SNS COLLEGE OF TECHNOLOGY, COIMBATORE – 35

Department of Mechanical Engineering

Academic Year 2019 -20 EVEN

II year B.E. – Mechanical Engineering IV semester

19MEE305 FLUID POWER Automation

UNIT - II

1. **What is the function of a pump in a hydraulic system?**

   A pump which is the heart of the hydraulic system converts mechanical energy in to hydraulic energy. The mechanical energy is delivered to the pump via a prime mover such as an electric motor.

2. **What is the function of hydraulic actuator?**

   The fluid discharged by the pump is directed to the hydraulic actuator. The actuator converts the pressure energy of the fluid in to mechanical energy.

3. **A pump has a displacement volume of 98.4 cm^3 / rev. It delivers 1.52 litres/sec. at 1000 rpm and 70 bar. If the prime mover input torque is 120 Nm. What is the over all efficiency of the pump? (Ap-May-04)**

   The volumetric displacement is,

   V_D = 98.4 cm^3 / rev * (1m / 100 cm) 3 = 0.000100 m^3 / rev

   Now we have,

   Q_T = V_D . N = (0.000100 m^3 / rev) (1000 / 60 rev/sec) = 0.00167 m^3/ sec

   Now the volumetric efficiency is,

   η_V = (Q_A/ Q_T) * 100 = ((0.00152 m^3/ sec) / (0.00167)) * 100 = 89.8%

   Now the mechanical efficiency is,

   $$\eta_m = (P.Q_T / T_A . N) * 100 = \frac{(70*10^5 \text{ N/ m}^2)\ (0.00167 \text{ m}^3\text{/ sec})}{(120 \text{ Nm})\ (1000 * 2\pi / 60 \text{ rad / sec})}$$

   η_m = (11,690 / 12570) * 100 = 93.0 %

   Therefore the overall efficiency is ,

   η_o = (η_v * η_m) / 100 =(89.8 * 93) / 100 = 85.5%

4. **What do you mean by cushioning of Fluid power actuators?**

   Due to the inertia force, the piston will hit cylinder head at full speed. To overcome this, cylinder cushioning is provided by which the hydraulic cylinder can be slowly retarded or cushioned.

5. **Define mechanical efficiency.**

   It indicates the amount of energy losses that occur due to the reasons other than leakages. This includes friction in bearings and between other mating parts.

   $$\eta_{mech} = \frac{\text{Theoretical Power required for operating the pump}}{\text{Actual power delivered to the pump}} * 100$$

6. Describe the working principle of screw pumps.

When the screws are turning, the spaces between the screws are divided into compartments. The fluid contained in these compartments is pushed uniformly along the axis towards the centre of the pump, where the compartments discharge the fluid.

7. What is the disadvantage of a balanced vane pump?

The disadvantage of this pump is that it cannot be designed as a variable displacement pump.

8. When there is no eccentricity in vane pump, what will happen?

When there is no eccentricity in vane pump, the pump flow will becomes zero

9. What is the working principle of piston pumps?

A piston pump works on the principle that it draws in fluid while retracting and discharge while extending.

10. What is a hydraulic actuator?

A hydraulic actuator converts fluid energy in to mechanical energy.

11. What is a hydraulic cylinder?

It is a device which converts fluid power into linear mechanical motion.

12. What is the use of single acting cylinder?

A single acting cylinder is designed to apply force in only one direction.

13. What is the use of double acting cylinder?

A double acting cylinder is capable of delivering forces in both directions.

14. When a telescoping rod cylinder is preferred?

Telescoping cylinders are used where long work strokes are needed.

15. How are single acting cylinders retracted?

Single acting cylinder retracts with the help of spring pressure.

16. Write the application of a double pump hydraulic system.

A typical application is punching press, in which the hydraulic ram must extend rapidly over a larger distance with very low pressure but high flow requirements.

17. Define hydraulic circuit.

A hydraulic circuit is an arrangement of interconnected components selected to achieve the desired work output.

18. What are the four critical sections of hydraulic circuit?

The four critical sections of hydraulic circuit are,

Section I- represents the energy input Section II-represents the energy control

Section III- represents the energy output Section IV- represents the auxiliaries

19. What is the design in formations required while designing hydraulic circuit?

The following are design in formations required while designing hydraulic circuit,

1. Sizing actuators from output objectives. 2. Sequence of operations.
3. Method of control. 4. Operating pressures. 5. Operating conditions.

6. Special requirements. 7. Component suppliers.

20. What is an accumulator?

An accumulator is a device that stores potential energy of an incompressible fluid held under pressure by an external source against some dynamic force.

21. List the forces that provide dynamic force for accumulators.

They are Gravity type, mechanical type and compressed gases.

22. Name the types of accumulators.

They are weight loaded, spring loaded and gas loaded accumulators.

23. Classify the gas loaded accumulator.

They are separator and non separator type.

24. What is called separator type accumulator?

In this type a physical barrier is provided between the gas and the fluid and hence they are called so.

25. List some of the gas loaded accumulators.

They are Piston type, diaphragm type and bladder type accumulators.

26. The operating principle of accumulator is based on what?

It is based on Boyle's law.

27. What is the formula used for isothermal charging and discharging?

The formula used for isothermal charging and discharging is $P_1 V_1 = P_2 V_2$

28. What is the formula used for adiabatic charging and discharging?

The formula used for adiabatic charging and discharging is $(P_1 V_1)^{\wp} = (P_2 V_2)^{\wp}$

29. Write the purpose of accumulator as compensator.

Accumulator is used as a compensator for internal and external leakage for an extended period of time during which the system is pressurized but is not in operation.

30. Why accumulator is called as an auxiliary power source?

Because it supplies oil to the system, in addition to the pump, when required.

31. Why accumulator is called as emergency source of power?

Because, the accumulator supplies the required fluid to the system to complete its operation, even pump fails.

32. Why accumulator is called as shock absorber?

Since it eliminates or reduces high pressure pulsation and hydraulic shocks, it is called so.

33. Which circuit is preferred for increasing the speed of extending stroke?

Regenerative circuit is preferred.

34. What is the use of synchronizing circuits?

When two or more cylinders are to be operated simultaneously, the synchronizing circuits are used.

35. List out the ways of synchronizing.

Tie cylinders, series piping, matching pumps are some of the ways of synchronizing.

36. List the applications of hydraulic circuits.

The hydraulic circuit is applied for the operations of planning, milling, drilling, grinding machines, etc.

37. What are safety circuits?

In case of emergency the operation has to be stopped immediately. For that purpose the safety circuits are provided in hydraulic systems.

38. What are two hand safety circuits?

In two hand safety circuits, until when the operator simultaneously presses push button by his both hands the circuit will function. During emergency if the operator removes any one of his hands, immediately the circuit will stop.

39. In a fail safe control circuit where the emergency cut off valve is installed?

It is installed between the pump and the DCV.

40. What are the types of piston rod mountings?

Rear pivot and centre trunnion mounted, one end rigidly fixed free load, One end rigidly fixed guided, One end rigidly fixed pivoted and guided load.

41. What are hydrostatic drives?

A hydrostatic drives consists of a positive displacement pump driving a hydraulic motor. Thus, a mechanical power transforms into fluid power and then reconverts the fluid power back into shaft power. The advantages of hydrostatic drive include power transmission to remote areas, infinitely variable speed control. Self-overload protection, etc.

42. What is the formula used to find the quantity of fluid flowing through flow control valve?

The formula used to find the quantity of fluid flowing through flow control valve is $Q= c\ a\ \sqrt{\Delta p}$, Q-quantity flowing, a-orifice area, c-constant, Δp-pressure drop.

43. What are the basic elements of hydraulic hoses?

The hose is made up of three basic elements namely reinforcement, inner tube and cover.

44. List any three factors considered in the selection of pump.

Maximum operating pressure, maximum delivery and pump speed.

45. List the uses of reservoir.

The reservoirs are used as Fluid storage tank, heat dissipation unit and entrained air to escape.

46. Write the empirical rule for sizing the reservoirs.

a) It must make allowance for dirt and chips to settle and for air to escape.

b) It must be able to hold all the oil that might drain into the reservoir from the system.

c) It must maintain the oil level high enough to prevent a Whirlpool effect at the pump inlet line opening. Otherwise, air will be drawn into the pump.

d) It should have a surface area large enough to dissipate most of the heat generated by the system.

e) It should have adequate air space to allow for thermal expansion of the oil.

For most of the cases, A reservoir having capacity of three times the volume flow rate is found to be adequate.

48. Name the basic components required in hydraulic system.

1) Reservoir 2) Pump 3) Hydraulic valves & Fittings 4) Hydraulic actuators

49. Why gear pump cannot be used as a variable displacement pump?

In the gear pumps, the displacement depends on the design parameters of gear and they cannot be changed. So the displacement cannot be varied in gear pumps.

50. What is meant by a balanced design vane pump?

In balanced design vane pump, there are two inlet and outlet ports which are diametrically opposite to each other. Because the pressure ports are opposite to each , a complete hydraulic balance is achieved.

51. Write the classification of pump.

i. Hydrodynamic (or) non-positive displacement pumps
ii. Hydrostatic (or) positive displacement pumps

52. Explain non-positive displacement pumps.

These types of pumps provide smooth continuous flow; their flow output is reduced when the circuit resistance is increased.

Example: centrifugal pump and propeller pump.

53. Explain positive displacement pumps.

This ejects a fixed quantity of fluid per revolution of the pump shaft. The pump outlet flow is constant and is not dependent on the system pressure.

Example: gear pump, vane pump

54. What are the types of positive displacement pump?

I. Gear pump

a)External gear pump b) Internal gear pump

c) Lobe pump d) Screw pump

II. Vane pump

a) Unbalanced vane pump b) Balanced vane pump

III. Piston pump

a) Axial pump b) Radial pump

55. Define volumetric efficiency of the pump.

It indicates the amount of leakage within the pump. This involves considerations such as manufacturing tolerances and flexing of the pump casing under the design pressure operating conditions.

η_v = (Actual flow rate produced by pump / Theoritical flow rate the pump should produced)*100

= (Q_A/Q_T) *100

56. Define overall efficiency of the pump.

η_O = (Power output by pump / Actual power given to the pump)

= $\eta_V * \eta_M$

PART - B QUESTIONS

UNIT - II

1. Name and explain three popular construction types of positive displacement pumps.
2. List out the important considerations when selecting a pump for a particular application.
3. Briefly describe the principle of working of balanced and non balanced vane pump.
4. Explain the working principle of bent axis piston pump.
5. What is pressure compensated vane pump and how does it work?
6. Explain the working principle of Gear & vane pump.
7. Explain the difference between axial & radial piston pumps.
8. Differentiate between internal & external gear pumps.
9. Distinguish between bent-axis-radial piston pumps and the swash plate pumps.
10. Distinguish between fixed displacement and variable displacement pumps.
11. Describe the construction and design features of hydraulic cylinders.
12. Explain the operation and features of double-rod cylinders and telescoping cylinders.
13. Describe the purpose, construction, and operation of hydraulic shock absorbers.
14. Explain the operation of gear, vane, and piston hydraulic motors.
15. Analyze the operation and performance of hydrostatic transmissions.