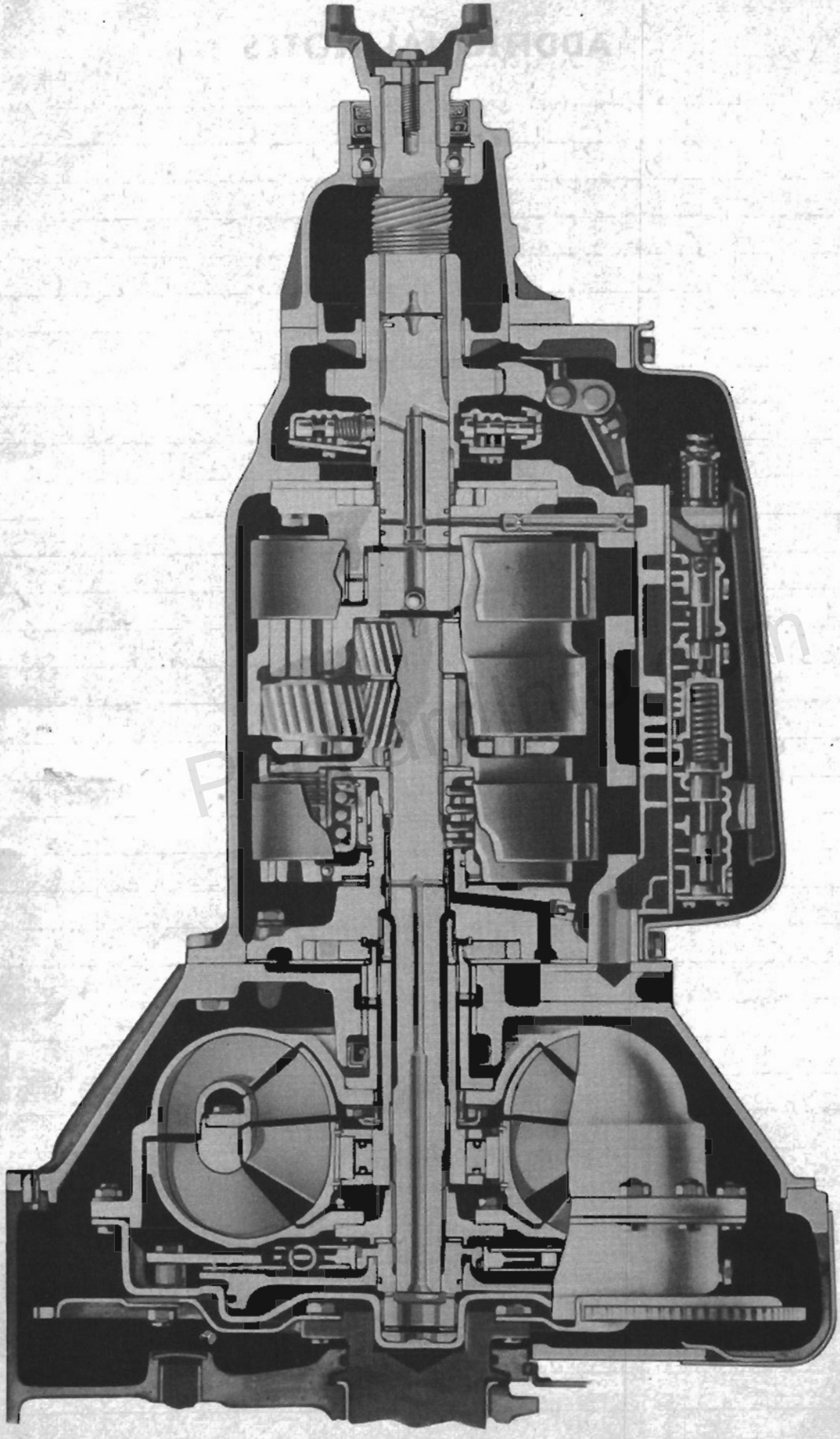

FIG. 242 CROSS SECTION VIEW OF ULTRAMATIC TRANSMISSION

ULTRAMATIC

The two major assemblies of the Twin Ultramatic used in models with the 352 cu. in. engine are: (1) the torque converter which provides for a smooth transfer of power through use of fluid, supplies a range of torque multiplication, and at higher car speeds couples the engine to the transmission input shaft through a direct drive clutch to by-pass the fluid elements of the converter; (2) a hydraulically controlled planetary transmission which provides two forward ratios and one reverse ratio.

WHAT IT IS AND HOW IT OPERATES

Torque Converter Assembly

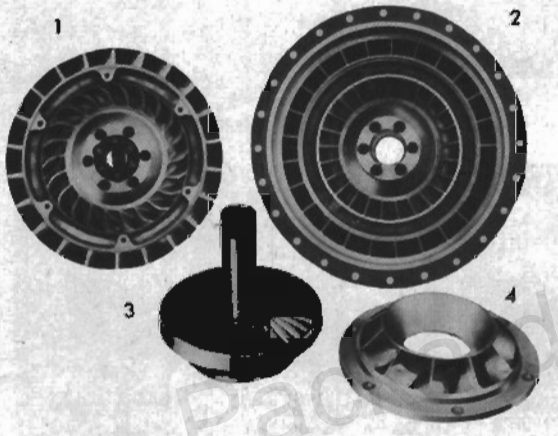

FIG. 243

1. First turbine
2. Pump
3. Reactor
4. Second turbine

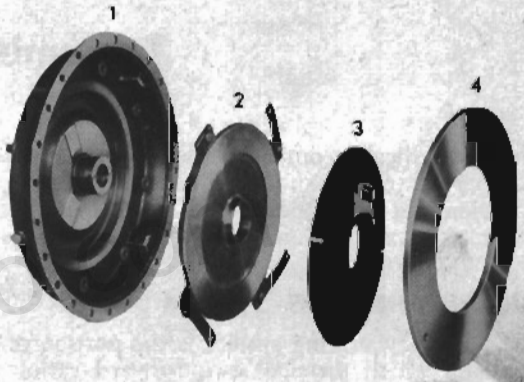

FIG. 244

1. Housing
2. Piston
3. Driven plate
4. Backing plate

The torque converter consists of: a pump, (driving member) (2, Fig. 243) connected to the engine crankshaft; a first and second turbines (driven members) (1 and 4) splined to the transmission input shaft; a reactor (reaction member) (3) connected to the pump body through a freewheel unit; a direct drive clutch housing (1, Fig. 244) which contains a clutch piston (2), driven plate (3), and a backing plate (4).

The pump and clutch housing are bolted together and enclose the other members of the converter. The unit is entirely filled with fluid from the transmission during operation.

When the converter is in operation, the rotation of the converter pump causes the swirling motion, or vortex flow, of the oil across the gap to strike the vanes of the first turbine in such a manner that the momentum and energy of the oil forces the turbine to rotate in the same direction as the pump.

As the oil leaves the first turbine, it is traveling in a direction opposite to the rotation of the first turbine and also to the second turbine which is bolted to the first turbine.

If this so-called "backward" oil flow was admitted into the second turbine at this time, it would oppose the rotation of the turbine resulting in a loss of power. Therefore, some means of changing the direction of oil flow is required before the oil enters the second turbine.

The change in direction of the oil flow is accomplished by the "reactor" located between the first and second turbines and which operates through an overrunning sprag-type clutch in its hub.

When starting the car in motion or when accelerating, the force of the oil leaving the first turbine strikes the vanes of the reactor in a "backward" direction causing the clutch sprags to wind up and lock the reactor in place. With the reactor stationary, its curved vanes change the direction of oil flow as it leaves the first turbine so that the flow is in the same direction as that of the first and second turbines and actually offering assistance to both turbines.

The oil leaving the reactor enters the second turbine at great velocity where the remaining energy in the oil is absorbed to increase the total power output of the converter. Because practically all of the energy has been absorbed from the oil by the time it leaves the second turbine, it offers no opposition as it re-enters

the pump where the flow cycle is repeated.

At steady car speeds when the turbines are rotating at approximately the same speed as the pump, the velocity of vortex oil flow is greatly reduced and the effects of the reactor are not needed. Since the reactor is operating through an overrunning clutch, it can rotate with both turbines. At this time the oil flow is almost entirely rotary and the assembly is operating with fluid coupling characteristics and no torque multiplication.

It is this cycle of oil flow through the converter that permits greater engine speed with relatively lesser propeller shaft speed. This multiplies the torque or twisting force of the engine crankshaft.

At higher car speeds the direct drive clutch, when engaged, provides a direct driving connection between the engine flywheel and the transmission input shaft eliminating slippage. This feature also permits the engine to act as a brake to reduce car speed on deceleration.

The direct drive clutch consists primarily of a combination piston and pressure plate, a stationary driving plate and a driven plate faced with friction material. These details are all contained in the direct drive clutch housing. Engagement of the direct drive clutch is accomplished by oil pressure acting on the piston to lock the three units together. This permits engine torque to be transmitted to the transmission input shaft at a 1 to 1 ratio in direct drive. Disengagement of the clutch is brought about by releasing the oil pressure on the front side of the piston and forcing the piston forward to the disengaged position by the oil pressure within the torque converter on the rear side of the piston. The driven plate is slightly "coned" to provide a quick breakaway or disengagement of the clutch when the pressure is cut off.

Transmission Assembly

The hydraulically controlled transmission assembly is made up of several sub-assemblies enclosed in the transmission case. The operation of each of these sub-assemblies is covered herein.

PLANETARY DRIVING SYSTEM

The planetary driving system is the portion of the transmission which provides two forward ratios and the reverse ratio required to meet all operating conditions.

This system basically consists of a compound planetary gear train, low range and reverse brake and bands and a multiple disc high range clutch. The combination of these units has the following functions to perform:

(1) To reverse the direction of propeller shaft rotation to move the car backward.

(2) To provide a means for obtaining gear reduction with a resultant increase in engine RPM and torque for rapid acceleration, if desired, when starting from a standstill.

(3) To provide an emergency low gear for operation under heavy engine loads such as when pulling through deep sand and also for ascending and descending steep grades.

(4) To act as a direct or solid driving coupling for high range operation.

Planetary Gear Train

The planetary gear train (see Fig. 245) consists of a driving sun gear (rear sun gear), a low range reaction sun gear (front sun gear), three long and three short pinions, a planetary cage and a ring gear.

The rear sun gear is the driver and is in mesh with the long planetary pinions. The long pinions mesh with the short pinions and the short pinions, in turn, mesh with the front sun gear and the internal tooth ring gear. The pinions are carried in the planetary cage

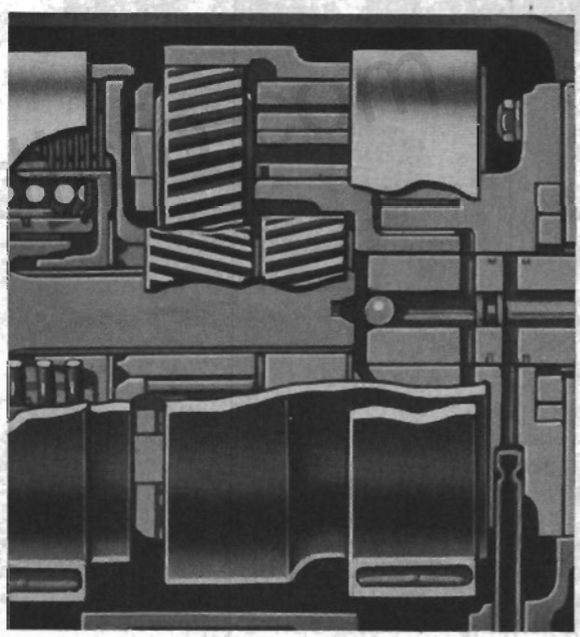

FIG. 245

which is integral with the transmission output shaft. The driving sun gear (rear sun gear) is splined to, and always rotates with, the transmission input shaft. The front sun gear is indirectly attached to the input shaft through the medium of the high range clutch and low range drum assembly. This front sun gear rotates with the input shaft at times and at other times is held stationary.

During high range operation (see Fig. 246), the high range clutch plates are compressed and locked together and the clutch assembly must rotate with the input shaft. The front sun gear, being flanged to the clutch assembly, also must rotate with the input shaft. The rear sun gear is directly splined to the

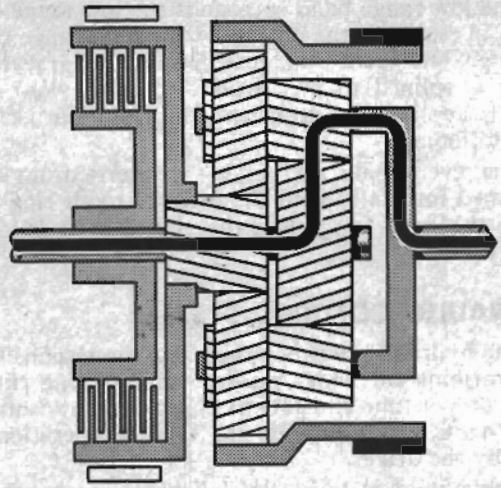

FIG. 246 POWER FLOW IN HIGH

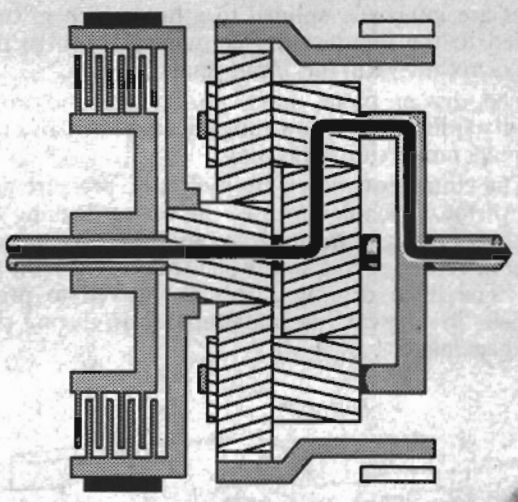

FIG. 247 POWER FLOW IN LOW

input shaft which means that it must always rotate with the shaft. When the two sun gears are locked together and rotating with the input shaft, the planetary gear train is locked up. This causes the entire planetary driving system to rotate as a solid coupling with no gear reduction.

During low range operation (see Fig. 247) the low range band is applied holding the high range clutch housing (low range drum) stationary. The front sun gear which is flanged to the clutch housing, also remains stationary.

The rear sun gear, being directly splined to the input shaft, turns with the shaft and rotates the long planetary pinions. The long pinions, in turn, rotate the short pinions which are in mesh with the front sun gear. Since the short pinions cannot rotate the front sun gear, because it is being held stationary, they "walk" around the gear. This results in the short pinions driving the planetary cage and output shaft at a reduced speed and in the same direction of rotation as that of the input shaft.

In reverse operation (see Fig. 248), the reverse band is applied holding the integrally-formed reverse drum and ring gear stationary. The rear sun gear, splined directly to the input shaft, turns with the shaft and rotates the long planetary pinions. The long pinions, in turn, rotate the short pinions which also mesh with the ring gear which is being held stationary and they "walk" within the ring gear. In doing so, they drive the planetary cage and output shaft at a reduced speed in a direction opposite to the rotation of the input shaft.

In neutral, the high range clutch is disengaged and both the low range band and the reverse band are free. At this time, no member of the planetary system is being held nor are any two members locked together. All gears rotate freely with no force being transmitted to the output shaft; consequently, there is no movement of the car.

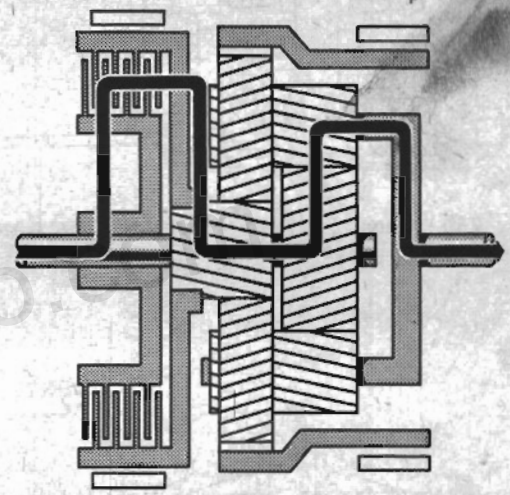

FIG. 248 POWER FLOW IN REVERSE

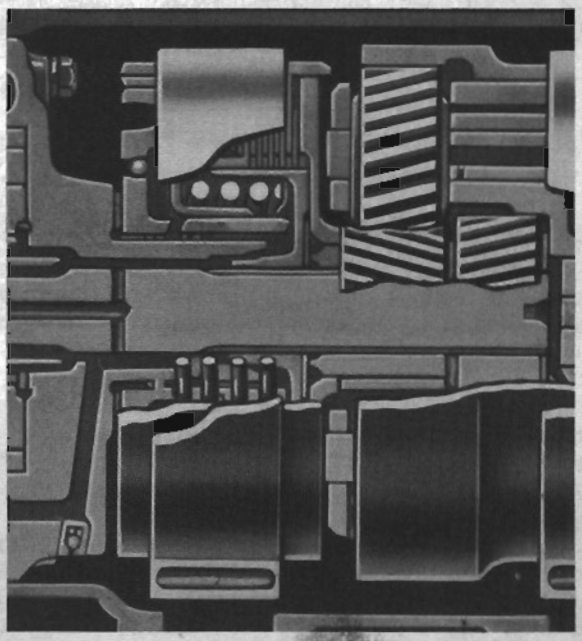

FIG. 249

High Range Clutch

The high range clutch is of the multiple disc type (see Fig. 249).

One-half the number of plates are driving plates and have facings attached to both sides. The driving

plates are internally splined to a hub which in turn is splined to the input shaft; consequently, these plates always rotate with the input shaft.

The driven plates have no facings and are externally splined to the low range drum which also forms the high range clutch housing.

The clutch is engaged by hydraulic pressure acting on a piston which compresses the plates, locking them together. Disengagement is accomplished by means of a piston return spring and by cutting off the oil pressure. The lined driving plates are waved to provide a quick "breakaway" or plate separation during clutch disengagement.

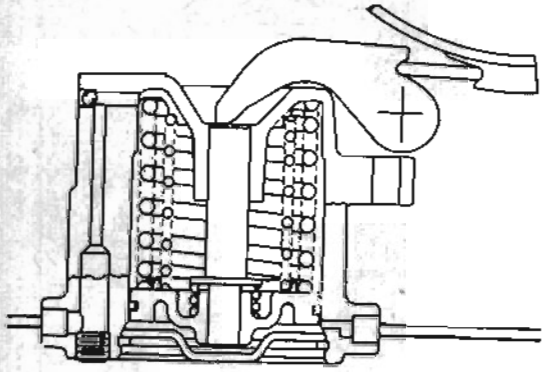

FIG. 250 CROSS SECTION THROUGH LOW RANGE BRAKE

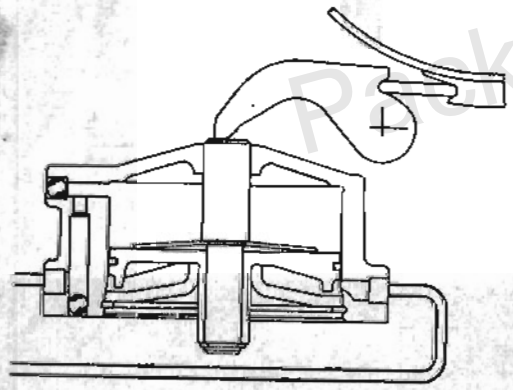

FIG. 251 CROSS SECTION THROUGH REVERSE BRAKE

Low Range and Reverse Brakes and Bands

The low range brake (see Fig. 250) incorporates a piston with a single aluminum piston ring. Application and release is by means of oil pressure with assist springs on the release side of the piston to obtain a quick "breakaway."

The reverse brake (see Fig. 251) also incorporates a piston with a single aluminum piston ring. Application and release of the brake is by means of oil pressure directed either above or below the piston as required.

Both the low range and the reverse bands incorporate composition linings moulded to the inside of the band. One end of both bands remains stationary while the other end is free to be moved hydraulically to tighten and apply the bands.

The low range band surrounds the low range drum which in reality is the outside of the high range clutch housing. The front sun gear has an integral flange which is splined to this drum. When the low range band is applied, the drum and the front sun gear are held stationary.

The reverse band surrounds the reverse drum which is formed integrally with the internal tooth ring gear. When the band is applied the ring gear is held stationary.

HYDRAULIC CONTROL SYSTEM

The hydraulic control system has the responsibility of furnishing oil under pressure and routing this oil at the proper time and rate to the various transmission components which provide the type of operation selected by the driver.

The system includes the following components or units which operate in conjunction with the brake assemblies, high range clutch and direct drive clutch previously described.

(1) Two rotor type oil pumps.
(2) Two governors.
(3) Hydraulic control valves.

Oil Pumps

The front oil pump (see Fig. 252), driven at engine speed, is larger and has a greater capacity than the rear oil pump. Under normal operating conditions, the front pump furnishes oil under pressure during all operations in which the converter functions as a driving member. At this time, the system demands a greater quantity of oil than it does when the converter is inactive.

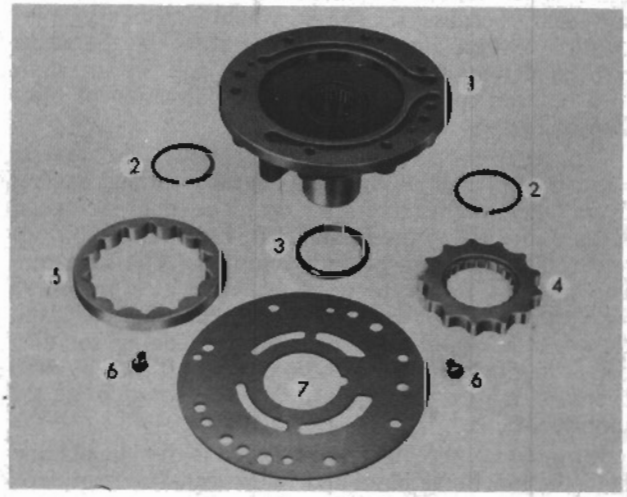

FIG. 252

1. Front pump body
2. Oil seal rings
3. Spacer
4. External tooth gear
5. Internal tooth gear
6. Screws
7. Cover

The rear oil pump (see Fig. 253) may be thought of as being driven by the rear wheels. Although the rear pump is smaller than the front pump, it still is capable of furnishing oil to satisfy the demands of the system both as to quantity and pressure; however, being smaller, it must do this at higher speeds than the

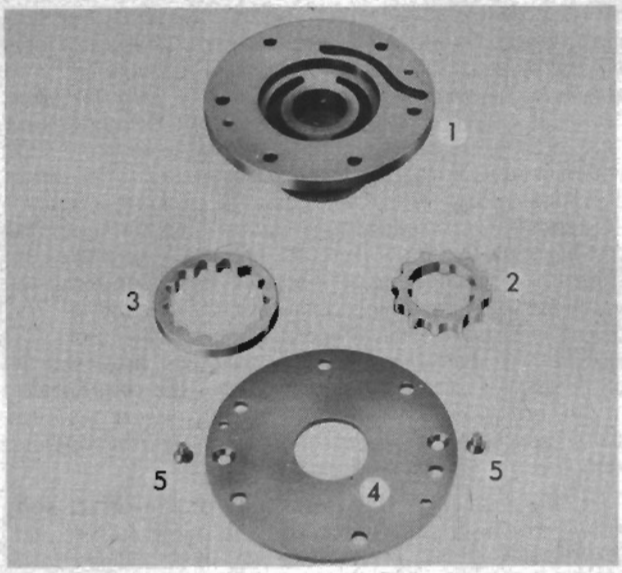

FIG. 253

1. Rear pump body
2. External tooth gear
3. Internal tooth gear
4. Cover
5. Screws

front pump. The rear pump takes over the duties of the front pump when a lesser quantity of oil is required in the system. This normally occurs when the converter becomes inactive and the direct drive clutch engages which is between approximately 18 and 65 miles per hour (29 and 105 kmph) depending upon car speed and throttle opening. The rear pump also furnishes oil under pressure when pushing or towing the car to start the engine.

Hydraulic Control Valves

The control valves operate in conjunction with the oil pumps and governors and their functions are to route or to vent the oil as required at the proper time and rate to bring about the automatic shifts which take place within the transmission.

The valves may be divided into five types and the forces under which they operate will be described for each type. Figures 254 through 259 show schematic diagrams of the hydraulic circuit. By referring to these diagrams occasionally, the operation of the valves may be more readily understood.

Figure 254 shows the manual valve which is a manually controlled distributing valve operated through linkage by the selector lever on the steering column.

This valve informs the transmission of the ranges or type of transmission operation the driver has selected. It is held in its selected position by spring loaded plungers which seat in detents in the forward end of the valve.

When the car is in motion, the springs are supplemented by oil pressure acting on the plungers and this pressure increases as car speed is increased. This is a safety feature which makes it difficult to accidentally knock the selector lever into another range while the car is under way. The passages through which the oil enters the plunger housing are indicated at points "A".

After the manual valve position has been selected, the valve then distributes the oil either directly to

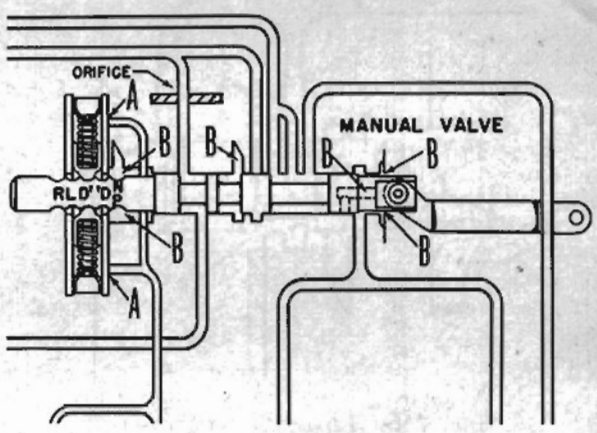

FIG. 254 MANUALLY CONTROLLED DISTRIBUTING VALVE

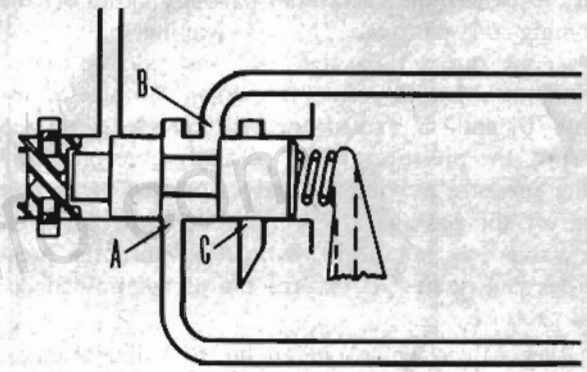

FIG. 255 REVERSE SHUTTLE VALVE

hydraulically operated units or to other valves for further distribution. It also vents or bleeds off pressure in the drilled passage in the valve or around the valve when required at points "B". This valve does not regulate pressure at any time.

You will note that one passage incorporates an orifice. The purpose of an orifice is to temporarily slow down or retard hydraulic action. Oil at the outgoing side of the orifice is temporarily at a lower pressure than it is at the incoming side. However, in time the outgoing pressure will rise to equal the incoming pressure. This principle applies to all orifices in the system.

Figure 255 shows the reverse shuttle valve which has only two positions and does not regulate pressure at any time. The movement of the valve is controlled by spring pressure at one end and oil pressure at the other end. When no pressure exists at the front end of the valve, the spring holds the valve against its forward stop connecting passages "A" and "B". When oil is directed to the front of the valve, its pressure value always is higher than the spring pressure and the valve immediately is forced against its rear stop shutting off passage "A" and connecting passages "B" and "C".

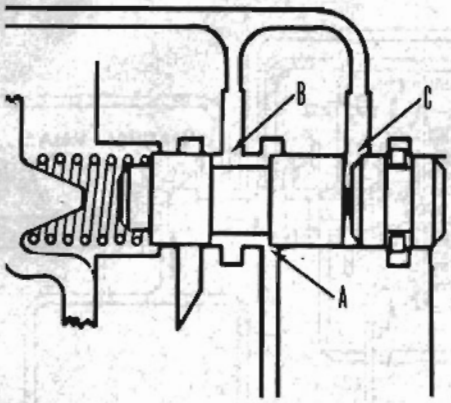

FIG. 256 THROTTLE LIMIT VALVE

The low regulator valve also operates on the same principles as the reverse shuttle valve.

Figure 256 shows the throttle limit valve which, as its name implies, limits oil pressure. The limiting point is at "A" where the valve land partially closes off the incoming oil passage. The oil leaving point "A" passes out through passage "B" and also is routed behind the valve to point "C". When the pressure at points "B" and "C" exceeds the desirable predetermined pressure, the pressure at "C" partially overcomes the spring pressure moving the valve forward to further close off the passage at "A" to reduce the pressure. The valve does not begin to function until the pressure leaving point "A" exceeds the predetermined desired pressure.

Other valves which operate in a similar manner, but which regulate instead of limit pressure, are the converter valve and the shift regulator valve.

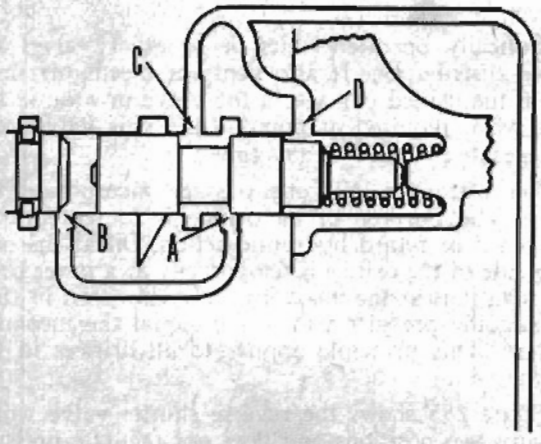

FIG. 257 DIRECT SHIFT THROTTLE VALVE

Figure 257 shows the direct shift throttle valve which also is a pressure regulating valve. Regulation, by this valve, is accomplished by oil pressure at one end of the valve opposing spring pressure supplemented by oil pressure at the other end of the valve. The regulating point is at "A" where the valve partially closes off the passage. Oil is being delivered to point "A" and also is being routed to the front of the valve at point "B". Oil entering point "A" passes out through point "C" and also is routed behind the valve to point "D" where it assists or supplements the spring to maintain a predetermined pressure. When the pressure at points "C" and "D" exceeds the predetermined pressure, the combination of oil pressure at "D" and spring pressure slightly overcomes the oil pressure at "B" moving the valve forward to further close off the passage at "A" to reduce the pressure. When the pressure at points "C" and "D" drops below the predetermined pressure, the oil pressure at "B" slightly overcomes the combination of oil pressure at "D" and spring pressure and the valve moves toward the rear to enlarge the opening at point "A" to increase the pressure.

Other valves of this same type or the direct shift valve, low-high shift valve and the pump valve.

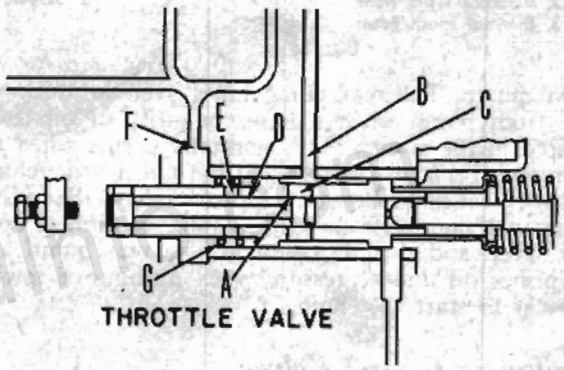

FIG. 258 THROTTLE VALVE—COMBINATION MANUAL VALVE AND REGULATOR VALVE

Figure 258 shows the throttle valve which is a combination of a manually operated valve within a pressure regulating valve. The function of this combination is to increase, decrease, and to maintain oil pressure in direct proportion to carburetor throttle openings. The manually operated valve, called the throttle valve shaft, is connected through linkage to the accelerator pedal which means that the position of this shaft has a relationship to the carburetor throttle valve openings.

The cylindrical throttle valve regulates pressure by the action of oil pressure around the front of the valve opposing spring pressure at the rear of the valve. At idle and at small carburetor throttle openings the oil pressure around the front of the valve is supplemented by spring pressure to maintain the desired regulated pressure. Above a predetermined throttle opening, the spring around the front of the valve is inactive.

The pressure regulating point is between a land on the shaft and openings in the valve at "A". Oil is delivered to the valve at passage "B" and it then passes through the openings "C" in the valve and past point "A" into area "D" between the shaft and the inside

of the valve. From this area it passes through openings "E" in the valve and exerts pressure against the valve forward land. At the same time, it passes out through passage "F" for distribution to other valves.

When the pressure at "F" exceeds the predetermined regulated pressure, the pressure rise around the front of the valve overcomes the main spring pressure to move the valve rearward to reduce the size of the opening at "A" and thereby reduce the pressure.

When the pressure at "F" falls below the predetermined pressure, the pressure around the front also decreases and the main spring pressure moves the valve forward enlarging the opening at "A" to increase the oil pressure.

At idle and at small carburetor throttle openings, the oil at point "F" would be at a pressure higher than would be desirable if idle spring "G" were not used and the shift pattern would be disrupted at low speeds. At low speeds, the spring supplements the oil pressure around the front of the valve to regulate the pressure at point "A".

Governors

Figure 259 shows the high speed and the low speed governors both of which incorporate regulating valves.

The valve in the high speed governor operates under the forces of oil pressure opposing spring pressure and centrifugal force.

The valve in the low speed governor operates with oil pressure opposing centrifugal force.

At low car speeds, oil from the rear pump is being delivered to the high speed governor where a certain amount of pressure regulation takes place. However, when the oil reaches the low speed governor, the pressure is higher than is desirable for low speed operation and it is further regulated by the low speed governor valve.

Oil enters the low speed governor through passage "A" and exerts pressure against the sides of the valve lands at points "B" and "C". Although the pressure is the same at these points, the valve area at "B" is larger than at "C" and this difference in areas causes the valve to move inward.

The regulating point is at "D" and oil leaving the governor passes out through passage "E" and also is routed through passage "F". When the pressure at point "E" rises above the desired regulated pressure, the pressure also rises at area "B" where it exerts enough force against the side of the valve land to partially overcome the centrifugal force and thereby move the valve inward. Moving the valve inward reduces the size of the opening at point "D" to lower the pressure.

Under some conditions of deceleration, it is desirable to have the pressure in passage "E" drop rapidly. This is accomplished by the valve moving inward far enough to uncover the opening of passage "F" to permit the oil to be vented at point "G".

When the pressure at point "E" drops below the desired regulated pressure, centrifugal force slightly overcomes the lowered oil pressure at area "B" and moves the valve outward to enlarge the opening at point "D" and thereby increase the pressure at "E".

At higher car speeds, centrifugal force acting on the low speed governor valve and flyweight holds the valve in its fully extended position where the valve no longer regulates. At this time, all of the pressure regulation for the governor pressure circuit is taking place in the high speed governor.

Oil is delivered from the rear pump through passage "H" and the pressure is regulated in the governor at point "I". Oil leaving the governor passes out through passage "J" and also is routed behind the outer end of the valve through passage "K".

When the pressure rises above the desired regulated pressure through passage "J", it also rises behind the outer end of the valve where it slightly overcomes the centrifugal force and spring pressure. This moves the valve inward to reduce the size of the opening at point "I" and thereby lower the pressure.

When the pressure falls below the desired regulated pressure, it also drops at the outer end of the valve and centrifugal force and spring pressure moves the valve outward to increase the size of the opening at point "J" to raise the pressure.

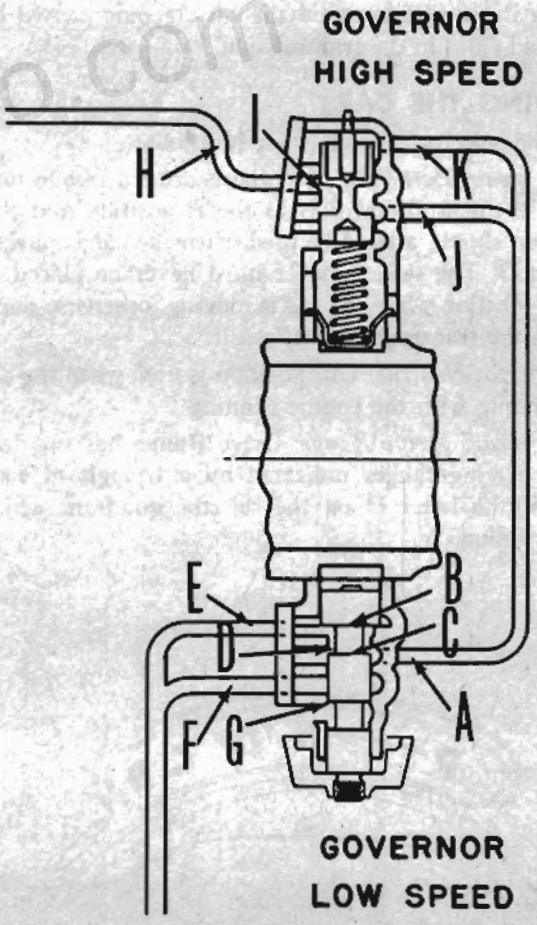

FIG. 259 GOVERNOR VALVE

OPERATING INSTRUCTIONS

SELECTOR LEVER

The selector lever is mounted on the steering column and attached to the lever is a pointer which indicates the selected position on a stationary quadrant. When the parking lights or head lights are on, a bulb in the selector lever lights the letter of the position selected.

For convenience the selector lever slides smoothly between N, D, and L positions, and, for safety, must be raised to engage P and R positions.

STARTING THE ENGINE

The engine can be started only if the selector lever is in the P or N position. The starting motor will not operate if the selector lever is in any other position.

Although the engine will start with the selector lever in the N position, it is recommended that the engine be started with the selector lever in the P position if the car is parked on a hill. In extremely cold climates, especially after the car has been standing for a long time, the engine should be started with the lever in the P position to avoid the car creeping caused by the cold fluid in the transmission.

DRIVING THE CAR

The selector lever has six positions:

P means Park. The rear wheels are not free to turn when the selector lever is in the P position and this position should always be used when the car is parked on a hill. The selector lever must never be placed in the P position while the car is moving, otherwise damage to the transmission will result.

N is for Neutral. This position is used when the car is standing with the engine running.

D means Drive Range. Drive Range has two forward driving ranges indicated by a triangle at each side of the letter D on the selector quadrant which are as follows:

FIG. 260

(1) The left hand triangle position in the Drive Range is provided for all normal forward driving; it reduces engine speed, provides smoother starting from a complete stop. This position normally is used when starting on ice or in snow when gradual rear wheel traction is desired. In this position the car will automatically shift to direct drive. When driving in this range at a car speed of less than approximately 60 mph (97 kmph), extra power for passing of another vehicle can be had by pressing the accelerator pedal firmly down against the floor.

(2) The right hand triangle position in the Drive Range is provided for faster acceleration from a complete stop and is very useful when driving in traffic. This position normally is used when quick starts are desired. In this position the car will automatically shift from the low gear to the high gear in the transmission and then automatically to direct drive. When driving in this range at a car speed of less than approximately 60 mph (97 kmph), extra power for quick passing of another vehicle can be had by pressing the accelerator pedal firmly to the floor.

L means Low Range. Low range is used in deep sand, snow or mud and on long, hard pulls. It should also be used when going up or down steep grades. Driving down a steep grade in low range lets the engine act as a brake to reduce car speed.

R is for Reverse. This position is used to reverse the direction of the car. The selector lever should never be moved to the reverse position with the car moving forward.

PUSH STARTING THE CAR

If it is necessary to push the car to start the engine, the selector lever should be placed in the N position and the ignition key turned on. When the car reaches a speed of approximately 25 mph (40 kmph), the selector lever should be moved to the triangle at the left of the D position, at which time the engine will start.

TOWING THE CAR

A disabled vehicle may be towed on the rear wheels if the transmission is not damaged or if no fluid has been lost; however, the selector lever must be placed in the N position. If the selector lever is placed in any other position damage to the transmission will result. Towing speed should not be greater than 30 mph (48 kmph.) and long distance towing is not recommended.

If the transmission is damaged and it is necessary to tow the car the propeller shaft must be removed or the car towed with the rear wheels off the ground.

MAINTENANCE AND ADJUSTMENTS

This section covers the maintainence and adjustment procedures required to keep the Ultramatic Transmission operating at peak efficiency to provide a smooth transfer of power from engine to rear wheels and for trouble free motoring.

Transmission Fluid

The transmission was filled to the proper level at the factory with Automatic Transmission Fluid—Type A. This type of fluid only should be used in the transmission when it is necessary to add a change fluid in the transmission. Use of improper or inferior fluid may affect operation of the transmission.

When to Check

The transmission fluid level should be checked at 1,000 mile intervals.

How to Check

Place the selector lever in the P position and start the engine and operate for approximately four minutes or until engine and transmission have reached operating temperature. Remove the inspection hole cover from the floor pan above the transmission. Clean the area around the inspection hole. Apply the parking brake and foot brake and move the selector lever from the P position to the R position and back to the D position. Remove the transmission dip stick from the transmission (see Fig. 261), wipe clean and reinstall the dip stick in the transmission. Remove the dip stick again and read the amount of fluid registered on the dip stick. Add fluid through the dip stick hole to bring the fluid level to the F mark on the dip stick. The quantity of fluid required to raise the fluid level in the transmission from the L mark on the dip stick to the F mark is 1½ quarts (1.25 Imp. qts., 1,45 liters).

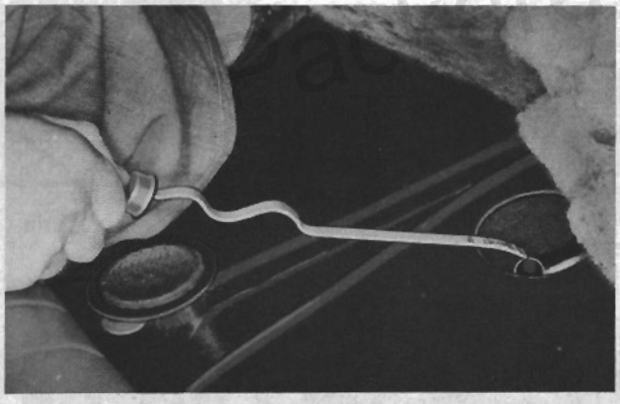

FIG. 261

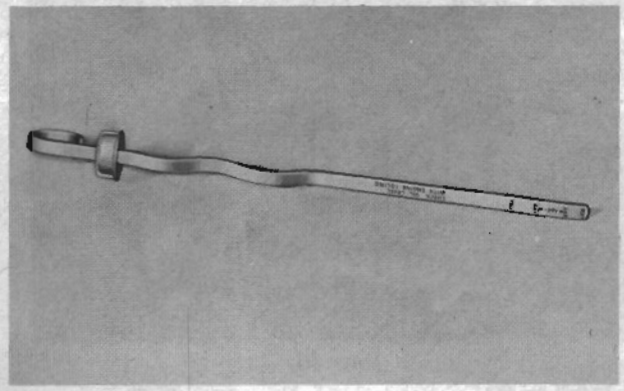

FIG. 262

When to Change

The transmission and converter should be drained, the oil strainer and the oil pan cleaned, and new fluid installed at 25,000 mile intervals.

How to Change

Raise the car on a hoist to provide working clearance. Remove the left exhaust pipe. Remove the flywheel housing lower cover and rotate the flywheel to bring one of the converter drain plugs to the bottom. (See Fig. 263).

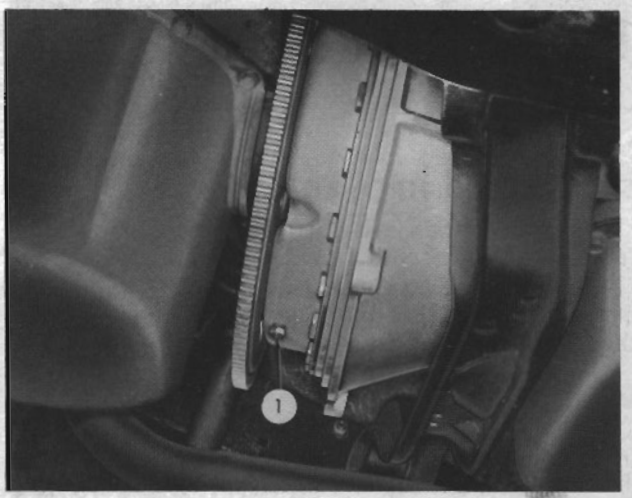

FIG. 263

Place a container under the converter and the transmission oil pan and then loosen but do not remove the converter drain plug.

Rotate the flywheel one-half turn to bring the other converter drain plug to the bottom and remove this plug and also the oil pan drain plug and drain the fluid.

Remove the oil pan and oil strainer. Clean the oil pan and then clean the oil strainer by scrubbing with a wire brush, swishing in cleaning solvent and then blow compressed air through it from the inside out.

Reinstall the strainer and the oil pan, using a new gasket.

Reinstall and tighten the converter and oil pan drain plugs. Rotate the flywheel one-half turn and tighten the converter drain plug which previously was loosened to vent the converter while it was draining.

Install the flywheel housing lower cover and torque, tighten the retaining screw to 15 to 18 ft-lbs (20.7 to 24.9 kg-m.).

When filling the unit, install the left exhaust pipe, use Type "A" automatic transmission fluid which has an AQ-ATF number embossed on the top of the container.

To fill the unit, pour seven quarts of the fluid through the filler tube as described in the section on how to check fluid. Start the engine and allow it to run at HIGH IDLE for five minutes with the selector lever at neutral ("N").

Bring the engine to low or curb idle, add approximately two to three quarts of oil, and then continue to add oil slowly and add only enough to bring the level to the "FULL" mark on the dip stick.

Adjustments

BANDS

Both the reverse and the low range brake bands are adjusted in the same manner.

Loosen the adjusting screw lock nut (2, Fig. 264), torque tighten the adjusting screw to 20 ft-lbs, back the screw out 1¾ turns, and then tighten the lock nut.

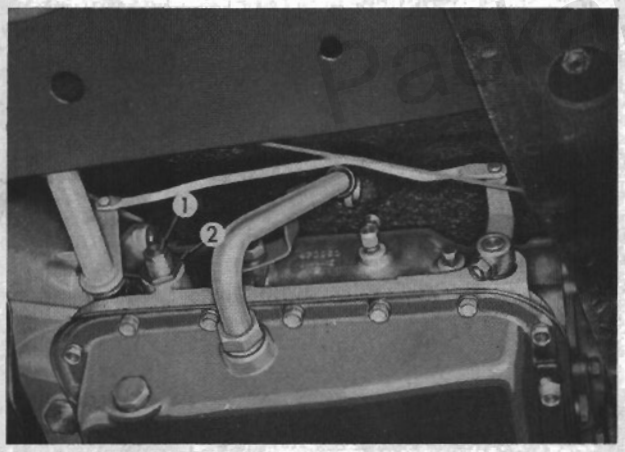

FIG. 264

1. Adjusting screw
2. Lock nut

SELECTOR CONTROL LINKAGE

Disconnect the clevis (3, Fig. 265) of the control rod from the bell crank (1).

Pull the transmission rod to its full forward limit of travel by means of the bell crank, which will place the manual valve in the reverse position.

Pull the control rod downward to its full limit of travel.

Adjust the clevis (3) so that the clevis pin (4) will freely enter the clevis and the bell crank arm. Tighten the clevis lock nut (2) and install the clevis pin cotter key.

THROTTLE LINKAGE

Check the operation of the linkage to make certain it is operating freely and not binding. Also check for excessive wear at the pivot points. Proper adjustment cannot be made with binding or excessively worn linkage.

Operate the engine for approximately four minutes or until the engine has reached operating temperature and the carburetor choke is in the wide open position. Set the engine idle speed at 400 rpm with the selector lever in a Drive (D) position. Apply the parking brake or block the wheels to prevent the car from moving. After stopping the engine, it is suggested that the carburetor choke valve be blocked open with cardboard to prevent the carburetor linkage from returning to fast idle while the adjustments are being made.

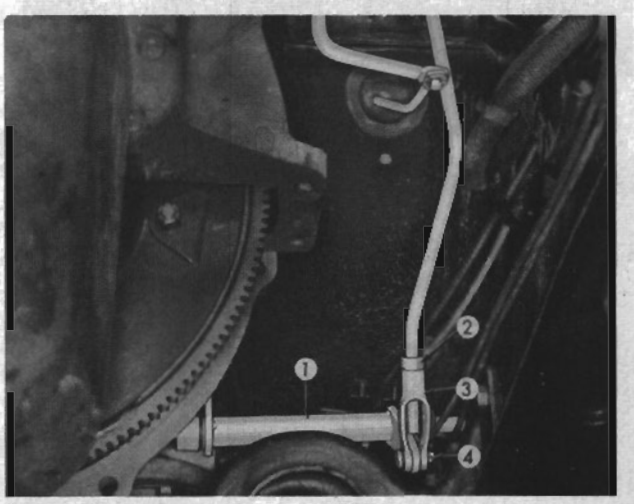

FIG. 265

1. Bell crank
2. Lock nut
3. Clevis
4. Clevis pin

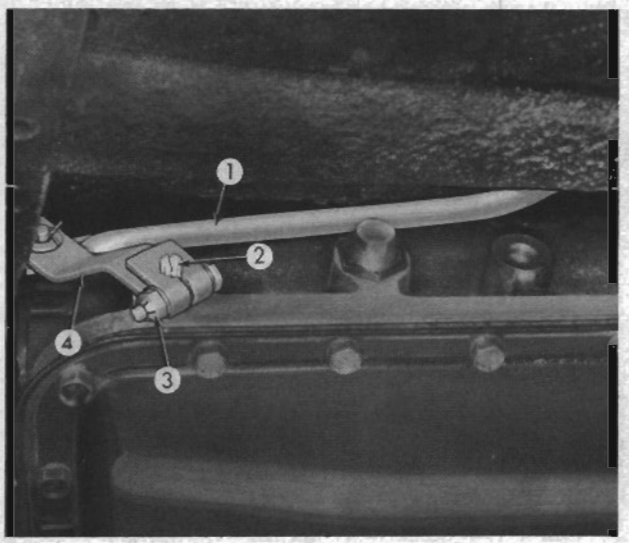

FIG. 266

1. Rod
2. Shaft
3. Clamp screw nut
4. Throttle valve outer lever

FIG. 267

Disconnect the rod (1, Fig. 266) at the throttle valve outer lever (4) at the right rear of the transmission. Move the lever rearward to its stop. Hold a straight edge across the milled surface of the transmission case. The taper on the end of the lever should just contact the straight edge (see Fig. 267).

If adjustment is necessary, loosen the lever clamp screw nut (3) and turn the shaft (2) to the left (counterclockwise) until the valve has reached its stop. With the shaft held in this position, rotate the lever on the shaft so that the taper on the lever lines up with the milled surface on the case checked with a straightedge and then tighten the clamp screw nut. Reconnect the rod to the lever.

Loosen the two lock nuts (2, Fig. 268) (approximately four or five turns) that position the cross-shaft rod adjuster and make certain the adjuster is free to move back and forth. Also make sure the adjuster to

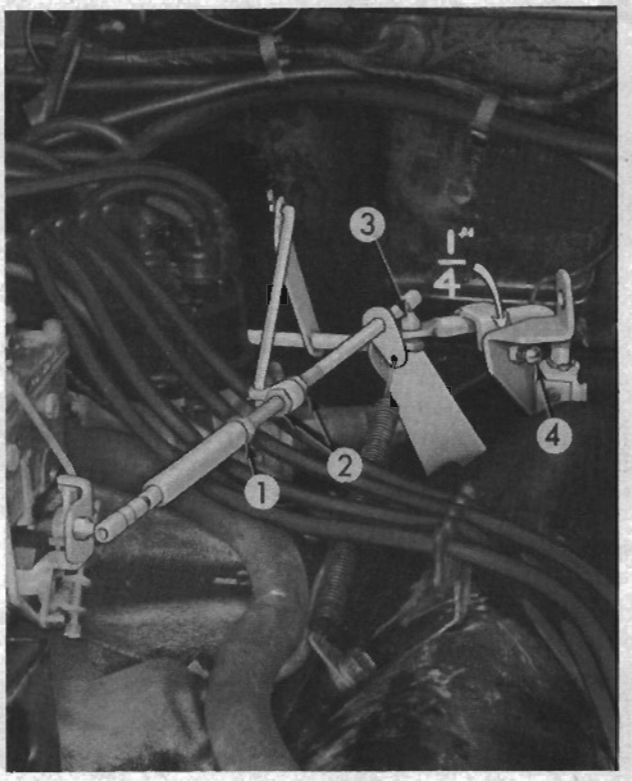

FIG. 268

1. Overtravel end assembly lock nut
2. Cross shaft rod adjuster lock nuts
3. Ball joint
4. Screw

cross-shaft rod is in the lower hole in the cross-shaft lever.

Disconnect the carburetor to bell crank rod ball joint (3) at the bell crank. Set the stop (4) on the bell crank to provide a ¼" gap at the bell crank. A ¼" drill should be used as a gauge.

While holding the carburetor idle screw against its stop and maintaining the ¼" (6,35 mm.) gap at the bell crank loosen the overtravel end assembly lock nut (1) and adjust the overtravel end assembly until the ball joint stud on the carburetor to bell crank rod freely enters the hole in the bell crank arm. Lock the lock nut at the overtravel end assembly.

Hold the cross-shaft lever *gently* forward to close the throttle valve inside the transmission. Position the rear lock nut against the adjuster and tighten the front lock nut against the adjuster.

STARTER CUT-OUT SWITCH

The starter cut-out control switch is located at the base of the steering post jacket and acts to break the starter solenoid circuit when the selector lever is in the D, L or R position and also to control the operation of the back-up light if so equipped.

Remove the hand control-to-switch rod. Loosen the screws that attach the switch to the steering post jacket.

Align the pin hole in the starter cut-out switch lever with the corresponding hole in the switch body. Install a pin through the holes to maintain alignment of the switch lever and the switch body. Tighten the attaching screws and install the hand control-to-switch rod.

TESTING

A complete and accurate diagnosis of Ultramatic trouble can be obtained only by performing a series of thorough, systematic diagnosis checks. This section contains the test procedures to be performed to arrive at an accurate and complete diagnosis.

Before performing any of these checks, the mechanic should ascertain that the engine is operating normally. A properly operating engine is essential to proper Ultramatic operation.

A thorough road test of the car to observe transmission performance is often beneficial before starting the diagnosis procedures.

INITIAL CHECKS

Certain initial checks and adjustments are the first step in complete Automatic Drive diagnosis. These initial checks will often correct most troubles and avoid damage to the transmission.

FLUID LEVEL

Check the fluid level as outlined in the section on Maintenance and Adjustments. A low fluid level may indicate an external leak that may damage the transmission.

ENGINE IDLE SPEED AND THROTTLE VALVE LINKAGE

Check and adjust the engine idle speed and the throttle valve linkage as outlined in the section on Maintenance and Adjustments. Too low an idle speed causes a rough engine idle. Too high an engine idle speed causes the car to "creep" excessively and affects the shift pattern.

MANUAL VALVE LINKAGE (HAND CONTROL LINKAGE)

The linkage between the manual valve outer lever and the selector lever should be checked and adjusted as outlined in the section on Maintenance and Adjustments.

BAND ADJUSTMENT

The transmission bands should be adjusted as outlined in the section on Maintenance and Adjustments.

STALL SPEED TEST

The stall speed is the maximum speed at which the engine can drive the torque converter impeller while the turbine is held stationary. Because the stall speed is dependent on engine characteristics, as well as torque converter characteristics, it will vary with the condition of the engine as well as with the condition of the Automatic drive. Hence, it is necessary to determine the condition of the engine in order to interpret correctly a low stall speed.

Because an engine's performance at higher altitudes differs from its performance at lower altitudes, the stall speed given below cannot be considered representative of stall speeds in regions of high altitudes. In such regions, representative stall speeds can be determined by testing several cars known to be normal.

Connect a tachometer to the engine and place it where it can easily be read from the driver's seat. Set the hand brake. Start the engine and run until operating temperature is normal, then shift the hand control selector lever to D position. Apply the service brakes so that the car will not move. Operate the engine at full throttle and note the tachometer reading. Repeat this procedure with the selector lever in L position and also with it in R position.

Caution—Do not operate the engine at high speed, while the selector lever is in one of the driving positions and the rear wheels held stationary, *for more than 10 seconds at a time or for a total time greater than one minute in any half hour period.*

A stall speed of approximately 1650 r.p.m. indicates converter to be functioning normally.

PRESSURE TESTS

Hydraulic pressure testing is a most important factor in diagnosing automatic transmission troubles.

If a trouble is not definitely located or established, do not disassemble the unit until the oil level is checked, the car road tested and the hydraulic pressure tests made. In the majority of cases, the pressure tests will indicate the cause of the trouble or give a clue to some component which is not functioning properly in the transmission.

Schematic diagrams of the hydraulic circuits during various stages of the transmission operation are shown at the end of this section. The bright colors show the path of the oil from either the front or rear pump to the hydraulic units which are actually driving the car. The subdued colors show the path of oil to other hydraulic units which are functioning but which play no part in driving the car during the particular stage of operation shown on the chart.

As most of the pressure tests are taken with the car in motion at various speeds, the gauges should be in the driver's compartment where they can be seen while driving.

Remove the oil inspection hole cover in the floor mat and thread the hoses through the hole to the transmission. Attach the hoses to the desired pressure take-off points on the transmission. It is advantageous to use two or more gauges connected to the various pressure take-off points when making a pressure test.

A tachometer should be connected to the engine and also placed in the driver's compartment.

The following pressure tests can be made by attaching the pressure gauges to the external pressure take-off points on the transmission. Refer to the transmission pressure chart for the location of each pressure take-off point.

(a) Front Pump Pressure
(b) High Range Clutch Pressure
(c) Converter in Pressure
(d) Direct Drive Clutch Pressure
(e) Governor Pressure

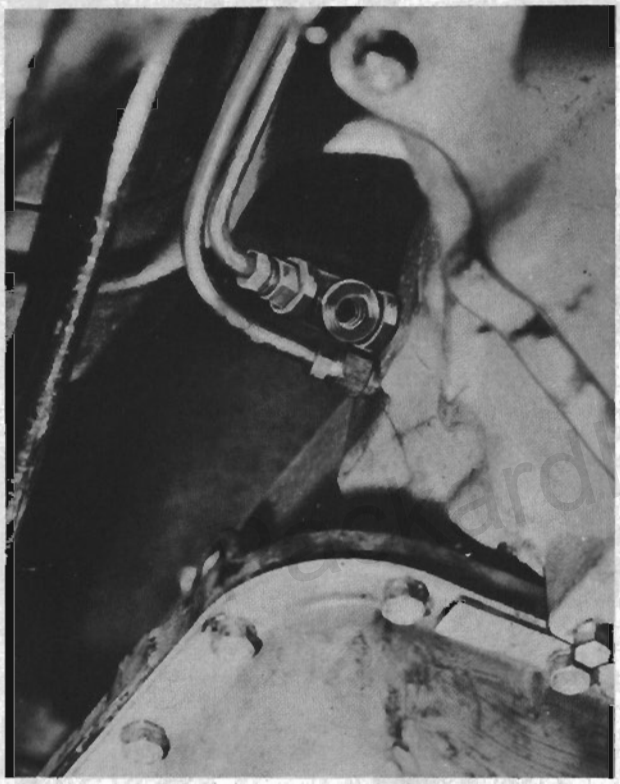

FIG. 269

The correct pressure for each of these, under the various driving conditions, are shown on the transmission pressure chart. To make the following pressure tests these procedures must be followed:

(a) Converter out pressure. A special fitting, made by installing a ⅛" (3,2 mm.) male nipple in one end of a ⅛" tee and brazing the nipple and tee, is required to make this test (see Fig. 269).

Remove the upper oil cooler tube adapter from the side of the bellhousing and install the special tee connection in the bellhousing. Install the oil cooler tube adapter in the tee and reconnect the cooler tube. Connect the gauge hose to the tee connection.
Pressure test as shown on the transmission pressure chart.

(b) Throttle pressure and low brake top pres-

ULTRAMATIC PRESSURE TEST CHART

FRONT PUMP (1)

All selector positions	90-120
▼D position—Full throttle, car standing with brakes applied—maximum pressure	160-180
D▼ position—Full throttle, car standing with brakes applied—maximum pressure	160-180
Manual low—Full throttle—25 mph	160-180

HIGH RANGE CLUTCH (2)

Pressure should be the same or not more than 10 lbs under pump pressure

	P.P.	H.R.C.P.
▼D position—400 rpm.	90-120	80-100
▼D position—10-15 mph., converter drive	70-90	60-80
D▼ position—400 rpm.	90-120	0
D▼ position—20 mph., steady throttle		60-70

LOW BRAKE TOP (3)

Pressure should be the same or not more than 10 lbs under pump pressure

	P.P.	L.B.T.P.
▼D position—400 rpm.	75-105	70-100
D▼ position—400 rpm.	75-105	0
D▼ position—Immediately after low to high upshift	75-105	65-85

CONVERTER IN (4)

D▼ position—400 rpm.	10-30
15 mph., "before direct drive"	45-70
Direct drive engaged	15-25
Kickdown	90-100

CONVERTER OUT (5)

D▼ position 15-18 mph.	
Converter drive	25-35
Direct drive	7-17

DIRECT DRIVE (6)

Pressure should be the same or not more than 10 lbs under pump pressure

	P.P.	D.D.P.
D▼ position 15-18 mph.		
Before engagement	70-100	0
After engagement		60-70
Kickdown	145-165	0

GOVERNOR (7)

13 mph.	11-14
28 mph.	37-41
56 mph.	47-54

THROTTLE (8)

400 rpm.	25-29
Full throttle	75-85
Kickdown before downshift	120-140

▼D position—High range, converter start
D▼ position—Low range, converter start

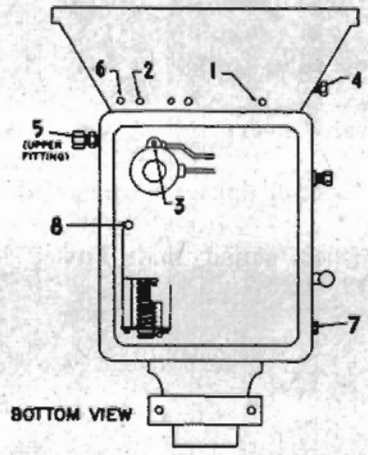

FIG. 270 ULTRAMATIC TRANSMISSION PRESSURE TEST CHART

sure. The throttle pressure and low brake pressure take-off points are located on the control assembly. To make these pressure tests follow the procedure outlined.

Drain the fluid and remove the transmission oil pan and screen.

Install the special test pan adapter, tool J-5975, and gasket with the adapter tube on the left side and toward the front of the car. Thread two gauge hoses through the elbow tube on the adapter.

Remove the ⅛" pipe plug "A" from the bottom of the low brake housing (see Fig. 271) and install a ⅛" elbow in this opening. Connect one of the gauge hoses to the elbow.

Remove the ⅛" pipe plug "B" from the throttle valve body and install a ⅛" elbow in this opening. Connect the other gauge hose to this elbow.

Install the two oil suction tube extensions, and install the oil pan and gasket.

Reinstall the fluid that was drained out or the same amount of new fluid.

Pressure test as shown on the transmission pressure chart.

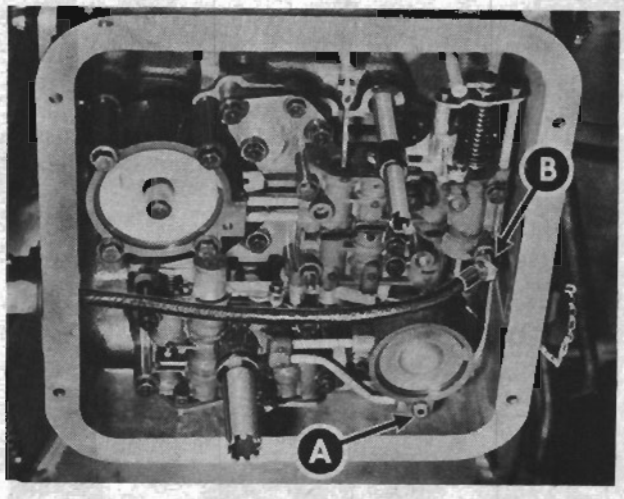

FIG. 271

THROTTLE PRESSURE

Adjustment

Throttle pressure is a very important pressure as it controls other pressures in the system, controls upshift, clutch engagements and disengagements. Therefore, it is important that the throttle pressure be accurate.

Before attempting to adjust the throttle pressure, recheck all of the throttle linkage adjustments as described under "Maintenance and Adjustments".

To adjust throttle pressure remove the rubber plug in the adapter and use the two wrenches, J-5975-11 and J-5975-10, to loosen the lock nut and adjust the throttle valve stop screw. Screwing in on the adjusting screw raises throttle pressure and screwing out on the adjusting screw lowers throttle pressure. Tighten the adjusting screw lock nut and recheck the throttle pressure.

DIAGNOSIS

CAR FAILS TO MOVE REGARDLESS OF SELECTOR LEVER POSITION

CAUSE	CORRECTION
(1) Insufficient oil.	(1) Add oil to proper level.
(2) Clogged inlet screen.	(2) Perform front pump pressure test. If little or no pressure is indicated, clean inlet screen.
(3) Converter valve stuck.	(3) Perform converter "In" pressure test. If little or no pressure is indicated, free up valve.
(4) Pump valve stuck.	(4) Perform front pump pressure test. If little or no pressure is indicated, free up pump valve.
(5) Selector control linkage disconnected.	(5) Inspect the selector control linkage. Connect and adjust the linkage.
(6) Transmission output shaft broken loose from planetary cage.	(6) Jack up the car and operate the engine with the selector lever in drive position. Holding your left foot on the brake pedal, accelerate the engine. If the engine accelerates freely and the propeller shaft does not rotate, it is an indication of an output shaft broken loose from the planetary cage. If this condition exists, the test will be accompanied by a grating noise in the transmission.
(7) Parking gear lever spring broken. This might allow the pawl to remain engaged in the parking gear.	(7) Jack up the car and try to rotate the propeller shaft by hand. If the propeller shaft cannot be rotated it is possible that the parking gear pawl is still engaged.

(8) Low and reverse bands adjusted too tight.	(8) Adjust the low and reverse bands properly.
(9) Bushings or bearings seized in the transmission. Noise may or may not be present.	(9) Disassemble the transmission. Inspect all bearings or bushings and replace all faulty parts.

CAR FAILS TO MOVE IN DRIVE "D" RANGE WITH THE SELECTOR LEVER IN THE GEAR START POSITION

CAUSE	CORRECTION
(1) Insufficient oil	(1) Add oil to the proper level.
(2) Selector control linkage disconnected or out of adjustment.	(2) Connect the selector control linkage and adjust properly.
(3) Loss of pressure to the apply side of the low range brake.	(3) Check for obstruction in the low range brake tube or inlet opening in brake housing.
(4) Low range brake band strut out of position.	(4) Remove oil pan and place strut in proper position.
(5) Low range brake band badly worn.	(5) Replace brake band.

CAR FAILS TO MOVE IN DRIVE "D" RANGE USING HIGH RANGE CLUTCH START

CAUSE	CORRECTION
(1) Rubber lip seal on high range clutch piston out of position causing piston to stick.	(1) Perform high range clutch pressure test. If pressure is normal disassemble high range and check position of piston rubber seal.
(2) Shift regulator valve stuck.	(2) Perform high range clutch pressure test. If little or no pressure exists, free up shift regulator valves.
(3) Burned or worn clutch plates.	(3) If high range clutch pressure is normal but car fails to move, the high range clutch plates may be worn or burned. Disassemble the transmission high range clutch.
(4) Selector control linkage disconnected or out of adjustment.	(4) Connect the selector control linkage properly and adjust.

CAR FAILS TO MOVE WITH THE SELECTOR LEVER IN MANUAL LOW "L" POSITION

CAUSE	CORRECTION
(1) Selector control linkage out of adjustment or not hooked up.	(1) Connect the control linkage and adjust properly.
(2) Badly worn low range band or strut out of position.	(2) Remove oil pan, check band and correct as necessary.
(3) Low range brake piston jammed.	(3) Remove oil pan and low range brake and disassemble brake. Correct as required.
(4) Insufficient oil pressure to the apply side of the low range brake.	(4) Check for obstruction in inlet opening in brake housing and also check for inlet tube being in proper position.

CAR FAILS TO MOVE WITH THE SELECTOR LEVER IN THE REVERSE "R" POSITION

CAUSE	CORRECTION
(1) Selector control linkage not hooked up or out of adjustment.	(1) Hook up linkage or adjust properly.
(2) Excessively worn reverse brake band or strut out of position.	(2) Remove oil pan and check band and correct as necessary.
(3) Manual valve stop inside transmission not adjusted properly allowing the manual valve to over-travel.	(3) Remove oil pan and adjust manual valve stop properly.
(4) Lack of oil to the apply side of the reverse brake piston caused by a stuck reverse shuttle valve.	(4) Remove valve body and free up reverse shuttle valve.
(5) Reverse brake piston stuck in housing.	(5) Remove reverse brake, free up piston.

EXCESSIVE SLIPPAGE IN ALL RANGES

CAUSE	CORRECTION
(1) Insufficient oil.	(1) Check oil level and bring up to full mark.
(2) Low front oil pump pressure due to sticking pump valve.	(2) Perform front pump pressure test. If little or no pressure is indicated, check pump valve.
(3) Low front oil pump pressure due to ball plugs being out of low range and reverse brake housings.	(3) Perform front pump pressure test. If the pump pressure is too low check both brake housings for having the ball plugs in place.
(4) Low oil pressure to the converter caused by stuck converter valve.	(4) Perform converter "In" pressure test. If pressure is too low remove valve body and check converter valve for being free.
(5) Low front pump pressure due to worn or badly scored rotors.	(5) Remove the front pump and check the condition of the rotors.

EXCESSIVE DRAG IN DRIVE "D" RANGE USING HIGH RANGE CLUTCH START. ALSO DRAGS IN REVERSE BUT IS OK IN LOW RANGE

CAUSE	CORRECTION
(1) Low range brake band too tight.	(1) Adjust the low range brake band properly.
(2) Low range brake piston stuck holding the brake partly applied.	(2) Free up low range brake piston. Also check piston ring for being properly gapped.
(3) Transfer tube to release side of low range brake out of position.	(3) Remove oil pan and check position of transfer tube.

EXCESSIVE DRAG IN BOTH DRIVE "D" RANGES. OK IN REVERSE

CAUSE	CORRECTION
(1) Reverse brake band too tight.	(1) Adjust reverse band properly.
(2) Reverse brake piston stuck holding the brake partly applied.	(2) Free up reverse brake piston. Also check piston ring for being properly gapped.

CAR CREEPS FORWARD IN NEUTRAL

CAUSE	CORRECTION
(1) Low range brake band too tight.	(1) Adjust the low range brake band properly.
(2) High range clutch plates sticking on splines.	(2) Disassemble high range clutch and free up clutch plates.
(3) High range clutch piston rubber lip seal out of position causing the piston to stick and partly engage the clutch.	(3) Disassemble the high range clutch and install a new lip seal properly.
(4) Low range brake piston stuck holding the brake partly applied.	(4) Free up low range brake piston. Also check piston ring for being properly gapped.

CAR CREEPS EXCESSIVELY IN ANY DRIVING RANGE WITH THE ENGINE IDLING

CAUSE	CORRECTION
(1) Engine idling too fast.	(1) Set engine idle to specifications.

CAR CREEPS FORWARD WHEN THE SELECTOR LEVER IS IN REVERSE

CAUSE	CORRECTION
(1) Manual valve linkage out of adjustment.	(1) Adjust the manual valve linkage properly.

CAR DOES NOT MOVE WITH THE SELECTOR LEVER IN THE REVERSE POSITION

CAUSE	CORRECTION
(1) Reverse shuttle valve stuck preventing the oil above the reverse brake piston from venting.	(1) Remove the control body and free up the reverse shuttle valve.
(2) Reverse brake band strut out of position.	(2) Remove the oil pan and position the strut properly.

CHATTER WHEN STARTING IN DRIVE "D" RANGE USING HIGH RANGE CLUTCH START

CAUSE	CORRECTION
(1) Low range brake band dragging.	(1) Adjust the low range brake band properly.
(2) Reverse brake band dragging.	(2) Adjust the reverse brake band properly.
(3) Worn, burned or distorted high range clutch plates. Could also be caused by sticking plates or piston.	(3) Disassemble the high range clutch. Install new clutch plates or correct as necessary.

CHATTER WHEN STARTING IN LOW RANGE

CAUSE	CORRECTION
(1) Low range brake band out of adjustment.	(1) Adjust low range brake band properly.
(2) Reverse brake band dragging.	(2) Adjust reverse brake band properly.
(3) Sticking high range clutch plates or piston.	(3) Disassemble the high range clutch. Free up clutch plates or piston or install new parts as necessary.

CHATTER WHEN STARTING IN REVERSE

CAUSE	CORRECTION
(1) Reverse brake band out of adjustment.	(1) Adjust reverse brake band properly.
(2) Low range band dragging.	(2) Adjust low range brake band properly.
(3) Sticking high range clutch plates or piston.	(3) Disassemble the high range clutch. Free up clutch plates or piston or install new parts as necessary.
(4) Reverse drum (ring gear) bushing badly worn.	(4) Remove planetary assembly. Replace ring gear bushing.

DIRECT DRIVE CLUTCH FAILS TO ENGAGE

CAUSE	CORRECTION
(1) Sticking high speed governor valve, low speed governor valve or direct shift valve. Could also be caused by direct shift throttle valve sticking.	(1) Check the governor pressure and the direct drive clutch pressure. If no direct drive clutch pressure is indicated and governor pressure is normal the direct shift valve or direct shift throttle valve is probably sticking. If no governor pressure exists or is very low, either of the governor valves may be sticking. Free up valves as necessary.
(2) Direct drive clutch piston sticking.	(2) If governor pressure and direct drive clutch pressures are normal, disassemble converter and check for sticking direct drive clutch piston.

DIRECT DRIVE CLUTCH "HANGS ON" OR FAILS TO RELEASE ON DECELERATION

CAUSE	CORRECTION
(1) Sticking direct shift valve or low speed governor valve.	(1) Perform direct drive clutch and governor pressure tests. If, on deceleration, the governor pressure lowers but the direct drive clutch pressure remains constant, check for sticking direct shift valve. If both pressures do not lower, check for sticking low speed governor valve.

DIRECT DRIVE CLUTCH ENGAGES LATE AND DISENGAGES EARLY

CAUSE	CORRECTION
(1) Direct shift valve spring "cocked" in valve bore.	(1) Remove valve body and relocate spring.
(2) Direct shift throttle valve sticking open.	(2) Remove valve body and free up direct shift throttle valve.

DIRECT DRIVE CLUTCH SLIPS

CAUSE	CORRECTION
(1) Excessive leakage in the direct drive clutch circuit.	(1) Perform direct drive clutch pressure test. If pressure is low, check for loose or worn bushings or broken piston inner ring.
(2) Sticking converter valve resulting in high converter pressure while in direct drive.	(2) Perform converter "in" pressure test. If pressure is too high, free up converter valve.

TRANSMISSION REMAINS IN LOW RANGE USING GEAR-START DRIVE "D" POSITION. WILL NOT UPSHIFT FROM LOW RANGE CONVERTER TO HIGH RANGE CONVERTER

CAUSE	CORRECTION
(1) Sticking low-high shift valves or sticking governor valves	(1) Perform high range clutch and governor pressure tests. If governor pressure is normal but high range clutch pressure cannot be obtained, check for sticking low-high shift valve. If no high range clutch pressure exists and governor pressure is low, check for sticking governor valves.
(2) Sticking throttle valve.	(2) Perform front pump and throttle pressure tests. If both pressures always remain the same, check for sticking throttle valve.

INCORRECT FRONT OIL PUMP PRESSURE

CAUSE	CORRECTION
(1) Low oil level.	(1) Bring oil up to proper level.
(2) Sticking pump valve.	(2) Free up pump valve.
(3) Ball plugs missing in reverse brake housing.	(3) Install and stake ball plugs or replace housing.
(4) Sticking pump check valves.	(4) Free up check valves.
(5) Incorrect pump valve spring.	(5) Install correct spring.
(6) Sticking modulating valve.	(6) Free up modulating valve.

INCORRECT HIGH RANGE CLUTCH PRESSURE

CAUSE	CORRECTION
(1) Sticking shift regulator valve.	(1) Free up shift regulator valve.
(2) Sticking low-high shift valve.	(2) Free up low-high shift valve.
(3) Incorrect pump pressure.	(3) Remedy cause for incorrect pump pressure.

INCORRECT LOW RANGE BRAKE TOP PRESSURE

CAUSE	CORRECTION
(1) Ball plug missing in low range brake housing.	(1) Install and stake ball plug or replace brake housing.
(2) Sticking low-high shift valve.	(2) Free up low-high shift valve.
(3) Incorrect pump pressure.	(3) Remedy cause for incorrect pump pressure.
(4) Threaded plug missing in low range brake housing.	(4) Install plug in housing.

INCORRECT CONVERTER "IN" PRESSURE

CAUSE	CORRECTION
(1) Incorrect front pump pressure.	(1) Remedy cause for incorrect front pump pressure.
(2) Sticking converter valve.	(2) Free up converter valve.
(3) Loss of pressure in the converter circuit caused by loose or worn bushings.	(3) Replace bushings as necessary.

INCORRECT DIRECT DRIVE CLUTCH PRESSURE

CAUSE	CORRECTION
(1) Sticking governor valves or sticking direct shift valve.	(1) Perform governor and direct drive clutch pressure tests. If both pressures are incorrect, check for sticking governor valves. If governor pressure is normal but direct drive clutch pressure is incorrect, check for sticking direct shift valve.
(2) Worn or leaking direct drive clutch piston rings.	(2) Check condition of all rings and replace as necessary.
(3) Loss of pressure through direct drive clutch circuit caused by loose or worn bushings.	(3) Replace bushings as necessary.

INCORRECT GOVERNOR PRESSURE

CAUSE	CORRECTION
(1) Sticking low or high speed governor valves.	(1) Free up governor valves.
(2) Governor housing plate not properly installed.	(2) Install housing plate properly.

INCORRECT THROTTLE PRESSURE

CAUSE	CORRECTION
(1) Throttle pressure adjusting screw improperly set.	(1) Adjust throttle pressure as specified.
(2) Throttle linkage not properly adjusted or binding.	(2) Free up linkage and adjust properly.
(3) Throttle valve sticking.	(3) Free up throttle valve.

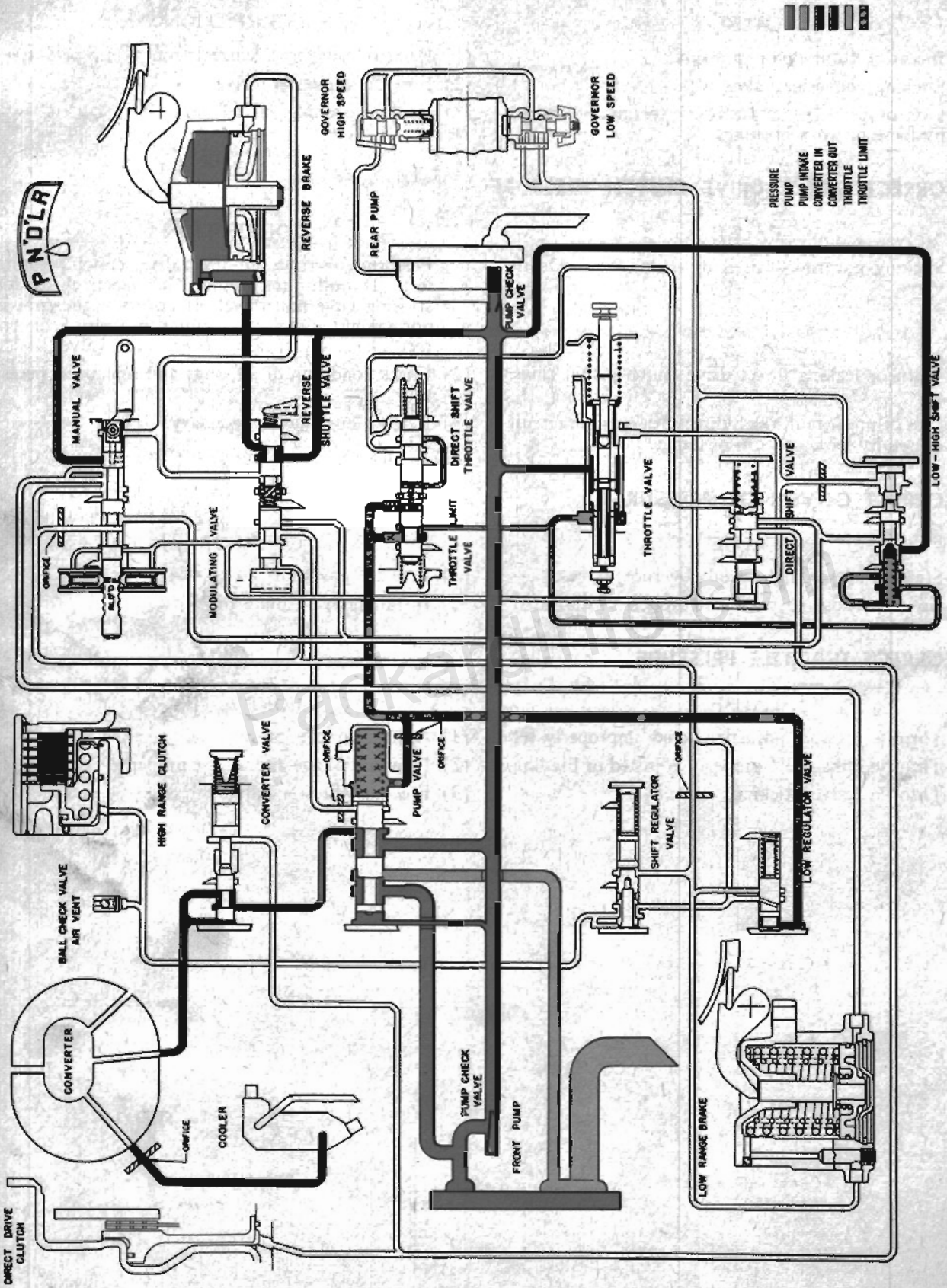

FIG. 272 NEUTRAL AND PARK

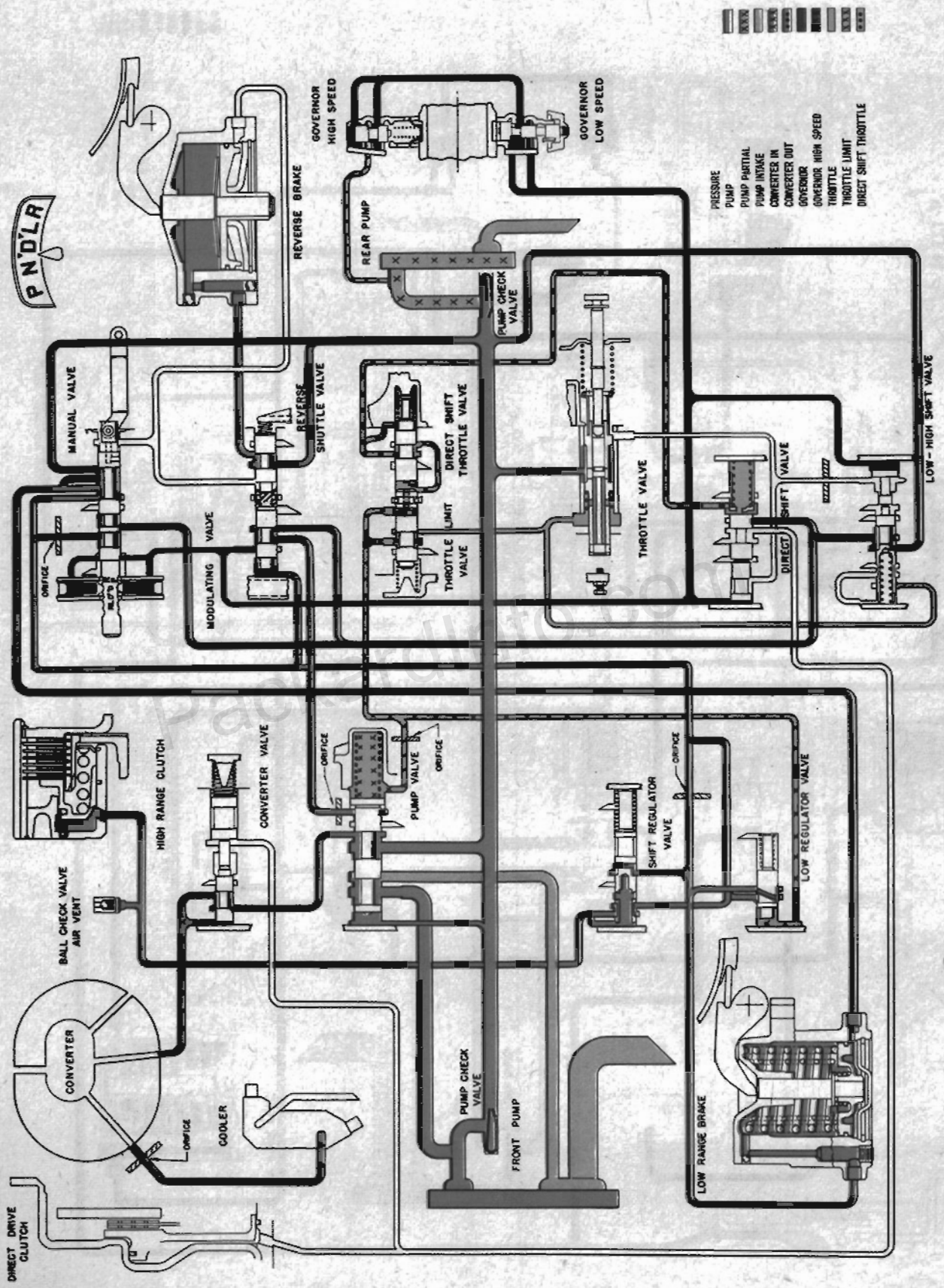

FIG. 273 HIGH RANGE CONVERTOR ("D")

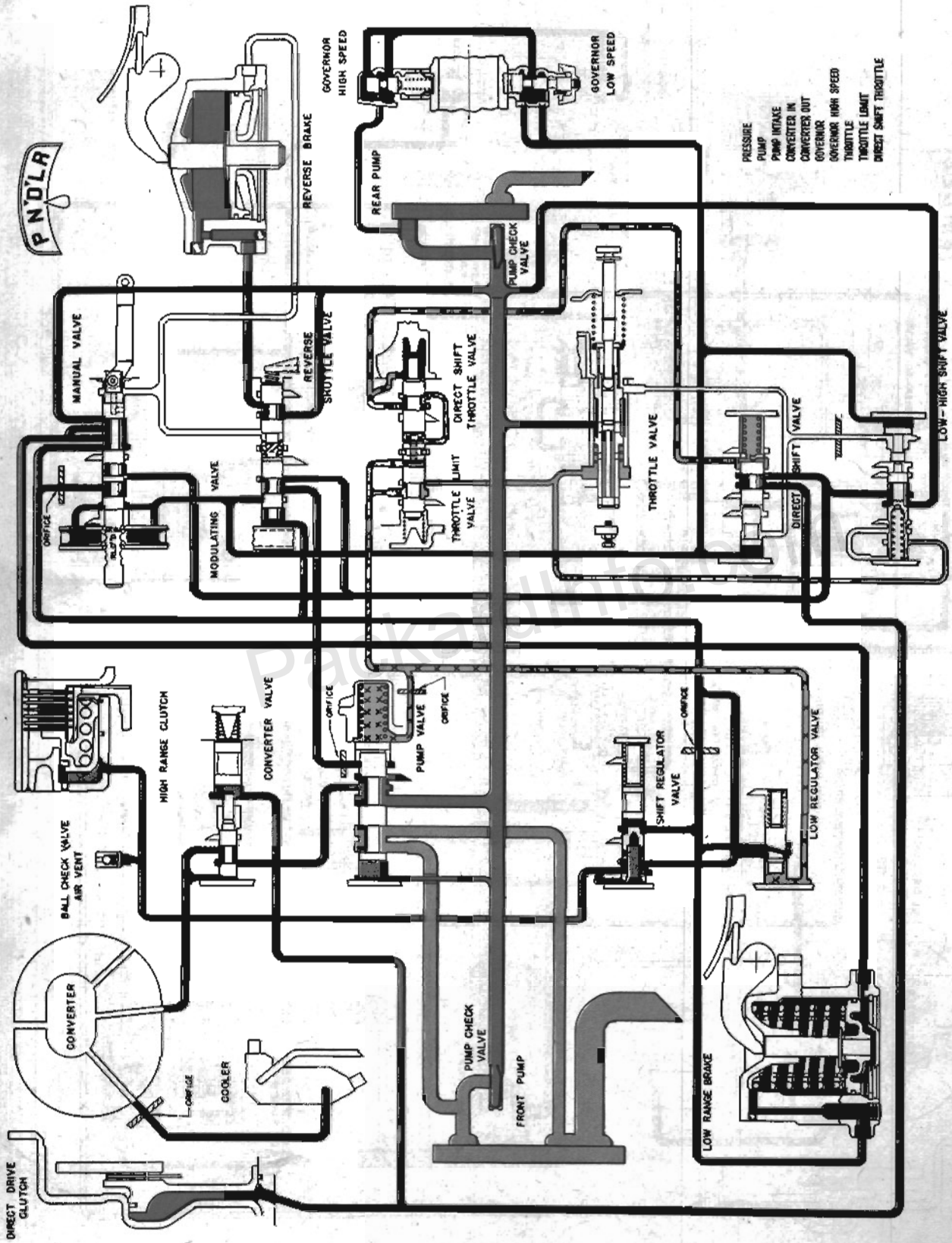

FIG. 274 HIGH RANGE DIRECT ("D")

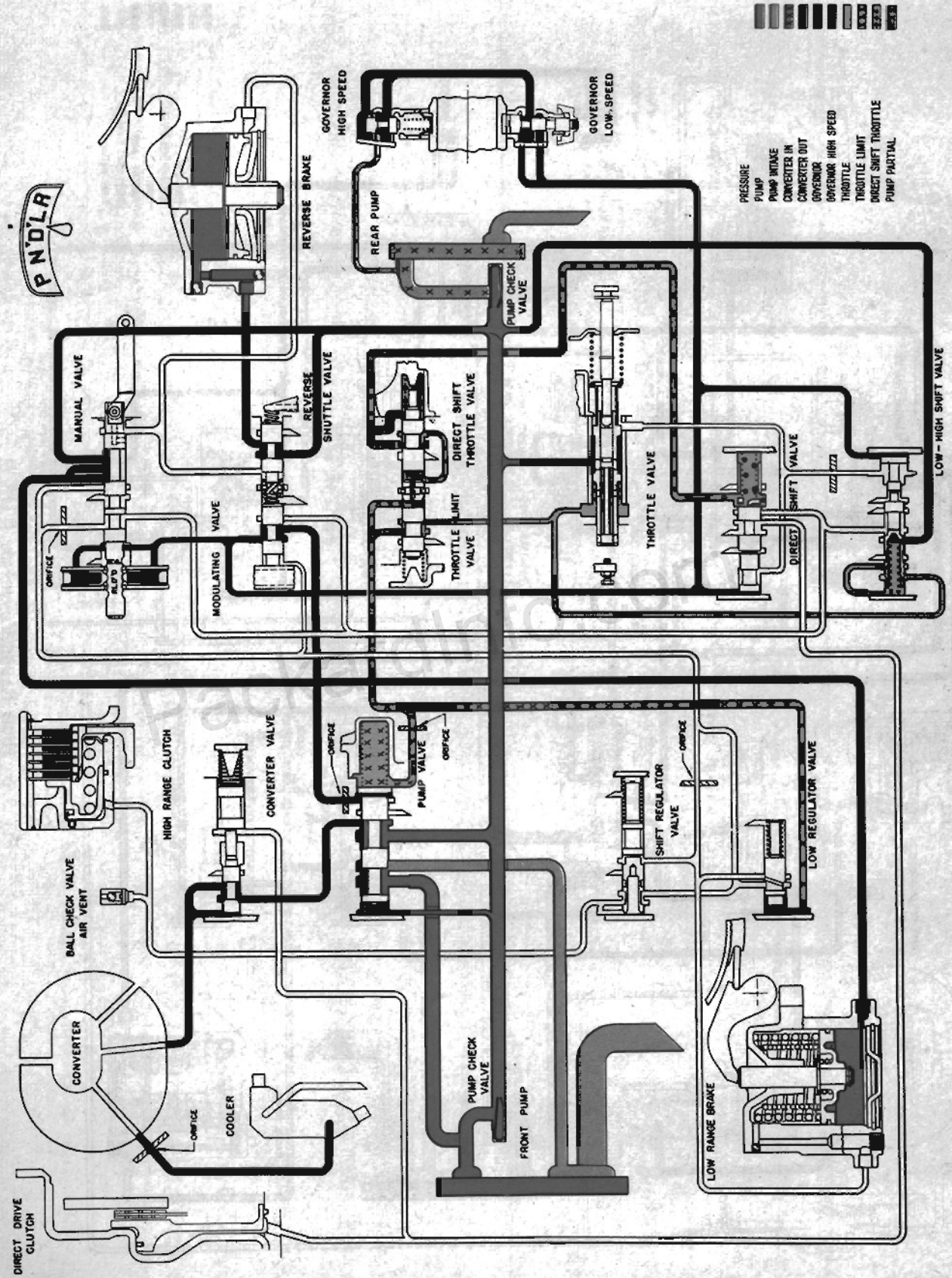

FIG. 275 LOW RANGE CONVERTOR ("D")

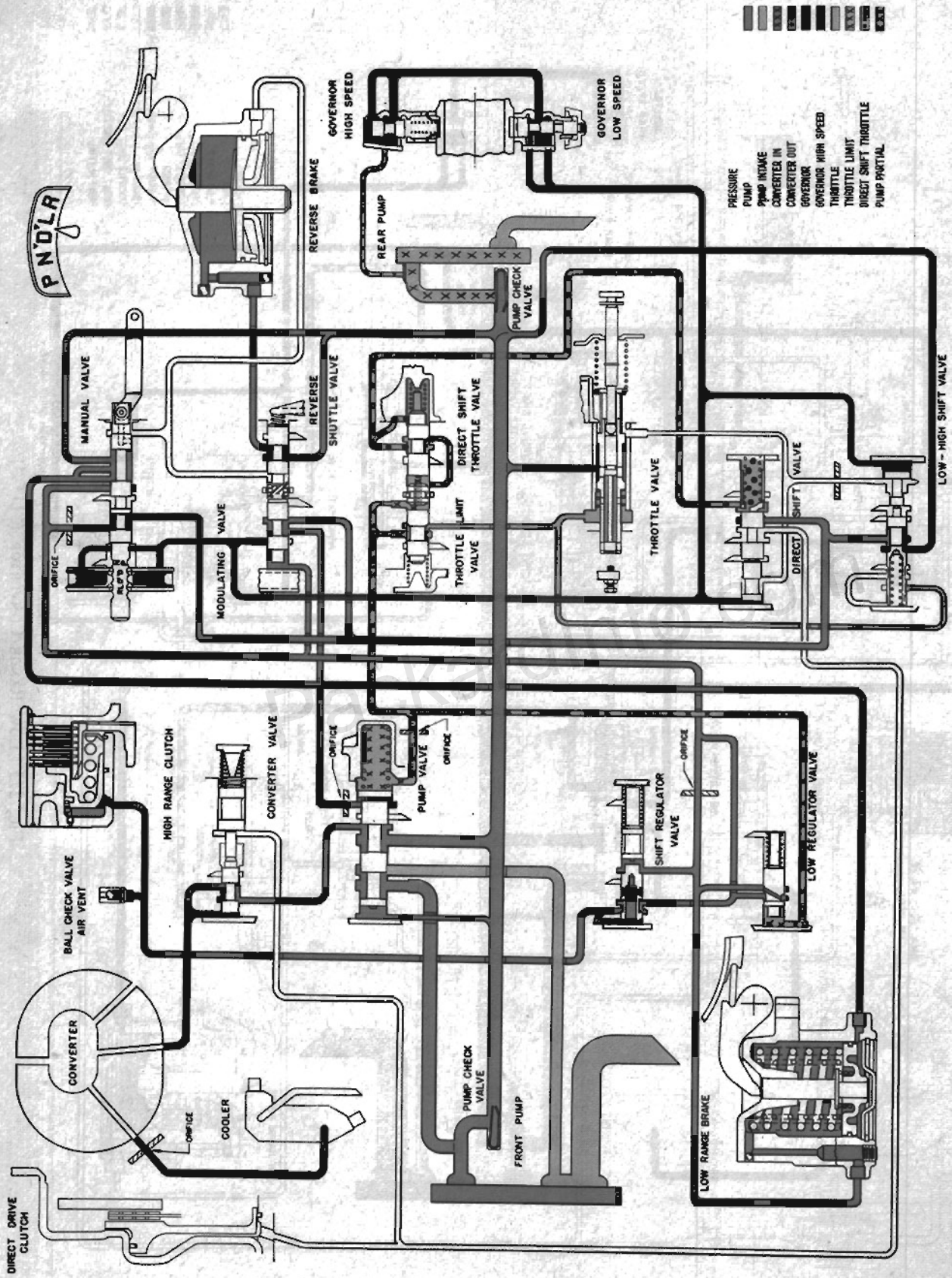

FIG. 276 HIGH RANGE CONVERTOR ("D")

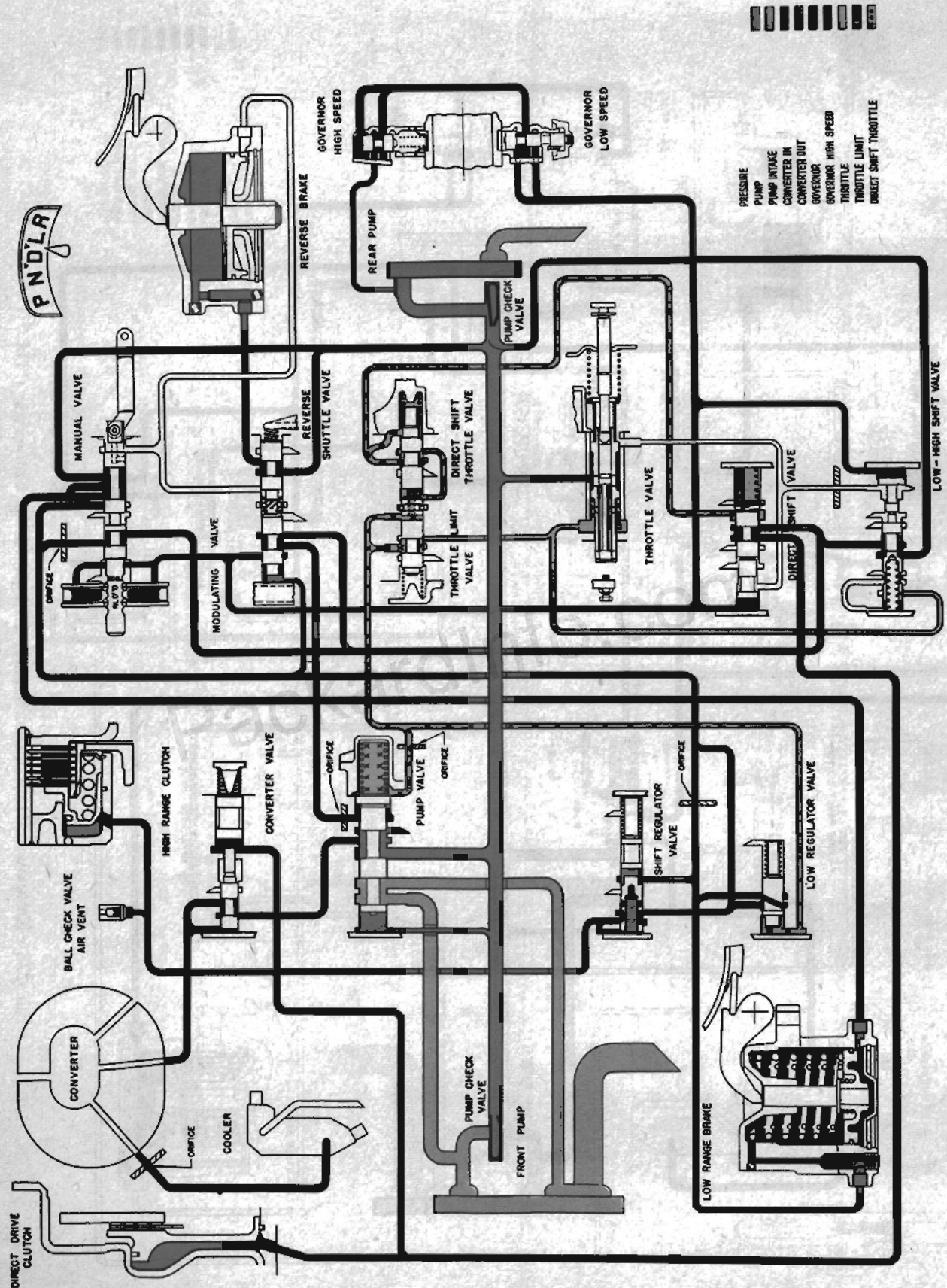

FIG. 277 HIGH RANGE DIRECT ("D")

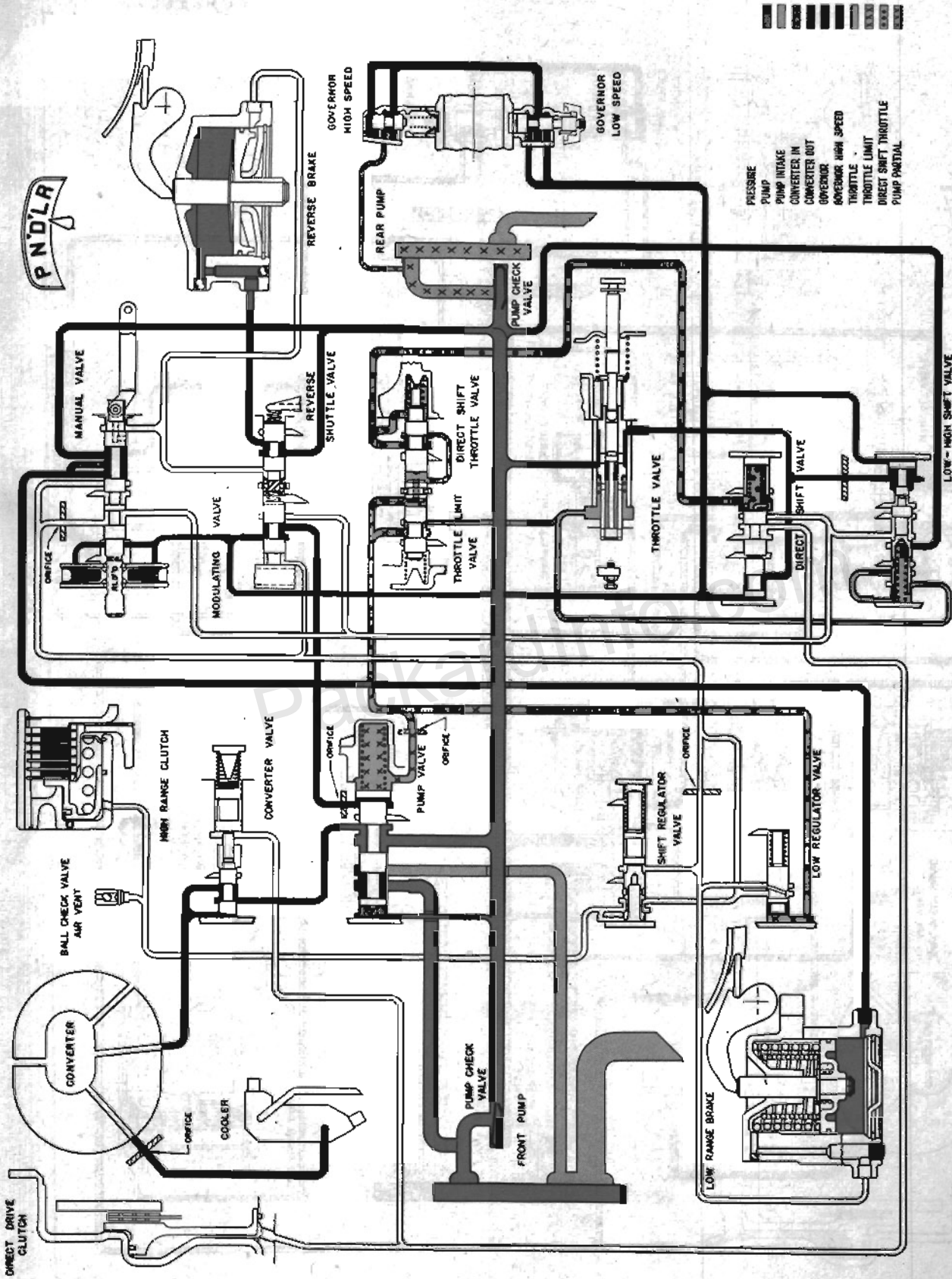

FIG. 278 KICKDOWN—HIGH RANGE DIRECT TO LOW RANGE CONVERTOR ("D")

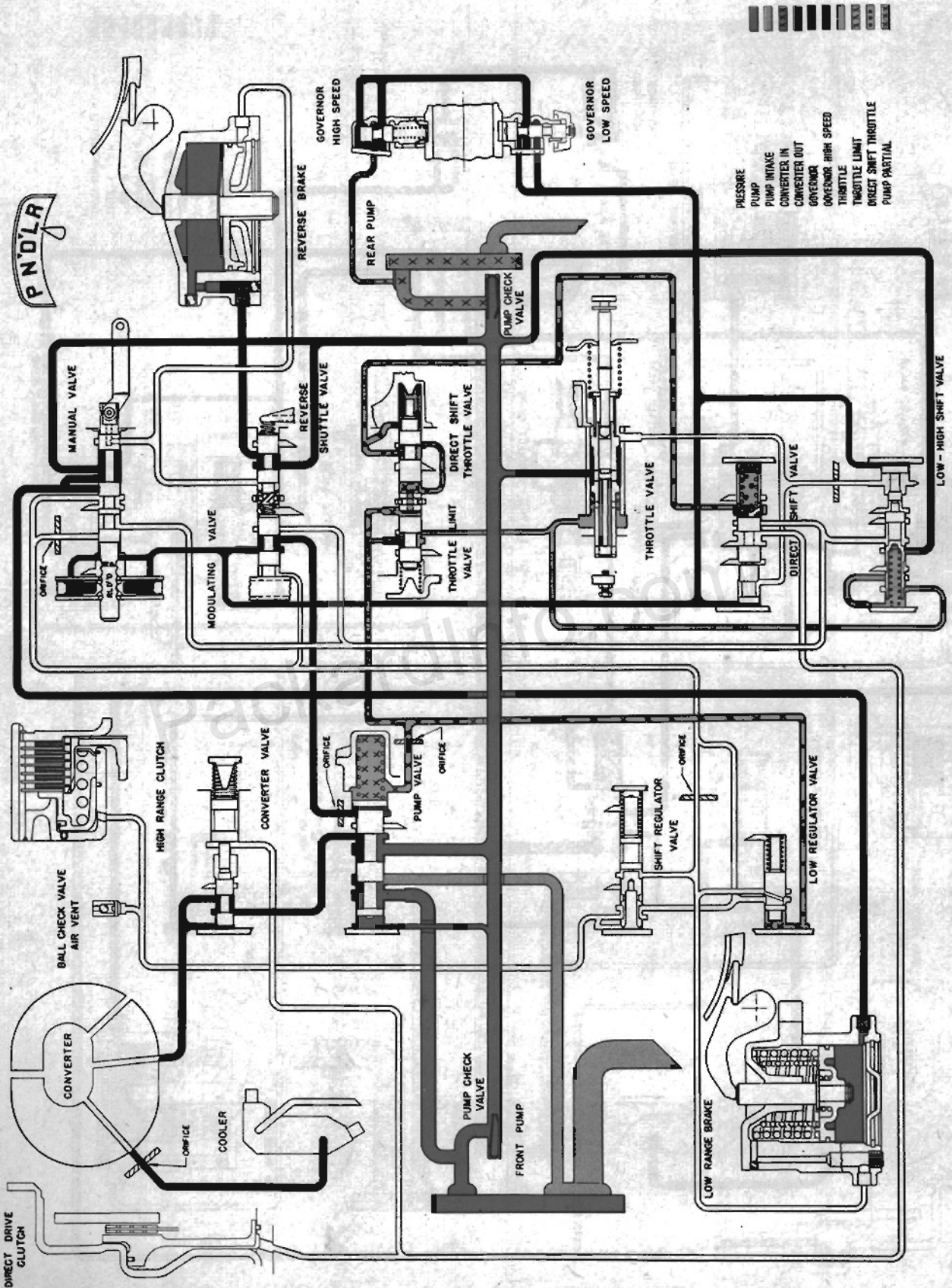

FIG. 279 LOW RANGE CONVERTOR ("L")

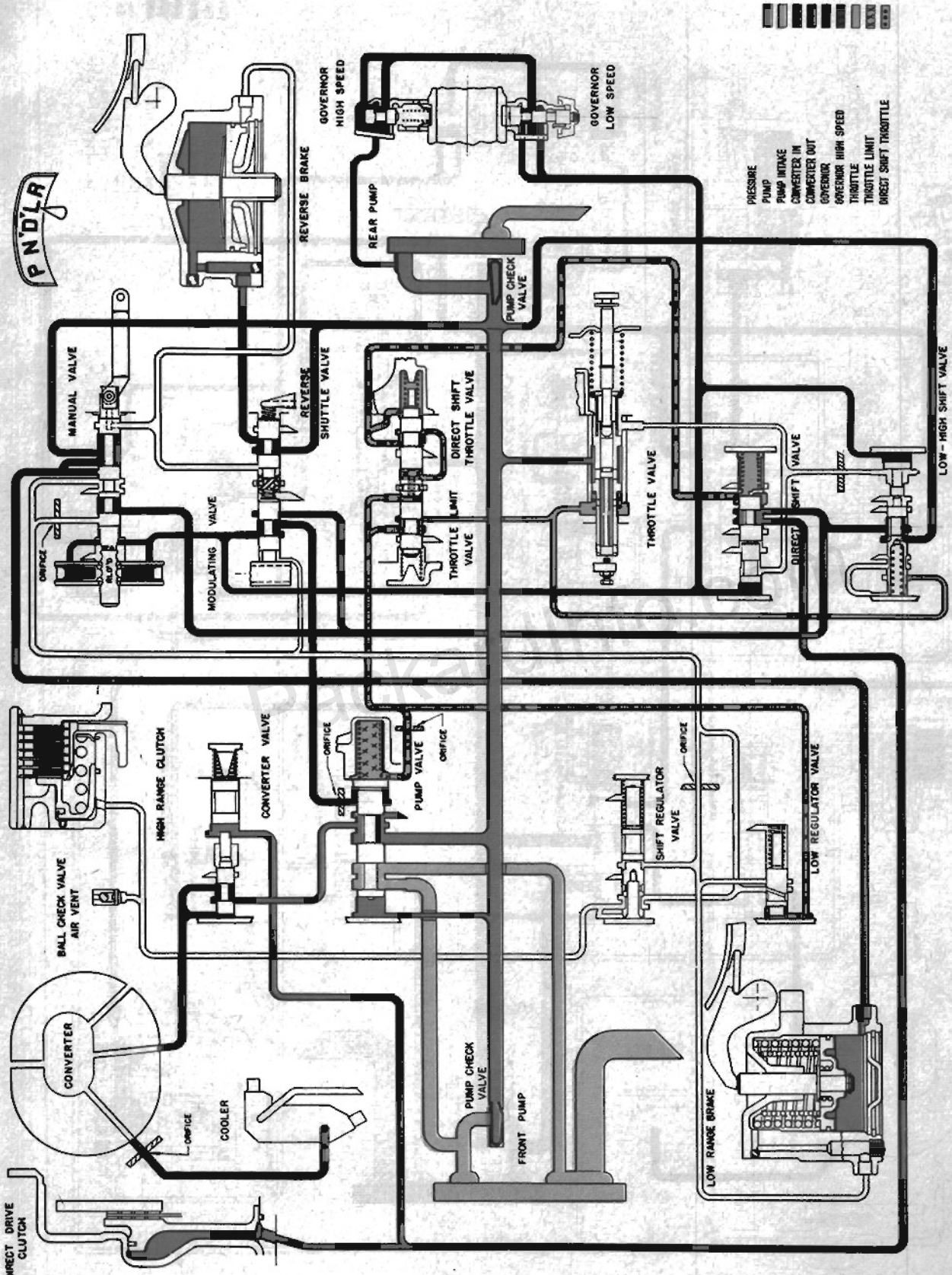

FIG. 280 LOW RANGE DIRECT ("L")

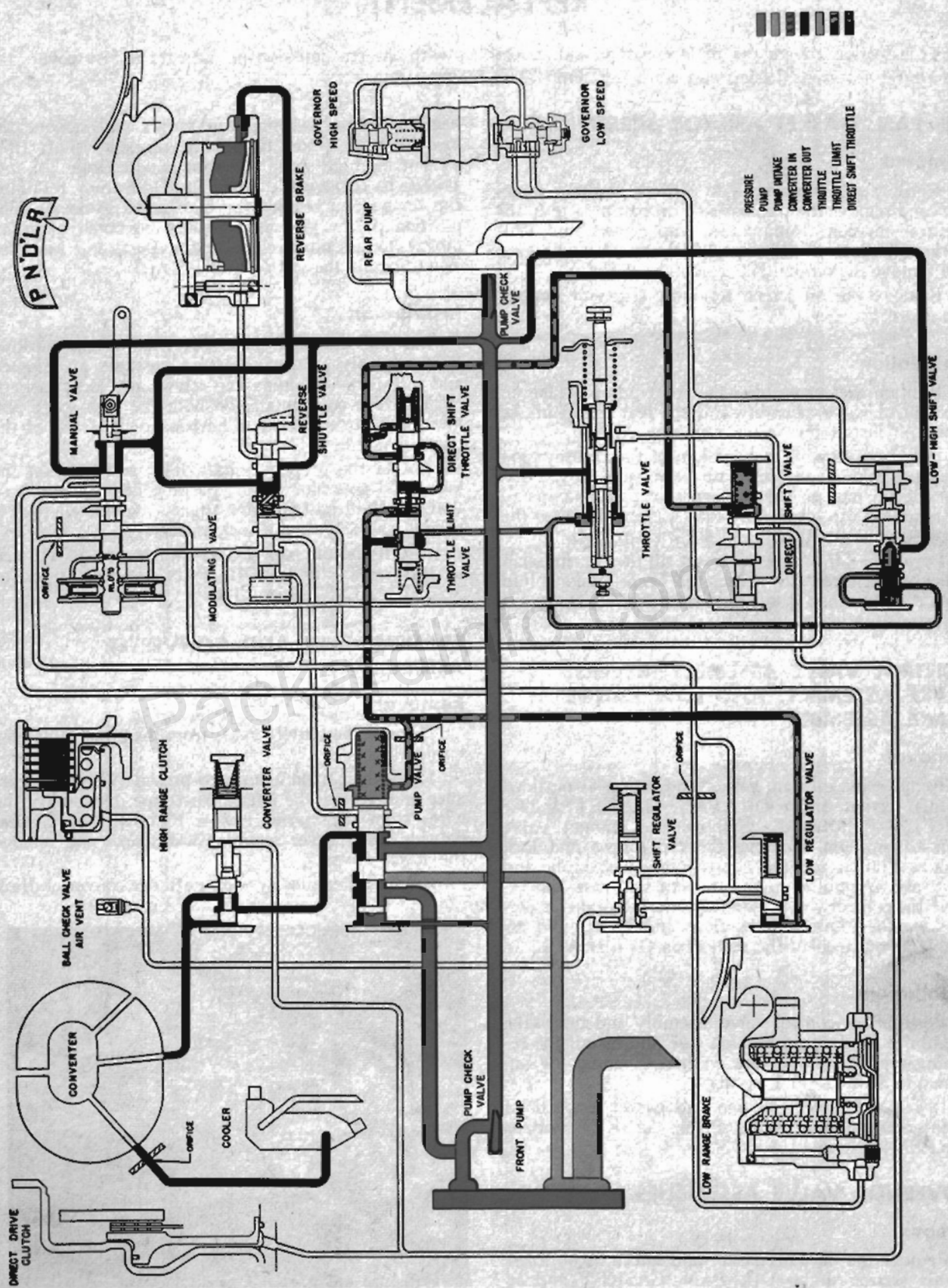

FIG. 281 REVERSE

REPLACEMENT

This section covers the replacement of sub-assemblies with the transmission in the car; it also covers the procedures for transmission and converter removal and installation.

OIL PAN, GASKET AND/OR SCREEN

Removal

Raise the car on a hoist to provide working clearance and remove the transmission oil pan plug to drain the transmission. Remove the cap screws and lock washers that attach the oil pan to the transmission case and remove the oil pan and gasket.

Remove the oil screen retaining clip and remove the screen.

Installation

Position the screen over the front pump intake on the control valve assembly and the rear pump intake tube and install the screen retaining clip.

Position a new oil pan gasket on the transmission case and hold in position with petroleum jelly. Position the oil pan on the transmission case and install the retaining cap screws and lock washers. Tighten the cap screws to 10-20 ft-lbs (1,4-1,7 kg-m.).

Lower the car on the hoist and fill the transmission to the proper level with Automatic Transmission Fluid Type A as outlined in the section on Maintenance and Adjustments.

CONTROL VALVE ASSEMBLY, REVERSE BRAKE ASSEMBLY, AND LOW RANGE BRAKE ASSEMBLY

Removal

Remove the oil pan, gasket and screen as outlined in this section under OIL PAN, GASKET and/or SCREEN REMOVAL. Remove the manual valve lever to link pin. Remove the cap screws and lock washers that attach the control valve assembly and the brake assemblies to the transmission case and remove the control valve assembly and the brake assemblies together. Disassemble, clean and inspect and assemble as outlined in the section on OVERHAUL.

Installation

Position the control valve assembly and the brake assemblies on the transmission case and install the retaining cap screws and lock washers. Tighten the cap screws to 9 ft-lbs (1,2 kg-m).

Install the screen, oil pan and gasket as outlined in this section under OIL PAN, GASKET and/or SCREEN—INSTALLATION.

GOVERNOR VALVE ASSEMBLIES

Removal

Remove the oil pan, gasket and screen as outlined in this section under OIL PAN, GASKET and/or SCREEN—REMOVAL.

Rotate the propeller shaft until the low speed governor is accessible. Use tool J-5976 to remove the Allen head governor retaining cap screws and remove the low speed governor. Rotate the propeller shaft 180° so that the high speed governor is accessible. Use tool J-5976 to remove the Allen head governor retaining cap screws and remove the high speed governor. The position of the governors should be noted upon removal. Disassemble, clean and inspect, and assemble as outlined in the section OVERHAUL.

Installation

Position the high speed governor on the parking gear assembly so that the fluid passages are aligned and install the retaining cap screws and lock washers. NOTE: The cover plates on both the high speed and low speed governors must be toward the front of the transmission.

Rotate the propeller shaft 180° and position the low speed governor on the parking gear assembly so that the fluid passages are aligned and install the retaining cap screws and lock washers.

Install the oil pan, gasket and screen as outlined in this section under OIL PAN, GASKET and/or SCREEN—INSTALLATION.

TRANSMISSION AND CONVERTER ASSEMBLY

Removal

Remove the battery cable from the positive battery terminal.

Raise the car on a hoist to provide working clearance and remove the left exhaust pipe. Disconnect the wires from the starter motor. Remove the flywheel housing lower cover retaining cap screws and remove the lower cover.

Rotate the engine flywheel until one converter drain

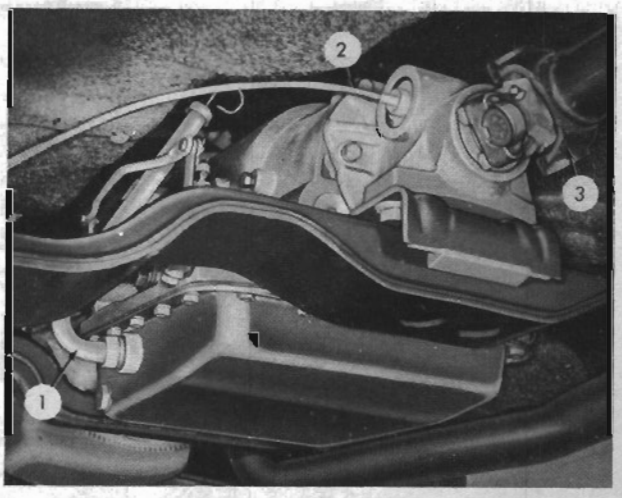

FIG. 282

1. Dipstick pipe
2. Speedometer cable
3. Front propeller shaft

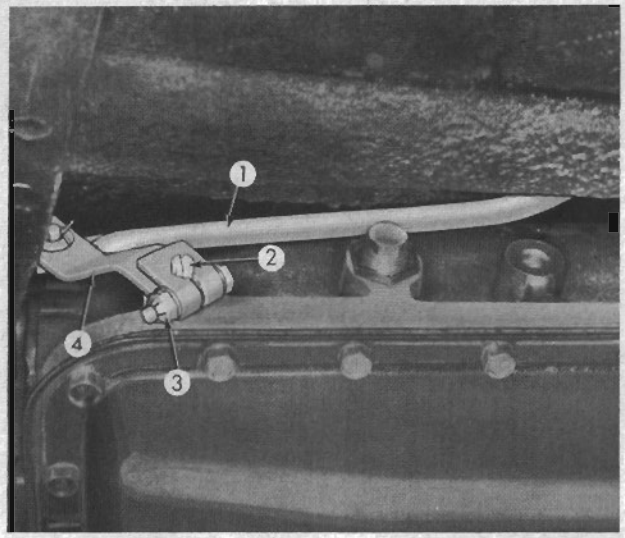

FIG. 283

1. Rod
2. Shaft
3. Clamp screw nut
4. Throttle valve outer lever

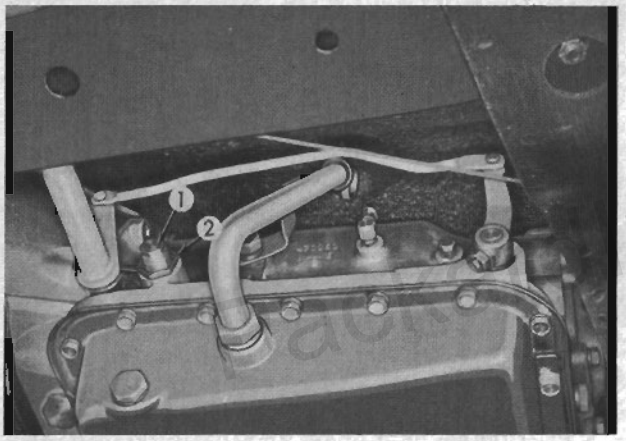

FIG. 284

1. Adjusting screw
2. Lock nut

plug is at the bottom and loosen but to do remove the drain plug. Rotate the flywheel 180° to bring the other drain plug to the bottom. Remove this drain plug. Also remove the transmission oil pan drain plug. After the transmission and converter have drained, reinstall the drain plugs and tighten all plugs securely.

Disconnect the front propeller shaft (3, Fig. 282) at the transmission companion flange and tie to the right side of the frame out of the way. Disconnect the throttle valve linkage (see Fig. 283) and the manual valve linkage (see Fig. 284) at the transmission. Disconnect the selector to bellcrank linkage by removing the clevis pin (4, Fig. 285) from the clevis at the bellcrank (1). Remove the bolts and nuts that hold the bellcrank to the transmission bracket and to the frame bracket and remove the bellcrank. Disconnect the speedometer cable (2, Fig. 282) and the transmission cooler lines.

Remove the dipstick tube (1, Fig. 282) from the transmission oil pan.

Support the engine at the rear using a support beam across the frame channels or with a large block under the rear end of the engine oil pan and a hydraulic jack.

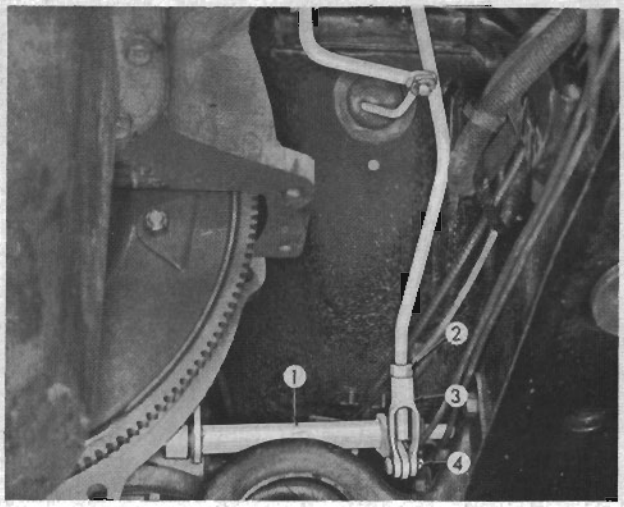

FIG. 285

1. Bell crank
2. Lock nut
3. Clevis
4. Clevis pin

Raise the engine and transmission enough to take the load off the rear engine support crossmember under the transmission rear housing. Remove the nuts and washers from the rear engine support. Remove the crossmember retaining bolts and slide the crossmember to the rear.

Remove the body front pillar support crossmember.

Place a transmission jack under the transmission with the saddle adapter, J-6316, properly positioned around the oil pan. Pick up the transmission load slightly by raising the jack.

Remove the direct drive clutch housing to flywheel retaining nuts (see Fig. 286) and slide the converter assembly toward the transmission.

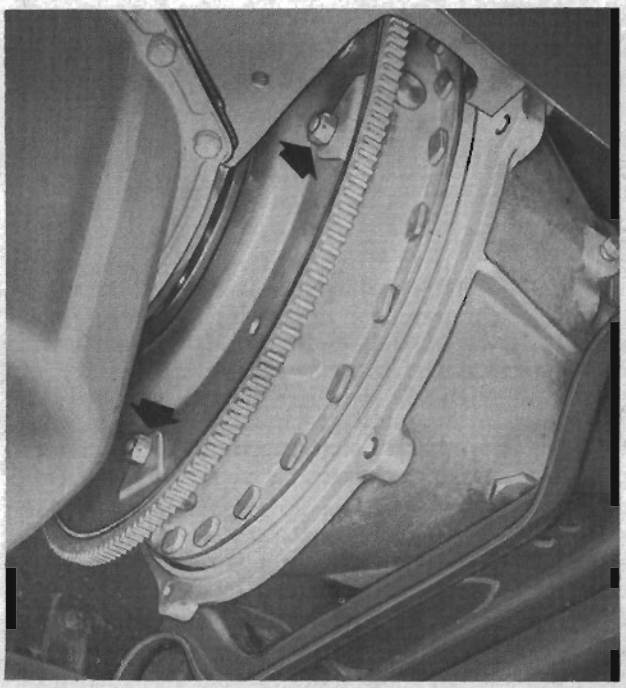

FIG. 286

Remove the bellhousing to flywheel housing cap screws and then move the transmission rearward until the direct drive clutch housing is clear of the flywheel (see Fig. 287). Wire the converter assembly to the bellhousing so that it cannot accidentally slide off the input shaft.

Lower the transmission on the jack and pull the jack and transmission from under the car.

Remove the bellcrank bracket from the transmission. Also remove the converter and place on the work bench. Transfer the transmission to the Transmission Bench Stand, J-6315.

Installation

Install the converter on the transmission input shaft and wire the converter to the bellhousing to prevent it from accidentally sliding off the input shaft.

Transfer the transmission from the holding fixture to the transmission jack and position in the saddle adapter. Install the bellcrank bracket on the transmission.

Move the transmission under the car and raise the jack until the pilot on the front of the direct drive clutch housing is in line with the bore in the crankshaft.

Move the transmission forward so that the pilot enters the crankshaft while at the same time the four studs on the converter housing enter the holes in the flywheel. Start two of the converter to flywheel retaining nuts and remove the wire holding the converter to the bellhousing.

Install all bellhousing to flywheel housing retaining cap screws and tighten to 25 to 30 ft-lbs (3,5 to 4,1 kg-m.).

Install the two remaining converter to flywheel retaining nuts and tighten all the retaining nuts to 25 to 30 ft-lbs.

Install the oil filler tube on the transmission; also connect the speedometer cable and the transmission cooler lines to the transmission.

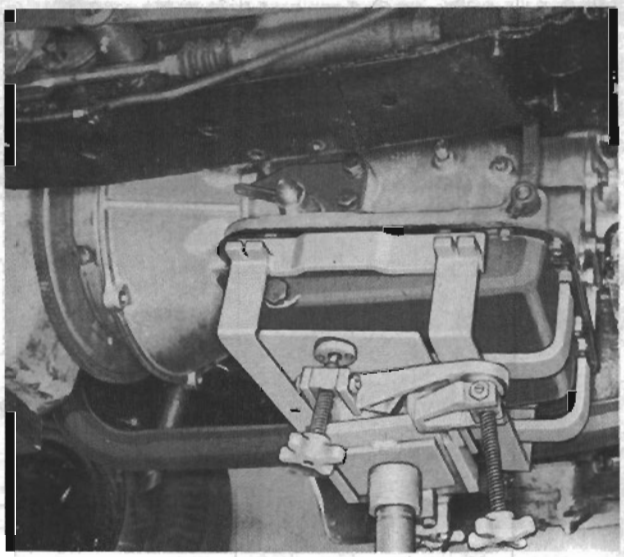

FIG. 287

Install the body front pillar support crossmember. Also install the engine support crossmember.

Lower the engine and transmission and install the rear engine support nuts and washers. Tighten securely. Lower the transmission jack and remove from under the car.

Connect the front propeller shaft to the transmission companion flange.

Position the selector bellcrank on the transmission bracket and on the frame bracket and install the retaining nuts and bolts. Connect the selector linkage to the manual valve lever and to the bellcrank lever.

Assemble the flywheel lower cover to the flywheel housing and install the retaining cap screws. Tighten to 25 to 30 ft-lbs (3,5 to 4,1 kg-m.).

Install the left exhaust pipe.

Lower the car on the hoist and fill with transmission fluid as outlined in the section on MAINTENANCE.

OVERHAUL

After a complete diagnosis has revealed that repairs to the transmission or converter will require the removal of sub-assemblies from the transmission that cannot be removed with the transmission in the car, the transmission and converter must be removed from the car as an assembly and the following procedures followed as work on the transmission or converter is performed on the mechanic's bench.

After the transmission and converter have been removed from the car the converter should be removed from the bell housing and the outside of the transmission thoroughly cleaned to prevent dirt from entering into the inside of the unit while work is being performed on the transmission.

When servicing the transmission, it is vitally important that the bench or work space as well as tools and hands be clean. The proper tools should always be used and, above all, a torque wrench should be used whenever a tightening torque is specified.

Any time a part or unit is removed or disassembled, it should be thoroughly cleaned in a suitable cleaning solvent. After cleaning, the parts should be blown dry using compressed air. In the event a cloth is used, it should be clean and lintless.

Before reinstalling parts or reassembling units, all parts should be thoroughly inspected. A rule-of-thumb inspection procedure cannot always be followed and it will be up to the discretion of the serviceman as to whether a part should be replaced.

When inspecting gears, pinions, or splined shafts, check all teeth for being nicked or burred and clean up, if necessary, with an abrasive stone having a fine grit

or with crocus cloth. When a part, such as a shaft, fits into another part, check the fit of the mating parts. Excessive clearance should not exist nor should the parts be excessively tight.

When inspecting any part which incorporates one or more oil passages, blow compressed air through the passages.

The friction facings on clutch plates and brake bands should be inspected for excessive wear and for being properly bonded and not loose. The areas on parts which are in contact with the facings and linings should be inspected for being scored or distorted.

Castings should be checked for cracks and sand holes. Where gaskets are used, the gasket contact areas should be clean, smooth, and free from deep scratches which would permit oil to pass the gasket. It is recommended that new gaskets be used on all reassembly operations.

All control valves should be very closely inspected for nicks and burrs. The valves should not be thrown together into a container for cleaning, otherwise the edges of the valve lands may become nicked. When it is necessary to clean up a burr or smooth out a nick, use a flat, finely gritted abrasive stone.

Check each valve in its respective bore in the valve body. The valve should move freely of its own weight as the body is tilted.

When assembling the valve controls, it is extremely important that the cap screws be tightened to their specified torque. Improperly tightening the cap screws can result either in valves sticking or in excessive leakage at the valves with consequent losses caused by normal expansion and contraction of the valves and bodies.

Bench work on the transmission can be facilitated if the transmission is placed in a suitable holder, tool J-6315.

Transmission Sub-Assembly Removal

OIL PAN, GASKET, AND SCREEN

Remove the twenty one (21) cap screws and lock washers that attach the oil pan to the transmission case and remove the oil pan and gasket. Remove the retaining clip from the control valve assembly stud and remove the screen.

CONVERTER BELL HOUSING AND FRONT PUMP ASSEMBLY

Remove the oil cooler tube adapters. Use an easy-out and remove the two (2) oil cooler tubes (see Fig. 288). Remove the ten (10) cap screws and lock washers that attach the bell housing to the transmission case. NOTE: One of the attaching cap screws is a special screw and is used without a lock washers and *must* be installed in the same position from which it was removed upon reassembly of the transmission. Remove the bell housing and front pump assembly by sliding toward the front of the transmission (see Fig. 289). Remove the bell housing gasket.

EXTENSION HOUSING

Place the manual lever in the P position to lock the

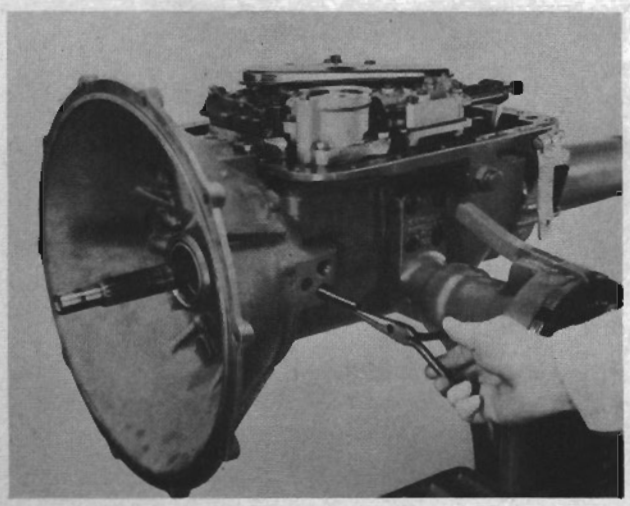

FIG. 288

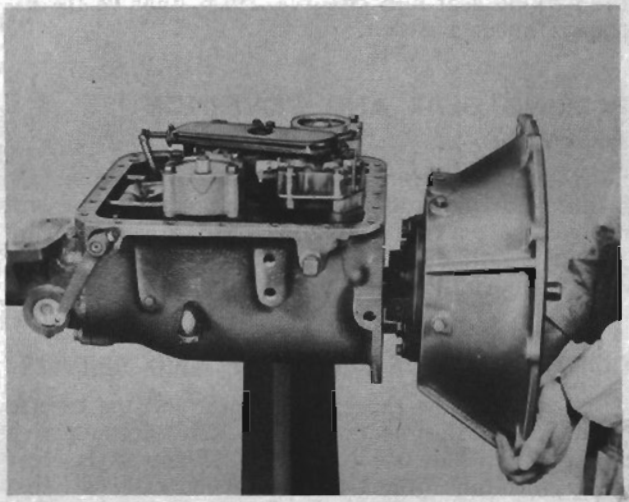

FIG. 289

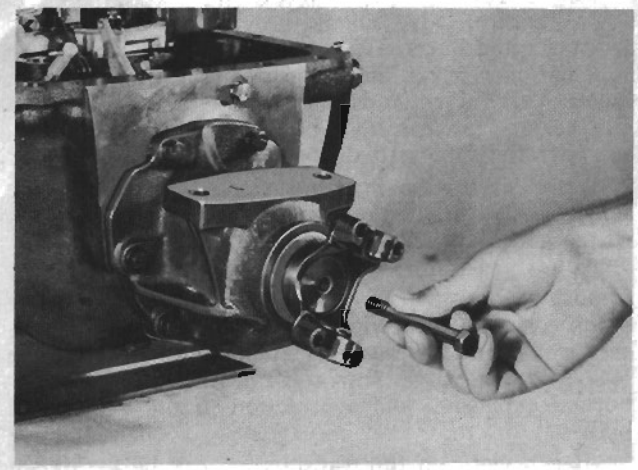

FIG. 290

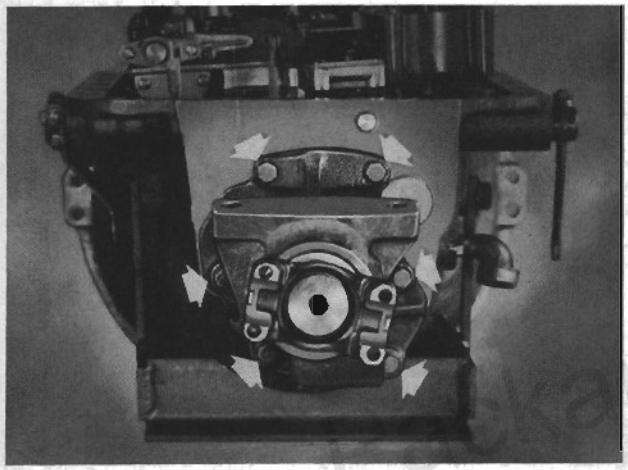

FIG. 291

output shaft to the transmission case and remove the companion flange cap screw (see Fig. 290). Remove the six (6) cap screws and lock washers (indicated in Fig. 291) that attach the extension housing to the transmission case and remove the extension housing by sliding toward the rear of the transmission. Remove the extension housing spacer washer from the inside of the parking gear hub (see Fig. 292). Remove the extension housing gasket.

PARKING GEAR AND GOVERNOR ASSEMBLY

Rotate the parking gear so that the governors are in line with the cutouts in the transmission case and remove the parking gear and governor assembly by sliding toward the rear of the transmission (see Fig. 293). Remove the parking gear lug ring.

CONTROL VALVE ASSEMBLY AND SERVOS

Loosen the low range brake band and the reverse brake band adjustments (see Fig. 294) four or five turns to facilitate servo removal. Remove the rear pump inlet tube from the transmission case (see Fig. 295). Remove the manual valve link pin (see Fig.

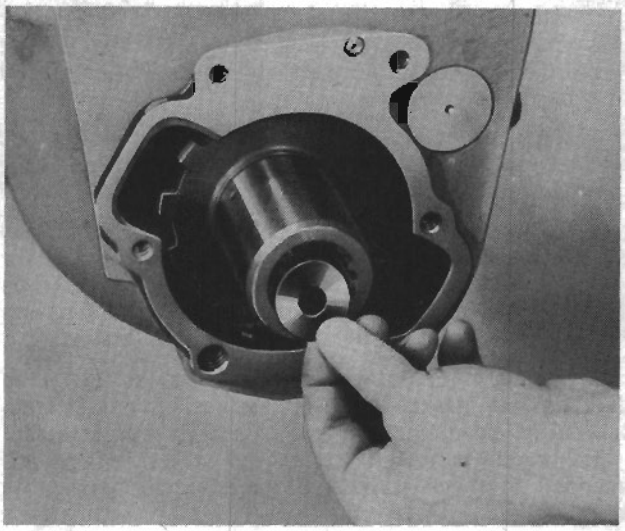

FIG. 292

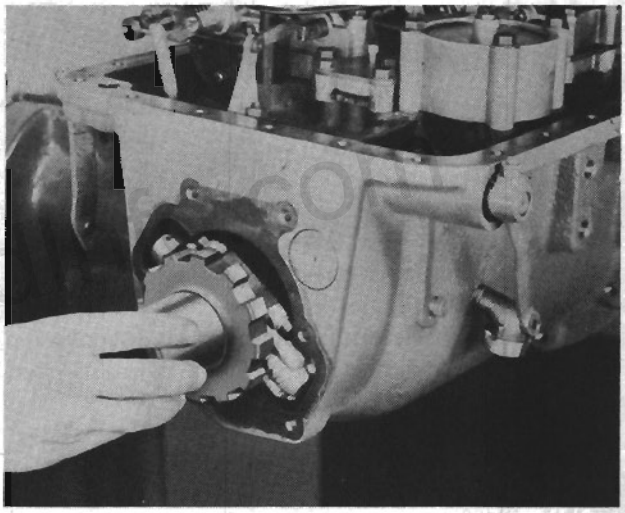

FIG. 293

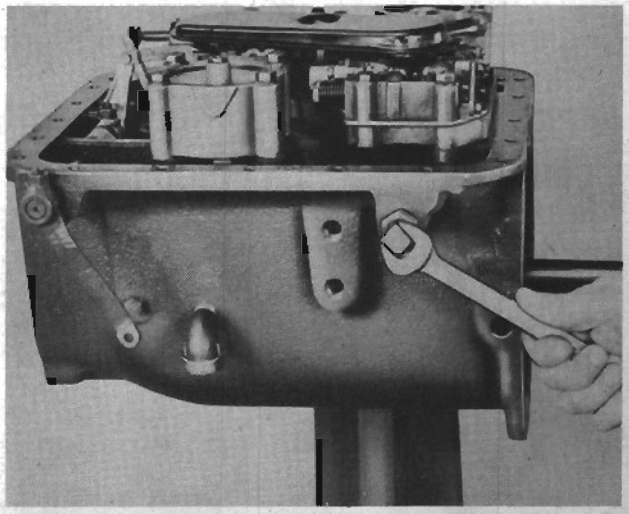

FIG. 294

FIG. 295

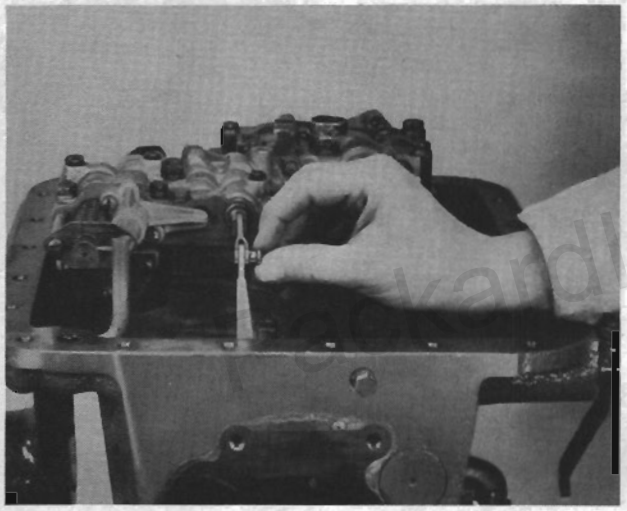

FIG. 296

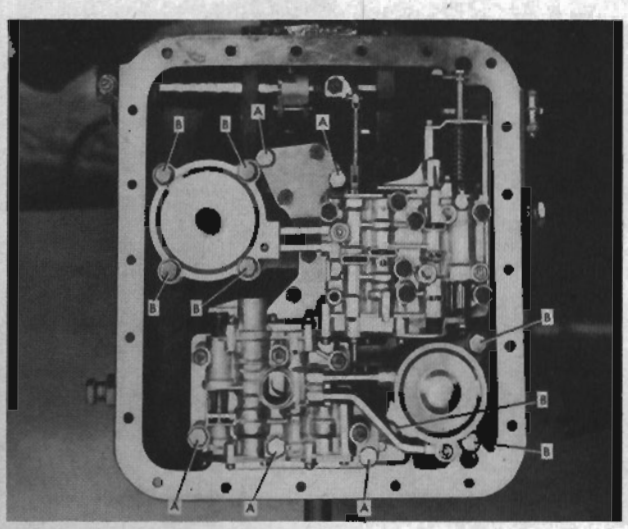

FIG. 297

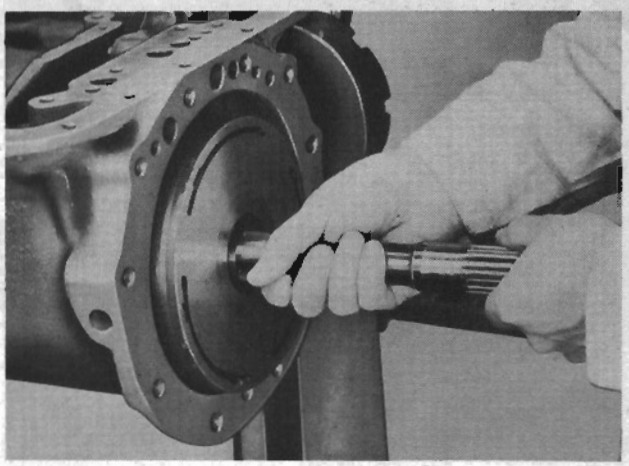

FIG. 298

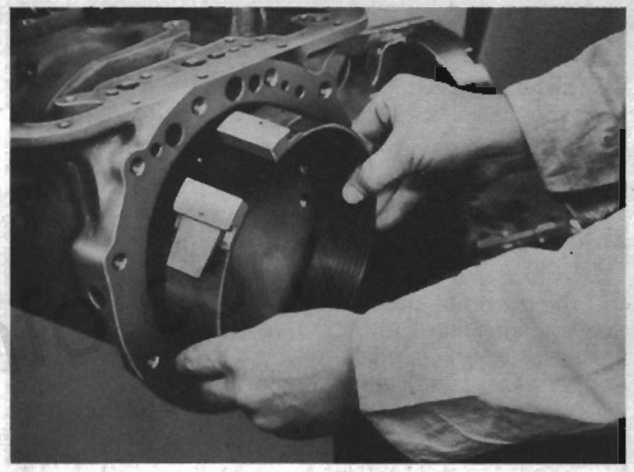

FIG. 299

296). Remove the five (5) cap screws and lock washers (A, Fig. 297) that attach the control valve assembly to the transmission case and the seven (7) cap screws and lock washers (B, Fig. 297) that attach the servos to the transmission case (see Fig. 297) and lift the control valve assembly and the low range brake servo and reverse brake servo off the transmission case together.

HIGH RANGE CLUTCH ASSEMBLY

Remove the high range clutch assembly by sliding through the front of the transmission case (see Fig. 298).

LOW RANGE BRAKE BAND

Disengage the band struts from the adjusting screw and the actuating lever and remove the brake band through the front of the transmission case (see Fig. 299).

PLANETARY GEAR ASSEMBLY

Support the planetary gear assembly with one hand on the output shaft and remove through the front of

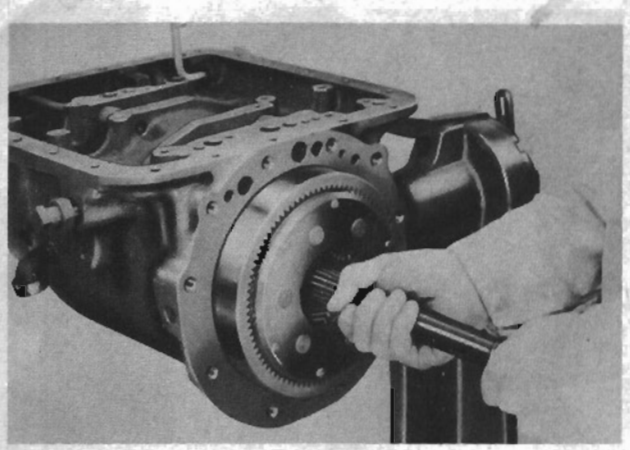

FIG...300

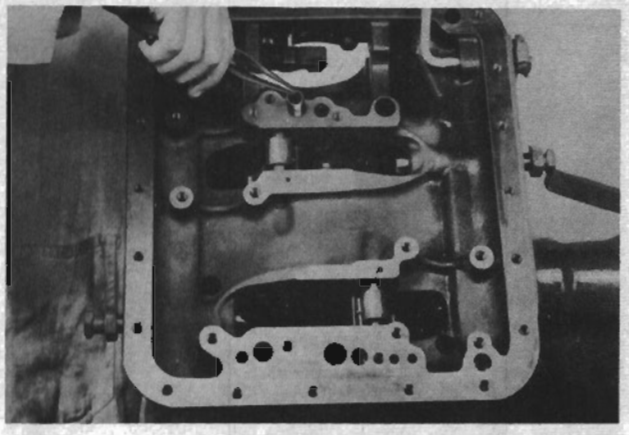

FIG. 301

the transmission case (see Fig. 300).

REVERSE BAND

Disengage the reverse band from the adjusting screw and the actuating lever and remove through the front of the transmission case.

REAR PUMP

Remove the rear pump outlet tube (see Fig. 301) and the governor pressure tube from the transmission case and the rear pump and remove the six (6) cap screws and lock washers that attach the rear pump to the transmission case and remove the pump through the front of the transmission case (see Fig. 302). Remove the fiber thrust washer from the rear pump.

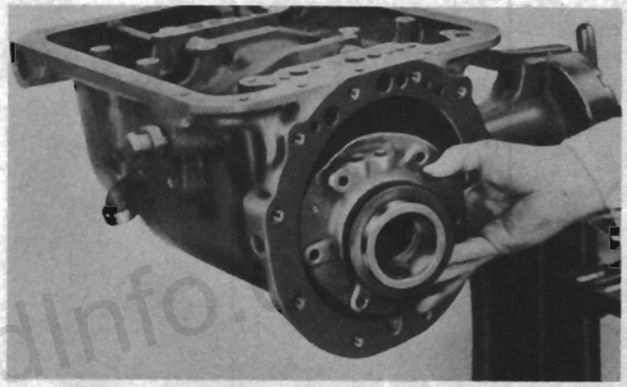

FIG. 302

Transmission Sub-Assembly Disassembly and Reassembly

BELL HOUSING AND FRONT PUMP ASSEMBLY

Disassembly

Remove the high range clutch thrust washer assembly. This assembly consists of a thrust plate, a caged needle bearing, and a thrust plate.

Remove the eight (8) cap screws and lock washers that attach the front pump to the bell housing and lift the pump off the bell housing.

Remove the two (2) piston ring type oil seals (2, Fig. 303) from the high range clutch journal on the front pump. Remove the two (2) screws (6) from the pump cover and remove the cover (7). Mark the internal and external tooth gears (5 and 4) with crayon or pencil to aid in assembly and remove the gears from the pump body, and also remove the spacer ring (3) from the pump body.

Wear of the pump body and gears can be checked by installing the gears in the pump body and checking the nose clearance between the gears, using a feeler gauge (see Fig. 304). This clearance should not exceed

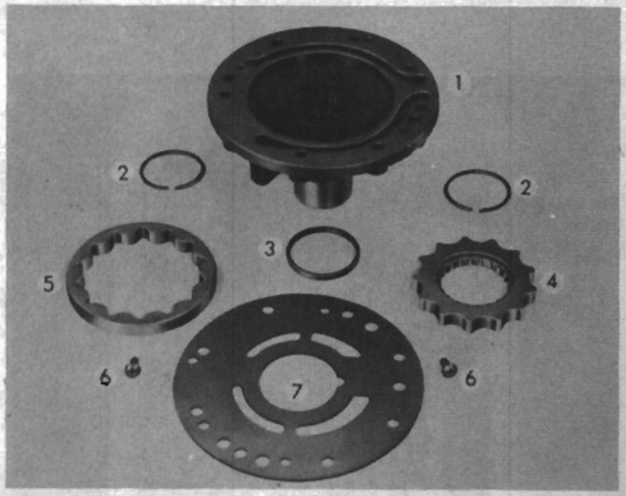

FIG. 303

1. Front pump body
2. Oil seal rings
3. Spacer
4. External tooth gear
5. Internal tooth gear
6. Screws
7. Cover

.008" (0,203 mm.). Clearance between the internal tooth gear and the pump body should be checked (see Fig. 305), and this clearance should not exceed .001" (0,025 mm.). The end clearance of the gears should also be checked by laying a straight edge across the pump body and measuring the end clearance of the gears (see Fig. 306). This clearance should not exceed .006" (0,15 mm.).

To remove the oil seal and bushing from the bell housing, assemble the details of the bushing remover tools as shown in Figure 307 and remove the bushing and seal.

Reassembly

To install the bushing in the bell housing, assemble the details of the bushing replacer tool as shown in Figure 308 and install the bushing.

To install the front pump seal, assemble the details of the seal replacer tool as shown in Figure 309 and install the seal.

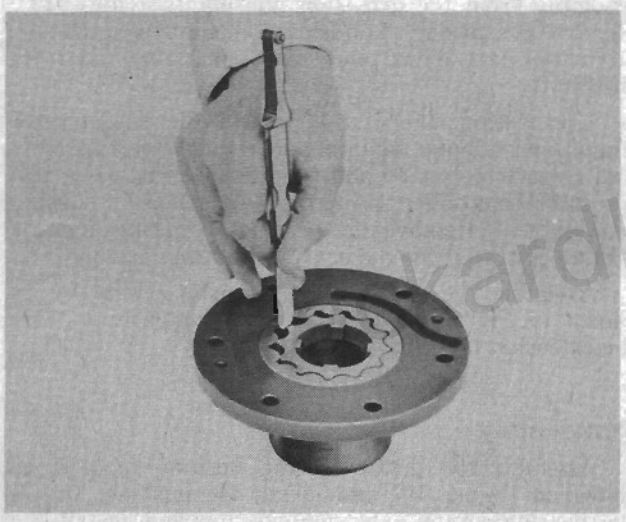

FIG. 304

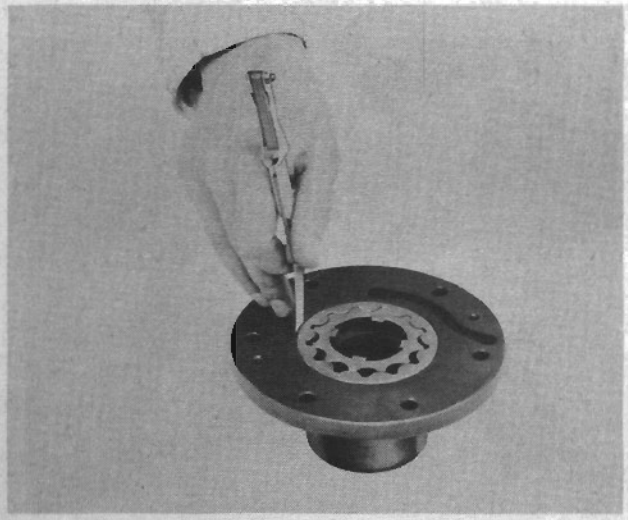

FIG. 305

FIG. 306

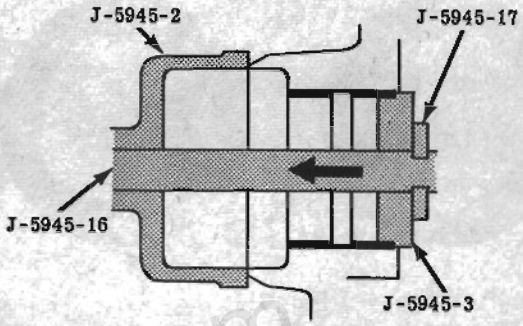

FIG. 307

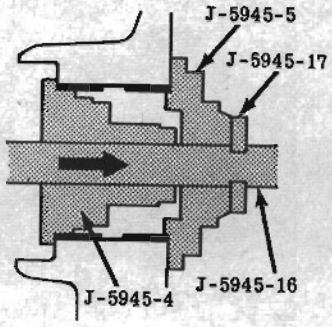

FIG. 308

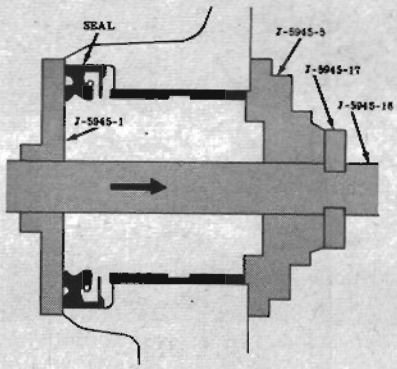

FIG. 309

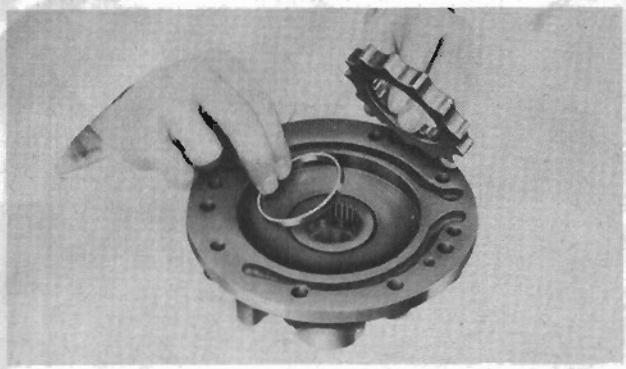

FIG. 310

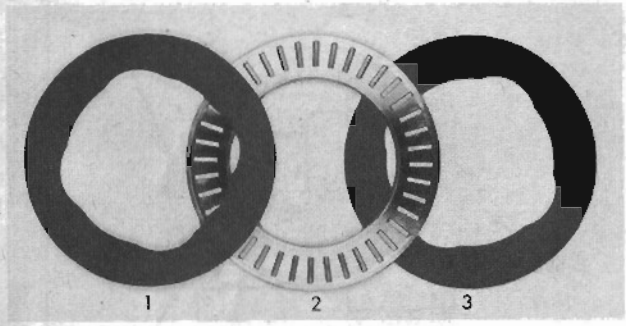

FIG. 311

1. High range clutch thrust plate
2. Caged needle bearings
3. Second thrust plate

FIG. 312

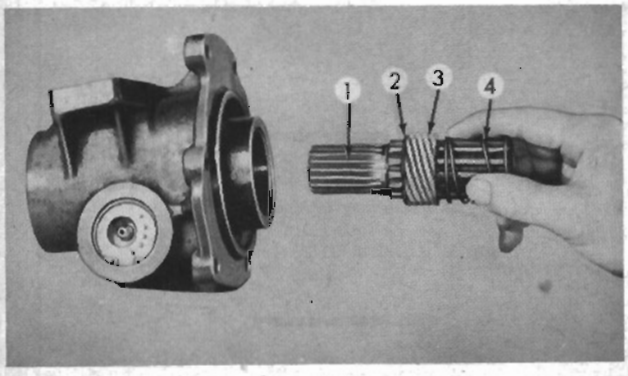

FIG. 313

1. Shaft
2. Snap ring
3. Speedometer drive gear
4. Spring

Install the spacer ring in the pump body (see Fig. 310) and position the internal and external tooth gears in the pump body with the marks previously made on the gears in the upward position. NOTE: One side of the external tooth gear has a deep undercut and this side of the gear should be installed toward the hub end of the pump body. Place the pump cover on the pump body, align the oil passages and the screw holes and install the retaining screws. Tighten the screws to 90-100 inch pounds (1,04-1,13 kg-m).

Install a high range clutch thrust plate (1, Fig. 311), the caged needle bearings (2), and the second thrust plate (3) on the front pump leader. Install the two piston ring type oil seals on the high range clutch journal of the pump body (see Fig. 312). Position the pump on the bellhousing dowels and install the retaining cap screws and lock washers. Tighten the cap screws to 15-18 foot pounds (20,7 to 25 kg-m.).

EXTENSION HOUSING

Disassembly

Remove the companion flange. Remove the shaft assembly from the extension housing (see Fig. 313). Remove the spring (4) and speedometer drive gear (3), from the shaft. Then remove the snap ring (2) from the shaft.

Use tru-arc pliers and remove the speedometer pinion and adapter retaining snap ring (see Fig. 314) and remove the pinion and adapter (see Fig. 315). Use a suitable seal puller and remove the extension housing rear oil seal. Remove the bearing snap ring and use a brass drift to drive the bearing from the housing.

Assemble the details of the bushing remover as shown in Figure 316 and remove the bushing from the extension housing.

Reassembly

Assemble the details of the bushing replacer as shown in Figure 317 and install the bushing. Install the bearing in the extension housing and install the bearing snap ring.

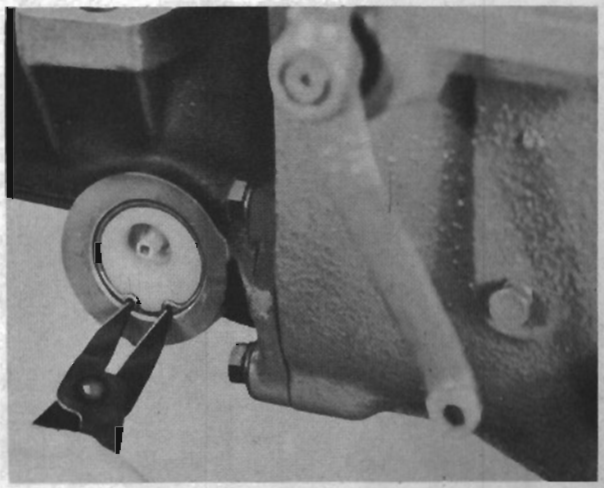

FIG. 314

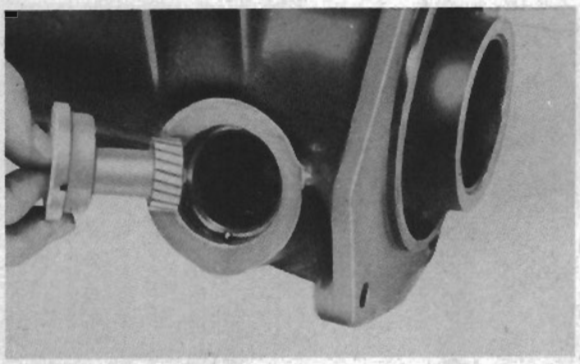

FIG. 315

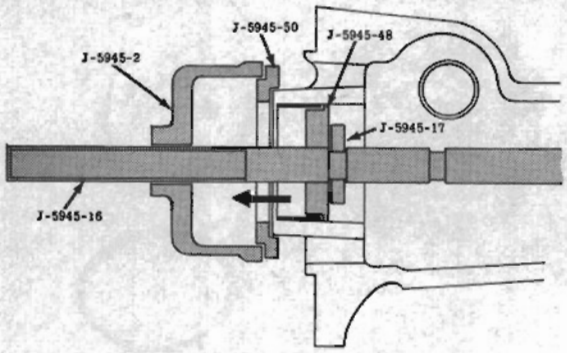

FIG. 316

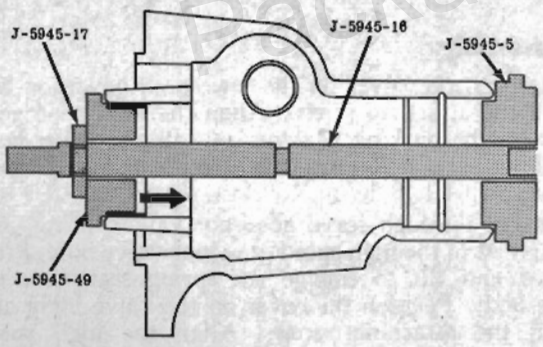

FIG. 317

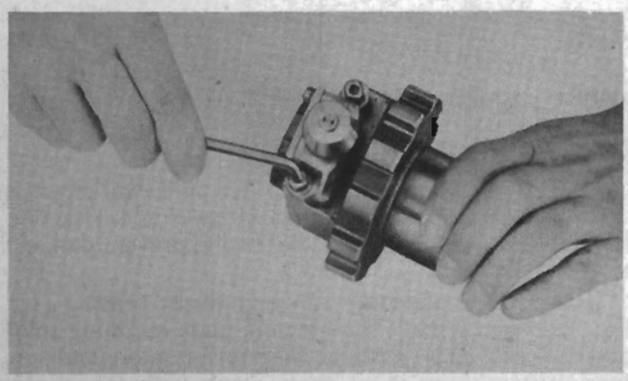

FIG. 318

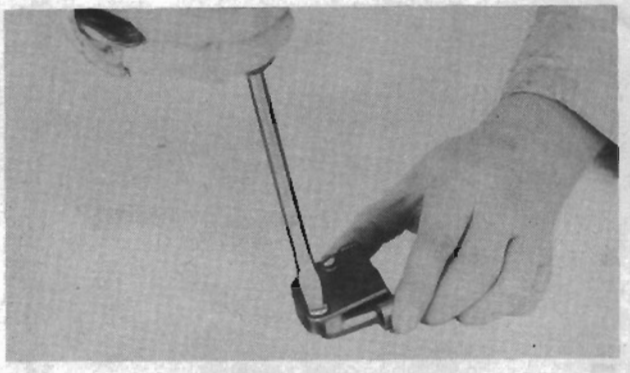

FIG. 319

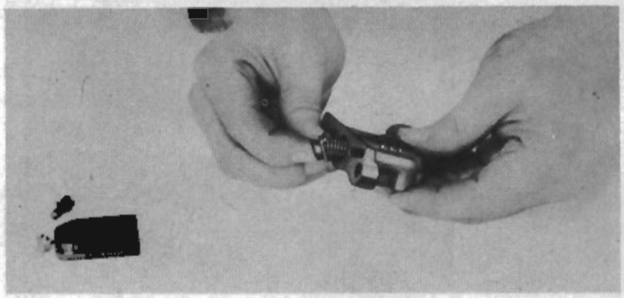

FIG. 320

Position the oil seal with the felt of the seal toward the rear of the extension housing and press into position until the face of the seal is flush with the extension housing.

Install the speedometer pinion and adapter assembly and install the retaining snap ring. Install the splined shaft snap ring and install the speedometer drive gear on the splined shaft. Install the splined shaft in the extension housing and install the companion flange on the splined shaft. Insert the spring in the extension housing.

PARKING GEAR AND GOVERNOR ASSEMBLY

Disassembly

Remove the two (2) Allen head screws that attach the high speed governor to the parking gear and remove the high speed governor. Remove the two (2) Allen head cap screws that attach the low speed governor (see Fig. 318) to the parking gear and remove the low speed governor.

Remove the screws from the high speed governor plate (see Fig. 319) and remove the plate. Press inward and tilt the spring seat to release (see Fig. 320) and remove the spring seat, spring, and governor valve.

Remove the screws from the low speed governor plate and remove the plate. No further disassembly is required since this governor is serviced as an assembly.

The snap ring is not removed from inside the parking gear hub. If a new parking gear is to be installed, transfer the snap ring from the original gear to the new one.

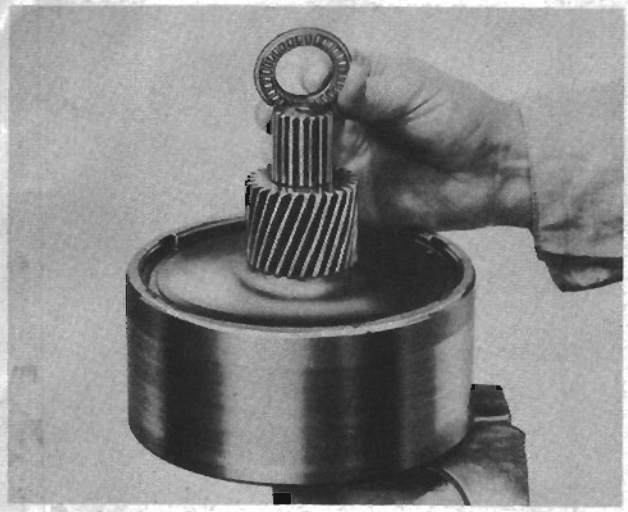

FIG. 321

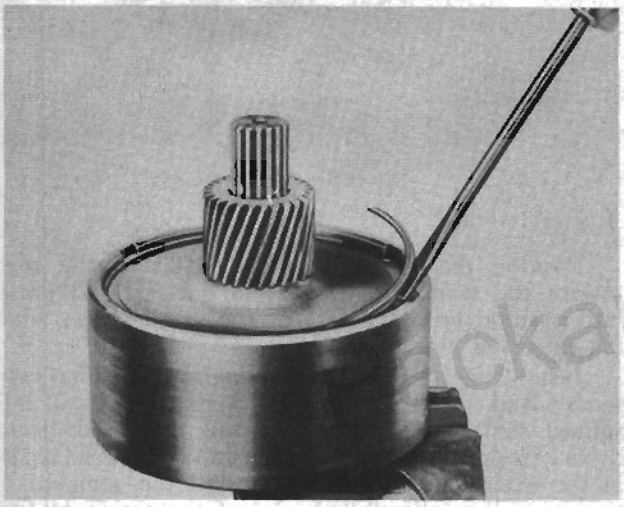

FIG. 322

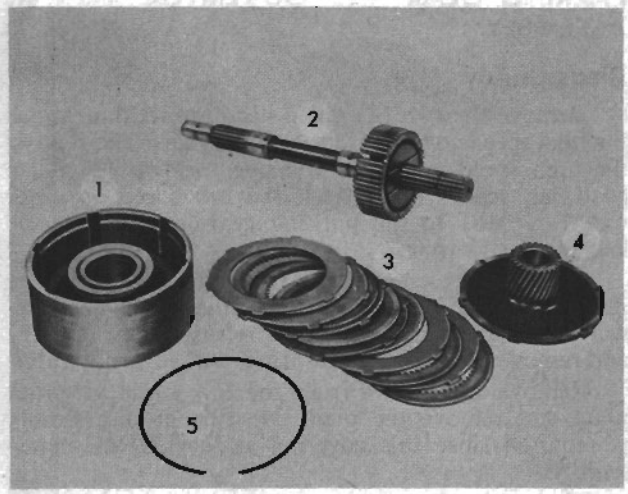

FIG. 323

1. Clutch housing
2. Shaft and clutch hub
3. Clutch plates
4. Sun gear and pressure plate assembly
5. Snap ring

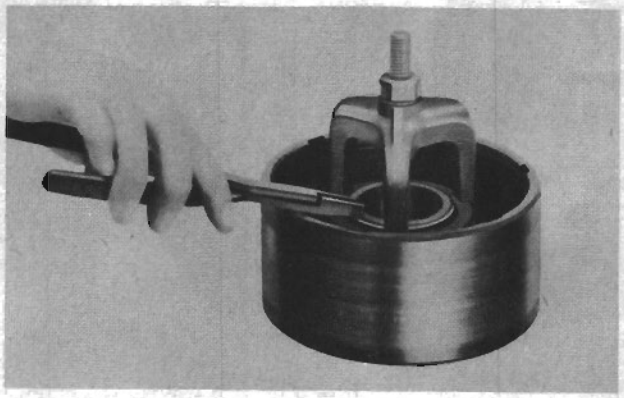

FIG. 324

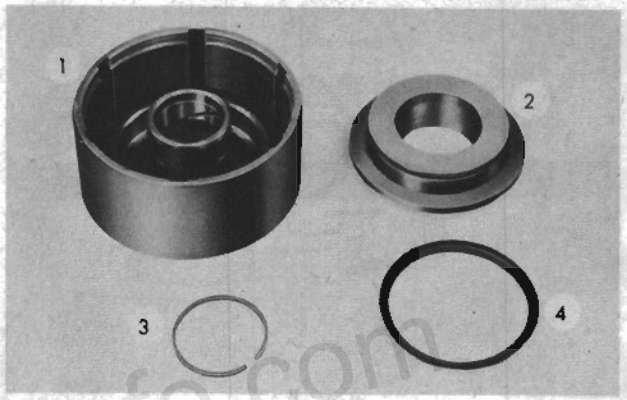

FIG. 325

1. Clutch housing
2. Clutch piston
3. Piston inner ring
4. Lip seal

Reassembly

Position the cover on the low speed governor and install the attaching screws. Align the low speed governor on the parking gear and install the Allen head attaching screws. Tighten the screws to 90-100 inch pounds (1,04-1,13 kg-m.).

Install the high speed governor valve, spring, and spring seat in the high speed governor valve bore. Press inward and tilt to engage the spring seat with the valve body. Position the cover on the valve body and install the attaching screws. Align the high speed governor on the parking gear and install the Allen head attaching screws. Tighten the screws to 90-100 inch pounds. NOTE: The governors are properly installed when the cover plates face toward the front of the transmission and are approximately parallel with the gear.

HIGH RANGE CLUTCH

Disassembly

A 1½" (38,1 mm.) hole drilled in a work bench will facilitate servicing the high range clutch. If a vise is used, lead jaws also should be used to prevent damage to the input shaft.

Remove the planetary sun gear thrust bearing (see Fig. 321) and remove the pressure plate retaining snap ring (see Fig. 322). Remove the pressure plate and sun gear. Lift out the input shaft along with the clutch hub. Then invert the clutch housing to remove the

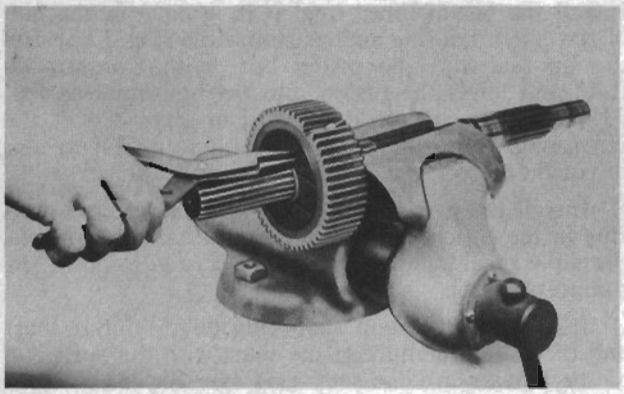

FIG. 326

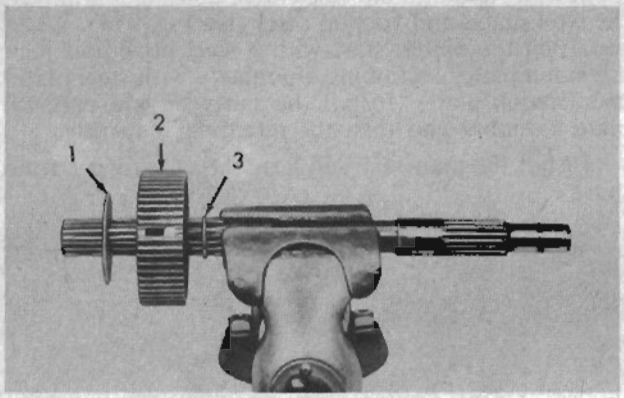

FIG. 327

1. Clutch hub thrust washer
2. Clutch hub
3. Rear snap ring

lined plates and steel plates from the clutch housing. There are six (6) flat steel plates and six (6) lined friction plates in the clutch assembly (see Fig. 323).

Use special tool J-5943 and compress the clutch spring and release the spring retainer snap ring using expander snap ring pliers (see Fig. 324). Back off the nut on the spring compressor tool and remove the tool, snap ring, retainer, and spring. Sharply rap or drop the clutch housing on the bench, open end downward, to dislodge the piston. In the event the rubber lip seal has swelled, it might be necessary to rap the housing on the bench more than once. Remove the lip seal (4, Fig. 325) from the clutch piston (2) and also remove the piston inner ring (3) from the clutch housing hub (1). Clamp the input shaft in a vise and remove the clutch hub snap ring (see Fig. 326). Then remove the clutch hub thrust washer (1, Fig. 327), clutch hub (2), and rear snap ring (3).

Inspect the bushing in the clutch housing and if replacement is indicated, assemble the details of the bushing remover as shown in Figure 328(A) and remove the bushing. For replacement to the bushing, assemble the details of the tool as shown in Figure 328(B) and push the bushing into position.

Insert the piston inner ring in the bore of the piston and check the ring gap (see Fig. 329). Proper ring gap is .004" to .018" (0,10 to 0,46 mm.)

Reassembly

Place a new piston lip seal on the piston with the lip away from the flange of the piston (see Fig. 330).

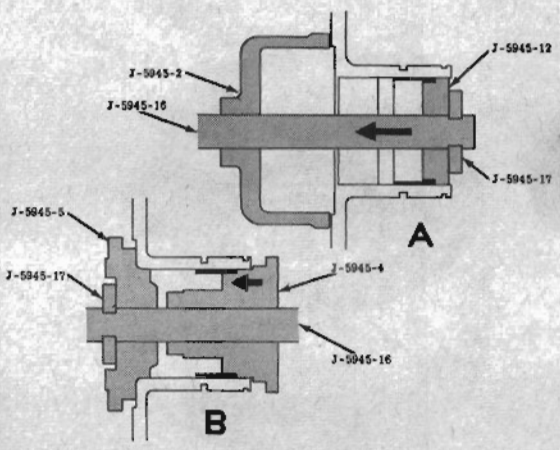

FIG. 328

FIG. 329

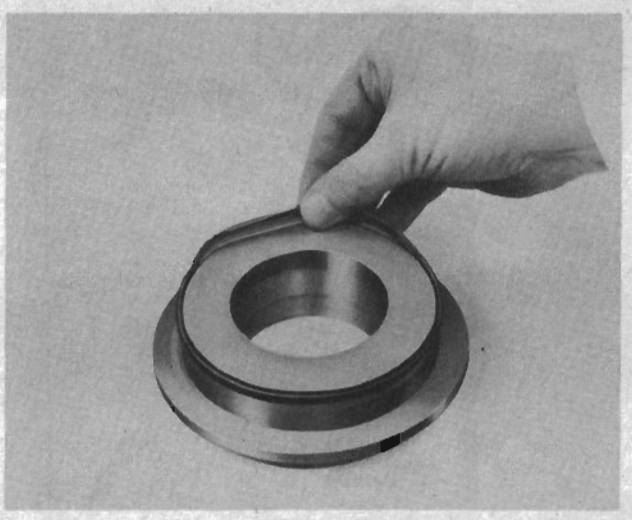

FIG. 330

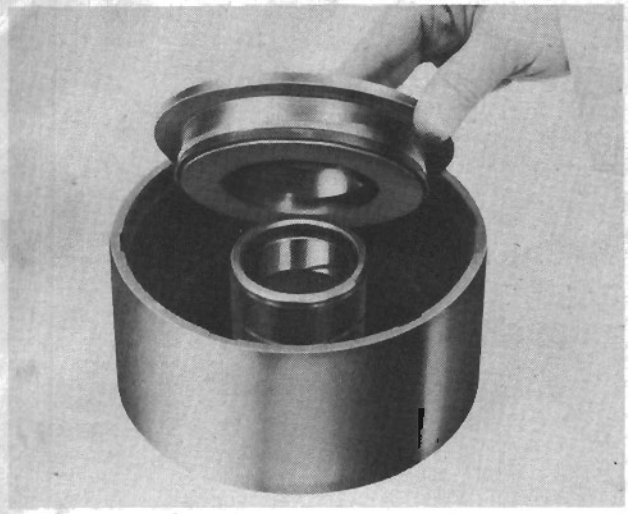

FIG. 331

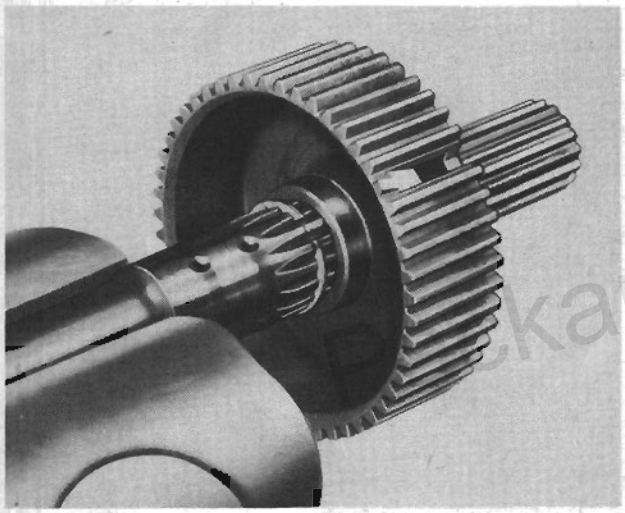

FIG. 332

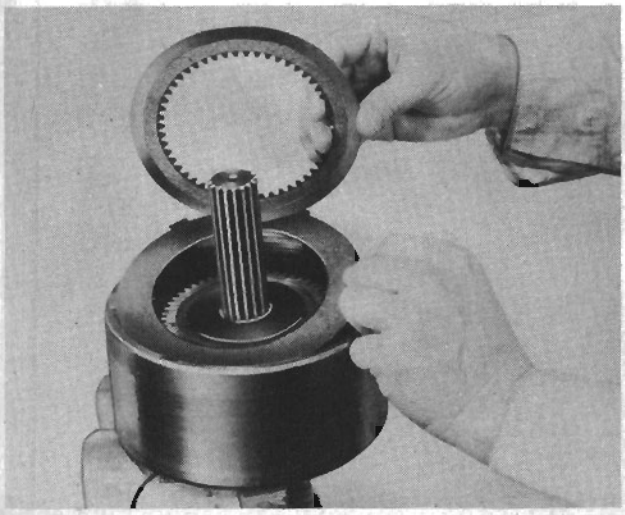

FIG. 333

Install the piston inner ring in its groove in the hub of the clutch housing and centralize the ring. Lubricate the lip seal and the piston bore with transmission fluid and lower the piston into the housing (see Fig. 331). Push the piston downward to start it over the inner ring. Care should be exercised so as not to tear or cut the lip while performing this operation.

Install the piston return spring, retainer, and snap ring in the clutch and use the compressor tool to compress the spring and install the snap ring. Remove the compressor tool.

Install a clutch hub snap ring on the input shaft and then slide the hub on the shaft with the open end of the hub toward the snap ring (see Fig. 332). Slide the clutch hub thrust washer on the shaft and against the hub and then install the rear snap ring. Place the input shaft and hub into the clutch housing and install the steel plates and friction discs (see Fig. 333). When installing the plates, start with a steel plate and then a friction plate, continuing alternately with steel plates and friction plates. Install the sun gear and pressure plate assembly and then the retaining snap ring.

Install the planetary sun gear thrust washer on the shaft.

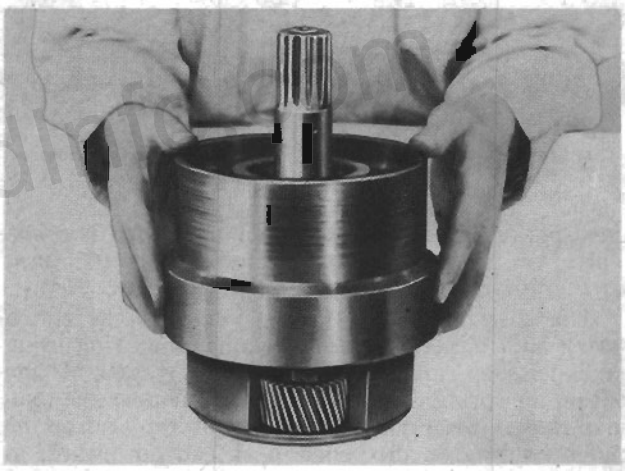

FIG. 334

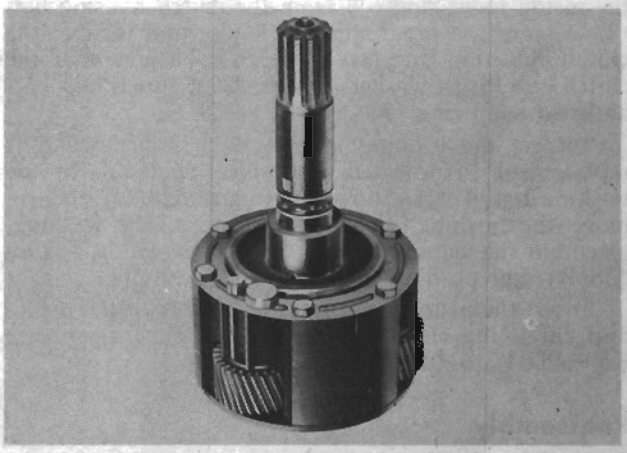

FIG. 335

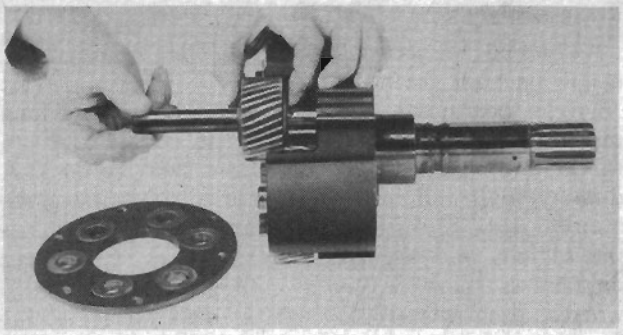

FIG. 336

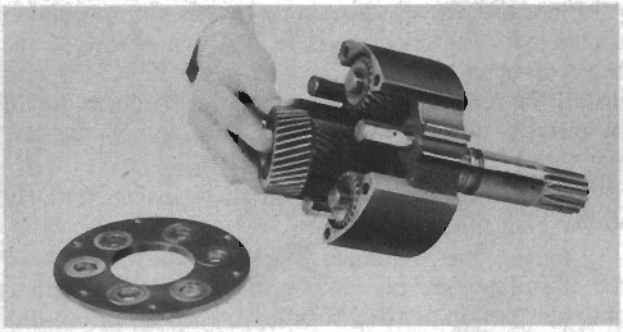

FIG. 337

PLANET CARRIER ASSEMBLY

Disassembly

Place the planetary assembly on the work bench with the shaft end upward and slowly lift off the planetary ring gear (see Fig. 334).

Scribe alignment marks on the planetary cage and on the oil scoop to insure installing the scoop in its correct position on assembly to maintain proper planetary balance (see Fig. 335). Remove the planetary cage bolts and remove the end plate.

Using a dummy planetary pinion pin, butt one end of the pin against a pin which carries a short pinion, hold the thrust washers against the pinion and slide the pinion, bearings, and washers onto the dummy shaft (see Fig. 336). Slide the pinion, bearings, and washers off the dummy shaft into a clean container exercising care not to lose any of the roller bearings. Remove the other two short pinions in the same manner.

Remove the planetary rear sun gear (see Fig. 337) and remove the rear sun gear thrust washer (see Fig. 338).

Remove the planetary long pinions following the procedure outlined for removing the short pinions.

Unhook the oil rings and remove from the shaft (see Fig. 339).

It is seldom necessary to remove the pinion shafts from the cage; however, they can be removed by tapping the shafts and Woodruff keys out toward the splined shaft.

Inspect the bushing in the planetary ring gear and if replacement is indicated, assemble the bushing remover and replacer as shown in Figure 340 and remove and replace the bushing.

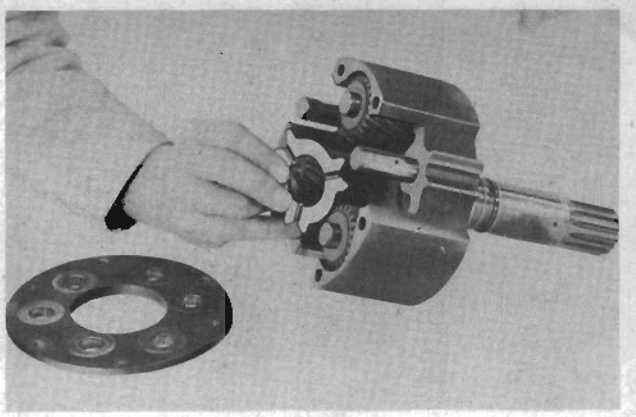

FIG. 338

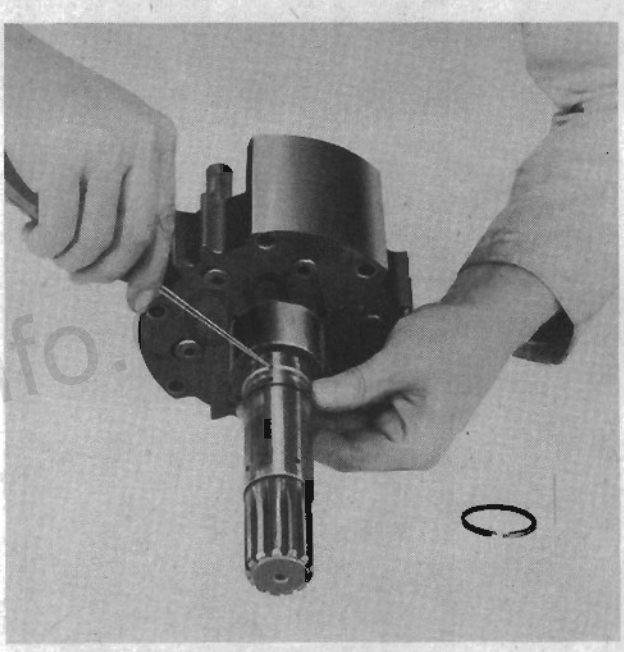

FIG. 339

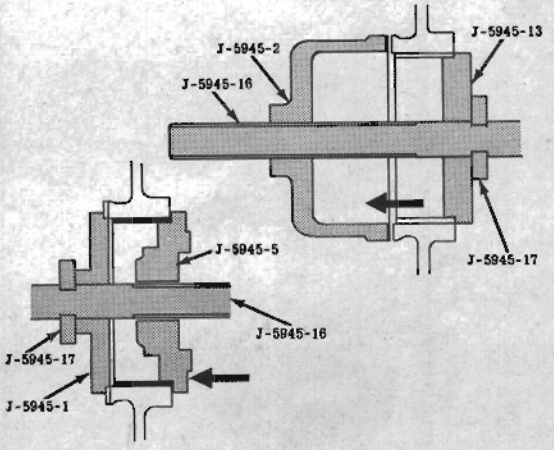

FIG. 340

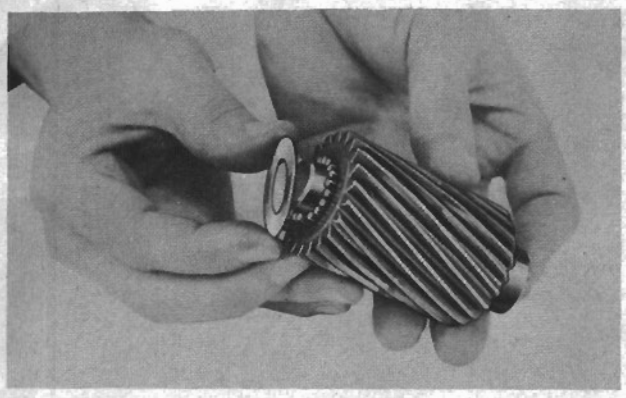

FIG. 341

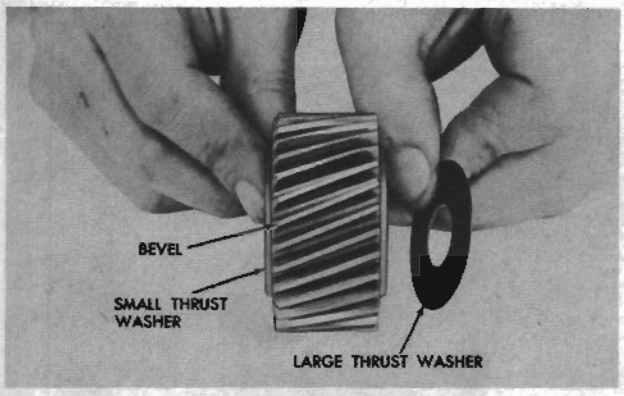

FIG. 342

FIG. 343

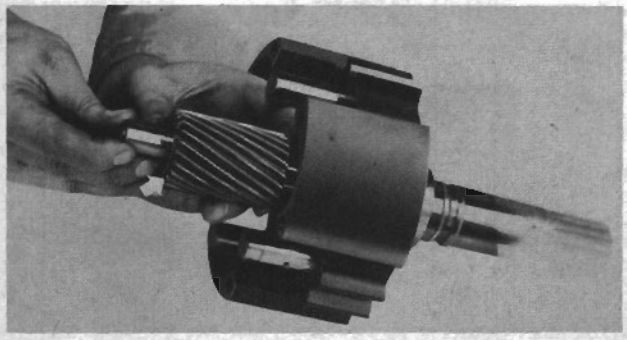

FIG. 344

Reassembly

Assemble the long pinions and roller bearings and install on their shafts in the cage. SPECIAL NOTE: 38 roller bearings are used in each pinion. The long pinions have 19 rollers at each end separated by a spacer. No spacer is used with the short pinions. A dummy shaft and spacer can be used to facilitate assembly. Also, 12 thrust washers are used at the end of the pinions and are two different sizes. Each long pinion uses a small washer at both ends (see Fig. 341), whereas each short pinion uses a small washer at the forward end and a large washer at the cage end (see Fig. 342). Too, the beveled end of the pinion should be toward the plate.

Place the rear sun gear thrust washer in the pinion carrier with the oil grooves in the washer toward the front of open end of the carrier (see Fig. 343) and install the rear sun gear. The recess of the gear should be installed toward the front or open end of the carrier (see Fig. 344).

Install the short pinions on their shafts similarly to the long pinions.

Line up the alignment marks on the carrier and the end plate (see Fig. 345) and install the end plate onto the pinion shafts. Position the oil scoop on the carrier so that the previously scribed marks on the scoop and the carrier are in register and install the retaining cap screws. Tighten the screws to 15-18 foot pounds (20,7 to 25 kg-m.).

Install the planetary cage into the ring gear. Rotate the ring gear to engage the pinions and seat the ring gear.

REAR PUMP

Disassembly

Remove the two (2) Allen head screws (5, Fig. 346) from the rear pump cover plate and remove the

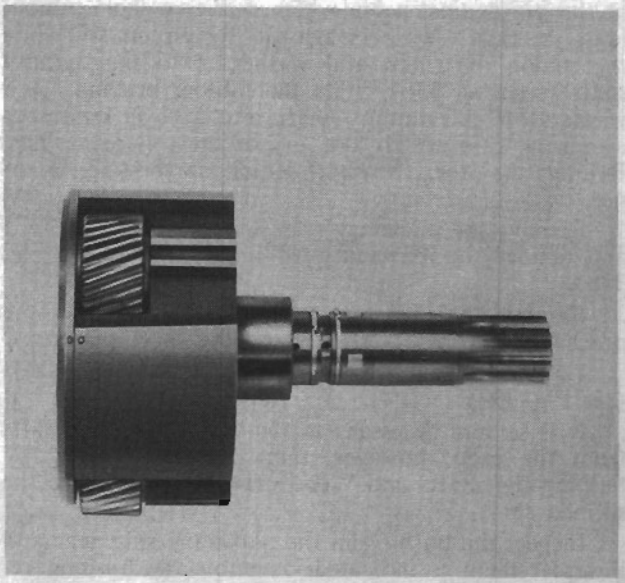

FIG. 345

cover plate (4). Mark the internal and external tooth gears (3 and 2) with crayon or pencil to aid in reassembly. Remove the gears by lifting out of the pump body.

Wear of the pump body and gears can be checked by installing the gears in the pump body and checking the nose clearance between the gears, using a feeler gauge (see Fig. 347). This clearance should not exceed .008" (0,20 mm.). Clearance between the internal tooth gear and the pump body should be checked (see Fig. 348), and this clearance should not exceed .011" (0,28 mm.). The end clearance of the gears should also be checked by laying a straight edge across the pump body and measuring the end clearance of the gears (see Fig. 349). This clearance should not exceed .006" (0,15 mm.).

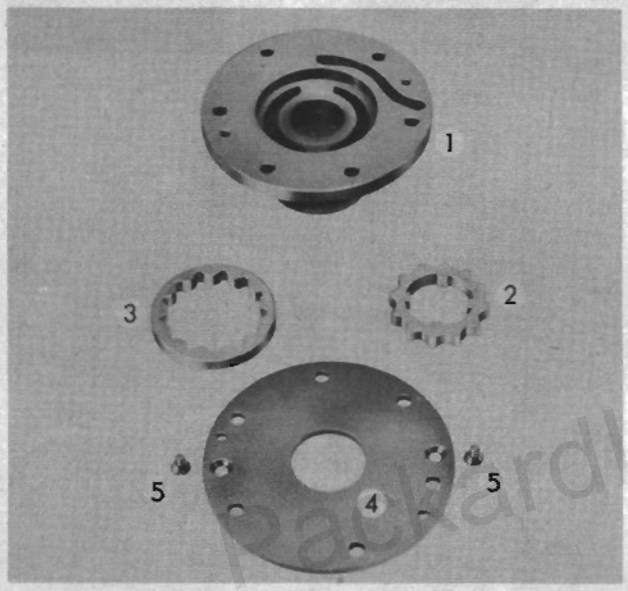

FIG. 346

1. Rear pump body
2. External tooth gear
3. Internal tooth gear
4. Cover plate
5. Plate screws

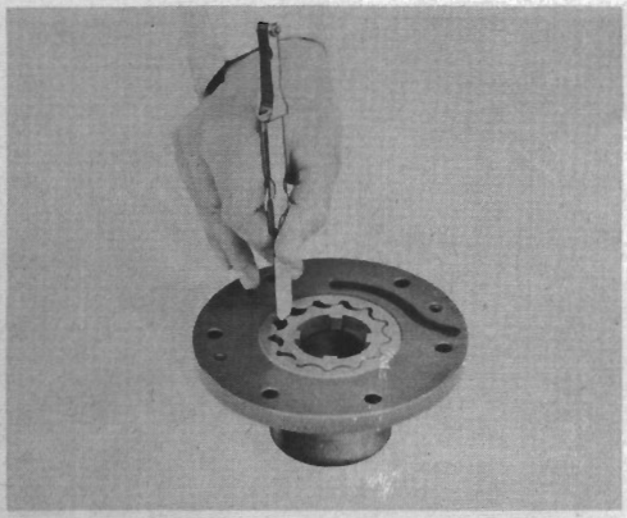

FIG. 347

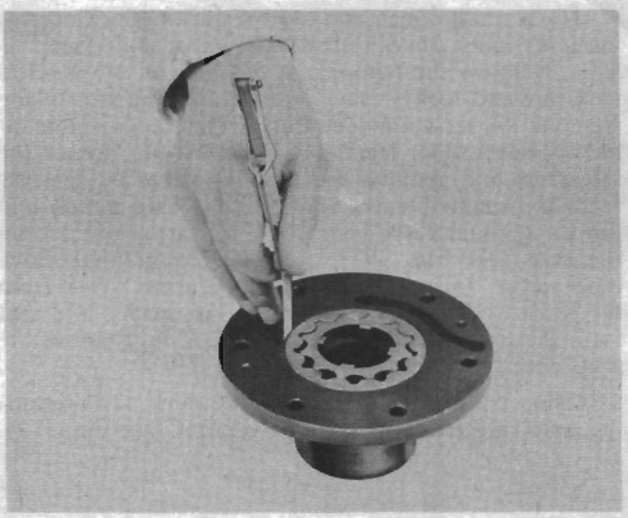

FIG. 348

FIG. 349

Reassembly

Install the internal and external tooth gears in the pump body with the marks previously made in the upward position. NOTE: The undercut on the external tooth gear is placed next to the pump body.

Align the pump cover plate on the pump body and install the Allen head screws. Tighten the screws to 90-100 inch pounds (1,04-1,13 kg-m.).

TRANSMISSION CASE ASSEMBLY

Disassembly

Remove the brake anchor pins from the transmission case by sliding out of the case and remove the "O" ring seals from the anchor pins. Remove the low range brake band adjusting screw and lock nut from the case and also remove the reverse brake band adjusting screw and lock nut.

Use a suitable punch and drive out the actuating lever shaft retaining pins (roll pins) of the low range brake and the reverse brake. Use a punch and drive the low range brake band actuating lever shaft out of the transmission case. NOTE: The band strut locating pin will be sheared off as this operation is performed, therefore it will be necessary to drill the sheared pin out of the actuating link and replace with a new locating pin during assembly. Repeat the procedure for the reverse band actuating lever shaft.

Use a small punch and tap the parking lock operating lever index pin out of manual valve shaft (see Fig. 350). Remove the manual valve inner lever set screw lock nut and lock washer and remove the stop plate. Remove the set screw (see Fig. 351). Loosen the manual valve set outer lever set screw lock nut, loosen the set screw and remove the manual valve outer lever from the manual valve shaft. Use a long punch and tap the manual valve lever shaft to start the seal from the case (see Fig. 352). Remove the manual valve inner lever and parking pawl operating lever from the shaft and remove the shaft, flat washer and seal from the transmission case (see Fig. 353). Remove the snap ring from the shaft.

Using tru-arc pliers, remove the park pawl retaining snap ring from the park pawl shaft (see Fig. 354).

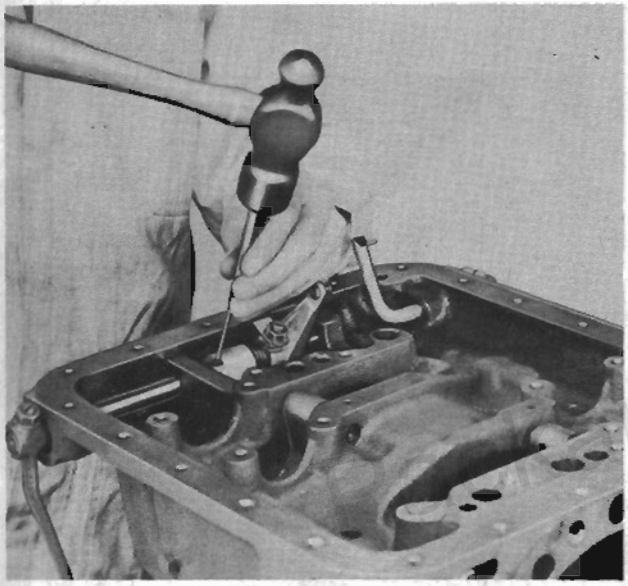

FIG. 350

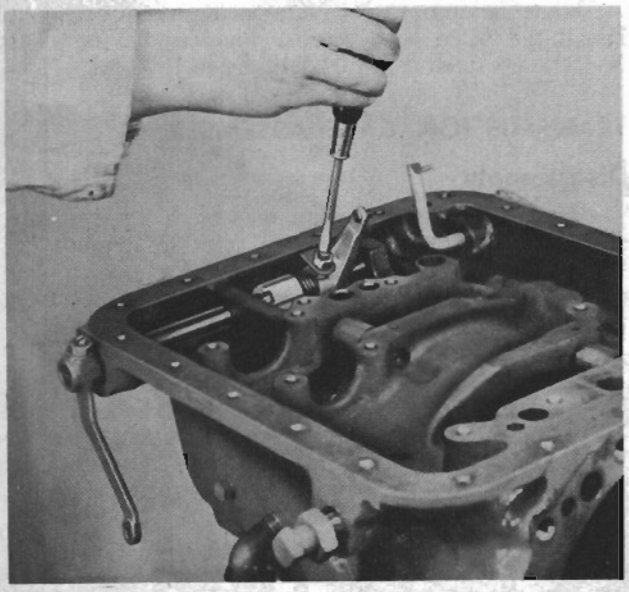

FIG. 351

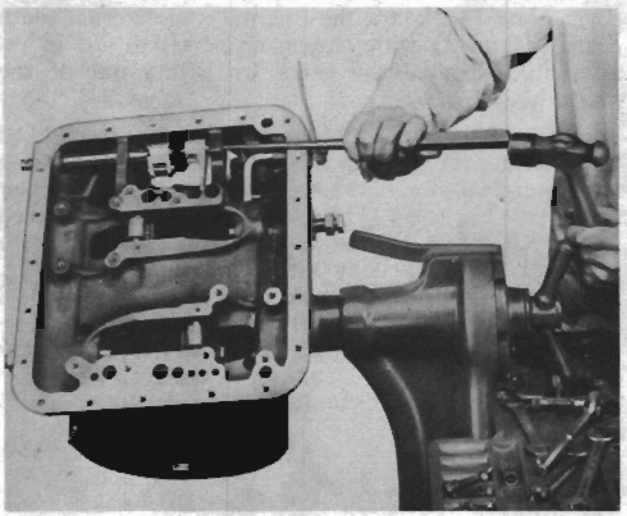

FIG. 352

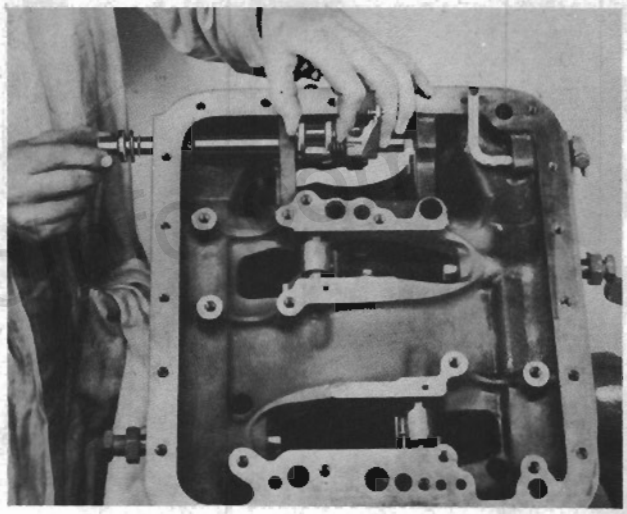

FIG. 353

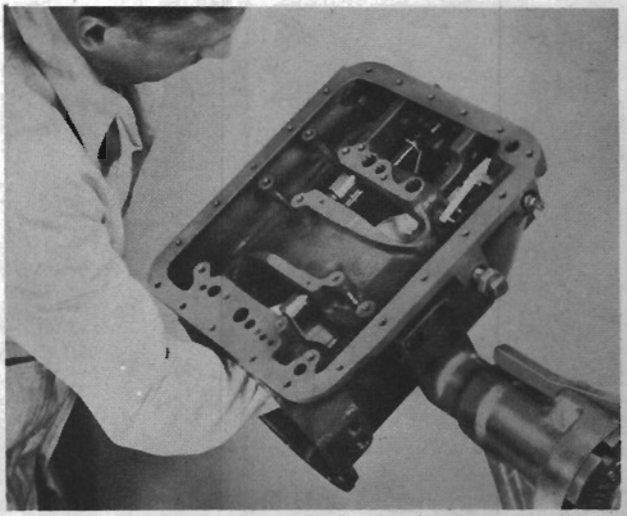

FIG. 354

Use a long punch and tap the park pawl shaft from the transmission case. Remove the park pawl and spring (see Fig. 355).

Remove the throttle valve outer lever clamp bolt from the throttle valve outer lever and remove the lever from the throttle valve shaft. Tap the shaft at the inner end (see Fig. 356) to remove the seal and washer from the transmission case and remove the seal and washer from the shaft. Use tru-arc pliers and remove the snap ring from the throttle valve shaft and remove the shaft from the case.

Remove the transmission vent from the transmission case.

Reassembly

Install the vent in the transmission case.

Install the throttle valve lever shaft in the transmission case and install the retaining snap ring on the shaft. Install the flat washer on the shaft and position a new throttle valve lever shaft seal on the shaft with the lip of the seal toward the transmission case. Use a ½" (12,8 mm.) deep socket to drive the seal into the case. Install the throttle valve outer lever on the shaft and install the clamp bolt but leave loose.

Install the park pawl shaft in the transmission case and position the park pawl and spring on the shaft. Tap the shaft into position in the transmission case. Lift the hook in the spring over the park pawl stop. Install the park pawl retaining snap ring.

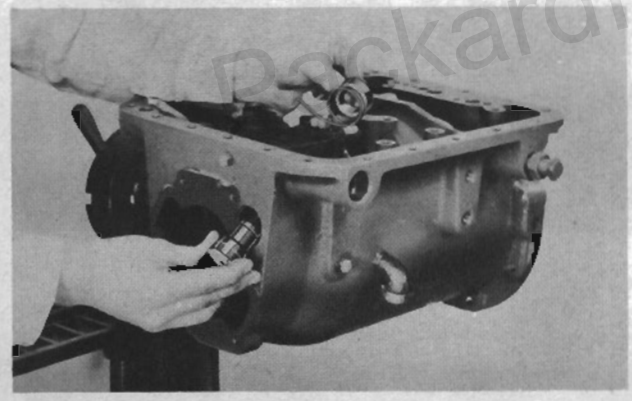

FIG. 355

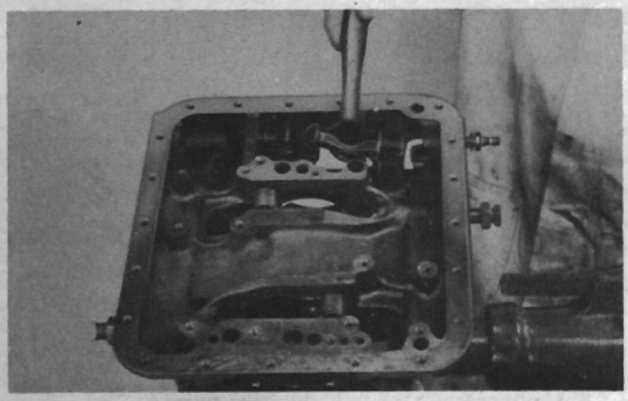

FIG. 356

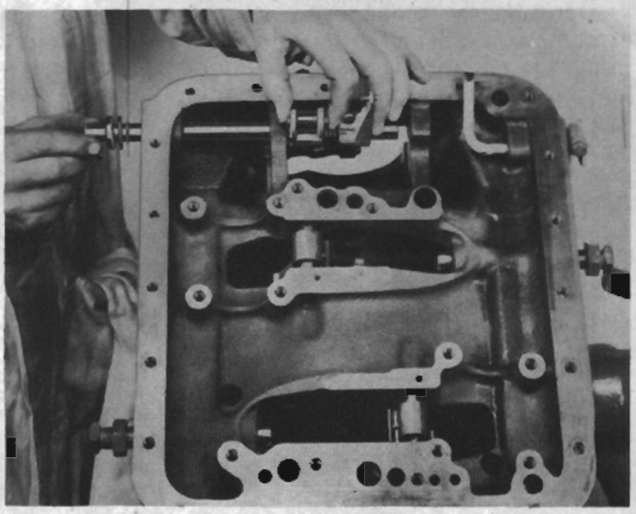

FIG. 357

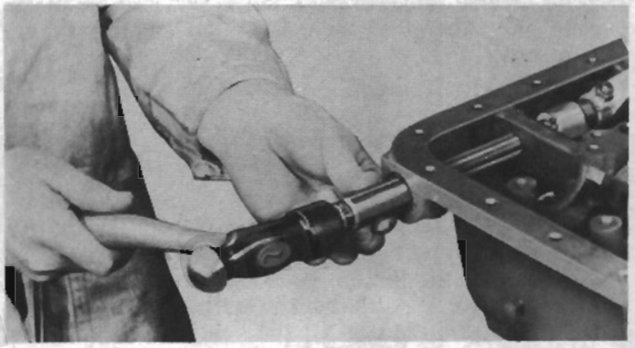

FIG. 358

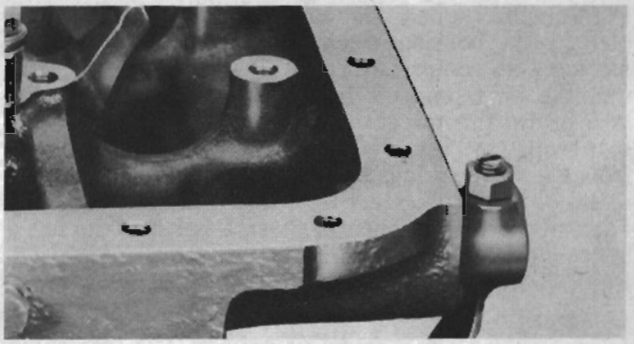

FIG. 359

Install the retaining snap ring and flat washer on the manual valve lever shaft and position a new manual valve lever shaft seal on the shaft with the lip of the seal toward the transmission. Install the shaft in the transmission case, and install the parking pawl operating lever, spring, and manual valve inner lever on the shaft (see Fig. 357). Tap the operating lever index pin into the shaft. Line up the set screw hole in the manual valve inner lever and the hole in the shaft and install the set screw, stop plate, lock washer, and lock nut. Use a 11/16" (17,5 mm.) deep socket and drive the oil seal into the case (see Fig. 358). Install the manual valve outer lever on the shaft (see Fig. 359) and install the set screw and lock nut.

Position the brake band actuating levers in the transmission case and install the actuating lever shafts. Align the actuating levers on the shafts and install new band strut locating pins in the actuating levers. Align the grooves in the actuating lever shafts with the holes in the transmission case and install the actuating lever shaft roll pins.

Install the band adjusting screws and lock nuts in the transmission case. Install new "O" ring seals on the brake anchor pins and slide the brake anchor pins into the transmission case.

LOW RANGE BRAKE BAND

The low range brake band is serviced only as an assembly, therefore there is no disassembly or assembly procedures.

REVERSE BRAKE BAND

The reverse range brake band is serviced as an assembly only, therefore there is no disassembly or assembly procedure.

LOW RANGE BRAKE SERVO

Disassembly

Remove the low range brake servo from the control valve assembly and remove the pressure tubes from the servo. Position the low range brake servo disassembly tool J-5977, on a work bench so that the open end of the tool clears the edge of the bench and attach the tool securely to the work bench.

Place the low range brake servo in the tool and secure in place with the special Allen head screws. Position the cupped adapter of the tool on the center of the servo housing cover and turn down the adjusting screw to compress the servo springs, make certain that the lower end of the adjusting screw enters the hole in the adapter. Remove the servo cover retaining snap ring (see Fig. 360) and slowly release pressure from the servo springs by backing off on the adjusting screw of the tool (see Fig. 361). SPECIAL NOTE: Particular attention must be given to see that the servo housing cover raises as the adjusting screw is loosened, and should the cover stick in the servo housing, a punch

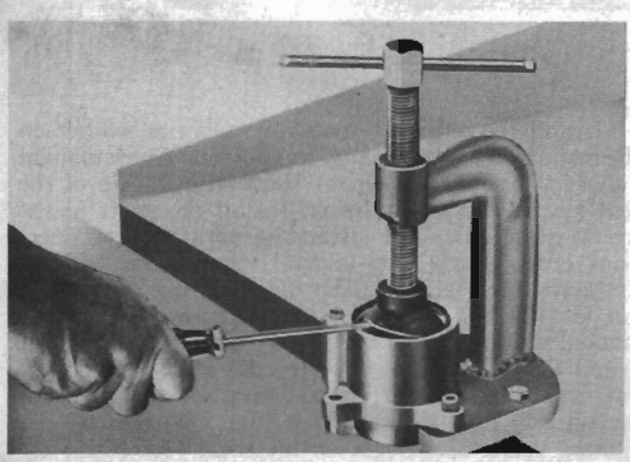

FIG. 360

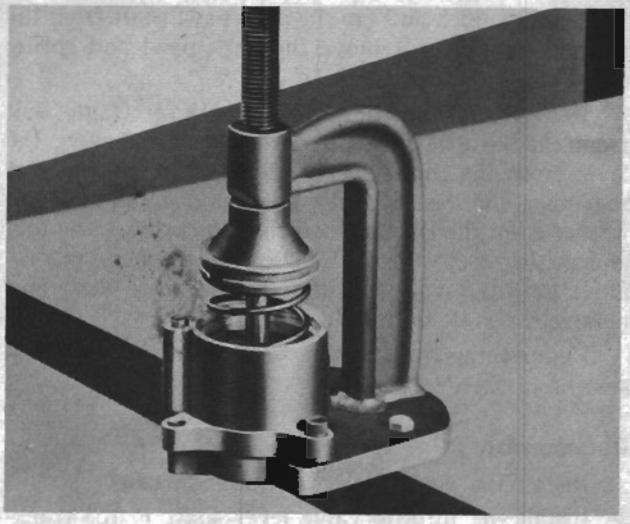

FIG. 361

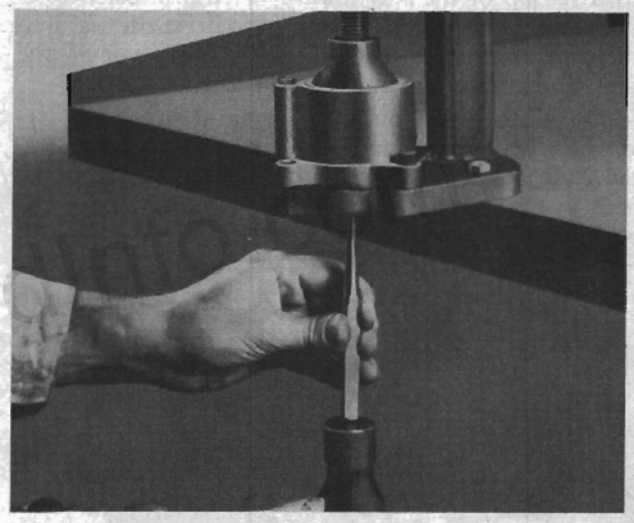

FIG. 362

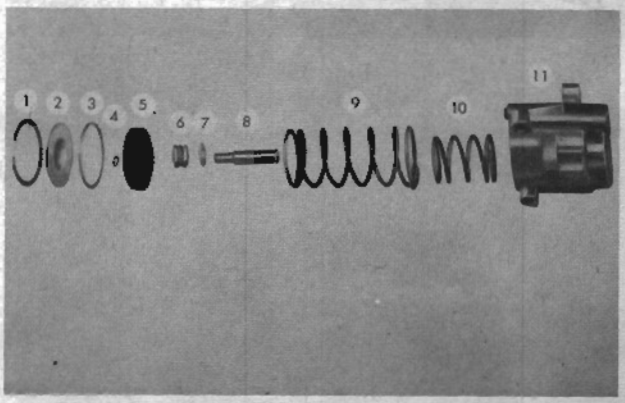

FIG. 363

1. Snap ring
2. Piston covers
3. Piston rings
4. Snap ring
5. Pisron
6. Cushion spring
7. Cushion spring seat
8. Piston shaft
9. Outer spring
10. Inner spring
11. Low range brake housing

and hammer should be used to tap the lower end of the servo piston upward to loosen the cover (see Fig. 362).

When all the pressure is released off the servo springs, remove the servo from the tool and remove the servo housing cover, servo piston, and two servo springs. Remove the servo piston ring seal from the piston.

Place the piston ring seal in the servo housing and check for proper ring gap. Ring gap should be .002" to .012" (0,05-0,30 mm.).

Reassembly

Place the low range brake servo housing in the tool and secure it in place with the two special screws. Install the two servo springs in the housing, (see Fig. 364), being sure they are level and on their seat. Place the ring compressor in the top of the brake housing. Install the piston ring seal on the piston and place the piston on top of the springs. Place the cupped adapter on top of the piston and turn down the adjusting screw (see Fig. 365), making sure that the lower end of the adjusting screw enters the hole in the adapter. Slowly turn the adjusting screw to compress the springs and guide the piston and ring into the compressor while tightening the adjusting screw. Be very careful while tightening the screw to make sure that the lower end of the piston shaft enters freely into the small bore of the brake housing. Continue tightening the adjusting screw until the springs are compressed and the piston is at the bottom of the brake housing. Install the brass clamp of the tool on the piston shaft that now extends below the brake housing. Push the clamp upward as far as it will go and securely tighten the clamp screw (see Fig. 366). This is important as the clamp holds the piston down while releasing the tool to install the cover and retaining ring. Back off the adjusting screw and remove the ring compressor and adapter and install the servo housing cover and place the cupped adapter on top of the cover and retighten the adjusting screw to hold the cover in place. Install the retaining snap ring (see Fig. 367). After the snap ring is properly in place, loosen the screw in the clamp to release the piston. Remove the servo assembly from the tool.

FIG. 364

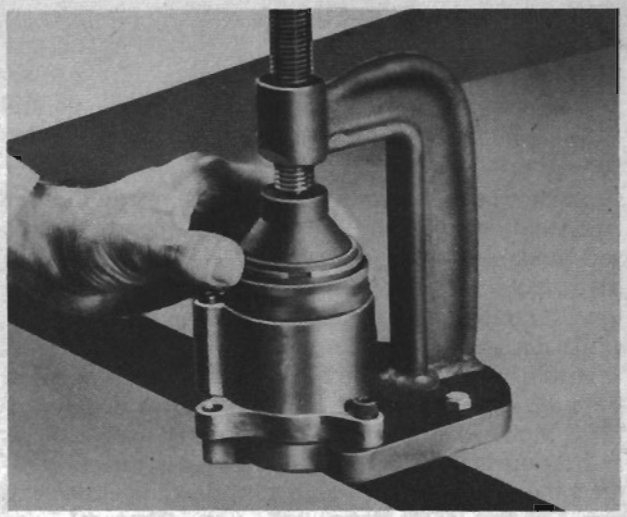

FIG. 365

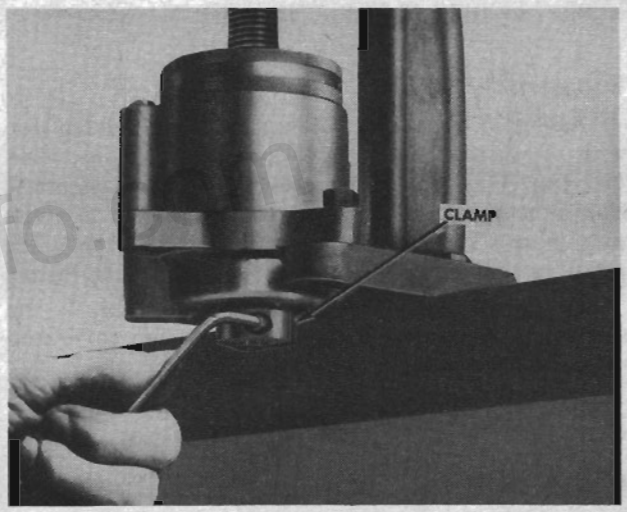

FIG. 366

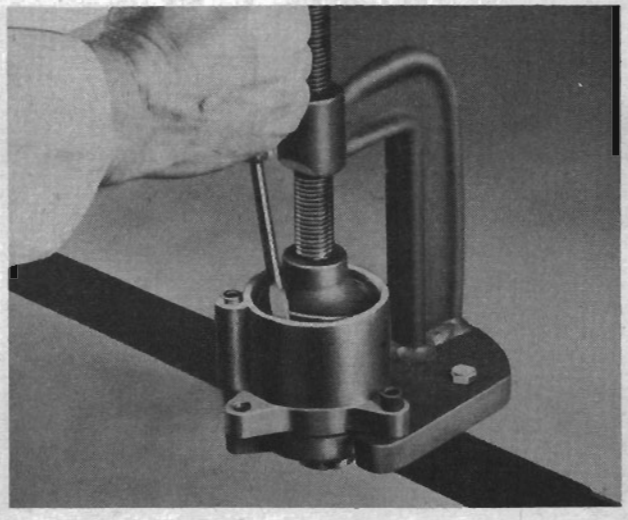

FIG. 367

REVERSE BRAKE SERVO

Disassembly

Remove the reverse brake servo from the control valve assembly and remove the servo pressure tubes from the servo.

Remove the servo housing cover retaining snap ring (see Fig. 368) and lift out the cover, piston, seal, and guide pin as an assembly (see Fig. 369). If the cover sticks in the housing bore, invert and support the servo assembly on blocks and lightly tap the end of the guide pin with a fiber or brass drift (see Fig. 370). After the piston, seal, and guide pin have been removed from the servo housing, use a sleeve approximately 7/8" (22;2 mm.) long and 1" (25,4 mm.) inside diameter and clamp the piston and guide pin in a vise to compress the spring washer and remove the guide pin snap ring (see Fig. 371). Remove the piston ring seal from the piston. Separate the piston, guide pin, and spring washer.

Place the piston seal ring in the housing bore and measure the ring gap (see Fig. 372). Proper ring gap is .002" to .014" (0,05 to 0,36 mm.).

Reassembly

Assemble the spring washer, guide pin, and piston with the dish of the spring washer toward the piston (see Fig. 373). Using the sleeve used in disassembly, clamp the piston, guide pin and spring washer in a vise to compress the spring washer and install the guide pin snap ring. Install the piston ring seal on the piston.

Position the piston and guide pin assembly in the servo housing bore and install the housing cover and retaining snap ring.

CONTROL VALVE ASSEMBLY

Disassembly

Remove the front valve body assembly retaining cap screws, washers, and lock washers and remove the front valve body. Remove the rear lower body-to-rear

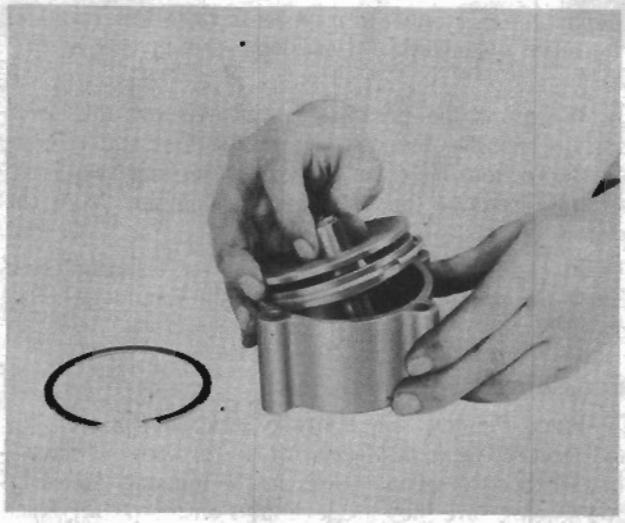

FIG. 369

FIG. 370

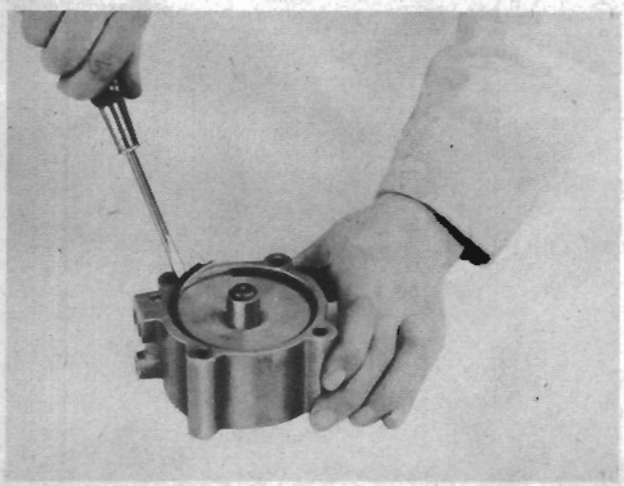

FIG. 368

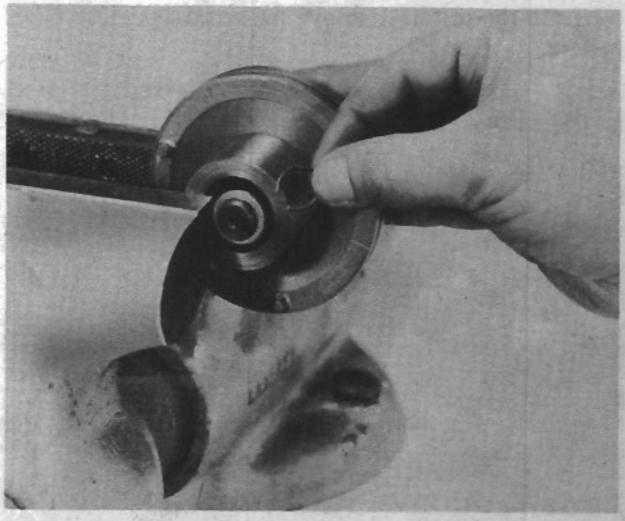

FIG. 371

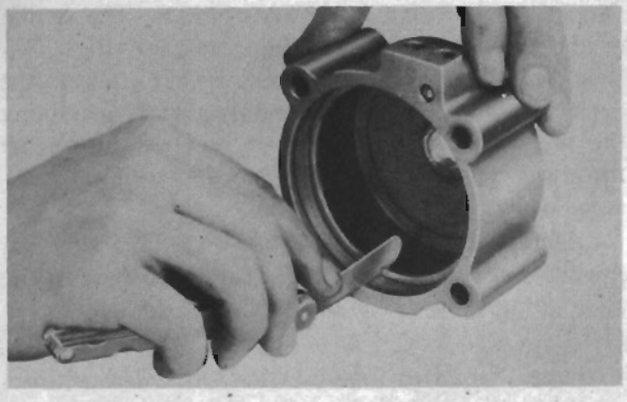

FIG. 372

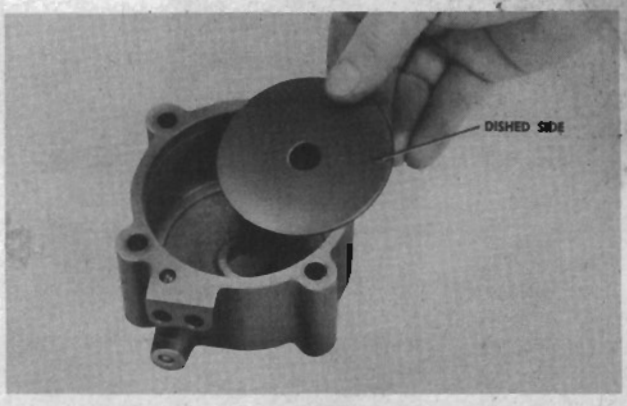

FIG. 373

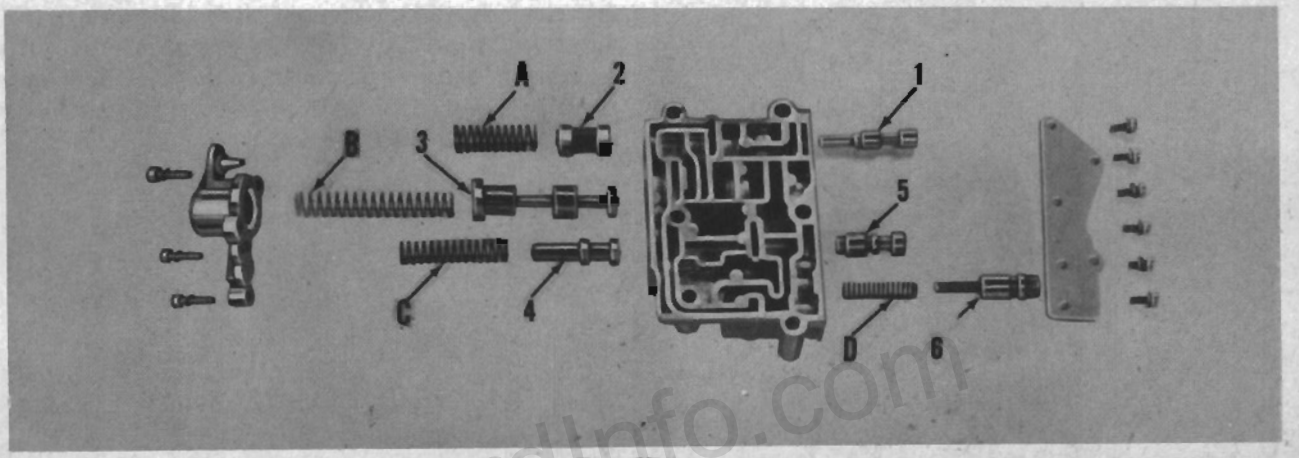

FIG. 374

1. Converter valve
2. Converter valve piston
3. Pump regulator valve
4. Shift regulator valve piston
5. Shift regulator valve
6. Low regulator valve

A. Converter valve spring
B. Pump regulator valve spring
C. Shift regulator valve piston spring
D. Low regulator valve spring

upper body and to manifold cap screws, washers, and lock washers and remove the two valve body assemblies. Remove the separator plate to manifold cap screws, washers, and lock washers and lift the separator plate and gasket off the manifold. Remove the front and rear pump check valves from the manifold.

SPECIAL NOTE: When servicing the control valve assembly, it is recommended that each valve body of the assembly be disassembled, cleaned and inspected and reassembled one at a time. This will reduce the possibility of accidentally interchanging the springs in the assembly. To aid in assembly, it is also recommended that the parts of each body be placed on a bench in the order in which they were removed from the body. Plugs in the bodies, that are held in place by lock rings, are not normally removed for service.

Front Valve Body. Remove the six (6) screws and lock washers and remove the end plate from the valve body. Remove the low regulator valve (6, Fig. 374) and low regulator valve spring (D), the shift regulator valve (5), shift regulator valve piston (4), and shift regulator valve piston spring (C), and the converter valve (1). Remove the three (3) screws and lock washers from the spring retainer end plate and remove the end plate; remove the pump regulator valve (3), pump regulator valve spring (B), converter valve piston (2) and converter valve piston spring (A).

The front valve body springs can be identified by their length and diameter. They are as follows:

	Free Length (Approx.)	O. D.
A—Converter Valve Spring	1-11/16" (42,9 mm.)	.590" (14,9 mm.)
B—Pump Regulator Valve Spring	3-21/32" (92,9 mm.)	.650" (16,5 mm.)
C—Shift Regulator Valve Piston Spring	2-3/16" (55,6 mm.)	.477" (12,1 mm.)
D—Low Regulator Valve Spring	1½" (38,1 mm.)	.408" (10,3 mm.)

To assemble the front valve body after cleaning and inspection, position the pump regulator valve and spring, and the converter valve piston and converter valve spring in their respective bores of the body and install the spring retainer end plate, screws, and lock washers. Tighten the screws to 20-30 inch pounds (2,8 to 4,1 kg-m.). Place the converter valve, shift regulator valve spring, shift regulator valve piston, and shift regulator valve, and low regulator valve spring, and low regulator valve in their respective bores of the valve body and install the end plate, screws and lock washers. Tighten the screws to 20-30 inch pounds.

Rear Lower Valve Body. Remove the manual valve from the body by pulling the valve out of the body. Remove the three (3) screws and lock washers from the detent housing and spring retainer end plate and

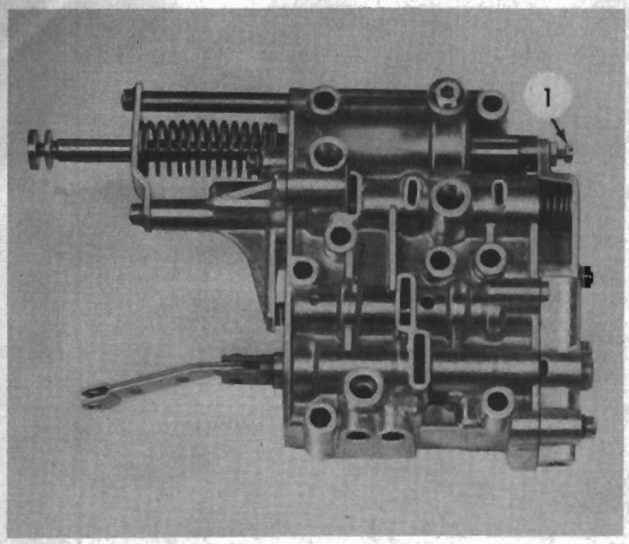

FIG. 375

1. Throttle valve adjusting screw

remove the end plate SPECIAL NOTE: The setting of the throttle valve adjusting screw (1, Fig. 375) should not be changed and should be left intact in the detent assembly when disassembling and assembling the body. Special equipment is required to set the throttle pressure which must be adjusted with the transmission in the car and operating.

Remove the throttle limit valve (9, Fig. 376) and throttle limit valve spring (E); and also remove the modulating valve (7), and modulating valve spring (F).

Remove the four (4) screws and lock washers from the spring retainer and remove the retainer, throttle valve shaft assembly (5), throttle valve spring (D), throttle valve (4), throttle valve idle spring (C), direct shift throttle valve (3), reverse shuttle valve spring (A), and reverse shuttle valve (2). The plug in the valve body (6), held in place by snap rings is not normally removed for service.

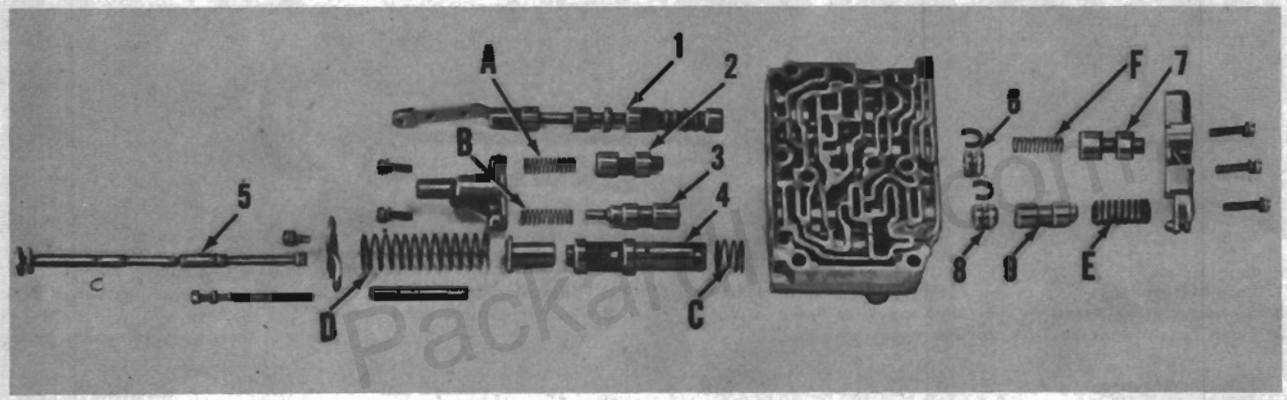

FIG. 376

1. Manual valve
2. Reverse shuttle valve
3. Direct shift throttle valve
4. Throttle valve
5. Throttle valve shaft assembly
6. Reverse shuttle valve plug
7. Modulating valve
8. Throttle limit valve plug
9. Throttle limit valve
A. Reverse shuttle valve spring
B. Direct shift valve spring
C. Throttle valve idle spring
D. Throttle valve spring
E. Throttle limit valve spring
F. Modulating valve spring

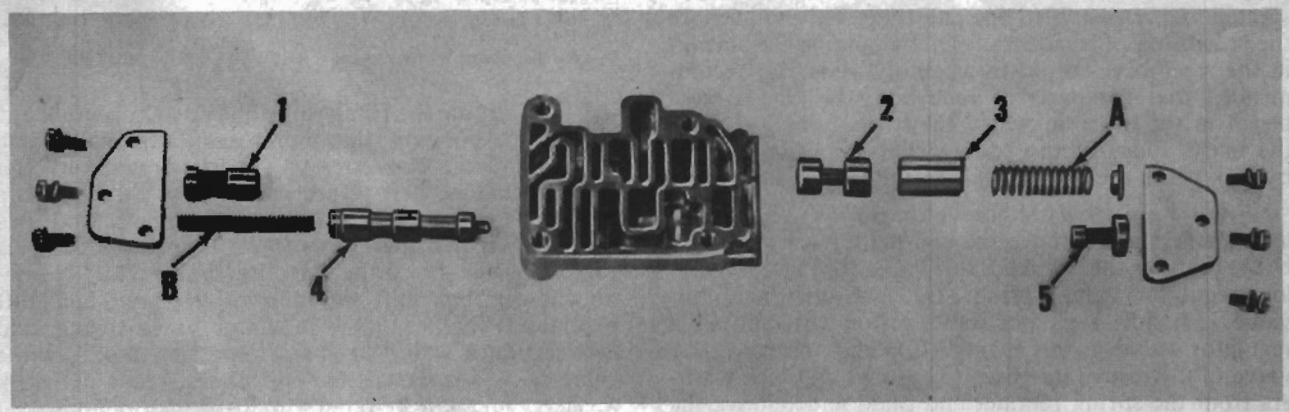

FIG. 377

1. Direct shift valve piston, front
2. Direct shift valve
3. Direct shift valve piston, rear
4. Low high shift valve
5. Low high shift valve piston
A. Direct shift valve piston spring
B. Low high shift valve spring

The springs of the rear lower valve body can be identified as follows:

	Free Length (Approx.)	O. D.
A—Reverse Shuttle Valve Spring	1-3/32" (27,8 mm.)	.330" (7,3 mm.)
B—Direct Shift Valve Spring	1-3/8" (34,9 mm.)	.418" (10,6 mm.)
C—Throttle Valve Idle Spring	1-37/64" (40,1 mm.)	.654" (16,6 mm.)
D—Throttle Limit Valve Spring	1-15/64" (31,4 mm.)	.550" (13,9 mm.)
E—Throttle Valve Spring	2-13/32" (60,1 mm.)	.802" (20,4 mm.)
F—Modulating Valve Spring	1-3/32" (27,8 mm.)	.330" (8,4 mm.)

To assemble the rear lower valve body after cleaning and inspection, position the reverse shuttle valve and reverse shuttle valve spring, the direct shift throttle valve and direct shift throttle valve spring, the throttle valve idle spring and the throttle valve assembly in their respective bores of the valve body and install the spring retainer, screws, and lock washers. Install the throttle valve shaft assembly, spacer and screws and lock washers. Tighten all screws to 20-30 inch pounds (2,8-4,1 kg-m.).

Install the throttle limit valve and throttle limit valve spring, and modulating valve and modulating valve spring in their respective bores of the valve body and install the detent and spring retainer assembly, screws, and lock washers. Tighten the screws to 20-30 inch pounds.

Install the manual valve in its bore and spread the detents and push the manual valve into position.

Rear Upper Valve Body. Remove the three (3) screws and lock washers from the end plate and remove the end plate. Remove the direct shift valve spring seat, the direct shift valve piston spring (A, Fig. 377), direct shift valve piston rear (3), and the direct shift valve (2); also, remove the low high shift valve piston (5). Remove the screws and lock washers from the other end plate and remove the direct shift valve piston front (1), low high shift valve (4), and low high shift valve spring (B).

The springs in the rear upper valve body can be identified as follows:

	Free Length (Approx.)	O. D.
A—Direct Shift Valve Piston Spring	2-5/32" (54,8 mm.)	440" (11,2 mm.)
B—Low High Shift Valve Spring	2-5/64" (52,8 mm.)	.250" (6,4 mm.)

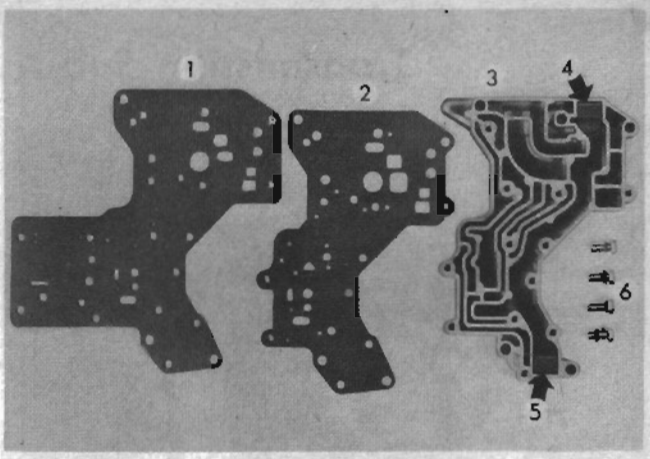

FIG 378

1. Plate
2. Gasket
3. Valve body
4. Front pump check valve
5. Rear pump check valve
6. Screws

To assemble the rear upper valve body after cleaning and inspection, position the low high shift valve and low high shift valve spring, and the direct shift valve piston front in their respective bores of the valve body and install the end plate, screws, and lock washers. Tighten the screws to 20-30 inch pounds (2,8-4,1 kg-m.). Install the direct shift valve, direct shift valve piston rear, direct shift valve spring, direct shift valve spring seal, and the low high shift valve piston in their respective bores of the valve body and install the end plate, screws, and lock washers. Care must be taken to assure that the direct shift valve spring seat is positioned properly in the bore of the valve body so that the end plate is sealed against the valve body. Tighten the screws to 20-30 inch pounds.

Reassembly

Install the front and rear pump check valves in the manifold (see Fig. 378) and position a new manifold gasket on the manifold. Install the separator plate, attaching screws and lock washers and tighten to 60 inch pounds (0,69 kg-m.). Position the rear upper and rear lower valve bodies on the manifold and install the cap screws, washers, and lock washers and tighten to 60 inch pounds. Position the front valve body on the manifold and install the cap screws, washers, and lock washers and tighten to 60 inch pounds.

Install the pressure tubes in the reverse brake servo and install the servo with the tubes in the valve body. Install the pressure tubes in the low range brake servo and install the servo with the tubes in the valve body.

Transmission Sub-Assembly Replacement

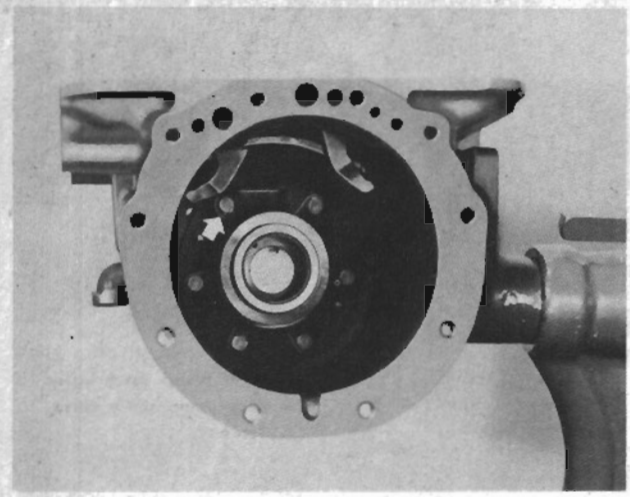

FIG. 379

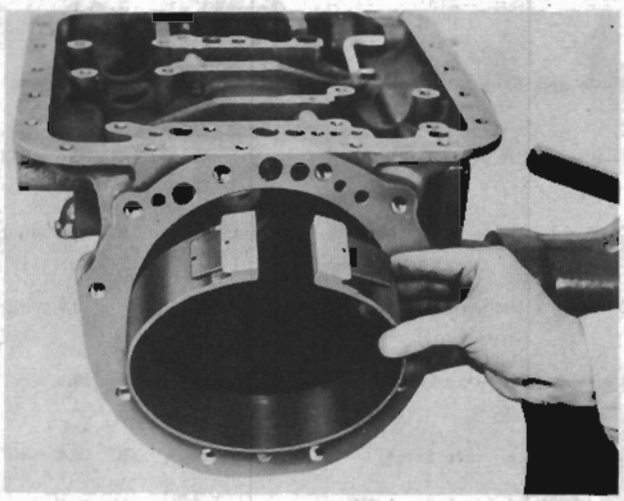

FIG. 380

REAR PUMP

Place the planetary ring gear fiber thrust washer on the hub of the rear pump and position the pump in the transmission case and install the retaining cap screws and lock washers (see Fig. 379). Tighten the screws to 15-18 foot pounds (20,7-25 kg-m.).

Install new "O" ring seals on the rear pump discharge tube and governor pressure tube, lubricate the seals with transmission fluid, and press the tubes into the transmission case.

REAR BAND

Position the rear band in the transmission case so that the band strut with the notch is on the same side as the band actuating lever (see Fig. 380).

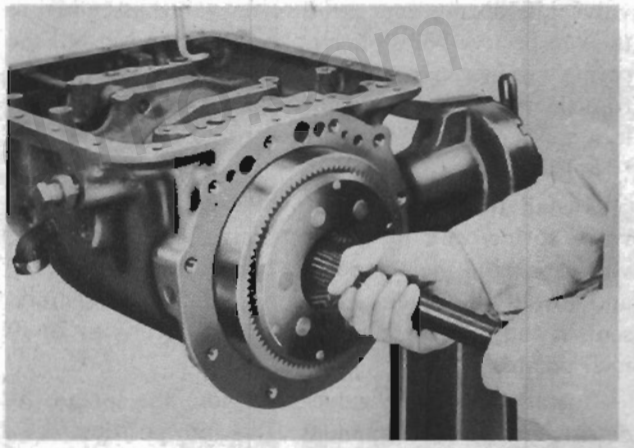

FIG. 381

PLANETARY GEAR ASSEMBLY

Install the planetary gear assembly in the transmission case by sliding the gear assembly through the front of the transmission while supporting the gear assembly with a hand (see Fig. 381).

LOW RANGE BRAKE BAND

Position the low range brake band in the transmission case so that the strut with the notch is toward the same side as the band actuating lever.

HIGH RANGE CLUTCH ASSEMBLY

Place the front sun gear thrust bearing (caged roller bearing) on the shaft and install the high range clutch assembly through the front of the transmission case (see Fig. 382). Rotate the high range clutch assembly to engage the splines of the shaft with the rear sun gear and the front sun gear with the planetary pinions.

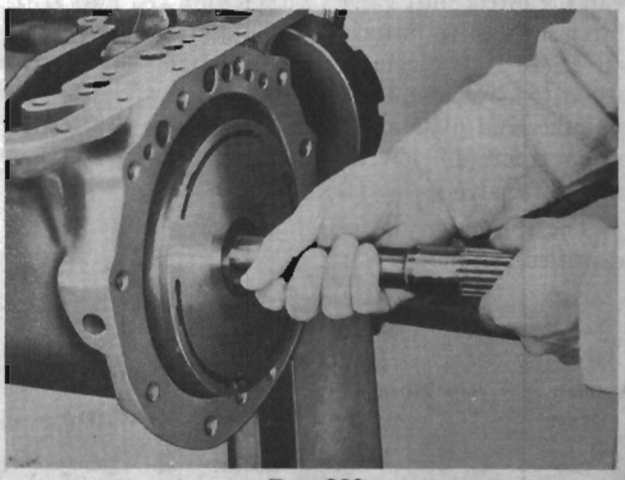

FIG. 382

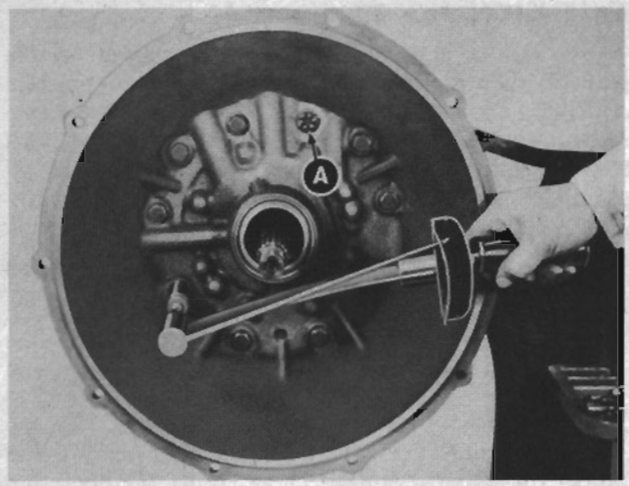

FIG. 383
A. Self-locking cap screw

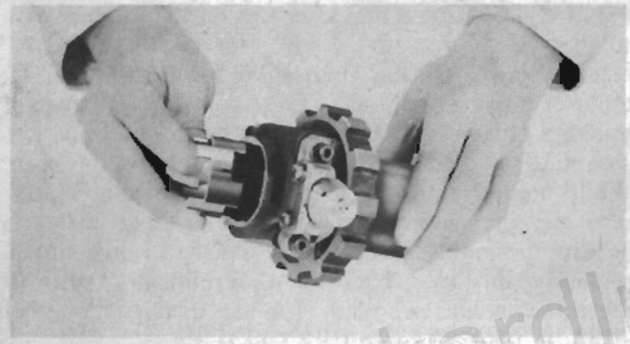

FIG. 384

FRONT PUMP AND BELL HOUSING ASSEMBLY

Install a new bell housing gasket on the front of the transmission case and hold in position with heavy grease. Position the front pump and bell housing assembly over the input shaft and align the holes of the bell housing with the holes in the transmission case and install the assembly. Install the retaining cap screws, washers, and lock washers. NOTE: One of the retaining cap screws is self-locking and does not use a plain washer and lock washer. The location of the self-locking cap screw is shown in Fig. 383. Tighten the cap screws to 55-60 foot pounds (7,6 to 8,3 kg-m.).

Install the oil cooler tubes in the transmission case and install the oil cooler tube adapters in the case.

PARKING GEAR AND GOVERNOR ASSEMBLY

Insert the parking gear lug ring into the hub of the parking gear (see Fig. 384). Rotate the planetary cage shaft until the pin between two of the splines is in position to allow the governors to pass through the cutouts in the transmission case when the master spline of the parking gear and governor assembly is aligned with the pin (see Fig. 385). Push the parking gear and governor assembly toward the front of the transmission (see Fig. 386) until the parking gear lug engages the rear pump.

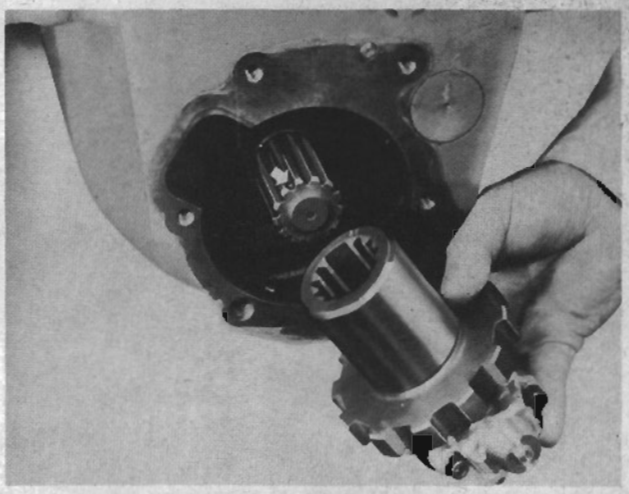

FIG. 385

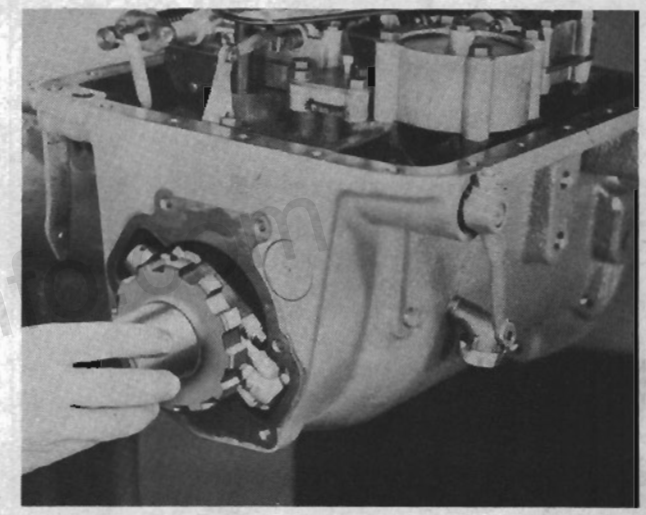

FIG. 386

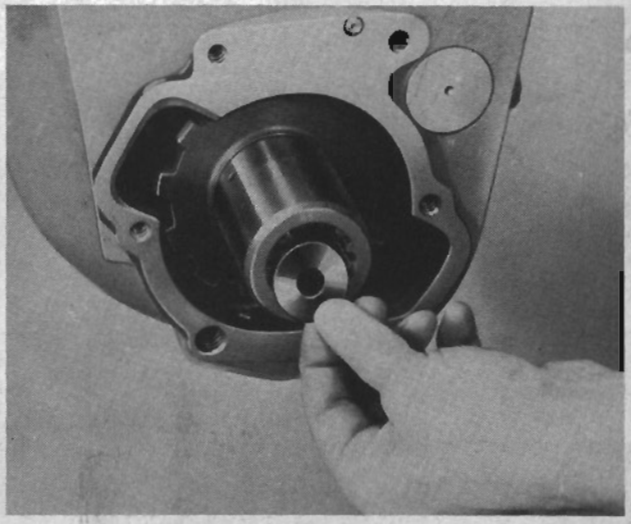

FIG. 387

Install the rear housing spacer washer in the hub of the parking gear (see Fig. 387).

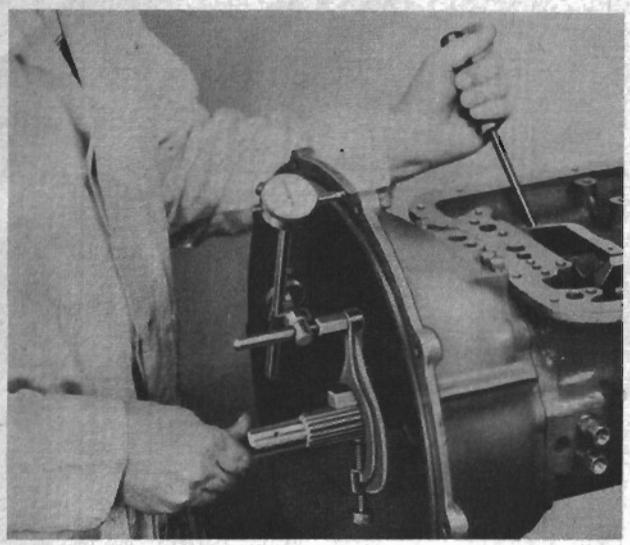

FIG. 388

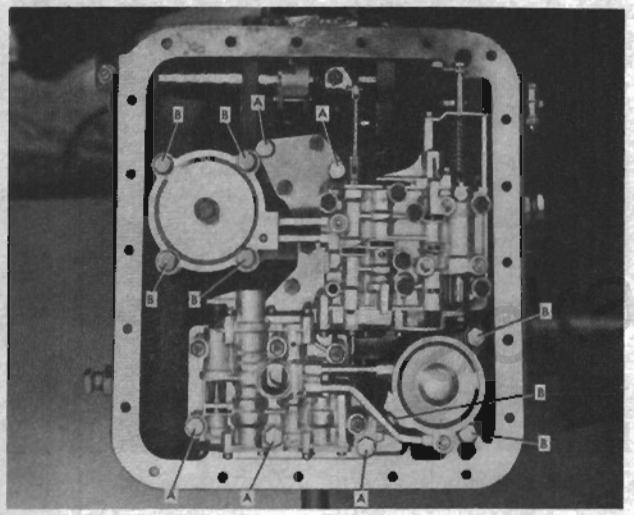

FIG. 389

A. Control valve retaining screws B. Servo retaining screws

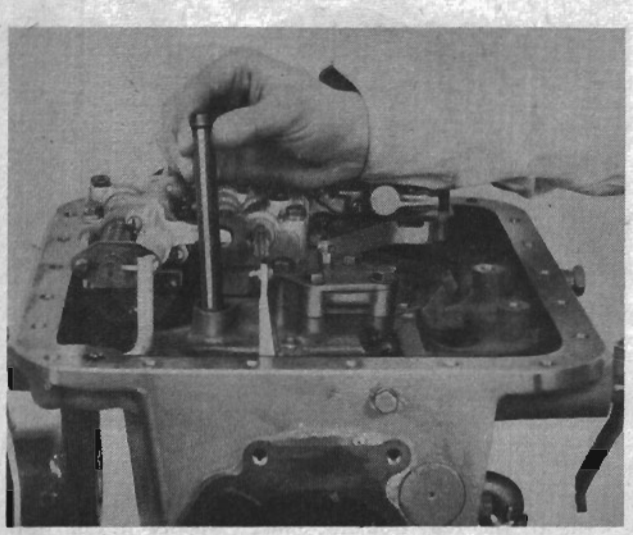

FIG. 390

EXTENSION HOUSING

Position a new extension housing gasket on the rear of the transmission case and hold in position with heavy grease. Position the housing on the transmission case and engage the splines of the output shaft with the splines of the parking gear and governor assembly. Install the retaining cap screws and lock washers. Tighten the screws to 15-18 foot pounds.

Install the companion flange cap screw. Tighten to 50-55 foot pounds.

TO CHECK TRANSMISSION ASSEMBLY END PLAY

To ascertain that the transmission assembly has proper operating clearance or to adjust the operating clearance, the following procedure should be followed:

Use a small block of wood and attach the Dial Indicator Support tool J-5942 to the input shaft (see Fig. 388). Position a dial indicator on the support tool so that the button of the indicator rests against the bell housing. Push the input shaft toward the rear of the transmission and insert a large screw driver between the high range clutch and the front of the transmission case and pry the high range clutch toward the rear. While holding pressure against the high range clutch zero the dial indicator. Continue to hold pressure against the input shaft and pry the high range clutch assembly forward. Read the dial indicator; this is the transmission end play. The specified end play is .023″ to .036″ (0,58 to 0,91 mm.).

If the end play is not within specifications, it will be necessary to change the extension housing spacer. Spacers are available in thicknesses ranging from .020″ (0,51 mm.) through .085″ (2,2 mm.) in .013″ (0,33 mm.) graduations. Select and install a spacer that will bring the end play within the specified limits and recheck the end play.

CONTROL VALVE ASSEMBLY

Position the control valve assembly on the transmission case and depress the reverse band actuating lever to engage with the reverse servo. Repeat the process for the low range brake band actuating lever. Also align the throttle valve shaft to engage with the throttle valve. Install the control valve retaining cap screws, washer, and lock washers, and also install the servo retaining cap screws, washers, and lock washers (see Fig. 389). Tighten the control valve retaining cap screws and the servo retaining cap screws to 9 foot pounds (1,24 kg-m.).

Torque tighten the reverse and the low range brake bands to 20 foot pounds (3,77 kg-m.) and back the screws out 1¾ turns and tighten the lock nuts.

Connect the manual valve link to the shaft inner lever and install the retaining pin.

Lubricate a new "O" ring seal with transmission fluid and install on the rear pump intake tube and install the tube in the rear pump (see Fig. 390).

Using a screw driver in the end of the throttle valve shaft, rotate the shaft counter-clockwise until the valve reaches its stop. With the valve against its stop, use a straight edge to position the outer lever so that the cutoff of the lever is parallel to the machined surface of the transmission case (see Fig. 391). Tighten the outer throttle lever clamp screw nut.

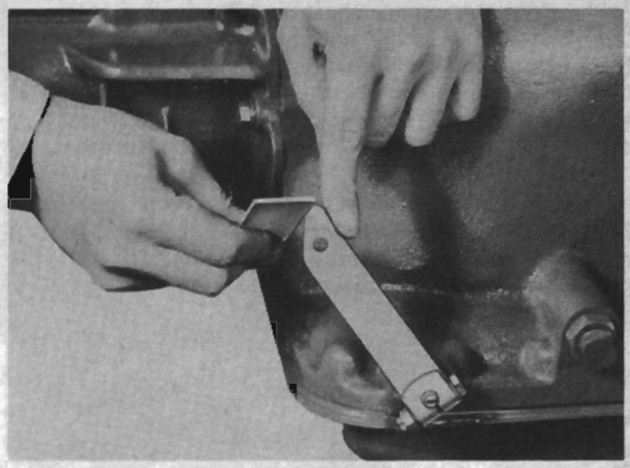

FIG. 391

OIL PAN, GASKET, AND SCREEN

Install the screen on the rear pump inlet tube and also on the front pump inlet tube and install the retaining clip on the control valve assembly stud.

Position a new oil pan gasket on the transmission case oil pan flange and install the transmission oil pan cap screws and lock washers. Tighten the cap screws to 10-12 foot pounds (1,3-1,7 kg-m.)

CONVERTER

The torque converter assembly is accurately balanced as a unit after factory assembly. Balancing is accomplished by welding lugs to the direct drive clutch housing. So that this balance can be maintained, it is important that various parts be marked on disassembly to insure their being installed in their related positions on reassembly.

All service replacement converter pumps are individually balanced and may or may not have balance lugs attached to the flange with drive screws. A new pump with a balance lug may be installed with the lug at any position in relation to the lug on the direct drive clutch housing without affecting converter assembly balance.

Disassembly

Place the converter assembly on a work bench with the pump end up. Using a scratch-awl or some other sharp instrument, scribe marks on the pump flange and the clutch housing.

Remove the converter pump to direct drive clutch housing nuts, washers, and bolts. Tap the pump with a plastic hammer to loosen it, then lift off the pump and remove the reactor thrust spacer (see Fig.392). Remove the large rubber "O" ring from the pump.

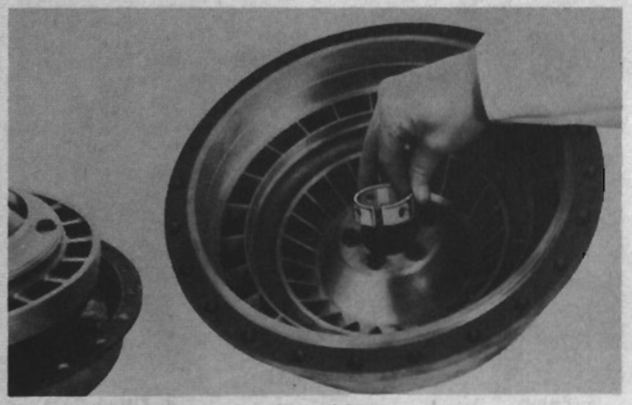

FIG. 392

Remove the cap screws and washers that attach the converter pump shaft assembly to the pump and remove the assembly.

Remove the second turbine to first turbine cap screws and washers, then lift off the second turbine (see Fig. 393). Remove the reactor rear thrust washer and wave washer (see Fig. 394).

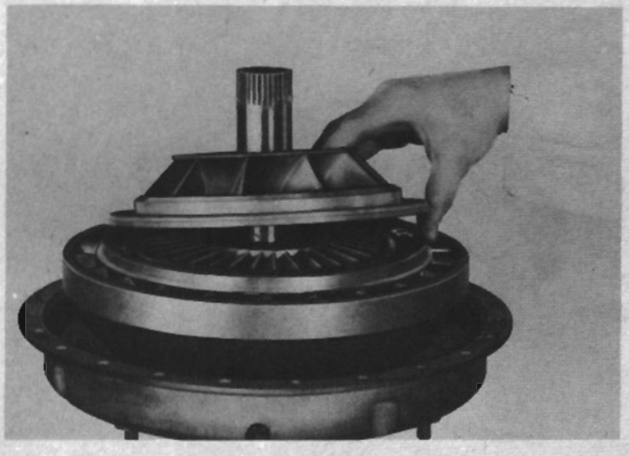

FIG. 393

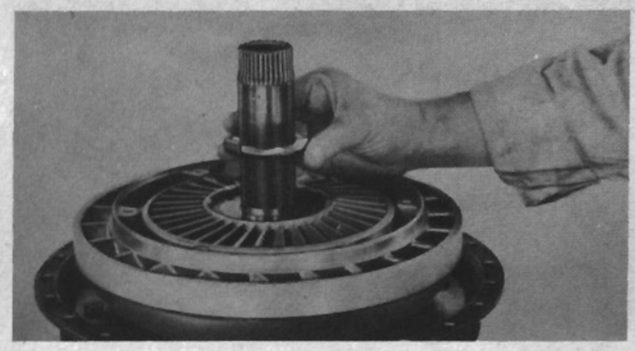

FIG. 394

Lift out the reactor shaft and the reactor as an assembly (see Fig. 395) and remove the reactor shaft front thrust washer (see Fig. 396). Lift out the first turbine and then remove the first turbine hub spacer (see Fig. 397). Remove the cap screws and washers that attach the first turbine hub to the first turbine and remove the hub.

Using a scratch-awl, scribe marks on the clutch housing and the pressure plate (see Fig. 398), then remove the plate retaining screws and lift out the pressure plate and the driven plate.

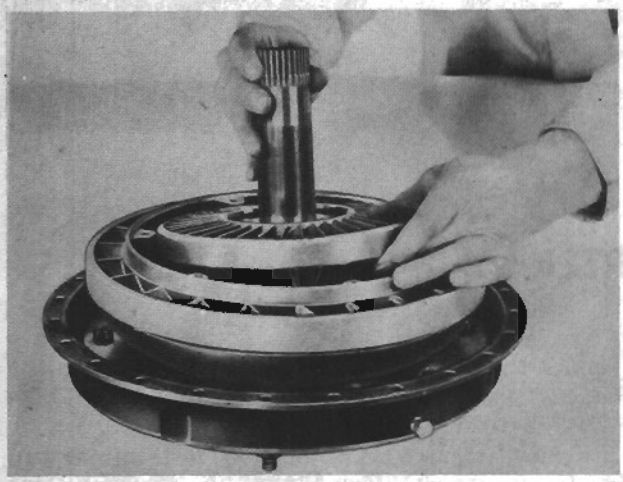

FIG. 395

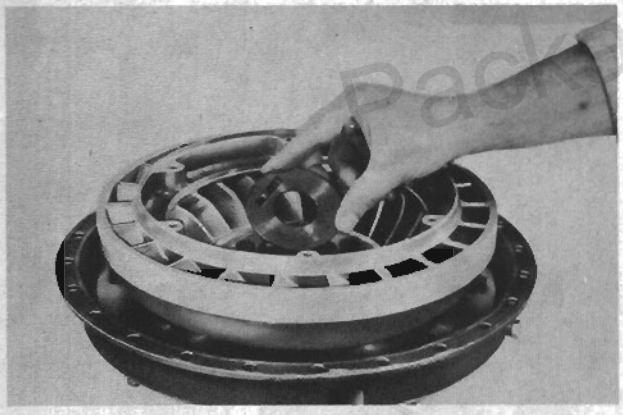

FIG. 396

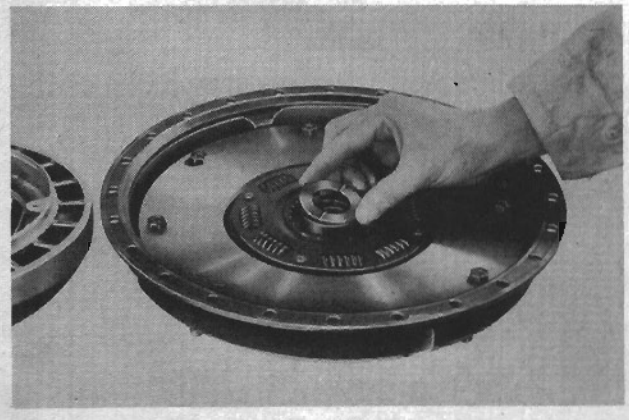

FIG. 397

Scribe a mark on the clutch piston to align with the mark on the clutch housing. Remove the four pressure plate spacers (see Fig. 399) and lift out the clutch piston.

Remove the four large rings (3, Fig. 400) from the piston and also remove the small inner ring (2) from the hub of the clutch housing. Examine the bushing and thrust bearing in the direct drive clutch housing hub and if replacement is indicated, assemble

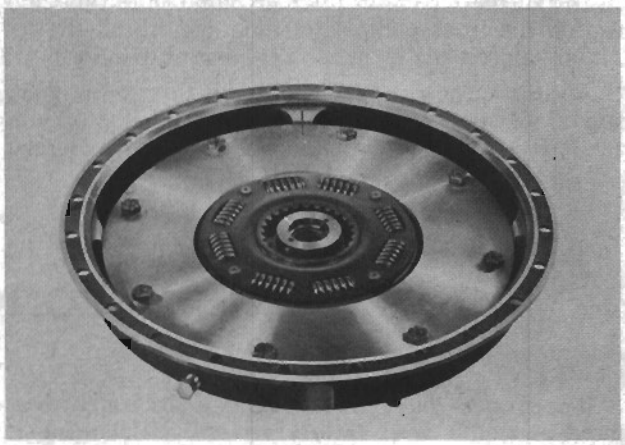

FIG. 398

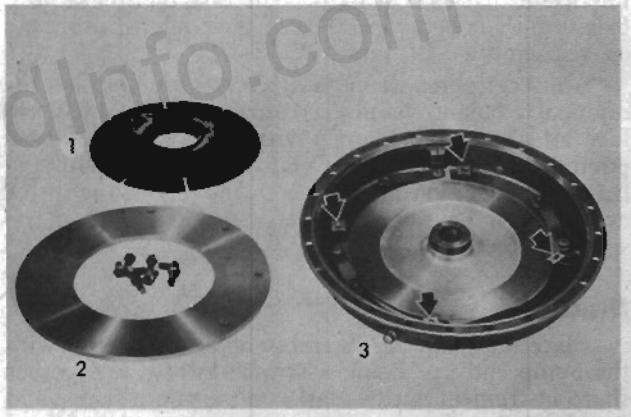

FIG. 399

1. Driven plate
2. Pressure plate
3. Piston and housing

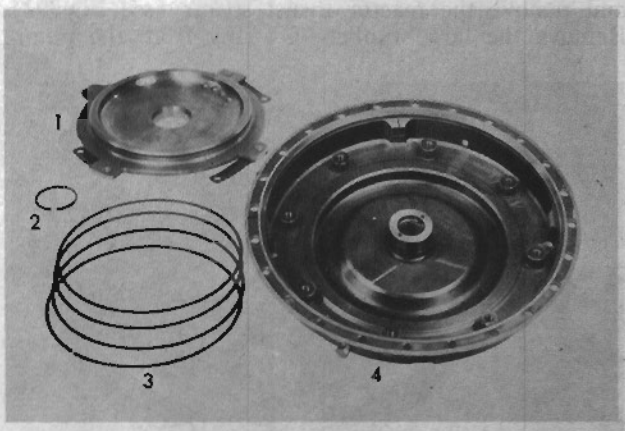

FIG. 400

1. Piston
2. Hub ring
3. Piston rings
4. Housing

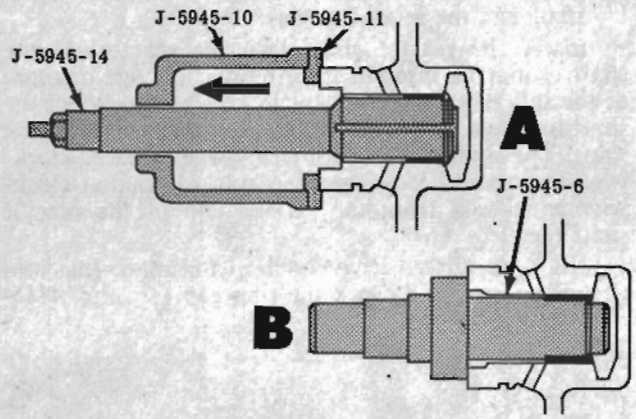

FIG. 401

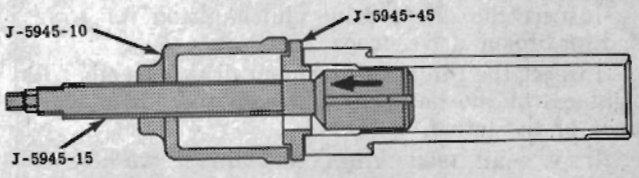

FIG. 403

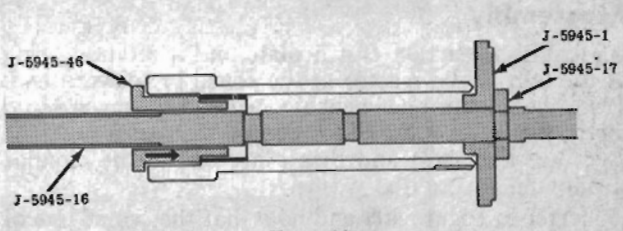

FIG. 404

FIG. 402

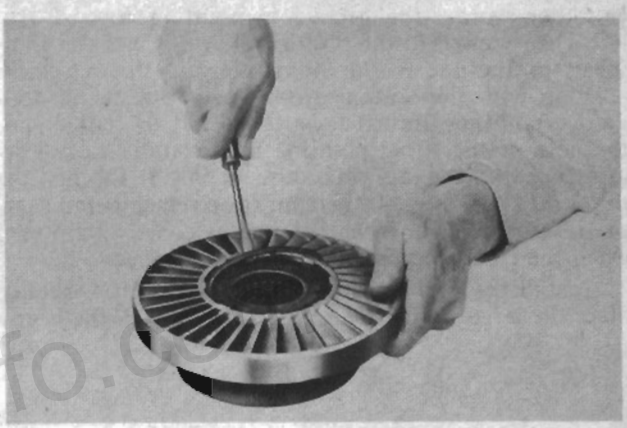

FIG. 405

the bushing remover tools, as shown in Fig. 401(A) and remove the bushing and thrust washer. Assemble the bushing replacer tools, as shown in Figure 401(B) to replace the bushing and thrust washer.

Lift the reactor shaft out of the reactor clutch in the hub of the reactor (see Fig. 402). Examine the bushing in the reactor shaft and if replacement is indicated, assemble the bushing remover tools, as shown in Figure 403 and remove the bushing. Assemble the bushing replacer tools, as shown in Figure 404 to replace the bushing.

Remove the reactor clutch retaining ring (see Fig. 405) and remove the reaction clutch bearing plates, sprag springs, washers, and sprags and lift the reaction clutch outer race out of the hub of the reactor (see Fig. 406).

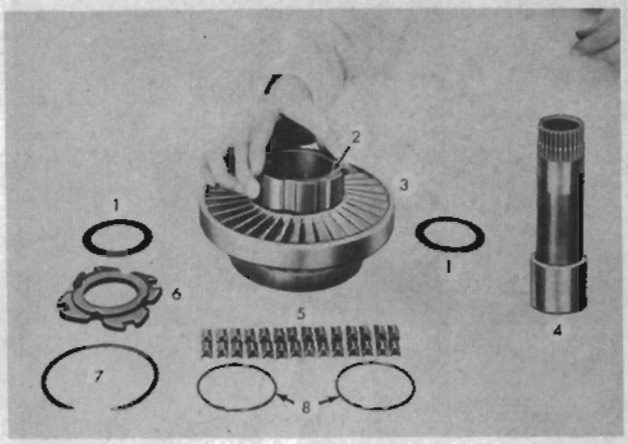

FIG. 406

1. Sprag plates
2. Sprag outer race
3. Reactor
4. Reactor shaft
5. Sprags
6. Reaction clutch plate
7. Retaining ring
8. Sprag springs

Inspection

Inspect the converter pump for broken vanes, damaged teeth on the converter pump shaft assembly, and for nicks and burrs on the mating surfaces.

Inspect the second turbine for nicks and burrs on the mating surfaces, and for broken vanes.

Inspect the first turbine for nicks and burrs on the mating surfaces, and for broken vanes.

Inspect the reactor for broken vanes, and for nicks and burrs on the mating surfaces.

Inspect the reactor shaft for brinelling on the bearing surface, worn bushing, and damage to the teeth.

Inspect the reactor hub, sprag outer race, and sprags for nicks and burrs and for brinelling.

Inspect the direct drive clutch piston for scores, and for broken drive straps.

Inspect the direct drive clutch driven member for tightness of the lining to the plate and for excessive wear of the lining.

Inspect all seals, rings, and thrust washers for excessive wear.

Reassembly

Install a reaction clutch plate and a retaining ring in the hub of the reactor at the coned or forward end. Place the reactor on a bench coned end downward and insert the outer race. Place one of the washers in the race (see Fig. 407) and then place one of the circular springs on top of the washer.

Refer to Figure 408 and note that the center line of the spring groove in the sprag is at an angle less than 90° in relation to the flat back portion of the sprag. In other words, the groove is pointing toward the left when viewed in the position shown. Place the first sprag in the race at approximately a three o'clock position with the bottom groove over the spring, top groove pointing inward toward the left or center and the nose of the sprag pointing in a counter-clockwise direction. Follow this procedure to install the rest of the sprags (see Fig. 409). It must be remembered that the reactor be on the bench with the coned side down when the foregoing operations are performed.

Install the circular spring in the sprag grooves and place the large washer over the sprags. Install the bearing plate and the retaining ring.

Insert the reactor shaft into the reactor. If the shaft cannot be inserted into the reactor, one or more of the sprags have been installed incorrectly. When the shaft has been installed, hold the reactor and rotate the shaft. The shaft should turn freely when rotated clockwise and should lock up when rotated counter-clockwise as viewed from the splined end of the reactor shaft (see Fig. 410).

Insert the direct drive clutch piston inner ring into the piston bore and check the ring gap (see Fig. 411).

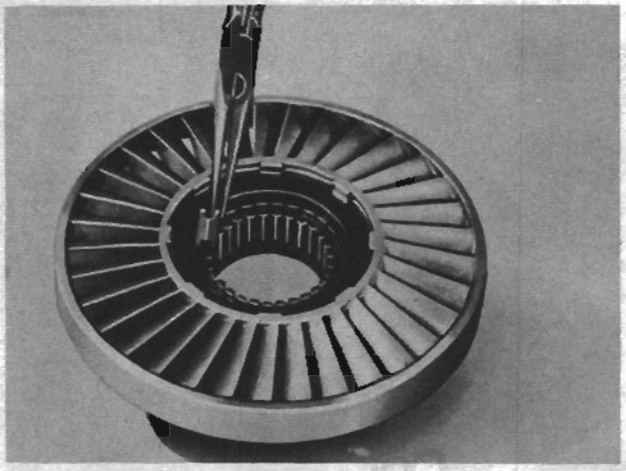

FIG. 409

FIG. 407

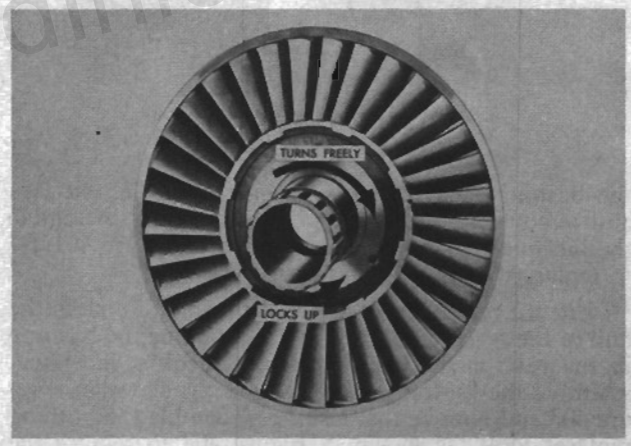

FIG. 410

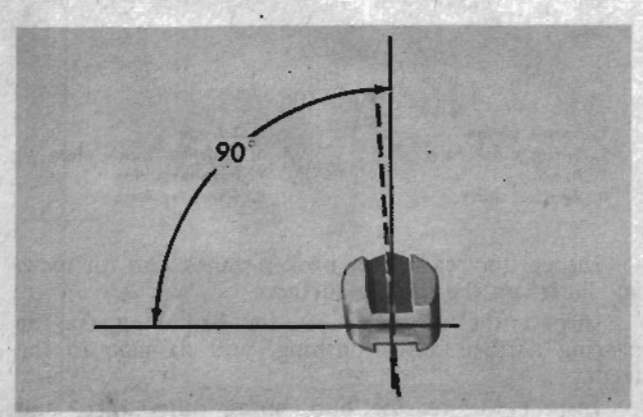

FIG. 408

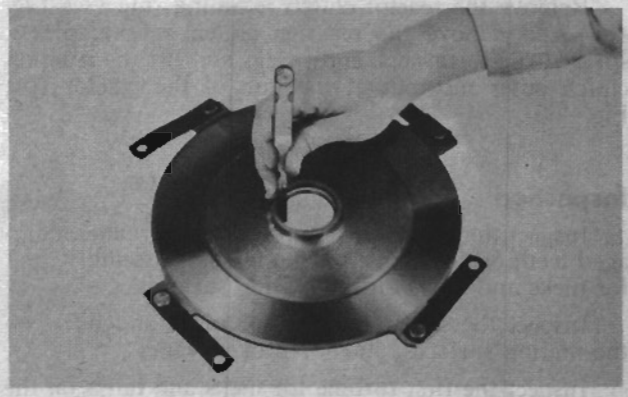

FIG. 411

The specified ring gap is .001" to .018" (0,03 to 0,46 mm.). Install the ring in its groove on the hub of the direct drive clutch housing and make certain that it is free in the groove.

Install the four outer rings on the direct drive clutch piston (see Fig. 412). The rings should be rotated on installation so that the gaps are approximately 90° apart. Centralize the inner ring in its groove in the hub of the clutch housing and push the piston into the housing, lining up the previously scribed marks. Place the four spacers on the bosses in the clutch housing.

Place the driven plate on the piston. Line up the scribe marks on the pressure plate and the housing and place the plate in the housing making certain that the four spacers are not knocked off the bosses. Four locating pins can easily be made to facilitate this operation. Install and tighten the retaining screws to 18-20 foot pounds (2,5-2,8 kg-m.) (see Fig. 413).

Place the first turbine hub spacer on the hub of the direct drive clutch housing.

NOTE: This is the spacer which controls reactor shaft end plate. Seven washers are available in .008" (0,20 mm.) graduations ranging from .062" to .110" (1,6 to 2,8 mm.).

If the turbine hub was removed from the first turbine, position the hub in the turbine and install the retaining cap screws and washers. Centralize the driven plate in the clutch housing and insert the first turbine splined hub into the driven plate hub.

Place the reactor shaft front thrust washer on the hub of the first turbine (see Fig. 414) and install the reactor shaft and the reactor as an assembly.

Install the second turbine, attaching screws and washers. Tighten the screws to 12-15 foot pounds (1,7-2,1 kg-m.) (see Fig. 415). Install the reactor rear thrust washer. The tangs on the washer go upward (see Fig. 416). Do not install the wave washer.

FIG. 412

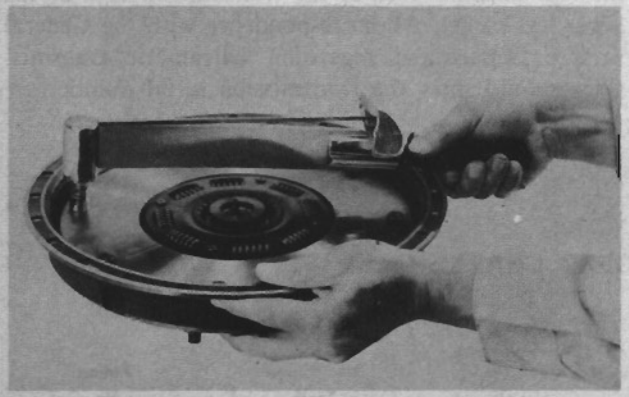

FIG. 413

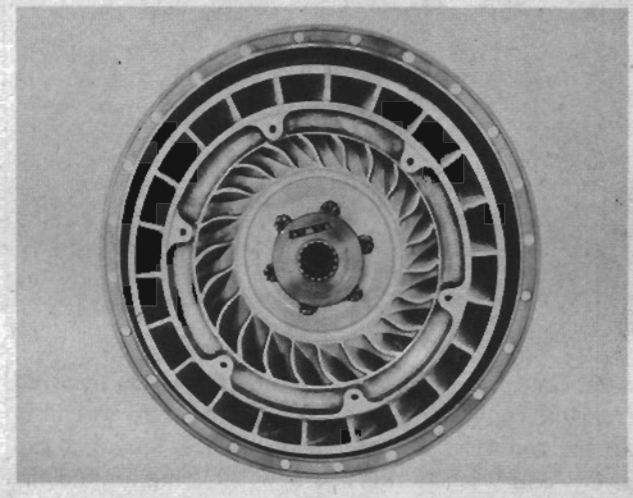

FIG. 414

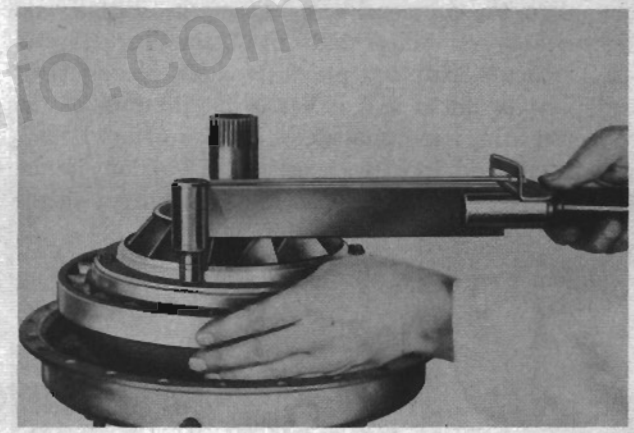

FIG. 415

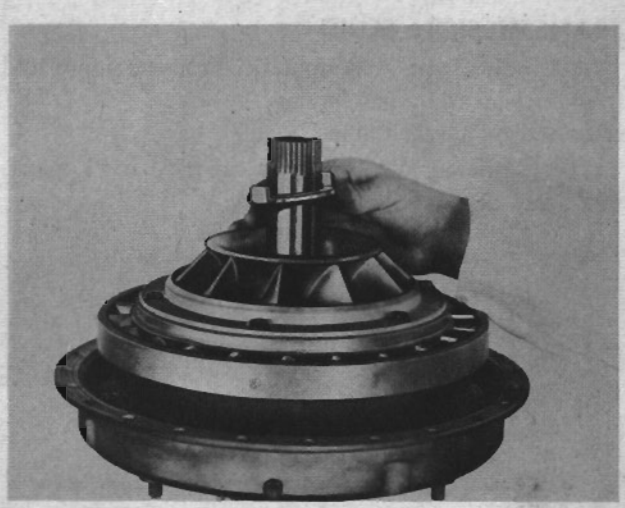

FIG. 416

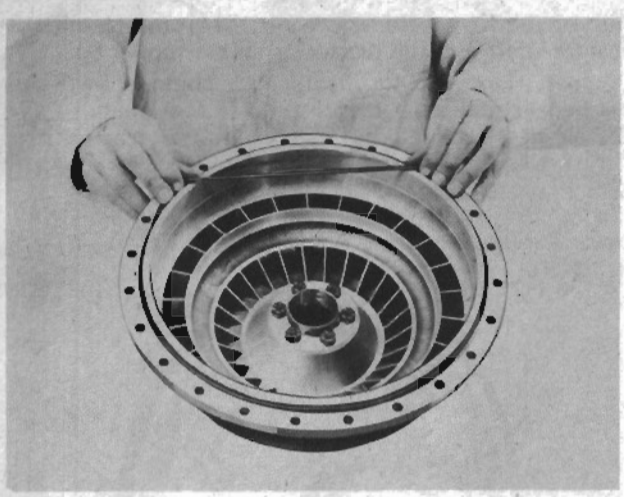

FIG. 417

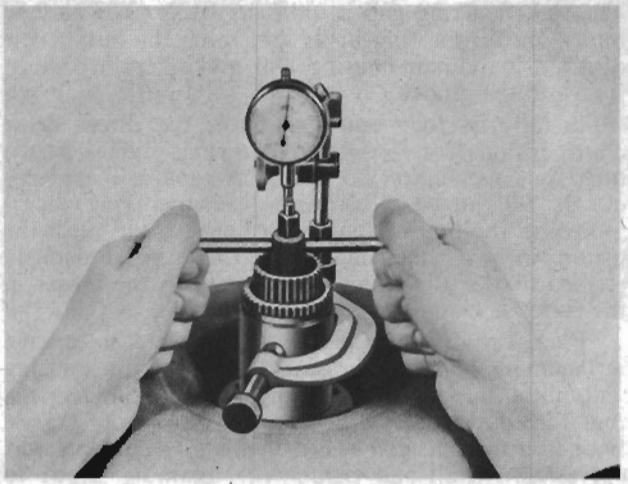

FIG. 418

If the converter pump shaft assembly was removed from the converter pump, position the shaft assembly on the converter pump and install the retaining cap screws and washers. Place a new "O" ring around the pump flange (see Fig. 417).

Position the converter pump on the clutch housing and align the previously scribed marks. Install and tighten four retaining bolts, nuts, and washers and check reactor shaft end play. To check reactor shaft end play, mount a dial indicator on the hub of the converter using the special mounting clamp, tool J-5942, and install and lock the special tool, J-6068, in the first turbine. Position the dial indicator button on the head of the special tool J-6068 and zero the dial indicator. Lift up on the handles of the special tool J-6068 and read the dial indicator (see Fig. 418). Record the reading from the dial indicator and subtract .028" (0,71 mm.) from this reading. This is reactor shaft end play. Correct end play is .010" to .017" (0,25 to 0,43 mm.) If the end play is not within these limits, disassemble the converter and install a front turbine spacer (steel washer) of the proper thickness to obtain the proper end play. Reassemble the converter and upon reassembly install the reactor shaft rear thrust washer wave washer. Install all the retaining bolts, nuts and washers and tighten to 20-25 ft-lbs (2,8 to 3,5 kg-m.).

SPECIFICATIONS

TRANSMISSION FLUID

Use only Type A Automatic Transmission Fluid from a clean container having the letters "AQ-ATF" embossed on the container.

Transmission and converter capacity is 11 quarts (9.2 Imp. qt.,-10,5 liters).

LOCATION OF SERIAL NUMBER

The serial number of transmission is stamped on the rear machine face of the transmission case at the lower left corner. All correspondence with the General Service Department regarding Ultramatic transmissions should show the transmission serial number.

SPEEDOMETER GEAR CHART

Axle Ratio	Tire Size	No. Speedometer Gear Teeth	Gear No.	No. Pinion Teeth	Pinion No.
3.07 to 1	7:10 x 15	8	450308	18	450318

SPECIAL TOOLS AND EQUIPMENT

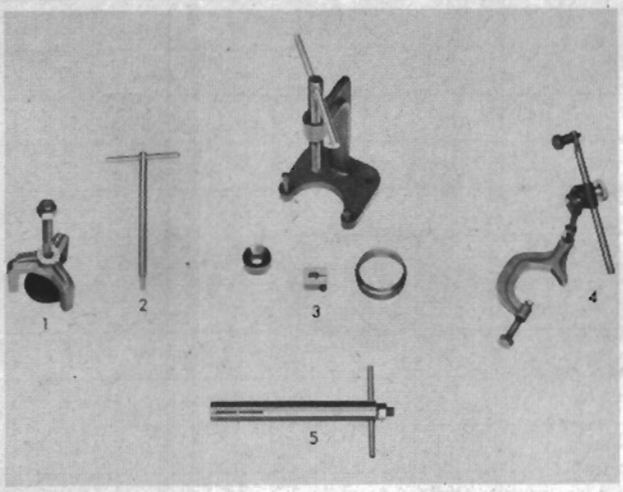

FIG. 419

1. J-5943 High Range Clutch Spring Compressor
2. J-5976. Governor Valve Remover and Replacer
3. J-5977 Low Range Brake Piston Remover and Replacer Set
4. J-5942 Special Clamp and Dial Indicator Support
5. J-6068 Turbine Locking Tool

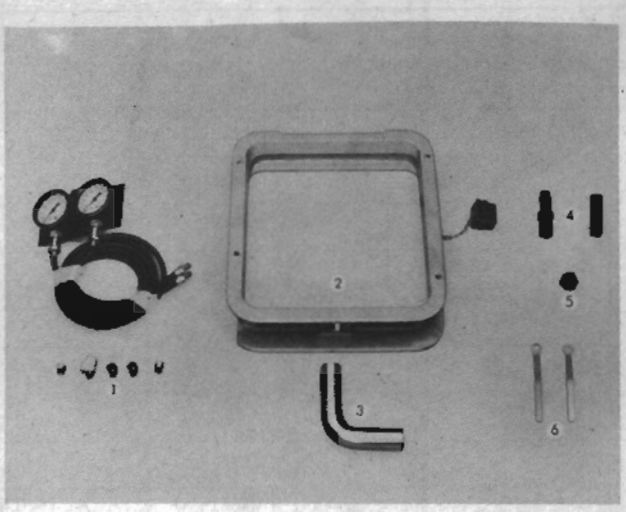

FIG. 420 J-5975 PRESSURE TEST SET

1. Gage and Fittings
2. Test Pan Adapter
3. Elbow Tube
4. Oil Tube Extensions
5. Fitting Adapter
6. Throttle Valve Adjusting Tools

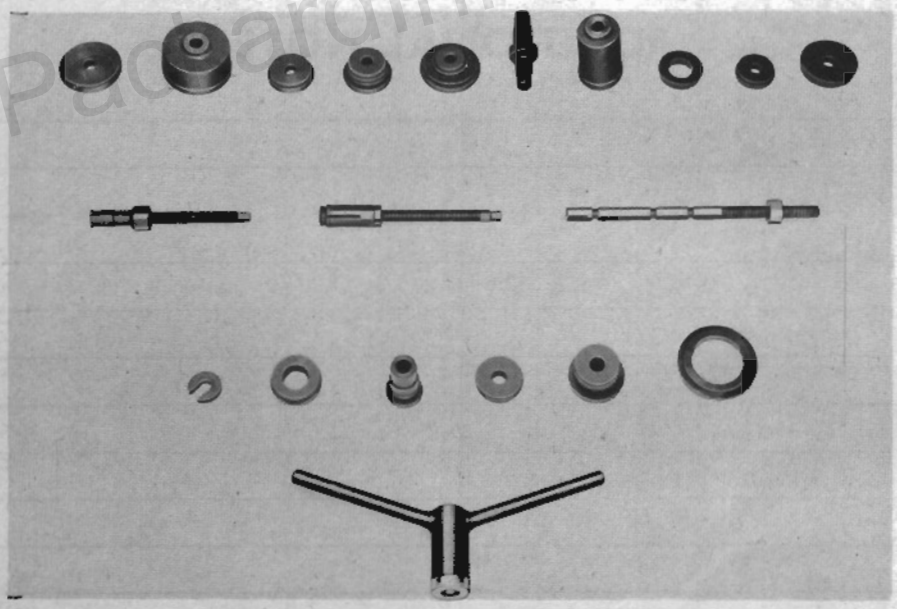

FIG. 421 J-5945 BUSHING REMOVER AND REPLACER SET

SERVICE BULLETIN REFERENCE

NUMBER	PAGE	SUBJECT

ADDITIONAL NOTES