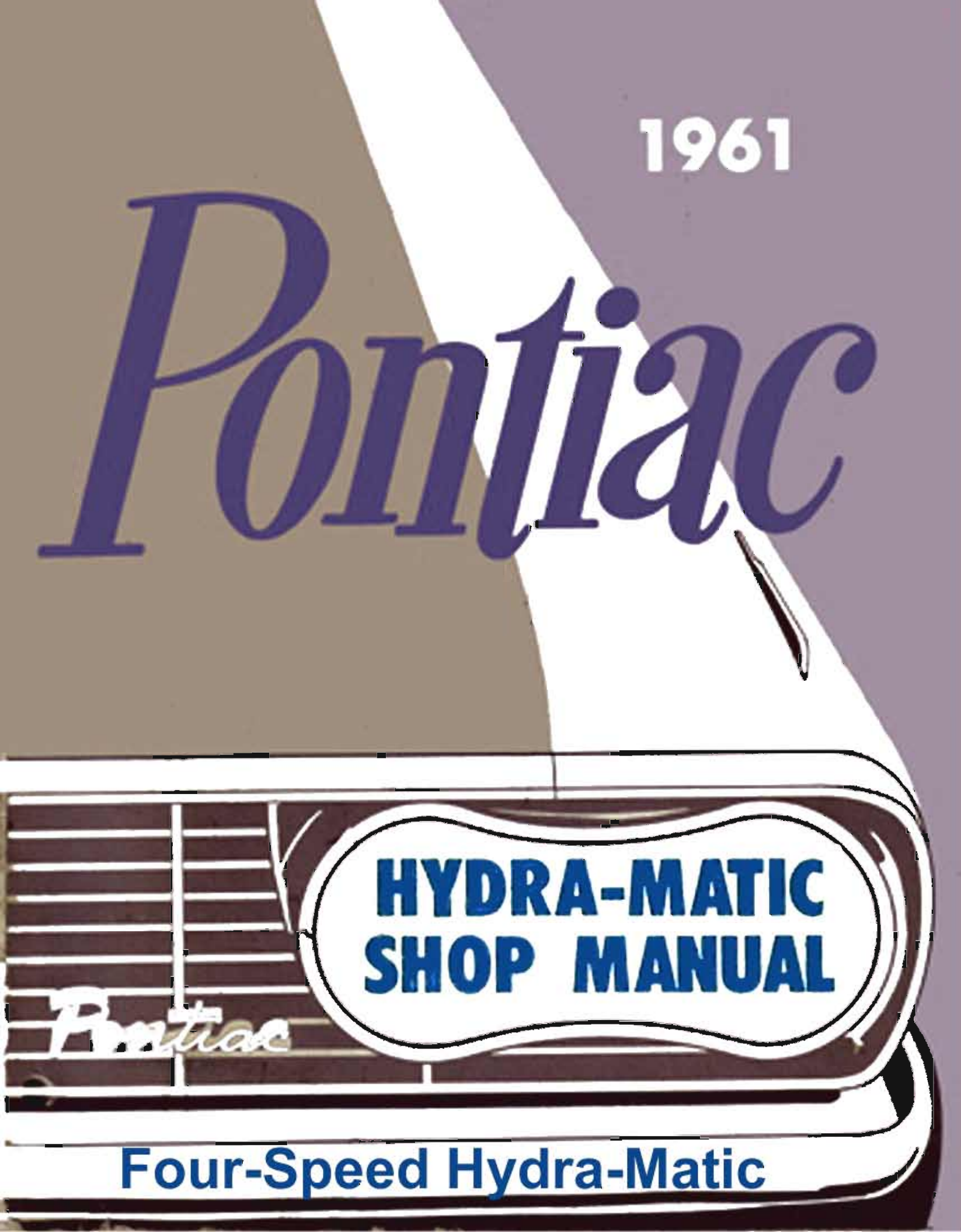
1961

Pontiac



Four-Speed Hydra-Matic

4-SPEED HYDRA-MATIC TRANSMISSION

This part of the 1961 Hydra-Matic Shop Manual describes the fundamental principles of the 4-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.

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DESCRIPTION AND OPERATING INSTRUCTIONS

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4-SPEED HYDRA-MATIC DRIVE

The 4-Speed Hydra-Matic drive consists of a fluid coupling, which replaces the conventional clutch, combined with a hydraulically controlled automatic transmission having four speeds forward and one reverse. Gear shifting is automatic and is controlled by the requirements of road conditions encountered and the wishes of the driver.

OPERATING THE 4-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 and maximum fuel economy.

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.

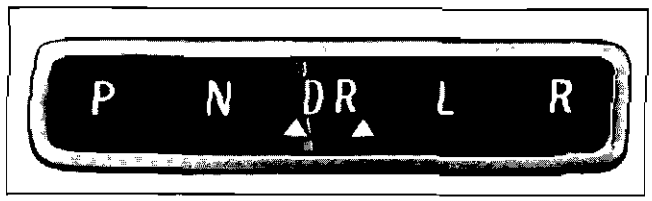

Fig. 1 Indicator

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 accelerator pedal. This will cause the transmission to shift down into third 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 fourth speed as car speed increases or the accelerator pedal is released. Refer to figure 187 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 overrun braking is required. In this range the transmission is prevented from shifting into fourth speed (except at very high car speeds). In effect it becomes a 3 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 speed can be obtained by completely depressing the accelerator pedal. This will cause the transmission to shift down to second speed. The transmission will automatically return to third or fourth 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 clutch 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, second speed to third, and third speed to fourth (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 accclerator 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 2nd speed (unless car speed exceeds approximately 45 mph). 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 (keep below 45 mph to avoid a 2-3 up shift).

The control lever can be moved from either DR position to L at any car speed. The shift from DR range into L will not occur at a car speed above 43 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 Hydra-Matic equipped car 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 from transmission. 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. Since the pump in the transmission is driven by the engine, there is no pressure to apply the clutches when the engine is not running. The transmission, therefore, cannot transmit power to the engine to start it.

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 on 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 38.

SERIAL NUMBER

The serial number plate is located at the left side of the rear face of the transmission (Fig. 2). The serial number begins with a designation such as PS-61 which denotes the transmission used with the 2-jet carburetor. PAS-61 is used with Tri-Power, PBS-61 with a 4-jet carburetor, and PES-61 with the economy engine.

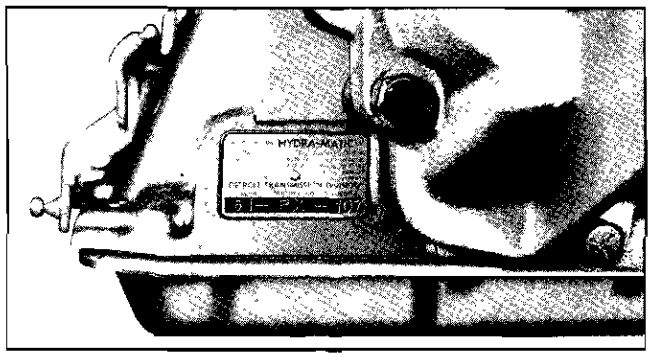

Fig. 2 Serial Number Plate

FUNDAMENTAL PRINCIPLES OF THE 4-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 pinoin gears, which rotate freely on pins attached to a common bracket called the "planet carrier." A ring with teeth machined on the inside circumference surrounds the assembly and meshes with the planet pinion gears. This is called the "internal" gear, because of its internal teeth.

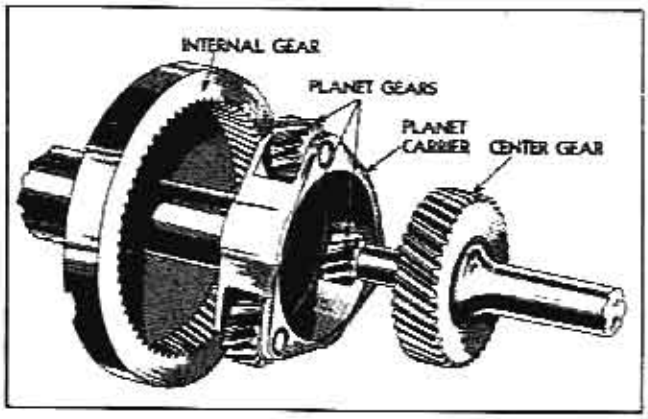

Fig. 3 Planetary Gear Train

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.

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 geers 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

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.

A second and smaller fluid coupling is used in the front unit. When filled, this coupling locks two members of the planetary gear train together to provide direct drive.

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

The principal parts of each torus member (Fig. 5) are, the outer shell, hub, inner shell, and vanes interconnecting the shells. The two members of each coupling are identical in construction except for the hubs which are different in size to fit their respective shafts.

A schematic cross section of two torus members attached to independent shafts and located in a fluid-filled housing is illustrated in Fig. 6. The shape of the compartment formed by the vanes is shown shaded. NOTE: An actual illustration of the component parts which make up the main fluid coupling is shown in Fig. 7.

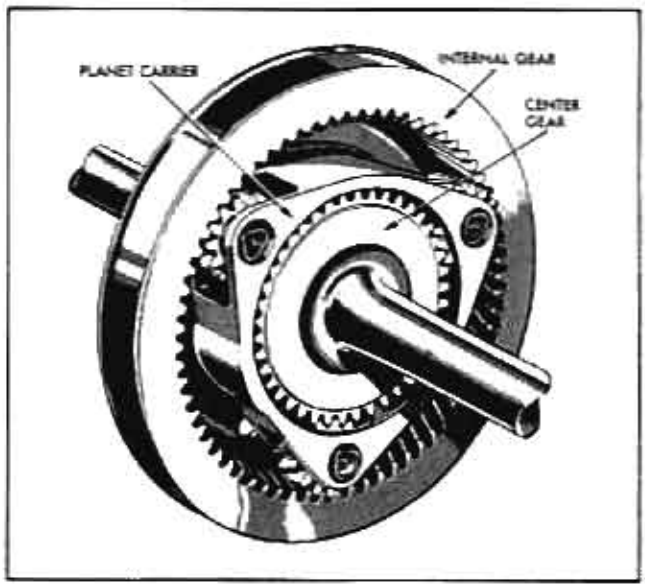

Fig. 4 Planetary Gears

In operation, rotation of the drive torus member causes the fluid within that member to be forced radially outward. Fluid then crosses over and strikes the vanes of the driven torus member, causing it to rotate in the same direction as the drive member (Fig. 8).

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

Very efficient at high speed.
Less efficient at low speed.
Very inefficient at idle speed.

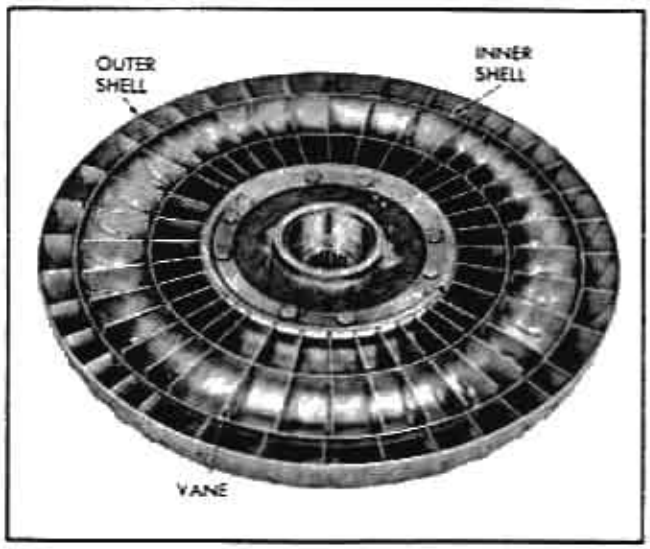

Fig. 5 Torus Member

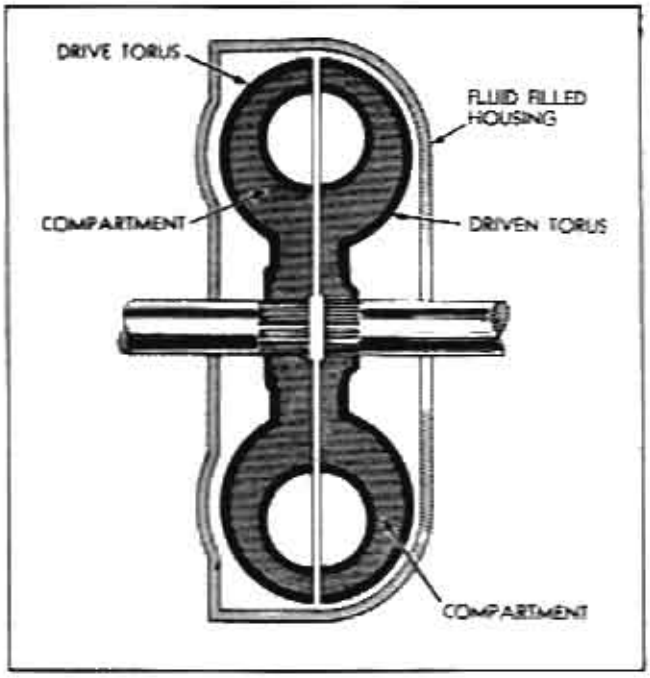

Fig. 6 Cross Section of Fluid Coupling

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.

The sprag clutch consists of three parts, the inner race, the sprag assembly, and the outer race (Fig. 9). 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.

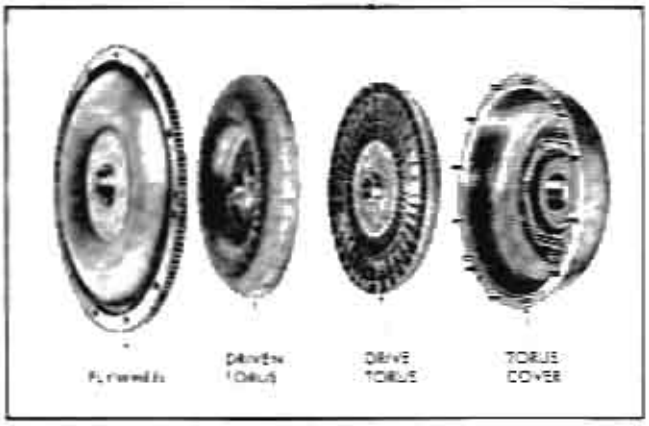

Fig. 7 Fluid Coupling Units

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.

HYDRA-MATIC DRIVE COMPONENTS AND THEIR LOCATION

It is possible to obtain only two forward speeds, reduction and direct, from one planetary gear train or unit when applying power at the same source (for example, the "sun" or center gear). As a greater variation of speed ratios is required to satisfactorily operate a vehicle, the Hydra-Matic transmission contains two planetary gear trains arranged to provide four speeds forward. It also contains a third planetary gear train for reverse. In all forward speeds the reverse planetary unit has no function and simply revolves with the output shaft.

While the large torus members are actually located in the forward end of the transmission, they function between the front and rear planetary units. This is due to the fact that the drive torus (rear member) is part of the front unit planet carrier and the driven

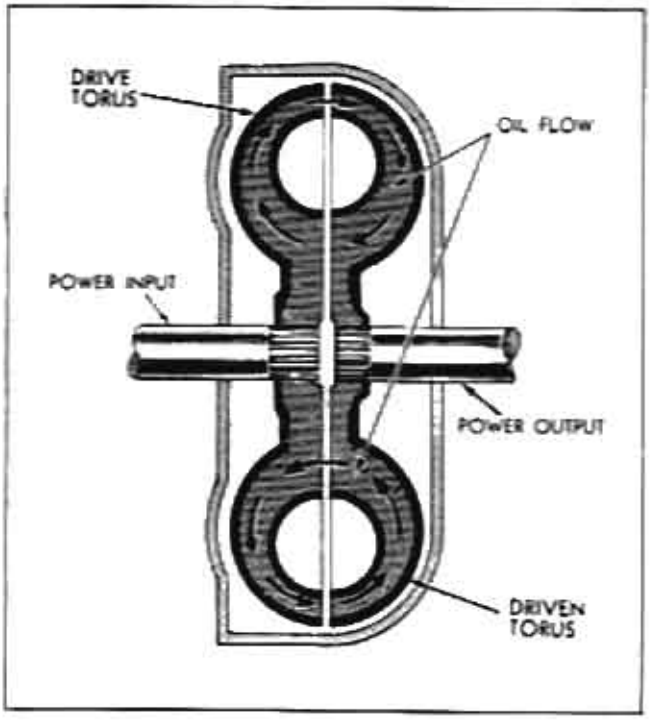

Fig. 8 Fluid Coupling in Operation

torus (front member) is splined on the main shaft, which includes the rear planetary unit center gear.

DRIVE TORUS SPEED REDUCTION

When the car is standing, with the engine running and the control lever in Drive, Lo, or Reverse, the large drive torus of the main coupling rotates at 65% engine speed. This speed reduction of the large drive torus allows the engine to idle without the car "creeping" forward excessively. When the transmission shifts to second speed, the front planetary unit is locked in direct drive. The drive torus then turns at engine speed.

Power is transmitted from the flywheel to the torus cover, (Fig. 10) through the front planetary, which is in reduction, to the rear torus member of the main fluid coupling. The rear torus is the drive member, while the front torus is the driven member.

PRINCIPLES OF OPERATION OF HYDRA-MATIC TRANSMISSION

Various parts of the Hydra-Matic transmission used in obtaining reduction and direct drive are shown in the simple schematic illustrations, figures 12-17 in their true relationship to one another. All parts connected by a line in the illustrations are *actually connected together in the transmission. For* example, the front unit planet carrier, the main drive torus member, the intermediate shaft and the rear clutch hub are all connected together and rotate as a unit. The simple schematics can be compared to figure 11 which is an actual cross section of the transmission.

RELATIONSHIP OF UNITS

The torus cover and flywheel are bolted to the engine flex plate (Fig. 10) and, therefore, rotate with the engine at all times. The front unit internal gear is connected to the torus cover and also to the drive torus of the front unit fluid coupling, thus, the front unit internal gear and front coupling drive torus member always rotate with the engine crankshaft.

The front unit sun gear is mounted on the front end of the shaft of the front unit coupling driven torus. The rear end of this shaft is connected to the inner race of the front sprag clutch and to the overrun clutch plate. Therefore, the front coupling driven torus and the sun gear can turn in a clockwise direction, but the sprag will not allow them to turn counterclockwise. If the overrun clutch plate is applied, the sun gear cannot turn in either direction.

The planet carrier of the front unit is connected

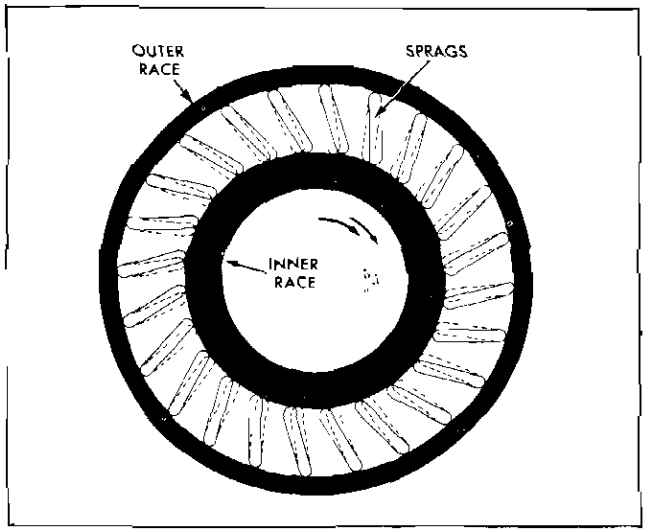

Fig. 9 Sprag Clutch

directly to the main drive torus which in turn is splined to the intermediate shaft. The rear unit clutch hub is splined to the rear end of the intermediate shaft and drives the rear clutch drive plates. Therefore, the main drive torus and the rear clutch hub and drive plates always rotate with the front unit planet carrier.

The main driven torus is splined to the front end of the main shaft. The sun gear of the rear unit is splined to the rear end of the main shaft. Thus, whenever the driven torus member rotates the sun gear of the rear unit rotates with it.

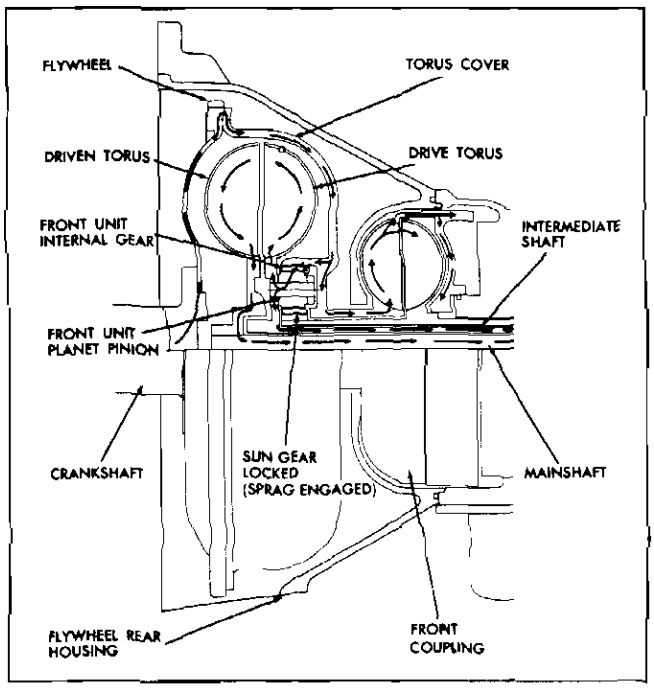

Fig. 10 Drive Torus Speed Reduction

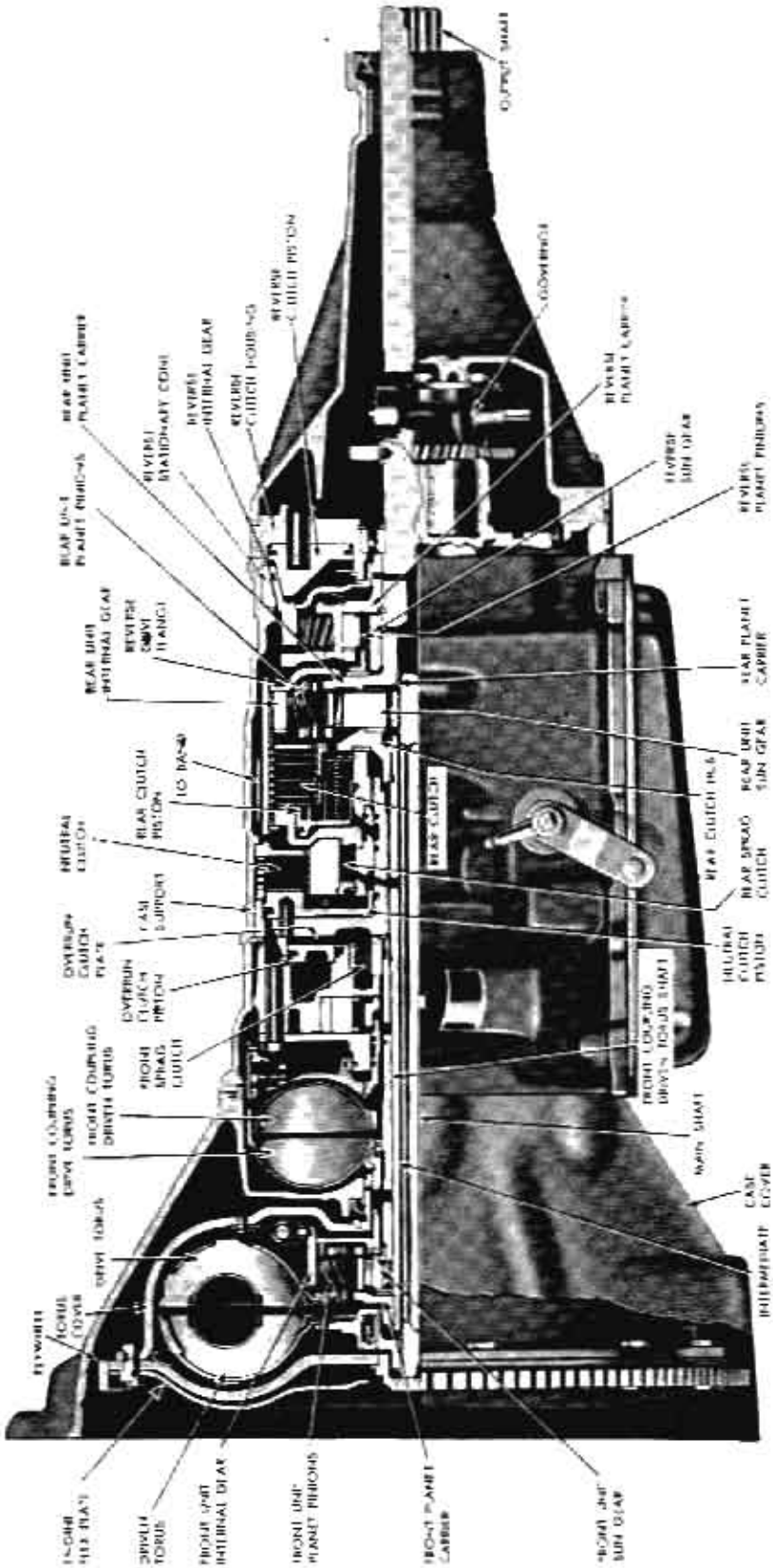

Fig. 11 Cross Section of 4-Speed Hydra-Matic Transmission

The internal gear of the rear unit is connected to the rear clutch drum which in turn is connected to the rear clutch driven plates and to the rear sprag inner race. The reverse sun gear is also connected to the rear clutch drum by means of the reverse drive flange. Thus, the rear internal gear, rear sprag inner race, rear clutch driven plates and reverse sun gear turn as a unit.

The outer race of the rear sprag is connected to the case by means of the neutral clutch plates. When the neutral clutch is released the sprag outer race is free to rotate, but when the neutral clutch is applied the rear sprag outer race is locked to the case. The Lo band encircles the rear clutch drum and when applied, locks the drum to the case.

The rear unit planet carrier is an integral part of the output shaft of the transmission. The reverse planet carrier is splined to the output shaft. The rear unit planet carrier, reverse planet carrier and output shaft, therefore, operate as one unit.

The reverse internal gear is locked to the case when clamped between the reverse stationary cone and the reverse piston.

HYDRAULIC APPLICATION OF UNITS

Direct drive or reduction in each of the units is controlled hydraulically. Reduction in the front unit is obtained when the front unit coupling is empty. Direct drive is secured when the coupling is filled. Reduction in the rear unit is obtained when the rear clutch is released by spring pressure. Direct drive in the rear unit is obtained by hydraulically applying the rear clutch.

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

The hydraulic pressure is maintained by a pump which is driven by the front coupling drive torus 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 is positioned to automatically direct oil to the proper places in the transmission.

POWER FLOW IN HYDRA-MATIC TRANSMISSION

The power flow (parts that are rotating) for each transmission speed is indicated by arrows on illustrations 12 through 17. The solid black areas indicate the sprags or clutches are on and front coupling is full.

The front coupling driven torus shaft, the intermediate shaft, and the main shaft are all concentric. In other words, the mainshaft operates inside the hollow intermediate shaft which in turn operates inside the hollow front unit driven torus shaft. The sprag assemblies also are concentric with the shafts; thus, the inner race of each sprag is the one nearest the centerline of the transmission.

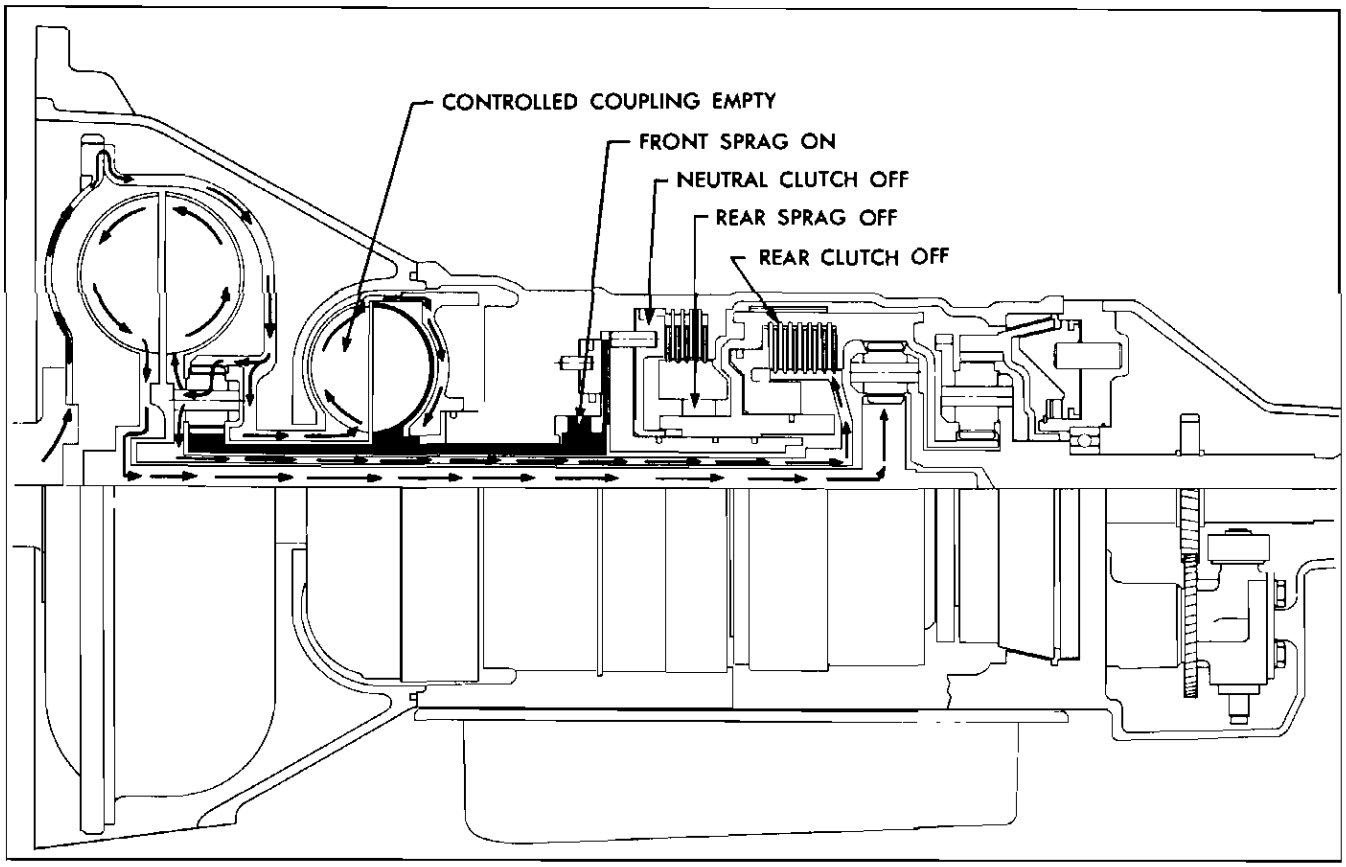

Fig. 12 Power Flow—Neutral—Engine Running

FRONT UNIT (REDUCTION)	NEUTRAL CLUTCH	REAR UNIT (NEUTRAL)	REVERSE UNIT (NEUTRAL)
SPRAG —ON COUPLING—EMPTY	OFF	SPRAG —OFF REAR CLUTCH—OFF L BAND —OFF	CLUTCH—OFF

Power flows mechanically from the flywheel to the torus cover and to the internal gear which is attached to the torus cover.

At the internal gear mechanical power divides.

Part of the power is directed into the front unit coupling, however, in neutral the front coupling is empty and power is not transmitted to the front unit driven member.

Power is also directed from the internal gear to the carrier assembly of the front unit where it divides and is directed to the rear unit in the following two ways.

1. FLUID

Since the front unit is in reduction the front unit carrier will be rotating at a slower rate. The carrier is attached to the drive torus member which through oil will drive the driven torus member. In turn the driven member drives the connected main shaft, and rear unit sun gear.

Here power stops for the rear unit is in neutral because the neutral clutch is released.

2. MECHANICAL

Power is directed mechanically back from the front unit carrier to the rear unit through the intermediate shaft which is splined to the drive torus member. The intermediate shaft is also splined to the rear clutch hub in the rear unit.

Here power stops because the rear clutch plates are released and the rear unit is in neutral.

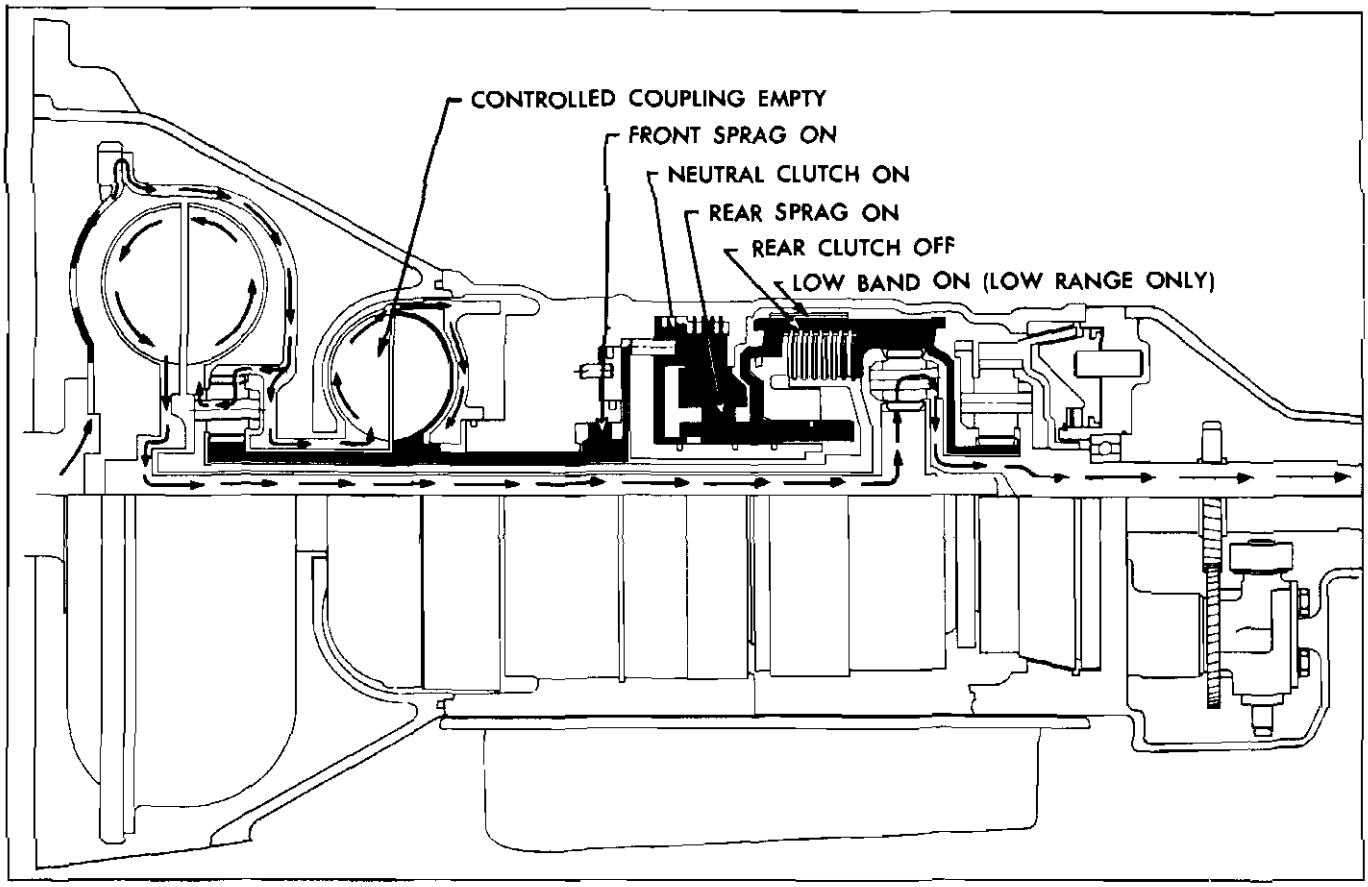

Fig. 13 Power Flow—First Speed—Drive Left

FRONT UNIT (REDUCTION)

SPRAG —ON
COUPLING—EMPTY

NEUTRAL CLUTCH

ON

REAR UNIT (REDUCTION)

SPRAG —ON
REAR CLUTCH—OFF

Power flows mechanically from the flywheel to the torus cover and to the internal gear attached to the torus cover.

At the internal gear mechanical power divides.

Part of the power is directed into the front unit coupling, however, in 1st speed the front coupling is empty and power is not transmitted to the front unit driven member.

Power is also directed from the internal gear to the carrier assembly of the front unit.

The center gear is held by the front sprag assembly so that the pinions of the carrier walk around the center gear at a slower rate or reduction. The front unit carrier is attached to the drive torus member and will through oil drive the driven torus member. In turn the driven torus member drives the connected main shaft and rear unit sun gear.

The rear unit sun gear drives the pinions of the rear unit carrier at a reduced speed or reduction around the internal gear for the internal gear is being held by the rear unit sprag assembly.

The carrier of the rear unit is part of the output shaft, hence power will be directed from the carrier through the output shaft.

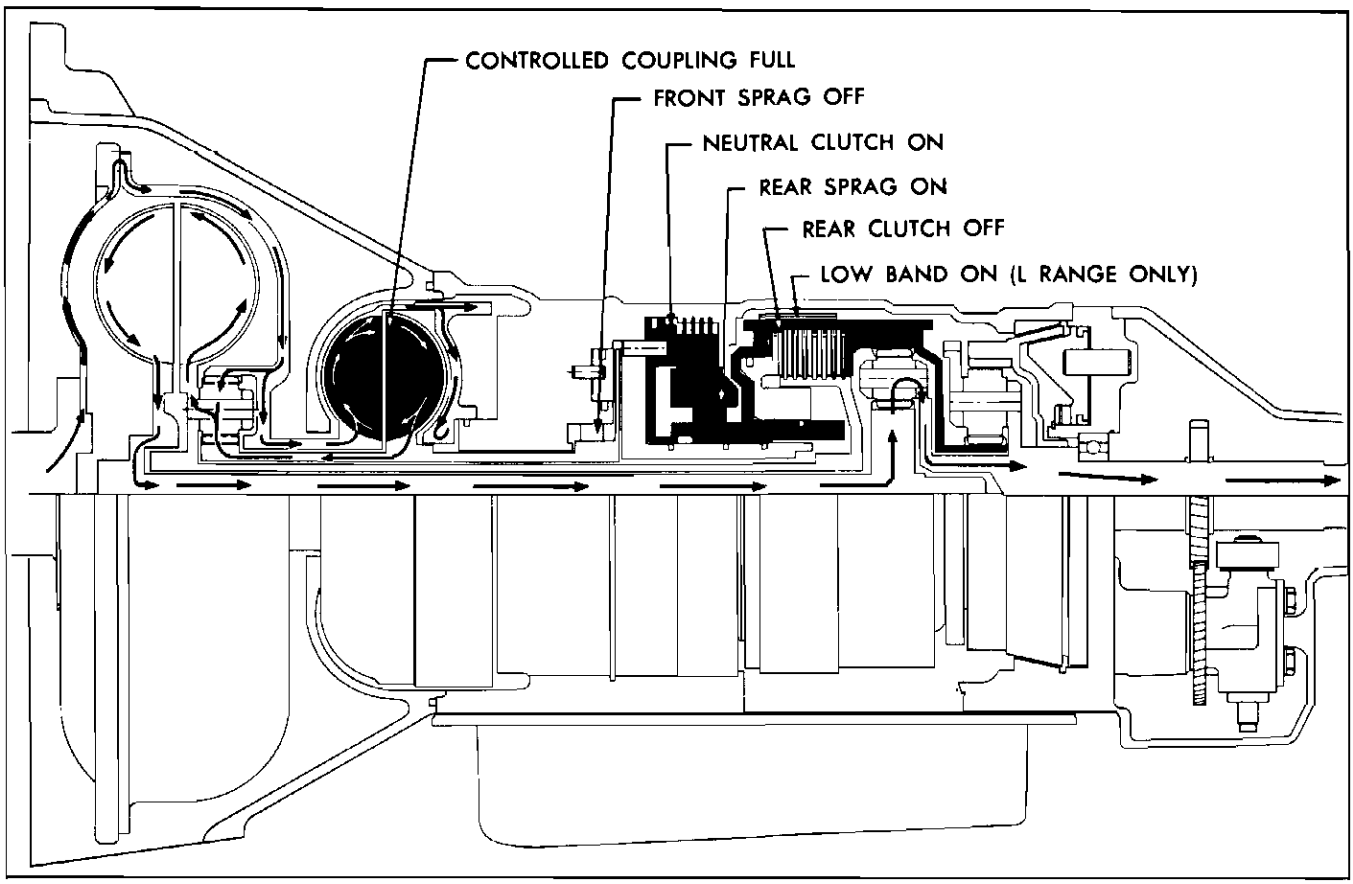

Fig. 14 Power Flow—Second Speed—Drive Left

FRONT UNIT (DIRECT DRIVE)

SPRAG —OFF
COUPLING—FULL

NEUTRAL CLUTCH
ON

REAR UNIT (REDUCTION)

SPRAG —ON
REAR CLUTCH—OFF

Power flows mechanically from the flywheel to the torus cover and to the internal gear attached to the torus cover.

At the internal gear mechanical power divides.

Part of the power is directed into the front unit coupling. The front unit drive member will drive through oil the front unit driven torus member which is attached to the front unit center gear.

Thus, we have two members of the front unit gear set rotating in the same direction at the same relative speed which will give direct drive. (Internal gear and center gear.) These two members drive the planet carrier.

The planet carrier attached to the drive torus member will drive through oil the driven torus member. In turn the driven torus member drives the connected main shaft and rear unit sun gear.

The rear unit sun gear drives the pinions of the rear unit carrier at a reduced speed or reduction around the internal gear for the internal gear is being held by the rear unit sprag assembly.

The carrier of the rear unit is part of the output shaft, hence power will be directed from the carrier through the output shaft.

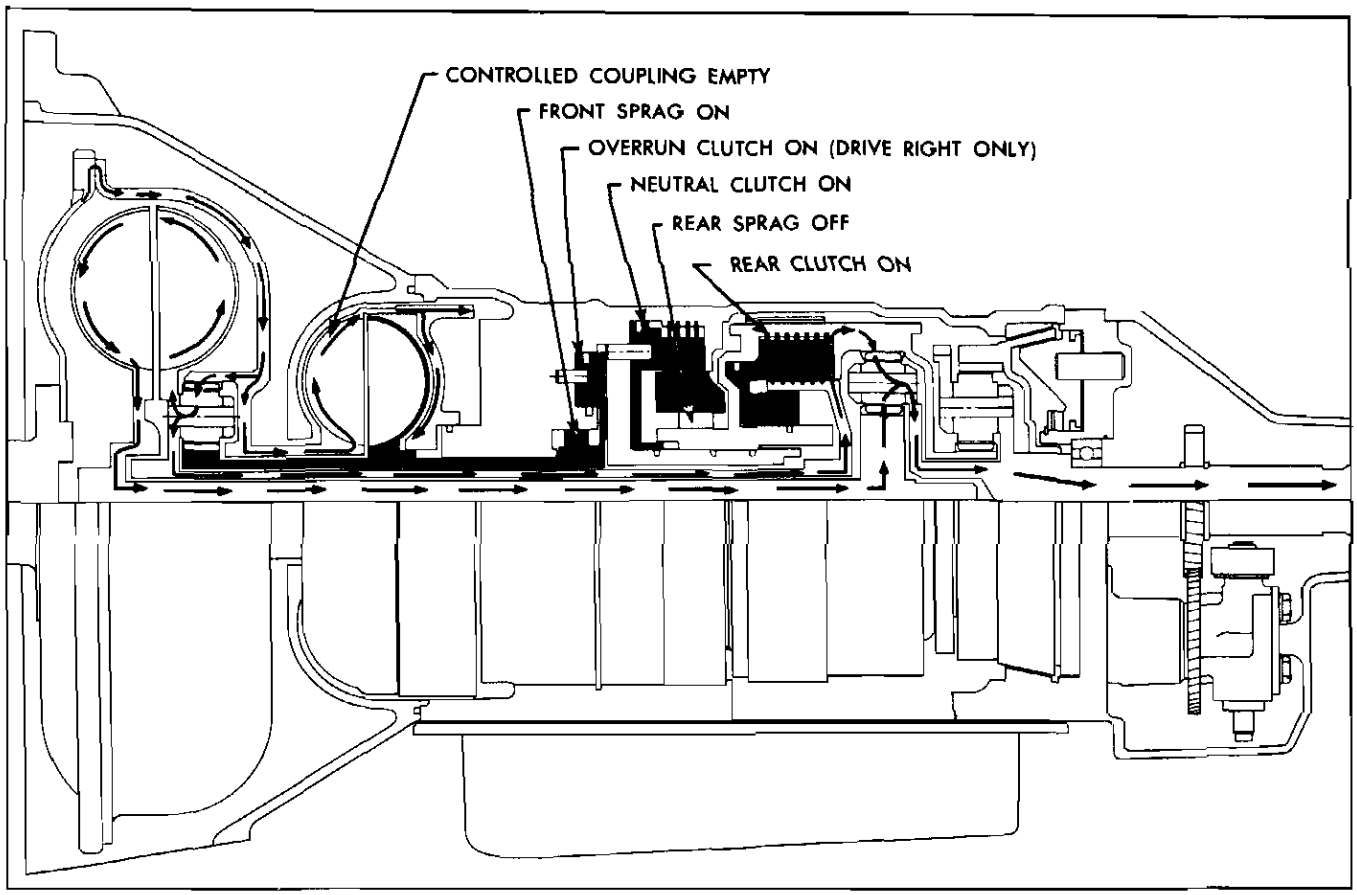

Fig. 15 Power Flow—Third Speed—Drive Left

FRONT UNIT (REDUCTION)

SPRAG —ON
COUPLING—EMPTY

NEUTRAL CLUTCH
ON

REAR UNIT (DIRECT DRIVE)

SPRAG —OFF
REAR CLUTCH—ON

Power flows mechanically from the flywheel to the torus cover and to the internal gear attached to the torus cover.

At the internal gear mechanical power divides.

Part of the power is directed into the front unit coupling, however, in 3rd speed the front coupling is empty and power is not transmitted to the front unit driven member.

Power is also directed from the internal gear to the carrier assembly of the front unit where it divides and is directed to the rear unit in the following two ways.

1. *FLUID*

The center gear of the front unit is held by the front sprag assembly so that the pinions of the carrier walk around the center gear at a slower rate or in reduction. The front unit carrier is attached to the drive torus member and will through oil drive the driven torus member.

In turn the driven torus member drives the connected main shaft and rear unit sun gear which will drive the pinions of the rear unit carrier.

2. *MECHANICAL*

Power is directed mechanically from the carrier of the front unit to the rear unit through the intermediate shaft which is splined to the drive torus member. The intermediate shaft is splined to the rear clutch hub which transmits power through the clutch plates drum and rear internal gear.

The carrier of the rear unit is part of the output shaft, hence power will be directed through the output shaft.

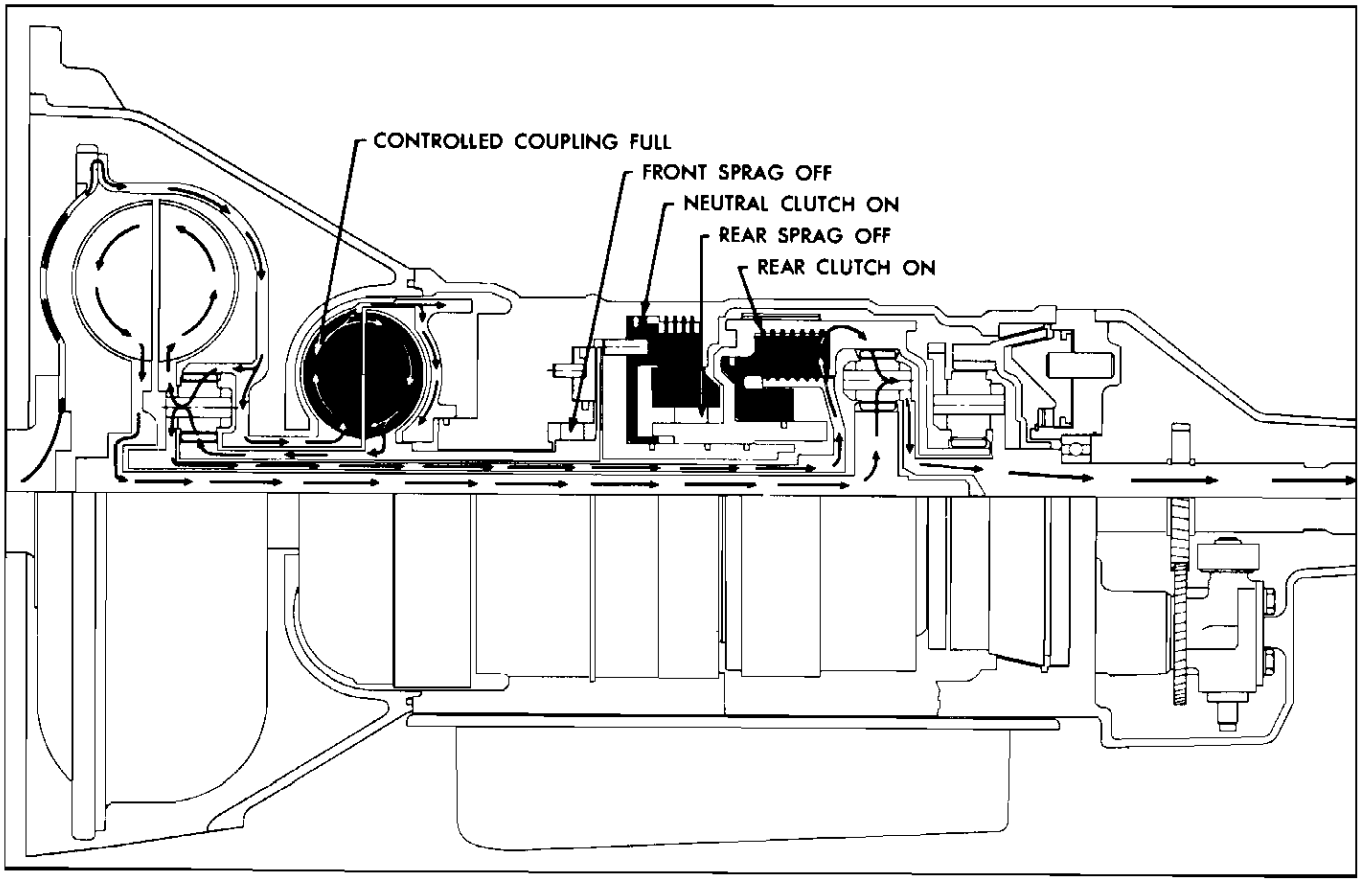

Fig. 16 Power Flow—Fourth Speed—Drive Left

FRONT UNIT
(DIRECT DRIVE)

SPRAG —OFF
COUPLING—FULL

NEUTRAL CLUTCH
ON

REAR UNIT
(DIRECT DRIVE)

SPRAG —OFF
REAR CLUTCH—ON

Power flows mechanically from the flywheel to the torus cover and to the internal gear attached to the torus cover.

At the internal gear mechanical power divides.

Part of the power is directed into the front unit coupling. The front unit drive member will drive through oil the front unit drive torus member, which is attached to the front unit center gear.

Thus, we have two members of the front unit gear set rotating in the same direction at the same relative speed which will give direct drive (internal gear and center gear). These two members drive the planet carrier.

Power is also directed from the internal gear to the carrier assembly of the front unit where it divides and is directed to the rear unit in the following two ways.

1. FLUID

Since the front unit is in direct drive the front unit carrier will be rotating at engine speed. The carrier is attached to the drive torus member which through oil will drive the driven torus member. In turn the driven torus member drives the connected main shaft and rear unit sun gear. The rear sun gear will drive the pinions of the rear unit carrier.

2. MECHANICAL

Power is directed mechanically from the carrier of the front unit back to the rear unit through the intermediate shaft which is splined to the drive torus member.

The intermediate shaft is splined to the rear clutch hub which transmits power through the clutch plates, drum and rear internal gear.

Thus, with the rear unit sun gear driven by fluid power and the rear unit internal gear driven by mechanical power, the rear unit planet carrier, which is part of the output shaft is in direct drive.

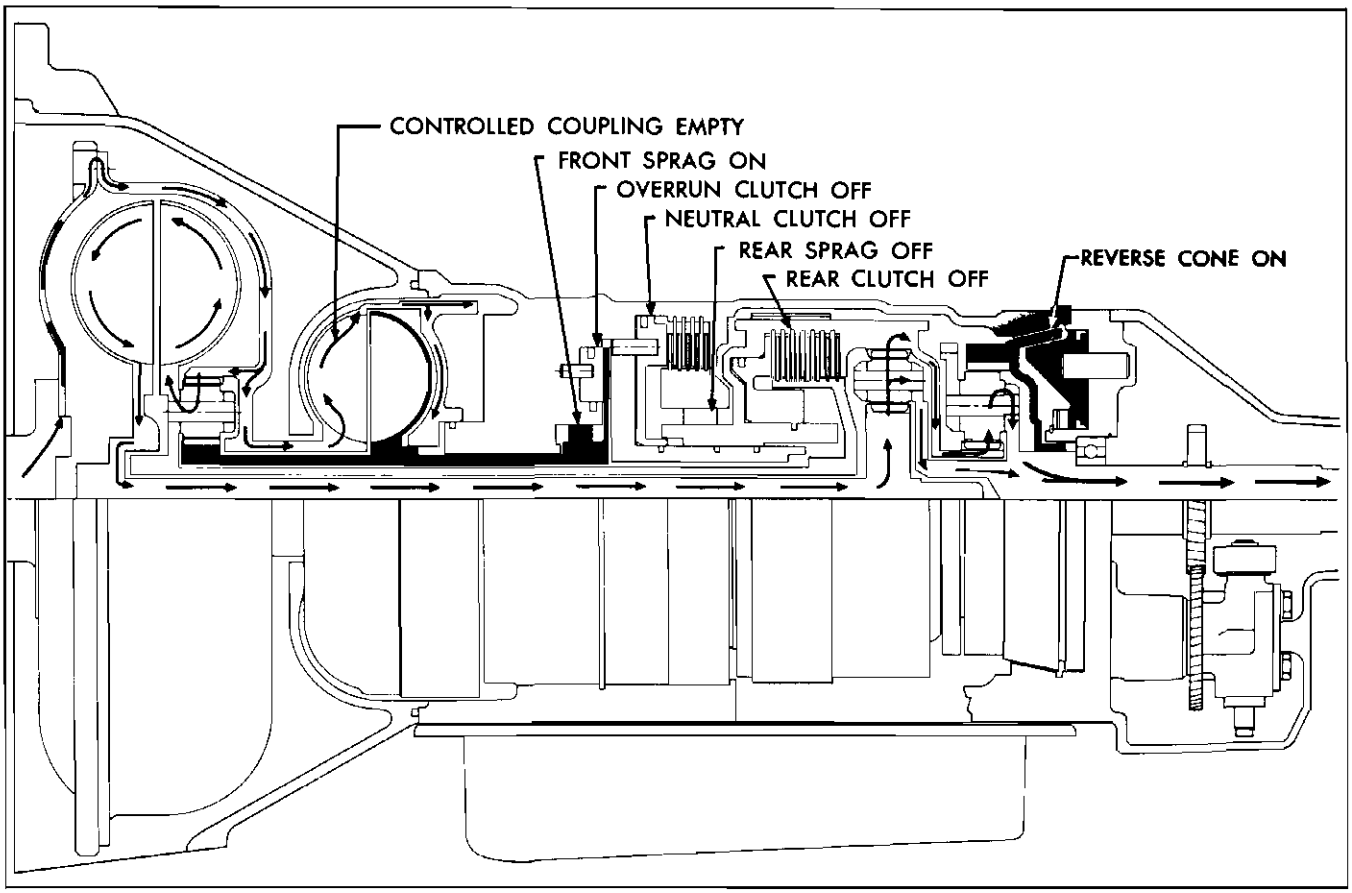

Fig. 17 Power Flow—Reverse

FRONT UNIT (REDUCTION)	NEUTRAL CLUTCH	REAR UNIT (NEUTRAL)	REVERSE UNIT (REDUCTION)
SPRAG —ON COUPLING—EMPTY	OFF	SPRAG —OFF REAR CLUTCH—OFF	CLUTCH—ON

Power flows mechanically from the flywheel to the torus cover and to the internal gear attached to the torus cover.

At the internal gear mechanical power divides.

Part is directed into the front unit coupling, however in reverse the front coupling is empty and no power is transmitted to the front unit driven member.

Power is also directed from the internal gear to the carrier assembly of the front unit.

The center gear is held by the front sprag assembly so that the pinions of the carrier walk around the center gear at a slower rate or reduction. The front unit carrier is attached to the drive torus member and will through oil drive the driven torus member. In turn the driven torus member drives the connecting main shaft and rear unit sun gear.

Since the rear sprag is released the sun gear of the rear unit will drive the rear internal gear counterclockwise or reverse. The internal gear through a flange will drive the center gear of the reverse unit counterclockwise. Power then travels through the reverse planetary carrier to the output shaft in reduction and backwards because the internal gear is held by the reverse cone clutch.

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 following list of speeds and conditions are effective with engine driving the car (car not coasting) and should provide an easy means of reviewing this information.

Range	Gear	Coupling Filled	Front Sprag Effective	Overrun Clutch Applied	Neutral Clutch Applied	Rear Sprag Effective	Rear Clutch Applied	Lo Band Applied	Reverse Cone Applied
Park	—		√						
Neutral	—		√						
▲Dr	First		√		√	√			
	Second	√			√	√			
	Third		√		√		√		
	Fourth	√			√		√		
Dr▲	First		√	√	√	√			
	Second	√			√	√			
	Third		√	√	√		√		
	Fourth	√			√		√		
Lo	First		√	√	√	√		√	
	Second	√			√	√		√	
	Third		√	√	√		√		
	Fourth	√			√		√		
Reverse	Reverse		√						√

REMEMBER

The front unit is in reduction when the coupling is empty, direct drive when the coupling is full.

The rear unit is in reduction when the clutch is released, direct drive when clutch is applied.

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 PUMP

The pump is a large, variable capacity, vane type pump driven by the engine. A slide is incorporated in the pump that automatically regulates pump output according to the needs of the transmission. Maximum pump output is obtained when the slide is in the up position. As the slide moves down, pump output is lowered until zero output is reached.

Movement of the slide is accomplished by directing oil from the pressure regulator to the top or bottom of the slide. With the engine off, the pump is at rest and the slide is held in the up position by the priming springs (Fig. 18). As the pump rotor operates, its output is directed to the pressure regulator valve. When output pressure is low, the pressure regulator valve is held deep in its bore by the pressure regulator valve spring. With the pressure regulator valve in this position, oil is directed below the slide to hold the slide up for maximum output. As the pump output pressure increases, the pressure regulator valve is moved outward, directing oil above the slide to push it down and decrease the output (Fig. 19).

Main line pressure as regulated by the pressure regulator valve is approximately 95 psi except in fourth speed with selector in drive left or in reverse. When the transmission shifts into fourth speed with the selector lever in drive left, line drop oil from the 3-4 shift valve is directed to the pressure regulator valve to push the valve outward. This reduces the pressure in fourth speed to approximately 65 psi thereby decreasing the amount of work performed by the pump during normal cruising. This makes more engine power available to drive the car and reduces the transmission operating temperature.

In reverse, additional pressure is desirable to assure positive holding of the reverse cone clutch. To provide this additional pressure, reverse oil is directed to the reverse booster plug in the pressure regulator. Reverse booster pressure aids the pressure regulator spring in holding the pressure regulator valve in its bore, thereby increasing main line pressure to 145-190 psi.

Incorporated in the pump is the torus feed valve. Movement of the torus feed valve is controlled by slide position. With the slide up, (maximum output) the torus feed valve is closed (Fig. 18). As the slide moves downward, the torus feed valve moves down and opens the feed passages to supply oil to the cooler and to the main torus assembly (Fig. 19).

When the pressure in the main torus assembly reaches a predetermined value, the torus check valve (in the driven torus) opens allowing oil to pass into the transmission lubrication passages.

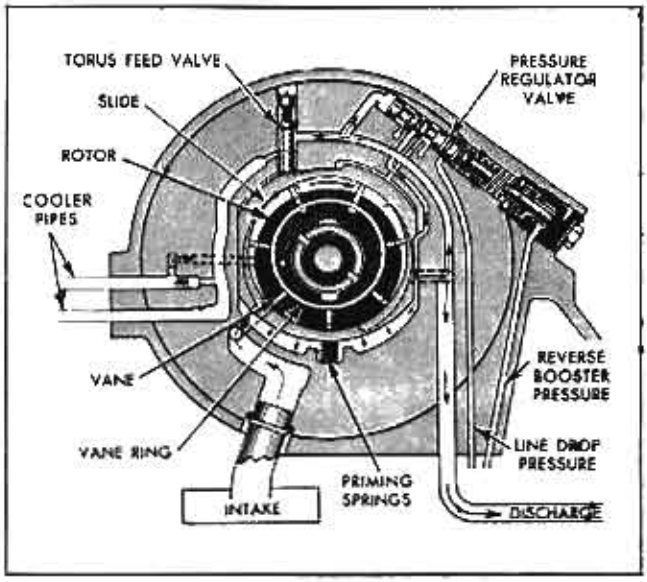

Fig. 18 Pump Delivering Maximum Output

The oil cooler ball check valve is a safety device that will unseat and allow oil to pass directly to the main torus assembly if the oil cooler should become blocked.

GOVERNOR

The timing of shift points with relation to vehicle speed is obtained by means of a governor which is driven through helical gears from the output shaft

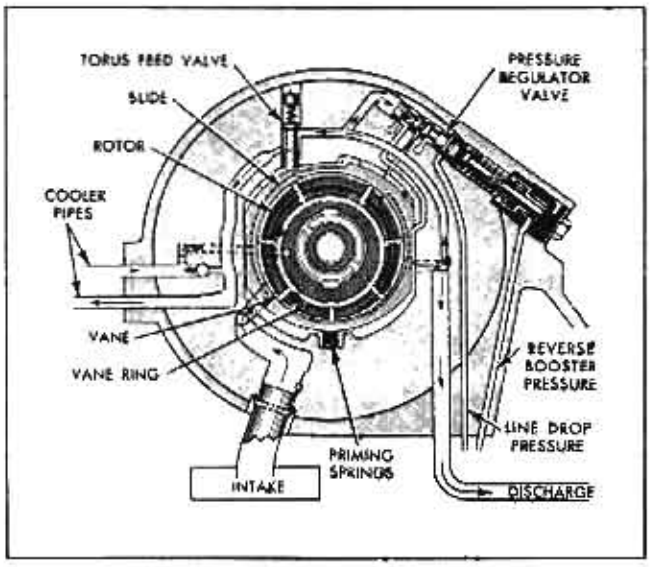

Fig. 19 Pump Delivering Minimum Output

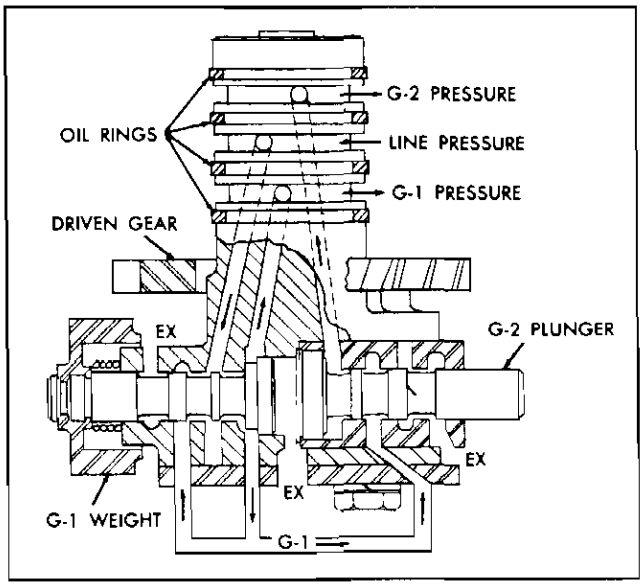

Fig. 20 Governor Assembly

as illustrated in Fig. 11. The drive gear (keyed to output shaft) contains 23 teeth and the driven gear (bolted to governor) 22 teeth thus providing for a uniform wear pattern.

Whenever the vehicle is moving, the governor rotates and centrifugal force tends to throw the governor valves outward, thus allowing main line pressure to be metered past the G-1 valve and regulated to become G-1 governor pressure. G-1 governor pressure is then directed to the control valve assembly and to the G-2 valve. As the G-2 valve opens, G-1 pressure enters and is re-regulated to G-2 pressure. As governor speed increases the centrifugal force on the valves increases and opens the valves wider against opposing oil pressure. Governor pressure is thus regulated from a minimum of zero to full main line pressure in direct proportion to vehicle speed.

The weight on the G-2 valve is very small and its centrifugal force is small compared to the G-1 valve. The G-2 valve, therefore, opens very slowly so that maximum G-2 pressure is not reached until the vehicle attains a very high speed.

To provide an initial G-1 pressure at very low speeds, a spring is placed under the G-1 weight to help hold the valve open.

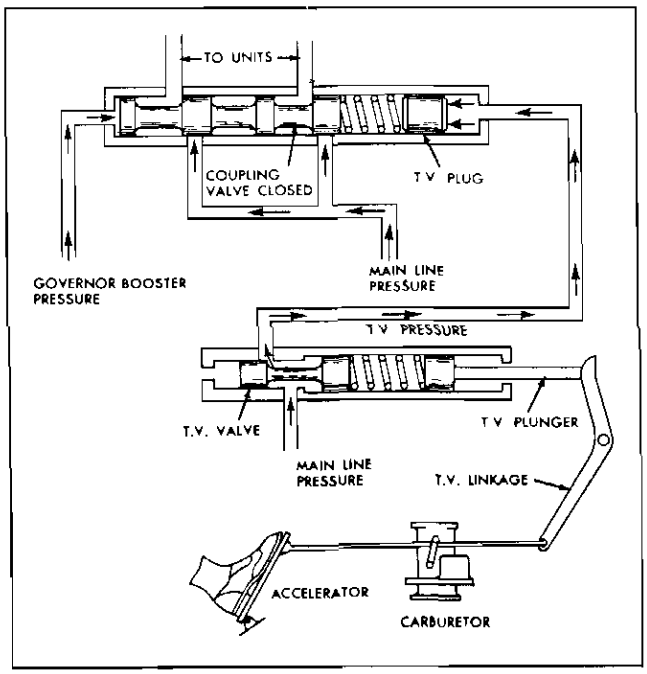

Fig. 21 TV Pressure

GOVERNOR BOOSTER VALVE

Since governor pressure is not great enough to open the coupling valve at the desired low vehicle speed, a booster valve is used. Governor pressure acting on the G-1 booster valve allows main line pressure to be regulated to G-1 booster pressure which is variable and capable of opening the coupling valve at desired speed.

TV PRESSURE

In order to provide greater acceleration or more pulling power, it is desirable to have shifts delayed until higher car speeds are reached. This delay is automatically accomplished by opposing governor pressure with a pressure, called TV pressure, which varies according to throttle opening. As illustrated in Fig. 21, when the accelerator pedal is depressed, linkage in conjunction with the carburetor acts against the TV plunger. The TV plunger acting on the spring opens the TV valve allowing a regulated (throttle or TV) pressure to act against the TV plug. The TV plug then assists the coupling valve spring in holding the coupling valve closed.

The vehicle must attain a higher speed because of the increased force on coupling valve spring before the governor will deliver sufficient pressure to the G-1 booster valve to open coupling valve and cause the transmission to shift into direct drive.

MANUAL VALVE

The manual valve is connected by linkage to the selector lever located at the steering wheel. Movement of the lever positions the manual valve for the speed range desired by the driver and directs flow of oil to apply the neutral clutch.

COUPLING VALVE

The coupling valve directs flow of oil to close the coupling exhaust valve and to fill the coupling.

LIMIT VALVE

The limit valve acts as a double safety device in the transmission.

First, it regulates line pressure passing from the manual valve to the coupling valve and thence to fill the front unit coupling. When the engine is started the limit valve remains closed until main line pressure builds up to approximately 55 psi. When this pressure is reached, the small inner limit valve spring is compressed and the valve opens the passage to the coupling valve.

If, due to a severe leak in the front coupling, the pressure should drop below 55 psi the limit valve will immediately close. It will then act as a pressure regulator keeping the pressure at 55 psi, thus protecting the neutral clutch and rear clutch from slipping and overheating.

The limit valve also acts as a relief valve. If main line pressure exceeds approximately 200 psi, the large (outer) spring behind the limit valve will be compressed and the limit valve will move far enough to open the exhaust port. Excessive output will then be dumped back into the sump relieving the excessive pressure.

ACCUMULATOR VALVE

The accumulator valve allows unregulated TV pressure to be directed to the accumulator to assist the accumulator spring (Fig. 22) until TV pressure reaches 20 lbs. At this point the accumulator valve and plug assembly begins to regulate TV pressure to the accumulator. Thus, with TV pressure higher than the 20 lbs. the pressure in the accumulator (rear clutch apply pressure) will vary according to throttle opening, but will always be less than TV pressure. It is obvious from the above that good transmission operation is dependent upon the free movement of the TV accumulator valve.

NEUTRAL CLUTCH REGULATOR VALVE

The neutral clutch regulator valve is used to provide smooth application of the neutral clutch in accordance with throttle opening.

CLOSED THROTTLE OPERATION

When the transmission is shifted from neutral to drive (with the accelerator pedal released) there will

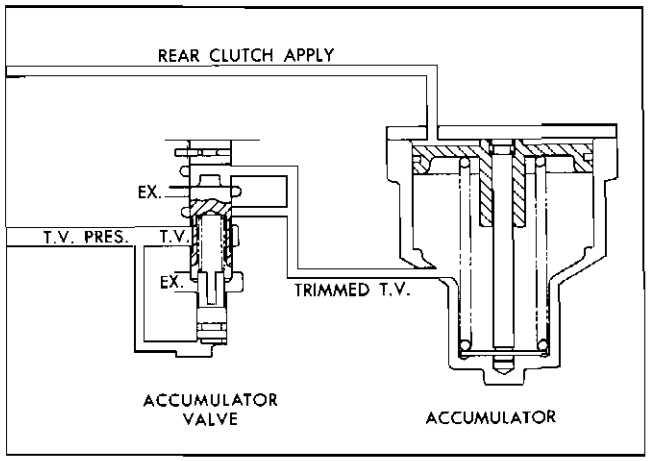

Fig. 22 Oil Flow Through Accumulator Valve

be no TV pressure. Main line pressure will move the neutral clutch valve against spring pressure causing netural clutch apply oil to be metered through the orifice in the reed valve (Fig. 23). Thus, the application of the neutral clutch with zero throttle opening is relatively smooth.

OPEN THROTTLE OPERATION

If the throttle is open when shifting from neutral to drive, TV pressure will move the regulator valve to the open position. The more TV pressure applied the farther the valve will be opened. Thus, there is less restriction to neutral clutch apply oil and the neutral clutch will engage more firmly. With full TV pressure there will be no restriction of neutral clutch apply oil.

NEUTRAL CLUTCH RELEASE

When the neutral clutch is released, as when shifting from drive to reverse, the reed valve lifts off its seat allowing a rapid dumping of oil from the neutral clutch.

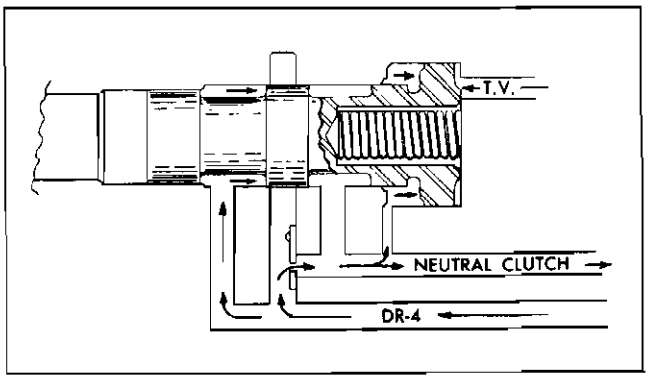

Fig. 23 Neutral Clutch Regulator Valve

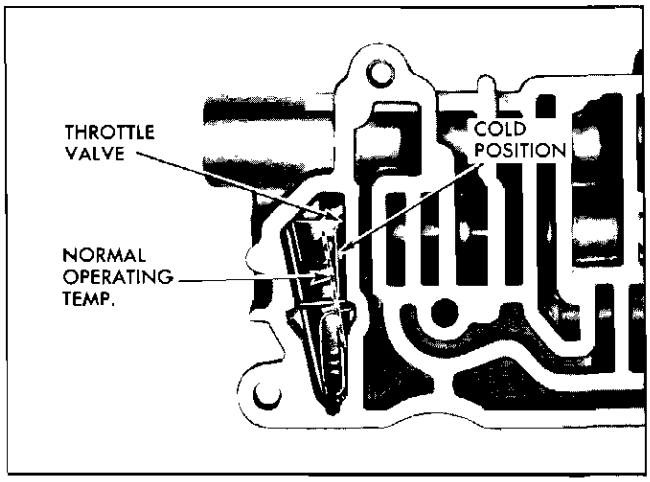

Fig. 24 TV Thermostatic Element in Manual Valve Body

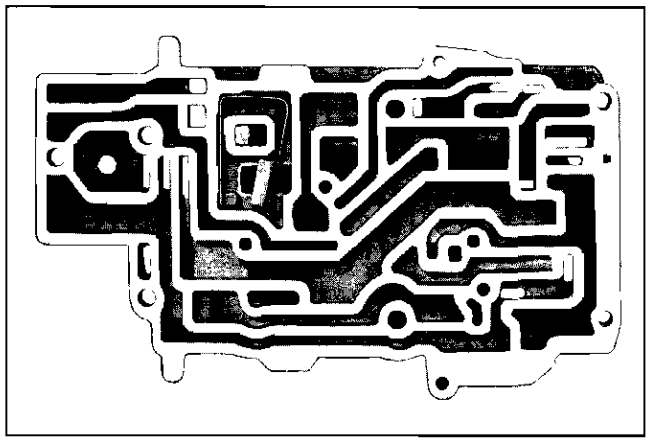

Fig. 25 Coupling Fill Thermostat in Channel Plate

THERMOSTATIC TV CONTROLS

Bi-metal thermostatic elements are used to compensate for increased viscosity of cold oil and thus provide a smooth, rapid 1-2 shift over the entire transmission oil temperature range.

One element, called the TV thermostatic element, is located in the manual valve body behind the throttle valve and is retained by a clip, Fig. 24. This element opposes opening of the throttle valve when the transmission oil is cold; then, as the oil temperature rises toward normal, the effect of the element is minimized, allowing normal TV pressure to be obtained. A screw in end of manual valve body is preset to render the thermostatic element ineffective at transmission oil temperatures above 75°F.

The other element, called the coupling fill thermostat, is located in the channel plate, Fig. 25. During cold oil operation the thermostat is contracted allowing the coupling fill passage to be fully open and thus provide a faster fill. As the transmission oil approaches normal operating temperature, the thermostat partially closes the passage.

REVERSE UNIT

The reverse unit in the controlled coupling Hydra-Matic transmission consists of a reverse planetary gear set with a cone clutch which holds the reverse internal gear. The reverse cone clutch is engaged by a piston which is oil applied.

Teeth on the perimeter of reverse planet carrier form a sprocket which receives a parking pawl to provide a positive lock when the selector lever is in the "P" (park) position. In the "Park" position the transmission is in neutral making it possible to start the engine or leave the car on an incline with the engine running.

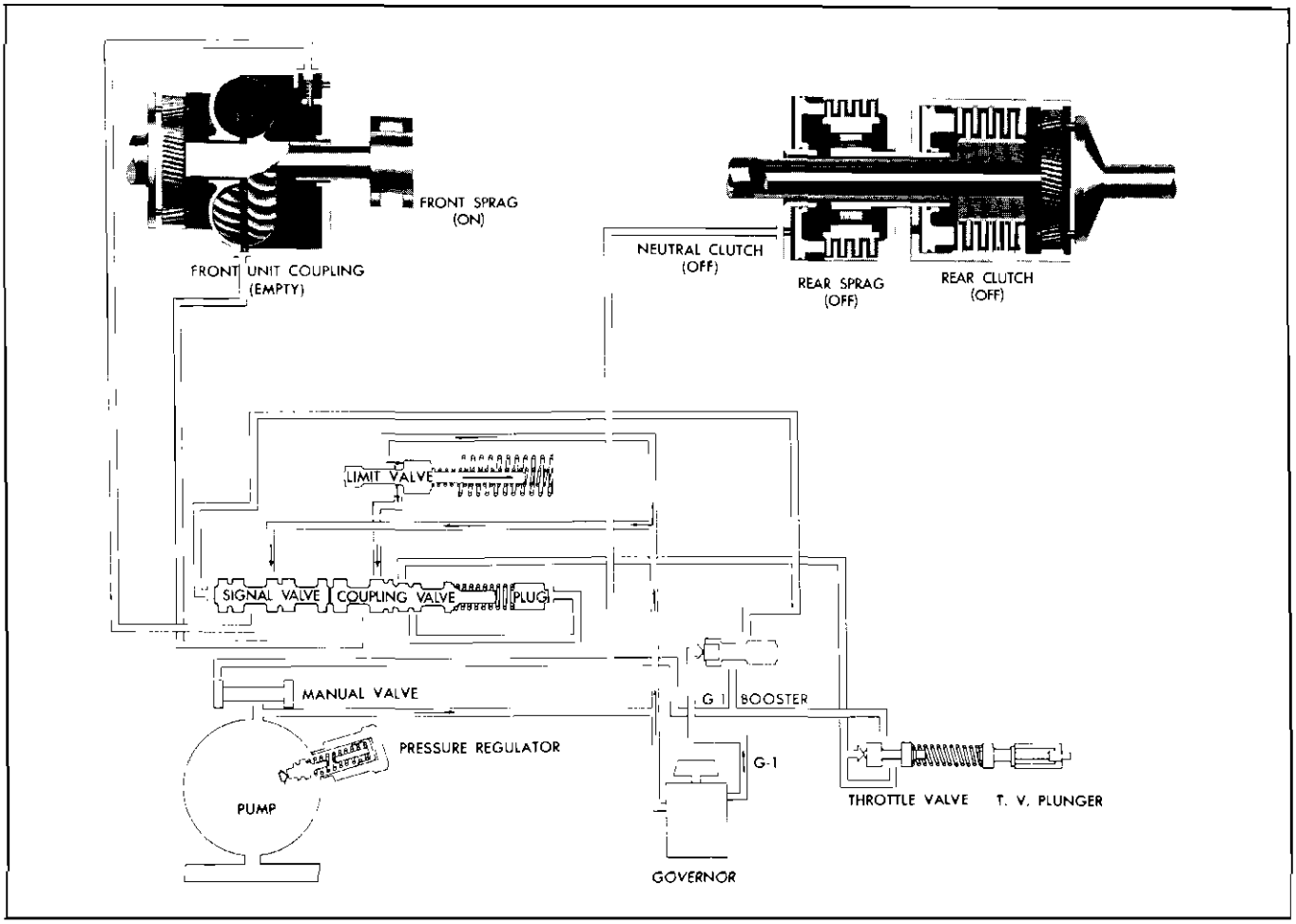

Fig. 26 Hydraulic Action in Neutral—Engine Running, Car Standing

FRONT UNIT (REDUCTION)	REAR UNIT (NEUTRAL)
COUPLING—EMPTY	REAR CLUTCH —OFF
SPRAG —ON	SPRAG —OFF
	NEUTRAL CLUTCH—OFF

When the engine is started, the pump builds up oil pressure which is directed to: (Fig. 26) The manual valve; governor; governor boost valve; limit valve and one land of the coupling valve. When oil pressure builds up to about 55 psi, the limit valve is moved to the open position allowing main line pressure to be directed to a second land of the coupling valve. (The limit valve acts merely as a safety device to maintain the oil pressure within safe limits (see page 00). Normally, main line pressure is always against two lands of the coupling valve.

The governor is used to supply a graduated pressure which increases in proportion to car speed. At a standstill some governor pressure will exist because the G-1 governor plunger is partially opened by spring pressure. This pressure is directed to the governor boost valve.

The governor boost valve supplies a variable pressure to the coupling valve. This pressure varies in proportion to governor pressure but is always greater than governor pressure.

The neutral clutch is spring released and oil applied. Since no oil pressure is present, it is released. With the neutral clutch released, the rear unit can not transmit motion and the transmission is in neutral.

The hydraulic circuit is exactly the same with the selector in park position. In park position the transmission output shaft is mechanically locked to the transmission case by a pawl which engages the teeth on the reverse planet carrier. The car is, therefore, locked from moving when the selector lever is in the park position.

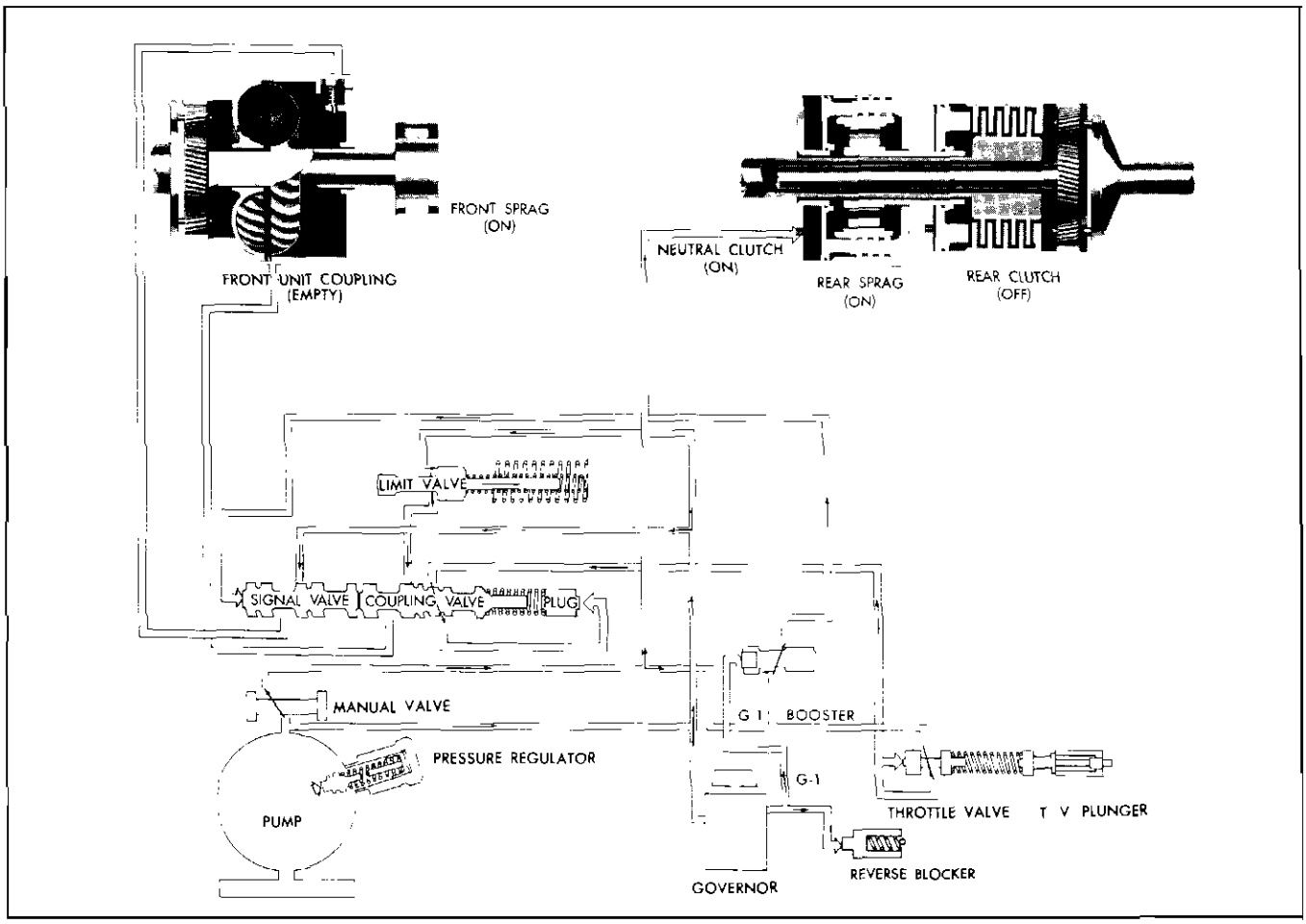

Fig. 27 Hydraulic Action in First Speed—Drive Left

FRONT UNIT IN REDUCTION	REAR UNIT IN REDUCTION
COUPLING—EMPTY	REAR CLUTCH —OFF
SPRAG —ON	SPRAG —ON
	NEUTRAL CLUTCH—ON

When the selector lever is placed in drive left position, main line pressure is directed from the manual valve to the neutral clutch and to the TV valve (Fig. 27) (Main line pressure is also directed to the 2-3 and 3-4 shift valves which are not shown here). The neutral clutch is thus applied, locking the outer race of the rear sprag to the transmission case, thus completing the power flow.

The front unit is already in reduction, since the coupling is empty, and with the neutral clutch applied the rear unit is also in reduction through the rear sprag. The transmission is therefore in first speed and the car will begin to move if the accelerator is depressed.

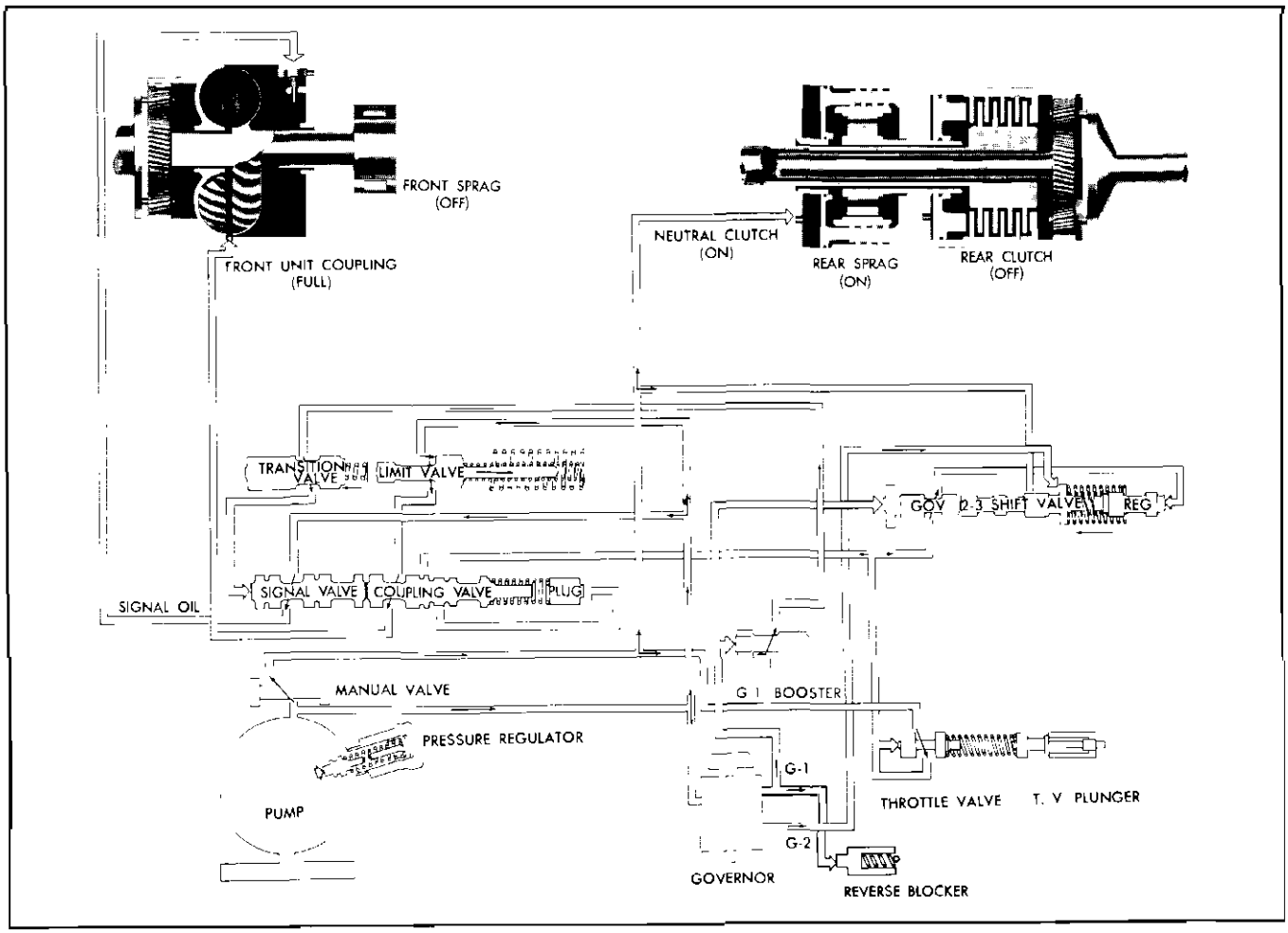

Fig. 28 Hydraulic Action in Second Speed—Drive Left

FRONT UNIT IN DIRECT DRIVE	REAR UNIT IN REDUCTION
COUPLING—FULL	REAR CLUTCH —OFF
SPRAG —OFF	SPRAG —ON
	NEUTRAL CLUTCH—ON

As the car accelerates in first speed, governor pressure increases and governor boost pressure increases correspondingly. When governor boost pressure becomes sufficient, the coupling and coupling signal valves are moved against spring pressure and TV pressure to the open position (Fig. 28). The more the accelerator pedal is depressed the greater TV pressure becomes. Thus with more throttle opening the car must reach a higher speed to develop enough governor boost pressure to cause the valves to open. When the coupling and coupling signal valves open, coupling signal oil passes through the coupling signal valve and closes the exhaust valves in the front unit coupling. Coupling fill oil, supplied to the coupling valve through the limit valve, passes through the coupling valve to fill the front unit coupling. As the coupling fills, the driven torus begins to rotate driving the front unit sun gear. When completely full, the sun gear and internal gear of the front unit are rotating at the same speed and the front unit is in direct drive.

As the coupling valve opens, TV pressure to the coupling valve plug is cut off.

The limit valve serves as a safety feature when the front coupling is filled. As mentioned earlier, approximately 55 psi is required to open the limit valve initially. If, due to a leak in the coupling fill circuit, the pressure drops below 55 psi, the limit valve will close preventing further drop in oil pressure.

The rear unit is unaffected and remains in reduction.

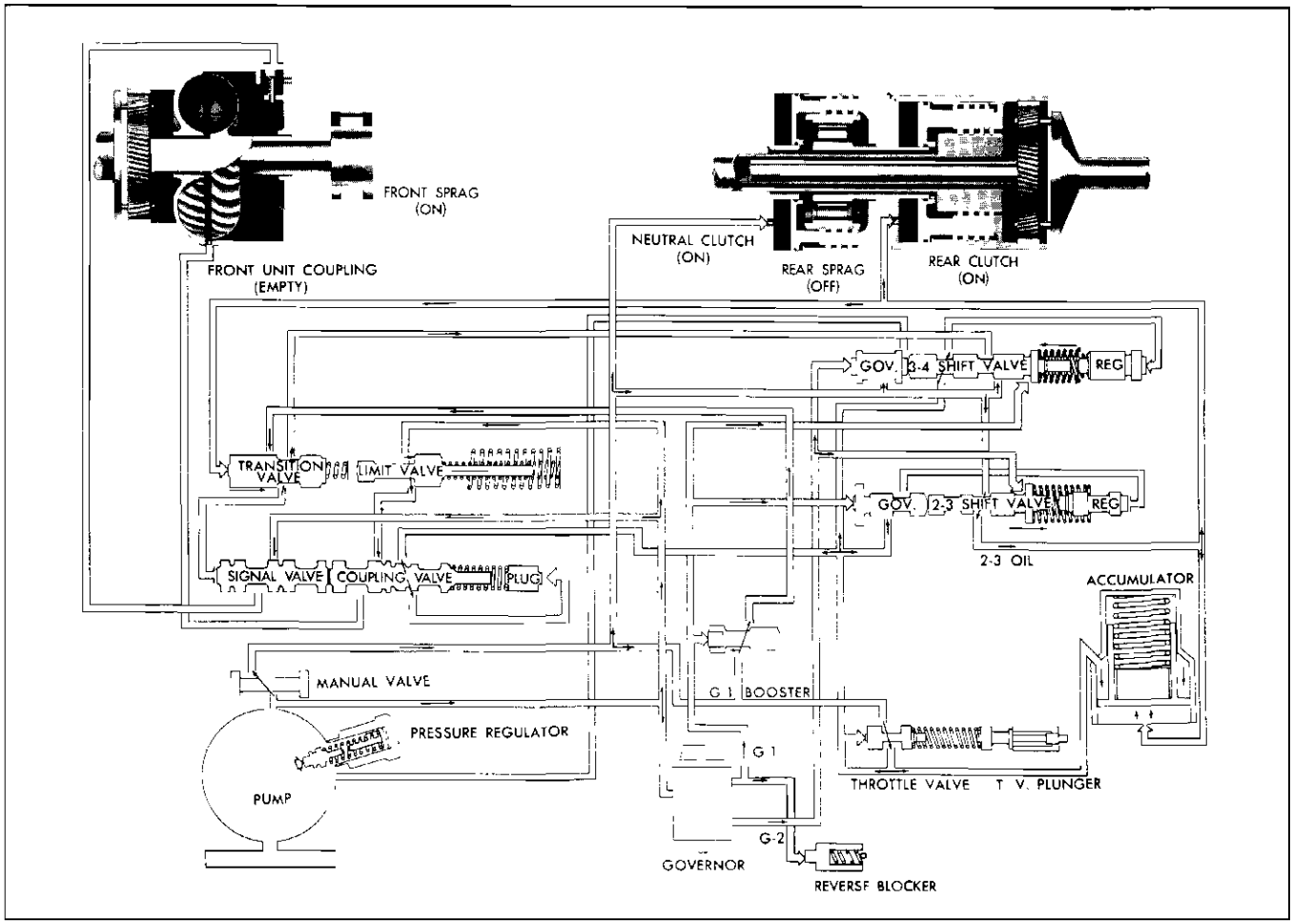

Fig. 29 Hydraulic Action in Third Speed—Drive Left

FRONT UNIT	REAR UNIT
IN REDUCTION	IN DIRECT DRIVE
COUPLING—EMPTY	REAR CLUTCH —ON
SPRAG —ON	SPRAG —OFF
	NEUTRAL CLUTCH—ON

As car speed increases in second speed, governor pressure increases. When governor pressure becomes sufficient, it moves the 2-3 shift valve to the open position against spring pressure and TV pressure (Fig. 29). Opening the 2-3 shift valve allows main line pressure to pass to the transition valve, rear clutch and accumulator. The action is as follows:

Main line pressure directed to apply the rear clutch must also compress the spring behind the accumulator piston. This action softens the rear clutch apply to provide a smooth 2-3 shift. TV pressure is also used behind the accumulator piston to provide for more positive clutch application on heavy throttle shifts.

Simultaneously with the application of the rear clutch, 2-3 shift oil moves the transition valve to the right. This cuts off governor boost pressure which originally moved the coupling and coupling signal valves to the open position. The coupling valve spring then moves the coupling and coupling signal valves back to the closed position, cutting off coupling signal oil and coupling fill oil. The coupling then empties through the exhaust valves and the front unit goes into reduction.

With the rear clutch applied the rear unit is in direct drive, and with the front unit coupling empty, the front unit is in reduction. The transmission is, therefore, in third speed.

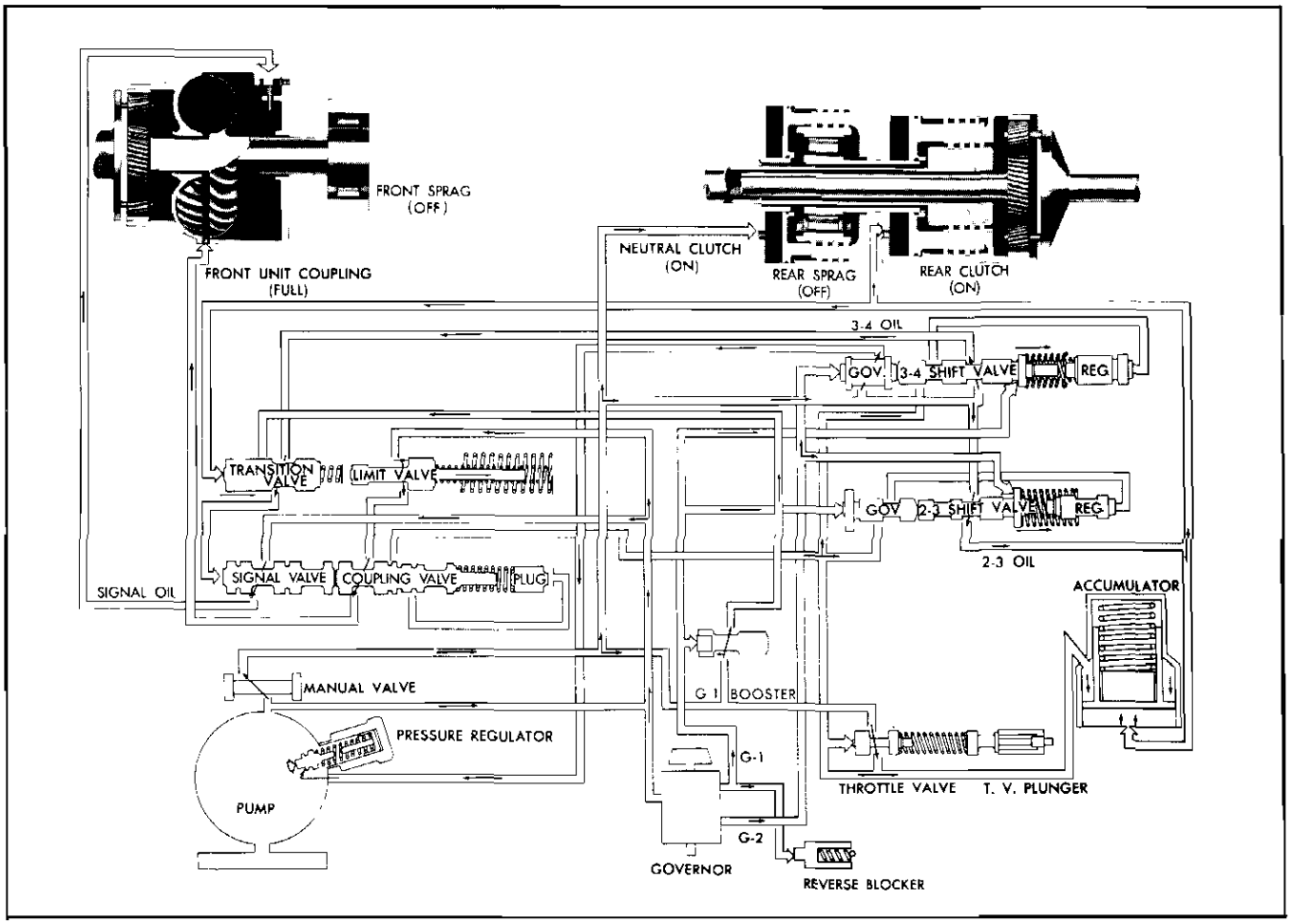

Fig. 30 Hydraulic Action in Fourth Speed—Drive Left

FRONT UNIT IN DIRECT DRIVE	REAR UNIT IN DIRECT DRIVE
COUPLING—FULL	REAR CLUTCH —ON
SPRAG —OFF	SPRAG —OFF
	NEUTRAL CLUTCH—ON

When car speed increases in third speed, governor pressure will become sufficient to move the 3-4 shift valve to the open position (Fig. 30). Main line pressure will then pass from the 3-4 shift valve to the transition valve.

With the transition valve still in its right hand position, main line pressure from the 3-4 shift valve can pass through the transition valve into the same passage which carried governor boost oil in 1st and 2nd gear. Thus main line pressure is directed to the left end of the coupling and coupling signal valves to move them to the open position.

Signal oil then passes from the coupling signal valve to close the front coupling exhaust valves. At the same time fill oil from the coupling valve enters and fills the coupling placing the front unit in direct drive. The rear unit remains in direct drive and the transmission is in fourth speed.

Main line pressure also passes through the 3-4 governor plug to the pressure regulator. The purpose of this oil is to resist the pressure regulator spring and reduce main line oil pressure after the transmission has shifted into fourth speed.

Not shown on the diagram is the fact that line drop pressure also is routed through the manual valve so that it is cut off in drive right and lo ranges.

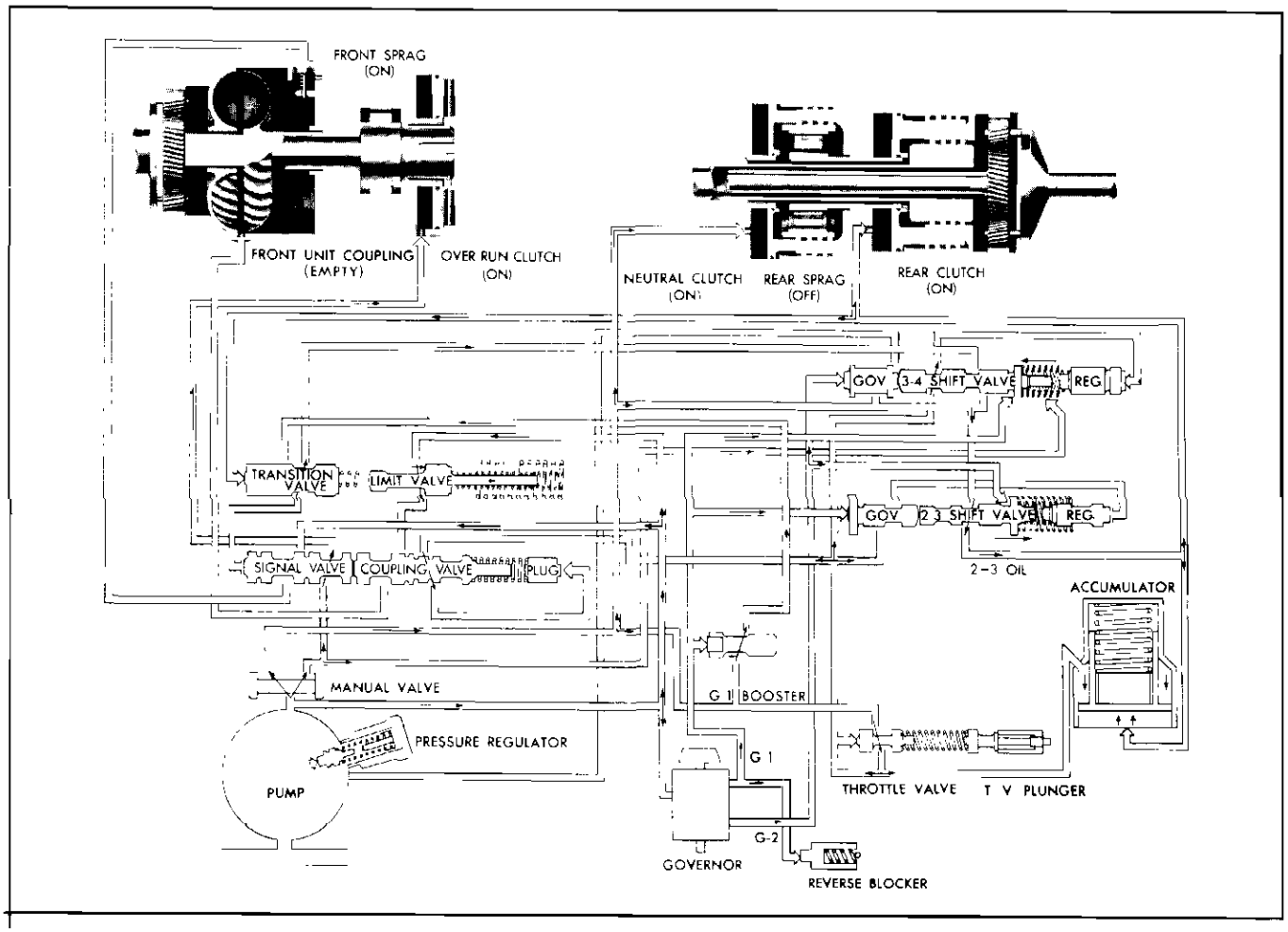

Fig. 31 Hydraulic Action in Third Speed—Drive Right

FRONT UNIT IN REDUCTION		REAR UNIT IN DIRECT DRIVE	
COUPLING	—EMPTY	REAR CLUTCH	—ON
SPRAG	—ON	SPRAG	—OFF
OVERRUN CLUTCH	—ON	NEUTRAL CLUTCH	—ON
		LO BAND	—OFF

When the selector lever is moved to the drive right position, "drive left oil" is still directed to the same places as with the lever in drive left (Fig. 31).

In the drive right position, however, an additional passage is opened to direct main line pressure (drive right oil) from the manual valve to the back side of the 3-4 shift valve. This pressure in addition to TV pressure and spring force normally prevents an upshift to fourth speed; however, at approximately 70 mph governor pressure becomes great enough to overcome these pressures and the 3-4 shift valve will open making a 3-4 upshift possible.

Drive right oil is also directed to apply the overrun clutch. Application of the overrun clutch is necessary to provide engine braking in third speed for descending long grades etc. Drive right oil to the overrun clutch is routed through the coupling valve so that when the front unit shifts into direct drive for second speed or fourth speed, the overrun clutch is released.

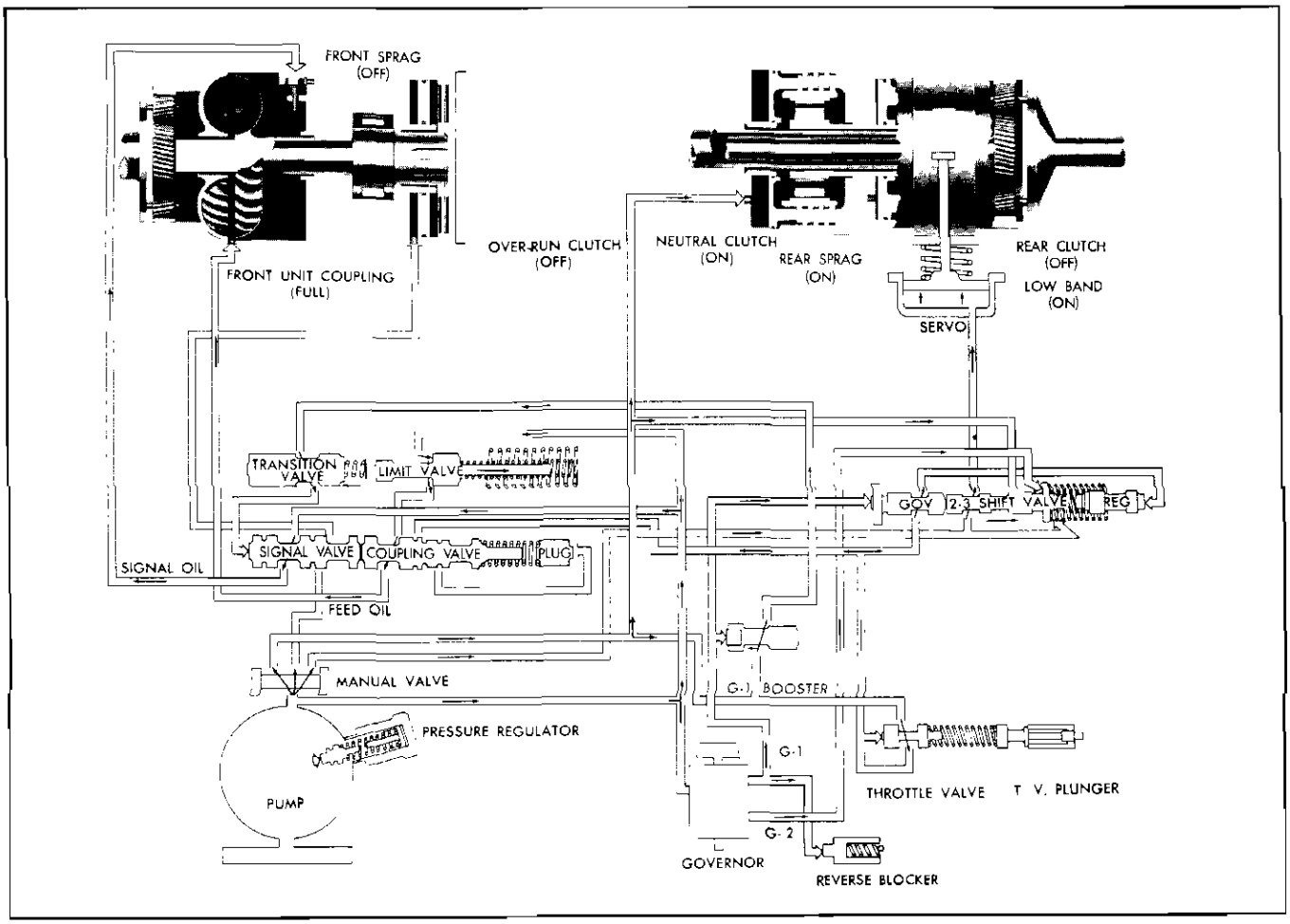

Fig. 32 Hydraulic Action in Second Speed—Lo Range

FRONT UNIT IN DIRECT DRIVE		REAR UNIT IN REDUCTION	
COUPLING	—FULL	REAR CLUTCH	—OFF
SPRAG	—OFF	SPRAG	—ON
OVERRUN CLUTCH	—OFF	NEUTRAL CLUTCH	—ON
		LO BAND	—ON

When the selector lever is moved to the lo range position, main line pressure is directed into the lo range circuit in addition to the drive left and drive right circuit (Fig. 32). The transmission starts in first speed and shifts to second speed in exactly the same manner as in drive left or drive right.

Lo range oil is directed through the 2-3 shift valve to apply the lo band, to the back side of the 2-3 shift valve to keep it closed, and to the transition valve to assist spring pressure.

The pressure behind the 2-3 shift valve prevents a 2-3 upshift unless car speed exceeds approximately 50 mph. Application of the lo band provides engine braking when the car is descending grades in first or second.

"Lo oil" to the back side of the 2-3 shift valve and to the lo band is cut off when the shift valve opens. This releases the lo band when the car is driven fast enough to cause a 2-3 shift.

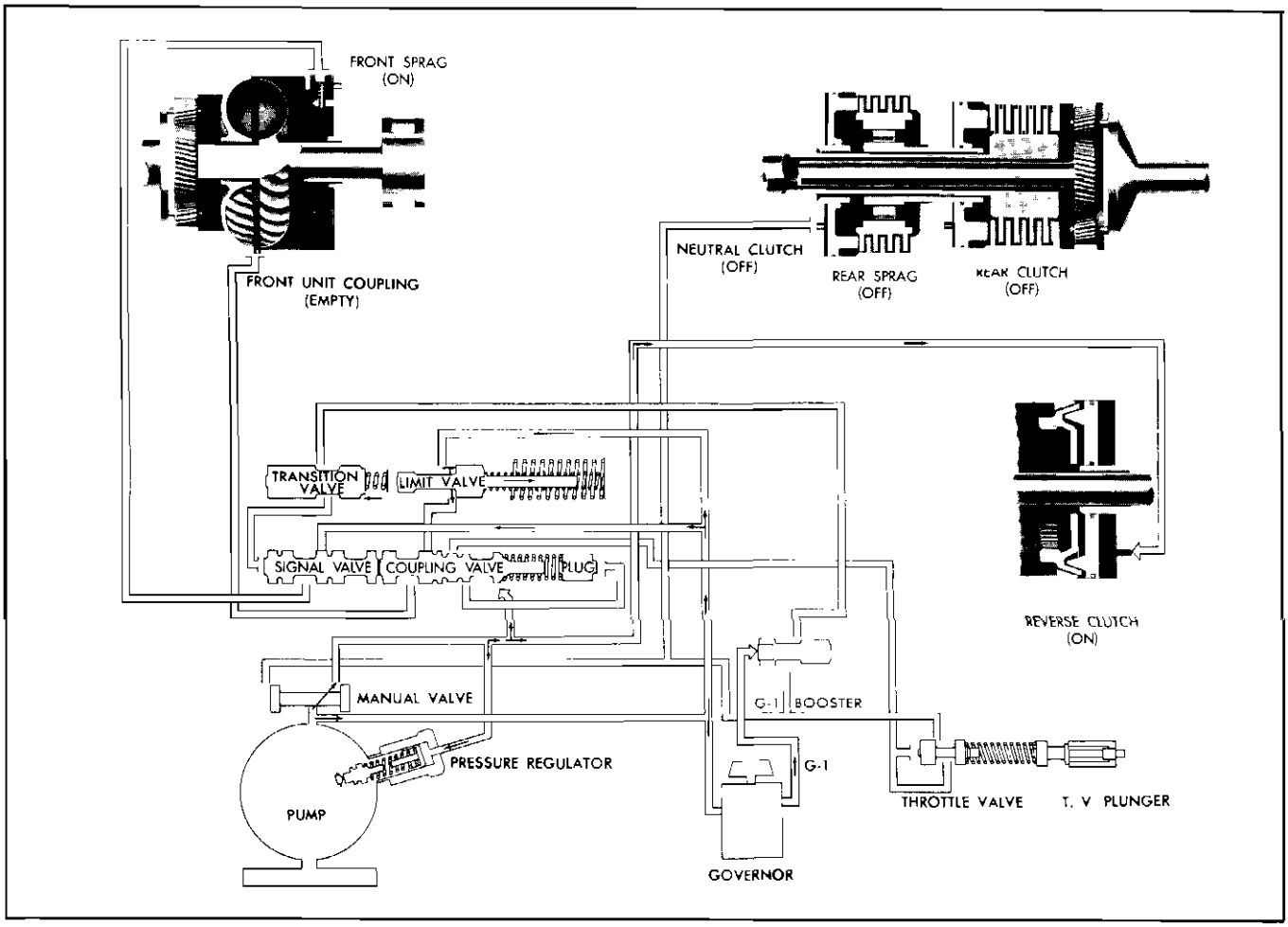

Fig. 33 Hydraulic Action in Reverse

FRONT UNIT		REAR UNIT	
IN REDUCTION		**IN NEUTRAL**	
COUPLING	—EMPTY	REAR CLUTCH	—OFF
SPRAG	—ON	SPRAG	—OFF
OVERRUN CLUTCH	—OFF	NEUTRAL CLUTCH	—OFF

REVERSE UNIT

IN REDUCTION

REVERSE CONE CLUTCH—ON

When the selector lever is moved to the reverse position, drive left, drive right and lo range oils are all cut off and main line pressure is directed to the reverse passage (Fig. 33).

"Reverse oil" is directed to apply the reverse cone. In addition reverse oil is directed to the back of the coupling valve to prevent it from opening and to the reverse booster in the pressure regulator. Main line pressure in the pressure regulator increases main line pressure in reverse to assure positive application of the reverse cone clutch.

The reverse blocker is used to prevent accidental selection of reverse while the car is moving forward at speeds above 10 mph. Governor pressure behind the blocker at higher speeds holds the blocker out to mechanically block the selector linkage from being moved into reverse. At speeds below 10 mph the blocker piston spring overcomes governor pressure on the blocker piston and moves the piston out of the way.

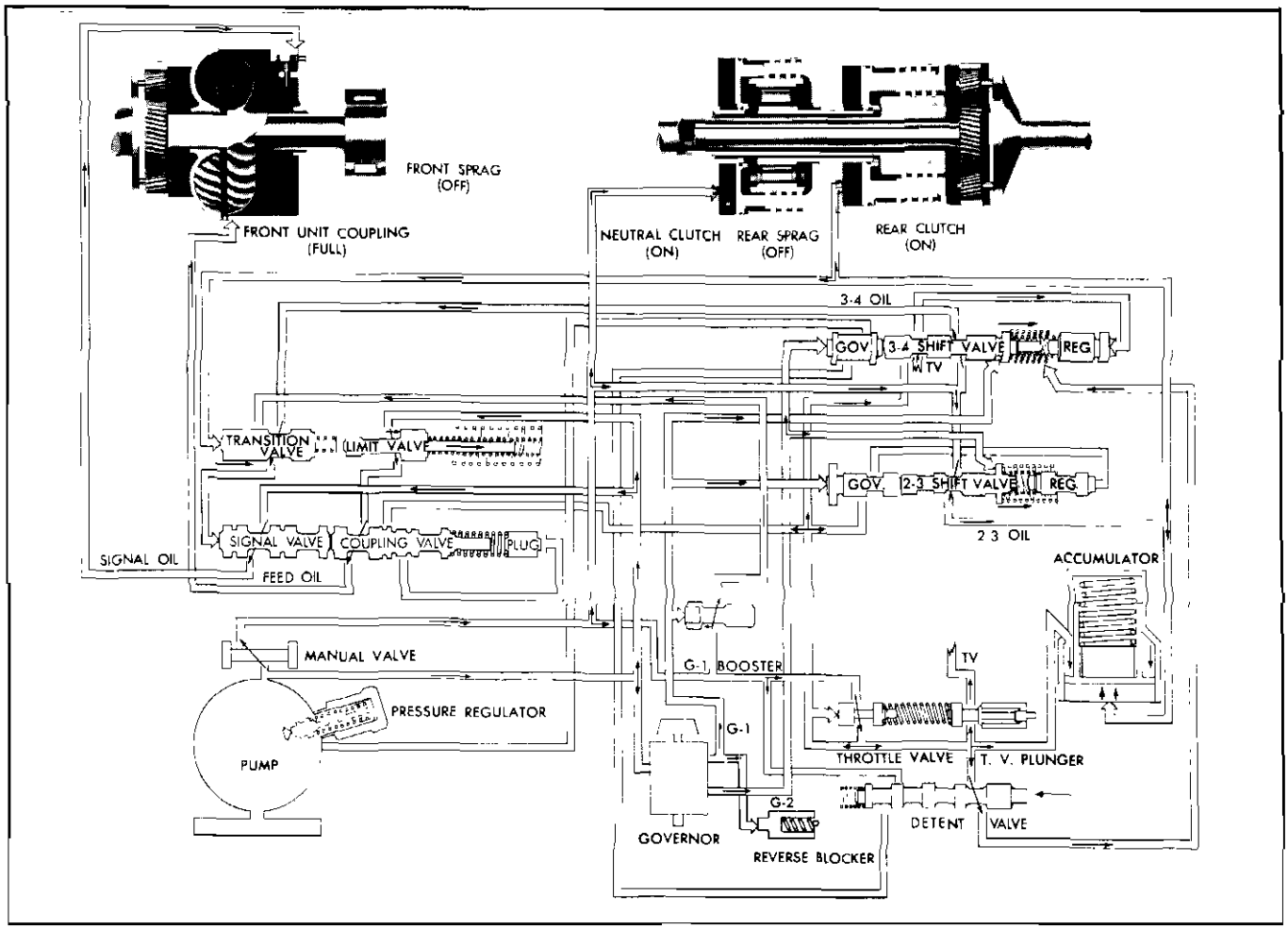

Fig. 34 Hydraulic Action During Forced 4-3 Downshift

FRONT UNIT	REAR UNIT
IN DIRECT DRIVE	DIRECT DRIVE
COUPLING—FULL	REAR CLUTCH —ON
SPRAG —OFF	SPRAG —OFF
	NEUTRAL CLUTCH—ON

In order to get maximum acceleration while driving in fourth speed, it is sometimes desirable to shift down to third speed. To make this possible the detent valve has been incorporated. The detent valve is controlled by the accelerator pedal position so that when the accelerator is pushed to its maximum travel the detent valve will be opened. At the same time maximum TV pressure is secured which is equal to main line pressure.

With the detent valve opened, TV pressure is allowed to pass the detent valve into a passage where it is directed to the back of the 3-4 shift valve (Fig. 34). TV pressure which is equal to main line pressure with the throttle wide open, then closes the 3-4 shift valve forcing the transmission to downshift from fourth to third. At speeds above approximately 68 mph governor pressure is high enough that this downshift cannot be made.

Line drop oil from the 3-4 governor valve to the pressure regulator is routed through the detent valve so that it will immediately be cut off on a forced 4-3 downshift. This assures that maximum line pressure will immediately be available for holding the neutral and rear clutches.

The diagram indicates fourth speed prior to the downshift to third.

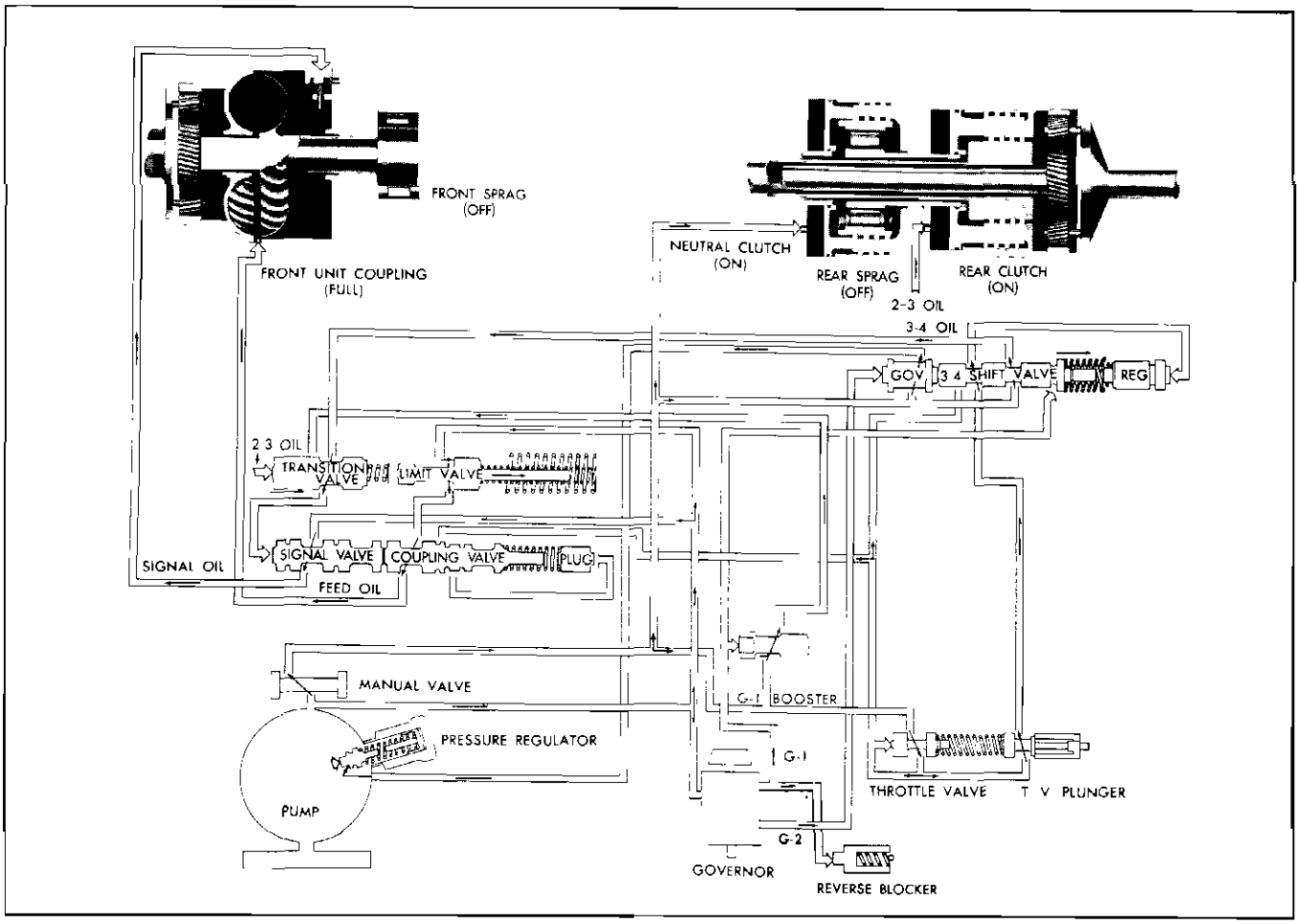

Fig. 35 Hydraulic Action During Part Throttle 4-3 Downshift

FRONT UNIT IN DIRECT DRIVE	REAR UNIT IN DIRECT DRIVE
COUPLING—FULL	REAR CLUTCH —ON
SPRAG —OFF	SPRAG —OFF
	NEUTRAL CLUTCH—ON

When operating at speeds below approximately 35 mph in fourth speed, depressing the accelerator part way to the floor causes TV pressure to be directed through a passage from the TV plunger against the 3-4 regulator plug. This TV pressure against the regulator plug overcomes governor pressure closing the 3-4 shift valve (Fig. 35). How far the accelerator must be depressed depends upon car speed. At 25 mph for instance the downshift is made with relatively little additional pedal travel while at 35 mph the accelerator will have to be depressed nearly to the floor. This downshift provides improved acceleration at lower speeds without the necessity of opening the throttle wide open.

The PE model uses TV oil to operate the detent valve to provide a better shift pattern for that engine.

The diagram indicates fourth speed prior to the downshift to third.

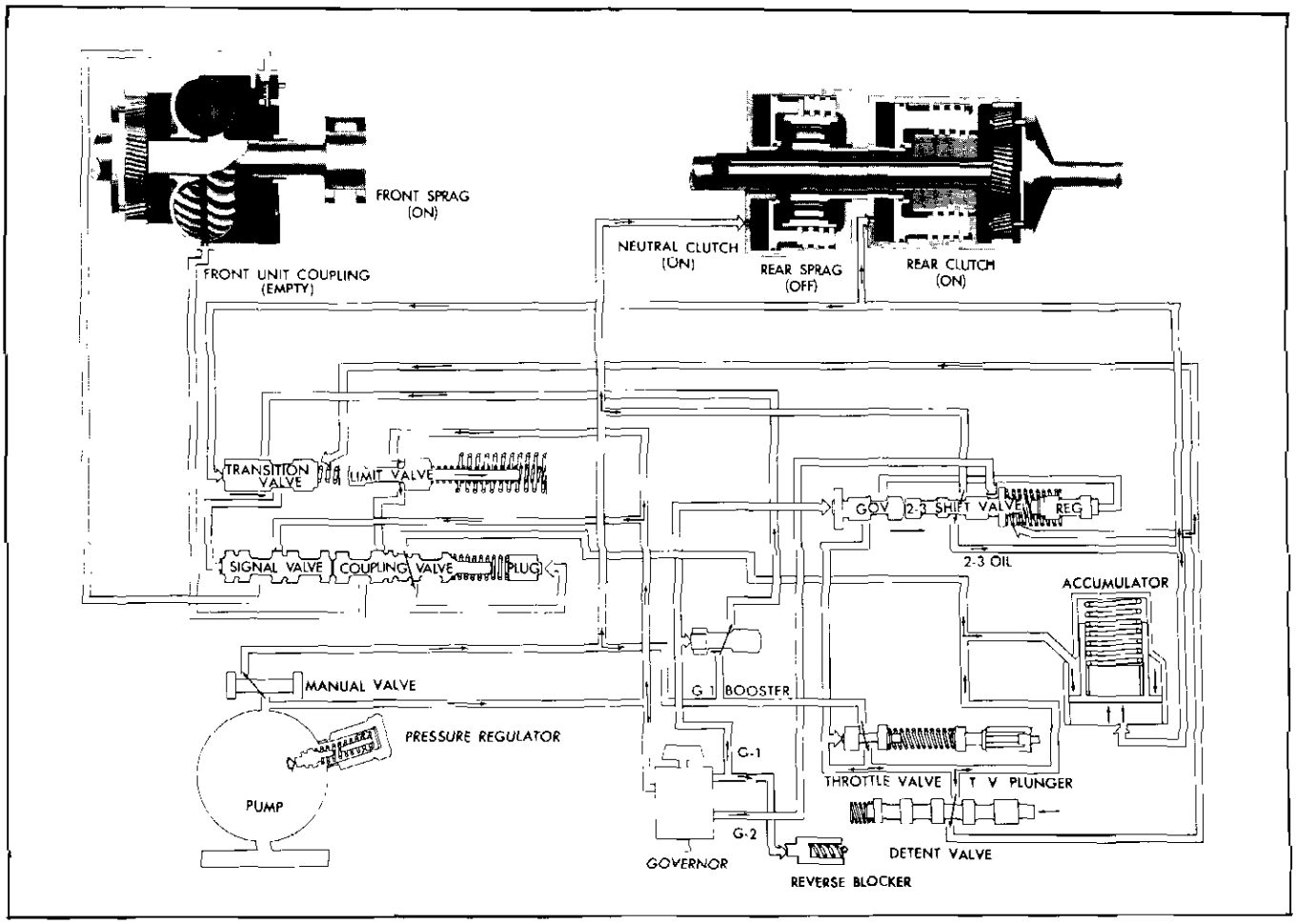

Fig. 36 Hydraulic Action During Forced 3-2 Downshift

FRONT UNIT	REAR UNIT
IN REDUCTION	IN DIRECT DRIVE
COUPLING—EMPTY	REAR CLUTCH —ON
SPRAG —ON	SPRAG —OFF
	NEUTRAL CLUTCH—ON

At car speeds below approximately 25 mph, it is possible to force the transmission to shift from third back into second for more rapid acceleration. This shift is obtained by depressing the accelerator pedal to the floor to open the detent valve.

When the detent valve is opened, TV pressure (which is equal to main line pressure at full throttle) passes the detent valve into the detent passage (Fig. 36). This pressure, referred to as detent oil, is directed to the back of the 2-3 shift valve to force it back to the closed position. At car speeds above approximately 25 mph, governor pressure is high enough to prevent this downshift.

TV pressure is also directed from the 2-3 shift valve to the transition valve. This pressure assures rapid movement of the transition valve to the left to allow governor boost pressure to quickly open the coupling and signal valves.

The diagram indicates third speed prior to the downshift to second.

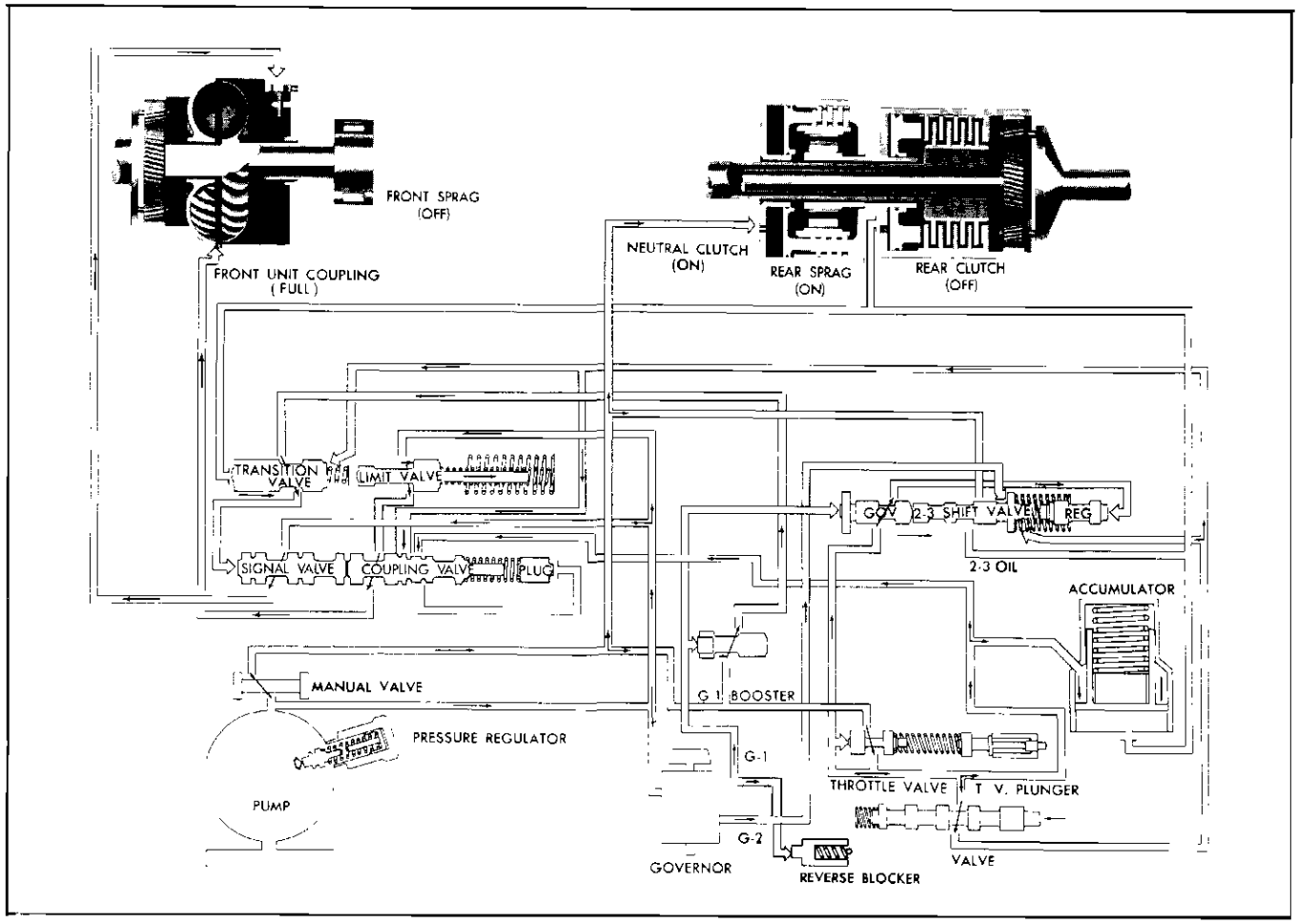

Fig. 37 Hydraulic Action During Forced 2-1 Downshift

FRONT UNIT	REAR UNIT
IN DIRECT DRIVE	IN REDUCTION
COUPLING—FULL	REAR CLUTCH —OFF
SPRAG —OFF	SPRAG —ON
	NEUTRAL CLUTCH—ON

At car speeds below approximately 5-7 mph, it is possible to force the transmission to shift from second back to first to prevent engine lugging and provide increased car speed, which is desirable for steep grades. This shift is obtained by depressing the accelerator pedal to the floor to open the detent valve.

When the detent valve is opened, TV pressure (which is equal to main line pressure at full throttle) passes the detent valve into the detent passage (Fig. 37). This pressure, referred to as detent oil is directed to the back of the coupling valve to force it back to the closed position. The opening of the direct drive circuit to fill the front unit coupling and disengaging the sprag. The transmission is now in first speed. At car speeds above approximately 5-7 mph, governor pressure is high enough to prevent this downshift.

The diagram indicates second speed prior to the downshift to first.

PERIODIC SERVICE RECOMMENDATIONS

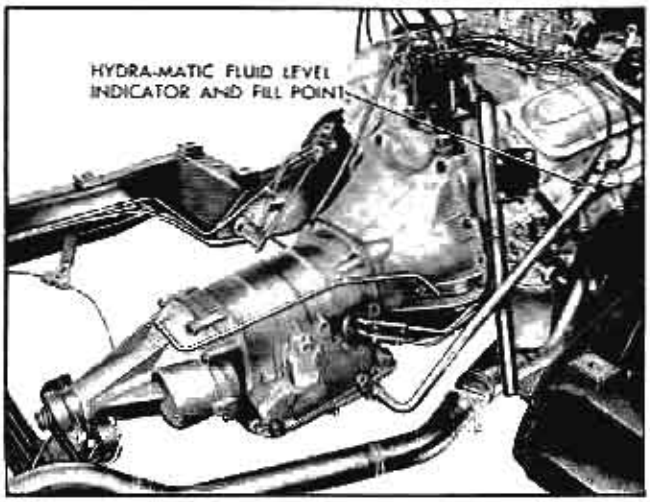

Fig. 38 Fluid Level Indicator

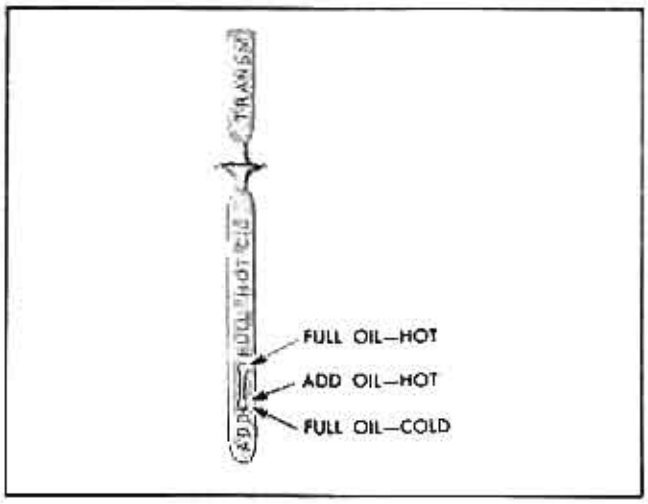

Fig. 39 Indicator Markings

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 38.

Since the 1961 transmission is sensitive to oil level, special precautions should be taken when checking the oil level otherwise valve buzz or shift malfunctions may be experienced.

FLUID LEVEL INDICATOR

The fluid level indicator is located in the filler pipe at the right rear corner of the engine (Fig. 38). To bring fluid level from lower mark to full mark requires 1 pint (Fig. 39).

NEW CAR AND 2000 MILE INSPECTIONS

New car and 2000 miles inspection should be performed as outlined on form S-6110, "Pontiac New Car Pre-Delivery and 2000 Mile Inspection and Adjustment." When road testing during both the new car and 2000 mile inspection and adjustment the following items are important:

1. Neutralizer switch should not start except in park and neutral (page 37).

2. Index pointer.

3. Fluid level should be to the FULL 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. 41).

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. 41).

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. 41) so that gauge pin is free

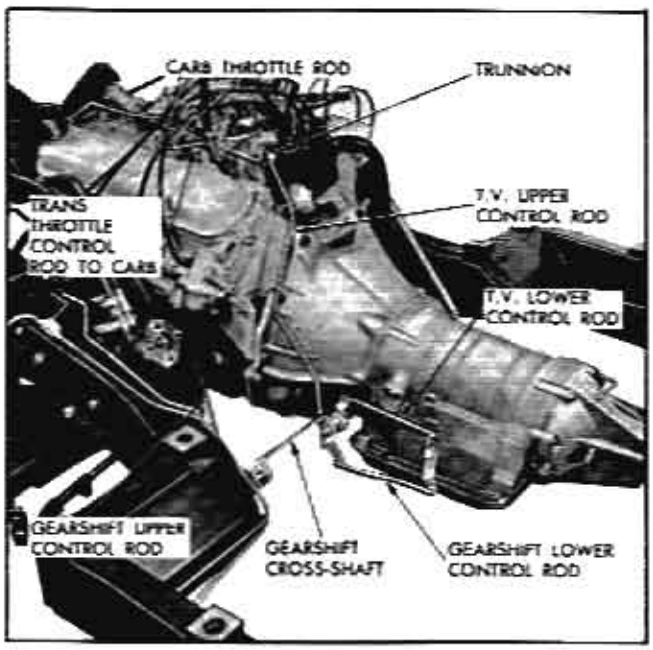

Fig. 40 Throttle Control Linkage

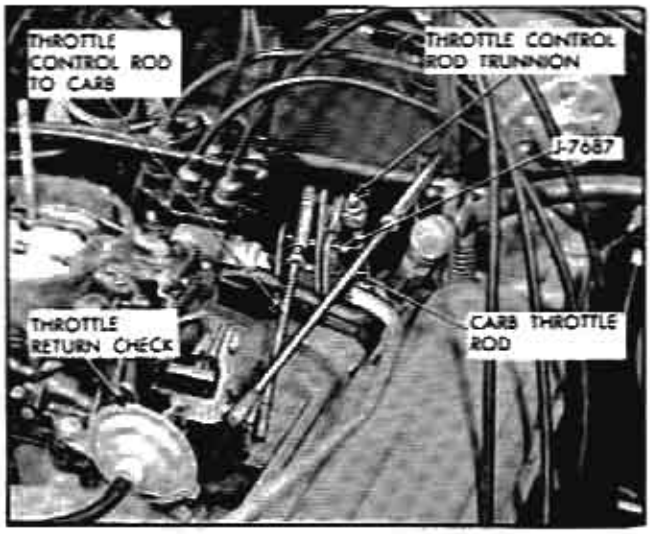

Fig. 41 Linkage Pin Installed

in hole. Leave pin installed and tighten lock nut securely. Recheck freeness of gauge pin in holes.

6. Push throttle control rod to transmission (T.V. upper rod) downward until the outer throttle lever is felt to touch end of travel (Fig. 40).

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

7. While holding throttle control rod to transmission in this position, tighten upper and lower trunnion lock nuts finger tight (Fig. 41). Shorten throttle control rod to transmission 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. 41).

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. 42. (App. 3¾" to carpet).

10. Tighten lock nut on carburetor throttle rod securely.

11. Install air cleaner.

12. After throttle linkage adjustment has been made, road test car and tailor adjustment as required

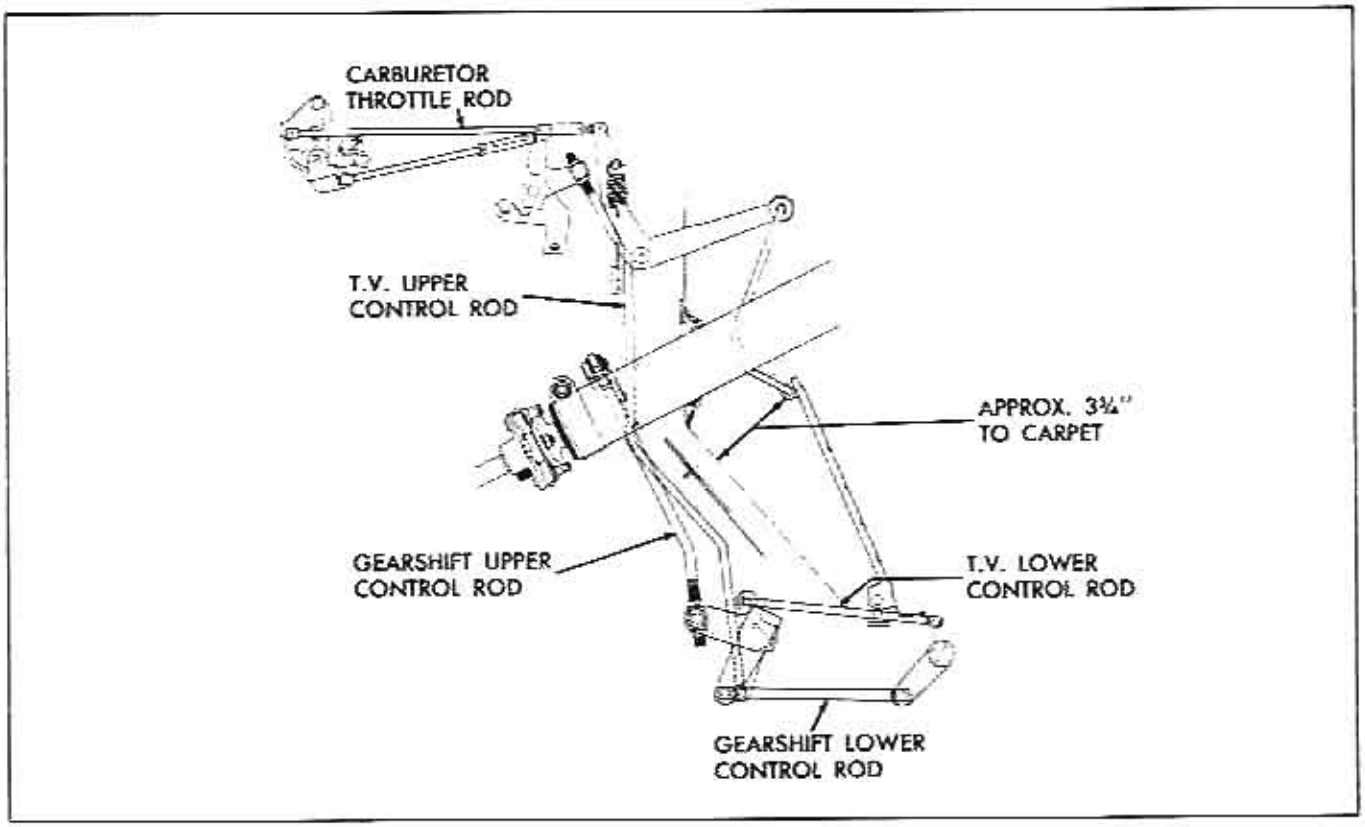

Fig. 42 Accelerator Linkage

by shortening or lengthening the throttle control rod to transmission (T.V. rod) one half turn at a time to obtain the best shift feel.

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. 40) 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 "right drive" 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.

ADJUST NEUTRALIZER SWITCH

1. Place selector lever in Neutral position.

2. Loosen switch mounting screw (Fig. 43).

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.

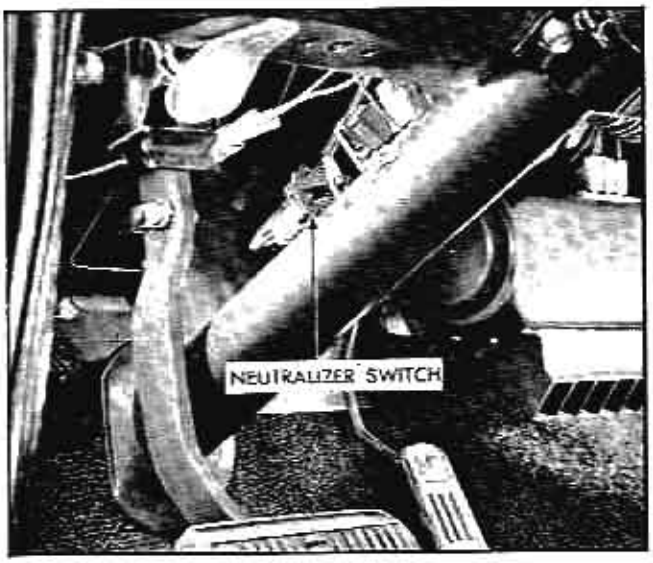

Fig. 43 Neutralizer Switch

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 "Removal of Units from Case" and "Installation of 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. 38) and note reading (Fig. 39). NOTE: When adding fluid use Automatic Transmission Fluid (Type A) from containers bearing Armour Institute qualification number "AQ-ATF".

Since the 1961 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.

FLUID CAPACITY, DRAINING AND REFILLING

CAPACITY

Approximately 10 quarts of fluid are required to refill transmission after torus cover and oil pan have been drained as outlined below. When unit has been disassembled and rebuilt, approximately 10½ 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 dropped and the oil intake strainer be replaced.

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

To drain oil proceed as follows:

1. Remove flywheel housing bottom cover.

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

3. Disconnect filler pipe from right side of oil pan. NOTE: Flushing of Hydra-Matic transmission is not recommended.

4. Remove oil pan and oil strainer. Discard strainer.

5. Thoroughly clean pan.

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

7. Affix new gasket to oil pan with petrolatum.

8. Install oil pan. Tighten attaching screws securely.

9. Connect filler pipe to oil pan. Tighten torus drain plug in flywheel to 6-7 lb. ft. torque using SIX-POINT SOCKET.

10. Install flywheel housing bottom cover.

11. Remove oil level indicator and wipe it clean.

12. Pour 8 quarts of Hydra-Matic fluid into transmission. BE SURE CONTAINER, SPOUT OR FUNNEL IS CLEAN.

13. Set selector lever in P position and apply hand brake. Run engine at speed equivalent to 20 mph for approximately 1½ minutes to fill fluid couping.

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

15. Add fluid to bring level to FULL mark on indicator.

16. With engine idling and transmission warm (approximately 150°F.) make final check to be certain transmission is filled to proper level. CAUTION: *Dot not overfill—foaming will result.*

17. Replace oil level indicator.

REPLACE REAR SEAL

1. 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 journals if tie wire is disconnected.

c. Slide propeller shaft rearwards off transmission output shaft.

2. Remove oil seal from housing with screwdriver.

3. Coat casing of new seal with gasket compound.

4. Position seal with lip facing forward, and drive it into housing with installer J-5154-A until it bottoms.

5. Wipe some oil on the drive shaft yoke and slide propeller shaft onto transmission output shaft.

6. Remove tape or rubber band from "U" joint bearings and assemble "U" joint. Bend nut locking plate.

REPLACE GOVERNOR

To replace a governor it will be necessary to disconnect the propeller shaft from the transmission and remove the rear bearing retainer.

1. Disconnect propeller shaft from transmission.

2. Disconnect speedometer cable from transmission.

3. Remove 2 rear mount support to crossmember nuts.

4. Place a jack under the transmission and raise the studs above the crossmember.

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

6. Remove the 2 bolts from each end of the frame crossmember and remove crossmember.

7. Lower rear of transmission and remove eight rear bearing retainer to reverse piston housing attaching screws and washers.

8. Remove breather pipe.

9. Withdraw rear bearing retainer and gasket and discard gasket. Tap retainer lightly, if necessary, to loosen.

10. Remove and replace governor.

11. Affix new gasket to reverse piston housing with petrolatum.

12. Pilot rear bearing retainer over end of output shaft and secure to reverse piston housing and case with eight attaching screws and washers.

13. Raise transmission and install frame crossmember. Attach with 2 attaching bolts at each end.

14. Lower transmission so studs in rear mount support enter holes in crossmember. Install nuts to studs.

15. Connect speedometer cable.

16. Install breather pipe.

17. Connect propeller shaft by sliding onto output shaft and assembling "U" joint.

REPLACE PARKING BRAKE LINKAGE AND INSIDE DETENT AND THROTTLE CONTROL LEVERS

The parking brake links, lever, bracket and lever spring can be replaced without disturbing the rear extension housing. After removing oil pan and screen, remove all control valve assembly attaching screws and allow valve body to hang (it will be retained where spacer plate extends under servo and accumulator assembly).

Letting the valve body hang allows the inside detent and throttle levers to be rotated as necessary to slide the parking brake bracket and spring off the shaft. It also provides clearance for removing the inside detent and throttle control lever.

When reassembling be sure to engage parking brake bracket properly in parking brake lever and detent lever, position throttle control lever between stop and stem of TV plunger and engage pin of detent lever in manual valve.

If parking pawl is to be replaced, it will also be necessary to remove the rear bearing retainer and reverse clutch housing, using the procedure for replacement of rear bearing, so that the reverse clutch housing can be removed to expose the parking pawl shaft for removal.

REPLACE CONTROL VALVE ASSEMBLY AND SERVO AND ACCUMULATOR ASSEMBLY

The servo and accumulator assembly can be removed without disturbing the control valve assembly. When removing the control valve assembly, however, it is first necessary to remove the servo and accumulator assembly.

REPLACE PRESSURE REGULATOR ASSEMBLY

When replacing the pressure regulator be sure to tighten it to 5 lb. ft. torque.

REMOVAL OF TRANSMISSION

The Hydra-Matic transmission, flywheel housing and torus assembly are removed as a unit.

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. Drain transmission by disconnecting filler pipe from right side of oil pan. The torus assembly can be drained at the same time or it can be drained after the transmission is removed from engine. To drain torus, remove flywheel housing bottom cover and remove hex head pipe plug from torus cover using **SIX-POINT** socket (never use twelve-point socket as this will damage head of soft pipe plug).

2. Disconnect oil cooler lines by either removing clamps and pulling hoses off pipes or by cutting the hoses.

3. Disconnect propeller shaft from transmission output shaft as follows:

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 bearing onto journals if tie wire has been removed to prevent loss of needle bearings when rear joint is disconnected.

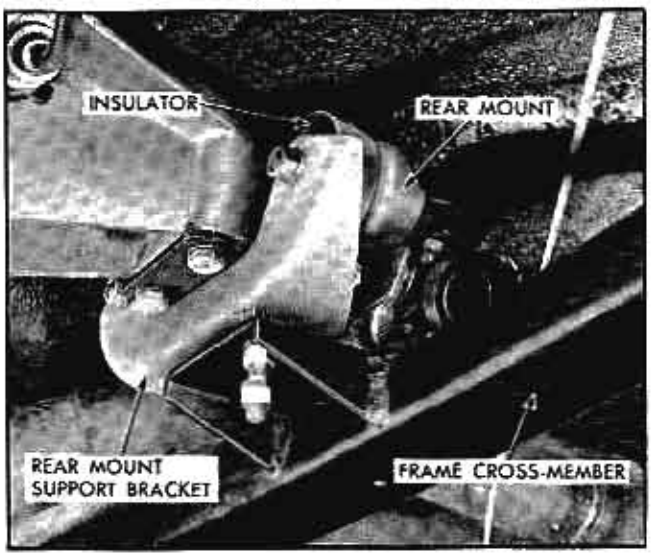

Fig. 44 Rear Mount Assembly

c. Remove complete drive line assembly by sliding rearward to disengage from splines on transmission output shaft.

4. Disconnect speedometer cable from speedometer driven gear.

5. Remove gearshift lower control rod.

6. Remove the two cross shaft bracket to frame attaching bolts and then remove the bracket, cross shaft lever, and bushing from transmission.

7. Remove lower end of T.V. upper control rod (engine to transmission idler lever).

8. Remove T.V. lever control rod.

9. Remove throttle idler lever.

10. Remove both starter cables.

11. Remove the starter and the splash shield by removing the two attaching bolts.

12. Remove flywheel housing bottom cover, if not previously removed.

13. Remove nuts from six torus cover and flywheel to flex plate attaching bolts.

14. Position special automatic transmission jack under transmission.

15. Remove two rear mount support to frame crossmember nuts (Fig. 44).

16. Remove the two bolts and retainers from each end of the frame crossmember.

17. Raise the transmission so rear mount support studs are clear of crossmember. Rotate crossmember slightly in frame and remove parking brake return spring and cable guide rod from frame crossmember.

18. Remove crossmember.

19. Lower transmission far enough so the flywheel housing to engine bolts can be removed with a long extension.

20. Work transmission rearward to disengage dowels from front flywheel housing, then lower transmission from car.

21. Remove insulators from rear mount and remove rear mount from transmission.

REMOVAL OF UNITS FROM CASE

CONTENTS OF THIS SECTION

Either holding fixture J-6115 or the new fixture J-8763, which is designed for the 3-speed transmission, may be used on the 4-speed transmission. Both fixtures fit in the same bench collet.

If the J-6115 is used, it will be attached to the transmission after the flywheel housing has been removed.

The J-8763 may be attached to the transmission and placed in the bench collet before disassembly is started. With transmission in horizontal position, oil pan down, insert lock handle through collet and fixture.

TORUS MEMBERS AND FLYWHEEL HOUSING

NOTE: These parts should be removed with transmission located horizontally in jack, on bench, or in holding fixture J-8763.

1. Remove oil cooler strap attaching bolt and strap (Fig. 45).

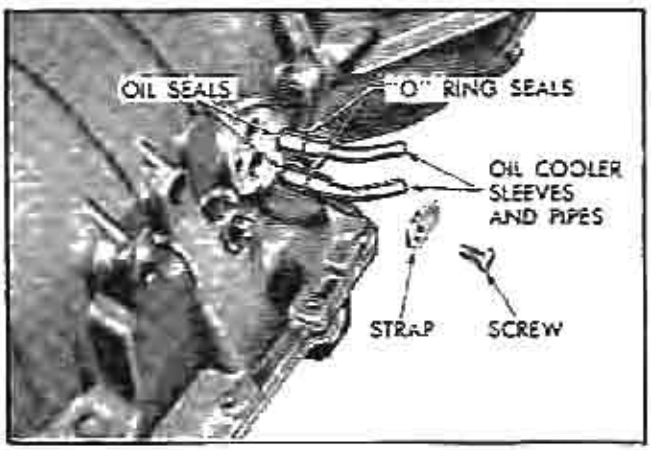

Fig. 45 Oil Cooler Sleeve and Seals

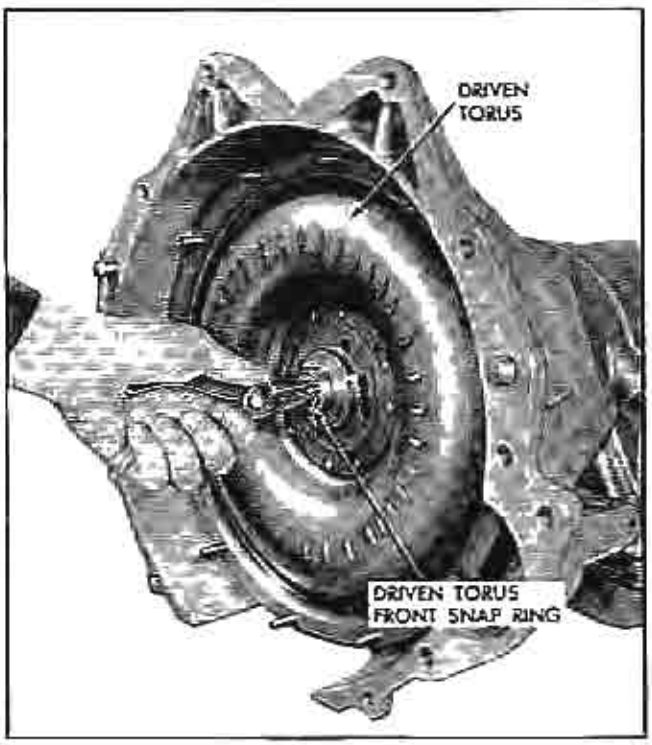

Fig. 46 Removing Driven Torus Front Snap Ring

2. Remove oil cooler sleeve assemblies, "O" rings, and sleeve seals. Snap ring pliers may be needed to remove sleeve seals.

3. Remove torus cover to flywheel attaching nuts and remove flywheel.

4. Remove large square sectioned seal from back of flywheel (torus cover to flywheel seal).

5. Using tool J-4880 (Fig. 46), remove Truarc snap ring from main shaft (snap ring which positions driven torus member).

6. Remove driven torus member from main shaft

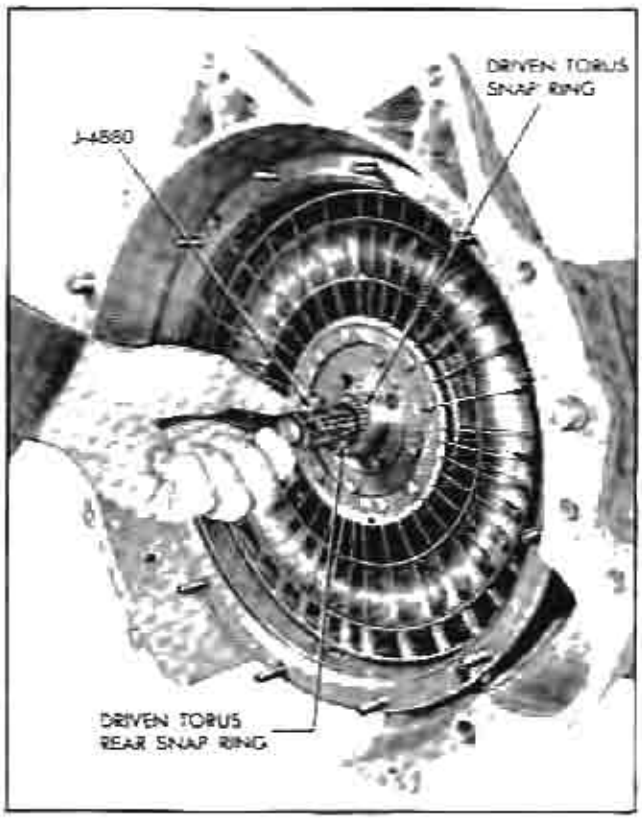

Fig. 47 Removing Driven Torus Rear Snap Ring

by sliding forward. NOTE: If torus member sticks, tap end of main shaft with soft hammer and at the same time pull out torus member.

7. Remove driven torus member rear snap ring from main shaft, using tool J-4880 (Fig. 47).

8. Remove drive torus member snap ring from intermediate shaft (Fig. 47).

9. Remove drive torus member. CAUTION: Do not attempt to remove drive torus and torus cover together.

10 Remove bronze thrust washer and steel selective spacer (front sun gear to torus hub) (Fig. 48).

11. Remove front unit sun gear from front coupling torus shaft.

12. Remove snap ring from front coupling driven torus shaft.

13. Withdraw front unit internal gear together with steel thrust washer, needle bearing and second (black) steel thrust washer.

14. Remove torus cover assembly by pulling out with even pressure.

15. Install seal protector J-6119 over intermediate shaft (Fig. 49).

16. Remove breather pipe and clip.

17. Remove six bolts holding flywheel housing to front end of transmission case.

18. Slide flywheel housing gently over seal protector away from case.

19 Remove seal protector J-6119.

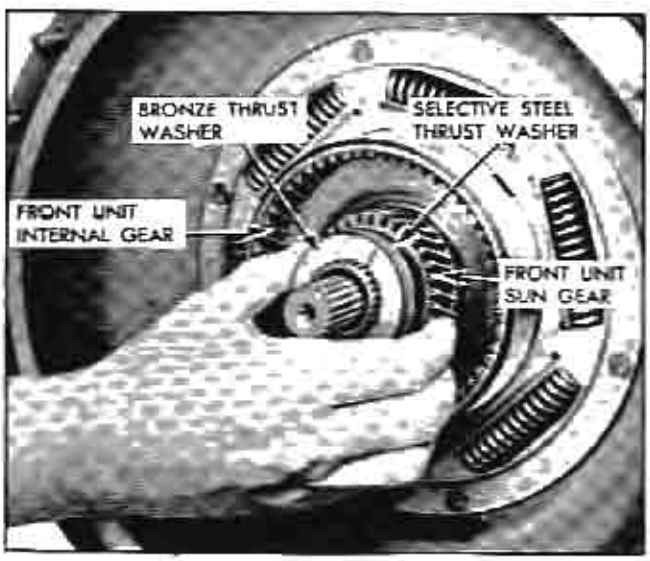

Fig. 48 Removing Sun Gear to Torus Hub Thrust Washers

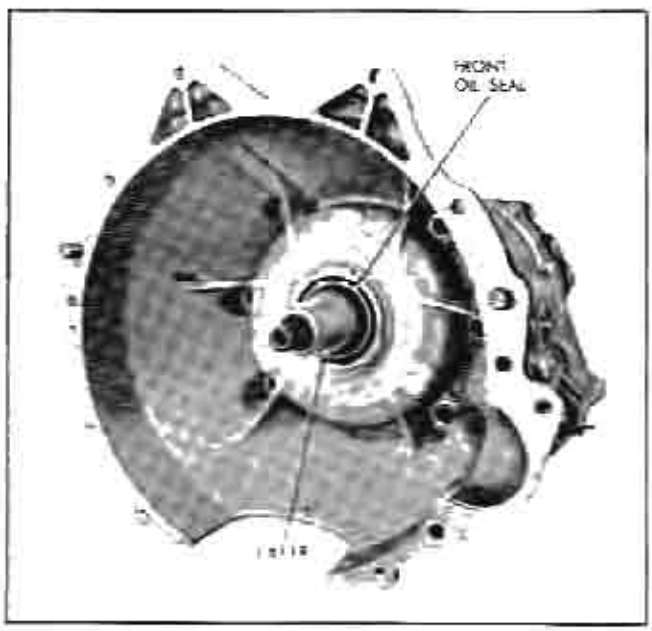

Fig. 49 Front Seal Protector in Place

20. Remove housing to case square sectioned seal from rear side of housing.

21. Remove front unit coupling assembly from case (Fig. 50).

Installation Page 87

INSTALL TRANSMISSION IN HOLDING FIXTURE

1. If holding fixture J-6115 is to be used:

a. Attach it to transmission case with supporting arm over transmission. Use flywheel housing attaching screws threaded through small holes in fixture.

b. Mount fixture in bench collet with transmission in horizontal position, oil pan up, and secure by inserting lock handle through collet and fixture.

2. If fixture J-8763 was attached and is in bench collet, rotate transmission so pan is up.

CHECK MAIN SHAFT END PLAY

1. Install collar of end play checking fixture J-6127 on intermediate shaft and secure in position by installing Truarc snap ring (Fig. 51). Attach fixture J-6127 to collar by threading collar securely into fixture.

2. Install dial indicator support J-6126.

3. Install J-8001 dial indicator (Fig. 52).

4. Move main shaft back and forth to check end play of main shaft. Be sure to get free main shaft end play. Forcing main shaft will give inaccurate reading.

5. Record amount of end play.

This mainshaft end play measurement will be used later to determine the proper rear unit selective thrust washer to use.

6. Remove dial indicator, support, and end play checking fixture.

OIL PAN, OIL STRAINER, AND INTAKE PIPE

1. Remove oil pan attaching screws.

2. Remove oil pan and gasket from transmission and discard gasket.

3. Loosen accumulator attaching bolt retaining the intake pipe clip. Pull oil strainer and intake pipe away from oil strainer attaching clip. Remove intake pipe and strainer from transmission (Fig. 53).

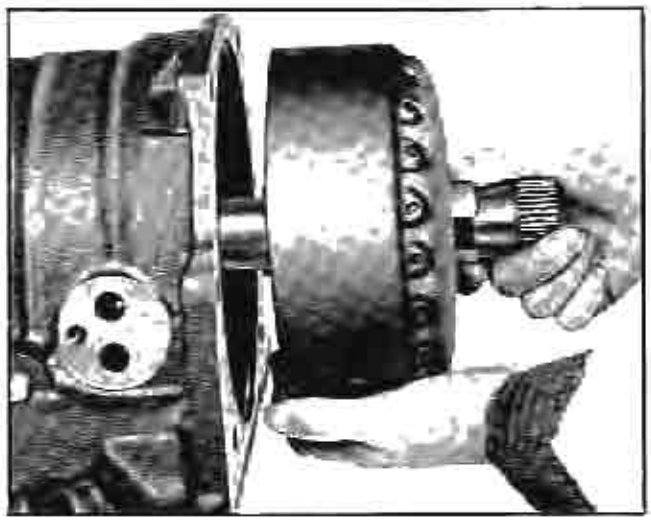

Fig. 50 Removing Front Unit Coupling

4. Withdraw intake pipe from strainer.

5. Remove "O" rings from pump and strainer, if replacement is necessary, and discard.

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SERVO AND ACCUMULATOR AND CONTROL VALVE

1. Remove two bolts holding accumulator and servo assembly to case. NOTE: There is some spring tension under the servo.

2. Remove servo and accumulator assembly.

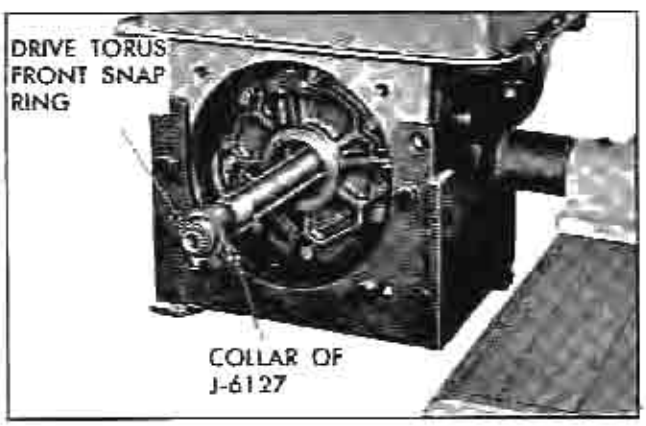

Fig. 51 Collar of Fixture J-6127 in Place Over Intermediate Shaft

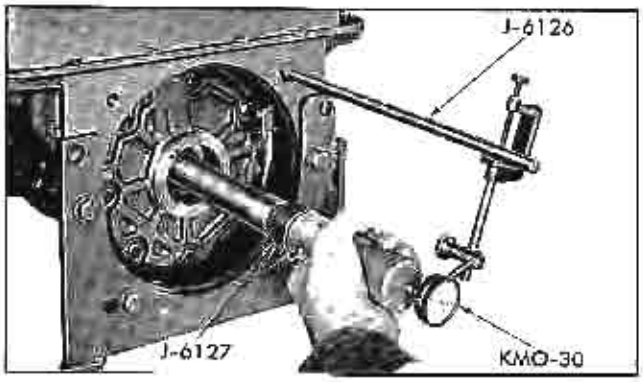

Fig. 52 Measuring Mainshaft End Play

3. Remove servo spring.

4. Remove five control valve assembly to case attaching bolts.

5. Remove control valve assembly from transmission and at same time carefully remove manual valve.

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PUMP AND OVERRUN CLUTCH

1. Remove pump locking screw (Fig. 54) from control valve case pad.

2. Remove pressure regulator plug assembly from side of case and withdraw regulator spring and valve using snap ring pliers.

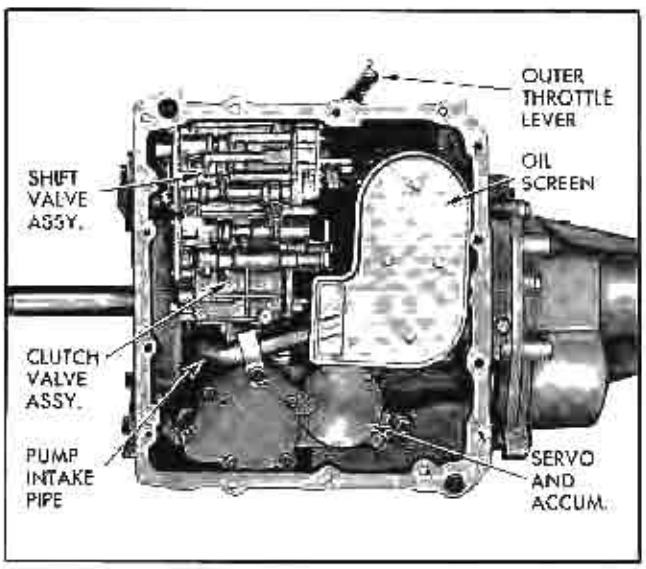

Fig. 53 Bottom View of Transmission with Oil Pan Removed

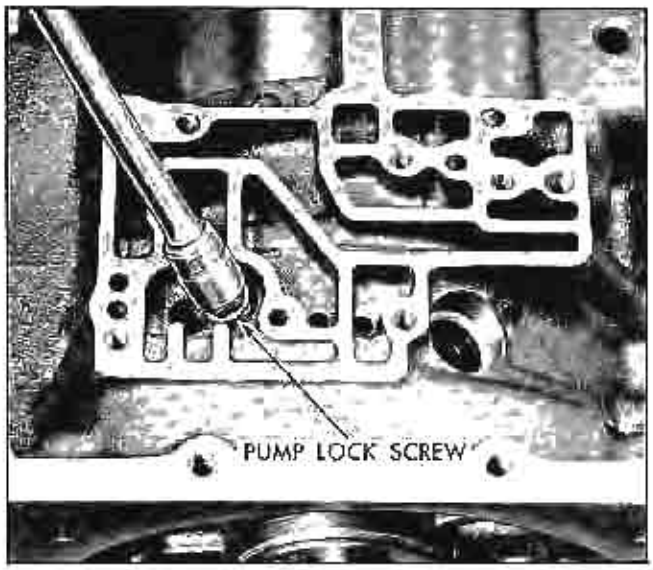

Fig. 54 Removing Front Pump Locking Screw

3. Remove three pump to case support washer head attaching screws (Fig. 55).

4. Withdraw pump assembly from case (Fig. 55), using pullers J-6125 if necessary. Two of the pump cover to pump body attaching screws must be removed to attach pullers.

5. Remove small "O" ring from rear clutch apply hole.

6. Remove overrun clutch release spring (Fig. 56).

NOTE: The spring may have remained in pump.

7. Remove front sprag inner race if it remained on the intermediate shaft.

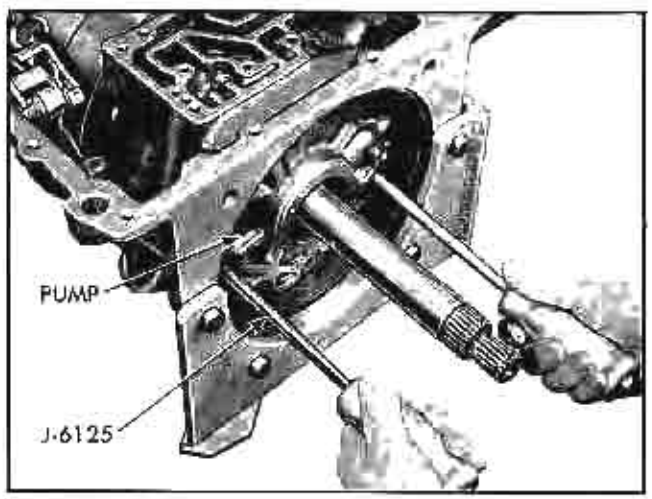

Fig. 55 Removing Pump

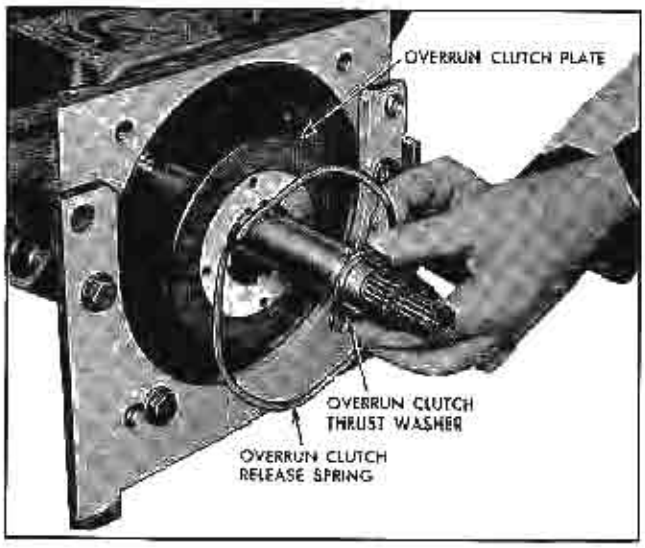

Fig. 56 Overrun Clutch Plate and Release Spring

8. Remove overrun clutch plate and bronze thrust washer (Fig. 56).

9. Back retainer screw out of retainer J-6135 so as not to score shaft, then slide retainer onto intermediate shaft against center case support and lock securely (Fig. 57).

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CASE SUPPORT, NEUTRAL CLUTCH, AND REAR UNIT

1. Remove speedometer driven gear from rear bearing retainer.

2. If rear oil seal is to be replaced, remove seal with screw driver.

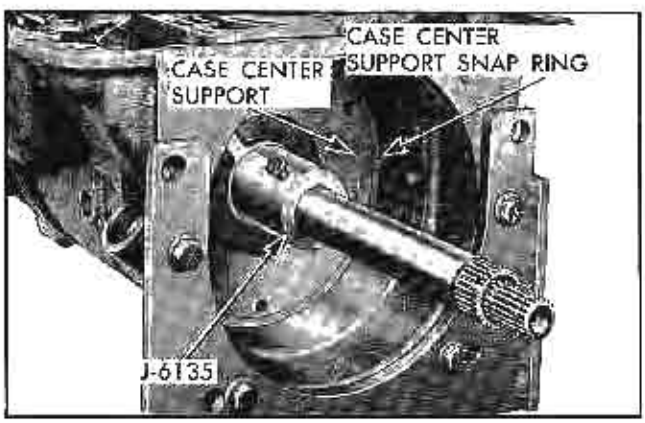

Fig. 57 Rear Unit Clutch Retainer in Position

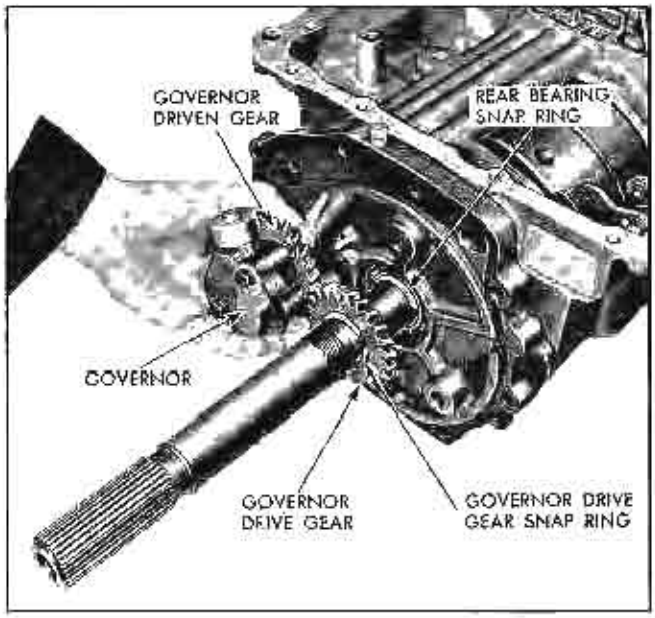

Fig. 58 Removing Governor from Reverse Piston Housing

3. Remove remaining rear bearing retainer to reverse clutch piston housing screws.

4. Remove rear bearing retainer and gasket and discard gasket. Tap housing toward rear to loosen.

5. Remove cylindrical screen from governor feed line.

6. Pull governor out of reverse clutch piston housing (Fig. 58).

7. Remove governor drive gear retaining snap ring, governor drive gear, drive gear key and second retaining snap ring. **NOTE**: Key may fall out when gear is removed.

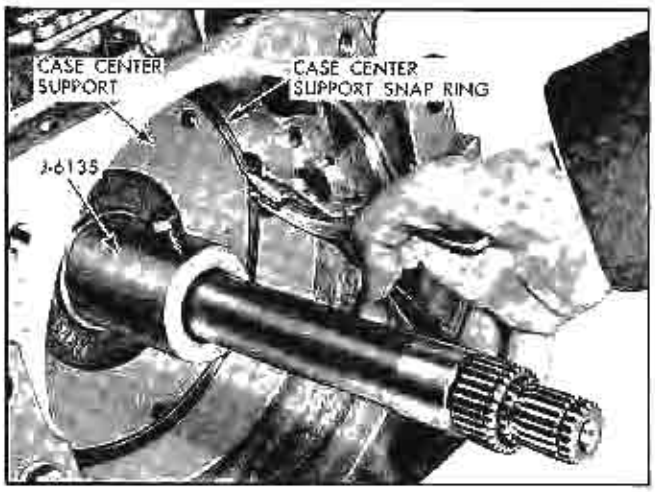

Fig. 59 Removing Case Center Support Snap Ring

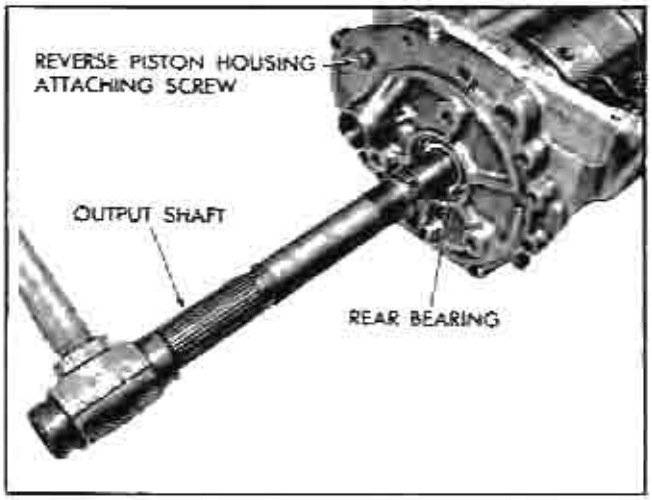

Fig. 60 Freeing Output Shaft

8. Remove rear bearing snap ring from output shaft (Fig. 58).

9. Remove center support to case snap ring, using screw driver (Fig. 59).

10. Tap rear end of output shaft with soft hammer to free shaft from rear bearing inner race (Fig. 60). Make sure parking brake pawl is not engaged.

11. Slide rear unit, neutral clutch, and case center support assembly out front end of case (Fig. 61).

12. Remove reverse clutch release spring (circular with 8 tangs) from output shaft (Fig. 62).

13. Remove reverse planet carrier from output shaft.

14. Rest rear unit, neutral clutch, and case support assembly in holding fixture J-6116, output shaft down (Fig. 63).

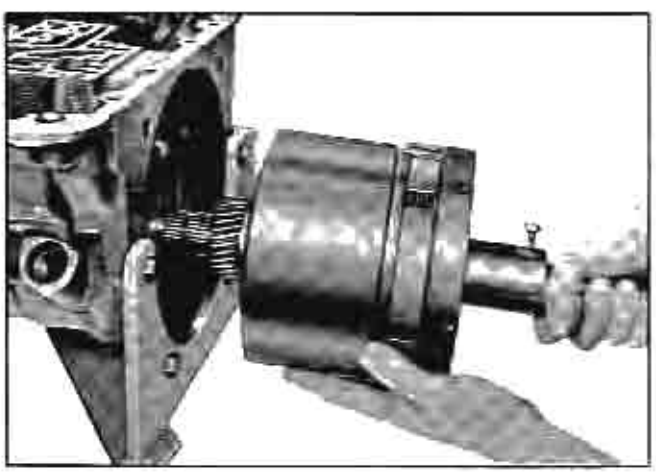

Fig. 61 Removing Rear Unit

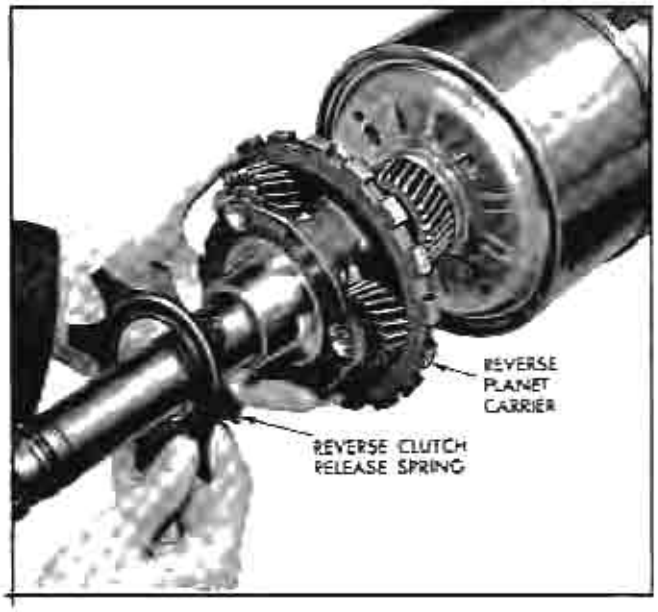

Fig. 62 Removing Reverse Planet Carrier

15. Remove neutral clutch drum locating key from transmission case (Fig. 66).

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REVERSE PARTS

1. Rotate transmission to vertical position so reverse piston housing is up.

2. Remove reverse clutch piston housing attaching screw and lift housing from case (Fig. 64).

3. Remove and discard gasket.

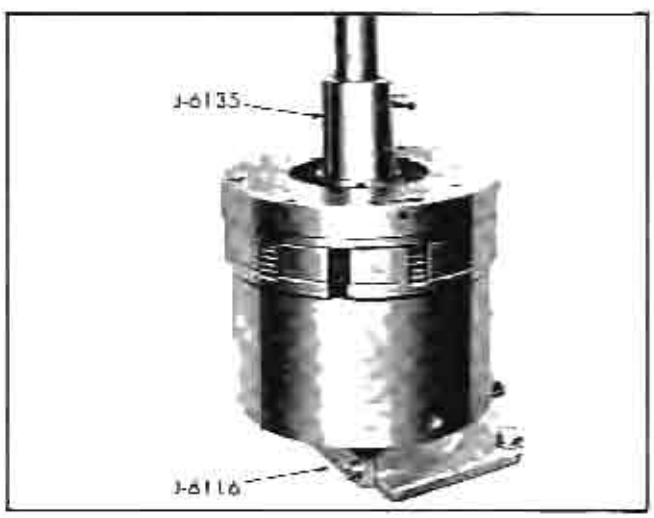

Fig. 63 Clutch Units Installed in Holding Fixture

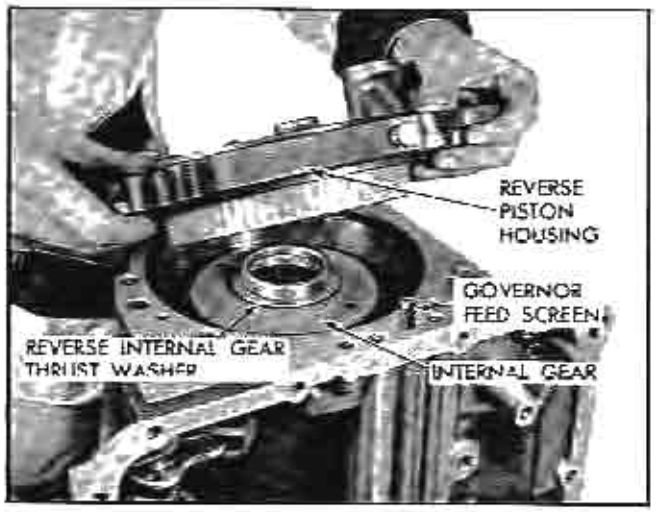

Fig. 64 Lifting Reverse Piston Housing from Case

4. Remove governor feed screen.

5. Remove reverse internal gear thrust washer and internal gear from case (Fig. 64).

6. Remove reverse stationary cone carefully from case, working it out gently with fingers. CAUTION: Stationary cone is very brittle, therefore, do not drive it from case with hammer or other tool.

7. Remove reverse stationary cone key. If key sticks, tap it out using $\frac{3}{8}$" brass rod through key hole in bottom of case.

8. Rotate transmission case to horizontal position.

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L (LOW) BAND

1. Unhook band end from anchor inside of case (Fig. 65).

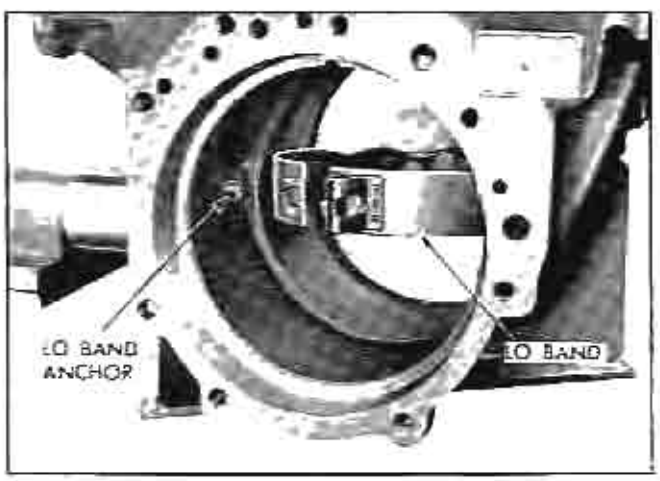

Fig. 65 Removing Lo Band

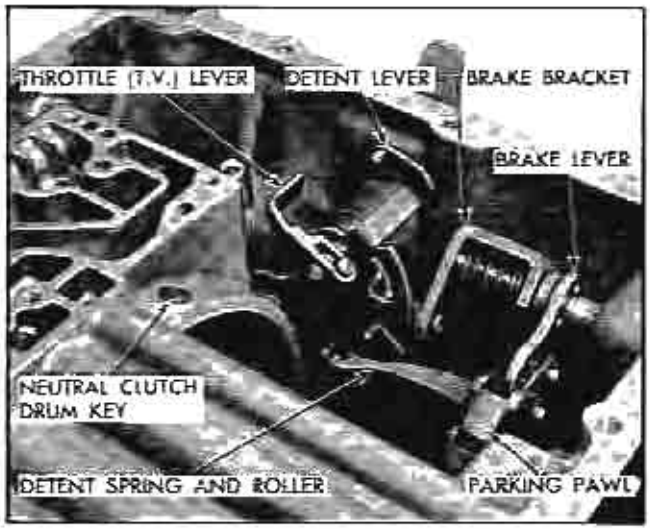

Fig. 66 Levers and Parking Linkage

2. With band unhooked, rotate it to horizontal position in case.

3. Turn band so that ends are facing rear of case (Fig. 65).

4. Pull band out front end of case.

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INSIDE DETENT AND THROTTLE LEVERS

These parts should not be removed unless they are to be replaced by new parts.

1. Loosen inner T.V. (throttle) lever to T.V. shaft clamp screw (Fig. 66).

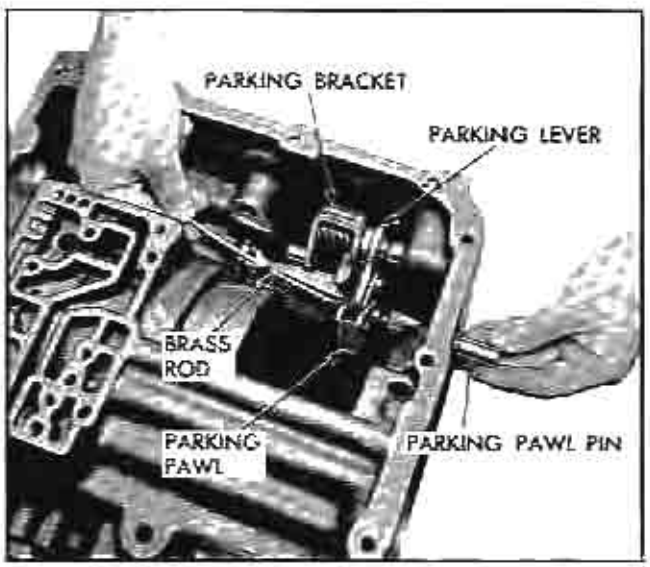

Fig. 67 Removing Parking Pawl

2. Remove inside T.V. lever. Withdraw outer T.V. lever, shaft, and "O" seal ring from case. Discard seal ring.

3. Loosen inside detent lever screw.

4. Withdraw outer shift lever, shaft, washer, and seal ring from case. Discard seal ring. Remove inside detent lever.

PARKING PAWL AND LINKAGE

These parts should not be removed unless they are to be replaced by new parts.

1. Remove parking pawl pin from transmission case by pushing on inside end of shaft with 1/8" brass rod (Fig. 67).

2. Remove parking pawl spacer washer from case.

3. Unhook parking bracket spring from parking lever.

4. Remove parking bracket and spring from parking brake pin.

5. Rotate parking lever and pawl and remove from parking brake pin.

DETENT SPRING AND ROLLER

1. Remove detent spring attaching bolt and detent spring assembly (Fig. 67).

DISASSEMBLY, INSPECTION AND ASSEMBLY OF INDIVIDUAL UNITS

CONTENTS OF THIS SECTION

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 101 and 102. Refer to these specifications when inspecting parts and replace only those that are worn, broken or damaged.

INSPECTION OF CASE, LO BAND, PARKING BRAKE LINKAGE, THROTTLE AND DETENT LEVERS

1. After the case has been thoroughly cleaned, blow out all passages in case (Fig. 69) with compressed air using blow gun J-8124-01.

2. Check for leaks or interconnections between passages using air pressure or smoke.

3. Carefully inspect case for cracks.

4. Make sure low band anchor is not worn excessively or is loose in case.

5. Inspect low band for burned, worn, cracked or loose lining. Band must not be distorted and band ends must be securely spot welded to band.

6. Inspect parking brake pawl to see that it is not worn or loose on its pivot shaft.

7. Inspect parking brake bracket for excessive looseness on its shaft.

8. Check connecting link between pawl and bracket to see that it is not worn excessively and does not bind. If difficulty has been reported in engaging or disengaging P (park) position, disassemble link and check for bent pins.

9. Inspect fit of throttle valve inner lever and shaft in hub of detent control inner lever. If shaft binds in hub, is excessively worn, or if oil seal is missing or damaged, replace defective parts.

10. Inspect oil cooler pipes and sleeves and rubber seals for damage which might cause leakage. Seals should be replaced if they have been damaged.

CASE SUPPORT, NEUTRAL CLUTCH AND REAR UNIT

DISASSEMBLY

1. Remove rear unit clutch retainer J-6135. CAUTION: Back off screw far enough to prevent damage to machined surface of intermediate shaft.

2. Remove hook-type oil ring from intermediate shaft (Fig. 70) by pushing one end toward center of shaft and other away to unhook.

3. Remove case center support and neutral clutch piston assembly from intermediate shaft (Fig. 71).

4. Remove two oil rings from case support hub and remove neutral clutch piston. Turn case support over and tap on bench to remove piston. Remove seals from piston and hub of case center support.

5. Remove neutral clutch drum assembly which contains five composition clutch plates, four steel clutch plates and five release springs (Fig. 71).

6. Remove large snap ring from rear drum with screwdriver (not the spiral ring on the sprag).

7. Lift rear clutch cylinder and sprag assembly over intermediate shaft (Fig. 72).

8. Remove intermediate shaft and clutch hub, including clutch hub thrust washer and backing washer from rear unit drum (Fig. 73). (The backing washer may have remained with the hub.) NOTE: The rear

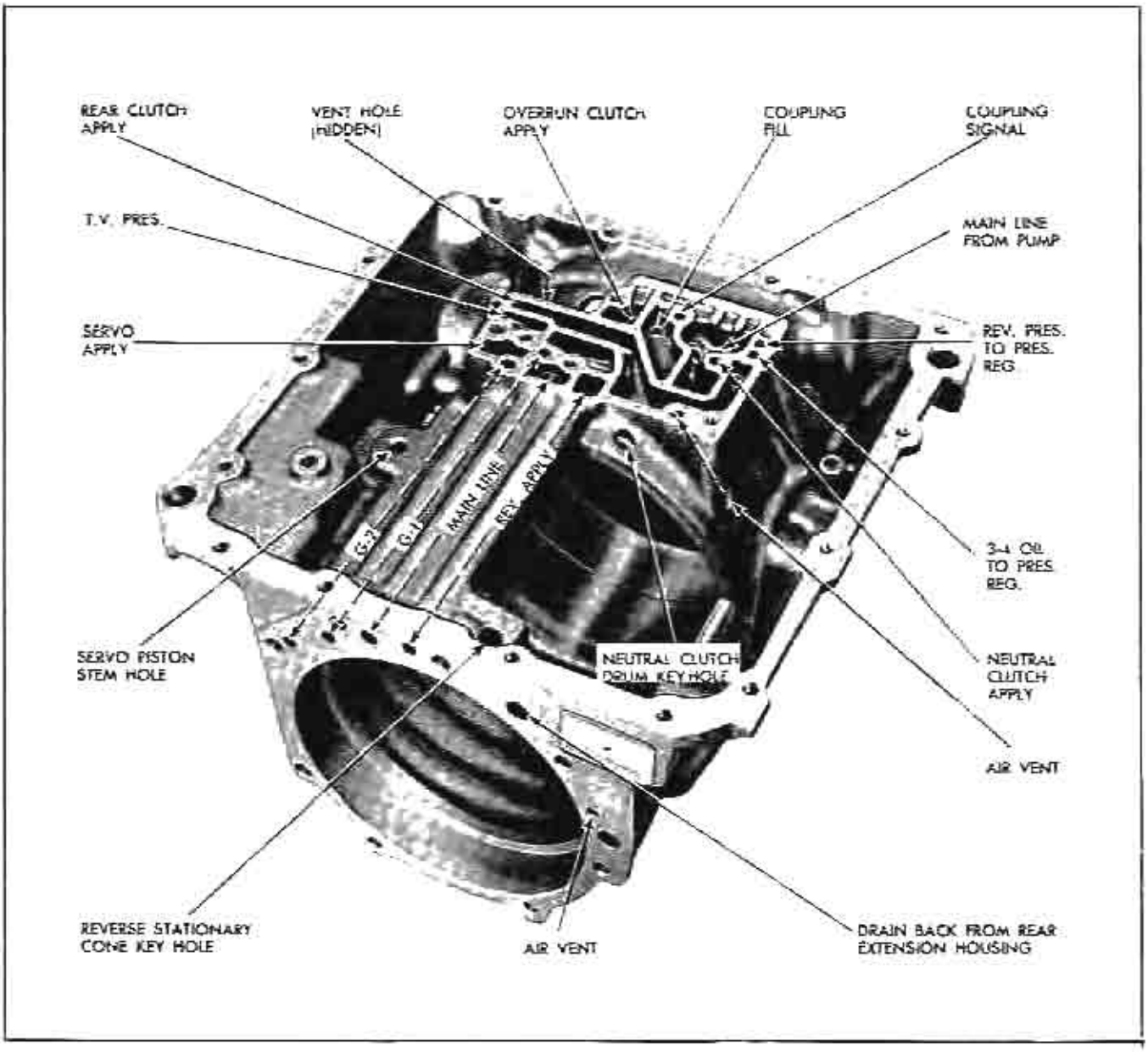

Fig. 68 Passages In Case

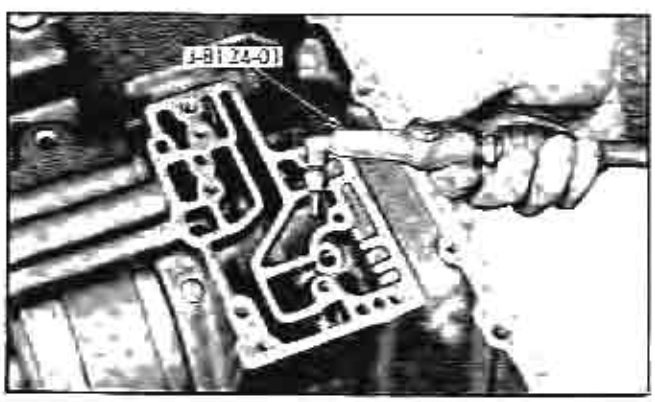

Fig. 69 Cleaning Passages In Case

clutch hub may be removed from the intermediate shaft, if replacement of shaft or hub is necessary, by removing snap ring retaining hub on shaft.

9. Remove clutch hub front thrust washer from clutch hub.

10. Remove main shaft and rear unit sun gear assembly from rear unit. Remove clutch hub thrust washer from sun gear. NOTE: The rear unit sun gear may be removed from main shaft if replacement of shaft or sun gear is necessary. Check for drill mark on rear face of sun gear since it must be assembled on main shaft with drill mark to rear.

11. Remove seven steel clutch plates and seven composition clutch plates.

12. Remove needle bearing and retainer from counterbore of output shaft.

13. Remove rear unit drum and output shaft assembly from holding fixture J-6116 and rest on bench with output shaft end up.

14. Remove large snap ring holding reverse drive flange in rear unit drum.

15. Lift output shaft and reverse drive flange assembly out of rear drum (Fig. 74).

16. If replacement of rear unit internal gear or clutch backing plate is necessary, remove internal gear and plate together from rear unit drum by tapping backing plate with soft hammer. NOTE: Mark internal gear so that upon reassembly balance will be maintained, if it is to be reinstalled, to ensure its reassembly in original position.

17. Remove snap ring from output shaft.

18. Remove reverse drive flange and sun gear assembly from output shaft.

19. Remove selective washer from reverse drive flange or output shaft.

20. Remove spiral snap ring from rear unit sprag outer race, using small needle nose pliers or small screwdriver to start if necessary (Fig. 75).

21. Remove outer race, sprag, and retainer by rotating counterclockwise and pulling upward (Fig. 76).

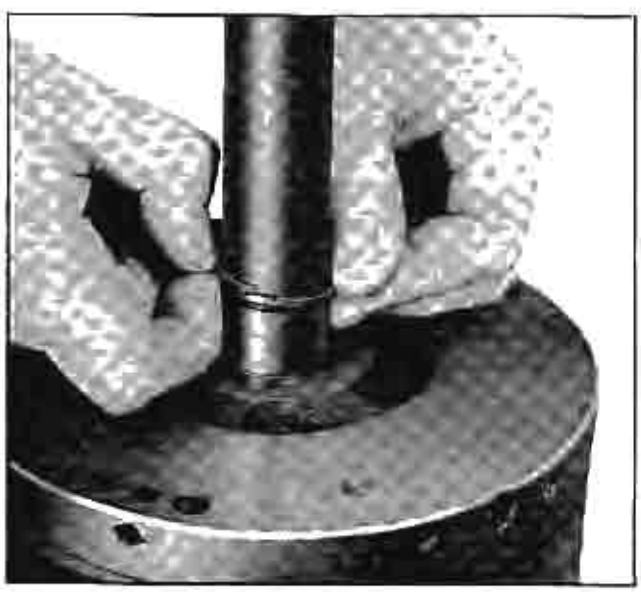

Fig. 70 Removing Oil Ring

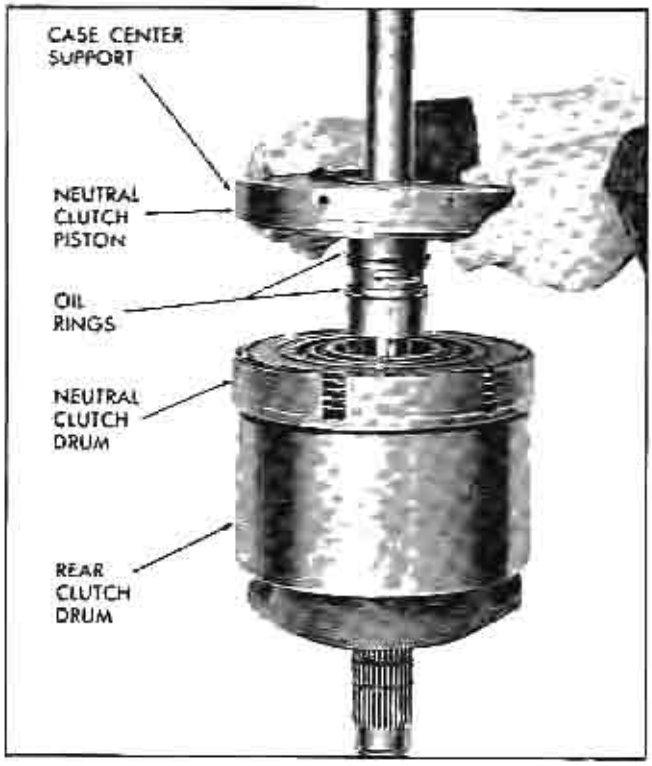

Fig. 71 Removing Case Support and Neutral Clutch Piston

22. Remove rear unit sprag retainer and sprag from outer race. NOTE: Do not disassemble sprag.

23. Disassemble rear unit clutch piston assembly as follows:

a. Place stud J-6129 on bench.

b. Lower cylinder and piston assembly over J-6129, spring end up. Set spring compressor J-4670 on top

Fig. 72 Removing Rear Clutch Cylinder and Sprag Assembly

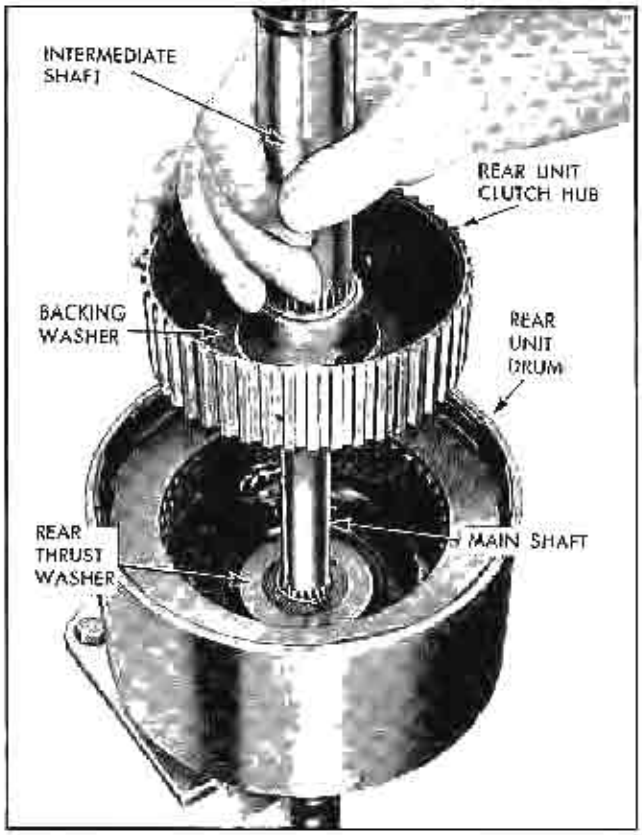

Fig. 73 Removing Clutch Hub

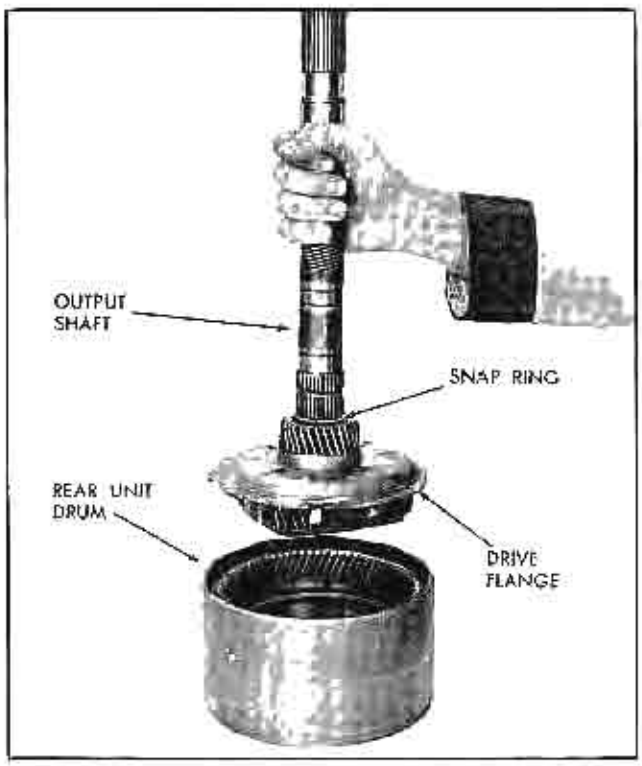

Fig. 74 Lifting Output Shaft and Drive Flange from Rear Unit Drum

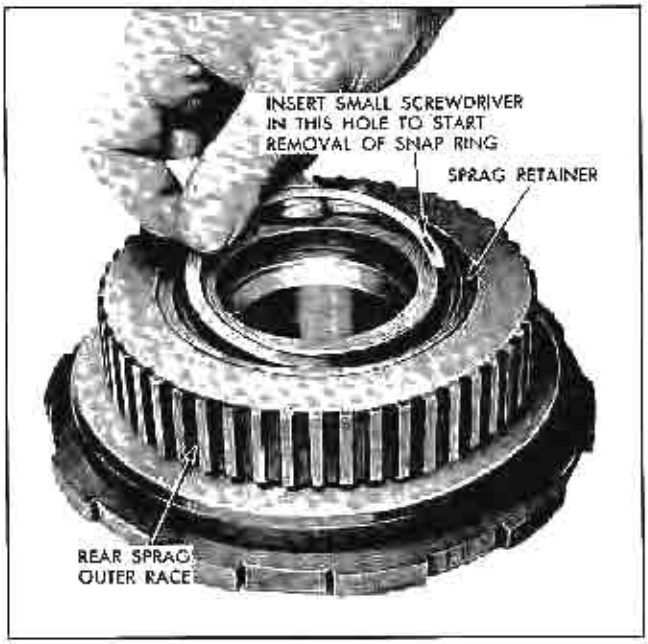

Fig. 75 Removing Retainer Snap Ring from Rear Unit Sprag Outer Race

of spring retainer and start nut on stud J-6129 (Fig. 77). **NOTE:** If compressor J-4670 has no hole in middle, drill a 7/16" hole so that stud J-6129 can be inserted through it.

c. Turn nut down on J-6129 to compress clutch springs until snap ring is free.

d. Remove snap ring (Fig. 77).

e. Remove compressor and release spring retainer from rear clutch springs.

f. Remove eight clutch release springs.

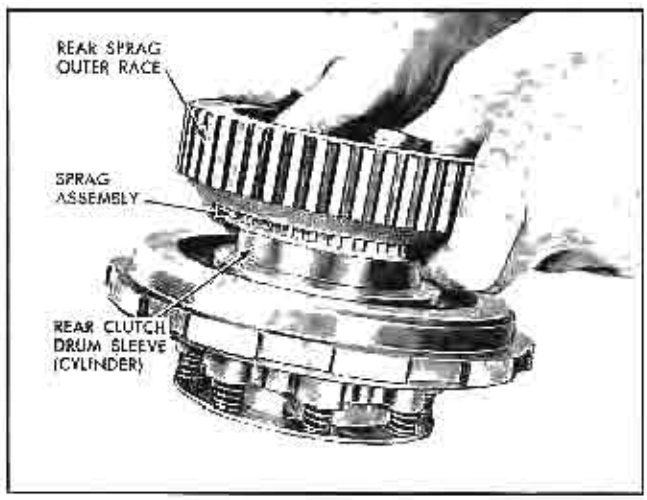

Fig. 76 Removing Rear Unit Sprag Assembly

g. Remove rear clutch piston from cylinder. Rap piston end of cylinder on wood block if necessary.

h. Remove seals from piston and hub.

INSPECTION

1. Inspect case center support for burrs, damaged oil seal grooves, worn or damaged bushing or damaged threads (Fig. 78). Using tag wire or air pressure check to ensure passages in support are open and not interconnected.

2. Inspect neutral clutch piston for scoring, burrs, or damaged oil seal groove.

3. Inspect five neutral clutch drive plates for damaged composition surfaces or worn teeth. Plates should be flat. If flakes of facing material can be removed by scratching surface with thumb nail, plates should be replaced. Discoloration does not indicate failure. Inspect release springs; eight waves should be evenly spaced and approximately 1/8" deep.

4. Inspect four steel neutral clutch driven plates for scored surfaces or damaged lugs. Six equally spaced waves should be approximately .010" deep.

5. Inspect neutral clutch drum for scored or damaged surfaces.

6. Inspect spiral snap ring for distortion or damage.

7. Inspect rear unit sprag retainer for scoring or damaged surfaces.

8. Inspect rear unit sprag for damaged shoulder, broken spring, or scored sprags.

9. Inspect rear unit sprag outer race for damaged splines or scored sprag race.

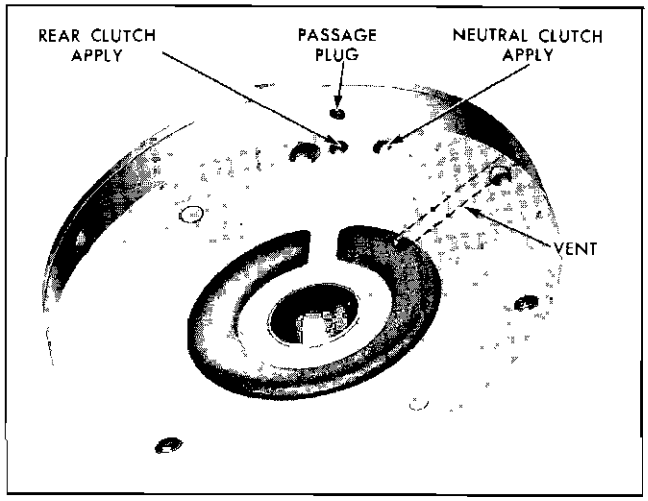

Fig. 78 Case Center Support Passages

10. Inspect rear clutch cylinder and bushing assembly for scoring, burrs or damaged lugs. Snap ring and oil seal grooves must be clean and smooth. Inspect drilled passage in cylinder with tag wire and compressed air to see that they are unobstructed (Fig. 79).

11. Inspect rear unit clutch pistons for scores, burrs or damaged seal groove.

12. Inspect eight rear clutch release springs for distortion or collapsed coils. See Page 101 for free length. NOTE: Slight wear "bright spots" on side of release springs, indicating slight contact with piston assembly, is permissible.

13. Inspect rear clutch release spring retainer for cracks or damage. Six raised spots on retainer keep snap ring in place.

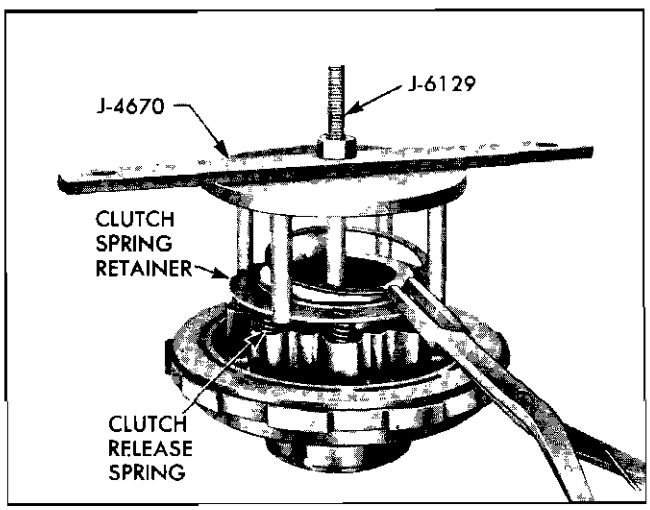

Fig. 77 Removing Rear Unit Clutch Spring Snap Ring

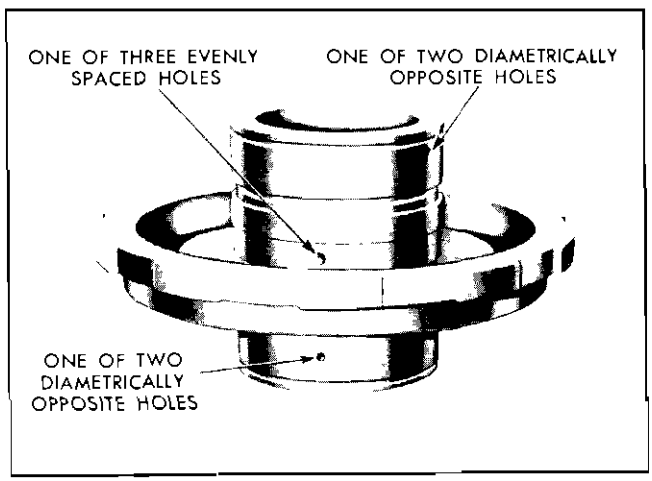

Fig. 79 Passages in Rear Cluch Drum Sleeve (Cylinder)

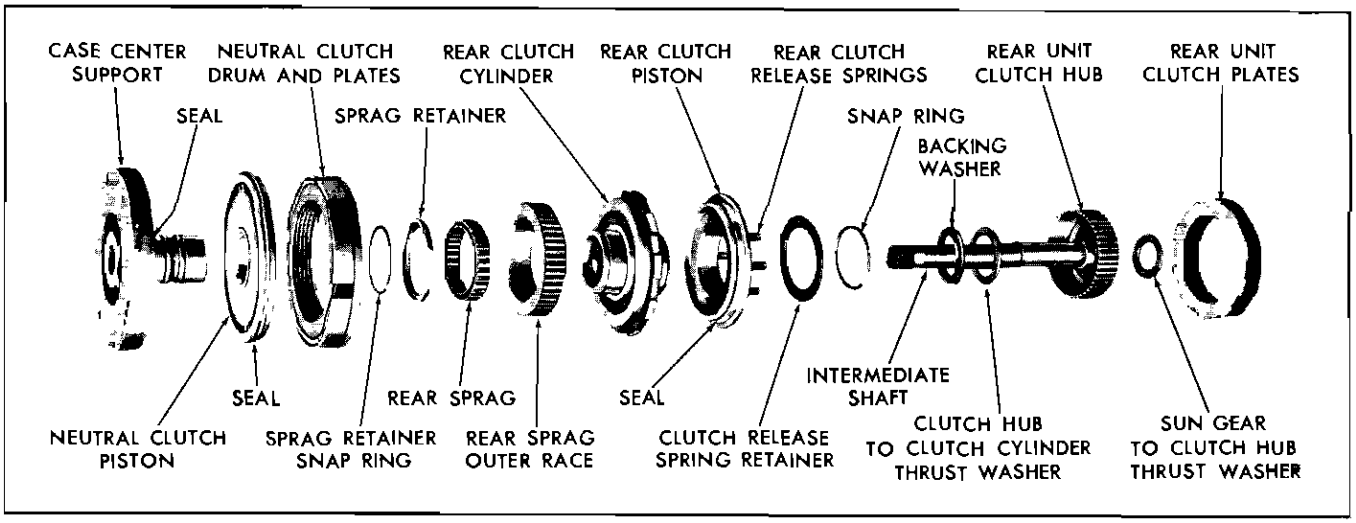

Fig. 80 Case Center Support, Neutral Clutch and Rear Unit Clutch Parts—Exploded

14. Inspect rear unit clutch cylinder to clutch hub thrust washer and backing washer.

15. Inspect intermediate shaft and rear unit clutch hub. Clutch hub and shaft can be separated if either part needs replacement.

16. Inspect rear unit sun gear to rear unit clutch hub bronze thrust washer.

17. Inspect seven rear unit composition faced clutch drive plates for damaged surfaces. Plates should be flat. If flakes of facing material can be removed by scratching surface with thumb nail, plates should be replaced. Discoloration is not an indication of failure.

18. Inspect seven rear unit steel driven plates for scored surfaces or damaged lugs. Driven plates must have six equally spaced waves (approximately .010" deep).

19. Inspect mainshaft and rear unit sun gear for damaged splines, teeth or bearing surfaces (Fig. 81). Gear and shaft can be separated if replacement is necessary. If shaft only is to be replaced, put old gear on new shaft with drill mark toward rear.

20. Measure end play of rear unit sun gear on mainshaft and determine correct selective washer to use in rear unit as follows:

a. Clamp sun gear and mainshaft assembly in holding fixture J-6116 using "C" clamp and dial indicator J-8001 (Fig. 82). Gear must be firmly clamped on both sides so it cannot give.

b. Set dial indicator stem to contact end of mainshaft.

c. Move mainshaft straight up and down to measure end play and record end play.

d. Subtract this end play from the mainshaft end play recorded before the transmission was disas-

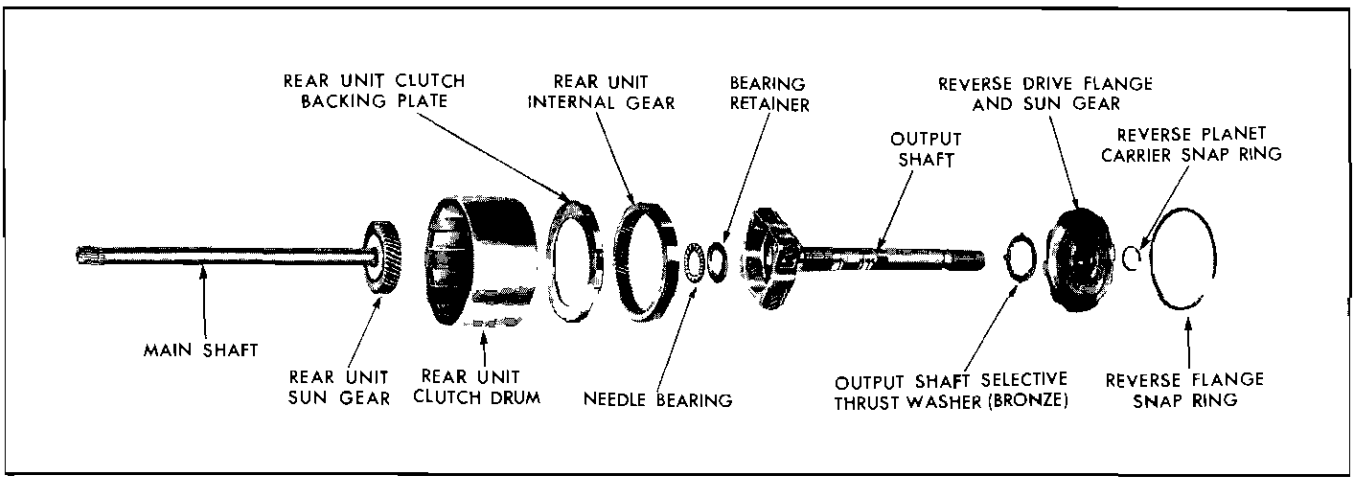

Fig. 81 Rear Unit Drum, Mainshaft and Output Shaft Parts—Exploded

sembled. The difference will be the actual end play of the rear unit and should be .004"-.013".

Example:

Mainshaft end play	.021"
Rear unit sun gear end play	.012"
Rear unit end play	.009"

If rear unit end play is outside the limits of .004"-.013", select the reverse drive flange to rear unit planet carrier thrust washer which will give the proper end play using the chart on page 85.

e. Remove sun gear and main shaft from holding fixture J-6119.

21. Inspect rear unit drum for scoring or cracks.

22. Inspect rear unit clutch backing plate for scoring.

23. Inspect rear unit internal gear for tooth damage. **NOTE:** Internal gear and clutch backing plate can be separated from drum if replacement is necessary. If drum or backing plate are replaced, the gear should be reinstalled with the same side toward the front. (The edges of the drive lugs of internal gear chamfered to facilitate assembly.)

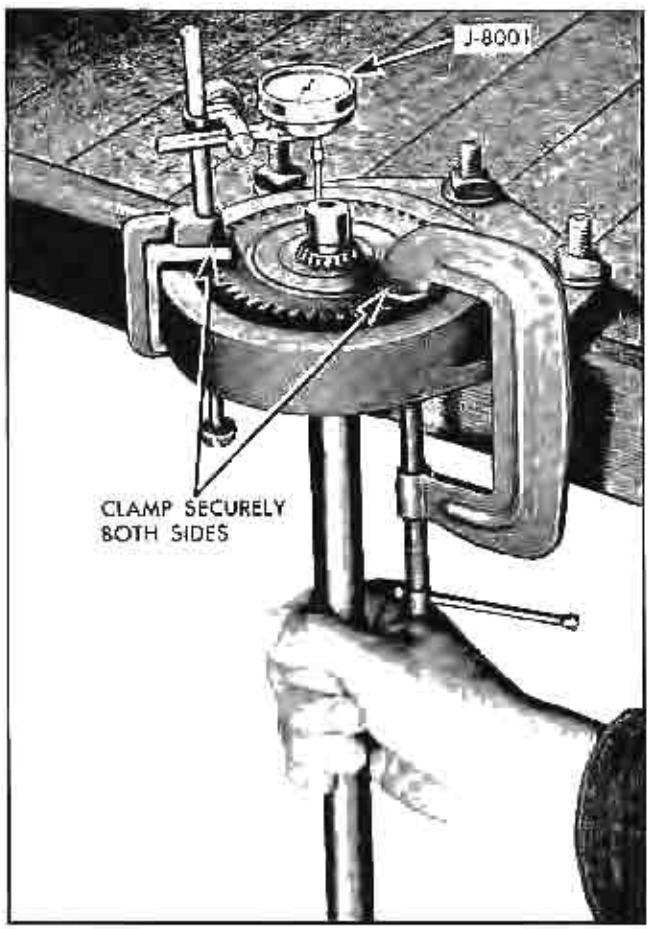

Fig. 82 Measuring End Play of Rear Unit Sun Gear on Mainshaft

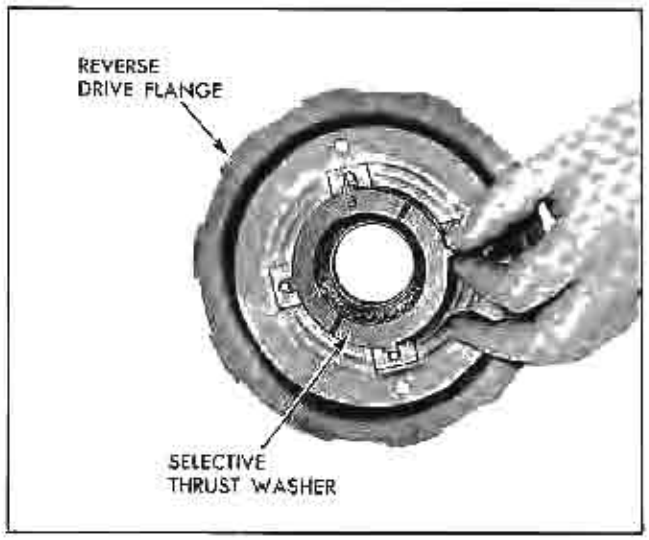

Fig. 83 Locating Selective Washer in Reverse Drive Flange

24. Inspect output shaft to rear unit sun gear bronze thrust washer.

25. Inspect output shaft for damaged pinions, splines, bearing surfaces or speedometer gear teeth.

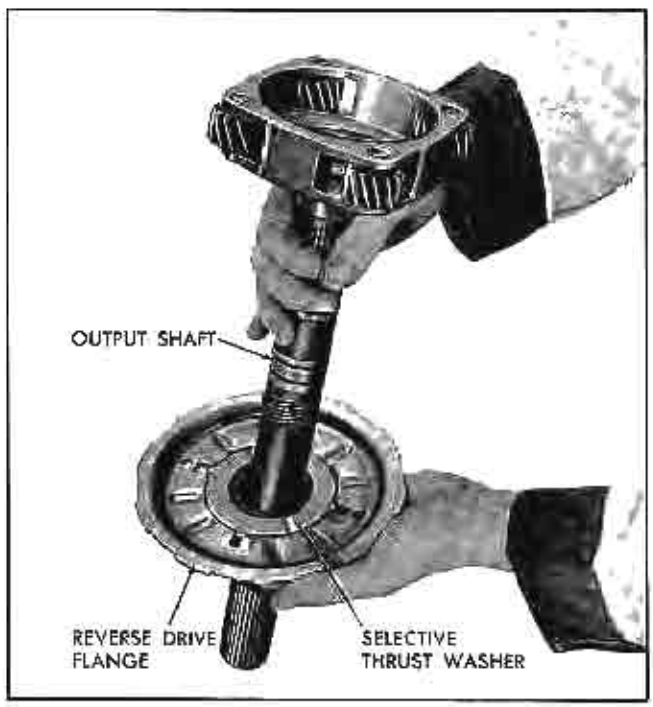

Fig. 84 Assembling Reverse Drive Flange to Output Shaft

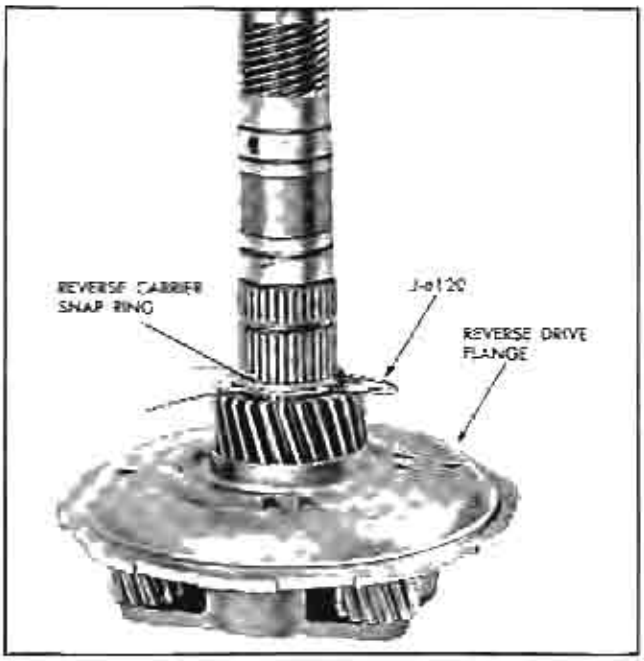

Fig. 85 Reverse Drive Flange Retainer Tool in Position

26. Inspect reverse drive flange and sun gear assembly. NOTE: Reverse drive flange and sun gear are serviced as an assembly and should not be separated.

27. Inspect rear unit selective thrust washer for wear or damage.

ASSEMBLY

1. Hold reverse drive flange and sun gear in left hand, drive flange up, and install proper selective thrust washer (as determined by rear unit end play check, page 54) in recess of drive flange. Use petro-

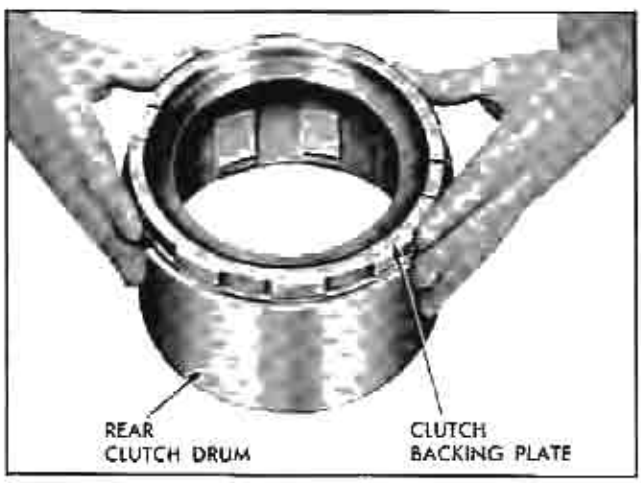

Fig. 86 Installing Rear Unit Clutch Backing Plate

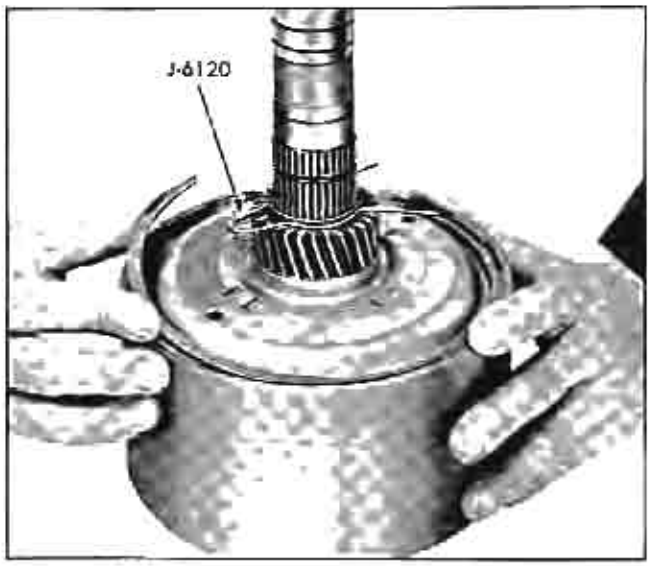

Fig. 87 Installing Output Shaft and Reverse Drive Flange Snap Ring

latum to hold washer in place and index lugs in flange (Fig. 83).

2. Still holding reverse drive flange and sun gear in left hand, insert output shaft with right hand through drive flange and sun gear until carrier bottoms on selective thrust washer (Fig. 84).

3. Holding drive flange and sun gear tightly against carrier to keep selective washer from moving, set output shaft and carrier on table on carrier end.

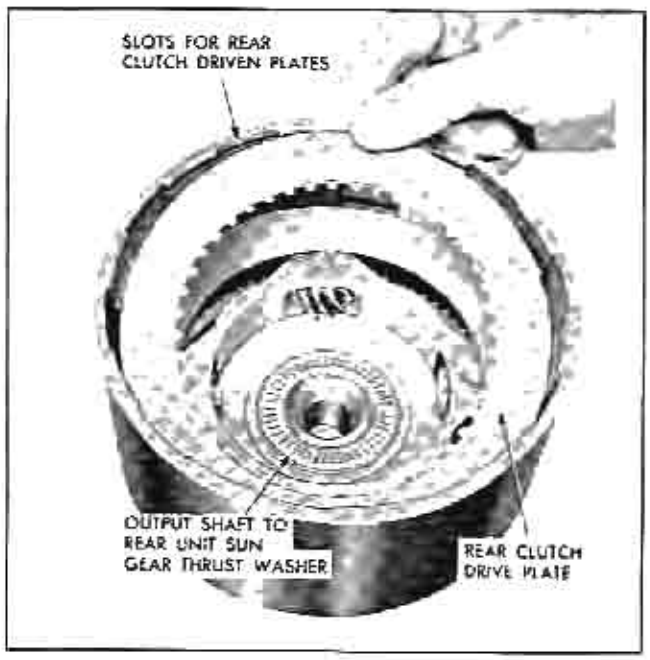

Fig. 88 Installing Rear Unit Clutch Plates

4. Install reverse planet carrier front snap ring on output shaft (Fig. 85).

5. Insert reverse drive flange retainer J-6120 between snap ring and flange snug against rear unit carrier to prevent selective washer from dropping out of position (Fig. 85). NOTE: When the selective washer used between the reverse drive flange and rear unit planet carrier is at or near the upper limit of thickness, retainer tool J-6120 cannot be inserted between snap ring and flange. In this case, however, it is not necessary to use the retainer since there is not enough clearance to allow the thrust washer to drop out of place.

6. Set rear unit drum on bench with long undercuts on lugs up (or with internal gear up if it was not removed) (Fig. 86).

7. Install clutch backing plate, flat surface down (Fig. 86). Align lugs of plate with slots of rear drum and tap plate, using soft hammer, into place against spline shoulder in drum.

8. Tap rear unit internal gear into place against clutch backing plate with soft hammer. NOTE: If internal gear previously removed is being installed, note mark made on gear at time of disassembly and align accordingly.

9. Install output shaft and reverse drive flange assembly in rear unit drum and secure with large snap ring (Fig. 87).

10. Rest rear unit assembly on holding fixture J-6116 with output shaft down. As unit is lowered, lift up on drum and remove retainer J-6120. CAUTION: Do not lift on output shaft after J-6120 is removed.

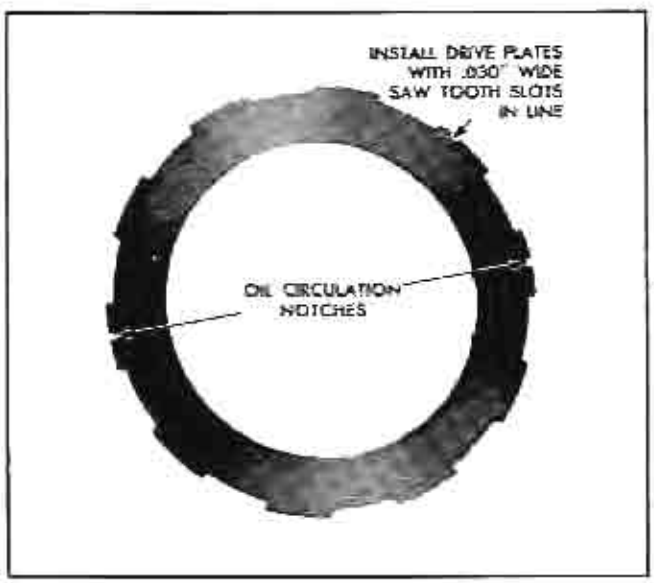

Fig. 89 Notches in Rear Unit Clutch Driven Plate

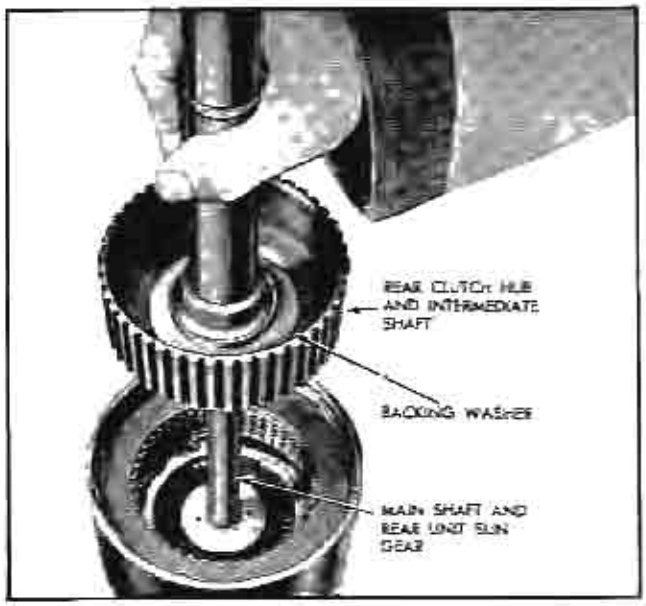

Fig. 90 Installing Intermediate Shaft and Clutch Hub into Plates

11. Position needle bearing and retainer in counterbore of output shaft and retain with petrolatum (Fig. 88).

12. Apply Hydra-Matic oil to faces of seven drive and seven driven plates, and alternately install them in rear unit drum. Start with drive (composition) plate and finish with driven (steel) plate. Assemble driven plates with lugs registering in rear unit drum slots (Fig. 88) and so .03" wide saw slots in driven plate lugs are all in line (Fig. 89). NOTE: Indexing the saw slots nests the plates together so that the

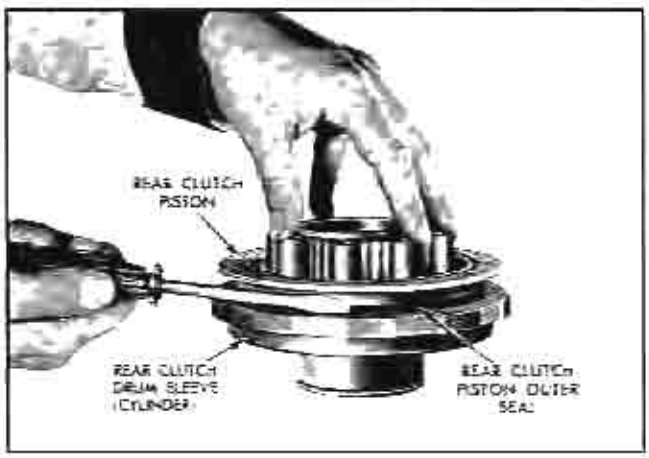

Fig. 91 Installing Rear Clutch Piston into Rear Clutch Drum Sleeve (Cylinder)

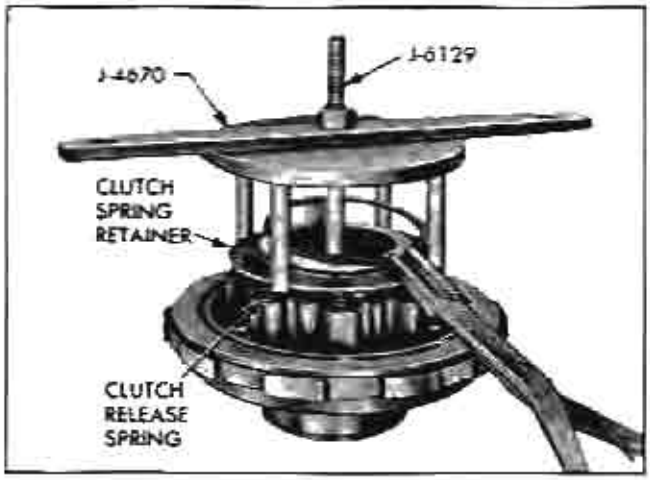

Fig. 92 Installing Rear Clutch Release Spring Retainer Snap Ring

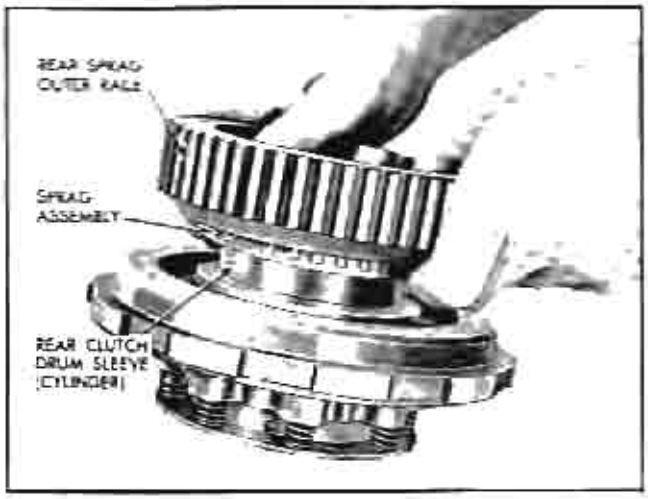

Fig. 94 Installing Sprag and Outer Race on Inner Race

waves are all in the same direction (no gaps between plates)

13. Install mainshaft and sun gear assembly into output shaft in rear unit, meshing sun gear with planet pinions of output shaft.

14. Assemble rear unit clutch hub to rear end of intermediate shaft if it was removed. Open side of hub goes toward front end of shaft on end with longest spline and long machined surface.

15. Apply petrolatum to two bronze thrust washers and backing washer and affix small diameter washer to rear side and large washer to front side of clutch hub (Fig. 90). Place backing washer, flange up, on the large thrust washer.

16. Lower intermediate shaft and clutch hub with thrust washers into rear drum (Fig. 90). NOTE: Pick up clutch drive plates by rotating intermediate shaft. Do not drive or force clutch hub into mesh with drive plates.

17. Install rear clutch piston in rear clutch cylinder as follows:

a. Install new inner seal on hub of clutch cylinder with lip down.

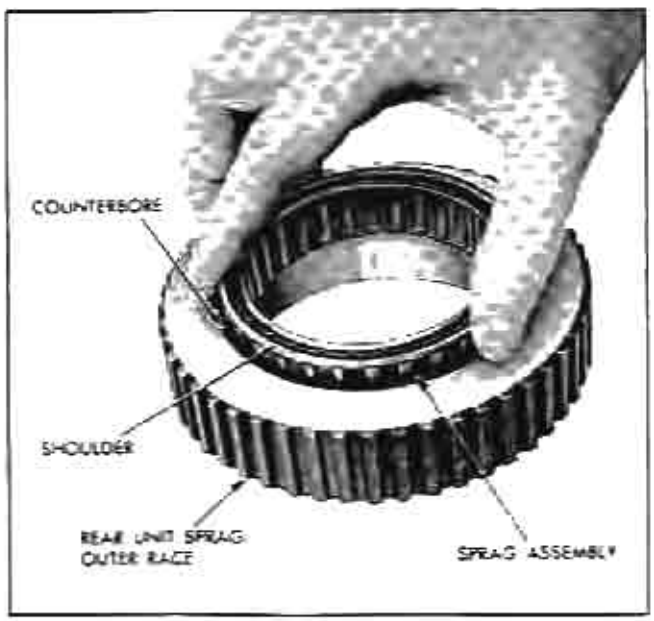

Fig. 93 Installing Rear Unit Sprag in Outer Race

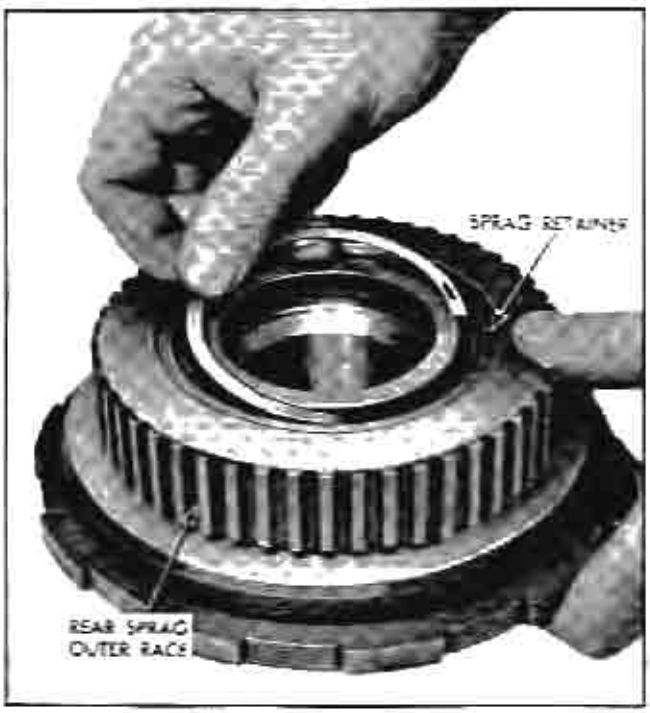

Fig. 95 Installing Rear Unit Sprag Retainer Snap Ring

b. Install new outer seal on piston with lip facing away from spring bore side (Fig. 91).

c. Start piston into cylinder using flat edge of screwdriver to compress seal (Fig. 91); then press piston into place.

d. Insert eight clutch release springs in bores of piston.

e. Place spring retainer on springs with tangs facing up. Compress springs using tools J-4670 and J-6129 (Fig. 92).

f. Install release spring retainer snap ring (Fig. 92). Remove compressor tools.

18. Install rear sprag in outer race with shoulder side of sprag on counterbored side of outer race (Fig. 93).

NOTE: The sprag must be installed in this manner or it will operate backward.

19. Lower sprag and outer race on rear unit inner race (rear clutch cylinder). NOTE: Push sprag part way down through outer race then rotate sprag counterclockwise to assist assembly (Fig. 94).

20. Install sprag retainer in rear unit outer race with large O.D. up. Push retainer down to expose snap ring groove.

21. Install spiral snap ring on rear sprag inner race (Fig. 95).

22. Apply petrolatum to clutch hub front thrust washer race and install, flange first, onto release spring side of cylinder.

23. Lower rear unit cylinder and sprag assembly over end of intermediate shaft and into rear clutch drum, sprag side up.

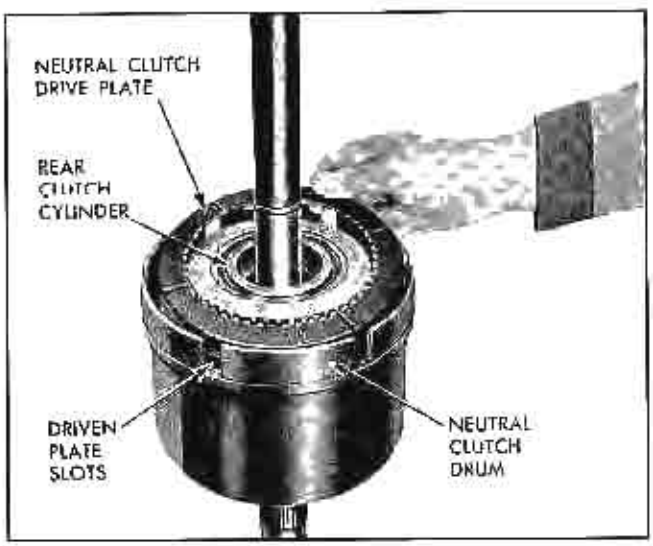

Fig. 96 Installing Neutral Clutch Plates

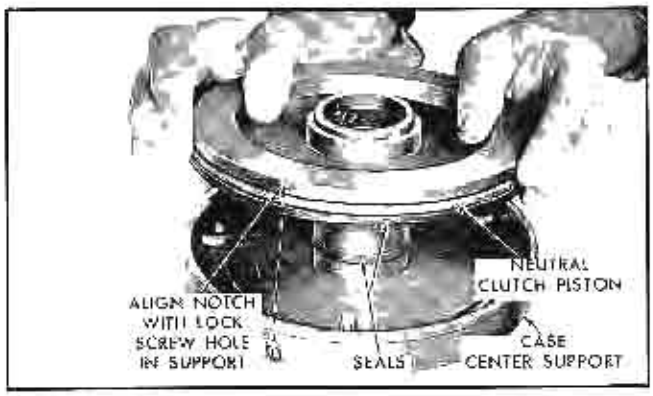

Fig. 97 Installing Neutral Clutch Piston

24. Secure cylinder and sprag assembly to rear unit drum with large snap ring.

25. Install neutral clutch drum on rear unit with driven clutch plate lug slots up (Fig. 96).

26. Apply Hydra-Matic oil to five clutch drive plates (composition) and four driven plates (steel) (Fig. 96). Install plates alternately using a release spring between steel plates. Start with composition plate and release spring then steel plate, etc. and end with composition plate and spring.

27. Install seal on hub of case center support with lip facing toward bottom of piston cavity.

28. Install seal on neutral clutch piston with lip facing side with dowel holes.

29. Pilot neutral clutch piston into case center support with notch in edge of piston aligned with lock screw hole in side of case center support (Fig. 96).

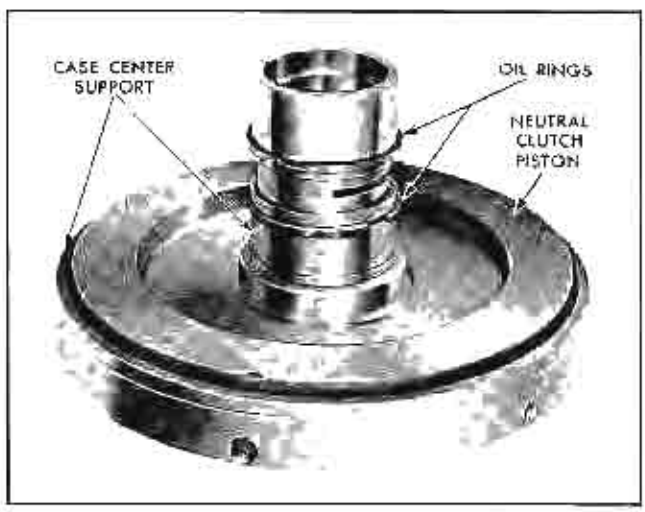

Fig. 98 Case Support Oil Rings in Place

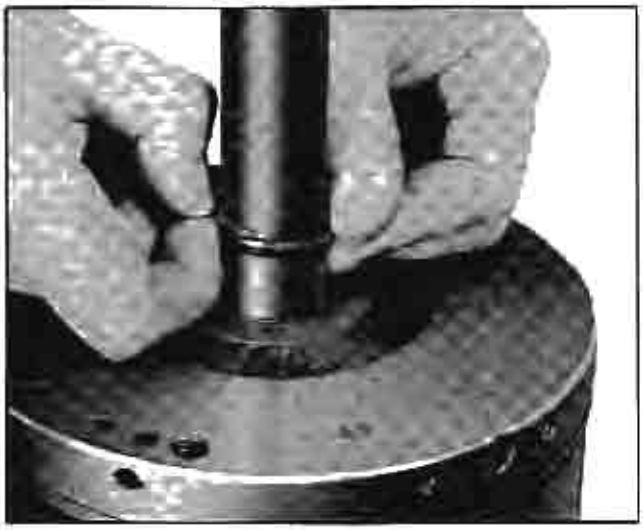

Fig. 99 Installing Hook Type Oil Ring on Intermediate Shaft

This alignment assures that dowels will enter dowel holes. Start seal into case center support by compressing with fingers.

30. Install two oil rings in ring grooves of case support hub (Fig. 98).

31. Center rings on hub and carefully lower case support assembly into rear clutch cylinder of rear unit so as not to damage bushing or break oil rings. If properly centered, oil rings on hub of case support will be compressed by taper in hub of rear clutch cylinder.

32. Install hook type oil seal ring on intermediate shaft (Fig. 99).

33. Slide clutch retainer J-6135 over end of intermediate shaft screw end up, apply pressure to compress clutch release springs, and tighten lock bolt (Fig. 100).

34. Rotate the case center support so that the right hand edge of cup plug in the center support is aligned with left edge of the first neutral clutch plate slot to the right of the neutral clutch drum key slot as illustrated (Fig. 100). CAUTION: This alignment must be accurate so as to ensure alignment of oil passage between pump and case when pump is installed.

35. Mark the rear drum to indicate the alignment of the neutral clutch drum key slot (Fig. 100).

Installation . . . Page 81

PUMP AND OVERRUN CLUTCH

DISASSEMBLY

1. Remove four pump cover to body attaching screws.

2. Lift pump cover from body. CAUTION: If cover sticks or hangs up on dowels, tap with soft hammer to remove. Do not pry between cover and body.

3. Using needle nose pliers, remove pin which holds torus feed valve retainer (place finger against retainer to prevent it from flying out). Remove retainer, spring and torus feed valve (Fig. 101). NOTE: If valve tends to stick, it may be removed after slide is removed.

4. Remove cooler check valve pin with needle nose pliers (while holding spring), and remove spring and ball (Fig. 102).

5. Remove pump rotor and top vane ring (vane

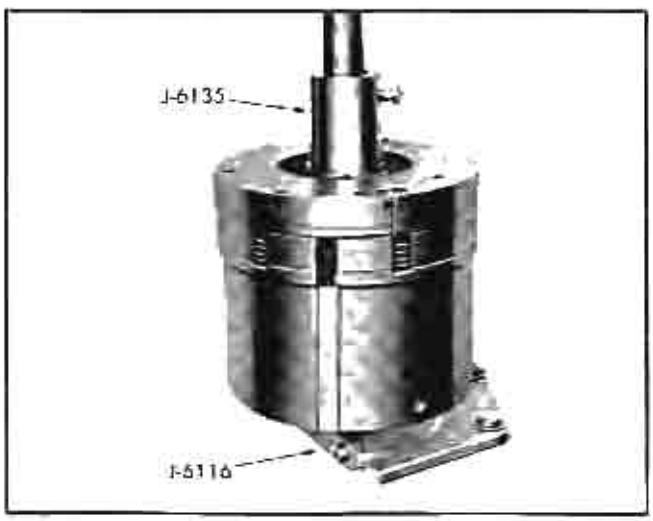

Fig. 100 Installing Rear Unit Clutch Retainer

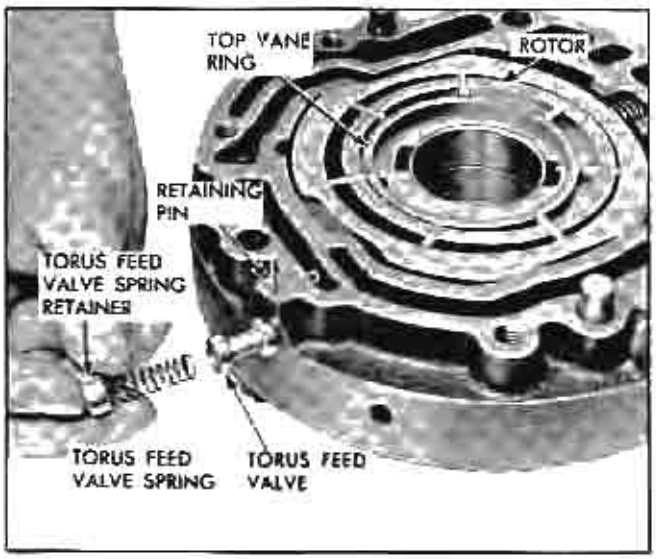

Fig. 101 Removing Torus Feed Valve

ring may have adhered to pump cover when cover was removed and vanes may stay with rotor)

6. Remove seven vanes.

7. Remove bottom vane ring.

8. Push slide toward priming springs, then lift it out of body at opposite end (Fig. 103).

9. Remove inner and outer pump priming springs.

10. Turn pump over and remove sprag inner race, if it was not previously removed, and spiral retaining ring (front sprag to pump) using small screwdriver or needle nose pliers (Fig. 104).

11. Remove sprag assembly from pump. Do not disassemble sprag. If it is damaged a new one should be used. NOTE: Do not remove outer race.

12. Turn piston (rear) side of pump down and gently tap outer periphery of piston side with soft hammer to remove overrun clutch piston from its bore. Remove seals from piston and hub in pump.

INSPECTION

1. Inspect all passages in pump body and cover for dirt or restrictions using tag wire and compressed air (Fig. 106-110).

2. Check fit of slide in pump body to make certain it slides freely. Examine slide for excessive wear or scoring.

3. Observe each pump vane. Pump vanes will normally have a polished surface on the side bearing against the slide and at the points where they contact the vane rings. If any wear is apparent at these points, pump should be replaced.

Fig. 102 Removing Oil Cooler Check Valve

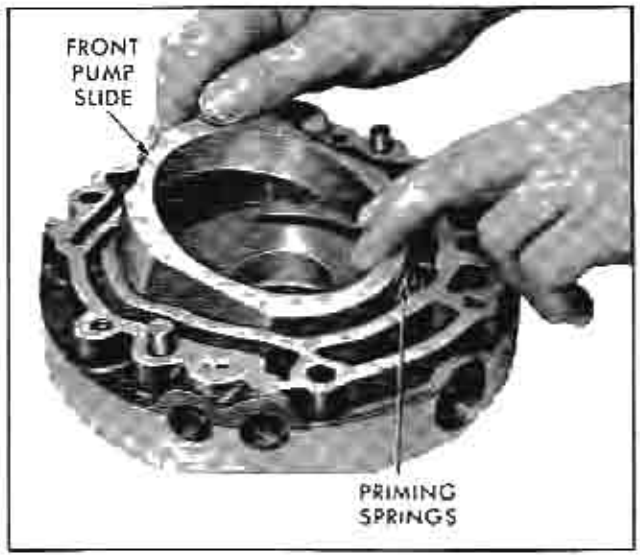

Fig. 103 Removing Pump Slide

4. Check priming springs, check valve spring and torus feed valve spring for collapsed coils or distortion. See page 101 for free length.

5. Measure wear of bushing in pump body as follows:

a. Set front unit coupling on bench with cover side up.

b. Fasten pump cover to body with one or two screws.

c. Place pump cover and body assembly over front unit coupling driven torus shaft with cover down.

d. Measure clearance between driven torus shaft

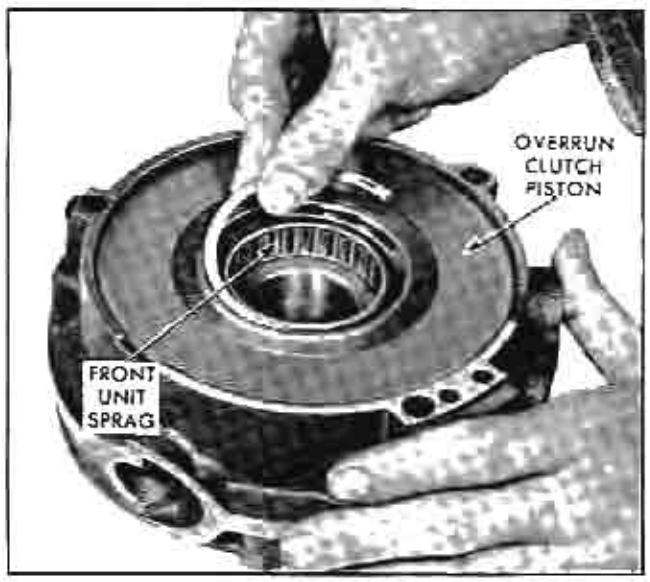

Fig. 104 Removing Front Sprag Retaining Ring

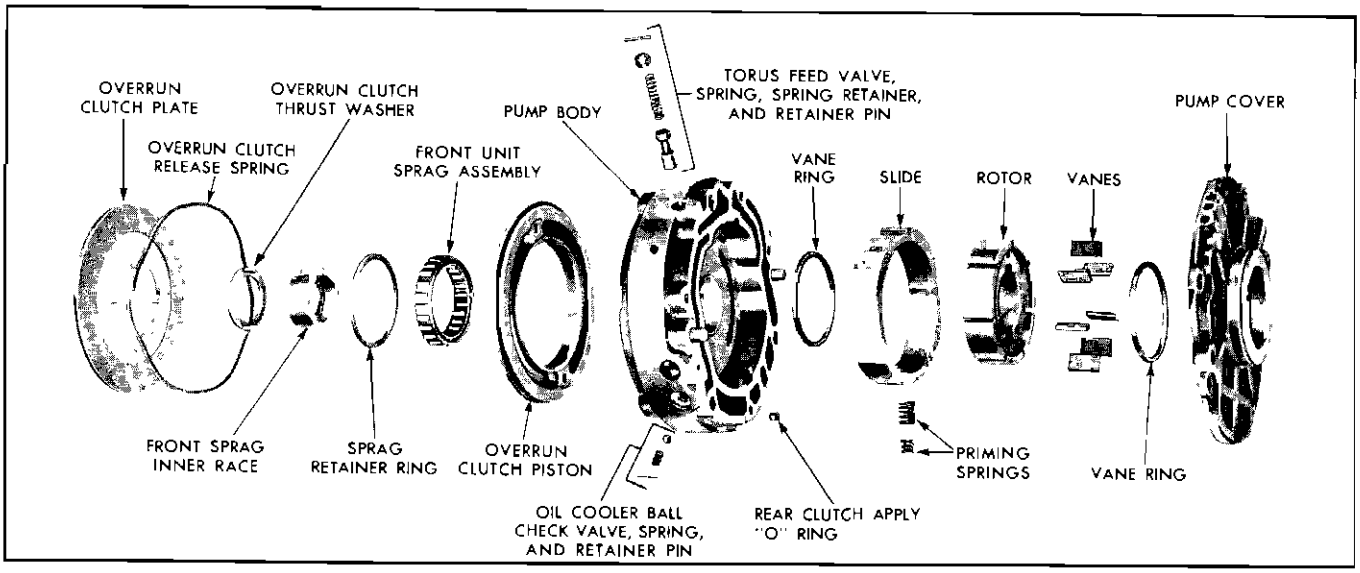

Fig. 105 Pump and Overrun Clutch—Exploded

and pump housing at the point shown in Fig. 111 using ½" width feeler gauges. (The thrust of the shaft against the bushing is taken at this point.) The clearance must not exceed .003". If a .004" gauge can be inserted between the shaft and the bushing, the pump and the driven torus member of the front unit must be replaced. NOTE: Bushing should be flush with rear side (piston side) of pump and project slightly from front side.

6. Examine pump body and pump cover slide surface contacts for smoothness. Also see that ball check valve seat and overrun clutch piston seal groove in pump body are in good condition.

7. Check fit of torus feed valve in its bore to see that it slides freely. (Valve is serviced separately.)

8. Examine rotor for cracks or wear. See that bushing in rotor is in good condition. Bushing should be flush with flat side and short on side with shoulder to allow clearance for bushing which projects from pump body.

9. Examine front sprag outer race to see that it is not damaged.

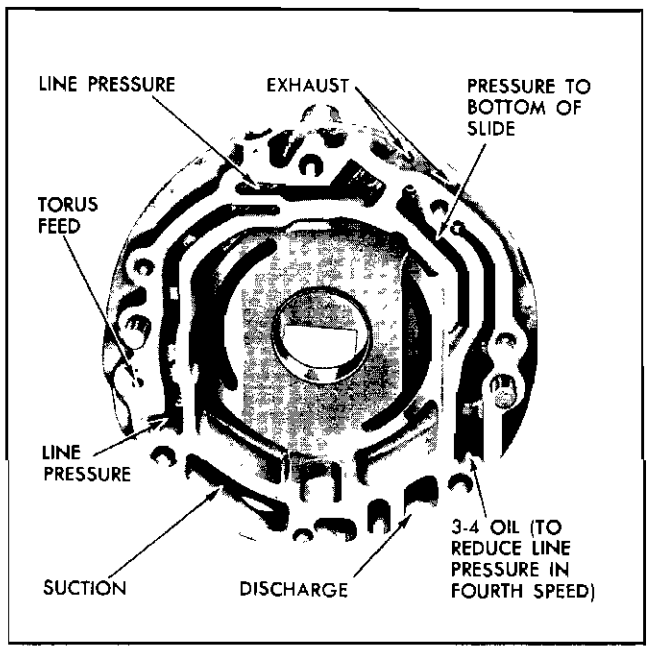

Fig. 106 Passages in Pump Body (Front Side)

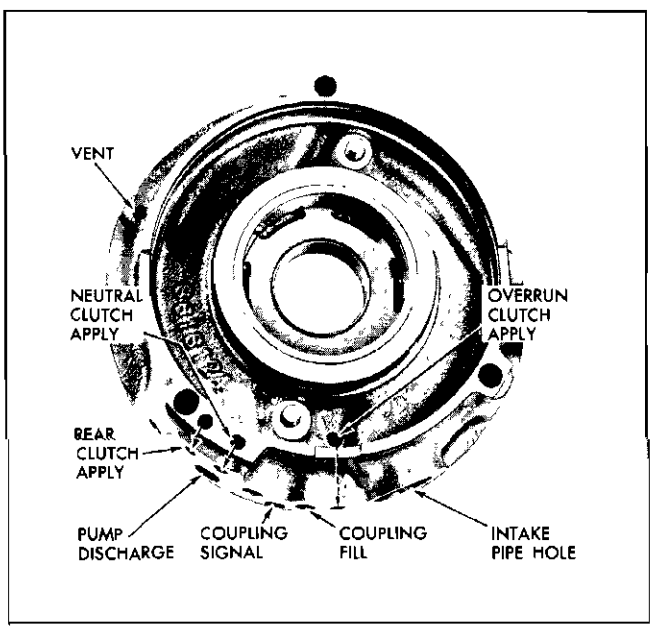

Fig. 107 Passages in Pump Body (Rear Side)

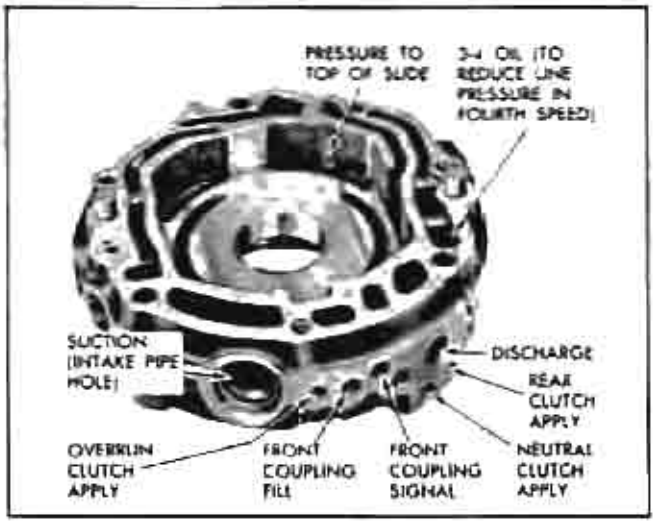

Fig. 108 Passages in Pump Body

10. Inspect overrun clutch piston for scoring or damaged seal groove.

11. Inspect front unit sprag for damaged shoulder, cage, spring or scored sprags.

12 Inspect sprag inner race for scored sprag surface or worn drive lugs.

13. Inspect overrun clutch plate for worn lugs or facing. Plate should be flat. If flakes of facing material can be removed by scratching surface with thumb nail, plate should be replaced. Discoloration is not an indication of failure.

14. Inspect overrun clutch release spring to see that it has five equally spaced waves approximately ¼" deep.

ASSEMBLY

1. Insert inner and outer priming springs in the recess in pump body (Fig. 112).

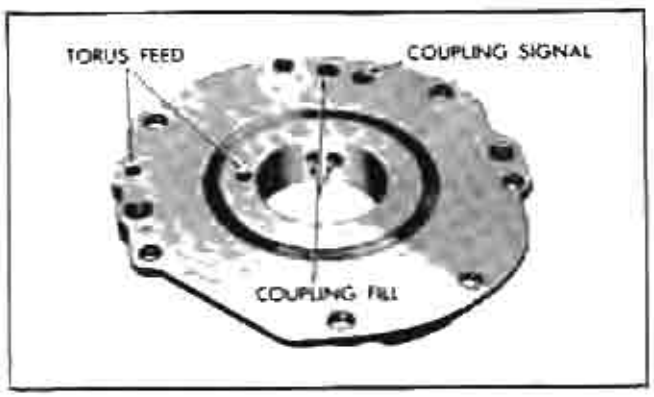

Fig. 109 Passages in Pump Cover

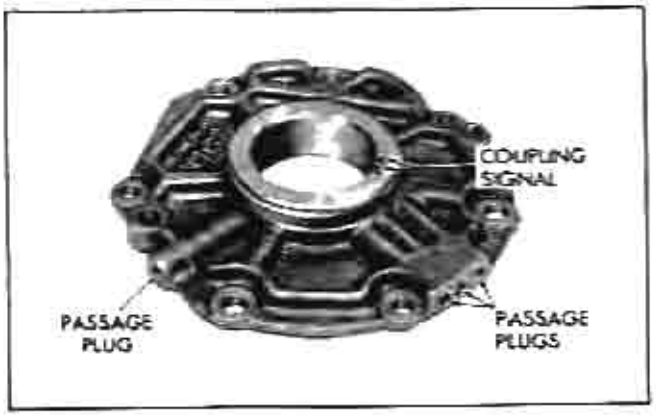

Fig. 110 Passages in Pump Cover

2. Position pump slide in pump body toward priming springs. Compress priming springs with slide until it drops into pocket of pump (Fig. 112). Work slide in position. NOTE: Slide can not be improperly installed.

3. Insert torus feed valve in large bore on side of pump opposite priming springs with long land entering first (Fig. 113).

4. Install valve spring, retainer (cupped side in) and valve retaining pin. Check free movement of the valve by moving slide.

5. Insert oil cooler check ball in oil cooler passage nearest to dowel (Fig. 114). Then install check ball spring and spring retaining pin.

6. Lay a vane ring in pump body, locating it concentrically with slide bore.

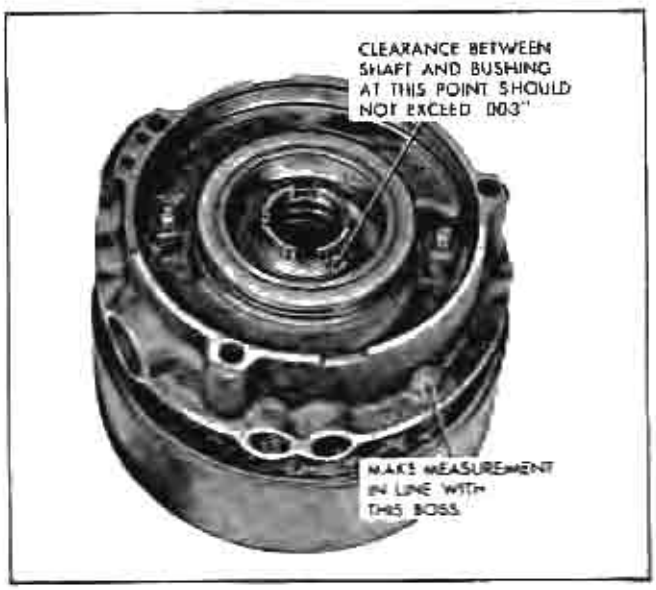

Fig. 111 Measuring Wear of Bushing in Pump Body

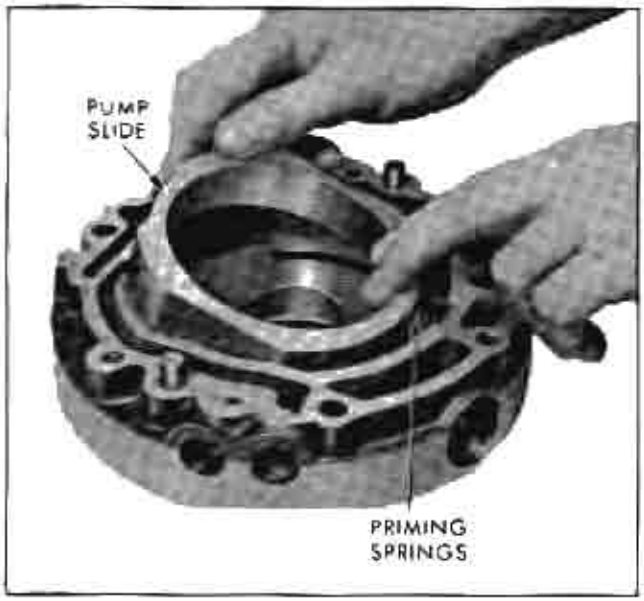

Fig. 112 Installing Front Pump Slide

7. Install rotor in pump cavity with drive slots up (Fig. 115).

8. Install seven vanes in rotor with polished areas toward vane rings (Fig. 115).

9. Install second vane ring on top of rotor. Check for free rotation of rotor.

10. Total clearance between vanes and slide with vane rings installed should be .001"-.003". Check with feeler gauge between each vane and I.D. of slide to ensure clearance does not exceed .003" (with vanes contacting slide on one side, clearance should not exceed .003" on opposite side). If clearance is excessive pump must be replaced.

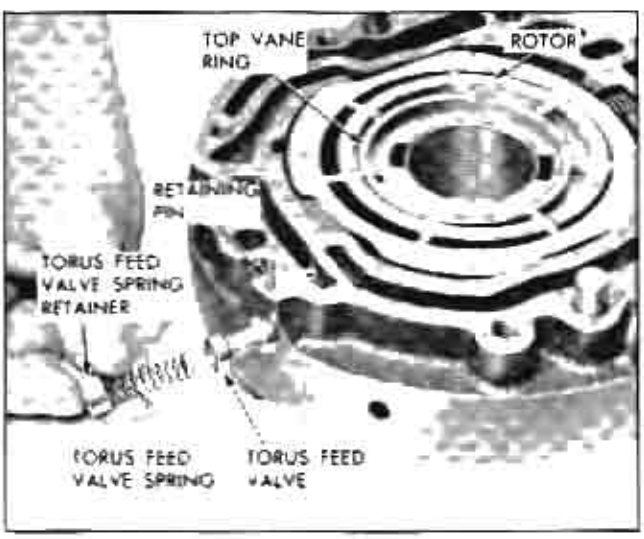

Fig. 113 Installing Torus Feed Valve

Fig. 114 Installing Oil Cooler Check Ball

11. Attach front cover to pump body with four screws. Tighten to 15-18 lb. ft. torque. NOTE: Use short screw in hole nearest top of pump (opposite intake pipe hole).

12. Install overrun clutch seal in hub of pump body with lip facing toward bottom of piston bore.

13. Install outer seal on overrun clutch piston with lip facing side with dowel holes.

14. Install overrun clutch piston in pump body. Compress seal with fingers.

15. Install sprag into rear of pump shoulder side up (Fig. 116). Rotate sprag counterclockwise while installing it.

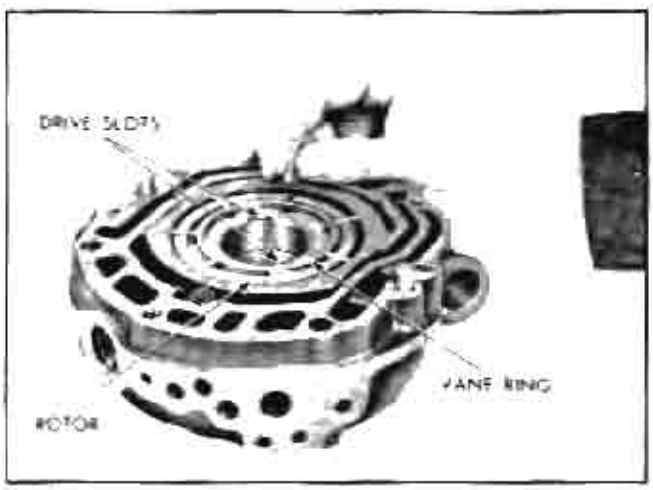

Fig. 115 Installing Vanes in Rotor

Fig. 116 Installing Front Sprag in Hub of Pump Body

16. Secure sprag with spiral snap ring.

17. Install sprag inner race into sprag with lug side up. Inner race must rotate counterclockwise from top.

18. Place overrun clutch plate on top of piston indexing drive lugs with sprag inner race. NOTE: Clutch plate should be retained with petrolatum so it will not fall out when pump is installed in case.

19. Coat overrun clutch thrust washer with petrolatum and place washer on sprag inner race with drive lugs down and indexed with sprag outer race.

20. Place clutch release spring on top of piston and retain with petrolatum (Fig. 117).

21. Install pump intake "O" ring seal in pump body.

Installation Page 83

FRONT UNIT COUPLING

DISASSEMBLY

The front unit coupling assembly is balanced after assembly at the factory, therefore, it is very important that the coupling cover always be installed in coupling in its original position.

In production the No. 1 exhaust valve in the cover and the gap in snap ring are aligned with a locating mark in the driving torus shell. If this mark is not visible, scribe mark the cover shell in line with the gap in snap ring. When reassembling, align all parts exactly the same, including the gap in snap ring.

1. Rest front unit coupling assembly in holding fixture J-6116 (Fig. 118).

2. Remove large snap ring retaining coupling cover to drive torus shell.

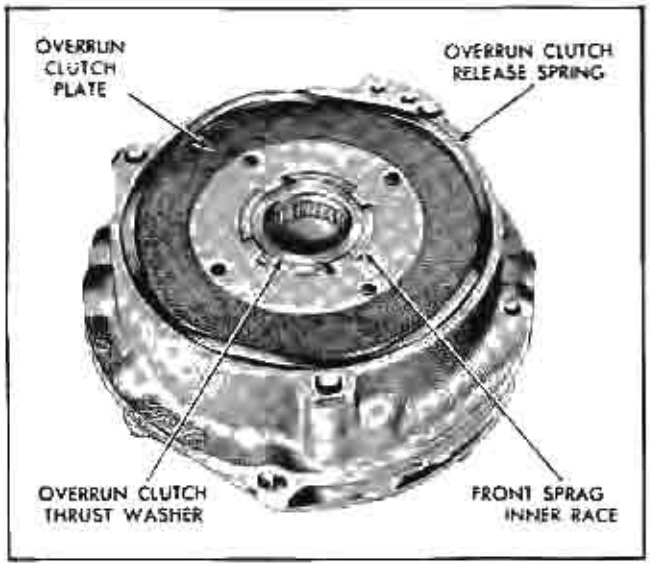

Fig. 117 Overrun Clutch Parts Installed in Pump

3. Install two coupling exhaust valve retainers J-6122 to hold exhaust valves in position when removing cover (Fig. 119).

4. Remove coupling cover from coupling using remover J-6121 (Fig. 118) as follows:

a. Place cross piece of remover J-6121 on end of

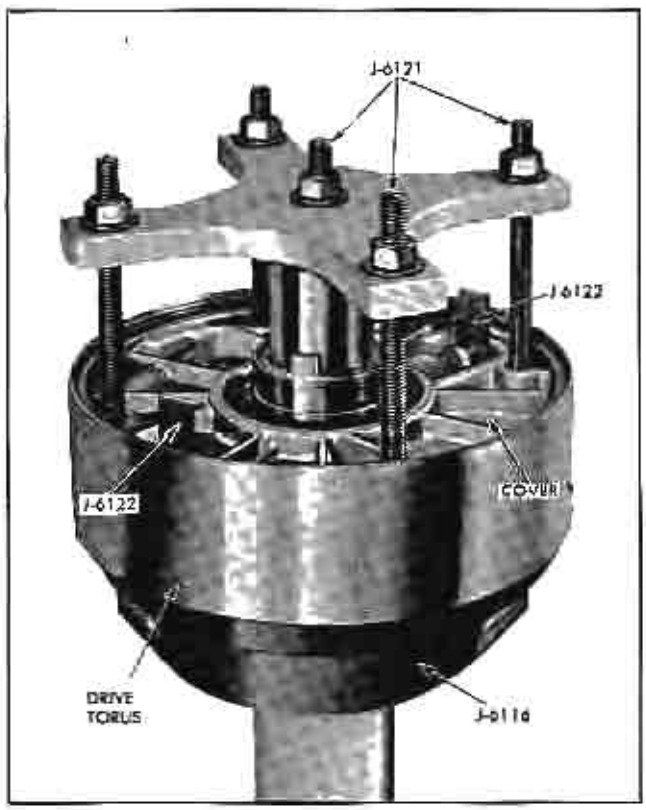

Fig. 118 Removing Coupling Cover

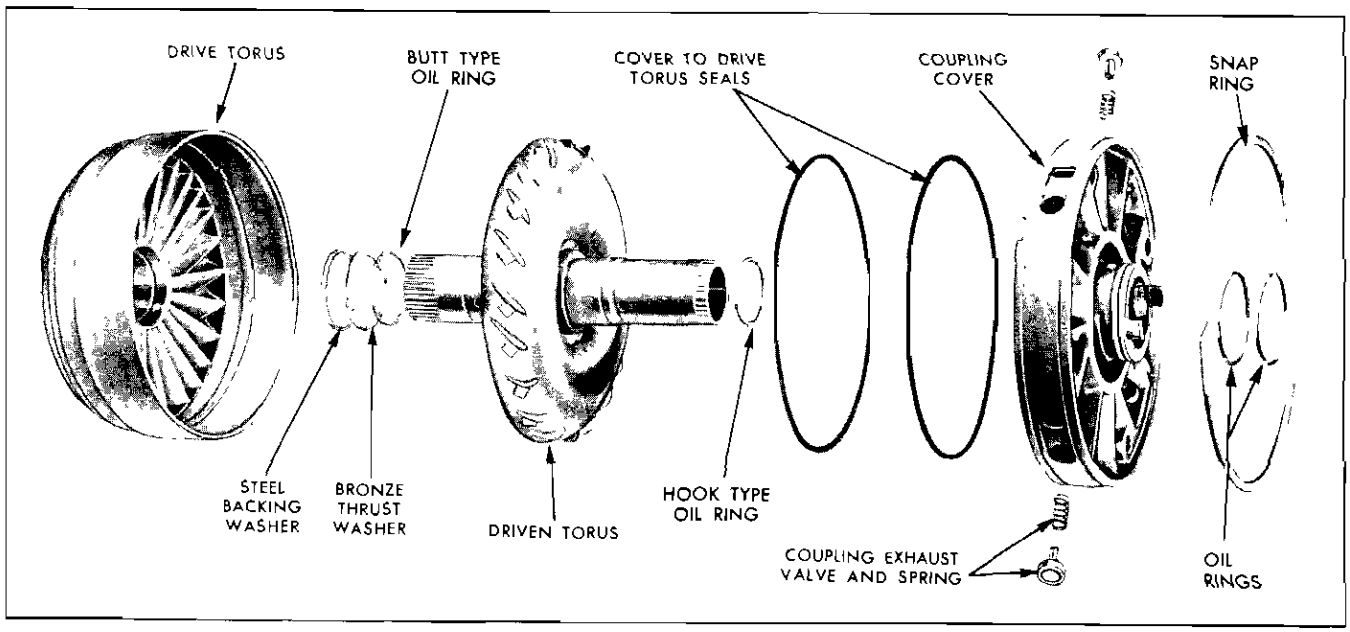

Fig. 119 Front Unit Coupling Ports—Exploded

torus shaft with end of shaft indexed in counterbore on underside of tool.

b. Screw stud at end of each leg into holes in coupling cover until they bottom (nuts on studs should be backed off so they will not contact cross piece).

c. Insert long stud of J-6121 through coupling and cross piece. Index bottom end with hole in clutch unit holding fixture so it cannot turn. Install washer and nut on upper end and tighten securely.

d. Tighten nuts on four studs evenly and only a small amount at a time to pull cover out of unit.

5. Remove tool J-6121.

6. Remove coupling cover from unit.

7. Hold fingers over valves so they will not be ejected and remove coupling exhaust valve retainers J-6122 and exhaust valves and springs from cover. Remove seal rings from outer diameter of cover and discard.

8. Remove driven torus member by pulling up on shaft, and remove bronze and steel thrust washers.

9. Remove drive torus member from holding fixture J-6116.

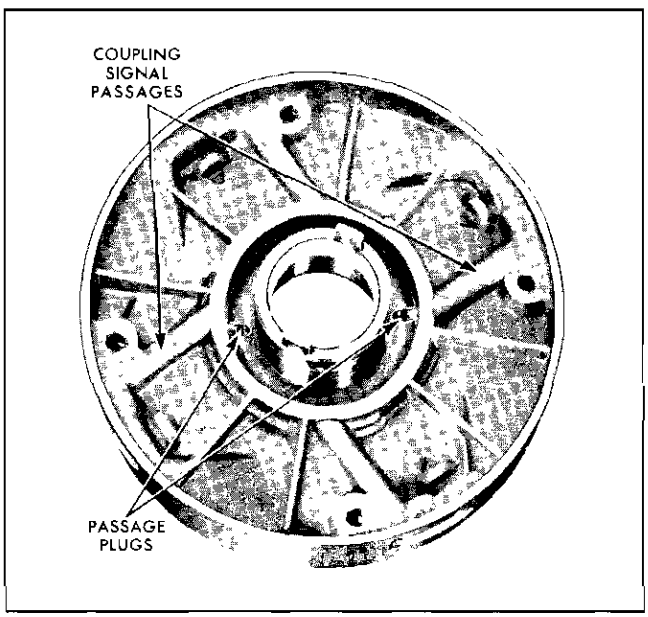

Fig. 120 Plugs in Exhaust Valve Signal Oil Passages in Coupling Cover

INSPECTION

1. Inspect vanes in both torus members to see that they are not loose or damaged.

2. Inspect steel and bronze thrust washers used between the drive and driven torus members to see that they are not worn excessively.

3. Inspect bushing in front end of driven torus shaft and outer polished surfaces on shaft. Also check to see that hook type oil rings and ring lands are in good condition.

4. Insert coupling exhaust valves in bores of coupling cover to see that they operate freely (valves are serviced separately). Observe coupling exhaust valve

springs for collapsed or distorted coils (Fig. 119).

5. Inspect front unit torus coupling cover for burrs or scratches on outer diameter caused by removal of cover. Burrs or scratches can usually be cleaned up with crocus cloth. Check for excessive wear of bushing in cover and condition of hook type ring and ring land. Inspect oil seal grooves of cover hub to ensure they are not damaged. Make sure signal oil passages in coupling cover are open and that plugs are in place (Fig. 120).

ASSEMBLY

1. Place drive torus in holding fixture J-6116 with hub down.

2. Install steel, then bronze thrust washer in drive torus member (Fig. 121).

3. With oil rings in place on driven torus shaft, install driven torus into drive torus (Fig. 122).

4. Install two new torus cover square ring seals making sure seals are square in grooves. Apply petrolatum freely to lubricate seals for installation of cover into drive torus.

5. Install springs and coupling exhaust valves in cover and install valve retainers J-6122.

6. Insert cover into drive torus shell indexing No. 1 exhaust valve (or mark made during disassembly) with mark on drive torus shell. Tap lightly on inner diameter of cover to position cover fully into shell (Fig. 123). The cover will be secure when snap ring groove in torus shell shows evenly above cover.

7. Remove two retainers J-6122 from cover.

8. Install snap ring to retain torus cover in drive

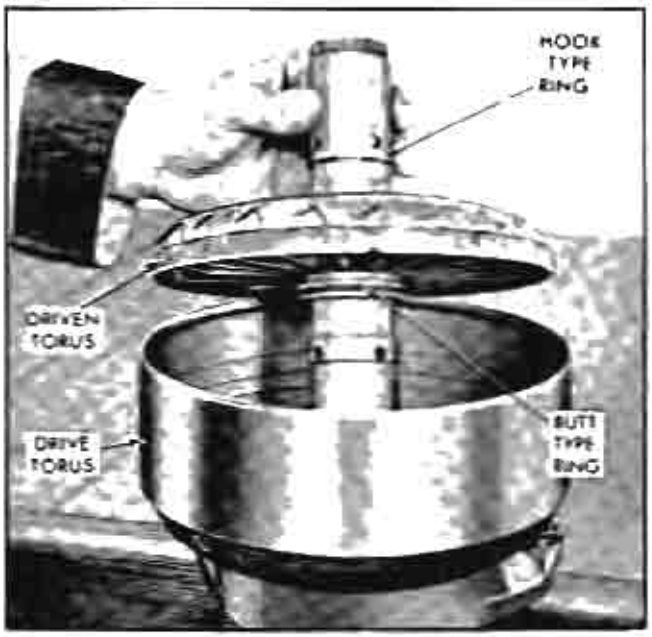

Fig. 122 Installing Driven Torus into Drive Torus

torus shell with gap in snap ring aligned with No. 1 exhaust valve. NOTE: Cover, shell and gap in snap ring must be replaced in original alignment to maintain balance of unit.

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REVERSE CLUTCH PISTON HOUSING

DISASSEMBLY

1. Remove large snap ring retaining wave type reverse piston release spring and retainer (Fig. 124).

2. Remove retainer and release spring.

3. Lift reverse piston from reverse clutch piston

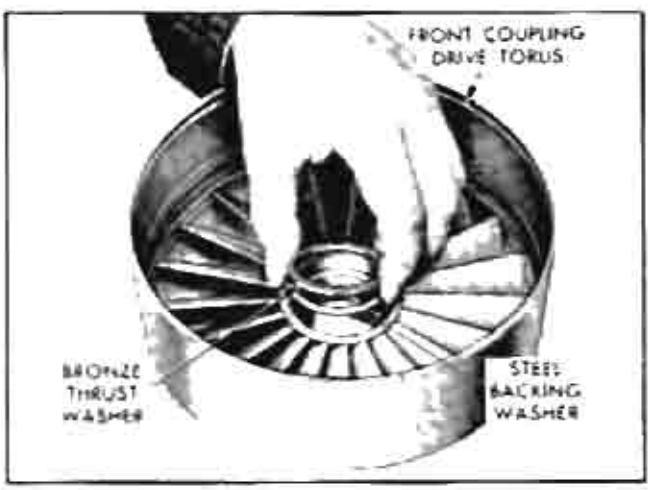

Fig. 121 Installing Thrust Washers in Drive Torus

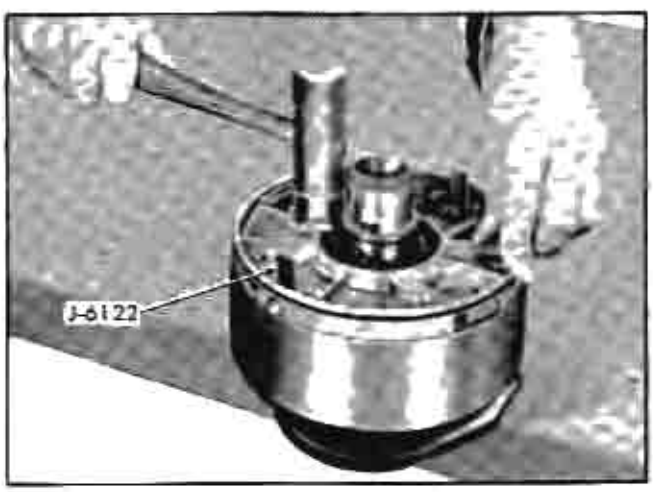

Fig. 123 Installing Torus Cover into Drive Torus Shell

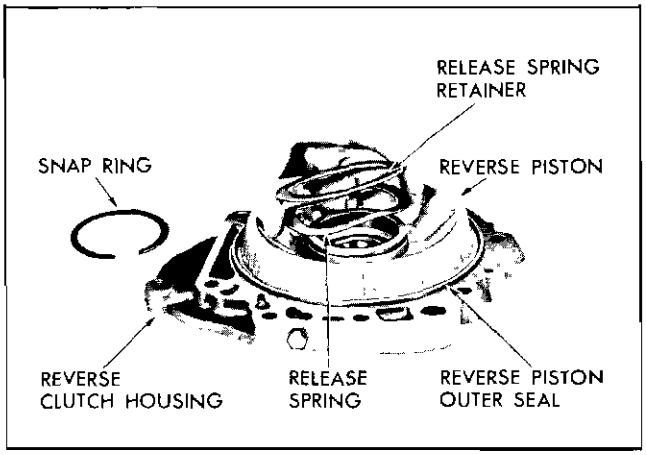

Fig. 124 Removing Snap Ring, Reverse Piston Release Spring and Retainer

housing (Fig. 125).

4. Remove bearing to housing snap ring.

5. Tap bearing out rear of housing.

INSPECTION

1. Check passages in reverse piston housing (Fig. 126) to see that they are not restricted or interconnected.

2. Check three piston dowel pins in the reverse piston housing for tightness. Also, check for burrs, scratches or nicks in housing.

3. Inspect rear bearing.

4. Observe reverse clutch piston for scoring, nicks, or burrs (Fig. 127). Check oil seal grooves to see that they are in good condition.

5. Observe reverse internal gear for possible damage to clutch surface on outer periphery or damaged internal gear teeth. Thrust washer surface on back of gear must not be damaged. Check bushing in center

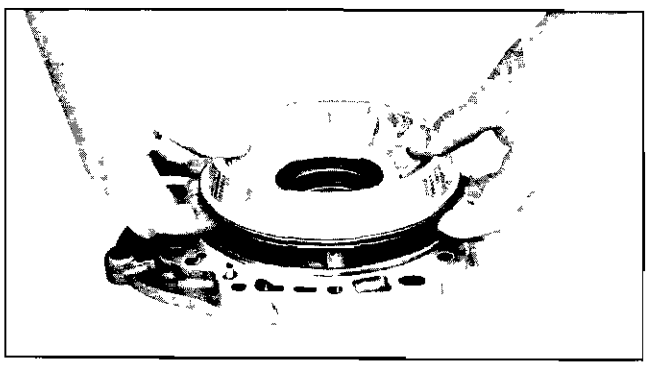

Fig. 125 Removing Reverse Piston from Reverse Clutch Housing

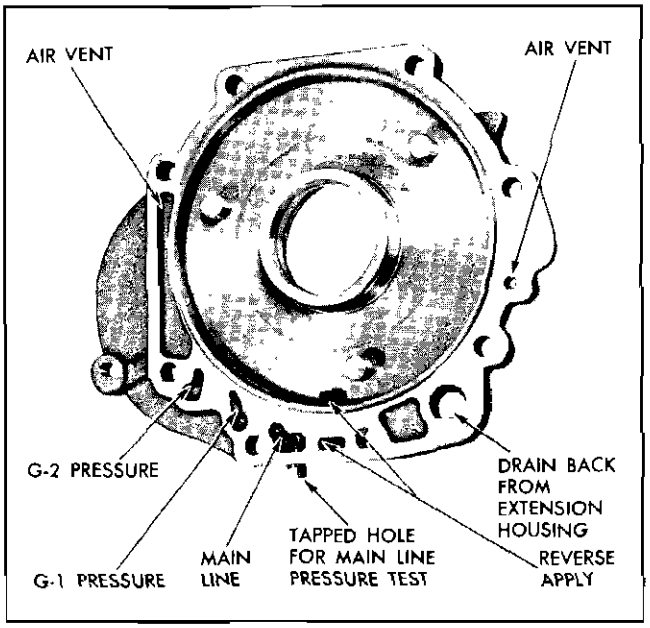

Fig. 126 Passages in Reverse Clutch Piston Housing

hole of gear flange for scoring or damage (Fig. 128).

6. Inspect reverse internal gear to reverse piston housing hub thrust washer for excessive wear.

7. Inspect reverse clutch stationary cone for excessive wear or cracks.

8. Check reverse clutch release spring for bent fingers.

9. Inspect reverse planet carrier for worn or damaged teeth or worn roller bearings. Also check splines and parking lugs on outer diameter of carrier.

10. Inspect reverse piston release spring. It should have five equally spaced waves approximately ¼" deep.

ASSEMBLY

1. Place tool J-7577 over inner hub of reverse piston housing (Fig. 129).

2. Lower reverse piston over tool, rotating it to engage dowel pins.

3. Compress outer piston seal to facilitate its entering into bore of cylinder. Use care so as not to damage piston seals during installation.

4. Remove tool J-7577.

5. Place release spring and retainer on piston and install large retaining snap ring (Fig. 127). **NOTE:** Rear bearing will be installed after reverse piston housing is attached to transmission case.

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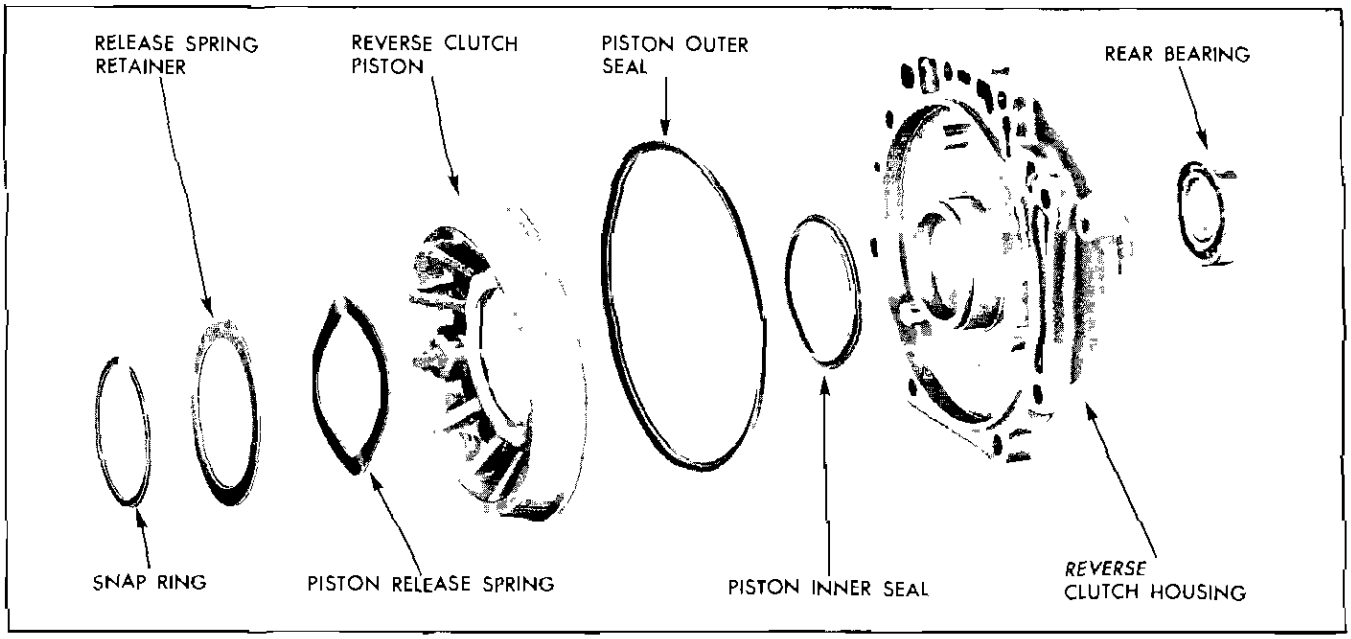

Fig. 127 Reverse Clutch Piston, Housing and Parts—Exploded

GOVERNOR

DISASSEMBLY

1. Remove two cover to governor driven gear attaching screws (Fig. 131).

2. Remove cover plate, G-2 bushing retaining pin, G-2 bushing and plunger assembly, and bushing stop washer.

3. Remove G-2 plunger from bushing.

4. Remove four governor oil rings.

5. Remove governor driven gear only if it needs replacement.

INSPECTION

1. Inspect governor rings and ring lands. Rings must be free in grooves. If lands are damaged or worn thin, replace governor assembly.

2. Inspect G-1 plunger for free movement. Plunger should be held in extended position by spring pressure.

3. Inspect G-2 plunger for free movement in bushing.

4. Inspect governor drive and driven gears.

ASSEMBLY

1. Insert G-2 bushing stop washer in body (Fig. 131).

2. Install G-2 (secondary) plunger into bushing.

3. Install G-2 bushing and plunger assembly into

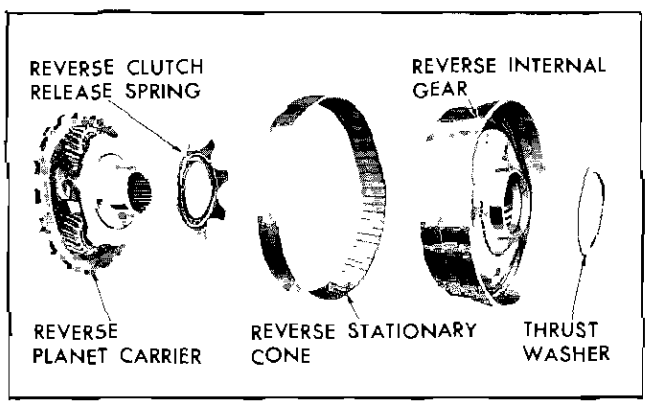

Fig. 128 Reverse Clutch Parts—Exploded

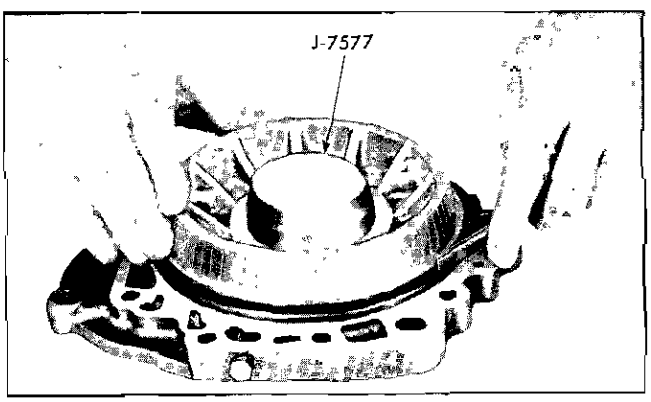

Fig. 129 Installing Reverse Piston in Housing

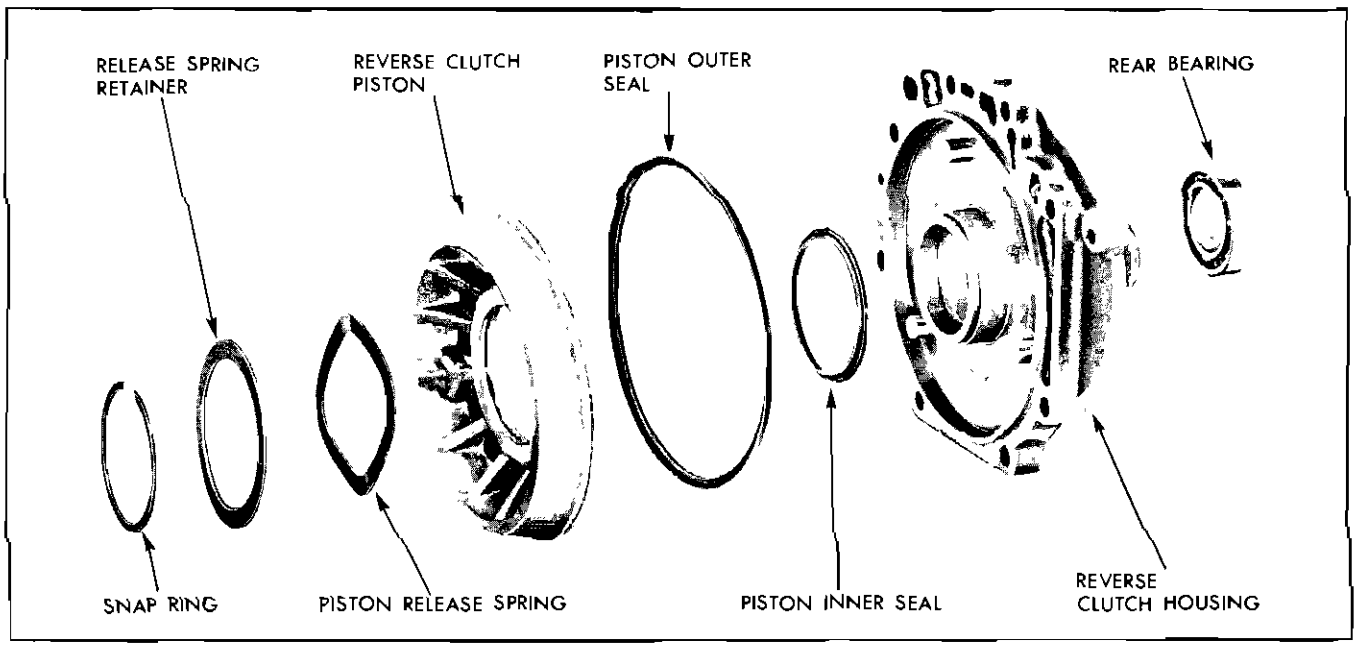

Fig. 130 Reverse Clutch Piston and Housing Parts—Exploded

governor body.

4. Rotate bushing to align recess in bushing to accept retaining pin and install pin.

5. If the governor driven gear was removed, install it over governor tower and roll the pin.

6. Attach governor cover plate to body with two screws entering driven gear. Overhang of plate must be toward G-2 weight. Use care not to drop bushing retaining pin.

7. Install four governor oil rings.

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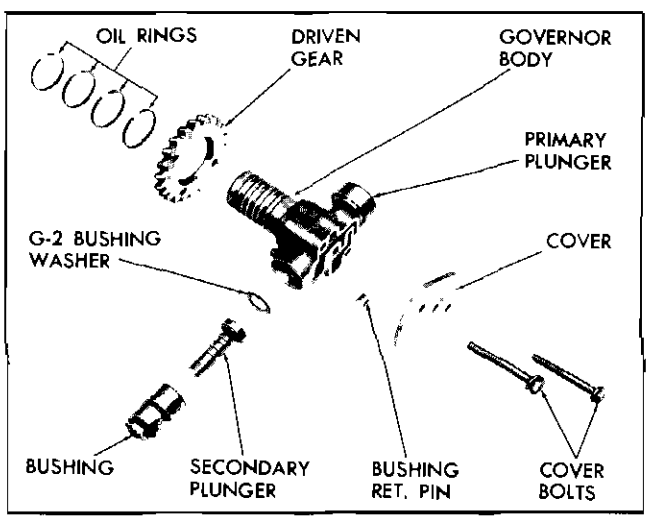

Fig. 131 Governor Parts—Exploded

SERVO AND ACCUMULATOR

DISASSEMBLY

1. Remove servo piston from servo body (Fig. 132).

2. Remove cover attaching screws; then remove cover and discard gasket.

3. Remove TV accumulator stop pin and accumulater valve plug retainer.

4. Remove plug, accumulator valve, spring, and TV accumulator plug.

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

6. Compress accumulator spring and remove retaining washer.

7. Remove accumulator piston pin from accumulator piston. NOTE: Do not remove small retaining ring from piston pin.

8. Remove oil seal ring from accumulator piston.

INSPECTION

1. Inspect accumulator and servo pistons for damaged oil rings, scores, or burrs in the ring land grooves (Fig. 132).

2. Inspect accumulator spring and servo spring for collapsed or distorted coils and proper length (page 101). NOTE: Slight wear "bright spots" on side of accumulator spring indicates slight contact which is permissible.

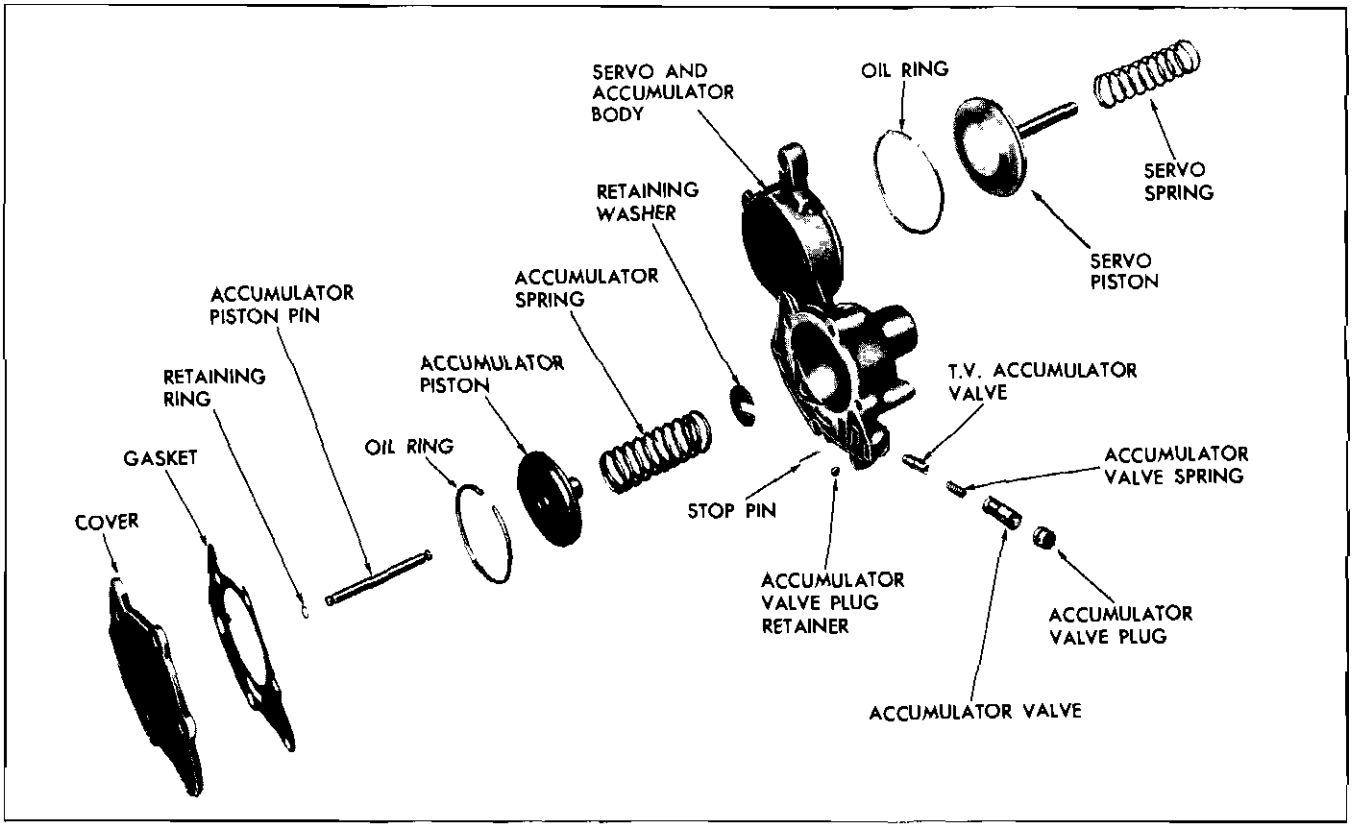

Fig. 132 Servo and Accumulator—Exploded

3. Inspect accumulator body for restricted passages (Fig. 133), scores or burrs.

4. Inspect accumulator valve spring for collapsed or distorted coils and proper length (page 101). Check trimmer valve operation in its bore. (Accumulator valve is serviced separately.)

5. Check to see that accumulator valve retainer pin bottoms in its bore so it cannot fall out.

ASSEMBLY

1. Install oil ring on accumulator piston (Fig. 132).

2. Assemble accumulator piston stem in piston with small retaining ring towards flat side of piston.

3. Place accumulator spring over stem end of piston, compress spring and install spring retaining washer.

4. Install TV accumulator plug, slotted end last and align the slot in plug with vent passage. NOTE: A small screwdriver may be used with care to align the valve in the bore.

5. Install accumulator valve spring in accumulator valve and install valve and spring, spring end first, into bore.

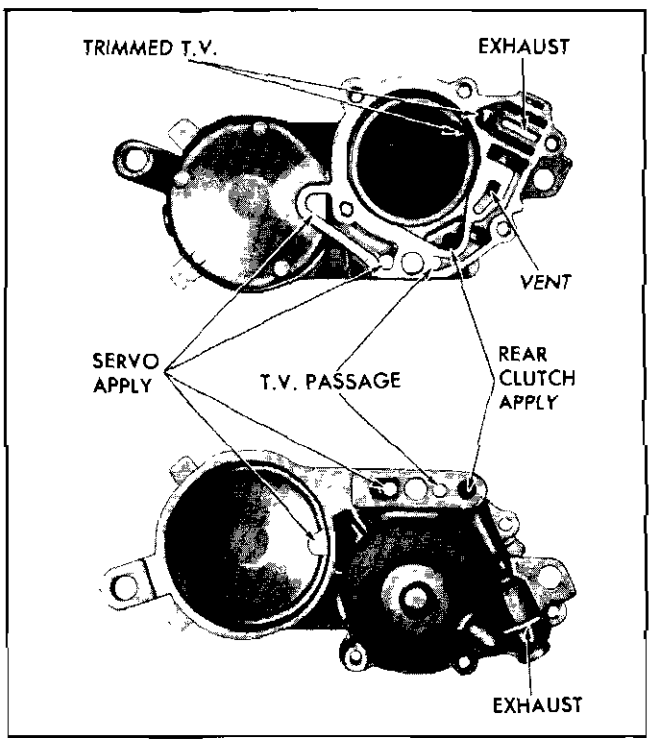

Fig. 133 Oil Passages in Servo and Accumulator Body

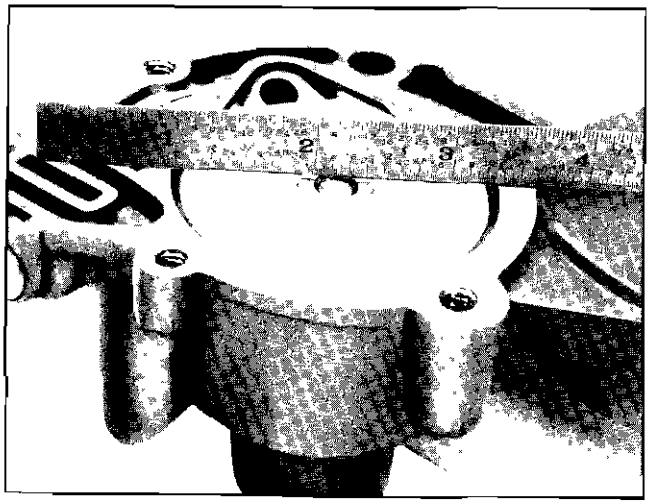

Fig. 134 Accumulator Piston Assembly Installed in Accumulator Body

6. Insert accumulator valve plug in bore.

7. Install the TV accumulator plug stop pin into vent passage and slot in plug.

8. Install plug retainer in body and in the groove in the plug.

9. Install accumulator piston assembly in accumulator (Fig. 134).

10. Attach accumulator gasket and cover with five screws being careful not to damage the accumulator piston oil ring.

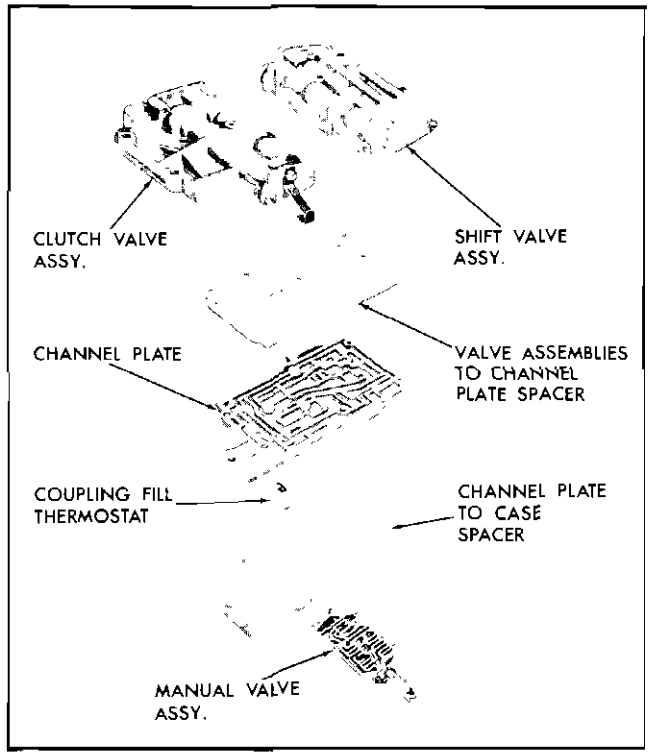

Fig. 135 Components of Control Valve Assembly

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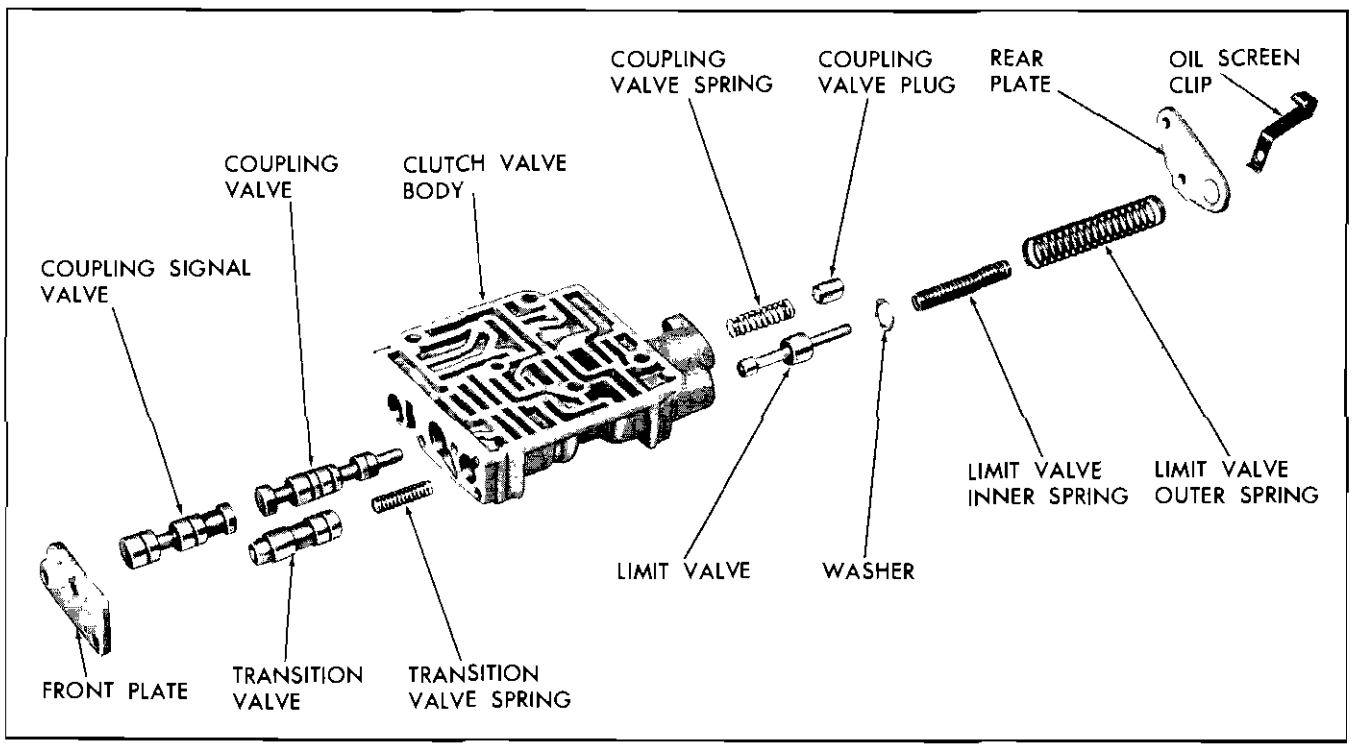

Fig. 136 Clutch Valve Parts—Exploded

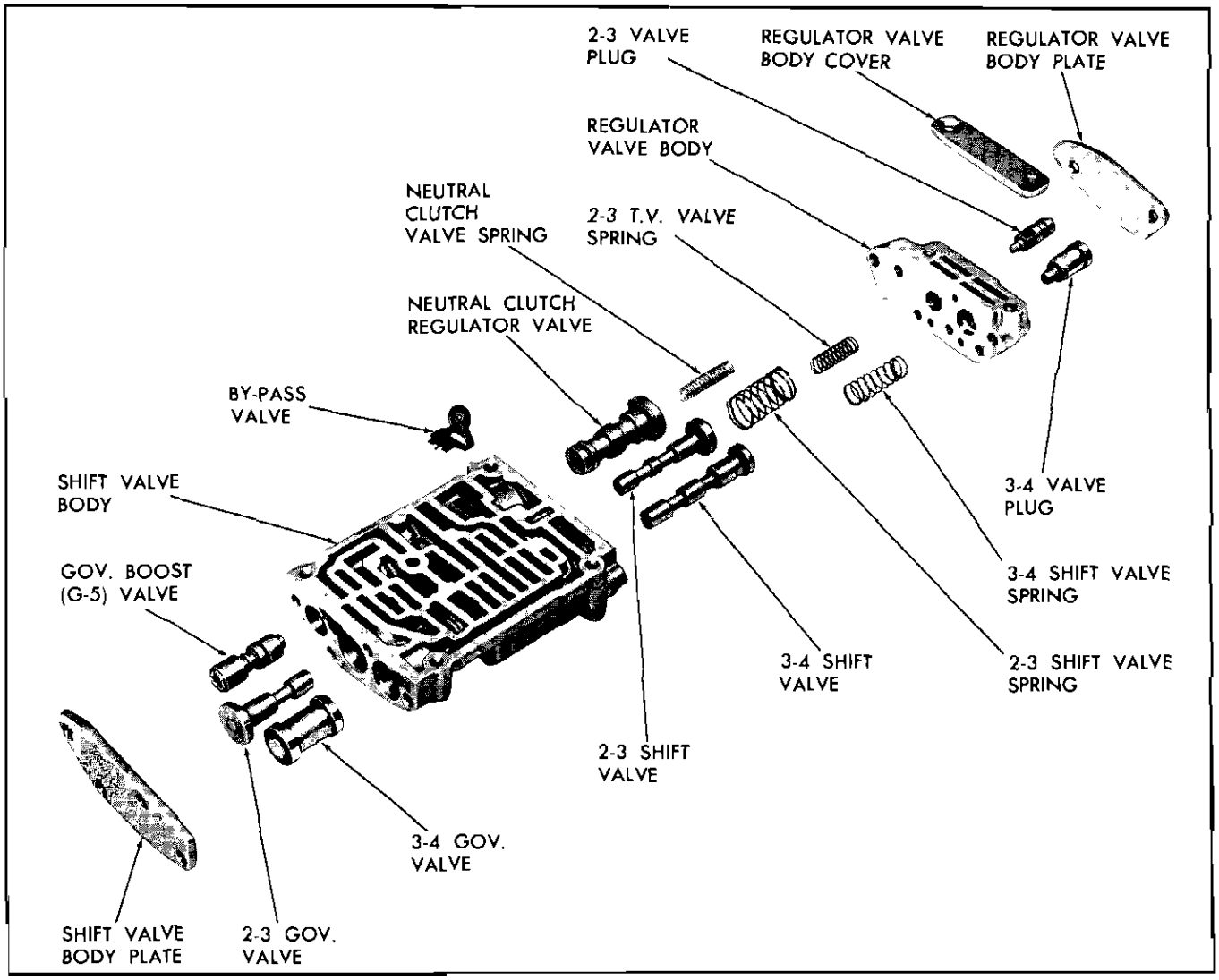

Fig. 137 Shift Valve Parts—Exploded

CONTROL VALVE ASSEMBLY

DISASSEMBLY OF COMPONENTS

The complete control valve assembly for the controlled coupling Hydra-Matic transmission consists of three individual assemblies and two spacer plates connected to a channel plate (Fig. 135). In the disassembly and assembly procedure each individual body should be disassembled, cleaned and inspected, and assembled before going to the next body. This should be done to avoid confusion of component parts. The names of these individual assemblies are:

A. Clutch Valve.

B. Shift Valve.

C. Manual Valve.

1. Remove three screws retaining the shift valve assembly to channel plate and remove shift valve assembly (Fig. 135).

2. Remove two screws retaining the clutch valve assembly to channel plate and remove the clutch valve assembly.

3. Remove channel plate to valve body spacer plate.

4. Remove three screws securing the manual valve assembly to channel plate and remove assembly.

5. Remove channel plate to case spacer plate.

6. Remove coupling fill thermostatic element from channel plate.

CLUTCH VALVE

DISASSEMBLY

1. Remove three screws retaining the clutch valve

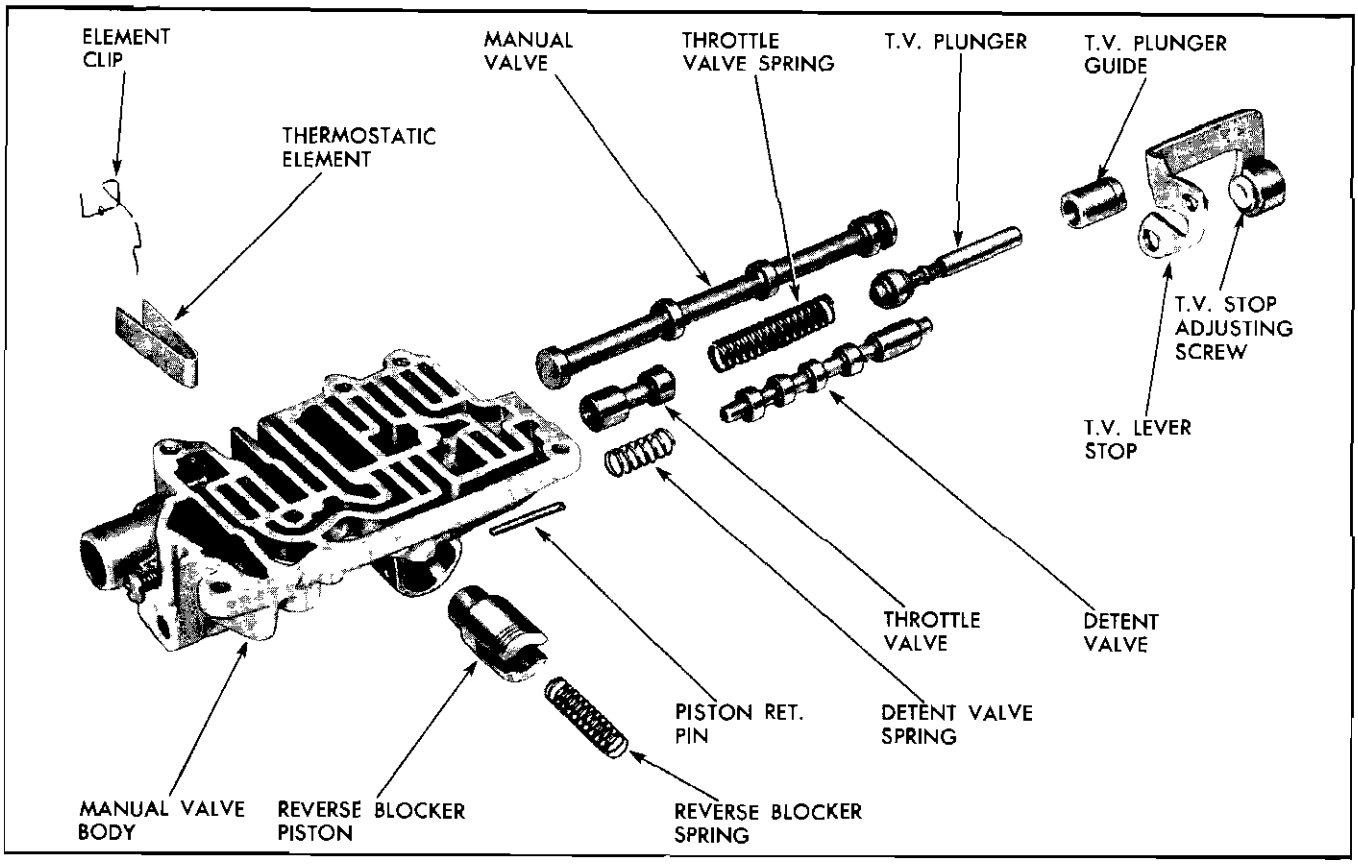

Fig. 138 Manual Valve Parts—Exploded

body front plate and remove plate (Fig. 136).

2. Remove transition valve and spring.

3. Remove coupling signal valve, coupling valve, coupling valve spring, and plug from the clutch valve body.

4. Carefully remove the two screws retaining the clutch body rear plate and remove the plate and oil screen retaining clip.

5. Remove inner and outer limit valve springs.

6. Remove limit valve spring washer and limit valve.

INSPECTION

1. Inspect each valve carefully to ensure they are free from burrs and not damaged in any way. Remove burrs carefully with fine stone. Valves have sharp eorners to prevent dirt from wedging between valve and body; therefore, when removing burrs, do not round off square edges.

2. Inspect each valve and plug for free movement in its respective bore and operating position. Valves can be assumed to be free in their operating positions if they will fall of their own weight in their respective bores when valve body is shaken slightly. Do not drop valves.

3. Inspect springs for distortion or collapsed coils. Refer to page 101 for spring specifications.

ASSEMBLY

1. Install limit valve, stem end out (Fig. 136).

2. Install limit valve washer, inner spring and outer spring.

3. Attach rear plate and retainer clip to clutch body with one screw through the clip. Leave the screw loose.

4. Rotate plate over the limit valve springs while holding springs compressed and install the remaining screw. Then tighten both screws.

5. Insert coupling valve plug, spring, coupling valve and coupling signal valve in valve body.

6. Insert spring in transition valve, then install the transition valve and spring, spring first, into the clutch body.

7. Attach clutch body front cover with three attaching screws.

Assembly of Components Page 76

SHIFT VALVE

DISASSEMBLY

1. Remove neutral clutch by-pass valve from shift valve body (Fig. 137).

2. Remove two screws retaining the regulator body cover and remove cover.

3. Remove three screws retaining the regulator body. Remove regulator body, end plate, and two TV valve plugs together.

4. Remove the 2-3 and 3-4 TV valve plugs from regulator body.

5. Remove the neutral clutch spring, 2-3 shift valve spring, 2-3 TV spring, and 3-4 shift valve spring from the shift body.

6. Remove the neutral clutch regulator valve, 2-3 shift valve, and 3-4 shift valve.

7. Remove four screws retaining the shift valve body plate and remove plate.

8. Remove governor boost valve, 2-3 governor valve, and 3-4 governor valve.

INSPECTION

1. Inspect each valve carefully to ensure they are free from burrs and not damaged in any way. Remove burrs carefully with fine stone. Valves have sharp corners to prevent dirt from wedging between valve and body; therefore, when removing burrs, do not round off square edges.

2. Inspect each valve and plug for free movement in its respective bore and operating position. Valves can be assumed to be free in their operating positions if they will fall of their own weight in their respective bores when valve body is shaken slightly. Do not drop valves.

3. Inspect springs for distortion or collapsed coils. Refer to page 101 for spring specifications.

ASSEMBLY

1. Install 3-4 governor valve with round end facing out (Fig. 137).

2. Install 2-3 governor valve and governor boost valve.

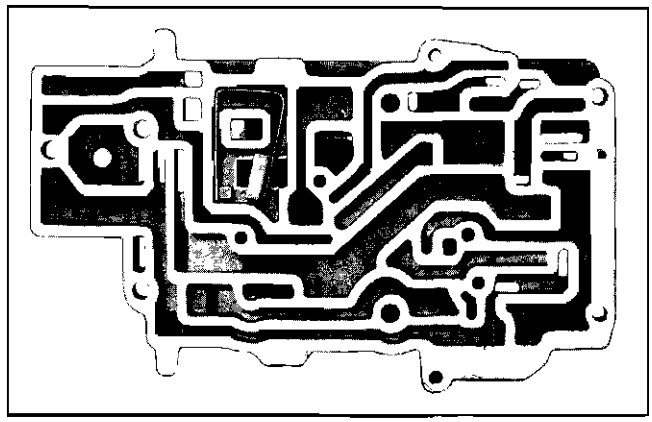

Fig. 139 Coupling Fill Thermostat Installed

3. Attach shift valve body plate with four screws.

4. Install the neutral clutch regulator valve, 2-3 shift valve, and 3-4 shift valve.

5. Insert the neutral clutch valve spring, 2-3 TV spring, 2-3 shift valve spring, and 3-4 shift valve spring in the shift valve body.

6. Install the 2-3 and 3-4 TV valves in the regulator body, so that small ends will be toward shift valves.

7. Mount regulator valve body and plate to valve body using the one plate attaching screw.

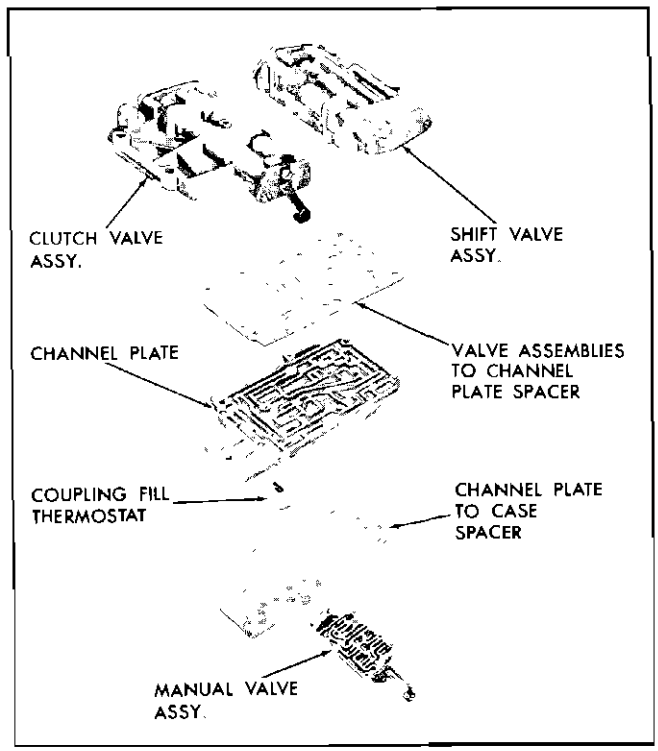

Fig. 140 Components of Control Valve Assembly

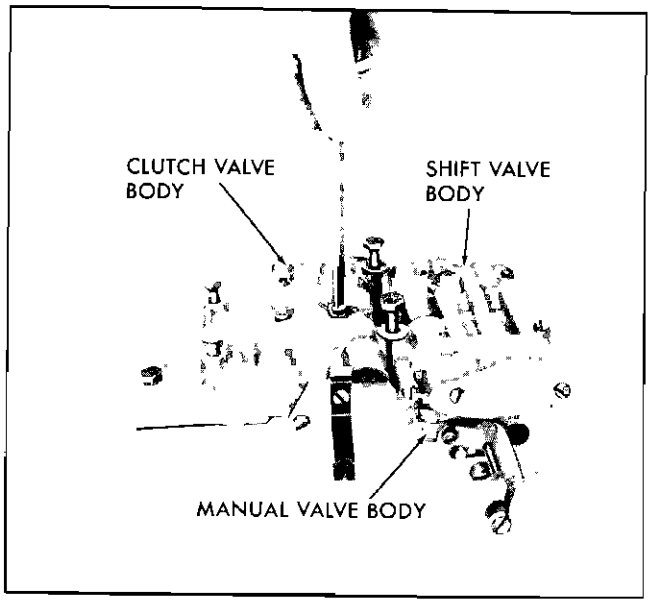

Fig. 141 Tightening Shift Valve and Clutch Valve Body Attaching Screws

8. Then, carefully align and secure the regulator body to shift valve body with two screws.

9. Attach the regulator body cover.

10. Install neutral clutch by-pass valve in shift valve body.

MANUAL VALVE

DISASSEMBLY

1. Remove two screws retaining the TV lever stop and remove stop (Fig. 138).

NOTE: Do not tamper with the factory adjusted TV stop adjusting screw.

2. Remove detent valve.

3. Remove TV plunger and guide and separate plunger from guide.

4. Remove TV spring.

5. Remove detent spring.

6. Remove throttle valve.

7. Remove thermostatic element retaining clip and element.

NOTE: Do not tamper with the small thermostatic element adjusting screw which is preset at factory.

8. Clip one end of the reverse blocker piston retaining pin.

9. While holding thumb over the reverse blocker piston bore, remove retaining pin.

10. Remove reverse blocker piston spring and piston.

INSPECTION

1. Inspect each valve carefully to ensure they are free from burrs and not damaged in any way. Remove burrs carefully with fine stone. Valves have sharp corners to prevent dirt from wedging between valve and body; therefore, when removing burrs, do not round off square edges.

2. Inspect each valve and plug for free movement in its respective bore and operating position. Valves can be assumed to be free in their operating positions if they will fall of their own weight in their respective bores when valve body is shaken slightly. Do not drop valves.

3. Inspect springs for distortion or collapsed coils. Refer to page 101 for spring specifications.

ASSEMBLY

1. Install reverse blocker piston, slotted end out (Fig. 138).

2. Insert reverse blocker piston spring and hold it compressed while installing a new retaining pin. Crimp the pin to secure it.

3. Install TV thermostatic element and clip.

4. Install throttle valve, large land first, into the manual body.

5. Insert TV spring in the TV bore.

6. Install detent valve spring in detent bore.

7. Install detent valve, long land last, in the detent bore.

8. Insert TV plunger in the guide and install both parts into the TV bore.

9. Attach the TV lever stop.

ASSEMBLY OF COMPONENTS

1. Place the coupling fill thermostatic element in channel plate (Fig. 139).

2. Lay channel plate to case spacer over channel plate and coupling fill element.

3. Place manual valve body assembly over channel plate to case spacer and attach with three screws. Leave screws one turn loose for final alignment (Fig. 140).

4. Turn the assembly over and position the channel plate to valve body spacer.

5. Lay the shift valve body in place opposite the manual body and secure with three screws. Leave screws loose.

6. Attach clutch valve body in place with two screws, leaving screws loose.

7. Use the five valve body to case attaching bolts as guides through valve bodies and tighten the shift valve and clutch valve body attaching screws (five screws) (Fig. 141).

8. Remove five bolts used as guides.

9. Turn assembly over and tighten three manual valve body screws.

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FLYWHEEL HOUSING OIL SEAL

REMOVAL

Drive the seal out of housing by inserting a blunt punch through housing oil drain back hole.

REPLACEMENT

1. Rest flywheel housing on recess end of support J-7027.

Fig. 142 Installing Flywheel Housing Oil Seal

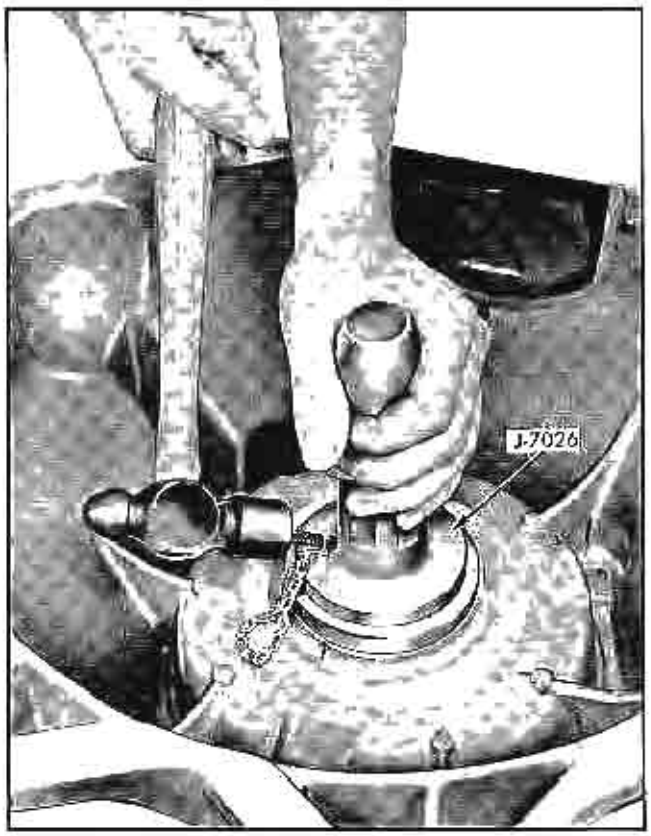


Fig. 143 Staking Oil Seal in Place

2. Apply light coat of sealer (0.665) on periphery of seal casing and place seal in bore of housing (lip down).

3. Inspect seal installer J-7026 to make sure no burrs are present which would damage seal.

4. Place installer in seal and drive seal into place (Fig. 141).

5. Stake seal at three housing reinforcement bosses with punch provided with tool (Fig. 142).

PRESSURE REGULATOR

DISASSEMBLY

1. Remove pressure regulator valve stop plug (Fig. 143).

2. Remove reverse booster plug.

3. Remove seal from pressure regulator plug and discard.

INSPECTION

1. Inspect pressure regulator valve (Fig. 144) for nicks or scores and free movement in pump body.

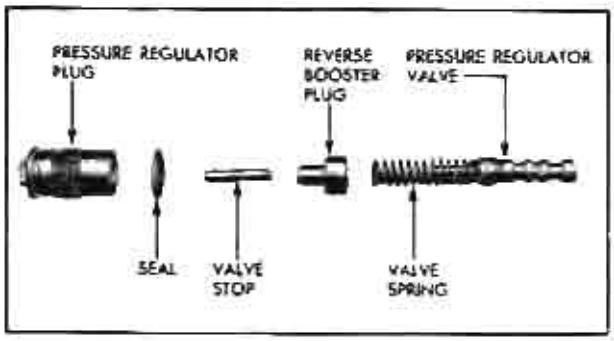


Fig. 144 Pressure Regulator Parts—Exploded

Inspect drilled passages in valve to make sure they are not obstructed.

2. Inspect pressure regulator spring for distortion, collapsed coils and free length (page 101).

3. Inspect drilled passage in pressure regulator plug to see that it is not obstructed.

4. Inspect reverse booster plug and regulator valve stop to see that they are not nicked or burred and that they move freely in their bores.

ASSEMBLY

1. Install new "O" ring seal on pressure regulator plug (Fig. 144).

2. Apply a small amount of petrolatum in bore of pressure regulator plug and in bore of reverse booster plug to keep parts in place after assembly.

3. Install reverse booster plug in pressure regulator sleeve.

4. Install pressure regulator valve stop in reverse booster plug.

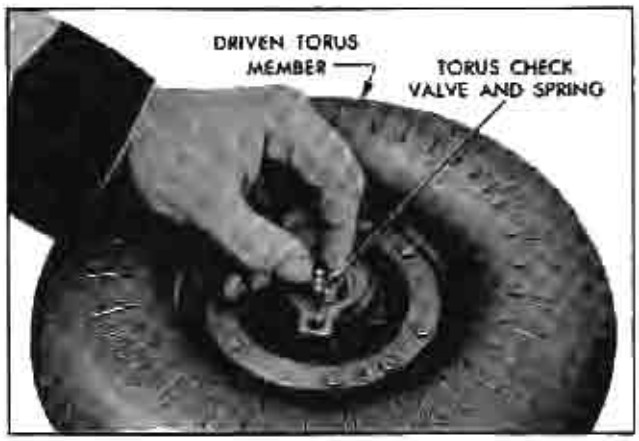


Fig. 145 Installing Torus Check Valve in Driven Torus

Installation ... Page 85

DRIVEN TORUS MEMBER CHECK VALVE

DISASSEMBLY

1. Hold finger or cloth over torus check valve bore and remove cotter pin.

2. Turn torus member over and tap lightly to work valve and spring out.

ASSEMBLY

1. Install spring in torus check valve (Fig. 145).

2. Install spring and check valve into torus member, making sure valve fully seats in bore.

3. Retain valve with cotter pin. NOTE: Check by pushing valve with brass rod to ensure it works freely.

INSTALLATION OF UNITS INTO CASE

CONTENTS OF THIS SECTION

INSTALL DETENT SPRING AND ROLLER

1. Place the detent spring and roller assembly on mounting pad in case and start attaching bolt into tapped hole.

2. While holding the inside detent lever in position in the case to act as a guide while centering the roller in detent, tighten attaching bolt to 15-18 lb. ft. torque (Fig. 147).

3. Bend lock tab of retaining clip against bolt head.

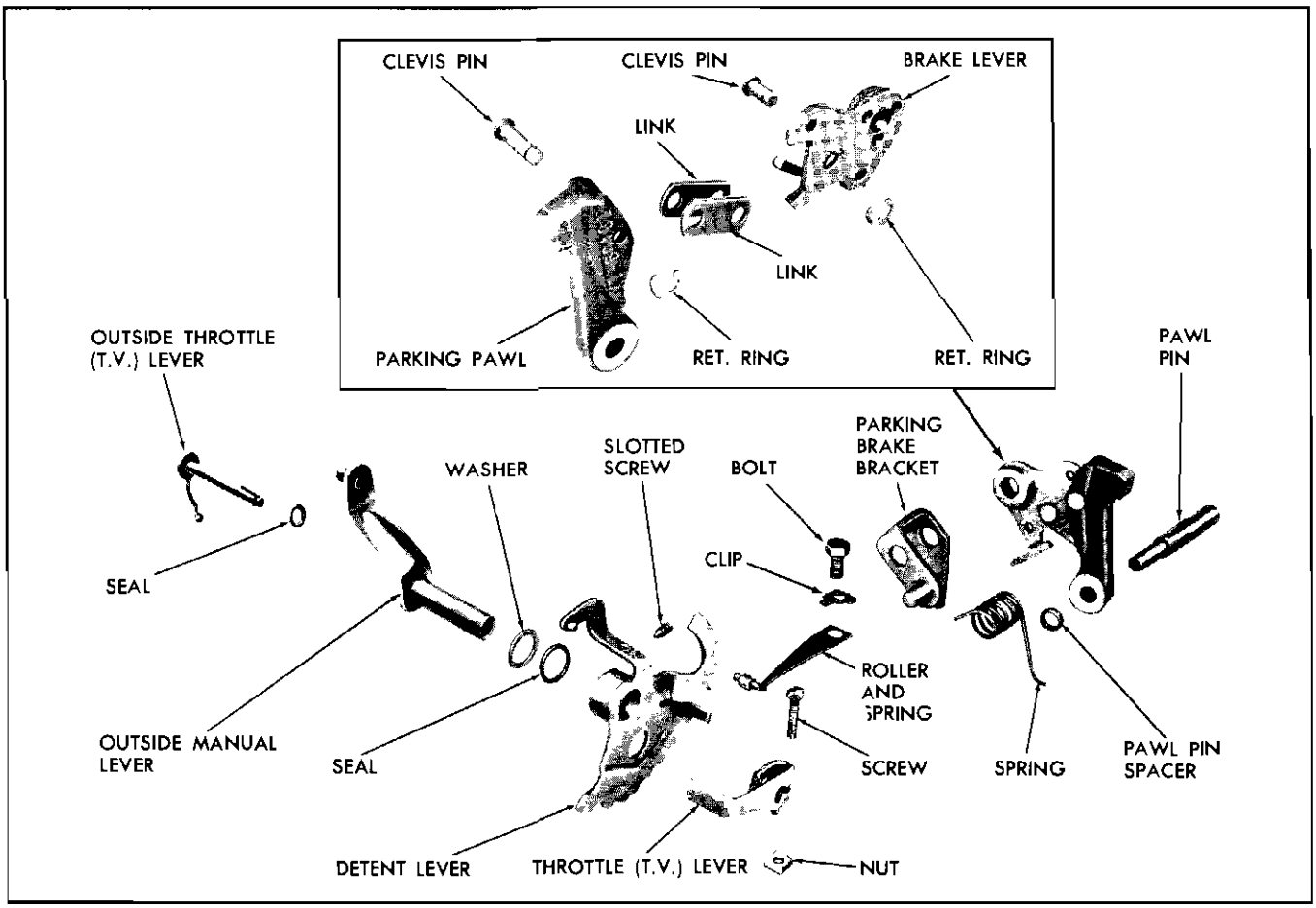


Fig. 146 Parking Brake Parts—Exploded

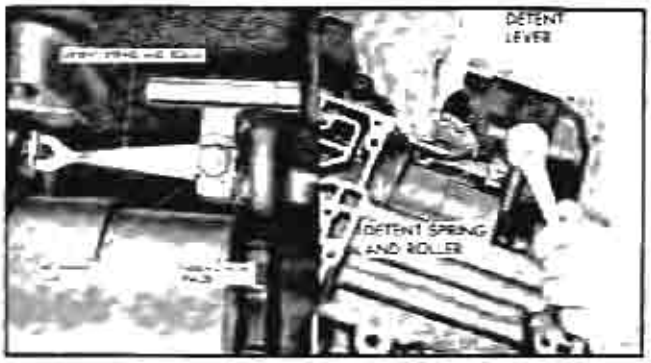


Fig. 147 Installing Detent Spring and Roller

INSTALL PARKING BRAKE LINKAGE

1. Place parking pawl pin spacer (Fig. 146) in recess in case (Fig. 147).

2. Position parking brake pawl and brake lever assembly in case with brake lever on pivot in case. Locate parking pawl at pawl pin hole and insert pin through case, pawl and spacer until shaft bottoms.

3. Position parking brake lever spring in bracket with long end toward rear. Slide bracket and spring assembly onto pivot shaft with short end of spring under parking brake bracket. Hook long end of spring under parking brake lever.

INSTALL INSIDE DETENT AND THROTTLE LEVERS

1. Install a new "O" ring on manual lever shaft.

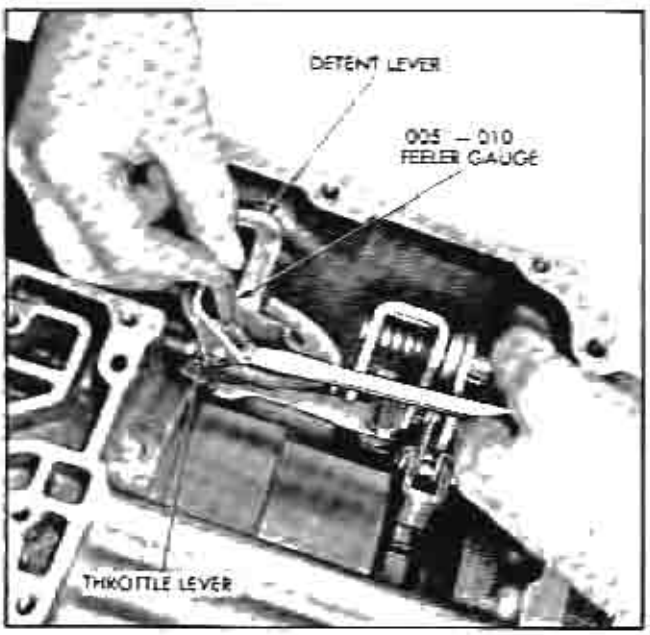


Fig. 148 Installing Inside T.V. Lever

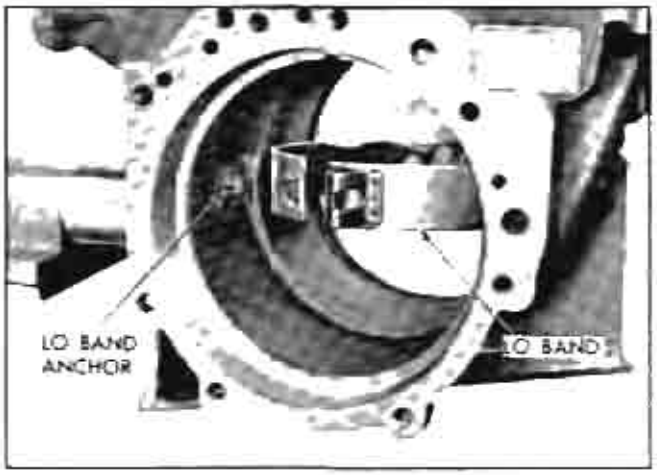


Fig. 149 Installing LO Band

2. Place detent lever in position against the detent roller so that the dowel pin on the parking brake bracket is between the lever and outside of case.

3. Insert the manual lever shaft through side of case, align serrations in detent lever with serrations on shaft and slide lever onto shaft.

4. Tighten set screw while holding lever as shown in Fig. 148.

5. Install a new "O" ring seal on TV lever shaft.

6. Insert the TV shaft through manual lever shaft.

7. Install inside TV lever on TV shaft with lever facing out.

8. Using .005"-.010" feeler gauge between inside TV lever and detent lever (Fig. 148) press TV lever onto TV shaft as far as possible and *tighten lock screw to 10-12 lb. ft. torque.*

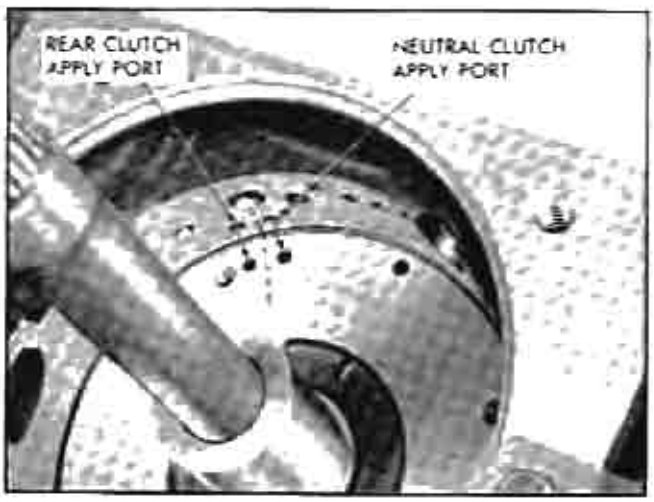


Fig. 150 Alignment of Case Center Support in Transmission Case

9. Pull on outside TV lever to be sure inside TV lever is secure on shaft.

INSTALL LO BAND

1. Install LO band through front end of transmission case with the band ends facing rearward in a horizontal position (Fig. 149). (Anchor support hole should face right hand side.)

2. When band is approximately half-way through transmission case, with band still horizontal, rotate band so that ends are in cavity in case above anchor pin and rotate band into position.

3. Position band end on anchor in the case.

INSTALL REAR UNIT, NEUTRAL CLUTCH, AND CASE SUPPORT

1. Install neutral clutch key in case using petrolatum to hold it in place. Position rounded side toward front to provide lead for guiding neutral clutch drum over key.

2. Install rear unit, neutral clutch, and case support assembly into case as follows:

a. Insert output shaft end of assembly part way into front of case and then rest rear unit drum on case, while holding intermediate shaft.

b. Rotate neutral clutch drum until groove for neutral clutch key is up.

c. With parts aligned, slide assembly into case, engaging neutral clutch drum key with slot in clutch drum. Parts must be aligned so that imaginary center lines through the neutral clutch apply and rear clutch apply ports in case center support intersect like ports in the transmission case (Fig. 150).

When properly installed, snap ring groove in case will be visible at front edge of case support. NOTE: If units fit tightly in case, assembly may be facilitated by pulling on output shaft. Also make sure low band does not cock on rear unit drum and hold unit.

d. With ring gap located opposite oil passages (to eliminate any chance of gap ends damaging bore area at passages), slide snap ring into transmission case against center support. Tap snap ring with screwdriver if necessary to ensure it is seated fully in groove.

INSTALL REVERSE PARTS

1. Install reverse planet carrier on output shaft, aligning splines and pinions (Fig. 151).

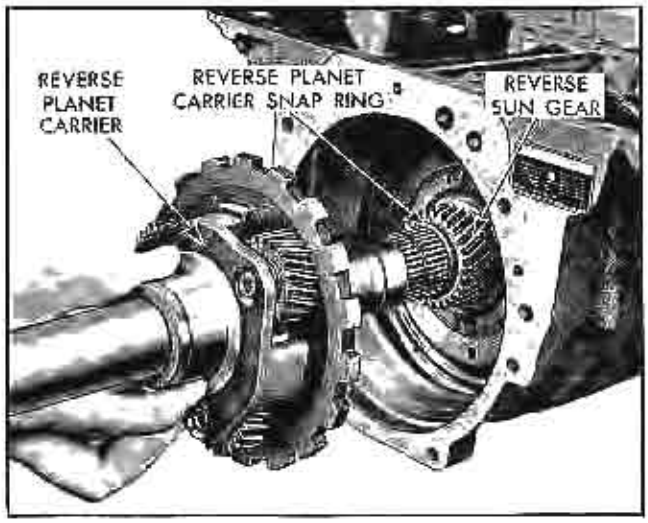


Fig. 151 Installing Reverse Planet Carrier

2. Install reverse stationary cone key in case with rounded side toward rear and retain with petrolatum.

3. Install stationary cone making sure that cone aligns with key. If cone sticks, *tap very gently* until seated.

4. Install reverse clutch release spring on carrier. Tangs must face away from carrier.

5. Install reverse internal gear on carrier (Fig. 152).

6. Place reverse internal gear to reverse clutch housing hub thrust washer against internal gear.

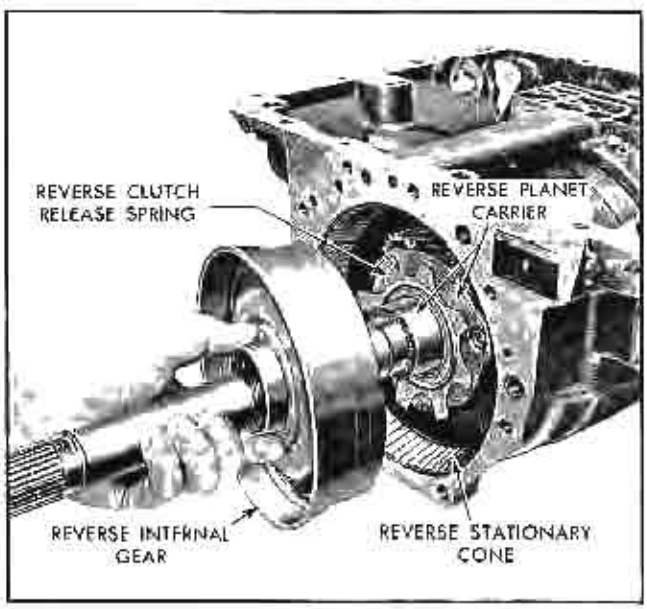


Fig. 152 Installing Reverse Internal Gear

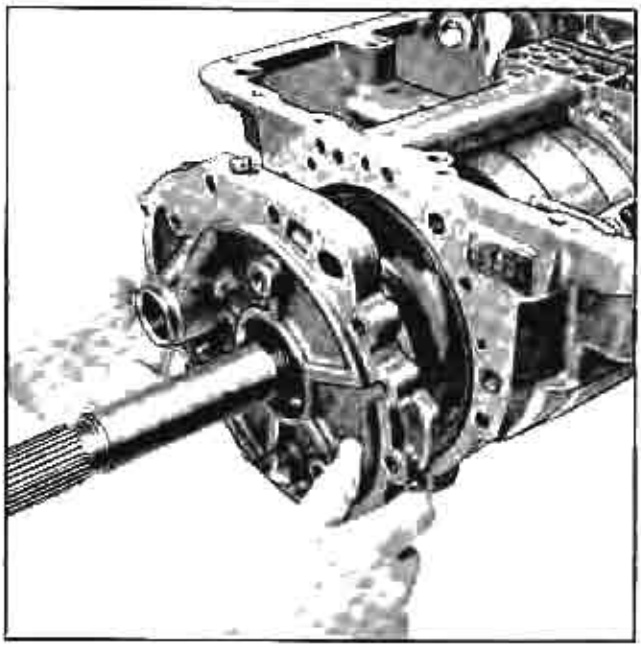


Fig. 153 Installing Reverse Clutch Housing

7. Affix a new gasket to the reverse clutch housing with petrolatum.

8. Install governor feed screen in reverse clutch housing governor feed line.

9. Slide housing over end of output shaft (Fig. 153) and secure to transmission case with one bolt as shown in Fig. 154.

10. Remove rear unit clutch retainer J-6135 from intermediate shaft.

11. Drive rear bearing over output shaft using bearing installer J-6133-A (Fig. 154) until the snap ring groove on output shaft can be seen behind the rear bearing. If bearing is a slip fit on output shaft, slide snap ring over shaft against bearing, pull shaft rearward and push snap ring into groove (Fig. 156); however, if snap ring will not seat in groove, rotate unit to position output shaft down, then drive snap ring into place with installer J-6133-A.

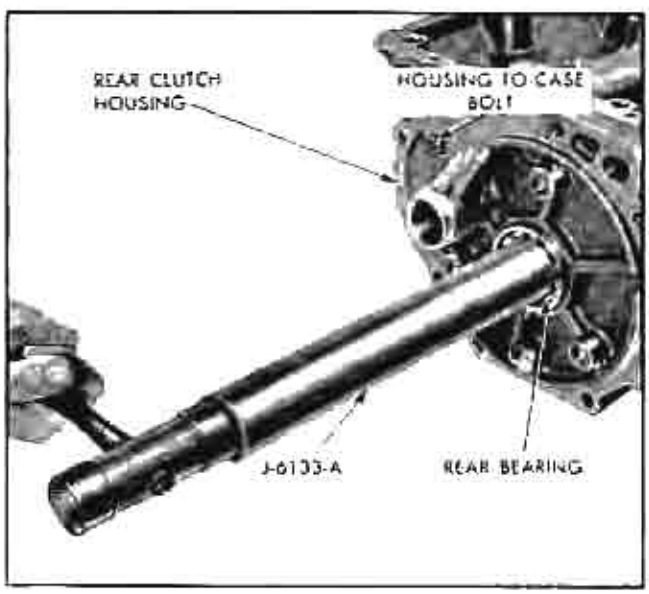


Fig. 154 Installing Rear Bearing

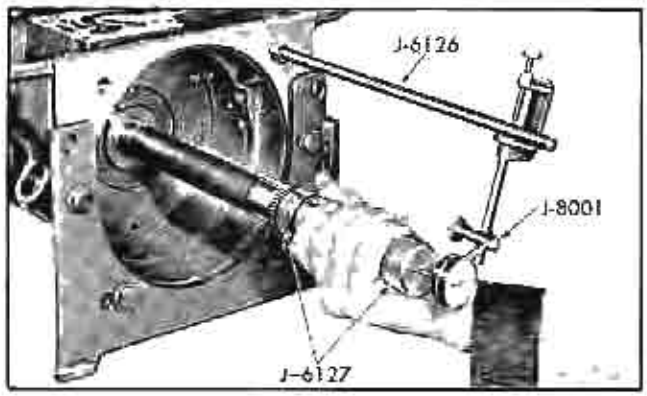


Fig. 155 Checking Mainshaft End Play

12. After bearing retaining snap ring is installed in groove of output shaft, install bearing retaining snap ring in reverse clutch housing.

13. Attach extension housing to transmission case with bolt at each long ear.

14. Check main shaft end play as follows:

a. Install dial indicator support J-6126.

b. Install collar of end play checking fixture J-6127 on intermediate shaft and secure in position by in-

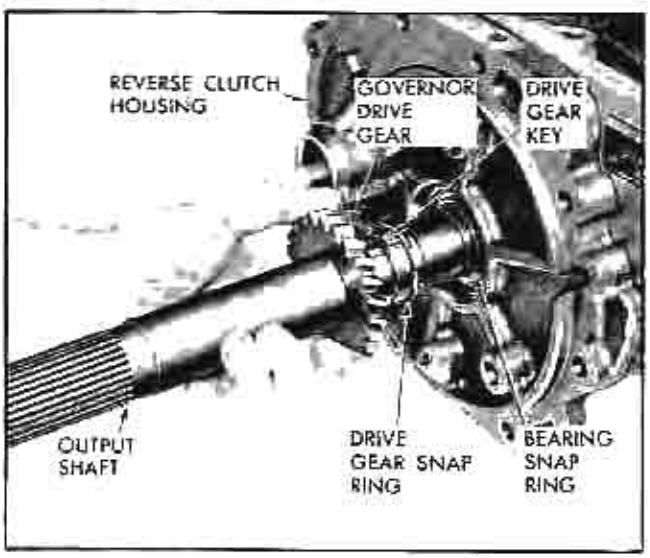


Fig. 156 Installing Governor Drive Gear

stalling Truarc snap ring on main shaft (Fig. 155). Attach fixture to collar by threading fixture securely onto collar.

c. Install J-8001 dial indicator (Fig. 155).

d. Move main shaft back and forth to check end play of main shaft. Be sure to get **free** main shaft end play. Forcing main shaft will give inaccurate reading.

Subtract end play of rear unit sun gear on mainshaft (page 43) from mainshaft end play. The difference is the actual end play of the rear unit and should be .004"-.013". If reading is outside these limits, it is necessary to remove and disassemble the clutch unit so that the correct thrust washer, as selected from table on page 85, can be installed between the rear unit planet carrier and the reverse drive flange.

e. Remove end play checking tool.

15. Remove extension housing.

16. Install governor drive gear front retaining snap ring.

17. Install governor drive gear key in output shaft.

18. Slide governor drive gear on output shaft, locating slot in gear over key (Fig. 156).

19. Install second snap ring to retain governor drive gear.

20. Install governor in reverse clutch housing as follows:

a. Align gaps of rings in up position.

b. Compress rings by hand and work governor into bore in reverse clutch housing.

21. Affix gasket to reverse clutch housing with petrolatum and slide extension housing over output shaft against reverse clutch housing.

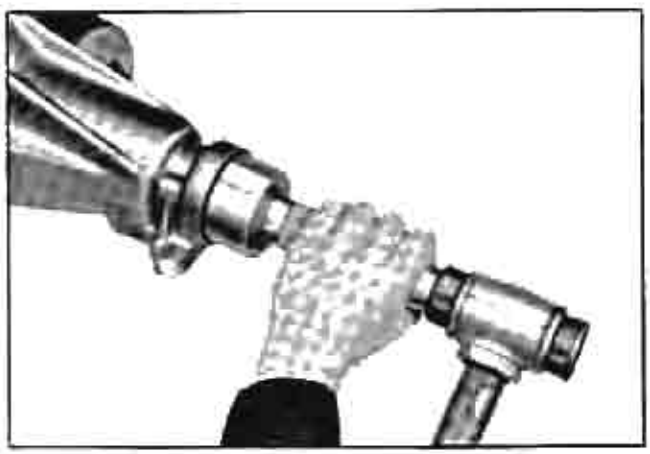


Fig. 157 Installing Rear Oil Seal

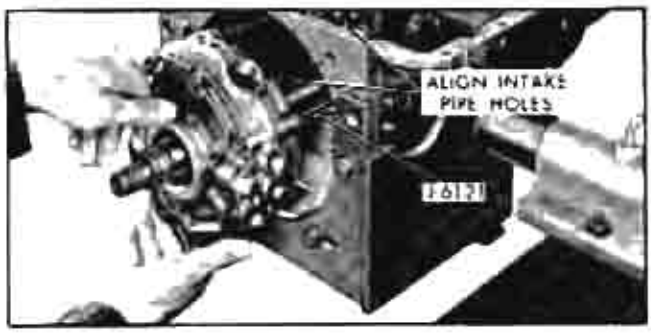


Fig. 158 Installing Pump

22. Thread seven extension housing bolts into case finger tight.

23. Tighten all bolts to 25 lb. ft. torque.

24. If rear oil seal was removed, coat outer casing of new seal with gasket sealing compound and drive seal into housing with installer J-5154-A (Fig. 157).

25. Install speedometer driven gear assembly.

INSTALL PUMP AND OVERRUN CLUTCH

1. Screw two studs from tool J-6121 into two of the three $\frac{3}{8}$" x 16 tapped holes in case center support.

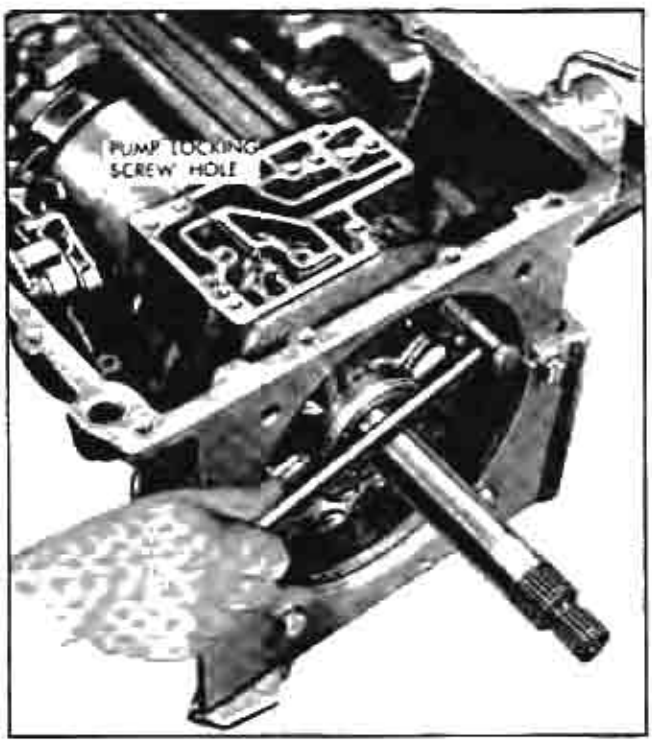


Fig. 159 Rotating Pump and Case Center Support

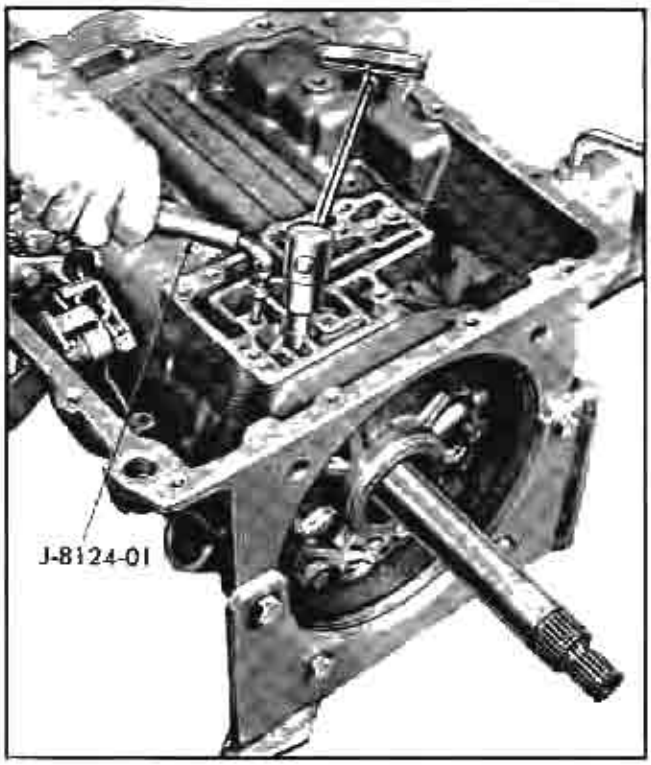


Fig. 160 Applying Air to Position Case Center Support

2. Install the small "O" ring in the rear clutch apply hole in the pump.

3. Pilot pump and overrun clutch assembly over intermediate shaft and studs (Fig. 158) making sure intake pipe holes in pump and case are aligned.

4. Secure pump to case with one screw; then remove two pilot studs and install remaining two screws.

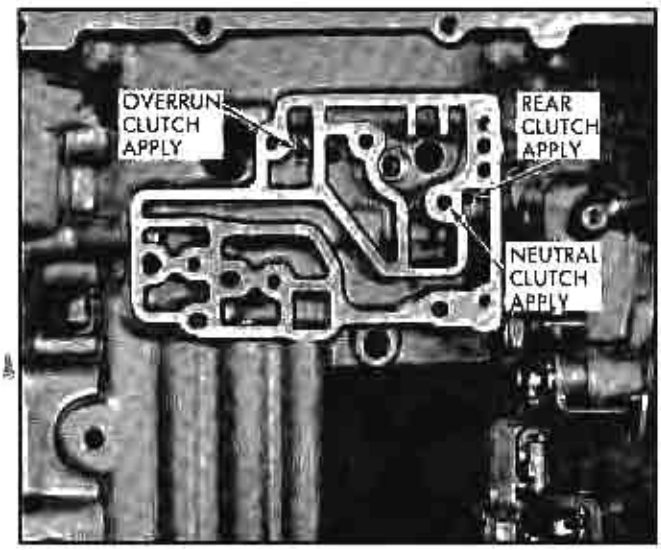


Fig. 161 Air Check Holes

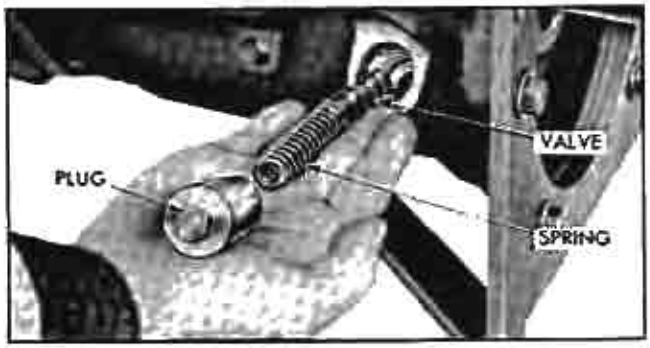


Fig. 162 Installing Pressure Regulator

5. Tighten all three screws then back off ¼ turn.

NOTE: If pump locking screw cannot be installed through case and into pump, the pump and center support can be rotated together as required using one pump screw as illustrated in Fig. 159.

6. Apply air pressure in neutral clutch apply hole (Fig. 160) with blow-gun J-8124-01 to position case center support against snap ring. With air pressure applied, tighten pump locking screw to 25 lb. ft. torque. Then tighten pump to case support screws to 25 lb. ft. torque. NOTE: Pump locking screw must be tightened first to draw pump tightly against case to ensure there is no leak between pump and case.

7. Recheck pump cover screws to ensure they are tightened securely.

8. The overrun clutch, neutral clutch, and the rear clutch should be checked for proper operation by applying air pressure to their respective apply holes in the case (Fig. 161). If operating properly, a distinctive clunk will be heard when the air pressure is

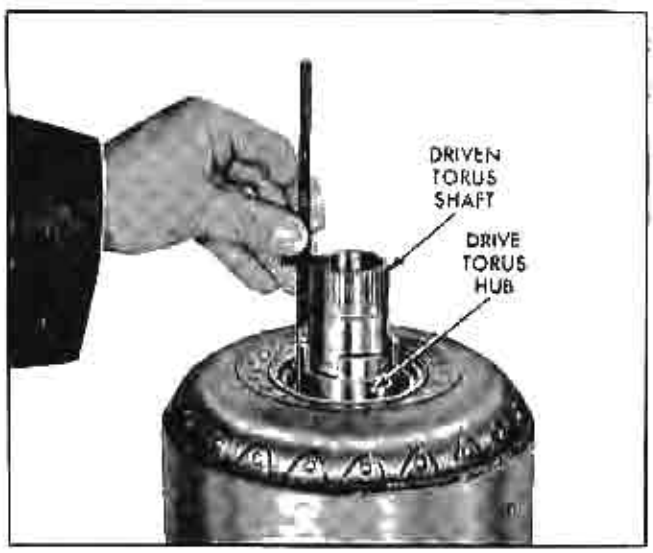


Fig. 163 Measuring Wear of Coupling Thrust Washer

released and the springs return the clutch pistons to their released positions.

PRESSURE REGULATOR

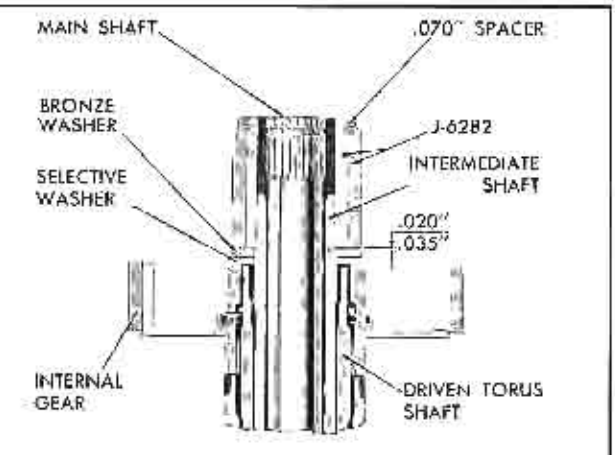
1. With spring assembled to pressure regulator valve, install valve and spring in case (Fig. 162).

2. Install pressure regulator plug assembly (Fig. 162) and tighten to 5 lb. ft. torque. CAUTION: Overtightening of pressure regulator may push pump away from side of case causing an oil leak between passages in pump and passages in case.

FRONT UNIT COUPLING

1. If front unit coupling has not been disassembled, the condition of the thrust washer between the drive and driven members should be checked. To make this check set the unit on a table, cover end down, so that all end play between the drive and driven members is taken up. Then measure the distance from hub of drive member to the end of splined shaft of the driven member (Fig. 163). If this distance is more than $1\frac{47}{64}$" the thrust washer is worn and should be replaced.

2. Install front unit coupling in case, cover end first. Rock driven torus shaft to engage splines on shaft and front sprag inner race, and rock drive torus to make sure hub engages pump rotor. Check rotation of front coupling after installation; the driven torus must turn clockwise only, as viewed from the front.



SELECTIVE WASHER IDENTIFICATION

NO.	THICKNESS	NO.	THICKNESS
1	.045"-.047"	7	.123"-.125"
2	.058"-.060"	8	.136"-.138"
3	.071"-.073"	9	.145"-.151"
4	.084"-.086"	10	.162"-.164"
5	.097"-.099"	11	.175"-.177"
6	.110"-.112"		

Fig. 164 Front Unit Selective Spacer Chart

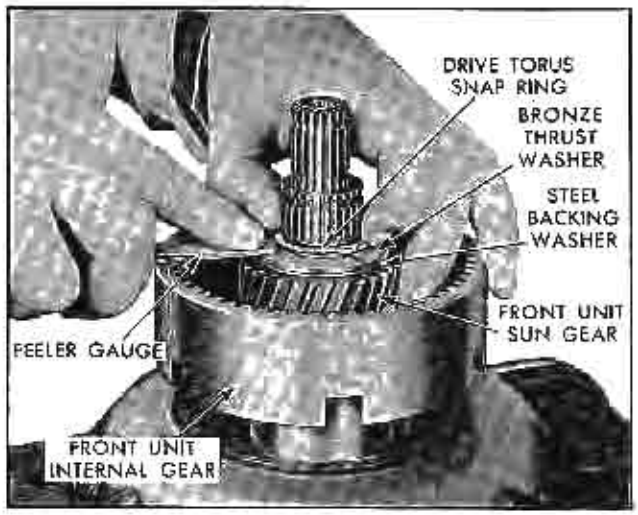


Fig. 165 Measuring Front Unit End Clearance

CAUTION: Install front coupling carefully so as not to break hook type oil rings on driven torus shaft, or on the pump cover neck.

MEASURE FRONT UNIT END CLEARANCE

To control front unit end play a selective spacer is used between the front unit sun gear and the bronze drive torus thrust washer.

Use one of the two methods outlined below to select the correct selective spacer to give a .020"-.035" front unit end clearance.

FEELER GAUGE METHOD

1. Rotate transmission to vertical position with mainshaft up.

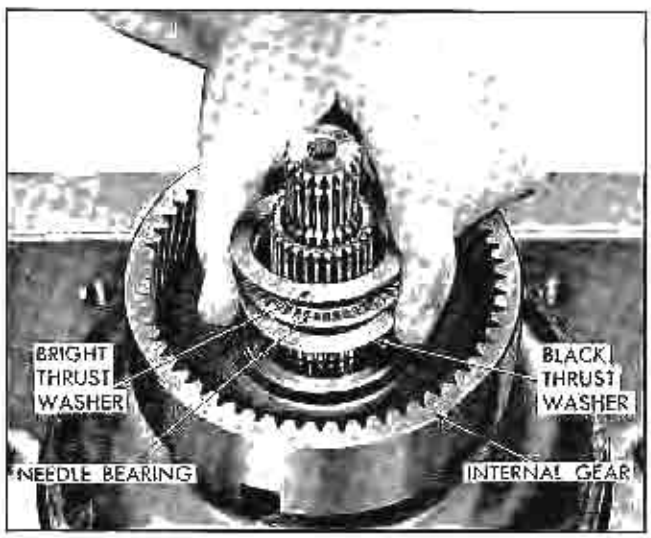


Fig. 166 Installing Internal Gear, Needle Bearing and Washers for Front Unit End Clearance Check

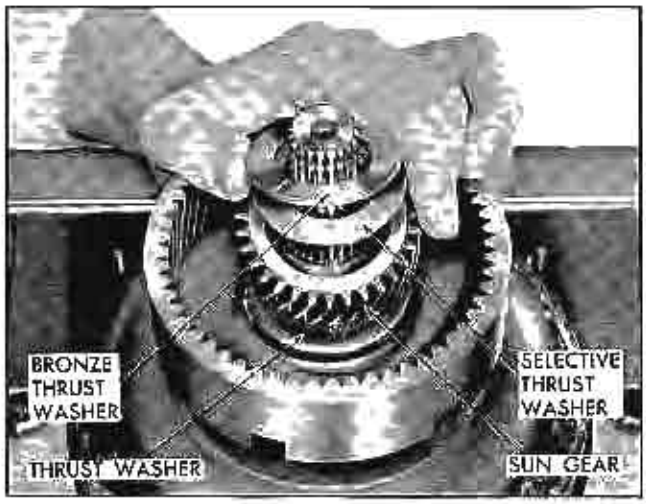


Fig. 167 Installing Sun Gear and Selective Washer for Front Unit End Clearance Check

2. Install front unit internal gear.

3. Install (black) steel thrust washer, needle bearing, and second (bright) steel thrust washer in recess of hub of internal gear.

4. Install snap ring in groove of driven torus shaft.

5. Slide front unit sun gear onto shaft of driven torus.

6. Lay a No. 1 (.046") steel selective washer (spacer) against sun gear followed by bronze thrust washer.

7. Install drive torus snap ring in groove on intermediate shaft next to bronze thrust washer.

8. Push intermediate shaft and sun gear firmly to rear of transmission (Fig. 165) to make sure all end play is taken up.

9. Push snap ring down against rear of groove and very carefully measure clearance between snap ring and bronze thrust washer using a set of feeler gauges (Fig. 165). CAUTION: The feeler gauge must be flat against the thrust washer to obtain an accurate reading.

10. Compare measurement found with feeler gauge with the chart in Fig. 164 to determine the correct selective spacer washer to use.

Example: If the feeler gauge measurement is .067", a No. 4 (.084"-.086") selective washer must be used to obtain the desired clearance of .020"-.035". This is determined by adding the mean thickness (.046") of No. 1 washer to gauge reading giving total thickness of .113". Then subtract thickness of No. 4 washer (.085"); this gives .028" which is within desirable clearance.

11. Remove snap ring, sun gear with bronze washer and steel selective spacer, snap ring, and internal gear with steel spacers and roller thrust bearing.

12. Remove front unit coupling.

SPECIAL TOOL METHOD

1. Rotate transmission to the vertical position with the intermediate shaft up.

2. Install front unit internal gear over coupling driven shaft (Fig. 166).

3. Install (black) steel washer needle bearing and second (bright) steel thrust washer over the coupling driven shaft and into recess in internal gear.

4. Install large snap ring over coupling driven shaft.

5. Install front unit sun gear with recessed side over snap ring (Fig. 167).

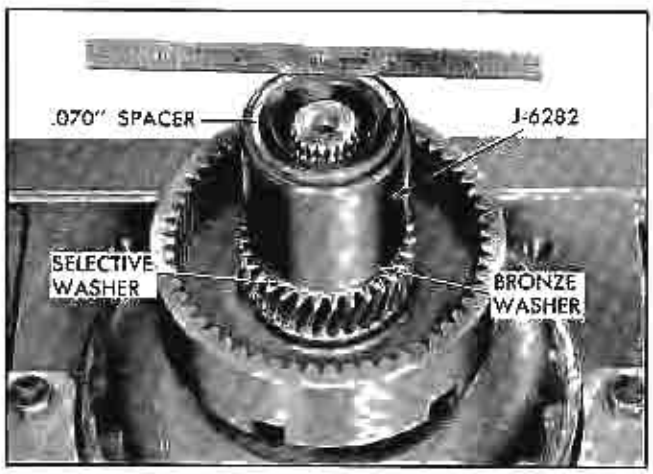


Fig. 168 Selecting Front Unit Spacer Using Special Tool

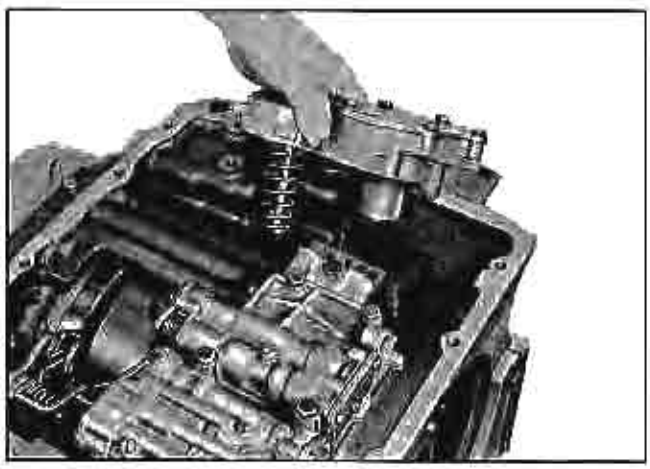


Fig. 169 Installing Servo and Accumulator Assembly

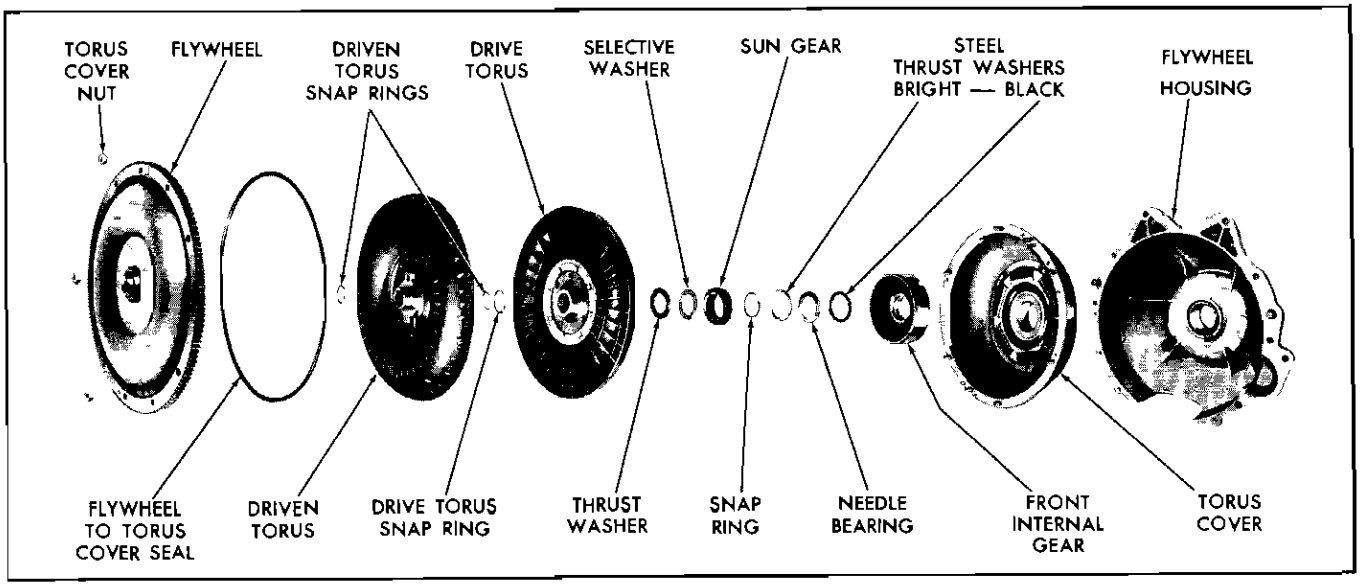


Fig. 170 Flywheel Housing and Torus Parts—Exploded

6. Install steel selective spacer and bronze thrust washer against sun gear.

7. Place end play gauge J-6282 over intermediate shaft (Fig. 168).

8. Place a No. 1 spacer (part number 8616703), on tool and check to see that spacer is flush with inner sleeve of tool. If spacer is not flush, remove tool and bronze thrust washer and replace selective spacer with one of proper size.

9. Remove tool, washers, sun gear, snap ring, and internal gear with washers and bearing.

10. Remove front unit coupling.

CONTROL VALVE ASSEMBLY AND SERVO AND ACCUMULATOR

1. Rotate transmission to horizontal position.

2. Attach control valve assembly to transmission with five attaching screws.

NOTE: Position the detent lever so that pin indexes with the manual valve. The dowel pin in manual body must index with hole provided in the transmission case.

3. Install new "O" rings in the screen and pump if they were not previously installed.

4. Lay the servo and accumulator assembly with servo release spring in position (Fig. 169) and attach to the case with two bolts. Do not tighten the long bolt which also retains the pump intake pipe clip.

5. Insert the intake pipe (dimple end) into the screen being careful not to cut the "O" ring.

6. Insert the other end of pipe in the pump and align the screen with the retaining clip on clutch valve body.

7. Rotate the pipe retaining clip over the pipe and tighten the long servo attaching bolt.

INSTALL INTAKE PIPE, OIL STRAINER, AND OIL PAN

1. Install pump intake pipe in case and secure with clip and valve body attaching screw.

2. Install oil screen on pump intake pipe and screen retaining clip.

3. Install oil pan with new gasket and tighten screws securely.

INSPECT FLYWHEEL HOUSING AND TORUS MEMBERS

1. Inspect torus cover hub bushing in center hole of flywheel housing (Fig. 170) to see that it is not worn excessively or damaged. Replace housing if bushing is damaged. Inspect seal and replace if cracked, hard, or damaged.

2. Inspect seal groove on back side of housing to see that it is not scratched or burred. Clean up any scratches or burrs to prevent possible leakage.

3. Inspect outer diameter of torus cover hub for score marks. Inspect beveled edge just inside flywheel attaching bolts. Carefully remove scratches or burrs to assure proper flywheel to torus cover seal.

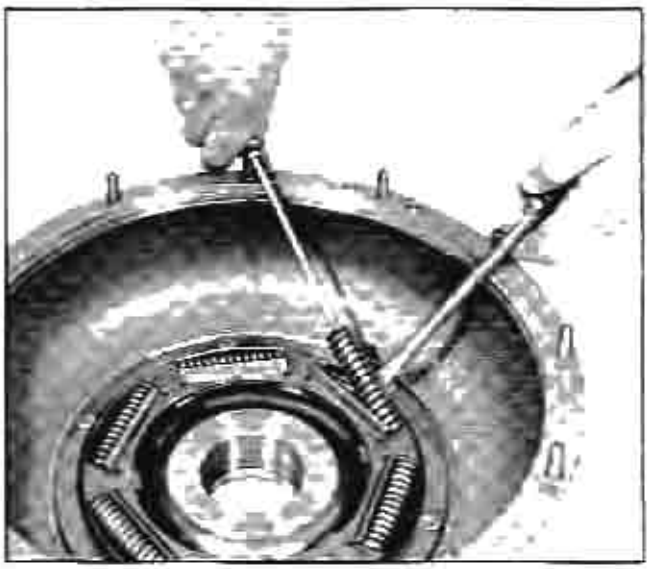


Fig. 171 Removing Torus Cover Damper Spring

4. Check torus cover for leaks.

5. Inspect face on flywheel against which flywheel to torus cover seal bears to make sure there are no scratches or burrs which could cause leakage. Inspect pilot bushing in center of flywheel and pilot on front of flywheel to see that they are not scored or damaged.

6. Inspect front unit internal gear for damaged gear teeth, worn drive lugs or broken welds.

7. Inspect steel spacer and bronze thrust washers for excessive wear.

8. Inspect front unit sun gear splines and gear teeth for excessive wear or damage.

9. Inspect drive torus member. Vanes must be tight and hub must be tight on shell. Check planet carrier for worn or damaged teeth or worn bearings.

10. Inspect driven torus member for loose vanes, worn splines, or damaged bushing.

11. Inspect torus check valve in its bore in driven torus to see that it operates freely. Inspect torus check valve spring for collapsed or distorted coils and proper free length (page 101).

12. Torus cover damper springs may be replaced, if necessary, in following manner:

a. Insert screwdriver in end of spring and twist to raise spring.

b. Place second screwdriver under spring and pry out of cover (Fig. 171).

c. Hook one end of new spring over tang of torus cover drive plate.

d. Using screwdriver, guide other end and press into place with thumb (Fig. 172).

INSTALL FLYWHEEL HOUSING AND TORUS MEMBERS

1. If holding fixture J-6115 is used, remove fixture from bench collet and place on jack or bench in horizontal position with pan down. Remove holding fixture.

If holding fixture J-8763 is used, transmission and fixture may be left in bench collet until entire reassembly has been completed.

2. Install front unit coupling, rotating driven torus counterclockwise as required to engage shaft splines in splines of front sprag inner race. Also rotate coupling to permit lugs to engage pump rotor.

3. Place protector J-6119 over intermediate shaft (Fig. 173).

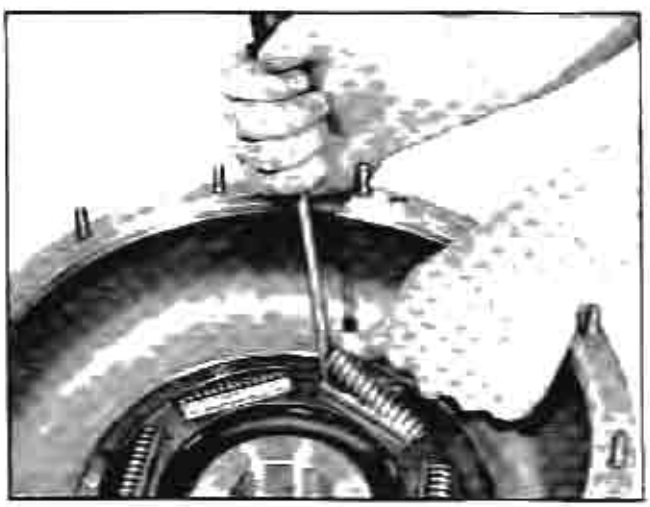


Fig. 172 Installing Torus Cover Damper Spring

Fig. 173—Flywheel Housing Bushing and Seal Protector

4. Lay new flywheel housing to case "O" ring in groove provided in housing.

5. Pilot flywheel housing into position against case and secure with six bolts, torqued to 40-50 lb. ft.

6. Remove protector J-6119 and apply coat of Hydra-Matic oil to hub of torus cover.

7. Slide torus cover into place carefully so as not to injure flywheel housing oil seal.

8. Install front unit internal gear in torus cover making sure lugs of gear engage those of front coupling drive torus (Fig. 174).

9. Install (black) steel thrust washer, needle bearing and second (bright) steel thrust washer in internal gear (Fig. 174).

10. Secure needle bearing and washers by installing snap ring in groove of front coupling driven torus shaft (Fig. 175).

11. Install sun gear with recess side facing toward needle bearing.

12. Install selective washer as previously determined by front unit end clearance check.

13. Place bronze thrust washer against selective washer.

14. Install drive torus member on intermediate shaft indexing front unit planet carrier with sun gear and internal gear.

15. Secure drive torus to intermediate shaft with snap ring.

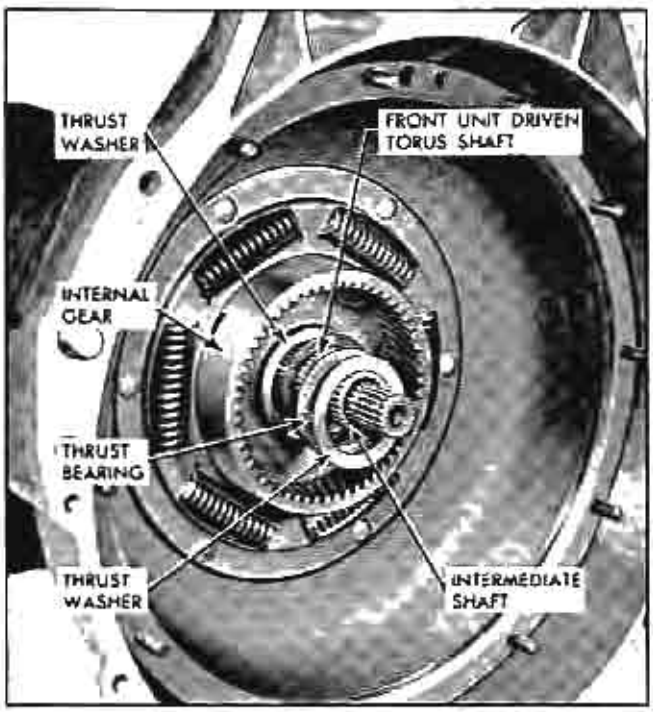


Fig. 174 Installing Front Unit Gear Needle Bearing and Thrust Washer

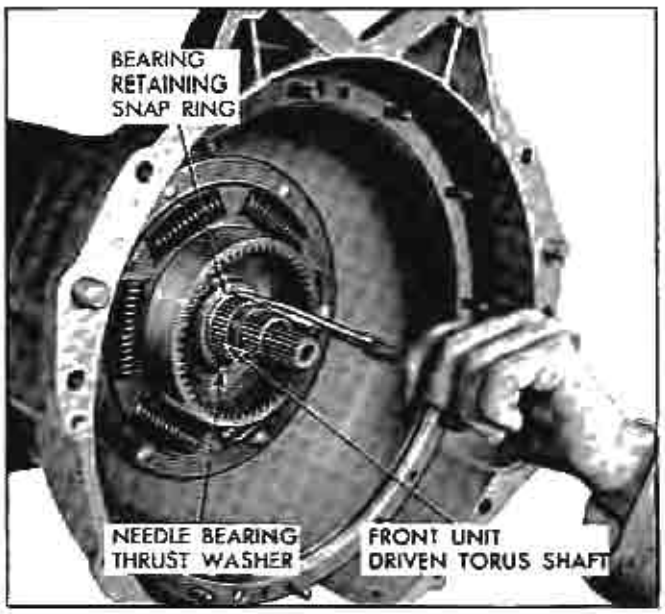


Fig. 175 Installing Bearing Retaining Snap Ring

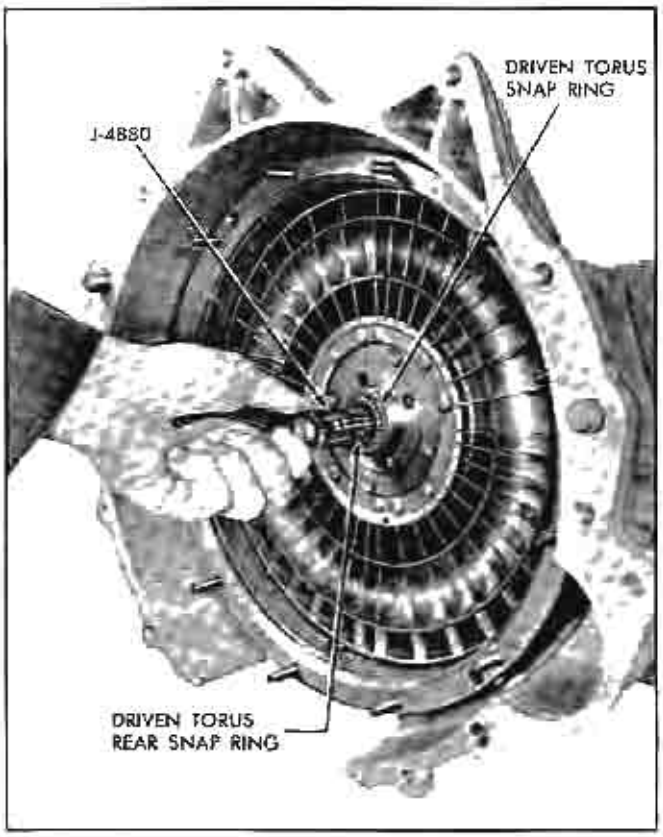


Fig. 176 Installing Driven Torus Rear Snap Ring

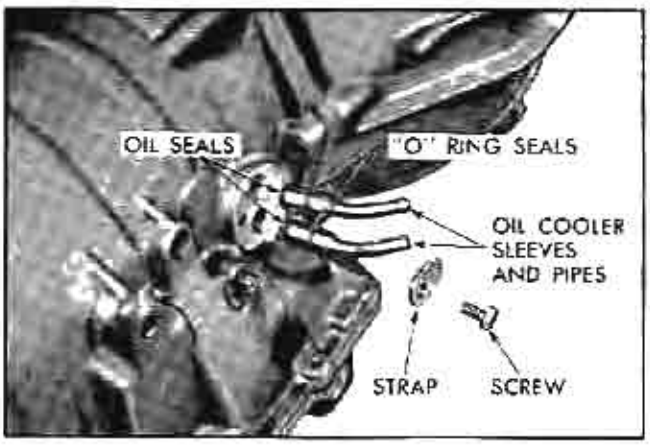


Fig. 177 Oil Cooler Sleeves and Seals

16. Install driven torus rear Truarc snap ring on main shaft (Fig. 176).

17. Install driven torus member on main shaft.

18. Secure driven torus on main shaft with Truarc snap ring.

19. Install "O" ring seal on flywheel and position flywheel against torus cover, indexing with dowels. NOTE: The flywheel can be installed in only one position since the dowels are of different sizes.

20. Install six flywheel to torus cover nuts leaving nuts off every second bolt. Tighten nuts to 15-20 lb. ft. torque. The remaining six bolts are used for attaching the flywheel and torus cover to the engine flex plate.

INSTALL OIL COOLER SLEEVES AND TV PIPE PLUG

1. Assemble sleeve seals and "O" rings on oil cooler sleeves (Fig. 177).

2. Insert sleeves in case, seal end first, and bolt strap to case.

3. Install pipe plug in TV pressure take-off tapped hole on right side of case if previously removed.

INSTALLATION OF TRANSMISSION

1. Install breather pipe and pipe clip attaching bolt.

2. Install rear mount on transmission with four attaching screws.

3. Install rubber insulators on rear mount and then install rear mount support on the insulators.

4. Raise transmission on special automatic jack until engine flex plate and transmission flywheel and torus cover are at the same level.

5. Move transmission into position engaging flywheel housing dowels into engine and torus cover bolts into flex plate.

6. Install and tighten two flywheel housing attaching screws. NOTE: If pilot on flywheel has entered end of crankshaft properly, flywheel and torus cover should move back and forth slightly.

7. Rotate flywheel to bring one flex plate mounting pad down to lowest position. Push flywheel forward lightly to seat it against crankshaft. Measure clearance between pad on flex plate and flywheel with feeler gauge. Clearance should be .015" minimum.

If clearance is less than .015", move transmission away from engine and install special spacer (Gr 0.666) over flywheel pilot (Fig. 178) and move transmission back into place installing two attaching bolts to hold it forward.

8. Install control rod splash shield, starter, and the rest of the flywheel housing to engine attaching bolts.

9. If not previously done, tighten torus drain plug in flywheel to 6-7 lb. ft. torque using SIX-POINT SOCKET.

10. Install nuts which retain flex plate to flywheel and torus cover and tighten to 15 lb. ft. torque using torque wrench with extension J-6498 (Fig. 179).

11. Install flywheel housing cover with three attaching bolts.

12. Install both wires on starter.

13. Raise transmission as far as necessary and install frame crossmember in the frame. Before locating crossmember in final position, install parking brake cable guide rod and parking brake return spring to frame crossmember. Brake cables go above crossmember.

14. Attach crossmember with two attaching bolts at each end.

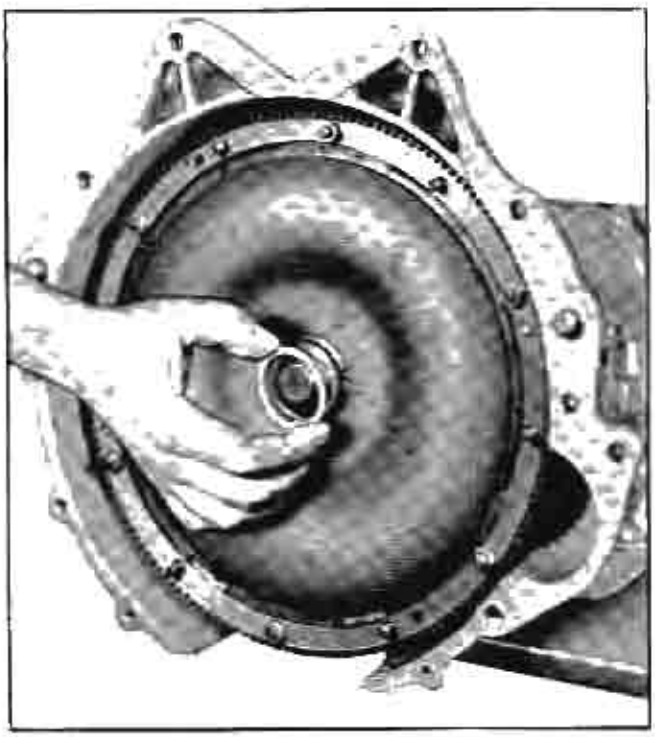


Fig. 178 Installing Spacer on Flywheel Pilot

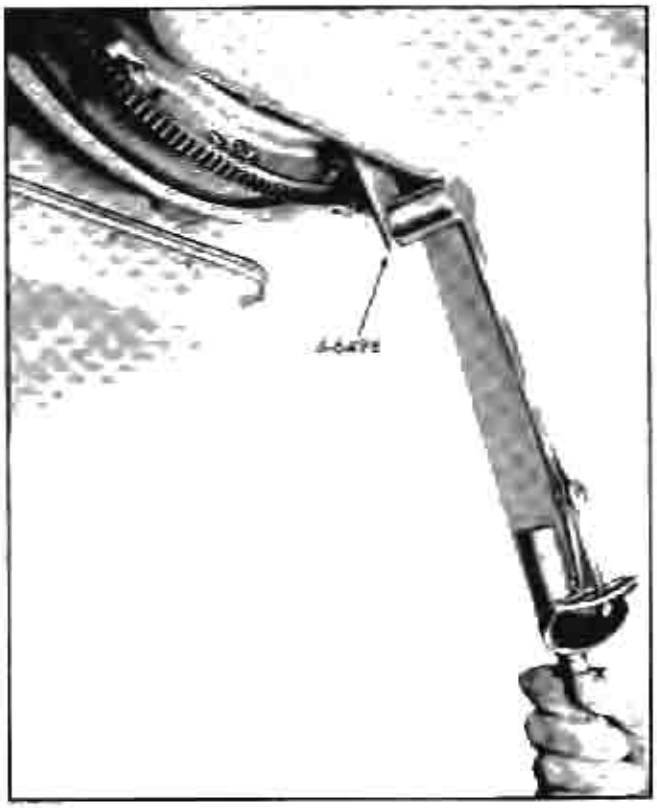


Fig. 179 Using Torque Wrench Extension J-6498

15. Lower the transmission so that the two rear mount support studs go through the crossmember bracket. Install nuts. Remove transmission jack.

16. Slide propeller shaft onto transmission output shaft.

17. Remove tape or rubber band from U-joint bearings and assemble U-joint. Bend locking plate.

18. Attach oil cooler lines using new hoses if necessary.

19. Install throttle idler lever.

20. Install T.V. upper control rod and T.V. lower control rod.

21. Install gearshift cross shaft lever and its mounting bracket.

22. Install gearshift lower control rod.

23. Connect speedometer cable.

24. Connect filler pipe to oil pan.

After car has been lowered from hoist, connect the battery cable that was removed.

Refill transmission with fluid as described on page 41 and adjust T.V. linkage as described on page 36.

TESTING AND DIAGNOSIS

CONTENTS OF THIS SECTION

TESTING AND DIAGNOSING OPERATING CONDITIONS

Before any testing or diagnosis is attempted, fluid level must be checked as outlined on page 38 and brought to the proper level. Insufficient fluid can cause slipping, jerking, erratic shifting, etc. Excessive fluid will promote leakage and foaming.

OIL PRESSURE TEST

1. Connect Oil Pressure Gauge J-5907 to take-off hole at bottom of reverse clutch housing (Fig. 180).

2. Start engine and operate for several minutes to warm transmission oil to normal operating temperature (approx. 175° F.).

3. When transmission is thoroughly warm, check pressure in all ranges. Pressure should be 50 lbs. minimum in P, N, both DR ranges and L (low) with a maximum variation of 10 lbs. between ranges, but may be higher in reverse.

4. Drive car on road and check pressure in DR right position at approximately 25 mph. Pressure should be 90-100 psi. NOTE: Pressure at any speed is constant regardless of throttle position.

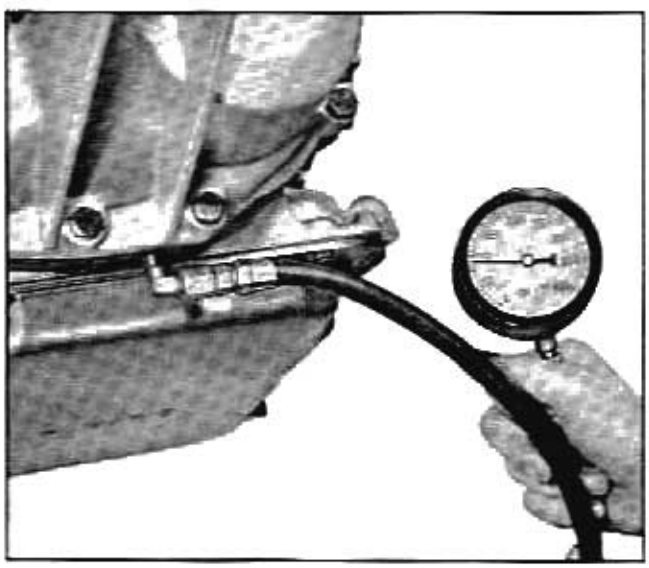


Fig. 180 Gauge Attached for Oil Pressure Test

5. While driving at 25 mph move selector back to DR left position so transmission will shift into fourth speed. Oil pressure should drop to 60-70 psi in fourth. NOTE: To reduce the amount of work done by the front pump, pressure is directed from the 3-4 shift valve to the pressure regulator to reduce line pressure in fourth speed when in the DR left position. In DR right position line pressure remains at 90-100 psi in fourth speed.

6. Check pressure in reverse as follows:

a. Stop car and set hand brake firmly.

b. Place selector lever in R (reverse), apply foot brake and open accelerator to half throttle. Pressure should increase to 150 to 200 lbs.

Diagnosis of malfunctions can frequently be aided by noting oil pressure under all operating conditions while driving on the road.

ROAD TEST FOR DIAGNOSIS OF MALFUNCTIONS

A predetermined test route should be established to save time and permit comparison of different cars over the same route. Where possible the route should be laid out to include a hilly section to test for full throttle upshift, slippage and throttle downshifts, a level section for testing upshift points and a quiet section for testing for noise. When a chassis dynamometer is available, it may be used as a substitute for the road test.

It will be observed that the closed throttle downshifts in DR left and the 3-2 downshift in DR right cannot be distinguished. The reason is that in DR left the sprags in both units free wheel when power input is from the rear wheels. The free wheeling of the front unit is eliminated in DR right by the use of the overrun clutch in order to provide engine braking on hills or whenever desirable. In L (low) range the Lo band applies to prevent free wheeling of the rear sprag and provide further engine braking.

If possible a pressure gauge should be installed and pressure should be checked in all speeds while car is being operated on road.

Shift speeds should be checked according to Fig. 181.

Abnormal operating conditions should be noted during road test. Always write down the conditions noted or check them on the **Diagnosis Guide.** Diagnosis may be aided by referring to the schematic oil circuit diagram (Fig. 182).

INSTRUCTIONS FOR USING 1961 DIAGNOSIS GUIDE

1. Before testing the operation of the transmission, check fluid for proper level with transmission warm and engine operating at normal idle speed (see page 38). Fluid must be at proper level before testing.

2. Connect pressure gauge before road testing so that pressures can be observed during road test.

3. When checking shift points keep in mind that there may be a slight variation from the speeds shown in the shift speed chart (Fig. 181). Slight variations are no cause for adjustment providing shifts are smooth.

4. During road test record conditions observed so that they can be diagnosed accurately using the **Diagnosis Guide.**

UPSHIFTS

Shift	Left Drive Range		Right Drive Range		Lo Range	
	Minimum Throttle	Full Throttle	Minimum Throttle	Full Throttle	Minimum Throttle	Full Throttle
1-2	5-9	11-15	5-9	11-15	4-9	11-15
2-3	11-15	39-43	11-15	39-43	—	47-54
3-4	21-25	65-75	—	74-80	—	74-80

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
4-3	18-15*	70-33	74-68	74-28	70-60	70-28
3-2	10-6*	25-14	10-6	25-14	48-44	48-44
2-1	8-3*	12-3	8-3*	12-3	8-3	12-3

Fig. 181 Shift Speed Chart

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 fourth speed at about 35 mph or less, partially depressing the accelerator pedal will cause the fourth to third downshift.

*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.

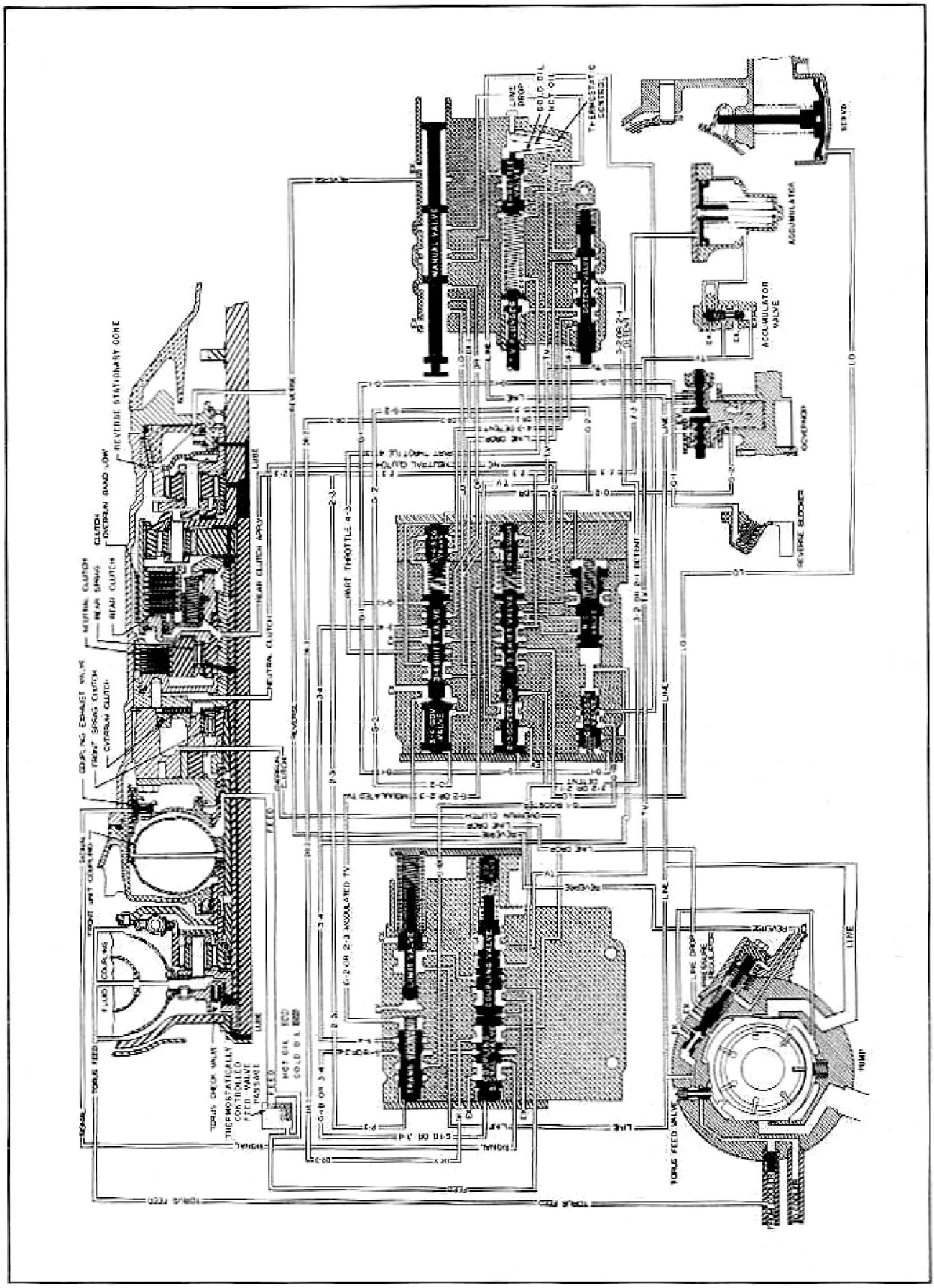


Fig. 182 Schematic Oil Circuit Diagram

DIAGNOSIS GUIDE

A. *SLIPS IN 1ST AND 3RD*

1. Front sprag clutch slipping
2. Front sprag clutch broken

B. *SLIPS IN OR MISSES 2ND AND 4TH*

1. Front unit torus cover seals leaking
2. Front unit torus cover exhaust valves sticking or missing
3. Front unit torus cover feed restriction or leak
4. Front unit torus cover signal restriction or leak
5. Low oil pressure
6. Coupling valve sticking
7. Sticking valves or dirt in valve body
8. Coupling snap ring improperly installed, or missing
9. Limit valve
10. Coupling passage restricted or leaking
11. Front unit torus vanes damaged

C. *SLIPS IN ALL DR RANGES*

1. Manual linkage
2. Neutral clutch slipping or burned
3. Neutral clutch apply restricted or leaking (case support or valve body)
4. Incorrect number of neutral clutch plates
5. Low oil pressure
6. Control valve
7. Torus members (check valve)
8. Intake pipe "O" ring damaged or missing
9. Pressure regulator valve stuck in pump
10. Pump slide stuck

D. *SLIPS IN 1ST AND 2ND (DR RANGE)*

1. Rear sprag clutch slipping or improperly assembled
2. Rear sprag clutch broken
3. Neutral clutch
   a. Burned
   b. Restricted
   c. Piston sticking

E. *SLIPS IN 3RD AND 4TH*

1. Rear unit clutch slipping or burned
2. Rear unit clutch apply restricted or "O" ring leaking
3. Incorrect number of clutch plates (rear)
4. Accumulator
5. Center support, leak at 2-3 passage
6. Low oil pressure
7. Accumulator valve stuck—3rd only

F. *SLIPS IN 3RD IN DR RIGHT ON COAST*

1. Overrun clutch slipping or burned
2. Overrun clutch apply restricted or leaking
3. Sticking valves or dirt in valve body
4. Overrun clutch passages restricted or leaking

G. *SLIPS IN 1ST AND 2ND IN LO RANGE ON COAST*

1. Low servo apply restricted or leaking
2. Lo band not anchored to case or broken
3. Low servo piston and rod binding in case or servo and accumulator body
4. Band facing worn or loose
5. Anchor dowel pin loose or missing in case

H. *NO DRIVE IN DR RANGE*

1. Manual linkage incorrectly adjusted
2. Manual valve not engaged with drive pin
3. Low oil pressure
4. Pressure regulator stuck
5. Pump intake pipe improperly installed
6. Front sprag broken
   a. Pump bushing
   b. Front unit drive torus shaft
7. Front and/or rear sprag incorrectly installed
8. Rear sprag broken
9. Front sprag inner race broken
10. Rear sprag outer race broken
11. Neutral clutch plates burned
12. Neutral clutch piston
13. Control valve
14. Pump

I. *NO UPSHIFTS OR ERRATIC*

1. Governor valves stuck
2. Broken governor rings
3. Sticking valves or dirt in valve body
4. G-2 bushing turned

J. *MISSES 2ND*

1. Governor boost valve stuck closed
2. Transition valve stuck away from plate
3. Sticking valves or dirt in valve body
4. Governor sticking

K. *MISSES 3RD—OR 2-4-3*

1. Transition valve sticking
2. Sticking valves or dirt in valve body
3. TV adjustment—too long
4. Rear clutch
5. Transition valve spring

L. *LOCKS UP IN 2ND AND 4TH*

1. Front sprag clutch broken or reversed.
2. Overrun clutch applied or sticking

M. *LOCKS UP IN 3RD AND 4TH*

1. Rear sprag clutch broken
2. Lo band not releasing

N. *ROUGH 2-3*

1. Accumulator valve stuck
2. Accumulator piston stuck
3. Accumulator gasket broken or leaking
4. Restricted or leaking oil passages
5. Broken accumulator spring
6. Broken or leaking piston oil seal rings
7. Control valve
8. TV adjusted incorrectly
9. Rear clutch pack
10. Case passages
    a. TV oil
    b. 2-3 oil
    c. Leaks or restrictions

O. *UPSHIFTS HIGH*

1. Throttle linkage adjusted short
2. Governor valves sticking
3. Broken governor rings
4. Sticking valves or dirt in valve body
5. Leaking or restricted main line feed to governor

P. *UPSHIFTS LOW*

1. Throttle linkage adjusted long
2. Governor valves sticking
3. Broken governor rings
4. Sticking valves or dirt in valve body
5. Leaking TV oil

Q. *NO REVERSE, SLIPS OR LOCKS UP*

1. Manual linkage incorrectly adjusted
2. Manual valve not engaged with drive pin
3. Reverse piston apply restricted or leaking
4. Low oil pressure
5. Pressure regulator
6. Neutral clutch not released
7. Flash restricting neutral clutch exhaust port on manual body

R. *SELECTOR LEVER WILL NOT GO INTO REVERSE*

1. Governor valves sticking
2. Broken governor rings
3. Reverse blocker piston stuck
4. Manual linkage interference

S. *REVERSE DRIVE IN NEUTRAL*

1. Reverse stationary cone sticking

T. *DELAYED 1-2*

1. Coupling valve sticking
2. Governor boost valve sticking
3. G-1 valve sticking
4. Wrong spring on coupling valve

U. *DRIVE IN LO RANGE ONLY*

1. Rear sprag broken
2. Neutral clutch not applying

V. NO FORCED DOWNSHIFTS 4-3 OR 3-2

1. Control valve
2. Linkage

W. *2-3 RUNAWAY OR 2-1-3*

1. 2-3 passage in center bearing support
2. Plug out of accumulator
3. Rear clutch burned
4. Valve body
   a. Transition valve
   b. Case passages—2-3 circuit

X. *WILL NOT GO INTO PARK*

1. Parking links broken
2. Interference—parking mechanical
3. Linkage—manual
4. Parking pawl

Y. *STARTS IN 2ND SPEED*

1. Valves sticking
2. Governor sticking
3. Governor boost valve stuck

Z-1 DRIVES FORWARD IN REVERSE AND NEUTRAL

1. Neutral clutch piston stuck in applied position

Z-2 LUNGES FORWARD BEFORE BACK UP WHEN PLACING SELECTOR IN REVERSE

1. G-2 plunger stuck in the outward position
2. Restricted neutral clutch release oil

NOISE DIAGNOSIS

Occurs Under Following Conditions	Possible Cause
1. P, N, R, DR 1st and 3rd	Front unit planetary gears
2. P, N, R, DR 1st and 2nd	Rear unit planetary gears
3. All Ranges, especially during warm up	Pump noisy Cut "O" Ring on intake pipe Cut "O" Ring on cooler sleeves
4. 1-2 and 3-4 with hot oil	Front unit coupling leaks
5. All Ranges—loaded only in reverse	Reverse planetary gears
6. Clicking (Low speed forward)	Pressure regulator Low oil pressure or level Coupling valve Governor
7. Buzzing	Pressure regulator Oil pressure TV valve Rear bearing (approx. 35 mph)
8. Rattle or buzz under light load in 3rd and 4th	Torus cover—damper spring
9. Squeak when engaging reverse	Low oil pressure or leak in front clutch overrun piston, rear pump
10. Vibration	Flywheel balance Torus cover balance Front unit assembly balance Rear brake drum balance

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. *OIL PAN*
   a. Improperly installed or damaged gasket.
   b. Attaching bolts not torqued to specifications.
   c. Oil filler pipe not tight.
   d. Pan not flat.

2. *EXTENSION HOUSING*
   a. Rear seal not installed properly or damaged.
   b. Gasket (extension housing to rear clutch) improperly installed.
   c. Gasket (rear clutch housing to case) improperly installed.

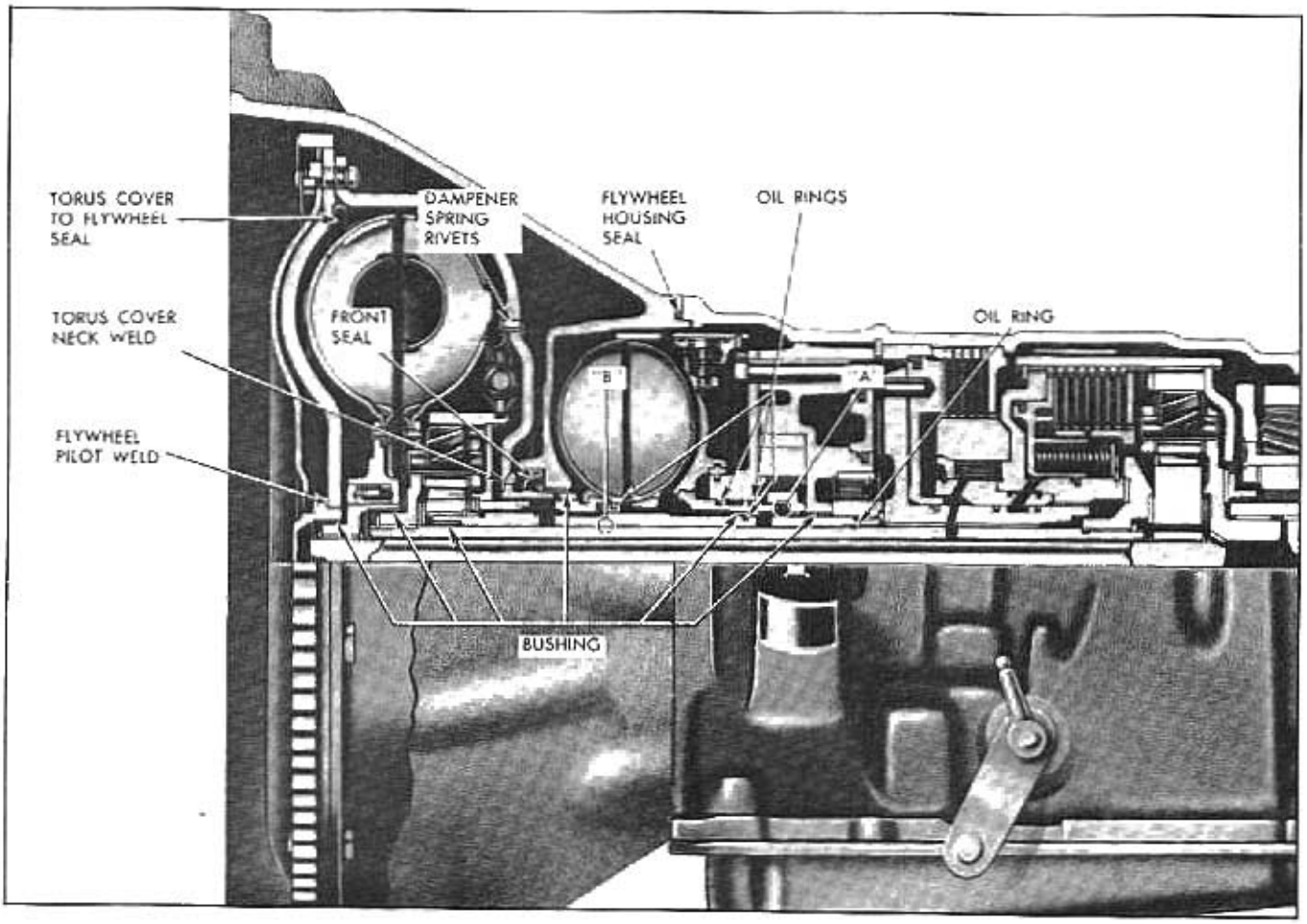


Fig. 183 Possible Points of Fluid Leak

d. Rear clutch housing and extension housing attaching bolts not torqued to specifications.

e. Breather pipe not tight.

f. Speedometer driven gear not tight.

g. Porous casting.

h. Line pressure plug not tight.

3. *INNER TV LEVER*

Poor seal resulting from improper assembly of "O" rings and washers.

4. *COOLER CONNECTION*

a. Sleeve seals.

b. "O" rings on sleeves.

5. *FRONT END*

a. Torus drain plug loose or improperly installed.

b. Torus cover to flywheel seal improperly installed or damaged. Check for possible obstruction at the point where the flywheel seal retainer joins the flywheel.

c. Flywheel bolts not torqued to specifications.

d. Front seal incorrectly installed or damaged. When installing a new front seal, make sure the bore is free from staking material and that the garter spring on the seal is correctly positioned. Also check the torus cover neck finish and the bushing in flywheel housing.

e. Inspect the flywheel housing for porosity or sand holes.

f. Flywheel housing to case seal improperly installed or damaged. Seal groove depth too great.

g. Loose flywheel housing bolts.

h. Inspect weld at torus cover neck for possible leak. Check for possibility of leaks at damper spring rivets.

i. Remove all sealer material from flywheel and torus cover faces.

j. Engine rear main bearing, oil filter, rocker arm cover.

k. Flywheel pilot weld leaking.

l. Case cracked, porosity or loose support bolt.

m. Cut "O" ring on pressure regulator.

DIAGNOSIS AND CORRECTION OF TORUS DRAIN BACK

Occasionally a Hydra-Matic transmission is encountered which will not drive the car for several seconds after the engine is started. This condition is usually noticed when the car has been parked for a considerable time, such as overnight.

The momentary failure to drive may be caused by the fact that a large portion of the fluid has drained back from the main fluid coupling. Since the points of leakage which have caused the fluid to drain back will also leak when the coupling is being filled, there will be a delay in refilling the coupling when the engine is started. As soon as the coupling is filled, it will function satisfactorily until it has again been parked for several hours.

To become familiar with the points at which leakage or drain back can occur, it is necessary to understand the flow of oil to the main fluid coupling. Actually the same bushings and oil rings which cause drain back are those which will cause leakage when the coupling is being filled.

TORUS FEED

Torus feed oil which originates at the pump passes through the torus feed valve to the oil cooler and then back through the pump cover to emerge into the torus supply line at "A" in Fig. 182. The oil then passes around the rear end of the front unit coupling cover, through holes in the front unit driven torus shaft, and into space "B" around the intermediate shaft.

Oil passes forward along the outer diameter of the intermediate shaft to the holes near the front of the front unit coupling driven torus shaft. From there the oil passes up around the front end of the front unit coupling drive torus hub, between the hub of the internal gear and the hub of the torus cover (area "C"), and into the main torus.

When the torus has filled completely and develops a pressure of approximately 30 lbs., the torus check valve opens, allowing oil to flow along the mainshaft for lubrication.

POSSIBLE POINTS OF DRAINBACK

Careful study of Fig. 182 will reveal the bushings and oil rings which control the flow of oil from the pump to the torus members. They are as follows:

AREA "A"

Oil is sealed from leaking out of area "A" by the rear oil ring on the hub of the front unit coupling cover and the bushing on the inside of the same hub, the hook type oil ring on the front unit driven torus shaft, and the bushings in the pump body and rotor.

AREA "B"

Area "B" is sealed at the rear by the hook type oil ring on the intermediate shaft just in front of the case center support. At the front it is sealed by the bushing inside the front of the front unit coupling driven torus shaft.

FLUID COUPLING

The fluid coupling is sealed (internally) by the pilot bushing inside the hub of the flywheel, by the torus check valve, and by the bushing in the hub of the driven torus member.

PUMP AND OIL COOLER SLEEVE SEALS

Two additional areas of possible trouble which are not shown are the torus feed valve in the pump and the oil cooler sleeve seals. If the torus feed valve should stick closed, it would cut off the feed to the torus entirely. If it should stick open the torus oil will drain back very rapidly.

While it is considered that oil is sealed by the above mentioned bushings and oil rings, actually there are "controlled leaks" at all these points. If the clearances become excessive, however, due to wear or damage, the leaks can become great enough to impair the filling of the torus. The result will be excessive drain back, slow filling, and a delay in drive after starting the engine.

SPECIFICATIONS

GENERAL SPECIFICATIONS

Rear Unit End Play (Mainshaft end play minus rear unit sun gear to mainshaft end play)	.004"-.013"
Front Unit End Play	.021"-.033"

GEAR RATIOS

1st speed	3.97:1
2nd speed	2.55:1
3rd speed	1.55:1
4th speed	1.00:1
Reverse	3.74:1

FLUID

Type	Automatic Transmission Fluid (Type A) bearing Armour Institute qualification no. "AQ-ATF . . ."
Capacity—Refill (after drain)	Approx. 9 qts.*
—Refill (after overhaul)	Approx. 10½ qts.*
Change Transmission Oil every	25,000 miles

*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 P (park).

SPRING SPECIFICATIONS

Name	Approx. Free Length	No. of Coils	Diameter	Color
Pump				
Oil Cooler By-Pass Valve	.54	8	.245	Copper Fl
Priming (Inner)	.52	5 LH	.465	Plain
Priming (Outer)	.86	6¾ RH	.605	Plain
Torus Feed Valve	.63	8	.310	Plain
Rear Clutch Release	1.58	14	.440	Plain
Servo and Accumulator				
Accumulator Valve P, PB	.68	10½	.250	Yellow
Accumulator Valve PE	.59	9½	.250	Cad. Fl
Accumulator Valve PA	.70	12½	.220	Plain
Accumulator P, PB	2.90	10½	1.100	Plain
Accumulator PE, PA	2.66	10½	1.100	Purple
Servo	3.22	11	1.000	Plain
Pressure Regulator P, PB, PE	2.17	14	.590	Plain
Pressure Regulator PA	2.19	14	.590	Copper Fl
Front Coupling Exhaust Valve	.72	7	.340	Plain
Torus Check Valve	.69	14	.187	Plain
Control Valve Assembly				
Clutch Valve				
Coupling Valve P, PB, PE	1.32	12	.380	Copper Fl
Coupling Valve PA	1.72	14½	.380	Copper Fl
Limit Valve (Inner)	2.03	23½	.350	Plain
Limit Valve (Outer)	2.79	19	.590	Plain
Transition Valve	.98	15½	.260	Plain
Shift Valve				
Neutral Clutch Valve	1.04	17	.250	Red
2-3 TV Valve (Inner) P, PB	.87	11½	.300	Plain
2-3 TV Valve (Inner) PE	.80	10½	.310	Red
2-3 TV Valve (Inner) PA	.85	11½	.260	Green
2-3 Shift (Outer) P, PB	1.17	9	.580	Copper Fl
2-3 Shift (Outer) PE	1.49	9	.580	Copper Fl
2-3 Shift (Outer) PA	1.70	9	.590	Plain
3-4 TV Valve P, PB, PE	1.10	9½	.390	Grey
3-4 TV Valve PA	1.03	9½	.390	Copper Fl
3-4 Shift Valve PA	1.00	10½	.530	Plain
Manual Valve				
Throttle Valve	1.68	17	.390	Plain
Detent Valve	.80	8½	.350	Copper Fl
Reverse Blocker Piston	1.44	16	.320	Plain
Torus Cover Damper (Red)	2.54	14	.638	Red
Torus Cover Damper (Black)	2.60	14	.638	Plain
Pressure Drop Dignal	.65	8½	.290	Copper Fl

THRUST WASHER SPECIFICATIONS

Key	Location	Part No.	O.D.	I.D.	Thickness	Material	Finish or Ident. No.
1	Front Sun Gear to Carrier Thrust Washer	8616091	2.020	1.258	.089	Bronze	
2	Front Unit Selective Washer	8618319	2.040	1.258	.046	Steel	1
		8618320	2.040	1.258	.059		2
		8618321	2.040	1.258	.072		3
		8618322	2.040	1.258	.085		4
		8618323	2.040	1.258	.098		5
		8618324	2.040	1.258	.111		6
		8618325	2.040	1.258	.124		7
		8618326	2.040	1.258	.137		8
		8618327	2.040	1.258	.150		9
		8618328	2.040	1.258	.161		10
		8618329	2.040	1.258	.176		11
3	Front Unit Sun Gear Needle Bearing	457197					
4	Front Sun Gear to Internal Gear Front Thrust Washer	8618524	2.255	1.667	.031	Steel	
5	Front Sun Gear to Internal Gear Rear Thrust Washer	8618523	2.227	1.710	.031	Steel	Black
6	Front Unit Drive Torus Thrust Washer	8616107	1.993	1.680	.089	Bronze	
7	Front Unit Drive Torus Thrust Backing Washer	8616646	1.990	1.680	.050	Steel	Bright
8	Front Sprag Overrun Clutch Inner Race Washer	8616097	1.785	1.410	.089	Bronze	
9	Rear Unit Clutch Drum to Clutch Hub Thrust Washer	8620567	2.940	2.118	.062	Bronze	
10	Rear Unit Clutch Drum to Clutch Hub Backing Washer	8620568	2.940	2.160	.031	Steel	
11	Rear Unit Sun Gear Thrust Washer	8616433	2.377 / 2.383	1.440	.089	Bronze	
12	Rear Unit Sun Gear Needle Bearing Retainer	8617949	2.370 / 2.380			Steel	
13	Rear Unit Sun Gear Needle Bearing	457209					
14	Output Shaft Selective Washer	8617821	3.150	2.060	.057	Bronze	1
		8617822	3.150	2.060	.062		2
		8617823	3.150	2.060	.067		3
		8617824	3.150	2.060	.072		4
		8617825	3.150	2.060	.077		5
		8617826	3.150	2.060	.082		6
		8617827	3.150	2.060	.087		7
		8617828	3.150	2.060	.092		8
		8617829	3.150	2.060	.097		9
15	Reverse Internal Gear to Reverse Clutch Housing Thrust Washer	8618398	2.730	2.180	.089	Fibre	

TORQUE SPECIFICATIONS

LOCATION	LB. FT.
Case to Pump Body	25
Control Valve Assembly	2-3
Control Valve to Case	6-8
Cooler Sleeve Strap	15-18
Cover to Accumulator Body	6-8
Detent Roller and Spring Bolt	15-18
Flywheel Drain Plug	6-7
Case Cover to Case	45
Governor Cover to Body	6-8
Oil Pan to Case	10-13
Oil Pressure Take-Off Plug in Reverse Clutch Housing	6-7
Pressure Regulator Plug	5
Pump Cover to Body	15-18
Pump to Center Support	25
Rear Extension Housing to Reverse Housing and Case	25
Reverse Clutch Housing to Case	25
Servo to Case	25
Torus Cover to Flywheel (Nut)	15-20
TV Pressure Take-Off in Case	6-7
TV Lever Lock Screw	10-12

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)	18:8	Yellow
43:15 (2.87)	17:8	Orange
43:16 (2.69)	16:8	Red
41:16 (2.56)	17:9	Orange

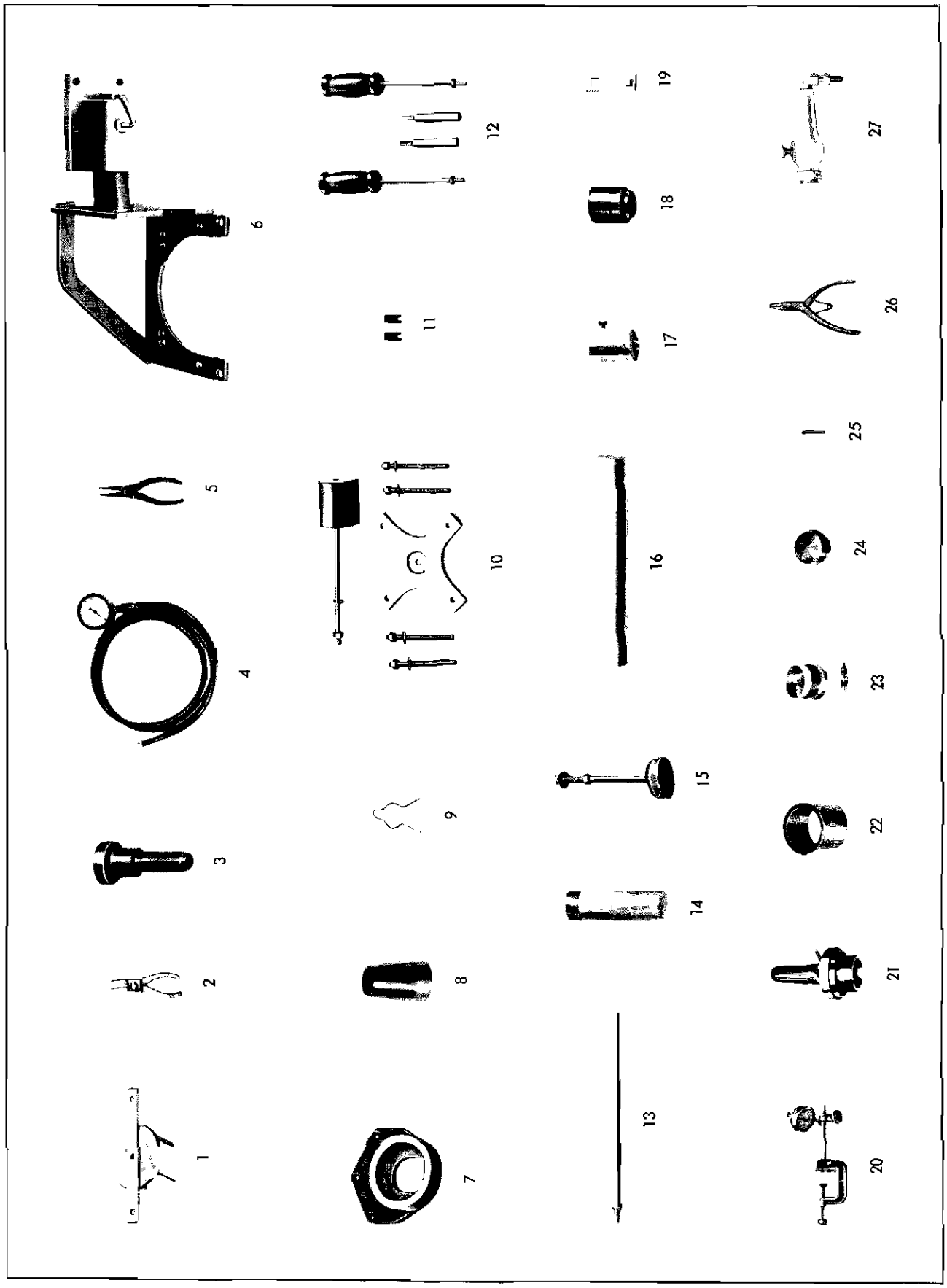


Fig. 184 Special Hydra-Matic Tools

SPECIAL HYDRA-MATIC TOOLS

No. on Fig. 184	Tool No.	Tool Name
1	J-4670-C	*Clutch Spring Compressor*
2	J-4880	Snap Ring Pliers (Truarc No. 2)
3	J-5154-A or J-5154	Extension Housing Oil Seal Installer
4	J-5907	Pressure Checking Gauge (with hose)
5	J-6083	Snap Ring Pliers (Truarc No. 4)
6	J-6115	Transmission Holding Fixture
7	J-6116	Clutch Unit Holding Fixture
8	J-6119	Flywheel Housing Oil Seal and Bushing Protector
9	J-6120	Reverse Drive Flange Retainer
10	J-6121	Front Unit Coupling Cover Remover
11	J-6122	Front Unit Coupling Valve Retainers (2)
12	J-6125	Slide Hammers
13	J-6126	Dial Indicator Support
14	*J-6127*	*Mainshaft End Play Checking* Fixture
15	J-6129	Rear Clutch Spring Compressor (Use with J-4670-C)
16	J-6133-A	Rear Bearing Installer
17	J-6135	Rear Unit Clutch Retainer
18	J-6282	Front Unit End Play Checking Gauge
19	J-6498	Torque Wrench Extension
20	KMO-30 or J-8001	Dial Indicator Set
21	J-7026	Flywheel Housing Oil Seal Installer and Staker
22	J-7027	Flywheel Housing Support
23	J-7073	Torus Cover Leak Check Set
24	J-7577	Reverse Piston Inner Seal Protector
25	J-7687	Linkage Gauge Pin
26	J-8059	Snap Ring Pliers
27	J-8124-01	Blow Gun Assembly

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