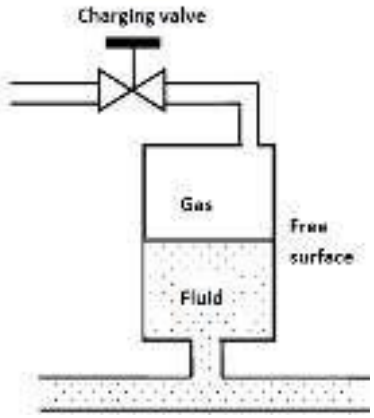
A spring-loaded accumulator stores energy in the form of a compressed spring. A hydraulic fluid is pumped into the accumulator, causing the piston to move up and compress the spring. The compressed spring then applies a force on the piston that exerts a pressure on the hydraulic fluid. This type of accumulator delivers only a small volume of oil at relatively low pressure.

GAS LOADED ACCUMULATOR:



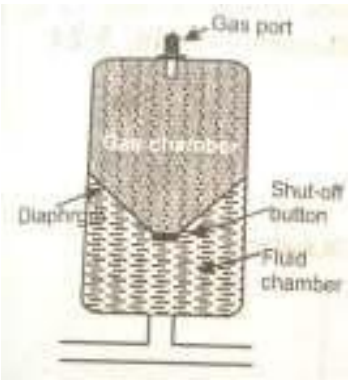
A gas-loaded accumulator is popularly used in industries. Here the force is applied to the oil using compressed air. A gas accumulator can be very large and is often used with water or high water-based fluids using air as a gas charge.

There are two types of gas-loaded accumulators:

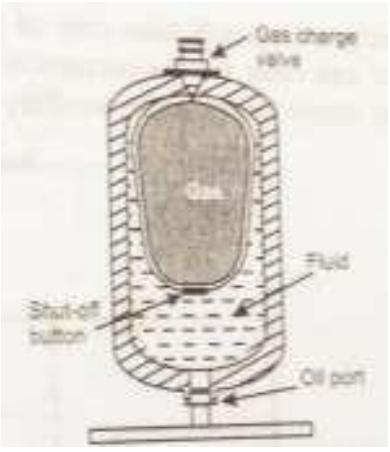
- **Non-separator-type accumulator:** Here the oil and gas are not separated. Hence, they are always placed vertically.
- **Separator-type accumulator:** Here the oil and gas are separated by an element. Based on the type of element used to separate the oil and gas, they are classified as follows:

a) Piston type accumulator: It consists of a cylinder with a freely floating piston with proper seals. Its operation begins by charging the gas chamber with a gas (nitrogen) under a pre-determined pressure. This causes the free sliding piston to move down. Once the accumulator is pre-charged, a hydraulic fluid can be pumped into the hydraulic fluid port. As the fluid enters the accumulator, it causes the piston to slide up, thereby compressing the gas that increases its pressure and this pressure is then applied to the hydraulic fluid through the piston.

b) Diaphragm type accumulator: In this type, the hydraulic fluid and nitrogen gas are separated by a synthetic rubber diaphragm. The advantage of a diaphragm accumulator over a piston accumulator is that it has no sliding surface that requires lubrication and can therefore be used with fluids having poor lubricating qualities. It is less sensitive to contamination due to lack of any close-fitting components.



c) Bladder type accumulator: Here the gas and the hydraulic fluid are separated by a synthetic rubber bladder. The bladder is filled with nitrogen until the designed pre-charge pressure is achieved. The hydraulic fluid is then pumped into the accumulator, thereby compressing the gas and increasing the pressure in the accumulator.



ACTUATORS:

An actuator is used to convert the energy of fluid back into the mechanical power. The amount of output power developed depends upon the flow rate, the pressure drop across the actuator and its overall efficiency. Thus, hydraulic actuators are devices used to convert pressure energy of the fluid into mechanical energy.

Depending on the type of actuation, hydraulic actuators are classified as follows:

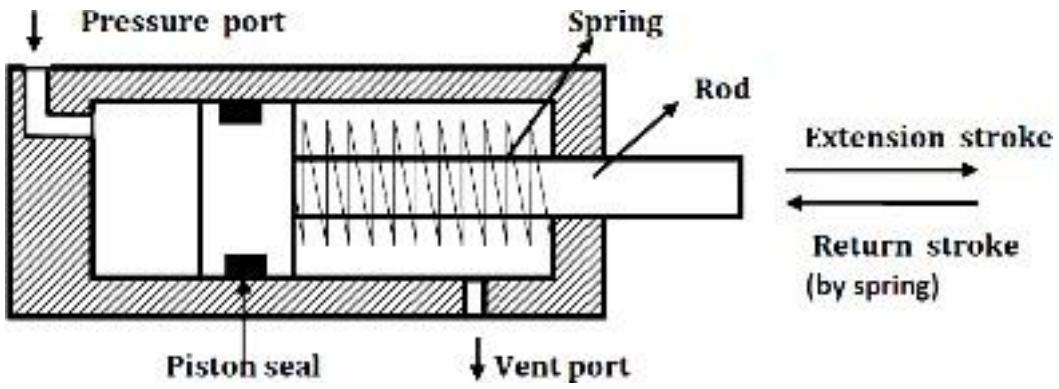
1) **Linear actuator**: For linear actuation (hydraulic cylinders)
2) **Rotary actuator:** For rotary actuation (hydraulic motor)

Hydraulic linear actuators, as their name implies, provide motion in a straight line. They are usually referred to as cylinders, rams and jacks. The function of hydraulic cylinder is to convert hydraulic power into linear mechanical force or motion. Hydraulic cylinders extend and retract a piston rod to provide a push or pull force to drive the external load along a straight-line path.

Hydraulic cylinders are of the following types:

- Single-acting cylinders
- Double-acting cylinders
- Double rod cylinders
- Tandem cylinders
- Telescopic cylinders
- Cushioned cylinders

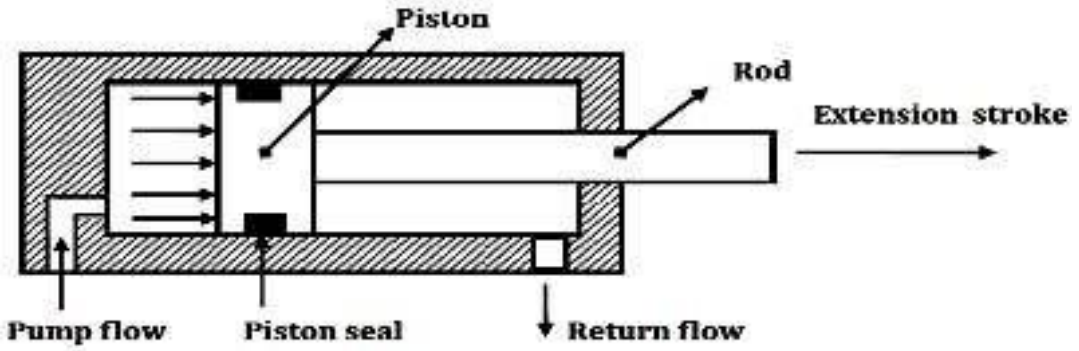
SINGLE-ACTING CYLINDERS:



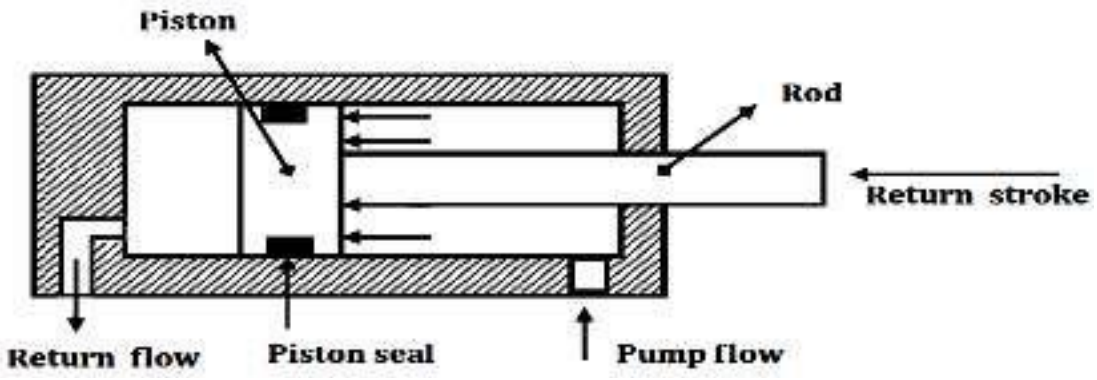
A single-acting cylinder is simplest in design and consists of a piston inside a cylindrical housing called barrel. On one end of the piston there is a rod, which can reciprocate. At the opposite end, there is a port for the entrance and exit of oil. Single-acting cylinders produce

force in one direction by hydraulic pressure acting on the piston during extension stroke. The retraction is done either by gravity or by a spring.

DOUBLE ACTING CYLINDERS:



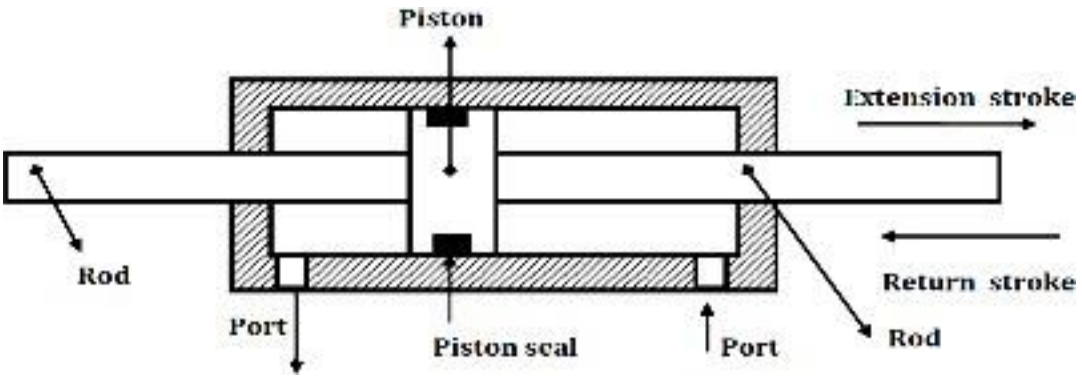
(a)



(b)

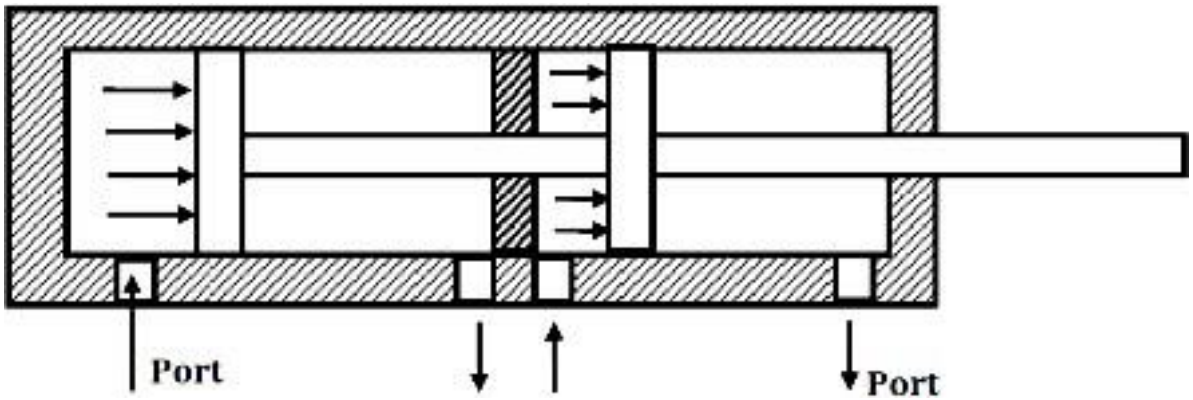
Figure shows the operation of a double-acting cylinder with a piston rod on one side. To extend the cylinder, the pump flow is sent to the blank-end port as in Fig.(a). The fluid from the rod-end port returns to the reservoir. To retract the cylinder, the pump flow is sent to the rod-end port and the fluid from the blank-end port returns to the tank as in Fig.(b).

DOUBLE ROD CYLINDERS:



A double-acting cylinder with a piston rod on both sides is a cylinder with a rod extending from both ends. This cylinder can be used in an application where work can be done by both ends of the cylinder, thereby making the cylinder more productive. Double-rod cylinders can withstand higher side loads because they have an extra bearing, one on each rod, to withstand the loading.

TANDEM CYLINDERS:



A tandem cylinder is used in applications where a large amount of force is required from a small-diameter cylinder. Pressure is applied to both pistons, resulting in increased force because of the larger area. The drawback is that these cylinders must be longer than a standard cylinder to achieve an equal speed because flow must go to both pistons.

CUSHIONED CYLINDERS: