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

Pressure Control Valves
Lecture - 39
Part 3: Construction, Operation and Application of Pressure reducing valve, Sequence valve, Counter balance valve and Brake valve

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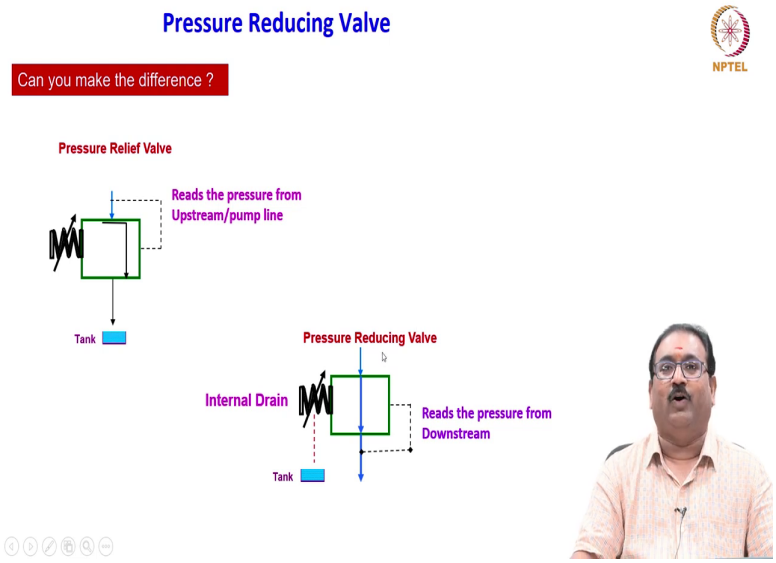

My name is Somashekar, course faculty for this course. Now, can you please tell me what is the difference between these two valve, what I have shown here? At least identify some of the features involved in the two valves. All the ISO symbol looks same friends please understand.

Here you will see this valve is a closed one, this is opened one. Now, we will see opened one then this is also adjustable type spring, this is also adjustable type of spring, this is also having the p port and t port. It is also having the p port and a t port, whatever it is, two ports are there.

But, you will see now here, here it is monitoring the pressure from the upstream. When it is measuring the pressure from the upstream to open the valve it is a pressure relief valve immediately how to tell. But, here you will see it will reads the pressure from the downstream to close the valve this is.

This is to open the valve pilot line, this is pilot line to close the valve. Correct? Then can you please tell me what is this valve? This valve is pressure relief valve. Also you will remember the both ends are subjected to the pressure differential always. Always oil will leak that is what you will call internal drain that is why it is having one more drain line connected to the tank during the operation also. This is happened due to the delta p at the valve, this is known as pressure reducing valve.

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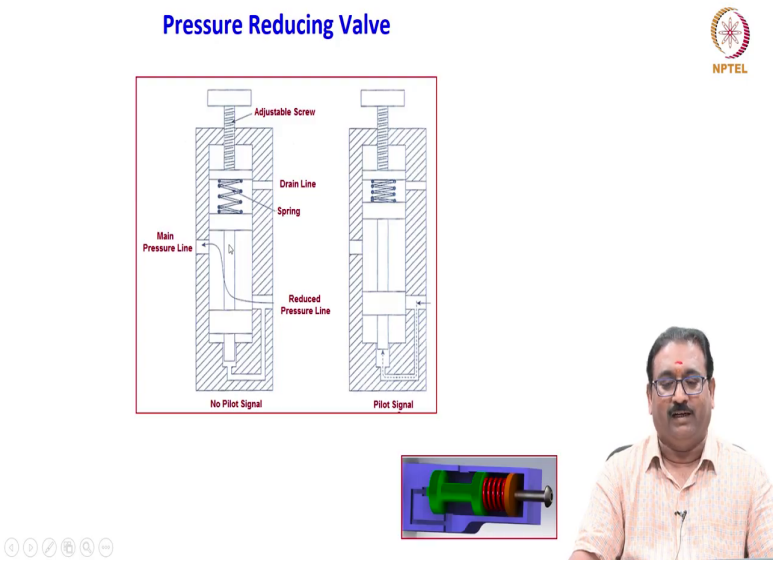

Now, I will show you the constructional future of pressure reducing valve always it is a open type. You will see now always from the reduced pressure line to main line it is always a opened. This setting again I am set the pressure how much you want. Once this pressure is increased then it will close, beginning it is opened. All looks same friends you will see when is the always it will close now it will closed.

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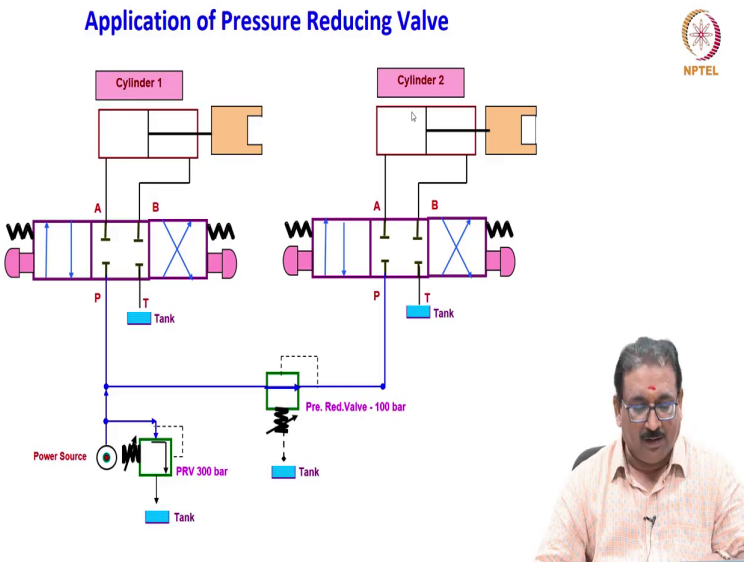

Now, you will see the one application in which I am using this pressure reducing valve here, correct and relief valve here. The pressure settings you will see here. Pressure relief valve 300 bar always a maximum pressure in the whole circuit which will controls the pump. And here you will see I am controlling the pressure in the cylinder 2 that is why I am using the pressure reducing valve here. Here I am setting the pressure 100 bar.

Can you please tell me, how it will work? Again I am controlling cylinder 1 and cylinder 2 using 4 by 3 direction control valve, the closed neutral or a center push what actuation and a spring centered valve it is. Then what happens friends? You will see when I will press this button and this button, the both the cylinder 1 and cylinder 2 receives the flow from the pump because this valve will also opened. Then as long as the pressure is below the 100 bar this cylinder 2 and cylinder 1 both receives the flow.

After reaching the destination the pressure starts building here. Then what happens? Once crosses the 100 bar what happens? This will close. Still cylinder 2 is receiving the flow from this, then it will do the complete task. This type of circuits are used simply incase of holding and pressing operation. Meaning, cylinder 2 will go and holds the work piece.

Once the pressure starts building to 100 bar no flow, it is holding that one only. But, cylinder 2 is coming from the top and pressing doing the work because it is receiving the flow until how much it is, 300 bar setting, correct. This reducing valve will restrict how much pressure you want in the branch circuit. If you want to control one more cylinder 3 for 50 bar again you will use one more pressure reducing valve.

If you will use as many as pressure reducing valve they will control the pressure level in different circuit different, different pressure, but only one power pack of the 300 bar what I have shown here.

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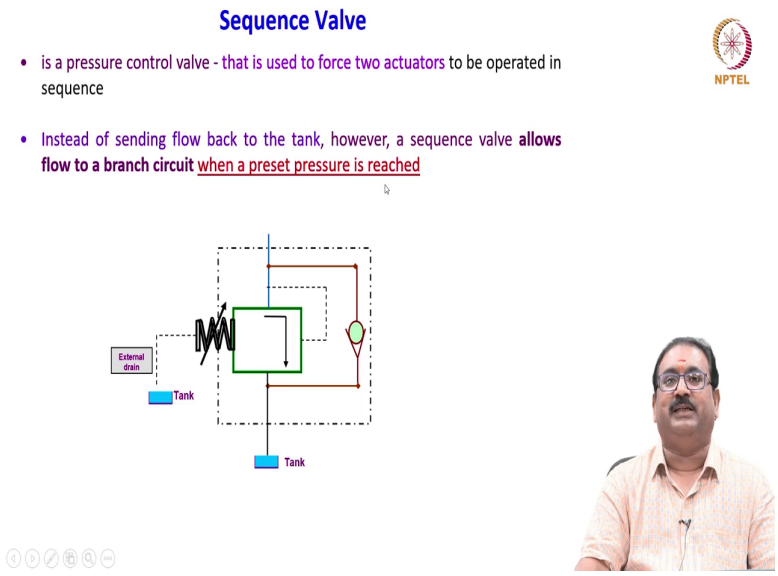

Then can you please tell me what is this, what I have shown here? Please critically see this, here it is also closed valve. Two ports are there; pressure port and tank port, adjustable type. Then you will see dotted is there, drain. External drain it is, I will tell you what is this connected to the tank.

Then what happens here? One some more thing is there friends tell me now. Here you will see one NRV is there, Non Return Valve is there which is parallelly connected here. The whole together is known as sequence valve. What is the sequence valve? This is a pressure relief valve along with the NRV is a sequence valve.

This is used whenever the sequencing of cylinder operation is required. Let us we will see. The sequence valve is a pressure control valve that is used to force two actuator to be

operated in sequence. Instead of sending flow back to the tank, however, a sequence valve allows the flow to a branch circuit when a preset pressure is reached.

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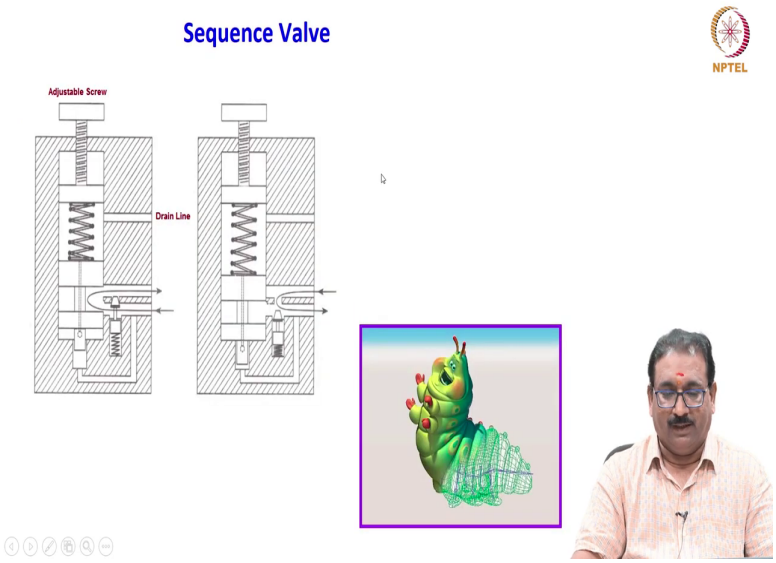

Sequence valve same here you will see here, the summarizement you know. The poppet type of arrangement is there here, what NRV arrangement, then it is similar. See in drain line is there ok, all are same here, the pilot line is coming through here. Constructional future is same, correct friends.

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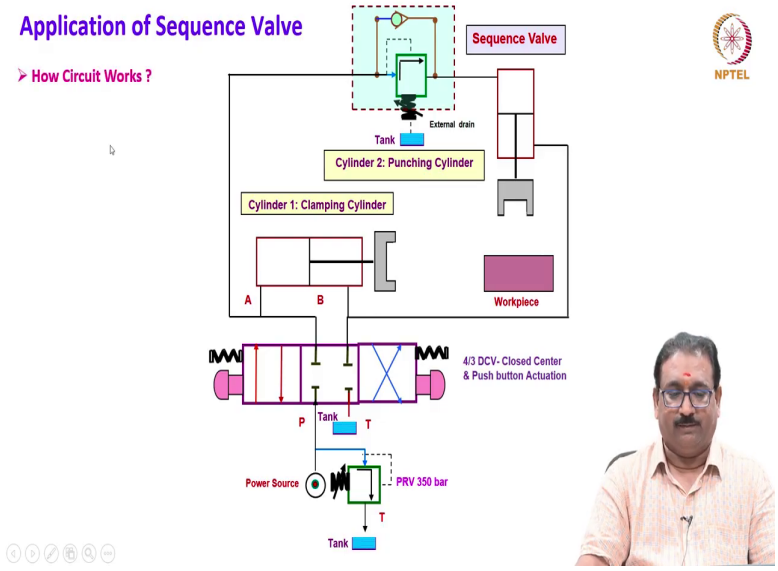

Now, let us we will see. I will explain this valve in one application. One I am using the cylinder 1, horizontally mounted cylinder, double acting cylinder and vertically mounted one more cylinder. This you will call the clamping cylinder, clamping the work piece and this is the punching cylinder. And here I used one sequence valve. Now, let us we will see friends how this will operate. Again to control this I am using the 4 by 3 closed center push button actuation spring centered valve and this is a relief valve setting.

As I have told you power source is always a pump line which is controlled using the pressure relief valve. 350 bar maximum pressure setting, it may not required, but here sequence pressure valve setting here how to do here. For example, 100 bar or 150 bar whatever you want you will set it here, this is different from this. This is controlling the whole circuits. This is controlling only for this. Let us we will see now how this will operate.

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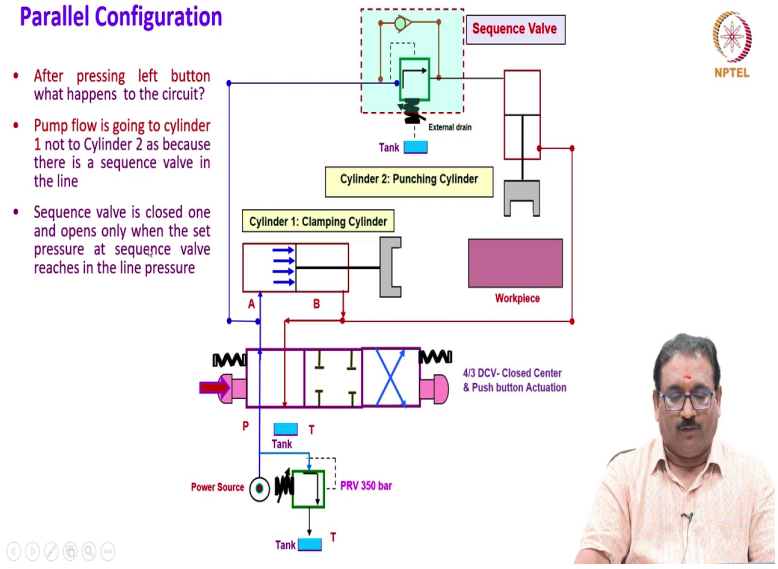

When I will press this button what happens friends? After pressing the left button what happens to the circuit you will see. As I have told you here when you will press this flow is coming here, it will go here, but it is closed valve then it will not pass through the NRV also. Then flow is coming back then only cylinder 1 starts moving in the parallel configuration. Cylinder 2 will not move then it is starts moving, correct. Sequence valve is closed opens only when the set pressure is reached.

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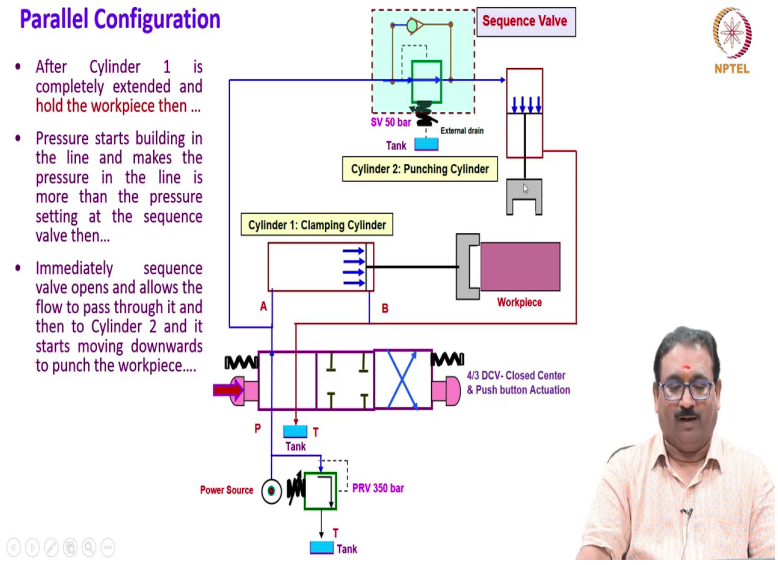

After the cylinder 1 is completely extended and holds the work piece, then what happens? The pressure starts building here in the line. The pressure starts building in the line and makes the pressure in the line is more than the pressure setting in the sequence valve. Once the pressure is higher than what you will set, valve will opens. Then what happens friends? This cylinder 2 starts moving downward, correct, cylinders two starts moving downwards to punch the work piece.

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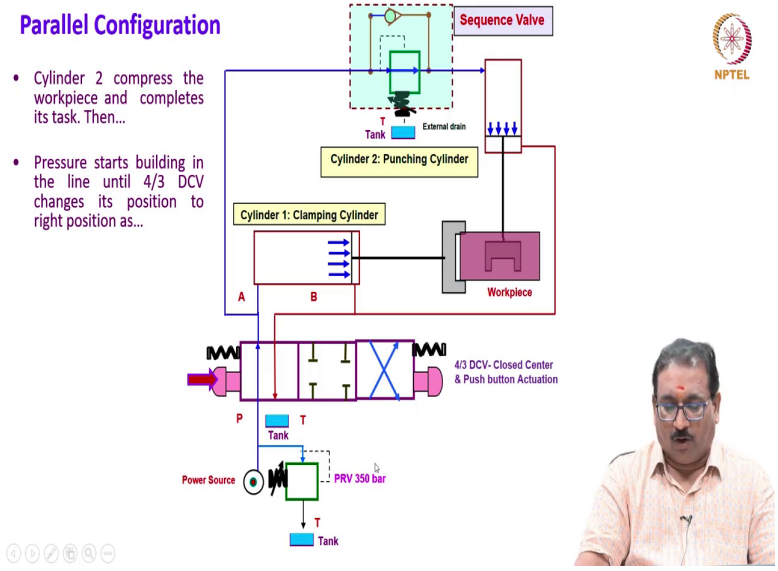

See here starts moving down. Cylinder 2 compresses the work piece and completes its task. Then what you will do now friends? Now, pressure starts building until 4 by 3 valve will change to crossed configuration. Extreme end you have to very careful. After doing the operation if you will not change here pressure start building in the line. Until how much? Until 350 bar.

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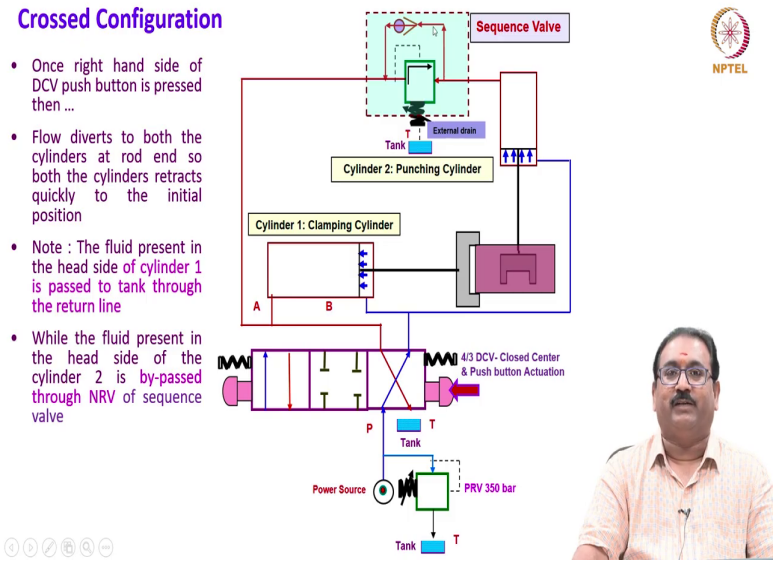

So, immediately you will push this button right button. Once the right side DCV is pushed pressed, the flow diverts to see here and the rod side it will go flow will go to the rod side.

But only one thing you will see here friends whatever the flow is there at the head side. Here in sequence valve will see it will not go through the valve, it will bypass through the NRV move very fast here. Here only through the valve whatever it is kept open, how the valve is this side? Here it will move faster than this cylinder.

The fluid present in the head side of the cylinder 1 is passed through the tank through the return line. While the fluid present in the head side of the cylinder 2 is bypassed through the NRV of the sequence valve, correct.

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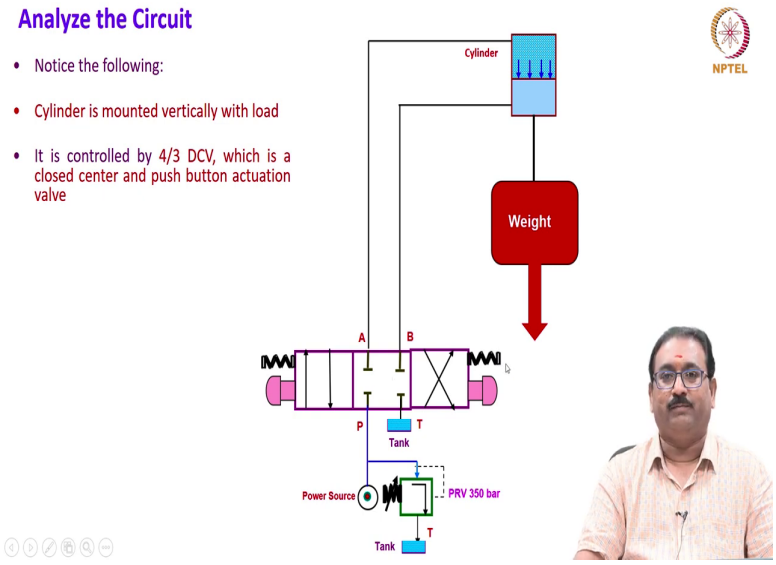

Now, can you please think now what happens now in this circuit? Now, what is there friends here? Now, double acting cylinder connected to the heavy weight I have shown you here heavy weight vertically mounted this is controlled through the 4 by 3 DCV.

And same again here the power source and a pressure relief valve. Now, please note here friends. How to analyze this? Cylinder is mounted vertically with the load. Please understand this. It is controlled by 4 by 3 DCV, which is a closed center push button actuation spring centered that is why two stiff springs at the end of this pole.

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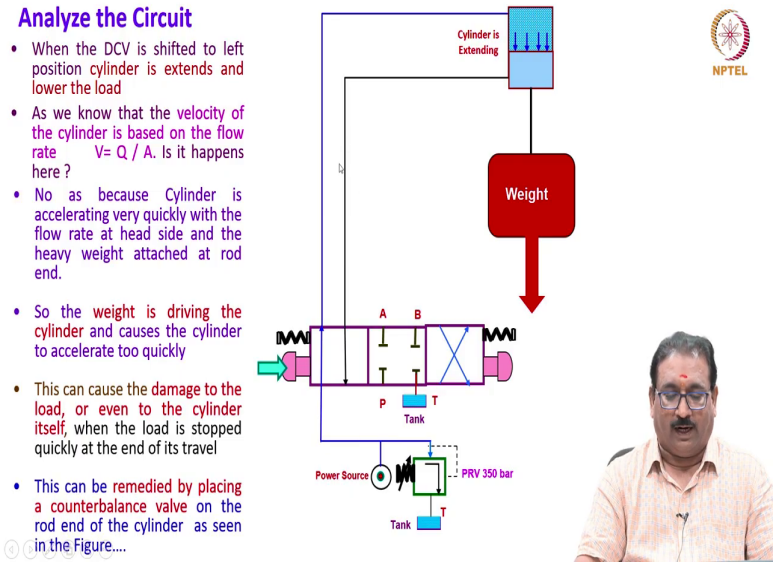

Now, what happens friends here? When the DCV shifted to the left configuration, the pump flow is going to the head side and what happens? From the tail side it is going to the tank. The load is starts should move correct. As we know that the velocity of the cylinder or the actuator is based on the flow rate this is a condition meaning what? V equal to Q by A. How much flow is coming it should move with that velocity is it happens here? No, why because the heavy load is there.

Meaning load will drives the cylinder instead of cylinder drives the load. Then it will go and hit to the ground this is not the case. See here cylinder is accelerating very quickly with the flow rate at the head side and the heavy weight attached to the rod side. So, the weight is driving the cylinder and causing the cylinder to accelerate too quickly. This can cause damage

to the load or even to the cylinder itself, when the load is stopped quickly at the end of the travel.

This is not the case, how to overcome this? This is a question mark now correct. This can be remedified by placing the counter balance valve on the rod side where you want you will see now; I am placing here the counter balance valve at the rod end as shown in the figure here.

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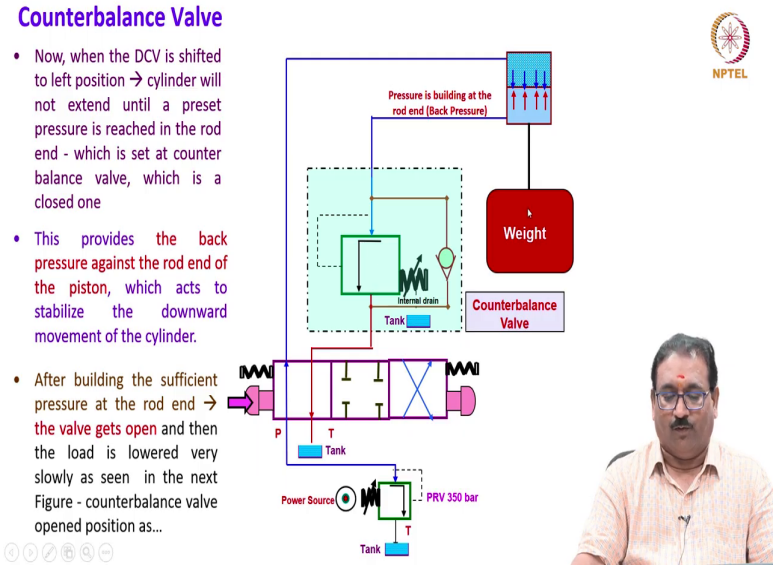

What is this you will see friends here, counter balance valve is similar to previous one. Meaning it is the pressure relief valve parallel to this NRV is there then internal drain as I have told you do a subjected to high pressure always oil will leak. The one more drain port is provided to divert the drained oil to the tank. Counter balance valve I am placing here.

Now, when the DCV is shifted to the left position, cylinder will not extend until the preset pressure in the rod side will increase as because, you will see here whatever the flow is there it will come here the valve is closed one. It will not pass through the valve or through the check valve.

Until how much pressure you are setting here in a counter balance valve how much pressure you are setting. You will create the back pressure here to lower the load very very slowly that is why, it is counter balance valve is used, which is a closed one closed type.

This provides that is why this provides the back pressure against the rod end of the piston, which acts to stabilize the downward movement of the cylinder. After building the sufficient pressure at the rod end this valve gets open correct and then load is lowered very slowly as seen in the next figure.

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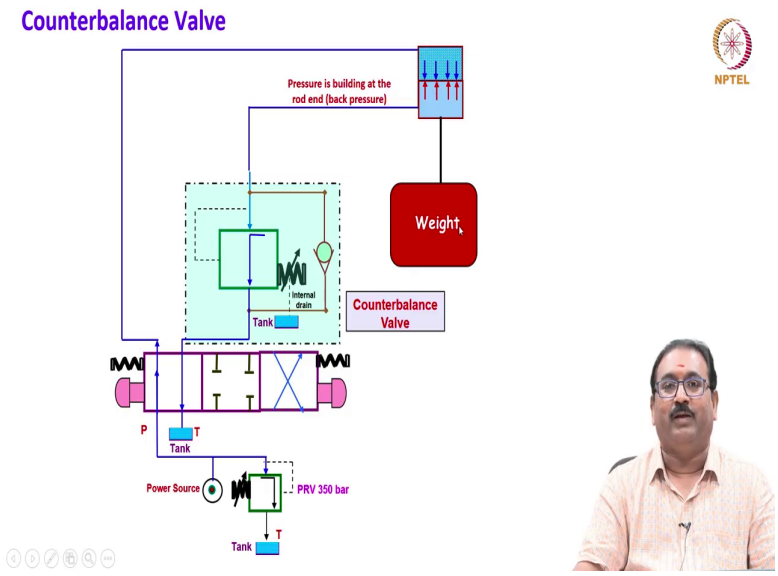

As because counter balance valve opened position you will see now it is opened. In this figure you will see the valve is opened oil is going to tank. Meaning here already the back pressure is there it will lowers the load very very slowly.

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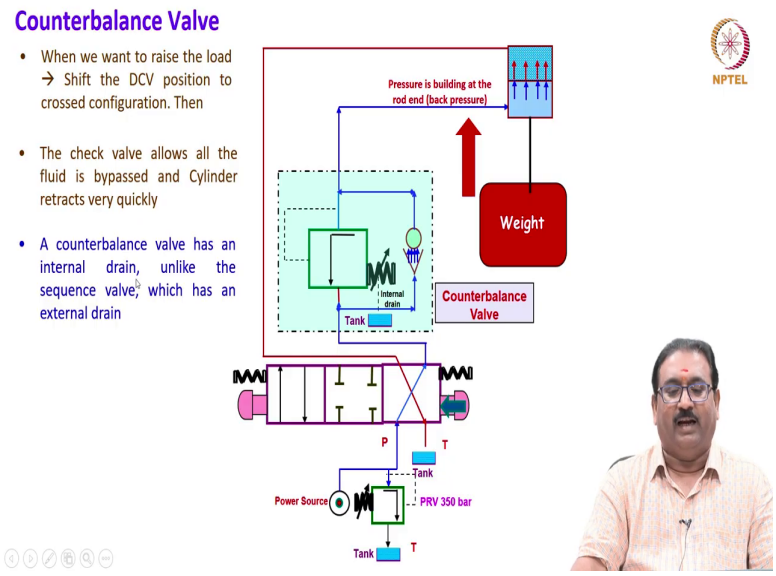

But, when will shift to this button meaning right side button what happen you will see the pump flow is coming here and here you will see friends, it is by passed through the NRV to the here.

Then whatever the flow is there again it will pass through this meaning the counter balance valve will bypass the flow in the crossed configuration, then load will be lifted up very quickly no need to worry. A Counter balance valve has an internal drain unlike the sequence valve, which has an external drain there.

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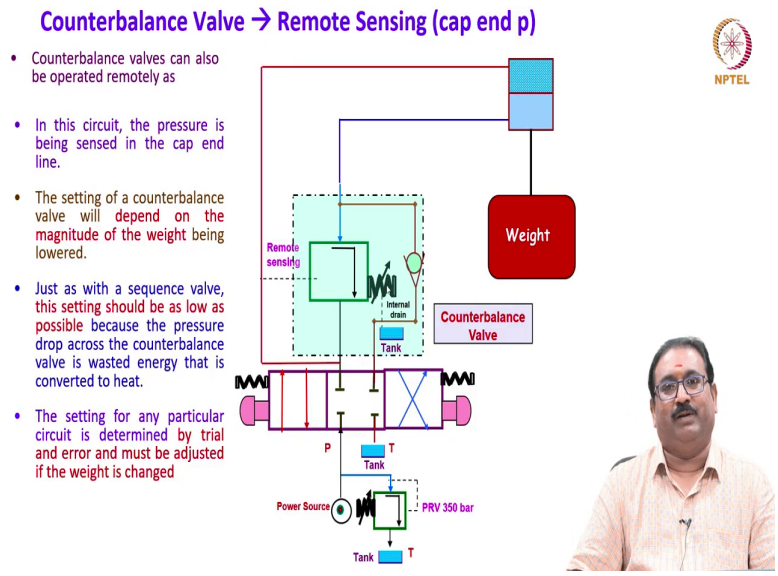

Also please remember friends here. You no need to monitor or open the valve you can read from the remote sensing. Now, you will see I am reading the head side pressure not from the tail side pressure. This is also allowed remote sensing counter balance valve can also be operated remotely as in this circuit; the pressure is being sensed in the cap end.

The setting of the counter balance valve will depend on the magnitude of the weight being lowered. Just as with a sequence valve, this setting should be as low as possible because the pressure drop across the counter balance valve is wasted energy that is converted to heat as we know already.

The setting for any particular circuit is determined by trial and error and must be adjusted if the weight is changed. The setting you know how much we have to create the back pressure is

based on the magnitude of the load. This will be adjusted manually by the maintenance people you no need to worry for that.

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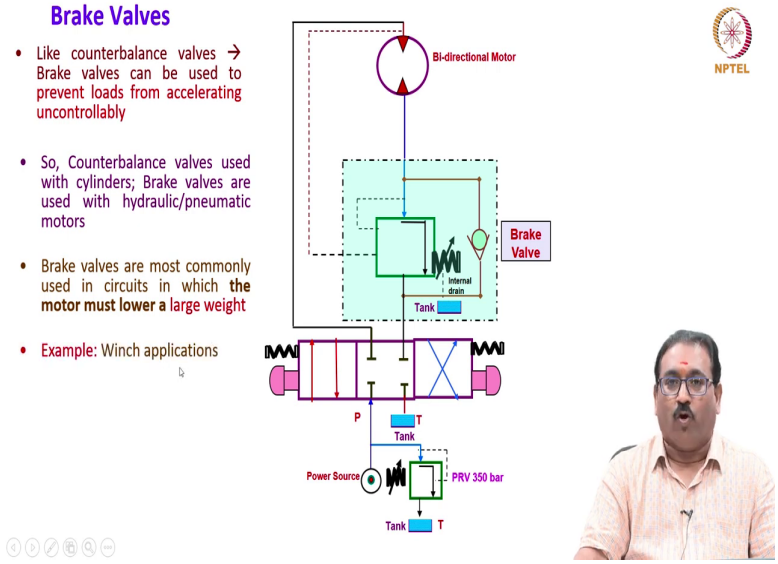

Similar to previous one, same it is what you have seen sequence valve now see here this is a pressure relief valve along with the check valve it is there now, I am writing the brake valve. Then what is this brake valve? I am controlling the see here friends. The bi-directional motor, hydraulic motor, or a pneumatic motor control anything. So, likewise counter balance valves, brake valves can used to prevent loads from accelerating unconditionally.

So, counter balance valves used with cylinders; brake valves are used with hydraulic or a pneumatic motors. If you are controlling the motor it is known as a brake valve. If you are controlling the cylinder it is known as counter balance valve. Brake Valves are most

commonly used in the circuit in which the motor must lower a large weight. Example, a winch applications.

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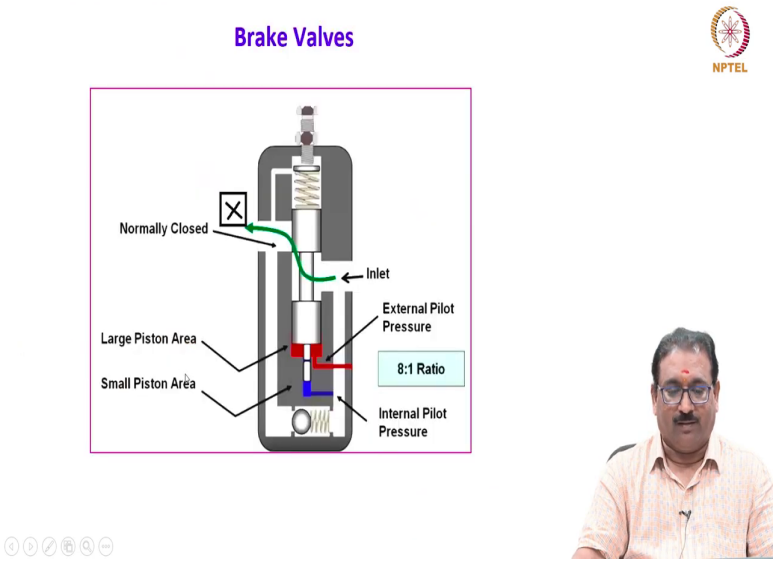

Now, quickly I will show you the constructional details of this brake valve. As you see here the brake valve is normally closed. Please understand normally closed. Here the inlet outlet is always closed using the spool valve here which is adjusted using the spring. The spring adjustment you will do when the valve will opens correct. Now it is closed one it is.

Here you will see friends here other side you will see very carefully in the brake valve it is a NRV Non Return Valve position. And here you will see friends there are the two pilot lines are there, it is a external pilot line you will see here red one external pilot line acts over the larger area of the spool.

And for the smaller area one more is there what you will call internal pilot pressure. Internal pressure, internal pilot pressure is from the inlet line, this is external pilot line from the external. You will see friends this area smaller piston what whatever you will call this and the larger area of the piston. It is 8 is to 1 this is 8 times bigger than this. Please understand this brake valve, it is a larger piston this area is 8 times bigger than the smaller piston area, then this is as usual the NRV.

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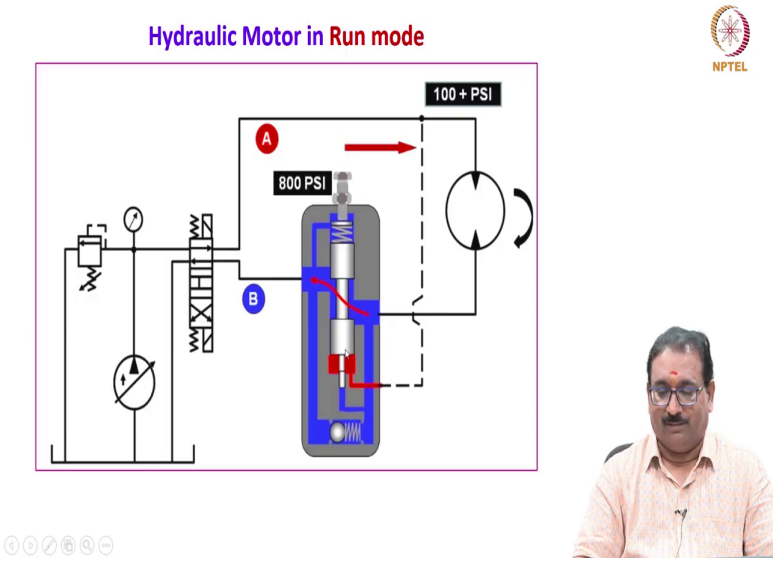

Let us we will see hydraulic motor in running mode how it will be. Running mode means you will see friends now, I am using the same valve here same valve. In running mode means this is a the pump pressure pump and compensated pump, the relief valve pressure relief valve I am monitoring the pressure here. Here it is a solenoid operated now you will see the open

type friends open type spring centered open type. Here it is a parallel configuration crossed configuration. How it is operating using the solenoids?

Now, we will see in the parallel configuration what you will call, the flow is coming pump flow is coming here it will go here and it will rotate the motor clockwise. And here I am setting the 100 plus PSI it is, here I am pressure setting I will do in the valve is 800 PSI. When you will see friends here the oil from here should go to the tank provided this will open correct because, this valve is always null position closed.

For this, what I will do here? As I have told you I am tapping here the pressure you will see this is a pilot line, then it is acting on the larger area. It is 100 bar means it is a 1 1 is to 800; 800 bar pressure is there which is more than this then it will be opened always, running mode.

Running mode means, flow will come go flow will come go, but in between what is there brake valve is there brake valve should open how it is using the pilot line pilot line is acting over the larger area.

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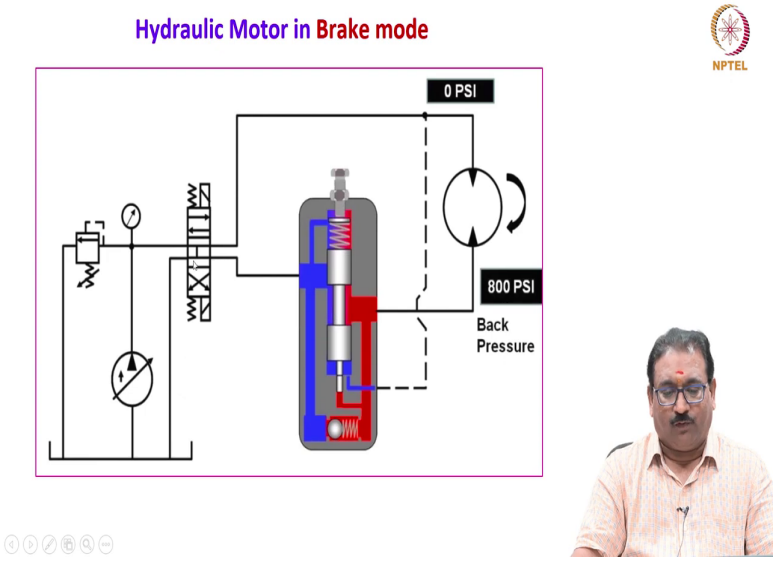

But in brake mode means when it will shift to the center position. What happens when you will move to center position it is a open center all oil whatever the oil is there it will go to the tank meaning you will get on the 0 pressure here.

Correct when 0 pressures is there what happen? Again this will push back. That pressure will starts building here. Also remember friends here this pressure is coming to like this correct it is a brake mode braking mode slowly load will come to the null positions. Please understand this in the here, correct.

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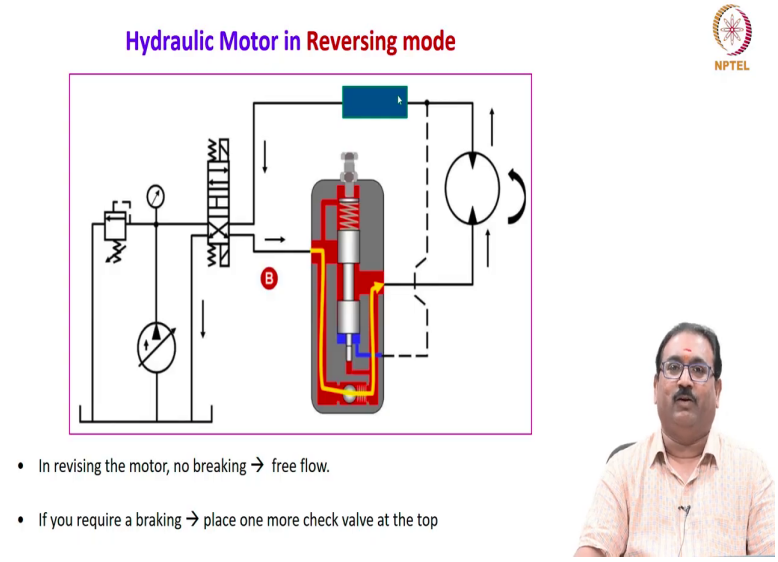

In reverse mode; in reverse mode means here in reversing mode what happens, when you will move here hydraulic pressure line will come here, it will bypass you will see now it will bypass.

Through NRV it will go here it will rotate in anti clockwise direction, then it will go to the tank no braking in the reversing mode. If you want to make the reversing mode also breakable then what you will do? One more valve like this you have to place it here, then it is possible to reversing mode also you have to brake it otherwise not possible.

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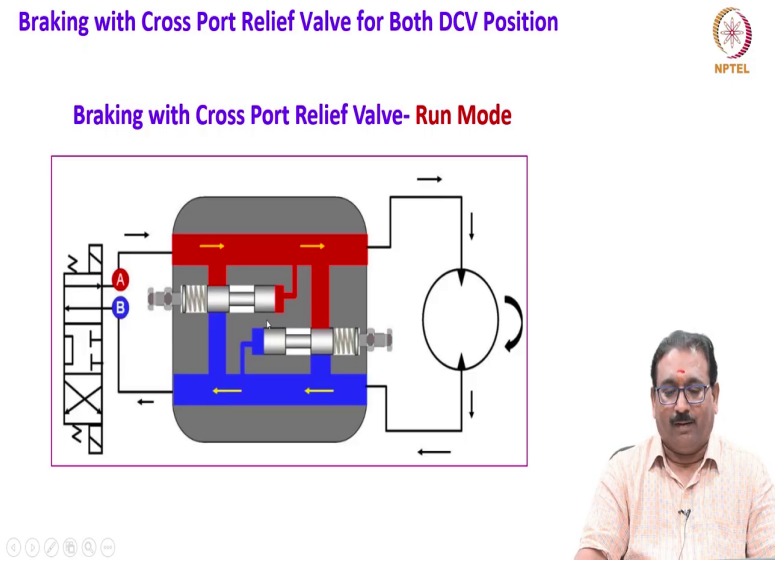

Then I will show you one more thing breaking with cross port relief valve for both DCV positions. Here you will see friends, the arrangement you will see here again here it is I am using the tandem center p is connected to tank and middle position A and B are blocked then solenoid actuation parallel configuration, crossed configuration and a spring centered. Here you will see there are the two piloting is there pilot valve.

The running mode what happens you will see breaking with the cross port configuration. What happens here you will see when it is parallel configuration oil will enter here it will go here it will rotate. Then oil will come here it will go directly to the tank. No need to worry in running modes. Correct here.

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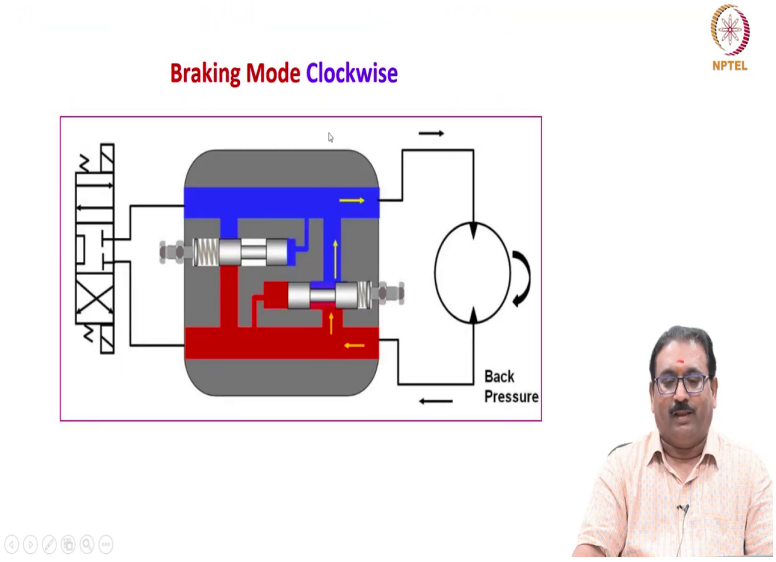

Now we will see when I will move immediately to center position. What happens you will see now, at the center position the flow is coming here you stopped immediately it will come here then it will go here, but it is closed. Then what happened? It will recirculate. Slowly the motor will come to the head position it will recirculate. When I am moving from parallel to middle position.

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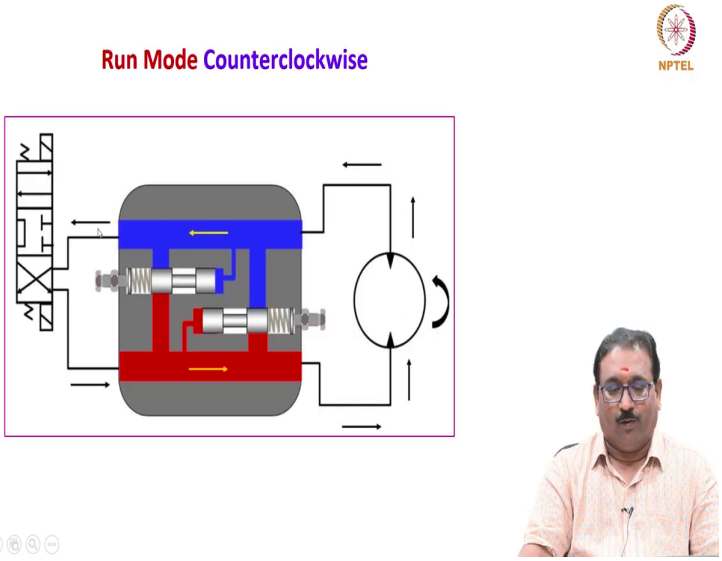

Similarly, counter clockwise you will see friends. Counter clockwise what happen? When you will shift here, the oil is coming here and it is rotating in anti clockwise direction, the flow coming here it will goes to the tank.

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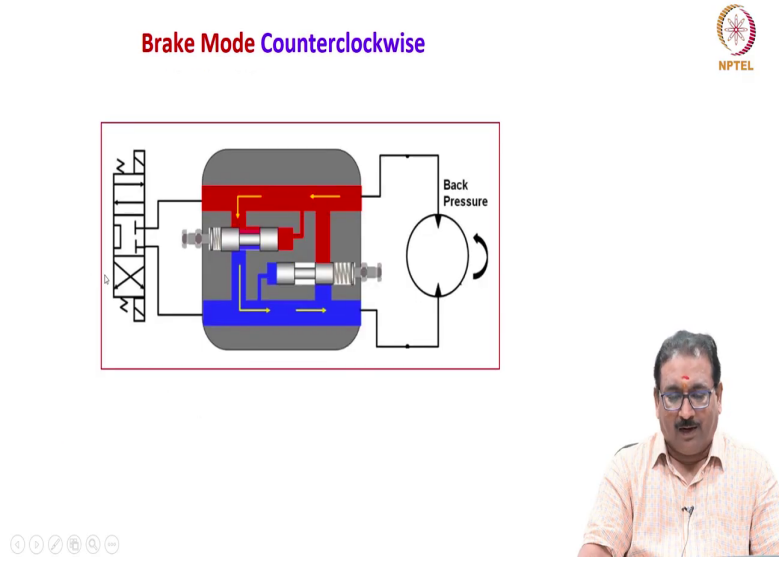

Again immediately you shift to the middle position what happened you will see. Then what happened the it is rotating anti clockwise the flow is coming here, it will not go here because it is closed. Then what happened? Through this it will recirculate here. Again breaking is possible when in the both crossed as well as the open configuration, correct.

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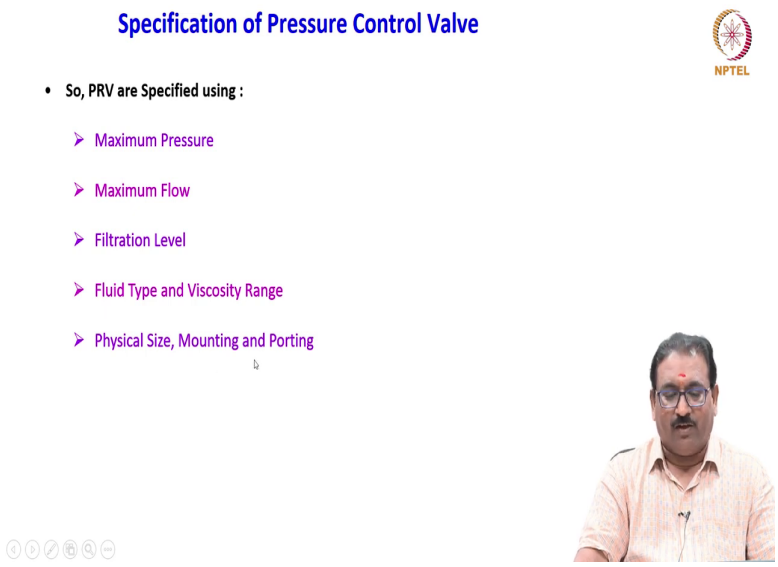

You have seen various types of pressure control valves. Quickly I will tell you, when you are buying the pressure control valves the main thing you have to considered are the maximum pressure, maximum flow rate, filtration level, fluid type and a viscosity range, then physical size mounting and a porting configurations.

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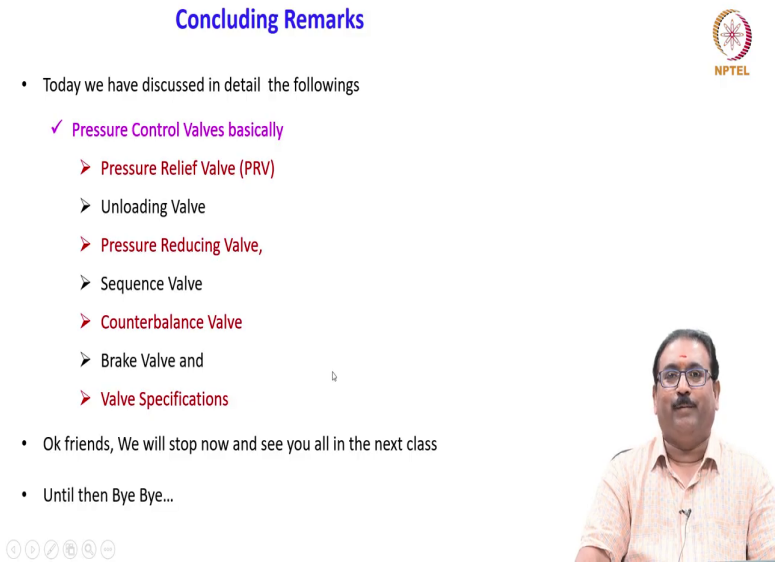

Now, quickly I will conclude today's lecture, today we have discussed in detail the following. Pressure control valves basically, pressure relief valve, unloading valve, pressure reducing valve, sequence valve, counter balance valve, brake valve and valve specifications. Ok friends, we will stop now and see you all in the next class. Until then bye bye.

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