

Tanta University	 Hydraulic and pneumatic circuits	4th Year Mech. Power
Faculty of Engineering		Final Exam – Sep., 2015
Mech. Power Engineering Dept.		Time: 3 hours.

• Assume any missing or additional data.
 • Attempt all questions.
 • Support your answers with neat sketches whenever necessary.

الامتحان من ورقتين كل ورقة لها وجهين

Question (1)

- What are the requirements of hydraulic fluids?
- Explain the principals of operation and the possible applications of the hydraulic accumulators.
- For the hydraulic circuit shown in Figure (Q1.c) and from the information given, calculate the following parameters:
 - Extending speed,
 - Retracting speed,
 - Pressure required to lift the load,
 - Flow from the rod end (annulus area) of the cylinder while extending,
 - Pump output power during load extension.

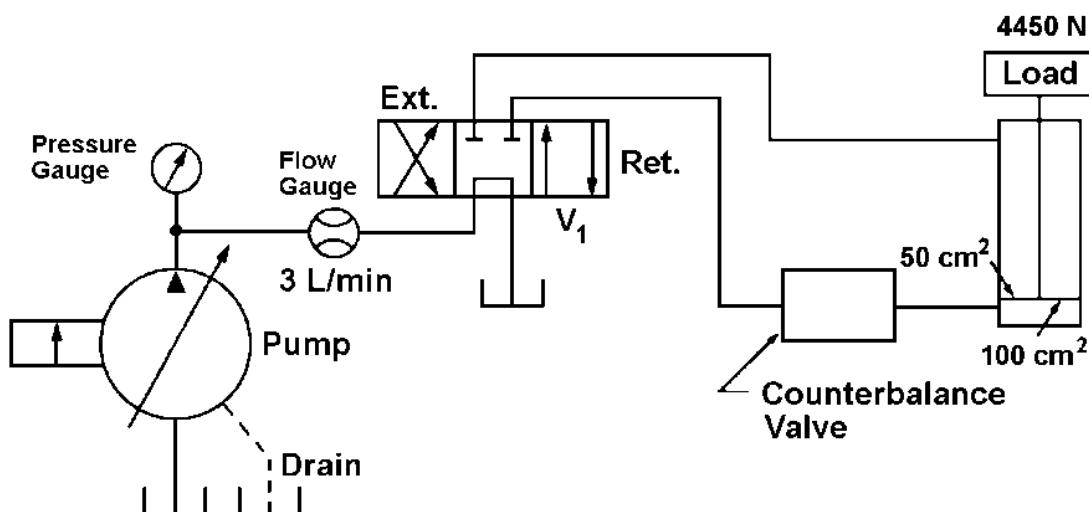


Fig. (Q1.c)

Question (2)

- Operationally, what is the difference between a pressure relief valve and a pressure reducing valve? Draw the construction and symbol of each valve.
- What is meant by a hydrostatic drive?
- Explain the function and principal of operation of cushion with a neat sketch.

d. A lathe head stock (غراب الرأس للمخرطة) is directly driven by a hydraulic motor. The lathe is used to turn a bar with a maximum diameter of 60 mm. The maximum tangential cutting force on the lathe tool is 2 kN and the maximum rotational speed of the head stock is 700 rev/min. The maximum pressure set by the relief valve is 200 bar and the total pressure drop between the relief valve and the hydraulic motor is 10 bar, the back-pressure at the motor being 5 bar. The overall and volumetric efficiencies of the motor are 0.85 and 0.9 respectively. Determine:

1. The minimum displacement in cm^3/rad .
2. The flow rate to the motor at maximum speed.
3. The maximum hydraulic input power to the motor.

Question (3)

a. What are the differences between internal leakage and external leakage in the control valves and actuators and its effects on them? Explain how you can overcome these problems?

b. A cylinder having a bore of 50 mm with a rod diameter of 32 mm is used to lift a vertical load of 3 tonnes. The circuit used is shown in **Figure (Q3.b)**. The quantity delivered by the pump is 8 l/min, the relief valve is set at 180 bar and the cylinder extend meter-out flow-control valve is set at 4 l/min. Calculate:

1. The extend speed.
2. The pressure reading at gauge P_1 when the cylinder is extending at a steady speed.
3. The pressure registered on gauge P_1 if the cylinder is extended under no load conditions, i.e. load removed.
4. The setting of the retract flow control valve in l/min if the retract speed is the same as the extend speed.

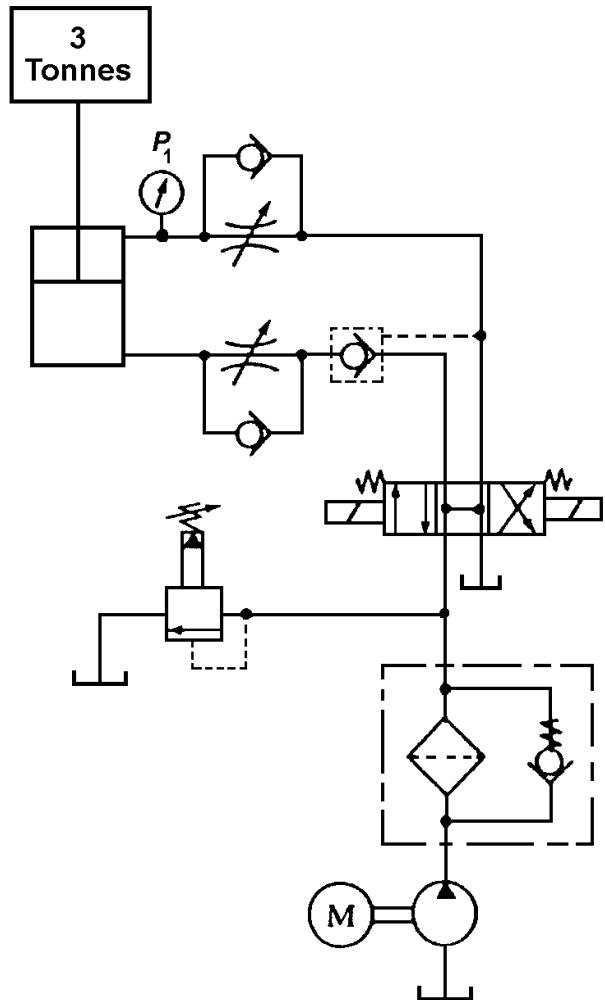


Fig. (Q3.b)

- c. A special machine is used to emboss graphic symbols on metal foil. The foil is fed through the embossing machine. The advanced motion of the stamp must be capable of being varied in accordance with the fed speed as shown in the **Figure (Q3.c)**. The return motion must always be executed as a rapid traverse. A One way flow control valve is used to control the speed of the stamp, while a pressure relief valve is used to prevent the weight of the stamp from pulling the piston rod out of the cylinder. A 4/2 way valve is used to switch between advance and return motion. Draw the hydraulic circuit diagram by choosing the correct components according to the machine function and above explanation.

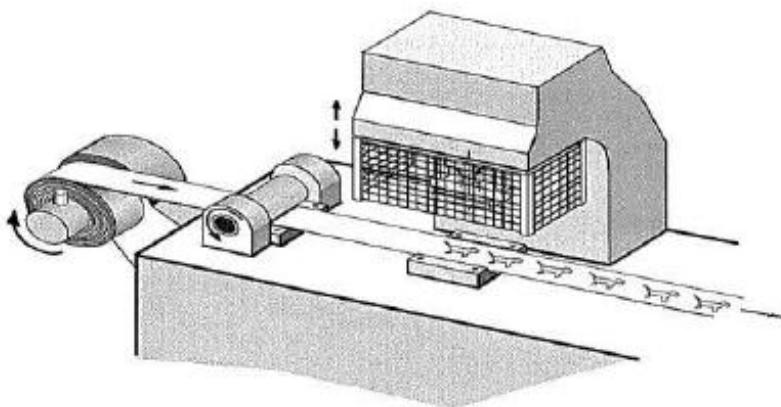


Fig. (Q3.c)

Question (4)

- a. In an application that requires a capacity flow of 100 L/min at 180 bar. If a partial load required a pressure of only 95 bar, and a metered flow rate of 40 L/min. Determine the total lost energy if:
1. The system as shown in **Figure (Q4.a)** under the same condition is used.
 2. A variable displacement pump under the same condition is used for the system in **Figure (Q4.a)**.
 3. A load-sensing system that uses a variable displacement pump has the destroking mechanism set at 15 bar under the same condition is used.
- Using (Q-P) diagram, show a comparison among three systems based on the used, lost and unused energies.
 - Explain the load-sensing system principle of operation with neat sketch.

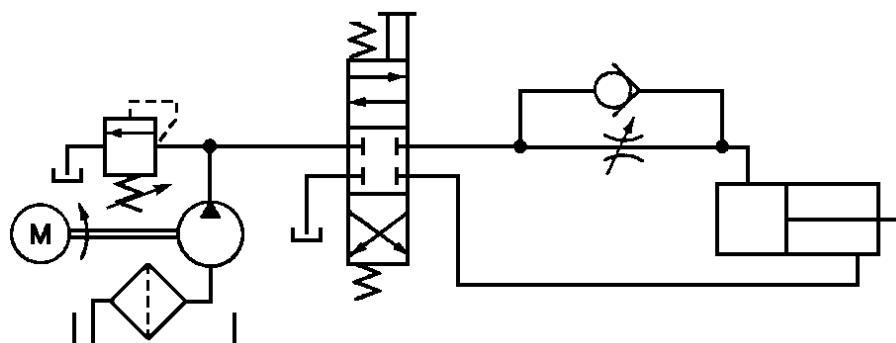


Fig. (Q4.a)

- b. For the circuit shown in Figure (Q4.b).

1. Identify the numbered components,
2. Describe the circuit's operation,
3. What are the functions of components number 5, and 8?
4. What is the pressure at PG1, PG2 and PG3 when the cylinders are extending?
(Consider left hand cylinder is carrying 75% of load)

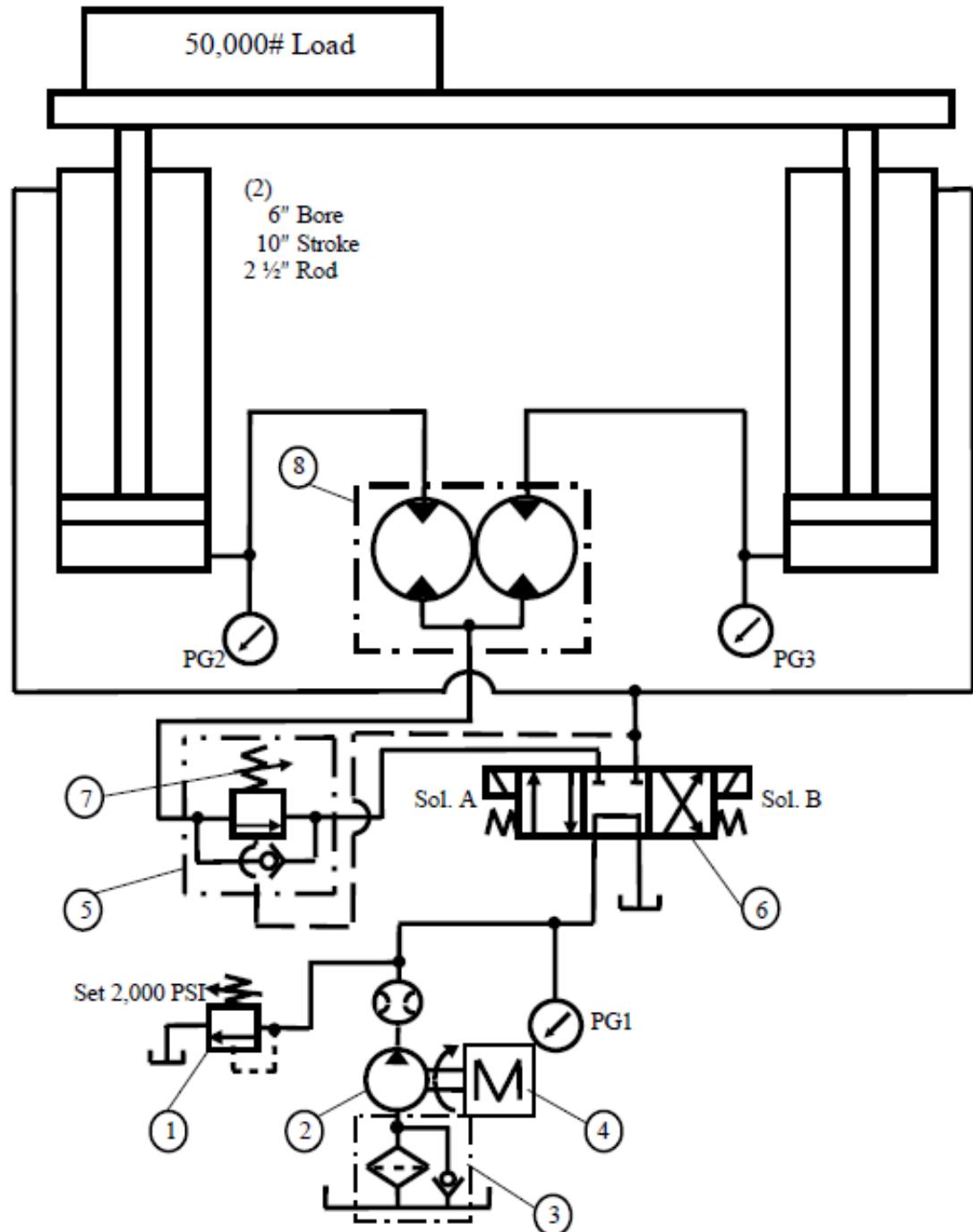


Fig. (Q4.b)

Good Luck