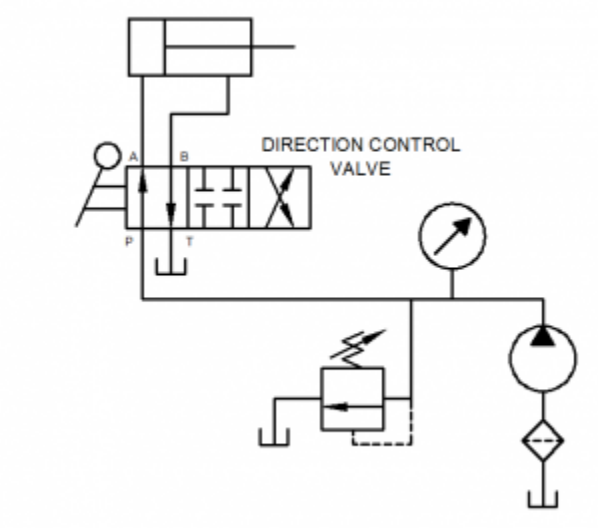
Hydraulic Cylinder Example

by ManufacturingET.org · September 6, 2012

Objective: To become more knowledgeable with the hydraulic system. The actuator is the general term used for the output device of hydraulic system. Two broad categories are linear actuators that deliver power in a straight line, and rotary actuator that deliver their power in a rotating or circular motion. The linear device is called a hydraulic cylinder. Hydraulic cylinder is linear actuator. This means that the output of a cylinder is a straight-line motion or force. The major function of a hydraulic is to convert hydraulic power into linear mechanical force to perform work or transmit power.



Procedure/ demonstrations:

1. Make sure relief valve #2 is set at 500 Pound per square inch (PSI). Globe valve # 3 is open, Needle valve #4 is closed, and Needle vale #6 is open.

2. At manifold pressure gauge #5 used the hoses connect with direction valve # 7.

3. Two-output gauge on the direction valve # 7 use the hoses connect with cylinder #12.

4. Shift direction valve # 7 to center or neutral position.

5. Turn on hydraulic power supply.

6. Shift direction valve # 7 to extend and retract both piston rod. We will see cylinder pressure to extend and retract.

7. Turn off hydraulic power supply.

Now: Re-design the circuit to apply an equal pressure to the rod and cap end of the cylinder. What is the predicted result? What is the actual result?

Discussion:

When we turn power on then shift direction valve to extend and retract we will see the cylinder pressure to extend and retract. This is a double acting cylinder is the most common type used in industrial hydraulics. Hydraulic pressure is applied to either port, providing powered motion when extending or retracting. The majority of cylinder in use is basic double acting cylinder as above. That cylinder is classed as differential cylinder because there is unequal area exposed to pressure during the extend and retract movements. The difference is cause by the cross section area of the rod, which reduces the area under pressure during retraction. Rod extension velocity is slower than retraction because more fluid is required to fill the swept volume of the piston. However, greater force is possible because the pressure operates in the full piston area. When retracting, the same flow from a pump causes faster movement of the cylinder because the volume of the cylinder rod reduces the swept volume. With the same system pressure, the maximum force exerted by the cylinder is also less because of the smaller area under pressure. Cylinder speed, the output force available, and the pressure required for a given load are all dependent on the piston area when extending the rod. When retracting the rod, the affective area of the rod end of the cylinder must be used. This “affective area” or “annulus area,” of the rod end is determined by subtracting the area of the rod from the piston area.

Summary: Hydraulic cylinder is among the simplest of devices in fluid power, having one moving part: the piston and the rod assembly. However, forces generated by cylinders are also among the largest found in fluid power systems. Pressure in the cylinders can, and often do, exceed system relief settings. The life of the cylinder and the system can be highly dependent on proper specification and maintenance of a simple element, the rod wiper/scraper.

Hydraulic Motor Circuit

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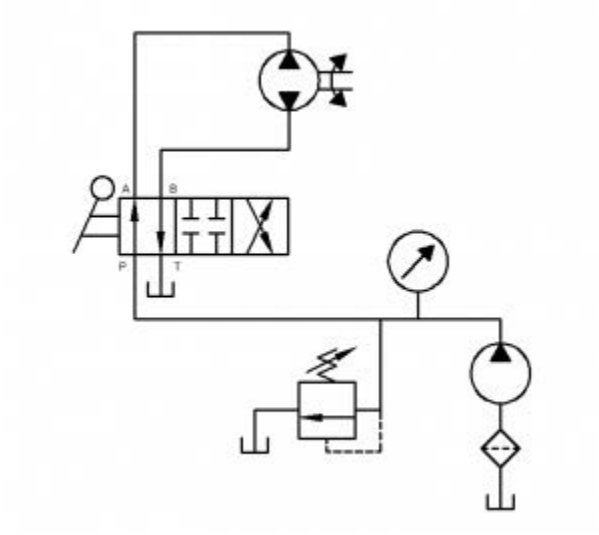
Exercises 1: The basic output motion of a hydraulic system to Hydraulic cylinder.

Objective: To become more knowledgeable with the hydraulic system. The actuator is the general term used for the output device of hydraulic system. Two broad categories are linear actuators that deliver power in a straight line, and rotary actuator that deliver their power in a rotating or circular motion. The linear device is called a hydraulic cylinder. Hydraulic cylinder is linear actuator. This means that the output of a cylinder is a straight-line motion or force. The major function of a hydraulic is to convert hydraulic power into linear mechanical force to perform work or transmit power.



Procedure/ demonstrations:

1. Make sure relief valve #2 is set at 500 Pound per square inch (PSI). Globe valve # 3 is open, Needle valve #4 is closed, and Needle vale #6 is open.

2. At manifold pressure gauge #5 used the hoses connect to direction valve # 7.

3. Two-output gauge from the direction valve # 7 use the hoses connect to hydraulic Motor #14. (Add a hose for drain from motor)

4. Shift direction valve # 7 to center or neutral position.

5. Turn on hydraulic power supply.

6. Shift direction valve # 7 to forward and reverse. We will see motor rotation for two way counter clockwise, and clockwise.

7. Turn off hydraulic power supply.

Discussion: when we shift the direction valve forward or reverse we will see the motor rotation two way there are counter clockwise and clockwise. The torque is the rotational force component of the motor's output. It is a turning or twisting effort by the output shaft. Motion is not required to have torque, but if the torque is sufficient to overcome any resistance to it, rotary motion will be result. The torque is always present at the drive shaft, but is equal to the load multiplied by the radius. A given load will impose less torque on the shaft if the radius is decreased. However, the large radius will move the load faster for a given shaft speed. Motor speed is a function displacement and the volume of fluid delivered to the motor. Maximum motor speed is the speed at a specific inlet pressure with the motor can sustain for an adequate period of time without damage. Minimum motor speed is the slowest, continuous, smooth rotational speed of the motor output shaft. Slippage is the leakage across the motor or the fluid that moves through the motor without doing any work. Pressure required in a hydraulic motor depends on the torque load and the displacement. A large displacement motor will develop a given torque with less pressure than a small unit. Motors will have maximum pressure rating, which is the highest inlet pressure and, therefore, the highest torque load. The motor can continuously withstand for an adequate period of time without damage. The size and torque rating of a motor is usually expressed in pound inches of torque per 100 PSI of pressure.

Summary: All hydraulic motors have several factors in common. Each type must have a surface area acted upon by a pressure differential. This surface is rectangular in gear and vane motors, and circular in radial and axial piston motors. The surface area in each kind of motor is mechanically connected to an output shaft from which the mechanical energy is delivered. Finally, the porting of the pressure fluid to the pressure must be timed in each type of hydraulic motor in order to sustain continuous rotation. The maximum performance of a motor in terms of pressure, flow, torque output, speed, expected life, and physical configuration is determined by the: Pressure capability of internal and external components, Internal leakage characteristics, and Efficiency of force and power transmittal. Hydraulic motors are rated according to displacement (size), torque capability, speed, and maximum pressure limitations.

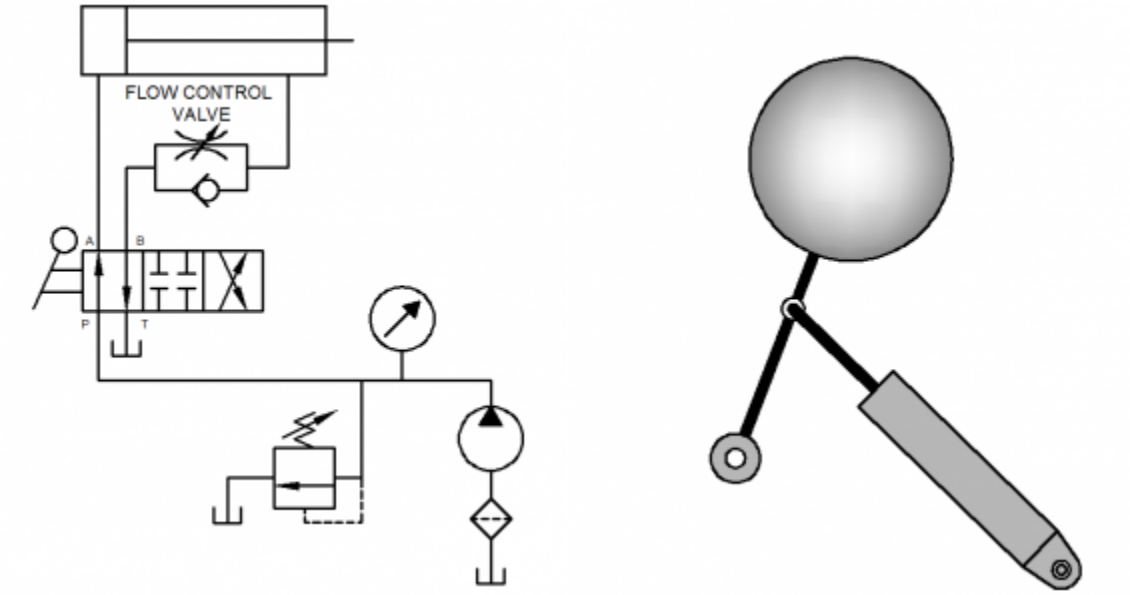
Flow Control Valve (Meter-out) Circuit

by ManufacturingET.org · September 6, 2012

The application of flow control valve (meter-out circuit)

Objective: To become more knowledgeable with the hydraulic system. Flow control valve is controlling the rate of flow in a hydraulic circuit; it's possible to control the speed of hydraulic cylinder. A cylinder is speed is determined by its size and the flow rate of the oil going to or out of it. A large diameter cylinder would hold more oil and take longer to complete its stroke; a smaller the cylinder would move faster. Changing the flow rate from the pump would also change the extension time of the cylinder.

Metering out has the advantage of maintaining back pressure on the lower pressure side of the cylinder. This prevents sudden extension or retraction of the cylinder if the load reverses.



Procedure/ demonstrations:

1. Make sure relief valve #2 is set at 500 Pound per square inch (PSI). Globe valve # 3 is open, Needle valve #4 is closed, and Needle vale #6 is open.

2. At manifold pressure gauge #5 used the hoses connect to direction valve # 7.

3. Two-output gauge at the direction valve # 7 use the hoses one connect to Extend hydraulic cylinder #12 and another one connect to flow control valve # 10, then at out put from flow control used the hose connect with retract cylinder (in this case we called meter-out circuit) also, connect gauge #16 to rod end of cylinder #12 as show above.

4. Make sure direction valve # 7 is in center or neutral position.

5. Fully open Flow control valve #10 (clockwise rotation of adjusting knob).

6. Turn on power unit.

7. Extend and retracted piston rod of # 12

8. The pressure reading on gauge # 15 and #16 represent while piston rod is moving.

9. With piston rod retracted, fully close flow control valve #10 (counterclockwise rotation of adjusting knob).

10. Shift direction valve # 7 to extend piston rod and slowly open flow control valve #10 until piston rod start moving slowly. The pressure in cap end of cylinder #12 indicates relief valve setting even though there is no external resistive load on piston rod of cylinder. The pressure in rod end gauge #16 higher than relief valve setting.

11. Turn off power unit.

Discussion:

The flow control is on the out let side of the cylinder to control the flow coming out. This is known as a meter-out circuit. A cylinder is speed is determined by its size and the flow rate of the oil going to or out of it. A large diameter cylinder would hold more oil and take longer to complete its stroke; a smaller the cylinder would move faster. Changing the flow rate from the pump would also change the extension time of the cylinder. Changing either the cylinder or pump size to regulate speed would be impractical, especial if a change were desired in mid-stroke. If the flow control were closed completely. In this case we should known about the retraction of the cylinder control by flow control valve. The oil could not exhaust from the cylinder and it could not move. Regulating the size of the open control flow rate, and therefore the speed, of the cylinder.

Conclusion:

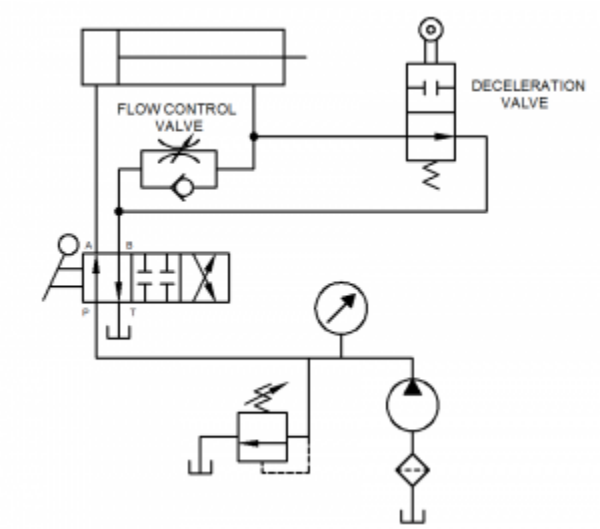
The meter-out circuit can be very accurate, but are not efficient. The meter-out circuit can control overrunning as well as opposing loads while the other one method must be used with opposing loads only. The choice of flown control valve method and the location of the flow control in the circuit are dependent on the type of application being controlled.

Bypass Flow Control Circuit

by ManufacturingET.org · September 6, 2012

Use a Deceleration valve to by-pass a flow control valve for part of a machine cycle.

Objective: The deceleration valve in this case to become knowledgeable more about the type of the valves for application in the hydraulic system. The hydraulic cylinder often has built-in cushions that slow down the cylinder pistons at the extreme end of theirs travel. An external valve is required when it is necessary to decelerate a cylinder at some intermediate position or to slow down or stop.



Procedure/demonstrations:

1. Make sure relief valve #2 is set at 500 Pound per square inch (PSI). Globe valve # 3 is open, Needle valve #4 is closed, and Needle vale #6 is open.

2. At manifold pressure gage #5 used the hoses connect to direction valve # 7.

3. Two-output gage at the direction valve # 7 use the hoses one connect to flow control valve #10 and deceleration valve # 11 another one connect to extend hydraulic cylinder # 12, then at out put from flow control and deceleration valve # 11 used the hose connect with retract cylinder (in this case we called meter-out circuit).

4. Make sure direction valve # 7 is in center or neutral position.

5. Fully close Flow control valve #10 (counterclockwise rotation of adjusting knob).

6. Turn on power unit.

7. Shift direction valve # 7 to Extend piston rod of # 12

8. The observe pressure on gage # 15 during the piston #12 extension.

9. The piston rod # 12 will be stopped when stem of deceleration valve #11 was depressed by cam on piston rod #12.

10. Open flow control valve # 10 until piston rod moving very slowly. The pressure in #15 is equal to relief valve setting when these are obviously no loads on the piston rod # 12.

11. Shift direction valve # 7 to retract piston rod # 12. The piston rod will return rapidly even though deceleration valve #11 is depressed a portion of the return stroke.

12. Turn off power unit.

Discussion:

The deceleration valve in a typical application above, at a preset point, the valve slows drill head cylinder from rapid advance speed to feed speed. There are exhaust flow from the cylinder passing unrestricted through the deceleration valve. With figure above that a cam mounted on the cylinder rod depresses the valve plunger. Exhaust flow is blocked at the deceleration valve and pass through the flow control valve, which sets the feed speed. The direction valve in this case is reversed to return the cylinder. The plunger is depressed or not, oil from the direction valve passes through the flow control valve.

Conclusion:

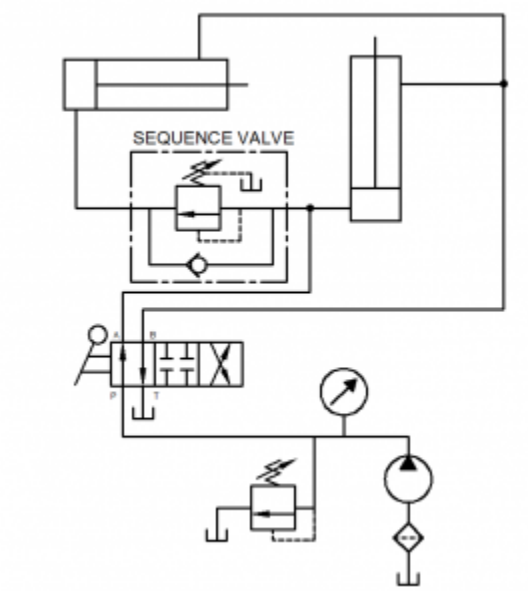
The deceleration valve is restricter type flow control. It is usually used in meter-out circuit. Most deceleration valves are cam operator with tapered spool. It is gradually decrease flow to or form an actuator for smooth stopping or deceleration. A normally open valve cuts off flow when a cam depresses its plunger. It may be used to slow the speed of a drill head cylinder at the transition from rapid traverse to feed.

Sequencing Valve Circuit

by ManufacturingET.org · September 6, 2012

The application of a Sequencing Valve

Objective: To become more knowledgeable with the hydraulic system. A sequence valve is used to cause actions to take place in a system in a definite order, and maintain a predetermined minimum pressure in the primary line while the secondary operation occurs. See simulation here.



Sequencing valve Detail:

Procedure/demonstrations:

1. Make sure relief valve #2 is set at 500 Pound per square inch (PSI). Globe valve # 3 is open, Needle valve #4 is closed, and Needle vale #6 is open.

2. At manifold pressure gage #5 used the hoses connect to direction valve # 7.

3. Two-output gage at the direction valve # 7 use the hoses one connect to sequence valve # 8 and cylinder # 13, then another one connect to hydraulic cylinder # 12, and from the pipe tee at end cap of cylinder # 12 use the hoses connect to cylinder # 13 as show above.

4. Make sure direction valve # 7 is in center or neutral position.

5. Increase pressure setting of sequence valve # 8 as far as possible.

6. Turn on power unit.

7. Shift direction valve # 7 to extend piston rod of # 12 and # 13.

8. We will see that only piston rod #13 extension and system pressure then increases to relief valve setting.

9. Reduce pressure setting of sequence valve # 8 until piston # 13 extends and gage #15 read at least 150 PSI less than relief valve setting. Extends and retract piston rod # 12 and # 13 a few time, so that the sequence valve operation and the different pressure indicated on gage #15.

10. Turn off power unit.

Discussion:

In this case, the sequence valve is used to cause action to take place in a system in a definite order, and to maintain a predetermined minimum pressure in the primary line while the secondary operation. The fluid flows freely through the primary passage to operate the first phase until the pressure setting of the valve is reached. As the spool lifts, flow is diverted to the secondary port to operate a second phase.

Conclusion:

The sequence valve is suitable for system where it can be installed upstream from the direction valve. If it is installed downstream a cylinder line, some provision must be made for return free flow when the cylinder is reversed. A typical application in this case it is clamping from the primary port and feeling a drill head from the secondary after the work piece is firmly clamped.