Oil Hydraulics and Pneumatics
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Basic Components. Application, Research Challenges, Status and Developments
Lecture – 04
Part 1: Introduction to Oil Hydraulics and its Basic Components

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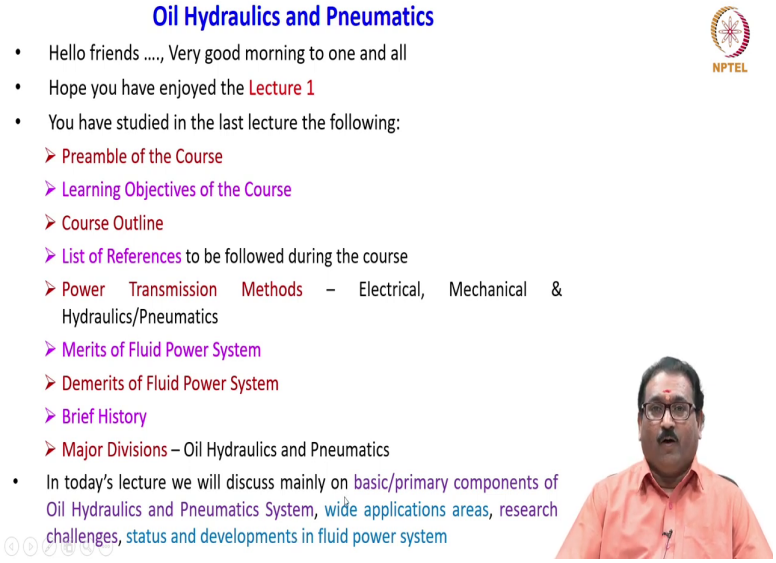

My name is Somashekhar, course faculty for this course. Hello friends, very good morning to one and all.

Hope you have enjoyed the lecture 1. You have studied in the last lecture the following. Preamble of the course, learning objective of the course, course outline, list of references to be followed during the course, then we move to power transmission methods, basically we

have studied the electrical power transmission, mechanical power transmission, and fluid power transmission that is a hydraulics and a pneumatics based on the media used.

In hydraulics, we are using the oil; in pneumatics, we are using the compressed air. Then we have seen the merits of fluid power systems and demerits of the fluid power system. Then we have seen also the brief history of fluid power system, and then we move to major divisions that is oil hydraulics and a pneumatics.

In today's lecture, we will discuss mainly on the basic or a primary components of oil hydraulics and a pneumatic system. And wide application areas of the fluid power system, and then research challenges, status and development in the fluid power system.

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Now, let us we will move on to lecture 2. I will give you the brief organization of presentation. Let us quickly we will recap basic components of oil hydraulics, basic components of the pneumatic systems, major difference between the hydraulic and a pneumatic system, application areas, research challenges in the fluid power industry, status and developments of fluid power industry, concluding remarks.

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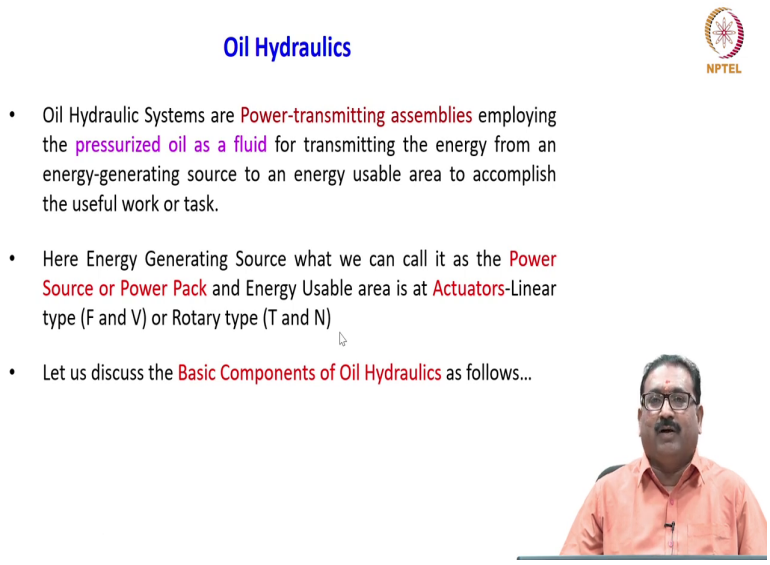

Already we know that oil hydraulic systems are power transmitting assemblies, employing the pressurized oil as a fluid for transmitting the energy from an energy generating source to an energy usable area to accomplish the useful work or task. Here energy generating source what we can call it as a power source or a power pack.

And energy usable area is at actuators. Actuators are two types – linear actuator and a rotary actuator. In linear actuator, the output parameters are force and velocity; and rotary actuator torque and the speed. Let us discuss basic components of oil hydraulics as follows.

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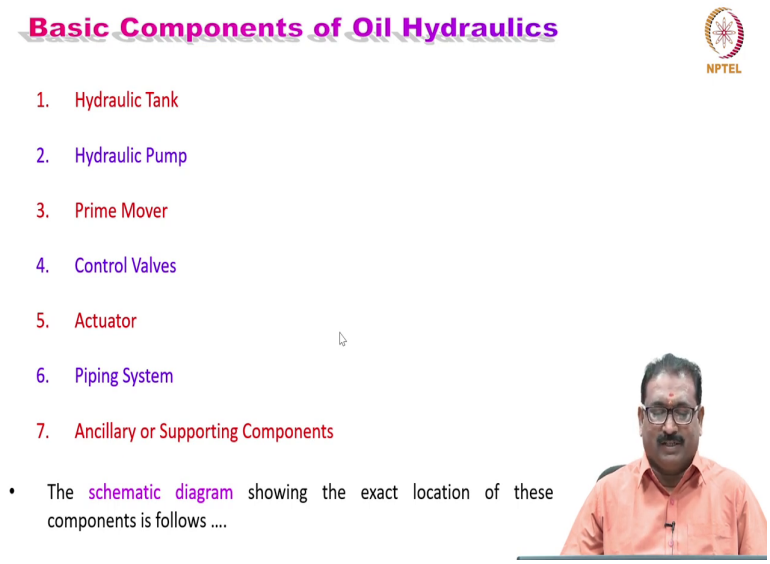

Hydraulic tank, hydraulic pump, prime mover, control valves, actuator, piping system, ancillary or supporting components. The schematic diagram showing the exact location of these components is as follows.

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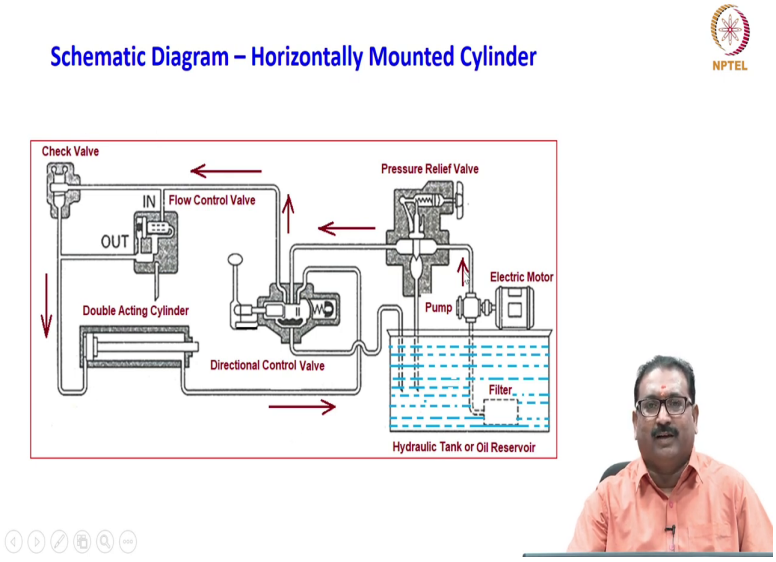

Now, I will show you the two sketches. One is horizontally mounted cylinder. Just see friends here, there are this is a schematic diagram showing the various components in the hydraulics. You will see here, we will start from here hydraulic tank, also known as oil reservoir it is. Filters are there. Pump drives through the electric motor, pressure relief valve, then you will get the directional control valves, flow control valves, check valves, and double acting cylinder which is an actuator.

Just see friends here the fluid will move from this direction. And after doing the work, it will come back to the tank meaning the closed loop things you will observe here. After doing the work, the oil will come back to the tank again this is we will see here the cylinder is mounted in the horizontal direction.

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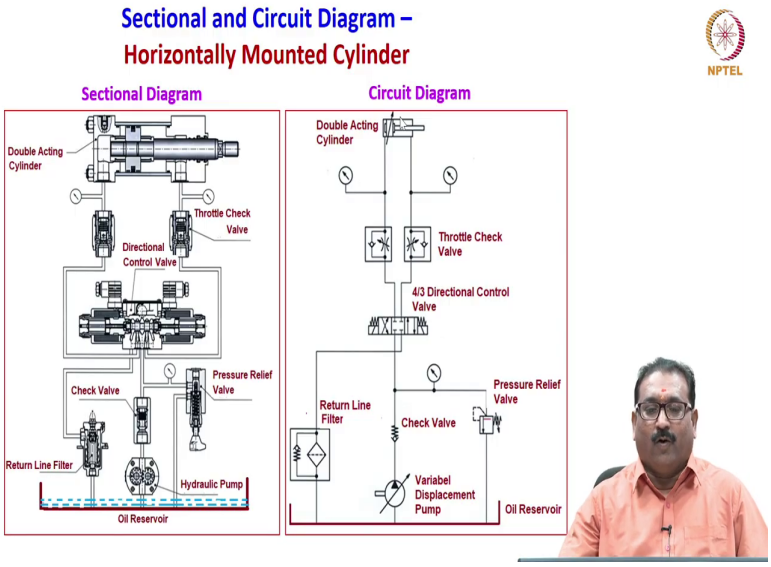

Now, we will see the sectional and a circuit diagram of horizontally mounted cylinder. See here these are the sectional diagram which we shows the double acting cylinder this is a piston, piston rod, then these are the throttle check valves, and direction control valve it is, and then pressure relief valve, check valve, and return line filter, and hydraulic pump.

These are schematically represented in the hydraulic circuit using the various symbols. These things we will discuss in later in the next class. Just I will show you the how these sectional components are represented in the hydraulic circuit pump.

Here I mentioned variable displacement pump, check valve, pressure relief valve, return line filter, 4 by 3 directional control valve – again it is a solenoid operated friends, throttle check

valve – they are also known as the flow control valve. These are the pressure gauges to monitor the pressure in the head side and a tail side. Finally, it is a double acting cylinder.

Always you will understand this, always in industry all the circuits are represented using the basic symbols, which are very important to understand the hydraulic circuit. This I will give you in detail in the next class, no need to worry now. Now, what I have shown is one-to-one representation of the sectional diagram and a circuit diagram showing with symbols.

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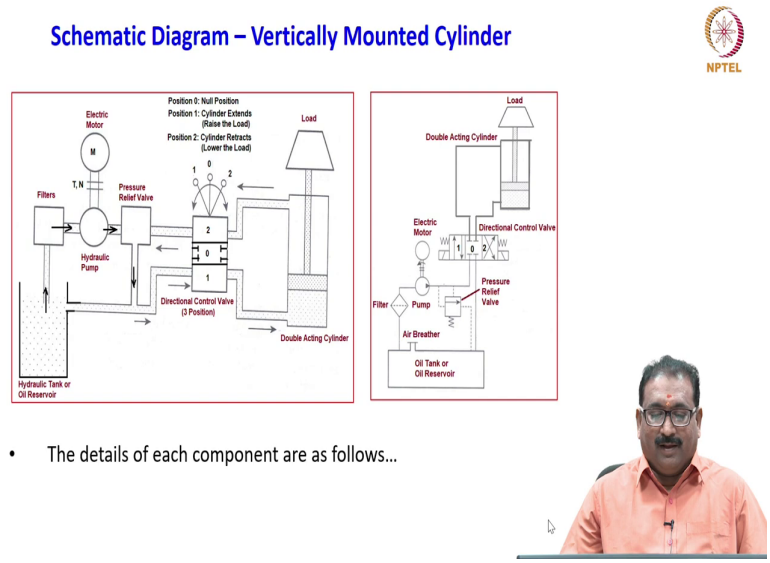

Now, I will show you the one more thing vertically mounted cylinder. See here it is a vertically mounted cylinder here in which we are using to raise the load and lower the load using again all the components friends. Again you will see here directional control valve it is having the three positions.

The 0th position is generally known as a null position meaning no flow is going to an actuator ends, meaning it is standstill. Then 1st position in which the fluid will flow from the tank through the filters, and like this it will go to the head side, then load will be raised. Whatever the fluid is there at the tail side it will go to the tank.

Now, we will understand this, friends. Again here the fluid is used to move the load up and down using the pressurized fluid. In most of the cases, we are using the single acting cylinder instead of double acting cylinder when we are mount the load in vertical directions.

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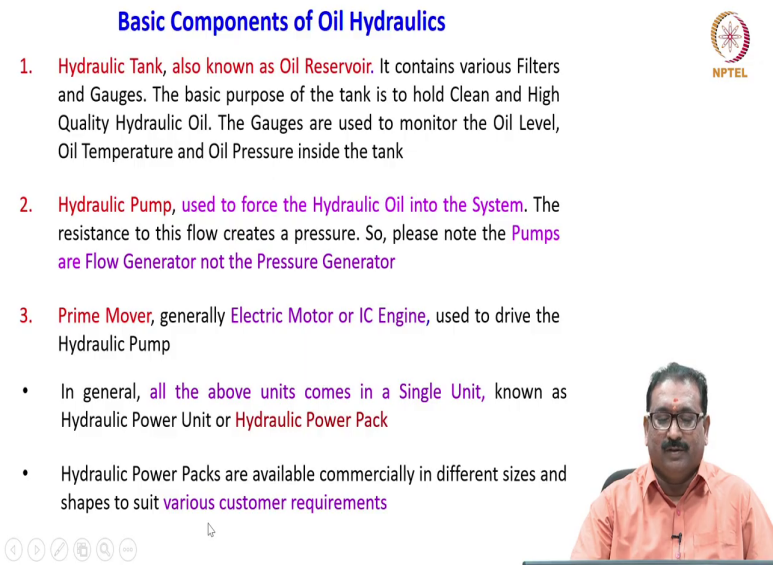

The details of each components are as follows. The hydraulic tank, also known as oil reservoir. It contains a various filters and a gauges. The basic purpose of the tank is to hold clean and high quality hydraulic oil. The gauges are used to monitor the oil level, oil

temperature and oil pressure inside the tank. Hydraulic pump, used to force the hydraulic oil into the system.

Please note the resistance to this flow creates a pressure. So, please note the pumps are flow generators not the pressure generators. Third component is prime mover, generally electric motor or IC engine, used to drive the hydraulic pump.

In general, all these units meaning hydraulic tank hydraulic pump and prime mover comes in a single unit known as hydraulic power unit or a hydraulic power pack. So, hydraulic power packs are available commercially in different sizes and shapes to suit various customer requirements.

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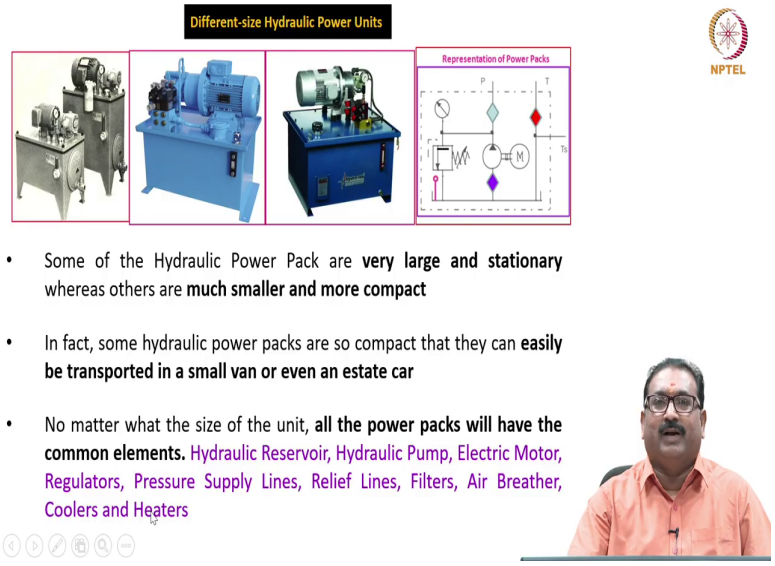

Here I am showing you the different sized hydraulic power packs, which contains the tank hydraulic tank, the pump, motor and various gauges. This is represented schematically in the circuit symbols here. Just see here this is a tank which will holds the oil, and then it is a filter, pump, then pressure relief valve, electric motor, return line filters.

The whole power pack is represented using the hydraulic symbols like this. Some of the hydraulic packs are very large and stationary; whereas others are much smaller and more compact. In fact, some hydraulic power packs are so compact that they can easily be transported in small van or even in estate car for the mobile applications.

No matter what the size of the unit, all the power packs will have the common elements. Hydraulic reservoir, hydraulic pump, electric motor, pressure regulators, power supply lines, relief lines, filters, air breather, coolers and heaters as and when needed in different environmental conditions.

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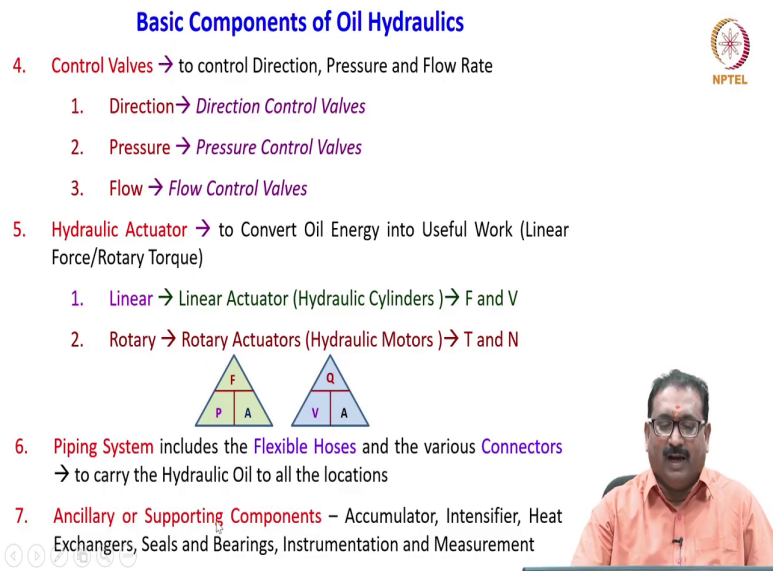

Move on to fourth components control valves. These are very very important in the hydraulic system to control the direction of the actuator or to limit the pressure level in the hydraulic circuits, and to control the flow rate to the actuators. Based on this, the control valves are available in three categories.

One is direction of the actuator to divert the flow into the head side or a tail side, they are known as direction control valves. Next one is pressure control valves which controls the pressure level in the hydraulic circuits. To control the velocity of the actuator or a speed of an hydraulic motor, we are using the flow control valves which controls the flow to the actuator – flow rate to the actuator.

Now, we will see friends here in all the cases the our objective in the linear actuator is a force output which is a function of P and A. A is constant in case of the linear actuators, then

variable thing is P to move the load of 1 Newton to 1 tonne variable parameter is a pressure, then pressure control valves are playing a major role to decide the force output.

Similarly, the velocity of the actuator V is based on the flow rate Q, again A is a constant for the particular cylinders. These will show you very quickly when you are calculating the P, F by A. When you are calculating F, P into A. Similarly, velocity of the actuator is q by A, or Q equal to V into A.

Fifth main components of the hydraulic system is hydraulic actuator to convert the oil energy into useful work linear force or a rotary torque what you want, you have to use the actuators. If you are control, the linear motion it is called a linear actuator, generally the hydraulic cylinders. Here important parameters are the F and V. Second category of actuator is rotary actuator in which we will get the torque and the speed they are known as hydraulic motors.

Sixth important component is piping system which includes the flexible hoses and the various connectors, to carry the hydraulic oil to all the locations in the circuit. Last but not the least, the hydraulic system consists of ancillary devices or a supporting components basically the accumulator, intensifier, heat exchangers, seals and bearings, instrumentation and measurement system to monitor the process parameters like a pressure and a flow.