Oil Hydraulics and Pneumatics
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Part 4: Locked cylinder using pilot-operated check valves, Pump-unloading circuit, Pressure reducing circuit, Sequencing circuit, Control of a hydraulic motors
Lecture - 73
Task Based Selection and Analysis of Oil Hydraulic Circuits

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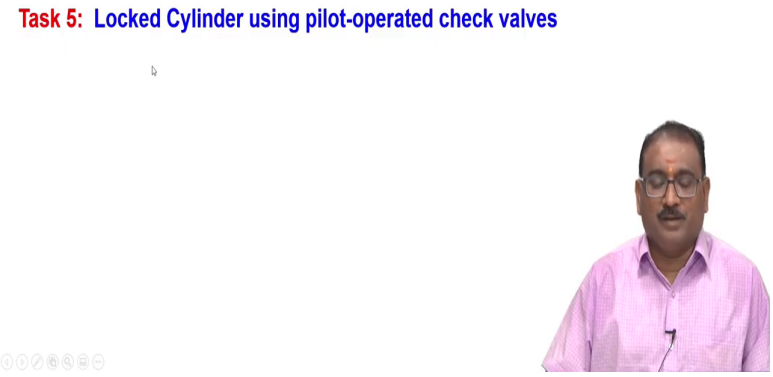

My name is Somashekhar course faculty for this course. So, now, we will see some more applications of the Hydraulic Circuits. Sometimes, we require during extension and retraction, we needs the locked cylinders. Here, we will achieve using the pilot operated check valves. Otherwise, what happen? During extension after extension, it may come back due to the leakage, losses many things.

To overcome this, what happen? The cylinder should be locked in the position. How to do this? We are using the pilot operated check valves which will ensures the locked cylinders.

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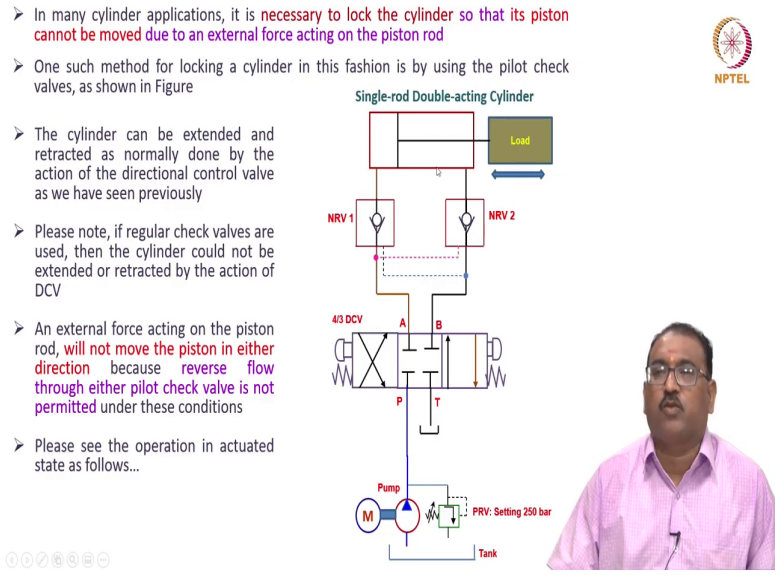

Now, we will see how it will can be achieved. As I have told you in many cylinder application, it is necessary to lock the cylinder so that its piston cannot be moved due to the external force acting on the piston rods. One such method for locking the cylinder in this fashion is by using the pilot check valve as shown in the figure.

You will see here, and again the power pack, here 4 by 3 DCV, roached neutral, then you will see here I am using the NRV 1 non return valve 1, non return valve 2 connected to the single rod double acting cylinder correct friends, but you will see the I am using the pilot signal to operate the NRV 2 from this line. NRV 1, I am using the pilot operated line to open this.

This will ensures the locked cylinder position, how it is we will see. The cylinder can be extended and retracted as normally done by the action of the direction control valve as we have seen previously nothing else it is. Please note, if the regular check valves are used here, instead of the pilot operation what happened? Then the cylinder could not be extended or retracted by the action of DCV.

As because if you will use NRV, simple NRV, then the pump flow will come for example, if you will push this pattern, pump flow will come here, but here it is locked position. But here, if you will use pilot operated, this will be get open when the sufficient pressure is builds here that is a beauty of pilot operation things.

So, an external force acting on the piston rod, will not move the piston in either direction because the reverse flow through either pilot check valve is not permitted under these conditions. Please see the operation in the actuated state as follows. Always you have to draw the circuit in the null position meaning no flow to the actuators.

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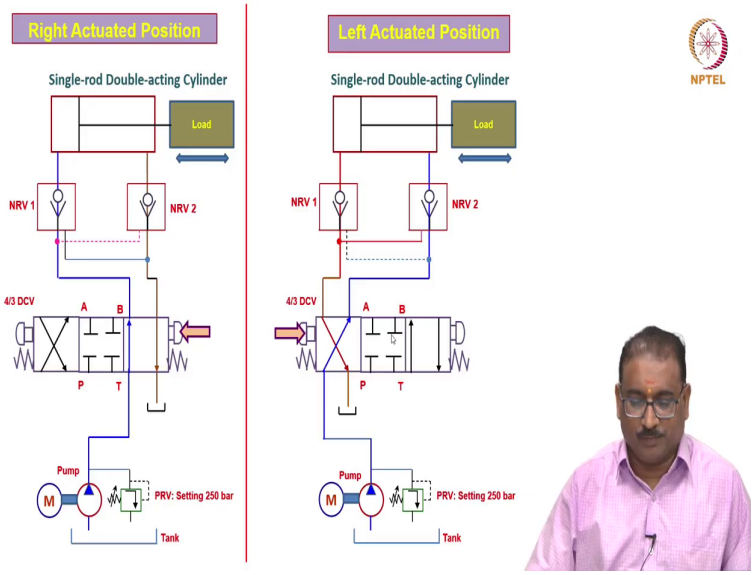

Now, we will see when I will operate the right side of the DCV button by pushing this button, you will see the pump flow is entering here and then, it will lift the ball and it will goes to the head side, then it will goes to here, but why it is opened? After building the pressure here, pilot lines are coming here sensing, then it will lift, then the return flow is taking place.

Similarly, you will see when you will press the left side of the DCV to get the crossed configuration, now the pump flow will go to the tail side, whatever the flow is there at the head side, it will come here when it will open?

After building because the pilot lines are there here, you will see it will lift, this pilot line is actuated ball will be lifted, then the flow is going to the tank. But when you will shift here,

what happens? Middle position, the cylinder will be locked in the any positions that is a beauty of this circuit.

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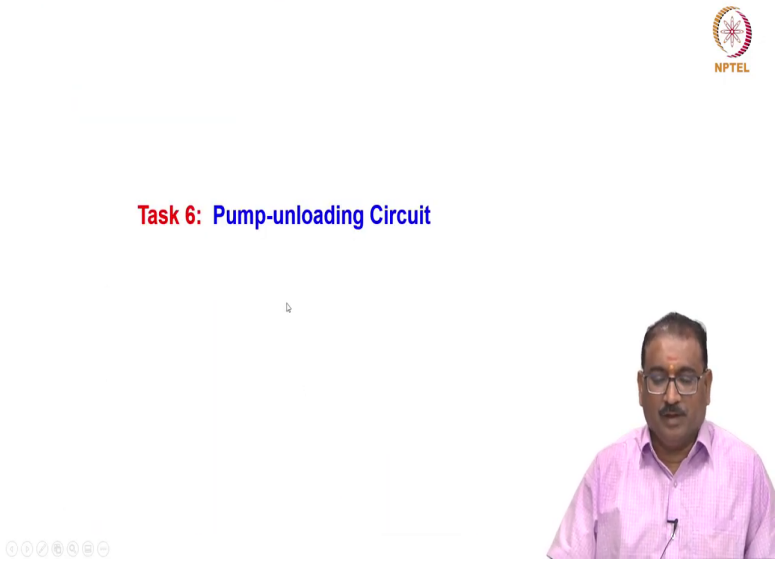

Now, we will see the pump unloading circuit. Sometimes, what happen when the cylinder will extends the pressure starts building where what we are doing generally? We are safeguarding the pump by providing the PRV. But sometimes for example, in the punching operation, bending operation that time, the cylinders are somewhere else you know the large stroke is required, very high speed of the RAM is required.

Then after reaching the workpiece we have to slow down the speed. In such cases, the pump unloading circuit plays a major role. Let us we will see now.

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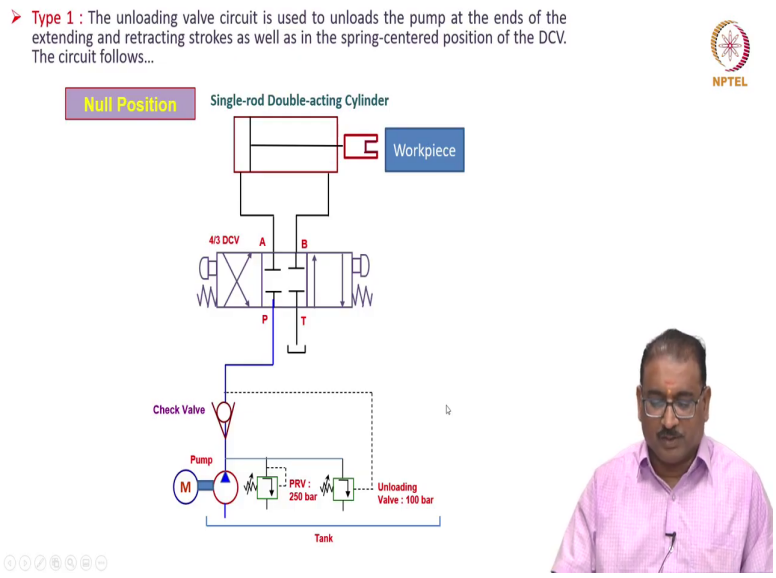

I am showing you different cases here, type 1 is the unloading circuit is used to unload the pumps at the ends of the extending and retracting strokes as well as in the spring-centered position of the DCV. The circuit looks like this, you will see the null position. It is a single-rod double-acting cylinder. Again here, 4 by 3 DCV, middle position is connections are shown here.

Then here, you will see friends, here I am using the two valves here; one is unloading valve, here I am setting the unloading pressure rating as 100 bar, then one more is there pressure relief valve which is set at the 250 bar. Now, we will see here unloading valve will reads the pressure from the other lines, see here it will reads line. Now, it will how it will operates, I will show you unloading valves and PRV when it will operates.

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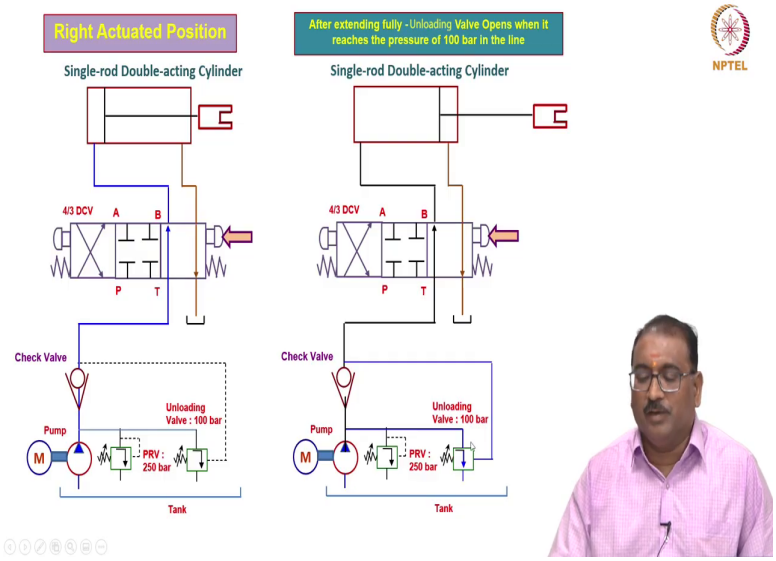

Now, we will see right actuated button when we will press this, what happens friends? The pump flow is coming here, then it will enters the head side, then piston is starts extending whatever the flow is there coming here and it will go here. Meaning what here, the pump air flow is completely exposed to the head side, then it will move very fast.

Now, we will see after extending fully, unloading valve opens when it reaches the pressure of 100 bar in the line, you will see when 100 bar is reached this line as I have told you fully extension, then what happens? The unloading valve it will shift get open, then what happen? The pump flow is coming here it is unloading here through this until you will shift the valve.

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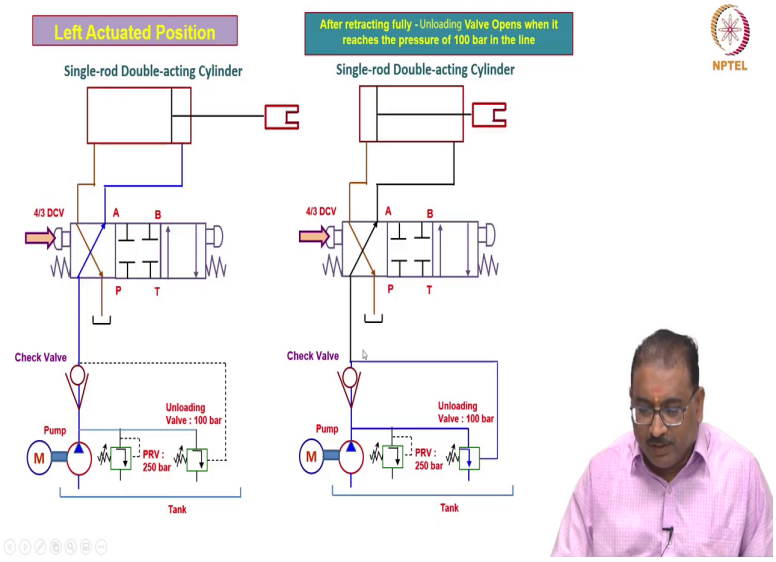

Now, we will see when you will press the left button of the DCV, then immediately what happen you will see, the pump flow is coming to the tail side, then it is pushing. The whatever the flow is there at head side, it will goes to the tank. But you will see friends after retracting also fully, the unloading valve opens when it reaches the pressure setting here 100 bar which is less than the PRV.

Once it is reached in this line, what happens? The pump flow is not going to the circuit, it will bypass through the unloading valve. The unloading valve pressure here it is less than the pressure relief valve. What for it is? As I have told you, when it is extending completely, we have to bypass the flow through the unloading valve.

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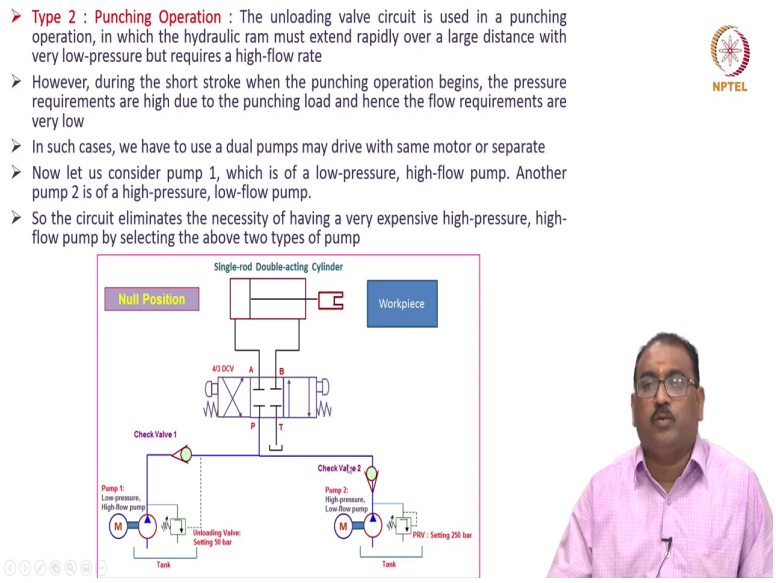

I will show you how it operates in the punching operation same circuit, but you will see here the unloading valve circuit is used in punching operation in which as I have told you the hydraulic ram must extend rapidly over a large distance with a very low pressure, but requires a high flow rate, fluid is required because I want to move very fast because no actions during the until it will reaches the workpiece.

However, during the short stroke when the punching operation begins, the pressure requirements are high due to the punching load and so many resistive forces and hence the flow requirements are very low. In such cases, we have to use now I am showing you I am using the dual pumps may drive with the same motor or a separate motor.

Now, let us consider the pump 1, which is of the category low-pressure, high flow pump it is and another pump 2 is high-pressure and a low flow pump which is required during the

punching operation or bending operations whatever it is. After reaching the workpiece actual thing will starts, very shorter distance it will move with very high pressure to complete the task.

See now the so, the circuit eliminates the necessity of having the very expensive high-pressure, high flow pump by selecting the above two types of the pump to serve the same purpose, let us we will see now how it is. Now, we will see friends here and first pump 1 is a low-pressure, high flow pump.

Here, pump 2 is a high pressure, low flow pump, it will produce low flow. Now, I am using the check valve 1 and check valve 2 to separate this one and this one. Now, we will see friends here again I as I have told you unloading valve, here I am setting pressure is 50 bar, but you will see here PRV setting is greater as I have told you 250 bar. Now, we will see how they will operate in the actuated positions.

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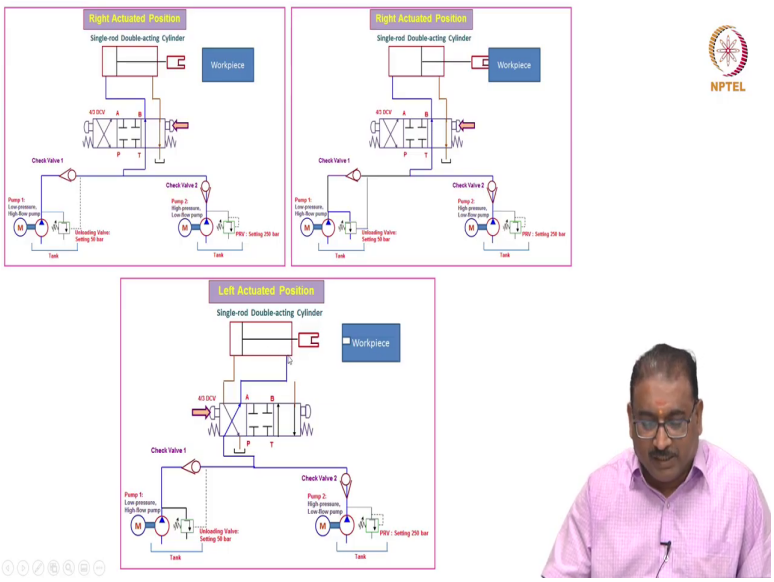

Now, we will see when I will press the right side of the DCV, what happens? The actuator head will receives the flow from the low pressure, high-flow pump as well as the high-pressure, low flow pump meaning the large quantity of fluid is entering the head side, it will move very fast.

After reaching the workpiece for punching or whatever the operation, the pressure starts building in the head side. Once it will reaches the 50 bar where you are setting in the unloading valve, it will get opens see here, flow is standing here that time actual punching operation is required, then what happens? It required the very low flow-rate which is supplied by the low-flow pump, pump 2 is sending the flows.

But this check valve 1 will isolates from the circuits because the fluid will not enters to the pump 1 inlet that is why this check valve will do the purpose, then what happens? It will

completes the work with a shorter stroke with high pressure. As high pressure because setting is 250 bar, no need to worry.

When you will press the left side button, automatically what happen you will see? The tail side of the piston is subjected to the flow from the high flow pump and a low flow pump, then it will retract very fast after punching the workpiece. Meaning, these are the unloading valves are very very essential. These unloading valves like a pressure relief valve both are closed, but unloading valve will monitor the pressure from the other lines of streamlines.

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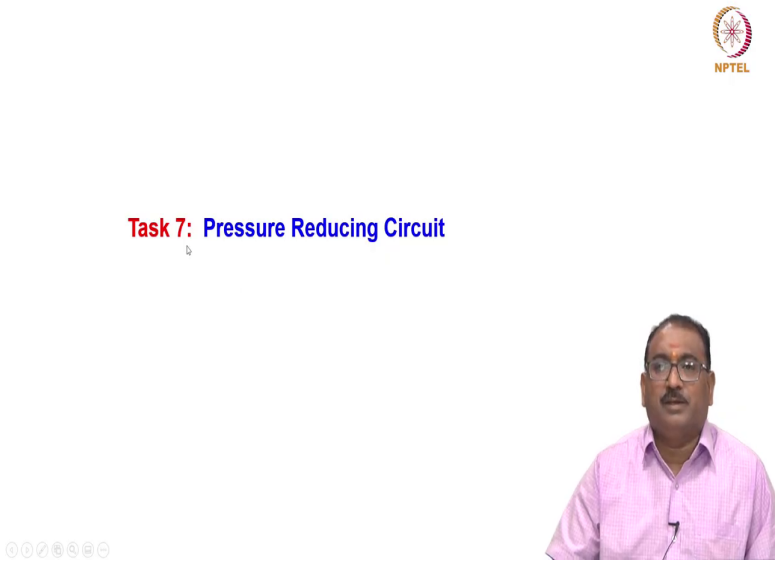

Now, I will show you one more task, pressure reducing circuit. This is very much essential when I am having the only one power pack of higher rating 250 bar, I want to send the, maintain the pressure in the different lines, each lines is operating as 50 bar, 100 bar, you

know 150 bar like this, how to do it this? Using the pressure reducing valve. How it will operates? We will see.

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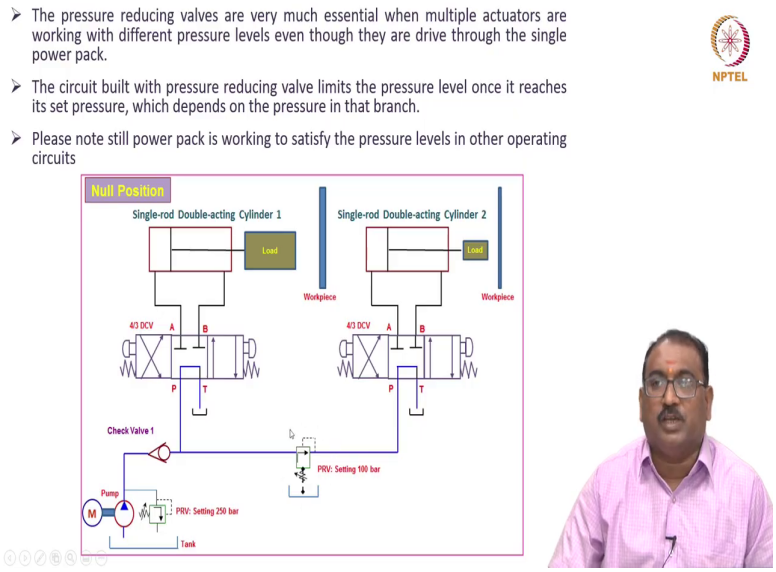

The pressure reducing valves are very much essential when a multiple actuators are working with the different pressure levels even though they are drive through the single power pack. The circuit built with the pressure reducing valve limits the pressure level once it reaches the set pressure, which depends on the pressure in that circuit. Please note, still power pack is working to satisfy the pressure levels in the other operating circuits.

Now, we will see here, now I am considering here the cylinder 1 and cylinder 2, both are operating at the different pressures for example, you will see here I am using the one pressure reducing valve, I am setting the pressure of 100 bar. The pressure reducing valve, we will see friends always it is open, but you will see unloading valve, pressure relief valve all are closed

type, but pressure reducing valve is a open type, but it will read the downstream pressure to operate this valve.

Now, we will see how it operates friends, I will show you the things how it will operates.

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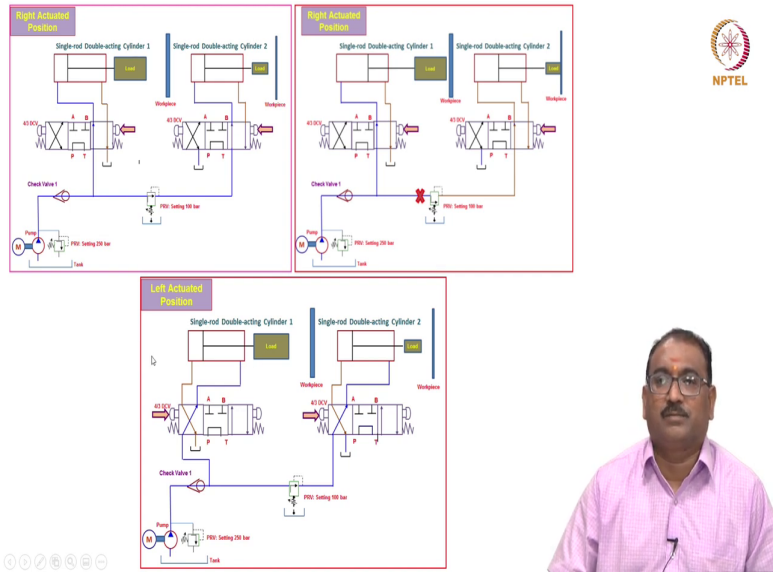

When we will press the right button of the 4 by 3 DCV, the flow is coming to the cylinder 1 see here through the parallel configuration. Similarly, here also from the parallel configuration, fluid is entering the head side, then piston starts moving, extending. Whatever the flow is there at the tank, it will go correct friends, but then piston will move very fast.

Once the cylinder 2 reaches the workpiece, what happens? Resistance start building, pressure starts building in the line correct friends. Then, what happens here? You will see from the pressure increases beyond 100 bar, then what happen?

Automatically, this will close, pressure reducing close, it will cut off the flow. But cylinder 1 is required the higher pressure, it will work until it will reaches the 250 bar where I am setting the pressure relief valve that time, this is not receiving the any flow because already 100 bar is it reached its pressure limits.

Then, please remember friends, this pressure reducing valve either two ends are subjected to the high pressure, then leakage is prone occur across the valve, then it is drain is provided. Then, once you will press the crossed configuration by pushing this button, now we will see here the both side flow at the tail side flow is coming here, see tail side flow is coming to the cylinder 2, then it will retract very fast.

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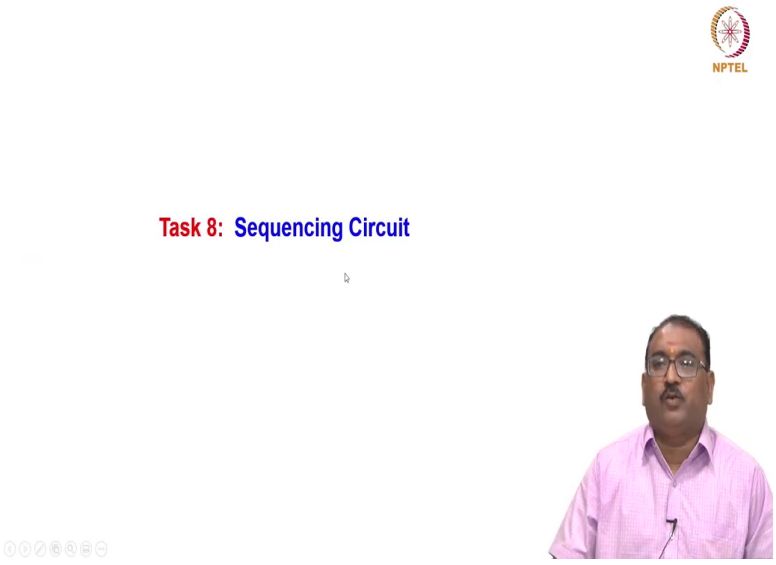

Now, I will show you the sequencing circuit, these are very very important when we are operating the multiple cylinders. Because after extending the one cylinder, then cylinder 2

will starts extending. After completing the work of the assigned, the cylinder 2 extend then cylinder 1 only extend. In such cases, we are using the sequential valve. What is this, I will show you now sequence valve.

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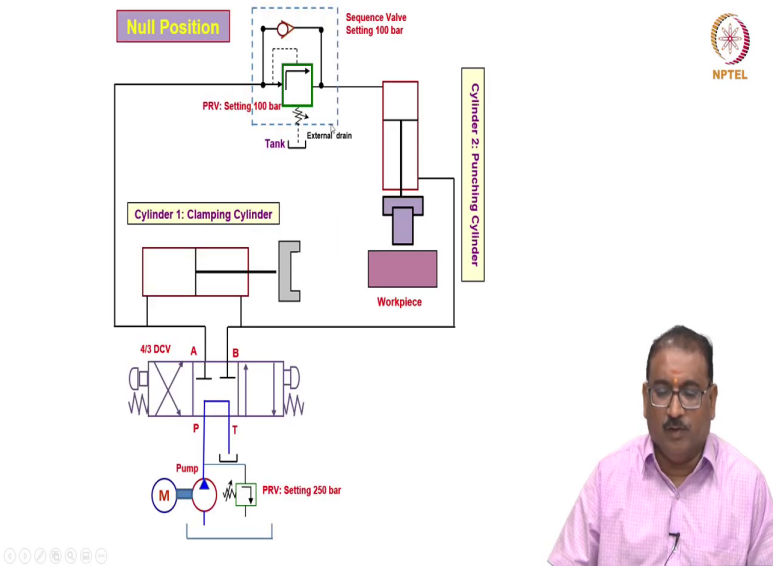

Now, you will see the sequence valve here it is I am using. The cylinder 1 and cylinder 2 are here. Cylinder 1 is a clamping cylinder, cylinder 2 is a punching cylinder. The clamping cylinder, when it will clamps the workpiece rigidly, then the punching cylinder will punch the workpiece, then it will retract, both will retract.

How I am achieving this? You will see friends here; I am using the sequence valve. The setting pressure here it is I am doing the 100 bar; it is a closed type. What is this we will see the sequence valve is nothing but is the pressure relief valve integral with the check valve correct nothing else it is.

Now, we will see as usual, I am using the DCV to direct the flow to the head side or a tail side based on the parallel configuration or a crossed configuration and this is a power pack. Power pack I am setting here the pressure relief valve is a the system pressure, maximum pressure I am setting 250 bar here, but here I am setting the pressure setting for the sequence valve is how much? 100 bar.

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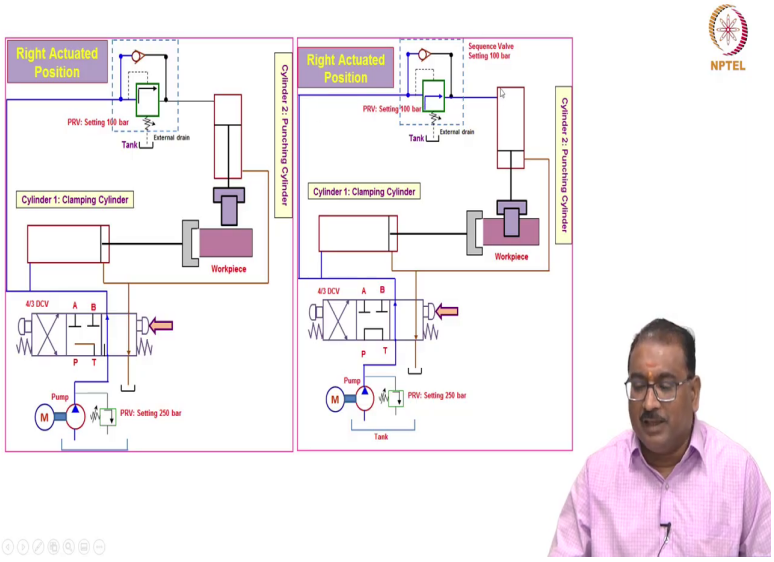

Now, we will see how it operates. When we will press the this button, push button, then what happens? The pump flow is coming here, it will enter to the head side of the cylinder 1, then piston start moving. But same flow is coming here, but you will see here the valve is closed, also your check valve is not allow the flow.

Then, you will remember friends only the cylinder 1 extends and holds the workpiece. Once the pressure starts building here, then after reaching the 100 bar in this line, this valve will get

opens. In the right actuated position only I am showing you, please remember. Once it reach 100 bar this will opens, then the cylinder 2 is extending to do the punching operations.

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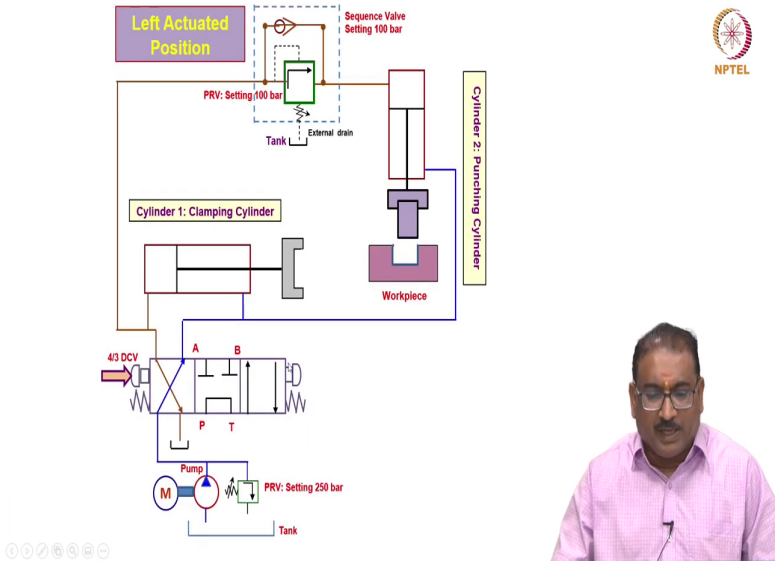

After doing this, when you will press the left actuated button, what happen? The flow is coming here, entering to the tail side here and also the flow is coming here, entering to the tail side. Then, what happens? Cylinder 1 will retract very quickly because the pump flow is experiencing to the tail side. Here also you will see the head side flow when it will move up, head side flow is bypassed through the check valve, then here, then it is going to the tank.

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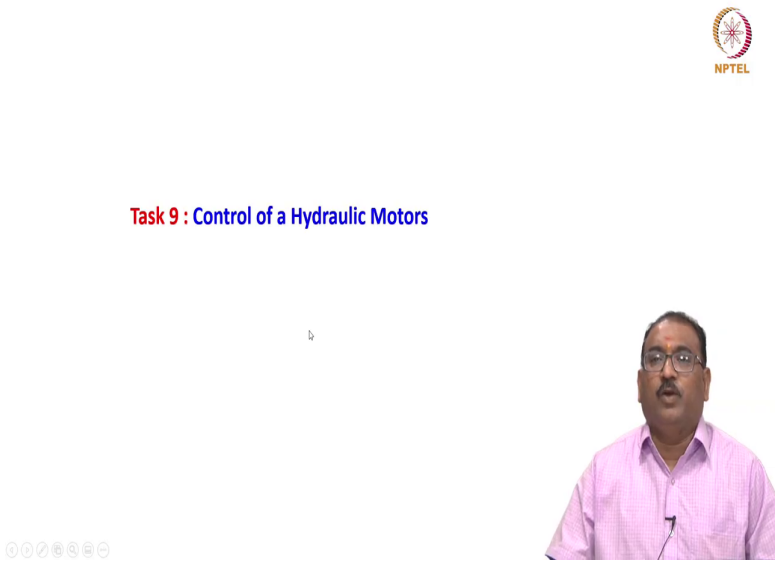

Now, we have seen the cylinder circuits many. Now, we have quickly we will see the control of hydraulic motors directions. If you will use a bidirectional motor, it is rotating in the clockwise directions. Then, you want anticlockwise direction, we have to use the suitable valves. Similarly, you have to control the speed of the motors similar to the cylinders, same you know flow control valves here also we are using.

I will cover some of the circuits for the hydraulic motors, but complete discussion on the hydraulic motors, we are discussed in these details in the when we are starting the HST Hydro Static Transmission. Completely on the hydraulic motors, we will see many circuits in that topic, but I will show you here some of the circuits.

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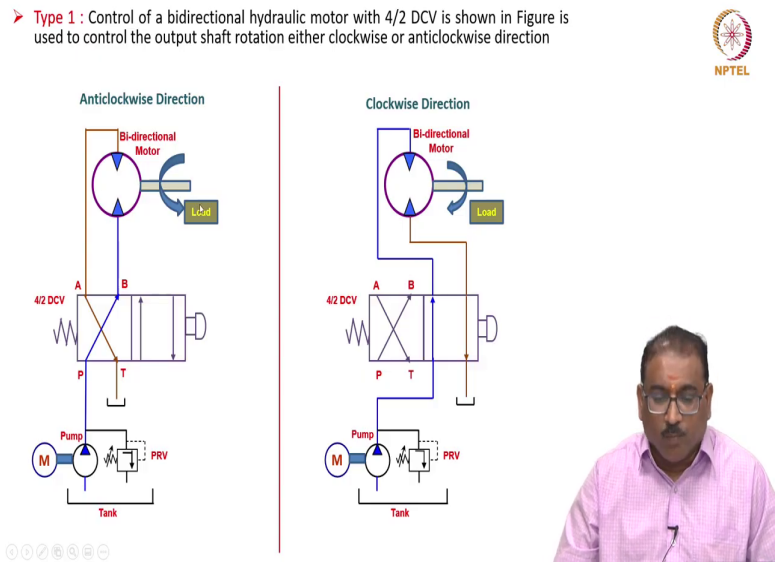

The type 1 here I am showing you. Control of bidirectional hydraulic motor with a 4 by 2 DCV as shown in the figure is used to control the output shaft rotation either clockwise or a anticlockwise direction as you required only direction control it is. You will see 4 by 2 DCV, it is a null position, the flow is sending to the one side, other side flow is taking to the tank, then it will rotate in the one directions.

Based on the pressure, you will get the torque, based on the flow rate, you will get the speed correct friends. Please remember friends, when I am using the 4 by 2 DCV, in either position the motor is rotating clockwise or anticlockwise. To keep the closed control over the circuit, always here you will put one valve what you will call the 2 by 2-way valve manual operated. After operating this one only, the line will get energized.

All the circuits you have to put one 2 by 2-way valve, 2 by 2 means the flow is going or completely shut off. When you are not using, you will press the button, the flow is cut off to the entire circuit. One button is very very important, one valve is very important, you have to place it here.

Now, we will see when I will press this button, the flow is going to the one more head side, tail side flow is going to the tank, it will rotate in the other directions meaning by using the 4 by 2 DCV, you have to reverse the direction of the hydraulic motors.

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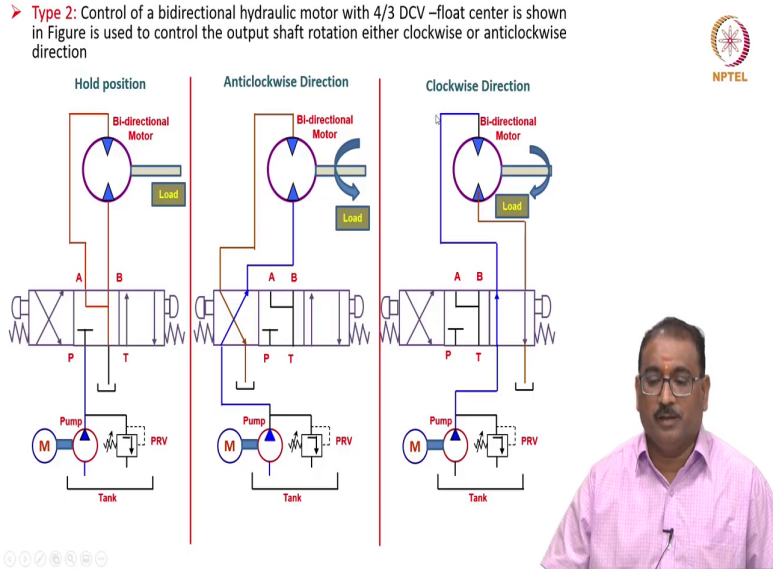

Now, as I have told you, when you will shift the left side button, motor will rotate in this direction. When it is rotating with the fluid flow, when you will shift to the center, you no need to worry for the motor as because it is you pushing the fluid out. It should be relieved

otherwise; it is a pressure pulsations are many things happening in the motor that is why it is a fluid center is very good, when you are controlling the bi-directional motors.

Either you will move from the left side to the middle position or right side to the middle position always the float neutral is very good for controlling the bi-directional hydraulic motors.

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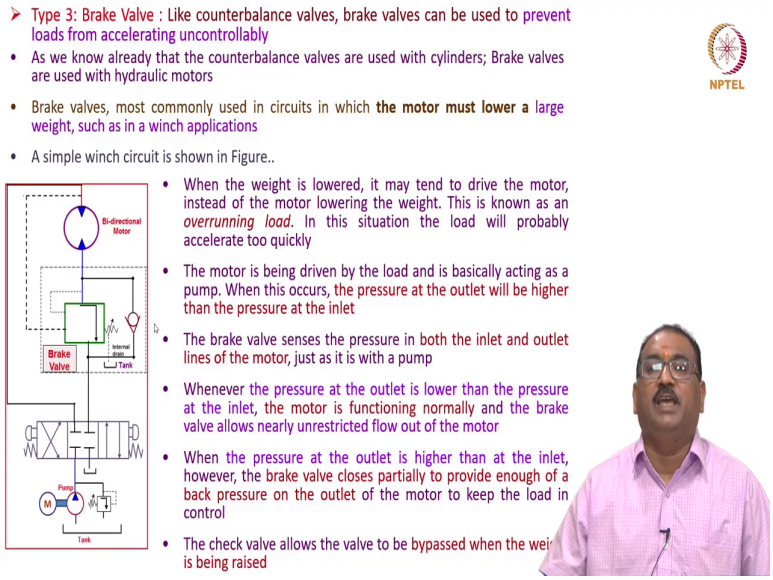

Now, I will show you the one more valve that is a brake valve. It is like a counterbalance valve; the brake valve can be used to prevent the loads from accelerating uncontrollably. As we know already that the counterbalance valves are used with the cylinders, brake valves are used with the hydraulic motor same it is.

Brake valves most commonly used in circuits in which the motor must lower a large weight, such as in the winch applications. A simple winch circuit is shown here. See here, this is a bi-directional motor, both from the both side pressure is monitored here by head side as well as a tail side, it is monitored. Here, it is a brake valve; brake valve is nothing but your counterbalance valve.

But you will see here, it is a pressure relief valve integral with the check valve correct. Always, it is subjected to the pressure on either side that is why it is always internal drain is provided. Now, I am using here 4 by 3 DCV closed neutral. When the weight is lowered, it may tend to drive the motor, instead of the motor lowering the load. This is known as an overrunning load. In this situation, the load is will probably accelerate too quickly.

The motor is being driven by the load and is basically acting as a pump. When this occurs, the pressure at the outlet will be higher than the pressure at the inlet. The brake valve senses the pressure in both the inlet and the outlet lines of the motor, just as it is with the pump. When the pressure what happens whenever the pressure at the outlet is lower than the pressure at the inlet, the motor is functioning normally and the brake valve allows nearly unrestricted flow out of the motor.

When the pressure at the outlet is higher than the inlet, however, the brake valve closes partially to provide a enough of a back pressure on the outlet of the motor to keep the load in control. The check valves here, the check valve allows the valve to be bypassed when the weight is being raised.

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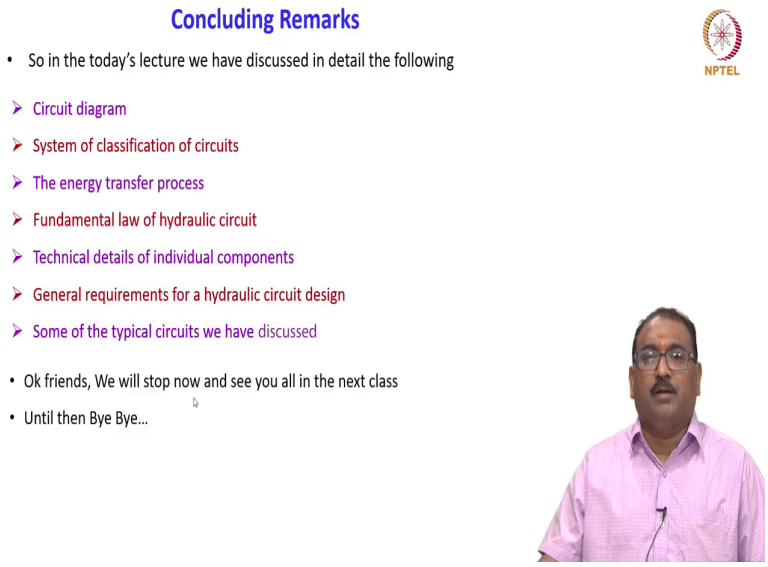

So, we have seen many circuits finally, I will conclude the today's lecture. We have discussed in detail the following: the circuit diagrams, system of classification of circuits, the energy transfer process, fundamental of hydraulic circuit, technical details of individual components, general requirements for a hydraulic circuit design, some of the typical circuits we have discussed to control both cylinders and a motors.

Motors still will discuss when we are discussing the hydro static transmissions. 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].