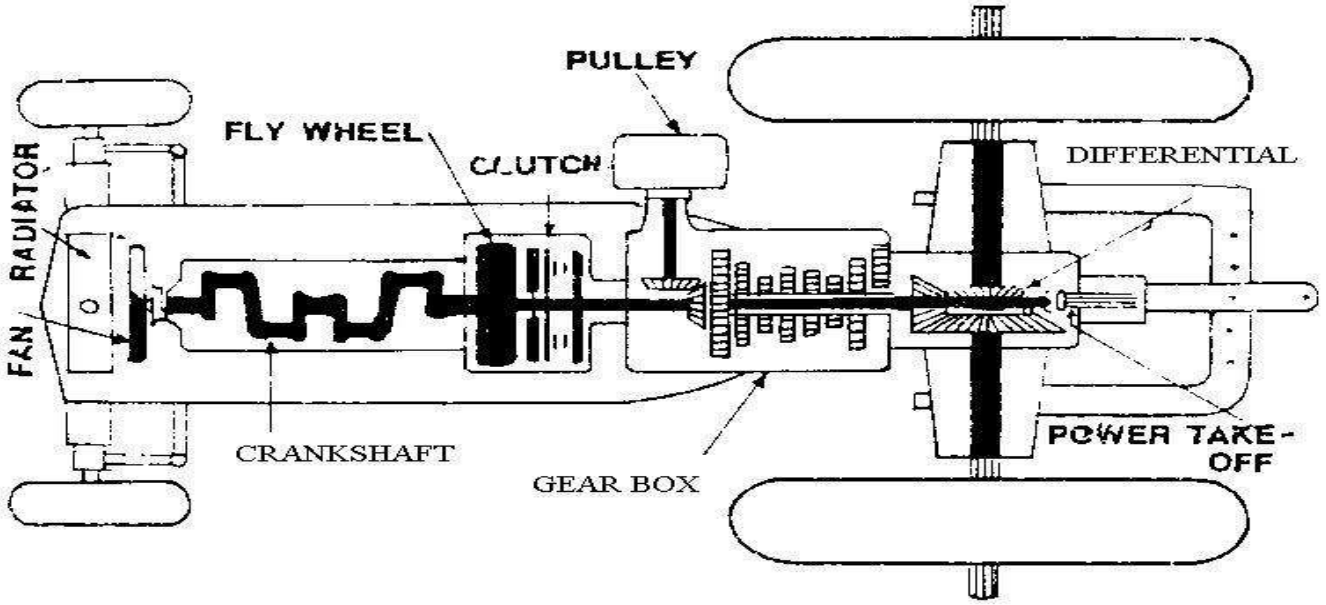
Lect.-6

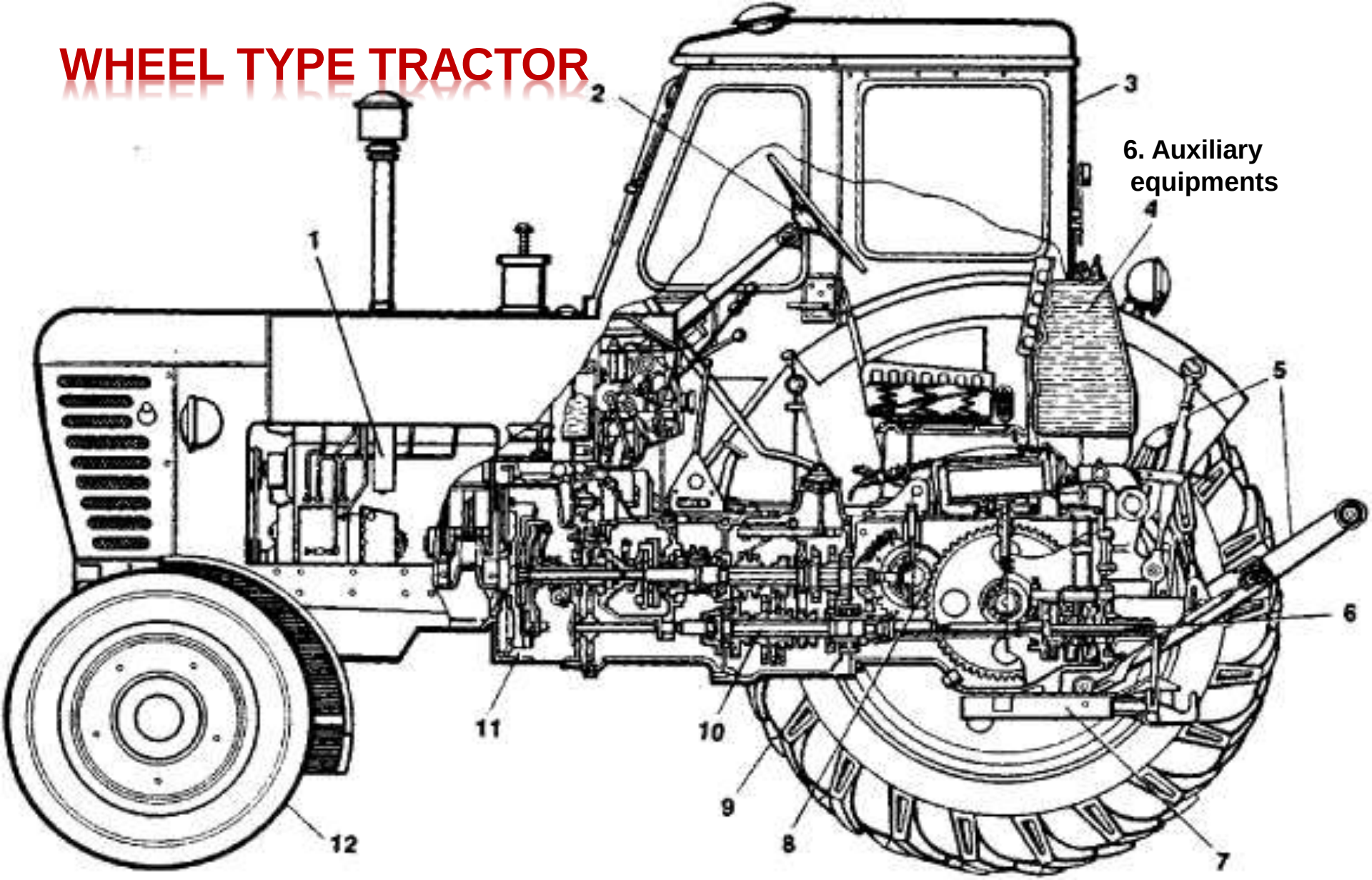
Transmission system- Clutch, Gear box, Differential, Final drive, P.T.O. shaft and Hydraulic control system.



TRACTOR POWER TRANSMISSION SYSTEM

Er. J. K. Gaur
Associate Professor and Head
Deptt. of Ag. Engineering
S. K. R. A. U., Bikaner

WHEEL TYPE TRACTOR

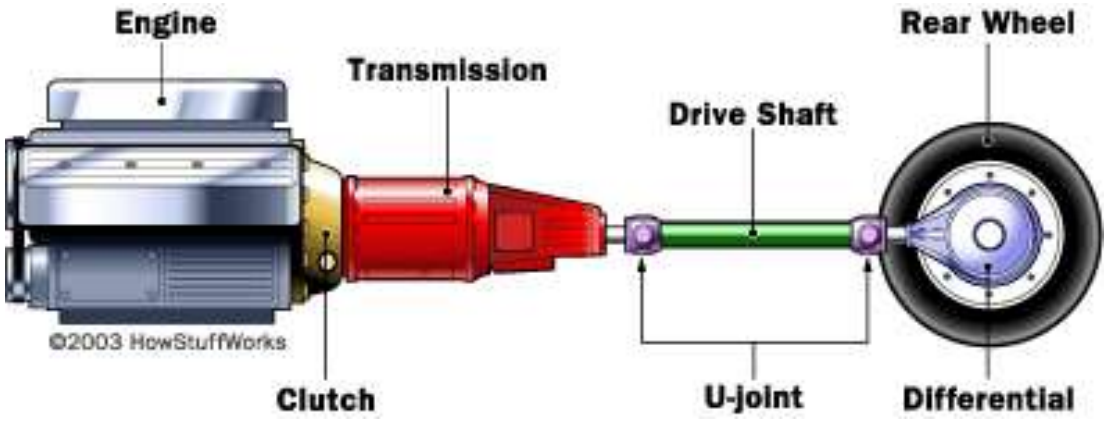


(1) engine, (2) steering wheel, (3) cab, (4) fuel tank, (5) levers of toolbar assembly. (6) power takeoff shaft, (7) hitch, (8) main drive, (9) driving wheel, (10) gear box, (11) clutch, (12) front (steerable) wheel

The transmission system is provided to perform following functions:

- To transmit engine brake power from its fly wheel to tractor rear drive wheels and to multiply the torque developed by the engine.
- To engage or disengage engine power with rest of tractor power trains as per load and speed.
- To select appropriate speed ratio according to type of work and draw bar load on the tractor.

- To distribute the power to the rear drive wheels of tractor for turnings.
- To provide means of reversing the tractor.
- To transmit engine power to P. T. O. shaft and belt pulley for operation of implements requiring rotary power.
- To drive the pump of hydraulic system of tractor.



Engine brake power

$$W = \frac{2N_eT_e}{4500}$$

Where W = engine brake power, hp (Power delivered to rear wheels)

N_e = engine rpm

T_e = engine torque, kg.m

For constant value of W, N_e will be less if T_e is high.

Draw bar power of tractor

$$W_d = \frac{P \times S}{75}$$

Where W_d = Draw bar power, hp

P = Draw bar pull, kg

S = Speed m/s

Clutch

- It is fitted between engine and gear box and is used to connect or disconnect the tractor engine from its power trains and for changing gear ratios.
- The clutch transmits power by means of friction between driving and driven elements.
- There are two main types of friction clutches used on tractor; i.e.

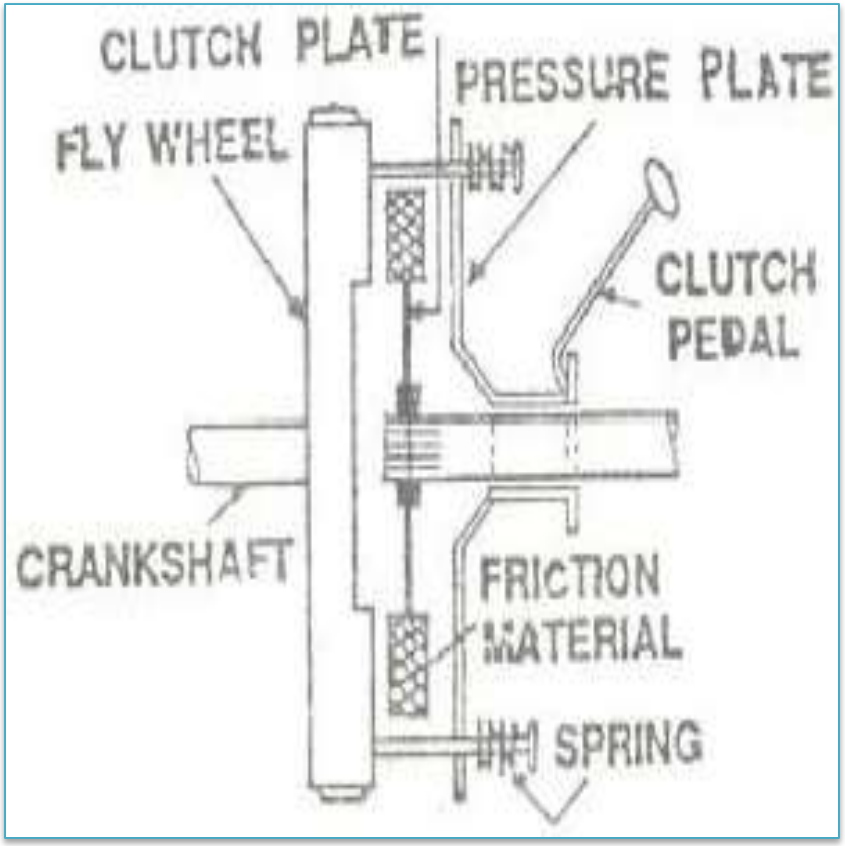
  single disc type and

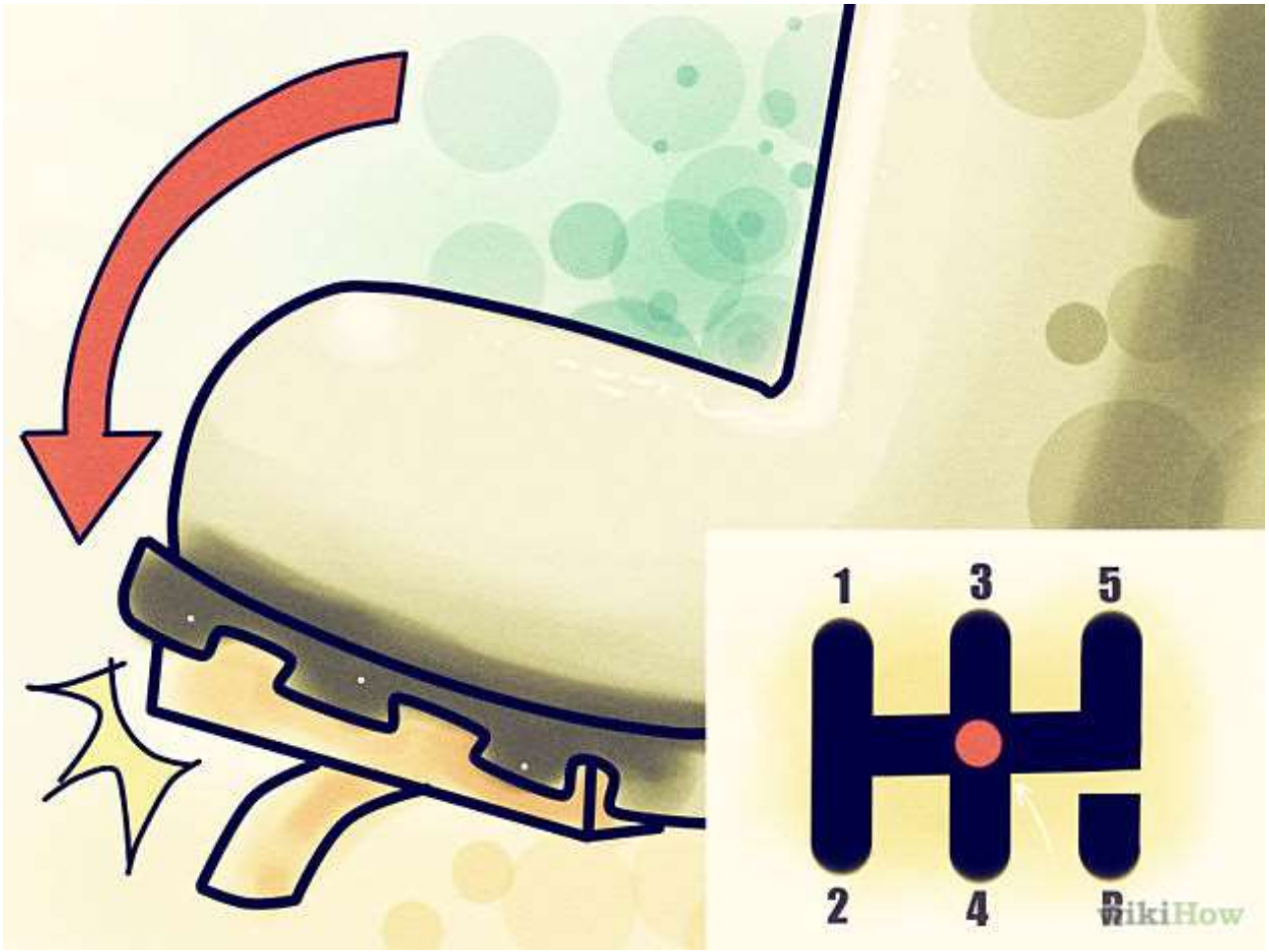
  multiple disc type.

The single plate clutch is dry type clutch.

When the clutch pedal is depressed, release fingers push the power plate back against the spring pressure, thus releasing the pressure from the clutch plate. Then the driven plate stops, whereas, flywheel continues to rotate.

When the clutch pedal is released the pressure plate forces the clutch plate against the flywheel with sufficient force to cause the clutch plate and flywheel to turn together as one unit.




1
3
5
2
4
R
wikiHow

Gearbox system

It is fitted in the tractor to increase the driving torque so as to enable tractor to pull more load.

Transmission systems of modern tractors are mostly of the **selective sliding gear** type.

Selection of gear is made with a gear shifting lever mounted above the transmission housing and very close to the operator's seat.

A transmission allows the operator to increase or decrease the speed and reverse the direction of the tractor.

The lower the gear, the more weight the tractor can pull, but at the slower speed.

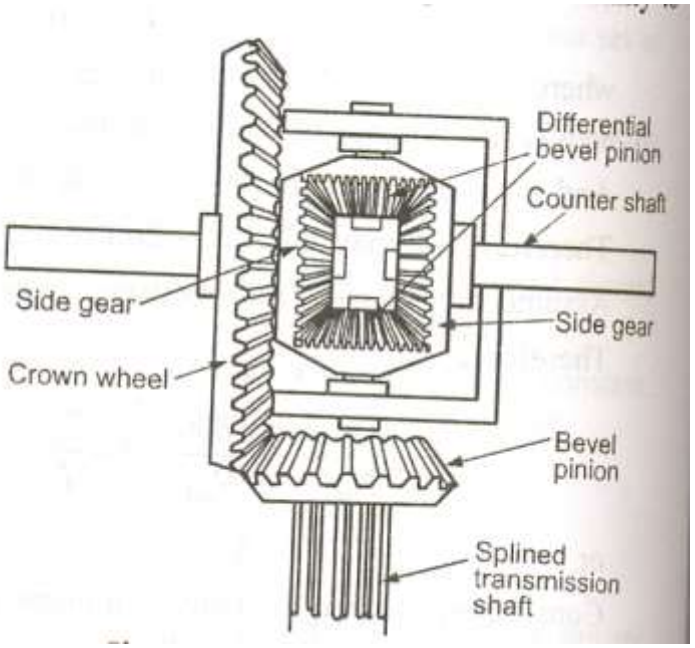
Differential

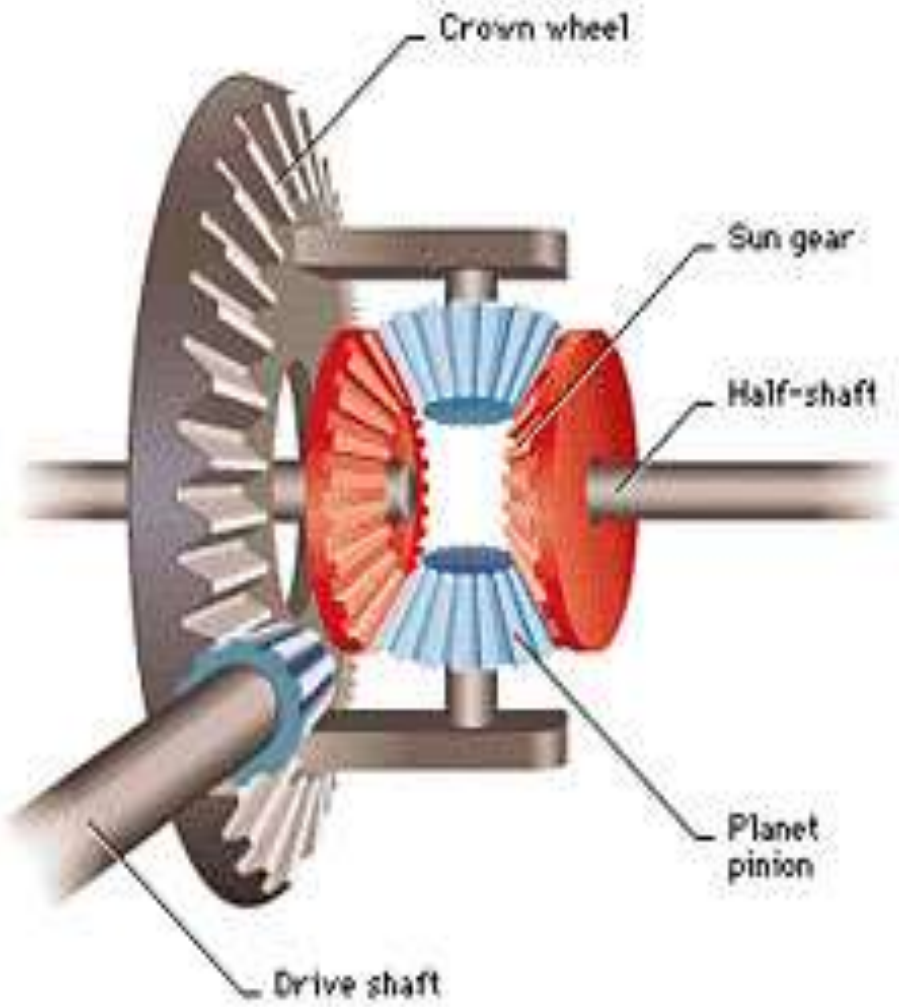
- The main purpose of differential unit is to work as compensating mechanism so that when the tractor takes a turn, the outer wheel may move faster than the inner one and still share the load equally.
- It also functions as a second speed reduction point in the tractor power trains.
- The differential assembly is fitted in the center of rear axle.

Design detail and working of differential

The standard differential used on tractor has planetary gear system which has four bevel gears (two side gears and two pinions).

It also has a bevel pinion and a crown wheel fitted at right angles to each other to transmit the power received from the gear box to the rear axles .The bevel pinion mounted at the end of the output shaft of the gear box drives crown gear.





Differential of a tractor

It acts as a speed reduction and transmission of power at 90^0. The differential divides the power into equal parts and finally to the rear wheels.

When the tractor is moving straight ahead, the bevel pinions of differential do not rotate on their carrier shafts and both the side gears rotate at same speed.

When the tractor turns, the outer rear wheel must travel faster than the inner one. **This is accomplished by differential pinion being rolled over the differential side gears as well as by rotating on their own axles.**

While turning a short corner, the inner wheel is slowed down and the outer one is speeded up. If one wheel is locked, the speed of the other one is increased by two times.

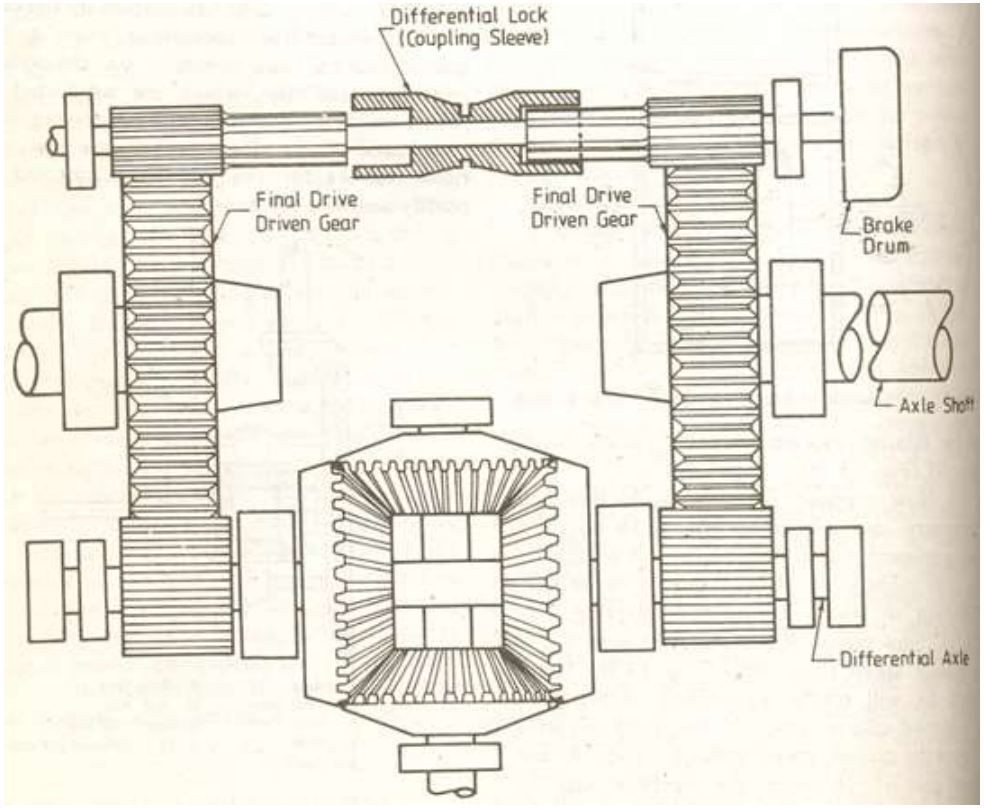
Differential lock

Whenever one wheel offers less resistance it turns faster causing a loss of traction.

If one wheel gets in the mud or loose soil, the wheel on the solid ground will not be driven while the other spins around due to the differential action.

To overcome this problem, all tractors are provided with a locking system known as differential lock. The purpose of lock is to join both half axles so that even if one wheel is under less resistance, the tractor comes out from the mud, etc. as both wheels move with the same speed and apply equal traction.

In its simplest form, differential lock consists of a movable collar which can be shifted along the splines of the two half shafts. As soon as the half shafts are locked, they give the effect of a straight – through rear axle, resulting in full traction on both the wheels.



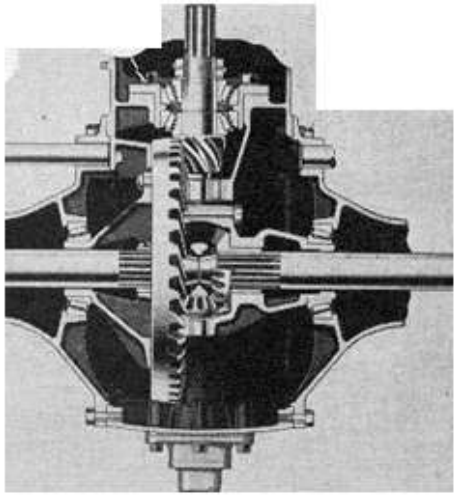
Final drive

The final drive is mounted near the rear- drive wheels of the tractor.

It helps in minimizing the number of gears and shaft in the gear box to achieve higher torque with less speed on driving wheels.

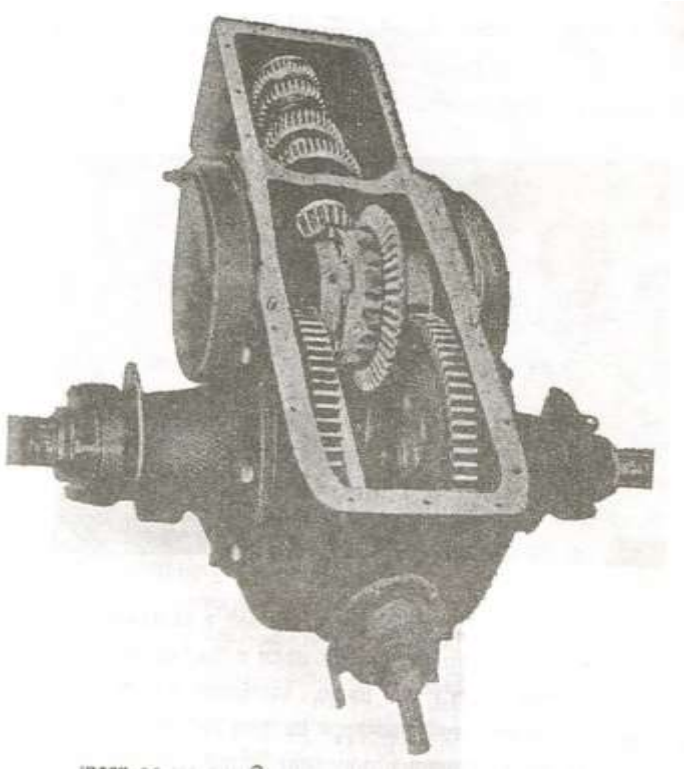
The final drive is driven by the differential through the final drive - shaft and spur/bull gears (2, one on each axle) trains or chains and sprockets which provide about

3 to 5: 1 reduction.



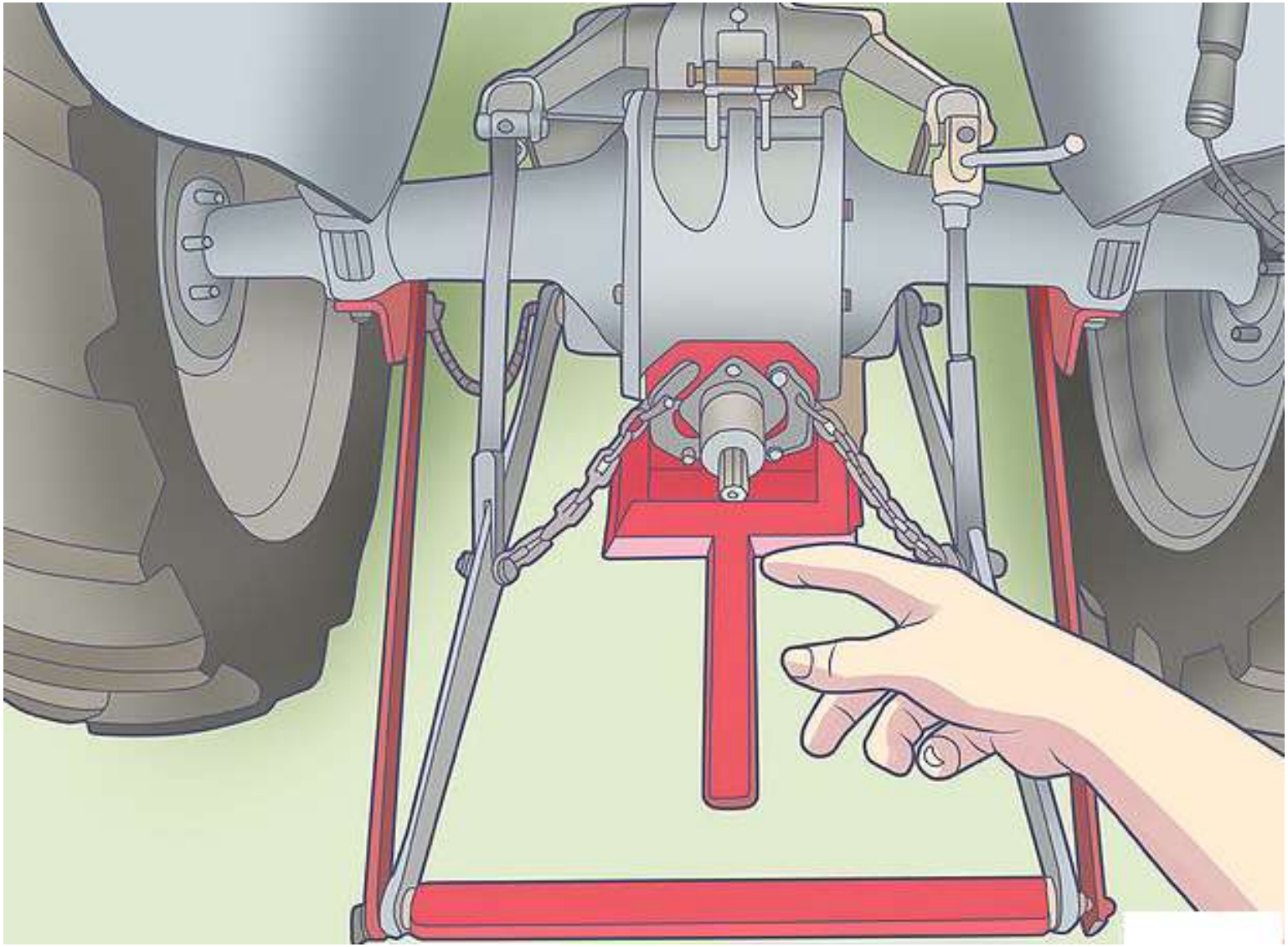
It is provided in the transmission system of tractor for following main reasons:

- To provide a permanent gear reduction between engine and rear wheels.
- To transmit the power from the gear box through 90^0.



Power take off:

- Power take off is a part of the tractor transmission system.
- It is provided with a standard splined shaft at the rear of the tractor to operate the P. T. O. operated machines like mowers, sprayers, etc.
- The power for the PTO comes from the engine through the dual clutch.
- The two transmissions of power are usually independent. For example, an operator can stop or move the tractor without affecting the use of the PTO, or can stop the PTO yet still move the tractor.



P. T. O.

PTO shaft types: 3 Types

Continuous Running type - operates when master clutch is engaged

Independent - transmission and PTO powered through separate clutches

PTO will still run when tractor is stopped or in motion.

Transmission Driven - PTO runs only when tractor is in motion.

PTO Speed

Type	PTO Speed	Shaft Size	Teeth
Continuous	540 r.p.m.	1 3/8”	6
Independent	1000 r.p.m.	1 3/8”	21
Transmission	1000 r.p.m.	1 ¾”	20

Tractor pulley

- It is located either on the left, right or rear side of a tractor for operating stationary machines like silage cutter, centrifugal pump, thresher etc.
- The rear mounted pulley is driven by P.T.O. shaft.
- The diameter of pulley depends upon the rpm of the shaft on which it is mounted. The pulley diameter should be such that it gives the belt speed of about 950 m per minute at full throttle.
- Pulley drive is engaged or disengaged from the engine by means of a clutch provided for the job.

Hydraulic control system

- Hydraulic control system used on tractor makes it possible to lower or raise the implements without much effort whereas, greater effort is required in doing the same job with mechanical linkages.
- They also shift transmissions, pull clutch plates, apply brakes, operate steering wheels etc.

- A simple hydraulic system consists of a hydraulic 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 fitted 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 fluid 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.

The basic components of a hydraulic system are:

- Hydraulic pump
- Hydraulic cylinder and piston
- Fluid reservoir (Hydraulic tank)
- Fluid control valve
- Pressure relief valve
- Hose pipe and fittings and
- 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:

- There is a common oil reservoir for hydraulic system and the transmission system in some tractors,
- There is a special tank for hydraulic oil. It is separate from the transmission chamber.