Simple Hydraulic Circuits and Controls

Objective:

To familiarize students with schematics and operation of simple hydraulic circuits.

Procedure:

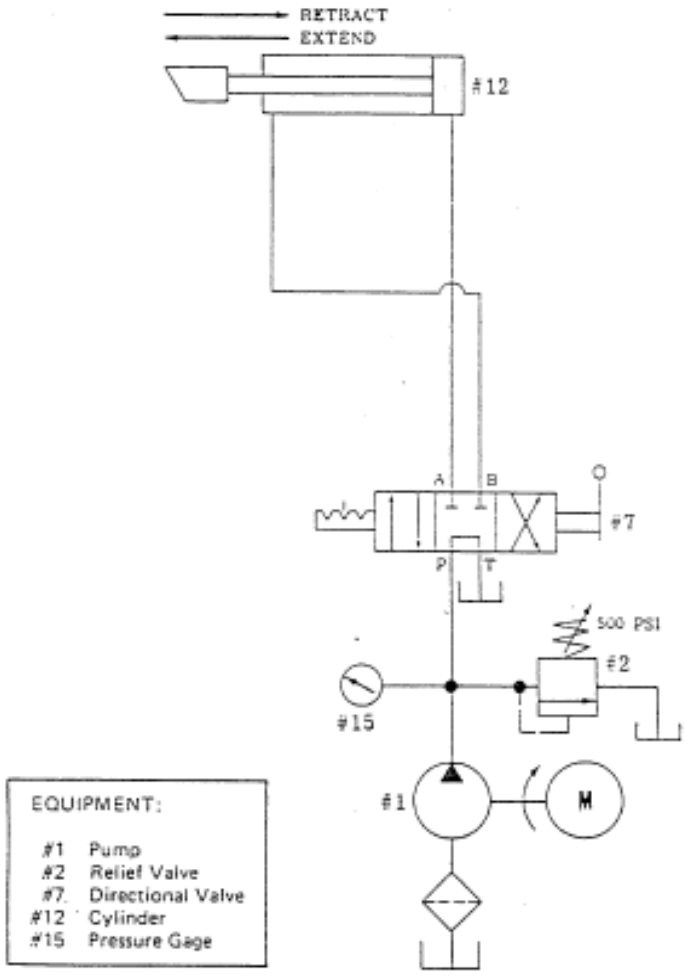
1). Analyze and understand several hydraulic circuits in the following pages . Schematic diagrams and descriptions of circuits are attached.

2) Complete and submit answers to problems and questions included with the material.

Circuit 1. Basic Hydraulic Circuit

TYPE: BASIC HYDRAULIC CIRCUIT (LINEAR)

OPERATION: EXTEND, RETRACT AND STOP



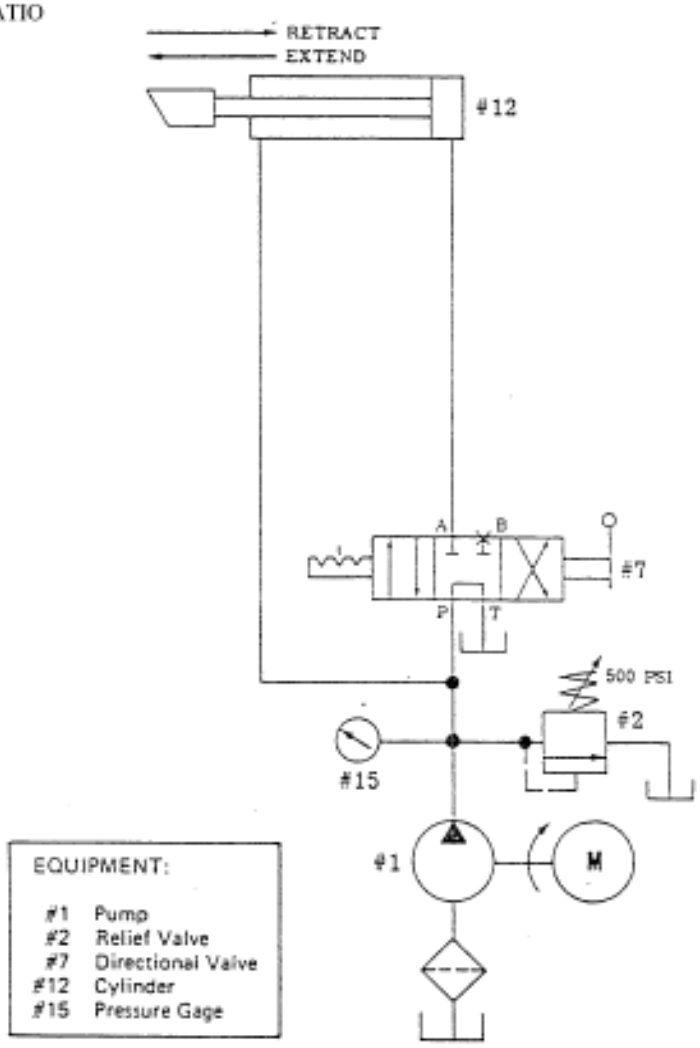
This system could be used for positioning a work table or other machine element. Direction of cylinder movement is controlled by shifting the handle of directional valve #7. When shifted to the left, oil flows from the pump (#1) through the valve, P to A, and to the cap end of cylinder #12, causing the cylinder rod to extend. Oil from the rod end of the cylinder flows back through the four-way directional valve, B to T, and to the reservoir.

Evaluate and briefly describe the hydraulic flow and cylinder operation of this circuit when the control valve is moved from the central position to the left position, and then from the central position to the right position. Comment on the difference in extension and retraction speeds and forces.

Circuit 2. Regenerative Hydraulic Circuit

TYPE: REGENERATIVE CIRCUIT

OPERATION: TO PROVIDE EQUAL SPEED AND FORCE WHILE EXTENDING AND RETRACTING, THROUGH THE USE OF A CYLINDER WITH 2 TO 1 AREA RATIO



Single rod cylinders move slower when extending than when retracting because of their differential piston areas. In the case of a 2 to 1 cylinder, such as cylinder #12, the area of the cap end is twice as great as the annular area* around the rod at the rod end of the cylinder. Consequently, it will move only half as fast when the rod is extending as it does when the rod is retraction.

*Annualar area = full area of piston minus area of the rod.

Evaluate and briefly describe the hydraulic flow and cylinder operation of this regenerative circuit when the control valve is moved from the central position to the left position, and then from the central position to the right position. Comment on the difference in extension and retraction speeds and forces.
Briefly describe the difference between a linear hydraulic cylinder and a regenerative one.

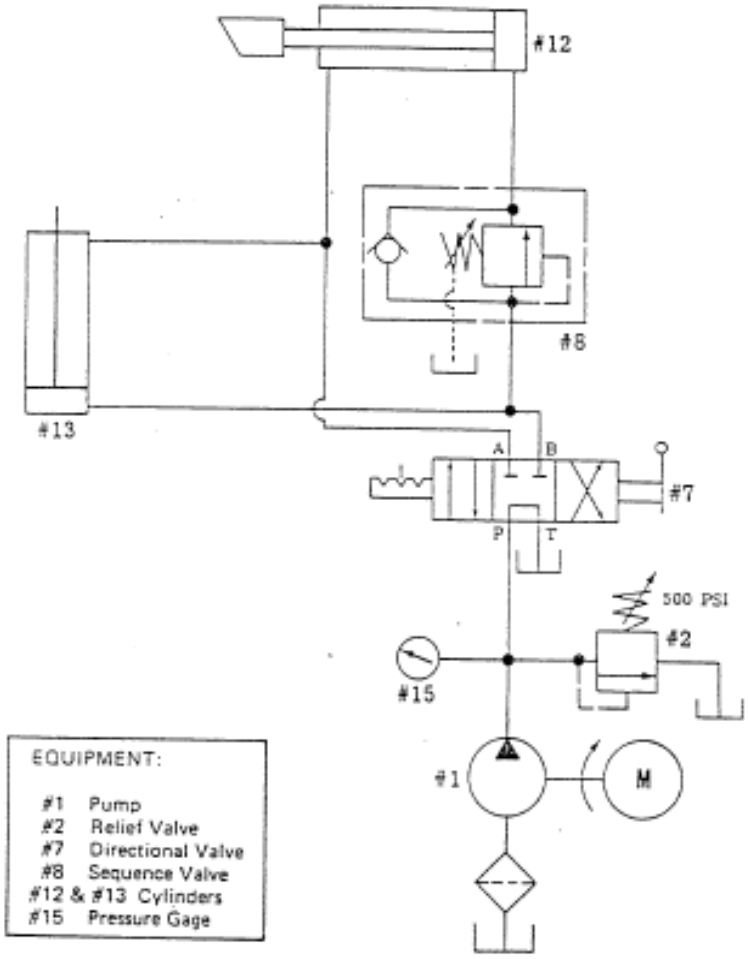
a) Will a single acting cylinder work in either case and, if not, why not?

b) What differential piston area ratio is required for the regenerative system? Will any other ratio work?

Circuit 3. Sequencing Hydraulic Circuit

TYPE: SEQUENCING CIRCUIT

OPERATION: TO HAVE ONE OPERATION OCCUR BEFORE ANOTHER



Hydraulic cylinders must often function in sequence. For example it would be necessary to clamp a workpiece before performing some operation such as drilling or milling. In this circuit, when the handle of directional valve #7 is shifted to the right, oil from port B flows to both the cap end of cylinder #13 and to the inlet port of sequence valve #8. The sequence valve is spring loaded to remain closed until cylinder #13 is extended and clamps the work.

Evaluate and briefly describe the hydraulic flow and cylinder operation of this circuit when the control valve is moved from the central position to the left position, and then from the central position to the right position.

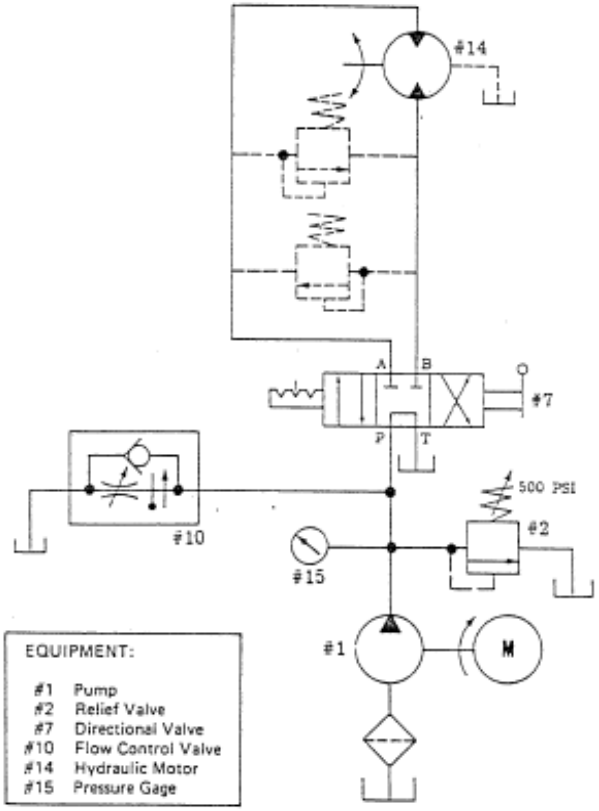
a) Determine the sequence of cylinder extension and/or retraction as the control value is moved from the center to left position

b) Determine the sequence of cylinder extension and/or retraction as the control value is moved from the center to right position

Circuit 4. Motor speed control Circuit

TYPE: HYDRALIC ROTARY DRIVE WITH SPEED CONTROL

OPERATION: TO CONTROL MOTOR SPEED IN EITHER DIRECTION WITH BLEED-OFF FLOW CONTROL



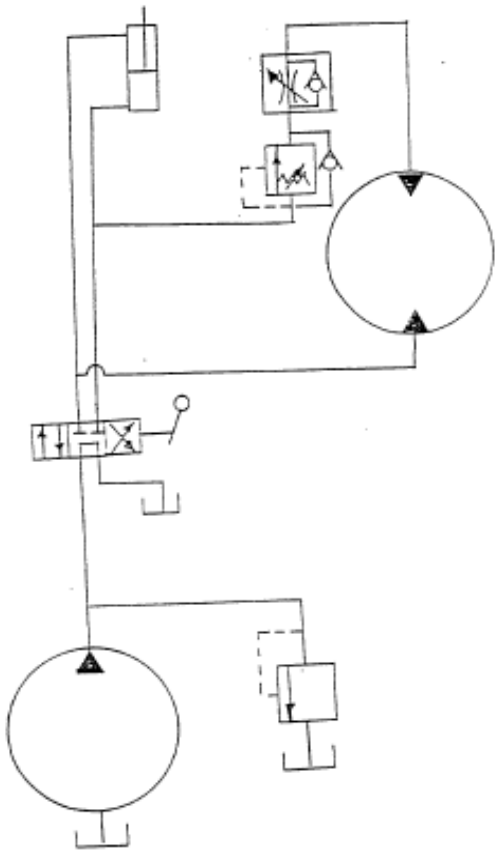
In this circuit, speed regulation of hydraulic motor #14 is accomplished through the use of flow control valve #10. Bleeding off fluid from the supply line permits the pump to operate at the pressure required to drive the motor and controls speed in both directions. It would not, however, control over-speeding in the event of an overhauling load. Should this be a problem, a meter-out circuit could be used; that is, one in which a flow control and check valve would be installed between the hydraulic motor and the directional valve.

Evaluate and briefly describe the hydraulic flow and cylinder operation of this circuit when the control valve is moved from the central position to the left position, and then from the central position to the right position.

a) Determine whether the motor speed can be controlled in both directions by the flow control valve #10. Explain how the speed control works in both directions.

b) What is the reason for the two pressure relief valves shown directly below the motor. Describe there operations as the control vale #7 closes.

Circuit 5. Motor speed control Circuit



Evaluate and briefly describe the hydraulic flow and cylinder operation of this circuit when the control valve is moved from the central position to the left position, and then from the central position to the right position.

a) Determine whether the motor speed can be controlled in both directions. Explain how the speed control works in both directions.

b)

i). Describe the sequence of events as the directional valve is move to its various positions.
ii). Is this an "open" or "closed" center system?
iii). Is the motor reversible or does it always run in the same direction?
iv). Can the motor speed be varied? How and when can it be varied?
v). Under what conditions can the motor speed not be varied?

Problems:

1. A double acting cylinder has a piston diameter of 2 inches and a rod diameter of 3/4". The piston stroke is 8 inches.

a) If oil can be supplied to either end of the cylinder at a pressure of 1000 psi and a flow of 3 gal/min, calculate the force that can be developed and time of travel (in seconds) during extension and retraction.

b) Briefly explain why the forces and speeds are different during extension and retraction.

c) Show whether the power developed is the same or different during extension and retraction.. Use your values of forces and time.