MULTI-SPEED TRANSMISSIONS

Utility and Pleasure of Auxillary Transmissions

By Murray Fahnestock

The following is a direct copy from an article by Murray Fahnestock which appeared in the September 1921 *Ford Owner and Dealer* magazine. Murray outlines the differences amoung a number of auxillary transmissions but by no means does he cover them all. In fact, the *Warford,* perhaps one of the most common of all, is not mentioned. The Ruckstell axle had not appeared by 1921 but its predecessor, the *Perfecto* is covered.

Reading Murray s articles seems to point out the unsophisticated audience to whom the material was directed. He not only repeats, over and over, the same information; his sentence structure would drive an English teacher to drink! Other than a number of spelling errors and out-of-place paragraphs, we have reproduced it here just as Murray wrote it. Read it, enjoy it, and perhaps learn a little. Murray Fahnestock was THE Ford expert of the Model T Ford era.

When the high speed gear is used, the car has speed but not so much power. When the low speed gear is used, then the car has plenty of pulling power - but the speed is lacking. It is in order to get a "betwixt-and-between speed that these auxillary transmissions are used. Then, when conditions of road or grade call for more power than can be supplied by the high speed gear, and for more speed than can be supplied by the low speed gear, an *intermediate* gear will be available, which will combine both speed and power to the most useful degree.

By using special-ratio gears in the rear axle system, of say four-to-one or of the 4.2-to-1 type, we can get increased power. But this is at the sacrifice of a certain amount of speed on smooth, level roads. By installing 3-to-1 ratio gears in the rear axle, we can get increased speed over smooth, level roads. But we will naturally sacrifice pulling power for traveling over hilly roads or through sand and mud. As it is obviously impractical to change the rear axle gears when traveling along the road, the only practical alternative is to install a multi-speed *transmission,* which will perform the same function of changing the rear axle gears, whenever the driver so desires.

It is thus to act as a *changeable* gear ratio that these multi-speed transmissions are designed. And by suitable combining a multi-speed transmission with special-ratio gears on the rear axle system, even better results can sometimes be secured. For instance, if one is driving a touring car over generally smooth and level roads, or over what would be called "rolling country without too many steep hills; then it might be desirable to install a set of 3-to-1 gears in the rear axle system for general use over level roads and easy grades. While the intermediate gear of the mulit-speed transmission could be used to secure greater pulling power over hills.

However, if one has a Ford Sedan of considerably greater weight, and if this car is used over mountainous roads, then it may be preferable to use a set of 4-to-1 gears in the rear axle, and to use the multi-speed transmission to obtain greater pulling power, or higher speed, as desired.

SPEED OR POWER

In a previous article (in *Ford Owner and Dealer* magazine) it was shown by means of pulleys used as a hoist that it was possible to get *either* speed or power by a suitable arrangement of pulleys, which had the same effect as changing the gear ratio. The big word in this case is the little word "or. It is not possible, by any means of gearing to obtain *both* speed and power at the same time, as the power is the *product* of the speed times the pull, or vice versa.

Most of these multi-speed transmissions are so arranged that they can be used to give what is called an "over-drive, which has the effect of gearing up the speed of the car. In other words, when the multi-speed transmission is in the highest gear position, then the car is geared up to travel at a higher rate of speed than the car would travel if the regular Ford high gear were used.

By installing these transmissions in the *opposite* direction or by turning them "end for end, it is possible to use what is called the "under-drive. This has the effect of *reducing* the speed of the car when the intermediate gear is used, and thus increasing the

available pulling power.*

ENCLOSED CARS

It is on such enclosed car models as the Ford Sedan or Coupelet the multi-speed transmissions will most frequently be used because, owing to the greater weight of these enclosed car bodies, a special ratio of transmission is more imperatively needed. There is another reason why the owners of enclosed Fords will be more apt to buy these special transmissions, and this is due to the fact that these enclosed Fords cost almost twice as much as the open Ford cars. And the man who pays that much for a car is usually willing to pay the additional amount to get just what he wants in speed and power.

Another important reason why a multi-speed transmission is needed more on the enclosed cars is due to the fact that when low gear is used with an enclosed car and the engine is spinning at a high rate of speed, the enclosed body acts as a sounding box, resembling the effect of a violin. Thus intensifying the sound and making it very disagreeable for the driver and passengers, if the engine is running at all fast.

By using a multi-speed transmission, it is possible to keep the engine running more regularly at its most efficient speed of about a thousand revolutions per minute, at which rate of speed the Ford engine develops its maximum power, with the least amount of thumping and vibration.

EFFICIENT ENGINE SPEED

At speeds of over a thousand revolutions per minute, the unbalanced forces of the pistons and crankshaft tend to give such considerable thumps, and the whole car is subjected to considerable strain and vibration. And the *normal* engine speed of about one thousand revolutions per minute, is the "happy medium at which the Ford engine works most efficiently and smoothly.

With the regular Ford rear axle gear ratio of 3.6340-l in the rear axle, the Ford engine is traveling at its normal speed of a thousand revolutions per minute when traveling along in high gear at a rate of speed of approximately twenty-five miles an hour. When low gear is used, this normal engine speed, of one thousand revolutions per minute, is attained when the car is traveling at about eight miles an hour. For this reason, the Ford car should not usually be driven much over eight miles an hour when low gear is used.

THE FORD TON-TRUCK

Multi-speed transmissions find another useful application for use with Ford Ton-Trucks, owing to the fact that the load carried by these trucks is so variable. For example, the truck may be overloaded to the extent of carrying a ton or a ton and a half of goods, and this load may be carried up a hilly district. Returning from the same trip, the truck may be empty, and the route may be generally down grade.

Under such conditions the use of a multi-speed transmission will enable the *right* gear ratios to be used carrying the overload up the long, hilly road, while the multi-speed transmission affords another change of gear ratio to enable the truck to return empty at a considerably higher rate of speed, without racing the engine and shaking the engine ail to pieces.

The "critical speed for the Ford Ton-Truck, using the regular ratio of 7.25-to-1 in the rear axle, is from 15 to not over 17 miles an hour. If the truck is driven much faster than this -- even when empty - the engine will soon be racked and shaken to pieces. While if a suitable over-drive transmission is used, it may be quite feasible to drive the truck on its return trip at a speed of 25 miles an hour of so, thus saving about 50% of the time.

If the time of the truck is worth ten dollars a day, then this may result in a saving of several dollars a day. And as truck operations are a "dollar-and-cents proposition, it is worth considering each and every factor which will multiply the utility of the truck.

Some of these multi-speed transmissions are expressly designed for use on the Ford Ton-Truck, all the parts being made "extra heavy to withstand the abuse to which they may be subjected when carelessly driven by indifferent drivers. Of course, when the Ton-Truck is used on the farm, and a member of the family is the driver, then the transmission will be handled with the same care as the sliding gears in a touring car of "other than Ford make. And there is no reason why these transmissions should not give as long service as the transmissions in the average automobile.

As we have previously mentioned, a car may be unable to ascend a certain hill in high gear, and so the speed of the car may drop suddenly from 25 miles an hour to about 8 miles an hour. However, if one has a multi-speed transmission and an *intermediate* gear is available, then a speed of 18 miles an hour may be easily maintained up the same hill, or when pulling through deep sand or mud. Thus the *average* speed of the car may be considerably increased on a long trip.

If an "over-drive transmission is used, so that even higher than regular speed can be used, then the normal running speed over good roads, without excessive vibration of the engine, may be increased from 25 up to say 35 miles an hour. By thus giving two additional speed changes, we may be able to increase the *average* speed to a considerable extent, thus enabling the car or truck to cover much more territory during the day.

FUEL SAVING

In considering fuel economy tests, it is generally known that the Ford car will cover most miles per gallon when the car is not driven over 20 to 25 miles an hour. This is due to the fact that, at higher rates of speed,

**Editor s note: Murray seems backwards here to me. Most of the auxillary transmissions are a step-down type in the normal position. Turning them "end-for-end as he suggests, if even possible, would make them in effect a "step-up device, or an overdrive. The gear ratios are such that, if reversed, if is doubtful the engine could pull the car.*

much of the power from the fuel is wasted in "shaking the engine and in vibration and noise. Consequently, if an "over-drive transmission is used, and the engine speed can be kept at about a thousand revolutions per minute, even though the car speed is about 30 miles an hour, it stands to reason that considerably better fuel mileage will be secured.

This will be evident if we will consider how wasteful of fuel it would be to drive ten miles over a level road using "low gear all the way. An evidence of this is given by the fact that the engine soon causes the radiator to boil over, if this "stunt is attempted. The fact that the radiator boils over is good evidence that the fuel is being burned up to produce an excessive amount of heat, and this is a good way of proving that fuel is wasted, when the gear ratio is too low.

If, when walking, one takes little steps, of about six inches in length, it is easy to surmise that this will take much more energy and be much more tiring than taking normal strides of about 27 inches. While if one attempts to take 4-foot steps, then this will also be a much more tiring method of walking than by taking steps of normal length. It is to enable the Ford engine to exert the power impulses of a normal amount that multi-speed transmissions are designed to accommodate the gear ratio to the conditions of the road, grade and load.

EASIER DRIVING

If one is driving up a hill which is too steep for the use of high gear and which makes it necessary to use low gear, then it will be easier for the driver if he has a multi-speed transmission. Then he can shift back into intermediate speed, and thus drive the car up the hill in a gear ratio which pulls the car along at a good rate of speed, yet without "racing the engine and getting on the driver s nerves.

Also, this makes it unnecessary for the driver to keep the low pedal constantly pressed down, which is very tiring. As one must hold this low speed pedal pressed down firmly, when traveling up a hill of a half a mile or more in length. The ability to shift into intermediate gear, which makes it unnecessary to use low gear so frequently, is very convenient when driving through traffic or through sandy or muddy roads, thus making it much pleasanter to drive the car and lessening the strain on the driver.

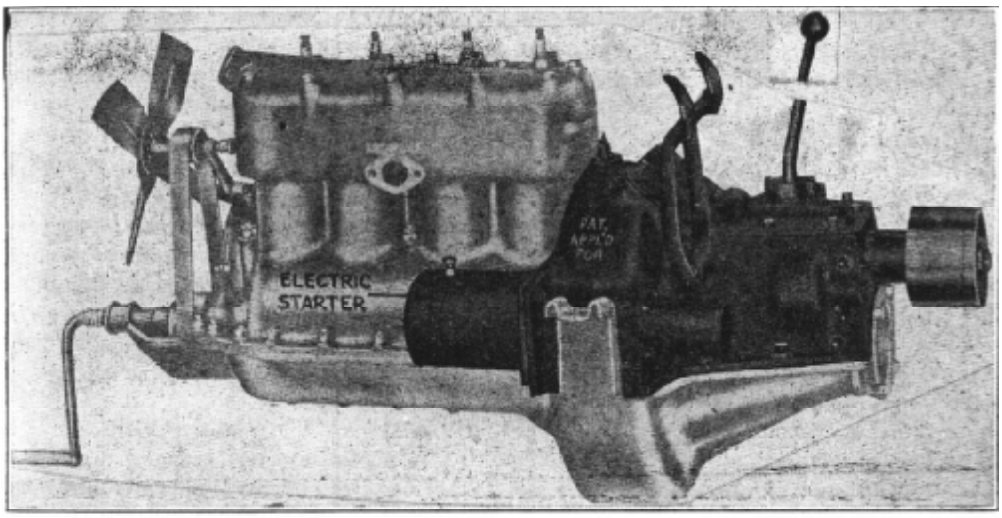
If one wishes to get back into high gear, and a multi-speed transmission is available, the car can be speeded up to 20 to 25 miles an hour in the "intermediate gear; thus making it easier to get back into high gear and maintain the speed of the car up the rest of the hill. One of the requisites of getting back into high gear easier is a sufficiently high speed of the car to enable the change to be made smoothly and easily.

NEEDS AN INTERMEDIATE GEAR

Most of the emphasis of the utility for multi-speed transmissions lies in the need for the intermediate, or "betwixt-and-between gear. This is the gear ratio which is usually most needed, just as most of us long for spring in December and January, while we often long just as fervently for cooler weather in the heat of July and August. The seasons of the year, at which the most work can be done, are the intermediate seasons of spring and fall.

One of the advantages of the intermediate gear is that the ability to secure the correct gear also lessens the strain of pulling the car up hills. This makes it easier on the engine and reduces the wear on the bearings of the crankshaft, and also the wear of the pistons and cylinder walls.

While some of us might manage to carry a 100-pound load across the street, we could much more easily handle this same load by carrying it in two or three trips. In the same manner, the Ford engine can then propel the car up a certain hill much easier by using the "intermediate gear ratio to obtain a more suitable ratio between the engine speed and the load.



Simplex Three-Speed Sliding Gear Transmission

The reason that the regular Ford low speed is not made higher is that this is the only "emergency pulling gear that the Ford transmission has. While it would be generally useful to have the Ford low speed higher than it now is, there are occasions when the Ford car needs every bit of power that the low speed makes available. In order to obtain this reserve of pulling power, it has been necessary to make the Ford low gear ratio lower than would be generally convenient for the average driver.

For instance, when one is starting the car in deep sand or mud, then the car needs every bit of power that the regular Ford low gear will give. Or when starting the car up hill, then the Ford low speed is needed to afford the necessary power. And if the Ford low gear were designed to give a higher speed, it would lack the necessary power to cope with these conditions.

LOWER THAN LOW

As it is the "intermediate speed which is most imperatively needed, the question may arise, "Why are many of these transmissions of the four-speed or six-speed type? The answer is that most of these auxillary transmissions really only give two changes of gear ratio. But as these two changes of gear ratio are applied to each available speed of the regular Ford transmission, this gives two changes of gear ratio for the Ford "high speed gear, and also two changes of gear ratio for the Ford "low speed gear, thus making *four* forward speeds ahead available.

This has the effect of also doubling the reverse speed and making two *reverse* speeds available. Though this is only an incidental consideration, as the reverse speed is so seldom used and for such short distances. It is not important whether or not an extra reverse speed is available, and it has been the experience of the writer that even when two reverse speeds are available, only one of these is generally used.

OVER-DRIVE TRANSMISSIONS

When the transmission is installed in the "over-drive position, thus *gearing up* the Ford car and increasing the car speed at the normal engine speed, then this means that when the Ford high gear is used, together with the high speed of the auxillary transmission; then the effect will be to increase the car speed, without increasing the speed of the engine.

Suppose for example, that the engine speed remains constant at the normal speed of one thousand revolutions per minute, and that the regular ratio gears of 3.63-to-1 are used in the rear axle. This would ordinarily mean a car speed of 25 miles an hour. But when an "over-drive auxillary transmission is used, this car speed would be increased to about 30 to 35 miles an hour, with the engine speed remaining constant at the same normal speed of one thousand revolutions.

When the auxillary transmission is shifted into the lower speed, then the gear ratio, from the engine to the rear axle, will be the same as if no auxillary transmission were used; thus giving the "straight drive from engine to rear axle of 3.6340-l. When the auxillary transmission gear shift lever is then placed in the "high gear position and the Ford low speed pedal is pressed, then the effect of an "intermediate speed, between the regular Ford low speed and the Ford high speed will be secured, the "gearing up being secured in the auxillary transmission.

When the gear shift lever of the auxillary transmission is moved to the "low speed position, and the Ford low speed lever is pressed, then this will give the same effect as the regular Ford low gear.

All this is about as clear as mud. But the result is that the regular Ford high and low speed are not changed, and that an "over-drive is secured which makes available a higher gear ratio for faster car speeds over smooth, level roads.

In our opinion, the over-drive transmission should only be used with the regular Ford 3.63-to-1 gears in the rear axle, with the Ford Sedan or Coupelet, when the roads are unusually smooth and level. Though this over-drive transmission might be used with the Ford touring cars or roadsters, under average conditions of dirt roads, which are not too hilly.

UNDER-DRIVE TRANSMISSIONS

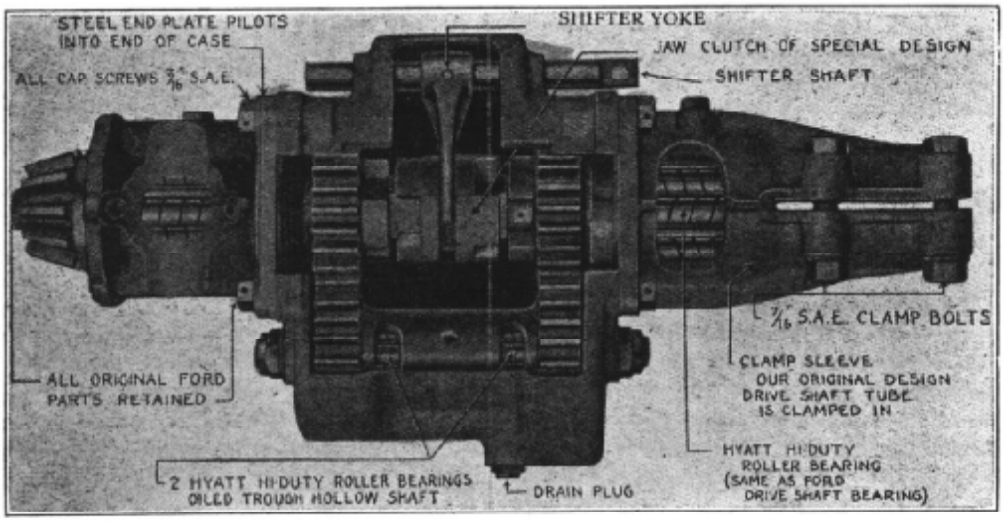
When the auxillary transmission is turned "end-for-end and installed in the under-drive position, this means that, when the auxillary transmission is used, the engine speed will be "geared down, and so *greater pullingpower* but *less speed,* will be available.

When the "under-drive transmission is used, and the gear shift lever is in the "high speed position, and the Ford transmission is in the high gear; then the regular ratio of 3.6340-l will exist between the engine and the rear axle. And the drive will not be through any of the gears in the auxillary transmission, so that the Ford car will have just the same pulling power in high gear, and just the same speed, as if no auxillary transmission were used.

When the gear shift lever is moved to the "low speed position, then the effect of an excellent *intermediate* gear will be secured, thus securing greater power than can be secured through the use of the Ford low speed.

By moving the gear shift lever of the auxillary transmission to the "high speed position and pressing the low speed pedal, then the same effect will be secured as if the regular Ford low speed were used and no auxillary transmission were installed.

If the gear shift lever of the multi-speed transmission is moved to the low speed position and the low speed pedal be depressed, then a "lower-than-low gear is secured, which gives greater pulling power but less available speed than can be secured by the use of the regular Ford low gear. This "lower-than-low gear ratio may be especially desirable on Ford Sedans or trucks driven over rough and muddy roads, or for pulling over exceptionally steep grades. And this "lower-than-low speed also makes it easier to start the heavily loaded car, when the car is standing on an uphill grade.



Moore Transmission

FREE NEUTRAL SAVES FUEL

The fact that a "sliding gear transmission is used enables a really "free neutral to be secured. When the gears are disengaged, then the two shafts can rotate freely without regard to each other. This gives a "free neutral that is impossible to secure with the ordinary Ford transmission.

When the Ford transmission is used, the so-called "neutral is with the *clutch* disengaged. As the Ford high speed clutch is composed of 25 steel disks, this means that there are about 24 contact surfaces between the disks of the high-speed clutch.

Now the entire clutch assembly on releases about a quarter of an inch or .25 of an inch. This means that the distance between adjacent plates of the high speed clutch will be only about .01 of an inch. By the time .01 of an inch is filled with oil there may be considerable "drag or friction between the disks of the high-speed clutch.

Of course, when the engine is warmed up and the oil is thin, then this "drag is not so noticeable. But this is the reason why the Ford car does not coast freely, no matter in what position the clutch pedal is held when the engine is stopped. Of course, when the engine is still running, there is not so much difference between the engine speed and the car speed, and so the "drag in the high speed clutch is not so noticeable.

In making fuel economy tests in other-than-Ford cars, it is usually customary to speed the car up to about thirty miles an hour. Then stop the engine, and allow the car to coast until the car speed decreases. Then the clutch is engaged and the engine started. Thus driving with a series of "jumps which secures the maximum fuel efficiency in covering the greatest distance over level roads.

On some down grades, where the Ford car will not ordinarily coast with the engine stopped, using the regular Ford transmission; it is possible, with one of these special transmissions, to use the "free neutral and thus allow the car to coast for a much greater portion of the time. Over rolling country roads, where traffic is not too heavy, it is sometimes possible to coast for a quarter of the total distance covered, thus greatly increasing the fuel economy and the miles per gallon.

EASIER STARTING

When cranking the Ford engine, the greatest difficulty in cranking is the apparent "stiffness of the Ford engine. This is really due to the "drag between the disks of the high-speed clutch. In cold weather, when the oil is congealed and stiff, it is the custom of many owners of Ford cars to jack up one of the rear wheels, and thus eliminate the "drag in the high-speed clutch, by rotating the drive shaft and the gears in the rear axle as well as one of the rear wheels.

Even the heavy grease in the rear axle housing does not cause as much friction and "drag as that which usually exists between the disks of the high-speed clutch. Consequently, this method of easier starting is an effective aid in really cold weather.

But if the car is fitted with one of these multi-speed transmissions, then the gears can be shifted to the really free neutral, and the engine can be cranked just as easily as the engines of "other-than-Ford cars of similar size. This advantage of easier starting is most useful in cold weather, and also for those who crank the engine by the "Armstrong method. However, even when an electric starting system is fitted, this method is useful as it reduces the strain on the battery and on the electric starting motor.

REAR HUB BRAKES

The fact that a really "free neutral is provided must be considered in the braking system of the car. For if one attempted to shift gears while descending a hill, and should fail to engage the gears; then the regular Ford

foot brake and reverse would be inoperative for controlling the speed of the car. For when these auxillary transmissions are in "neutral, there is no connection between the engine and the rear axle.

By speeding up the engine, so that the gears are rotating at the same speed as that at which they would rotate if the engine were driving the car, it is usually possible to engage the gears. But not every driver is skillful and so it is better to increase the efficiency of the rear hub brakes, when one of these multi-speed transmissions is installed.

The regular Ford rear hub brakes have cast-iron brake shoes, acting against pressed steel drums. And when the grease works out from the rear axles and covers these cast-iron brake shoes, the coefficient of friction is very low, and the brakes are not effective. So that we recommend the installation of some form of "lined rear hub brake shoes, as these fabric-lined brake shoes are much more effective in stopping the car than the plain, cast-iron brake shoes.

Many car owners consider it even better to install a set of "contracting rear hub brakes. Some of these "contracting rear hub brakes are arranged to be connected to the foot pedal or "service brake of the car. And they are much easier to reline than the Ford foot brake inside of the transmission.

But the multi-speed transmissions have the advantage that they allow the engine to be more effectively used as a "brake, when the car is being driven over hilly country roads. When the regular Ford transmission is used, and the hill is too steep for the engine to hold back the car in high gear with the ignition switched off; then there is usually too much of a "jump between the high speed and the Ford low speed, as the use of the Ford low speed would generally stop the car altogether, unless the hill is unusually steep. That is why the Ford low speed gear is practically never used, in connection with the engine, for slowing down the car.

When one of these multi-speed transmissions is installed and the hill is too steep for the use of high gear, then the "intermediate speed can be used and the engine will act *as an effective* brake, thus practically eliminating wear on the regular transmission brakes and saving them so that they will stop the car smoothly and easily in traffic.

SIMPLEX SLIDING TRANSMISSION

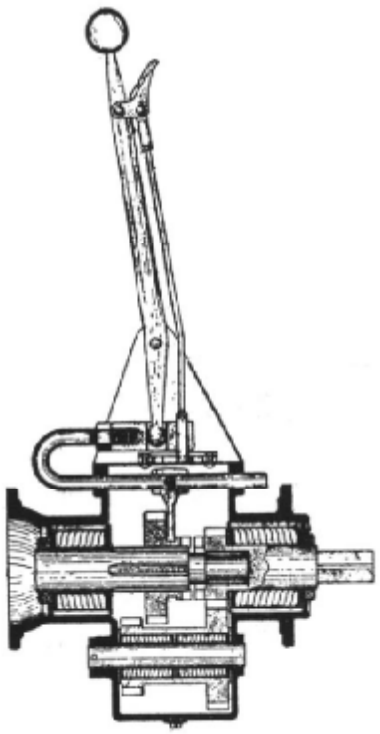
The Simplex "sliding gear transmission can be used equally well on either Ford passenger cars or Ford Ton Trucks, because it *replaces* the regular transmission of the Ford car. And there is no difference between the Ford passenger car, and the Ford Ton Truck, until after the universal joint is passed.

In the Simplex sliding gear transmission there are *three* forward speeds. And this sliding gear transmission is of the same general type as is used in most "other-than-Ford cars. This is considered an advantage by some drivers, who own two or more cars, one of these cars being a Ford used for general city work, while the other car may be a larger car for touring and special occasions. In such cases, the driver may be accustomed to the sliding gear transmission, as found in the large cars, and by installing a sliding gear transmission on the small Ford; then both cars can have the same type of transmission, and the driver is less apt to become confused when changing from one car to another. This transmission has the standard S.A.E. gear shift.

One of the advantages of these Simplex transmissions is that it *eliminates* the Ford transmission bands, and the necessity of replacing the band linings. In this transmission, the regular Ford multiple disk clutch is used for the forward and reverse speeds. The foot brake operates on a drum, on a shaft extending at the back of the transmission. As this foot brake operates on a wide drum, a brake of ample capacity is secured. And when it does become necessary to reline this brake band, it is not necessary to remove the transmission cover.

As this transmission has *three* speeds, the use of the intermediate gear makes it unnecessary for the driver to rush hills in high gear in order to avoid the necessity of dropping into the use of the disagreeable Ford low gear. When the intermediate gear is used, fairly steep hills can be taken at a speed of about 15 or 20 miles an hour, without racing or straining the engine. When the roads are muddy or sandy, it is possible to shift into the intermediate speed, thus making it unnecessary for the driver to hold his foot on the low speed pedal over long stretches of road.

The low gear ratio of this transmission is lower than



Woodward Transmission

the regular Ford low speed, thus giving more power, which is convenient for use on the Ford Ton Truck. The high gear ratio is the same as the regular Ford high gear, being a direct drive from the engine crankshaft to the rear axle. The intermediate gear is half-way between the low and high gears.

Owing to the location of the foot brake outside of the transmission, there is no lint or strands of cotton worn from the band linings to clog the oiling system. This tends to promote greater reliability of the engine bearings.

The cover of this transmission replaces the regular Ford transmission cover. And it will be noticed that this transmission cover is fitted for the installation of a Ford electric starting motor, so that the Ford electric starting system can be more easily installed on old Ford cars.

MOORE TRANSMISSION

The Moore transmission is of the "four speed type, giving two speed ratios in the sliding gears. These two speed ratios are used in connection with the regular Ford transmission, which gives two speeds with the Ford high gear, and two speeds with the Ford low gear; thus making a total of four forward speeds. Of course, two reverse speeds are also afforded, but this is a secondary consideration.

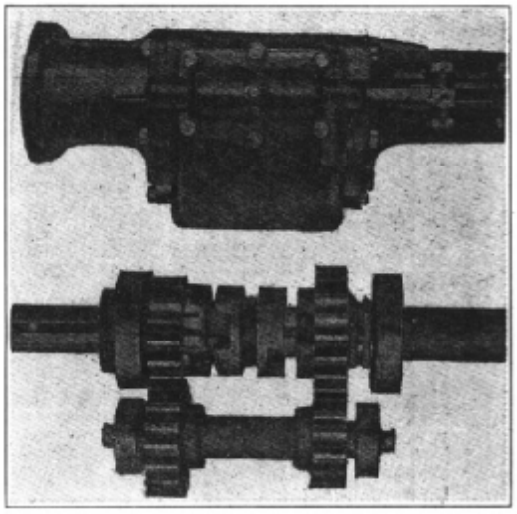
The Moore transmission replaces part of the drive shaft, just ahead of the drive shaft roller bearing housing. This transmission can be installed with the aid of an ordinary hack saw, and the regular Ford wrenches. The Moore transmission does away with the use of sliding gears, as there is a pair of jaw clutches, which are used to engage the different gears. This means that the gears are "always-in-mesh and there is no clashing or grinding of the gears, even though the gear shift lever may be carelessly operated by an indifferent driver.

When the "regular Ford transmission is used, the low gear ratio is about 10-to-1. That is, the engine makes about ten turns, to one revolution of the rear wheel. When the Moore transmission is used, the low gear is considerably lower, and the engine makes about 20 turns for each revolution of the rear wheels, thus practically doubling the power. This is sometimes an advantage, in securing an easy start up hill, or in pulling the car out of heavy sand or mud. And this "extra low gear is especially convenient for use on the Ford Ton Trucks, as it practically doubles the power available for emergency use.

When the intermediate gear is used, there is almost twice the pulling power as when the regular Ford "high speed is used. Consequently, when the gears are set at this speed, the car can be driven up almost any hill without the necessity of the driver holding his foot on the low-speed pedal.

Two different types of this transmission are furnished. In the "under-drive type, the power furnished to the rear wheels is doubled. While in the "over-drive type, the road speed of the car is increased about 20 percent. When the gears are shifted into the "positive neutral, this makes it easy to crank the engine and the car can be more easily moved about the garage without the necessity of starting the engine.

One of the features of this transmission is the Hyatt roller bearings on which both the secondary shaft and the drive shaft are mounted. The Hyatt bearings on which the drive shaft are mounted, are the same as the regular Ford drive shaft bearings, so that it is easy to secure new roller bearings if ever they should be needed. The installation of one of these transmissions means the addition of only 35 pounds to the net weight of the car.



Langbein Truck Transmission

WOODWARD TRANSMISSION

The Woodward transmission is of the "sliding gear type and is attached to the rear end of the Ford transmission, replacing the universal joint, which is then moved farther back.

This transmission is of the "front end design and the weight is carried by the car springs, rather than directly on the axles. All the shafts of this transmission are mounted on roller bearings, thus preventing loss of power through friction. This transmission is made for both the Ford cars and trucks - the same transmission being used for both.

The No. 1 transmission is of the "90 percent under-drive type, while the No. 2 transmission gives "37% percent over-drive, thus increasing the speed of the car to this extent. Another transmission, of the "90 percent over-drive is also made.

One of the features of this transmission is that the three different types of transmissions are the same, with the exception of the gears. If one has a set of extra gears at hand, a different set of gears can be installed in the same transmission, to accommodate the car to different work, or different seasons. As an example of this, the No. 1, or 90 percent under-drive type, could be used to give more power to the car or truck during the winter

and spring, when more power is needed. If the roads are level and good, the No. 2 over-drive, giving 37% percent more speed, could be used during the summer and fall.

LANGBEIN TRANSMISSION

One of the chief features of the Langbein transmission is the use of Hess-Bright annular ball-bearings to support the main shaft and the side shaft. These annular ball bearings are accurately and expensively made, and must not be confused with the cheap, adjustable cone ball bearings which were formerly used as standard equipment on Ford front wheels.

Friction imposes a constant drag on the engine and limits the load carrying capacity of the truck or car, thus increasing the amount of fuel required. By the use of these expensive annular bearings the losses, due to friction, are greatly reduced, and the gears are held accurately in mesh, so that the transmission runs freely and quietly in either high or low speed positions.

These Langbein transmissions are made in two sizes - one for use on the Ford passenger cars, and the other for use with the Ford Ton Truck. Both sizes are made in either the "overdrive and "under-drive designs. With the "over-drive design, there is 45 percent more road speed with the same engine speed. While in the "under-drive type the power is increased 45 percent, with the same engine speed.

With the "over-drive type installed on a Ford Ton Truck, the maximum speed of the truck is increased, from the usual speed of 12 to 17 miles an hour, to a maximum of 17 to 30 miles an hour.

UNIVERSAL TRANSMISSION

The Universal transmission is of the sliding gear, jaw-clutch type and is mounted on the drive shaft forward of the drive shaft roller bearing. This transmission is made in either the "over-drive or "under-drive type. When the "over-drive transmission is used, a high gear ratio of 2.75-to-1 is secured - while the regular Ford high gear remains the same as before. Then between the Ford "high gear and the "low gear, there is an *intermediate* speed of 7.25-to-1, which is secured by using the high speed of the over-drive, together with the Ford low speed.

When the under-drive transmission is used, the high speed is the regular Ford high speed of 3.63-to-1. When intermediate is used, the gear ratio is changed to 7.25-to-1, but a "special low gear ratio of 20-to-1 is available.

All the gears of this Universal transmission are constantly in mesh, thus practically eliminating the danger of stripping the gears, as engagement is made by sliding the jaw clutch along the shaft.

These gears are made of alloy steel of one inch face and are heat treated and oil tempered. The shafts are carried on Hyatt roller bearings. The gear case is made of one piece of Manganese bronze, which has a high tensile strength and is practically unbreakable. The same Ford drive shaft sleeve and Hyatt bearings are used as a part of the regular Ford equipment.

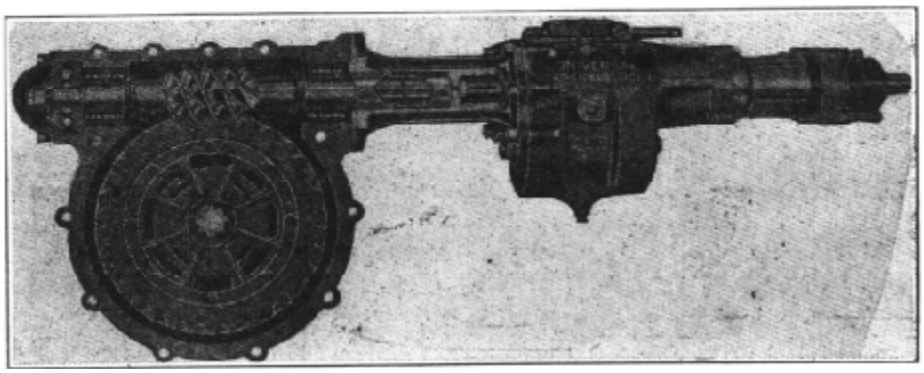
The control lever is mounted on the bracket attached to the transmission cover and has a double ball lock, to hold the gears in proper mesh.

A Universal transmission is made for use with the Ford Ton Truck, and this transmission works in the same manner, and uses the same size gears, as the passenger car transmission. But of course the gear ratios are changed, owing to the fact that the Ford Ton Truck had a rear axle gear ratio of 7.25-to-1, as compared to the ratio of 3.63-to-1 as used in the Ford passenger car.

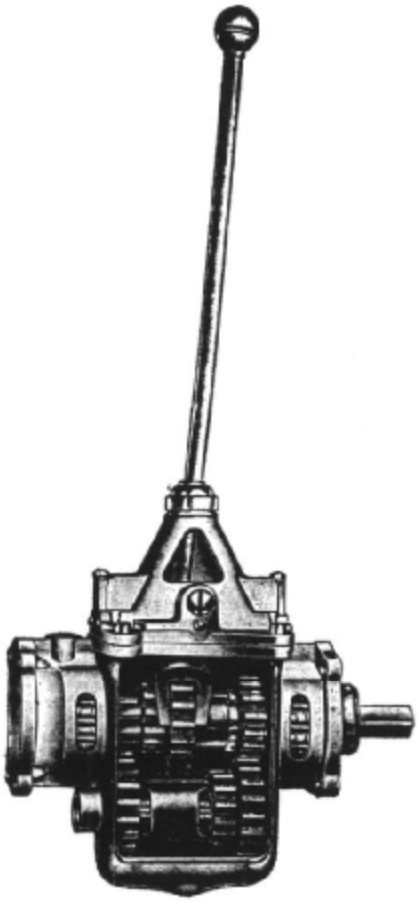
THE CONORD TRANSMISSION

The Conord transmission is different from all the others in that it affords *three* changes of speed in the auxillary transmission. And each of these three speed changes can be applied to either the regular Ford "high or to the "low gear, thus making a total of *six forward* speeds available. This also gives three reverse speeds, which are more than most of us have occasion to use.

The chief advantage claimed for this six-speed transmission is that an "over-drive for speed, and an "under-drive for power are both combined in the same transmission, and are available without using the Ford "low gear at all. With such a wide range of gear ratios available, one can adapt the gear ratio to the conditions of road and load, and thus secure the maximum of fuel effiency and road ability of the car. As three speeds are



Universal Truck Model



Conord Transmission

available with the Ford low gear, it is possible to secure tremendous pulling power, for carrying heavy loads.

As this transmission is attached above the springs, it does not add any weight to the rear axle. And this transmission only adds a total of about 30 pounds to the net weight of the complete car.

This Conord transmission is mounted in an aluminum gear case and cover. And there is a lock on the shift lever, so that the gears cannot slide out of mesh. With this transmission, the extra high gear is 3.240-l. Then the next speed is the regular Ford high speed of 3.6340-l. The next speed is the intermediate speed of 7.25-to-1, and these three speeds are all available without using the Ford s low gear.

When the Ford low gear is used, the "higher-low gear of 8.5-to-1 is available. Then the regular Ford low of 10-to-1 can be used. By shifting the auxillary transmission to the "emergency low, a gear ratio of practically 20-to-1 can be secured. And this practically doubles the pulling power of the Ford car in low gear.

PERFECT0 TWO-SPEED AXLE

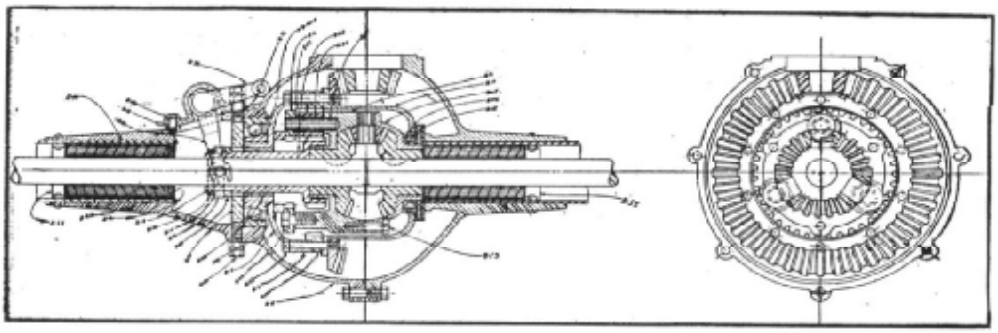
Another type of auxillary transmission, which differs from those already described in that it is located in the rear axle housings, is the Perfecto 2-Speed Axle. When this Perfecto 2-Speed Axle is used, the high gear, or direct drive is the same as the regular high gear. But the *intermediate,* about half-way between high and low, is available for harder pulling.

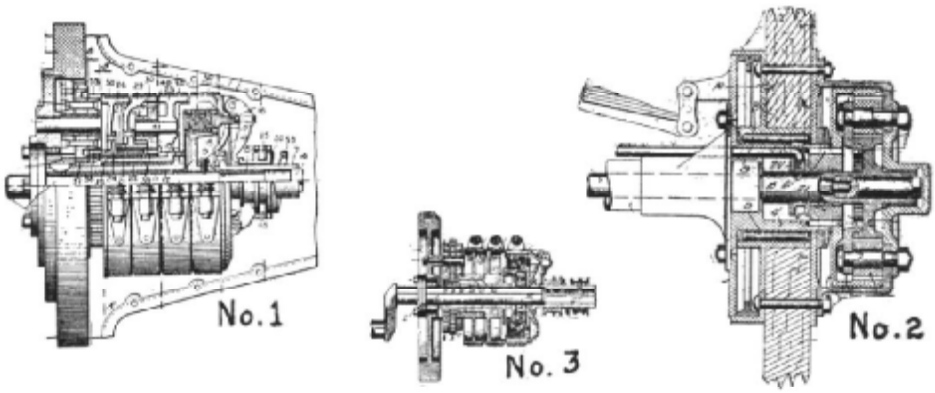
With the Ford "low in use, two speeds are available, thus doubling the pulling power when the emergency low gear is used. In the Perfecto device, the gears are of the planetary type and are constantly in mesh in all positions. The gears have three points of contact bearing, thus reducing the wear and making the gears as durable and reliable as the Ford differential gears, which give but little trouble in actual service. These gears are cut from chrome-nickel steel, and are hardened and ground.

To eliminate friction, all those parts run in oil, in the same direction as the wheels, thus reducing the friction to a minimum and making it unnecessary to supply lubrication to any other parts.

The installation is made by simply exchanging one of the regular Ford axle housings for another housing of special make, and changing the parts attached to the differential. When driving in high gear, all parts revolve as a "unit, and no noise at all is caused by the gears. When this transmission is used, the additional weight is only 15 pounds, and additional power of about 60% is made available. The road clearance is the same as that of the regular Ford rear axle system.

(Editor s note: The Perfecto was the forerunner of the Ruckstell axle, both being made by the same company (Hall-Scott). The Ruckstell is similar in principle but of simpler construction.)





Interesting Transmission Patents

PATENT TRANSMISSIONS

In an earlier part of this article, we stated that a four-speed "planetary transmission was hardly a practical device, owing to the complication and numerous parts which would be required, but sketch No. 1 shows a patent which has been obtained for a four-speed "planetary transmission.

A study of this drawing will bear out what we have said about the complication and friction which is involved in a four-speed planetary type of transmission. And if one will count the bushings and bearing surfaces between the transmission drive shaft and the outer row of planetary gears, one will understand that there would probably be a tremendous lot of "friction in a four-speed transmission of this type.

While the regular Ford transmission only has one set of triple gears mounted on pins attached to the flywheel, this four-speed transmission has *another* set of double planetary gears, which are mounted on pins attached to the drum next to the brake drum.

With four brake drums in use, a different transmission cover would have to be used, thus giving "four pedals for the driver to use instead of three. Also this might make it necessary to use *narrower* transmission bands which might wear out more rapidly. Consequently while this transmission is interesting, it does not seem probable that it will soon be placed on the market.

In patent No. 2, we see a very interesting form of a two-speed planetary transmission in which the two-speed gears are mounted directly in the *hub* of the rear wheel, so that no changes need be made except to remove the wheels, and to fit this special transmission in the rear wheel hubs. There is an internal gear, carried in the wheel hub which, when low gear is used, meshes with a sliding pinion slipped over the axle shaft, thus giving a low speed gear reduction. This is a very interesting type of transmission.

Patent No. 3 shows the Duncombe Auto Coaster which is intended as a "free engine device to allow the car speed to exceed the engine speed at any time, or act as a friction clutch for driving the car when the engine speed equals the speed at which it should drive the car.

As a result of this, whenever the car has a chance to coast, it does so automatically, thus securing greater fuel efficiency, as the car does not have to drag the engine when high gear is used.

This device only acts in connection with the high gear, and does not interfere with the regular use of the Ford low gear or Ford transmission brake. And it would seem that, besides securing increased gasoline mileage, this device should increase the life of the rear tires, by decreasing the strains to which they are subjected.

The Auto Coaster consists of a cam and eccentric rings on a disk holder which fits inside the high-speed disk drum, and make a simple and durable mechanism.

THE WARFORD

One of the better-known auxillary transmissions not mentioned in Murray Fahnestocks article is the Warford. Sales figures are not available but based on the number of survivors, the Warford was either better than most, or more were sold. Only the Ruckstell axle is more common today.

The Warford came in two basic designs, with modifications of both. One was the "Six Speed and the other was the "Four Speed. The Six Speed was actually a three speed; the "six coming from the two speeds in the Ford transmission. This model Warford had a low, direct, and overdrive gear. Gear ratios from 22.40-to-1 in low-low to 2.932-to-1 in overdrive were available when the Six Speed was used on a standard Ford passenger car.

The "Four Speed was actually a two speed, and came in two models; an underdrive and an overdrive. The more common was the underdrive, which gave a low-low of 19.02-to-1 and a intermediate gear of 6.92-to-1 in addition to the standard Ford gears (9.98-to-1 in low, and 3.63-to-1 in high). The overdrive model gave a 8.086-to-1 low (Ford low/Warford overdrive) and a 2.94-to-1 overdrive in addition to the standard Ford ratios.

The “Six Speed transmission was quite similar to a standard (non-Ford) transmission of the day except that it had no provision for a reverse gear. It was of the sliding-gear type, using straight-cut gears running in roller bearings.

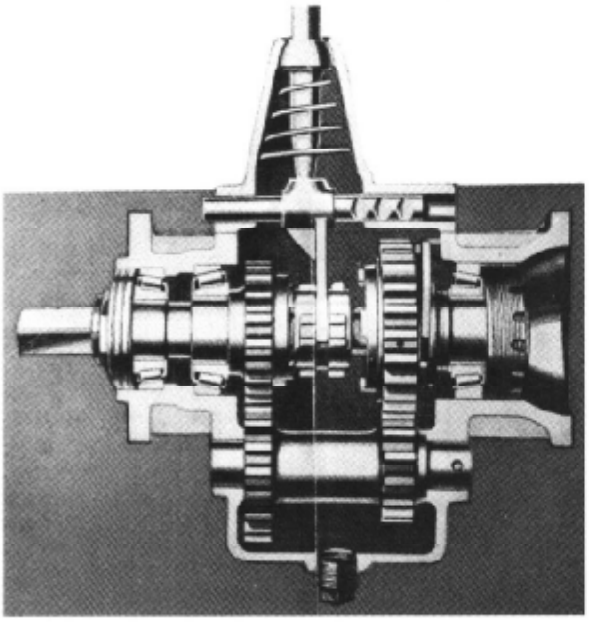
The “Four Speed model had constant-mesh gears; the speed selection being made by a sliding dog clutch on the main shaft. The main shaft ran in roller bearings while the counter-shaft ran in bushings.

The “Four Speed model was also made in a “heavy duty version for truck use. This model used still heavier gears and was also made to accept a power take-off attachment. (The power take-off could be had on the Six Speed as well.)

All models of the Warford mounted at the rear of the Ford engine and required either a shortened driveshaft (and radius rods) or a lengthened chassis for installation. Earlier models (apparently) were available with cast aluminum cases but most seemed to have cases of cast iron. The Warford company supplied a special cross-member to support the rear of the transmission in the Ford frame, and made a great point in the fact that its construction retained the Ford “three point construction.

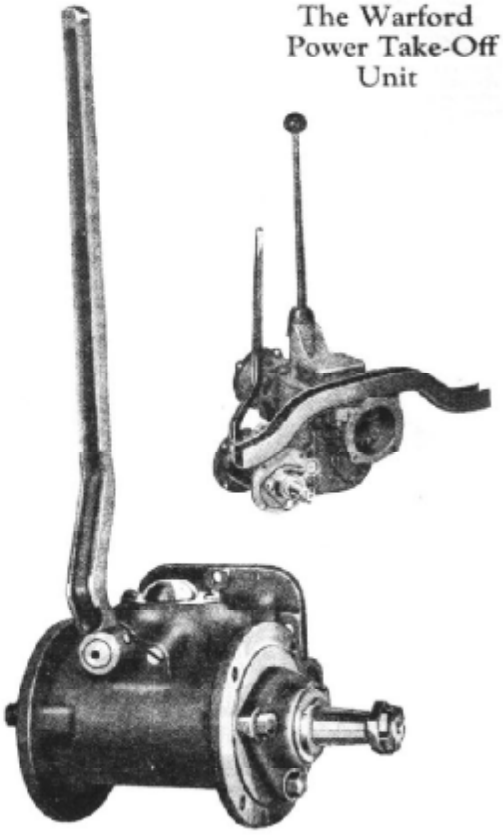
As in all auxillary transmissions of this type, gear noise was a problem. The War-ford in “overdrive is NOISY. Low gear is noisy too, but since the engine was also making considerable noise in low, the gear noise was not so noticeable. And, as in other transmissions of this type, outside brakes are a “must since the Ford transmission brake is totally ineffective when the auxillary transmission is in neutral. Murray Fahnestock noted that a skilled driver could synchronize engine speed with car speed and get the gears engaged while the car was rolling but it s doubtful he ever tried it.

The Warford Six Speed Transmission



The Warford Four Speed transmission

The Warford
Power Take-Off
Unit



The Gears of the Warford Six Speed Transmission