1961

Pontiac

Three-Speed Hydra-Matic

1961
HYDRA-MATIC MANUAL

This manual contains complete information for properly servicing both 3-speed and 4-speed Hydra-Matic transmissions used in 1961 Pontiac cars.

Information on the 3-speed transmission is located in the forepart of the manual and that covering the 4-speed transmission is in the rear of the manual.

Arrangement of material is similar for both transmissions with appropriate table of contents at the front and alphabetical index at the rear of each transmission section.

PONTIAC MOTOR DIVISION
GENERAL MOTORS CORPORATION
PONTIAC 11, MICHIGAN

Litho in U. S. A. August, 1960 S-6104 H-M

3-SPEED HYDRA-MATIC TRANSMISSION

This part of the 1961 Hydra-Matic Shop Manual describes the fundamental principles of the 3-speed transmission and contains complete instructions for operating and servicing the unit.

A basic understanding of the principles of operation and use of the diagnosis and testing guide in rear of manual will aid the service man in quickly determining the cause of any malfunction.

The step by step procedures in the manual are appropriately illustrated to assist the service craftsman in doing a quality job.

Adjustments and certain minor services are performed with the transmission in the car; major repairs or reconditioning require removal of the transmission from the car.

The Titles in Table of Contents on the right hand side of this page register with black tabs at the beginning of each section. An Alphabetical Index at the rear of manual should be used to locate specific information on servicing the unit.

Table of Contents

DESCRIPTION AND OPERATING INSTRUCTIONS

CONTENTS OF THIS SECTION

3-SPEED HYDRA-MATIC DRIVE

The 3-Speed Hydra-Matic drive consists of a fluid coupling, which replaces the conventional clutch, combined with a hydraulically controlled automatic transmission having three speeds forward and one reverse. Gear shifting is automatic and is controlled by the requirements of road conditions encountered and the wishes of the driver.

OPERATING THE 3-SPEED HYDRA-MATIC

The Hydra-Matic drive is convenient to operate in that the driver need only select, by use of the control lever and indicator segment (Fig. 1), the speed range in which he wishes the car to operate. The speed ranges are clearly shown on the indicator segment, and are illuminated when the instrument panel lights are turned on. The speed ranges are designated as follows:

P—Parking and starting

N—Neutral and starting

▲DR—For all normal forward driving

DR▲—For faster acceleration when driving in congested traffic and for engine braking in hilly terrain.

L—For controlled power

R—Reverse

TO START ENGINE

1. Place control lever in P or N position. Starter is inoperative in any other position.

2. Engine Cold—Depress accelerator pedal to floor once and release (this presets automatic choke and throttle).

Engine Warm—Hold accelerator pedal about half open.

3. Turn ignition key to right to engage starter, release as soon as engine starts.

NOTE: At temperatures below 0°F. it may be necessary to hold the accelerator pedal down slightly while starting.

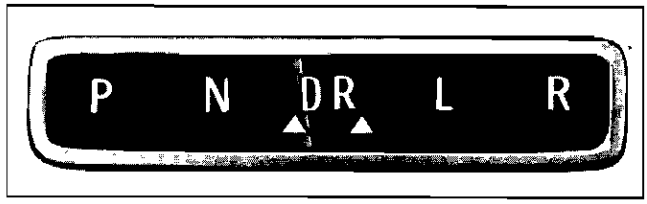

Fig. 1 Indicator

Do not pump the accelerator at any time. Avoid racing the engine during the warm-up period. Should the engine flood, hold the accelerator pedal to the floor forcibly while starting the engine.

COLD WEATHER

In cold weather (0° F. and colder) the engine must idle with the control lever in P (park) or N (neutral) position until engine and transmission are warmed up. This can more safely be done in the P (park) position as the transmission will then keep the car from rolling on a grade or incline. When engine is cold and running at fast idle, the car will creep when the control lever is moved to a driving position. A slight application of the foot brake or parking brake will hold the car until motion is desired.

OPERATING IN DR RANGE

DR range has two driving positions, each marked by an arrow. The control lever can be moved at will from one arrow position to the other when traveling at any car speed on dry roads where traction is good.

The left hand arrow position in DR range is provided for all normal forward driving; it reduces engine speed, provides better driving comfort and improves fuel economy. When driving in this range, extra performance can be obtained by fully depressing the accelcrator pedal. This will cause the transmission to shift down into second speed. The car speed determines the amount the accelerator pedal must be depressed to cause this shift. At a speed of about 35 mph or less the accelerator pedal need only be partially depressed to cause the shift and at speeds

of 35 mph to 65 mph it is necessary to completely depress the pedal. The transmission will automatically return to third speed as car speed increases or the accelerator pedal is released. Refer to figure 132 for shift speeds.

The right hand arrow position in DR range is provided for improved performance at medium car speeds and is very useful when driving in congested traffic or in hilly terrain where engine braking is required. In this range the transmission is prevented from shifting into third speed (except at very high car speeds). In effect it becomes a 2-speed transmission in DR right range. It is also effective when ascending or descending long mountain grades.

When driving in either DR range at a car speed of less than 25 mph an extra burst of power can be obtained by completely depressing the accelerator pedal. This will cause the transmission to shift down to first speed. The transmission will automatically return to second or third speed, depending on the DR range being used, as the car speed increases or pedal is released.

Placing the selector lever in the right hand arrow position in DR range is also recommended when starting out with a hot engine after parking, or idling for an extended period, during extremely hot weather. Under these conditions the application of the overrun band in drive right will prevent the engine from stalling if there is excessive vapor in the fuel lines. After a short distance of operation, the control lever may be placed in drive left position if desired.

Acceleration in left hand DR range—The shift points from first speed to second and second speed to third (direct drive) will occur at progressively higher car speeds depending on the amount the accelerator pedal is depressed.

Caution Against Coasting in Neutral—Do not coast with the control lever in the N (neutral) position. It is unlawful in some states and sometimes is harmful to the transmission.

Stopping the Car—Leave the control lever in the driving position selected and release the accelerator pedal. The engine is then left "in gear" which helps to slow down the car. For further stopping effort apply the brakes in the conventional manner. *CAUTION: When the driver leaves the car, with the engine running the control lever should always be in P (park) position.* This precaution prevents movement of the car, should the accelerator pedal be accidentally depressed by a passenger and also will keep the car from rolling on a grade or incline.

OPERATING IN L RANGE

L (low) range prevents the transmission from shifting above first speed. L range is provided for pulling through deep sand or snow and ascending or descending steep grades where traffic signs call for placing the transmission in first or second gears.

The control lever can be moved from either DR position to L at any car speed. The shift into first gear will not occur at a car speed above approximately 45 mph.

CAUTION: Do not shift into L range on slippery roads as a skid may be induced.

REVERSE

To engage reverse, simply move the control lever to the R position. Moving lever between L and R while applying light accelerator pedal pressure permits rocking the car when required to get out of deep snow, mud or sand. Avoid engaging reverse at speeds above 5 mph.

PARKING

For additional safety when car is parked leave the selector lever in the P (park) position. Mechanical engagement of parts within the transmission will then keep the car from rolling. The selector lever must be raised to move it into or out of the P (park) position.

TOWING

A 1961 car equipped with 3-Speed Hydra-Matic can be towed at speeds up to 30 miles per hour for distances up to 50 miles, if it is known there is nothing wrong with the transmission. When towing at speeds above 30 miles per hour, disconnect propeller shaft. Check oil level after towing and add fluid if required to bring to proper level.

PUSHING

Do not attempt to start the engine by pushing the car. The pump in the transmission is driven by the input shaft which does not turn when the engine is not running. Therefore, with no fluid pressure to operate the clutches, the transmission will not transmit power to the engine.

HYDRA-MATIC DRIVE FLUID

It is important to use only Automatic Transmission Fluid (Type A) identified by Armour Institute Qualification Number "AQ-ATF . . .". Fluids carrying

this identification followed by the letter "A" may also be used. This is an all-season fluid, ideal for year-round operation. No special additives to these fluids are required or recommended. NOTE: In cases of emergency, when the specified fluid is not available, any good quality 20 W 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.

Instructions for checking fluid level and for draining and refilling transmission are given on page 41.

SERIAL NUMBER

The serial number plate is located on the left side of the transmission just ahead of the outer shift lever (Fig. 2). The serial number begins with the designation P-61, PE-61, PA-61 or PB-61. The PE-61 is used with the economy engine and the PA-61 is used with the 425A engine, tri-carbs, and the special police engine. Cars with 4-barrel carburetors have the PB-61 transmission. All others use the P-61 transmission.

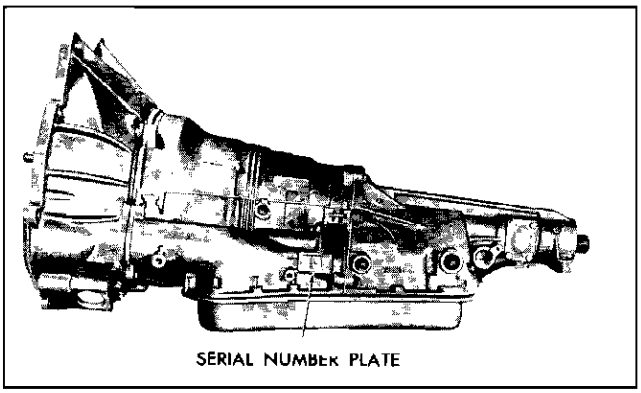

Fig. 2 Serial Number Plate

FUNDAMENTAL PRINCIPLES OF THE 3-SPEED 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. 3) consists of three members:

1. A center or "sun" gear.

2. A planet carrier with three or four 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.

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. 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.

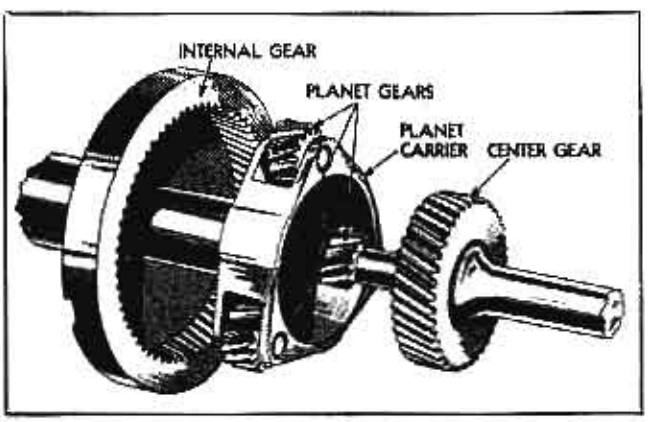

Fig. 3 Planetary Gear Train

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 when any two of its members are locked together.

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.

a. One method of obtaining speed reduction (power multiplication) is to hold the internal gear stationary while power is applied to the center gear (Fig. 4). 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 "rotate 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 unit.

b. The same result can be obtained by holding the center gear stationary and applying power to the internal gear. In this case, rotation of the internal gear causes the planet pinion gears to rotate on their respective pins and at the same time "rotate around" the center gear, thus rotating the planet carrier at a speed less than that of the internal gear. The gear train then functions 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.

In all of the examples described, 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 as a coupling for direct mechanical drive when any two members are locked together.

Under this condition movement can not take place between the gears and the entire gear train will rotate as a unit.

4. When none of the members are held or locked together the planetary gear train will not transmit power; therefore it is in neutral.

FLUID COUPLING AND TORQUE MULTIPLIER

A fluid coupling is a hydraulic clutch used to transmit engine torque to the transmission. The use of the fluid coupling eliminates the need for a manual clutch and also provides a cushioning effect of the gear changes between the engine and the transmission.

The fluid coupling and torque multiplier consists of three members (Fig. 5) located within an oil filled housing. The drive and driven members are shaped like halves of a split torus, having a series of radially arranged vanes within them. The torque multiplier consists of a series of curved blades mounted radially on a hub. The torque multiplier is located between the drive and driven coupling members.

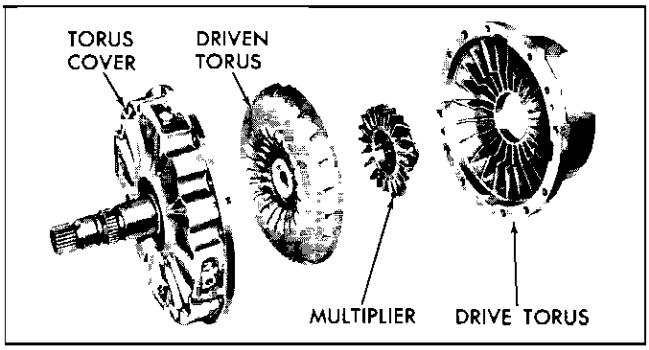

Fig. 5 Torus and Multiplier

The drive coupling member is connected to and driven by the engine, the driven coupling member is connected to the main shaft and rear unit sun gear, the torque multiplier is connected to the carrier shaft and output shaft.

OPERATION

Step 1. The engine turns the coupling drive member thus causing the drive member to force the oil against the vanes of the driven member, forcing the driven member to turn (Fig. 6).

Step 2. After the oil has acted on the driven member the oil is forced to the torque multiplier (Fig. 7).

Step 3. The oil flow rushing out of the curved blades of the torque multiplier is then directed back to the drive member in such a way as to impart an additional driving force to the back side of the drive member vanes (Fig. 8). This additional driving force plus the energy added to the flowing oil from engine power, allows an even

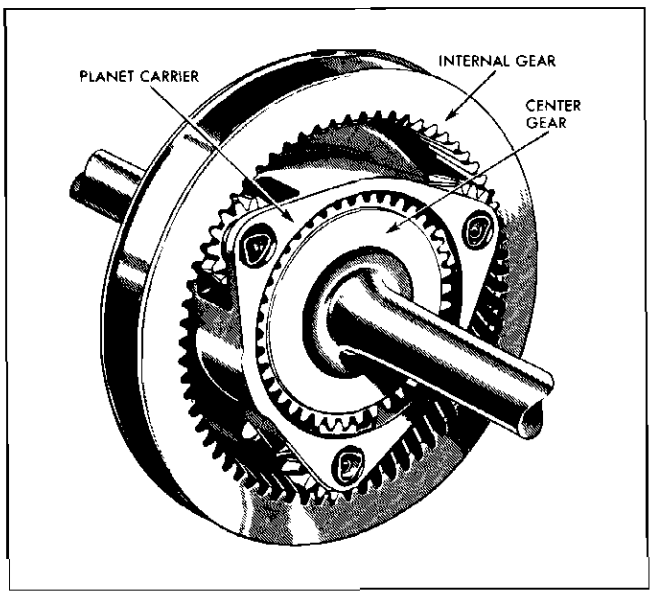

Fig. 4 Planetary Gears

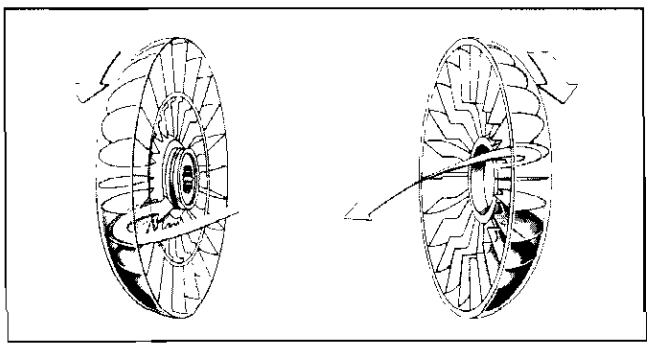

Fig. 6 Torus Operation—Step 1

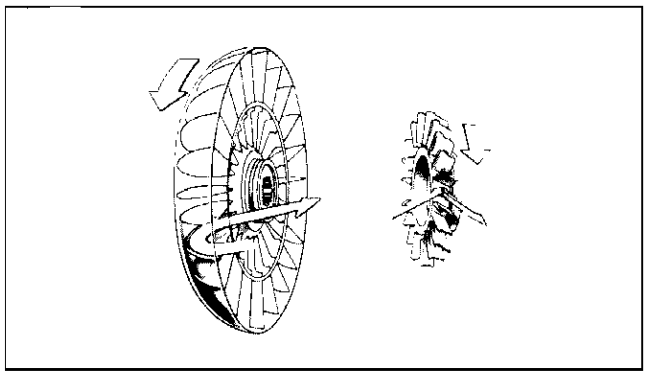

Fig. 7 Torus Operation—Step 2

greater force of oil to be directed against the vanes of the driven member.

This causes the torque on the driven member to be multiplied.

In first speed the fluid coupling and torque multiplier provide an increase of 1.3 times engine torque to the rear unit, thus increasing the over all ratio.

In second speed the coupling is emptied and not used. Drive through the transmission is pure mechanical drive.

In third speed all three members of the fluid coupling are turning at approximately the same speed, therefore the torque multiplier is no longer effective. Because of the over all transmission design the coupling is required to carry only 40% of the engine torque.

During reverse operation the coupling and torque multiplier is again capable of increasing torque output from the engine by 1.3.

SPRAG CLUTCH

A sprag clutch is a device having irregular members wedged between two concentric members. It allows rotation of a unit in one direction and locks the unit from rotating in the opposite direction. Sprag clutches are used in the Hydra-Matic to lock one member of each planetary gear set for reduction. In direct drive the sprag clutches allow free rotation.

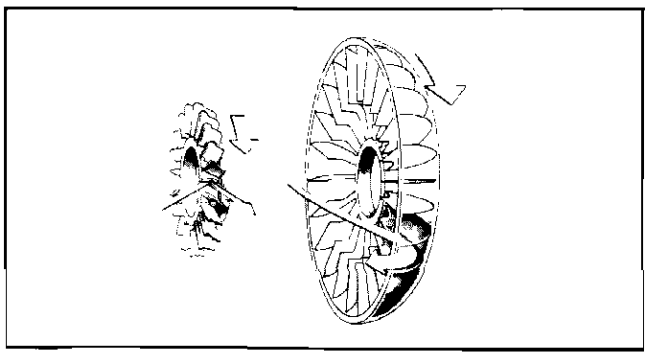

Fig. 8 Torus Operation—Step 3

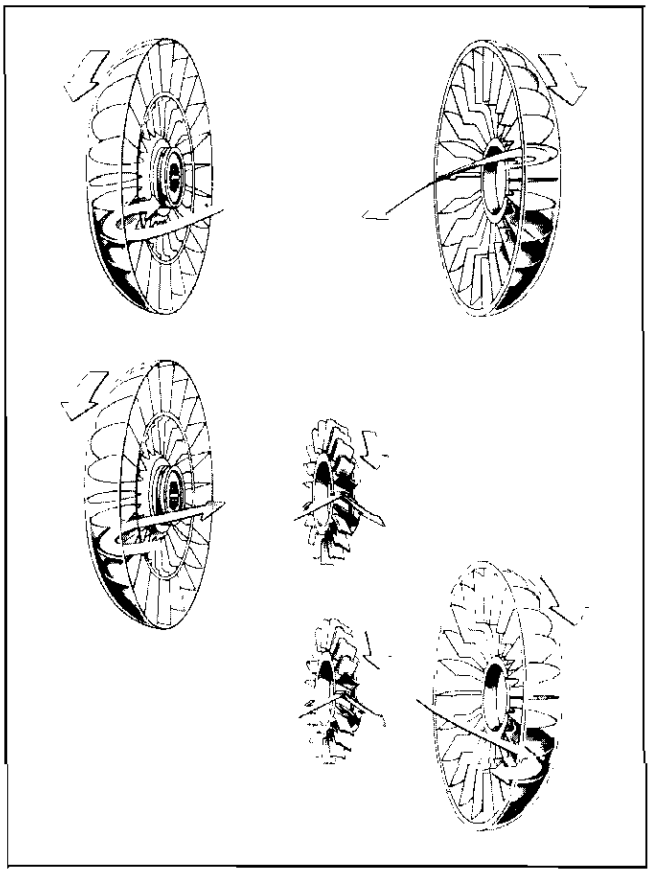

Fig. 9 Torus Operation—Combined Steps

The sprag clutch consists of three parts, the inner race, the sprag assembly, and the outer race (Fig. 11). The inner race is connected to the part which is to be held for reduction, or allowed to rotate for direct drive. The outer race is fastened to the transmission case and is stationary.

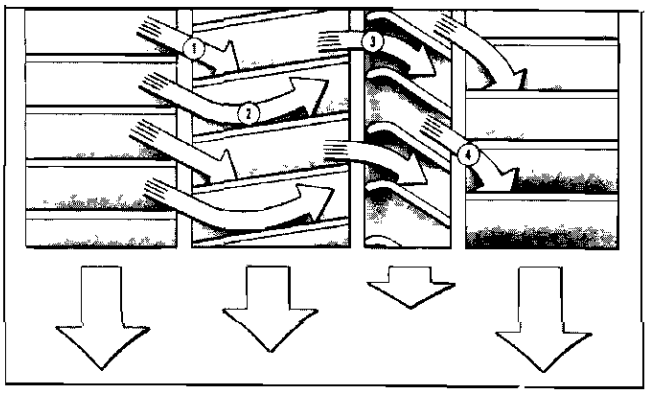

Fig. 10 Oil Flow Through Torus Members and Multiplier

When torque is applied to the inner race in a counterclockwise direction as indicated by the dotted arrows, the sprags will be wedged between the inner and outer races. This wedging action, shown by the dotted sprags, locks the inner race from turning.

When torque is applied to the inner race in a clockwise direction as indicated by the solid arrows, the sprags will fall free. When the sprags fall free as indicated by the solid sprags, the inner race is allowed to rotate freely in a clockwise direction.

3-SPEED HYDRA-MATIC COMPONENTS

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 operate a vehicle, the Hydra-Matic transmission contains two planetary gear trains arranged to provide three speeds forward and one reverse.

Direct drive or reduction in each of the units is obtained hydraulically by controlling the front clutch and the fluid coupling as will be explained in the power flow section.

The overrun band, neutral clutch, and reverse cone clutch are also applied, when necessary, by hydraulic pressure.

The hydraulic pressure is maintained by a pump which is driven by the input shaft whenever the engine operates.

Oil pressure is directed to the proper places in the transmission by means of a control valve assembly. When the driver places the selector lever in the desired range, the control valve automatically directs oil to the proper places in the transmission.

RELATIONSHIP OF UNITS

The damper assembly is bolted to the engine flywheel and is splined to the transmission input shaft. The input shaft is integral with the torus cover and is bolted to the torus drive member. The torus drive member must then turn at engine speed at all times.

The torus driven member is splined to the mainshaft which in turn is splined into the rear unit sun gear. The rear unit sun gear then must turn at the speed of the driven torus member.

The output shaft is doweled and bolted to the rear carrier and its shaft. The front carrier and torque multiplier are splined to the rear carrier shaft. Therefore, the torque multiplier, front carrier, rear carrier and shaft are always turning at output shaft speed.

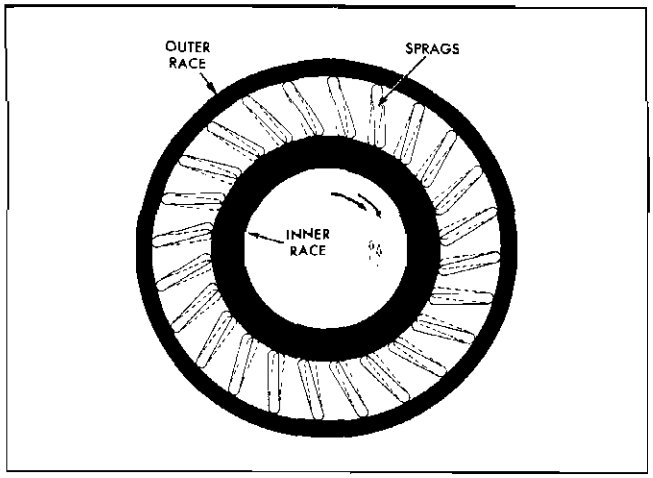

Fig. 11 Sprag Clutch

The front sun gear and shaft is splined into the sprag inner race, the sprag inner race is common with the rear unit internal gear. Any time that the sprag is effective in holding the sprag inner race stationary the front unit sun gear and rear unit internal gear are also held stationary.

The neutral clutch drive plates are splined to the sprag outer race. The neutral clutch driven plates are splined to the transmission case so that whenever the neutral clutch is applied the sprag outer race is locked to the transmission case.

The sprag assembly is a one-way clutch that will prevent the inner race, front unit sun gear and rear unit internal gear from turning counterclockwise, but will overrun allowing the aforementioned components to turn clockwise.

The front clutch drive plates are splined to the coupling drive member and the front clutch driven plates are splined to the front internal gear. Whenever the front clutch is applied the front unit internal gear is turning at engine speed.

The reverse stationary cone is keyed to the transmission case, the reverse piston is doweled to the case center support and the case center support is keyed to the transmission case. These components never rotate.

The reverse cone is splined to the front clutch housing and the front clutch housing is bolted to the front unit internal gear. Whenever the reverse piston is applied the reverse cone is clamped stationary thus holding the front unit internal gear stationary.

The overrun band is wrapped around the rear unit internal gear to hold the rear unit internal gear and front unit sun gear stationary whenever the band is applied.

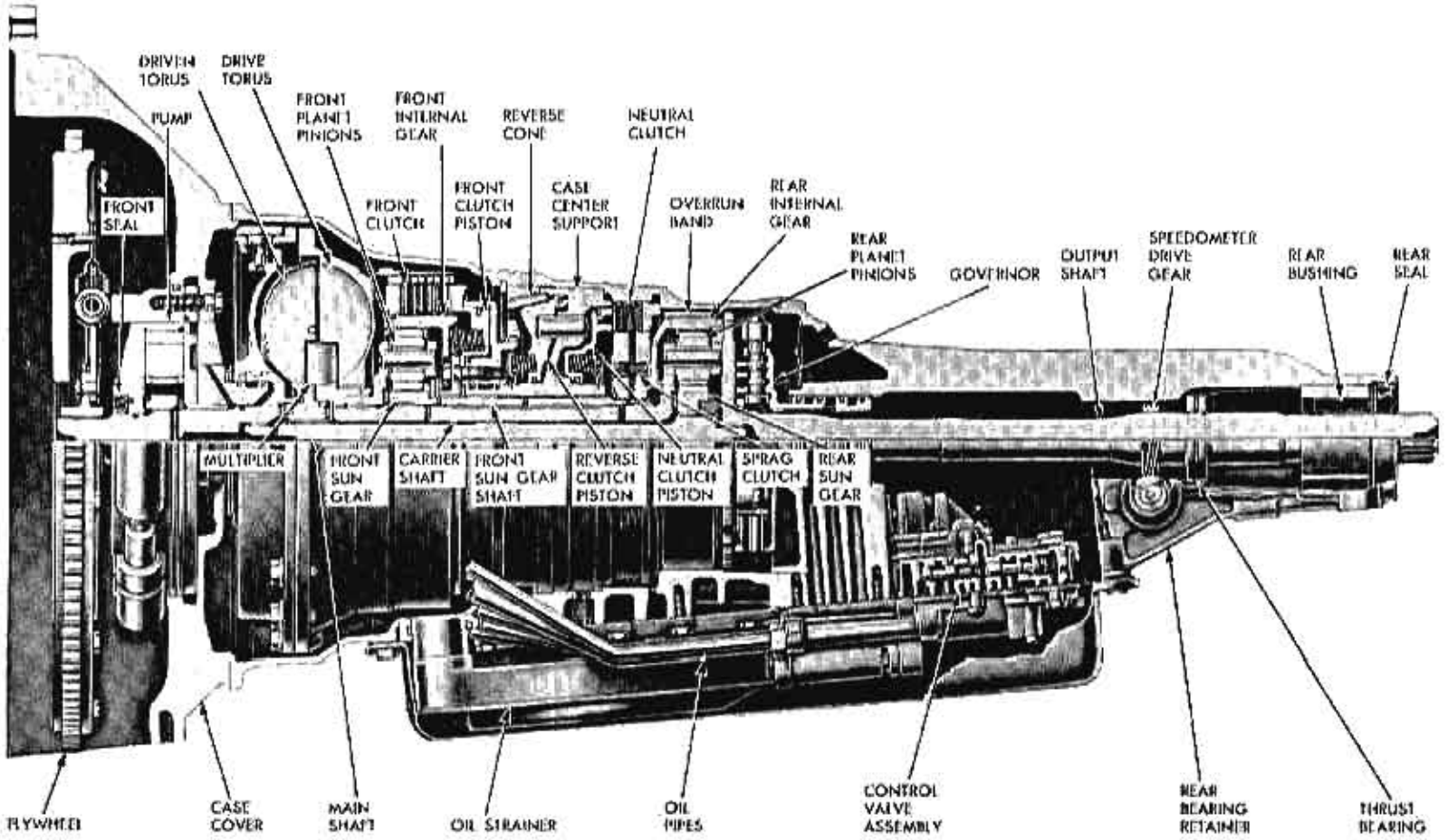

Fig. 12 Cross-Section of 3-Speed Hydra-Matic Transmission

POWER FLOW IN HYDRA-MATIC TRANSMISSION

The power flow (parts that are rotating) for each transmission speed is indicated by arrows on illustrations 13 through 17.

The front sun gear shaft, the rear planet carrier shaft, and the main shaft are all concentric. In other words, the main shaft operates inside the rear planet carrier shaft which in turn operates inside the hollow front sun gear shaft.

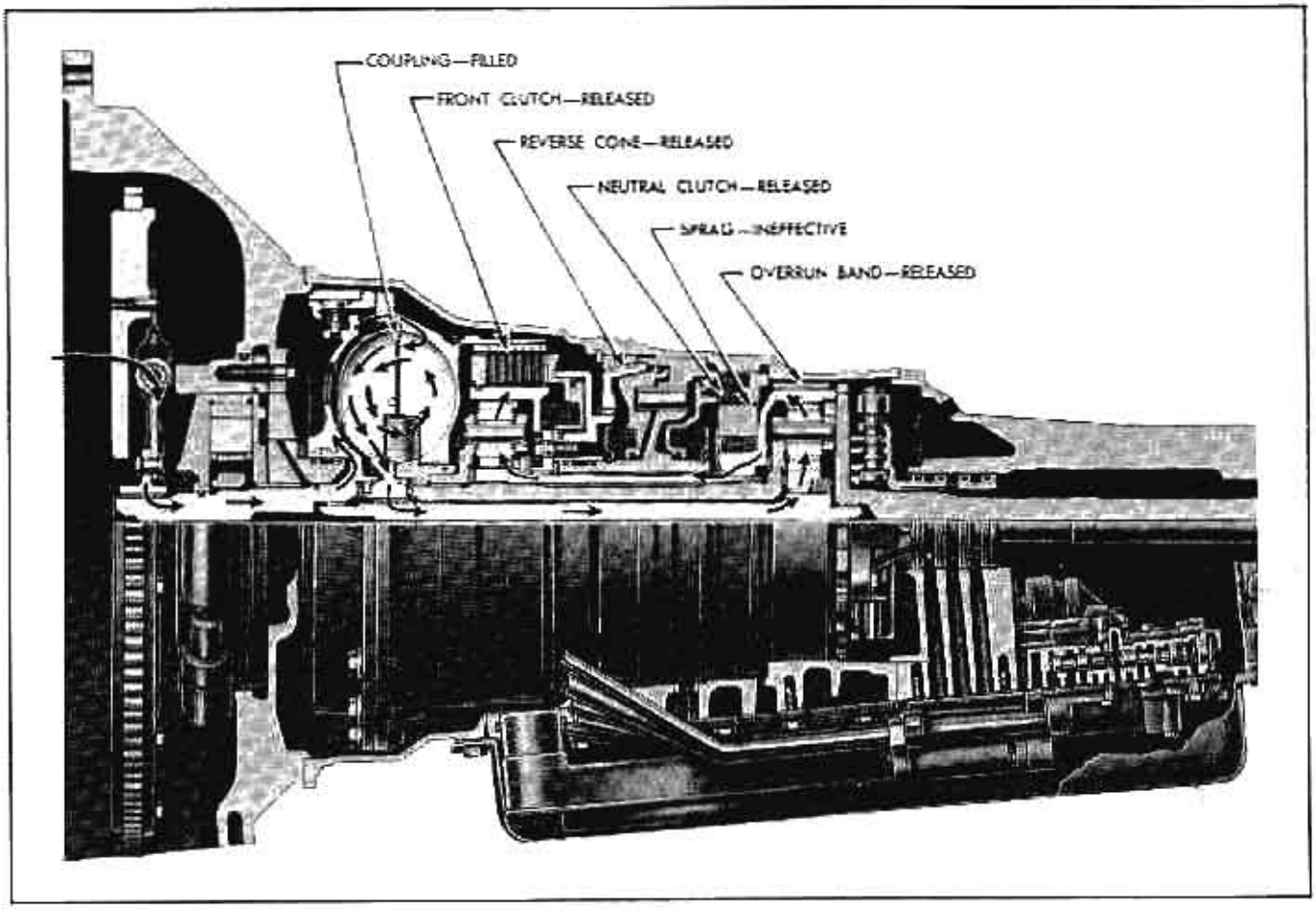

Fig. 13 Neutral—Engine Running

COUPLING —FILLED	REVERSE CONE —RELEASED	OVERRUN BAND—RELEASED
FRONT CLUTCH —RELEASED	NEUTRAL CLUTCH—RELEASED	SPRAG —INEFFECIVE

Power from the engine (in a clockwise direction) is mechanically transmitted through the flywheel, damper assembly and torus cover to the drive torus member. The drive member directs the oil against the driven member causing it to turn the main shaft and rear unit sun gear clockwise.

In neutral the neutral clutch is released thus preventing the sprag assembly from being effective in holding the rear unit internal gear against turning counterclockwise. Therefore, as the rear unit sun gear turns clockwise, the rear unit pinions turn counterclockwise driving the rear internal gear counterclockwise.

The front unit sun gear is mechanically connected to the rear internal gear and is also turning counterclockwise; this causes the front unit pinions to rotate clockwise on their pins. The clockwise motion of the front unit pinions drives the front internal gear clockwise.

Because both the rear unit internal gear and the front unit internal gear are spinning freely, there is no transfer of torque from the front or rear units to the carriers or output shaft.

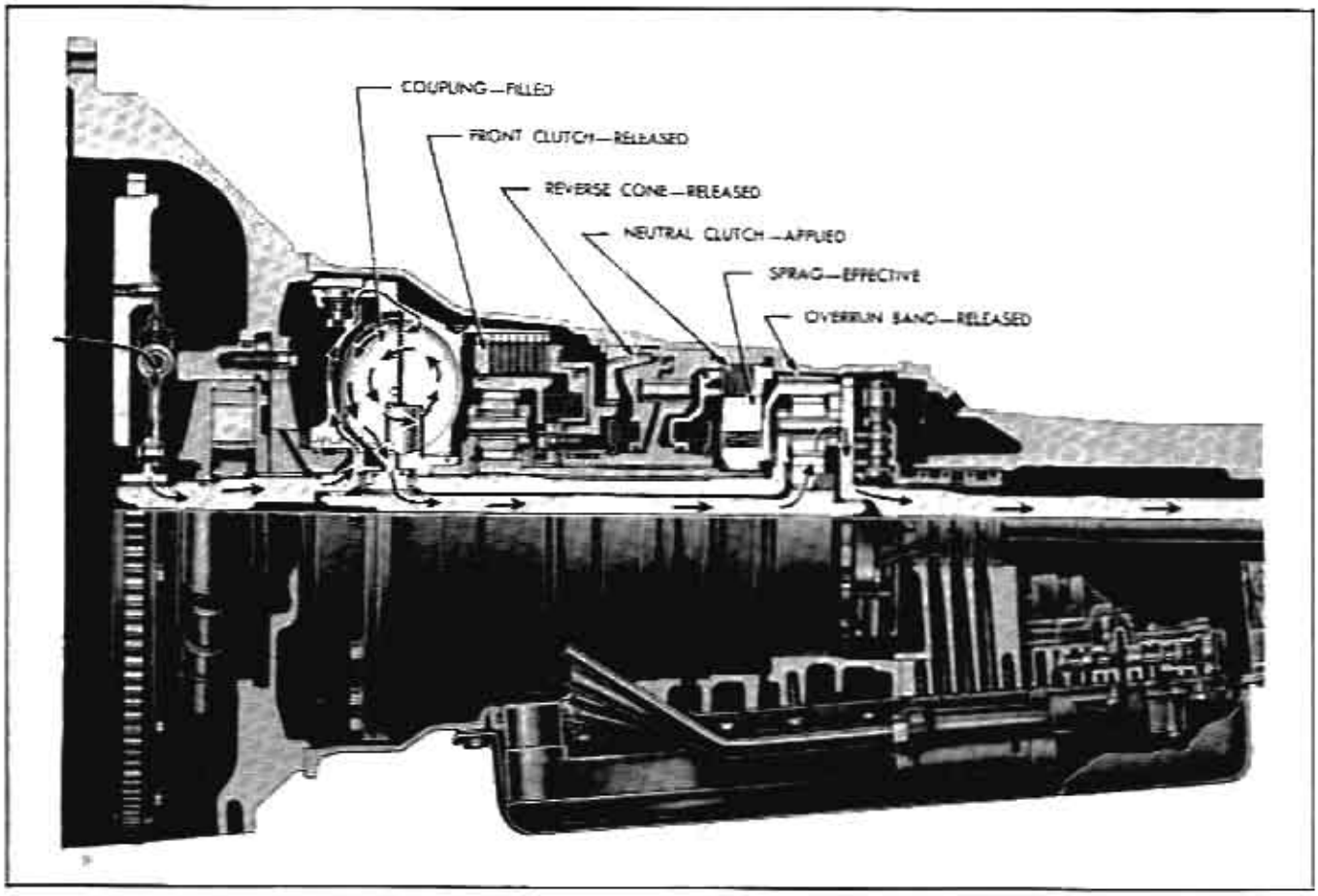

Fig. 14 First Speed—Drive Range

COUPLING —FILLED
FRONT CLUTCH—RELEASED
OVERRUN BAND—RELEASED
SPRAG —EFFECTIVE
REVERSE CONE —RELEASED
NEUTRAL CLUTCH—APPLIED

RATIO: 3.56:1

Power from the engine is mechanically transmitted through the flywheel, damper assembly and torus cover to the drive torus member. Engine torque is hydraulically transmitted through oil to the driven torus member. Oil from the driven torus member is directed against the torque multiplier which redirects the force of the oil back to the drive member in such a way as to assist in turning the drive member. Engine torque through the coupling is multiplied and applied to the mainshaft and rear unit sun gear.

The neutral clutch is applied locking the sprag outer race to the case, thus making the sprag effective for holding the rear unit internal gear stationary. Coupling torque clockwise through the rear sun gear then attempts to drive the pinions and internal gear counterclockwise; however, because the sprag assembly holds the internal gear stationary, the output shaft through the pinions is compelled to rotate clockwise within the internal gear at a reduced speed and with increased torque.

As the rear carrier and output shaft rotate clockwise at reduced speed the front carrier, which is mechanically connected to the rear carrier, also rotates clockwise at a reduced speed. Because the sprag assembly is holding the front unit sun gear stationary against counterclockwise rotation, the carrier and pinions rotate the front unit internal gear clockwise at approximately one-half engine speed.

Because the front clutch is released the reduction in first speed is due to the rear unit gear reduction, times the coupling torque multiplication, less the .3 engine torque acting on the output shaft through the torque multiplier.

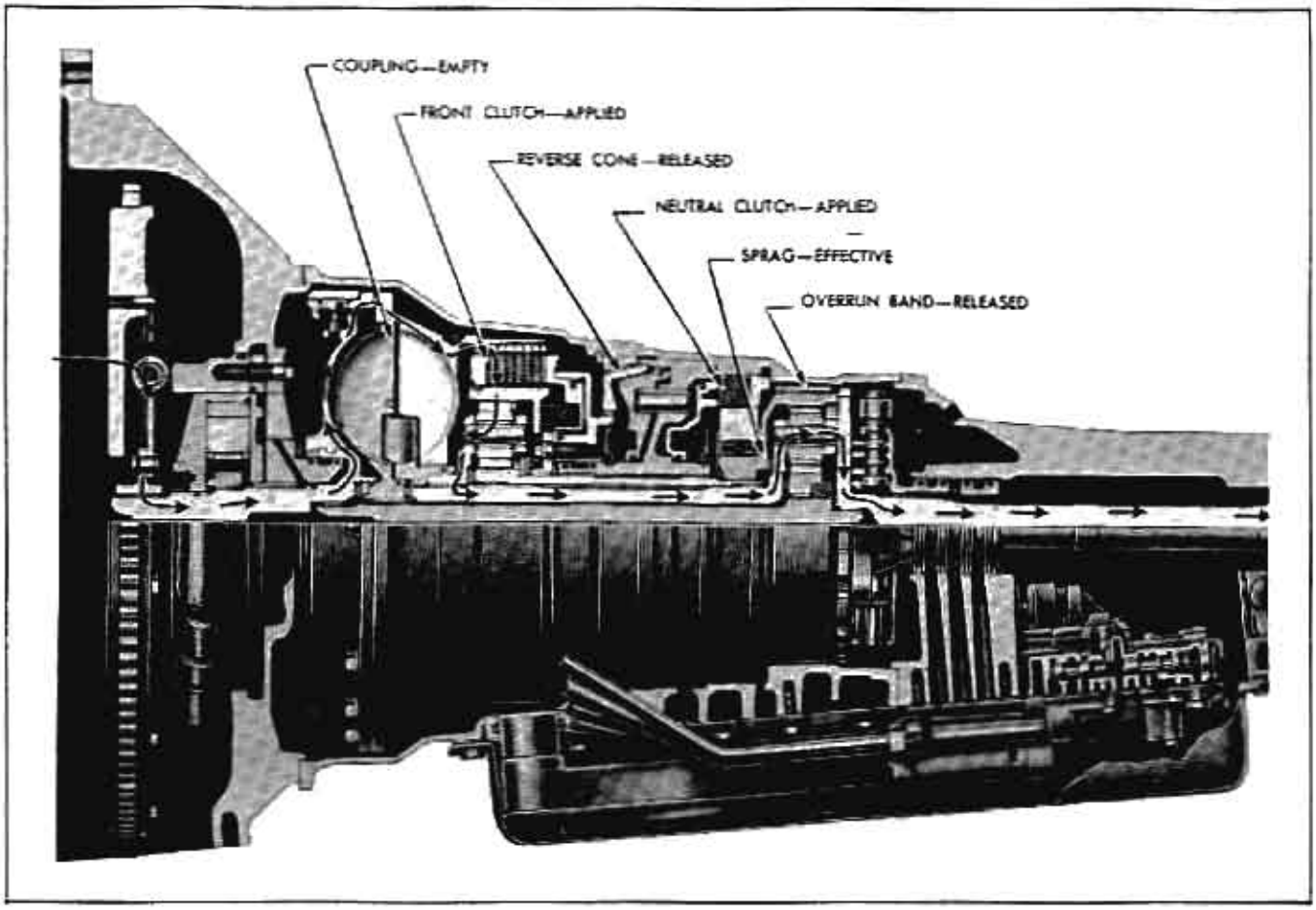

Fig. 15 Second Speed—Drive Range

COUPLING —EMPTY	OVERRUN BAND—RELEASED	REVERSE CONE —RELEASED
FRONT CLUTCH—APPLIED	SPRAG —EFFECTIVE	NEUTRAL CLUTCH—APPLIED

RATIO: 1.56:1

Power from the engine is mechanically transmitted through the flywheel, damper assembly and torus cover to the drive torus member. The front clutch is applied and the coupling is empty so engine torque is mechanically applied to the front unit internal gear.

The front unit sun gear assembly is splined to the sprag inner race and is prevented from turning counterclockwise by the sprag when the neutral clutch is applied. Engine torque at the front internal gear is applied to the pinions, and because the sun gear cannot rotate counterclockwise the planet pinions and carrier are compelled to revolve clockwise around the sun gear in reduction. The front carrier is splined to the rear unit carrier and shaft assembly which in turn is bolted directly to the output shaft.

As the output shaft and rear unit carrier turns clockwise in reduction, the pinions will drive the rear unit sun gear and driven torus in a clockwise direction faster than engine speed. Because the coupling is empty no power is transmitted and all torque multiplication in second speed is due to the front unit gear ratio.

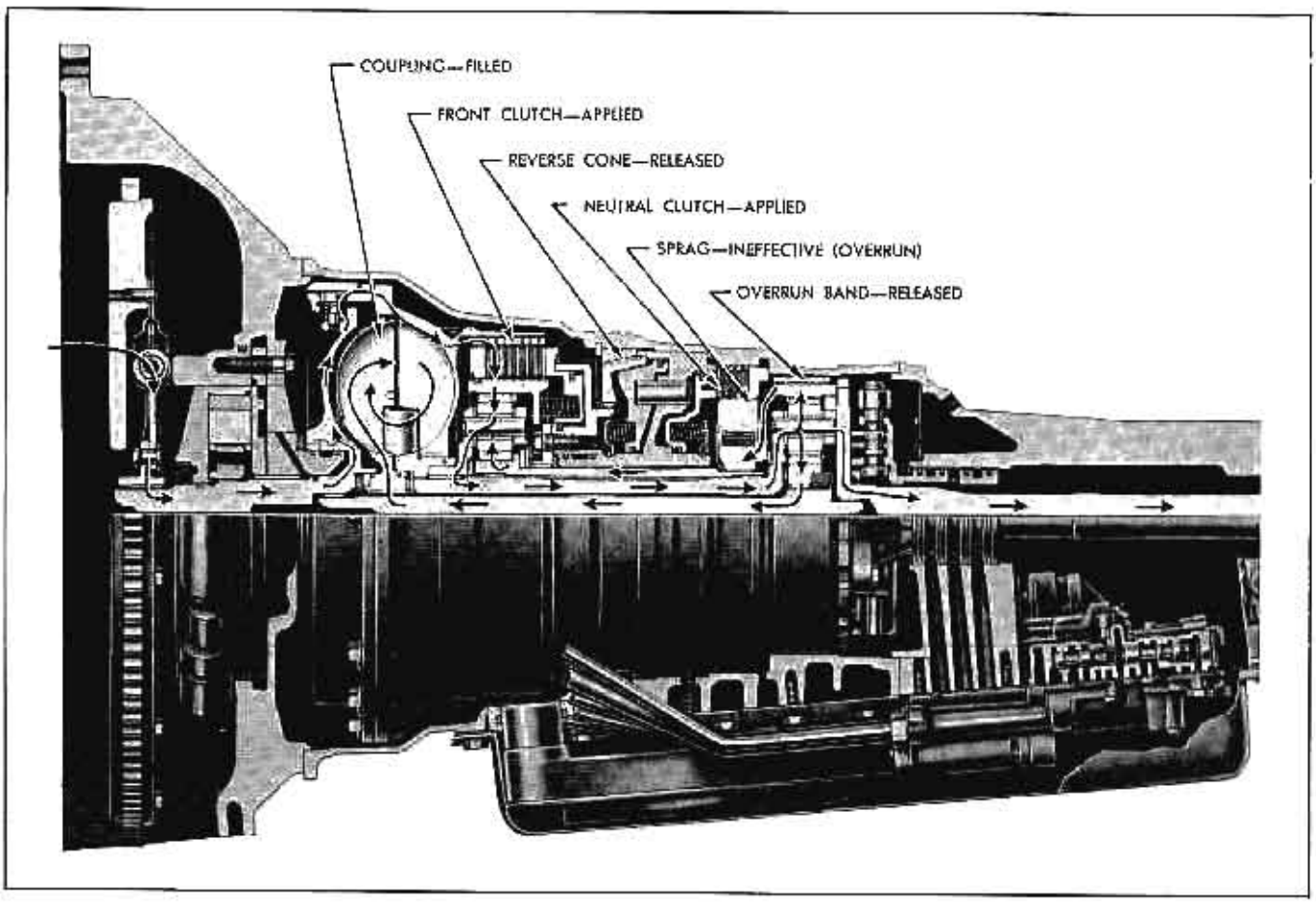

Fig. 16 Third Speed—Drive Range

COUPLING —FILLED	OVERRUN BAND—RELEASED	REVERSE CONE —RELEASED
FRONT CLUTCH—APPLIED	SPRAG INEFFECTIVE (OVERRUN)	NEUTRAL CLUTCH—APPLIED

RATIO: 1:1

Power from the engine through the flywheel, damper assembly and torus cover is applied through the front clutch to the front unit internal gear. The front internal gear, through the pinions tends to turn the front sun gear against the sprag. This would cause the front carrier to run clockwise in reduction. The rear carrier then must also attempt to revolve clockwise in reduction. With the rear carrier rotating clockwise in reduction, and the rear internal gear tending to be stationary against the sprag, the rear unit pinions attempt to rotate counterclockwise on their pins, thus driving the rear unit sun gear and driven torus clockwise faster than engine speed.

However, because the coupling is filled, the coupling driven member and rear unit sun gear can not revolve faster than the drive torus which turns at engine speed. Therefore, the rear sun gear speed is slowed down to approximately engine speed. In so doing, the rear unit pinions are slowed down in their rotation on the pinion pins. The carrier and pinions change the direction of load against the internal gear causing it to overrun the sprag and revolve with the carrier and sun gear at the same speed. Because the output shaft and carriers are connected to the torque multiplier in the coupling, the torque multiplier is also turning the same speed as the drive and driven member so that it has no effect in multiplying torque in the coupling.

Both carriers and the output shaft are common, the front sun gear and rear internal gear are common, and the front internal gear and rear unit sun gear are turning at approximately the same speed, thus the entire train must revolve as one common unit in direct drive.

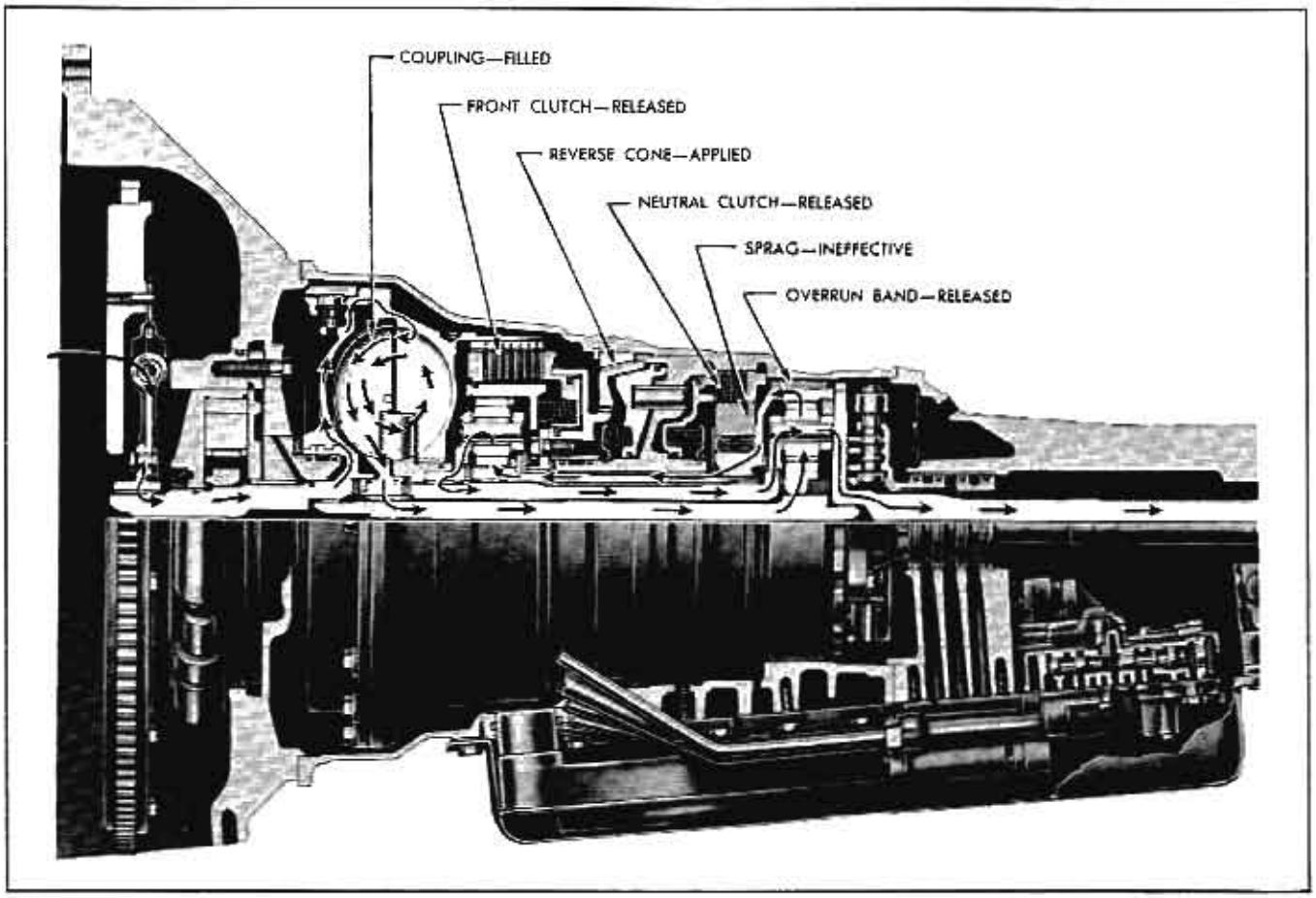

Fig. 17 Reverse

COUPLING —FILLED
FRONT CLUTCH—RELEASED
OVERRUN BAND—RELEASED
SPRAG —INEFFECTIVE
REVERSE CONE —APPLIED
NEUTRAL CLUTCH—RELEASED

RATIO: 3.53:1

Power from the engine is mechanically transmitted through the flywheel, damper assembly and torus cover to the drive torus member. Engine torque is hydraulically transmitted through oil to the driven torus member. Oil from the driven torus member is then directed against the torque multiplier which redirects the force of the oil back to the drive member in such a way as to assist in turning the drive member. Engine torque through the coupling is multiplied and applied to the mainshaft and rear unit sun gear.

The rear unit sun gear drives the rear unit pinions as idlers which in turn drive the rear unit internal gear in a counterclockwise direction. (The neutral clutch is released rendering the sprag ineffective for holding the internal gear).

Because the rear unit internal gear is turning counterclockwise, the front unit sun gear is turning counterclockwise. The reverse cone is holding the front unit internal gear stationary so that the front unit pinions and carriers are compelled to walk around the front internal gear in counterclockwise direction in reduction. The output shaft is common with the front and rear unit carrier so the output shaft is turning counterclockwise in reverse in reduction.

The effect of the force of the oil in the coupling is such that the torque multiplier is imparting an additional .3 times engine torque to the carrier and output shaft in the reverse direction.

The total reduction in reverse is due to the 1.3 coupling torque ratio times the 2.49 gear ratio plus the .3 engine torque acting on the torque multiplier and output shaft in the reverse direction.

Range	Gear	Coupling Filled	Front Clutch Applied	Reverse Clutch Applied	Neutral Clutch Applied	Overrun Band Applied
Park	—	√				
Neutral	—	√				
Drive Left	First	√			√	
	Second		√		√	
	Third	√	√		√	
Drive Right	First	√			√	√
	Second		√		√	√
	Third	√	√		√	
Lo	First	√			√	√
	Second		√		√	√
	Third	√	√		√	
Reverse	Reverse	√		√		

Note: The transmission will shift into third gear while in Drive Right at very high engine r.p.m.; however, transmission will not shift out of first gear in Lo.

REVIEW ACTION OF UNITS

In order to diagnose transmission difficulties it is very important to know what happens in each unit during each shift. The preceding list of conditions is effective with the engine driving the car (car not coasting).

HYDRAULIC ACTION IN THE HYDRA-MATIC TRANSMISSION

The proper shifting of the transmission is controlled by hydraulic oil pressure. The direction of this oil pressure to the proper places in the transmission is accomplished by the control valve assembly.

The diagrams and text on the following pages explain how the transmission is hydraulically controlled for each shift and operating condition.

OPERATION OF THE PUMP

The transmission pump is of the variable displacement high capacity type and is engine driven.

A variable capacity type pump is one that will vary its output according to the oil flow and pressure requirements of the transmission. The effort required to drive the pump is only great when the demand for oil is great, consequently, large pumping capacity can be obtained at low pump speeds without having large pumping loads at high speeds.

The rotor of the pump is engine driven and carries vanes. Oil trapped between vanes at the suction or intake side is moved to the pressure side in greater quantity than oil from the pressure side is moved to the suction side (Fig. 18).

Variable output of the pump is obtained in the following manner.

When the slide is in the up position maximum volume will be delivered, when the slide is in the middle "neutral" position no volume will be delivered.

Two springs are located on the bottom of the slide. The longer spring keeps the slide in the up or prime position so that the moment the engine is started the slide will be in the prime position and full output will be obtained.

The small spring or inner spring acts as a bumper keeping the slide from returning to a full exhaust position if the demand for oil falls quickly.

CONSTANT MAIN LINE PRESSURE

Main line oil pressure from the pump is directed to the end of the pressure regulator valve. The valve will then move against the pressure regulator spring. The pressure regulator spring, having a predetermined value, will then produce a constant pressure. The lands on the pressure regulator valve direct pressure to both the top and bottom of the pump slide. Pressure to the bottom will force the slide into the up or

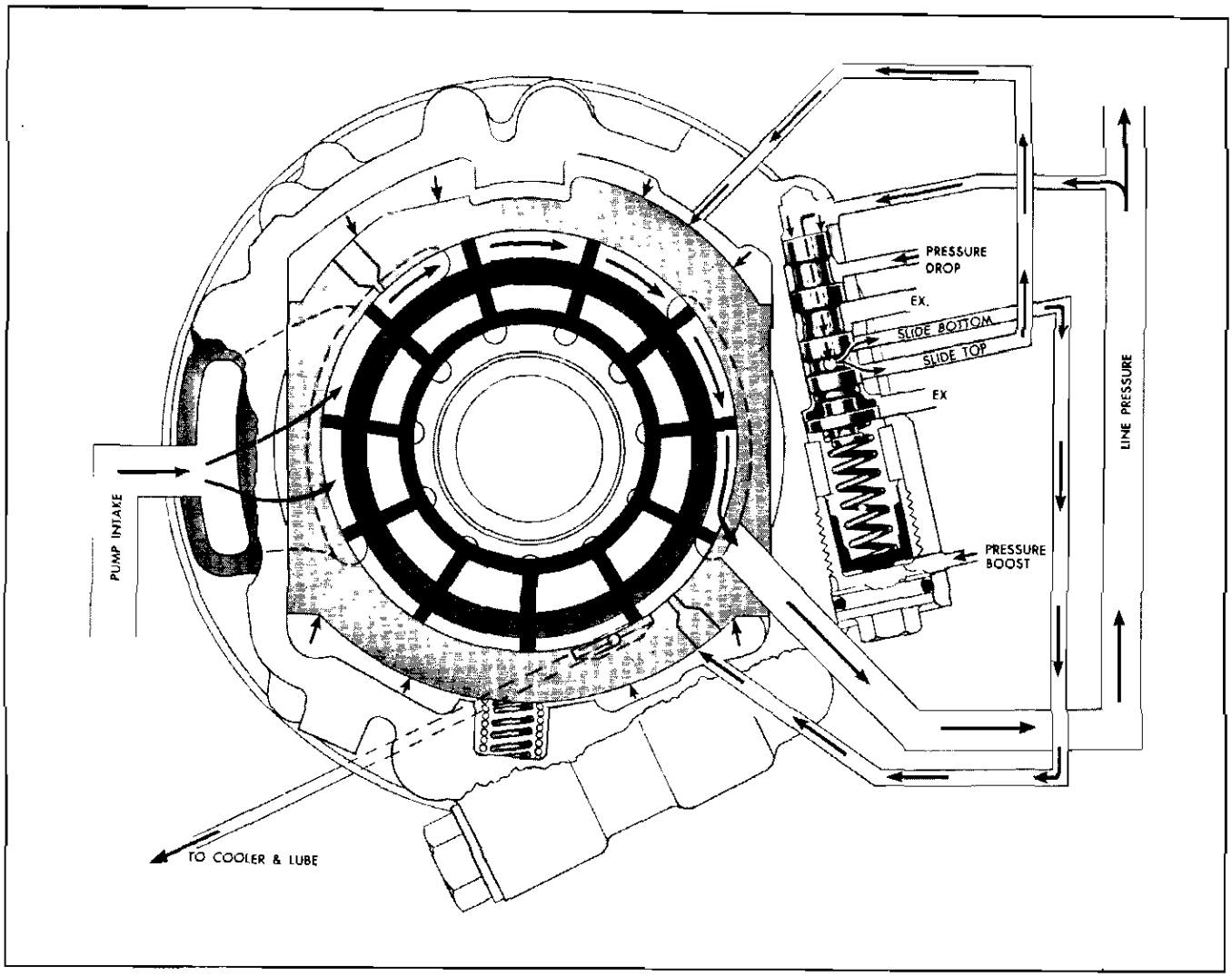

Fig. 18 Operation of Pump

pumping position. Pressure to the top of slide will force the slide downward to the neutral position.

When line pressure drops the pressure regulator spring will move the pressure regulator valve against reducing line pressure thereby moving the valve so that a feed hole in the valve indexes with a passage to the underside of the slide causing the slide to move upward to the prime position thereby causing pump output to increase.

Conversely if there is little or no oil demand from the transmission, pressure will increase and move the pressure regulator valve so that main line oil is directed to the top of the slide moving the slide to the down position reducing output.

Thus, it has been seen that the pressure regulator valve will produce consistent pressure determined by the pressure regulator spring.

HIGHER CONSTANT LINE PRESSURE

A higher pressure may be obtained by directing a pressure called line boost pressure behind the pressure boost plug, compressing the pressure regulator spring, which increases the spring load, thus raising pressure.

LOWER VARIABLE LINE PRESSURE

A lower pressure for certain types of operation may be obtained by directing line drop oil to the main line oil side of the pressure regulator valve. This will work against spring pressure sending line pressure to the top of the slide moving it toward the lower output position. This line drop oil will reduce main line pressure as the line drop pressure increases. Also, included in the pump is the coupling limit valve which is used to fill the coupling.

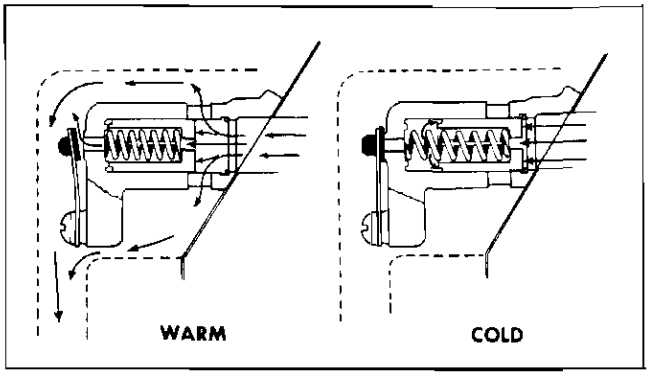

Fig. 19 Cooler Control Volve

THE COOLER CONTROL VALVE ASSEMBLY

The cooler control valve assembly, which is located in the case cover adjacent to the front pump, ports oil from the pump to the cooler. Rising temperature actuates the valve and allows oil to be directed to the transmission cooler only when required, thus eliminating unnecessary pumping requirements.

OPERATION

A. COLD OIL

At temperatures under approximately 190° to 205°F. oil will be directed to the cooer control valve where it enters an orifice in the end of valve, providing equal pressure on both ends of the valve (Fig. 19). Spring pressure keeps the valve closed preventing oil from entering the cooler passage.

B. WARM OIL

At temperatures under approximately 190° to 205°F. the thermostatic element opens allowing oil in back of the valve to exhaust and be directed to the cooler line. With reduced pressure on the spring end of the valve, spring pressure is not great enough to keep the valve in the closed position. Therefore, the valve will open allowing more oil to be directed through the ports and to the cooler line.

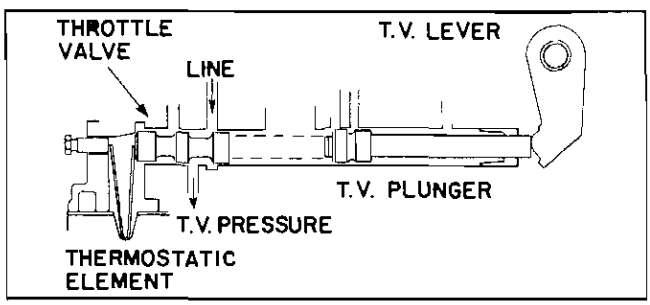

Fig. 20 Throttle Volve Operotion

As the transmission temperature is reduced (160° to 180°F.) the thermostatic element will close blocking oil flow to the cooler.

T.V. PRESSURE

Under some conditions it is desirable to provide for greater acceleration and/or greater pulling power, such as climbing hills, etc. To accomplish this, higher shift speeds are required. This is accomplished by an oil pressure that will oppose the effect of governor pressure in opening the shift valves. This pressure, called T.V. is a regulated pressure and increases with throttle opening, which is regulated by the driver. Therefore, at the driver's option, the shift speeds can be raised or lowered to insure suitable shift speeds for operation under all driving conditions.

When the accelerator pedal is depressed, linkage connected with the carburetor and the accelerator pedal acts against T.V. plunger, opens the throttle valve and allows main line pressure to become regulated T.V. pressure (Fig. 20).

T.V. pressure is directed to the shift valves to assist spring pressure to hold the shift valve closed against governor pressure. Governor pressure increases with car speed until it can overcome spring and T.V. pressure causing the shift valve to open and the shift to occur.

THERMOSTATIC T.V. CONTROL

A bi-metal spring type thermostatic element is used to compensate for the effects of temperature on shift speed control, engine power output, and shift feel control.

The element is positioned behind the throttle valve and is adjusted by a screw to give an accurate spring value at a given temperature. Under cold oil conditions the element will expand, and apply a greater load against the throttle valve (Fig. 20).

This produces less T.V. pressure at a given throttle open. Less T.V. pressure allows some shifts to start quicker and reduces the forces applying the front clutch. As the oil temperature rises toward normal the element will contract making it ineffective.

GOVERNOR OPERATION

The governor is a centrifugal type, rotating with the transmission output shaft to generate two speed-controlled oil pressures which are primarily used in the control valve assembly to initiate the shifts.

G-1 PRESSURE

As the governor rotates with the output shaft, centrifugal force acting on the G-1 or primary governor valve tends to throw the valve outward (Fig. 21). Main line pressure to the governor is then ported into the G-1 passage where it can act on the large land of the G-1 valve to provide a force in the opposite direction to the centrifugal force. The G-1 valve will then move to close off the incoming line pressure and allow G-1 pressure to exhaust until the force of G-1 pressure acting against the centrifugal force is equal to the centrifugal force. The G-1 valve continues to regulate against centrifugal force so that G-1 pressure increases with output shaft speed.

G-2 PRESSURE

The second governor valve is called the G-2 or secondary governor valve. As centrifugal force throws the G-2 valve outward, G-1 pressure is admitted to the G-2 passage. G-2 pressure then acts against the large land of the G-2 valve to oppose the centrifugal force. G-2 pressure then increases with output shaft speed.

G-2 pressure is designed to be more sensitive at the higher car speeds.

FRONT CLUTCH ACCUMULATOR

The front clutch accumulator is a cushioning and timing device,which enables the front clutch to apply smoothly under all throttle conditions. Regulation is necessary due to the varying torque loads that the front clutch is subjected to. For example. with light throttle conditions the front clutch can be applied quickly with a minimum of pressure, conversely with full throttle operation the front clutch is applied slower with greater oil pressure required.

The accumulator body contains two opposed sets of springs and pistons. One is called the upper accumulator piston and spring and the other lower accumulator piston and spring. with each piston acting against spring pressure.

When the front clutch is engaging, front clutch apply oil is also directed to the front clutch accumulator. Front clutch oil compresses the pistons against spring pressure, causing the accumulator to absorb an amount of clutch apply oil. During the initial application of the front clutch piston, a comparatively small quantity of clutch apply oil is diverted to the accumulator. When the clutch piston is stroked to its apply position, the accumulator pistons move against spring pressure and the amount of oil absorbed by

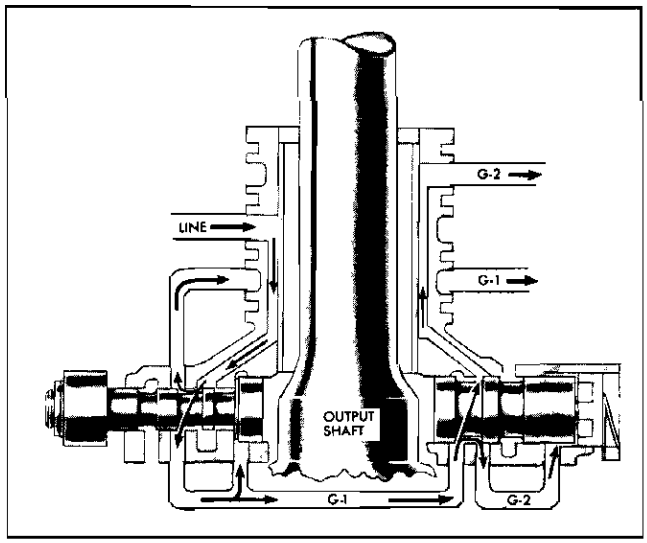

Fig. 21 Governor

the accumulator will increase thereby stopping the flow to the clutch. Since the pistons moving against their springs meet increasing resistance to their motion, the oil pressure applying the front clutch increases gradually to provide a smooth application.

When the pistons reach the ends of their strokes, the front clutch pressure rises to main line pressure to insure positive and complete engagement following the shift.

COMPENSATOR

Further control of front clutch pressure as produced by the accumulator is obtained by the primary and secondary compensator valves and springs. The

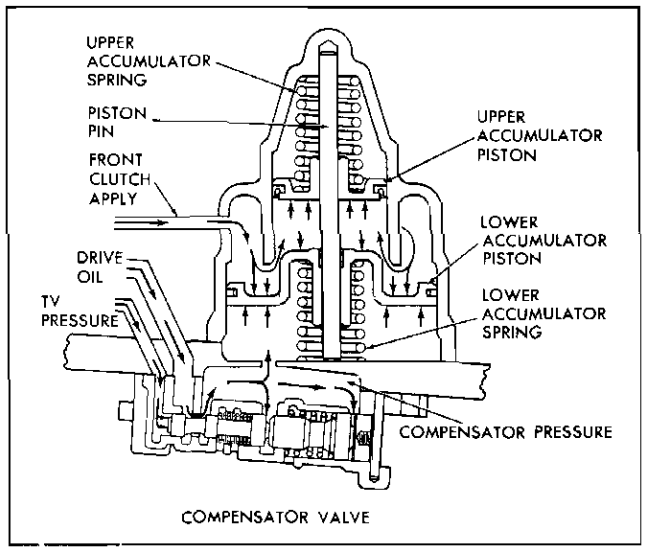

Fig. 22 Accumulator and Compensator

purpose of these valves and springs is to provide pressure to the accumulator to help the lower accumulator piston spring to resist piston motion and thus further increase the front clutch pressure during shifting. T.V. pressure, along with spring pressure, acts against the primary compensator valve allowing drive oil to enter the compensator line and fill the accumulator.

When T.V. pressure is low, the compensator pressure is low, and the secondary compensator valve is held against its stop by the secondary compensator valve spring. When T.V. pressure is high the secondary compensator valve is pushed against the primary compensator valve by higher compensator pressure. It then moves with the primary compensator valve. When the front clutch oil is fed into the accumulator, compensator oil is forced over to the compensator valves where it pushes open the primary valve and discharges compensator oil to exhaust. The resistance of the compensator valves to permitting compensator oil to be exhausted controls the compensator pressure which helps to control the front clutch pressure during a shift.

OVERRUN BAND SERVO

The overrun band and servo are used to obtain engine braking when coasting in first or second speed with the selector lever in the intermediate or low range position. Normally, when the engine is driving the transmission and vehicle, the sprag assembly is effective in holding the rear unit internal gear, or front unit sun gear stationary so as to obtain reduction. When the vehicle is coasting however, the rear wheels and transmission output shaft are driving the transmission. In this condition the sprag assembly loses its effectiveness for holding the rear unit internal gear or front unit sun gear stationary, the transmission would then overrun and not provide the desired braking action.

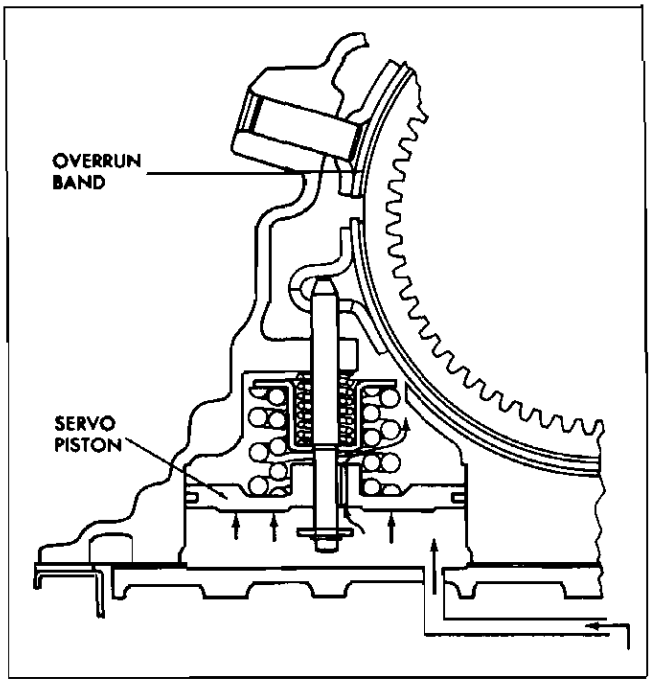

Fig. 23 Overrun Band Servo

To prevent the transmission from overrunning, the overrun band assembly is applied to the rear unit internal gear thus holding the rear internal and front unit sun gears stationary for the desired braking (Fig. 23).

An overrun band servo is used to apply and release the overrun band.

SERVO OPERATION

When the manual selector lever is in the Low Range position and the transmission is in first or second speed, overrun band apply pressure is applied to the overrun band servo.

FIRST STAGE

Band apply pressure acts against the servo piston moving the piston, servo springs, retainer and piston pin against the release spring to start the application of the band. When the band has been applied to the rear internal gear it begins to offer resistance to the travel of the piston pin.

SECOND STAGE

As band apply pressure continues to build up under the piston, the piston begins to travel up on the piston pin against the force of the servo springs. The piston then moves away from the washer which allows a small portion of the band apply pressure to bleed to exhaust through the bleed hole in the piston. Overrun band apply pressure under the piston then continues to build up at a slower rate and causes a greater force to be applied to the band. (See Fig. 23).

THIRD STAGE

When the piston travels up far enough to contact the servo spring retainer the bleed hole is sealed off again, this allows the band apply pressure to build up quickly again and causes the piston to apply its full force directly against the servo spring retainer and piston pin to give the final full apply force.

The design of the servo is such as to provide for a smooth gradual apply of the band under all driving conditions and oil pressures.

MANUAL VALVE

The manual valve distributes pressures to place the transmission in either neutral, drive left, drive right, Lo Range or Reverse. It is controlled mechanically through a linkage from the selector lever on the steering column.

1-2 SHIFT VALVE

The 1-2 shift valve initiates the 1-2 and 2-1 shifts by sensing a balance between T.V. and G-1 governor pressures.

2-3 SHIFT VALVE

The 2-3 shift valve initiates the 2-3 and 3-2 shifts by sensing a balance between T.V. and both G-1 and G-2 governor pressures.

COUPLING FEED LIMIT VALVE

This valve is located in the pump body and provides a direct feed to the coupling from the pump in first gear and reverse. It is controlled by coupling signal pressure but opens only when coupling signal pressure is greater than 90 psi.

COUPLING EXHAUST VALVES

The coupling exhaust valves are located in the torus cover assembly and they seal the coupling exhaust ports whenever coupling signal pressure is directed to close them.

COUPLING TIMING VALVE

The coupling timing valve controls the dump and fill of the coupling.

It is controlled by front clutch pressure on 1-2 shift and delays the dump of the coupling until clutch capacity is sufficient to carry the drive load.

On a 2-3 shift it is controlled by 1st and 3rd pressure and shifts immediately after the 2-3 shift valve.

PRESSURE BOOST VALVE

The pressure boost valve controls the flow to the line boost area of the pressure regulator valve. It is shifted by front clutch pressure and is timed to move after the clutch has assumed the drive.

PRESSURE DROP VALVE

The pressure drop valve controls the flow to the line drop area of the pressure regulator valve. It generates a varying pressure inversely proportional to T.V. pressure which results in a modulated line pressure.

2-1 DOWNSHIFT VALVE

The 2-1 downshift valve regulates the exhaust of the front clutch on throttle 2-1 downshifts. It is designed to allow the clutch to slip momentarily until the coupling is full enough to assume the drive without excessive engine flare.

FRONT CLUTCH EXHAUST VALVE

The front clutch exhaust valve controls the duration of front clutch slipping during a throttle 2-1 downshift. It provides a wide open clutch exhaust when coupling pressure is sufficient.

TV PLUNGER (DETENT VALVE)

The T.V. plunger initiates the part throttle 3-2 and the detent 3-2 and 2-1 shifts. It is operated mechanically by the T.V. linkage.

REVERSE BLOCKER VALVE

The reverse blocker valve prevents a shift into reverse at speeds above 10 mph. It is controlled by G-1 pressure and provides a mechanical stop for the manual linkage.

2-1 CUTOFF VALVE

The 2-1 cutoff valve is a valve which senses drive conditions relative to overrun by shifting at about 17 psi T.V. pressure. It provides an immediate exhaust of front clutch oil on overrun or closed throttle 2-1 downshifts and provides a source for 2-3 boost oil on very light 2-3 upshifts.

2-3 BOOST VALVE

The 2-3 boost valve provides 2-3 boost pressure on light throttle 2-3 upshifts until the coupling reaches sufficient charge pressure.

NEUTRAL CLUTCH VALVE

The neutral clutch valve senses a balance between T.V. pressure and neutral clutch pressure to regulate the flow of neutral clutch apply oil. This insures a smooth but firm clutch application under all throttle conditions.

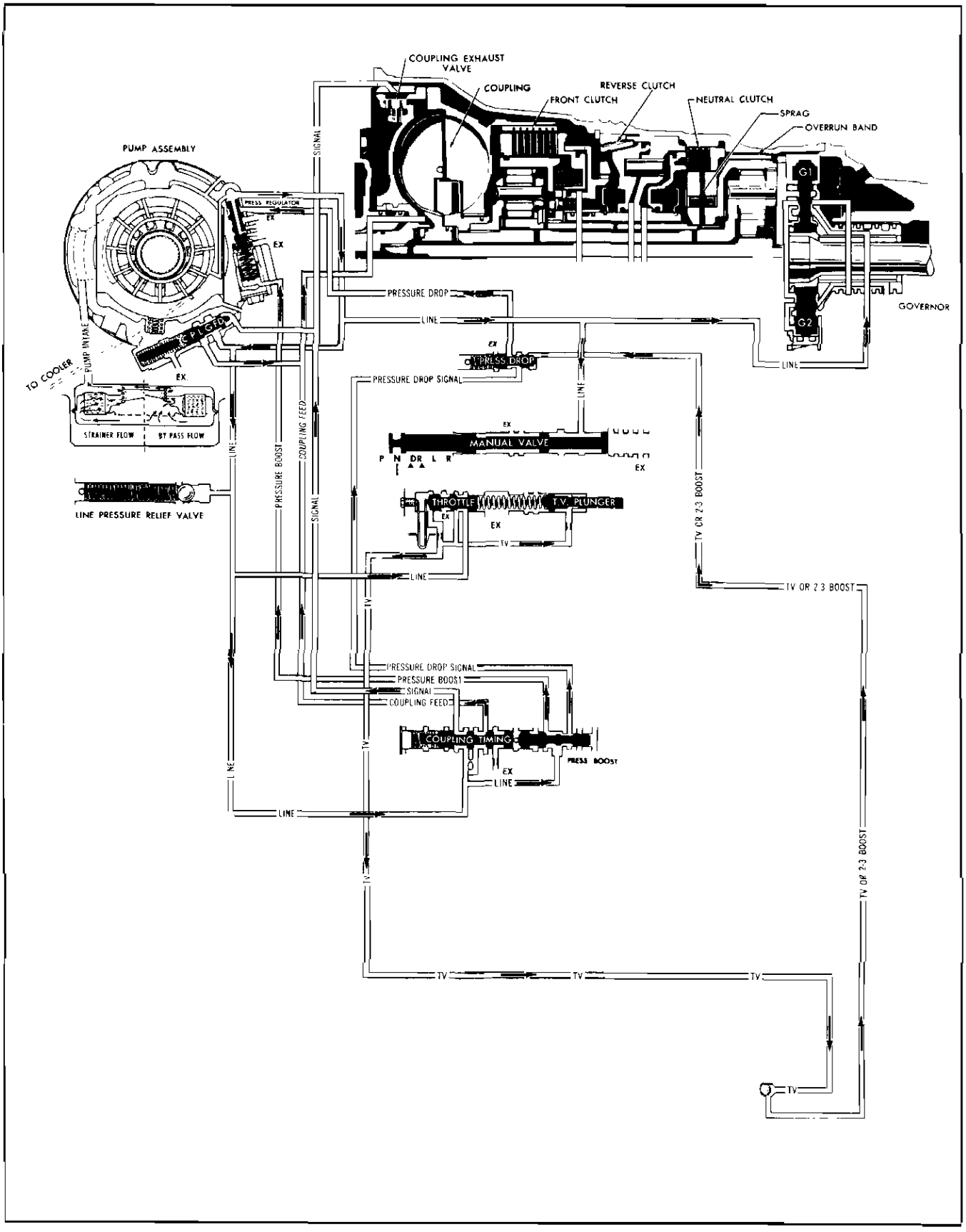

Fig. 24 Neutral—Engine Running

NEUTRAL—ENGINE RUNNING

COUPLING —FILLED	REVERSE CONE —OFF	SPRAG —INEFFECTIVE
FRONT CLUTCH—OFF	NEUTRAL CLUTCH—OFF	OVERRUN BAND—OFF

Whenever the engine is running line pressure is always directed to the:

1. Pressure Regulator
2. Pressure Relief Valve
3. Coupling Feed Limit Valve
4. Throttle Valve
5. Coupling Timing Valve
6. Manual Valve
7. 2-3 Governor Valve
8. Governor Assembly
9. Pressure Boost Valve

BASIC CONTROL

Line pressure through the coupling timing valve is directed into the signal passage. Signal oil closes the coupling exhaust valves and opens the coupling feed limit valve to provide coupling feed oil. Line pressure through the orifice at the coupling timing valve provides an additional source of coupling feed oil to fill the coupling. The neutral clutch is released, thereby rendering the sprag ineffective.

PRESSURE CONTROL

The pressure relief valve provides for the exhaust of excessive main line pressures at approximately 242 psi. This condition may occur only in the event of a malfunction in the pump or pressure regulator.

Line pressure to the throttle valve is regulated to a variable pressure called T.V. pressure. The throttle valve, which regulates T.V. pressure, is controlled by the T.V. spring and throttle plunger, through adjustable linkage from the carburetor throttle. As the throttle is opened, the linkage depresses the throttle plunger to increase the force of the T.V. spring, thus causing the throttle valve to regulate T.V. pressure to a higher value. T.V. pressure is designed to vary with throttle opening and is used throughout the control system to activate or control different valves at various times in relation to throttle opening.

Line pressure through the pressure boost valve enters two passages to become pressure boost and line drop signal oil. Pressure boost oil is routed against the boost plug in the pressure regulator to give an increase in line pressure. Line drop signal pressure is routed to the pressure drop valve where T.V. pressure acting on the end of the pressure drop valve regulates line drop signal oil to a variable decreasing pressure which in turn is applied against the second land of the pressure regulator valve.

At closed throttle, line drop pressure is maximum thus causing the greatest drop in line pressure; at full throttle, line drop pressure is regulated to exhaust resulting in high line pressure. Line pressure then is controlled to vary in accordance to throttle opening from 132-180 psi.

Line pressure directed to the governor will be regulated to become two variable governor pressures: G-1 and G-2.

These pressures vary in proportion to output shaft or vehicle speed. G-1 being more sensitive at the lower speeds and G-2 being more sensitive at high vehicle speeds. Governor pressure is used to initiate the 1-2 and 2-3 shifts.

SUMMARY

The coupling is filled and the neutral clutch is released, thereby causing the transmission to be in neutral.

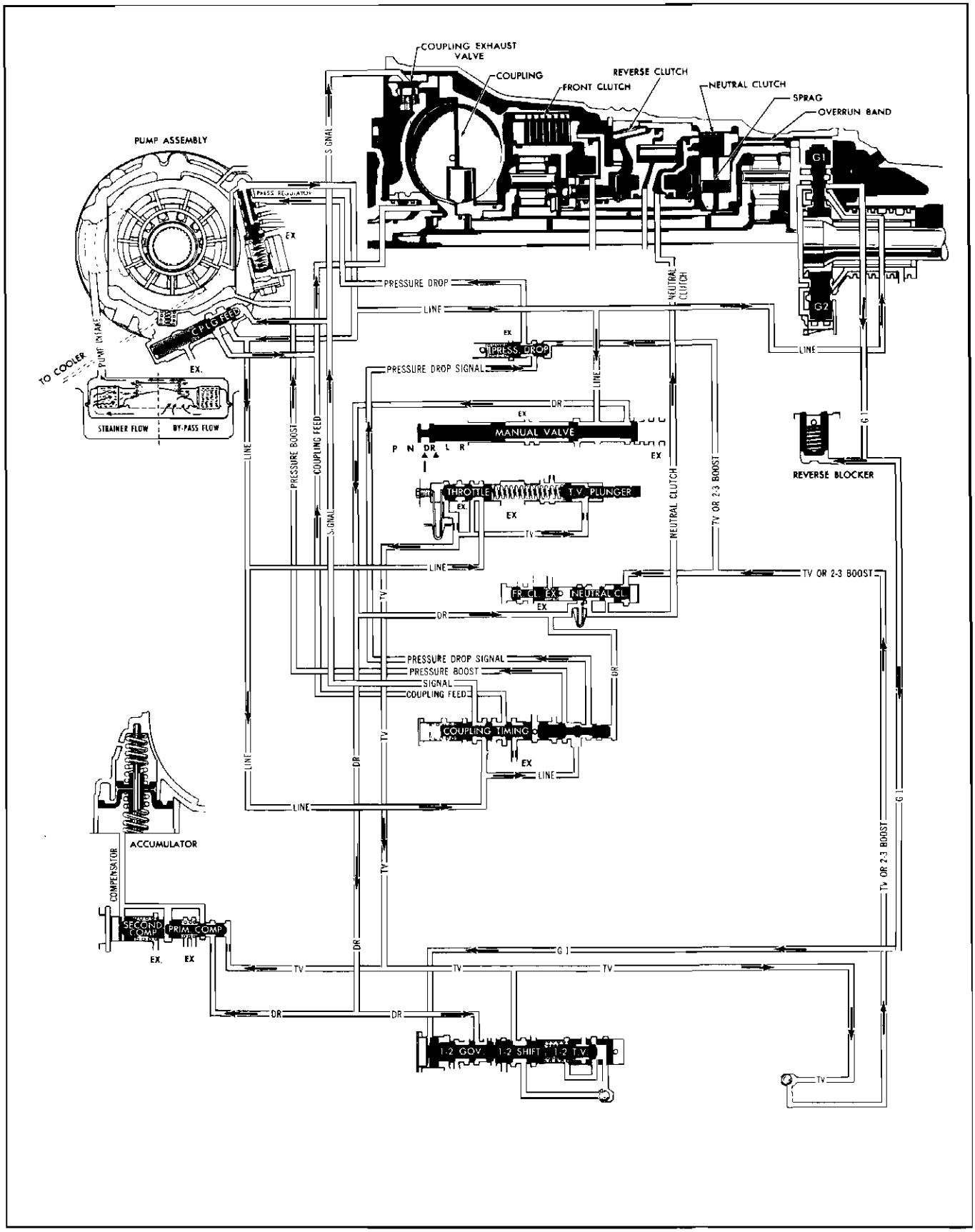

Fig. 25 First Speed—Drive Left

FIRST SPEED—DRIVE LEFT

COUPLING —FILLED
FRONT CLUTCH—OFF
REVERSE CONE —OFF
NEUTRAL CLUTCH—ON
SPRAG —EFFECTIVE
OVERRUN BAND—OFF

When the selector lever is moved to the drive position, the manual valve is repositioned to allow line pressure to enter the drive oil circuit. Drive oil then flows to the following:

Neutral Clutch Valve

1-2 Shift Valve Train

Pressure Boost Valve

Primary Compensator Valve for use during 1-2 shift.

BASIC CONTROL

Drive oil to the Neutral Clutch Regulator Valve is directed into the neutral clutch apply passage. The neutral clutch valve senses a balance between neutral clutch apply pressure and T.V. plus spring pressure to regulate the flow of neutral clutch apply pressure to insure a smooth but firm clutch application under all throttle conditions. As the neutral clutch applies the sprag becomes effective for first speed.

PRESSURE CONTROL

Pressure control in first speed is identical to that in neutral.

TIMING CONTROL

FAIL SAFE FEATURES

To provide a safety feature, five check balls have been placed in the hydraulic circuit. Normally, these balls restrict the oil to its normal circuit. However, if certain valves stick in the wrong position, the balls will shift and provide an alternate source of pressure to the necessary units so the transmission continues to operate.

SUMMARY

The coupling is filled, the neutral clutch is applied and the sprag is effective placing the transmission in first.

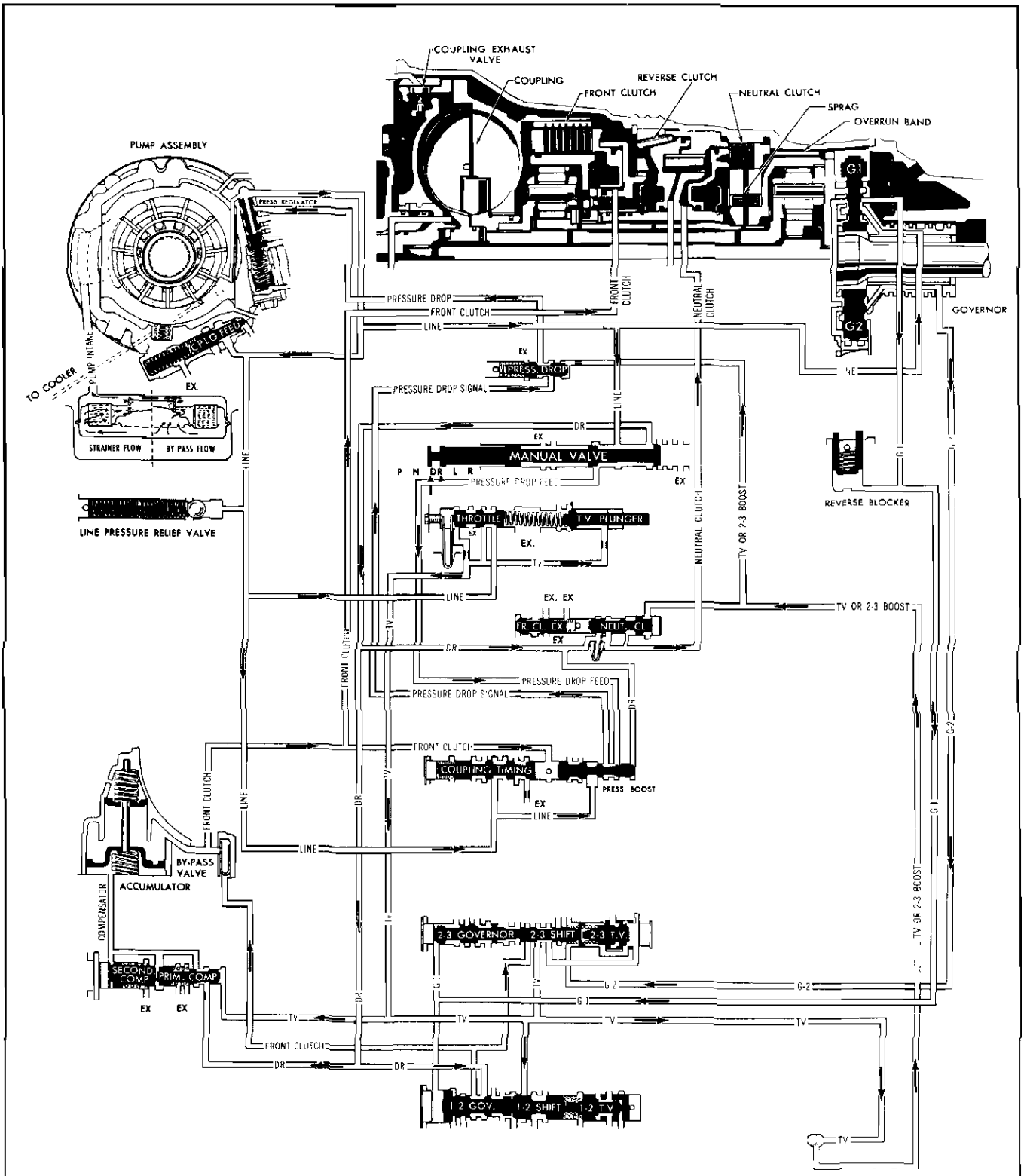

Fig. 26 Second Speed—Drive Left

SECOND SPEED—DRIVE LEFT

COUPLING—EMPTY	REVERSE CONE —OFF	SPRAG —EFFECTIVE
CLUTCH —ON	NEUTRAL CLUTCH—ON	OVERRUN BAND—OFF

As vehicle speed and G-1 pressure increases, the force of G-1 acting on the 1-2 governor valve will overcome the force of the 1-2 shift valve spring, 1-2 T.V. spring, and modulated T.V. pressure. This causes the 1-2 governor valve to open, which allows drive oil to enter the front clutch passage. Simultaneously shift T.V. to the 1-2 T.V. valve is cut off at the 1-2 shift valve, and first gear oil is exhausted through the 1-2 shift valve.

BASIC CONTROL

Front clutch oil from the 1-2 governor valve then is directed to the 2-3 shift valve for later use and, after passing an orificed one way check valve, to the:

a. Front Clutch

b. Front Clutch Accumulator

c. Coupling Timing Valve

d. Pressure Boost Valve

Front clutch oil to the front clutch applies the clutch, and moves the coupling timing valve against the spring cutting off line pressure to the signal passage. As signal pressure is cut off, the coupling exhaust valves open, thus allowing the coupling to empty and the coupling feed limit valve closes, cutting off coupling feed pressure to the coupling.

PRESSURE CONTROL

Front clutch to the pressure boost valve overcomes drive oil at the opposite end, thus moving the valve to cut off line pressure from entering the pressure boost passage. Because pressure drop feed is again directed through the boost valve line pressure will then drop to a variable value of (74-105 psi). Front clutch oil is used on the pressure boost valve since it is a signal oil which notifies the pressure boost valve that the oil pressure in the clutch itself is sufficiently high to allow the clutch to carry second gear torque. Also, if the line pressure were not kept in a boosted condition temporarily, the neutral clutch would not have sufficient pressure to prevent its slipping before the transmission had completed the shift to second gear.

TIMING CONTROL

Front clutch oil is directed to the accumulator to provide a cushion for clutch apply pressure. Compensator pressure is also fed to the accumulator to control the amount of cushioning the accumulator will provide according to throttle opening. At light throttle, compensator pressure is low, thus allowing the accumulator to absorb a greater amount of clutch oil for greater cushioning. At heavy throttle, compensator assists the lower accumulator spring in acting against clutch pressure to give a firmer and smoother clutch application. Front clutch oil acting on the coupling timing valve times the movement of the valve and the resulting exhaust of the coupling to coincide with the application of the front clutch.

SUMMARY

The front clutch is now applied and the coupling is empty shifting the transmission into second speed.

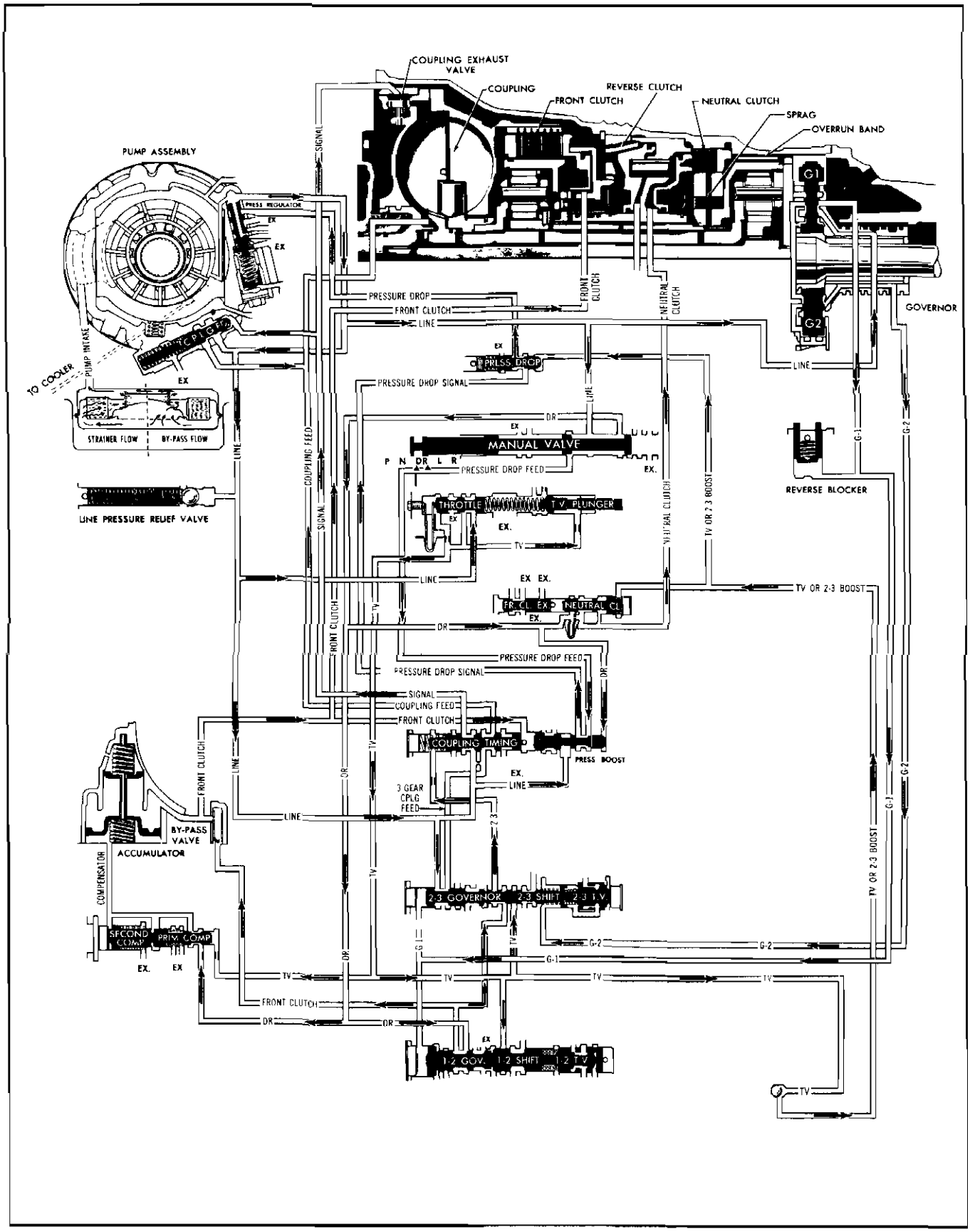

Fig. 27 Third Speed—Drive Left

THIRD SPEED—DRIVE LEFT

COUPLING —FILLED	REVERSE CONE —OFF	SPRAG —OVERRUN
FRONT CLUTCH —ON	NEUTRAL CLUTCH —ON	OVERRUN BAND —OFF

As vehicle speed increases further, G-1 and G-2 pressure and the 2-3 shift valve spring acting on the 2-3 shift valve train will overcome the force of the T.V. regulator spring and modulated T.V. pressure on the 2-3 shift valve. The shift valve will then open allowing front clutch pressure and line pressure to enter the 2-3 and 3rd speed coupling feed passages respectively. T.V. pressure is now cut off from entering the shift T.V. passage.

BASIC CONTROL

2-3 oil will then reposition the coupling timing valve to allow signal pressure to close the coupling exhaust valves and open the coupling feed limit valve to provide coupling feed. Third gear coupling feed pressure flows to the coupling timing valve where it provides an additional source for coupling feed pressure.

PRESSURE CONTROL

Under most driving conditions line pressure is not changed between second and third speed however, below approximately 28 psi T.V. pressure, the 2-1 cutoff valve opens against T.V. pressure to allow 2-3 pressure to enter the 2-3 transfer passage. 2-3 transfer oil then opens the 2-3 boost valve against spring pressure to allow 2-3 transfer oil to enter the 2-3 boost passage and in turn flows past a ball check valve to the pressure drop valve to prevent line drop from occurring. Simultaneously 2-3 boost pressure flows past a second ball check valve to enter the passage which supplies the source for line boost. Line pressure is then raised to a sufficient value to give a fast coupling feed. As the coupling fills and reaches operating pressure, coupling feed pressure acts on the end of the 2-3 boost valve to cut off 2-3 transfer oil and the source for line boost pressure. With the 2-3 boost pressure cut off, T.V. pressure is again directed through the ball check valve to control line drop signal pressure. Line pressure will then drop to its normal third speed value (74-105.2 psi).

SUMMARY

The front clutch remains applied and the coupling is filled so the transmission is in third speed.

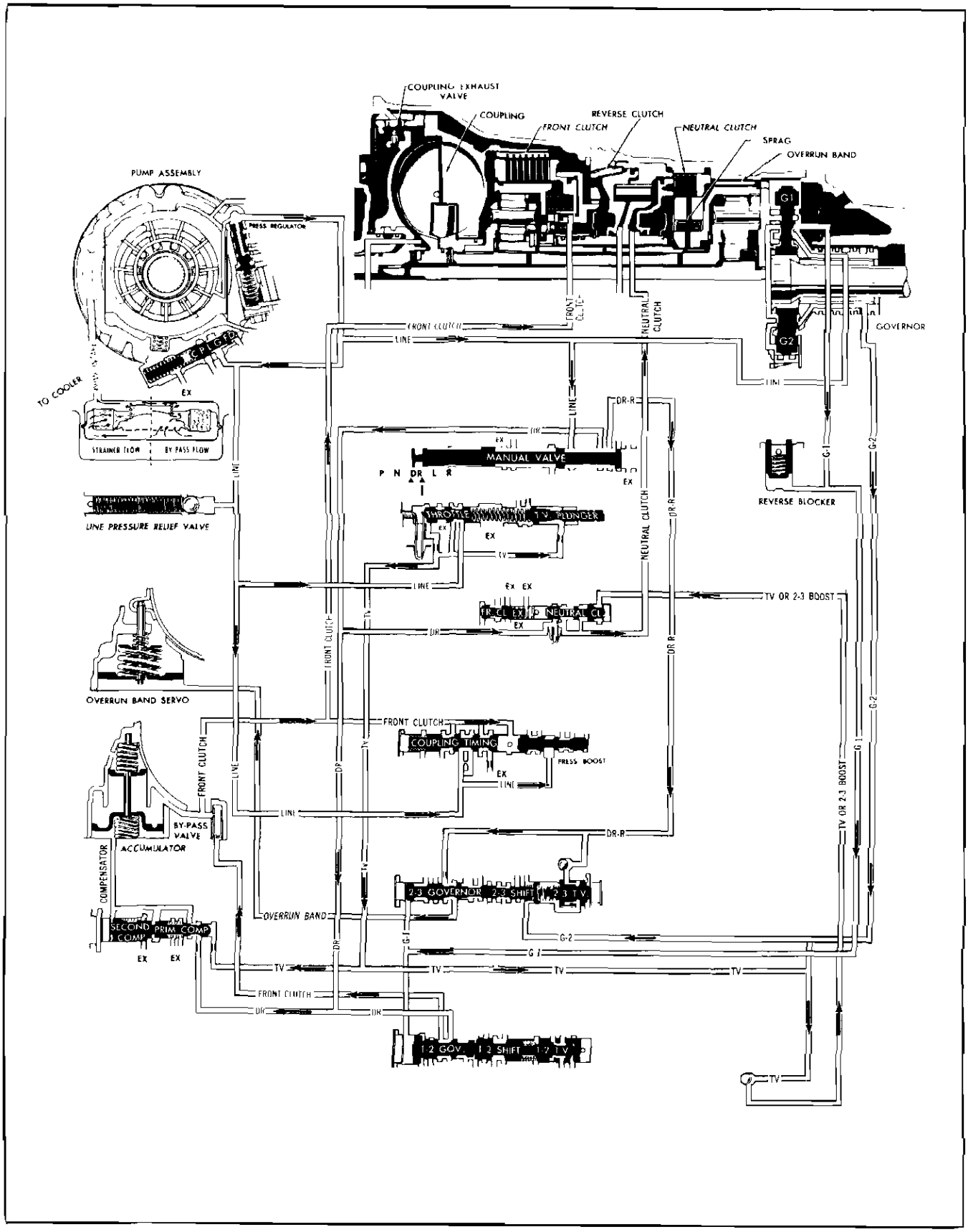

Fig. 28 Second Speed—Drive Right

SECOND SPEED—DRIVE RIGHT

COUPLING —EMPTY
FRONT CLUTCH—APPLIED
REVERSE CONE —OFF
NEUTRAL CLUTCH—APPLIED
SPRAG —EFFECTIVE
OVERRUN BAND—ON

Oil flow in intermediate range-second speed is primarily identical to that in drive range second speed, with the following exceptions:

1. OIL PRESSURE

When the manual valve is in the right drive position the line drop feed passage is cut off. This stops the source of line drop pressure so that line pressure is constant at approximately 105 psi regardless of throttle opening.

2. INTERMEDIATE RANGE PRESSURE

Right drive range pressure from the manual valve performs two functions. First, it is directed through the ball check against the large end of the 2-3 shift valve to prevent a 2-3 shift from normally occurring in the intermediate range.

As a safety feature, it is possible to obtain a 2-3 upshift in the intermediate range but only above the speed at which the normal drive range through detent 2-3 upshift occurs.

Secondly, it is directed through the 2-3 governor valve to apply the overrun servo and band for overrun braking in second gear.

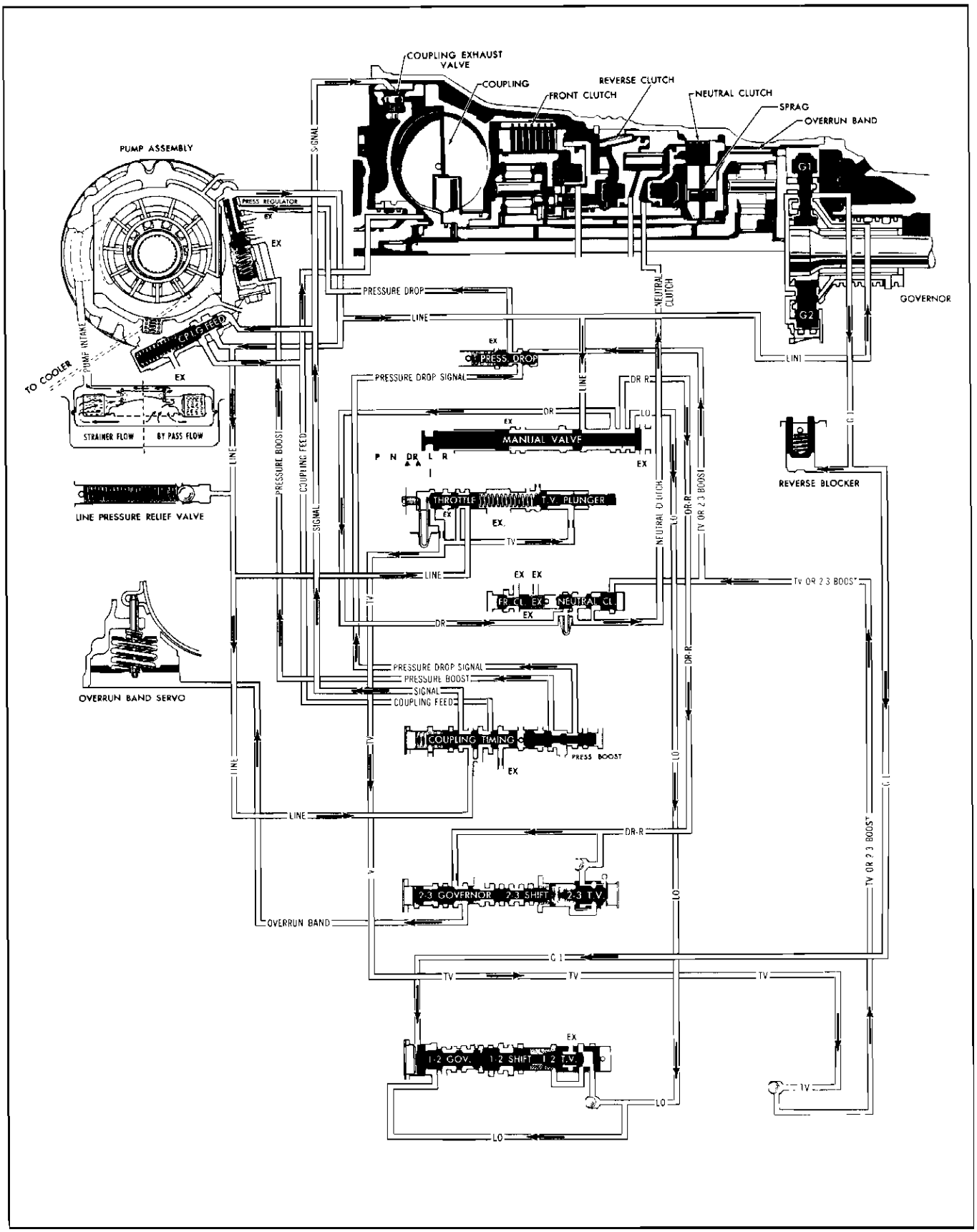

Fig. 29—First Speed—Lo Range

FIRST SPEED—LO RANGE

COUPLING —FILLED
FRONT CLUTCH—OFF
REVERSE CONE —OFF
NEUTRAL CLUTCH—ON
SPRAG —EFFECTIVE
OVERRUN BAND—ON

When the selector lever is placed in the Lo position, the Manual Valve is moved to uncover an additional source of pressure, Lo oil.

Lo oil is directed to two locations:

1. Against the large end of the 1-2 Governor Valve to work against the force of G-1 pressure.

2. Through the ball check valve, past the 1-2 T.V. regulator valve to act against the 1-2 shift valve to further assist in keeping the 1-2 shift valve closed against G-1 pressure.

The primary purpose of Lo oil is to provide a definite means of preventing a 1-2 upshift from occurring in the Lo range position.

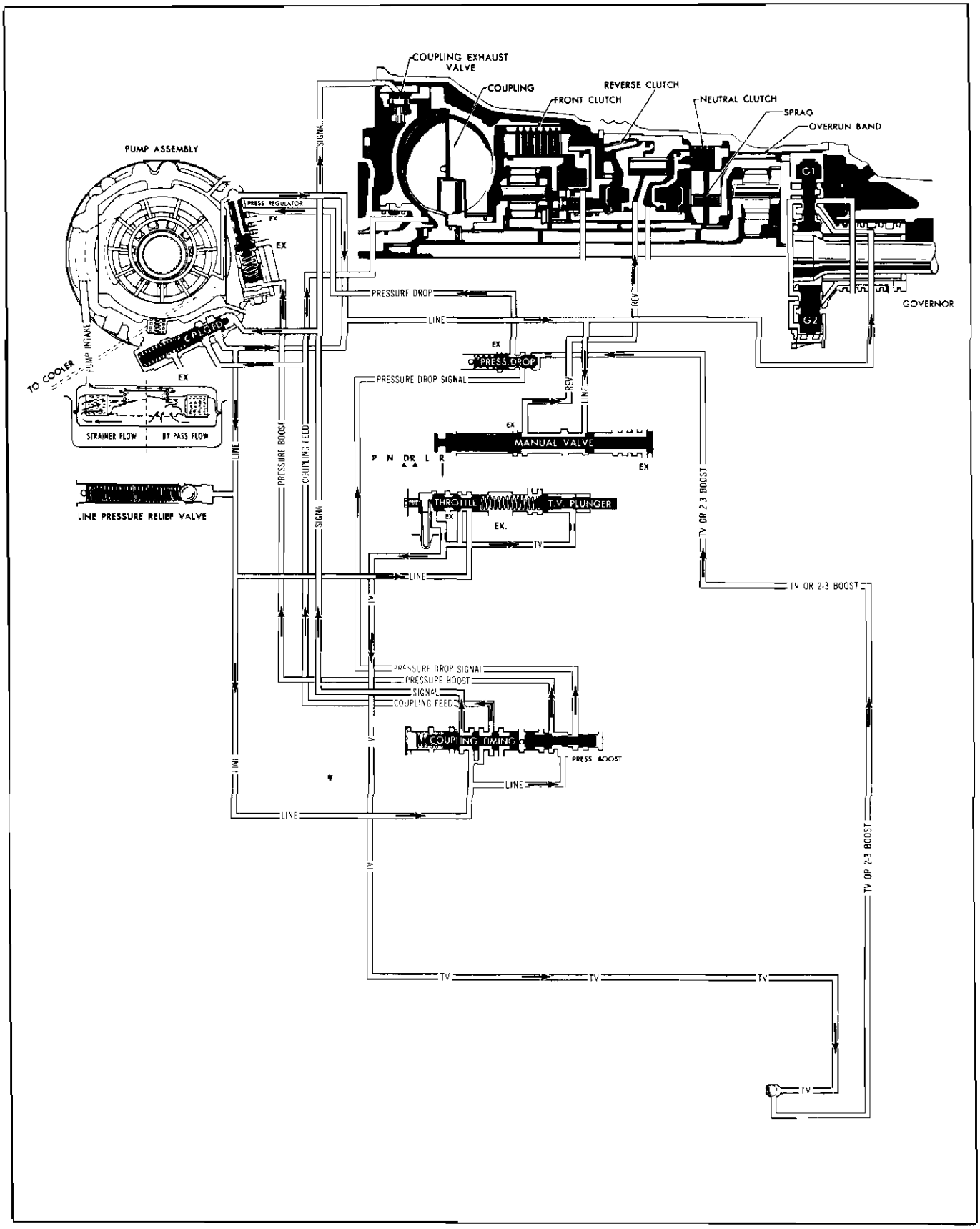

Fig. 30 Reverse

REVERSE

COUPLING —FILLED
FRONT CLUTCH—OFF
REVERSE CONE —ON
NEUTRAL CLUTCH—OFF
SPRAG —INEFFECTIVE
OVERRUN BAND—OFF

When the selector lever is moved to the Reverse position, the manual valve is repositioned to exhaust Drive, Intermediate and Lo Oil. Reverse pressure from the manual valve is allowed to enter the control system.

BASIC CONTROL

Reverse pressure applies the reverse cone.

Line pressure, through the coupling timing valve enters the signal passage to close the coupling exhaust valves and open the coupling feed limit valve for coupling fill.

PRESSURE CONTROL

Pressure control in reverse is identical to that obtained in neutral. Line pressure will vary from 132-180 psi. depending on T.V. pressure.

DRIVE LEFT—PART THROTTLE 3-2

COUPLING—EXHAUSTING

At vehicle speeds below approximately 35 mph a 3-2 downshift can be obtained by depressing the accelerator a given amount. When the accelerator is depressed sufficiently, T.V. pressure acting hehind the T.V. plunger is allowed to enter the part throttle T.V. passage. Because the 2-3 shift valve is open, part throttle T.V. enters the shift T.V. passage and acts against the large end of thc 2-3 T.V. valve which causes the 2-3 shift valve to close.

BASIC CONTROL

As the 2-3 shift valve closes, 2-3 oil and 3rd speed coupling fill oil from the 2-3 shift valve are cut off, thereby causing the coupling to exhaust shifting the transmission back into second gear.

PRESSURE CONTROL

The pressure remains the same as in third speed.

DRIVE LEFT—DETENT 3-2

COUPLING—EXHAUSTING

While operating in third gear at speeds below approximately 62 mph, a forced or detent 3-2 downshift is available. This is accomplished by depressing the accelerator fully.

As this is done, the T.V. plunger is fully depressed exposing the detent passage to T.V. pressure. Detent pressure which flows past the ball check is directed against the large land of the 2-3 shift valve.

Detent pressure will overcome the force o˙ G-1 and G-2 pressure and one spring acting in the opposite direction, thereby causing the 2-3 shift valve to close. The transmission will then shift into second gear.

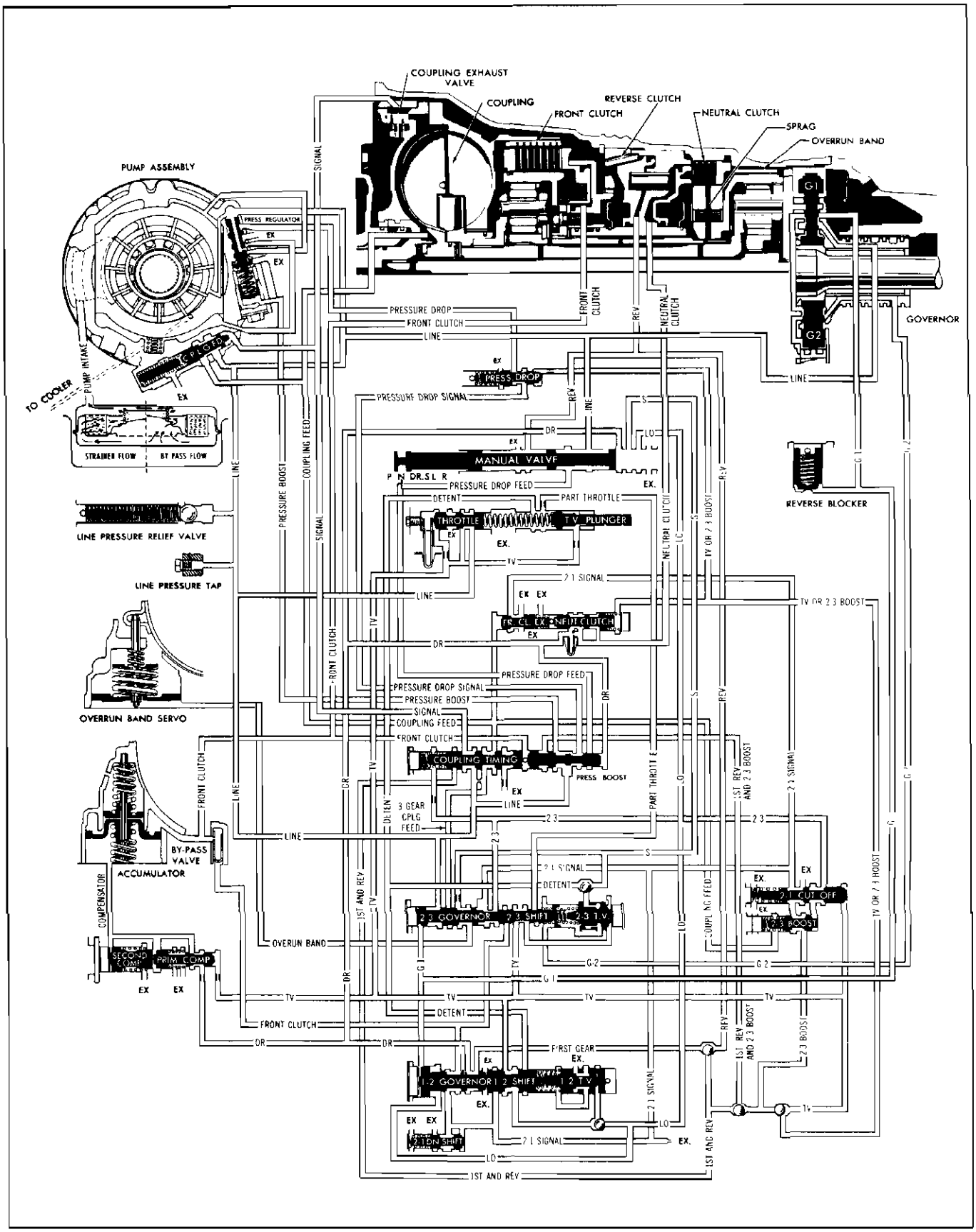

Fig. 31 Complete Oil Circuit Diagram

DRIVE LEFT—DETENT 2-1

COUPLING —FILLING
FRONT CLUTCH—EXHAUSTING

At vehicle speeds below approximately 22 mph in second gear a forced or detent 2-1 downshift can be obtained by depressing the accelerator fully past the detent. This causes the T.V. plunger to open the detent passage to T.V. pressure. Detent pressure then enters the 1-2 shift pressure passage to act against the 1-2 T.V. valve. This causes the 1-2 shift valve to close against the force of G-1 pressure.

BASIC CONTROL

As the 1-2 shift valve closes, drive oil to the front clutch is cut off and all front clutch pressure in the front clutch and accumulator is compelled to exhaust into the 2-1 signal passage. The spring repositions the coupling timing valve to provide coupling signal pressure and coupling feed pressure.

PRESSURE CONTROL

Drive oil acting on the pressure boost valve repositions the valve against exhausting front clutch oil to provide both boost pressure and line drop signal.

TIMING CONTROL

During a heavy throttle 2-1 downshift the release of the clutch must be timed to coincide with the filling of the coupling. To accomplish this timing exhausting front clutch oil or 2-1 signal oil is used as follows:

1. It flows through the closed 2-3 shift valve into the 2-3 passage to rapidly reposition the coupling timing valve for coupling fill.

2. It flows to the 2-1 cut off valve where a rapid exhaust is obtained at light throttle only, but no effect is obtained at heavy throttle 2-1 shifts.

3. It regulates to exhaust through the 2-1 downshift valve that will hold the front clutch torque in second speed but not in first speed. This feature permits the front clutch to handle the transmission torque in second gear until such time that first gear torque is predominant.

4. It rests against the front clutch exhaust valve until such time that coupling pressure attains a sufficient value to handle torque capacity in first gear. Coupling pressure then opens the front clutch exhaust valve to exhaust all remaining 2-1 signal or front clutch oil.

DRIVE LEFT—LIGHT THROTTLE 2-1

During a light or closed throttle 2-1 downshift, as the 1-2 shift valve closes, drive oil to the front clutch passage is cut off; however, all front clutch pressure in the system is exhausted into the 2-1 signal passage. Because T.V. pressure is slight with light throttle, the 2-1 cut off valve is open to exhaust the 2-1 signal oil. This allows an immediate exhaust of front clutch oil.

DRIVE LEFT—LIGHT THROTTLE 2-3

BASIC CONTROL

The basic control on light throttle 2-3 upshifts is the same as a basic 2-3 upshift.

PRESSURE CONTROL

When a 2-3 upshift is made at light throttle positions the 2-1 cut off valve is positioned against T.V. pressure by the spring. This allows 2-3 oil to flow past the 2-1 cut off valve, thus opening the 2-3 boost valve against the spring. This allows 2-3 oil to flow into the 2-3 boost passage and in turn past a ball check valve to the pressure drop valve. This closes the pressure drop valve cutting off pressure drop. Simultaneously, 2-3 boost oil flows past another ball check valve into the 1st, Reverse and 2-3 boost passage where it supplies an alternate source for pressure boost. Line pressure is then raised to a sufficient value to provide a fast coupling feed. As the coupling fills and reaches operating pressure, coupling feed pressure acts on the end of the 2-3 boost valve to cut off the source of boost pressure. With 2-3 boost cut off, T.V. pressure is again directed through the ball check valve to control the pressure drop valve. Line pressure will then drop to its normal third speed value.

PERIODIC SERVICE RECOMMENDATIONS

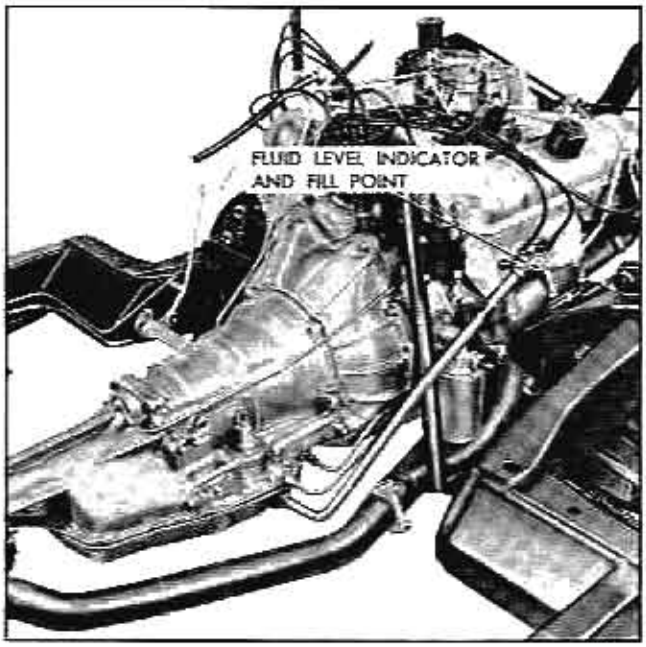

Fig. 32 Fluid Level Indicator

TRANSMISSION FLUID

Transmission fluid level should be checked (with transmission warm) every 2000 miles at time chassis lubrication is performed. Procedure for checking level is included on page 41 of this manual. Hydra-Matic fluid should be changed every 25,000 miles. Instructions for draining and refilling appear on page 41.

Since the Hydra-Matic transmission is very sensitive to oil level, special precautions should be taken when checking the oil level otherwise valve buzz or shift malfunctions may be experienced. Do not overfill.

FLUID LEVEL INDICATOR

The fluid level indicator is located in the filler pipe at the right rear corner of the engine (Fig. 32). To bring fluid level from lower mark to full mark requires 1 pint (Fig. 33).

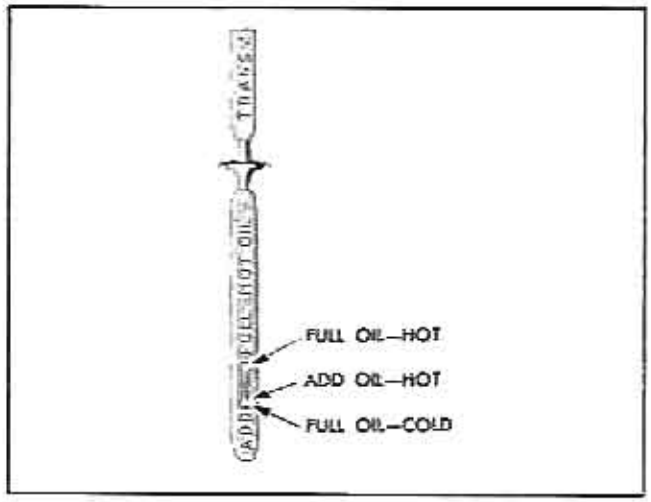

Fig. 33 Indicator Markings

NEW CAR AND 2000 MILE INSPECTIONS

New car and 2000 mile inspections should be performed as outlined on form S6110, "1961 Pontiac New Car Pre-Delivery and 2000 Mile Inspection and Adjustment." When road testing during both the new car and 2000 mile inspection, following items are important:

1. Neutralizer switch should not start except in park and neutral (page 40).

2. Index Hydra-Matic indicator pointer.

3. Fluid level should be to the FULL mark with transmission at normal operating temperature (with cold oil fluid level should be at ADD mark).

GENERAL RECOMMENDATION

Observe operation of transmission when car is road tested for any reason at any time.

ADJUSTMENTS WITH TRANSMISSION IN CAR

CONTENTS OF THIS SECTION

ADJUST THROTTLE CONTROL LINKAGE

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

1. Remove air cleaner.

2. Loosen both nuts at transmission throttle control rod trunnion (Fig. 34).

3. Adjust engine idle speed to 480-500 rpm *in drive range* (540-560 with air conditioning).

4. Shut off engine and install linkage adjustment pin J-7687 through holes in throttle control lever and bracket (Fig. 34).

NOTE: Four-barrel units are equipped with a throttle return check. Before installing pin, it will be necessary to either remove throttle return check or install tool J-6342-01 over return check so that it will not interfere with linkage adjustment.

5. With throttle valves fully closed, loosen lock nut and adjust length of transmission throttle control rod to carburetor (Fig. 34) so that gauge pin is free in hole. Leave pin installed and tighten lock nut securely. Recheck freeness of gauge pin in holes.

6. Push T.V. upper control rod downward until the outer T.V. lever is felt to touch end of travel (Fig. 35).

CAUTION: Make sure that, when lever is in this position, the upper lock nut is not touching trunnion.

7. While holding T.V. upper control in this position, tighten upper and lower trunnion lock nuts finger tight (Fig. 35). Shorten T.V. upper control rod by backing off lower trunnion nut 2½ turns and tighten upper nut securely. Remove gauge pin.

8. Loosen lock nut on carburetor throttle rod (Fig. 34).

9. Adjust carburetor throttle rod to obtain 4.55" clearance from underside of attaching boss on pedal to body toe pan as shown in Fig. 36 (approx. 3¾" to carpet).

10. Tighten lock nut on carburetor throttle rod securely.

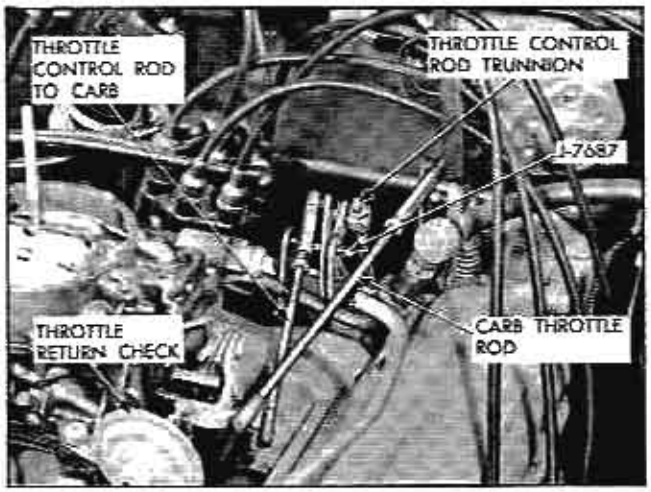

Fig. 34 Linkage Pin Installed

11. Install air cleaner.

12. After throttle linkage adjustment has been made, road test car and tailor adjustment as required by shortening or lengthening the T.V. upper control rod one half turn at a time to obtain the best shift feel.

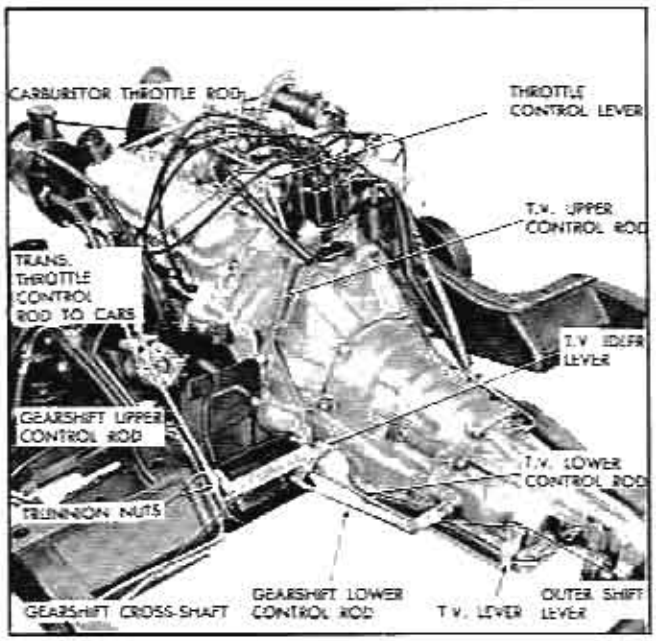

Fig. 35 Throttle Control Linkage

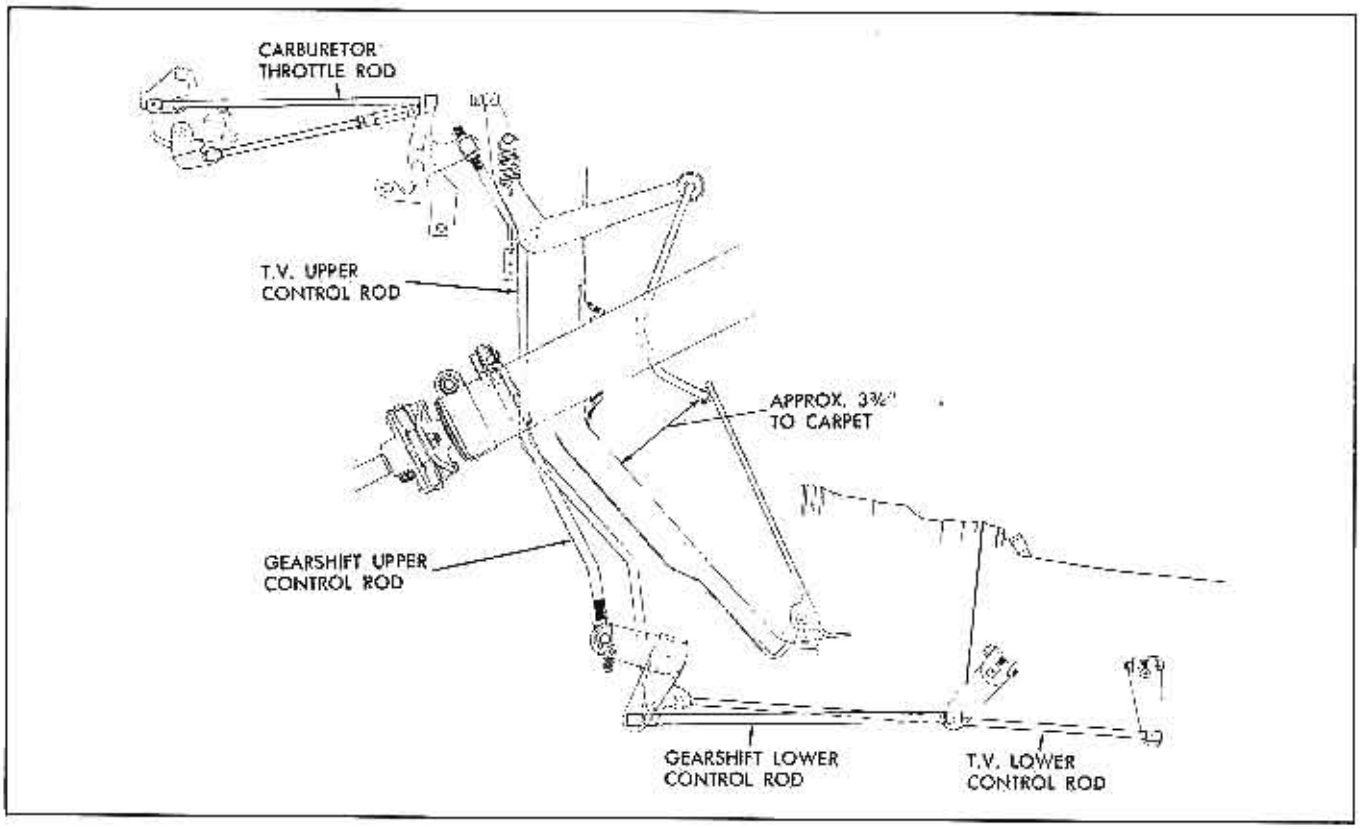

Fig. 36 Accelerator Linkage

ADJUST SELECTOR LEVER LINKAGE

1. Put upper shift control lever and transmission lever in park P position and, with the transmission outer shift lever trunnion nuts (Fig. 35) backed clear of the trunnion, pull the shift rod down toward the transmission as far as possible. While holding rod in this position, run the trunnion upper nut down to just contact the trunnion. Run lower nut up to contact trunnion and lock nuts securely.

2. After completing above adjustments, check transmission parking lock with car on ramp or grade for positive lock.

3. Place upper shift lever in Drive Right position and check Hydra-Matic indicator pointer index. If necessary to adjust, loosen check nut above ball stud, adjust index by rotating rod and lock check nut securely.

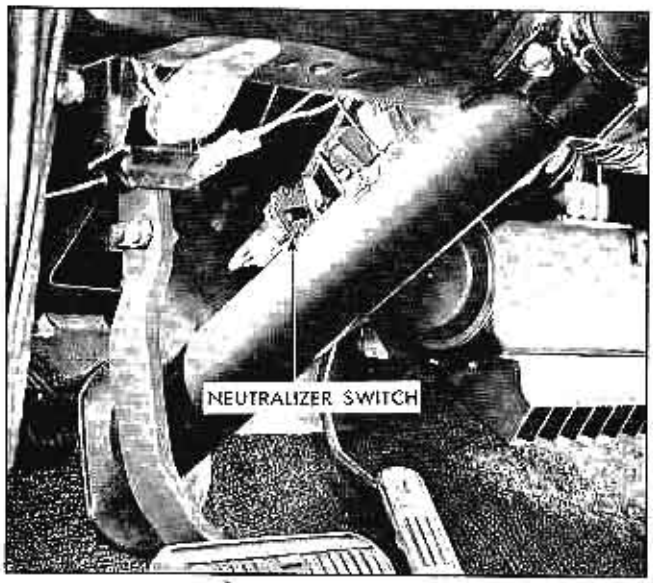

Fig. 37 Neutralizer Switch

ADJUST NEUTRALIZER SWITCH

1. Place selector lever in Neutral position.

2. Loosen switch mounting screw (Fig. 37).

3. Adjust neutralizer switch to index with selector lever. Starter must not operate when ignition key is turned to start position with selector lever in ▲DR position.

4. Test to see that engine starts when selector is in P or N position.

5. Tighten switch mounting screw securely.

MINOR SERVICE AND REPAIRS

CONTENTS OF THIS SECTION

Services outlined in this section can be performed without removing the transmission from the car. Complete procedures are not given for all of these services, since they are covered in detail under "Remove Units from Case" and "Install Units into Case."

CHECKING OIL LEVEL

1. Park car on level floor, place selector lever in park position and run engine until it reaches normal operating temperature (to make certain transmission is at normal operating temperature).

2. With engine idling at normal idle speed, check oil level indicator (Fig. 32) and note reading (Fig. 33). NOTE: When adding fluid use Automatic Transmission Fluid (Type A) from containers bearing Armour Institute qualification designation "AQ-ATF".

Since the 3-speed transmission is very sensitive to oil level, special precautions should be taken when checking the oil level otherwise valve buzz or shift malfunctions may be experienced. Do not overfill.

FLUID CAPACITY, DRAINING AND REFILLING

CAPACITY

Approximately 4¼ quarts of fluid are required to refill transmission after oil pan has been drained as outlined below. When unit has been disassembled and rebuilt, approximately 8½ quarts will be required to refill. Use only Automatic Transmission Fluid (Type A) from containers bearing Armour Institute qualification number "AQ-ATF . . .".

DRAINING AND REFILLING TRANSMISSION

Transmission oil should be changed every 25,000 miles at which time it is also recommended that the oil pan be removed and the oil intake strainer be replaced.

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

To drain oil proceed as follows:

1. Disconnect filler pipe from right side of oil pan and drain transmission.

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

2. Remove oil pan and oil strainer.

3. Thoroughly clean oil pan.

4. Install strainer using new pump intake pipe "O" ring if necessary.

5. Affix new gasket to oil pan with petrolatum.

6. Install oil pan, tighten attaching screws securely.

7. Connect filler pipe to oil pan.

8. Remove oil level indicator and wipe it clean.

9. If only the oil pan has been removed, pour 4 quarts of fluid into the transmission. If the valve body has also been removed, use 5 quarts. After a complete overhaul, 8 quarts are required. BE SURE CONTAINER, SPOUT, OR FUNNEL IS CLEAN.

10. Start engine and let engine idle (carburetor off fast idle step). Place selector lever in P position and apply hand brake.

11. With transmission warm (approximately 150°F), add fluid to bring level to full mark on indicator.

CAUTION: Do not overfill—foaming will result.

12. Replace oil level indicator and stop engine.

PRESSURE REGULATOR VALVE

REMOVAL

1. Remove left-hand inspection cover on case cover.

2. Using 3/4" socket, remove regulator valve plug, stop, spring, and valve from pump body.

INSTALLATION

1. Replace "O" ring on plug, if necessary.

2. Place valve plug in 3/4" socket with speed handle.

3. Place the line boost plug in the valve plug, hollow end facing out and then set the valve stop on top of the plug. See line boost plug information below.

4. With the spring attached to the regulator valve, place the spring through the plug stop and into the plug. The assembly is now assembled the same way it is installed in the pump.

5. Feed entire assembly through inspection hole and into the pump. Some manipulation may be required to get the valve and the plug stop properly into their bores. Torque plug to 15-20 ft. lbs.

6. Replace inspection cover.

LINE BOOST PLUG

The line boost plug in the pressure regulator valve assembly is supplied in three different bore depths which provide different line boost pressures.

The plugs are distinguished by either a plain side, a ring, or a groove on the side of the cap at the end of the plug. The plain side plug creates normal pressure, the ring plug a higher pressure and the groove plug creates the highest pressure.

If replacement of a plug is necessary, the same size should be used unless a pressure test shows otherwise.

Procedure for checking line boost pressure is as follows:

1. Disconnect control rod to T.V. outside lever.

2. Secure the T.V. lever in the full T.V. position with a length of wire.

3. Install oil pressure gauge in upper of the two test holes in rear bearing retainer.

4. Start the engine and run at 1500 r.p.m. in P position. Main line pressure should be 176-183 psi.

5. Change line boost plug if necessary to obtain correct pressure.

COUPLING FEED LIMIT VALVE

REMOVAL

1. Remove inspection plate on right hand side of case cover.

2. Coupling feed valve plug is located in the lower portion of the pump and may be removed using a 3/4" socket and an appropriate extension.

3. The valve plug and the pin will come out with the socket. The spring and valve will usually remain in the pump body and may be removed with long nose pliers.

INSTALLATION

1. Using long nose pliers, carefully insert spring and valves (together) into pump with long nose pliers.

2. Replace "O" ring on plug. if necessary.

3. Place the valve plug into the wrench socket and then place the pin into the plug.

4. Insert the plug and pin through the inspection hole and, with the pin in the center of the spring, screw plug into pump. A speed handle wrench works best for starting the plug. Torque to 15-20 ft. lbs.

5. Replace inspection plate.

REAR SEAL AND REAR BUSHING

To remove the rear seal it is necessary only to remove the propeller shaft and then remove the seal from the rear bearing retainer with a screwdriver.

To replace the seal, coat the outer casing with gasket sealing compound and drive it into the rear extension housing with installer J-5154. Replace propeller shaft.

If removal of both the rear bushing and sleeve assembly and the rear seal is necessary, remove the bushing retaining bolt from the left side of the rear bearing retainer and remove the propeller shaft. Bushing remover J-8845, with slide hammer J-2619, is then fitted into the bushing and tightened. The slide hammer will then remove the bushing and seal in one operation.

To replace the bushing, install it, chamfered end first, into the rear bearing retainer aligning the retaining bolt slot with the retaining bolt hole. Install with soft hammer and drift. Coat the casing of the new seal with gasket sealing compound and install with tool J-5154. Replace propeller shaft.

CONTROL VALVE BODY

REMOVAL

1. Remove oil filler pipe and drain transmission.

2. Remove outer throttle lever from shaft.

3. Remove throttle lever seal using a small screwdriver behind the flange.

4. Remove oil pan and gasket.

5. Remove five valve body to rear bearing retainer attaching bolts.

6. Slide valve body off of pipe assembly and remove from transmission.

CAUTION: Do not let manual valve drop out of the valve body during removal.

INSTALLATION

1. Install manual valve in valve body.

2. Apply petrolatum to valve body pipe ports to prevent injury to "O" rings during assembly.

3. Install valve body in rear bearing retainer by guiding throttle shaft through its opening and then positioning manual valve on pick-up pin (detent lever). Guide valve body over pipe assembly and slide forward to seat seals. Attach with five attaching bolts.

4. Install throttle shaft seal over throttle shaft and into case.

5. Place oil pan gasket on oil pan, using petrolatum, and then install oil pan. Torque to 12-15 ft. lbs.

6. Install oil filler pipe.

7. Refill transmission (Page 41).

GOVERNOR

REMOVAL

1. With car on hoist, remove oil filler tube and drain transmission.

2. Remove oil pan.

3. Remove T.V. lower control rod from T.V. outside lever, remove T.V. outside lever, and gearshift control lower rod from outside shift lever.

4. Remove speedometer cable.

5. Remove hand brake cable guide rod and return spring from frame crossmember.

6. Remove rear "U" joint clamps and slide propeller shaft rearward to remove from transmission.

7. Place a jack under front of transmission.

8. Remove 2 rear mount support to crossmember nuts.

9. Remove attaching bolts from each end of crossmember and remove the retaining clamp from the rubber insulator.

10. Raise the jack sufficiently for rear mount support to clear crossmember and remove crossmember.

11. Remove control valve assembly (5 attaching bolts).

12. Lower transmission to remove breather pipe clamp and pull pipe out of its bore.

13. Reach into the rear bearing retainer and remove the 4 governor and output shaft attaching bolts. Hold the outside manual lever forward to engage parking brake when loosening bolts. Rotate shaft as necessary to remove all 4 bolts.

14. Mark the edge of the output shaft flange and a corresponding spot on the inside of the case with a grease pencil to match the output shaft with the planet carrier when reassembling. They will fit together in one position only. Do not rotate the carrier after removing output shaft or guide marks will become meaningless.

15. Remove rear bearing retainer to case attaching bolts (2 are inside) and slide retainer rearward away from transmission.

16. Remove rear bearing retainer cover (4 bolts).

17. Reach through access hole with 90° snap ring pliers and unseat the snap ring from the output shaft.

18. Remove output shaft from front of retainer. Do not strike the inner sleeve of the rear bearing retainer with the speedometer drive gear when removing shaft.

19. Press speedometer drive gear off of shaft using press plates J-8904 and plate holder J-6407.

20. Remove governor.

INSTALLATION

1. Place governor and gasket on output shaft.

2. Drive speedometer drive gear onto output shaft with J-6133-A. Rear side of drive gear should be 69_{32}" from end of shaft.

3. Place snap ring through the access hole in the

rear bearing retainer and slide over end of output shaft as it is carefully installed into the retainer. Seat snap ring in grooves against thrust bearing race.

4. Install rear bearing retainer cover and gasket.

5. Affix rear bearing retainer to case gasket to retainer using petrolatum. Be sure manual shaft retainer is installed.

6. Align guide marks on output shaft flange and case and place unit in position on case assuring that parking linkage is aligned with manual lever.

7. Install 8 rear bearing retainer to case attaching bolts. Use a short bolt in the center hole on each side and one inside the rear bearing retainer. Install breather pipe and breather pipe clip.

8. Install 4 governor attaching bolts rotating shaft as necessary. Hold manual lever forward to engage parking brake while torquing to 19-23 ft. lbs.

9. Raise transmission with jack and install frame crossmember. Brake cables go above crossmember.

10. Lower transmission so rear mount support studs engage the crossmember bracket.

11. Install insulator retainers and 2 attaching bolts at each end of crossmember and install 2 stud nuts on rear mount support.

12. Install propeller shaft by sliding over output shaft and installing the "U" joint clamps on the "U" joint bearings. Bend locking clips.

13. Install control valve body by putting T.V. lever shaft through its seal and positioning the manual valve on its control pin. Slide body carefully forward onto the pipe assembly.

14. Install 5 attaching bolts and torque to 6-8 ft. lbs.

15. Place oil pan gasket on oil pan using petrolatum, and then install oil pan. Torque to 12-15 ft. lbs.

16. Install outside T.V. lever.

17. Install T.V. control rod.

18. Install gearshift lower control rod.

19. Install speedometer cable.

20. Install oil fitter pipe.

21. Install brake cable guide and return spring.

22. Refill transmission as described on page 00.

PARKING LINKAGE

The parking linkage may be removed by following steps 1-17 of the governor removal instructions (page 43). Then push the parking pawl pin from the case with a small rod and remove pin and the pawl pin spacer from the case. The rest of the linkage may then be removed as a unit from the rear of the case.

To replace the parking linkage in the case, install the linkage, as a unit, into the case from the rear and insert the parking pawl shaft into its bore. Place the pawl spacer in the case and then install the pawl pin into the case, through the pawl and spacer. Proceed with steps 4-23 of the governor installation procedure (page 43).

SERVO AND ACCUMULATOR

REMOVAL

1. Remove oil filler pipe and drain transmission.

2. Remove oil pan.

3. Remove oil strainer.

4. Remove compensator valve body (three attaching screws and one bolt).

5. Remove remaining servo and accumulator cover attaching bolts and remove cover. The servo release spring pushes the servo piston against the cover, so care is required to prevent dropping servo piston when cover is removed. Accumulator lower spring and possibly the case center support springs will be removed with the cover.

6. Use the accumulator pin to remove both accumulator pistons and the remaining spring.

7. Remove the case center support seal springs and seals if they did not previously fall free.

INSTALLATION

1. It will be necessary to make a retainer to hold the servo piston in place while the cover is being installed. A rectangular piece of stiff sheet metal can be cut so it will hold the servo piston in its bore when bolted to the right rear oil pan bolt hole.

2. Place upper accumulator piston on piston pin and place tapered spring over the pin with large end of spring against piston and piston seal facing away from spring.

3. Install tapered spring, pin and upper piston into case with small end of spring up. Hold these parts in case and install lower accumulator piston, pocket side down.

4. Screw the ends of the case center support seal springs into the seals far enough so they will not fall off easily and install the seals into the case so the springs are suspended below them. Petrolatum may be needed to help hold the seals and springs in place.

5. Place servo return spring over the servo pin and install assembly in case. Retain it in its bore using the previously mentioned tool bolted to an oil pan hole.

6. Place the remaining accumulator spring in position over the accumulator pin and hold in place while installing servo and accumulator cover. Attach cover with three bolts and leave just loose enough to remove servo retaining tool. Make sure the three seal springs enter the case straight.

7. Remove servo retaining tool and install remaining cover bolts except the strainer attaching bolt. Torque to 6-8 lb. ft.

8. Install compensator.

9. Install oil strainer.

10. Fix new gasket to oil pan with petrolatum and install oil pan.

11. Install filler tube and refill transmission according to instructions on page 41.

REMOVAL OF TRANSMISSION

Before raising the car on the lift, remove one cable (either one) from the battery, since the starter must be removed, and release the emergency brake.

1. Remove the filler tube and drain the transmission. Push the filler tube up toward its upper bracket out of the way.

2. Disconnect propeller shaft from transmission:

a. Remove "U" bolt nuts, lock plates, and "U" bolts from rear axle drive pinion flange.

b. Use a suitable rubber band or tape to hold bearings on "U" joint journals if tie wire is broken.

c. Slide propeller shaft rearwards off transmission output shaft.

3. Disconnect speedometer cable from speedometer driven gear.

4. Remove gearshift control lower rod.

5. Remove lower end of gearshift control upper rod by removing "E" ring.

6. Remove the 2 cross-shaft bracket to frame attaching bolts and then remove the bracket, cross-shaft lever, and bushing from car.

7. Remove lower end of throttle control transmission rod (engine to transmission idler lever).

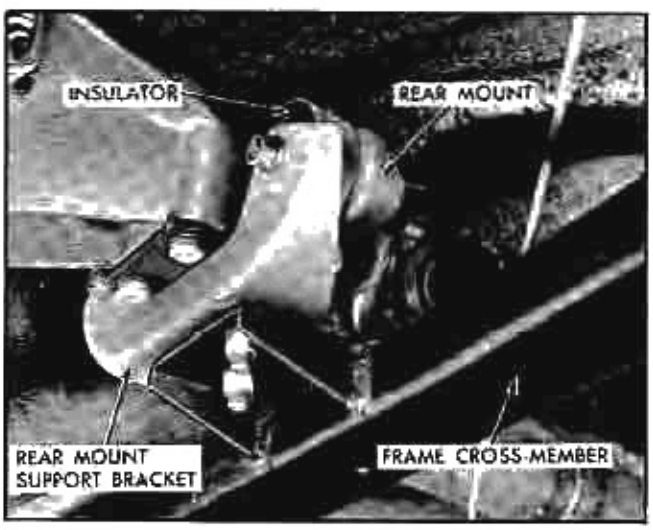

Fig. 38 Rear Mount

8. Remove idler lever to outer T.V. lever control rod.

9. Remove throttle control idler lever.

10. Remove parking brake return spring and brake cable guide hook from frame crossmember.

11. Remove oil cooler lines.

12. Loosen exhaust pipe to manifold bolts about ¼ inch.

13. Remove both starter cables.

14. Remove the starter and the splash shield by removing the 2 attaching bolts.

15. Remove bottom cover from bottom of case cover (3 attaching bolts).

16. Remove the 4 bolts holding the flywheel front cover plate to the transmission case cover.

17. Place special automatic transmission jack under transmission and raise it enough to support the transmission.

18. Remove 2 rear mount support to frame crossmember nuts and raise transmission so studs clear the crossmember (Fig. 38).

19. Remove the two bolts at each end of the frame crossmember and remove crossmember.

20. Lower the transmission until the jack is barely still supporting it.

21. Remove breather pipe clip bolt and remove pipe from transmission.

22. Using a long wrench extension with a "U" joint, remove the remaining 6 transmission case cover to engine attaching bolts.

23. Raise transmission to its normal position, slide rearward from the engine and flywheel, and lower it away from the car.

24. Remove rear mount support from rear mount by removing a nut from each insulator.

25. Remove 4 rear mount to rear bearing retainer attaching screws.

REMOVAL OF UNITS FROM TRANSMISSION CASE

CONTENTS OF THIS SECTION

REMOVAL OF INDIVIDUAL UNITS FROM TRANSMISSION CASE

CONTROL VALVE, SERVO, AND ACCUMULATOR

1. Attach transmission holding fixture J-8763 to transmission case (Fig. 39). Tighten handscrews moderately so case is not distorted making removal of case center support difficult.

2. Remove outer shift lever and T.V. lever.

3. Place transmission and holding fixture into bench adaptor J-6115-A rotating transmission so that bottom pan is up.

4. Remove 21 oil pan attaching screws.

5. Remove oil pan and gasket.

6. Remove oil strainer attaching bolt.

7. Remove oil strainer from transmission.

8. Inspect and remove, if necessary, oil strainer to case "O" ring seal with small blade screwdriver.

9. Pry throttle shaft seal from side of rear bearing retainer (rear extension housing) with small screwdriver (Fig. 40).

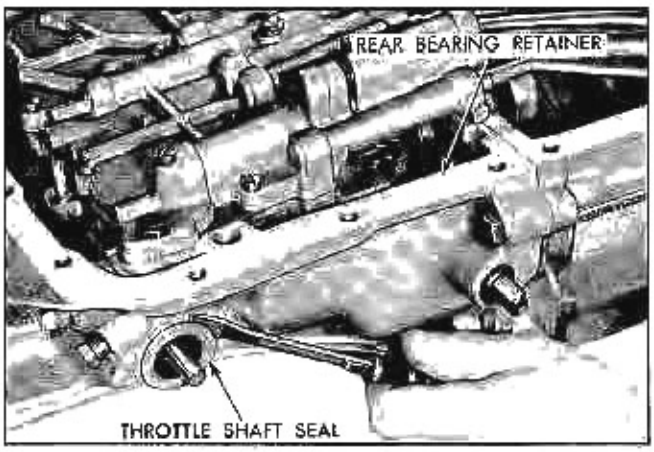

Fig. 40 Removing Throttle Shaft Seal

10. Remove five (5) control valve assembly attaching bolts and carefully remove control valve assembly from the pipe assembly and rear bearing retainer being careful not to drop the manual valve (Fig. 41).

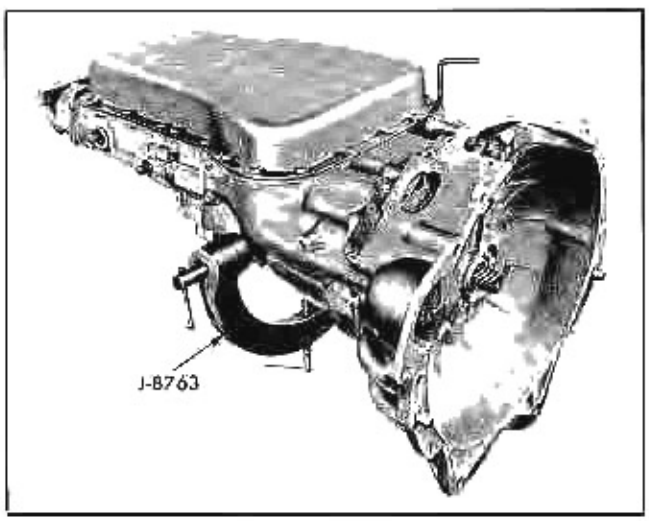

Fig. 39 Transmission in Holding Fixture

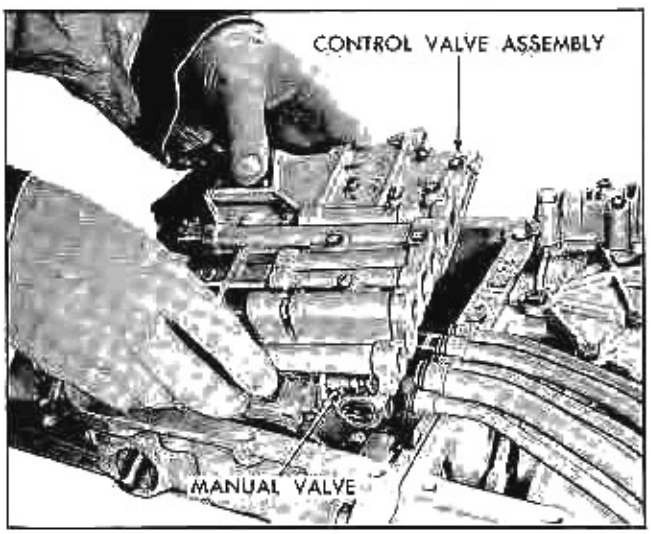

Fig. 41 Removing Control Valve Body

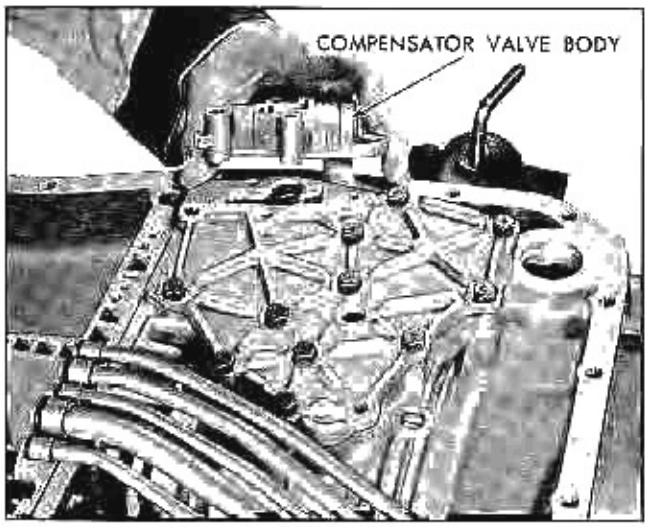

Fig. 42 Removing Compensator Valve Body

11. Remove manual valve from control valve assembly.

12. Remove 1 bolt and 3 screws attaching the compensator valve body assembly to the servo and accumulator cover.

13. Remove the compensator valve body assembly (Fig. 42).

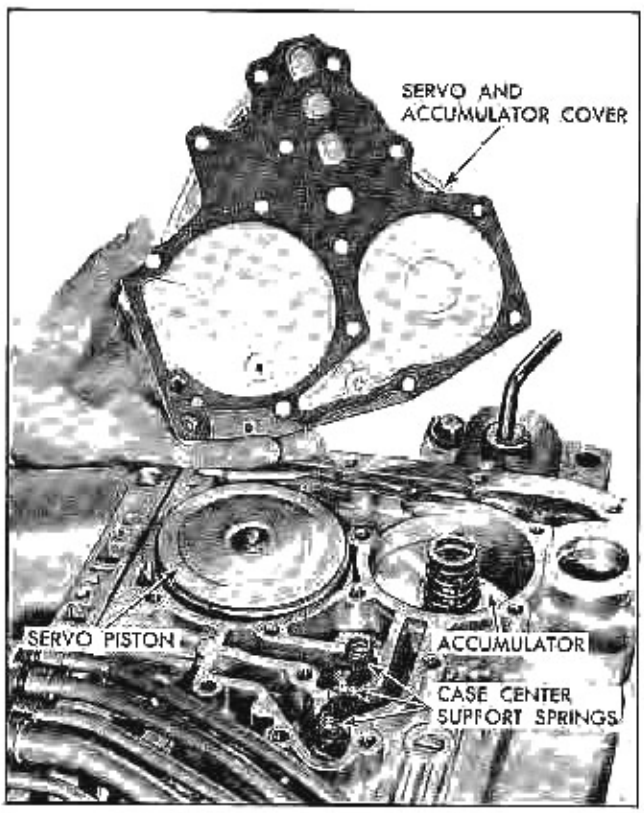

Fig. 43 Removing Servo and Accumulator Cover

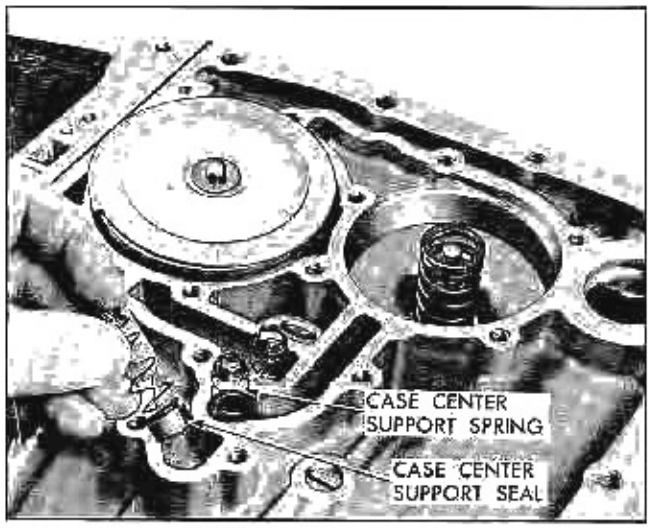

Fig. 44 Removing Case Center Support Seals

14. Remove the 12 remaining servo and accumulator cover attaching bolts.

15. Remove the servo and accumulator cover (Fig. 43).

16. Remove the servo and accumulator cover gasket.

17. Remove the three (3) case center support springs and seals (Fig. 44). (Seals may have remained in transmission case).

18. Remove the servo piston assembly from bore in case (Fig. 45).

19. Remove the servo release spring.

20. Remove the lower accumulator spring (Fig. 46).

21. Remove lower accumulator piston.

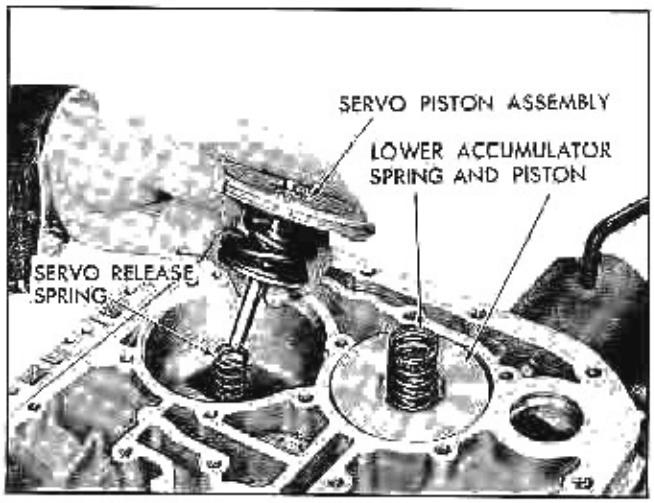

Fig. 45 Removing Servo Piston

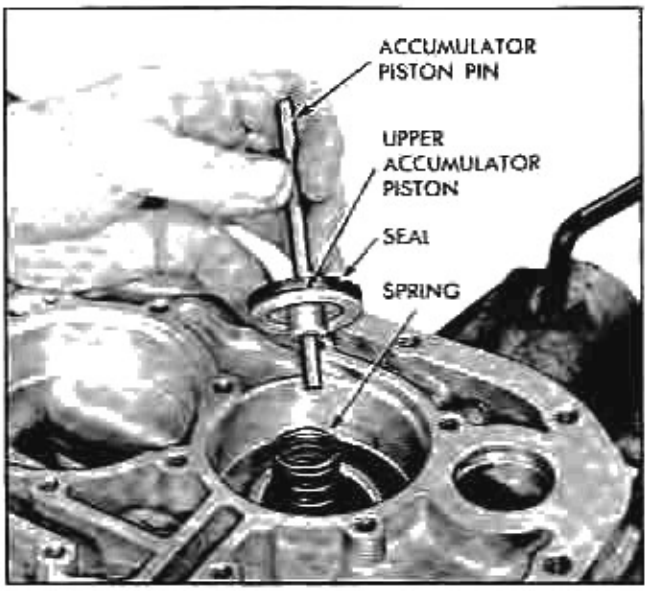

Fig. 46 Removing Accumulator Piston

22. Remove the lower accumulator piston pin and, using the stem of the accumulator pin as a tool, remove the upper accumulator piston (Fig. 46).

23. Remove the upper accumulator spring.

24. Remove the ring and seal from the lower and upper accumulator pistons.

If transmission is to be completely disassembled, measure front unit end travel as follows:

FRONT UNIT END PLAY CHECK

a. Remove one case cover to case attaching bolt and install dial indicator support J-6126 into transmission case (Fig. 47).

b. Assemble end play adapter J-8865 on the input shaft of the torus cover.

c. Clamp dial indicator J-8001 on bolt and index indicator with end of tool J-8865.

d. Position a screwdriver through case, behind the flange on the output shaft (Fig. 47).

e. Gently pry forward on output shaft to position units forward.

f. At the same time move handle on end tool and record end play.

g. End play should be .006" to .018". If end play is not within these limits, carefully inspect thrust bearings, thrust washers, and races when removing units from case to determine source of end play error and replace them if necessary.

25. Remove the pipe assembly attaching bolt and seal from front side of transmission case cover.

26. Withdraw the pipe assembly and seals from transmission. Multiple seals may have remained in transmission.

REAR BEARING RETAINER

1. Remove bushing and sleeve assembly and rear seal only if replacement is necessary. If only the seal is to be removed it may be driven rearward and out with a screwdriver and hammer.

To remove both the bushing and seal, proceed as follows:

a. Remove the rear bearing retainer bushing and sleeve assembly retaining bolt.

b. Remove the rear seal and the bushing and sleeve assembly from the rear bearing retainer. Use tool J-8845 and J-2619 slide hammer, or large drift (Fig. 48).

2. Rotate the transmission to the vertical position with the output shaft up.

3. Remove speedometer driven gear (one attaching bolt).

4. Remove eight rear bearing retainer to case at-

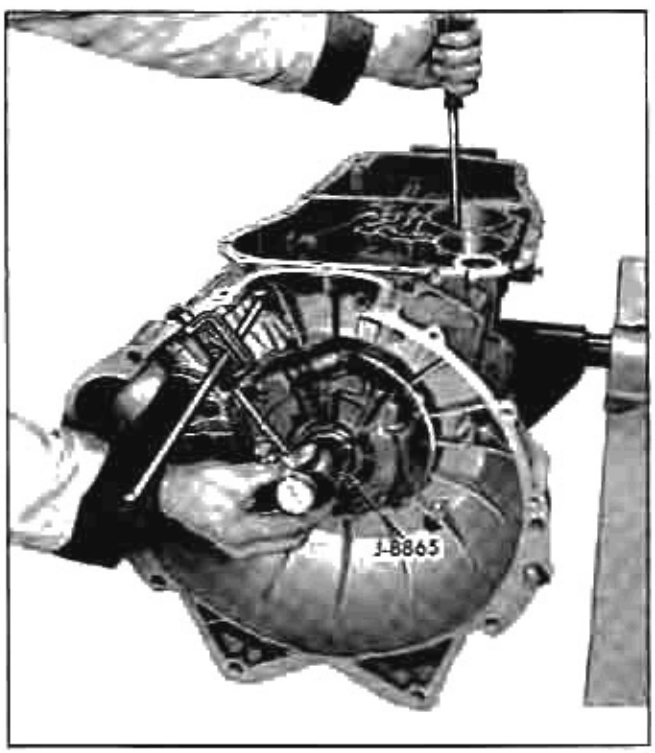

Fig. 47 Check Front Unit End Play

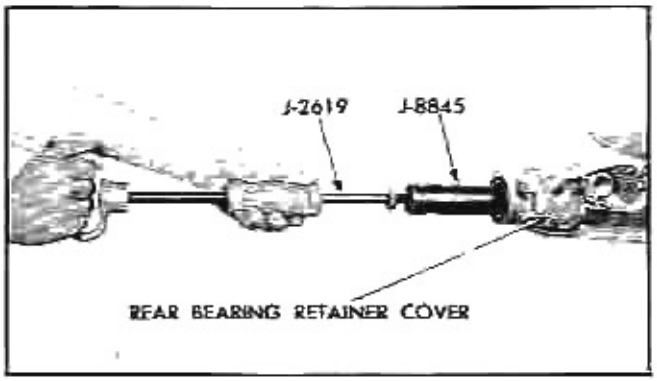

Fig. 48 Removing Rear Seal

taching bolts (six on outside and two on inside of rear bearing retainer).

5. Remove the rear bearing retainer cover and gasket by removing four (4) rear bearing retainer cover attaching bolts (Fig. 48).

6. Reaching through the rear bearing retainer access hole unseat the rear output shaft snap ring using J-8872 and move upward a short distance (Fig. 49).

7. Carefully remove the rear bearing retainer and gasket upward over output shaft. This will slide rear output shaft snap ring from output shaft.

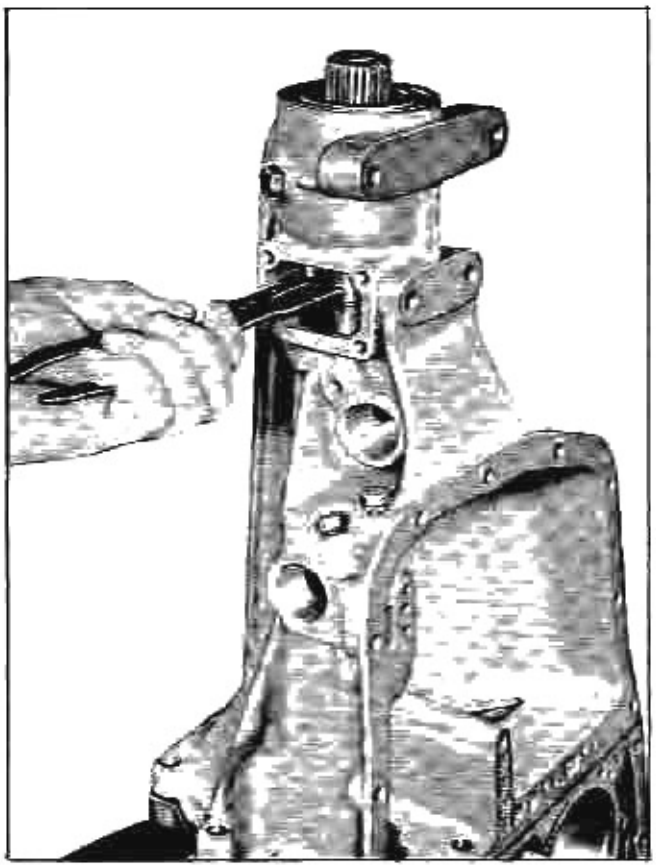

Fig. 49 Unseating Output Shaft Snap Ring

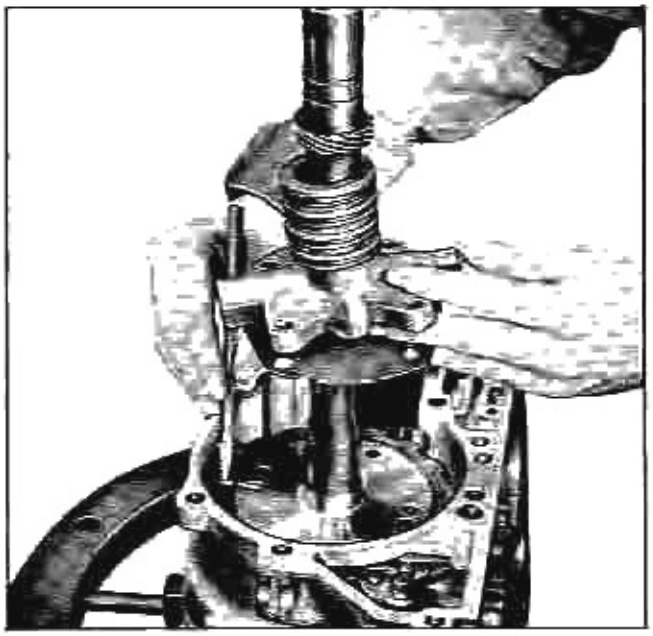

Fig. 50 Marking Output Shaft for Reassembly

NOTE: Care should be exercised to prevent manual shaft retainer from falling out of front face of rear bearing retainer.

In lifting retainer over output shaft, use care to prevent the retainer sleeve from striking the speedo drive gear on the output shaft.

8. Remove the dislodged snap ring from rear bearing retainer.

9. Remove the remaining snap ring from the output shaft.

10. Remove the 4 governor attaching bolts.

11. Raise governor high enough to mark one dowel pin and nearest tooth on the output shaft flange with grease pencil for ease in reassembling. CAUTION: Do not abuse machined surface on output shaft flange (Fig. 50).

12. Remove the output shaft assembly from transmission by lifting straight up.

13. Remove speedometer drive gear from output shaft by installing it in press plates J-8904 and holder J-6407 and pressing gear off of shaft (Fig. 51).

14. Remove the governor assembly and gasket over output shaft.

15. Rotate the transmission to the vertical position with input shaft up.

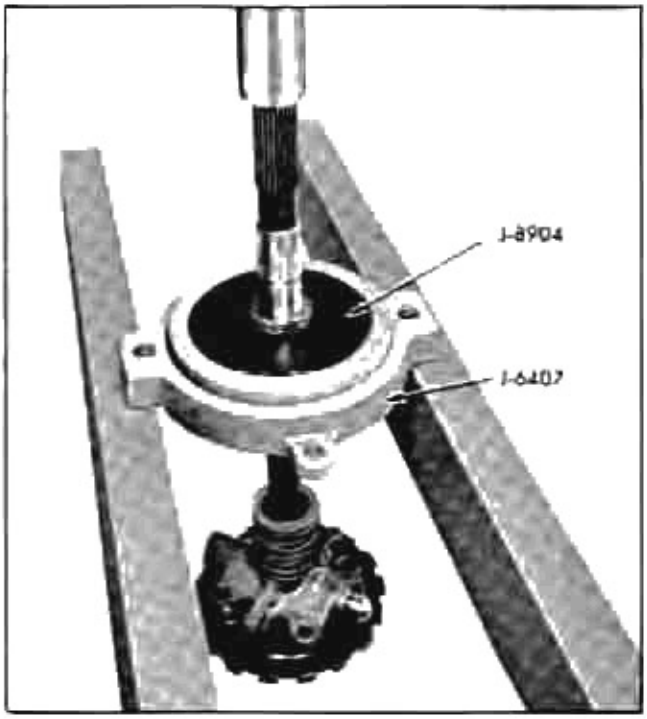

Fig. 51 Tool Set-Up for Removing Speedo Gear

CASE COVER, PUMP, AND TORUS COVER

1. Remove 5 remaining large and 3 small case cover to case attaching bolts. Two of the small bolts are attached from the case side of the case cover.

2. Remove case cover and pump assembly by lifting straight up. Slight tapping with plastic hammer may be necessary. Remove thrust bearing race from torus cover if it did not remain with case cover.

3. Remove case cover to case gasket and discard.

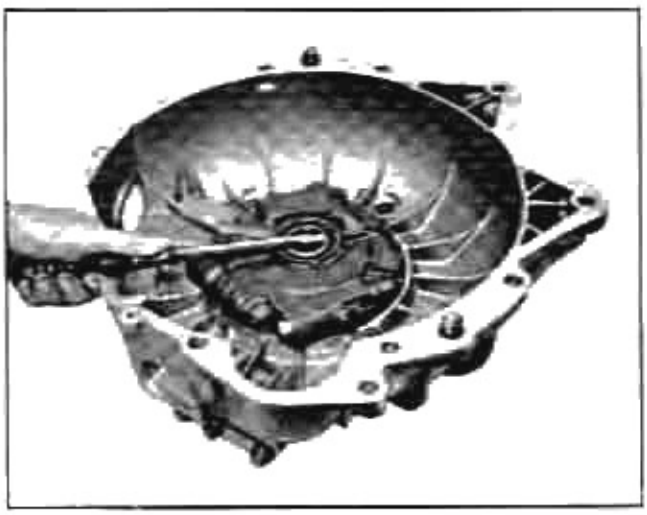

Fig. 52 Removing Front Seal

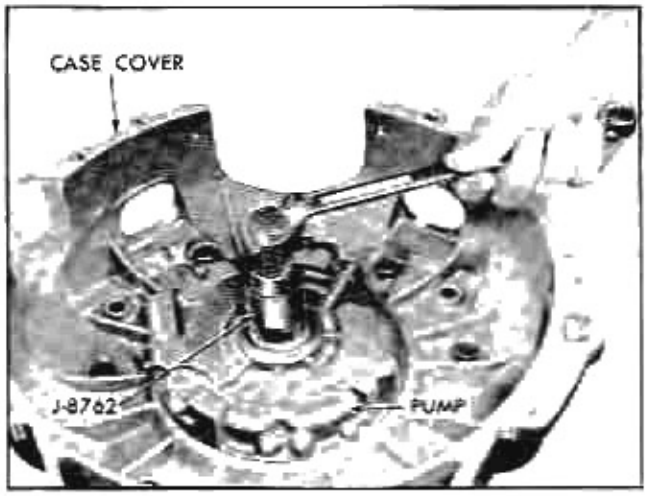

Fig. 53 Removing Front Seal Using J-8762

4. If replacement is necessary, remove and discard front seal by bending the entire outer edge of the seal in toward the center with a punch or screwdriver. The seal can then be removed with pliers or by prying out with a long screwdriver as shown in Fig. 52.

If difficulty is encountered, the case cover can be replaced on the case, held by two attaching bolts, and optional tool J-8762 used as follows.

a. Install front seal remover J-8762 over input shaft (Fig. 53).

b. Thread main body of tool into front seal securely with wrench.

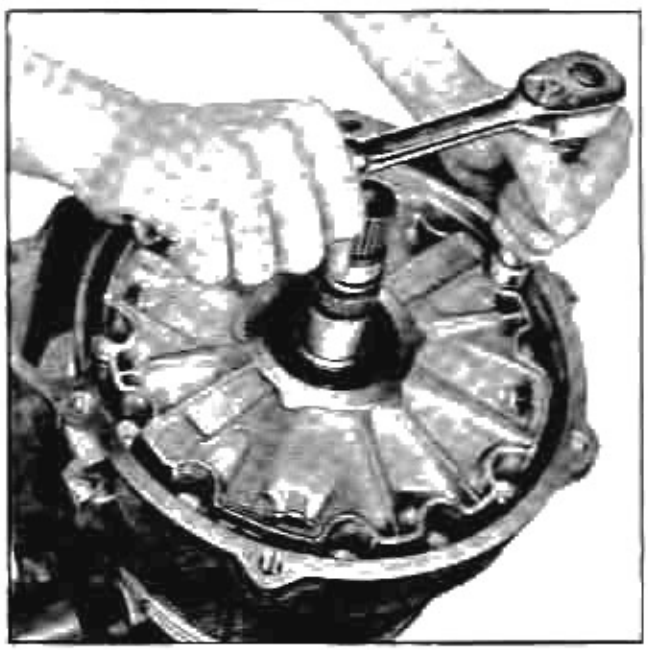

Fig. 54 Removing Torus Cover Bolts

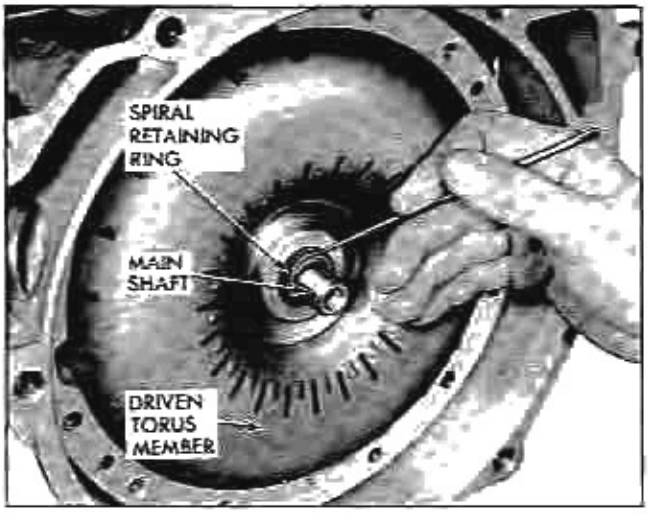

Fig. 55 Removing Mainshaft Spiral Ring

c. Tighten top end of tool until seal is removed.

d. Remove tool and seal.

5. Remove 12 torus cover attaching bolts by moving wrench handle across center shaft so the torus cover has little tendency to rotate (Fig. 54).

6 Remove torus cover from torus assembly by lifting input shaft straight up. Some effort may be required for this operation.

7. Remove and discard torus cover to drive member steel gasket. This gasket cannot be re-used.

8. Remove race, thrust bearing, and race from either torus cover or torus member. Parts may have remained with either unit.

9. Rotate transmission to horizontal position with bottom up.

TORUS, FRONT UNIT, AND REAR UNIT

1. From the front of the transmission, remove the driven torus member to main shaft spiral snap ring, with a small pointed tool (Fig. 55).

2. Push main shaft through driven torus member and remove driven torus member.

3. Remove race, thrust bearing and race from drive torus member. Some of these parts may have been removed with the driven torus member.

4. Remove the mainshaft and sun gear from the rear of the transmission.

5. Remove the bearing and race from the rear carrier. These parts may have remained with the main shaft.

6. Remove sun gear from mainshaft by pushing toward splined end of shaft. Gear is cushion mounted and may be easily removed from shaft.

7. From the front of the transmission, remove the drive torus member and torque multiplier as a unit (Fig. 56).

8. Remove the torque multiplier by pushing from rear of the drive torus member.

9. If necessary, remove oil seal rings from driven torus member and torque multiplier (three rings).

10. Remove front carrier to carrier shaft snap ring (Fig. 57).

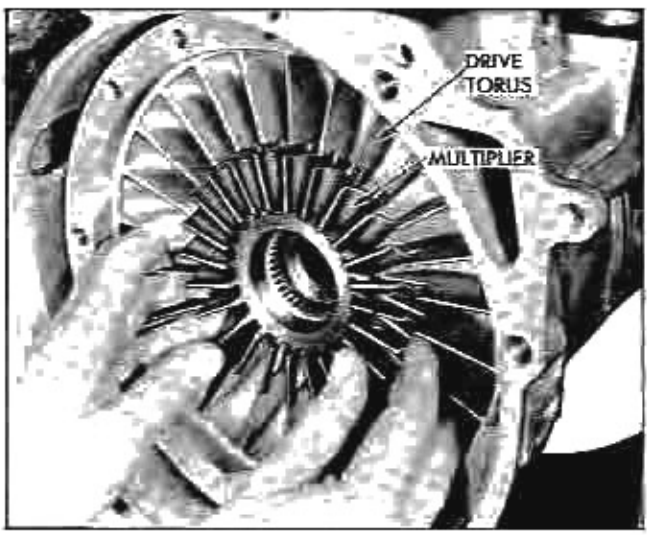

Fig. 56 Removing Multiplier and Drive Torus

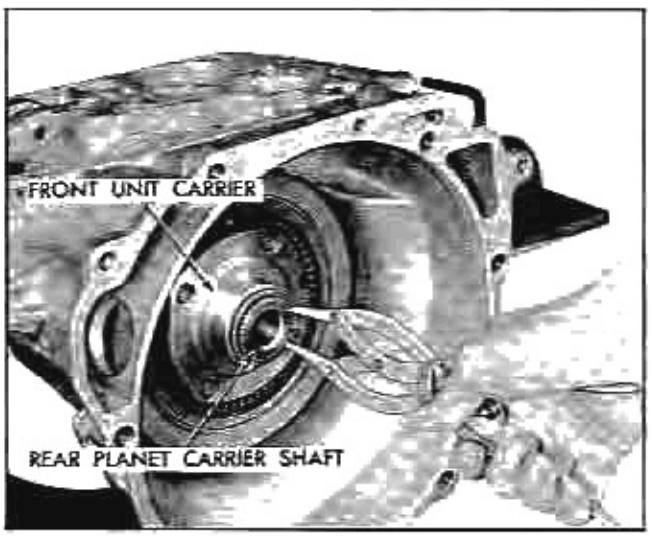

Fig. 57 Removing Front Unit Carrier Snap Ring

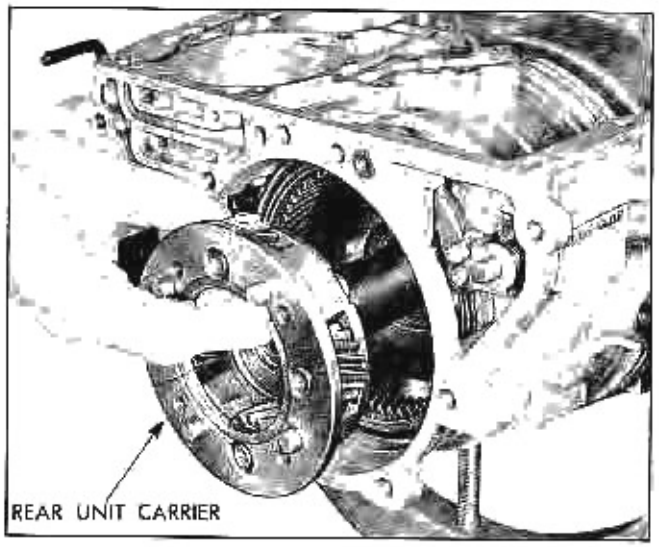

Fig. 58 Removing Rear Unit Carrier

11. Remove the front unit carrier assembly.

12. Remove race, thrust bearing and race. Some of these parts may have remained with the carrier.

13. Remove the rear carrier and shaft assembly from the rear of the transmission (Fig. 58).

14. Remove the roller thrust bearing, and race from the rear unit carrier assembly. These parts may have remained with the rear unit internal gear.

15. From the rear of the transmission, remove the rear internal gear to front sun gear shaft snap ring (Fig. 59).

16. Remove the rear unit internal gear and sprag assembly including retainer. Make certain parking pawl is disengaged (Fig. 60).

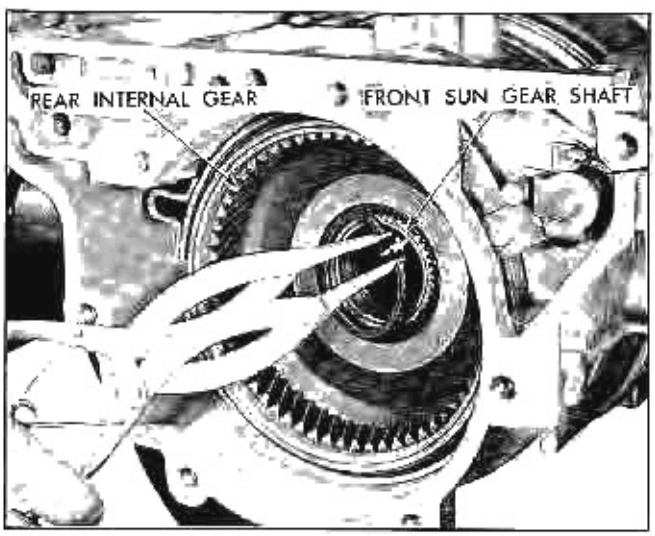

Fig. 59 Removing Rear Internal Gear Snap Ring

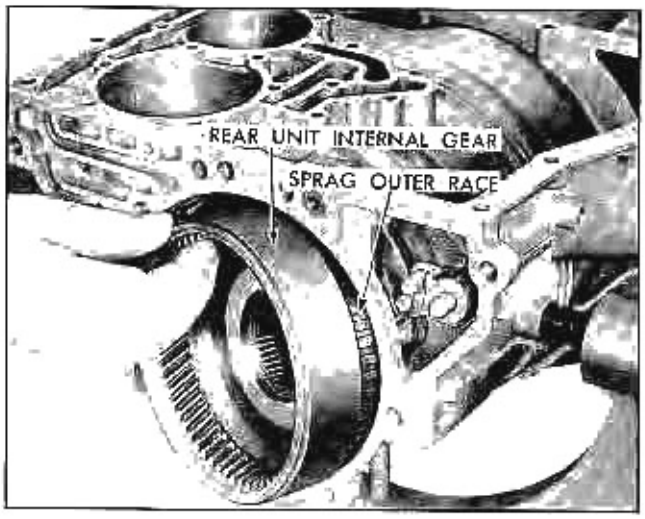

Fig. 60 Removing Rear Internal Gear

17. Rotate the transmission 90° to the vertical position—front of transmission up. CAUTION: Transmission parts are loose and will drop out if transmission is not rotated as described

18. Remove the front unit sun gear assembly, race, roller thrust bearing and race (Fig. 61).

19. Remove the front unit internal gear and clutch assembly from the front of transmission.

20. Remove the bronze thrust washer from the front unit clutch drum. The bronze thrust washer may have remained on the case center support.

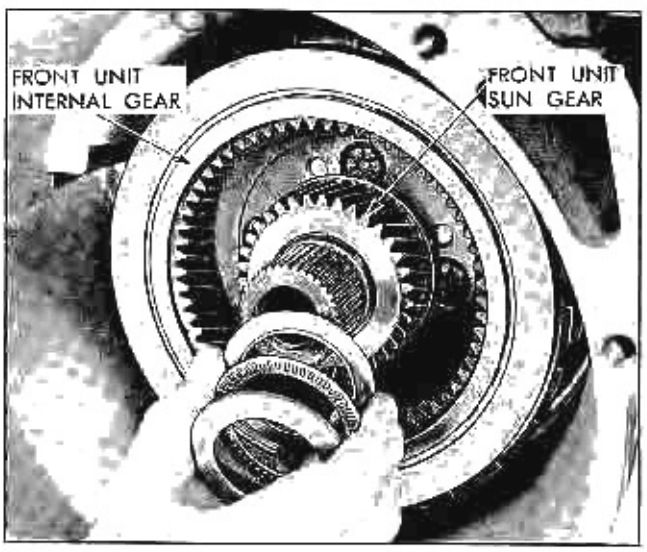

Fig. 61 Front Sun Gear to Front Carrier Thrust Bearing and Races

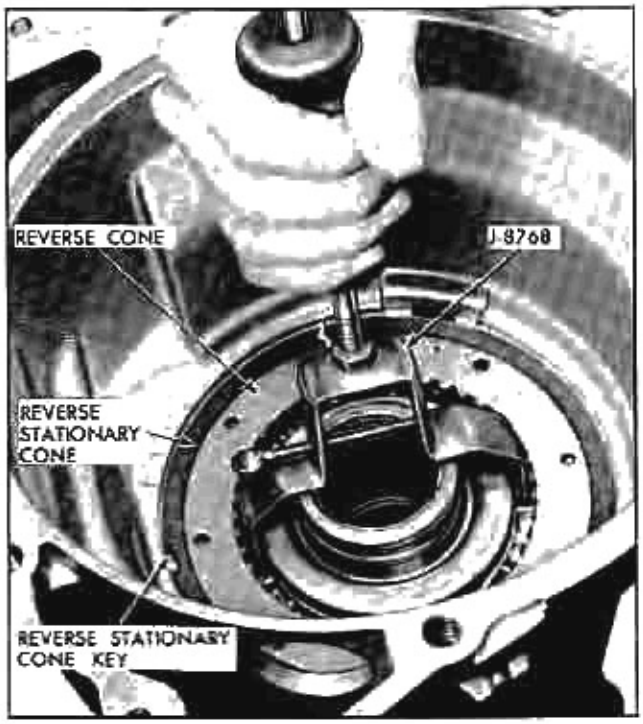

Fig. 62 Removing Reverse Cone

REVERSE CLUTCH AND CASE CENTER SUPPORT

1. Remove the reverse stationary cone to case snap ring.

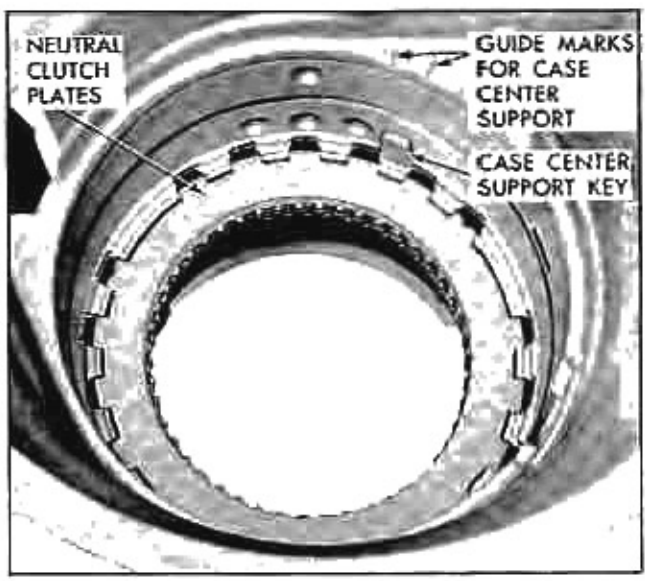

Fig. 63 Neutral Clutch Plates and Case Center Support Key in Case

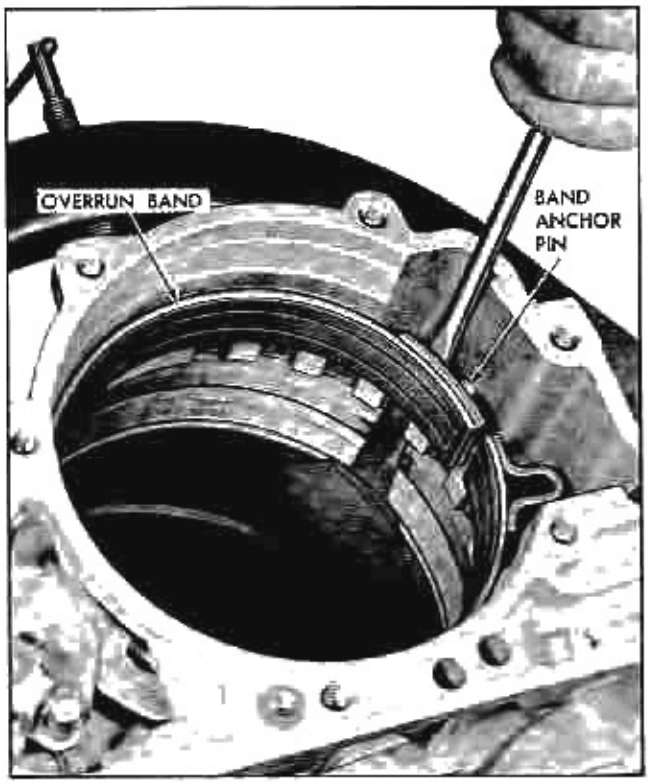

Fig. 64 Removing Overrun Band from Anchor Pin in Case

2. Using reverse cone puller J-8768, remove the reverse cone and reverse stationary cone. Position tool under lugs of reverse cone and pull upward (Fig. 62).

3 Remove the reverse stationary cone key from case.

4. Remove the reverse and neutral piston and support assembly. If assembly is tight in case, tap gently with soft hammer from rear.

5. Remove the case center support key from the transmission case (Fig. 63).

6 Remove the neutral clutch plates (4 drive-composition and 4 driven-steel) and clutch backing plate from transmission case.

7. Rotate the transmission to the vertical position with rear end up.

8. Remove the band assembly by unhooking from the anchor and lifting upward (Fig. 64).

PARKING LINKAGE

If necessary, remove the parking pawl linkage as follows:

9. Remove parking pawl pin from case.

10. Remove parking linkage assembly from case by lifting parking bracket shaft and entire assembly out of the hole in the rear of the case (Fig. 65).

11. Remove parking pawl spacer from case.

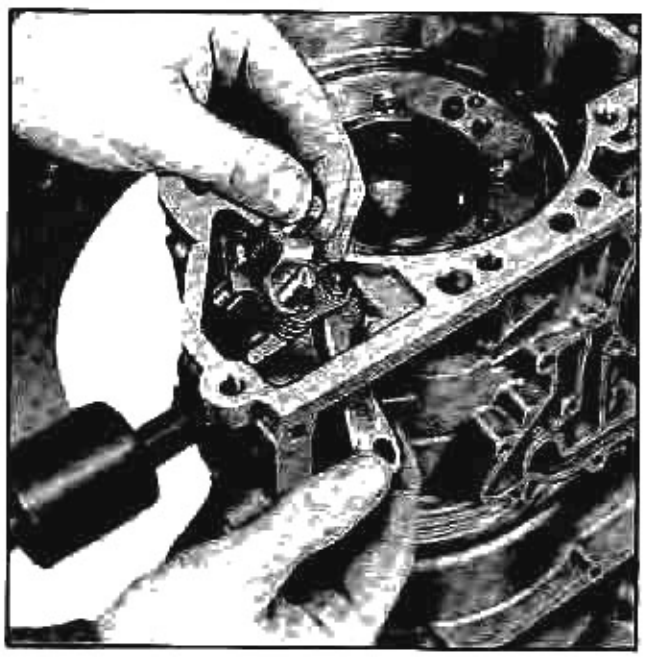

Fig. 65 Removing Parking Linkage

DISASSEMBLY, INSPECTION, AND ASSEMBLY OF INDIVIDUAL UNITS

CONTENTS OF THIS SECTION

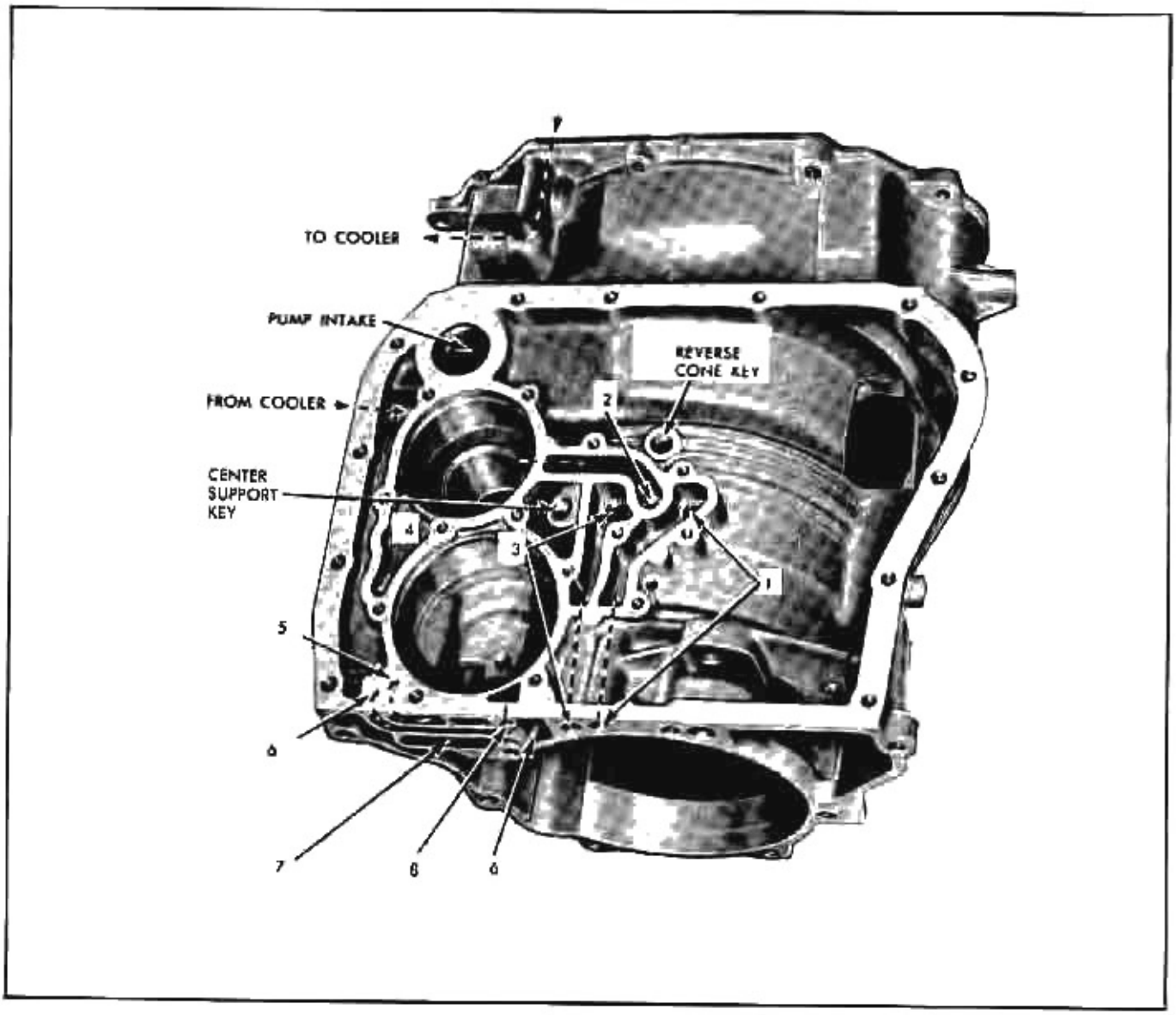

Fig. 66 Case Passages

1. Neutral Clutch
2. Front Clutch
3. Reverse Clutch
4. Compensator
5. Drive
6. T.V.
7. Front Clutch
8. Overrun Band

Clean all parts thoroughly. Make thorough inspection of all parts to determine which 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 the operation of the unit. Spring and thrust washer specifications are given on pages 94 through 96. Refer to these specifications when inspecting parts and replace only those that are worn, broken or damaged.

1. Case should be thoroughly cleaned, blow out case passages with suitable air nozzle. Inspect bolt threads for cross threading.

2. Inspect case for leaks or inter-connected passages by using air gun or smoke (Fig. 66).

3. Inspect case for hair line cracks.

4. Inspect case to strainer neck "O" ring seal for cuts, hardness or pinched seal.

5. If parking linkage was not removed inspect parking pawl pin and parking brake links for excessive wear or bind.

6. Inspect parking bracket spring for collapsed coil, breaks, and correct position of the tang end of spring on parking brake lever.

7. Inspect case center support to case seals for hardness or cracks. Inspect the seal springs for collapsed coils and good fit of seals on spring ends.

CASE COVER AND PUMP

DISASSEMBLY

1. Loosen 6 case cover to pump attaching bolts approximately 4 turns.

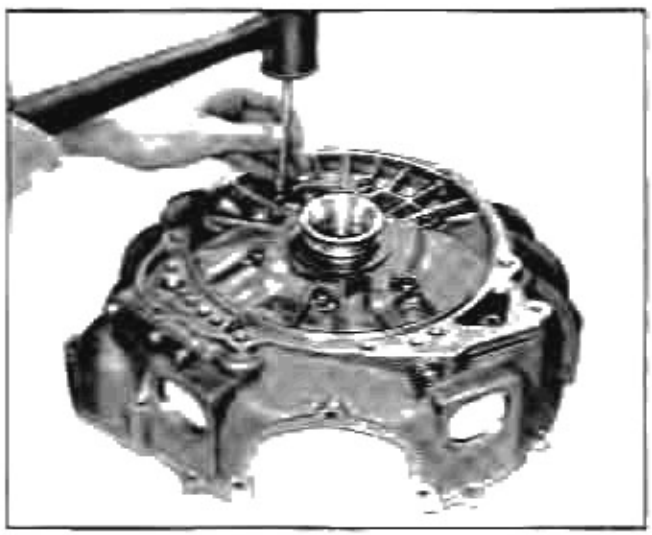

Fig. 67 Removing Pump from Case Cover

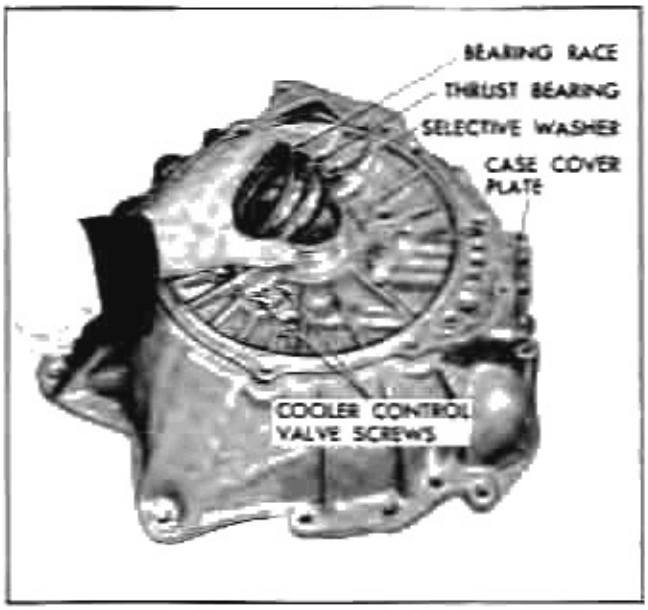

Fig. 68 Case Cover Thrust Bearing and Selective Washer

2. Support cover so that pump is off bench and gently tap loosened bolts to remove pump from case cover (Fig. 67).

3. Remove 6 bolts from case cover and remove pump.

4. Remove 2 hook type oil seal rings from case cover.

5. Remove race, thrust bearing and selective washer from case cover (Fig. 68). Race may have been previously removed.

6. Remove 2 screws (case cover to cooler control valve assembly, Fig. 68) and remove cooler control valve assembly and gasket. Do not disassemble cooler control valve assembly.

7. Remove 3 case cover plate to case cover bolts and seals (Fig. 69).

8. Remove case cover plate and gasket.

9. Remove the remaining bolt and seal in the case cover.

INSPECTION

1. Clean thoroughly and inspect all oil passages for interconnected passages, or restrictions. Use air gun and smoke (Fig. 70).

2. Inspect the bushing for tight fit or excessive wear.

3. Inspect the case cover for cracks or porosity.

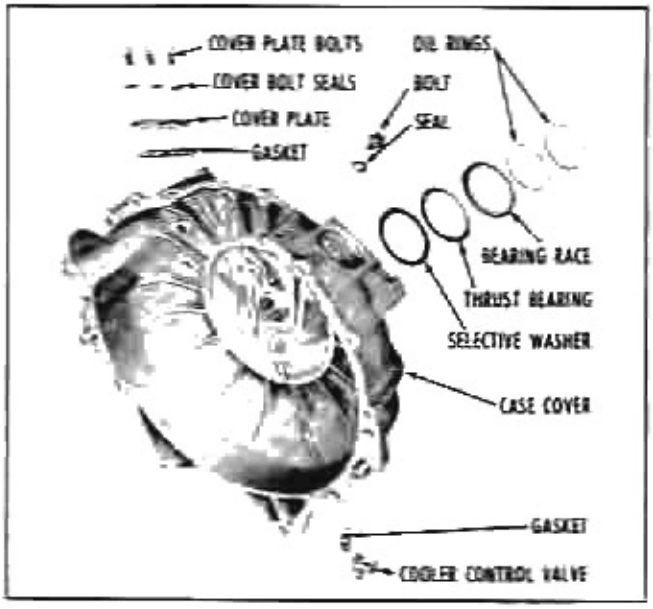

Fig. 69 Case Cover—Exploded

4. Inspect the rings and ring grooves for nicks or burrs.

5. Inspect the case cover plate bolts (3) for leaks or cross thread, discard cover plate gasket.

6. Discard case cover to case gasket.

7. Inspect cooler passage connection threads in cas cover for cross thread. Worn threads may be repaired with one of the commercial thread repair kits available.

8. Inspect the case cover to coupling cover thrust bearing and the two bearing races.

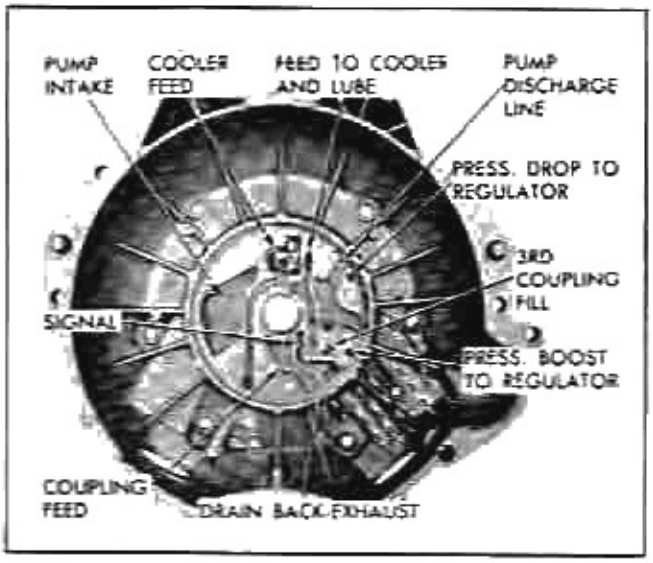

Fig. 70 Case Cover Oil Passages

ASSEMBLY

1. Install case cover plate and gasket with 3 attaching bolts and seal washers. Torque to 18-20 ft. lbs.

2. Install the remaining bolt and seal washer in case cover. Torque to 18-20 ft. lbs.

3. Attach cooler control valve assembly and gasket with 2 attaching screws. Torque to 2.5-3.5 ft. lbs.

4. Install selective washer over tower of case cover.

5. Install thrust bearing and cupped race—cup side over bearing on case cover.

6. Install 2 hook type oil seal rings on tower.

Pump to case cover installation Page 61.

PUMP

DISASSEMBLY

1. Inspect and, if condition indicates replacement is necessary, remove pump to cover seal ("O" ring).

2. Remove the pump cover to body attaching screw (Fig. 71).

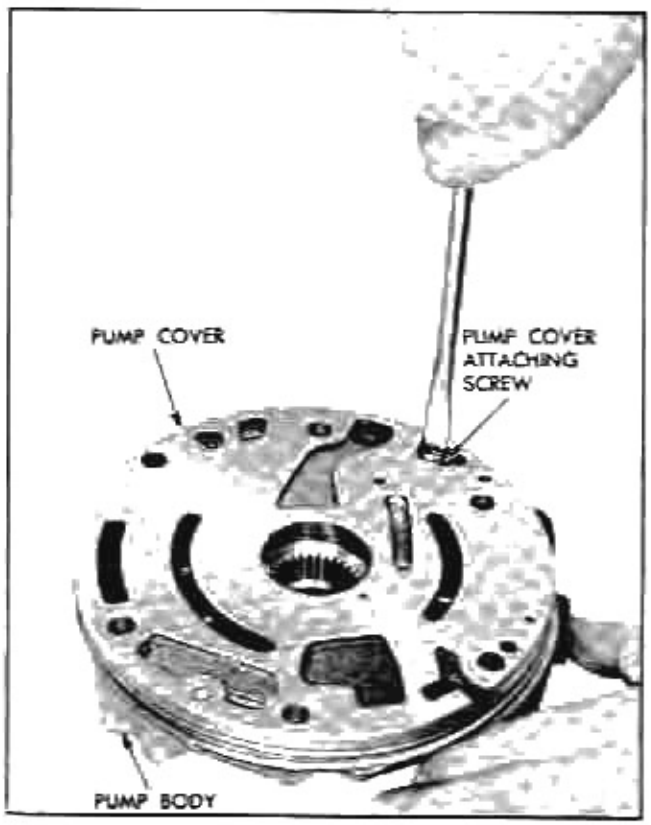

Fig. 71 Removing Pump Cover from Pump

3. Remove the pump cover from the pump over roll pin—do not pry to remove.

4. Remove the top vane guide ring, rotor, 11 vanes and bottom vane guide ring (Fig. 75).

5. Remove the pump slide by compressing slide against priming springs and lift up on opposite end (Fig. 72).

6. Remove the inner and outer priming springs.

7. Remove the coupling feed limit plug and "O" ring.

8. From the same bore remove the coupling limit spring, guide pin and valve.

9. Remove the pressure regulator plug assembly and "O" ring.

10. Remove the line boost plug from the pressure regulator plug.

11. Remove the line boost plug stop from pump.

12. Remove the pressure regulator valve spring and valve by inserting snap ring pliers into spring.

13. If necessary, remove rubber cushion from pressure regulator valve.

INSPECTION

1. Inspect all oil passages in the pump body (Fig. 73) and cover (Fig. 74) for dirt or restrictions, using tag wire and compressed air.

2. Check fit of slide in the pump body, slide should move freely.

3. Inspect (11) pump vanes for excessive wear at the guide ring contact point. The vanes will show bright spots at the two wear points. This is normal and should not be considered unusable, unless there are deep score marks on the vanes, which will usually indicate foreign material has found its way into the pump and other related parts will indicate scoring.

4. Inspect the pump rotor for scoring, check the splines for nicks, burrs.

5. Inspect the pressure regulator valve for scoring, nicks, burrs. Be sure the regulator valve moves freely in bore.

6. Inspect the coupling feed limit valve for nicks, burrs. Be sure valve moves freely in bore.

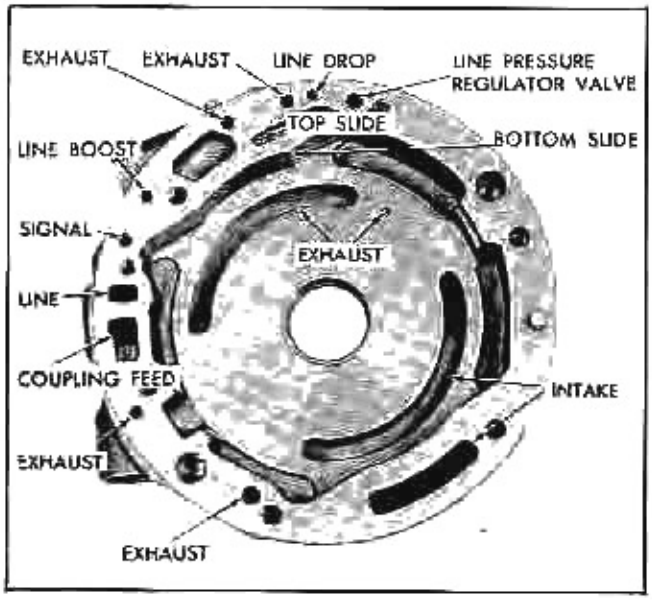

Fig. 73 Pump Body Oil Passages

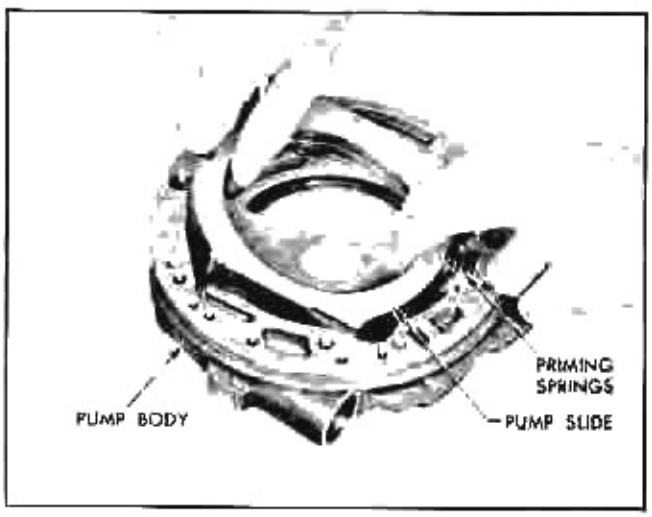

Fig. 72 Removing Pump Slide

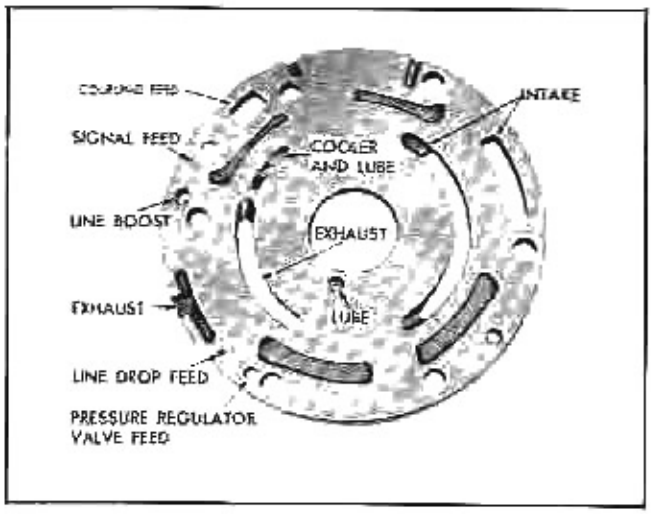

Fig. 74 Pump Cover Oil Passages

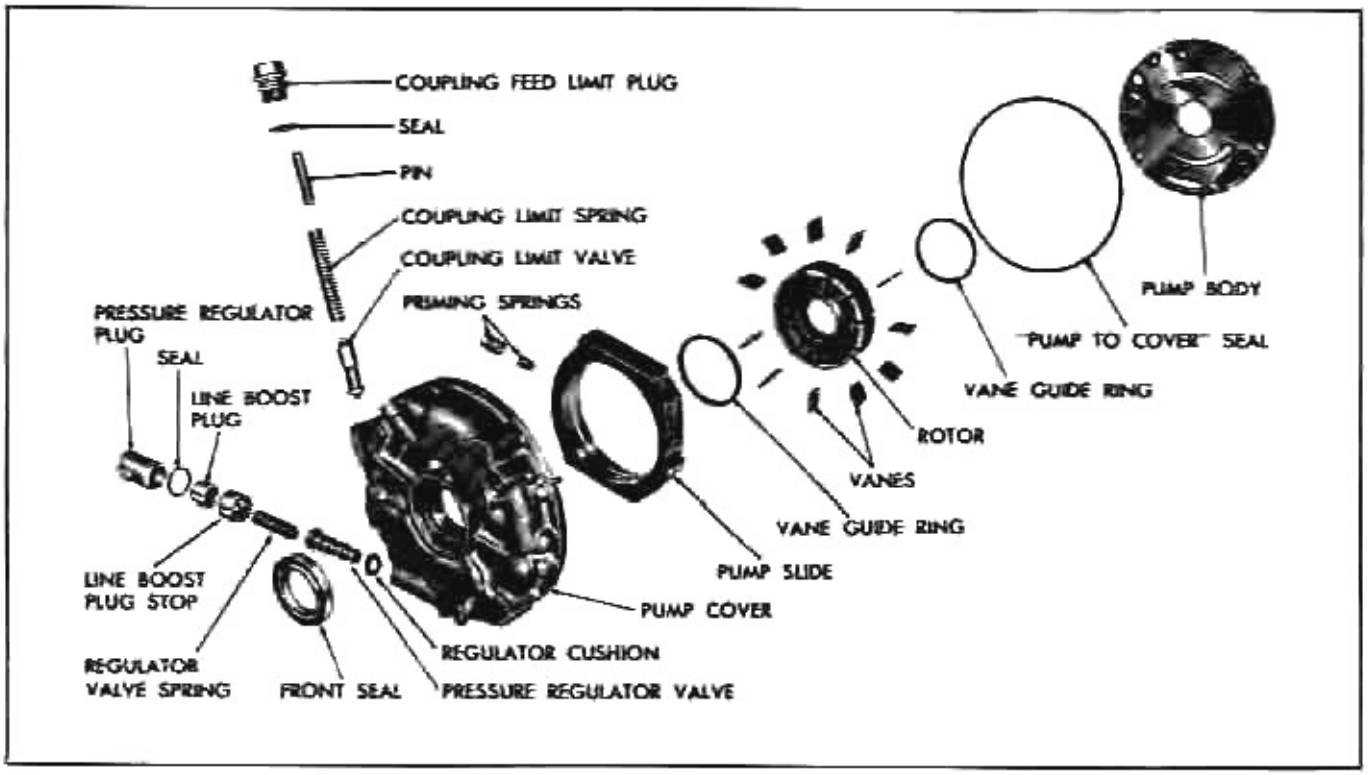

Fig. 75 Pump Assembly—Exploded

7. Inspect the pressure regulator valve spring for distortion or collapsed coil.

8. Inspect the inner and outer primary spring for distortion, collapsed coil.

9. Replace the pump to case cover "O" ring.

10. Check coupling feed limit valve spring for distortion or collapsed coil.

11. Inspect coupling feed limit valve plug for cross thread.

12. Inspect coupling feed limit valve plug "O" ring seal for cuts or damage.

ASSEMBLY

1. Install new cushion on pressure regulator valve if previously removed, and install pressure regulator spring on valve.

2. Install pressure regulator valve and spring in bore of pump.

3. Install pressure regulator stop into pump over spring.

4. Install new "O" ring on pressure regulator plug, if condition warrants.

5. Install line boost plug into pressure regulator plug, cup side out.

6. Install plug assembly into pump. Torque to 15-20 ft. lbs.

7. Install coupling limit valve, spring and pin into pump.

8. Install new "O" ring on coupling feed limit valve

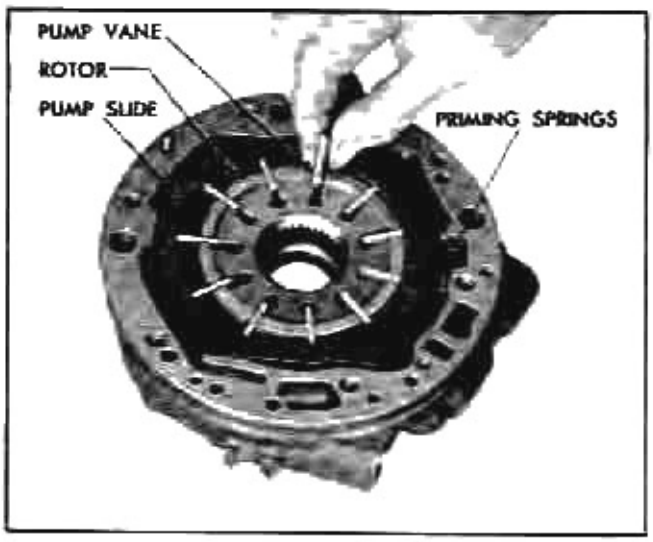

Fig. 76 Installing Pump Vanes

plug, if condition warrants.

9. Install coupling feed limit valve plug into pump. Torque to 15-20 ft. lbs.

10. Install inner and outer pump priming springs into bottom cavity of pump.

11. Assemble slide into pump body by compressing slide against priming springs at lower end until slide can be fully installed into pump (Fig. 72).

12. Install bottom guide ring into pump cavity.

13. Install pump rotor (shoulder side down) in pump pocket over guide ring.

14. Install 11 vanes into rotor. Install the vanes so that the ring wear pattern on the edge of the vane is against the guide ring (Fig. 76).

15. Install top guide ring on rotor.

16. Install pump cover over roll pin and secure with cover to pump retaining screw. Torque to 6-8 ft. lbs.

17. Install pump to cover "O" ring on pump, if removed.

ASSEMBLE PUMP TO CASE COVER

1. With case cover on bench, open side up, lay pump in its recess with coupling feed limit plug and pressure regulator plug facing their access holes.

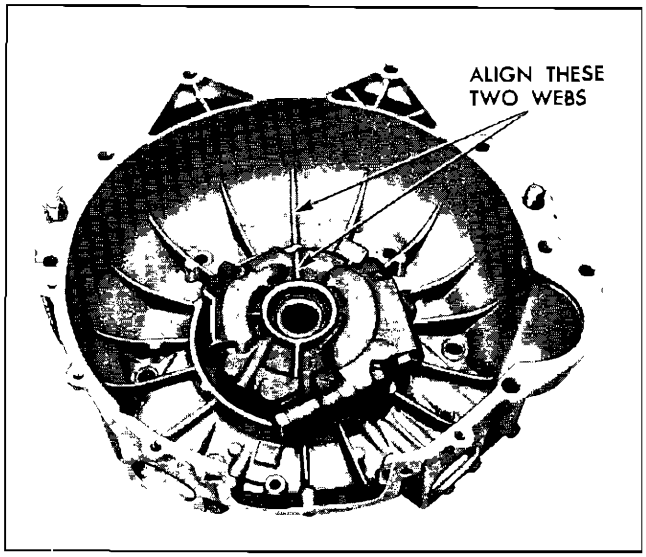

Fig. 77 Aligning Pump in Case Cover

2. Align the top structural web of the pump exactly with the top web in the case cover (Fig. 77). Start one pump attaching bolt from under side of cover to assure proper alignment before pushing pump to bottom of its recess in the the cover.

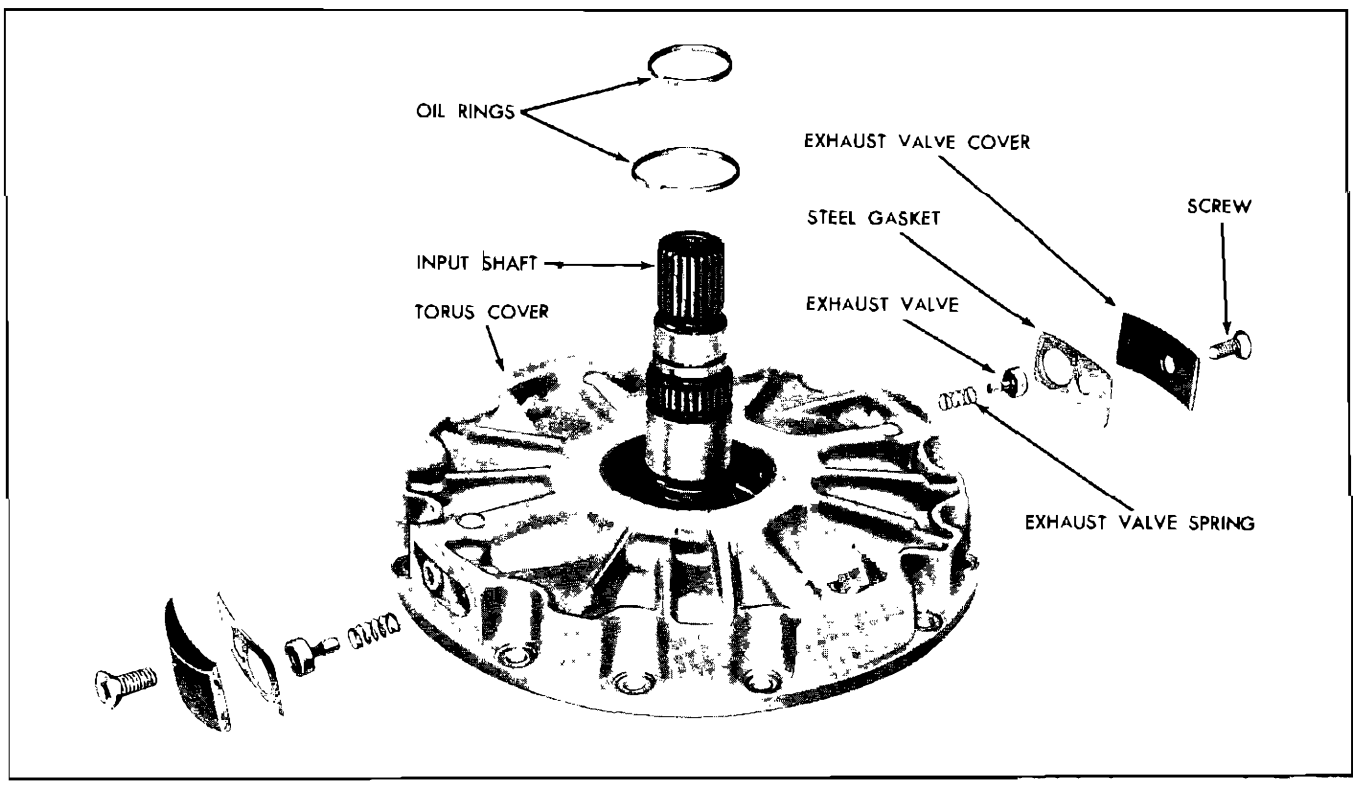

Fig. 78 Torus Cover—Exploded

3. Install six case cover to pump attaching bolts from the rear side of the case cover. Torque to 15-18 ft. lbs.

Installation . . . . . Page 85

TORUS COVER

DISASSEMBLY

1. Inspect and remove if necessary, 2 hook type oil rings from input shaft (Fig. 78).

2. Remove torus exhaust valve cover screw with a clutch head socket.

3. Remove exhaust valve cover, steel gasket, valv and spring. Discard the gasket.

4. Repeat operation for second exhaust valve.

INSPECTION

1. Inspect splines and snap ring grooves for nicks, burrs. Check for broken rings.

2. Use tag wire and check coupling signal passages for restriction.

3. Inspect coupling cover exhaust valves for nicks, burrs. Be sure valves move freely in bore.

4. Check exhaust valve spring for distortion or collapsed coil.

5. Replace coupling exhaust valve cover gasket.

6. Inspect cover for cracks or porosity.

7. Inspect the coupling cover to driven torus thrust bearing and race.

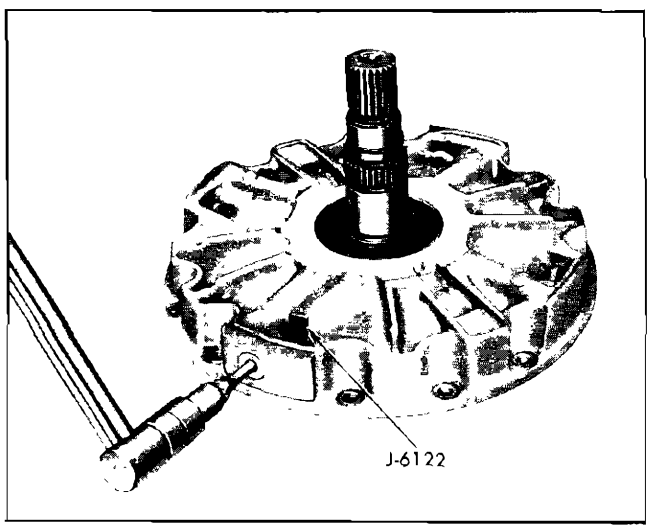

Fig. 79 Installing Exhaust Valve Covers

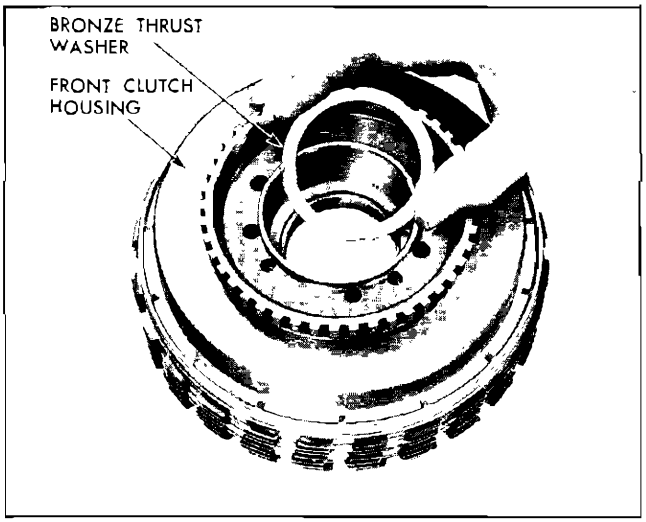

Fig. 80 Thrust Washer in Front Clutch Housing

8. Inspect the mainshaft pilot bushing for excessive wear and tight fit.

ASSEMBLY

1. Install exhaust valve spring and valve.

2. *Install exhaust valve retaining tool J-6122 (Fig.* 79).

3. Install cover and new torus cover exhaust valve gasket and retaining screw, using a clutch head socket. Torque to 19-23 ft. lbs.

4. Repeat above operation for second exhaust valve.

5. Install 2 hook type oil rings on input shaft.

Installation . . Page 83

FRONT CLUTCH

DISASSEMBLY

1. Remove the bronze thrust washer from the front clutch assembly if it has not been removed (Fig. 80).

2. Install entire assembly in soft-jaw vise with internal gear up and vise engaging large teeth on opposite side of assembly.

3. Remove 4 front internal gear to front clutch housing attaching bolts.

4. Gently tap a dowel pin with a drift to remove front internal gear from front clutch housing. The housing is spring loaded.

5. Remove front internal gear.

6. Remove front clutch backing plate.

7. Remove 7 drive and 7 driven front unit clutch plates (Fig. 81).

8. Remove 20 front clutch release springs.

9. Remove front clutch piston from front clutch housing.

10. Remove front clutch piston outer seal from piston and discard.

11. Remove front clutch inner piston seal from clutch housing and discard.

INSPECTION

1. Inspect front unit internal gear for tooth damage, nicks, burrs.

2. Inspect front unit internal gear bushing for excessive wear, nicks, burrs. Be sure bushing is not loose.

3. Inspect clutch plate splines on front internal gear for free clutch plate movement, remove any obstruction.

4. Check lubrication ports for restriction.

5. Inspect clutch backing plate for nicks, burrs or foreign material.

6. Inspect 7 drive and 7 driven clutch plates, check for foreign particles embedded in plates. Check for excessive wear on clutch plates such as metal spots appearing through the facing material on the drive plates or deep cuts in the steel driven plates. The steel driven plates are waved and a wear pattern will appear at the high points of the wave, this is normal wear pattern and should not be replaced for those bright spots. The drive plates with the facing material will appear discolored after a few hundred miles, this is a normal reaction from the oil absorbing characteristics of the facing material. The drive plates are flat and an even wear pattern will appear over the entire area. See Fig. 82 for proper unnesting of clutch plate notches on assembly.

7. Inspect front clutch apply piston, check for scores, nicks and burrs, check for cracks in casting.

8. Replace the inner and outer clutch piston rubber lip type seals. Use caution when installing seals. Be sure seal is not nicked or pinched during installation. The inner seal should be installed first using the clutch piston without the outer seal to seat the inner seal snug in the ring groove by clockwise and counterclockwise movement of the piston.

9. Inspect the front clutch housing for foreign material. Check the clutch apply oil passages for restrictions or off location oil passages.

10. Inspect bolt threads for cross threading or stripped threads.

11. Inspect internal gear to center support thrust washer for excessive wear, nicks, burrs or foreign particles imbeded on thrust face.

ASSEMBLY

1. Install new inner piston seal on front clutch housing with lip of seal facing down.

2. Install new outer piston seal on clutch piston with lip facing away from spring pockets.

3. Install clutch piston in clutch housing, carefully rotating assembly while depressing lip of piston seal with small blade screw driver.

4. Install piston release springs (20) into spring pockets in piston.

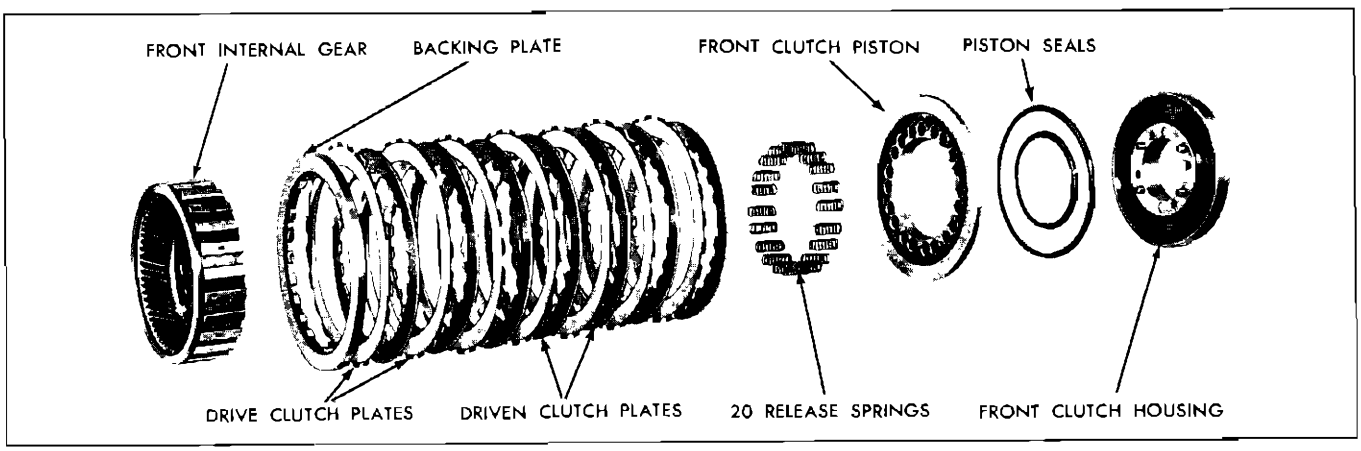

Fig. 81 Front Clutch—Exploded

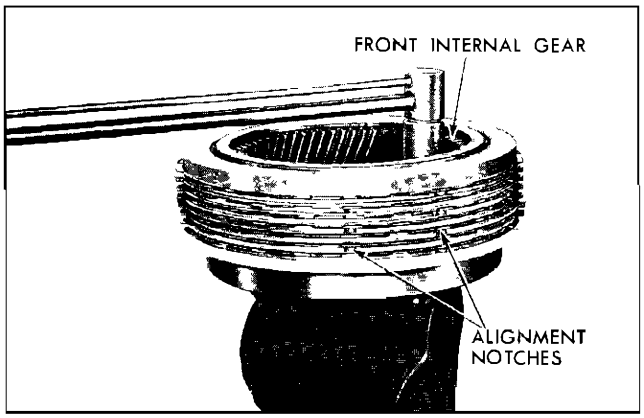

Fig. 82 Torquing Front Clutch Bolts

5. Install front clutch backing plate on front internal gear with undercut facing flange on internal gear.

6. Install 7 composition drive and 7 steel driven clutch plates alternately over the front internal gear starting with a composition clutch plate.

NOTE: The steel clutch plates must be assembled in an un-nested position as follows:

a. Place a composition plate and first steel plate over the internal gear noticing the location of the slight half moon noteh in the edge of the steel plate.

b. Install another composition plate and then the second steel plate so that the half moon is located 2 drive lugs on the internal gear away from the notch in the first steel plate.

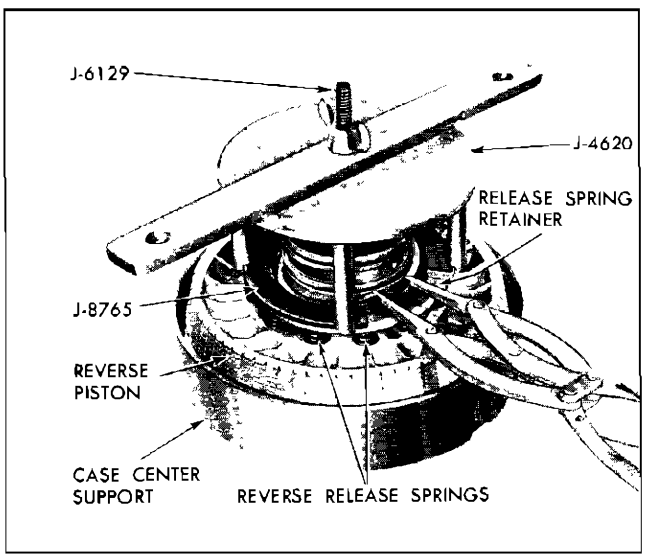

Fig. 83 Removing Reverse Release Spring Retainer Snap Ring

c. Continue to alternately install the composition and steel plates so that the notches in the odd numbered steel plates are one above the other and the notches in the even numbered steel plates are one above the other.

7. Holding assembly together, position front unit internal gear, with plates, on clutch release springs, aligning dowels.

8. Place entire assembly in soft-jawed vise with vise engaging large teeth on clutch housing (Fig. 82).

9. Install four front unit internal gear to front clutch housing bolts. Alternately tighten bolts to properly seat front internal gear on dowels. Check bottom steel clutch plate for freedom after tightening bolts. Torque to 22-27 lb. ft.

10. Install bronze thrust washer into recessed I.D. of front clutch housing bore using petroleum to retain (Fig. 80).

Installation . . . . . Page 80

CASE CENTER SUPPORT

DISASSEMBLY

1. Remove 2 oil delivery sleeve hook type oil seal rings from case center support (Fig. 85).

2. Using tools J-8765, J-6129 and J-4670-B, remove reverse release spring retainer snap ring. Center tool and position ring gap between legs (Fig. 83).

3. Remove tools from the reverse and neutral clutch assembly.

4. Remove reverse release spring retainer.

5. Remove 12 reverse piston release springs.

6. Remove reverse clutch piston—It may be necessary to tap housing gently.

7. Remove inner and outer reverse piston seal rings and discard.

8. Using tools J-8765, J-6129, and J-4670-B remove neutral clutch release spring retainer snap ring. Center tool and position ring gap between legs (Fig. 84).

9. Remove tools.

10. Remove neutral clutch release spring retainer.

11. Remove 16 neutral clutch release springs. Do not mix neutral clutch springs with reverse springs.

12. Remove neutral clutch piston. It may be necessary to tap housing gently.

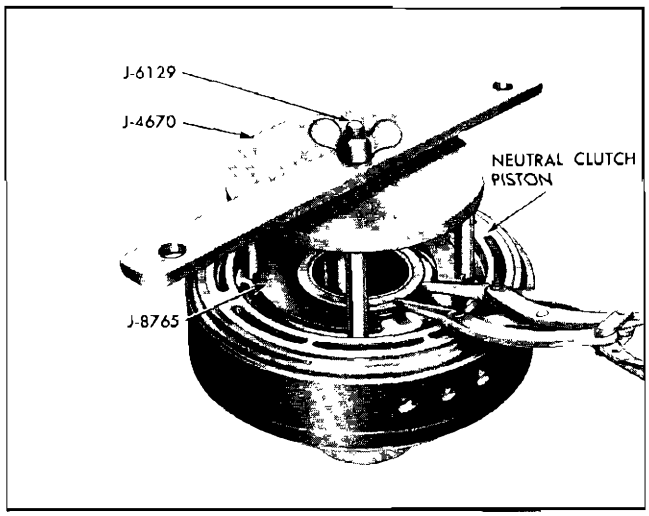

Fig. 84 Removing Neutral Clutch Spring Retainer Snap Ring

13. Remove inner and outer neutral clutch seal rings and discard.

INSPECTION

1. Inspect case center support for nicks, burrs, damaged or excessive wear on bushing. Make certain bushing is not loose.

2 .Check the reverse apply oil passage with air and tag wire. Check for inter-connected passages or restricted passages.

3. Check the front clutch apply passage with air and tag wire. Check for restriction or inter-connected passages.

4. Check the neutral clutch apply passage with air and tag wire. Check for restriction or inter-connected passages.

5. Inspect the two hook-type oil seal rings on the oil delivery sleeve. Check for excessive wear or broken ring.

6. Inspect the neutral clutch piston for cracks or distortion.

7. Replace the neutral clutch inner and outer piston seals.

8. Inspect the neutral clutch release spring for distortion or collapsed coils.

9. Inspect the reverse piston for excessive wear, burrs, cracks or distortion.

10. Inspect the reverse piston release springs for distortion or collapsed coils.

11. Inspect the neutral clutch release spring retainer and snap ring groove.

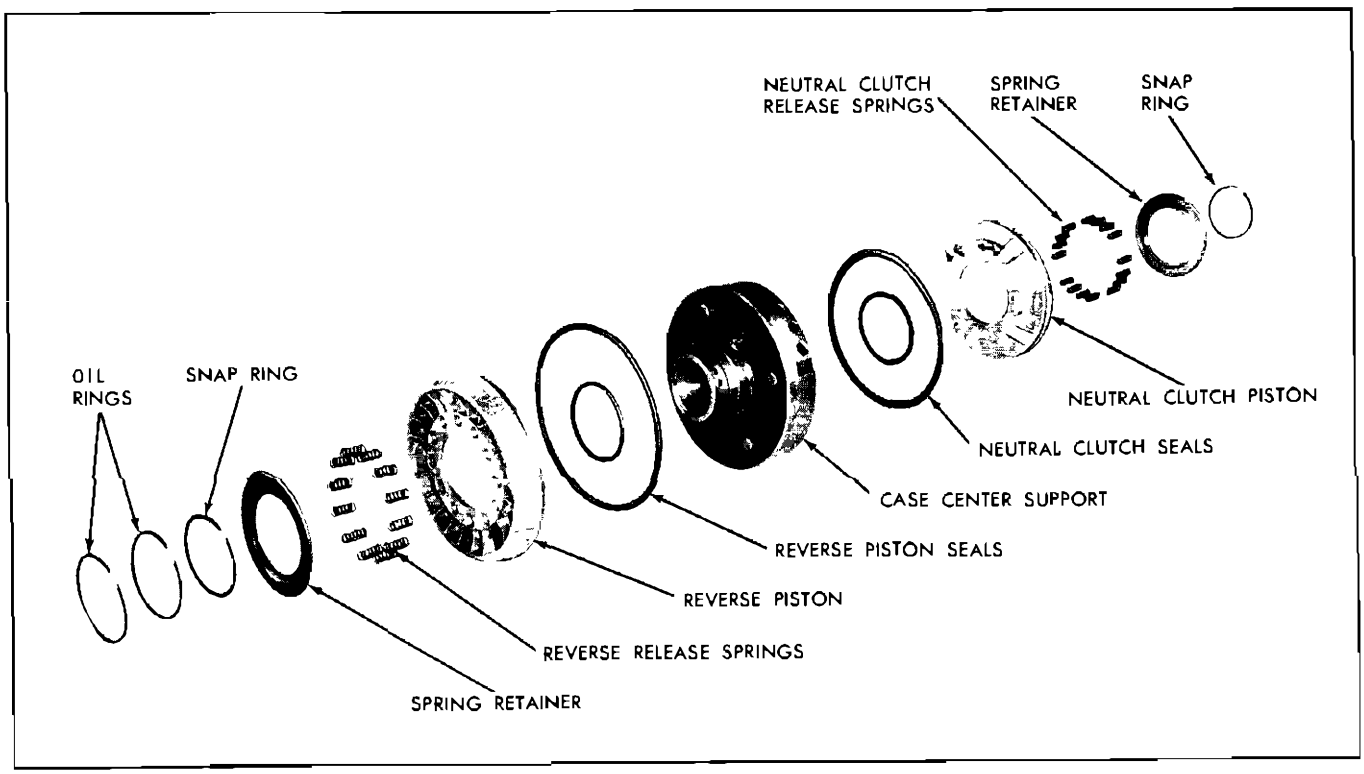

Fig. 85 Case Center Support—Exploded

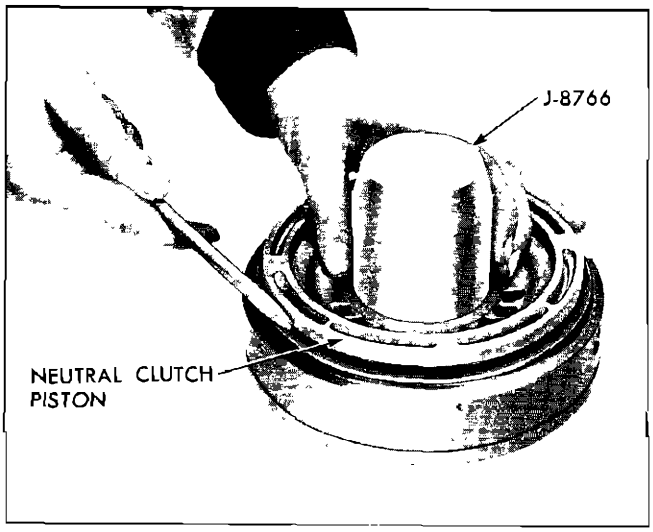

Fig. 86 Installing Neutral Clutch Piston

12. Inspect the reverse piston spring retainer and snap ring groove.

ASSEMBLY

1. Install new inner and outer neutral clutch seals with lip of seal facing away from spring pockets.

2. Install J-8766, inner seal protector over neutral clutch inner hub (Fig. 86).

3. Install neutral clutch piston. Use small blade screw driver to depress lip of outer seal into case center support.

4. Remove seal protector J-8766.

5. Install 16 release springs into spring pockets of neutral clutch piston.

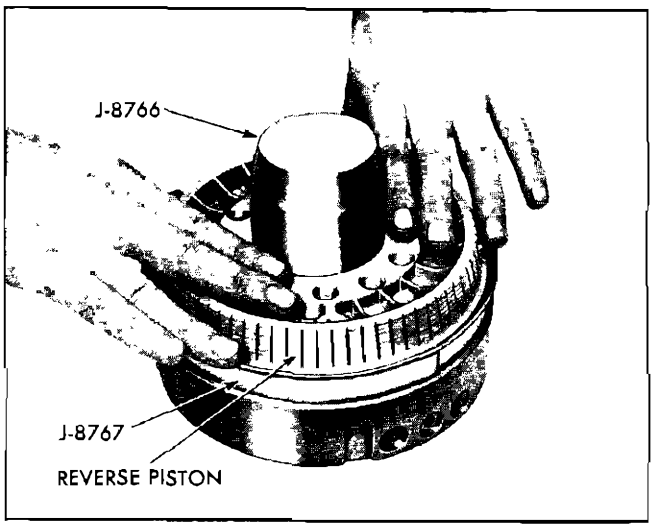

Fig. 87 Installing Reverse Clutch Piston

6. Install neutral clutch spring retainer over release springs.

7. Using tools J-8761, J-6129 and J-4670-B, compress neutral clutch release springs and install retainer snap ring (Fig. 84).

8. Remove tools.

9. Install inner seal protector tool J-8766 over oil delivery sleeve.

10. Install reverse outer seal protector tool, J-8767 into case center support. Some oil on inside of the tool will ease installation of seal.

11. Install new inner and outer reverse piston seal rings on reverse piston, lip of seals facing dowel pin holes in piston.

12. Install reverse piston, aligning piston to index with dowel pins (Fig. 87).

13. Remove tools.

14. Install 12 reverse piston release springs into spring pockets.

15. Install reverse piston spring retainer.

16. Lay snap ring on top of tower, then using tools J-8761, J-6129 and J-4670-B compress release springs (Fig. 83).

17. Install reverse piston spring retainer snap ring.

18. Remove tools.

19. Check all springs for proper position in pockets.

20. Install 2 hook type oil seal rings on oil delivery sleeve.

Installation . . . . . Page 79

REAR INTERNAL GEAR AND SPRAG

DISASSEMBLY

1. Remove sprag retainer (Fig. 88).

2. Remove sprag outer race from sprag assembly and rear internal gear (Fig. 88).

3. Remove the sprag and bushing assembly from internal gear. (Sprag assembly consists of sprag assembly and two bronze bushings).

INSPECTION

1. Inspect the rear internal gear for tooth damage,

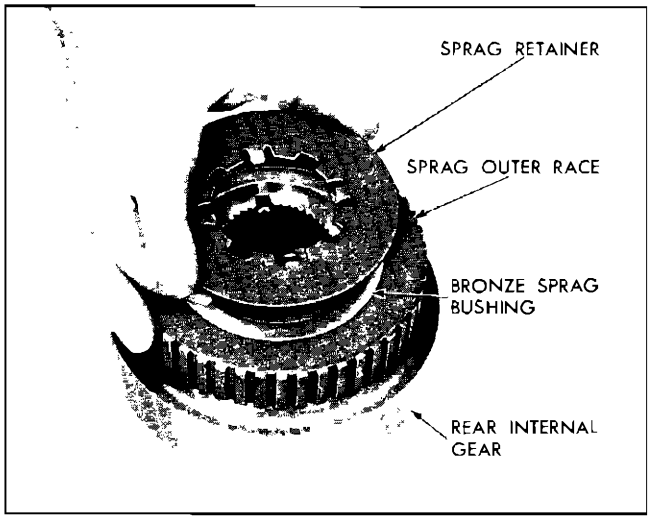

Fig. 88 Removing Sprag Retainer

nicks or burrs.

2. Inspect the rear internal gear bushing for excessive wear, nicks or burrs.

3. Inspect the splines on the I.D. of the inner sprag race for burrs or broken splines.

4. Inspect the inner sprag race for scoring.

5. Inspect outer sprag race for scoring.

6. Inspect outer sprag race for nicks, burrs or damaged splines. Test one drive plate over the splines for free up and down movement.

7. Inspect sprag assembly for score marks, damaged spring retainer or damaged shoulder. Test sprag action with sprag installed in outer sprag race over the inner sprag race. Note shoulder of sprag should face up or toward sprag retainer.

8. Inspect the sprag retainer for bent tangs or distortion.

ASSEMBLY

1. Place one bronze bushing over inner race of internal gear with cup side facing up.

2. Place sprag assembly into the sprag outer race.

3. With shoulder side of sprag up, start sprag and outer race over internal gear (Fig. 90).

4. Slide sprag and outer race down against internal gear.

5. Install second bronze bushing cup side down, against sprag assembly.

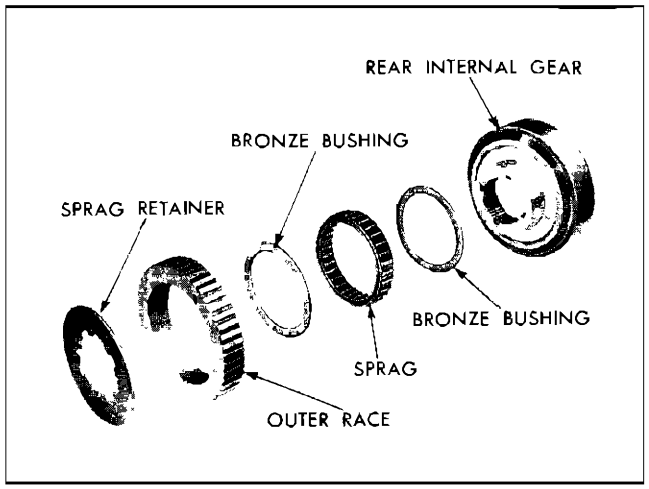

Fig. 89 Sprag Assembly—Exploded

6. Apply petrolatum on sprag retainer and install sprag retainer on internal gear aligning tangs with the internal gear slots.

NOTE: Check to make certain sprag assembly is properly installed by rotating outer race counterclockwise. Outer race should not turn clockwise.

Installation . . . . . Page 80

GOVERNOR

DISASSEMBLY

1. Compress finer of G-2 plug retainer and remove (Fig. 91).

2. Remove G-2 plug and G-2 valve (Fig. 91).

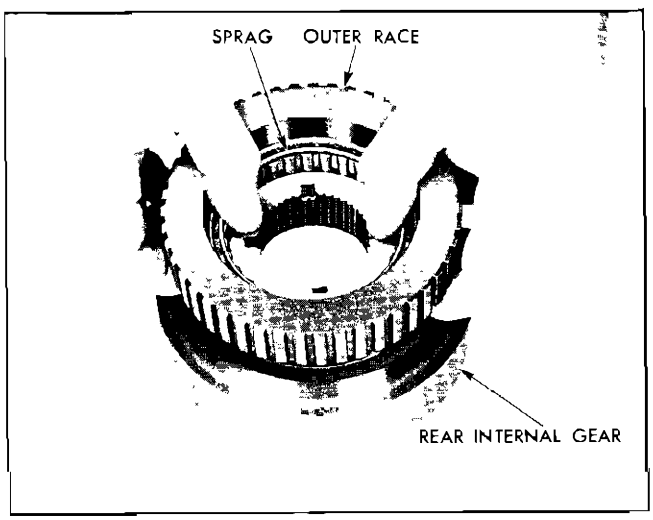

Fig. 90 Installing Sprag Outer Race

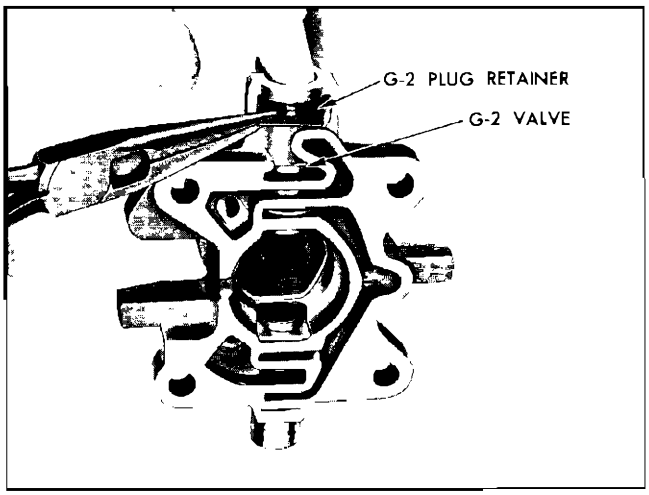

Fig. 91 Removing G-2 Plug Retainer

3. Inspect and remove, if necessary, 4 governor oil hook-type oil seal rings from governor tower.

INSPECTION

1. Inspect 4 governor rings and ring grooves. Rings should fit freely in ring grooves.

2. Use tag wire and check G-1, G-2 and line pressure oil passages for restrictions.

3. Inspect governor bushing for scores, nicks or burrs.

4. Inspect G-1 and G-2 valves for free movement.

5. Be certain the entire governor casting is free from all dirt and small chips, use air gun.

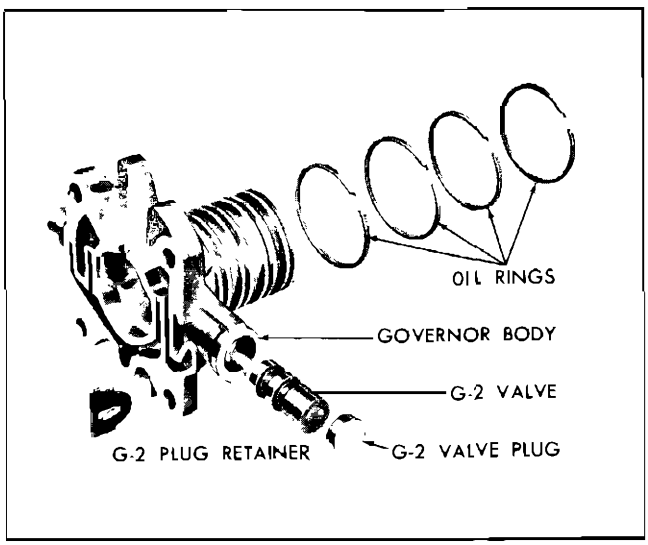

Fig. 92 Governor—Exploded

ASSEMBLY

1. If removed, install 4 hook-type governor oil seal rings on governor tower.

2. Install G-2 valve (small land first) into governor (Fig. 92).

3. Install G-2 plug with the flat side out.

4. Install G-2 plug retainer with finger side out. In assembling governor, care should be exercised to prevent the G-2 valve from dropping out of governor body.

Installation . Page 82

PARKING LINKAGE

The following steps are used only if linkage was removed from case.

DISASSEMBLY

1. Install assembly in vise using a soft jaw vise on dowel pin (Fig. 93).

2. Lift hook end of bracket spring off parking lever and disassemble parts (Fig. 94).

INSPECTION

1. Check all pins for excessive wear or binding in their bores.

2. Check bracket spring for collapsed coil or breaks.

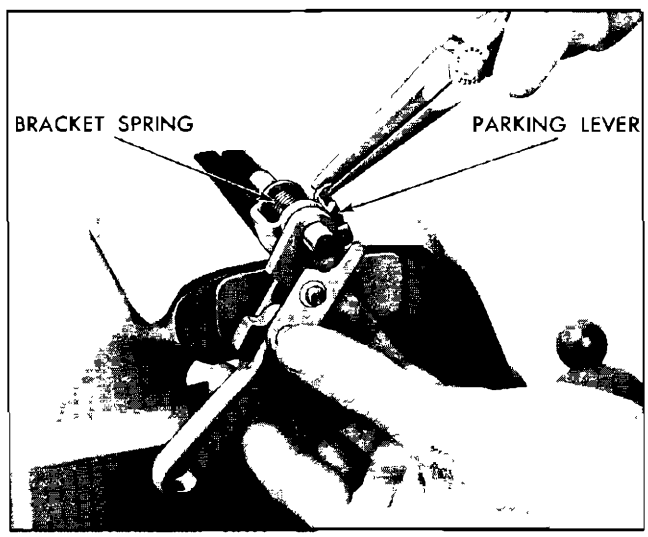

Fig. 93 Removing Parking Bracket Spring from Parking Lever

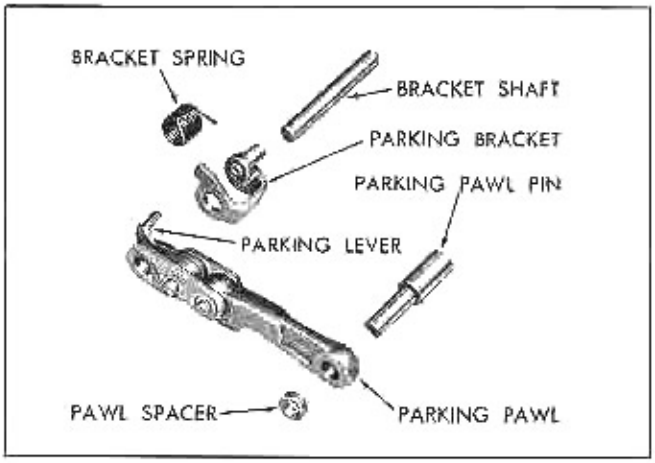

Fig. 94 Parking Brake Assembly—Exploded

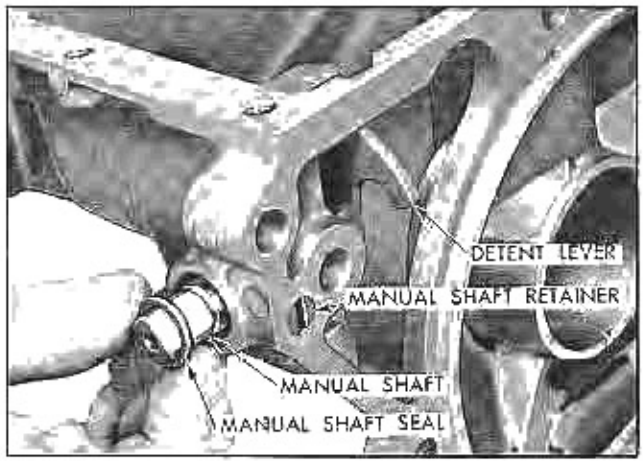

Fig. 95 Removing Manual Shaft Seal

ASSEMBLY

1. Clamp dowel pin of parking bracket in soft jawed vise (Fig. 93).

2. Place bracket spring in bracket with straight leg of spring in the narrow slot between the sides of the bracket and the hook end of the spring near the fixed end of the dowel pin.

3. Place bracket shaft approximately half way through bracket and spring and then slide pawl and lever assembly onto shaft so parking lever and links are as shown in Fig. 93.

4. Using long nose pliers, hook bracket spring over parking lever.

5. Remove assembly from vise.

Installation . . . . . Page 81

REAR BEARING RETAINER

DISASSEMBLY

1. Remove inside detent lever and shaft assembly by removing manual shaft retaining pin from case side of retainer (Fig. 95). CAUTION: This is not a screw.

2. Rotate lever and shaft assembly to remove from rear bearing retainer.

3. If necessary, remove manual shaft seal from bore in retainer.

4. Remove the rear thrust bearing race to rear bearing retainer truarc snap ring through access hole in retainer (Fig. 97).

5. Remove rear race, bearing and front race from rear bearing retainer.

INSPECTION

1. Inspect rear bearing retainer for hair line cracks or leaks (Fig. 96).

2. Check for inter-connected oil passages, use air gun or smoke.

3. Inspect rear bearing and bearing race.

4. Check bolt hole threads for cross threading or stripped.

5. Check air vent passage for restriction and anti-siphoning valve for proper movement.

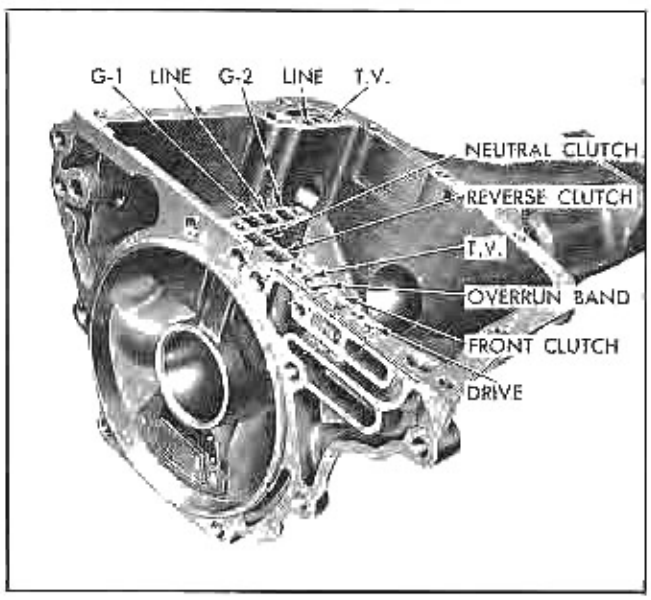

Fig. 96 Rear Bearing Retainer Passages

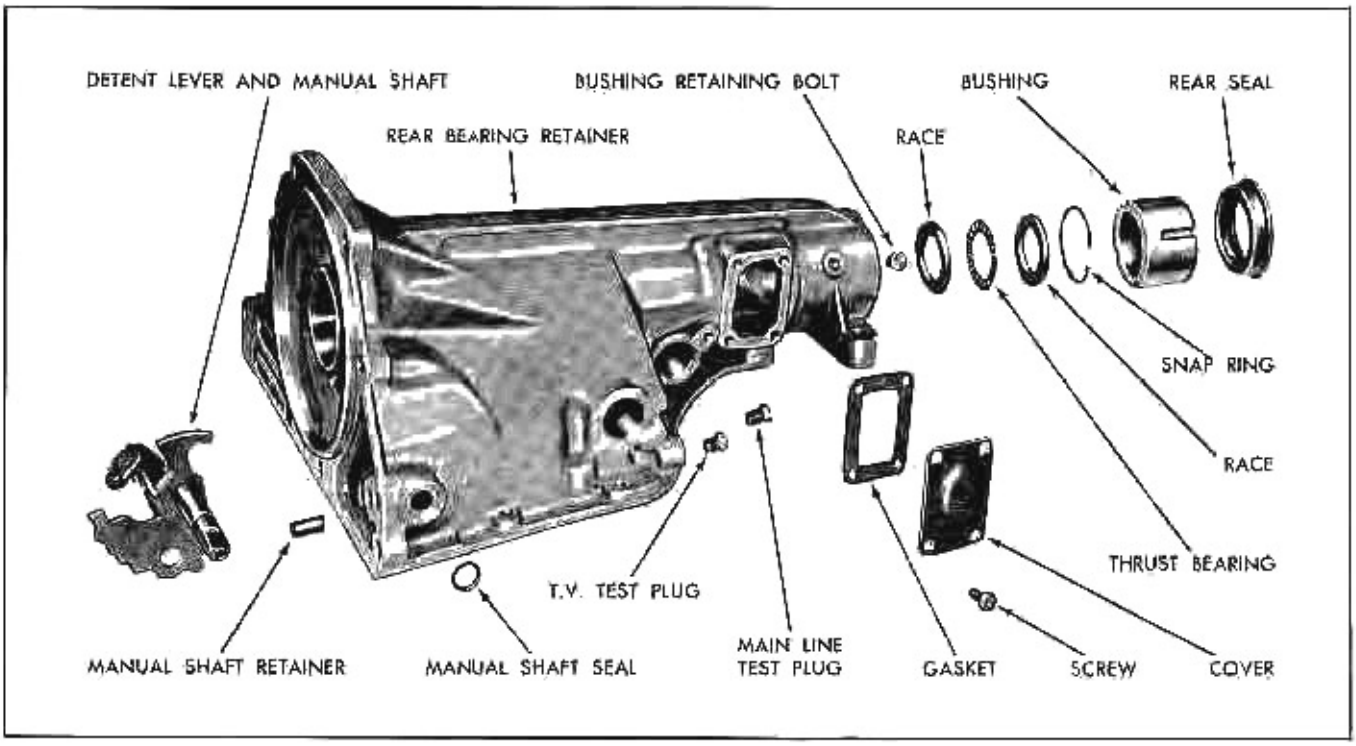

Fig. 97 Rear Bearing Retainer

6. Inspect detent lever for nicks, burrs, replace detent lever shaft "O" ring seal.

7. Clean thoroughly with air gun.

ASSEMBLY

1. Install race, thrust bearing, and race into rear bearing retainer.

2. Install snap ring, concave side towards rear, (identification side away from race) and align ear on snap ring with top slot in retainer.

3. If removed, install the bushing and sleeve assembly in rear end of rear bearing retainer, chamfered end first. Align short slot in bushing with retaining bolt hole in rear bearing retainer. Install with soft hammer and drift.

4. Install bushing retaining bolt. Torque to 12-15 ft. lbs.

5. Install inside detent lever and shaft assembly into rear bearing retainer.

6. Install detent shaft retainer into hole in rear bearing retainer, aligning key with annular groove in detent shaft.

7. If removed, install new manual shaft seal (grooved side toward retainer) over detent shaft.

Installation . . Page 83

SERVO PISTON AND ACCUMULATOR PISTONS

DISASSEMBLY

1. Place a 7/16" deep socket over the long end of the servo piston pin (Fig. 98).

2. Position a "U" shaped spacer against the piston end of the piston assembly and place the socket, piston assembly and "U" shaped spacer between the jaws of a bench vise (Fig. 98).

3. Slowly tighten the vise sufficiently to remove the snap ring.

4. Remove the servo piston to piston pin snap ring and washer being careful not to spread snap ring more than necessary as it can be easily distorted.

5. Carefully remove piston assembly from the vise.

6. Remove the servo piston, springs and retainer.

7. From the upper accumulator piston, remove and discard the lip seal.

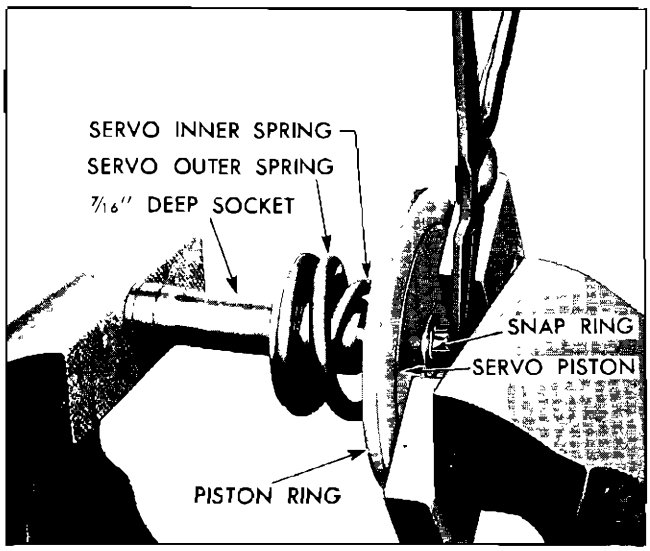

Fig. 98 Method of Removing Snop Ring from Servo Piston Pin

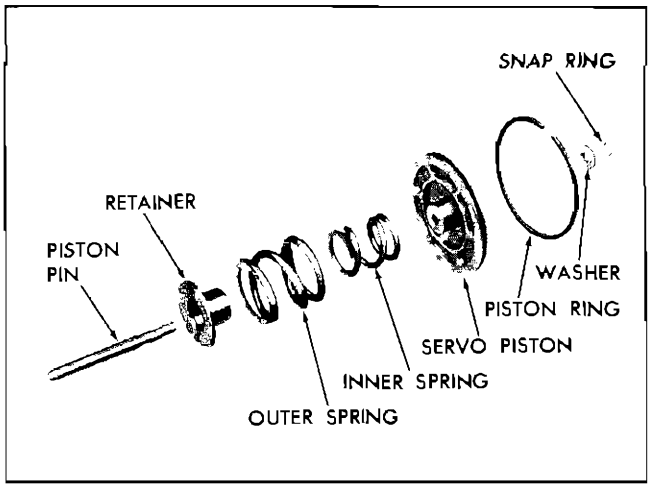

Fig. 99 Servo Piston—Exploded

INSPECTION

1. Inspect servo piston ring and ring groove for broken ring and ring groove for nicks or burrs.

2. Check the release springs for collapsed coils or broken spring.

3. Check the piston stem for scoring.

4. Use tag wire and check the oil passages in the piston.

5. Inspect lower accumulator piston ring and ring groove for broken ring and ring grooves for nicks or burrs.

6. Replace the rubber lip type seal on the upper accumulator piston.

7. Inspect the accumulator release springs for collapsed coils or broken ring.

8. Inspect the accumulator piston pin for scoring.

ASSEMBLY

1. Install a new piston seal on the upper accumulator piston, lip facing flat side of piston.

2. Install the spring retainer, springs and servo piston over the servo piston pin (Fig. 99).

3. Place the assembled servo components with a 7/16" deep socket over the piston pin and "U" shaped spacer against the servo piston into a vise and, aligning pin carefully, compress the assembly to allow the flat washer and snap ring to be installed (Fig. 98).

4. Install the washer and a new snap ring.

5. Remove the servo piston assembly and tools from the vise.

Installation . . . . . Page 86

CONTROL VALVES

The following inspection procedure is to be used for the compensator valve body, the 2-3 boost body, and the control valve body (Fig. 100).

1. Inspect each valve in the valve body for free movement in the valve bore. It may be necessary to stone the lands of the valve lightly to remove small burrs. The valves will have sharp edges to perform a cleaning action within the valve bore. Do not remove square edges.

2. Inspect springs for distortion or collapsed coils.

3. Be sure check ball seats are not pitted or chipped.

4. Inspect spacer plates for restrictions, dents or distortion.

5. Clean valve body thoroughly with air gun.

COMPENSATOR VALVE BODY

DISASSEMBLY

1. Compress compensator plug and remove retaining pin (Fig. 101).

2. Remove compensator plug.

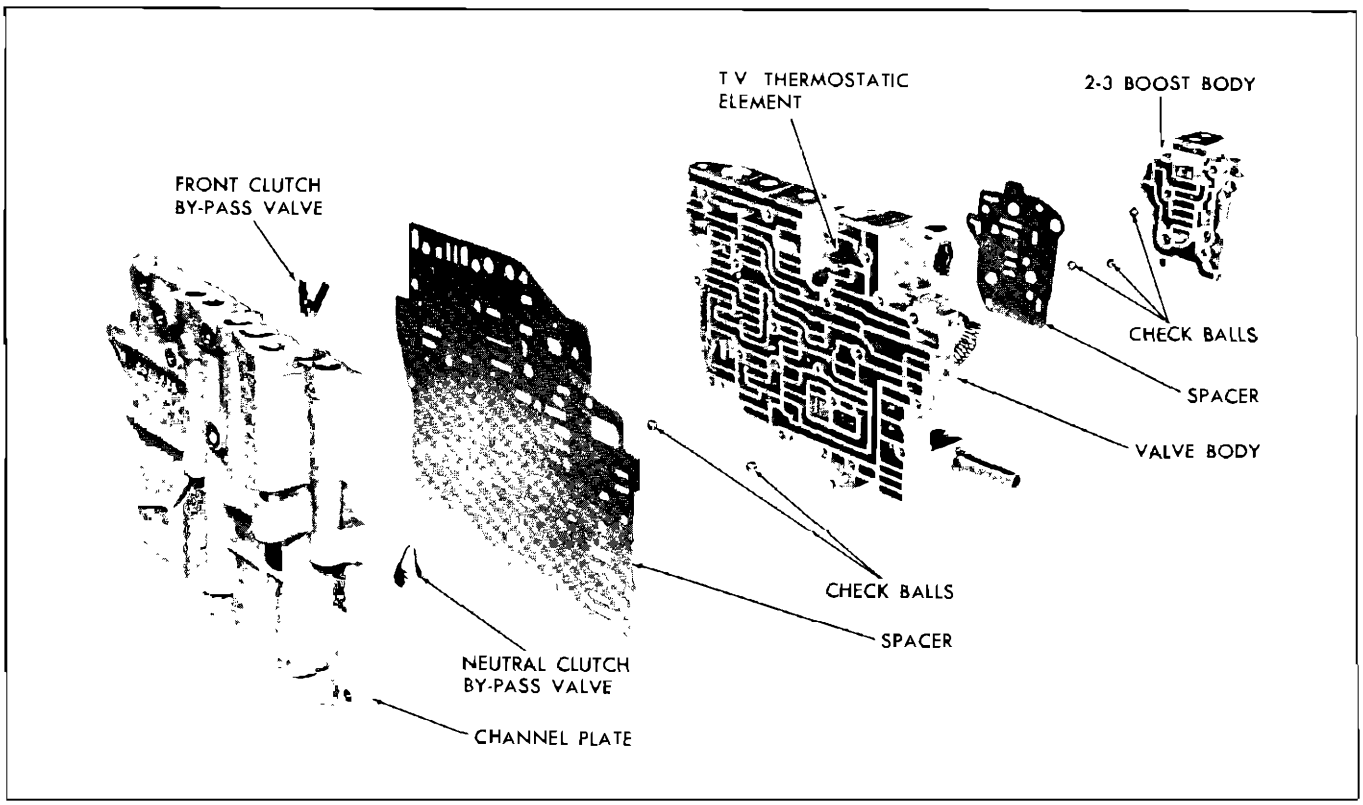

Fig. 100 Control Valve Assembly

3. Remove secondary compensator valve and spring.

4. Remove primary compensator valve and spring.

ASSEMBLY

1. Install primary compensator spring on primary compensator valve.

2. Install primary compensator spring and valve—small end first into body.

3. Install secondary compensator spring on secondary compensator valve.

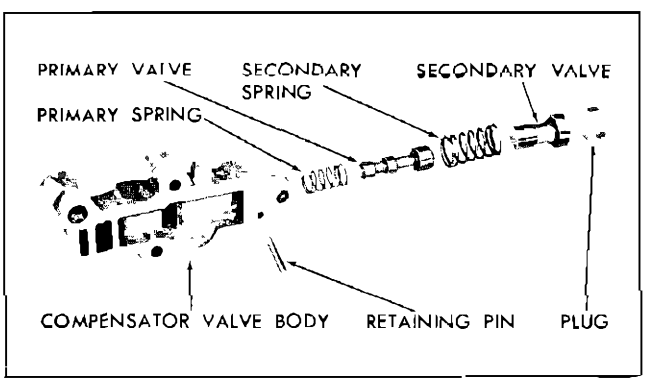

Fig. 101 Compensator Valve—Exploded

4. Install the secondary spring and valve into compensator body, spring end first.

5. Install compensator plug threaded side out.

6. Compress compensator plug and install retaining pin.

CONTROL VALVE

DISASSEMBLY: 2-3 BOOST BODY

1. Remove the 2-3 boost body assembly by removing 4 attaching screws. (One screw is located on channel plate side of body.) The 2-3 boost body contains 3 loose check balls and care should be exercised to prevent their loss (Fig. 100).

2. Remove the three check balls and spacer plate from the valve body.

3. Remove the retainer from the 2-3 boost body. Retainer is under spring pressure (Fig. 102).

4. Remove the 2-1 cut off valve spring and valve.

5. Remove the 2-3 boost plug, spring, and valve.

ASSEMBLY: 2-3 BOOST BODY

1. Install the 2-3 boost valve, long stem out, spring

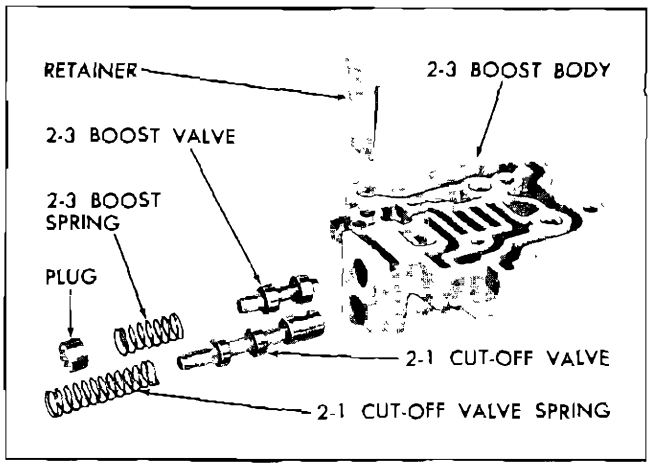

Fig. 102 2-3 Boost Body—Exploded

and plug in the bore of the boost body nearest the cored face.

2. Compress the 2-3 boost plug against spring tension and partly install the 2-3 boost body retainer.

3. Install the 2-1 cut off valve, stem out, and spring in remaining bore of boost body.

4. Compress the 2-1 cut off valve spring and slide 2-3 boost body retainer over spring. Leave spacer plate and check balls loose at this time.

DISASSEMBLY—CONTROL VALVE BODY

1. Remove channel plate from valve body assembly by removing two attaching screws from the valve body side and thirteen attaching screws from the channel plate side (Fig. 100).

2. Remove neutral clutch by-pass valve from cored side of channel plate (Fig. 103).

3. Remove front clutch by-pass valve from channel plate.

4. If necessary to remove pressure relief ball and spring: (Fig. 103)

a. Turn channel plate over to casting side and remove retaining pin. Pin under extreme pressure.

b. Remove pressure relief spring.

c. Remove pressure relief ball.

d. Assemble pressure relief ball, spring and retaining pin into channel plate.

5. Install neutral clutch by-pass valve and front clutch by-pass valve into channel plate.

Set assembled channel plate aside and continue with disassembly.

6. Remove spacer (channel plate to valve body). Place on channel plate and check alignment of by-pass valves.

7. Remove 2 check balls and T.V. thermostatic element.

8. Remove T.V. plunger guide retainer located in cored passage near T.V. adjusting screw. Retainer is loose. Position control valve assembly with the cored side up and the T.V. lever positioned on the top right hand side.

9. Remove multiple valve plug retainer located in lower left hand corner. Plugs under spring tension.

10. Remove the 2-1 downshift spring and valve from the lowest bore (Fig. 104).

11. Remove the valve bore plug by threading a valve body attaching screw into plug, and slide plug out from the adjacent bore.

NOTE: The valve bore plug is a non-operating retaining plug used in valve bores. They are all threaded and should be removed and installed with a valve body attaching screw as described above.

12. Remove the 1-2 governor valve from the same bore.

13. Remove the valve bore plug from the adjacent bore.

14. Remove the 2-3 governor valve from the same bore.

15. Remove the valve bore plug from the next adjacent bore.

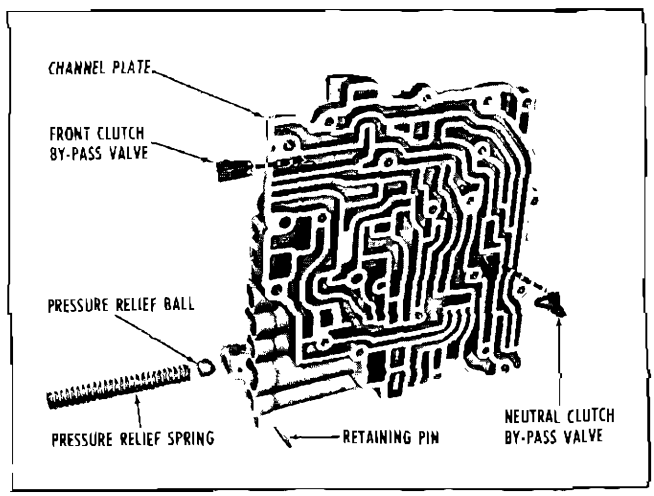

Fig. 103 Channel Plate—Exploded

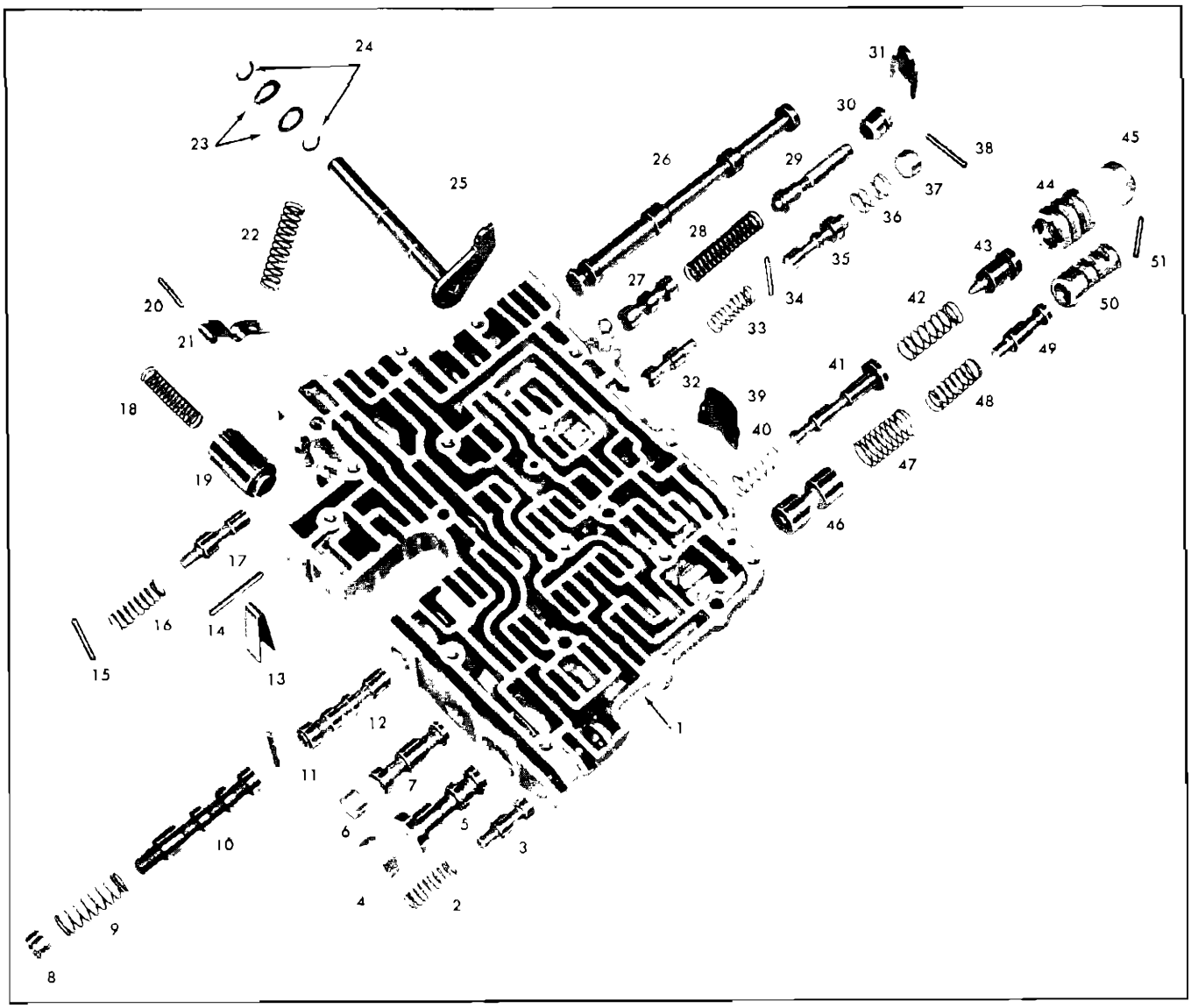

Fig. 104 Control Valve Assembly—Exploded

1. Control Valve Body
2. 2-1 Downshift Valve Spring
3. 2-1 Downshift Valve Spring
4. Plug
5. 1-2 Governor Valve
6. Plug
7. 2-3 Governor Valve
8. Plug
9. Coupling Timing Valve Spring
10. Coupling Timing Valve
11. Retaining Pin
12. Pressure Boost Valve
13. T.V. Thermostatic Element
14. Retaining Pin
15. Retaining Pin
16. Pressure Drop Valve Spring
17. Pressure Drop Valve
18. Reverse Blocker Spring
19. Reverse Blocker Piston
20. Detent Pin
21. Detent Lever
22. Detent Spring
23. Washers
24. "C" rings
25. Throttle Lever
26. Manual Valve
27. Throttle Valve
28. Throttle Valve Spring
29. Throttle Valve Plunger
30. Throttle Valve Plunger Guide
31. Throttle Valve Plunger Guide Retainer
32. Front Clutch Exhaust Valve
33. Front Clutch Exhaust Valve Spring
34. Retaining Pin
35. Neutral Clutch Valve
36. Neutral Clutch Valve Spring
37. Plug
38. Retaining Pin
39. Plug Retainer
40. 2-3 Shift Valve Spring
41. 2-3 Shift Valve
42. 2-3 T.V. Valve Spring
43. 2-3 T.V. Valve
44. 2-3 T.V. Valve Bushing
45. Plug
46. 1-2 Shift Valve
47. 1-2 Shift Valve Spring
48. 1-2 T.V. Valve Spring
49. 1-2 T. V. Valve
50. 1-2 T.V. Valve Bushing
51. Retaining Pin

16. Remove the coupling timing valve spring and valve from the same bore.

17. Remove the pressure boost valve retaining pin from the center of the cored side of the valve body in the same bore.

18. Remove the pressure boost valve from the same bore.

19. On the opposite side of the valve body start with the lower bore and remove the retaining pin.

20. Remove the 1-2 T.V. bushing and valve from the same bore.

21. Remove the 1-2 T.V. and shift valve springs—then remove the 1-2 shift valve from the same bore.

22. Remove the valve bore plug retainer and plug, while holding finger over plug as plug is under spring pressure, from the adjacent bore.

23. Remove the 2-3 T.V. valve, spring and bushing from the same bore.

24. Remove the 2-3 shift valve and spring from the same bore.

25. Remove the retaining pin and valve bore plug from the fourth bore.

26. Remove the neutral clutch valve spring and neutral clutch valve.

27. Remove the front clutch exhaust valve retaining pin, which is under spring pressure, from the same bore on the cored side of valve body. Unload spring pressure from uncored side with a small screw driver to remove pin.

28. Remove the front clutch exhaust valve spring and valve.

29. Mark T.V. adjustment screw and loosen **exactly 5 turns.**

30. Turn the valve body over and remove the throttle lever by removing the outside "C" ring and washer, positioning the shaft so that the lever will clear the T.V. adjustment screw, remove washer.

31. Remove T.V. plunger and sleeve.

32. Remove T.V. spring and valve.

33. Remove the pressure drop retaining pin, spring and valve from the last bore on the opposite side of the control valve assembly.

34. If necessary, remove the reverse blocker piston retaining pin, spring and reverse blocker piston.

35. Remove detent spring. Do not remove detent lever unless necessary to replace. If necessary to replace, drive pin out with small punch.

36. If necessary to remove detent lever, use a small punch to tap detent retainer pin through lever. Remove detent lever and pin from valve body.

INSPECTION

1. Inspect each valve in the valve body for free movement in the valve bore. It may be necessary to stone the lands of the valve lightly to remove small burrs. The valves will have sharp edges to perform a cleaning action within the valve bore. Do not remove square edges.

2. Inspect springs for distortion or collapsed coils.

3. Be sure check ball seats are not pitted or chipped.

4. Inspect spacer plates for restrictions, dents or distortion.

5. Clean valve body thoroughly with air gun.

ASSEMBLY—CONTROL VALVE BODY

NOTE: All attaching screws are to be torqued to 2.5 to 3.5 ft. lbs.

All attaching bolts are to be torqued to 6-8 ft. lbs.

1. If previously removed, install manual detent by positioning manual detent in valve body and installing retaining pin.

2. Install detent spring into manual detent.

3. If removed, install the reverse blocker piston, spring and pin.

4. Install the pressure drop valve, stem end of valve last, spring and retaining pin in the top bore adjacent to the detent spring.

5. Install the T.V. valve (round end first) spring, plunger and sleeve into the T.V. bore adjacent to the manual valve bore.

6. Place washer against "C" ring on T.V. lever shaft.

7. Install T.V. lever shaft through hole in valve body so that the T.V. lever will index between the T.V. plunger and throttle adjusting screw.

8. Install washer and "C" ring securing lever assembly to valve body.

9. Turn T.V. adjusting screw back to original position, **exactly 5 turns.**

10. Install the T.V. plunger guide retainer through cored side of valve body into annular groove in T.V. plunger guide.

11. Install the front clutch exhaust valve (land end first) and front clutch exhaust valve spring in the bore adjacent to the T.V. bore.

12. Install short retaining pin through cored side of valve body while compressing the front clutch exhaust valve spring.

13. Install the neutral clutch valve and spring in the same bore.

14. Compress the neutral clutch valve spring and install valve bore plug (threaded end out) and retaining pin.

15. Place the 2-3 shift valve spring on the 2-3 shift valve.

16. In the next open bore install the 2-3 shift valve and spring as a combination.

17. Install the 2-3 T.V. spring into spring pocket of 2-3 shift valve.

18. Install the 2-3 T.V. valve into the 2-3 regulator bushing so that valve will completely enter bore of bushing.

19. Install the 2-3 T.V. valve and bushing into the 2-3 bore in the valve body (small end of T.V. valve first).

20. Install the 2-3 valve bore plug (threaded side out) and retainer.

21. Install the 1-2 shift valve in the bore adjacent to the 2-3 shift valve train.

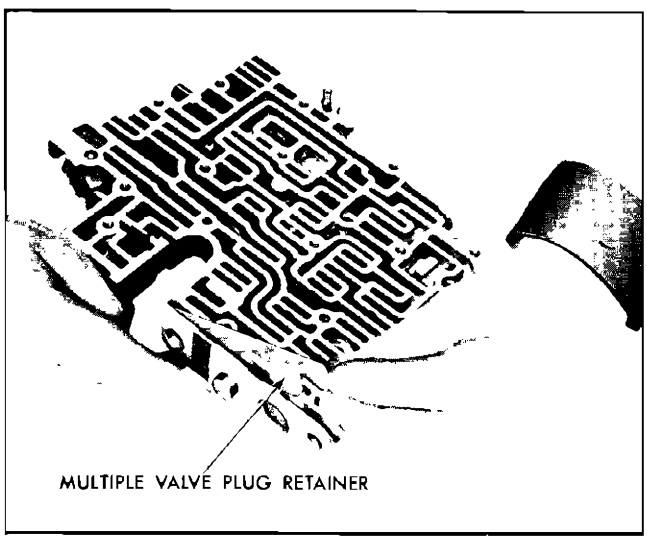

Fig. 105 Installing Multiple Valve Plug Retainer

22. Install the 1-2 T.V. and shift valve springs in the same bore.

23. Install the 1-2 T.V. valve into the bushing with the stem end out.

24. Install the 1-2 T.V. valve and bushing into the 1-2 bore, valve end first.

25. Depress the bushing and install short retaining pin from the cored side of the valve body.

26. In the bore adjacent to the "U" shaped "cut-out" install the pressure boost valve, using brass rod to guide valve into bore (long land first).

27. Install retaining pin through same bore.

28. Install coupling timing valve (land end first) into the same bore.

29. Install coupling timing valve spring over stem end of coupling timing valve.

30. Install valve bore plug in valve body compressing and partially installing multiple plug retainer. Install retainer in such a manner that only one corner of the plug is retained. This will permit the installation of the remaining valves (Fig. 105).

31. Install the 2-3 governor valve into the adjacent 2-3 bore, small land first.

32. Install the 2-3 valve bore plug against the 2-3 governor valve, compressing plug against spring tension into the bore and position the retainer again so that edge of plug is secured and the adjacent bore hole is unobstructed by the retainer.

33. Install the 1-2 governor valve into the adjacent 1-2 shift valve bore.

34. Install the bore plug in the 1-2 bore, compressing the valve against spring pressure and position multiple retainer. Make certain remaining bore is unobstructed.

35. Install the 2-1 downshift valve (land end first) into the remaining bore.

36. Place 2-1 downshift spring over 2-1 downshift valve compressing spring and secure with multiple retainer.

ASSEMBLY OF COMPLETE CONTROL VALVE

1. Install the T.V. thermostatic element open end down in cavity behind throttle valve in control valve body (location—Fig. 100).

2. Position spacer plate over cored side of control valve body.

3. Install small 2 ball check valves into pockets on cored side of valve body.

4. Position channel plate on valve body and attach with 13 screws. Leave loose for final adjustment.

5. Turn control valve assembly over and install 3 ball check valves into pockets.

6. Place 2-3 boost valve body spacer on valve body.

7. Place 2-3 boost body on spacer plate and install 3 attaching screws. (Do not tighten screws at this time.)

8. Install loosely two screws attaching valve body to channel plate.

9. Turn control valve assembly over and install the remaining 2-3 boost body assembly control valve body assembly long attaching screw.

10. Tighten 19 control valve body assembly attaching screws.

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INSPECTION OF REMAINING UNITS

DRIVE TORUS MEMBER AND TORQUE MULTIPLIER

1. Inspect drive torus member for porosity, chipped or damaged vanes (Fig. 106).

2. Inspect drive torus bushing for good staking and excessive wear.

3. Check for damaged splines on torque multiplier, bent or damaged vanes. Check oil seal ring on torque multiplier for broken ring and free movement in ring groove.

4. Check for burrs or restrictions on the clutch plate drive lugs.

5. Check bolt threads in drive member for cross threading.

DRIVEN TORUS MEMBER

1. Inspect driven torus member for bent or damaged vanes.

2. Check splines in driven member hub for nicks or burrs.

3. Check (2) oil seal rings and ring grooves for broken rings, check the oil seal grooves for nicks, burrs, rings, when locked should turn freely in groove.

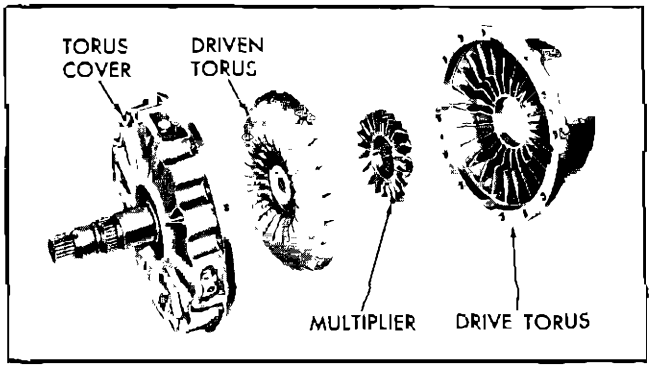


Fig. 106 Torus Assembly

4. Inspect the balance weight, if present, for good weld.

5. Inspect the driven coupling to torque multiplier thrust bearing race for distorted bearing surface or excessive wear on thrust race. Check for foreign particles on thrust race and clean thoroughly. A slight distortion or bend on the thrust bearing could cause a side loading effect and cause part of the rollers to dislodge from the cage.

FRONT UNIT CARRIER ASSEMBLY

1. Inspect front carrier planet pinions for damaged pinion gears, chipped tooth, nicks or burrs.

2. Check for free movement of pinion gears on pinion pins, be sure pinion pins are well staked.

3. Check splines on carrier hub for nicks or burrs.

4. Inspect front sun gear to carrier thrust washer for excessive wear, nicks, burrs or foreign particles embedded on thrust race.

MAINSHAFT AND SUN GEAR

1. Inspect mainshaft and rear unit sun gear for damaged splines, teeth or thrust washer surface. Remove sun gear from mainshaft and inspect damper for cracks, peeling or foreign material.

OUTPUT SHAFT

1. Inspect output shaft splines for nicks, or burrs.

2. Inspect snap ring groove on output shaft for good machine cut and free of dirt and chips.

3. Inspect mainshaft pilot bushing for excessive wear and tight fit.

4. Inspect parking sprocket lugs for burred edges.

5. Inspect speedo drive gear for misalignment and tight fit on output shaft.

REAR PLANET CARRIER AND SHAFT

1. Inspect rear carrier planet pinions for damaged pinion gear and free movement on pinion pins, be sure pinion pins are well staked. Check (8) planet pinion thrust washers, be sure washers have not cut a pocket in the carrier.

2. Inspect the carrier shaft splines for nicks or burrs.

3. Inspect rear carrier to rear internal gear thrust bearing and thrust bearing race. Check for foreign particles embedded in thrust race. Handle the thrust bearings with care throughout the disassembly, inspection and assembly. A slight distortion or bend eaused by dropping or eareless handling could cause a side loading effect, which may not be visible and cause some of the rollers to dislodge from the cage.

4. Inspect rear sun gear to rear carrier thrust washer and thrust race.

5. Use tag wire and check 6 lubrication ports for restrictions.

OVERRUN BAND

1. Inspect overrun band for excessive wear, cracks in lining and distortion.

INSTALLATION OF UNITS INTO TRANSMISSION CASE

CONTENTS OF THIS SECTION

NEUTRAL CLUTCH, CASE CENTER SUPPORT AND REVERSE CLUTCH

1. Place transmission case in holding fixture in vertical position, front end up.

2. Install neutral clutch backing plate into case—flat side up.

3. Install 4 neutral clutch drive and 4 driven clutch plates as follows:

a. Install a composition drive plate above the clutch backing plate and then a steel driven plate with notched lug of plate in a slot adjacent to one of the wide lugs in the case.

b. Install a second composition plate and then another steel plate with its notched lug on the opposite side of the wide case lug from the first. The steel plates must be installed in this arrangement to properly un-nest the clutch pack.

c. Alternately, install composition and steel plates so that notches on the first and third steel plate are on one side of a wide lug and the second and fourth steel plate notches are on the opposite side.

4. Install long case center support key with longer lip toward front of case. Hold in place with petrolatum (Fig. 107).

5. Mark the case to indicate sides of the key to assist in alignment for installation of case center support (Fig. 107).

6. Install neutral and reverse clutch assembly (case center support) into case, aligning case center support key into key way. Tapping may be required. Make sure oil rings did not come unhooked during installation.

7. Install reverse stationary cone key into case—rounded side toward front of case (Fig. 108).

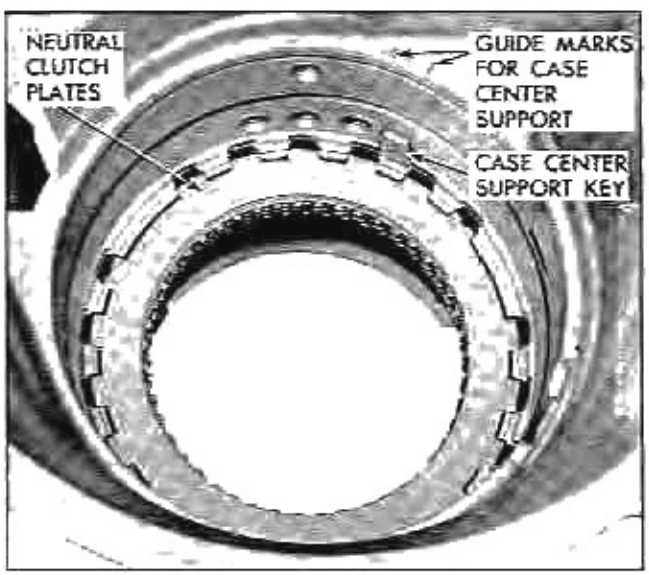


Fig. 107 Neutral Clutch Plates in Case

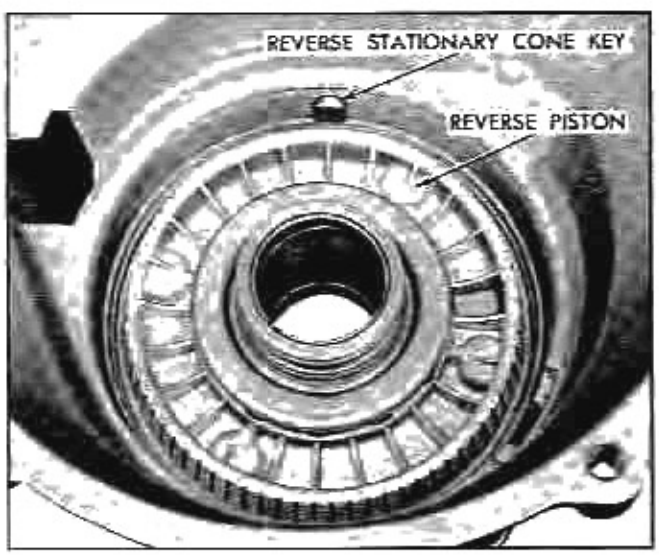


Fig. 108 Reverse Piston in Case

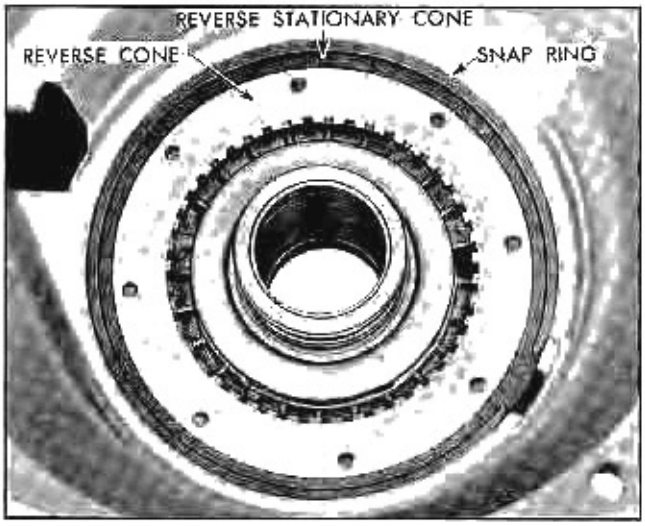


Fig. 109 Reverse Cone in Case

8. Install reverse cone (steel) into case cover reverse piston.

9. Install reverse stationary cone (plastic) in case aligning reverse stationary cone key with key way in cone, lightly tapping into place, if required.

10. Install large reverse cone snap ring into snap ring groove in case with flat ends of snap ring up, and ring gap at open segment of ring groove in case (Fig. 109).

11. Reposition transmission, rear end up, and install overrun band over anchor in case.

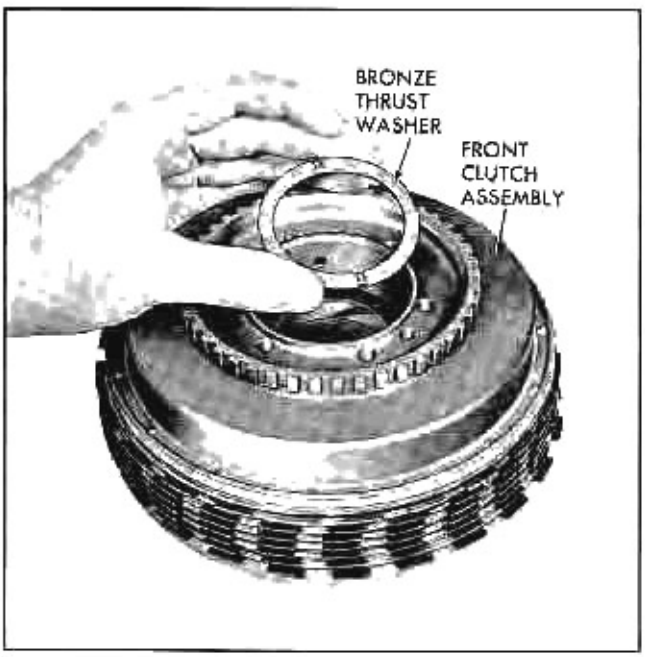


Fig. 110 Installing Bronze Thrust Washer in Front Clutch Assembly

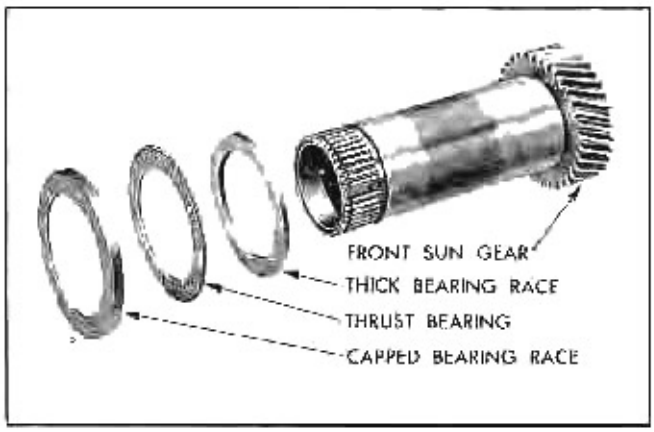


Fig. 111 Front Sun Gear Assembly

12. Install rear unit internal gear, sprag assembly and sprag retainer into case, aligning neutral clutch plates with sprag outer race. Be sure sprag retainer bottoms against case center support to insure engagement of all plates.

13. Reposition transmission, bottom up.

FRONT UNIT AND REAR UNIT

1. Install front clutch assembly into front of transmission engaging teeth in front clutch hub with reverse cone. Be sure bronze washer is positioned in counterbore of front unit clutch drum (Fig. 110).

2. Install thick bearing race, thrust bearing, thin cupped bearing race on front sun gear and shaft

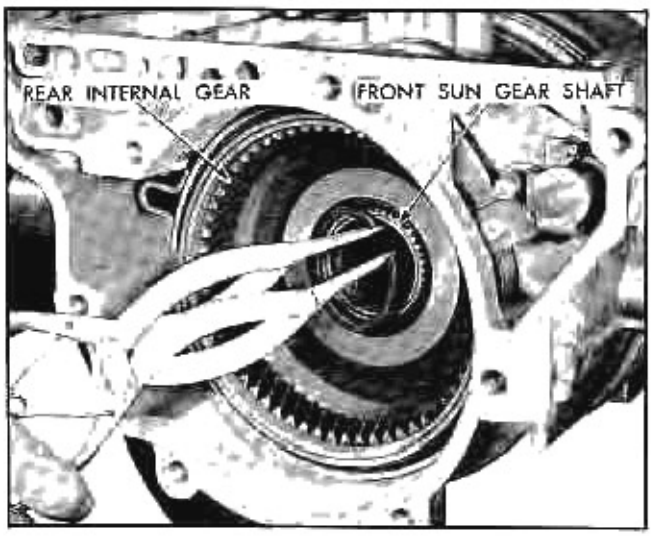


Fig. 112 Installing Front Sun Gear Shaft to Rear Internal Gear Snap Ring

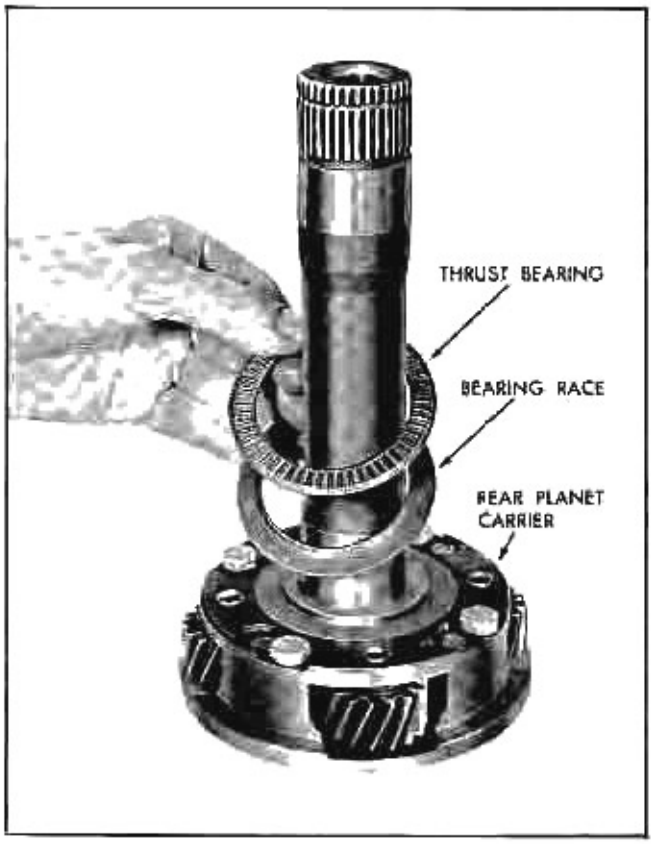


Fig. 113 Installing Thrust Bearing on Rear Planet Carrier

assembly (Fig. 111).

3. Install front sun gear and shaft assembly through case center support aligning splines of sun gear shaft with rear internal gear and cutaway splines with sprag retainer. CAUTION: Be sure to hold rear unit internal gear forward during this operation (Fig. 112).

4. Install front sun gear shaft to rear unit internal gear snap ring.

5. Install bearing race (flange up) and bearing on rear planet carrier. Retain with petrolatum (Fig. 113)

6. Install rear planet carrier through front unit sun gear shaft from rear of transmission.

7. Install front carrier thrust bearing race onto rear carrier shaft—inner flange out (Fig. 114).

8. Install front carrier thrust bearing into race.

9. Install thrust bearing race over front thrust bearing—outer flange inward.

10. Holding the rear planet carrier forward install front unit carrier.

11. Install front unit carrier to rear planet carrier

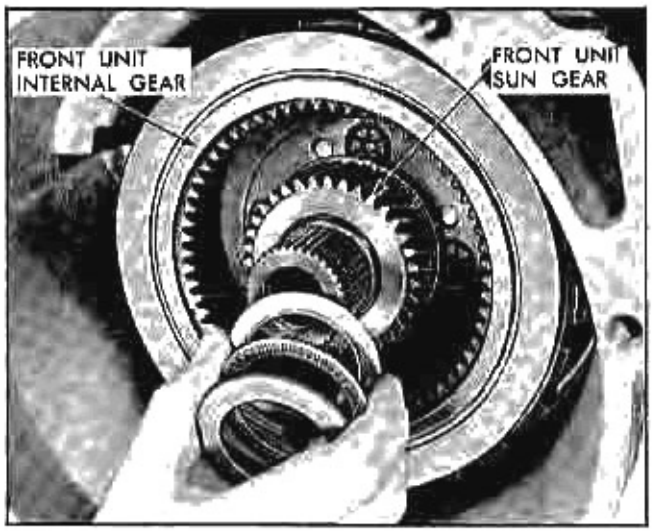


Fig. 114 Installing Thrust Bearing and Races on Front Sun Gear

shaft snap ring while holding rear carrier forward (Fig. 115).

12. Reposition transmission, rear end up.

PARKING LINKAGE

1. Install pawl spacer in case.

2. Install parking assembly, parking pawl first, through hole in rear of case so that pawl tooth faces inside of case (Fig. 116).

3. Install pawl pin into case, through pawl and spacer.

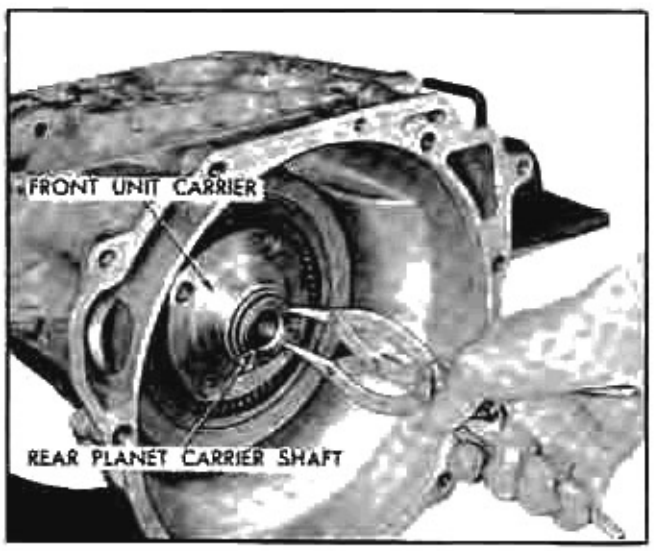


Fig. 115 Installing Front Carrier to Rear Carrier Shaft Snap Ring

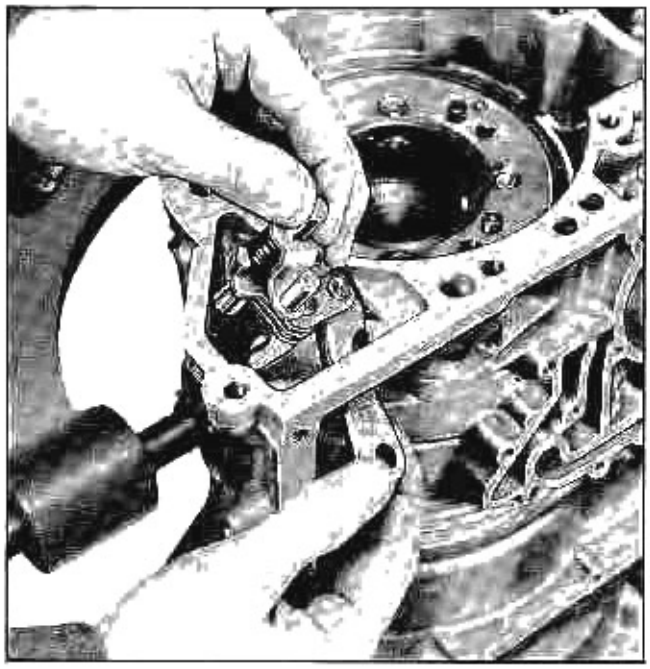


Fig. 116 Installing Parking Linkage in Case

4. Push parking bracket shaft to bottom of its bore.

5. Move pawl to its disengaged position.

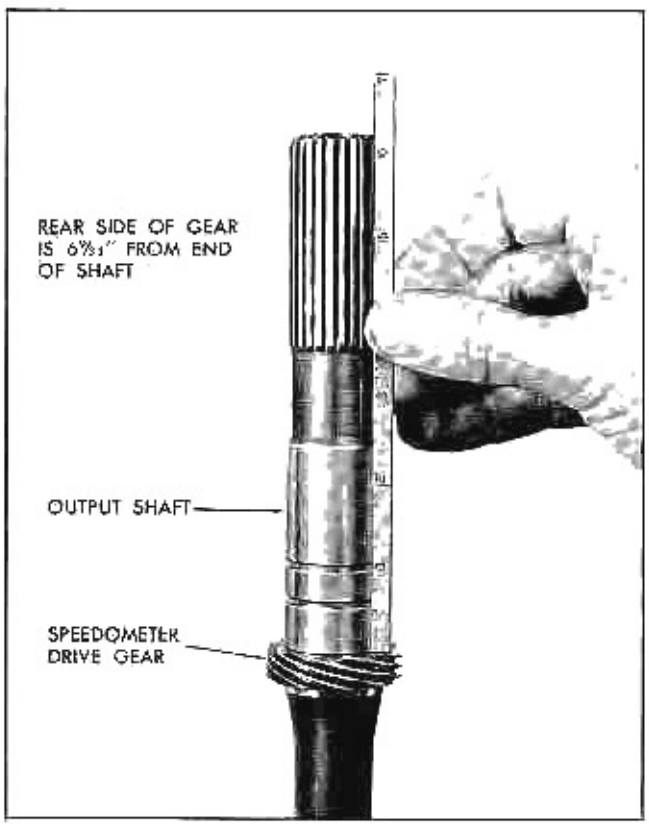


Fig. 117 Locating Speedometer Drive Gear

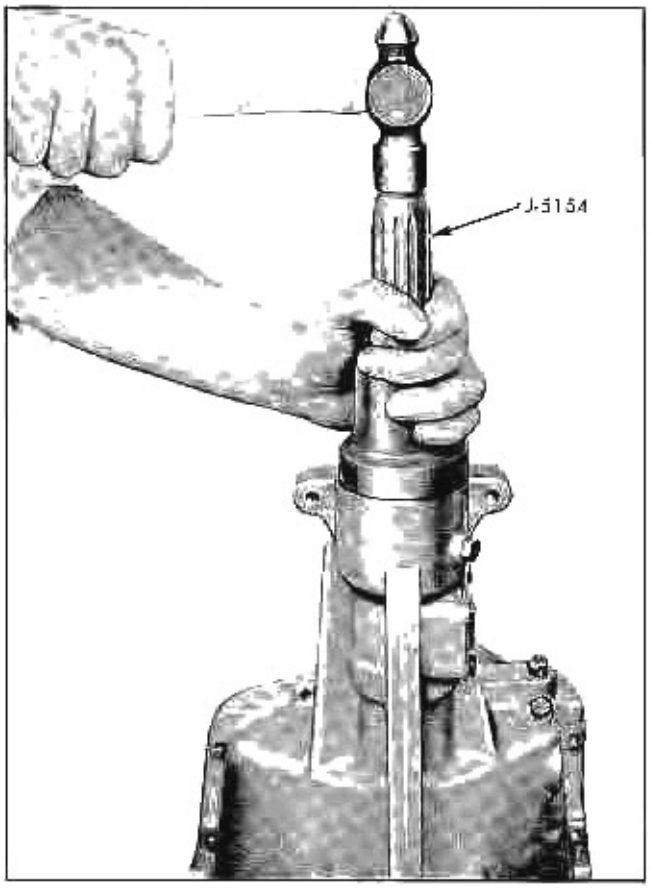


Fig. 118 Installing Rear Seal

OUTPUT SHAFT AND GOVERNOR

1. Install rear unit sun gear to rear carrier bearing race into rear carrier with flange up, retain with petrolatum.

2. Install rear unit sun gear to rear carrier thrust bearing into bearing race.

3. Assemble rear unit sun gear to mainshaft, if removed, and install through rear carrier.

4. Install governor gasket and governor on output shaft.

5. Install speedo drive gear using either tool J-6133 or press plates J-8904. Drive until rear side of gear is $6\frac{9}{32}$ inches from end of output shaft (Fig. 117).

6. Install output shaft to rear carrier assembly using alignment marks.

7. Engage parking pawl.

8. Install 4 governor attaching bolts. Torque to 19-23 ft. lbs.

9. Install truarc snap ring on front output shaft groove.

REAR BEARING RETAINER

1. Install rear bearing retainer gasket on rear bearing retainer and retain with petrolatum.

2. Start rear bearing retainer down over output shaft and install rear output shaft snap ring through access hole and over end of output shaft while retainer is being carefully lowered over governor assembly.

3. Carefully, align parking linkage pin and manual detent lever as rear bearing retainer is aligned with dowel pin and case.

4. Using tool J-6133, if necessary, seat rear bearing snap ring. It may be necessary to move output shaft rearward to locate snap ring by repositioning transmission to horizontal position.

5. Install 2 short rear bearing retainer to case attaching bolts at center location on each side. Install the remaining short bolt inside the rear bearing retainer. Install 5 remaining long rear bearing retainer bolts. Torque all bolts 20-25 ft. lbs.

6. If rear seal was removed, install new rear seal, using tool J-5154 (Fig. 118).

7. Install rear bearing retainer cover plate and gasket with 4 attaching bolts.

8. Reposition transmission, front end up.

TORUS

1. Install front unit drive torus aligning front unit clutch plates with drive slots in drive torus. Looking through vent port in bottom of case, observe that all clutch plates are engaged.

2. Install hook type oil ring on torque multiplier hub, if removed (Fig. 119).

3. Install hook type oil ring on front and rear hubs of driven torus member, if removed.

4. Install torque multiplier into drive torus aligning splines and position torque multiplier so that the I.D. of the hub of the torque multiplier is flush with the planet carrier shaft. A light tap with plastic hammer may be required.

5. Install driven torus to torque multiplier rear bearing race into torque multiplier.

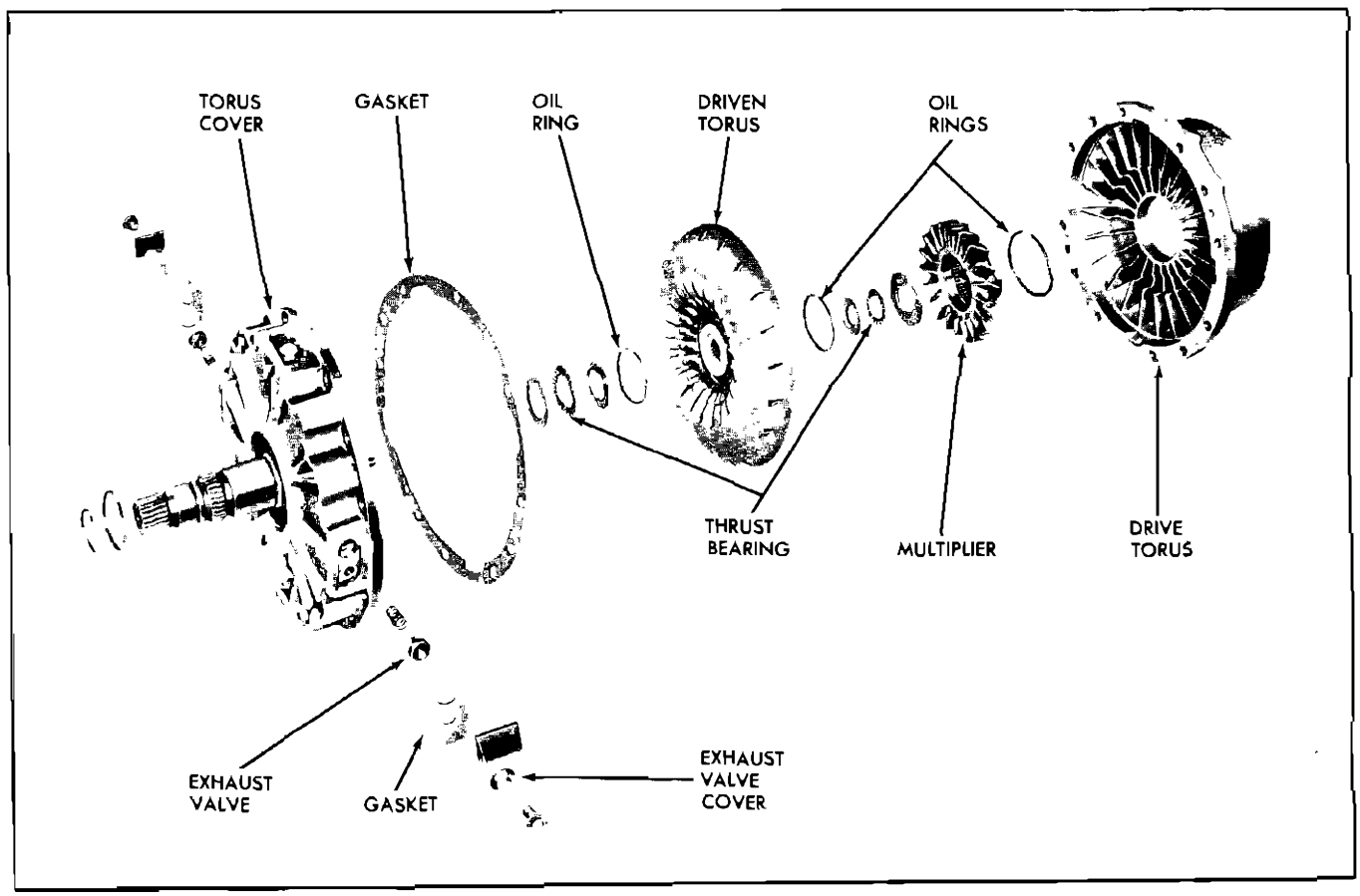


Fig. 119 Torus and Multiplier Assembly—Exploded

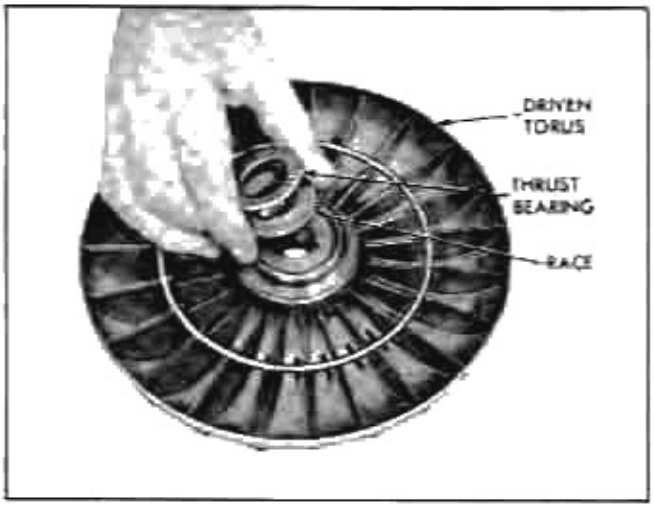


Fig. 120 Installing Thrust Bearing in Driven Torus

6. Install flanged race, flange up into driven torus (Fig. 120).

7. Install bearing into flange race, retain with petrolatum.

8. Install driven torus member over main shaft.

9. Reposition transmission 90 degrees so bottom is up. (Do not rotate more than 90 degrees or parts will fall out of front.)

10. While moving main shaft forward (with small tool inserted in hole of main shaft if necessary), install driven torus to main shaft spiral retaining ring (Fig. 121).

11. Reposition transmission, front end up.

12. Install new drive torus to torus cover metal gasket on torus drive member. Retain with petrolatum.

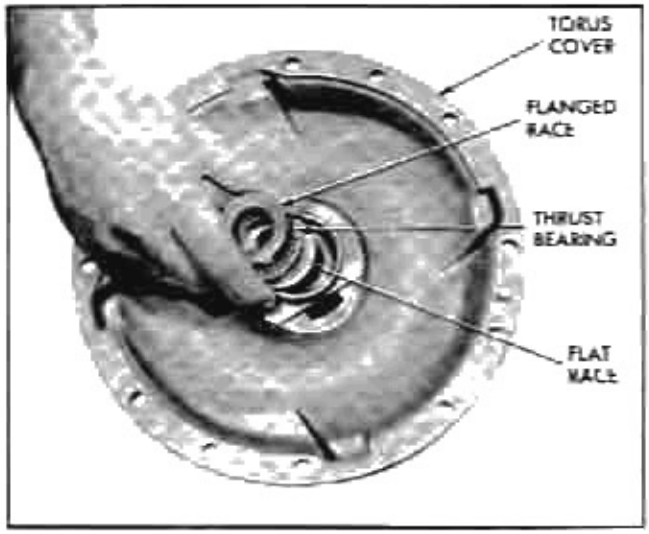


Fig. 122 Installing Thrust Bearing and Race in Torus Cover

13. Install flat bearing race into torus cover (Fig. 122).

14. Install bearing into flanged race.

15. Install bearing and flanged race into torus cover, flange down. Use petrolatum.

16. Install torus cover to the drive torus member, aligning to the dowel pins. J-8938, Guide Pins, may be used.

17. Install box head wrench on case, as a tool, (Fig. 123), and install 12 torus cover to drive torus attach-

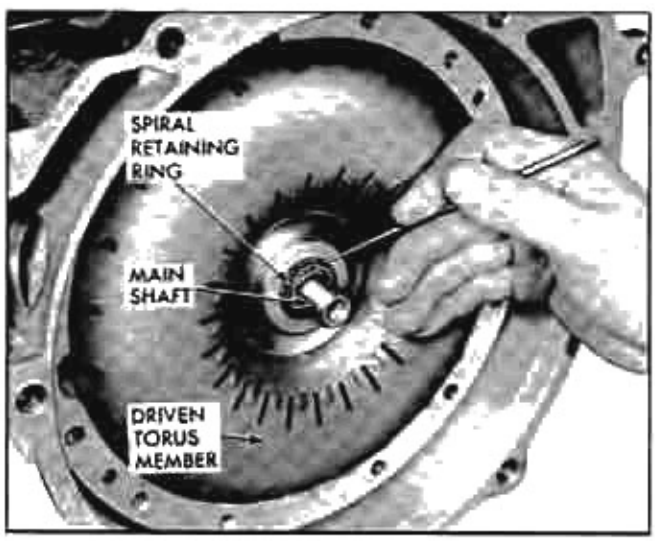


Fig. 121 Installing Spiral Retaining Ring on Main Shaft

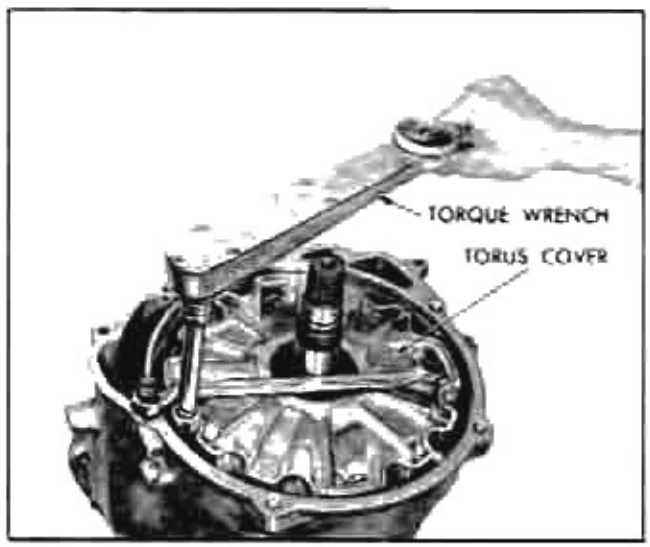


Fig. 123 Torquing Torus Cover Bolts

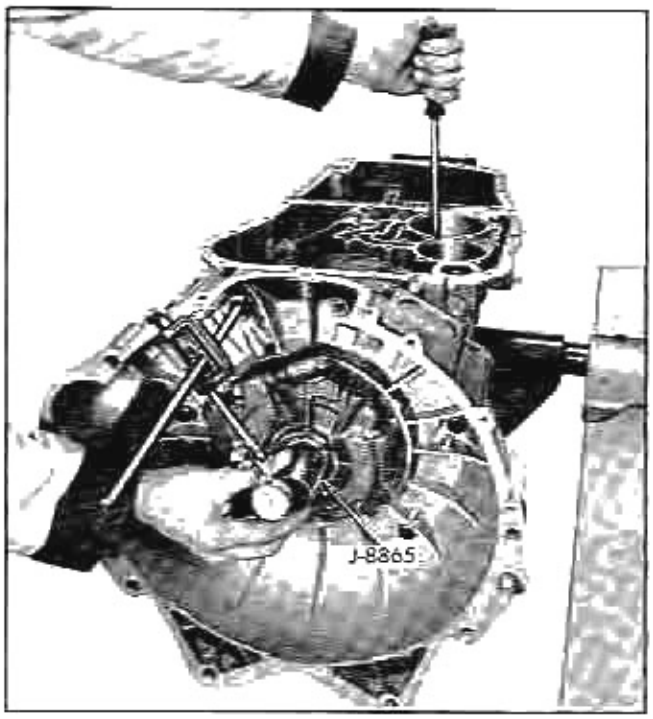


Fig. 124 Tool Set-Up for End Play Check

ing bolts, cross tightening the bolts. Torque to 17-20 ft. lbs.

18. Remove box head wrench.

CASE COVER

1. Install case cover to case gasket on case cover, use petrolatum.

2. Install case cover and pump assembly on transmission case.

3. Install five of the six large case cover to case attaching bolts leaving one hole in which to install dial indicator support. Torque to 30-35 ft. lbs. Of the three small attaching bolts the one long bolt is attached from the front of the case cover. The two remaining cover bolts are installed from the rear of the case cover. Torque 3 short bolts 15-18 ft. lbs.

FRONT UNIT END PLAY CHECK

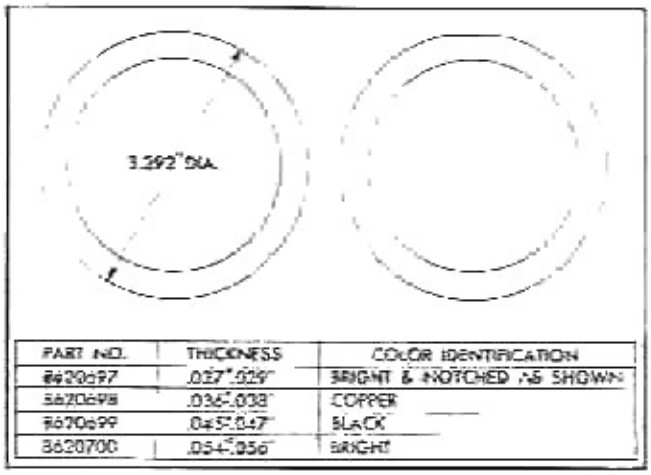
a. Rotate transmission so bottom is up.

b. Install dial indicator support J-6126 into remaining hole in transmission case (Fig. 124).

c. Assemble end play adapter J-8865 on the input shaft of the torus cover.

d. Clamp dial indicator on support and index indicator with end of tool J-8865.

e. Position a screw driver through case, behind the



PART NO.	THICKNESS	COLOR IDENTIFICATION
8620697	.027"-.029"	BRIGHT & NOTCHED AS SHOWN
8620698	.036"-.038"	COPPER
8620699	.045"-.047"	BLACK
8620700	.054"-.056"	BRIGHT

Fig. 125 Table of Selective Washers

flange on the output shaft.

f. Gently pry forward on output shaft to position units forward.

g. At the same time move handle on tool and record end play.

h. End play should be .006" to .018".

If end play is not within these limits, remove case cover and install proper thrust washer or combination of thrust washers between case cover and torus cover to produce .006"-.018" end play (Fig. 125). Replace cover and re-check end play.

i. Remove tools and install remaining case cover to case attaching bolt. Torque to 30-35 ft. lbs.

4. Rotate transmission so front end is up.

5. Install front seal, rubber lip down, using J-8761 (Fig. 126). Rotate transmission back to horizontal position, bottom up.

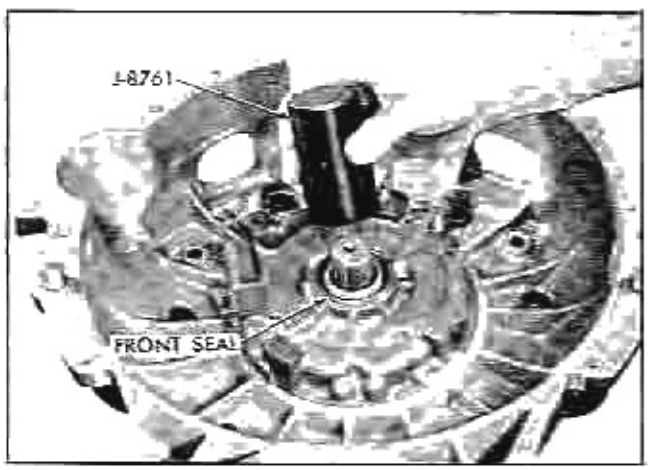


Fig. 126 Installing Front Seal

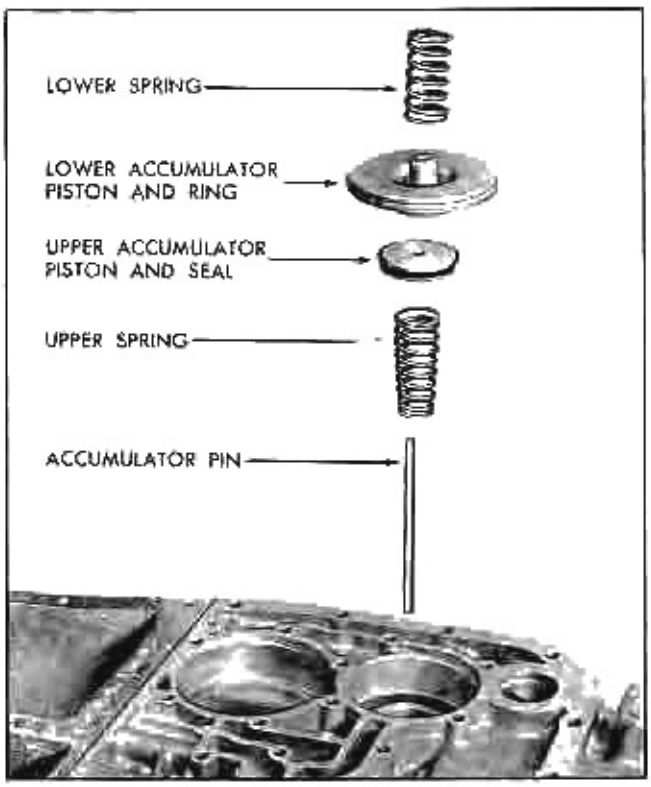


Fig. 127 Accumulator Assembly—Exploded

SERVO AND ACCUMULATOR

1. Install accumulator pin into case.

2. Install upper accumulator spring, small end first (Fig. 127).

3. Install new upper accumulator piston seal with lip of seal facing flat side of piston.

4. Install upper accumulator piston with lip of seal facing away from tapered spring.

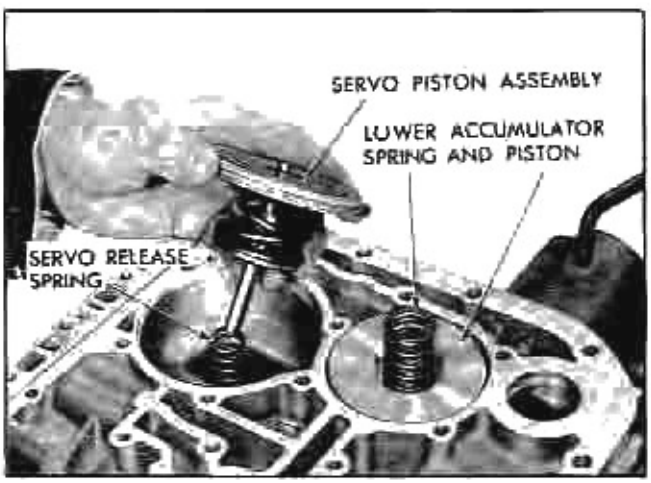


Fig. 128 Installing Servo Piston

5. Install lower accumulator piston ring on piston, if removed.

6. Install lower accumulator piston over pin with spring pocket facing out.

7. Install lower accumulator spring into spring pocket as in Fig. 128.

8. Install servo release spring into case bore.

9. Install servo piston assembly into case, stem first (Fig. 128).

10. Install 3 case center support to case seals and springs, seals down (Fig. 129).

11. Install servo and accumulator gasket on servo and accumulator cover. Use petrolatum.

12. Install servo and accumulator cover. Use 4 bolts to locate the cover and then align case center support to case seal springs and accumulator spring. After cover is lined up, install all bolts loosely. Then, while depressing cover by hand, tighten bolts. Torque to 6-8 ft. lbs.

13. Install 8 servo and accumulator cover bolts leaving the remaining bolts until installation of the compensator body and the strainer. Torque to 6-8 ft. lbs. (Fig. 130).

14. Install compensator body assembly on accumulator cover using 3 attaching screws and 1 attaching bolt. Torque screws to 2.5-3.5 ft. lbs., torque bolt to 6-8 ft. lbs.

15. Install seals on both ends of pipe assembly, if removed.

16. Install pipe assembly fixed end first into case cover through opening in case.

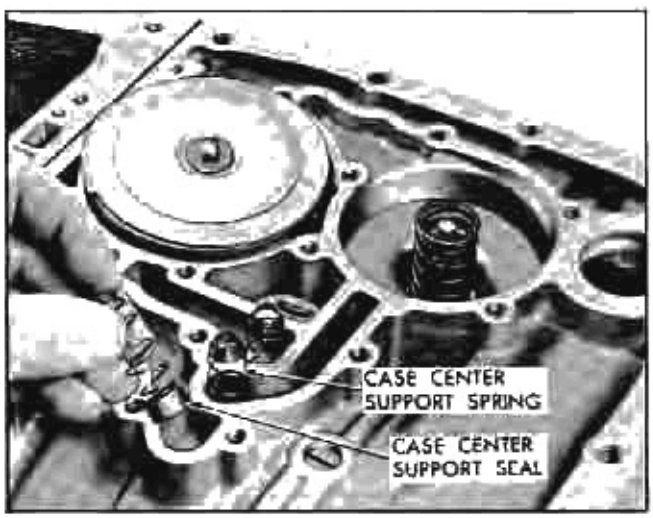


Fig. 129 Installing Case Center Support Seals and Springs

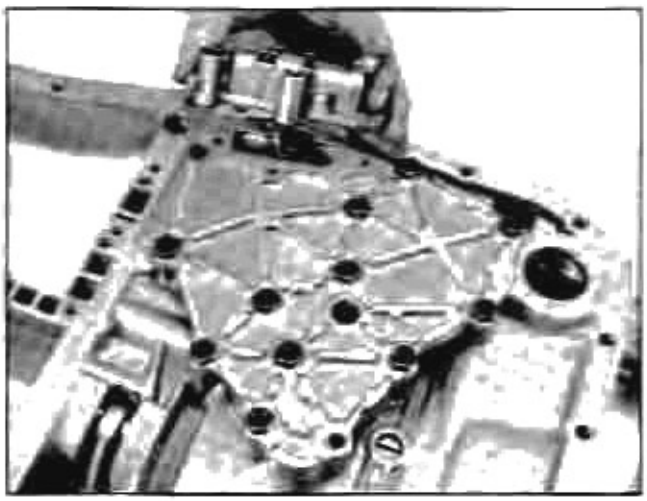


Fig. 130 Installing Compensator Valve Body

17. Install seal and washer, if removed, on pipe assembly attaching bolt, and install bolt to pipe assembly from front side of case cover.

CONTROL VALVE BODY AND OIL PAN

1. Install manual valve in valve body (Fig. 131).

2. Apply petrolatum to valve body pipe ports so not to injure "O" rings and install valve body assembly to rear bearing retainer, guiding T.V. shaft through opening in rear bearing retainer and position manual valve on pick up pin (Fig. 131). Position pipe assembly to index with pipe ports in valve body and move forward to seat pipe seals. Secure valve body assembly with 5 attaching bolts. Torque to 6-8 ft. lbs. If it is difficult to index pipes with valve body ports, loosen the pipe assembly to case cover bolt one-half turn.

The control valve body is more easily installed with

Fig. 131 Installing Control Valve Body

this bolt loose but it must be tightened after control valve is installed.

3. Install throttle shaft seal over T.V. shaft into case, using care not to fold lip under.

4. Install a case to strainer neck "O" ring in case bore, if removed.

5. Install strainer with neck in case bore and secure strainer in position with one remaining servo and accumulator cover attaching bolt. Torque to 6-8 ft. lbs.

6. Install new oil pan gasket on transmission.

7. Install oil pan on transmission. Secure with 21 attaching bolts. Torque to 12-15 ft. lbs.

8. Install outer shaft lever and T.V. lever.

9. Install speedometer driven gear assembly.

INSTALLATION OF TRANSMISSION

1. Place transmission in jack and raise to approximate location in car.

2. Move transmission forward into position engaging transmission input shaft with the damper hub.

3. Install one transmission case cover to engine attaching bolt on each side and then lower the transmission and install the remaining bolts other than the starter attaching bolts and tighten to 50-70 lb. ft.

4. Place splash shield in position and place lower bolt through hole.

5. Place starter in position and install nut on lower bolt finger tight. Install the other splash pan to starter bolt.

6. Install both wires on starter.

7. Install 4 flywheel cover attaching bolts.

8. Install transmission case cover inspection plate with 3 attaching bolts.

9. Install breather pipe and pipe clip attaching bolt.

10. Install rear mount on transmission with 4 attaching screws.

11. Install rubber insulators on rear mount and then install rear mount support on the insulators.

12. Raise transmission as far as necessary and install frame cross-member in the frame with 2 attaching bolts at each end.

13. Lower the transmission so that the 2 rear mount support studs go through the cross-member bracket. Install nuts. Remove transmission jack.

14. Tighten the exhaust pipe to manifold bolts.

15. Wipe some oil on the O.D. of the drive shaft yoke and slide propeller shaft onto transmission output shaft.

16. Remove tape or rubber band from "U" joint bearings and assemble "U" joint. Bend nut locking plate.

17. Install parking brake cable guide rod (cable to frame cross-member).

18. Install parking brake return spring.

19. Install oil cooler lines.

20. Install throttle idler lever.

21. Install throttle control rod (engine to idler lever) and transmission to idler lever control rod.

22. Install gearshift cross-shaft lever and its mounting bracket (2 bolts).

23. Install gearshift control upper rod on cross-shaft lever with "E" ring.

24. Install gearshift control lower rod.

25. Connect speedometer cable.

26. After car has been lowered, connect the battery cable that was removed.

27. Refill transmission with fluid as described on page 41.

28. Adjust throttle and shift linkage following instructions on page 39.

29. Test transmission oil pressure as outlined on page 41 and road test car to see that transmission operates properly.

DIAGNOSIS AND TESTING GUIDE

CONTENTS OF THIS SECTION

The information contained in this Diagnosis Guide has been prepared as a Supplementary Guide. It is an aid to and not a substitute for a good basic understanding of the Principles of Operation.

It is of utmost importance to observe and perform all preliminary steps outlined in this Diagnosis Guide.

Make certain that all "on the car repairs" possibilities have been exhausted before the transmission is removed from the car.

TESTING AND DIAGNOSIS

TESTING

This section outlines the procedure to be followed in testing and diagnosis prior to attempting to correct any assumed malfunctions of the 61-10 Hydra-Matic transmission.

1. *Check Oil Level*

   Always check the oil level before road testing. Erratic shifting or other malfunctions can in some cases be traced to improper oil level.

   a. Park the car in a level position and set selector lever in the "P" position. Let engine idle until operating temperature is reached.

   b. Check oil level indicator. If oil level is low add Hydra-Matic fluid to "Full" mark.

CAUTION: Use only "Automatic Transmission Fluid" (type A) which has been approved and labeled "AQ-ATF" or "AQ-ATF-A".

For a proper diagnosis, a thorough knowledge of the operation of the new Hydra-Matic transmission is essential. 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 some hilly section to test for open throttle downshifts, a level section for testing upshift points and a quiet section for testing for noise.

CAUTION: Do not stall test transmission under any conditions.

Always be certain the engine is operating at peak performance. The engine and transmission are designed and built to operate as an integral power unit. Failure of the engine to deliver peak power can result in improper shift characteristics and apparent transmission malfunction.

While road testing, the transmission oil pressure gauge should be connected to the upper of the two test holes on the left-hand side of the rear bearing retainer and the pressure checked as follows:

DRIVE RIGHT

	MINIMUM	MAXIMUM
2ND—Steady Road Load at Approximately 25 mph.	98.6	111.4

LOW OIL PRESSURE

1. Oil Level—Low
2. Boost Plug—Wrong—Stuck
3. Pressure Regulator Valve
4. Strainer and "O" Ring
5. Manual Valve—Misaligned with Quadrant
6. Foaming or Cavitation
7. Internal Leak
8. Control Valve Assembly—Stuck Valve
9. Front Pump—Slide Stuck—Low Output

HIGH OIL PRESSURE

1. Pressure Regulator Valve—Stuck
2. Boost Plug—Wrong—Stuck
3. Manual Valve—Misaligned with Quadrant
4. Control Valve Assembly—Stuck Valve
5. Front Pump—Slide Stuck—High Output

UPSHIFTS

Shift	Left Drive Range		Right Drive Range		Lo Range	
	Minimum Throttle	Full Throttle	Minimum Throttle	Full Throttle	Minimum Throttle	Full Throttle
1-2	14-18	33-40	14-18	33-40	No Shift Possible	
2-3	18-23	76-89	—	76-89	—	76-89

DOWNSHIFTS

Shift	Left Drive Range		Right Drive Range		Lo Range	
	Closed Throttle	Full Throttle Forced	Closed Throttle	Full Throttle Forced	Closed Throttle	Full Throttle Forced
3-2	20-15*	84-68	84-72	84-72	84-72	84-72
2-1	16-13*	29-25	16-13	29-25	52-46	52-46

Fig. 132 Shift Speed Chart

*When this shift occurs, the transmission will freewheel; therefore, it is impossible to observe shift with throttle closed. To check for shift, decelerate, with throttle closed to specified speed, then accelerate to determine which speed transmission is in.

The term "Minimum Throttle" denotes a fixed throttle opening only sufficient to provide acceleration enough to accomplish each of the shifts. The transmission should shift within the limits indicated in the columns under the heading "Minimum Throttle."

The conditions under which downshifts occur are as follows: (1) Closed throttle: When the accelerator pedal is in the released position and the car is coasting gradually losing speed. (2) Forced: When the accelerator pedal is fully depressed through the detent to full throttle. NOTE: When driving in the left drive range in third speed at about 35 mph or less, partially depressing the accelerator pedal will cause the third to second downshift.

When checking shift points keep in mind that there may be a slight variation from the speeds shown in the shift speed chart (Fig. 132). Slight variations are no cause for adjustment providing shifts are smooth.

DIAGNOSIS

EXTERNAL LINKAGE

The importance of proper linkage adjustment can not be over-emphasized. Improper linkage adjustment can cause rough erratic shifting, missing shifts, or the inability to select one or more of the ranges.

NO DRIVE IN DRIVE RANGE

1. Neutral Clutch
2. Sprag Assembly—Or Race
3. Coupling
4. Low Oil Level
5. Low Oil Pressure
6. Passage Restricted
7. Internal Leak
8. Linkage—Manual
9. Control Valve Assembly
10. Reverse Cone Sticking

POWER FLOW—REVIEW

DRIVE RANGE	SPEED	CPLG	FRONT CLUTCH	OVERRUN BAND	NEUTRAL CLUTCH	REVERSE CLUTCH
PARK	—	Filled	Off	Off	Off	Off
NEUTRAL	—	Filled	Off	Off	Off	Off
DRIVE LEFT	First	Filled	Off	Off	On	Off
	Second	Empty	On	Off	On	Off
	Third	Filled	On	Off	On	Off
DRIVE RIGHT	First	Filled	Off	On	On	Off
	Second	Empty	On	On	On	Off
	Third	Filled	On	Off	On	Off
LO	First	Filled	Off	On	On	Off
	Second	Empty	On	On	On	Off
	Third	Filled	On	Off	On	Off
REVERSE	—	Filled	Off	Off	Off	On

DRIVE IN NEUTRAL

1. Neutral Clutch
2. Linkage—Manual

NO REVERSE

1. Linkage—Manual
2. Low Pressure
3. Reverse Cone Clutch
4. Restricted Passage
5. Neutral Clutch

DRIVE IN "RIGHT DRIVE" OR LOW RANGE ONLY

1. Sprag Assembly
2. Neutral Clutch

FORWARD DRIVE IN REVERSE

1. Manual Linkage
2. Neutral Clutch

REVERSE DRIVE IN NEUTRAL

1. Reverse Cone Clutch

DRIVE IN SECOND AND THIRD ONLY

1. Control Valve Assembly

DRIVE IN FIRST AND THIRD ONLY

(MIGHT BE REPORTED AS 1-2 SLIP)

1. Control Valve Assembly
2. Coupling

DRIVE IN FIRST AND SECOND ONLY

1. Governor (G-2)
2. Control Valve Assembly

SLIPPING 1-2 SHIFT

(CAN BE REPORTED AS 1-3 ONLY)

1. Front Clutch
2. Control Valve Assembly
3. Accumulator
4. Compensator Body Assembly
5. Low Oil Pressure
6. T.V. Linkage
7. 1-2 Oil Passages

SLIPPING 2-3

1. Coupling
2. Control Valve Assembly
3. Front Clutch

SLIPPING ALL RANGES

1. Low oil pressure

ROUGH 1-2 SHIFT

1. Accumulator
2. Compensator Body Assembly
3. Front Clutch
4. Front Clutch Passage
5. Control Valve Assembly
6. T.V. Linkage
7. Coupling

ERRATIC SHIFTS

1. Governor Assembly
2. Control Valve Assembly

HIGH OR LOW UPSHIFTS.

1. T.V. Linkage (Short—High Upshifts)
   (Long—Low Upshifts)
2. Control Valve Assembly
3. Governor
4. T.V. Lever
5. Governor Oil Passage
6. T.V. Pressure
7. Line Pressure

NO ENGINE BRAKING INTERMEDIATE OR LOW RANGE

1. Overrun Band
2. Overrun Servo

NO PART THROTTLE OR DETENT DOWNSHIFTS

1. T.V. Linkage
2. Control Valve Assembly
3. Accelerator Travel
4. Governor

SELECTOR LEVER WILL NOT GO INTO REVERSE

1. Manual Linkage
2. Reverse Blocker Valve
3. Governor

SELECTOR LEVER WILL NOT GO INTO PARK

1. Parking Linkage
2. Manual Linkage

NOISE DIAGNOSIS

Occurs Under Following Conditions	Possible Cause
1. All ranges—More pronounced with hot oil—1st gear approximately 1000 to 1200 R.P.M. (Moan)	1. Oil Pump
2. 2-1—2-3 Shift (Whine)	2. Oil Pump
3. 2nd and Reverse Gear Noise Low RPM (Only)	3. Front Unit Gear Set
4. 1st-2nd, Reverse and Neutral Gear Noise—High R.P.M. Predominate noise 2nd during 2-3 shift	4. Rear Unit Gear Set
5. 2-3 Hot Oil Low R.P.M.	5. (Coupling Fill) Pump Whine
6. All Except 2nd	6. Coupling
7. Buzzing	7. T.V. Valves and Governor
8. Rattle—Light Load—3rd	8. Damper

OIL LEAKS

Before attempting to correct an oil leak, the actual source of the leak must be determined. In many cases the source of the leak can be deceiving due to "wind flow" around the engine and transmission. If any doubt exists as to the source of the leak there are two ways to determine it.

1. RED DYE

The addition of red dye to the transmission oil will indicate if the leak is from the transmission.

2. BLACK LIGHT

The use of a "Black Light"* to identify the oil from the leak is also suitable. Comparing the oil from the leak to that on the engine or transmission dip stick when viewed by black light will determine the source of the leak.

*A "Black Light" testing unit may be obtained from several different service tool suppliers.

Oil leaks around the engine and transmission are generally carried toward the rear of the car. For example, a transmission "oil filler tube to oil pan leak" will sometimes appear as a leak at the rear of the transmission.

1. TRANSMISSION OIL PAN

a. Improperly installed or damaged gasket.

b. Attaching bolts not correctly torqued.

c. Filler pipe flange weld or stripped threads.

d. Filler pipe.

e. Oil pan not flat.

f. Rear bearing retainer and/or case not positioned correctly at oil pan.

2. REAR BEARING RETAINER

a. Rear seal not installed properly or damaged.

b. Gasket (rear bearing retainer to case) damaged or improperly installed.

c. Rear bearing retainer to case attaching bolts not correctly torqued.

d. Speedo gear housing not tight or seal damaged.

e. Main line pressure plug not tight.

f. T.V. line pressure plug not tight.

g. Porus casting.

h. T.V. lever seal.

i. Cover plate not flat.

j. Cover plate gasket improperly installed or defective.

k. Cover plate screw not correctly torqued.

3. COOLER CONNECTIONS

a. Adaptor not correctly torqued.

b. Adaptor defective.

4. CASE COVER ASSEMBLY LEAKS

a. Gasket-Case to Case Cover improperly installed.

b. Bolts—Improperly torqued.

c. Washer Seals—Damaged.

d. Plate—Not flat.

e. Plate Gasket—Defective.

5. FRONT END LEAKS

a. Front pump "O" ring cut or improperly installed.

b. Front seal.

c. Case to case cover gasket.

d. Case cracked or porus.

e. Cut or improperly installed "O" ring—coupling feed limit valve, (in pump).

f. Cut or improperly installed "O" ring—pressure regulator assembly, (in pump).

g. Manual shaft seal—defective or improperly installed.

SPECIFICATIONS

GENERAL SPECIFICATIONS

Input Shaft End Play	.006"-.018"
Gear Ratios	
1st Speed	3.56:1
2nd Speed	1.56:1
3rd Speed	1.00:1
Reverse	3.53:1
Fluid	
Type	Automatic Transmission Fluid (Type A) bearing Armour Institute Qualification No. "AQ-ATF . . . "
Capacity	
Refill (after drain)	Approx. 4¼ qts.*
Refill (after removing control valve)	Approx. 5¾ qts.*
Refill (after overhaul)	Approx. 8½ qts.*

*Correct amount of fluid should always be determined by indication on oil level indicator with transmission warm, car level, and engine idling with control lever in Park.

Change transmission oil every	25,000 miles

REAR AXLE RATIOS

	Ratio	
Standard—All except Catalina	2.87	(43:15)
Standard—Catalina	2.69	(43:16)
Economy—All except Catalina	2.69	(43:16)
Economy—Catalina	2.56	(41:16)
Performance—All Series	3.08	(40:13)
425-A Engine	3.08	(40:13)
425-E Engine	2.56	(41:16)
Air Conditioning—All Series	2.87	(43:15)

SPEEDOMETER GEAR USAGE CHART

Rear Axle Ratio	Speedometer Sleeve Assembly Ratio	Color
40:13 (3.08)	23:10	Yellow
43:15 (2.87)	21:10	Orange
43:16 (2.69)	20:10	Red
41:16 (2.56)	19:10	Dark Gray

SPRING SPECIFICATIONS

Name	Approx. Free Length	Diameter	No. Of Coils	Color
Damper Outer	2.67	.80	12.5	Black
Damper Inner	2.02	.49	14.5	Black
Pump Priming Inner	.49	.38	5.35	Plain
Pump Priming Outer	.73	.51	5.75	Plain
Cplg. Feed Limit Valve	2.66	.49	23	Plain
Pressure Regulator	1.58	.48	12.75	Yellow
Coupling Exhaust Valve	.72	.34	7	Plain
Frt. Clutch Release	1.04	.44	8.5	Plain
Neutral Cl. Release	.84	.34	10	Plain
Reverse Clutch Release	.79	.36	7.8	Plain
Servo Outer	1.50	1.75	3.5	Plain
Servo Inner	1.34	1.25	3.5	Plain
Accumulator Lower	1.51	.87	7	Plain
Accumulator Upper	1.96	.91-.77	9.3	Plain
Servo Release	1.83	.67	9	Plain
Primary Comp. Valve (P, PE)	.60	.39	6.5	Copper Fl.
Primary Comp. Valve (PA)	.67	.39	6.5	Red
Secondary Comp. Valve (PE)	1.28	.57	8.5	Green
Secondary Comp. Valve (P, PA)	1.11	.57	7.5	Plain
Park Brake	.66	.61	6.6	Plain
Cplg. Timing	1.30	.41	11.5	Green
Ft. Cl. Exhaust Valve	.91	.32	11	Gray
Pressure Boost*	1.06	.18	20	Plain
Detent	1.25	.36	11	Red
Neutral Cl. Valve	.70	.44	5.5	Plain
Pressure Drop	1.30	.36	11.5	Plain
Pressure Relief	3.04	.42	26.5	Yellow
Reverse Blocker	1.32	.32	16.5	Yellow
Throttle Valve (P, PA)	1.68	.39	17	Plain
Throttle Valve (PE)	1.60	.39	16	Green
1-2 Shift	1.01	.53	10.5	Plain
1-2 T.V.	.99	.40	9.5	Yellow
2-1 Cut-Off Valve	1.23	.35	13.5	Green
2-1 Down Shift Valve	.94	.32	10.5	Cad. Fl.
2-3 Boost Valve	1.35	.35	10.5	Cad. Fl.
2-3 T.V.	1.26	.42	9.5	Plain
2-3 Shift	.91	.39	7	Plain

*Early Models Only

TORQUE SPECIFICATIONS

Location	Lb. Ft.
Cooler Control Thermo Element to Case Cover	2.5-3.5
Channel Plate to 2-3 Boost Body	2.5-3.5
Channel Plate to Valve Body	2.5-3.5
Valve Body to Channel Plate	2.5-3.5
2-3 Boost Body to Valve Body	2.5-3.5
Compensator Body to Servo & Accumulator Cover	2.5-3.5
Case Cover to Cooler Control Body	2.5-3.5
Servo and Accumulator Cover to Case	6-8
Rear Bearing Retainer Cover to Retainer	6-8
Valve Body to Case	6-8
Compensator Valve Body to Case	6-8
Pump Cover to Pump Body	6-8

Location	Lb. Ft.
Case to Case Cover (Small)	15-18
Case Cover to Case (Large)	30-35
Case Cover to Pump	15-18
Oil Pan to Case	12-15
Front Internal Gear to Clutch Housing	22-27
(Governor) Output Shaft to Carrier	19-23
Torus Exhaust Valve to Torus Cover	19-23
Rear Bearing Retainer to Bushing Sleeve	12-15
Torus Cover to Driving Torus	17-20
Case Cover to Pipe	10-12
Rear Bearing Retainer to Case	20-25
Plate to Case Cover	18-20
Coupling Feed Limit Valve Plug	15-20
Pressure Regulator Plug	15-20

THRUST BEARINGS

LOCATION	O.D.	I.D.	NO. OF ROLLERS
Pump To Torus	3.36	2.61	64
Torus Cover — Driven Torus	1.63	1.00	30
Driven Torus — Carrier Shaft	1.50	.89	29
Front Carrier—Front Sun Gear	2.20	1.66	52
Front Sun Gear—Internal Gear	2.73	1.91	54
Rear Internal Gear—Rear Carrier	2.86	2.13	56
Rear Sun Gear—Rear Carrier	2.05	1.38	42
Rear Bearing Ret.—Output Shaft	1.92	1.19	38

THRUST WASHERS

	O.D.	I.D.	Thickness
Front Internal Gear—Case Support	2.49	2.06	.090
Case Cover Selective Washers	3.29	2.62	.028
	3.29	2.62	.037
	3.29	2.62	.046
	3.29	2.62	.055

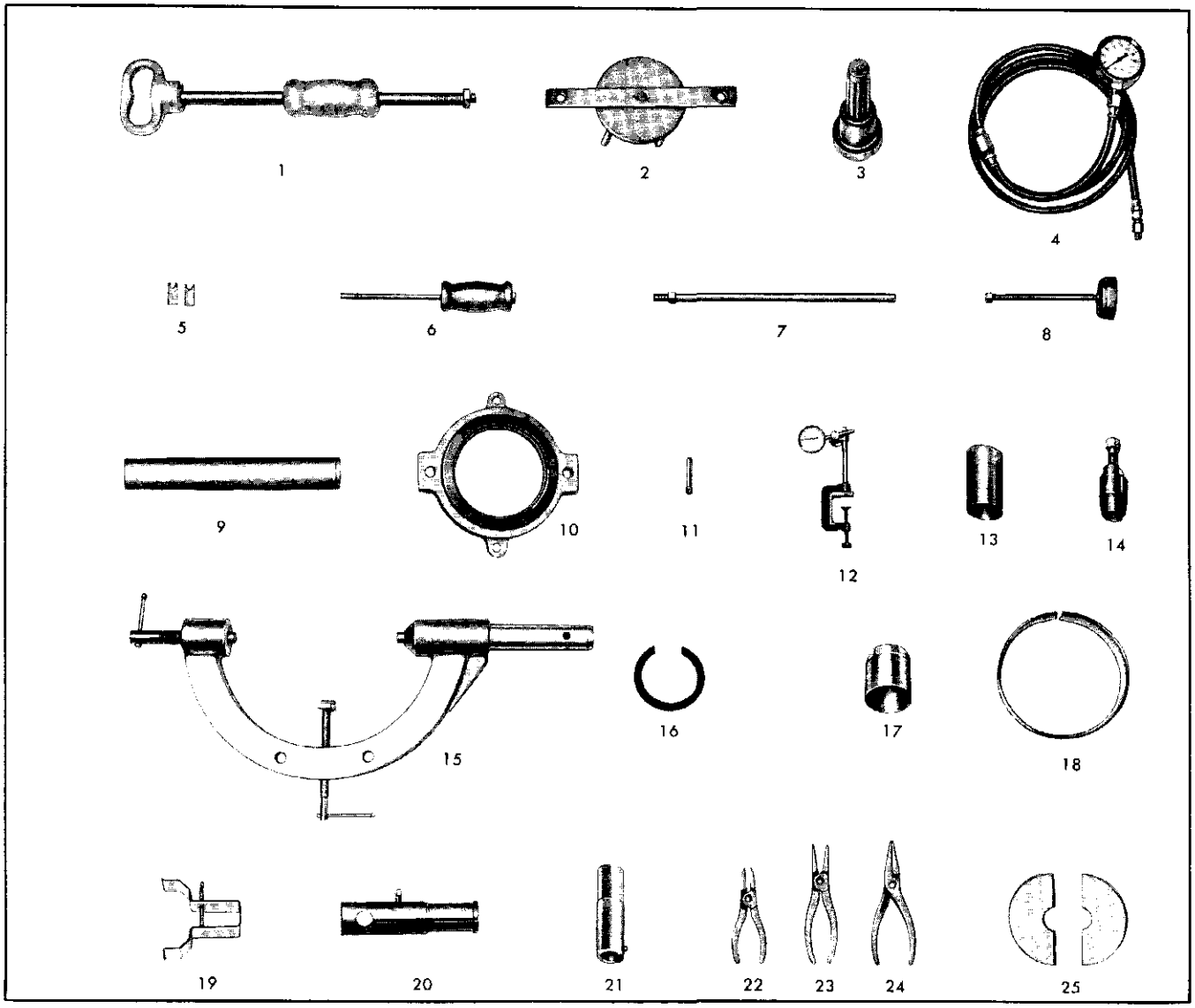


Fig. 133 Special Hydra-Matic Tools

SPECIAL HYDRA-MATIC TOOLS

No. on Fig. 133	Tool No.	Tool Name
1	J-2619	Slide Hammer
2	J-4670-C	Clutch Spring Compressor
3	J-5154-A or J-5154	Rear Oil Seal Installer
4	J-5907	Pressure Checking Gauge (with hose)
5	J-6122	Fluid Coupling Valve Retainers (2)
6	J-6125	Slide Hammer
7	J-6126	Dial Indicator Support
8	J-6129	Clutch Spring Compressor (Use with J-4670—C)
9	J-6133-A	Installer
10	J-6407	Press Plate Holder
11	J-7687	Linkage Gauge Pin
12	KMO-30 or J-8001	Dial Indicator Set
13	J-8761	Pump Oil Seal Installer
14	J-8762	Pump Oil Seal Remover (Optional)
15	J-8763	Transmission Holding Fixture
16	J-8765	Reverse-Neutral Clutch Piston Adapter
17	J-8766	Reverse Clutch Inner Seal Protector
18	J-8767	Reverse Clutch Outer Seal Protector
19	J-8768	Reverse Cone Puller
20	J-8845	Rear Bearing Retainer Bushing Remover
21	J-8865	Input Shaft End Play Checking Adapter
22	J-8871	Truarc Plier 90 Degree Tip External
23	J-8872	Truarc Plier 90 Degree Tip Internal
24	J-8873	Truarc Plier 90 Degree Tip Internal
25	J-8904	Speedo Gear Remover and Installer

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