Oil Hydraulics and Pneumatics
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Pneumatic Circuits: Design and Analysis
Lecture - 76
Part 3: Pneumatic circuits- Control of double-acting cylinder using-plunger, plunger and sensor, Plunger and Time delay valve, Flow control valve, Sequencing of motion

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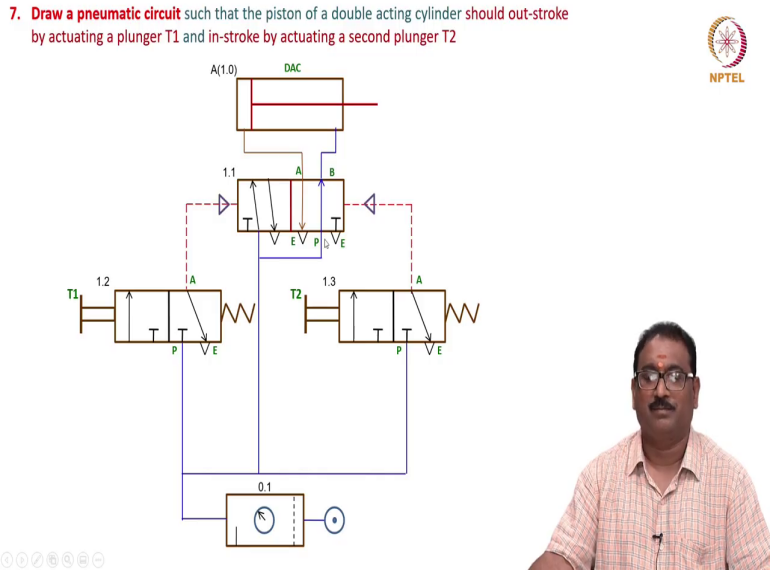

My name is Somashekhar, course faculty for this course. Next one, 7th problem. Draw a pneumatic circuit such that the piston of a double acting cylinder should out-stroke by actuating the plunger T1 and in-stroke by actuating the second plunger. Then you will see double acting cylinder put the pilot operated valve, one plunger another plunger, you will press it here, it will extend, press it again here, it will retract then power source we add it all.

How it is? You will see now very very simple. Double acting cylinder, the pilot operated valve, one is here, I am connecting to 3 by 2 T1 and 3 by 2 T2 push button actuations correct, then all same correct, it is a FRL unit power source. In null position, you will see here all are closed, closed, closed, here closed, here it will see here, it will come here. Correct friends, very very simple.

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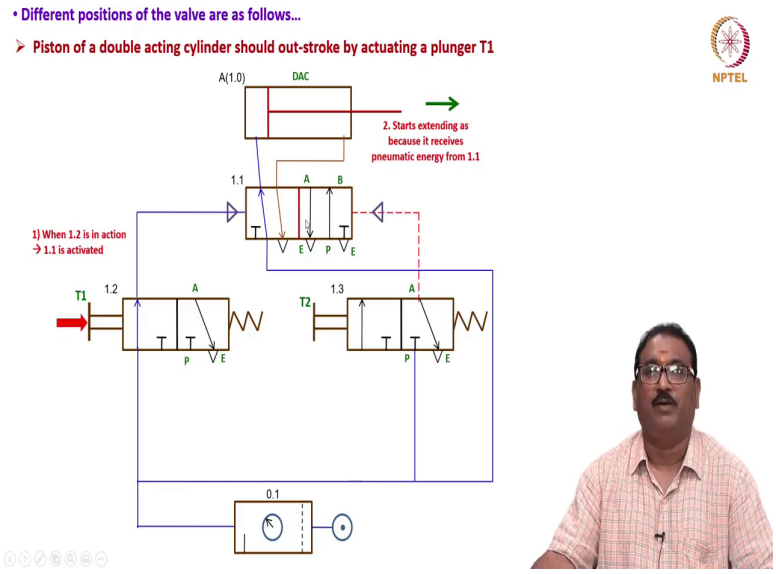

How it will operate? I will show you the position, different position. When you will piston of a double acting cylinder should out-stroke by actuating the plunger T1. If you will press this, what happen? You will see here the signal will come here. Then, what happened? The energy will come here, come here, enters to the head side, it will extend, start extending because it receives the pneumatic energy from the 1.1.

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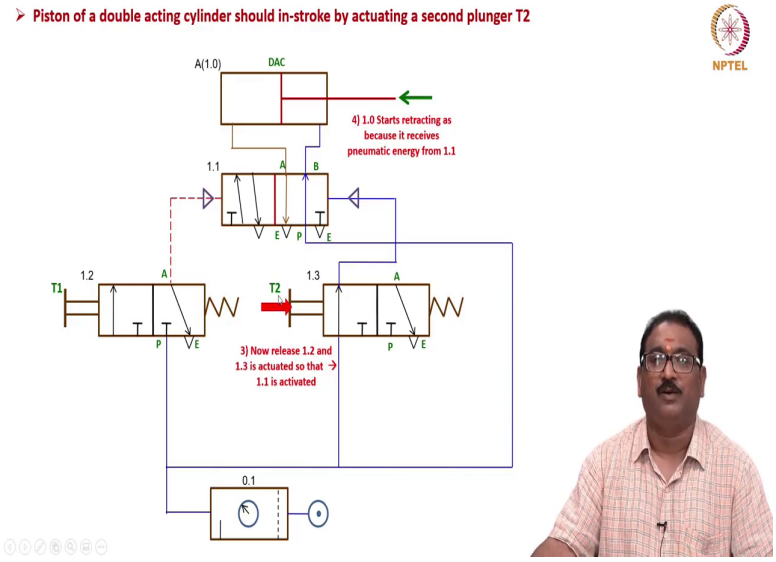

Then, piston of a double acting cylinder should in stroke by actuating this. Press again one more, it will go to here, no signal here. When you will press this here, the pneumatic energy will come here, actuate this position. What happened? The air will enters to the tail side, then it is pushing, air will go to the atmosphere through this port. Meaning, it will retract through plunger T2 extension through T1, retraction through T2.

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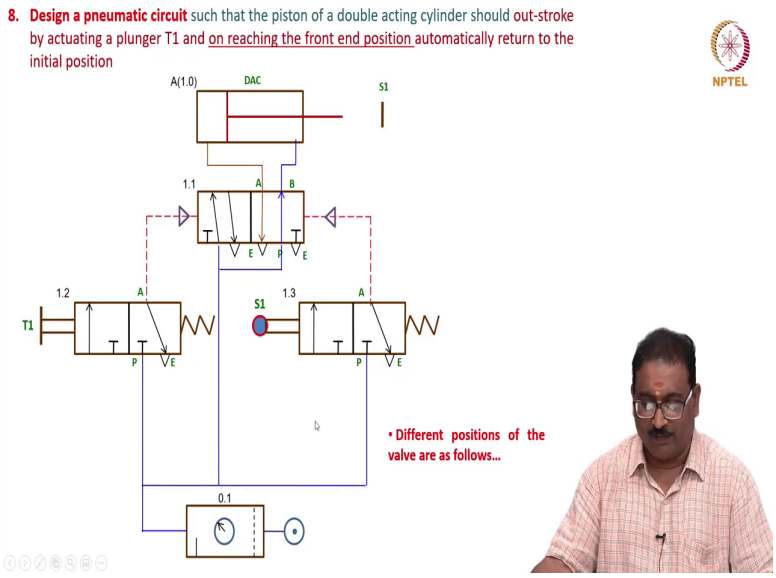

We will move on to the one more circuit, design a pneumatic circuit such that the piston of a double acting cylinder should out-stroke by actuating the plunger T1 and on reaching the front-end position, automatically returns to the initial position. Previously, you have to press T1 and T2, T1 for extension, T2 for retraction, now it is doing automatic operation. How will I achieve this? By putting the limits switch that is all, very very simple here.

Now, we will see the S1 is a limits switch position same, same here ok. The now here, T1 same as it is for the extension. Now, we will see after it will reaches and touches the S1, automatically this 3 by 2 DCV's actuated otherwise no. Now, how it operates, I will show you very quickly, different positions are like this.

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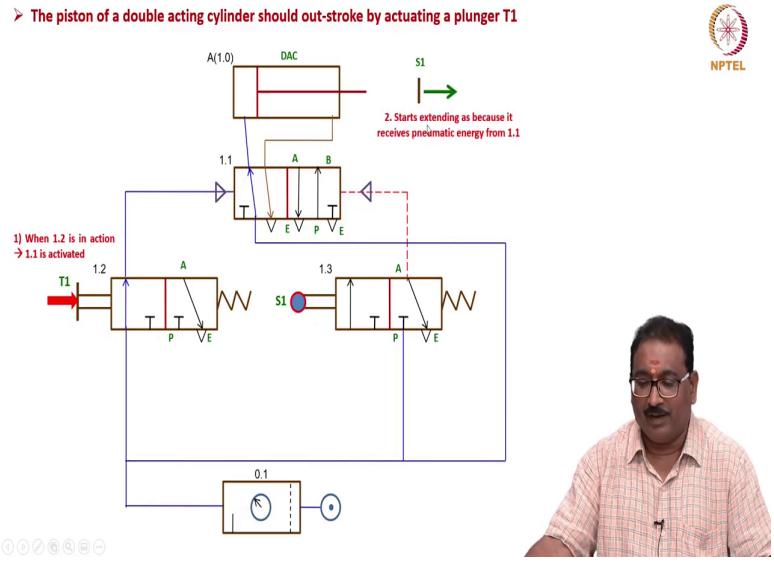

The piston of a double acting cylinder should out-strokes by actuating the plunger T1. Press it here, see here it will go here energy, it will actuates, extends correct it starts extending. After reaching this, what happen? See here, after reaching this, the energy will come here, actuate this position.

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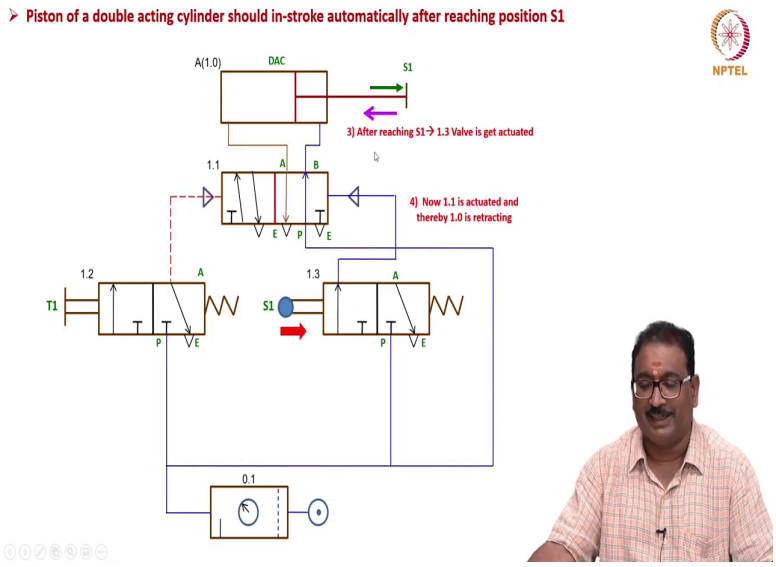

After reaching S1, 1.3 valve is get actuated. Then, now, it is what happen? Now, it is start retracting, remember very simple it is correct friends.

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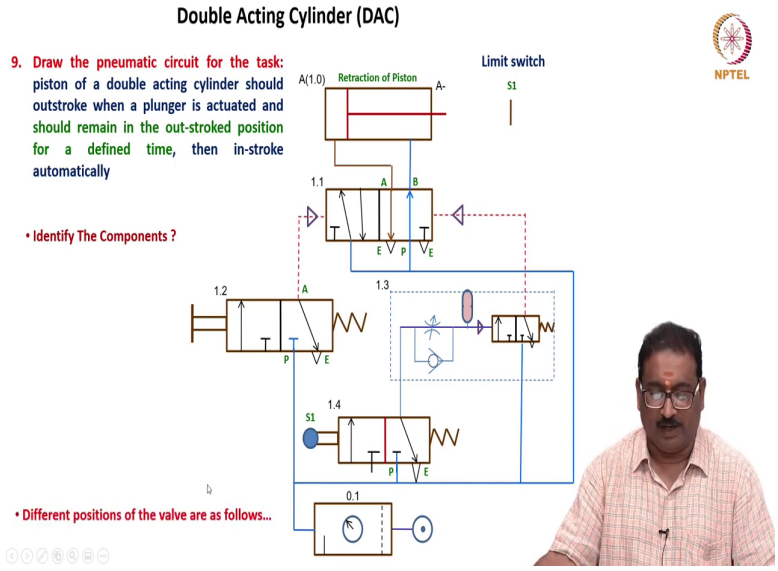

Now, we will see the 9th problem. Draw the pneumatic circuit for the task: the piston of a double acting cylinder should out-stroke when a plunger is actuated and should remain in the out-stroke position for a defined time, 10 second, 20 second, 30 second, you should wait because loading and unloading operation may takes place, then in stroke automatically, after waiting for a certain period. How to do this? Identify the components now.

Here, I am showing you here very very important component I am added is a time delay valve, time delay valve is a 3 by 2 DCV. Then, here throttle is there, based on the times require to fill the accumulator only that time, it will actuate otherwise it will not actuate. The return is through the NRV.

This is the time delay valve, I am placing here because it should after reaching S1, it should wait. How much time it will wait? The oil when it will actuate; when it will actuate, after

reaching S1 actuate, the air will come, it will not quickly actuate this position, it will fills the accumulator after passing through the throttle meter, throttling, then only it will actuates. How it is operating, you will see, the different position of the valve.

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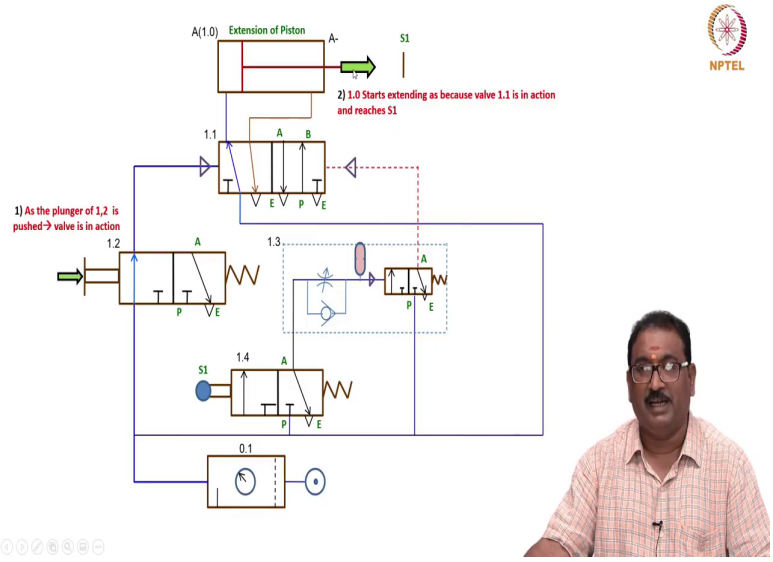

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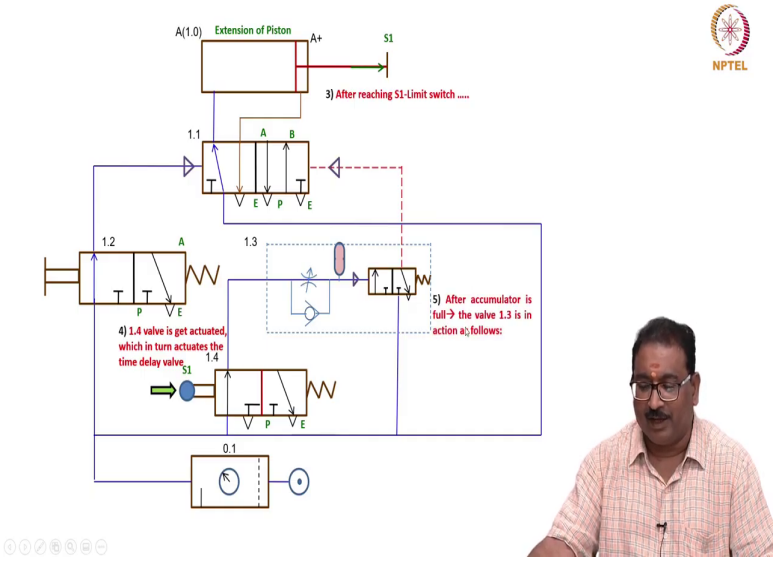

Now, how, what happens here? When after pressing this, the pneumatic energy will actuate the left position of the pilot operated valve. Then, air will come here enters the head side, start extending correct, it will start extending. After reaching this, what happen friends?

Correct, this 3 by 2, but it will not actuate here please remember, it will not actuate here because it is filling the accumulator, time delay valve, delay is adjusted using the metered orifice. Once it is after the accumulator is full, the valve get actuates see here, it will come here.

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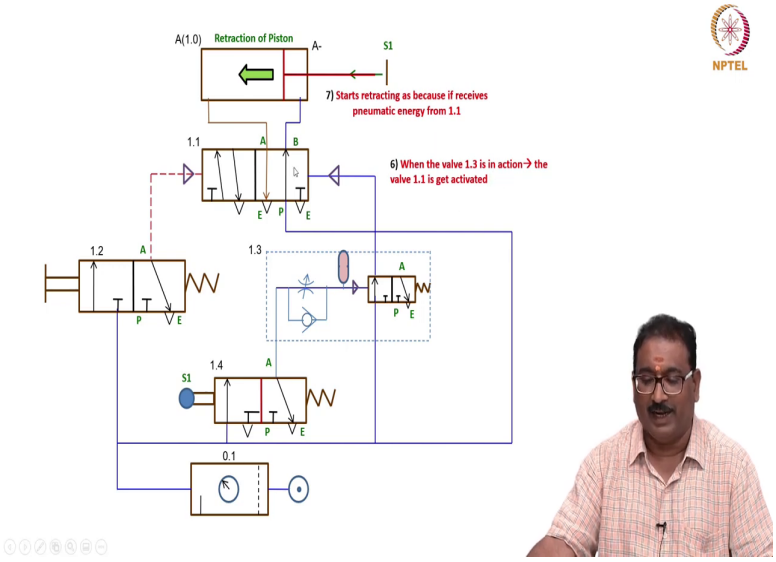

Then, it starts retracting because as because it receives the pneumatic energy from 1.1 because it is actuated. When the 1.3 is in action, the valve 1.1 get actuates, then it will return simple, very simple.

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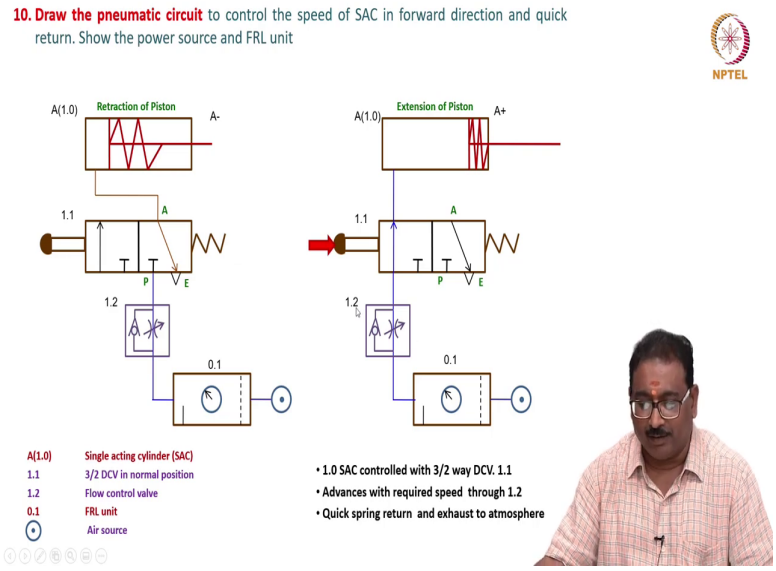

10th problem. Draw the pneumatic circuit to control the speed of single acting cylinder in forward direction and quickly return. Show the power source and FRL unit. Very simple here, we have seen these type of problems in the hydraulics also same thing here, I am putting the 1.2 is a work flow controlled valves, again it is a single acting cylinder it controlled through the 3 by 2 DCV power source.

When, these are the elements, we have to list it out, what are the components here, then here, what happens here? The 1.2 controlled through the 3 by 2 DCV 1.1 advances with a required speed through 1.2. Then, when it will go here, quickly it will exhaust that is why I am placing here.

Now, we will see how it operates. When you will press this button, what happens? The air will come here, it will pass through the metered orifice, required flow rate, extension is with

the required speed, return is bypass, you will see return is by speed, very quickly it will return that is why I am placing the flow control valve here. It is represented 1.2 here.

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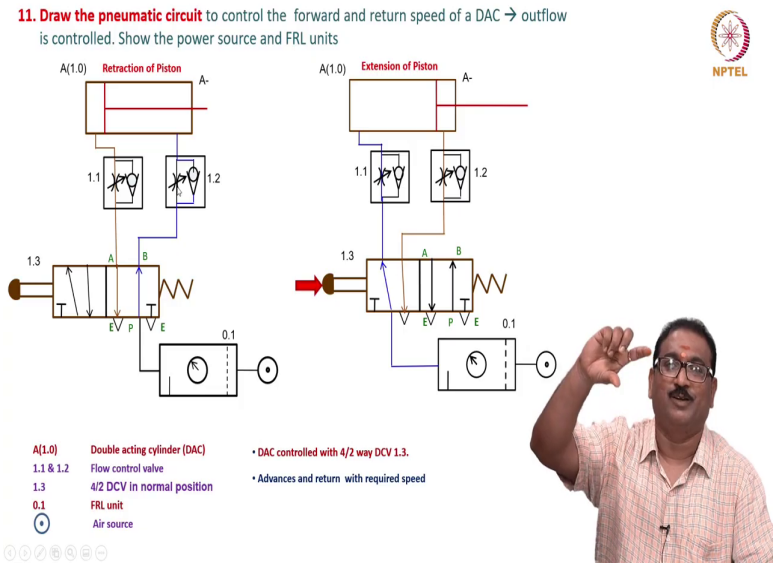

Next, draw the pneumatics circuit to control the forward and return speed of the double acting cylinder here, outflow is controlled. Show the power source and FRL unit. How to do here? Both forward and return should be controlled, but outflow is controlled. How to do? See here, the position of the check valve will matters.

You will see here, retraction of the cylinder always as I have told you, power source come here, how it will go here friends? It will bypass, see here, it will pass through the check valve here. Inlet is not controlled, then here outlet you will see when it will push, the outlet will come here, come here, how it is? It will not pass through the check valve; it will pass through

the metered orifice. Outflow is controlled; it will retract very slowly even though flow is coming here completely.

Similarly, these are the component list you have to do, always we have to list the component, what are the component you are using? Then, when you will press this button, what happens friends? You will see here, it will come here, again the inlet is bypassed through the check valve, it will go here, not through this, it will go here.

Then, return flow is always again through the metered orifice that is why it is outflow is controlled. If they are asking inflow is controlled, reverse these two valve in the other direction ok.

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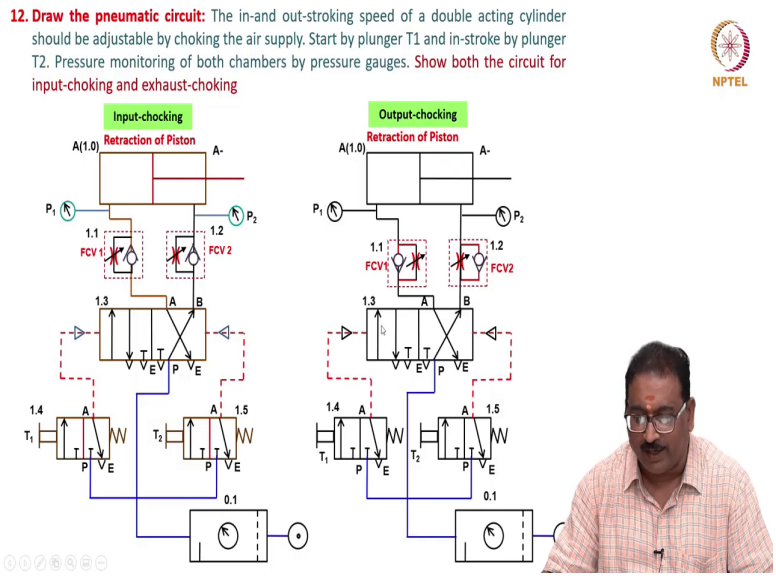

Now, we will see draw the next problem; next problem it is. Draw the pneumatic circuit. The in and out stroking speed of a double acting cylinder should be adjusted by choking the air supply. Choking means by controlling the air. Start by plunger T1 and in stroke by plunger T2.

If we will press T1, it will extends, T2 retract, but you have to control the speed. Pressure monitoring of both chambers by pressure gauges. Show both the circuit for input choking, controlling the only input and exhaust chocking, both circuit you have to do. How to do?

See here, I am drawing the input choking here. Same way here, you will see here it is a pilot operated valve which is controlled through the 3 by 2 correct plungers T1 and T2. T1 for actuating the left pilot and right pilot is for the T2, one for extension, one for retraction, but you will see the inlet choking it is inlet.

Now, you will see for example, if I will press the T1, what happen? The air will come here, it actuates. Then, what happens? The this will connect here, it will come here, it will enters, now it will not pass through this, it will only pass through the metered orifice head side, it will go. Return flow, it will not pass through the metered orifice because direction you will see, lift the ball and then, it will go to the tank here meaning what is controlled here? The input choking is taking place, see the position.

Now, output choking, reverse, you will see nothing else change only I am reversing the valve. Now, you will see for example, if we will press T1, what happen? The flow will come here, it actuates this position. I have not drawn the position, you have to draw it and you will see correct, you have to draw ok; you have to see the position. Output choking, how it is?

Same. If will comes here, it will now you will see the bypass, the output flow is through the metered orifice, very simple friends, correct only directions of the FCV1, FCV2 matters ok.

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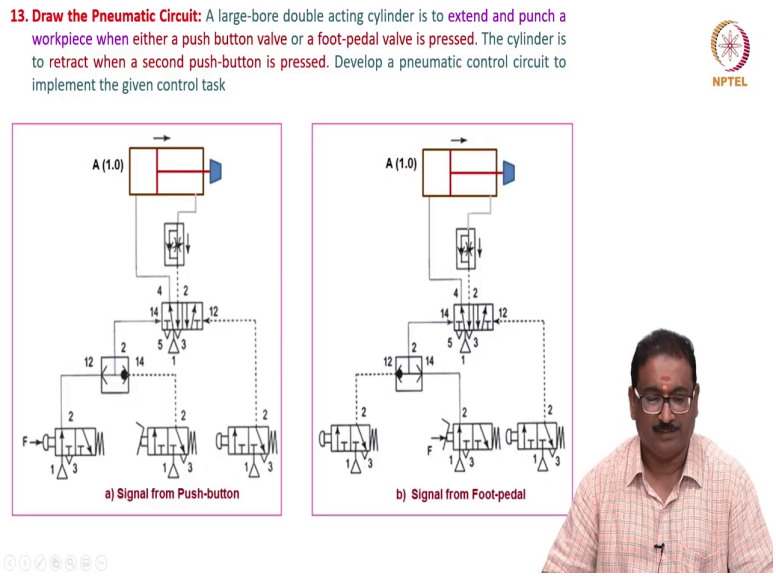

Now, we will move on to the 13th circuit. Draw the pneumatic circuit. A large-bore double acting cylinder is to extend and push a workpiece when either a push button valve or a foot-pedal valve is pressed. Any one is pressed, it should out stroke. The cylinder is to retract when a second push button is pressed. Develop a pneumatic circuit to implement the given control task. How to do this? You will see, now I am using the shuttle valve here.

This shuttle valve will operate with push button or a pedal operated. If we will press this p, now we will see the air is receiving here, actuating this. The pneumatic air will come here, it will extends. Even though, you will press for example, if you will press this button, what happens? Foot pedal, now I foot pedal, it will come here, again it will extend. Meaning here, I am using the shuttle valve, OR function it is doing.

When we will press this button automatically, it will retract please remember friends. When you will press this, what happen? Air will come here, it enters to the tail side, it will retract, very simple circuit it is.

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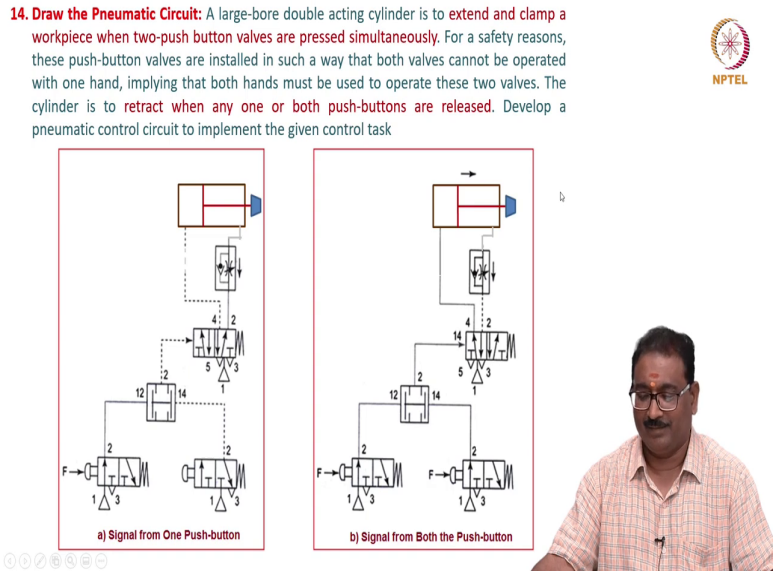

Now, 14th one. Draw the pneumatics circuit. A large-bore double acting cylinder is to extend and clamp a workpiece when two-push buttons are pressed simultaneously, then only it will work otherwise no. For a safety reasons, these push button valves are installed in such a way that both valves cannot be operated with one hand, implying that both hand must be used to operate these two valves.

The cylinder is to retract when any one or both push buttons are released. Develop a pneumatic controls circuit to implement the given control task. Meaning, now I am using the AND function valves, you have to operate both. See how it is. This is a what a double acting

cylinder used for you know clamping and pressing the job here, same here flow control valve to controlling the speed.

Now, we will see friends, if will press this, it will not actuate. If we will only press this, only it will not actuate. You have to press both, you will see both you will press, then only here. Now, we will see what happen? Air will connect here; it will start extending. Whatever the air is there, it will come here, it will pass through the controlled way, it is pushing please remember friends correct.

Meaning here, this is a AND function valves, if will press both, then only it will extend otherwise no. You will press any one, again it will shift to the null, again it will back to the normal positions.

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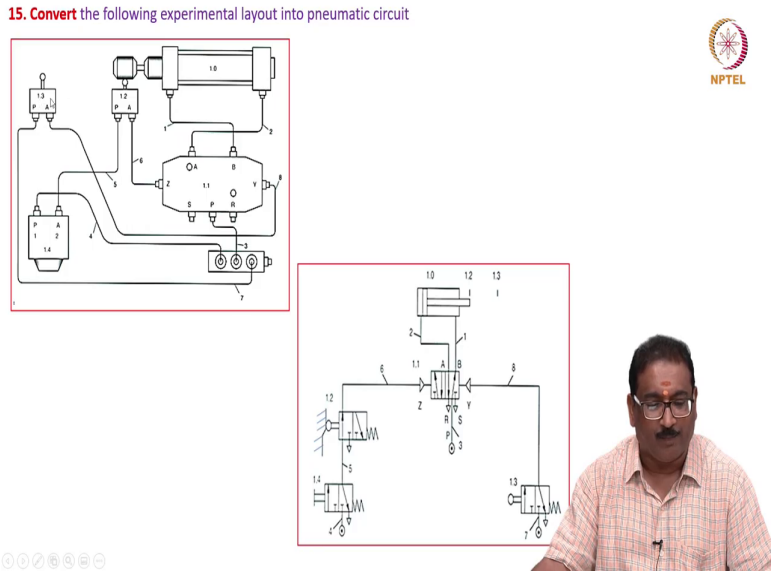

Now, sometimes in industry, how to convert this experimental layout what I am giving here and given here, see the you will see the parts, here double acting cylinder it is 1.0, two parts are there, then initial position is monitored and 1.2 is a valve sensor, 1.3 is also sensor, then this is controlled through this correct friend, this is controlled through this. How to do it now? That is a question now.

You have to convert this diagram into pneumatic circuit. What is this friend? 1.2 is a double acting cylinder; draw the double acting cylinder connected through the what is this? Look here Y and Z are the pneumatic signals, pilot signals, then it is a what it is? You draw the 4 by 2 DCV connected through the pilot signals.

These two pilot signals are connected to the 3 by 2 DCV, 3 by 2 DCV correct, I am drawn here, you will see friends here very easy. It is a double acting cylinder and then, this is a pilot operated 4 by 2 DCV, here you will see it is initially it is a press fitting that is why I am connecting press fitting, but always in the retracted position until you will press, nothing will move, it will not extend.

Here also, it is a 1.3 is a position, 3 by 2 DCV, very simple. If I will give in the examination like this, you have to convert into here. This you will see friends, 1.2 and 1.3 are the retracted position and extended positions of the valves, very simple it is, very very simple.

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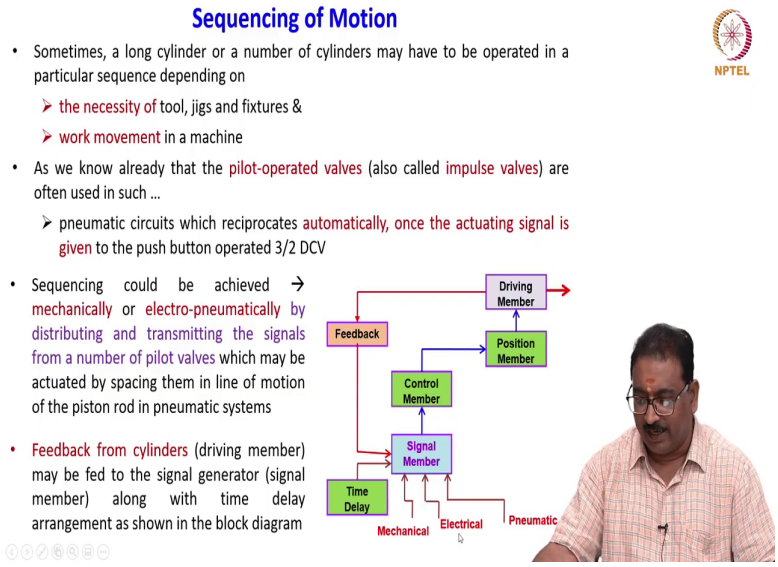

Now, quickly we will see the a one more very important thing is sequencing of motion which is very very essential when you are handling the multiple actuators. Sometimes, a long cylinder or a number of cylinders may have to be operated in a particular sequence depending on the necessity of tools, jigs and a fixtures and work movement in machine.

As we know already that a pilot operated valves are also called a impulse valves are often used in such circuits which reciprocates automatically, once the actuating signal is given to the push button operated 3 by 2 DCV, you are seen already how it is done. Sequencing could be achieved mechanically or electro-pneumatically by distributing and transmitting the signals from a number of pilot valves which may be actuated by spacing them in line of motion of the piston rod in the pneumatic system.

Feedback from the cylinder that is whatever limits switches we are putting know, we have to take the feedback to the which is a driving member may fed to the signal generator, signal member along with the time delay arrangement as shown in the block very simple it is.

Sequencing of motion you will see, it is a signal member which works on the mechanical signal, electrical signal, pneumatic signal with a time delay which will take this signal from the driving using the feedback, limits switches, here control member, here is a position member which will sense the energy here correct, very important and simple block diagram here, sequencing of motion.

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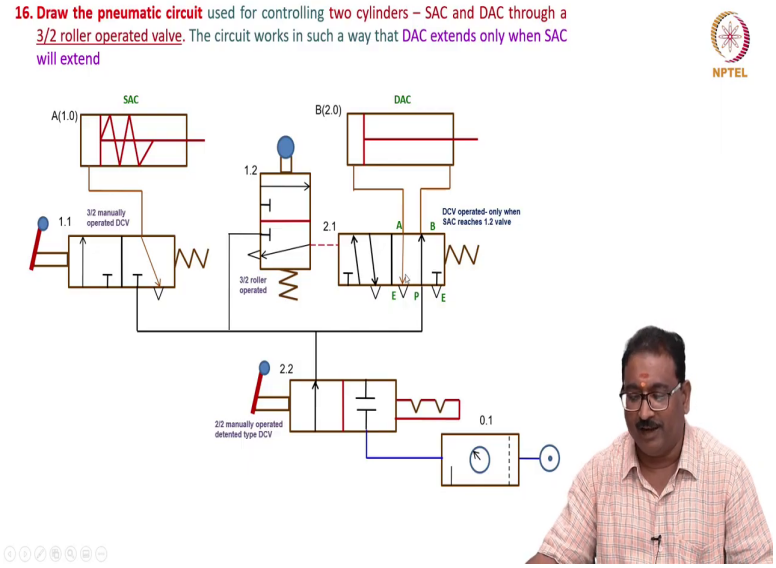

Now, I will show you one more circuit on this. Draw the pneumatic circuit used for controlling the two cylinders. Now, we will see single acting cylinder and a double acting

cylinder through a 3 by 2 roller operated valve. The circuit works in such a way that the DAC, double acting cylinder extends only when SAC will extends. You will see how it is.

The two cylinders are there single acting cylinder to a double acting cylinder. Double acting cylinder will extend only when? When A will extends, A plus will go, then only the B plus otherwise no, then we require to monitor the extension of the single acting cylinder. How to do it now? Very simple friends.

I have used a single acting cylinders, spring return which is controlled through the 3 by 2 DCV and here, you will see again it is a 3 by 2 DCV, when it will hits here, then only this your DCV, pilot operated DCV I am putting, this is actuated otherwise, it is in the null position where the spring is there. Null position is always in the retracted positions correct friends. Now, how it operates? I will quickly I will show you here.

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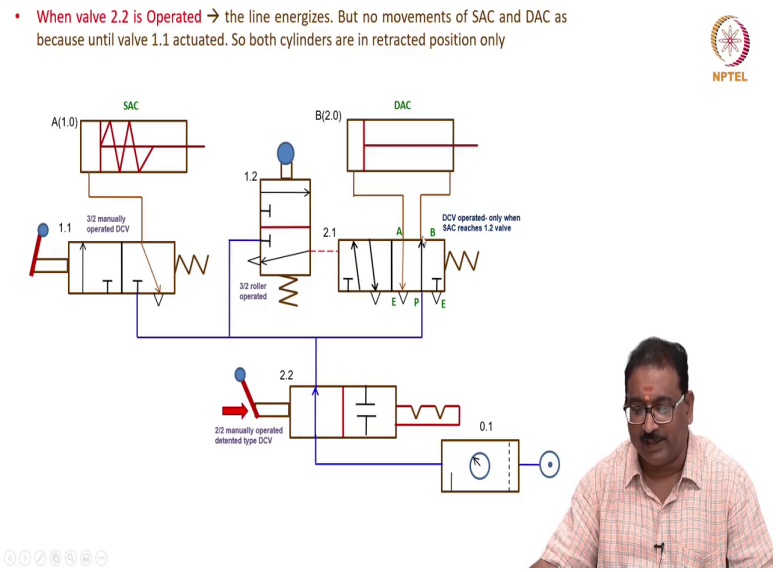

When the valve 2.2 is operated, the line energizes, main valve is there know 2 by 2 valve. But no movements of SAC and DAC as because until the valve 1.1 actuated. So, both cylinders are in the retracted position only where it is this is 2 by 2 manually operated detented type DCV, always you have to use this friends because either it will sends the flow or blocks the flow, then only line will energize, always it is a main control here whole circuit.

You will see when you will press this, the energy will come here, but it is blocked, here it is also blocked, here it will go, but it is in a retracted position only, you no need to worry it is. We all our retracted position only SAC also retracted, DAC is also retracted.

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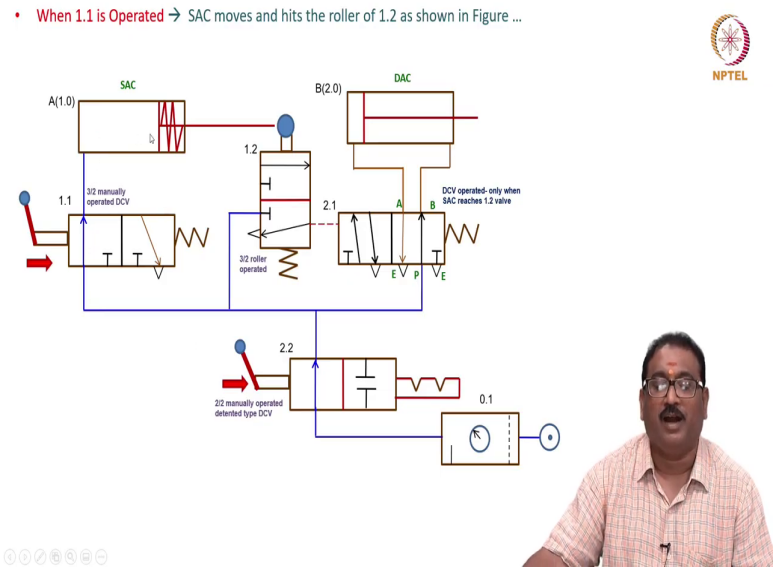

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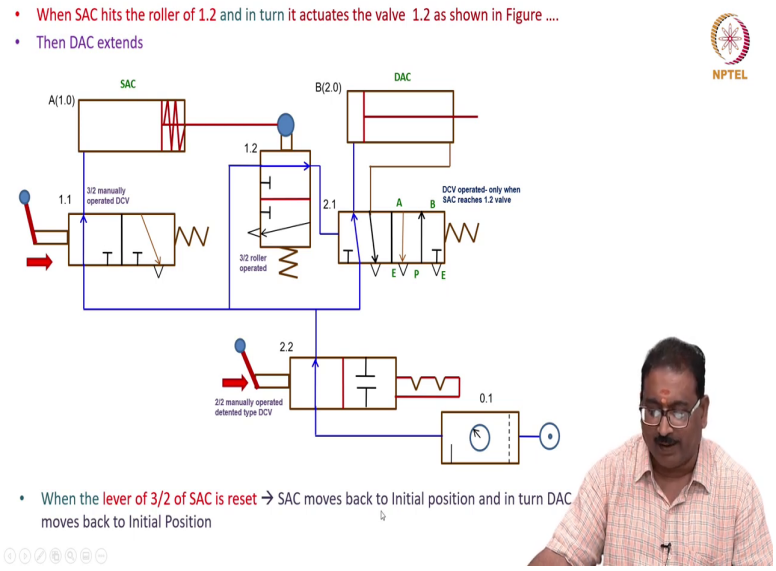

But you will see friends, when you will operate 1.1 SAC will start moving. You will move here, then energy will come here, it will starts move until what? Until it will what happen? It will hits here. When it will touches this position, what happen? Energy will come here, it will pilot signal will go here, then air will enters to the head side, it will extends. Until what? One more pressing of this, it will release correct, it will lift to the here it will retract.

Please note, whenever the lever of 3 by 2 of SAC is reset, SAC moves back to initial position and in turn DAC will move back as because it is a pilot signal will be lost then it will go to the null positions, very simple friends here.

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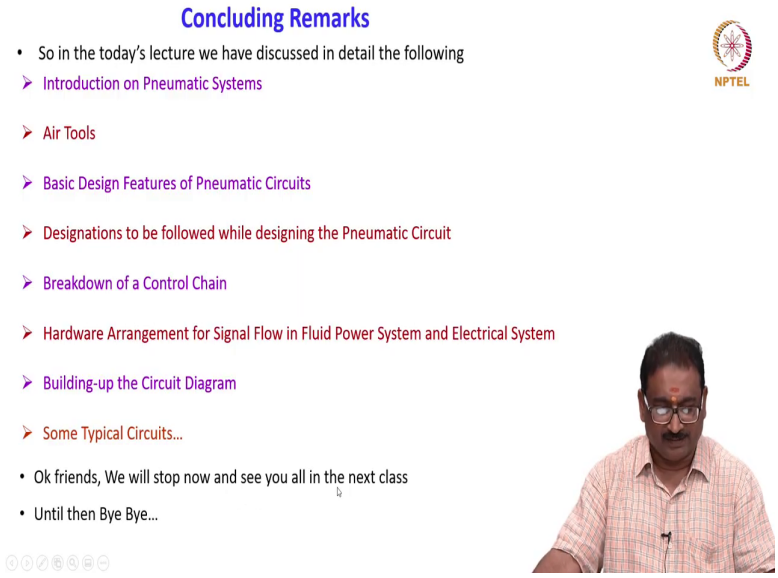

After knowing the task based pneumatic circuits how to draw, practice all the circuits in actuated position how it operates, in null position how it operates, please understand friends. Always you will draw one circuit null position, actuators are in the retracted position remember this.

So, in today's lecture, we have discussed in detail the following: introduction on pneumatic control system, air tools, basic design features of pneumatics circuits, designations to be followed while designing the pneumatic circuit, breakdown of control chain, hardware arrangements for signal flow in fluid power and electrical systems, building up the circuit diagram, how to go about it, we have seen the typical circuits for the task based.

Ok friends, we will stop now and see you all in the next class. Until then, bye bye.

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