Oil Hydraulics and Pneumatics
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Part 4: Screw type hydraulic motors, Vane type hydraulic motor -Unbiased and Balanced type
Lecture - 48
Hydraulic Motors

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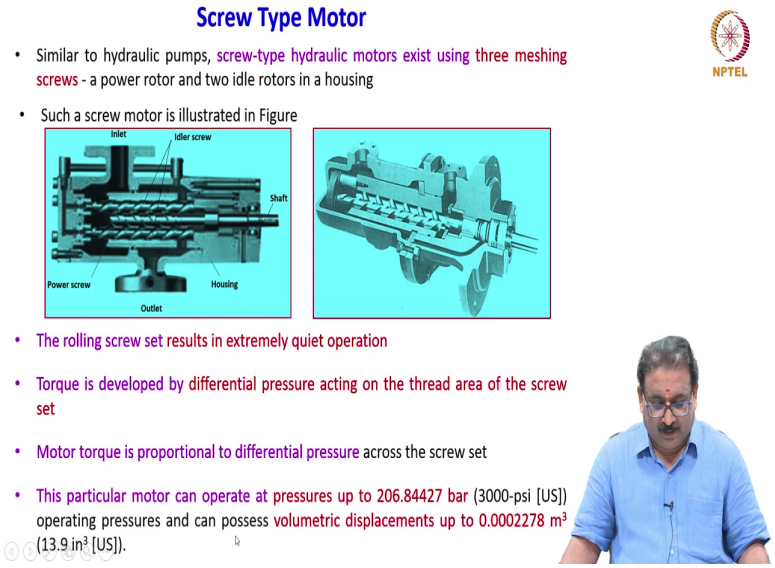

My name is Somashekhar, course faculty for this course. Now, we will move on to the one more type of motor that is a screw type motor. Similar to the hydraulic pumps, screw type hydraulic motors exist using three machine screws; one power rotor and a two idle rotors in a housing.

You will see here, the middle one is a power rotor or a power screw what you will call; middle one which is connected to the shaft and two are there; they are known as idle screw or a two idle rotors which will move when the centre one will move. And this is also the view which will show the three screws in the housing. The rolling screw set results in extremely the quiet operation; torque is developed by differential pressure acting on the thread area of the screw set.

Here, you will see here friends, here inlet is there here outlet is there. Inlet is a high pressure fluid which will act on the surface area mean along the axis of the screw; the fluid is rotates along the axial direction, then it will go to the outlet. Motor torque is proportional to differential pressure across the screw set. This particular motor can operate at pressure up to 206 bar operating pressure and can possess a volumetric displacement up to 0.0002278 m cube or 13.9 inch cube; US customary unit.

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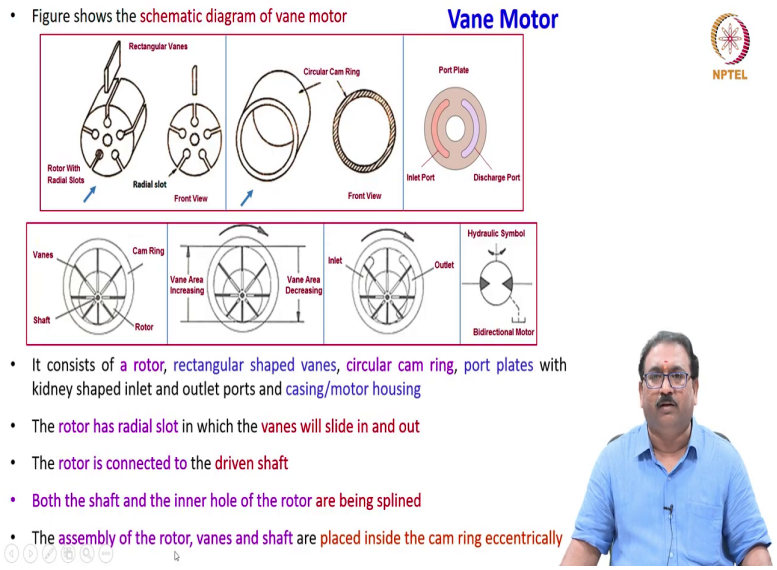

Now, we will move on to the vane motors; here the figure shows the schematic diagram of the vane motor. Please carefully observe here what are the main parts in the vane motor. Here you will see, again you will remember friends all the parts, constructional details are similar to the vane pumps.

Now, let us we will see here; here you will see the rotor with radial slots are there; you will see radial slots are there. And rectangular vanes are inserted in the radial slot correct; this is the front view of this. Next, you will see the circular cam ring which is a very important part in the vane motor because to which always vanes are in just the cam ring.

Then you will see one more I have shown here; port plate, how it is? Port plates are the kidney shaped port openings; inlet port and the outlet port. Now, we will see friends the

whole vane motor it is; here you will see this is the cam ring and middle one is a slotted rotor; the axis of the cam ring and the rotor are offset always.

Then, you will see here this area always increasing; increasing area vane area increasing because the fluid will enters from the inlet and acts on the exposed vanes which results in the torque to rotate; correct here; here I am showing you the vane area increasing when I will move from here to here. Then, here when it will rotate again further, the vane area goes on decreasing meaning always the discharge is here same.

So, see here the kidney shaped port openings I have shown here; exposed areas of vane will experience the pressurized fluid. And as it will move further after rotating the shaft which is connected to the rotor and it leaves the outlet to the tank. As I have told you the gear motors and vane motors are bi directional; please note the bi directional symbol of the motor.

Now, we will see the constructional details of this; I already told you, just we will see very quickly. It consists of a rotor, rectangular shaped vanes, circular cam ring, port plates with a kidney shaped inlet and outlet port and a casing or a motor housing; all are enclosed in the motor housing. Motor housing is not shown in the figure; the rotor has a radial slot in which the vanes will slide in and out.

The rotor is connected to the drive; driven shaft where you require the torque and speed with a pressurized fluid and the flow rate. Both the shaft and the inner hole of the rotor are being splined. The assembly of the rotor vanes and shaft are placed inside the cam ring eccentrically.

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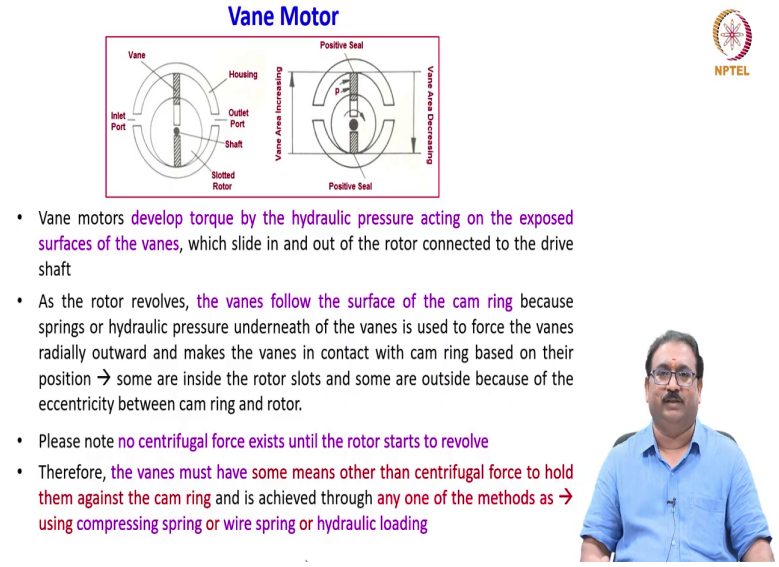

Vane motors develop a torque by the hydraulic pressure acting on the exposed surface of the vanes. You will see when the some vanes are coming out; some vanes are inside based on the; based on the eccentricity. You will see now only two vanes I am shown here; the one vane is inside the radial slot, other vane is away it away from the real slot. Now, this is experienced in the pressure; you will see here.

The vanes are always in contact with the cam ring; they will provide the positive seal, how to achieve this; I will tell you. As the rotor revolves, the vanes follows the surface of the cam ring always it is because springs or a hydraulic pressure underneath of the vanes used to force the vanes radially outward and makes the vanes in contact with the cam ring based on their position.

That is some are inside the rotors; as I have told you and some of the vanes are outside because of the eccentricity between the cam ring and the rotor always. You have make an arrangement such a way that the vanes are always in contact with the cam surface. How to do this? As I have told you using the springs or the hydraulic pressure; I will tell you now how it is. Please note, no centrifugal force exist until the rotor starts to revolve.

Therefore, the vanes must have some means other than the centrifugal force to hold them against the cam ring and is achieved through any one of the following methods as using the compressing spring or a wire spring or hydraulic loading. Use any one of the methods to keep waves always in contact with the cam surface.

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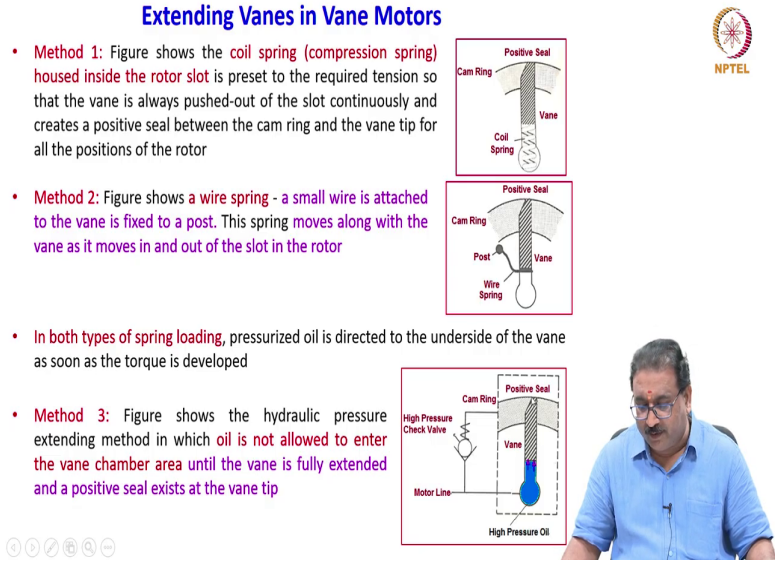

How it is; I will show you this is what is known as extending of vanes in the vane motor. Method 1, you will see here; I am using the coil spring to make vane always in contact with

the cam ring, to ensures the positive seal correct. And one more I will show you; method 2, I will show you here you will see I am using the wire spring, a small wire is attached to the vane; it is fixed to the post.

This spring moves along the vane as it moves in and out of the slot in the rotor; always this spring, wire spring ensures the positive seal with the vane and the cam ring. In both type of spring loading, you load it like this or load it like this; the pressurized oil is directed to the underside of the vane, as soon as the torque is developed; method 3. You will see here in method 3; underneath of the vane always a high pressure oil which makes the vane to form the positive seal along with the cam ring.

Here figure shows the hydraulic pressure; extending method in which the oil is not allowed to enter the vane chamber area, until the vane is fully extended and positive seal exists at the vane tip; that is the beauty of the here because it will not allow; once it is full and making the seal, oil will entering in the chamber.

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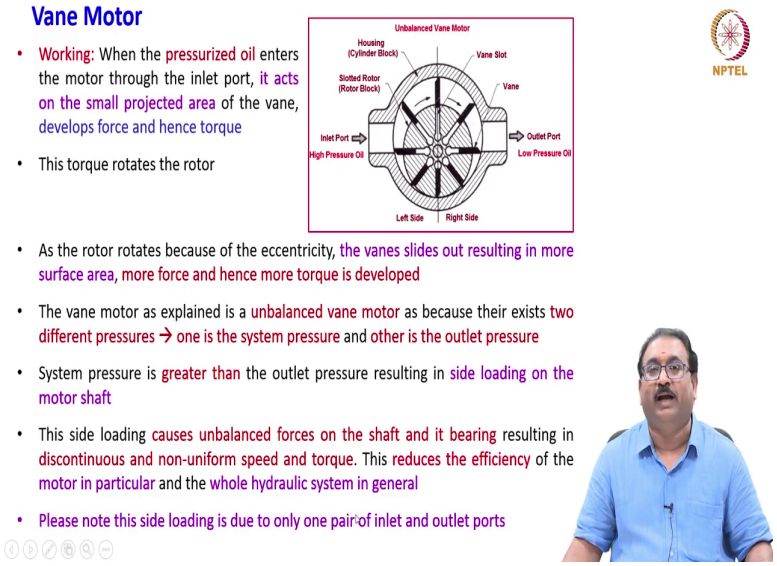

Now, quickly I will show you the working principle here; same as usual the vane pump how we are seeing. Here, you see the inlet is there, outlet is there; this is the rotor and the cam ring with the housing I have shown you here; both are offset.

The high pressure fluid will enter here; then these are the vanes exposed via which will create the torque to rotate the shaft; after rotating they will leaves the outlet with a low pressure oil. See, when the pressurized oil enters the motor through the inlet port, it acts on the small projected area of the vanes; here projected areas of the vane develops the force and hence the torque. This torque rotates the rotor.

As the rotor rotates because of the eccentricity, the vanes slides out resulting in more surface area and more force; hence more torque is developed. The vane motors as explained is unbalanced vane motor as because there exist a two different pressure; one is that, the inlet

pressure is system pressure very high and the outlet pressure is the very low pressure which is a tank pressure.

System pressure is greater than the outlet pressure resulting in side loading on the motor shaft. The side loading causes the unbalanced force on the shaft and its bearings resulting in discontinuous and non uniform speed and torque. This reduces the efficiency of the motor in particular and the wholes hydraulic systems in general. So, please note this side loading is due to the only two ports; inlet port and outlet port.

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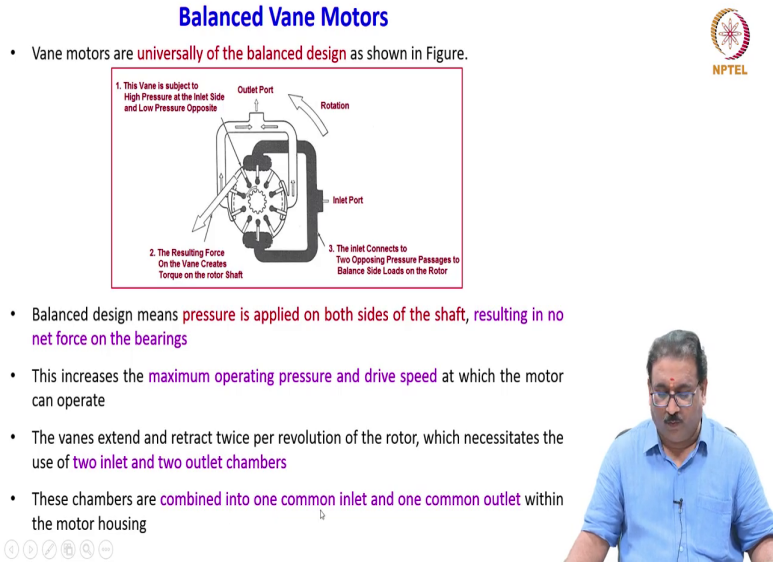

Now, we will see the balanced vane motor; the vane motors are universally of the balanced design as shown figure. Here you will see friends; again I have marked the very important points on the figure. And here you will see the inlet diametrically opposite to inlets and diametrically opposite to outlets which are combined.

Here, you will see friends meaning here it is instead of the circular cam ring; I am using the elliptical cam ring, to form the two inlet exactly opposite to each other and two outlet exactly opposite to each other and they will connect as a one line; inlet port and a outlet port, as I am told you.

You will see here friends; here you will please see this vane is subjected to high pressure, at the inlet side and a low pressure opposite. The resulting force on the vane creates a torque on the rotor shaft. The inlet connects to two opposing pressure passages to balance side loads on the rotor. How it will work, you will see now; the balanced design means pressure is applied on both sides of the shaft resulting in no net force on the bearings.

This increases the maximum operating pressure and a drive speed at which the motor can rotate. The vanes extend and retract twice per revolution of the motor which necessitates the use of two inlet and a two outlet chambers. These chambers are combined into one common inlet and one common outlet within the motor housing.

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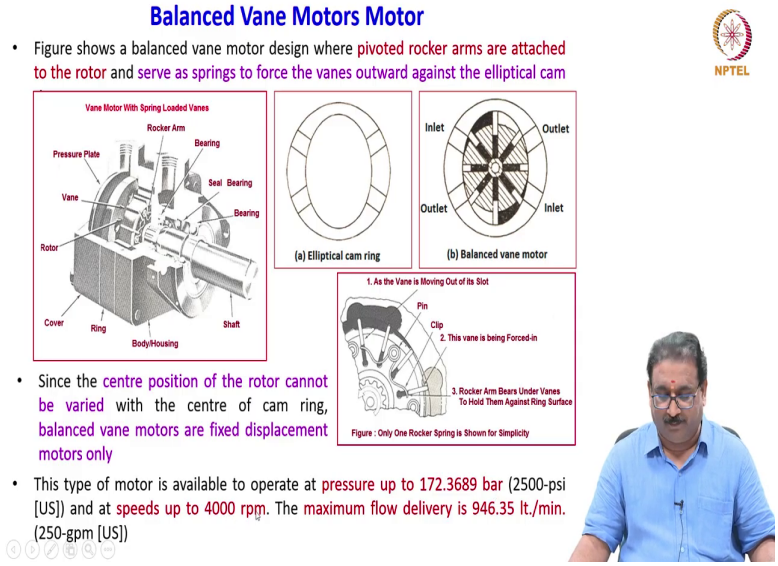

Figure shows here; I have shown the figure here the balanced vane motor design where pivoted rocker arm are attached to the rotor and serve as a springs force the vanes outward against the elliptical cam ring. Please see here carefully friends here; here the spring is there, see here this is the rocker arm means spring is used to keep the vanes always in touch with the cam ring.

The cam ring here; it is see the elliptical cam ring and you will see here the inlets exactly opposite outlets. These are the vanes meaning here inlet you will see where I have marked the black colour. Hydraulically balanced it is and also you will see here to understanding better through; the vanes will be keep always in touch with the cam ring.

You will see here, when it will move inside; this will compress, this will expand; here it is a pin. This is what we will call the rocker spring which is used to keep the vanes always

follows the surface area of the cam ring. Since the centre position of the rotor here cannot be varied with the centre of the cam ring; balanced vane motors are always a fixed displacement motors alone.

But in the previous case, you will see the motor and a cam ring axis offset; you will vary this eccentricity more more eccentricity more flow; if here it is not possible. Because here it is a elliptical cam ring and rotor is middle, you cannot vary this; that is why it is always the balanced vane motors are the fixed displacement motors.

This type of motor is available to operate at pressure up to 172 bar and at a speed up to 4000 rpm. The maximum flow delivery is 946 litres per minute; in US customary unit, 250 Gallons per minute.