

# Hydraulic And Pneumatic Circuit : A Review

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**Abstract-** In industrial sector, there are various machines, equipments and devices which works on the principle of hydraulic and pneumatic system.

This system use the prime mover to drive a pump or compressor that pressurizes liquid or gas, which is then transferred through pipes and hoses to an actuator to perform the specified application.

Fluid power is the technology that deals with the generation, control and transmission of forces and movement of mechanical element or system with the use of pressurized fluids in a confined system. Both liquids and gases are considered fluids. Fluid power system includes a hydraulic system (hydra meaning water in Greek) and a pneumatic system (pneuma meaning air in Greek). Oil hydraulic employs pressurized liquid petroleum oils and synthetic oils, and pneumatic employs compressed air that is released to the atmosphere after performing the work.

**Keywords-** Oil hydraulic system, Pneumatic system.

## I. INTRODUCTION

In the industry we use three methods for transmitting power from one point to another. Mechanical transmission is through shafts, gears, chains, belts, etc. Electrical transmission is through wires, transformers, etc. Fluid power is through liquids or gas in a confined space.

Hydraulic or fluid power system has wide spread applications throughout industry . A few Examples are :-

- (A) Mechanical Engineering
- (B) Agricultural technology
- (C) Earthmoving Equipments
- (D) Aircraft Manufacturing
- (E) Ship building, etc.

### Classification of Fluid power system :-

#### 1. Based on the control system

**Open-loop system** :- There is no feedback in the open system and performance is based on the characteristics of the individual components of the system.

**Closed-loop system** :- This system uses feedback. The output of the system is fed back to a comparator by a measuring element.

#### 2. Based on the type of control

**Fluid logic control:-** This type of system is controlled by hydraulic oil or air

**Electrical control:-** This type of system is controlled by electrical devices.

**Electronic control:-** This type of system is controlled by microelectronic devices

#### Oil hydraulic system :-

The oil under pressure is used to transmit motion or force in the oil hydraulic system .

The oil under pressure is utilized to obtain movement of the actuators which is further used to carry out the specified application.

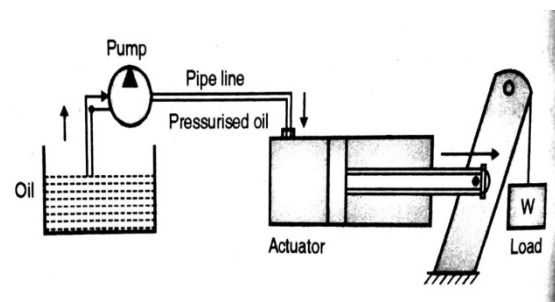


Fig.1 :- Oil hydraulic system

Oil hydraulic system examples are :-

- (a) JCB and other construction equipment
- (b) Hydraulic lifts, cranes, elevators, etc.

**Basic Principle of Oil Hydraulic System :-**

Oil hydraulic system operate on the principle of "Pascal's law".

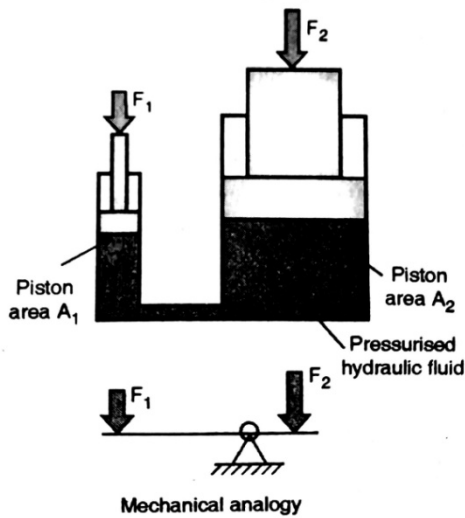


Fig. 2 :- Principle of hydraulic system

" The Pressure in a static hydraulic fluid in a closed system is same everywhere ".

Fig.2 shows the use of Pascal's law to obtained "hydraulic advantages " which is useful for practical application of hydraulic system.

Force increased with hydraulics

$$F_2 = F_1 (A_2/A_1)$$

**Basic Components of a Hydraulic System :-**

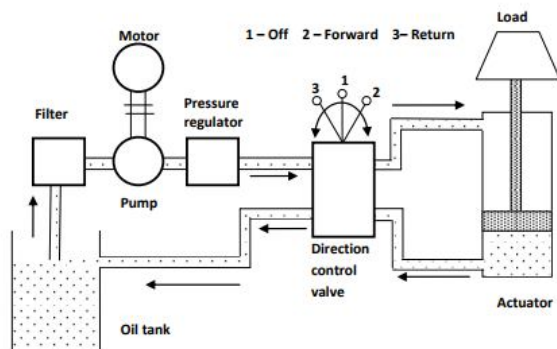


Fig. 3 Components of Hydraulic system

(A) Hydraulic actuators

(B) Hydraulic Pump

- (C) Valves
- (D) Motor
- (E) Reservoir
- (F) Piping System
- (G) Filters
- (H) Pressure Regulators

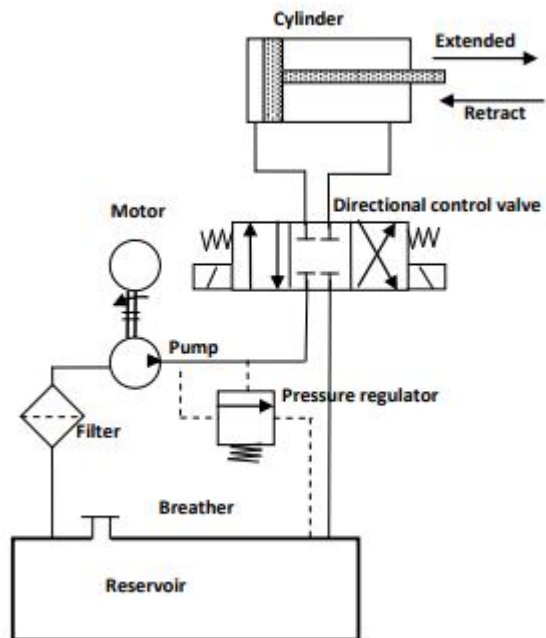


Fig. 4 Components of a hydraulic system (using symbols).

The hydraulic system discussed above can be broken down into four main divisions that are analogous to the four main divisions in an electrical system.

1. The power device parallels the electrical generating station.
2. The control valves parallel the switches, resistors, timers, pressure switches, relays, etc.
3. The lines in which the fluid power flows parallel the electrical lines.
4. The fluid power motor (whether it is a rotating or a non rotating cylinder or a fluid power motor) parallels the solenoids and electrical motors.

**The circuit Diagram For Single acting Cylinder :-**

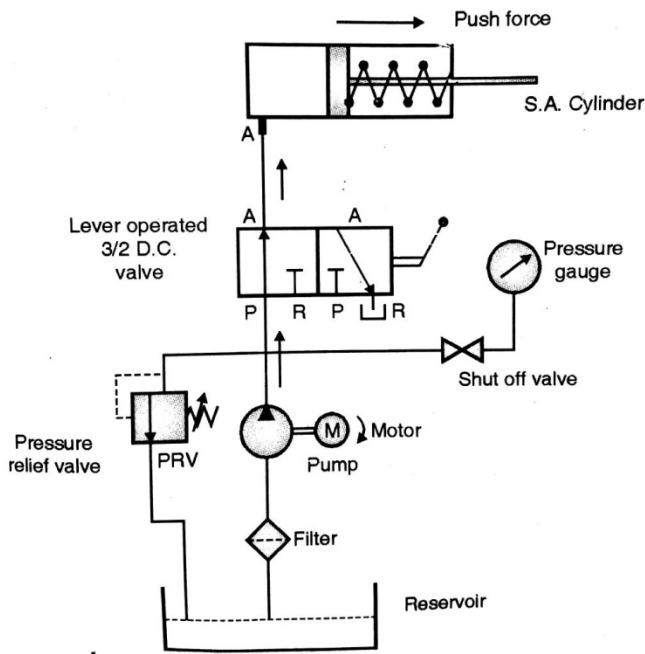


Fig. 5 Hydraulic circuit for Single Acting Cylinder (Actuated Position ) ( Push force )

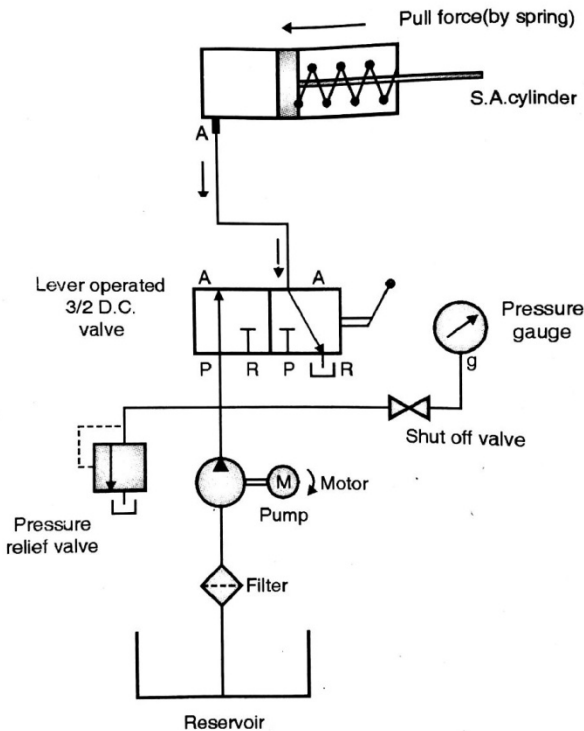


Fig. 6 Hydraulic circuit for Single Acting Cylinder (Pull Force ) ( Normal Position )

**Basic Components of Pneumatic system :-**

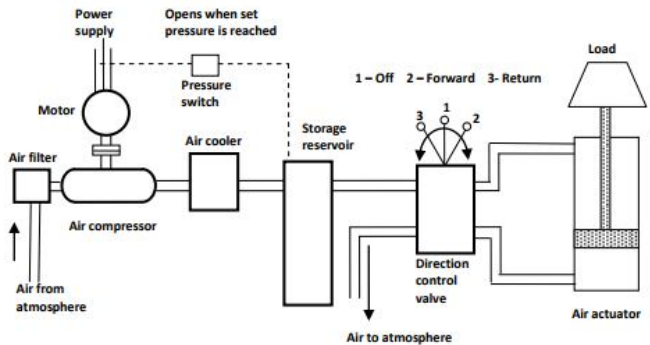
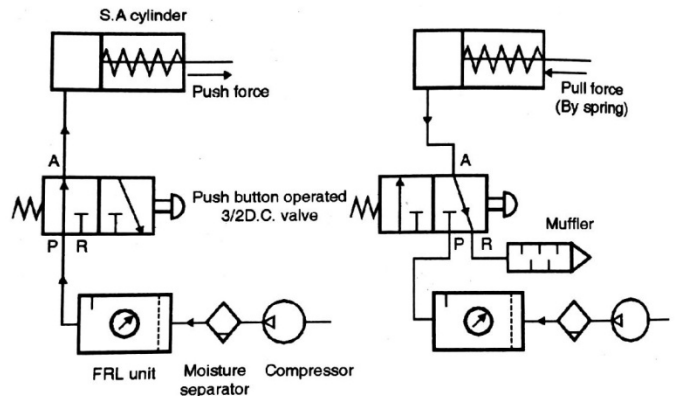


Fig. 7 Components of Pneumatic System

- (a) Pneumatic Actuators
- (b) Air Compressor
- (c) Reservoir
- (d) Valve
- (e) Motor
- (f) Piping System

**Pneumatic Circuit For Single Acting Cylinder:-**



( Actuated Position ) ( Normal Position )  
Fig. 8 Pneumatic Circuit for Single Acting Cylinder.

**Comparison Of Hydraulic And Pneumatic System :-**

**Hydraulic System :-**

- (1) It employs a pressurized liquid as a fluid.
- (2) An oil hydraulic system operates at pressures up to 700 bar.
- (3) Generally designed as closed system.
- (4) The system slows down when leakage occurs.
- (5) Valve operations are difficult .
- (6) Heavier in weight.
- (7) Pumps are used to provide pressurized liquids.
- (8) The system is unsafe to fire hazards.
- (9) Automatic lubrication is provided.

**Pneumatic System :-**

- (1) It employs a compressed gas, usually air, as a fluid .
- (2) A pneumatic system usually operates at 5–10 bar.
- (3) Usually designed as open system.
- (4) Leakage does not affect the system much.
- (5) Valve operations are easy.
- (6) Lighter in weight.
- (7) Compressors are used to provide compressed gases.
- (8) The system is free from fire hazards.
- (9) Special arrangements for lubrication are needed.

**II. CONCLUSION**

- 1) Fluid power industry is gaining a lot of importance in Indian industry. According to a recent survey, it has shown a growth of 20% over the last 10 years and the size of market is estimated to be close to 5000 crores per annum.
- 2) Recent development and Future scope of hydraulic system the automation market in India is estimated to be 1/10th that of China. If India has to become one of the leading economies in the world, based on manufacturing, it will have to attain higher technological standards and higher level of automation in manufacturing.
- 3) In the past 30 years, fluid power technology rose as an important industry. With increasing emphasis on automation, quality control, safety and more efficient and green energy systems, fluid power technology should continue to expand in India.

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