SECTION A

FLIGHT PITCH DYNAFLOW SPECIFICATIONS

DESCRIPTION AND OPERATION

1—FLIGHT PITCH DYNAFLOW TRANSMISSION IDENTIFICATION NUMBER

A production identification number is stamped on the lower side of the transmission case directly forward of the left front corner of the oil pan. The identification number consists of a letter followed by a number containing one or more digits.

Since the production identification number furnishes the key to construction and interchangeability of parts in each transmission, the number should be used when selecting replacement parts as listed in the master parts list. The number should always be furnished on Product Reports, AFA Forms, and correspondence with the factory concerning a particular transmission.

2—FLIGHT PITCH DYNAFLOW GENERAL SPECIFICATIONS

Oil Capacity ..... 12 Quarts

NOTE: *A completely dry transmission will require 1⅓ pints more than amount given above.*

Oil quantity indicated between marks on gauge rod ..... 1 Pint

Oil Specification

Factory ..... Special Buick Oil for Dynaflow Drive

Petroleum Suppliers ..... Automatic Transmission Fluid, Type A*

*Must be identified by AQ-ATF Number embossed in can.

Drain and Refill Mileage Recommendation 25,000 miles

Torque Multiplication at Stall

Stator at High Angle ..... 4.50 to 1 at 3200 RPM

Stator at Low Angle ..... 3.85 to 1 at 2000 RPM

Stator Blade Position Control .. Position determined by throttle setting

Grade Retard Control ..... Manual

Front Oil Pump Drive ..... Engine

Rear Oil Pump Drive ..... Output Shaft

Car Speed When Front Pump Cuts Out ..... Approx. MPH 45-50

Pump Pressure Regulation .....

Drive Range

1. Line (varied by throttle setting) ..... 70-180 psi
2. Converter Charging Line ..... 25-180 psi
3. Cooler Circuit ..... 30-50 psi

Reverse Range

1. Line (varied by throttle setting) ..... 190-210 psi
2. Converter Charging Line ..... 25-180 psi
3. Cooler Circuit ..... 30-50 psi

Planetary Gearing Type ..... Dual sets interconnected; driving set determined by converter action

Number of Pinions in Front Planet Set 6

Number of Pinions in Rear Planet Set 4

3—FLIGHT PITCH DYNAFLOW TIGHTENING SPECIFICATIONS

Use a reliable torque wrench to tighten the attaching bolts or nuts of the parts listed below.

NOTE: *These specifications are for clean and lightly lubricated threads only. Dry or dirty threads produce increased friction which prevents accurate measurement of tightness.*

Rear Pump
Rear Bearing Retainer
U Joint
Output Shaft Support Anchor

		Size	Torque-Ft.-lbs.
Bolt	Rear Bearing Retainer to Case	⅜-16	30-35
Bolt	Torque Ball Retainer to Rear Bearing Retainer	⅜-16	25-30
Bolt	Universal Joint to Output Shaft	½-20	50-55
Bolt	Output Shaft Anchor	½-13	35-40
Bolt	Torque Ball to Torque Tube	5/16-18	30-35
Bolt	Rear Oil Pump to Rear Bearing Retainer	5/16-18	15-20

Oil Pan
Valve Body
Parking Lock Mechanism

Bolt	Oil Pan to Case	5/16-18	10-12
Bolt	Valve Body to Case	5/16-18	15-20
Screw	Valve Body Plate to Valve Body	#12-24	5-10
Bolt	Pressure Regulator Spring Retainer to Valve Body	¼-20	10-15

Front Pump
Reaction Shaft Flange

Bolt	Front Pump Body to Case	⅜-16	30-35
Bolt	Reaction Flange to Pump Body	5/16-18	20-25

Stator

Screw	Stator Free Wheel Cam to Stator Rear Carrier	#12-24	10-12
Screw	Stator Rear to Front Carrier Case	¼-20	10-12

Case

Bolt	Case to Engine Block	7/16-14	45-55

4—FLIGHT PITCH DYNAFLOW MANUAL CONTROL MECHANISM AND OPERATING CONTROLS

a. Manual Control Mechanism

The Flight Pitch Dynaflow provides five different control or operating ranges which may be manually selected by the driver through move-

ment of the shift control lever at top of steering column. A pointer on the control lever and a dial located on the instrument panel aid in locating the lever for each range. Letters on the dial, reading from left to right identify each range as follows:

P = Parking
R = Reverse
N = Neutral
D = Drive
G = Grade Retard

The control lever can be moved in the same plane from Drive "D" to Neutral "N" by overcoming detent resistance. To shift lever to Parking "P", Grade Retard "G" or Reverse "R" it is necessary to raise the lever against spring pressure. The control lever actuates a shaft housed in the steering column which is connected by levers and rods to a shift control valve in the transmission. The control shaft also operates a neutral safety switch in the starter motor circuit which does not allow the starter to be energized with the transmission in any range other than Parking "P" or Neutral "N" position.

b. Parking "P" Range

Parking range is to be used in conjunction with the step-on parking brake to prevent possibility of car motion. The shift control lever must be raised when shifting into or out of Parking range.

Parking range must never be entered when the car is in motion or serious damage to the transmission may result.

Parking range should always be used when it is desirable to run and accelerate the engine without possibility of car movement, as when working in the shop.

When in Parking range a parking lock ratchet wheel on transmission output shaft is engaged by a locking pawl mounted in rear of transmission case, providing a positive mechanical lock for the rear wheels.

The locking pawl is actuated by the transmission control linkage through a system of rollers and apply spring which hold the pawl solidly against the ratchet wheel until engagement is accomplished. If the pawl does not engage the ratchet wheel when first applied it will snap into place as the wheel turns if the car moves slightly. See figure 1. The engine may be started while the shift lever is in Parking "P" position.

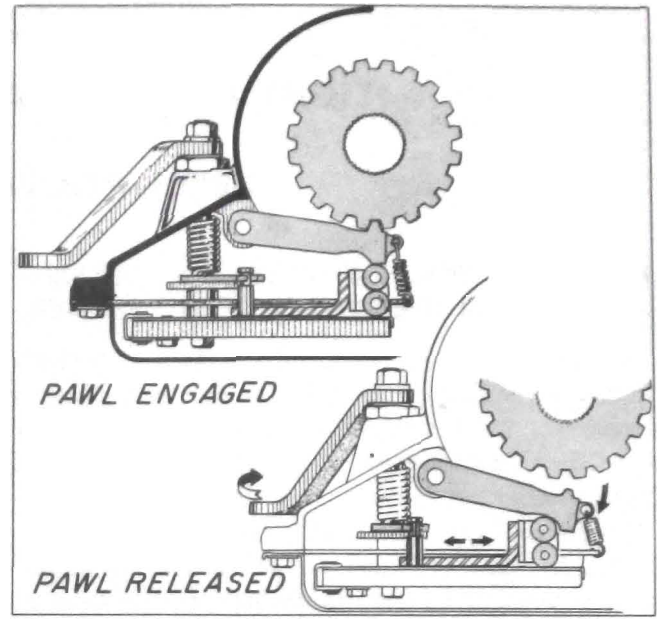


Figure 1—Parking Lock Mechanism

c. Neutral "N" Range

Neutral range may be used when it is desirable to operate the engine without car motion. Should it ever become necessary to push a Dynaflow equipped car to start it, Neutral range should be used until the car has reached sufficient speed to crank the engine in Grade Retard "G" range. The starter may be used to crank the engine in Neutral "N" range.

d. Drive "D" Range

Drive range is used for all normal driving except when it is desirable to slow the car on descending grades as specified for Grade Retard "G" range.

During part throttle operation and light acceleration the Flight Pitch stator blades are in low angle or "cruise" position. When extraordinary acceleration is required the blades are automatically positioned at a higher angle as the accelerator pedal is depressed beyond the half throttle position. The stator blade position is infinitely variable; the blades being positioned at maximum high angle "performance" position as wide open throttle is reached.

e. Grade Retard "G" Range

Grade Retard range is used when additional engine braking is desired to descend hills or grades safely.

With selector lever in Grade Retard "G" range, a hydraulic piston engages a multiple disc clutch housed in the rear of the transmission case which acts on the torque converter components to drive the engine at a greater speed, thereby slowing the

car. Light throttle pressure can be used to reduce the effectiveness of the retarder, however, the car should not be accelerated in Grade Retard "G" range. Grade Retard "G" range should not be entered at car speeds above 45 MPH.

f. Reverse "R" Range

Reverse range is used to move the car to the rear. The shift control lever must be raised slightly to shift into Reverse range.

g. Rocking Car Between Drive and Reverse

When the car is stuck in deep snow or mud it can be driven out by "rocking" the car back and forth alternately using Drive and Reverse until sufficient momentum is obtained to move car out in desired direction.

After accelerating engine slightly to provide sufficient power, hold shift lever up and move back and forth between Drive and Reverse. Control engine speed and time the movement of control lever so that the rear wheels push firmly against the snow or mud in each direction, but avoid spinning wheels.

h. Pushing Car to Start Engine

If it becomes necessary to push a Dynaflow equipped car to start engine, place shift control lever in Neutral until car speed reaches approximately 30 MPH. Then shift into Grade Retard "G" range. Increase car speed until engine cranks. After engine starts, return control lever to Neutral for warm-up. *It is safer to push car than to tow it.*

i. Towing Disabled Dynaflow Drive Car

A disabled Dynaflow Drive car must not be towed on rear wheels with transmission in any range other than Neutral, because unnecessary damage to transmission may result. It may be safely towed in Neutral (N) only, and towing speed should not exceed 35 m.p.h.

5—PRINCIPAL SECTIONS OF THE FLIGHT PITCH DYNAFLOW TRANSMISSION

To simplify description of construction and operation of the Flight Pitch Dynaflow, it will be divided into the following sections as shown in Figure 2.

a. Transmission Case

The transmission assembly is bolted to the engine crankcase through the converter housing section of the transmission case. The transmission case and converter housing are one integral cast aluminum part.

b. Torque Converter and Planetary Gear Sets

The torque converter is coupled to the engine and hydraulically transmits engine torque through two connected planetary gear sets to drive the car. The torque converter automatically provides torque multiplication to meet varying driving conditions. Construction and operation of the torque converter are described in Paragraph 6.

c. Hydraulic Controls

The hydraulic control system includes devices for controlling forward clutch, reverse clutch, neutral clutch, Flight Pitch stator, and grade retard clutch. The hydraulic system also provides for filling the torque converter and circulation of oil for lubrication and cooling.

Oil pressure is provided by two pumps, one mounted just rearward of the torque converter and driven at engine speed by lugs on converter pump housing hub. The other is located at the forward end of the rear bearing retainer and is driven by the output shaft. The units which regulate oil pressure, govern engagement of forward or reverse clutch, and application of grade retarder, are contained in a valve body mounted on the bottom of the transmission and enclosed by the oil pan. Construction and operation of all hydraulic control units are described in Paragraph 8.

d. Grade Retarder

A hydraulically operated multiple disc clutch housed at the rear of the transmission case, when engaged, causes the output shaft to turn the first turbine at an accelerated rate thus overdriving the engine. The grade retard clutch is engaged as the selector lever is moved to Grade Retard "G" range. The car should not be accelerated in Grade Retard "G" range. Construction and operation of grade retarder is described in Paragraph 7.

e. Rear Bearing Retainer and Torque Ball

The rear bearing retainer is bolted to the rear end of the transmission case and the torque ball is assembled on the rear of the retainer. The rear bearing retainer houses the rear oil pump, output shaft rear bearing, and speedometer drive gear.

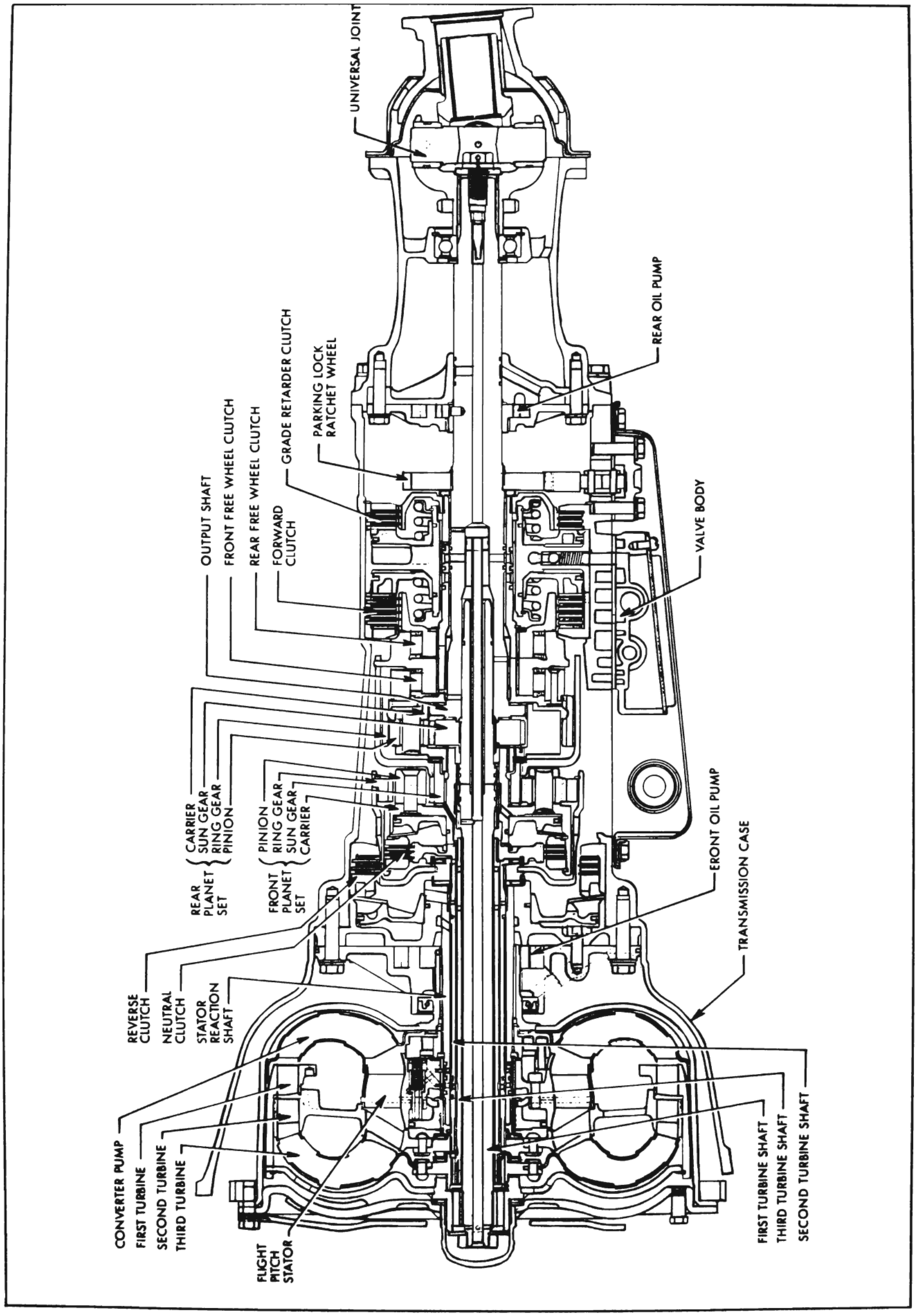


Figure 2—Side Sectional View of Flight Pitch Dynaflow Transmission

6—FLIGHT PITCH DYNAFLOW TORQUE CONVERTER

The Dynaflow torque converter is connected to the engine flywheel and serves as a drive through which engine torque (turning force) is transmitted to move the car. The torque converter "steps up" or multiplies the engine output torque whenever car operating conditions demand greater torque than the engine can supply. In this respect it serves the same purpose as the selective reduction gears used in other types of automotive transmissions.

Torque multiplication is always required when a car is started or accelerated at low speeds. Torque multiplication may be required when car is ascending steep grades, moving in deep snow, sand, etc. Torque requirements decrease as the car gains momentum, and when a point is reached where engine torque is adequate, no torque multiplication is required. From this point, the converter functions as an efficient fluid coupling, providing maximum economy.

The Dynaflow torque converter automatically provides the proper ratio of torque multiplication to meet the varying demands imposed by starting and driving under all ordinary driving conditions of load and grade. The transition through the various ratios or torque multiplication is smooth and devoid of steps or change points, since it is accomplished without the use of selective gears or controlled shifts.

The principle elements of the Flight Pitch torque converter are described in sub. paragraphs a, b, and c, and the operation of these units is described in sub. paragraph d.

a. Converter Pump

The converter pump is bolted to the engine flywheel so it rotates whenever the engine is running. The converter pump and its cover comprise a housing for all converter components. See Figure 2. The converter pump assembly consists of an inner shell, an outer shell and thirty vanes, all welded solidly to the converter pump housing.

The pump operates as a centrifugal pump, picking up oil at its center and discharging the oil at its rim, however, the shell of the pump is shaped to discharge the oil parallel to its axis in the form of a spinning hollow cylinder. The function of the pump is to convert engine torque into an energy transmitting flow of oil to drive the converter turbines, into which the oil is projected.

b. Triple Turbine Assembly

The Triple Turbine assembly is connected by coaxial shafts to the transmission output shaft through a neutral clutch and two planetary gear sets; the planet gear carriers of which are coupled together to act as a common carrier, a part of the transmission output shaft.

The Triple Turbine assembly consists of:

1. A *first turbine*, first turbine disc and hub assembly, first turbine shaft and rear planet set sun gear. See Figure 3.

2. A *second turbine*, second turbine shaft, front planet set ring gear and a multiple disc reverse clutch. See Figure 4.

3. A *third turbine*, multiple disc neutral clutch and third turbine shaft splined to both front and rear planet carriers, and the transmission output shaft splined to the rear planet carrier. See Figure 5.

4. A Flight Pitch stator, stator reaction shaft and free wheel clutch. See Figure 6.

Each turbine is independently connected to a member of the planetary gear sets, thus gear reduction in the planetary train is determined by relative motion of the turbines. The first turbine has a narrow set of vanes located at the pump exit in position to receive the spinning cylinder of oil projected from the pump. The first turbine is connected to its shaft and rear planet set sun gear by a disc and hub assembly supported on bronze bushings. The second turbine also has a narrow set of vanes positioned to receive oil after it has passed through the first turbine. The second turbine is riveted to a hub and shaft assembly which is supported on bronze bushings and splined to the front planet set ring gear and internally splined plates of the reverse clutch assembly. The third turbine has a broad set of vanes positioned at the second turbine exit and curved to direct the oil back into the Flight Pitch stator in a direction opposite converter pump rotation. The third turbine is riveted to a hub and shaft assembly which, when the neutral clutch is engaged, is solidly connected to the planetary gear carriers and the output shaft. Thus the third turbine, planet carriers and output shaft are an integral unit and turn together at the same rate of speed when the neutral clutch is engaged.

The function of the turbine and planetary gear system is to absorb energy from the oil projected by the pump and convert the energy to torque, the need for which is determined by driver demands and driving conditions.

c. Flight Pitch Stator

The Flight Pitch stator is located between the

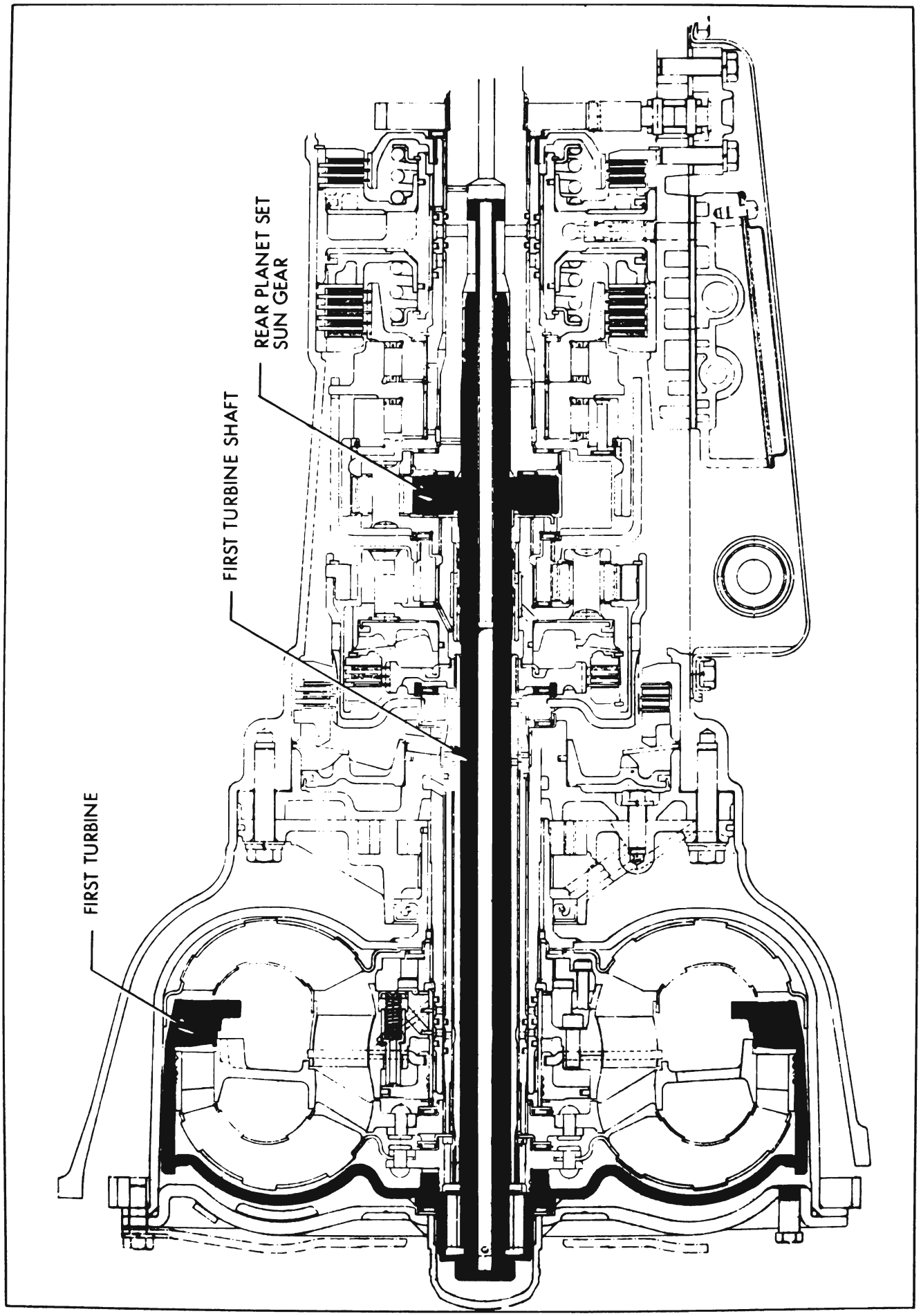


Figure 3—First Turbine, First Turbine Shaft and Rear Planet Set Sun Gear

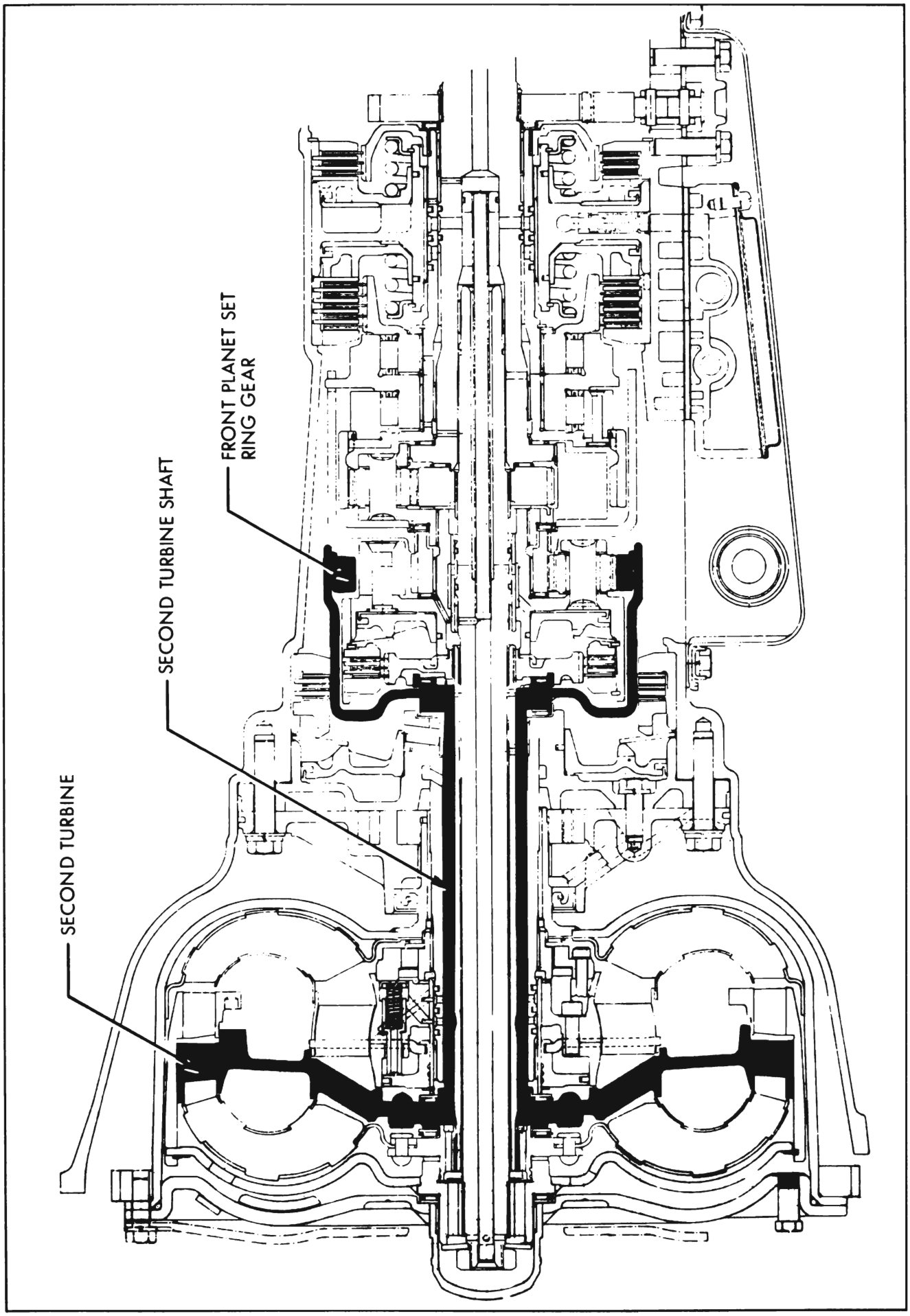


Figure 4—Second Turbine, Second Turbine Shaft, Front Planet Set Ring Gear and Reverse Clutch

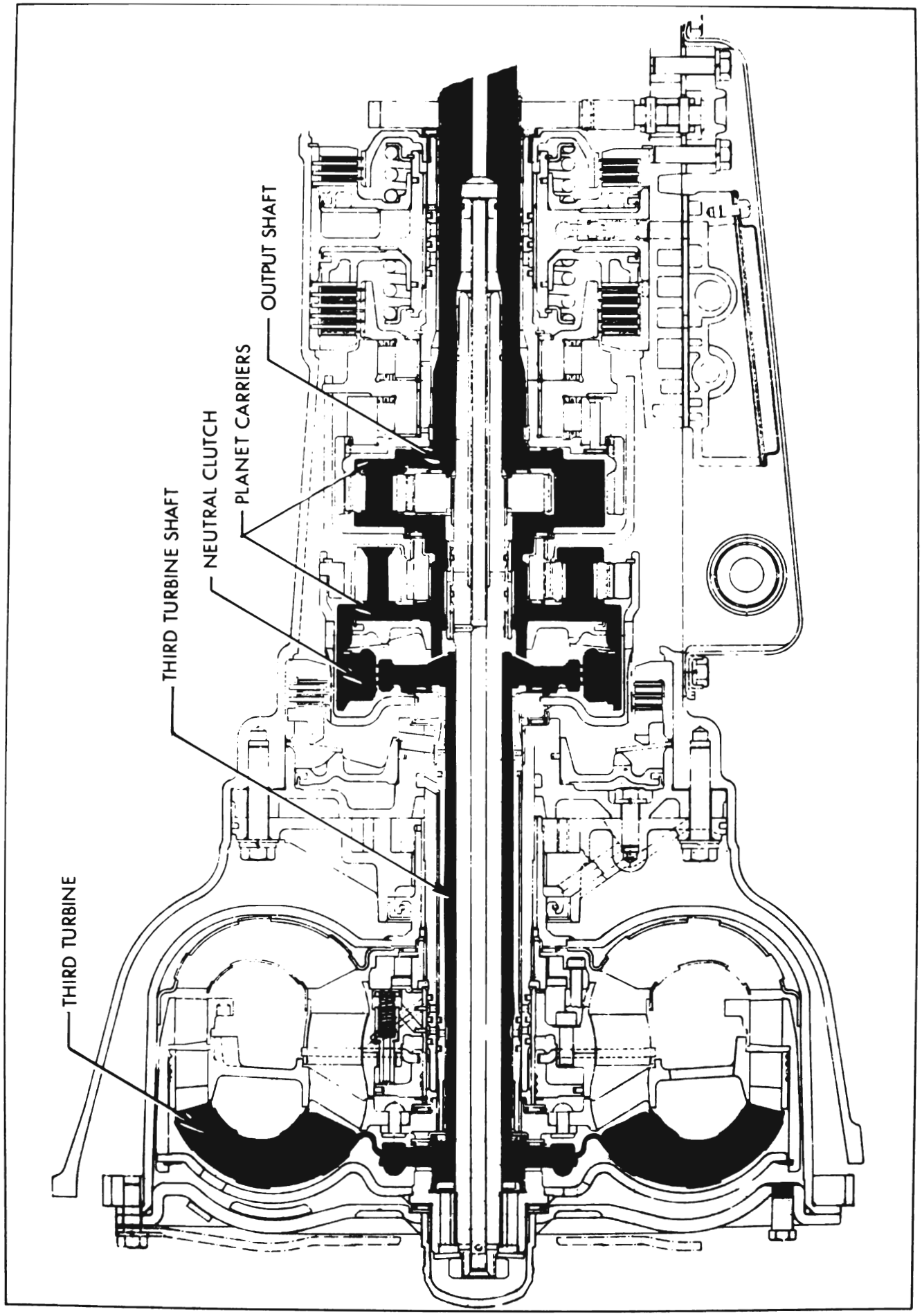


Figure 5—Third Turbine, Third Turbine Shaft, Neutral Clutch Planet Carriers, and Output Shaft

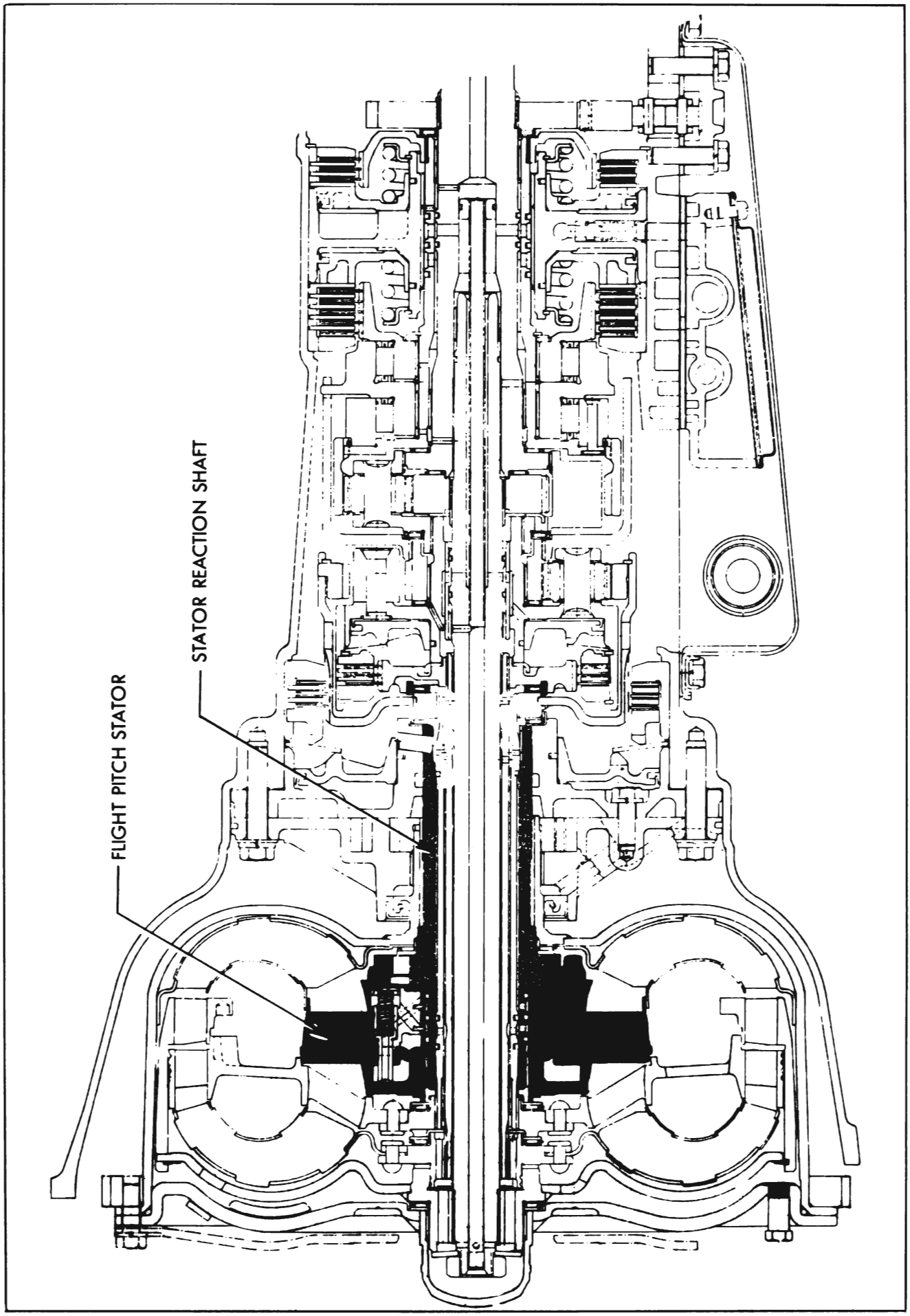


Figure 6—Flight Pitch Stator, Reaction Shaft and Free Wheel Clutch

third turbine exit and the converter pump entrance. It is mounted on a reaction shaft and is equipped with a free wheel clutch. This clutch allows the stator to turn freely when torque multiplication is not required.

For normal "cruising" operation, the stator blades are set at a low angle relative to the centerline of the converter. Increased torque for acceleration may be obtained by greater throttle opening which accelerates the engine and simultaneously sets the stator blades at a higher angle.

Each of the twenty stator blades is mounted on an individual control crank supported at its outer end by a carrier ring and free to turn in its bearing in the stator blade carrier. The carrier houses a piston which controls the angle of all blades through the control cranks when oil pressure on either or both sides causes the piston to reposition itself as explained in sub. par. d, below.

The function of the stator, when stationary, is to alter the direction of oil flow from third turbine so oil enters converter pump spinning in same direction as pump rotation.

d. Operation of Torque Converter and Planetary Gear Sets in Forward Range

Description of torque converter operation will begin with the car stationary, transmission in Drive range and engine running at idling speed. The neutral and forward clutches are thus engaged, the converter pump is turning with the engine, and turbine members are stationary.

The engine driven converter pump projects a rotating cylinder of oil into the first turbine, the vanes of which are curved in such a manner that the oil leaving them is directed into the second turbine at a slight angle opposite pump rotation. The vanes of the second turbine are curved at a greater angle than those of the first turbine enabling the second turbine to absorb energy remaining in the oil after passing the first turbine. Oil is discharged from the second turbine into the third turbine and then into the Flight Pitch stator. As oil emerges from the third turbine near its center, the backward curvature of the exit ends of the third turbine causes the oil to spin opposite pump rotation as it enters the Flight Pitch stator. Oil thus striking the forward face of the stator blades causes its free wheel clutch to lock and hold the stator stationary. The stator blades then redirect the oil into the pump in the same direction as pump rotation.

At idling speed the force of oil flow against the turbine vanes is not sufficient to cause motion and oil flows from the pump through the first, second and third turbines, then into the Flight Pitch stator and back to the pump without transmitting any appreciable amount of torque.

When the throttle is opened the engine speeds up and with increased speed the pump projects a large volume of oil into the turbines at high rotary speed. This spinning cylinder of oil is similar to a flywheel in that it has stored energy (torque) which will be transferred to any object opposing its motion. Since the vanes of the turbines oppose the spinning flywheel of oil projected from the pump, the stored energy exerts a powerful impulsion force against the vanes, tending to rotate the turbines in the same direction as the pump. At this point the impulsion force of the oil is not sufficient to move the turbines. The oil flows through the turbine channels and into the stator, spinning at high speed in a reversed direction. It exerts a powerful reaction force against the stator vanes tending to rotate it opposite pump rotation. The stator is prevented from turning opposite pump rotation by its "free wheel" clutch.

(A reaction (rearward force) is exerted by a fluid changing direction or being accelerated. It is reaction force which tends to kick back the nozzle of a firehose when a stream of water emerges under pressure.)

Engine torque applied to the converter pump generates a given amount of energy in the oil projected from the pump against the turbine vanes When the turbines are stationary, the oil passes through the turbines and stator and returns to the pump with almost as much energy as when projected. The amount of energy in the oil thereafter projected from the pump, becomes the sum of the energy in the returning oil plus the energy resulting from engine torque application, or almost double the amount of energy that could be generated by engine torque alone. The greatly increased energy in the spinning flywheel of oil then projected into the turbines produces a corresponding increase in the impulsion and reaction forces acting on the turbine vanes.

The described buildup of forces produces a turning force or torque upon the turbine vanes which is much greater than the torque produced by the engine, therefore torque multiplication is accomplished. It would seem the torque multiplication would increase indefinitely as the cycle repeats itself, but mechanical factors limit the increase of torque multiplication beyond a definite ratio in any given torque converter design.

The buildup of forces against the turbine vanes causes the first turbine to turn in the same direction as the converter pump. The first turbine absorbs

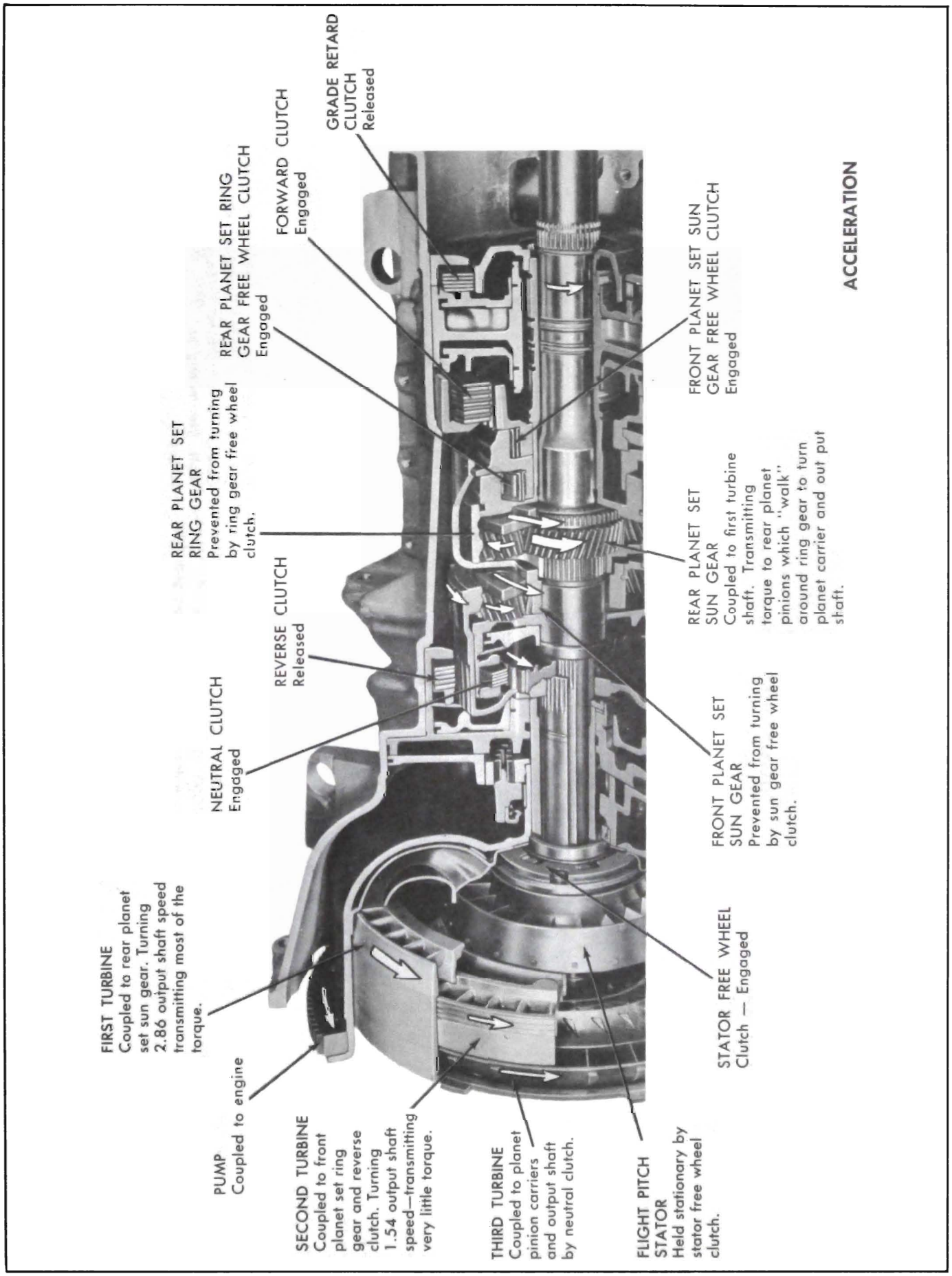


Figure 7—Operation of Components on Acceleration

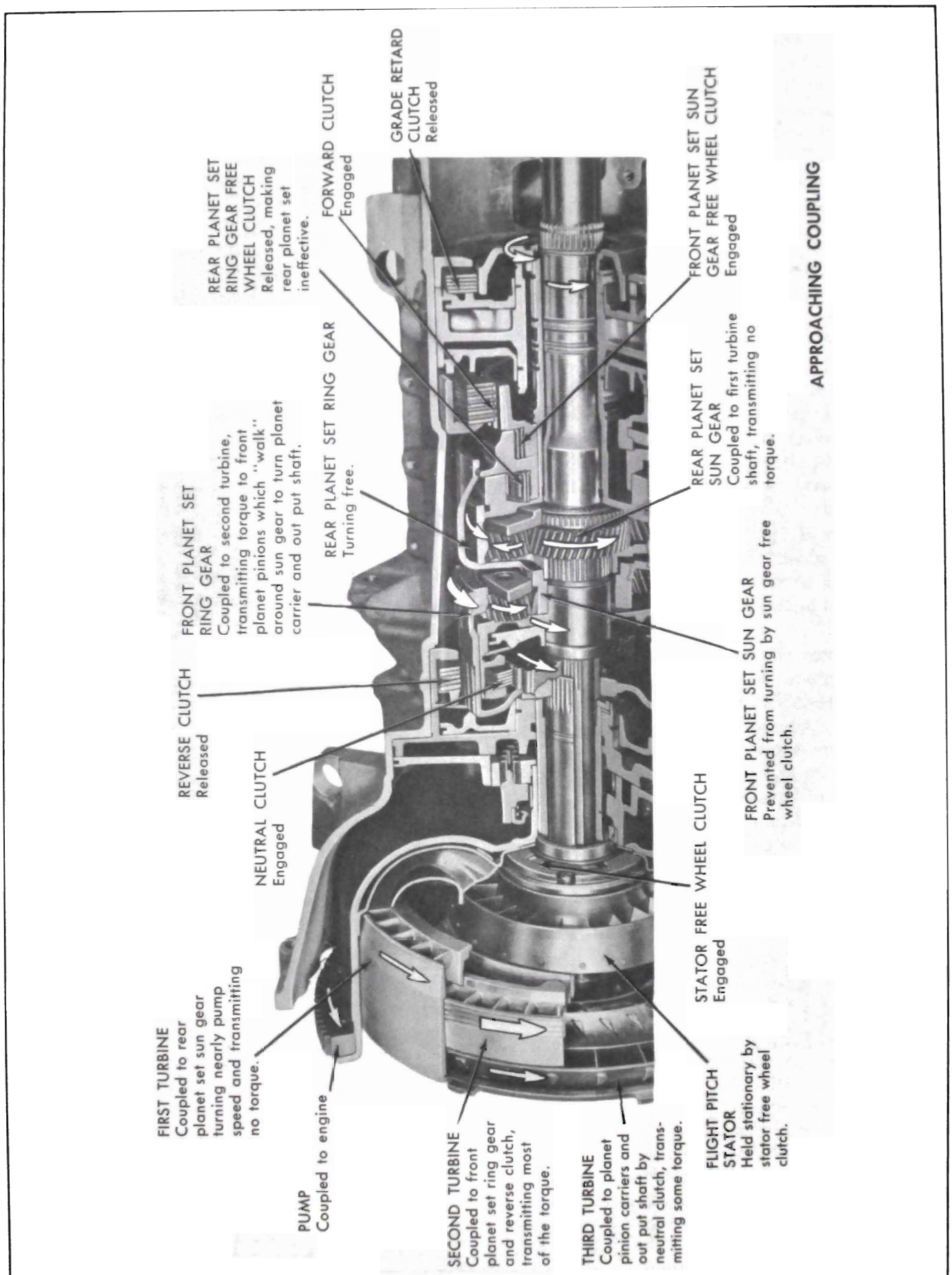


Figure 8—Operation of Components Approaching Coupling

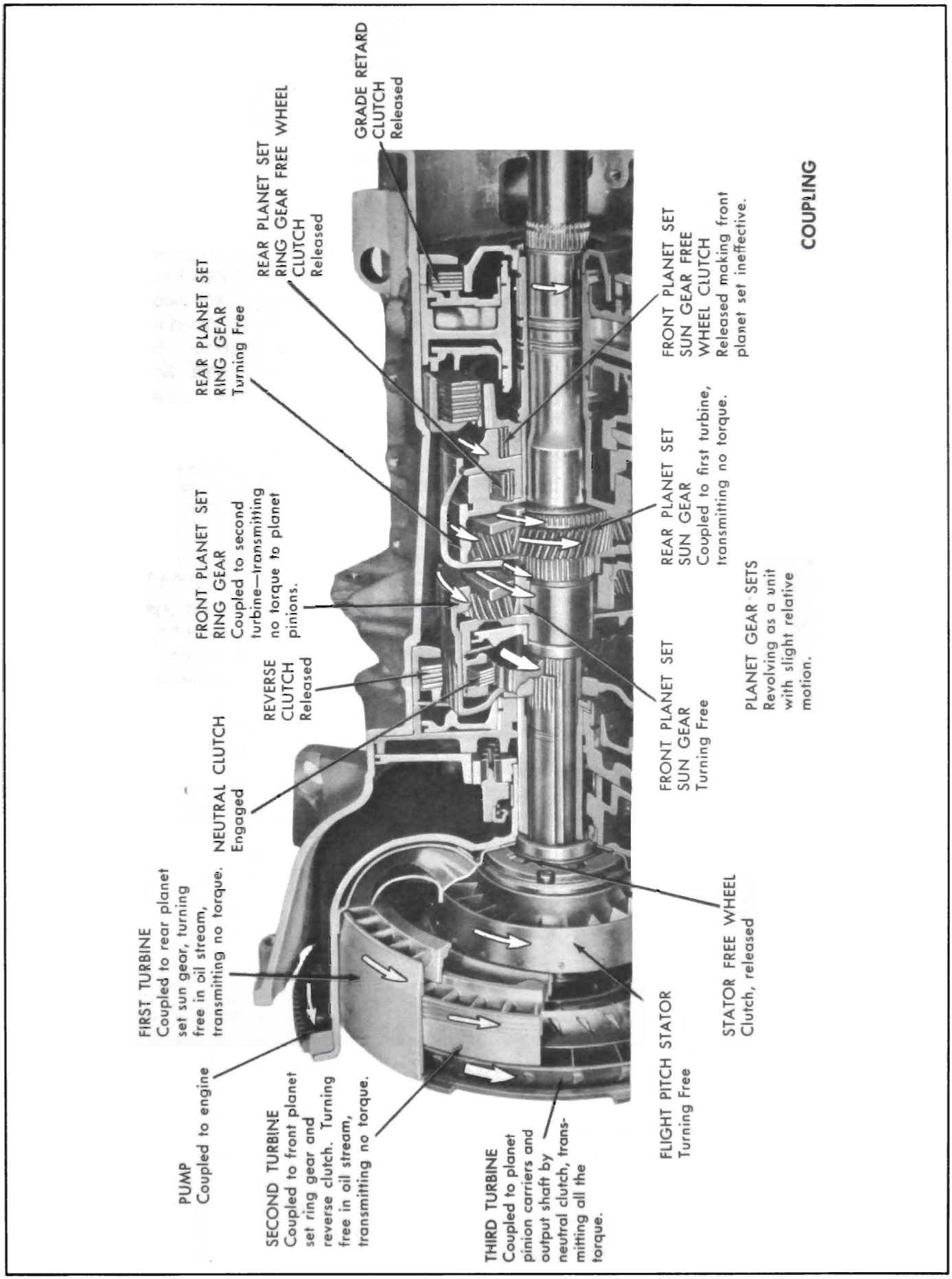


Figure 9—Operation of Components at Coupling

part of the energy transmitted by the oil stream and converts it into torque, which is imparted to the rear planet set sun gear, causing its planet pinions to turn and "walk" around the rear planet set ring gear, held stationary by a free wheel clutch. Thus, turning force is applied to the planet pinion carrier through the planet pinion shafts. The planet pinion carriers, the third turbine neutral disc clutch and output shaft are splined together and turn as a unit to drive the car. The ratio of the first turbine to the output shaft is 2.86 to 1. See Figure 7. In this manner the first turbine provides torque at high multiplication to drive the car at very low speeds. During low speed operation the first turbine transmits nearly all the torque to drive the car. As car speed increases more and more energy remains in the oil as it is emitted from the first turbine into the second turbine vanes. This energy is then absorbed and converted to torque which is transmitted to the front planet set ring gear, causing its planet pinions to turn and "walk" around the front sun gear held stationary by a "free wheel" clutch. See Figure 8. In this manner the second turbine applies force to the front planet carrier which is splined to the rear planet carrier, and it to the output shaft. The ratio of the second turbine to output shaft is 1.54 to 1. Accordingly, at low car speeds both first and second turbines multiply engine torque which is further multiplied by the planet sets to accelerate and drive the car. As car speed increases, the second turbine supplies a greater percentage of driving torque and the first turbine less, until first turbine approaches a speed at which the width and curvature of first turbine vanes do not allow it to absorb energy from oil projected from the pump. The first turbine then "free wheels" turning free in the oil stream offering virtually no resistance to the oil flow from pump to second turbine. As the first turbine no longer transmits torque to rear planet set sun gear, the ring gear "free wheel" clutch is released, thus neutralizing the rear planet gear set. The rear planet set sun gear, planet carrier and *ring gear* then turn as a unit with the output shaft.

At this point the second turbine is transmitting a greater percentage of engine torque than the third turbine, but as engine and car speed increase, the angle at which oil is emitted from second turbine changes, striking vanes of third turbine at greater angle to axis of converter. The third turbine then transmits a greater percentage of engine torque and the second turbine less, until second turbine approaches a speed at which the width and shape of its vanes allow the second turbine to transmit no more torque to the front planet set ring gear. This action releases front planet set sun gear "free wheel" clutch. The front planet set ring gear, carrier and *sun gear* then turn as a unit with the output shaft. Accordingly, the second turbine free wheels allowing unimpeded oil flow from pump to third turbine.

The third turbine is now transmitting all engine torque to output shaft. See Figure 9. Oil flows from pump through third turbine and as third turbine vanes are curved to emit oil at an angle opposite pump rotation, the oil strikes the front (concave) face of the Flight Pitch stator blades. As the stator free wheel clutch prevents the stator from turning backward, the oil is redirected to the pump entrance spinning in the same direction as pump rotation. See Figure 10.

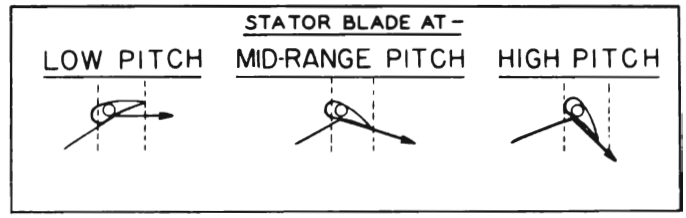


Figure 10—Oil Flow Through Stator

As the car reaches cruising speed, torque requirements decrease so applied torque causes third turbine speed to rapidly approach pump speed. As this occurs it is important for torque multiplication to taper off so car speed can be maintained at minimum engine speed. This tapering off occurs automatically because centrifugal force generated in the rotating mass of oil in the third turbine creates an outward counter force which opposes the flow of oil from the pump.

Reduction of oil flow and pump output energy effects a decrease in impulsion and reaction forces on the turbine so multiplication of engine torque rapidly tapers off as third turbine speed increases.

As speed of third turbine increases, the angle at which oil leaves the third turbine changes, until it strikes the rear face of the Flight Pitch stator blades, causing the stator to free wheel. The stator then offers no resistance to flow of oil from third turbine to pump.

At this point the torque converter functions as an efficient fluid coupling transmitting torque at a 1 to 1 ratio. However, sufficient speed differential remains between pump and turbine to permit flow of oil from pump to third turbine where the oil gives up energy and returns to pump.

The operation described has occurred without reaching half throttle position; therefore, the Flight Pitch stator blades have remained in the low angle "cruise" position. If the accelerator pedal is de-

pressed to the half throttle position, or beyond, the stator blades will be shifted to a higher angle through the hydraulic control action described in Paragraph 9. As the angle of the stator blades is increased the stall speed and torque multiplication of the converter are increased providing higher performance for rapid acceleration.

The position of the stator blades is infinitely variable between low angle and high angle and entirely governed by throttle operation (beyond the half throttle position). High stator blade angle is reached simultaneously with wide open throttle.

The various stages of the turbines and stator described do not occur at set speeds, but are dependent upon torque requirements imposed by car operating conditions. With light load and steady driving, torque multiplication may cease at very low car speeds, but with continued acceleration, some torque multiplication may be present through the major portion of the car speed range. When the torque converter is operating as a fluid coupling and car operating conditions change so that increased torque is demanded, the converter automatically adjusts to meet the demand.

When the drive through the converter is reversed so turbine speed is greater than pump speed, (as on deceleration or when descending grades,) the converter functions as a fluid coupling to permit normal engine braking.

e. Operation of Torque Converter and Planetary Gear Sets In Reverse Range

As the transmission selector is moved to Reverse range, the reverse and neutral clutches are hydraulically engaged and the forward clutch released. Engagement of reverse clutch holds second turbine and front planet set ring gear stationary. See Figure 11.

Description of torque converter operation in Reverse range will begin with car stationary, transmission in Reverse range and engine running at idling speed. The converter pump is turning with the engine and turbine members are stationary.

As engine is accelerated, oil projected from the pump strikes the first turbine vanes causing a buildup of torque. Upon development of sufficient force, the first turbine begins to move, turning its shaft and rear planet set sun gear.

This action causes rear planet set pinions to revolve the rear planet set ring gear opposite pump rotation. The rear planet set ring gear free wheel clutch thus engaged rotates the front planet set sun gear "free wheel" clutch, and forward clutch hub, with it opposite pump rotation. The front planet set sun gear turning opposite pump rotation causes the front planet pinions to turn and "walk" around the stationary ring gear, turning the planet carrier and output shaft opposite pump rotation accomplishing reverse operation. The second turbine, held stationary, functions in a manner similar to a stator, aiding effective reverse operation.

7—GRADE RETARDER

a. Construction

The grade retarder consists of:

A piston operated multiple disc clutch splined to a coaxial shaft operating outside transmission output shaft and coupled to the rear planet set ring gear.

b. Operation

As the transmission control is moved to Grade retard "G" position the forward clutch, neutral clutch and reverse clutch are disengaged and the grade retard clutch engaged, holding the grade retard reaction shaft and the rear planet set ring gear stationary. Forward motion of the car turns the output shaft and causes the rear planet pinions to "walk" around the stationary ring gear, spinning the rear planet set sun gear, first turbine shaft and first turbine in the same direction and faster than the converter pump. As the first turbine turns in the converter it tends to act as a pump, forcing converter oil forward through the second turbine, third turbine and back through the stator into the engine coupled converter pump which accelerates in speed and resists turning to the extent that the engine resists turning. Sufficient power is absorbed by the engine to allow safe descent of grades with the transmission in this range "G".

8—FLIGHT PITCH DYNAFLOW HYDRAULIC CONTROL SYSTEM

The Flight Pitch Dynaflow transmission is supplied with sufficient oil to keep the torque converter filled when in operation and approximately four additional quarts for lubrication and operation of controls. Two oil pumps are used to provide oil circulation and pressure.

The hydraulic control system consists of the following main components:

Front oil pump
Rear oil pump
Front and rear pump check valves
Pressure regulator valve
Manual control valve
Stator control valve
Stator modulator valve
Stator piston control valve
Limit valve
Reverse Boost Valve
Lubrication oil pressure pop-off valve

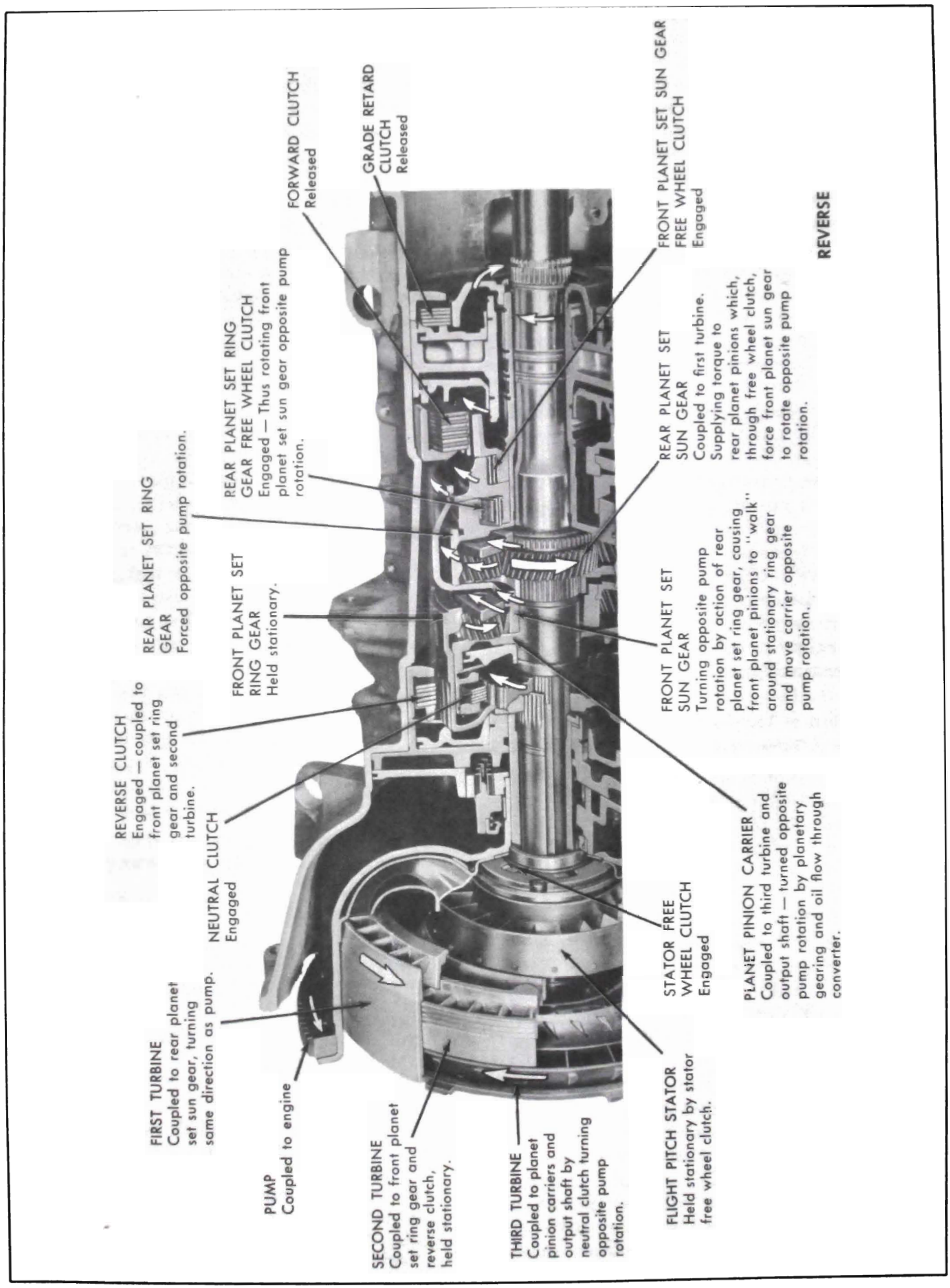


Figure 11—Operation of Components in Reverse Range

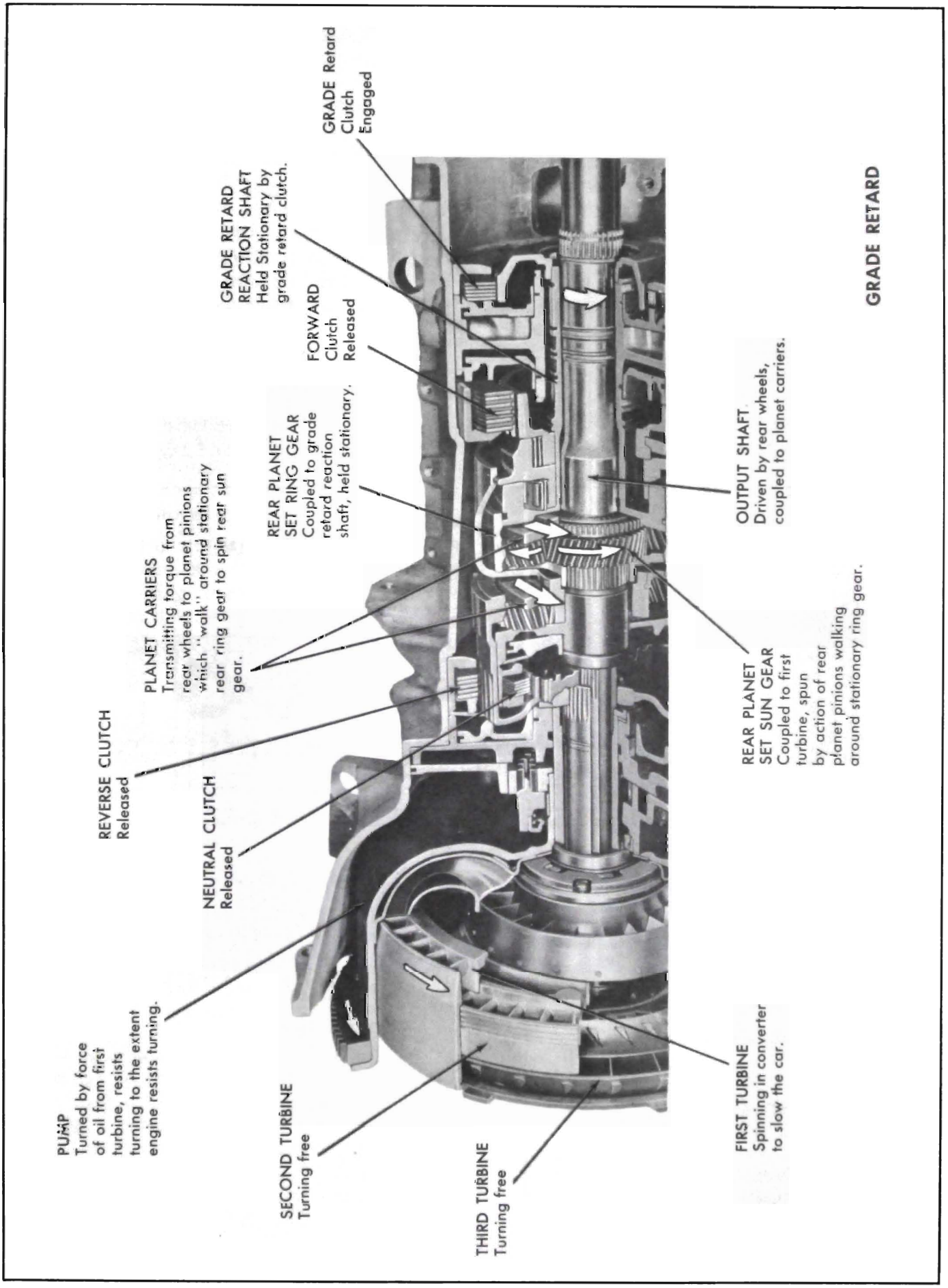


Figure 12—Operation of Components in Grade Retard Range

a. Oil Pumps

Two internal gear type oil pumps are used to provide oil circulation and pressure, to engage the clutches, control the stator valve and fill the converter and supply the necessary cooling and lubrication oil. The front oil pump, driven by lugs on the converter pump hub, is in operation whenever the engine is running. The rear oil pump is smaller than the front and is driven by the transmission output shaft; therefore it is in operation only when the rear wheels are turning.

The front oil pump is sufficient for all normal operation with engine running. When pushing the car to start engine, oil pressure is required to engage grade retard clutch. Under these conditions the front pump is not operating, but the rear pump, driven by the rear wheels, provides the necessary oil pressure and circulation.

The oil pumps are inter-connected by oil channels provided with check valves so they can operate together or independently. The pressure regulator valve and check valves are arranged in such a manner that a minimum of power is used in driving the pumps.

b. Pressure Regulator Valve

The pressure regulator valve operates in the valve body to regulate "line" pressure to a predetermined value under any operating condition, raising oil pressure during periods of heavy load or acceleration and lowering oil pressure in the system to a safe minimum during "cruise" operation.

Oil from the front and/or the rear pump enters the area between the first and second and second and third lands of the valve and flows through a hole in the first land to fill the cavity between the end of the valve body and the first land of the

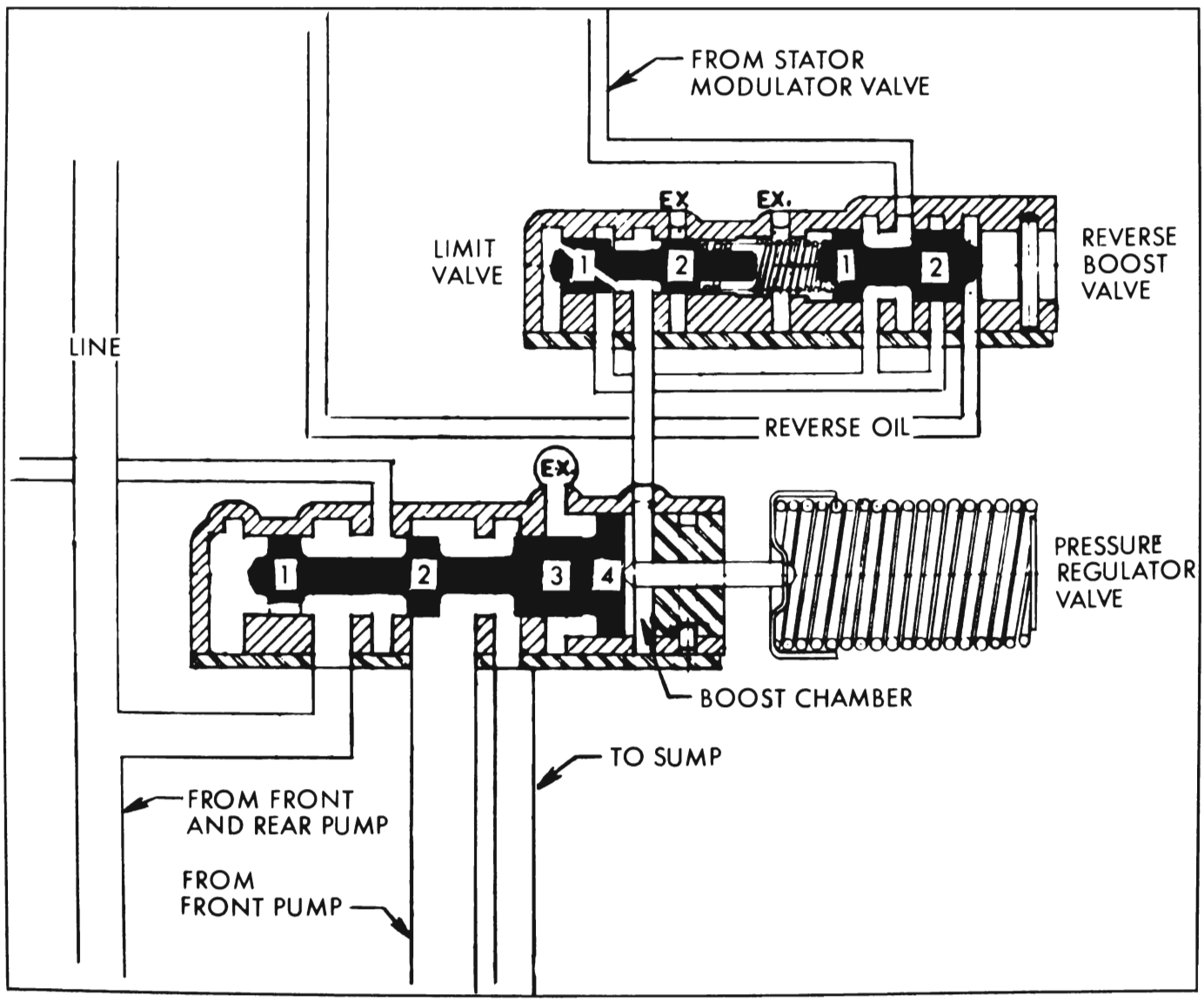


Figure 13—Pressure Regulator Valve and Limit Valve

pressure regulator valve. Upon sufficient build-up of pressure against the end of the valve, the valve is moved against the pressure of the pressure regulator valve spring, opening an exit port between the first and second land of the pressure regulator valve which directs oil through the converter and oil cooler, accomplishing line pressure regulation at low car speeds.

At higher car speeds, the oil pump output is great enough to move the regulator valve further against its spring, opening a second exit port which directs oil to the front pump intake and sump. This causes a drop in front pump pressure which allows the front pump check valve spring to close the valve and rear oil pump pressure to hold the front pump check valve closed. The rear pump then supplies oil under pressure to the hydraulic system. The front pump under these circumstances absorbs very little power as it is not operating under pressure. See Figure 13.

c. Manual Control Valve

The manual control valve has five lands that serve to open and close the proper ports to determine the operating range of the transmission and is connected by linkage to the transmission selector lever on the steering column. It can be set in five positions: Park, Reverse, Neutral, Drive, and Grade Retard.

d. Stator Control Valve and Stator Modulator Valve

The stator control valve and modulator valve govern the supply of oil at varying pressures to raise "line" pressure for more positive engagement of clutches during acceleration and to position the stator piston control valve. The stator control valve is connected to the carburetor linkage, and its position is determined by throttle opening.

As the throttle is opened, linkage moves the stator control lever to depress the stator valve which moves the stator modulator valve by means of a spring between the two valves. Movement of the modulator valve toward the end of the valve body opens a port between the modulator valve lands to oil at "line" pressure, which flows through a hole in the second land of the valve into a cavity between the second land and the end of the valve body. Build up of pressure in this cavity moves the modulator valve against spring pressure to partially shut off oil entry. This action accomplishes modulation or governing of "line" oil pressure.

Oil at modulated pressure flows between the lands of the modulator valve through an exit port and enters the stator control valve between the first and second lands. Upon sufficient throttle opening, an exit port is uncovered which directs oil through the reverse boost valve and limit valve to a boost chamber of the pressure regulator valve, which has the effect of increasing the pressure regulator valve spring pressure. Increased regulator valve spring pressure requires a higher oil pressure to move the regulator valve and consequently "line" pressure is raised.

e. Stator Piston Control Valve

Position of the Flight Pitch stator blades is determined by the position of the stator piston control valve as described in the Flight Pitch stator section.

f. Limit Valve and Reverse Boost Valve

Pressure of oil entering the boost chamber of the pressure regulator valve is governed by the limit valve and reverse boost valve. As described above, oil at modulated pressure enters the reverse boost valve between its lands and exits to the limit valve without affecting the reverse boost valve.

At the first stage of operation of the limit valve, modulated oil pressure is not great enough to build up pressure sufficient to move the limit valve against its spring. As a result, oil at a low modulated pressure is directed to the boost chamber of the pressure regulator valve. This stage of limit valve operation is not illustrated.

The second stage of operation occurs when modulated oil pressure is sufficient to move the limit valve against its spring to regulate (limit) the pressure of oil entering the boost chamber of the pressure regulator valve to approximately 12 p.s.i.

The third stage of limit valve operation occurs in reverse range. With the shift control valve in reverse "R" range, oil from the shift control valve is channeled to the reverse clutch and to the cavity between the second land of the reverse boost valve and the valve body. Oil under pressure in this area moves the boost valve against its spring and opens an exit port to direct oil to the space between the first and second lands of the limit valve. Oil flows through the hole in the first land of the limit valve and builds up pressure against the valve body and limit valve to move the valve. As spring pressure against the valve is increased by the change in position of the reverse boost valve, much higher oil pressure is required

to move the limit valve. Under these circumstances, the limit valve directs oil at approximately 40 p.s.i. to the boost chamber of the pressure regulator valve, accomplishing an increase in line pressure for positive engagement of the reverse clutch. See Figure 13.

g. Lubrication Oil Pressure Pop-off Valve

Oil returning to the transmission from the oil cooler is used to lubricate the moving parts of the transmission. The pressure of the lubricating oil is maintained at approximately 30 p.s.i. by a spring loaded ball valve in the output shaft support.

h. Operation of Hydraulic Controls in Neutral "N" Range and Parking "P" Range

During operation in neutral the manual control valve is positioned as shown in Figure 14, "Oil Flow in Parking and Neutral." The manual control valve is positioned further to the left during operation in parking. In both Parking and Neutral ranges, the neutral clutch piston oil supply is cut off and an exhaust port opened to disengage the neutral clutch. The forward and reverse clutches are also disengaged in a similar manner. Thus, the turbine members are allowed to turn but transmit no torque to the output shaft when operating in Parking or Neutral range.

The route of oil to the neutral clutch is illustrated and discussed in the Trouble Diagnosis Section.

i. Operation of Hydraulic Controls in Drive "D" Range 60 MPH—Cruise

During operation in Drive "D" range, the manual control valve is positioned as shown in Figure 15, "Oil Flow in Drive "D" Range 60 MPH Cruise." With the manual control valve thus positioned, oil is directed to the neutral clutch and forward clutch pistons solidly connecting the third turbine to the planet carriers and output shaft and preventing rotation of the rear free wheel clutch inner race. The neutral and forward clutches thus engaged, engine torque can be transmitted to the turbine members to drive and accelerate the car. The route of oil to the forward clutch is illustrated and discussed in the Trouble Diagnosis Section.

As the accelerator is depressed the stator modulator valve spring is compressed by the stator control valve (connected to carburetor linkage). Compression of the modulator valve spring provides higher modulated oil pressure exiting from the stator modulator valve chamber. This modulated oil is directed to the Flight Pitch stator piston control valve and to the space between the first and second lands of the stator control valve, which at half throttle is depressed sufficiently to open an exit port directing oil through the reverse boost valve to the space between the first and second lands of the limit valve. A hole in the first limit valve land allows the limit valve to position itself as described previously and direct oil at limited pressure (approx. 12 psi.) to the boost chamber of the pressure regulator valve. This "boost" raises line pressure to 170—190 psi. thus insuring positive engagement of the neutral and forward clutches and insuring ample oil flow through the converter and oil cooler for proper cooling and lubrication of the transmission.

j. Operation of Hydraulic Controls in Drive "D" Range—Wide Open Throttle

Hydraulic component operation in Drive "D" range at wide open throttle is similar to cruise with the following exceptions: (See Figure 16.)

The stator control valve at wide open throttle is fully depressed further compressing the stator modulator valve springs. Greater pressure on the stator modulator valve springs provides modulated oil at higher pressure (80-90 psi.). The modulated oil flows to the limit valve which limits the pressure of oil entering the boost chamber of the pressure regulator valve to 12 psi. the same as during cruise operation at half throttle. However, higher modulated oil pressure at the stator piston control valve shifts the valve and allows converter charging pressure to move the stator piston and set the stator blades at high angle as described in the Flight Pitch Stator Section.

k. Operation of Hydraulic Controls in Reverse "R" Range

With the transmission selector lever set in Reverse "R" range the manual control valve is positioned as shown in Figure 17, "Oil Flow in Reverse "R" Range".

Oil supply to the grade retard and forward clutch pistons is thus cut off and exhaust ports opened to allow rapid disengagement of the clutches. Oil at line pressure is channeled to the neutral and reverse clutch pistons and also to the reverse boost valve.

Oil from the reverse clutch piston supply is directed to the space between the second land of the reverse boost valve and the valve retainer. Oil pressure in this space moves the boost valve

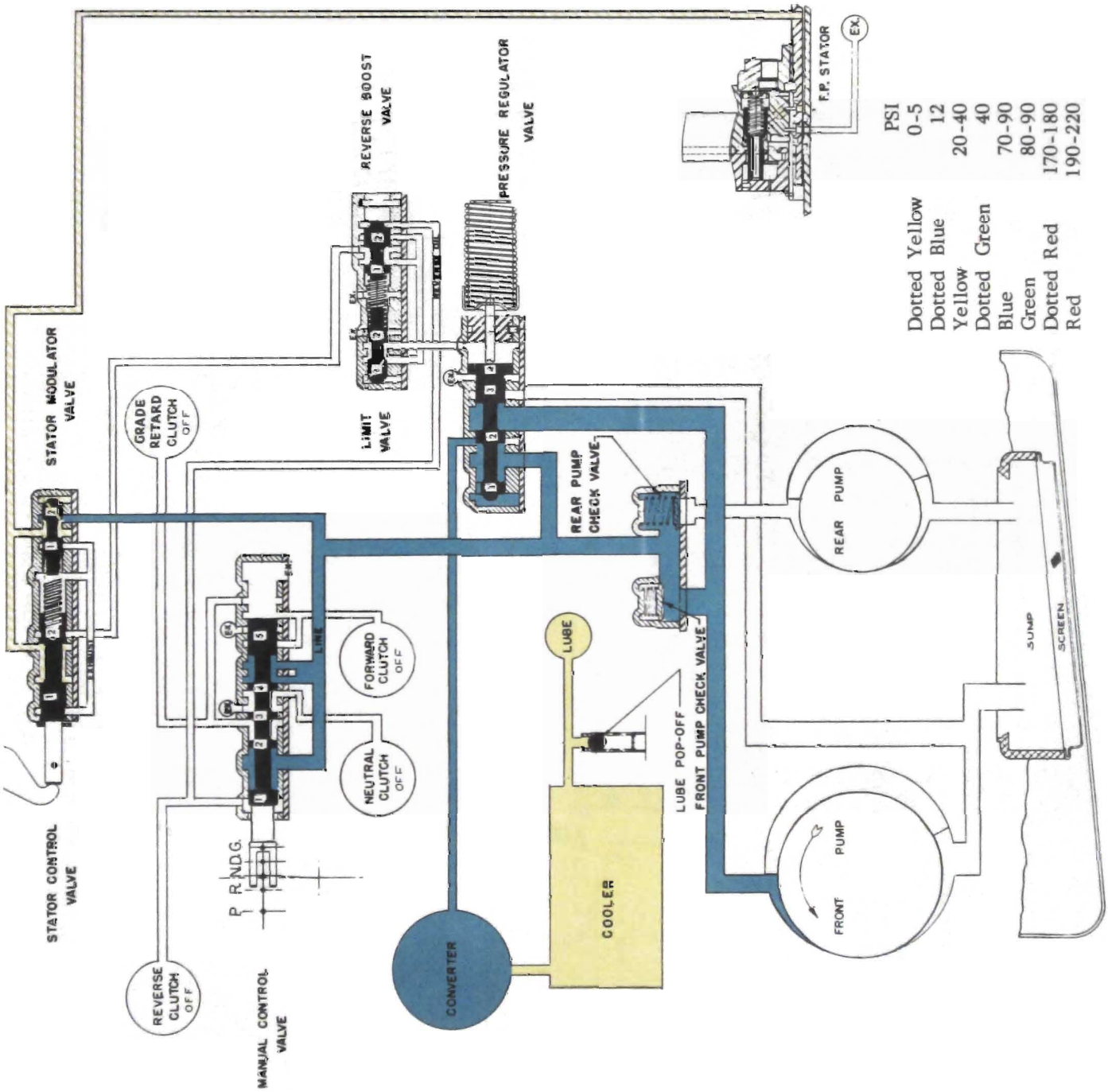


Figure 14—Oil Flow in Neutral and Park Range

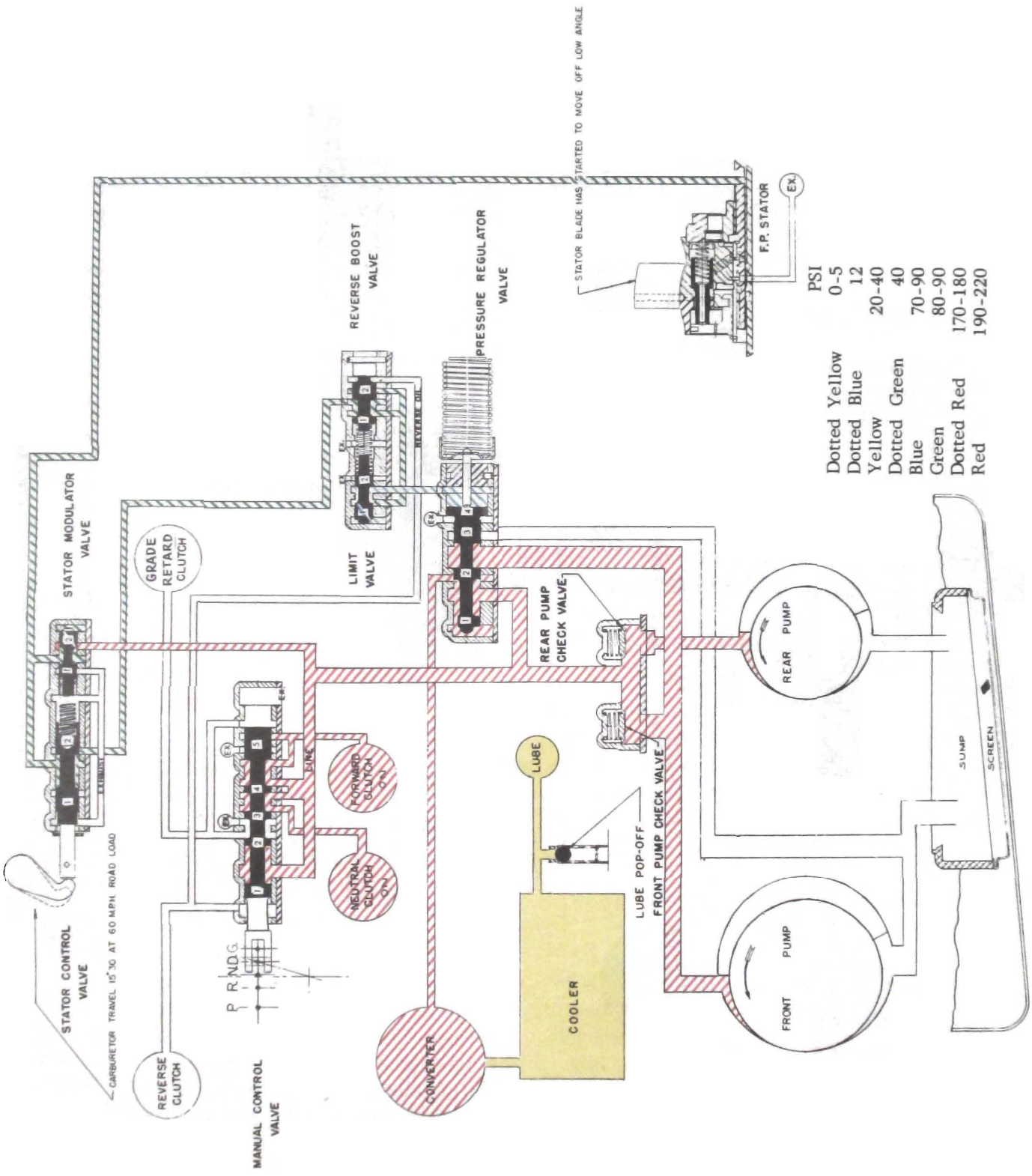


Figure 15—Oil Flow in Drive Range, 60 MPH Cruise

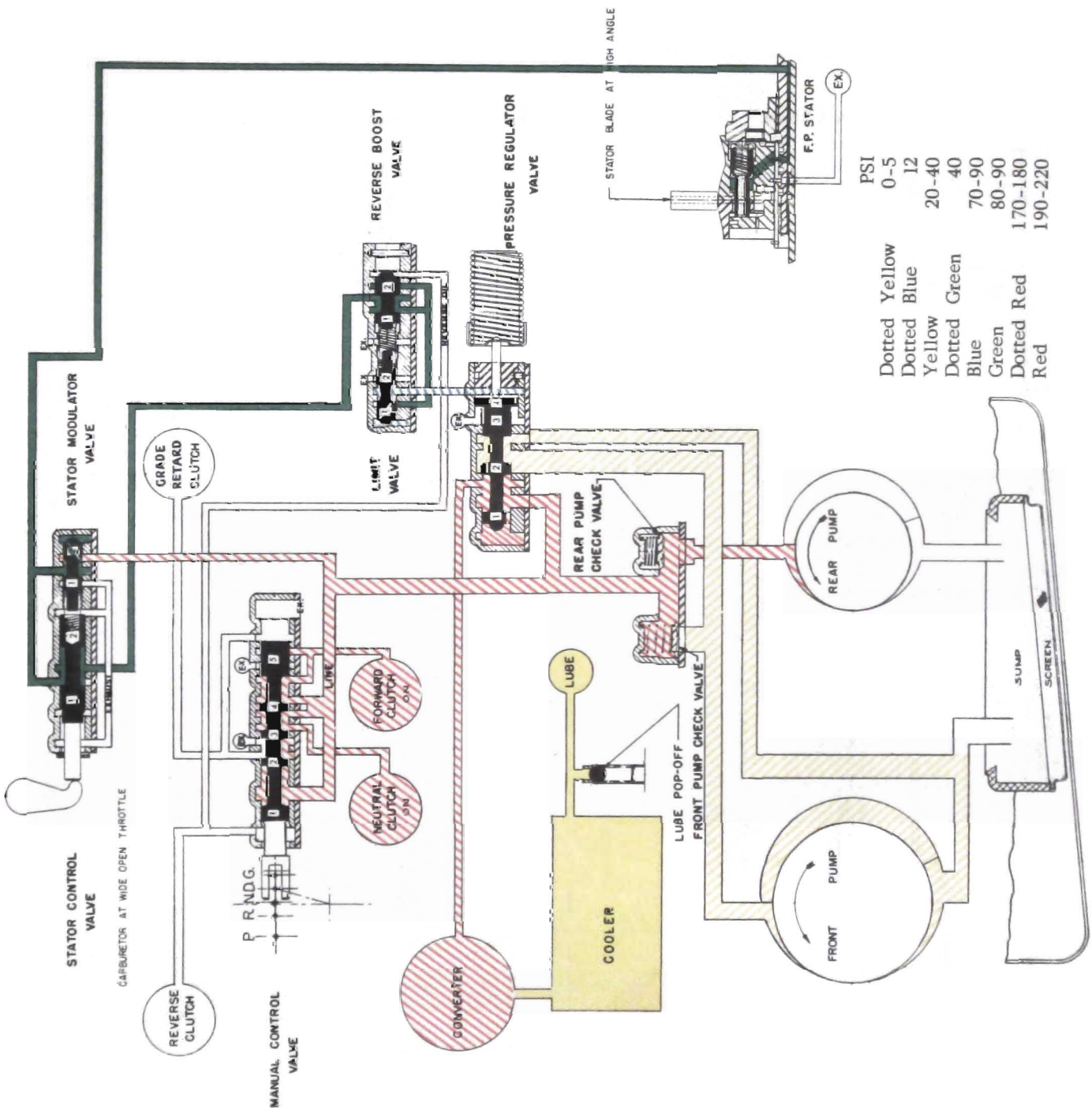


Figure 16—Oil Flow in Drive Range, Wide Open Throttle

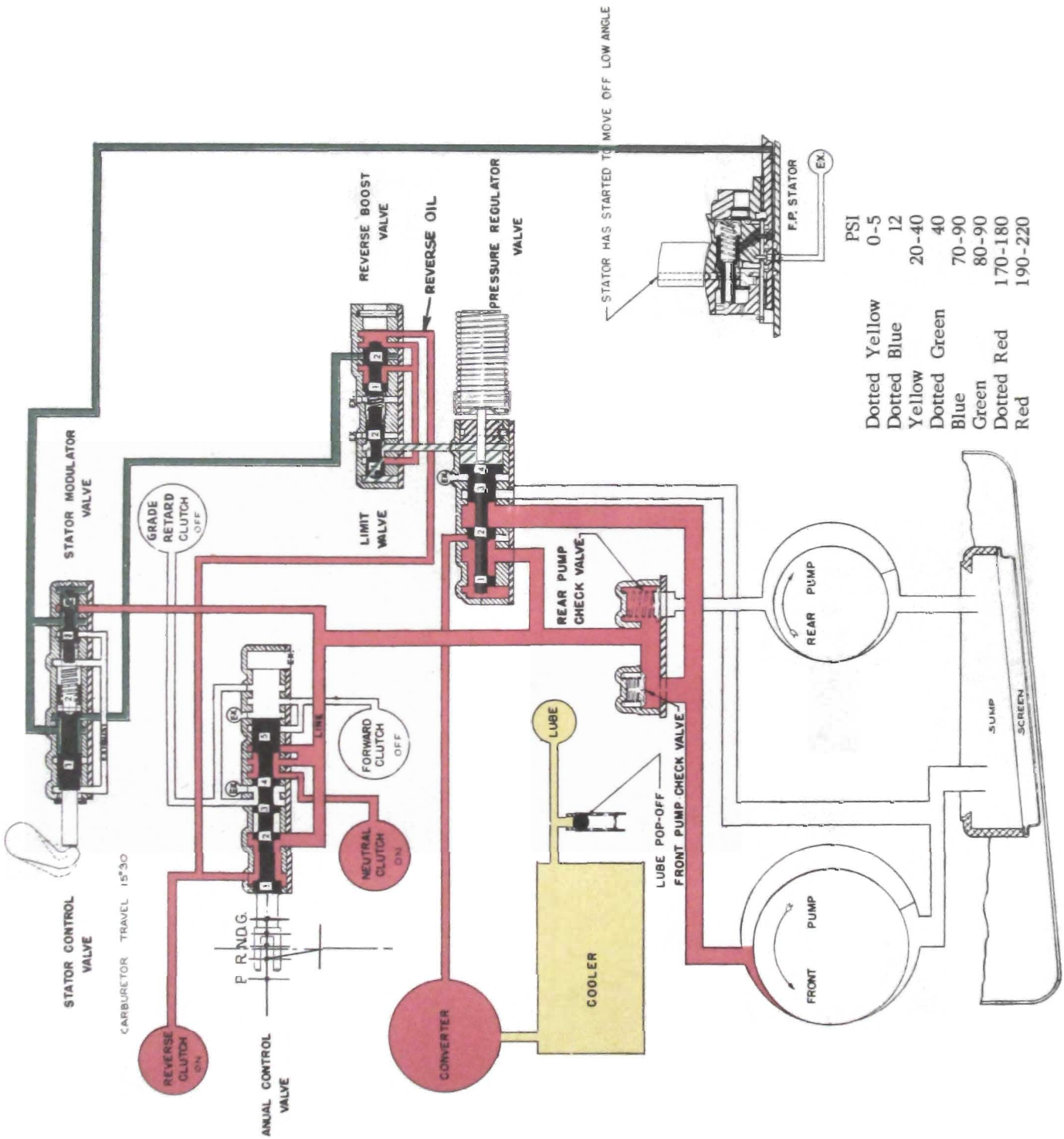


Figure 17—Oil Flow in Reverse Range

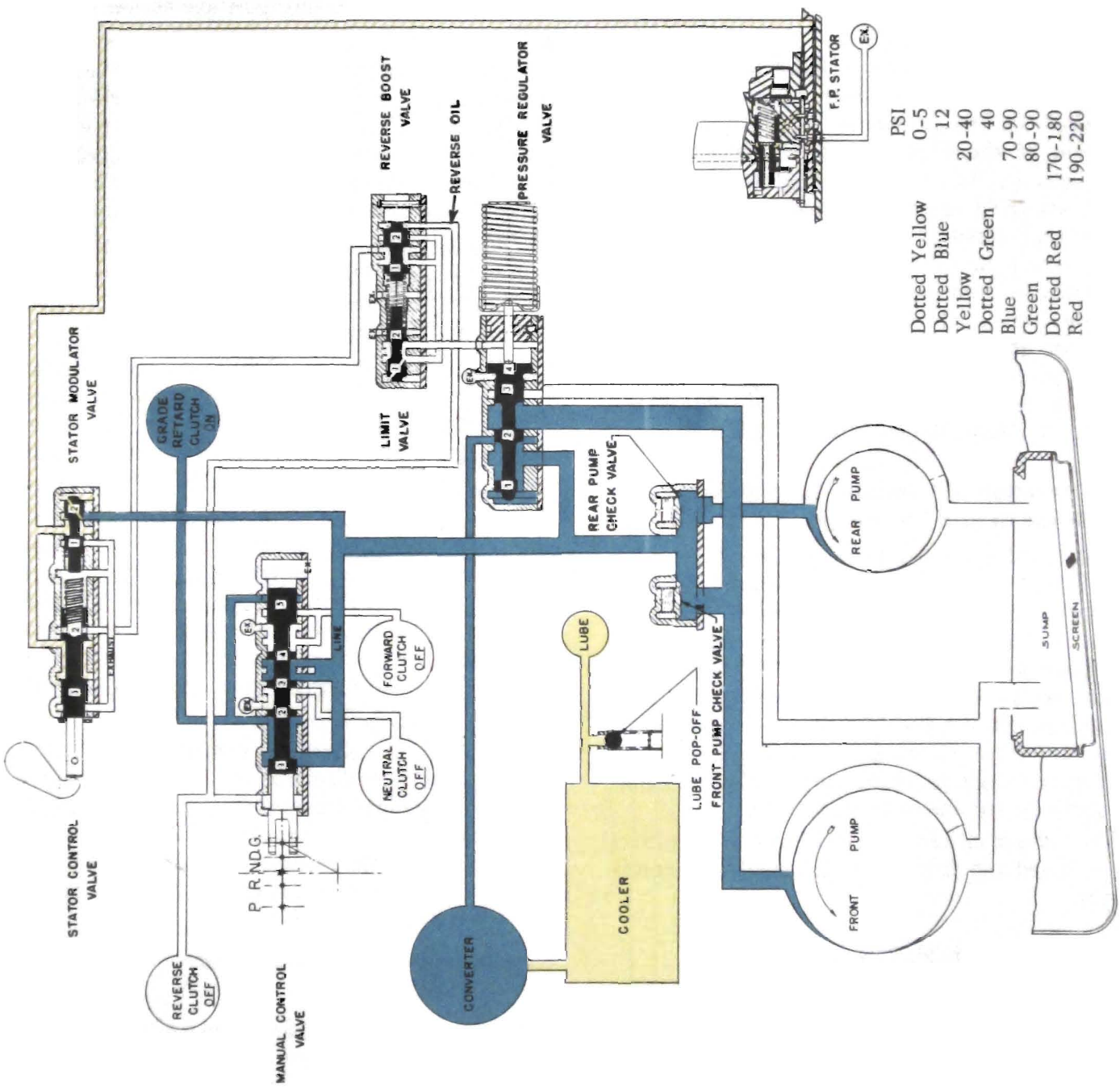


Figure 18—Oil Flow in Grade Retard Range

against spring pressure toward the limit valve, closes the modulated oil entrance port and opens an exit port to the limit valve. The spring between the reverse boost valve and limit valve thus compressed, higher oil pressure is required to move the limit valve. Consequently line boost pressure to the pressure regulator valve boost chamber is raised to approximately 40 psi. raising line pressure to approximately 200 psi. Higher line pressures during operation in Reverse "R" range are necessary to insure positive engagement of the reverse clutch. As previously described, reverse operation of the Flight Pitch Dynaflow is accomplished by holding the second turbine-front planet set ring gear stationary. The second turbine then functions in a manner similar to a stator having sharply curved vanes operating in the oil stream from the converter pump. Thus to preclude the possibility of second turbine-front planet set ring gear rotation during operation in reverse range, a larger more positively engaged clutch is used than is necessary for Forward, Neutral or Grade Retard clutch applications.

I. Operation of Hydraulic Controls in Grade Retard "G" Range

With the shift control lever positioned in Grade Retard "G" range the manual control valve is positioned as shown in Figure 18 "Oil Flow in Grade Retard "G" Range." The valve thus positioned shuts off the oil supply to the forward clutch, neutral clutch and reverse clutch pistons and opens exhaust ports to provide rapid disengagement of the clutches. Oil at line pressure is directed to the grade retard clutch piston engaging the grade retard clutch to slow the car.

The route of oil to the grade retard clutch piston is illustrated and discussed in the trouble diagnosis section.

9—FLIGHT PITCH STATOR

I. DESCRIPTION

The 1958 Flight Pitch stator consists of:

a. Twenty movable stator blades and cranks. See Figure 19.

b. A Stator piston which acts on the cranks to set the blades at any angle from Low to High.

c. A stator piston control valve, sensitive to throttle opening, which controls the position of the stator piston.

d. A front and rear carrier which supports the blade cranks and houses the piston and valve mechanism.

e. A free wheel clutch which allows the stator to free wheel when torque multiplication is not required.

II. OPERATION

a. The stator blades of the Flight Pitch transmission can be set at any position between high and low.

b. As the accelerator pedal is depressed beyond approximately half throttle position, carburetor linkage has moved the stator control lever which causes oil under pressure to be directed to a cavity formed by the shoulder of the stator piston control valve and the stator rear carrier. See Figure 19.

1.This oil pressure is proportional to throttle opening; that is, the wider the throttle opening, the higher the oil pressure bearing on the shoulder of the piston control valve.

2. When the throttle has been opened sufficiently to cause the oil pressure bearing on the shoulder of the control valve to reach 38-40 psi., the valve moves against its spring until the resistance of the spring balances the force of the oil pressure.

c. The forward end of the stator control valve extends through a cavity behind the stator piston and bears against the rear face of the piston except when the valve is caused to move by an increase in throttle opening. The stator piston moves in a bore formed by the stator front carrier and a sleeve extending forward from the stator rear carrier.

1. The stator piston has a small "bleed hole" which allows oil to fill the cavity behind the piston to nearly equal the converter charging pressure at the front of the piston except when a change of stator blade position is desired. This "bleed hole" is actually the gap in the stator piston oil ring.

d. Operation During a Change to Higher Angle

1. Wider throttle opening causes oil at increased pressure to move stator control valve rearward against spring pressure.

2. Front end of stator valve leaves rear face of stator piston.

3. Oil flows from cavity behind stator piston through center of valve, causing decrease in oil pressure behind piston.

4. Converter charging pressure moves piston rearward till it touches valve and oil flows through bleed hole to fill rear cavity.

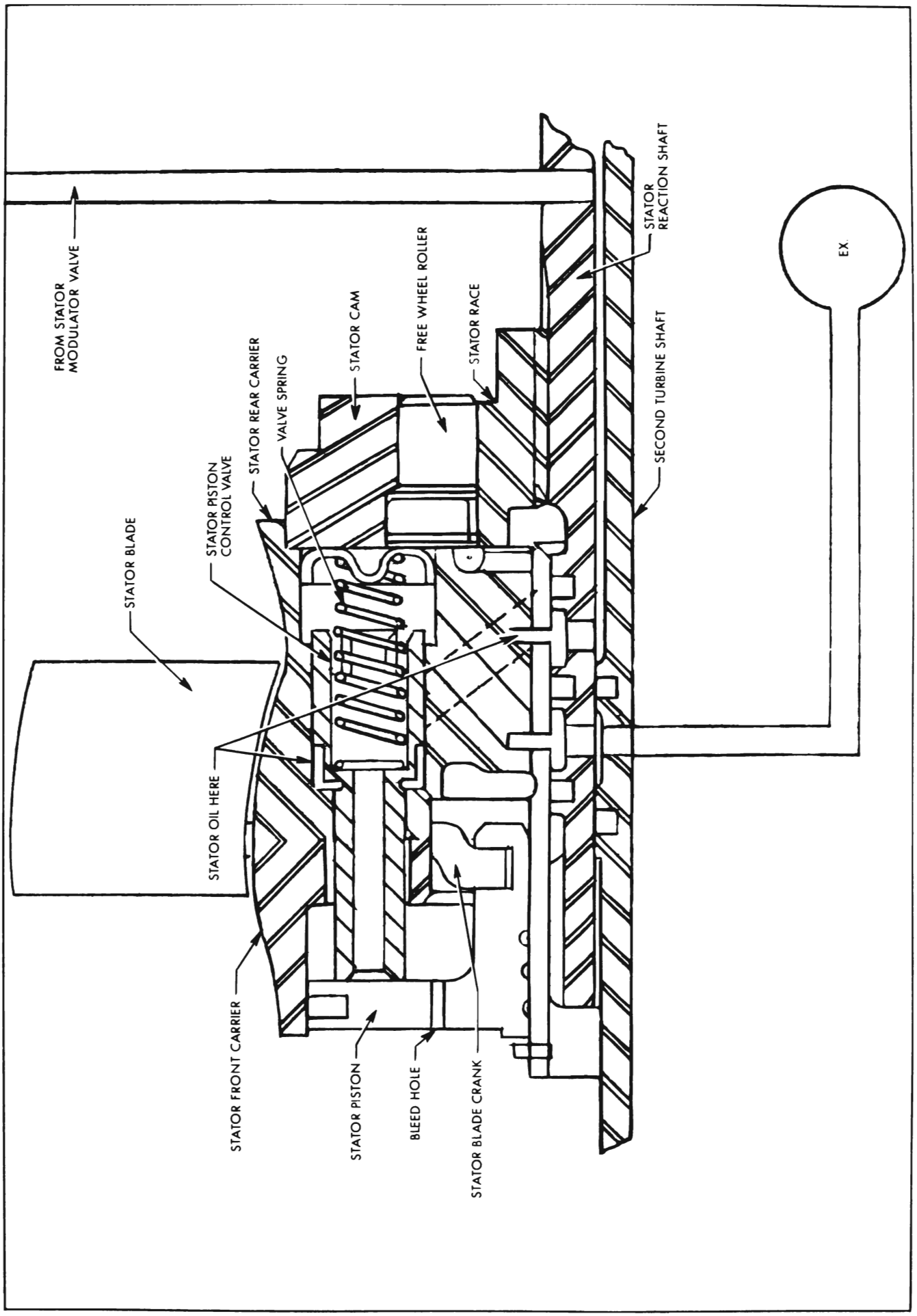


Figure 19—Flight Pitch Stator

5. As piston moves rearward, it rotates stator blade cranks to set stator blades at higher angle.

e. Operation During Change to Lower Angle

1. Decreased throttle opening lowers oil pressure at valve shoulder.

2. Valve spring moves valve forward to touch piston.

3. Flow of oil across stator blades forces them to lower angle.

4. Valve follows piston forward till oil pressure on shoulder and spring pressure are equal.

f. Operation with No Change in Blade Angle (Blades Not at Low Angle)

1. Oil pressure on shoulder of valve and spring pressure equal—valve does not move in bore.

2. Flow of oil across stator blades tends to move them to lower angle.

3. Force of oil across stator blades tends to rotate cranks and move piston forward.

4. As piston tends to move forward, oil pressure is lost from cavity at rear of piston and piston is immediately moved rearward by converter charging pressure to touch valve and allow oil to "bleed" into cavity. This stator blade angle remains constant till throttle opening is changed.

SECTION B

FLIGHT PITCH DYNAFLOW TEST, INSPECTION, ADJUSTMENT ON CAR

10—FLIGHT PITCH DYNAFLOW TEST AND INSPECTION

a. Road Test

When improper operation of a Dynaflow transmission is reported, time and expense can usually be saved by first making a thorough road test to observe operation in all ranges under appropriate driving conditions. The road test will also serve to thoroughly warm up the transmission, which is required for any tests made in the shop.

The person making the road test should be familiar with the operation and performance of Dynaflow Drive in all ranges so that he will be able to detect any sub-standard condition. The required "feel" of a Dynaflow car can best be acquired by driving through a test routine on a number of cars whose performance is known to be satisfactory. Knowledge of which parts are in operation and which hydraulic controls govern operation in each range is essential to intelligent diagnosis, therefore, a study of Paragraphs 5 through 12 is recommended.

After the transmission has been warmed up to normal operating temperature, thoroughly test operation in all ranges, making tests on steep grades as well as on level road, if possible.

While in "D" range test shifting of the Flight Pitch stator by depressing the accelerator pedal. As the accelerator pedal is depressed beyond half way a change of engine speed accompanied by acceleration pick-up should be noted, indicating that the stator blades are starting to move toward the high angle position.

Shift to Grade Retard "G" range, clutch should engage immediately. A definite braking action should be experienced at car speeds above 15 MPH.

Check for abnormal slip or over-run of the engine on low speed acceleration. With car stopped on level road and brakes released, check for creep when engine is accelerated with transmission in Neutral. Little or no creep should be evident. Check for abnormal creep with engine idling and transmission in each of the driving ranges.

Place transmission in Direct Drive and firmly apply brakes. Snap the throttle open to give engine speed of approximately 1400 RPM and immediately release the accelerator pedal. If the engine returns to idle too slowly, or returns to idle so fast that it either stalls or rolls unevenly, improper throttle linkage and dash pot adjustment is indicated. Rough operation on idle after slow deceleration indicates the need for engine tune-up adjustments.

During all tests, be alert for any unusual or abnormal noises. Carefully note the range, speed and other conditions under which the noise is evident.

b. Shop Inspection and Test

After the road test described above, a number of shop inspections and tests should be made while the transmission is thoroughly warmed up to operating temperature.

1. Check Oil Level.

In every case of a transmission complaint first check the oil level. If oil level is low bring it to proper level and check the effect on operation before doing further work. If oil level is low and the car history indicates oil loss of one pint or more per 1000 miles, or transmission exterior is oily, a thorough inspection for oil leakage should be made as described in Paragraph 10.

2. Check Manual Control Linkage.

In cases of improper operation in one or more ranges it is always advisable to check the adjustment of transmission manual control linkage and stator control linkage as described in Paragraph 12.

3. Test Oil Pressures in Hydraulic Control System.

When diagnosing almost all cases of improper operation it is necessary to have accurate knowledge of oil pressures in the hydraulic control system. Pressure Test Specification Chart below. These pressure tests should be made before performing any mechanical work.

4. Check Engine and Transmission Mountings.

Check the engine and transmission mounting bolts and condition of the rubber mounting bolts and condition of the rubber mountings. Also check for any marks on transmission case or oil pan that would indicate that these parts had been damaged by some obstruction, which might affect alignment of the transmission.

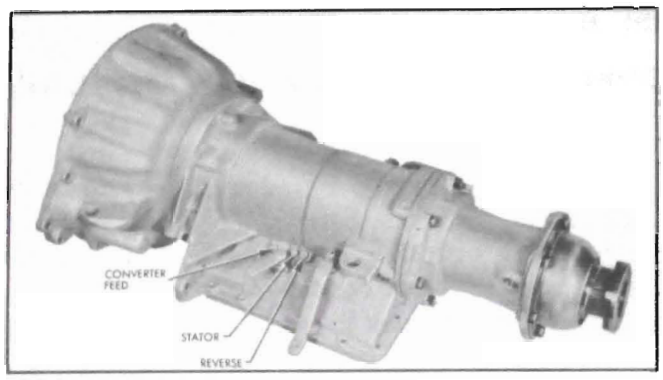


Figure 20—Oil Pressure check locations, right side

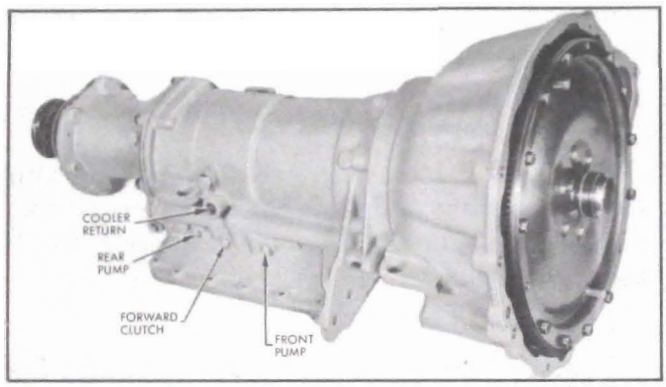


Figure 21—Oil Pressure check locations, left side

11—DYNAFLOW OPERATIONAL FAULTS AND CAUSES

The following illustrations and descriptions may prove of value in Flight Pitch Dynaflow trouble diagnosis. The important oil circuits are illustrated with all sealing points to enable the service man to locate possible points of leakage which should be examined carefully during disassembly.

For Example:

Trouble—Forward Clutch Slips.

Possible points of leakage—(1) Valve body gaskets, (2) Output shaft support adapter sleeves and O-rings, (3) Forward clutch piston inner oil ring, (4) Forward clutch piston outer seal.

a. Oil Circuit through Converter to Oil Cooler

Oil at line pressure leaves an exit port of the pressure regulator valve between the first and second lands, passes through the valve body plate and gaskets to the case. Drilled passages in the case carry the oil forward through the reaction flange gasket to the reaction flange. A cast channel and drilled hole in the reaction flange conduct the oil to a counterbored recess in the reaction flange behind the front pump driving lugs of the converter pump. The oil flows inside the converter pump hub between the hub and stator reaction shaft, through the Flight Pitch stator needle thrust bearing and stator free wheel pilot bearing, into the converter. Oil flows out of the converter between the second and third turbines, forward through drilled holes in the third turbine hub and first turbine disk hub to a counterbored recess in the first turbine disk hub where it is retained by the first turbine shaft nut and special washer. The oil then flows through drilled holes in the first turbine shaft to the hollow center of the first turbine shaft. The oil then flows rearward the length of the first turbine shaft into the first turbine shaft tube which extends into the output shaft. An oil ring on the first turbine shaft tube plug prevents leak back and the oil is directed through the output shaft to a hole between the two rear output shaft oil rings where it exits through the rear pump body and gasket to the rear bearing retainer line to the oil cooler.

b. Flight Pitch Stator Valve Oil Supply and Exhaust

1. Oil at modulated pressure to the stator piston control valve leaves the valve at an exit port between the first and second lands, passes through the valve body plate and both gaskets to the case where drilled passages conduct it through the reaction shaft flange gasket to the reaction shaft flange. Cast and drilled passages in the reaction shaft flange carry the oil to an undercut in the flange which allows the oil to flow through a drilled hole in the reaction shaft to the space between the reaction shaft and the second turbine shaft. The rearmost oil ring on the second turbine shaft prevents the oil from flowing to the rear, so the oil is directed forward to the center oil ring of the second turbine shaft. Just rearward of the center second turbine shaft oil ring a drilled hole in the reaction shaft allows passage to a groove cut in the O.D. of the reaction shaft between the center and rear oil rings. The oil then flows through the rear slot in the stator rear carrier sleeve through a drilled hole in the stator rear carrier to the cavity formed by the stator piston control valve shoulder and the stator rear carrier.

2. Exhaust oil through the center of the stator piston control valve leaves the stator rear carrier through a drilled hole connected to the front slot in the stator rear carrier sleeve. From the sleeve the oil enters a groove in the reaction shaft between the front and center oil rings. A drilled hole through the reaction shaft allows the oil to

Figure 22—PRESSURE TEST SPECIFICATIONS

Range	Engine RPM	Stator Control Lever Position	Stator	Front Pump	Rear Pump	Forward Clutch	Reverse Clutch	Cooler Return
Drive	500	Low Angle	0-5	67-80	0	67-80	0	0-35
Drive	1000	Low Angle	0-5	67-80	67-80	67-80	0	20-40
Drive	2000	High Angle	80-90	0-180	170-180	170-180	0	20-40
Reverse	1000	High Angle	80-90	190-220	0	0	190-220	0-35

With engine and transmission warmed up:

1. Support car in a safe manner with wheels not touching floor and brakes off.
2. Connect pressure gage at point to be checked.
3. Disconnect stator lever linkage to allow stator lever position to be changed without moving throttle.
4. Connect reliable tachometer to engine.
5. Start engine and take pressure reading at specified RPM. Stop engine, remove gage, replace plug and lower car.

These pressures should be attained with a correctly functioning Flight Pitch Dynaflow.

Note: Never drive car on road test with stator linkage disconnected.

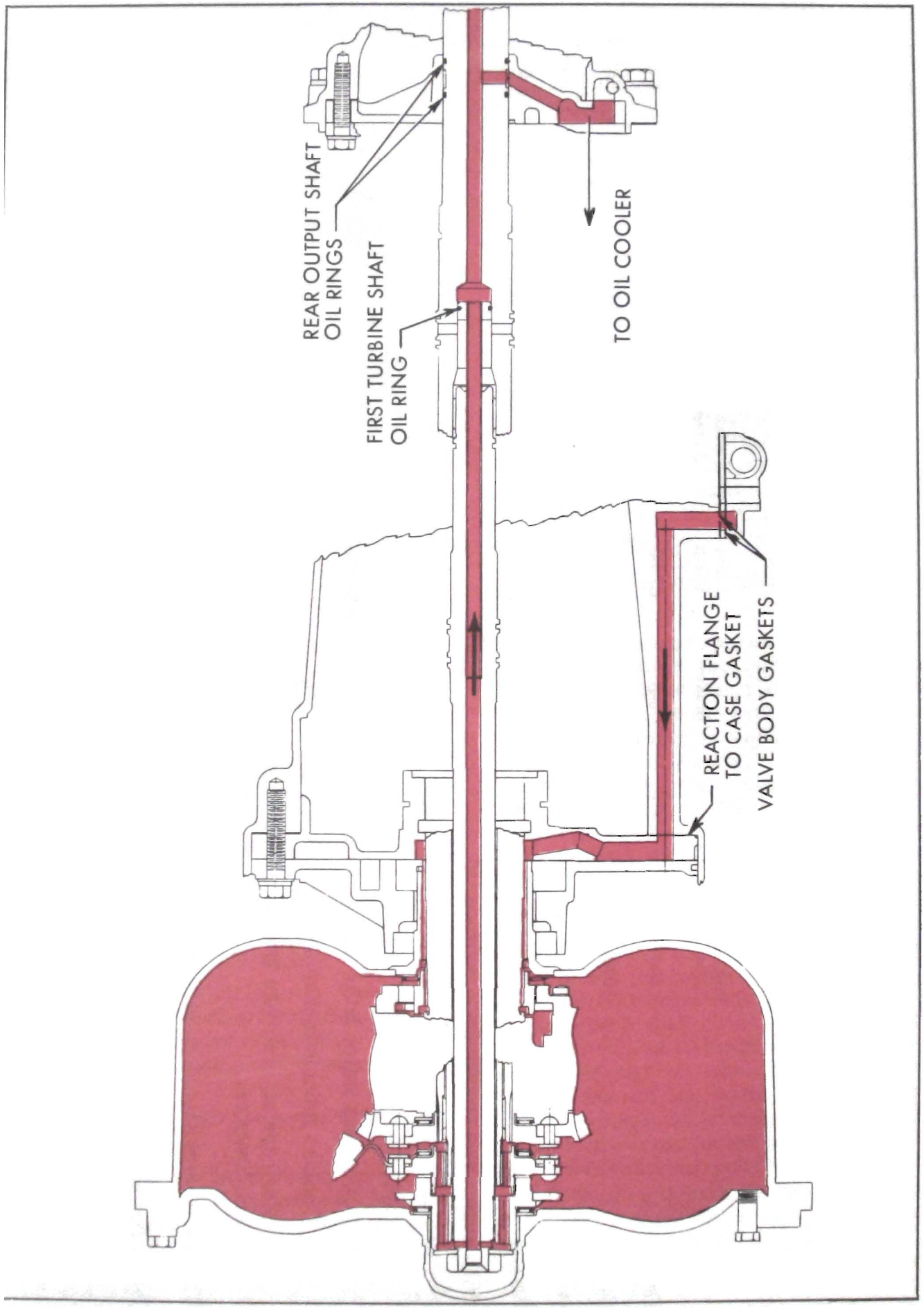


Figure 23—Oil Circuit Through Converter to Oil Cooler

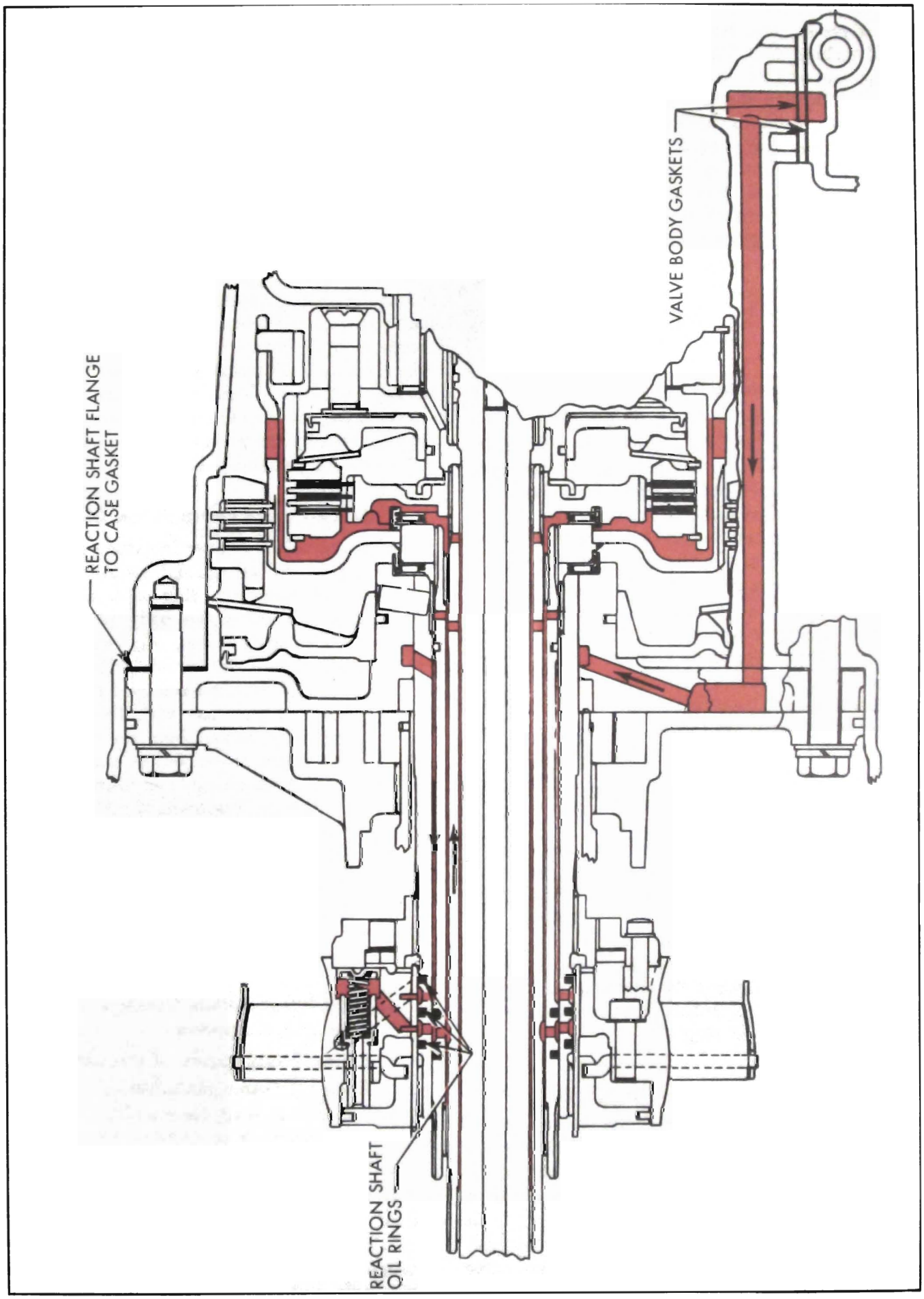


Figure 24—Flight Pitch Stator Valve Oil Supply and Exhaust

enter a groove and pass through a hole in the second turbine shaft between the front and center oil rings and occupy the space between the second and third turbine shafts. The oil here lubricates the second turbine to third turbine shaft bushing and also flows rearward to a hole in the third turbine shaft to the space between the first and third turbine shafts. The oil then flows rearward to a second hole in the third turbine shaft forward of the neutral clutch hub and behind the front planet set ring gear hub where it exits to lubricate the caged needle thrust bearing in the neutral clutch hub and other components of the neutral clutch.

c. Neutral Clutch Oil Supply

With the selector lever in either Drive "D" range or Reverse "R" range, oil at line pressure leaves the manual control valve, passes through the valve body plate and both gaskets to the case where cast passages direct it through the center oil adapter sleeve and O-rings, to the output shaft support. A drilled hole in the output shaft support directs the oil to a groove and hole in the grade retard reaction shaft between the center and rear oil rings. A groove and hole in the output shaft between the two forward oil rings direct the oil to the space formed by the forward end of the first turbine shaft tube plug and the rear of the first turbine shaft inside the output shaft. The two rear oil rings of the first turbine shaft prevent excessive leakage at this point. The oil then flows forward outside the first turbine shaft tube, between the tube and the first turbine shaft I.D. to a drilled hole in the first turbine shaft where the oil exits to a groove between the two front oil rings of the first turbine shaft. Oil flows from the first turbine shaft groove to a drilled hole and groove in the front planet set carrier to a drilled hole leading to the rear of the neutral clutch piston. Oil is contained in the neutral clutch piston bore by the neutral clutch piston outer rubber seal and the inner oil ring.

d. Forward Clutch Piston Oil Supply

With the selector lever in Drive "D" range, oil to the forward clutch piston leaves the control at an exit port between the fourth and fifth lands, passes the valve body plate and both gaskets to enter the case. The oil then passes through an adapter sleeve and O-rings. (Left hand adapter sleeve of the three removed through the valve body portion of the case with the transmission upside down and viewed from the rear.) Leaving the adapter sleeve the oil enters the output shaft support and flows forward through a drilled hole to bear on the forward clutch piston. The oil is contained in this area by the forward clutch piston inner oil ring and outer rubber seal.

e. Reverse Clutch Piston Oil Supply

With the selector lever in Reverse "R" range, oil leaves the manual control valve at an exit port between the first and second lands, passes through the valve body plate and both gaskets to the case where a drilled passage conducts it forward, through the reaction shaft flange gasket to the reaction shaft flange. A drilled hole in the rear of the reaction shaft flange allows the oil to enter the cavity in the rear of the reaction shaft flange and bear on the reverse clutch piston. Oil is contained in this area by the reverse clutch piston inner oil ring and outer rubber seal.

f. Grade Retard Clutch Piston Oil Supply

With the selector lever in Grade Retard "G" range, oil leaves the manual control valve at an exit port between the first and second lands, passes through the valve body plate and both gaskets to enter the case. The oil then passes through an adapter sleeve and O-rings. (The right hand adapter of the three removed from the valve body section of the case with the transmission upside down and viewed from the rear.) Leaving the adapter sleeve the oil enters the output shaft support and flows to the rear through a drilled hole to bear on the grade retard piston. Oil is contained in this area by the grade retard clutch piston inner oil ring and outer rubber seal.

With the results of test and inspection, the causes of improper operation may be determined from the suggestions below.

TROUBLE DIAGNOSIS

a. Engine Stalls While Decelerating Car with Brakes Applied

1. Improper adjustment of throttle dash pot
2. Engine not properly tuned

b. Transmission Oil Foams and Spews Out of Breather Pipe or Filler Pipe

1. Transmission over-filled.

If transmission is over-filled, check for blackened condition of oil, indicating leakage of rear axle lubricant into transmission due to defective propeller shaft seals. Check for low oil level in rear axle housing. Correct cause of leakage and completely drain and refill transmission.

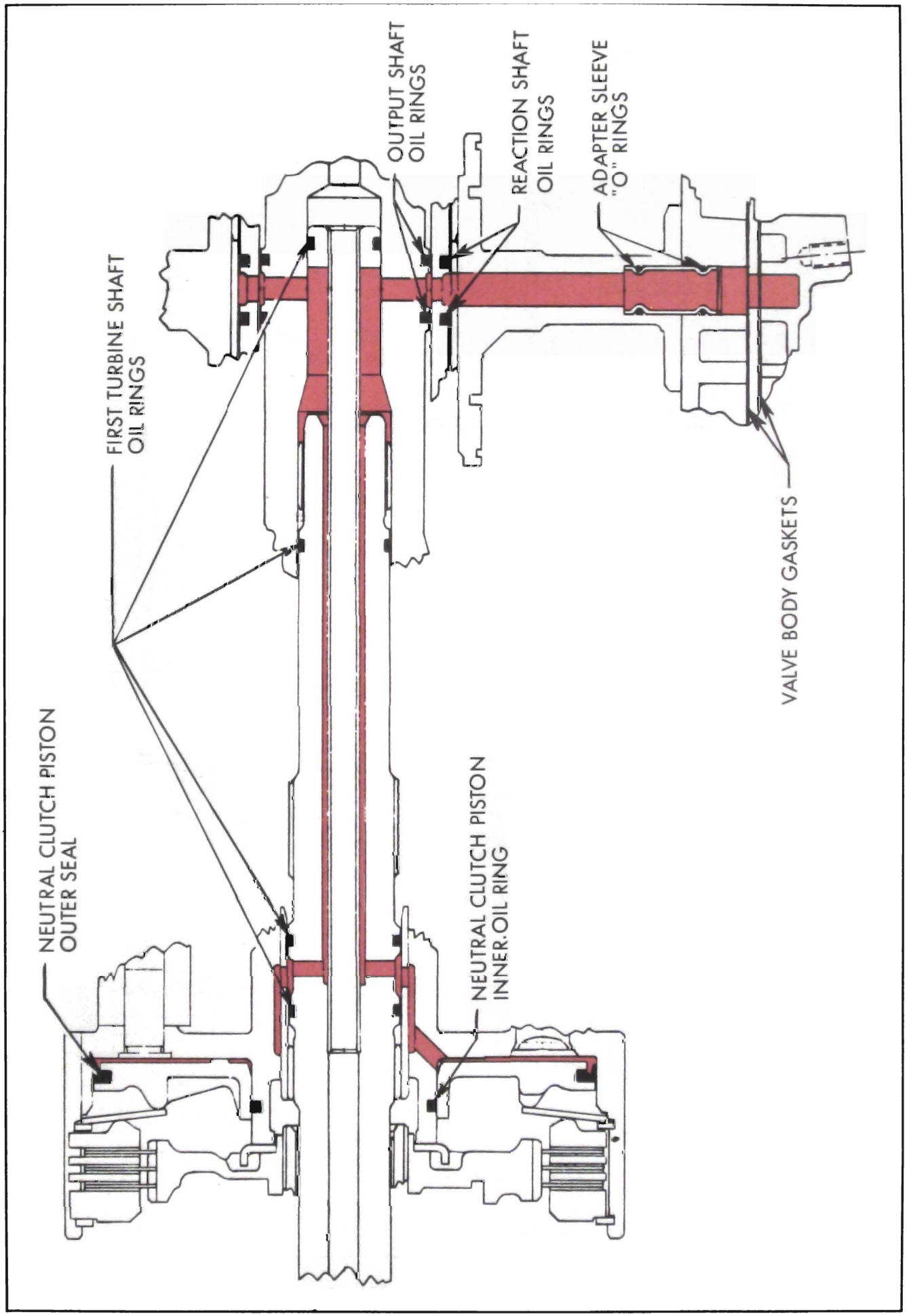


Figure 25—Neutral Clutch Oil Supply

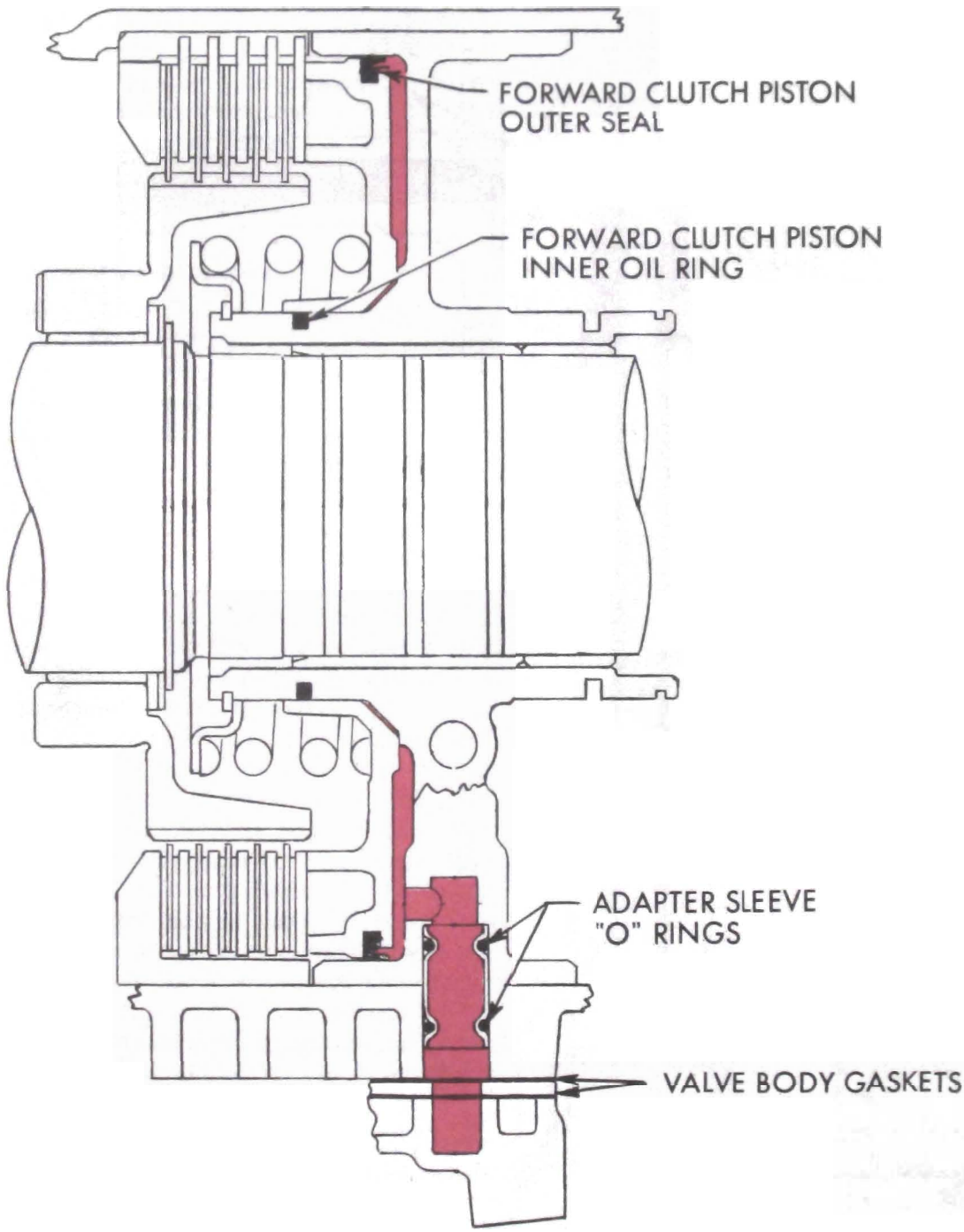


Figure 26—Forward Clutch Piston Oil Supply

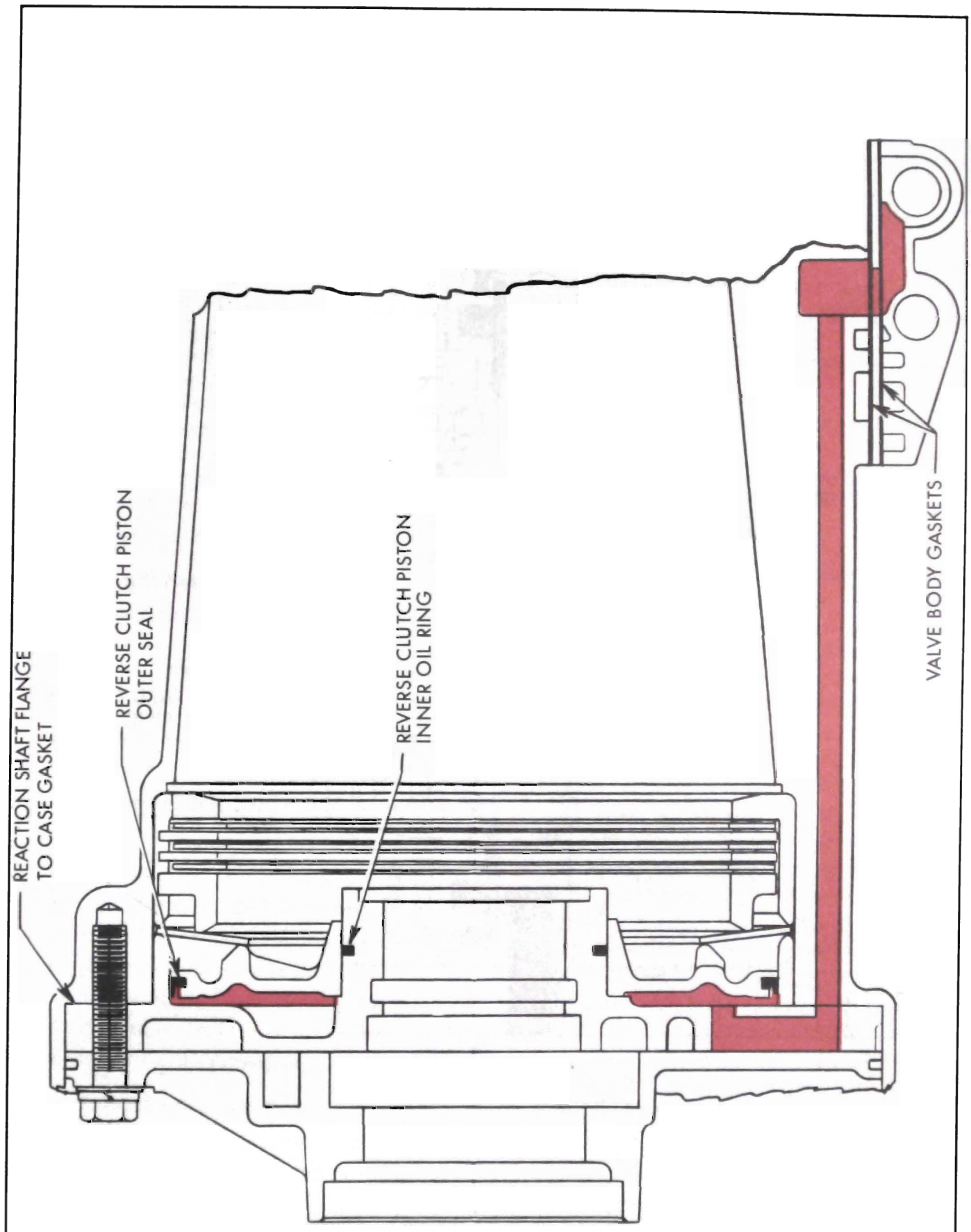


Figure 27—Reverse Clutch Piston Oil Supply

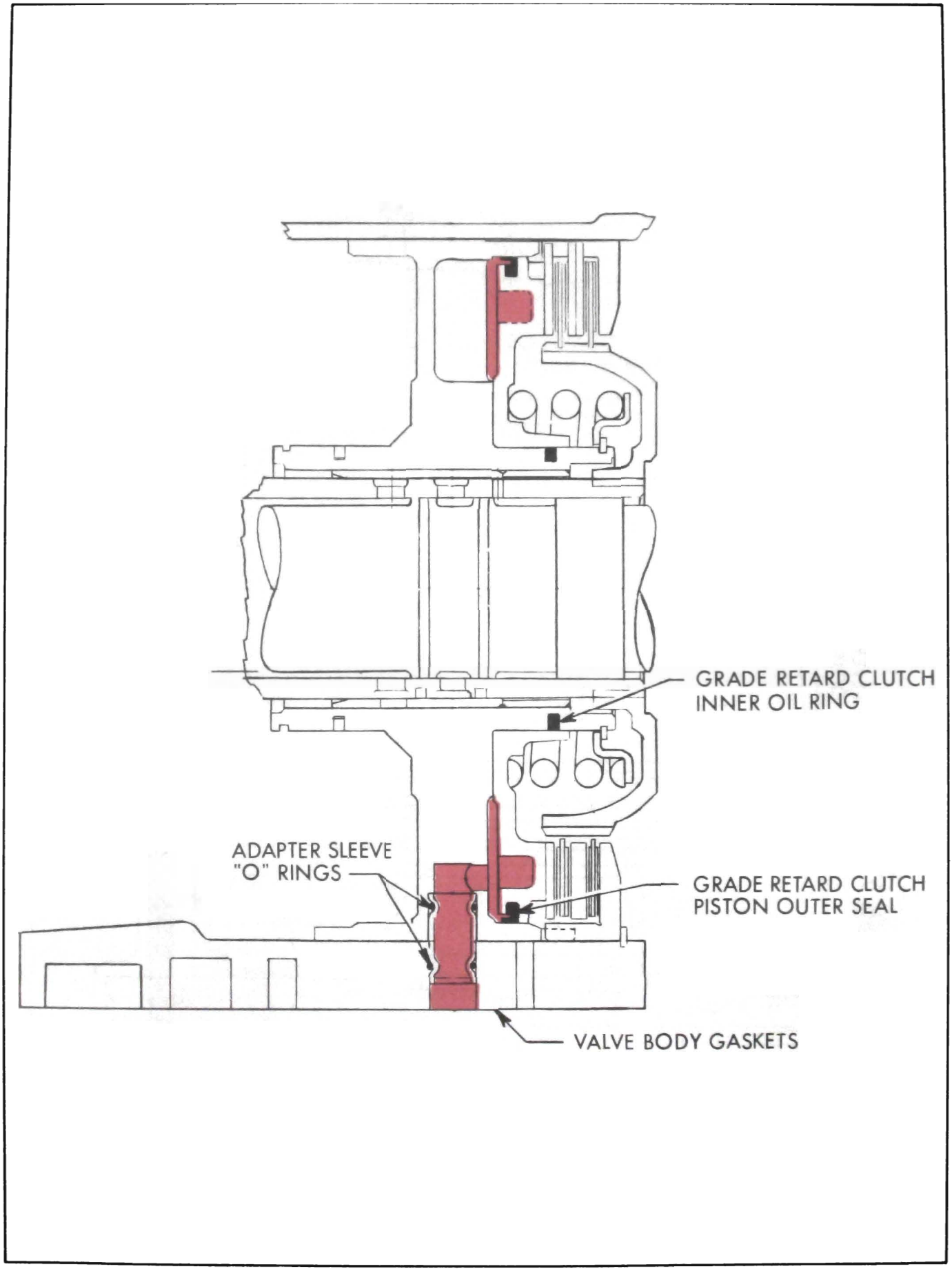


Figure 28—Grade Retard Clutch Piston Oil Supply

2. Water in transmission.

Indicated by over-filled condition and caramel color of transmission oil. Water in transmission usually comes from a leaking oil cooler. In this case there may be excessive oil accumulation in top tank of the engine radiator. Correct the cause of leakage, and completely drain and refill transmission.

c. Car Will Not Move In Any Range—Rear Wheels Free

1. If car will not move for 1 to 8 minutes after standing over night, park car for several hours with engine stopped. Start engine and check front oil pump pressure. A zero reading until such time as car will move indicates that front pump loses its prime due to excessive clearances. Inspect front pump. If condition has existed for some time it is advisable to inspect clutches for excessive wear due to slippage at low apply pressure.

2. Excessively worn neutral clutch plates.

d. Car Will Not Move In D Only

1. Reverse clutch assembly sticking in applied position.

2. Forward clutch inoperative or excessively worn.

e. Car Will Not Move In Reverse Only

1. Forward clutch not releasing.

2. Reverse clutch inoperative or excessively worn.

f. Excessive Slip In All Ranges

1. Low oil level.
2. Manual control linkage improperly adjusted.
3. Neutral clutch worn or damaged.
4. Forward and reverse clutches slipping.
5. Inoperative free wheeling clutches.
6. Stator control linkage improperly adjusted.

g. Excessive Slip In D Only

1. Manual control linkage improperly adjusted.
2. Faulty free wheeling clutches.
3. Forward clutch slipping.

h. Excessive Slip In Reverse Only

1. Manual control linkage improperly adjusted.
2. Faulty front free wheeling clutch.
3. Reverse clutch slipping.

i. Car Creeps Forward In Neutral

1. Manual control linkage improperly adjusted.

2. Neutral clutch or forward clutch not releasing.

3. Foreign material collected behind neutral clutch piston.

j. No Brake Action In G Range

1. Inoperative clutch.
2. Excessively worn clutch plates.
3. Manual control linkage improperly adjusted.

k. Car Slips at Speeds Above 40 MPH

1. Defective neutral clutch.
2. Stator control linkage improperly adjusted.

12—FLIGHT PITCH DYNAFLOW LINKAGE ADJUSTMENT

a. Shift Control Adjustment

If a Dynaflow transmission does not shift properly, the shift control linkage adjustment may easily be checked as follows:

1. Move manual control lever carefully until transmission is shifted into its Drive detent position (manual lever will seem to seat).

2. Move manual control lever toward Grade Retard (without lifting toward steering wheel) and note how far it moves before contacting stop.

3. Move manual control lever until transmission is in Neutral "N" detent position.

4. Move manual control lever toward Reverse and note how far it moves before it contacts stop.

5. If movement from Drive detent to stop is the same as movement from Neutral detent to stop, shift control linkage is correctly adjusted.

If above check shows linkage to be incorrectly adjusted, adjust linkage as follows:

1. With manual control lever in Drive, raise car to gain access to linkage adjusting clevis on lower shift rod.

2. Loosen clevis lock nut. Remove cotter pin, clevis pin and spring washer.

3. Make sure transmission shift lever is in Drive detent (center position of 5 possible detents).

4. Move idler lever so that *upper* shift rod is forced upward as far as possible, then turn clevis until clevis pin will just slip in place without moving transmission shift lever. See Figure 29.

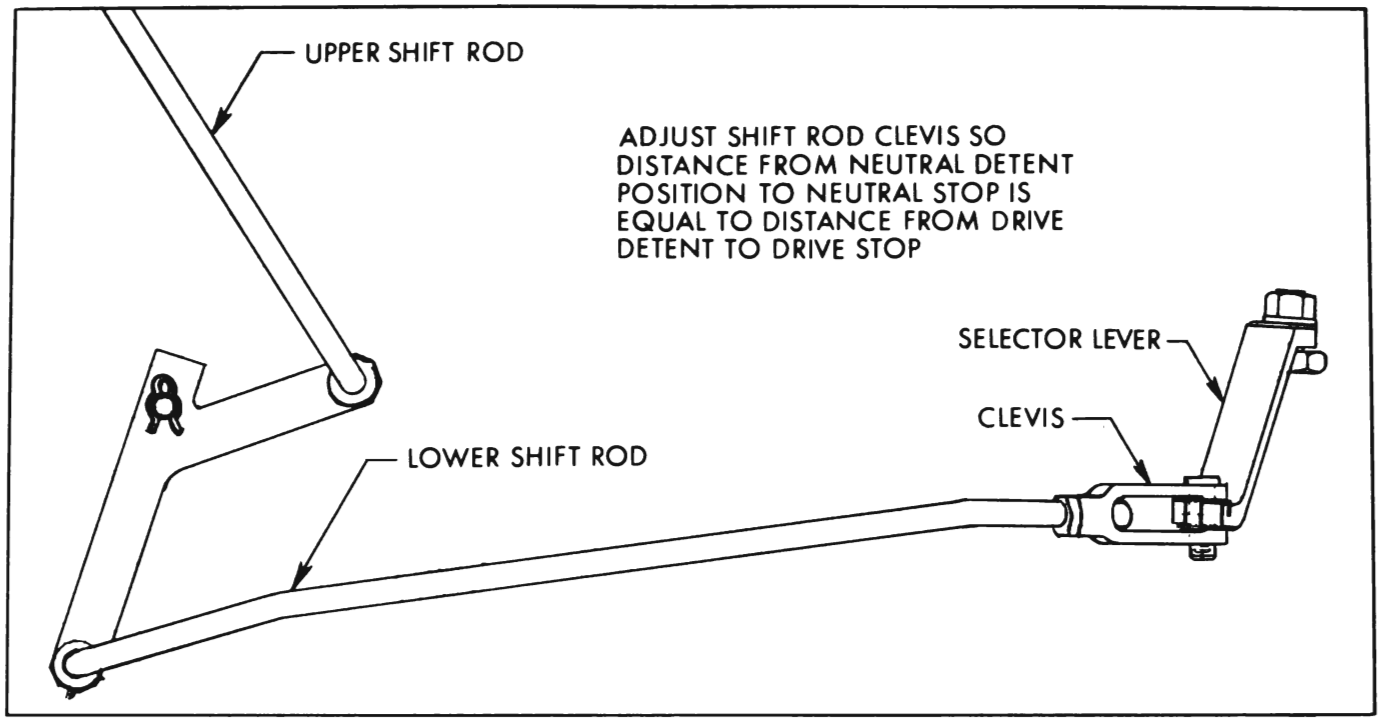


Figure 29—Shift Control Adjustment

b. Stator Linkage Adjustment

1. With throttle in *hot idle position*, adjust upper stator rod so that ball joint at forward end will just slip freely in stator lever with both stator lever and stator rod pushed rearward.

2. Shorten stator rod one turn to provide clearance at stop.

3. Reconnect ball joint to stator lever and tighten nut.

SECTION C

FLIGHT PITCH DYNAFLOW TRANSMISSION REMOVAL AND INSTALLATION

13—REMOVAL AND INSTALLATION OF FLIGHT PITCH DYNAFLOW TRANSMISSION FROM CAR EQUIPPED WITH AIR-POISE SUSPENSION

a. Removal

1. Raise car by operating manual over-ride valve.

2. Raise car front and rear solidly supporting front suspension and rear of frame. Support axle housing with floor jack.

3. To prevent damage to air spring assemblies, *carefully* and *slowly* loosen air lines from rear air springs to allow springs to bleed air out. Remove plungers from air spring.

4. Disconnect height control valve links at strut rods using 7/16" wrench.

5. Disconnect radius rod at axle end using 3/4" wrench and 9/16" deep socket.

6. Disconnect lower ends of rear shock absorbers using 5/8" wrench.

7. Disconnect parking brake cable at rear cable sheave and at bracket on torque tube. Disconnect brake hose from pipe at frame X member and remove yoke. Cover hose and pipe to prevent entrance of dirt.

8. To prevent strain on parts, disconnect exhaust pipe(s) at manifold(s) and loosen exhaust pipe to muffler joint(s).

9. Install 3" guide pins in alternate bolt holes in torque ball. Remove remaining two torque tube flange bolts using 9/16" socket.

10. Lower axle assembly and push back to clear torque ball.

11. Remove converter housing cover.

12. Turn flywheel until one converter drain plug can be loosened to provide an air vent. Turn flywheel until opposite drain plug is down. Remove this plug and allow oil to drain from converter.

13. Remove filler pipe from oil pan and allow oil to drain from transmission.

14. Remove converter to flywheel bolts using 1/2" socket.

15. Disconnect oil cooler pipes.

16. Disconnect speedometer cable. Disconnect stator control rod at transmission lever. Disconnect lower shift rod at transmission lever and upper shift rod at idler lever. Leave lower rod, idler lever and bracket attached to cross-member.

17. Support transmission securely and use jack to safely support engine.

18. Remove two nuts and four bolts and nuts holding mounts to support using 9/16" socket.

19. Raise engine and transmission just enough to relieve strain on support. Remove eight attaching bolts and nuts using 9/16" socket and remove transmission support. If shims are present, note number and location so they may be reinstalled in original position.

20. Lower transmission sufficiently to remove six transmission case to crankcase bolts using 5/8" socket and extension.

21. With engine separately supported, move transmission to rear to disengage converter pump cover from crankshaft. Lower transmission and remove from under car.

NOTE: *If transmission is to be placed on oily surface, remove mounts to prevent deterioration of rubber.*

CAUTION: *Do not tilt transmission forward as weight of converter may damage bushings in front planet carrier and oil rings on first turbine shaft.*

b. Installation of Transmission

1. Turn flywheel so that one hole for converter attaching bolt is straight up and wide flange is straight down. Be certain drive lugs on converter pump do not disengage from front pump gear.

2. Raise transmission into place with same equipment used for removal. Align converter attaching bolt holes with flywheel holes before moving transmission forward against crankcase.

3. Adjust lifting equipment so transmission meets crankcase squarely. Install converter housing to crankcase bolts, tightening evenly to 45-55 ft. lbs. torque.

4. Install three flywheel to converter bolts, tightening to 25-30 ft. lbs. torque.

5. Check converter drain plugs for tightness and install converter housing cover.

6. Raise transmission just enough to install transmission support, installing any shims in their original position. Tighten bolts to 25-30 ft. lbs. torque. Install two nuts and four bolts and nuts holding mounts to support. Tighten to 25-30-ft. lbs. torque.

NOTE: *If transmission cannot be made to seat on support, the front engine mounts should be loosened and the engine raised (by means of a pry bar) and pulled forward to remove bind from front mounts. If bind is allowed to remain, engine may set up vibration when running. Following installation of transmission, retighten motor mounts.*

7. Remove engine support jack and transmission hoist.

8. Connect upper shift rod to idler lever and lower shift rod to transmission lever. Connect stator control rod to transmission lever. Connect speedometer cable.

9. Connect oil filler pipe to oil pan.

10. Connect oil cooler pipes.

NOTE: *Following installation, check to insure that pipes are not contacting transmission support, frame, front spring crossmember, body, etc.*

11. With 3" guide pins in place, align and connect torque tube to torque ball, making certain that blank splines on propeller shaft line up with those in rear yoke of universal joint. Remove guide pins and install bolts.

12. Install parking brake cable. Connect brake hose to pipes and secure with yoke at frame X member. Bleed rear brakes and adjust parking brake cable.

13. Loosely connect radius rod and shock absorbers.

14. Connect air lines to rear air spring domes.

15. Insert plungers into air springs, and carefully pull down on height control valve arm to partially inflate air spring assembly and retain plunger.

16. Connect height control valve links to strut rod brackets.

17. Connect and tighten exhaust system. Be certain all pipes are centered in holes in frame and no bind exists.

18. Wipe all oil from outside of transmission and lower car so normal weight is on rear wheels. Tighten shock absorber bolts and radius rod bolts. Lower car to floor.

19. Add four quarts Dynaflow oil to transmission. Raise rear wheels and with transmission in "Drive" "D" range and engine idling add eight more quarts Dynaflow oil. Place transmission selector lever in "N" Neutral and lower rear wheels to touch ground. Check oil level and add oil as necessary to bring to level on dip stick.

20. Check car for proper adjustment of linkage. Road test car thoroughly with frequent stops and starts as might be encountered in heavy traffic. A thorough warm-up is desired.

21. Place car on hoist and carefully examine transmission and all connections for leaks. Recheck oil level.

FLIGHT PITCH DYNAFLOW

DISASSEMBLY,

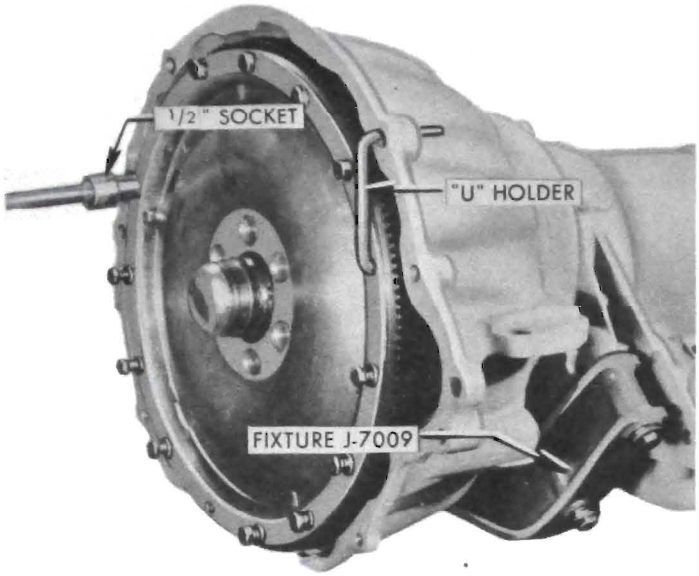
INSPECTION AND REASSEMBLY

BUSHING REPLACEMENT

Special service tools are available which will allow the replacement of most of the bushings used in the Flight Pitch Dynaflow if they are found to be worn or scored. The bushings which cannot be replaced (due to their being machined following assembly) are as follows:

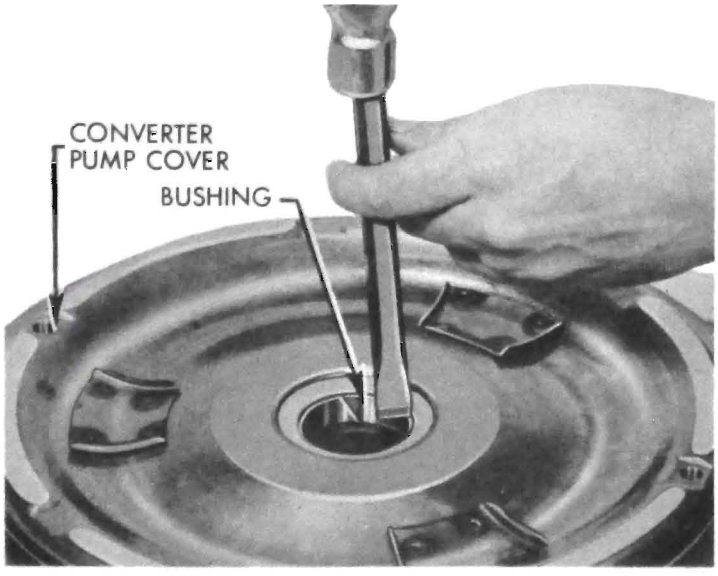
Front Pump Bushing
Front Planet Carrier Bushing
Output Shaft Support Bushing

The procedure for removal of the worn or scored bushing and installation of the replacement bushing follows in sequence the disassembly of the affected part. Care should be exercised when installing a new bushing to be certain that bushing is started squarely into bore. The bushing should also be driven fully into bore until tool bottoms.

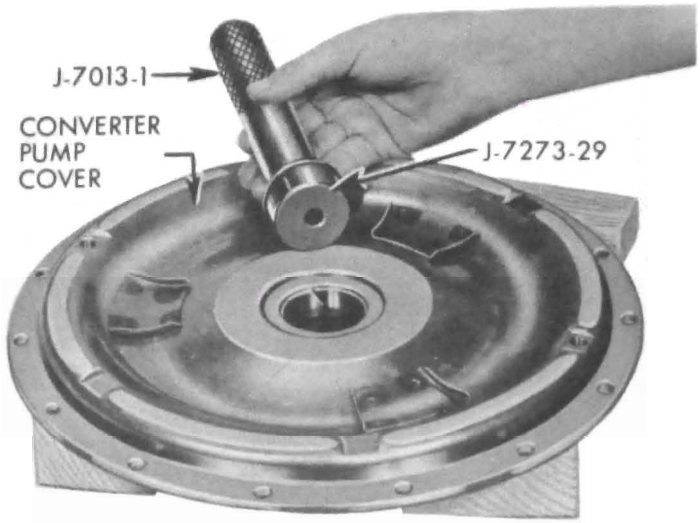


1. Assemble Flight Pitch Dynaflow to Fixture, J-7009. Remove twelve converter cover bolts using "U" holder and 1/2" socket. Mark with paint or chalk position of cover to converter pump. The converter pump and cover are balanced as an assembly and to preserve this balance, these two parts should always be reassembled in the same position.

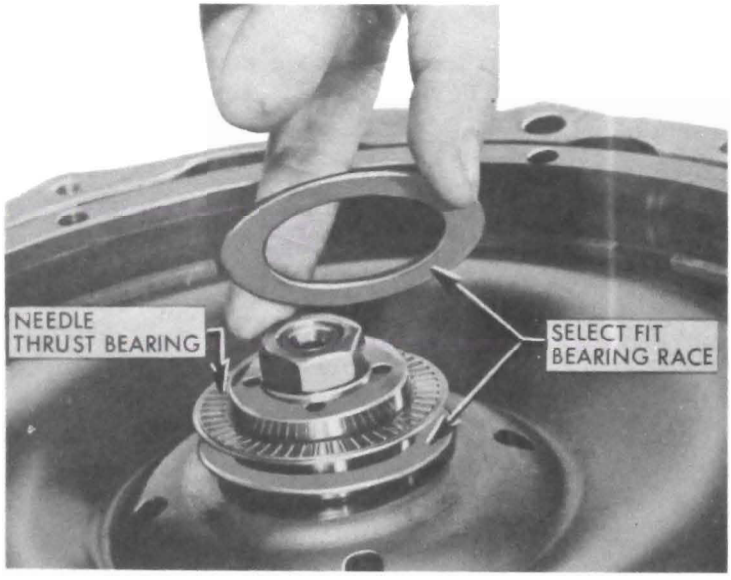
2. Pry to loosen, remove cover and,"O"ring. Discard "O" ring.



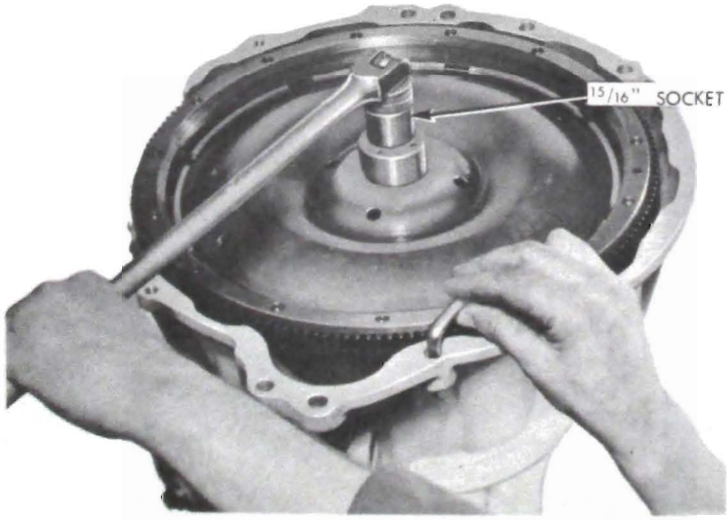
2A. Examine converter pump cover bushing. If worn or scored, collapse bushing with chisel and remove.



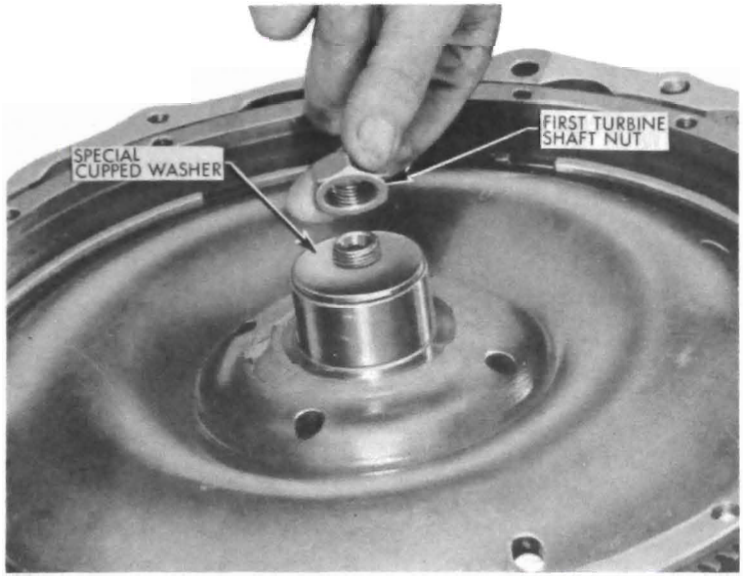
2B. Install new converter pump cover bushing using J-7013-1 Handle and J-7273-29 Installer.



3. Remove select fit bearing races and needle thrust bearing. (Between first turbine hub and converter pump cover). Place in converter pump cover.

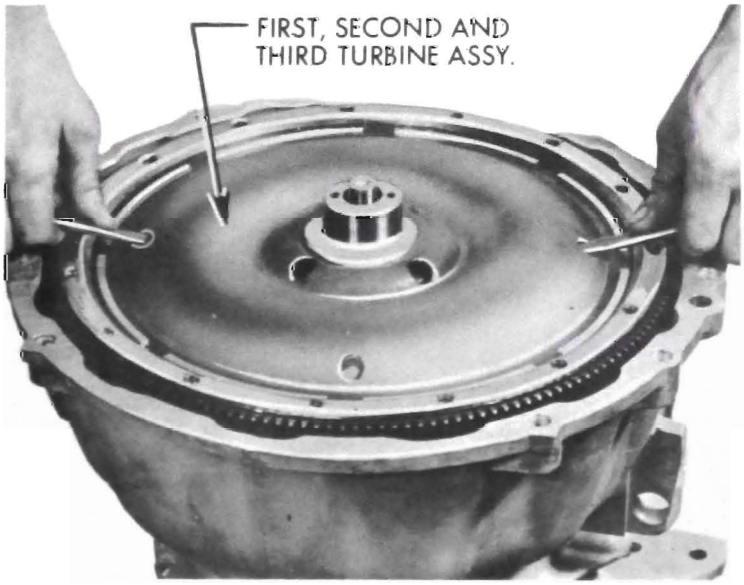


4. Loosen first turbine shaft nut using "U" holder and 15/16" socket.



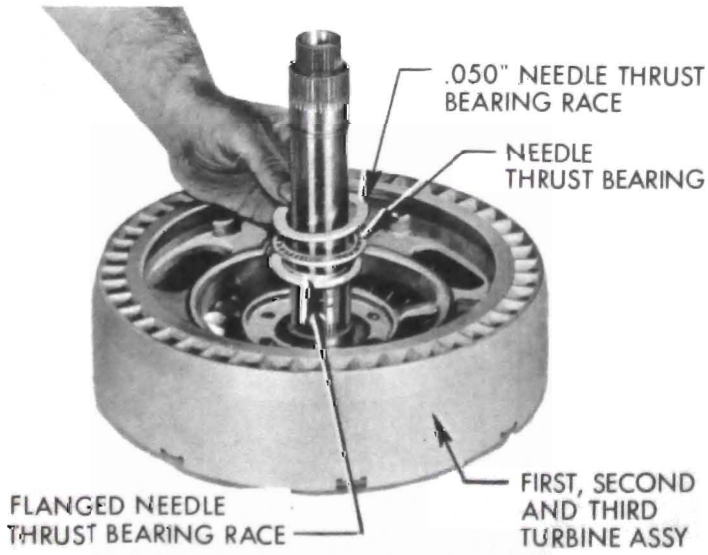
5. Remove nut and special washer.

Discard washer.



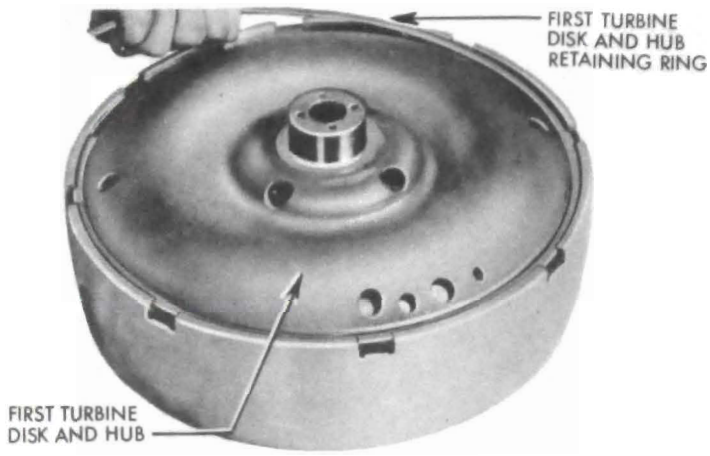
6. Use two screwdrivers or other suitable tool to lift the complete lst, 2nd and 3rd turbine assembly, remove from transmission case.

Set assembly on bench shafts up.

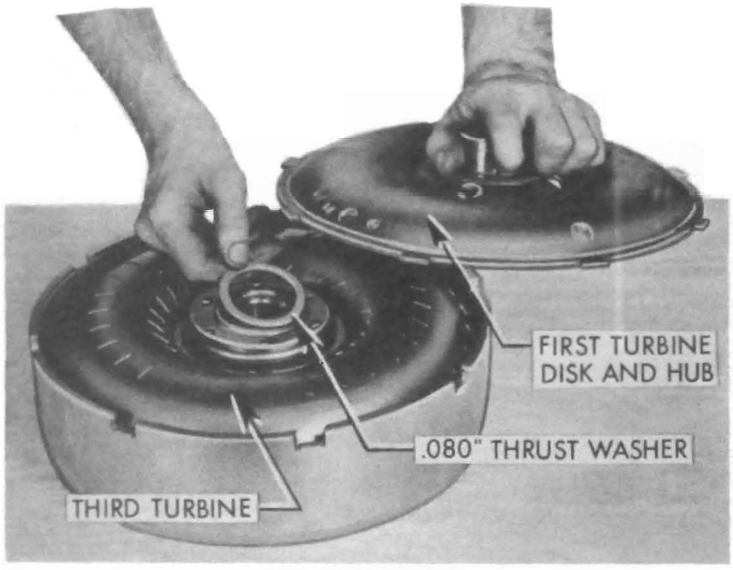


TURBINE DISASSEMBLY, INSPECTION AND REASSEMBLY

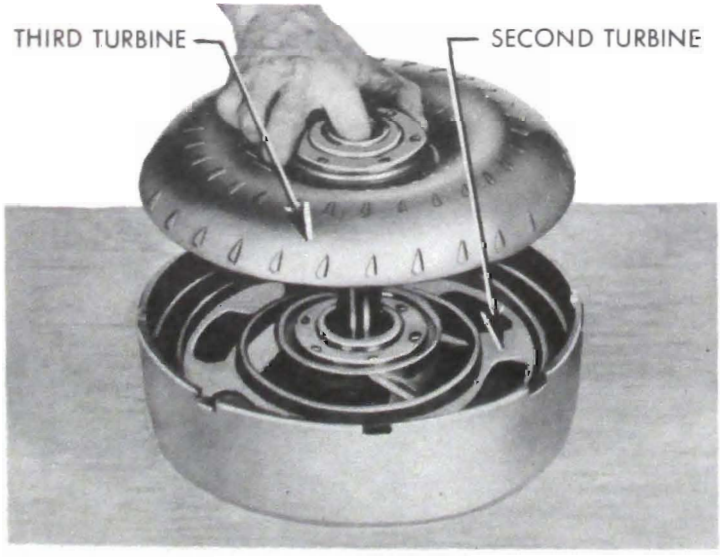
7. Remove needle bearing flanged needle bearing race and .050" plain bearing race from second turbine hub. NOTE: These races and bearing may have remained on top of stator.



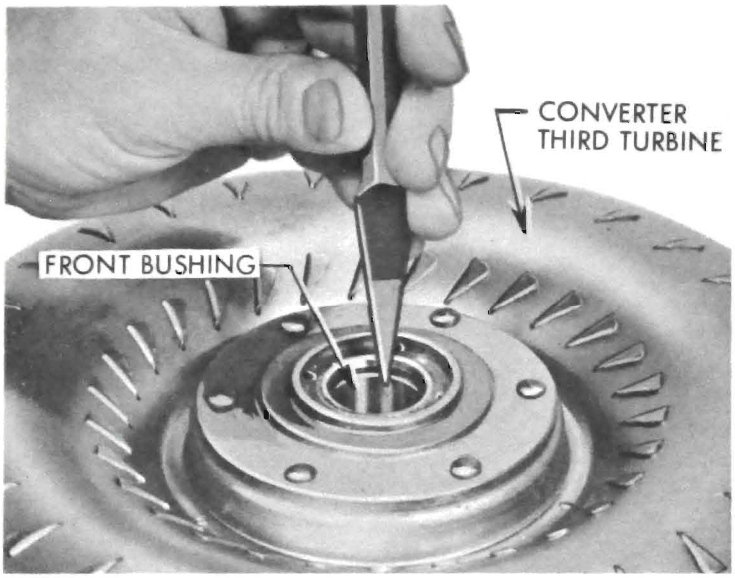
8. Set assembly shafts down through hole in bench. Remove first turbine to disc and hub retainer ring. Use a thin bladed screwdriver at inner edge of ring to raise edge of ring. Press on outer edge of ring to slide ring up slope of thin screwdriver over step of first turbine disk and hub.



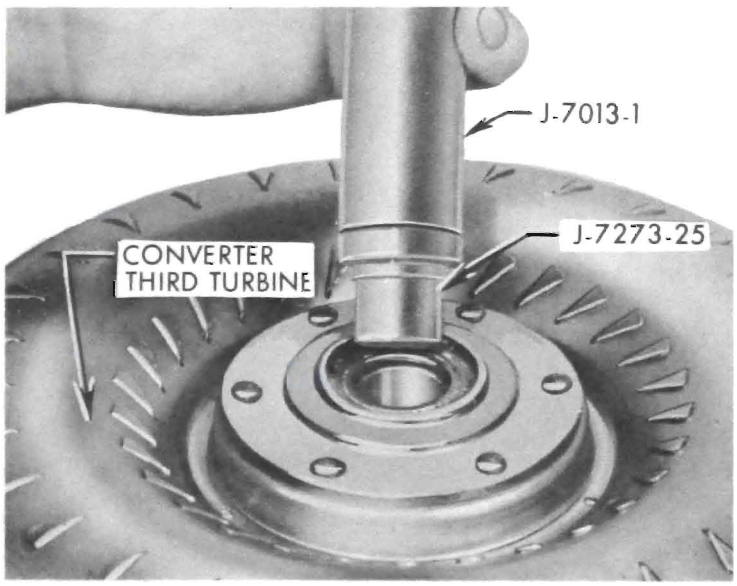
9. Remove lst turbine disc, hub and .080'' bronze thrust washer on 3rd turbine hub.



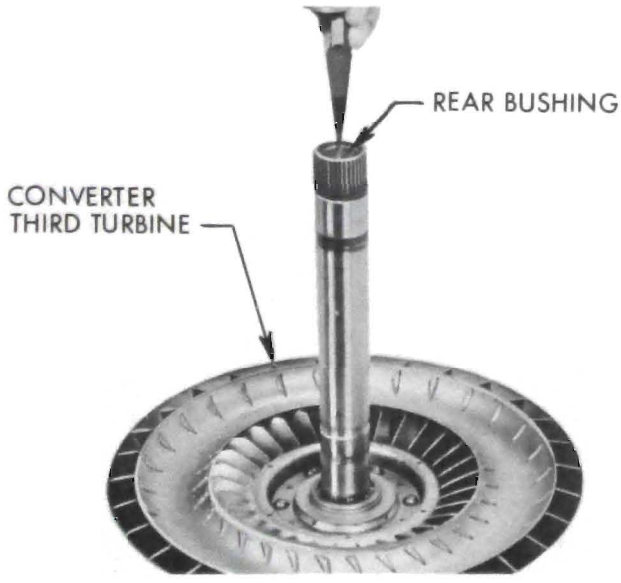
10. Remove 3rd turbine, flanged needle bearing race, needle bearing and .030'' plain needle bearing race.



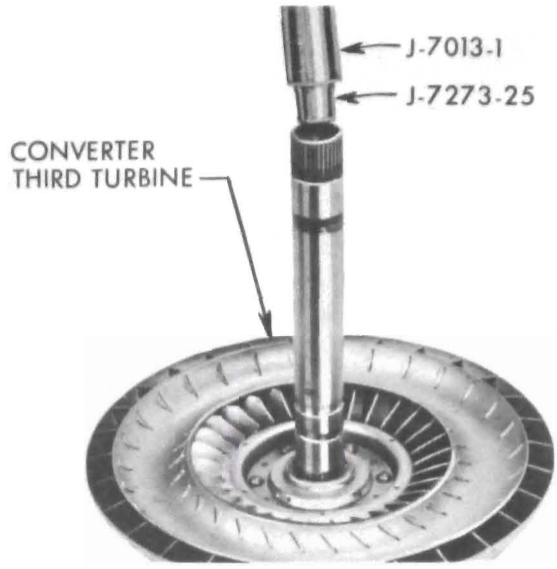
10A. Examine third turbine front bushing. If worn or scored, cut out bushing with chisel.



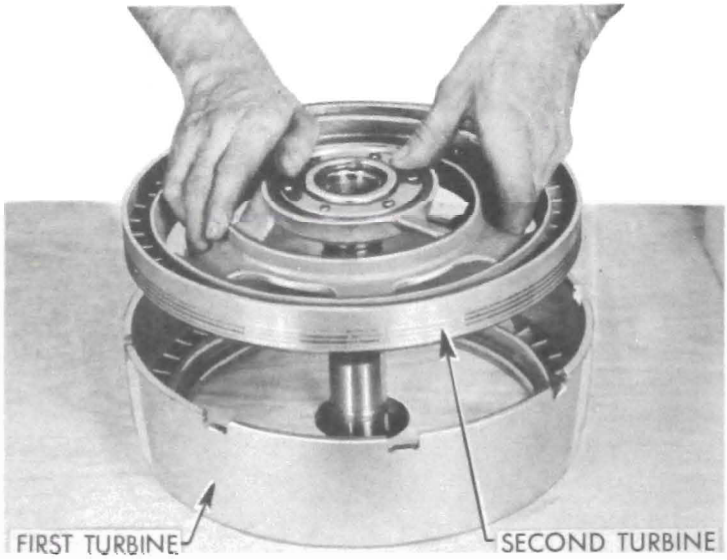
10B. Install new third turbine front bushing using J-7013-1 and J-7273-25.



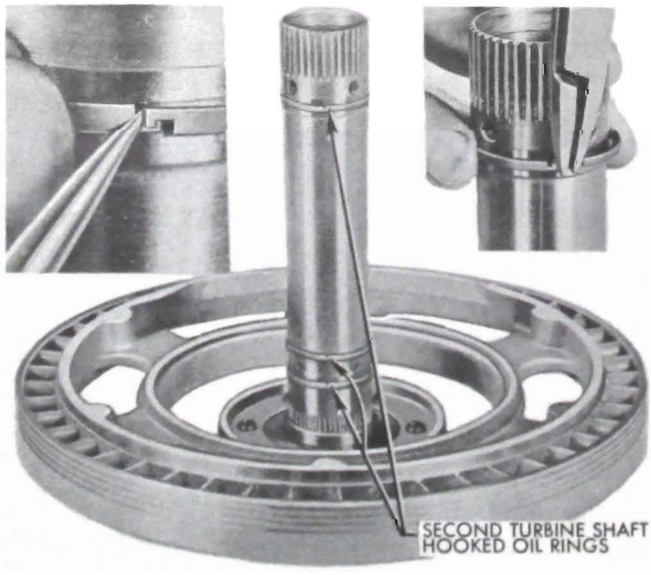
10C. Examine third turbine rear bushing. If worn or scored, cut out bushing with chisel.



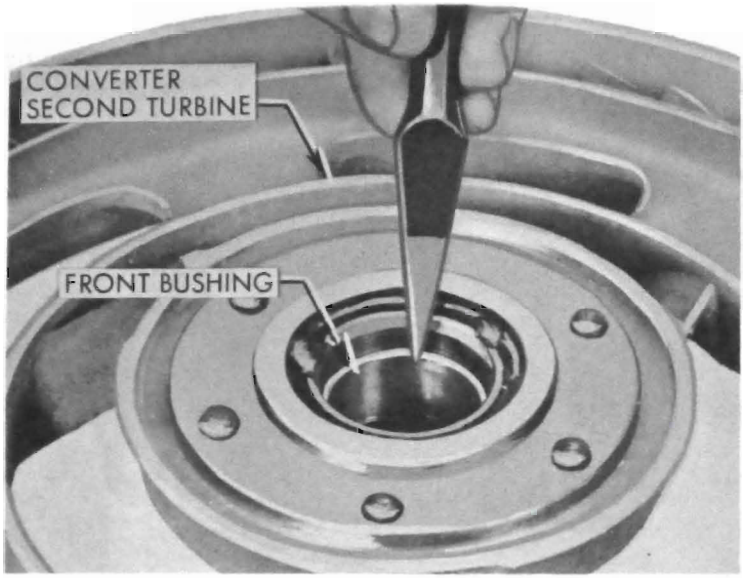
10D. Install new third turbine rear bushing using J-7013-1 and J-7273-25.



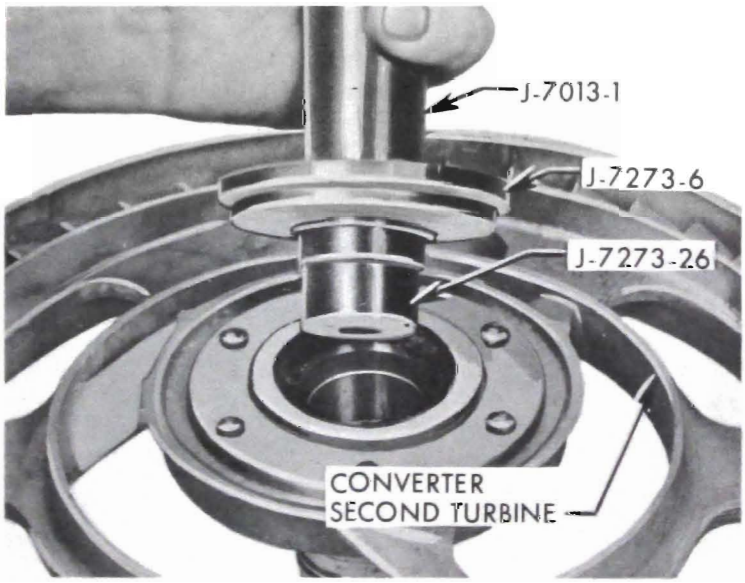
11. Remove 2nd turbine.



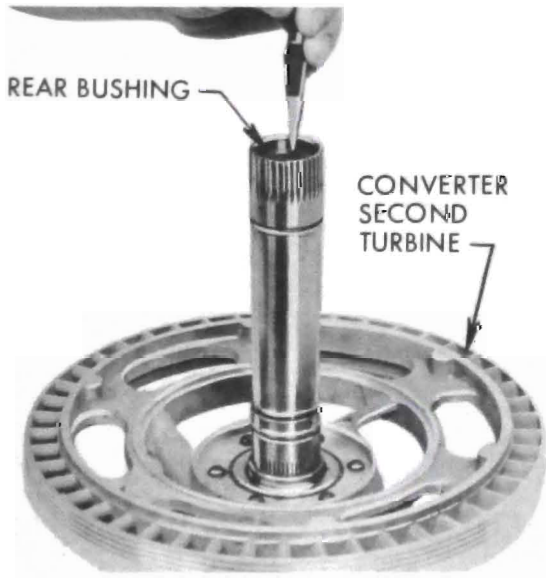
12. Inspect and if necessary to replace, unhook, expand and remove three second-turbine shaft hooked oil rings.



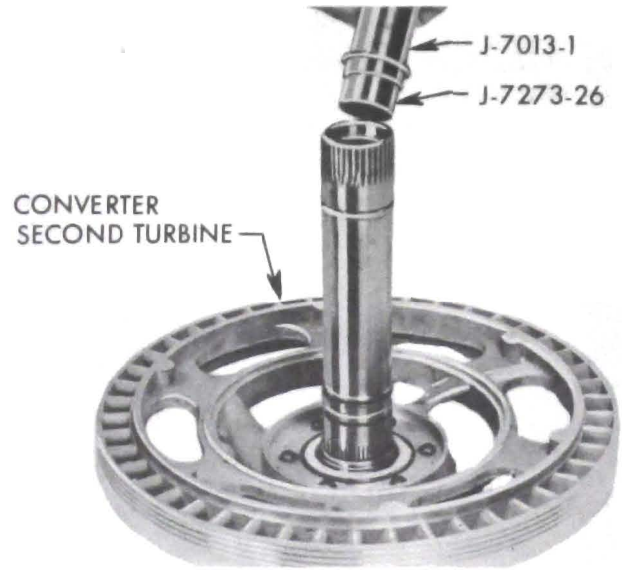
12A. Examine second turbine front bushing. If worn or scored, collapse bushing with chisel and remove.



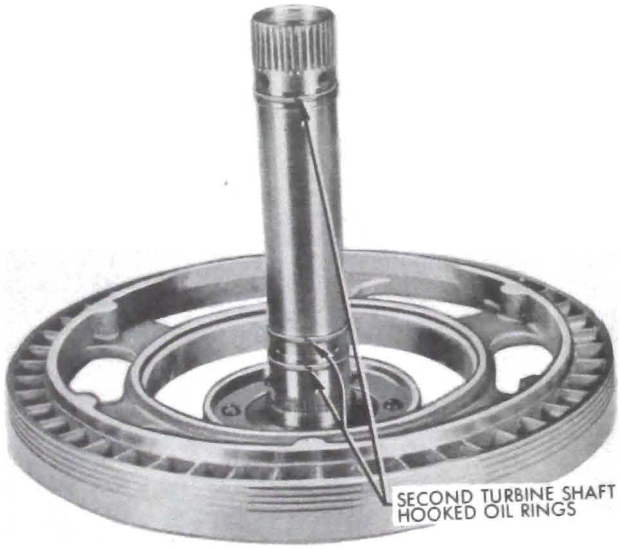
12B. Install new second turbine front bushing using J-7013-1 Handle and J-7272-26-6 (Counter bore on 6 toward handle).



12C. Examine second turbine rear bushing. If worn or scored, collapse bushing with chisel and remove.

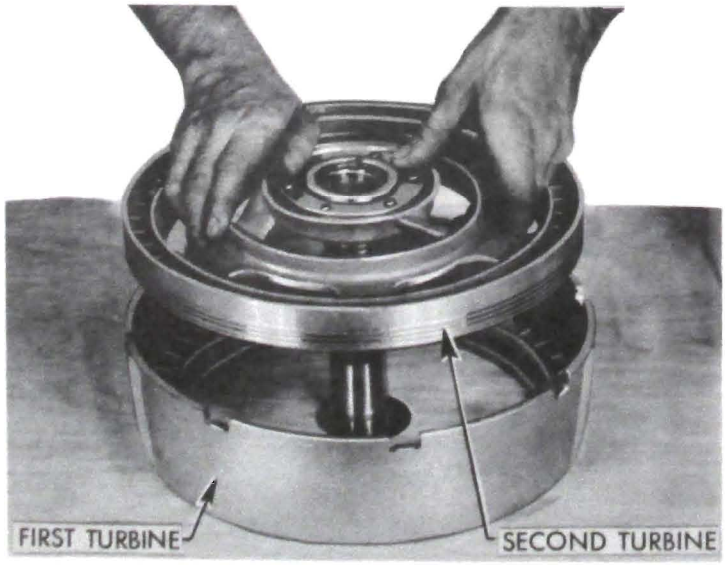


12D. Install new second turbine rear bushing using J-7013-1 Handle and J-7273-26 Installer.



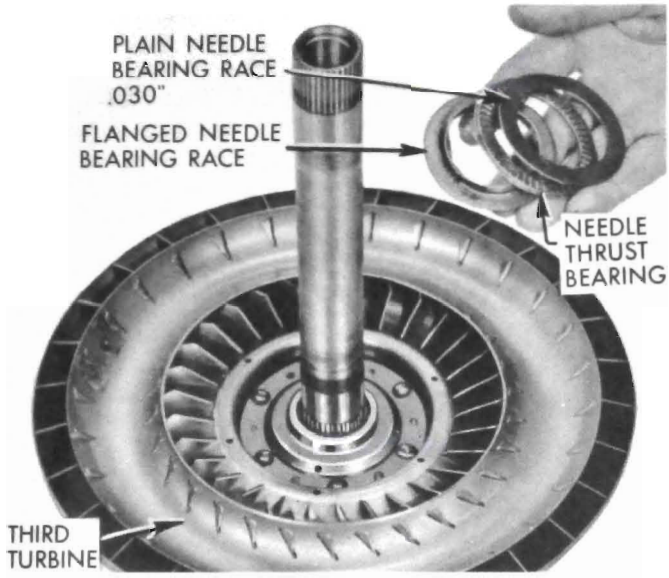
13. Expand and install new hooked oil rings on 2nd turbine shaft. Hook ends of rings by holding one end firmly in groove and working other end around to hook.

NOTE: Second turbine shaft oil rings are slightly smaller (.050") than two rings used on the output shaft. These rings must not be interchanged with those used on the output shaft.



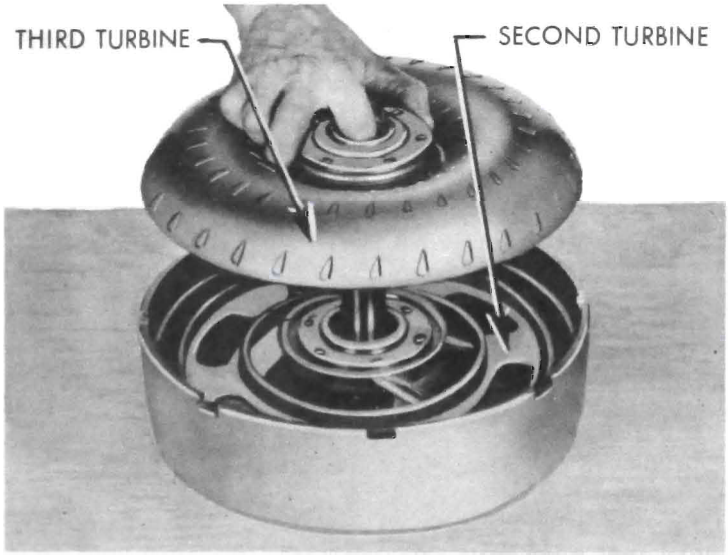
REASSEMBLY OF TURBINES

14. With lst turbine on bench, insert 2nd turbine with oil rings in place through hole in bench to rest on lst turbine.



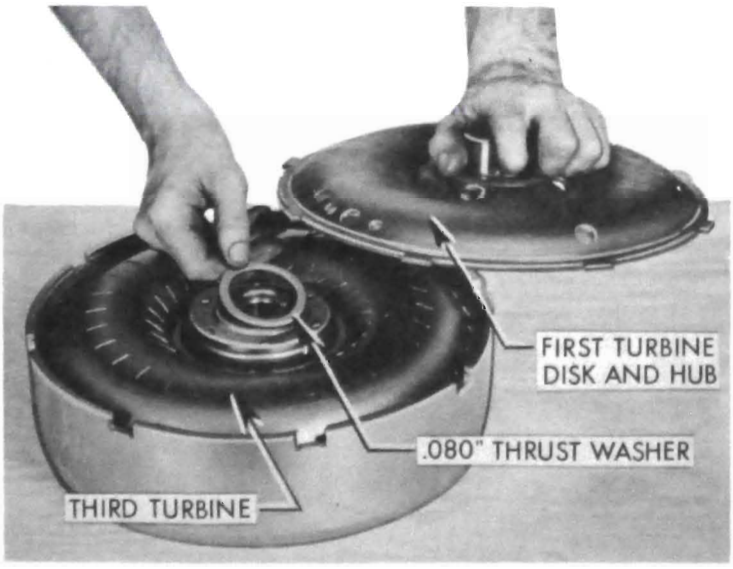
15. Inspect and if necessary, install new flanged needle bearing race, flange "up", needle thrust bearing (1 3/4" X 2 1/2"), and plain needle bearing race (.030") on 3rd turbine hub. Hold in place with heavy lube.

NOTE: Always measure needle bearings and races. Some are within .010" thickness and 1/16" diameter of each other and can easily be incorrectly assembled.

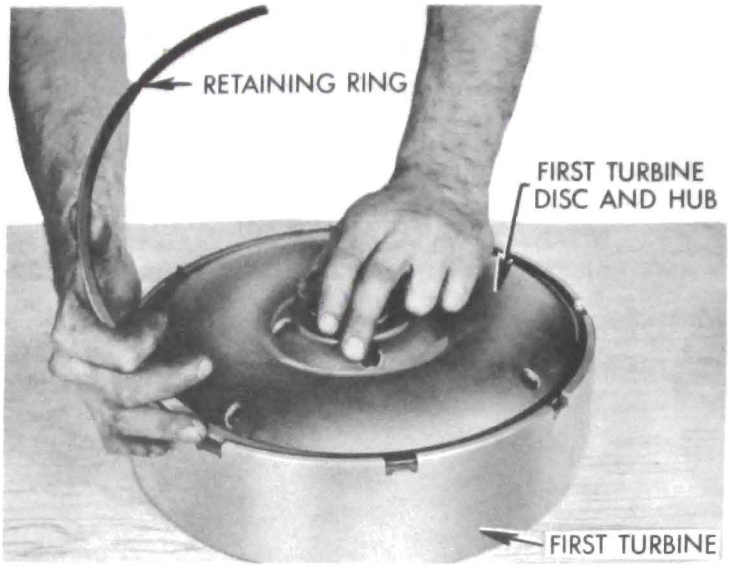


16. With needle bearing and races held in place with heavy lube, insert 3rd turbine shaft into 2nd turbine shaft. Lower into position.

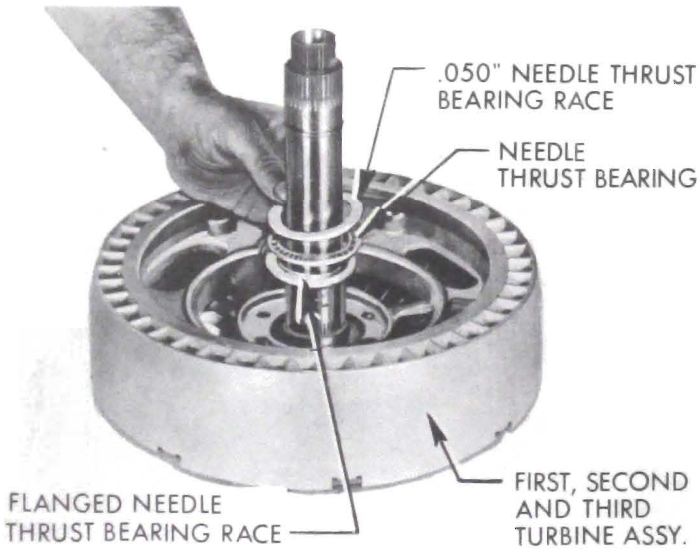
NOTE: Heavy lube referred to in this manual can be wheel bearing grease or chassis lube. Use only enough to hold bearings and races in place.



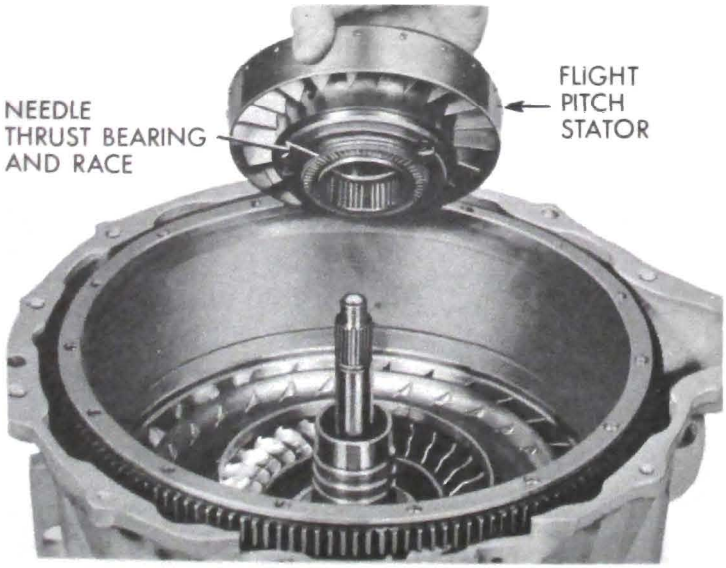
17. Inspect and, if necessary, place new .080" bronze thrust washer on hub of 3rd turbine, and position lst turbine disc and hub with tangs in slots of lst turbine.



18. Install lst turbine disc and hub retaining ring so high edge will engage the groove in the lst turbine and the inner lower edge forces down on the lst turbine disc and hub. Tap solidly into groove and inspect for proper installation.

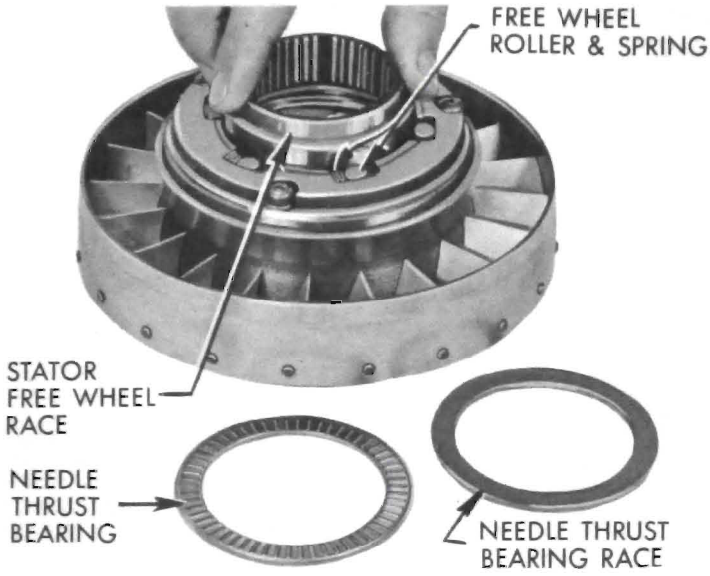


19. With assembly on bench, shafts up, inspect and, if necessary, install new flanged needle bearing race, flange "up" on second turbine hub, next, needle thrust bearing (1 3/4" X 2 1/2") and last, .050" bearing race which is thicker than the other plain races used in the turbine build up. Set completed sub-assembly aside if further work is to be done on the transmission.



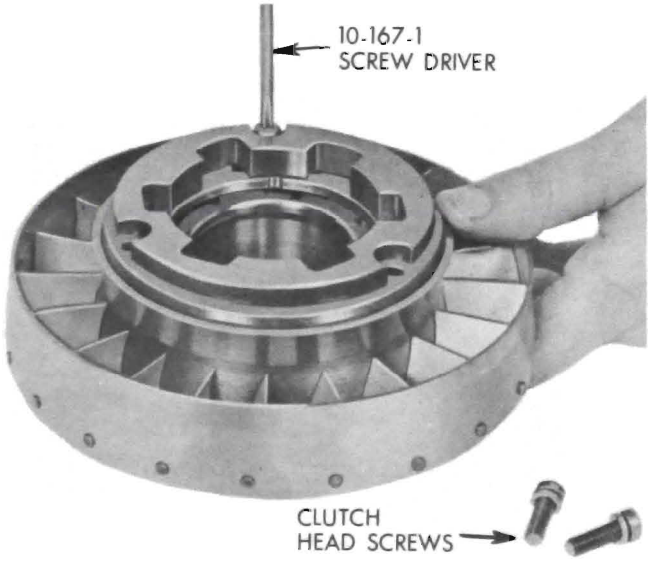
20. Lift converter pump until stator race is clear of splines on reaction shaft (approximately 2 1/2"). Lower converter pump and remove the stator. To avoid pinching fingers, use cuation when lowering pump.

Remove needle thrust bearing and bearing race (Stator cam to converter pump hub).

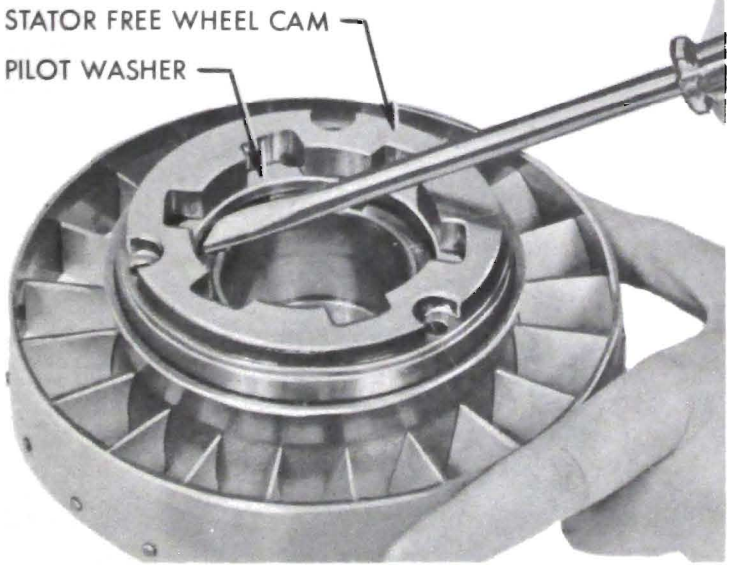


FLIGHT PITCH STATOR OVERHAUL

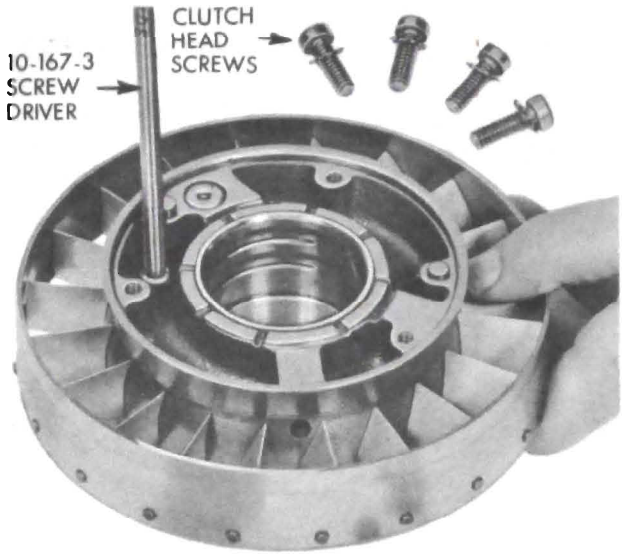
21. Pull out stator free wheel race by rotating clockwise.



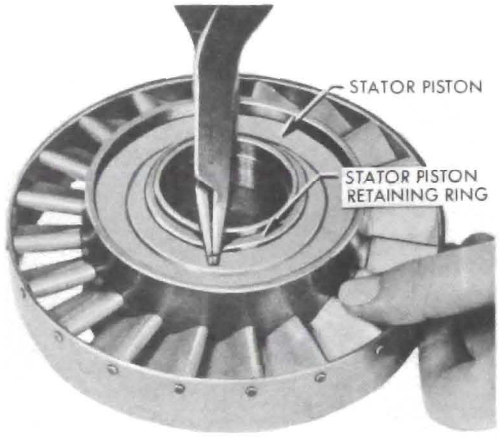
22. Remove 3 special clutch head screws from stator cam to stator carrier using Tool 10-167-1.



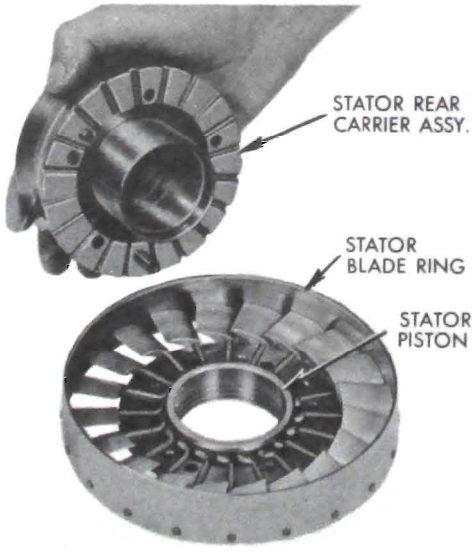
23. Pry up stator free wheel cam and bronze washer with screwdriver, using care to avoid damage to washer. Remove cam and washer.



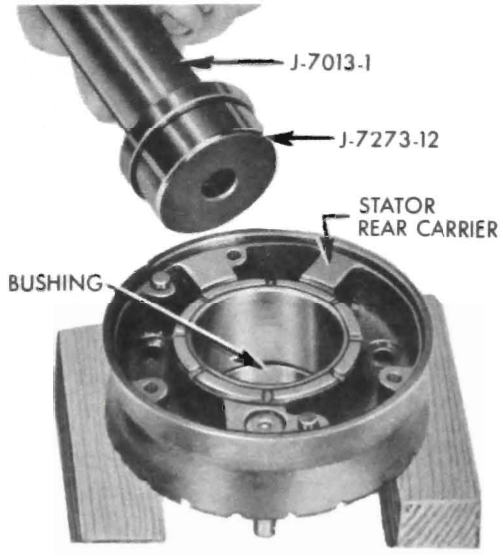
24. Remove five clutch head front to rear carrier screws using Tool 10-167-3.



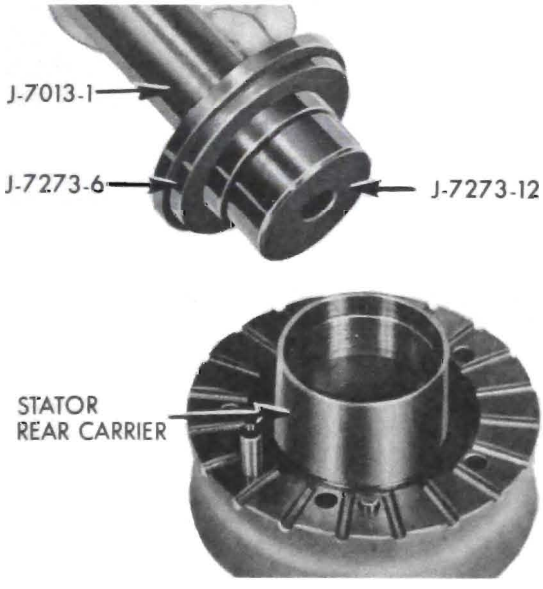
25. Invert assembly, expand and remove stator piston retaining ring from rear carrier to stator piston.



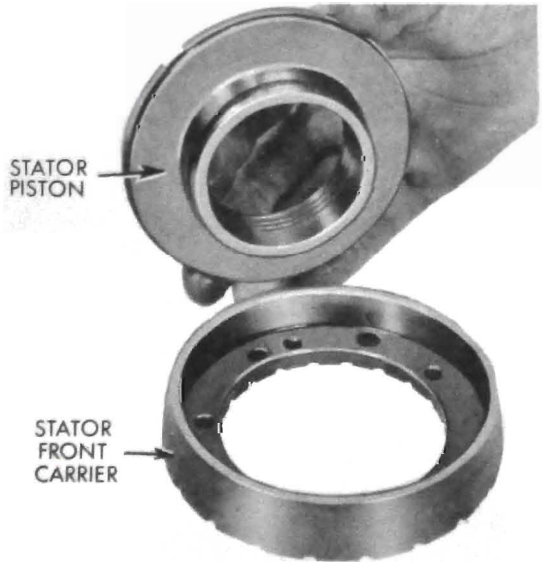
26. Invert assembly and rotate all stator blades to extreme high angle position and remove stator rear carrier assembly from front carrier. Remove blades and stator blade ring from stator front carrier and piston assembly.



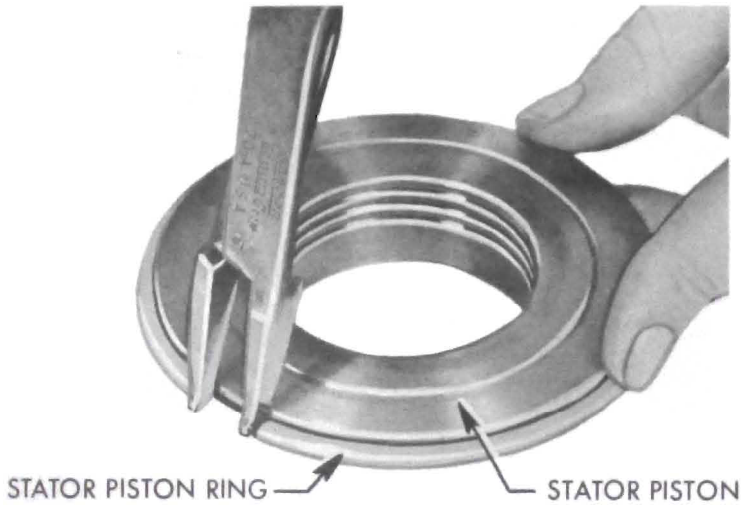
26A. Examine stator rear carrier bushing. If worn or scored, remove bushing using tool J-7013-1 Handle and J-7273-12 Remover.



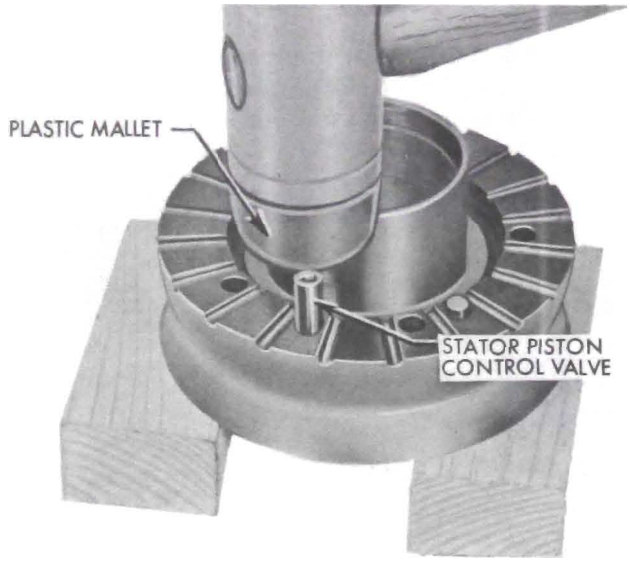
26B. Install new stator rear carrier bushing using tool J-7013-1 Handle and J-7273-6-12 Installer. (Counterbore on 6 toward handle).



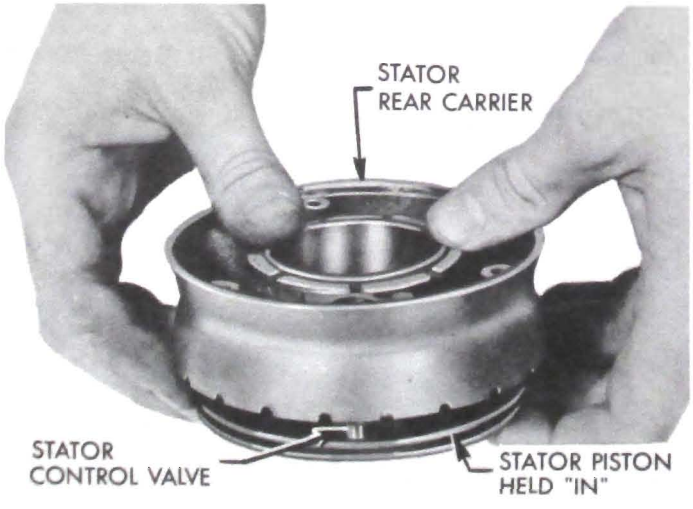
27. Remove stator piston and ring from front carrier.



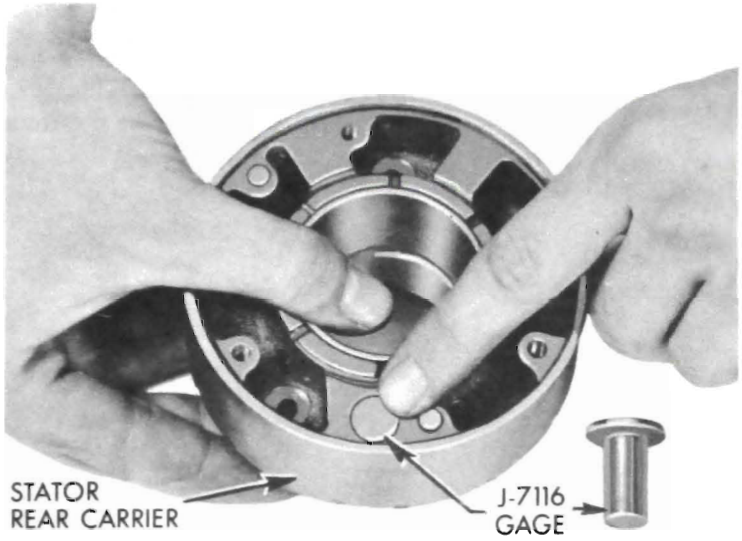
28. Expand and remove ring from stator piston with snap ring pliers.



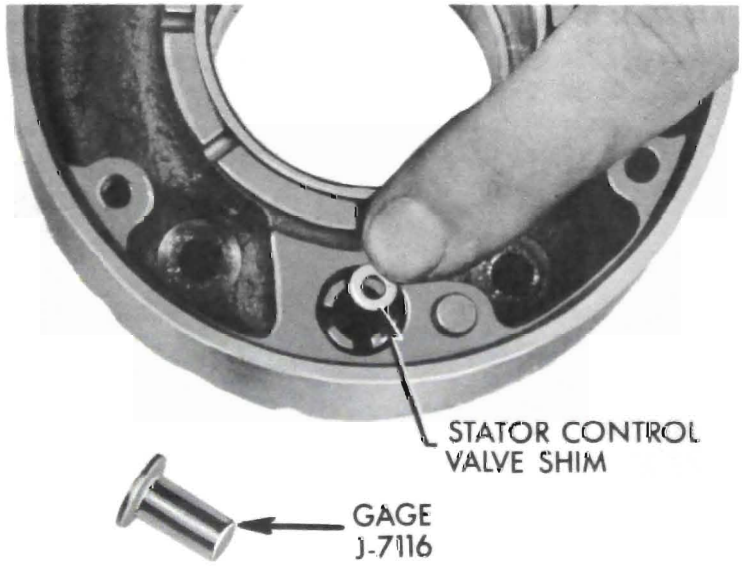
29. Suitably support stator rear carrier and remove stator piston control valve, spring and retainer from stator rear carrier by rapping sharply on valve with a plastic hammer.



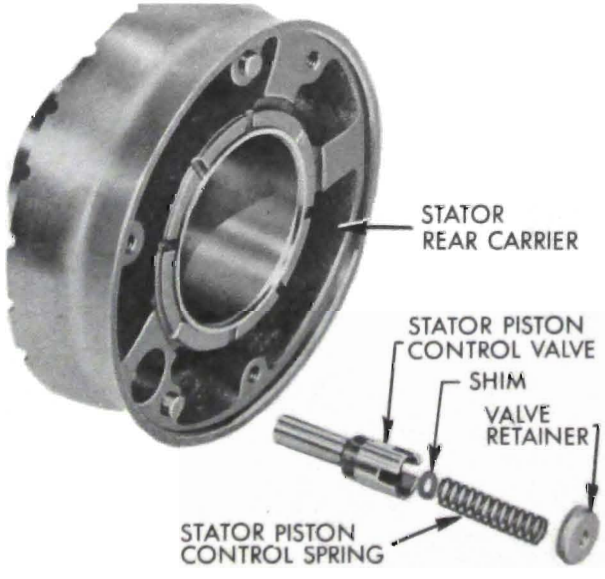
30. For gaging purposes only: assemble stator piston shoulder "up" to rear carrier and press together. Insert valve in bore of rear carrier.



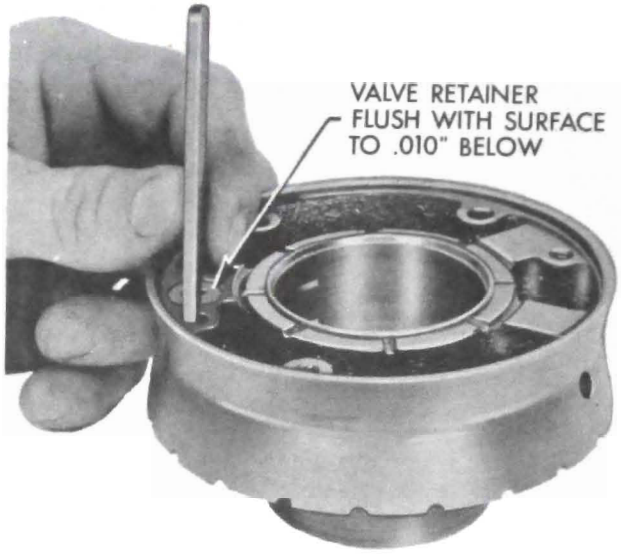
31. Insert gage J-7116 in stator control valve. With piston held against carrier and tool in place, top of tool should be flush with boss of stator rear carrier.



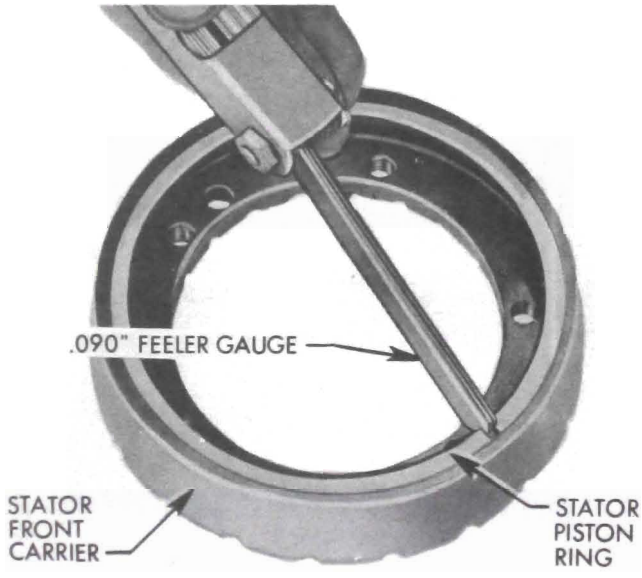
32. If gage is below surface of stator rear carrier, add shims to bring gage as close to flush with surface as possible. Shims are available in two sizes only, .007'' and .021''. Total thickness of shims used should not exceed .042''. If thickness of shims required exceeds .042'' stator rear carrier, stator piston or stator valve may require replacement.



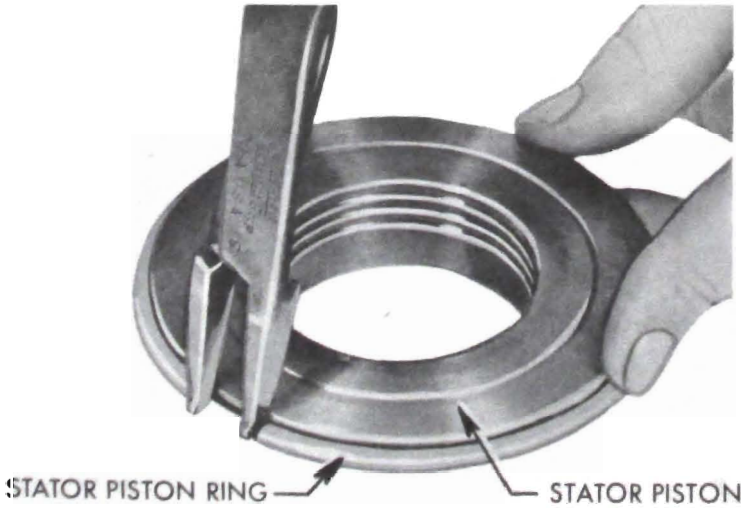
33. After stator valve has been checked and shims added if necessary, assemble valve, spring, and retainer to stator rear carrier. NOTE: Be certain shims lay flat in position inside valve bore.



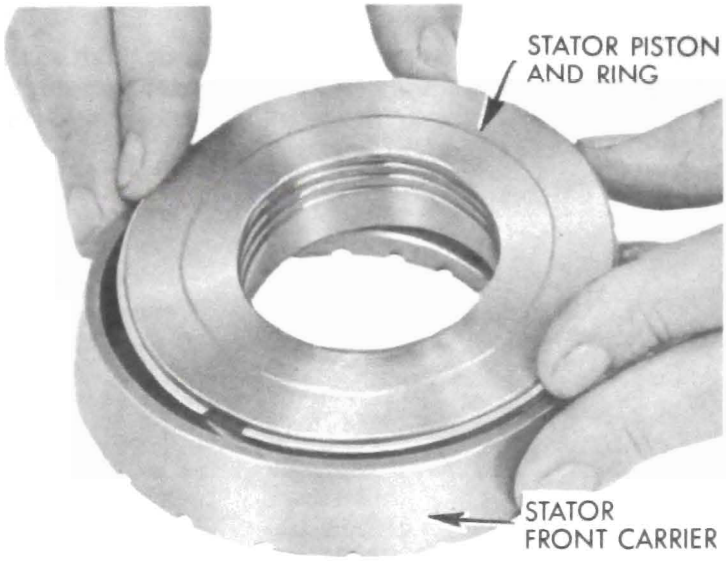
34. Tap valve retainer into stator carrier squarely and flush with stator carrier surface to .010'' below. Use flat tool to drive retainer to prevent cocking of retainer during installation.



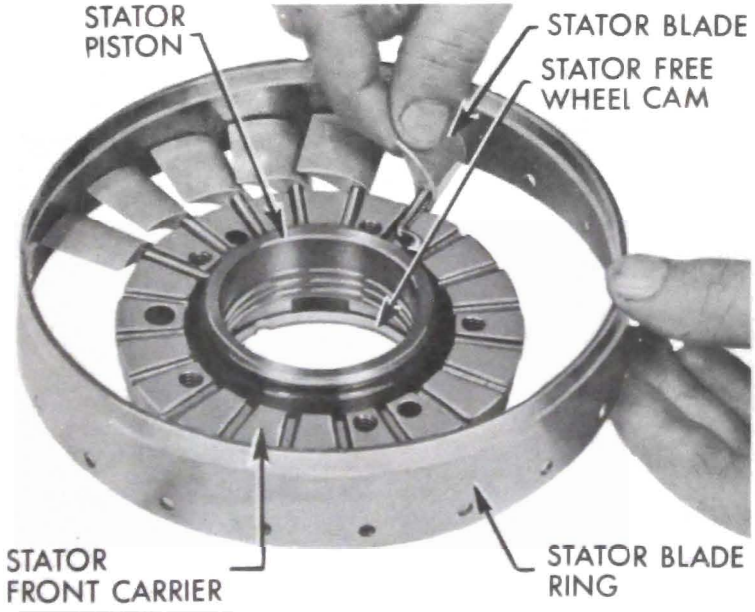
35. Insert stator piston ring in bore of stator front carrier. (Check gap with feeler gage - should be .090'' ± .010''.) NOTE: This gap serves as the piston ''bleed'' hole for the stator piston.



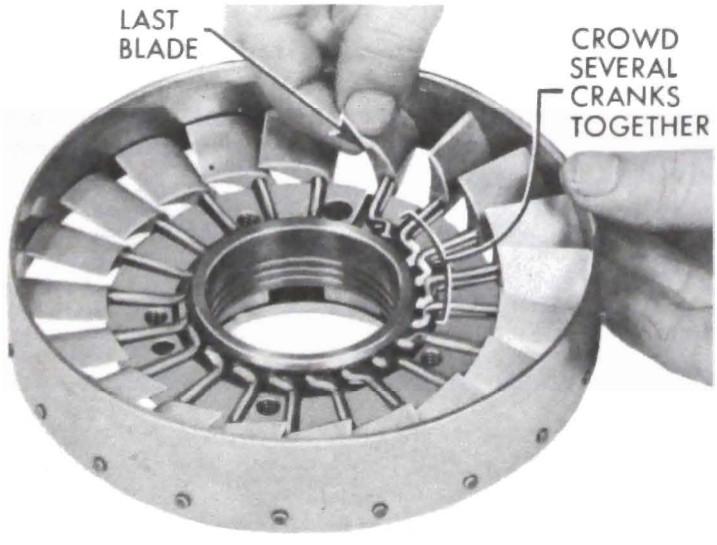
36. Expand and install stator piston ring on stator piston.



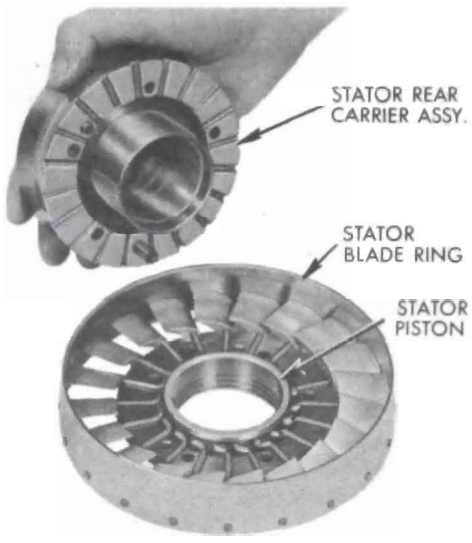
37. Install piston and ring into stator front carrier by tilting and inserting gap side of ring first and then pressing in.



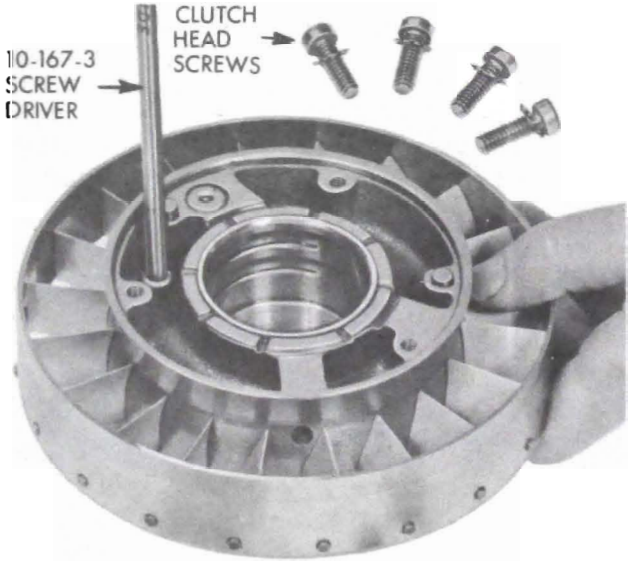
38. Set stator front carrier assembly and piston on stator free wheel cam and pilot washer assembly to hold piston "in." Support edge of stator blade ring and insert blades into carrier and piston assembly. Be sure edge of ring nearest holes is "down" as pictured.



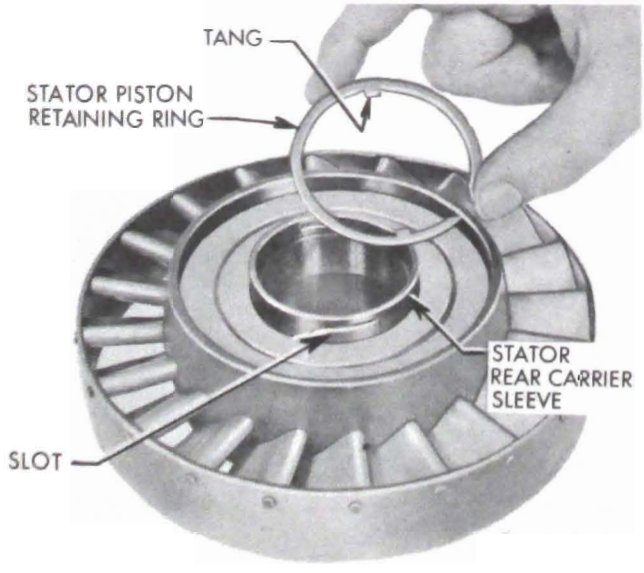
39. Install last blade by crowding several adjacent blade cranks together.



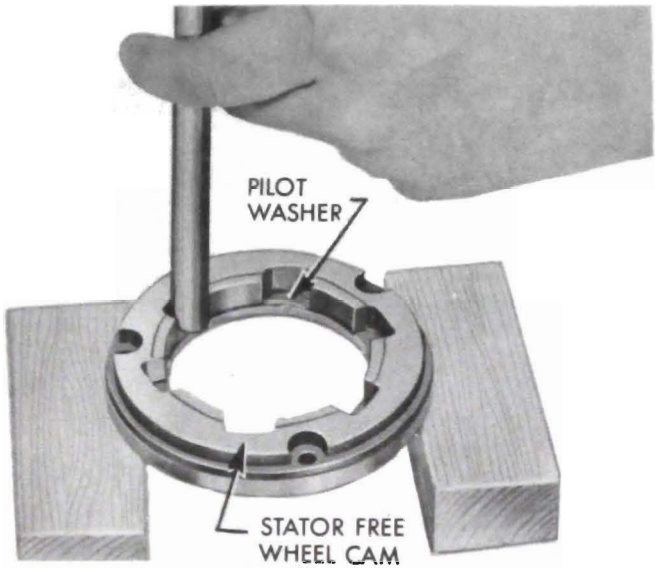
40. With stator blades at extreme high angle position, assemble rear stator carrier assembly to stator front carrier assembly. Note position of dowels and dowel holes.



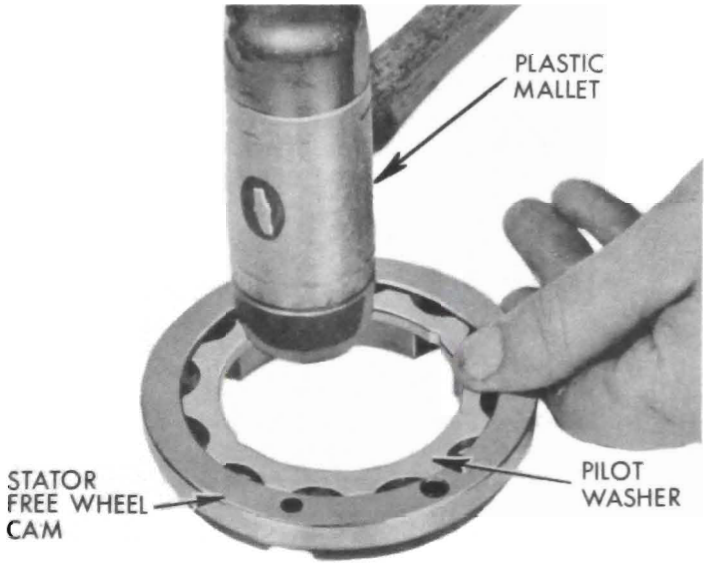
41. Install five clutch head screws and lock washers using Tool 10-167-3. Torque to 10 - 12 ft. lbs.



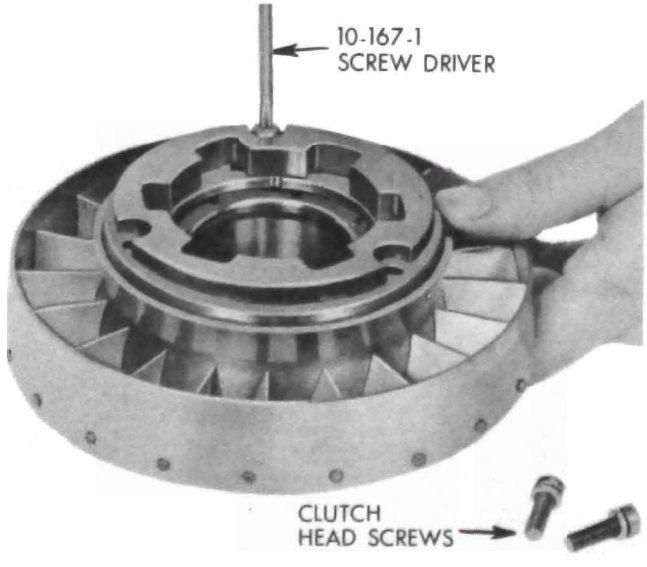
42. Install stator piston retaining ring on stator rear carrier sleeve. NOTE: Tangs on retaining ring must enter slots in sleeve. Move stator blades from high to low angle several times. Check for free operation.



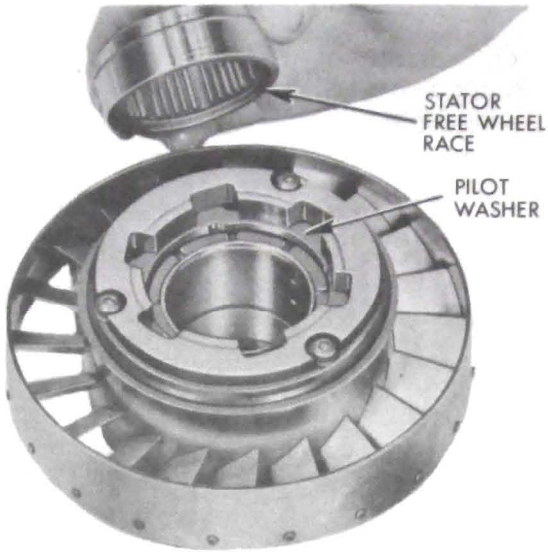
43. Inspect and if necessary, suitably support stator free wheel cam and remove pilot washer using a plastic hammer and drift.



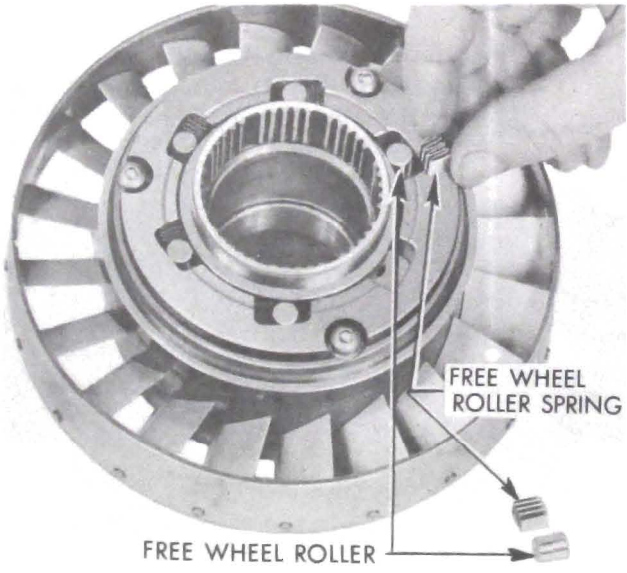
44. Install new pilot washer in stator free wheel cam using a plastic hammer. Make sure pilot washer is seated in bore of cam.



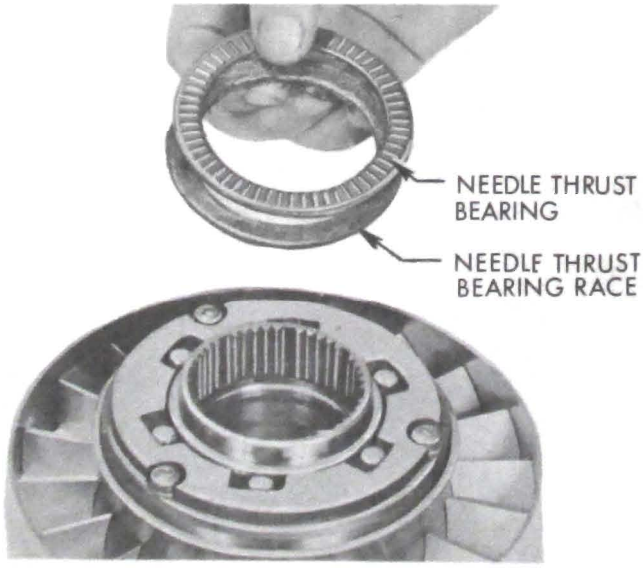
45. Assemble stator free wheel cam and pilot washer assembly to stator rear carrier with three clutch head screws and lock washers using Tool 10-167-1. Note position of dowels and dowel holes. Torque screws to 10 - 12 ft. lbs.



46. Insert stator free wheel clutch inner race, small diameter end up, into pilot washer. Inner race should rotate freely in pilot washer.

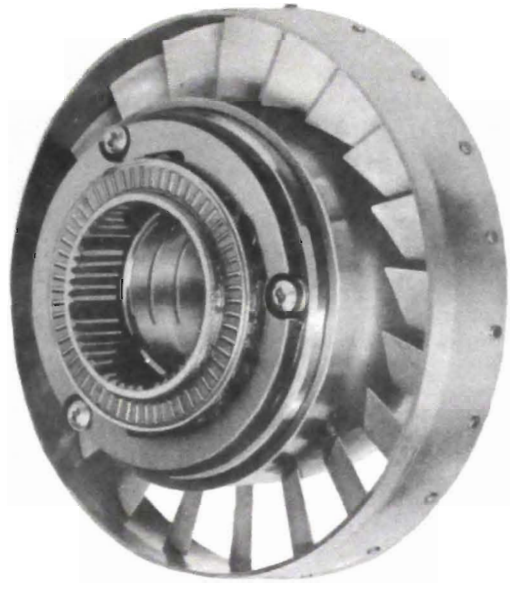


47. Install free wheel clutch rollers and springs - roller toward narrow end of cam opening, and spring at wide end of opening. Inner race should rotate freely in clockwise direction and lock on counter-clockwise rotation.

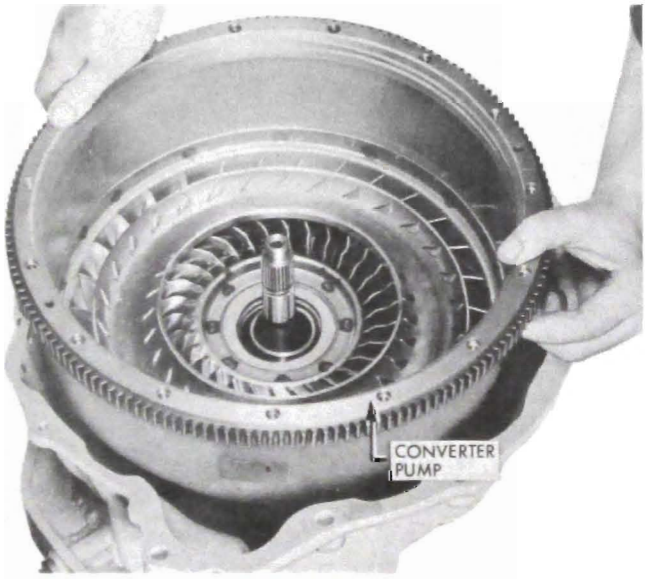


48. Apply heavy lube and install bearing race and needle thrust bearing (2 1/4" I.D. X 3" O.D.) on stator free wheel race. NOTE: Race next to free wheel rollers and springs.

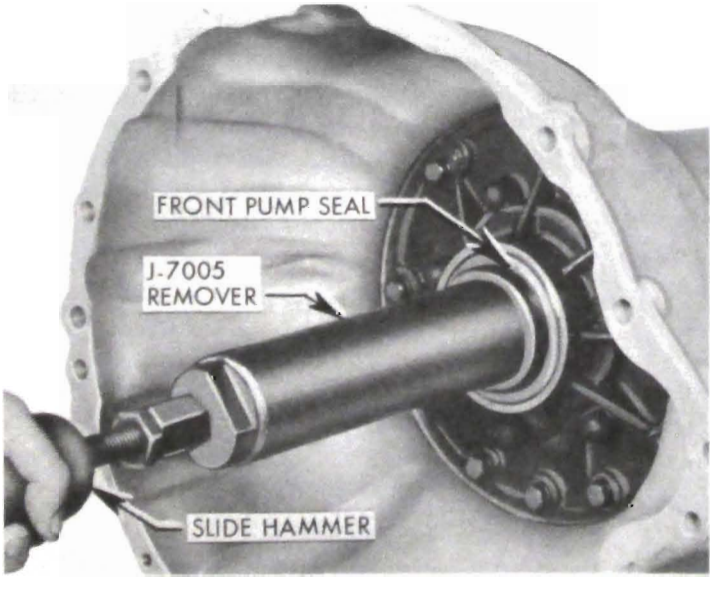
NOTE: If the needle thrust bearing or race is scored or worn, both should be replaced.



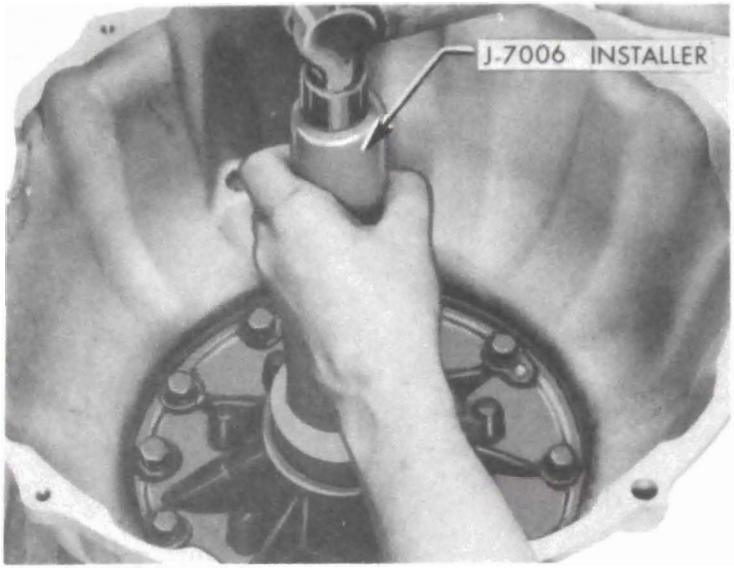
49. Set assembly aside if further work is to be done on transmission.



50. Remove converter pump.

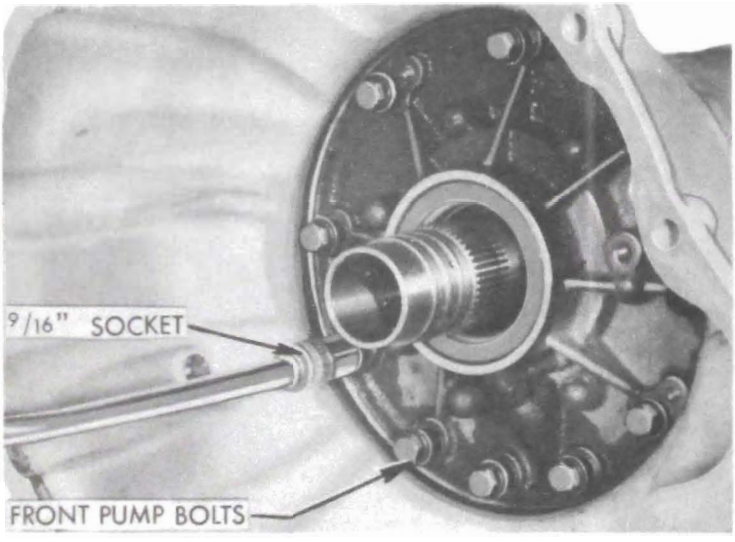


51. With transmission horizontal remove front pump seal with front pump in transmission using slide hammer and J-7005. Thread tool into seal until threads are engaged with sheet metal portion of seal.

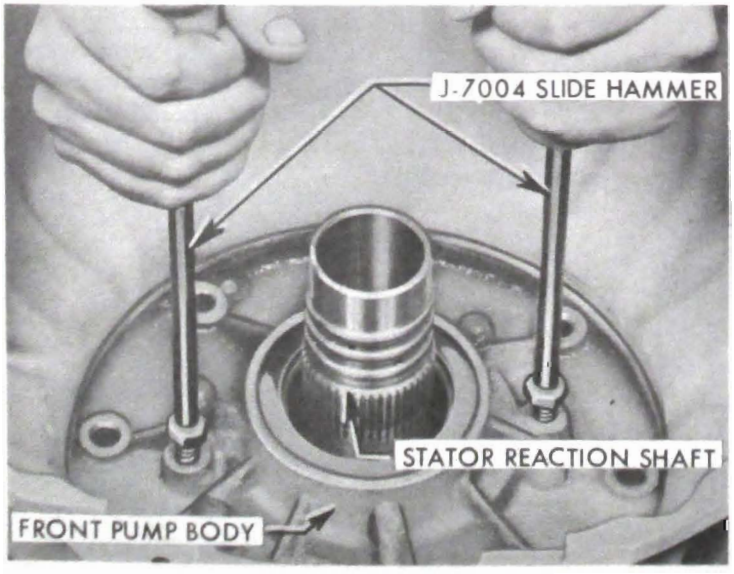


52. Install new front pump seal with pump in transmission using Tool J-7006.

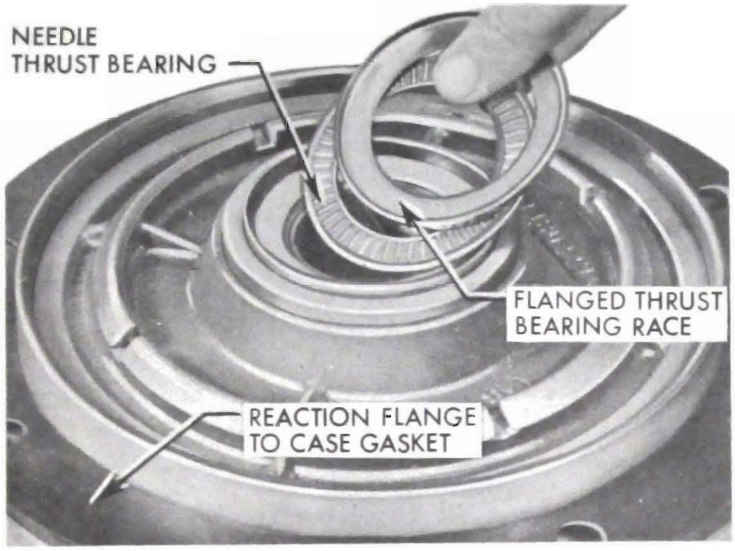
NOTE: It is not necessary to remove the planet sets, first turbine shaft, and output shaft assembly to remove and reinstall the front pump seal or the complete front pump-reverse piston assembly.



53. Remove ten front pump to case bolts (9/16'' socket.)



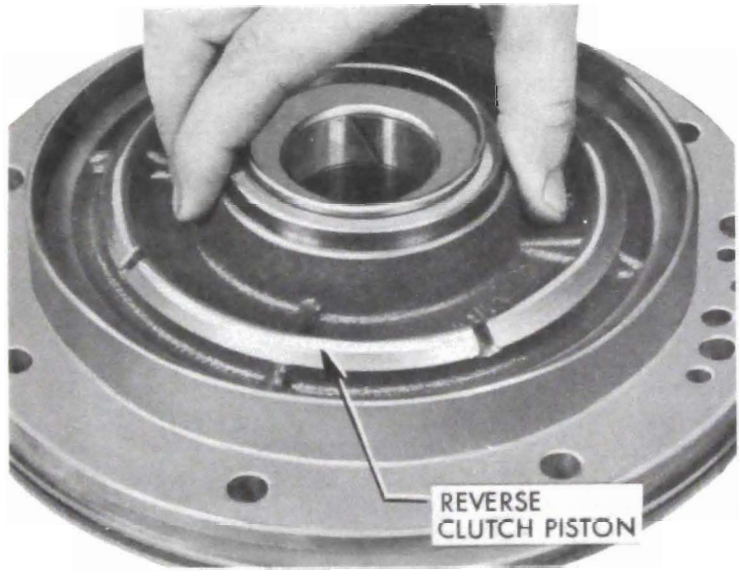
54. With transmission front end up install two J-7004 slide hammers in tapped holes of front pump body and hammer evenly to remove front pump, stator reaction shaft and flange, and reverse clutch piston assembly. Set assembly on bench and remove slide hammers.



DISASSEMBLY, INSPECTION & REASSEMBLY OF FRONT PUMP, STATOR REACTION SHAFT AND FLANGE, & REVERSE CLUTCH PISTON

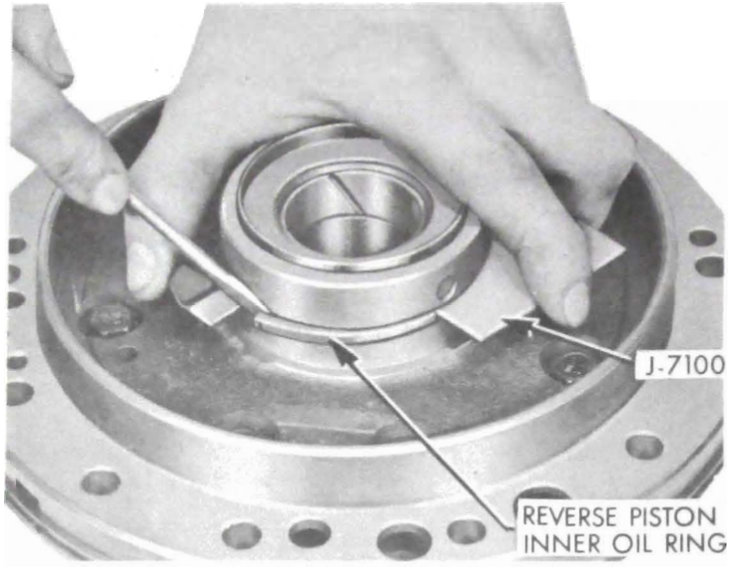
55. Remove needle thrust bearing and flanged rear thrust bearing race (between stator reaction shaft and front planet ring gear assembly). Remove reaction flange to case gasket.

NOTE: This bearing and rear race may have stuck to front planet set ring gear carrier during disassembly.

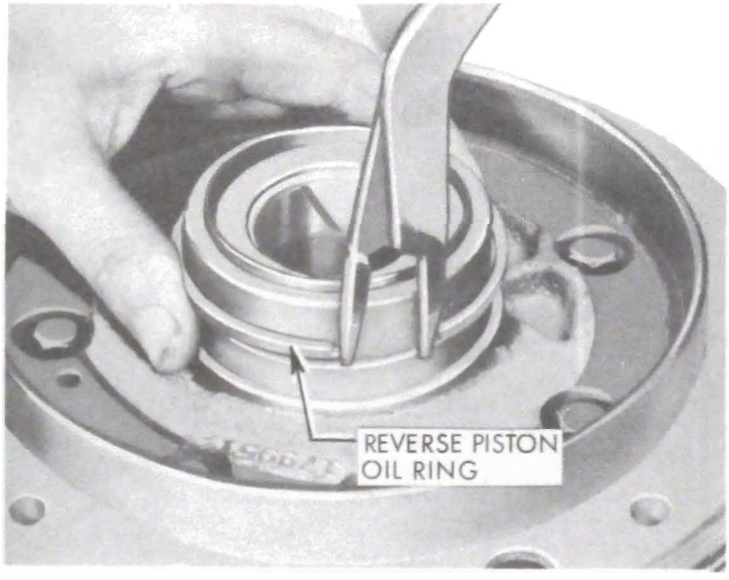


56. Remove reverse clutch piston. Use pliers to grip ribs of piston if piston sticks in bore.

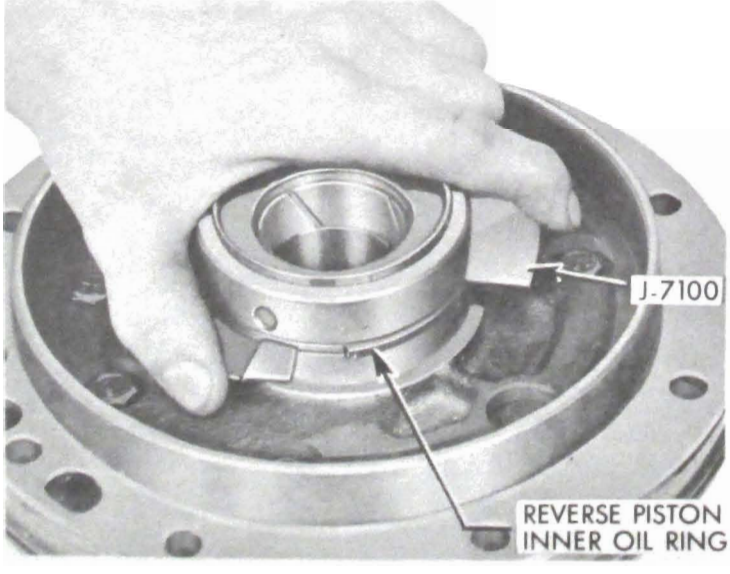
57. Remove reverse piston seal.



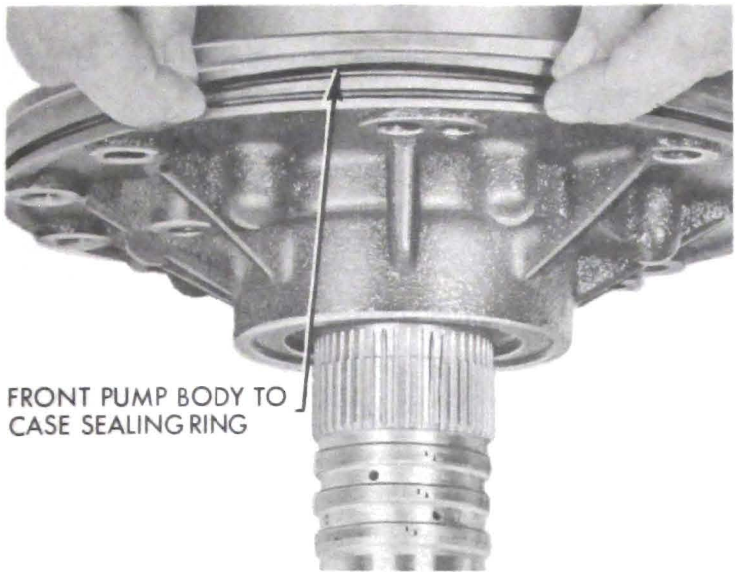
58. Inspect and if necessary to replace, unhook reverse piston oil ring, using Tool J-7100. Assemble tool on ring so ring is forced solidly in groove and movable arm contacts ring approximately 1/4'' from end. Press in on movable arm and pry up free end of ring with small screwdriver. Release arm.



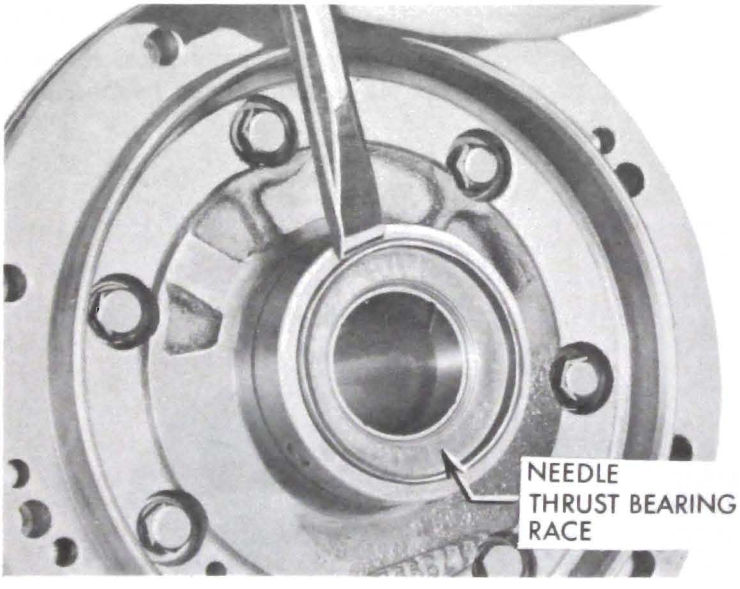
59. Expand reverse piston oil ring and remove from reaction shaft flange hub.



60. Expand and install new reverse piston oil sealing ring on reaction shaft. Hook ends using Tool J-7100. Assemble tool on ring so ring is forced solidly in groove and movable arm contacts ring approximately 1/4'' from end. Press in on arm to hook ends.

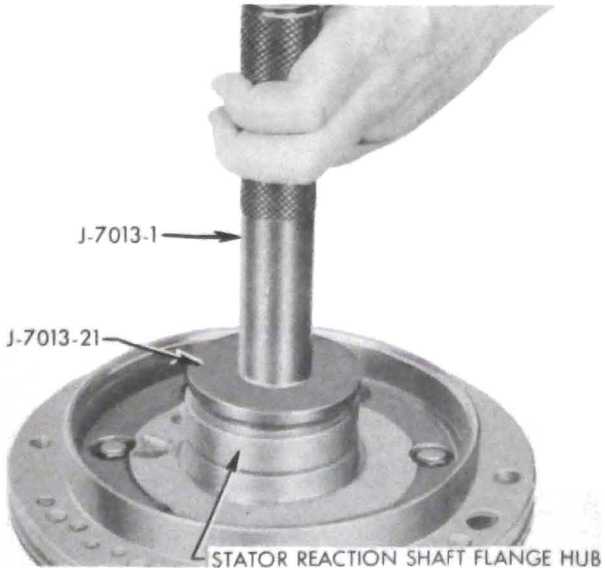


61. Remove front pump body to case sealing ring (square section).



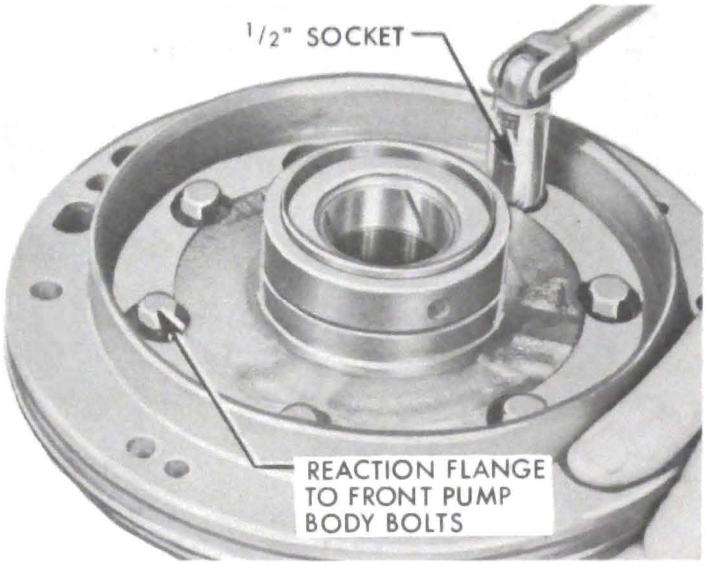
62. Inspect flanged needle thrust bearing race (between stator reaction shaft and front planet ring gear assembly).

NOTE: This bearing race is specially hardened and is very brittle. It is not likely it will need replacement; however, if it is to be replaced, be careful to use eye protection as the race may shatter when struck with chisel.

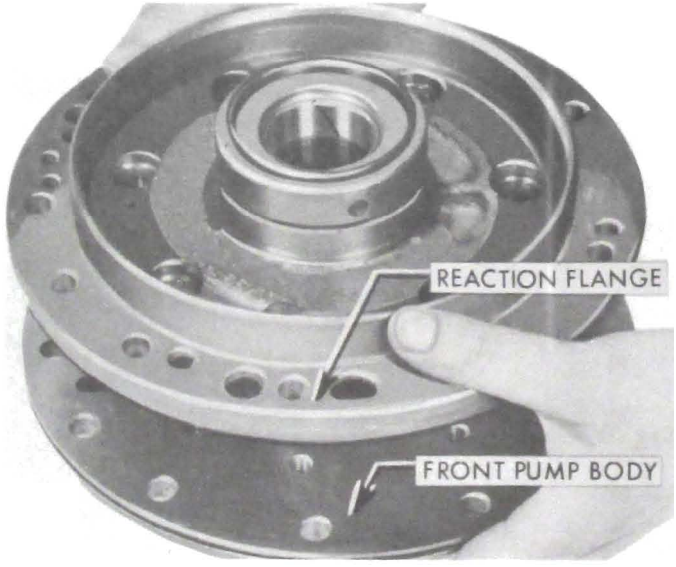


63. Inspect reaction shaft end; clean up all burrs and nicks.

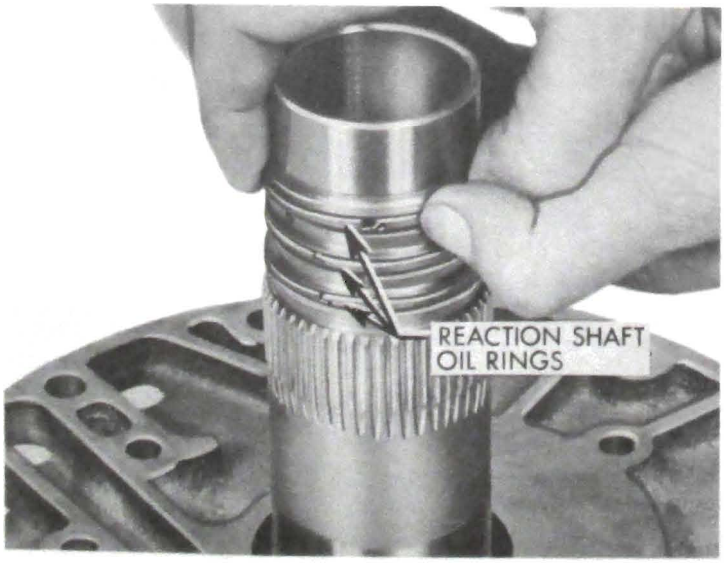
Install new flanged needle thrust bearing race in reaction shaft using Tool J-7013-1 Handle, and J-7013-21 Installer.



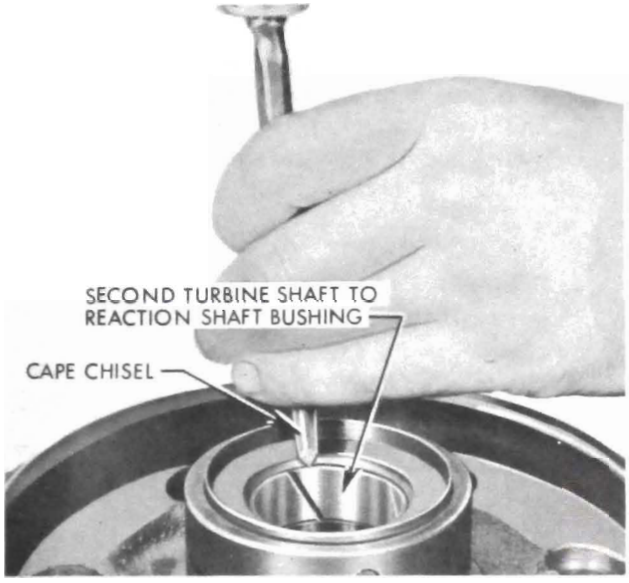
64. Remove seven reaction flange to front pump body bolts (1/2" socket).



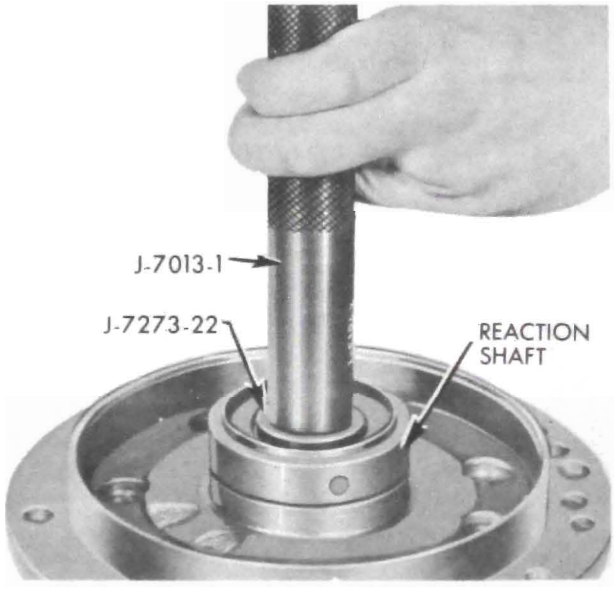
65. Separate front pump body from reaction flange by tapping assembly on bench, shaft down.



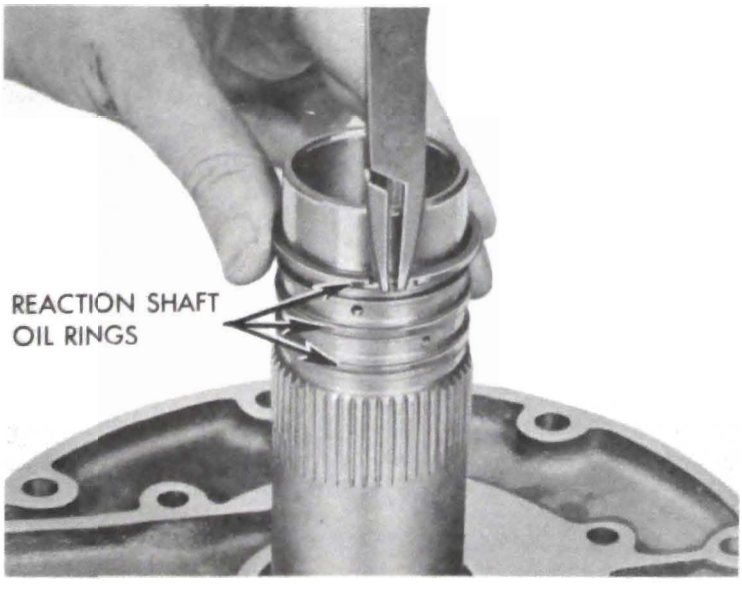
66. Inspect and if necessary to replace, unhook and expand the three reaction shaft oil rings. Remove from reaction shaft.



66A. Examine second turbine shaft to reaction shaft bushing. If worn or scored, collapse bushing with cape chisel. Remove bushing.

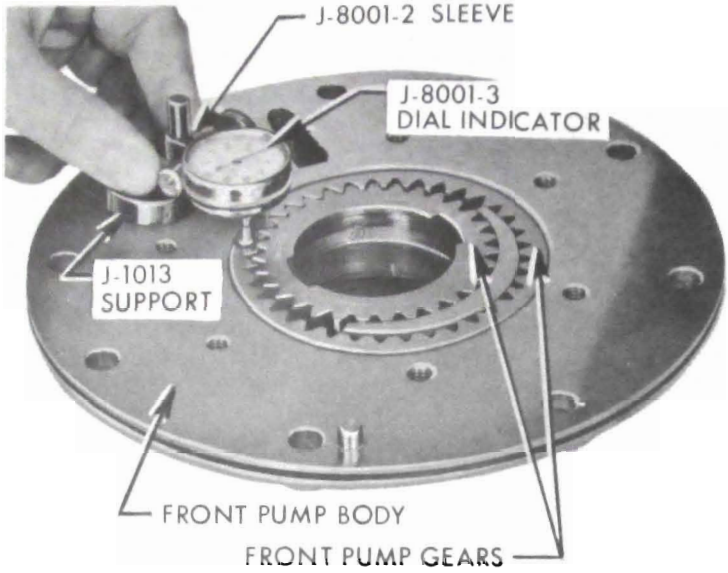


66B. Install new second turbine shaft to reaction shaft bushing using Tool J-7013-1 Handle and J-7273-22 Installer.

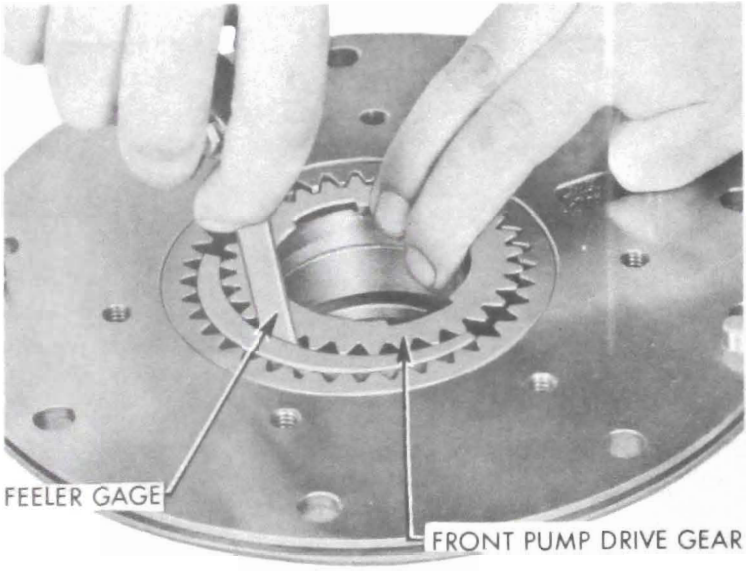


67. Using snap ring pliers, carefully expand and install three new reaction shaft oil rings in grooves.

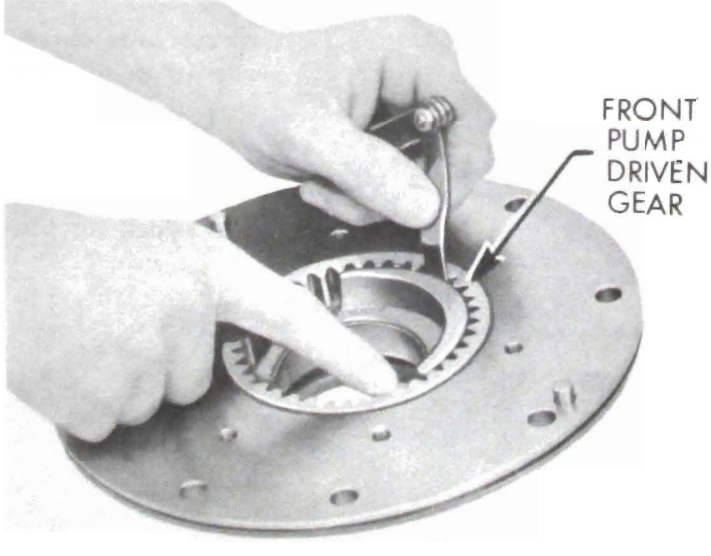
Hold one end of hooked ring firmly in groove and work other end of ring into position. Rotate hooked ring in groove to check for burrs or dirt that may be present.



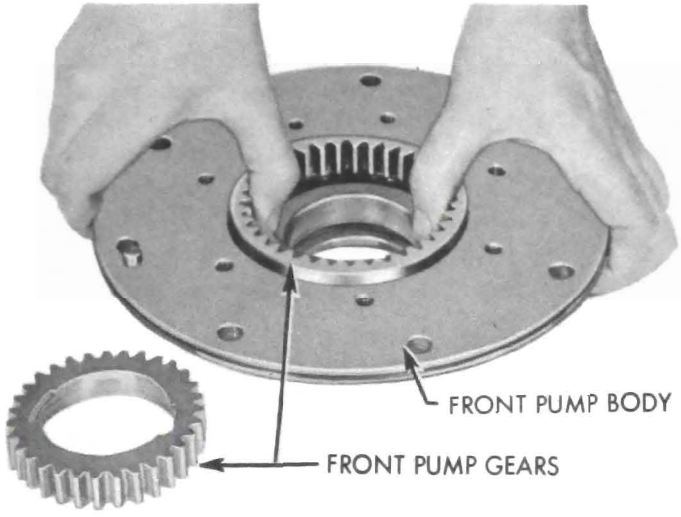
68. Check front pump gear end clearance using Dial Indicator Support J-1013, J-8001-2 Sleeve, and J-8001-3 Dial Indicator. Zero indicator on pump body, then slide plunger to rest on gears, one at a time. Reading should be between .001" and .002" below pump body.



69. Hold drive gear away from crescent and check gap between gear and crescent with a .009" feeler gauge and then a .017" feeler gauge. The .009" gauge should "go" and the .017" should "not go". If the .009" does "not go" the clearance is less than .010" required. If the .017" "goes" the clearance is more than the .016" maximum allowed. Replace pump if necessary.

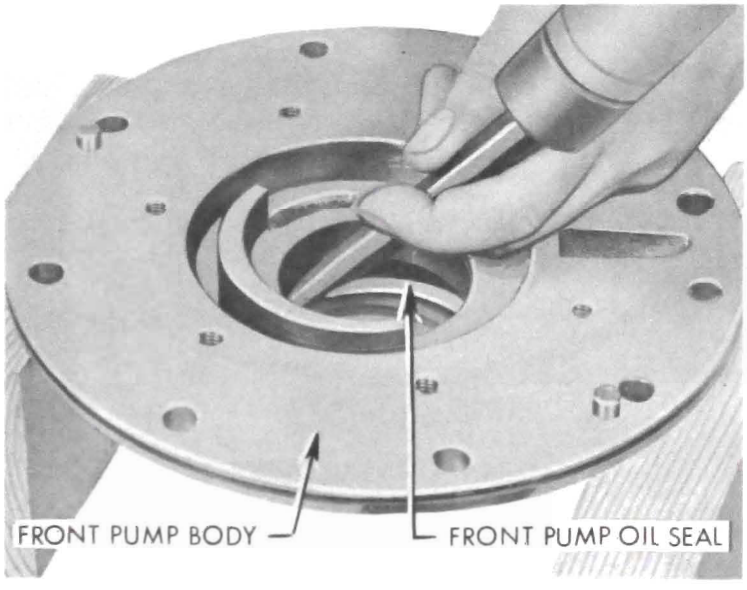


70. Hold front pump driven gear away from crescent and check gap between gear and crescent with a .004" feeler gauge and then a .010" feeler gauge. The .004" gauge should "go" and the .010" should "not go". If the .004" does "not go", the clearance is less than .005" required. If the 010" "goes" the clearance is more than the .009" maximum allowed.

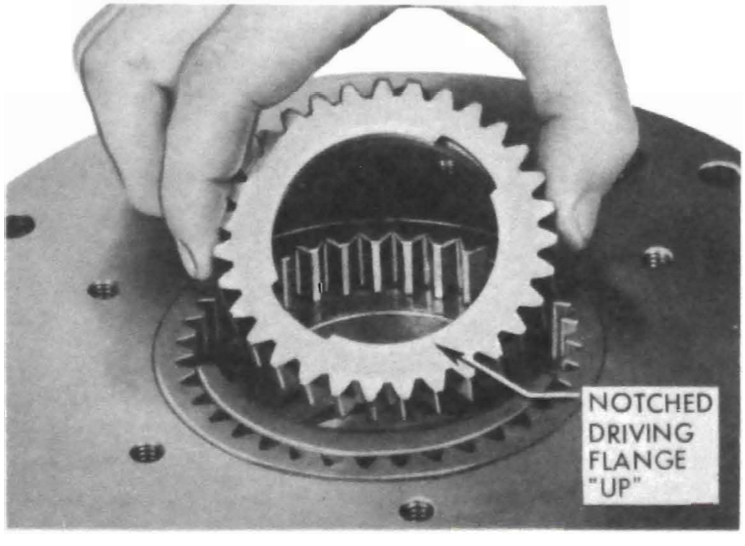


71. Remove front pump gears by lifting straight up.

NOTE: All surfaces of these gears are accurately ground and must be protected against nicks, scratches and dirt of any kind.

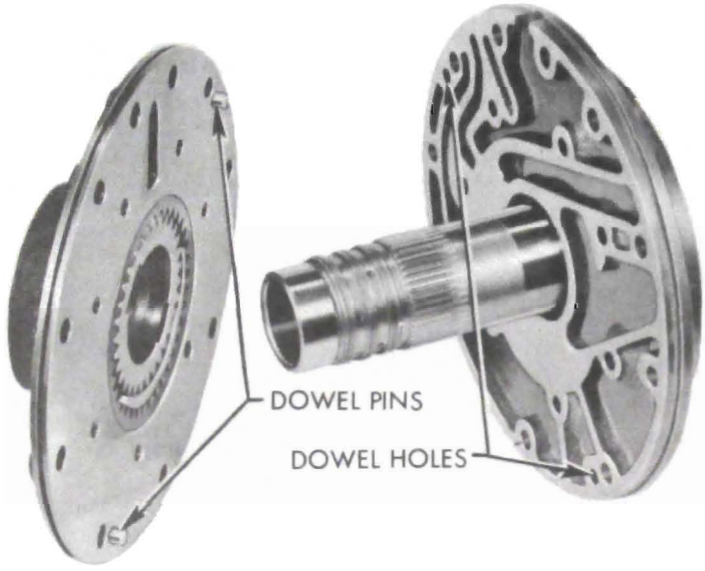


72. If front pump seal is to be replaced at this time rather than with pump in transmission, suitably support pump body and drive out front pump seal using drift and hammer.

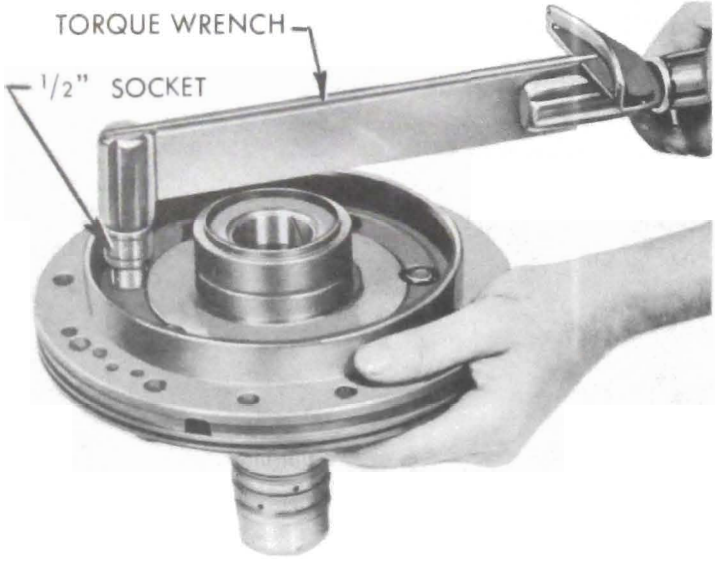


73. Clean and lubricate front pump gears and install in pump body by lowering straight down into body. Do not use force.

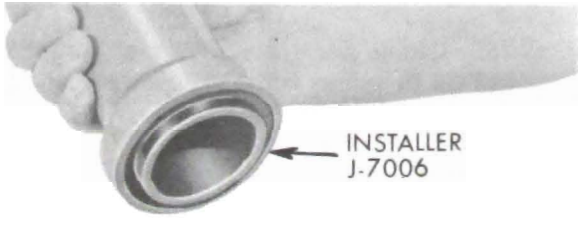
NOTE: Front pump drive gear must be installed with notched driving flange "up" and counter-bored side toward front pump seal.

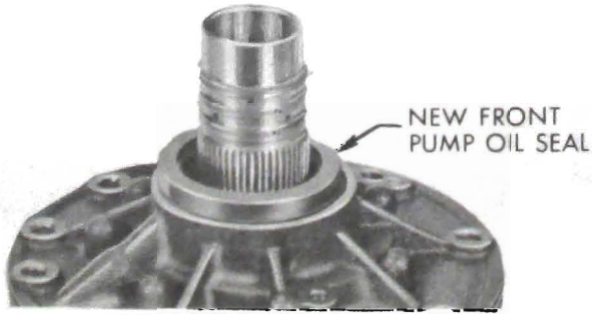


74. Lubricate with Dynaflow oil and carefully assemble front pump assembly to reaction shaft flange assembly. Note position of dowel pins in pump body and holes in reaction shaft flange.



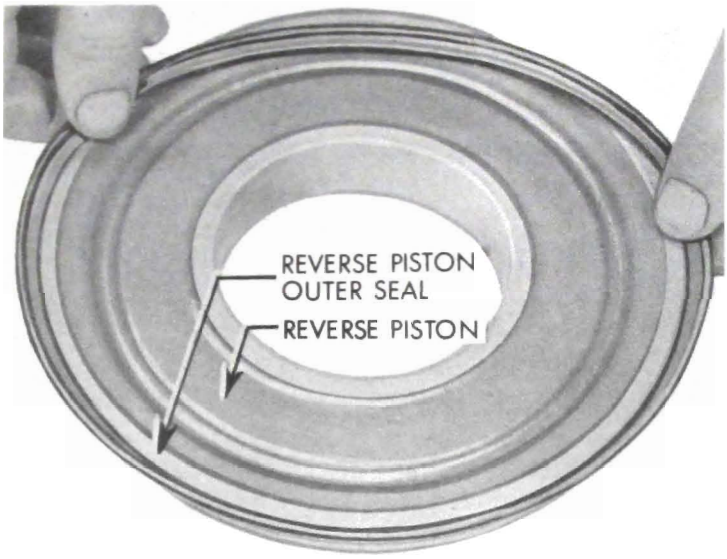
75. Install seven 5/16''-18 X 1 7/8'' reaction shaft flange to front pump body bolts (1/2'' socket). Tighten alternately and evenly to 20 - 25 ft. lbs. using a torque wrench.



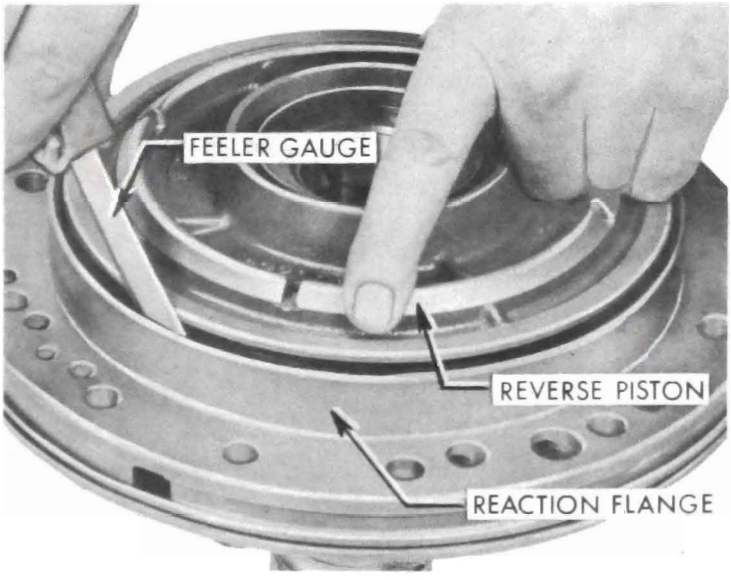


76. Suitably support assembly to protect needle bearing race and drive new front pump seal into front pump body using hammer and Seal Installer J-7006.

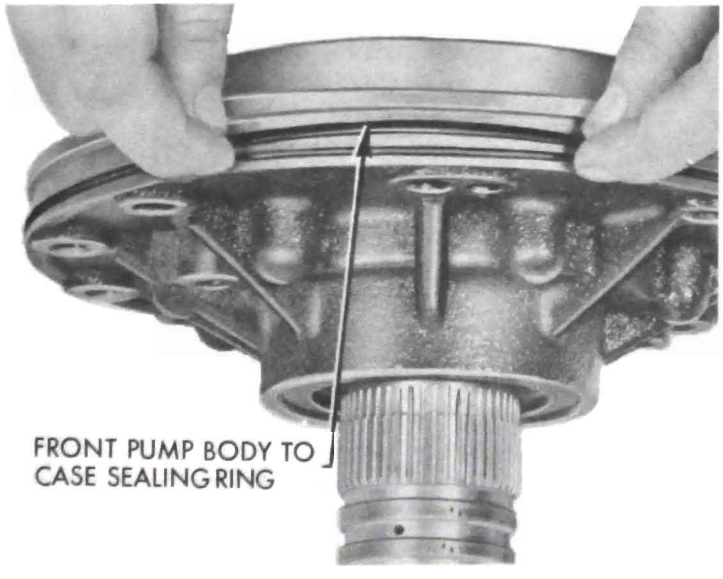
NOTE: Reaction shaft pilots tool to insure square seating of seal.



77. Install new reverse piston seal with lip away from ribbed side of piston.



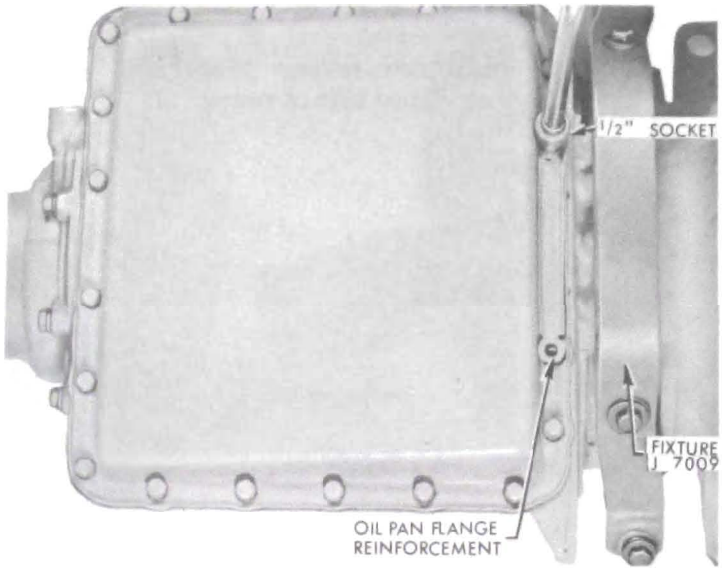
78. Lubricate reverse piston seal and install piston assembly in bore of reaction flange by running a smooth edged feeler gauge around reverse piston to keep lip of seal down. Use care to prevent damage to seal.



79. Install new front pump body to case sealing ring squarely in groove of front pump body.

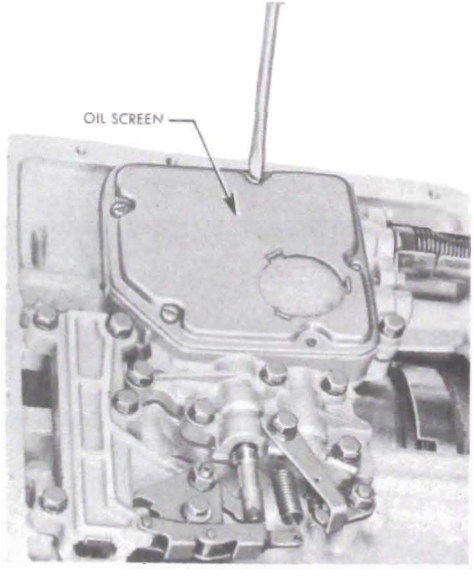
If further work is to be done on transmission assembly, set pump aside, otherwise reinstall pump in case using a new gasket and 3/8" - 16 guide pins J-7003. Refer to step #259.

IMPORTANT: Be certain the 1 3/4" X 2 1/2" needle thrust bearing is correctly positioned in the cupped bearing race at the rear of the reaction shaft. Apply heavy lube to hold needle bearing in place during installation of pump.

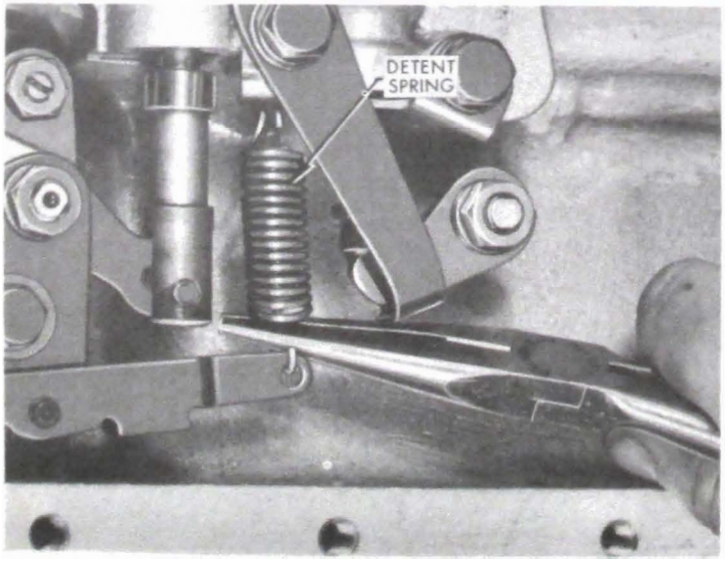


VALVE BODY REMOVAL

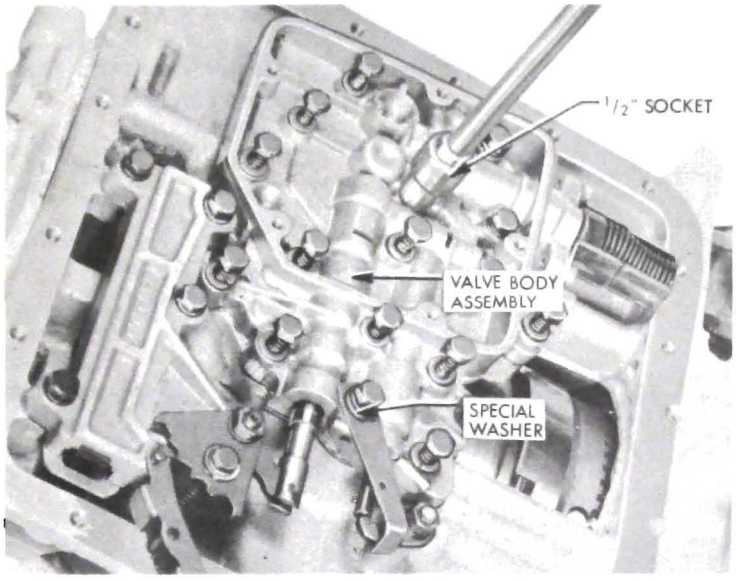
80. With transmission upside down, remove twenty oil pan bolts (1/2'' socket), oil pan flange reinforcement and oil pan.



81. Remove five oil screen screws, remove screen.

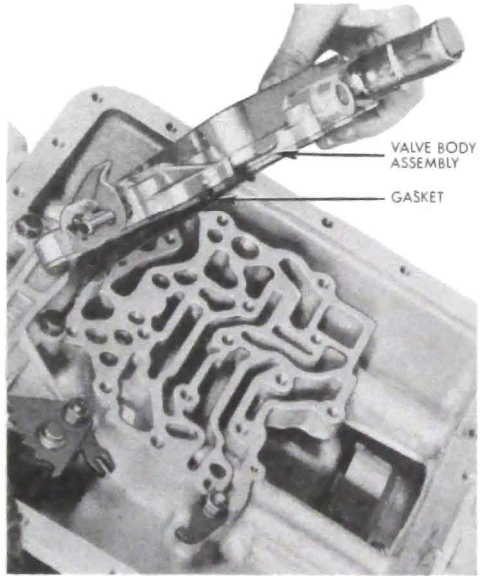


82. Remove detent spring using needle nose pliers.

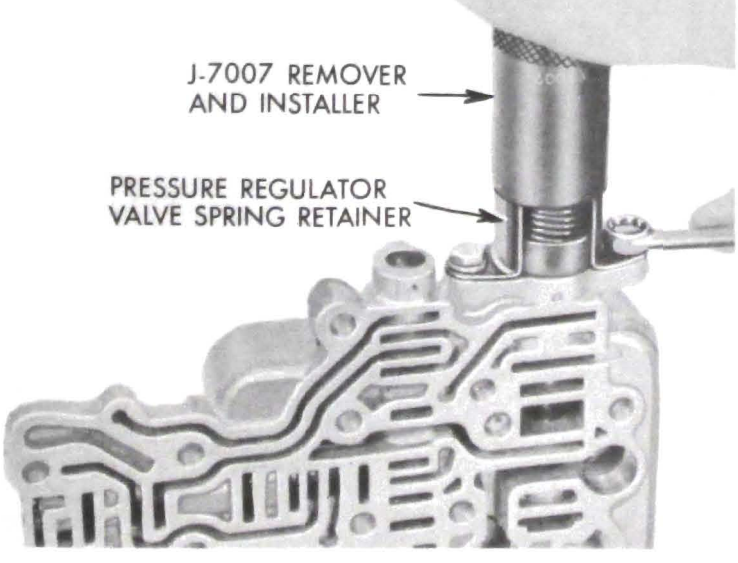


83. Remove sixteen valve body bolts and lock washers (1/2'' socket).

NOTE: Special washer on stator control stop bolt.



84. Remove valve body assembly and gasket carefully to avoid dropping valves. Examine gasket for evidence of leakage or improper installation.



VALVE BODY DISASSEMBLY

85. Use the exploded view of the valve body as a guide during disassembly.

Remove pressure regulator valve spring retainer and spring seat and pin using Tool J-7007 and 7/16'' wrench.

86. Remove manual shift valve.

87. Remove stator control valve and stop assembly.

88. Remove stator modulator valve and springs by rapping valve body against hand.

89. Remove two valve body cover plate screws with Phillips screwdriver. Remove plate and gasket.

90. Examine gasket for evidence of leakage or improper installation.

91. Remove front and rear pump check valves and springs.

92. Remove pressure regulator guide retaining pin by rapping valve body against hand.

93. Remove pressure regulator valve pin guide by rapping valve body against hand.

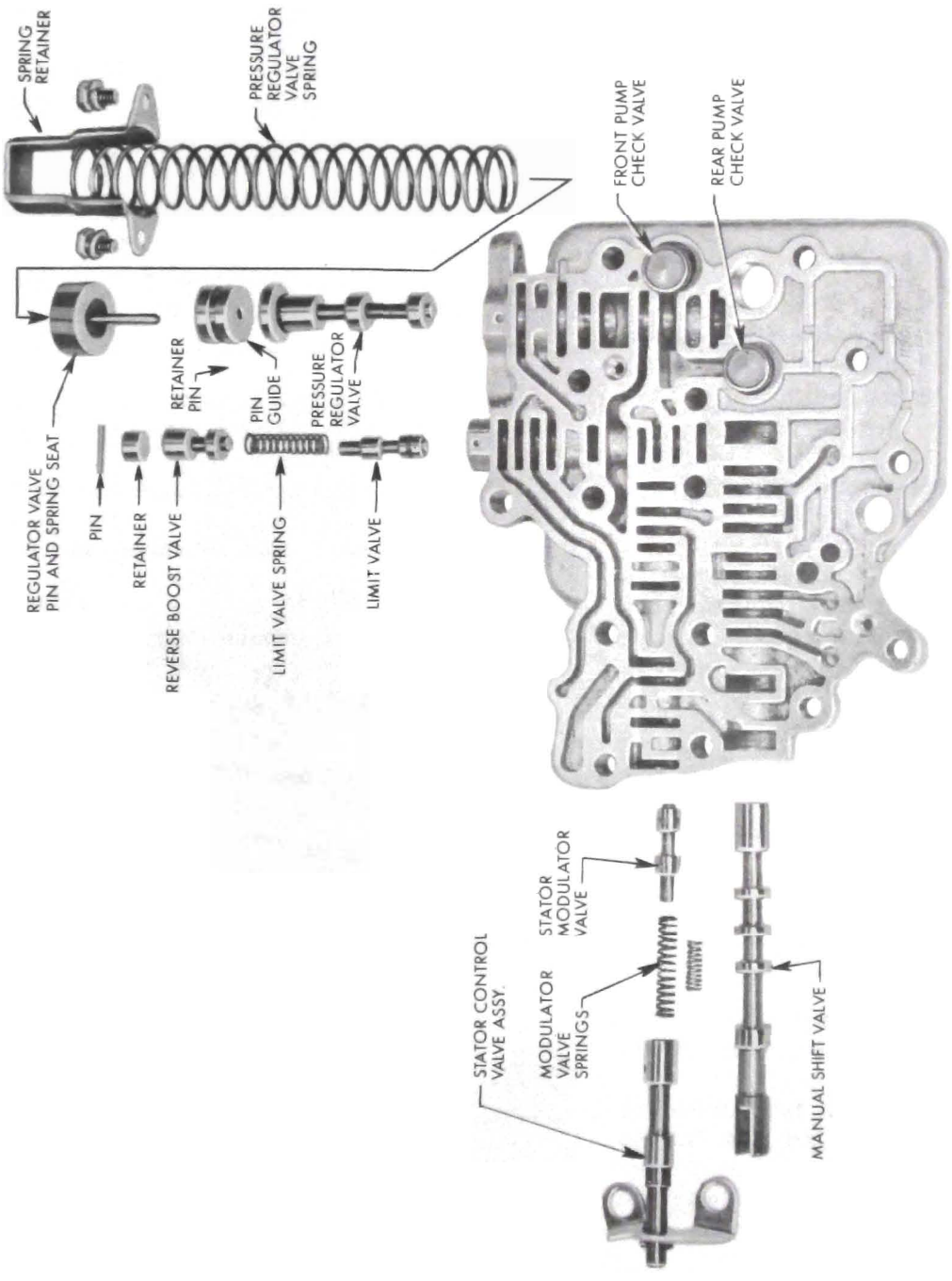
94. Slide out pressure regulator valve.

95. While holding in on retainer, remove reverse boost valve retainer pin with needle nose pliers.

96. NOTE: Retainer and valve will pop out when pin is removed. Catch valve and retainer to prevent damage.

97. Remove reverse boost valve retainer.

98. Remove reverse boost valve, spring and limit valve by rapping valve body against hand.



VIEW OF VALVE BODY DISASSEMBLED

99. After thorough cleaning and inspection, assemble valve body as follows.

REASSEMBLY OF VALVE BODY

100. Use the exploded view as a guide during reassembly.

101. Install limit valve, grooved land first. Shake valve body to allow limit valve to reach proper position. The limit valve and the stator modulator valve are the same length and are interchangeable.

102. Install reverse boost valve spring, (longer than stator modulator valve spring) then install reverse boost valve, narrow land first.

103. Insert reverse boost valve retainer.

104. Depress reverse boost valve retainer against spring tension and install reverse boost valve retainer pin flush with surface of valve body.

105. Insert pressure regulator valve into valve body, small end first.

106. Insert pressure regulator valve pin guide so end is flush with edge of valve body.

Install pressure regulator valve pin guide retainer pin into valve body and groove of pin guide.

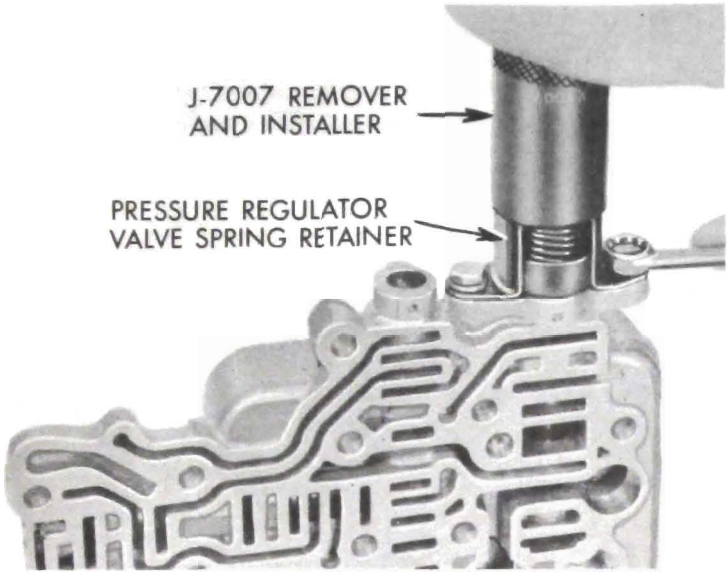
107. Insert stator modulator valve into valve body, grooved land first. Shake valve body to allow stator modulator valve to seek proper position.

108. Install stator modulator valve springs into valve body. (Shorter than reverse boost spring)

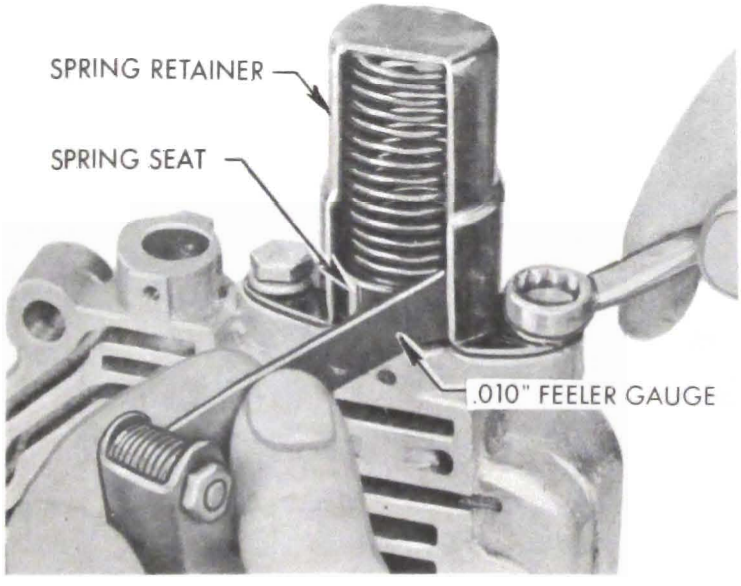
Install stator control valve and stop assembly.

Install shift control valve, slotted end out.

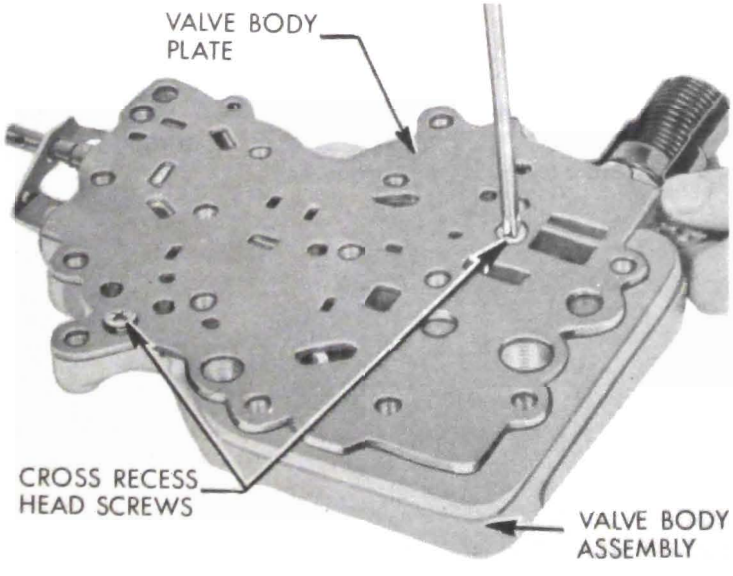
109. Insert pressure regulator valve pin and spring seat into pin guide.



110. Install pressure regulator valve spring and spring retainer using Tool J-7007.



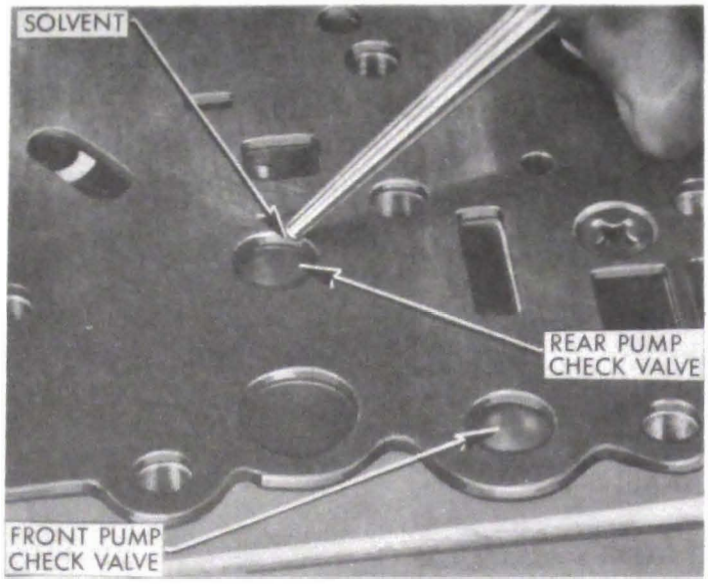
111. Before tightening retainer bolts, check clearance between spring seat and retainer with a .010" feeler gauge. Spring seat must rotate and move in retainer without touching retainer.



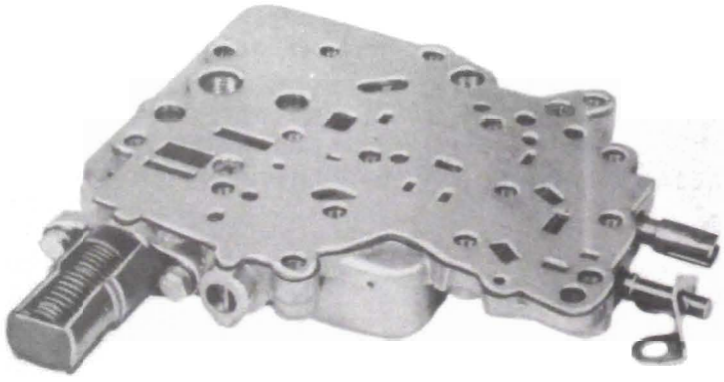
112. Install check valve springs and check valves, step sides of valves toward springs.

Be certain that surface of valve body is clear of dirt and has no burrs. Install new valve body plate to valve body gasket. Check and be certain that the pressure regulator valve pin guide retaining pin is in place.

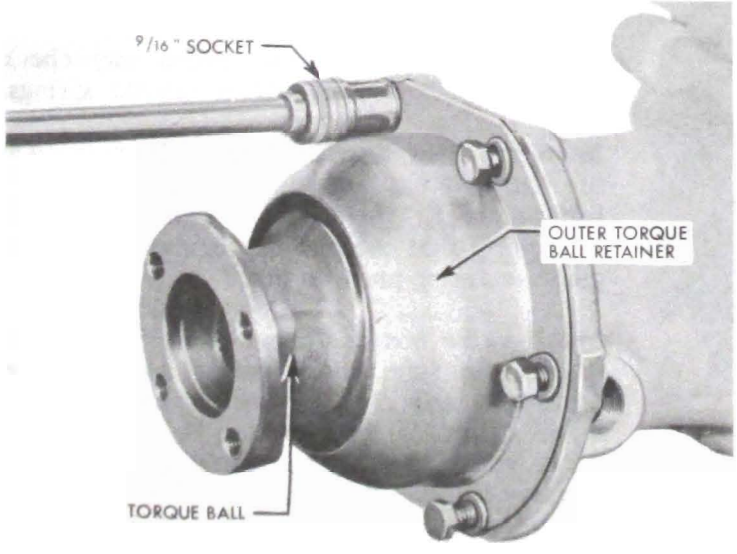
Install valve body plate with two Phillips head screws. Be sure check valves are correctly positioned and operate freely during installation of valve body plate. Be certain that valve body plate gasket lines up with holes in valve body.



113. Pour small quantity of solvent on each check valve. If valve leaks, it is burred or worn and must be repaired or replaced.

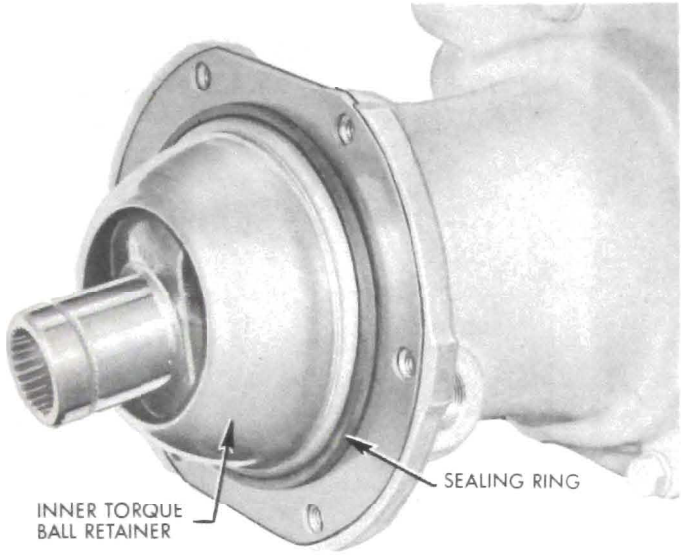


114. Completed valve body sub-assembly. If further work is to be done on transmission, set sub-assembly aside.

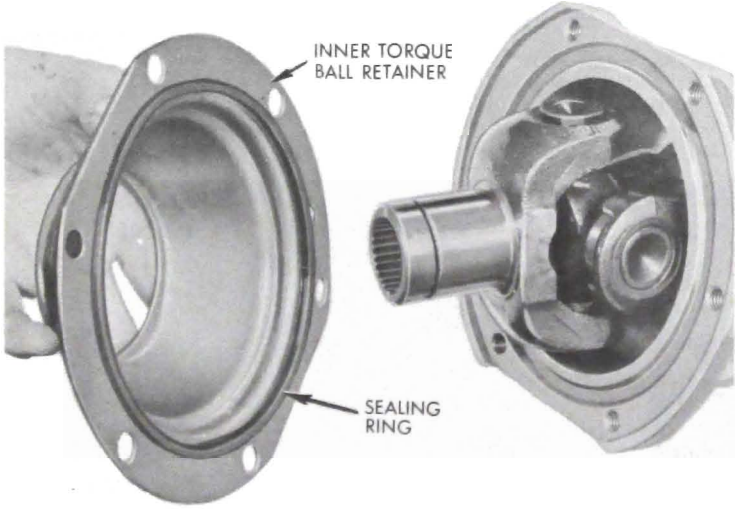


TORQUE BALL & U-JOINT REMOVAL

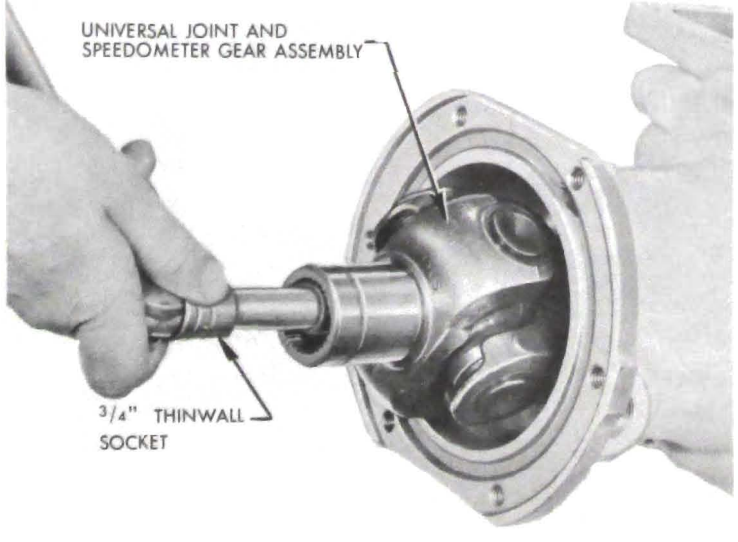
115. Remove six torque ball retainer bolts (9/16" socket). Remove outer torque ball retainer. Remove torque ball.



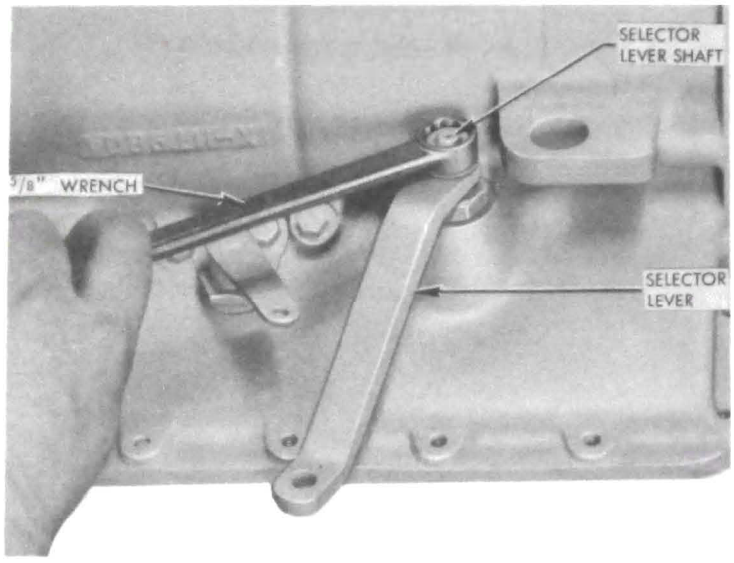
116. Remove sealing ring from outside of inner torque ball retainer.



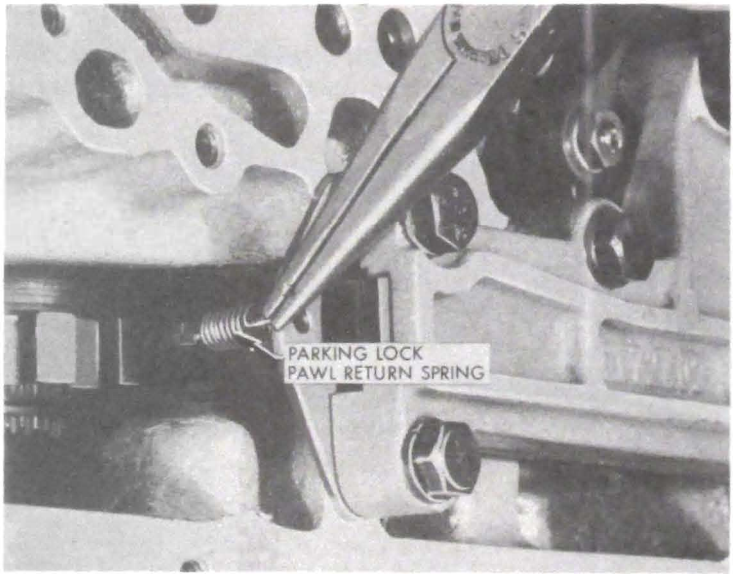
117. Remove inner torque ball retainer. Remove sealing ring, inner torque ball retainer to rear bearing retainer.



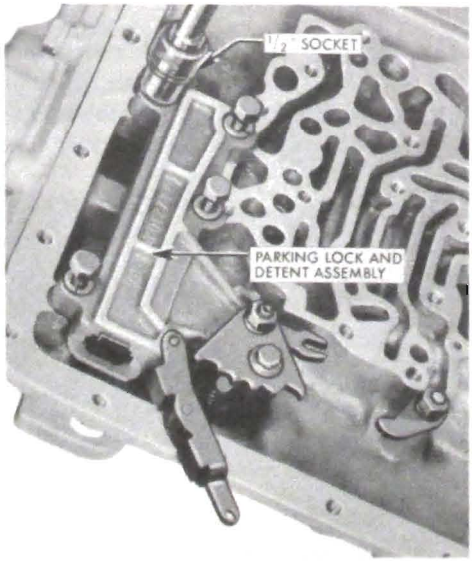
118. Engage parking lock pawl. Using a 3/4'' thin wall socket, remove special drilled U-joint bolt, lock washer and plain washer. Remove U-joint and speedo gear assembly.



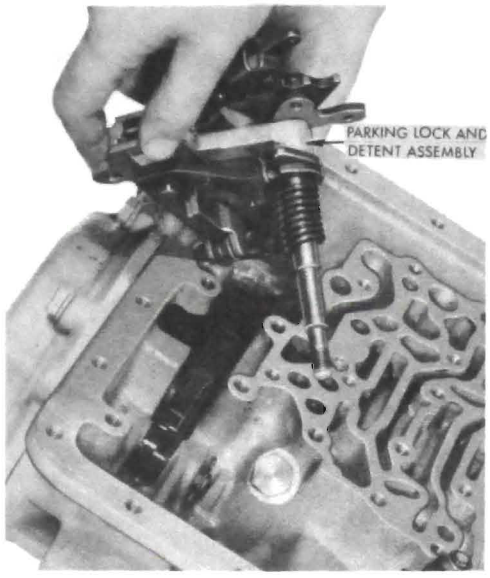
119. Remove transmission selector lever shaft nut (5/8" wrench). Remove selector lever.



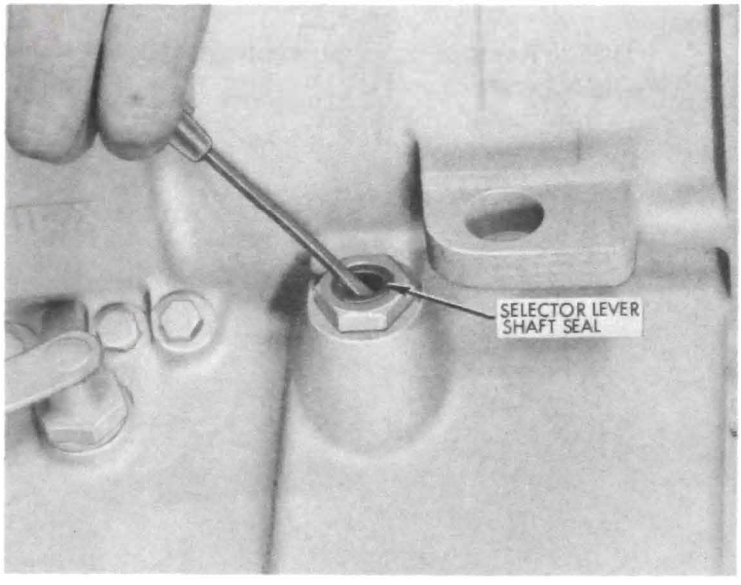
120. Remove parking lock pawl return spring using needle nose pliers.



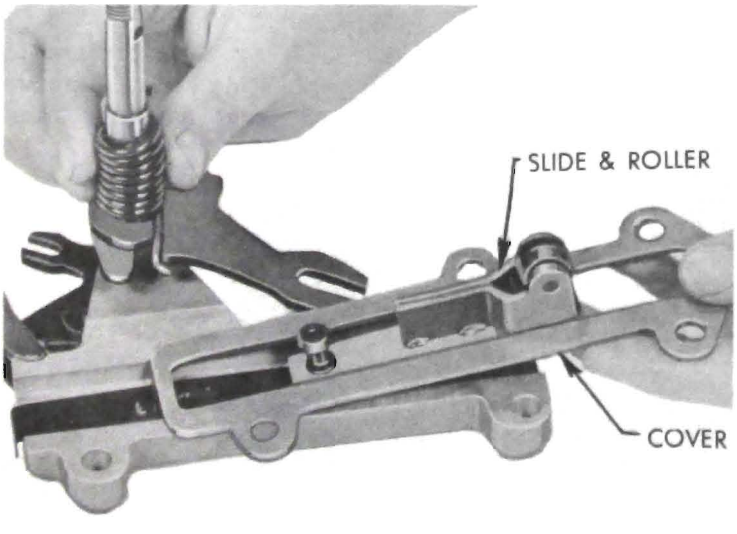
121. Remove four parking lock and detent assembly bolts (1/2" socket).



122. Remove parking lock and detent assembly.

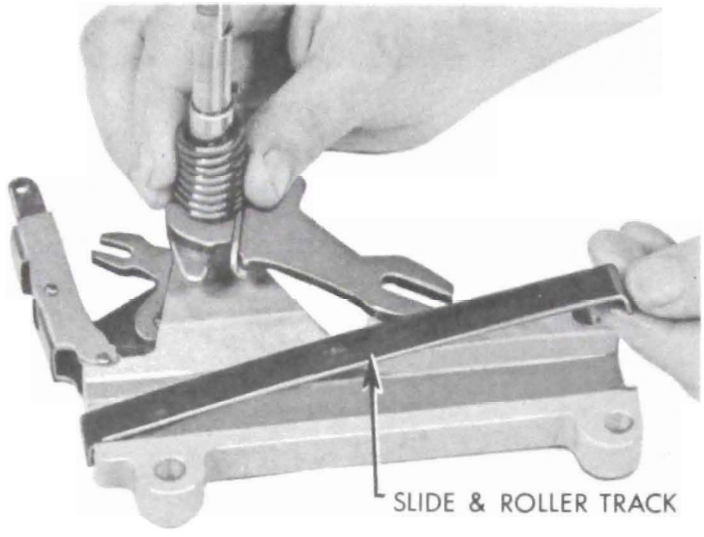


123. Remove selector lever shaft seal (pry out).

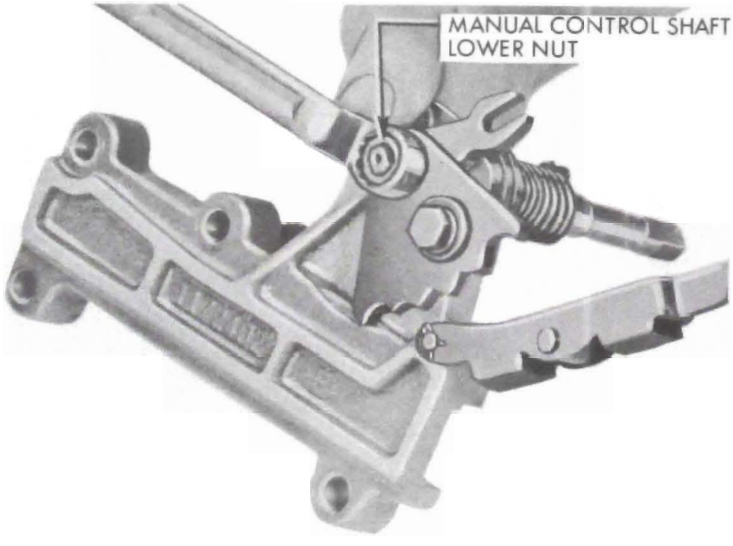


MANUAL CONTROL AND PARKING LOCK DISASSEMBLY, INSPECTION & REASSEMBLY

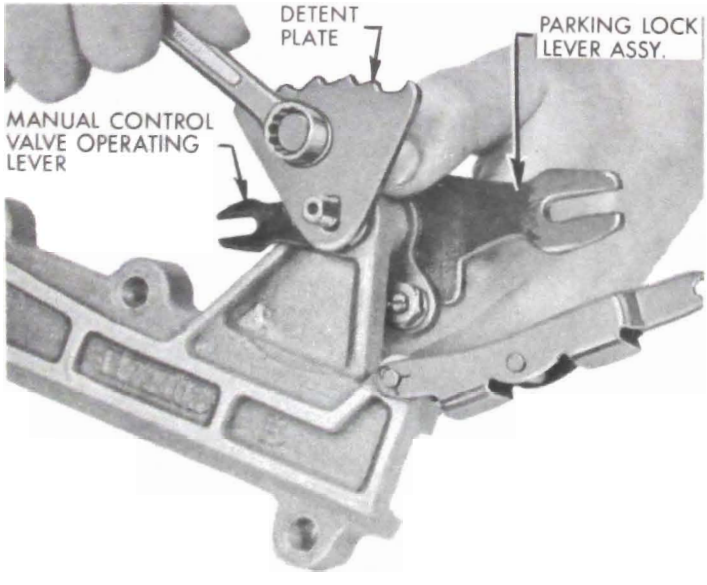
124. Remove slide and roller with slide and roller cover.



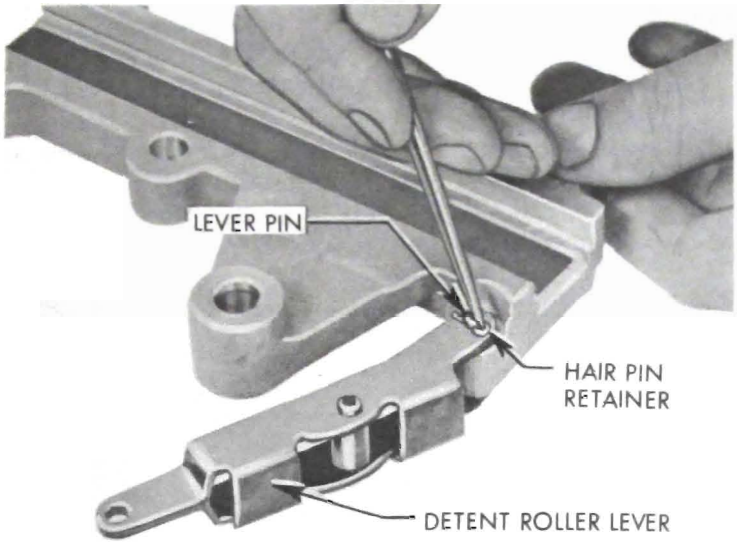
125. Remove slide and roller track.



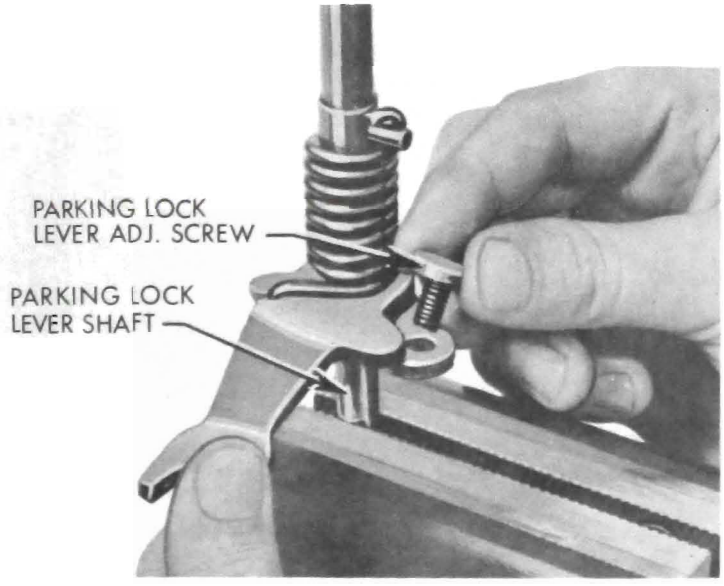
126. Remove manual control shaft lower nut (1/2'' wrench).



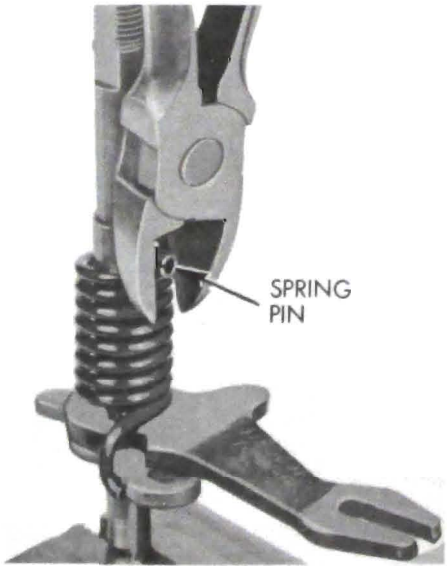
127. Remove bolt holding detent plate to manual control valve operating lever. Remove shaft and parking lock lever assembly from parking lock slide body.



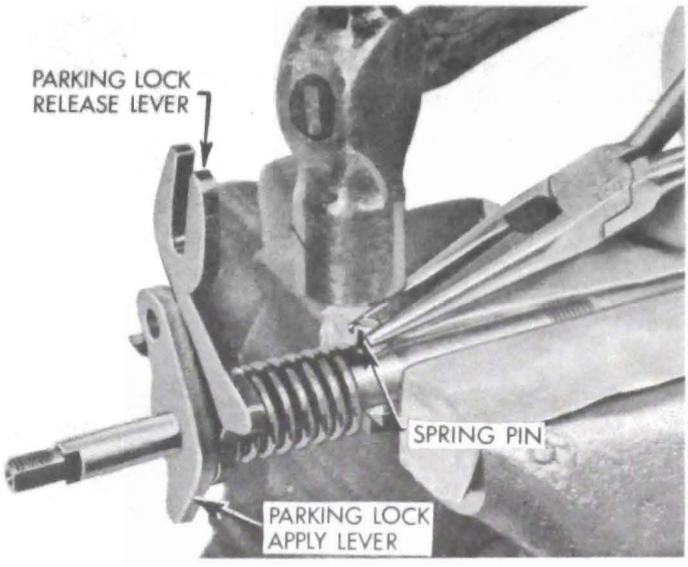
128. Remove hair pin retainer from detent roller lever pin, remove pin and roller lever.



129. Clamp lower flats of parking lock lever shaft in vise, rotate lever against spring tension and remove nut from parking lock lever adjusting screw (7/16" wrench). Remove screw.

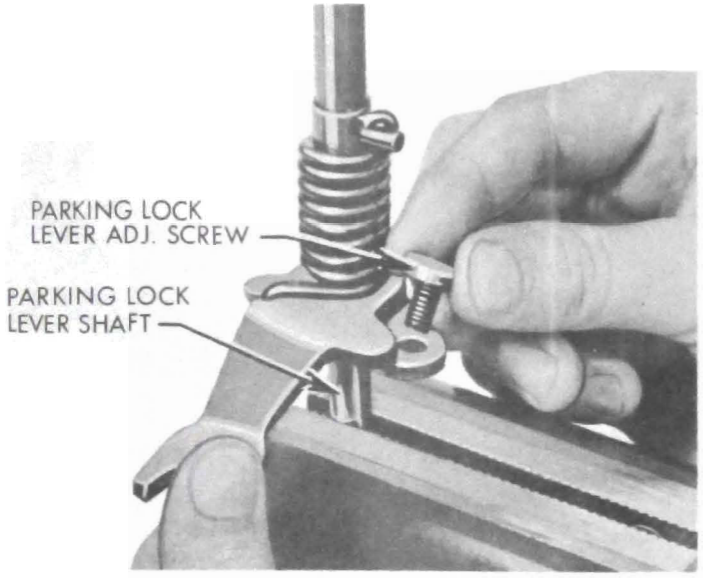


130. Rotate lever to release spring tension and pull pin from shaft. Remove spring and parking lock apply lever.

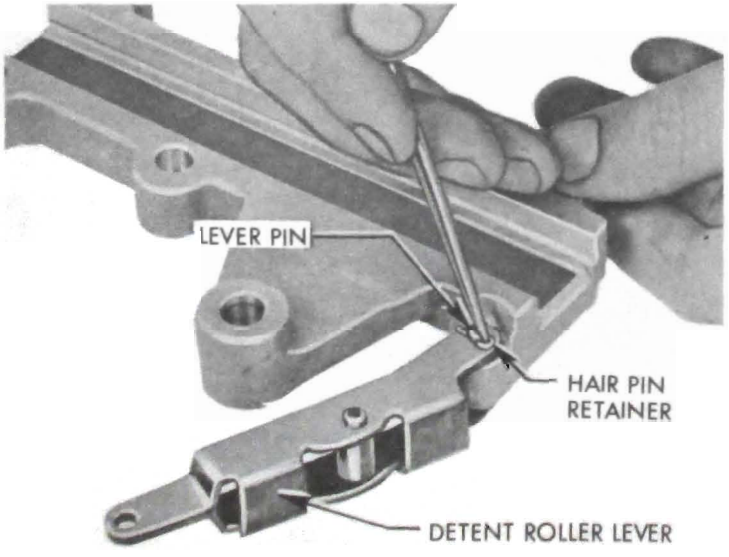


REASSEMBLY OF MANUAL CONTROL AND PARKING LOCK

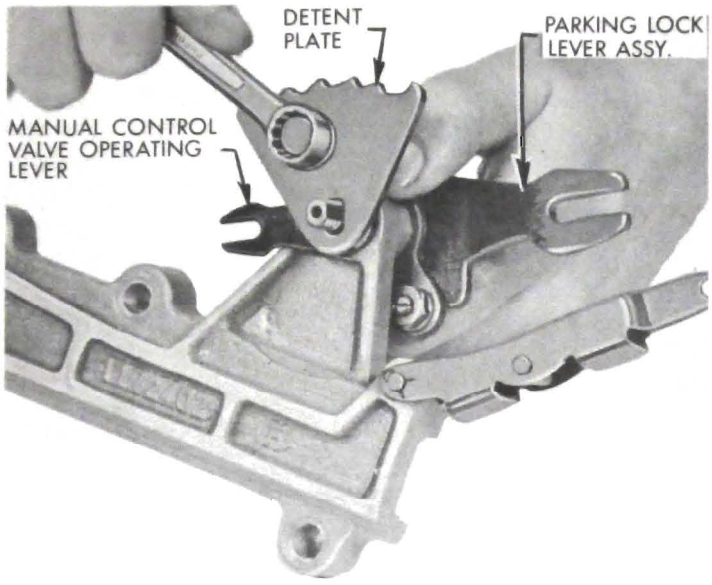
131. Assemble spring on shaft with levers as shown in Figure. Reinstall roll pin holding with pliers to start. Use soft jaws on vise to prevent damage to shaft.



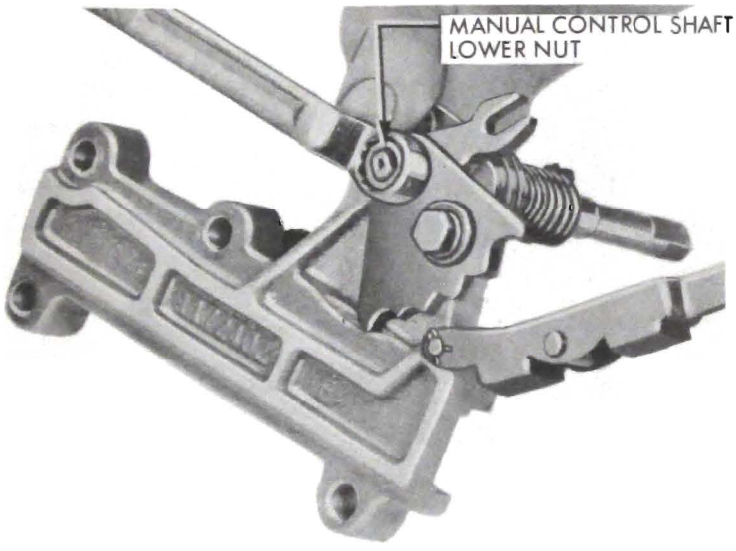
132. Clamp lower flats of parking lock lever shaft in vise, raise and rotate lever against spring tension and install parking lock lever adjusting screw, lock washer and nut. Do not tighten.



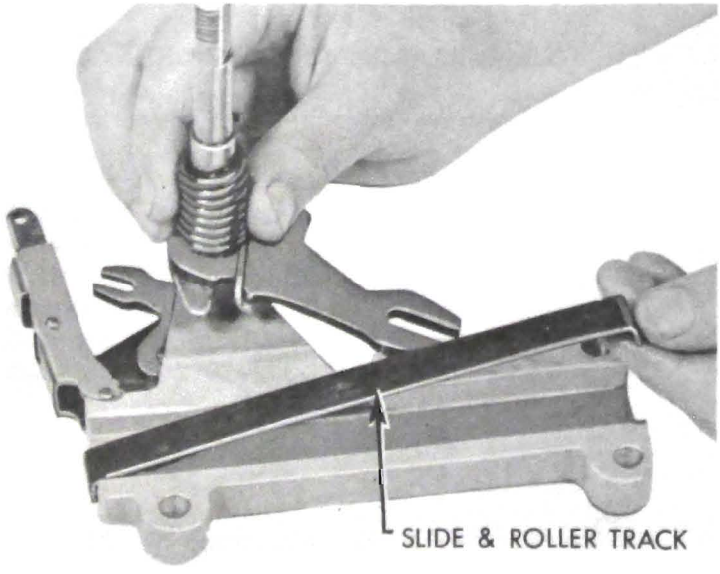
133. Assemble roller lever to slide body with pin and hair pin retainer.



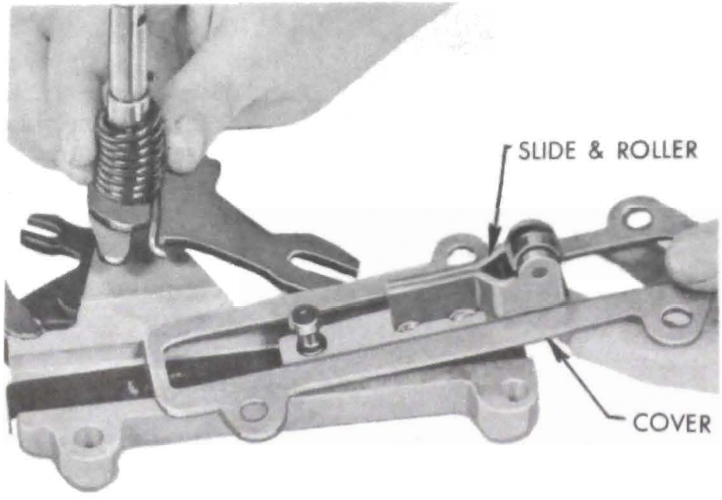
134. Assemble parking lock and shaft lever assembly to parking lock slide body. Assemble manual valve operating lever, then detent plate on shaft. (Bolt hole slot in detent plate must be closest to left side of detent plate). Install bolt, flat washer and lock washer. (detent plate to manual control valve operating lever) (7/16'' wrench).



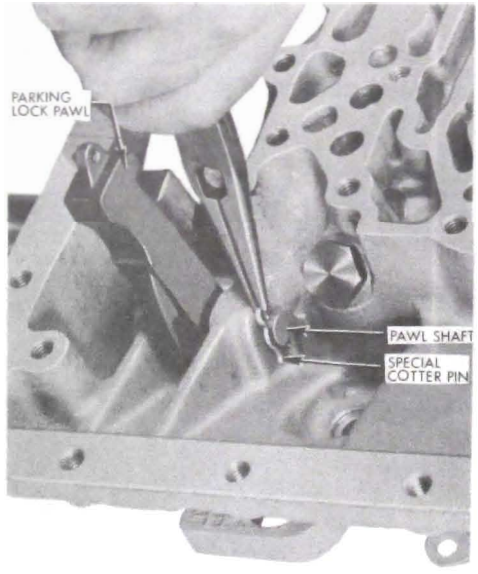
135. Install lower nut and lock washer on manual control shaft (1/2'' wrench).



136. Install slide and roller track in groove of slide body.

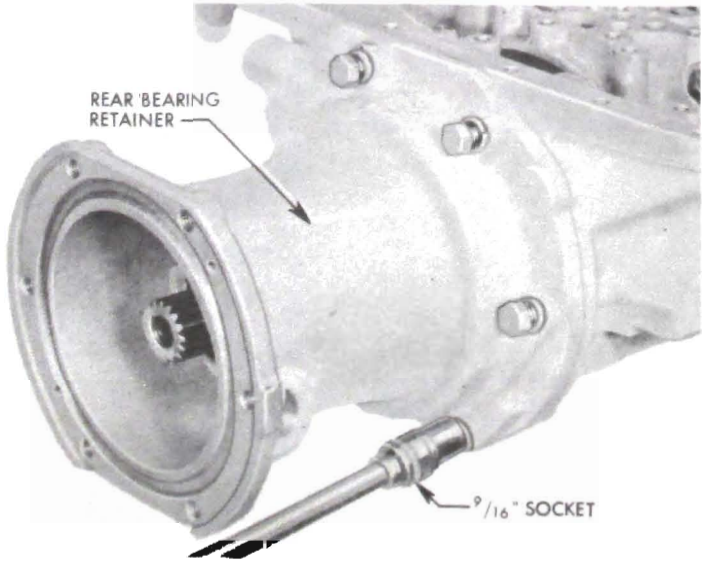


137. Install slide and roller and cover into slide body, rotate shaft and move slide and roller so slot in lever engages pin of slide and roller. If further work is to be done on transmission, set completed sub assembly aside.



138. If the parking lock pawl or the pawl shaft require replacement, follow the instructions below. Otherwise, swing the pawl out of the way.

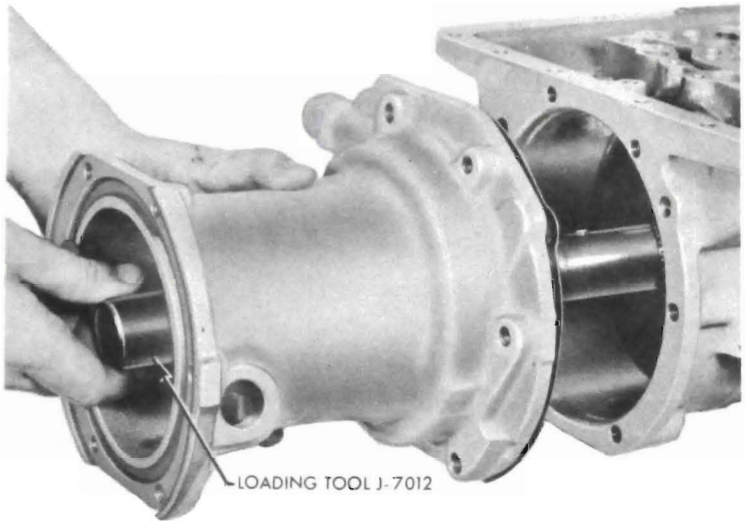
Remove spring pin from parking lock pawl shaft. Slide shaft rearward. Remove pawl.



REAR BEARING RETAINER REMOVAL

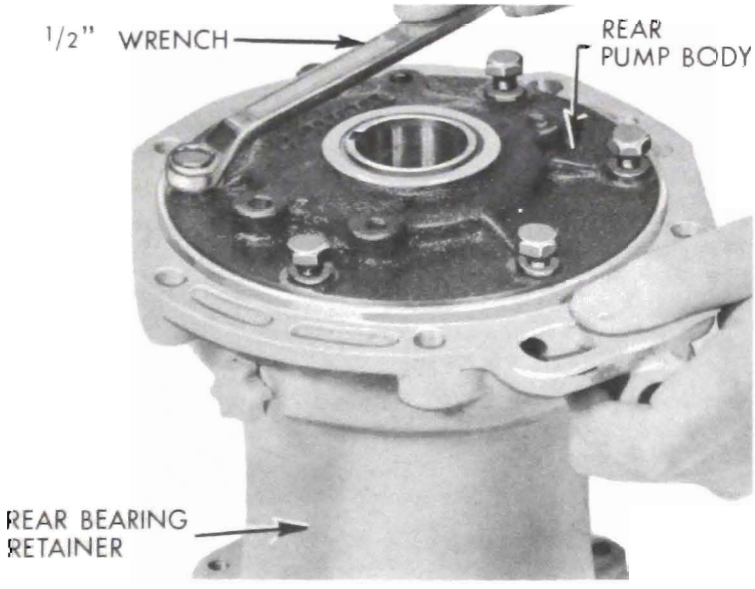
139. Remove six rear bearing retainer bolts (9/16" socket).

IMPORTANT: A spacer and shim forward of the rear bearing ride on a shoulder of the output shaft. This spacer and shim will fall off the output shaft and lodge in the rear bearing retainer between the rear bearing and rear oil pump if loading Tool J-7012 is not used.



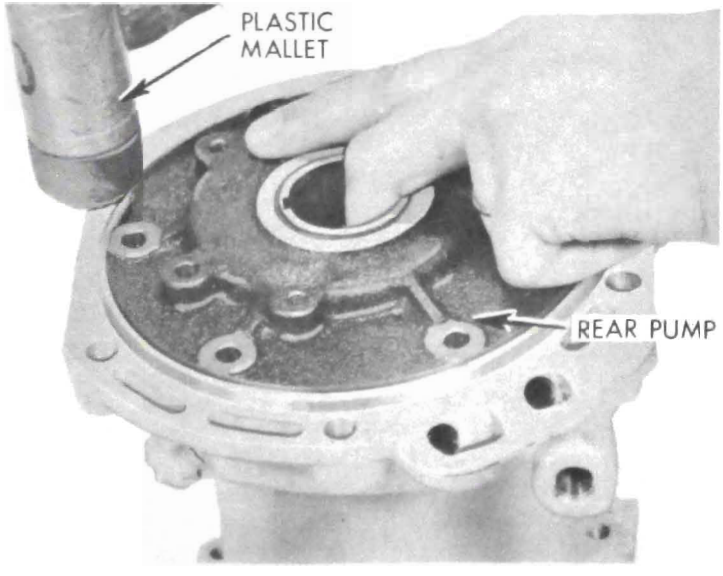
140. Insert loading Tool J-7012 in end of output shaft to prevent spacer and shim from falling. Hold loading tool forward while sliding rear bearing retainer and rear oil pump assembly away from case. Shim and spacer will be transferred from output shaft to loading tool. Leave loading tool in rear bearing retainer assembly. Remove gasket.

If rear bearing or rear oil pump are not to be inspected or repaired, leave loading tool in place and set assembly aside. Otherwise, proceed with rear bearing retainer - rear oil pump disassembly.

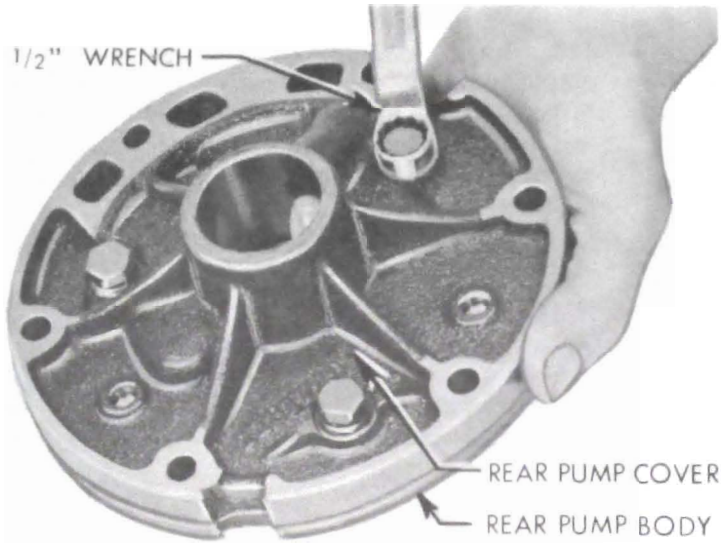


REAR BEARING RETAINER - REAR OIL PUMP DISASSEMBLY, INSPECTION & REASSEMBLY

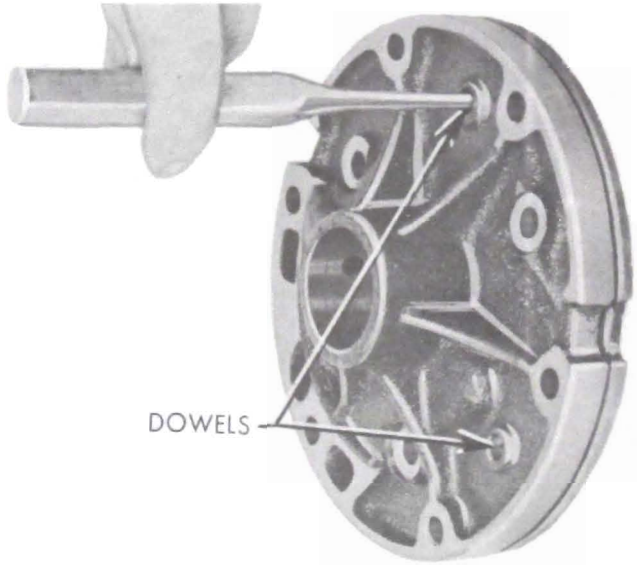
141. Remove six rear oil pump body to rear bearing retainer bolts (1/2" wrench).



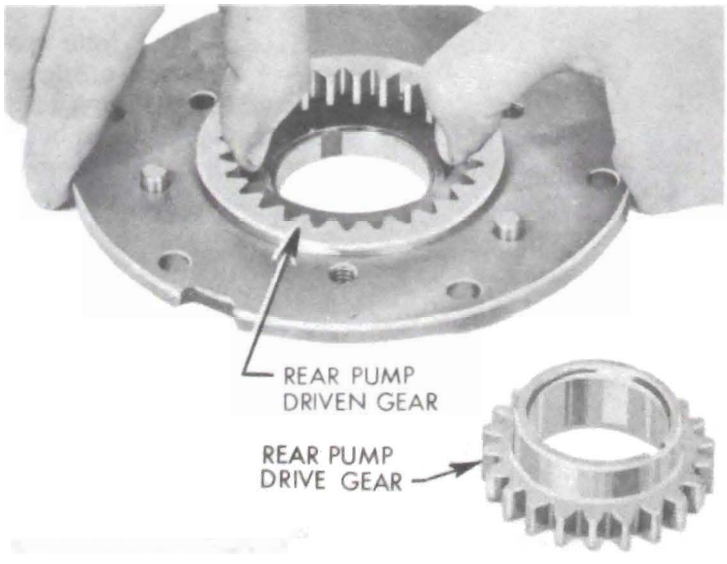
142. Remove loading Tool J-7012 from rear bearing retainer assembly. Separate oil pump body from rear bearing retainer by supporting assembly by oil pump and tapping rear bearing retainer with plastic mallet. Remove rear oil pump and gasket.



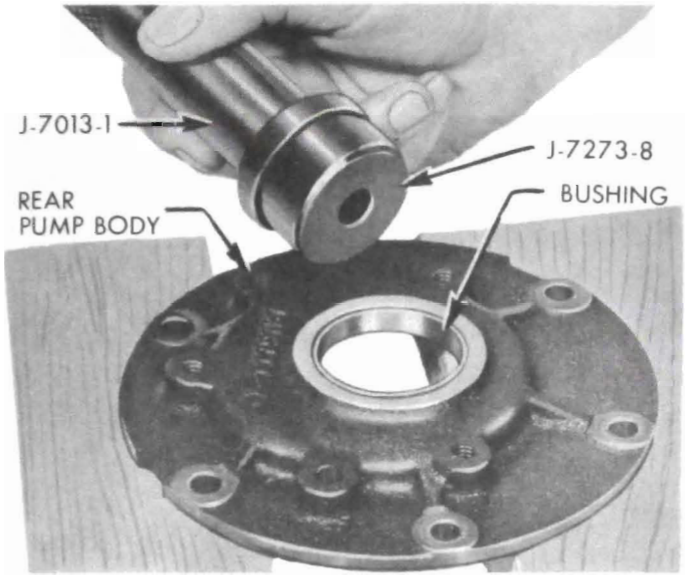
143. Remove three rear oil pump cover to body bolts (1/2'' wrench).



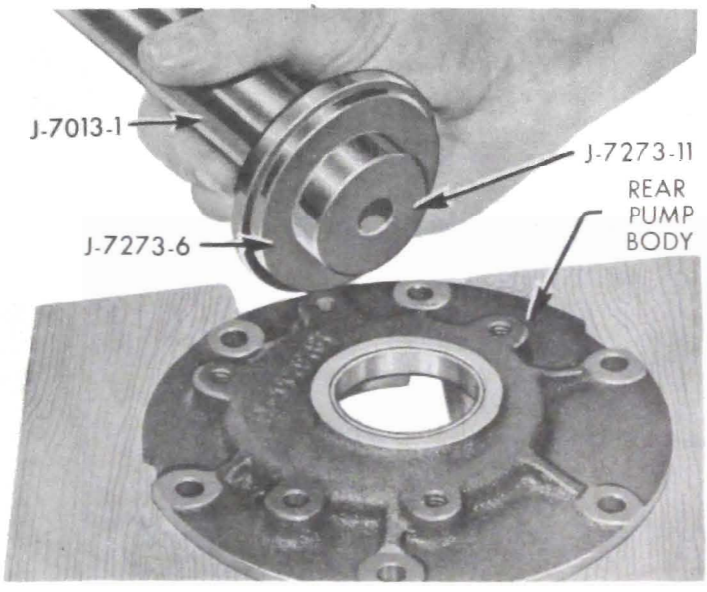
144. Separate rear pump cover from body by rapping two dowels with drift if necessary.



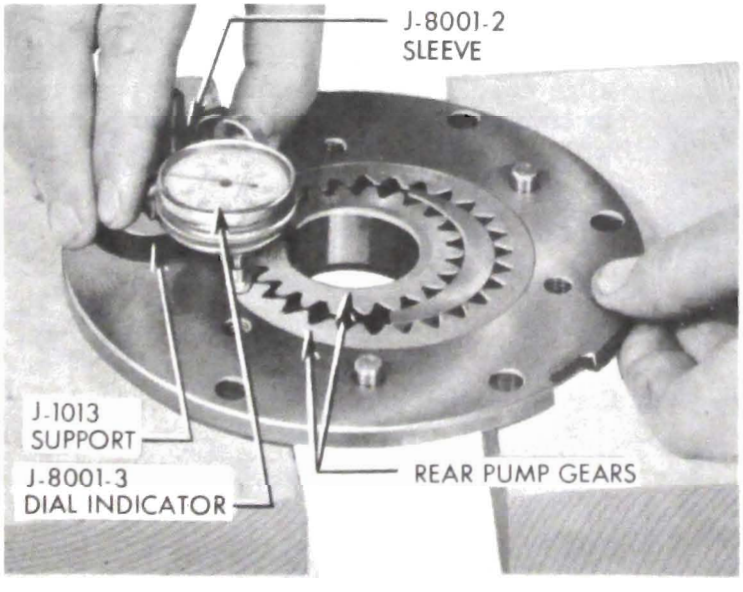
145. Remove rear pump gears by lifting straight up. Examine gears.



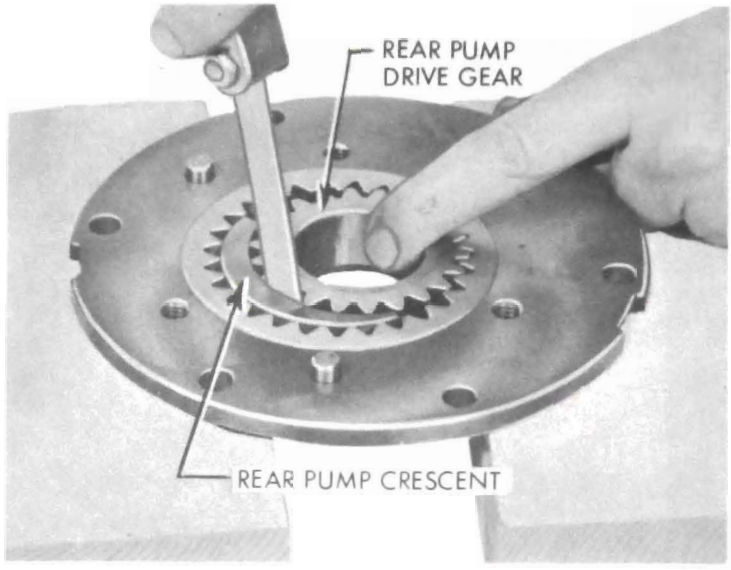
145A. Examine rear pump body bushing. If worn or scored, drive bushing out using J-7013-1 Handle and J-7273-8 Remover.



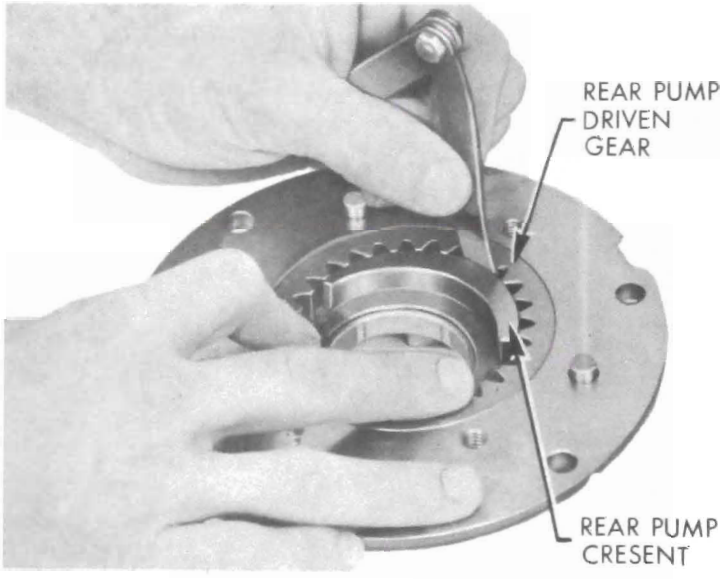
145B. Install new rear pump body bushing using J-7013-1 Handle and J-7273-6-11 Installer. (Counterbore on 6 toward handle.)



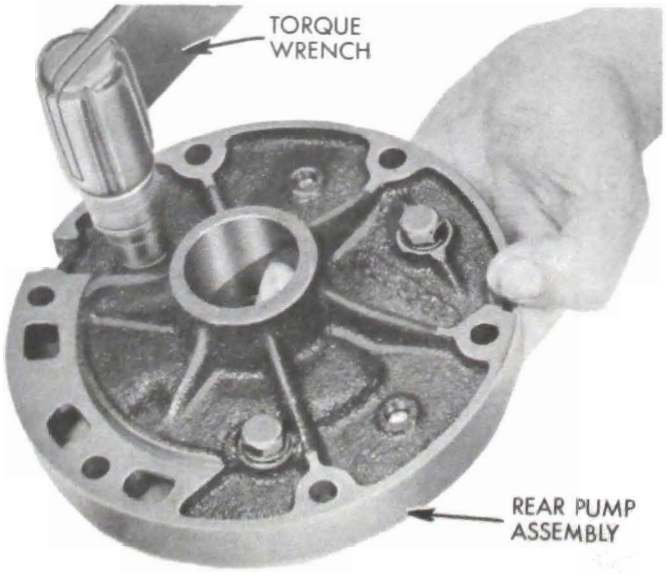
146. Check rear pump gear end clearance using support sleeve and dial indicator. Zero indicator on pump body then slide plunger to rest on gears, one at a time, reading should be between .001" and .002" less.



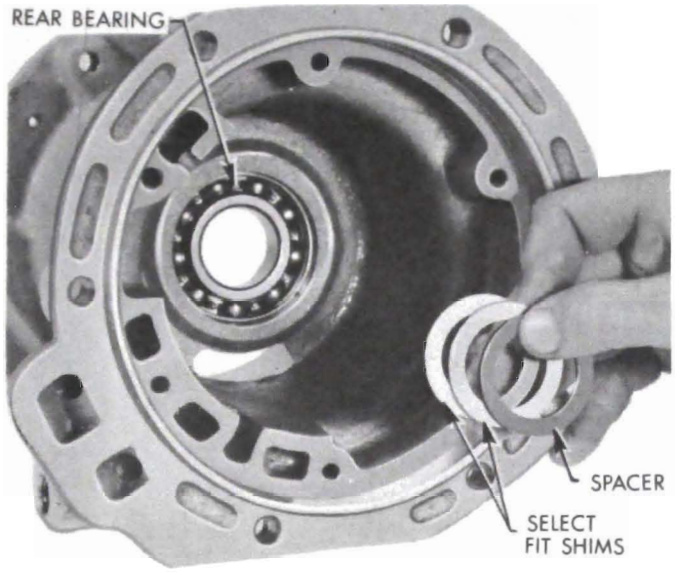
147. Check drive gear clearance using feeler gauge. Should be no more than .006" to .012".



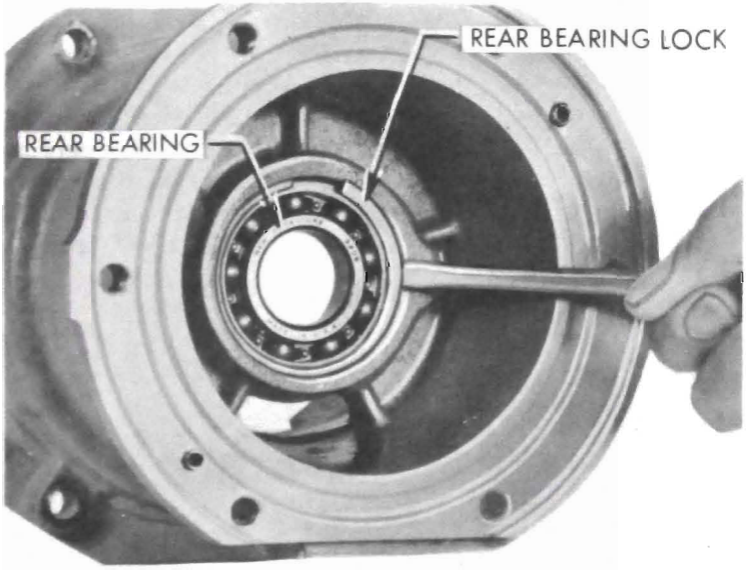
148. Check driven gear clearance using feeler gauge. Should be between .0045" and .012".



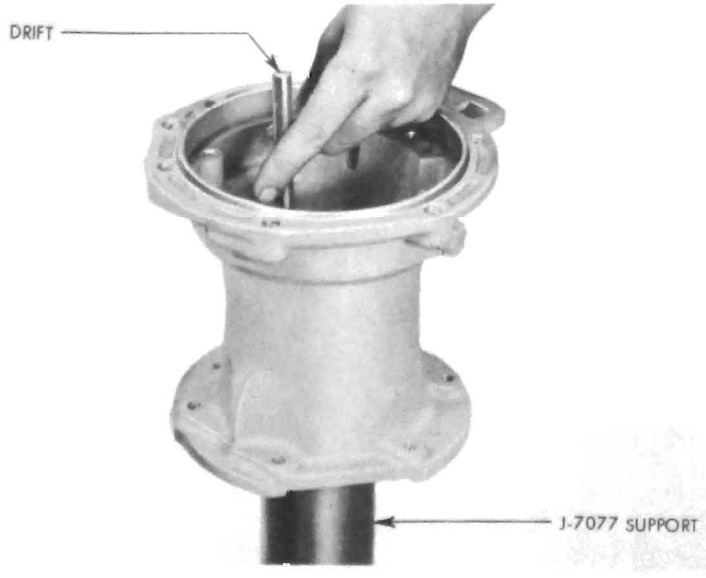
149. With gears installed in rear pump body, align dowel pins and assemble rear pump body to cover with three bolts. Torque to 20 ft. lbs. with 1/2" socket.



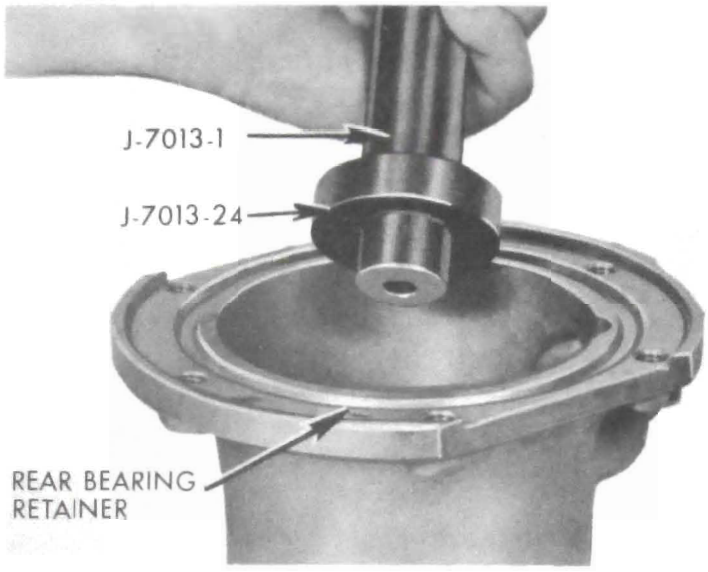
150. Remove select fit shims and spacer from rear bearing retainer.



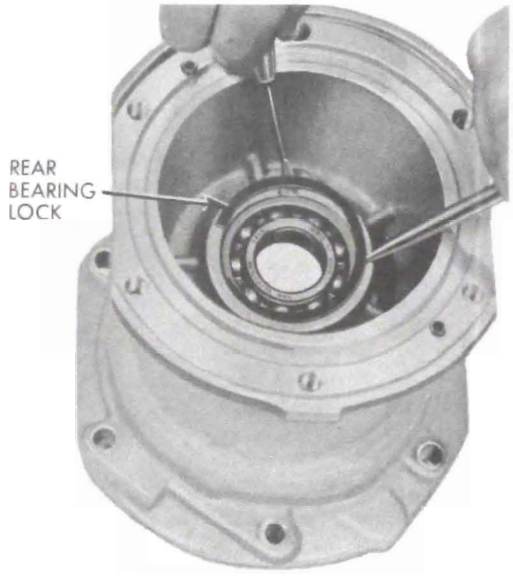
151. Using screwdriver, pry out rear bearing lock.



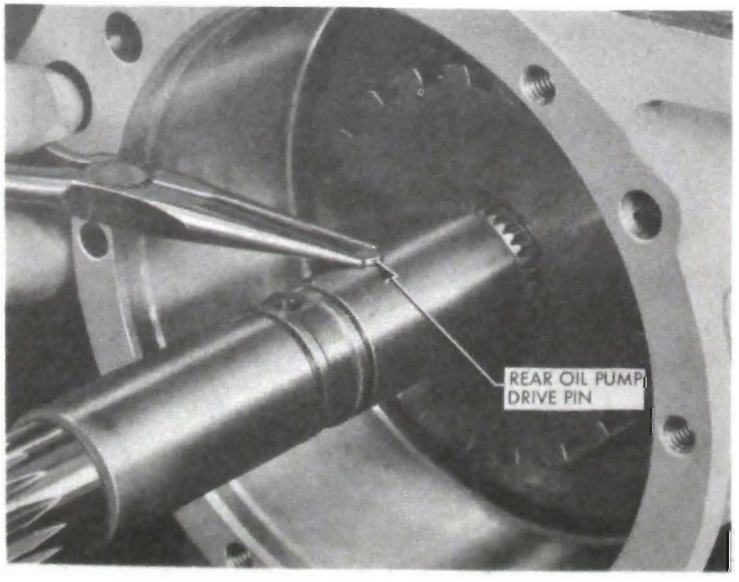
152. Support rear bearing retainer web with chamfered edge of Tool J-7077 and drive out bearing with hammer and drift. Drive from front to rear. The rear bearing races are damaged during removal and the bearing must not be reused.



153. Support rear bearing retainer web on chamfered edge of Tool J-7077 and install new bearing using J-7013-1 Handle and J-7013-24 Installer.

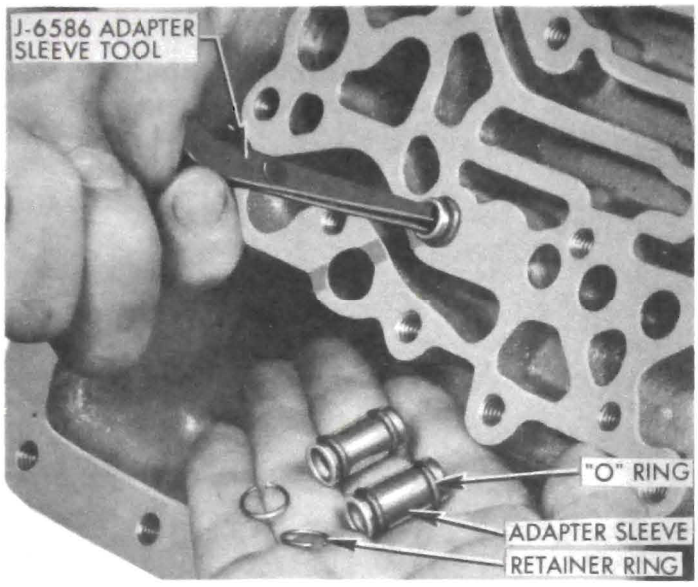


154. Install rear bearing lock behind rear bearing by prying in on one end of ring with screw driver in drain slot and forcing ring down into groove with another screwdriver. Use care to avoid dropping aluminum chips in rear bearing. Do not install rear oil pump until output shaft end play has been checked and brought within limits.

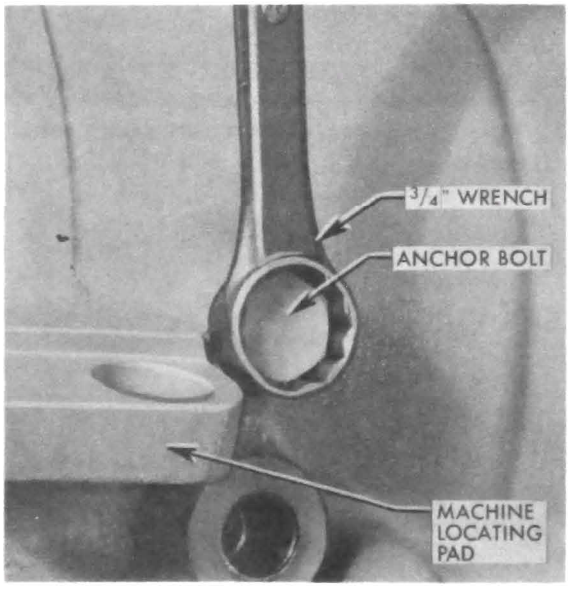


OUTPUT SHAFT ASSEMBLY REMOVAL

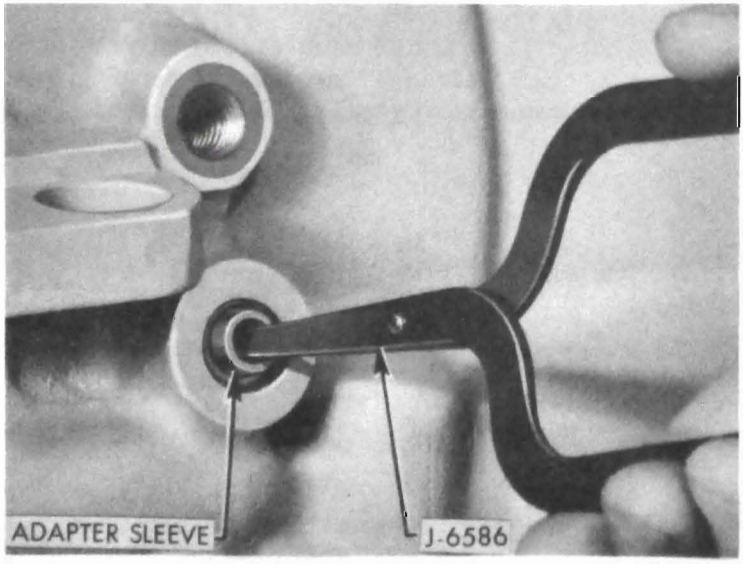
155. Remove rear oil pump drive pin using needle nose pliers.



156. Remove three of the four adapter sleeves with retaining rings and "O" rings using J-6586 Adapter Sleeve Tool.

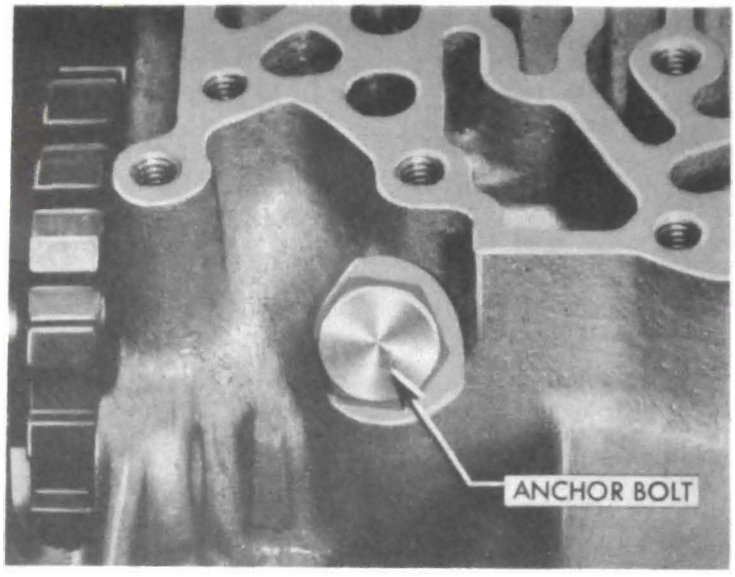


157. Remove one of the two output shaft support anchor bolts forward of right rear machine locating pad (outside case). Use 3/4" wrench.

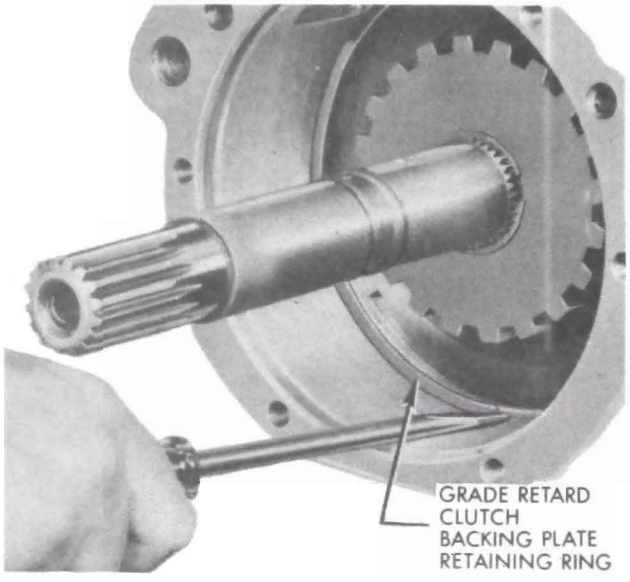


158. Remove fourth adapter sleeve with O rings at oil cooler return pipe location. (Next to anchor bolt location).

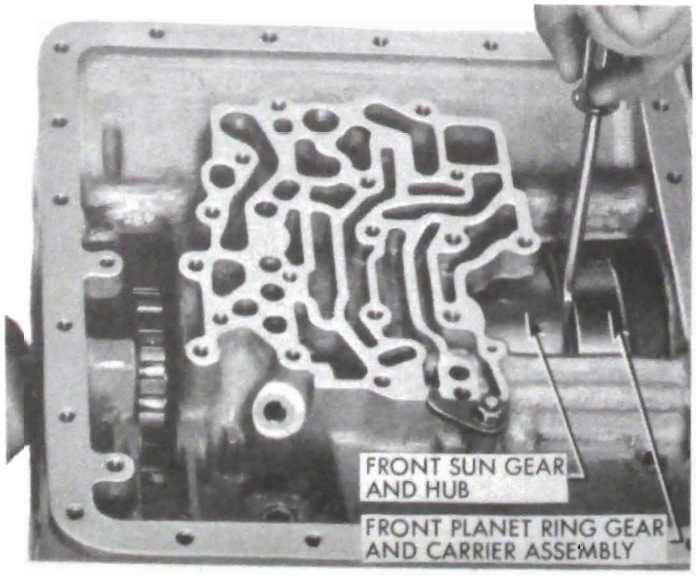
NOTE: No retaining ring.



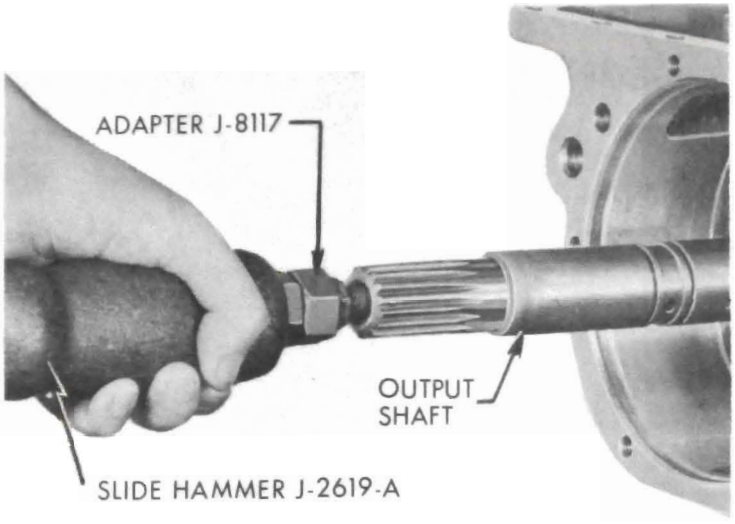
159. Remove second output shaft support anchor bolt forward of ratchet wheel (inside case) (3/4'' socket).



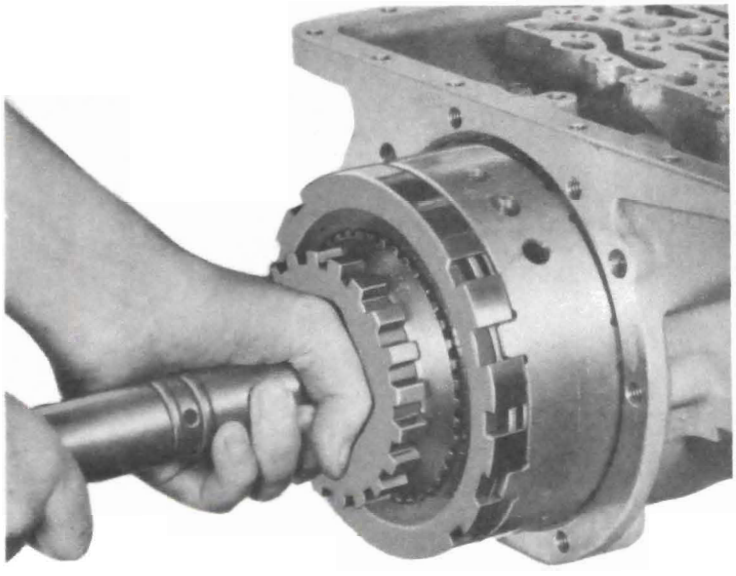
160. Remove retaining ring behind grade retard clutch backing plate using a screw driver to pry ring out of groove in transmission case.



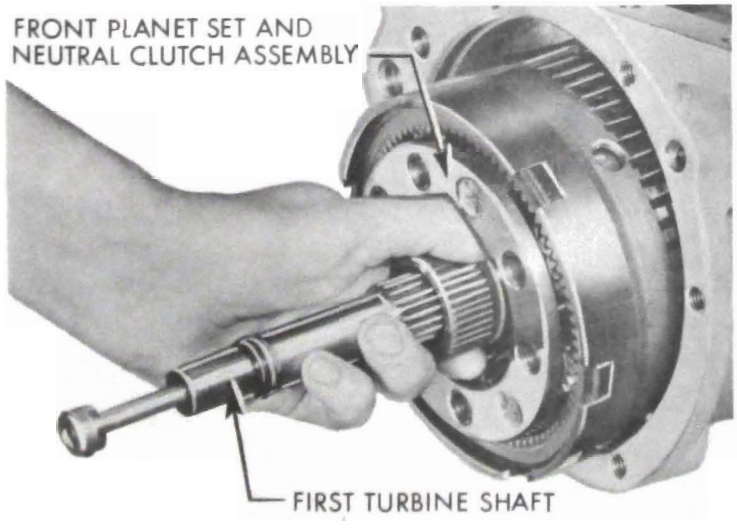
161. To facilitate removal, carefully pry front sun gear and hub from front planet ring gear and carrier assembly.



162. Install slide hammer J-2619-A and Adapter J-8117 in rear end of output shaft and hammer sharply to start grade retard clutch, output shaft support, forward clutch, free wheel clutches, rear planet set and front sun gear out of transmission case.

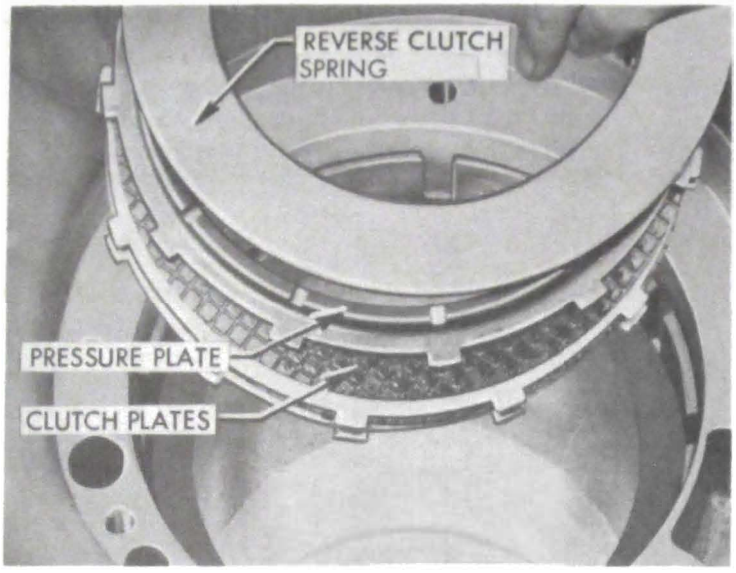


163. After assembly has been moved part way with slide hammer, remove slide hammer and lift assembly from case and set on bench.

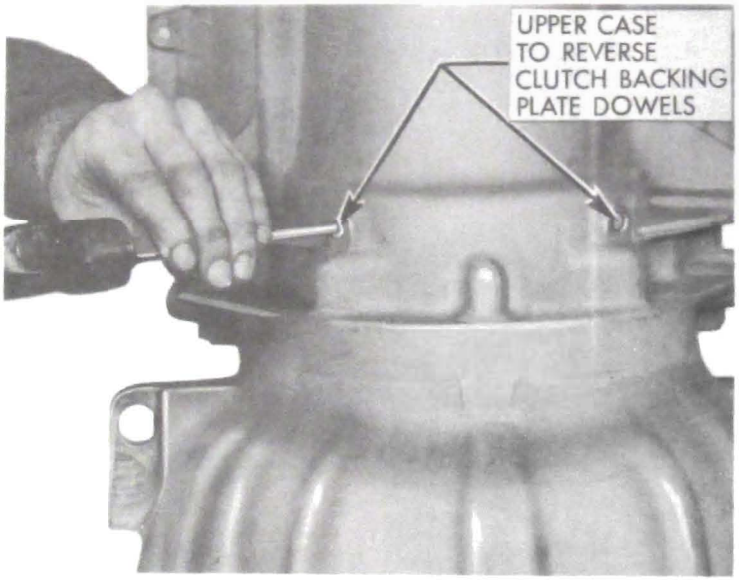


164. Remove first turbine shaft and front planet set - neutral clutch assembly. Remove needle thrust bearing and cupped race (front planet ring gear carrier to reaction flange hub.) This bearing and race may have been removed with front pump assembly.

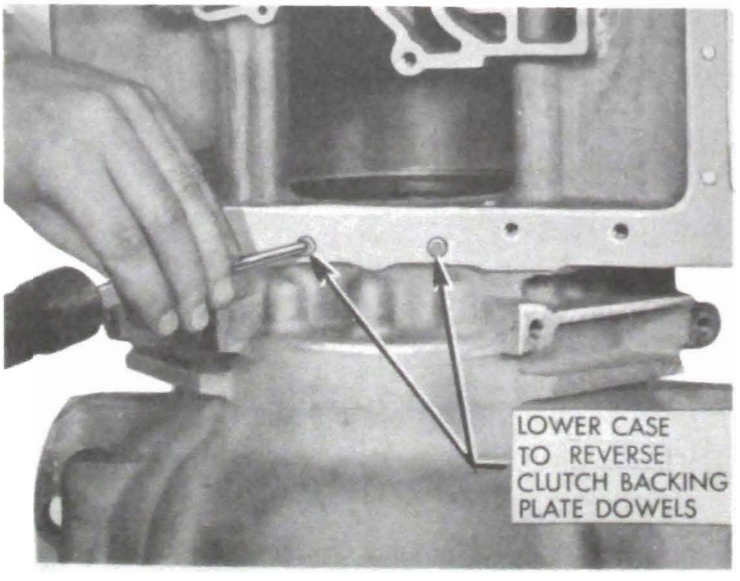
NOTE: First turbine shaft may have been removed with output shaft.



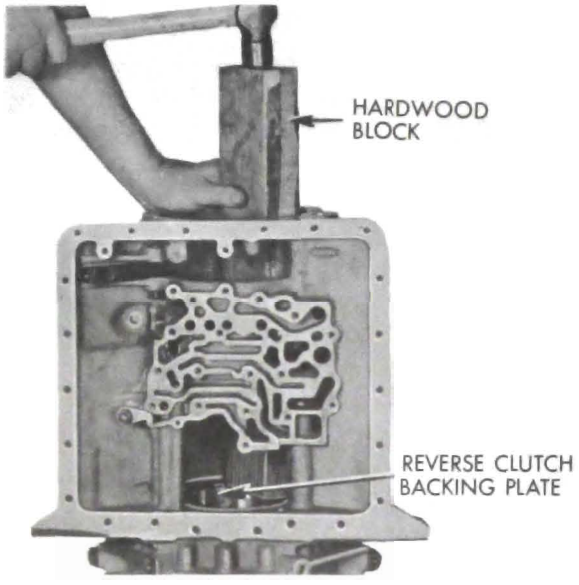
165. Remove reverse clutch spring, pressure plate, and clutch plates.



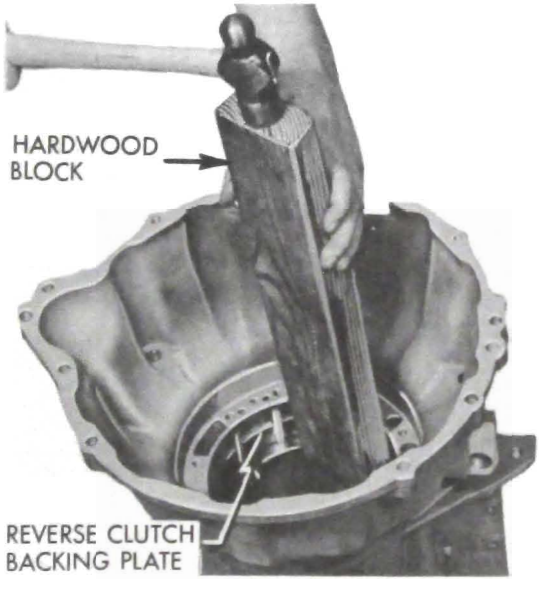
166. Inspect reverse clutch backing plate and if necessary to replace, drive out upper case to reverse clutch backing plate dowels.



167. Drive out lower case to reverse clutch backing plate dowels.



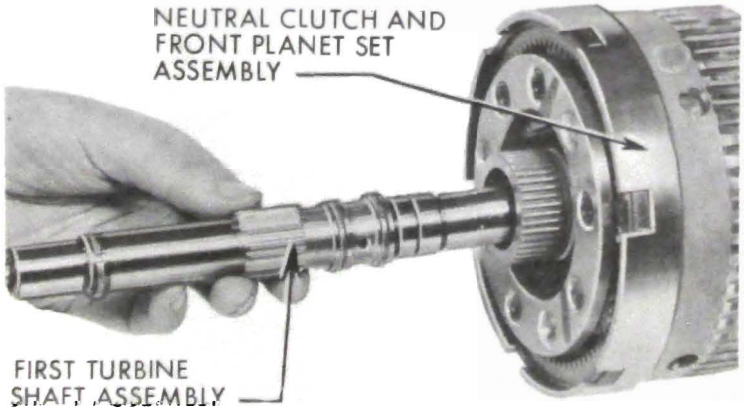
168. Using a hard wood block to rest on rear of backing plate, drive backing plate out toward front of transmission.



169. Drive new backing plate into position using a hard wood block.

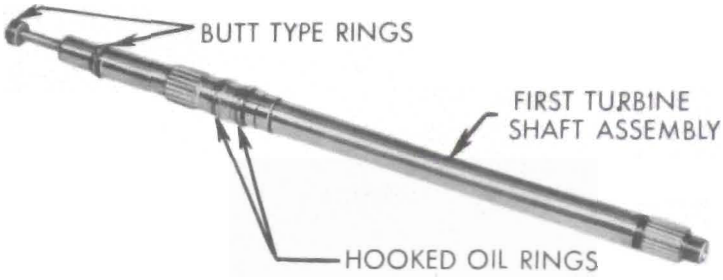
Align dowel holes in backing plate with dowel holes in transmission case and install new dowels.

CAUTION: Dowels must not extend beyond the inner surface of the backing plate.

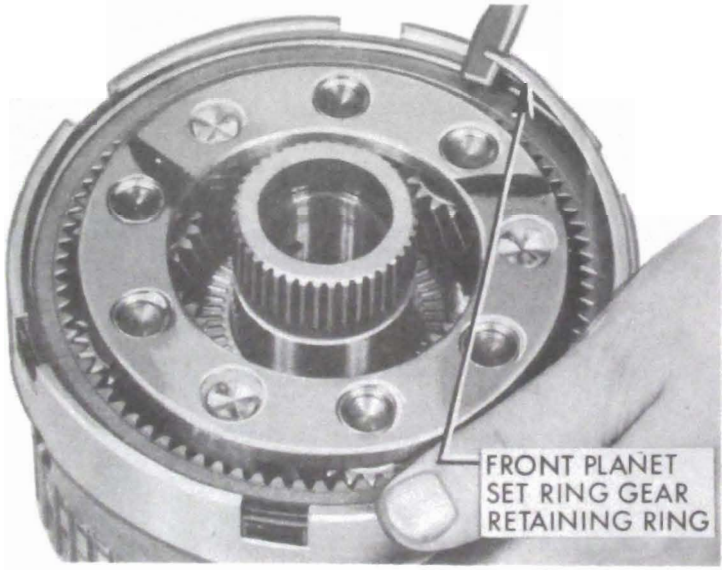


NEUTRAL CLUTCH AND FRONT PLANET SET - FIRST TURBINE SHAFT DISASSEMBLY, INSPECTION & REASSEMBLY

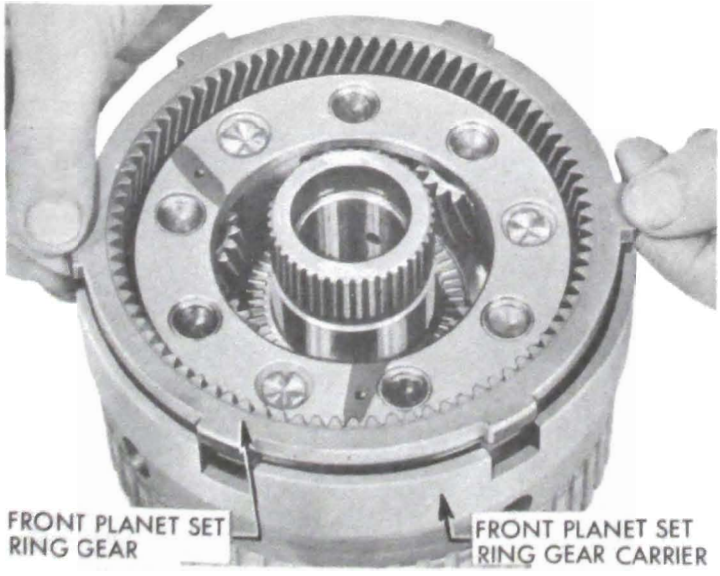
170. Slide first turbine shaft rearward out of neutral clutch and front planet set assembly if it was not removed with output shaft.



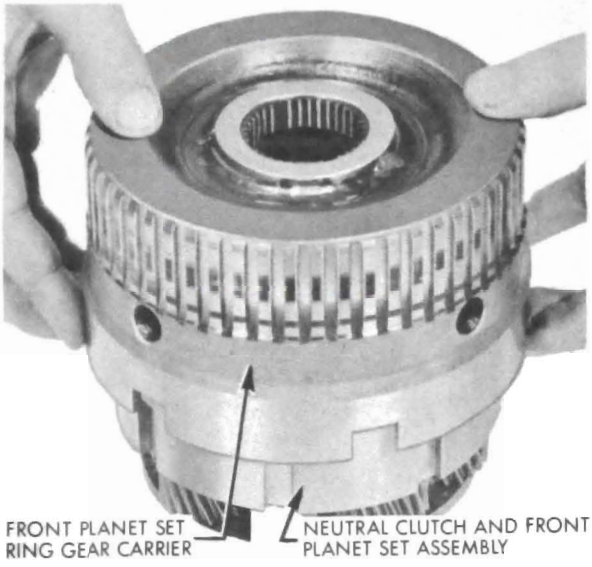
171. Examine and if necessary, remove and reinstall four new oil rings, two butt type rings and two hooked rings on first turbine shaft. Set first turbine shaft aside.



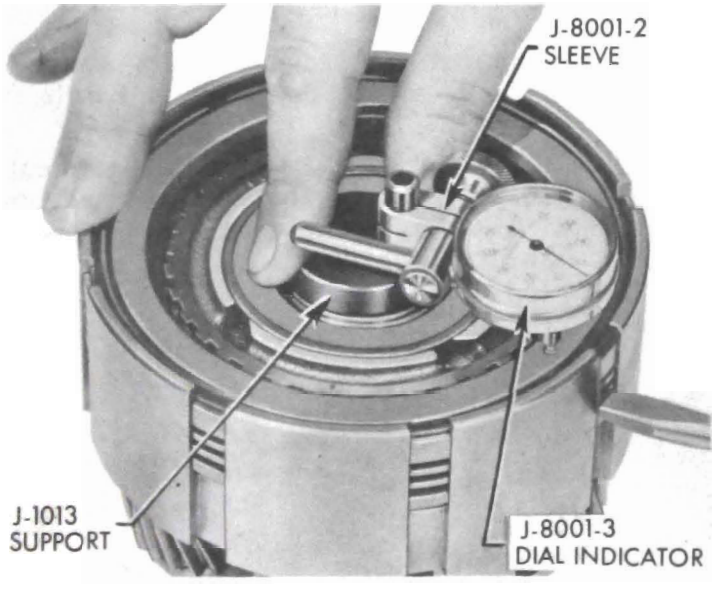
172. Remove front planet set ring gear retaining ring using a screwdriver to pry out of groove in front ring gear carrier.



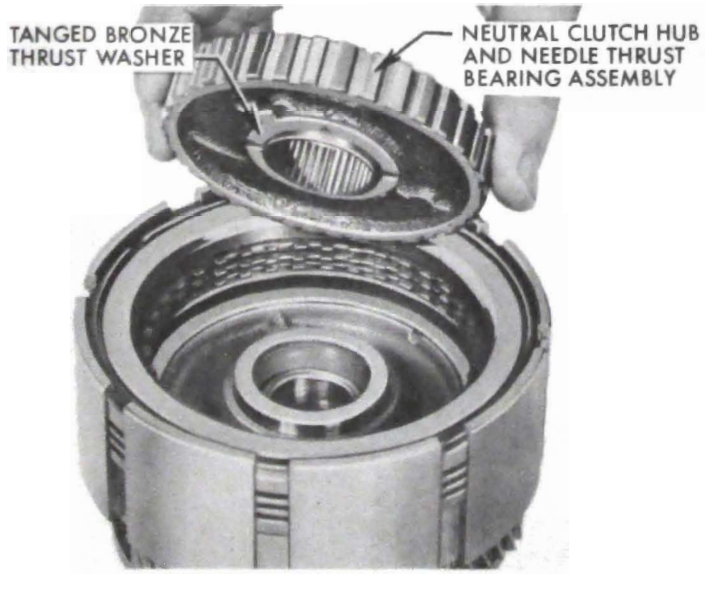
173. Remove ring gear from ring gear carrier.



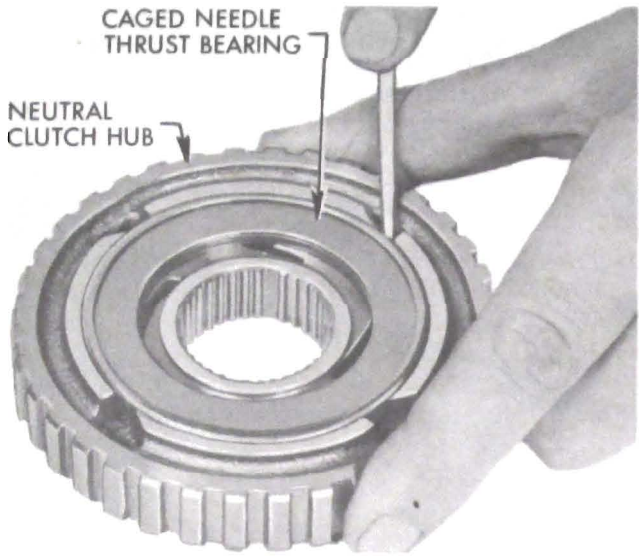
174. Invert assembly and remove ring gear carrier from neutral clutch and front planet set assembly.



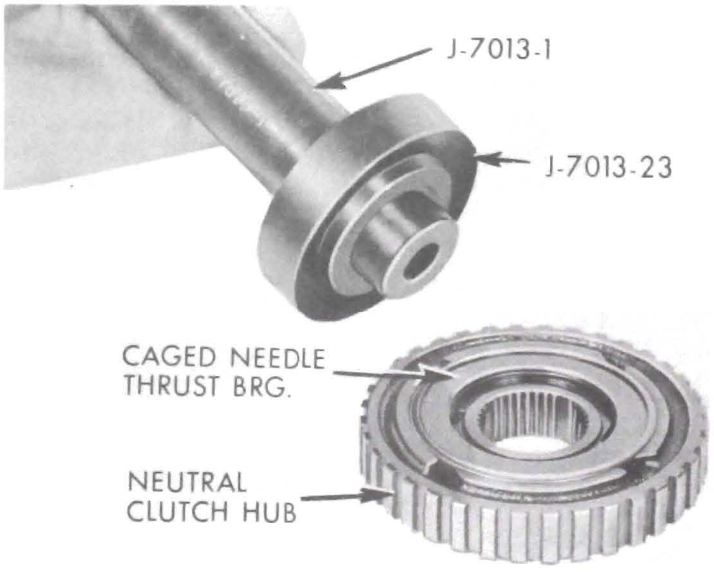
175. Check clearance in neutral clutch pack. Use a dial indicator with support J-1013 resting on hub. Set plunger of dial indicator on backing plate. Force plate pack down with fingers and note reading. Force plate pack up with screwdriver between neutral clutch spring snap ring and pressure plate and note clearance. Should be between .010'' and .060''.



176. Remove neutral clutch hub, needle thrust bearing assembly and tanged bronze thrust washer from neutral clutch and front planet set assembly.

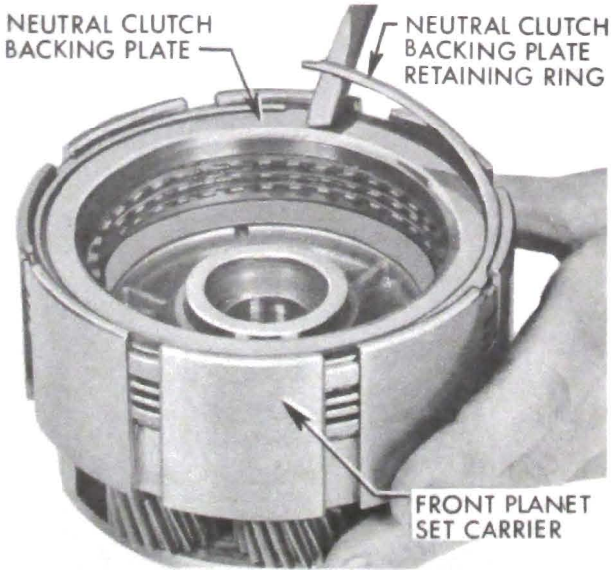


177. If necessary to replace, pry out caged needle thrust bearing with small screwdriver.

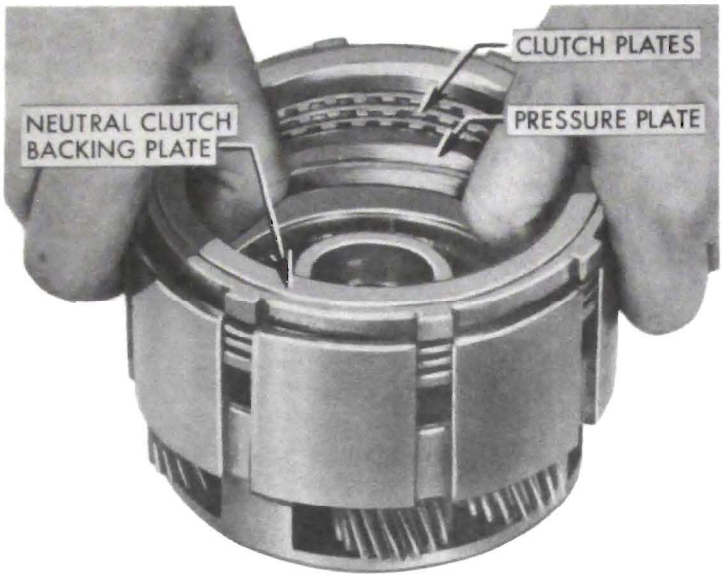


178. Install new caged needle bearing in neutral clutch hub using J-7013-1 Handle and J-7013-23.

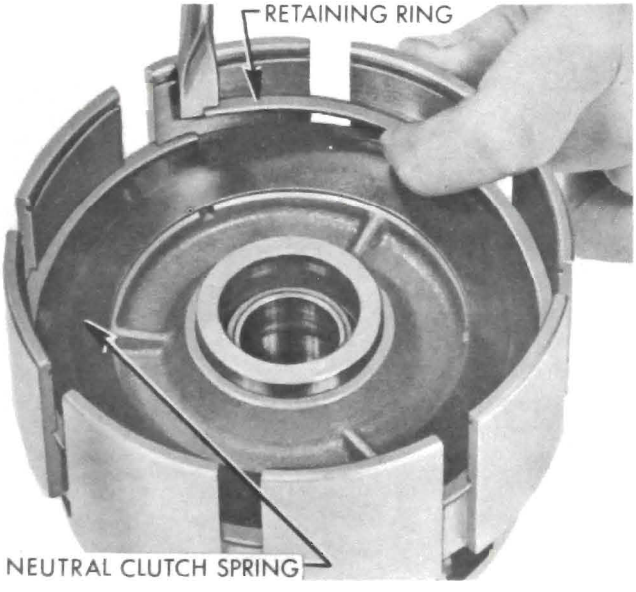
NOTE: Be certain needle thrust bearing is installed squarely in neutral clutch hub and after installation, rotate race to check for free operation. Race must operate freely.



179. Remove retaining ring from neutral clutch backing plate to front planet set carrier using a screwdriver to pry ring out of groove in front planet set carrier.

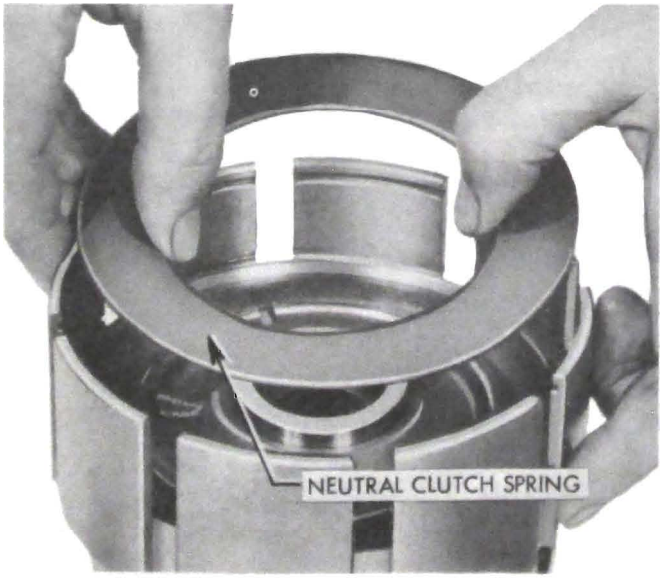


180. Remove neutral clutch backing plate, clutch plates and pressure plate from front planet set carrier.

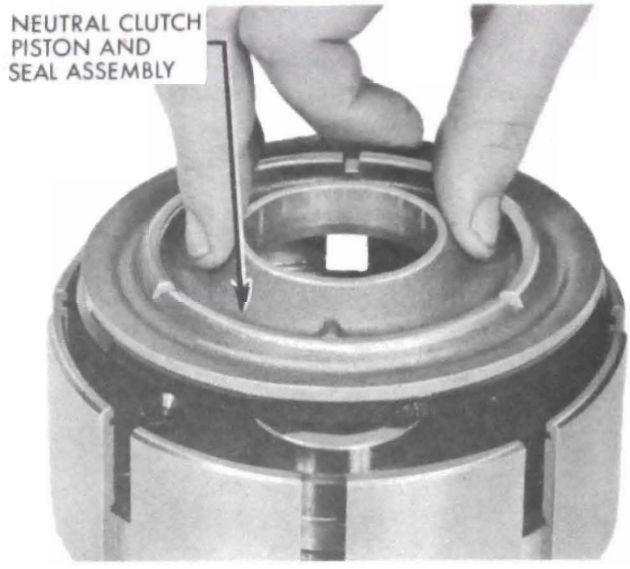


181. Remove retaining ring (neutral clutch spring to front planet set carrier) using a screwdriver to pry ring out of groove in front planet set carrier.

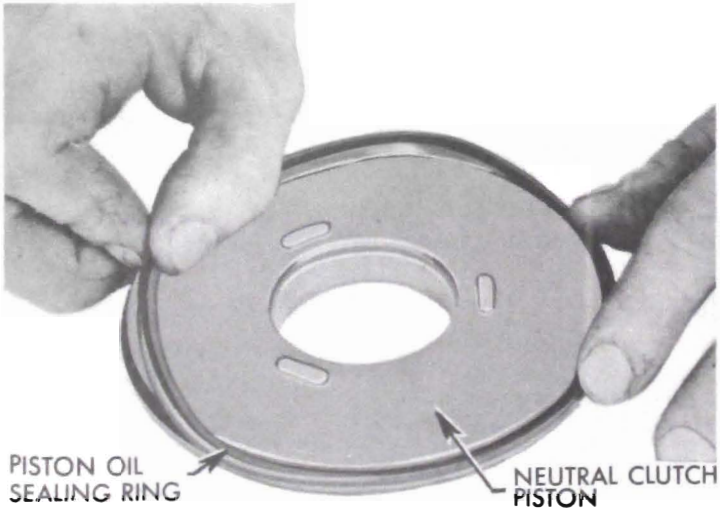
NOTE: This retaining ring is the same as the neutral clutch backing plate retaining ring.



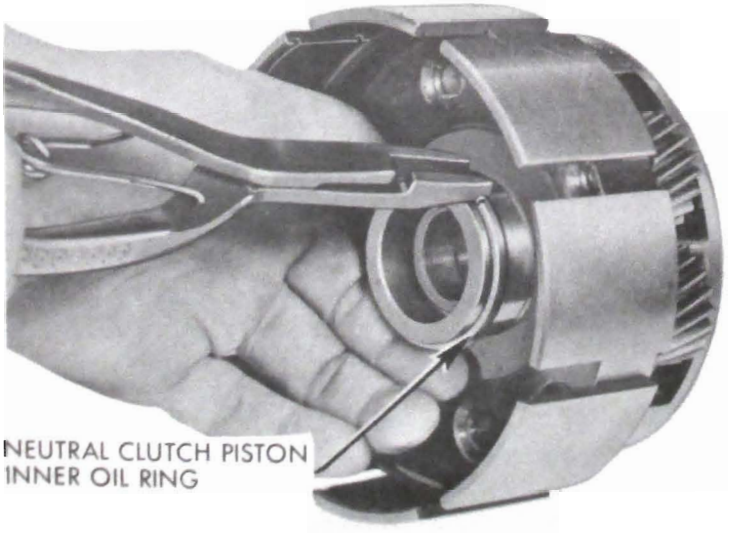
182. Remove neutral clutch spring from front planet carrier.



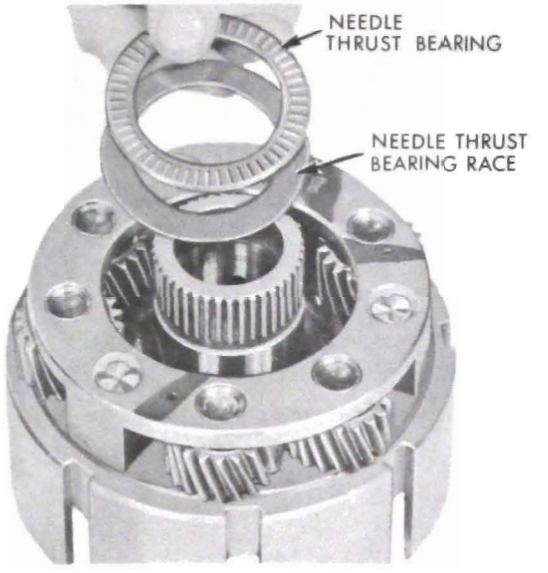
183. Remove neutral clutch piston and seal assembly.



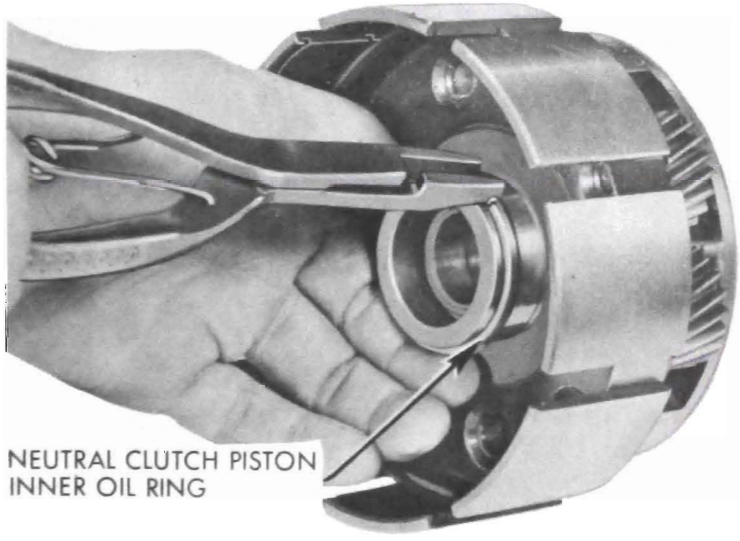
184. Remove neutral clutch piston rubber sealing ring.



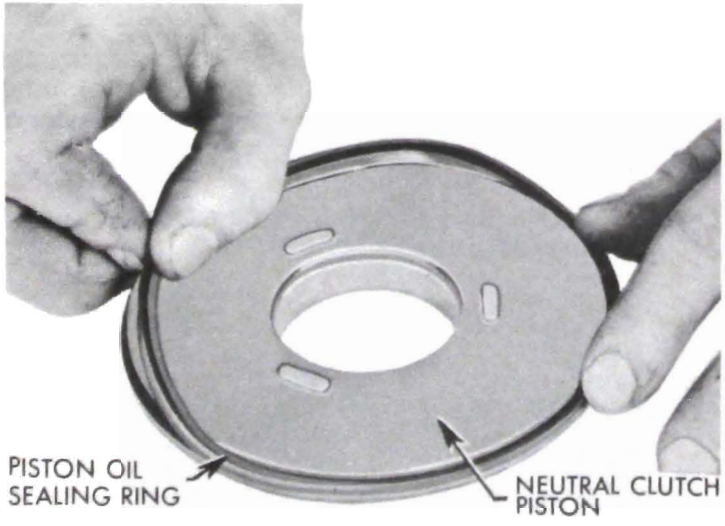
185. Examine and if necessary, unhook, expand and remove neutral clutch piston inner oil ring.



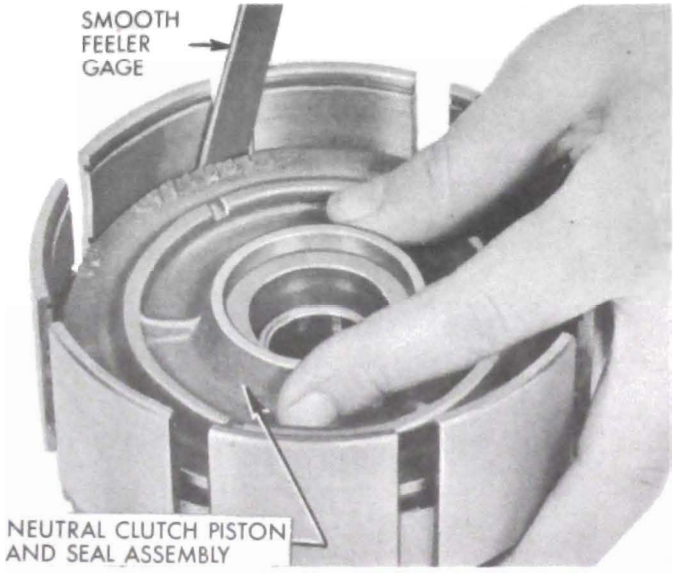
186. Remove needle thrust bearing and thrust bearing race from rear of front planet set carrier. It may be necessary to pry them loose from the suction created by oil. Use two very thin, sharp awls inserted between planet pinion gears and under-edge of race.



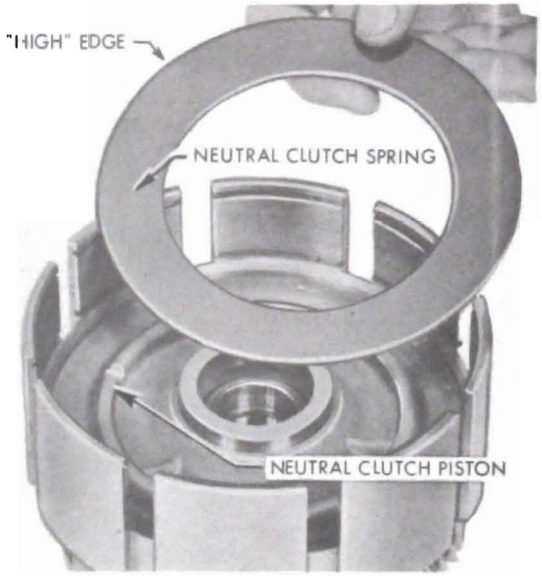
187. If necessary to replace, expand and install new neutral clutch piston inner oil sealing ring on hub of front planet carrier. Hold one end of ring and work other end of ring around to hook.



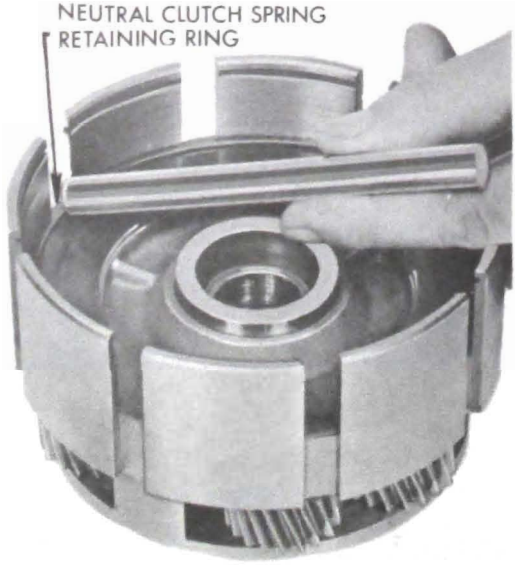
188. Install new neutral clutch piston sealing ring, lip away from hub.



189. Lube and install neutral clutch piston and seal in bore of front planet set carrier using a smooth feeler gauge to aid entry of seal lip. Use care to avoid damage to seal.

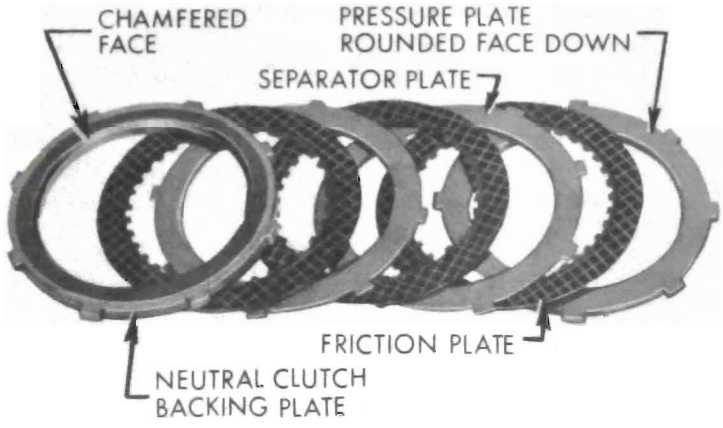


190. Install neutral clutch spring on top of piston outer "high" edge up.



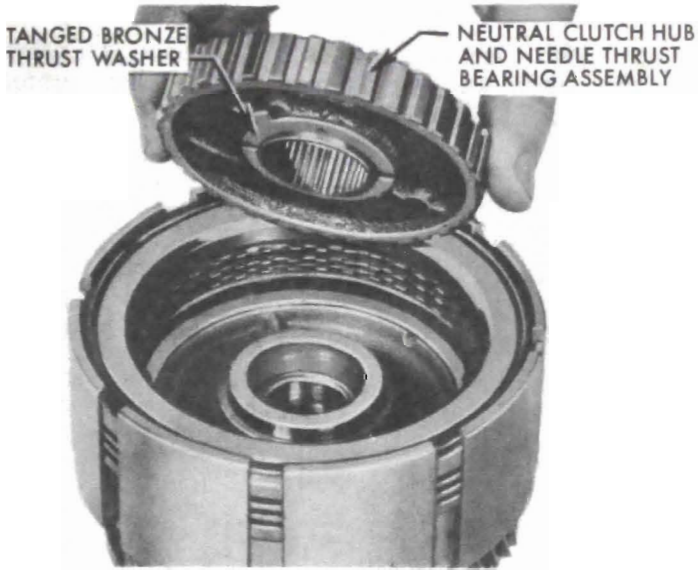
191. Install neutral clutch spring retaining ring by starting one end into groove and using plastic hammer and drift to force remainder of ring into groove.

NOTE: Neutral clutch spring is under tension when retainer ring is installed.

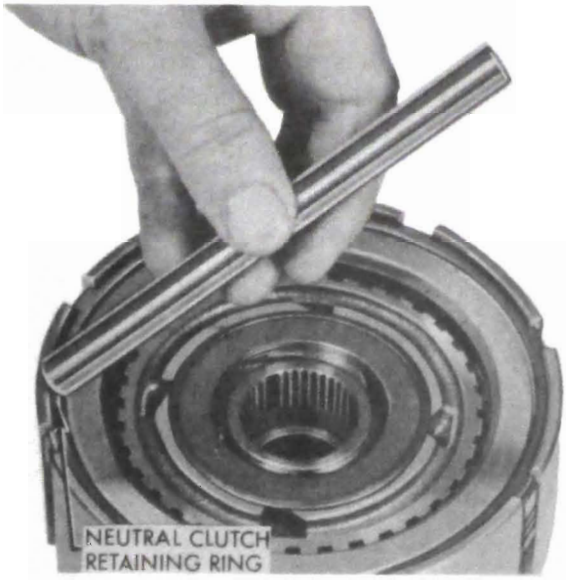


192. Install clutch plate pack with rounded face of pressure plate toward spring, then lubricate and install friction plate, separator plate, etc., and chamfered face of clutch backing plate "up" and on top.

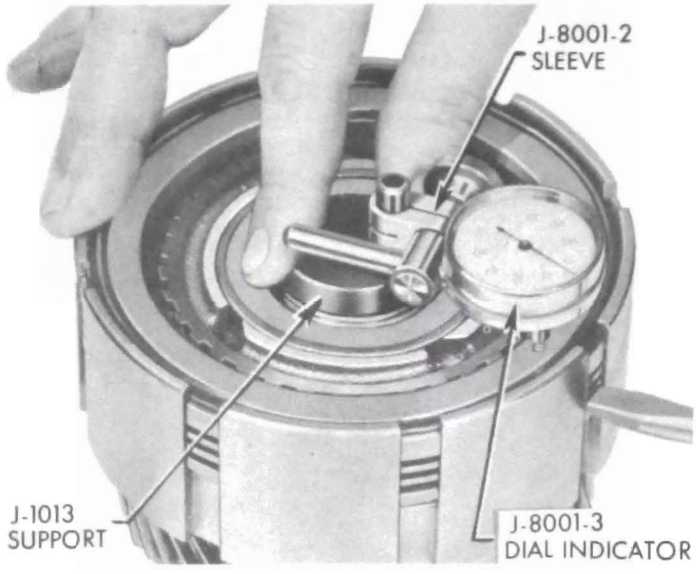
NOTE: All clutch plates in neutral clutch pack are flat, three friction plates and two separator plates.



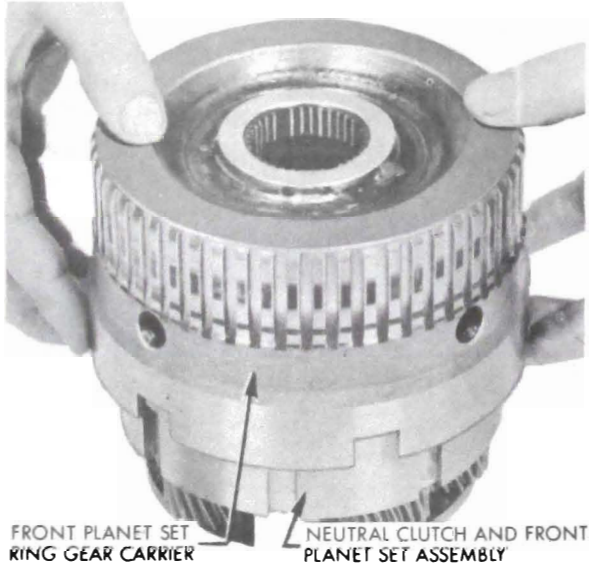
193. After sticking bronze thrust washer to hub and needle bearing assembly with heavy lube, line up grooves of friction plates and install hub in bore of front planet set carrier (needle bearing up). When neutral clutch hub is correctly installed it will be below chamfered edge of neutral clutch backing plate.



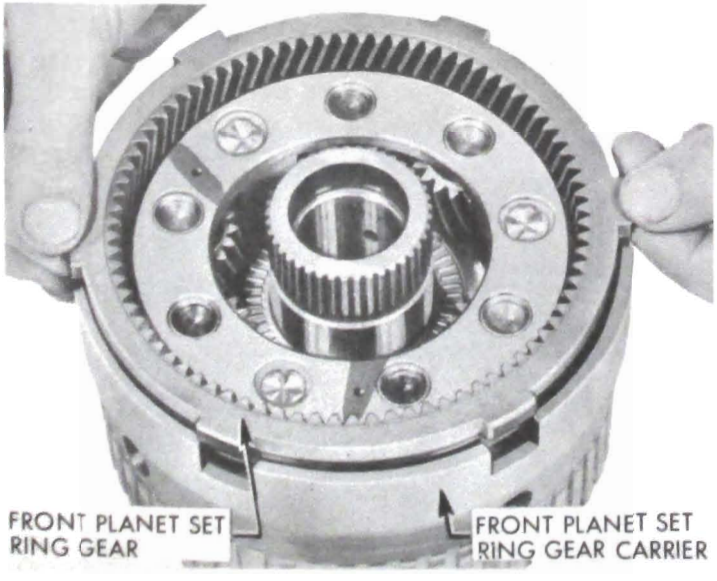
194. Install neutral clutch retaining ring in groove of front planet set carrier above backing plate. Tap solidly into groove with drift.



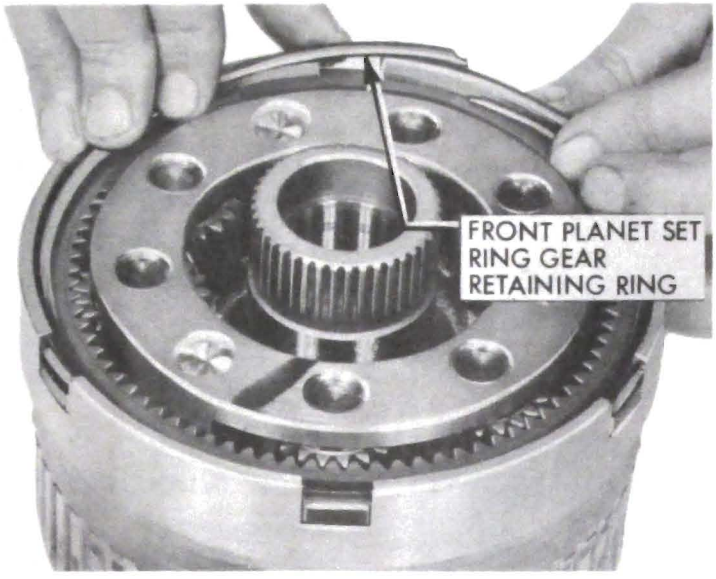
195. Check clearance in neutral clutch pack. Use a dial indicator with support J-1013 resting on hub. Set plunger of dial indicator on backing plate. Force plate pack down with fingers and note reading. Force plate pack up with screwdriver between neutral clutch spring snap ring and pressure plate. Note reading. Difference between two readings (clearance) should be between .010'' and .060''.



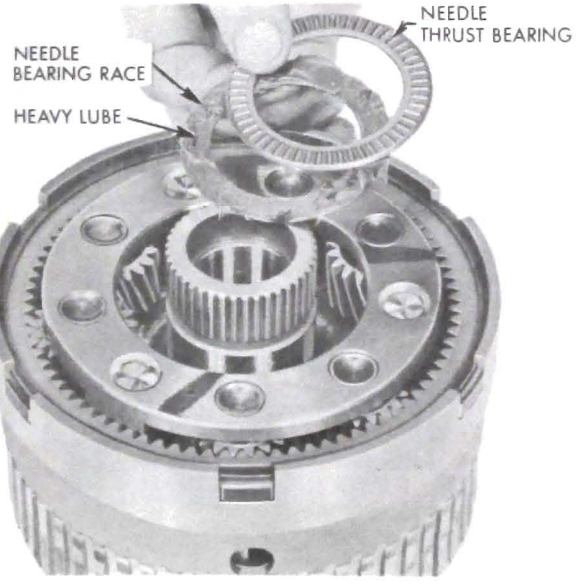
196. Install front ring gear carrier over neutral clutch and carrier assembly. Grasp carefully under the carrier and invert.



197. Mesh ring gear with planet gears and install in carrier with tangs up.

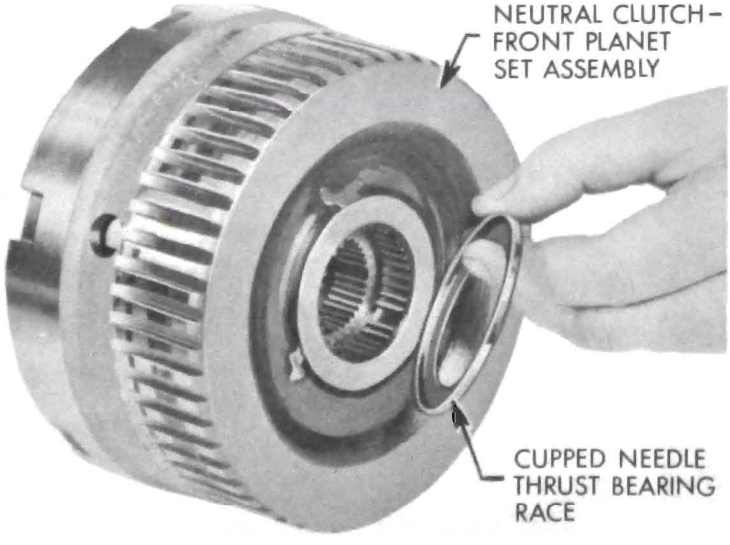


198. Install ring gear retaining ring and tap into groove of ring gear carrier.



199. Apply heavy lube to needle bearing race and needle bearing (1 3/4" X 2 1/2") (Between front sun gear and front planet carrier). Insert race first, then bearing into bore of front planet set. Press down to seat.

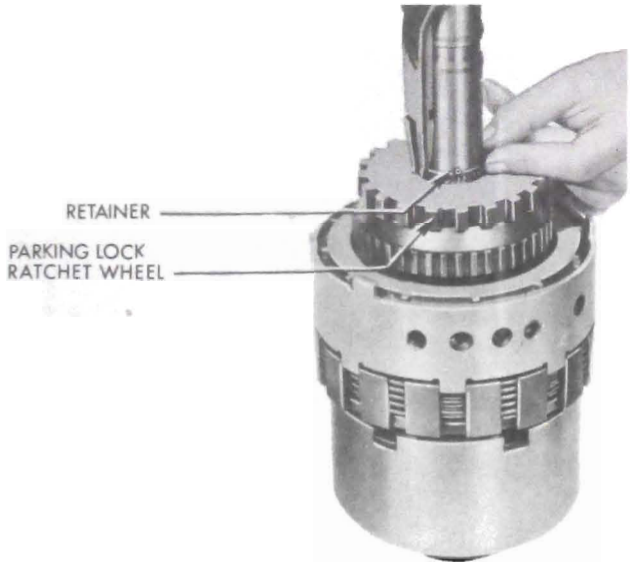
NOTE: No race on top of needle bearing. Front of front sun gear acts as race. This bearing and race are smaller in I.D. and O.D. than the bearings used in the turbine build-up. Care should be used to avoid interchanging these bearings and races.



200. Invert assembly, examine and if necessary, apply heavy lube to new cupped needle bearing race and install on front planet ring gear carrier.

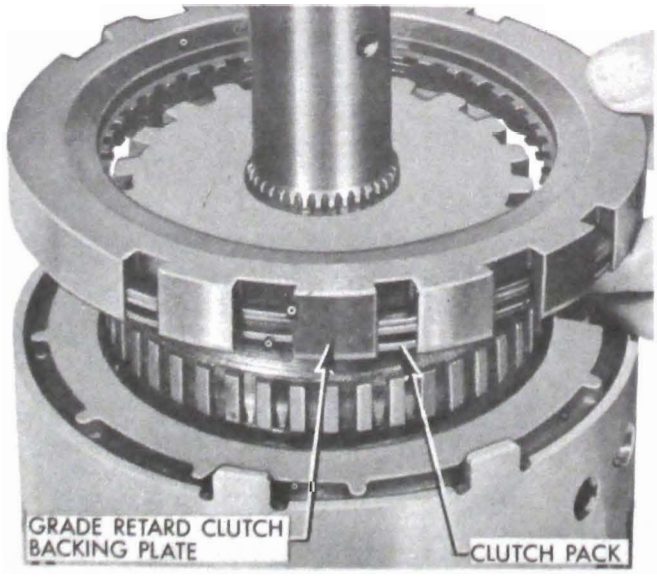
NOTE: This race may have remained on rear of stator reaction shaft when transmission was disassembled.

201. Front planet set - neutral clutch assembly. Set completed assembly aside.

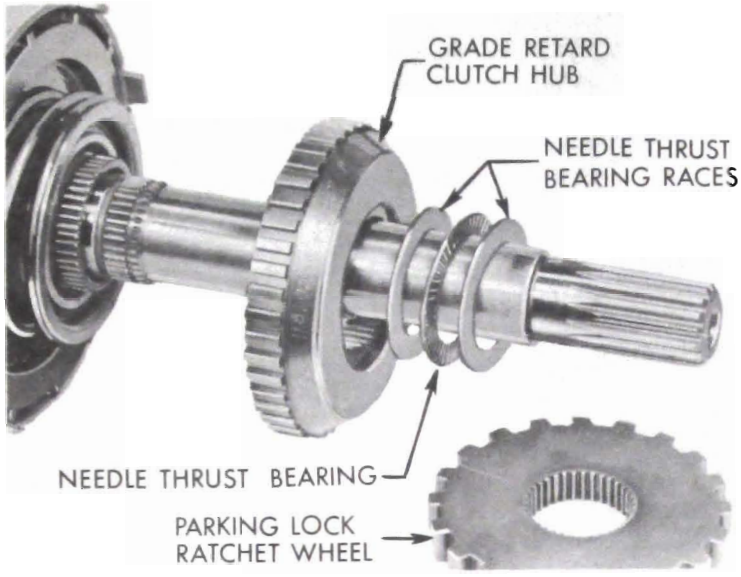


DISASSEMBLY, INSPECTION & REASSEMBLY OF OUTPUT SHAFT ASSEMBLY

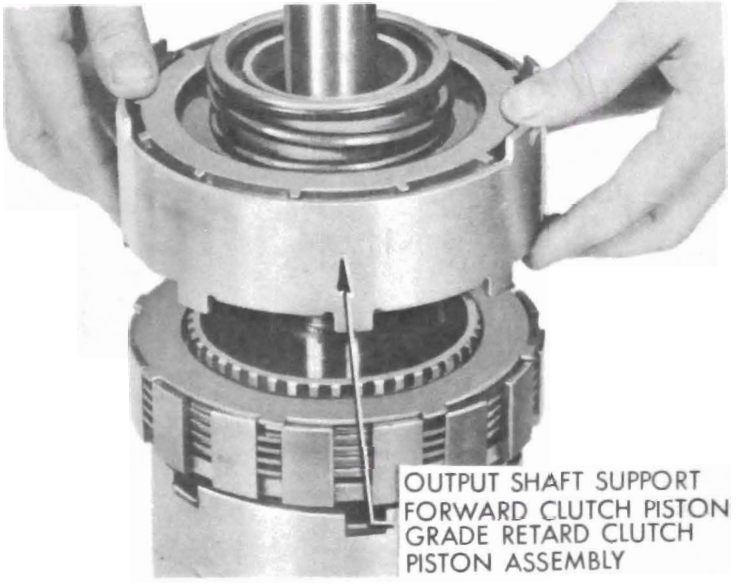
202. Expand and remove parking lock ratchet wheel retaining ring.



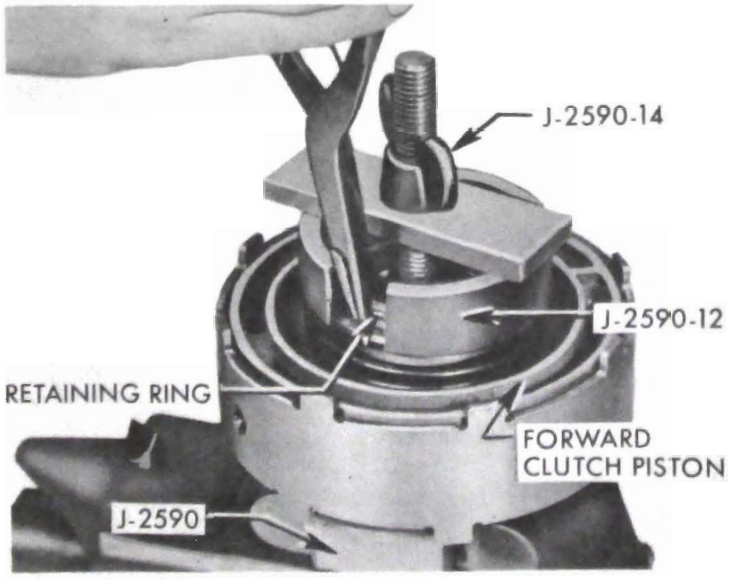
203. Slide grade retard clutch backing plate and clutch pack off clutch hub and output shaft.



204. Remove parking lock ratchet wheel and grade retard clutch hub. Needle thrust bearing and two thrust bearing races will come off output shaft with grade retard hub.

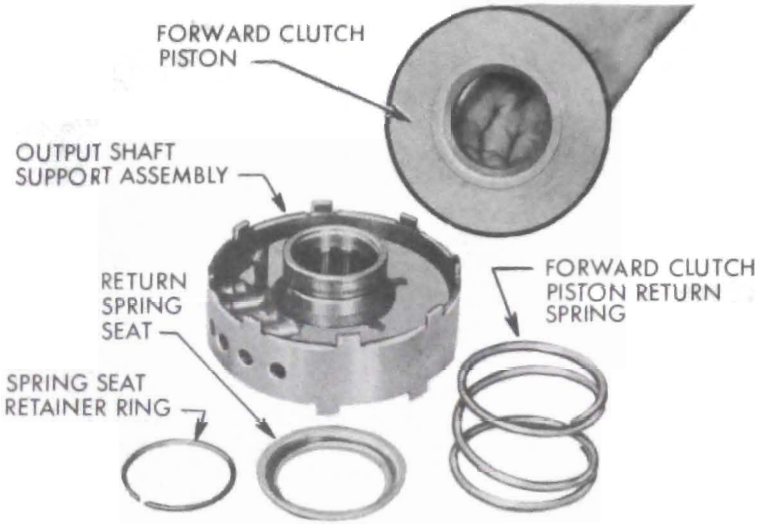


205. Slide output shaft support, forward clutch piston and grade retard piston assembly off output shaft.



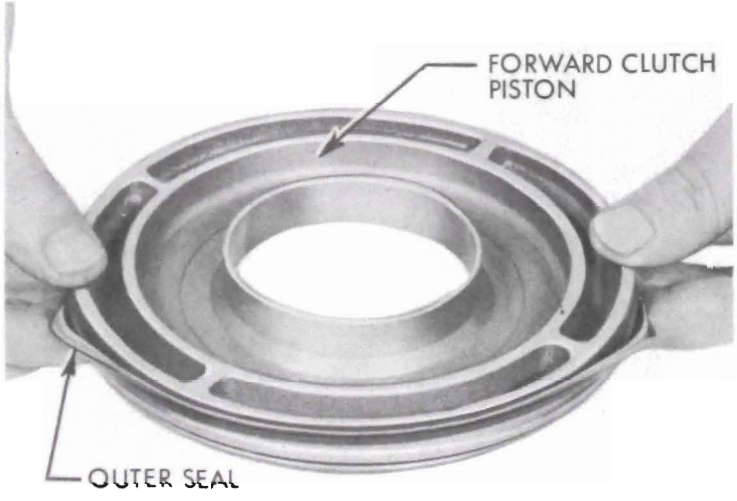
OUTPUT SHAFT SUPPORT DISASSEMBLY, INSPECTION AND REASSEMBLY

206. From side of output support having eight lugs, remove forward clutch piston spring retainer ring using snap ring pliers and J-2590-12 and 14.

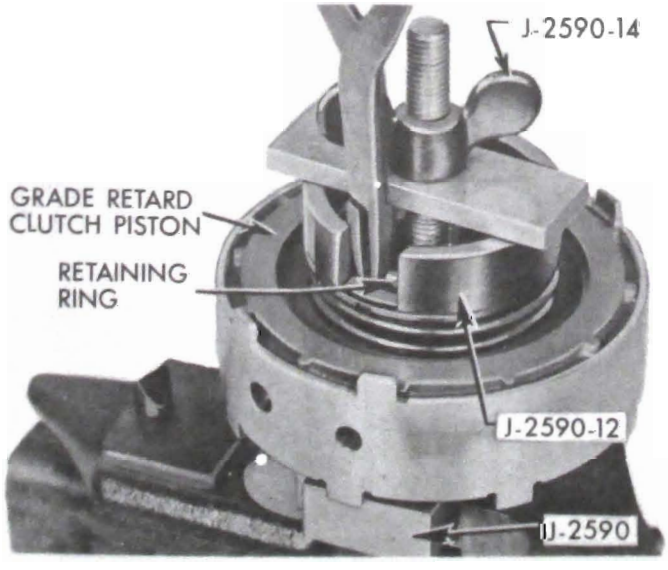


207. Remove tool, retainer ring, spring seat, spring and forward clutch piston from output shaft support.

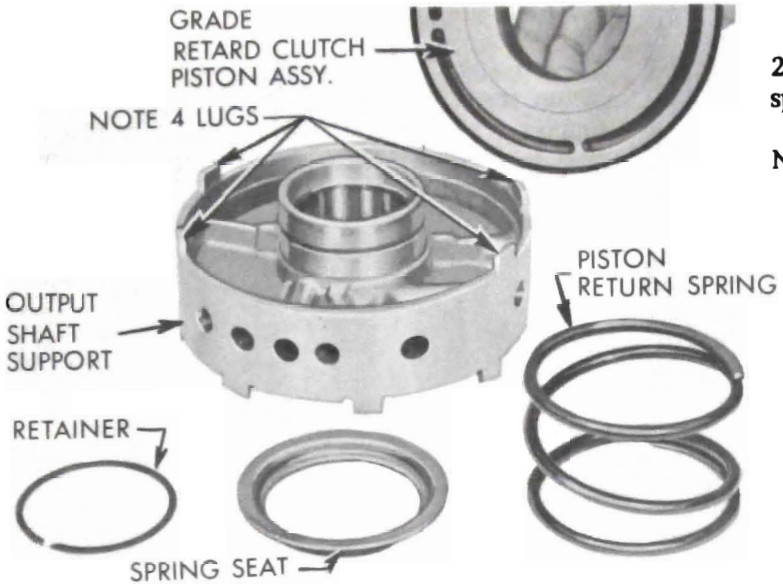
NOTE: Note wide chamfer on I.D. of piston.



208. Remove rubber outer seal from forward clutch piston.

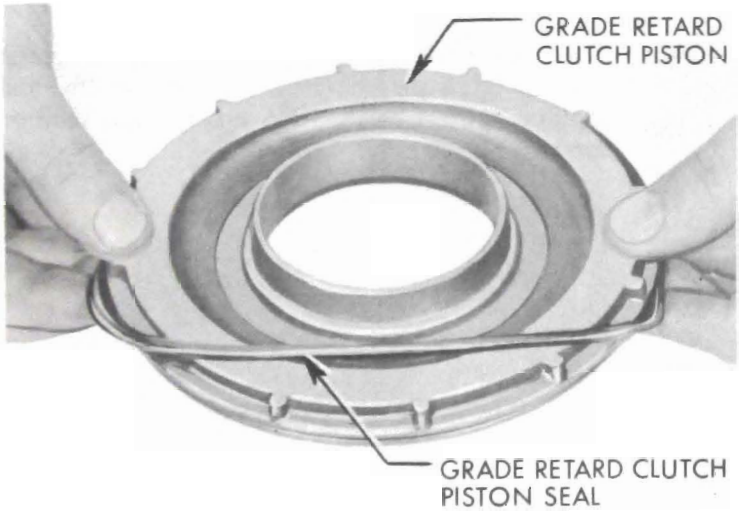


209. From side of output support having four lugs, remove grade retard spring retainer ring using snap ring pliers and Tool J-2590-12 and 14.

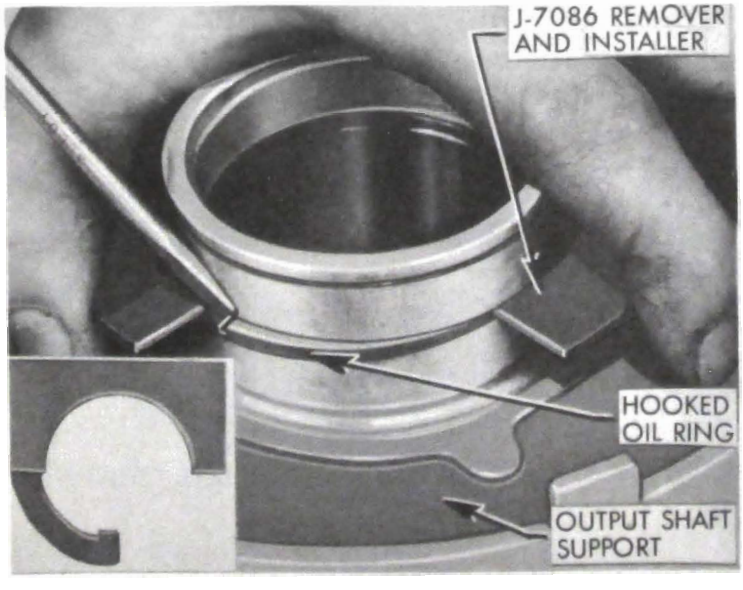


210. Remove tool, retainer ring, spring seat, spring and grade retard piston.

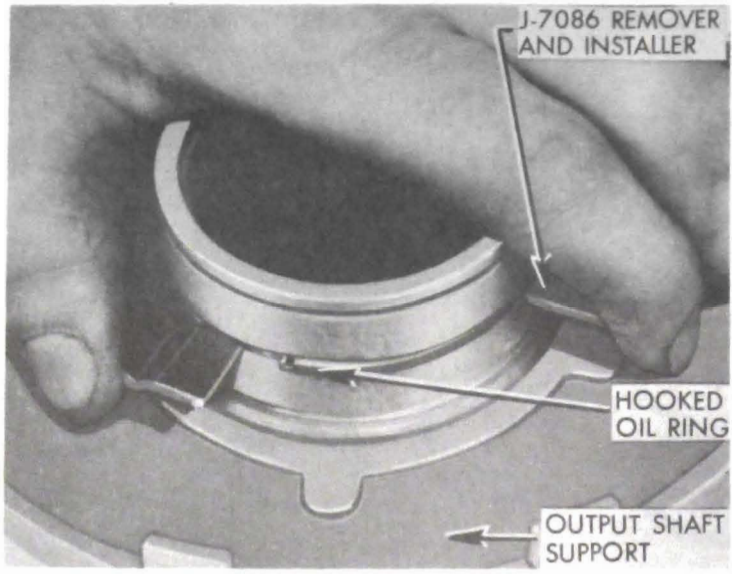
NOTE: No chamfer on piston or on bore.



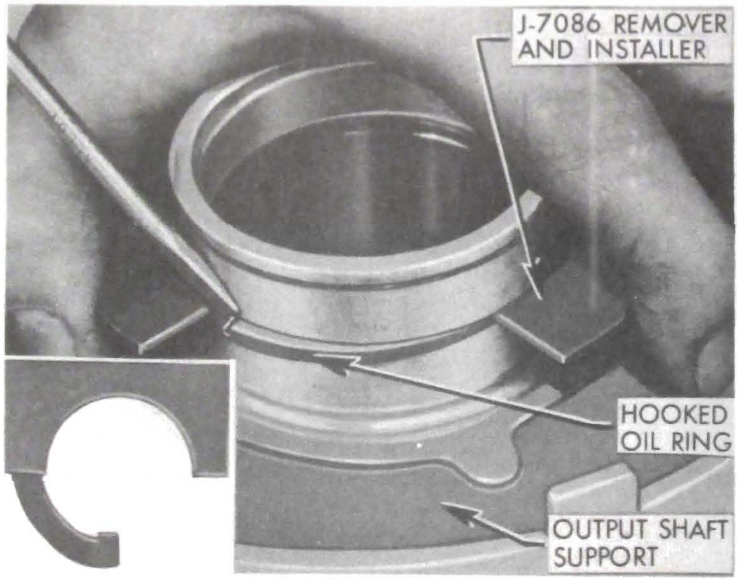
211. Remove rubber oil sealing ring from grade retard piston.



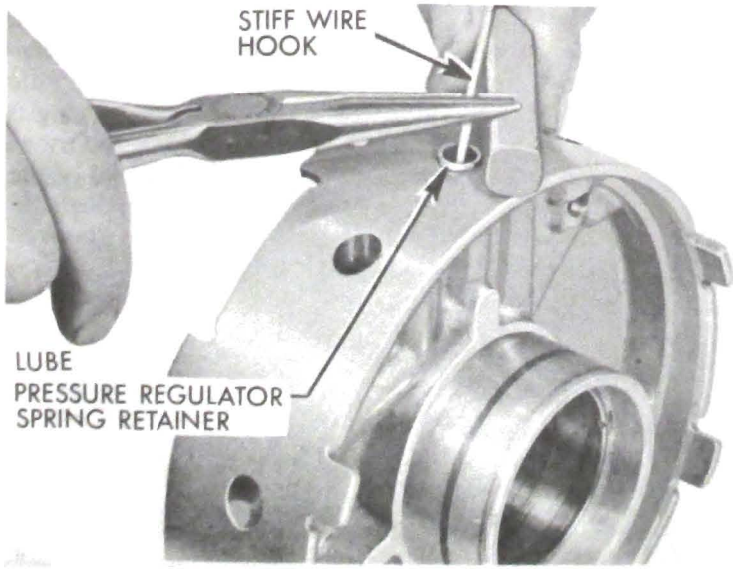
212. Examine and if necessary to replace forward clutch piston inner oil ring; assemble Tool J-7086 so forward clutch inner oil ring is forced solidly into groove. Press down the movable arm of Tool J-7086 and pry free end of the hooked oil ring out with screwdriver. Release movable arm of tool, expand and remove hooked oil ring from output shaft support.



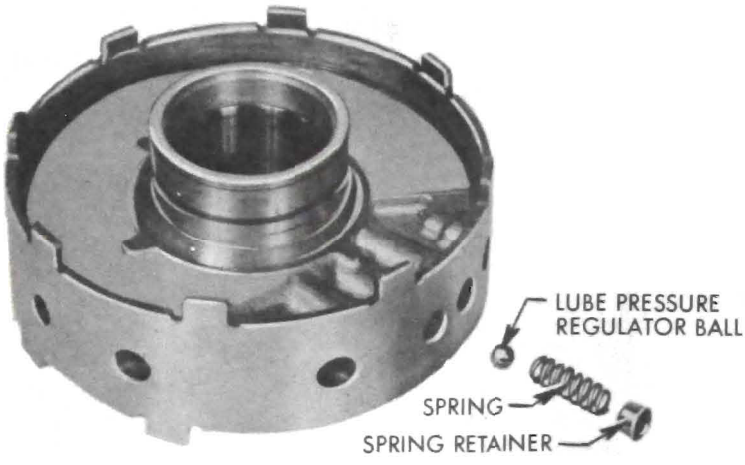
213. Expand and install new forward clutch piston inner oil ring in groove of output shaft support. Assemble Tool J-7086 to compress ring in groove. Press on movable arm of Tool J-7086, free end of ring will snap into hooked position.



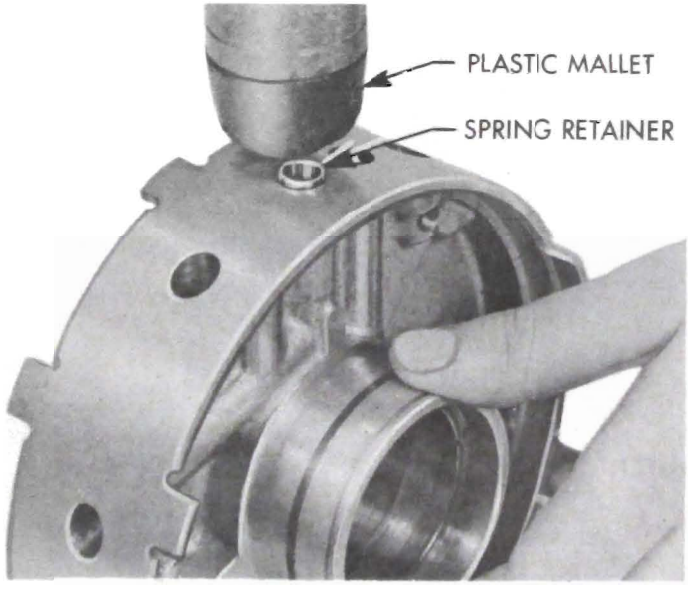
214. Examine and if necessary to replace grade retard clutch piston inner oil ring, remove and replace using Tool J-7086 and method used on forward clutch ring.



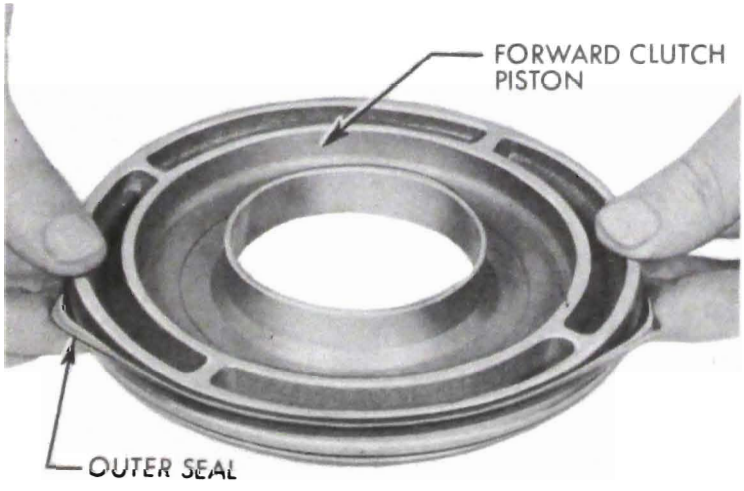
215. Using hook made of stiff wire pull out lube pressure regulator spring retainer, spring and ball.



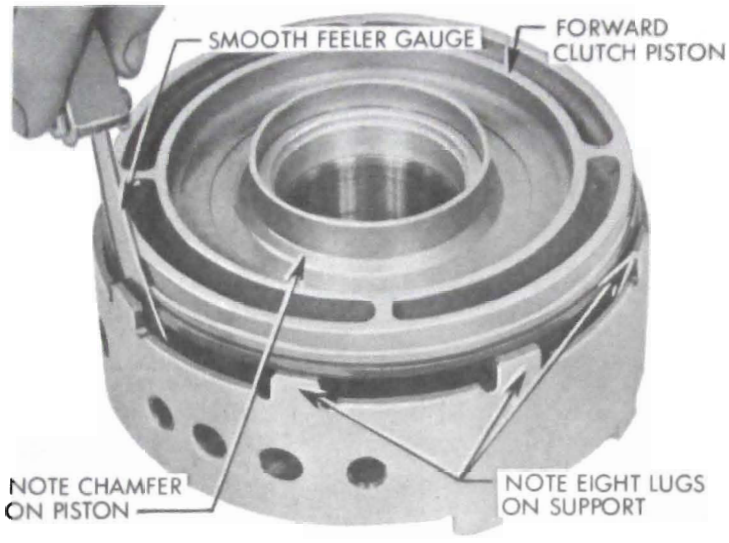
216. Examine ball. If worn or scored, install new ball in lube pressure hole of output shaft support, then spring, then retainer, small hole down.



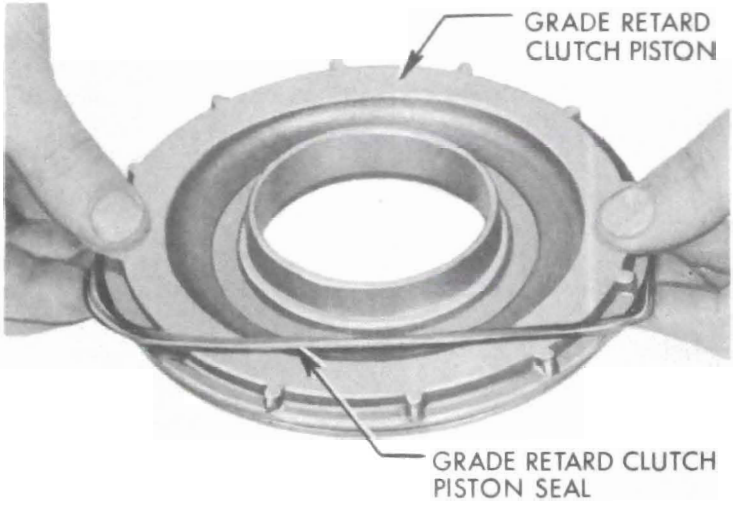
217. Using a plastic or rawhide mallet, drive lube pressure regulator spring retainer flush with surface of support to .010'' below.



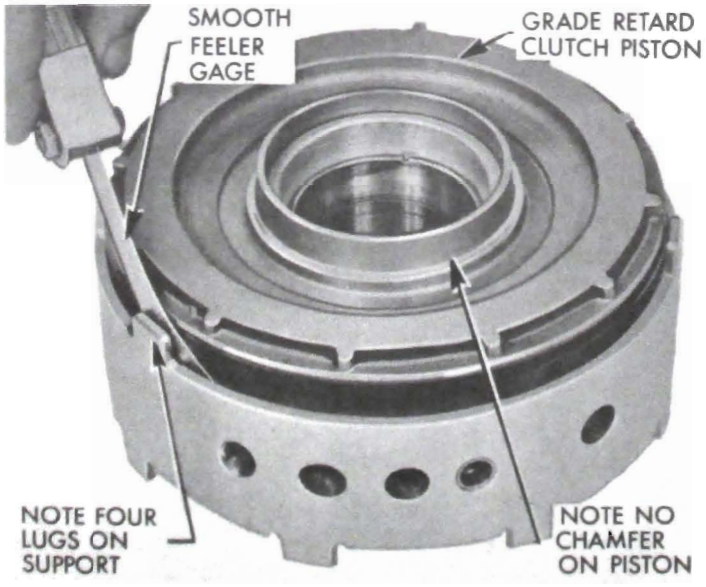
218. Install new rubber sealing ring on forward clutch piston. (Forward clutch piston has wide chamfer in bore)



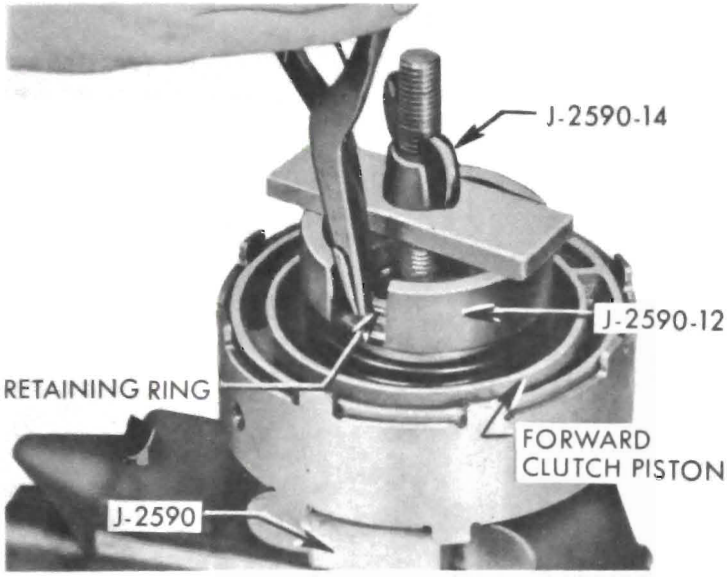
219. Lube and use smooth edge feeler gauge to hold lip of rubber ring down while inserting piston assembly into output shaft support.



220. Install new rubber sealing ring on grade retard piston.

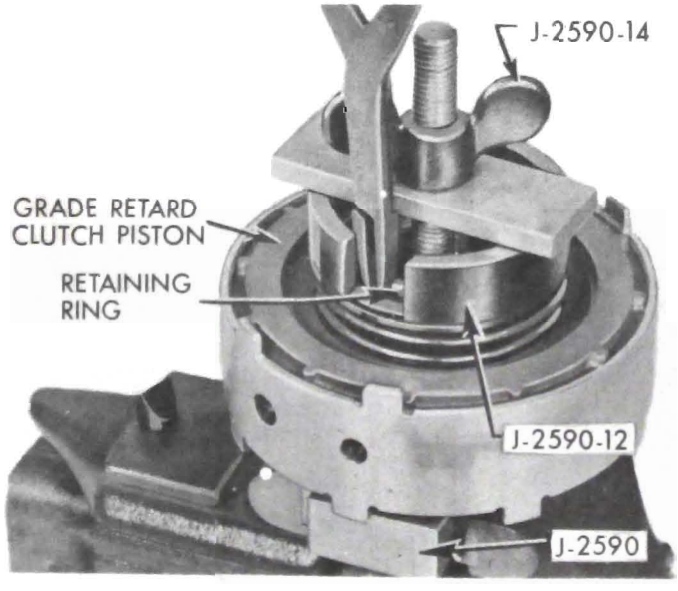


221. Lube and use smooth edged feeler gauge to hold lip of rubber ring down while inserting piston assembly into output shaft support.



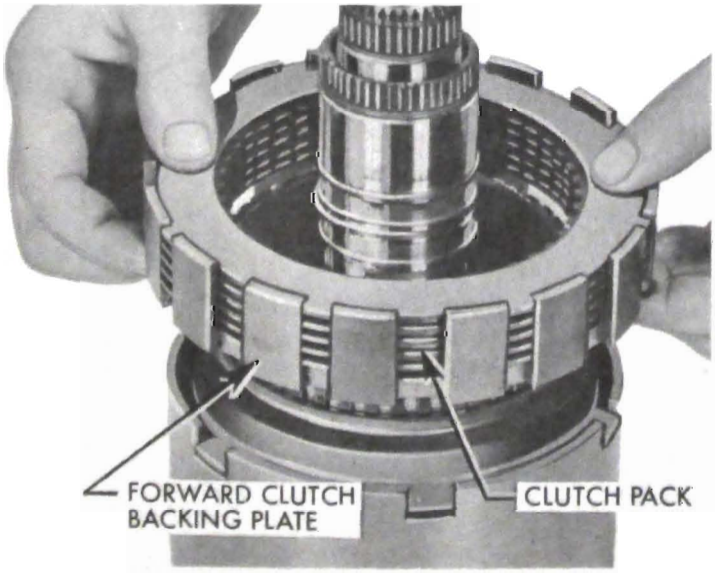
222. Install forward clutch spring, retainer and snap ring using Tool J-2590-12 and 14, and snap ring pliers.

NOTE: Spring, retainer and snap ring are interchangeable with grade retard spring, retainer and snap ring.

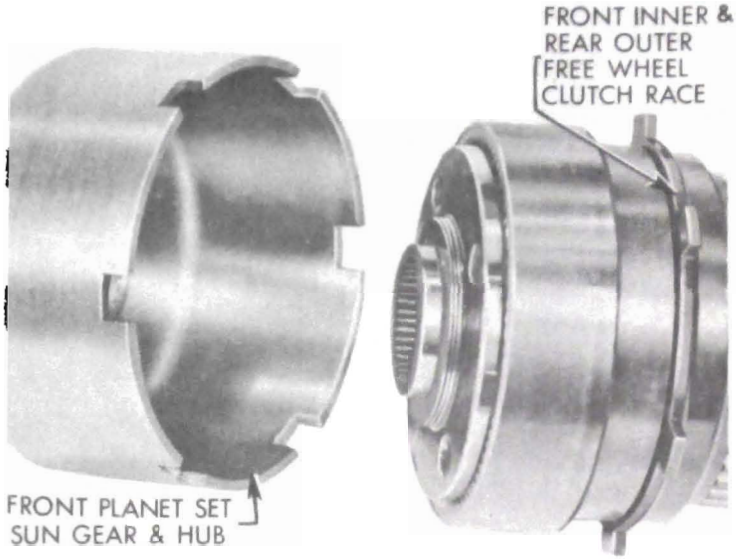


223. Install grade retard clutch spring, retainer and snap ring using Tool J-2590-12 and 14 and snap ring pliers.

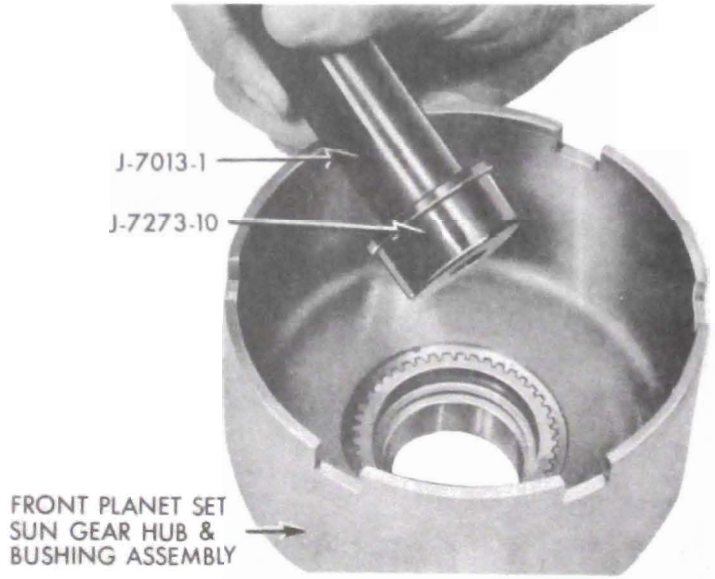
Set completed output shaft support assembly aside.



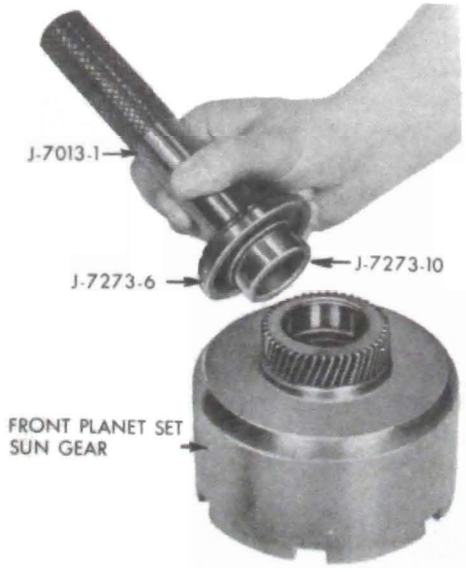
224. Slide forward clutch backing plate and clutch pack off forward clutch hub and output shaft.



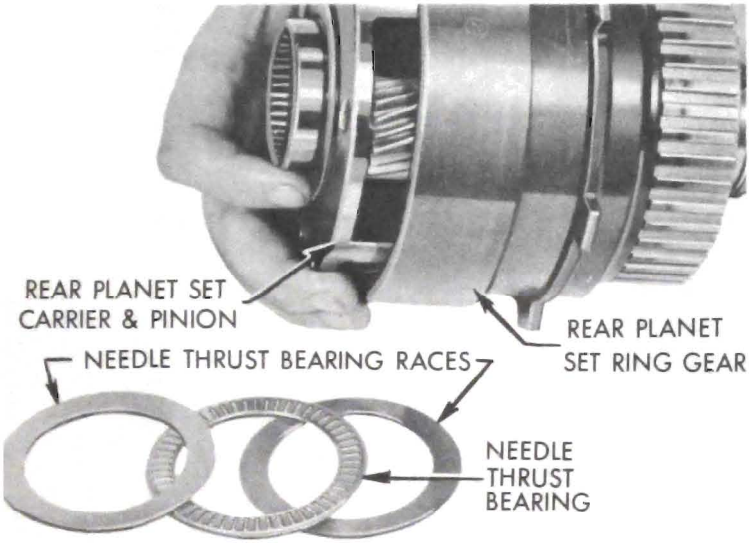
225. Separate front planet set sun gear and hub from tangs of front inner and rear outer free wheel race by prying with a screwdriver. Remove sun gear and hub.



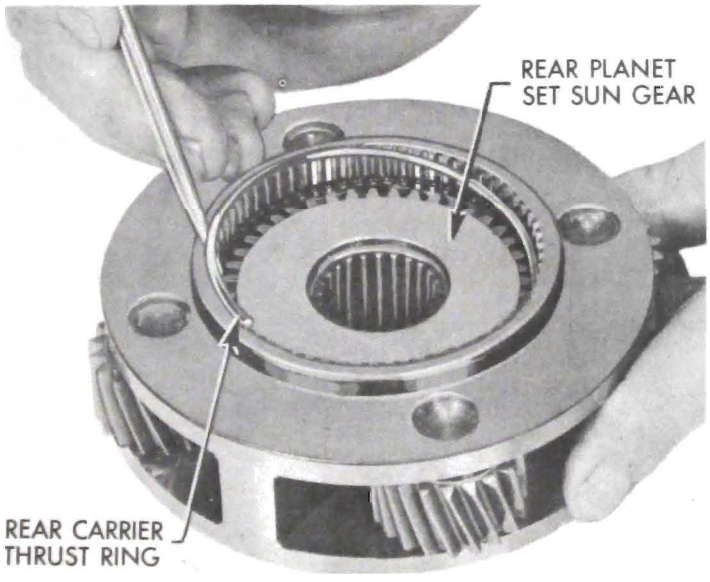
225A. Examine front sun gear bushing. If worn or scored, drive bushing out using J-7013-1 Handle and J-7273-10 Remover.



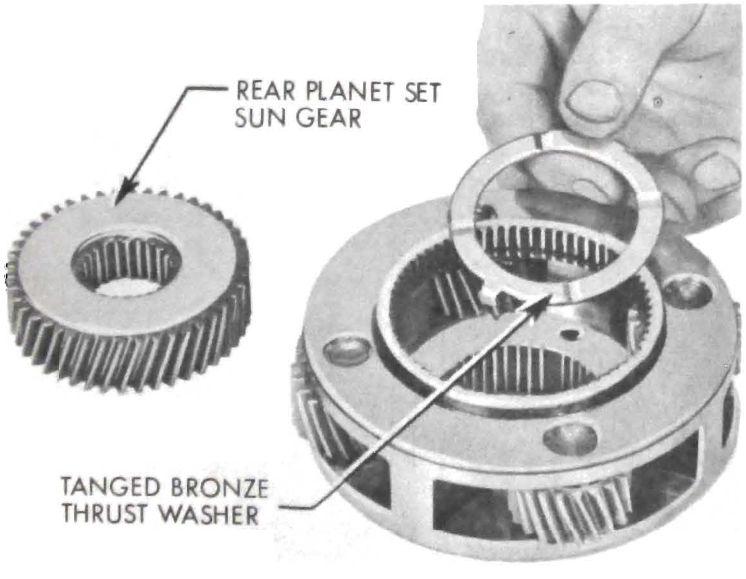
225B. Install new front sun gear bushing using J-7013-1 Handle and J-7273-6-10 Installer. (Counterbore on 6 toward 10.)



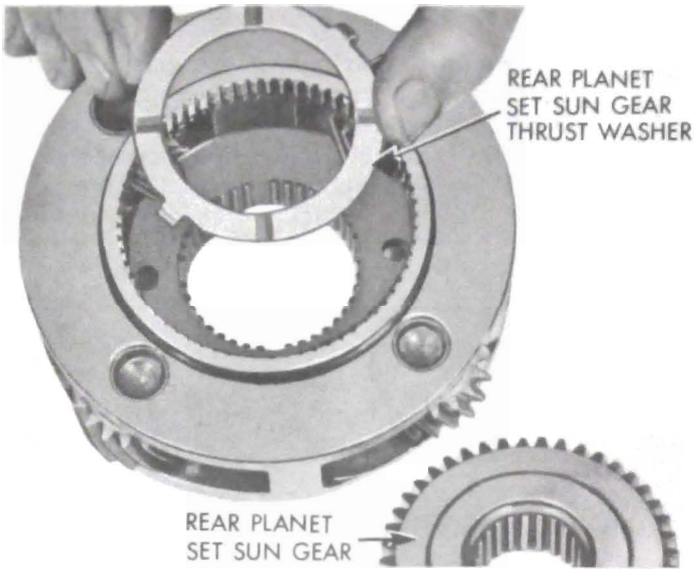
226. Remove rear planet set carrier needle thrust bearing and two thrust bearing races from hub of carriers. Grasp carrier and slide carrier and planet assembly out of rear planet set ring gear. it may be necessary to pry to start out.



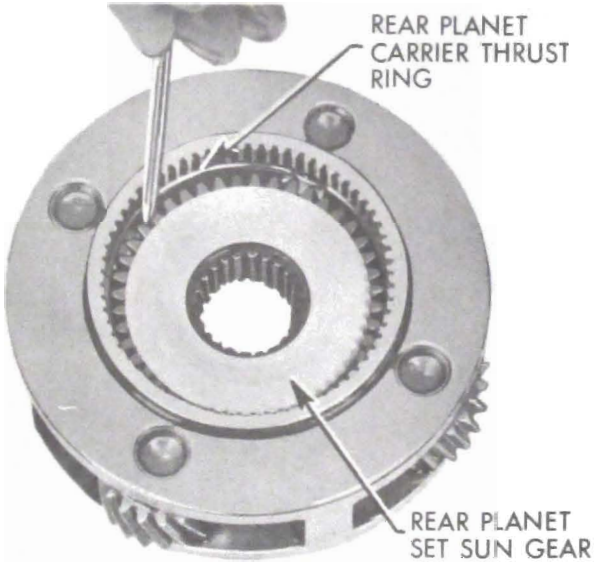
227. Pry rear carrier thrust ring out of groove in carrier. Remove ring.



228. Remove rear planet set sun gear and tanged bronze thrust washer (between rear sun gear and rear planet carrier) from rear planet set.

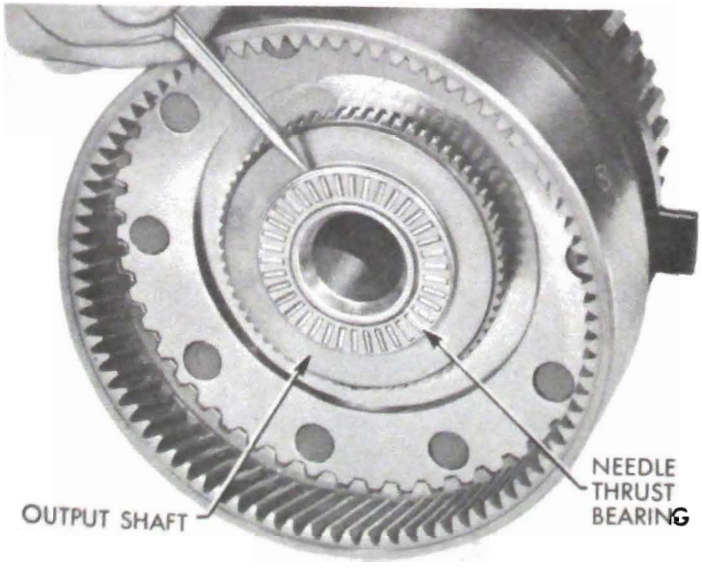


229. Examine and if necessary to replace, apply heavy lube to new rear planet set sun gear thrust washer. Position in carrier, tangs down, in holes of carrier. Install sun gear either end up.



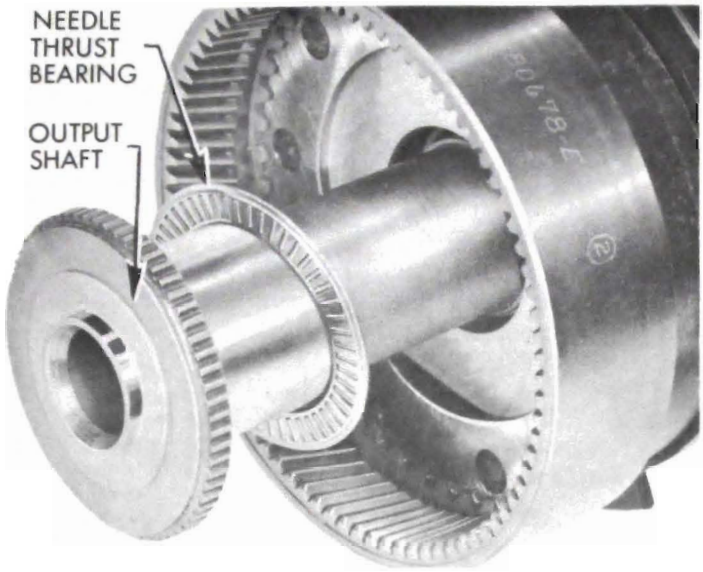
230. Install rear carrier thrust ring solidly in groove above sun gear.

Set rear planet set assembly aside.

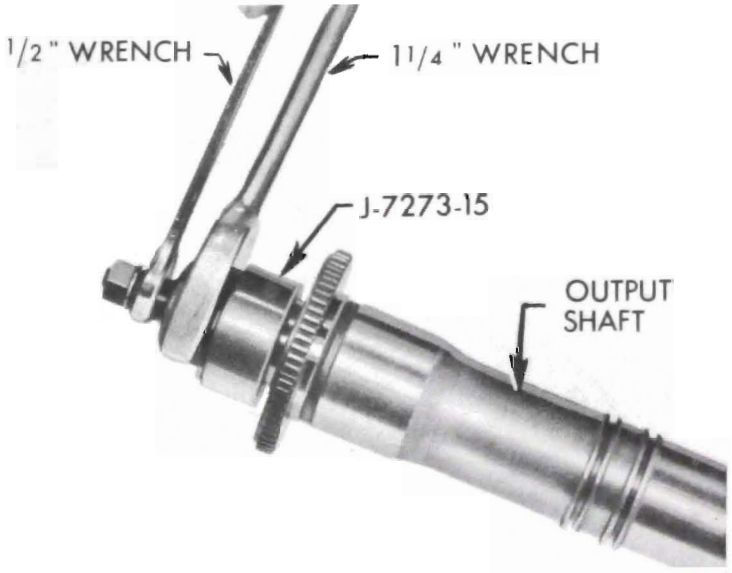


231. Remove needle thrust bearing (between rear sun gear and output shaft) from front of output shaft.

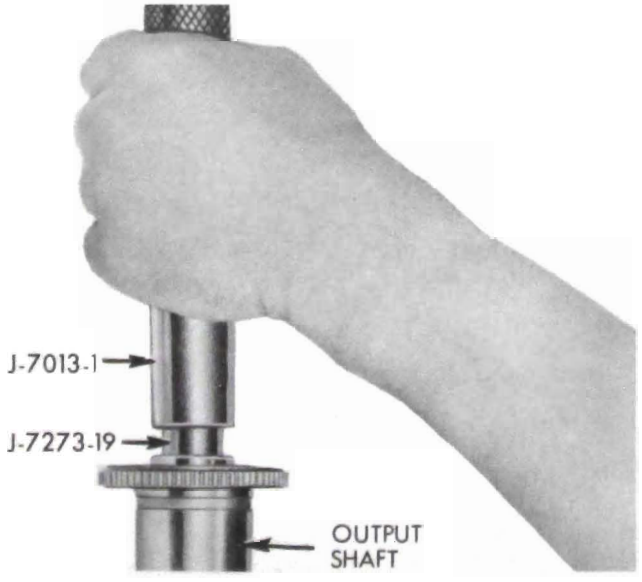
NOTE: No separate needle bearing races used at this point.



232. Slide output shaft forward through grade retard reaction shaft. Needle thrust bearing (between grade retard reaction shaft and output shaft) has no races. Remove needle thrust bearing.



232A. Examine output shaft bushing. If worn or scored, pull bushing using J-7273-15 with output shaft in vise equipped with soft jaws. Slip puller into position in output shaft. Expand puller by holding shaft with 1/2'' wrench and turning 5/8'' nut. Hold shaft with 1/2'' wrench and turn, 1 1/4'' nut to pull bushing.

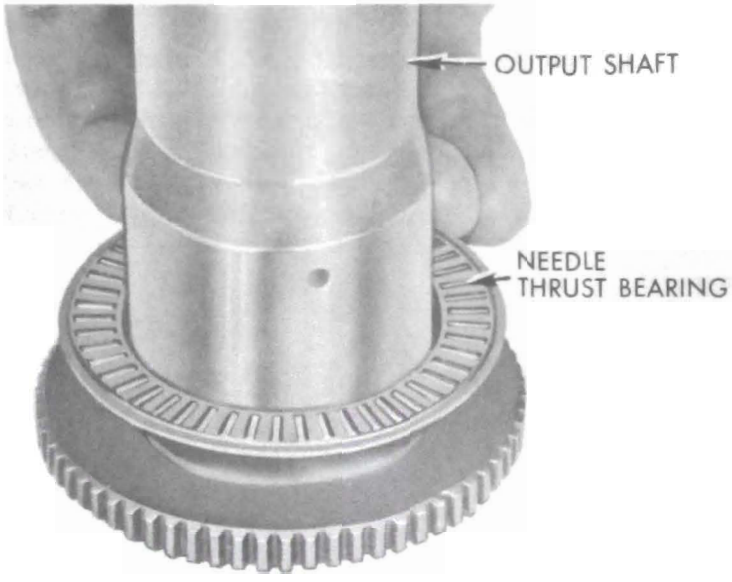


232B. Install new output shaft bushing using J-7013-1 Handle and J-7273-19 Installer.

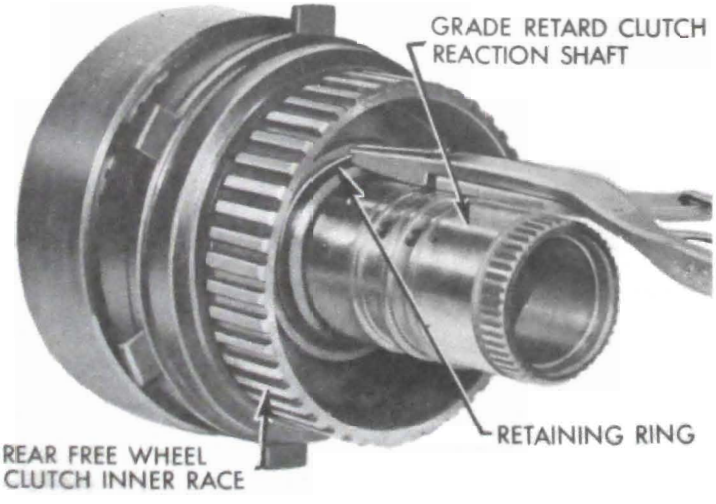
233. Examine and if necessary to replace, unhook, expand and remove four hooked oil rings on output shaft.

Expand and install four new hooked oil rings in grooves of output shaft.

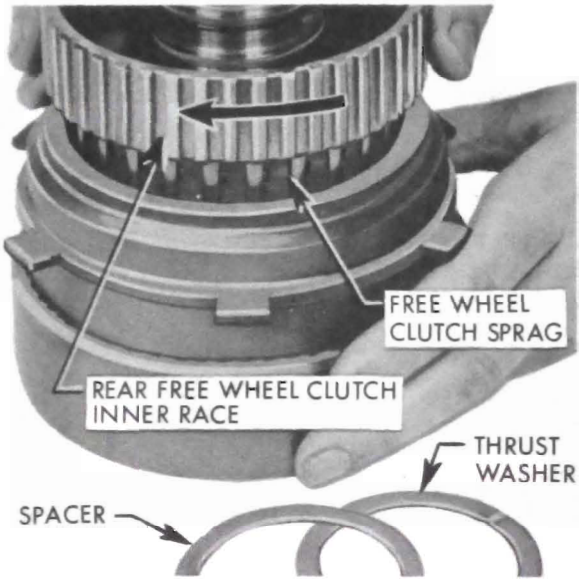
Blow compressed air through rear end of output shaft to clean small oil bleed hole and screen in output shaft.



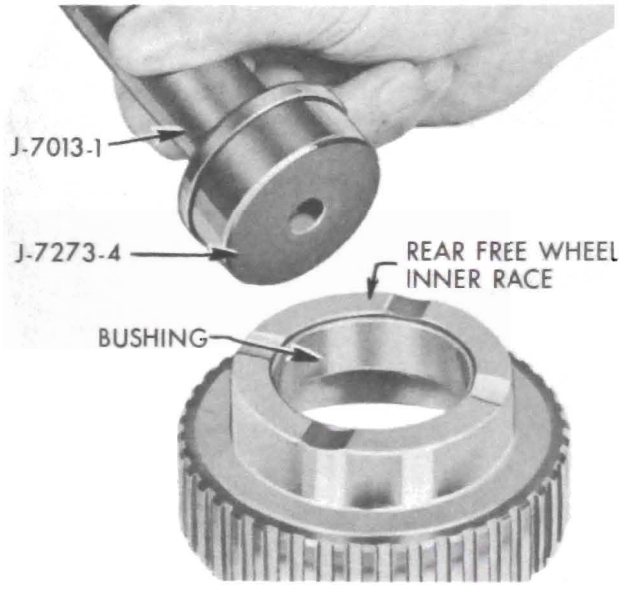
234. Examine and if necessary to replace, apply heavy lube to new output shaft to grade retard reaction shaft needle thrust bearing (1 3/4'' I.D. X 2 1/2'' O.D.) and place in position on output shaft.



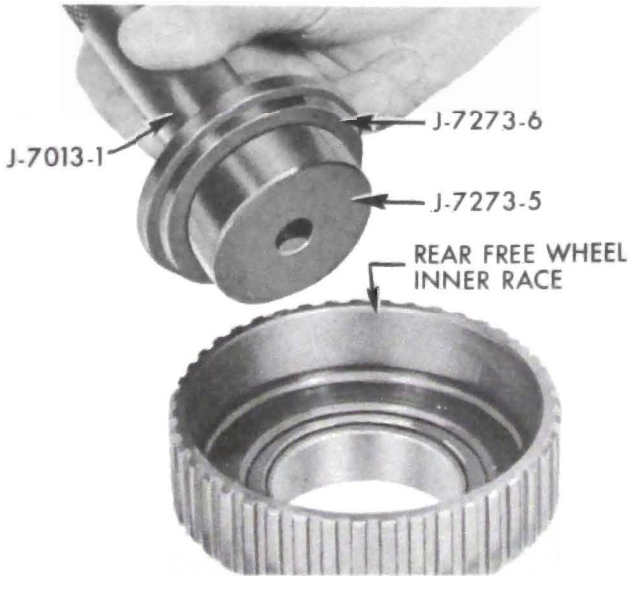
235. Expand and remove rear free wheel inner race to grade retard reaction shaft retaining ring.



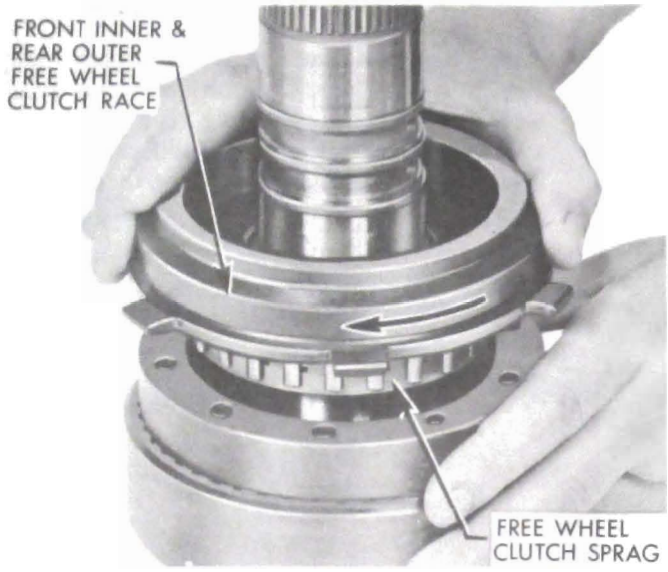
236. Remove rear free wheel clutch inner race thrust washer and spacer (between rear free wheel race and retaining ring). Rotate race clockwise and slide sprag and race out of rear free wheel outer race. Remove and examine sprag.



236A. Examine rear free wheel clutch inner race bushing. If worn or scored, drive bushing out using J-7013-1 Handle and J-7273-4 Remover.

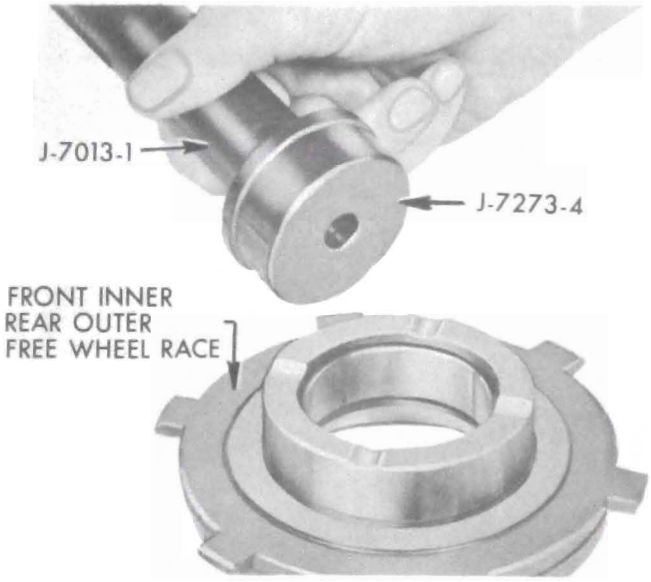


236B. Install new rear free wheel clutch inner race bushing using J-7013-1 Handle and J-7273-5-6. (Counterbore on 6 toward handle.)

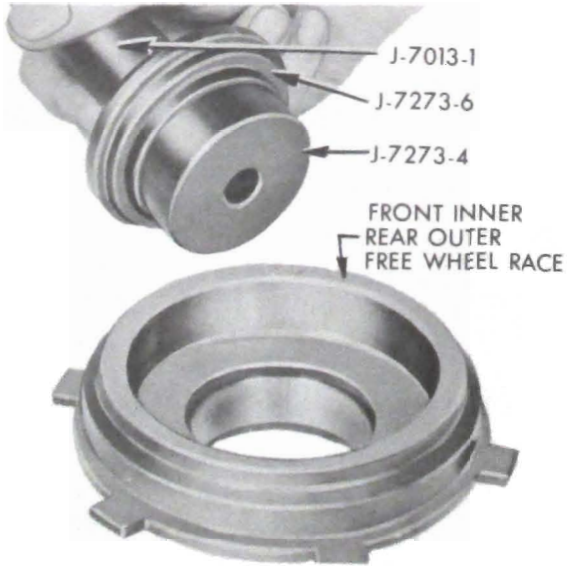


237. Rotate front inner and rear outer free wheel clutch race clockwise and slide race and sprag out of rear planet ring gear - front free wheel clutch outer race. Remove and examine sprag.

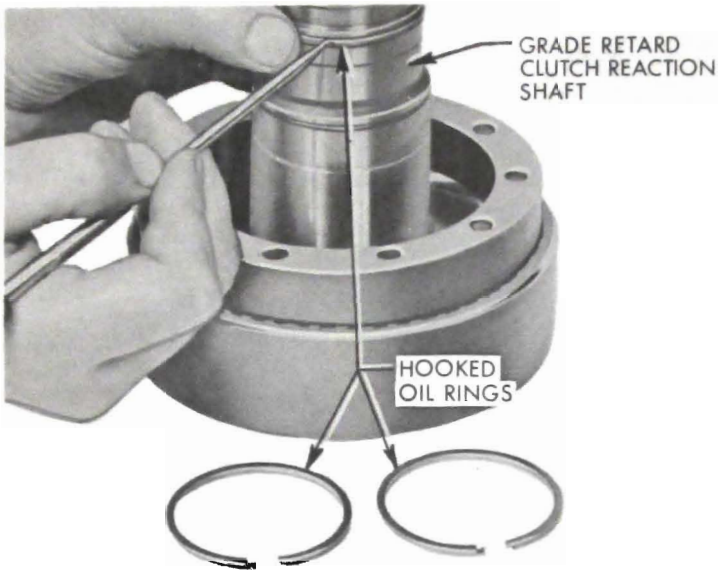
NOTE: The free wheel clutch sprags are identical.



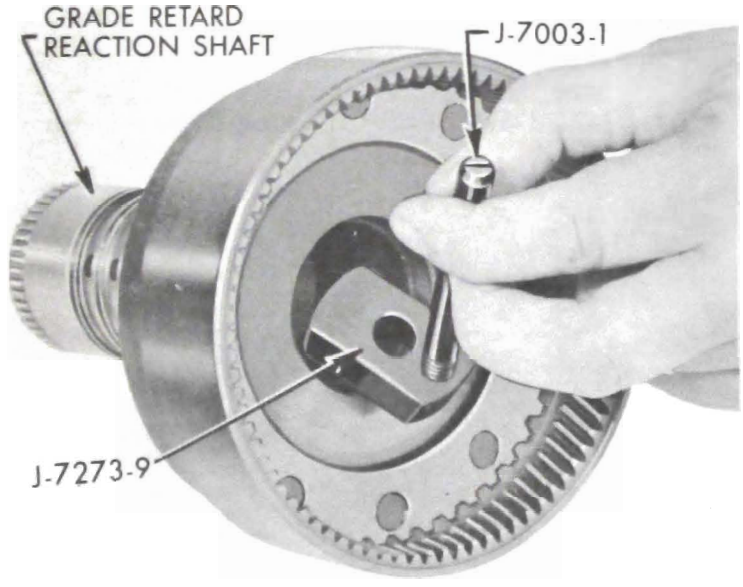
237A. Examine front inner and rear outer free wheel clutch race bushing. If worn or scored, drive bushing out using J-7013-1 Handle and J-7273-4 Remover.



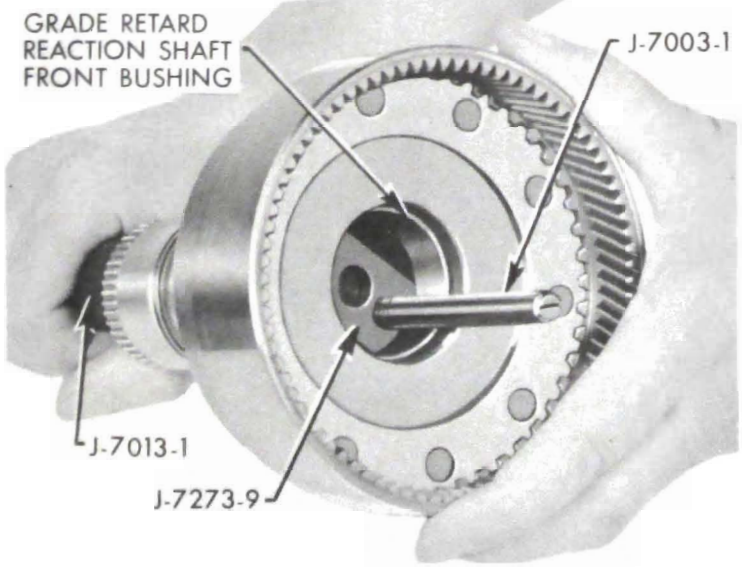
237B. Install new front inner and rear outer free wheel clutch race bushing using J-7013-1 and J-7273-4-6. (Counterbore on 6 toward handle.)



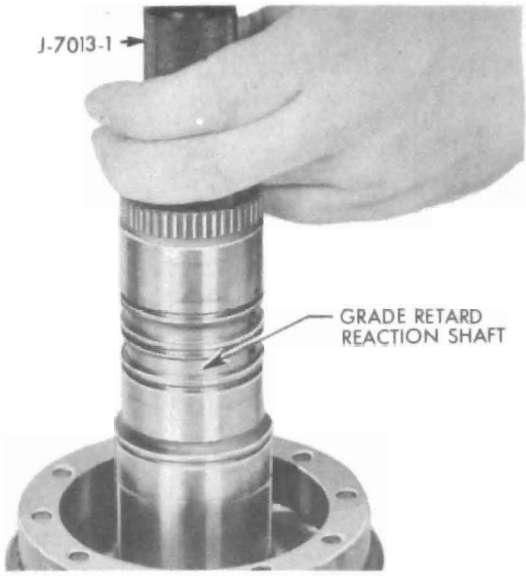
238. Examine and if necessary to replace, unhook, expand and remove three oil rings from grade retard reaction shaft. Expand and install three new oil rings in grooves of grade retard reaction shaft, hook ends.



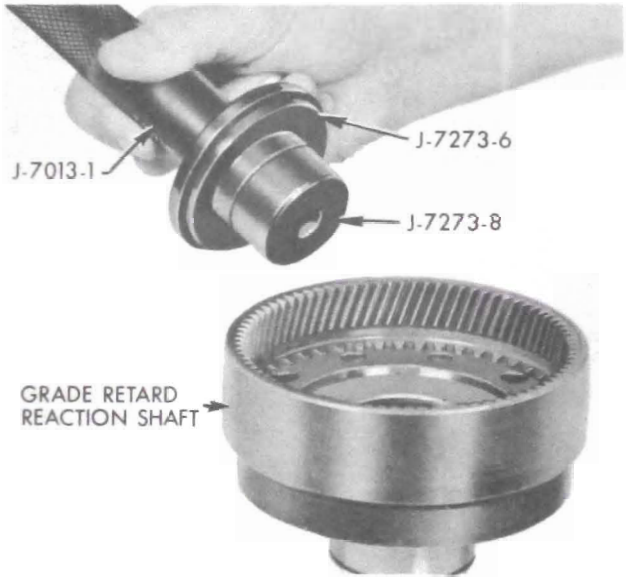
238A. Examine front grade retard reaction shaft bushing. If worn or scored, assemble J-7003-1 Guide Pin to J-7273-9 Remover. Tilt remover to assemble behind front bushing.



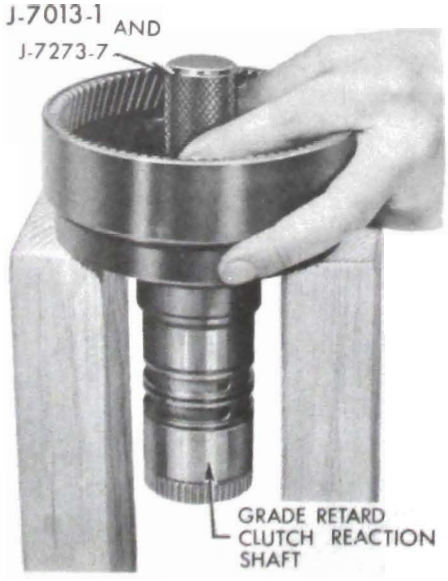
238B. Insert J-7013-1 Handle through rear of reaction shaft to enter J-7273-9 Remover.



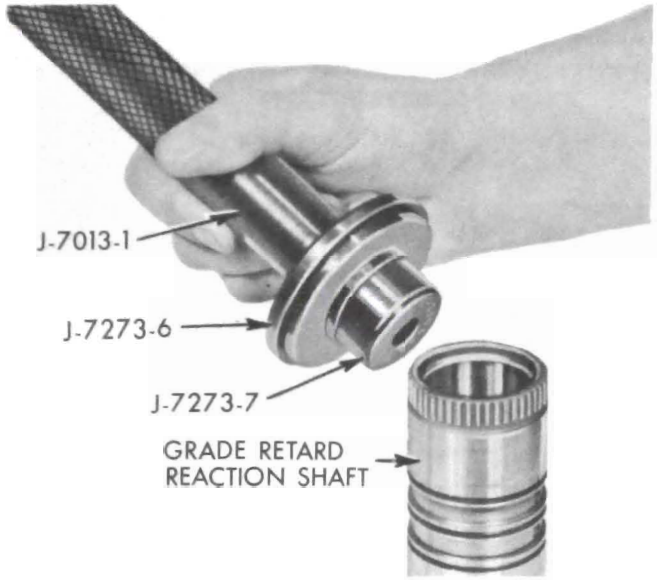
238C. Drive out bushing.



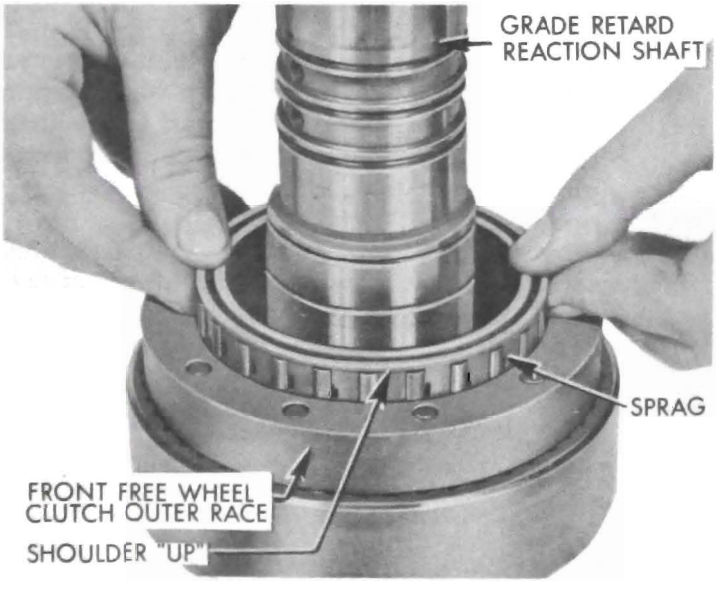
238D. Install new grade retard reaction shaft front bushing using J-7013-1 Handle and J-7273-6-8. (Counterbore on 6 toward handle.)



238E. Examine grade retard reaction shaft rear bushing. If worn or scored, drive out bushing using J-7013-1 and J-7273-7 Remover.

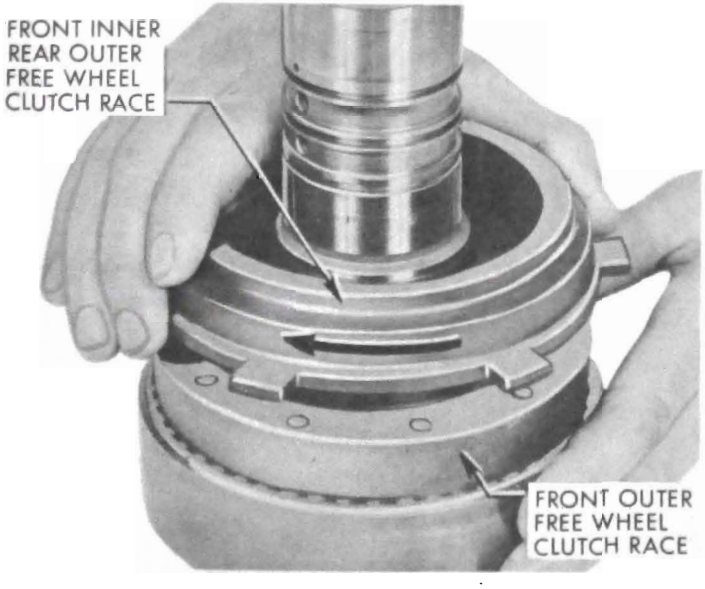


238F. Install new grade retard reaction shaft rear bushing using J-7013-1 Handle and J-7273-6-7. (Counterbore on 6 toward handle.)



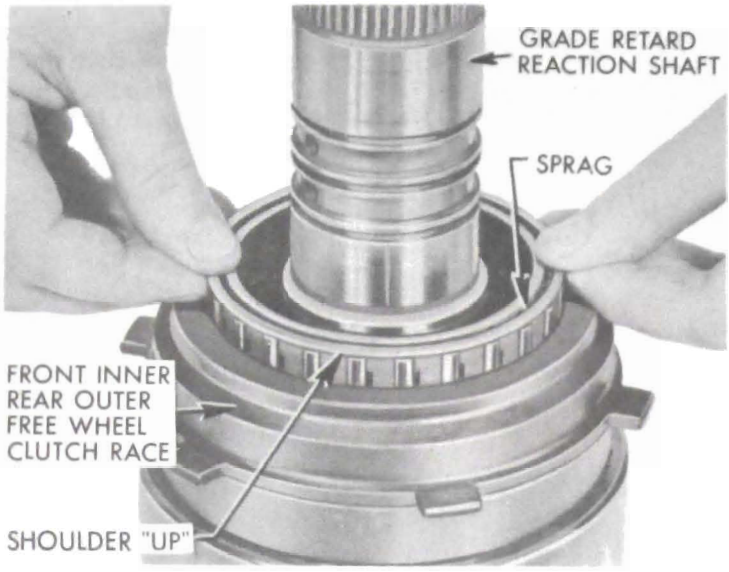
239. Slip sprag into front free wheel clutch outer race.

NOTE: Shoulder of sprag up toward reaction shaft.



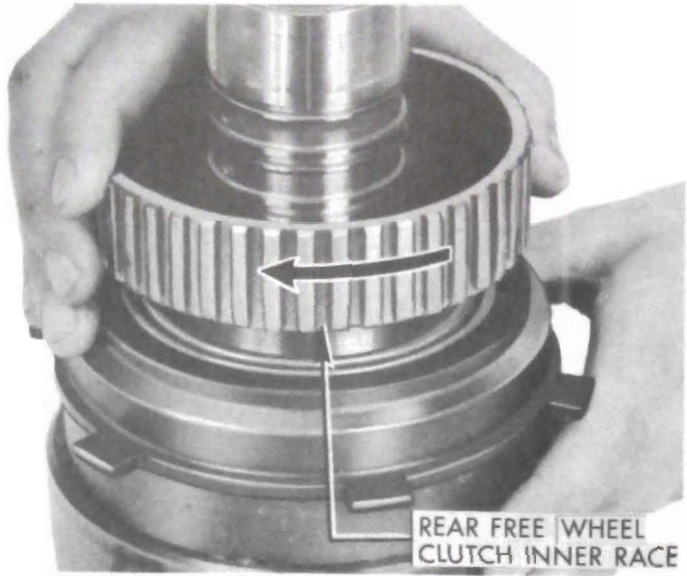
240. Insert front free wheel clutch inner race into sprag while rotating clockwise. The inner race must rotate freely on clockwise rotation and lock on counterclockwise rotation.

When correctly installed, the front inner free wheel race will be approximately 1/16" from front outer race. If this dimension is approximately 1/8" the inner race is hanging up on the bronze strip near the bottom of the sprag assembly.



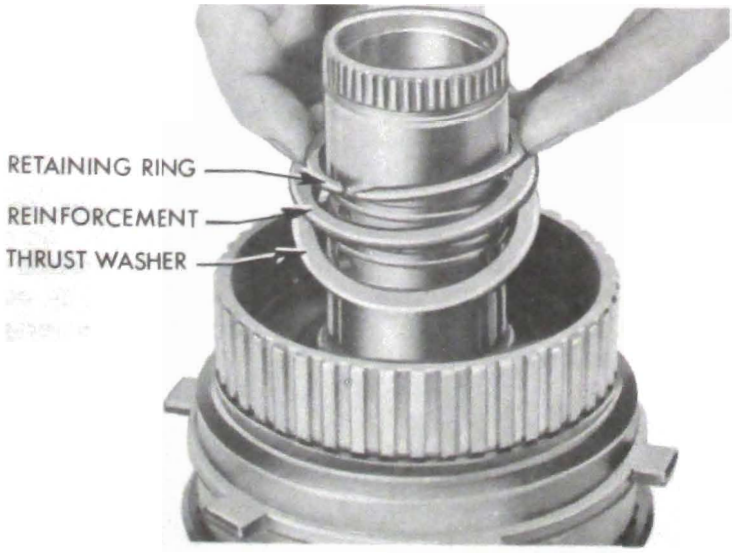
241. Insert rear free wheel clutch sprag into rear outer race.

NOTE: Shoulder up toward reaction shaft.

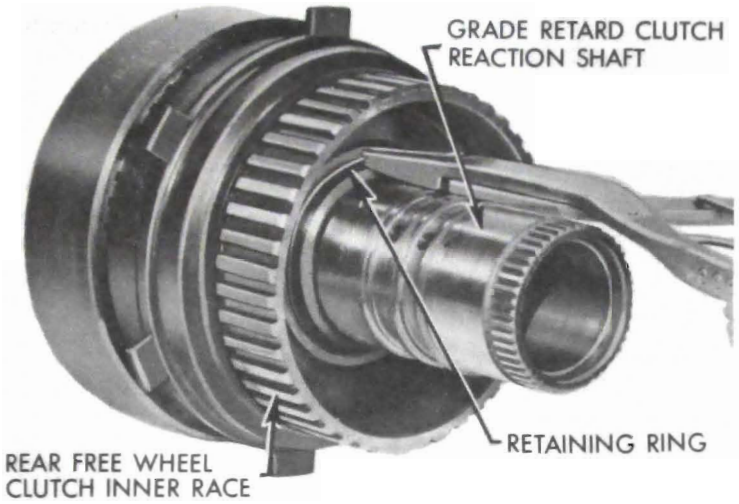


242. Insert rear free wheel clutch inner race-forward clutch hub into sprag while rotating clockwise. The inner race must rotate freely on clockwise rotation and lock on counter-clockwise rotation.

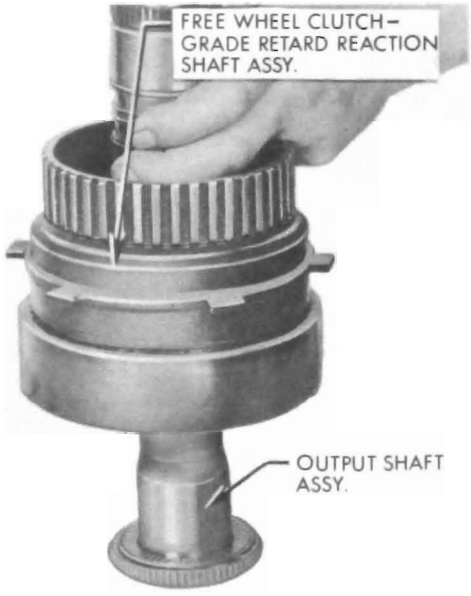
When correctly installed, the rear free wheel inner race should contact front inner rear outer race. If approximately 1/8'' clearance exists rear inner race may be hanging up on bronze strip at bottom of sprag assembly.



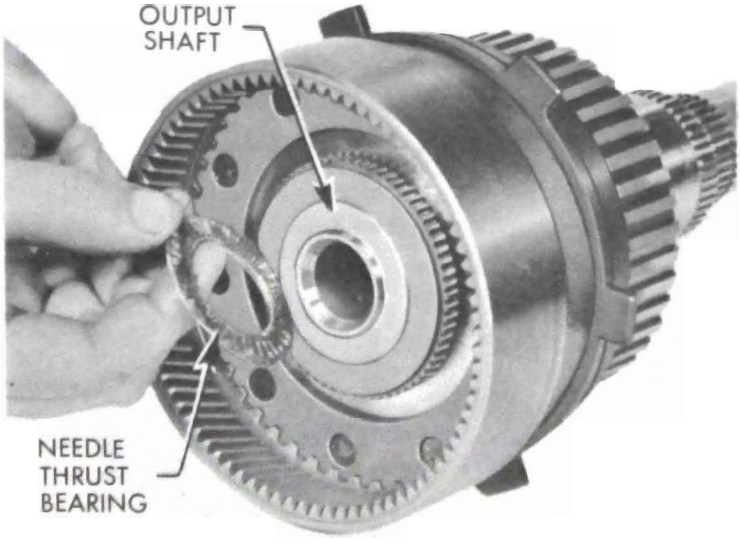
243. Assemble new rear free wheel clutch inner race thrust washer first, then reinforcement and retaining ring on grade retard reaction shaft.



244. Expand and install retaining ring solidly in groove of reaction shaft.

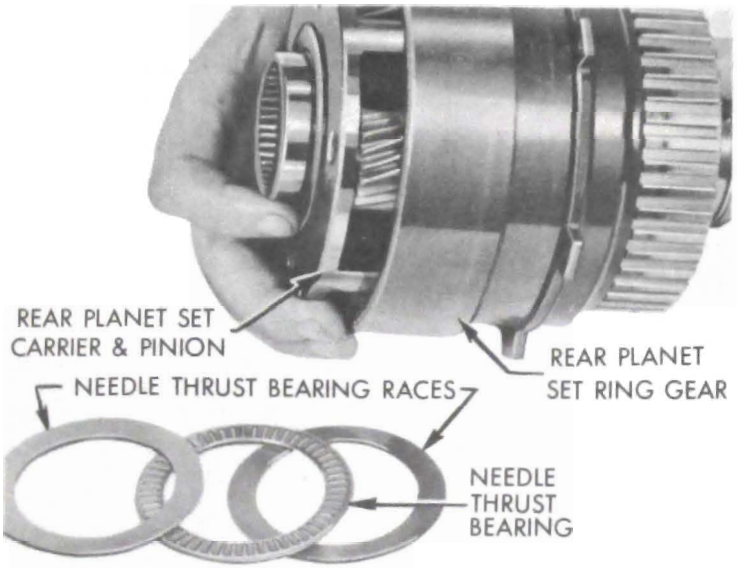


245. Slide free wheel-clutch assembly over output shaft with needle thrust bearing in place.

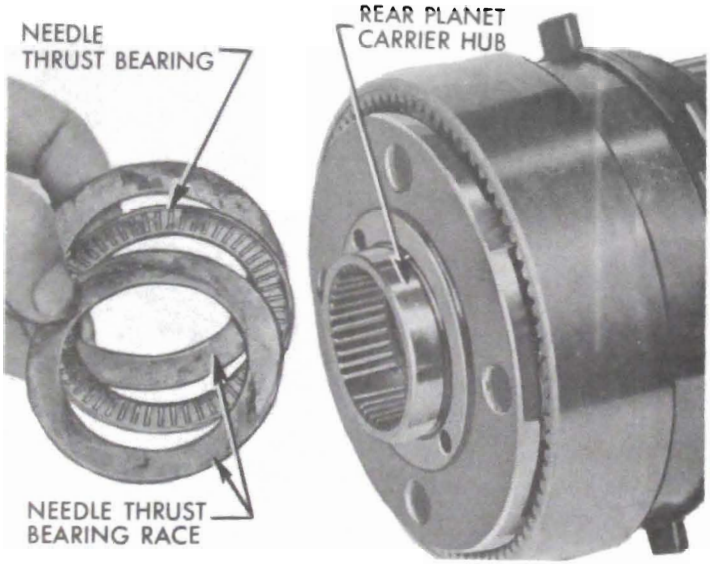


246. Examine and if necessary to replace, apply heavy lube to new output shaft to rear planet sun gear needle thrust bearing (13/16''I.D. X 1 7/8'' O.D.) and set on forward end of output shaft.

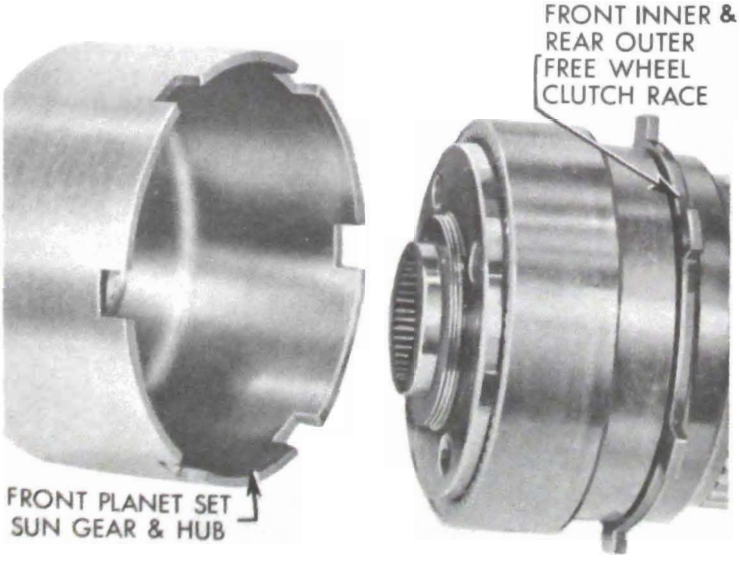
NOTE: No races used at this location.



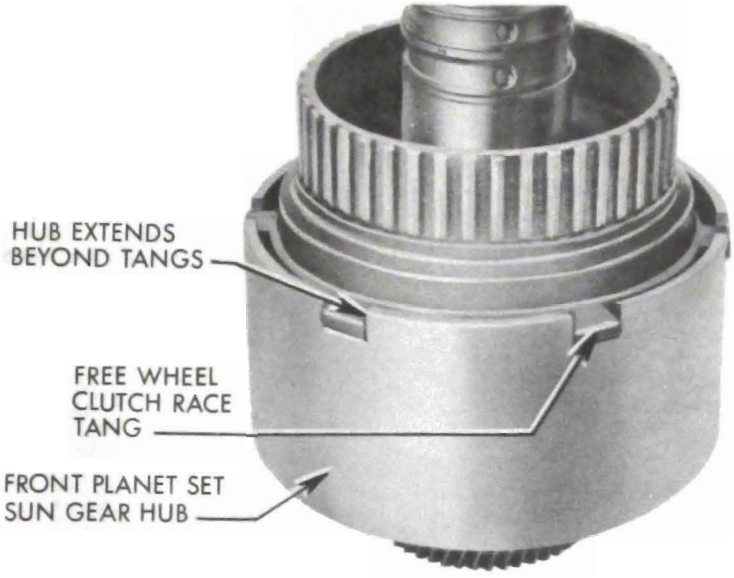
247. Insert rear planet set and sun gear assembly into rear planet ring gear assembly.



248. Apply heavy lube to rear planet set carrier, to front sun gear needle thrust bearing (2" I.D. X 2 3/4" O.D.) and two bearing races. Position on hub of carrier.

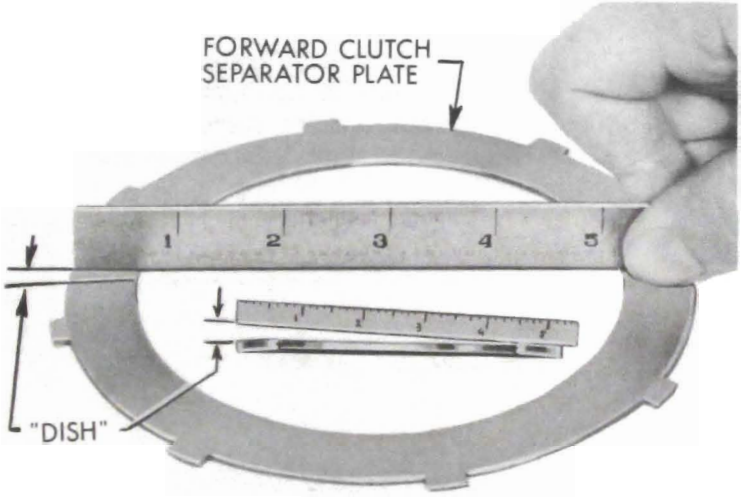


249. Install front planet set sun gear and hub over front of rear planet set and free wheel clutch assembly. Do not lift assembly by end of output shaft as thrust washer, etc., may fall out of position. It is best to make this installation with the assembly horizontal and it may be necessary to tap the front sun gear and hub into position.



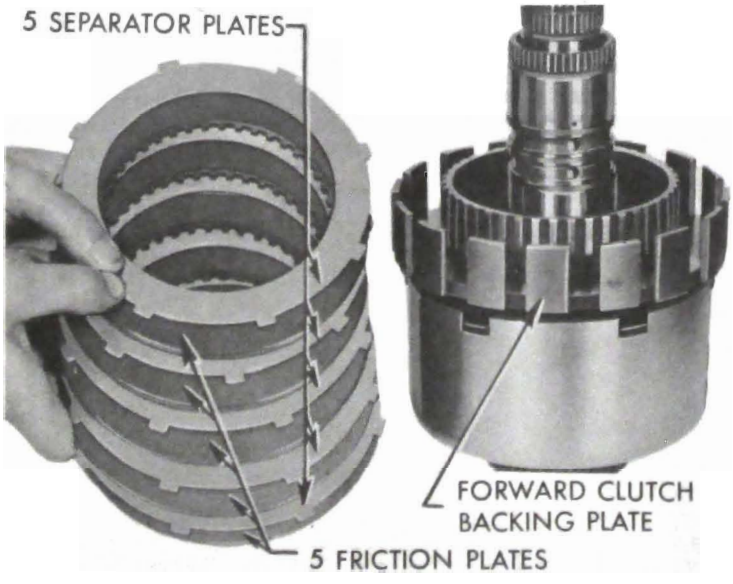
250. Be sure front planet set sun gear hub extends beyond front inner-rear outer free wheel clutch race tangs as shown in picture.

NOTE: Tangs of front inner-rear outer race do not seat in bottom of slots of sun gear hub.

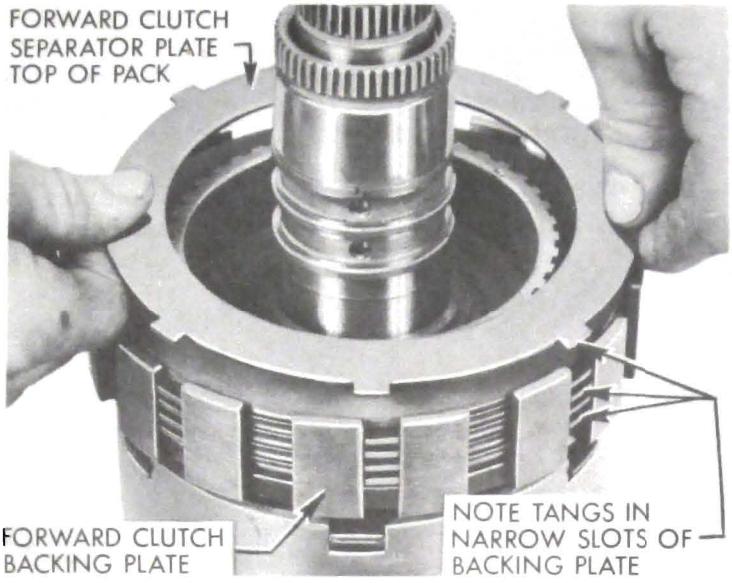


251. Examine the forward clutch plates. If they are worn, scored or burned, replace them. The forward clutch friction plates when new are .098" to .102" thick.

Check five forward clutch separator plates for "dish" by holding a straight edge against one side of the plate and observing the slope of the straight edge. All separator plates must be assembled with "dish" same way. Plates may be assembled dish "up" or dish "down" as long as plates are installed all with dish same way.

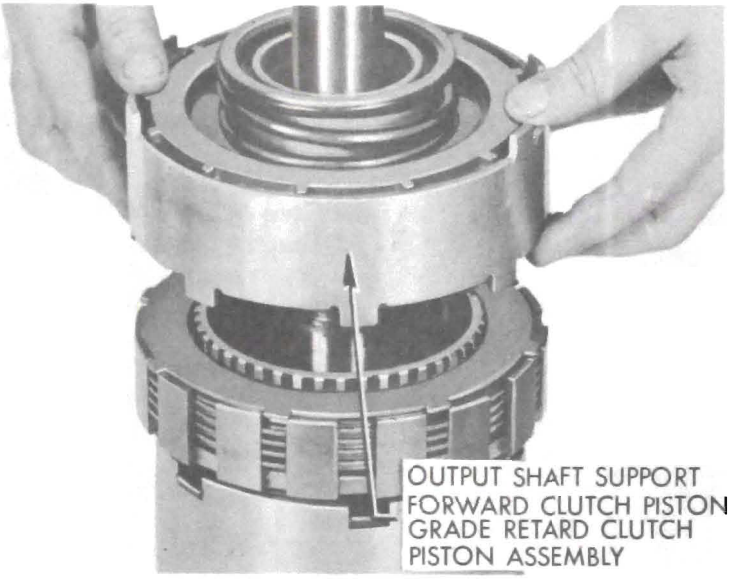


252. Install forward clutch backing plate over rear free wheel clutch inner race. Lubricate with Dynaflow oil and install a friction plate next to the backing plate. Engage the tangs of a separator plate in the narrow slots of the backing plate and continue the build-up by alternately assembling a friction plate and a separator plate with all five separator plates "dished" in the same way.

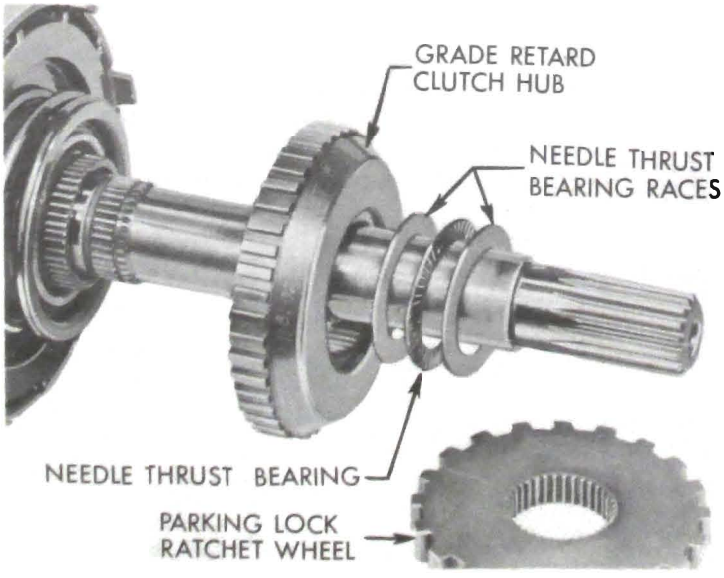


253. It is very important to have a friction plate assembled next to the backing plate and a separator plate on top. Serious damage to the forward clutch piston will result if a friction plate is assembled next to the piston.

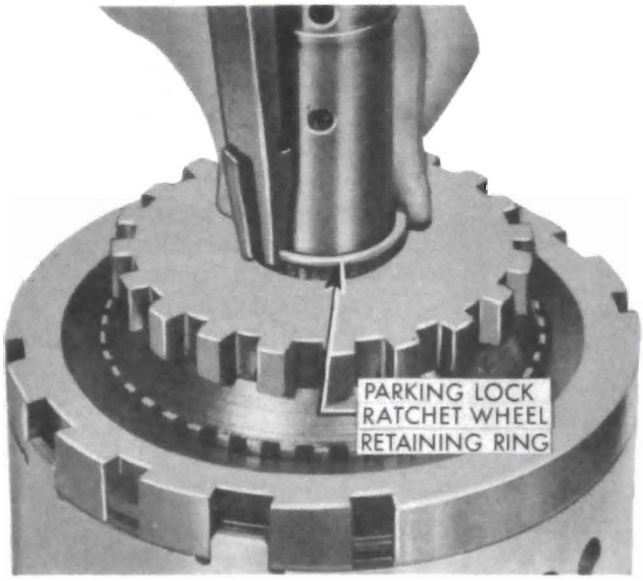
Tangs of separator plates fit in narrow slots of backing plate.



254. Lube and install output shaft support assembly on output shaft, eight lugs down and four lugs toward end of output shaft. Engage eight lugs in wide slots of forward clutch backing plate.

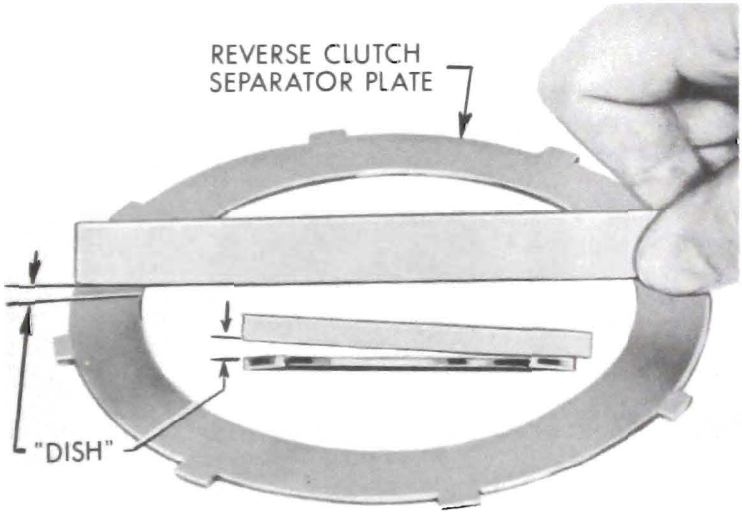


255. Install grade retard clutch hub, needle thrust bearing (1 1/2'' I.D. X 2 3/16''O.D.) and two thrust bearing races, one on each side of needle thrust bearing.



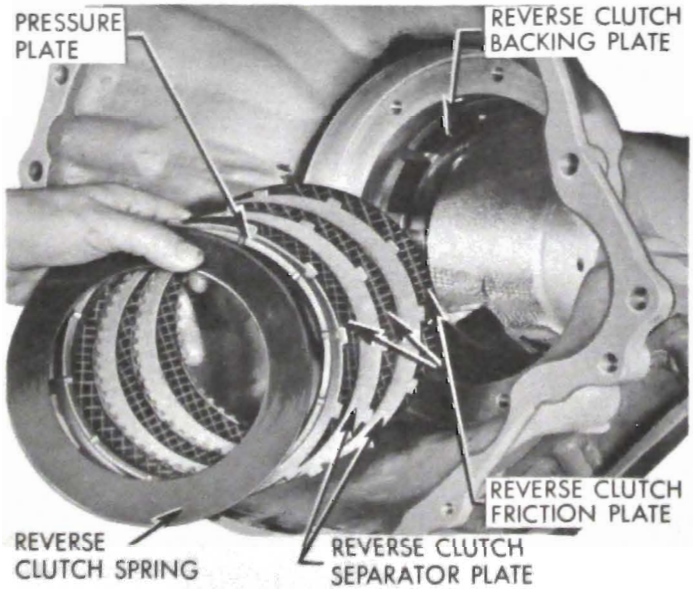
256. Slip on parking lock ratchet wheel and expand and install retaining ring solidly in groove of output shaft.

Set completed output shaft assembly aside.



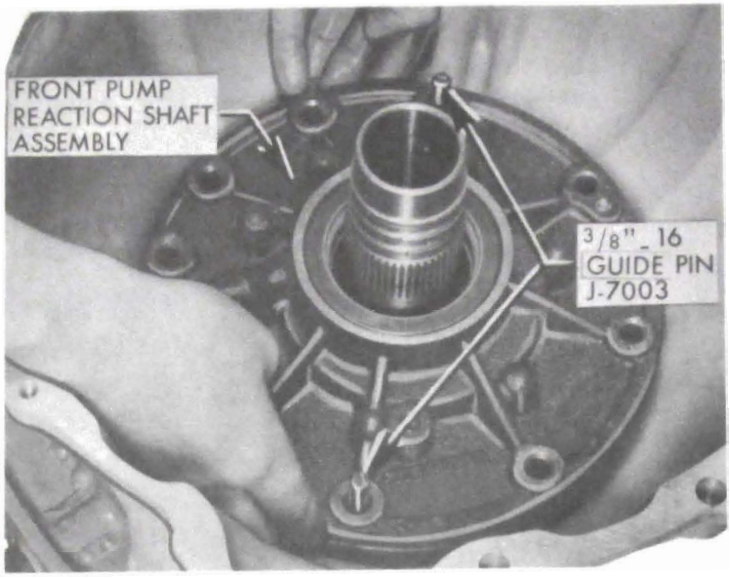
REVERSE CLUTCH PACK INSTALLATION

257. Check "dish" of two reverse clutch separator plates.



258. With transmission front end "up" lubricate and install a reverse clutch friction plate into reverse clutch backing plate, then a separator "dished" same as first, then last friction plate. Install reverse clutch pressure plate, rounded edge up and reverse clutch spring, center high edge up.

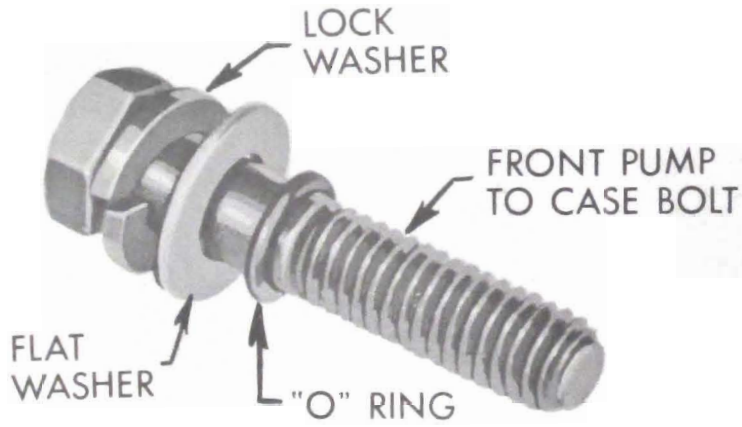
NOTE: Both reverse clutch separator plates must be "dished" same way.



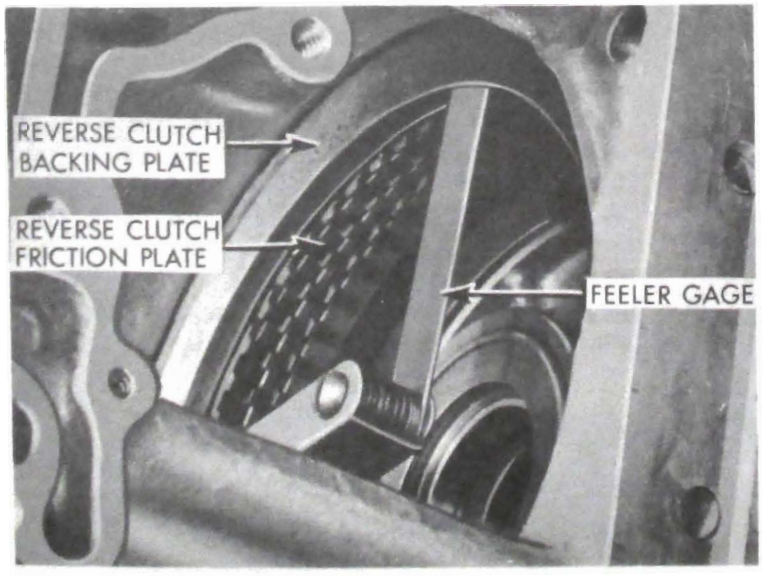
FRONT PUMP - REACTION SHAFT INSTALLATON

259. Install new front pump to case gasket in transmission case. Be absolutely certain that gasket holes line up properly. Install two 3/8'' - 16 Guide Pins J-7003 in transmission case, liberally lube rubber seal on front pump assembly with heavy lube and slip front pump and reverse clutch piston assembly into case so that the three closely spaced holes are at bottom of case. Tap the assembly evenly and solidly in position in case with brass drift and plastic hammer.

CAUTION: Never attempt to draw the front pump assembly into position with front pump bolts as transmission case threads will almost certainly be stripped.

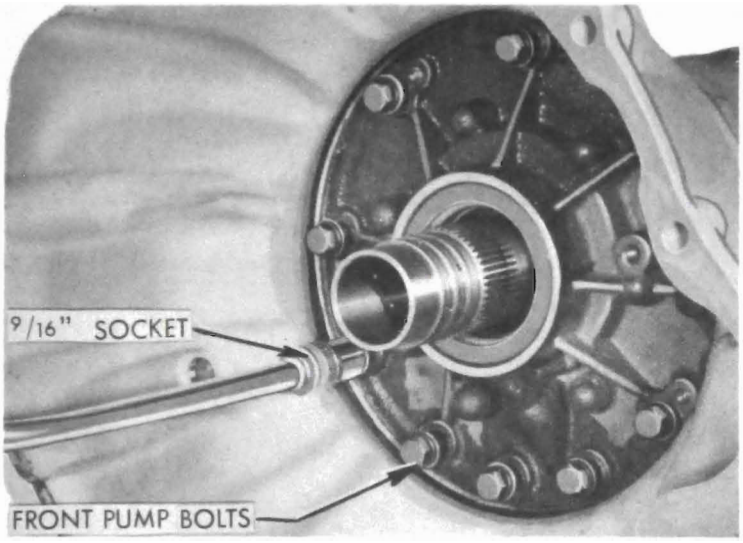


260. Assemble lock washer, new flat washer, and new ''O'' ring on ten front pump to case bolts.

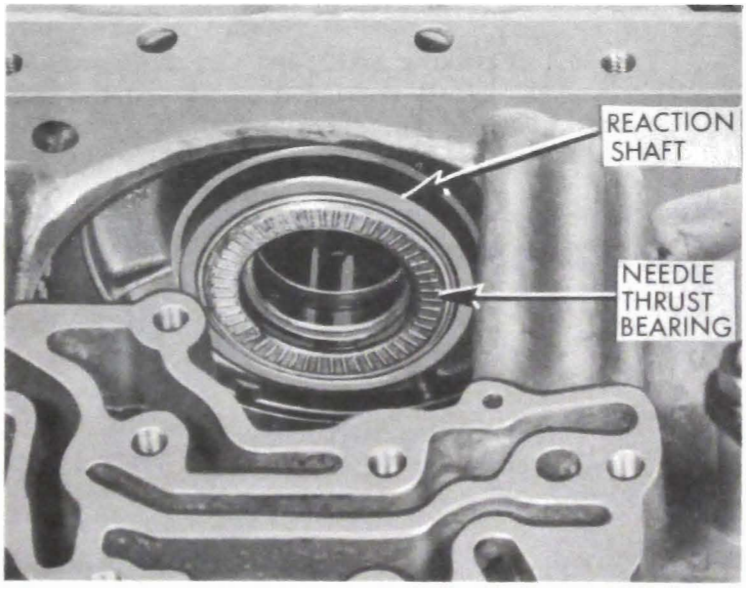


261. Install at least two front pump to case bolts to check reverse clutch pack clearance.

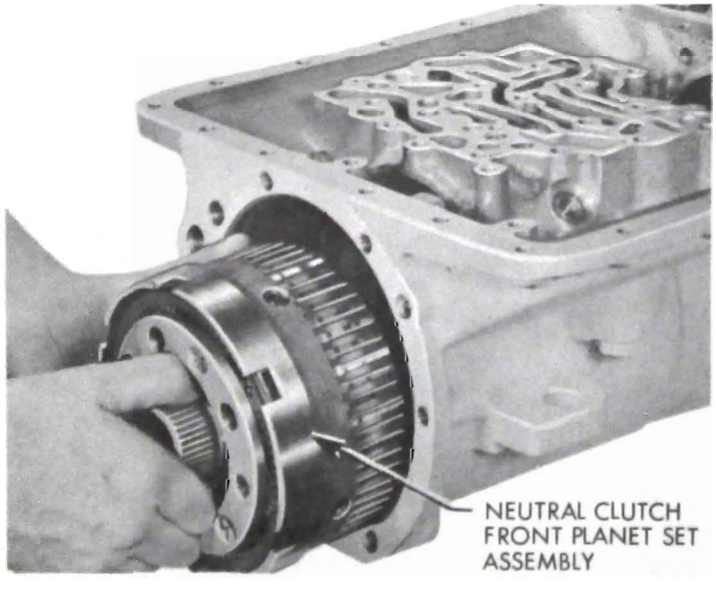
Check reverse clutch pack clearance with feeler gauge between any two plates. Clearance should be between .007'' and .055''. If clearance is more than .055'', friction plates should be replaced.



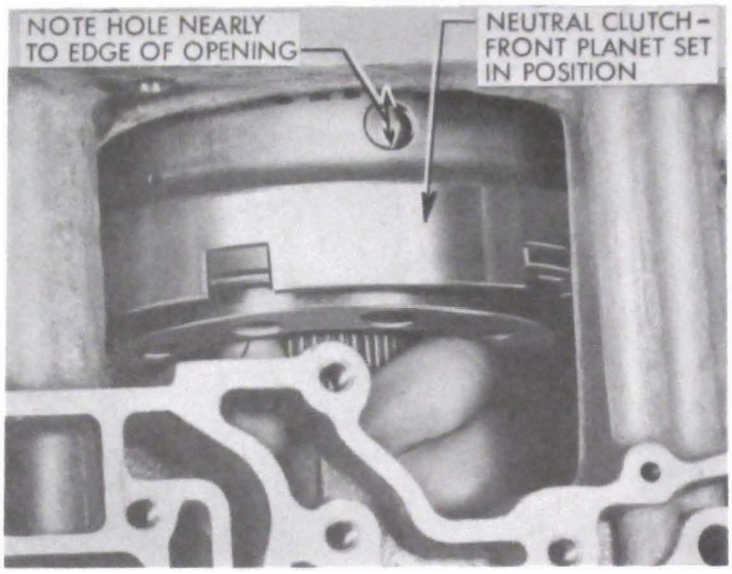
262. Remove guide pins and install all front pump to case bolts. Torque to 30 to 35 ft. lbs. after preliminary tightening by criss-crossing from one bolt to another (9/16'' socket).



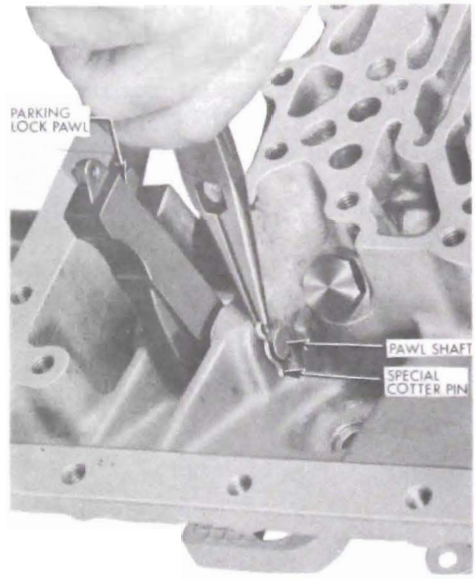
263. With transmission upside down, apply heavy lube and install needle thrust bearing (1 3/4'' I.D. X 2 1/2'' O.D.) in cupped bearing race at rear of stator reaction shaft.



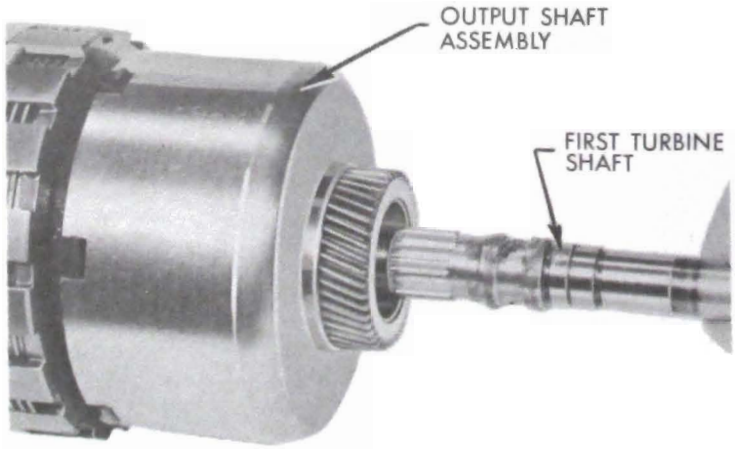
264. Install neutral clutch assembly into case. Be certain cupped bearing race is in position on hub of front planet set ring gear carrier (Front of neutral clutch assembly).



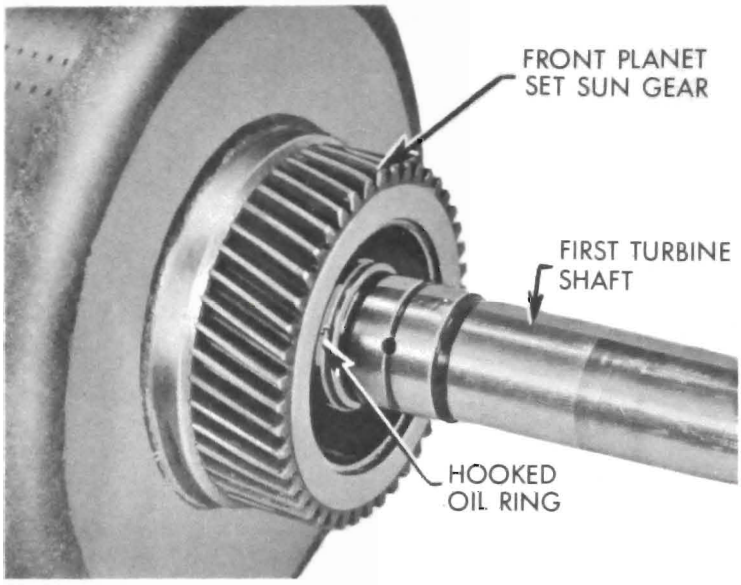
265. When installing neutral clutch assembly into reverse clutch pack, rotate neutral clutch assembly to line up splines and allow front planet ring gear carrier assembly hub to seat against needle thrust bearing. Hole in front ring gear carrier will be nearly even with edge of opening in transmission case when assembly is seated against needle thrust bearing.



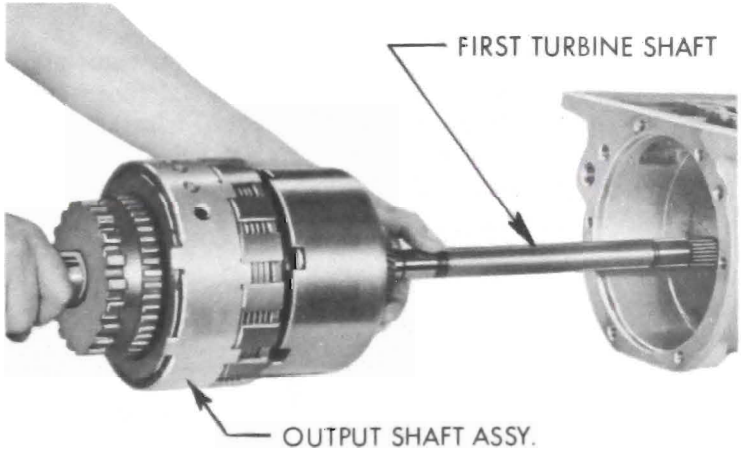
266. If parking lock pawl and shaft were removed, install parking lock pawl, pawl shaft and retaining pin.



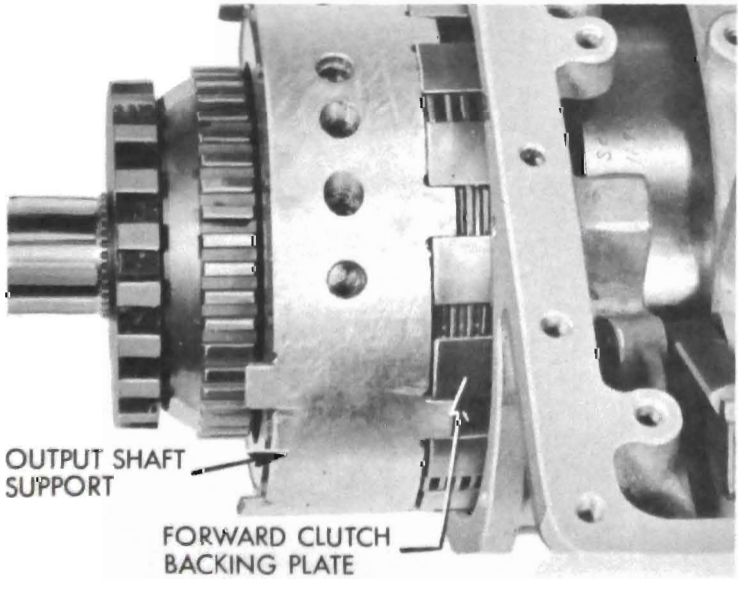
267. Lube oil rings on first turbine shaft, rotate shaft to line up splines and insert in output shaft assembly until last oil ring is inside front planet set sun gear.



268. First turbine shaft correctly installed in front end of output shaft assembly.

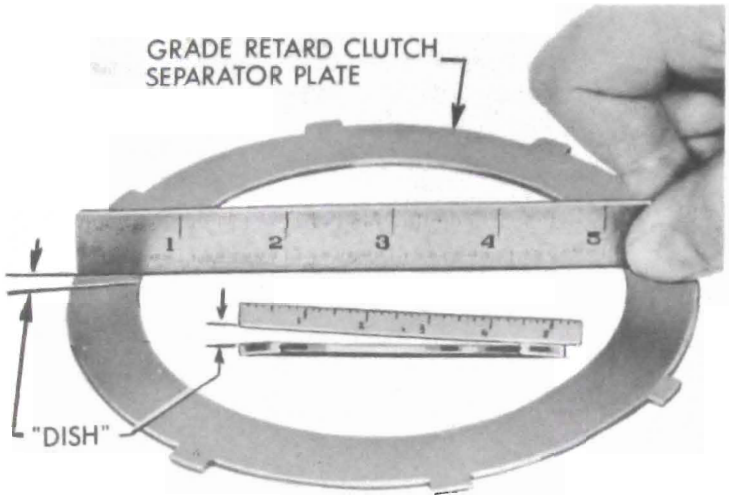


269. Start input and output shaft assembly, input shaft first, into rear of transmission case. Guide front of first turbine shaft through neutral clutch assembly.

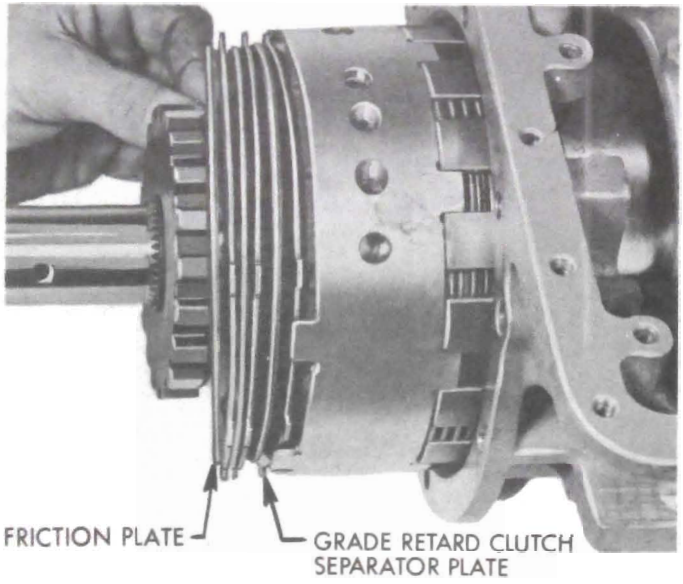


270. Push into case till assembly is in position pictured. Check forward clutch backing plate to be certain it is in contact with output shaft support. Be certain clutch plates are properly positioned in slots in backing plate and oil sleeve holes in support are up.

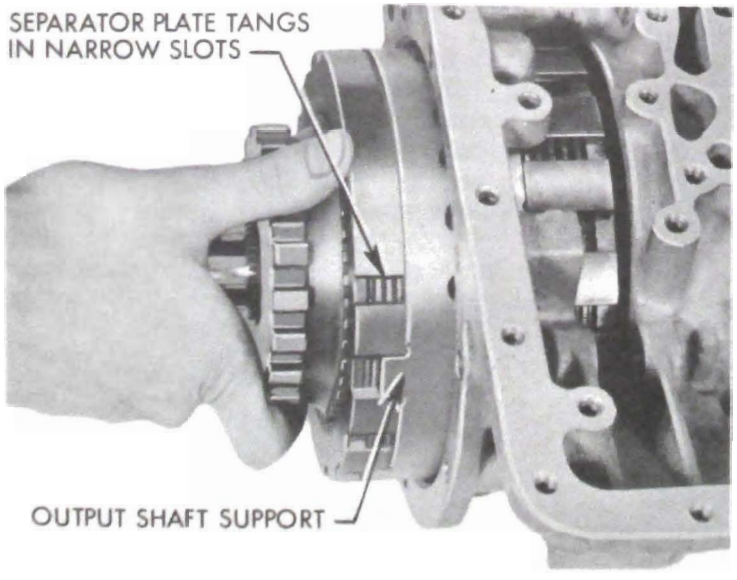
NOTE: Before proceeding with installation, read the following FIVE steps:



271. Check three grade retard clutch separator plates for dish. It makes no difference whether separator plates are installed with dish "in" or "out" but all must be installed same way.

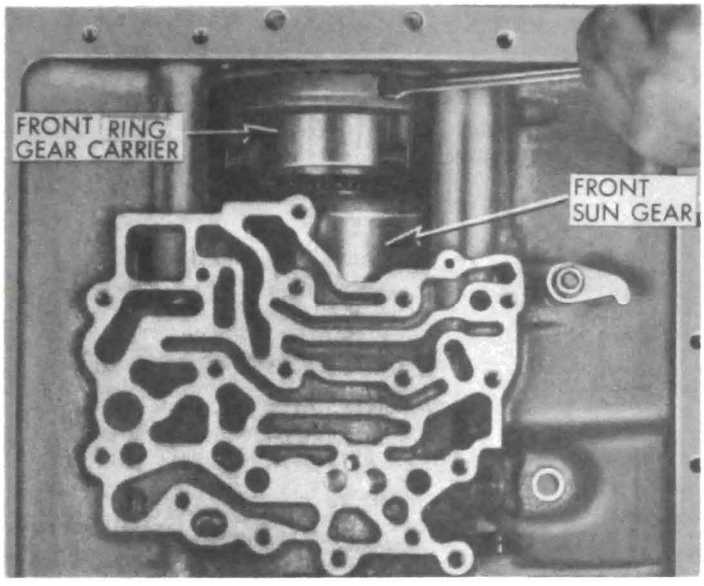


272. Install grade retard clutch separator plate next to piston with center tang of three tangs between lugs of support, then friction plate, separator plate and so on, until three separator plates and three friction plates are installed.

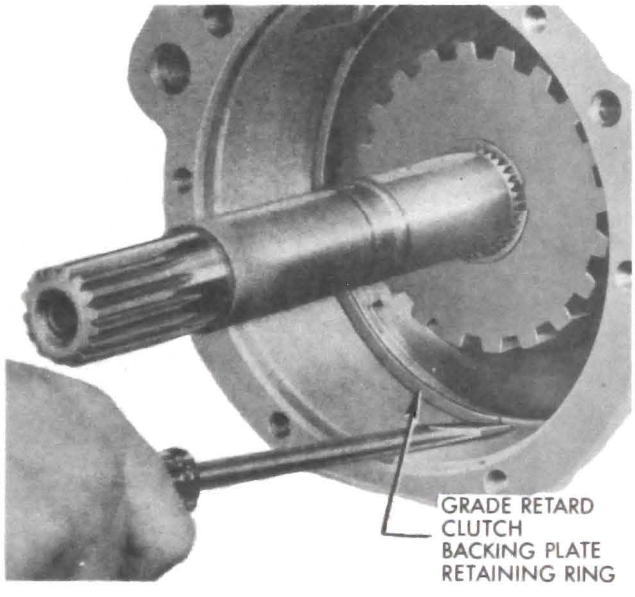


273. Install grade retard clutch backing plate with tangs of separator plates in narrow slots and tangs of output shaft support in wide slots. Hold backing plate firmly in contact with output shaft support and slide assembly into position.

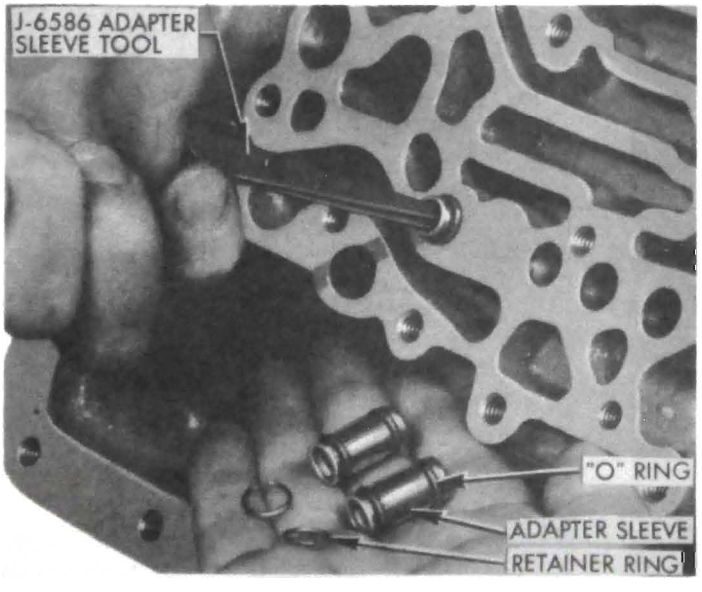
CAUTION: Maintain hand pressure forward on grade retard clutch backing plate at all times until assembly is correctly positioned in case and backing plate retainer ring is installed. If backing plate is allowed to separate from support, clutch pack will fall out of position and complete assembly must be removed from case and reassembled according to instructions.



274. While installing assembly, it may be necessary to rotate front planet set ring gear or carrier with screwdriver to line up teeth on sun gear with front planet pinions. It is not necessary to force assembly into place. Assembly is correctly positioned in case when grade retard clutch backing plate retaining ring can be installed in groove in case.



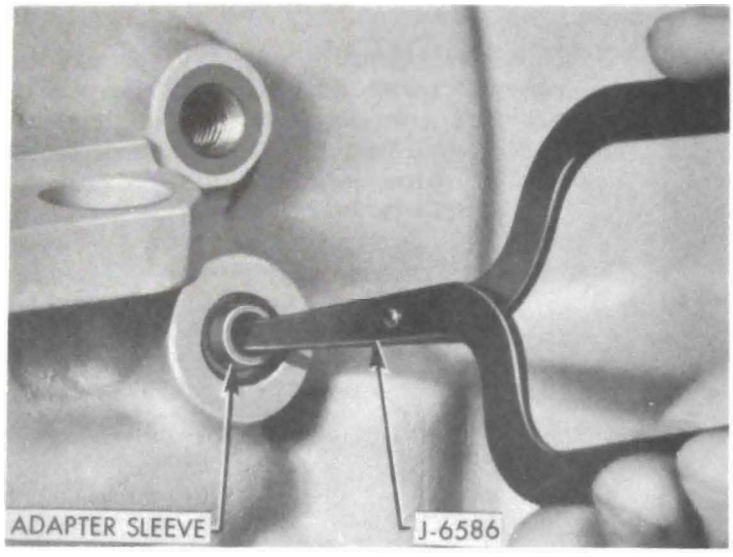
275. Install grade retard clutch backing plate retaining ring solidly in groove of case.



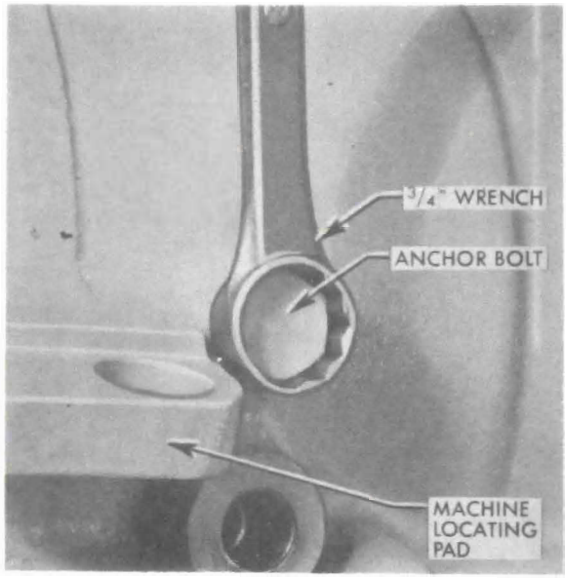
276. Use smooth punch inserted in anchor bolt hole to line up oil sleeve adaptor holes in support with holes in case. Do not use oil adaptor sleeve holes for this purpose.

Lube and install three adaptor sleeves with new O-rings into valve body portion of transmission case using Tool J-6586. Push down firmly to seat adapter sleeves in output shaft support. Install retainer rings above the O-ring sleeve assemblies using a screwdriver to seat retainer rings against sleeve assemblies.

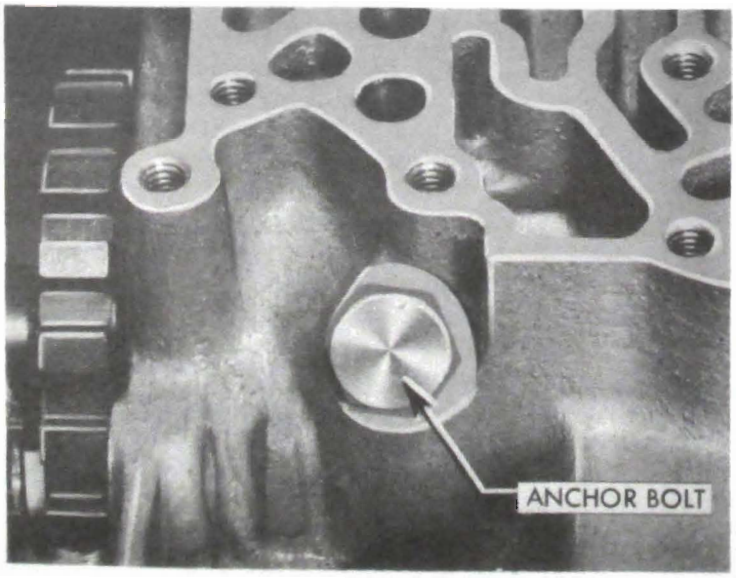
NOTE: Center adaptor sleeve does not enter case as far as outer two.



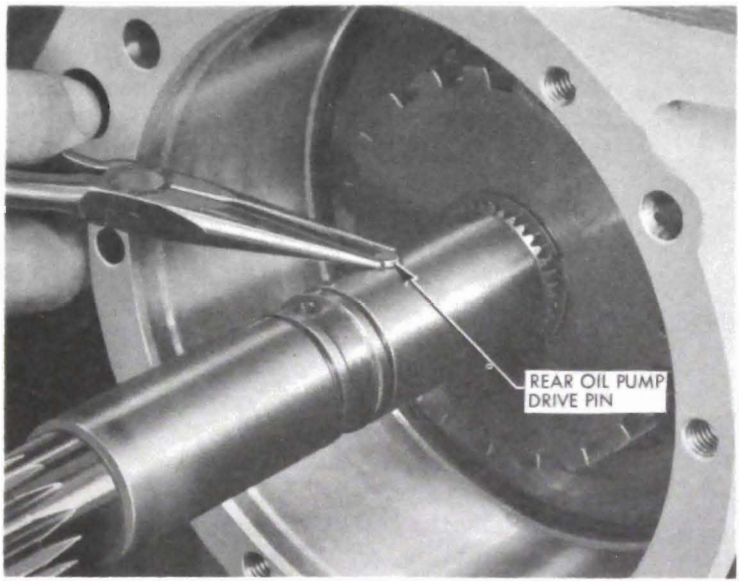
277. Lube and install fourth adapter sleeve with new O-rings at oil cooler return line location using Tool J-6586. Oil adapter sleeve retainer ring is not used at this location.



278. Install outer anchor bolt. Torque to 35 - 40 ft. lbs. (3/4'' wrench).

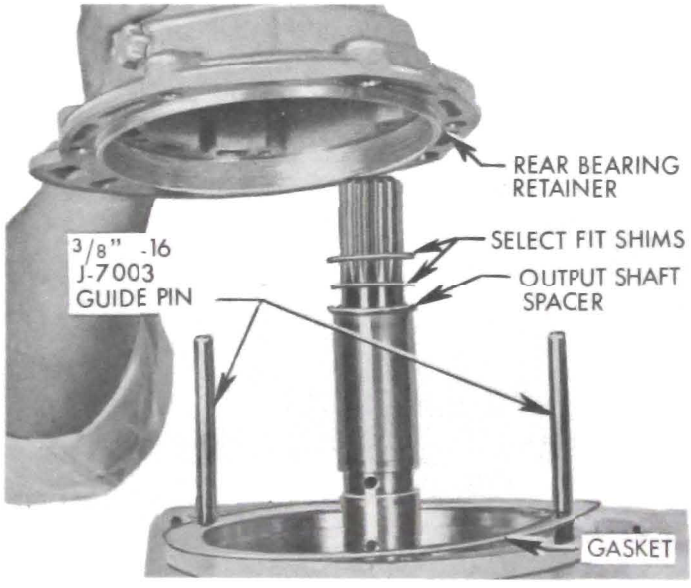


279. Install inner anchor bolt. Torque to 35 - 40 ft. lbs.

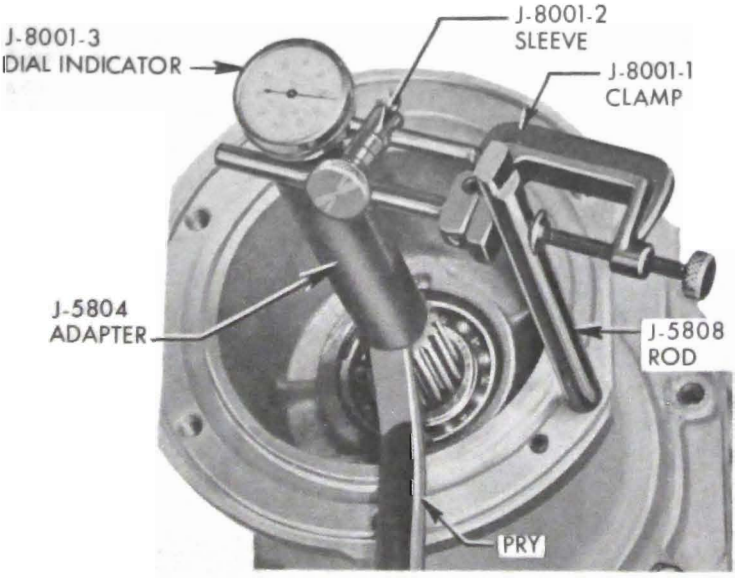


280. Install rear pump drive pin in output shaft.

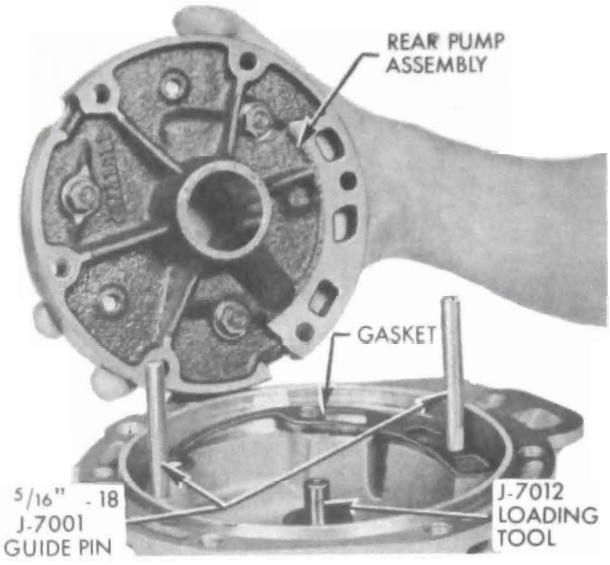
NOTE: If rear oil pump was not removed from rear bearing retainer, proceed with Step 287.



281. If rear oil pump and loading tool were removed from rear bearing retainer, install .120" spacer on output shaft with shims removed from output shaft when transmission was disassembled. Install two guide pins 3/8" - 16, J-7003, gasket and rear bearing retainer without oil pump.

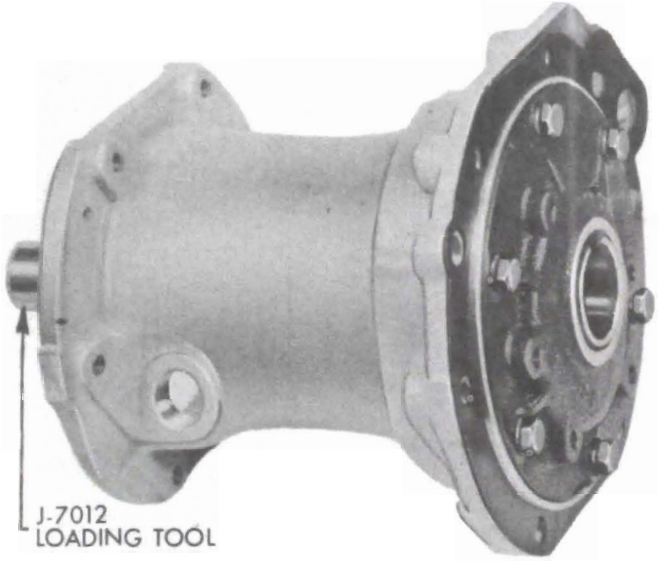


282. Check output shaft end clearance with rear bearing retainer bolted to case with at least two bolts as shown and transmission upside down. Tap several times on output shaft to squeeze out lube used on thrust bearings during assembly. Use J-8001-3 Dial Indicator, Tool 5804 threaded into output shaft and Tool J-5808 threaded into rear bearing retainer. Use pry bar under edge of J-5804 to move output shaft. End play should be .015" to .035". If output shaft end clearance is less than .015", remove rear bearing retainer and install a thinner shim on output shaft. If output shaft end clearance is more than .035", remove rear bearing retainer and install a thicker shim.

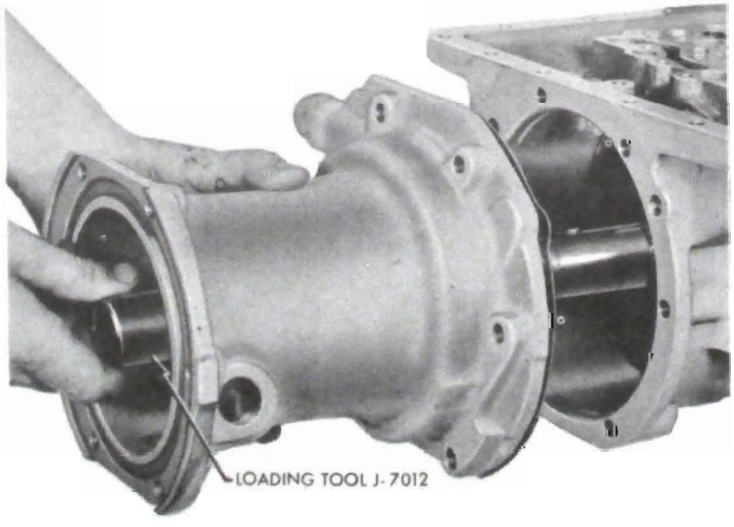


283. When output shaft end play has been measured and brought within limits, remove end play gage setup and remove rear bearing retainer from case. Insert loading tool J-7012 in rear of rear bearing retainer through rear bearing. Slip correct shims and spacers from output shaft onto loading tool with shim next to bearing. Install two 5/16'' - 18 guide pins J-7001 in rear bearing retainer. Install new rear oil pump to rear bearing retainer gasket; observe openings in pump and openings in rear bearing retainer and assemble rear oil pump to rear bearing retainer with six 5/16'' - 18 bolts. Torque bolts to 15 - 20 ft. lbs.

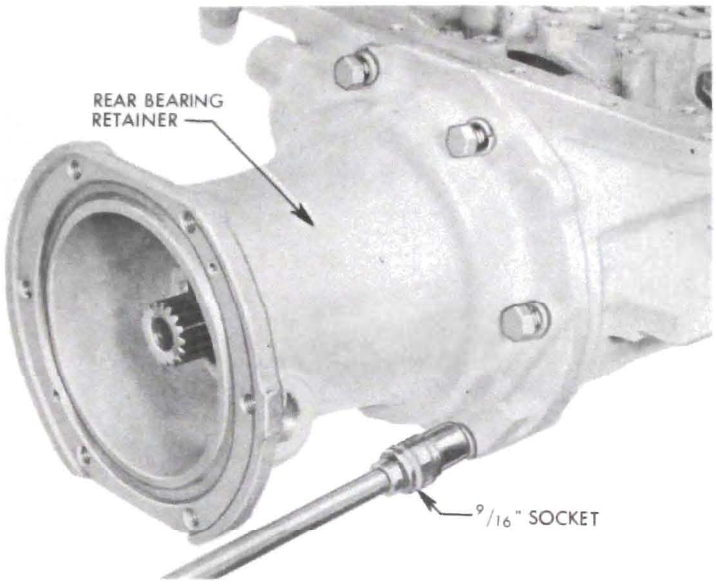
NOTE: Check gasket for correct position before assembling oil pump to rear bearing retainer.



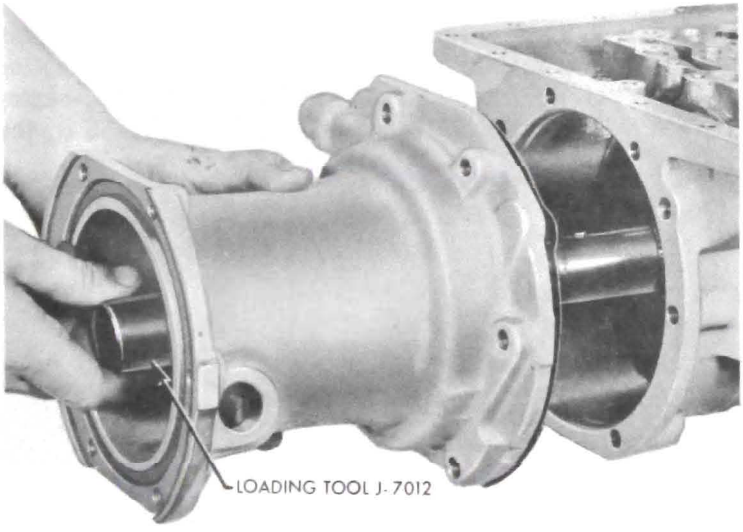
284. Completed rear bearing retainer, rear oil pump assembly with loading tool in place.



285. With rear bearing retainer to case gasket in place assemble rear bearing retainer - rear oil pump assembly to case observing position of slot in oil pump drive gear and driving pin in output shaft. If necessary to turn output shaft to line up pin with oil pump drive gear, turn parking lock ratchet wheel. Hold loading tool forward while sliding bearing retainer onto output shaft to transfer spacer and shims onto output shaft.

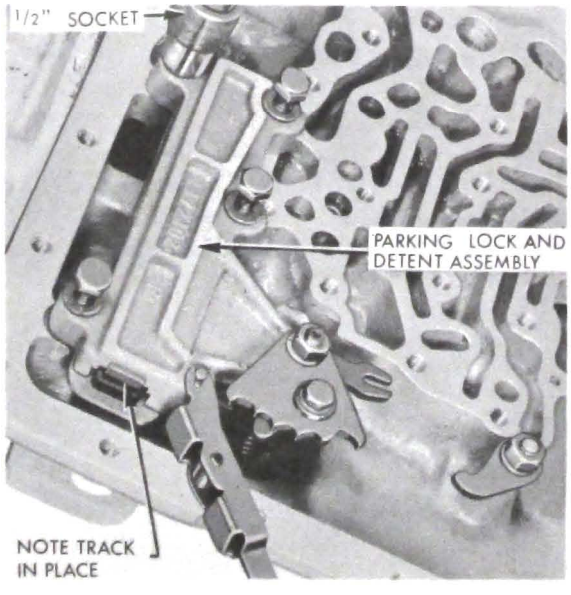


286. Remove loading tool and install six rear bearing retainer to case bolts. Torque alternately and evenly to 25 - 30 ft. lbs.

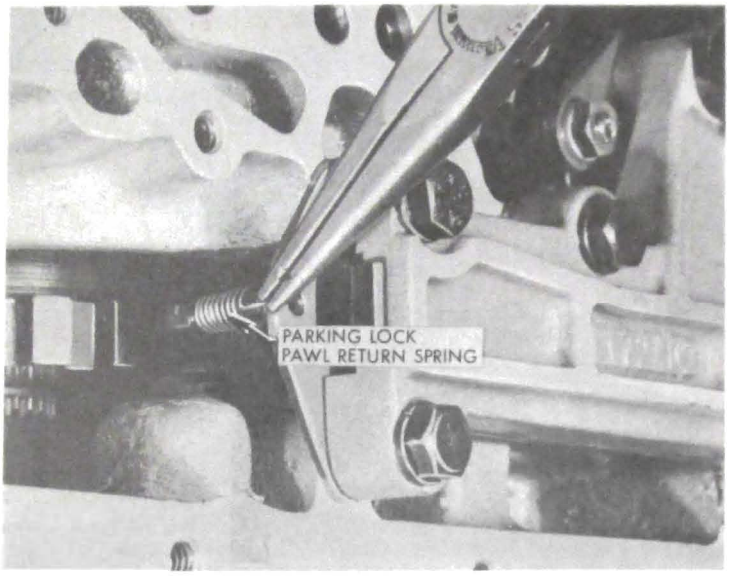


287. IF REAR OIL PUMP WAS NOT REMOVED from rear bearing retainer and loading tool was left in rear bearing retainer, assemble rear bearing retainer to transmission case with new gasket and at least two bolts (9/16'' socket). Observing drive pin and slot in oil pump drive gear, hold loading tool forward during assembly of rear bearing retainer. Check output shaft end clearance as outlined above. If output shaft end clearance is within .015'' to .035'' limits, install remaining bolts and torque all six bolts alternately and evenly to 25 - 30 ft. lbs.

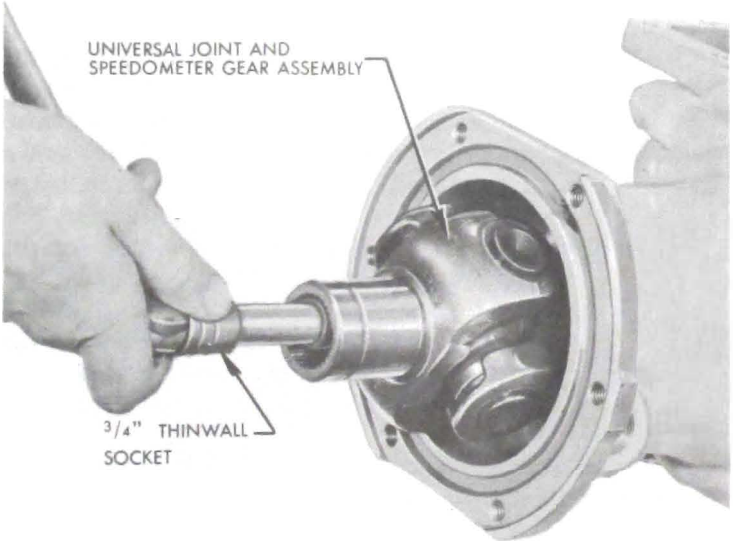
If end clearance is not within limits, rear bearing retainer and rear pump must be removed and end clearance corrected as outlined above.



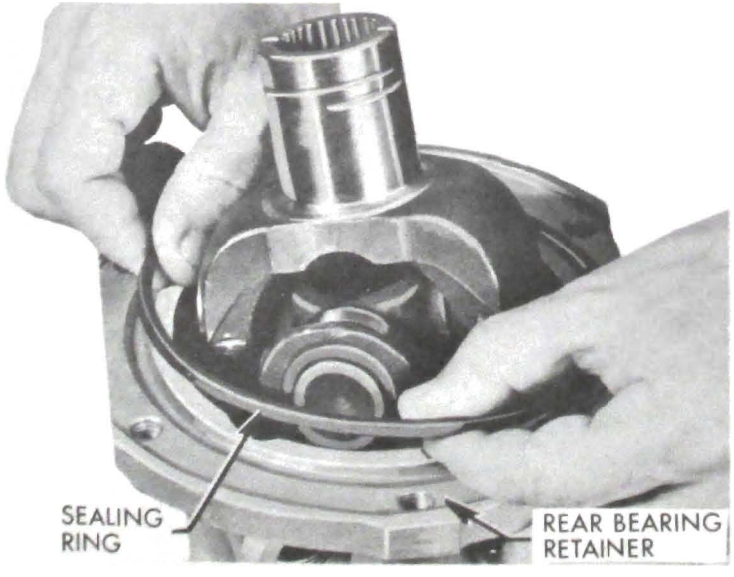
288. Install properly assembled parking lock mechanism to case with four bolts 5/16''-18. Torque bolts to 15 - 20 ft. lbs. (1/2'' socket).



289. Install parking lock pawl return spring.

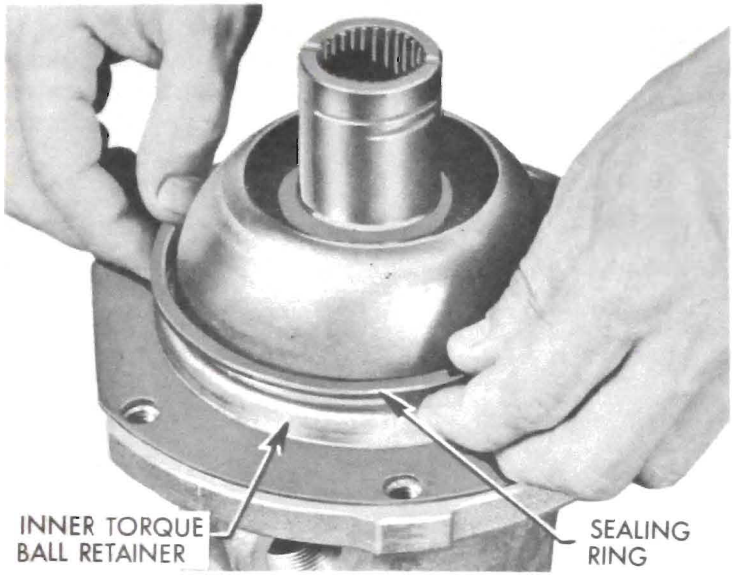


290. Engage parking lock pawl. Install U-joint and speedo gear assembly with special drilled U-joint bolt, lock washer and plain washer using 3/4" thin wall socket. Torque to 50 - 55 ft. lbs.

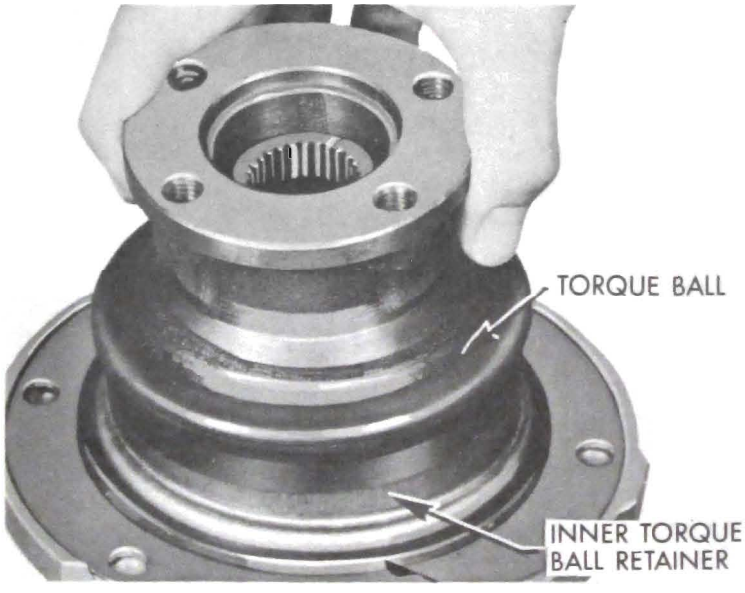


REAR BEARING RETAINER - TORQUE BALL INSTALLATION

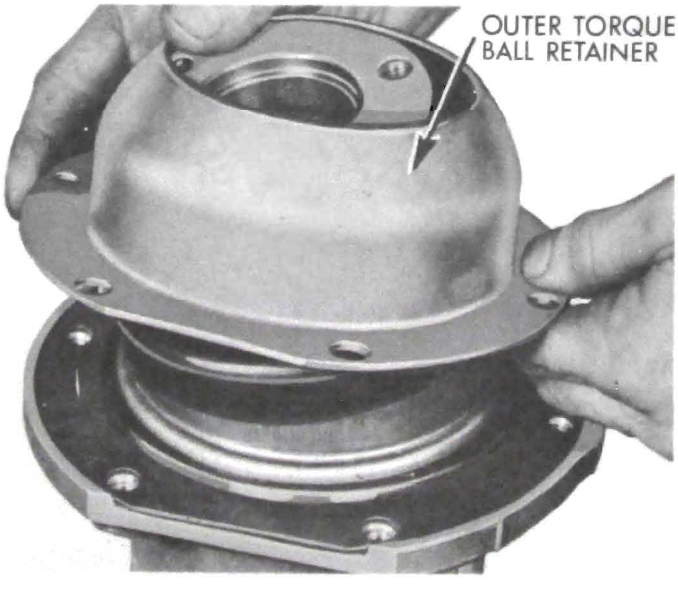
291. With transmission rear end "up", use heavy lube and install inner torque ball retainer to rear bearing retainer sealing ring in groove of rear bearing retainer. Install inner torque ball retainer on rear bearing retainer.



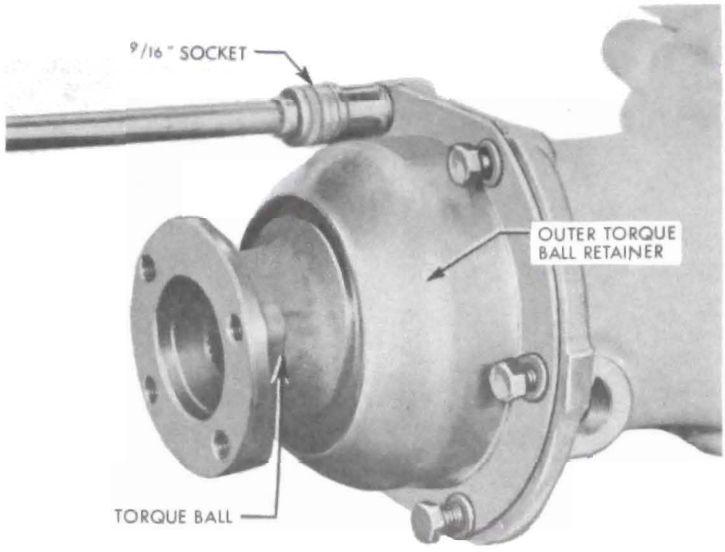
292. Install new sealing ring on outside of inner torque ball retainer.



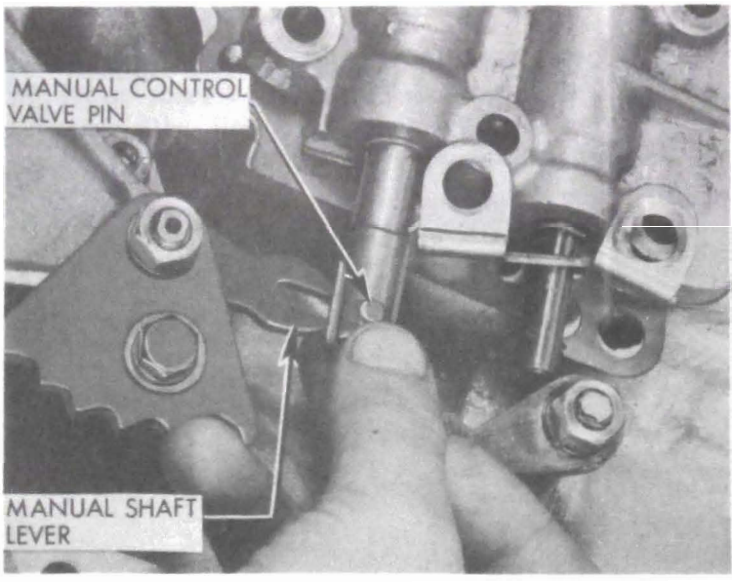
293. Liberally lubricate inside of torque ball and install over U-joint and inner torque ball retainer. Position torque ball with drain slot down as transmission is installed in car.



294. Install outer torque ball retainer over torque ball.

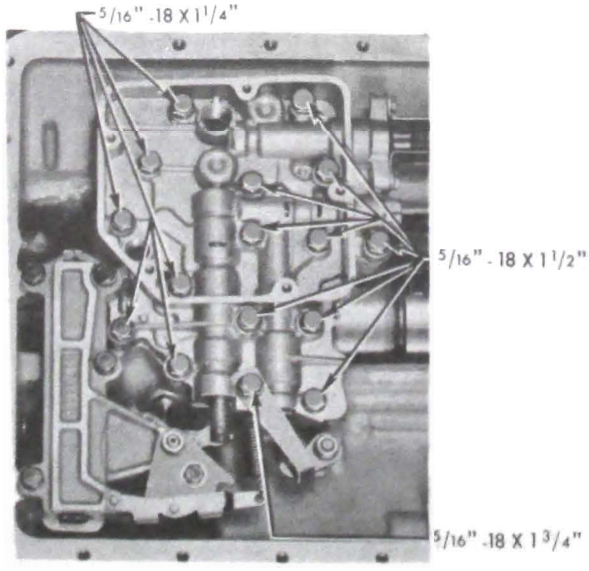


295. Install torque ball bolts using 9/16" socket but do not tighten until transmission is installed in car to facilitate coupling of torque tube and propeller shaft.



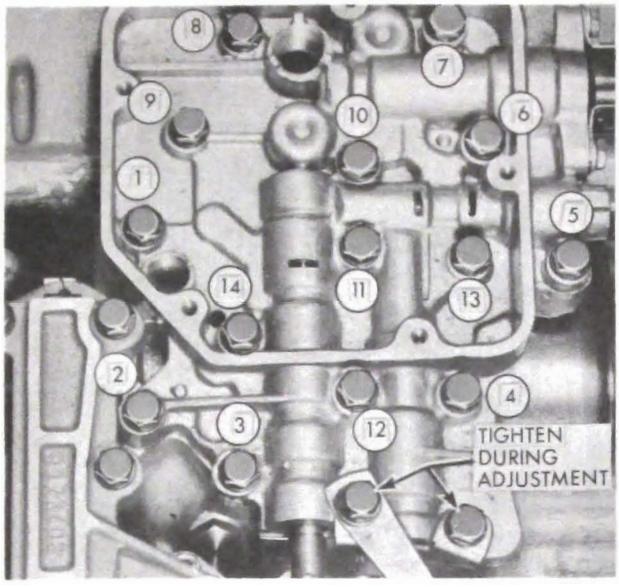
VALVE BODY INSTALLATION

296. With transmission upside down, use new gasket and carefully install valve body assembly. Engage slot in shift lever with slot and pin in manual control valve.

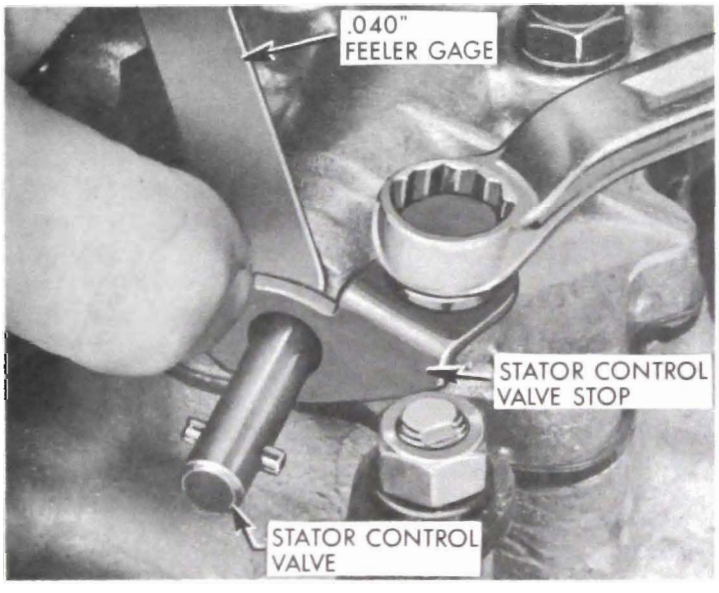


297. Install bolts and lever stop as shown but do not tighten.

NOTE: Special washer under head of lever stop clamp bolt.

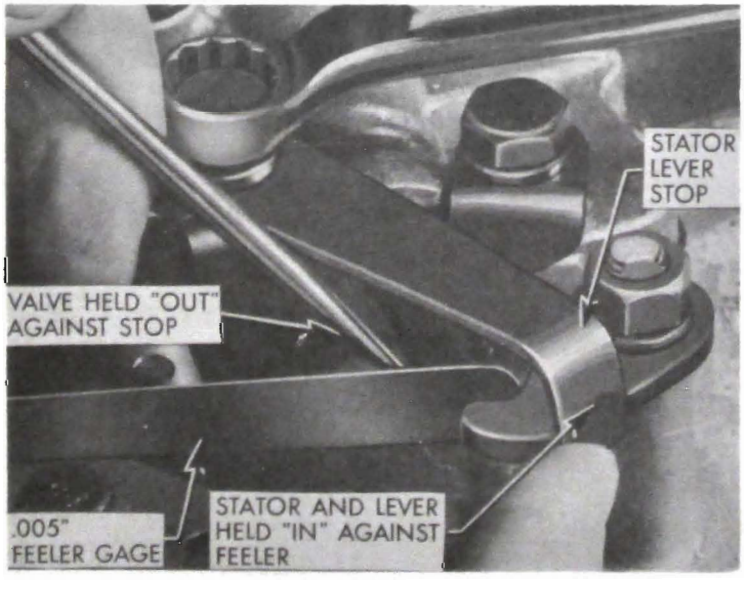


298. Torque all valve body bolts to 15 -20 ft. lbs. in sequence shown except two bolts on stator stop (1/2'' socket). Check for free operation of shift control valve.



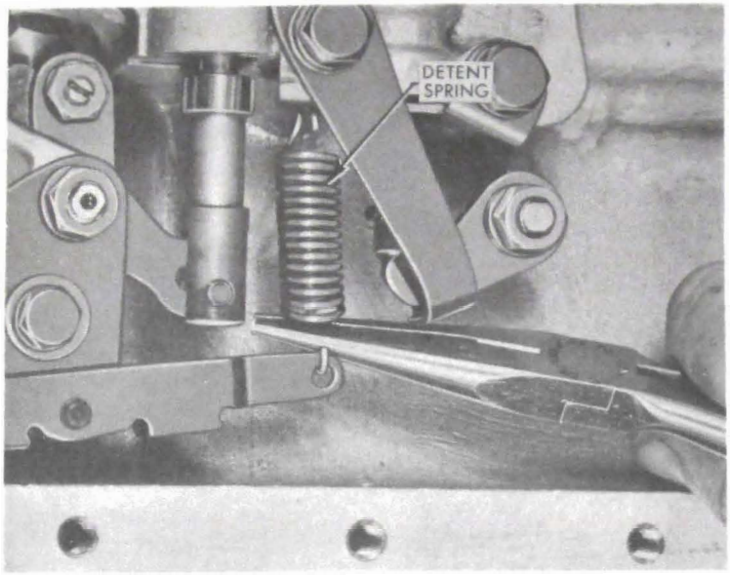
STATOR VALVE ADJUSTMENT

299. Swing lever stop aside and slip .040'' feeler gauge into position between valve body and valve stop. Press stator valve stop toward valve body and hold in this position by tightening forward bolt as shown (1/2'' wrench).

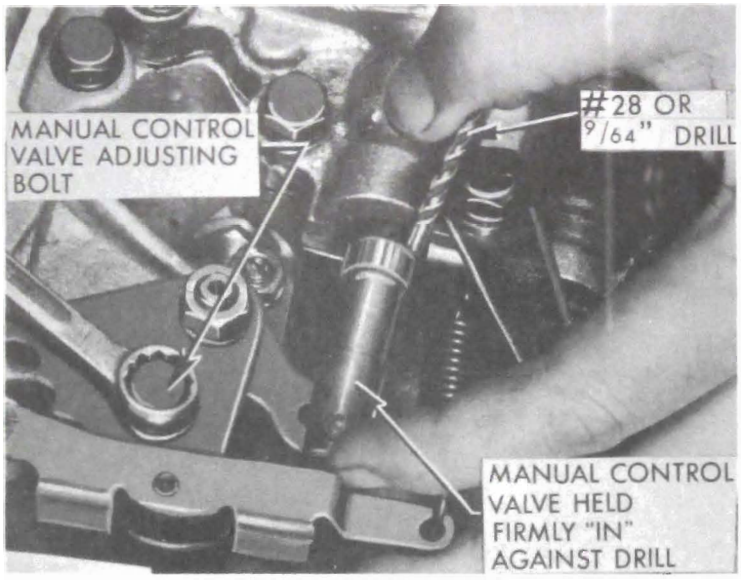


STATOR CONTROL LEVER STOP ADJUSTMENT

300. Position lever stop over stator control lever. Place .005'' feeler gauge between end of stator valve and lever. Hold valve ''out'' and lever stop against lever. Tighten lever stop clamp bolt in this position (1/2'' wrench).

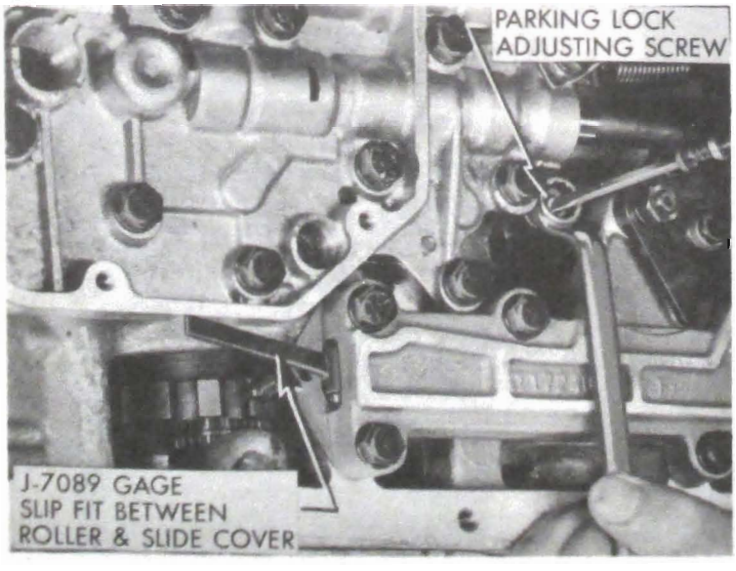


301. Install detent spring.



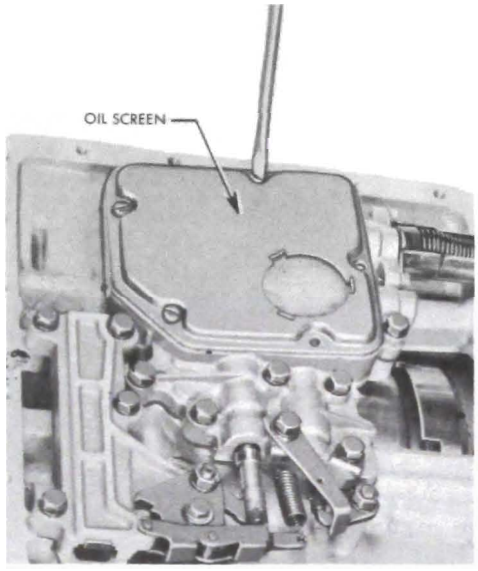
MANUAL SHIFT VALVE ADJUSTMENT

302. With transmission in "Park" position, (detent plate rotated rearward to last notch) loosen manual control valve adjusting bolt (7/16" wrench), insert 9/64" drill between inner edge of first land of manual valve and valve body; hold valve "in" toward valve body with drill in position; at same time hold detent lever solidly in notch, and tighten adjusting bolt with valve in this position.

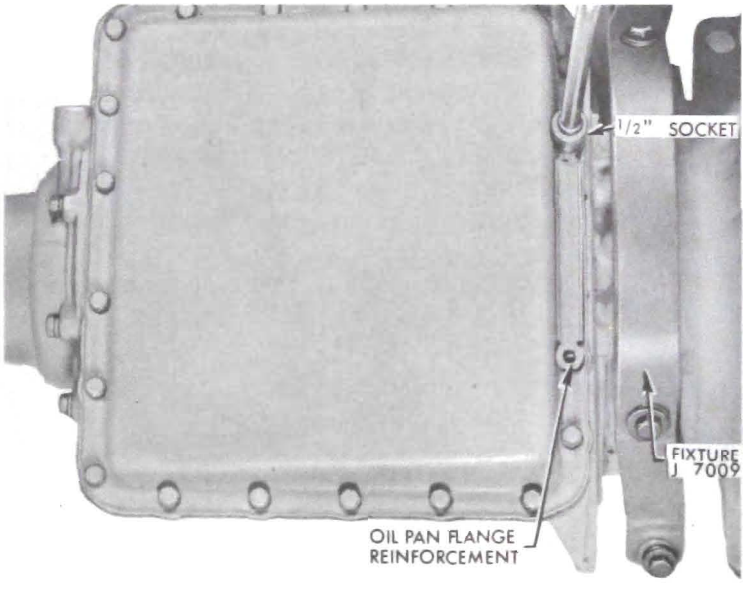


PARKING LOCK ADJUSTMENT

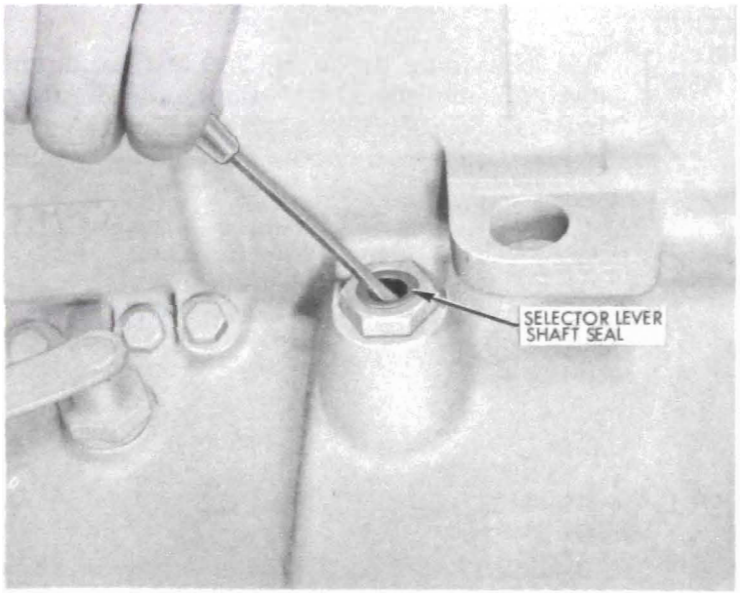
303. With transmission in park position, loosen parking lock adjusting screw - insert .067" gauge J-7089 between parking lock roller and slide cover. Turn eccentric screw to give .067" clearance between roller and slide cover. Hold screw in this position and tighten nut (7/16" wrench). This adjustment insures proper engagement of parking lock pawl.



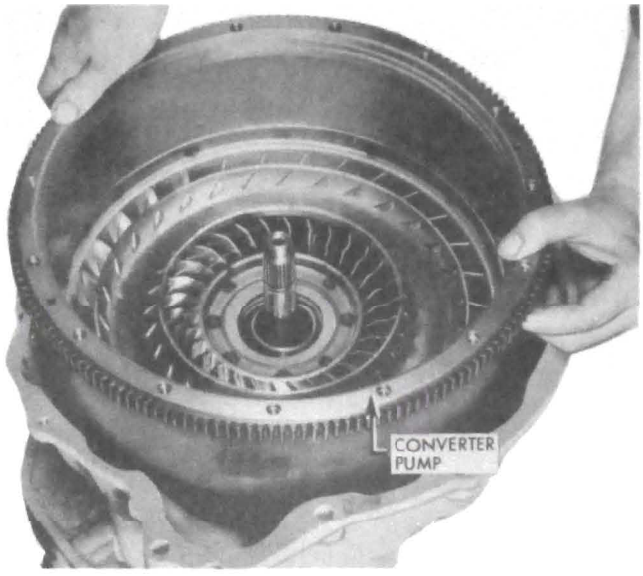
304. Install oil screen and five oil screen screws.



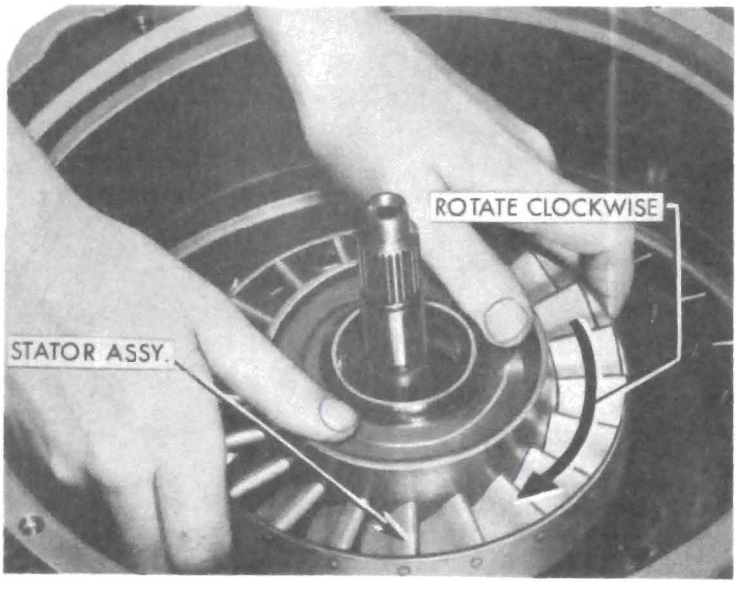
305. Install new oil pan gasket, oil pan, oil pan flange reinforcement and 20 oil pan bolts (1/2'' socket). Torque to 10 - 12 ft. lbs.



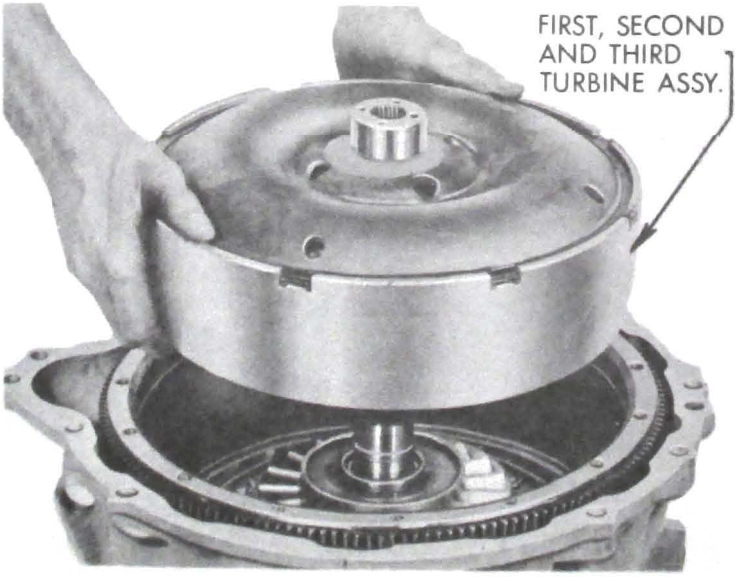
306. Install selector shaft seal and selector lever.



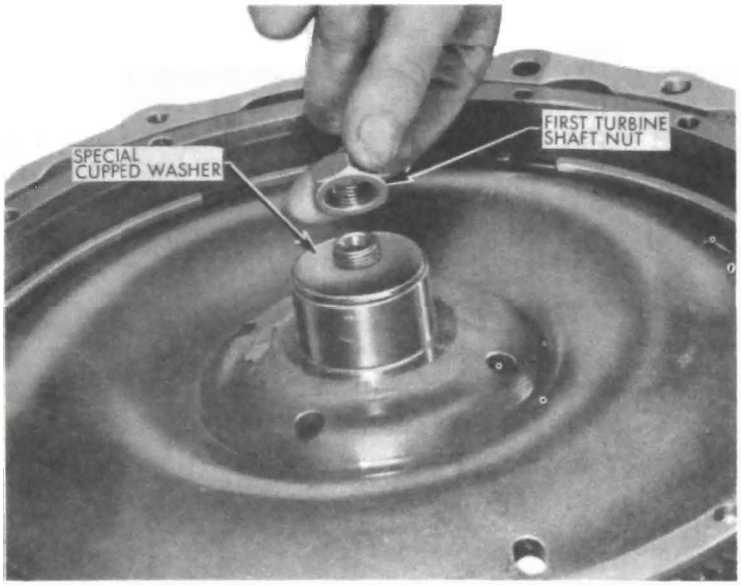
307. With transmission front end up, carefully install converter pump in transmission case and rotate to engage lugs of pump hub with front pump drive gear.



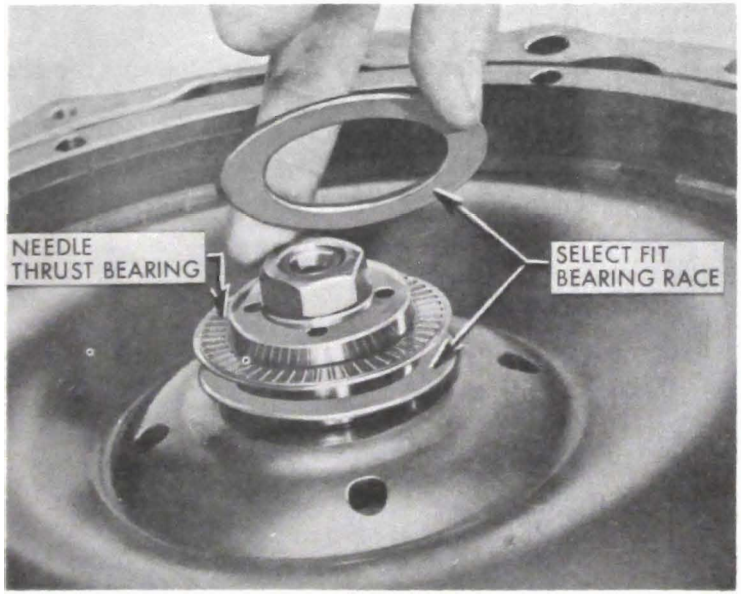
308. With needle thrust bearing (2 1/4'' I.D. X 3'' O.D.) and race in place, install stator assembly on reaction shaft. Stator must rotate clockwise and lock on counterclockwise rotation. Press down and rotate stator.



309. Carefully lower lst, 2nd and 3rd turbine assembly into place with flanged needle thrust bearing and .050'' (thickest) bearing race held in place on second turbine hub with heavy lube. Rotate turbine assembly to align splines.

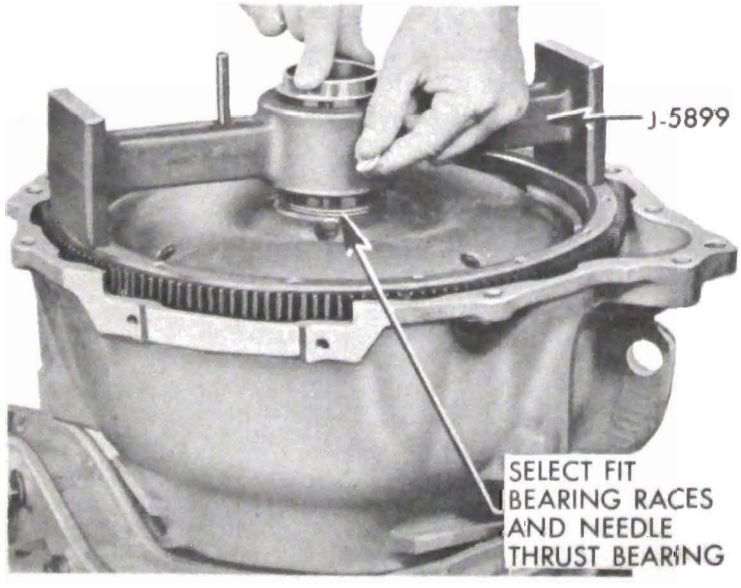


310. Install new special washer on first turbine shaft. Install and torque first turbine shaft nut to 45 - 50 ft. lbs. using U holder (15/16'' socket).

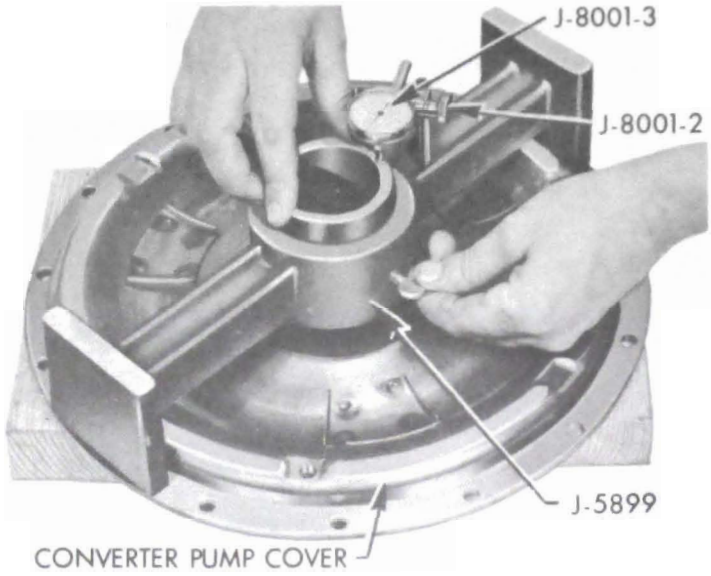


311. Position two select fit plain bearing races on first turbine hub with needle thrust bearing (1 3/4''I.D. X 2 1/2''O.D.) between the races.

NOTE: The select fit bearing races are available in .030'', .040'' and .050'' thicknesses.

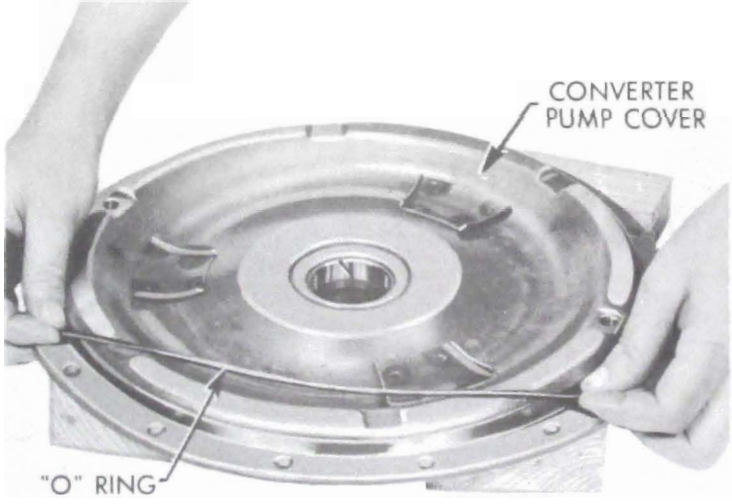


312. Set converter clearance gauge J-5899 in place with small diameter of sleeve up and loosen set screw, push sleeve down to firmly seat, tighten set screw.

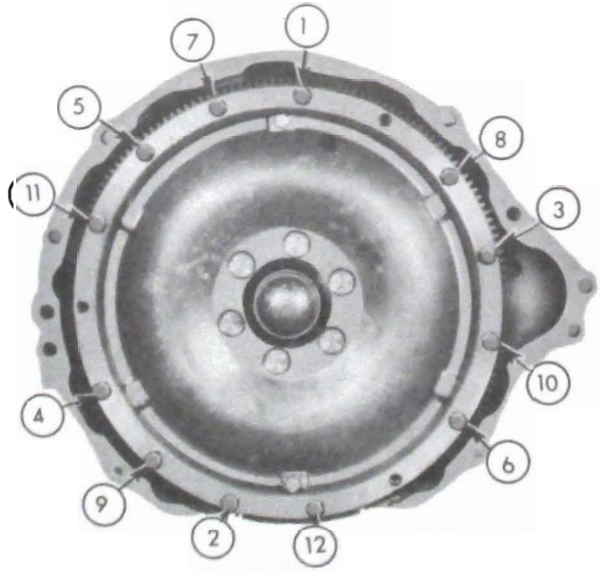


313. Remove gauge from first turbine hub - invert gauge and place on suitably supported converter pump cover. Assemble dial indicator to post. Place plunger of indicator on gauge sleeve. "Zero" gauge. Loosen sleeve set screw, push sleeve down. Reading on dial indicator is total converter clearance.

If indicator reading is less than .004" change select fit bearing races to a thinner size. If indicator reading is more than .017" change select fit races to a thicker size.



314. Install new O-ring on converter pump cover.



315. Assemble converter pump cover in same position as when removed. Install converter pump cover to pump bolts and tighten in sequence as shown. Torque to 35 - 40 ft. lbs.