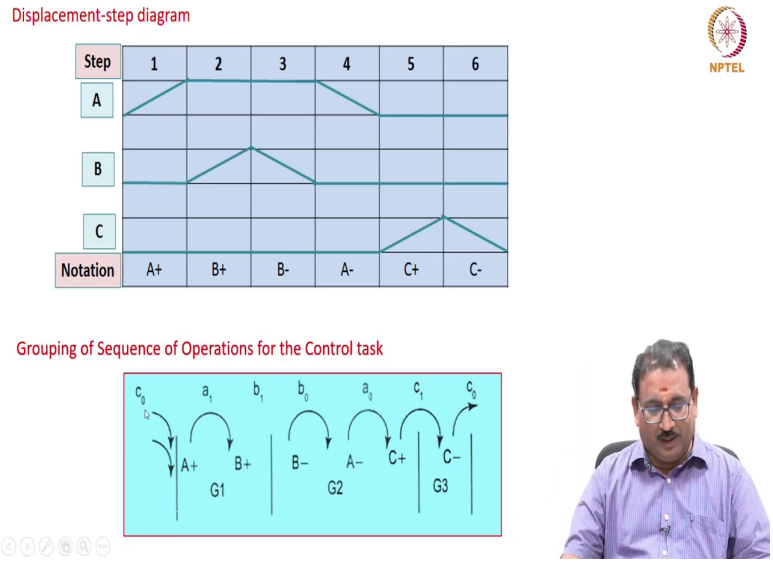

Next displacement step diagram. From the given statement, you have to form the displacement step diagram, how cylinder A operates, B operate, C operates. Yes, I am showing you here steps 1, 2, 3, 4, 5, 6 and notation I am showing you here down A plus, B plus whatever it is. Now, we will see a what happens the cylinder A will extend first, A plus action.

As soon as it will extend what happen the drilling operation should perform that is why B plus. After drilling operation is over, the drilling cylinder should move back that is why it is a B minus. Then after this what happens friends? A clamping cylinder should go back A minus.

Then only the ejecting cylinder will extend and pushes the finished job onto the movable magazine, then it will retract back.

You have to represent the displacement step diagram next step. Afterwards you have to place the sensors. What are the sensor? To monitor the retracted position as well as extended position. How many sensors? a 0, a 1, b 0, b 1, c 0, c 1, correct, these are the sensor. You have to mark all.

Or in the notational diagram, I will show you here the grouping of the control sequence of operation for the control task A plus B plus, then B minus A minus, C plus C minus. You will see now here friend how I am grouping A plus B plus I am grouping. Then you will see B minus A minus if you will group one group that is possible, but that time what happen C plus and C minus G 3 contradictory, it should not that is why I am taking C plus here.

If we group here nothing will happen in the G 2 group. Also always it will starts with the all cylinders are in the retracted position. Then when the cylinder C 0 in a retracted position a will start extending. When it will extend, what happens? a 1 signal will generate makes the B plus action should happen.

When B plus will takes place, it actuates the b 1 signal which makes the cylinder to retract B minus. B minus will lead to b 0 which makes the A minus should happen. Once A minus will takes place which will generates the a 0, then only it will makes the C plus. When C plus happens, then c 1 signals correct. When c 1 actuates, then C minus will takes place. I already explained this thing in the stamping operation.

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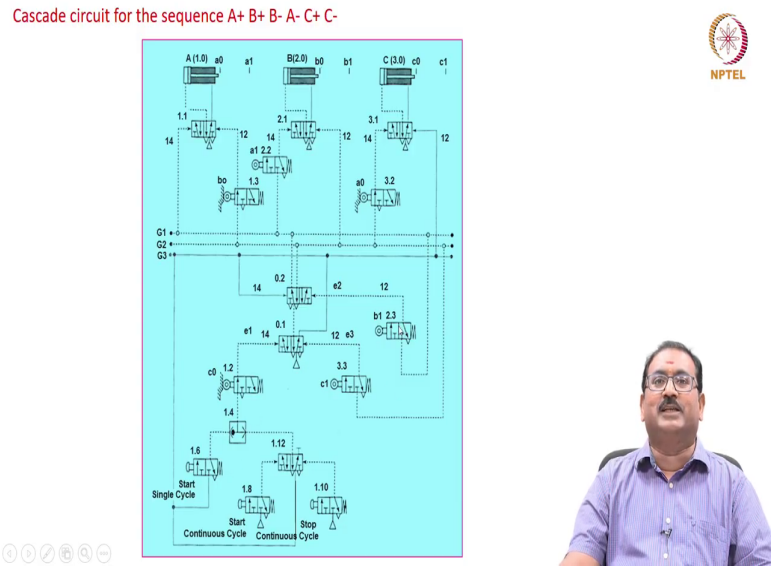

Quickly, we will go. Now, I quickly I will show you the cascade circuit for the sequence of operation A plus B plus, B minus A minus, C plus C minus, three groups I have made. Please understand friends A plus B plus in G 1 group, B minus A minus C plus in G 2 group, C minus alone in the last group. You may group anyway. Please remember friends, but we will remember at any instant of time G 1 or G 2 or G 3 is receiving the power.

Now, I am showing you here all the position. I already explained these things in detail in the stamping operation A 1.0, B 2.0, C 3.0. I have marked here a 0, a 1, b 0, b 1, c 0, c 1. As usual you will see friends a 0 I am monitoring, b 0 I am monitoring, c 0 I am monitoring. Then I am using the various other valves to make the circuit active. Please take care the how many signals I am using e 1, e 2, e 3, because it is a three groups are there.

This will, how many valves if you want you will use it? But any instant of time, you will see once this, for example 1.1 of 14 is connected to G 1 other in the other group it should not be in the same group. Similarly, here correct? You will try to analyze this circuit again. It is very easy it is. As I have explained in the previous stamping operation same way it is.

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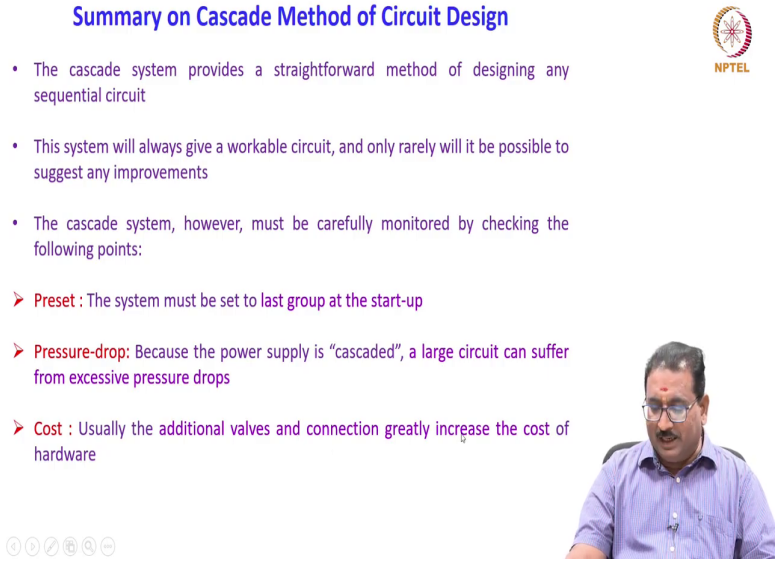

Summary on cascade method of circle design. The cascade system provides a straightforward method of designing any sequential circuit. This system will always give a workable circuit, and only rarely will it be possible to suggest any improvements. The cascade system, however, must be carefully monitored by checking the following points.

Preset, the system must be set to last group at the start-up. The additional valves, the pressure-drop, because the power supply is cascaded, a large circuit can suffer from excessive

pressure drops. Cost, usually the additional valves and connection greatly increase the cost of hardware.

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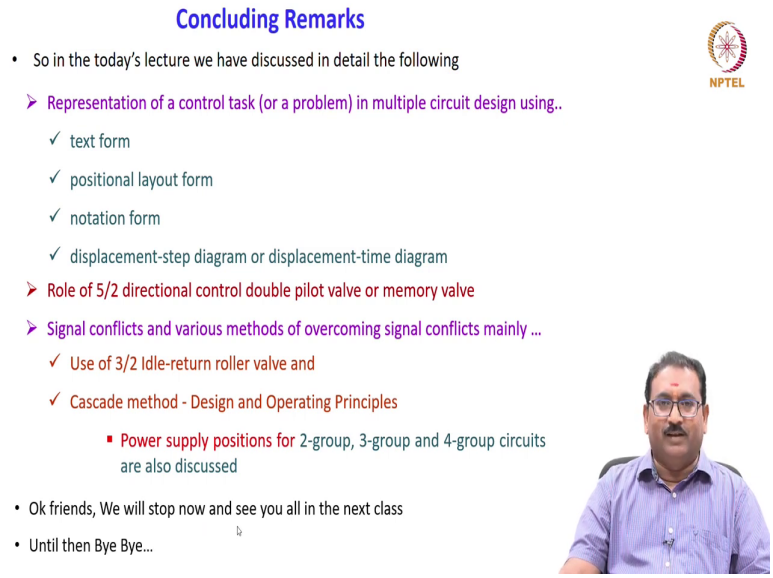

So, we will conclude today's lecture. In today's lecture, we have discussed in detail the followings, representation of the control task in a multiple circuit using text form, positional layout form, notation form, displacement-step diagram, or a displacement time diagram. The role of 5 by 2 directional control double pilot valve also known as a memory valve. Signal conflicts and various methods of overcoming the signal conflicts, mainly we discussed here is a use of 3 by 2 idle-return roller valve and cascade method.

Here we discussed designing in operating principle or stamping as well as a drilling. Due to shortage of time, I am concentrated only two problems. Power supply positions for the

2-group, 3-group and a 4-groups circuits also discussed. Ok friends, we will stop now and see you all in the next class. Until then bye bye.

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Thank you on and all for your kind attention. [FL].