



HWH[®] REGENERATIVE HYDRAULIC CIRCUIT

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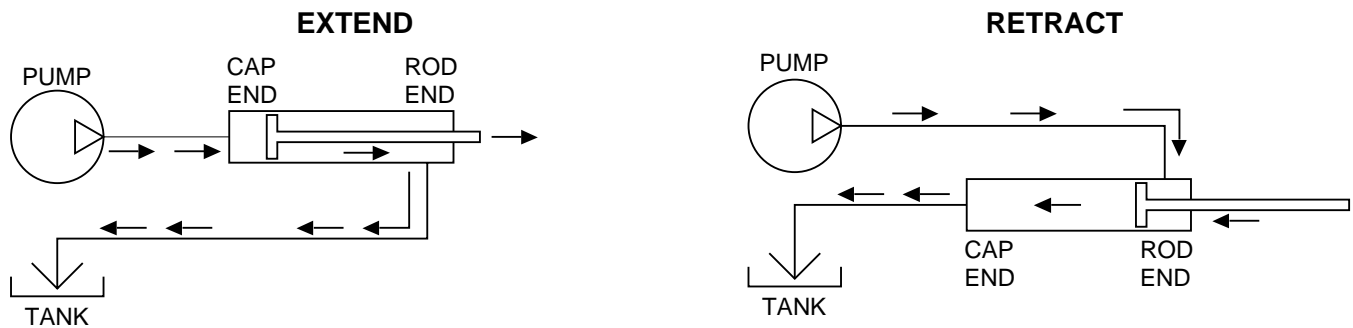
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HWH REGENERATIVE HYDRAULIC CIRCUIT

The Regenerative circuit is used when it is desirable to simplify the valving to retract or extend a cylinder. The regenerative circuit can be used to operate any number of cylinders on the same circuit. The use of a regenerative circuit allows the system to be operated with a simple manifold employing just two solenoid valves and a check valve as opposed to some type of spool valve or a manifold with three or four valves needed to operate a regular double-acting cylinder. The regenerative circuit is just a different way to operate a double-acting cylinder.

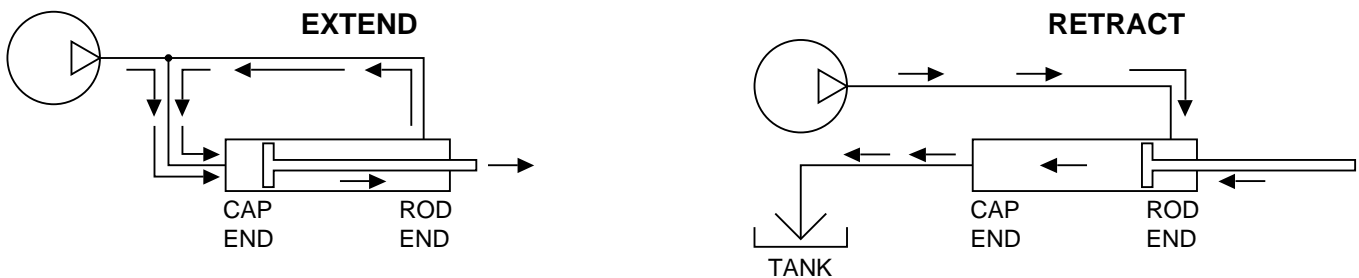
The most common way to operate a double-acting cylinder is to change the flow and pressure of the fluid to and from the cylinder when extending and retracting the cylinder. To extend a regular double-acting cylinder, fluid flow and pressure is directed to the cap end of the cylinder. Fluid is allowed to flow from the rod end of the cylinder back to the reservoir. There is little or no pressure on the rod side of the hydraulic circuit at this time. To retract the cylinder, fluid flow and pressure is directed to the rod end of the cylinder. Fluid is allowed to flow from the cap end of the cylinder back to the reservoir. There is little or no pressure on cap side of the hydraulic circuit.

DOUBLE ACTING CYLINDER



In a Regenerative circuit, when extending the cylinder, there is pressure on the cap side and the rod side of the cylinder. Fluid flows from the pump to the cap end of the cylinder. The piston pushes the fluid out of the rod end of the cylinder which then combines with the fluid from the pump going to the cap end of the cylinder, thus a regenerating motion. The fluid from the rod end is used to help extend the cylinder. When retracting the cylinder, there is pressure on the rod side of the cylinder only. Thus the Regenerative circuit is only used when extending a cylinder. The cylinder is retracted in the same manner as a regular double-acting cylinder. **An important difference between a double-acting cylinder and a regenerating cylinder is that there is pressure on the rod side of a regenerating cylinder when extending AND retracting.**

REGENERATIVE CYLINDER



HWH REGENERATIVE HYDRAULIC CIRCUIT

With a regenerative circuit, when extending the cylinder, there is essentially the same pressure on both sides of the piston. By making the area of the rod approximately $\frac{1}{2}$ the area of the piston, we have approximately a 2:1 ratio of area size. This will give us equal force when extending and retracting the cylinder.

To understand how the regenerative circuit works, it is necessary to understand two simple hydraulic formulas.
1st $F=PA$, 2nd $A = \text{Pi} (r^2)$.

F = FORCE (POUNDS)

A = AREA (SQUARE INCHES)

R = RADIUS OR DIAMETER DIVIDED BY 2 (INCHES)

PI = 3.14

PSI = POUNDS DIVIDED BY SQUARE INCHES

P = PRESSURE (PSI)

Because the pressure is essentially the same on both sides of the piston the force generated to extend the cylinder is the ROD AREA times the PRESSURE.

When retracting a regenerative cylinder there is full pressure on the side of the piston attached to the ROD and essentially no pressure on the other side. Therefore the force generated to retract the cylinder is PRESSURE times the PISTON AREA minus the AREA of the ROD.

Another important thing to remember is EXTERNAL FORCE can only be generated by the pressure acting on the movable sealed area. For example the sealed piston area and the rod sealed area.

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The following example is using the actual rod and piston size used in our most common room extension cylinders. By using special seals and materials, we are able to obtain an approximate 2:1 area size on our piston. The pressure in the system while the cylinder is moving is variable and would actually depend on many different factors such as weights in the room, room seal tensions, awning tensions, etc. In the following example the working pressure is assumed to be 3000 psi.

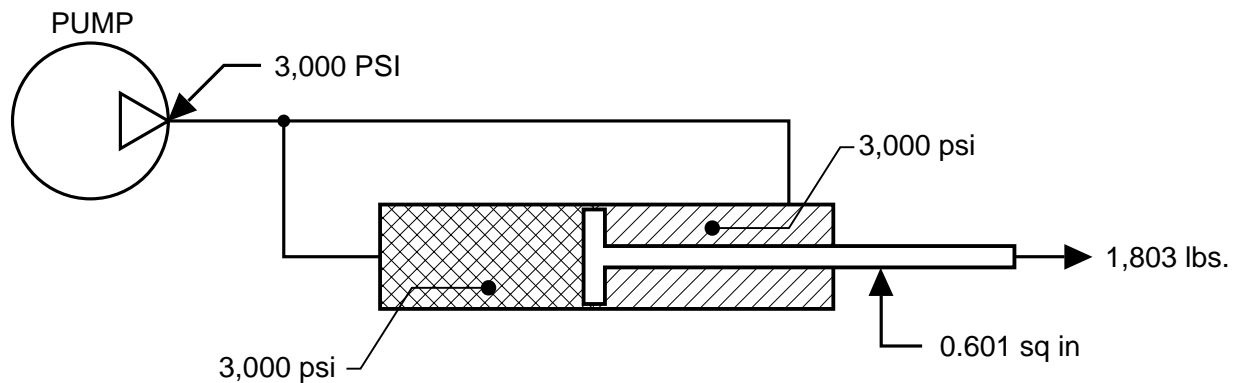
CYLINDER EXTEND

There will be 3,000 psi pressure on the cap and rod sides of the piston while the cylinder is extending.

The result is pressure on both sides will balance each other except for the area of the rod.

The rod diameter is .875" or .601 sq. in. [$3.14(.4375 \times .4375)$]

The net force this cylinder will produce when the cylinder is extending is $0.601 \text{ (Area of the Rod)} \times P \text{ (3000 psi)} = 1803 \text{ lbs.}$

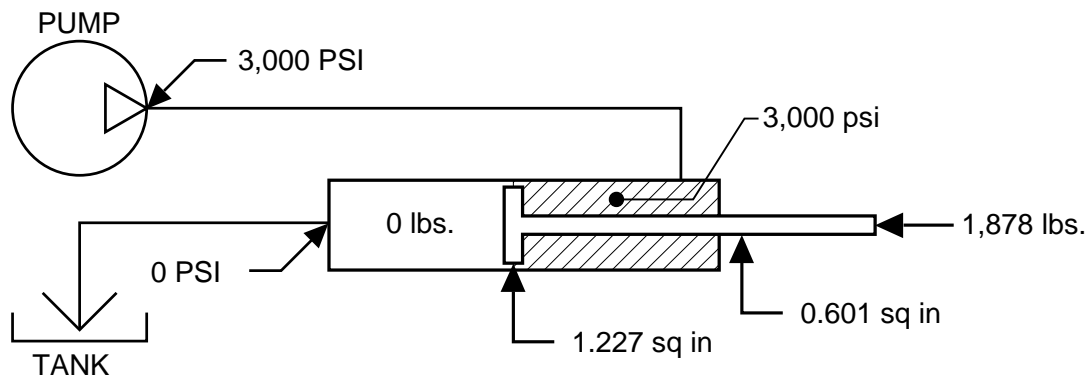


CYLINDER RETRACT

The piston and rod diameters do not change, thus the area on the cap and rod sides do not change.

The difference is there is no pressure on the cap side while retracting the cylinder.

The net force the cylinder will produce when retracting is $1.227 \text{ sq in (Area of the Piston)} - 0.601 \text{ (Area of the Rod)} \times 3000 \text{ psi} = 1,878 \text{ lbs.}$

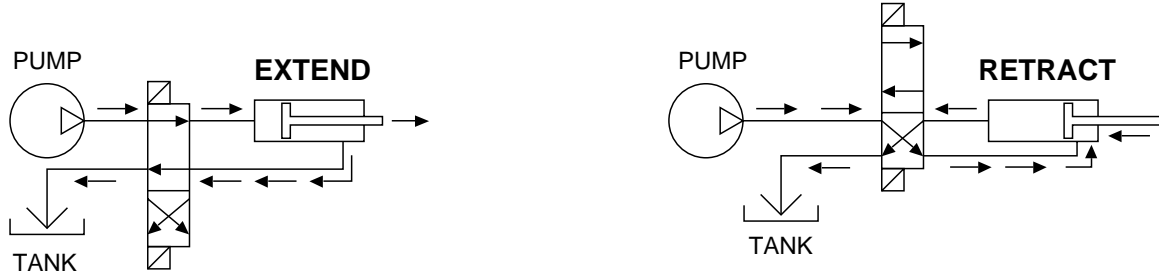


As you can see, by sizing the piston and rod size correctly, the force the cylinder in this example will produce is almost the same when extending, 1,803 lbs. and retracting, 1,878 lbs., moving the room out and in.

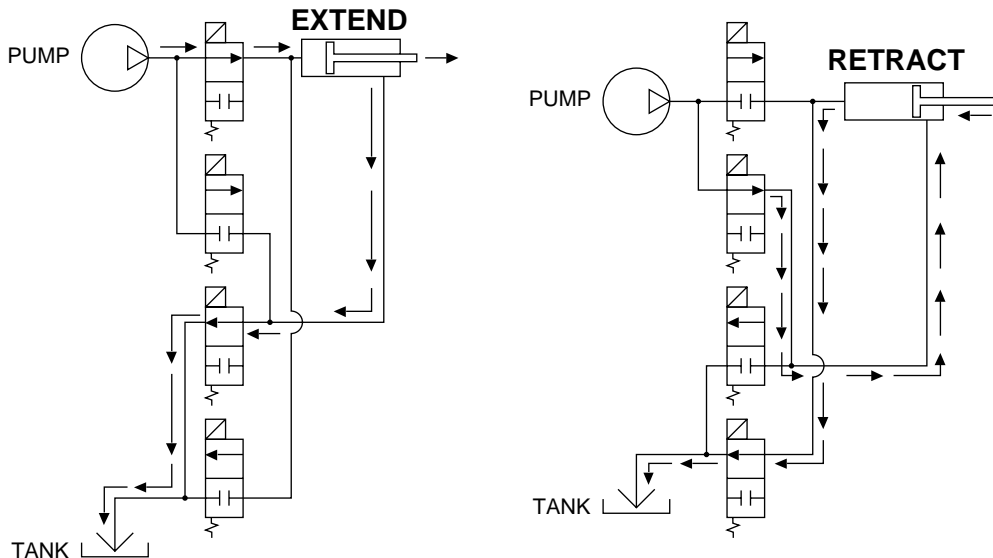
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The valve arrangement to operate a regenerative circuit is also different than one needed to operate a regular double-acting cylinder. A spool valve or multiple normally closed solenoid valves are needed to operate a double acting cylinder.

SPOOL VALVE

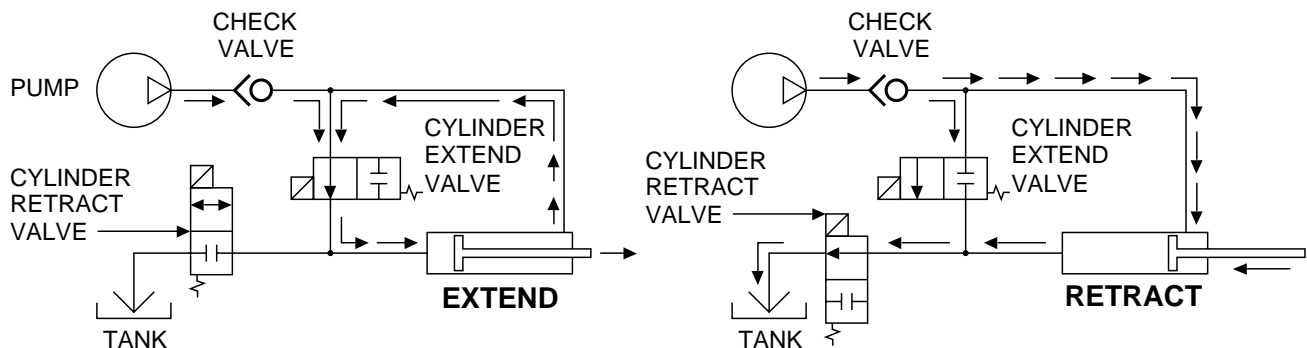


MULTIPLE NORMALLY CLOSED SOLENOID VALVES



The regenerative circuit can be operated with two normally closed solenoid valves and a check valve. The check valve is used to keep oil from the rod side of the cylinder from flowing backwards to the pump when the pump is NOT running or when the pump pressure is lower than the rod pressure. This maintains the cylinder in the retracted position. There is also pressure on the rod side of the cylinder when the cylinder is extended but this is not critical for keeping the cylinder extended.

REGENERATIVE CIRCUIT



By using the regenerative circuit it allows the use of a simpler manifold with fewer valves. Fewer valves means less weight, less space needed [smaller manifold], fewer possible problems and reduced cost of the system. All of this makes the design of systems with multiple room extensions and slides more efficient.