Oil Hydraulics and Pneumatics
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Part 3: Hydraulic power pack in a nutshell, Essential components of a hydraulic circuit, Unloading circuit for energy saving, Section of system operating pressure
Lecture - 69
Oil Hydraulic Circuits: Design and Analysis

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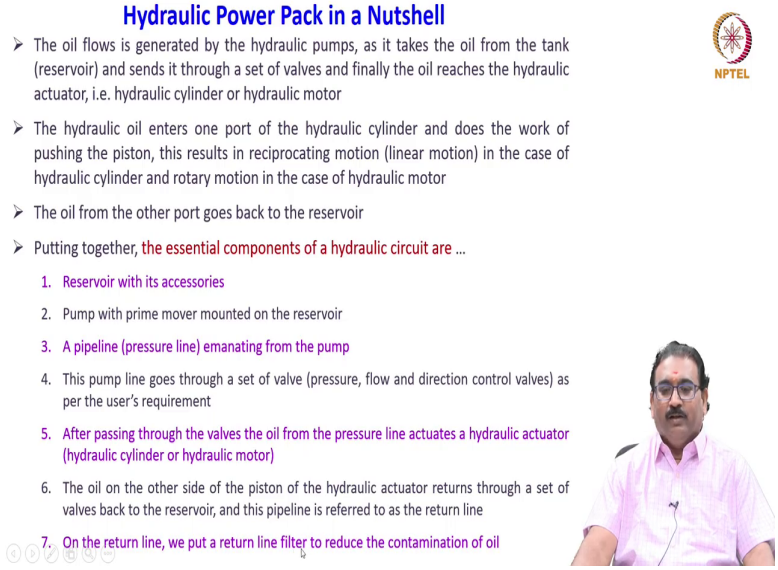

My name is Somashekhar, course faculty for this course. Very quickly hydraulic power pack in a nutshell: The oil flow is generated by the hydraulic pumps, as it takes the oil from the tank and send it through a set of valves and finally, the oil reaches the hydraulic actuator that is a cylinders and motor.

The hydraulic oil enters one part of the hydraulic cylinder and does the work of pushing the piston, this results in reciprocating motion that is a linear motion in case of the hydraulic cylinder and a rotary motion in case of the hydraulic motor. The oil from the other end goes to the reservoir.

Putting together, the essential components of the hydraulic circuit are; reservoir with its accessories, pump with prime mover, mounted on the reservoir, a pipeline the pressure line what you will call a P-line emanating from the pump. The pump line goes through a set up valves meaning pressure, flow, direction control valves as per the users requirement. After passing through the valve the oil from the pressure line actuates the hydraulic actuator either a cylinder or a motor.

The oil on the other side of the piston of the hydraulic actuator returns through a set of valves back to the reservoir, and this pipeline is referred to as a return line R-line or a tank line T-line. On the return line, we put a return line filter to reduce the contamination of the oil before it enters to the tank.

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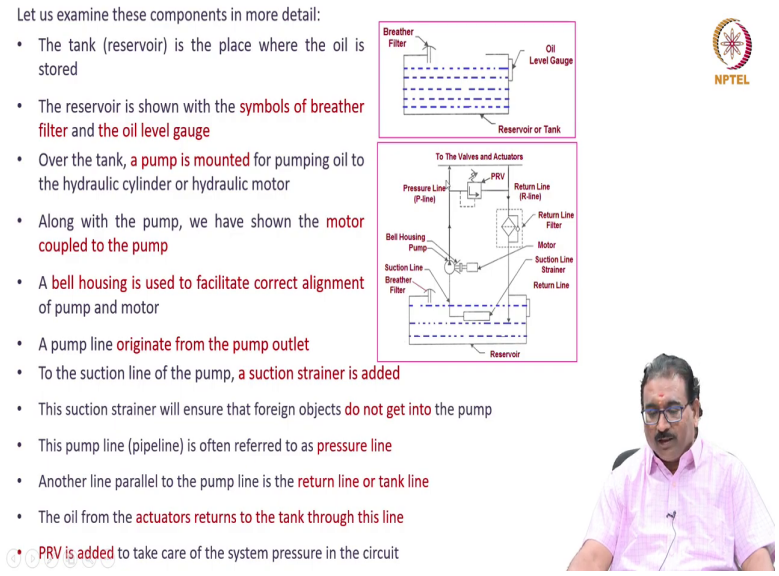

Let us examine these components in more detail: the tank what I will call a reservoir is the place where the oil is stored. The reservoir is shown with a symbols of breather filter and the oil level filter, previous slide you are seen only systematic now we will see the symbols. The this is a reservoir, the breather filter or filler how it is represented you will see, then this is a oil level gauge.

Over the tank, a pump is mounted for pumping oil to the hydraulic cylinder or a motor through the valves. See here friends all symbolic representation I am showing you here the pump and motor coupled together using the bell house housing for proper alignment. Pump then it will this is known as a pressure line or a P-line pressurized line it is, then it will go to the valves and actuator after doing the work, it will comeback this line is known as a return line parallel to this.

Then here you will see the return line filter. Along with the pump, we have shown the motor coupled to the pump. A bell housing is used to facilitate the correct alignment of pump and a motor. A pump line originates from the pump outlet. To the suction line of the pump a suction strainer is added.

This suction strainer will ensure that the foreign objects do not get into the pump. This pump line or a P-line is often referred to as a pressure line. Another line parallel to the P-line is R-line return line or a tank line. The oil from the actuator returns to the tank through this line.

Then also you will see friends P here you will see PRV to monitor the total system pressure if it exceeds it diverts the flow to the tank. Otherwise, it is always a close type it will monitors the pump line pressure line always. If it exceeds what happen? It will open then flow will divert like this you will see here divert like this.

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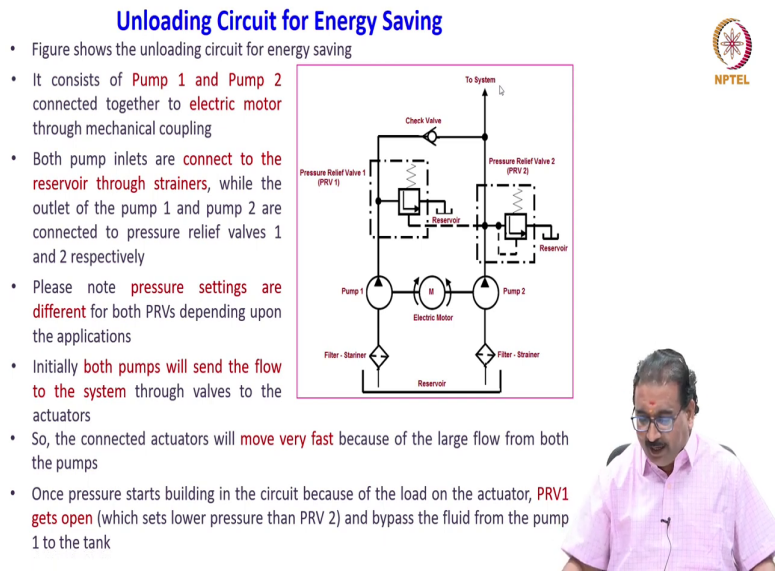

After knowing the power pack, I will show you some of the power saving futures as and when required you will use. Some I will show you some of the circuits like a unloading circuit for energy saving. Figure shows the unloading circuit for energy saving, you will see now friends here the circuits please see here the two pumps are there pump 1 and a pump 2 connected together through the electric motor.

Then it is connected to the tank inlets are connected to the tank through the strainers, then you will see here it will go to the pressure relief valve 1 different setting and this pump 2 again the pressure relief valve 2 PRV 2. It will go to the system then I am using the check valve here how it will work I will show you now.

It consists of pump 1 and pump 2 connected together to a electric motor through a mechanical coupling. Both pump inlets are connected to the reservoir through the strainer and the

pressure relief valves please note the pressure settings are different for both the PRV 1 and PRV 2.

Initially you will friends, here when it this is connected to the system. System means the control valves and the actuator. Initially what happens you will see when the electric motor is running both the pumps will sucks the fluid and sends then both will join here it will come here this pump 1 will come here lift the check valve, it will joint here this will sucks the fluid it will go here, system will receives the flow from both the pump 1 and the pump 2.

So, the connected actuator will move very fast because it will receives the large amount of fluid from the pump 1 and pump 2. Assume to be after it is reaching the workpiece pressure starts building then what happens? When the pressure starts building from the actuator it will reflect in the lines. That time you will see here the PRV 1 is kept for the lower pressure and PRV 2 is kept for the higher pressure that time what happens?

Once the pressure setting here it will reaches the pressure from the system then what happen? This pump 1 is sending the flow to the reservoir then load on the motor will reduces. Then what happens? The pump 2: pump 2 still it is sending the flow to the system, but you will understand here whatever the pump will send here because it is higher pressure setting the oil will not enter through this because it is a check valve is there.

Check valve will allows the flow from only one direction other direction is not allowed then what happens friends? The actuator will move with very slowly because oil is sending by the pump 2. Assume to be after doing the work if the operator is not shifting to return back the cylinder or sometimes the load on the cylinders increases beyond some limits then what happen?

Whatever the pressure setting is here also exceeds then what happens? This PRV 2 gets open then that time also the pump 2 is sending a flow back to the tank until the pressure in the system reduces. Once it is reduces then automatically they will close please understand the

PRVs are normally closed they will get open when the pressure setting here increases. Meaning you will see the pump both pumps will not send always same flow to the actuator.

When there is no load that time actuators will move very fast that time flow is coming from pump 1 and pump 2 after reaching that load start building then what happens? The with the load actuator will move very slowly. That time the pump 1 is sending the flow back to the tank only pump 2 is sending then it will move very slowly with the load. These are known as the unloading circuit for energy saving because I am releasing the load on the electric motor.

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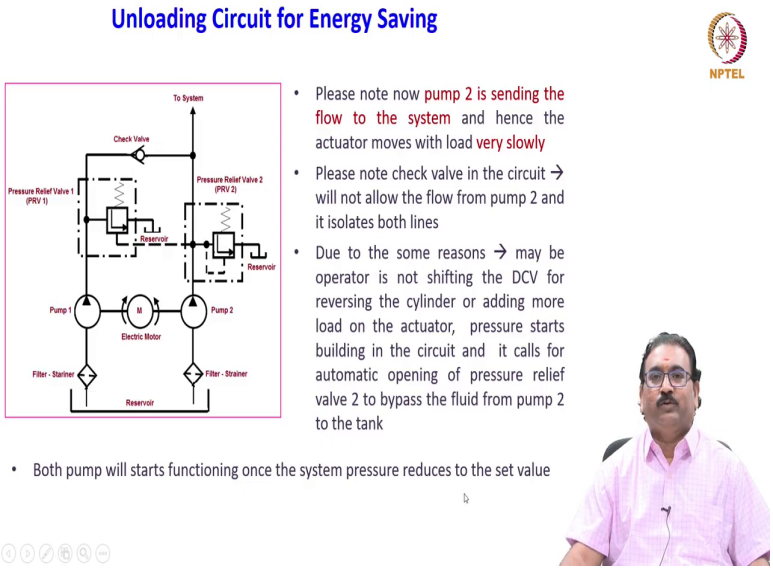

Please note that same thing I am explaining here, the pump 2 is sending the flow to the system and hence the actuator moves with load very slowly. Please note the check valve in the circuit will not allow the flow from the pump line to as it isolates this line and this line.

Due to the some reason as I have told you may be the operator is not shifting the DCV for reversing the cylinder or adding the more load on the cylinder, the pressure starts building in the circuit and it calls for automatic opening of the pump 2 also when the set pressure is exceeding from the system. Both pumps will start functioning once the system pressure reduces to the set value.

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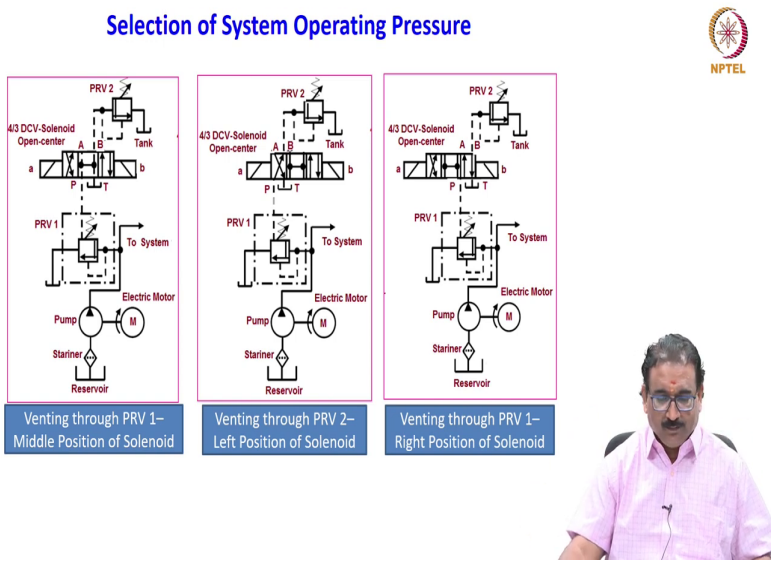

This is unloading circuit. Now, what I am showing you now one more is this pressure relief valve is controlled through the pilot then how it will work you will see with one more circuit, selecting the system operating pressure. Now, we will see friends here this is a PRV 1 and this is PRV 2 both are setting with the different pressures.

Now, we will see friends identify the elements very quickly the reservoir strainer pump drives through the electric motor, then it is going to the sustain here, then you will see here the PRV

1 is controlled pilot operating from the 4 by 3 solenoid operated open enter it is meaning all are interconnected in the middle positions.

Then a and b small a and b are the solenoids then a is actuated it will go here when b is actuated it will shift here parallel configuration and this is the PRV 2. Now we will see friends here now this PRV is controlled through the pilot also you will remember you will also controlled through the system pressure see there are the two ways here.

This is a self contained and also this valve is controlled here. Now, what happens you will see friends in the null position; null position means no current in the solenoids both are de energized that time the valve is in the middle position then what happens? You will see the pump line is connected to the middle then it will connected to the tank meaning it is a what it is how many how much pressure is there? Only the tank pressure.

That is what I will call a one bar pressure. That time what happen when there is no pressure in the system what happen? The pump line pump flow will be send to the tank with the low pressure it will go. In the middle line the pump is not sending the flow it will send to the tank, but you will see now when you are actuating the solenoid a now what happens you will see friends here now.

The how is the pump flow? Pump flow will come here then you will see here it will go to the here and then here. Meaning here the pilot line pressure is the setting pressure at the PRV 2 you will see here this is block here you will see the line, meaning the pilot line pressure is what it is whatever the pressure you will set here then what happens? When the for example, I am telling you when the when it is lefted; left for the medium pressure this is for the zero pressure.

Zero pressure what happen? It will send the flow through the this directly it will go like this. When you will set the minimum pressure what happens? You will see here the pump the pilot line for this is it will come here, it will go here then you will see here in the medium pressure, this valve will get open the pump will the pump flow will go here and goes to the tank.

Then you will see again, if the pressure building enormously for example, when it is when it will shift to the right side position meaning when the b is actuated right side solenoid are actuated. Now, we will see friends what is that? Now you will see here the pressure line is this is blocked one A is blocked. Now, you will see here this is a tank then what happen? Pressure starts building pump line pressure is building then what happens? When the system pressure is very high then what happen?

It is monitoring the pressure here this will get open then it will send to the tank. When the system pressure exceeds enormously then here maximum pressure please understand this. The selection of the system pressure operating pressure, when it is a middle position no need to worry what happen? Now, pump line this is a pilot line will actuate this because it is pilot operated then pump flow will go to the tank like this.

For medium pressure what happens? For example, medium pressure when it is at the left side solenoid actuated then what happen? Pump line it will go here it will pass here meaning whatever the pressure setting is there it is acting here. Meaning first this will get opened the flow will get opened after doing the work it will bypass here.

But when it will shift to the right positions that time you will see here the pump line will come here, but it is blocked, A is blocked that time pressure starts building how much maximum pressure this will come from the system this valve will get open because it is one more pilot it will get open.

That time again it will send back to the flow to the tank, meaning when the different types of pressures are to be set based on the user requirement you may use the different types of valves in the power packs this is all related to the power packs students ok.

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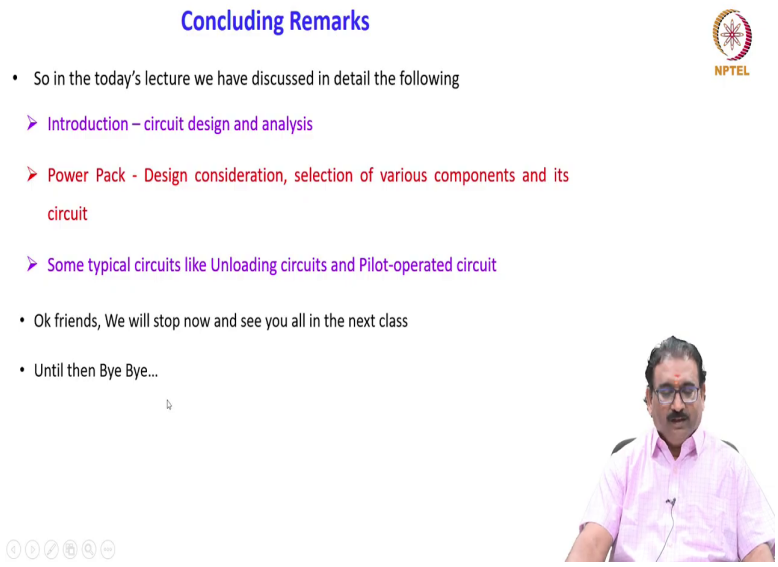

So, in the today's lecture we have discussed in detail the followings: interaction, the circuit design and analysis, we concentrated more on the power pack, design consideration, selection of various components and its circuits. Some typical circuits like a unloading circuits and pilot operated circuit in power saving modes. 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].