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D-Drive Transmission for Small Tractors

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Abstract: *One of the most important part of any vehicle is its transmission. For years researches have been done in this field and better alternatives have come forth. A recent introduction to this list is a transmission mechanism by Stephen Durnin called the d-Drive. A d-Drive is an infinitely variable geared transmission which allows an engine to operate at its most efficient setting while allowing the vehicle speed to be continuously varied to suit driving conditions. The advantage it has to offer is its capability to transmit infinite speed ratios without the use of complicated gear mechanism. The reduction of gears has lead to a conclusion that the wear and failure of the transmission is less frequent. Its special engineering design means that d-Drive can operate not only as a continuously variable transmission, but as an infinitely variable one, for maximum efficiency according to operating conditions and operator preferences.*
The use of this type of mechanism on small tractors can prove to be a ground breaking innovation.
Since in countries like India, Bangladesh etc the land holdings are small, so the tractors here are relatively smaller and to make them more cost efficient d-Drive can be incorporated in them. The conventional transmission system has drawbacks of having a cumbersome mechanism for transmission, the wear induced while changing gears, fixed speed ratio etc. With the introduction of a d-Drive the wear associated with changing gears will be reduced, also the operator will be able to change speed ratio with relative ease and may attain the same speed and torque in both directions i.e. forward and reverse. This paper reviews the possibilities of incorporating a d-Drive mechanism in small tractors and the benefits associated with it.

1. INTRODUCTION

One of the main components of a vehicle is its transmission and it has recently seen a lot of transformation. Researches in this area are prevalent and usually aim at achieving maximum efficiency with an optimum amount cost. A recent introduction to this list is a d-Drive. The concept put forward by Stephen Durnin.

A d-Drive is an infinitely variable geared transmission which allows an engine to operate at its most efficient setting while allowing the vehicle speed to be continuously varied to suit driving conditions.

Because of its versatility it has the potential to develop into a transmission system that every vehicle would incorporate. A small farm tractor is considered in this case for the study of this transmission.

2. TRANSMISSION

2.1 Geared Transmissions

In basic terms, the idea of a gearbox is to create the ideal level of mechanical advantage between a motor and its output. Motors of all kinds have a speed of maximum efficiency, and a speed of maximum power, and you use a gearbox to decide what engine speed you're running compared to the output speed.

In a car, that means you want a low gear at low speeds or for quick acceleration - because in lower gears, the engine revs harder and produces more power. Cruising on the freeway, you want a high gear that lets you trundle along using the minimum practical engine RPM so you don't waste fuel.

So most gearboxes offer a compromise - manual, semi-auto and auto transmissions offer you a set number of gears you can choose to find one that's close to the ideal ratio for what you're doing. But there's efficiency losses in between gearshifts as you disengage the engine using a clutch - or in the case of an auto, a torque converter. And although some geared transmissions offer lots of gear choices, every set gear ratio is a compromise.

And the clutch itself is a fairly crude device - when you're engaging a clutch, you're basically pushing a set of plates together, some of which are coated in high-friction material, which grab the other plates and force them to spin. This approach is inefficient and prone to slip and wear under large power loads.

2.2 Variable Transmissions

Then there's Continuously Variable Transmissions, or CVTs. The CVT is in theory a much better solution, because it allows a constant range of gear ratios between low and high gears. Scooters use them, as do some cars nowadays - with a CVT,

the engine can sit at its most efficient or powerful RPM, while the gear ratio constantly adjusts itself to match wheel speed.

But most CVTs have a limited range of ratios they can work through - so while you can transition all the way from low gear up to high, you can't go all the way down to neutral. So they need to use a friction clutch or torque converter to get them started from a standstill - and what's more, in order to achieve variability in the gear ratio, they're almost always built around some sort of friction drive too - like belts pulling on conical rollers, or rollers being mashed against toroid shapes.

All these friction components cause troubles when you start trying to put high power and torque through them - they start to slip and fail, they wear and generally contribute to inefficiencies in the drive train. That's why you tend to go back to gears when you're designing a high-powered machine. Gear teeth are reliable - the bigger the teeth, the more power they can handle.

3. D-DRIVE UTILITY

A d-Drive gear transmission has a wide range of applicability. It may be used on cars, tractors, trucks etc.

d-Drive can operate not only as a continuously variable transmission, but as an infinitely variable one, for maximum efficiency according to operating conditions and operator preferences.

The d-Drive:

a) Requires no clutch at all
b) Is infinitely variable - from top gear through neutral and even into reverse; and
c) Doesn't use any clutches or friction drive components - instead, the power is always transmitted from input to output through gear teeth.

The gear sizes, or cones and belts, or any familiar transmission type is out of question when you're talking about the D-Drive.

Because when you look at it, the only way to tell what sort of ratio it's in at a given moment is to look at the two spinning shafts in the middle of it. If the bottom shaft is still and the top one's turning, you're in top gear. If the top shaft is still and the bottom one's turning, you're in reverse. If the top and bottom shafts are spinning at the same speed but in opposite directions, you're in neutral. And you can speed up or slow down those shafts as much as you like to vary the gear ratio to any point between full speed reverse and full speed forward.

In essence it's built around planetary gear systems at either side, with sun gears, planet gears and revolving ring gears all interacting with one another.

4. D-DRIVE CONSTRUCTION

1) The engine is delivering power to one of the three members,
2) The propeller shaft is connected to one of the other members, and
3) The remaining member is held against rotation. All three conditions must be satisfied for power to be transmitted in the system. Automatic transmissions provide for holding a member through hydraulic servos and spring pressure.

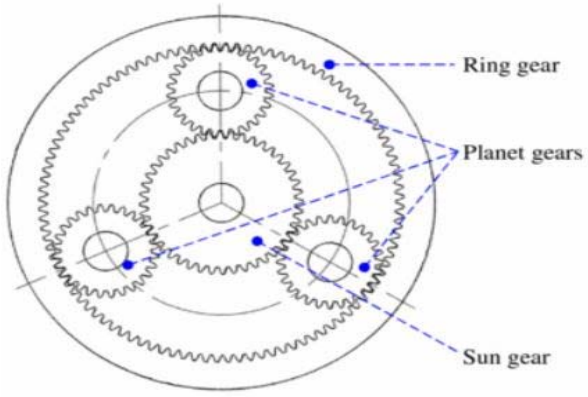

Fig. 1: d-Drive construction

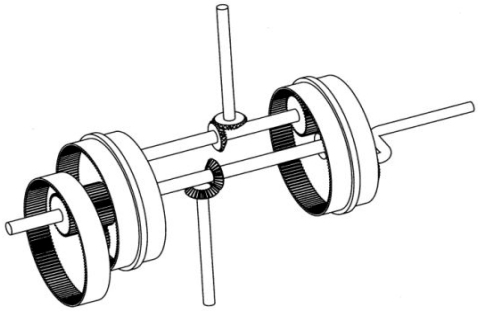

Fig. 2

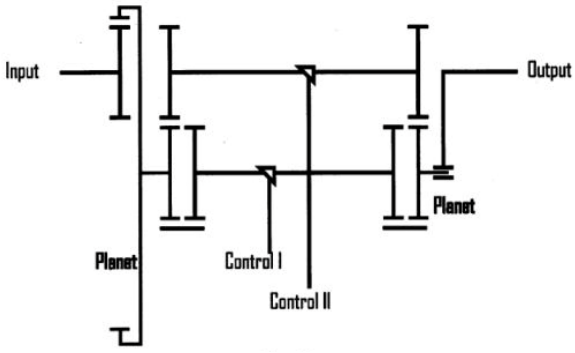

Fig. 3: Line Diag.

5. TRANSMISSION IN TRACTORS

Transmission is a speed reducing mechanism, equipped with several gears. It may be called a sequence of gears and shafts, through which the engine power is transmitted to the tractor wheels. The system consists of various devices that cause forward and backward movement of tractor to suit different field condition. The complete path of power from the engine to the wheels is called power train.

A transmission system of a tractor is quite complex. It has a lot

of gears and usually faces a lot of failures. The wear and tear associated with it is also considerable as the clutch is constantly required for this purpose.

A small farm tractor that is useful in farm conditions of India, Bangladesh etc. d-Drive can be incorporated.

The conventional system can be replaced by the d-Drive.

Older farm tractors use a manual transmission with several gear ratios, typically three to six, sometimes multiplied into two or three ranges. This arrangement provides a set of discrete ratios that, combined with the varying of the throttle, allow final-drive speeds from less than one up to about 25 miles per hour (40 km/h), with the lower speeds used for working the land and the highest speed used on the road.

Slow, controllable speeds are necessary for most of the operations performed with a tractor. They help give the farmer a larger degree of control in certain situations, such as field work. However, when travelling on public roads, the slow operating speeds can cause problems, such as long queues or tailbacks, which can delay or annoy motorists in cars and trucks.

In these, unsynchronized transmission designs were replaced with synchronization or with continuously (CVTs). Either a synchronized manual transmission with enough available gear ratios (often achieved with dual ranges, high and low) or a CVT allow the engine speed to be matched to the desired final-drive speed, while keeping engine speed within the appropriate speed (as measured in rotations per minute or rpm) range for power generation (the working range) (whereas throttling back to achieve the desired final-drive speed is a trade-off that leaves the working range). The problems, solutions, and developments described here also describe the history of transmission evolution in semi-trailer trucks. The biggest difference is fleet turnover; whereas most of the old road tractors have long since been scrapped, many of the old farm tractors are still in use. Therefore, old transmission design and operation is primarily just of historical interest in trucking, whereas in farming it still often affects daily life.

6. D-DRIVE FOR SMALL TRACTORS

Because the transmission required for small tractors deals with less load d-Drive fits perfectly into it. Replacing the transmission mechanism by d-Drive will overcome a majority of problems associated with it.

Some advantages of having a d-Drive for small farm tractors is that it requires no clutch at all, is infinitely variable - from top gear through neutral and even into reverse; and doesn't use any clutches or friction drive components - instead, the power is always transmitted from input to output through gear teeth.

dDrive can be expected to deliver improved fuel economy–and therefore reduced emissions from any carbon-based fuel source.

Also, through its innovative design, dDrive offers the prospect of high torque throughout the power curve–even at the critical low-revolutions end of the range.

7. CONCLUSIONS

A d-Drive mechanism has a very versatile role to play if used to maximum of its efficiency. A transmission with reduced gears and less probability of failure is undoubtedly better. d-Drive offers operation not only as a continuously variable transmission, but as an infinitely variable one, for maximum efficiency according to operating conditions and operator preferences

So it does stand as a viable option for transmission system for a small tractor.

Though the d-Drive have a lot of advantage to talk of but still there are some possible problems that can emerge when we will put this system under real load conditions. We have found following shortcomings:-

1. When we think of tractor we know there is a large power to deal with, now in case of d-drive a variable speed motor is required to control the transmission. In the demonstration of d-drive by Steve Durnin he used an electric motor for that purpose. To govern the speed ratio, the speed of the two spinning shaft is to be adjusted but it isn't easy in case of tractor because a lot more power is required to govern the speed of the shafts and it is difficult to by an electric motor and when we think of doing this by mechanical means it becomes a more complicated system by using a the power from the flywheel.

2. Plus when the output shaft will be under load from the rear wheels of the tractor there will be chances of transmission of the load backward to the d-drive transmission and may lead to damage through the weakest points.

If these two things can be controlled and adjusted then the d-Drive can be revolutionary concept in the field of tractor.

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