

point forward and a little below the wheel axle. When the pinion is in this location the driving force is carried directly to the ground, so that the load on the drive wheel axle bearings due to power delivered, is opposite to the load due to weight, and the amount of load is the difference between the driving effort delivered by the drive pinions and the weight of the tractor that is supported by the axle when the tractor is standing. In other words, the drive axle bearings are practically floating when the tractor is pulling a certain load. At less load the bearing pressure is down and at greater load the pressure is up. The strain of the draw bar pull is carried by the drive pinion bearings through the pinion teeth to the drive wheel rim and the ground. It is the lifting effect on the front end of the tractor that results in its forward movement. There are a number of tractors that have enough power to raise the front end clear of the ground so that the front end weight is the limit of their pulling power. These tractors are very difficult to guide and are of no use at all on hills. Enough dead weight must be carried on the steering wheels so that the tractor can be guided on the steepest hill.

The front wheel drive offers an easy solution for hilly ground as in this case the reaction from the load is down on the rear steering wheels. There is no tendency to tip up, and the harder the pull the more positive is the control. The rear wheels must be ample to carry the additional load and the difficulty is in arriving at a suitable arrangement to handle the implements when the front wheels are drivers. While the steering mechanism may be complicated, the power transmission can be simple, the weight can be placed mostly on the drive wheels, and ditches and hills can be easily negotiated. The four-wheel drive immediately suggests itself, but the mechanical complication and expensive construction make it prohibitive.

Protection of working parts is not easily accomplished in tractor transmissions. An argument used by those who favor open rough cast gearing, is that the farmers cannot keep transmission grease or oil clean and that some grit is always put into the case at every filling. They claim that as long as parts cannot be kept clean that they wear out and may as well be made simple, open, and to operate without lubrication or when covered with dirt.

One unprotected drive known as "The Roller Pinion Drive," has been quite successful on tractors as it can be made to last a season, is very cheap, and is easily replaced. Perhaps the worm

drive gear can be taken as the opposite extreme because the excessive tooth pressures together with the vibration and dirt have prevented its being a success, no matter how carefully it is built.

As the users of tractors become more educated so as not to abuse their machines, then thoroughly protected well made parts will become more general. To-day simplicity is vital if a tractor is to be successful, but education is increasing the demand for well made, efficient, protected parts.

A notable advance in tractor transmission design is that anti-friction bearings are becoming so universally used. It has been found that an ample, non-adjustable, anti-friction bearing can last indefinitely in tractor service. Transmission bearing trouble has been a common tractor fault in

the past, and its elimination is a decided step ahead.

Shafting used is usually ordinary mild steel, as gears and bearing generally have to be of such size that the shaft sizes are ample. It is very important that splines be used instead of keys.

The standard type of automobile or truck transmission does not meet tractor requirements at all. The amount of gear reduction is too small, no belt pulley is provided for the change speed arrangement is wrong, the parts are not ample, and it can be applied to a good tractor design.

The total gear reduction in a tractor varies between 30 to 1 and 100 to 1, so several reductions have to be used. I think it is best to discuss each reduction separately and especially to consider the final reduction by itself, al-

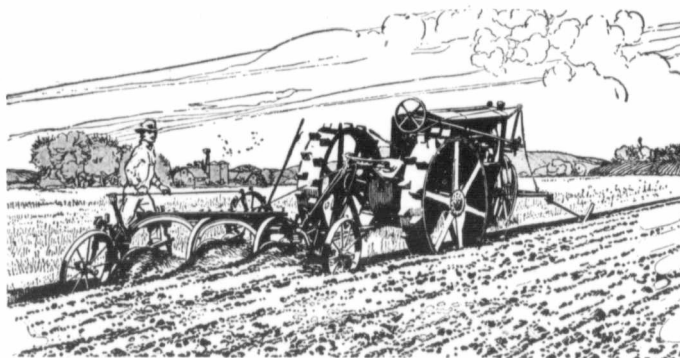
though in some cases entire transmissions are built as a single unit.

In general all tractor transmissions are driven from the engine through a friction clutch and without the use of universal joints except that some clutches are designed to take care of any misalignment. Cone, disc, shoe, band clutches, and friction drives are in use. The tone clutch and the internal expanding shoe clutch are most common.

First reduction gearing may be almost any kind that one can imagine, and the amount of reduction from 1 to 1 to as much as 8 to 1. The change in speeds and the reverse are often worked in on the first reduction, but also it is very common to have the second reduction used for this. Where the engine shaft is not parallel to the drive wheel axis the first reduc-

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