Fluid Power and Rotary Gears

History of Fluid Power

Fluid power is the technology that deals with the generation, control, and transmission of power using pressurized fluids. In its most basic form, the study is as old as civilization itself. It wasn't until 1650 that the work of Blaise Pascal, a French mathematician, spawned the science of fluid power technology.

Pascal observed that forcing a cork into a jug full of wine could cause the bottom to break and fall out *(figure 1)*. While pressure is equal throughout the jug, the area of the bottom of the cork was much smaller than the area of the bottom of the jug, thus a small force applied to the cork was multiplied as a much larger force acting on the jug bottom. Pascal's law, Force = Pressure x Area, explains how pressure supplied to a large area (like the piston of a hydraulic actuator) can be converted to a large enough force to lift shipping containers, cut steel, and crush cars.

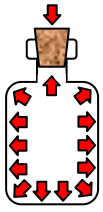


Figure 1
Demonstration
of Pascal's Law

Hydraulic Pumps

A hydraulic floor jack is an excellent example of Pascal's Law in action. By moving a lever back and forth, a small piston pump fills the actuator with oil and forces a larger piston to extend and lift the car. Unfortunately this means that the smaller piston must be pumped many times to move the actuator over this small distance. For larger scale applications (like car crushers) or applications that require higher speeds (like hydraulic rescue tools) pumping by hand is not an option *(figure 2)*.

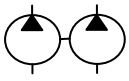
Figure 2
Hurst Jaws of Life®
Hydraulic Rescue Tool

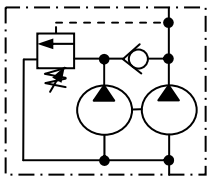
In applications such as these, rotary positive displacement pumps are utilized to provide higher flows with the capability of handling pressures of 5,000 PSI and higher. While there are several different types of hydraulic pumps, one of the most common is the gear pump *(figure 3)*. Nearly every vehicle on the road carries several gear pumps onboard. Some handle hydraulic applications such as power steering, while others handle transfer applications such as supplying fuel. The gear pump is simple and compact with a capability to generate pressures to 3,000 PSI. This makes it well suited to handling a wide variety of industrial and mobile hydraulic applications.

Figure 3
External Gear Hydraulic Pump &
ANSI Symbol for Fixed Displacement Pump

Variations of the gear pump include double pumps and 2-stage pumps (commonly called log splitter pumps). Double pumps are typically used to provide flow to multiple actuators from a single pump *(figure 4)*. Staged pumps are designed to deliver full flow under low pressure to allow an actuator to move quickly, but will bypass the majority of their flow when operating at higher pressure / higher force. 2-stage pumps are commonly used for log splitters or trash compactors.

Figure 4
Double Pump & Symbol





2-Stage
Diagram

Hydraulic Motors

Rotate the pump's shaft and oil is forced through the pump. Force oil through the pump and the pump shaft rotates. Understandably, hydraulic pumps and hydraulic motors are very similar in design. High pressure oil turns the motor's gears / shaft to develop torque and produce continuous rotary motion. This rotary motion can be used to open or close valves, perform lifting or rotating operations for industrial machinery, or even to drive other pieces of rotary equipment. Figure 5 shows a hydraulic motor directly coupled to an internal gear pump. This allows for the internal gear pump to be used where electricity is unavailable (mobile equipment for example).

Figure 5
Hydraulic Motor &
Internal Gear Pump

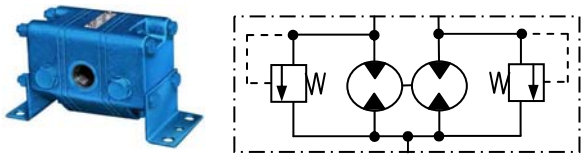
Flow Dividers

Often hydraulic equipment uses multiple actuators to complete a task. If this task is to lift a heavy load for example, it's critical that the actuators move in unison to keep the load level.

Flow dividers use multiple gear sets to divide one source of flow into two or more equal flows*. This allows multiple actuators to be driven from a single hydraulic pump. Rotary gear flow dividers achieve greater accuracy and are more efficient than spool type dividers. They also provide a wider viscosity and flow range.

Figure 6 shows a typical rotary gear flow divider with built-in relief valves. These valves synchronize the hydraulic cylinders when they reach the end of their stroke.

Figure 6
Two Section Rotary Gear
Flow Divider & Diagram



Additional Gear Pump Roles

The heart of a fluid power system is the hydraulic pump, but rotary gear pumps play other critical roles in the fluid power industry as well. As mentioned previously, gear pumps can be utilized to transfer fluids as well. Some are used to fill or "top off" hydraulic oil reservoirs. Others are used to circulate the oil through filters or heat exchangers. Transferring, filling, pressurizing, rotating, and dividing, gear technology plays a critical role in the fluid power industry.