Oil Hydraulics and Pneumatics
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Pneumatic Circuits: Design and Analysis of Multiple Actuators
Lecture - 78
Part 02: Power circuit, Signal conflicts, 3/2 idle-return rollers, Cascade method – design and operating principles, Power supply positions in 2 group, 3 group and 4 group circuits

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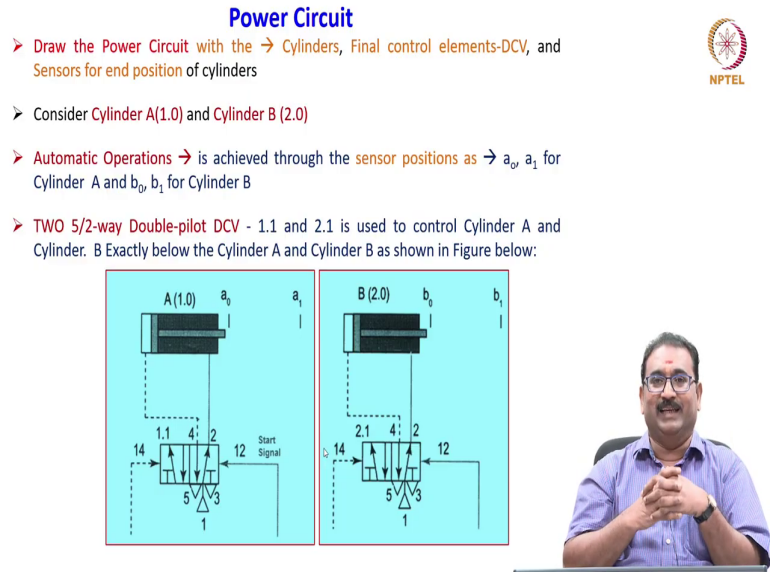

My name is Somashekhar, course faculty for this course. Now, come back to the problem of stamping operation a plus b plus b minus a minus to stamp the workpiece come back to this. The first and foremost thing is we have to represent the task in the power circuit, first while building the pneumatic circuits.

Draw the powers circuit with the cylinders final control elements DCV, and sensors for end positions of the cylinders. Has already know it we are two cylinders, we are using A 1.0, B 2.0. Automatic operations is achieved through the sensor positions as a 0, a 1 for the cylinder A a 0 for the retracted position a 1 for the extended position.

Similarly, b 0 and b 1 for the cylinder B. Then, we are using the two 5 by 2 double pilot DCV, we can name it as 1.1 and 2.1 is used to control the cylinder A and cylinder B. But, remember exactly below the cylinder A and cylinder B, you have to place as shown in the figure below here. You will see here friends a cylinder A 1.0 initial position a 0 extended position a 1.

Similarly, B b 0, b 1 exactly below this 1 I am using the 5 by 2 DCV 1.1 exactly below this 1.1, here 2 is there know 2.0 that is why 2.1 is 5 by 2 DCV 14 and 12 are the signals 14 and 12 are the signals, this is known as a power circuit. Power circuit is main cylinders beneath this the main control valves 5 by 2 DCV adding this. And, then mentioning the sensor positions of each cylinders.

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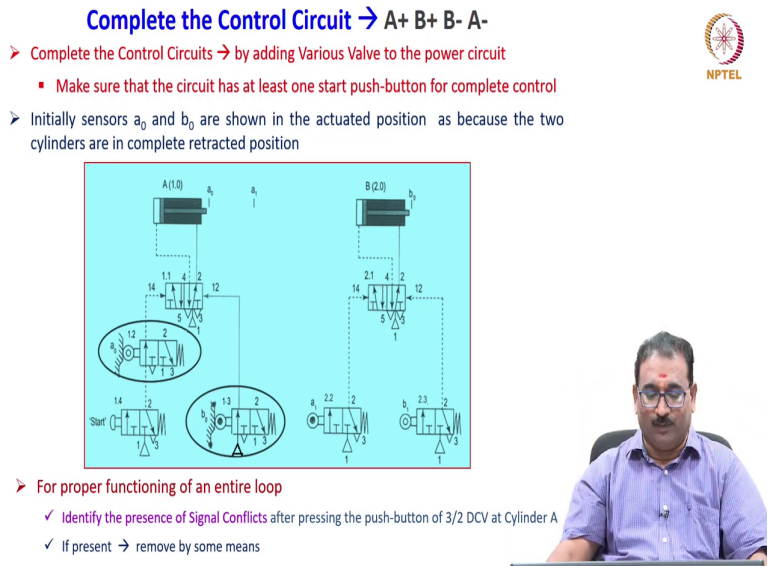

Now, complete the control task A plus B plus B minus A minus you already know that how to do this, complete the control circuits by adding the various valves to the power circuits. Make sure that the circuit has at least one start push button, as I have told you now remember this for complete control.

When you will press this stop no energy to any cylinder, when we will press this energy starts moving. One control valve is very very important in the any circuits; initially sensors a 0, b 0 are shown in the actuated position. As because the two cylinders are in complete retracted position as I have told, you always retracted position is a 0, b 0 should be there. That is why, what I am doing is I am doing here a 0 position I am making to monitor starting here.

Then, b 0 position you have to sense it please remember friends here, beneath the main 5 by 2 control valve 3 by 2 a valve I am using for controlling the this actuation 14 3 by 2 a valve it

is. But, as I have told you it will always starts with the a 0 and b 0 that is why I am making this position a 0, b 0 please remember. This is I am taking 1.2 1.3 one main control valve is required that is 1.4 again; it is a 3 by 2 a valve.

When, we will push this all the things will start otherwise it is stopped. Always you will remember, always you have to draw it in the retracted position retracted position you will see always. But, this purposely I am doing a 0 and b 0 like this a 0 and b 0, let us we will see now.

For proper functioning of the entire loop, identify the presence of signal conflicts after pressing the push button 3 by 2 a of DCV, this is 1.4. After pressing this one only we will come to know that, because of both cylinders are in the null position. Now, if present remove by some means, otherwise this valve 5 by 2 a valve will not switch over if signal conflicts will occur. If signal conflict is both appeared at the same time, let us will see now here.

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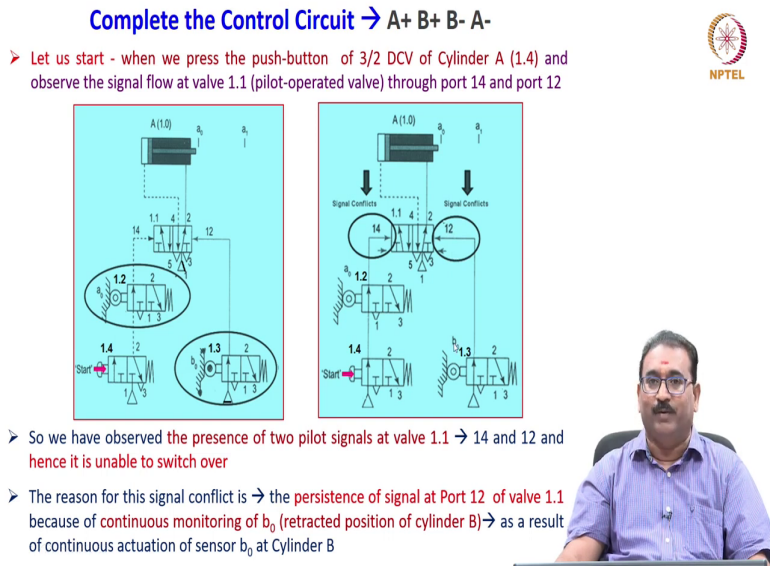

Let us start when we press the push button of 3 by 2 DCV of a one point this is 1.4 correct. If we will press this observe the signal flow at 1.1 through the port 14 and 12 what is there. See now here when you will press this, what happen energy will pass through this, but we will see now. But, previously we made the b 0 is to monitor continuously I am given this position for the cylinder A correct.

Now, we will see signal is appearing here and appearing here continuous monitoring, meaning valve will not switch over signal conflicts occur because of continuous monitoring of b 0 here, b 0 means cylinder B should be in the retracted position that is a main problem here now what I did, we will see this how to do it, but understand this now. So, we have observed the presence of two pilot signals at valve 1.1 14 and 12.

And, hence it is unable to switch over what we will do now? The reason for this signal conflict is as I have told you, the persistence of signal at port 12 of valve 1.1, because of the continuous monitoring of b 0. As a result of continuous actuation of b 0 at cylinder B both signals are there, then what to do somehow how you have to release this, how to do I will teach you do not need to worry now.

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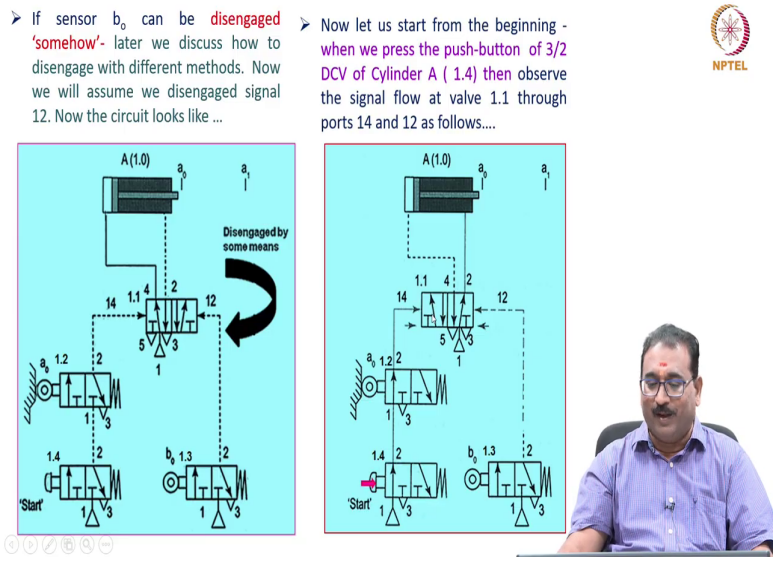

Now, we will see if sensor b 0 can be disengaged somehow later, but it is required mandatory b 0 should be there, then only a will extend then b extend it is require, but you have to disengage now. That is why I am writing here, if sensor b 0 can be disengaged somehow later we discuss how to disengage with different methods. Now, we will assume that I disengaged signal 12.

Now, circuit looks like this I disengaged. How to do it what is a mechanism? I will tell you, but now we will assume it if there is no signal here. Now, we will see friends what happens? Now, correct it is no signals, if we will press this signal. Now, let us start from the beginning when we press the push button of 3 by 2 DCV of cylinder the 1.4, then observe the signals always at the 5 by 2 a 1.

Now, we will see energy will come here it will come, but here no signal we disengaged by somehow, I will teach you how now what happens automatically. It will switch over it will energy will come to this position left position, then what happens cylinder will a will start moving.

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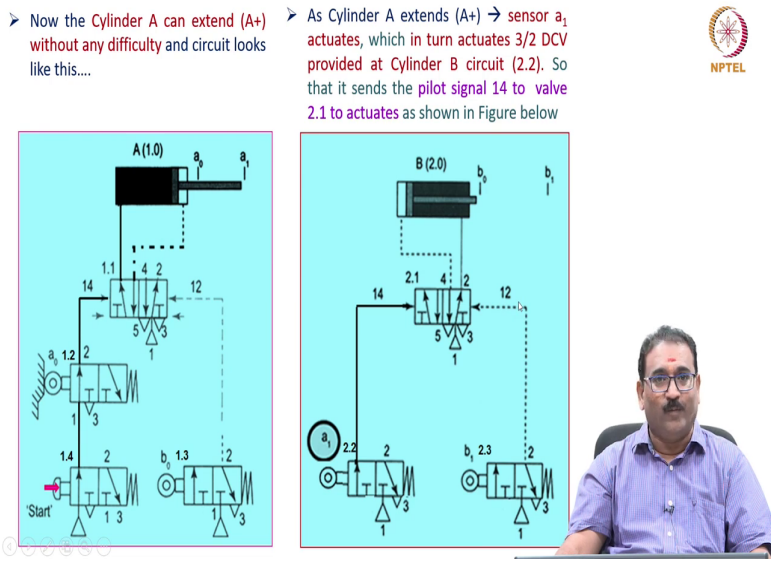

Now, we will see this now the cylinder now see here when it will come automatically, it will energy will come to the head side. The cylinder A is extending as soon as it will reaches the a

1 sensor will actuated correct. Now, we will see as cylinder A extends A plus sensor a 1 actuates which in turn actuates, after A cylinder extend B should actuates know that is why we will see here, the sensor position is here. The sensor a 1 actuates, which in term actuates the 3 by 2 DCV provided at cylinder B, this is 2.2 get actuated.

So, that it will sense the pilot signal 14 to the valve 2.1 to actuate correct it will actuate, but you will always you will check signal conflict is there at this here, here it is there signal conflict now.

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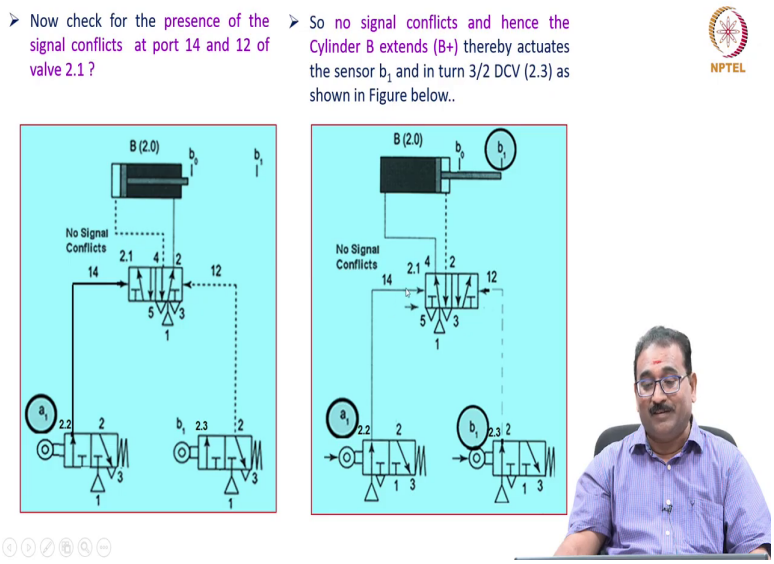

Now, check the presence of signal conflicts at 14 and 12 of 2.1. So, friends what happen no signal conflicts. Hence the cylinder B extends B plus will takes place energy automatically it will come here, it will extends. Thereby actuates b 1 after extend b 1 will extends which in

turn after b 1 what happen after extending b minus will takes place, that is why you will see here it will come here.

When, it will extend to b 1 it actuates this valve. What happens friends? The signal will come here, then what is there here, signal is there signal conflict will takes place remember.

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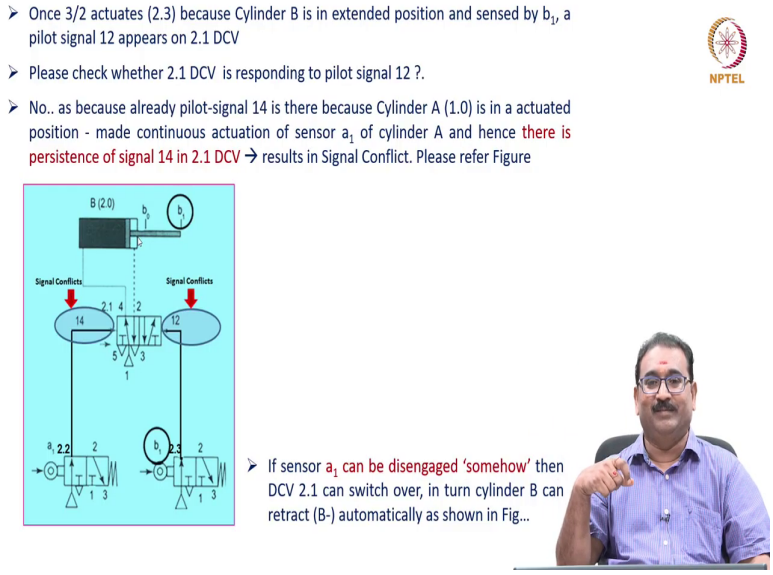

Now, we will see friends here once the 3 by 2 actuates meaning 2.3 actuates. Because of the cylinder B is in extended position and sensed by the b 1 a pilot signal 12 appears on 2.1 DCV. Please check the 2.1 DCV is responding to pilot signal 12 no, as I have told you already signal 14 is there why 14 is there, because I want to monitor A extended position afterward, when B retracts A retracts that is why I want to monitor that position.

That is why it is look here signal conflicts correct. What we will do now? If a 1 can be disengaged somehow then DCV 2.1 switch over to this then only it retract otherwise no, because already a I am making it should extend.

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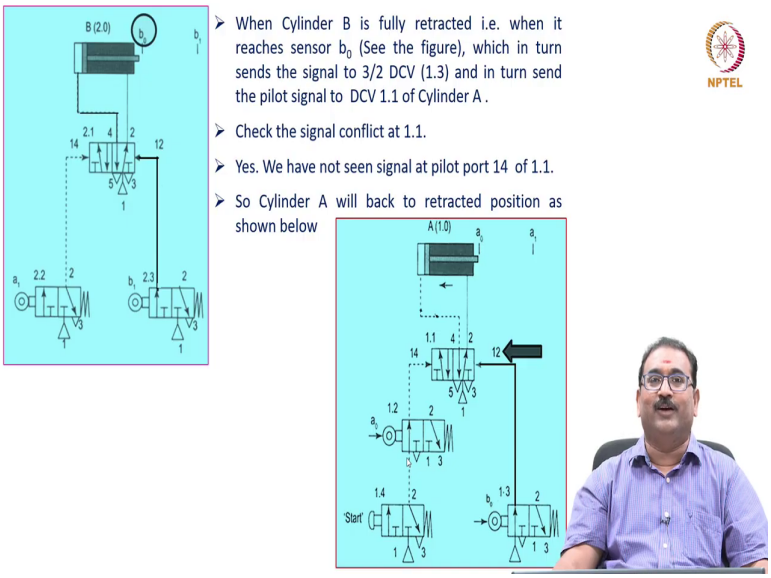

Now, will see friends when I will disengage this by somehow what is that I will tell you. If now I will making assuming that there is no signal here, then it will come energy will come to the road end it will retract. When the cylinder B is fully retracted meaning when it reaches, the position b 0 which in turn after b 0 what happen.

A will retract back that is why we will see which in turn sends the signal 3 by 2 of 1.3 meaning 1.3 or further cylinder A, which in turns sends the signal to DCV 1.1 of cylinder A meaning it is a 5 by 2 valve we will see now. Again you will check the signal conflicts, I will draw this you will see here friends. Now, we will see when the b 0 will takes place here b 0

will takes place, automatically it will signal will come, check the signal conflict no signal conflict because it is dotted.

Then, what happen? Cylinder A will be back energy will go to the tail side whatever the air is there it will go to the atmosphere correct. See now how the signal conflicts will occur, when we are making to monitor continuously. The cylinder retracted positions. And, also we are putting the condition cylinder A is extended position only because, it is holding the workpiece we will do the work, then what happen you have to monitor A is in extended position only. After B will go a will go.

This conditions makes us the signal conflicts to occur at 5 by 2 DCV correct your seen now.

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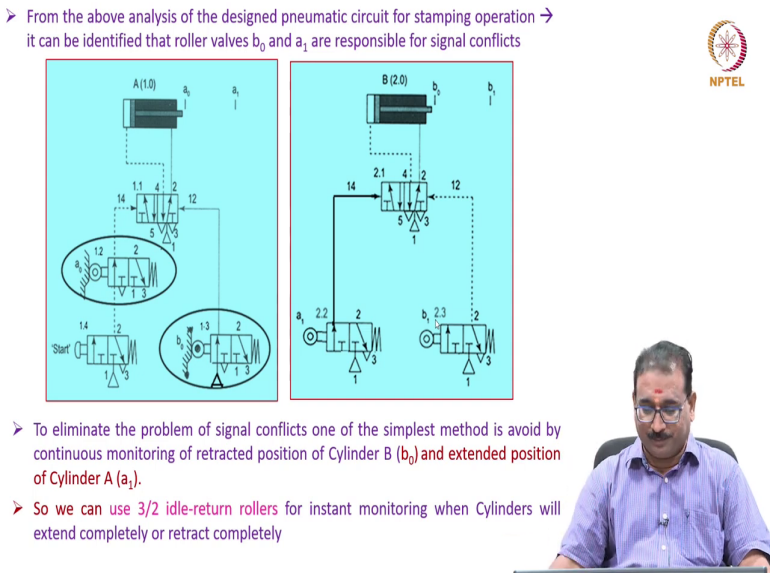

So, from the above analysis of the design pneumatic circuit for stamping operation, what we have shown here. It can be identified that the roller valve b 0 correct and a 1 these are the problems correct you have to release I told you then I told you release this. If you will make this instantaneous detection, then no signal conflicts you will see now. Because, this b 0 meaning this side 12 of 1.1 and 14 of 2.1 these are responsible for the signal conflicts.

To eliminate the problem of signal conflicts, one of the simplest method is avoid by continuous monitoring of the retracted position of cylinder B, b 0 and extended position of cylinder A, a 1. Because, these are responsible for signal conflicts you are seen already, there are many methods are there. One among them is we can use 3 by 2 idol return roller valves, for instant monitoring when cylinders will extend completely or retract completely.

Because, valves are like this when it is extent it will sense it is extended. Once it will go out it will inactive this valve is inactive, but it is ensuring that cylinder is extended. If will place in the other direction, when it will come back one instant it will detect afterward no. You have to use 3 by 2 idle return roller valves at b 0 and a 1, but a 0 and b 1 no problem you keep this 3 by 2 roller valve is more than enough.

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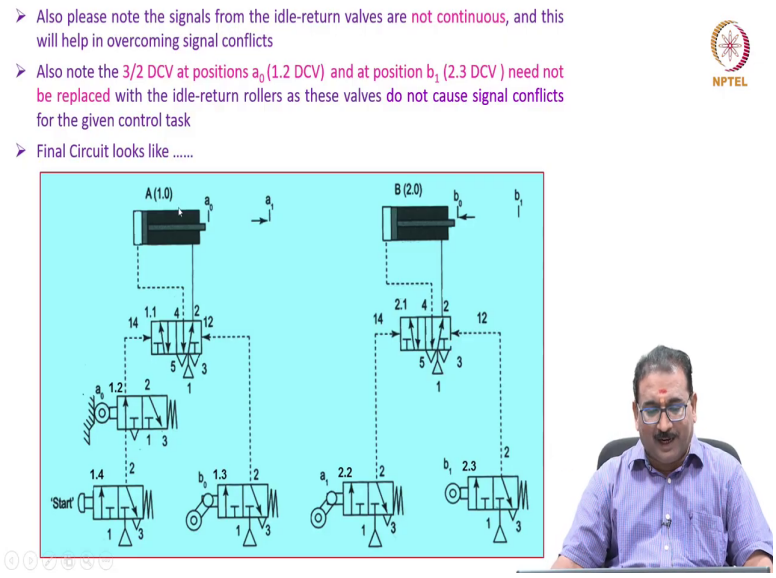

Also please note that as I have told you the signals from the idle return valves are not continuous. And, this will help in overcoming the signal conflicts, also note the 3 by 2 DCV at position a 0 1.2 of DCV and at position b 1 2.3 DCV, need not be replaced with the idle return roller valves. As these valves do not cause any signal conflicts for the given control task.

So, the final circuit looks like this see here I am keeping same here, A is in actuated in the retracted position I am monitoring. But, here how I am relieving I am using the 3 by 2 idle return roller valve. If you will use this what happen the b 0 position when it will retract it will monitors. Instantly not continuous monitoring is not required.

Similarly, here also what is our objective here B is extended are not to monitor that is why you will see here, you will put the 3 by 2 idle return roller valve, then it is disengaged. This is one of the easiest way to overcome the signal conflicts across the 5 by 2 DCV.

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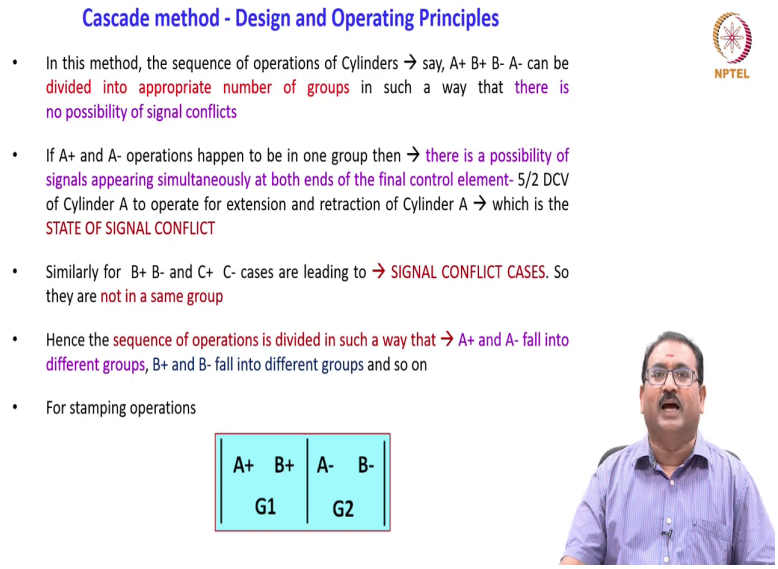

Now, we will move onto cascade method design and operating principle, this is also one of the important method, widely usually in industry to overcome the signal conflicts in pneumatic circuits. In this method the sequence of operations of cylinders for example, A plus B plus B minus A minus can be divided into appropriate number of groups. In such a way what there is no possibility of signal conflicts.

If A plus A minus operations happen to be in one group, then there is a possibility of signal appearing simultaneously at both ends of the final control element 5 by 2 DCV of cylinder A to operate for extension and retraction of cylinder A which is the state of signal conflict.

Meaning here, in one group you should not make the group A plus A minus, because it will not understand whether shall I extend or shall I retract that is why A plus A minus should be in the different group.

Similarly, for B plus B minus C plus C minus cases are leading to signal conflict cases, if we will group it in the same group. So, they are not in the same group. An hence the sequence of operations is divided in such a way that A plus and A minus fall into different groups B plus B minus fall into different groups and so on.

For example, we have seen in the previous slides stamping operation A plus B plus B minus A minus correct how to group these things, you will see here how I am grouping A plus cylinder A is extending, then cylinder B is extending no problem it is correct, A minus cylinder A is retracting cylinder B is retracting, you will make a group in such a way that they are in the A plus A minus should be in the different group similarly, B plus B minus in the same group.

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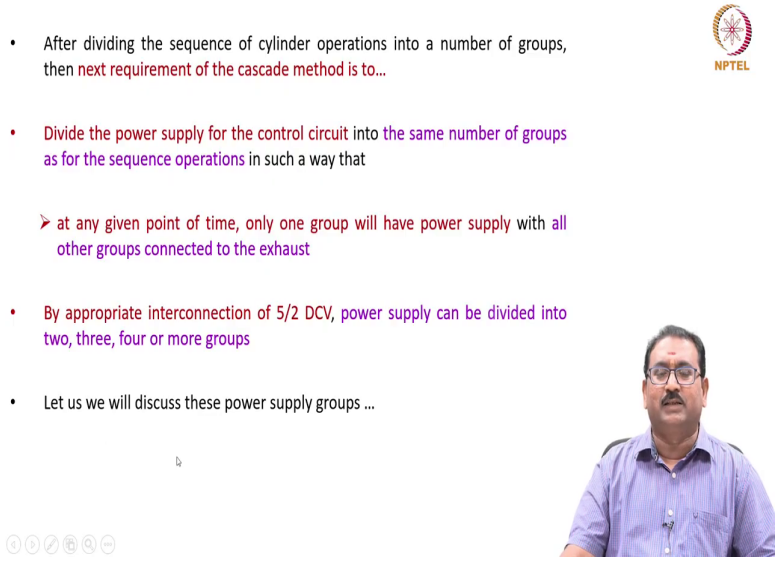

After dividing the sequence of operations into a number of groups, then next requirement of the cascade method is to divide, the power supply for the control circuit into the same number of groups, as for the segments of operation. In such a way that at any given point of time only one group will have a power supply with all other groups connected to the exhaust.

So, by appropriate interconnection of 5 by 2 DCV power supply can be divided into 2, 3 or more number of groups, based on how you are dividing the sequence of operations to be performed. Let us we will discuss first these power groups, how they will divide.

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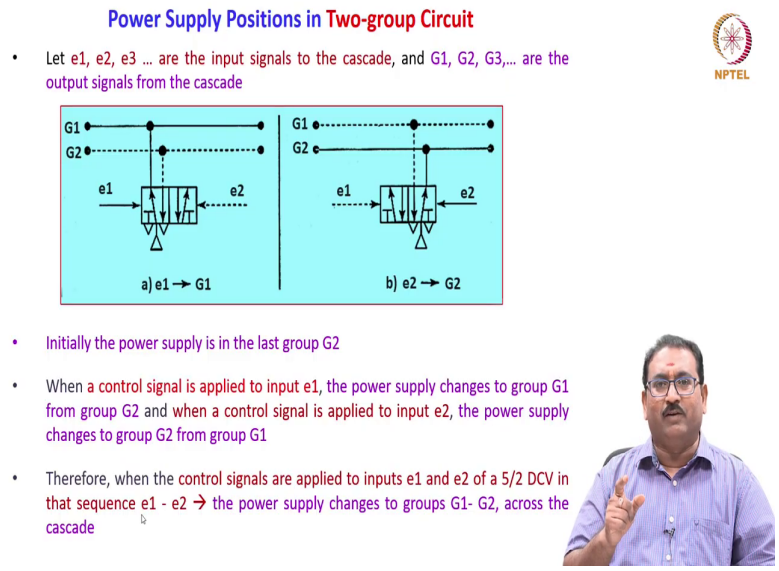

Power supply positions in a two groups circuit, if you are making the to group. For example, in the stamping operation A plus B plus A minus B minus, we made known for this how the power supply positions will looks. Let us we will see now, let e 1, e 2, e 3 what how many want are the input signals to the cascade, and G 1, G 2, G 3 are the output signals from the cascade.

You will see here how I am dividing this G 1, G 2, 5 by 2 a valve e 1, e 2, here I am showing here e 1 signal is there that is why this port is an active. You will see here the e 2 signal is an active this port is an active meaning G 2 is an active, please remember friends how to draw this circuit.

Meaning the power supply position in two groups circuits two groups are there G 1, G 2 that is why e 1 and e 2 signals are required. To invoke either G 1 group or a G 2 group for this I

am using 1 5 by 2 DCV. How it operates you will see? Initially the power supply is in the last group G 2 please remember this friends. To all the circuits when you are designing using the cascade method, always the power supplies in the last group here, it is a G 2 group we will see it will starts from here G 2.

Meaning G 1 is vented out please see here only G 1 is dark here, because it is receiving the power, but G 1 is vented out. When e 1 is signal is coming that time G 1 is receiving the power G 2 is vented out please understand this very important friends it is. When a control signal is applied to input e 1, the power supply changes from G 2 to G 1 and when the control signal apply to e 2, the power supply changes to group G 2 from group G 1.

Therefore, when the control signals are applied to inputs e 1 and e 2 of a 5 by 2 DCV b in that sequence e 1 e 2 the power supply changes to the group G 1 and G 2 across the cascade. Meaning you will see, remember here friends, when I am grouping the sequence of operation of multi cylinders in each group I am taking care that there should not be a signal conflicts.

For example, A plus A minus should not be in the same group B plus B minus should not be in the same group. That time what happen, what are the sequences of operation you grouped in the G 1 or G 2 or G 3 only that group is on other groups are vented to the atmosphere, they will not receive any signal.

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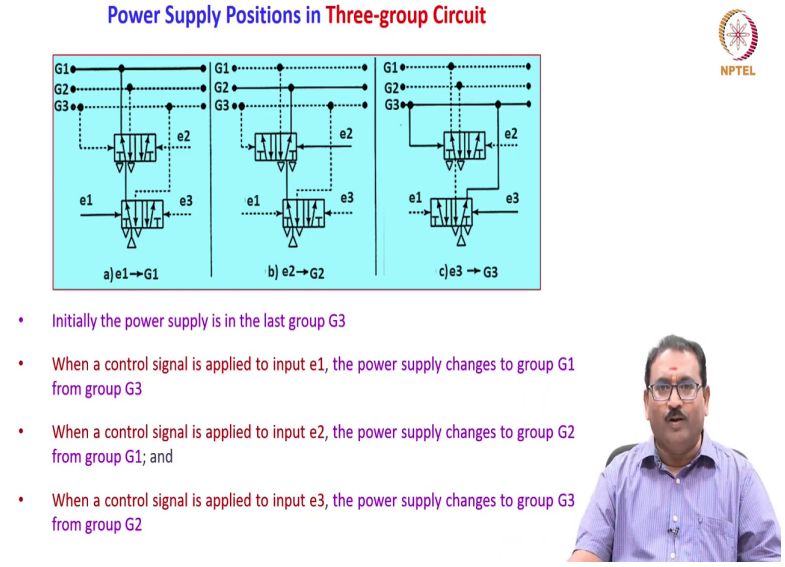

Similarly, let us we will see the power supply positions in a three group circuit meaning, if I am making the sequence of operation control task G 1, G 2, G 3 for example, if I am operating the three cylinders that time three groups are there. I will make the three groups G 1, G 2, G 3 that time how many signals are require? e 1 e 2 e 3 correct friends, already we know that.

Now, previously we are seen two group only 1 5 by 2 a valve e 1 and e 2. Now, I may required the three control signal to invoke the G 1, G 2, G 3 how many signals e 1, e 2, e 3 are required that is why I am using now, we will see how it is. I am using the 2 5 by 2 DCV. Now, always we will remember what is the null position? Always in the last group meaning you will see e 3, meaning other groups are you will see here vented off other groups are vented off.

When signal e 3 is there, G 3 group whatever you clubbed in the G 3 those cylinders will receive the signal, other cylinders are not receiving any power that is a beauty of cascade method. Now, we will see how it will work. Initially the power supply is in the last group e 3, meaning G 3. When a control signal is apply to e 1, what happens now friends? The power supply changes to group G 1 from G 3, G 2 and G 3 vented to atmosphere you will see here.

Only when I will apply the e 1 signal, you will see the power supply is coming here, only dark this is G 1 group is receiving the energy. Others you will see others are vented off you will see here, others are vented off please remember friends this is a beauty. Similarly, when a control signal is applied to e 2, if I am applying to e 2, then what happens the power supply changes to group G 2 from G 1 correct from G 1.

Then, what happens here? You will see here friends energy is coming here coming here going to G 2 is an active, G 1 is vented off G 3 is also vented off remember very important it is. When, the control signal is applied back to input e 3, what happen the power supply changes to group G 3 from G 2 because previous state is G 2.

Now, we will see here again G 1 and G 2 are vented off e 3 and G 3 are active please remember, how the power supply positions in the three group circuit. Similarly, you have to make a number of groups; I will show you one more if your operations control sequence is more. You are handling the multiple cylinders like a 4 like a 5 6 that time you have to group this in such a way that no signal conflicts in each group.

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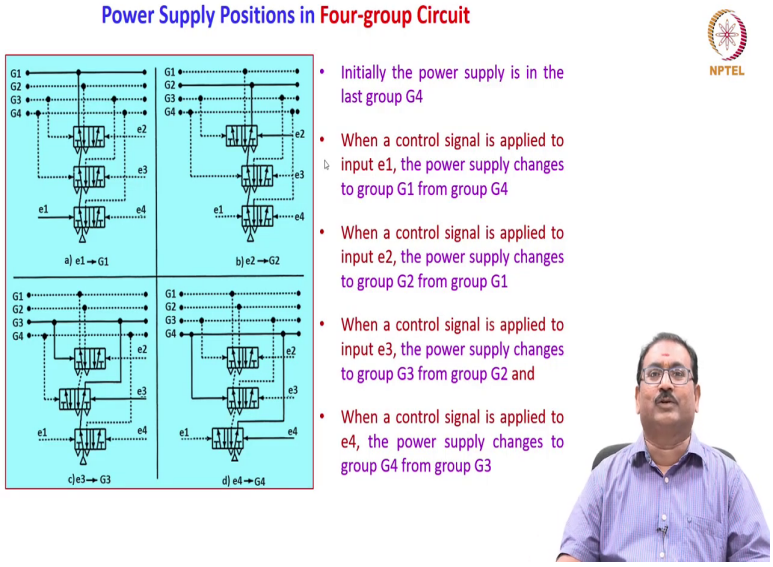

Now, I will show you one more four groups circuit four group means G 1, G 2, G 3, G 4 draw quickly the horizontal lines G 1, G 2, G 3. But, make sure that how many signals are required e 1, e 2, e 3, e 4 correct you will see here e 1, e 2 is required a 3 is required e 4 is required.

As I have told you the null position always power supplies in the last position, meaning when e 3 is there power supply is coming here. You will see G 4 is on all the elements all the actions in G 3 are receiving the signals. Others are vented off you will see others are vented off.

Now, let us we will see how it will work now, initially the power supply is in the last group G 4. When, the control signals applied to input e 1 the power supply changes to group G 1 from G 4 remember, because previous state is a G 4 when you apply the signal G 1.

Immediately it will jump to the G 1 the G 4 is vented off. Similarly, when a control signal is applied to the input e 2, the power supply changes to group G 2 from group G 1, when a control signal is applied to e 3 what happen G 3 is an active G 1, G 2, G 4 are vented off.

Similarly, when a control signal is applied to e 4 the power supply changes to group G 4 from group G 3. Please remember this, even though it increases the number of pi by 2 a valves, but it will never leads to signal conflict place. As we have seen simple operation in stamping operation, you will see here friends when I am operating the multiple cylinders that time if you will not use this cascade method, then difficult task it is, you have to identify every time pi by 2 a valve, where we are getting the signal conflicts.

In which position it is affecting the either you have to use, as I have told you 3 by 2 idle return roller valve. The best method is cascade method, but it require the practice you have to practice the how the circuit will work.