

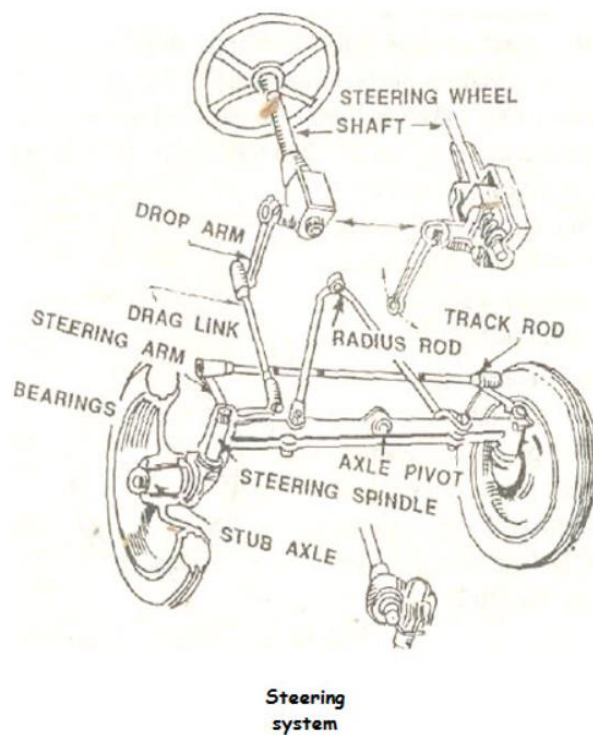
AI 3401 TRACTORS AND ENGINE SYSTEMS

UNIT III NOTES



Steering System

The steering system is required to control the direction of motion of the vehicle (tractor in our case). This is done through a series of links used to convert the rotation of the steering wheel into change of angle of the axis of the steering wheels. Another function of the steering system is to provide directional stability.



The steering system consists of many components, which are listed below:

- Steering Wheel
- Steering Gear
- Steering Shaft
- Drop Arm (Pitman Arm)
- Steering Arm
- Drag Link
- King Pin
- Tie Rod

Tractor Steering System Working

The steering system uses all these components to help the tractor turn at the operator's convenience. When the driver applies force on the steering wheel, the motion is transferred to the tyre's angular motion of the drop arm with the help of gears. Then, the angular motion is further transferred to the steering arm from the drop arm with the help of tie rods and drag links. The steering arms are inputted to the king pin. It is an important section of the stub axle

on which the wheels of the tractor are installed. In this way, the steering arm movement affects the front wheel movement. In some tractors, the working of the steering system takes place with two drop arms and drag links in place of a tie rod.

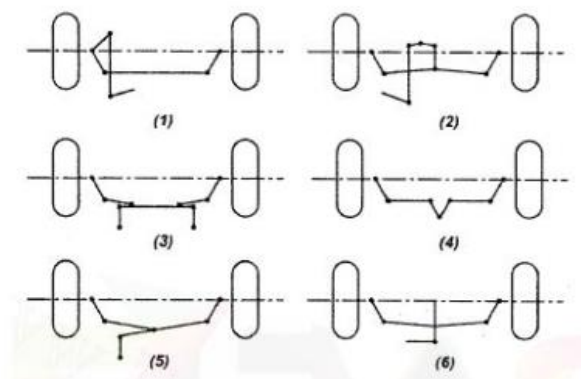
1. Steering wheel:

It is the control wheel to steer a vehicle by the driver. It contains traffic indicator switch, light switch, wiper switch etc.

2. Steering linkage:

The steering wheels are turned by the steering linkage. The steering linkage consists of pitman arm, ball joints, drag link, steering arm, spindle, tie rod and kingpin assembly.

Different forms of steering linkages are shown in Figure



(a) Pitman arm:

It is also called drop arm which converts the output torque from the steering gear into force to the drag link. It is connected to the sector shaft of the steering gear by a split joint. Either full serrations or partial splines are used for transmitting the torque from the sector shaft to the pitman arm. The split arm is tightened around the sector shaft by a clamping bolt. It is done for differentiating the male and female serrations or splines. The end of the pitman arm connected with the drag link has a tapered hole. The ball stud on the drag link is fixed into this hole.

(b) Ball joints:

These joints are connected at both ends of the drag link and tie rod. It performs the angular displacement, rotational movement of the drag link and the tie rod produced by the front wheel rotation and suspension articulation.

(c) Drag link:

It is connected between pitman arm and steering arm. It is a single pre-forged component having a ball joint socket formed at the end in some other cases.

(d) Steering arm:

It is also a forged component which is connected to the steering knuckle. During turning, the drag link force is converted into a turning moment about the left kingpin. The steering arm is connected to the spindle through a keyway, locking taper and nut. The arm is extended either

to the front or rear spindles according to package constraints. The end of the steering arm connects with the drag link and a tapered hole receives the ball stud.

(e) Left spindle and kingpin:

The torque obtained by the steering arm rotates the left spindle, wheel and tyre about the kingpin.

(f) Left tie rod arm:

The left tie rod arm is connected with the spindle in the same way as the steering arm. It converts the available torque to turn the right wheel into force in the tie rod. The tie rod has a tapered hole to receive the tie rod ball stud.

(g) Tie rod:

The tie rod is a tubular member. Both the left and right tie rod arms are connected by this tie rod. The force is transmitted between these two components. The tie rod ends have female threads. But the ball joint shafts have mating male threads. The threaded connections are held together firmly by locking clamps after setting the correct length. The length of the tie rod is an adjustable one to the specified amount.

In the direct cross type steering linkage, the pitman arm is directly connected to one tie rod which in turn is connected to another tie rod. The other end of the tie rod is connected to steering arms.

Types of Steering in Tractors

In tractors, normally, two types of steering are provided, which are mechanical and power steering. Both steering types have their own advantages and disadvantages

Mechanical Steering

Mechanical steering is a simple steering system that consists of mechanical linkage. In this tractor steering system, a rack is mounted on the steering wheel. When the operator applies force on the steering wheel, the pressure is transferred from the steering wheel to the steering shaft, then the drop arm and then to the steering arm through the drag link. This steering system works manually and is less complex.

Some popular tractor models with manual steering systems are Mahindra 255 DI Power Plus, Swaraj 717, and Sonalika GT 20.

Advantages of a Mechanical Steering

- The mechanical system in a tractor is more cost-effective compared to the power steering system.
- In this steering system, the operator experiences lesser vibrations while working on uneven lands.
- It has low maintenance since its structure is less complex.

Disadvantages of Power Steering

- Mechanical steering is harder than power steering, which means the operator needs to apply a lot of force to turn the tractor.
- The operator needs more time in this type of steering to turn the tractor on the road; therefore, the risk of accidents is greater. In other words, it offers less safety to the operator.

Power Steering

This type of steering is also known as hydraulic steering. This steering system comes with a power steering pump. In this type of steering system, the power steering pump compresses the hydraulic fluid and ensures the hydraulic fluid reaches the steering system. It further helps the operator steer the tractor's steering wheel.

This steering system offers controlled power to the steering device so that the operator applies less effort to move the steering wheel while driving at normal speed or in the stationary position. It is the latest type of steering system, and nowadays, most tractors come with a power steering system.

Some popular tractor models with power steering systems are Mahindra Yuvo 475 DI, John Deere 5310 Trem III, and Swaraj 724 XM Orchard.

Advantages of Power Steering

- It is the latest technology steering system that reduces the efforts of the operators.
- It offers more safety compared to the mechanical steering system.
- All the components of the power steering system are serviceable.
- It provides accurate and controlled turning on the roads.
- It offers more stability as well as control of the steering wheels and helps the operator move easily in wet farmlands.
- It is quite effective on hard surfaces and grounds.
- It offers excellent straight-line stability.

Disadvantages of Power Steering

- This tractor steering price is high because it is equipped with different components, such as a steering wheel, shaft, steering pump, steering column, and pitman's arm.
- The power steering system design is complex.
- The maintenance cost of this steering system is high.
- The different components of power steering take up a lot of space.

Importance of wheel alignment

1. Improve Handling: - This helps in controlling the vehicle. Improper handling can be due to vehicle pulling on one side, vibration of the steering wheel.

2. Improves tyre life and performance: - Proper rolling tyre contact on road and prevention of slipping of the tyres due to improper alignment results in better tyre life.
3. Helps in identifying problems: - Improper alignment could be a symptom of something wrong in the vehicle. A check on this can lead to correction in the fault in the vehicle.
4. Ensures Safety: - By keeping the system in order by removing the defective parts, enhances the vehicle systems, especially the suspension system, leading to better safety.
5. Improves fuel efficiency: - By enhancing the performance of various systems, leads to better fuel efficiency from the vehicle