AI 3401 TRACTORS AND ENGINE SYSTEMS

UNIT IV

Tractor Hitch-Control

The agricultural tractor at the beginning was used to pull and to carry implements for soilcultivation, most of them were ploughs. Ploughing is a field-operation with high energy requirements and consumption per area. With the mechanical power of the tractor the farmers could do ploughing quicker with only a few people and without animals. This was one of the most important steps to field-work mechanization. The hydraulic hitch-system was introduced for lifting and lowering the implements at the headland and for transportation. When ploughing the system was switched in the float position, so that the plough worked with constant working depth and could free follow the soil-surface even under undulated conditions. It was Harry Ferguson, a son of an Irish farmer, who invented in 1925 the so called "draft-control" for the plough. The principle of his idea is still used and it is one of the most successful inventions of the agricultural engineering history.

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.

Hitching systems

(a) Trailed - one point hitch Here the implement is attached to the tractor at one (drawbar) hitch point. This represents the simplest arrangement, but it provides a minimum in the way of implement control and weight transfer. The implement, which is usually carried on wheels (for support and / or depth control), is free to move in both the horizontal and vertical planes as it follows the varying ground surface. Two common arrangements can be identified. (i) where the implement is fully carried on its wheels and its drawbar is pivoted at both ends; the implement force is essentially horizontal

(ii) where the front of the implement (such as in an unbalanced trailer or similar two-wheeled implement) is carried on the tractor drawbar and the rear on a wheel or wheels, Figure 6.1(b). There is usually a significant static vertical component in the implement attachment force and hence the weight transfer from implement to tractor rear wheels is greater than in (i) above.

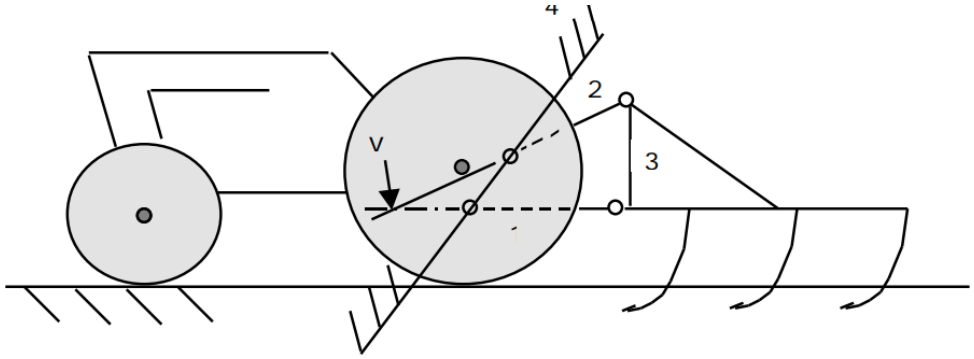
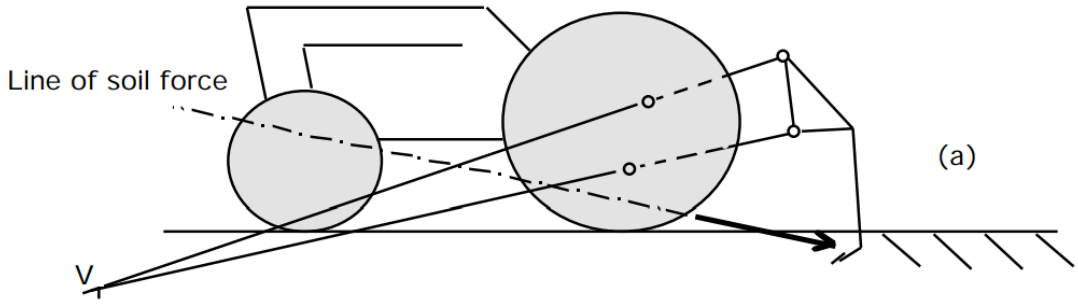
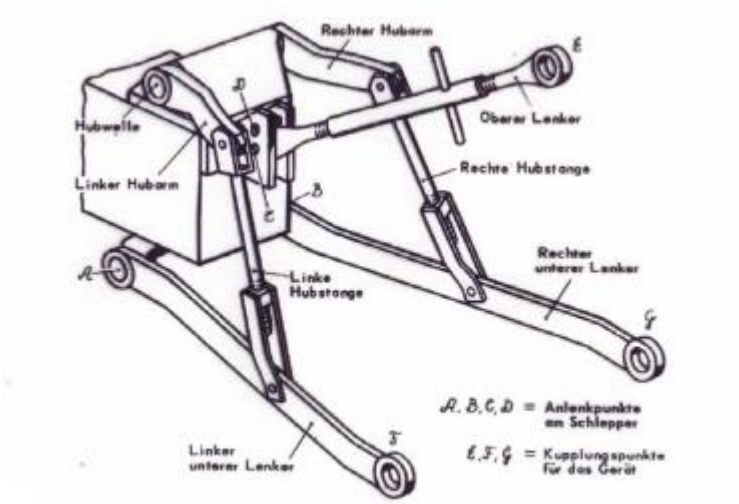


Figure 6.4: Three-point linkage as a four bar 'chain'.



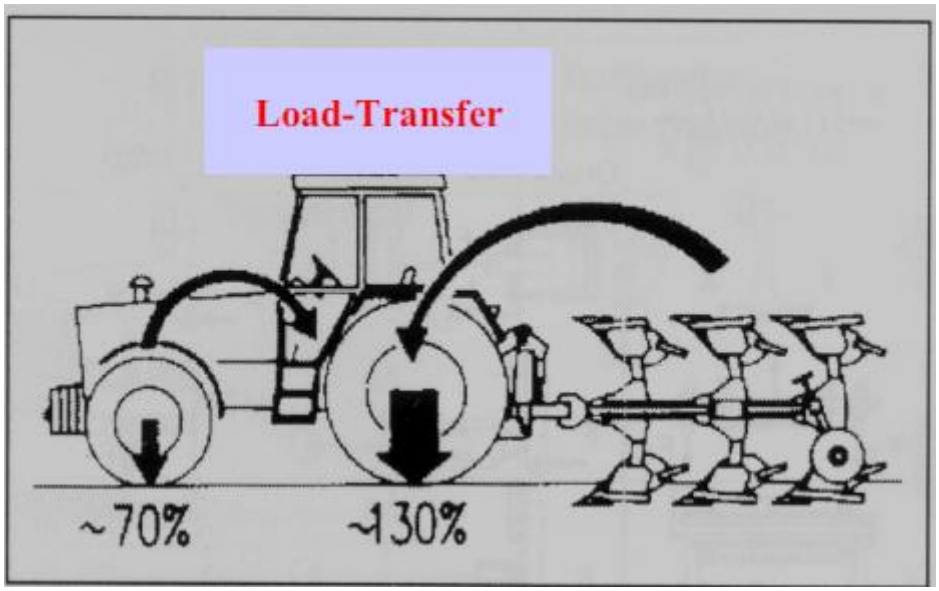
Three point Linkage

Ferguson invented and used a 3-point-linkage to connect the plough with the tractor. This solution was standardized later on and is now used all over the world



Tractor 3-Point Linkage for Mounted Implements

Wheel-slip could be reduced or the pulling force of the tractor could be increased by higher vertical forces on the pulling tractor-wheels. This can be done by ballast-weights or by a procedure of weight-transfer from the pulled implement to the tractor, so that the tractor carries the plough partialy during ploughing, To realize this, the implement cannot be fixed in a constant position to the tractor, because of to large variations of the working depth of the plough on undulated soil-surfaces.



To prevent this, a system-variable is needed, which can be held constant by a closed loop control-system, without the plough being in a fixed position to the tractor. To realize this, there are four basic system parameters, which can be used as a control-variable in a closed loop control-system. This parameters are : * the pulling-forces (draft) of links in the 3-point-linkage * the pulling-torque of the tractor drive-axel * the working-depth of the plough * the pressure in the lift-cylinder All these possibilities have been used in control-systems, which were developed and used on their tractors by different companies. But only the Ferguson-System, which uses the forces of the 3-point-linkage has survived and is still used.

Components:

The three-point linkage typically consists of two lower lift arms, which are attached to the tractor's hydraulic lift system, and an upper link. The lower lift arms are usually adjustable in length and are attached to the implement using pins or other locking mechanisms.

Categories:

Three-point linkages are commonly categorized based on their size and lifting capacity. Categories include Category 0, Category 1, Category 2, and so forth, with each category representing a range of lifting capacities and dimensions.

Operation:

To attach an implement to the tractor's three-point linkage, the operator typically backs the tractor up to the implement, aligns the lower lift arms with the implement's mounting points, and secures them in place using pins or other locking mechanisms. The upper link is then adjusted to ensure proper alignment and stability.

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.

Implement control:

The tractor with a built in lift system is connected to the implement through a specific type of mechanical linkage termed as three point linkage and the system is known as mounted system. The implement is connected to the tractor hydraulic system at two bottom links and one top link. Both the bottom links are connected to two lift arms through lift links. The lift arms are directly mounted on a rock shaft which is further connected to the piston rod. Any movement of the piston is transferred to the bottom links. The top link is used for connecting the third hitch point of the implement and is adjustable for maintaining the implement level and suction angle. Load sensing for the

draft control can also be done through the top

link which is spring loaded. In some tractors the lower links are spring loaded for draft sensing.

Depending upon the soil condition and type of operation the mounted implement can be controlled either by position control or draft control.

Weight transfer:

Rear part of the tractor is heavier than the front part to get higher tractive efficiency. However, sufficient weight on the front axles is also required to facilitate easy steering and to compensate the effect due to weight transfer. When the load is pulled, the tendency of front axle is to become light by losing some weight and the same adds to the rear axle.

The higher the pull, the greater is the weight transfer. Mathematically this can be represented by:

Weight transfer= pull× hitch height/ wheel base.

Where the line of pull is always assumed to be parallel to the ground.

Power take off unit (PTO):

It is a part of tractor transmission system. It consists of a shaft, a shield and a cover. The shaft is externally splined to transmit torsional power to another machine. A rigid guard fitted on a tractor covers the power take off shaft as a safety device. This guard is called power take off shield. Agricultural machines are coupled with this shaft at the rear part of the tractor. As per ASAE standard PTO speed is 540± 10 rpm when operating under load. In order to operate 1000rpm PTO drive machine, a new standard has been developed.

Types of PTO Activation Methods are;

Switch Type

Lever Type

What is Tractor PTO Shaft?

PTO shaft used to supply mechanical energy between agricultural tractors and implements. That energy which changes the energy of the engine to hydraulic pressure is called PTO shaft. PTO Shaft needs a daily check, they used for pulling heavy loads, and its deprivation can defect the PTO. PTO shaft is too heavy, use properly.

Types of PTO:

1. **Rear PTO**: The most common type of PTO is mounted at the rear of the tractor. It typically consists of a rotating shaft with splines or a flange at the end, which allows implements to be attached directly or via a driveline. Rear PTOs are used for a wide range of applications, including powering rotary mowers, balers, and tillers.
2. **Mid-Mount PTO**: Some tractors also feature a mid-mount PTO, which is located between the front and rear axles. Mid-mount PTOs are often used to drive implements such as mid-mount mowers or front-mounted snow blowers.
3. **Front PTO**: In certain tractors, especially those equipped with front-mounted implements like snow blowers or loaders, a front PTO may be available. This allows the tractor to power implements mounted on the front of the vehicle.