

## **Hydraulic system:**

### **Working Principle:**

The working principle of hydraulic system is based on Pascal's law. This law states that the pressure applied to an enclosed fluid is transmitted equally in all directions. Small force acting on small area can produce higher force on a surface of large area.

A simple hydraulic system consist of a pump which pumps oil to a hydraulic ram. This pump may be driven from tractors transmission system or it may be mounted on its engine. This system consists of a cylinder with a close fitting piston like an engine cylinder. As the oil is pumped into the closed end of the cylinder, the piston is forced along with it. The movement of the piston is transmitted to the lower links by means of a cross shaft and lift rods. A control valve controls the flow of oil and directs it back to the reservoir. It allows the oil in the cylinder to flow out again when the links are to be lowered. It also traps the oil in the cylinder when the links are to be held at any height.

### **Basic components of hydraulic system:**

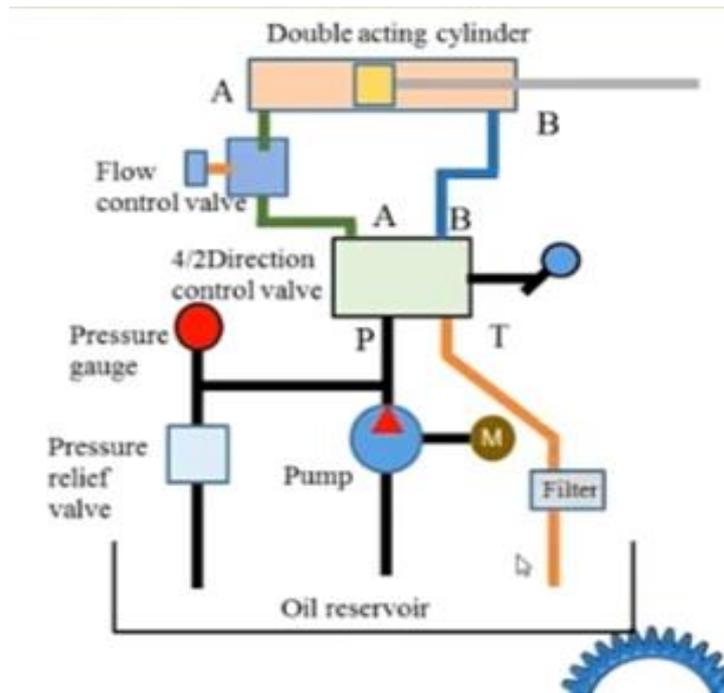
The basic components are:

- 1) Hydraulic pump
- 2) Hydraulic cylinder and pump
- 3) Hydraulic tank
- 4) Control valve
- 5) Safety valve
- 6) Hose pipe and fittings
- 7) Lifting arms

### **Operation:**

The hydraulic pump draws up oil from the oil reservoir and sends it to the control valve under high pressure. From the control valve, the oil goes to the hydraulic cylinder to operate the piston, which in turn, raises the lifting arms. The lifting arms are attached with implements. The hydraulic pump is operated by suitable gears, connected with engine.

There are two types of arrangements for storing hydraulic oil in the system: (i) there is a common oil reservoir for hydraulic system and the transmission system in some tractors, (ii) there is a special tank for hydraulic oil. It is separate from the transmission chamber.



### 1. Hydraulic pump:

There are several types of hydraulic pump, such as gear pump, plunger pump, vane pump and screw pump. Gear pump is widely used in tractors. Gear pump can flow a bigger amount of oil, compared to plunger pump. The oil pressure in the pump varies from 150 to 200 kg/cm<sup>2</sup>.

### 2. Hydraulic cylinder:

It is a bigger size cylinder, fitted with a piston and a connecting rod. It is also called Ram cylinder. The connecting rod transmits power from the piston to the lifting arms. Piston moves in the hydraulic cylinder and causes reciprocating motion in the cylinder. The lifting arms are raised by the hydraulic pressure while raising the implement but it is lowered by its own weight.

### 3. Hydraulic tank:

Hydraulic tank is used for storing hydraulic oil for the system. In some tractors, transmission chamber itself works as a hydraulic tank and same oil is used for transmission system as well as hydraulic system. In some tractors separate tank is there for hydraulic oil.

### 4. Control valve:

Control valve is a type of valve, which controls the movement of hydraulic oil to have desired direction, magnitude and speed of lifting. Thus control valve is to perform three functions:

- a) To change the direction of lifting
- b) To change the power of lifting
- c) To change the speed of lifting

The control valve is operated by hand lever and it is of two types:

- 1) Manual type
- 2) Automatic type

Manual type valve is used mostly for small tractors. There are only three positions in this case (i) up (ii) down and (iii) neutral. In automatic type, there are more than three positions. Any of the positions inside a quadrant can be chosen for operation.

**Oil filter:**

It is small filter, located at a convenient position in the passage of the oil.

**Types of hydraulic system:**

There are three important methods in hydraulic control system:

- 1) Position control
- 2) Draft control
- 3) Mixed control

**Position control:**

In this system, constant depth of ploughing is maintained by automatic adjustment of draft of tractor. In this system the control valve can be operated directly by the driver to raise lower or hold an implement, mounted on the linkage at any chosen height.

**Draft control:**

In this system, the working depth of any implement can be controlled continuously without the need for a depth wheel on the implement. The hydraulic control valve reacts to change in the loading in either the top or lower links which are due to changes in the draft or pull required by the implement. If any implement goes too deep its draft increases. This increase is sensed through the top link or lower links. The control system then raises the implement until the draft is back to the present level and the implement is at the original depth again using the draft control system.

**Mixed control:**

It is a combination of position control and draft control.

**Hitch and control board of tractor hitch:**

Implements are needed to be hitched properly for efficient and safe operation of the tractor. Implements can be:

- a) Trailed
- b) Semi- mounted and
- c) Mounted

Implements can be hitched in two ways:

- a) Drawbar hitch
- b) Three point linkage

1. **Drawbar hitch:** Drawbar is a device by which the pulling power of the tractor is transmitted to the trailing implement. It consists of a crossbar with suitable holes, attached to the lower hitch links. It is fitted at the rear part of the tractor.
2. **Three point linkage:** it is a combination of three links, one is upper link and two are lower links, the links articulated to the tractor and the implements at their ends in order to connect the implements to the tractor.

**Advantage of three point linkage:**

1. Easy control of working implements.
2. Quick setting of implements.
3. Automatic hydraulic control of implements such as position control, draft control, etc.
4. Good balancing of attached implements.