HYDRA-MATIC DRIVE

Principles of Operation

DUAL RANGE HYDRA-MATIC

"Dual Range" Hydra-Matic offers maximum economy, flexibility of performance, and long life. "Dual Range" allows the use of the most favorable axle ratios in the automotive industry. Engine speed and wear are reduced and economy is increased.

Whether the performance demand of the car is maximum acceleration, economy, or power, the "Dual Range" will do the job.

Select the range of operation desired, and the rest is automatic. For maximum economy, it's the Dr. 4 Range! For acceleration characteristics and engine braking action best suited for heavy traffic and exceptionally hilly terrain, it's the Dr. 3 Range! For maximum engine braking power, it's the Low Range!

The requirements of you and your car are fulfilled automatically by the "Dual Range". The purpose of this booklet to show you how it is accomplished.

INTRODUCTION

The information contained herein has been designed to explain in simple manner the automatic shifting in the "Hydra-Matic" Transmission.

A thorough understanding of how it is possible with a single planetary gear set to obtain reduction and direct drive is necessary. This will make it easy to understand the operation of the fully automatic four forward speeds and reverse "Hydra-Matic" Transmission which employs three planetary gear sets.

As band and clutch application is responsible for obtaining reduction and direct drive, it is important that this particular phase of the operation be understood.

HOW AUTOMATIC SHIFTING CAN BE ACCOMPLISHED

The main purpose of a transmission is to...

provide suitable gear ratios between the engine and rear wheels for all driving conditions.

Gear ratios can be secured in several ways...but we will cover only one—

Namely by—

PLANETARY GEARS

and

AUTOMATIC CONTROL

is more easily

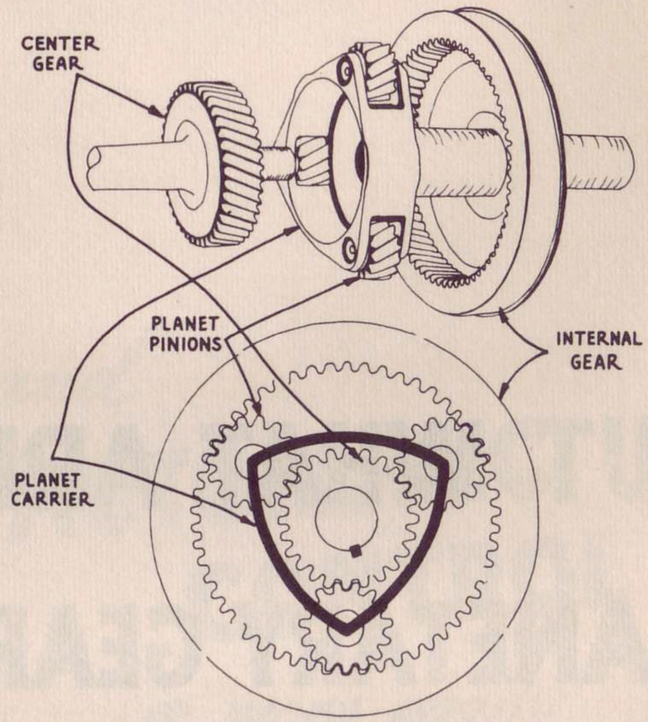
accomplished through the use of

PLANETARY GEARS

BUT WHAT ARE PLANETARY GEARS

and

HOW DO THEY WORK ?



PLANETARY GEAR ASSEMBLY

The center or "sun" gear is surrounded by and meshes with the planet gears which rotate freely on pins, all of which are attached to a single bracket called the "planet carrier". A ring with teeth machined on the inside circumference surrounds the assembly and meshes with the planet gears. This is the "internal" gear, so-called because of its internal teeth.

The advantages of planetary gears are:

a. Planetary gears are compact and sturdy because the load is distributed over several gears instead of only two as in the sliding gear type of transmission. This means that, while planetary gears are smaller and occupy less space, they can transmit more power because there are more of them and because there is more tooth area in contact to transmit power.

b. Because planetary gears are always completely in mesh there is no possibility of tooth damaged due to gear clash or to partial engagement.

c. The common axis for all members of the planetary unit makes the unit more compact and facilitates using it as a coupling.

A planetary gear train can be used to:

1. Increase power and decrease speed

2. Reverse direction of rotation, *and*

3. Function as a coupling in direct drive.

In the next few charts we will show how the above conditions might be accomplished.

A planetary gear train can be used to

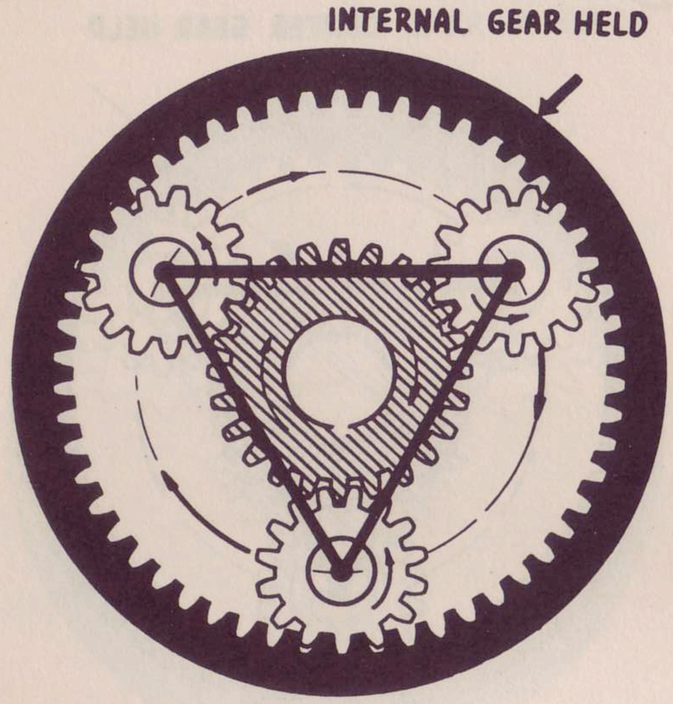
INCREASE POWER

and

DECREASE SPEED

in either of two ways.

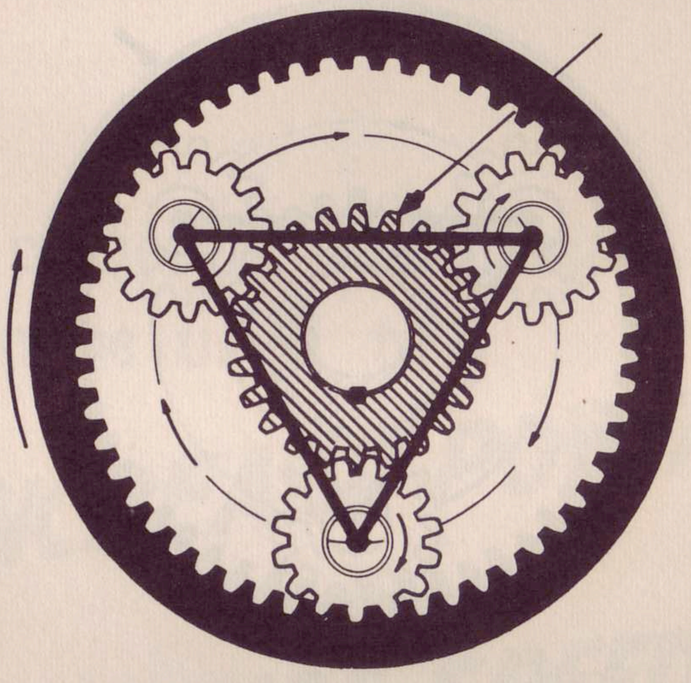
First-



REDUCTION-INTERNAL GEAR HELD

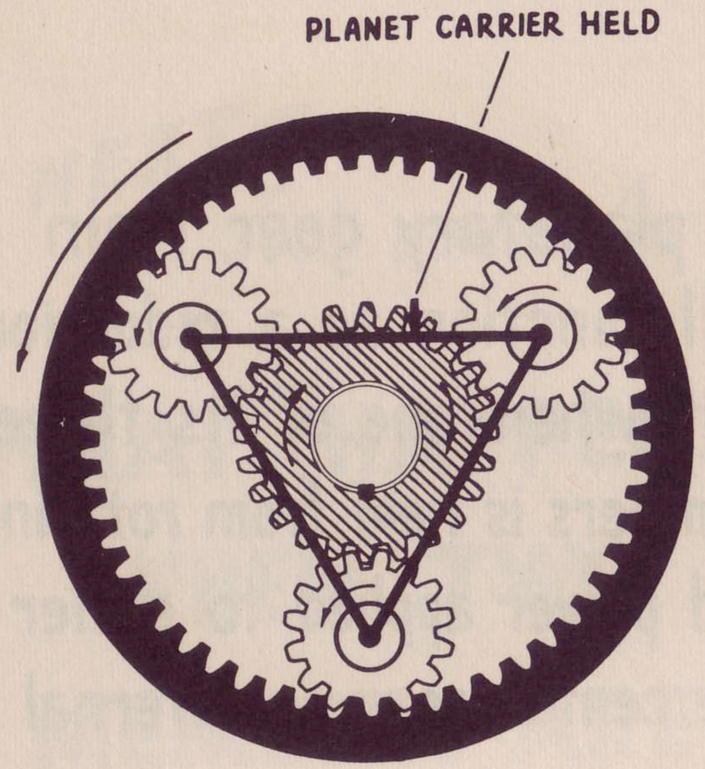
The internal gear is held stationary and the power is applied to the center gear. As the center gear rotates the planet pinions which are in mesh with it also rotate on their respective pins and since they are also in mesh with the stationary gear - they must "walk around" inside the internal gear, carrying the planet carrier with them in the same direction of rotation as the center gear. The planet carrier rotates at a speed less than that of the sun gear, and the planetary gear train functions as a power - increasing, speed reduction unit.

And Second



REDUCTION-CENTER GEAR HELD

The same result of power increase and speed reduction as shown on the previous chart can be obtained by holding the center gear stationary and applying power to the internal gear. In this case, rotation of the internal gear causes the planet pinions to rotate on their respective pins and at the same time to "walk around" the center gear, thus rotating the planet carrier at a speed less than that of the internal gear, and making the gear train function as a power-increasing, speed-reduction unit.



REVERSE-PLANET CARRIER HELD

A different use is provided when the planet carrier is held stationary. In this instance, if power is applied to the sun gear, the planet gears rotate on their pins, but since the carrier is stationary, they act merely as idlers, transmitting power to the internal gear and causing it to rotate in the opposite direction and at a reduced speed.

A planetary gear train will function as a reduction unit when one of its three members is held from rotating and power applied to either the center gear or internal gear.

We have stated a general principle which is a result of the examples shown. In all cases one member was held stationary, the power applied to another member, and taken off at a third member.

NEXT— let's consider

WHAT HAPPENS WHEN TWO MEMBERS ARE LOCKED TOGETHER

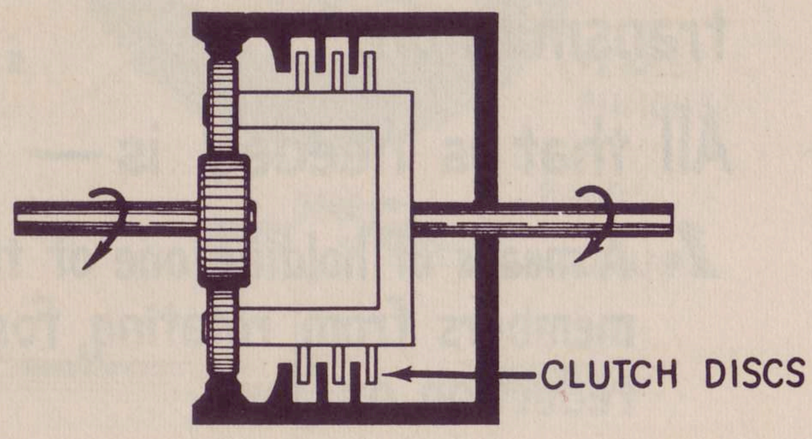
A planetary gear train will function as a coupling and transmit power directly when two of its members are locked together.

A SERIES OF CLUTCH DISCS

could be used to lock two members of the Planetary Gear set together for Direct Drive or High Gear.

Attaching part of the Discs to one of the members of the Planetary Gear Set and the remaining Discs to another member would form a Multiple Disc Clutch.

When no pressure is applied to the Clutch, the members to which the two sets of Discs are attached are free to rotate independently of each other.



When pressure is applied...

THE CLUTCH DISCS ARE HELD TOGETHER

and this locks together two members of the Plantary Gear set and produces Direct Drive or High Gear.

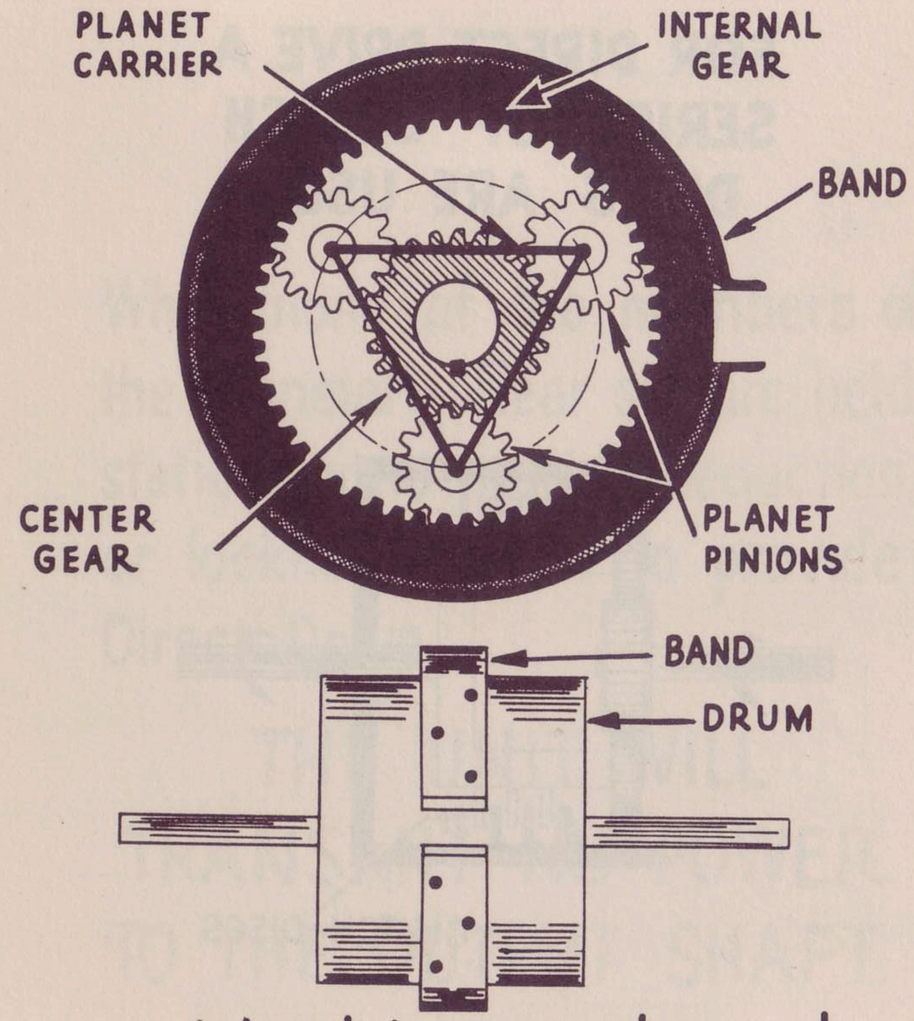
It is thus possible to use a single planetary gear assembly as a two-speed transmission.

All that is needed is —

1. A means of holding one of the members from rotating, for reduction or "low".

2. A means of locking two members together for direct drive or "high".

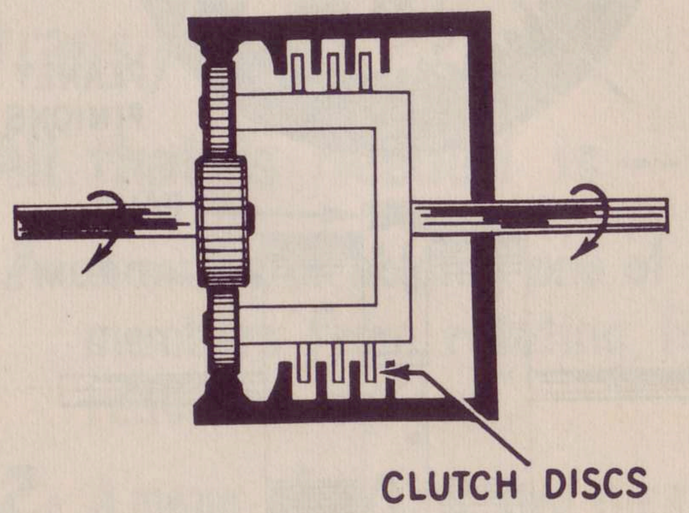
We can now proceed to build up a two-speed transmission.



A band is wrapped around the drum for reduction.

The band is wrapped around the large internal gear which is also called the drum and when applied will stop the internal gear. The center gear would still be turning and thus drive the planet carrier at a reduced speed. In this case the planet carrier with its planet pinions is the output shaft while the center gear is attached to the input shaft.

FOR DIRECT DRIVE A SERIES OF CLUTCH DISCS ARE USED



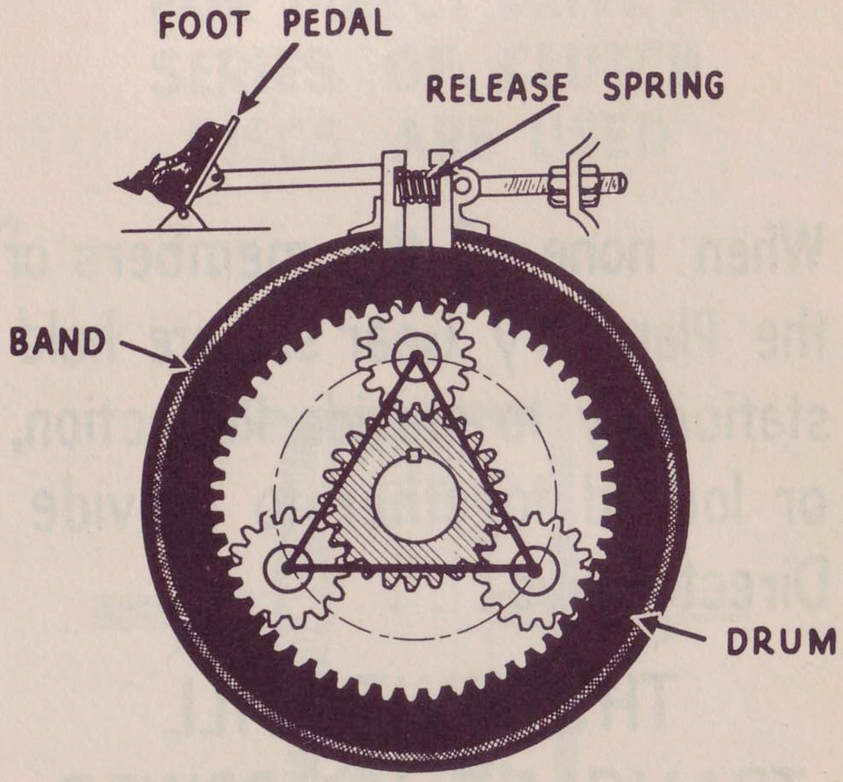
In the example above we show how some of the clutch discs are attached to the internal gear and the remainder to the planet carrier or center gear and thus we obtain a multiple disc clutch. The discs, of course, are alternately attached to the two different members to make the multiple disc clutch. When there is no pressure applied to the clutch, the members to which the two sets of discs are attached are free to rotate independently of each other.

However, when pressure is applied the two units are locked together and the assembly is in Direct Drive.

When none of the members of the Planetary Gear set are held stationary to provide Reduction, or locked together to provide Direct Drive . . .

THE UNIT WILL TRANSMIT NO POWER TO THE OUTPUT SHAFT.

THIS IS NEUTRAL



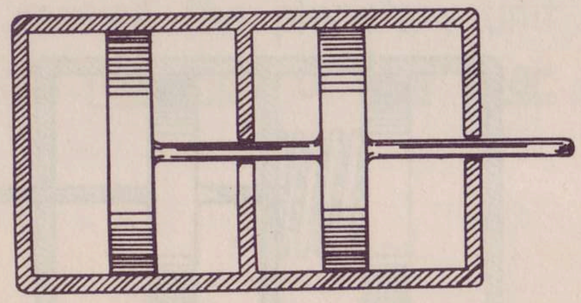
MECHANICAL BAND APPLICATION

Here we show a mechanical means of applying a band to the large internal gear. Foot pressure on the pedal would tighten the band and hold the gear. Then, if power were applied through the center gear the pinions would be forced to turn around it at a reduced speed. Since the pinions are attached to the carrier, the carrier and output shaft will be driven at reduced speed.

Of course when the foot pressure is removed the release spring will force open the band and the internal gear will be free to rotate.

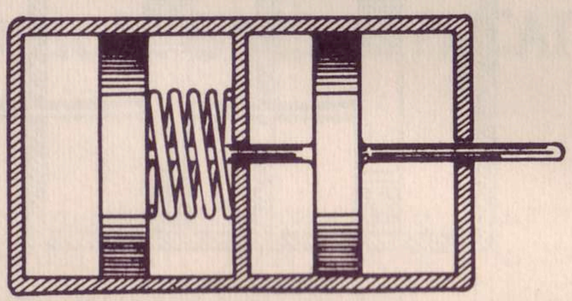
However . . .

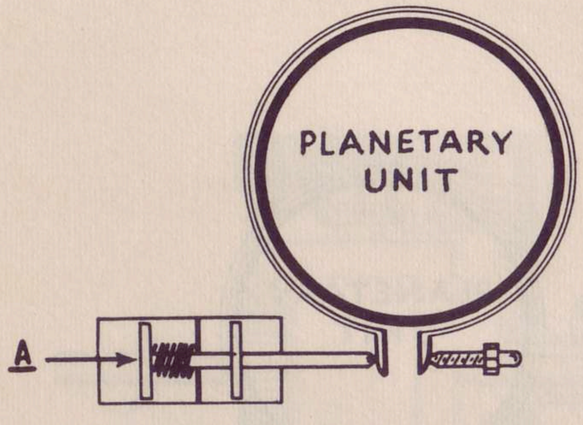
to apply and release the band HYDRAULICALLY, a simple device called a SERVO is used. It consists of a stem on which two pistons are located. This piston and stem assembly is installed in a cylinder or servo body with a division in the body between the two pistons...



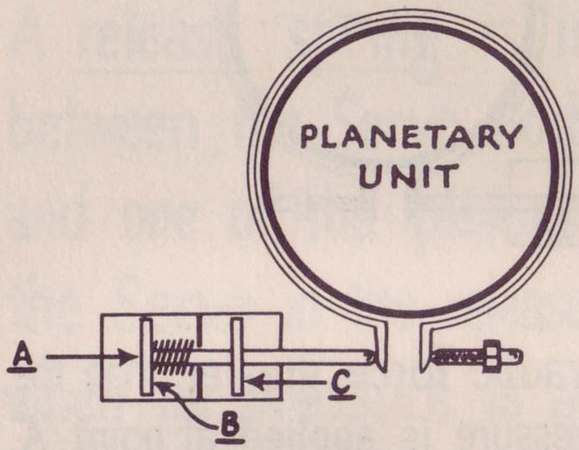
A Servo with one piston could be used but why a double piston unit is used will be discussed later.

A release spring is installed between the Servo Body Division and one of the pistons to hold the Servo in the released position when no pressure is applied...

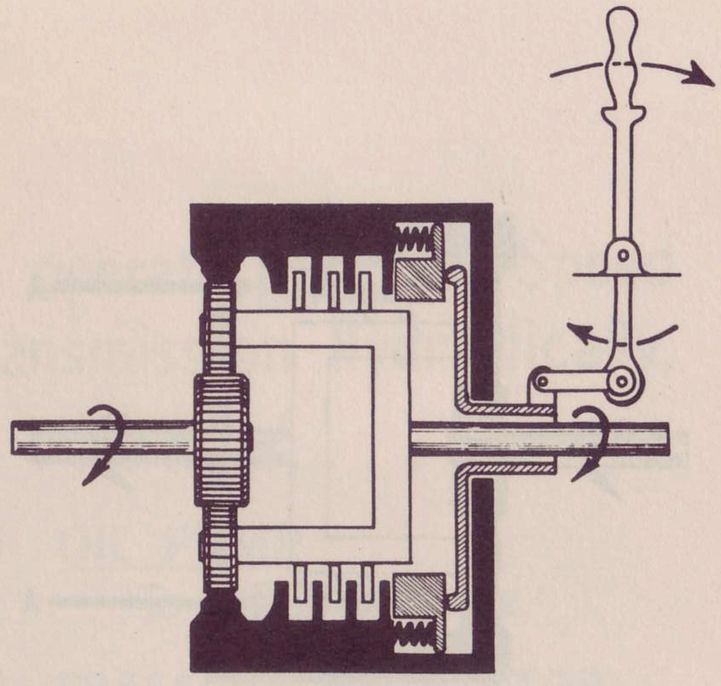




If a hydraulic force greater than the spring pressure is applied at point "A", the piston stem will be forced out against the band, applying the band and causing the planetary unit to go into reduction or low gear.



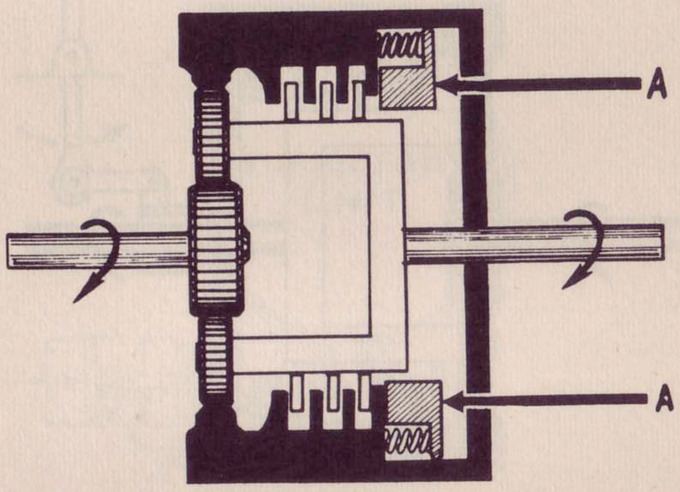
Applying hydraulic pressure to the points "B" and "C" (equal pressure to that at point "A", which is still applied) will move the piston and stem assembly in the opposite direction and release the band because in this case pressure is applied to two areas as well as assisted by the spring.



NOW LET'S CONSIDER CLUTCH APPLICATION

This is a cross section of a schematic multiple disc clutch. The clutch discs are attached to the different units in such a way that they will slide back and forth to give clutch application or release. The spring behind the pressure plate is to insure release when there is no apply force from the lever mechanism.

When the lever is actuated to apply pressure on the clutch discs it causes our two speed transmission to go into direct drive.



HYDRAULIC CLUTCH APPLICATION

In this Transmission we are discussing, the clutch could be actuated Hydraulically by a piston located in a clutch drum.

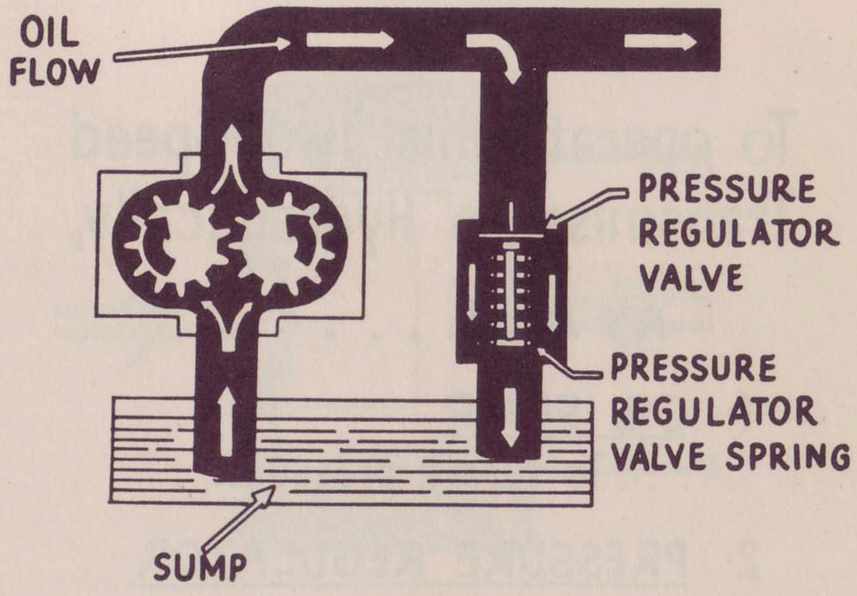
When no pressure is applied to the clutch piston, the clutch is held in the released position by clutch release springs.

If a hydraulic force is applied at point "A", the piston will be forced against the clutch discs, causing them to lock together. The planetary unit will then be in Direct Drive or High Gear.

To operate this Two-Speed Transmission Hydraulically,

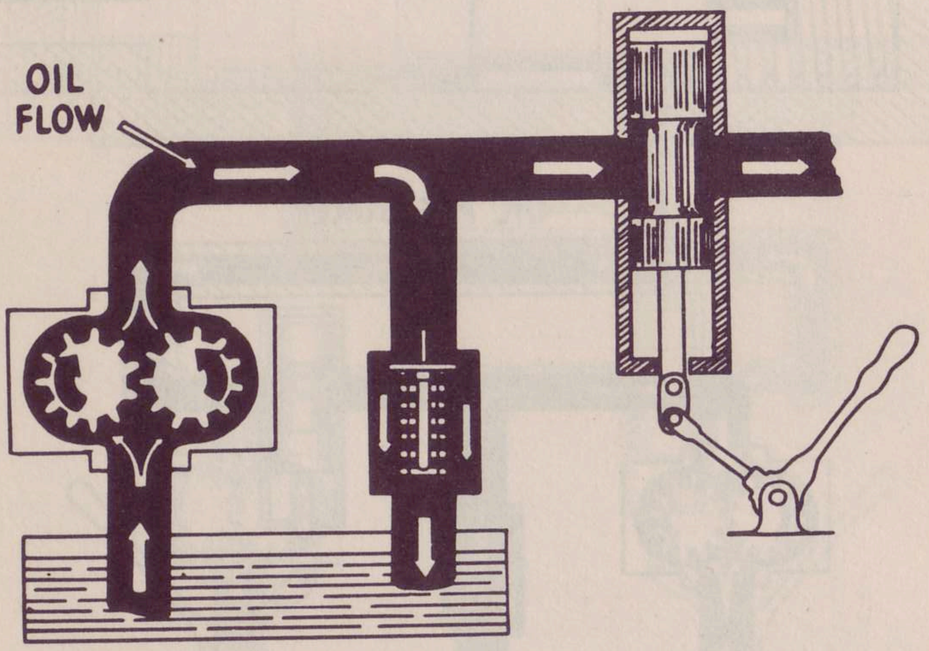
we need....

1. **OIL PUMP**
   ...To supply pressure.
2. **PRESSURE-REGULATOR**
   ...To maintain constant pressure.
3. **MANUAL VALVE**
   ...To turn oil pressure on or off.
4. **SHIFT VALVE**
   ...To direct oil to Servo or Clutch.



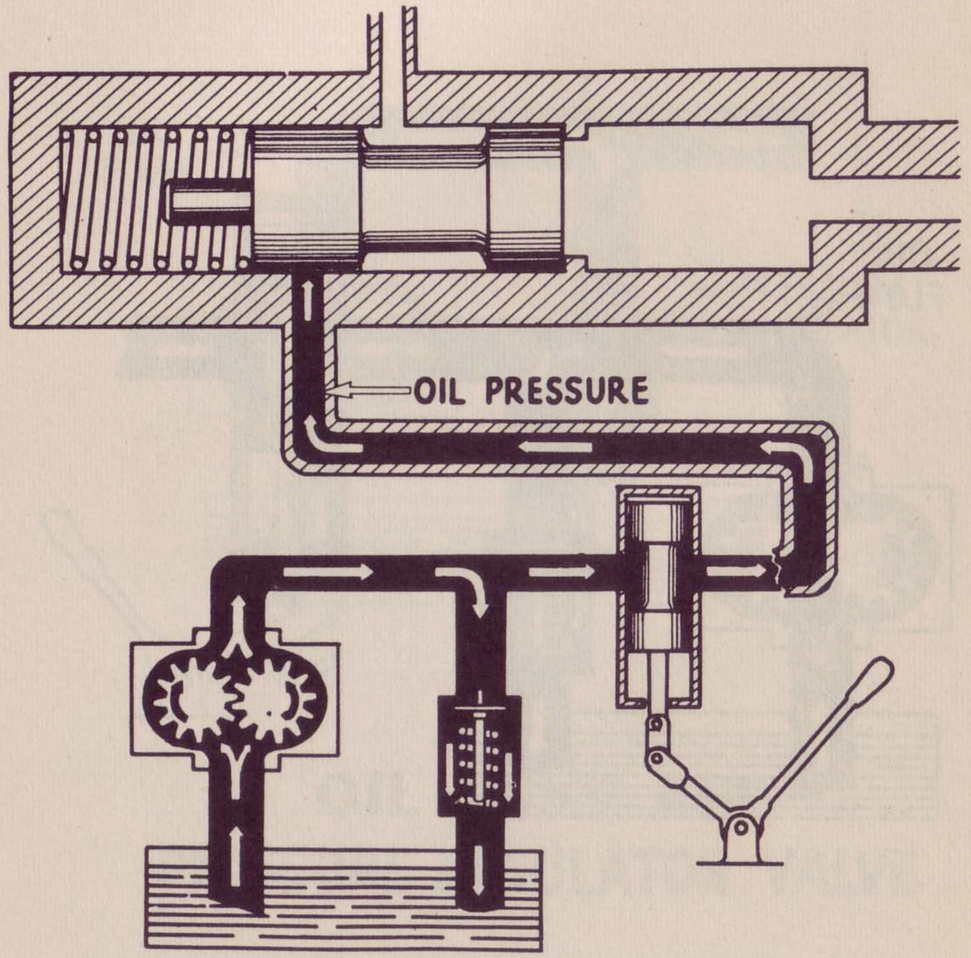
OIL PUMP AND PRESSURE REGULATOR VALVE

The oil pump is driven by the engine. Any type of pump which will supply sufficient pressure can be used. Some of the more common ones are vane, rotor, or gear type pumps, which include either internal and external gears, or spur gears.



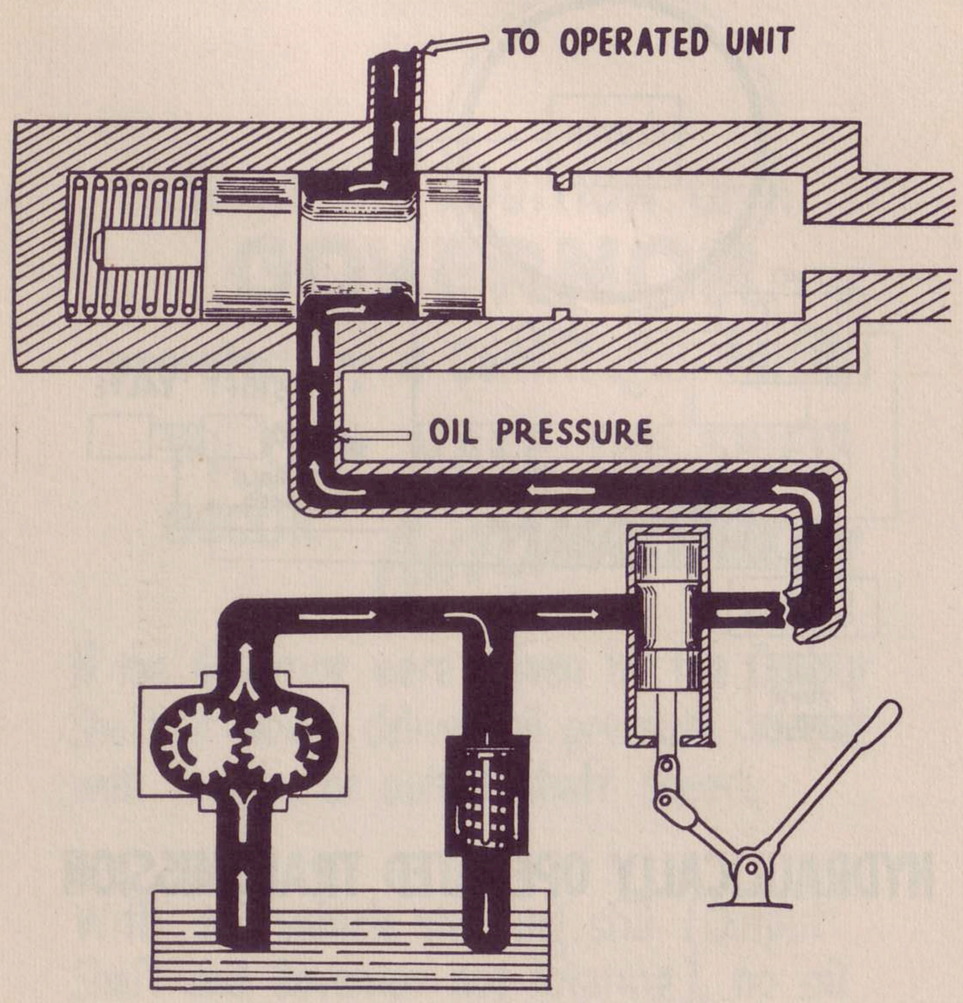
MANUAL VALVE

We must now add a manual valve in the system so that we can control the flow of oil.



SHIFT VALVE CLOSED

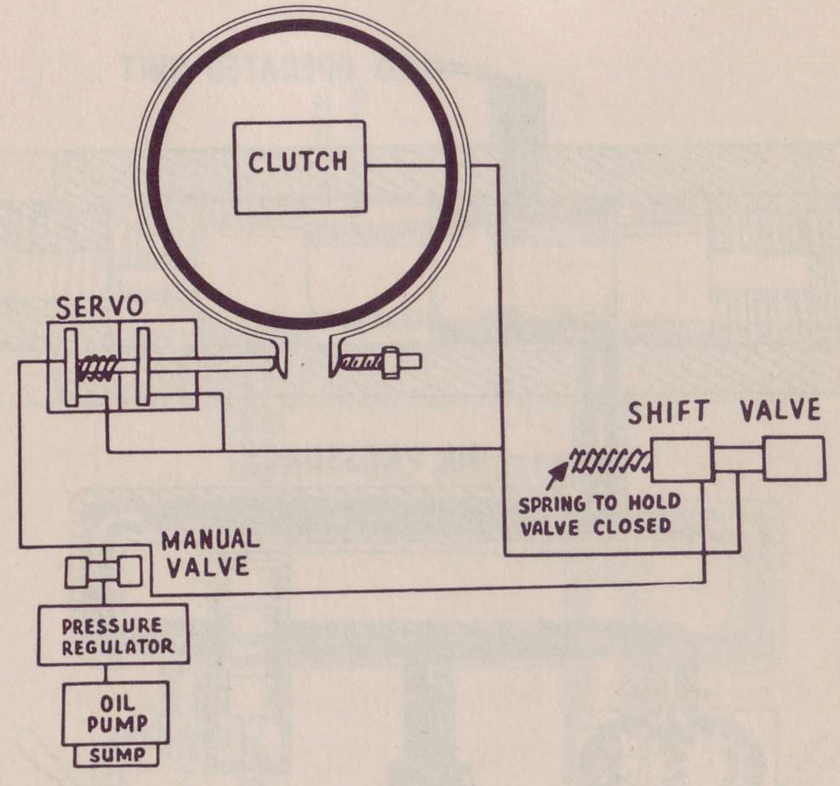
In addition to the manual valve we also nee a valve to direct the flow of oil to either apply the l d or the clutch.



SHIFT VALVE OPEN

The shift valve could be opened mechanically with a rod and a lever, or by oil pressure.

Now we will connect the pump, regulator, manual valve, and shift valve to the clutch and servo of our two-speed transmission previously discussed.



HYDRAULICALLY OPERATED TRANSMISSION

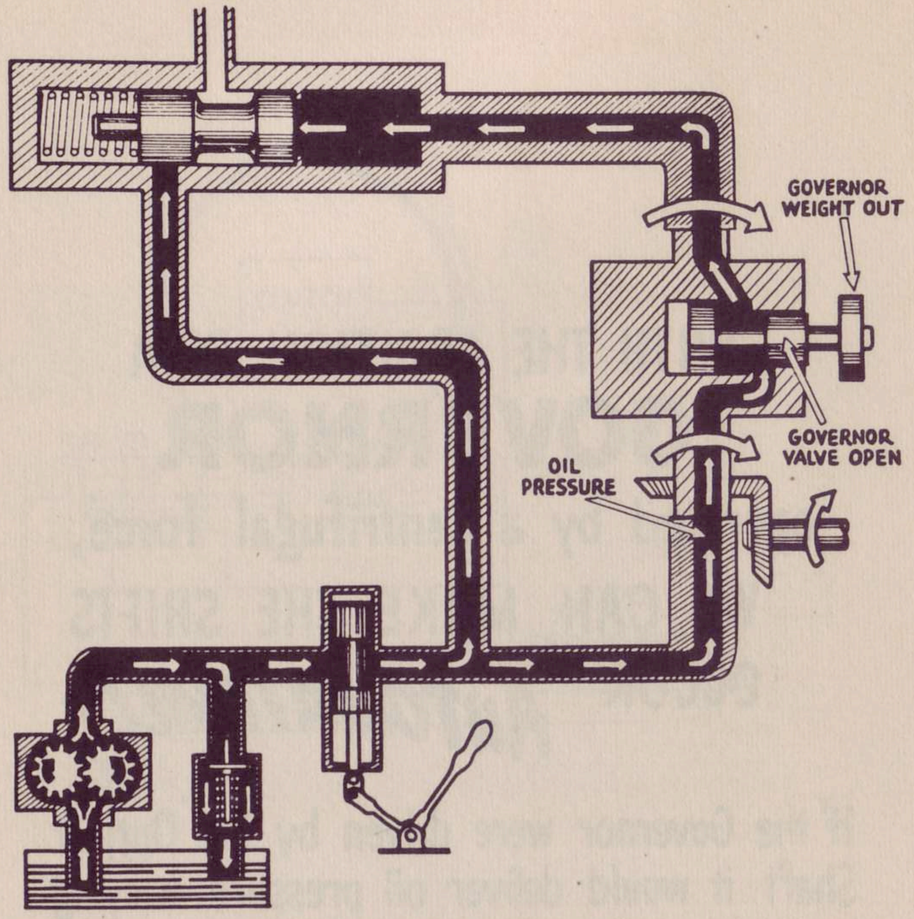
We now have everything necessary to operate the transmission by oil pressure, even though some of the valves have to be operated manually. Whenever the manual valve is in the open position, oil will flow to the "apply" side of the servo, applying the band and putting the two-speed transmission in reduction. Then, while the manual valve is open, if the shift valve is opened against spring pressure, the servo will be released, and the clutch will be applied, putting the two-speed transmission in Direct Drive or high gear.

WITH THE ADDITION OF A **GOVERNOR** operated by a Centrifugal force, WE CAN MAKE THE SHIFTS OCCUR *AUTOMATICALLY.*

If the Governor were driven by the Output Shaft it would deliver oil pressure varying with vehicle, or output shaft speed.

With the vehicle standing still (Output Shaft and Governor not rotating), no oil could pass through the Governor. . .

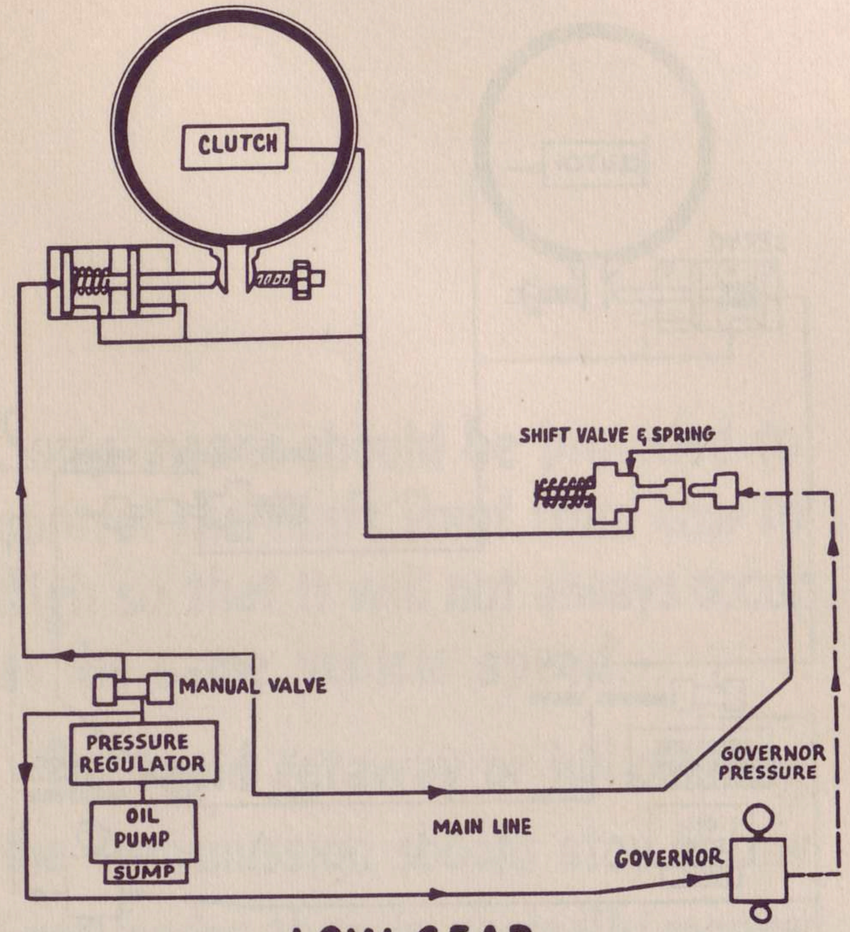
If we assume the output shaft is connected to the rear wheels, whenever the governor is being driven, the output shaft and rear wheels revolve. Thus governor pressure varies with vehicle speed.



When the vehicle is set in motion, the governor starts to operate and directs oil pressure to the shift valve.

Notice that the shift valve is still closed. We will assume in the operation of the governor and shift valve that the governor develops one pound of pressure for each mile per hour of speed. How many pounds governor pressure would you have at 12 m.p.h.? Then, if the shift valve had a 10-pound spring, how fast would the vehicle have to move for the governor pressure to overcome the spring.

The vehicle in the illustration shown must be going less than 10 m.p.h. if the governor develops one pound of pressure for each mile per hour of speed since the shift valve is closed.



LOW GEAR

Band applied - Shift Valve has not moved.

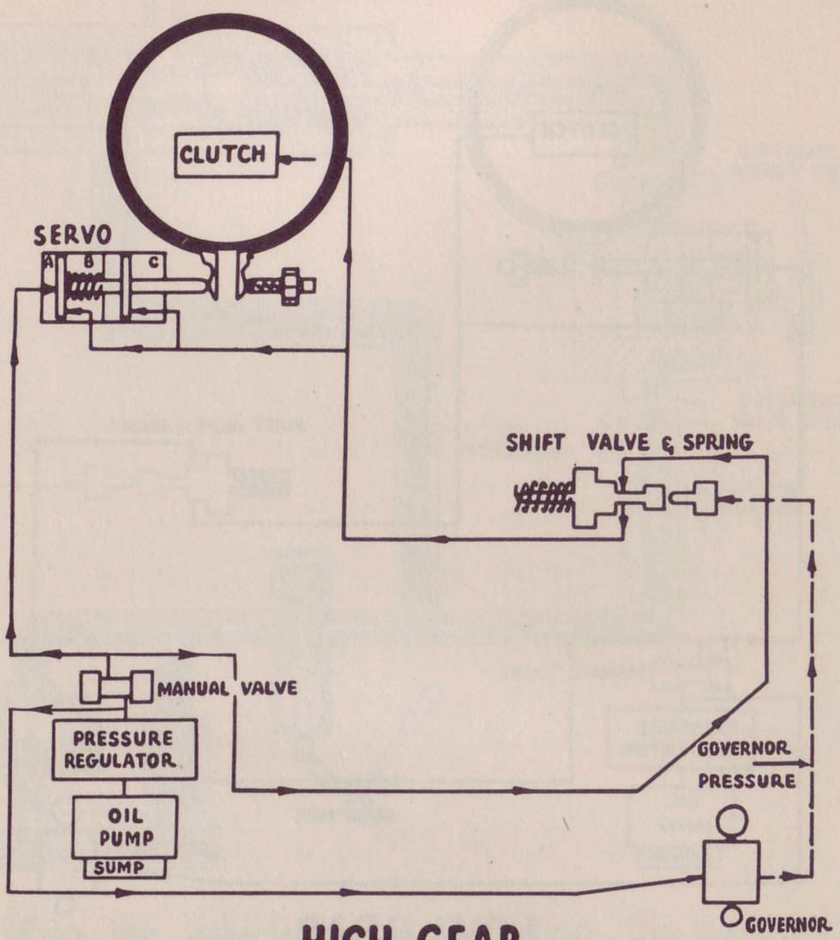
The scheme of oil flow is as follows:

1. Solid lines with arrows represent passages filled with oil at constant or line pressure.

2. Lines either solid or dotted with no arrows represent empty oil passages.

3. Dotted lines with arrows represent passages filled oil at variable pressure.

We show here low gear i.e. oil is on the apply side of servo and the band is applied. Also shown is the addition of the governor and its oil lines.



HIGH GEAR

Shift Valve has moved due to effect of Governor pressure. Clutch is applied. Band released due to pressure operating against <u>two</u> areas ("B" and "C").

When the vehicle speed is such that the Governor Pressure overcomes the Shift Valve Spring, the valve will open automatically and allow oil to flow through the oil line to apply the Clutch and release the Servo.

This puts the planetary unit in direct drive and the vehicle is now in HIGH GEAR.

In other words, as the vehicle speed increases, it reaches a point where the oil pressure through the governor is sufficient to open the shift valve against the opposing spring pressure. This opens up the main line pressure to apply the clutch and release the servo. The main line pressure at points "B" and "C" in the servo, plus the release spring pressure, overcomes the main line pressure at point "A".

Some means should be provided to control the Shift Point from Low to High so that it will not always occur at the same vehicle speed.

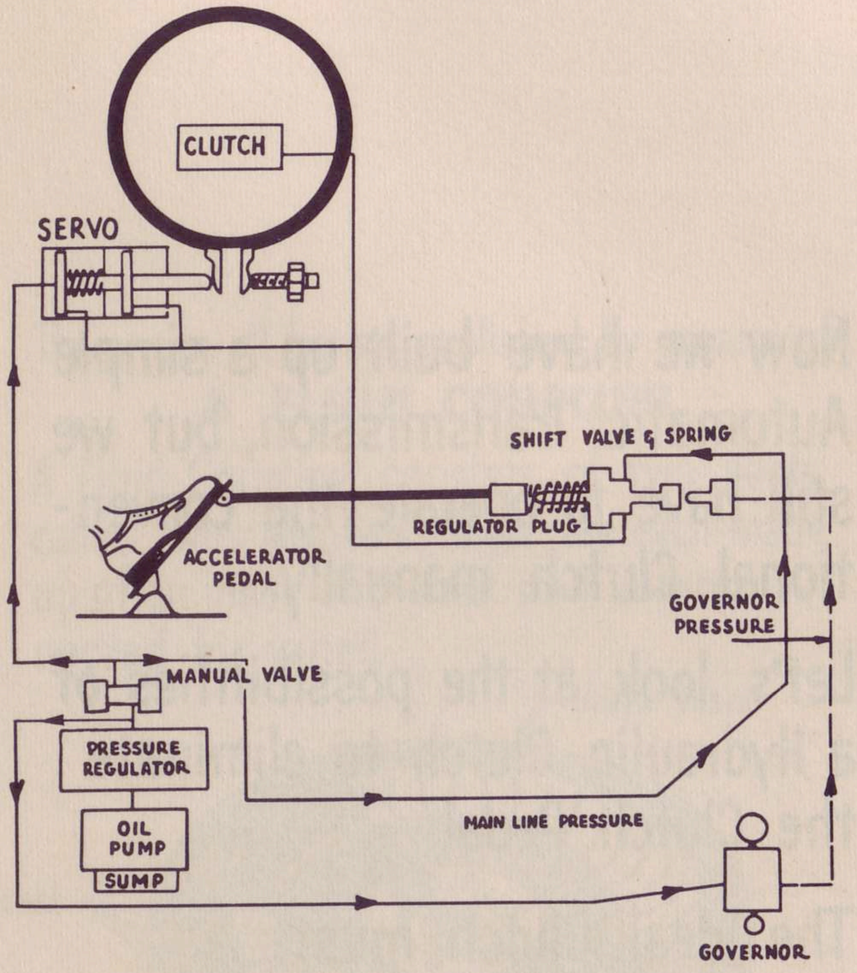
For rapid getaway or hill climbing, the Transmission should stay in Low Gear longer than is normally required. This could be accomplished by varying the Shift Valve Spring Pressure by Mechanical Linkage to the Accelerator Pedal.

Then, if the Accelerator Pedal were depressed, the linkage would move against the Shift Valve Spring and cause an increase in the Spring Pressure . . .

Because of this increased pressure,

MORE GOVERNOR PRESSURE WOULD BE REQUIRED

to open the Shift Valve, and the shift from Low to High would occur at a higher vehicle speed.



REGULATOR PLUG

Notice that the linkage from the accelerator pedal applies pressure on the shift valve with governor pressure opposing it. A plug is placed on the end of this linkage, and, as far as we are concerned here, only for the purpose of maintaining equalized pressure on the spring. Because this linkage and plug are used to regulate the shift point according to the accelerator position, it is called a regulator plug.

Now we have in this chart a complete two-speed transmission, which shifts from Low to High gear hydraulically and automatically, according to vehicle speed and accelerator pedal position.

Now we have built up a simple Automatic Transmission, but we still have to operate the conventional Clutch manually.

Let's look at the possibilities of a Hydraulic Clutch to eliminate the Clutch Pedal.

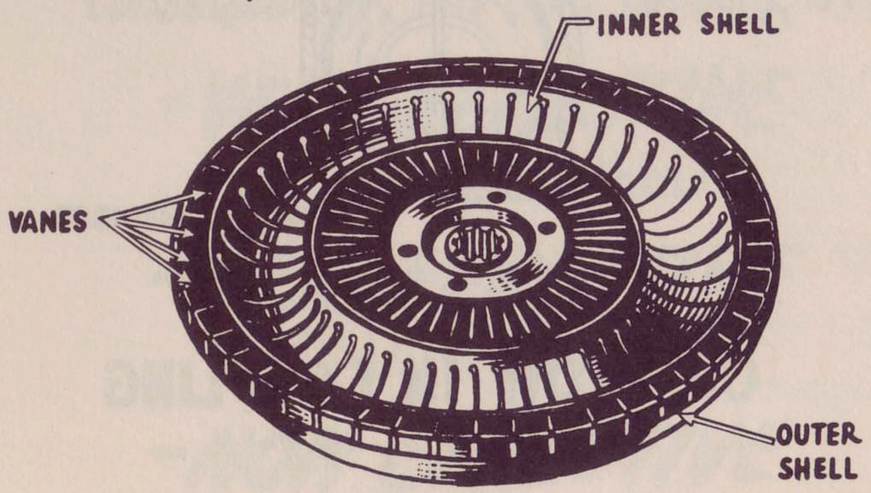
The ideal Clutch must. . . .

1. ENGAGE SMOOTHLY
2. RELEASE COMPLETELY
3. TRANSMIT POWER EFFICIENTLY

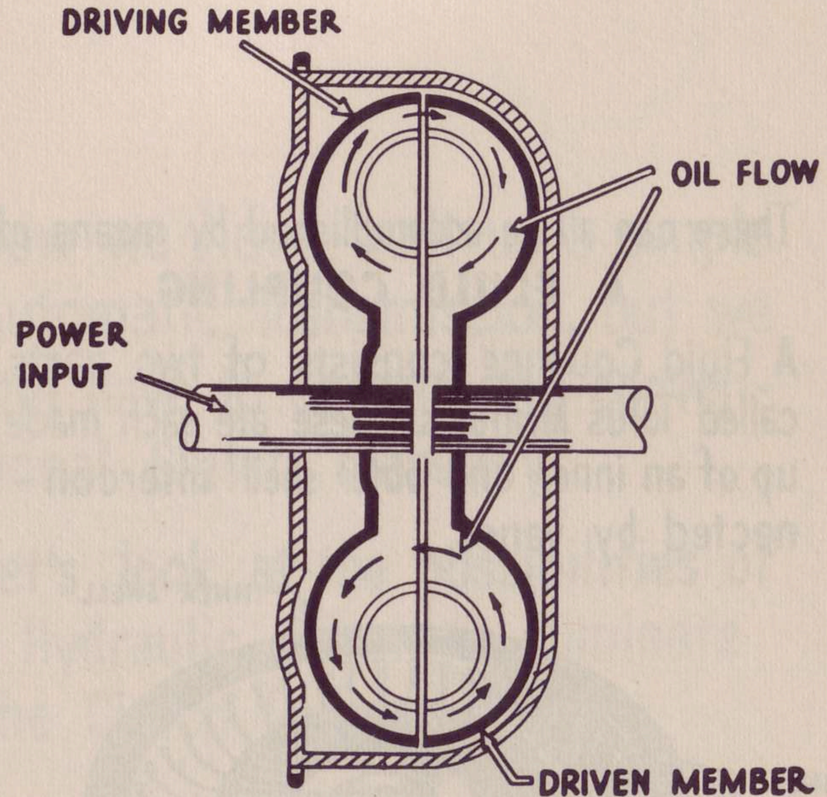
These can all be accomplished by means of

A FLUID COUPLING

A Fluid Coupling consists of two parts called Torus Members. These are each made up of an inner and outer shell interconnected by vanes.



TORUS MEMBER



OIL FLOW IN COUPLING

Each torus member is splined to an independent shaft and the assembly located in an oil-filled housing.

In operation, rotation of the Driving Member causes the oil within it to be forced radially outward. The oil then crosses over and strikes the Vanes of the Driven Member in such a manner as to make it rotate in the same direction as the Driving Member.

Thus, the higher the speed of the Driving Member the greater the force exerted by the oil on the Driven Member due to centrifugal action.

Consequently, this Fluid Coupling is...

-VERY EFFECTIVE
AT HIGH SPEED

-LESS EFFECTIVE
AT LOW SPEED

-NON EFFECTIVE
AT IDLING SPEED

Now it can be seen that the combination of a Fluid Coupling and a fully automatic Transmission is an ideal unit for transmitting power from the engine to the wheels

Such is the

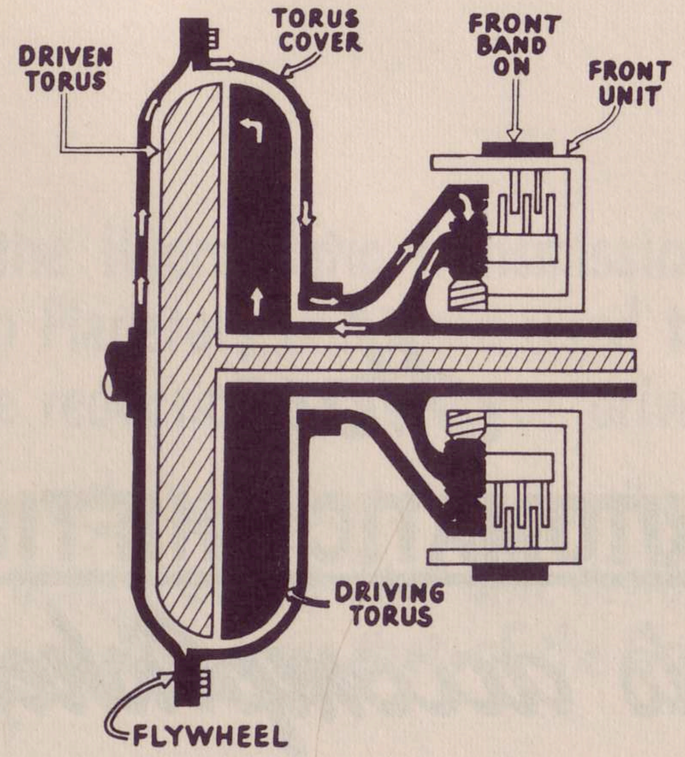
"HYDRA-MATIC DRIVE,"

which takes the place of two conventional units, the Clutch and the Selective Sliding Gear Transmission . . . .

We mentioned previously that the Fluid Coupling was <u>less</u> effective the <u>slower</u> the Driving Member was rotated.

This is a desirable feature when the car is standing *"In Gear"* with the Engine idling -- such as waiting for a Stop Light.

To incorporate this feature
in the
"HYDRA-MATIC DRIVE,"
the speed of the Driving Member of the Fluid Coupling is reduced below that of the Engine by driving it through the Front Planetary Unit and taking advantage of the reduction in this Unit as follows . . . . .



FLUID COUPLING DRIVE

The power from the engine flywheel is transmitted to the torus cover which is bolted to it. This cover has the dual purpose of enclosing the fluid coupling and transmitting the power from the flywheel to the front unit internal gear (drive gear). With the pinions meshed in the internal gear power is passed from the internal gear to the pinions which turn at a reduced speed.

Power from the front planet carrier is then transmitted to the driving torus. Make sure you understand how this flow reduces the speed of the driving torus member below the speed of the engine. Refer to charts on Planetary Gears.

How

AUTOMATIC SHIFTING

is accomplished

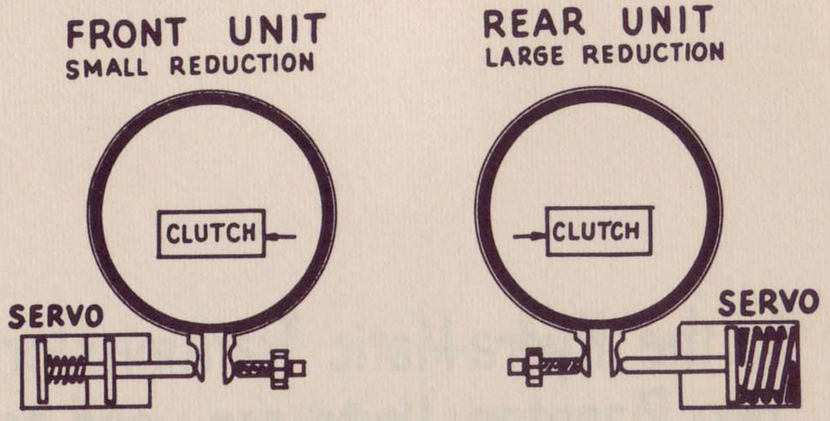
in the

HYDRA-MATIC TRANSMISSION

In the Hydra-Matic Transmission, two Planetary Units are used to give reductions and direct drive.

Although both Units are similar, the design of the Rear Unit differs in two ways from that of the Front Unit.

1. It is larger and gives a greater gear reduction.
2. The Servo is normally applied by spring pressure instead of oil pressure.



By using two planetary gear units, each with a different gear reduction, it is possible to have a transmission with four forward speeds.

NEUTRAL -- Both bands and clutches released.

1ST. SPEED -- Front & rear units--in reduction.

2ND. SPEED -- Front unit in direct drive--rear in reduction.

3RD. SPEED -- Front unit in reduction ---rear in direct drive.

4TH. SPEED -- Front and rear units --- in direct drive.

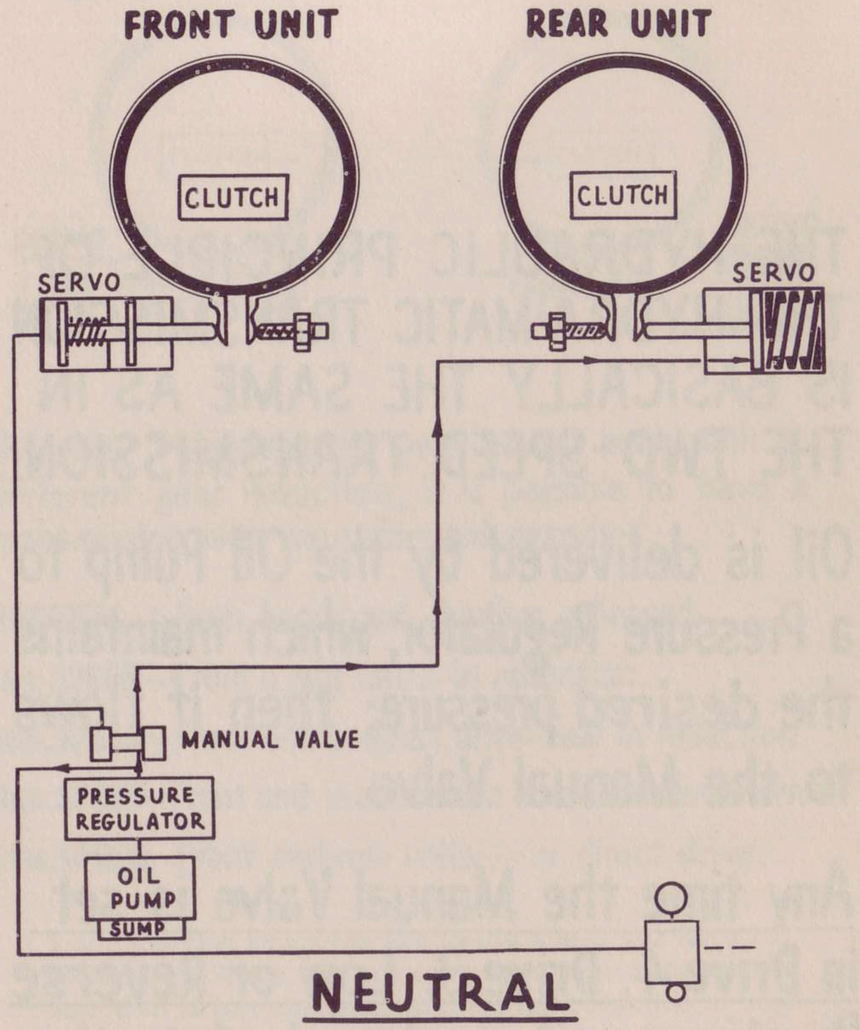
You know that when you are in low speed you have full reduction. When you are in second your reduction is less than in low and when in third the reduction is less than in 2nd. Of course 4th speed or high is direct drive with no reduction in the transmission.

It might make it easier for you if you think of the various speeds as per cent of reduction and that the front unit gives 40% and the rear unit 60%. Now in low or first speed both bands are on and you have 100% reduction. In second speed the band is still applied on the rear unit thereby getting a 60% reduction while the clutch is applied, in the front unit giving it direct drive. In 3rd speed the front unit which has 40% reduction built into it now has its band applied giving reduction and the rear unit is in direct drive. 4th speed of course has the clutches applied in both units for direct drive. It might make it easier to remember the 100%, 60%, 40% and direct drive example.

THE HYDRAULIC PRINCIPLE OF THE HYDRA-MATIC TRANSMISSION IS BASICALLY THE SAME AS IN THE TWO-SPEED TRANSMISSION:

Oil is delivered by the Oil Pump to a Pressure Regulator, which maintains the desired pressure; then it flows to the Manual Valve.

Any time the Manual Valve is set in Drive 4, Drive 3, Low or Reverse Position, oil is directed to the Band apply side of the Front Servo.

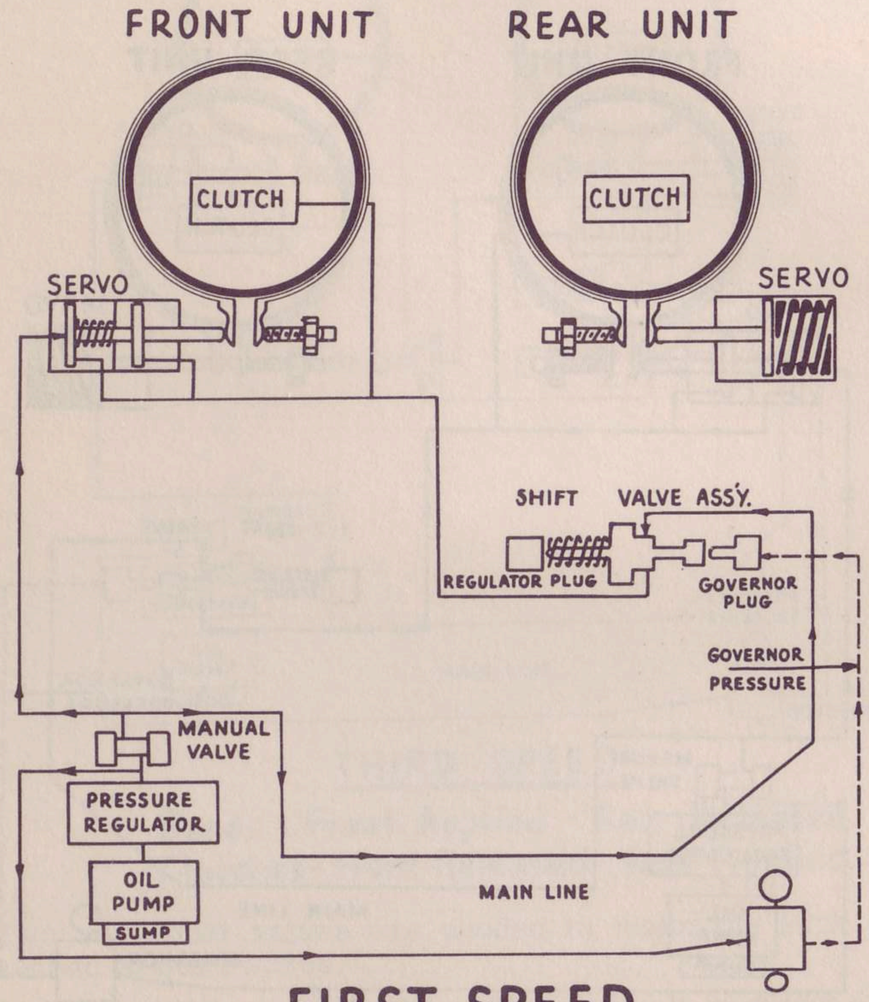


NEUTRAL

Bands - Both released - Clutches - both released

The manual valve in the neutral position directs oil to the rear servo to release the band. No oil can get into the line leading to the apply side of the Front Servo; so this Servo is held in the released position by the Retracting Spring.

Both Bands and Clutches are now released and the Transmission is in neutral.



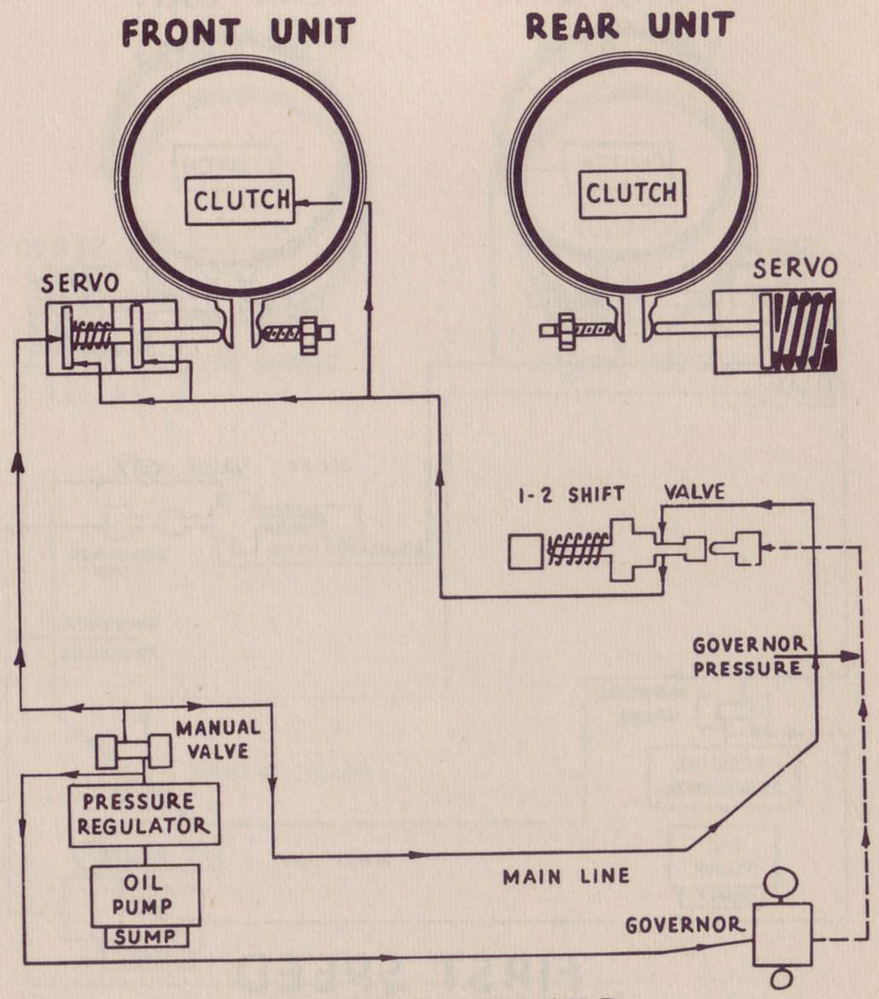
FIRST SPEED

Bands - Both applied - Clutches - Both released

Placing the selector lever in Dr. 4 range, positions the manual control valve for all forward speeds. It cuts off oil pressure to the rear servo, permitting the spring to apply the band, and at the same time directs oil pressure to the front servo, applying the front band. Both units are in reduction, and the transmission is in first speed.

Oil is also directed to the shift valves. But since they are in a closed position, no oil can pass to the units.

When the vehicle is set in motion the output shaft and governor start to rotate and oil from the governor "governor pressure" is directed against the governor plugs.

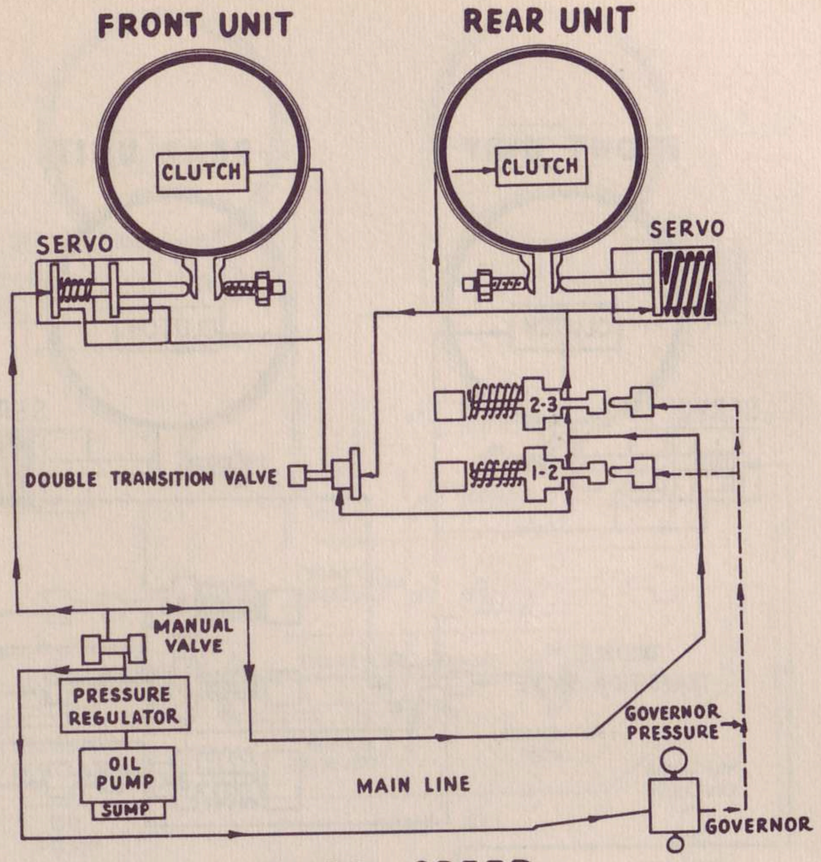


SECOND SPEED

Bands - Front released - rear applied
Clutches - Front applied - rear released

Governor pressure increases with vehicle speed to a point where it will overcome the 1-2 shift valve spring and automatically open the shift valve. Oil is then directed to the front unit where it releases the band and applies the clutch.

The rear unit remains in reduction. With the front unit in direct drive and the rear unit in reduction, the transmission is in second speed.



THIRD SPEED

Bands - Front Applied - Rear Released
Clutches - Front Released - Rear Applied

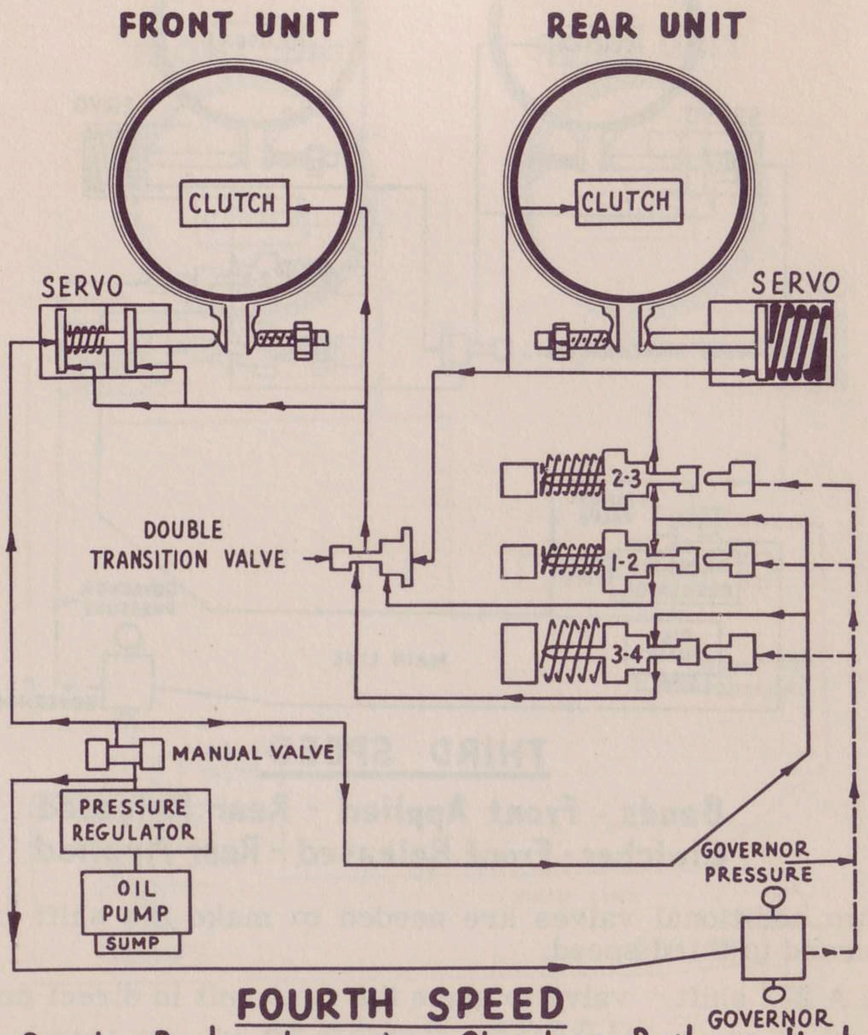
Two additional valves are needed to make the shift from second to third speed.

1. A 2-3 shift valve to place the rear unit in direct drive.
2. A double transition valve to cut off the oil holding the front unit in direct drive, allowing it to go back into reduction automatically.

The 2-3 shift valve opens at a higher speed than the 1-2 valve because of greater spring tension. When vehicle speed is such that the increasing governor pressure overcomes the 2-3 shift valve spring, the valve opens allowing oil to flow to the rear unit where it releases the band and applies the clutch.

At the same time oil is directed against the double transition valve moving it over and cutting off the oil that holds the front unit in direct drive. The front servo "apply pressure" applies the front unit band causing the unit to go into reduction. With the front unit in reduction and the rear unit in direct drive the transmission is in third speed.

Thus it can be seen that to transfer from 2nd to 3rd speed, a complete change or transition takes place in each planetary unit.

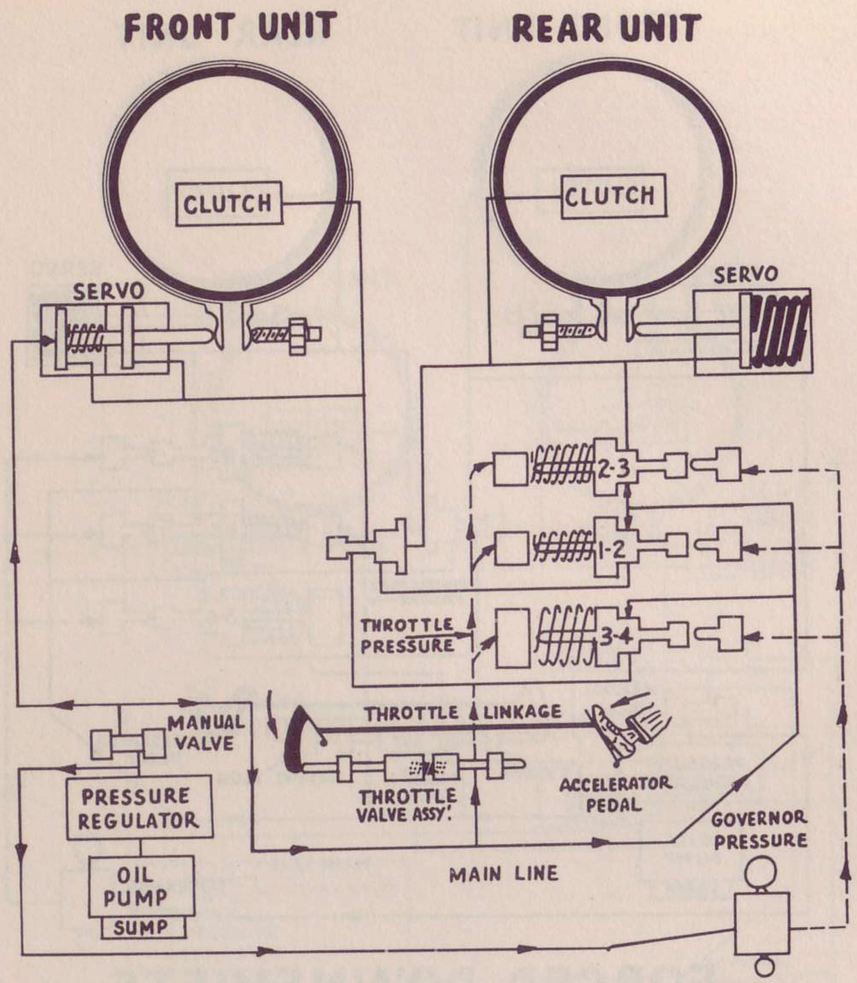


FOURTH SPEED

Bands - Both released · · · Clutches - Both applied

A 3-4 shift valve is added to obtain the shift into fourth speed. The 3-4 shift valve spring is heavier than the 2-3 valve spring and therefore its operation requires higher governor pressure.

When the vehicle reaches sufficient speed, governor pressure will overcome the 3-4 shift valve spring, opening the valve and directing oil through the double transition valve to the front unit without affecting the rear unit. This applies the front clutch and releases the front band. Both units are in direct drive and the transmission is in fourth speed.



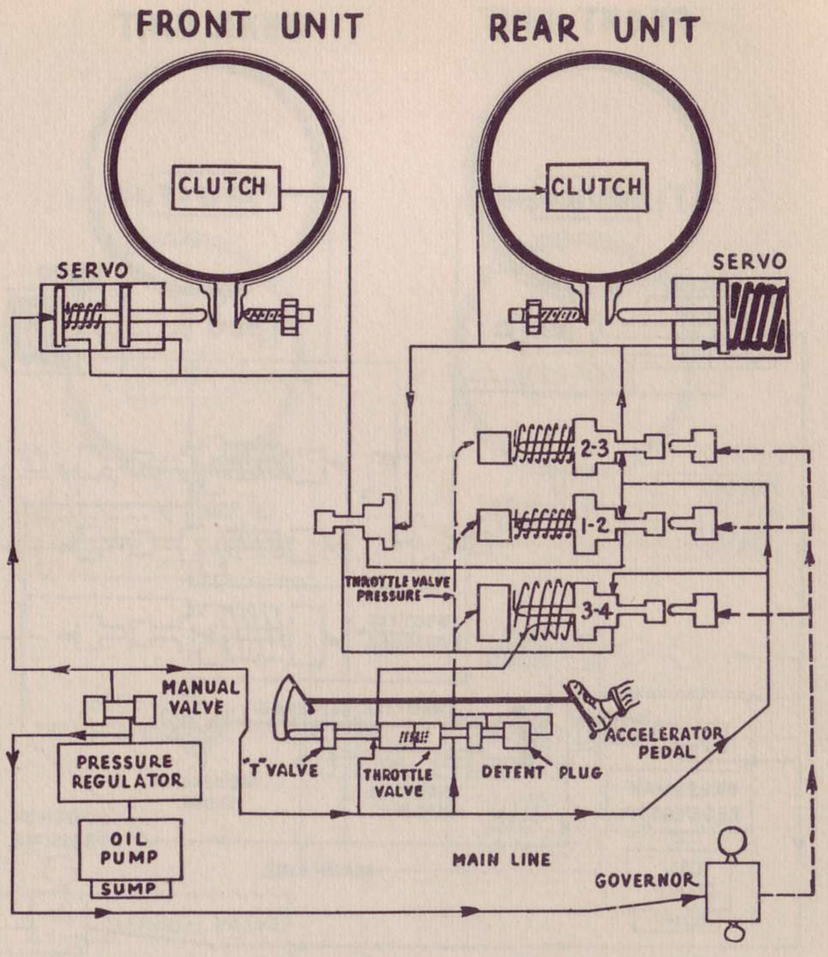
THROTTLE VALVE ASSEMBLY

TIMING THE SHIFTS:

With the shift valves, valve spring, and governor described on the preceding pages, the shifts will always occur at the same vehicle speed. This arrangement is undesirable in a vehicle because many circumstances arise when shifts at different speeds are desirable. Examples of this are rapid getaway and hill climbing.

To delay the shifts for rapid acceleration or hill climbing, a throttle valve assembly is used. This valve assembly is operated by linkage from the accelerator pedal and regulates the oil pressure which varies with the carburetor throttle opening. This pressure, called "throttle pressure," works against three regulator plugs to increase shift valve spring pressure. Therefore, higher vehicle speeds and higher governor pressure will be required to accomplish each shift.

When accelerating slowly the accelerator pedal is depressed only slightly, the shifts will then occur at a low vehicle speed. When accelerating rapidly the accelerator pedal is almost fully depressed and therefore, the shifts will not take place until a higher vehicle speed is reached.

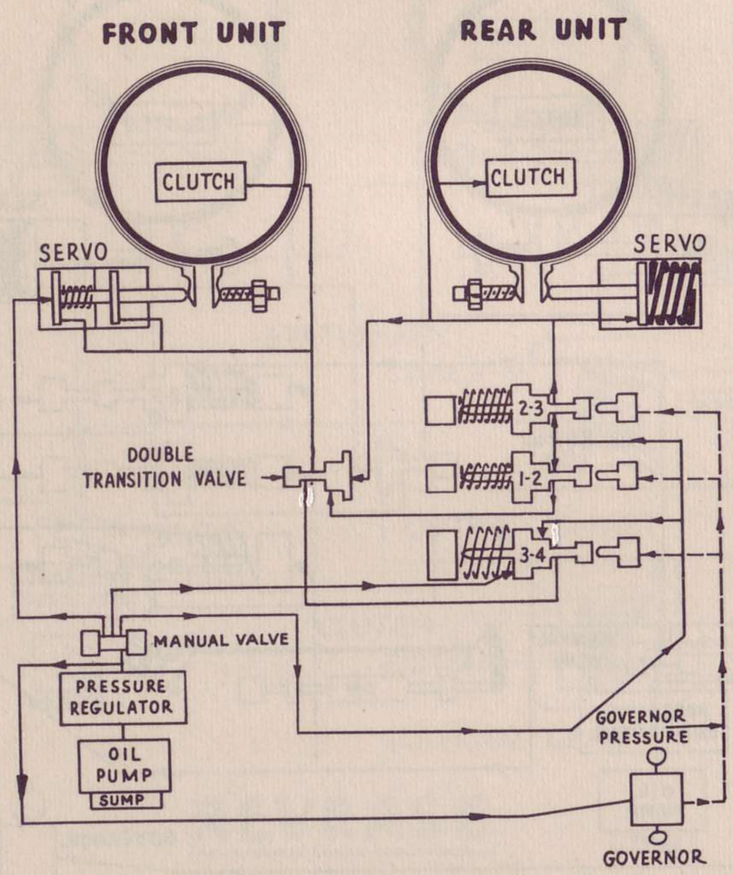


FORCED DOWNSHIFTS

We have previously mentioned that the shifts occurred automatically. However, it is desirable to be able to downshift the transmission for a sudden extra spurt of acceleration such as for passing. For example with the car running in fourth speed, full throttle performance can be obtained by pressing the accelerator pedal all the way down until a pronounced extra resistance is felt. By overcoming the extra resistance and pressing the accelerator pedal further, the transmission will downshift to third speed.

This is accomplished by the throttle valve assembly which consists of a T valve, throttle valve and detent plug.

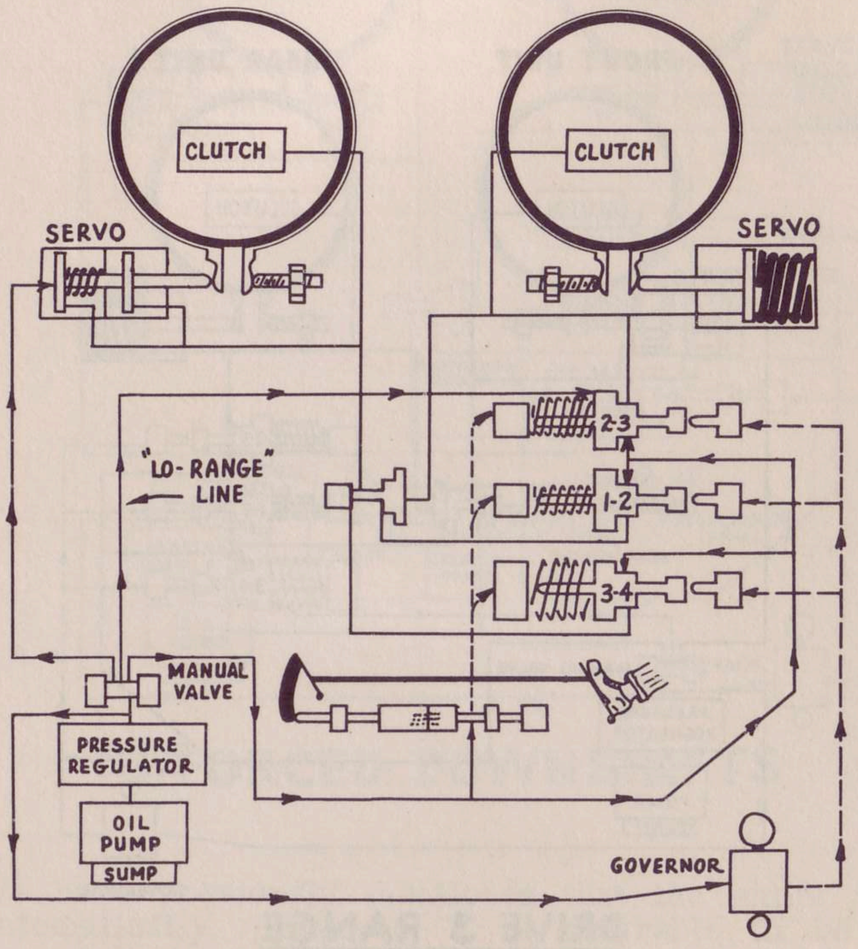
When this pressure or resistance is overcome, the T valve moves past its normal open position and allows oil to be directed to the 3-4 shift valve. This additional pressure along with spring and throttle pressure overcomes governor pressure and forces the shift valve to close. The downshift then takes place. Forced 3rd to 2nd, and 2nd to 1st speed downshifts are also possible. The hydraulic action for these downshifts is similar to that of the 4th to 3rd downshift.



DRIVE 3 RANGE

Dr. 3 range gives the transmission greater flexibility to suit all types of road conditions. With the selector lever in Dr. 3 range, the transmission will not shift above third speed within a normal speed range. This feature is desirable for improved performance in congested city traffic and hilly terrain.

With the manual valve positioned for Dr. 3 range, an additional passage is opened to direct oil behind the 3-4 shift valve, which opposes governor pressure to hold the shift valve in the closed position. Since the 3-4 shift valve is held closed, the transmission will not shift above third speed. The 1-2 and 2-3 shifts are not affected.

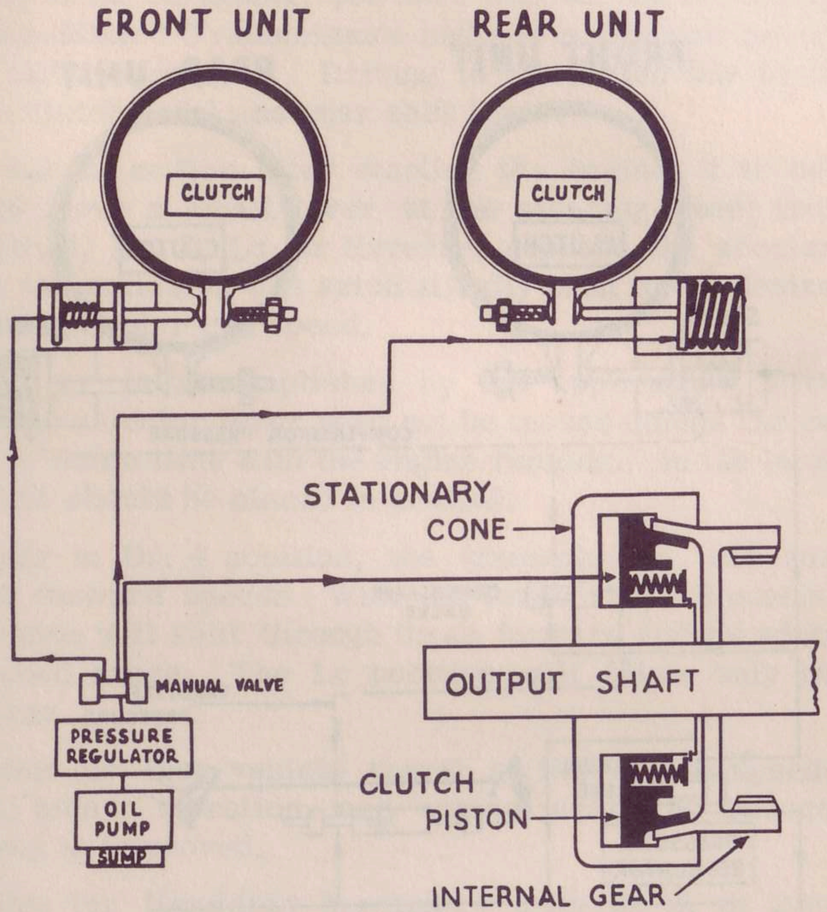


Manual Lever - "Lo - Range" Position.

When descending steep grades where maximum braking power of the engine is desired, it is desirable to keep the vehicle operating in first and second speeds regardless of vehicle speed. It is also desirable to keep the transmission from shifting above second speed when pulling through deep sand or up steep grades. This is accomplished by moving the manual valve to the Lo position which directs main line pressure back of the 2-3 shift valve, locking it closed.

NOTE: If the manual valve is moved from Dr. to Lo position when the vehicle is traveling at high speed the shift will not occur until speed decreases. This is to prevent engine over speeding.

The vehicle speeds obtainable in first and second speed do not develop enough governor pressure to open the 2-3 shift valve against spring and main line pressure. Therefore, the transmission will not shift above second speed.



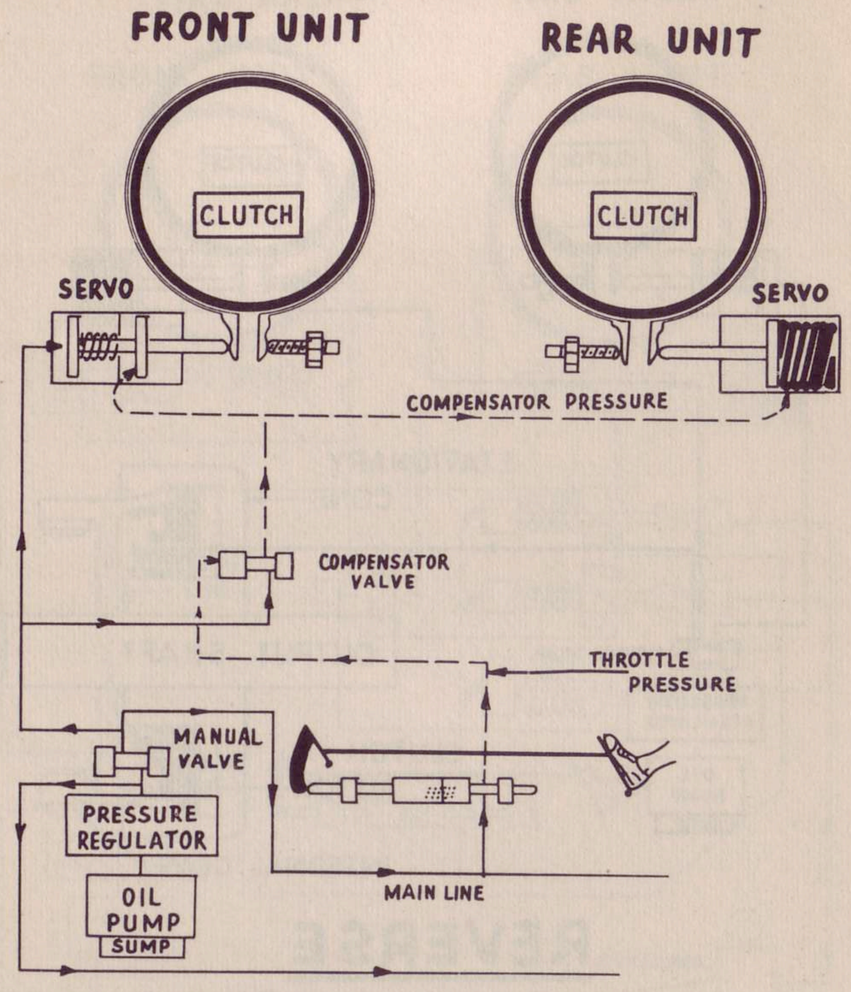
REVERSE

Bands - Front Applied - Rear Released
Clutches - Front and Rear Released
-Reverse Clutch Applied
Manual Lever - Reverse Position

The hydraulic reverse, because of the cone reverse clutch, provides a smooth, effortless engagement into reverse gear. This allows easy fingertip rocking from Lo to reverse, when stuck in snow or sand.

With the manual valve in the "Reverse" position, oil is directed to the

1. Front servo to apply to band
2. Rear servo to release the band
3. Reverse clutch to hold the reverse internal gear.



COMPENSATOR VALVE

Compensator Pressure:

The increased load under rapid acceleration requires additional pressure to hold the bands to the drums without slipping.

This pressure is obtained through the use of a compensator valve which directs a variable regulated oil pressure to both the front and rear servos.

The compensator valve is operated by throttle pressure. Therefore, the greater the accelerator pedal travel (giving greater throttle pressure) the greater the resulting compensator pressure.

From a study of the foregoing, you have learned the functioning of the "Hydra-Matic" Transmission and now it remains for you to drive a car so equipped. Driving is simplified due to the absence of a clutch pedal and gear shift lever.

To put the car in motion after starting the engine, it is only necessary to move a small lever at the steering-wheel from neutral to Dr. 4, Dr. 3, Lo, or Reverse, depress the accelerator and the transmission will automatically shift to the desired ratio for the particular car speed.

Stopping the car is accomplished by the application of the brakes and the selector lever need not be moved unless the car is to stand for some time with the engine running. In the latter case, the lever should be placed in neutral.

With the lever in Dr. 4 position, the transmission will shift through four forward speeds. With the lever in Dr. 3 position the transmission will shift through three forward speeds within a normal speed range. The Lo position will allow only two forward speeds.

Dr. 4 provides for fast vehicle travel at low engine speeds. As a result, noise, vibration, and engine wear are reduced while economy is improved.

Dr. 3 provides for flexibility heretofore unknown in an automatic transmission. Dr. 3 prevents the transmission from shifting above 3rd speed. By holding the transmission from shifting into 4th speed, better engine braking is provided at highway speeds. Under the same conditions, instantaneous 3rd speed acceleration is available at the lightest touch of the throttle. Dr. 3 range can be used in hilly terrain or heavy traffic to reduce brake wear and driver fatigue.

Lo provides for sustained extra power while pulling or ascending steep grades. It also provides for extra engine braking action on steep down grades. This is accomplished by not allowing the transmission to shift above second.

For added acceleration and power in any forward range, all that is necessary is to fully depress the accelerator pedal. The transmission automatically selects the most favorable gear ratio.

With the versatile Hydra-Matic, driving is reduced to a matter of depressing the accelerator pedal to go and applying the brakes to stop.