Oil Hydraulics and Pneumatics
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Part 3: Bleed-off circuit, Construction, Operation and Application of Flow dividers, Specification of FCV
Lecture - 42
Flow Control Valves

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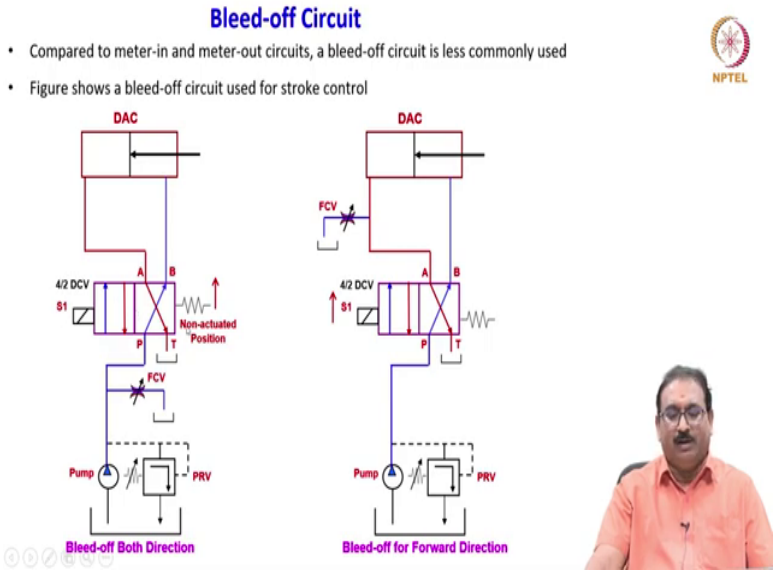

My name is Somashekhar, course faculty for this course. Now bleed off circuit compare to meter in and meter out circuits. A bleed off circuit is less commonly used. Figure shows the bleed off circuit used for stroke control. You will see here friends, I have drawn the two sketches here double acting cylinder and 4 by 2 DCV solenoid actuated and spring neutral.

Then you will see here, pump is there PRV is there pressure relief valve connected to the tank correct here; the bleed off in both direction. You will see here friends where I connected the flow control valve exactly between the DCV and the pump. You will see, this is the flow control valve.

What for? Then it is connected to the tank itself. This is bleeding in the both direction forward as well as reverse direction, I will tell you. If you will connect at the head side FCV, I am connecting here in the next figure; all the same here only I am connecting at the head side. Now here bleed off for the forward direction; if you want to do for reverse direction connect this flow control valve to the rod side.

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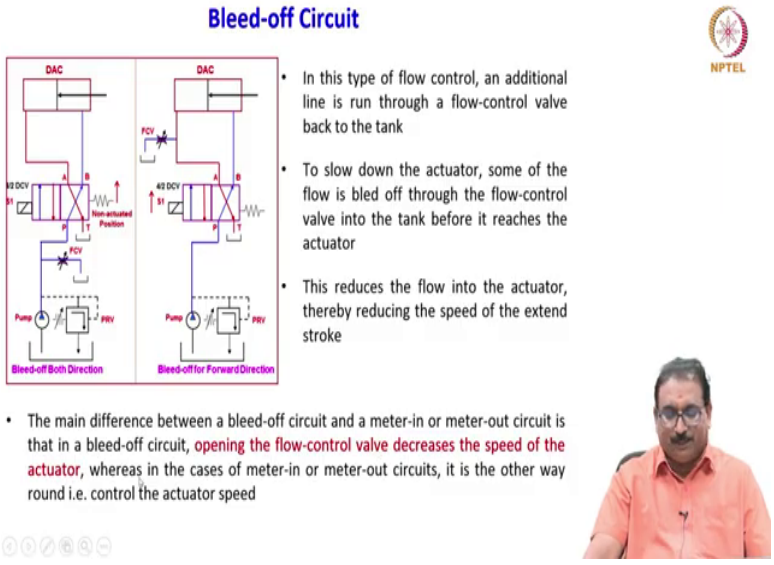

Let us we will see now how it is. In this type of flow control valve, an additional line is run through the flow control valve back to the tank. Always you will see, it will go to the tank

through the flow control valve. To slow down the actuator, some of the flow is bleed off through the flow control valve back to the tank.

Please remember here to slow down the actuator speed, some of the flow is bleed off through the flow control valve into the tank before it reaches the actuator. Because exactly here we will see here wherever it will go, here I am controlling the I am not sending the complete flow of the pump to the head side or a tail side.

Now I am using bleeding of the flow to the tank using the flow control valve. This reduces the flow into the actuator thereby reducing the speed of the extended stroke. The main difference between the bleed off circuit and a meter in or a meter out circuit is that in bleed off circuit opening the flow control valve, decreases the speed of the actuator. Whereas, in case of the meter in or a meter out circuit it is the other way around that is controlling the actuator speed.

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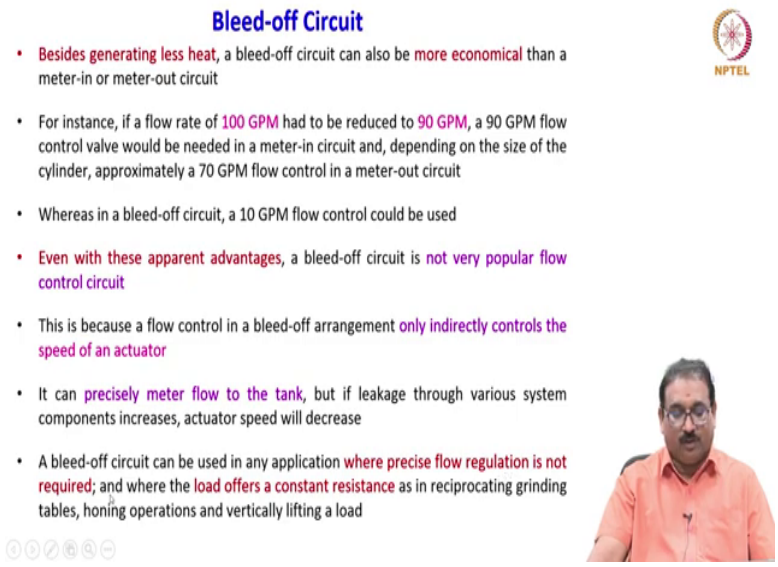

Besides generating the less heat, a bleed off circuit can also be more economical than the meter in or a meter out circuit. For instance if flow rate of 100 gallons per minute had to be reduced to 90 GPM; a 90 GPM flow control valve would be needed in a meter in circuit. And depending on the size of the cylinder approximatively 70 GPM flow control valve in the meter out circuit.

Please see here friends if the flow rate 100 GPM has to reduce to 90 GPM, what we are doing now? If you are controlling using the meter in the flow control valve, you have to select 90 GPM, meter out 70 GPM whereas, in the bleed off circuit a 10 GPM flow control valve could be used.

Even with these apparent advantages the bleed off circuit is not very popular flow control circuits. This is because a flow control in a bleed off arrangement only indirectly controls the

speed of an actuator. It can precisely meter flow to the tank, but if leakage through the various system components increases, actuator speed will decrease.

A bleed off circuit can be used in any applications where a precise flow regulation is not required and where the load offers a constant resistance as in reciprocating grinding tables, honing operations and vertically lifting a load.

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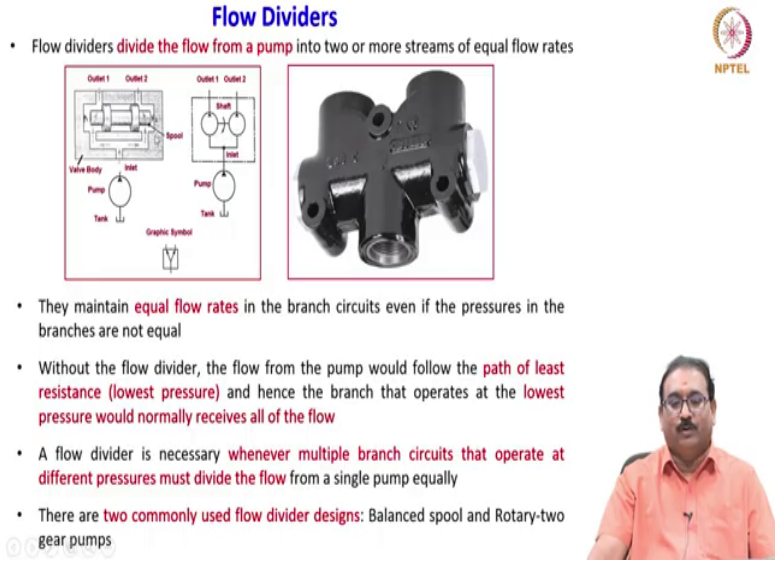

Now we will move on to the flow dividers. The flow divider divides the flow from a pump into two or more streams of equal flow rates. See here this is a flow divider, what I have drawn here. The pump flow is dividing equally through outlet 1 and outlet 2, the pump flow is divides equal.

This is equal flow dividers, unequal flow divider are also there available in commercially in the market. This is represented neatly here correct here. This is a what you will call the commercially available the flow divider, the pump flow is dividing into two flows.

They maintain equal flow rates in the branch circuits even if the pressure in the branches are not equal. Without the flow divider the flow from the pump would follow the path of least resistance that is the lower pressure and hence the branch that operates at the lowest pressure would normally receives all of the flow. A flow divider is necessary whenever a multiple branch circuits that operate at different pressures must divide the flow from a single pump equally.

There are two commonly used flow divider design; one what I told you here the balanced spool and another one is here what you will call rotary two gear pumps. The two designs are available in the market.

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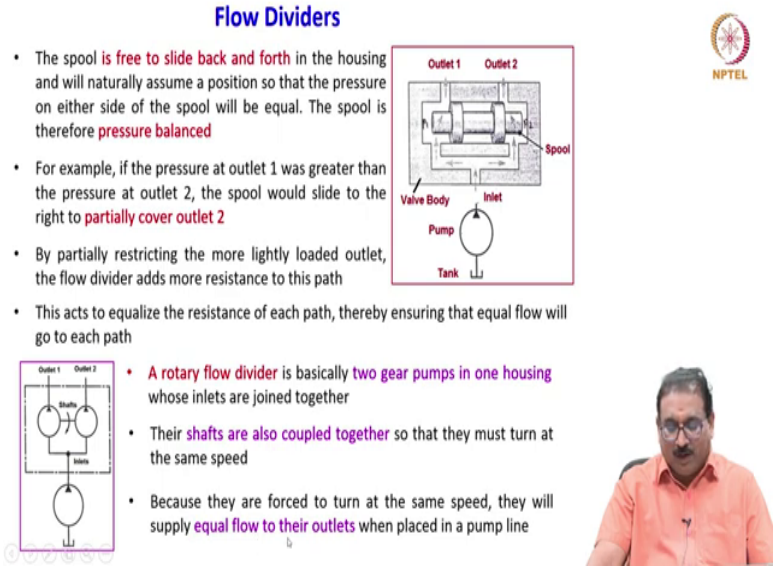

This is what you will call the spool type divider. The spool is free to slide back and forth in the housing and will naturally assumes a position. So, that the pressure on either side of the spool will be equal p 1 equal to p 2, then you are receiving the pump flow into two halves. The spool is always a pressure balanced.

For example, if the pressure at the outlet 1 was greater than the pressure at the outlet 2, what happen? The spool will slide to the right to partially cover the outlet. If this pressure is increasing this will push partially closes, always it is a pressure balance by partially restricting the more lightly loaded outlets.

The flow divider adds more resistance to this path. This acts to equalize the resistance of each path thereby ensuring that equal flow will go to each path. A rotary type flow divider as I

have told you, it consists of the two gear pumps in one housing whose inlets are joined together, their shafts are also coupled together. So, that they run at the same speed.

These are the rotary flow dividers because they are forced to turn at the same speed. They will supply the equal flow to their outlet 1 and outlet 2 when placed in a pump line. These are the rotary type flow divider, this is the spool type flow dividers; both are available in the market.

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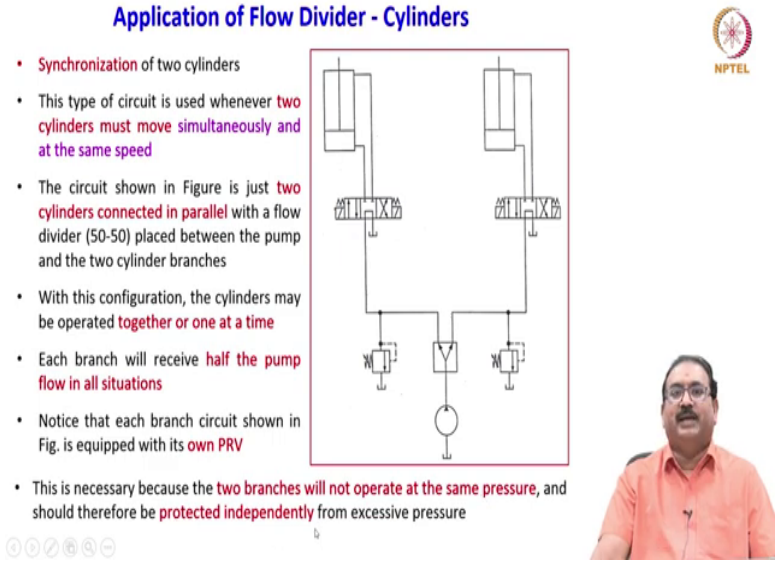

Quickly I will show you the application of flow divider when controlling the cylinders. Here you will see friends here two vertical cylinders are there parallelly connected to the; what is this? Can you please tell me 4 by 3 tandem center solenoid actuated spring centered valve correct 4 by 3 it is. It is connected to the flow divider here, then pump and tank, then each branch circuit PRV 1 and PRV 2 because they will receives the flow equally or unequally based on the requirement.

Here the cylinders synchronization of the two cylinders are required that time I am using the flow dividers. This type of circuit is used whenever two cylinder must move simultaneously and at the same speeds; I want to move up and down at the same speed.

The circuit shown in figure is just two cylinders connected in parallel with the flow divider 50-50 placed between the pump and the two cylinder circuit branches. With this configuration, the cylinder may be operated together or one at a time based on the DCV which one you are using.

Each branch will receives half the pump flow in all situation because it is a 50-50 flow divider. Notice that each branch circuit shown in figure is equipped with the PRV pressure relief valve. This is necessary because the two branches will not operate at the same pressure and should therefore, be protected independently from the excessive pressure.

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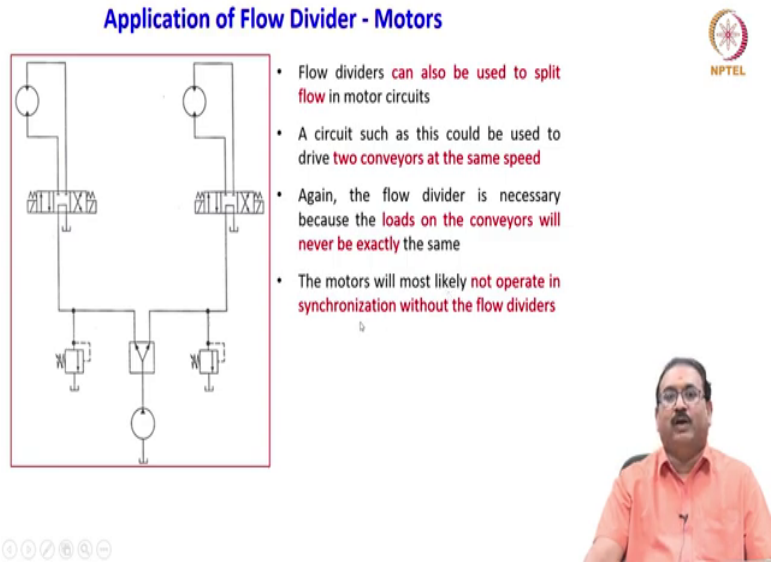

Then motor similar to this application of divider now here 50-50 divider, I am connecting to the bi directional motors here. The flow divider can also be used to split the flow in the motor circuits.

A circuit such as this could be used to divide the two conveyors at the same speed. Again the flow divider is necessary because the loads on the conveyors will never be exactly the same. The motors will most likely not operate in the synchronization without the flow divider.

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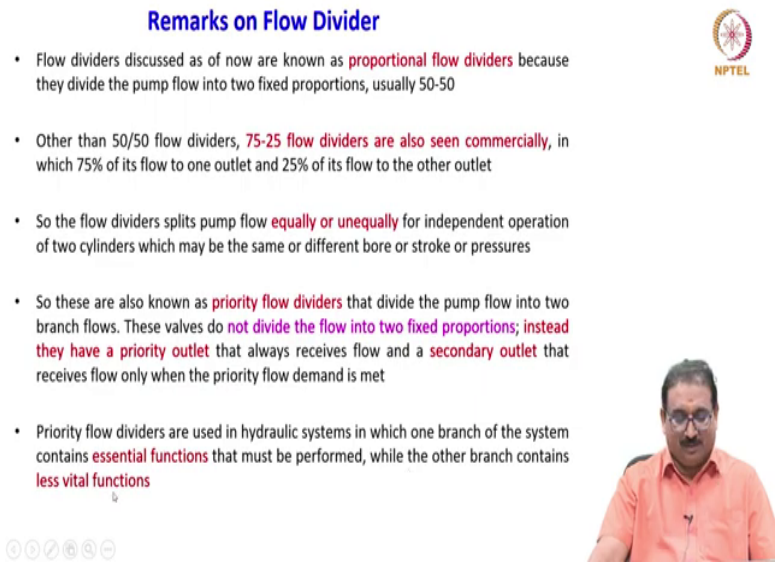

Quickly I will give you some lights on the flow dividers. Flow dividers discussed as of now are known as proportional flow dividers because they divide the pump flow into two fixed portions; usually 50 percent and 50 percent. Other than 50-50 flow dividers, a 75-25 flow dividers are also seen commercially in which 75 percent of the flow to one outlet, 25 percent of the flow to the other outlet is possible.

So, the flow divider splits the pump flow equally or unequally for independent operation of two cylinders which may be the same or different bore or stroke or a pressures. So, these are also known as a priority flow divider that divide the pump flow into two branch flows.

These valves do not divide the flow into two fixed proportions instead they have the priority outlet that always receives the flow and a secondary outlet that receives the flow only when the priority flow demand is met. Priority flow dividers are used in hydraulic systems in which

one branch of the system contains essential function that must be performed while the other branch contains a less vital functions.

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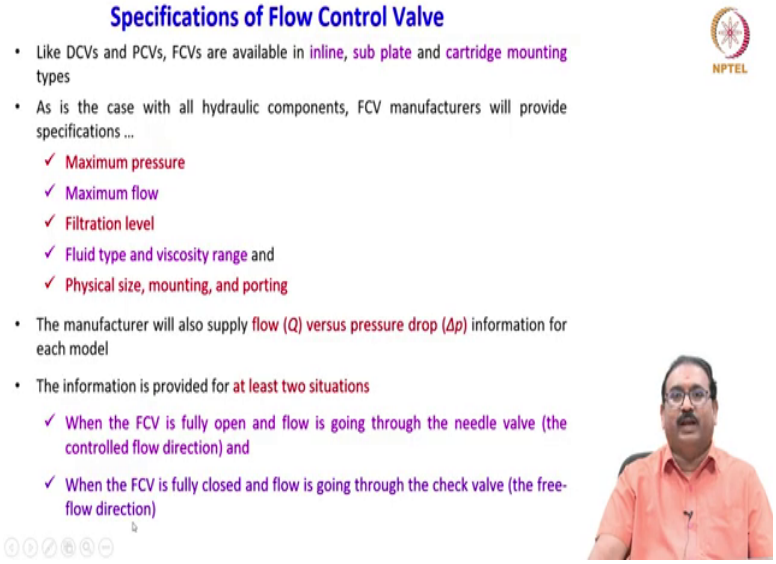

After knowing these flow dividers when we are buying the any flow control valves whether it is a needle valve or a choke valve or a pressure compensated valve or a pressure temperature compensated valve or a flow dividers valve, we must consider some of the following specifications. What are those? Like DCV and PCVs, FCVs are available inline, sub plate and a cartridge mounting types.

As is the case with all hydraulic components, FCV manufacturers will provide the specifications as maximum pressure, maximum flow, filtration level, fluid type and viscosity range it can handle and physical size mounting and porting. The manufacturer will also supply the flow Q versus the pressure drop information for each model.

The information is provided for at least two situations when the FCV is fully open and flow is going through the needle valve that is the controlled flow direction. And when the FCV is fully closed, flow is going through the check valve that is a free flow direction ok.

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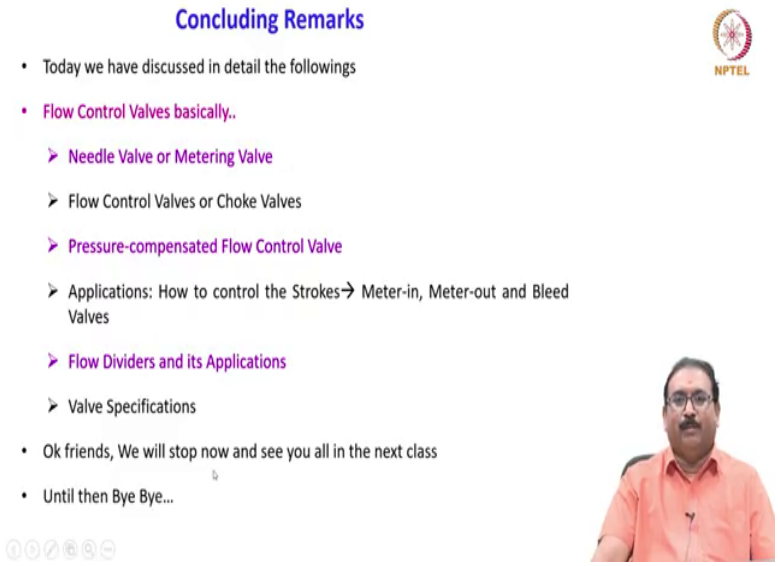

I will conclude today's lecture. Today we have discussed in detail the followings flow control valves basically we have seen the needle valve or a metering valve, flow control valves or a choke valves, pressure compensated flow control valves, applications: how to control the stroke of an actuator using the meter in circuit, meter out circuit and a bleed valves flow dividers and its applications in a multi cylinders.

Also we discussed the main valve specification while choosing in the variety of flow control valves available in the market 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].