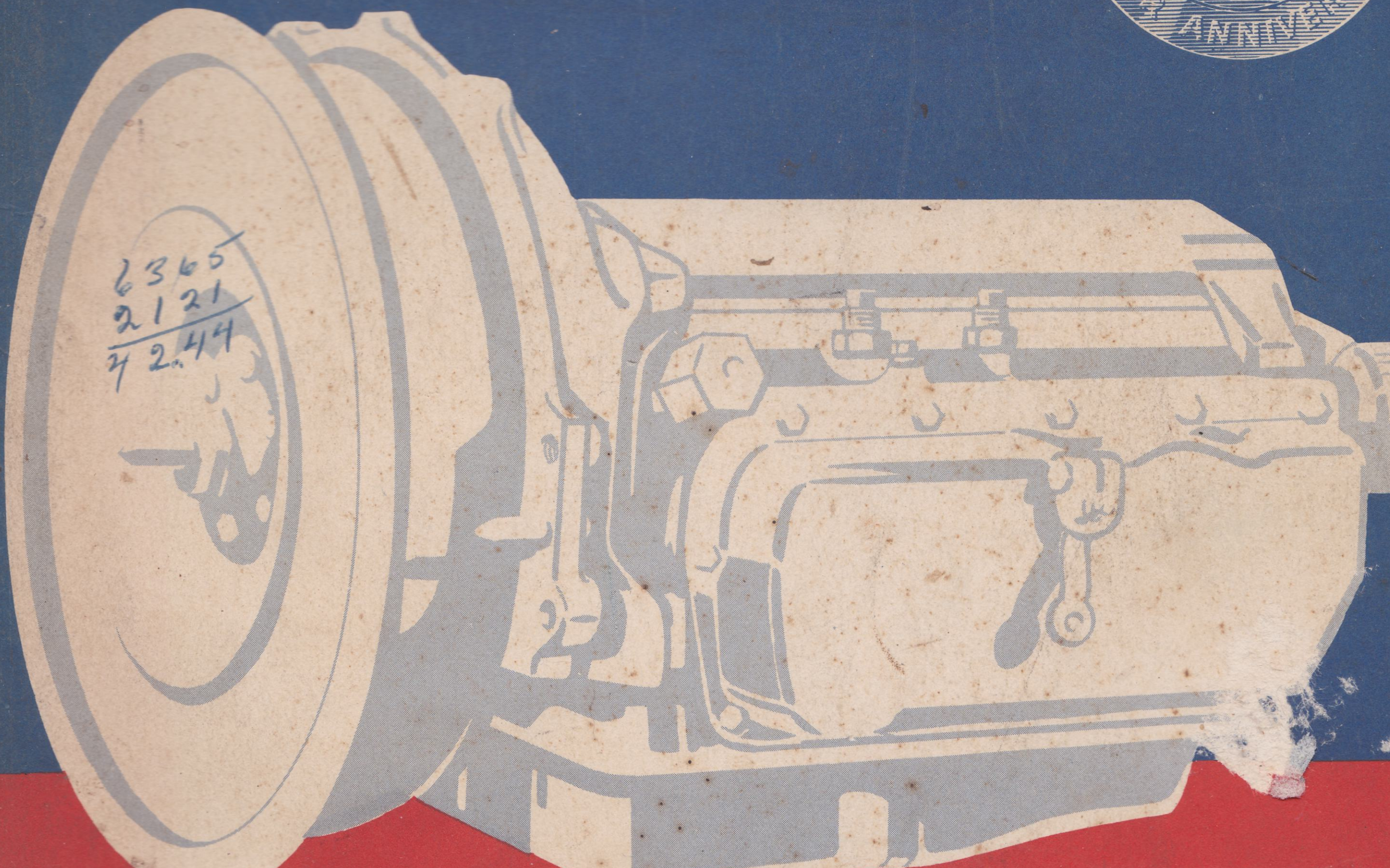
1951 PONTIAC



HYDRA-MATIC DRIVE SHOP MANUAL

1951 PONTIAC

HYDRA-MATIC DRIVE

SHOP MANUAL

This manual contains information on the GM Hydra-Matic Drive used in the 1951 Pontiac. Arrangement of the information included in the manual is shown by the table of contents on the right-hand side of this page. A more detailed table of contents precedes each of the longer sections. An index will be found on pages 177 through 182.

The information in this manual applies to both P51 (6 cylinder) and D51 (8 cylinder) transmissions except as indicated by the note "D51 only" in a few instances.

Section 5 "Minor Services and Repairs" contains operations which can be performed while the transmission is in the car.

Section 9 "Repairs" contains operations which may be found necessary during cleaning and inspection of parts after the transmission has been disassembled. The operations in this section require disassembly of some units beyond operations covered in Section 7.

To make this manual a complete source of Hydra-Matic information it should be cross-indexed with articles contained in the "Pontiac Service Craftsman News."

PONTIAC MOTOR DIVISION

GENERAL MOTORS CORPORATION

PONTIAC 11, MICHIGAN

MAY, 1951 Litho in U.S.A. S-5104 HM

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DESCRIPTION AND OPERATING INSTRUCTIONS

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GENERAL DESCRIPTION

The Hydra-Matic Drive is an automatic means of transmitting the engine power to the vehicle propeller shaft, after which it is directed to the rear axle and the rear wheels in the conventional manner.

The Hydra-Matic Drive consists of a fluid coupling, which replaces the conventional clutch, combined with a hydraulically-controlled automatic transmission having four speeds forward and one reverse.

With the Hydra-Matic Drive, clutch pedal operation and conventional gearshifting are eliminated. The gear ratio in which the car is operating at any time is selected automatically in accordance with the performance demands required by road conditions and the car driver. The control lever position selected will always provide the maximum efficiency under any combination of conditions.

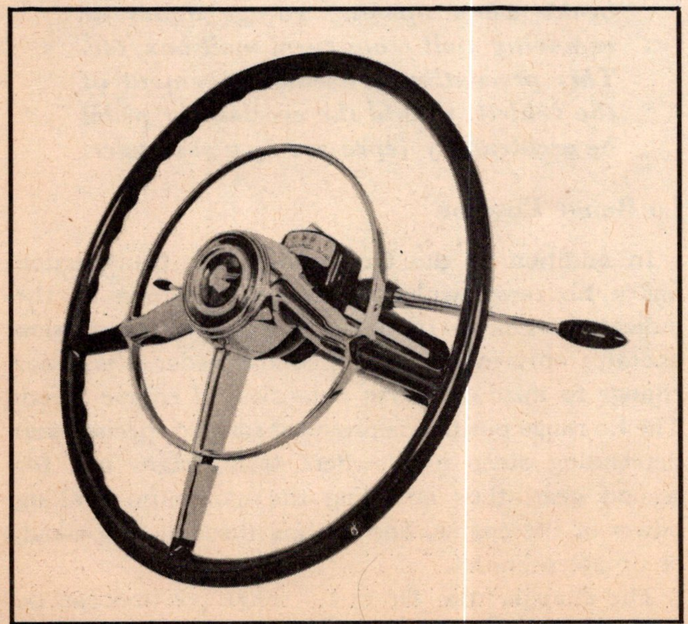

Fig. 1—Indicator Segment and Control Lever

HOW TO OPERATE THE HYDRA-MATIC

The control lever (Fig. 1) located just below the steering wheel is used to select neutral, one of two forward speed ranges or reverse. These positions are all shown on the indicator segment which is illuminated when the instrument lights are on. These positions are as follows:

N—Neutral

Dr—For all normal forward driving.

Lo—For controlled power forward, such as operating up steep grades or in sand and also can be used as a brake when descending steep grades.

R—For Reverse. (Note: Control lever must be raised to engage reverse position.)

STARTING ENGINE

Place Hydra-Matic control lever in N (neutral) position. The starting circuit is wired so that starter will not operate unless the lever is in neutral; press accelerator pedal to toe-board once, and release (in order to set the AUTOMATIC CHOKE); turn the ignition switch on and press starter button. Release starter button as soon as engine starts.

> ***NOTE:*** **When starting a warm or hot engine hold accelerator pedal down half way while pressing starter button.**
>
> ***CAUTION: Do not "pump" the accelerator pedal at any time. Avoid racing the engine during the warm-up period.***
>
> ***NOTE:*** **Should the car fail to start in five to ten seconds, it is possible that the engine is flooded. In that case, press the accelerator slowly to the floor and hold it there when starting. This renders the choke inoperative and relieves the flooded condition.**

OPERATING IN DR RANGE

After the engine is started, move the control lever to Dr position and leave it in this position for all normal forward driving. When the engine is cold and running on fast idle, the car will tend to creep forward after the control lever is moved to the Dr position. A slight application of the foot brake or hand brake will hold the car during this condition. After releasing the brakes, the car will move forward when the accelerator pedal is depressed.

Acceleration

The shift events from first speed to second, second speed to third, and third to fourth (direct drive) will occur at different car speeds depending upon the amount of accelerator pedal pressure. With a slight accelerator pedal pressure, the shift events will be at lower speeds. As accelerator pressure is increased, the shift events will occur at higher car speeds.

The transmission will automatically shift into second speed somewhere between five and fifteen miles per hour, into third speed between ten and thirty-five miles per hour, and into fourth speed between fifteen and seventy miles per hour.

Forced Downshift, Fourth to Third

When driving on the open highway at speeds below 60 miles per hour, an extra burst of speed needed for passing can be secured by pressing the accelerator pedal all the way down; it will be noted that a slight resistance must be overcome to produce this downshift. The drive then changes from fourth speed to third for rapid pickup and returns to direct drive automatically at some higher speed, depending upon how soon the accelerator pedal is released. If the accelerator pedal is held all the way down, the shift returns to fourth at approximately 65 miles per hour.

Deceleration

When car is decelerating with the accelerator pedal free and the control lever in Dr position, the shift from fourth speed to third occurs automatically at approximately fourteen to ten miles per hour. Continuing to decelerate, the transmission will automatically shift from third speed to second and finally from second to first.

Stopping the Car

To stop the car, merely release the accelerator pedal and apply the brakes in the conventional manner. Leave the control lever in Dr position; the engine is then "in gear" and helps to slow down the car until its speed reaches a few miles per hour. The slippage of the fluid coupling at low engine speed is sufficient to prevent the engine from stalling.

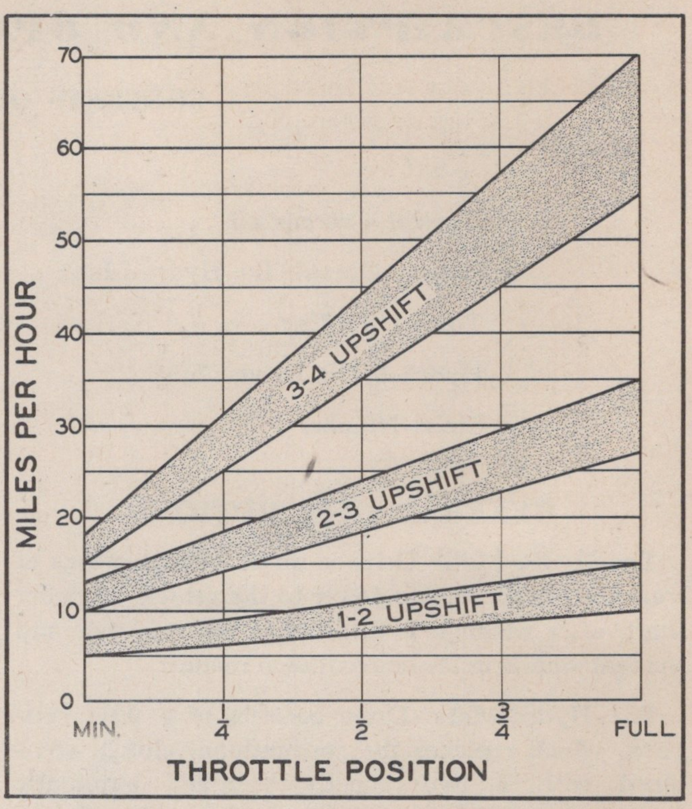

Fig. 2—Approximate Upshift Speeds

> ***CAUTION: Under no circumstances should the control lever remain in any other position except N when driver leaves car, with the engine still running. For additional safety, apply parking brake when opening garage doors or removing mail from rural mail box, etc. This precaution prevents movement of the vehicle, should the accelerator pedal be accidentally depressed by a passenger.***

Lo Range Position

In addition to the Dr position, the transmission has a Lo range which is the next position on the indicator segment. In this position, the transmission operates only in first and second speeds; it will not change to third or fourth regardless of engine speed. The Lo range position is provided for two special uses: descending steep hills, where traffic signs call for second gear, thus affording the maximum braking power of the engine, and pulling through deep sand, or up steep grades.

The change from Dr to Lo range position can be made at any speed below 48 miles per hour on dry pavement where traction is good. It is not recommended that Lo range be used on slippery pavement since its use could induce a skid. On slippery roads safety demands that car speed be reduced by judicious use of the brakes before changing to Lo range.

> ***CAUTION: Release accelerator pedal when moving lever from Dr to Lo.***

Reverse

It is not necessary to bring the 1951 Pontiac to a complete stop before engaging Reverse. Simply raise the control lever and move it to the R position. This feature permits rocking the car forward and back when required to get out of snow, mud, or sand. Avoid engaging Reverse at speeds above 5 MPH.

Parking

For additional safety while parking, turn off ignition key and move selector lever to R position. This permits engagement of transmission parts thereby providing "in gear" parking ability. When parking on an incline, hold the car with foot brake a few seconds to permit engagement of transmission parts.

Coasting

To maintain better control of the car and to prevent possible damage to the Hydra-Matic unit, it is advisable to keep the shift lever in Dr or Lo range position when traveling forward.

When coasting in neutral with the engine shut off, only the rear oil pump in the transmission is in operation. It must supply sufficient oil pressure to lubricate the transmission and, also, keep the rear band released to maintain the transmission mechanism in neutral. If this rear oil pump pressure happens to drop for any reason, (such as low fluid level, etc.) serious damage to the transmission may result.

To Start Engine By Pushing Car

To start the engine by pushing the car, move the selector lever to the N (neutral) position. When the car reaches a speed of approximately 18 to 20 miles per hour, turn on the ignition switch and move the selector lever to the Dr position (not to Lo).

Towing the Car

For Transmission Not Functioning Properly—Disconnect the propeller shaft at the rear universal joint and remove from the car by sliding the front universal joint and shaft assembly backwards or raise the rear wheels off the ground to prevent possible damage to the transmission.

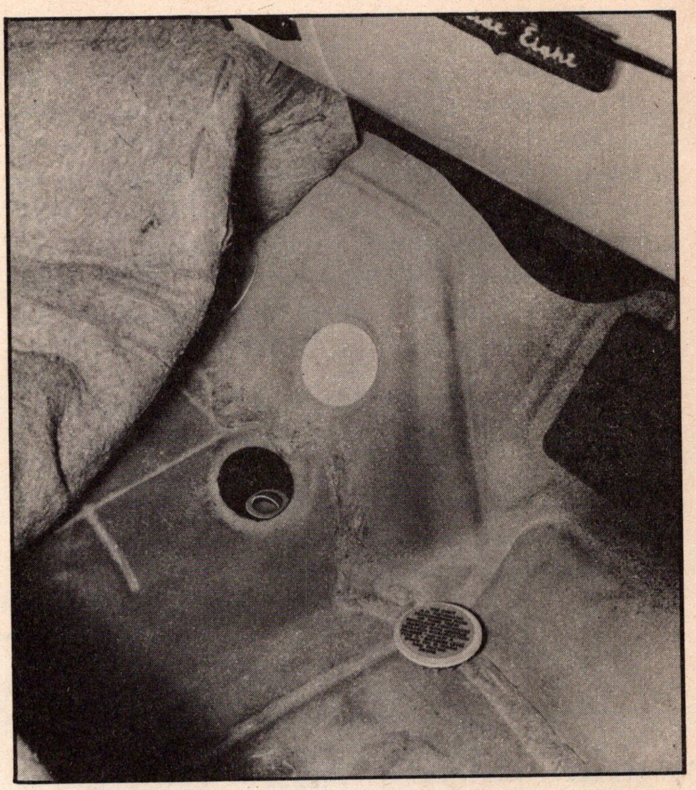

Fig. 3—Oil Level Indicator

For Mechanical Failures Other Than Transmission —Propeller shaft need not be disconnected if transmission has been operating normally provided that car has been driven a minimum of 1000 miles and that towing speeds of not more than 25 miles per hour are maintained. When towing, place selector lever in neutral.

Hydra-Matic Drive Fluid

It is important to use only "G.M. Hydra-Matic Drive Fluid," or "Automatic Transmission Fluid (Type A)" from containers bearing Armour Institute Qualification Number "AQ-ATF. . . ." This is an all-season fluid, ideal for year-round operation. "G.M. Hydra-Matic Drive Fluid" is available through all GMPD Warehouses.

> ***NOTE:*** **In cases of emergency, when the specified fluid is not available, any good quality 20W engine oil will operate for a temporary period. When such oil is used, however, it should be removed as soon as possible and the transmission refilled with the recommended fluid.**

Ordinarily, flushing of the transmission is not necessary; however, if it is flushed for any reason, use only the specified fluid.

Serial Number

A name and serial number plate is attached to the right-hand side of each Hydra-Matic transmission case. The 1951 transmissions may be identified by the fact that the six cylinder transmission nameplate has a black background color and the letters "P51" preceding the transmission serial number; the eight cylinder transmission nameplate has a green background color and the letters "D51" preceding the transmission serial number.

> ***IMPORTANT NOTE:*** **The background color and letters preceding the serial number should always be referred to in order to correctly identify the model transmission being worked on and insure ordering correct parts.**

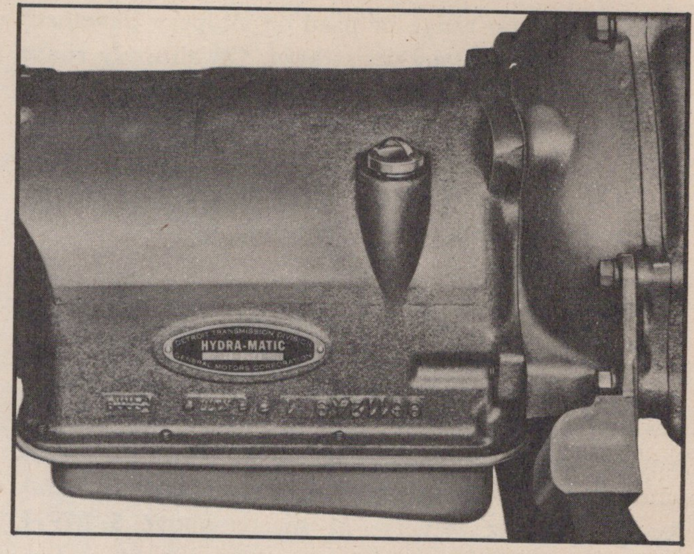

Fig. 4—Transmission Serial Number

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FUNDAMENTAL PRINCIPLES OF THE HYDRA-MATIC TRANSMISSION

CONTENTS OF THIS SECTION

PURPOSE OF A TRANSMISSION

The purpose of a transmission is to provide suitable gear ratios between the engine and rear wheels for all driving conditions. Gear ratios are obtained through planetary gears in the Hydra-Matic transmission.

PLANETARY GEAR TRAIN

A planetary gear train (Fig. 5) consists of three members:

1. A center or "sun" gear.
2. A planet carrier with three planet pinion gears.
3. An internal gear.

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

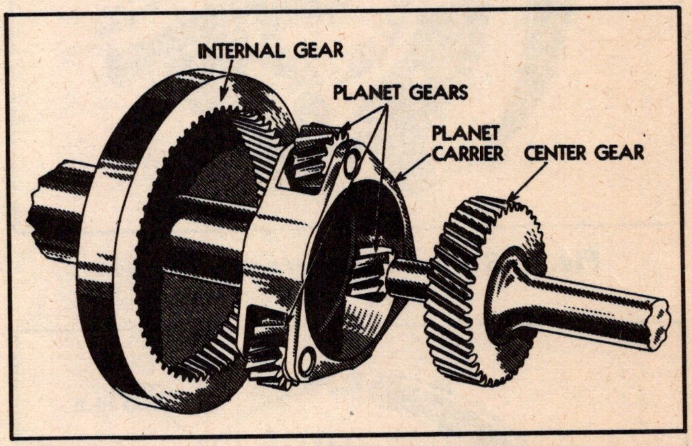

Fig. 5—Planetary Gear Train—Schematic—Exploded

Advantages of a Planetary Gear Train

1. A planetary gear train is compact and sturdy because the load is distributed over several gears instead of only two as in the sliding gear type of gear train. While planetary gears are smaller and occupy less space, they can transmit more tooth load because there is more tooth area in contact at all times.
2. Planetary gears are always completely in mesh, thus there is no possibility of tooth damage due to gear clash or partial engagement.
3. The common axis for all members of the planetary train makes the unit more compact and facilitates its use as a coupling.

Operation of a Planetary Gear Train

1. A planetary gear train can be used to increase power and decrease speed in either of two ways (Figs. 6 and 7).

a. In Fig. 6 the internal gear is held stationary, and power is applied to the center gear. As the center gear turns, the planet pinion gears, which are in mesh with it, rotate on their respective pins. Since they are also in mesh with the stationary internal 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 then rotates at a speed less than that of the center gear, and the planetary gear train functions as a power-increasing, speed-reducing units.

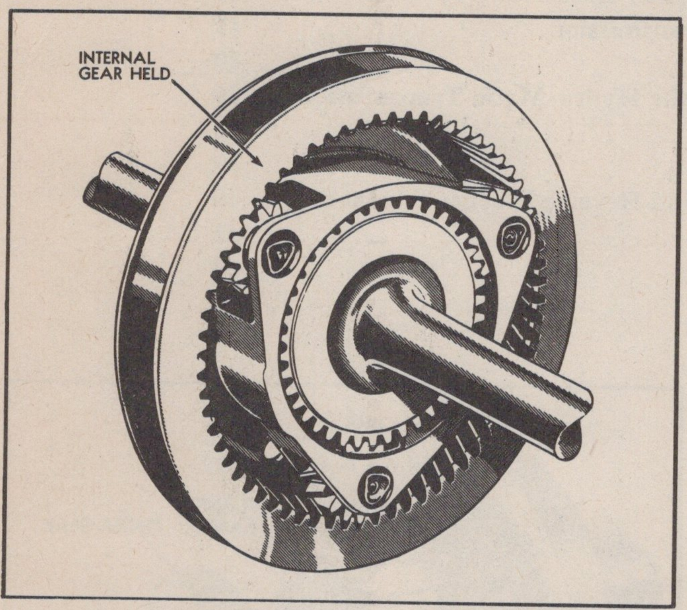

Fig. 6—Reduction—Internal Gear Held

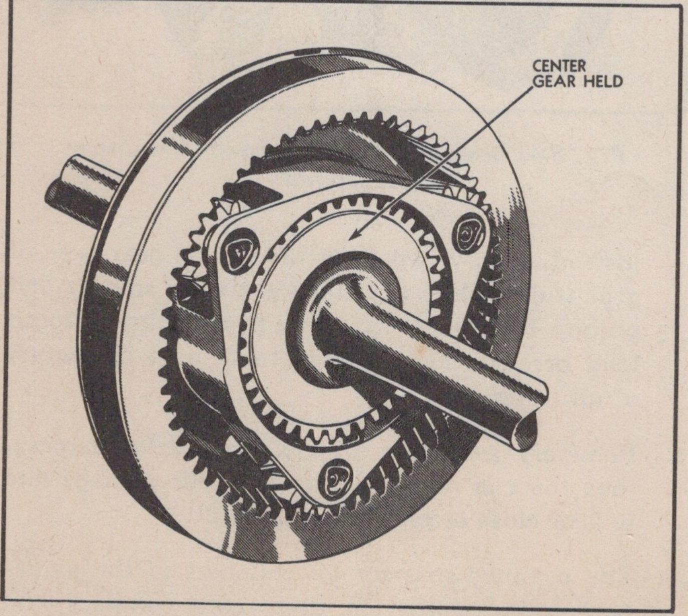

Fig. 7—Reduction—Center Gear Held

b. The same result can be obtained by holding the center gear stationary and applying power to the internal gear (Fig. 7). In this case, rotation of the internal gear causes the planet pinion gears to rotate on their respective pins and at the same time "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-reducing unit.

2. A planetary gear train can be used to reverse direction of rotation when the planet carrier is held stationary. In this instance, if power is applied to the center gear, the planet pinion gears rotate on their respective 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 (Fig. 8).

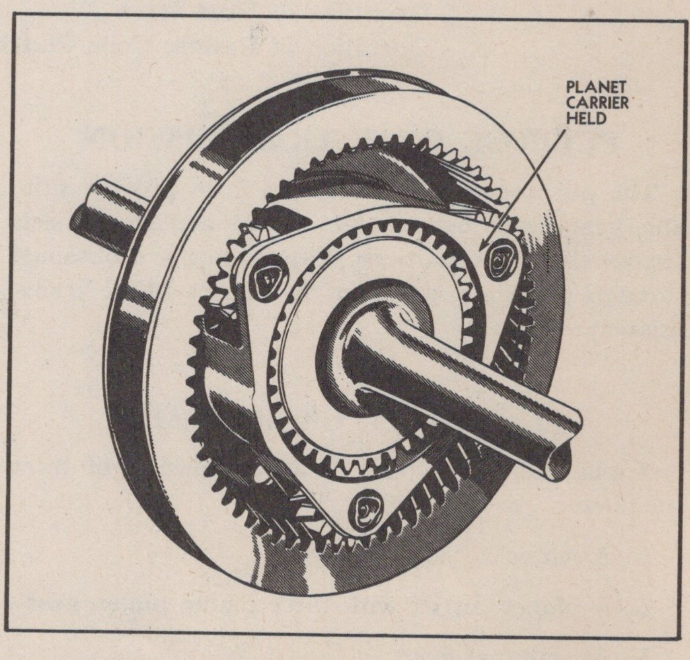

Fig. 8—Reverse—Planet Carrier Held Stationary

In all of the examples shown, one member has been held stationary, the power applied to another member, and taken off the third member.

3. A planetary gear train can be used to function as a coupling for direct mechanical drive when any two members are locked together.

Under this condition no movement can take place between the gears and the entire gear train will rotate as a unit (Fig. 9).

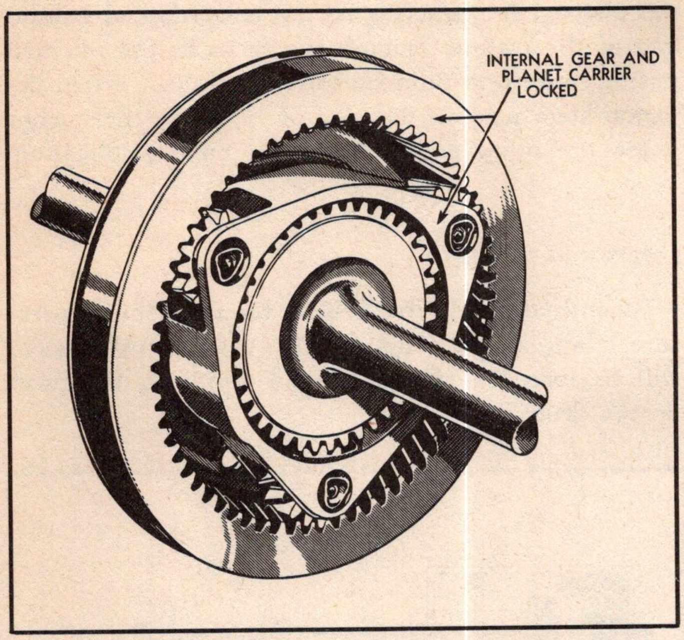

Fig. 9—Direct Drive—Two Members Locked Together

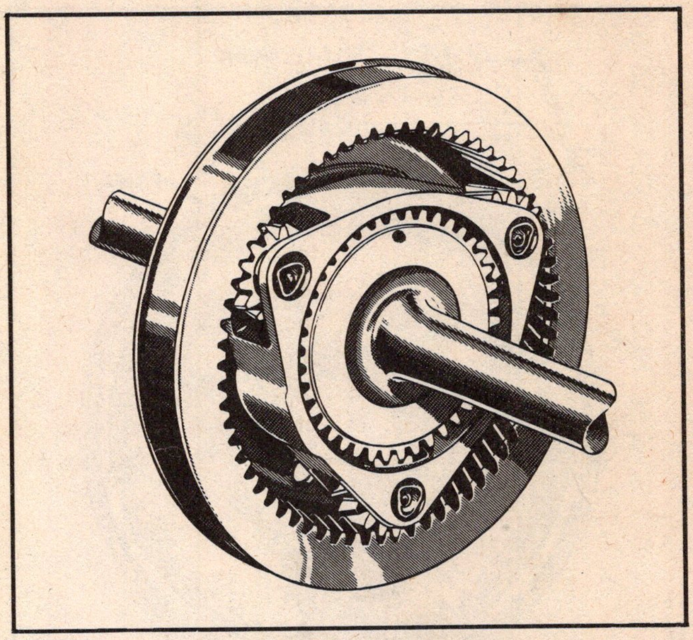

Fig. 10—Neutral—No Member Held—No Members Locked

4. When no member is held and no two members are locked together the planetary gear train will not transmit power, therefore it is in neutral (Fig. 10).

COMPONENTS OF A TWO-SPEED PLANETARY TRANSMISSION

A simple two-speed planetary transmission will be described as an introduction to the operation of the Hydra-Matic Drive.

The following components make up the two-speed transmission:

1. A single planetary gear train.
2. A band and servo for band application.
3. A clutch to lock two members together.
4. An oil pump and pressure regulator.
5. A manual valve.
6. A shifter valve.
7. A governor.
8. A regulator plug.

Planetary Gear Train

The planetary gear train in the two-speed transmission is arranged as shown in Fig. 11.

The internal gear is part of the input shaft. The planet pinion gears and carrier are part of the output shaft. The center gear is attached to the drum which is encircled by a band.

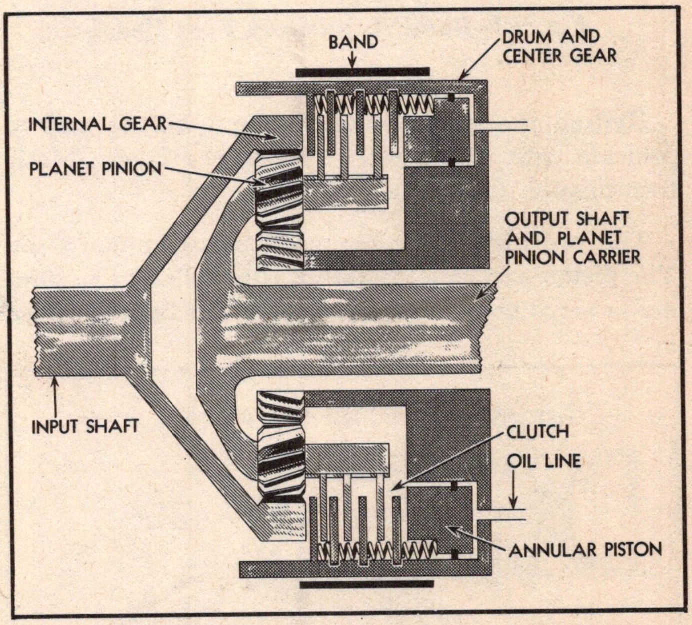

Fig. 11—Planetary Gear Train of Simple Two-Speed Transmission

In the multiple disc clutch one set of plates is splined to the planet carrier, the other set is attached to the drum. The annular piston is also attached to the drum and when applied, locks the center gear to the planet carrier.

Band and Servo for Band Application

A band is used to hold the drum which is attached to the center gear. At one time, some cars used planetary transmissions in which the band was applied by a foot pedal (Fig. 12).

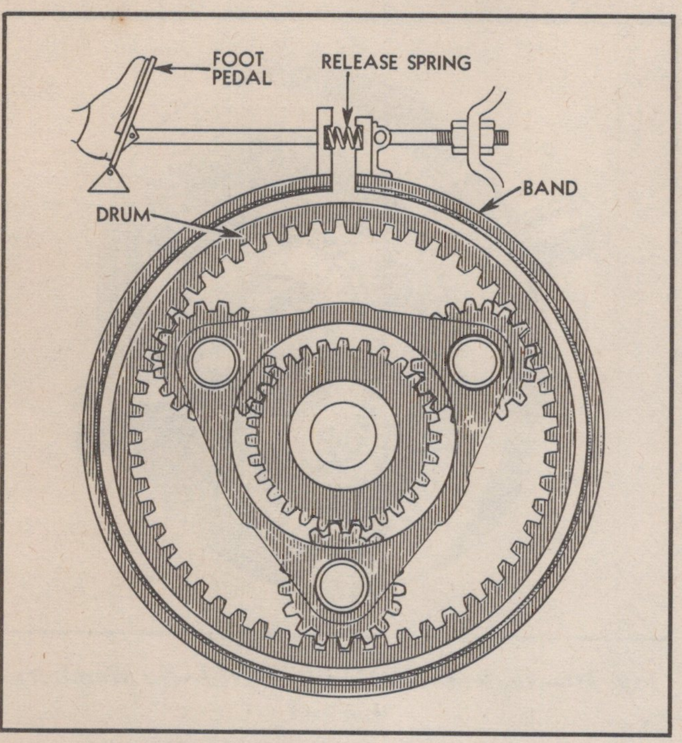

Fig. 12—Band Applied by Foot Pedal

Hydraulic application of the band will be used to coincide with the method used in the Hydra-Matic transmission (Fig. 13).

The two pistons are mounted on a common stem. The piston and stem assembly is installed in a cylinder or servo body with a division in the body between

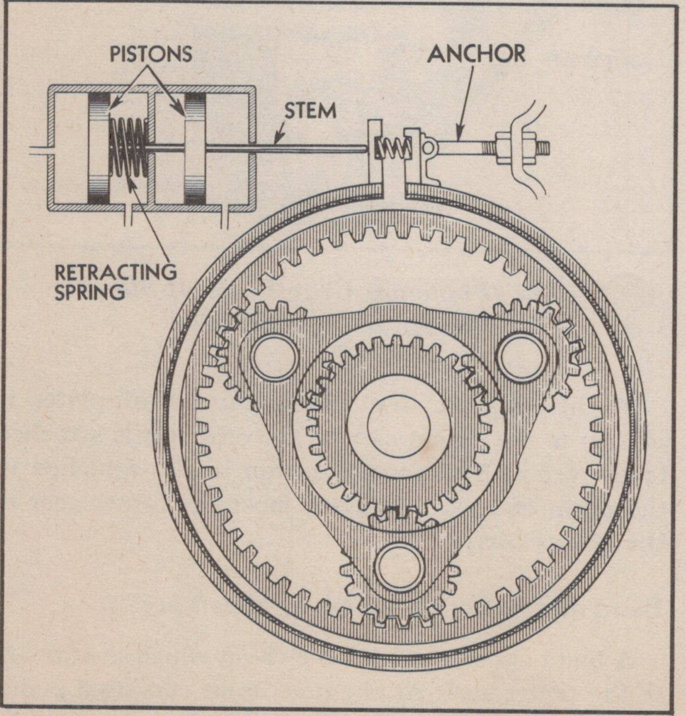

Fig. 13—Servo for Band Application

the pistons. A retracting spring is positioned behind one of the pistons to hold the servo in the released position when no fluid pressure is applied. When the piston stem acts on one end of the band the anchor holds the other end to facilitate band application.

Operation of Servo

When hydraulic force greater than the spring pressure is applied at point A (Fig. 14) the piston stem will be forced against the band, applying the band on the drum.

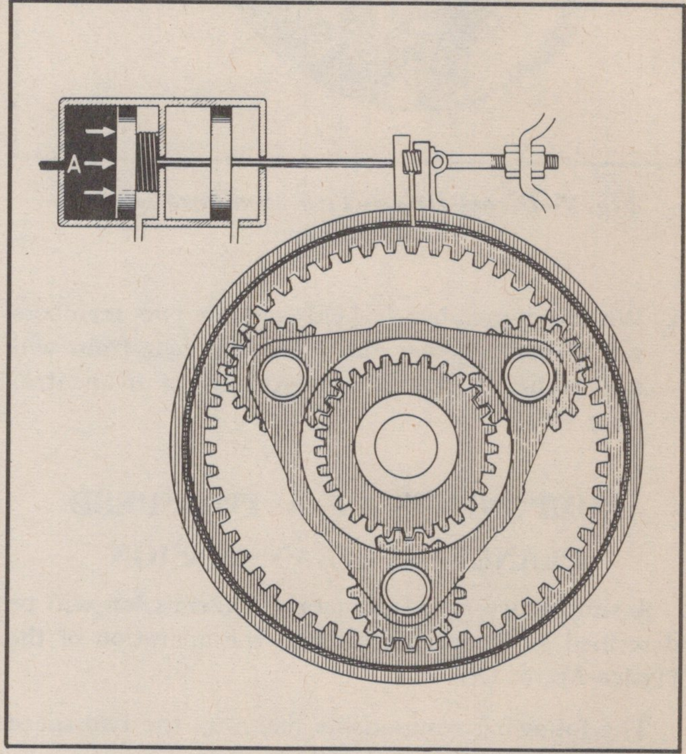

Fig. 14—Servo Applying Band

When hydraulic force equal to that applied at point A is applied at both points B and C the piston stem will be forced away from the band because in this case "release" force is greater than "apply" force (Fig. 15).

Clutch to Lock Two Members Together

A multiple plate clutch is used to lock the planet carrier and output shaft to the center gear. The clutch could be applied mechanically and released by spring pressure (Fig. 16).

Hydraulic application will be used to coincide with the method used in the Hydra-Matic transmission.

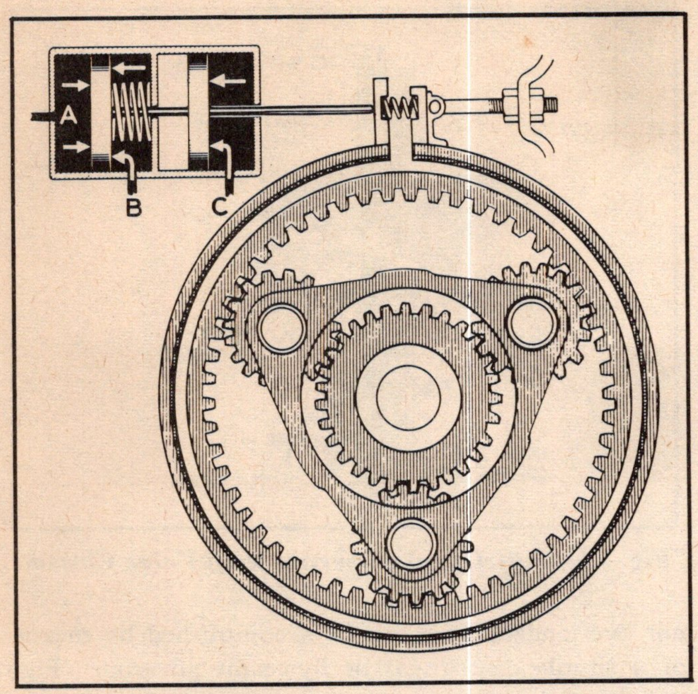

Fig. 15—Servo Releasing Band

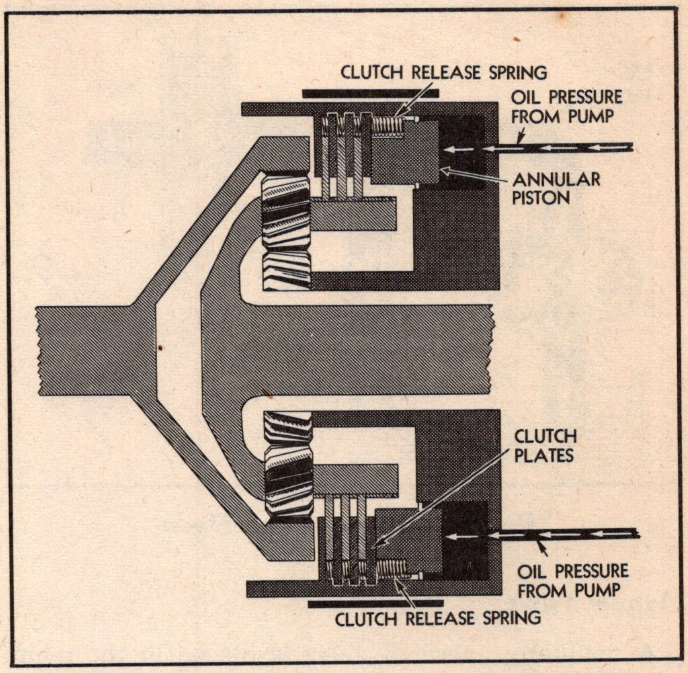

Fig. 17—Hydraulic Clutch Application

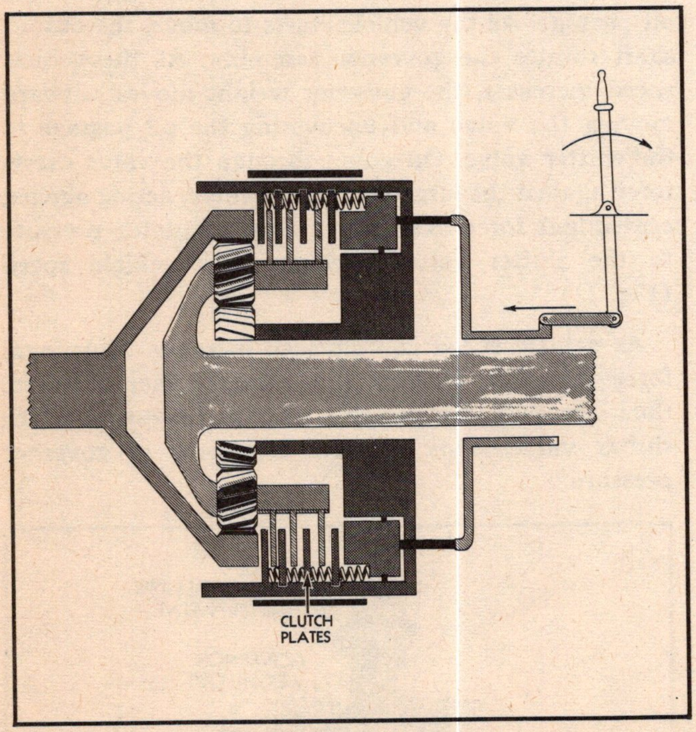

Fig. 16—Mechanical Clutch Application

An annular piston is located in the drum which surrounds the gear train (Fig. 17). When no hydraulic force is applied to the piston the clutch is released by the release springs. When hydraulic force is applied on the piston it compresses the multiple plates locking the planet carrier and output shaft to the center gear.

Oil Pump and Pressure Regulator

A gear type oil pump driven by the input shaft, and a spring loaded pressure regulator valve are required to provide hydraulic pressure for operation of the transmission (Fig. 18).

With the pump in operation oil is drawn up from the pan and forced into the system and against the regulator valve. When pressure is sufficient to force the regulator valve off its seat, the valve will bypass oil to the pan. When pressure in the system falls below that required to hold the valve open, it will close. This cycle is repeated continuously and constant regulated "main line" pressure results.

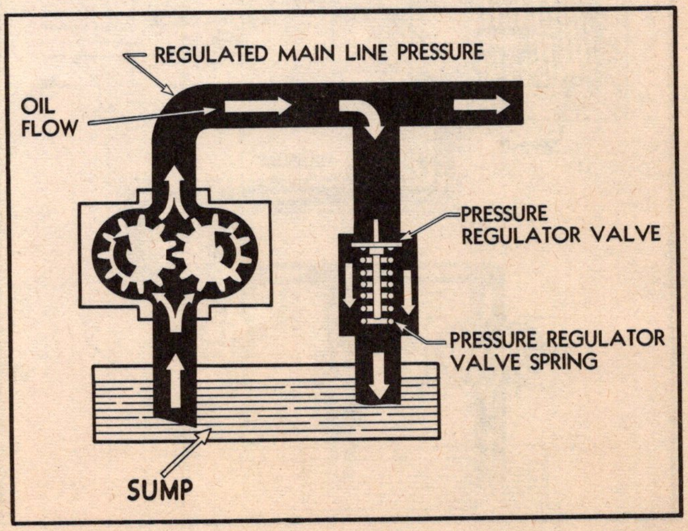

Fig. 18—Oil Pump and Pressure Regulator

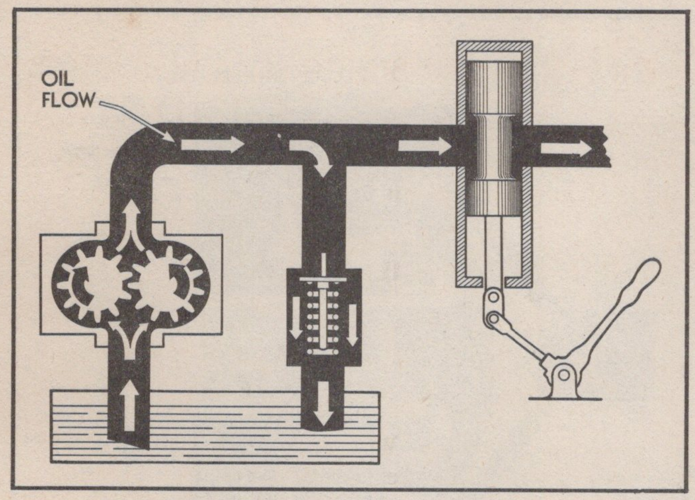

Fig. 19—Manual Valve Open

Manual Valve

A manually operated valve is placed in the main line beyond the pressure regulator valve to permit shutting off oil to the hydraulically operated components (Fig. 19).

Shifter Valve

A shifter valve is required to make the automatic shift from low to direct drive. The valve is held in the closed position by a spring (Fig. 20). The valve is opened hydraulically when oil pressure on the end of the valve is greater than spring pressure.

Governor

The shift from reduction to direct drive must be made at the correct time in relation to vehicle speed so that the engine will be neither racing excessively

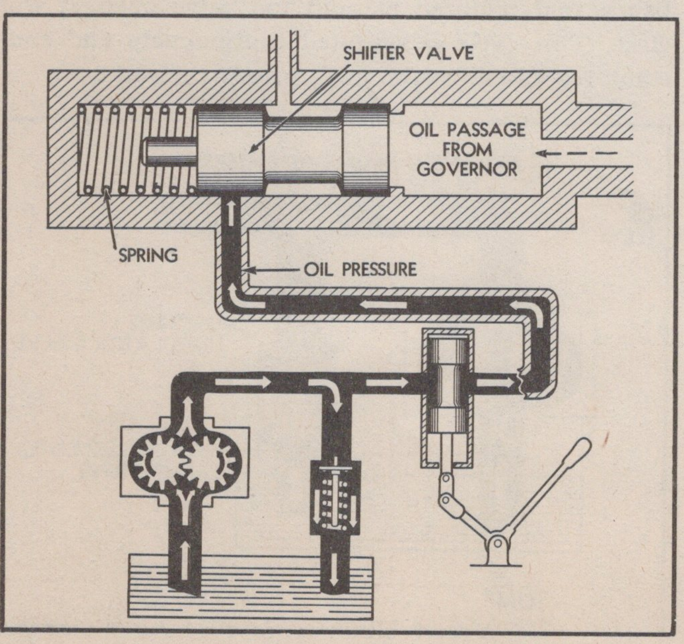

Fig. 20—Shifter Valve Closed

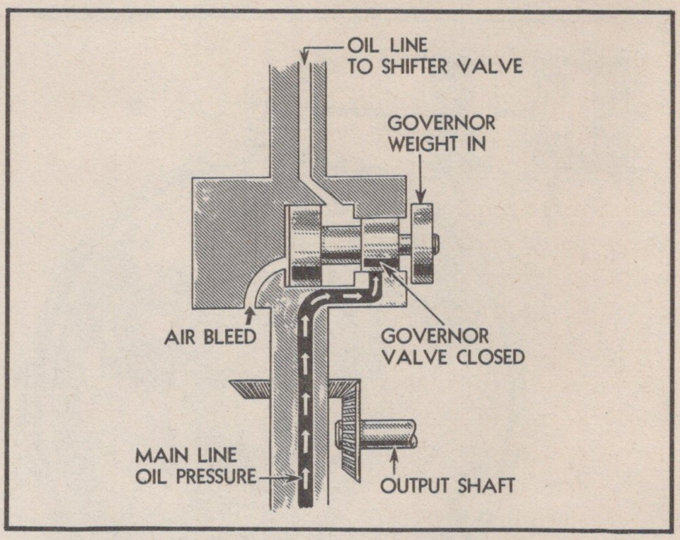

Fig. 21—Centrifugal Governor with Valve Closed

nor overloaded. This can be accomplished by means of a simple centrifugal or flyweight governor (Fig. 21) driven by the transmission output shaft.

When the vehicle is standing, the governor weight, to which a valve is attached, is "in," closing off the oil passage. As the vehicle starts to move, the output shaft rotates the governor assembly. As the vehicle speed increases, the governor weight moves outward moving the valve and uncovering the oil passage to the shifter valve. Oil going through the valve exerts force against the large area of the valve, acting against centrifugal force. The valve then regulates pressure to the shifter valve, variable with vehicle speed (Fig. 22).

As vehicle speed continues to increase, centrifugal force increases, moving the valve further outward, thus increasing the variable regulated pressure to the shifter valve. This pressure is known as governor pressure.

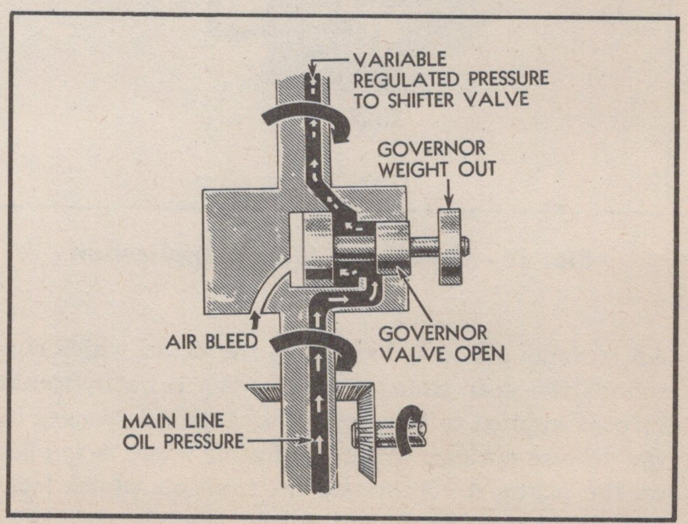

Fig. 22—Centrifugal Governor with Valve Open

Regulator Plug

With the shifter valve, shifter valve spring, and governor described above, the shift from low to direct drive will always occur at the same vehicle speed.

This arrangement is undesirable in a vehicle because many circumstances arise when a shift at higher or lower speeds is desired. Examples of this are when rapid getaway is desired or when climbing a hill.

The need for a higher shift point thus corresponds closely with the need for increased power output of the engine. Since engine power output is controlled by throttle opening, which in turn is controlled by the accelerator pedal, the timing of the shift can be regulated with the position of the accelerator pedal.

One way of accomplishing this is shown in Fig. 23. Assume that the shifter valve spring is seated against a movable regulator plug which is connected to the accelerator pedal. As the accelerator pedal is depressed, the plug is moved inward, compressing the spring and thereby increasing its tension. Because of this increased tension, more governor pressure is required to move the shifter valve and consequently the shift will occur at higher vehicle speeds, determined by the accelerator pedal position.

With this arrangement, the transmission will upshift at a very low vehicle speed when the throttle is nearly closed, and at a much higher speed when the throttle is wide open.

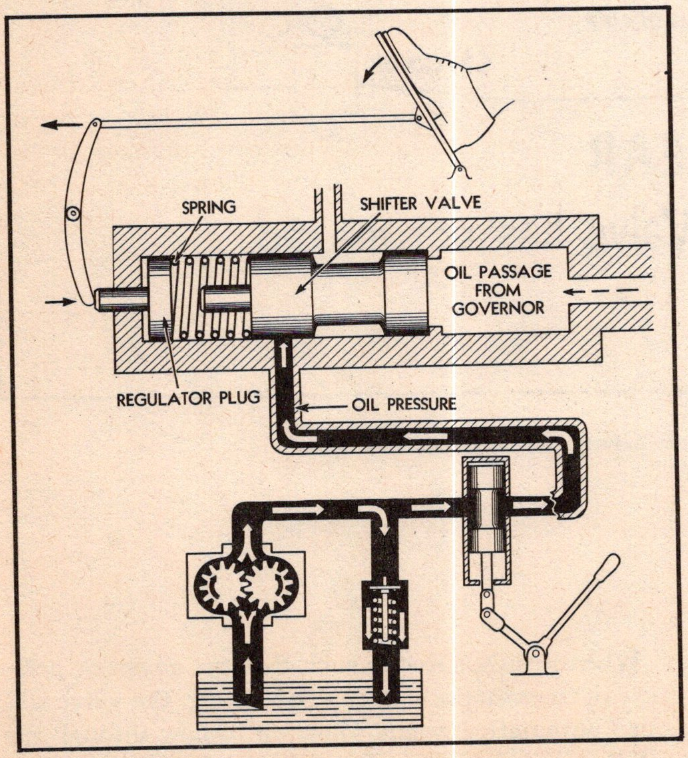

Fig. 23—Shifter Valve Regulated Manually

OPERATION OF A HYDRAULICALLY OPERATED TWO-SPEED TRANSMISSIO

In order to simplify the explanation of the two speed transmission the components described abo will be illustrated schematically.

Legend for Schematic Illustrations

1. →→ Solid lines with arrows represent pa sages filled with oil at constant regulated ma line pressure.
2. ________Solid lines without arrows represent pa sages in which no pressure exists.
3. –→ –→ Broken lines with arrows represent pa sages filled with oil at variable pressure.
4. ——————Broken lines without arrows represe passages in which no variable pressure exists.

Neutral—Engine Running

In neutral the manual valve is closed. The pump, driven from the input shaft which turns wi the engine, delivers oil to the pressure regulator a the shifter valve. The regulator returns excess oil the sump (Fig. 24).

The band is released by the spring because th is no oil pressure on the servo piston. The clutch released by springs because there is no oil pressu to apply the annular piston.

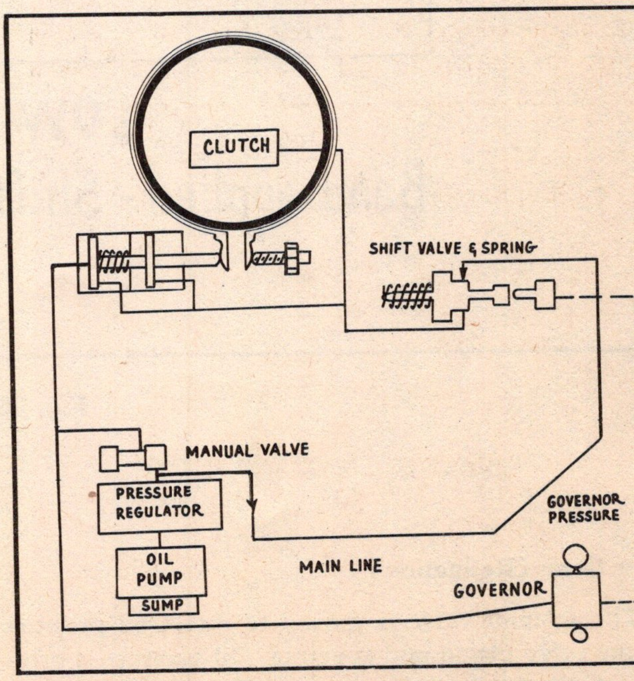

Fig. 24—Neutral (Engine running) Band Rele —Clutch Released

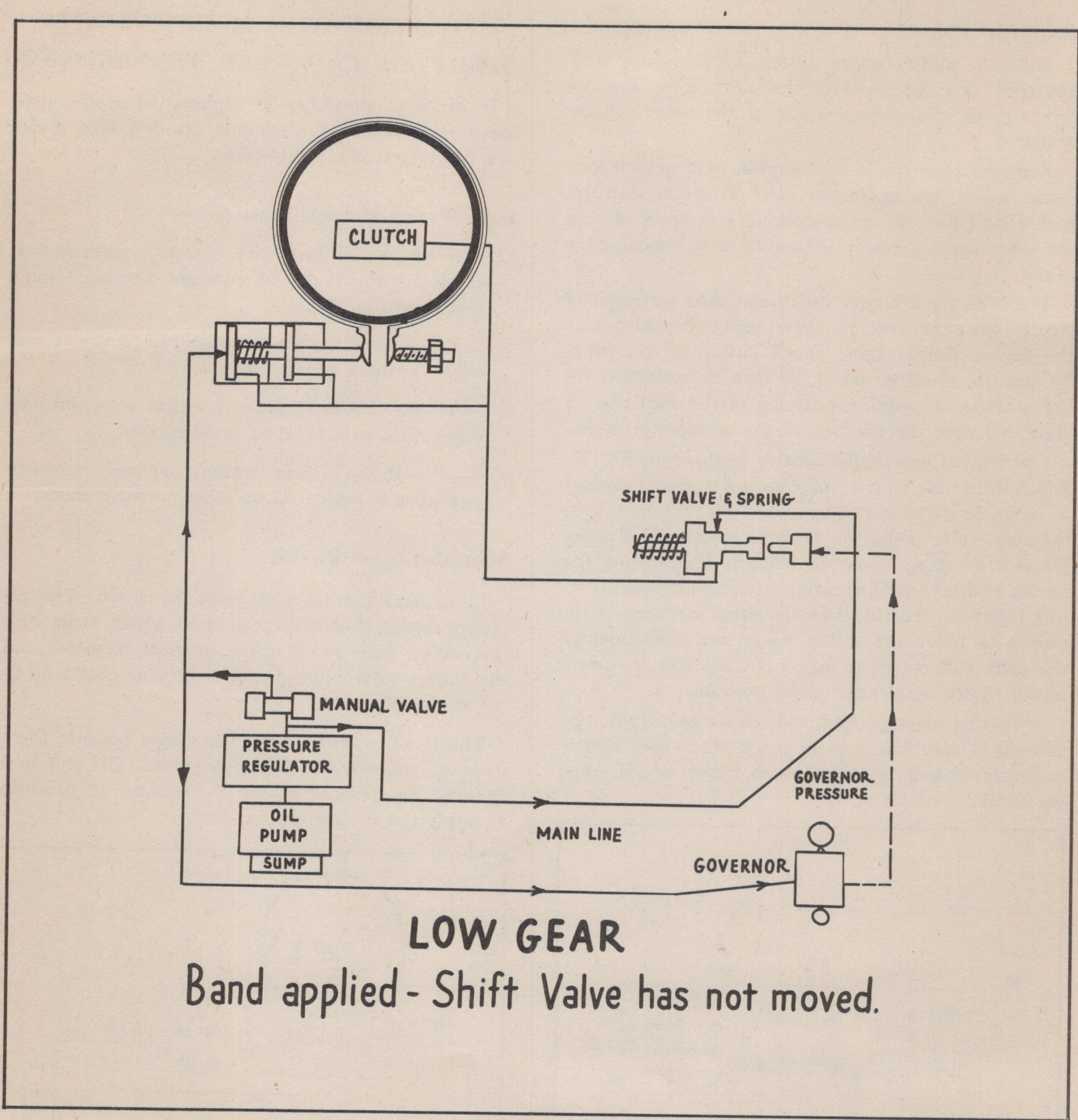

Fig. 25—Low Gear

Low Gear (Reduction)

The manual valve is moved to direct oil pressure to the servo piston and governor. Oil pressure is present on the land of the closed shift valve. The servo applies the band and the clutch is released by springs (Fig. 25).

When vehicle speed is such that the governor pressure overcomes the shifter 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 places the planetary unit in direct drive.

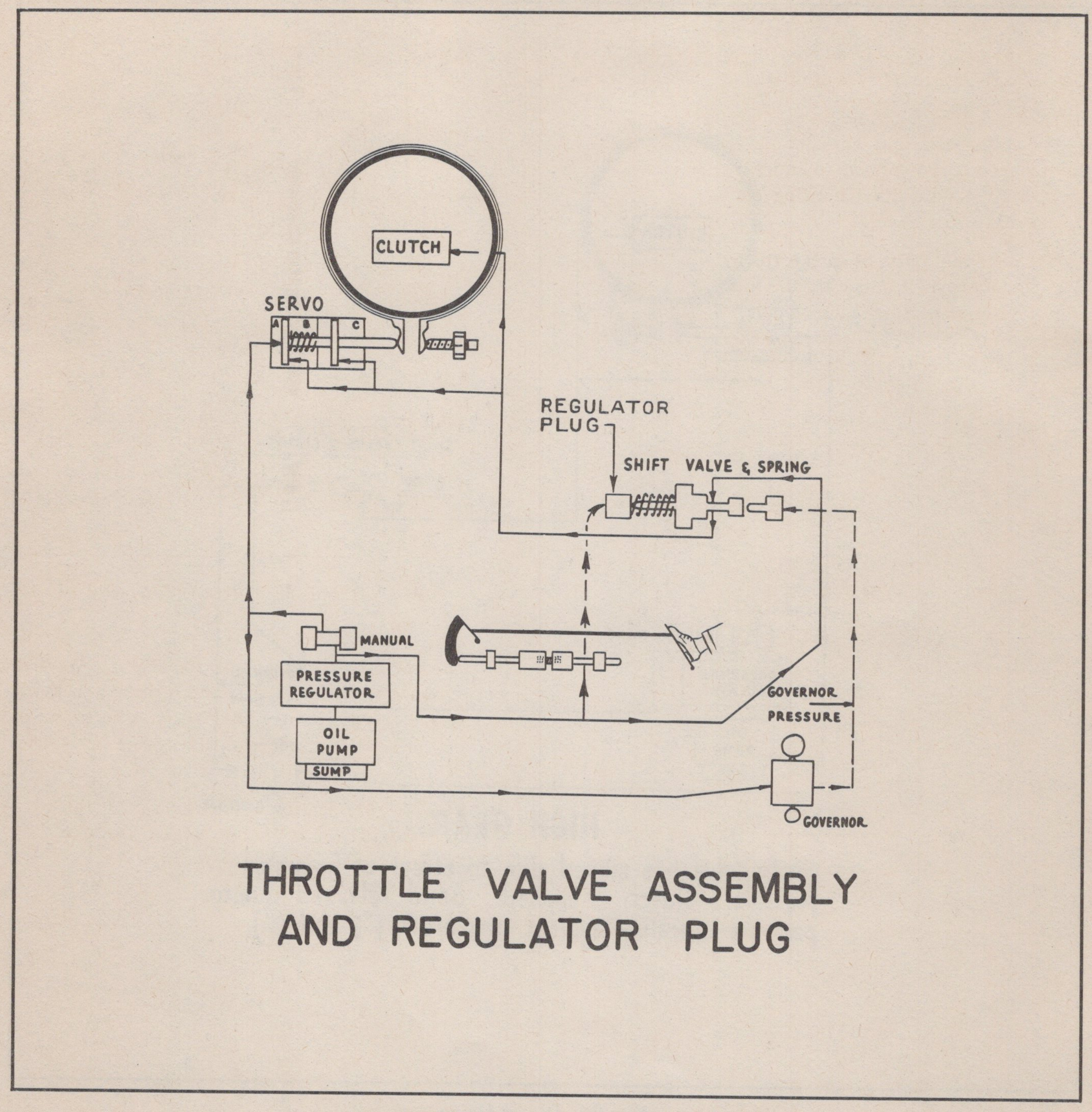

Fig. 27—Throttle Pressure to Delay the Upshift

Regulator Plug

The need for a regulator plug was outlined on page 13. In that case the regulator plug was moved mechanically to increase spring tension to delay the upshift. To coincide with the Hydra-Matic Drive the regulator plug in the simple two-speed transmission is moved by a variable regulated hydraulic pressure called "throttle pressure".

Throttle pressure is obtained by the use of a throttle valve assembly which is moved by mechanical linkage from the accelerator pedal. The valve assembly is so designed that "throttle pressure" increases with carburetor throttle opening. Therefore, the further the accelerator pedal is depressed the more the shifter valve spring tension is increased to delay the upshift (Fig. 27).

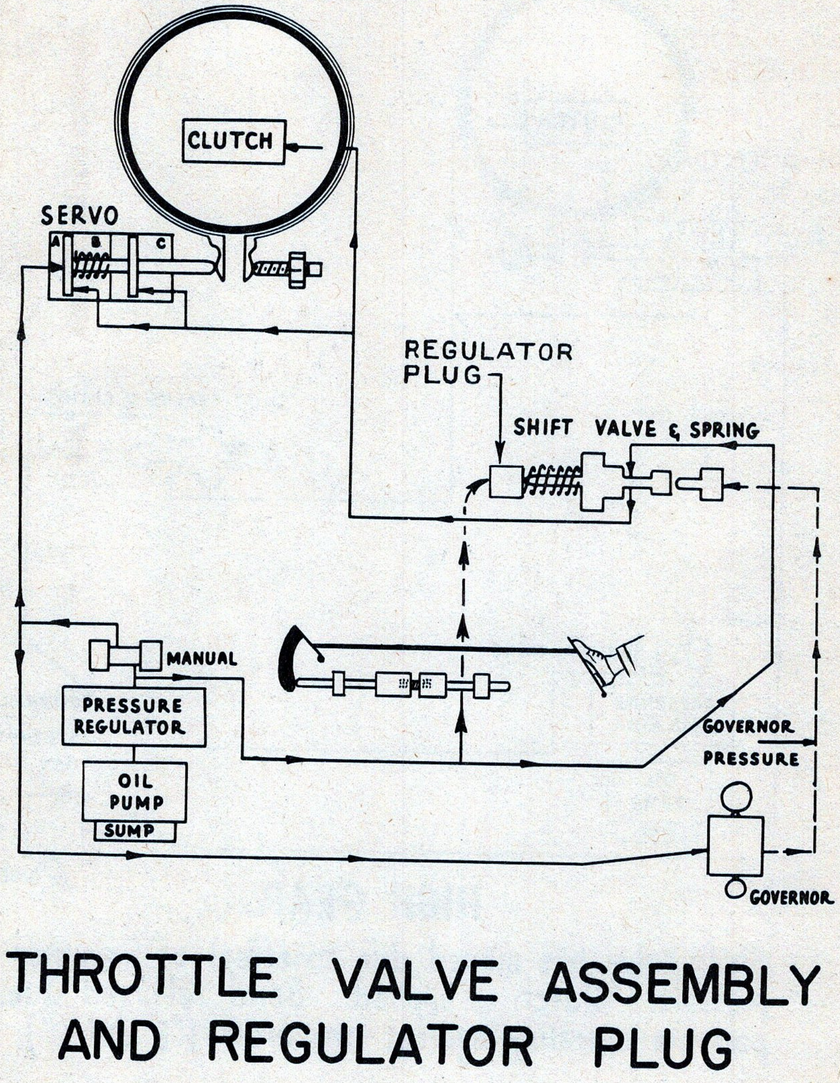

Fig. 27—Throttle Pressure to Delay the Upshift

Regulator Plug

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FLUID COUPLING

A fluid coupling is employed in the Hydra-Matic Drive to relieve the driver of operating a clutch pedal and to cushion the shifts.

The fluid coupling consists of two parts called "torus members" splined to independent shafts and located in a fluid-filled housing consisting of a fly-wheel and torus cover.

The principal parts of each torus member (Fig. 28) are, the outer shell and hub, the inner shell, and the vanes interconnecting these shells. The two members are identical in construction except for the hubs which are different in size to fit their respective shafts.

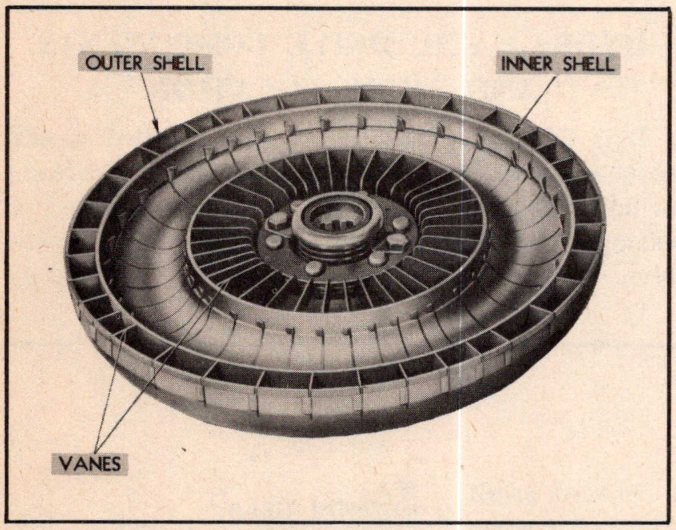


Fig. 28—Torus Members

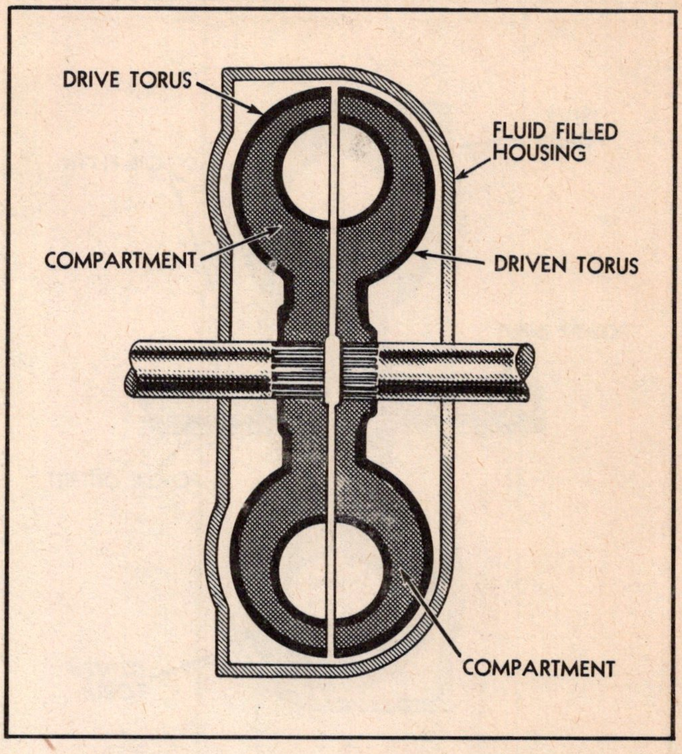


Fig. 29—Torus Members in Housing

A schematic cross section of two torus members attached to independent shafts and located in a fluid-filled housing is illustrated in Fig. 29. The shape of the compartment formed by the vanes is shown shaded.

> ***NOTE:*** **An actual illustration of the component parts which make up the fluid coupling is shown in Fig. 30.**

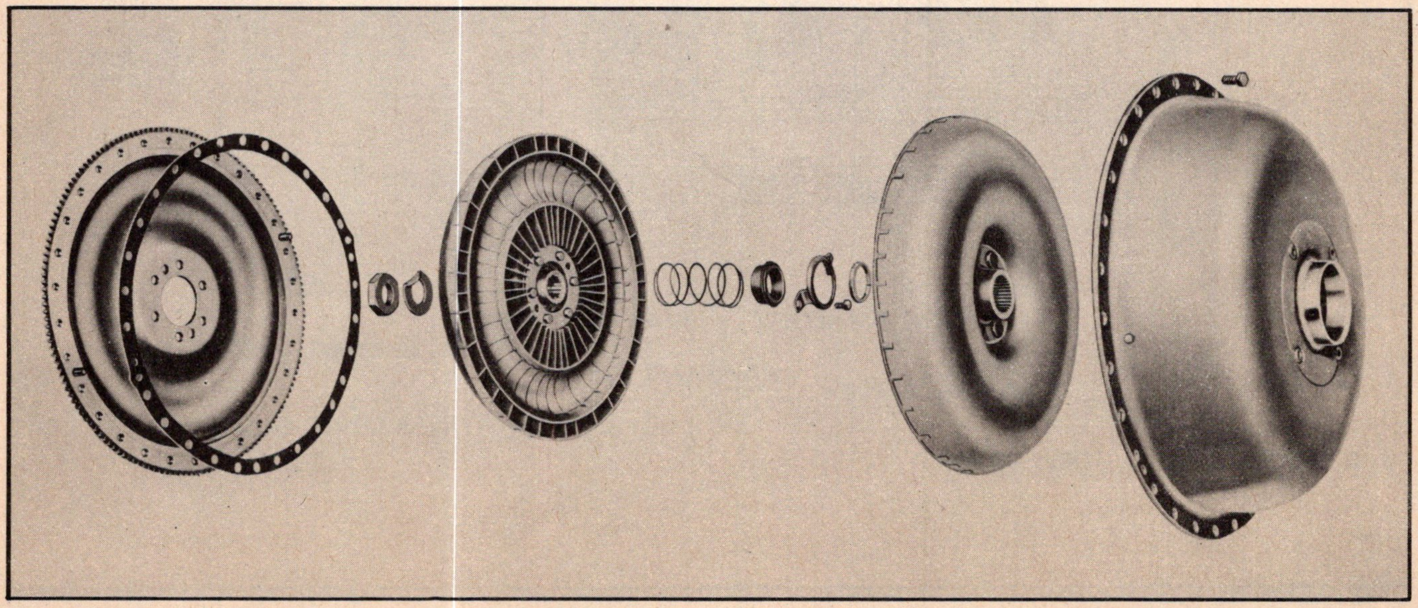


Fig. 30—Fluid Coupling Units

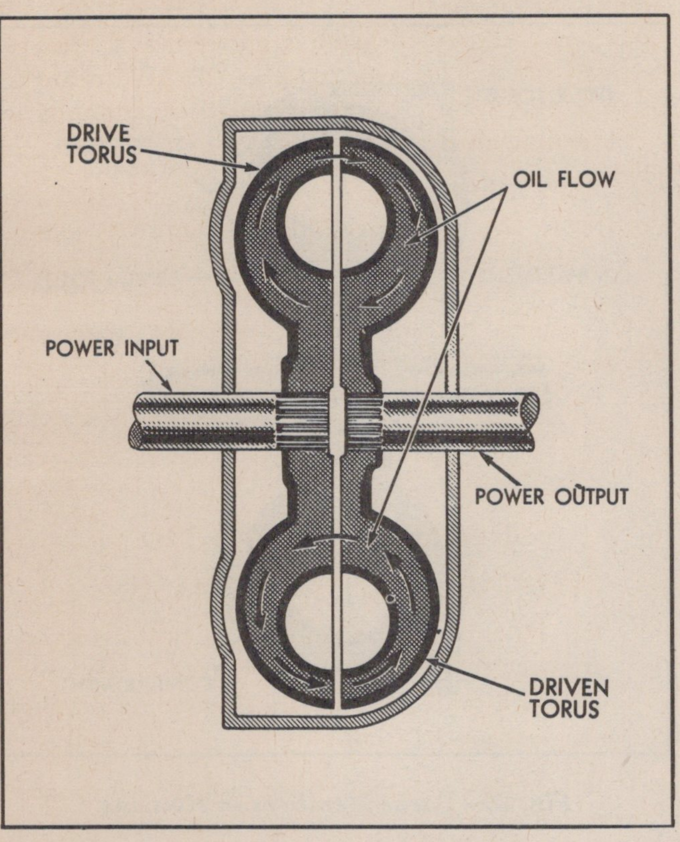


Fig. 31—Torus Members in Operation

In operation, rotation of the drive torus member causes the fluid within that member to be forced radially outward. Fluid then crosses over and strikes the vanes of the driven torus member, causing it to rotate in the same direction as the drive member (Fig. 31).

The higher the speed of the drive member, the greater the force exerted by the fluid on the driven member due to centrifugal action. Consequently, a fluid coupling is:

Very effective at high speed.
Less effective at low speed.
Non-effective at idle speed.

Keep this latter point in mind. It will be referred to later.

HYDRA-MATIC DRIVE COMPONENTS AND THEIR LOCATION

It is possible to obtain only two forward speeds, reduction and direct, from one planetary gear train or unit when applying power at the same source (for example, the sun or center gear). As a greater variation of speed ratios is required to satisfactorily

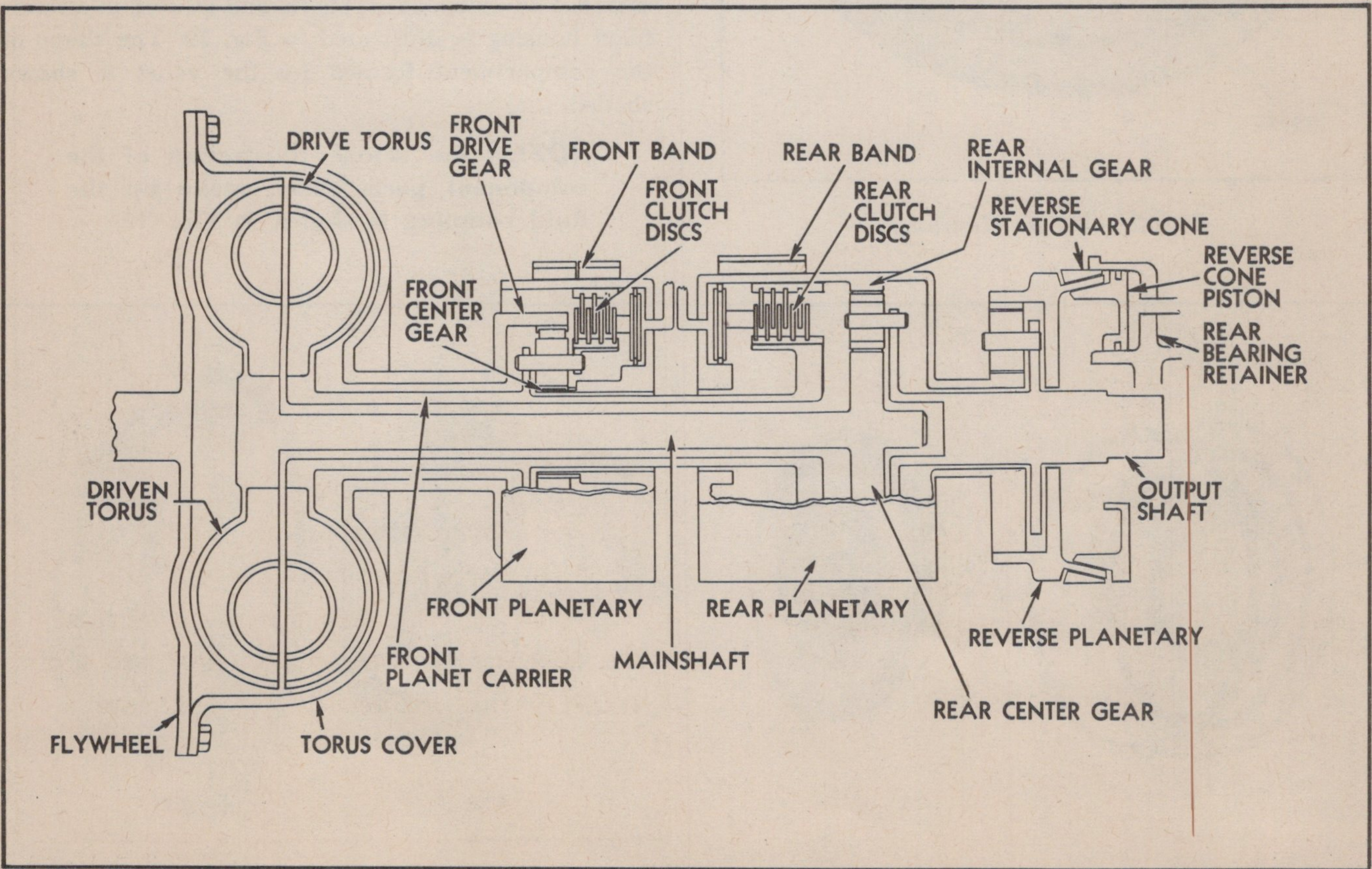


Fig. 32—Location of Hydra-Matic Components

operate a vehicle, the Hydra-Matic transmission contains two planetary gear trains arranged to provide four speeds forward. This is accomplished by various combinations of bands and clutches. It also contains a third planetary gear train for reverse. In all forward speeds the reverse planetary unit has no function and simply revolves with the output shaft (Fig. 32).

While the torus members are actually located in front of the transmission, they are in effect between the front and rear planetary units. This is due to the fact that the drive torus is splined on the front unit planet carrier and the driven torus is splined on the main shaft, which includes the rear planetary unit center gear.

Drive Torus Speed Reduction

When the car is standing, with the engine running and the control lever in Dr, Lo or Reverse, the drive torus turns at 7/10 engine speed. This reduction in the front unit makes possible an engine idle of 375 RPM without the car "creeping" forward.

Power travels from the flywheel to the torus cover (Fig. 33) through the front planetary, which is in reduction because the band is applied, and then to the rear torus. The rear torus in the Hydra-Matic Drive is the drive member, while the front torus is the driven member.

As the vehicle starts, power travels from the flywheel to the torus cover through the front planetary in reduction, then through the fluid coupling and back to the rear planetary unit. When the speed of the vehicle has increased to a point where the reduction of the front planetary unit is no longer required, the front planetary shifts to direct drive and the drive torus turns at the same speed as the engine.

FUNDAMENTALS OF THE HYDRA-MATIC TRANSMISSION

In the Hydra-Matic transmission two planetary units are used to give four forward speeds (Fig. 34). Although both units are similar, the rear unit differs in two ways from the front unit.

1. It is longer, has more clutch plates and greater gear reduction.
2. The servo is normally applied by spring pressure and released by oil pressure.

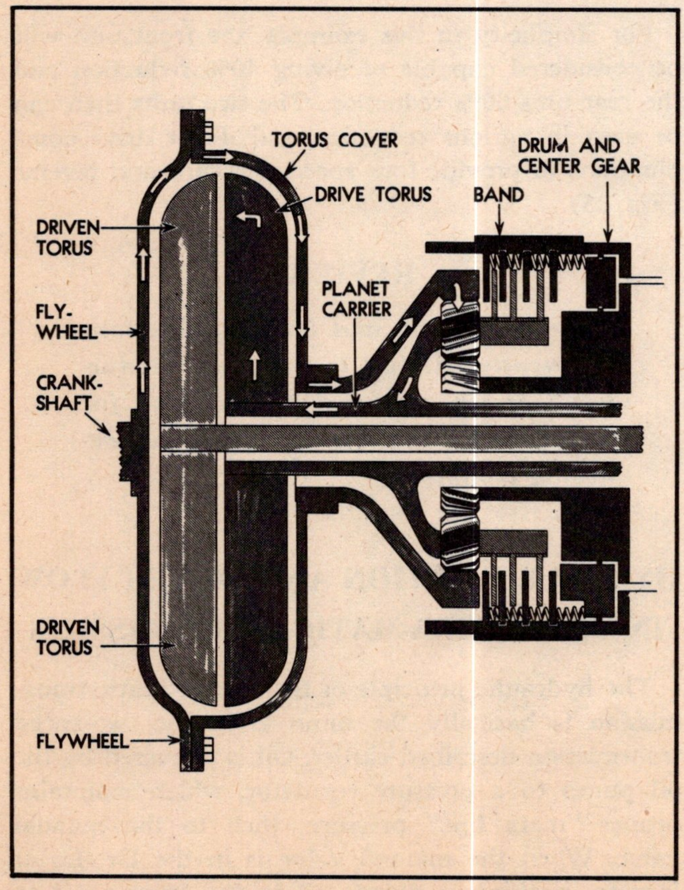


Fig. 33—Drive Torus Speed Reduced

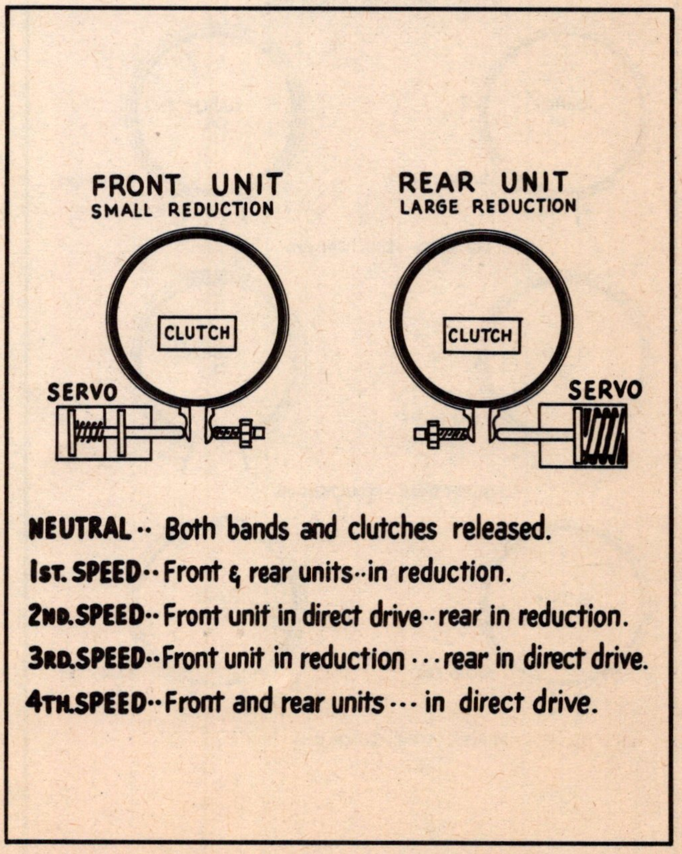


Fig. 34—Band and Clutch Positions in Different Gears

IMPORTANT

Knowledge of clutch and band application is basic and must be acquired by anyone who is to understand Hydra-Matic transmission operation and who wishes to become expert in trouble diagnosis.

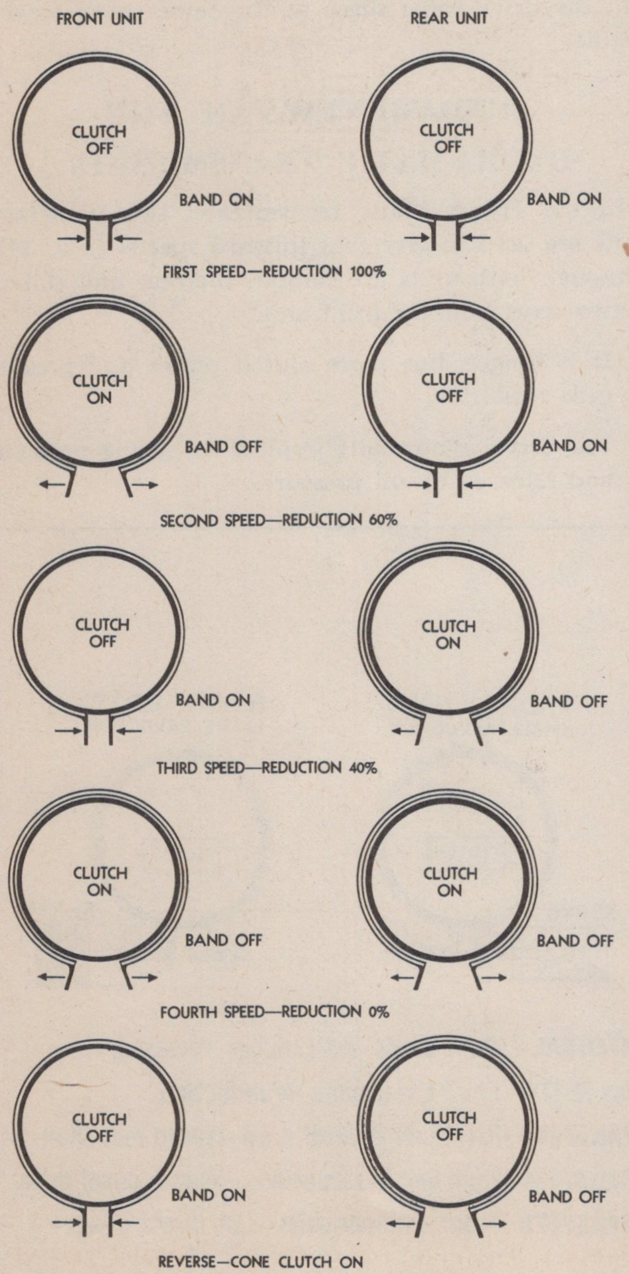


Fig. 35—Band and Clutch Application

REMEMBER

In either planetary unit of the Hydra-Matic transmission:

—When the band is applied the clutch is disengaged and the unit is in reduction.

—When the clutch is applied the band is disengaged and the unit is acting as a coupling for direct drive.

MEMORIZE

Memorize band and clutch application for the four forward speeds. The following example is given as one way this can be done.

Example

The greatest forward speed reduction will be wanted in first speed—call this 100% reduction.

The next greatest reduction will be wanted in second speed—call this 60% reduction.

The next greatest reduction will be wanted in third speed—call this 40% reduction.

In fourth speed, direct drive is wanted—call this 0% reduction.

For simplicity in this example, the front unit will be considered capable of giving 40% reduction and the rear unit 60% reduction. The two units then can be used in various reduction and direct drive combinations to provide four speeds forward and reverse (Fig. 35).

REVIEW

Review clutch and band applications frequently. Ability to visualize "reduction" or "direct drive" in each unit for each forward speed is invaluable in diagnosing trouble.

HYDRAULIC ACTION AND POWER FLOW IN THE HYDRA-MATIC TRANSMISSION

The hydraulic principle of the Hydra-Matic transmission is basically the same as in the two-speed transmission described earlier. Oil is delivered by the oil pump to a pressure regulator, which maintains proper "main line" pressure, then to the manual valve. When the manual valve is in the Dr, Lo or Reverse position it directs oil to the front servo to apply the band.

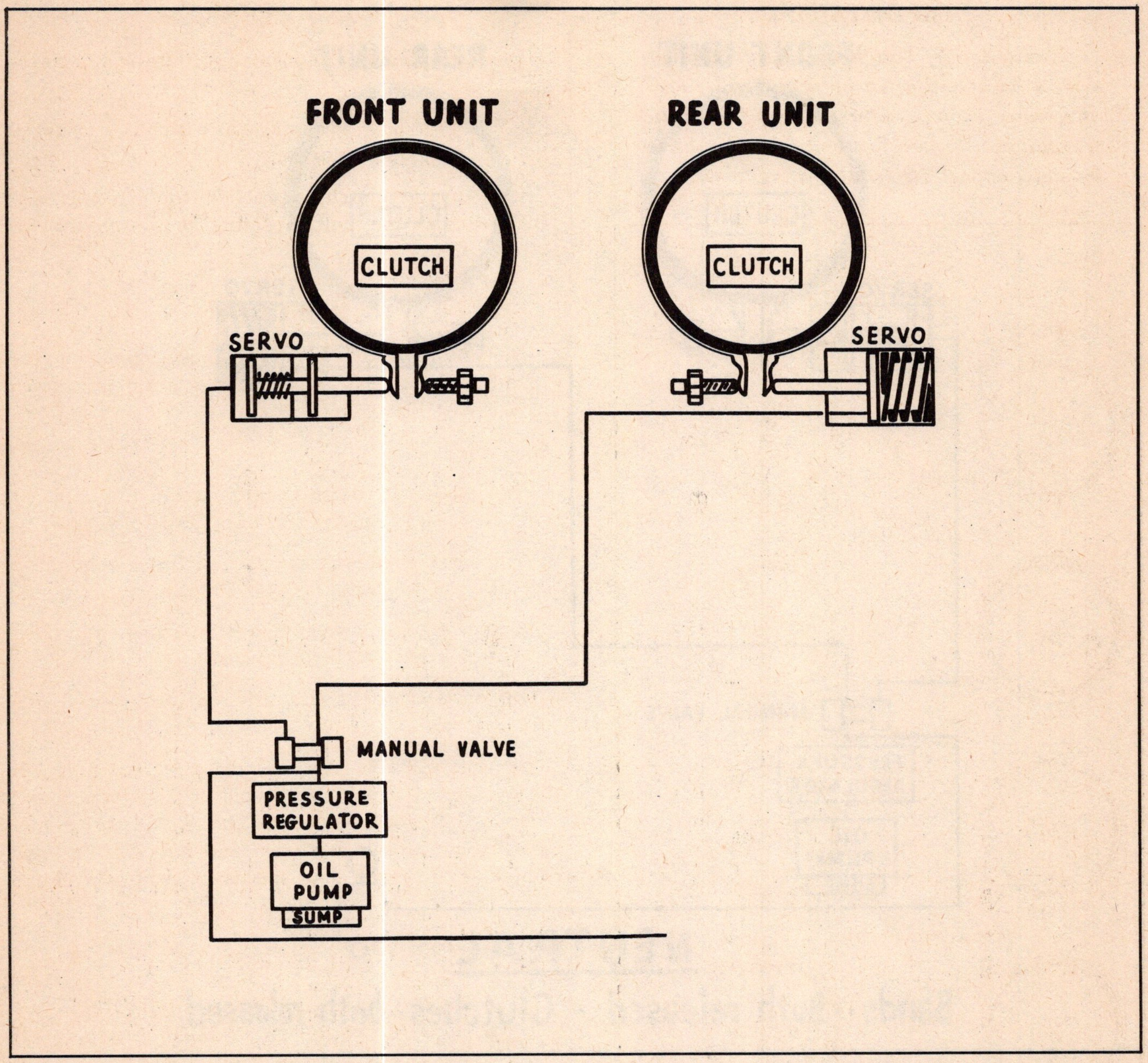


Fig. 36—Hydraulic Action in Neutral (Engine not running)

NEUTRAL

Car Standing—Engine Not Running

The front servo is oil applied and oil and spring released. Therefore, when the car is standing and the engine not running, the front band and the front clutch are released by springs.

The rear servo is spring and oil applied and oil released. When the vehicle is standing and the engine not running, there is no oil pressure. The band is applied by spring pressure, placing the rear unit in reduction. The clutch is released by spring pressure.

SUMMARY: Car standing—engine not running
Front band released—front clutch released

Rear band applied—rear clutch released

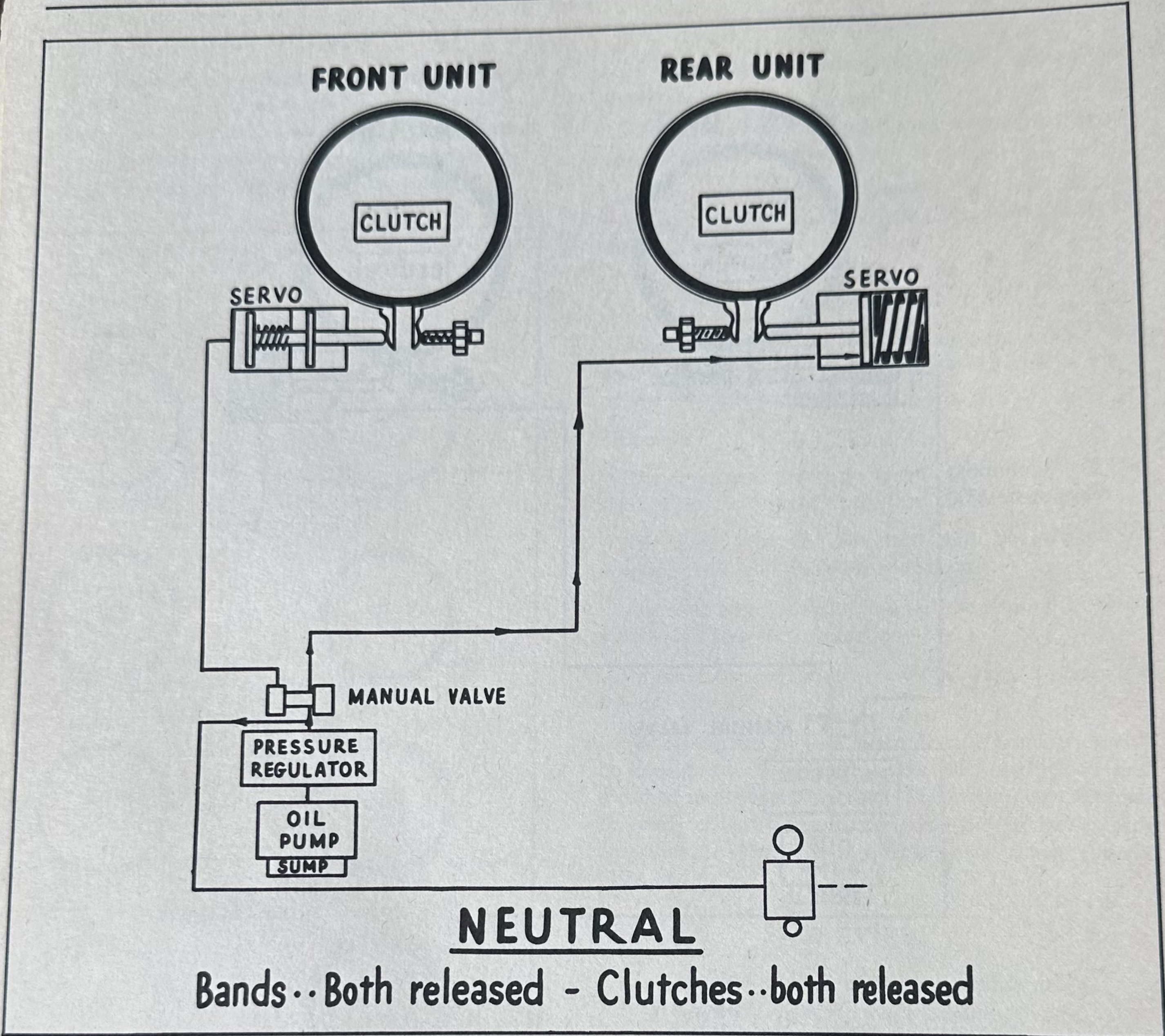


Fig. 37—Hydraulic Action in Neutral (Engine running)

NEUTRAL

Car Standing—Engine Running

Hydraulic Action in Neutral—Engine Running

When the manual valve is in the neutral position, oil is directed to the rear servo to release the band. No oil can get into the line leading to the front servo so it is held in the released position by a retracting spring. Both bands and clutches are then released and the transmission is in neutral (Fig. 37).

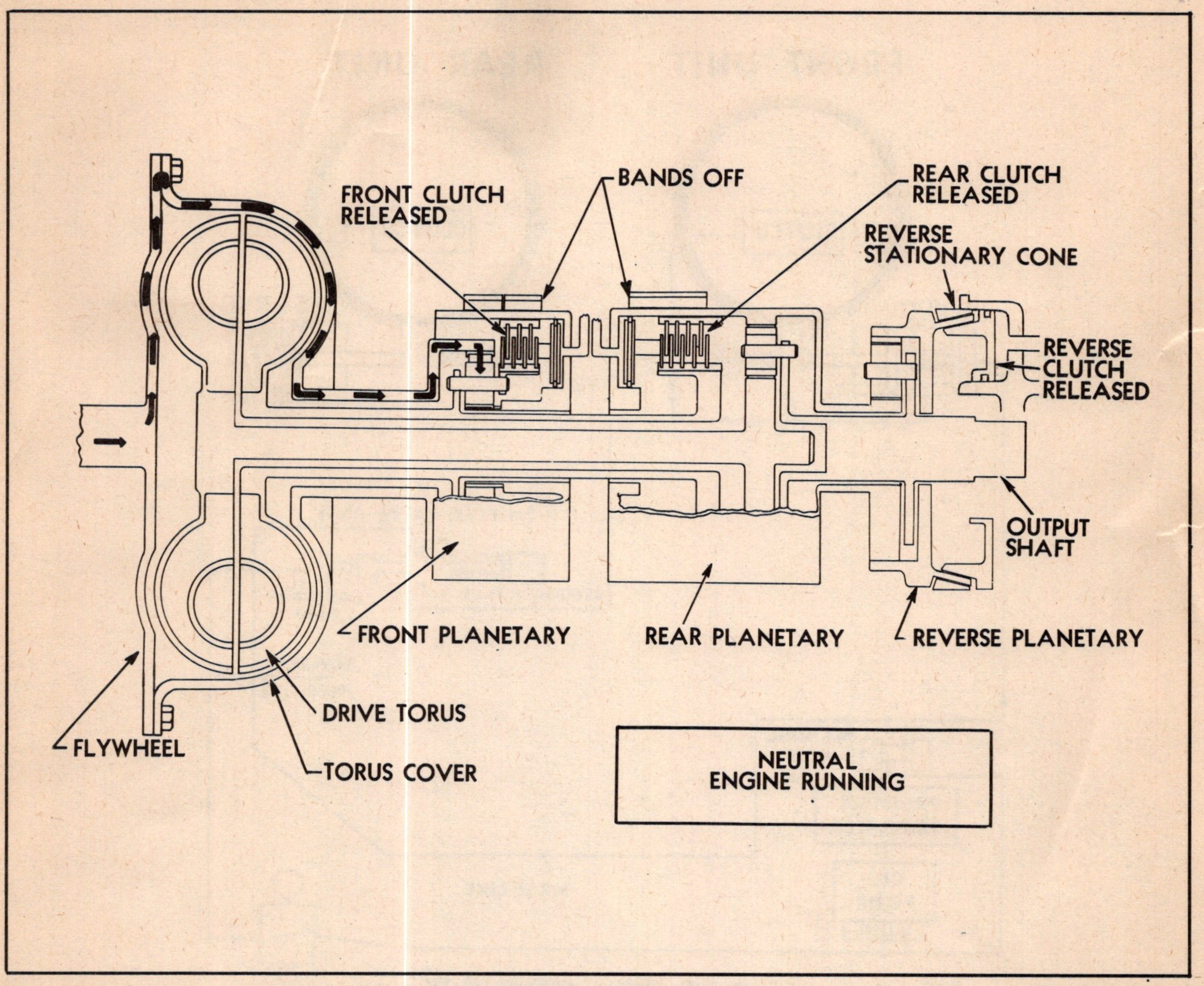


Fig. 38—Power Flow in Neutral (Engine running)

Power Flow in Neutral—Engine Running

The flywheel, torus cover, and the front drive gear (front unit internal gear) are all attached to each other and rotate at engine speed. Since the front drive gear is the internal gear of the front planetary unit its rotation causes the front unit planet gears to rotate on their pins. Since no member of the front unit is held, no power is transmitted to the planet carrier and drive torus (Fig. 38).

SUMMARY: Car standing—engine running
Front band released—front clutch released

Rear band released—rear clutch released

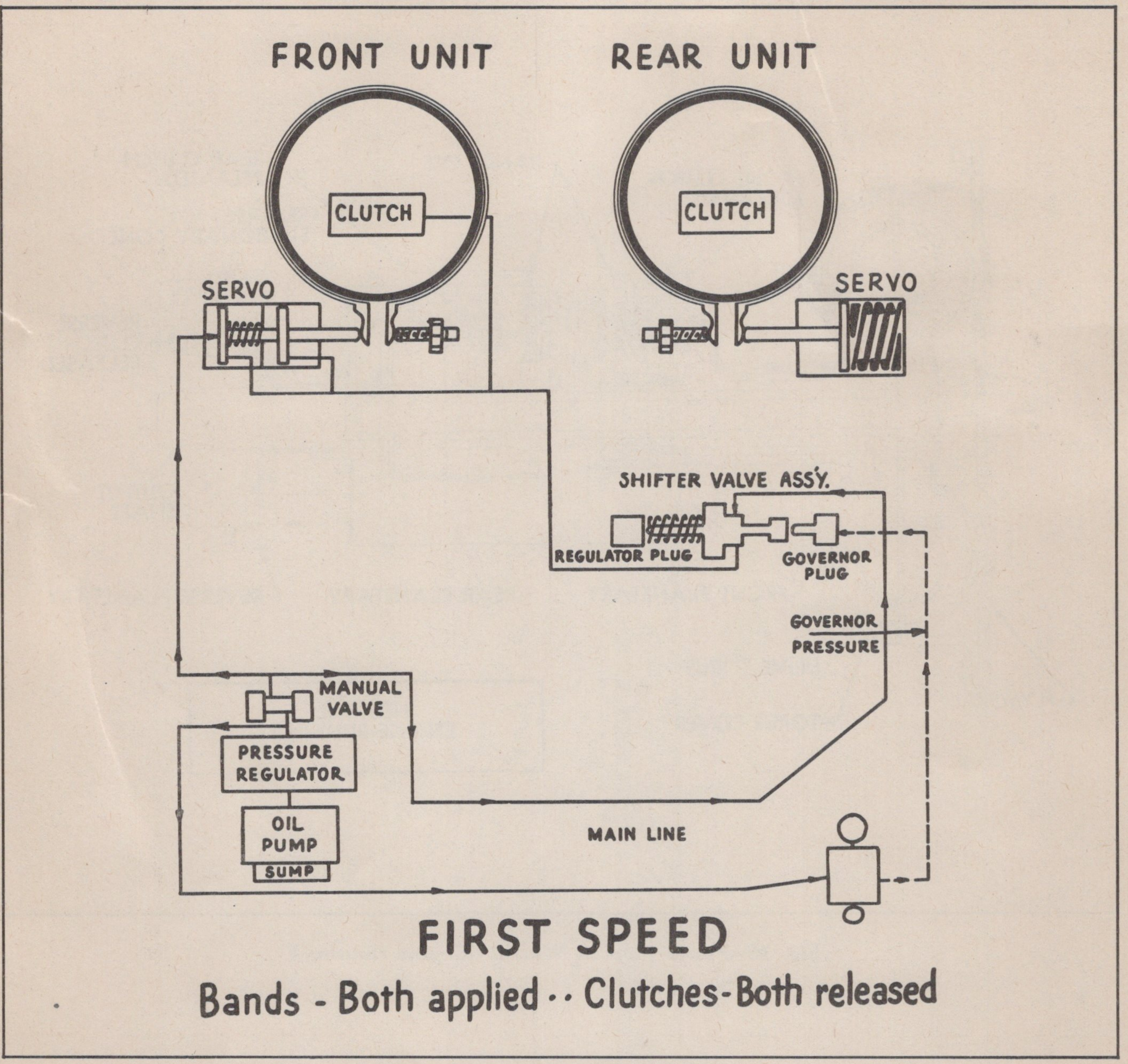


Fig. 39—Hydraulic Action in First Speed

FIRST SPEED

Hydraulic Action in First Speed

Placing the selector lever in Dr range positions the manual control valve for all forward speeds. It cuts off oil pressure to the rear unit servo, permitting the spring to apply the band, and at the same time directs oil pressure to the front unit servo, applying the front band. There is no oil pressure to the clutches. Oil is also directed to the shifter valves, but their position is such that the oil is blocked off from 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. Both units are in reduction, and the transmission is in first speed (Fig. 39).

SUMMARY: Front band on—front clutch released.
Rear band on—rear clutch released.

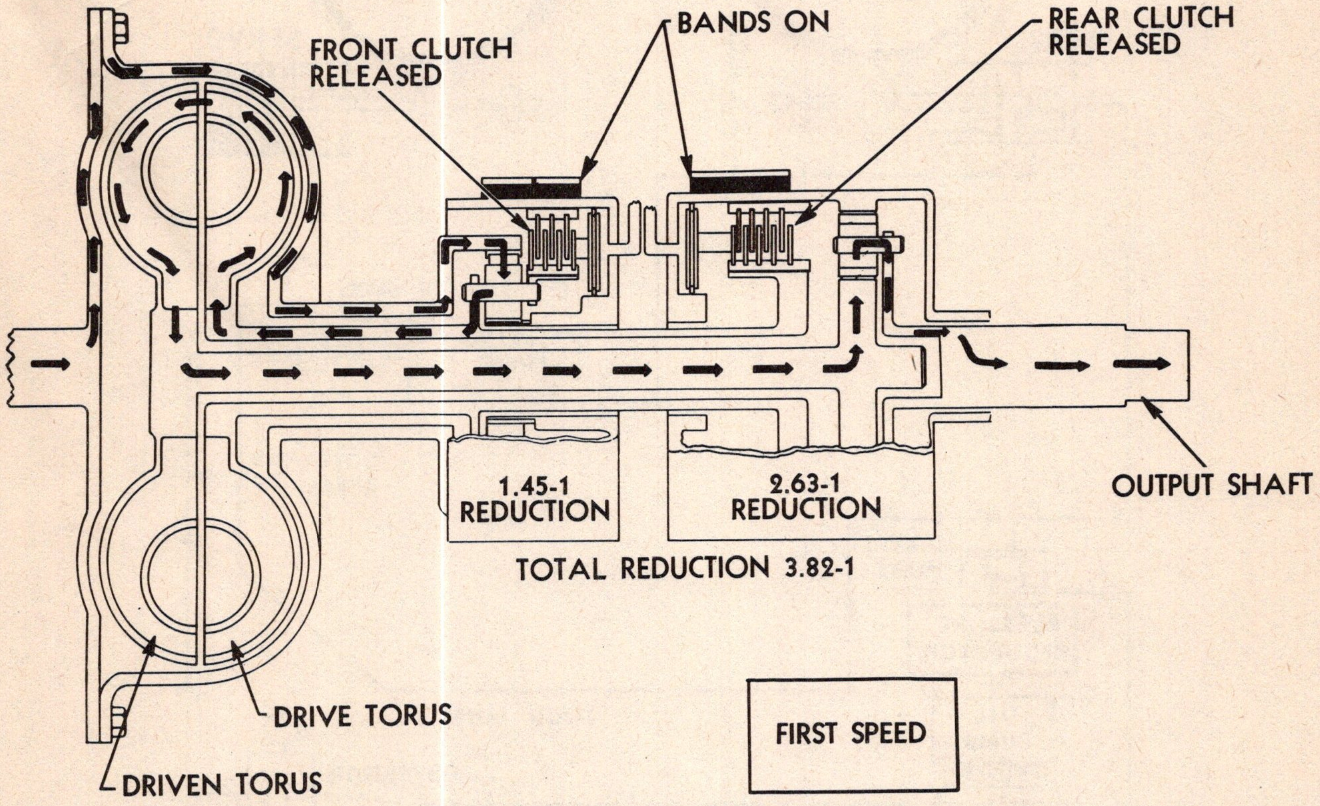


Fig. 40—Power Flow in First Speed

Power Flow in First Speed

When the vehicle starts to move, the path of power is through the flywheel to the torus cover and front drive gear (Fig. 40) to the front planet carrier. The front band is holding the front unit center gear, causing the planetary pinions to "walk around" the center gear, carrying the front planet carrier in the same direction as the internal gear but at reduced speed. Since the drive torus is connected to the front planet carrier it also turns at reduced speed. From the drive torus the power is transferred through fluid to the driven torus, then along the main shaft to the center gear of the rear planetary, then, through the planet pinions to the planet carrier on the output shaft in reduction because the internal gear of the rear unit is held stationary by the band.

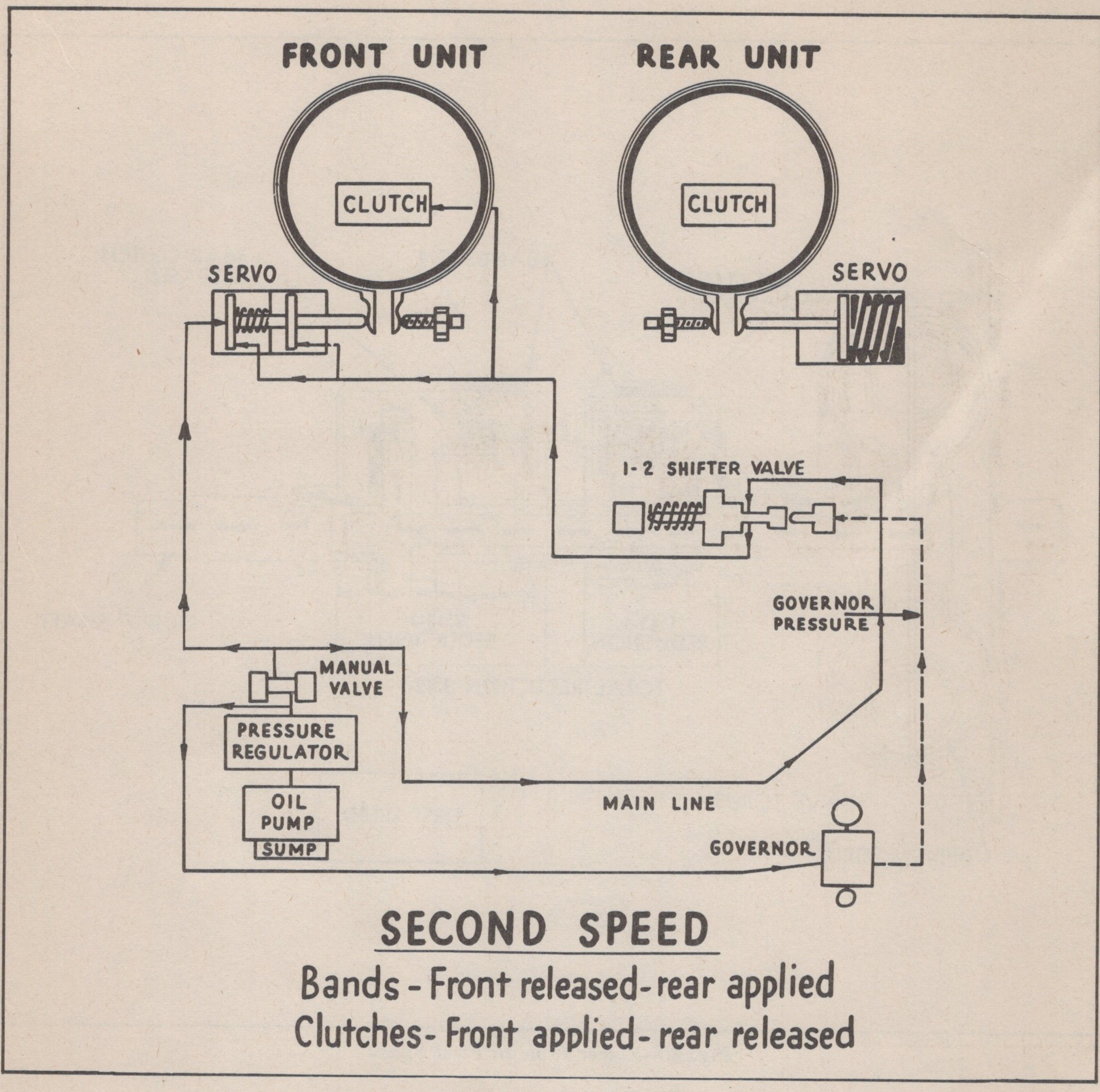


Fig. 41—Hydraulic Action in Second Speed

SECOND SPEED

Hydraulic Action in Second Speed

Governor pressure increases with vehicle speed to a point where it will overcome the 1-2 shifter valve spring and automatically open the valve. Oil is then directed to the front unit where it releases the band and applies the clutch. Application of the front unit clutch locks the planet carrier to the center gear and the front unit acts as a coupling. The drive torus is now revolving at the same speed as the flywheel. The rear unit meanwhile remains in reduction (Fig. 41).

SUMMARY: Front band released—front clutch applied.

Rear band applied—rear clutch released.

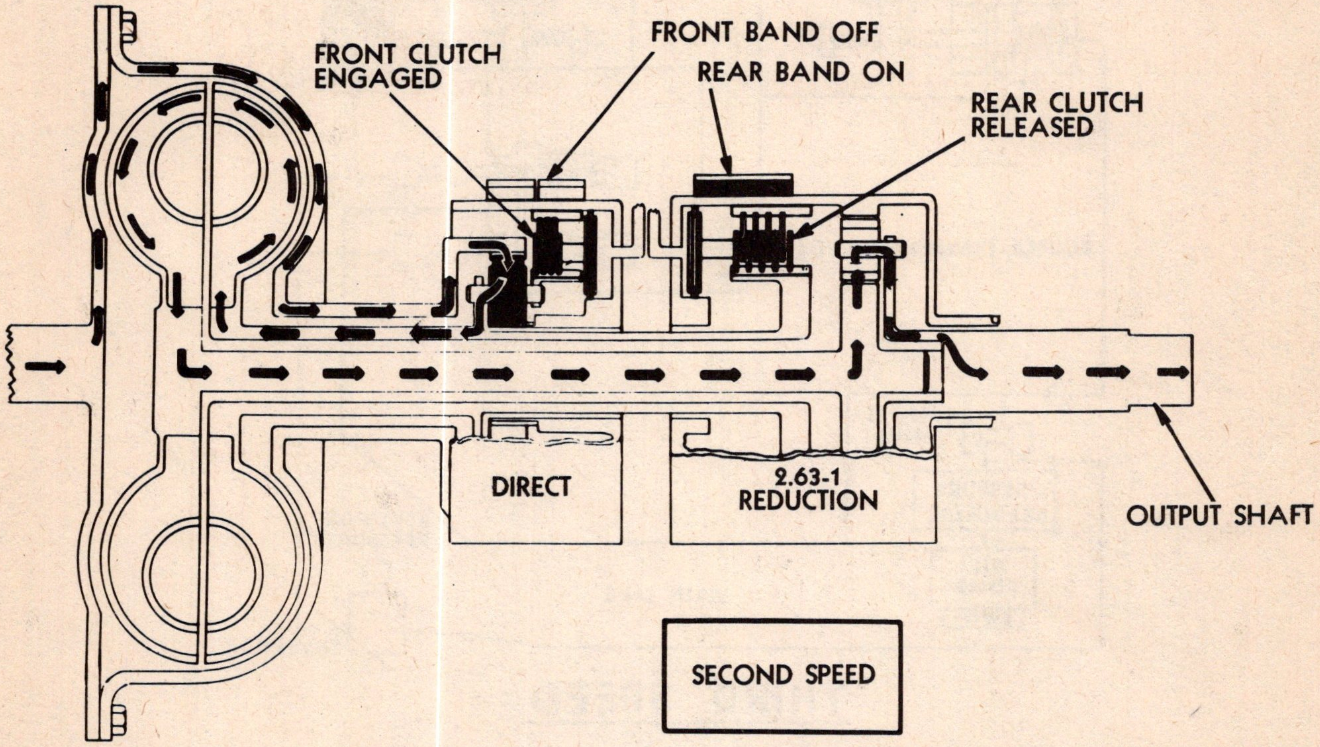


Fig. 42—Power Flow in Second Speed

Power Flow in Second Speed

Power travels from the flywheel to the torus cover, through the front planetary unit in direct drive, forward to and through the fluid coupling, then back along the main shaft through the rear planetary which is in reduction, to the output shaft (Fig. 42).

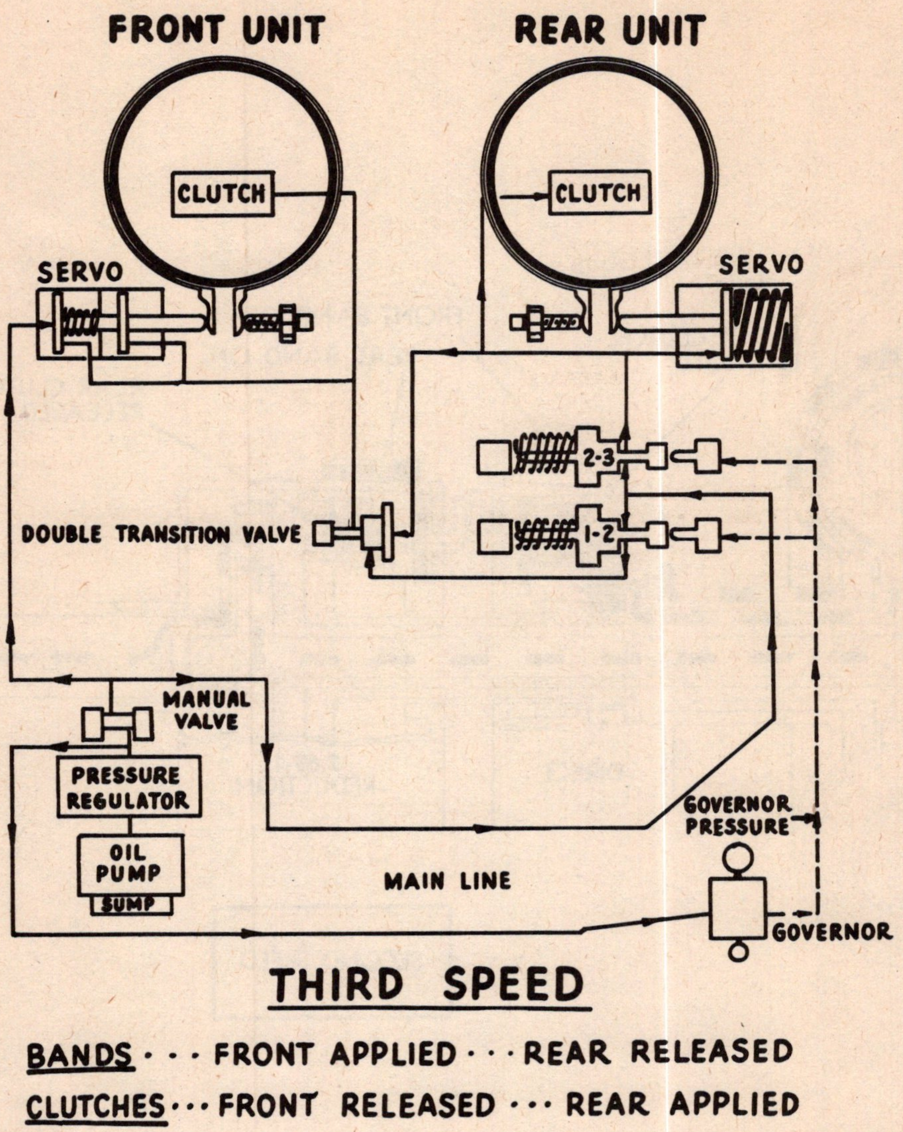


Fig. 43—Hydraulic Action in Third Speed

THIRD SPEED

Hydraulic Action in Third Speed

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

1. A 2-3 shifter 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 shifter 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 shifter 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 (Fig. 43).

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

SUMMARY: Front band applied—front clutch released.

Rear band released—rear clutch applied.

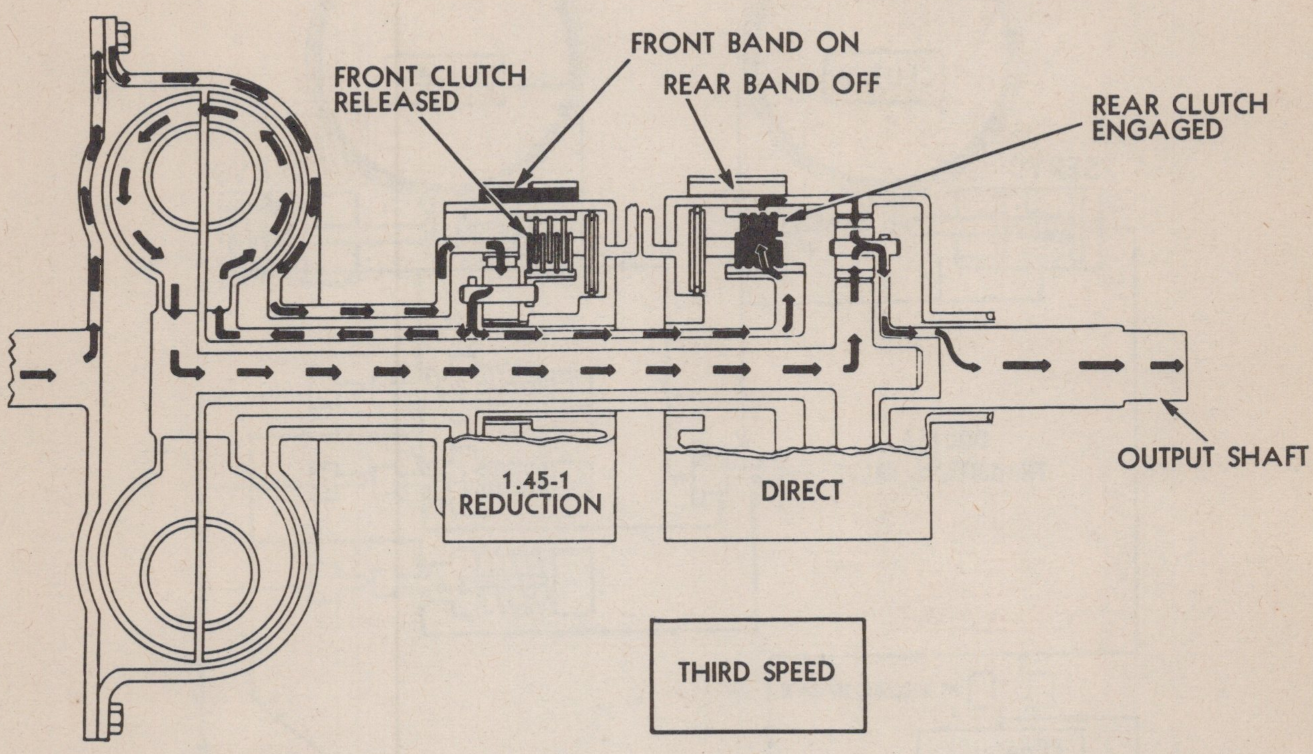


Fig. 44—Power Flow in Third Speed

Power Flow in Third Speed

Power travels from the flywheel to the torus cover, then through the front unit in reduction. But at the front planet carrier the power divides. Part of it travels forward, through the shaft of the front planet carrier, through the fluid coupling and back along the main shaft to the center gear and planet gears of the rear unit. The other part of the power travels back through the shaft of the front planet carrier, through the rear unit clutch to the internal gear where it is combined with the power from the fluid coupling at the center gear and planet pinion gears then passes to the output shaft (Fig. 44).

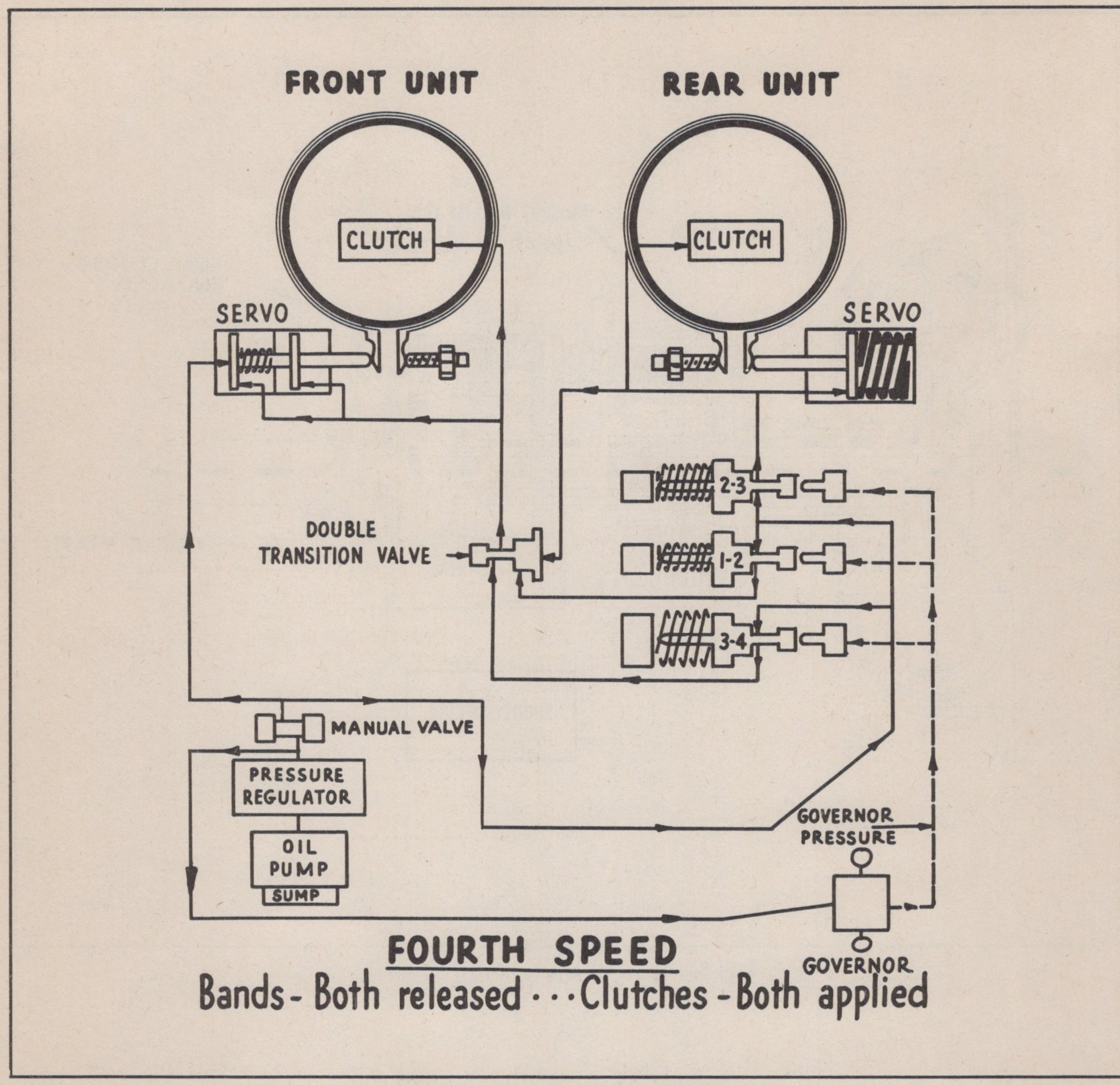


Fig. 45—Hydraulic Action in Fourth Speed

FOURTH SPEED

Hydraulic Action in Fourth Speed

A 3-4 shifter valve is added to obtain the shift into fourth speed. The 3-4 shifter 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 shifter 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 (Fig. 45).

SUMMARY: Front band released—front clutch applied.

Rear band released—rear clutch applied.

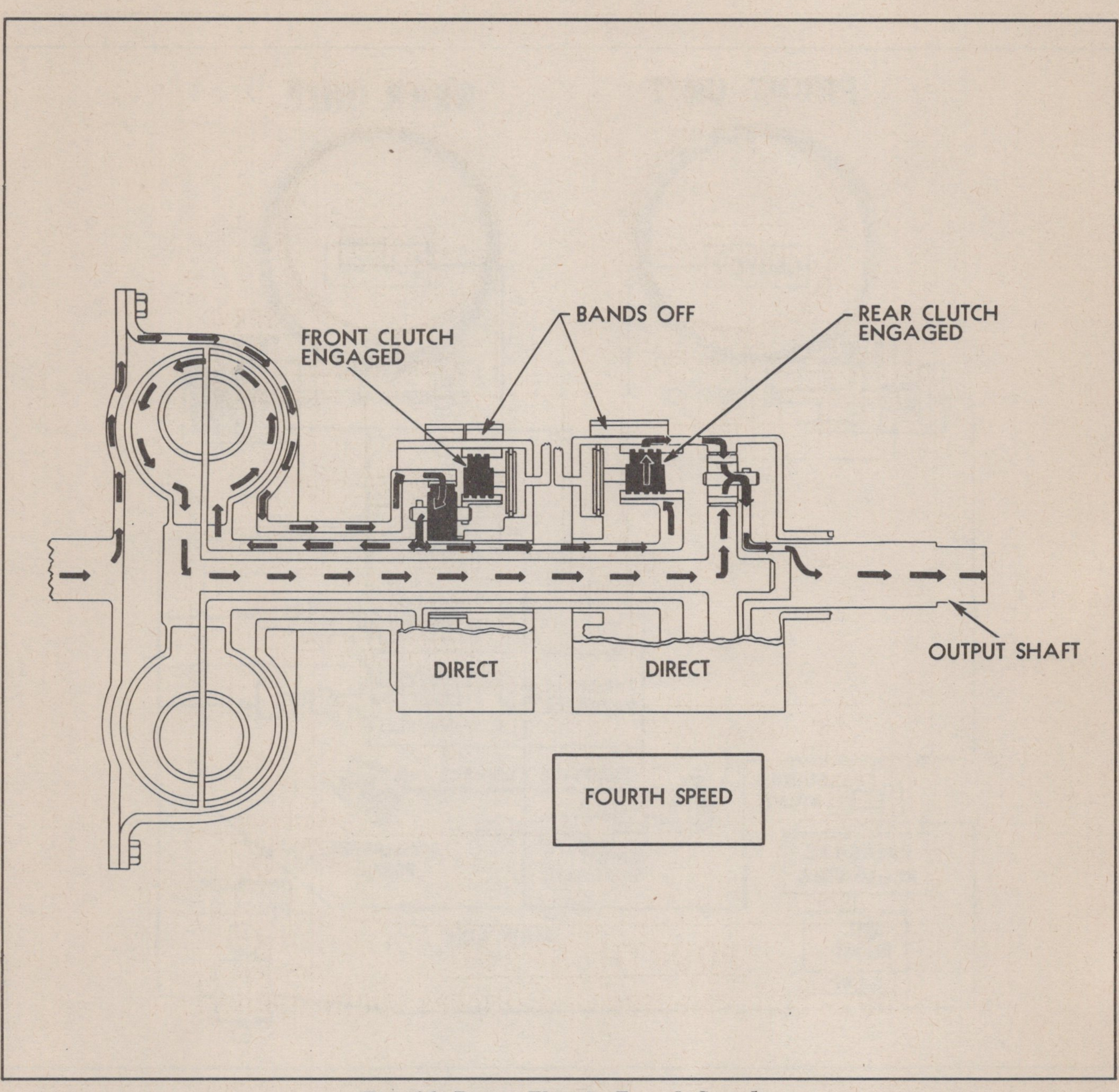


Fig. 46—Power Flow in Fourth Speed

Power Flow in Fourth Speed

The path of power is exactly the same as in third speed except that it passes through the front planetary in direct drive instead of reduction. The same division of power applies in fourth speed as in third. Thus the fluid coupling is relieved of excess strain which prevents it from slipping (Fig. 46).

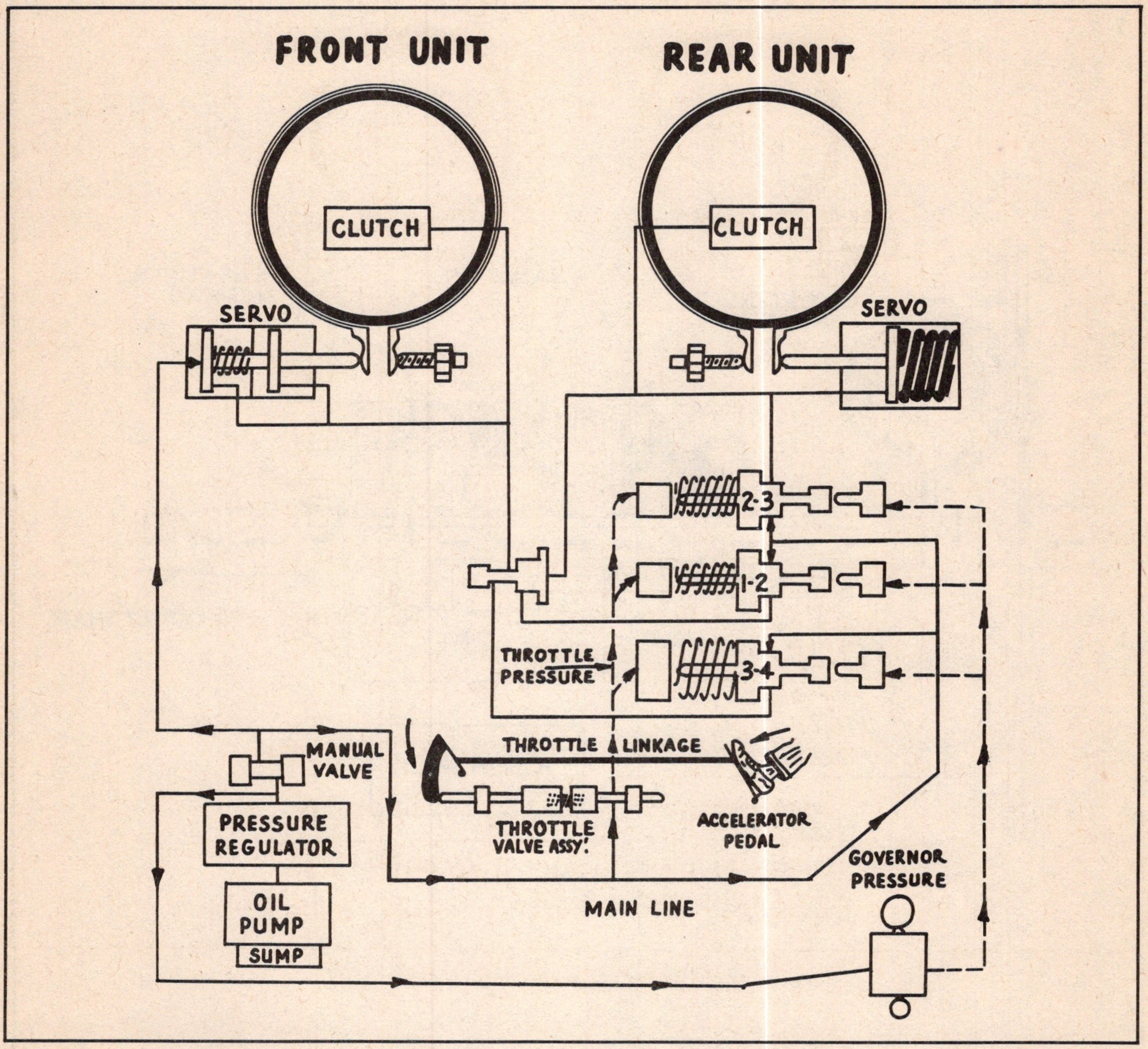


Fig. 47—Throttle Pressure to Delay Shifts

TIMING THE SHIFTS

With the shifter valves, valve springs, and governor described above, the shifts will always occur at the same vehicle speed. This arrangement is undesirable in a vehicle because many circumstances arise when shifts at higher or lower speeds are desirable. Examples of this are when rapid getaway is desired or when climbing a hill.

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 shifter valve spring pressure (Fig. 47). 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.

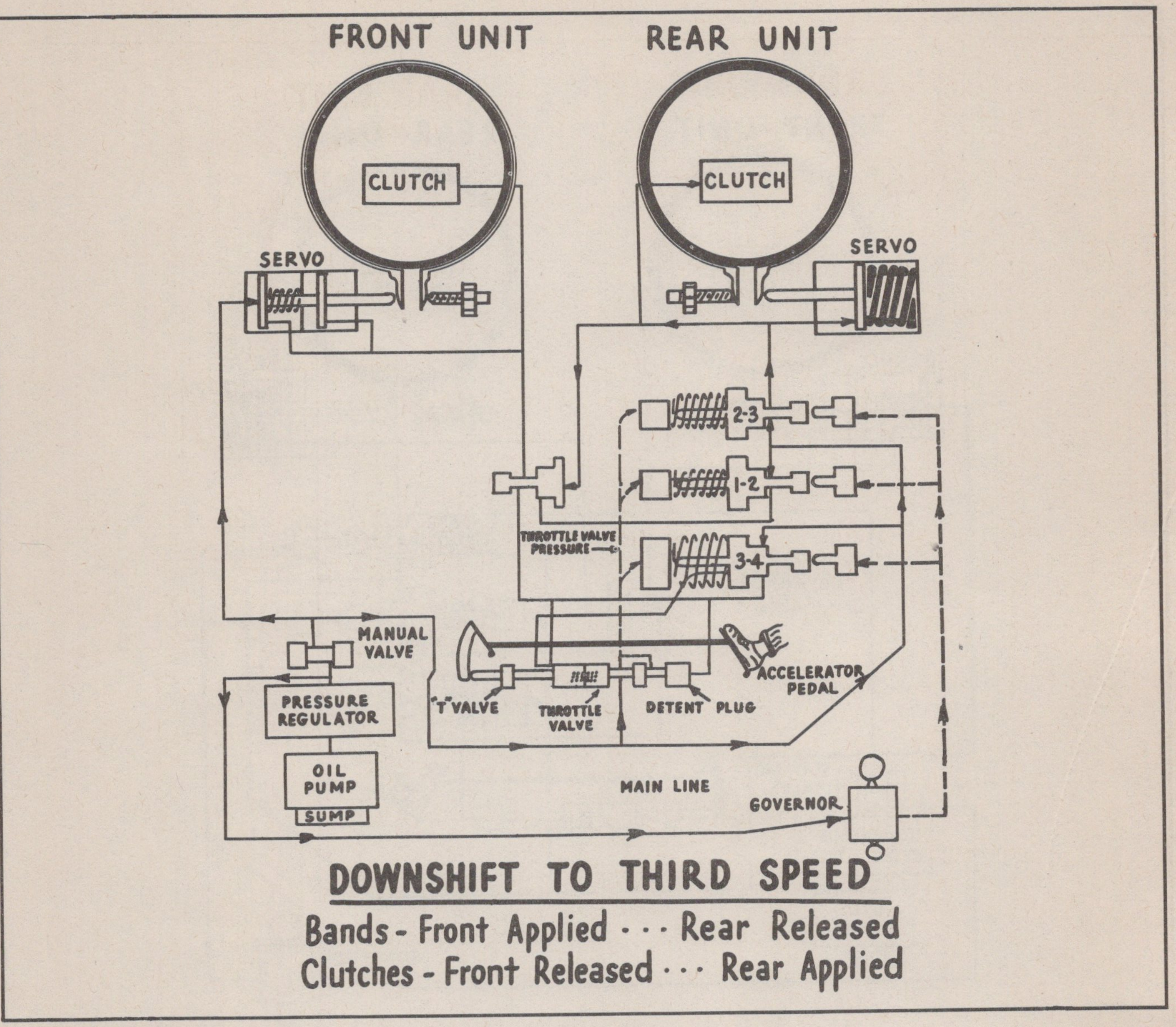


Fig. 48—Forced 4-3 Downshift

FORCED 4-3 DOWNSHIFT

It is sometimes desirable, while driving in fourth speed, to shift the transmission into third speed for rapid acceleration.

The 4-3 downshift is accomplished through the T valve (part of the throttle valve assembly) and a detent plug. The detent plug is located at the end of the throttle valve assembly (Fig. 48).

When the accelerator pedal is depressed to wide open throttle position the throttle valve comes into contact with the detent plug where resistance can be felt in the pedal. Depressing the pedal further will overcome this resistance and move the detent plug. The T valve then reaches a position where it opens a port directing main line pressure back of the 3-4 shifter valve, forcing it closed. This cuts off the pressure to the front unit clutch and it is disengaged by spring pressure. Pressure is also cut off from the release side of the front servo and pressure on the apply side of the servo applies the band. The transmission is then in third speed. The main line pressure which was directed behind the 3-4 shifter valve to force it closed, is cut off by the shifter valve as it closes. With accelerator pedal held fully depressed, however, throttle pressure with spring pressure is sufficient to hold the valve closed until a high vehicle speed is reached. If the accelerator pedal is released the shift from third to fourth will occur when governor pressure overcomes throttle and spring pressure.

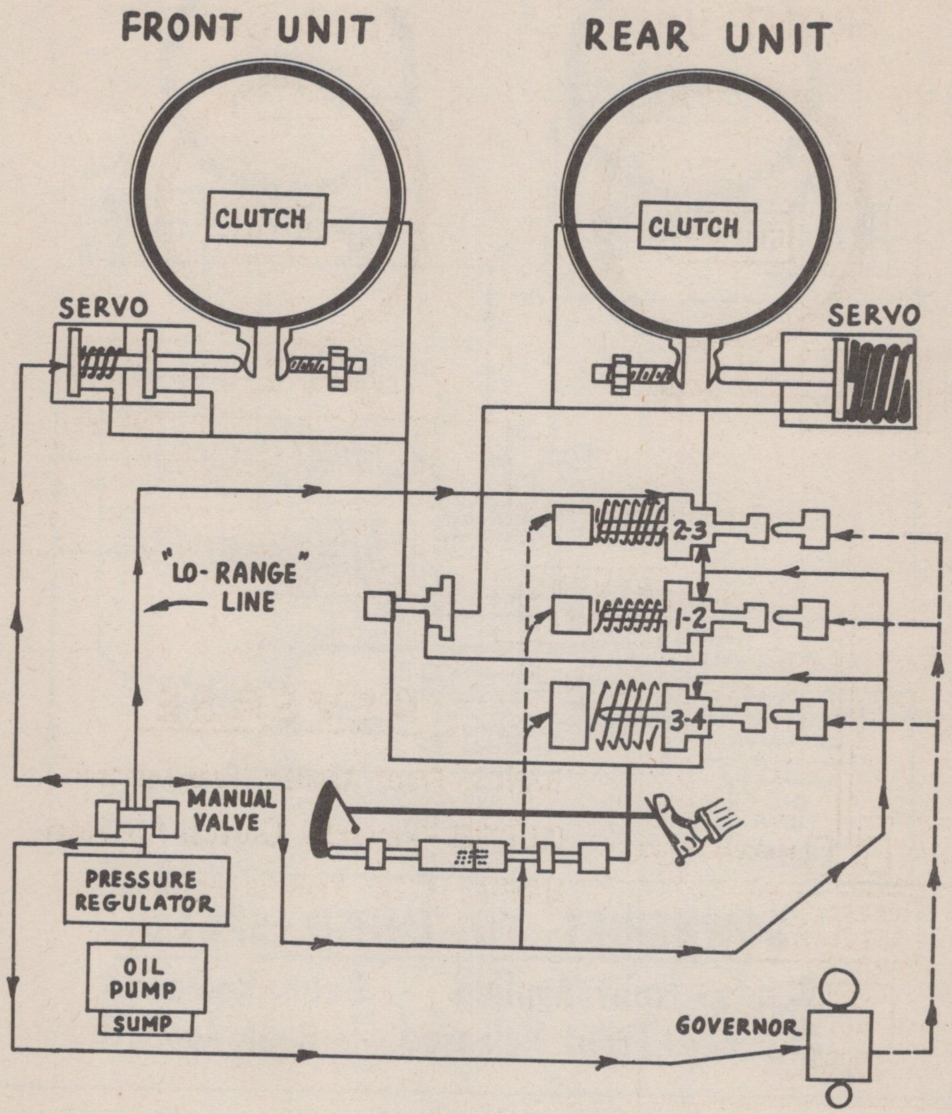


Fig. 49—Manual Lever in Lo Range

LO RANGE

When descending steep grades where maximum braking power of the engine is desired or when pulling through deep sand, or up steep grades it is desirable to keep the vehicle operating in first and second speeds regardless of vehicle speed.

This is accomplished by moving the manual valve to the Lo position which directs main line pressure back of the 2-3 shifter valve, locking it closed (Fig. 49).

***NOTE:* If the manual valve is moved from Dr to Lo position when vehicle is traveling at high speed the shift will not occur until speed decreases to where the gear reduction will not be detrimental to the engine.**

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

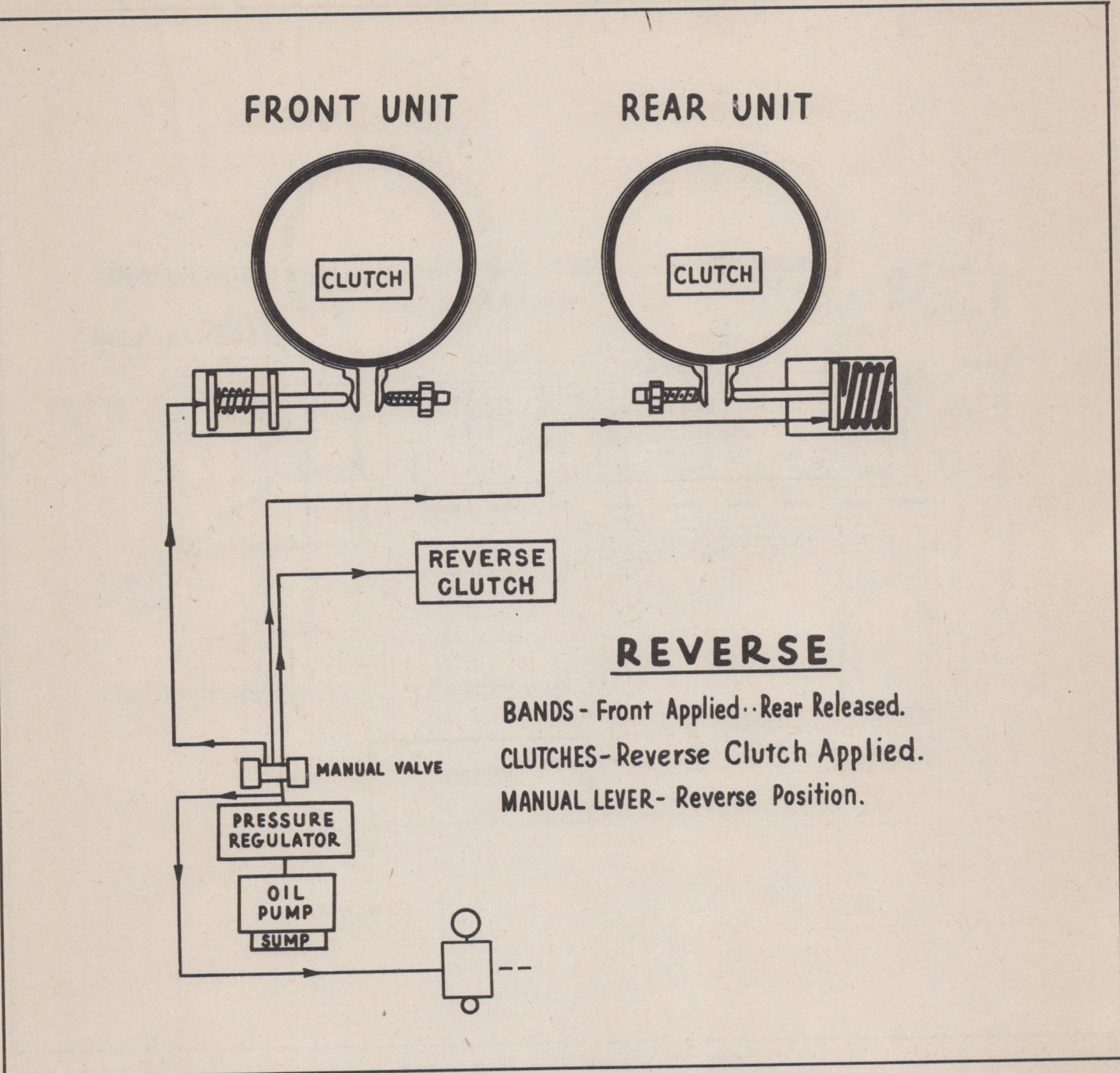


Fig. 50—Hydraulic Action in Reverse

REVERSE

When the control lever is moved to the R position the manual valve directs oil:

1. To the front servo to apply the band.
2. To the rear servo to release the band.
3. To the reverse clutch to hold the reverse internal gear.

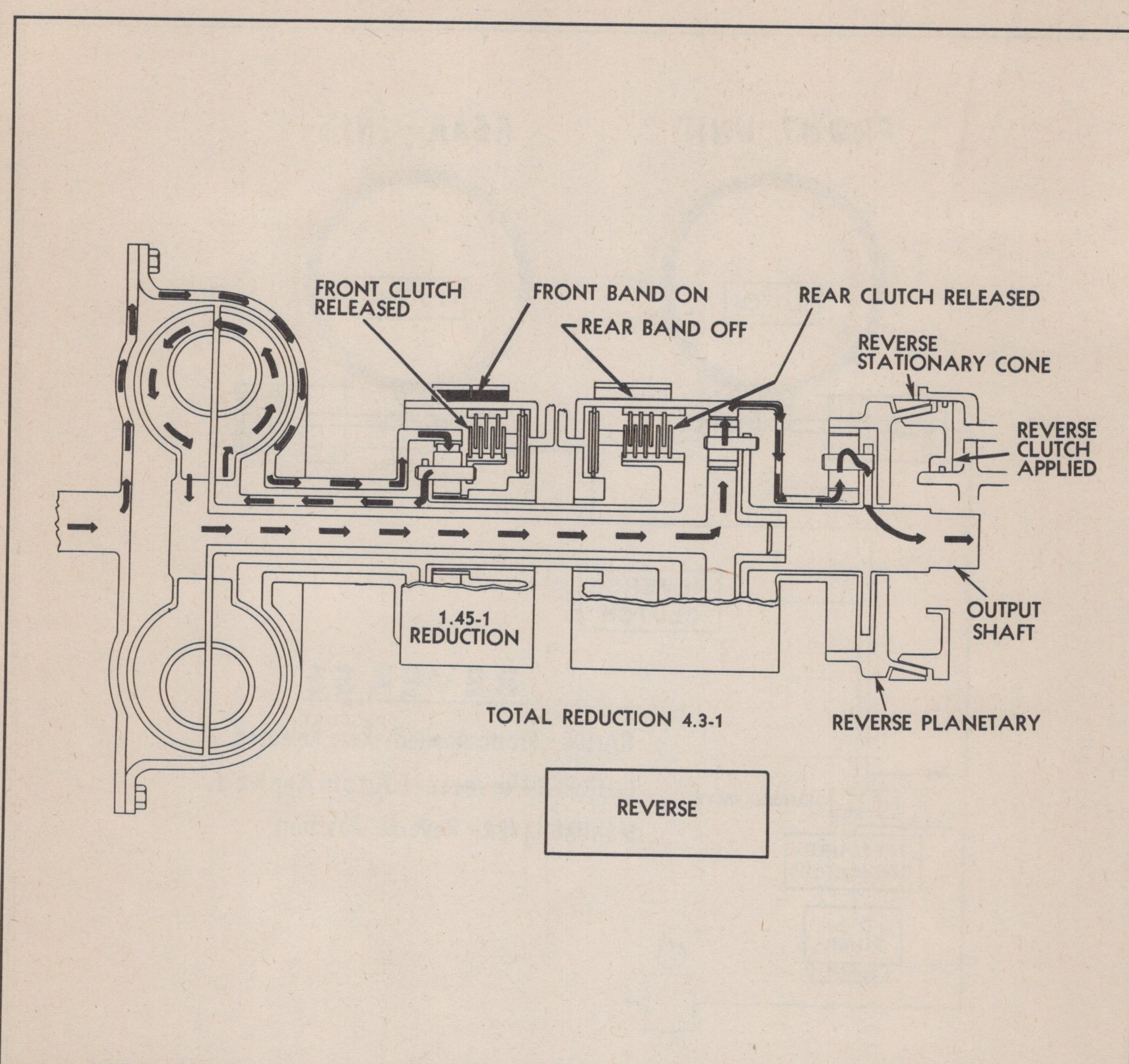


Fig. 51—Power Flow in Reverse

Power Flow in Reverse

Power travels from the flywheel and torus cover through the front planetary in reduction to the fluid coupling, then along the main shaft to the center gear of the rear planetary. The clutch and band of the rear planetary are released and the planet carrier is held by the propeller shaft. The planet pinion gears then act as idlers and the rear unit center gear turns the internal gear in the opposite direction. The internal gear through a flange, drives the center gear of the reverse unit in a reverse direction. Power then travels through the reverse planetary to the output shaft (which is also the planet carrier of the rear unit) in reduction because the internal gear is held by the reverse clutch (Fig. 51).

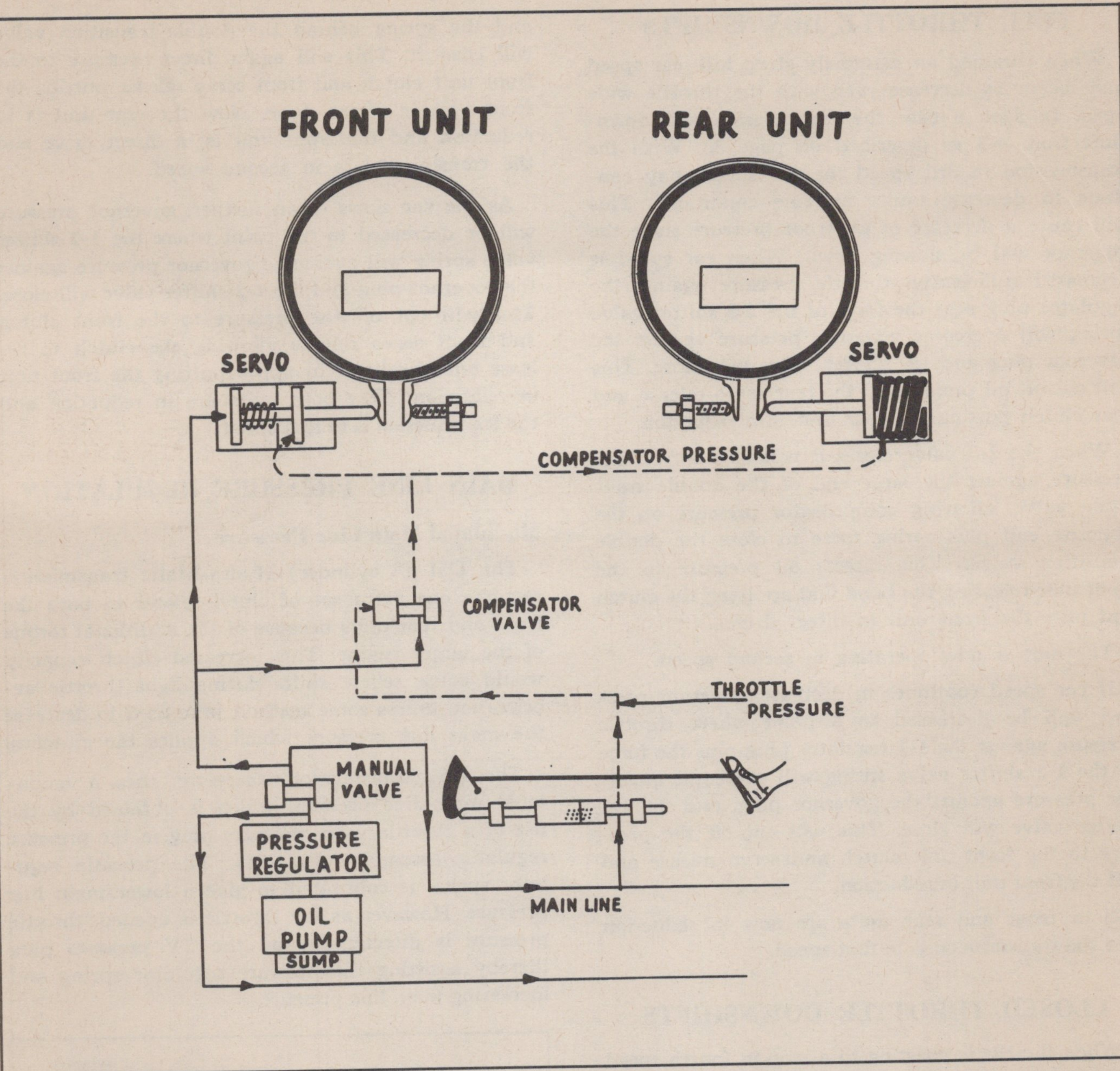


Fig. 52—Compensator Valve

COMPENSATOR PRESSURE

The increased torque developed 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 (Fig. 52).

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.

FULL THROTTLE DOWNSHIFTS

When climbing an extremely steep hill, car speed may begin to decrease even with the throttle wide open. In such a case the transmission will downshift from 4-3 as described on page 33. With the transmission in 3rd speed the car speed may continue to decrease under extreme conditions. This will cause a decrease in governor pressure since the governor will be slowing down. When car speed is decreased sufficiently, throttle pressure against the regulator plug plus the force of the 2-3 shifter valve spring will overcome governor pressure against the governor plug and the shifter valve will close. This will cut off oil pressure to the rear servo release and rear clutch putting the rear unit into reduction.

When the 2-3 valve closes it will also cut off the pressure against the large end of the double transition valve, allowing compensator pressure on the opposite end plus spring force to close the double transition valve. This directs oil pressure to the front unit releasing the band and applying the clutch and puts the front unit in direct drive.

The unit is now operating in second speed.

If car speed continues to decrease, governor pressure will be decreased to a point where throttle pressure against the 1-2 regulator plug plus the force of the 1-2 shifter valve spring will overcome governor pressure against the governor plug, and the 1-2 shifter valve will close. This will cut off the pressure to the front unit clutch and servo release and put the front unit in reduction.

Both front and rear units are now in reduction and the transmission is in first speed.

CLOSED THROTTLE DOWNSHIFTS

When the car is coasting to a stop in fourth speed with the throttle closed, governor pressure is gradually diminishing. At approximately 12 MPH governor pressure will be low enough to allow the shifter valve spring to close the 3-4 valve. When the 3-4 valve closes the pressure which has been applying the front clutch and releasing the front servo will be cut off allowing the front unit to go into reduction, putting the transmission in third speed.

As the car slows down further the governor pressure will be reduced to a point at which the 2-3 shifter valve spring will overcome governor-pressure and close the 2-3 shifter valve. This will cut off the pressure which has been applying the rear clutch and releasing the rear band, allowing that unit to go into reduction. At the same time line pressure will be cut off from the double transition valve and the spring behind the double transition valve will close it. This will again direct pressure to the front unit clutch and front servo release putting the front unit in direct drive. Now the rear unit is in reduction and the front unit is in direct drive and the transmission is in second speed.

As the car slows down further, governor pressure will be decreased to the point where the 1-2 shifter valve spring will overcome governor pressure against the governor plug and the 1-2 shifter valve will close. This will cut off the pressure to the front clutch and front servo release allowing the clutch to release and the band to apply putting the front unit in reduction. Now both units are in reduction and the transmission is in first speed.

MAIN LINE PRESSURE REGULATION

Modulated Main Line Pressure

The D51 (8 cylinder) Hydra-Matic transmission requires one extra set of clutch plates in both the front and rear units because of the additional torque of the larger engine. This increased clutch capacity would cause severe shifts during light throttle acceleration unless some method were used to decrease the main line pressure which applies the clutches.

The D51 transmission, therefore, uses a modulated main line pressure which is obtained by the use of a throttle valve pressure plug in the pressure regulator assembly (Fig. 53). The pressure regulator spring is calibrated to give a lower main line pressure. However as the throttle is opened, throttle pressure is directed behind the TV pressure plug thereby assisting the pressure regulator spring and increasing main line pressure.

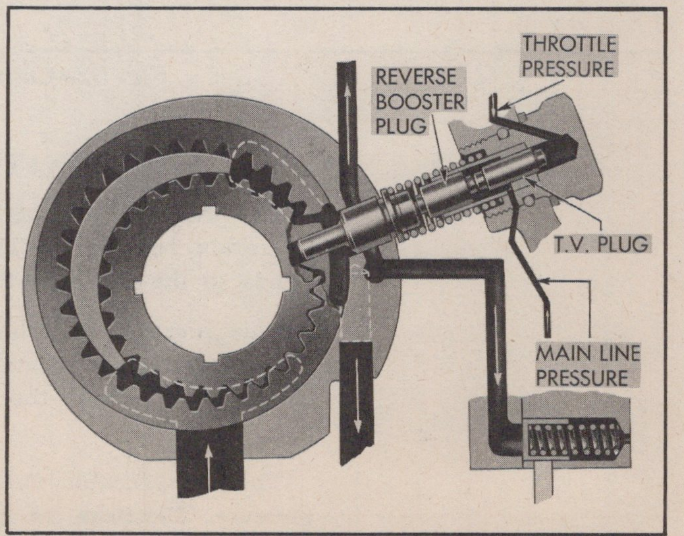


Fig. 53—Schematic View of Front Pump and Pressure Regulator (D51 Transmission)

Thus during light throttle acceleration the main line pressure is regulated almost entirely by the regulator spring, resulting in a mild, low pressure action of the clutches giving a smooth shift. During heavy throttle acceleration, increased throttle pressure against the TV plug assists the regulator spring causing main line pressure to increase thereby preventing the clutches from slipping.

Reverse Booster Pressure

Because of the new friction reverse assembly, it is necessary to raise main line pressure considerably in order to obtain the proper force to prevent the reverse cone from slipping. This increase in main line pressure is obtained in much the same manner as modulated main line pressure is obtained. When the transmission is shifted into reverse, main line pressure is directed behind the reverse booster plug in the pressure regulator (Fig. 53). Because main line pressure is used as the booster pressure and a large diameter booster plug is used, the resulting line pressure in reverse will be approximately double the normal main line pressure.

FRONT SERVO EXHAUST VALVE

The purpose of the front servo exhaust valve is to allow for instantaneous exhausting of the front servo apply oil while the reverse clutch is engaging. This momentarily sets the transmission in neutral so that the reverse cone can be applied without excessive torque tending to wear the stationary cone or reverse piston. As soon as the reverse clutch is fully engaged, the front servo exhaust valve recedes allowing the front servo to apply the band for operation in reverse.

In Figure 54, the front servo exhaust valve is in the closed or normal position (lever in N, Dr, or Lo). The manual valve keeps it in the inoperative position until the selector lever is placed in the reverse position.

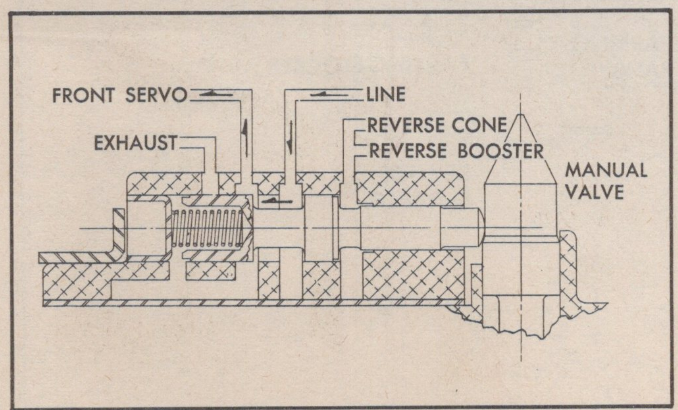


Fig. 54—Front Servo Exhaust Valve—Selector Lever in Lo

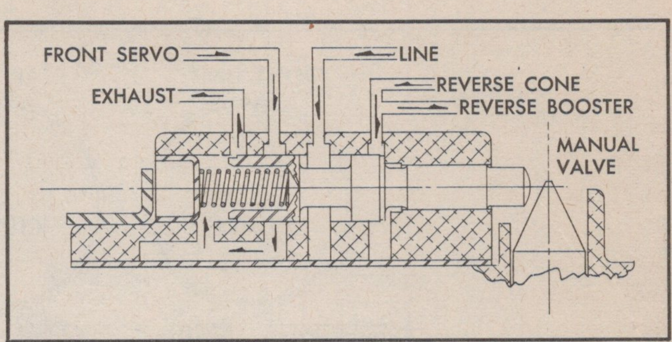


Fig. 55—Front Servo Exhaust Valve—Immediately After Shift to Reverse

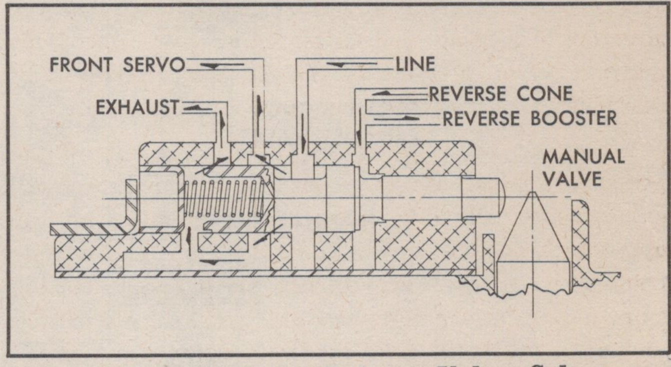


Fig. 56—Front Servo Exhaust Valve—Selector Lever in R

When the selector lever is placed in the reverse position (Fig. 55), the release spring opens the valve, shuts off line pressure and allows the front servo apply oil to exhaust.

Simultaneously, the manual valve directs oil to the reverse clutch, the reverse booster plug in the pressure regulator, and the release side of the front servo exhaust valve. The oil to the reverse booster valve causes a greater force to be applied behind the pressure regulator plug. Resulting line pressure will be approximately 180 PSI. As the reverse clutch line pressure builds up, the servo exhaust valve moves back and forth regulating the front servo apply pressure to approximately 50% of the reverse line pressure (Fig. 56).

OPERATION OF PARKING BLOCKER PISTON AND REVERSE BLOCKER PISTON

Reverse Blocker Piston

While the car is moving forward at speeds above 8-10 miles per hour, governor pressure is directed behind the reverse blocker piston (Figs. 57a and 58). This prohibits the shift lever from being moved to the reverse position. When the car has been slowed to a speed below 8-10 miles per hour the blocker piston return spring overcomes the reverse blocker

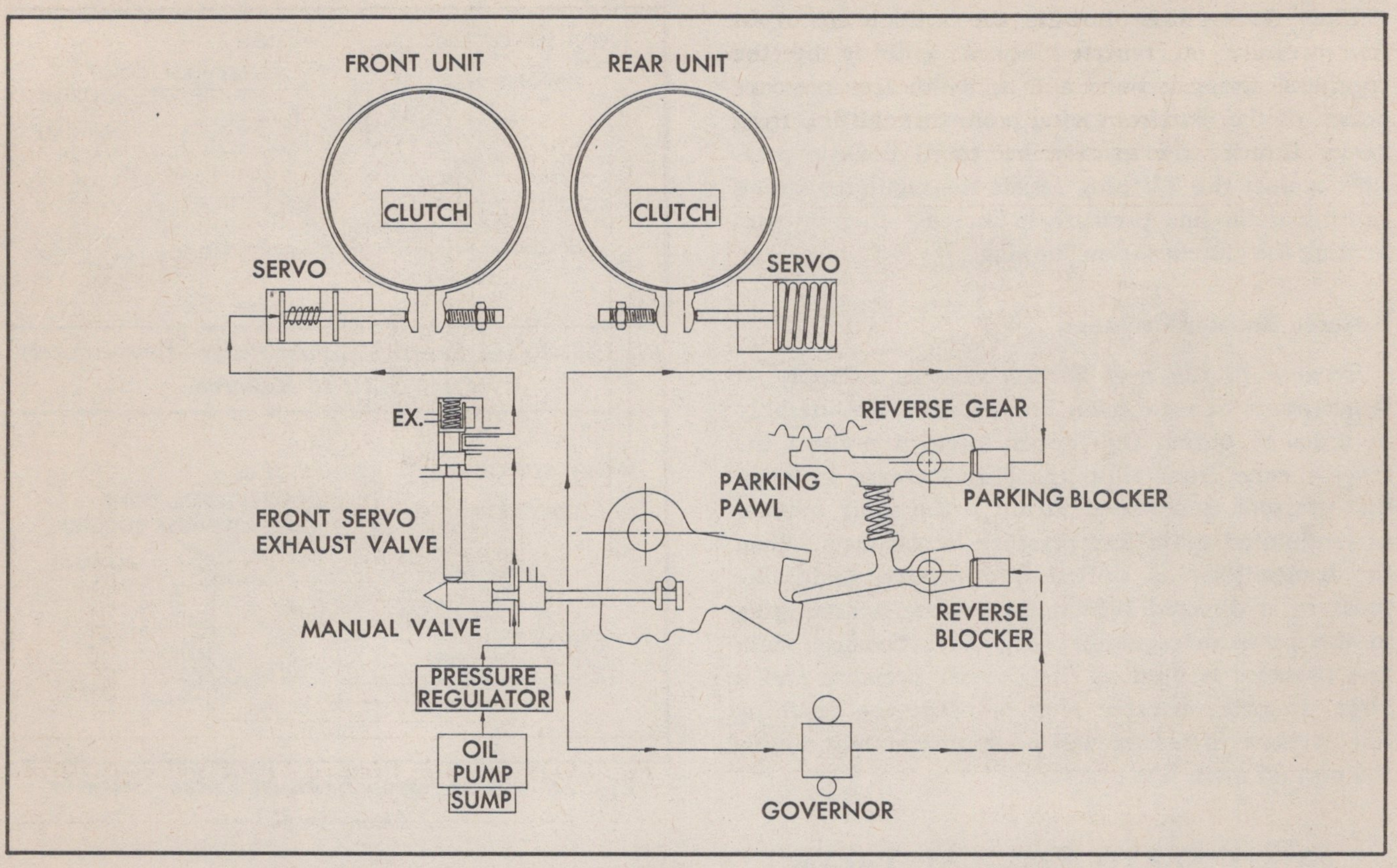


Fig. 57a—Action of Blocker Pistons (at speeds above 8-10 MPH)

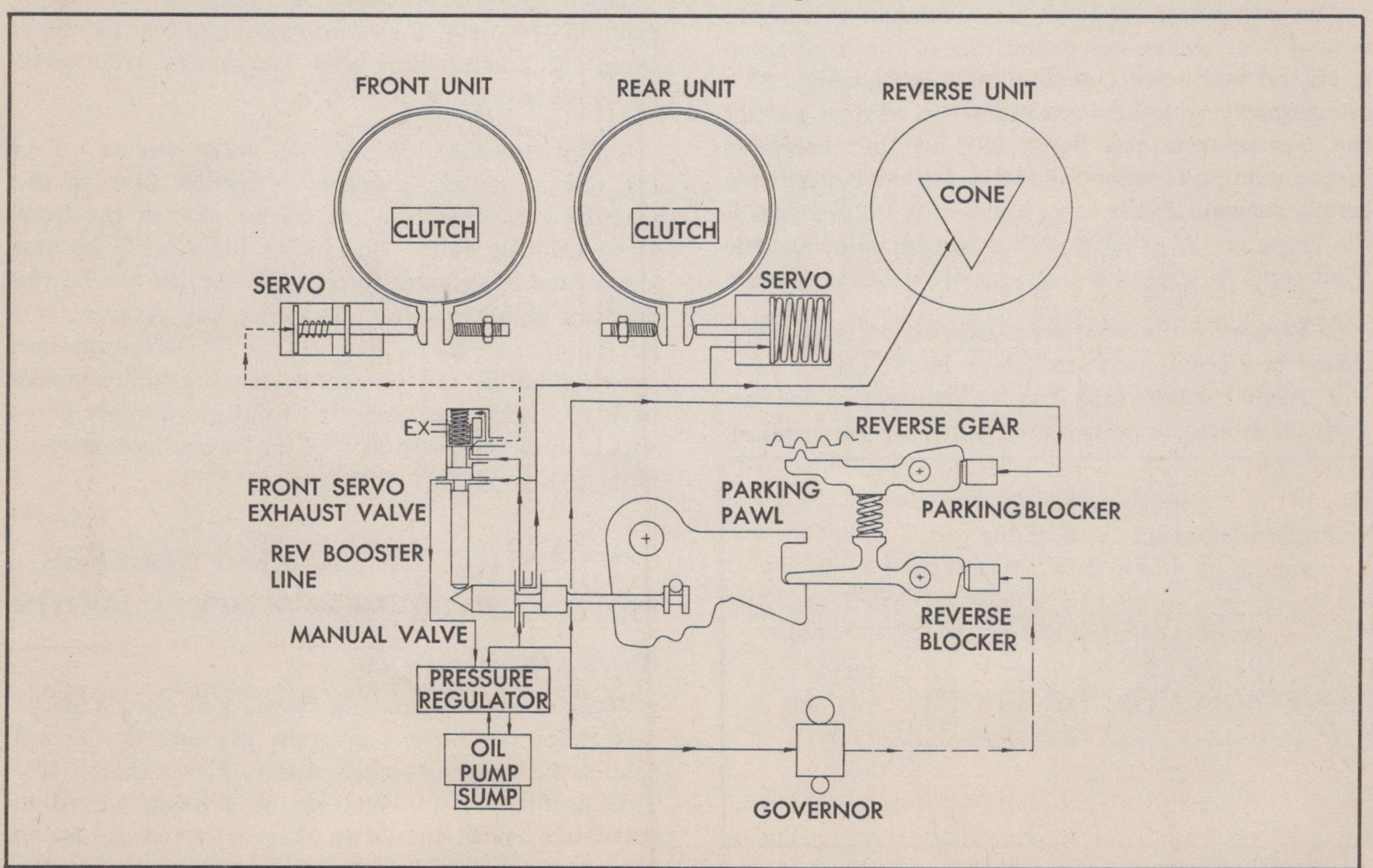


Fig. 57b—Action of Blocker Pistons (Engine running, car speed below 8-10 MPH)

piston oil pressure allowing the shift lever to be moved easily into reverse (Fig. 57b). Oil is directed to release the rear band and apply the reverse cone clutch. Oil to the front servo goes through the front servo exhaust valve as described on page 39.

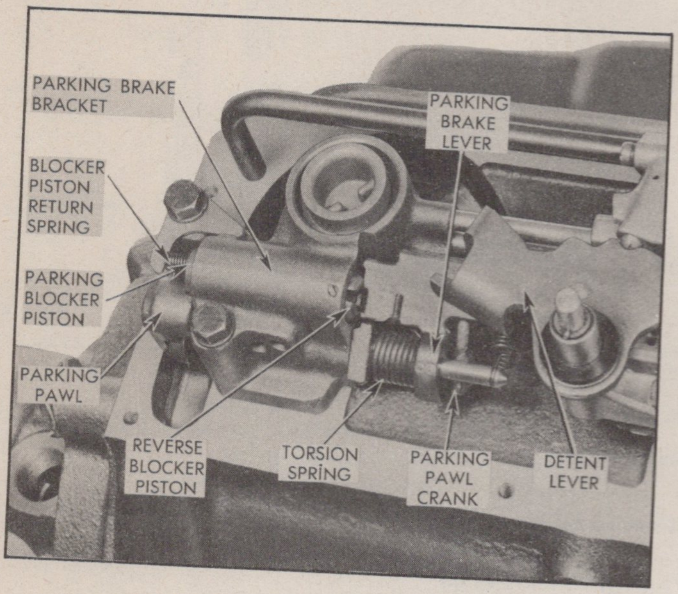


Fig. 58—Parking Brake Bracket Assembly (Blocker pistons in lockout position)

Parking Blocker Piston

As the detent lever on the valve body rotates into the reverse position, it engages and turns the parking brake lever. This lever sets the parking brake lever spring in tension against the parking brake pawl crank.

As long as the engine is running or the vehicle is rolling forward at a speed of approximately 4 MPH or more, the parking blocker piston (actuated by line pressure) will prevent the parking pawl from engaging the reverse internal gear.

The parking pawl crank is energized by a torsion spring at all times when shift lever is in reverse. When the engine is turned off and the vehicle stops rolling, oil pressure back of the parking blocker piston is reduced, and eventually is overcome by blocker piston release spring. Parking pawl will then complete engagement with teeth on reverse internal gear.

OPERATION OF FRONT SERVO

Neutral

When the control level is in N position there is no oil pressure to the servo and the retracting spring holds the servo apply piston in the released position (Fig. 59).

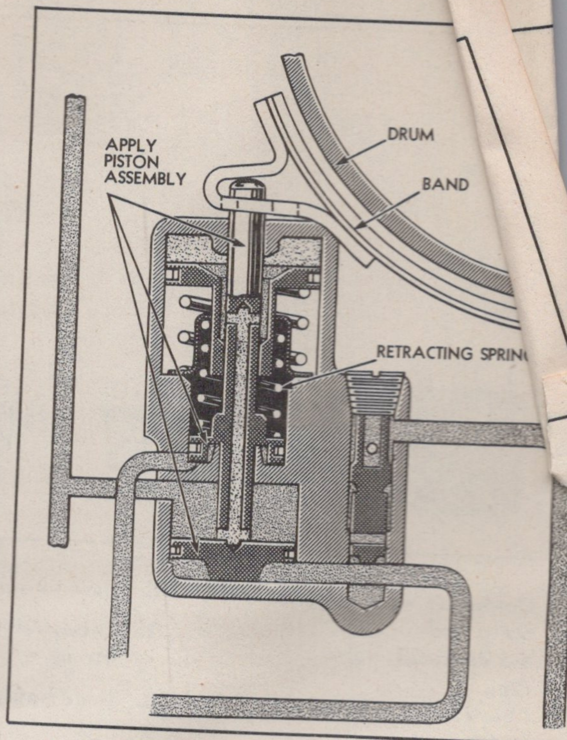


Fig. 59—Schematic View of Front Servo—Neutra

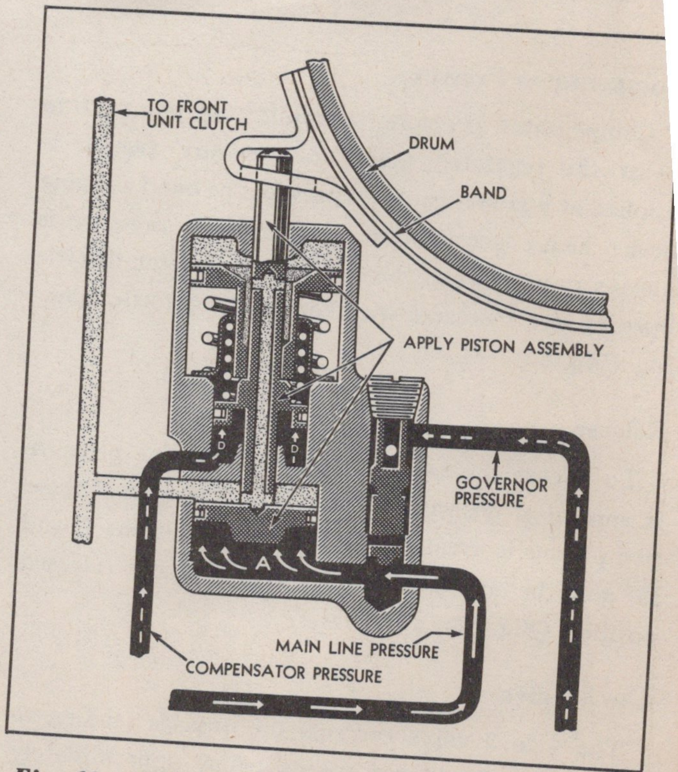
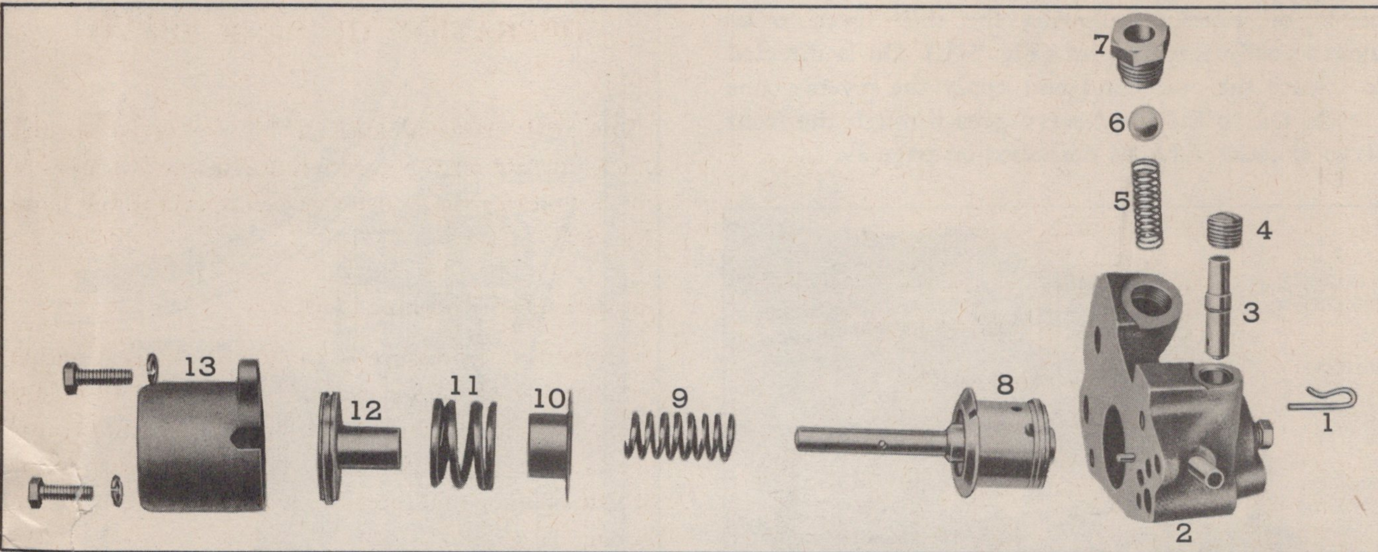


Fig. 60—Schematic View of Front Servo—Applied

Apply

With the control lever in Dr, Lo or R position regulated main line pressure is directed to piston area A to move the piston and stem and apply the band (Fig. 60).



1. Downshift valve retainer
2. Servo body
3. 4-3 downshift valve
4. Plug
5. Check valve spring
6. Rear pump ball check valve
7. Check valve seat and oil pipe fitting
8. Band apply piston assembly
9. Retracting spring
10. Retracting spring retainer
11. Booster spring
12. Band release piston
13. Release cylinder

Fig. 61—Exploded View of Front Servo

Compensator Pressure

Compensator pressure is applied at point D to assist the regulated main line pressure (which is applied at piston area A) to prevent the band slipping under heavy acceleration. Compensator pressure is always present when there is any carburetor throttle opening and increases with carburetor throttle opening (Fig. 60).

Release

To release the band, regulated main line pressure is applied at piston areas B and C. The area of these two pistons is greater than the area of pistons A and D, and the apply piston is moved to the released position (Fig. 62).

4 to 3 Valve

The 4 to 3 valve controls the passage leading to piston area A. At car speeds below approximately 25 miles per hour regulated main line pressure under the 4-3 valve keeps the valve in a position so the entire passage leading to point A is open (Fig. 63).

At car speeds above approximately 25 miles per hour governor pressure on the top of the 4-3 valve is great enough to move the valve to restrict the oil flow which delays front band application and permits the necessary engine speed increase before the front unit goes into reduction during the 4-3 downshift. This same condition exists on full throttle 2-3 upshifts.

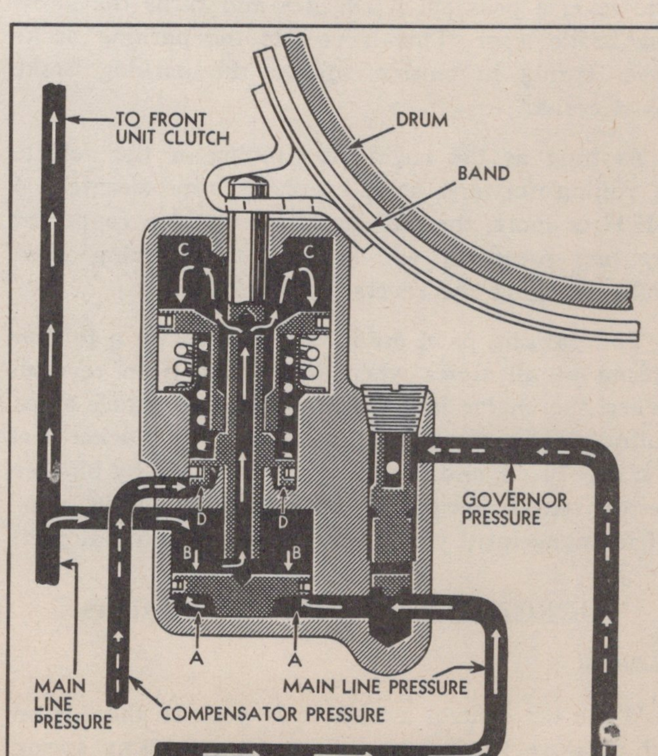


Fig. 62—Schematic View of Front Servo—Released

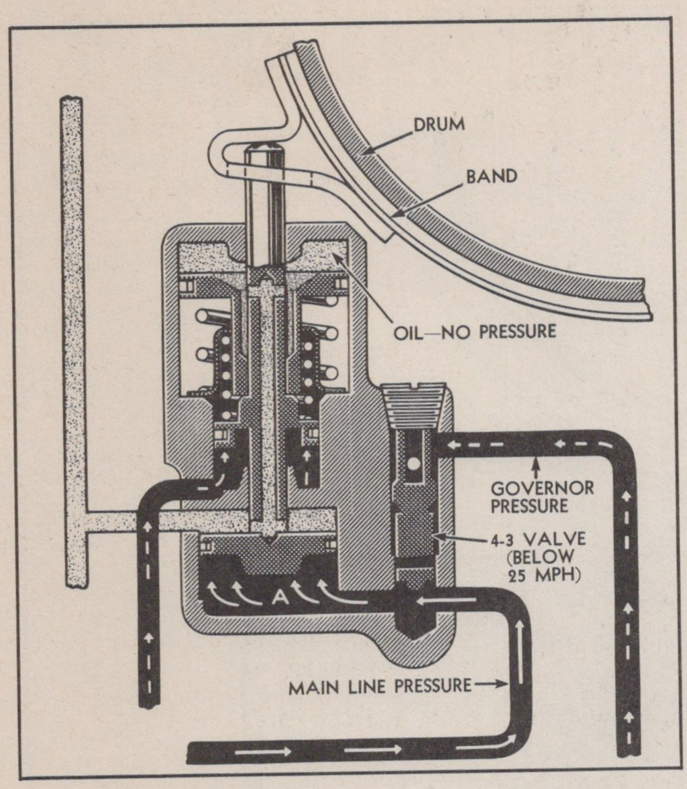


Fig. 63—Schematic View of Front Servo—4-3 Valve

OPERATION OF REAR SERVO

Apply

The rear servo is applied by the servo springs which operate on the accumulator piston the stem of which contacts the booster piston applying the band (Fig. 64).

Compensator Pressure

Compensator pressure is applied at points A and B to assist the servo springs and to prevent the band slipping under rapid acceleration. Compensator pressure is always present when there is any carburetor throttle opening and increases with carburetor throttle opening (Fig. 64).

Release

Regulated main line pressure is applied at points C and D to release the band. The force applied at these two areas is greater than the force of the servo springs and the compensator pressure and the servo pistons are moved to the released position (Fig. 65).

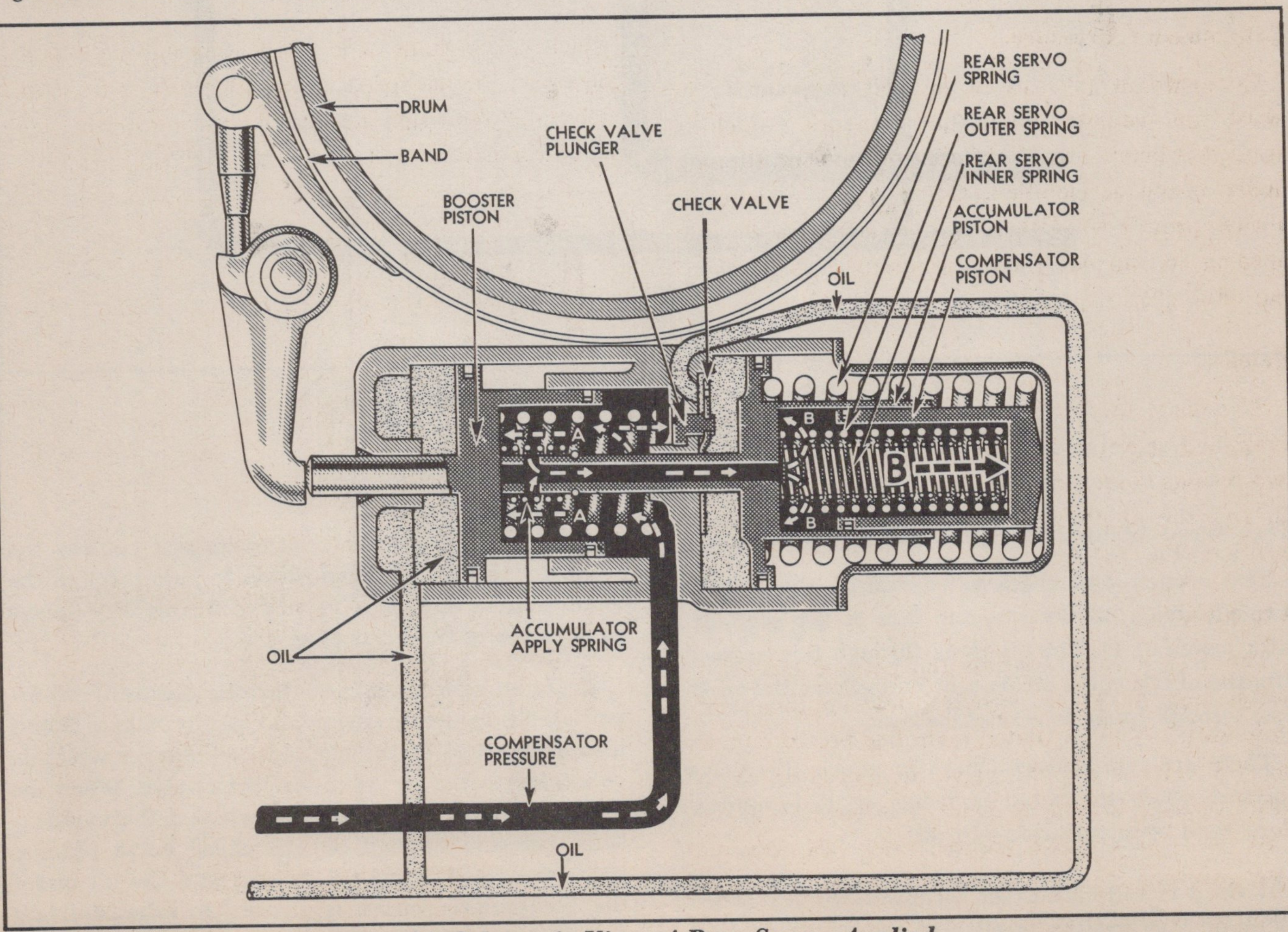


Fig. 64—Schematic View of Rear Servo—Applied

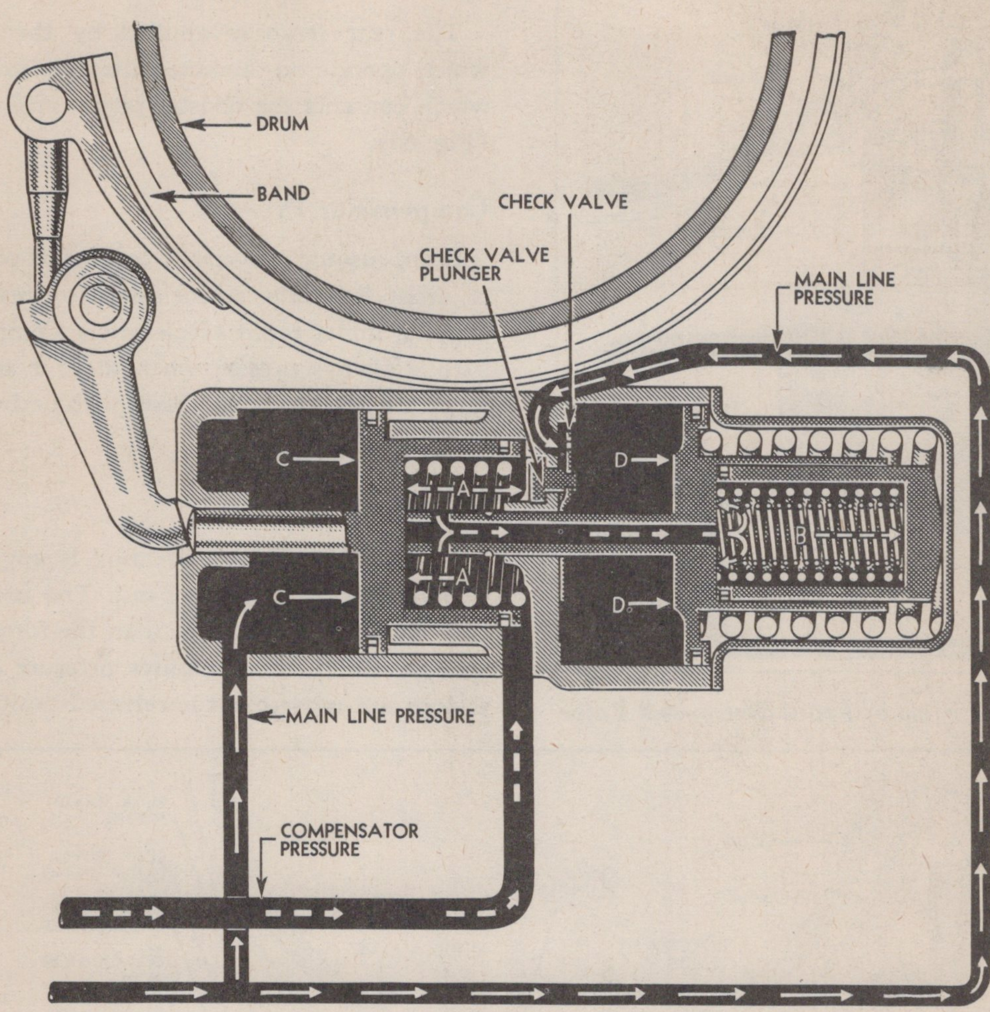


Fig. 65—Schematic View of Rear Servo—Released

Rear Servo Accumulator Check Valve and Plunger

This accumulator check valve controls the passage through which oil flows to the face of the accumulator piston at D. The oil going through this passage lifts the check valve off its seat and allows the oil to flow through freely to release the band.

There are two different ways in which this valve operates when the servo is being applied, namely closed and open carburetor throttle.

1. On a closed carburetor throttle downshift when the main line pressure applied at point D is released the check valve then returns to its seat causing the oil under the accumulator piston to pass through the small hole in the check valve and in this way delays application of the band (Fig. 65).

2. On an open carburetor throttle downshift, compensator pressure is effective at points A and B and also on the end of the check valve plunger which is connected to the accumulator check valve. When the pressure applied at point D is released the compensator pressure applied on the check valve plunger holds the check valve off its seat and the oil under the accumulator piston is allowed to exhaust freely for a rapid application of the band (Fig. 65).

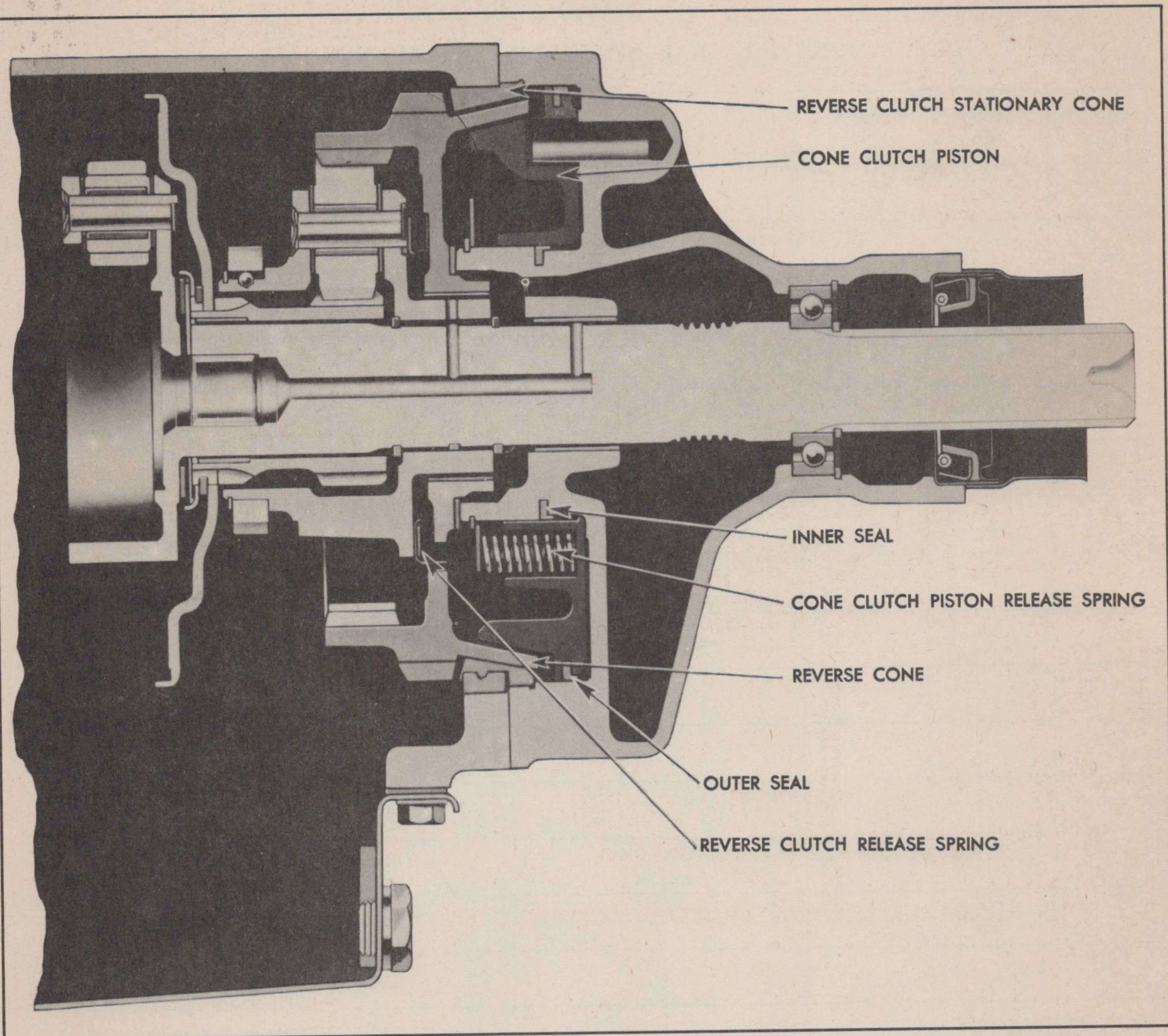


Fig. 66—Reverse Assembly Construction

OPERATION OF REVERSE CONE CLUTCH

When the selector lever is moved to the reverse position, oil is directed from the valve body through the reverse clutch oil pipe, through the case, and then into the reverse assembly. Oil is retained in the reverse assembly with two seals; an inner seal on the rear bearing retainer and an outer seal on the cone clutch piston. (See Fig. 66.) While under pressure, oil pushes the cone clutch piston forward engaging the internal surface of the reverse cone. This action forces the entire reverse cone forward causing the outside surface of the reverse cone to contact the stationary cone, thereby holding the reverse internal gear by friction.

When selector lever is moved to any other position, the cone clutch piston releases. When pressure is cut off, the six cone clutch piston release springs disengage the piston. When the reverse clutch piston is applied, there is some float in the reverse internal gear. To get release, the reverse internal gear must be centralized. This is obtained through the action of the reverse clutch release spring installed on inside of the reverse internal gear.

Teeth cut on the outside of internal gear are used only for parking.

SERVICE CRAFTSMAN NEWS REFERENCE

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PERIODIC SERVICE RECOMMENDATIONS

Transmission Fluid

Hydra-Matic transmission fluid level should be checked every 2000 miles at the time the chassis lubrication is performed. The procedure for checking level is included on the lubrication chart and on page 153 of this manual. Hydra-Matic transmission fluid should be changed every 25,000 miles. Instructions for draining and refilling appear on page 57.

Linkage Lubrication

Lubricate Hydra-Matic linkage every 2000 miles using light engine oil.

Oil Level Indicator

The air cleaner in the oil level indicator cap should be cleaned every 10,000 miles or twice a year.

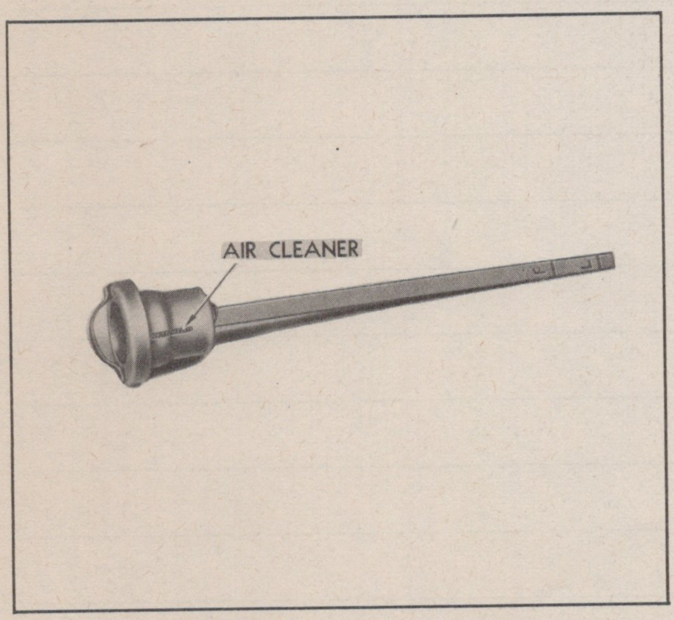

Fig. 67—Oil Lever Indicator Air Cleaner

New Car 1000-2000 Mile Inspections

New car 1000-2000 mile inspections should be performed as outlined on form S10, "1951 Pontiac New Car Pre-Delivery 1000 Mile and 2000 Mile Inspection and Adjustment". For Hydra-Matic equipped cars, the form includes the following in addition to the conventional operations.

New Car Inspection

1. Tighten band adjusting screw lock nuts.

2. Road test for operation of Hydra-Matic using the Hydra-Matic Diagnosis Guide. See page 154.

3. Check operation of neutralizer switch. Starter should not work in any position except neutral. For adjustment see page 52.

4. Check position of the pointer. Move the control lever from N to Dr, stopping when the detent is felt. The pointer should then be directly over the letters Dr. See page 52.

5. Hydra-Matic fluid level should be to the "Full" mark with engine running as shown on page 58.

6. Engine idle speed should be 365 to 385 RPM with control lever in N position.

1000 Mile Inspection

For Hydra-Matic equipped cars the form includes:

1. Adjust bands as outlined on page 53.

2. Road test for operation of Hydra-Matic, using the Hydra-Matic Diagnosis Guide. See page 154.

3. Check operation of neutralizer switch. Starter should not work in any position except neutral. For adjustment see page 52.

4. Check position of the pointer. Move the control lever from N to Dr, stopping when the detent is felt. The pointer should then be directly over the letters Dr. See page 52.

5. Hydra-Matic fluid level should be to the "Full" mark with engine running as shown on page 58.

6. Engine idle speed should be 365 to 385 RPM with control lever in N position.

2000 Mile Inspection

For Hydra-Matic equipped cars, the form includes the same inspection operations given above for the 1000 mile inspection except that a band adjustment is not required.

General Recommendation

Observe operation of transmission on Hydra-Matic equipped cars when road tested for any reason, using the Hydra-Matic Diagnosis Guide.

SERVICE CRAFTSMAN NEWS REFERENCE

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ADJUSTMENTS WITH TRANSMISSION IN CAR

CONTENTS OF THIS SECTION

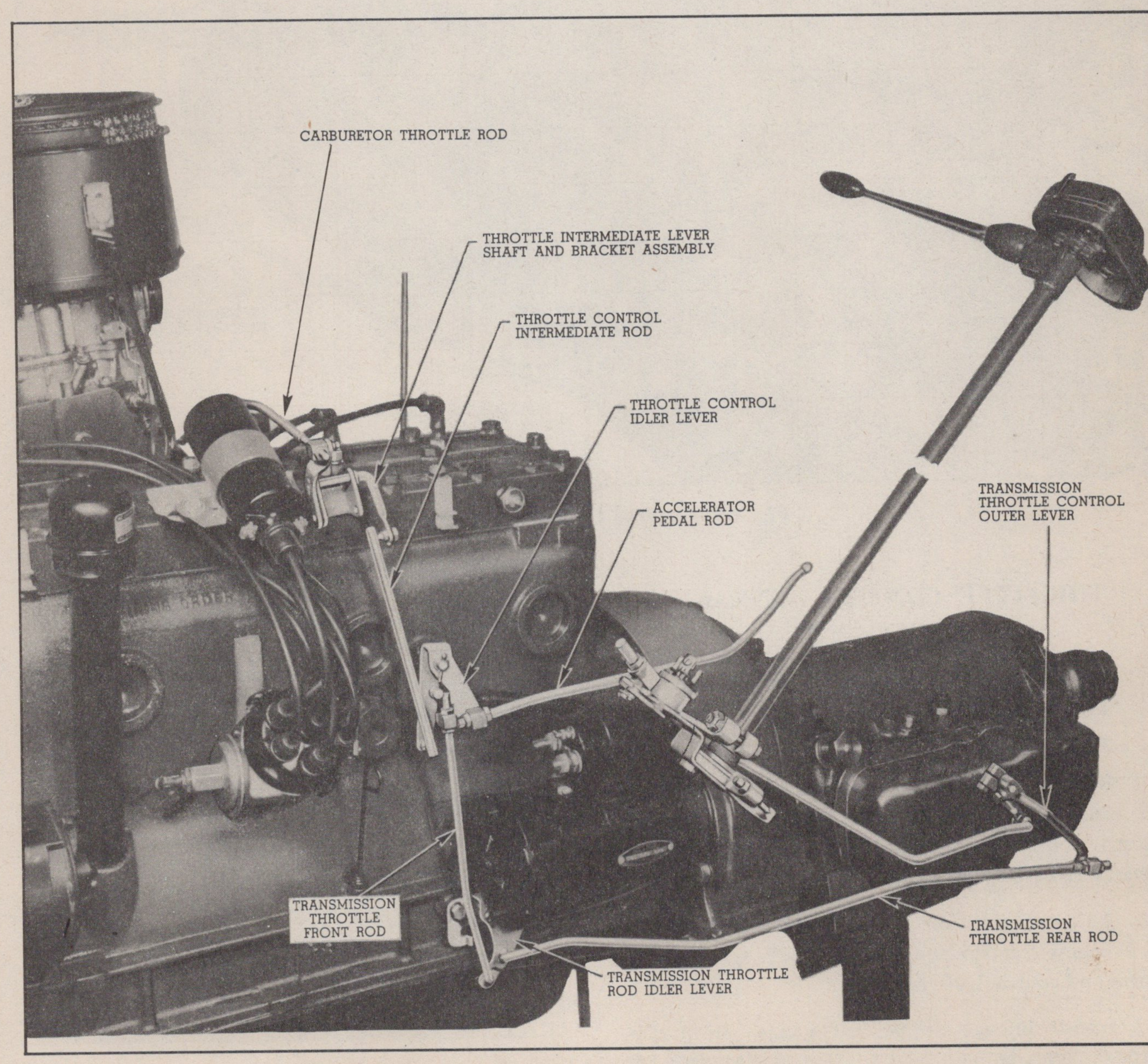

Fig. 68—Control Linkage—6 Cylinder

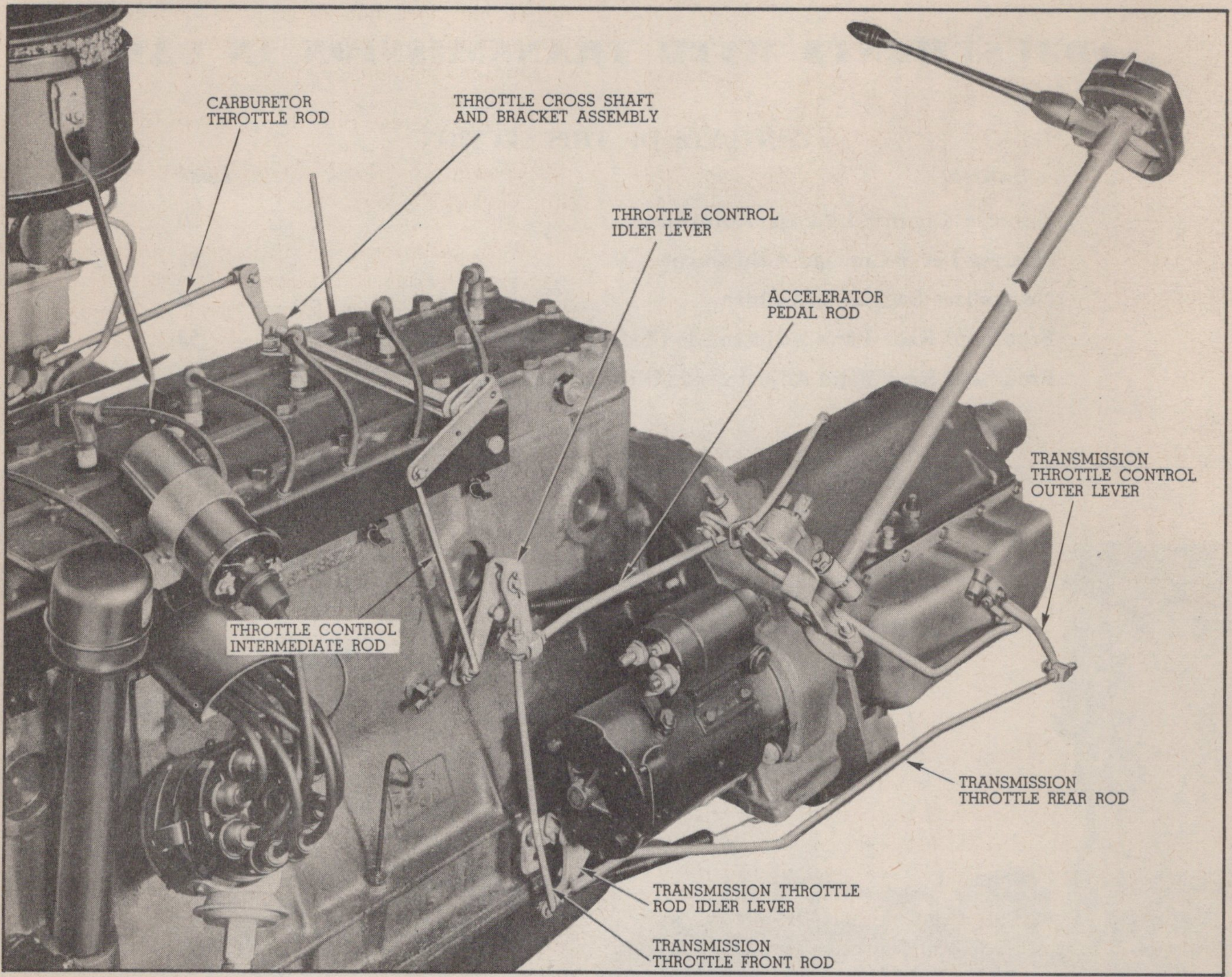

Fig. 69—Control Linkage—8 Cylinder

THROTTLE CONTROL LINKAGE ADJUSTMENT

CAUTION: Linkage operation will not be satisfactory if binding or excessive wear exists.

1. Remove cotter pin and washers from trunnion on transmission throttle rear rod at transmission throttle control outer lever (Fig. 68 and Fig. 69) and remove rod from lever.

2. Adjust engine idle speed to 365 to 385 RPM with engine temperature 150° to 160°, transmission warm and control lever in neutral.

3. Install linkage adjustment gauge pin J-2544 through holes in lever and bracket at "A" (Fig. 70 and Fig. 71).

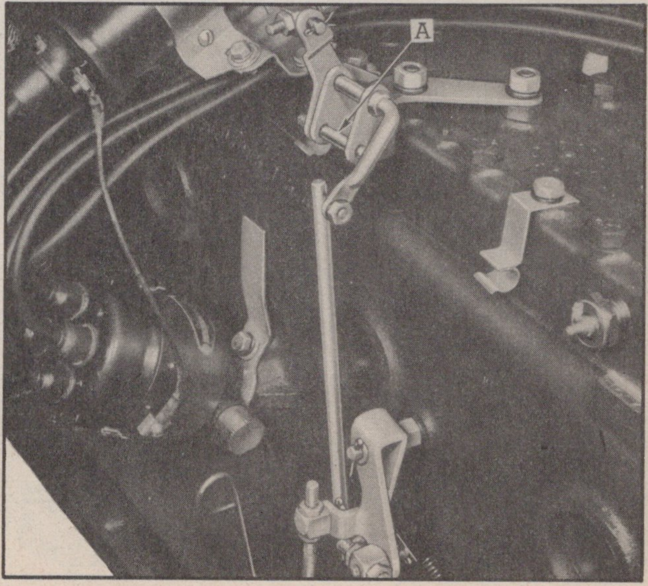

Fig. 70—Adjusting Pin Installed at "A"— 6 Cylinder

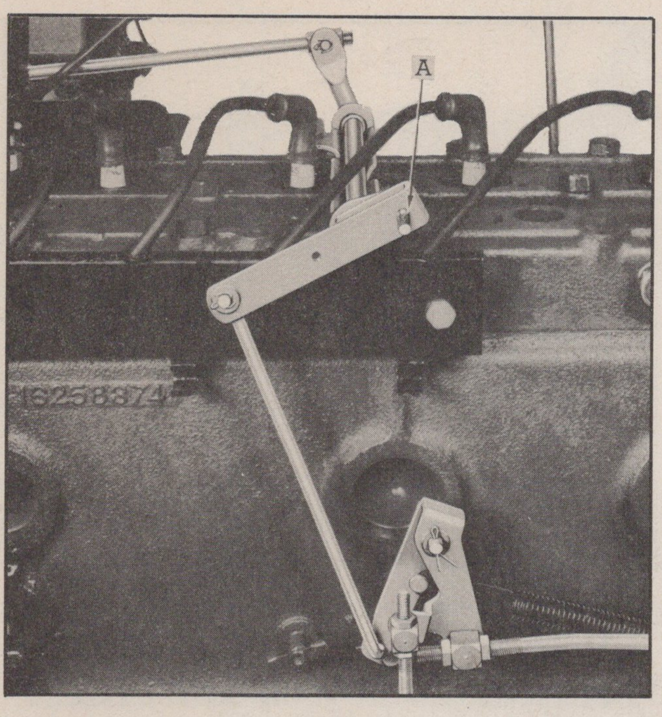

Fig. 71—Adjusting Pin Installed at "A"—8 Cylinder

4. With idle adjusting screw seated against its stop, adjust length of carburetor throttle rod (Fig. 68 and Fig. 69) at lock nuts so that adjustment gauge pin is free in hole "A". Leave pin installed. Tighten lock nuts securely.

5. Install second linkage adjustment gauge pin through transmission throttle rod idler lever and bracket in hole marked "B" (Fig. 72).

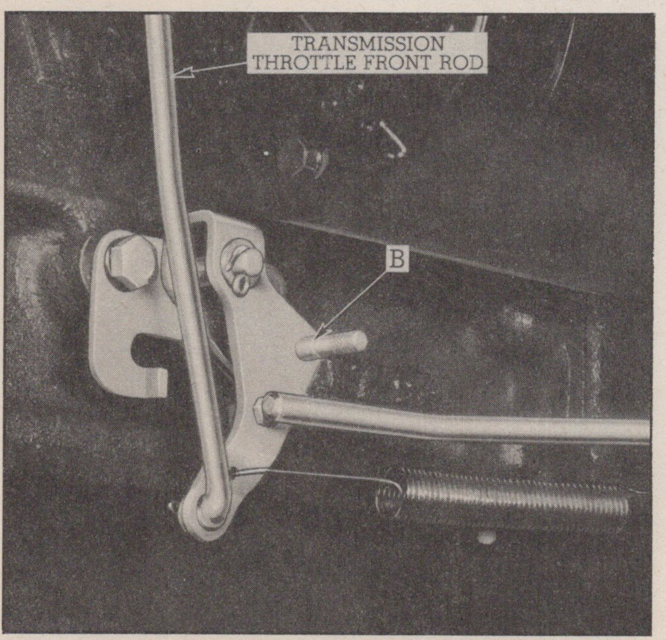

Fig. 72—Adjusting Pin Installed at "B"

6. If pin does not enter hole "B" freely, adjust transmission throttle front rod (Fig. 68 and Fig. 69) at trunnion. Tighten lock nuts securely.

7. Remove gauge pins from "A" and "B".

8. Loosen front lock nut on accelerator pedal rod (Fig. 68 and Fig. 69).

9. With carburetor in "Full Open" position, adjust accelerator pedal rod trunnion at throttle control idler lever so that accelerator pedal clears floor mat by approximately ¼″ at closest point. Tighten lock nuts at trunnion securely.

10. Tighten clamp bolt (12-15 ft. lbs. torque) in transmission throttle control outer lever.

11. Check position of outer throttle lever as follows:

(a) Clean machined surface at back of transmission case (Fig. 73) and place Throttle Lever Checking Gauge J-2545 flat against surface with edge of gauge against transmission side cover.

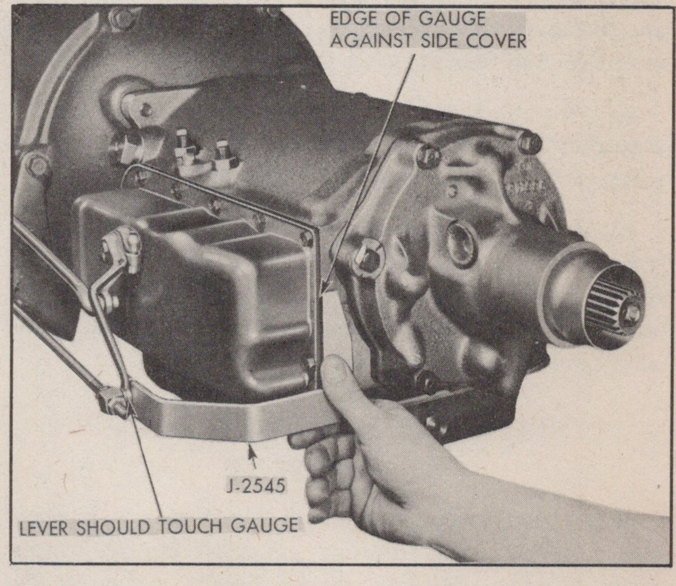

Fig. 73—Checking Throttle Lever

(b) Back off rear check nut at throttle rod trunnion. With outer lever held against stop (toward rear of transmission) move gauge upward toward trunnion pin installed in lever. When gauge is moved upward, the notch in gauge should pass over pin and the inside face of the throttle control lever (toward transmission) should just touch the outer side face of gauge (Fig. 73).

(c) If gauge does not pass over pin freely, bend lever, using tool J-2807 (Fig. 74).

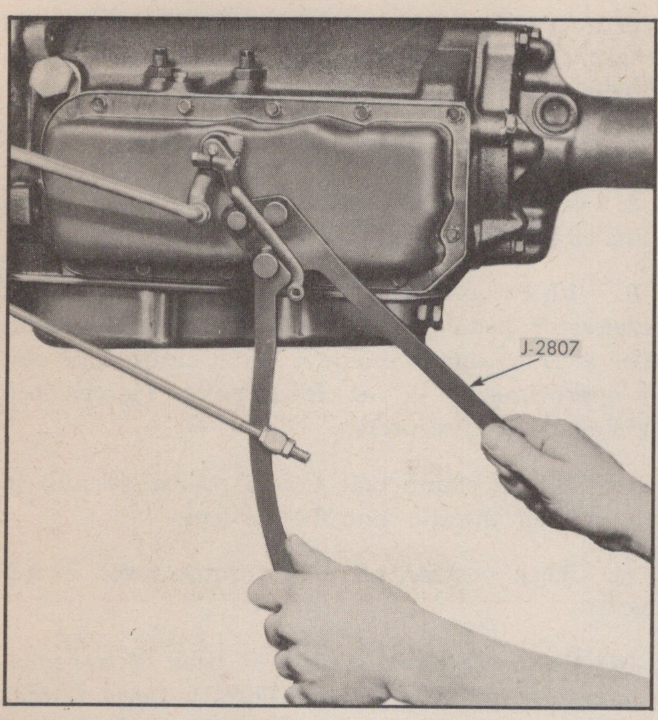

Fig. 74—Bending Throttle Lever

(d) Recheck, using gauge J-2545, and correct until gauge passes freely over pin in lever and just touches inside face of transmission throttle lever.

(e) Assemble transmission throttle rear rod with trunnion to transmission throttle control outer lever, using anti-rattle spring washer and cotter pin.

12. Adjust transmission throttle rear rod trunnion toward the rear so lever is lightly against its stop in transmission. Shorten this rod length by backing off trunnion front lock nut one full turn. Tighten trunnion rear lock nut securely.

SELECTOR LEVER LINKAGE ADJUSTMENT

1. Tighten gearshift control shaft upper bracket clamp screw while holding gearshift control upper lever (under steering wheel) firmly down in Lo position.

2. Back off both gearshift control rod trunnion lock nuts (Fig. 75).

3. See that transmission outer shift lever is in Lo detent position (second position from rear).

4. With both control levers in Lo position, turn lower lock nut against trunnion finger tight. Lengthen control rod by turning lower lock nut one additional full turn. Tighten upper lock nut securely.

5. Check tightness of clamp bolt in transmission outer shift lever (10-13 ft. lbs. torque).

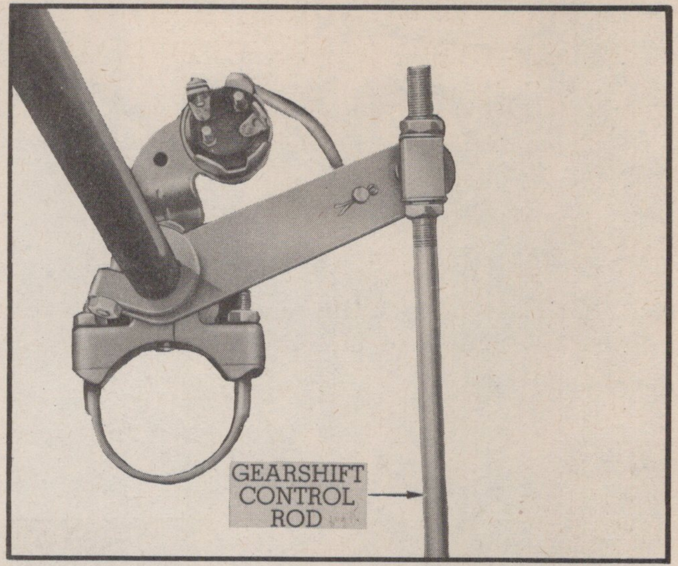

Fig. 75—Manual Control Adjustment

NEUTRALIZER SWITCH ADJUSTMENT

1. Place manual control lever in Dr position.

2. Loosen neutralizer switch bracket clamp screw (Fig. 76).

3. Adjust neutralizer switch bracket to a position where starter will not operate when starter button on dash is depressed.

4. Place manual control lever in N position.

5. Make certain that neutralizer switch arm does not touch stop on switch bracket.

6. Tighten clamp screw securely.

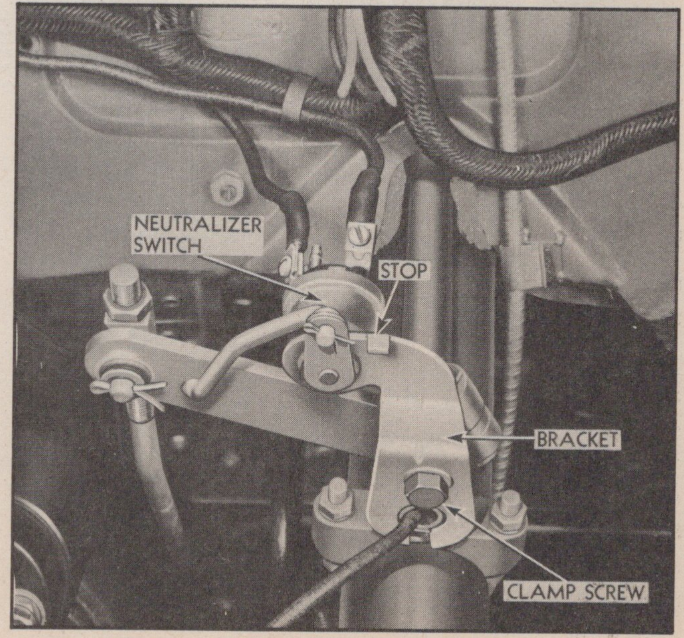

Fig. 76—Neutralizer Switch

PROCEDURE FOR ADJUSTING HYDRA-MATIC BANDS EXTERNALLY

***CAUTION:* If tool No. J-2681 and tachometer are not available, adjust bands by removing pan. Do not attempt to adjust bands externally without tool No. J-2681 and tachometer.**

1. *Set hand brake firmly and block front wheels with wheel chocks* to prevent car running forward during adjustment

2. Remove accelerator pedal, floor mat and adjusting hole cover (Fig. 77).

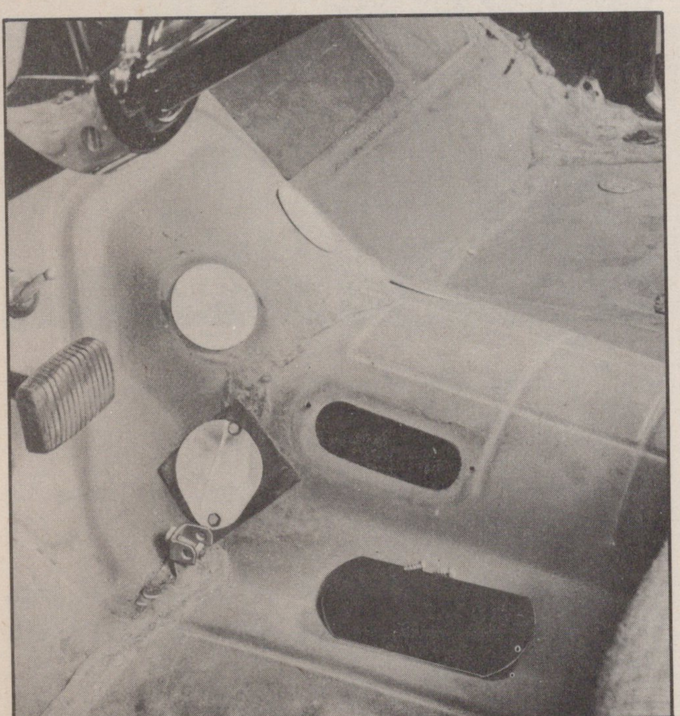

Fig. 77—Band Adjusting Floor Hole Cover Removed

3. Start engine and allow it to run until temperature is normal (choke and fast idle off) before proceeding.

4. Connect electrical tachometer to engine and set to correspond with distributor cam.

5. Position control lever in Dr range.

6. Adjust carburetor idle speed screw to give 700 RPM.

Front Band

1. Using band adjusting tool No. J-2681 loosen front band adjusting screw lock nut (Fig. 78).

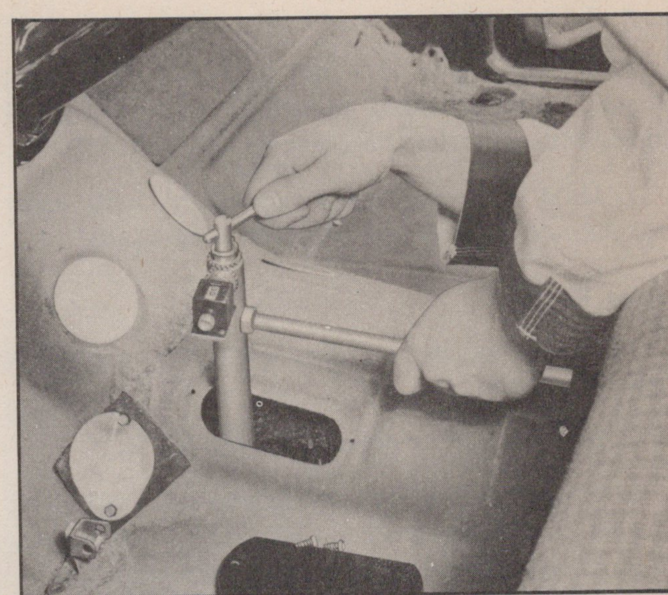

Fig. 78—Adjusting Front Band Using J-2681 and Tachometer

2. Loosen band adjusting screw until engine speed increases to 900-1000 RPM (front drum now spinning freely).

***NOTE:* In operation 2 under FRONT BAND if engine fails to increase speed to 900-1000 RPM, this is an indication that the band is slipping badly under normal driving conditions. The bottom pan should be dropped and the bands and drums inspected for damage. If no apparent damage is evident, adjust both bands using tools J-1693 and J-5071 as outlined on page 54. It will not then be necessary to reset the bands externally after the pan is installed.**

3. Tighten band adjusting screw slowly until engine returns to *700 RPM* (front drum now stopped).

4. Loosen band adjusting screw until engine speed increases and tighten again slowly until engine speed returns to 700 RPM.

***NOTE:* The object in loosening and retightening the screw is to locate the exact point at which the band stops the drum from spinning. At this point wait 30 seconds. If engine speed increases, tighten screw 1/10 of a turn. Wait 30 seconds and if engine speed again increases, tighten screw 1/10 of a turn more. Repeat this procedure until engine speed remains at 700 RPM for at least 30 seconds.**

5. Set counter on tool to 00 (Fig. 78).

6. While holding lock nut stationary with long handle of tool, tighten adjusting screw exactly 5½ turns with short handle (counter will read 5.5).

7. Hold adjusting screw stationary with short handle and tighten lock nut with long handle.

Rear Band

1. Repeat operations 1, 2, 3, 4, and 5 under heading FRONT BAND.

2. Position selector lever in N position.

3. While holding lock nut stationary with long handle of tool, tighten band adjusting screw exactly 2 turns with short handle (counter will read 2.0).

4. Position selector lever in Dr range.

5. Hold adjusting screw stationary with short handle and tighten lock nut with long handle.

6. *Reset engine idle at 365 to 385 RPM* (selector lever in N position).

7. Turn off ignition.

8. Install adjusting hole cover, floor mat and accelerator pedal.

FRONT AND REAR BAND ADJUSTMENT (Transmission Oil Pan Removed)

1. Place front end of car on car jacks.

2. Remove oil pan drain plug to drain fluid.

3. Remove oil pan.

4. Remove accelerator pedal and raise left side of front compartment mat.

5. Remove band adjusting floor hole cover.

6. Loosen both servo band adjusting screw lock nuts.

To Adjust Front Band

1. Loosen front band adjusting screw approximately five (5) turns.

2. Remove pipe plug from front servo.

3. Loosen ½″ "hex" adjusting screw of gauge J-1693, until approximately ⅛″ of threads are exposed above gauge body.

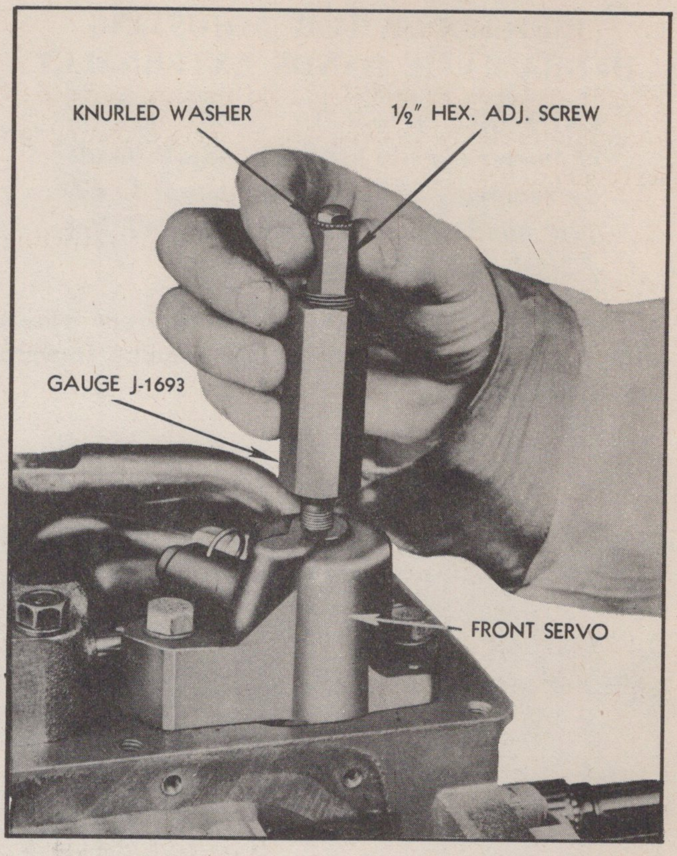

Fig. 79—Adjusting Front Band

4. Screw gauge into front servo, tightening by HAND only (Fig. 79).

5. Tighten the ½″ "hex" adjusting screw with fingers until the stem of gauge is felt to *JUST* touch piston in front servo.

6. With a ½″ wrench continue tightening the adjusting screw six full turns from the point where it was felt by hand that stem of gauge *JUST* touched piston.

7. Tighten band adjusting screw until knurled washer on gauge is just free to turn.

NOTE: While tightening screw be sure band is lined up over drum.

8. Tighten band adjusting screw lock nut securely, while holding adjusting screw.

9. Loosen ½″ "hex" adjusting screw at least six turns and then remove gauge from servo.

10. Install pipe plug in servo.

To Adjust Rear Band

1. Place servo gauge J-5071 on finished surface of accumulator body, having leg of gauge resting on servo stem (Fig. 80).

2. Back off adjusting screw until face of actuating lever is well away from face of gauge.

3. Tighten band adjusting screw until face of band actuating lever just touches gauge.

> ***CAUTION: Do not go beyond adjustment. If adjusting screw is accidentally turned beyond adjustment, loosen two or three turns and repeat adjustment.***

4. Tighten band adjusting screw lock nut securely while holding adjusting screw.

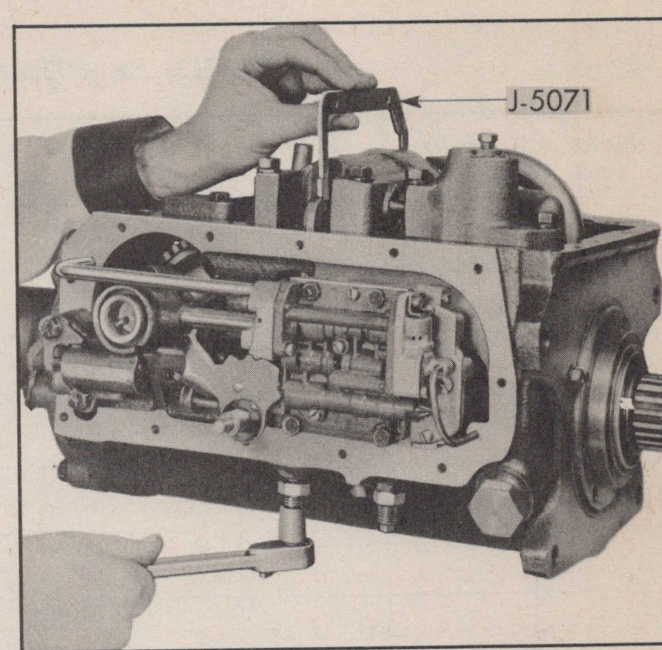

Fig. 80—Adjusting Rear Band

SERVICE CRAFTSMAN NEWS REFERENCE

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SERVICE CRAFTSMAN NEWS REFERENCE

News Year	News No.	Page No.	Subject

MINOR SERVICES AND REPAIRS

CONTENTS OF THIS SECTION

When trouble can be isolated to the sub-assemblies mentioned above, time and effort can be saved by following the procedures given in this section. These procedures can be performed without removing the entire Hydra-Matic assembly from the car.

FLUID CAPACITY, DRAINING AND REFILLING

Capacity

Approximately eleven quarts of fluid are required to refill the transmission after torus cover and oil pan have been drained. When a unit has been disassembled and rebuilt, approximately twelve quarts will be required to refill. Use only "G.M. Hydra-Matic Fluid" or "Automatic Transmission Fluid (Type A)" from containers bearing the Armour Institute Qualification number "AQ-ATF. . . .".

Draining and Refilling Transmission

Drain oil immediately after operation before it has had an opportunity to cool.

To drain oil proceed as follows:

1. Remove flywheel housing bottom cover.

2. Remove hex head pipe plug from torus cover (Fig. 81) using SIX-POINT socket (never use a twelve point socket as this will damage head of soft pipe plug).

3. Remove oil pan drain plug (at back of pan).

NOTE: Flushing of the Hydra-Matic transmission is not recommended.

4. After draining, install and tighten both drain plugs. Tighten torus cover drain plug to 6-7 ft. lbs. torque using SIX-POINT socket. Tighten oil pan drain plug to 35-40 ft. lbs. torque.

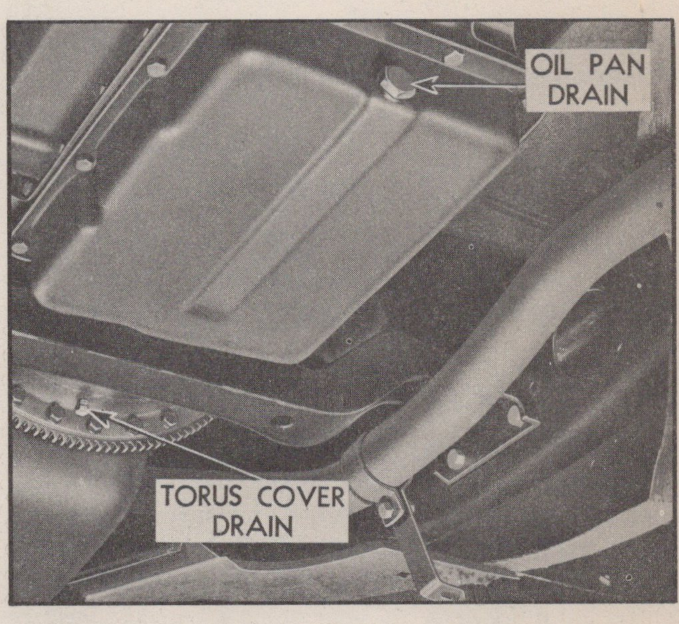

Fig. 81—Hydra-Matic Transmission Drain Plugs

5. Replace flywheel housing bottom cover.

6. Cover seat to protect upholstery and raise right side of front floor mat.

7. Remove transmission inspection floor hole cover (Fig. 82).

CAUTION: Clean all gravel, sand, or lint from floor and around oil level indicator before it is removed.

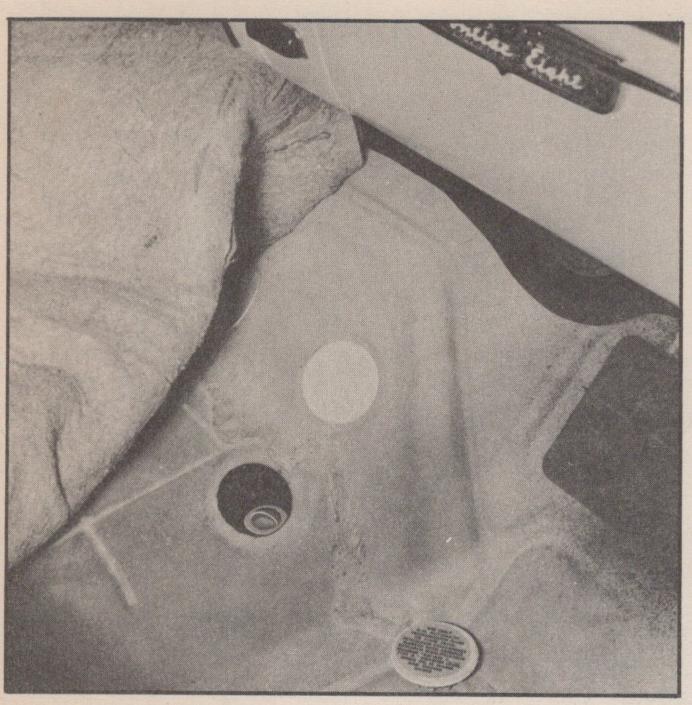

Fig. 82—Inspection Cover Removed

8. Remove dipstick and wipe it clean. Clean the dipstick cap air cleaner in solvent.

9. Pour approximately 8 qts. of Hydra-Matic fluid into transmission. BE SURE CONTAINER, SPOUT OR FUNNEL IS CLEAN.

10. Set selector lever in N position and apply hand brake. Run engine at a speed equivalent to 20 MPH for approximately 1½ minutes to fill fluid coupling.

11. Reduce engine speed to slow idle (carburetor off fast idle step).

12. Add sufficient Hydra-Matic fluid to bring fluid level up to just below the "L" mark on the dipstick. Again run the engine at a speed equivalent to 20 MPH for 3 minutes to heat the fluid to near normal operating temperature which is indicated by a rise in fluid level to near the "F" mark. Reduce engine speed to slow idle and add fluid to bring level to the "F" mark. With engine idling and transmission warm (approximately 150°F.) make a final check to be certain transmission is not overfilled.

> ***CAUTION:** Do not overfill — foaming will result.*

13. Stop engine. Replace dipstick and cover in floor.

14. Return front floor mat to original position.

> ***IMPORTANT:*** **Oil level as observed on the level indicator will vary as shown in figures 83, 84, 85, 86 and 87.**

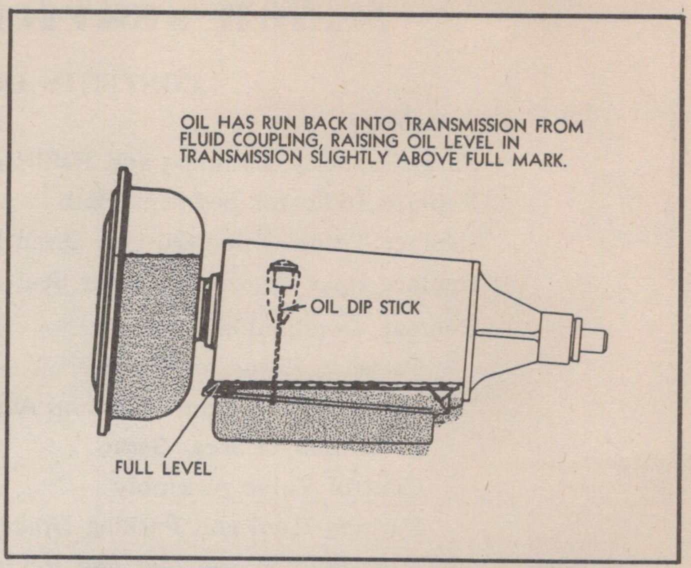

Fig. 83—Oil Level, Engine Not Running

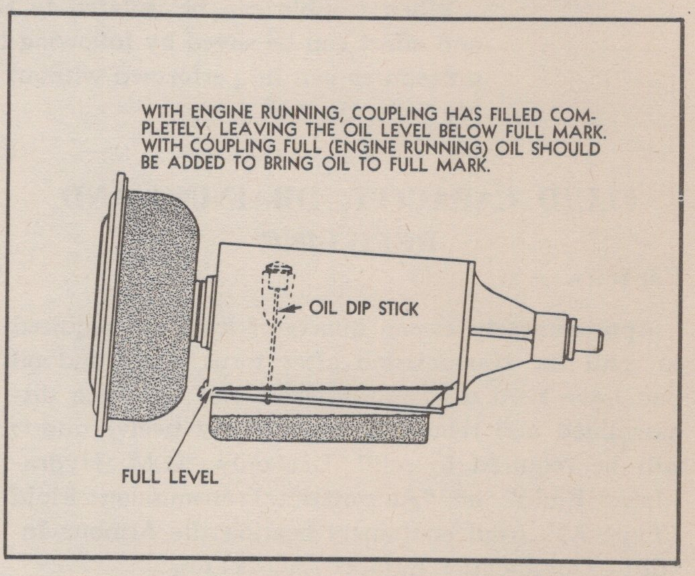

Fig. 84—Oil Level, Engine Running

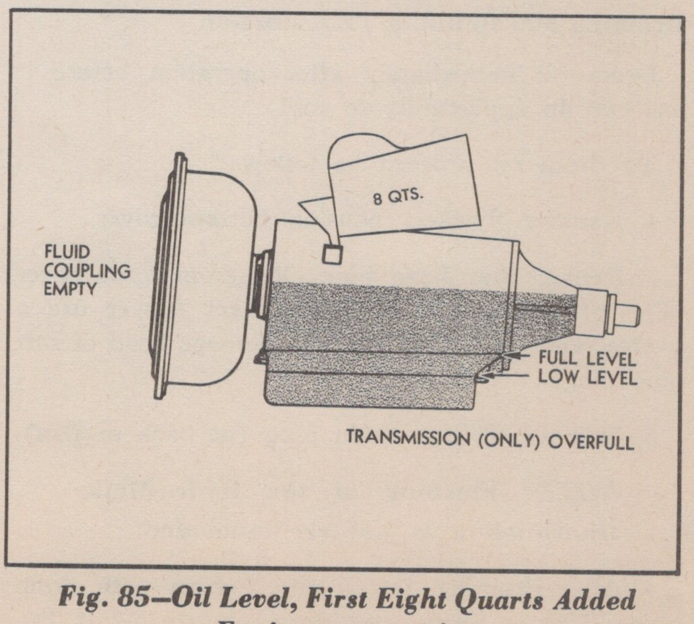

Fig. 85—Oil Level, First Eight Quarts Added Engine not running

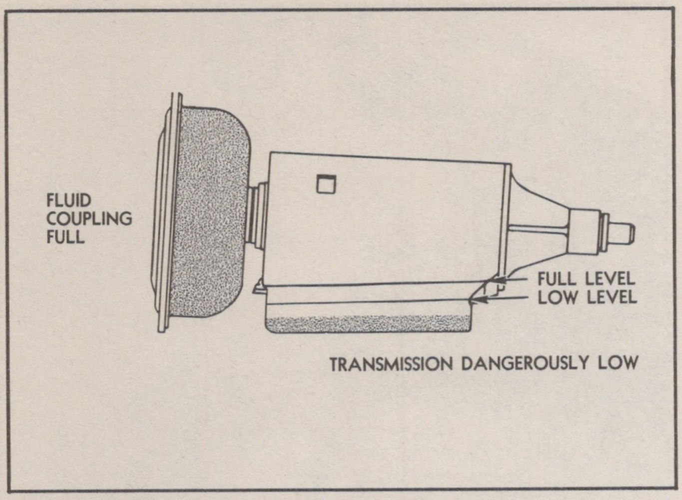

Fig. 86—Oil Level, First Eight Quarts Added
Engine running

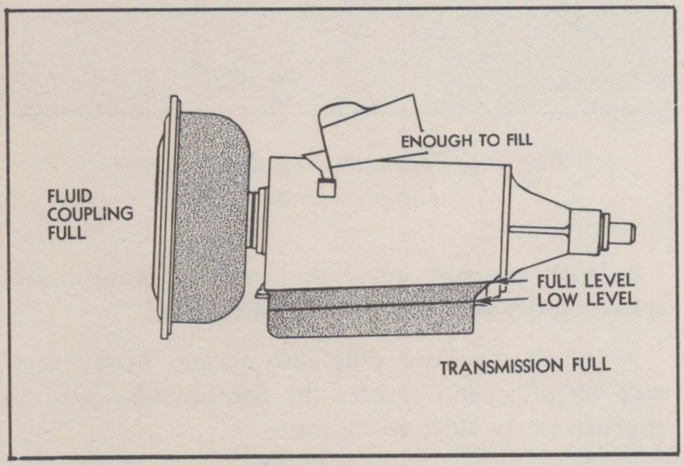

Fig. 87—Oil Level, Final Filling to F
Engine running

REPLACE INDICATOR SEGMENT BULB

1. Remove the two cover attaching screws from underside of segment.

2. Slide cover off the unit.

3. Remove the screw holding bulb socket to indicator.

4. Remove hood from socket and replace bulb.

5. Replace hood on socket.

6. Replace the screw holding bulb socket to indicator.

7. Slide cover on the unit.

8. Replace the two cover attaching screws from underside of segment.

REPLACE TRANSMISSION OIL PAN DRAIN PLUG GASKET

1. Place rear of car on car stands.

2. Remove transmission oil pan drain plug.

3. Remove drain plug gasket.

4. Inspect oil pan and drain plug for nicks and burrs.

5. Soak new gasket in water until it is sufficiently pliable to install on drain plug.

> ***CAUTION: Do not enlarge hole of gasket.***

6. Install gasket on drain plug and allow it to dry.

7. Replace drain plug in transmission oil pan.

8. Lower car from car stands.

9. Raise right side of front compartment mat.

10. Remove transmission inspection floor hole cover (Fig. 82).

> ***CAUTION: Clean all gravel, sand, or lint from floor and around oil level indicator before removing indicator.***

11. Remove indicator and refill transmission with Hydra-Matic fluid previously drained.

12. Set hand brake lever tightly and run engine for several minutes. Then add oil to bring level to full mark when oil is hot.

> ***NOTE:*** **Check oil level when oil is hot, engine running, control lever in N position and hand brake lever set tightly.**

13. Replace transmission floor hole cover and lower front compartment mat.

REPLACE REAR BEARING RETAINER SEAL

1. Hoist rear end of car.

2. Disconnect propeller shaft at differential flange and slide propeller shaft from transmission output shaft.

3. Remove rear bearing retainer seal shield and seal from rear bearing retainer.

4. Inspect rear bearing retainer and output shaft for nicks and burrs.

5. Apply Hydra-Matic transmission fluid to felt portion of new rear bearing retainer seal. Apply Lithium Soap Grease to rubber portion of seal.

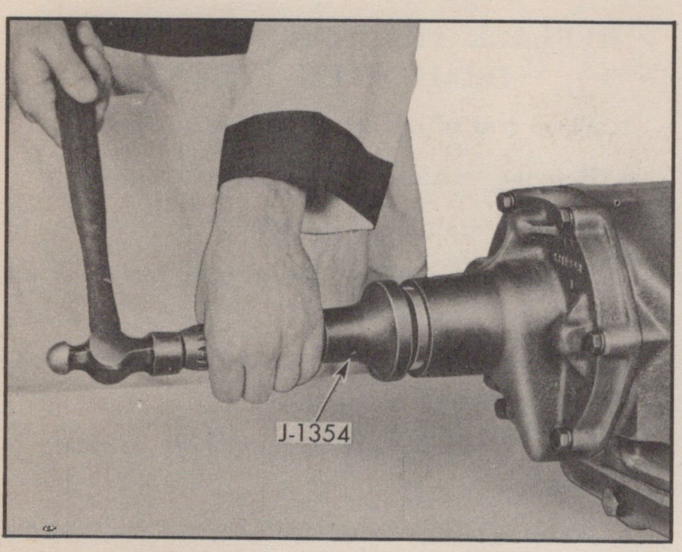

Fig. 88—Installing Rear Bearing Retainer Seal Using Tool J-1354

6. Install the new rear bearing retainer seal using tool J-1354 (Fig. 88).

7. Apply sealing compound (Permatex No. 3, Aviation Form-A Gasket Cement) to outside of seal against rear bearing retainer.

8. Install rear bearing retainer seal shield with tool J-1354.

9. Replace propeller shaft.

10. Lower rear end of car.

PRESSURE REGULATOR VALVE REMOVAL, OVERHAUL AND INSTALLATION

1. Remove accelerator pedal and front compartment mat.

2. Remove floor hole cover over regulator (Fig. 89). Clean transmission so dirt will not enter assembly when regulator plug is removed.

3. Loosen pressure regulator valve plug in transmission case (1¼″ open-end wrench).

CAUTION: Pressure regulator valve assembly is under spring tension.

4. Hold pressure against regulator plug while unscrewing plug by hand.

5. Remove plug, spring, valve, and gasket from side of transmission case.

6. Clean and inspect pressure regulator valve according to instructions on page 106.

7. Place a new gasket over pressure regulator plug.

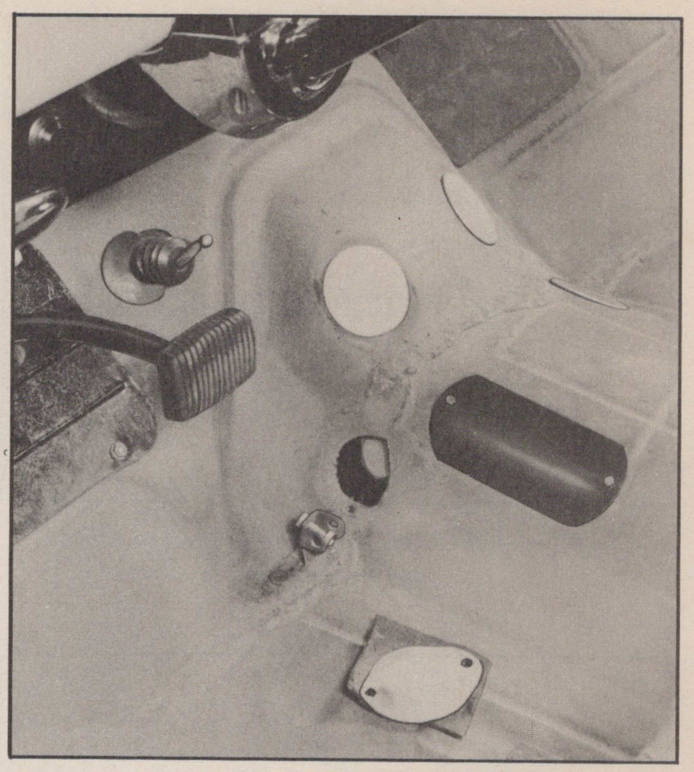

Fig. 89—Pressure Regulator Access Cover Removed

8. With pressure regulator valve assembled into spring, locate valve on seat in front pump.

9. Install regulator plug into spring. Apply pressure to plug and tighten in transmission case to approximately 40 ft. lbs. torque.

10. Check transmission oil pressure according to instructions on page 157.

11. Install and seal floor hole cover.

12. Install front compartment mat and accelerator pedal.

GOVERNOR AND REAR OIL PUMP ASSEMBLY—REMOVAL, OVERHAUL AND INSTALLATION

Removal

1. Place car on car stands.

2. Remove oil pan drain plug and drain fluid into *clean container.*

3. Disconnect transmission throttle rear rod from throttle control lever (Fig. 90).

4. Remove throttle control lever from shaft at side of transmission (7/16″ socket).

5. Disconnect gearshift control rod assembly from shift lever.

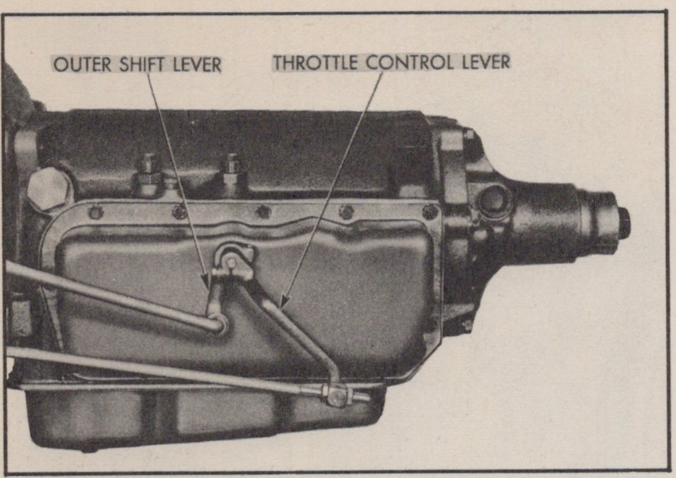

Fig. 90—Outer Throttle and Shift Control Levers

6. Remove shift lever from shaft (½″ wrench).

7. In order to provide clearance for reaching upper side pan bolts the engine and transmission must be lowered as follows:

(a) Place a jack (with block of wood on jack pad) under the rear of engine oil pan (or use any suitable tool for supporting engine from frame) and raise jack only enough to take weight of engine off rear engine support insulators.

(b) Remove two bolts holding left engine support to flywheel housing and carefully lower engine and transmission until side cover screws can be reached.

8. Clean transmission as well as possible so dirt will not enter assembly when side cover is removed.

9. Remove parking pawl support bolt from rear of case (parking pawl cannot be removed at this time).

10. Remove side cover bolts, cover, and gasket (7/16″ socket).

11. Position inner detent control lever in Lo position, and remove pressure regulator reverse oil pipe (Fig. 91).

12. Unhook parking brake release spring from parking brake lever pin assembly and loosen two bolts holding parking brake bracket to transmission case.

13. Remove four bolts holding control valve assembly to case. Work control valve assembly toward front of case to remove (Fig. 92). Governor pipes may remain either in valve body or parking brake bracket. Remove pipes from either assembly and remove reverse clutch oil pipe from case.

NOTE: **Wrap control valve in clean rag to prevent damage.**

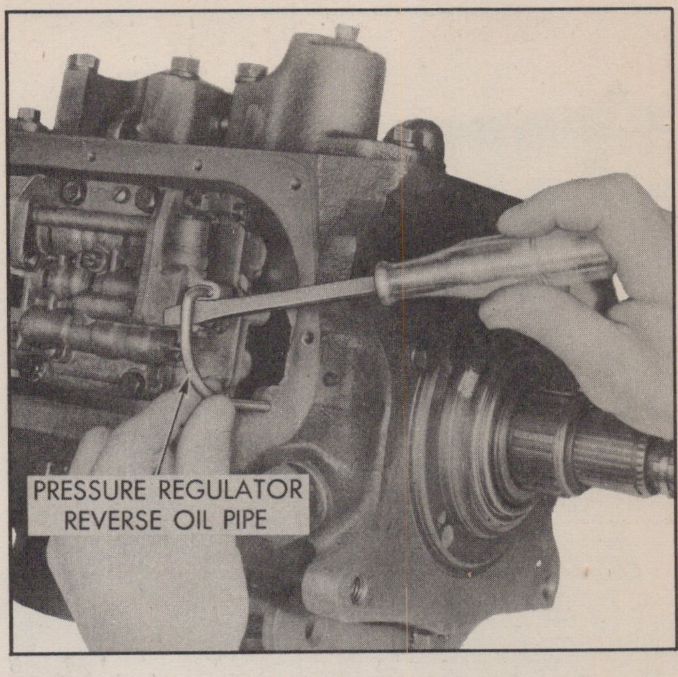

Fig. 91—Removing Pressure Regulator Reverse Oil Pipe

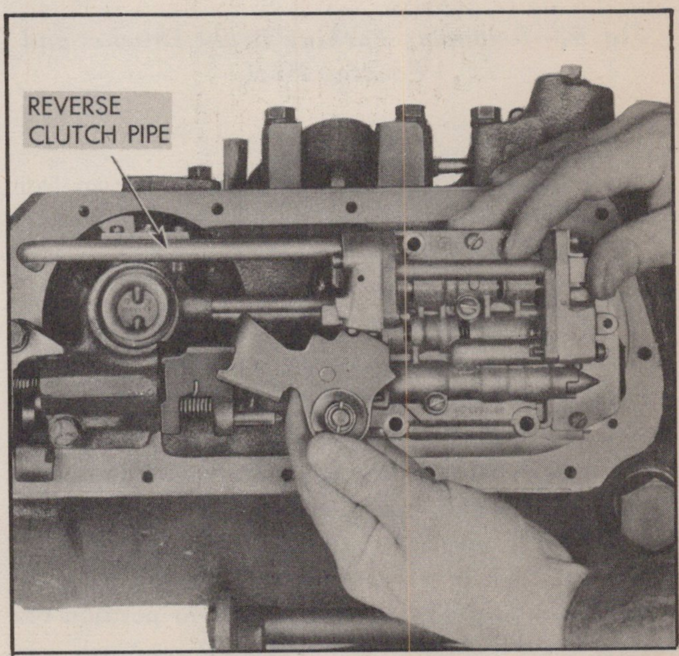

Fig. 92—Removing Control Valve Assembly

14. Remove bolts from parking brake bracket assembly and remove piston release spring stop and spring. Hold parking pawl out of way against top of case and carefully remove parking bracket from governor (Fig. 93). Parking pawl can now be removed.

15. Remove oil pan bolts and lock washers, oil pan and gasket (½″ socket).

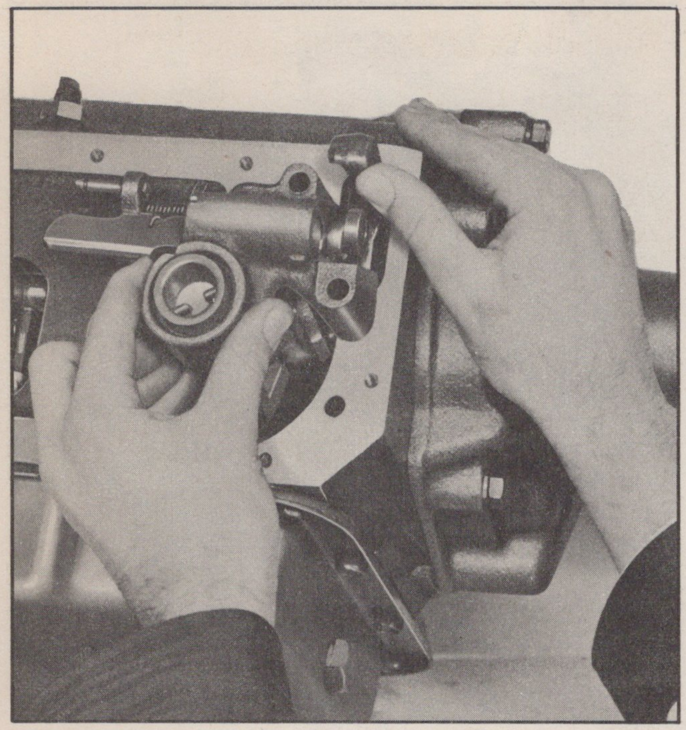

Fig. 93—Removing Parking Brake Bracket and Parking Pawl

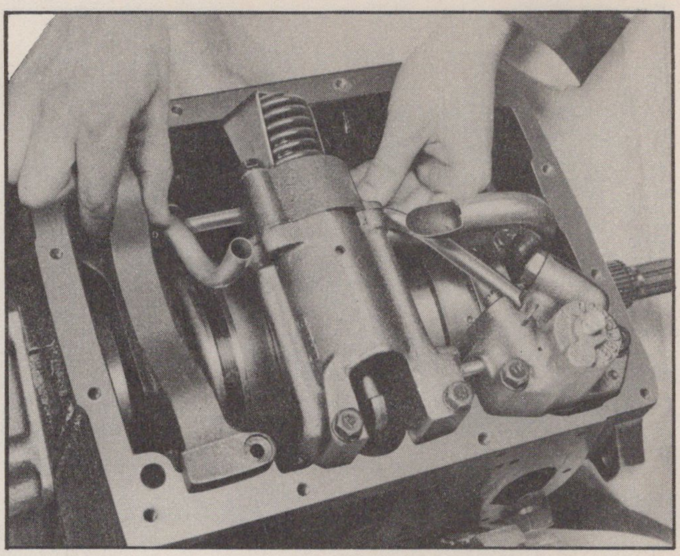

Fig. 94—Removing Rear Oil Pump Discharge Pipe

16. Remove oil pan screen by pulling down from rear oil pump intake pipe and sliding to rear off front pump intake pipe.

17. Remove rear oil pump and governor assembly attaching bolts. With pump bolts removed work rear oil pump discharge pipe into rear pump until it comes out of the front servo. Then turn the pipe so that the front end is between the front servo and front unit (Fig. 94). The pipe can then be pulled from the rear pump and removed from the transmission.

18. Turn propeller shaft by hand to position one reverse drive flange attaching bolt down. Turn governor to a position where large governor weight is toward front of transmission. Remove rear pump and governor assembly.

> ***NOTE:*** **To remove rear pump and governor assembly slide it to the left until pump end will clear the right side of case (Fig. 95). Then lower the pump end of the assembly below the case and move the unit out of the case to the right.**

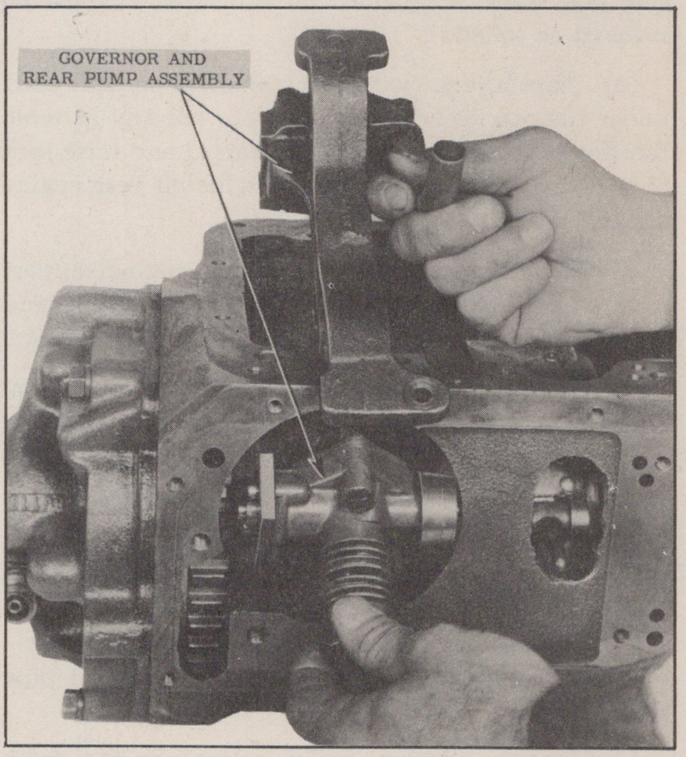

Fig. 95—Removing Rear Pump

Overhaul

For overhaul of governor and rear pump assembly refer to:

a. Disassembly .... page 90
b. Cleaning and Inspection .... page 107
c. Repair .... page 113
d. Assembly .... page 136

Installation

1. Before installing rear pump, make certain the pump to case mating surface is entirely free of nicks and burrs, and that both attaching bolt holes in the case have a good chamfer.

2. Position large round governor weight to front of case and slide governor and pump assembly into case.

3. Insert proper end of rear pump discharge pipe into rear pump as shown in Fig. 96 (a small hole is drilled one inch from the front pump end of the pipe). With the pipe in the rear pump as far as it will go turn the pipe so the front end indexes with the hole in the front servo and work the pipe part way out of the rear pump into the front servo.

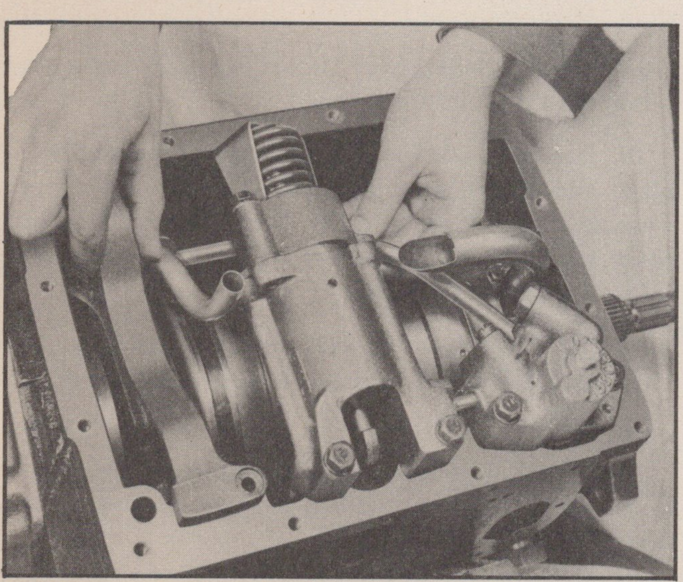

Fig. 96—Installing Rear Pump Discharge Pipe Into Rear Pump

4. Install rear pump and governor assembly attaching bolts and tighten.

5. Check governor runout as outlined on page 146.

6. Install parking pawl in case and hold it against top of case with one hand (Fig. 97). While holding parking pawl, place chamfered side of oil delivery sleeve over end of governor and press gently on, guiding rings into oil delivery sleeve.

7. Install roller on parking brake pawl crank. Locate parking pawl in proper position and install parking pawl support bolt. Torque to 23-28 lb. ft. and bend lock plate over flat of bolt.

8. Install parking blocker piston spring and spring stop and start bracket to case bolts.

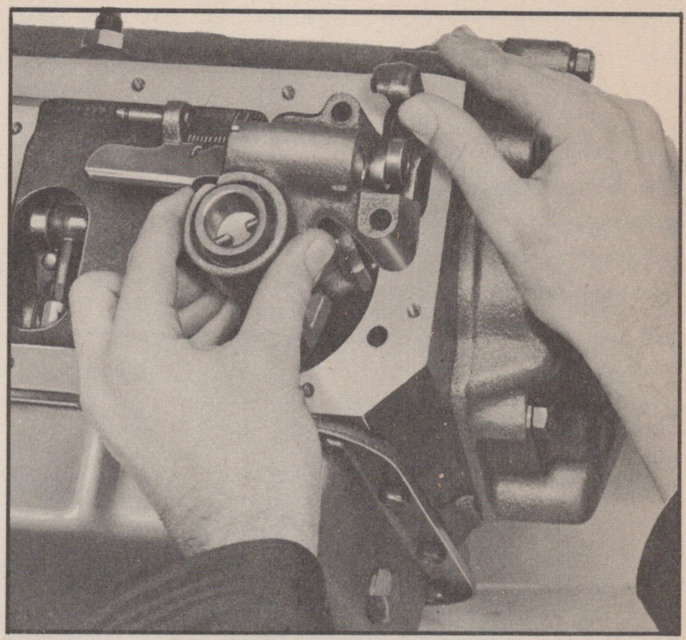

Fig. 97—Installing Parking Brake Bracket and Parking Pawl

9. Install reverse clutch oil pipe with "L" end in rear of transmission case. Insert three oil delivery pipes in parking brake bracket.

10. Install parking pawl return spring over inside oil delivery pipe (hook outward) and hook lower end over parking brake lever pin.

11. Install control valve assembly over three oil delivery pipes and reverse clutch pipe and start bolts (Fig. 98). Press valve body and bracket assembly against case and torque four valve body to case bolts to 6-8 lb. ft.

12. Install pressure regulator reverse oil pipe.

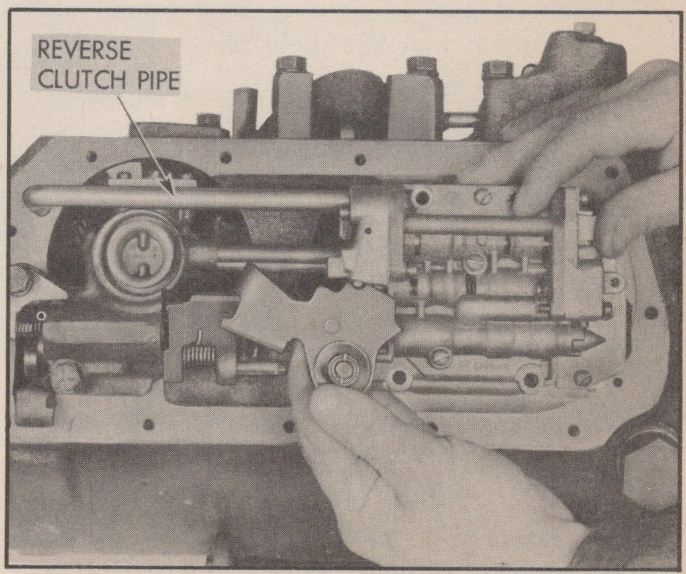

Fig. 98—Installing Control Valve Assembly

13. To insure proper alignment of governor and parking bracket assembly use the following procedure:

a. Loosen rear pump attaching bolts.

b. Install governor alignment tool J-4731 between governor and bracket as shown in Fig. 99. With tool in place torque rear pump bolts to 15-18 lb. ft. and tighten parking bracket bolts.

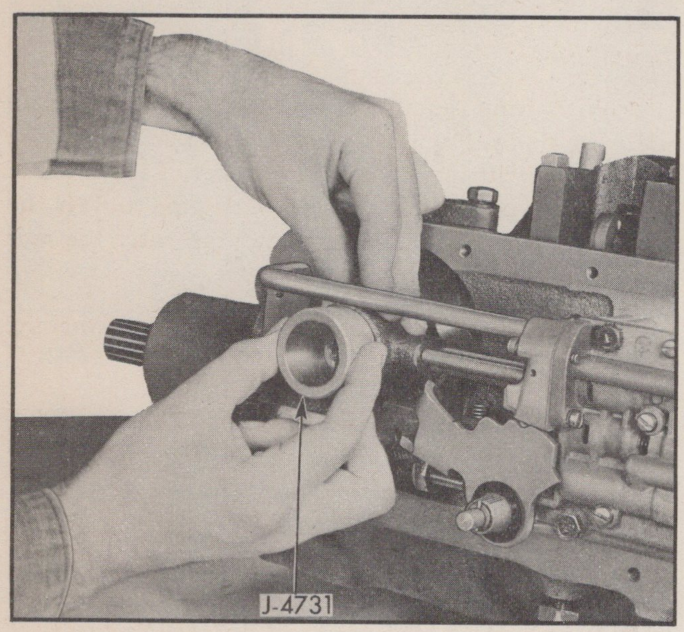

Fig. 99—Using Governor Alignment Tool J-4731

14. Check position of parking blocker return spring stop if early type is used (see Fig. 208 for identification). The spring seat surface of the stop should be ½ to 17/32 inch from the face of the parking bracket assembly.

15. Slide oil pan screen over front pump intake pipe and position it on rear intake pipe.

> ***CAUTION: Make certain screen is free of foreign matter.***

16. Position oil pan gasket on oil pan and retain with petrolatum. Place oil pan against transmission case and install attaching bolts and lock washers. Torque bolts to 10-13 lb. ft.

17. Before installing side cover make the following checks:

a. See that pick-up pin inside detent control lever engages in neck of manual valve, and that control lever indexes properly with parking brake lever.

b. See that inner and outer spring washers and rubber seal are in place on manual control shaft (Fig. 100).

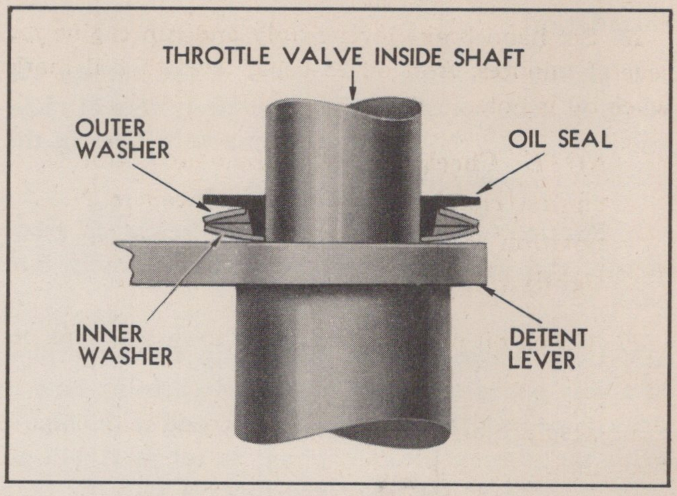

Fig. 100—Inner and Outer Spring Washers and Rubber Seal on Manual Control Shaft

18. Position side cover gasket on side cover and retain with petrolatum.

19. Position side cover and gasket assembly in place and install attaching bolts. Bolts with copper washers must be installed in the bottom holes. Shift cover to centralize manual shaft in hole and tighten bolts to 10-12 lb. ft. torque.

> ***CAUTION: Bolts with copper washers must be in the bottom holes to prevent leakage.***

20. Install outer shift lever and tighten clamp bolt to 10-13 lb. ft. torque. Make certain lever does not bind on side cover.

21. Connect gearshift control rod to outer shift lever.

22. Install throttle control outer lever and tighten clamp bolt to 10-12 lb. ft. torque.

23. Install transmission throttle rear rod.

24. Install oil pan drain plug and tighten to 34-45 lb. ft. torque.

25. Check throttle control adjustments, shift control adjustment and starter neutralizer according to instructions in section "Adjustments on Car", page 50.

26. Lower car from stands.

27. Remove oil lever indicator and refill transmission with Hydra-Matic fluid which was previously drained.

> ***CAUTION: Clean all gravel, sand, or lint from floor around indicator before it is removed.***

28. Set hand brake lever firmly and run engine for several minutes. Add oil to bring level to full mark when oil is hot.

> ***NOTE:* Check oil level when oil is hot, engine running and control lever in N position with parking brake lever set tightly.**

29. Check oil pressure according to instructions on page 157.

30. Replace and seal floor hole covers and replace floor mat.

FRONT OR REAR SERVO—REMOVAL, OVERHAUL AND INSTALLATION

Removal

1. Place car on car stands.

2. Remove accelerator pedal and front compartment mat.

3. Remove band adjusting floor hole cover.

4. Loosen both band adjusting screw lock nuts and loosen band adjusting screws approximately five turns.

5. Remove oil pan drain plug and drain fluid from oil pan into *clean container*.

6. Remove oil pan bolts, lock washers, oil pan and gasket (½″ socket). Remove oil pan screen by pulling down at rear off rear pump intake pipe and sliding toward rear off front pump intake pipe.

7. Remove front and rear servo attaching bolts (9/16″ socket).

> ***NOTE:* Remove rear servo attaching bolts only, if front servo is not to be removed.**

8. Separate front and rear servos at oil transfer pipe by moving rear servo toward rear of transmission. Remove rear servo.

9. If front servo is to be removed, first work the rear pump discharge pipe as far out of the servo as it will go. Then pull the servo down off the front pump delivery pipe. If the rear pump discharge pipe has been moved into the rear pump far enough, the pipe will easily come out of the front servo as it is pulled off the front pump delivery pipe.

Overhaul

For overhaul of servos refer to:

	Front Servo	Rear Servo
a. Disassembly	Page 91,	Page 92
b. Cleaning and Inspection	Page 107,	Page 108
c. Repair		Page 115
d. Assembly	Page 136,	Page 137

Installation

1. With front pump delivery pipe in front pump and rear pump discharge pipe in rear pump, position front servo with piston stem in socket of front band. Place servo on front pump delivery pipe and as the servo is pushed onto the delivery pipe enter the rear pump discharge pipe into the servo.

2. Hold front servo in position and enter attaching bolts only a few threads.

3. Place rear servo in position engaging rear band strut with actuating lever while entering oil transfer pipe from front servo.

4. Enter rear servo attaching bolts, then tighten all four servo attaching bolts to 23-28 lb. ft.

5. Adjust front and rear bands as outlined on page 54.

6. Install oil pan screen on front and rear pump discharge pipes. Make certain screen is free of foreign matter.

7. Place new gasket on oil pan and retain with petrolatum. Position oil pan and gasket assembly against case and start attaching bolts with lock washers. Torque bolts to 10-13 lb. ft.

8. Install oil pan drain plug and tighten to 34-45 lb. ft. torque. Lower car from stands.

9. Remove oil level indicator and refill transmission with fluid previously drained.

> ***CAUTION: Clean all sand, gravel, or lint from floor and around oil level indicator.***

10. Set hand brake lever and run engine for several minutes to heat the oil. Check oil level with engine running and selector lever in N and add fluid necessary to bring level to full mark.

11. Check oil pressure according to instructions on page 157.

12. Replace floor hole cover and floor mat.

CONTROL VALVE ASSEMBLY—REMOVAL, OVERHAUL AND INSTALLATION

Removal

1. Place car on car stands.

2. Drain fluid from transmission oil pan into *clean container.*

3. Disconnect transmission throttle rear rod from throttle control lever (Fig. 90).

4. Disconnect gearshift control rod from shift lever at side of transmission.

5. Remove throttle control lever (7/16" wrench) and shift lever (1/2" wrench) from transmission.

6. Remove accelerator pedal and front compartment mat.

7. Lower left side of transmission as outlined on page 61, step 7.

8. Clean side of transmission as well as possible to prevent dirt from entering unit when the side cover is removed.

9. Remove side cover bolts (7/16" socket), cover and gasket.

10. Position inner detent control lever in Lo position and remove pressure regulator reverse oil pipe (Fig. 91).

11. Unhook parking brake release spring from parking brake lever pin.

12. Remove four control valve assembly attaching bolts. Work control valve assembly toward front of case to remove (Fig. 92). Governor pipes may remain either in valve body or parking brake bracket. They should be removed from the assembly in which they remained.

Overhaul

For overhaul of the control valve assembly refer to the following sections:

a. Disassembly .... Page 93
b. Cleaning and Inspection .... Page 109
c. Assembly .... Page 138

Installation

1. Install three oil delivery pipes into holes in parking brake bracket.

2. Hook parking brake release spring over inside oil delivery pipe with the hook outward and fasten other end over parking brake lever pin.

3. With detent control lever in Lo position install control valve assembly over three oil delivery pipes and reverse clutch pipe and start bolts (Fig. 98). Torque valve body bolts to 6-8 lb. ft.

4. Install pressure regulator reverse oil pipe.

5. Before installing side cover make the following checks:

a. See that pick-up pin of inside detent control lever engages neck of manual valve.

b. See that inner and outer spring washers and rubber seal are in place on the manual control shaft (Fig. 100).

6. Place new gasket on side cover and retain with petrolatum.

7. Position side cover and gasket assembly in place and start attaching bolts. Bolts with copper washers must be in bottom holes. Shift cover to centralize manual shaft in hole and torque bolts to 10-12 lb. ft.

> ***CAUTION: Bolts with copper washers must be in bottom holes to prevent leakage.***

8. Install outer shift lever and tighten clamp bolt to 10-13 lb. ft. torque. Make certain lever does not bind on side cover.

9. Connect gearshift control rod to outer shift lever.

10. Install throttle control outer lever and tighten clamp bolt to 10-12 lb. ft. torque.

11. Fasten transmission throttle rear rod to throttle control outer lever.

12. Install oil pan drain plug and tighten to 34-45 lb. ft. torque.

13. Check throttle control adjustments, shift control adjustment and starter neutralizer according to instructions in section "Adjustments on Car", page 50.

14. Lower car from stands.

15. Remove indicator and refill transmission with fluid previously drained.

> ***CAUTION: Clean all sand, gravel or lint from floor and around oil level indicator.***

16. Set hand brake and run engine for several minutes to heat the oil. Check oil level with engine running and selector lever in N and add fluid necessary to bring level to full mark.

17. Check oil pressure according to instructions on page 157.

18. Replace floor hole cover and floor mat.

PARKING PAWL AND PARKING BRAKE BRACKET REMOVAL, OVERHAUL AND INSTALLATION

Removal

Remove parking pawl and parking brake bracket assembly according to steps 1 through 14 under "Governor and Rear Oil Pump Assembly—Removal, Overhaul and Installation", (page 60).

Overhaul

For overhaul of parking brake bracket refer to the following:

a. Disassembly .... Page 96

b. Cleaning and Inspection .... Page 111

c. Assembly .... Page 140

Installation

1. Install three oil delivery pipes into parking brake bracket assembly.

2. Install parking pawl in case and hold it against top of case with one hand (Fig. 97). While holding parking pawl, place chamfered side of oil delivery sleeve over end of governor and press gently on, guiding rings into oil delivery sleeve.

3. Install roller on parking brake pawl crank. Locate parking pawl in proper position and install parking pawl support bolt. Torque to 23-28 lb. ft. and bend lock plate over flat of bolt.

4. Install parking blocker piston spring and spring stop and start bracket to case bolts. Install parking pawl return spring over inside oil delivery pipe (hook outward) and hook other end over parking brake lever pin.

5. Install reverse clutch oil pipe with "L" end in rear of transmission case.

6. Install control valve assembly over three oil delivery pipes and reverse clutch pipe and start bolts (Fig. 98). Press valve body and bracket assembly against case and torque four valve body to case bolts 6-8 lb. ft.

7. Install pressure regulator reverse oil pipe.

8. To insure proper alignment of parking brake bracket and governor, insert governor alignment tool J-4731 between governor and bracket as shown in Fig. 99. Tighten parking bracket bolts with tool in place.

9. Check position of parking blocker return spring stop if early type which mounts with only one bolt is used (see Fig. 208 for identification). The spring seat surface of the stop should be ½ to 17/32 inch from the face of the parking bracket assembly.

10. Before installing side cover make the following checks:

a. See that pick-up pin inside detent control lever engages in neck of manual valve, and that control lever indexes properly with parking brake lever.

b. See that inner and outer spring washers and rubber seal are in place on manual control shaft (Fig. 100).

11. Position side cover gasket on side cover and retain with petrolatum.

12. Position side cover and gasket assembly in place and install attaching bolts. Bolts with copper washers must be installed in the bottom holes. Shift cover to centralize manual shaft in hole and tighten bolts to 10-12 lb. ft. torque.

> ***CAUTION: Bolts with copper washers must be in the bottom holes to prevent leakage.***

13. Install outer shift lever and tighten clamp bolt to 10-13 lb. ft. torque. Make certain lever does not bind on side cover.

14. Connect gearshift control rod to outer shift lever.

15. Install throttle control outer lever and tighten clamp bolt to 10-12 lb. ft. torque.

16. Install transmission throttle rear rod.

17. Install oil pan drain plug and tighten to 34-45 lb. ft. torque.

18. Check throttle control adjustments, shift control adjustment and starter neutralizer according to instructions in section "Adjustments on Car", page 50.

19. Lower car from stands.

20. Remove oil level indicator and refill transmission with Hydra-Matic fluid which was previously drained.

> ***CAUTION: Clean all gravel, sand, or lint from floor around indicator before it is removed.***

21. Set hand brake lever firmly and run engine for several minutes. Add oil to bring level to full mark when oil is hot.

> ***NOTE:*** **Check oil level when oil is hot, engine running and control lever in N position with parking brake lever set tightly.**

22. Check oil pressure according to instructions on page 157.

23. Replace and seal floor hole covers and replace floor mat.

REAR BEARING RETAINER AND REVERSE ASSEMBLY—REMOVAL, OVERHAUL AND INSTALLATION

Removal

1. Remove governor and rear oil pump assemblies (refer to steps 1 through 18 on pages 60-62).

2. Loosen rear band adjusting screw lock nut (3/4" wrench) and loosen adjusting screw approximately five turns.

3. Remove rear bearing retainer oil seal.

4. Remove six reverse center gear and drive flange attaching bolts (1/2" wrench). Drive flange can be held from turning by bracing screw driver under drive flange bolt head.

5. Install screw driver or spacer J-2173 between the center bearing cap and rear clutch drum to prevent the drum from moving forward. The screw driver should be placed at an angle to prevent damage to the oil delivery sleeve.

> ***CAUTION: If screw driver or spacer J-2173 is not installed the rear clutch hub front thrust washer may drop from position. It will then be necessary to remove the transmission from the car to reposition this washer.***

6. Remove five rear-bearing-retainer-to-transmission-case attaching bolts and lock washers. Carefully remove rear bearing retainer and reverse assembly from transmission case.

> ***CAUTION: The selective washer may stick to the main shaft or it may remain in the counterbore of the output shaft. Be sure to remove this washer when rear bearing retainer and reverse assembly are removed. Remove stationary cone lock key.***

Overhaul

For overhaul of rear bearing retainer and reverse assembly refer to:

Installation

1. Position rear clutch hub rear thrust washer in counterbore of rear hub and retain with petrolatum.

2. Install selective washer in counterbore of output shaft and retain in place with petrolatum.

3. Install rear bearing retainer and reverse assembly into rear end of transmission case, turning output shaft to aid in engaging rear unit center gear with planet carrier pinions and aligning stationary cone lock key into keyway in case. Then align rear bearing retainer bolt holes to case.

4. Start five rear bearing retainer to case attaching bolts and lock washers and parking brake pawl support bolt and lock plate. Do not attempt to pull rear bearing retainer against case.

5. Align holes in reverse drive flange and rear drum and install six reverse drive flange bolts and lock washers. After two bolts are entered finger tight, remove screw driver or spacer J-2173. Tighten bolts to 10-13 ft. lbs. torque.

> ***CAUTION: Tighten the six bolts evenly to prevent distorting flange.***

6. Push or tap rear bearing retainer against case and tighten mounting bolts evenly to 28-33 ft. lbs. torque. Then remove parking pawl support bolt (bolt was installed to insure proper alignment between rear bearing retainer and case).

7. Test for freeness by holding rear unit drum and turning output shaft.

8. Install rear bearing retainer oil seal.

9. Install governor and rear oil pump assemblies as outlined in steps 1 through 30 on pages 63-65.

10. Adjust front and rear bands as outlined on page 54.

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REMOVING THE HYDRA-MATIC TRANSMISSION

The Hydra-Matic transmission, rear flywheel housing, torus cover, and torus members are removed as an assembly. To remove assembly, proceed as follows:

1. Raise the car sufficiently to set on car stands so all wheels clear the floor approximately 8″.

2. Drain transmission oil pan.

3. Remove the accelerator pedal and front compartment mat.

4. Remove floor hole covers over rear flywheel housing upper bolts (Fig. 102).

5. Disconnect speedometer cable and housing at transmission.

6. Disconnect propeller shaft at differential flange and slide propeller shaft from transmission output shaft.

7. Remove crankcase ventilator outlet pipe and loosen exhaust pipe bracket on exhaust pipe to facilitate removal of flywheel housing bottom cover.

8. Remove flywheel housing bottom cover.

9. Drain oil from torus cover by removing the pipe plug using a six-point socket.

10. Disconnect hand brake cables at cross lever and remove cross lever.

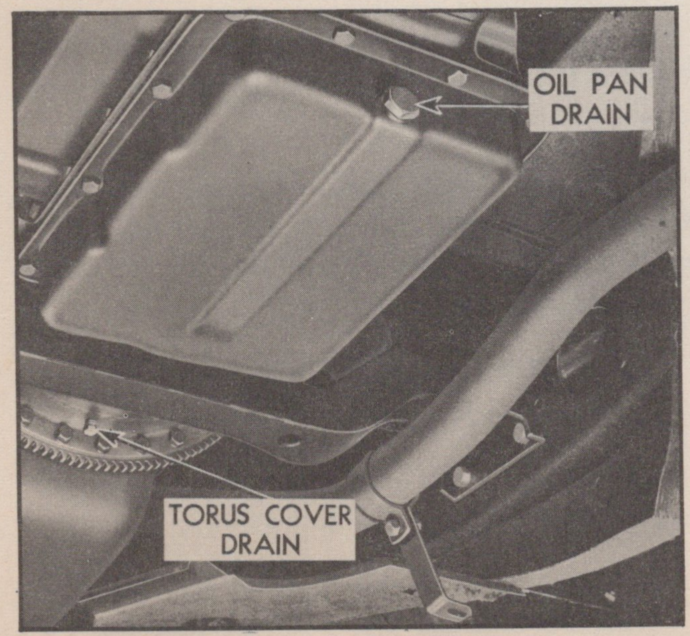

Fig. 101—Hydra-Matic Fluid Drain Points

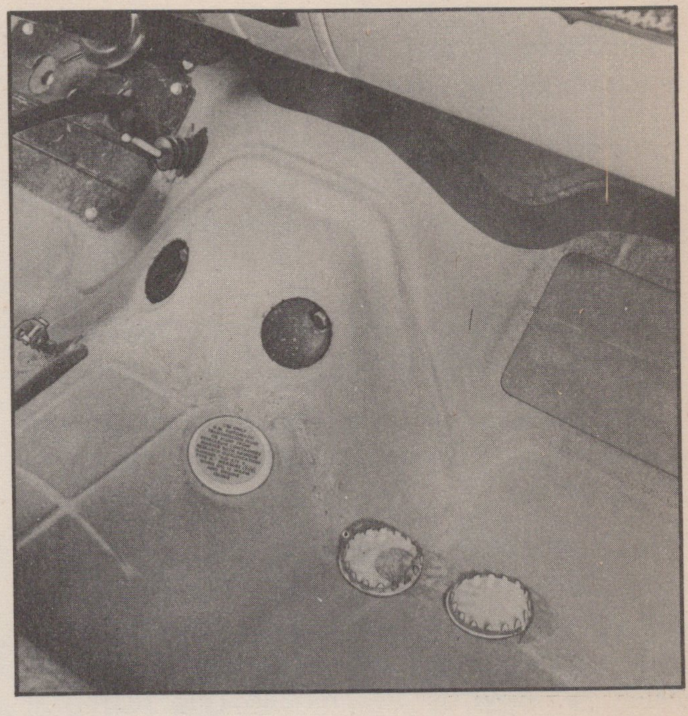

Fig. 102—Floor Hole Covers Removed

11. On cars equipped with underseat heater it will be necessary to remove the heater to radiator rear tube in order to permit removal of the engine rear support cross member. To enable removal of the heater tube without draining radiator and block proceed as follows:

a. Make two (2) clamps by using two rear engine support to cross member plates, two bolts (approximately 1½″ long), and two nuts for each clamp.

b. Install a clamp on the rubber hose below the heater that attaches to the heater to radiator rear tube. Tighten clamp to prevent flow of coolant from the heater.

c. Remove clamp in the X member that holds the heater to radiator rear tube and defroster to heater tube.

d. Loosen heater hose clamp at the front of the heater to radiator rear tube to permit tube to move from hose. Do not remove tube from hose.

e. Slip heater to radiator rear tube back far enough to permit installation of second clamp. Tighten clamp to prevent coolant from escaping.

f. Remove heater to radiator rear tube.

g. Proceed in the removal of the transmission.

12. Remove throttle control lever (outer) from shaft at side of transmission.

13. Disconnect gear shift control rod assembly from shift lever at side of transmission.

> ***NOTE:*** **Hand brake cable may be wrapped around lower control rods to hold them clear when transmission is lowered.**

14. Remove the 30 torus cover to flywheel attaching bolts and lock washers.

15. Disconnect two rear engine mountings and reinforcing plates from the cross member (two bolts per mounting).

16. With a 4″ x 4″ x 10″ block of wood held on a hydraulic floor jack pad and placed between the rear and center of engine oil pan, raise the back end of engine until the rear engine mountings are approximately ½″ above the cross member (Fig. 103).

> ***CAUTION: Do not raise engine more than is necessary to remove cross member. To give clearance for transmission jack, position engine jack with handle to side of car.***

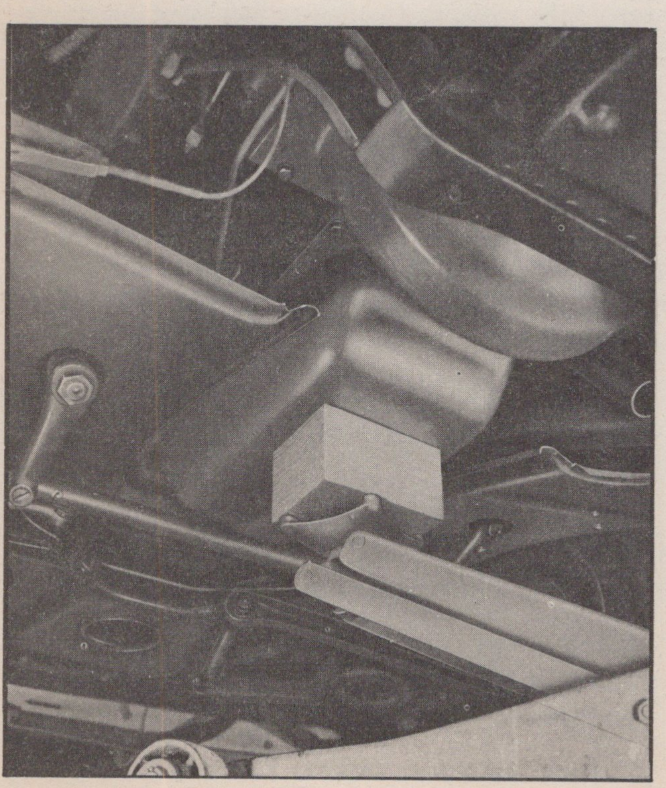

Fig. 103—Raising Rear End of Engine

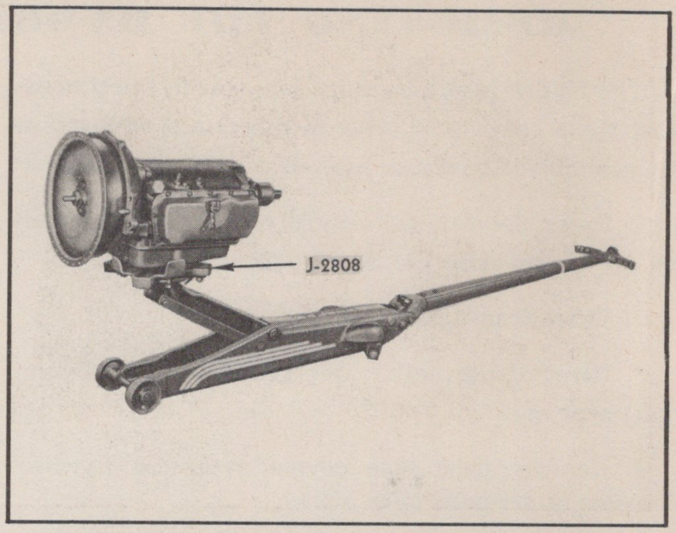

Fig. 104—Transmission on Tool J-2808 and Jack

17. Remove six cross member to frame side rail bolts (three bolts on each side) and remove reinforcing plates from inside of side rails.

18. To remove cross member, tap both ends of cross member down until right end is resting on exhaust pipe. Then tap left end down until it clears the frame side rail. Lift right end over exhaust pipe and remove.

> ***NOTE:*** **Observe position of cross member so left side can be distinguished from right when reinstalling.**

19. Lower engine to normal position so that rear flywheel housing upper attaching bolts are accessible through floor hole.

20. Place hydraulic jack with tool J-2808 under transmission, handle to rear of car, and lift transmission slightly to take strain off rear flywheel housing attaching bolts.

> ***CAUTION: Tool J-2808 must be fastened securely to jack pad to prevent slipping.***

21. Remove six rear housing to front flywheel housing attaching bolts and lock washers.

> ***NOTE:*** **The lower two bolts on each side of rear housing also hold the rear engine mountings to housing.**

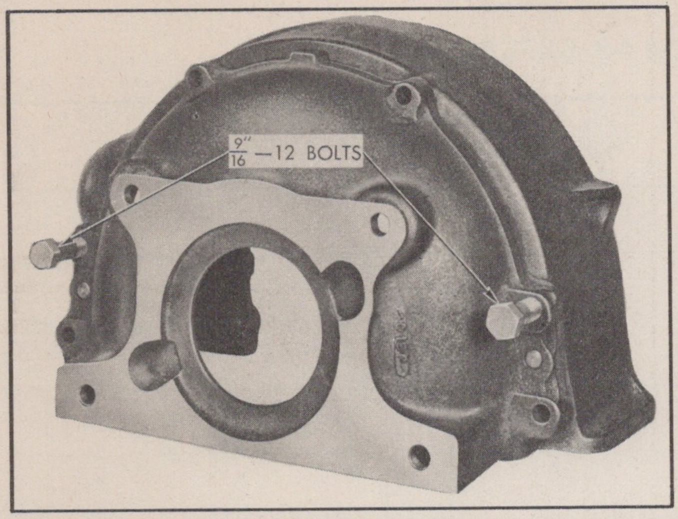

Fig. 105—Removing Dowel Pins from Housing

22. Enter two 9/16" — 12 bolts into rear flywheel housing (one on each side) just above dowel pins (center hole on either side). Thread bolts into housing to remove rear housing dowel pins from front flywheel housing. After dowel pins are free of front housing, remove the two bolts (Fig. 105).

23. Remove transmission assembly by moving the transmission toward rear of car and at the same time lowering assembly to the floor.

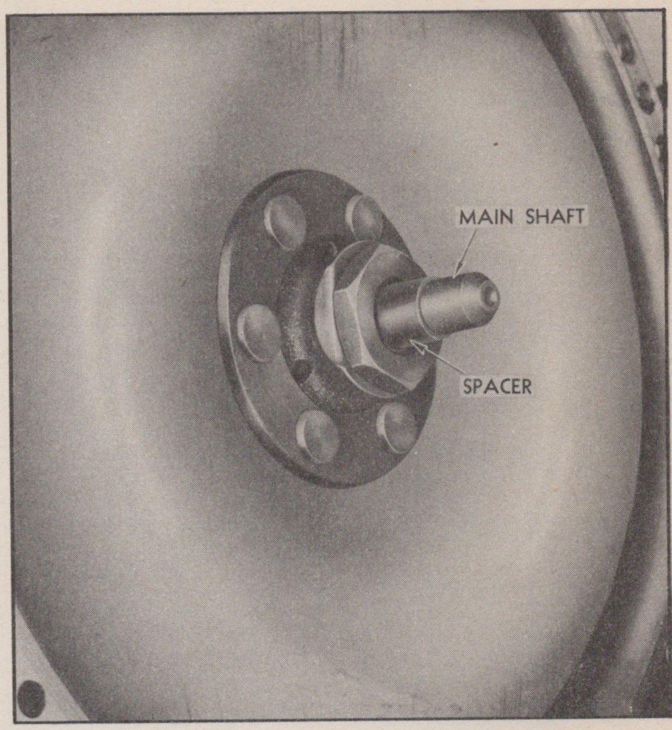

Fig. 106—Pilot Bearing Spacer on Main Shaft

24. Remove pilot bearing spacer from end of main shaft (Fig. 106).

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DISASSEMBLY PROCEDURE

CONTENTS OF THIS SECTION

REMOVE TORUS MEMBERS, TORUS COVER AND FLYWHEEL REAR HOUSING FROM TRANSMISSION

1. Remove oil level indicator from transmission case.

2. Place transmission and fluid coupling assembly in fixture on bench (Fig. 107).

3. Move shift lever on side of transmission toward rear to reverse position (Fig. 108).

4. Straighten main shaft nut lock washer, using chisel and a light hammer.

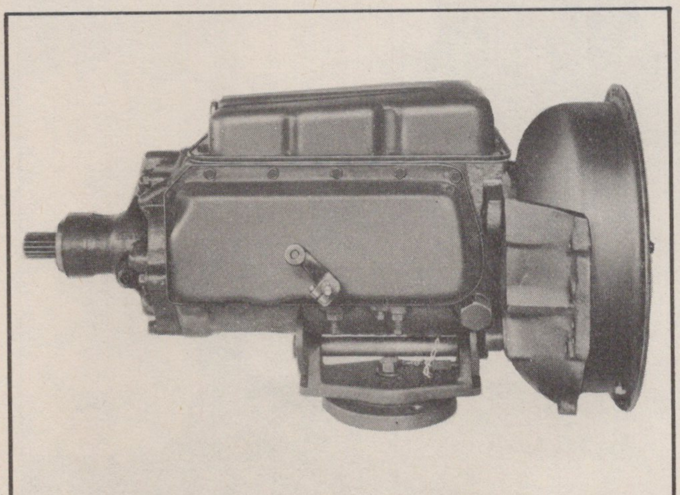


Fig. 107—Transmission Mounted in Holding Stand J-2541

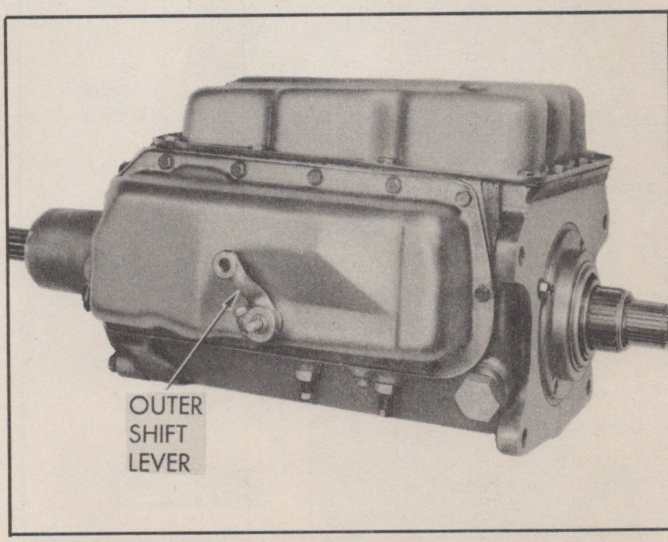


Fig. 108—Outer Shift Lever in Reverse Position

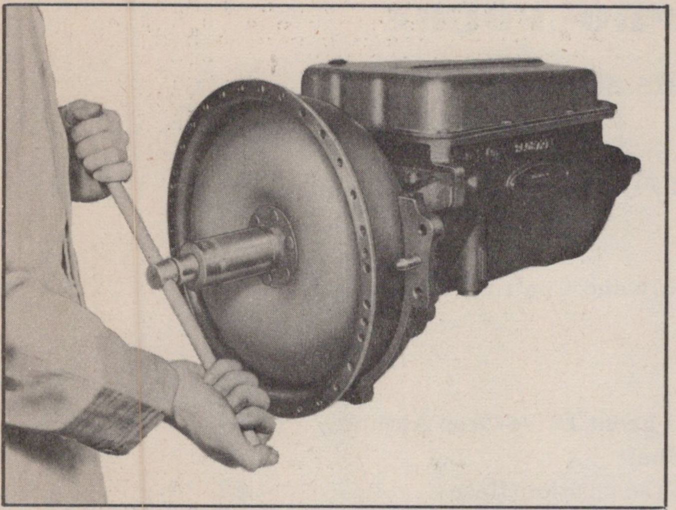


Fig. 109—Removing Main Shaft Nut

5. Remove main shaft nut, using 1$\frac{7}{16}$" socket (Fig. 109).

6. Slide driven torus off front end of transmission main shaft.

> ***NOTE:*** **If torus sticks, tap end of main shaft with rawhide or similar hammer. At same time, pull out at hub of torus member.**

7. Remove driving torus snap ring (Fig. 110).

8. Remove driving torus assembly (Fig. 111.)

> ***CAUTION: Do not attempt to remove torus cover and driving torus together.***

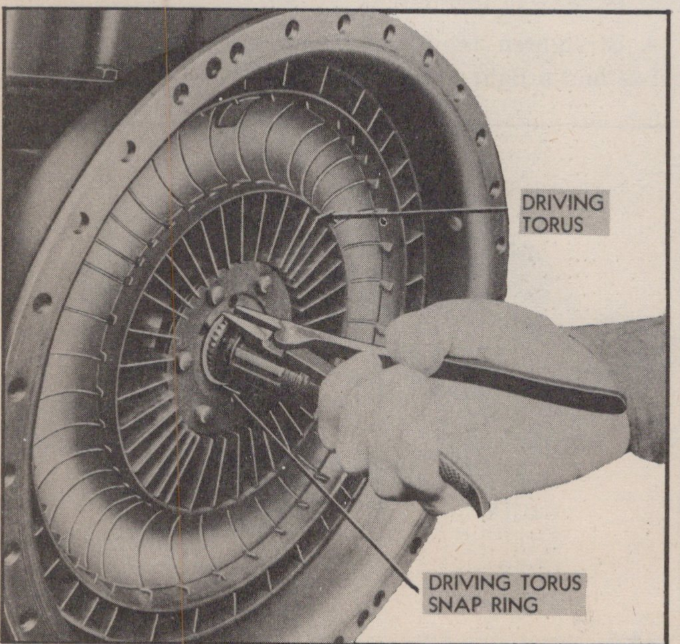


Fig. 110—Removing Torus Snap Ring

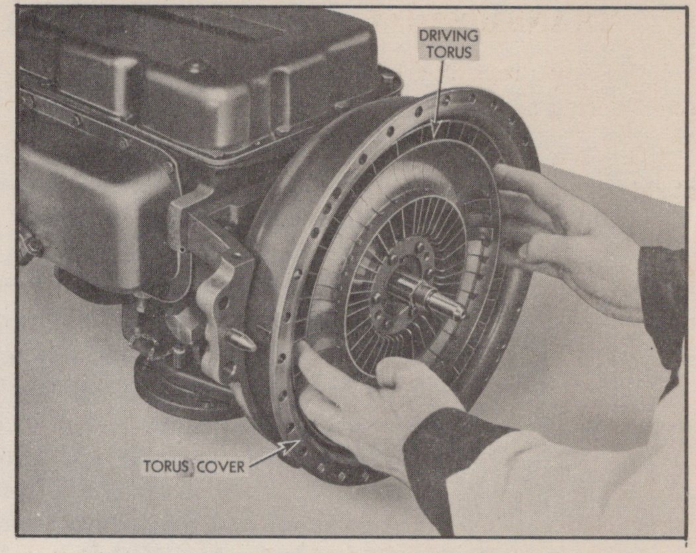


Fig. 111—Removing Driving Torus

9. Remove torus cover. Do not attempt to remove torus cover by pulling and pushing on cover in a rough manner as this may result in a broken oil seal ring. Work hub of torus cover back through oil seals gently, and then pull torus cover off with a quick jerk.

10. Remove four bolts and lock washers holding flywheel rear housing to front of transmission case. Remove flywheel rear housing and gasket (¾" socket) (Fig. 112).

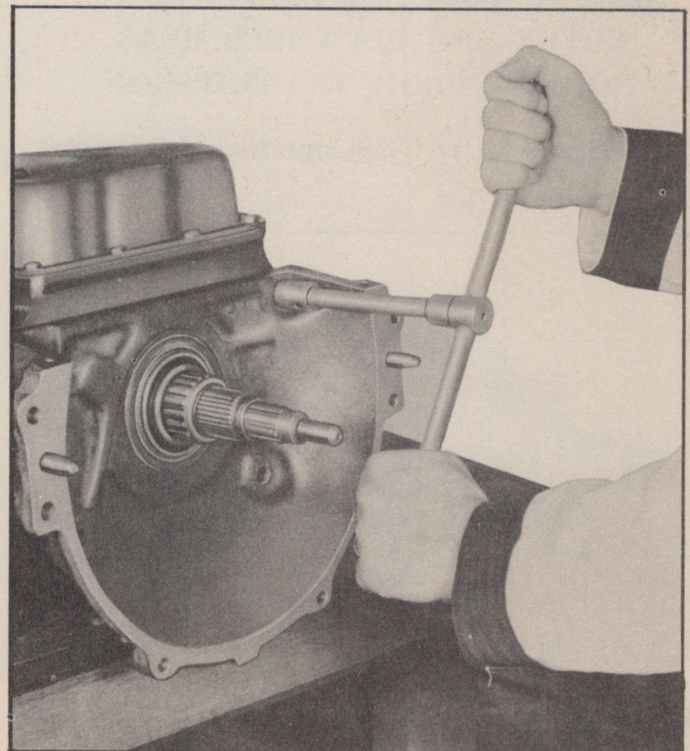


Fig. 112—Removing Flywheel Rear Housing

TRANSMISSION DISASSEMBLY

1. Remove rear bearing retainer seal shield from rear bearing seal.

2. Loosen clamp bolt holding shift lever to shaft at side of transmission, and remove lever (½" socket).

3. Remove driven torus snap ring from main shaft (Fig. 113) using snap ring pliers.

4. Remove oil pan bolts and lock washers (½" socket). Remove oil pan gasket.

5. Remove side cover bolts and cover gasket (7/16" socket).

6. Remove oil pan screen by lifting from rear oil pump intake pipe, and slide screen toward rear from the front pump intake pipe.

7. Straighten two front oil pump intake pipe lock plates. Loosen bolts while lifting slightly on pipe to avoid dropping bolts (7/16" socket).

8. Lift front oil pump intake pipe, bolts, lock plates and paper gasket from transmission.

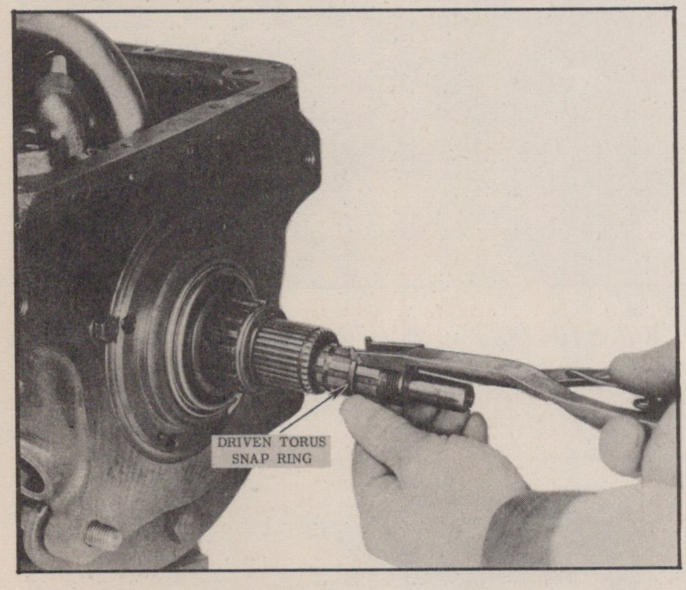


Fig. 113—Removing Driven Torus Snap Ring

REMOVE PARKING BRAKE BRACKET ASSEMBLY AND CONTROL VALVE ASSEMBLY

1. Back off front and rear band adjusting screws at least 5 turns.

2. Remove parking brake pawl support bolt (9/16" socket) from rear of case and position anchor down in case as far as it will go (Fig. 114). (Pawl cannot be removed at this time.)

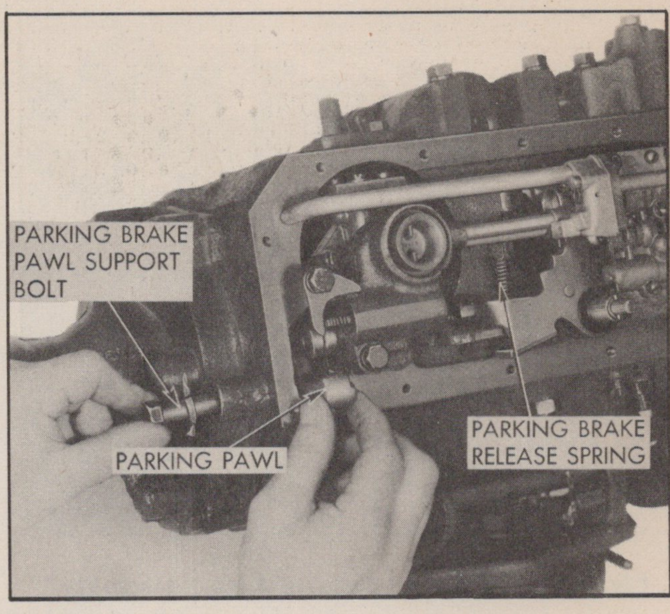


Fig. 114—Positioning Parking Pawl

3. With screw driver remove pressure regulator reverse oil pipe (Fig. 115). (Use very light pressure to avoid bending oil pipe.)

4. Loosen the two bolts holding the bracket assembly to the transmission case.

5. Place detent control lever in Lo position.

6. Unhook parking brake release spring from pin assembly and inner oil delivery pipe (Fig. 114).

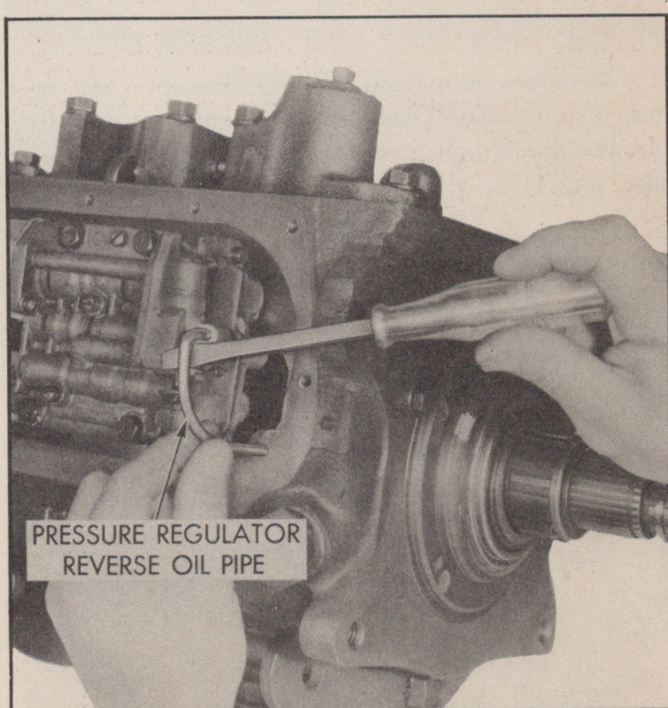


Fig. 115—Removing Pressure Regulator Reverse Oil Pipe

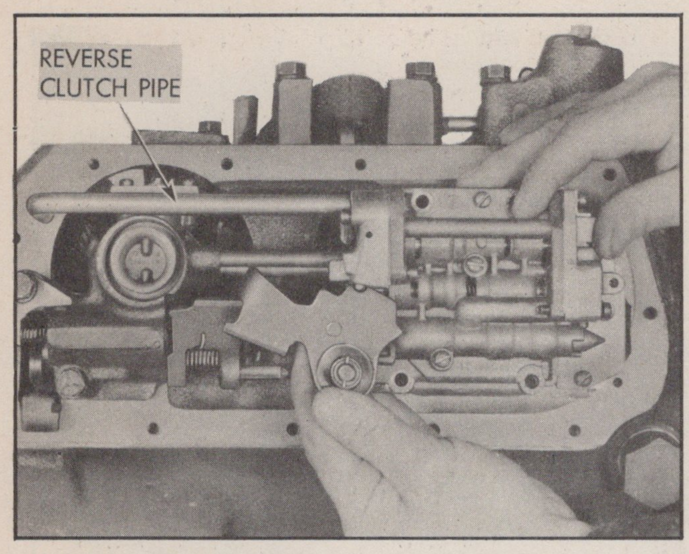


Fig. 116—Removing Control Valve Assembly

7. Remove the four bolts holding the control valve assembly to the transmission case.

8. Work control valve assembly toward the front of the case to remove governor pipes and reverse clutch pipe (Fig. 116).

9. Pipes may remain with either control valve assembly or bracket assembly. Remove pipes from either assembly.

> ***NOTE:* Wrap control valve assembly in clean rag to prevent damage.**

10. Remove reverse clutch oil pipe from case.

11. Remove bolts from bracket assembly and remove piston release spring stop and spring. Carefully remove sleeve from governor to avoid damage to oil rings (Fig. 117).

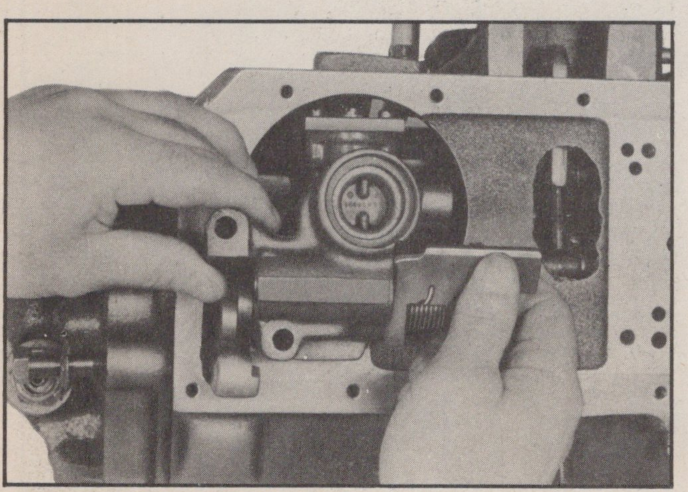


Fig. 117—Removing Parking Brake Bracket Assembly

12. Remove parking pawl support bolt and parking pawl from case.

REMOVE SERVOS AND REAR OIL PUMP

1. Remove front and rear servo attaching bolts (9/16" wrench).

2. Remove rear oil pump attaching bolts (1/2" wrench).

3. Separate front and rear servos at oil transfer pipe by moving rear servo toward rear of transmission (Fig. 118). Remove rear servo.

4. Remove rear pump discharge pipe (Fig. 119).

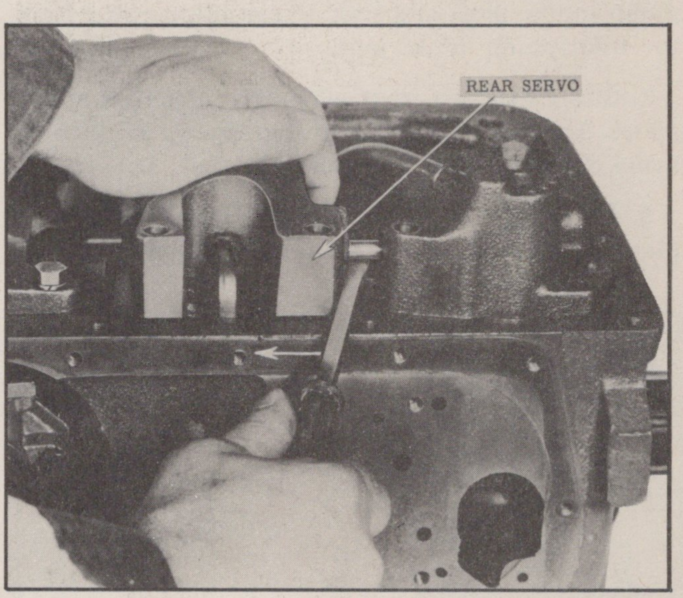


Fig. 118—Moving Rear Servo Toward Rear of Transmission

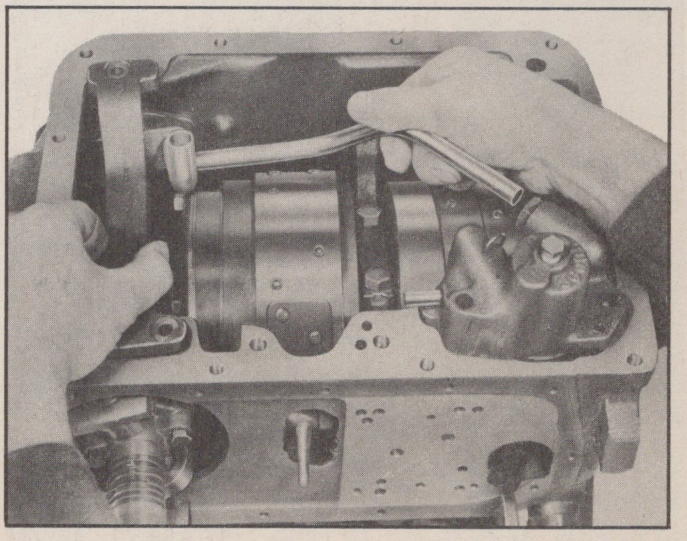


Fig. 119—Removing Rear Pump Discharge Pipe

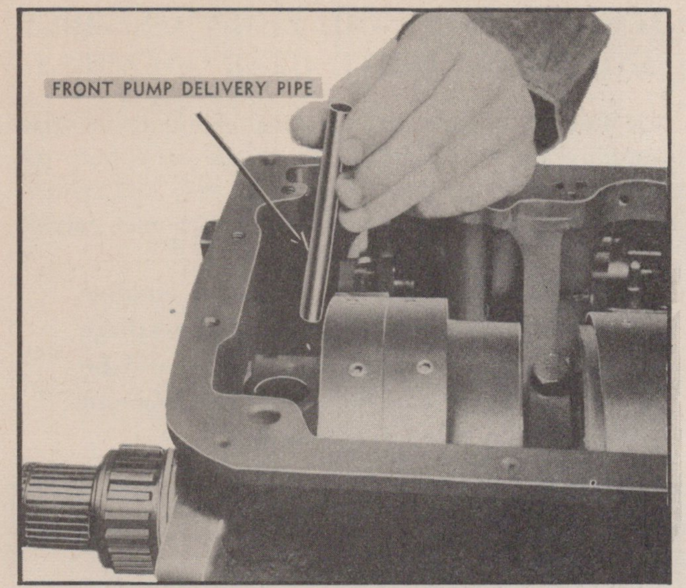


Fig. 120–Removing Front Pump Delivery Pipe

5. Remove front servo, pulling straight up from case, off of front pump delivery pipe.

6. Remove front pump delivery pipe by pulling straight up from front pump (Fig. 120).

7. Position governor so that the large round governor weight is toward the front of the transmission.

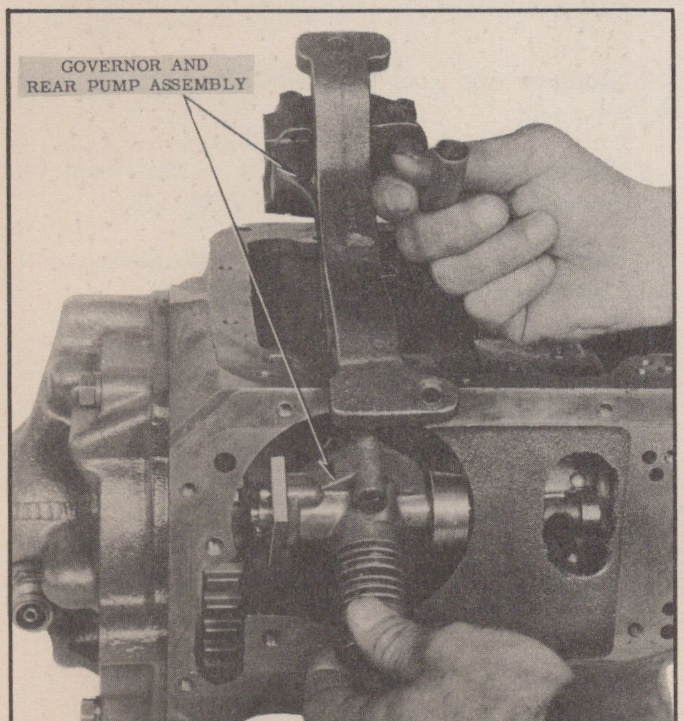


Fig. 121–Removing Governor and Rear Pump Assembly

8. Position one reverse drive flange attaching bolt up.

9. Remove governor and rear pump assembly by moving toward control valve assembly side of transmission case and lift to clear case (Fig. 121).

REMOVE PRESSURE REGULATOR ASSEMBLY

1. Loosen pressure regulator valve plug in transmission case (1¼" wrench).

CAUTION: Pressure regulator valve assembly is under spring pressure.

2. Hold pressure against regulator plug while unscrewing plug by hand.

3. Remove plug, spring and valve from side of transmission case (Fig. 122).

Fig. 122–Removing Pressure Regulator Assembly

CHECK END CLEARANCE OF MAIN SHAFT

1. Install main shaft end play guide J-2587 over main shaft and front planet carrier.

2. Set up dial indicator on transmission case using tool J-1465.

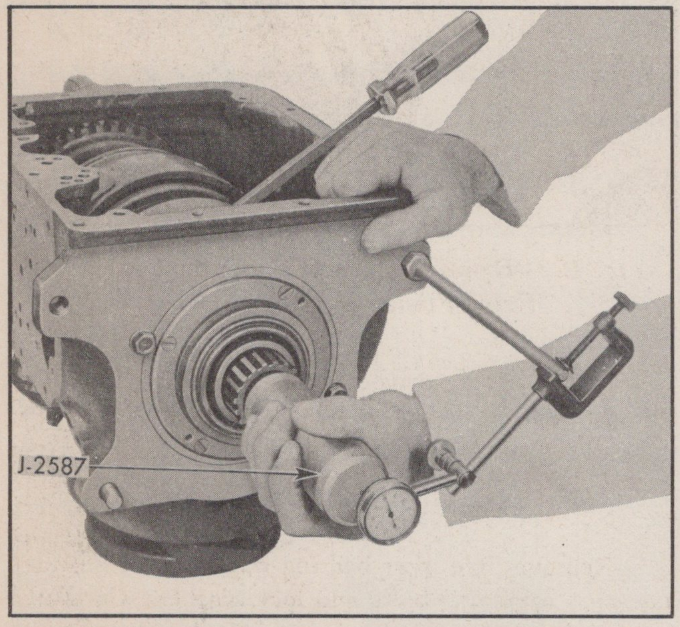


Fig. 123—Checking Main Shaft End Play

3. Insert screw driver between front clutch drum and center bearing cap, holding front planet unit forward. The screw driver should be placed at an angle to prevent damage to the oil delivery sleeve.

4. Move main shaft back and forth (Fig. 123). End clearance should be .004″ to .015″. Be sure to get just free main shaft end play. Forcing main shaft will give inaccurate reading.

> ***NOTE:*** **Record amount of end clearance so that the proper selective washer can be installed when the transmission is reassembled.**

5. Remove screw driver from between front clutch drum and center bearing cap.

6. Remove dial indicator and main shaft end play guide.

REMOVE FRONT OIL PUMP ASSEMBLY AND FRONT DRIVE GEAR ASSEMBLY

1. Remove snap ring holding front drive gear assembly on front end of front planet carrier assembly using snap ring pliers (Fig. 124) and remove steel and bronze thrust washers from planet carrier.

> ***NOTE:*** **These washers have a smaller outside diameter than similar washers used in the transmission and should be tied together and kept separate to avoid confusion when reassembling.**

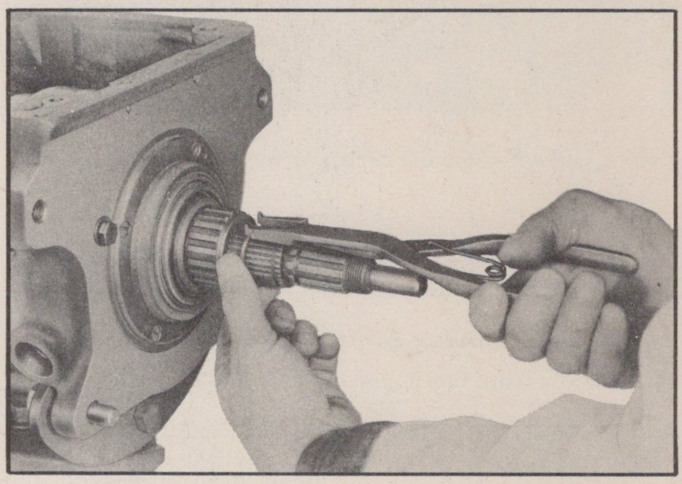


Fig. 124—Removing Front Drive Gear Snap Ring

2. Remove two front oil pump cover to case bolts (7/16″ wrench).

3. Remove front pump locating washer from its counterbore using snap ring pliers (Fig. 125).

4. Remove front oil pump assembly, gasket, and front drive gear as an assembly.

> ***NOTE:*** **Tap lightly from rear of pump with light hammer and brass drift if necessary.**

5. Remove bronze thrust washer from front end of planet carrier.

REMOVE REVERSE ASSEMBLY AND MAIN SHAFT

1. Remove rear bearing retainer oil seal (Fig. 126).

2. Remove six reverse center gear and drive flange attaching bolts (1/2″ wrench). Drive flange can be held from turning by bracing screw driver under drive flange bolt head (Fig. 127).

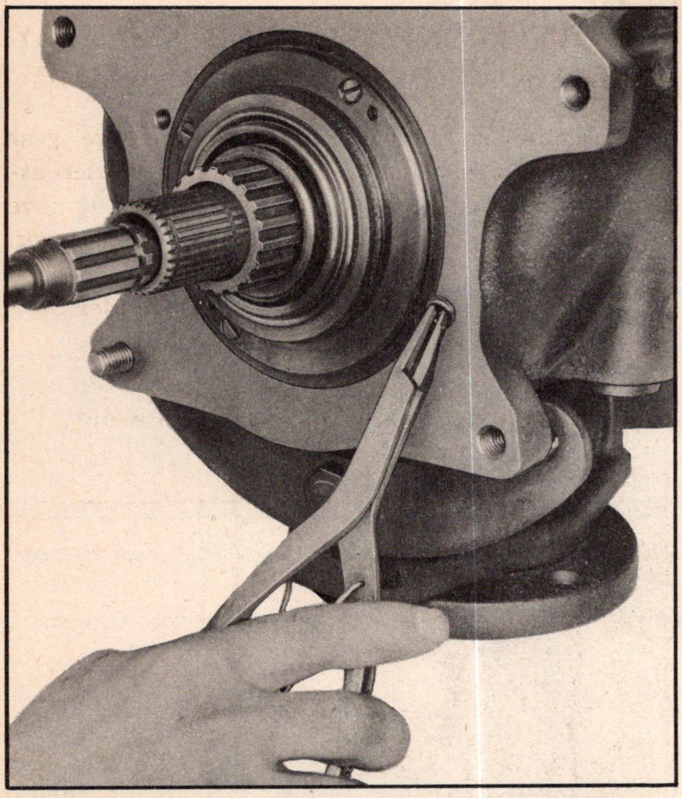


Fig. 125—Removing Front Pump Locating Washer

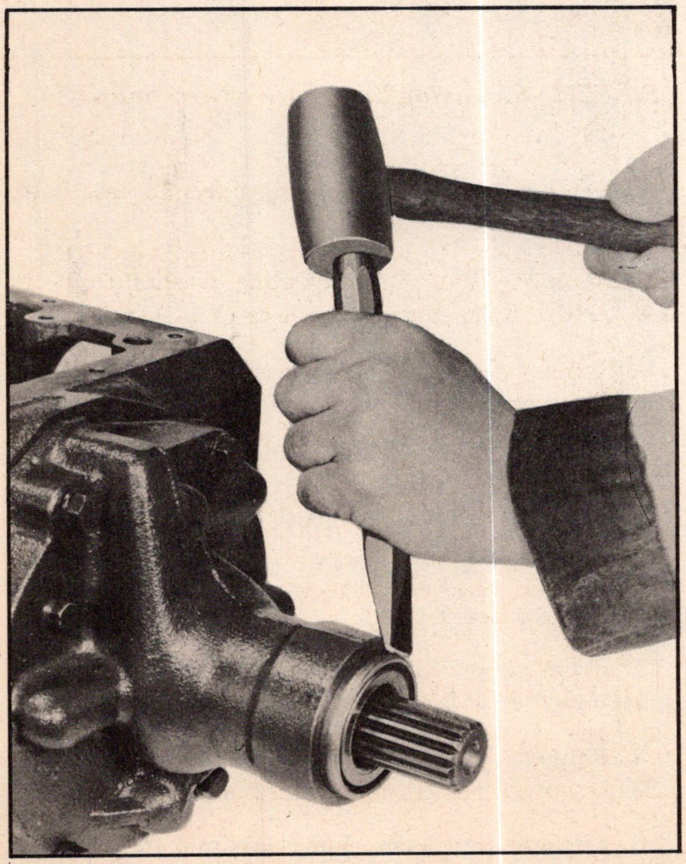


Fig. 126—Removing Rear Bearing Retainer Oil Seal

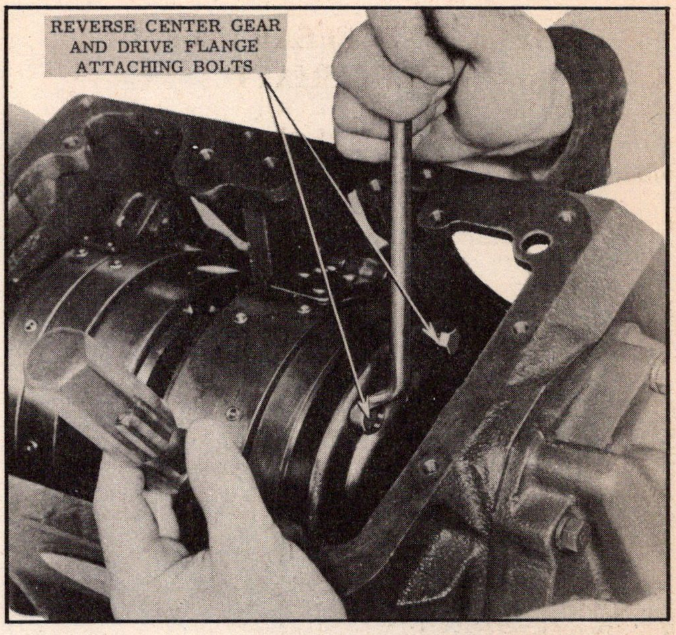


Fig. 127—Removing Reverse Center Gear and Drive Flange Attaching Bolts

3. Install screw driver or spacer J-2173 between the center bearing cap and rear clutch drum to prevent the drum from moving forward. The screw driver should be placed at an angle to prevent damage to the oil delivery sleeve (Fig. 128).

4. Remove five rear-bearing-retainer-to-transmission-case attaching bolts and lock washers. Carefully remove reverse assembly from transmission case (Fig. 128). If assembly sticks, tap on front end of main shaft with rawhide or similar type hammer. Remove stationary cone lock key.

> ***CAUTION:** The selective washer may stick to the main shaft or it may remain in the counterbore of the output shaft. Be sure to remove this washer when reverse assembly is removed.*

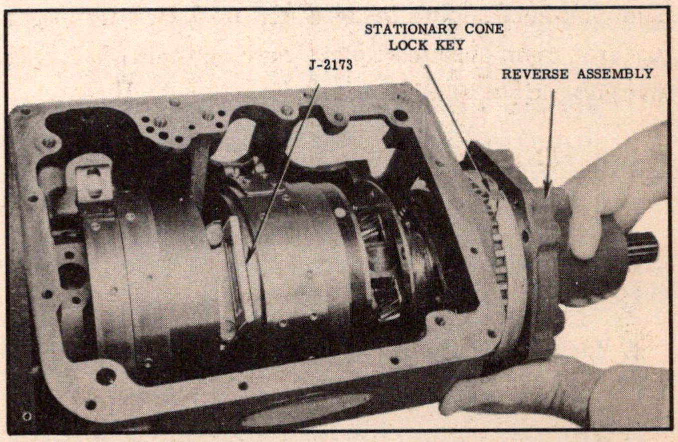


Fig. 128—Removing Reverse Assembly

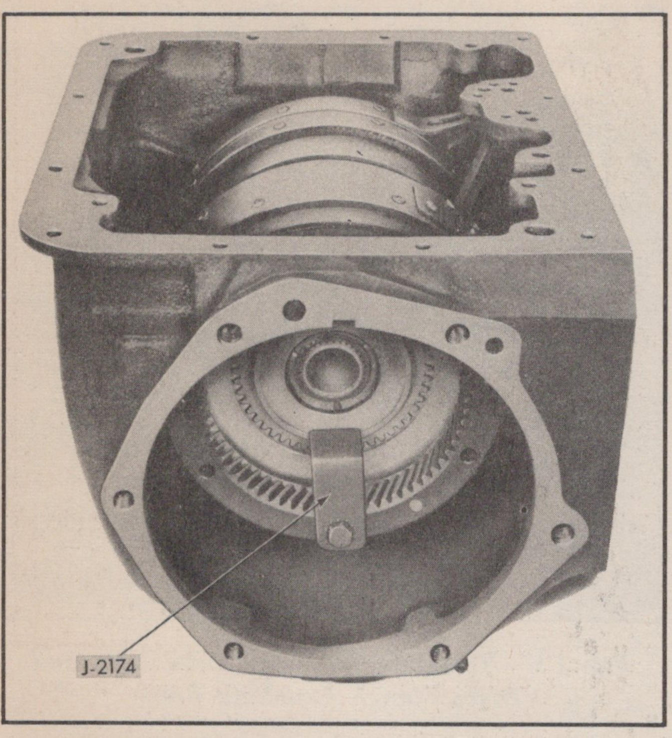


Fig. 129—Rear Hub Holding Tool Installed

5. Remove main shaft from front planet carrier through rear of transmission.

6. Remove bronze thrust washer from rear clutch hub.

7. Install rear hub holding tool and remove screw driver from in front of rear unit (Fig. 129).

REMOVE FRONT AND REAR UNITS FROM TRANSMISSION CASE

1. Using a light hammer and chisel, bend back edges of lock plate under two center bearing cap attaching bolts.

2. Remove two center bearing cap to case bolts and lock plate (5/8″ socket).

> ***NOTE:*** **It may be necessary to equalize distance by moving front and rear clutch drums to allow socket wrench to seat on bolt head.**

3. Remove rear band and strut assembly. Lift rear unit to allow the band to slide clear of drum while in the case.

4. Install suitable spring or wire to hold front band on front unit drum (Fig. 130).

5. Lift both front and rear planet assemblies with band from transmission case (Fig. 131).

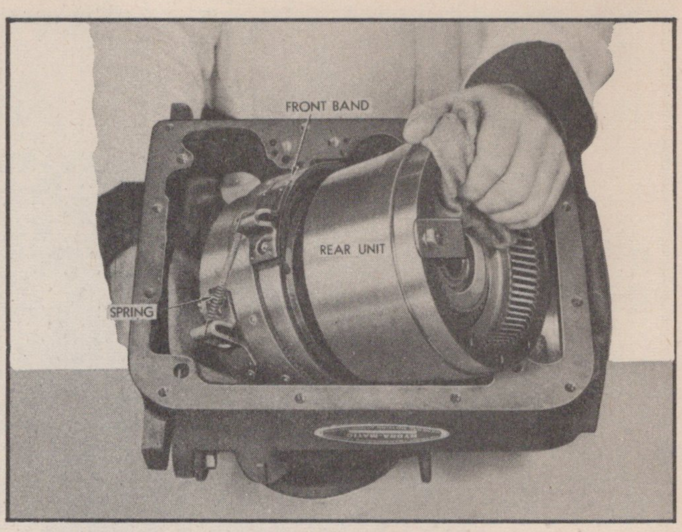


Fig. 130—Spring Holding Front Band on Drum

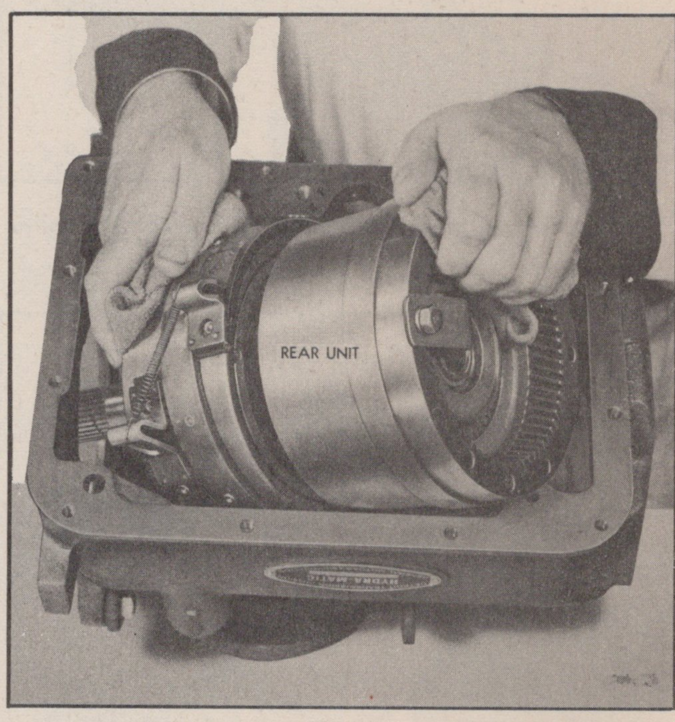


Fig. 131—Removing Units from Case

REMOVE FRONT AND REAR UNITS FROM PLANET CARRIER

1. Remove front band.

2. Place planet carrier with front and rear planet assemblies into holding fixture J-2187 (Fig. 132).

3. Remove rear clutch hub rear snap ring (Fig. 133).

4. Lift rear unit from planet carrier.

5. Remove rear clutch hub front snap ring from planet carrier.

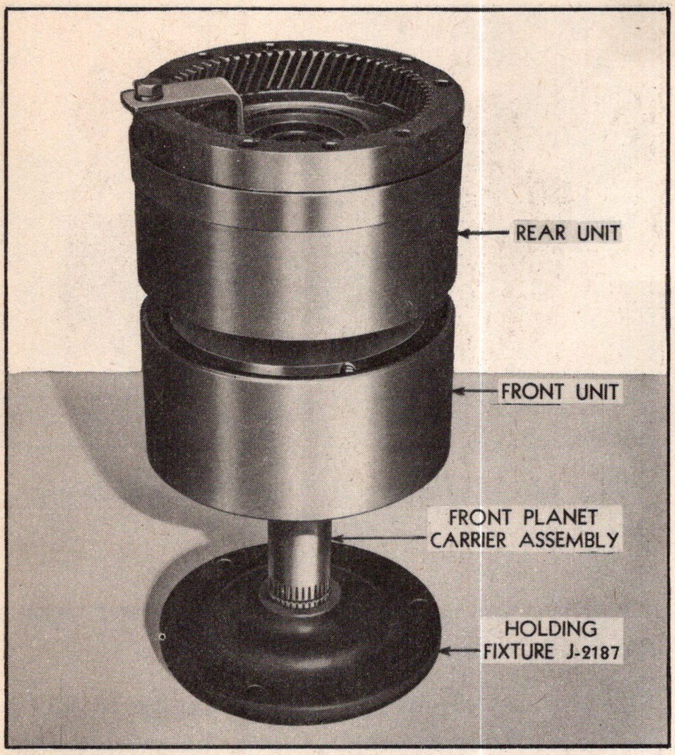


Fig. 132—Front and Rear Units and Holding Fixture

6. Remove center bearing cap from oil delivery sleeve.

7. Remove oil delivery sleeve from planet carrier.

8. Remove snap ring from recess in front unit (Fig. 134).

CAUTION: Hold snap ring open while lifting from carrier to avoid damaging bearing surface.

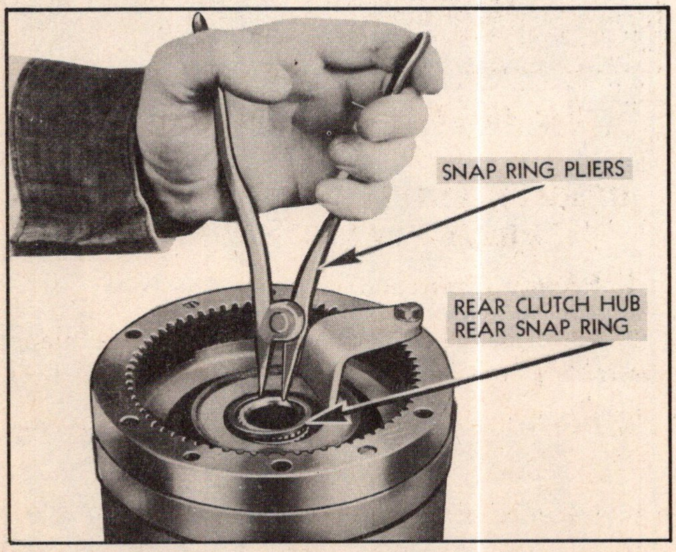


Fig. 133—Removing Rear Clutch Hub Rear Snap Ring

Fig. 134—Removing Snap Ring from Recess in Front Unit

9. Lift front unit assembly from planet carrier.

10. Remove steel and bronze thrust washers from recess of front unit.

DISASSEMBLY OF INDIVIDUAL UNITS

Disassembly of Front Unit

1. Place front unit assembly in press and remove clutch drum snap ring (Fig. 135).

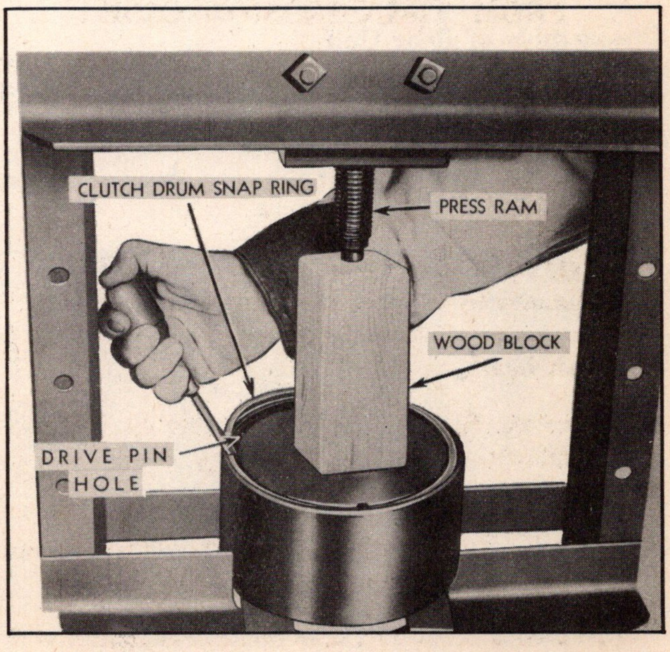


Fig. 135—Removing Clutch Drum Snap Ring

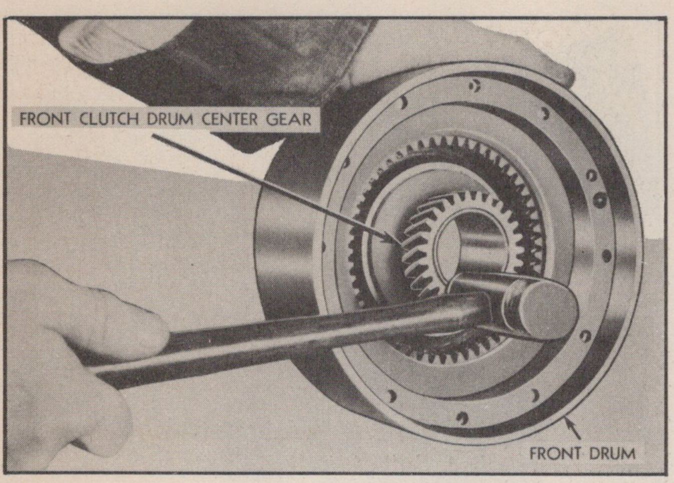


Fig. 136—Removing Front Clutch Drum from Front Unit Drum

2. Separate drums by tapping front face of center gear on front clutch drum with rawhide or similar hammer (Fig. 136).

3. Remove front clutch annular piston from clutch drum by bumping front face of center gear on soft wood block (Fig. 137).

4. Remove six inner and six outer front clutch release springs from front unit drum.

5. Remove four composition clutch drive and four steel clutch driven plates from drum (3 of each on 6 cyl. transmission).

6. Remove rubber piston seals and brass expanders from annular piston and clutch drum piston. Use blunt edge screw driver (Fig. 138).

Disassembly of Rear Unit

1. Remove rear clutch hub retainer tool J-2174 from rear unit drum.

2. Remove rear clutch hub and bronze thrust washer.

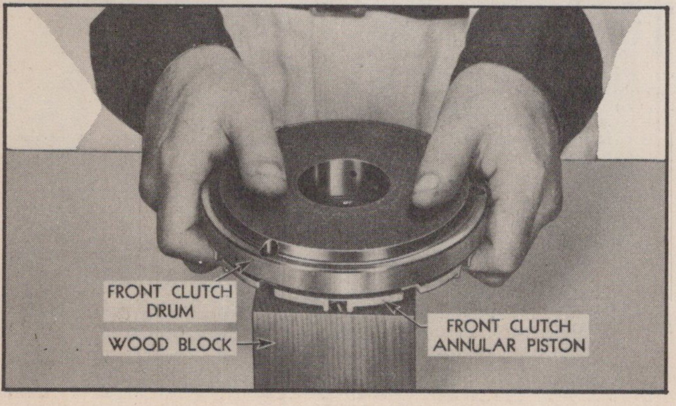


Fig. 137—Removing Annular Piston

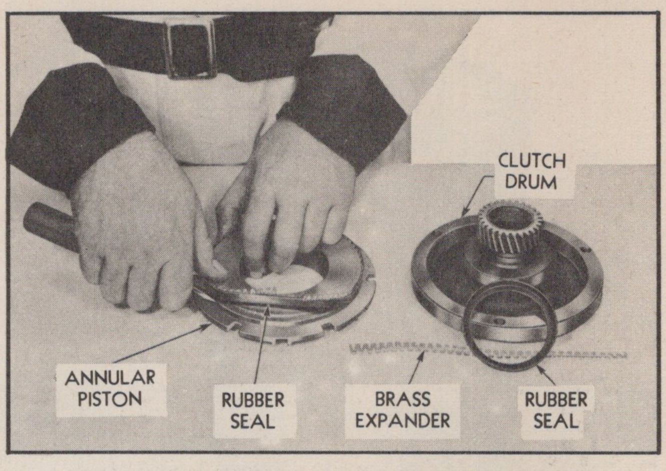


Fig. 138—Removing Rubber Seals and Brass Expanders

3. Place rear unit assembly in a press and remove clutch drum snap ring (Fig. 139).

4. Separate drums by tapping lightly on clutch drum rear thrust face, using block of wood and hammer (Fig. 140).

5. Remove six inner and six outer clutch release springs and six guide pins (Fig. 141). Separate springs for inspection.

6. Remove seven composition and seven steel clutch plates (6 each on 6 cyl. transmission).

7. Remove annular piston from clutch drum by tapping clutch drum rear thrust face on block of wood (Fig. 142).

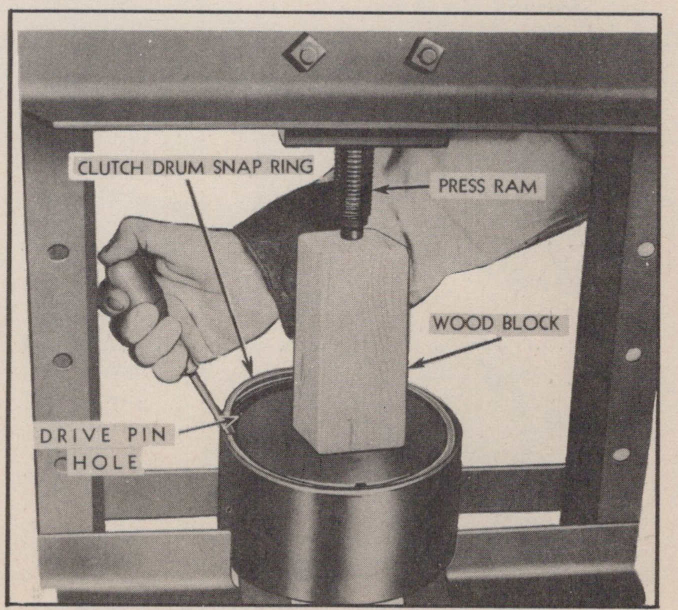


Fig. 139—Removing Clutch Drum Snap Ring

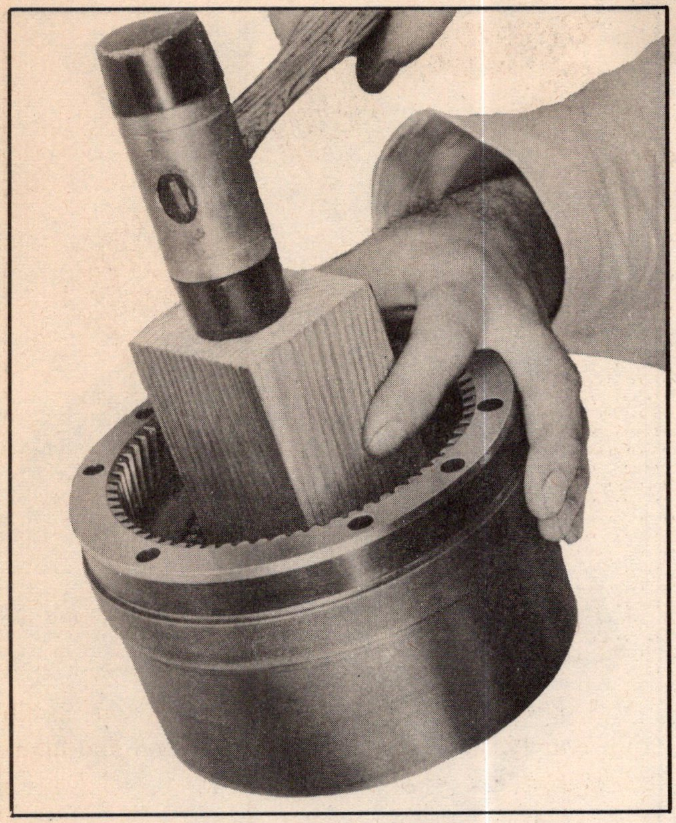


Fig. 140—Removing Rear Unit Clutch Drum

8. Remove rubber seals and brass expanders from annular piston and rear unit clutch drum.

***NOTE:* If necessary to replace the internal gear, remove the two fillister head**

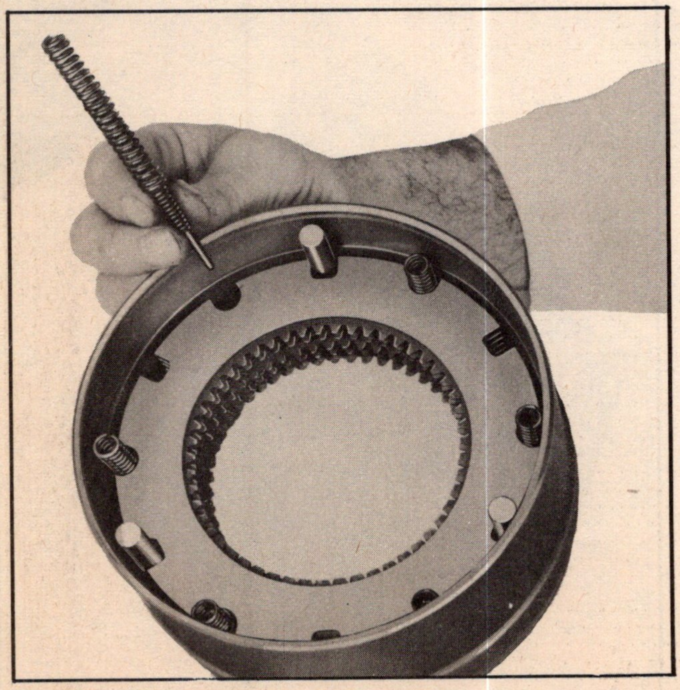


Fig. 141—Removing Clutch Release Springs and Guide Pins

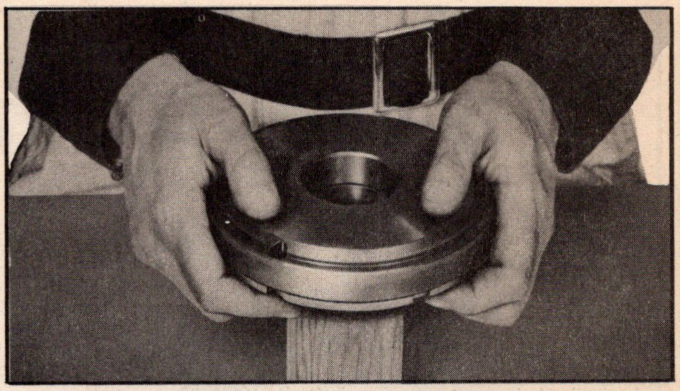


Fig. 142—Removing Annular Piston from Clutch Drum

screws that attach the gear to the drum and remove the gear. This gear should not be removed from the drum unless replacement is necessary.

Disassembly of Reverse Unit

1. Remove speedometer driven gear and sleeve assembly from rear bearing retainer (1" wrench).

2. Remove snap ring on output shaft inside of rear bearing retainer at ball bearing. This snap ring is smaller than other snap rings used in the transmission (Fig. 143).

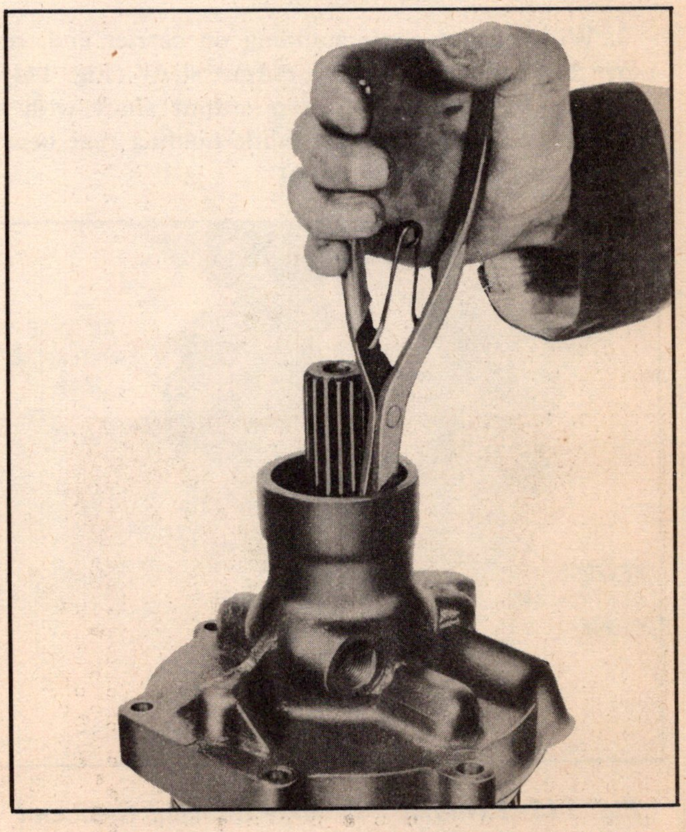


Fig. 143—Removing Snap Ring on Output Shaft

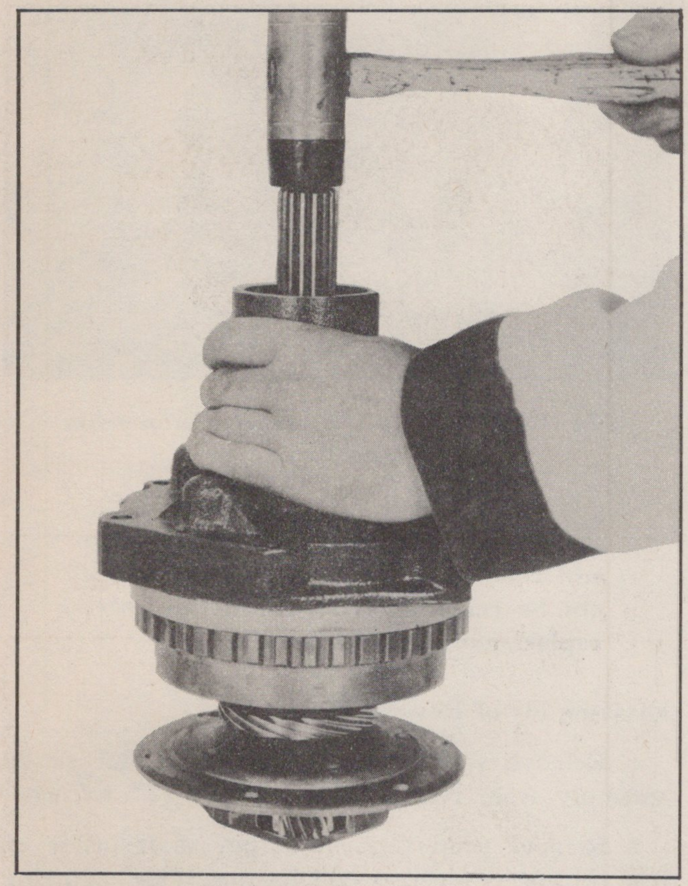


Fig. 144—Removing Rear Bearing Retainer from Output Shaft

Fig. 146—Removing Snap Ring Locating Ball Bearing

3. With output shaft standing on carrier end, remove bearing retainer from output shaft (Fig. 144). (It may be necessary to tap output shaft with a rawhide or similar hammer while holding rear bearing retainer to separate units.)

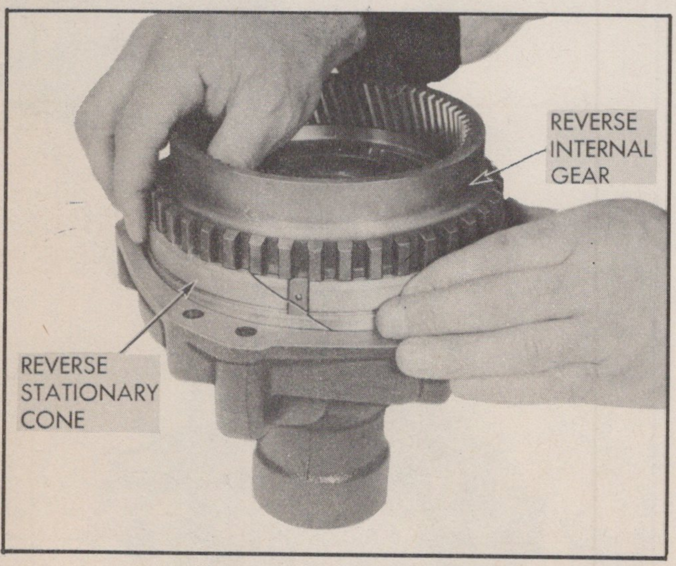


Fig. 145—Removing Reverse Internal Gear and Stationary Cone

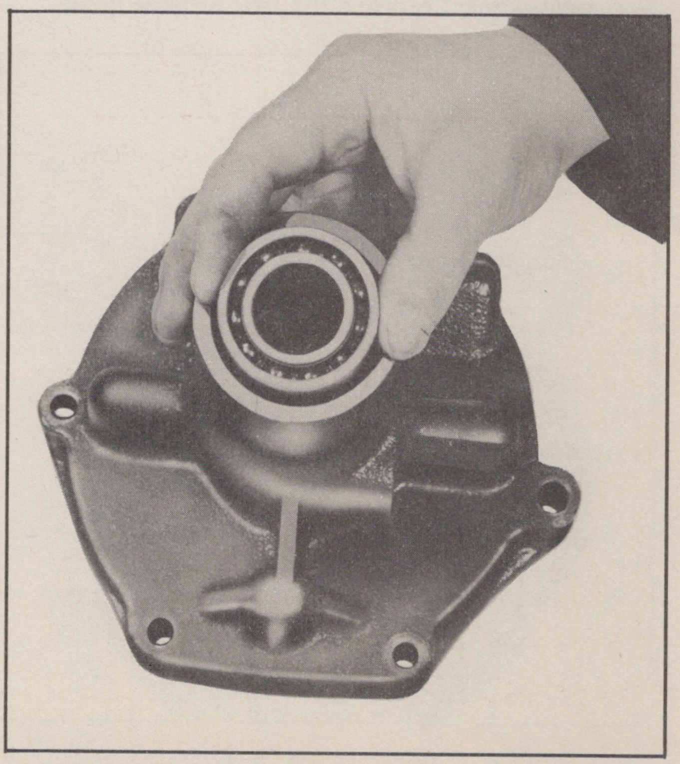


Fig. 147—Removing Ball Bearing

4. Remove reverse internal gear and stationary cone from rear bearing retainer by compressing stationary cone by hand (Fig. 145).

5. Remove snap ring locating ball bearing in rear bearing retainer with a screw driver (Fig. 146).

> ***NOTE:*** **Snap ring will be damaged during removal.**

6. Remove ball bearing from rear bearing retainer (Fig. 147). (It may be necessary to tap bearing toward rear of bearing retainer.)

7. With special tool J-4670, compress reverse cone clutch release coil springs and remove large snap ring (Fig. 148).

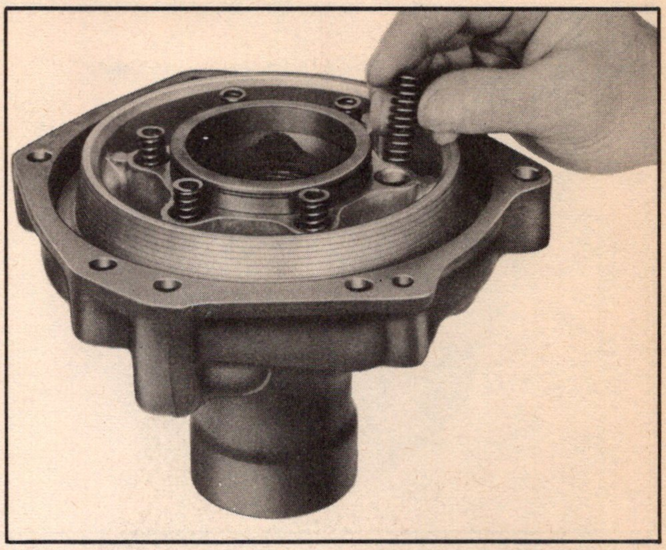


Fig. 149—Removing Coil Release Springs

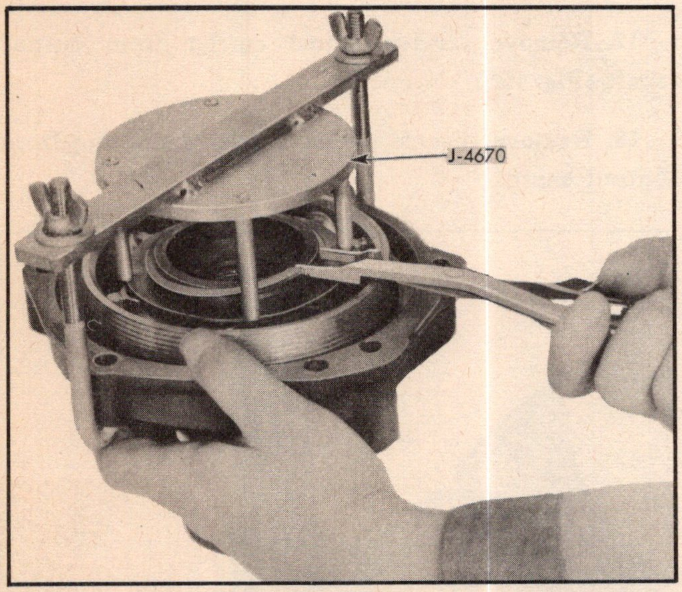


Fig. 148—Removing Large Snap Ring

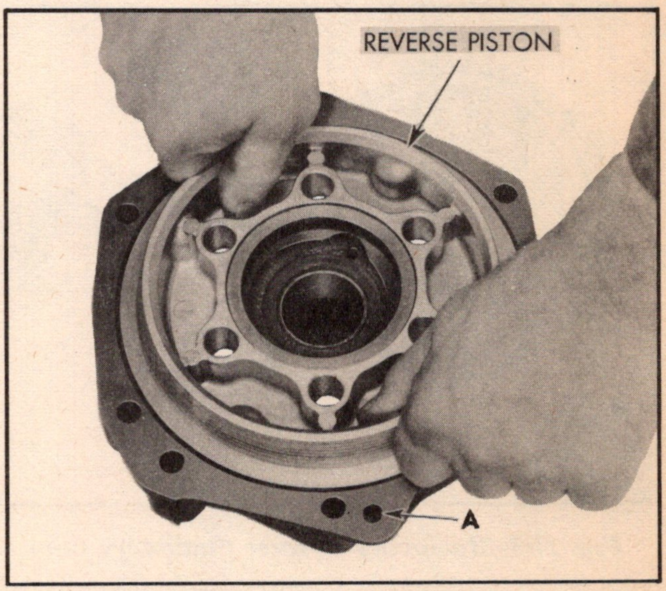


Fig. 150—Removing Reverse Piston

8. Remove special tool and remove coil spring retainer.

9. Remove the six coil release springs (Fig. 149).

10. Remove reverse piston by pulling straight out (Fig. 150). (Do not try to turn piston since it is located by four dowel pins.)

> ***NOTE:*** **It may be necessary to apply air pressure behind piston to aid in removal. Apply pressure in small hole at "A" in Fig. 150. *Extreme caution must be used when applying air.***

11. Remove outer oil seal from reverse piston.

12. Remove reverse piston inner oil seal from hub on rear bearing retainer (Fig. 151).

Fig. 151—Removing Inner Oil Seal

Fig. 152—Removing Large Bronze Thrust Washer

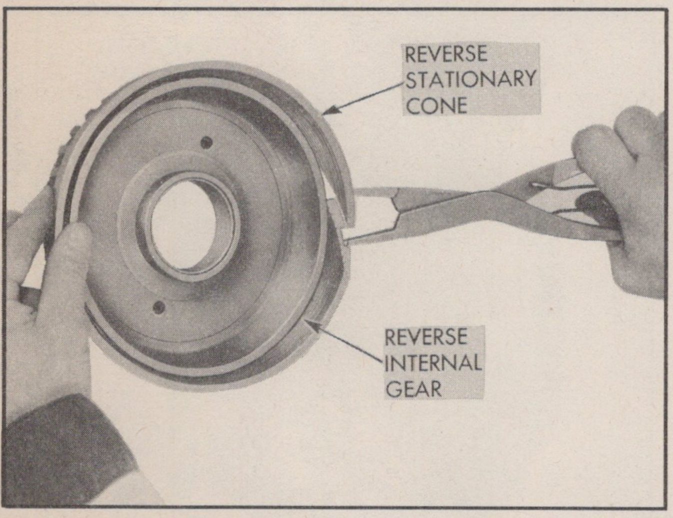


Fig. 153—Removing Reverse Stationary Cone

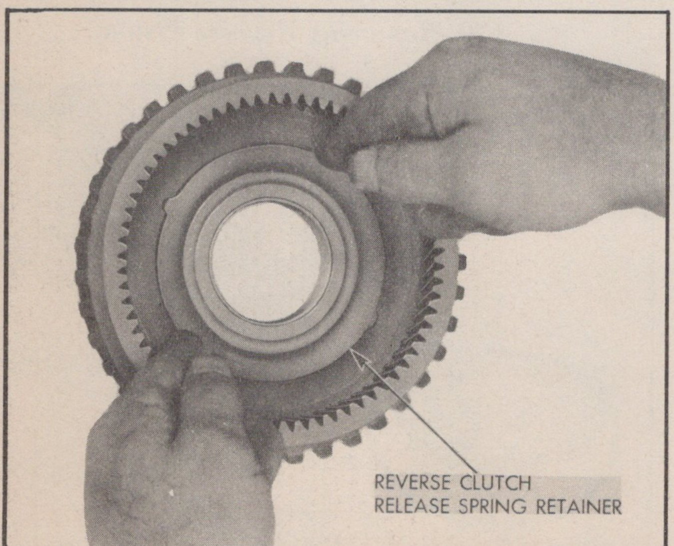


Fig. 154—Removing Reverse Clutch Flat Spring

13. Remove large bronze thrust washer from reverse internal gear (Fig. 152).

14. Remove reverse stationary cone from reverse internal gear cone by using large snap ring pliers to expand cone (Fig. 153).

> ***CAUTION: Do not expand reverse stationary cone more than absolutely necessary when removing.***

15. Remove reverse clutch release flat spring and spring retainer from reverse internal gear by lifting straight out (Fig. 154).

16. Remove snap ring that holds reverse planet carrier to the output shaft (Fig. 155).

17. Remove reverse planet carrier from output shaft (Fig. 156).

18. Remove reverse planet carrier snap ring from output shaft.

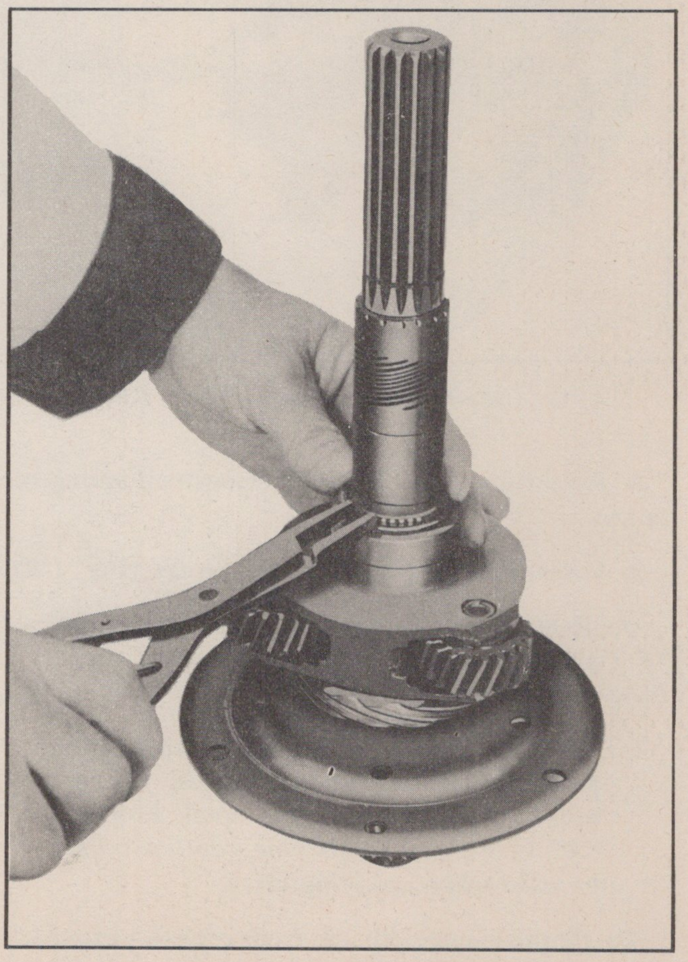


Fig. 155—Removing Reverse Planet Carrier Snap Ring

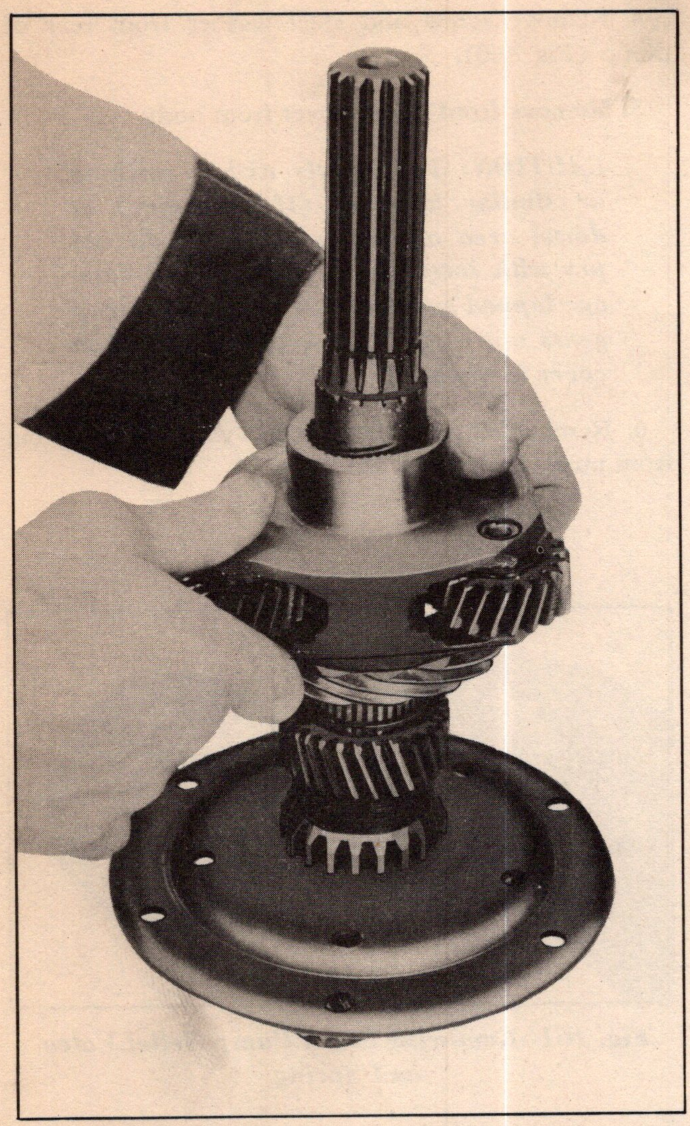


Fig. 156—Removing Reverse Planet Carrier

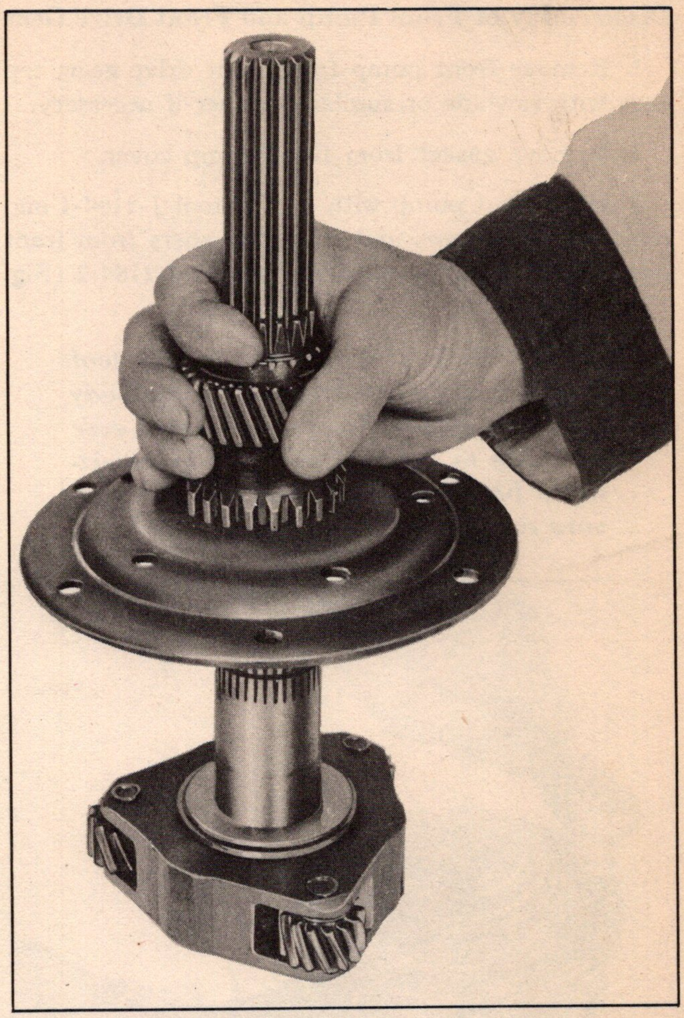


Fig. 157—Removing Sun Gear and Drive Flange Assembly

19. Remove reverse center gear and drive flange assembly from output shaft (Fig. 157).

20. Remove steel and bronze thrust washers from output shaft.

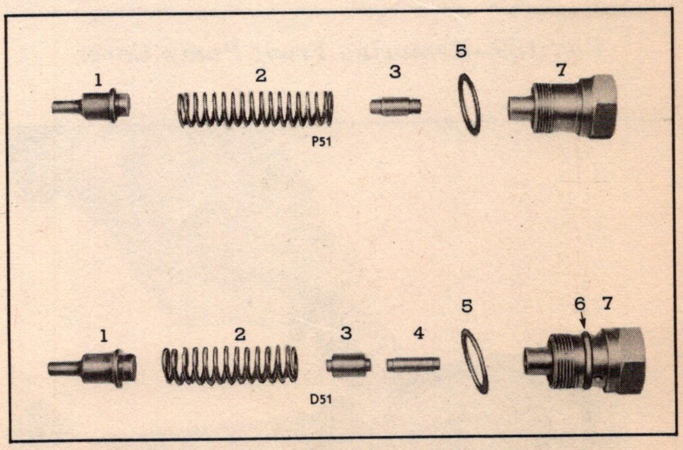
Disassembly of Pressure Regulator Assembly

1. Remove pressure regulator spring from pressure regulator plug.

2. Remove reverse booster plug from pressure regulator plug assembly (Fig. 158).

3. Remove TV pressure plug from pressure regulator plug assembly (8 cylinder transmission only).

4. Remove pressure regulator valve from pressure regulator spring.



1. **Pressure regulator valve**
2. **Pressure regulator spring**
3. **Reverse booster plug**
4. **TV pressure plug (D51 only)**
5. **Pressure regulator plug gasket**
6. **Pressure regulator plug seal (D51 only)**
7. **Pressure regulator plug**

Fig. 158—P51 and D51 Pressure Regulator Assemblies

Disassembly of Front Pump and Front Drive Gear

1. Remove front pump from front drive gear; tap gear with rawhide or similar hammer if necessary.

2. Remove gasket from front pump cover.

3. Hold front pump with special tool J-2184-1 and remove three screws and copper washers from front pump cover, using screw driver socket J-2184-2 (Fig. 159).

> ***CAUTION:*** ***It is important to use tool J-2184-1 while removing the pump body attaching screws. No attempt should ever be made to hold pump body by inserting a bar into the intake bore or pressure regulator piston bore.***

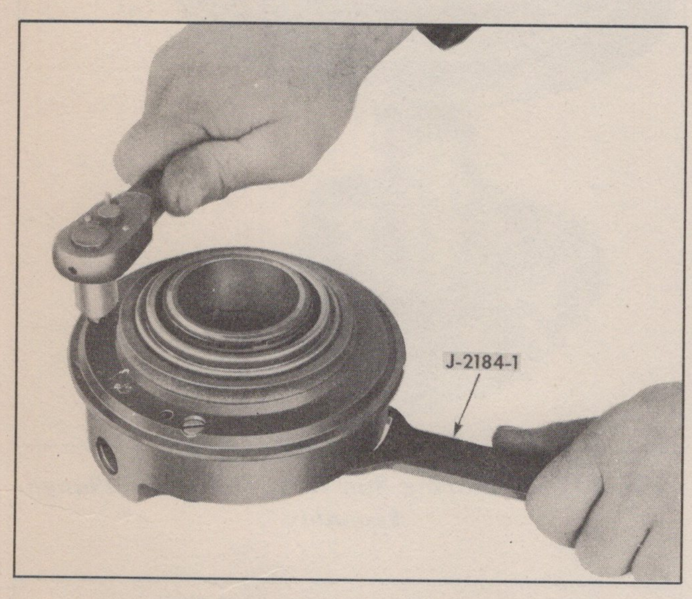


Fig. 159—Removing Front Pump Cover

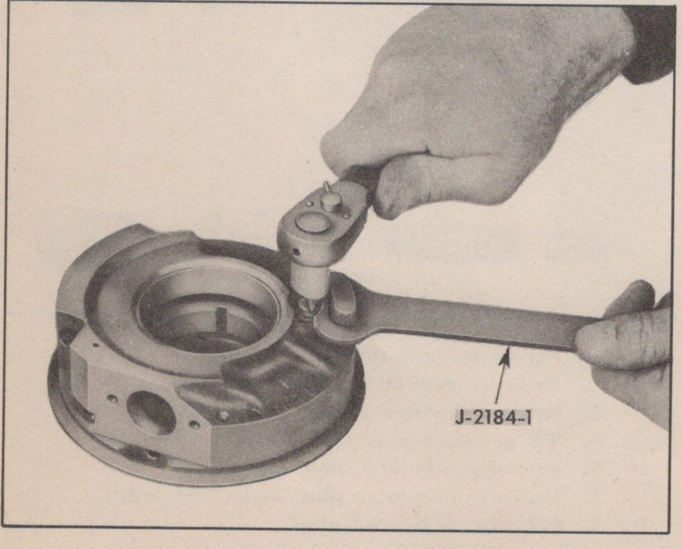


Fig. 160—Removing Front Pump to Cover Attaching Screw

4. Remove screw and steel washer from rear of pump (Fig. 160).

5. Remove front pump cover from body.

> ***CAUTION:*** ***Tap lightly with a rawhide or similar hammer (if necessary) at dowel area on pump body but do not pry with screw driver, as this will damage lapped surface. Use care not to drop gears out of gear pockets in body when cover is removed.***

6. Remove front pump relief valve and spring from pump body (Fig. 161).

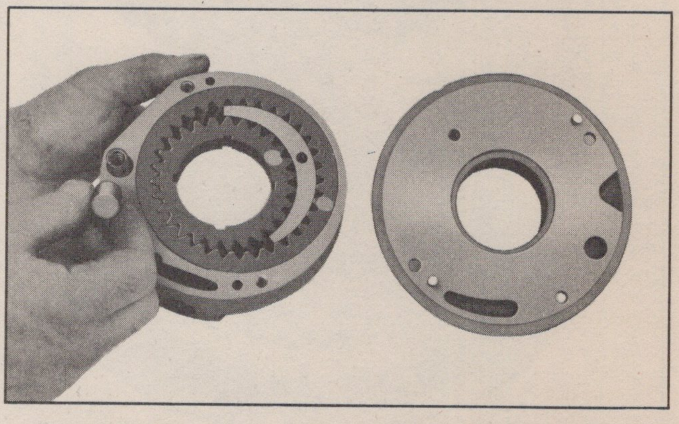


Fig. 161—Removing Front Pump Relief Valve and Spring

> ***NOTE:*** **Mark top face of drive and driven gear with Prussian Blue for identification when reassembling.**

7. Remove both the drive and driven gears.

8. Remove front cover oil seal from cover, using a small chisel.

Disassembly of Governor and Rear Pump Assembly

1. Mark edge of governor body and governor drive flange (if not previously marked) so they may be reinstalled in original position (Fig. 162).

2. Remove two bolts and lock washers holding governor body to governor drive flange (7/16" socket).

> ***NOTE:*** **Do not remove small governor plunger and bushing assembly unless inspection (page 107) indicates repairs are necessary.**

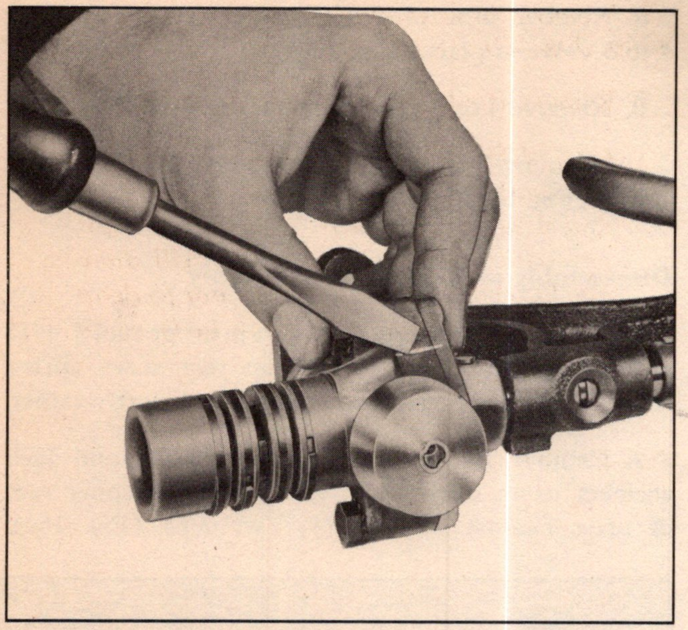


Fig. 162—Marking Governor Body and Drive Flange

3. Remove four bolts holding rear pump cover to pump body and remove cover (7/16" wrench).

4. Remove rear oil pump driven gear from gear pocket in pump.

Disassembly of Front Servo Assembly

1. Remove two bolts and lock washers holding front band release cylinder to servo body and remove front band release cylinder (7/16" socket) (Fig. 163).

2. Remove booster spring.

3. Remove retracting spring retainer.

4. Remove retracting spring.

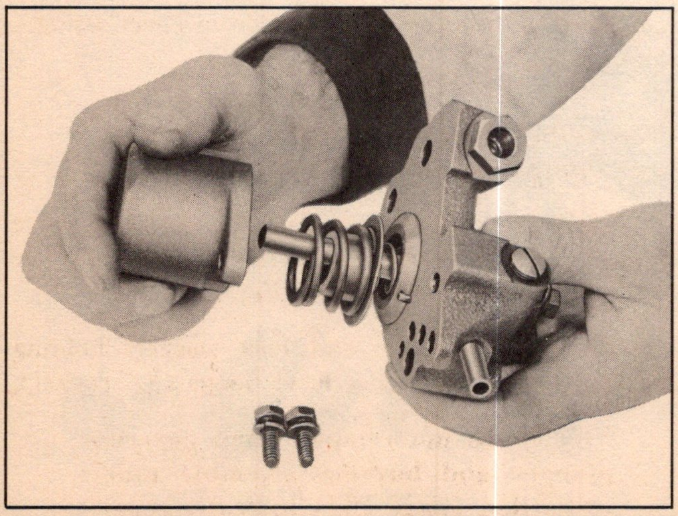


Fig. 163—Removing Front Band Release Cylinder

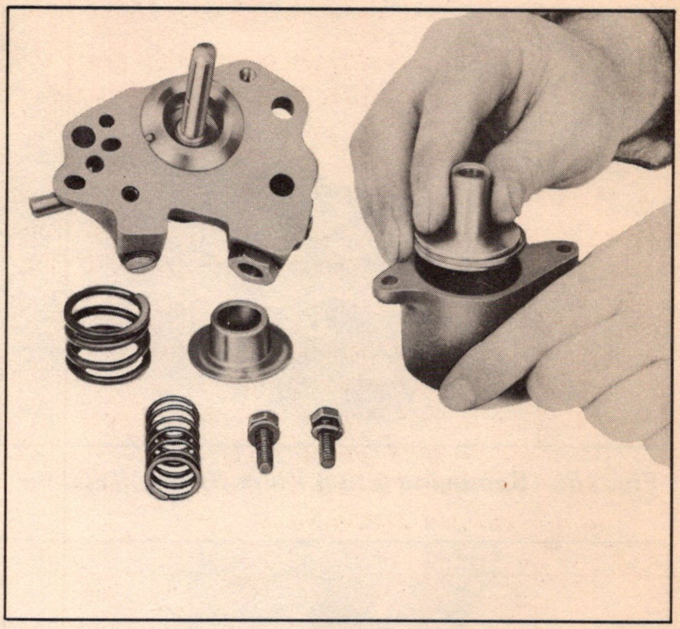


Fig. 164—Removing Front Band Release Piston

5. Remove front band release piston from cylinder (Fig. 164).

6. Remove front servo piston assembly from servo body (Fig. 165).

> ***NOTE:*** **Piston assembly must not be disassembled as it is furnished as a complete unit.**

7. Remove dowel pin from body if loose to prevent loss while cleaning.

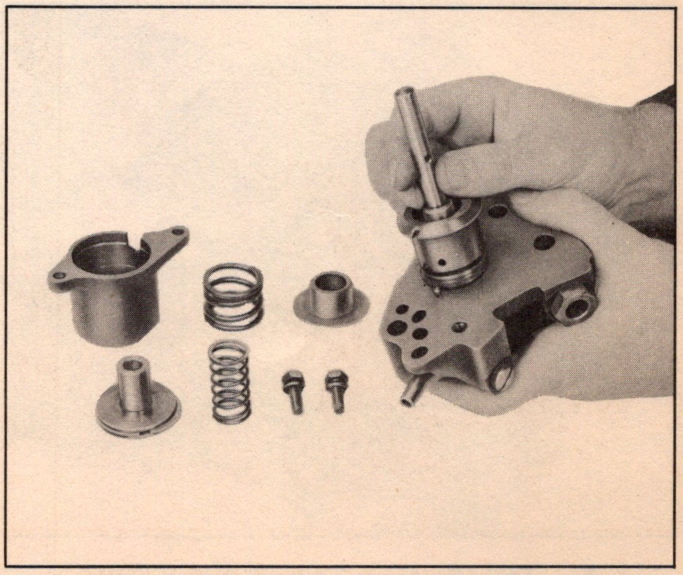


Fig. 165—Removing Servo Piston

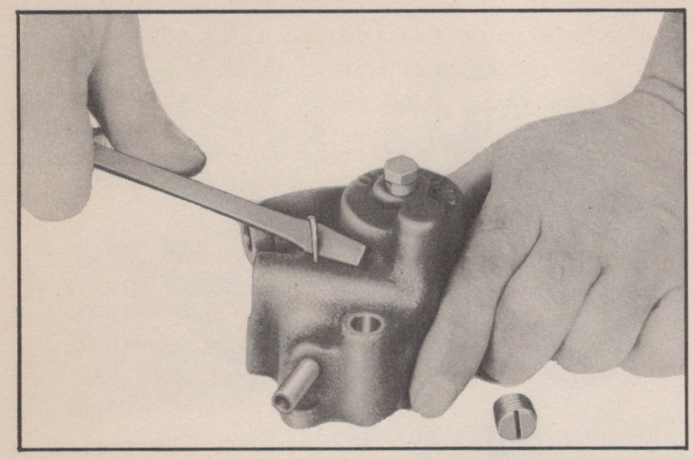


Fig. 166—Removing 4 to 3 Valve Spring Retainer

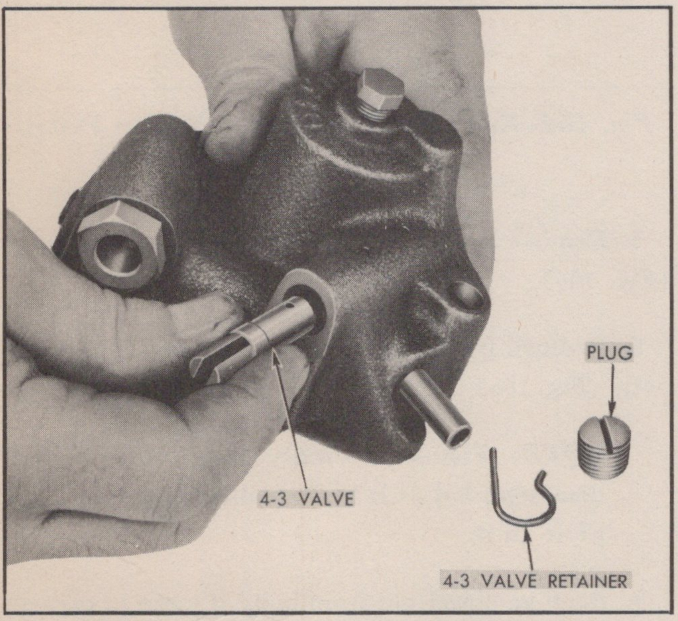


Fig. 167—Removing 4 to 3 Valve

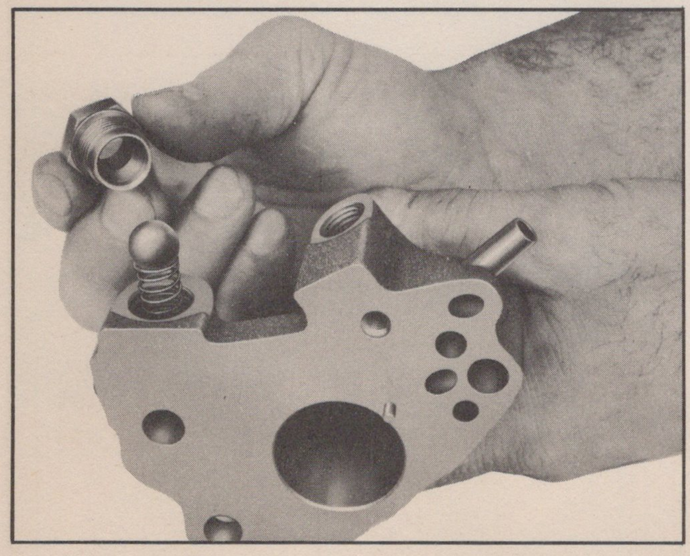


Fig. 168—Removing Check Valve Seat, Ball and Spring

8. Remove pipe plug and spring retainer holding 4 to 3 valve in place (Fig. 166).

9. Remove 4 to 3 valve from servo body (Fig. 167).

10. Remove rear pump check valve seat, ball and spring (Fig. 168).

Disassembly of Rear Servo Assembly

1. Place rear servo assembly in press or tool J-4415 and bring ram down to rest on rear servo spring retainer. Do not press hard enough to distort retainer.

2. Remove two retainer to body bolts and lock washers using open end wrench while keeping ram of press against retainer (½″ wrench) (Fig. 169).

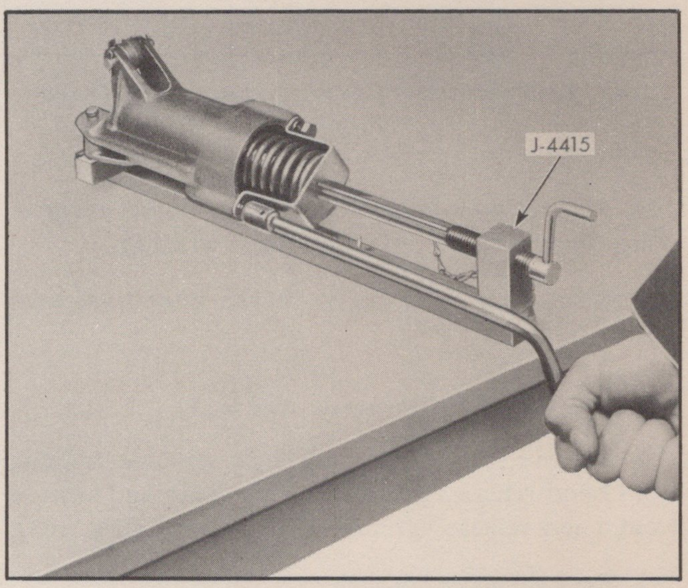


Fig. 169—Removing Rear Servo Spring Retainer Bolts

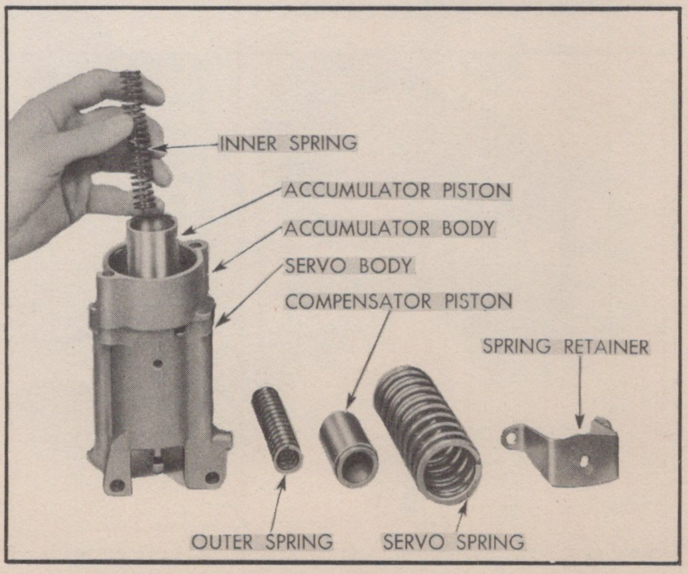


Fig. 170—Disassembling Rear Servo

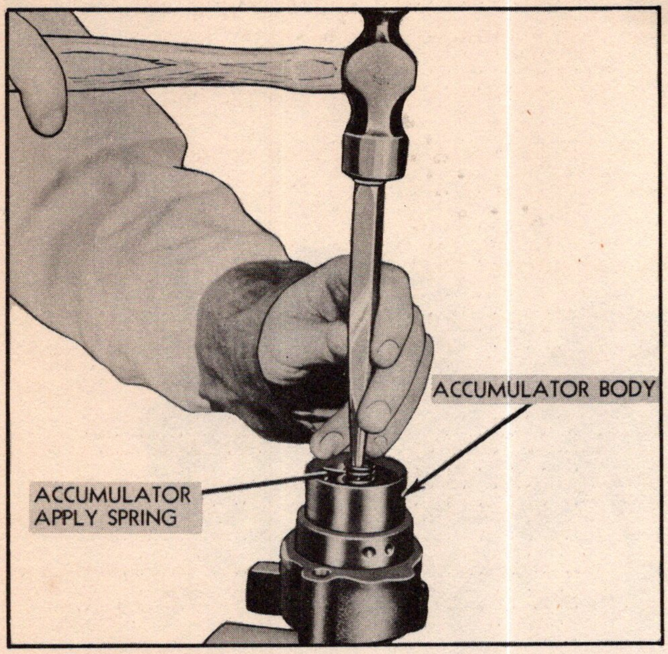


Fig. 171—Removing Accumulator Apply Spring

3. Release press slowly until springs are free.

4. Remove spring retainer, servo spring, compensator piston, and two springs (inner and outer) (Fig. 170).

> ***NOTE:*** **Only one spring will be found inside compensator on later rear servos. See note on page 108.**

5. Remove accumulator body and piston assembly from servo body.

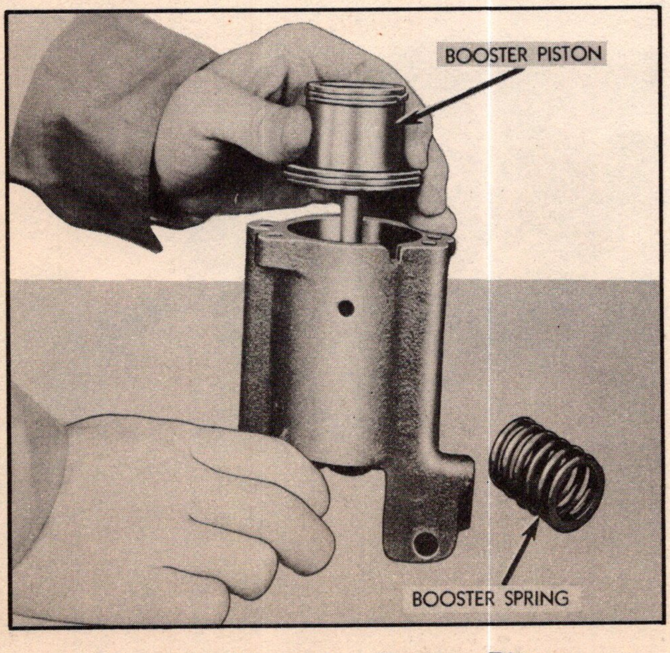


Fig. 172—Removing Booster Piston

6. Rest accumulator body on a vise with soft jaws and tap accumulator piston through accumulator apply spring and accumulator body (Fig. 171).

7. Remove booster spring and booster piston from servo body (Fig. 172). Do not cock piston in bore.

Disassembly of Control Valve Assembly

> ***NOTE:*** **Extreme care must be taken in handling the Hydra-Matic transmission control valve assembly. Never grip the bodies in a vise or use force in removing or installing valves or plugs. The control valve assembly should be laid flat on clean paper for disassembling.**

> ***CAUTION: Keep screws with correct part as valve body is disassembled.***

1. Move inside detent control lever slowly counterclockwise to remove detent tension spring and plunger (Fig. 173). Remove manual valve.

2. Remove manual shaft rubber seal and outer and inner manual shaft seal washers from shaft (Fig. 174).

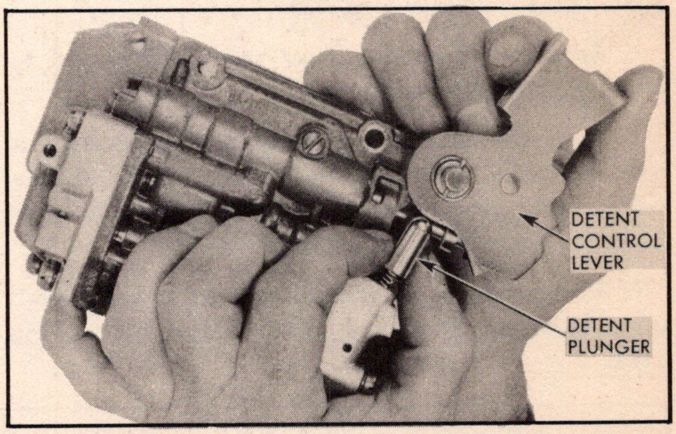


Fig. 173—Removing Detent Spring and Plunger

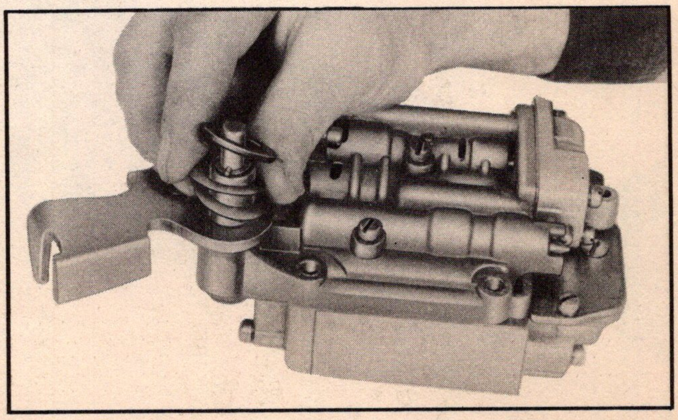


Fig. 174—Removing Rubber Seal and Seal Washers

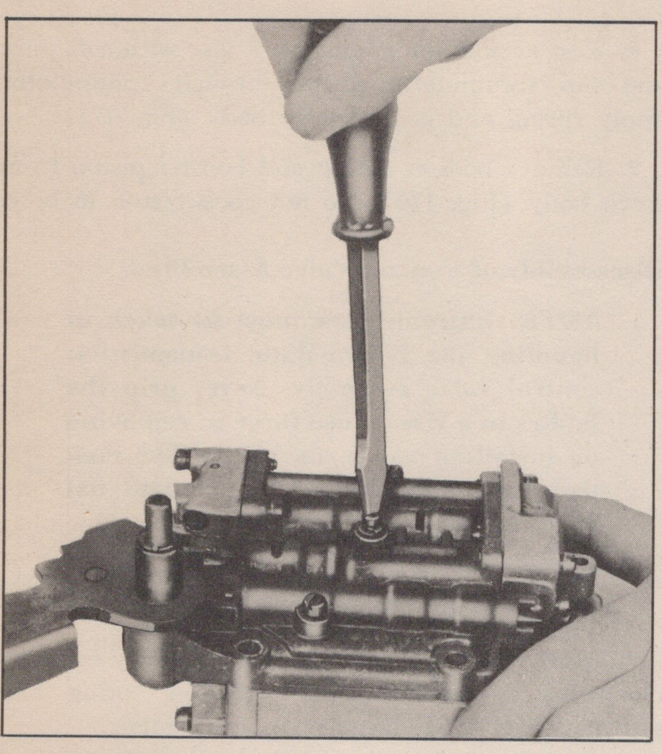


Fig. 175—Removing Outer Valve Body Screws

3. Remove three screws holding inner and outer valve bodies together (Fig. 175).

4. Separate inner and outer valve bodies and remove valve body spacer plate.

5. Remove three screws holding valve body rear cover to valve body and remove rear cover and inner valve body rear plate (Fig. 176). Remove three governor plugs from inner valve body.

6. Remove three screws holding front valve body plate to front valve body and remove plate (Fig. 177).

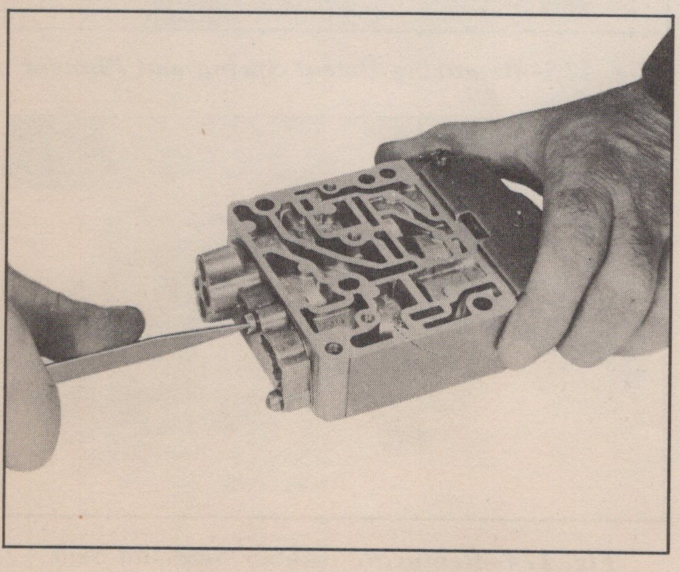


Fig. 176—Removing Valve Body Rear Cover

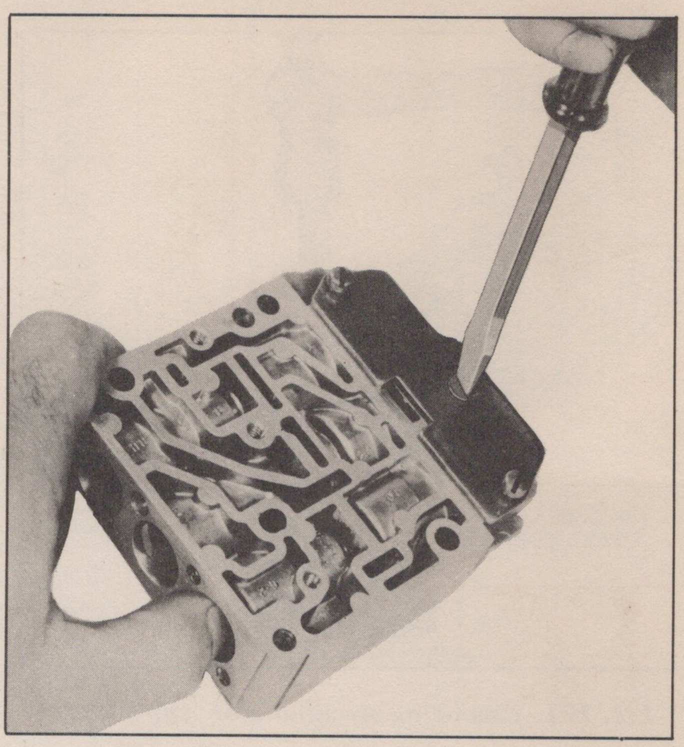


Fig. 177—Removing Front Valve Body Plate

7. Remove three screws holding front valve body to inner valve body and remove front valve body. Hold front valve body and inner valve body together while removing screws to avoid springs jumping out of place (Fig. 178).

8. Remove 1-2 regulator plug spring, 2-3 valve spring, 2-3 regulator plug spring and 3-4 valve spring.

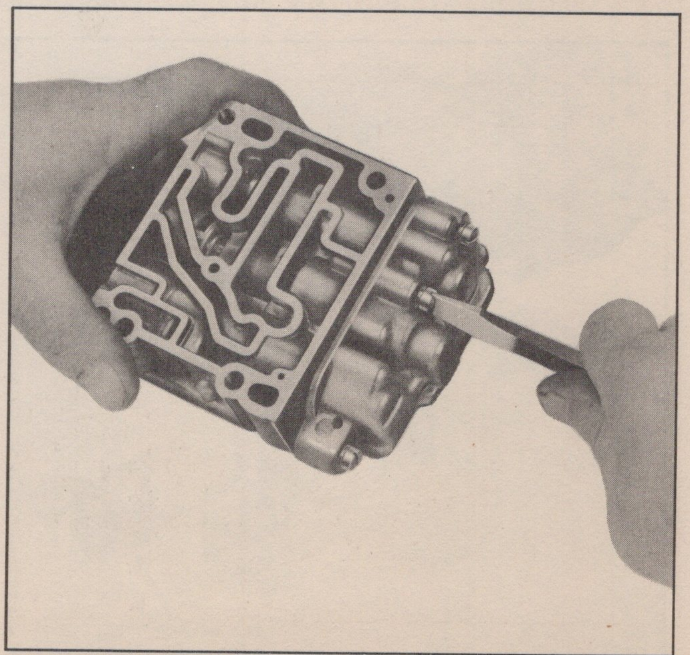


Fig. 178—Removing Front Valve Body

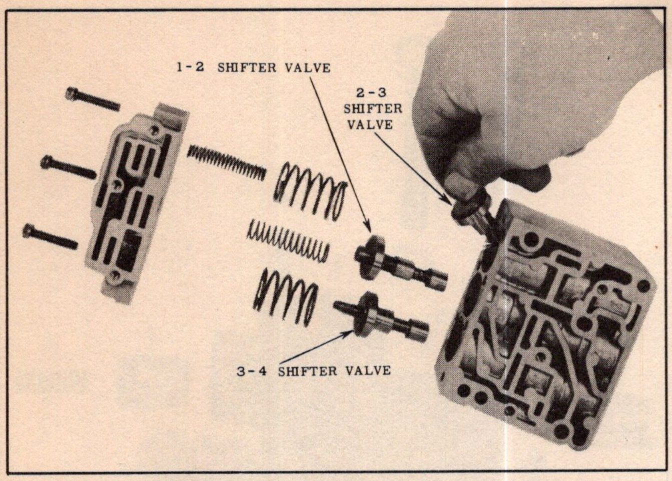


Fig. 179—Removing Shifter Valves

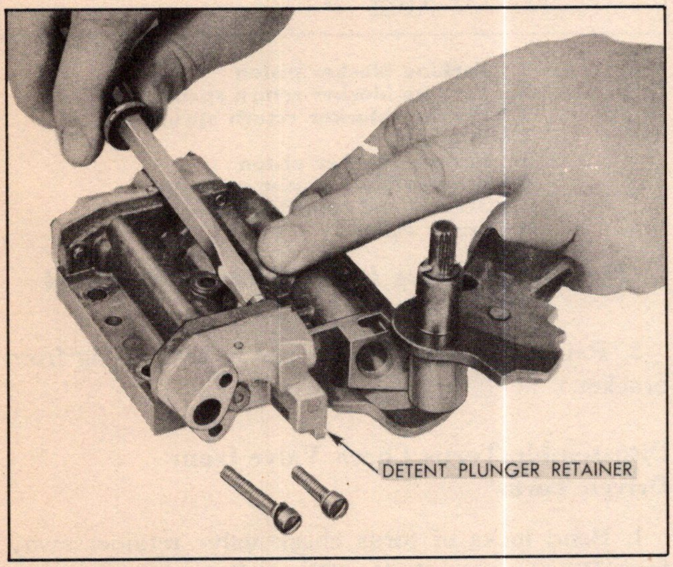


Fig. 180—Removing Detent Plunger Retainer

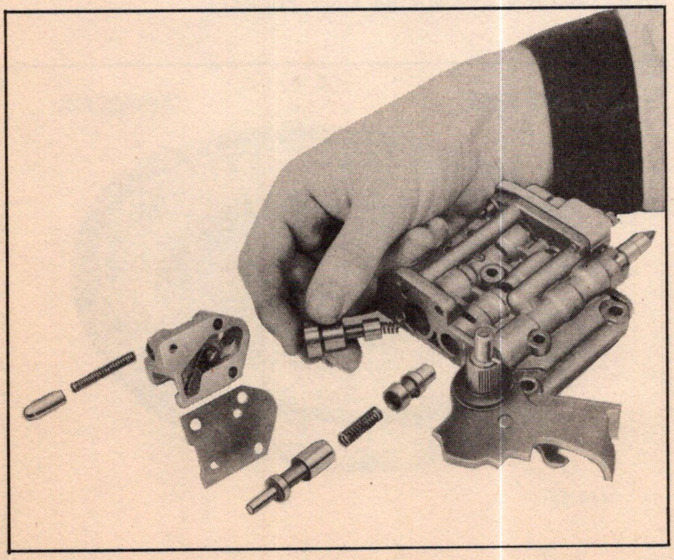


Fig. 181—Removing Double Transition Valve and Spring

9. Remove three shifter valves (Fig. 179). Valves should be free to move from body by pushing on opposite ends against governor plugs with fingers.

10. Remove three regulator plugs by bumping front valve body on hand.

11. Remove three screws from detent plunger retainer and remove retainer and plate (Fig. 180).

12. Remove T valve, throttle valve spring and throttle valve.

13. Remove double transition valve and spring (Fig. 181).

14. Remove three screws holding front servo exhaust body over compensator valve and detent plug in outer valve body (Fig. 182). Remove front servo exhaust body and spacer.

15. Remove compensator valve, spring and detent plug from outer valve body (Fig. 183).

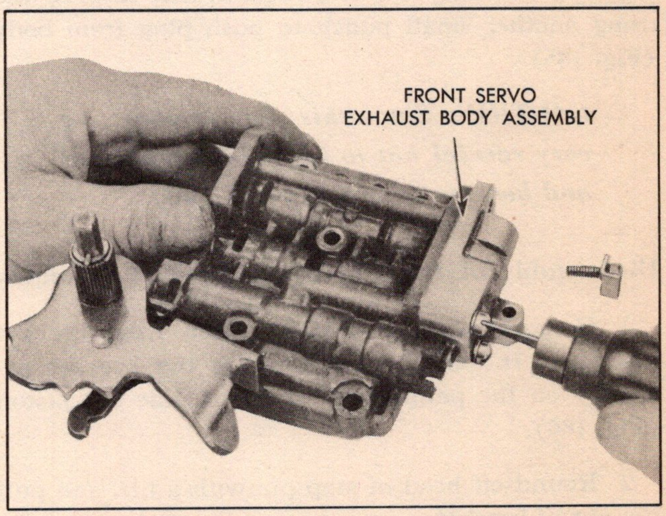


Fig. 182—Removing Front Servo Exhaust Body Assembly

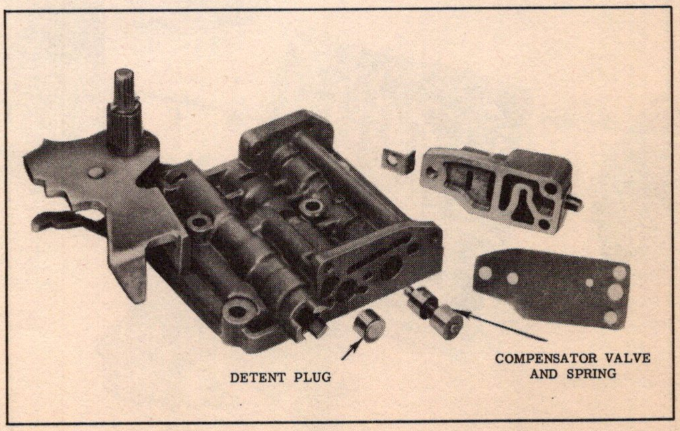


Fig. 183—Compensator Valve, Spring and Detent Plug

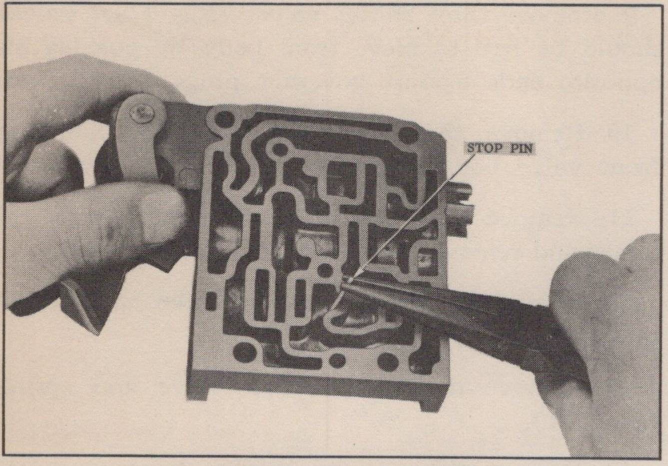


Fig. 184—Removing Stop Pin

16. Remove stop pin (needle bearing roller) holding compensator auxiliary plug in place (Fig. 184).

17. Remove compensator auxiliary plug by inserting a ⅛″ welding rod, or punch, in hole in plug and using another small punch to push plug from body (Fig. 185).

CAUTION: Since this plug is short, be very careful not to let it drop from rod and become lodged in valve body.

Disassembly of Parking Brake Bracket Assembly

1. Remove parking blocker piston from bracket assembly. It may be necessary to tap bracket assembly on the palm of the hand to slide out piston (Fig. 186).

2. Round off head of stop pin with a file, and pull pin out of bracket.

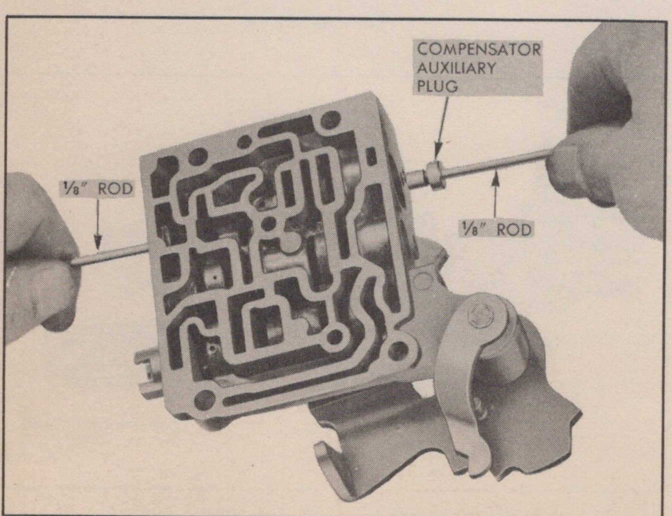
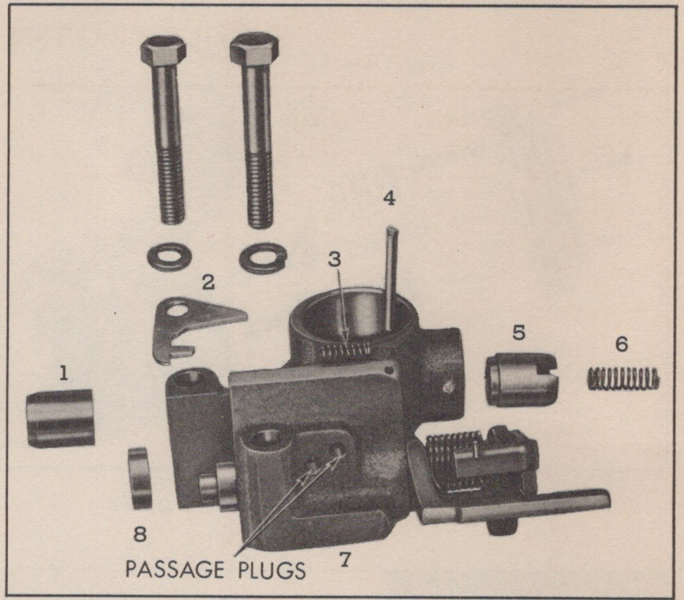


Fig. 185—Removing Auxiliary Plug



1. Parking blocker piston
2. Parking blocker return spring stop
3. Parking blocker return spring
4. Stop pin
5. Reverse blocker piston
6. Reverse blocker piston spring
7. Bracket and crank assembly
8. Crank roller

Fig. 186—Parking Brake Bracket—Exploded

3. Remove reverse blocker piston and spring from bracket.

Disassemble Torus Check Valve from Driven Torus

1. Bend locks of torus check valve retainer away from the mounting bolts (Fig. 187).

2. Remove bolts, retainer, torus check valve and torus check valve spring (7/16″ socket).

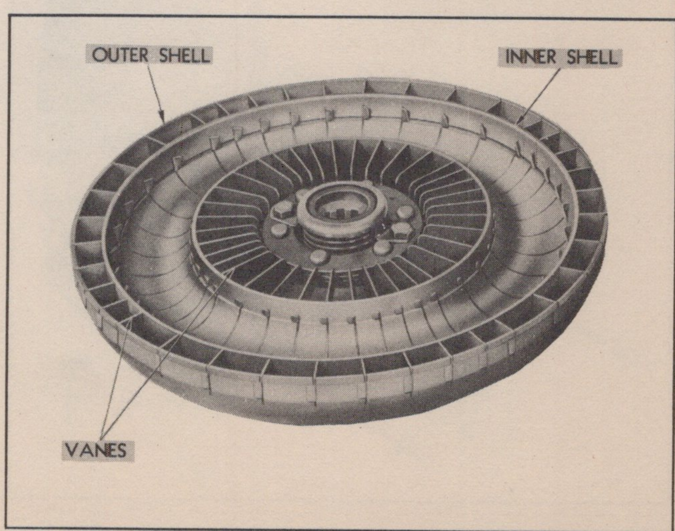


Fig. 187—Torus Assembly and Check Valve

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CLEANING AND INSPECTION OF PARTS

CONTENTS OF THIS SECTION

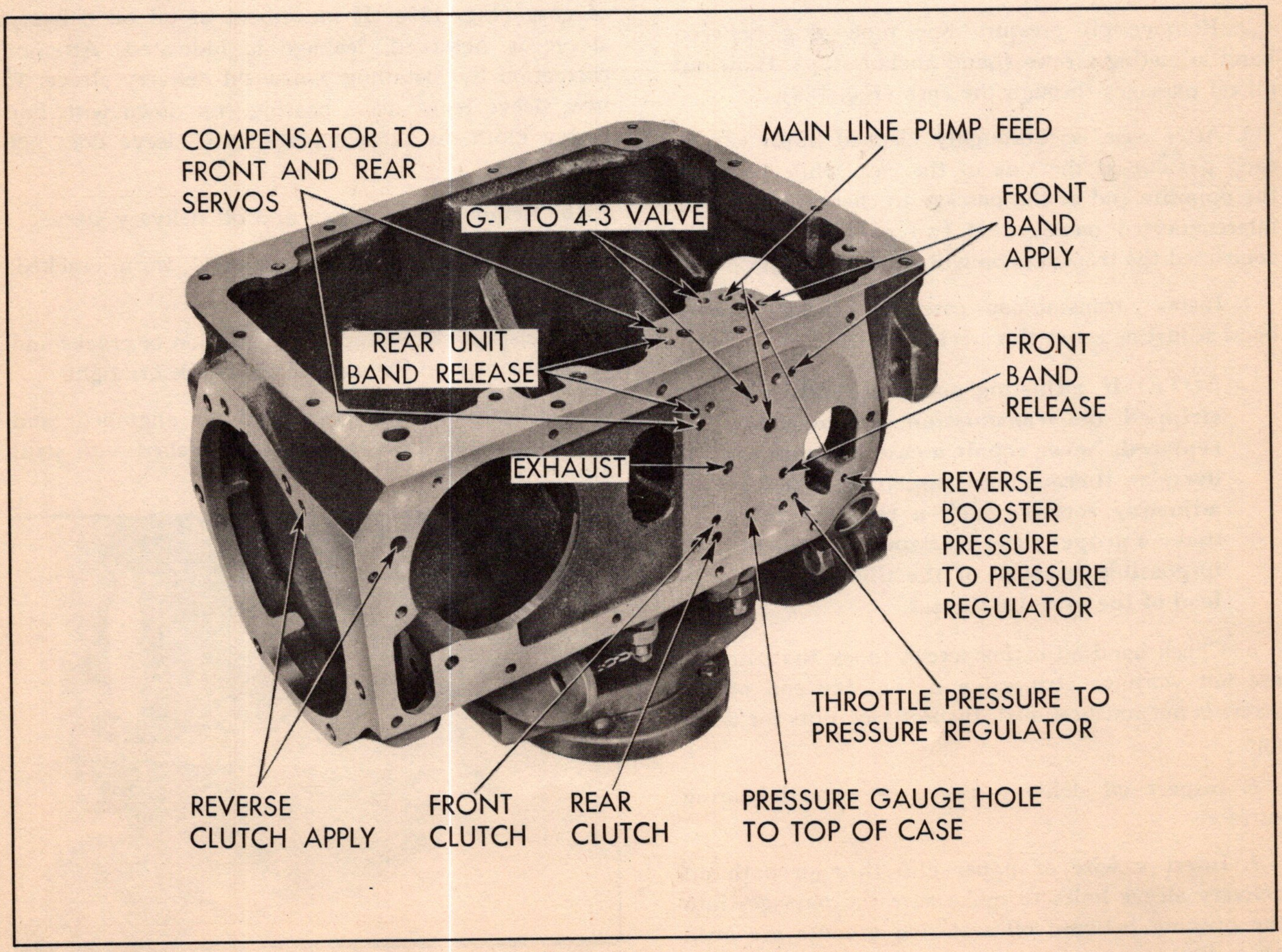


Fig. 188—Oil Passages in Transmission Case

GROUP DISASSEMBLED UNITS FOR INSPECTION

A thorough inspection should be made of each part after the transmission is disassembled to determine which parts should be replaced. It is very important to distinguish between parts that are simply "worn in" and those worn to the extent that they affect operation of the unit. Only worn, broken, or damaged parts should be replaced.

A list of parts that need replacement should be made while inspecting each unit. This procedure will assure better service from the Parts Department with less chance of error and a saving in time for the mechanic.

INSPECTION OF CASE, OIL DELIVERY SLEEVE, AND FRONT AND REAR BANDS

1. Thoroughly clean the transmission case with cleaning fluid.

2. Remove oil pressure line pipe plug between band adjusting screws (band anchor stop). Blow out all oil passages through the case (Fig. 188).

3. After case is thoroughly cleaned apply air at each passage at the side of the case while blocking the opposite end of the passage to check for leaks or interconnected passages. If two passages are interconnected the transmission will not function properly.

4. Inspect transmission case for cracks. Inspect band adjusting screw threads in case.

> ***NOTE:* If adjusting screw threads are stripped, the transmission case must be replaced. Never repair a case by tapping oversize threads and inserting oversize adjusting screws. Such a repair would make a proper external band adjustment impossible because of the difference in lead of the oversize thread.**

5. Check band adjusting screws to see that threads are not worn or stripped and that the end of the screw is not mushroomed. Inspect lock nuts for damage.

6. Inspect oil delivery sleeve for scored bearing surfaces.

7. Insert a wire or paper clip through both oil delivery sleeve holes to make sure the passages into the opening between oil seal ring grooves are open (Fig. 189).

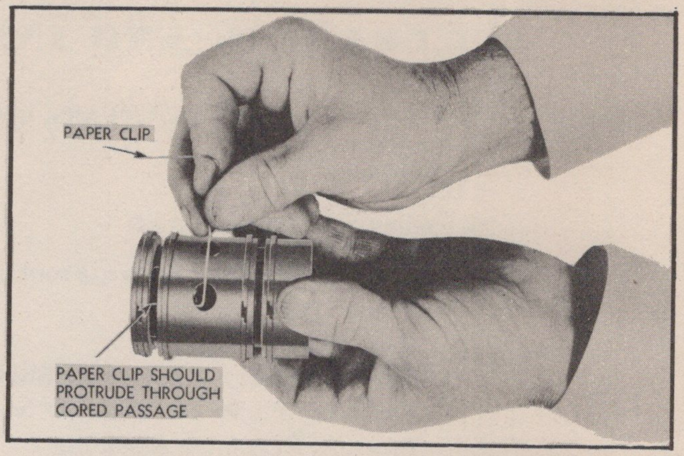


Fig. 189—Inspecting Passages in Oil Delivery Sleeve

8. Check oil seal rings for freedom in grooves. Examine grooves for damage.

9. Install oil delivery sleeve with dowel hole toward case and tighten cap with dowel in one of the two oil holes. Apply oil on each side of bearing cap. Apply air pressure to two clutch holes in side of case (Fig. 190). If movement of oil on delivery sleeve is observed, leakage is indicated. Attempt correction by installing a new oil delivery sleeve. If new sleeve leaks dress bearing cap down with fine emery cloth on surface plate until sleeve does not leak.

10. Remove bearing cap and oil delivery sleeve.

11. Inspect both bands for burned, worn, cracked, or loose lining.

12. Inspect steel bands for distortion or cracks and see that rivets on the ends of the bands are tight.

13. Check strut on rear band for alignment and free pivoting. The rear band is furnished with strut attached.

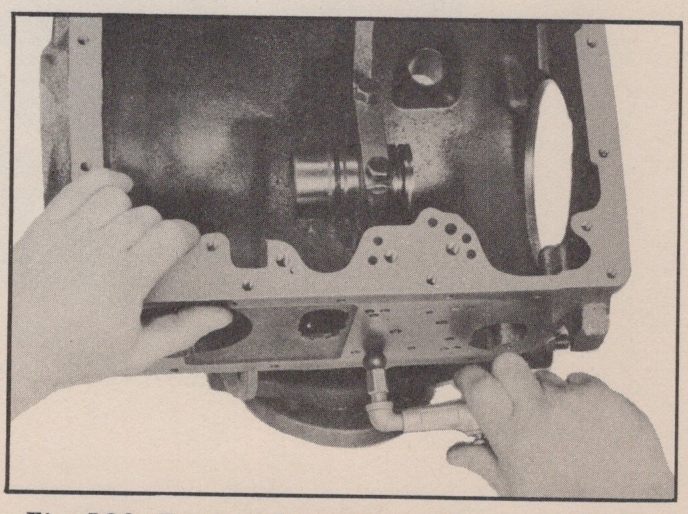


Fig. 190—Testing Oil Delivery Sleeve for Leaks

14. Inspect anchor ends of front band for broken welds or worn sockets.

> ***CAUTION: Do not pry either band open or distort bands in any manner. They are surface ground at the factory for drum fit.***

15. Clean all parts thoroughly.

INSPECTION OF FRONT UNIT

> ***NOTE:*** **The front unit has 3 drive and 3 driven clutch plates on the P51 (6 cyl.) transmission and 4 drive and 4 driven clutch plates on the D51 (8 cyl.) transmission. In order to allow room for the additional plates in the D51 front unit, the annular piston has been machined differently as shown in Fig. 192.**

1. Inspect clutch drive pins in front unit drum. If they are scored, loose or distorted, replace drum and drive pin assembly. Pins are not furnished separately.

2. Inspect drum for deep grooves or scores at band surface and clutch plate surface.

3. Inspect clutch release springs for distortion or collapsed coils. Free length 2$\frac{15}{64}$".

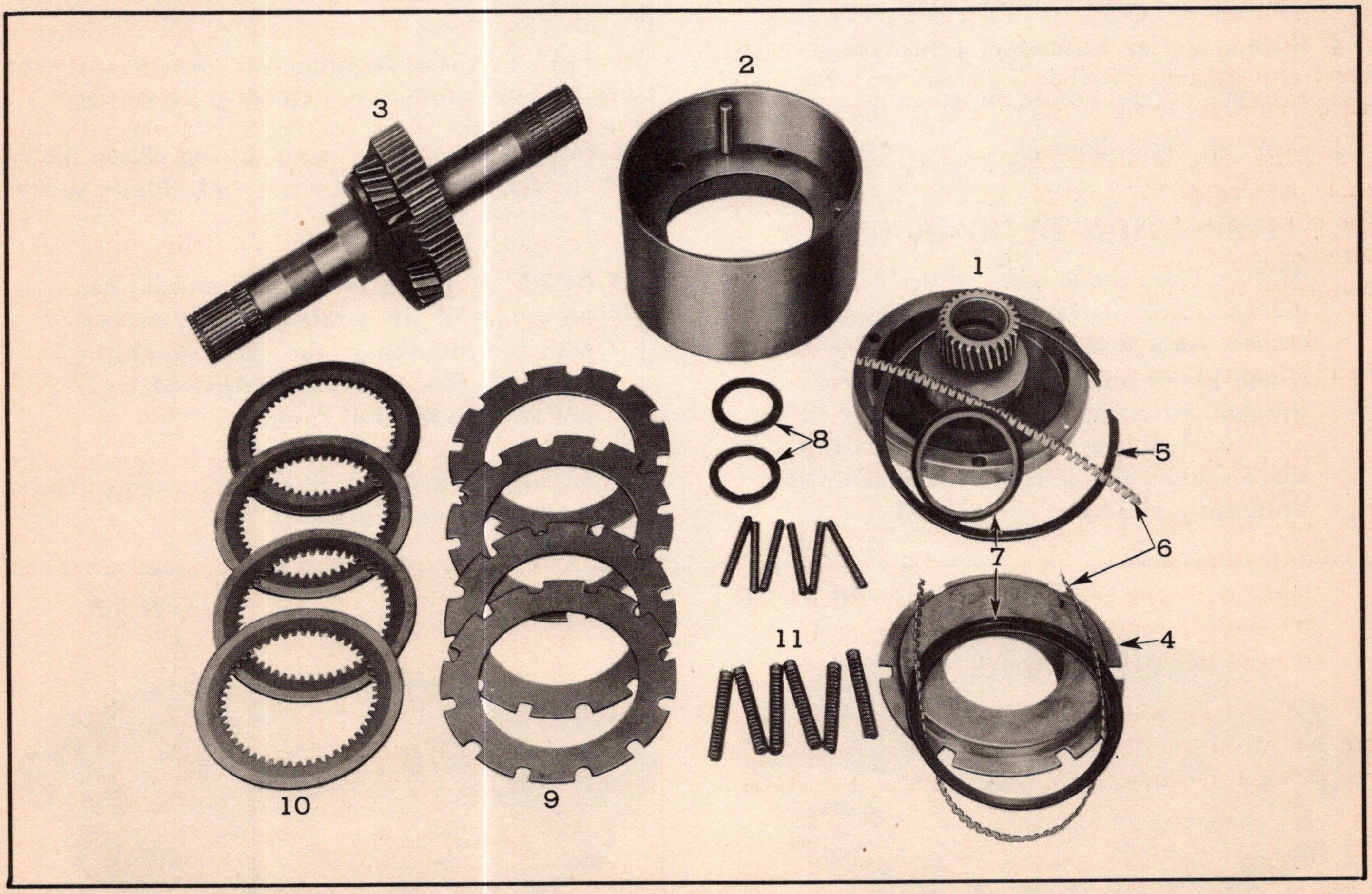
> ***NOTE:*** **Slight wear, "bright spots", on side of outer release springs indicating slight contact with drum is permissible.**

4. Inspect composition-faced driving clutch plates for damaged surfaces and worn teeth. Plates should have 6 visible waves.

> ***NOTE:*** **If flakes of facing material can be removed by scratching the surface with the thumbnail, the plate should be replaced. Discoloration of drive plates is not an indication of failure.**

5. Inspect clutch driven plates for scored surfaces. Driven plates must be flat.

6. Inspect annular clutch piston for scores. Be sure oil seal grooves are thoroughly clean.



1. Front clutch drum assembly
2. Front drum and pin assembly
3. Planet carrier assembly
4. Clutch annular piston
5. Retaining ring
6. Oil seal expanders
7. Oil seals
8. Steel and bronze thrust washers
9. Clutch driven plates
10. Clutch drive plates
11. Clutch release springs

Fig. 191—Disassembled View of Front Unit

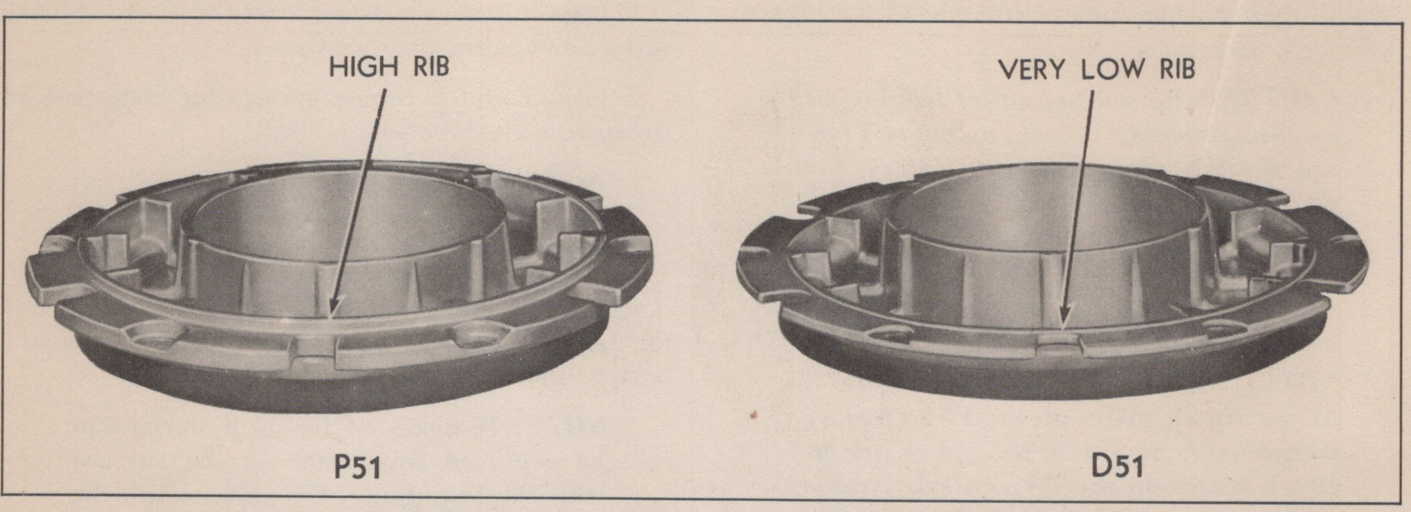


Fig. 192—Comparison of P51 and D51 Front Annular Pistons

7. Inspect front clutch drum for scores in piston bore, oil delivery sleeve bore and oil seal grooves. Inspect gear teeth and thrust faces for damage.

8. Inspect front planet carrier gears for damaged teeth and excessive roller bearing wear.

9. Inspect bearing surfaces of planet carrier shaft.

10. Inspect steel and bronze thrust washers.

11. Clean all parts thoroughly.

INSPECTION OF REAR UNIT

***NOTE:* The rear unit has 6 drive and 6 driven clutch plates on the P51 (6 cyl.) transmission and 7 drive and 7 driven clutch plates on the D51 (8 cyl.) transmission. In order to allow room for the additional plates in the D51 rear unit, the annular piston has been machined differently as shown in Fig. 193.**

1. Inspect rear internal gear for damaged teeth.

2. Inspect clutch drive pins in rear unit drum. If they are scored, loose or distorted, replace rear drum and drive pin assembly. Pins are not furnished separately.

3. Inspect rear unit drum for deep grooves or scores at band surface and clutch plate surface.

4. Inspect composition-faced driving clutch plates for damaged surfaces and worn teeth. Plates should have 6 visible waves.

***NOTE:* If flakes of facing material can be removed by scratching the surface with the thumbnail, the plate should be replaced. Discoloration of drive plates is not an indication of failure.**

5. Inspect driven clutch plates for scored surfaces. Driven plates must be flat.

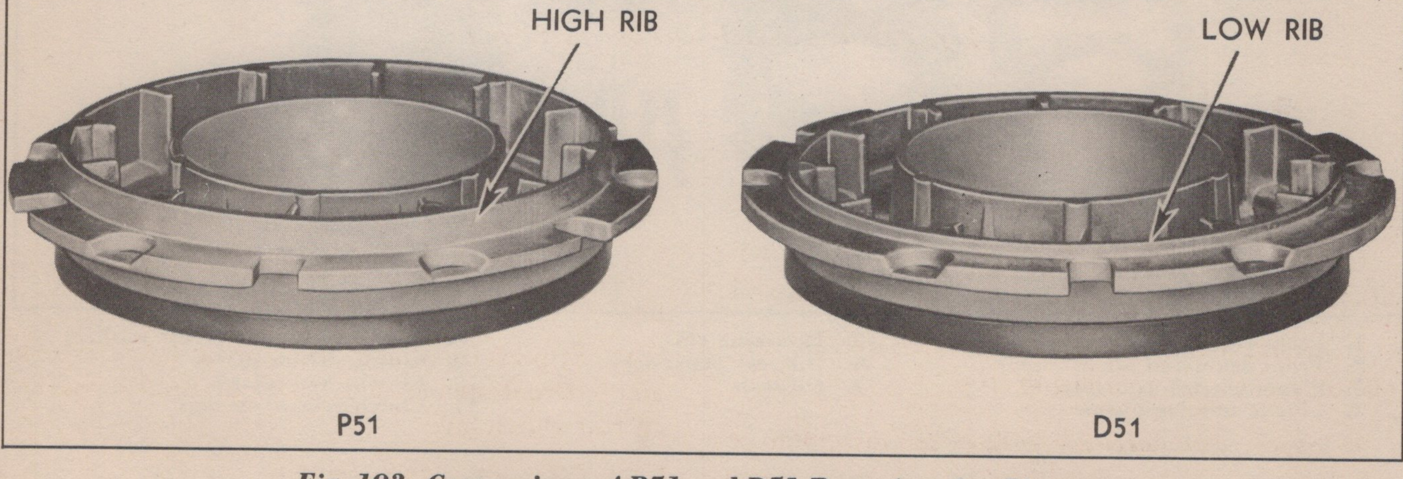
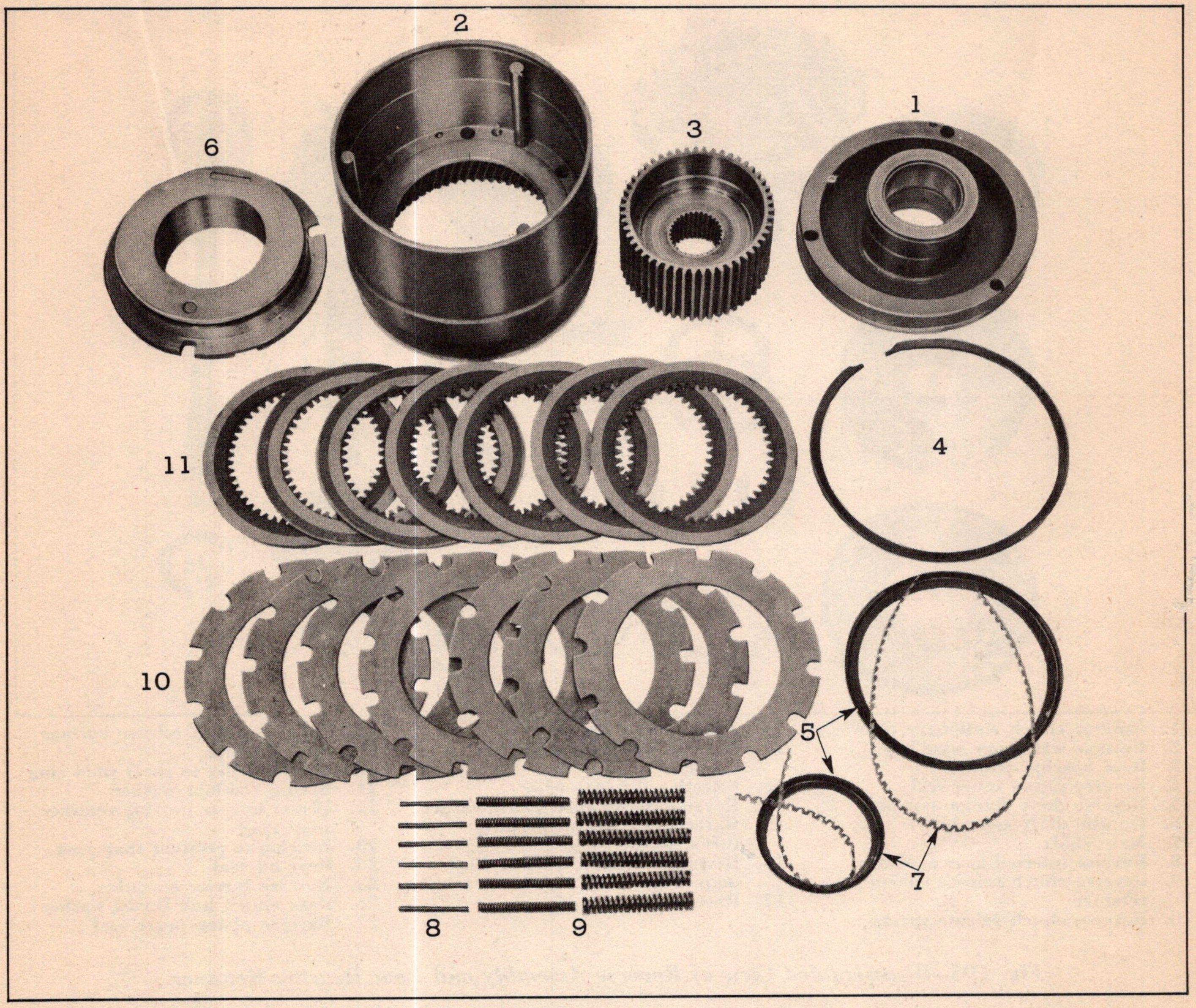


Fig. 193—Comparison of P51 and D51 Rear Annular Pistons



1. **Rear clutch drum assembly**
2. **Rear drum and pin and rear internal gear assembly**
3. **Rear clutch hub**
4. **Retaining ring**
5. **Oil seals**
6. **Clutch annular piston**
7. **Oil seal expanders**
8. **Release spring guide pins**
9. **Clutch release springs**
10. **Clutch driven plates**
11. **Clutch drive plates**

Fig. 194—Disassembled View of Rear Unit

6. Inspect rear unit clutch drum for scores in piston bore and thrust surface.

7. Inspect surface of babbitt bushing in clutch drum.

8. Inspect annular clutch piston for scores. Be sure oil seal grooves are thoroughly clean.

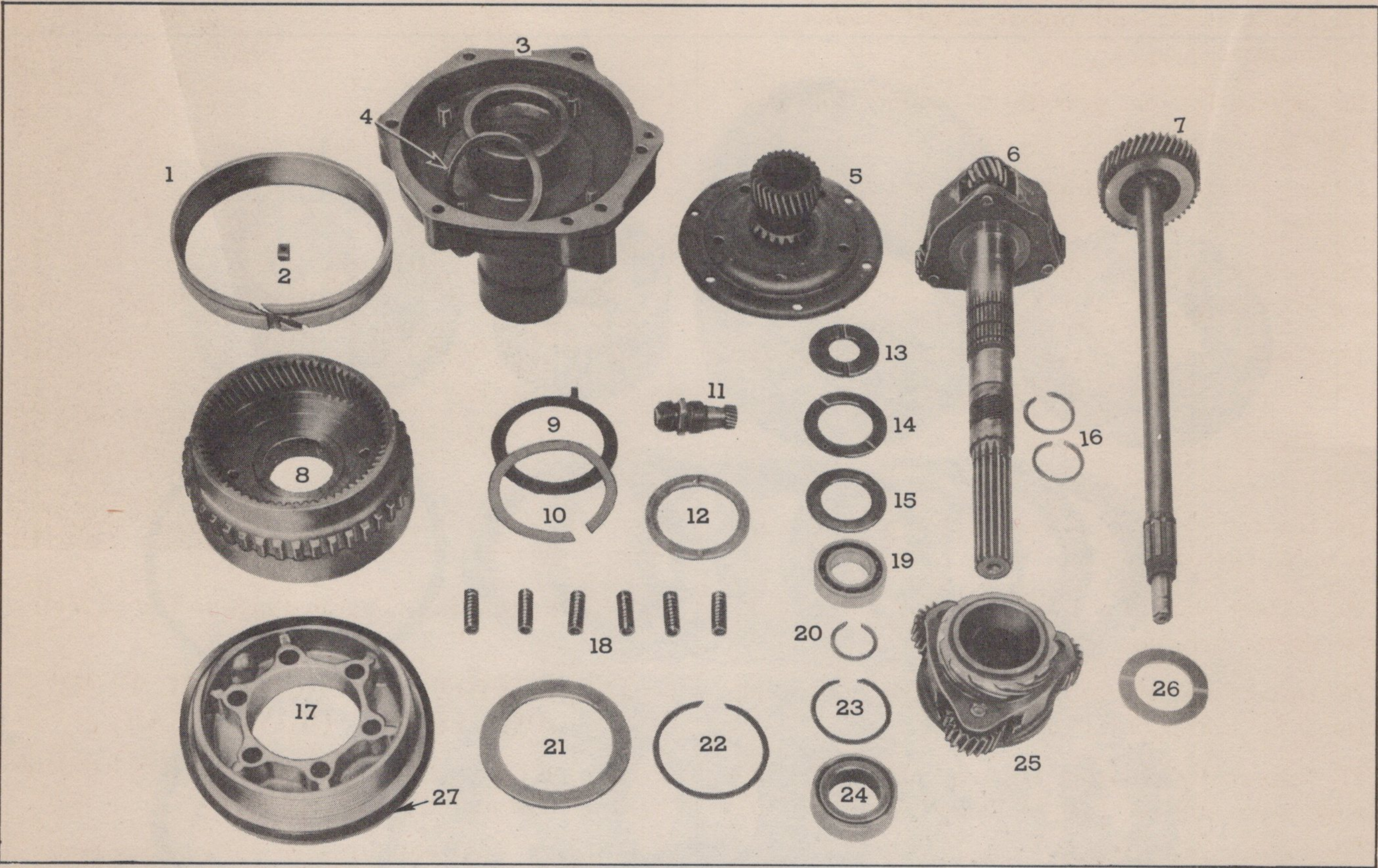
9. Inspect clutch release springs for distortion or collapsed coils. Free length $2\frac{15}{64}''$.

NOTE: **Slight wear, "bright spots", on side of outer release springs indicating slight contact with drum is permissible.**

10. Inspect clutch release spring guide pins for distortion and length ($1\frac{5}{8}'' \pm .010''$).

11. Inspect front and rear thrust faces, internal and external splines and blow out drilled passages on rear clutch hub.

12. Clean all parts thoroughly.



1. Reverse clutch stationary cone
2. Reverse stationary cone key
3. Rear bearing retainer
4. Reverse piston inner seal
5. Reverse drive flange assembly
6. Output shaft assembly
7. Main shaft
8. Reverse internal gear assembly
9. Reverse clutch release spring retainer
10. Reverse clutch release spring
11. Speedometer driven gear
12. Reverse internal gear thrust washer
13. Selective thrust washer
14. Reverse center gear thrust washer
15. Reverse center gear backing thrust washer
16. Reverse carrier to output shaft snap rings
17. Reverse piston
18. Reverse piston release springs
19. Rear bearing
20. Rear bearing to shaft snap ring
21. Spring retainer washer
22. Piston to rear bearing retainer snap ring
23. Bearing to retainer snap ring
24. Rear oil seal
25. Reverse carrier assembly
26. Rear clutch hub thrust washer
27. Reverse piston outer seal

Fig. 195—Disassembled View of Reverse Assembly and Rear Bearing Retainer

INSPECTION OF REVERSE ASSEMBLY AND MAIN SHAFT

1. Inspect ball bearing by first thoroughly cleaning and oiling, then rotate slowly by hand, feeling for roughness. Do not spin bearing with air.

2. Inspect reverse internal gear for damaged teeth and scored or damaged inside bearing surface.

3. Inspect reverse internal gear for scored or burned cone surface.

4. Inspect reverse internal gear parking teeth for damage.

5. Inspect reverse planet carrier for worn or damaged teeth and worn roller bearings.

6. Inspect splines of reverse planet carrier for damage.

7. Inspect bronze oil pump drive gear for damage or excessive wear. See that bronze gear is tight on carrier and that pump drive gear ball is in place. If gap in the ring is not over the ball, move the ring around to where the ball can be seen.

8. Inspect gear in reverse center gear and flange assembly for damaged teeth or worn bushing. If replacement is necessary, replace assembly. The center gear is not furnished separately.

9. Inspect output shaft assembly for scored thrust and bearing surfaces.

10. Inspect output shaft splines for nicks or burrs.

11. Inspect output shaft speedometer drive gear surface for wear or damage.

12. Inspect steel and bronze thrust washers for excessive wear.

13. Inspect internal gear thrust washer for wear or scoring.

14. Inspect reverse clutch release spring and retainer for signs of damage or burning.

15. Inspect reverse clutch stationary cone for burning or excessive wear.

16. Inspect reverse piston coil release springs for distortion or collapsed coils. Free length $1\frac{11}{32}''$.

17. Inspect reverse piston for burning on cone surface.

18. Inspect reverse piston for scores on piston. Be sure oil seal grooves are thoroughly clean.

19. Inspect four reverse piston pins for scoring, looseness or distortion.

20. Inspect inner and outer piston seal operating surfaces for scoring or roughness.

21. Inspect rear bearing retainer bushing for excessive wear and see that oil holes in retainer are open.

22. Inspect main shaft for damaged gear teeth, thrust and bearing surfaces.

23. Clean all parts thoroughly.

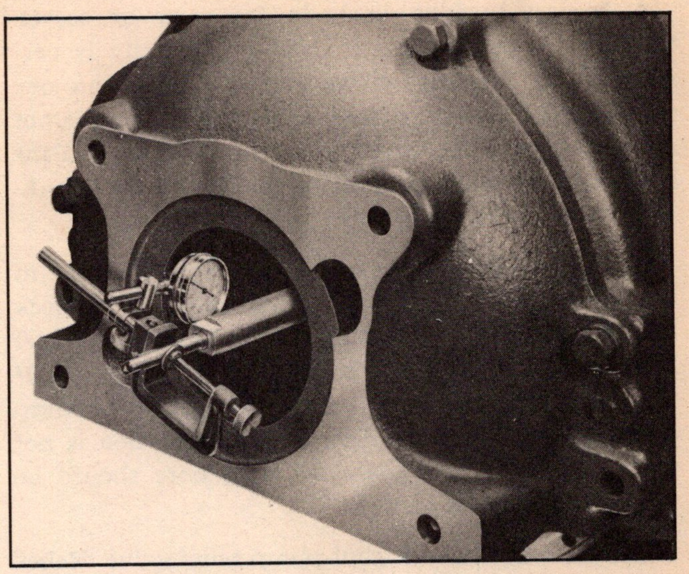


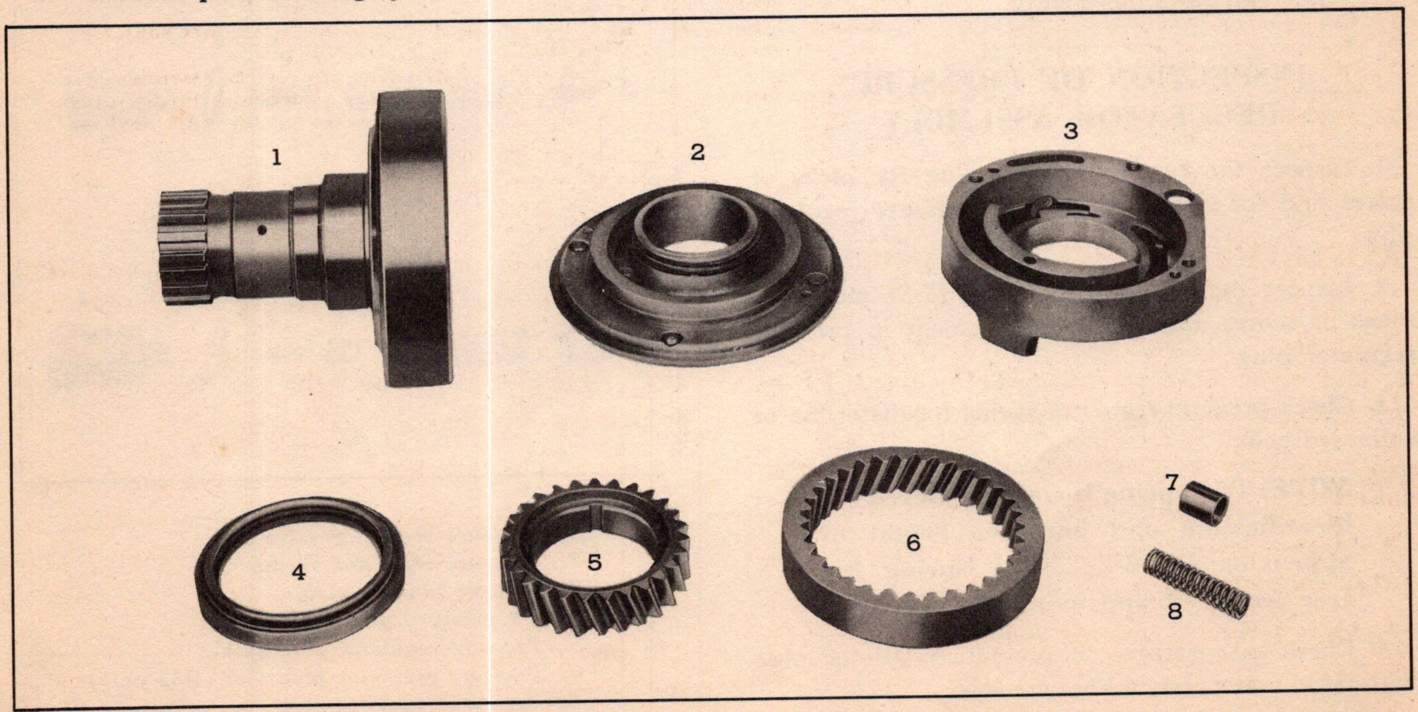
Fig. 196—Dial Indicator in Place to Check Hole

INSPECTION OF FRONT OIL PUMP AND FRONT DRIVE GEAR

1. Inspect pump drive and driven gears for damaged teeth or scored end surfaces.

2. Inspect pump body for scored gear pockets.

3. Inspect all passages for obstruction. Be sure small drilled hole at end of pressure regulator bore is open.



1. Front drive gear
2. Front pump cover
3. Front pump body
4. Oil seal
5. Pump drive gear
6. Pump driven gear
7. Relief valve
8. Relief valve spring

Fig. 197—Disassembled View of Front Pump

4. Inspect bushing in body for wear or scores. Slight wear of bushing in front pump body is permissible. If bushing shows excessive wear on one side, it is an indication that either the bushing is not concentric with the cover or the locating bore in the rear flywheel housing is not aligned with the crankshaft bore in the crankcase.

A misaligned bushing will cause excessive wear in the pump gears. If this condition exists, first check the alignment of the locating bore in the rear flywheel housing (Fig. 196). See intructions on page 117. If this is within specified limits, a new front pump assembly must be installed. If this indication is not within specified limits, the locating bore should be aligned as outlined on page 121.

5. Check freedom of front pump relief valve. Relief valve spring should push relief valve well above face of pump body. Valve should be free to travel the depth of the bore in the pump body.

6. Check for broken front pump rings. Rings should be free in their grooves.

7. Check pressure regulator valve for freedom in valve passage in pump body (Fig. 198).

8. Check woodruff key for wear or looseness.

9. Inspect front drive gear for scored surfaces, worn bushings or damaged teeth.

10. Clean all parts thoroughly.

INSPECTION OF PRESSURE REGULATOR ASSEMBLY

1. Inspect the reverse booster plug for nicks or scores and for free movement in pressure regulator plug.

2. Inspect the TV pressure plug (D51 only) for nicks or scores and for free movement in pressure regulator plug.

3. Check pressure regulator spring for distortion or collapsed coils.

> ***NOTE:*** **D51 spring is copper colored for identification and has free height of approximately 2 37/64". P51 spring has free length of approximately 3 29/64".**

4. Check oil passages in pressure regulator plug with air to make certain lines are free.

5. Check pressure plug seal and gasket for damage or wear.

6. Clean all parts thoroughly.

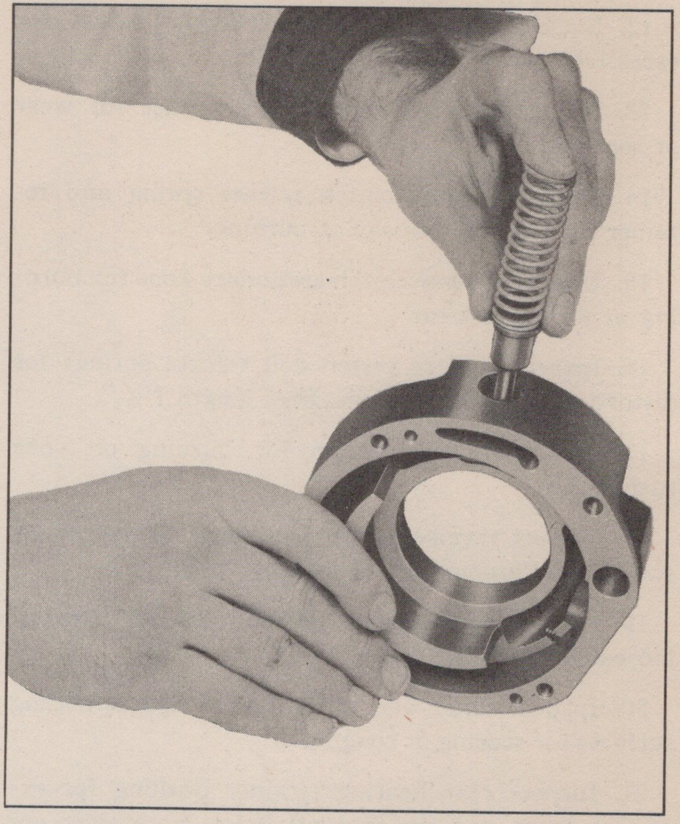
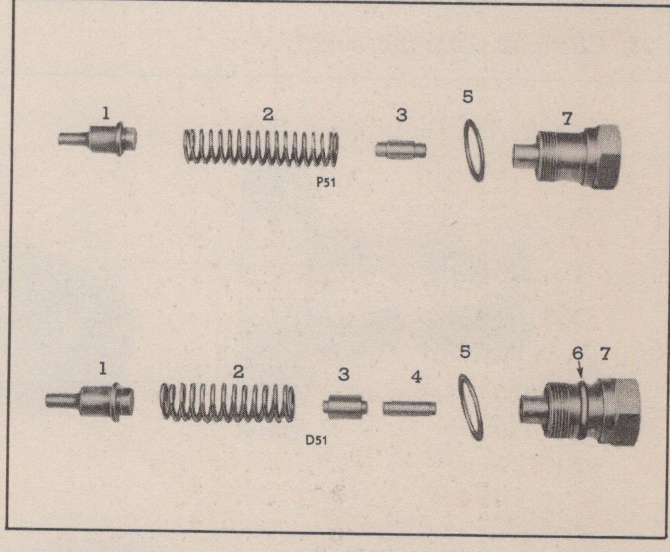
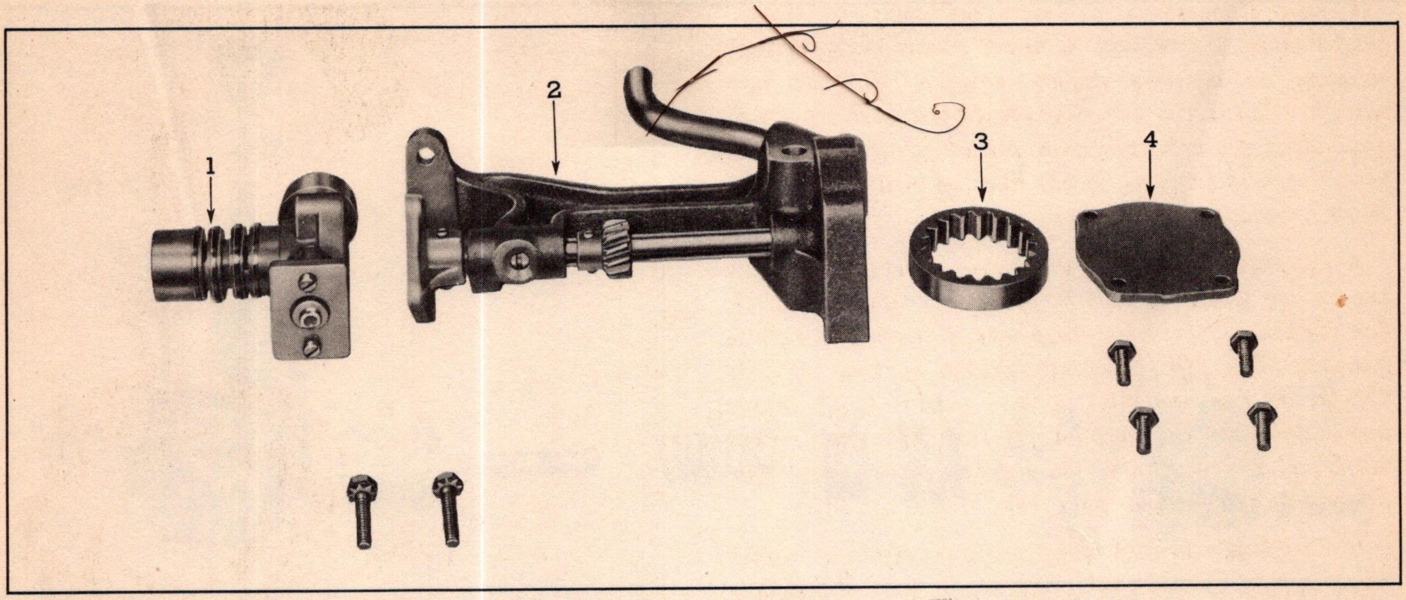


Fig. 198—Checking Fit of Pressure Regulator Valve



1. Pressure regulator valve
2. Pressure regulator spring
3. Reverse booster plug
4. TV pressure plug (D51 only)
5. Pressure regulator plug gasket
6. Pressure regulator plug seal (D51 only)
7. Pressure regulator plug

Fig. 199—Disassembled View of 6 Cyl. (P51) and 8 Cyl. (D51) Pressure Regulator Assemblies



1. Governor body
2. Rear oil pump body
3. Oil pump driven gear
4. Oil pump cover

Fig. 200—Disassembled View of Governor and Rear Pump Assembly

INSPECTION OF GOVERNOR AND REAR PUMP ASSEMBLY

1. Inspect pump gears for damaged teeth.

2. Inspect cover, and gear pockets in body, for scores.

3. Inspect governor ring lands and rings for freedom in grooves. If lands are damaged or worn thin, replace the complete governor assembly.

4. Inspect both the G-1 plunger and G-2 plunger for free movement of from .118″ to .148″.

   ***NOTE:* If after thoroughly cleaning governor and plungers, the G-1 plunger still sticks, the complete governor assembly should be replaced. If only the G-2 plunger sticks, then the G-2 plunger and bushing assembly should be replaced as outlined on page 114.**

5. Clean all parts thoroughly.

INSPECTION OF FRONT SERVO

1. Inspect servo body for scores and obstructed or interconnected passages (Fig. 201).

2. Inspect band apply piston assembly for scores, broken ring, freedom of ring in groove and obstructed passages (Fig. 202).

3. Inspect front band release cylinder for scores.

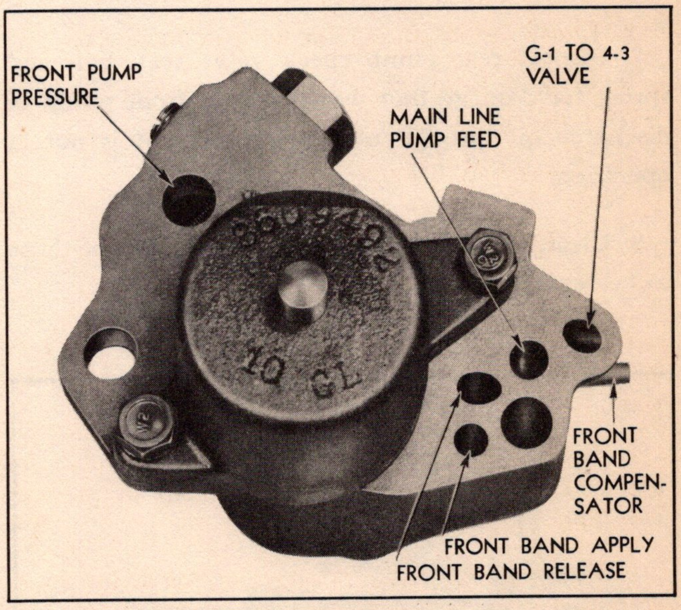
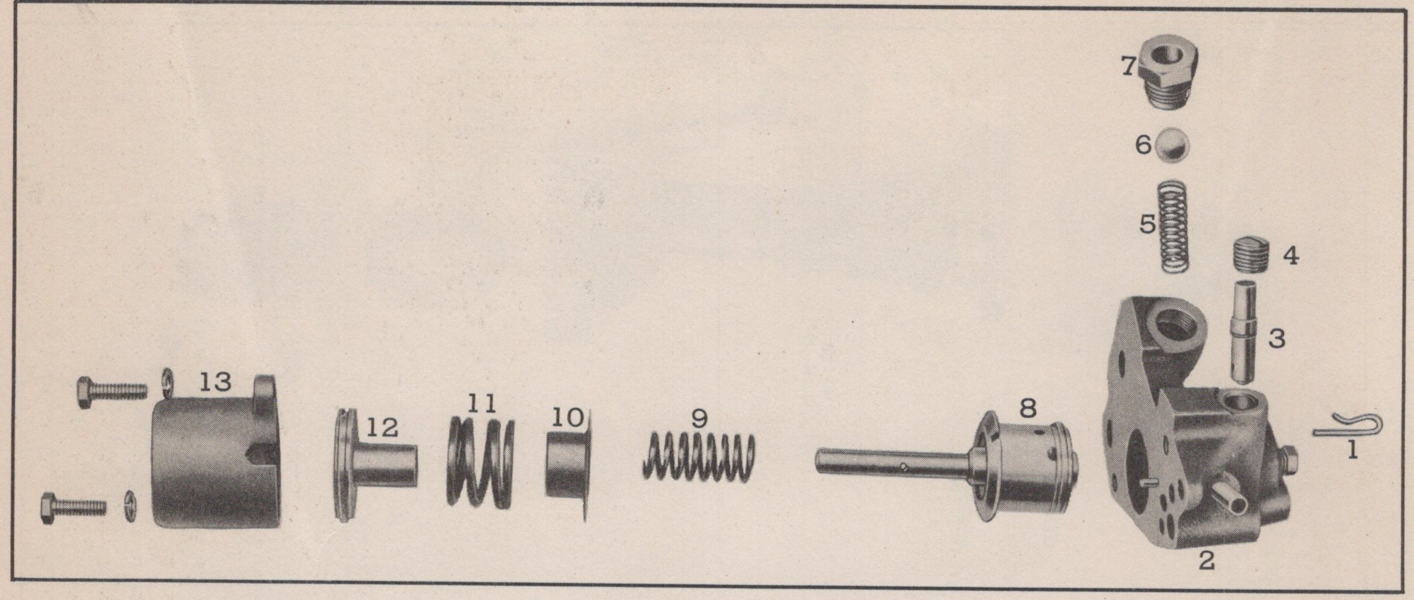


Fig. 201—Oil Passages in Front Servo

4. Inspect front band release piston for scores, broken ring, and freedom of ring in groove.

5. Inspect 4 to 3 valve for obstructed orifice or scores.

6. Inspect front servo springs for distortion or collapsed coils. Booster spring free length $^{61}/_{64}$″. Retracting spring free length $1^{33}/_{64}$″.



1. Downshift valve retainer
2. Servo body
3. 4-3 downshift valve
4. Plug
5. Check valve spring
6. Rear pump ball check valve
7. Check valve seat and oil pipe fitting
8. Band apply piston assembly
9. Retracting spring
10. Retracting spring retainer
11. Booster spring
12. Band release piston
13. Release cylinder

Fig. 202—Disassembled View of Front Servo

7. Inspect rear pump check valve seat, ball and spring for damage that would permit front pump to discharge oil through rear pump when it is not in operation.

8. Clean all parts thoroughly. Make a list of those to be replaced.

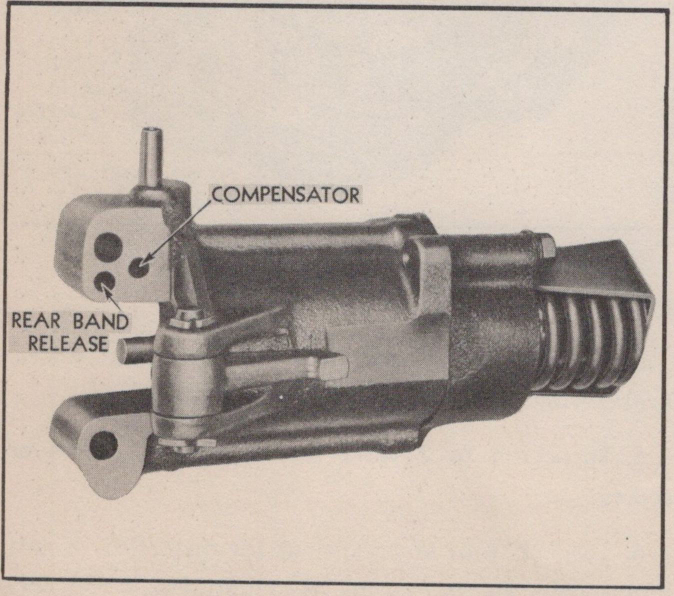


Fig. 203—Oil Passages in Rear Servo

INSPECTION OF REAR SERVO

1. Inspect servo body for scores and obstructed or interconnected passages (Fig. 203).

2. Inspect actuating lever for free operation, worn socket, and excessive wear at actuating lever pin.

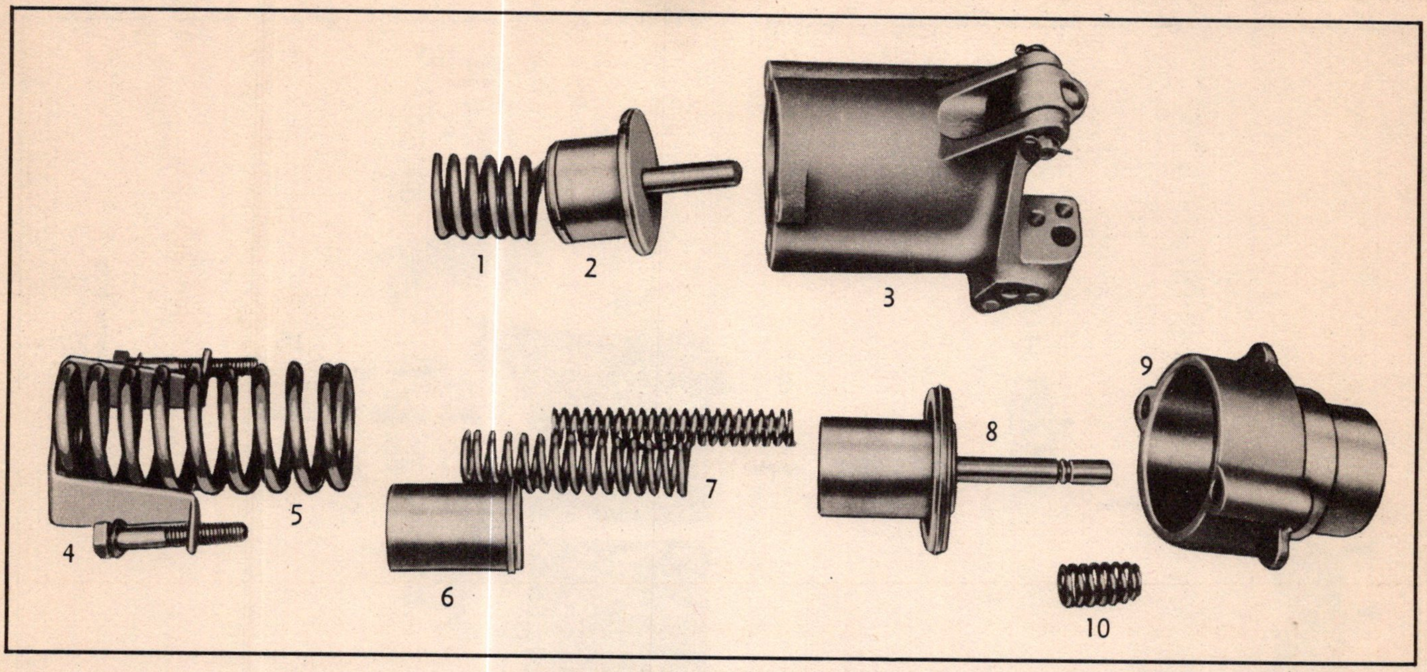
3. Inspect booster piston for scores, broken rings and freedom of rings in grooves.

4. Inspect accumulator body for scores or obstructed passages. Be sure check valve is not broken or rivet is not loose, and that check valve plunger is free. Check to see that hole in check valve is open and valve seats flat on accumulator body.

5. Inspect accumulator piston for scores, damaged ring, freedom of ring in groove, or obstructed passage in stem.

6. Inspect compensator piston for scores, damaged ring and freedom of ring in groove.

> ***NOTE:*** **In the rear servo assembly on later transmissions a stamped type compensator piston will be found in place of a cast iron piston. Because of the characteristics of the stamped piston no ring is required and only one servo spring is used in place of the inner and outer servo springs. Performance of this**



1. Booster spring
2. Booster piston
3. Servo body
4. Spring retainer
5. Rear servo spring
6. Compensator piston
7. Servo springs (inner and outer)
8. Accumulator piston
9. Accumulator body
10. Accumulator apply spring

Fig. 204—Disassembled View of Rear Servo

late type compensator piston is exactly the same as with the cast iron piston. If replacement of a compensator piston is necessary either type can be used providing the proper servo spring or springs are used.

7. Inspect all servo springs for damage, distortion or collapsed coils.

Spring	*Free Length*
Rear Servo Spring	$4\frac{1}{4}''$
Servo Spring, Inner	$3\frac{25}{32}''$
Servo Spring, Outer	$3\frac{15}{32}''$
Accumulator Apply Spring	$1\frac{15}{64}''$
Booster Spring	$1\frac{19}{32}''$
Servo Spring (Used with optional stamped compensator piston)	$4\frac{11}{32}''$

8. Clean all parts thoroughly.

INSPECTION OF CONTROL VALVE ASSEMBLY

***NOTE:* The D51 control valve assembly is exactly the same as the P51 control valve assembly except for the 3-4 shifter valve spring and the front valve body.**

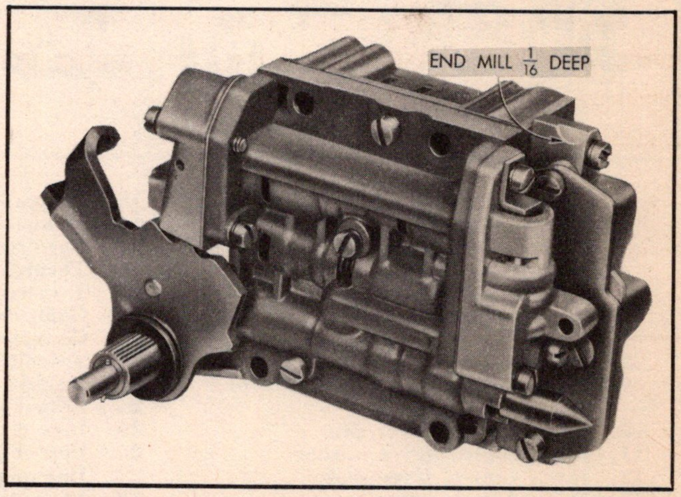
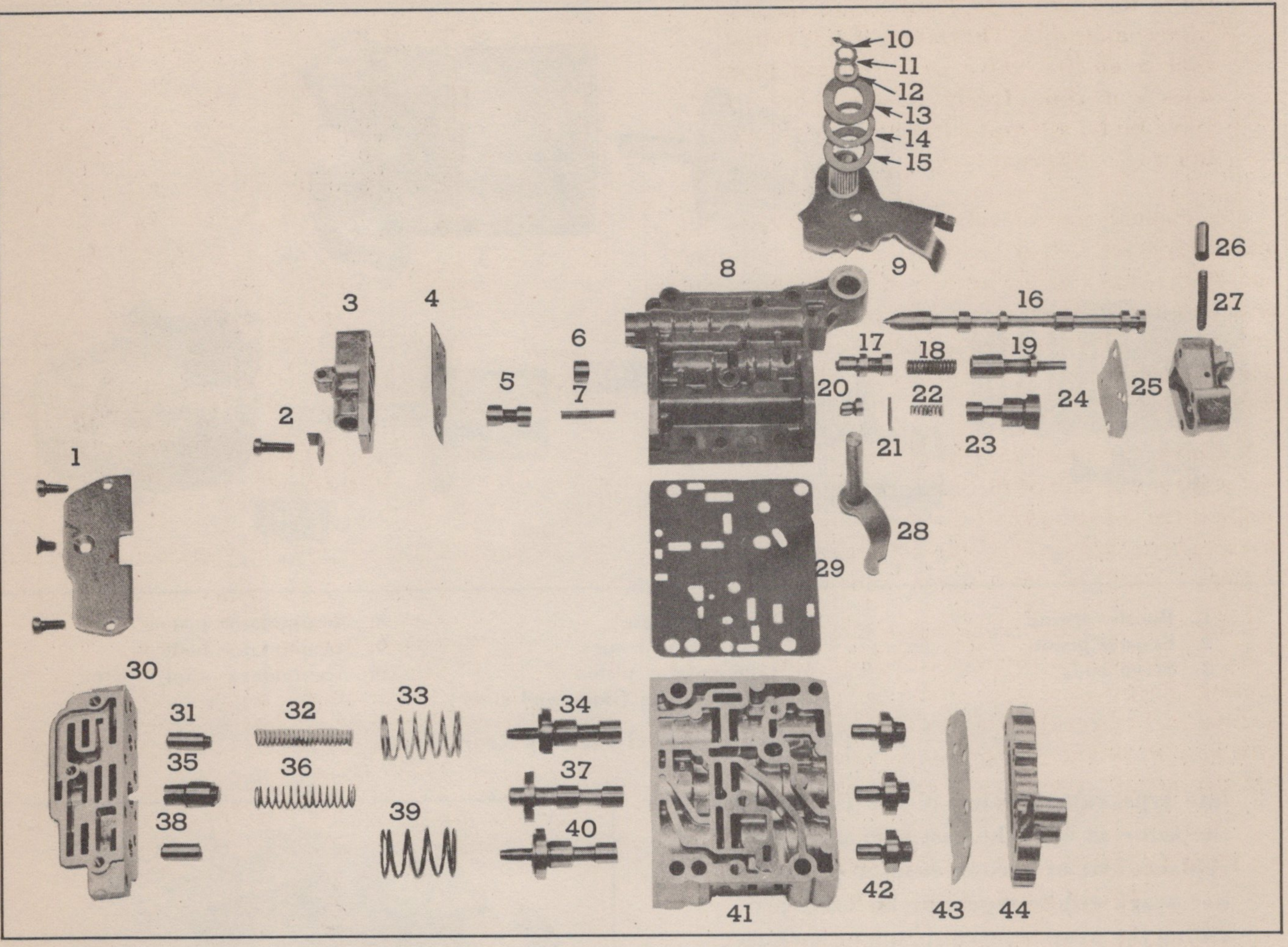


Fig. 205—Identification of D51 Control Valve Assembly

The free length of the P51 3-4 valve is approximately $1\frac{1}{4}''$ while the free length of the D51 3-4 valve spring is approximately $1\frac{5}{32}''$.

The front valve body used on the D51 transmission has a passage for throttle pressure to the pressure regulator. Identification of the valve bodies can be determined by means of the $\frac{1}{16}''$ deep end mill on the front valve body of the D51 shown in Fig. 205.



1. Front valve body plate and screws
2. Servo release plug lock and screw
3. Front servo exhaust body
4. Front servo exhaust body spacer
5. Compensator valve
6. Detent plug
7. Compensator valve spring
8. Outer valve body
9. Manual shaft and detent control lever
10. Inner control lever pin
11. Inner control lever washer
12. Inner control lever seal
13. Manual shaft seal
14. Manual shaft seal outer washer
15. Manual shaft seal inner washer
16. Manual control valve
17. Throttle valve
18. Throttle valve spring
19. T valve
20. Compensator auxiliary plug
21. Compensator auxiliary plug pin
22. Transition valve spring
23. Double transition valve
24. Detent plunger spacer
25. Detent plunger retainer
26. Detent plunger
27. Detent plunger spring
28. Inner throttle lever
29. Valve body spacer plate
30. Front valve body
31. 2-3 regulator plug
32. 2-3 regulator plug spring
33. 2-3 shifter valve spring
34. 2-3 shifter valve
35. 1-2 regulator plug
36. 1-2 regulator plug spring
37. 1-2 shifter valve
38. 3-4 regulator plug
39. 3-4 shifter valve spring
40. 3-4 shifter valve
41. Inner valve body
42. Governor plugs
43. Inner valve body plate
44. Valve body rear cover

Fig. 206—Disassembled View of Control Valve Assembly

Before inspecting the valve bodies and valves, they should be thoroughly cleaned with CLEAN cleaning fluid.

1. Inspect all valves carefully to see that they are free from burrs and not damaged (Scored—for example) in any way. Burrs can be removed by carefully using fine crocus cloth. This type of valve has sharp corners to prevent dirt from wedging between valve and body, therefore, when removing burrs, do not round off square edges.

2. With the valves and valve bodies clean and dry, check each shifter valve, governor plug, and regulator plug for free movement in their respective bores and operating positions.

> ***NOTE:*** **Valves can be assumed to be free in their operating position if they will fall of their own weight in their respective bores when valve body is shaken slightly. Do not drop valves. All governor plugs are interchangeable. Likewise,**

the 2 to 3 and 3 to 4 shifter valves are interchangeable. Therefore, if it is found that a shifter valve or governor plug does not slide freely in one bore of valve body, attempt correcting by changing it to a different bore.

The manual control valve is the only valve furnished separately. If it becomes necessary to replace one of the other valves or one of the bodies (inner or outer), the complete control valve assembly should be replaced. Refer to Master Parts Catalog for component parts which are replaceable on the control valve assembly.

3. Check the fit of the throttle valve inside lever and shaft in the hub of the inside detent control lever, on the outer valve body. If the shaft binds in the hub, is excessively worn, or if the oil seal is missing or damaged, it will be necessary to make repairs.

4. Examine reverse check valve located in detent plunger housing. Valve should be firmly attached to housing. Free end should extend ¼" above face of housing in free position. Hole (.062") should line up with hole in detent plunger spacer plate and should rest flat against spacer plate when installed.

INSPECTION OF PARKING BRAKE BRACKET ASSEMBLY

1. Inspect the bracket and crank assembly to see that the crank operates freely in the bracket without binding but does not show signs of unusual wear.

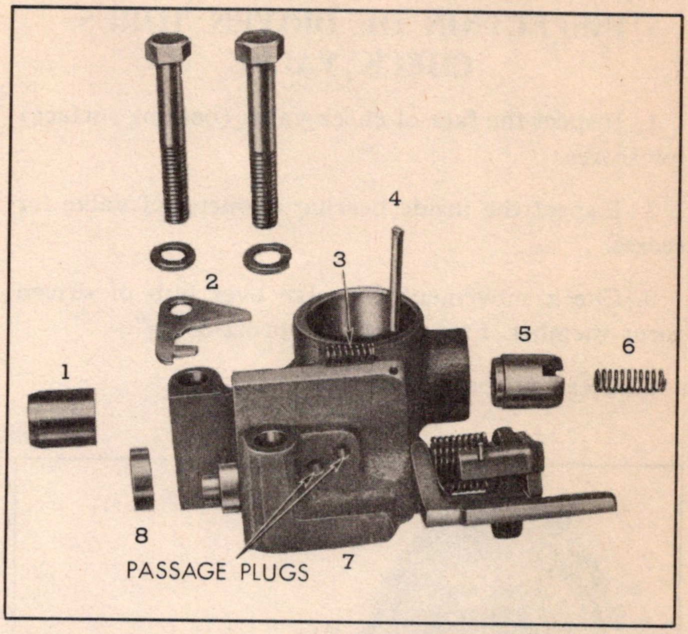
2. Check the crank roller for signs of unusual wear.

3. Inspect the crank pin which carries the roller to see that there are no visible cracks at the point where the pin joins the crank.

4. Clean and inspect the oil passages to the two blocker pistons in order to remove all dirt and any other obstructions.

5. Inspect the two blocker pistons and bores in the bracket to see that both are free of scores and burrs. Check the fit of the two blocker pistons in their respective bores to insure a non-binding, non-leaking fit. This can readily be done by placing one finger over the oil hole in the sleeve, pulling the piston outward, and observing if a slight vacuum is created. Excessive leak may be caused by passage plugs omitted from bracket.

6. Inspect parking pawl for cracks or signs of unusual wear.



1. **Parking blocker piston**
2. **Parking blocker return spring stop**
3. **Parking blocker return spring**
4. **Stop pin**
5. **Reverse blocker piston**
6. **Reverse blocker piston spring**
7. **Bracket and crank assembly**
8. **Crank roller**

Fig. 207—Disassembled View of Parking Brake Bracket

7. Check oil delivery sleeve for score marks or excessive wear.

8. Inspect parking blocker piston release spring. Early type (Fig. 208) should have a free length of $3\frac{9}{64}$". Late type spring should have free length of $1\frac{1}{32}$".

9. Clean all parts thoroughly.

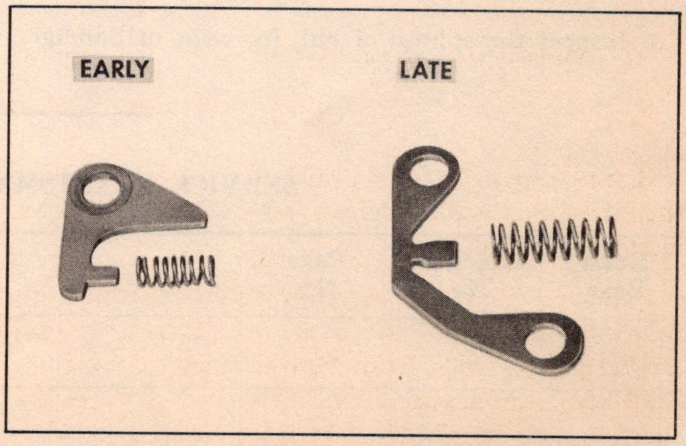


Fig. 208—Parking Blocker Piston Spring and Stop (Early and Late)

INSPECTION OF DRIVEN TORUS CHECK VALVE

1. Inspect the face of check valve (bearing surface) for scores.

2. Inspect the inside bearing diameter of valve for scores.

3. Check movement of valve over hub of driven torus member. Free length of spring $3\frac{17}{32}''$.

4. Clean all parts thoroughly.

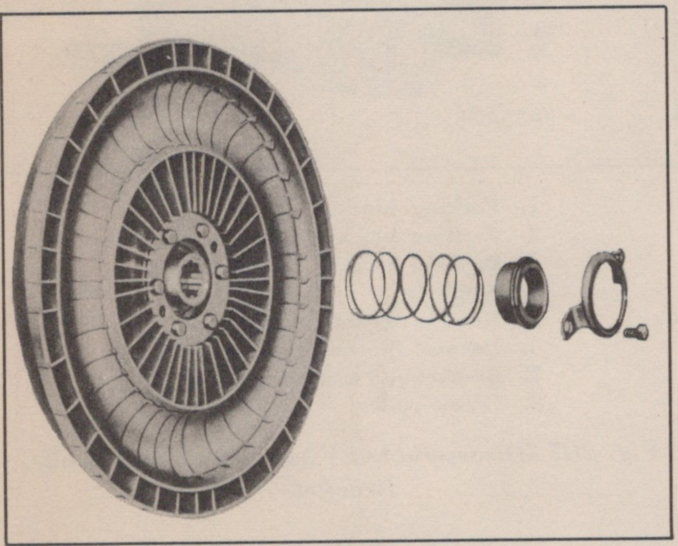


Fig. 209—Torus Check Valve—Exploded View

INSPECTION OF TORUS COVER

1. Inspect inner and outer diameter of torus cover oil seal hub for score marks.

2. Inspect grooved gasket surface for nicks or burrs. Two continuous ridges should appear on the sealing surface.

3. Inspect the splines of hub for wear or damage.

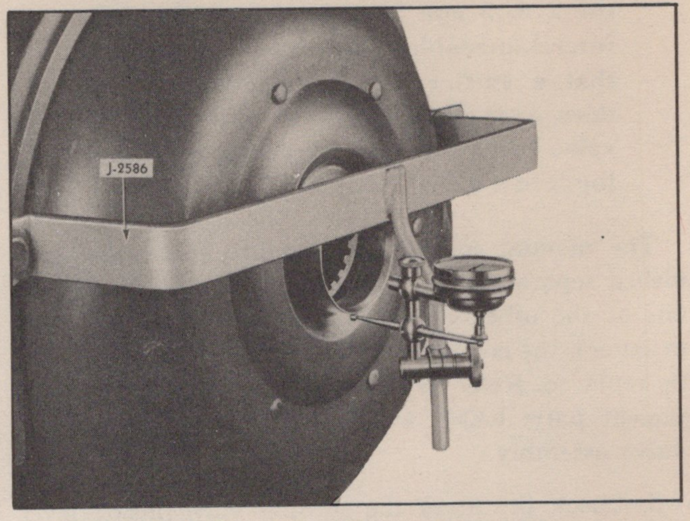


Fig. 210—Checking Torus Cover Runout

4. Check torus cover hub runout as follows:

(a) Assemble the torus cover to the flywheel, using four bolts evenly spaced.

(b) Assemble a dial indicator to tool No. J-2586 so the hole attachment contacts the hub of the torus cover (Fig. 210).

(c) Rotate the engine and observe the runout which must not exceed .005″.

(d) If runout exceeds .005″ and flywheel runout (see below) does not exceed .005″, replace torus cover.

INSPECTION OF FLYWHEEL

1. Inspect the sealing surface which bears against the torus cover to flywheel gasket for nicks or burrs.

2. Inspect the flywheel gear teeth for damage.

3. Check flywheel runout with the dial indicator mounted so the stem will contact the sealing surface just inside the row of torus cover bolt holes. Flywheel runout should not exceed .005″ total reading.

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REPAIRS

CONTENTS OF THIS SECTION

The procedures in this section are provided to take care of repair operations which are found necessary during inspection.

REAR OIL PUMP REPAIR

To replace governor drive flange, rear oil pump and governor driven gear, pump body or rear oil pump shaft assembly, proceed as follows.

> ***NOTE:* Governor and rear oil pump should be disassembled according to instructions on page 90 before starting repair work.**

1. Grind off one end of each of lock pins holding governor drive flange and oil pump driven gear on shaft.

2. Drive pin through governor drive flange (Fig. 211). (Tool J-2183-1 is helpful in this operation.)

3. Remove governor drive flange.

4. Drive pin through pump shaft and driven gear.

5. Remove any burrs from shaft at pin holes, then remove shaft and gear through body.

6. Slide drive shaft and gear into pump end of body. Slide driven gear over shaft with teeth toward pump end of body, then enter shaft into governor end of body.

7. Line up holes in gear and shaft and install a new pin.

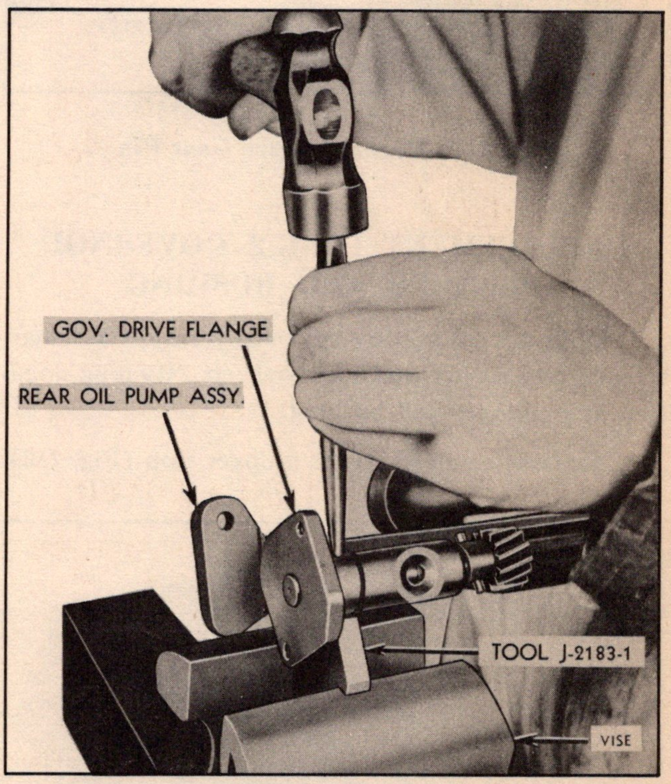

Fig. 211—Removing Governor Drive Flange

8. Peen ends of pin to fill holes in shaft and gear (Fig. 212). (Tools J-2183-1 and J-2183-2 are helpful in this operation.)

> ***CAUTION: Height of peened ends of pins must not exceed .070".***

9. Install governor drive flange on end of shaft and peen a new pin as in operation 8 above.

> ***NOTE:* Complete assembly procedure is given on page 136.**

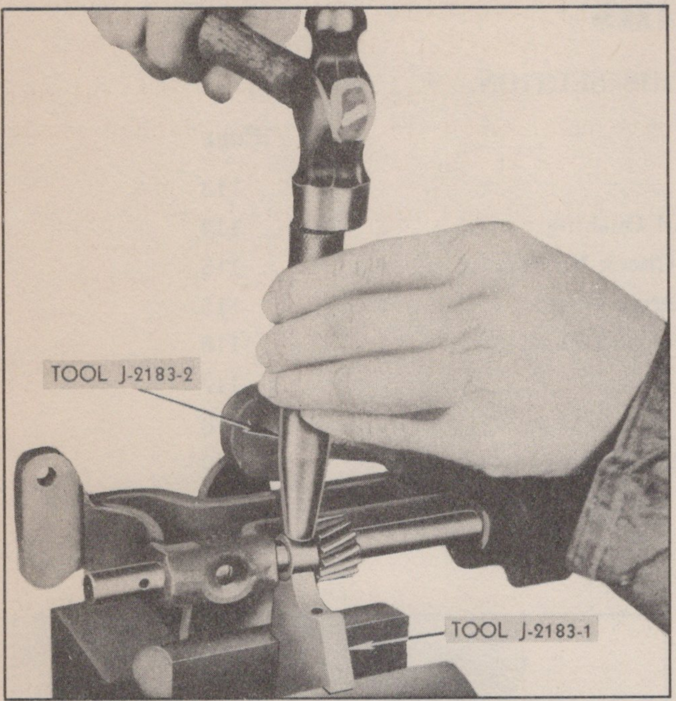

Fig. 212—Peening Drive Gear Pin

REPLACEMENT OF G-2 GOVERNOR PLUNGER AND BUSHING

1. With governor body removed from drive flange, remove two screws and lock washers retaining small governor plunger and bushing.

2. Remove small governor plunger stop (Fig. 213).

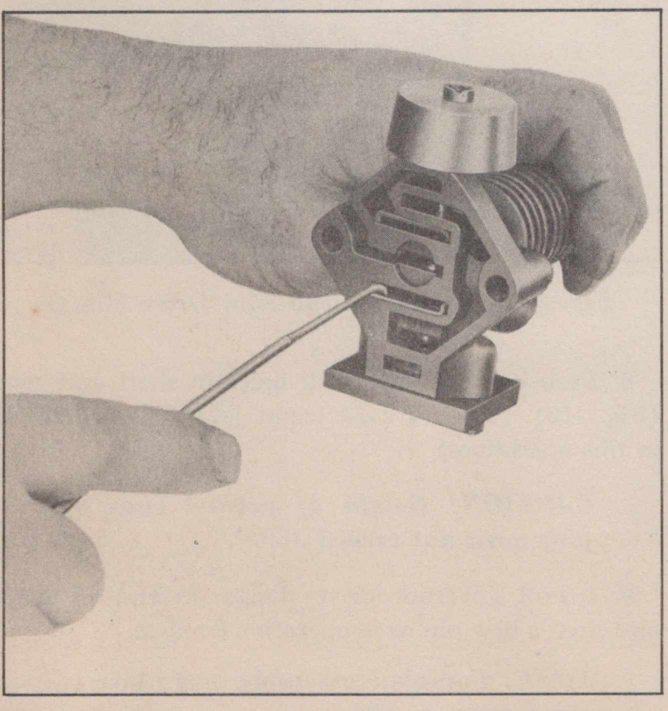

Fig. 213—Removing Small Governor Plunger Stop

3. Pull small governor plunger and bushing assembly from governor body. Considerable force may be required in removing the assembly.

> ***CAUTION: Do not attempt to remove governor plunger or weights from either plunger assembly.***

4. Install new G-2 plunger and bushing assembly with slot in bushing for governor plunger stop up (Fig. 214).

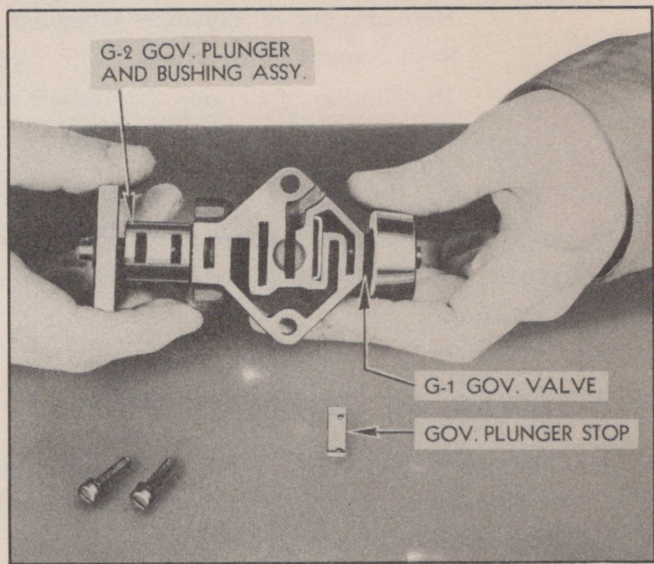

Fig. 214—Installing G-2 Governor Plunger and Bushing

5. Install and tighten two G-2 governor plunger and bushing assembly attaching screws and lock washers.

6. While holding G-2 plunger in, install the G-2 plunger stop with two small holes up (Fig. 215).

> ***CAUTION: Be sure stop does not extend above the surface of the governor body.***

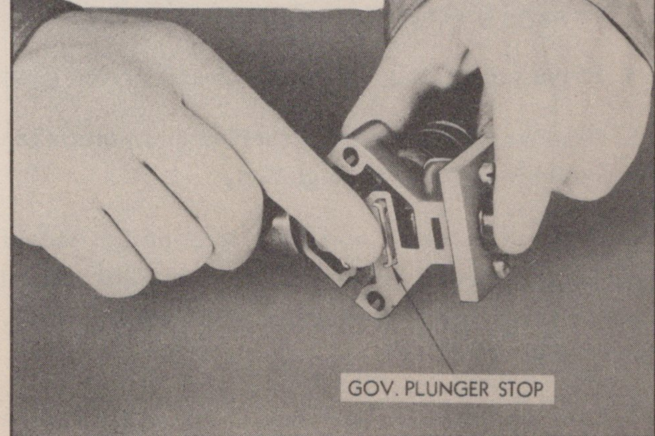

Fig. 215—Installing G-2 Governor Plunger Stop

Fig. 216—Removing Check Valve Rivet

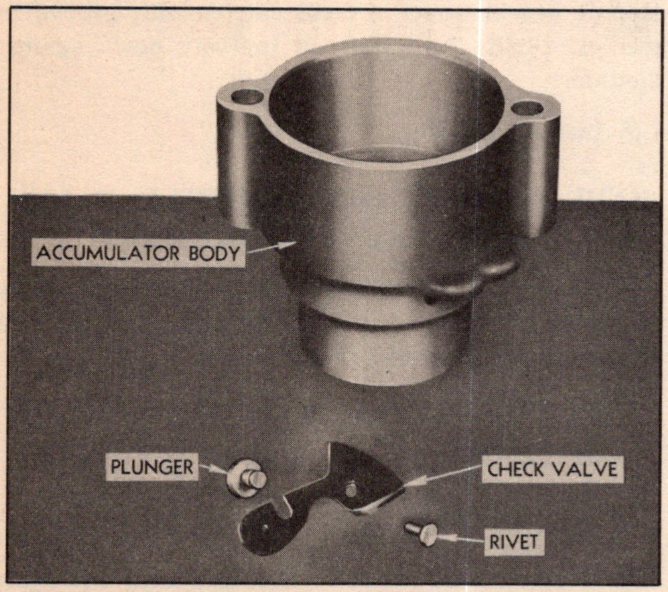

Fig. 217—Check Valve, Plunger and Rivet

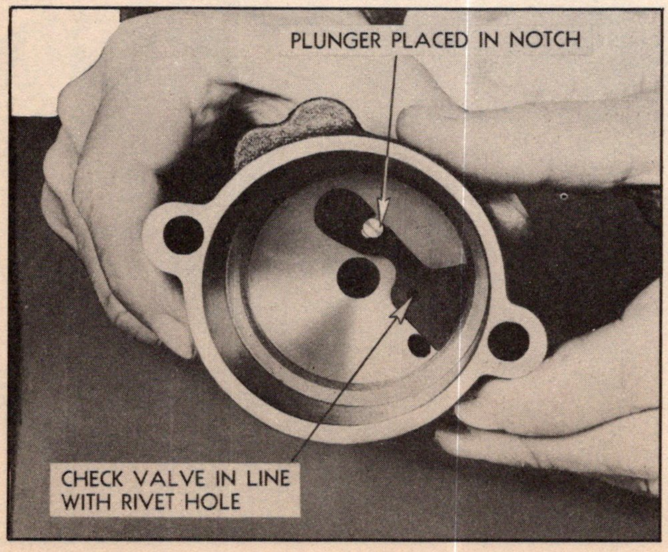

Fig. 218—Check Valve and Plunger in Body

REPLACEMENT OF REAR SERVO ACCUMULATOR CHECK VALVE

When tests or inspection indicate that the rear servo accumulator check valve is at fault it should be replaced as follows:

***NOTE:* Accumulator body should be removed from the servo assembly according to instructions on page 92 before starting repair work.**

1. Drive out rivet holding check valve in place (Fig. 216).
2. Remove check valve and plunger (Fig. 217).
3. Clean body and passages.
4. Install plunger.
5. Install check valve, placing notch in groove in plunger (Fig. 218).
6. Insert new rivet through valve and into body. Peen rivet.

***NOTE:* Small bleed hole in valve should be over hole in body.**

7. Check assembly by working plunger to be sure the plunger and flat check valve are free.

REPLACEMENT OF REAR OIL PUMP AND GOVERNOR DRIVE GEAR

When necessary to replace the rear oil pump and governor drive gear on the reverse planet carrier assembly proceed as follows:

1. Remove snap ring (Fig. 219).

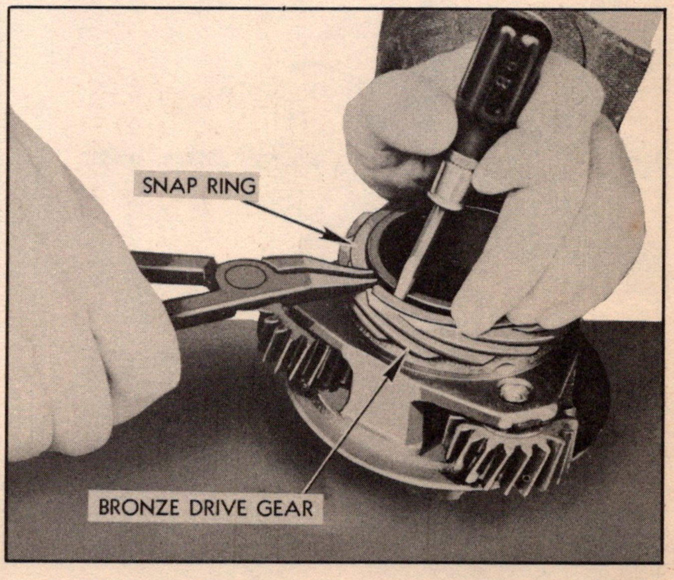

Fig. 219—Removing Oil Pump and Governor Drive Gear Snap Ring

2. Place reverse planet carrier assembly in vise with soft jaws and saw the bronze gear between teeth to within $1/32''$ of hub. Do not saw into hub.

3. Select a chisel with a blunt taper and remove gear by splitting in saw slot. Do not use a slender tapered chisel, as hub may be damaged (Fig. 220).

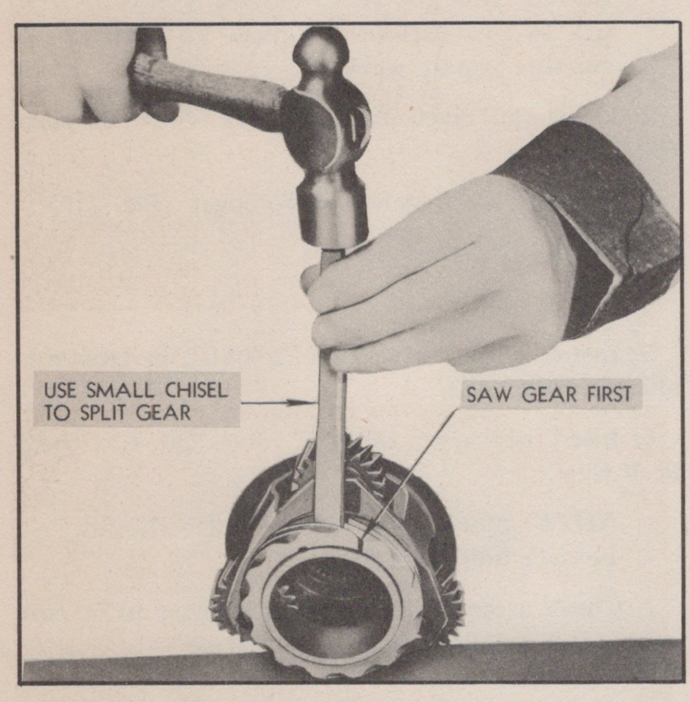

Fig. 220—Removing Oil Pump and Governor Drive Gear

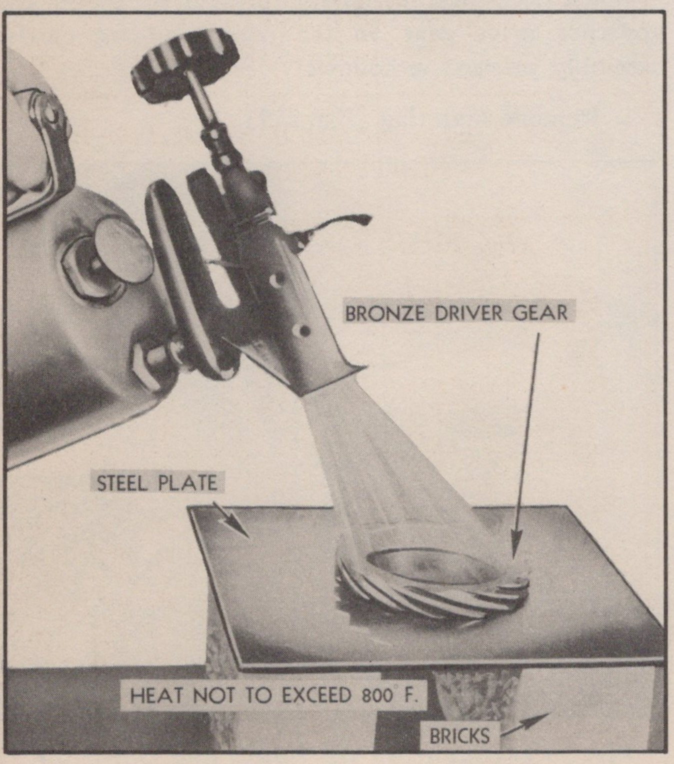

Fig. 221—Heating Bronze Drive Gear

4. Remove steel locating ball from hub.

5. Clean all parts thoroughly. Smooth surface where gear is to be installed. Make sure snap ring groove is clean and free of burrs.

6. Place locating ball in hub. Hold in place with petrolatum.

7. Place new gear on metal plate supported by two bricks. Heat gear with torch until it just begins to discolor or show traces of blue. Do not overheat (Fig. 221).

> ***NOTE:* The face of gear having a forged depression ($5/64''$ diameter by $1/16''$ deep) goes down toward the shoulder of the planet carrier assembly.**

8. Using heavy asbestos gloves, pick up gear and drop it quickly over reverse carrier with groove in gear over ball. Push gear all the way down against shoulder.

9. Install snap ring.

REPLACEMENT OF THROTTLE VALVE INSIDE LEVER AND SHAFT

When inspection indicates that replacement of the throttle valve inside lever, shaft, and shaft oil seal are necessary, proceed as follows:

1. Drive out the throttle valve shaft pin (Fig. 222).

> ***NOTE:* Support the shaft so as not to damage the detent control lever or outer valve body during this operation.**

2. Replace the throttle valve inside lever and shaft and shaft oil seal.

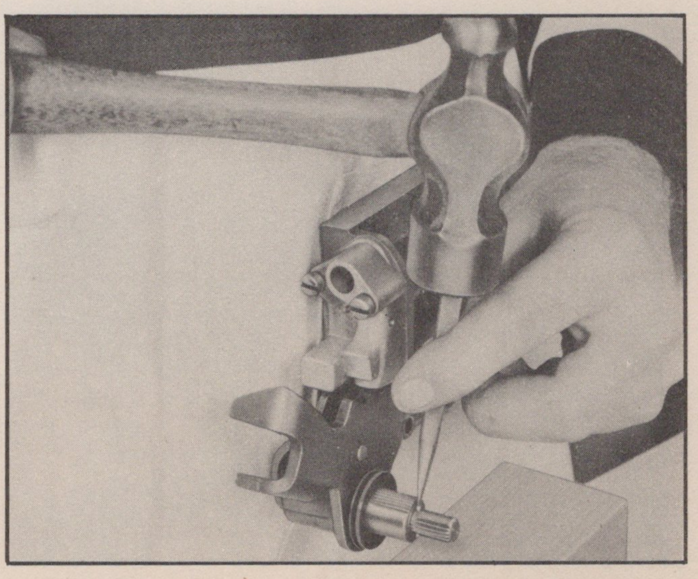

Fig. 222—Driving Out Throttle Valve Shaft Pin

3. Drive in a new shaft pin, observing the note of 1 above.

4. Check the throttle valve inside shaft for freedom of movement.

REPLACEMENT OF FLYWHEEL HOUSINGS

Service Flywheel Housing Assembly

Front and rear flywheel housings for service are finish machined while assembled on a master cylinder block and therefore are not available separately. The front housing fits over the dowels in the engine block. The rear housing includes dowels which enter holes in the front housing. The letter S is stamped at the top of both housings near the parting line. Lock washers must be added when installing the housings, as they are not included in the service assembly.

Installation of Service Flywheel Housing Assembly

1. Remove transmission assembly (see page 71).

2. Remove flywheel to crankshaft dowel and flywheel (see page 118).

3. Remove front flywheel housing from engine.

4. Install service flywheel housing assembly on engine to permit checking alignment.

5. Mount dial indicator on crankshaft flange so spindle on indicator contacts inside of four-inch hole in rear housing (Fig. 223).

6. Check location of hole in rear flywheel housing as follows:

a. Check horizontally: Rotate crankshaft to place dial indicator spindle at point A, Fig. 224. Set dial at 0. Rotate crankshaft until indicator spindle is at B directly opposite starting point A. Indicator reading at B must not be more than .004″ on either side of initial reading. This will insure that center of housing hole is within .002″ on either side of center of flywheel.

b. Check vertically: Rotate crankshaft to place dial indicator spindle at point C, Fig. 224. Set dial at .010″. Rotate crankshaft until indicator spindle is at D directly under C. Indicator reading must be between .006″ and .000″ (.004″ preferred). This will insure that center of hole in housing is between .002″ and .005″ below center of flywheel.

7. Change indicator location so stem contacts rear face of flywheel housing ⅜″ from the edge of the hole (Fig. 225).

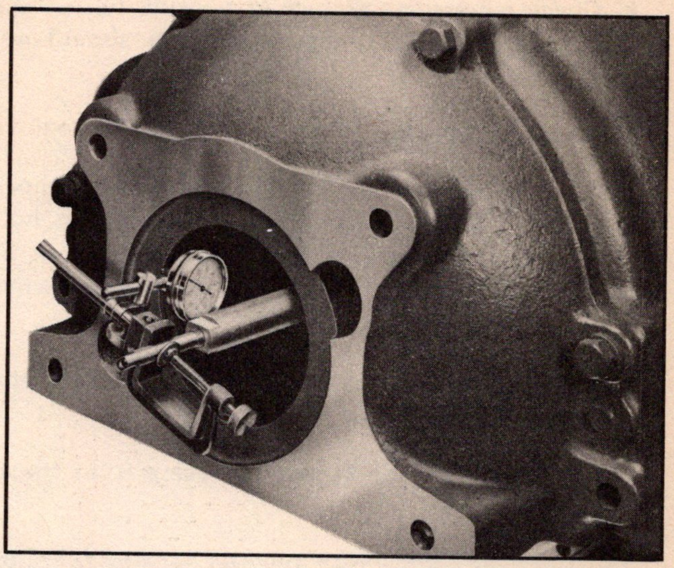

Fig. 223—Dial Indicator in Place to Check Hole

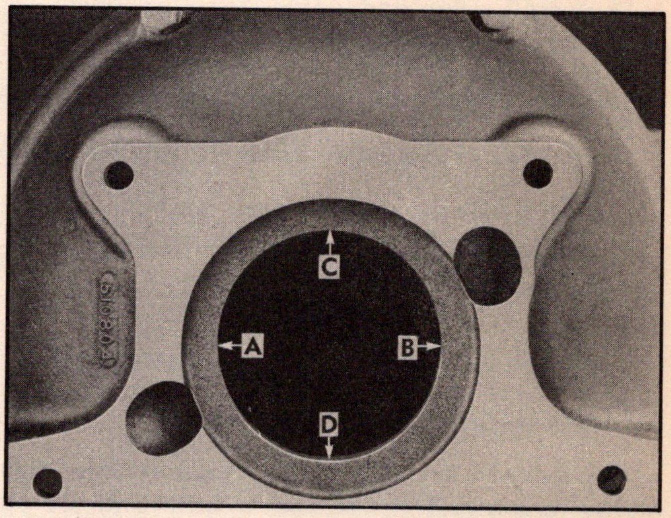

Fig. 224—Checks for Location of Hole in Rear Flywheel Housing

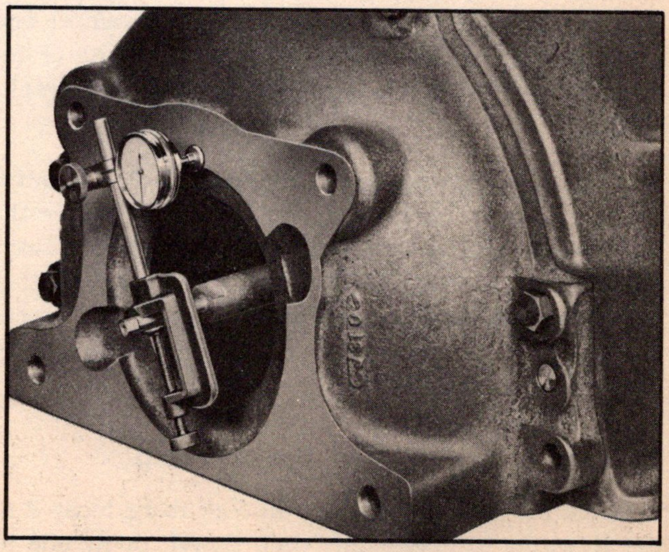

Fig. 225—Dial Indicator in Place to Check Face

8. Check squareness of face of housing by turning the crankshaft. Total indicator reading should not exceed .003″.

9. Remove indicator.

10. If hole location and rear face of housing check within limits, remove rear flywheel housing. If hole and rear face do not check within limits align as instructed on page 120. Remove rear housing when alignment is completed.

11. Remove driven and drive torus members and torus cover from transmission.

12. Remove old rear flywheel housing from transmission.

13. Assemble service rear flywheel housing to transmission.

14. Install drive and driven torus members and torus cover on transmission.

15. Install flywheel and oversize dowel (see below).

16. Replace transmisison assembly (see page 151).

> ***NOTE:* Be sure to use lock washers under heads of front to rear flywheel housing bolts.**

REPLACEMENT OF FLYWHEEL

Flywheel to Crankshaft Construction

The flywheel has a fit of .001″ loose to .002″ tight on the crankshaft flange and is held with six ½″ special bolts which are tightened gradually to 105 ft. lbs. torque, using alternate opposites. A dowel pin is used to carry part of the torque. This dowel has a .001″ to .0025″ press fit in both the flywheel and crankshaft (Fig. 226). A special seal compound (Pliobond 30) is used between the flywheel and the crankshaft.

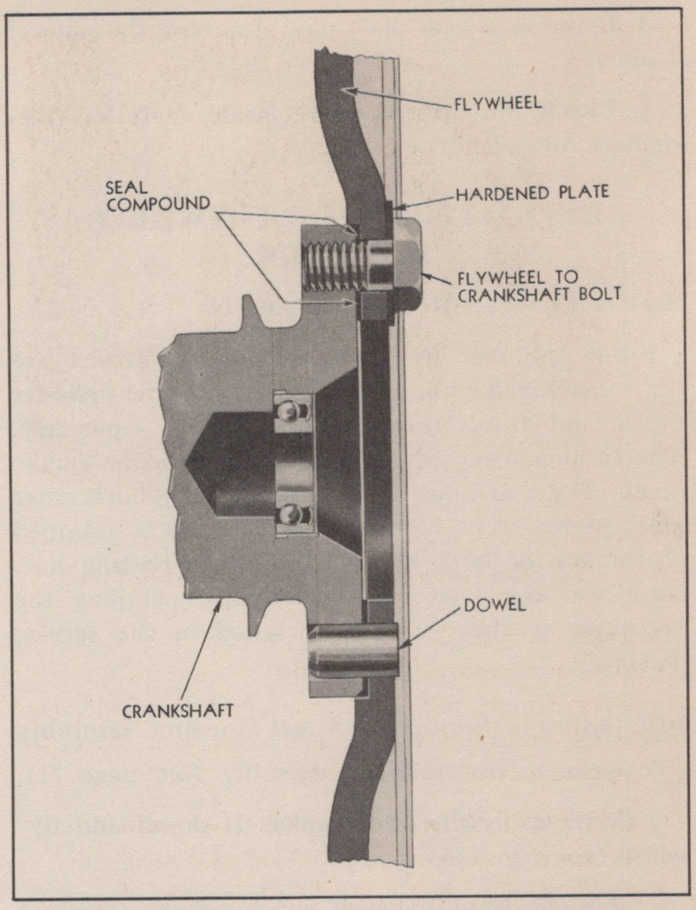

Fig. 226—Flywheel to Crankshaft Construction

When making repairs, the dowel hole is finish reamed and an oversize dowel is installed after the six flywheel to crankshaft bolts are tightened. Dowels cannot be reused after removal, nor can another dowel be used in the same dowel hole. This procedure removes scores and prevents oil leakage. Special tools are available for this procedure.

Oil Leak at Flywheel Seal, Dowel or Bolts

When inspection shows an oil leak to be located at the flywheel to crankshaft seal, dowel, or at one or more of the flywheel to crankshaft bolts (see Trouble Diagnosis and Testing, page 153), it will be necessary to remove the flywheel and make the following repair.

Replacement of Flywheel, Flywheel Seal, Dowel or Bolts

1. Remove transmission assembly (see page 71).

2. Remove flywheel to crankshaft dowel, using tool J-2774-1 and J-2153 (Fig. 227). Dowel must be tapped (5⁄16″—24) for tool J-2774-1.

3. Remove flywheel bolts, plates, and flywheel. If flywheel does not come off easily, a slight prying action between front surface of flywheel and block may be necessary.

> ***CAUTION: Do not hammer on flywheel in any way so that it will become damaged or distorted. Protect torus cover gasket surface from nicking or burring.***

4. Clean flange of crankshaft and mating surface of flywheel by scraping. If available, Acetone may be used as a solvent for the Pliobond 30 seal compound.

> ***CAUTION: Do not scratch or nick these surfaces.***

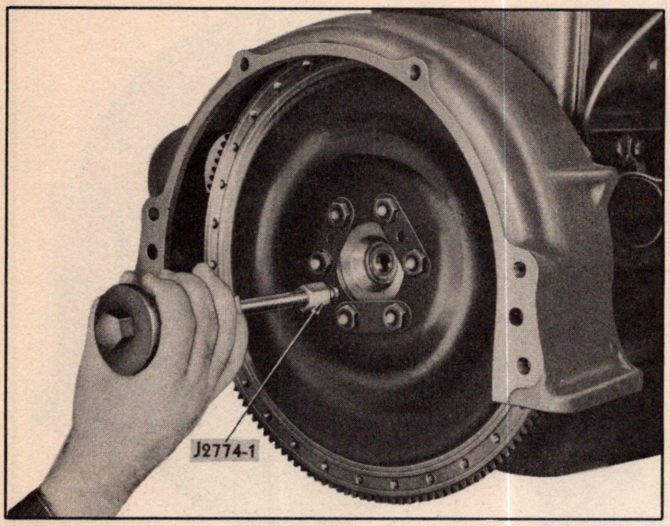

Fig. 227—Removing Dowel with Special Tools

5. Apply a thin film (approximately ½″ wide) of special seal compound (Pliobond 30) on the surface of crankshaft at bolt circle diameter. Smooth seal compound around toward outer edge and allow to dry (approximately one minute).

> ***CAUTION: In no case will a fiber gasket be used between the flywheel and crankshaft flange. Use only Pliobond 30 seal compound in all cases.***

6. Install flywheel on crankshaft flange carefully and enter all flywheel bolts through plates. Tighten bolts diametrically opposite in uniform manner to 105 ft. lbs. torque.

> ***NOTE:*** **Care exercised to draw the flywheel on evenly during this operation will prevent leakage and excessive runout.**

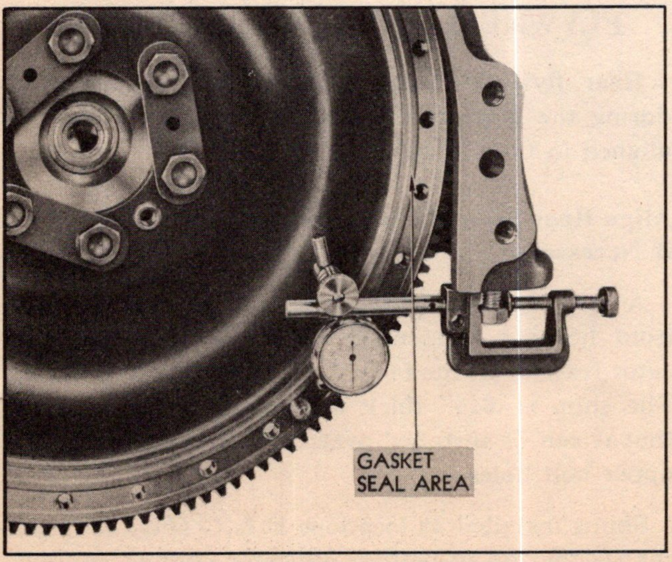

Fig. 228—Checking Flywheel Runout

7. Mount indicator so stem or button rests on torus cover gasket seal area and check flywheel runout. Runout should not exceed .005″ total indicator reading (Fig. 228).

8. Ream dowel hole for oversize (service) dowel, using tool J-2774-12, J-2774-14, J-2774-15, J-2774-16 and J-2774-17 (Figs. 229, 230, and 231).

> ***CAUTION: The bolts used for holding the guide block, tool J-2774-12, to flywheel are not heat treated alloy steel and should be tightened only enough to hold the block firmly to flywheel (45 to 50 ft. lbs. torque).***

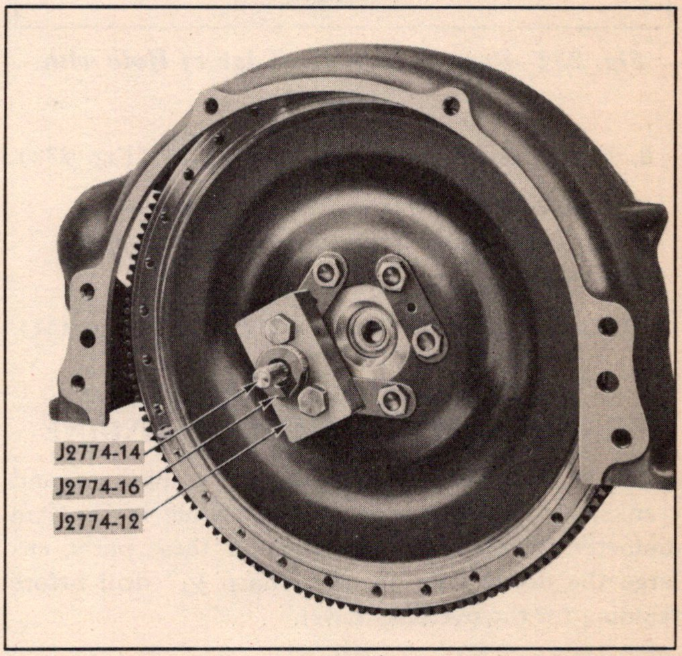

Fig. 229—Locating Reamer Guide Block

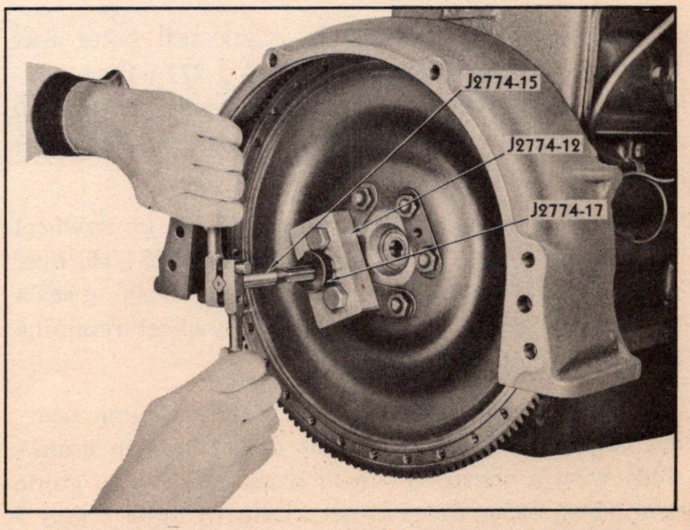

Fig. 230—Reaming for Oversize Dowel

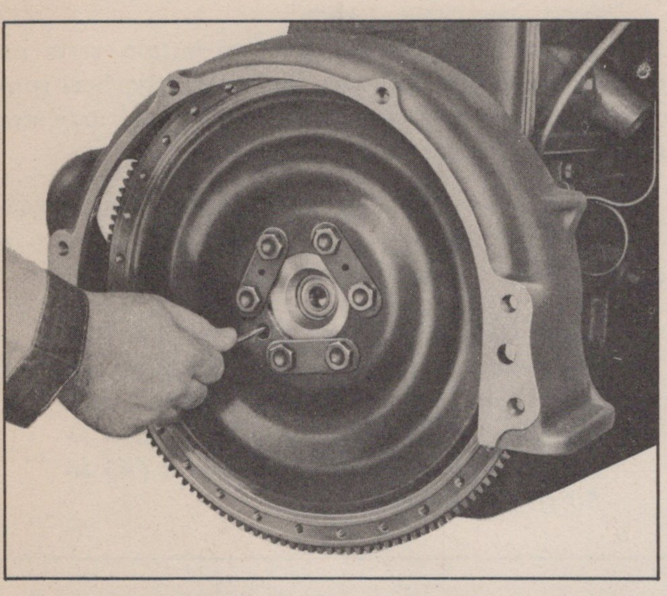

Fig. 231—Removing Sharp Edge of Hole with Scraper

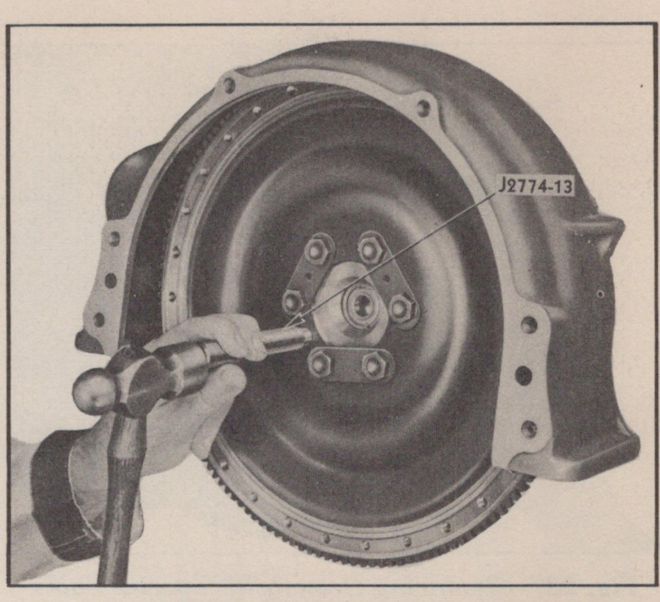

Fig. 232—Installing Oversize Dowel

9. Install dowel, using tool J-2774-13 (Fig. 232).

CAUTION: Front end of dowel must not extend beyond front face of crankshaft flange.

10. Install transmission assembly (see page 151).

INSTALLATION OF SERVICE CRANKSHAFT OR PARTIAL ENGINE

The dowel hole in the service crankshaft and crankshaft in the service partial engine is 15⁄32″ in diameter. When installing either of these parts, enlarge the dowel hole, using a sharp ½″ drill before reaming for the oversize dowel.

To do this proceed as follows:

1. Follow steps 4, 5, 6, and 7 under Replacement of Flywheel (page 118).

2. Remove two flywheel to crankshaft bolts next to dowel. Fasten guide block, tool J-2774-12, to flywheel with the two bolts furnished with kit but do not tighten. See that bushing, tool J-2774-16, is removed from guide block.

3. Place locating pin, tool J-2774-14, in flywheel dowel hole, then place bushing, tool J-2774-16, over pin and move guide block slightly until bushing seats in block. Tighten guide block to flywheel retaining bolts (45 to 50 lbs. torque).

4. Remove locating pin. See that rear main bearing cap is removed. Drill out dowel hole in crankshaft with a sharp ½″ drill, using bushing to guide drill (Fig. 233). Proceed according to steps 8 and 9 under Replacement of Flywheel.

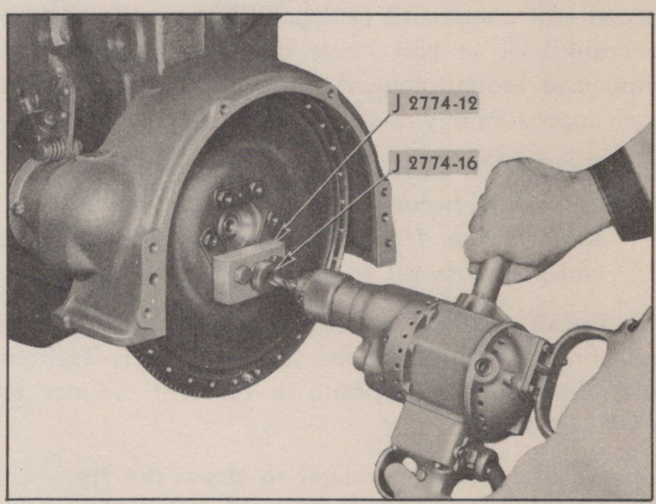

Fig. 233—Drilling Out Crankshaft Dowel Hole

FLYWHEEL HOUSING ALIGNMENT

Rear flywheel housings found to be misaligned during the inspection operation on page 117 can be aligned in the following order:

Align Rear Face of Flywheel Housing if Necessary

A special shim is available for use between the front housing and engine block to bring the indicator reading on the face of the housing within limits. The shim is .010″ thick and has holes so arranged that it can be installed over the dowel pins or at the upper bolt holes.

Shims installed at locations B & C (Fig. 234) will change the top to bottom indicator reading approximately .0045″. Shims installed at locations A & B or C & D will change the side to side indicator reading approximately .002″. Shims installed at locations A & D will change the top to bottom indicator reading approximately .006″. The shims should always be used in pairs as mentioned in the above locations.

Aligning Procedure

1. Remove front and rear flywheel housing assembly.

2. Locate shims as required, holding them in position with petrolatum.

3. Install front and rear flywheel housing assembly.

4. Recheck face alignment. Total indicator reading on a 5¾″ diameter should not exceed .003″ (Fig. 225). Relocate shims if necessary to bring reading within limits.

Relocate Rear Flywheel Housing to Position Hole if Necessary

Special oversize crankcase to flywheel housing dowels and a special reamer are available to permit shifting of the housings to position the transmission pilot hole.

Relocating Procedure

1. Remove housings from cylinder block.

2. Remove dowels from cylinder block.

3. Using a ⅜″ drill, increase depth of dowel holes to 1″.

> ***CAUTION: Do not use drill deeper than 1″ measured to bottom of ⅜″ diameter.***

4. Install front housing on block, using two ⅜″ drills in dowel holes to locate housing. Leave bolts loose enough so that housing can be shifted with a lead hammer. If shims were necessary to align rear face of housing be sure they are in proper position.

5. Remove two ⅜″ drills.

6. Install rear housing.

7. Install indicator and shift front housing at cylinder block surface until indicator reads within limits given in paragraph 6a and b on page 117.

8. Tighten housing attaching bolts and recheck alignment.

9. Using special reamer, ream dowel holes for oversize dowels. Stop when reamer bottoms in hole.

10. Install oversize dowel. Drive dowel into taper cut by lead on reamer.

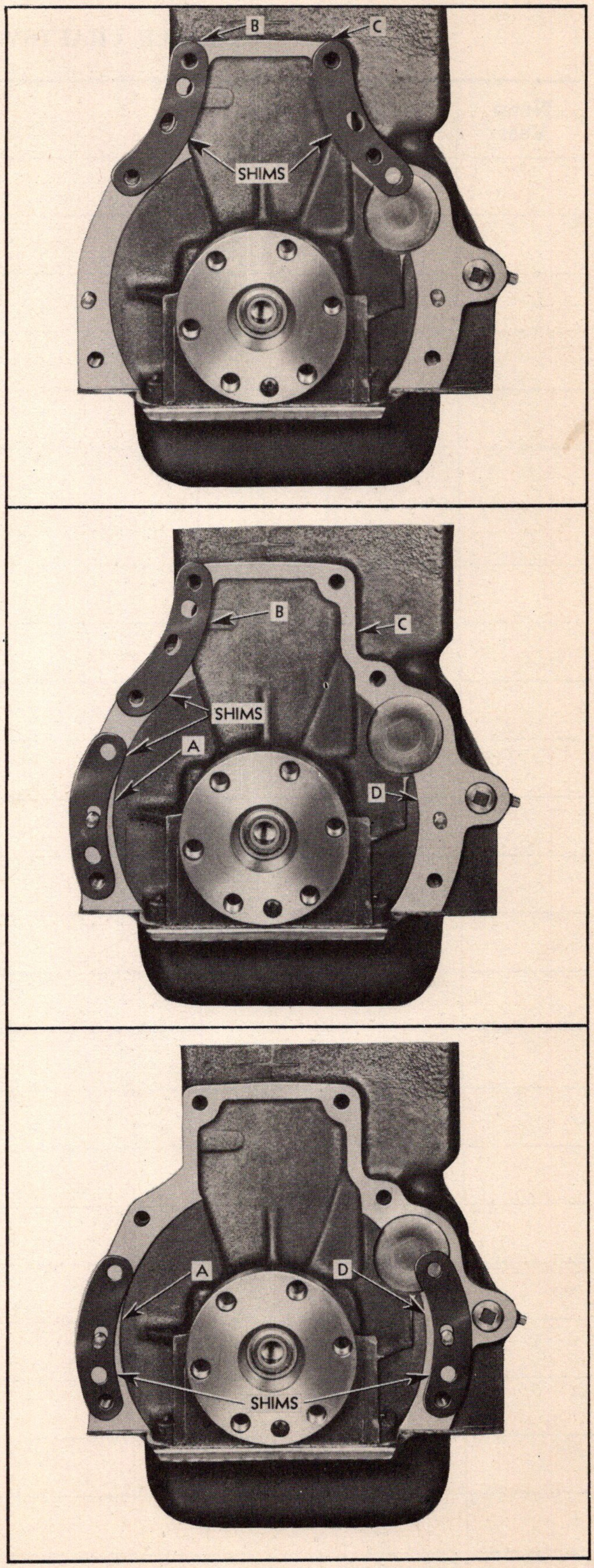

Fig. 234—Shims in Place

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ASSEMBLY OF INDIVIDUAL UNITS

CONTENTS OF THIS SECTION

Before assembling the Hydra-Matic Transmission, parts which were found to be defective during inspection should be obtained from the Parts Department and placed in their respective groups, thoroughly cleaned and ready for assembly.

INSTALLATION OF SNAP RINGS

The ends of retaining or snap rings are cut with a double taper to provide a sharp point for use with snap ring pliers. Snap rings should always be installed with the points positioned as shown in Fig. 235.

ASSEMBLY OF FRONT UNIT

1. Place front planet carrier assembly in holding fixture, J-2187, with clutch hub up.

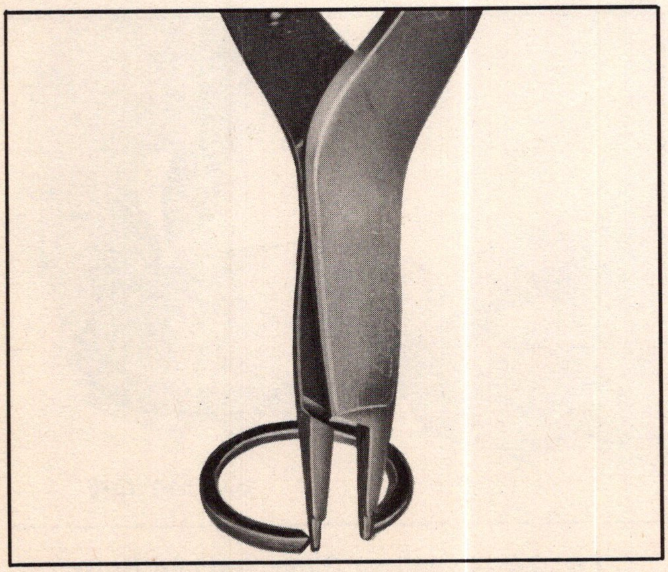


Fig. 235—Positioning Snap Ring

2. Place front unit drum over hub to rest on pinion gears with drive pins up (Fig. 236).

3. Install four drive and four driven plates (3 each on 6 cylinder transmissions) into front drum, alternating plates.

***CAUTION:** Start with a drive (composition) plate (Fig. 237) and finish with a driven (steel) plate. Assemble the driven plates with square notches over the drive pins.*

NOTE: Apply Hydra-Matic fluid to face of each plate surface as assembled.

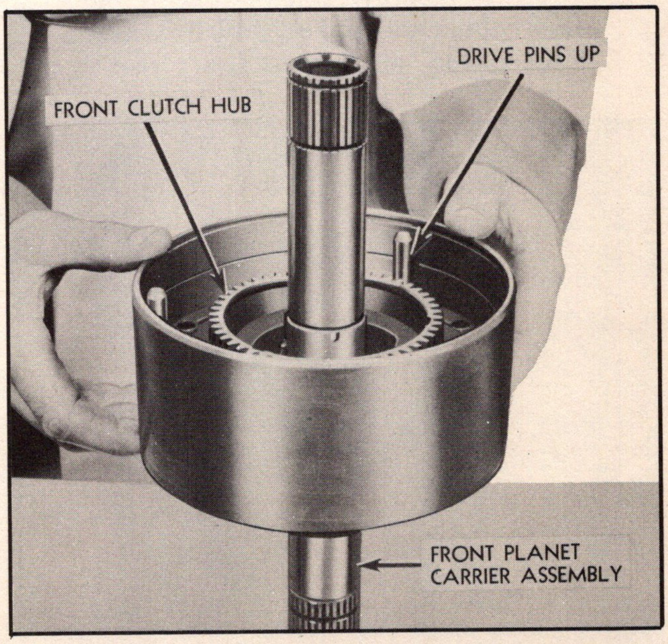


Fig. 236—Assembling Front Unit Drum to Planet Carrier

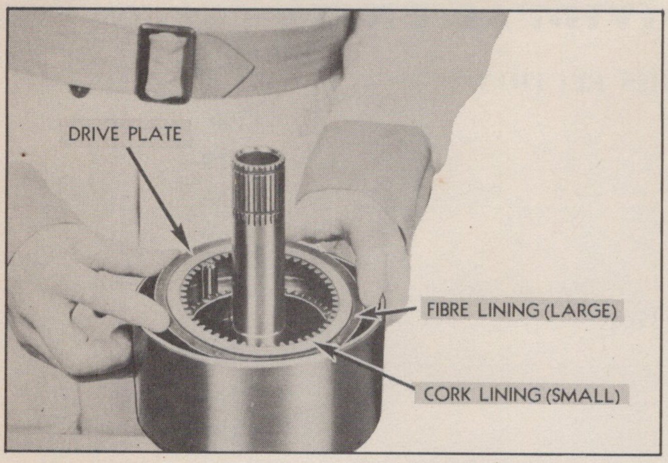


Fig. 237—Installing Clutch Plates

4. Install six outer clutch release and then six inner clutch release springs through plates into spring holes of drum (Fig. 238).

5. Install new inner brass expander into ring groove in clutch drum with expanding lips down.

6. While holding brass expander in position with masking tape as shown in Fig. 239, work new inner piston rubber seal into ring groove with lip down over brass expander. Remove masking tape by pulling down and out.

> ***NOTE:*** **Work expander well back into position under seal so brass edges are not exposed. Before replacing large outer seal on clutch piston, install the piston into the clutch drum to insure proper installation and seating of new inner rubber seal and expander. Remove clutch piston and inspect inner seal.**

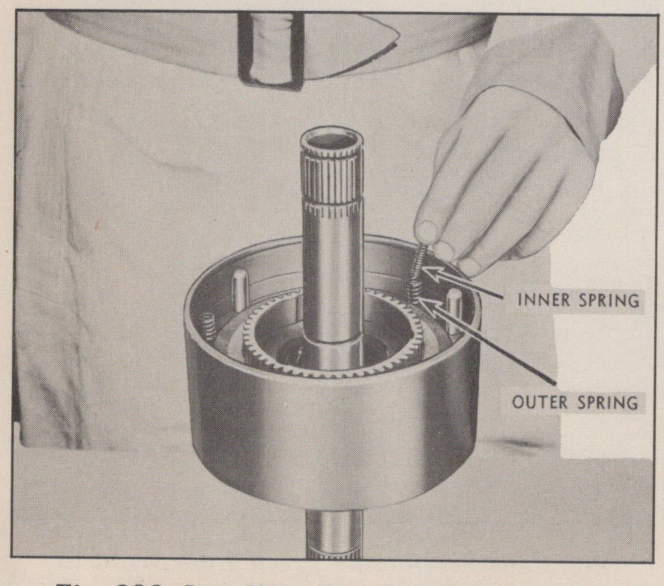


Fig. 238—Installing Clutch Release Springs

Fig. 239—Installing Inner Seal and Brass Expander

7. Place new large rubber seal over front annular piston beyond seal groove.

8. Install new large brass expander in piston groove with lips up.

9. While holding expander in position with masking tape as shown in Fig. 240, work rubber seal well into groove with lip up. Remove tape by pulling out and up.

> ***NOTE:*** **Work expander well back into position under seal so brass edges are not exposed.**

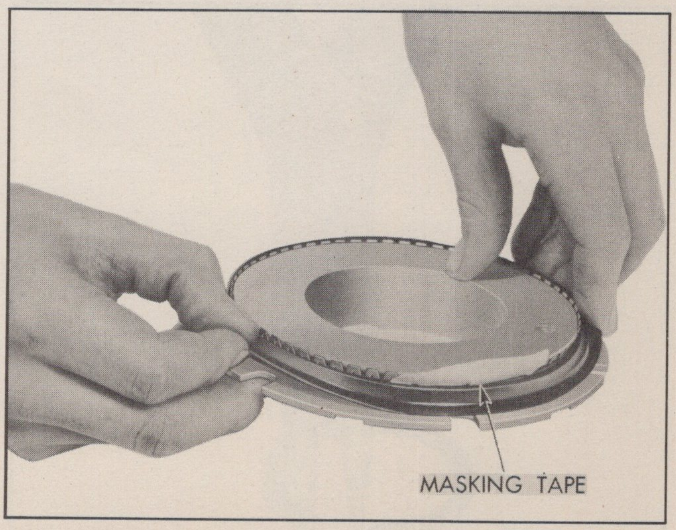


Fig. 240—Installing Outer Seal and Brass Expander

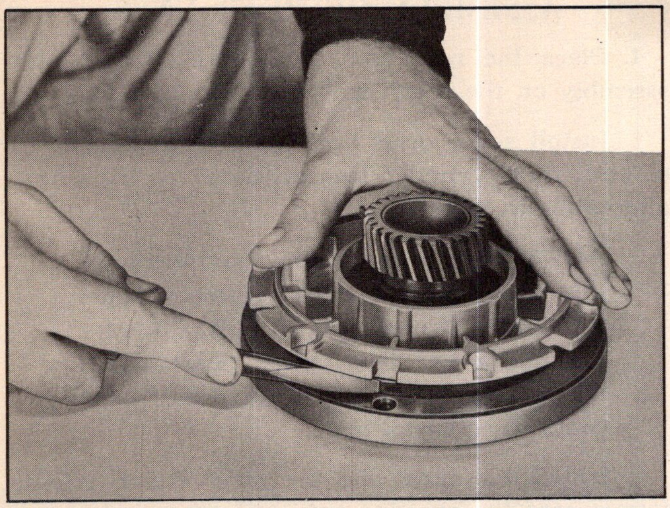


Fig. 241—Installing Annular Piston

10. Install piston into clutch drum resting on outer rubber seal. Align square notches in piston with holes in drum. While applying slight hand pressure to piston, guide seal into bore with the flat side of a blunt screw driver (Fig. 241).

11. Install clutch drum and piston assembly over front planet carrier into front unit drum.

12. Lift front unit assembly off planet carrier, place in press and press clutch drum below snap ring groove. Install clutch drum snap ring, positioning gap of ring between two drive pin holes (Fig. 242).

> ***CAUTION: Snap ring must be well seated into groove to prevent interference with ledge on drum.***

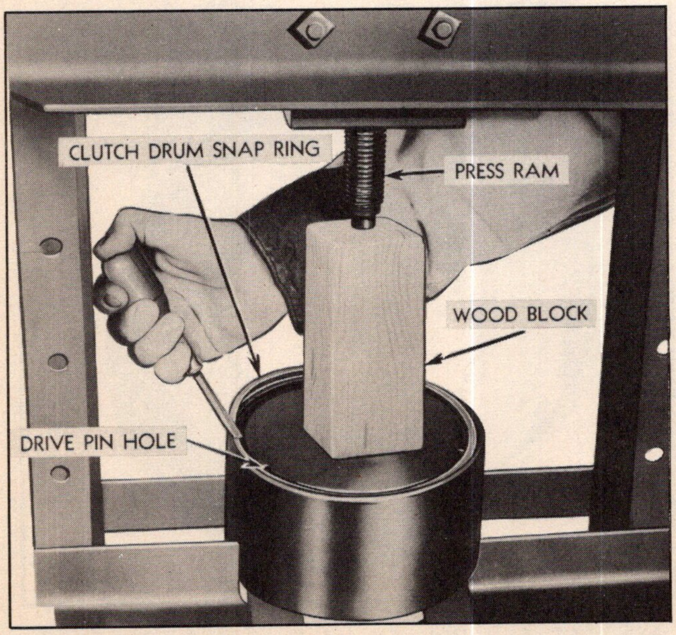


Fig. 242—Installing Clutch Drum Snap Ring

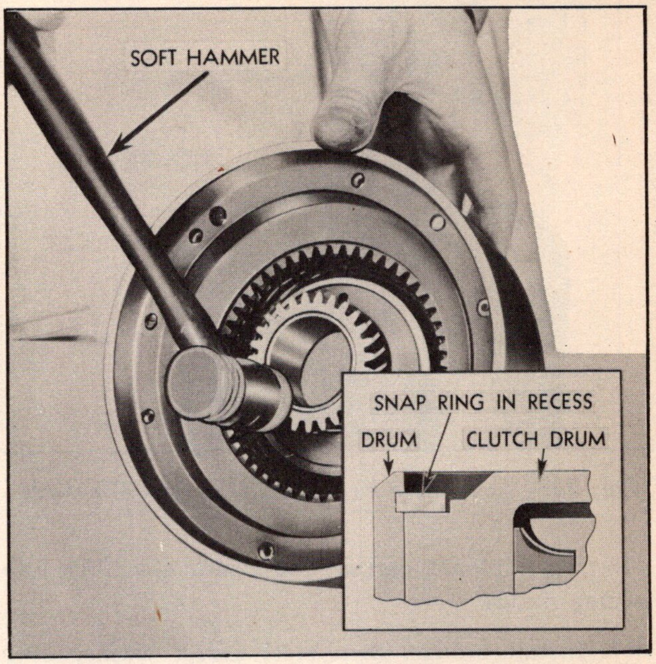


Fig. 243—Seating Clutch Drum Against Snap Ring

13. Release press and remove assembly.

14. Tap front face of center gear with a rawhide or similar hammer so the clutch drum will seat against snap ring (Fig. 243).

15. Remove planet carrier from holding fixture and insert planet carrier into drive plates and drum by rolling drum on bench while pressing carrier firmly into the plates (Fig. 244).

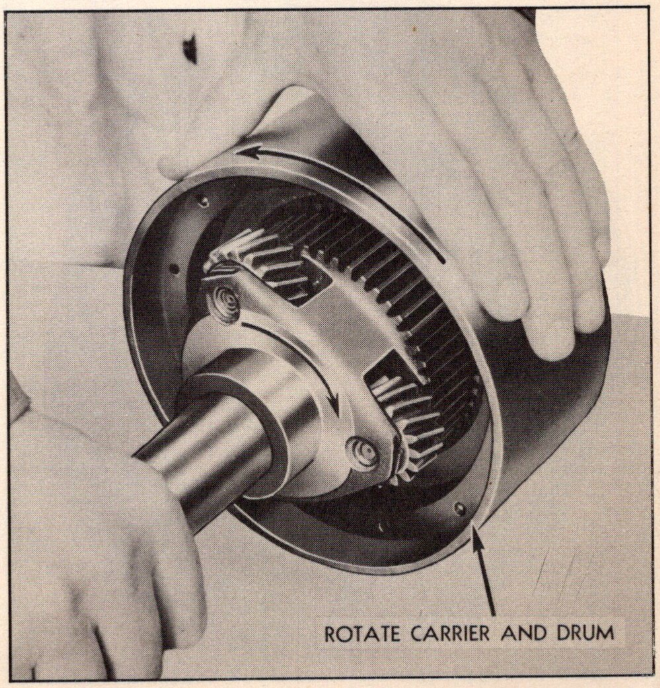


Fig. 244—Aligning Clutch Plates

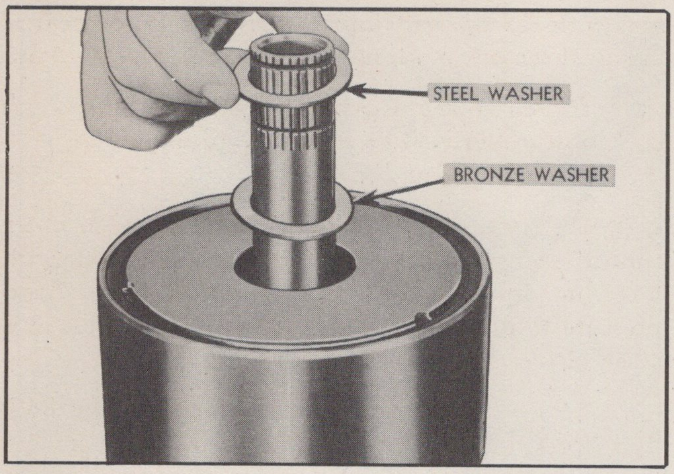


Fig. 245—Installing Front Unit Thrust Washers

16. Place planet carrier and drum assembly into holding fixture.

17. Install bronze, then steel thrust washer over planet carrier (Fig. 245).

> ***NOTE:*** **Locating lug on steel washer must fit over flat portion of planet carrier.**

18. Install snap ring over planet carrier into groove above steel washer.

> ***CAUTION: Do not allow snap ring to score bearing surface of planet carrier.***

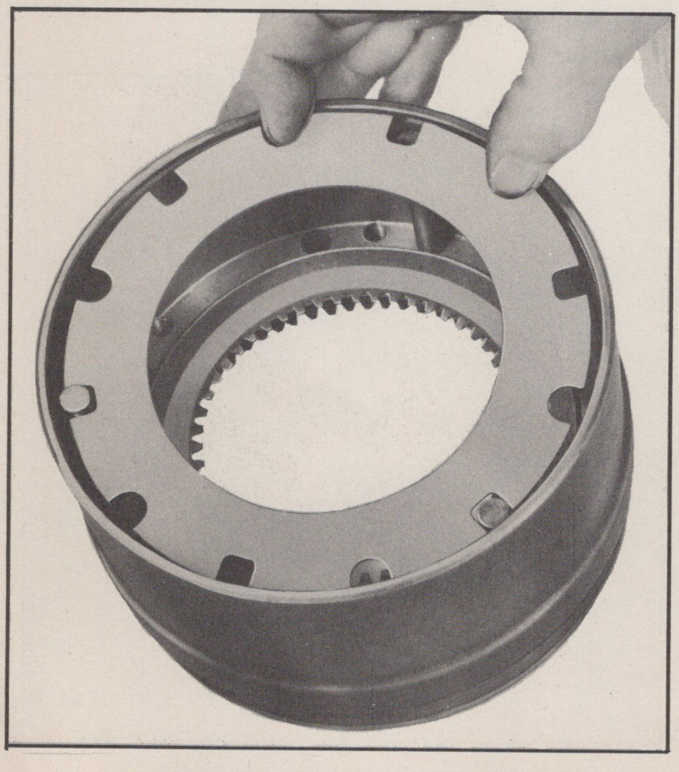


Fig. 246—Assembling Clutch Plates

ASSEMBLY OF REAR UNIT

1. Place the rear unit drum and internal gear assembly on the bench with the drive pins up.

2. Install seven drive and seven driven plates (6 of each on 6 cylinder transmissions) in the drum, alternating the plates.

> ***NOTE:*** **Start with a drive (composition) and finish with a driven (steel) plate. Assemble driven plates with square notches over drive pins (Fig. 246). Apply Hydra-Matic fluid to face of each plate when installing.**

3. Install six outer and six inner clutch release springs into the rounded cutouts in the steel clutch discs and into the holes in the drum. Install the six release spring guide pins (Fig. 247).

4. Position a new rubber seal on inner piston of clutch drum above groove. Install a new brass expander into ring groove of clutch drum with expanding lips down.

5. While holding the brass expander in position with masking tape as shown in Fig. 239, work the rubber seal into ring groove with lip down over brass expander. When seal is installed remove masking tape by pulling down and out.

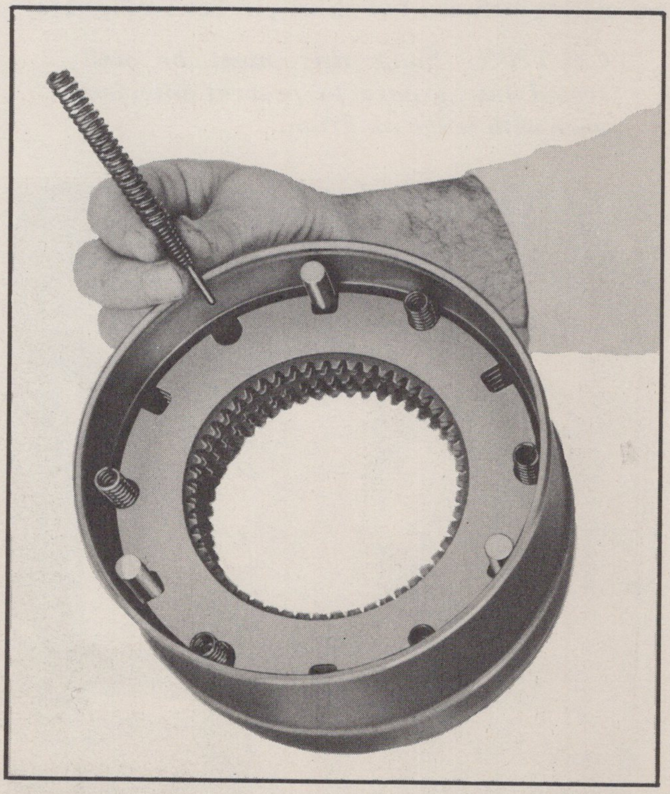


Fig. 247—Installing Clutch Release Springs and Guide Pins

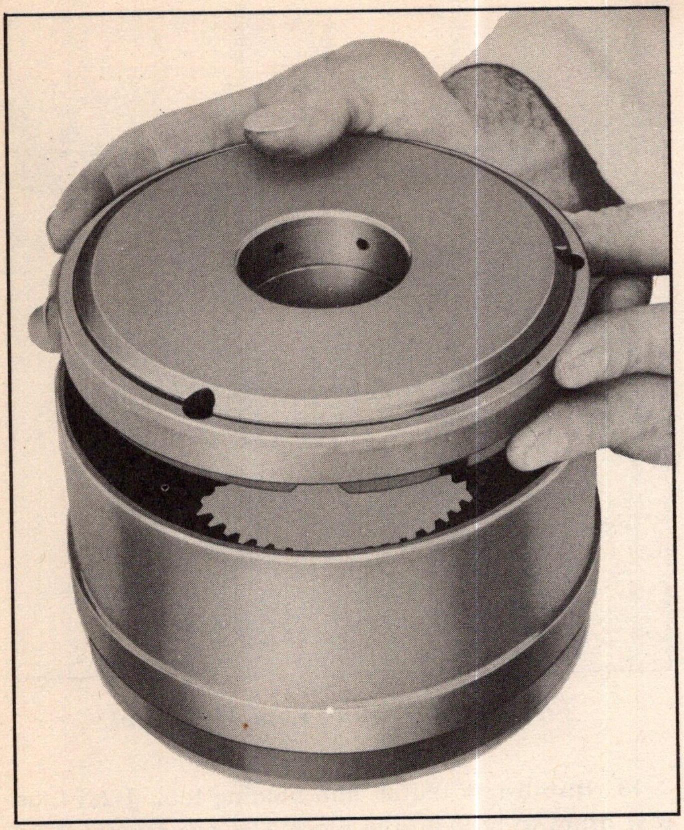


Fig. 248—Installing Rear Clutch Drum

6. Place a new rubber seal over rear annular piston beyond seal groove.

7. Install a new brass expander in piston groove with the lips facing up. While holding expander in position with masking tape (Fig. 240), work rubber seal with lip up well into the groove. When seal is installed remove masking tape by pulling out and up.

> **NOTE: Work expander well into position under seal so that edge of expander is not exposed.**

8. Place piston into clutch drum resting on outer rubber seal. Align square notches in piston with holes in clutch drum. While applying slight hand pressure to piston, guide seal into bore with side of a screw driver.

9. Install rear clutch drum and piston assembly over drive pins into drum (Fig. 248).

10. Place rear unit on a press and press the clutch drum until it is below the snap ring groove in the drum. Install clutch drum snap ring, positioning gap of ring between two drive pin holes (Fig. 249).

> ***CAUTION: Snap ring must be well seated in the groove to prevent interference with ledge on drum.***

11. Release press and remove assembly.

12. Tap front face of clutch drum using wood block and hammer to seat the clutch drum against the snap ring (Fig. 250).

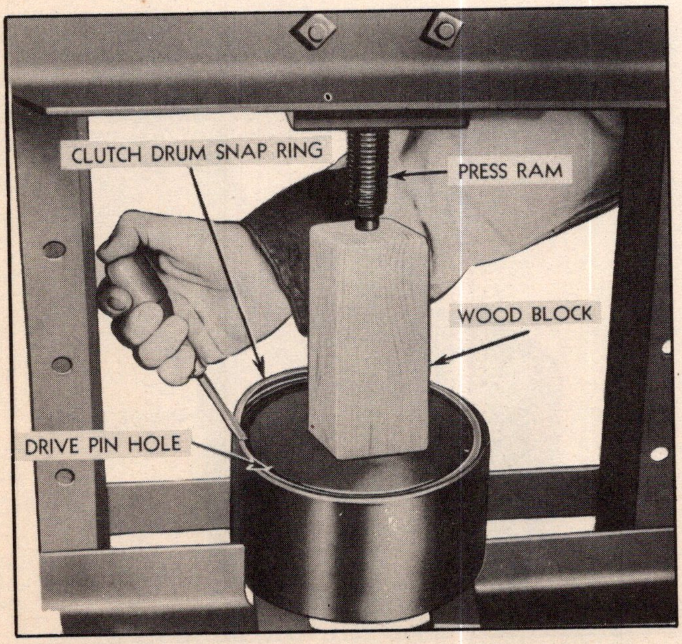


Fig. 249—Installing Clutch Drum Snap Ring

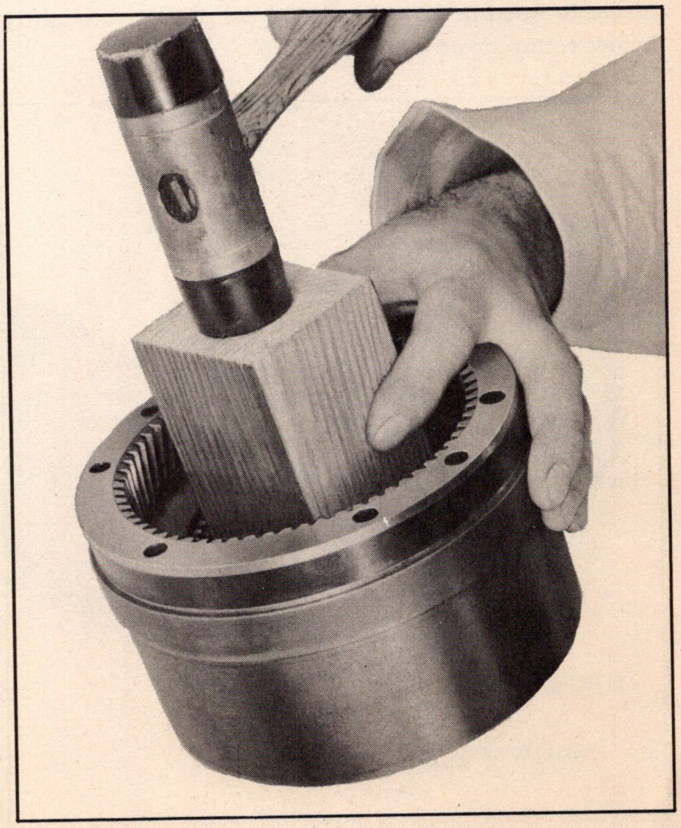


Fig. 250—Seating Clutch Drum Against Snap Ring

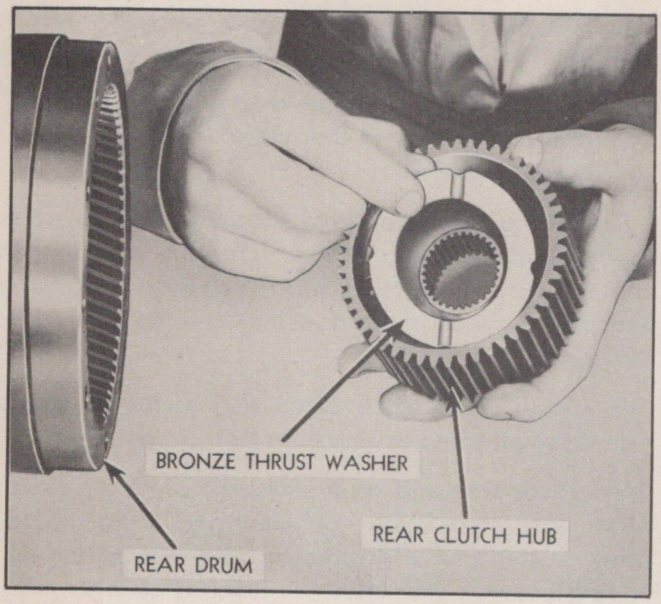


Fig. 251—Installing Rear Clutch Hub Front Thrust Washer

13. Install front bronze thrust washer into deep counterbore in rear clutch hub and retain with petrolatum (Fig. 251).

14. Install rear hub and thrust washer into clutch drive plates. Rotate hub and drum on bench to mesh splines with teeth of plates (Fig. 252). When properly installed, hub should be flush or slightly below counterbore in drum.

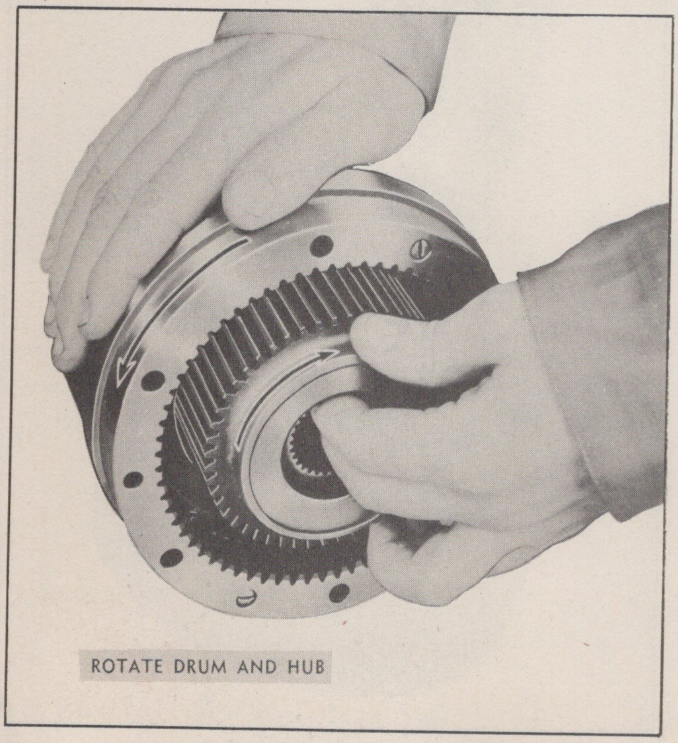


Fig. 252—Installing Rear Clutch Hub

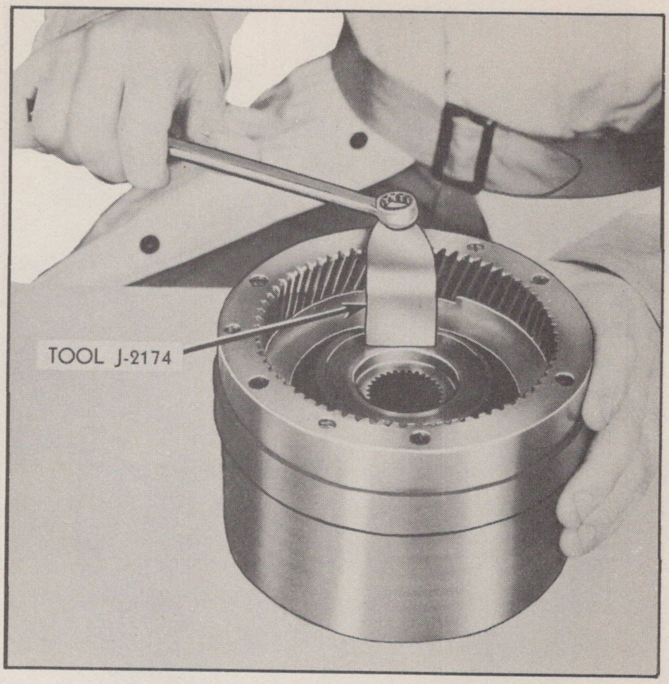


Fig. 253—Installing Rear Hub Tool

15. Install rear clutch hub holding tool, J-2174, on rear drum to hold hub in place. Use one reverse drive flange attaching bolt to hold tool (Fig. 253).

16. Install oil delivery sleeve over planet carrier with long bearing up. Compress exposed oil delivery sleeve rings with ring compressor, J-1537, and tap oil delivery sleeve into bore of front clutch drum with rawhide or similar hammer (Fig. 254).

17. Install rear clutch hub front snap ring into second groove on planet carrier.

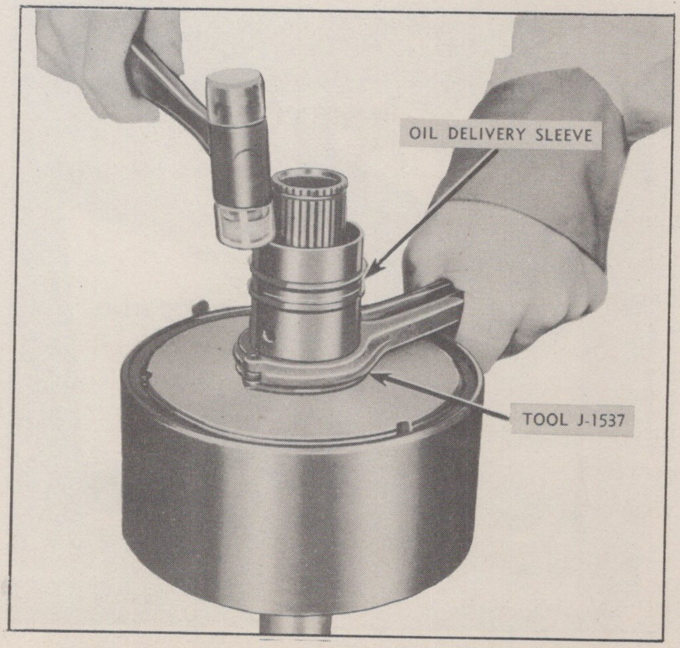


Fig. 254—Installing Oil Delivery Sleeve

18. Compress exposed oil delivery sleeve rings, install rear unit drum assembly on planet carrier.

19. Install rear clutch hub rear snap ring (Fig. 255).

> ***NOTE:*** **Both the front drum and rear drum should be free to rotate under slight force. If either drum binds, the unit should be disassembled and the cause of trouble corrected.**

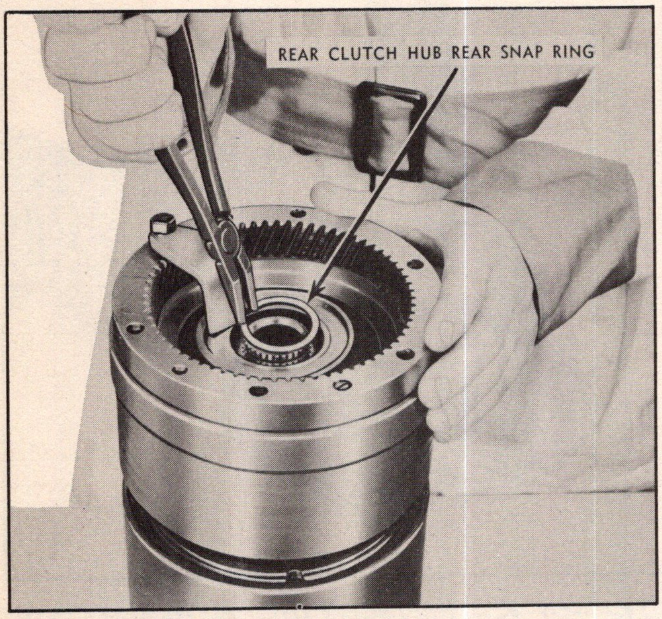


Fig. 255—Installing Rear Clutch Hub Rear Snap Ring

ASSEMBLY OF REVERSE UNIT

1. Hold reverse center gear in left hand with drive flange up; install the steel thrust washer, and then the bronze thrust washer in the recess of the drive flange (Fig. 256).

2. Still holding the reverse center gear in the left hand, pick up the output shaft with the right hand, insert output shaft end through drive flange and center gear until carrier bottoms on the two thrust washers (Fig. 257).

3. Holding drive flange and center gear tightly against the carrier to keep thrust washers from moving, set output shaft and carrier on table on the carrier end.

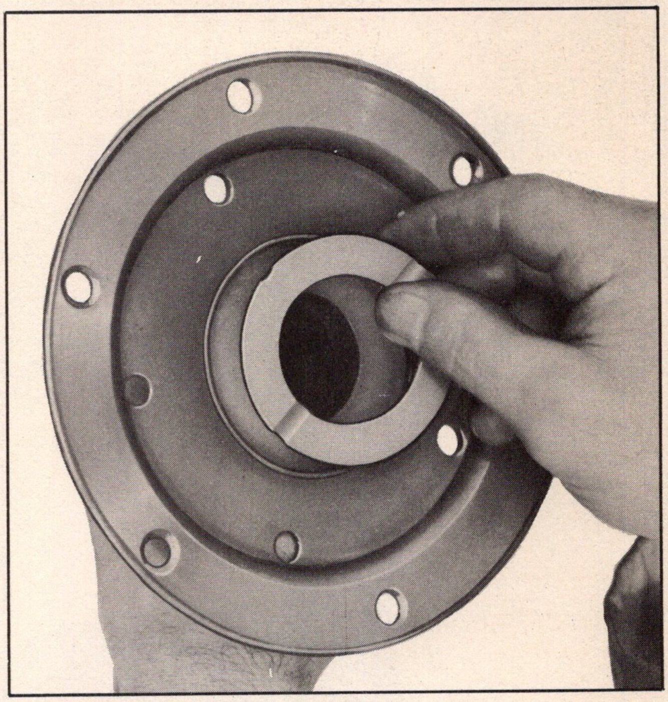


Fig. 256—Installing Thrust Washers

Fig. 257—Installing Output Shaft in Drive Flange

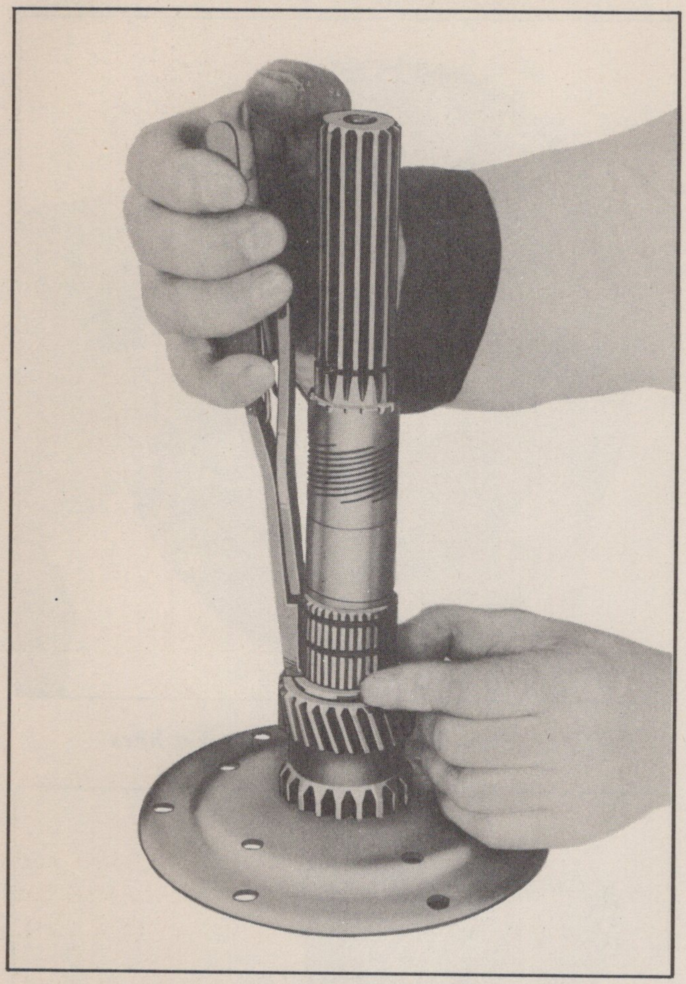


Fig. 258—Installing Reverse Planet Carrier Snap Ring

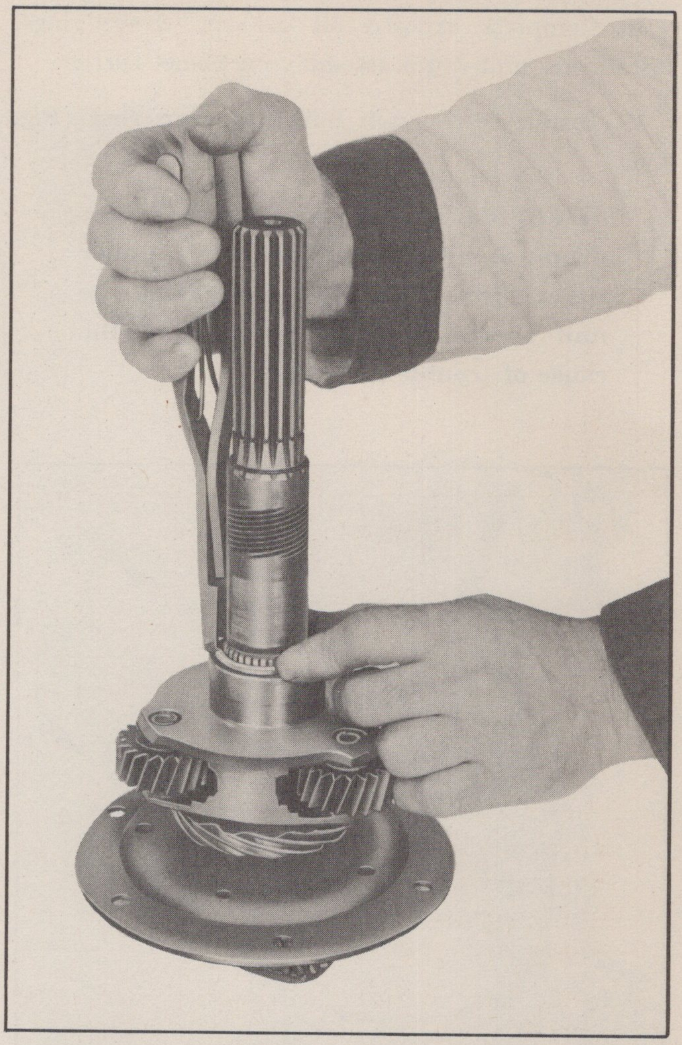


Fig. 259—Installing Snap Ring on Output Shaft

4. Install reverse planet carrier snap ring (Fig. 258).

   ***NOTE:* Do not pick up this unit until completely assembled to prevent washers from slipping out of place.**

5. Install reverse planet carrier over output shaft with bronze drive gear down, meshing pinions with the sun gear. (Be certain unit is bottomed against reverse planet carrier snap ring.)

6. Install snap ring on output shaft to position reverse planet carrier (Fig. 259).

7. Install reverse clutch release flat spring and spring retainer on reverse internal gear on internal gear side (Fig. 260). Make certain spring is in recess. If retainer tips are misaligned preventing centering, use new retainer.

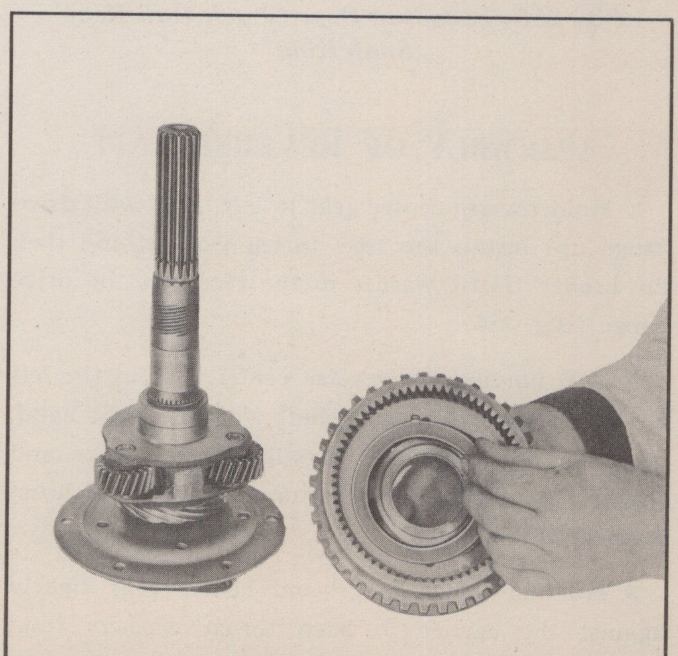


Fig. 260—Installing Reverse Clutch Release Spring

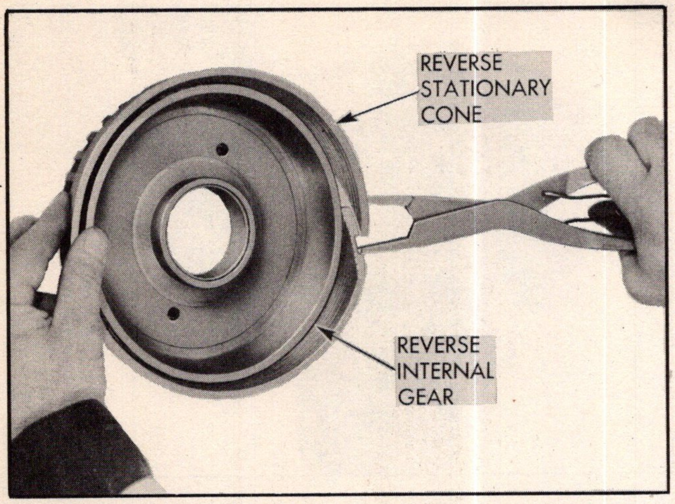


Fig. 261—Installing Reverse Stationary Cone

8. Install reverse stationary cone on reverse internal gear cone with keyway toward external teeth on internal gear. (Use snap ring pliers to spread stationary cone for installation.) (Fig. 261).

CAUTION: Do not spread cone more than necessary to make the installation. To avoid excessive expansion, tilt stationary cone and slide side opposite keyway onto reverse internal gear first as shown in Fig. 261.

9. Install large bronze thrust washer over collar of reverse internal gear and retain with petrolatum (Fig. 262).

10. Install reverse cone piston inner seal with lip down (Fig. 263). Slide seal down past groove then work back up into groove.

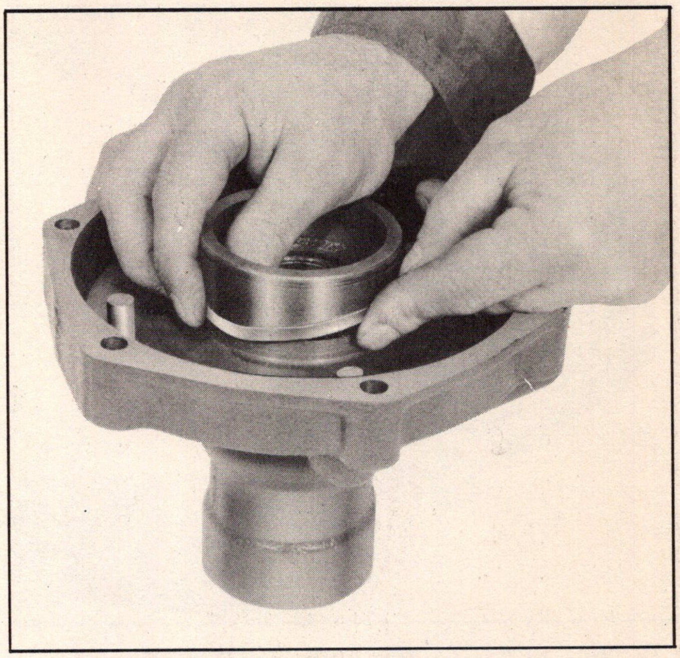


Fig. 263—Installing Inner Seal

11. Install piston in rear bearing retainer to see that inner seal is properly installed.

12. Remove piston from rear bearing retainer and install outer seal on piston with seal lip toward flat side of piston. Work seal well into groove (Fig. 264).

13. Install reverse cone piston in rear bearing retainer. Because of interference between ledge inside rear bearing retainer and outer seal, the following method must be used when installing piston:

a. Install reverse cone piston in rear bearing retainer so that the dowel pins are not aligned with

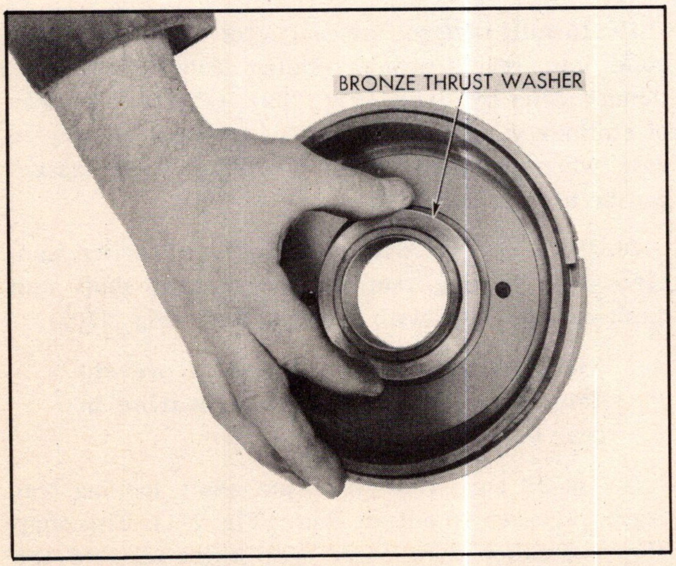


Fig. 262—Installing Bronze Thrust Washer

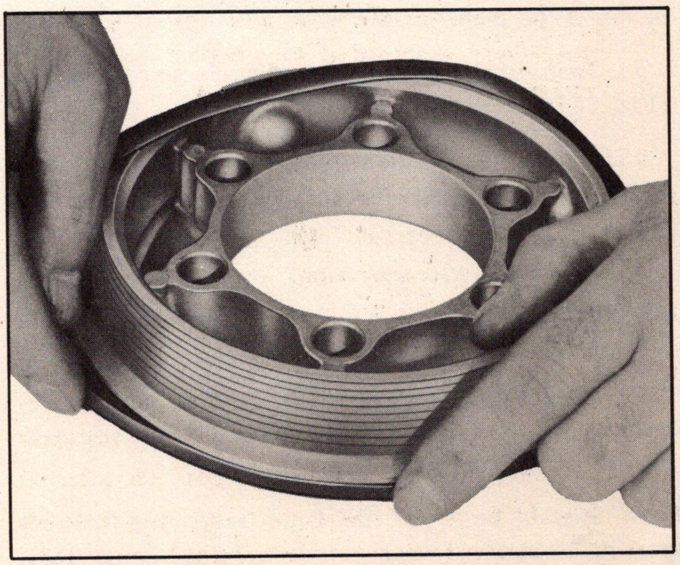


Fig. 264—Installing Outer Seal

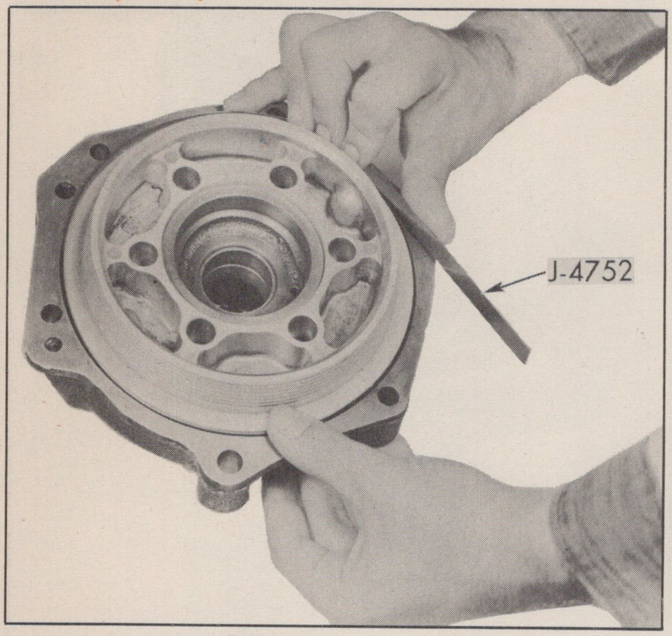


Fig. 265—Installing Reverse Cone Piston

holes in piston. This prevents piston from entering far enough to damage outer seal.

b. Install tool J-4752 between piston and rear bearing retainer as shown in Fig. 265. Work tool down against ledge in rear bearing retainer. This will give a smooth surface inside the rear bearing retainer allowing the seal to pass the ledge without interference.

c. Turn piston so that dowel pins align with holes in piston and push piston into rear bearing retainer. Tool J-4752 can now be removed. To make certain piston is fully seated lay a straight edge across the face of the piston and measure from straight edge to face of rear bearing retainer. Measurement should be $13/32 \pm 1/32$ inch.

14. Install the six reverse clutch release coil springs (Fig. 266).

15. Install the reverse clutch coil spring retainer and compress springs with special tool J-4670 (Fig. 267).

16. Install large type snap ring holding spring retainer in place and remove special tool. Remove tool J-4670.

17. Install ball type bearing in rear bearing retainer. (Be sure that bearing is fully and squarely seated by tapping gently.)

18. Install large special type snap ring in rear bearing retainer locating ball bearing (Fig. 268). (Use a new snap ring.)

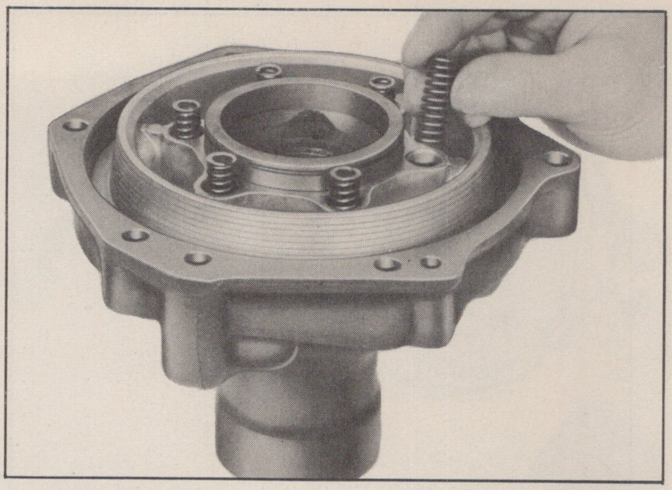


Fig 266—Installing Reverse Clutch Release Springs

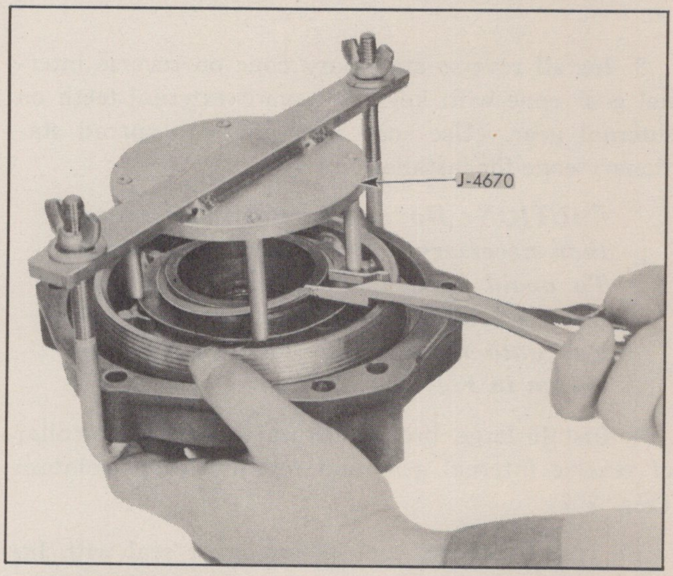


Fig. 267—Installing Reverse Clutch Spring Retainer Snap Ring

19. Install reverse internal gear and stationary cone into rear bearing retainer compressing stationary cone by hand (Fig. 269). (Position keyway of stationary cone so it will line up with keyway in case when installed. Rear bearing retainer gasket can be used as a guide.)

20. With output shaft standing on carrier end, place rear bearing retainer over output shaft and mesh carrier gears with internal gear (Fig. 270).

> ***NOTE:* Use extreme caution to prevent damage to bushing and ball bearing in rear bearing retainer.**

21. Install snap ring on output shaft, locking rear bearing retainer to output shaft (Fig. 271). This snap ring is smaller than other snap rings used in the transmission.

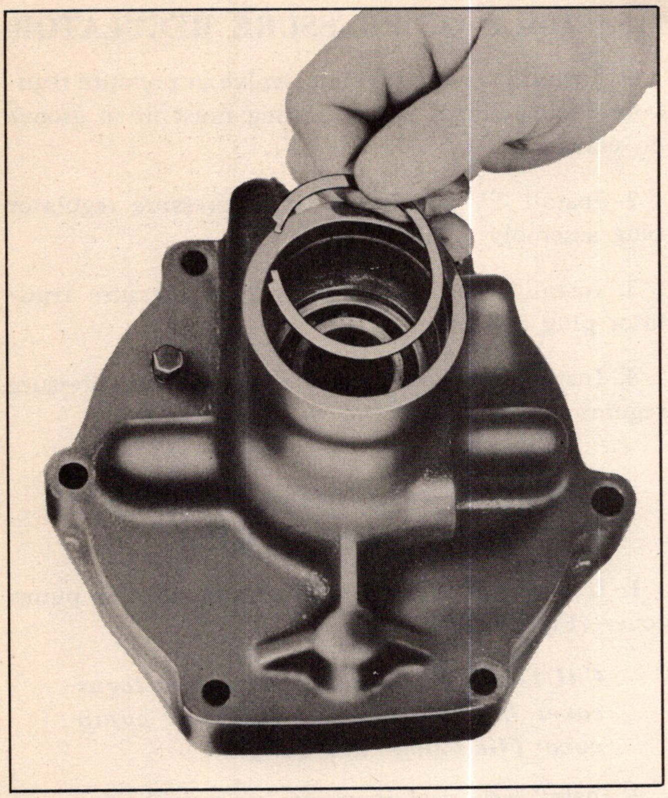


Fig. 268—Installing Snap Ring in Rear Bearing Retainer

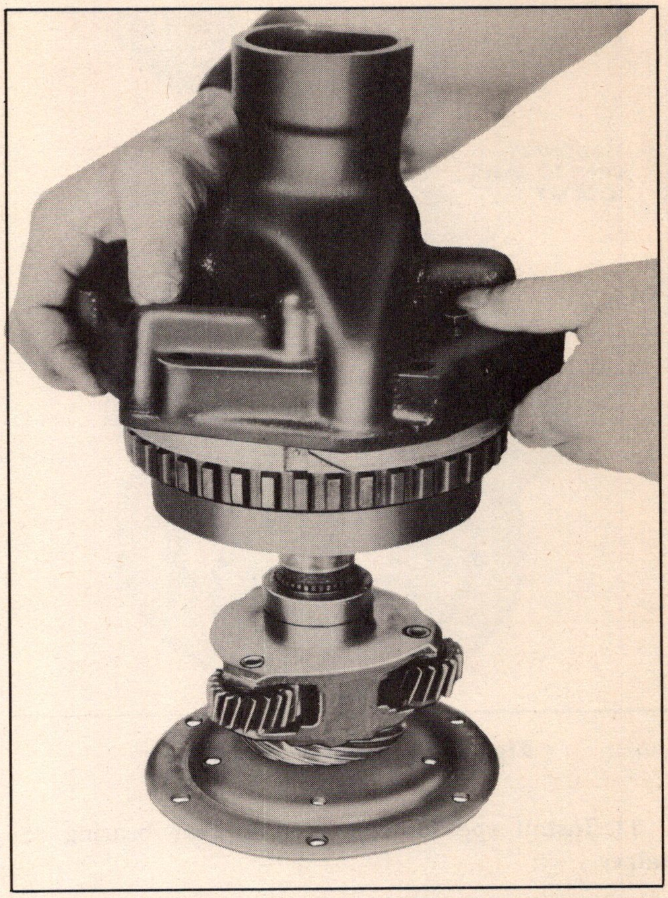


Fig. 270—Installing Rear Bearing Retainer on Output Shaft

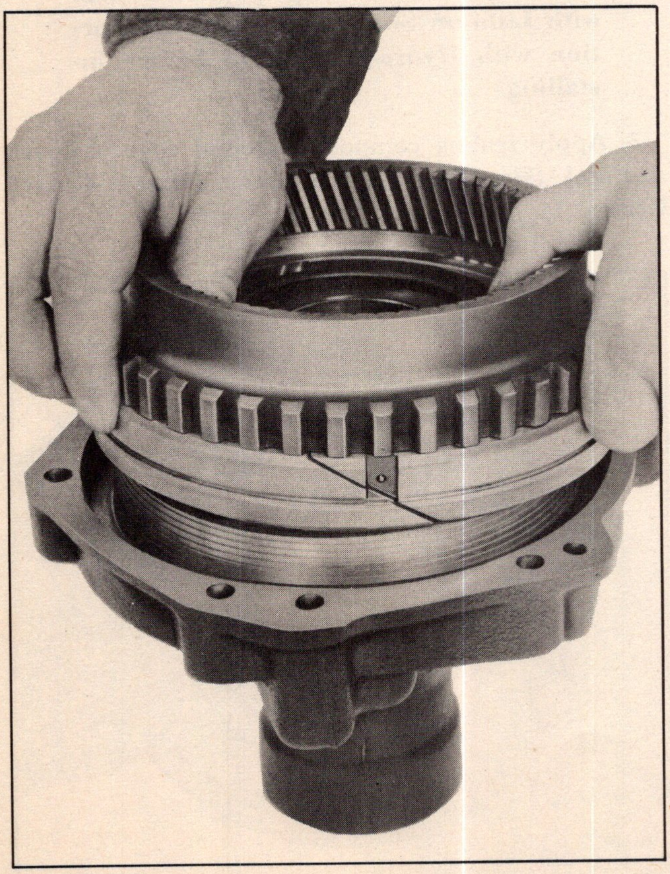


Fig. 269—Installing Reverse Internal Gear and Stationary Cone

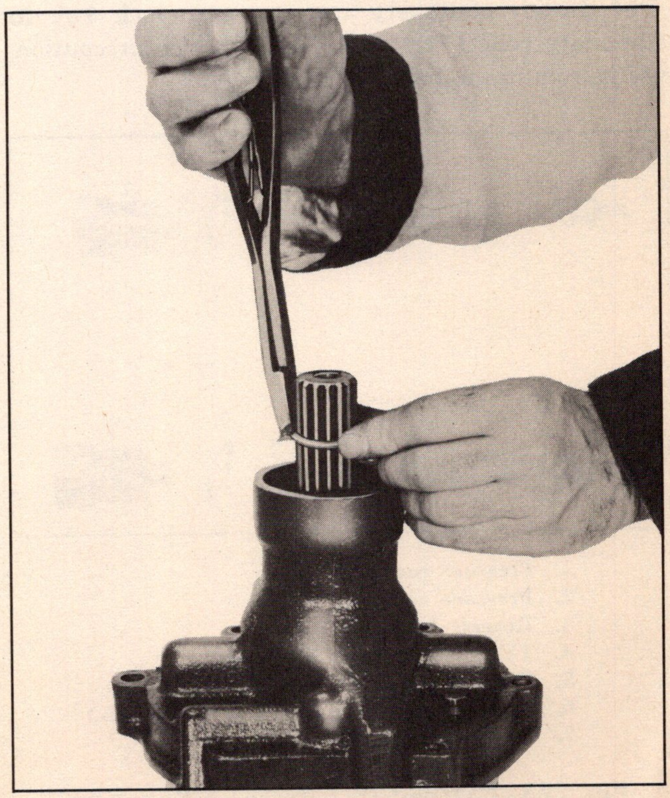


Fig. 271—Installing Snap Ring

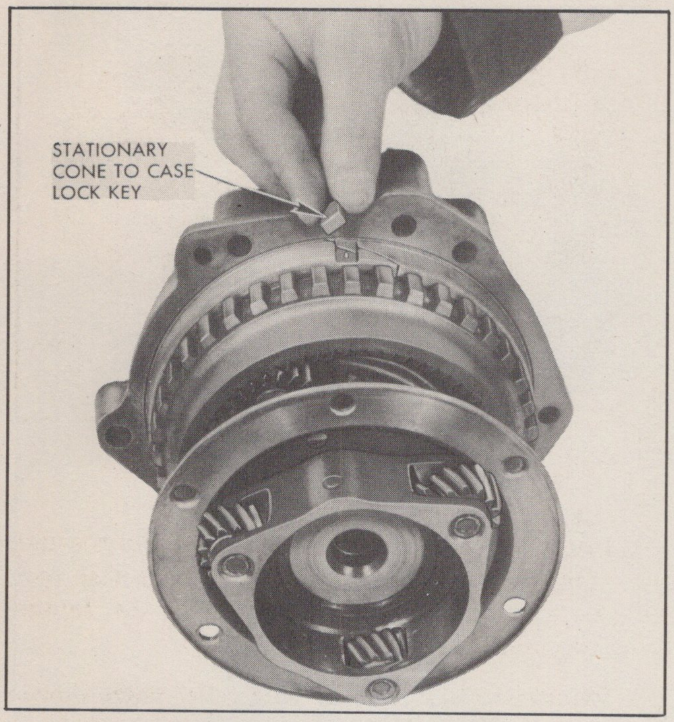
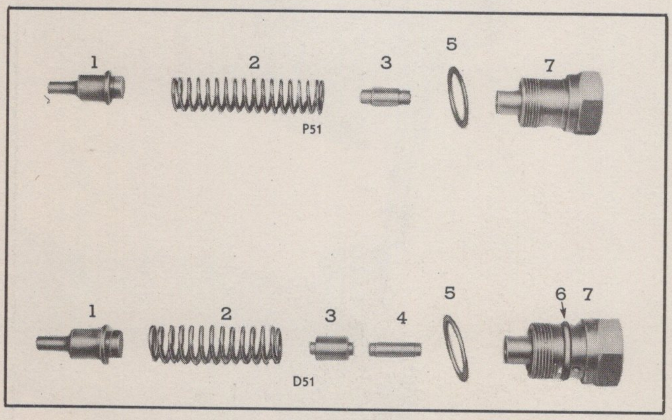


Fig. 272—Installing Lock Key

22. Install speedometer gear in rear bearing retainer.

23. Install rear bearing retainer gasket on rear bearing retainer and retain with petrolatum.

24. Install stationary cone to case lock key in stationary cone (Fig. 272). (As an added precaution, use petrolatum to hold key in place.)



1. **Pressure regulator valve**
2. **Pressure regulator spring**
3. **Reverse booster plug**
4. **TV pressure plug (D51 only)**
5. **Pressure regulator plug gasket**
6. **Pressure regulator plug seal (D51 only)**
7. **Pressure regulator plug**

Fig. 273—P51 and D51 Pressure Regulator Assemblies

ASSEMBLY OF PRESSURE REGULATOR

1. Install pressure regulator valve in pressure regulator spring. Small end of spring must fit in groove on valve.

2. Install TV pressure plug in pressure regulator plug assembly (D51 only).

3. Install reverse booster plug in pressure regulator plug assembly.

4. Install pressure regulator spring in pressure regulator plug.

ASSEMBLY OF FRONT PUMP AND FRONT DRIVE GEAR

1. If necessary, install new oil seal rings in pump cover (Fig. 274).

> ***CAUTION: Check new ring gap in torus cover before installing rings on pump cover (Gap .005" to .010").***

2. Install new seal in pump cover with step side up. Drive seal into place with tool J-2170 (Fig. 275).

> ***NOTE:* Lubricate rubber portion of seal with Lithium Soap Grease and felt portion with Hydra-Matic fluid before installing.**

3. Apply sealing compound around edge of cover and seal. (Permatex No. 3, Aviation Form-A-Gasket Cement.)

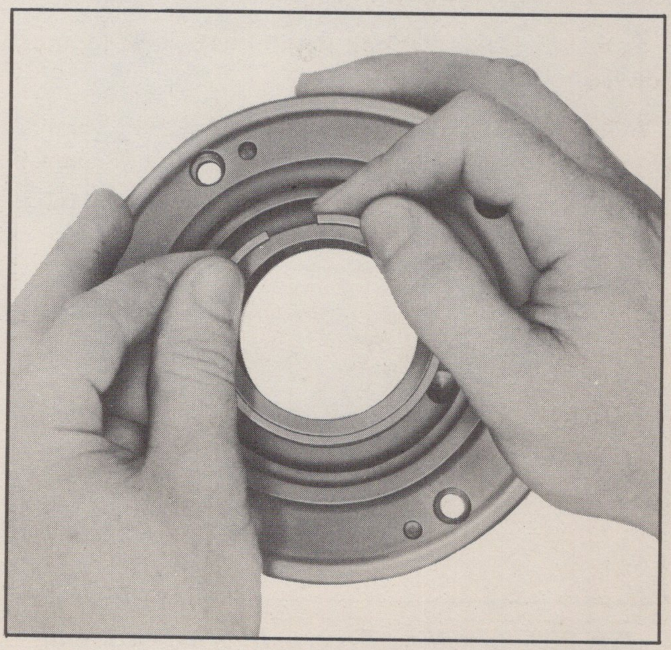


Fig. 274—Installing Front Cover Oil Seal Rings

Fig. 275—Installing Front Cover Oil Seal

4. Lubricate both pump gears with Hydra-Matic fluid. Install both gears in gear pockets of body. (Be sure sides of gears marked with Prussian Blue are up.) (Fig. 276)

5. Install the relief valve spring, and relief valve into the pump body. Press down on valve and insert feeler stock in slot to hold valve down (Fig. 277).

6. Install pump cover to pump body, locating over dowels.

7. Apply sealing compound on threads of screws. (Permatex No. 3, Aviation Form-A-Gasket Cement.)

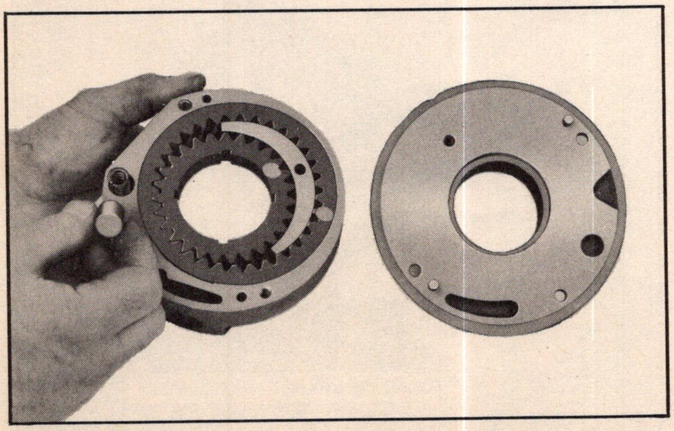


Fig. 276—Assembling Front Oil Pump

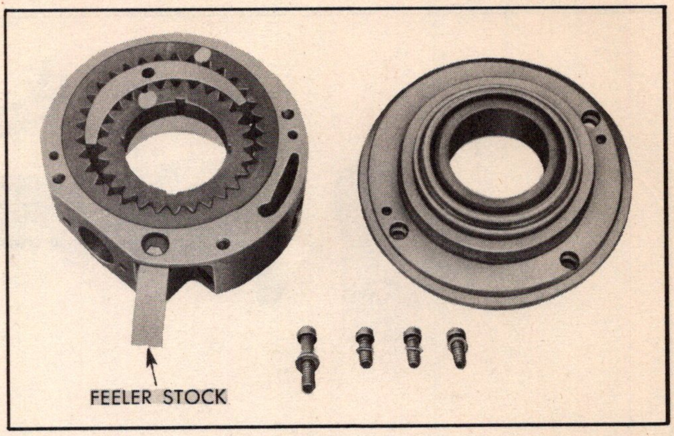


Fig. 277—Holding Relief Valve Down

8. Install three cover to body attaching screws and new copper washers. Hold pump with special tool J-2184-1 and tighten screws to 12-15 ft. lbs. torque using special socket J-2184-2 (Fig. 278).

9. Remove feeler stock, holding relief valve down.

10. Turn pump assembly over and install 1⅜" long screw, using the large steel washer. Torque to 12-15 ft. lbs.

11. Assemble the front pump over front drive gear, aligning key to keyway.

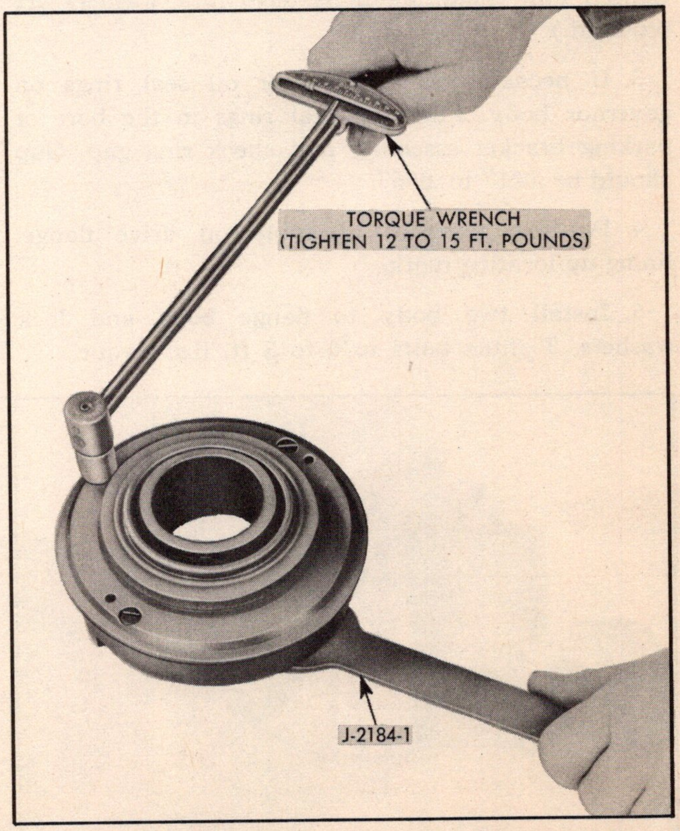
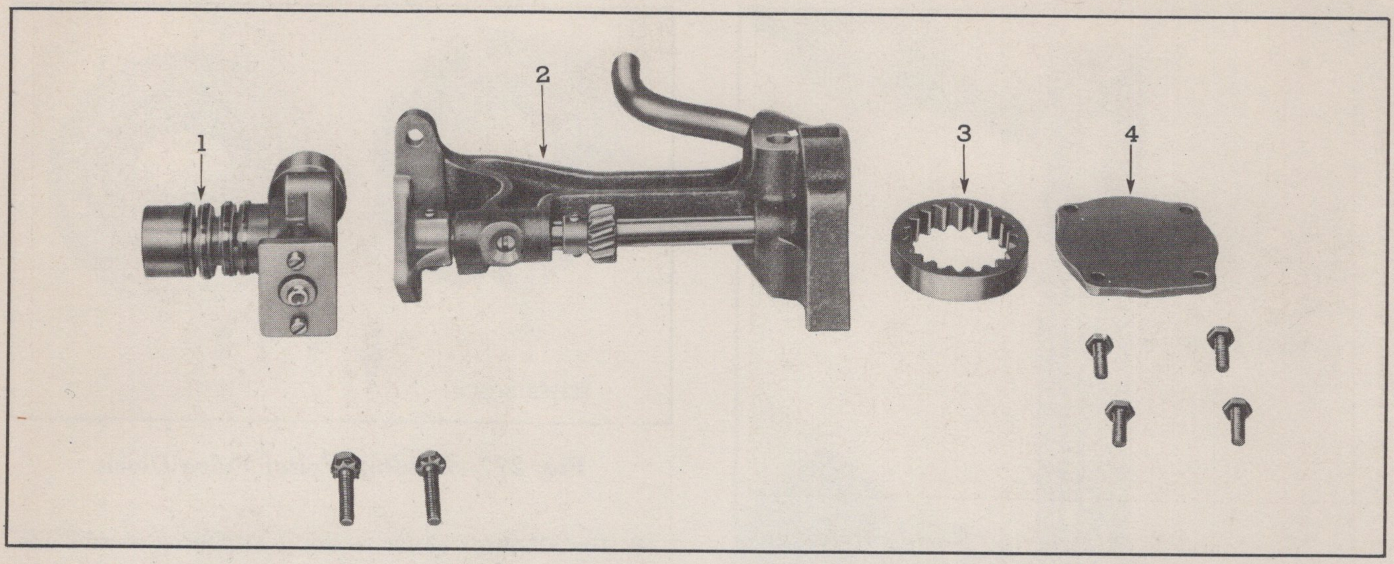


Fig. 278—Installing Pump Cover



1. Governor body 2. Rear oil pump body 3. Oil pump driven gear 4. Oil pump cover

Fig. 279—Exploded View of Rear Oil Pump and Governor

ASSEMBLY OF GOVERNOR AND REAR OIL PUMP

1. Install rear oil pump driven gear in pump body.

2. Position cover on pump body and install and tighten four mounting bolts. (No lock washers are required.)

3. If needed, install governor oil seal rings on governor body. Place oil seal rings in the bore of parking bracket assembly and check ring gap. Gap should be .001″ to .006″.

4. Position governor assembly on drive flange, lining up locating marks.

5. Install two body to flange bolts and lock washers. Tighten bolts to 6 to 8 ft. lbs. torque.

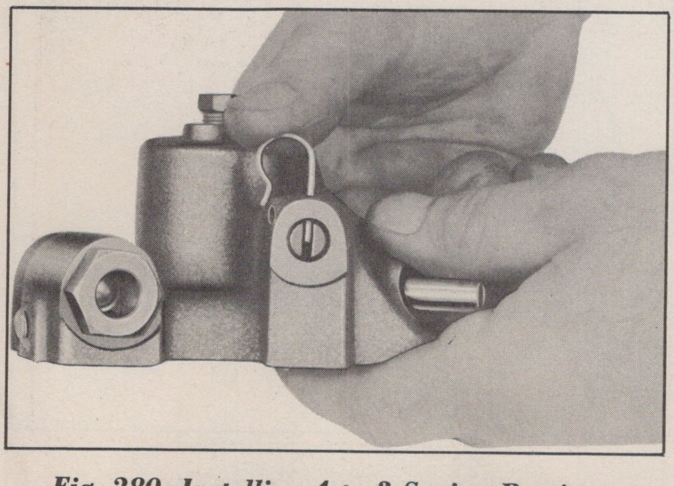


Fig. 280—Installing 4 to 3 Spring Retainer

ASSEMBLY OF FRONT SERVO

1. Install rear pump spring, ball and check valve seat in servo body and tighten.

2. Install the 4 to 3 valve into bore of body. Align slot with hole for spring retainer and install retainer (Fig. 280). Check the valve for free movement after installing the retainer.

3. Install and tighten pipe plug over 4 to 3 valve.

4. Install dowel pin if previously removed.

5. Install front servo piston assembly into body. Align slot in sleeve over dowel pin (Fig. 281).

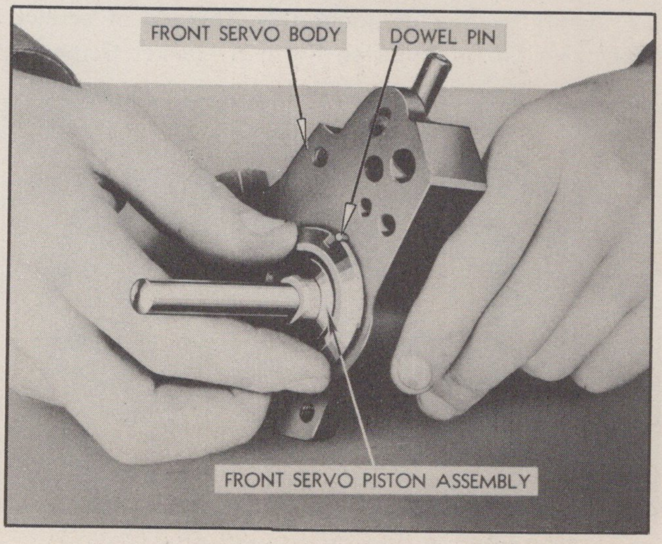


Fig. 281—Installing Servo Piston

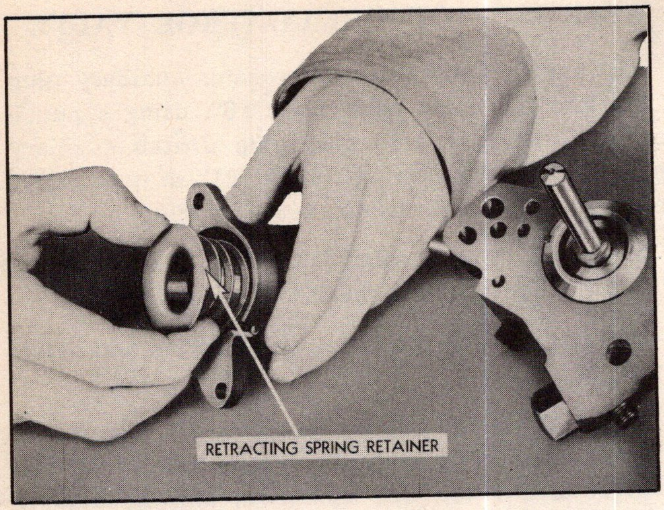


Fig. 282—Installing Retracting Spring Retainer

6. Install front band release piston into cylinder, using care when compressing ring.

7. Install booster spring (large spring) over front band release piston.

8. Place retracting spring retainer over piston stem, on booster spring (Fig. 282). End with smallest diameter goes down into cylinder.

9. Place retracting spring over apply piston stem.

10. Place band release cylinder assembly on servo body (Fig. 283). Cylinder should seat squarely on body before bolts are installed. Insert and tighten two attaching bolts and lock washers.

Fig. 283—Assemble Release Cylinder to Servo Body

Fig. 284—Installing Accumulator Apply Spring

ASSEMBLY OF REAR SERVO

1. Install accumulator piston in accumulator body, using care not to damage piston ring.

2. Install accumulator apply spring over stem with small tapered end seating against shoulder (Fig. 284).

3. Install booster spring in booster piston. Be sure spring fits snugly in recess in bottom of booster piston.

4. Install booster piston into servo body. (Fig. 285)

Fig. 285—Installing Booster Piston

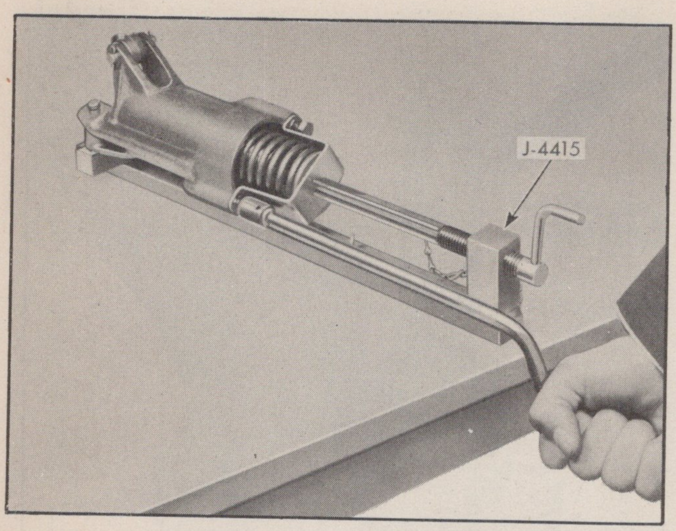


Fig. 286—Installing Rear Servo Spring Retainer

5. Install accumulator body and piston in servo body. Use care not to break piston ring. Be sure bosses on accumulator body match bosses on servo body.

6. Place two servo springs (one spring on late transmissions) in bore of accumulator piston.

7. Install compensator piston over servo springs.

8. Place servo spring and retainer with two attaching bolts and lock washers in position.

9. Place complete assembly into press or tool J-4415. Slowly compress springs while tightening mounting screws (Fig. 286).

CAUTION: Use extreme care to avoid breaking oil seal ring on compensator piston.

10. Remove assembly and tighten attaching bolts.

11. Test operation of servo by applying air pressure in the rear band release passage (Fig. 287).

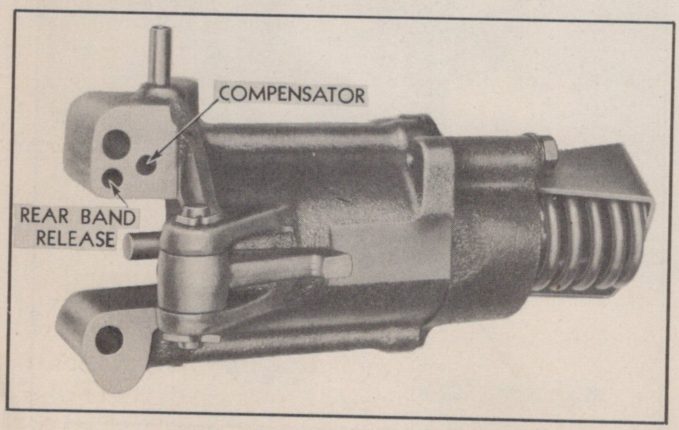


Fig. 287—Oil Passages in Rear Servo

ASSEMBLY OF OIL CONTROL VALVE

1. Carefully assemble compensator auxiliary plug "20" into the outer valve body "8", using a punch or ⅛" welding rod to hold plug. Install auxiliary plug pin (needle bearing roller) "21" in outer valve body locating compensator auxiliary plug.

2. Install throttle valve "17", throttle valve spring "18", T valve "19" and check for freeness.

3. Install double transition valve spring and valve, "22" and "23".

4. Install detent plunger retainer "25" and spacer "24" to outer valve body. Be certain to use the three correct screws for this operation, and have inner throttle lever inside of stop.

5. Install compensator valve "5" with spring "7".

6. Install detent plug "6".

7. Install front servo exhaust body "3" with spacer "4" to outer valve body. Install servo release plug lock "2" and screw at small end of servo release body. Install two screws at other end of servo release body, and tighten the three screws.

8. Install the manual control valve "16" making sure operating pin engages valve correctly.

To do this:

a. Rotate inside detent control lever counter-clockwise past the reverse position.

b. Insert manual valve detent spring "27" in bore of detent plunger retainer.

c. Insert detent plunger "26" over spring.

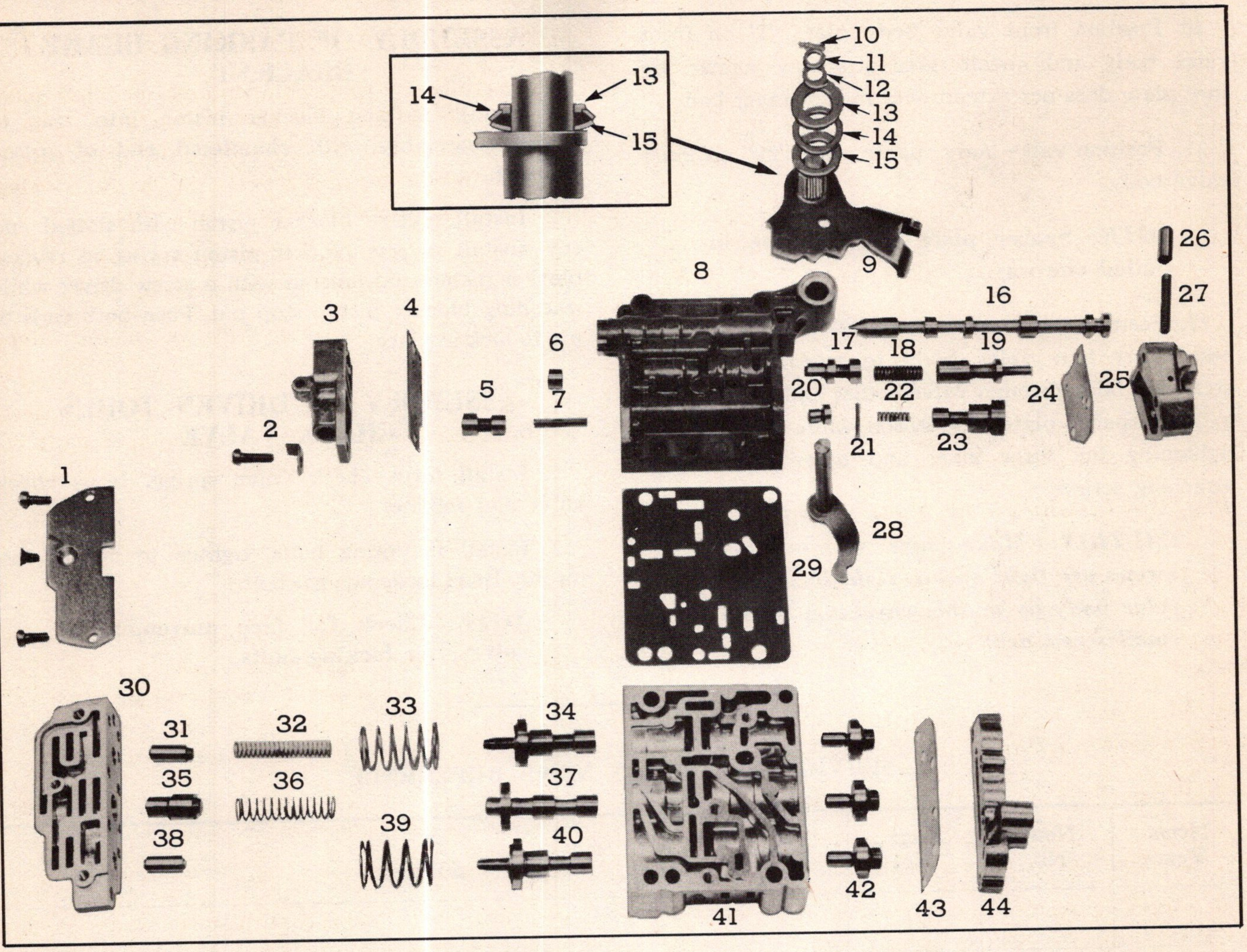
d. Push plunger and spring into bore with finger while rotating manual control lever clockwise into L position.

> ***NOTE:* Check to see that manual valve will go into reverse. If necessary loosen front servo exhaust body and raise as necessary to allow manual valve to go into reverse.**

9. Install manual shaft seal inner washer "15" with small inside diameter over manual control shaft, dish up.

10. Install manual shaft seal outer washer "14" with large inside diameter over manual control shaft, dish down.

11. Install rubber manual shaft seal "13" over shaft with lip extending into inside diameter of outer washer.



1. Front valve plate and screws
2. Servo release plug lock and screw
3. Front servo exhaust body
4. Front servo exhaust body spacer
5. Compensator valve
6. Detent plug
7. Compensator valve spring
8. Outer valve body
9. Manual shaft and detent control lever
10. Inner control lever pin
11. Inner control lever washer
12. Inner control lever seal
13. Manual shaft seal
14. Manual shaft seal outer washer
15. Manual shaft seal inner washer
16. Manual control valve
17. Throttle valve
18. Throttle valve spring
19. T valve
20. Compensator auxiliary plug
21. Compensator auxiliary plug pin
22. Transition valve spring
23. Double transition valve
24. Detent plunger spacer
25. Detent plunger retainer
26. Detent plunger
27. Detent plunger spring
28. Inner throttle lever
29. Valve body spacer plate
30. Front valve body
31. 2-3 regulator plug
32. 2-3 regulator plug spring
33. 2-3 shifter valve spring
34. 2-3 shifter valve
35. 1-2 regulator plug
36. 1-2 regulator plug spring
37. 1-2 shifter valve
38. 3-4 regulator plug
39. 3-4 shifter valve spring
40. 3-4 shifter valve
41. Inner valve body
42. Governor plugs
43. Inner valve body plate
44. Valve body rear cover

Fig. 288—Control Valve Assembly

12. Install three governor plugs "42" in inner valve body.

13. Position inner valve body rear cover plate "43" and inner valve body rear cover "44" on body. Install and tighten three screws.

14. Install regulator plugs 1-2 "35", 2-3 "31" and 3-4 "38" in front valve body and check for freeness.

15. Install shifter valves 1-2 "37", 2-3 "34", and 3-4 "40" in inner valve body "41" and check for freeness.

16. Install 1-2 regulator plug spring "36" in front valve body "30".

17. Install 2-3 valve spring "33" and 2-3 regulator plug spring "32" in valve body.

18. Install 3-4 valve spring "39" in valve body.

19. Lay front valve body and inner valve body on clean surface, line up regulator plug springs in inner body with regulator plugs in front body. Compress springs with front body and install three attaching screws.

20. Position front valve body plate "1" on front valve body and install three attaching screws. Be sure plate does not extend over face of inner body.

21. Position valve body spacer plate "29" on inner valve body.

> ***NOTE:*** **Spacer plate can only be installed one way.**

22. Position outer valve body "8" on spacer plate and insert four valve body to transmission case attaching bolts through valve bodies and spacer plate to hold spacer plate in position while starting and tightening the three inner and outer valve body attaching screws.

> ***CAUTION: Make sure all assembly screws are tight and in right location in valve body by double checking, using a small screw driver.***

ASSEMBLY OF PARKING BRAKE BRACKET

1. Install parking blocker piston into rear of bracket assembly with chamfered end of piston exposed.

2. Install reverse blocker piston with slotted end out. Install reverse blocker piston spring in reverse blocker piston and hold in with a screw driver while installing blocker piston stop pin. Peen both ends of pin to lock in place.

ASSEMBLY OF DRIVEN TORUS CHECK VALVE

1. Install torus check valve spring, torus check valve and retainer.

2. Install mounting bolts, tighten to 6-8 ft. lbs. torque. Bend locks against bolts.

> ***NOTE:*** **Check for free movement of valve after locking bolts.**

SERVICE CRAFTSMAN NEWS REFERENCE

News Year	News No.	Page No.	Subject

ASSEMBLY OF UNITS IN TRANSMISSION CASE

CONTENTS OF THIS SECTION

INSTALLING FRONT AND REAR UNITS

1. Remove front and rear units from holding fixture and position front band over front of front unit drum so short anchor end will be positioned to fit over adjusting screw when units are placed in the case. Install suitable spring or wire to hold front band on front drum.

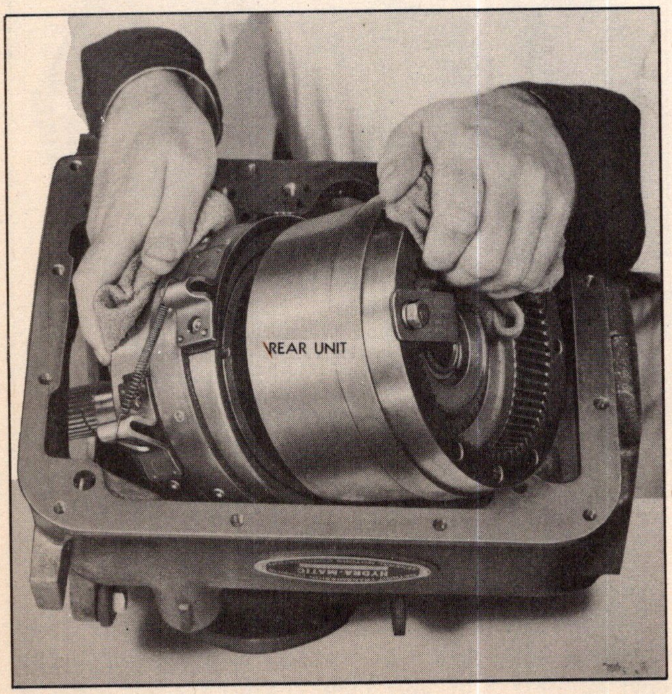


Fig. 289—Installing Units in Case

2. Install front and rear units in case by lowering front end of planet carrier into case first (Figs. 289 and 290).

> ***NOTE:*** **Make sure single hole in oil delivery sleeve is centered between center bearing cap attaching bolt holes and is facing up.**

3. Install rear band on rear unit drum and position anchor end of band over adjusting screw.

4. Remove spring and position anchor end of band over adjusting screw.

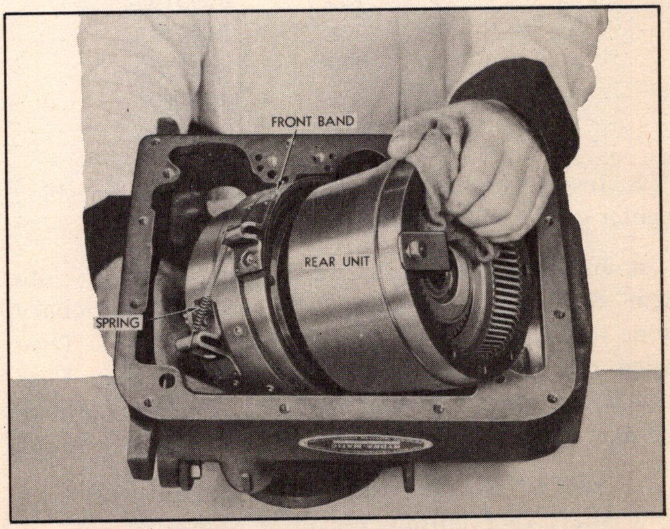


Fig. 290—Installing Units in Case

5. Position center bearing cap over oil delivery sleeve with dowel registering with single dowel hole in sleeve. Lightly tap bearing cap in place.

6. Install a new center bearing cap lock plate under attaching bolts and tighten bolts.

INSTALLING REVERSE ASSEMBLY AND MAIN SHAFT

1. Install screw driver or spacer J-2173 between the center bearing cap and rear clutch drum to prevent the drum from moving forward. The screw driver should be placed at an angle to prevent damage to the oil delivery sleeve.

2. Remove rear clutch hub holding tool from rear drum.

3. Position rear clutch hub rear thrust washer in the counterbore of rear hub and retain with petrolatum (Fig. 291).

4. Install correct size selective washer in counterbore of output shaft and retain in place with petrolatum (Fig. 292).

> ***NOTE:*** **If main shaft did not have correct end clearance prior to disassembly, select proper washer to bring end clearance within limits of .004"-.015".**

Selective washers are furnished in the following eight sizes.

Mark	*Size*	*Part No.*
1	.055"-.059"	8609191
2	.063"-.067"	8609192
3	.071"-.075"	8609193
4	.079"-.083"	8609194
5	.087"-.091"	8609195
6	.095"-.099"	8609196
7	.103"-.107"	8609197
8	.111"-.115"	8609198

5. Install main shaft in output shaft, meshing center gear with planet pinions.

6. Install main shaft and reverse assembly into rear end of transmission case, aligning stationary cone lock key into keyway in case (Fig. 293). Then align rear bearing retainer bolt holes to case. Rear bearing retainer will not fit tightly against the case at this point.

> ***NOTE:*** **Revolve output shaft and main shaft to facilitate meshing planet gears with drum internal gear.**

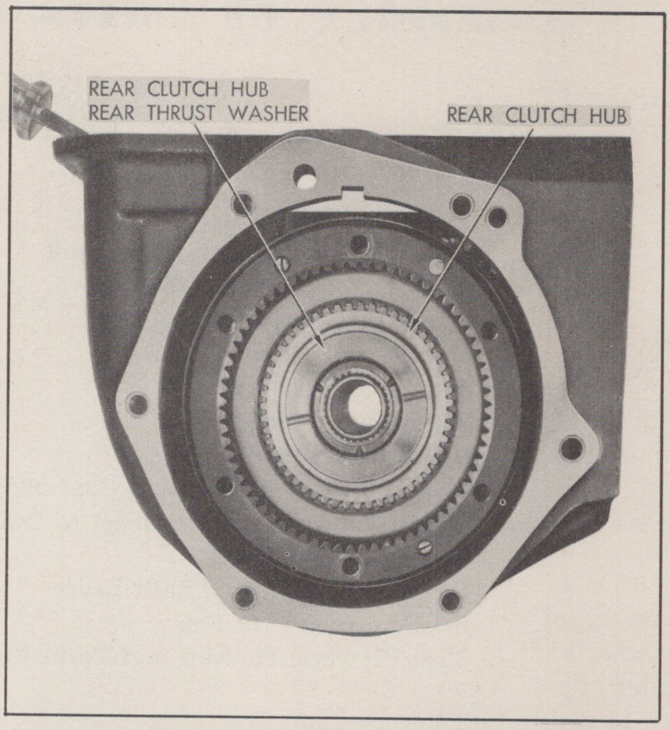


Fig. 291—Rear Clutch Hub Rear Thrust Washer Installed

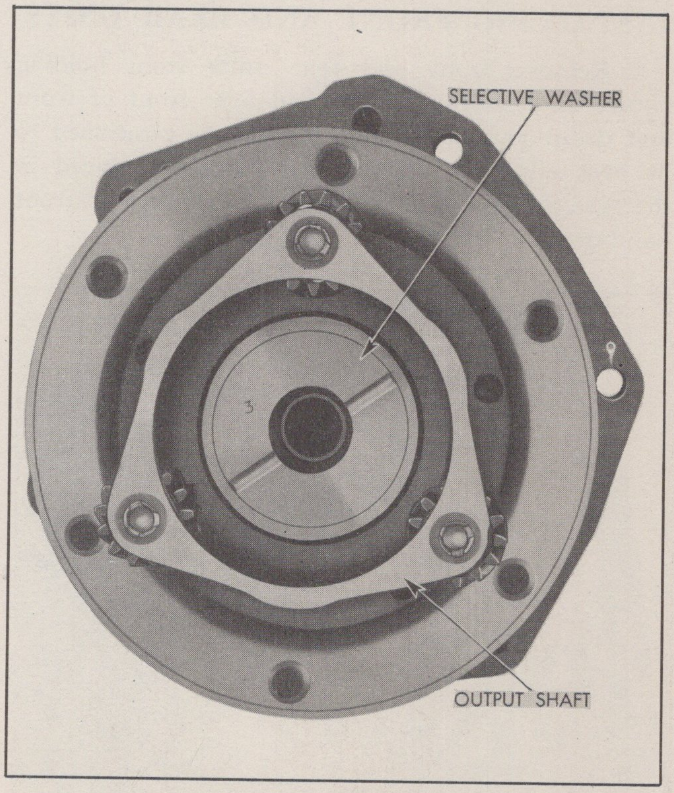


Fig. 292—Selective Washer in Place

7. Just start five rear bearing retainer to case attaching bolts and lock washers and parking brake pawl support bolt and lock (parking pawl support bolt must be installed to insure alignment of threads).

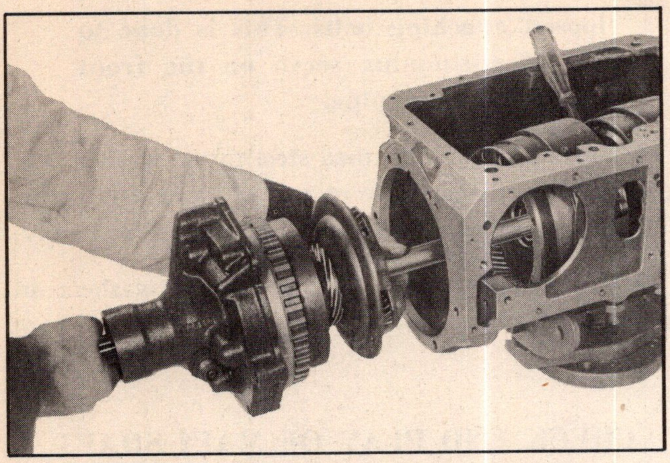


Fig. 293—Installing Reverse Assembly

8. Align holes in reverse drive flange and rear drum and install six reverse drive flange bolts and lock washers (Fig. 294). After two bolts are entered finger tight, remove screw driver. Tighten bolts to 10-13 ft. lbs. torque.

> *CAUTION: Tighten the six bolts evenly without distorting flange. While tightening bolts, test for freeness by holding output shaft and turning main shaft.*

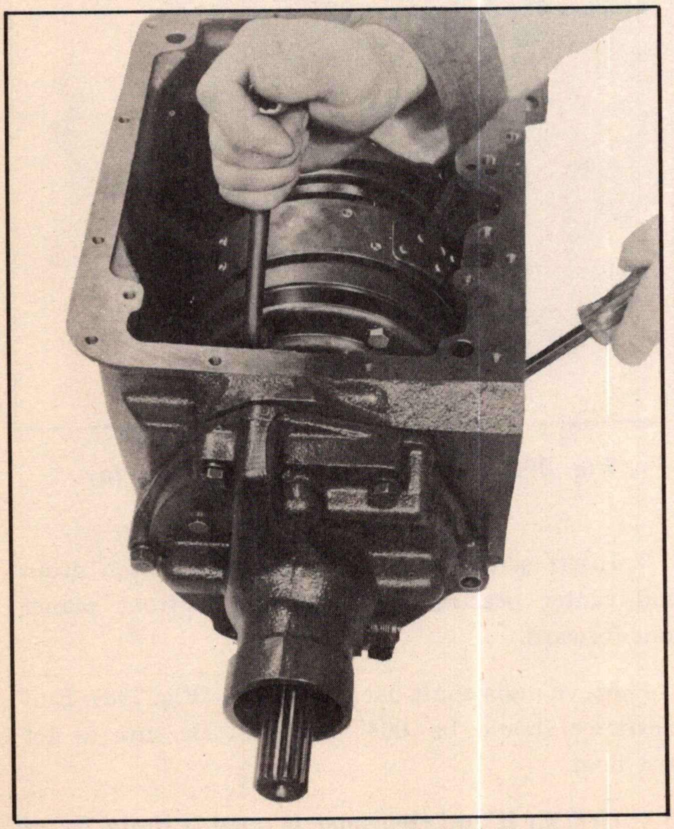


Fig. 294—Installing Reverse Drive Flange Attaching Screws

9. Push or tap rear bearing retainer against case. Then tighten mounting bolts evenly to 28-33 ft. lbs torque.

> ***NOTE:* Not necessary to torque parking brake pawl support bolt at this time.**

10. Test for freeness by turning main shaft, output shaft and front and rear unit drums.

11. Tighten center bearing cap attaching bolts to 40-50 ft. lbs. torque.

12. Bend lock plate up around bolts using large pliers.

INSTALLING FRONT PUMP AND FRONT DRIVE GEAR

1. Position bronze thrust washer over intermediate shaft, against front carrier.

2. Position front oil pump cover gasket over front pump cover.

3. Install front pump and front drive gear assembly over planet carrier. Align locating counterbore in pump cover with counterbore in case (Fig. 295).

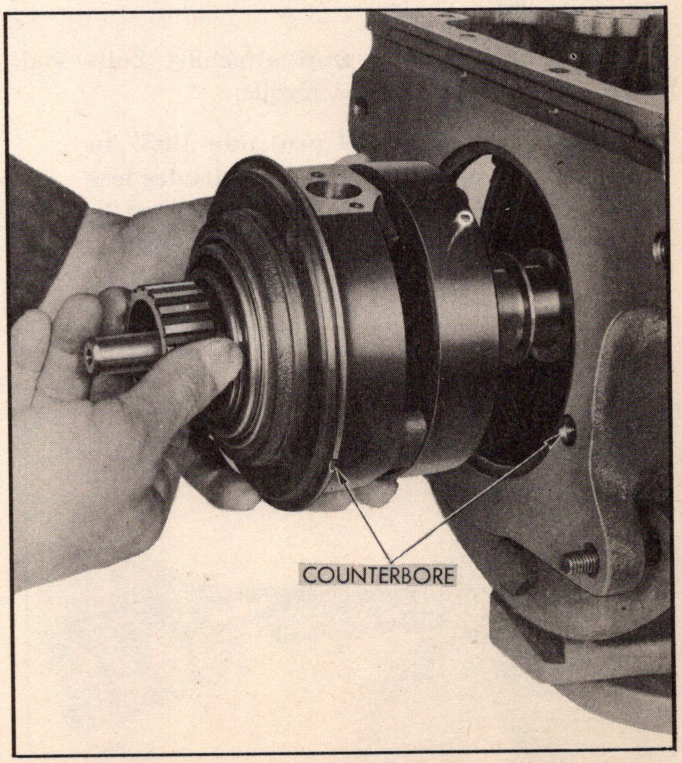


Fig. 295—Installing Front Pump and Front Drive Gear Assembly and Bronze Thrust Washer over Planet Carrier

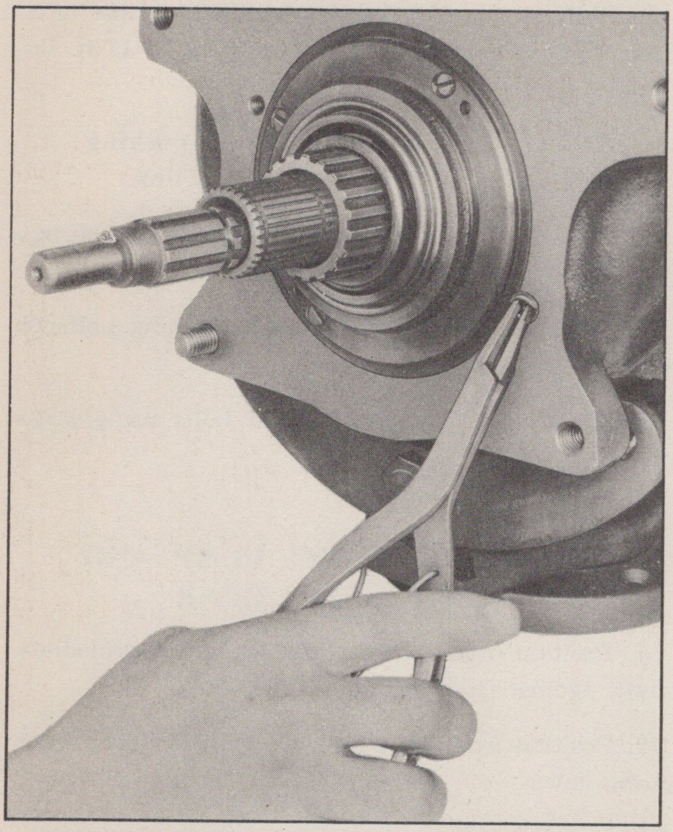


Fig. 296—Installing Locating Washer

4. Install pump cover locating washer in counterbore (Fig. 296).

5. Install two front pump attaching bolts and tighten bolts to 10-13 ft. lbs. torque.

NOTE: Cover should protrude .003" to .015" out of case. If cover protrudes less than .003" add a pump cover gasket to allow cover to protrude within limits. After this check has been completed, loosen attaching bolts. This is done to aid in positioning servo on the front pump discharge pipe.

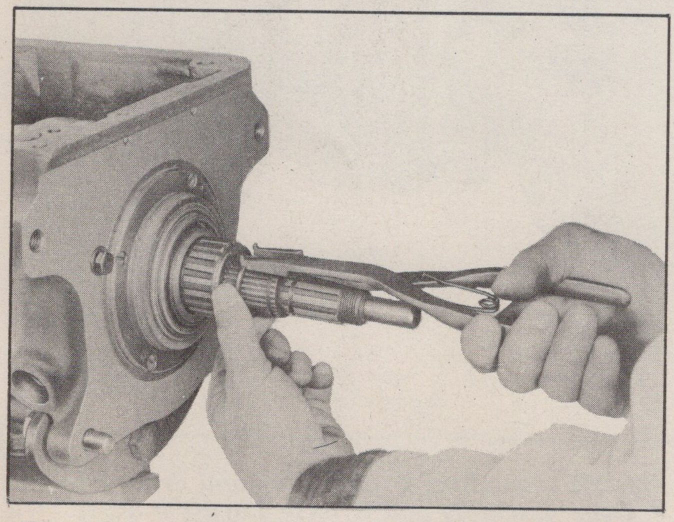


Fig. 297—Installing Front Drive Gear Snap Ring

6. Install the bronze, then steel thrust washer over planet carrier, against front end of front drive gear. These washers were tied together during disassembly.

7. Install snap ring holding thrust washers in place (Fig. 297).

CHECK END PLAY OF MAIN SHAFT

1. Install main shaft end play guide J-2587 over main shaft and front planet carrier to support main shaft.

2. Set up dial indicator on transmission case using tool, J-1465 (Fig. 298).

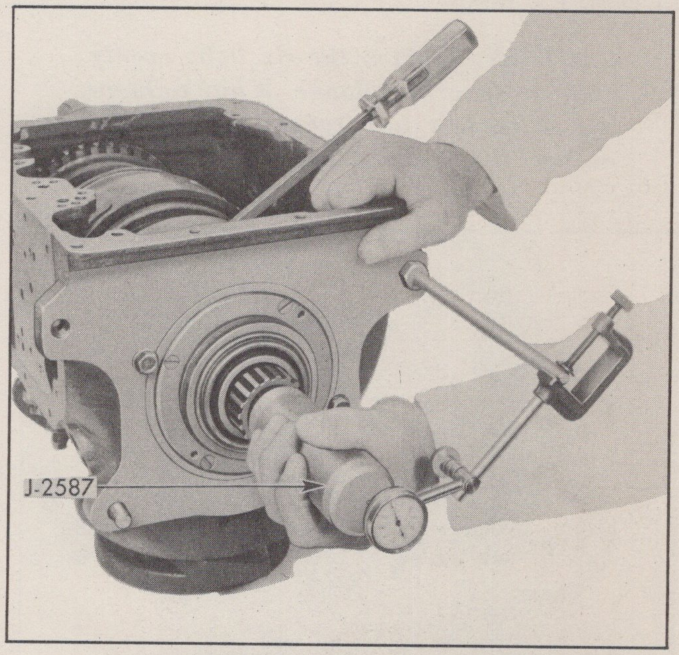


Fig. 298—Checking Main Shaft End Play

3. Insert screw driver between front clutch drum and center bearing cap, holding the front planet unit forward.

4. Move main shaft back and forth (Fig. 298). End clearance should be .004" to .015". Be sure to get just float.

NOTE: If end clearanee is outside limits, disassemble and install correct selective washer in counterbore of output shaft.

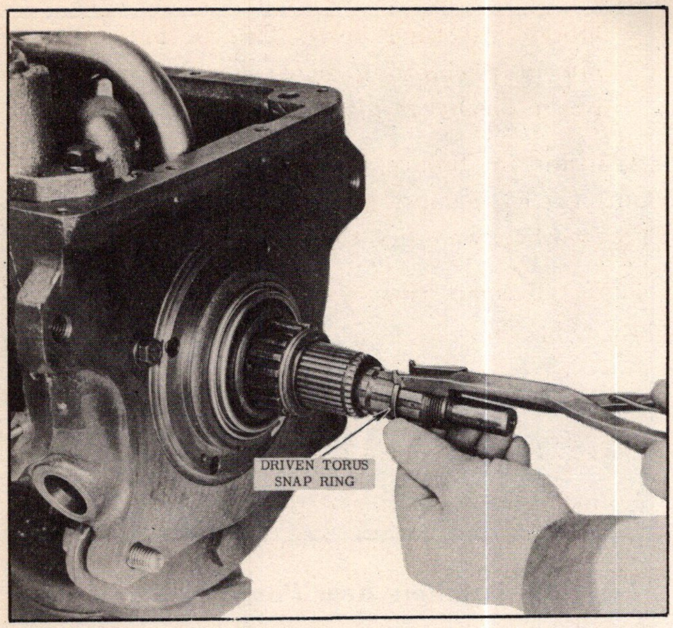


Fig. 299—Installing Driven Torus Snap Ring on Main Shaft

5. Remove screw driver from between front clutch drum and center bearing cap.

6. Remove dial indicator and main shaft end play guide.

7. Install snap ring in groove on main shaft (Fig. 299).

8. Install new rear bearing retainer oil seal using tool J-1354 (Fig. 300).

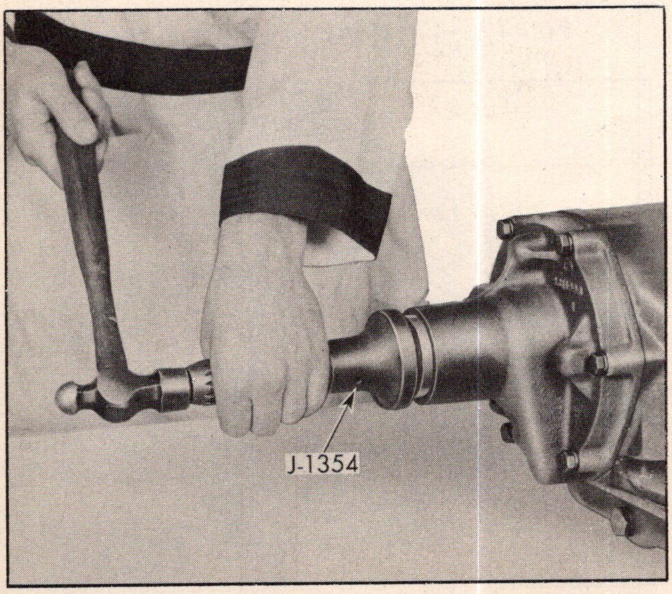


Fig. 300—Installing Rear Bearing Retainer Oil Seal

NOTE: **Lubricate rubber portion of seal with Lithium Soap Grease and felt portion with Hydra-Matic fluid before installing.**

9. Apply sealing compound (Permatex No. 3, Aviation Form-A-Gasket Cement) to outside of seal against rear bearing retainer.

10. Install rear bearing retainer seal shield using tool J-1354.

INSTALL GOVERNOR AND REAR PUMP ASSEMBLY

1. Before installing the rear pump, make certain the pump to case mating surface is entirely free of nicks or burrs, and that both attaching bolt holes in the case have a good chamfer.

2. Position the large round governor weight to the front of transmission and locate one reverse drive flange attaching bolt up to provide clearance for pump and governor assembly to slide into transmission case.

3. Slide the pump and governor assembly into position in case (Fig. 301).

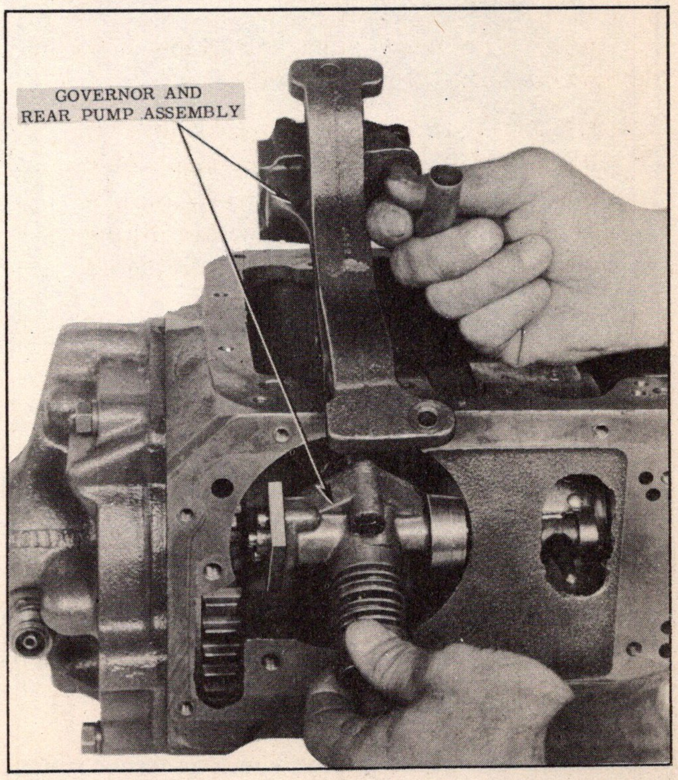


Fig. 301—Positioning Rear Pump and Governor Assembly

INSTALL FRONT AND REAR SERVOS

1. Install front pump delivery pipe in front pump body (Fig. 302).

2. Position front servo with piston stem in slot on end of front band; place servo on front pump delivery pipe; push servo into position against case.

3. Enter front servo attaching bolts and lock washers. Do not enter more than 2 or 3 threads.

4. Enter rear pump discharge pipe into passage in front servo and rear pump (Fig. 303).

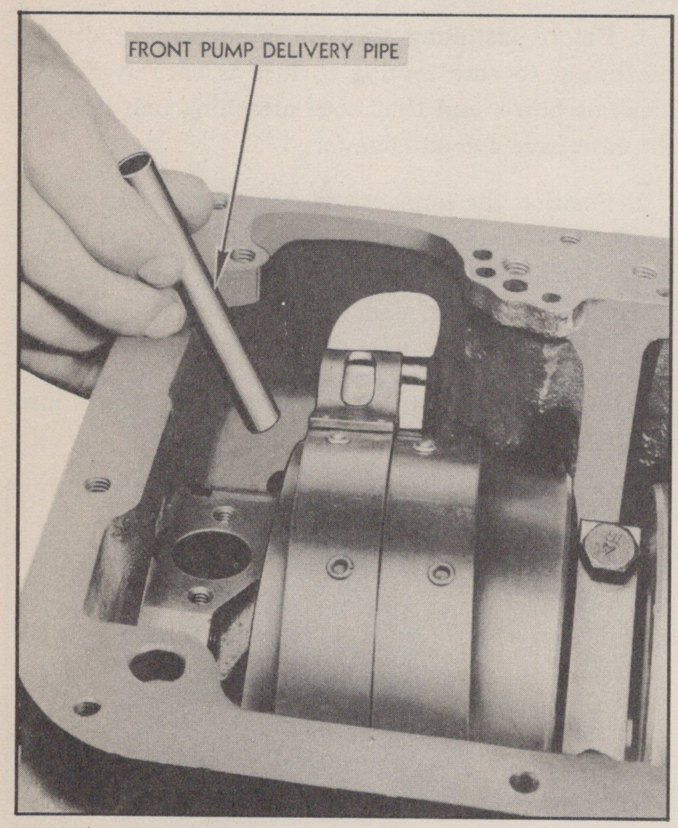


Fig. 302—Installing Front Pump Delivery Pipe

5. Place rear servo in position, engaging rear band strut with actuating lever while entering oil transfer pipe from front servo.

6. Enter rear servo attaching bolts, then tighten all four servo attaching bolts to 23-28 ft. lbs. torque.

7. Enter rear pump bolts and tighten.

8. Install dial indicator and check governor runout at tower about ¼″ from the end of the governor (Fig. 304). Runout should not exceed .005″. If run-

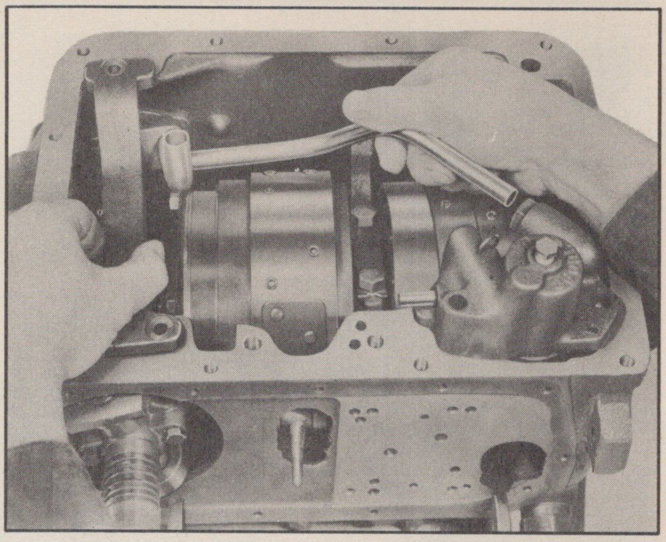


Fig. 303—Installing Rear Pump Discharge Pipe

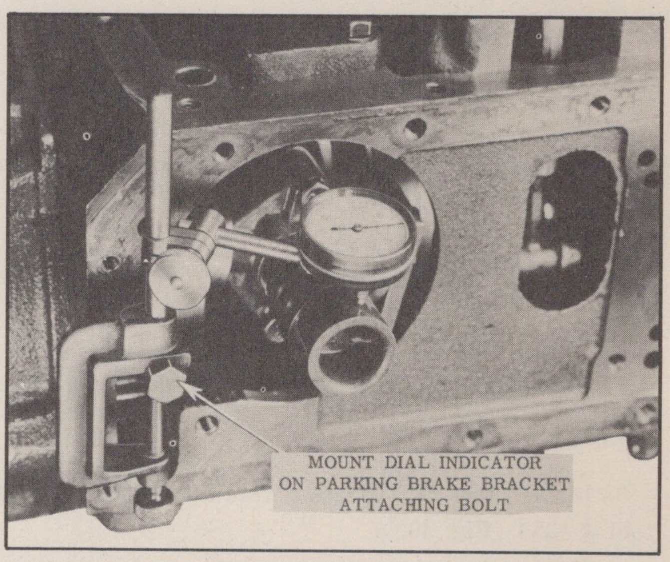


Fig. 304—Checking Governor Runout

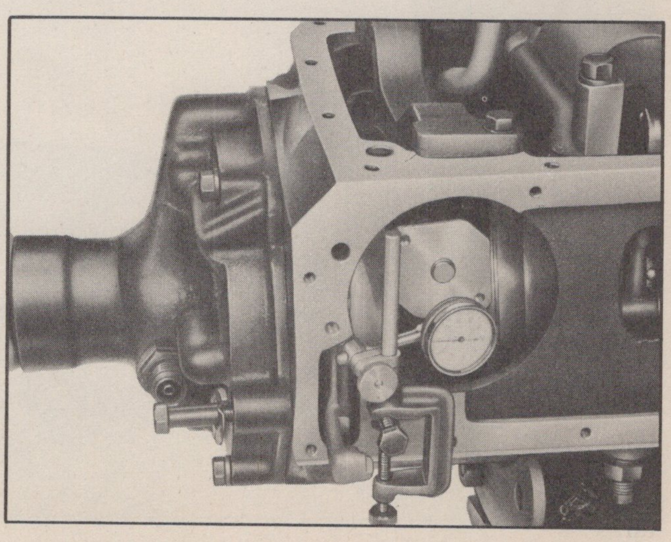


Fig. 305—Checking Drive Flange Runout

out exceeds .005″, rotate governor 180° on flange and recheck. If runout still exceeds .005″, check flange runout at a point ⅞″ from edge of shaft (Fig. 305). If flange runout is less than .002″, replace governor. If runout of drive flange exceeds .002″, correct condition by replacing one or all of the following parts: governor drive flange, gear set or complete rear oil pump assembly.

9. Install front pump intake pipe to front pump, using a new gasket and new attaching bolt locks (Fig. 306).

> ***CAUTION: Do not drop gasket, bolts or lock plates into case.***

10. Tighten front pump intake pipe bolts to 10-12 ft. lbs. torque. Bend locks up against flat side of bolts.

11. Tighten two front pump attaching bolts to 10-13 ft. lbs. torque.

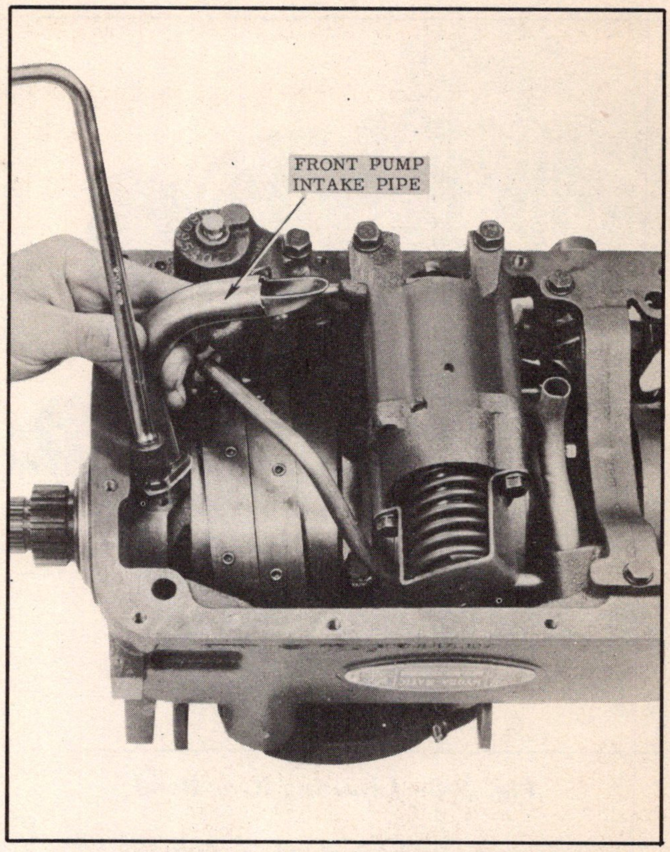


Fig. 306—Installing Front Pump Intake Pipe

ADJUST FRONT BAND

1. Remove the pipe plug from front servo, using a 7/16″ six-point socket. Loosen "hex" adjusting screw of gauge J-1693, until approximately ⅛″ of threads are exposed above gauge body. Install gauge, tightening by hand only (Fig. 307).

> ***NOTE:* Before making band adjustment, be sure anchor is seated on adjusting screw and the band is centered on drum.**

2. Tighten the "hex" adjusting screw with fingers until the stem of gauge is felt to just touch piston in front servo.

3. Using a wrench, tighten "hex" adjusting screw six complete turns from the point where it was felt by hand that stem just touched piston.

4. Tighten front band adjusting screw until knurled washer on top of the band adjusting gauge is just free to turn.

5. Hold band adjusting screw and tighten band adjusting screw lock nut securely to 40-50 ft. lbs. torque.

6. Loosen "hex" adjusting screw at least six full turns and remove gauge. Install and tighten pipe plug.

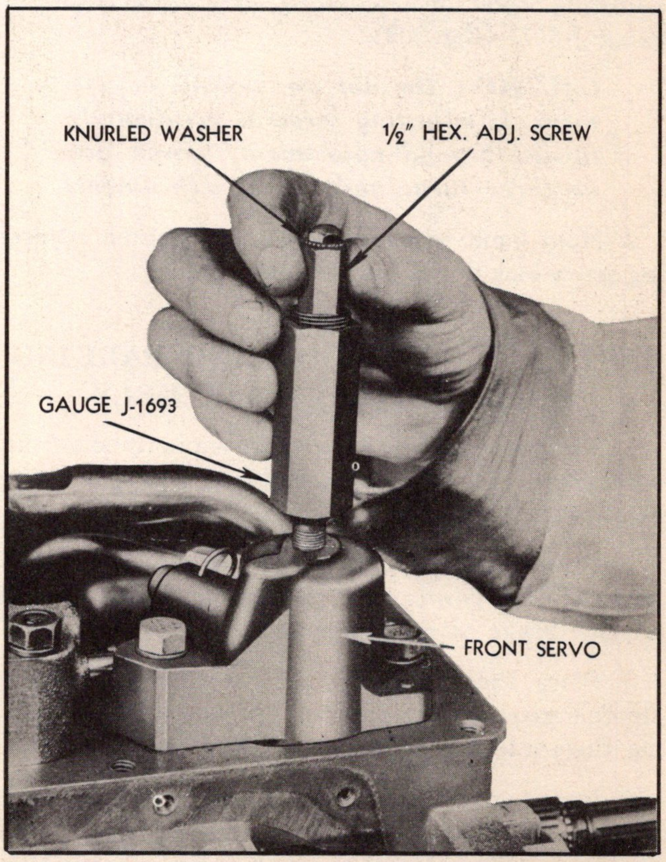


Fig. 307—Adjusting Front Band

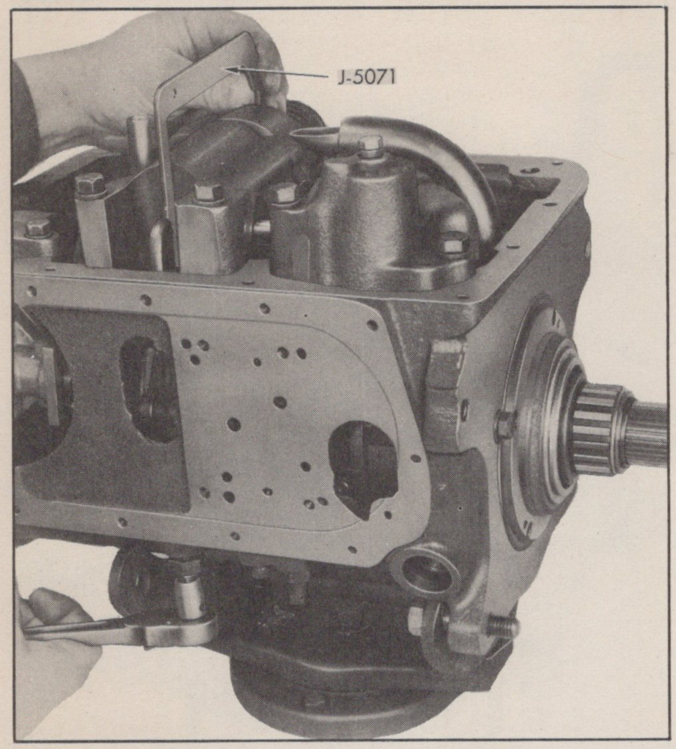


Fig. 308—Adjusting Rear Band

ADJUST REAR BAND

1. With rear band centered on drum, tighten band adjusting screw until actuating lever contacts face of gauge J-5071 (Fig. 308).

CAUTION: Do not go beyond adjustment. If adjusting screw is accidentally turned beyond adjustment, loosen two or three turns and repeat adjustment.

2. Hold band adjusting screw and tighten adjusting screw lock nut to 40-50 ft. lbs. torque.

INSTALL VALVE BODY AND PARKING BRAKE BRACKET ASSEMBLY

1. Remove parking brake pawl support bolt from case. This bolt was previously installed to insure alignment of threads.

2. Install parking pawl into position in case but let pawl slide down as far as possible. Do not install parking brake pawl support bolt.

3. Place the chamfered side of the oil delivery sleeve over end of governor and press gently on, guiding rings into the oil delivery sleeve (Fig. 309).

4. Install parking blocker piston spring, piston release spring stop and start bracket to case bolts into case (Fig. 310). Loosen rear pump attaching bolts.

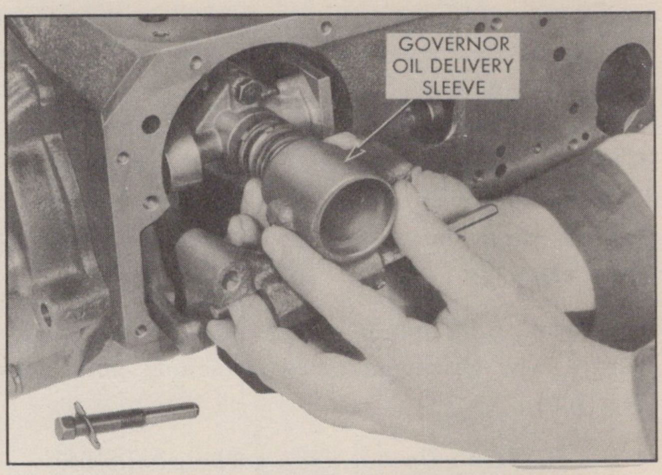


Fig. 309—Installing Parking Brake Bracket Assembly

5. Install roller on parking brake pawl crank, raise pawl to position and install parking brake pawl support bolt. Tighten bolt to 23-28 ft. lbs. torque. Bend lock plate over flat of bolt.

6. Install reverse clutch pipe with "L" end in rear of transmission case and install three oil delivery pipes into parking brake bracket.

7. Install parking pawl return spring over inside oil delivery pipe (hook outward) and hook other end over parking brake lever pin.

8. Install control valve assembly over three oil delivery pipes and reverse clutch pipe and start bolts (Fig. 311). Press valve body and bracket assembly against case. Torque valve body bolts to 6-8 ft. lbs.

9. Install pressure regulator reverse oil pipe.

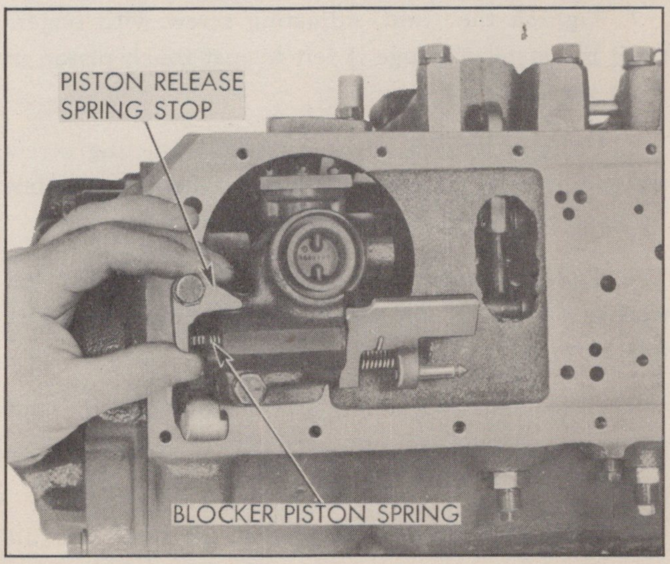


Fig. 310—Installing Parking Blocker Piston Spring and Piston Release Spring Stop

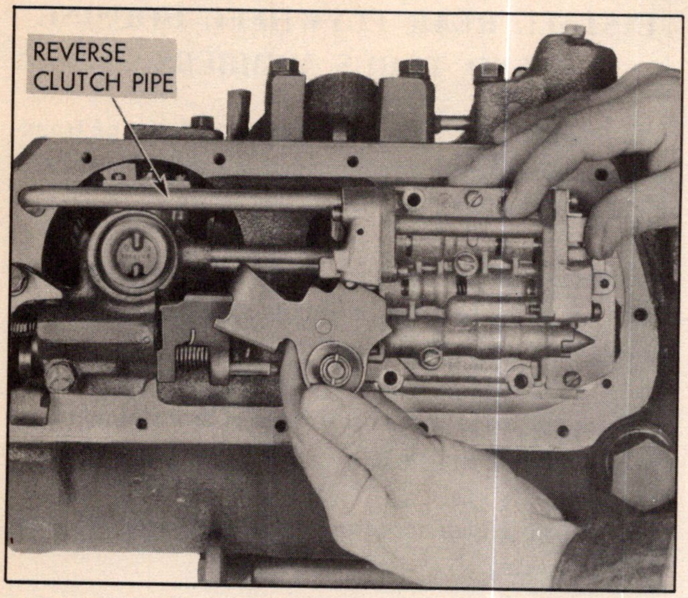


Fig. 311—Installing Control Valve Assembly

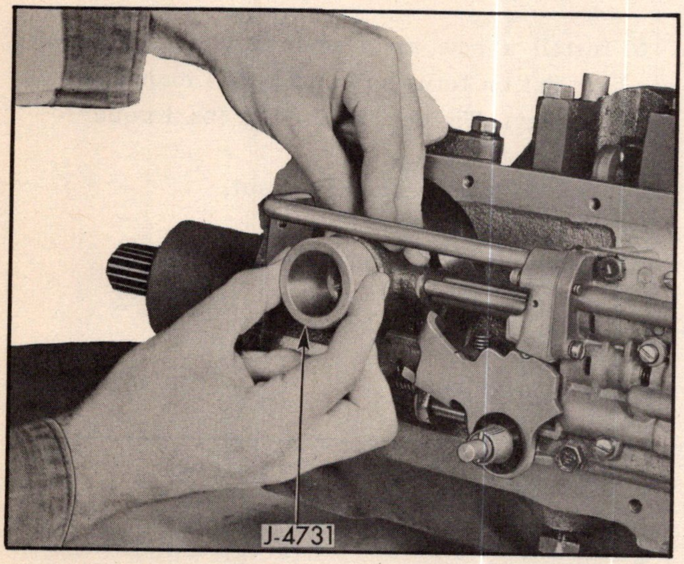


Fig. 312—Governor Aligning Tool in Place

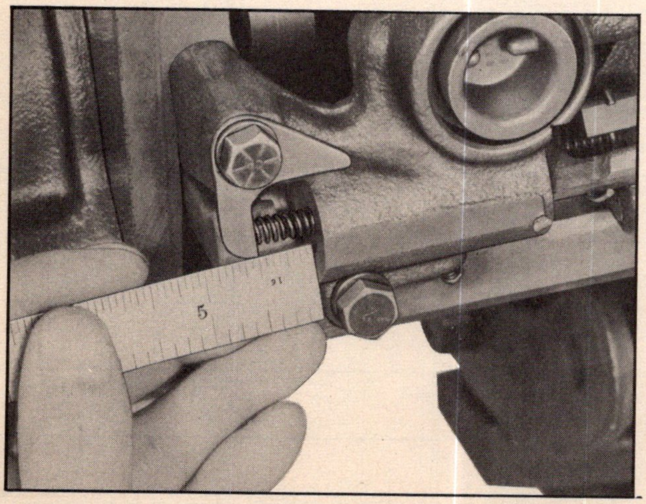


Fig. 313—Checking Parking Blocker Return Spring Stop (Early type)

CHECKING PARKING BRAKE BRACKET TO GOVERNOR ALIGNMENT

1. With governor alignment tool, J-4731, in place (Fig. 312), tighten the rear pump bolts and parking brake bracket bolts. Tool should rotate freely, and governor should rotate freely as much as gear backlash allows. If tool is tight, loosen parking brake bracket bolts, and shift bracket to position where alignment tool will rotate freely. Tighten parking bracket bolts and check to see that tool still rotates freely.

2. Check position of the parking blocker return spring stop if early type spring stop is used. Spring seat surface of early type stop should be $\frac{1}{2}''$ to $\frac{17}{32}''$ from the face of the parking brake bracket assembly (Fig. 313). This measurement should be $\frac{5}{8}''$ when the late type parking blocker return spring stop is used.

INSTALL PRESSURE REGULATOR ASSEMBLY AND PRESSURE LINE PLUG

1. Place a new gasket over pressure regulator plug.

2. With pressure regulator valve and guide assembled into spring, locate valve on seat in front pump (Fig. 314).

3. Apply pressure on regulator plug and tighten in transmission case to 40-50 ft. lbs. torque.

4. Apply sealing compound (Permatex No. 3, Aviation Form-A-Gasket Cement) to threads of oil pressure line pipe plug and install plug between band adjusting screws, using $\frac{7}{16}''$ six-point socket.

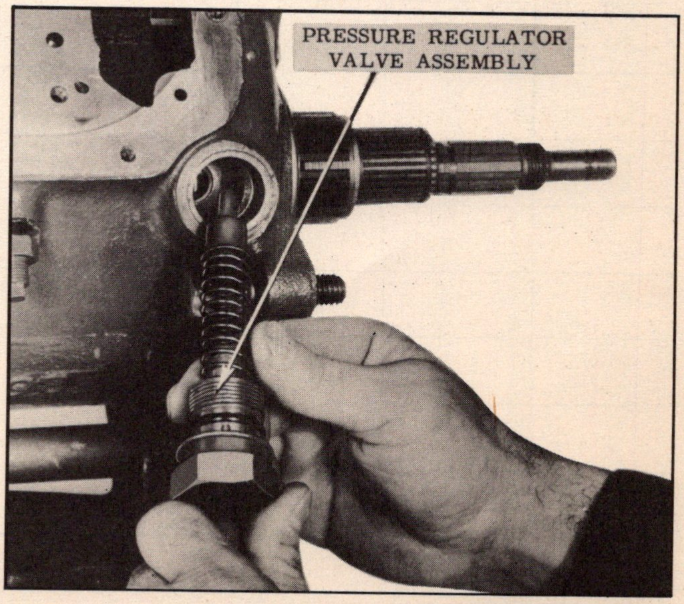


Fig. 314—Installing Pressure Regulator Valve Assembly

INSTALL SIDE COVER AND OUTER SHIFT LEVER

1. Place a new gasket on side cover and retain in place with petrolatum.

2. Position side cover and gasket assembly over manual shaft.

3. Start side cover attaching bolts with copper washers in lower 5 holes and those with lock washers in remaining holes and tighten finger tight. Shift cover to centralize manual shaft in hole and tighten bolts to 10-12 ft. lbs. torque.

4. Install outer shift lever. Tighten clamp bolt to 10-13 ft. lbs. torque.

INSTALL TRANSMISSION OIL SCREEN AND PAN

1. Slide oil screen over front pump intake pipe and position over rear pump intake pipe.

2. Place new oil pan gasket on transmission case.

3. Position oil pan over gasket.

4. Start attaching bolts with lock washers to line up pan. Then tighten bolts to 10-13 ft. lbs. torque.

5. Install new oil pan drain plug gasket and tighten plug to 35-45 ft. lbs. torque.

INSTALL REAR FLYWHEEL HOUSING AND TORUS MEMBERS

1. Position rear flywheel housing on front of transmission, and install attaching bolts and lock washers. Tighten to 40-50 ft. lbs. torque.

2. Install torus cover on splines of front drive gear. Push on cover evenly, without rocking, to prevent damage to oil seal and rings.

3. Install drive torus on splines of front planet carrier and install snap ring.

4. Install driven torus on main shaft against main shaft snap ring.

5. Move shift lever (inner) into reverse position.

6. Install a new main shaft nut lock plate with ear over flat on torus hub and install main shaft nut ($1\frac{7}{16}''$ socket). Tighten to 50-60 ft. lbs. torque.

7. Bend lock plate up against nut.

8. Install oil level indicator.

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INSTALLING HYDRA-MATIC TRANSMISSION

1. Thoroughly clean face of flywheel. Make sure clutch pilot bearing is staked in crankshaft.

2. Place a new gasket on face of flywheel. To provide a good seal it is very important that the gasket be in perfect condition and that the flywheel be free of burrs. Gasket should be held in place with petrolatum. Do not use shellac or any other sealer.

3. Line up flywheel with one of the dowel pins approximately 4" below left side of front flywheel housing so transmission main shaft can pass between two flywheel to crankshaft bolts.

4. Install pilot bearing spacer on end of main shaft (Fig. 315).

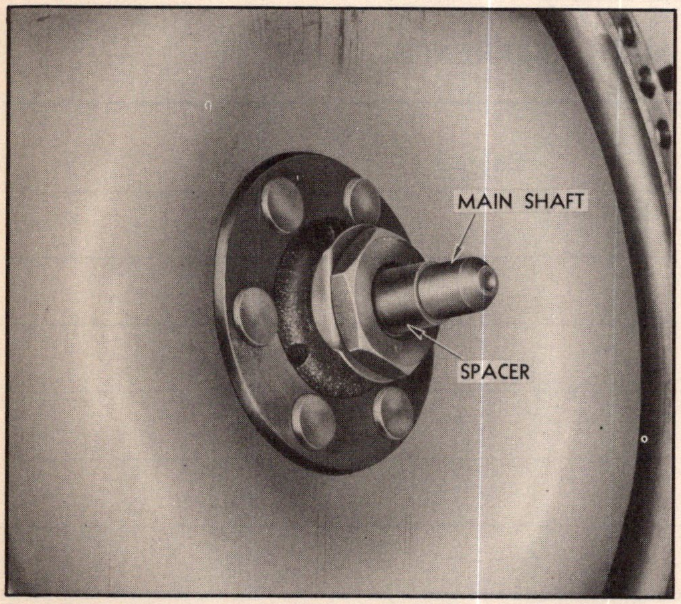

Fig. 315—Pilot Bearing Spacer on End of Main Shaft

5. Lift transmission into position, using a hydraulic floor jack with tool J-2808 attached and with handle toward rear of car. While lifting transmission, guide main shaft pilot into pilot bearing in crankshaft.

CAUTION: Tool J-2808 must be securely fastened to jack pad to prevent slipping.

6. Position torus cover so that blue markings on flywheel dowel and torus cover (or punch marks on dowel and torus cover) correspond.

7. Push transmission forward until dowels of rear flywheel housing engage holes of front housing. Install and tighten six rear housing attaching bolts and lock washers. (The lower two bolts on each side of the rear housing also hold the rear engine mounting to housing. Install mountings with these bolts.) Remove hydraulic jack.

8. Raise engine approximately ½" above its normal height to permit installation of cross member.

9. Tap cross member into place between frame side rails, making sure it is installed in the correct position. (The rear edge of the cross member is cut away slightly along the bottom edge to give ample clearance for the transmission oil pan.)

10. Install six cross member to side rail attaching bolts. Position reinforcing plates over bolts, install lock washers and nuts and tighten.

11. Lower engine, making sure mountings seat properly on cross member. Remove jack and wooden block from beneath engine oil pan.

12. Position reinforcing plates over engine mount to cross member bolts. Install lock washer and nuts and tighten.

13. Install 30 torus cover to flywheel attaching bolts with lock washers finger tight.

***NOTE:* Torus cover to flywheel bolts are alloy steel. No substitutes should be used.**

14. Tighten torus cover to flywheel bolts as follows:

a. Tighten two bolts adjacent to dowels 12-15 lb. ft. torque (Fig. 316).

b. Tighten two bolts located 90° to dowels 12-15 lb. ft. torque.

c. Tighten all bolts in rotation to 20-25 lb. ft. torque.

d. Tighten all bolts in rotation to 25-30 ft. lbs torque.

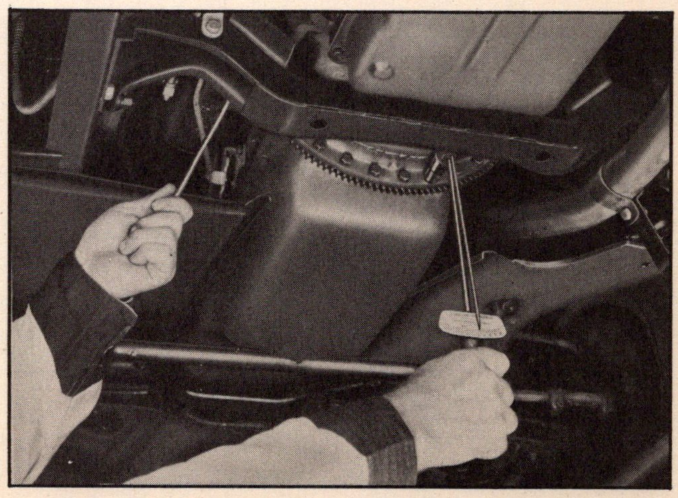

Fig. 316—Tightening Torus Cover to Flywheel Bolts with Torque Wrench

15. Tighten torus and oil pan drain plugs.

16. Install flywheel housing bottom cover.

17. Install crankcase ventilator outlet pipe and tighten exhaust pipe bracket.

18. Connect shift control rear rod to outer shift lever.

19. Install outer throttle control lever.

20. Connect speedometer cable and housing to transmission.

21. Install hand brake cross lever and connect hand brake cables.

22. Install lower heater pipe and remove clamps from heater hoses. Connect heater pipe support bracket to cross member.

23. Install propeller shaft.

24. Fill transmission with Hydra-Matic drive fluid. Follow instructions in "Minor Repairs" section, page 57.

25. Test main line oil pressure according to instructions on page 157.

26. Install floor hole cover, mat and accelerator pedal.

27. Adjust throttle and shift control linkage. See instructions in "Adjustments on Car" section, page 49.

28. Remove car from stands.

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TROUBLE DIAGNOSIS AND TESTING

CONTENTS OF THIS SECTION

The procedures contained in this section are for use when testing a Hydra-Matic equipped car for standard performance. Select the test required and perform it in the manner recommended. This will lead to accurate diagnosis of the trouble and minimize the need for complete disassembly of the transmission. *Transmission oil must be checked and Hydra-Matic fluid added, if required, before any tests are conducted.*

CHECKING OIL LEVEL

1. Set selector lever in N position and apply hand brake. Start engine and allow it to idle continuously for a minimum of two minutes until oil is warm.
2. Roll back right side of floor mat and remove inspection hole cover in floor pan directly over transmission oil level indicator.
3. Remove all gravel, sand or lint from floor and around oil level indicator before removing indicator.
4. Remove and wipe indicator and re-insert.
5. Remove indicator and note reading.

NOTE: Engine must be running at idle speed while fluid level is being checked.

ROAD TEST USING HYDRA-MATIC DIAGNOSIS GUIDE

The Pontiac Hydra-Matic Diagnosis Guide (Fig. 317) provides a uniform and systematic trouble diagnosis which is both accurate and thorough. During the road test place a check mark in the space provided after the various conditions when encountered. The information under "Diagnosis of Malfunctions" (page 158) gives more specific instructions for some of the conditions which may be encountered.

The normal speeds at which the shifts should take place and the Stall or Torque test specifications are listed on the back of the Diagnosis Guide (Fig. 318).

Instructions for using the Diagnosis Guide are printed on the inside of the cover of the pad (Fig. 319).

The letters in the column of the Diagnosis Guide headed "Possible Causes" refer to the units listed in the "Legend".

FOLLOW THE INSTRUCTIONS PERFORM A COMPLETE DIAGNOSIS

REMEMBER

75% of all troubles can be corrected by external adjustments and oil level—over 80% of remainder of troubles can be corrected with the transmission in the car.

Test Route

A predetermined test route should be established to save time and permit comparison of different cars over the same route. Where possible the route should be laid out to include a hilly section to test for open throttle upshift, slippage and throttle downshifts, a level section for testing upshift points and a quiet section for testing for noise. When a chassis dynamometer is available, it may be used as a substitute for the road test.

PONTIAC HYDRA-MATIC DIAGNOSIS GUIDE (1948-1951)

Date ____________ Mileage ____________ Trans. No. ______________ R.O. No. ____________

Owner ____ Tester ______________________

PRELIMINARY TEST

Bring fluid to proper level
Set engine idle at 365-385 RPM
Check oil pressure as outlined in Hydra-Matic Manual

OPERATING CONDITIONS

CONDITION*	√	Possible Causes	CONDITION	√	Possible Causes
Upshifts not normal (high___ Low___ varies___misses one or more shifts___ violent shifts___)		B-F-H-J-R	No drive or slipping in reverse only		C-D-E-F-O
Slips in 1st, 3rd, and reverse (Front Band)		D-F-L-M-U-V	Drives in reverse only (after reverse application)		B-F-G-O
Slips in 1st and 2nd only (Rear Band)		D-F-N-U-V	Reverse application during forward movement in Dr or Lo (1951)		E-F-O
Slips in 2nd and 4th only (Front Clutch)		R-T-U-V	Low oil pressure		E-H-K-Q-V
Slips in 3rd and 4th only (Rear Clutch)		S-T-U-V	Parking pawl will not engage when engine is shut off (1951)		H
Slips in all speeds or no drive forward		B-C-P-U-V			
Improper throttle downshift		B-C-F-J-Q	Locks up on reverse coast (prior to 1951)		C-E-F-N-Q
Engine speeds up, band apply rough		B-E-M	Clashes when shifted to reverse (prior to 1951)		A-B-F-I-N-O
Shifts above second in low range		F-J			
Rough downshift (coasting to stop)		F-N	Jumps out of reverse (prior to 1951)		B
Excessive creeping		A	Noisy		See Noise Section
Moves forward in reverse		S			
Cannot move lever to reverse (engine running) (1951)		H-J	Ratching noise when shifted to reverse with car moving (1951)		A-C-F-H

LEGEND

	MINOR REPAIRS—Trans. in Car			MAJOR REPAIRS—Trans. Removed from Car	
A	Engine Idle	I	Reverse Shifter Bracket	P	Fluid Coupling
B	Linkage	J	Governor	Q	Front Oil Pump
C	Oil Pressure	K	Rear Oil Pump	R	Front Unit
D	Servo Bands	L	Front Servo	S	Rear Unit
E	Pressure Regulator	M	Front Servo 4-3 Valve	T	Oil Delivery Sleeve
F	Control Valve Assembly	N	Rear Servo	U	Restriction in Oil Circuit
G	Manual Detent Lever	O	Reverse Unit	V	Excessive Leak in Oil Circuit
H	Parking Brake Bracket (1951)				

OIL LEAKS

WHERE NOTICED	POSSIBLE CAUSE	√
Between Flywheel & Crankshaft Flange	Loose Flywheel to Crankshaft Bolts, Loose Dowel, or Insufficient Sealer	
Torus Cover and Flywheel	Flywheel to Torus Cover Gasket, Flywheel Sealing Area, Drain Plug or Dampener Rivets	
Front of Transmission	Front Pump Cover or Screws, or Front Oil Seal	
Oil Pan	Oil Pan Gasket or Drain Plug	
Side Cover	Side Cover Gasket or Screws, Throttle & Manual Shaft Seals, Pressure Line Plug	
Rear of Transmission	Rear Oil Seal, Rear Bearing Retainer Gasket, Rear Bearing Retainer Bolts	

NOISE

OCCURS UNDER FOLLOWING CONDITIONS	POSSIBLE CAUSE	√
Neutral and all Gears whenever engine is running	Front Oil Pump	
Neutral only (disappears when shifted to drive)	Rear Unit Planetary Gears	
Neutral, 1st and 2nd Speeds only	Rear Unit Planetary Gears	
Neutral, 1st, 3rd, reverse speeds only	Front Unit Planetary Gears	
Reverse Gear, Acceleration only	Reverse Unit Planetary Gears	
Reverse Gear, Deceleration only	Rear Unit Planetary Gears	
Metallic scraping at front of transmission	Excessive Backlash—Torus Members	
Vehicle coasting 20 to 35 MPH, Engine not running & selector lever in neutral	Rear Oil Pump Gears	

*See back of Sheet for *INSTRUCTIONS* covering correct Shift Point

Fig. 317—Pontiac Hydra-Matic Diagnosis Guide—Front

PONTIAC HYDRA-MATIC SHIFT POINTS IN M.P.H. (1948-1951)

UPSHIFTS

	DRIVE RANGE		LO RANGE	
SHIFT	MINIMUM THROTTLE	FULL THROTTLE	MINIMUM THROTTLE	FULL THROTTLE
1-2	5-7	10-15	No Shift*	19-24
2-3	10-13	27-35		
3-4	14-18	55-70		

*With control lever in Lo Range, ⅓ to ½ throttle, 1-2 shift will occur at approximately 16-21 MPH.

DOWNSHIFTS

	DRIVE RANGE			LO RANGE		
SHIFT	CLOSED THROTTLE	FULL THROTTLE	FORCED	CLOSED THROTTLE	FULL THROTTLE	LOCKOUT
4-3	14-10	20-15	60-15			
3-2 or 3-1 (P50, 51)	6-2					
3-2 or 3-1 (D50, 51)	10-6					
3-1 (1948-49)	8-4					
3-2		12-9				
2-1		8-4		6-3	14-10	
4-2						48-40

STALL TEST

TEST CONDITIONS	1400 TO 1600 ENG. R. P. M.	UNDER 1400 ENG. R. P. M.	OVER 1600 ENG. R. P. M.
With the engine at operating temperature, set control lever in Dr position. Fully apply hand and foot brake, and accelerate engine to wide open throttle.	NORMAL	Poor engine performance such as need of tune up, etc.	Transmission slippage or excessive torus coupling slippage. (Do not hold throttle open.)

Fig. 318—Pontiac Hydra-Matic Diagnosis Guide—Back

INSTRUCTIONS

for Using the

PONTIAC HYDRA-MATIC DIAGNOSIS GUIDE

1. Before testing the car with this guide, check the transmission fluid for proper level, with engine running and its slow idle speed set at 365 to 385 R.P.M. (with gearshift control lever in "N" position). Either of these items will cause many different irregularities in transmission operation.

2. While driving the car, be on the alert for any indications of any improper engine performance. If any, correct them before making final diagnosis.

3. The shift points shown on the back of this guide are average and may vary slightly. One or two miles per hour either way is no cause for adjustment as long as the shifts are smooth.

4. The causes for these irregular operating conditions are necessarily general, pointing to the major assemblies. This permits the use of a concise one-page diagnosis form.

5. The various causes of any particular condition are listed in order of the trouble. Over one-fourth of these can be remedied by *external* adjustments, and over three-fourths can be repaired with the transmission *in the car*. Never order the transmission removed from the car until the "on car" repairs have been completed, or until visual inspection of the transmission after removal of the oil pan and side cover (oil sediment, excessive backlash, burned drums, etc.) definitely indicates the need for complete disassembly. *ALWAYS CHECK THE CAUSES IN THE SEQUENCE LISTED.*

6. The only exception to step 5 occurs when two or more conditions have one common cause; then fix that particular item first.

7. When checking linkage, always inspect rods and relay levers for wear as well as for proper adjustment, because worn linkage will never hold proper adjustment.

8. When checking for slippage, always use the "stall test" on the back of this guide.

9. Obviously, the value of this diagnosis guide will be lost *unless it is used properly*. After the sheet has been filled out during the road test, the proper corrective measures for the repair order will be apparent. The sheet should then be attached to the shop copy of the repair order and remain with it throughout the shop, finally, accompanying it into the car records. This will enable the mechanic to know what specific condition his work is to correct and will provide definite information for future reference.

Fig. 319—Inside Cover of Diagnosis Guide

"STALL" OR TORQUE TEST

A "Stall" or Torque test may be made to determine engine and transmission performance. This test must be used with moderation because considerable strain is exerted on the drive line, differential gears and axles. To perform "Stall Test" proceed as follows:

1. Start engine and warm up to operating temperature.

2. Connect electric tachometer.

3. Set hand brake lever tightly and apply foot brake firmly.

4. Place shift control lever in Dr position.

5. Depress accelerator pedal to floor.

Action here has placed transmission in first speed. Brakes are applied, therefore the car cannot move. Opening the throttle and speeding up the engine is comparable to slipping a mechanical clutch, as the driving torus is turning and trying to turn the driven torus which is held stationary by the transmission being in first speed and brakes locked.

The engine will speed up until the friction created between the torus members equals the power output of the engine. Engine efficiency will be noted by its stall RPM which should be between 1400 to 1600 RPM.

a. If engine RPM is less than 1400 the engine is in need of a tune-up.

> ***NOTE:*** **If transmission front planetary unit is locked up, low engine RPM will result.**

b. If engine continues to speed up to, or above 2000 RPM, it indicates that bands are not holding properly or that there is slippage in fluid coupling due to missing check valve, front pump relief valve, or damaged torus members.

> ***CAUTION: Extreme care must be used in making this test. NEVER HOLD THROTTLE OPEN MORE THAN ONE MINUTE. If engine speeds up to 2000 RPM, close throttle immediately to avoid possible damage to transmission.***

Sometimes it is desirable to know which band is slipping. After making tests with control lever in Dr position, place lever in R position and test again. If slippage still occurs, fault is with front band or reverse cones. If slipping does not occur, then slippage is in the rear band.

Check Cause for Slipping Under "Stall Test"

1. Set hand brake lever tightly.

2. Start engine and run at a speed equivalent to 20 MPH for approximately 1½ minutes. Then, with engine IDLING, control lever in Dr range, check the fluid level in the transmission.

3. See that fluid is at the "Full" mark on the indicator.

4. After level has been checked, shut off engine and wait 10 minutes. Re-check fluid level with engine shut off. If after 10 minutes, the fluid level in the transmission has not raised more than ½ inch, the driven torus check valve and front pump relief valve are operating satisfactorily.

5. If check valve and relief valve are operating satisfactorily, adjust bands and test car using Diagnosis Guide.

TESTING MAIN LINE OIL PRESSURE

Use pressure checking gauge J-2540 when checking oil pressure in the Hydra-Matic transmission.

Due to the use of modulated main line pressure in the D51 transmissions a different procedure will have to be used on these transmissions than on the P51 transmissions.

Testing Main Line Pressure on P51 (6 Cyl.) Transmissions

1. Roll back floor mat and remove floor hole cover over band adjusting screws.

2. Remove pipe plug from transmission case (between band adjusting screws) using a SIX-POINT socket.

3. Screw fitting on gauge J-2540 into transmission (Fig. 320).

4. Start engine and operate for several minutes to warm transmission oil to normal operating temperature (150° to 200°F.). When the oil is thoroughly warmed check pressure in N, Dr, and Lo positions. Pressure should be between 75 and 90 lbs. at 1000 RPM and should be equal in all three positions.

5. With engine running at idle speed, approximately 375 RPM, note pressure indicated on gauge with selector lever in Dr and Lo positions. Pressure

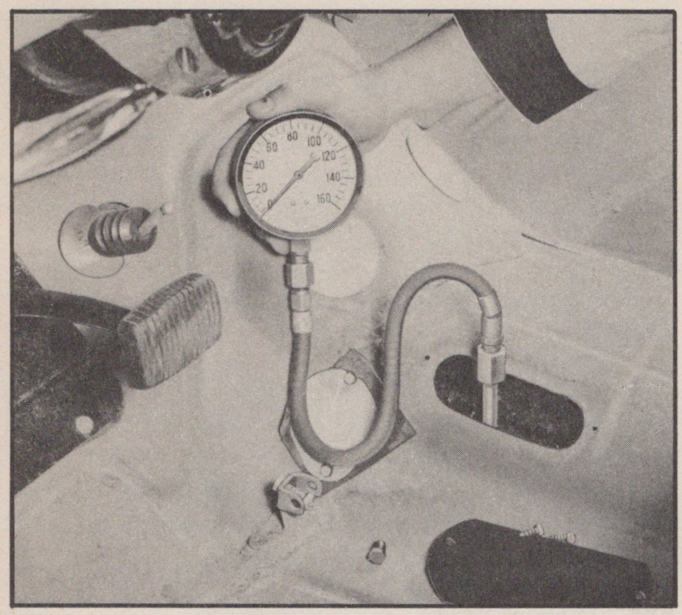


Fig. 320—Checking Main Line Oil Pressure

should be 75 to 90 lbs. Then move lever to R position. Pressure in reverse should be higher than the pressure in either drive or low.

> ***NOTE:* When shift lever is moved to reverse, pressure will momentarily drop before the higher pressure reading.**

6. If pressure checked satisfactorily in step 5, place selector lever in reverse position and apply foot brake. Accelerate engine to approximately half throttle. The pressure should increase to at least 125 lbs.

Testing Main Line Pressure on D51 (8 Cyl.) Transmissions

1. Install pressure gauge on transmission as outlined in steps 1-3 above, and operate engine to thoroughly warm transmission oil.

2. Make Zero Throttle Pressure Test by road test.

a. Depress accelerator pedal to give a car speed over 30 MPH in 4th speed.

b. Close throttle and note pressure gauge reading when car speed drops to exactly 30 MPH. Gauge reading should be between 45 and 72 lbs.

3. Make Full Throttle Pressure Test by road test as follows:

a. With car moving forward approximately 25 MPH in 4th speed, depress accelerator to detent without going into forced 4-3 downshift.

b. Note pressure gauge reading when car speed reaches exactly 30 MPH. Gauge reading should be between 75 and 105 lbs.

4. With engine running at approximately 375 RPM, note pressure indicated on gauge with selector lever in Dr and Lo positions. Pressure should be 45 to 72 lbs. Then move lever to R position. Pressure in reverse should be higher than the pressure in either drive or low.

> ***NOTE:* When shift lever is moved to reverse, pressure will momentarily drop before the higher pressure reading.**

5. If pressure checked satisfactorily in step 4, place selector lever in reverse position and apply foot brake. Accelerate engine to approximately half throttle. Pressure should increase to at least 125 lbs.

DIAGNOSIS OF MALFUNCTIONS

Selector Lever Stuck In Reverse Position

Inspect detent plunger and detent control lever for rough surfaces which may cause sticking (Fig. 321). Sticking could also be caused by damaged parking brake pawl crank. In this case it would be necessary to replace parking brake bracket.

Check manual control linkage adjustment and neutralizer switch adjustment.

Selector Lever Will Not Go Into Reverse

Inspect reverse blocker piston to see that it is not stuck in lockout position and that the reverse blocker piston spring is not broken or weak.

A governor G-1 valve stuck in the open position will not permit the selector lever to go into the reverse position with engine running since governor pressure holds the reverse blocker piston in the

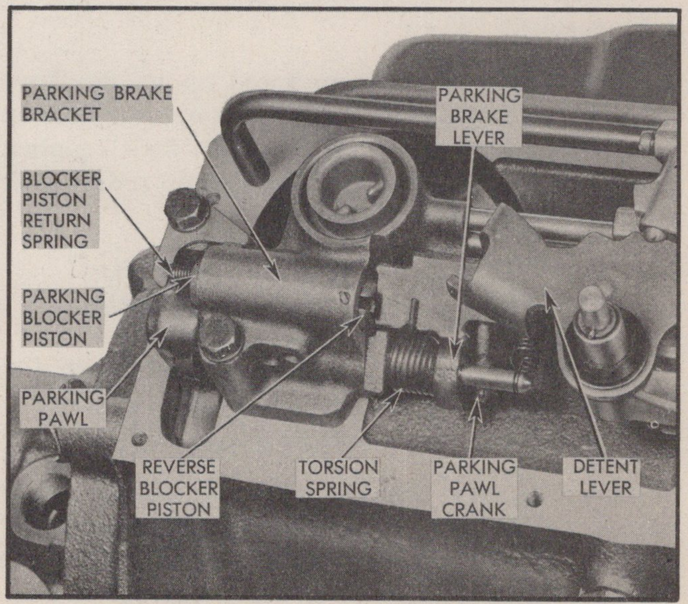


Fig. 321—Parking Brake Bracket Assembly (Blocker pistons in lockout position)

lockout position. Correct this condition by carefully cleaning the governor assembly.

Broken governor ring or excessive ring gap or groove clearance can cause main line pressure to leak between the governor ring lands into the reverse blocker piston oil circuit when engine is running. Leak at this point could also be caused by defective governor oil delivery sleeve, in which case the parking bracket assembly would have to be replaced.

Selector Lever Hard to Shift

Disconnect gearshift control rod from transmission outer shift lever and test linkage for free operation. If linkage operation is normal, the binding condition may be found in the manual control valve. Binding of manual valve may be caused by:

1. Distorted outer valve body. This would require replacement of the control valve assembly.

2. Front servo exhaust valve body may have been set too close to the manual valve when attaching screws were tightened. In this case loosen the attaching screws and reposition the front servo exhaust body in a position away from the manual valve.

3. If a binding condition still exists between the manual valve and front servo exhaust valve the front servo exhaust valve spring retainer plug (Fig. 322) may be pushed in too far, preventing the valve from having enough travel when the manual lever is shifted from reverse to drive. This can be corrected by carefully tapping the exhaust valve against the plug to push it out slightly.

4. A binding condition may be caused by a rough surface on the manual valve detent plunger or rough surface in the notches of the control lever that contacts the detent plunger (Fig. 321). To correct, replace detent plunger or detent control lever.

5. Side cover not properly centered over manual shaft or manual shaft seals improperly installed.

Sticking Throttle Linkage

Check the carburetor throttle rod to make certain it does not bind on the ball joint at the carburetor end. Correct by loosening the rear lock nut and positioning the rod so it is properly centered over the ball.

Also make certain the transmission throttle rear rod has not been twisted in a similar manner causing a bind at the ball joint on the front end.

Check transmission throttle front rod to make certain it does not bind.

Lubricate linkage with light engine oil.

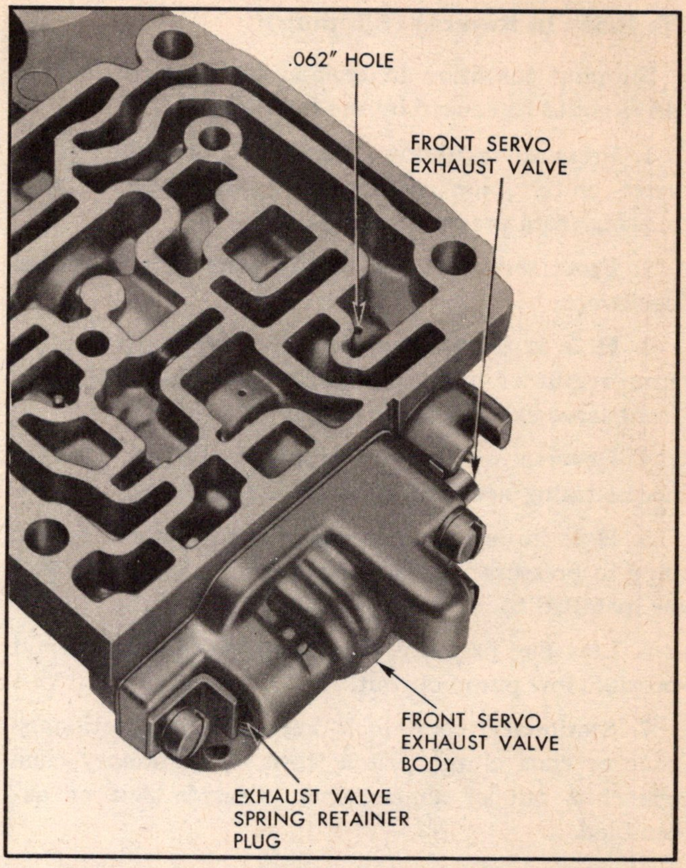


Fig. 322—Outer Valve Body (Manual lever in reverse)

Slipping 2-3 Shift and Forced 4-3 Downshift

This condition may be caused by the 4-3 downshift valve sticking in the front servo or by omission or incomplete installation of the 4-3 valve retainer (Fig. 323). Check valve to make certain it is drilled and operates freely and install retainer properly.

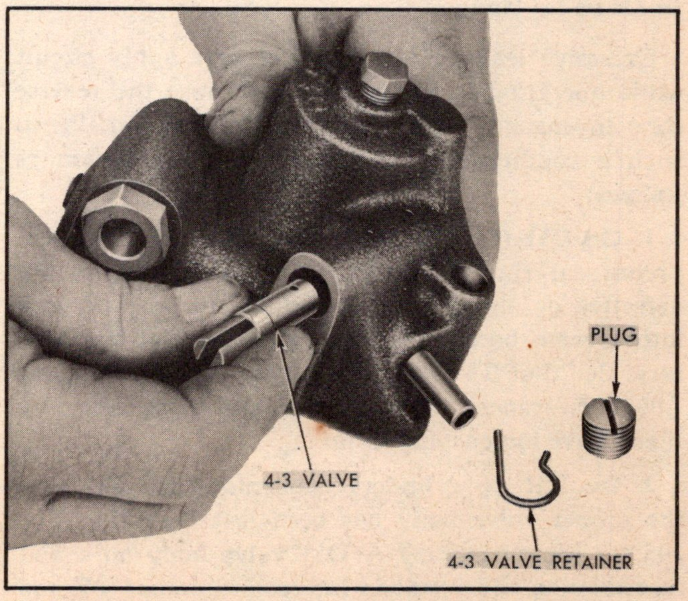


Fig. 323—Front Servo and 4-3 Downshift Valve

No Drive In Reverse (Slipping)

Slipping condition in reverse or complete lack of drive could be caused by the following:

1. Pressure regulator reverse oil pipe missing, reverse clutch pipe missing or reverse booster plug missing from pressure regulator.

2. Front servo exhaust body spacer plate installed backward.

3. Hole in front servo exhaust valve body to pressure regulator pipe not drilled, necessitating new front servo exhaust valve body.

4. Reverse oil line in valve body not drilled, necessitating new control valve assembly.

5. Hole in case from pressure regulator reverse oil pipe to pressure regulator not drilled. New case must be installed to correct.

6. Low line pressure. Check for leak in circuit and possible low pump output.

7. Stationary cone lock key missing, stationary cone or cone clutch piston worn, or stationary cone stretched out of shape when disassembled or assembled.

No Drive In Reverse (Lock-up) When Shifting from Dr to Lo to R

Remove valve body and thoroughly clean outer valve body. Make sure .062″ drilled hole (Fig. 322) supplying oil for rear servo release is unobstructed. If the hole is not drilled install a new control valve assembly.

Reverse Application During Forward Movement In Dr or Lo Range

Excessive leakage of oil into reverse apply circuit while operating in Dr or Lo may cause the reverse cone to engage, locking up the transmission. When such a condition occurs check the transmission as follows:

1. On D51 (8 cylinder) transmissions see that neoprene seal ring on pressure regulator plug is not defective or damaged, allowing TV pressure to leak into reverse booster passage. Replace seal if necessary. See that TV plug is not loose in regulator plug (.002″ clearance). Replace regulator plug assembly if excessive looseness is found.

2. On P51 (6 cylinder) transmissions make sure the proper valve body has been installed. (See Fig. 205 for identification.) A D51 valve body on a P51 transmission will result in interconnection of TV and reverse oils.

3. Check front servo exhaust valve (Fig. 322) for proper fit in exhaust valve body (.002″ clearance). If too loose, front servo oil will leak past valve into reverse apply circuit.

4. Check the detent retainer spacer to see that it is not damaged allowing pressure to leak from the end of the double transition valve into the reverse apply circuit.

Ratcheting Noise When Moving Selector Lever to Reverse with Car Moving

Ratcheting noise in the transmission when the selector lever is moved to reverse while car is moving forward 2 to 4 MPH is due to parking pawl trying to engage external teeth of internal gear. This condition is usually the result of a sharp drop in line pressure. The following procedure should be used for locating and correcting the trouble:

1. Check engine idle and set to 365-385 RPM. Excessively low engine idle speed may result in a low enough pressure to allow the parking blocker piston to release.

2. Check the parking blocker piston release spring and release spring stop. The early type spring should have a free length of 3⁹⁄₆₄″. (See Fig. 208 for identification.) Measurement from spring seat to face of parking brake bracket (Fig. 313) should be ½″ to 1⁷⁄₃₂″ on early type. Late type spring should have free length of 1¹⁄₃₂″. Late type spring stop has a fixed position since it is mounted with two bolts.

3. See that parking blocker piston (Fig. 321) is free in its bore.

4. Examine reverse check valve located in detent plunger retainer (Fig. 324). Valve should be firmly

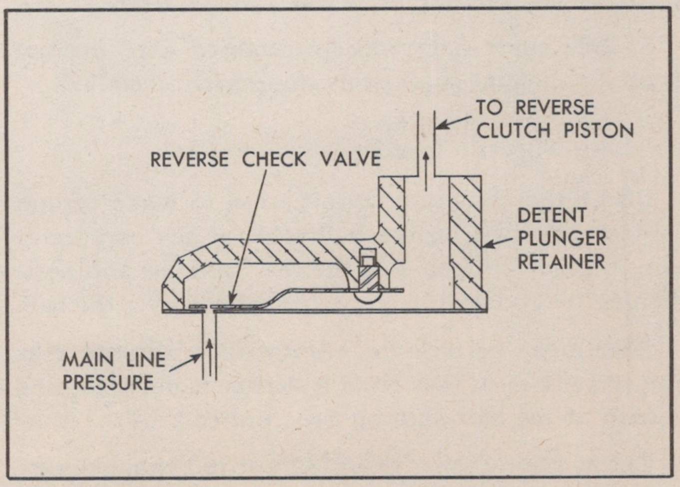


Fig. 324—Reverse Check Valve in Detent Plunger Housing

riveted to housing. Bend check valve at base so free end extends ¼" above face of detent plunger housing, and make certain face of valve is flat against spacer plate when installed. Hole in valve should index with hole in spacer plate.

> ***NOTE:*** **The purpose of this reverse check valve is to prevent a sudden momentary drop in pressure when shifting to reverse.**

If the selector lever is placed in reverse with the engine idling, the sudden demand for oil to the reverse cone may cause sufficient drop in main line pressure that the parking blocker piston will recede allowing the parking pawl to engage.

The reverse check valve overcomes this condition since it retards the flow of oil to the reverse cone so that the cone will fill slowly thereby not placing any demand for oil on the line leading to the parking blocker piston.

If, however, the pump has sufficient capacity to maintain adequate pressure in the system, the line pressure will lift the spring valve off its seat so that the cone will fill quickly.

5. Check for excessive leak in oil circuit or low pump output which would result in low main line pressure.

Drives Only In Reverse After Reverse Application

This condition may be caused by reverse check valve not indexed with the hole in the detent plunger spacer plate or if the reverse check valve has no hole in the free end. If the hole has not been punched through it will be necessary to replace the detent plunger retainer assembly.

Car Remains Locked In Reverse After Reverse Application

In some instances the reverse clutch units may remain locked together after the car has been driven in reverse. This will cause the transmission to lock up in Dr or Lo, while it works normally in reverse.

To correct this condition apply both foot and hand brakes, place selector lever in neutral, increase engine speed to approximately 1/3 throttle, then move selector lever to Dr while engine is speeded up.

This condition may be found only on new cars and will usually disappear with usage.

Parking Pawl Does Not Engage When Engine Is Shut Off with Selector Lever In Reverse

Check parking pawl to be certain it does not bind on parking pawl support bolt. See that parking brake pawl crank is not damaged or binding in parking brake bracket. A defective parking brake pawl crank will necessitate replacement of parking brake bracket. Check parking blocker piston and free up if sticking.

Inspect parking blocker piston return spring and stop as outlined in step 2 under "Ratcheting Noise When Moving Selector Lever to Reverse with Car Moving". A weak or broken spring will not release the blocker piston and therefore the parking pawl cannot move.

Low Oil Pressure, Slippage, Delayed Erratic Upshifts

These conditions will result when one or both of the ¼" cup shaped passage plugs (Fig. 207) are omitted from the parking brake bracket. These plugs are not service parts and should never be removed. If plugs are loose or missing, replace the bracket assembly. A loose or missing plug in the oil passage to the parking blocker piston will result in a drop in main line pressure to about half of normal. If the plug in the oil passage to the reverse blocker piston is missing, governor pressure will drop causing delayed and erratic upshifting.

TESTING FOR FLUID LEAKS

If a transmission fluid leak is detected, the following locations should be checked:

Transmission fluid leaks can be divided into two groups, those which can be corrected without removing the transmission and those which require its removal.

The first group includes:

1. Torus cover drain plug.
2. Side cover bolts or pressure line pipe plug.
3. Side cover at manual shaft seal.
4. Oil pan bolts.
5. Oil pan drain screw.
6. Rear bearing retainer bolts and seal.
7. Pressure regulator plug gasket.

Fluid leaks at any of the above points are easily located and should be corrected no matter how slight they may seem.

Fluid leaks that require removal of the transmission from the car include the following. (See Fig. 325.)

8. Crankshaft to flywheel seal, dowel, and bolts.
9. Flywheel to torus cover.
10. Dampener rivets in torus cover.
11. Front oil pump cover screws.
12. Front oil pump cover casting (sand hole).
13. Front oil pump cover oil seal.
14. Front oil pump cover oil seal rings.
15. Front oil pump cover to transmission case.
16. Sand hole in transmission case.

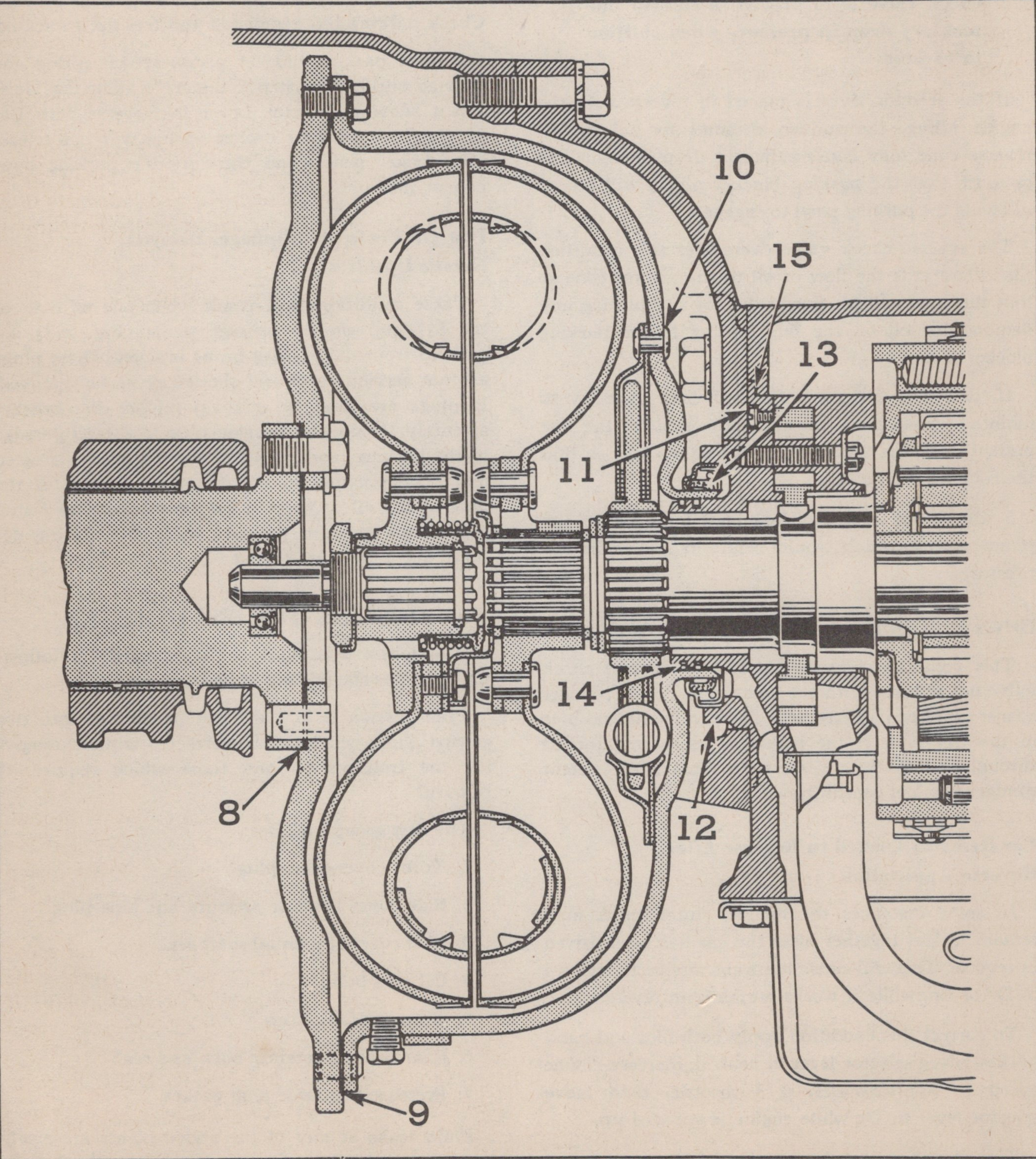


Fig. 325—Possible Points of Fluid Leaks

Check for Fluid Leaks at Torus Cover and Flywheel

1. Run engine until transmission fluid is at operating temperature.

2. Remove flywheel housing bottom cover.

3. Wipe fluid from flywheel and torus cover.

4. Place a clean piece of white or brown paper under flywheel and transmission.

5. Start engine and run at approximately 800 RPM for two minutes.

6. Stop engine and examine paper for fluid leaks.

Fluid leaks, if present will be indicated by a fine spray on the paper usually directly in line with the leak.

Locating Fluid Leaks at Torus Cover and Flywheel

If fluid leaks are indicated, examine flywheel and torus cover for fluid.

1. Fluid on the front face of the flywheel indicates a leak at the crankshaft to flywheel seal, dowel, or bolts. Remove transmission, remove flywheel, replace seal, flywheel and dowel as outlined in Repair Section, page 113.

> ***NOTE:* Do not confuse an engine oil leak at the rear main bearing with a flywheel fluid leak.**

2. Fluid on the torus cover may be coming from the front cover oil seal rings (14), the front cover oil seal (13) or the dampener rivets (10).

3. If there is no fluid on either the flywheel or torus cover, the leak is at torus cover to flywheel (9).

Tighten all bolts to 30 ft. lbs. torque and if leak continues, it is due to a broken gasket or insufficient or damaged sealing surface on the flywheel or torus cover. If damage cannot be corrected, install new parts.

If all parts ahead of the front of transmission are dry and fluid leaks between flywheel housing and transmission, the leak may be caused by—

a. Loose pump cover screws (11) or damaged copper washers.

b. No sealer on pump cover screws.

c. Sand hole in pump cover (12).

d. Poor seal between front cover and case (15).

To correct above cause of leak proceed as follows:

1. Remove transmission from car. Remove torus members and rear flywheel housing from transmission.

2. If pump cover attaching screws are loose, it will be necessary to remove the pump, remove the three pump cover screws and the one pump body screw, seal the screws with Permatex No. 3 cement and tighten to 12 to 15 ft. lbs. torque. Damaged copper washers should be replaced.

3. If pump cover screws are tight but have no sealer remove the pump and reseal all screws. Tighten to 12 to 15 ft. lbs. torque. Damaged copper washers should be replaced.

4. If a sand hole is present in pump cover casting, replace complete front pump assembly.

5. The front pump cover should protrude .003″-.015″ out of transmission case with pump cover gasket in place. If pump cover protrudes less than .003″, add a pump cover gasket to allow the cover to protrude within limits.

TESTING FOR NOISES

Hydra-Matic transmissions are relatively quiet in operation. However, they do make a certain amount of noise, as will any such unit when operating. One should become familiar with these before testing the transmission for noise. Tune the engine to run smoothly before testing for noise.

FRONT OIL PUMP NOISE

When noise is present it may be heard as a sharp shrill whine and is most noticeable when pump is under load. The pitch is steady when driving car and does not change like differential noise.

Front pump whine may be heard with shift control lever in NEUTRAL and engine speed increased. To make a systematic check for front pump noise proceed as follows:

Test for Front Oil Pump Noise

1. With engine idling, shift control lever in neutral, listen for whine.

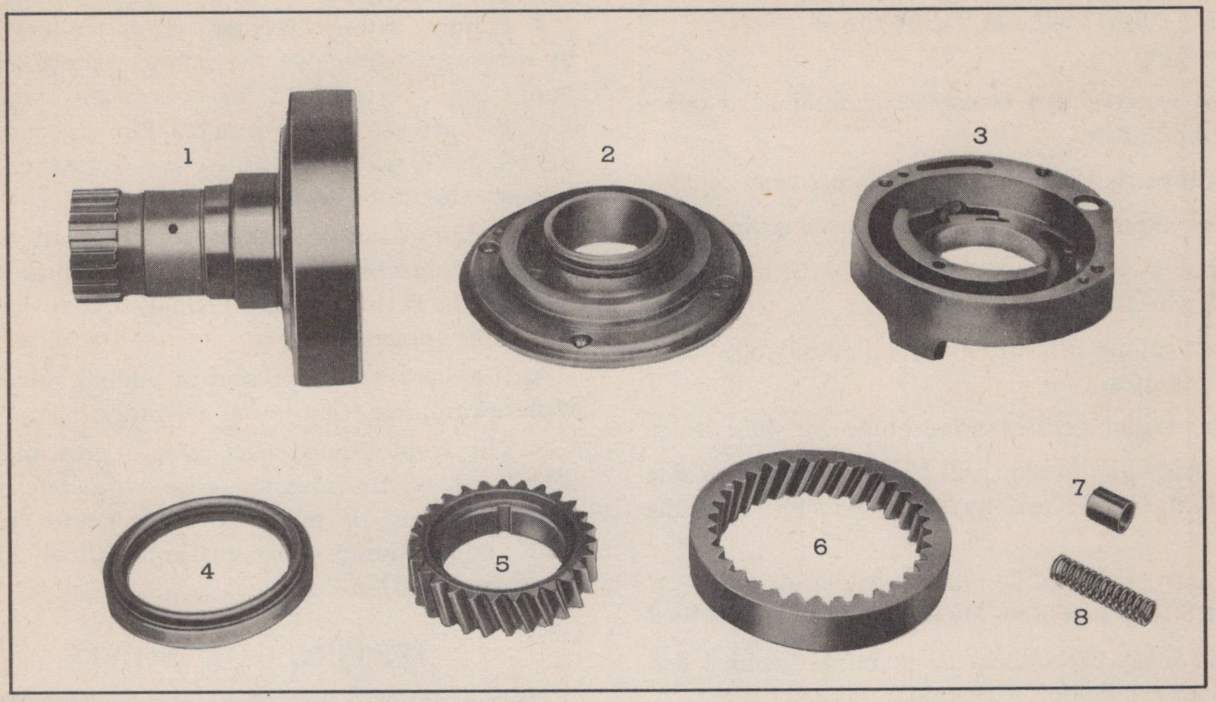
2. Raise engine speed gradually. Front pump whine, if present, may be more pronounced at a certain engine speed.

3. Start the car in motion and increase car speed so that engine speed will be the same as when the whine was most pronounced. The front pump (if noisy) will again be heard at the same engine speed as when the car was standing.

4. Drive the car 25 MPH to 35 MPH; listen to pump whine.

a. Turn ignition key off.

b. Quickly move the shift control lever into the neutral position.



1. Front drive gear
2. Front pump cover
3. Front pump body
4. Oil seal
5. Pump drive gear
6. Pump driven gear
7. Relief valve
8. Relief valve spring

Fig. 326—Front Oil Pump (Disassembled view)

If whine was heard while shifting through all speeds, being loudest between 25 MPH to 35 MPH and disappeared when ignition was turned off (shift control lever in neutral), the front pump is at fault.

> ***NOTE:*** **Front pump noise is usually caused by the ends of the teeth on the drive gear interfering with the crescent, or by the omission of a $\frac{5}{16}''$ drill spot from the face of the pump cover.**

REAR UNIT PLANET GEAR NOISE

Noisy rear planet gears may be heard as a low growl on idle which increases to a very high-pitched whine when engine speed is increased (shift control lever in neutral).

Test for Rear Unit Gear Noise (Car Standing)

1. Drive car to a reasonably quiet spot. Stop car.
2. Move shift control lever into neutral position.
3. Listen for noise with engine idling.
4. Accelerate engine to higher speed.

Rear planet gear whine will increase to a very high pitch as engine speed is increased.

Test for Rear Unit Gear Noise (Car In Operation)

1. Move shift control lever into Lo range position.
2. Drive the car until transmission shifts into 2nd speed.
3. Accelerate and decelerate in 2nd speed. Rear planet gear noise will follow car speed and if present will be very noticeable in second gear.

> ***NOTE:*** **Open the front door and listen. Rear planet gear noise will seem to be transferred down the propeller shaft.**

4. Move the shift control lever back into the Dr range position and again accelerate through the gears. Rear planetary whine, if present, will be heard in 1st and 2nd speed, and will disappear after transmission shifts into 3rd or 4th speed (rear unit is then in direct drive).

> ***NOTE:*** **Where no objectionable low growl in neutral is heard while engine is idling and only a very slight whine is heard when engine speed is increased, which disappears when shift lever is**

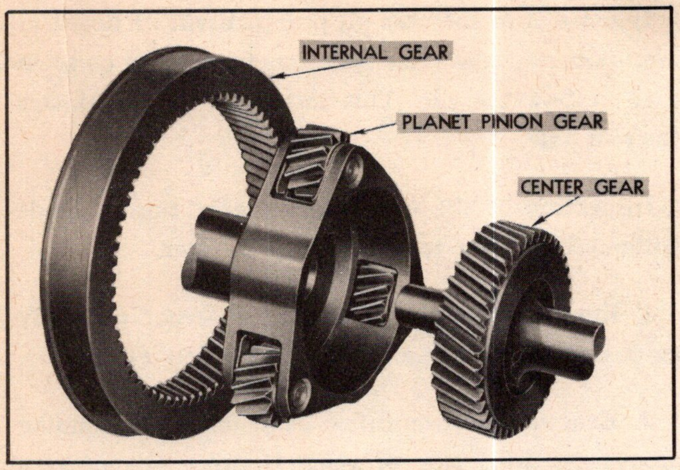


Fig. 327—Rear Planet Gears

placed in the Dr range position, no attempt should be made to eliminate the slight whine.

The three units responsible for rear planetary noise are the center gear on the main shaft, rear planet pinions on the output shaft and the rear unit internal gear.

FRONT UNIT PLANET GEAR NOISE

Front unit planet gear noise is similar to front pump noise, but of a higher pitch. To test for front planet noise, start the engine, place the shift control lever in Lo range position. Start the car in motion. If front planet gears are noisy, whine will be heard in first speed and disappear after transmission shifts into second speed. The cause is probably worn or nicked planet pinion gears, center gear, front drive gear, worn pinion needle bearings, or thrust washers.

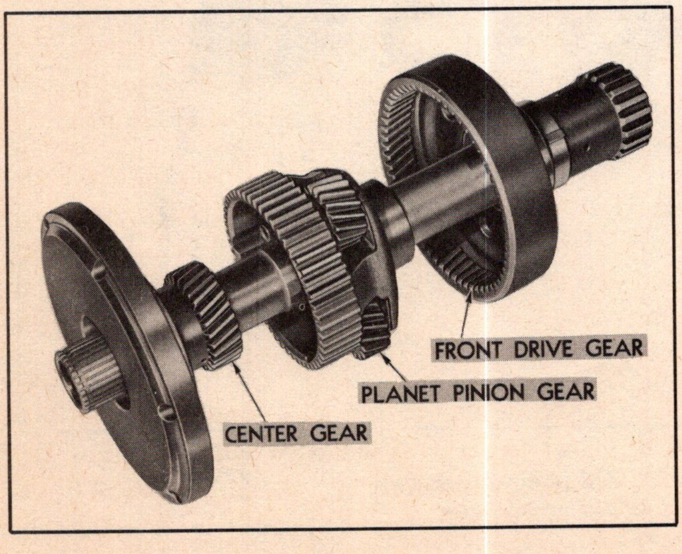


Fig. 328—Front Planet Gears

REVERSE PLANET GEAR NOISE

Reverse planet gear noise, if present, will be heard in reverse, only when car is under ACCELERATION. In this case noise is in the reverse planet assembly.

NOTE: **Due to the ratio of the reverse gears and engine speed when accelerating in reverse, it is doubtful that reverse gear noise will ever become objectionable.**

NOTE: **Reverse noise on DECELERATION ONLY, is caused by noisy rear unit planet gears (see rear unit planet gear noise).**

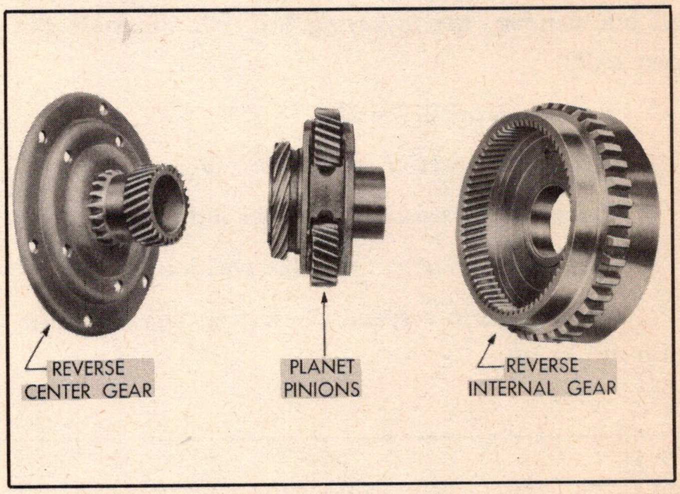


Fig. 329—Reverse Planet Gears

SCRAPING TORUS MEMBERS

Scraping torus members can be identified by a metallic scraping at the front of transmission. If this noise is present it may be caused by:

1. Main shaft nut not tightened.

2. Main shaft nut lock plate broken or not bent over. Either one of the above conditions may permit the driven member to strike the flywheel.

REAR OIL PUMP NOISE
(Cross Drive Noise)

Rear oil pump noise may be heard as a high pitched whine much like light axle noise, but not sensitive to throttle opening, drive, float and coast.

Rear oil pump whine in most cases will be heard at 20 to 35 MPH. It is seldom heard below 20 MPH. Rear axle whine may be audible at other speeds.

Tests for Rear Oil Pump (Cross Drive) Noise

1. Drive the car to determine at what speed noise is heard.

2. After noise is first heard, increase car speed approximately 10 MPH above that point.

3. Move control lever to neutral, turn off the ignition and coast down through the range in which noise was heard.

> ***NOTE:*** **With the ignition off, the front oil pump is not running. If noise is still present and was not sensitive to engine speed the noise is in the rear oil pump.**

If there is any doubt between axle noise and rear oil pump noise, the following test will eliminate the rear axle:

1. Remove propeller shaft.
2. Lift right corner of front floor mat.
3. Remove transmission oil level indicator.
4. Place shift lever in Dr range position.
5. Run engine to a speed where transmission shifts into 4th speed.

If noise is in the rear oil pump it will be heard at approximately the same speedometer reading as when road testing the car. This test definitely eliminates the rear axle.

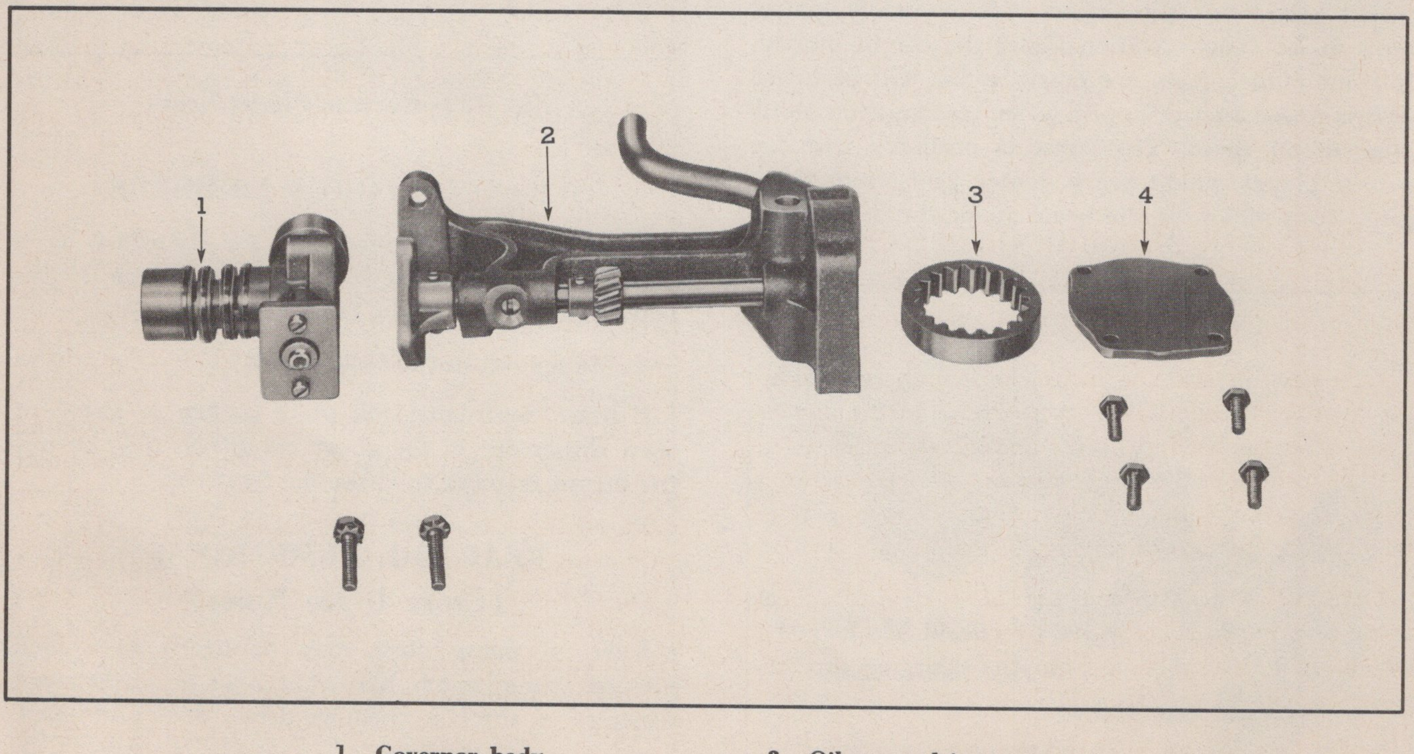
Inspection of the bronze drive gear can be made without removing transmission from car.

1. Remove rear oil pump and governor assembly as described in "Minor Repair" Section (Page 57).

2. Examine bronze drive gear for deep running groove on drive side of gear. If drive side of gear shows a deep running groove, remove and disassemble reverse unit assembly and replace the bronze gear as per instructions in "Repair" Section (Page 113).

Test for Rear Oil Pump Inner Gear Noise

Rear pump inner gear noise is similar to cross drive noise but is heard in the form of a low growl and is usually heard at speeds above 35 MPH. If rear pump inner gears are noisy, the bushings may be worn, permitting gears to contact bores in pump body. In this case a new pump will need to be installed. See "Minor Repair" Section (Page 57).



1. Governor body
2. Rear oil pump body
3. Oil pump driven gear
4. Oil pump cover

Fig. 330—Rear Oil Pump (Disassembled view)

TEST FOR BROKEN REAR SERVO CHECK VALVE

When the rear servo check valve is broken, the 3-2 shift is rapid and produces a severe clunk.

1. With the engine idling (365 to 385 RPM) move shift control lever from neutral to the Dr range position. A broken check valve will cause rapid rear band application causing the car to lunge forward.

2. With transmission cold, drive car to a speed where transmission shifts into 4th (direct).

3. Coast to a stop. When the transmission is cold no objectionable clunk will be noticeable during the 3-2 downshift.

4. Apply hand brake and foot brake.

5. With shift lever in Dr range, speed up engine for approximately one minute to heat up oil in transmission.

6. Make the same test as outlined under 2 and 3.

If the 3-2 shift occurs at above 8 to 4 MPH and is severe, causing objectionable clunk, a broken rear servo accumulator check valve spring is indicated.

No attempt should be made to eliminate a slight bump felt only when the transmission is cold and which disappears when the transmission is warm. See "Replacement of Rear Servo Accumulator Check Valve" in "Repair" Section (Page 115). If accumulator check valve is not broken check tightness of rivet. If rivet is loose replace valve and rivet as instructed in "Repair" Section. Check for free operation of plunger in body. If sticky, free up plunger.

TEST FOR MISSING OR STICKING TORUS CHECK VALVE OR FRONT PUMP RELIEF VALVE

A missing or sticking torus check valve will cause the engine to speed up excessively when starting away after the car has been standing. A similar effect will be produced by the omission of a front pump relief valve or relief valve spring, or by the relief valve being stuck in the open position.

Determine the effectiveness of the torus check valve and pump relief valve by checking the rate at which fluid drains back from the coupling into the transmission.

1. Set hand brake lever tightly.

2. See that fluid is at the "Full" mark on the indicator as outlined on Page 153.

3. After level has been checked, shut off engine and wait 10 minutes. Recheck fluid level with engine shut off. If after 10 minutes, the fluid level in the transmission has *not* raised more than ½ inch, the check valve and relief valve are operating satisfactorily. Should oil level be raised more than ½", the check valve or relief valve is not operating satisfactorily and should be replaced.

TESTING COMPLETE TRANSMISSION WITH AIR PRESSURE

The following procedure outlines a method for testing a Hydra-Matic transmission in the car by use of air pressure applied with a special gun to the transmission case passages which are reached after removing the control valve body and reverse clutch pipe. It is to be considered as a further step in diagnosis over and above the Diagnosis Guide. The Diagnosis Guide must first be used to bring out possible causes of difficulty and then proceed to confirm the cause of malfunction. While primarily designed to allow checking before removing the transmission from the car, the procedure applies equally well to checking a transmission assembly on the bench.

Test Procedure

Remove bottom pan (after draining oil), oil screen, side cover pan, control valve assembly, and reverse clutch pipe. Using blow gun, tool J-4353-1, connected to approximately 80 lbs. per sq. in. air pressure, and referring to passage identification illustration in Fig. 331, carefully check each passage in sequence, observing operation of unit actuated and presence of any unusual leakage.

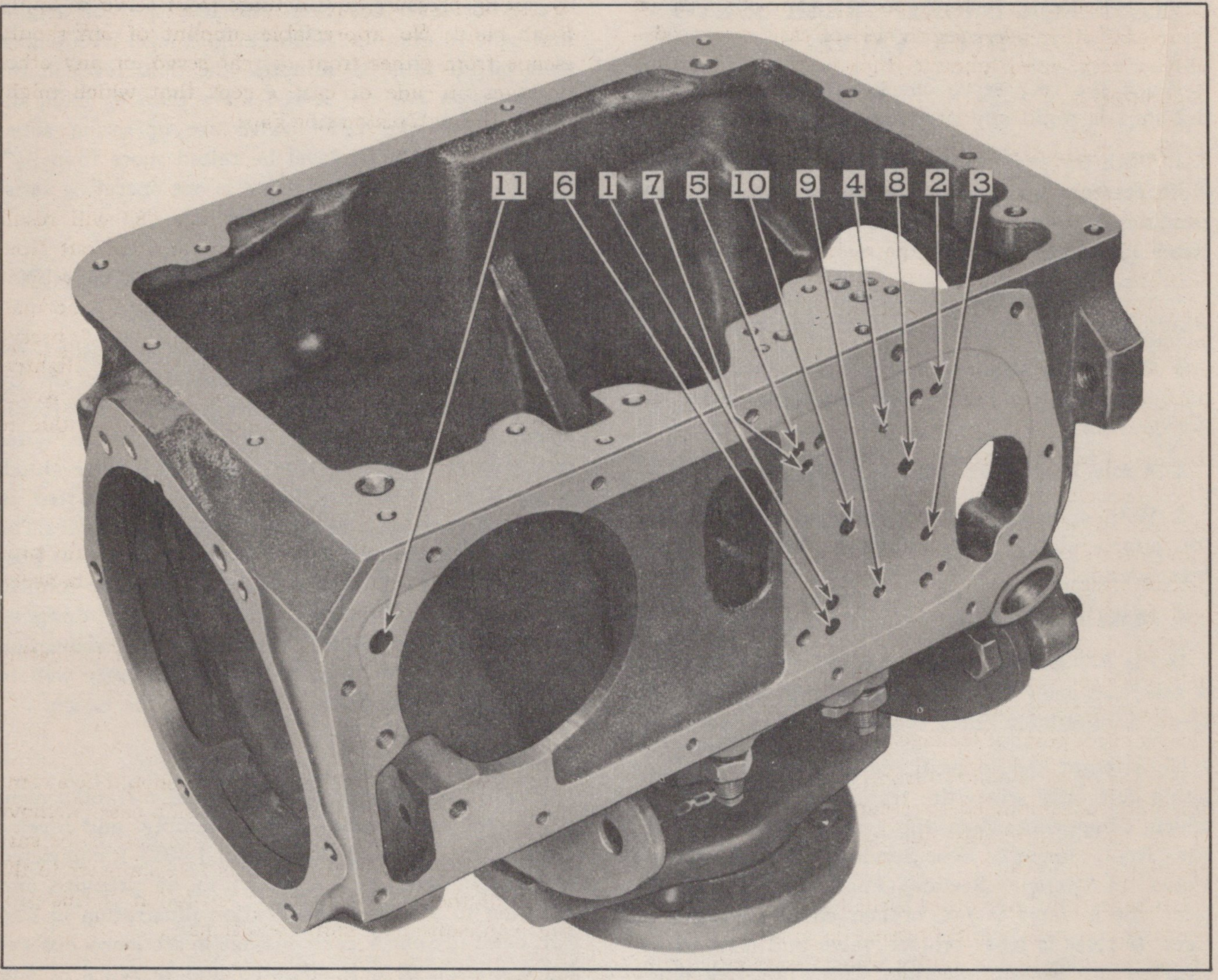
1. Front Clutch Apply

Air pressure applied into passage "1" should actuate front clutch. As pressure is intermittently applied, movement of the clutch piston should be audible and, in most cases, can be felt by holding front drum firmly with free hand.

If an unusual amount of air is escaping around oil delivery sleeve area, another check at this point must be made after servos are removed to observe more clearly the exact point of leakage.

If a fog of oil is emitted from inside of front unit drum assembly accompanied by the escape of great amount of air, leak is probably due to a faulty front clutch annular piston seal.

Leakage from any other drilled passages in side of transmission case, while pressure is applied at point "1", is an indication of a faulty transmission case or oil delivery sleeve allowing pressure to "short circuit" between passages.



1. Front clutch apply
2. Front band apply
3. Front band release
4. G-1 to 4-3 valve
5. Rear band release
6. Rear clutch apply
7. Compensator to front and rear servos
8. Main line pump feed
9. Pressure to top of case for gauge
10. Exhaust port for valve body
11. Reverse cone clutch apply

Fig. 331—Passage Identification for Checking

2. Front Band Apply

Air pressure applied into passage "2" should actuate the front servo and apply band with no unusual escape of air. Observe area around flat surface of servo body that rests on case. No appreciable escape of air should be present at this location.

A small amount of leak from exhaust hole for 4-3 valve and from hole "3" is permissible. However, leak from hole "3" should not be an open blow-by but only the amount that would leak past servo apply piston ring gap.

3. Front Band Release

Air pressure applied into passage "3" will not actuate servo because apply piston is held in released position by retracting spring. However, there should be no unusual escape of air between servo body and transmission case or around joint between servo band release cylinder and servo body, except that which would normally leak past servo release piston ring gap.

4. Governor (G-1) to 4-3 Valve

Air pressure applied into passage "4" normally leaks around wire retainer of 4-3 valve. No air should escape between servo body and transmission case or from any other passages on side of case except possibly a very small amount from passage "2" (front band apply).

5. Rear Band Release

Air pressure applied into passage "5" should release rear servo and band. A small amount of air will escape through piston ring gaps, but this would not indicate enough leakage to impair normal servo operation. See that no appreciable amount of air escapes between servo body and case. A very small amount of air may be emitted from passage "7", but there should be no leakage from any other passage.

6. Rear Clutch Apply

Air pressure applied into passage "6" should actuate rear clutch. As pressure is intermittently applied, movement of the clutch piston should be audible and, in most cases, can be felt by holding rear drum firmly with free hand.

If an unusual amount of air is escaping around oil delivery sleeve area, another check at this point must be made after servos are removed to observe more clearly exact point of leakage.

If a fog of oil is emitted from inside rear unit drum assembly, accompanied by escape of a large amount of air, leak is probably due to a faulty rear clutch annular piston seal.

Leakage from any other drilled passage in side of transmission case while pressure is applied at point "6" is an indication of faulty transmission case or oil delivery sleeve allowing pressure to "short circuit" between passages.

7. Compensator to Front and Rear Servos

Air pressure applied into passage "7" should actuate rear servo to tighten rear band which is applied by spring pressure, and actuate front servo to apply front band. No appreciable amount of air should escape from either front or rear servo, or any other passages on side of case except that which might escape through piston ring gaps.

8. Main Line Pump Feed

Air pressure applied into passage "8" will result in a large amount of air and oil blowing out from front side of front drum assembly. This blow-by is emitted from rear side of front pump and is normal. While air pressure is applied to point "8", observe closely other passages on side of case for slightest amount of escaping air or oil bubbles which would be an indication of interconnected passages due to faulty case.

9. Pressure Gauge Hole to Top of Case

Air pressure applied into passage "9" should produce no leak whatever if plug is in place between band adjusting screws.

Observe other passages for escaping air indicating interconnecting passages due to faulty case.

10. Exhaust Port for Valve Body

Air pressure applied into hole "10" should be a complete blow-by to inside of transmission case. Remove blow nozzle and visually inspect this hole to be sure that it is completely open for its full diameter to the inside of the case. A partial obstruction of this passage can cause poor shift conditions.

11. Reverse Cone Clutch Apply

Air pressure applied into passage "11" should actuate the reverse cone clutch with no unusual escape of air. As pressure is intermittently applied movement of the reverse internal gear can be felt as the cone clutch is applied and released.

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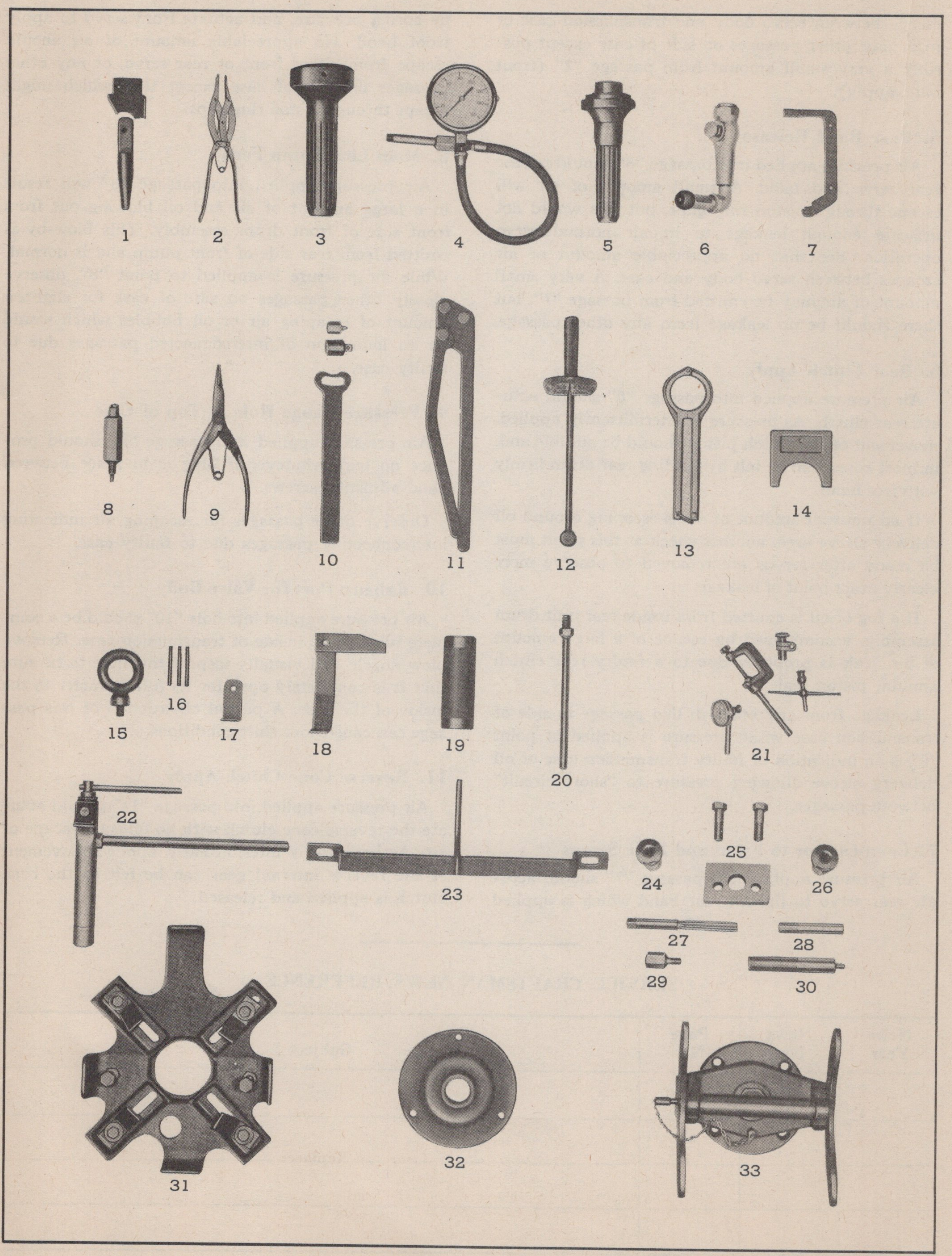
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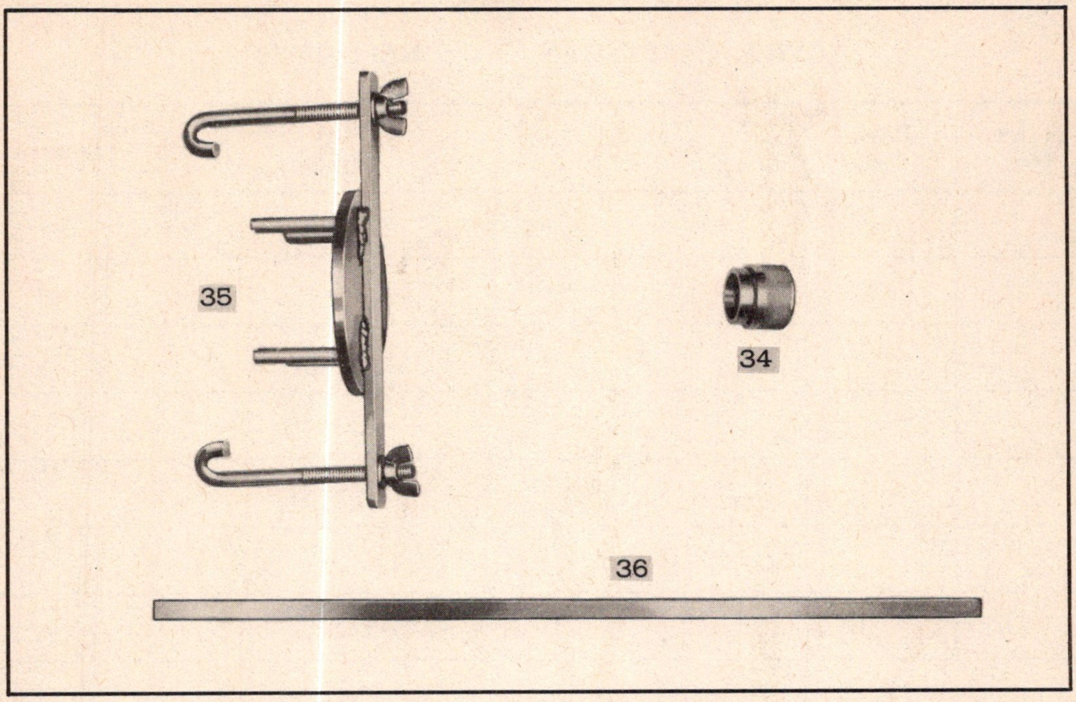

SPECIAL HYDRA-MATIC TOOLS

No. on Illust.	*Tool No.*	*Tool Name*
1	J-2183	Governor Flange and Pump Riveting Set
2	KMO-630	Snap Ring Pliers
3	J-2170	Front Pump Cover Oil Seal Installer
4	J-2540	Pressure Checking Gauge
5	J-1354	Rear Bearing Retainer Oil Seal Installer
6	J-4353-1	Blow Gun Assembly
7	J-5071	Rear Servo Gauge
8	J-1693-A	Front Servo Gauge
9	J-1575	Snap Ring Pliers
10	J-2184-A	Front Pump Holder and Socket Set
11	J-2807	Throttle Lever Bending Tool
12	KMO-629	Tension Wrench, 0-50 lbs.
13	J-1537	Oil Delivery Sleeve Ring Compression
14	J-2173	Front Drum Spacer
15	J-1636-SA-5	Transmission Lifting Eye Bolt
16	J-2544-A	Linkage Adjusting Pin Set
17	J-2174	Rear Clutch Hub Retainer Bracket
18	J-2545	Throttle Lever Checking Gauge
19	J-2587	Main Shaft End Play Guide
20	J-1465	Dial Indicator Extension Rod
21	KMO-30	Dial Indicator Set
22	J-2681-A	Servo Band Adjusting Tool
23	J-2586	Torus Cover Hub Checking Fixture
24	J-2774-16	Drill Bushing (½")
25	J-2774-12	Bushing Plate
26	J-2774-17	Reamer Bushing (33/64")
27	J-2774-15	Reamer
28	J-2774-14	Centering Arbor
29	J-2774-1	Remover Adapter
30	J-2774-13	Dowel Driver
31	J-2808	Transmission Remover and Replacer
32	J-2187	Planet Carrier Holder
33	J-2541-A	Transmission Holding Stand
34	J-4731	Governor to Sleeve Alignment Tool
35	J-4670	Clutch Spring Compressor
36	J-4752	Reverse Piston to Drum Installing Tool

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SPECIFICATIONS

CONTENTS OF THIS SECTION

RECOMMENDED TORQUE TIGHTNESS FOR BOLTS

Location	*Thread Size*	*Torque Ft. Lbs.*
Internal Gear to Rear Drum	#10–24	3–4
Front Body to Inner Body	#10–24	3–4
Outer Body to Inner Body	#10–24	3–4
Rear Cover to Inner Body	#10–24	3–4
Front Body Plate to Body	#10–24	3–4
Front Plate to Outer Body	#10–24	3–4
Governor Bushing Retainer to Governor Body	#10–24	3–4
Detent Retainer to Outer Valve Body	#10–24	3–4
Front Servo Assembly	1/8 Pipe	6–7
Torus Cover Drain	1/8 Pipe	6–7
Case-Oil Pressure Take-off	1/8 Pipe	15–18
Front Servo Assembly	1/4 Pipe	6–7
Front Pump Cover to Body	1/4–20	12–15
Intake Pipe to Front Pump	1/4–20	10–12
Governor Body to Drive Flange	1/4–20	6–8
Rear Pump Cover to Body	1/4–20	6–8
Control Valve Assembly to Case	1/4–20	6–8
Side Cover to Case	1/4–20	10–12
Front Servo Body to Cylinder	1/4–20	6–8
Blocker Piston Retracting Spring to Bracket	1/4–20	6–8
Outer Throttle Lever	1/4–28	10–12
Torus Check Valve Retainer	1/4–28	6–8
Oil Pan to Case	5/16–18	10–13
Front Cover to Case	5/16–18	10–13
Drive Flange to Rear Drum	5/16–18	10–13
Rear Servo Spring Retainer to Body	5/16–18	10–13
Reverse Shifter Bracket to Case	5/16–18	15–18
Rear Pump to Case	5/16–18	15–18
Outer Shifter Lever	5/16–24	10–13
Torus Cover to Flywheel	5/16–24	25–30
Front Servo to Case	3/8–16	23–28
Rear Servo to Case	3/8–16	23–28
Rear Bearing Support to Case	3/8–16	28–33
Center Bearing Cap to Case	7/16–14	40–50
Bolt-Reverse Anchor Support	7/16–20	23–28
Band Adjusting Screw Lock Nut	1/2–20	40–50
Oil Pan Drain Screw	5/8–18	35–45
Trans. Main Shaft Nut	7/8–16	50–60
Pressure Regulator Valve Plug	1 1/16–16	40–50

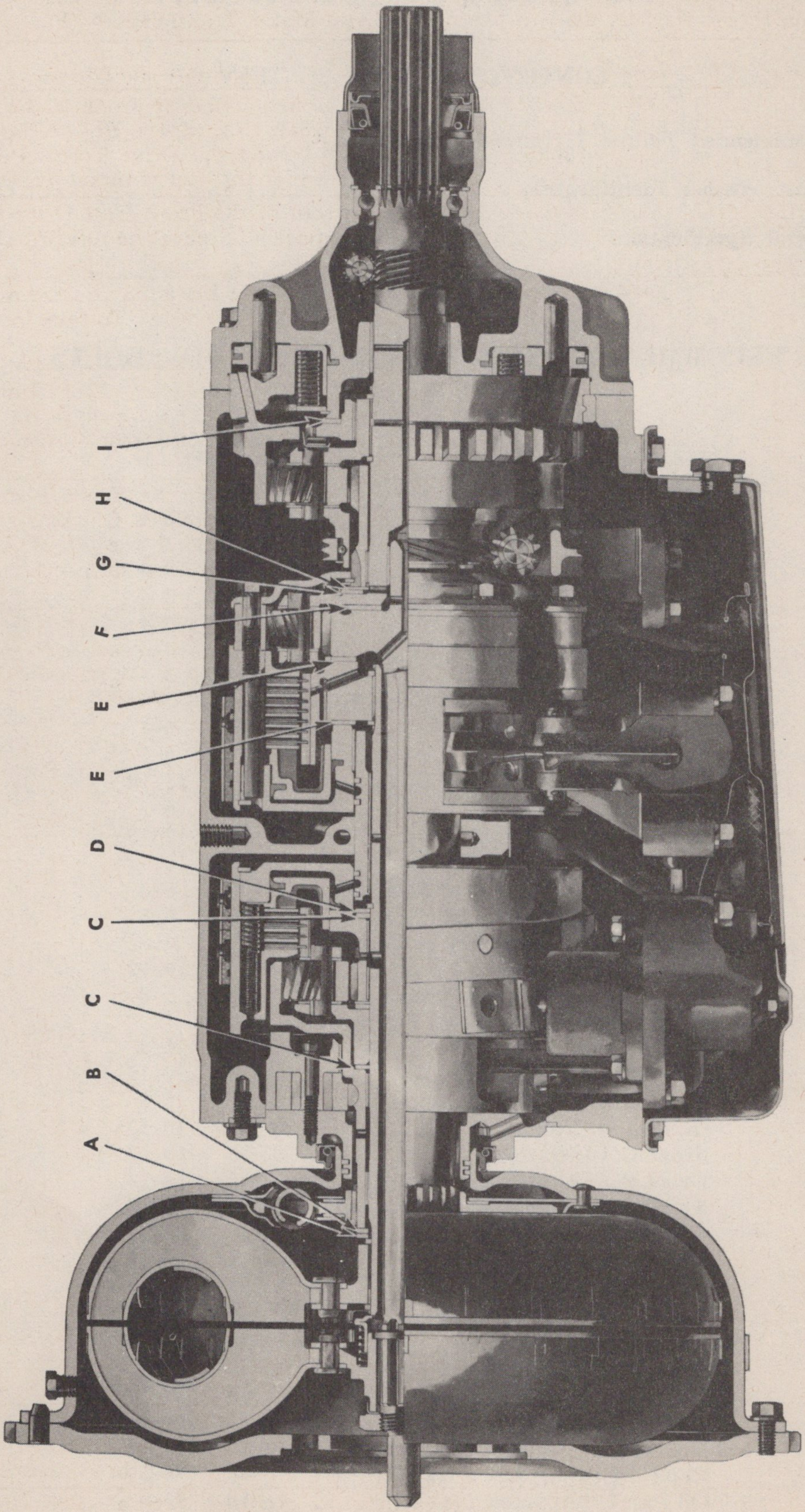

Fig. 332—Hydra-Matic Transmission—Cross Section

THRUST WASHERS—SPECIFICATIONS, LOCATION AND PURPOSE

The following chart covers in detail the specifications, location and purpose of the various thrust washers used in the 1951 Hydra-Matic Transmission. (Fig. 332).

Ref.	*Part No.*	*O.D.*	*I.D.*	*Thick-ness*	*Material*	*Location and Purpose*
A	8609487	1.812 / 1.822	1.374 / 1.379	.088 / .092	Steel-I.D. tang	Between the bronze washer in front of the Front Unit Drive Gear and the snap ring on the Front Planet Carrier (Intermediate Shaft) behind the Drive Torus. **Purpose**—To act as a bearing surface for the bronze thrust washer.
B	8609512	1.815 / 1.822	1.377 / 1.384	.088 / .090	Bronze	Between the front of the Front Unit Drive Gear and the steel washer A. **Purpose**—It takes the forward thrust of the Front Drive Gear.
C	8609511	1.910 / 1.917	1.377 / 1.384	.088 / .091	Bronze	Between the rear of the Front Drive Gear and the front of the Front Planet Carrier. **Purpose**—To take the rear thrust of the Front Drive Gear. Also use—Between the rear of the Front Unit Center Gear and the steel washer (with locating flat) on the Intermediate Shaft. **Purpose**—To take the rear thrust of the Front Unit Center Gear.
D	8609455	1 15/16	1.374 / 1.377	.088 / .093	Steel-I.D. tang	Between the snap ring on the Front Planet Carrier (Intermediate Shaft), in front of the Oil Delivery Sleeve and the bronze thrust washer behind the Front Unit Center Gear. **Purpose**—To act as a bearing surface for the bronze thrust washer.
E	8609497	2.872 / 2.878	1 15/16	.087 / .091	Bronze	Between the rear of the Rear Unit Clutch Drum and in front of the Rear Unit Clutch Hub. **Purpose**—To take the rear thrust of the Rear Clutch Drum and the forward thrust of the Front Planet Carrier (Intermediate Shaft). Also use—Between the rear of the Rear Clutch Hub and the front of the Rear Unit Center Gear. **Purpose**—To take the rear thrust of the Front Planet Carrier (Intermediate Shaft) and the forward thrust of the Main Shaft.
F	8609191	2.247 / 2.253	1	.055 / .059	Bronze	
	8609192	2.247 / 2.253	1	.063 / .067	Bronze	
	8609193	2.247 / 2.253	1	.071 / .075	Bronze	
	8609194	2.247 / 2.253	1	.079 / .083	Bronze	Selective. Between the rear of the Main Shaft and the front of the Output Shaft. **Purpose**—To take the rear thrust of the Main Shaft. (Note: Main Shaft end play is controlled by this washer.)
	8609195	2.247 / 2.253	1	.087 / .091	Bronze	
	8609196	2.247 / 2.253	1	.095 / .099	Bronze	
	8609197	2.247 / 2.253	1	.103 / .107	Bronze	
	8609198	2.247 / 2.253	1	.111 / .115	Bronze	
G	8608658	2.591 / 2.596	1 11/16	.087 / .091	Bronze	Between the steel washer in front of the Reverse Center Gear and the Output Shaft. **Purpose**—To take the forward thrust of the Rear Drum and Internal Gear.
H	8608761	2 7/16	1.499 / 1.504	.049 / .052	Steel	Between the front of the Reverse Center Gear and the bronze thrust washer behind the Output Shaft. **Purpose**—To furnish a bearing surface for the bronze thrust washer.
I	8613114	3 1/4	2.565 / 2.575	.087 / .091	Bronze	Between rear of Reverse Internal Gear and flange on Rear Bearing Retainer. **Purpose**—To take the rear thrust of the Reverse Internal Gear.

GENERAL SPECIFICATIONS

Main Shaft End Clearance	.004"–.015"
Oil Seal Rings	
Front oil pump cover rings	.005"–.010"
Rear servo accumulator piston ring	.003"–.008"
Front servo release piston ring	.002"–.007"
All other rings	.001"–.006"
Rear Pump Drive Gear Retaining Pin	
Height of peened end of pin must not exceed	.070"
Transmission Case Front Pump Cover	
With gasket in place and pump assembly installed in case with attaching screws tight, front pump cover should protrude beyond front of case	.003"–.015"
Governor Runout	
Governor runout, taken with governor, governor sleeve and oil control valve assembly installed must not exceed	.005"
Governor Flange Runout	
Flange runout, taken with the governor removed, must not exceed	.002"
Throttle Lever Location	
With throttle lever installed (draw bolt tight) and lever moved to its extreme rear position dimension from rear machined face of transmission case to center of lever clevis pin hole must be (Use Tool J-2545. See Page 51.)	$3\frac{19}{32}'' \pm \frac{1}{32}''$
Torus Cover Hub Runout	
When mounted on flywheel, torus cover hub runout must not exceed	.005"
Flywheel Runout	
The facial runout of the gasket seal surface of the flywheel, when mounted on crankshaft, must not exceed	.005"
Oil Capacity and Change Interval	
Drain oil pan and torus cover and refill	11 qts.
Drain, disassemble, assemble transmission and refill	12 qts.
Change transmission oil every	25,000 miles
Band Adjustment Interval	
Initial band adjustment at 1,000 mile inspection. Thereafter no specific interval is established for band adjustment. Transmission bands should be adjusted any time malfunction indicates adjustment is necessary	
Rear Axle Ratio	
All Hydra-Matic models	3.63–1

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