HUDSON

AMERICAN MOTORS CORPORATION

1956

TECHNICAL SERVICE MANUAL

SUPPLEMENT "HORNET" SPECIAL V-8

FOREWORD

The following product information will provide Hudson Service Information for the 1956 "Hornet" Special V-8 Series when used in conjunction with the Electrical Section of the 1956 "Rambler" Technical Service Manual and the 1956 Technical Service Manual Supplement.

This product information should be kept in a convenient location together with the Service Manuals so that complete information will be available for prompt model and series reference.

AMERICAN MOTORS CORPORATION
Automotive Technical Service
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TECHNICAL SERVICE MANUAL

SUPPLEMENT 1956

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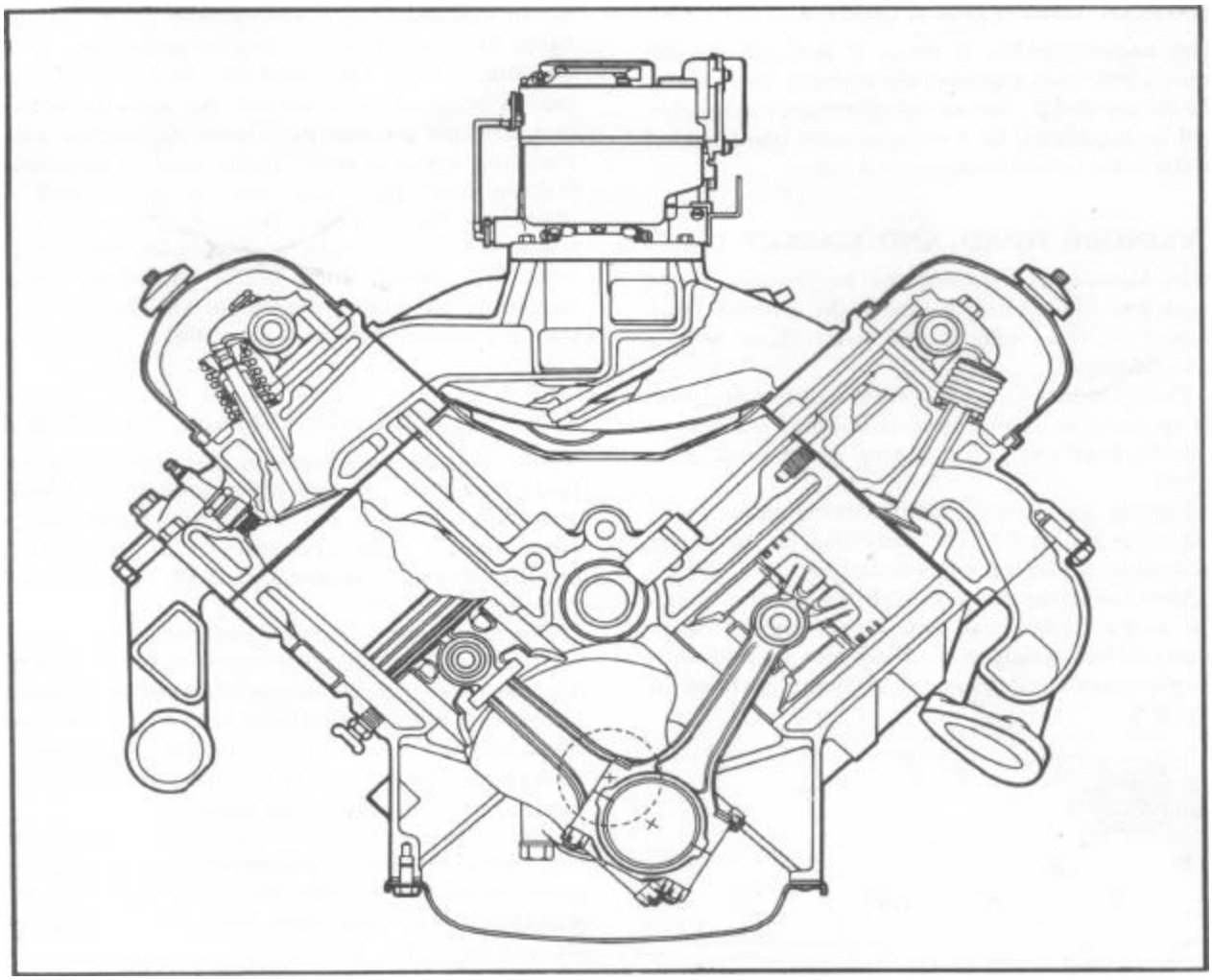


V-8

V-8 Engine Assembly

CONTENTS OF THIS SECTION

ENGINE IDENTIFICATION

The engine number is stamped vertically on the lower right front corner of the cylinder block above the oil pan flange. For service reference, the number will be duplicated on a stainless steel plate welded to the valve tappet compartment cover.

CYLINDER HEAD AND GASKET

After thoroughly cleaning the top surface of the block and the bottom surface of the cylinder head, inspect each for smooth and flat surfaces with a straight edge.

The cylinder block surface has two locating dowels to assist in lining up and holding position of cylinder head and gasket during installation or removal.

Coat the gasket with non-hardening gasket paste.

The "A.M." and "TOP" markings on the gasket are located to the top when installing.

After installing the push rods, rocker arm assembly, and cylinder head cap screws, tighten them evenly. Then retighten to 60-65 foot pounds with torque wrench following the sequence outlined in Figure 1.

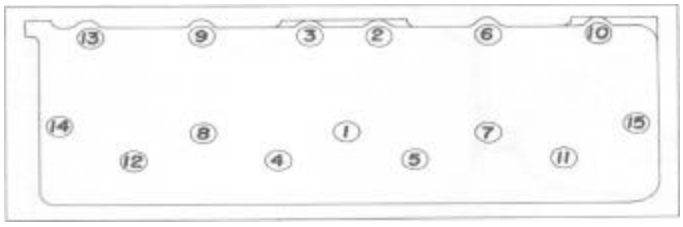


FIGURE 1—*Torque Tightening Sequence*

Fifteen cap screws retain the cylinder head and rocker arm assembly to the cylinder block on each bank. They are of various lengths and design. Four medium 315/16", two short 3", two with special tapped heads to accommodate the retaining screws that hold the cylinder head cover 41/4", three long plain cap screws to retain rocker arm assembly and cylinder head 63/4" long, and one special bolt to index with oil holes for rocker arm lubrication and retain rocker arm shaft and cylinder head 63/8" long. This special drilled bolt is part of the lubrication system and must be installed in the rear position to index with oil passages in the tappet area.

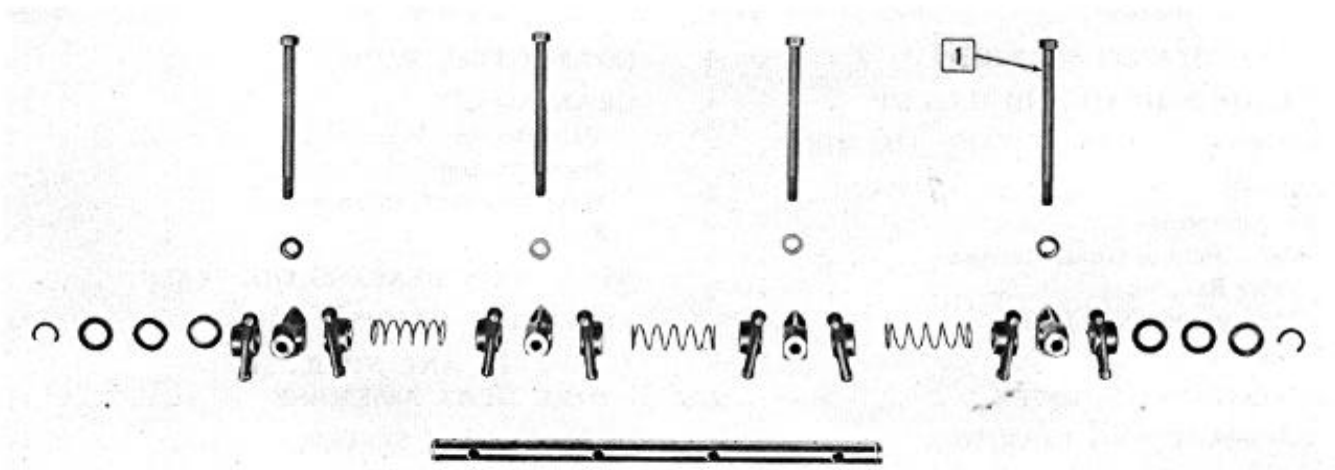
ROCKER ARM AND SHAFT ASSEMBLY

The rocker arm shaft assembly is secured to the cylinder head with four long cylinder head and rocker arm shaft retaining cap screws 6-3/8". The rocker arm shafts are hollow, plugged at each end, serving as oil galleries for rocker arm, push rod end, and valve stem lubrication.

The oil pressure supply for each rocker arm assembly is taken from the valve tappet main oil gallery. The oil under pressure through connecting passages in cylinder block and cylinder head enters through the special drilled rear bolt around the undercut stem area of the rear rocker arm shaft mounting cap screw upward into the rocker arm shaft.

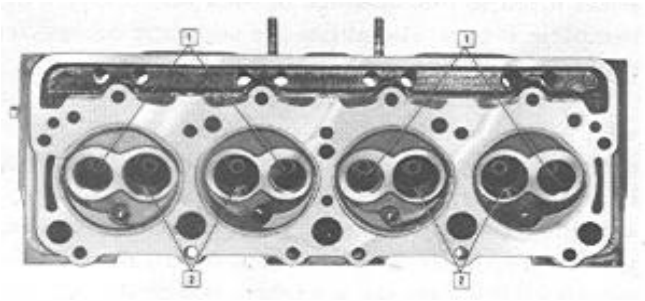
Two different rocker arms are used to accommodate the angle from the rocker arm shaft support to the valve stems. However, the rocker arm shaft assemblies are interchangeable from cylinder bank to cylinder bank (Fig. 2).

The rocker arm shafts are .858"-.8585" outside diameter and the rocker arms are .860"-.861" inside diameter. Oil clearance is .002".



1. Drilled Bolt (Right Bank Shown)

FIGURE 2—*Valve Rocker Arm Assembly*



1. Exhaust Valves 2. Intake Valves
FIGURE 3—*Valve Arrangement*

Valve Springs

Whenever valve springs are removed, they should be tested according to the specifications listed below. Use valve spring tester and replace all springs not within specifications.

Intake or Exhaust Valve Springs:

Valve Closed	85-91 Lbs. @ 113/16"
Valve Open	150-160 Lbs. @ 17/16"

Valve springs are installed with the inactive (closed) coils against the cylinder head.

The valve spring retainer serves the purpose of holding the valve and spring together. The seal is mounted onto the valve guide. At valve service periods, the valve stem oil seals should be replaced to insure good oil control at this point.

The half conical shaped valve locks can be removed after compressing the spring.

Valve springs are 2.20" long free length. They are .938"-.953" inside diameter.

Valve Stem to Guide Clearance

The valve stem to guide clearance is maintained through replacement of valve guides. The valve guides are an interference fit in their bores in the cylinder head and can be replaced by driving out the old guides and driving in the new. The new guides are driven, to a depth to permit 3/4" + or —1/44" to remain exposed above the cylinder head. Measure from top of the guide to flat machined surface for lower valve spring retainer.

New valve stem to guide clearance is as follows:

Intake	.0013"-.0028"
Exhaust	.0018"-.0033"

Valve guides are reamed to .3430"-.3440" inside diameter, after installation.

Rubber valve stem oil deflectors are provided on the valve guides to aid in preventing oil consumption between the valve stem and guide.

Valve Refacing

The intake valves are faced to a 29° angle and the exhaust valves to a 44° angle. Valves may be refaced until remaining margin is down to 1/32"; then the valve must be replaced.

The valve stem tip when worn can be resurfaced and rechamfered. However, never remove more than .010".

Valve Seat Refacing

Grind the valve seats to the following specifications:

Seat Angle	
Intake Valve	30°
Exhaust Valve	45°
Seat Width	
Intake Valve	.078"-.093"
Exhaust Valve	.093"-.104"

Narrowing stones should be used to obtain the proper seat widths when required.

Control seat runout to a maximum of .002".

Valve Tappets and Push Rods

The hydraulic valve tappet consists of a body, plunger, plunger return spring, check valve assembly, push rod socket, and lock ring (Fig. 4).

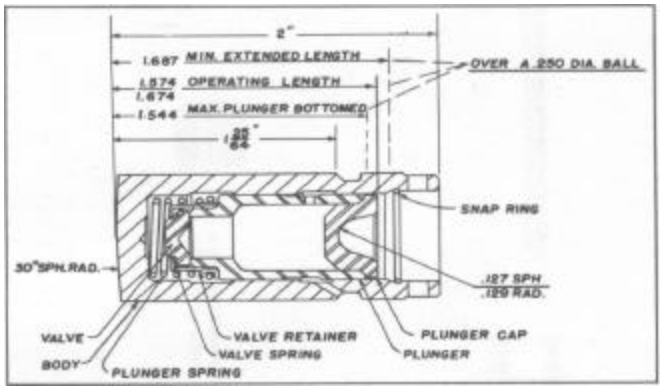


FIGURE 4—*Sectional View of Hydraulic Tappet Assembly*

The tappet operates in a guide bore which has an oil passage drilled into the adjoining main oil galleries.

When the tappet is on the heel of the cam lobe, the plunger return spring indexes an oil hole undercut in the plunger with the oil supply admitted through the tappet body. Oil under pressure flows into the body- through the check valve assembly maintaining the tappet fully charged. This cycle of operation occurs when tappet leaks off some oil during the normal valve opening events. Opening movement of the cam lobe causes tappet body movement, closing the check valve and transmitting "zero-lash" movement of the push rod to open the cylinder valve.

The valve tappets should be cleaned and serviced at time of engine overhaul or whenever excessive noise exists.

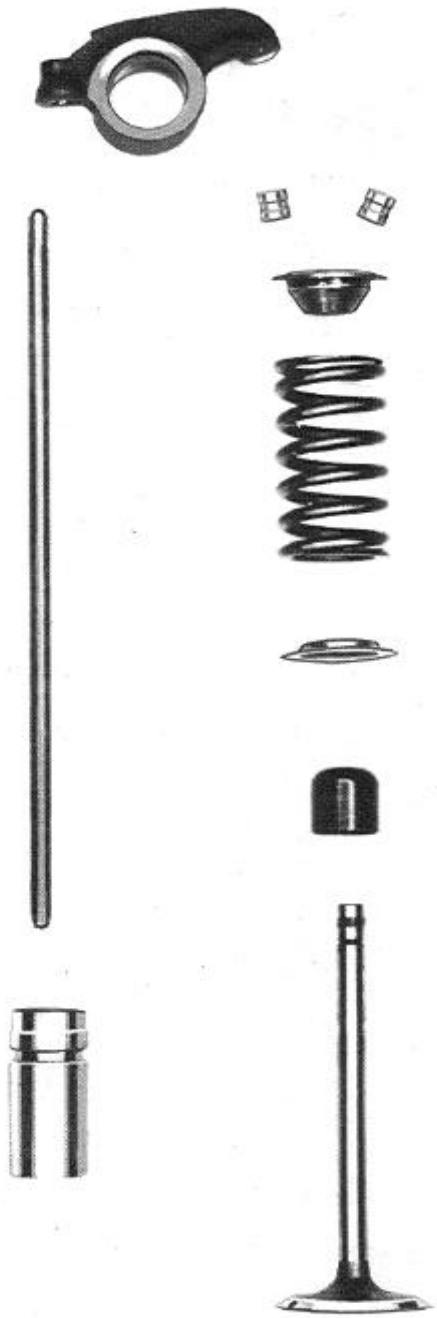


FIGURE 5—*Valve, Push Rod, and Tappet Assembly*

When removing the tappets, they must be kept in an order that will insure replacement in their respective operating bores in the engine because they are select fitted to that bore. Keep each tappet component group by itself as all detail components are select fitted to one another in manufacturing. Only complete tappet assemblies are supplied for service replacement.

The tappet assembly should be cleaned in a solvent to remove all varnish or leaded deposits. After cleaning, the tappet must be "leak-down" tested to insure its "zero-lash" operating ability. Kerosene should be used for this test. Test the tappet by filling the body with kerosene and then install the plunger return spring, plunger assembly, and push rod socket. Leave out snap ring for test. Insert the push rod in tappet socket and check it for "leak-down" by pushing downward on rod.

If the tappet leaks down rapidly or collapses immediately, it must be rechecked and/or replaced with a complete new tappet assembly. The normal tappet will take approximately 10-45 seconds to "leak-down" with kerosene with a 50 lb. load, travel of .125". After testing tappets, they should be pre-lubricated and assembled in the engine without an oil charge. They will normally charge themselves in 3 to 8 minutes of engine operation.

Tappet Noise

A loud clicking noise is usually the result of the plunger stuck down below its operating position or a check valve held open. A light clicking noise is usually the result of excessive "leak-down" caused by wear or slight leakage at the check valve and its seat.

An intermittent noise at tappet is the result of dirt or chips stopping the check valve or a lack of oil flow into the body because of dirt. A general tappet noise is in most cases due to a lack of oil volume or pressure.

The normal tappet plunger operating range is .143".

Valve Timing

The correct valve timing is established by the relation between the sprocket on the camshaft and the sprocket on the crankshaft.

To obtain the correct valve timing, index the "0" marks on camshaft and crankshaft sprockets on a line drawn vertically through the center line of each shaft (Fig. 6). To check the assembly, rotate the crankshaft until the timing mark on camshaft sprocket is on a horizontal line at either the 3 or 9 o'clock position. Count the number of links or pins on the timing chain between timing marks. You should have 10 links and/or 20 pins between timing marks. Each link contains two pins (Fig. 7).

To make an external check of valve timing, remove the cylinder head covers and spark plugs. Crank the engine until

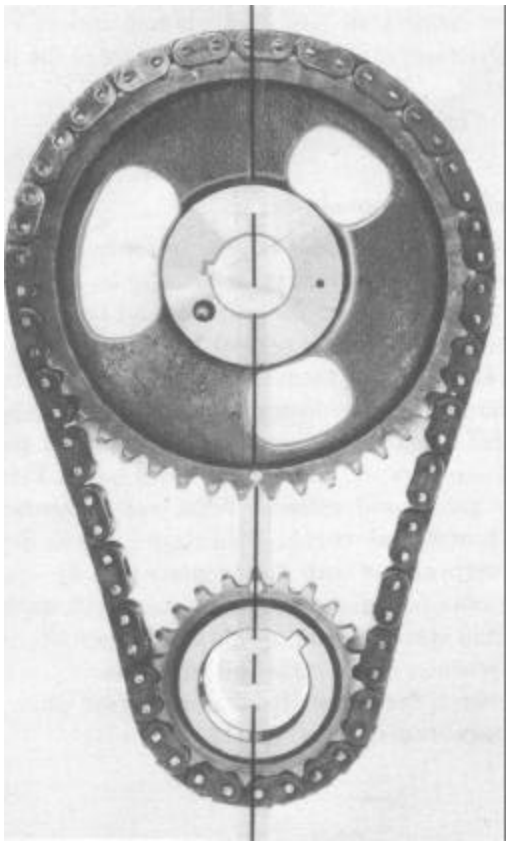


FIGURE 6—*Properly Installed Timing Assembly*

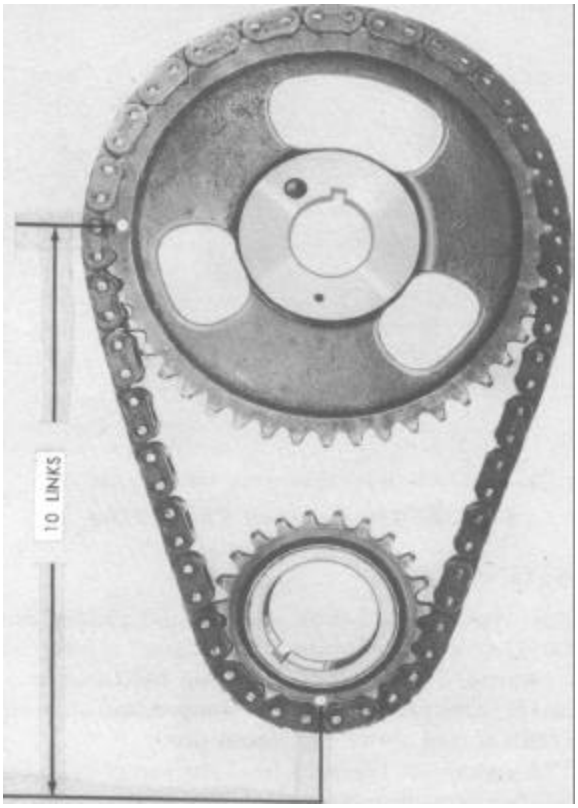


FIGURE 7—*Link Count Position*

No. 6 cylinder piston in right bank is on T.D.C. on compression stroke. This places No. 1 cylinder piston on T.D.C. on the exhaust stroke valve overlap position. Rotate the crankshaft counterclockwise 90°.

Install a dial indicator on the number one intake valve rocker arm push rod end (Fig. 8). Crank the engine slowly in direction of rotation (clockwise) until the dial indicator indicates push rod movement. The hydraulic lifter should be fully charged for this check.

At the time the dial indicator moves, the ignition timing pointer on the front cover should align with a point approximately 25/32" before T.D.C. position on the vibration damper. If more than 1/2" variance in either direction is evident, remove the timing chain cover and inspect timing chain installation. Replace timing chain if over 1/2" chain deflection exists.

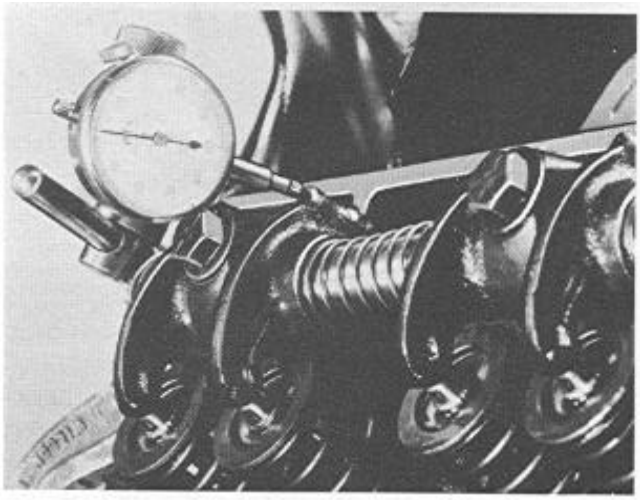


FIGURE 8—*Installation of Dial Indicator for External Valve Timing Check*

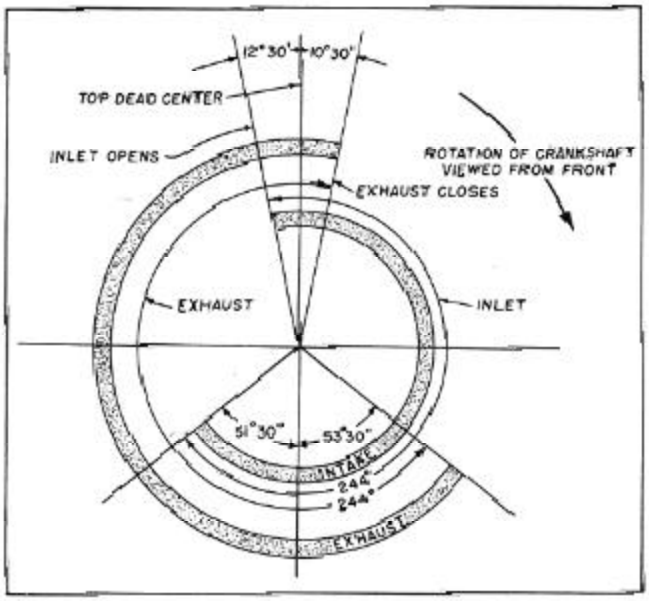
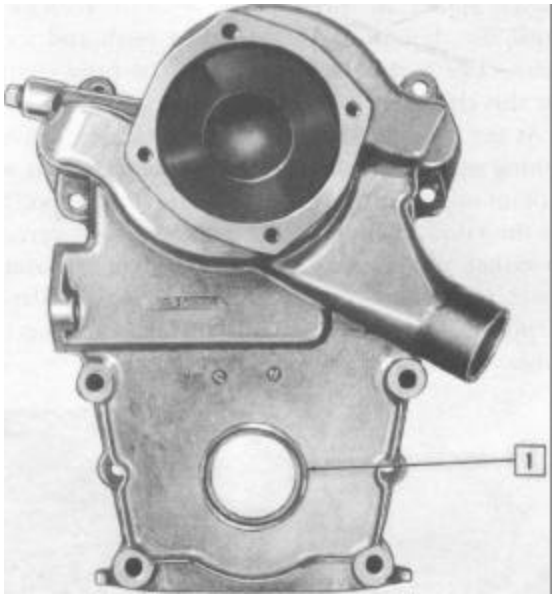


FIGURE 9—*Valve Timing Diagram*

TIMING CHAIN COVER

The timing chain cover is a casting incorporating an oil seal at the vibration damper hub.

To remove the timing chain cover, first remove water pump, fuel pump assembly, and vibration damper.



1. Oil Seal
FIGURE 10—*Timing Chain Cover*

To prevent damage to the oil seal, it is important that the cover be properly aligned when installing the vibration damper. This is accomplished by locating dowels in the cylinder block and by leaving the cover to block screws loose until the vibration damper has been partially installed. Then tighten the cover screws.

CAMSHAFT AND BEARINGS

The camshaft is supported by five steel-shelled, babbitt-lined bearings which have been pressed into the block and line reamed. The camshaft bearings are step bored, being larger at the front bearing than at the rear, to permit easy removal and installation of the camshaft. All camshaft bearings are lubricated under pressure.

The oil lubrication is supplied through connecting drilled passages from the central main oil gallery.

Camshaft cam heels should not run-out over .001" on base circle when gauged between two adjacent camshaft bearings. Camshaft oil clearance is .001" to .003".

Camshaft End Play

The camshaft end thrust is controlled by the front surface of the camshaft bearing and the rear surface of the thrust plate, and the rear hub surface of the camshaft sprocket and the front surface of the thrust plate.

The end play tolerance is .003" to .006".

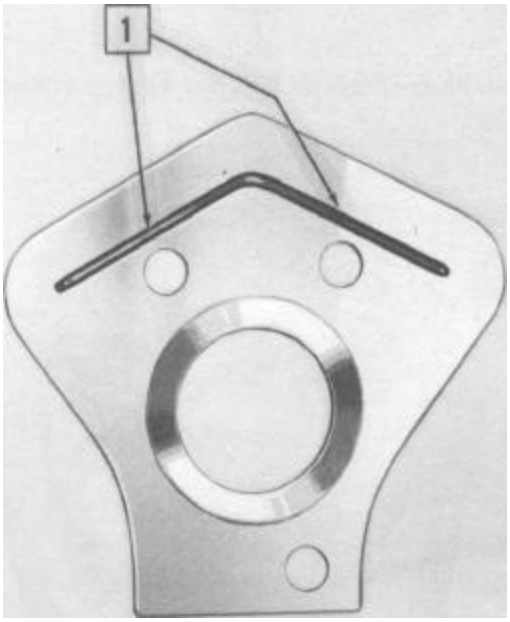
Camshaft Removal

Remove cylinder head covers, ignition plug wires, rocker arm assemblies, intake manifold, and carburetor. Remove upper oil breather and tappet assembly cover. Remove inner oil baffle cover. Remove push rods, keeping them in their relative operational positions. Remove hydraulic tappets and keep in relative operational positions. Remove fuel pump, vibration damper, and timing chain cover.

Remove water pump and cylinder head water distribution manifold. Crank engine until timing marks line up on a vertical line with shaft centers (Fig. 6)

Remove fuel pump eccentric, crankshaft sprocket, camshaft sprocket, and timing chain assembly. Timing sprockets can be pried off with ease.

Remove the camshaft retainer thrust plate and the end thrust spacer (Fig. 11).



l. Oil Channels for Connecting Oil Galleries

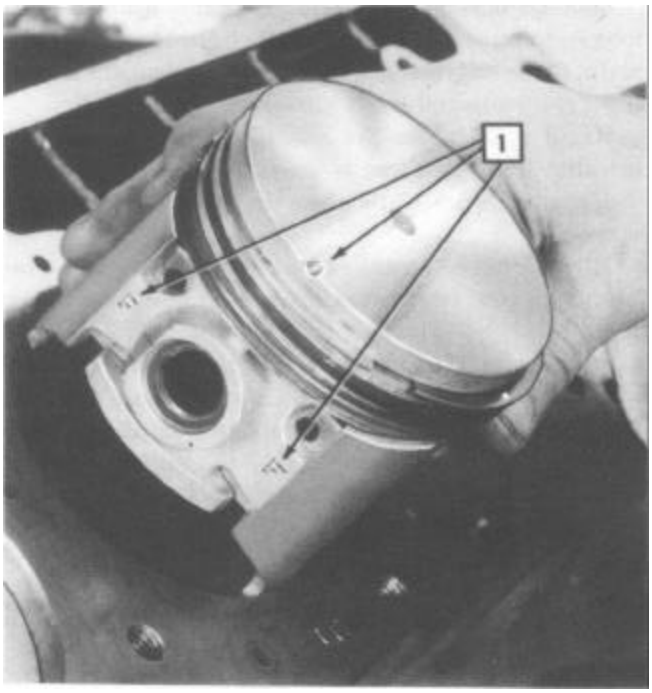
FIGURE 11—*Camshaft Thrust Plate*

PISTONS

Slipper-type, tapered skirt, cam ground pistons are used. They are of aluminum alloy, steel reinforced for controlled expansion. The ring belt area provides for three piston rings, two compression and one oil control ring above the piston pin.

The pistons are removed from the top of cylinder bore after removing ring ridge.

The piston pin boss is "offset" from the piston center line to place it nearer the thrust side of the cylinder. To insure proper installation of the piston in the bore, a notch is cast in the piston top, and letters "F" cast in the pin boss structure at the front (Fig. 12).



1. Notch and "F" Letter to Front of Engine

FIGURE 12—Correct Piston Position

The piston to bore clearances are .020" to .024" at top land, .001" to .0015" top of skirt, and .0009" to .0015" bottom of skirt.

PISTON PINS

The piston pins are a press fit into the connecting rod, thus requiring no locking device.

The piston pin is removed with piston pin remover j-6360 and an arbor press. The piston is placed on the remover support so that the pin will enter the support when pressed out with the piloted driver.

To install the piston pin, place the piston pin pilot in the support and insert in piston and connecting rod. This aligns the piston and connecting rod piston pin bores. Press the piston pin into the connecting rod and piston assembly until the lower pilot bottoms in the support. The connecting rod is automatically centered on the pin (Figs. 13 and 14).

CAUTION: *The pin must be a tight press fit in the connecting rod.*

The piston pin should be a palm press fit in piston boss at room temperature. With parts dry and free of oil, the pin must support its weight in a vertical position, over its entire length, in either of the two piston pin bosses.

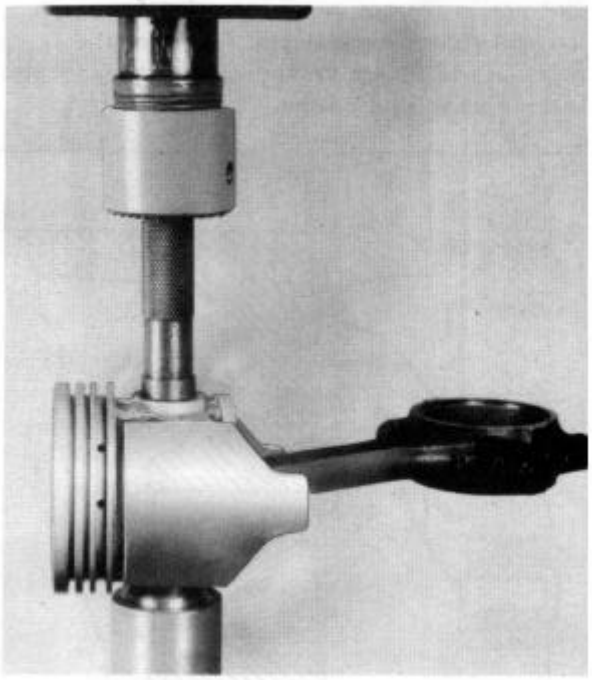


FIGURE 11—*Removing Piston Pin*

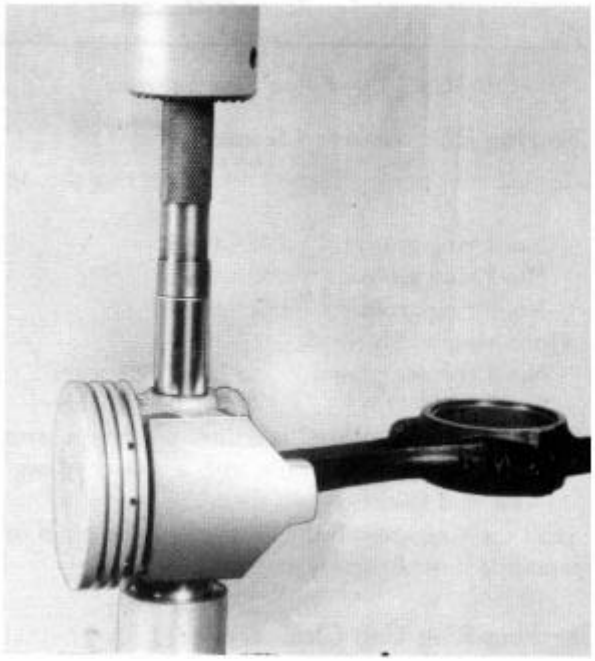


FIGURE 14—*Installing Piston Pin*

PISTON RINGS

A three ring piston is used. The two compression and one oil control rings are located above the piston pin boss.

Before assembling the rings to the piston, carbon must be cleaned from all ring grooves. The oil drain holes in the oil ring grooves and pin boss must be cleared with the proper size drill. Care must be exercised not to remove metal from

the grooves since that will change their depth, nor from the lands since that will change the ring groove clearance and destroy ring to land seating.

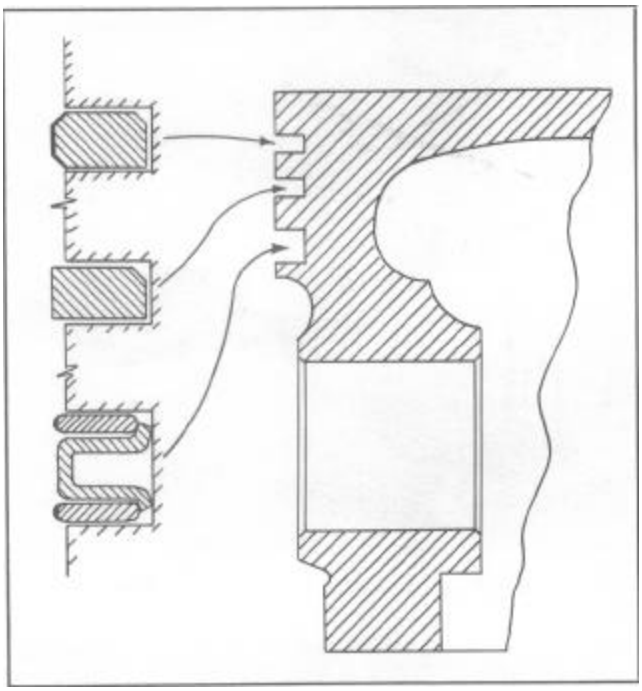


FIGURE 15—*Piston Ring Location*

Checking Ring Groove Clearance
Side clearance between land and piston ring should be:

No. 1 ring groove	.002"-.0035"
No. 2 ring groove	.002"-.004"
No. 3 ring groove	.001"-.0079"

Piston ring width is:

No. 1 chrome plated	.0775"-.0780" wide
No. 2 plain	.0770"-.0780" wide

No. 3 oil control ring is a three-piece type (two oil control wiper rails with a spacer of segmented steel between them).

Roll the ring around the groove in which it is to operate. It must fit freely at all points.

Checking Ring Gap Clearance

Piston ring gap or joint clearance is measured in the bottom of the cylinder near the end of the ring travel area. To square the ring in the bore for checking joint clearance, place the ring in the bore. Then with an inverted piston, push the ring down near the lower end of the ring travel area.

When other than standard ring sizes are used, rings should be individually fitted to their respective bores for a gap clearance of:

No. 1 .	010"-.020"
No. 2 .	010"-.0201'
No. 3 .	015"-.055" (Gap of Rail)

Piston Ring Installation

Removal of glaze from the cylinder wall for quicker ring seating can be accomplished by various methods. Where an expanding type hone is used, do not use more than ten strokes (each stroke down and return) to recondition a cylinder wall.

Successful ring installation depends upon cleanliness in handling parts and while honing the cylinder walls. The engine bearings and lubrication system must be protected from abrasives.

Rigid type hones are not to be used to remove cylinder glaze as there is always a slight amount of taper in cylinder walls after the engine has been in service.

Rings must be installed on the pistons with a ring installing tool to prevent distortion and ring breakage.

For service ring replacement, follow the detailed instructions enclosed in the ring package.

Prior to installing the piston and connecting rod assembly into engine, the piston ring gaps are to be arranged so that the gap for the oil ring is toward the inside of the block. The gaps on the compression rings are 120° apart. Do not locate a ring gap over the piston pin boss.

CONNECTING RODS

Connecting rods are the "I" beam drop forged steel type. The connecting rods are stamped with the cylinder numbers in which they are assembled. The numbers are opposite the squirt holes and toward the outside of the banks in which they are located.

The squirt holes from connecting rods in one bank lubricate the cylinders in the opposite bank.

The connecting rod squirt holes are located in the parting surface of the bearing cap (Fig. 16).

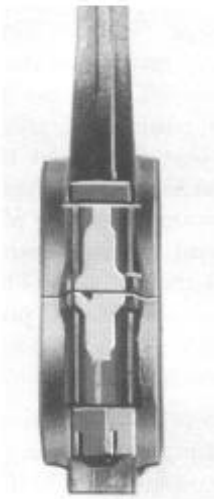


FIGURE 16—*Connecting Rod Squirt Hole Location*

Assemble connecting rod to piston with notch in piston and connecting rod identification mark to front of engine. Cylinder numbers should be toward the outside of bank in which they are installed.

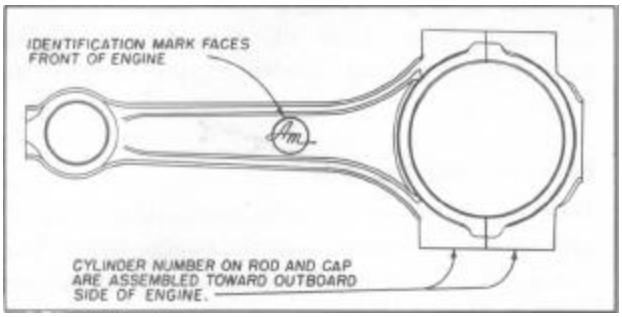


FIGURE 17—*Connecting Rod Identification Mark*

The cylinders are numbered 1, 3, 5, 7 in the left bank of engine from front to rear, and even numbers 2, 4, 6, 8 in the right bank, front to rear as viewed from driver's seat.

Two connecting rods are mounted side by side on each crankpin. The side clearance is .004" to .012" (Fig. 18).

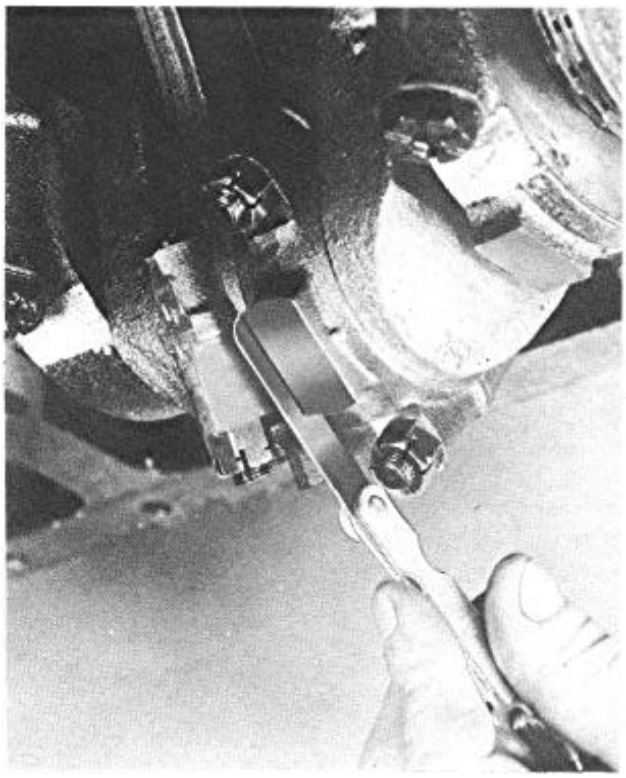


FIGURE 18—*Checking Connecting Rod Side Clearance*

Connecting Rod Alignment

Whenever new rings are installed or new piston pins are replaced, it is necessary to align the connecting rods and pistons as assemblies to insure true operation in the cylinder bore.

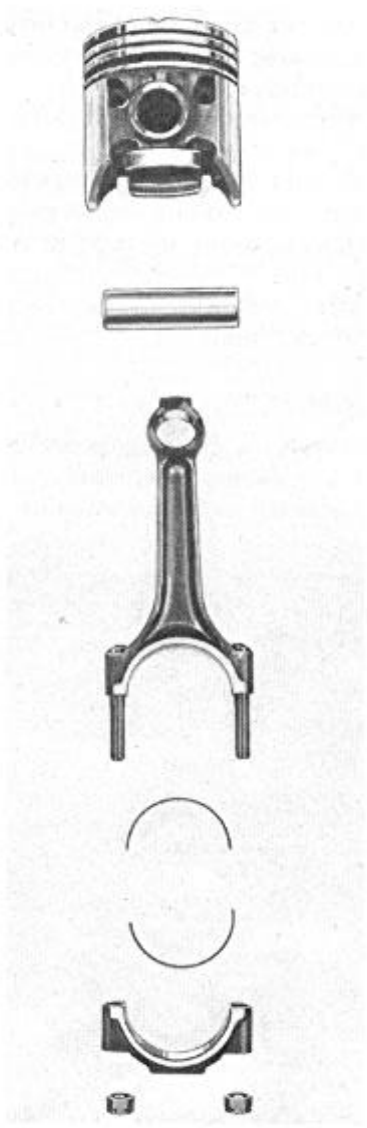


FIGURE 19—*Piston and Connecting Rod Assembly*

Misaligned rods will cause uneven piston and ring wear which will result in oil consumption. The connecting rod should be inspected for a twisted or bent condition.

Connecting Rod Bearings

The connecting rod bearings are the steel-backed, babbitt-lined precision type. They are installed as pairs in the connecting rod and cap.

CAUTION: *Never file a connecting rod or cap to adjust bearing clearance.*

To determine the amount of bearing clearance, use a piece of Plastigage in the bearing cap. Then tighten the cap to torque specifications to compress the gauge. Remove the bearing cap and calibrate the width of the Plastigage with the scale furnished.

If the bearing clearance is excessive, the correct undersize bearing insert (pair) should be installed in the connecting rod.

The correct connecting rod bearing clearance is .0007" to .0028".

The crankpin diameter is 2.2483" to 2.2490".

It is important that the connecting rod bearing cap bolt nuts be drawn up to 52 to 56 foot pounds torque.

Connecting rod bearings are serviced in .001"-.002"-.010"-.012" undersize.

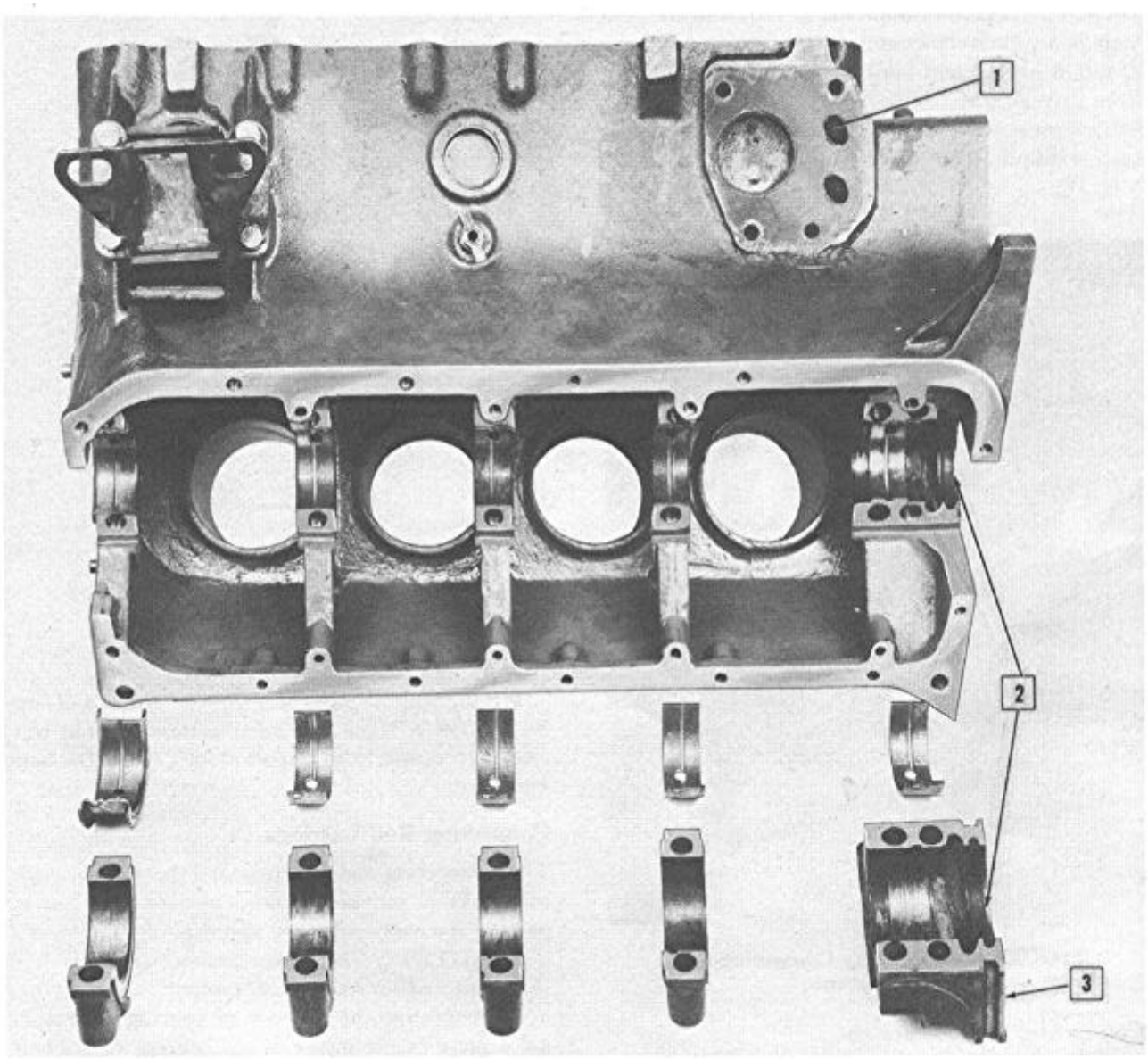
CRANKSHAFT

The crankshaft is a drop forged steel shaft, counterweighted and balanced independently. There are five main bearings and four crankpins. It is provided with an oil slinger at reat with an oil slinger at rear journal inboard of the rear oil seal.

The component parts of the crankshaft assembly are individually balanced, and then the complete assembly is balanced as a unit. Replacement of crankshaft, flywheel, or vibration damper can be accomplished without rebalancing the complete assembly.

Main Bearing Journals

Main bearing journals can be measured without removing the crankshaft from the engine block. Various gauges are available for this purpose. Always check both ends of the journal to note the taper. Then rotate the shaft 90° and measure for out of round.



1. Oil Passage, Oil Filter Supply
2. Upper and Lower Rear Main Oil Seal
3. Rear Main Oil Seal Side Grooves

FIGURE 20—*Main Bearing Arrangement*

The main bearing diameter is 2.4983" to 2.4990" and should not taper or be out of round more than .002".

Crankshaft Main Bearings

Main bearings are of the precision type having a steel back with a babbitt lining. The bearings are not adjustable. Shims should never be used and the bearing caps should never be filed.

Service bearings are supplied in .001", .002", .010", and .012" undersize.

When either half of a bearing requires replacement, a complete set should be installed. To replace the upper half of a bearing, remove the bearing cap of the bearing to be replaced. Then loosen all of the other bearing caps and insert a small pin about 1/2" long in the crankshaft oil hole. The head of this pin should be large enough so that it will not fall into the oil hole, yet thinner than the thickness of the bearing.

With the pin in place, rotate the shaft so that the upper half of the bearing will rotate in the direction of the locating tongue on the bearing.

Crankshaft Main Bearing Clearance

The standard clearance of .0006" to .0032" can be accurately checked by the use of Plastigage.

NOTE: *When checking bearing clearance, with the engine in such a position that the bearing caps support the weight of the crankshaft and flywheel, keep all main bearings tight except the one being checked. Support the weight of the crankshaft with a jack.*

Remove the bearing cap and wipe the oil from the bearing insert.

Place a piece of Plastigage across the full width of the bearing insert.

Reinstall the bearing cap and tighten 80 to 85 foot pounds torque. Then remove the bearing cap and with the graduated scale, which is printed on the Plastigage envelope, measure the width of the flattened Plastigage at its widest point. The number within the graduation indicates the clearance in thousandths of an inch. Install the proper size bearing liners (inserts) to bring the clearance to standard.

Grinding of the crankshaft may be required to accommodate the nearest undersize bearings when cleaning up a scored bearing surface.

Crankshaft End Play

The crankshaft end thrust of .003" to .007" is taken at the front or No. 1 bearing insert which is flanged for this purpose.

To check this clearance, attach a dial indicator to the crankcase and pry the shaft fore and aft with a screw driver (Fig. 21).

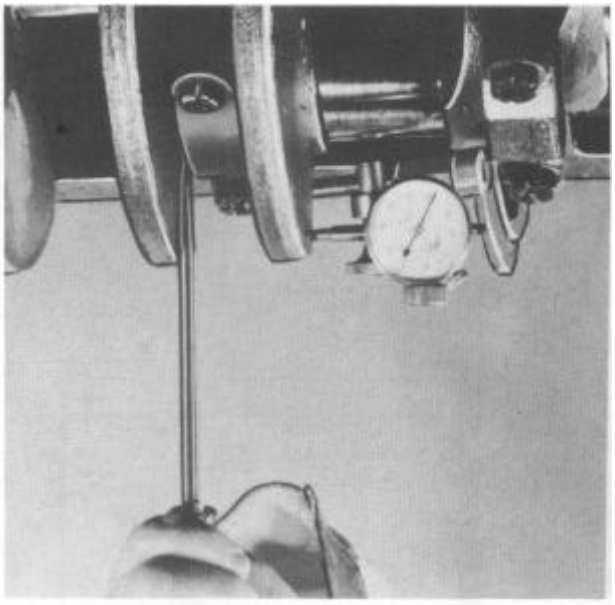


FIGURE 21—*Checking Crankshaft End Thrust*

REAR MAIN BEARING OIL SEALS

The rear main bearing oil seal is composed of two hemp packings, one in the block, the other in the cap.

The packing is driven into place with Tool J-3048-A (Fig. 22). Excess packing is cut off flush with the cap.

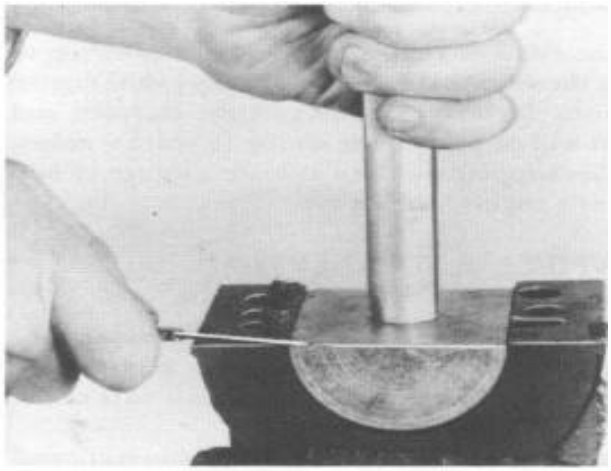


FIGURE 22—*Installing Hemp Packing Oil Seal in Rear Main Bearing Cap*

VIBRATION DAMPER

The vibration damper is balanced independently and then rebalanced as part of the complete crankshaft assembly. Service replacement dampers may be installed without attempt to duplicate balance holes present in original damper.

Figure 23 illustrates a vibration damper puller which may be fabricated locally.

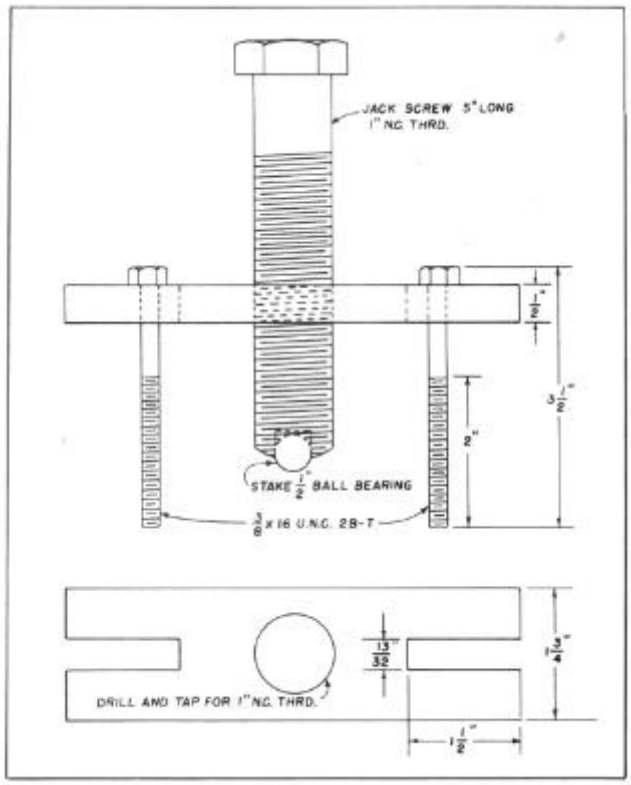


FIGURE 23—*Suggested Damper Puller*

In the event of engine noises, it is time-saving to inspect the vibration damper assembly before engine tear-down. Incorrect assembly of the cushions and rubbers will permit a noise similar to bearing noises.

Engine support cushions also are a source of misdiagnosed engine bearing rap.

FLYWHEEL AND STARTER RING GEAR ASSEMBLY

The flywheel plate is balanced as a component of the fluid coupling on Hydra-Matic transmission equipped cars. The flywheel ring gear is part of the torus cover assembly.

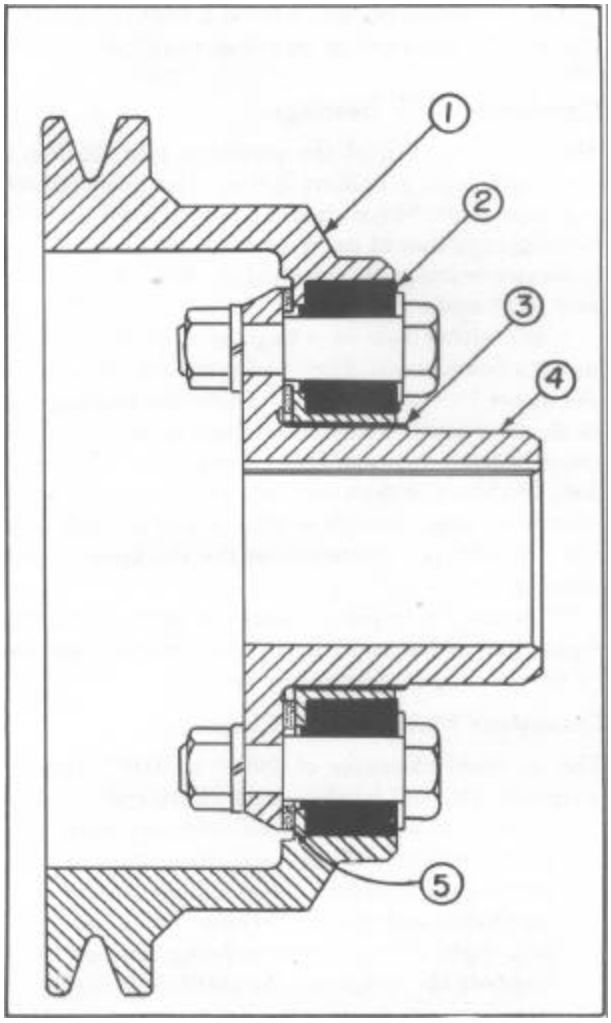
On standard and overdrive transmission equipped cars, the flywheel is balanced as an individual component and also as part of the crankshaft assembly.

Service replacement flywheels may be installed without attempt to duplicate balance holes present in original assembly.

LUBRICATION SYSTEM

The lubrication system is the full pressure type.

Pressure is supplied by a gear type, positive pressure pump mounted on the rear main bearing cap.



1. Pulley
2. Rubber Cushion
3. Rubber Friction Washer
4. Hub
5. Friction Disc

FIGURE 24—*Vibration Damper Pulley*

Oil Pump

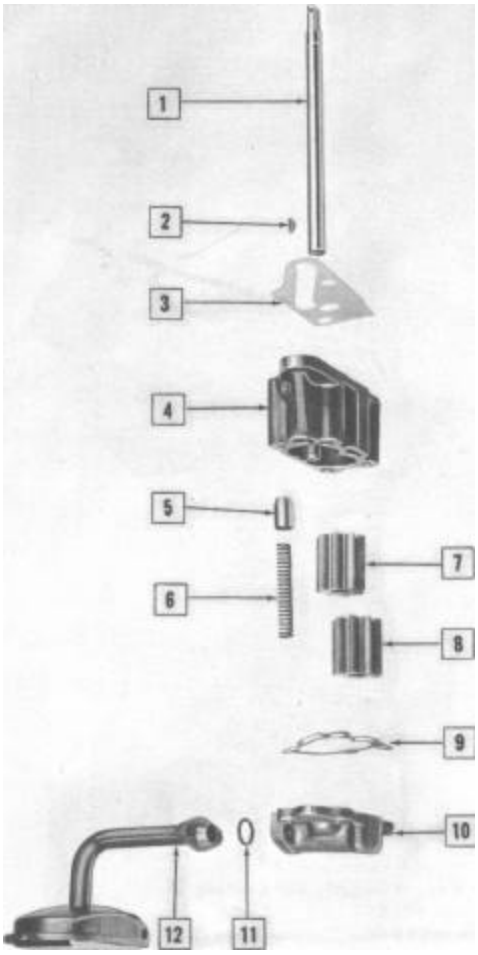
The oil pump is driven by the distributor drive shaft.

Oil pump removal or replacement will not affect distributor timing as the distributor drive gear remains in mesh with the camshaft gear.

Upon disassembly of the oil pump, locate a straight edge across the pump body and gears in their operational cavity and check the gear to cover clearance which should not exceed .004".

A clearance of .008" maximum should exist between the gears and the walls of the gear cavity opposite point of gear mesh.

NOTE: *The pump cover should be installed with pump out of engine and pump checked for freedom of operation before installation.*



1. Oil Pump Drive Shaft
2. Key
3. Pump Mounting Gasket
4. Body
5. Relief Valve Plunger
6. Relief Valve Spring
7. Drive Gear
8. Driven Gear
9. Cover to Body Gasket
10. Cover
11. "0" Seal Ring
12. Inlet Tube and Screen Assembly

FIGURE 25—*Oil Pump Assembly*

Oil Pressure Relief Valve

The oil pressure relief valve is not adjustable. A setting of 55-60 pounds pressure is built into the tension of the spring.

On the released position, the valve permits oil to by-pass through ports and a passage in the pump cover to the inlet side of the pump.

Lubrication Circuit

Oil drawn through the inlet screen and tube assembly is displaced into the pressure discharge side of pump to a port indexing with a vertical oil gallery up into the cylinder block where it indexes with a horizontal passage leading to the lower oil filter mounting adapter (Figs. 20 and 26).

Oil is returned from the oil filter to the timing chain compartment. All camshaft and main crank-shaft bearings are lubricated from the center longitudinal oil gallery. Holes drilled in the crankshaft throws afford lubrication to the connecting rod bearings. Low speed cylinder wall lubrication is obtained through small holes or channels in the parting surface of the connecting rod and bearing caps.

Throw-off oil from the connecting rods lubricates camshaft lobes and cylinder walls at higher speeds.

Passages at the front of the engine (Fig. 27) and in the camshaft thrust plate (Fig. 11) connect the main center oil gallery with the two (left and right) oil galleries to the hydraulic valve tappets.

At the rear section of each tappet oil gallery, a passage connects upward to the rear rocker arm shaft support retaining bolt hole. These bolts are drilled to permit oil flow to the rocker arm shafts, rocker arms, push rods, valve stems, and valve guides.

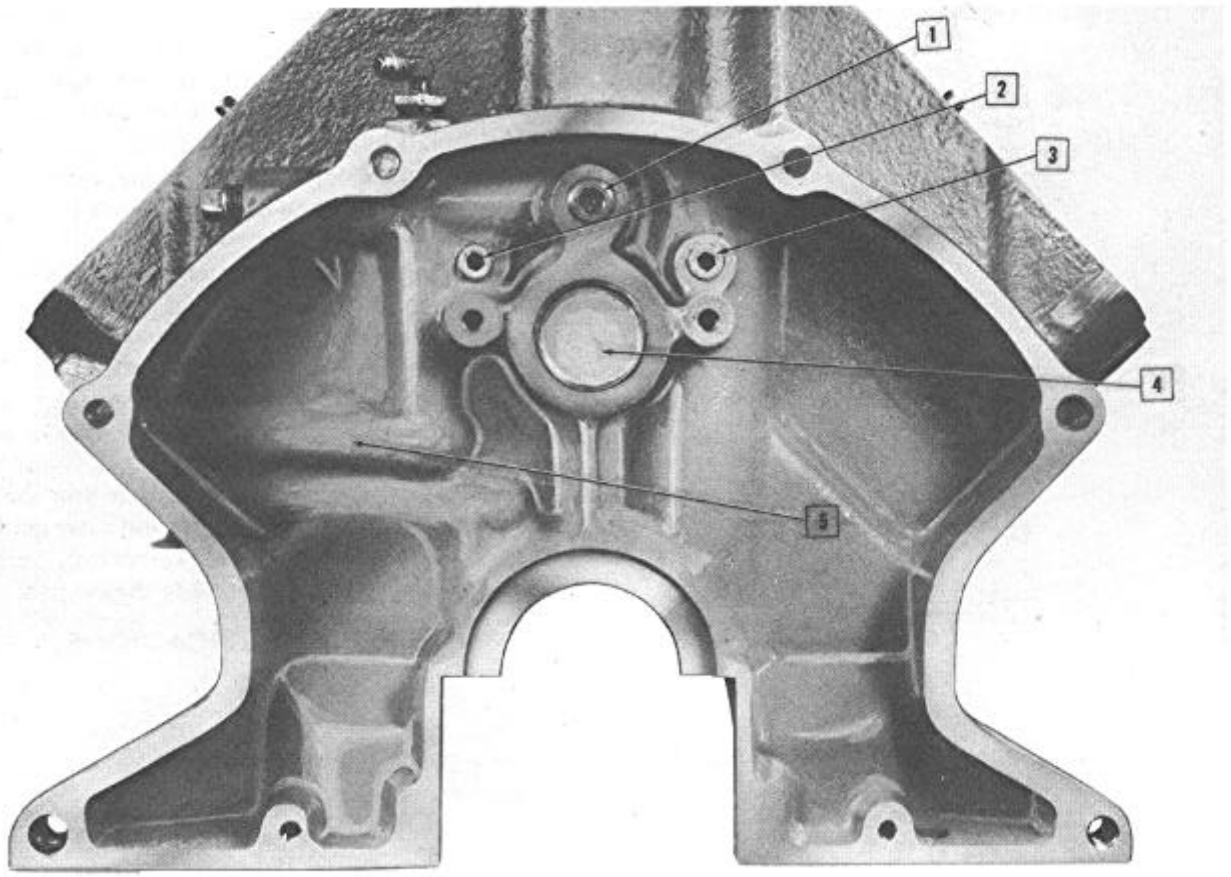
Two drain holes in the lower corners of the cylinder head casting return the oil to the oil pan.

ENGINE SPECIFICATIONS

Bore	3-1/2"
stroke	3-1/4"
Displacement	250 Cu. In.
Compression Ratio	8.0:1
carburetor	WGD—Twin-Throat
Brake Horsepower	190 @ 4900 R.P.M.
Torque	240 Ft. Lbs. @ 2000-3000 R.P.M.
Taxable Horsepower	39.2
Piston Displacement	250 Cu. In.
Valve Timing	
Intake	
Opens	12° 30' B.T.D.C.) 244°
Closes	51° 30' A.B.D.C.) Duration

PISTONS AND RINGS

Piston to Bore Clearance	
Top Land	.020"-.024"
Skirt Top	.001"-.0015"
Skirt Bottom	.0009"-.0015"
Piston Ring Gap Clearance	
Top	.010"-.020"
Center	.010"-.020"
Bottom (Steel Rail)	.015"-.055"
Piston Ring Side Clearance	
Top	.002"-.0035"
Center	.002"-.004"
Bottom	.001"-.0079"
Piston Pin to Connecting Rod	Press Fit
Piston Pin to Piston	Palm Press Fit in Piston at Room Temperature



1. Main Center Horizontal Oil Gallery Plug 2. Left Tappet Supply Oil Gallery Plug
3. Right Tappet Supply Oil Gallery Plug
4. Camshaft Rear Bearing Hole Plug 5. Oil Filter Supply Passage Boss

FIGURE 26—Rear *of Engine Block*

VALVES AND SPRINGS

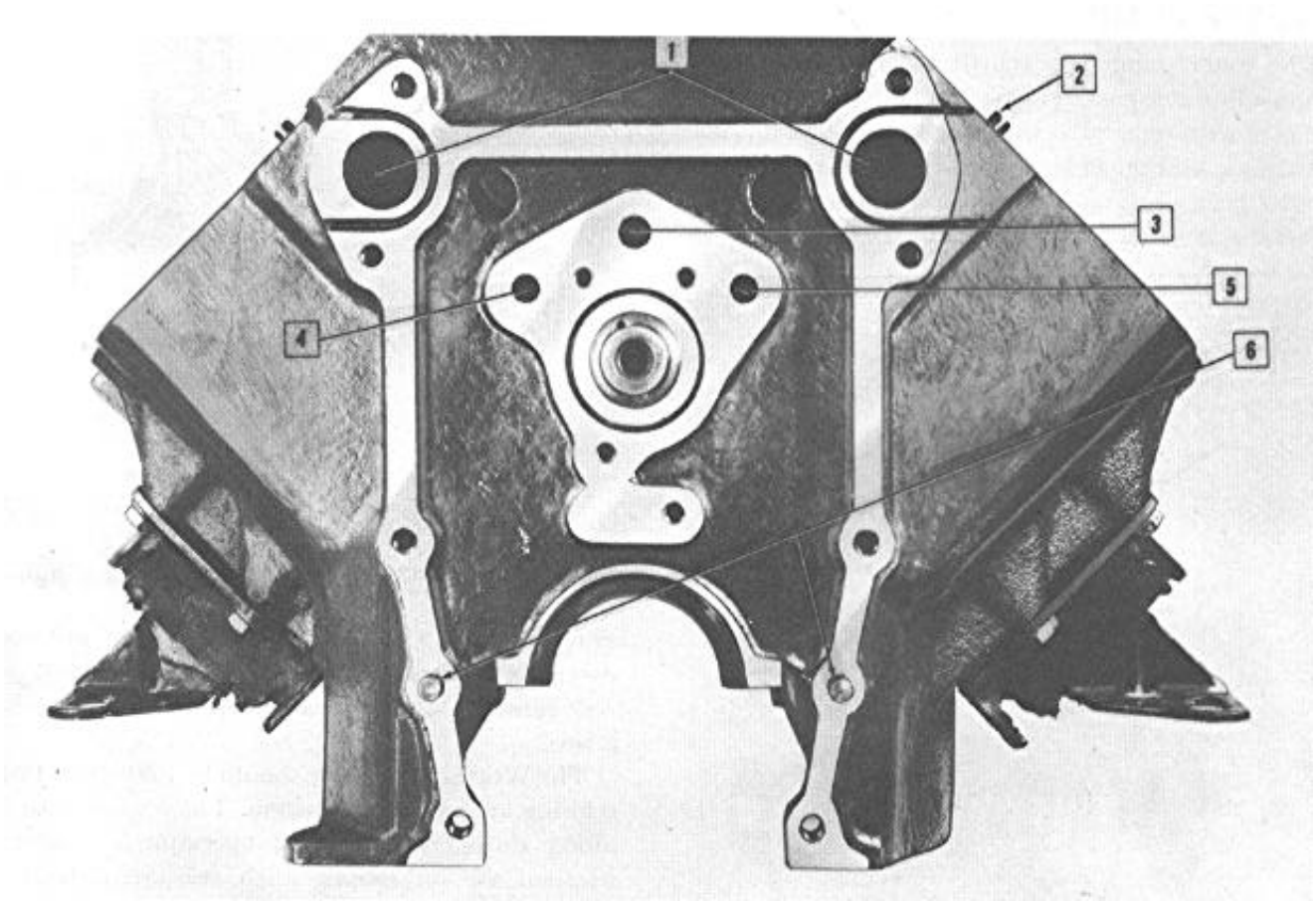
Valve Lift	.375"
Intake Valve Stem Standard Diameter	.3412"-.3417"
Intake Valve Face Angle	29°
Intake Valve Seat Angle	30°
Intake Valve Seat Width	.078"-.093"
Intake Valve Spring Tension	
Valve Closed	85-91 Lbs. @ 113/16"
Valve Open	150-160 Lbs. @ 17/16"
Intake Valve Stem to Guide Clearance	.0013"-.0028"
Valve Guide I.D.	.03430"-.03440"
Exhaust Valve Stem Standard Diameter	.3407"-.3412"
Exhaust Valve Face Angle	44°
Exhaust Valve Seat Angle	45°
Exhaust Valve Seat Width	.093"-.104"
Exhaust Valve Spring Tension	
Valve Closed	85-91 Lbs. @ 113/6"
Valve Open	150-160 Lbs. @ 17/16"
Exhaust Valve Stem to Guide Clearance .	0018"-.0033"
Exhaust Guide I.D.	.03430"-.03440"

OIL SYSTEM

Oil Pump Type	Gear
Normal Oil Pressure	10 Lbs. Min. @ 600 R.P.M.
Oil Pressure Release	55-60 Lbs.
Engine Oil Refill Capacity	5 Qts.

CRANKSHAFT AND BEARINGS

Main Bearing Diameter	2.4983"-2.4990"
Main Bearing Clearance	.0006"-.0032"
Main Bearing Cap Torque	80-85 Ft. Lbs.



1. Cylinder Block Water Supply Hole
2. Cylinder Head Locating Dowel
3. Main Center Longitudinal Oil Gallery
4. Right Hand Tappet Oil Supply Gallery
5. Left Hand Tappet Oil Supply Gallery
6. Engine Front Cover Locating Dowl

FIGURE 27—*Front of Engine Block*

Crankshaft End Play	.003"-.007"
Connecting Rod Bearing Diameter	2.2483"-2.2490"
Connecting Rod Bearing Clearance	.0007"-.0028"
Connecting Rod Cap Torque	52-56 Ft. Lbs.
Connecting Rod Side .Clearance	004"-.012"

CAMSHAFT

Camshaft End Play	.003"-.006"
Camshaft Bearing Clearance	.001"-.003"

TUNE-UP DATA

Compression Pressure Cranking Speed (Throttle Wide Open)	140 @ 315 R.P.M.
Engine Idle R.P.M. Standard and Overdrive	
Hydra-Matic—In	550
Neutral	425
With Air Conditioning	450

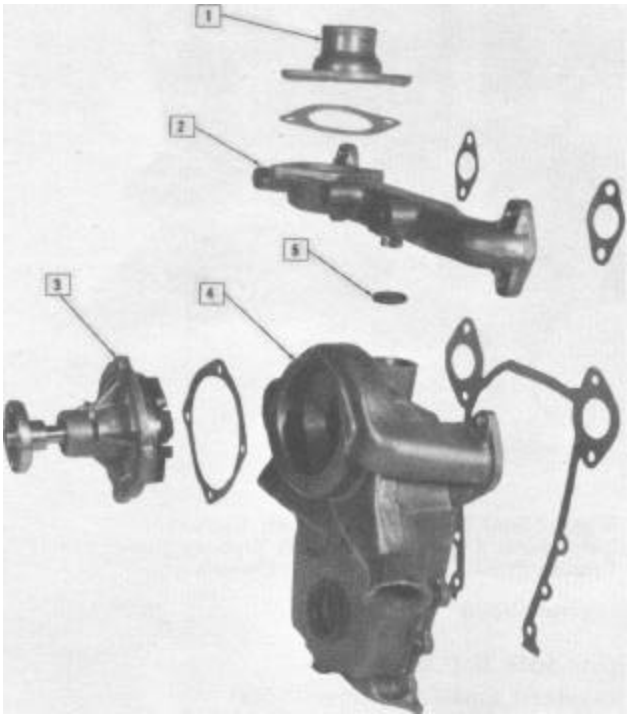
NOTE: When equipped with air conditioning, adjust idle with air conditioning unit "ON."

Ignition Timing	5° B.T.D.C.
Distributor Point Gap	.016"
Dwell or Cam Angle	28°-35°
Breaker Point Tension	19 Oz.-23 Oz.
Rotor Rotation	Left Hand, Rotor End
Spark Plugs	Auto-Lite AL-7
Gap	.035"
Torque	30 Ft. Lbs.
Cylinder Head Torque	60-65 Ft. Lbs.

COOLING SYSTEM

WATER PUMP

The water pump is a centrifugal type utilizing a non-adjustable packless type seal. The impeller housing is cast integrally with the water distribution manifold and the engine front cover. A separate cylinder head water outlet manifold which houses the thermostat is mounted to the impeller housing at the by-pass port and sealed by means of a rubber "0" ring seal (Fig. 1).



1. Thermostat Housing
2. Water Outlet Manifold
3. Water Pump
4. Water Pump Housing
5. Outlet Manifold By-pass Seal

FIGURE 1—*Water Pump and Manifold Assemblies*

The water pump discharges coolant into the distribution manifold where dual outlets supply a balanced flow of coolant into both cylinder banks. The coolant flows through the block and back through the cylinder head to the radiator inlet.

RADIATOR

The radiator is a conventional vertical flow type with the expansion tank located on top of the tube section. Although the capacities remain essentially the same, radiators with increased fin area are used on models equipped with air conditioning. On models equipped with Hydra-Matic transmission, an oil cooler is incorporated in the bottom of the radiator core to facilitate cooling Hydra-Matic oil.

Water or anti-freeze solution should, whenever possible, be added to the radiator only when the system is cool. Coolant should be added to barely cover the tubes of the core. This precaution will prevent constant loss of coolant due to expansion when heated.

The Weather-Eye valve should be fully open when refilling or flushing the system. The engine must be idling during the refilling operation to prevent trapped air interfering with the circulation or Weather-Eye operation.

A drain cock is provided on the lower tank of the radiator as well as two drain cocks located approximately in the center of the side of each cylinder bank.

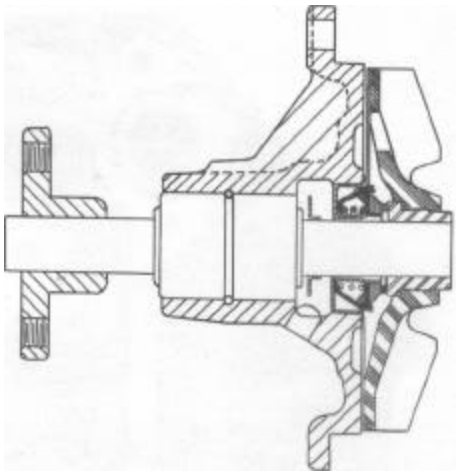


FIGURE 2—*Cross Sectional View of Water Pump*

Cooling System Capacity

The cooling system capacity is 22 quarts including heater and oil cooler.

Radiator Filler Cap

The cooling system radiator filler cap is an atmospheric vented cap. The atmospheric vent valve closes only if there is a coolant vapor flow through the vent valve of .4 to .7 cubic feet per minute. When the vent valve closes, the system will become pressurized 61/4 to 73/4 pounds per square inch. Pressurizing the cooling system increases the boiling point of the coolant.

On models equipped with air conditioning, the pressure cap pressurizes the cooling system 12 to 15 pounds per square inch.

THERMOSTAT

A thermostat is located in the cylinder head water outlet manifold to insure proper engine operating temperatures for maximum economy and engine life. A restricted passage permits the coolant to circulate through the water pump and cylinder block when the thermostat is closed, thus by-passing the radiator core.

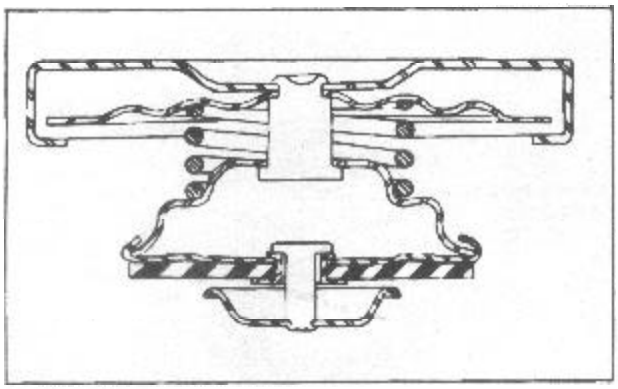


FIGURE 3—*Cross Section Radiator Filler Cap*

FAN ASSEMBLY

An "X" type fan is attached to a hub on the water pump shaft. When equipped with air conditioning, a five-blade fan is used.

FAN BELT

The cooling system fan, generator, and water pump are driven by a "V" type fan belt from a pulley on the vibration damper.

The fan belt is adjusted by moving the generator on its mounting bracket to obtain a deflection of approximately 1/2" inward at a point midway between the water pump and generator pulleys.

It is important that the proper tension of the fan belt be maintained to insure efficient operation of the cooling and electrical systems. Too much tension will cause excessive wear on the fan and generator bearings.

ELECTRICAL SECTION

The twelve-volt electrical system is outlined in the 1956 Series Technical Service Manual Supplement.

Delco-Remy electrical unit maintenance and adjustment procedures are outlined in the 1956 "Rambler" Series Technical Service Manual. Specifications follow.

DISTRIBUTOR

The distributor, Delco-Remy Model 1110863, (Fig. 1) is a 12-volt,

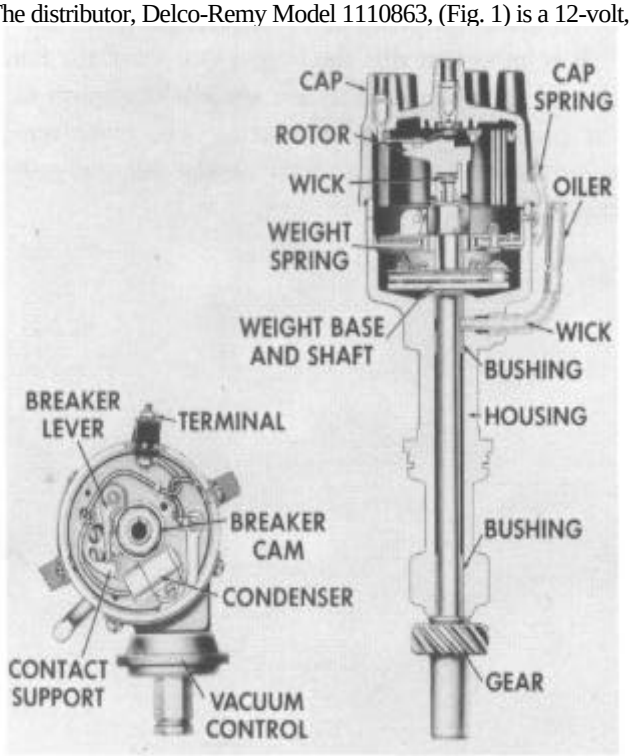


FIGURE 1—*Distributor Assembly*

A center bearing type of vacuum advance breaker plate assembly is used in this distributor. The vacuum advance breaker plate assembly consists of a movable breaker plate, a support plate, and a lubricating felt between the two plates. These parts are held together by means of retainer washers on a hub and bearing washer, spiral stabilizing spring, and retainer on the stabilizing spring post. The movable breaker plate is supported by three moulded buttons which ride on the support plate.

A vacuum control unit is mounted on the outside of the distributor housing. The vacuum control unit consists of an enclosed spring-loaded diaphragm linked mechanically to the movable breaker plate inside the distributor. The airtight side of the diaphragm is connected to the intake manifold side of the carburetor. Under part throttle operation, the intake manifold vacuum is sufficient to actuate the diaphragm and cause the movable breaker plate to move, thus advancing the spark and increasing fuel economy. During acceleration or when the engine is pulling heavily, the vacuum is not sufficient to actuate the diaphragm and the movable

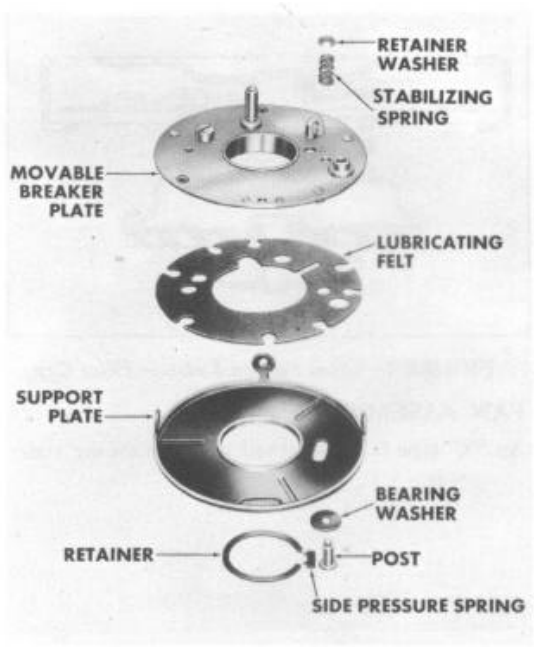


FIGURE 2—*Distributor Vacuum Advance Breaker Plate Assembly*

breaker plate is held in the retarded position by a calibrated return spring which bears against the vacuum diaphragm.

The centrifugal advance mechanism consists of an automatic cam actuated by two centrifugal weights controlled by springs. As the speed of the distributor shaft increases with engine speed, the weights are thrown outward against the pull of the springs. This advances the cam assembly and rotor to make ignition occur earlier in relation to piston position.

If centrifugal advance mechanism requires attention, remove distributor cam, centrifugal advance weights, and springs from distributor weight base.

Cleaning and Inspection

When inspecting the distributor parts, keep in mind the results of the pre-disassembly test on the distributor tester as this will indicate certain parts which probably are defective. Before inspection, clean all parts in cleaning solvent except cap, rotor, condenser, breaker plate assembly and vacuum control unit. Degreasing compounds may damage insulation of the parts listed, or in the case of the breaker plate assembly, will saturate the felt between the plates and impair its lubricating ability.

Servicing of Breaker Plate Assembly

The movable breaker plate and support plate are not serviced separately. It is necessary to replace the breaker plate assembly if either part becomes seriously damaged or worn

However, this assembly requires very little maintenance other than lubrication at regular intervals.

Disassembly of this unit should be attempted only when removed from the distributor. Otherwise, parts will drop into the distributor bowl when the stabilizing spring post assembly is released, necessitating removal and disassembly of the entire distributor. To disassemble the breaker plate assembly, release the C-shaped retainer washer and the spiral stabilizing spring from the post. The stabilizing post and bearing washer can then be removed from the support plate. Remove the retainer washer from the center bearing and separate the movable breaker plate from the support plate. (Take care that the small side spring is not dislodged from its recess in the edge of the center hole in the support plate. This spring helps to prevent any side play in the breaker plate assembly and also contributes to the over-all tension of the assembly.) Reassembly is the reverse of disassembly. After reassembly of this unit, two checks are required. The stabilizing spring tension (Fig. 3) is measured with the breaker plate assembly right side up in a horizontal position. Apply a spring scale (either push type or a pull type with a "C" hook) at the stabilizing spring post, and note the force required to start vertical movement of the post. This force should be not less than 18 ounces or more than 24 ounces. If necessary, the stabilizing spring force can be increased by carefully stretching the spring or replacing it.

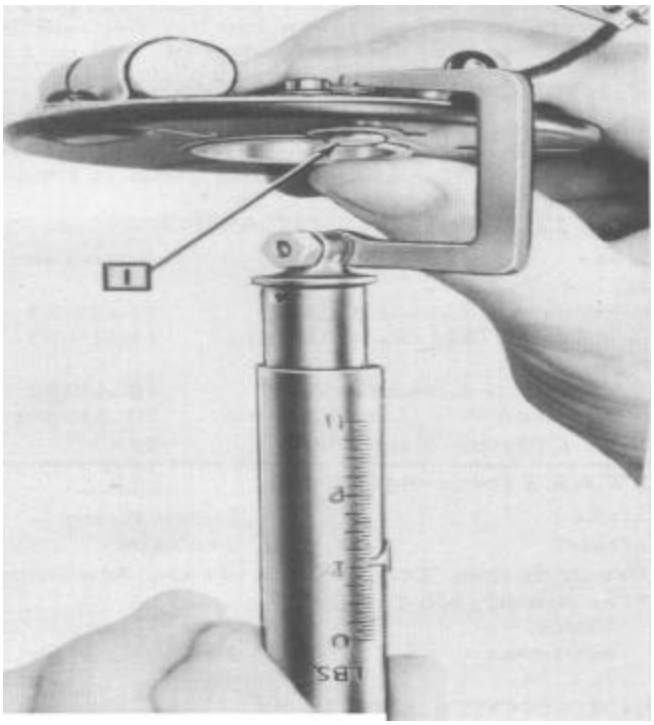
It is also necessary to check the friction between the plates. With the breaker plate assembly right side up in the horizontal position, rotate the movable breaker plate to the fully retarded position. Measure the force required to rotate the movable breaker plate from the fully retarded position (measure at the bearing to which the vacuum control units are normally connected). The pull required to rotate the movable breaker plate should not exceed 15 ounces. Readings in excess of 15 ounces may be caused by insufficient lubrication, cupped or distorted upper or lower plate, or dirt between the plates.

Whenever a complete breaker plate assembly is reinstalled in the distributor, care must be taken when attaching the vacuum control linkage. The linkage must be fitted to the connector bearing on the movable breaker plate so that there is no upward or downward thrust on the plate when the vacuum control operates. Also check the clearance, of the linkage through full travel to be sure that the condenser or condenser lead does not interfere with the operation of the assembly.

Replacing Distributor Contact Points

When replacing distributor contact points, particular care should be given to:

Assembly of contact support
Assembly of breaker lever and breaker spring



l. With "C" Hook on Top of Post, Note Scale Reading at Start of Post Movement

FIGURE 3—*Checking Breaker Plate Stabilizing Spring Tension*

Lubrication

The hinge cap oiler should be filled with light engine oil at each vehicle lubrication period. Every 5000 miles add a trace of Delco-Remy Cam and Ball Bearing Lubricant or equivalent to the breaker cam, place three to four drops of light engine oil on the wick in the cam shaft under the rotor, one to two drops on the breaker lever pivot, and three to four drops to the felt wick between the plates of the vacuum advance assembly. Wipe off any excess oil appearing on the breaker plate.

In addition to lubrication, the distributor requires periodic inspection of the cap and rotor, wiring, breaker points, and timing.

IGNITION RESISTOR

A Delco-Remy resistor, Model 1927809, is used in the

ignition primary circuit to increase coil efficiency for starting and permits a smaller size coil for operation. It has a resistance value of 1.40 to 1.62 ohms.

IGNITION TIMING

The distributor can be rotated in its mounting to obtain ignition timing. Correct timing is 5° B.T.D.C. at idle speed. Firing order is 1-8-4-3-6-5-7-2.

BATTERY SPECIFICATIONS

Make	Auto-Lite
Model	
With Air Conditioning	11-HS-60
Without Air Conditioning	11-HS-50
Rating	
With Air Conditioning	60 Ampere Hours
Without Air Conditioning	50 Ampere Hours
No. of Plates (Each Cell)	11

STARTING MOTOR

Make	Delco-Remy
Model	1107648
Brush Spring Tension	35 Oz. Minimum
Free Speed (No Load)	
Volts	10.3
Amperes	75
R.P.M.	6900

SOLENOID SWITCH

Model	1119760
Hold-in Winding	18-20 Amperes at 10 Volts
Both Windings	72-76 Amperes at 10 Volts

SPARK PLUGS

Type	AL-7 (Auto-Lite)
Torque	30 Ft. Lbs.
Gap	.035"
Thread Reach	7/16"

DISTRIBUTOR SPECIFICATIONS

Model	1110863
Rotation	Left Hand (c.c.) @ Rotor End
Point Opening	.016"
Cam Angle	28°-35°
Breaker Lever Tension	19-23 Ozs.
Condenser Capacity	.18-.23 Microfarads
Centrifugal Advance	

	Engine R.P.M.	Engine Degrees
Start	700	1-5
Intermediate	800	4-8
Intermediate	1600	14-18
Maximum	2250	22-26

VACUUM CONTROL

Model	1116095
Inches of Mercury to Start Advance	5-7
Inches of Mercury for Full Advance	11-11.5
Maximum Advance	20° (Engine Degrees)

GENERATOR SPECIFICATIONS

Make	Delco-Remy Without Air Conditioning	Delco-Remy With Air Conditioning
Model	1100324	1103011
Brush Spring Tension	28 Oz.	28 Oz.
Cold Output	25 Amperes @ 14.0 Volts, 2780 R.P.M.	30 Amperes @ 14.0 Volts, 2150 R.P.M.
Field Current Draw	1.5-1.62 Amperes @ 12 Volts, 80°F.	1.48-1.62 Amperes @ 12 Volts, 80°F.

VOLTAGE AND CURRENT REGULATOR SPECIFICATIONS

Make	Delco-Remy Without Air Conditioning	Delco-Remy With Air Conditioning
Model	1119122	1119003
Cut Out Relay Air Gap	.020"	.020"
Cut Out Relay Point Opening	.020"	.020"
Cut Out Relay Closing Voltage	11.8-13.5	11.8-13.5
Voltage Regulator Air Gap	.075"	.075"
Voltage Regulator Normal Range	13.8-14.8 Volts	13.8-14.8 Volts
Current Regulator Air Gap	.075"	.075"
Current Regulator Allowable Limits	23-27 Amperes	27-33 Amperes

CARBURETION

CARBURETION CARBURETOR SPECIFICATIONS CARTER MODEL WGD 2352 S

DIMENSIONS	
Flange Size	1-1/4" Dual Four Bolt
Primary Venturi	1-1/32,
Secondary Venturi	21/32
Main Venturi	1-3/16"
FLOAT LEVEL	7/32"—T-109-106
VENTS	Outside None, Inside—Balance Vent Tube Above Choke Valve
GASOLINE INTAKE	Size 34 Drill in Needle Seat
LOW SPEED JET TUBE	
Jet Size	No. 66 Drill
By-pass	No. 54 Drill
Air Bleed	No. 54 Drill
Economizer	No. 56 Drill
IDLE PORT (Upper Port)	Slot Type .160" x .030"
IDLE PORT OPENING	Top of Port .109" to 115" Above Top Edge of Tightly Closed Throttle Valve
LOWER PORT (For Idle Adjusting Screw)	.065" to .069" Diameter
IDLE SCREW ADJUSTMENT	1/2 to 11/2 Turns Out. For Richer Mixture, Turn Screw Out
IDLE SPEED MINIMUM R.P.M.	
Standard and Overdrive	550
Hydra-Matic—In Neutral	425
With Air Conditioning	450
NOTE: When equ tioning, adjust idle unit "ON."	uipped with air condie with air conditioning

NOTE: When equuipped with air cond- tioning, adjust idle with air conditioning unit "ON."

MAIN NOZZLE	Installed Permanently. Do Not Remove
ANTI-PERCOLATOR	No. 71 Drill
METERING ROD	Vacumeter Type
Economy Step	.0605"
Middle Step Tapers to	.056"
Power Step	.040"
METERING ROD JET	.086"
METERING ROD SETTING	After Accelerator Pump Adjustment, Rods Must Bottom in Jet Well With Tight Closed Throttle Valves While Vacumeter Link Contacts Metering Rod
ACCELERATING PUMP	Plunger Type Mechanically Operated, Discharge Jet (Twin) Size No. 72 Drill; Intake Ball Check in Plunger Shaft. Discharge (Needle Seat) Size No. 50 Drill
ACCELERATING PUMP ADJUSTMENT	Pump Arm Boss Parallel to Dust Cover with Tight Closed Throttle Valves. Adjust by Bending Upper End of Throttle Connector Link
CHOKE	Carter Climatic
CHOKE SETTING	Index
HEAT SUCTION HOLE	Size No. 42 Drill
FAST IDLE ADJUSTMENT	.023" Between Throttle Valve and Bore (Side Opposite Idle Port) With Choke Valve Fully Closed
UNLOADER ADJUSTMENT	3/16" Between Upper Edge of Choke Valve and Side of Air Horn With Throttle Wide Open
VACUUM SPARK PORT .	Horizontal Slot .040" x .130"
Location of Bottom of Port Above Top Edge of Throttle Valve in Closed Position	.018"-.024"

CLUTCH SECTION

This series with standard or overdrive transmission incorporates a 10" clutch plate assembly. A beam type clutch release linkage is also used.

CLUTCH SPRING SPECIFICATIONS

No. of Springs	9	
Compressed Length	155 Lbs.	5 @ 11%6"

CLUTCH COVER LEVER HEIGHT

Levers are adjusted flush with the hub. (Use gauge plate J-1507 or J-5490.)

CLUTCH PEDAL FREE PLAY

Maintain 1/2" to 3/4" pedal play by varying the length of beam to throw out lever rod.

CLUTCH PEDAL TO BEAM ROD ADJUSTMENT

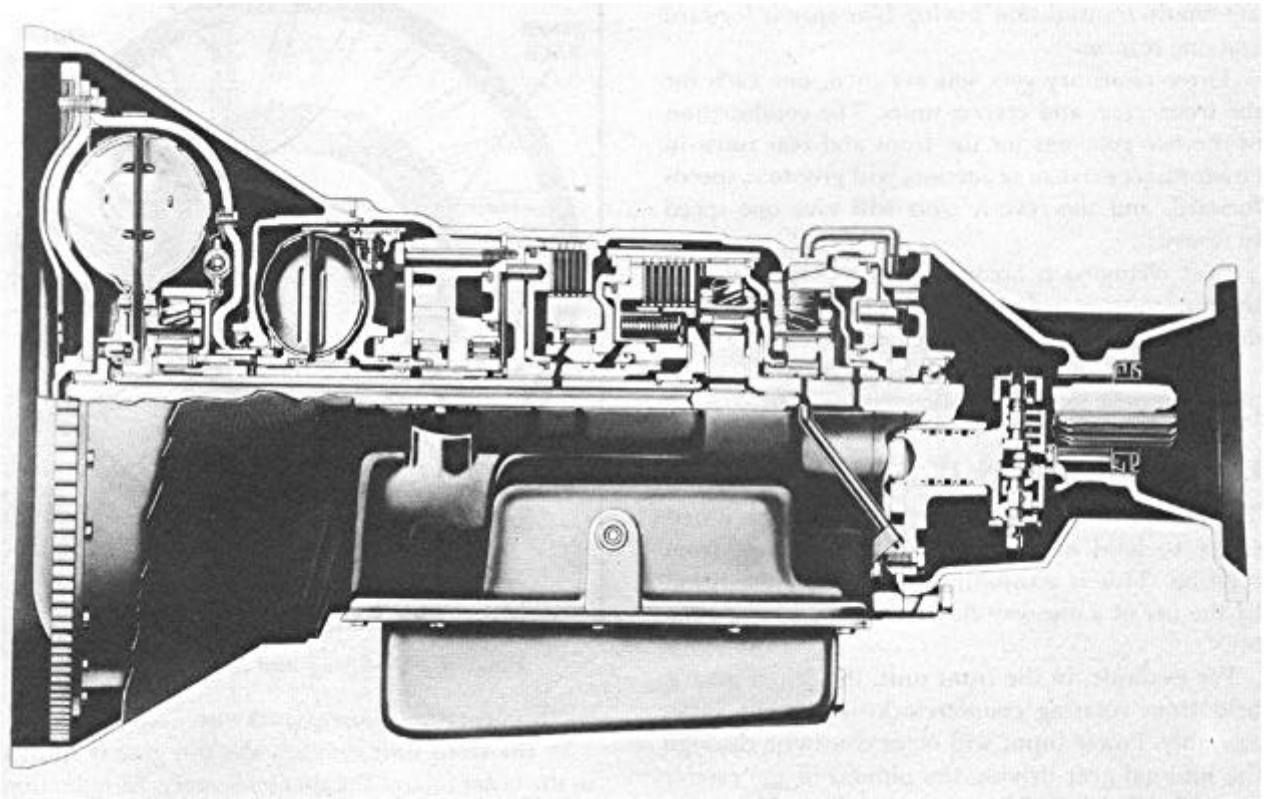
The clutch pedal to beam rod adjustment (adjusted in production) is made to provide proper leverage. The outer rear edge of the beam lever should be located 3/8" forward of the rear edge of the beam bracket with the clutch pedal against the floor panel. The pedal to beam rod should not be disturbed at time of service.

TRANSMISSION AND OVERDRIVE

The standard and overdrive to the units installed on the 1956 transmissions 60 Series. incorporated on this series are identical

Refer to the 1955 Technical Service Manual for service procedures.

HYDRA-MATIC TRANSMISSION



Cross Section View of the 1956 Series Flashaway Hydra-Matic Transmission

GENERAL DESCRIPTION

The Flashaway Hydra-Matic drive consists of a fluid coupling combined with a hydraulically controlled automatic transmission having four speeds forward and one reverse.

Three planetary gear sets are used, one each for the front, rear, and reverse units.. The combination of the two gear sets for the front and rear units in either direct drive or reduction, will give four speeds forward, and the reverse unit will give one speed in reverse.

Gear changing is accomplished automatically by the transmission in accordance with the performance demands or road conditions encountered.

Reduction and direct drive is achieved in the planetary gear set in the following manner:

HOW REDUCTION IS ACCOMPLISHED

To obtain reduction in a planetary gear set, it is necessary to hold one member of the gear set from rotating. This is accomplished in this transmission by the use of a one-way clutch called a sprag assembly.

For example, in the front unit, the center gear is held from rotating counterclockwise by the sprag assembly. Power input will enter clockwise through the internal gear driving the pinions of the carrier assembly clockwise. The pinions will tend to drive the center gear in the opposite or counterclockwise direction. However, this movement is prevented by the one-way sprag assembly. The pinions and carrier assembly can then travel in only one direction, clockwise and in reduction around the center gear which is held stationary.

The Sprag Assembly

The sprag assembly consists of inner race, outer race, and sprags (Fig. 1).

The outer race is anchored to the transmission case. The inner race is attached to the planetary gear set. As the driving member of the gear set turns clockwise, the sprags will fall free and let the inner race and driving member turn clockwise. However, if the driving member attempts to turn counterclockwise, it is prevented from doing so by the sprag assembly in the following manner:

When a counterclockwise rotation is imparted to the inner race of the sprag assembly, the sprags or wedges will be forced against the outer race by action of the inner race. This locking or wedging action is due to the force expended by the driving members, forcing the sprags or wedges into an area which is too limited to accommodate them. The sprag assembly will then keep one member of a planetary gear set from rotating counterclockwise.

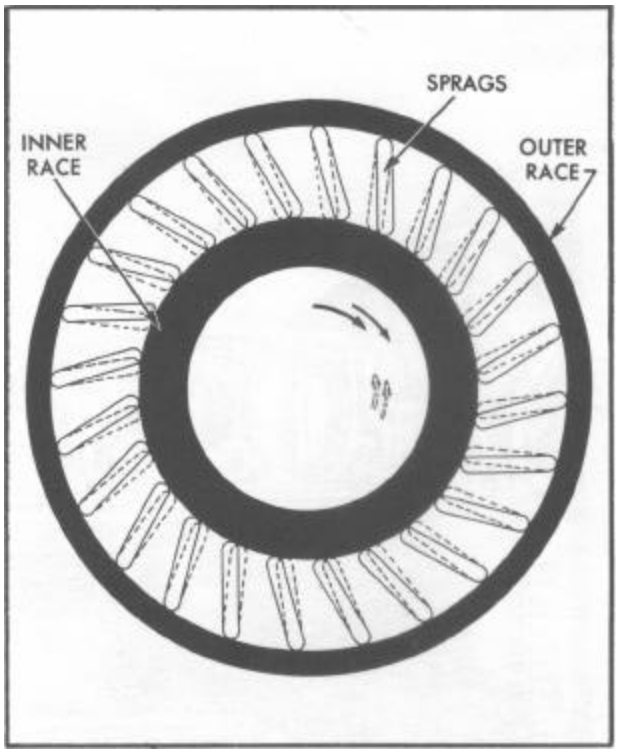


FIGURE 1—*Sprag and Race Assembly*

In the front unit gear set, the sun gear is splined to the inner race of the sprag assembly. In reduction, the sun gear is held. The power input is to the internal gear and the output is from the planet carrier.

HOW DIRECT DRIVE IS ACCOMPLISHED

To effect direct drive, it is necessary to lock together two members of a planetary gear set. Direct drive in the Flashaway Hydra-Matic is produced in two ways:

Front Unit—Fluid

Direct drive in the front unit is obtained by the use of a fluid coupling. The fluid coupling consists of a small engine driven front unit drive torus member, which is splined to the internal gear of the front unit gear set. The front unit driven torus member is splined to the sun gear of the front unit planetary gear set and to the inner race of the sprag assembly. Thus when the small coupling is filled, the internal and sun gear are locked together through oil giving direct drive in the front unit. In direct drive, the front unit sun gear is allowed to turn clockwise by the sprag.

The oil used to feed the front unit coupling is controlled hydraulically in the control valve assembly. The coupling is filled in second and fourth gear for direct drive and empty in first and third gear.

Rear Unit—Clutch

To obtain direct drive in the rear unit, a multiple disc clutch will lock the internal gear mechanically. The application of the rear clutch is controlled hydraulically.

REVERSE UNIT

The reverse unit consists of a reverse planetary gear set with a cone clutch which holds the reverse internal gear. The reverse cone clutch is engaged by a piston which is oil applied and spring released.

Located in the reverse carrier assembly is a parking pawl sprocket. This sprocket has external teeth which receive a parking pawl and provide a positive lock when the selector lever is in the "P" (Park) position. In the park position, it will be possible to start the engine or leave the car on an incline when the engine is running.

NEUTRAL CLUTCH

The sprag assemblies keep the drive line from rotating counterclockwise. However, for neutral and reverse, the rear unit must rotate in a counterclockwise direction. This is accomplished by means of a neutral clutch.

The neutral clutch operates as a connection between the outer race of the rear sprag assembly and the transmission case through the multiple disc clutch. When the plates are applied, there is a solid connection between the race and the case. When the clutch plates are released (reverse and neutral) the connection is broken between the sprag clutch and case. The sprag clutch is non-effective allowing the rear unit to rotate counterclockwise for neutral and reverse.

OVERRUN CLUTCH

Reduction is obtained by holding one member of the front and rear planetary gear sets from rotating counterclockwise only. This is accomplished by the use of a sprag one-way clutch. The held member is then free to rotate clockwise even though the gear set is in reduction.

A condition might exist where the rear wheels would drive the engine (Zero throttle downhill). In this case, the power flow would be from the rear wheels to the output shaft into the rear unit. Power flows from the rear unit through the intermediate shaft to the drive torus. The carrier of the front unit is attached to the torus and thus becomes the drive member of the front planetary gear set.

The power flow in the front gear set would be reversed with the input on the carrier, the internal gear held by the engine, and the sun gear free to rotate clockwise at a faster rate or overrun. This, in effect, would put the front unit gear set in neutral condition.

To prevent the center gear from overrunning, a simple disc called an overrun clutch is used, which operates when overrun braking is needed (Drive 3 Range—Zero throttle). The overrun clutch disc is splined to the driven torus member in the front unit, which is also splined to the center gear of the front unit.

The overrun clutch is actuated by an oil applied piston and will compress the overrun clutch against spring pressure locking the center gear to the case. This will retain the front unit center gear from rotating counterclockwise or overrunning.

GOVERNOR

The governor is located in the rear pump housing and is driven by the rear pump driven gear which fits into the governor tower. When the vehicle is started in motion, the governor starts revolving.

Centrifugal force causes the governor plungers to move away from the center. This opens a passage allowing oil to flow into the regulated governor pressure lines. At the same time, the regulated governor pressure exerts force on the plungers to move them toward the center. Therefore, we have governor to exhaust any pressure not required to balance centrifugal force pressures that will vary with vehicle or output shaft speed.

G-1 pressure rises faster than G-2 pressure, as the speed increases, because the G-1 unit has greater weight than the G-2 unit, therefore G-1 pressure will reach main line pressure before G-2.

The G-1 weight has a one-pound spring holding the weight in the open position to produce an initial G-1 pressure of five pounds per square inch. G-1 pressure is directed to the G-5 valve, to the 2-3 governor valve, to the 3-4 shift valve, and the reverse blocker. G-2 pressure is directed to the 2-3 shift valve and to the 3-4 governor valve.

FRONT PUMP

The front pump is a variable output vane type pump which automatically regulates the output according to the need of the transmission. It consists of the pump body, cover, slide, rotor, seven vanes, two guide rings, and two priming springs.

Output of the pump is controlled by the position of the slide. The slide is held up by the priming spring for maximum output when the pump is started. When the pump is operating, the position of the slide is controlled by the pressure regulator valve. When the output pressure is low, the pressure regulator valve is pushed deep into its bore in the pump, directing pressure below the slide to hold

it up for maximum output. When pressure becomes high, the pressure regulator valve is forced outward, directing oil pressure above the slide to push it down and decrease the output.

When the slide is up, it delivers maximum output. When the slide is centered, output is zero.

The torus check valve is held against the pump slide by spring pressure. When the slide moves down, oil will pass through the torus check valve and into the cooler passage from the cooler to the torus feed passage. If the cooler should become inoperative, oil from the torus check valve will unseat a ball check held in position by spring pressure and flow into the torus feed passage.

REAR PUMP

The rear pump is of the fixed displacement gear type and is driven by the output shaft; therefore, rear pump capacity will vary with car speed. At idle, the rear pump is not supplying oil to the transmission and all oil pressure will be supplied by the front pump.

As the speed of the car increases, the oil from the rear pump will flow together with the front pump oil through a passage in the case. Much of the oil pressure requirements of the transmission will be taken over by the rear pump and the front pump will compensate by reducing its output.

The basic requirements of a need for a rear pump was the necessity for oil pressure to supply the transmission in the event of a need for a push to start the vehicle.

ACCUMULATOR

To effect a smooth apply of the rear clutch, 2-3 oil being directed to the rear clutch apply piston is also directed to an accumulator. The accumulator contains a piston with heavy springs holding the piston in the down position which is opposing 2-3 oil directed to the other side of the piston. Oil from the 2-3 shift valve will move the accumulator piston against spring and oil pressure and also apply the rear clutch.

Since the flow of oil to the accumulator and clutch apply piston is restricted, the accumulator is capable of collecting any oil that does flow through the restriction at the pressure valve which is required to move it. This maintains the pressure acting on the clutch piston, at a value below line pressure, until the accumulator is full. At that time, the pressure rises to line pressure. The engagement of the clutch must be completed before the accumulator is full to produce smooth shifts at the lower apply pressures.

Clutch apply requirements will vary with throttle and load conditions. The accumulator is a factor in rear clutch engagement; its operation is varied accordingly by directing T.V. pressure to assist the spring in resisting 2-3 oil pressure. This T.V. pressure to the accumulator is regulated by a trimmer valve located in the accumulator body, held in the open position by spring and closed by T.V. pressure, thereby regulating T.V. pressure to the accumulator as the need requires.

LOW SERVO

The low servo located in the accumulator body is used to apply the low range band when the selector lever is moved to the "L" range position. Oil is directed from the manual valve to the servo to apply the low range band which holds the rear unit internal gear and prevents the vehicle from overrunning the rear sprag clutch when "L" range is being used for engine braking.

HOW TO OPERATE THE FLASHAWAY HYDRA-MATIC

The Flashaway Hydra-Matic drive is convenient to operate by placing the selector lever in the desired speed range. These positions are shown on the indicator which is illuminated when the instrument lights are on (Fig. 2).

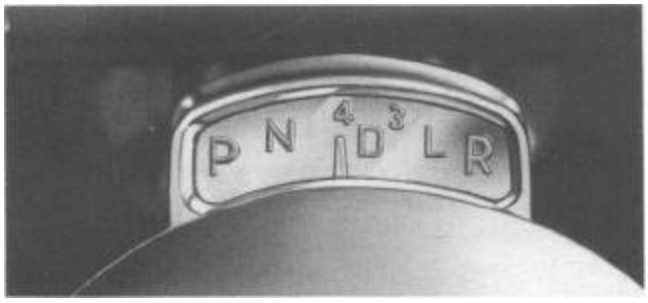


FIGURE 2—*Selector Lever Indicator*

The speed range positions are designated as follows:

P —Parking and starting
N —Neutral and starting
D-4—For all normal forward driving
D-3—For faster acceleration and driving in congested t raffic
L —For controlled power
R —For reverse

NOTE: **Selector lever must be raised to engage parking and reverse position.**

ENGINE STARTING

The safety starter switch is mounted on the starter switch

bracket located at the lower end of the steering gear jacket tube. Contact can only be made in the "P" (Park) or "N" (Neutral) positions. Press the foot accelerator pedal, part way to the floor board once and release (in order to set the Automatic Choke on fast idle).

Turn the ignition switch "ON" and lift the selector knob toward the steering wheel to engage the starter.

NOTE: Do not start a cold engine with throttle wide open (accelerator pedal fully depressed). This overrules the automatic choke and prevents the engine from breathing in a mixture rich enough to start.

If engine should flood (because of attempting to start with ignition off, or because of "pumping" accelerator) operate engine starter with accelerator pedal fully depressed. Press accelerator down slowly to reduce tendency for more raw gasoline to be pumped into the manifold. Opening throttle wide overrules choke mechanism and opens choke valve, thereby admitting more air so that starting becomes possible.

In cold weather (0°F. or colder) the engine must idle with the selector lever in "P" (Park) or "N" (Neutral) position until engine and transmission are warmed up.

This can more safely be done in the "P" (Park) position as the transmission will then keep the car from rolling on a grade or incline. When the engine is cold and running on fast idle, the car will tend to creep when the selector lever is moved to a driving position. A slight application of the foot brake or hand brake will hold the car until motion is desired.

OPERATING IN "D" RANGE

"D" Range has two positions, Drive 4 and Drive 3. The selector lever can be moved at will from one position to the other at any car speed on dry roads where traction is good. Drive 4 is provided for all normal forward driving; it reduces engine speed, provides better driving comfort and improves fuel economy. When driving in this range at a car speed of less than 65 M.P.H., extra performance can be obtained by depressing the accelerator pedal. This will cause the transmission to downshift into third speed. The car speed determines the amount the accelerator pedal must be depressed to cause this shift. At a speed of 35 M.P.H. or less, the accelerator pedal need only be partially depressed to cause the shift and at speeds of 35 M.P.H. to 65 M.P.H., it is necessary to completely depress the pedal. The transmission will automatically return to fourth speed as car speed is increased or the accelerator pedal is released.

Drive 3 is provided for improved performance at medium car speeds and is very useful when driving in congested traffic. In this range, the transmission is prevented from shifting into fourth speed (except at very high car speeds). In effect, it becomes a three speed transmission in Drive 3 Range. It is also effective when ascending or descending long mountain grades.

When driving the car in either Drive Range at a car speed of less than 24 M.P.H., an extra burst of speed can be obtained by completely depressing the accelerator pedal. This will cause the transmission to shift down to second speed. The transmission will automatically return to third or fourth speed, depending on the Drive Range being used, as the car speed increases, or pedal is released.

Variable shifting events from first to second, second to third, third to fourth, (Direct Drive) will occur depending on the amount the accelerator pedal is depressed.

CAUTION: Do not coast with the selector lever in "N" (Neutral) position. It is unlawful in some states and sometimes is harmful to the transmission.

FORCED DOWNSHIFT

To obtain extra power or acceleration when driving in D-4, D-3 or "L" range, depress accelerator pedal completely.

When in D-4 Range and with a car speed of less than 60 M.P.H., transmission will shift down to third speed.

When in D-3 range and with car speed of less than 20 M.P.H., transmission will shift down to second speed.

STOPPING THE CAR

Leave the selector lever in the driving position selected and release accelerator pedal. The engine is then left "in gear" which helps to slow down the car. For further stopping effort, apply the brakes in the conventional manner.

CAUTION: When the driver leaves the car with the engine running, the selector lever should always be placed in the "P" (Park) position.

This precaution prevents movement of the car, should the accelerator pedal be accidentally depressed by a passenger and will also keep the car from rolling on a down grade or incline.

OPERATING IN "L" RANGE

Low Range prevents the transmission from shifting above 2nd speed (unless the car exceeds approxi-

mately 35 M.P.H.). Low range is provided for pulling through deep sand or snow and ascending or descending steep grades when traffic signs call for placing the transmission in first or second gears (keep below 35 M.P.H. to avoid a 2-3 shift).

The control lever can be moved from "D" to "L" Range at any car speed. This shift into low will not occur at a car speed above 43 M.P.H. Release the accelerator pedal when moving the selector from either of the two "D" positions to "L."

CAUTION: *The change from either of the two D positions to L should only be made on dry roads when traction is good. It is not recommended to change to L on slippery roads since this change could induce a skid. On slippery roads, safety demands that the car speed be reduced by judicious use of your brakes.*

Release the accelerator pedal when moving the selector lever from either of the two D positions to L.

REVERSE

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

PARKING

For additional safety when parking, turn off ignition key and move selector lever to R position. When parking on an incline, hold car with foot brake a few seconds to permit full engagement of transmission.

HOLDING CAR ON HILLS

It is possible to hold the car stationary on slight upgrades by depressing accelerator pedal slightly with selector lever in a "D" range. The effect is the same as slipping a conventional clutch, with the difference that in the Hydra-Matic, the fluid coupling does the "slipping," without injury to the mechanism if done for only limited periods of time. For longer periods or on steep hills, this practice is not recommended.

PUSHING TO START ENGINE

If it should become necessary to start the engine by pushing the car, this can be done in a manner equivalent to that used in a car with 3 speed transmission. Push car in Neutral until a speed of 20 M.P.H. or more is reached, turn on the ignition, then move selector lever to a "D"' range (not to "L"). Under these conditions, the engine will be engaged in fourth gear and ordinarily will start within a few seconds.

It is better to push than to tow the car, to avoid the possibility of sudden acceleration, after the engine starts, causing a collision with the car ahead.

CAUTION—If it becomes necessary to tow or push the car for distances greater than necessary to start a normally operating engine, a speed between 15 and 25 M.P.H. should be maintained. Towing or pushing under these conditions will be satisfactory assuming the Hydra-Matic transmission has been operating satisfactorily AND assuming the car mileage is in excess of 1000. If transmission has not been operating properly, the car should be towed ONLY with rear wheels lifted off the ground.

TOWING THE CAR

Disconnect the torque tube and propeller shaft at the transmission or raise the rear wheels off the ground to prevent possible damage to the transmission. If the torque tube and propeller shaft are disconnected, for towing, make certain that oil does not leak from the rear bearing retainer.

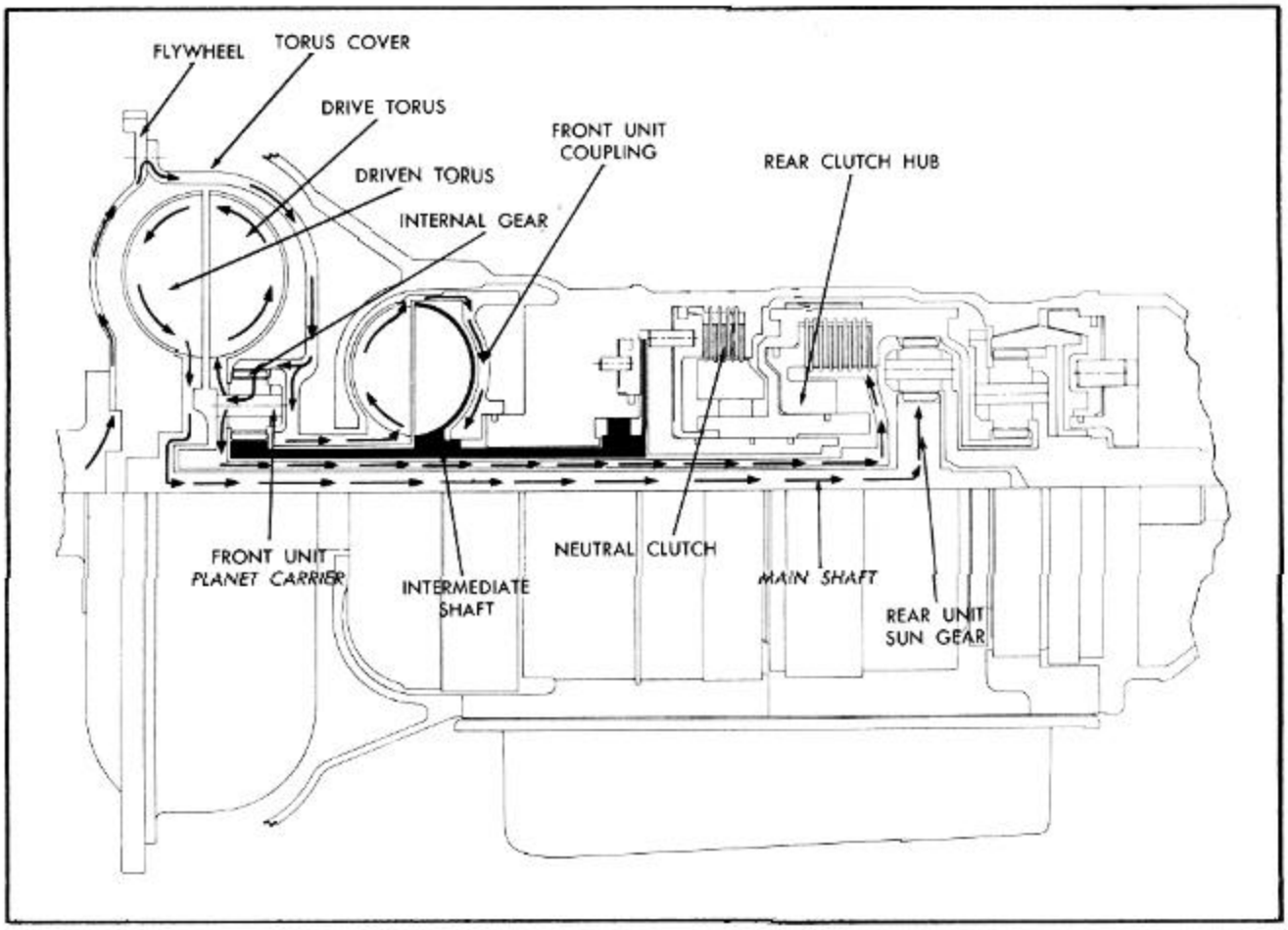


FIGURE 3—*Power Flow—Neutral Engine Running*

FRONT UNIT (REDUCTION)		NEUTRAL CLUTCH	REAR UNIT (NEUTRAL)	
Sprag	On	Released	Sprag	Off
Front Coupling	Empty		Rear Clutch	Off

NEUTRAL-ENGINE RUNNING

In neutral with engine running, the front unit is in reduction and the rear unit is in neutral.

Power flows mechanically from the flywheel to the torus cover and to the internal gear which is attached to the torus cover. At the internal gear, mechanical power divides.

Part of the power is directed into the front unit coupling. However, in neutral, the front unit coupling is empty and no power is transmitted to the front unit driven member.
Power is also directed from the internal gear to the carrier assembly of the front unit where it divides and is directed to the rear unit in two ways.

Fluid

Since the front unit is in reduction, the front unit carrier will be rotating at a slower rate. The carrier is attached to the drive torus member, which through oil will drive the driven torus member. In turn, the driven member drives the connected main shaft and rear unit sun gear. At this point, power stops, for the rear unit is in neutral because the neutral clutch is released.

Mechanical

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

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

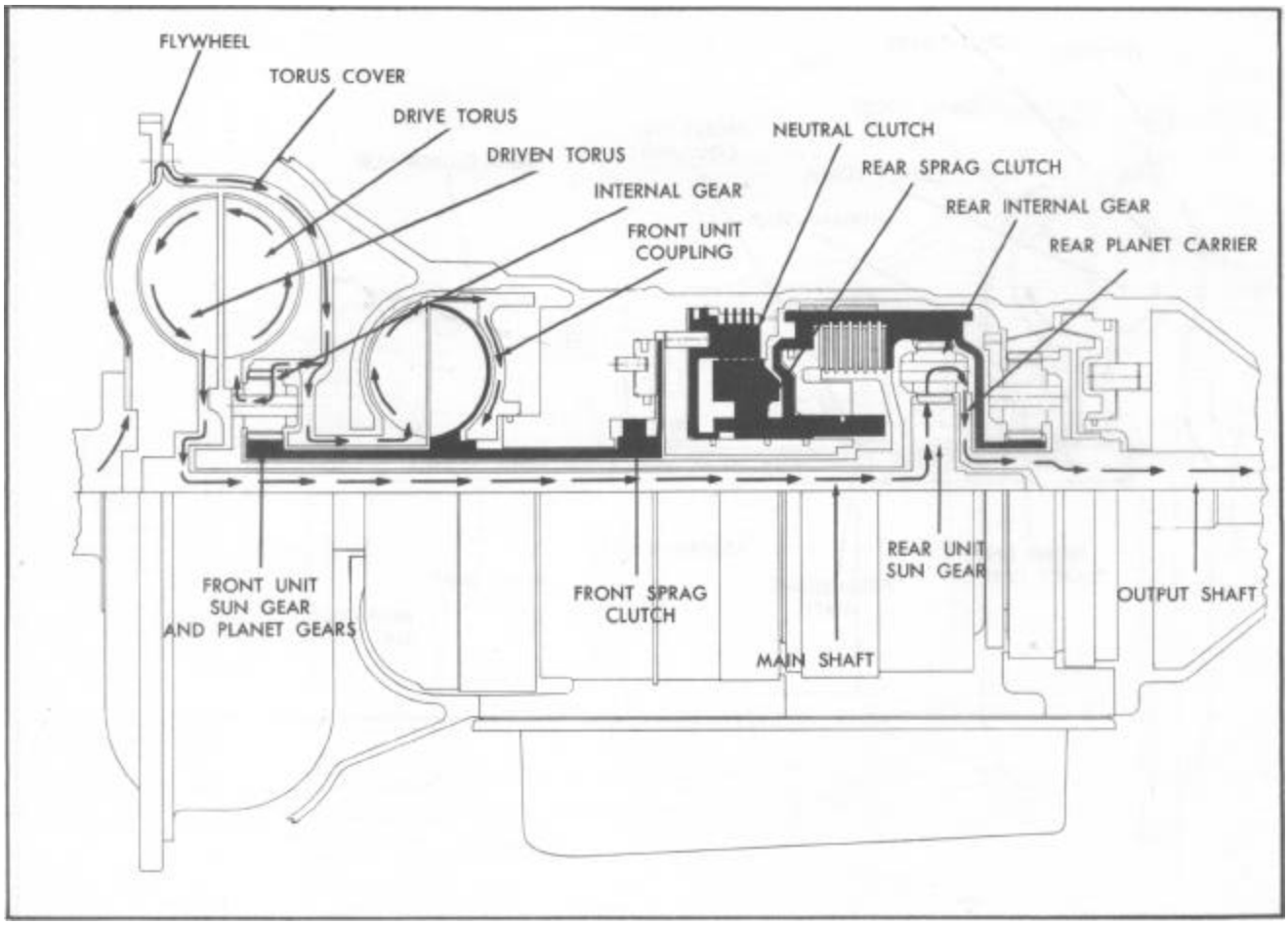


FIGURE 4—*Power Flow—First Speed*

FRONT UNIT (REDUCTION)		NEUTRAL CLUTCH	REAR UNIT (NEUTRAL)	
Sprag	On	On	Sprag	On
Coupling	Empty		Rear Clutch	Off

FIRST SPEED

In first speed, the front and rear planetary units are in reduction. The transmission gear ratio is 3.96 to 1.

Power flows mechanically from the flywheel to the torus cover and to the internal gear attached to the torus cover. At the internal gear, mechanical power divides.

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

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

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

The planet carrier of the rear unit is attached to the output shaft. Therefore, power will be directed from the planet carrier through the output shaft.

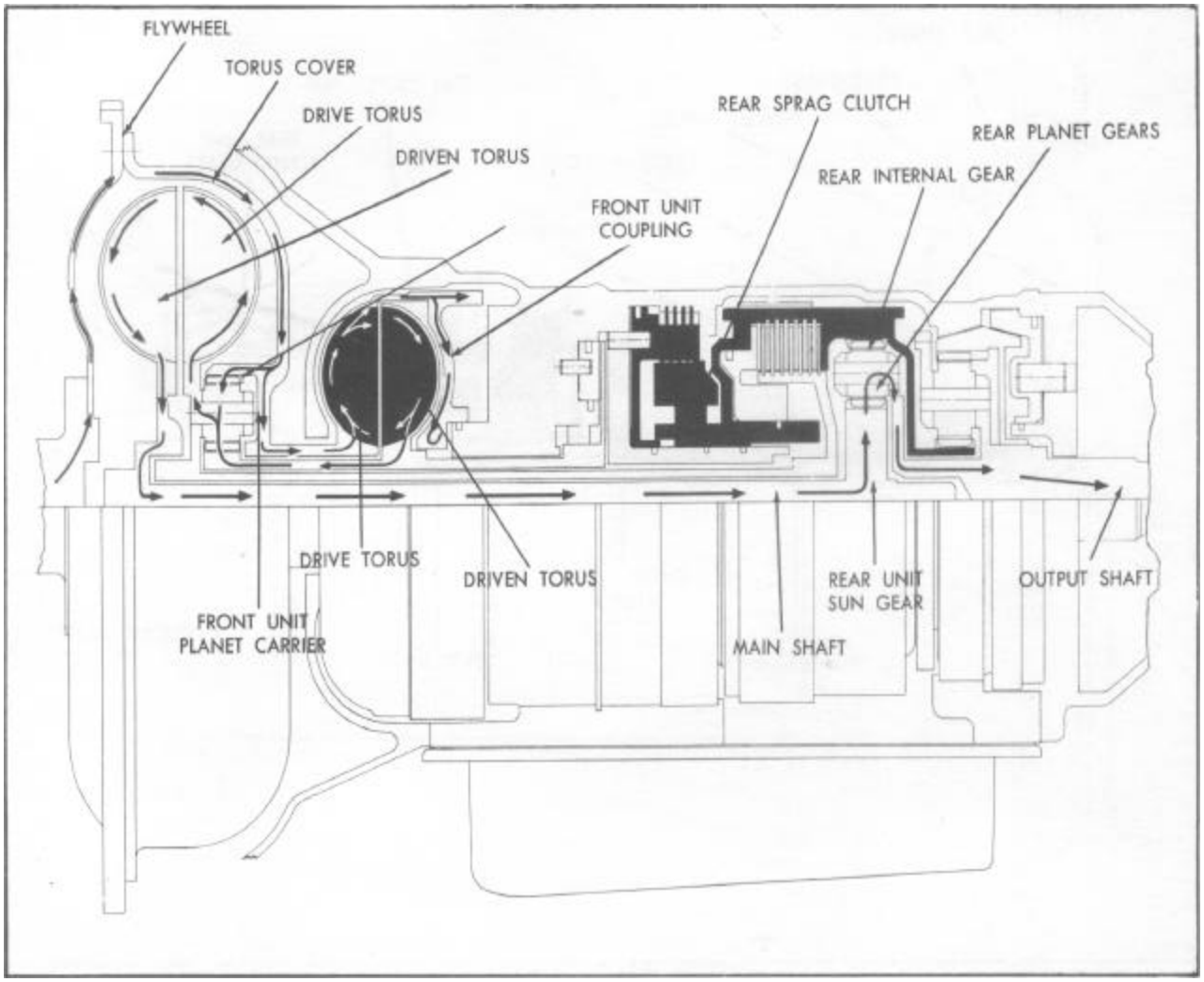


FIGURE 5—*Power Flow—Second Speed*

FRONT UNIT (DIRECT DRIVE)		NEUTRAL CLUTCH	REAR UNIT (REDUCTION)	
Sprag	Off	On	Sprag	On
Coupling	Full		Rear Clutch	Off

SECOND SPEED

In second speed, the front unit is in direct drive and the rear unit is in reduction. The transmission gear ratio is 2.55 to 1.

Power flows mechanically from the flywheel to the torus cover and to the internal gear attached to the torus cover. At the internal gear, mechanical power divides.

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

Thus, we have two members of the front unit gear set (internal gear and sun gear) locked together through oil which will give direct drive. These two members drive the front unit planet carrier at engine speed.

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

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

The carrier of the rear unit is attached to the output shaft. Therefore, power will be directed from the carrier through the output shaft.

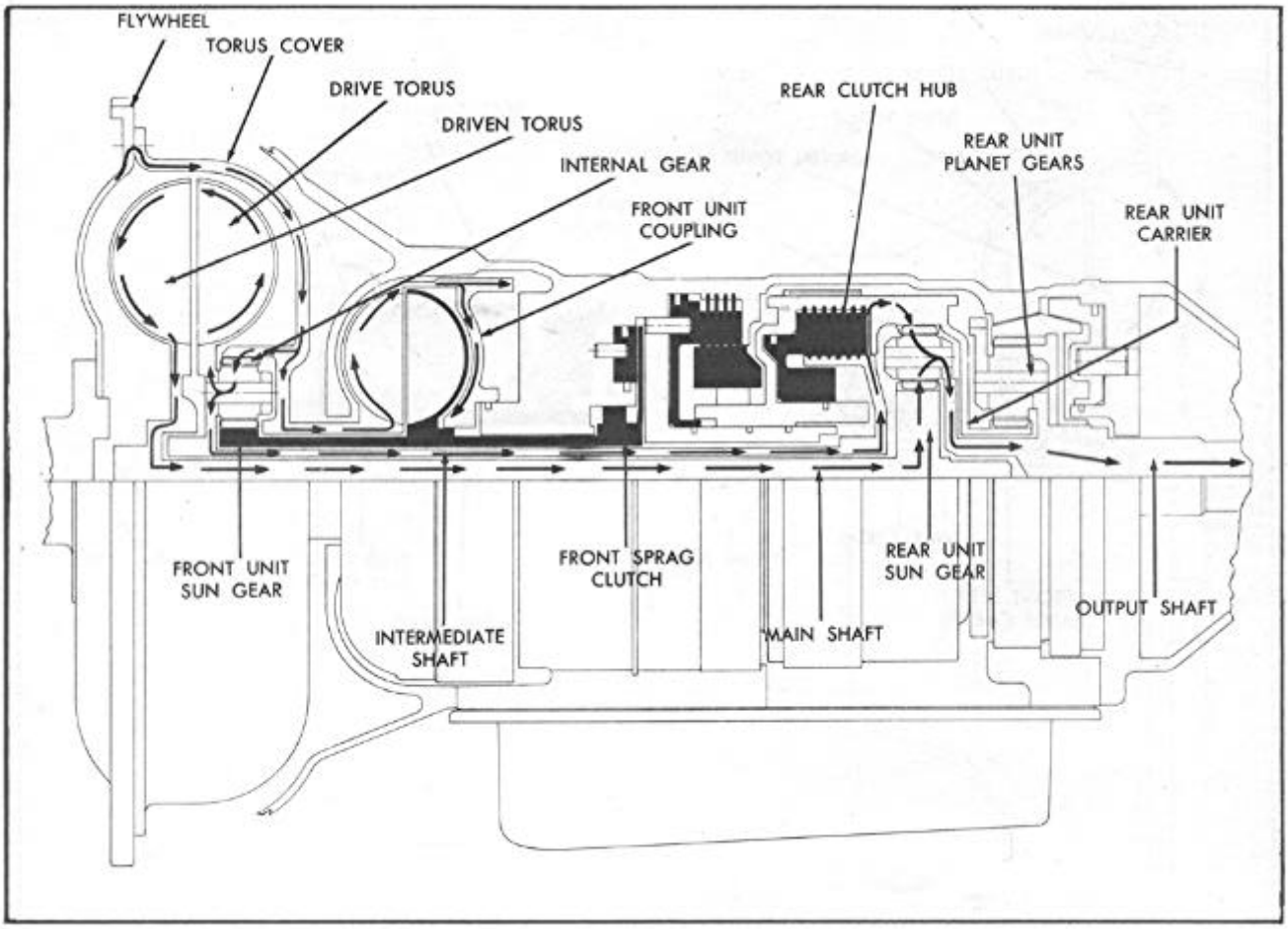


FIGURE 6—*Power Flow—Third Speed*

FRONT UNIT (REDUCTION)		NEUTRAL CLUTCH	REAR UNIT (DIRECT DRIVE)	
Sprag	On	On	Sprag	Off
Coupling	Empty		Rear Clutch	On

THIRD SPEED

In third speed, the front unit is in reduction and the rear unit is in direct drive. The transmission gear ratio is 1.55 to 1.

Power flows mechanically from the flywheel to the torus cover and to the internal gear attached to the torus cover. At the internal gear, mechanical power divides.

Part of the mechanical power is directed into the front unit coupling. However, in third speed, the front coupling is empty and no power is transmitted to the front unit driven member.

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

Fluid

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

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

Mechanical

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

The carrier of the rear unit is attached to the output shaft. Therefore, power will be directed through the output shaft.

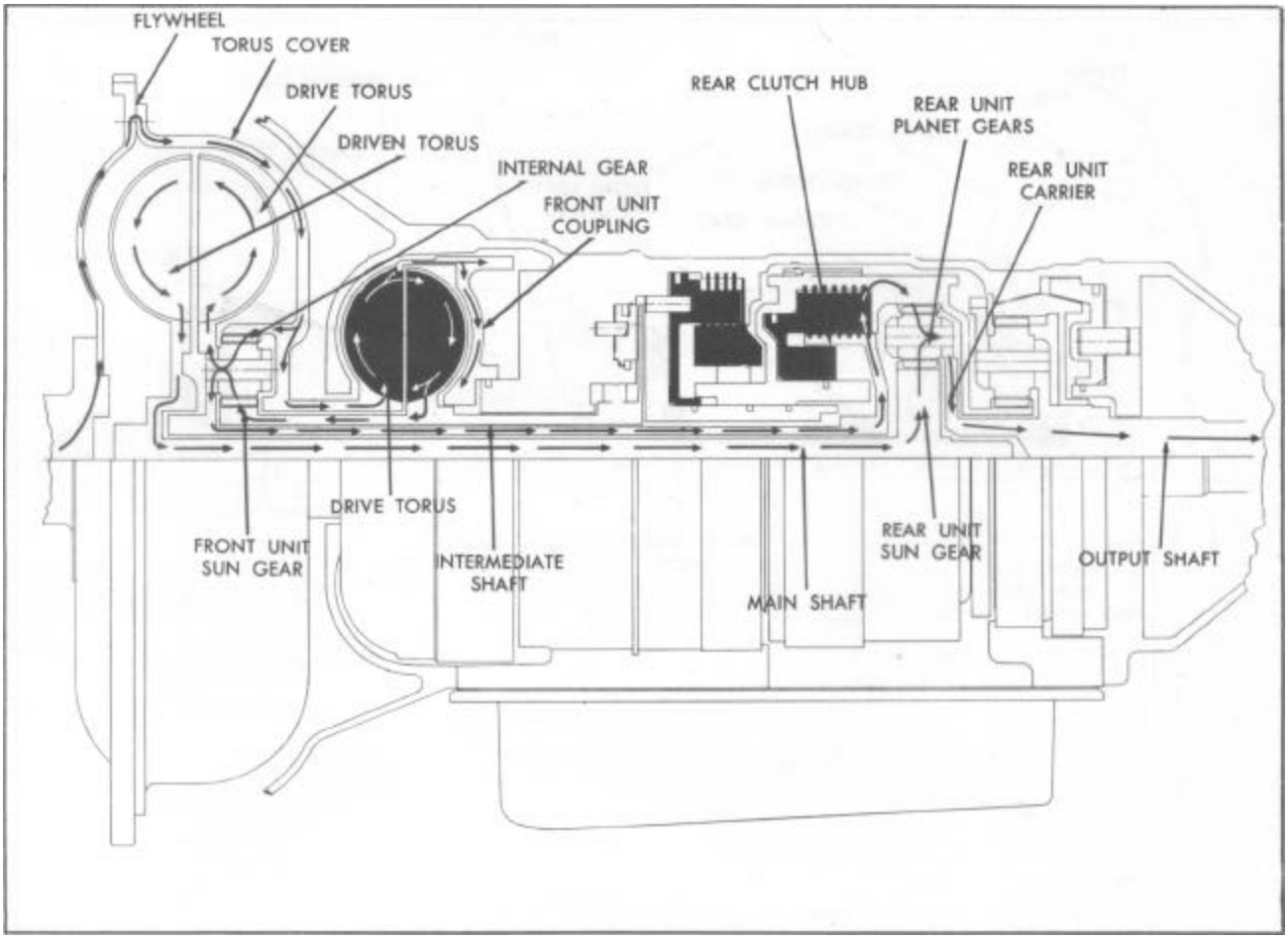


FIGURE 7—*Power Flow—Fourth Speed*

FRONT UNIT (DIRECT DRIVE)		NEUTRAL CLUTCH	REAR UNIT (DIRECT DRIVE)	
Sprag	Off	On	Sprag	Off
Coupling	Full		Rear Clutch	On

FOURTH SPEED

In fourth speed, the front and rear units are in direct drive. Therefore, the transmission operates as a solid coupling between the engine and rear axle.

Power flows mechanically from the flywheel to the torus cover and to the internal gear attached to the torus cover. At the internal gear, mechanical power divides.

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

The internal gear and sun gear members of the front unit gear set are locked, through oil, which will give direct drive. These two members drive the front unit planet carrier at engine speed.

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

Fluid

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

Mechanical

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

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

The carrier of the rear unit is attached to the output shaft. Therefore, power will be directed from the carrier through the output shaft.

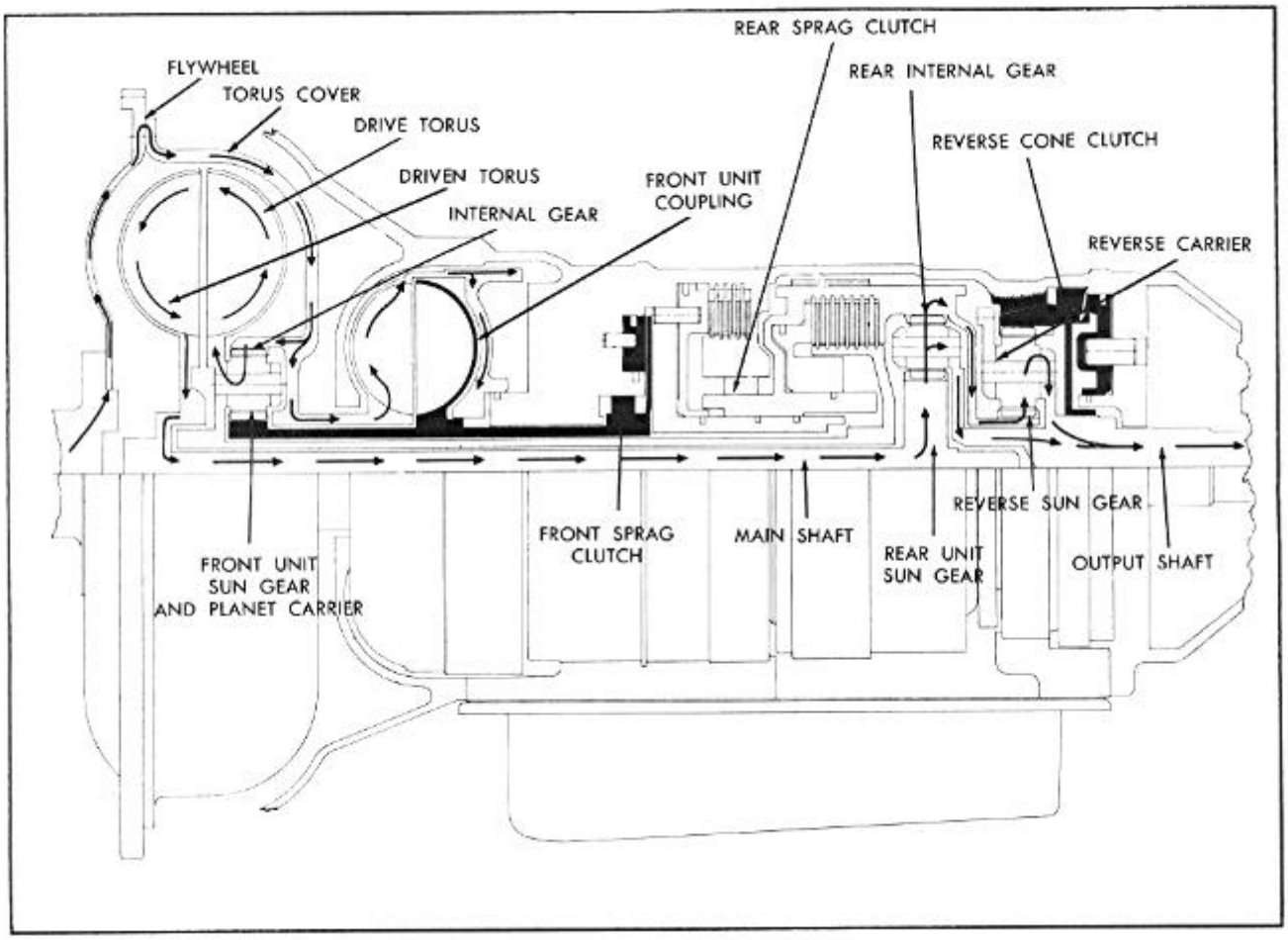


FIGURE 8—*Power Flow—Reverse*

FRONT UNIT (REDUCTION)	REVERSE UNIT	NEUTRAL CLUTCH	REAR UNIT (NEUTRAL)
Sprag On	(REDUCTION)	Off	Sprag Off
Coupling Empty	Clutch On		Clutch Off

REVERSE

In reverse, the front unit and reverse unit are in reduction and the rear unit is in neutral. The transmission gear ratio is 4:30 to 1. Power flows mechanically from the flywheel to the torus cover and to the internal gear attached to the torus cover. At the internal gear, mechanical power divides.

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

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

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

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

LIMIT VALVE

The limit valve prevents a sudden drop in line pressure when the front unit coupling fills. It also acts as a pressure relief valve to protect the system from excessive pressure. Pump pressure on the large diameter of the valve will move the valve to the right and open the passage to the coupling valve feed oil passage. The larger spring serves as the pressure relief.

COUPLING VALVE

The coupling valve is in the oil circuit to control the filling and emptying of the front unit coupling. It is held in the closed position in the forward speeds by spring pressure and T.V. pressure and in reverse position by spring pressure, T.V. pressure and reverse oil pressure. The coupling valve opens when G-1 booster pressure builds up high enough to overcome the combined spring pressure and throttle pressure. The valve will not open in reverse. When the valve opens, main line pressure is directed into the signal oil passage to close the two exhaust valves in the front unit coupling. Main line pressure through the limit valve is also directed into the feed passage to fill the front unit coupling. The T.V. passage to the end of the valve is also cut off and the pressure on the plug is allowed to exhaust out the reverse passage. This prevents throttle downshift. D-3 range oil is directed through the valve to apply the overrun front clutch in third and first speeds, D-3 range and "L" range. The coupling valve closes the D-3 range oil passage to the overrun front clutch in second and fourth, D-3 range and "L" range. When the coupling valve moves to the left, it cuts off main line pressure to the signal oil and feed oil passages. The exhaust valves in the front unit coupling will open and oil will be thrown from the front unit coupling by centrifugal force.

OVERRUN CLUTCH VALVE

The overrun clutch valve is positioned to the right by throttle pressure in D-4 and reverse. In drive range, the overrun front clutch apply passage is open to exhaust through the reverse passage at the manual valve. In reverse, oil is directed from the manual valve to the overrun front clutch piston to apply the clutch.

In D-3 and "L" range, pump pressure is directed from the manual valve through the coupling valve, in first and third, to the right end of the overrun clutch valve.

Pump pressure moves the overrun clutch valve to the left against throttle pressure and slowly opens the passage to the overrun front clutch to delay application of the clutch. In second and fourth speeds, the coupling valve cuts off the pump pressure to the overrun clutch valve and throttle pressure moves the valve to the right. The overrun clutch apply pressure then exhausts through the reverse passage and the overrun clutch is released by spring force. This delay in applying the overrun clutch is to allow the front unit coupling to empty and front sprag clutch to engage, resulting in a smooth 4-3 downshift when moving the selector lever from D-4 to D-3 range.

TRANSITION VALVE

The transition valve controls the front unit on the 2-3 upshif t. When the 2-3 shift valve opens, 2-3 oil pressure is directed to one end of the transition valve which moves it to the right against combined G-2 pressure and spring force. Movement of the valve cuts off G-1 booster pressure to the coupling valve and exhausts it through the 3-4 valve. The orifice in the 2-3 passage to the transition valve is to aid in timing the front unit with the rear unit during the 2-3 shift.

DETENT VALVE

Main line pressure from the manual valve is directed through the detent valve to the 3-4 governor valve. This pressure has no action on the detent valve, and the passage to the 3-4 governor valve is closed when the detent valve has been pushed to the left.

D-3 range oil is directed through the detent valve to the 3-4 shift valve to hold the transmission in third speed. The detent valve is mechanically opened by linkage. It is returned to the closed position by spring force on the end of the valve. The valve is in the circuit to make the 4-3 and 3-2 detent downshifts. When the accelerator pedal has been depressed all the way, the valve will be positioned to the left. T.V. pressure at the detent valve will then be directed to the 2-3 and 3-4 shift valves. At car speeds

below 65 M.P.H. the 4-3 shift valve will close for a 4-3 downshift, and at speeds below 20 M.P.H., the 2-3 shift valve will close for a 3-2 downshift.

PUMP PRESSURE

The first requirement of a hydraulic control system is a source of oil pressure. Oil pressure for the Hydra-Matic transmission is supplied by two oil pumps. One is at the front of the transmission, driven by the engine, the other at the rear, driven by the transmission output shaft. The front pump operates whenever the car is in forward motion.

The front pump is of the vane type and consists of seven vanes rotated within a movable slide by a rotor. Variable output is achieved through the movable slide. A priming spring holds the slide up to deliver maximum output to quickly attain regulated pressure in the control system when the engine is started. The pressure regulator will then adjust the position of the slide so that only the amount of oil required is pumped. Main line pressure operates on the end of the pressure regulator and tends to move it downward. When the pressure regulator is in the upward position, oil is directed to hold the slide up for maximum output. Oil is directed to the opposite side of the slide when the pressure regulator is forced down and the volume output of the pump will be decreased to the amount required to maintain regulated pressure.

The torus feed valve controls the flow of oil to the fluid coupling, the valve is held against the slide by the spring. The valve closes the oil passage to the fluid coupling until oil pressure moves the slide toward the priming springs. The valve follows the slide and opens to direct oil through the oil cooler in the radiator lower tank, through the fluid coupling and lubrication system. A ball check is provided to by-pass the cooler in the event the cooler becomes plugged. The limit valve in the front clutch valve body protects the system against excessive pressures. The rear pump is a gear type. Both pumps deliver oil at regulated pressure (controlled by the pressure regulator valve through the front pump) when the car is driven forward.

THROTTLE PRESSURE

Throttle valve pressure originates at the throttle valve and varies according to carburetor throttle opening by means of linkage from the accelerator pedal. As the accelerator pedal is depressed, linkage to a lever on the side of the transmission moves the throttle valve plunger. Plunger movement opens the throttle valve through spring force, and oil from the pump then flows through an opening at the throttle valve. This oil under pressure acts on the end of the throttle valve to oppose the throttle valve spring force which opened the valve. In this manner, the throttle valve comes a balanced valve; balanced between spring force and throttle pressure. As a result of this action, throttle pressure varies with accelerator pedal position from zero pressure at closed throttle to full line pressure at full throttle. Throttle pressure is directed to a land on the throttle valve plunger to assist in moving the plunger which gives a lighter feel to the accelerator pedal. This pressure cannot move the plunger without assistance from the accelerator linkage.

Throttle valve pressure is directed to the 2-3 and 3-4 regulator valves where it is modulated. Throttle valve pressure acts against the end of these valves, and due to their design, the pressure of the oil passing the valves is reduced. It is, therefore, called modulated throttle valve pressure.
This pressure assists the 2-3 and 3-4 shift valve springs in opposing governor pressures.

Throttle valve pressure is directed to one end of the overrun clutch valve to position it to the right and to the coupling valve plug to assist the coupling valve spring in opposing G-1 booster pressure.

Throttle valve pressure is directed to the transition valve when in detent position for a 3-2 downshift to prevent a 3-1-2 downshift by properly timing the front and rear unit change.

Throttle pressure is directed to the accumulator to absorb the shock of the rear clutch apply oil pressure.

GOVERNOR PRESSURE

A centrifugal governor driven by the rear pump supplies two governor pressures. G-1 is supplied from the governor valve having the large weight. G-2 is

supplied from the governor valve having no weight. These two pressures vary with car speed. However, G-1 increases at a faster rate than G-2 pressure because of the large weight. The G-1 valve also has a spring to assist in opening the valve to give an initial G-1 pressure when the engine is running. This is to provide a higher G-1 pressure at low car speeds. The G-1 valve is a balanced valve, balanced between G-1 pressure and centrifugal force assisted by spring force. The G-2 valve is a balanced valve, balanced between G-2 pressure and centrifugal force. Pump pressure is the supply for G-1 pressure and G-1 pressure is the supply for G-2 pressure. G-1 pressure is used to open the G-1 booster valve, and is also used to assist G-2 pressure in opening the 2-3 and 3-4 shift valves. G-2 pressure is used on the transition valve to help control the 2-3 shift.

G-1 BOOSTER VALVE PRESSURE

G-1 booster pressure originates at the G-1 booster valve. G-1 pressure working on the larger diameter end of the valve moves it to the right allowing main line pressure to feed into the center area of the valve. As G-1 booster pressure builds up in the center of the valve, it moves the valve back to the closed position cutting off the main line pressure. Since the G-1 booster pressure must force the valve closed against G-1 pressure and it has less area of the valve to work on, booster pressure will be higher than G-1.

The G-1 booster valve is a balanced valve, balanced between G-1 and G-1 booster pressure. G-1 booster pressure increases with car speed until it reaches main line pressure. As car speed decreases, G-1 booster pressure forces the valve further to the left against G-1 pressure and allows G-1 booster pressure to enter the G-1 passage where it is regulated at the G-1 valve.

G-1 booster pressure is directed through the transition valve to one end of the coupling valve. When G-1 booster pressure on the end of the coupling valve becomes high enough, depending on car speed, to overcome the spring force and T.V. pressure on the other end of the coupling valve, it will move the valve for the 1-2 upshift.

NEUTRAL—ENGINE RUNNING

Oil at full line pressure is directed to the manual valve, governor, throttle valve, G-1 valve, and G-1 booster valve, coupling valve, and limit valve.

The oil directed to the limit valve opens the valve sufficiently to permit the oil to enter a passage to a land on the coupling valve. Full line pressure also goes to another land on the coupling valve. The oil pressures on the coupling valve lands have no function with the transmission in neutral.

As main line oil is directed to the governor, a spring in the G-1 governor holds the governor at a predetermined opening and an initial G-1 pressure is obtained. A regulated amount of G-1 pressure is directed to the end of the G-1 booster valve allowing regulated G-1 booster pressure to be directed to the end of the coupling valve.

Main line pressure is directed through the throttle and coupling valves and to the end of the coupling valve plug.

The front unit coupling is empty and the front sprag clutch is on. The neutral clutch, rear clutch, and the rear sprag clutch is off.

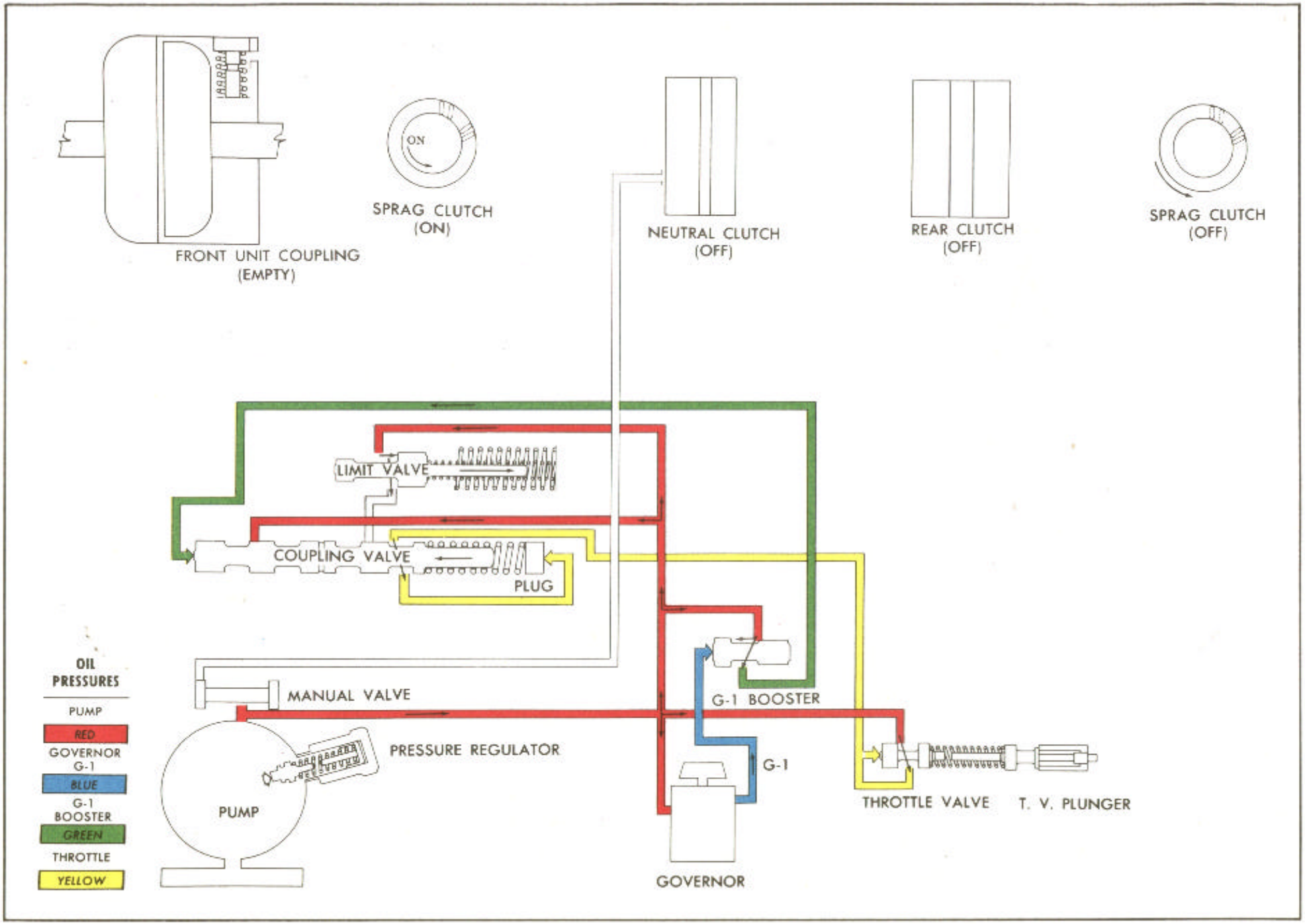


FIGURE 9—*Oil Control Circuit—Neutral Engine Running*

FIRST SPEED D-4 RANGE

When the manual valve is moved to the D-4 position, main line pressure is directed to the same control units as in neutral. In addition, another passage is opened at the manual valve and oil flows past the manual valve and is directed to the neutral clutch.

The front unit coupling is empty, the front sprag clutch is on and the front unit is in reduction.

The neutral clutch is applied and the rear clutch is released. The rear sprag clutch is on and the rear unit is in reduction.

The front unit being 40% reduction and the rear unit 60% reduction power passes to the output shaft with 100% reduction for first speed.

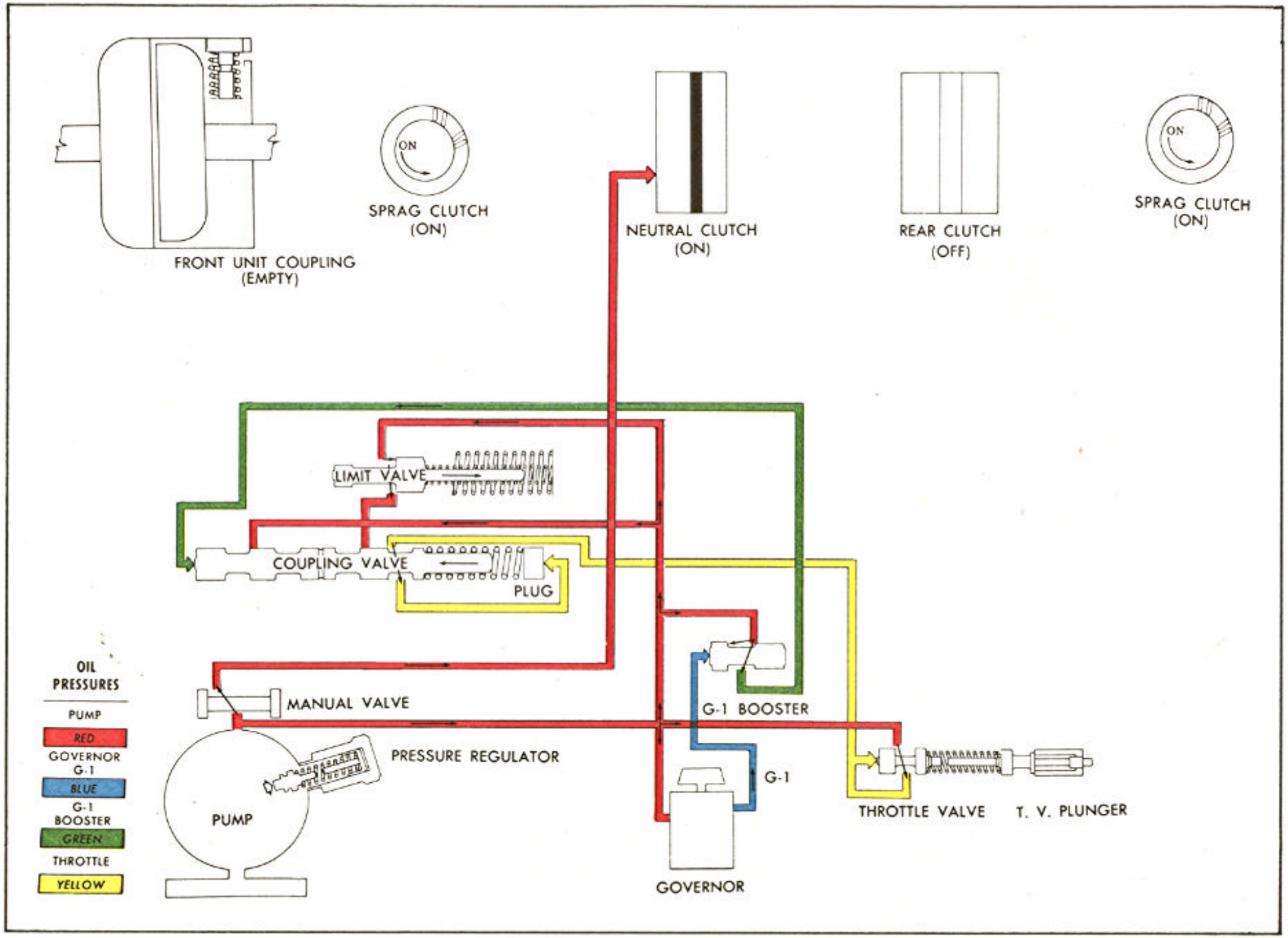


FIGURE 10—*Oil Control Circuit—First Speed D-4 Range*

SECOND SPEED D-4 RANGE

As car speed increases in first speed, governor pressure increases accordingly, so that G-1 pressure builds up behind one end of the G-1 booster valve, opening the valve further increasing G-1 pressure by metering in more main line oil pressure.

The G-1 booster pressure passing through the transition valve acting on the end of the coupling valve, tends to open the coupling valve against opposition of the coupling valve spring pressure.

When T.V. pressure is greater than the spring load, the spring is compressed and the coupling valve plug pushes against the valve. This produces a force in proportion to T.V. pressure which delays the speed at which the valve opens.

When G-1 booster pressure exceeds spring pressure or T.V. pressure on the opposite end of the coupling valve, the valve moves to its open position and causes the following action:

With the coupling valve opened, main line oil is directed to the signal and feed oil circuits. The signal oil closes the exhaust valve in the front unit coupling and the feed oil fills the coupling. When the coupling is filled, the front sprag clutch is automatically released and the front unit changes from reduction to direct drive.

With the front unit in direct drive, the rear clutch is released, the neutral clutch is applied, the rear sprag clutch is on, and the rear unit is in reduction giving a 60% reduction for second speed.

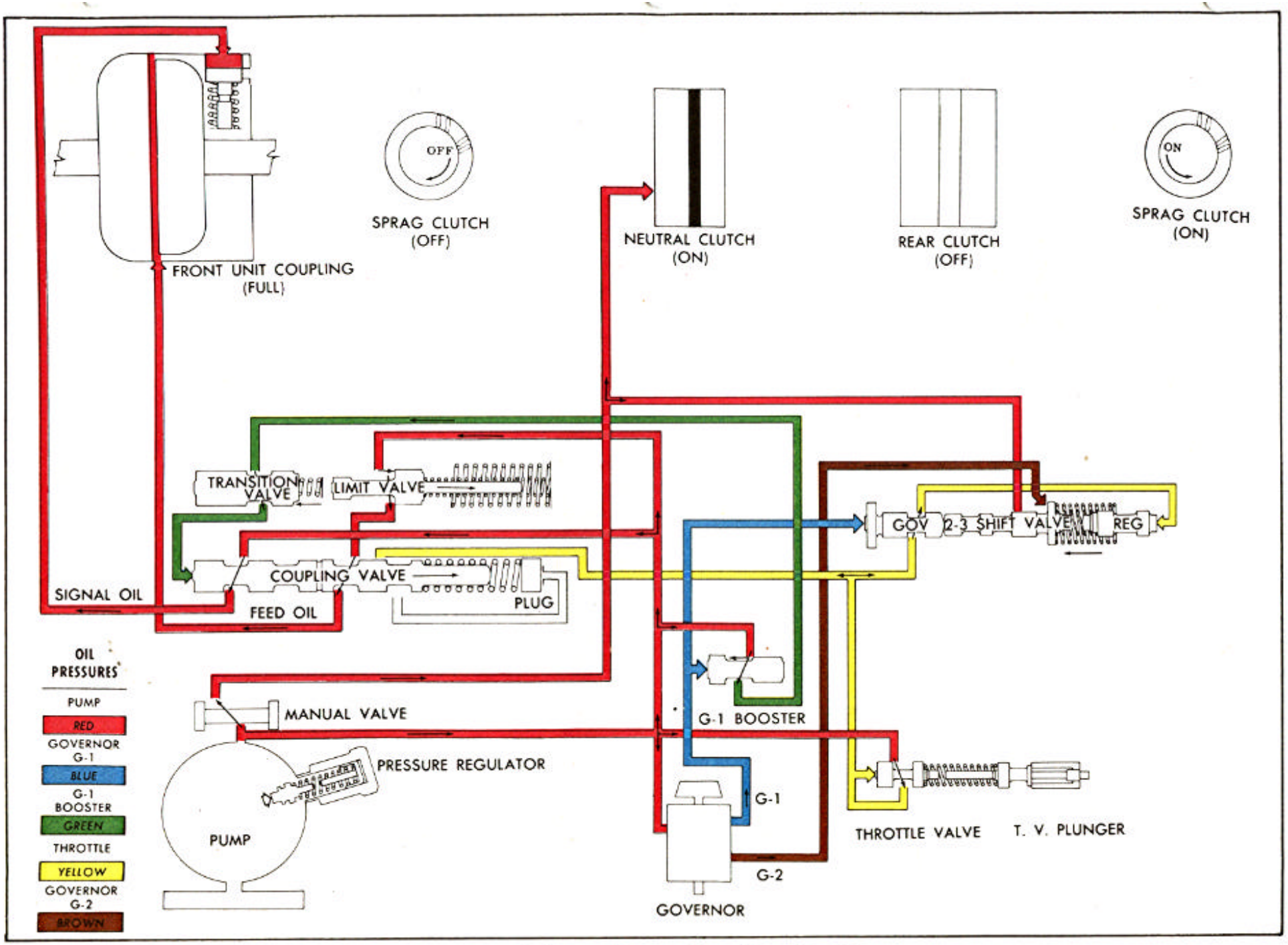


FIGURE 11—*Oil Control Circuit—Second Speed D-4 Range*

THIRD SPEED D-4 RANGE

As the car speed increases inc second speed, both G-1 and G-2 governor oil pressures increase. G-1 pressure on the 2-3 governor valve, and G-2 pressure on the large land of the 2-3 shift valve overcome the spring force and modulated T.V. pressure on the 2-3 shift valve, and the 2-3 shift valve opens and directs oil to the rear unit where it applies the rear clutch. Applying the clutch automatically releases the rear sprag clutch.

During the 2-3 shift, rear clutch apply oil is directed to the accumulator and must move the piston against spring and throttle pressure. The rise of pressure due to rear clutch apply oil working against the accumulator and rear clutch is gradual and a harsh apply of the rear clutch is avoided. The accumulator T.V. pressure is limited by a trimmer valve, located in the accumulator body, which provides an accumulator pressure which is in proportion to the torque on the clutch plates during the shift.

Oil is also directed from the 2-3 shift valve to the transition valve moving it to the right which closes the G-1 booster passage to the coupling valve and opens it to exhaust through the 3-4 shifter valve.

When G- I booster pressure is cut off, the coupling valve spring moves the valve to the left, closing the main line passage to the front unit signal oil and signal oil is opened to exhaust at the coupling valve. This allows the two valves in the front unit coupling to open. Movement of the coupling valve also closes the main line passage to the feed oil and opens the feed oil passage to an air vent which allows the front unit coupling to exhaust at the two exhaust valves.

When the front unit coupling is empty, the front sprag clutch automatically engages and the front unit is in reduction.

With the front unit in reduction and the rear unit in direct drive, the transmission is in third gear or 40% reduction.

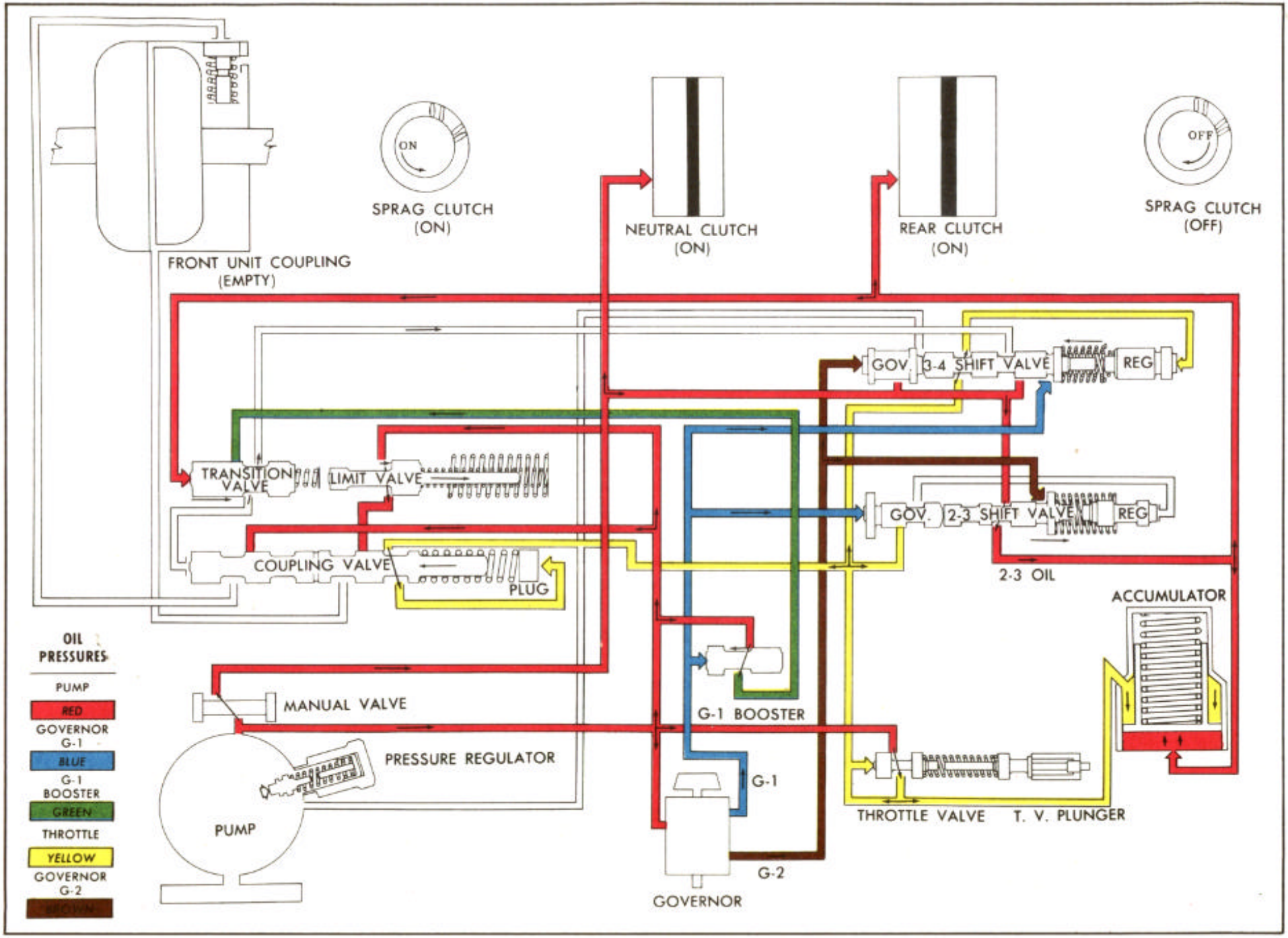


FIGURE 12—*Oil Control Circuit—Third Speed D-4 Range*

FOURTH SPEED D-4 RANGE

When the car reaches sufficient speed, G-1 pressure on the large land of the 3-4 shift valve and G-2 pressure on the 3-4 governor valve will overcome the 3-4 shift valve spring and modulated T.V. pressure on the 3-4 shift valve and regulator plug. The 3-4 shift valve will open and direct pump pressure through the transition valve to the coupling valve. Pump pressure on the coupling valve moves it to the right, opening the valve and causes the following action:

Pump pressure is directed through the coupling valve through two separate passages. Pump pressure will go through the signal oil passage to the front unit coupling closing the two exhaust valves. Pump pressure through the limit valve and coupling valve will also be directed through the feed oil passage to fill the front unit coupling. When the front unit coupling is filled, the front sprag clutch is automatically released and the front unit is in direct drive.

When G-2 pressure moved the 3-4 governor valve to the right, it directed pressure on the center of the valve to a land on the pressure regulator valve to lower pump pressure in fourth speed (line drop). The transmission will operate on less pressure in fourth gear which will lower horsepower requirements. To prevent pressure from dropping until after the front unit has changed, the pressure to the pressure regulator valve is also directed to a ball check in the front unit coupling feed oil passage. As the front unit starts to fill, pressure on this side of the ball check will drop and the higher pump pressure on the other side will unseat the ball and assist in filling the front unit coupling. When the front unit coupling has filled, pressure will be equal on both sides of the ball and the spring will again seat the ball. Pressure will then act on the pressure regulator valve to lower pump pressure.

With the front and rear units in direct drive, the transmission is in fourth gear with no reduction.

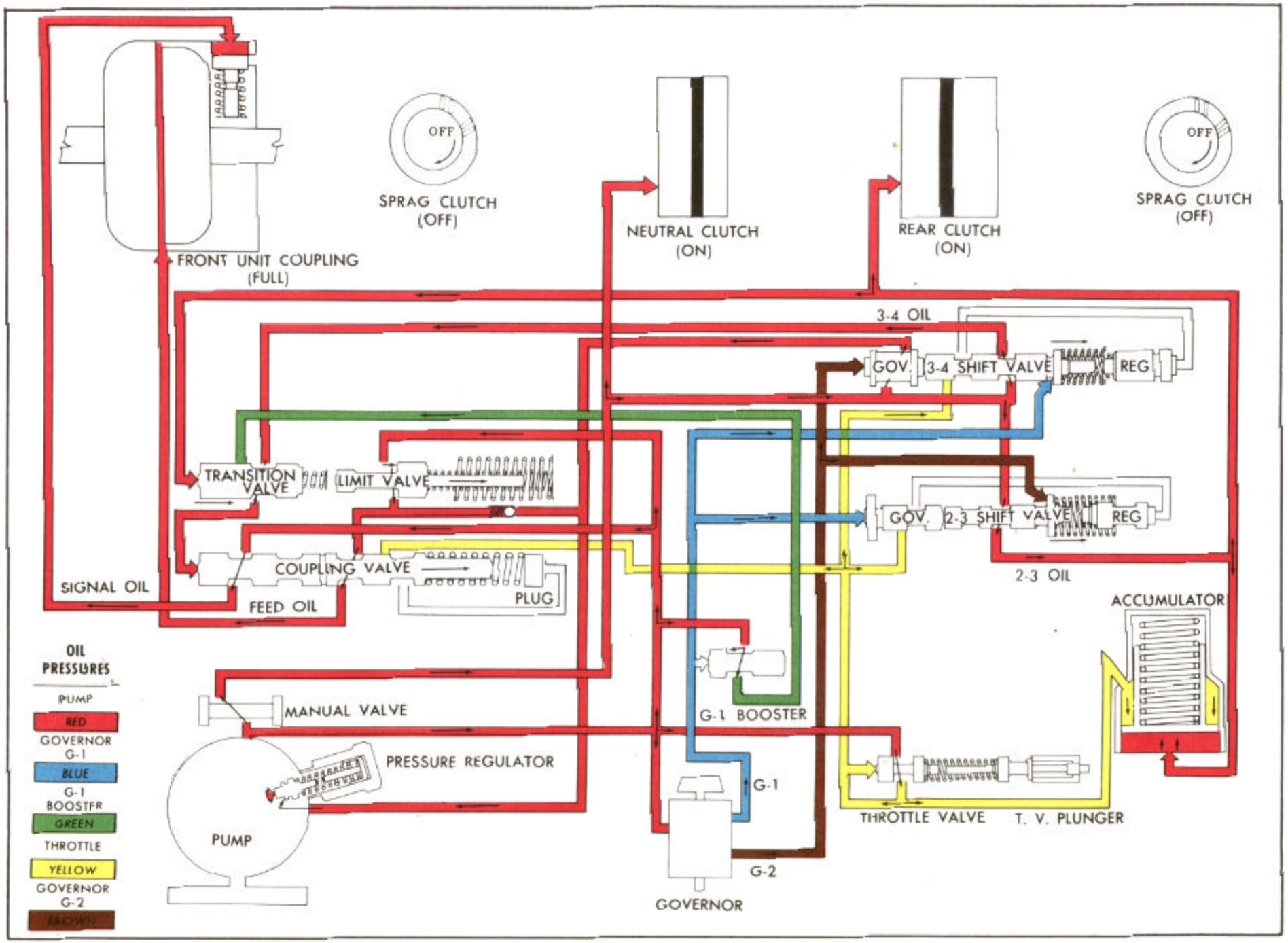


FIGURE 13—*Oil Control Circuit—Four Speed D-4 Range*

FOURTH SPEED 4-3 PART THROTTLE DOWNSHIFT

A 4-3 part throttle downshift can be made any time the transmission is in fourth gear and the car speed is below approximately 30 M.P.H. This is desirable in traffic because the transmission can be downshifted to third gear for faster pick up without a wide open throttle. The part throttle downshift can be obtained in the following manner:

When the transmission is in fourth gear and the accelerator is depressed, approximately IA down, throttle pressure on the plunger is directed through the 3-4 shift valve to the regulator valve. Throttle pressure and spring force on the regulator valve will close the valve and the transmission will be in third gear. When the shift valve closes, throttle pressure from the plunger will be cut off and throttle pressure from the throttle valve will hold the shift valve closed until the governor pressure can increase enough to open the shift valve again for fourth gear. If pressure on the accelerator is released enough, the governor pressure will open the shift valve immediately.

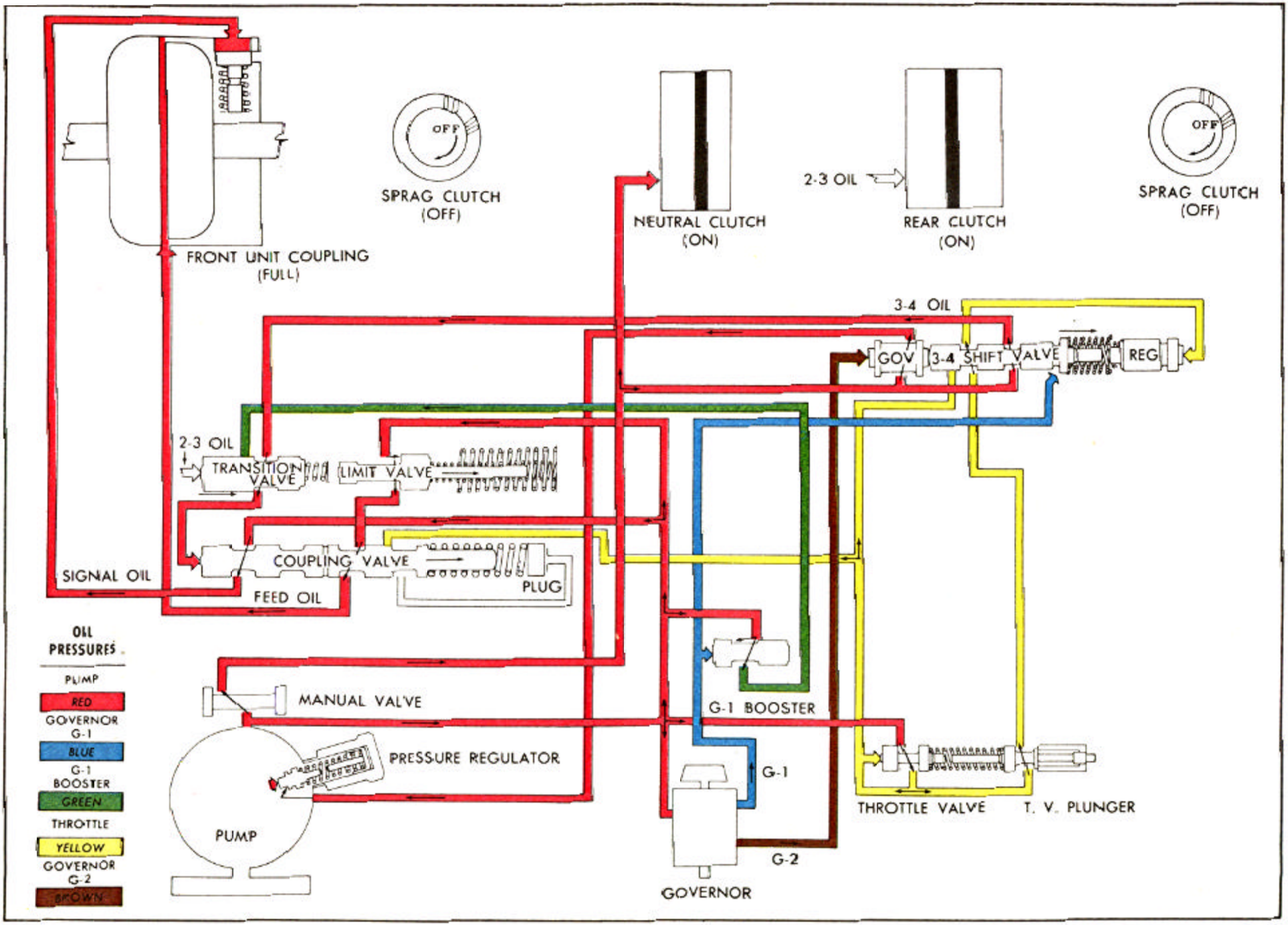


FIGURE 14—*Oil Control Circuit 4-3 Part Throttle Downshift*

FOURTH SPEED 4-3 DETENT DOWNSHIFT

It may be desirable to downshift the transmission from fourth to third speed at a speed higher than the part throttle downshift would occur. This downshift can be made up to speeds of approximately 65-70 M.P.H. by pressing the accelerator pedal all the way down.

As the throttle lever contacts the detent valve, the increased resistance is to warn the driver and prevent an accidental downshift. If additional foot pressure is used, the detent valve moves to the right. Detent oil is then directed to the 3-4 shift valve which will close the valve against governor pressures and the transmission will downshift from fourth to third gear.

When the detent valve moves to the right, it cuts off the main line passage through the 3-4 governor valve to the pressure regulator valve. Pump pressure immediately builds up to a maximum operating pressure for the fourth to third gear downshift.

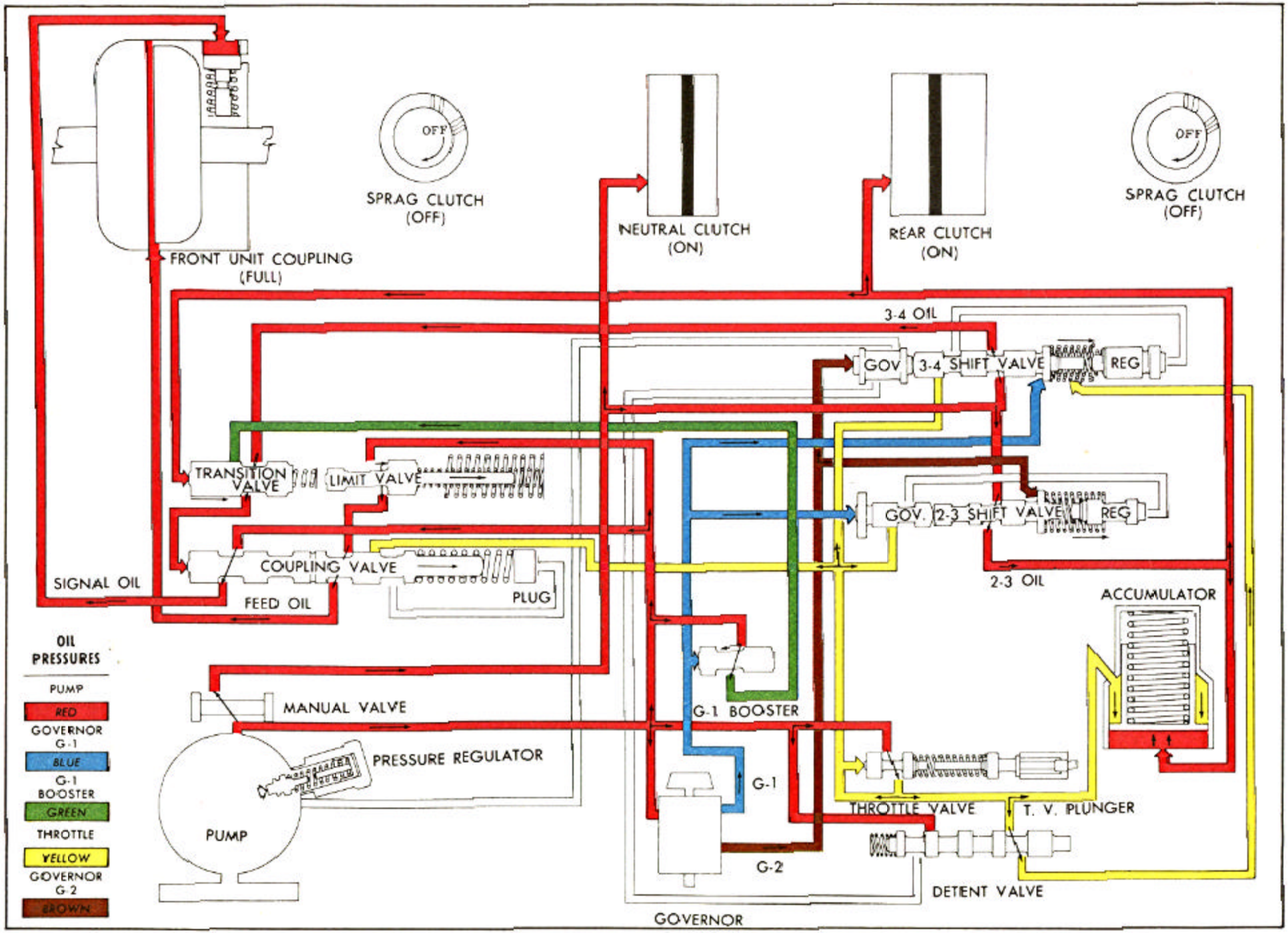


FIGURE 15—*Oil Control Circuit—Fourth Speed 4-3 Detent Downshift*

THIRD SPEED 3-2 DETENT DOWNSHIFT

Below 20 M.P.H., a forced downshift to second gear may be obtained.

Pressing the accelerator pedal to the floor will move the detent valve to the left. Throttle pressure will then be directed from the throttle valve through the detent valve to the 2-3 regulator valve.

Detent oil assisted by spring force will overcome the governor pressures and the valve will close, placing the transmission in second gear.

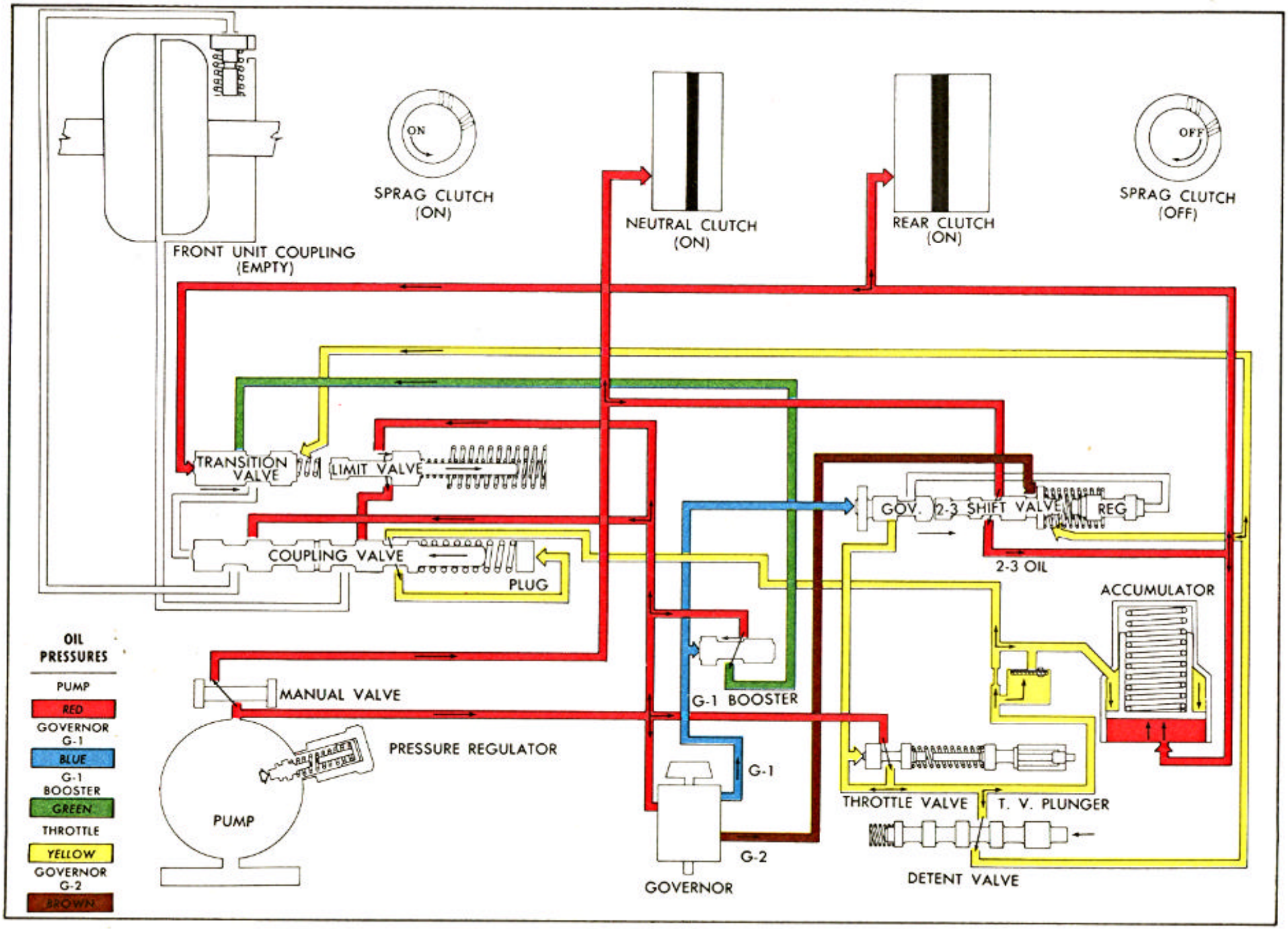


FIGURE 16—*Oil Control Circuit—Third Speed 3-2 Detent Downshift*

THIRD SPEED D-3 RANGE

D-3 range is provided in order to keep the car operating in third gear over a large portion of the driving range. This is of particular advantage for engine braking for hilly driving, or acceleration in heavy traffic with part throttle. Placing the selector lever in D-3 range results in the following:

The manual valve directs line pressure around the 3-4 regulator valve into the area between the 3-4 shift valve and the 3-4 regulator valve. With main line pressure assisting the 3-4 shift valve spring, the 3-4 upshift will be delayed until G-l and G-2 has built up enough pressure to overcome them.

Since the front sprag clutch will overrun while coasting, pump pressure from the manual valve is directed through the coupling valve to one end of the overrun clutch valve. This pump pressure moves the overrun clutch valve (with delayed action) to the left against throttle pressure. Movement of the overrun clutch valve closes the reverse passage to the overrun clutch and the pump pressure applies the clutch to hold the front unit sun gear to provide engine braking. This overrun clutch assist is present in first and third in D-3 range.

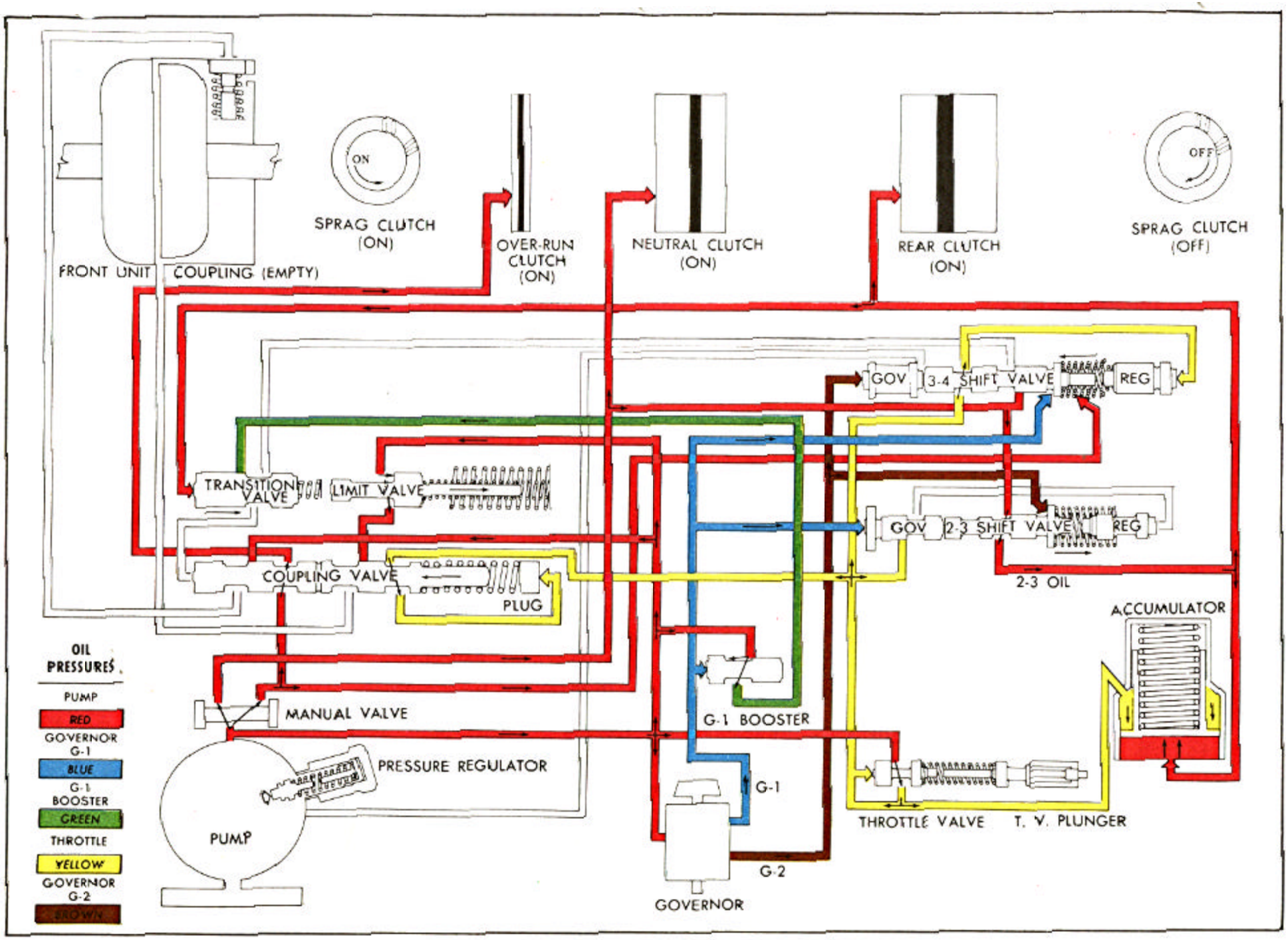


FIGURE 17—*Oil Control Circuit—Third Speed D-3 Range*

SECOND SPEED "L" RANGE

First gear "L" range is the same as first gear drive range except that the manual valve directs low range oil through the 2-3 shift valve to the low band servo to apply the band for first and second gear. The low band is necessary for engine braking since the rear sprag is not effective when coasting. The D-3 passage is also open so the overrun clutch is applied for engine braking.

A 2-3 upshift will occur at approximately 45-50 M.P.H. When G-1 and G-2 pressures increase enough to overcome pump pressure on the 2-3 shift valve from the low range passage and spring force, the 2-3 shift valve will open.

Low range oil pressure remains on the 2-3 shift valve so that if the car speed decreases, the transmission will downshift to second gear approximately the same speed as the upshift occurred.

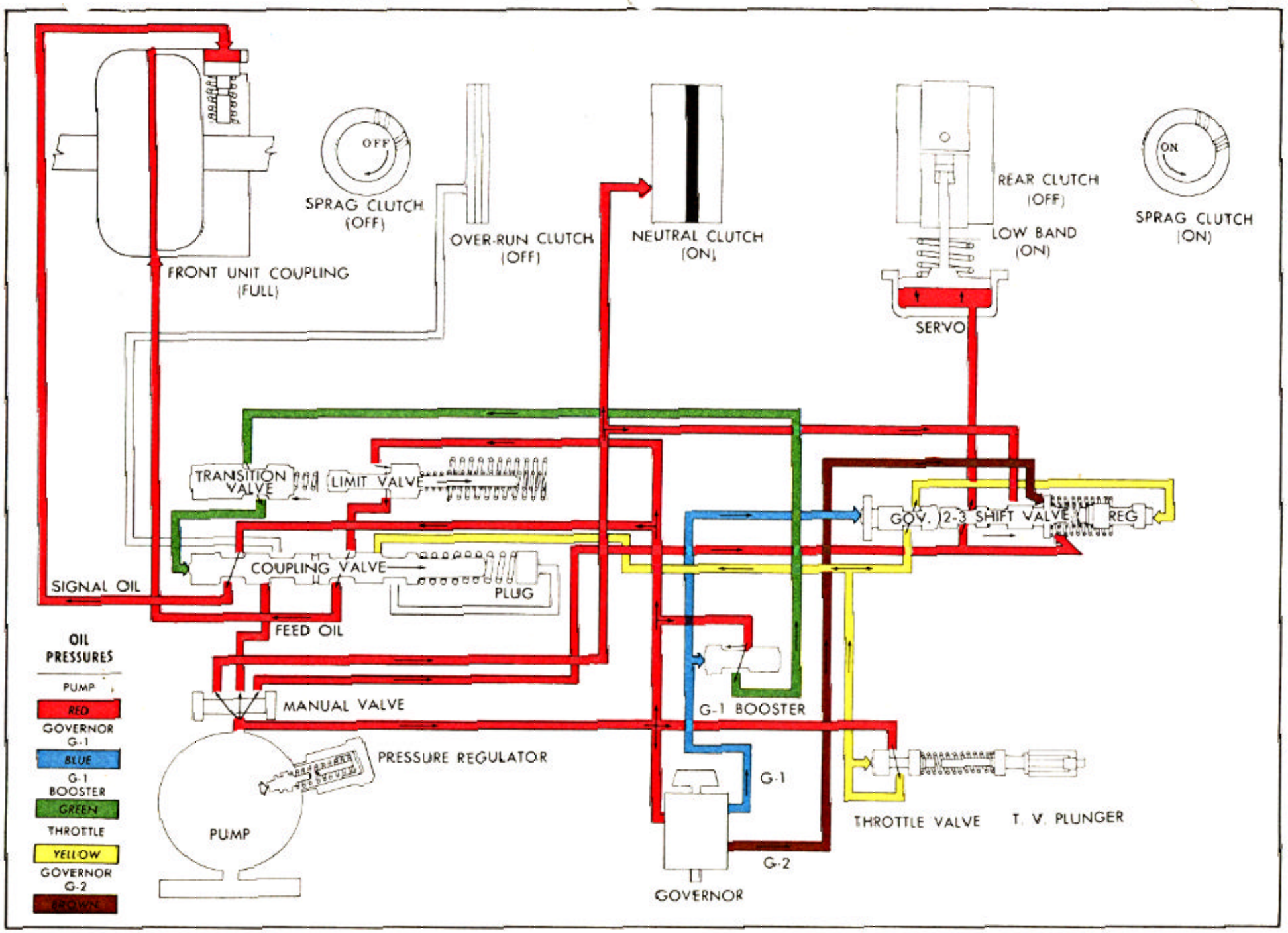


FIGURE 18—*Oil Control Circuit—Second Speed "L" Range*

REVERSE

When the selector lever is moved to the "R" position, the manual valve directs oil to the reverse cone clutch to hold the reverse internal gear and to the pressure regulator; through the overrun valve passage to apply the overrun clutch, and to the coupling valve to oppose G-1 booster pressure to prevent an upshift in reverse.

With the front sprag clutch and overrun clutch on, the neutral clutch, rear sprag clutch, and the rear clutch released, and the reverse cone clutch applied, conditions for reverse range are completed.

Throttle pressure is used in reverse to move the overrun clutch valve (not shown) to the right to open the reverse passage to the overrun clutch.

Pump pressure directed to the reverse booster plug in the pressure regulator increases pump pressure which is necessary to hold the reverse cone clutch.

Although governor pressures are present in reverse, they have no function to perform. Since there is no check valve between the front and rear pumps, the rear pump will be exhausting in reverse. The front pump will furnish sufficient oil pressure to operate the transmission and allow the rear pump to exhaust.

Pressures to D-4, D-3 and "L" range passages will be cut off and these passages are open to exhaust.

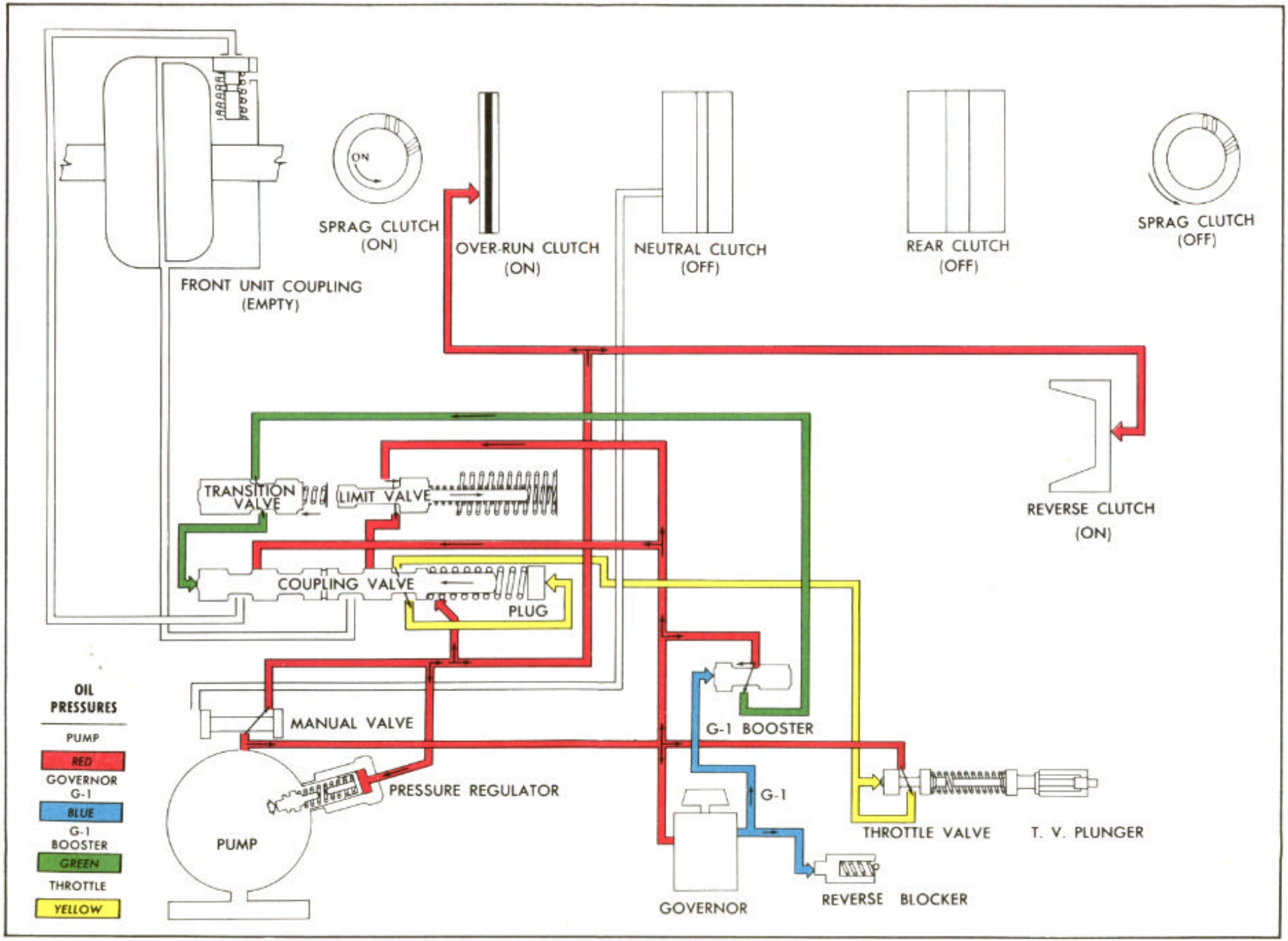


FIGURE 19—*Oil Control Circuit—Reverse*

LOCATION OF OIL HOLE PASSAGES

Figures 20 to 28 inclusive illustrate the location of oil passages. After thoroughly cleaning each part, all oil passages should be blown out with compressed air.

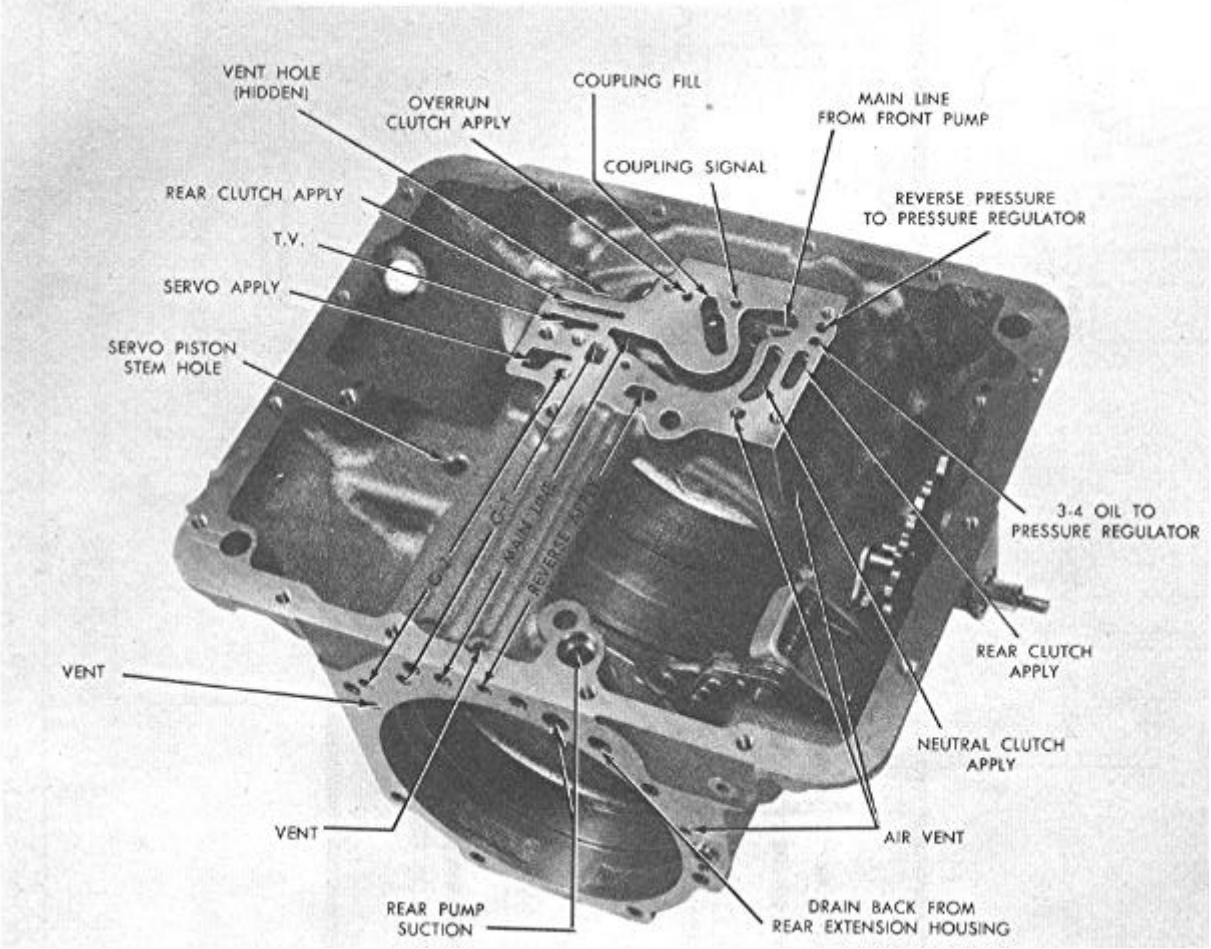


FIGURE 20—*Transmission Case Oil Passages*

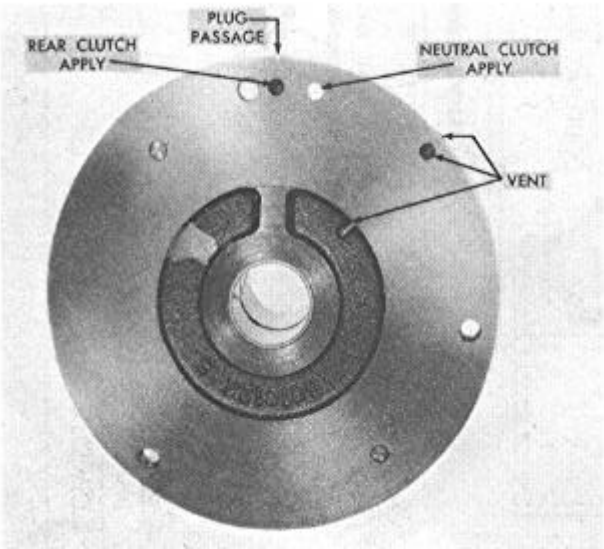


Figure 21—*Case Center Support Passages*

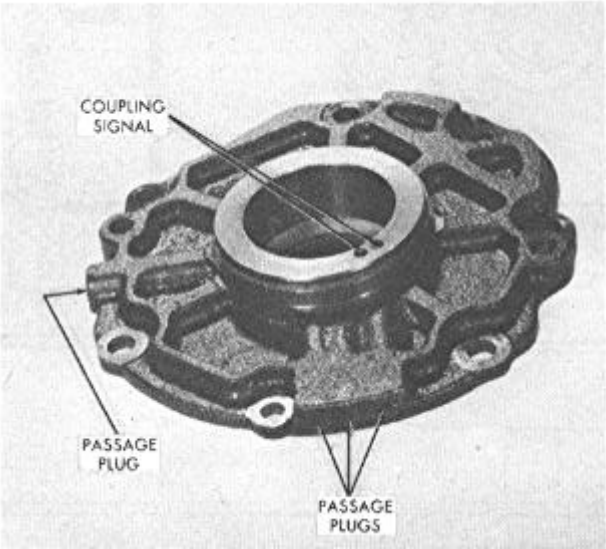


Figure 22—*Front Pump Cover Passeges*

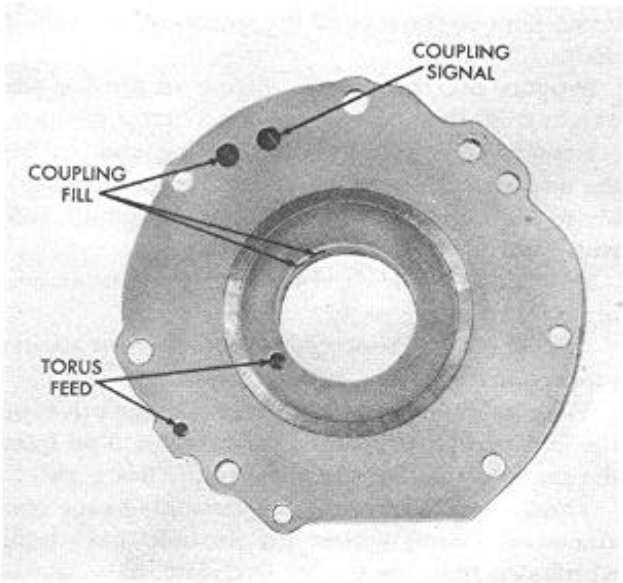


FIGURE 23—*Front Pump Cover Passages*

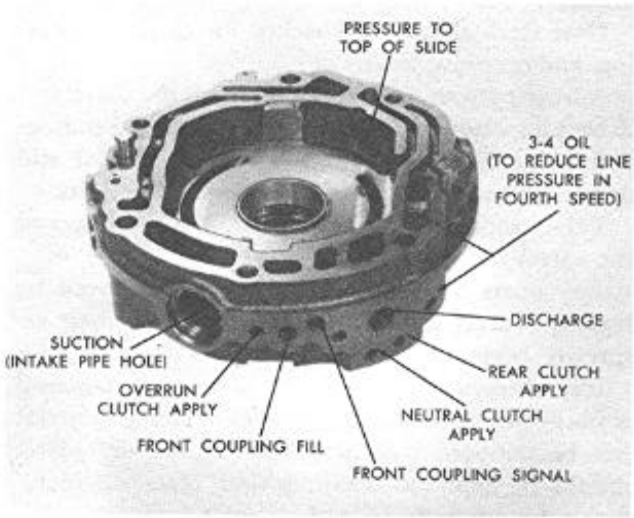


FIGURE 24—*Front Pump Body Passages*

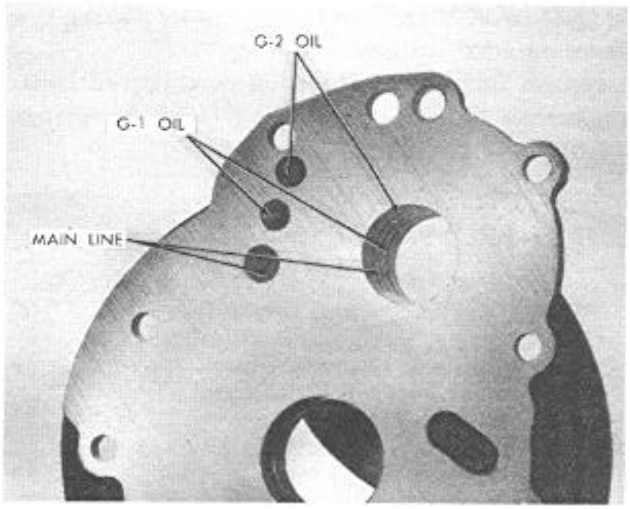


FIGURE 25—*Rear Pump Cover Passage*

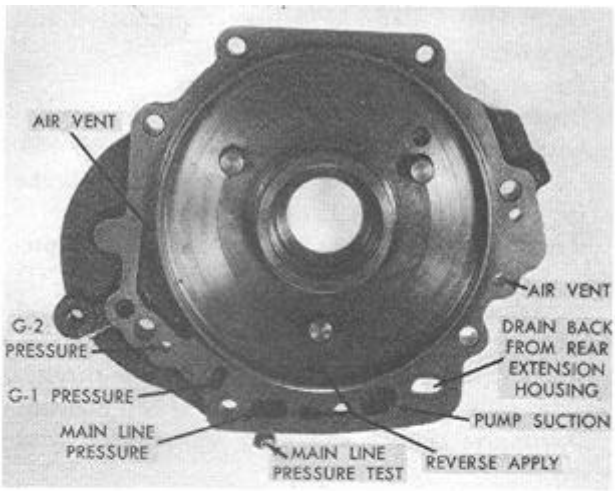


FIGURE 26—*Rear Pump Body Passages*

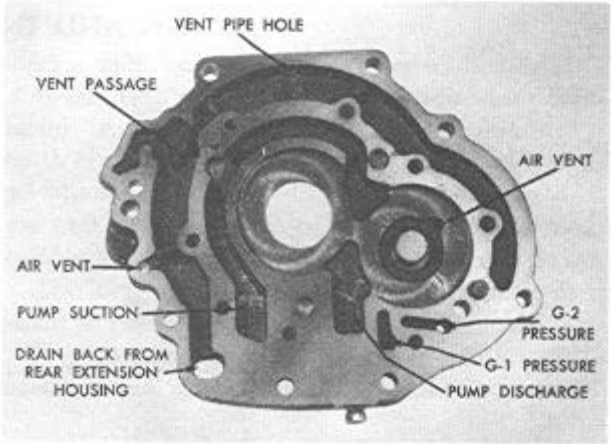


FIGURE 27—*Rear Pump Body Passages*

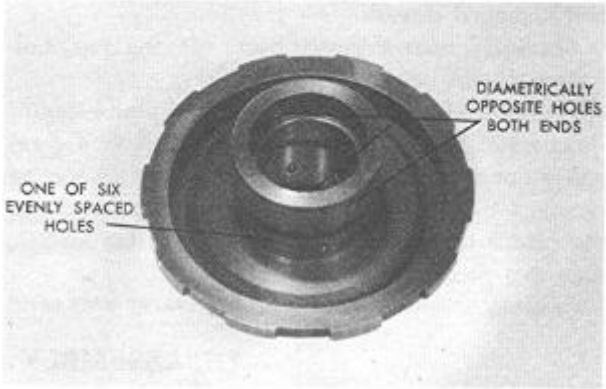


FIGURE 28—*Rear Clutch Cylinder Passages*

REMOVING THE TRANSMISSION

The transmission flywheel housing, torus cover, torus members, and flywheel are removed as an assembly.

Raise the car sufficiently on car stands, supporting the rear of the car at side sills. Support rear axle with hydraulic jack.

Drain Hydra-Matic fluid from transmission and torus cover.

Remove oil filler tube from oil pan.

Disconnect oil cooler tubes at right side of transmission.

Disconnect hand brake cable at bell crank brake cable housing at the bell crank bracket.

Remove brake hose bracket from floor pan to prevent damage to hose.

Disconnect speedometer cable and housing at transmission adapter.

Disconnect throttle rod assembly from throttle lever at transmission and bell crank at bell housing.

Disconnect control rod from transmission shift lever.

Disconnect the torque tube from the rear bearing retainer; then move the rear axle and torque tube assembly to the rear and separate by sliding the universal joint to the rear off the splines of the output shaft. Support the rear of the engine to remove the weight from the rear engine support cross member.

Remove plate from flywheel housing, and remove the six nuts that retain the flywheel and torus assembly to the engine flex plate. Place a hydraulic jack with Tool J-6130 under transmission.

Disconnect the flywheel housing to engine attaching bolts.

Disconnect the crossmember from the rear engine supports and from the body side sills.

With jack handle toward the rear of the car, raise the jack slightly to remove the strain or bind from the six bolts that were fastened to the flex plate.

Move complete transmission assembly to the rear and lower assembly after the six bolts have been withdrawn from the engine flex plate.

CLEANING AND INSPECTION OF PARTS

Care should be exercised during and after a complete disassembly of any hydraulically operated unit. Cleanliness is of the utmost importance. All metal parts should be washed in a clean solvent and dried with compressed air. Each oil passage should be blown out and checked to make sure that they are not obstructed. Small oil passages should be probed with a tag wire to insure against an obstruction.

A thorough inspection of all parts should be made to determine which parts are to be replaced.

Inspect linkage and pivot points for excessive wear.

Bearing and thrust surfaces of all parts should he checked for excessive wear and scoring.

Check for broken seal rings, damaged ring lands, and damaged threads.

Check the neutral clutch outer oil ring gap. Tolerance should be .002" to .007".

Mating surfaces of castings and end plates should be checked for burrs and irregularities. If a good seal is not apparent, burrs and irregularities may be removed by lapping the surface with crocus cloth; the crocus cloth should be held on a flat surface, such as a piece of glass.

Castings should be checked for cracks and sand holes.

Gear teeth should be checked for chipping, scoring, and excessive wear.

A wear pattern may be apparent on the drive and driven lugs, however, this is to be considered normal and the amount of clearance between the drive and driven lugs will not affect operation of the units.

Valves should be free of burrs. The shoulders of the valves must be square.

Any burrs or irregularities may be removed by honing. Valves should be free to slide in their respective bores.

Inspect composition clutch plates for damaged surfaces and loose facings. If flakes of facing material can be removed with the thumb nail, the plates should be replaced. Composition plate discoloration is not an indication of failure.

Inspect steel clutch plates for scored surfaces and damaged lugs. The six equally spaced waves must be .008" to .012" and can be checked by placing the plates on a flat surface.

Inspect springs for distortion or collapsed coils. Slight wear (bright spot) on the sides of the springs is permissable.

DISASSEMBLY OF UNITS FROM CASE

Mark flywheel and torus cover so flywheel can easily be reinstalled in the same position. Remove torus cover so flywheel cover to flywheel attaching nuts and remove flywheel assembly (Fig 29)

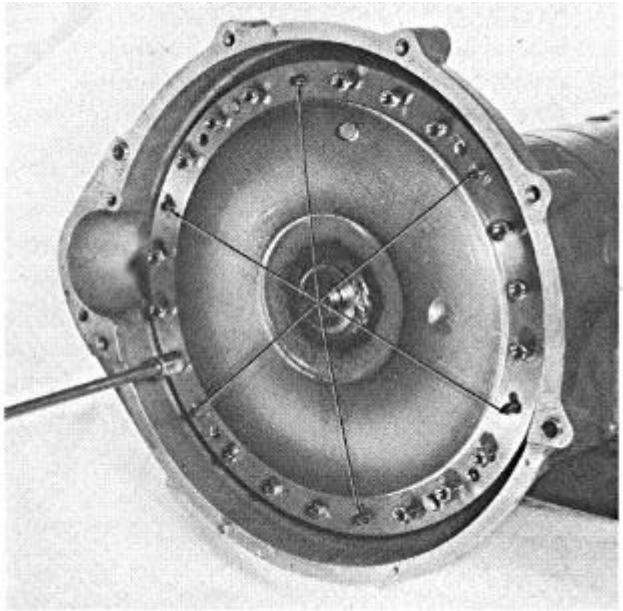


FIGURE 29—*Removing Torus Cover to Flywheel Attaching Nuts*

Remove large "0" ring seal from back of flywheel (torus cover to flywheel seal).

Remove driven torus Truarc snap ring from main shaft (Fig. 30).

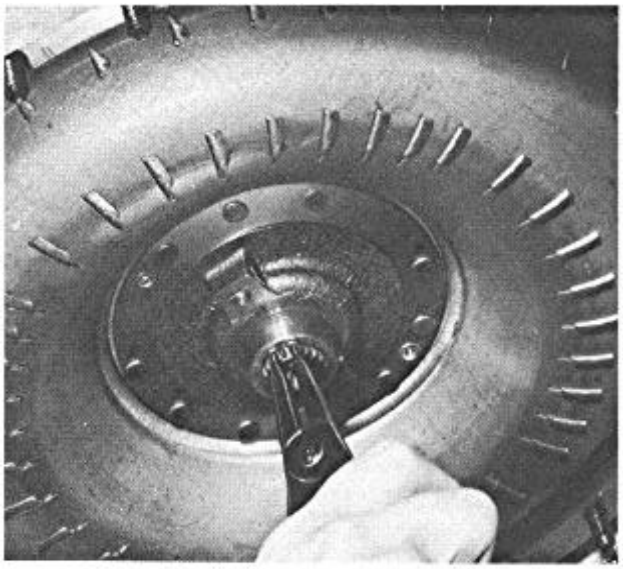


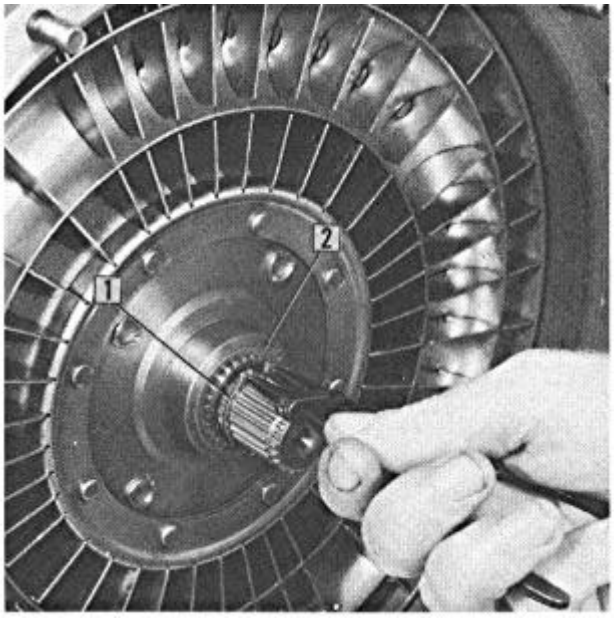
FIGURE 30—*Removing Driven Torus Front Snap Ring*

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

Remove driven torus member rear Truarc snap ring from main shaft (Fig. 31).

Remove drive torus member Truarc snap ring from intermediate shaft.

Remove drive torus member.



1. Driven Torus Rear Snap Ring
2. Drive Torus Snap Ring

FIGURE 31—*Removing Driven Torus Rear Snap Ring*

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

Remove bronze thrust washer and steel backing washer from sun gear to torus hub (Fig. 32).

1. Thrust Washers 2. Front Unit Sun Gear

FIGURE 32—*Removing Sun Gear to Torus Hub Thrust Washers*

Remove front unit sun gear from front unit driven torus shaft.

Remove front unit internal gear with steel backing and bronze thrust washer by pulling it out of the

torus cover assembly. Remove torus cover assembly by working hub of torus cover back through oil seal. Carefully pull torus cover out with even pressure to prevent damage to oil seal.

Remove selective spacer washer from front unit driven torus hub. (Spacer may have remained in internal gear, Figure 33.)

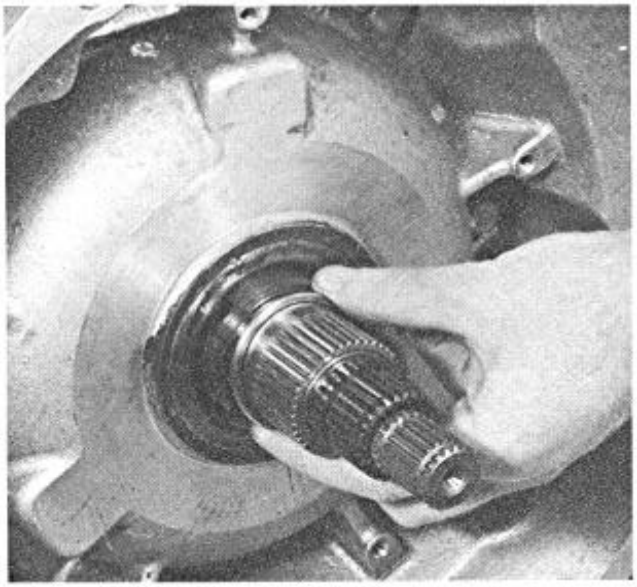
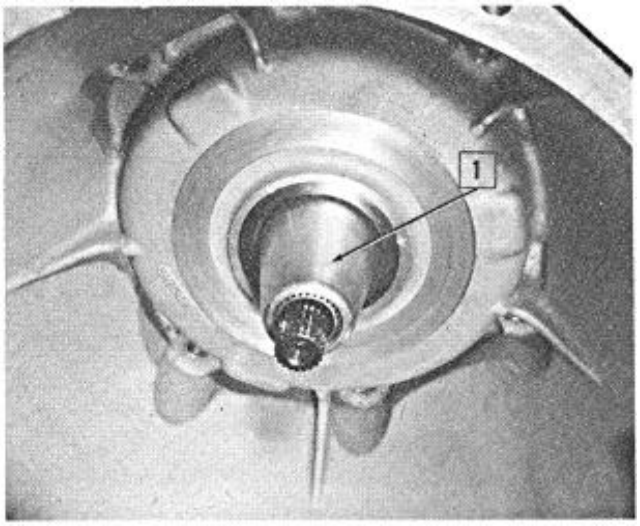


FIGURE 33—*Removing Front Unit Selective Spacer*

Install front seal protector, J-6119 over intermediate shaft to protect the front oil seal and bushing when removing the flywheel housing (Fig. 34).



1. Front Seal Protector J-6119

FIGURE 34—*Front Seal Protector in Position*

Remove bolts and washers holding flywheel housing assembly to front end of transmission case. Remove flywheel housing assembly gently over front seal protector.

NOTE: *If front unit coupling steel thrust washer adheres to bushing in housing, it should be removed to prevent it from dropping out and being damaged*.

Remove front seal protector and housing to case "0" ring seal from rear side of housing.

Install transmission holding fixture J-6115 to transmission case. Position so that supporting arm of stand is over transmission. Use flywheel rear housing attaching screws threaded through small holes in fixture (Fig. 35).

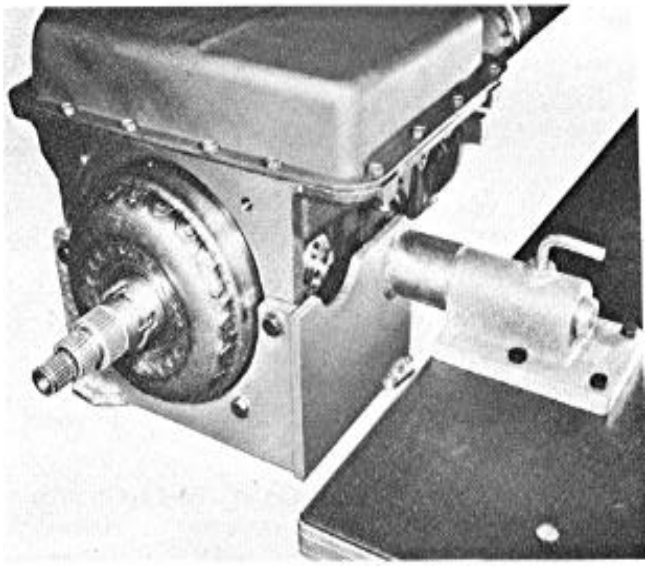


FIGURE 35—*Transmission Mounted in Holding Stand*

Install transmission into bench collet. \

CAUTION: *Use care to prevent front unit from sliding out of transmission and falling on floor. Position transmission horizontally with oil pan up and install lock handle in bench collet.*

CHECKING MAIN SHAFT END PLAY

To check main shaft end play, install collar of end play checking fixture J-6127 on main shaft and secure it in position by installing Truarc snap ring (Fig. 36).

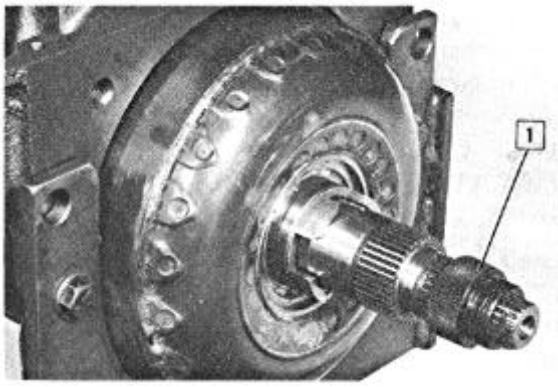
Attach fixture J-6127 to collar by threading collar securely into fixture.

Install dial indicator support J-6126 and dial indicator (Fig. 37).

Move main shaft back and forth to check end play of main shaft. End play should be .004" to .018". Be sure to get free main shaft end play. Forcing main shaft will give inaccurate reading.

NOTE: *Record amount of end play*.

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



l. Special Tool J-6127

FIGURE 36—*Collar of Tool J-6127 Installed on Shaft*

MEASURING FRONT UNIT END CLEARANCE

Feeler Gauge Method

Rotate transmission to vertical position with main shaft "up."

Install a No. 1 (.070") selective spacer washer over

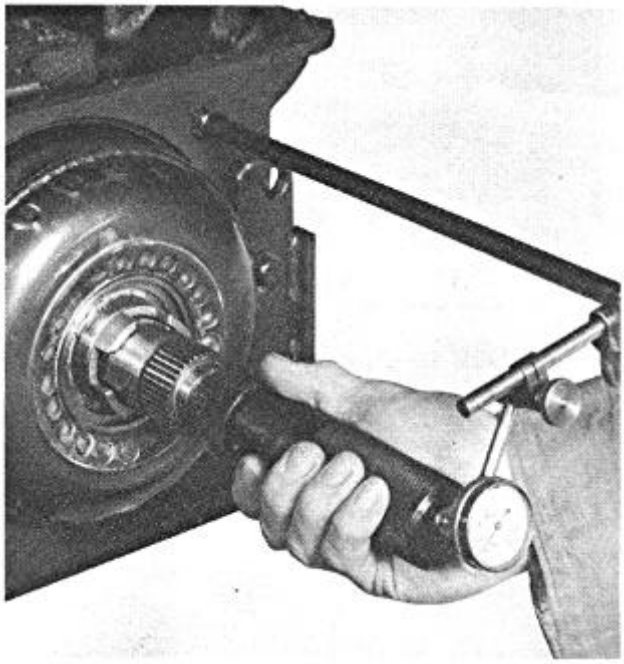
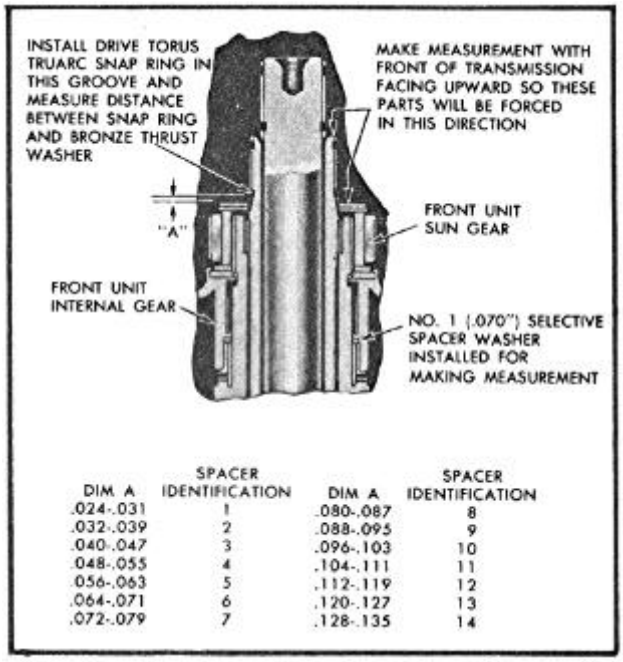


FIGURE 37—*Measuring Main Shaft End Play*

the front unit driven torus hub in place of the washer removed. The No. 1 washer must be installed for gauging purposes (Fig. 38).

Install front unit internal gear over front unit driven torus shaft against spacer washer.

Install bronze thrust washer and steel backing washer in front unit internal gear (steel washer has splines which engage splines of driven torus shaft).



DIM A	SPACER IDENTIFICATION	DIM A	SPACER IDENTIFICATION
.024-.031	1	.080-.087	8
.032-.039	2	.088-.095	9
.040-.047	3	.096-.103	10
.048-.055	4	.104-.111	11
.056-.063	5	.112-.119	12
.064-.071	6	.120-.127	13
.072-.079	7	.128-.135	14

FIGURE 38—*Front Unit Selective Spacer Chart*

Install front unit sun gear and install steel and bronze thrust washers over intermediate shaft against sun gear.

Install drive torus Truarc snap ring in groove on intermediate shaft nearest to bronze thrust washer.

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

Push snap ring down against bottom of groove and with feeler gauges, very carefully measure clearance between snap ring and bronze thrust washer (Fig. 39).

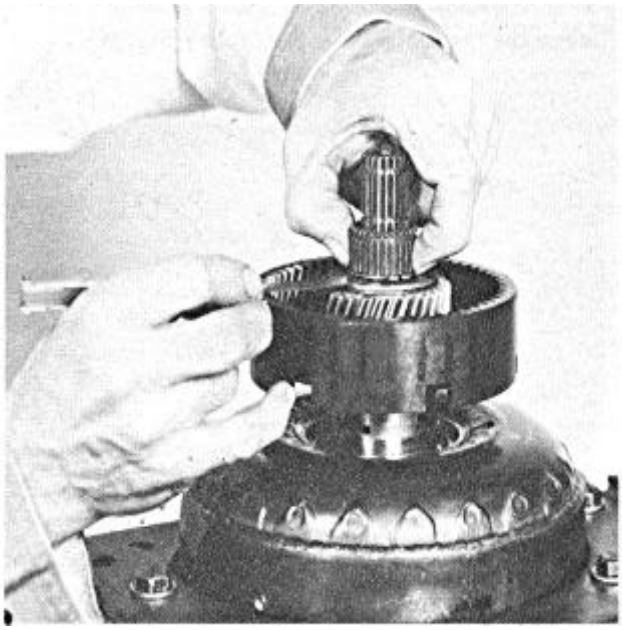


FIGURE 39—*Measuring Front Unit End Clearance with Feeler Gauge*

CAUTION: *The feeler gauge must be flat against the thrust washer to obtain an accurate reading.*

Compare measurement found with feeler gauge with the chart in Figure 38 to determine the correct selective spacer washer to use. For example: if measurement is found to be .067", a number 6 selective spacer washer should be used when transmission is reassembled. Check the number on the original spacer (which was removed from the transmission). It should be the same as the number found on the chart. If not, a new spacer must be used for reassem bly. The identification number of the required spacer should be recorded so that it can be obtained for assembly.

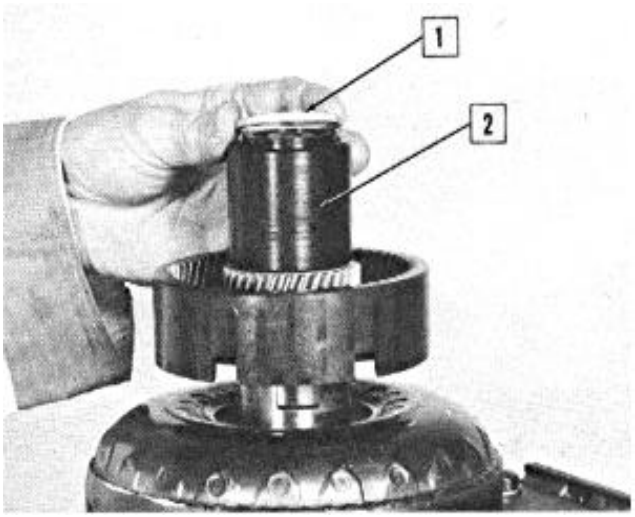
Remove Truarc snap ring, sun gear with bronze and steel thrust washers, internal gear with steel and bronze thrust washers, and .070" selective spacer washer.

Special Tool Method

Assemble parts as outlined in the first five paragraphs listed under "Feeler Gauge Method."

Place front unit end play checking gauge J-6282 over intermediate shaft with splined end of inner sleeve facing down. The outer sleeve of tool will rest on front unit sun gear bronze thrust washer and the splines of the inner sleeve will rest against the bottom edge of the groove from which the clearance is measured (Fig.,40). It will be noted that the inner sleeve now projects above the outer sleeve.

Place the front unit selective spacer washer, which was removed from the transmission, over the inner sleeve of gauge J-6282. When the washer lies flat on the outer sleeve, the top of it should be flush with the top of the inner sleeve. If it is not flush, select a washer which is flush and install the new washer when the transmission is assembled (Fig. 40).



1. Selective Spacer 2. Special Tool J-6282

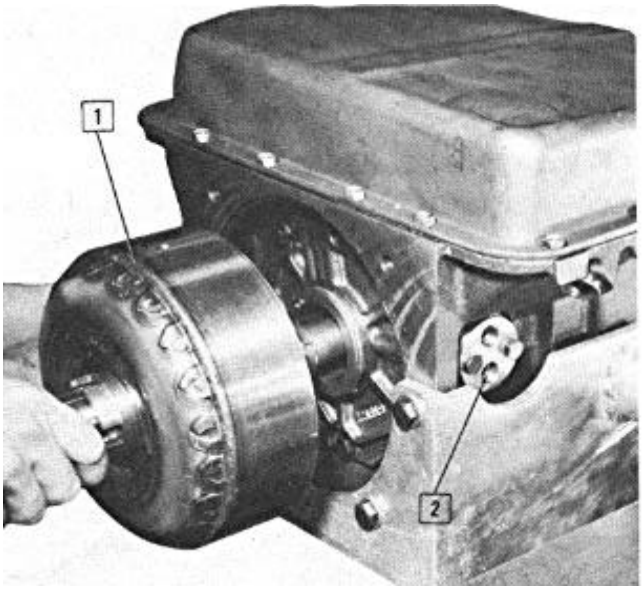
FIGURE 40—*Measuring Front Unit End Clearance with Tool J-6282*

Remove gauge, sun gear with bronze and steel thrust washers, internal gear, with steel and bronze thrust washers, and .070" selective spacer washer.

FRONT UNIT COUPLING, PRESSURE REGULATOR, AND COOLER ADAPTER REMOVAL

Rotate transmission to horizontal position with oil pan "up."

Remove front unit coupling assembly from transmission case and remove oil cooler adapter attaching screws and adapter with gasket from side of transmission case. Remove two oil cooler sleeves and seals by pulling from case (Fig. 41).



1. Front Unit Coupling 2. Oil Cooler Adapter

FIGURE 41—*Removing Front Unit Coupling Assembly*

Remove pressure regulator plug assembly from side of transmission case (Fig. 42).

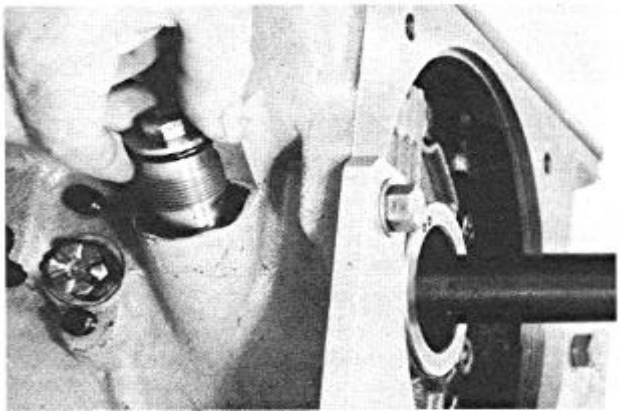


FIGURE 42—*Removing Pressure Regulator Plug Assembly*

Remove pressure regulator spring and pressure regulator valve (Fig. 43).

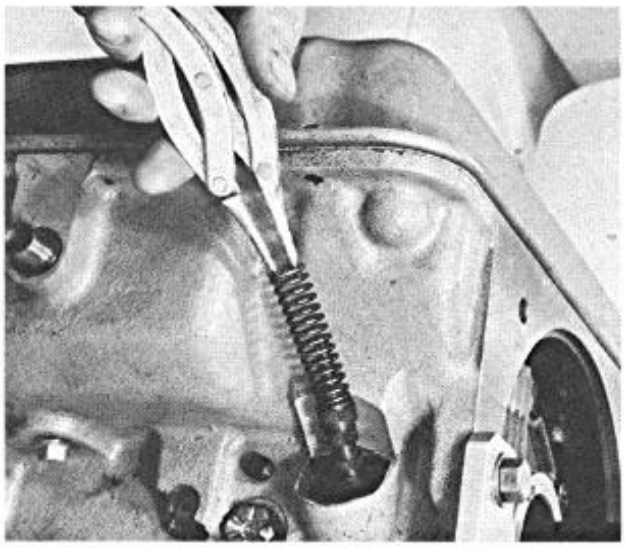


FIGURE 43—*Removing Pressure Regulator Spring and Valve*

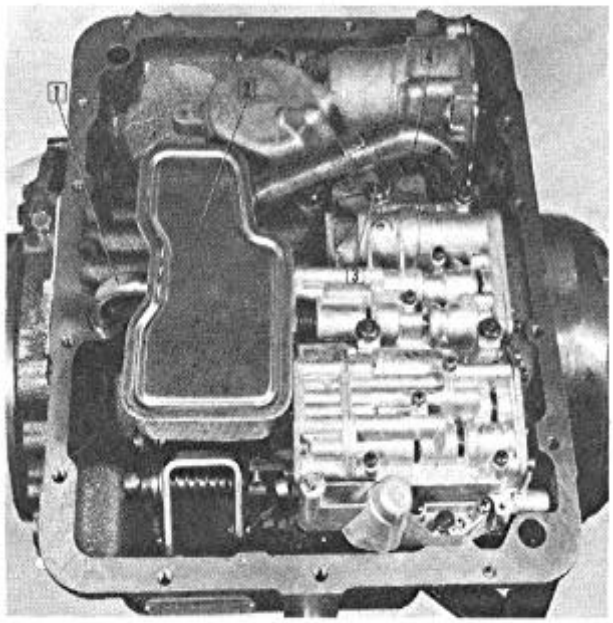
OIL PAN, OIL SCREEN, AND INTAKE PIPE REMOVAL

Remove oil pan attaching screws, oil pan and gasket from transmission; discard gasket.

Remove screw holding front pump intake pipe clamp.

Remove front pump intake pipe and clamp from pump and screen. Remove "0" ring from pump.

Remove oil screen and rear pump intake pipe and "0" ring (Fig. 44).



1. Rear Pump Intake Pipe
2. Oil Screen
3. Clamp and Bolt
4. Front Intake Pipe

FIGURE 44—*Transmission with Oil Pan Removed*

CONTROL VALVE, SERVO AND ACCUMULATOR REMOVAL

Remove three attaching screws holding servo and accumulator assembly to case.

NOTE: *Servo piston is spring loaded.*

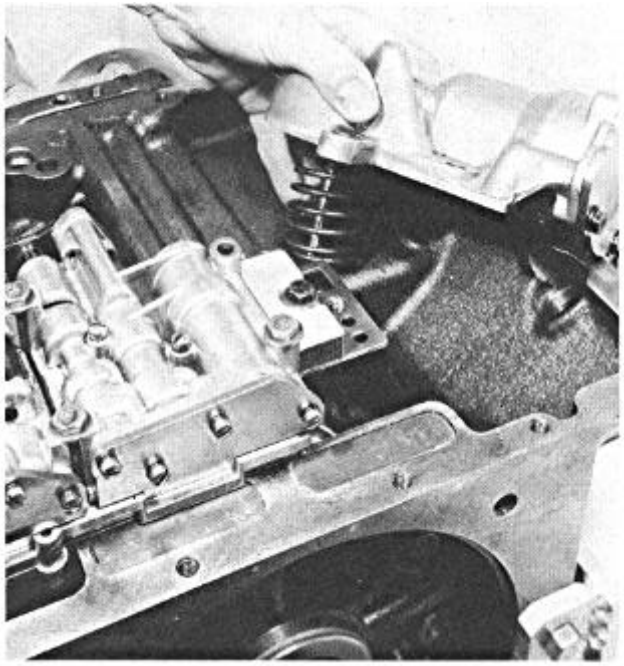


FIGURE 45—*Removing Servo and Accumulator Assembly*

Remove servo and accumulator assembly and servo spring (Fig. 45).

Remove remaining control valve assembly to case attaching screws.

Remove control valve assembly from transmission case. Use care not to drop manual valve (Fig. 46).

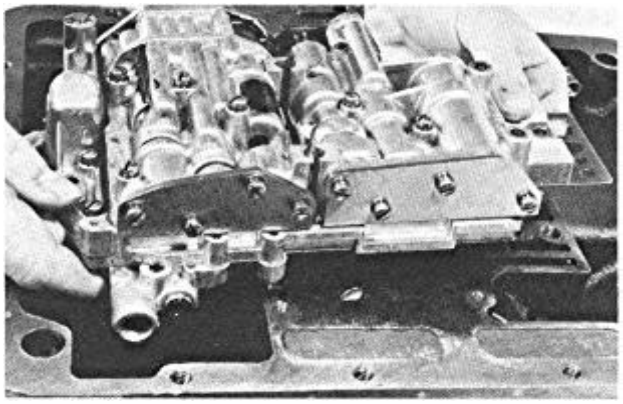


FIGURE 46—*Removing Valve Control Assembly*

FRONT PUMP AND OVERRUN CLUTCH REMOVAL

Remove front pump locking screw and lock washer located under control valve assembly (Fig. 47).

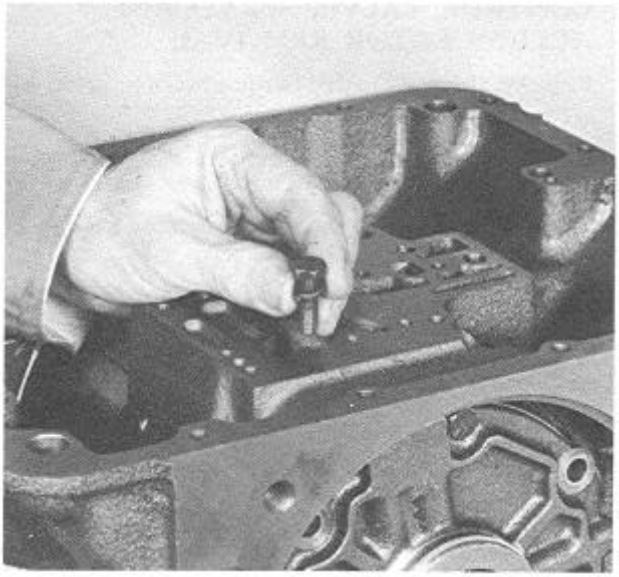


FIGURE 47—*Removing Front Pump Locking Screw*

Remove the three 9/16" front pump attaching screws. Then remove two opposite front pump cover to body screws using 1/2" socket.

Install two slide hammers (J-6125) into the two opposite cover to body screw holes in front pump, and remove front pump assembly from case (Fig. 48).

NOTE: *Front sprag inner race may stick in pump. Be careful not to drop it on floor if it is in pump as removed. Remove front sprag inner race if it did not come out with pump.*

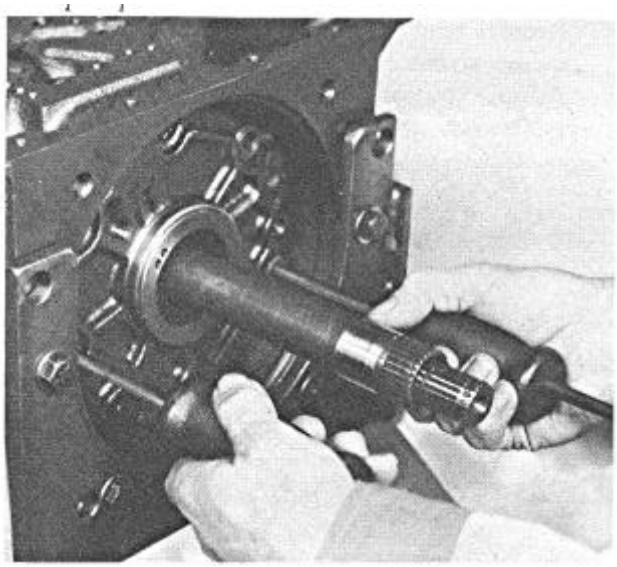
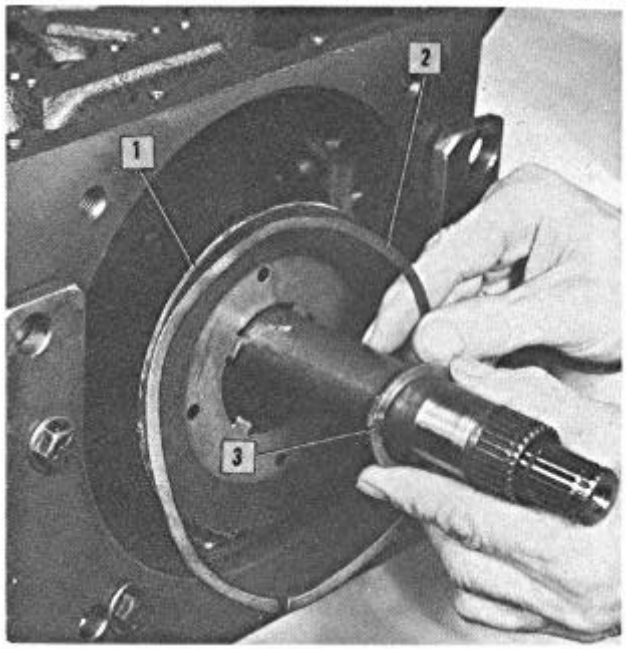


FIGURE 48—*Removing Front Pump*

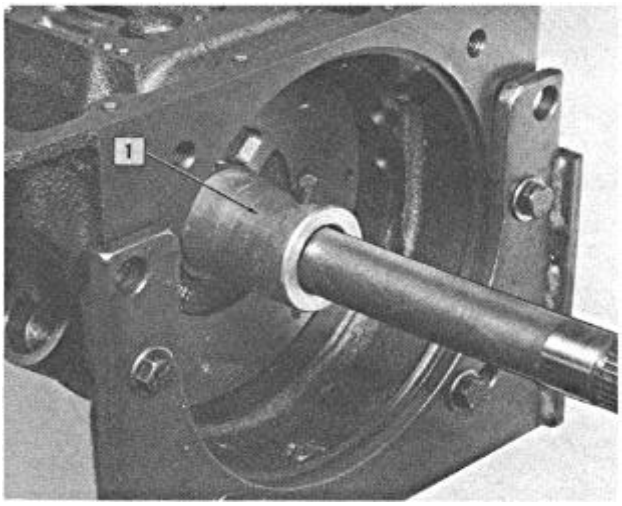
Remove overrun clutch thrush washer, release spring, and overrun clutch plate (Fig. 49).

Install case support holding tool J-6135, set screw end toward front and lock securely (Fig. 50).



1. Overrun Clutch Plate
2. Release Spring
3. Thrust Washer

FIGURE 49—*Removing Overrun Clutch Thrust Washer, Spring, and Plate*



1. Special Tool J-6135

FIGURE 50—*Case Support Holding Tool in Position*

CASE SUPPORT, NEUTRAL CLUTCH, AND REAR UNIT ASSEMBLY REMOVAL

Remove speedometer driven gear from rear extension housing.

If rear oil seal is to be replaced, remove seal using tool J-2623 and slide hammer J-2619B.

Remove rear extension housing and gasket and discard gasket. It may be necessary to tap housing to rear to loosen.

Remove governor assembly by pulling governor out of rear pump housing (Fig. 51).

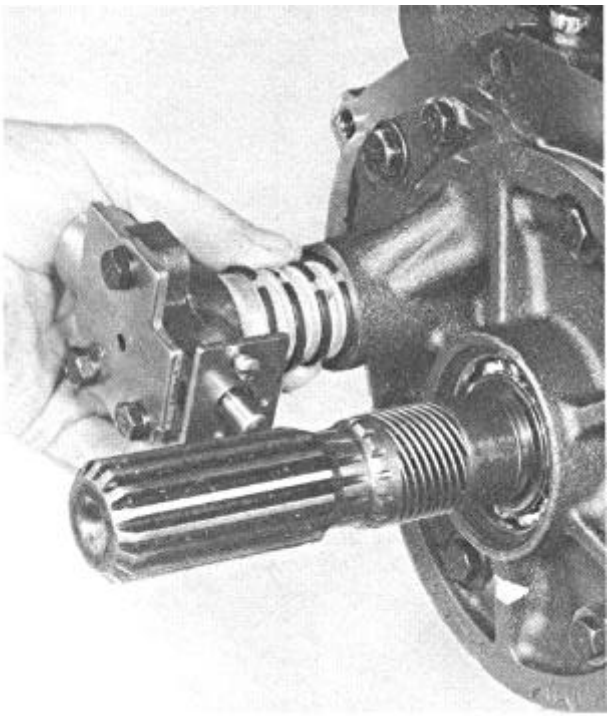


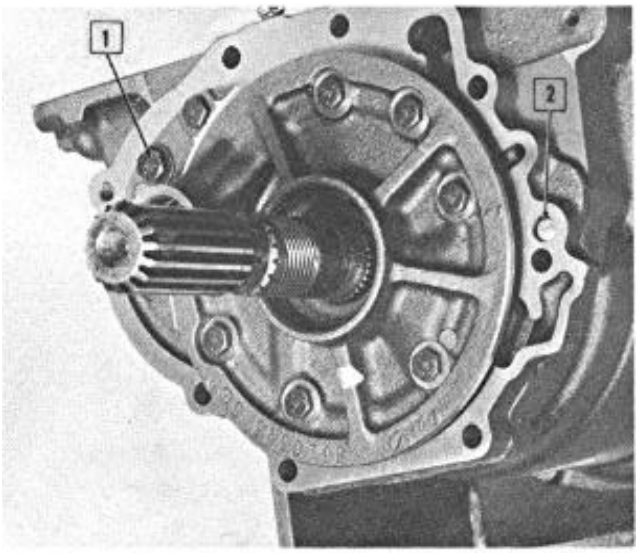
FIGURE 51—*Removing Governor from Rear Pump Assembly*

Governor drive key may or may not stay with governor.

Remove breather pipe clamp screw from rear of transmission case and carefully pry breather pipe out of rear pump body.

Remove rear bearing snap ring from output shaft.

Remove rear pump locating screw and attaching screw (Fig. 52).



1. Rear Pump Attaching Screw
2. Rear Pump Locating Screw

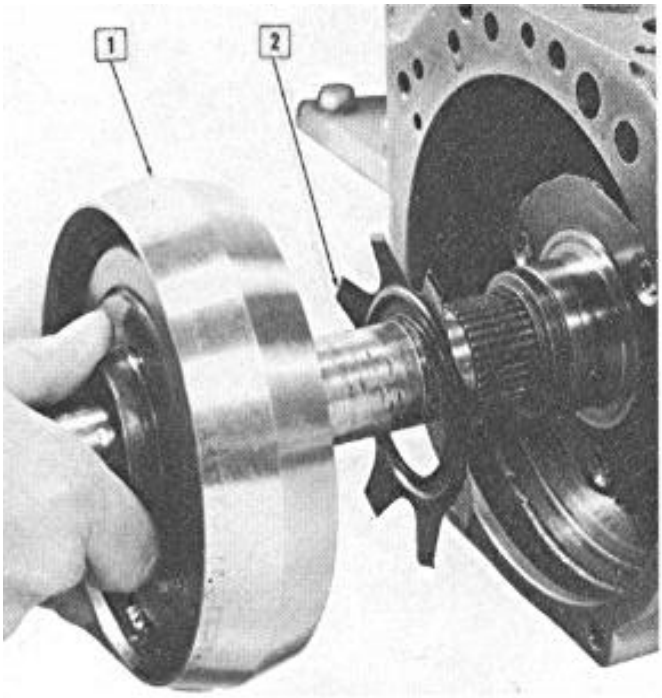
FIGURE 52—*Rear Pump Attaching and Locating Screws*

Remove rear pump, gasket, and reverse piston as an assembly, over output shaft; discard gasket.

NOTE: *If necessary, remove two pump cover attaching screws and insert two slide hammers (J-6125) and pull pump over shaft.*

Remove thrust washer from reverse internal gear. Remove reverse piston release spring.

Remove internal gear and the reverse clutch release spring (Fig. 53).



1. Reverse Internal Gear
2. Reverse Clutch Release Spring

FIGURE 53—*Removing Reverse Internal Gear*

Remove reverse planet carrier snap ring.

Remove reverse stationary cone and planet carrier by pulling the reverse planet carrier assembly out of transmission.

Remove reverse stationary cone key if it did not fall out of transmission case when stationary cone was removed. If key sticks, it can be tapped out through hole in bottom of case.

Remove center support to case snap ring at front of case, using screw driver (Fig. 54).

Remove case support locking screw on pressure regulator plug side of transmission case (Fig. 55).

Remove rear unit, neutral clutch, and case center support assembly by sliding complete assembly out the front of transmission case.

NOTE: *If assembly is tight in case, use J-6125 slide hammer assemblies with J-6134 adapters (Fig. 56).*

Install complete assembly into clutch unit holding fixture J-6116 positioning output shaft down or drill 2" hole in bench to hold assembly (Fig. 57).

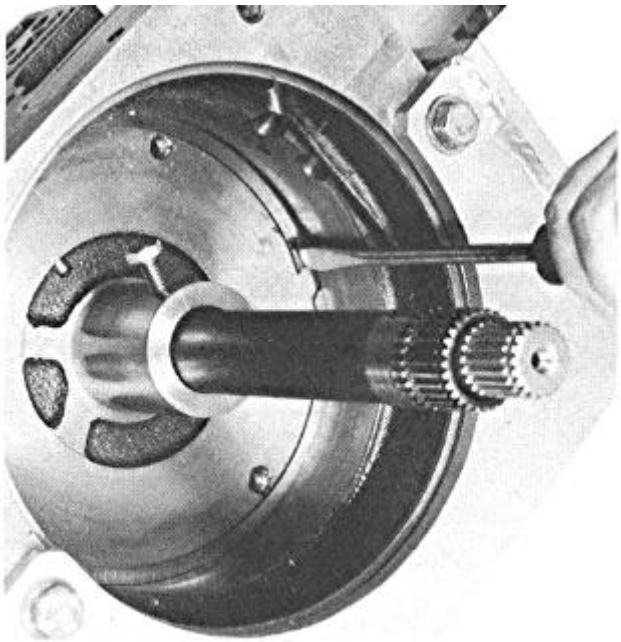


FIGURE 54—*Removing Case Center Support Snap Ring*

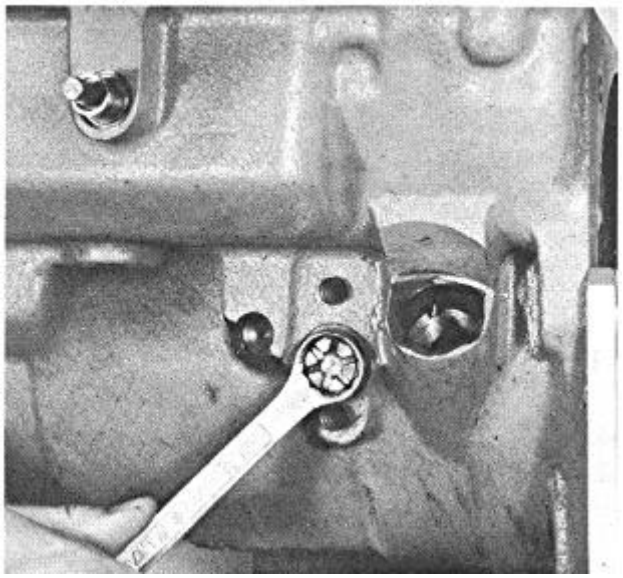


FIGURE 55—*Removing Case Support Locking Screw*

Remove neutral clutch key from case. If key is tight, it can be tapped out through hole in bottom of case.

Remove low band from transmission case as follows:

Unhook band end from case anchor located inside of case.

With band unhooked, rotate band to horizontal position in transmission case.

Turn band so that band ends are facing rear of transmission case and pull out through front of case Fig. 58)

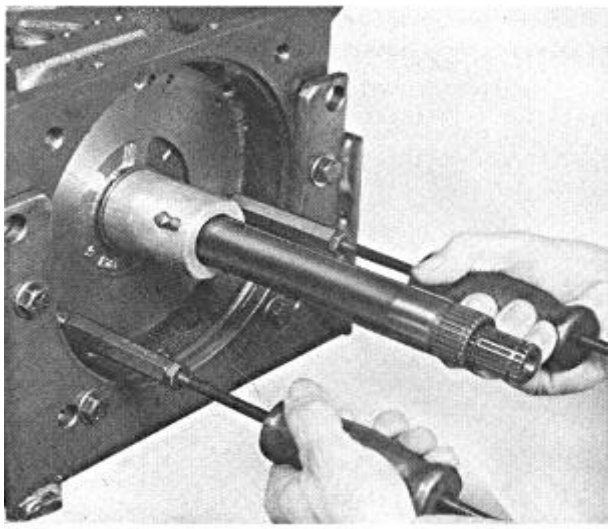


FIGURE 56—*Using Slide Hammer and Adapter to Pull Units*

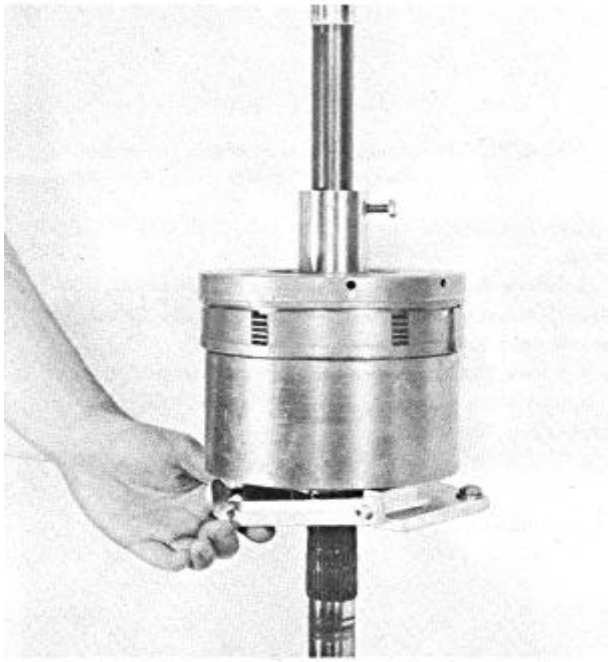


FIGURE 57—*Clutch Unit Installed in Holding Fixture*

INSIDE DETENT AND THROTTLE LEVER REMOVAL

NOTE: *Normally these parts should not be removed unless they are to be replaced.*

Remove outer shift lever from detent lever shaft.

Remove snap ring from detent lever shaft (Fig 59).

Rotate detent lever to position which would engage parking pawl so that detent lever will clear the parking bracket assembly. Then remove detent lever, throttle lever

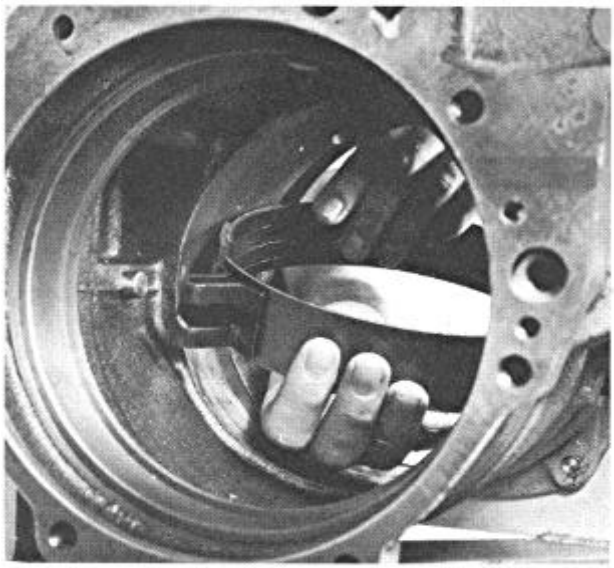
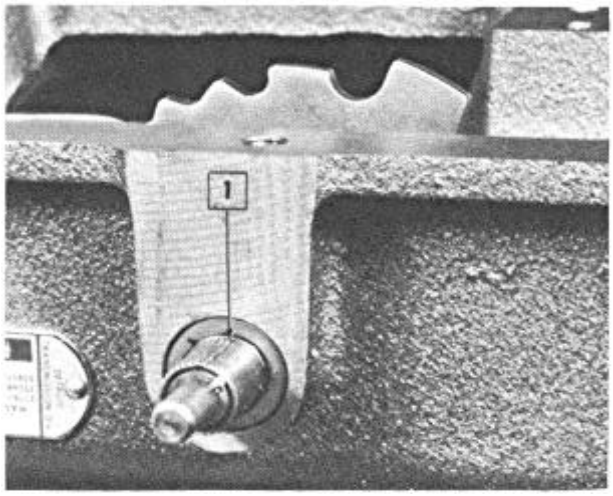


FIGURE 58—*Removing Low Band from Case*



1. Snap Ring

FIGURE 59—*Detent Lever Retaining Snap Ring.*

assembly, and inner steel washer from case by sliding toward center of case. Remove steel washer and "0" ring from case.

PARKING PAWL AND LINKAGE REMOVAL

NOTE: *These parts should not be removed unless they are to be replaced.*

Thread a 3/8" cap screw into the parking pawl pivot shaft, then use the screw to work (or slide) the pivot shaft out of the case (Fig. 60). Remove cap screw from pivot shaft.

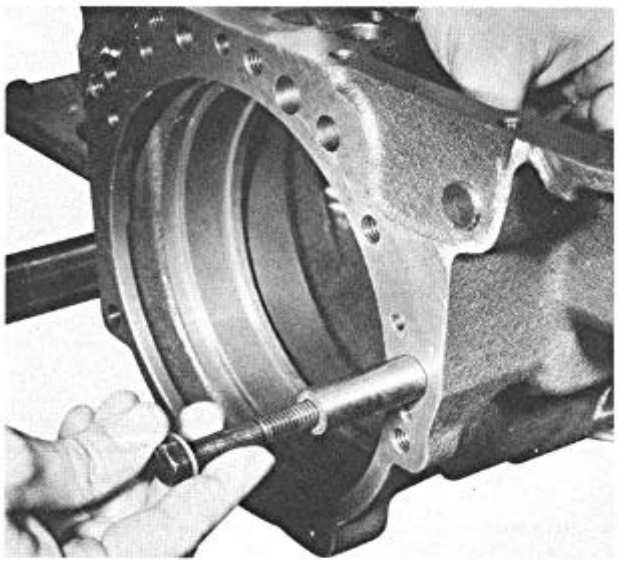


FIGURE 60—*Removing Parking Pawl Pivot Shaft*

Unhook parking pawl spring; slide bracket and spring from shaft.

Remove washer from shaft.

Rotate pawl upward and slide pawl and linkage from shaft.

Remove parking pawl spacer washer from case

DISASSEMBLY OF CASE SUPPORT, NEUTRAL CLUTCH, AND REAR UNIT

Remove case support holding tool J-6135, backing off set screw far enough to prevent damage to machined surface at front of intermediate shaft.

Remove hook type oil ring from intermediate shaft by pushing one end toward the center of shaft and other away from shaft to unhook the oil ring (Fig. 61).

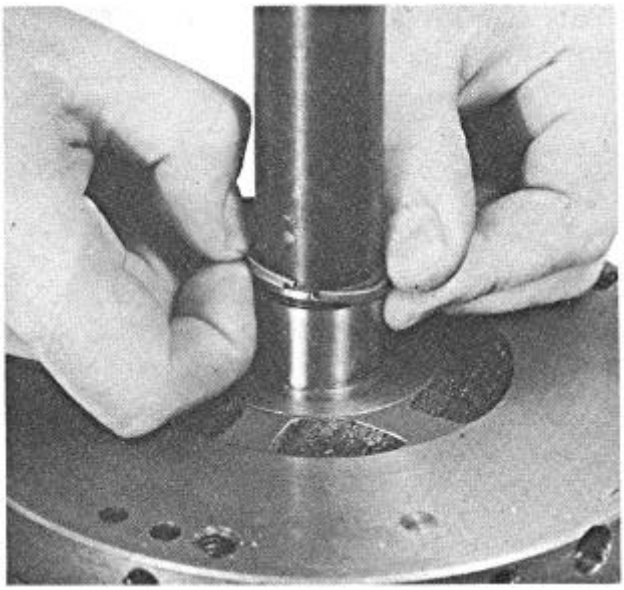


FIGURE 61—*Removing Oil Seal Ring*

Remove case support and neutral clutch piston assembly (Fig. 62).

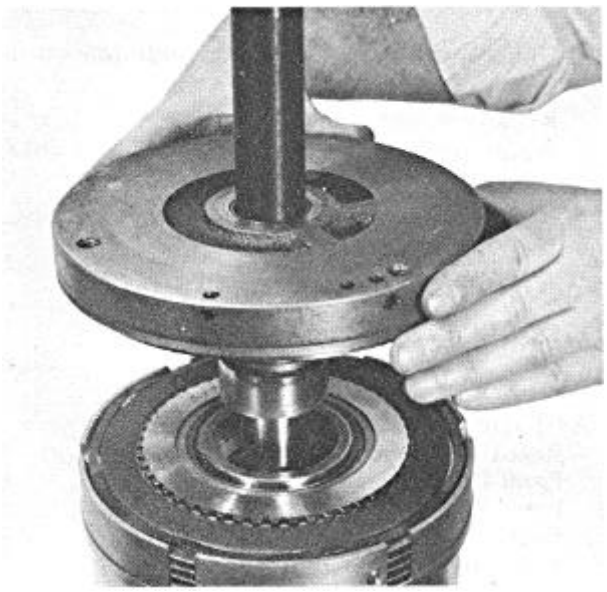


FIGURE 62—*Removing Case Support and Clutch Piston Assembly*

Remove two oil rings from case support hub and remove neutral clutch piston. Turn case support over and bump on bench to remove piston.

NOTE: *Leave rings in place on piston and case hub support.*

Remove neutral clutch drum assembly which contains five composition clutch plates, four steel clutch plates, and five release springs (Fig. 63).

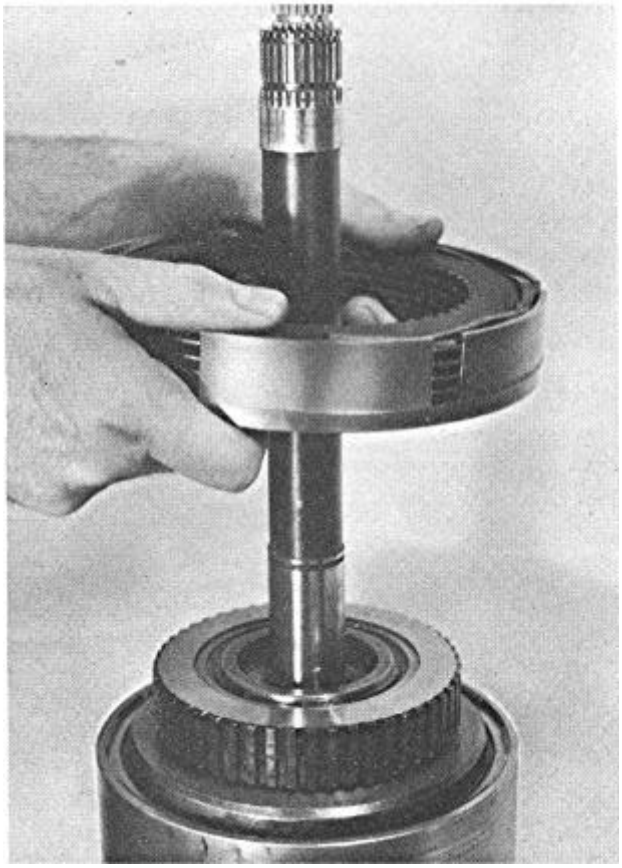


FIGURE 63—*Removing Neutral Clutch Drum*

Remove large snap ring from rear drum assembly with screw driver (Fig. 64).

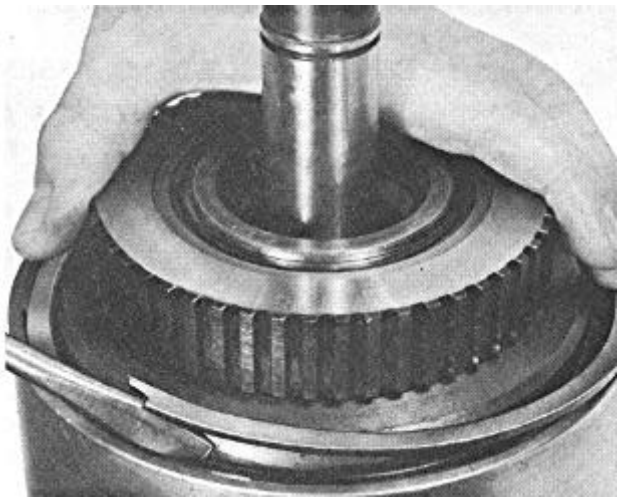


FIGURE 64—*Removing Snap Ring from Rear Drum*

Remove rear clutch cylinder and sprag assembly by lifting over intermediate shaft (Fig. 65).

FIGURE 65—*Removing Rear Clutch Cylinder and Sprag Assembly*

Remove intermediate shaft and clutch hub, together with neutral clutch hub washer from rear unit assembly (Fig. 66).

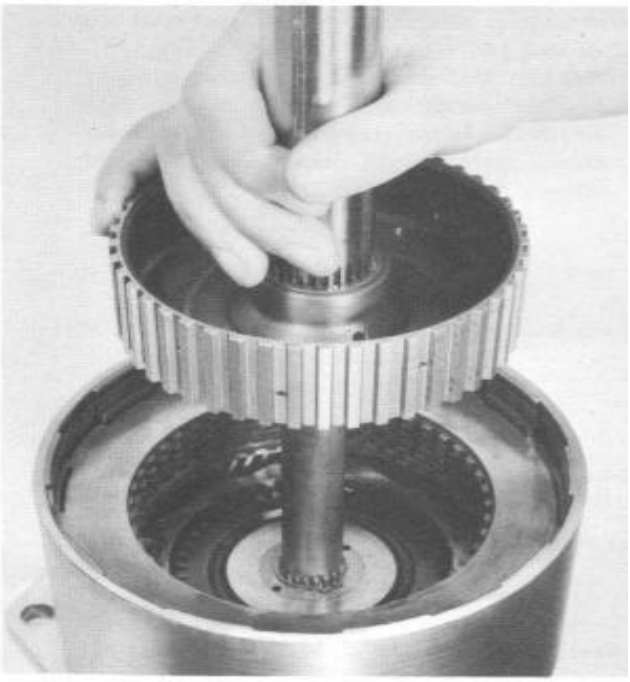


FIGURE 66—*Removing Intermediate Shaft and Clutch Hub*

NOTE: *Intermediate shaft and clutch hub may be disassembled if parts replacement is necessary.*

Remove clutch hub front thrust washer from clutch hub.

Remove the main shaft assembly and rear unit sun gear from rear unit and the clutch hub thrust washer from sun gear.

NOTE: *Main shaft and rear unit sun gear may be disassembled if parts replacement is necessary.*

Remove the seven steel clutch plates and seven composition plates.

Remove bronze thrust washer from rear unit carrier.

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

Remove large snap ring holding reverse drive flange to rear unit drum. Lift output shaft and reverse drive flange assembly out of rear unit drum (Fig. 67).

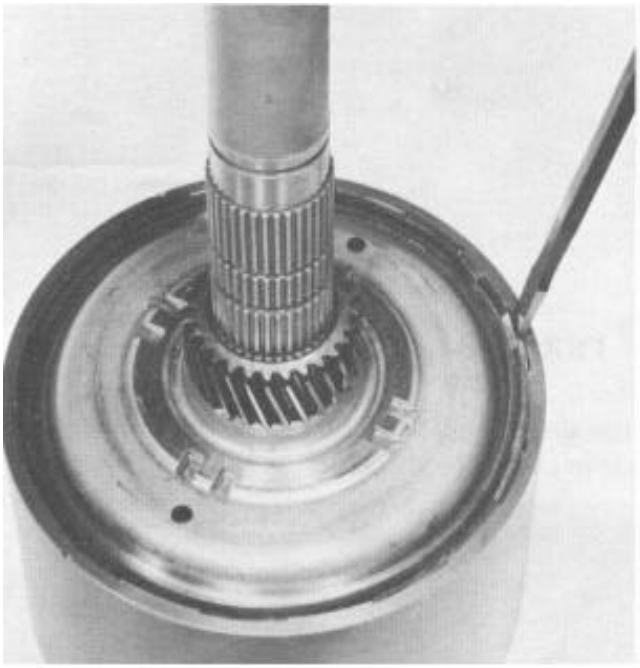
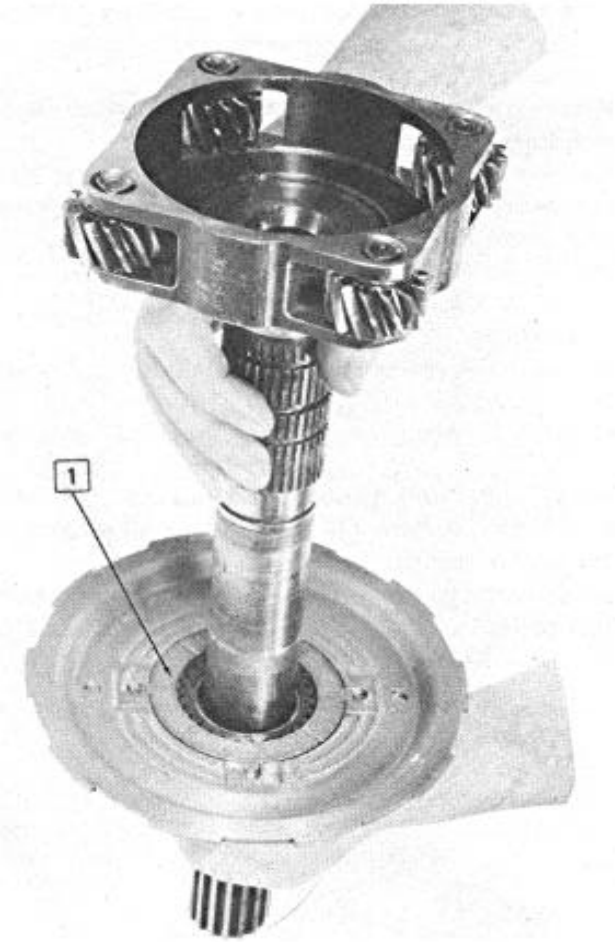


FIGURE 67—*Removing Snap Ring from Rear Unit Drum*

If parts replacement is necessary, mark internal gear so it can be replaced with same side up. Then remove internal gear and rear unit clutch backing plate from rear unit drum assembly together by tapping backing plate with soft hammer.

Remove reverse planet carrier locating snap ring from output -shaft. Remove reverse drive flange and sun gear assembly from output shaft and remove selective washer from reverse drive flange assembly or output shaft (Fig. 68).

Remove spiral snap ring from rear unit sprag inner race. Using a small needle nose pliers or small screwdriver, insert



1. Selective Thrust Washer

FIGURE 68—*Removing Output Shaft from Reverse Drive Flange*

small tool into small elongated hole in end of spiral ring and pull upward (Fig. 69).

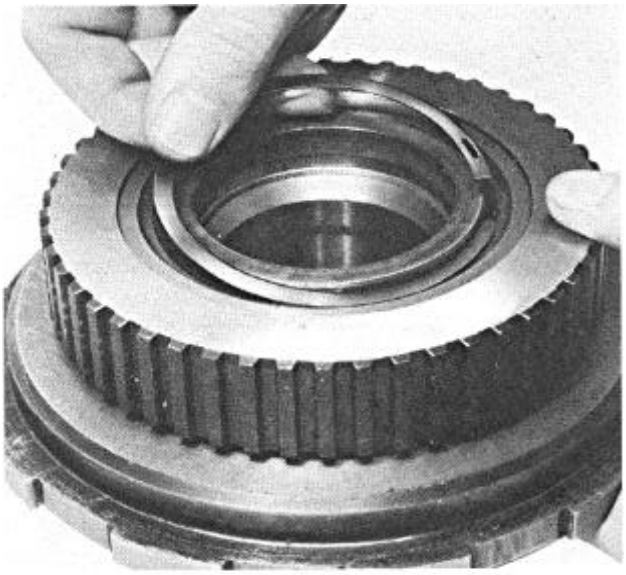
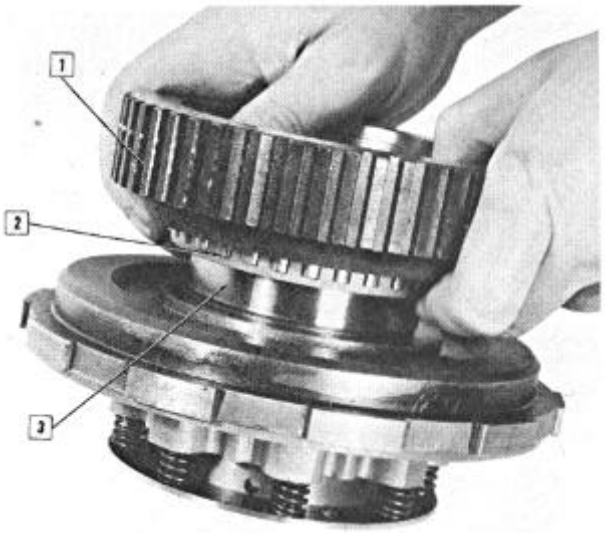


FIGURE 69—*Removing Spiral Snap Ring from Inner Race*

Remove outer race, sprag and retainer by rotating clockwise and pulling upward (Fig. 70).



1. Rear Sprag Outer Race 3. Rear Sprag Inner Race
2. Sprag Assembly

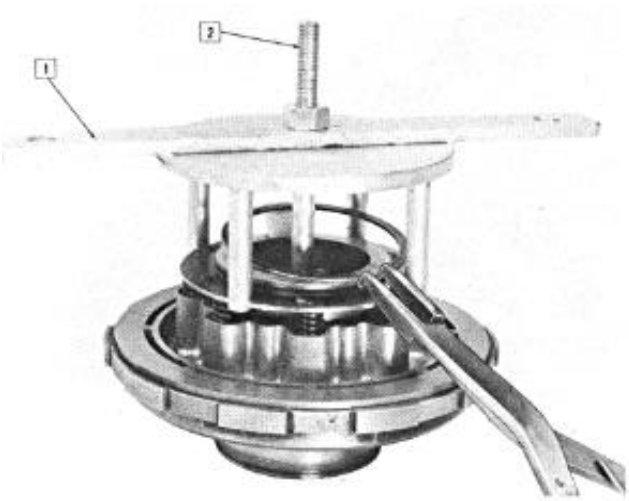
FIGURE 70—*Removing Rear Unit Sprag Assembly*

CAUTION: *Do not attempt to disassemble sprag assembly.*

Remove rear unit sprag retainer and sprag.

Disassemble rear unit clutch piston assembly by placing cylinder and piston assembly over tool J-6129 with spring end "up." Set spring compressor tool J-4670 on top of spring retainer and start nut on stud of tool J-6129.

NOTE: *On special tool J-4670, without hole in middle, drill a 7/16" hole so tool 1-6129 can be inserted through it. Compress clutch springs until snap ring is free and remove snap ring (Fig. 71).*



1. Tool J-4670 2. Tool J-6129

FIGURE 71—*Removing Rear Unit Clutch Spring Snap Ring*

Remove compressor tool, retainer, and clutch release springs. Remove rear clutch piston from cylinder by tapping piston on wood block. Remove seals from piston and hub.

ASSEMBLY OF REAR UNIT, NEUTRAL CLUTCH AND CASE SUPPORT

Hold the reverse drive flange and sun gear with the drive flange "up." Install proper selective thrust washer (as determined by mainshaft end play check), in recess of drive flange, with locating lugs indexed in flange. Use petrolatum to hold washer in place (Fig. 72).

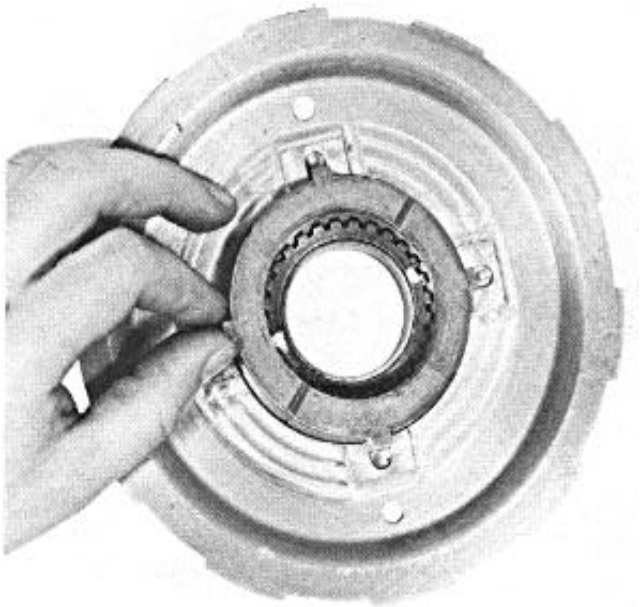


FIGURE 72—*Installing Selective Washer in Reverse Drive Flange*

Insert output shaft through drive flange and sun gear until carrier bottoms on selective thrust washer (Fig. 73).

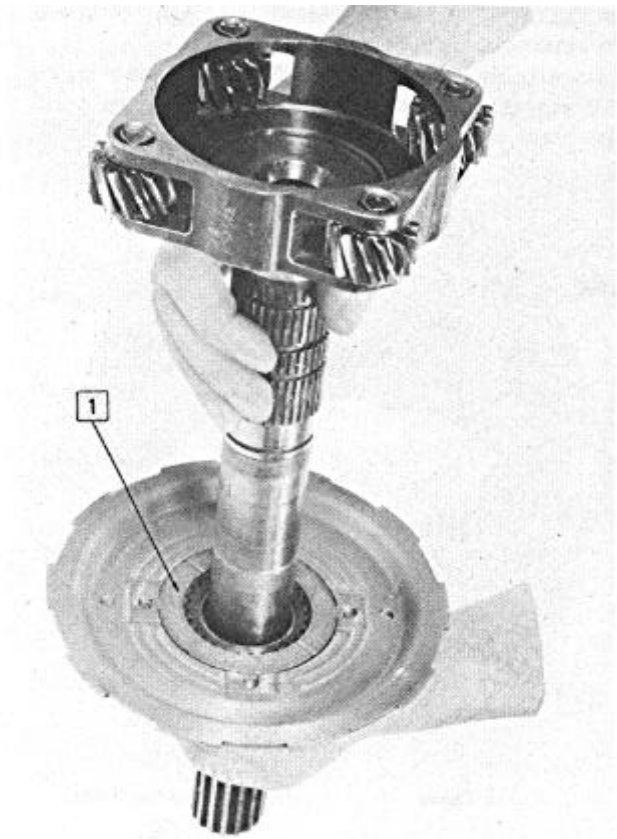
Hold the drive flange and sun gear tightly against carrier to keep selective washer from moving and set output shaft and carrier on table on carrier end.

Install reverse planet carrier front snap ring on output shaft.

Insert reverse drive flange retainer J-6120 between snap ring and sun gear to prevent selective washer from dropping out of position (Fig. 74).

> NOTE: *When the selective washer used between the reverse drive flange and rear unit planet carrier is at or near the upper limit of thickness, retainer tool 1-6120 cannot be inserted between snap ring and flange. In this case, it is not necessary to use the retainer since there is not enough clearance to allow the thrust washer to drop out of place.*

Set rear unit drum on bench with long undercuts on lugs



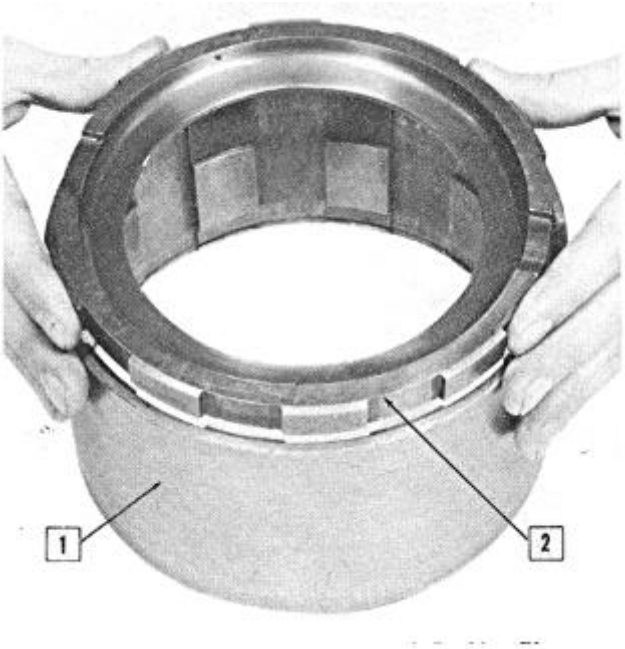
1. Selective Wahers

FIGURE 73—Assembling Reverse Drive Flange to Output Shaft

IGURE 74—*Reverse Drive Flange Retainer J-6120 in Position*

"up" or with internal gear "up" if it was not removed.

Install clutch backing plate with flat surface down if it was removed. It may be necessary to tap plate into place with soft hammer (Fig. 75).



1. Rear Clutch Drum 2. Clutch Backing Plate

FIGURE 75—*Installing Rear Unit Clutch Backing Plate*

Install rear unit internal gear with mark "up" if the gear was originally removed. Position gear against clutch backing plate. Slight tapping with soft hammer may be necessary (Fig. 76).

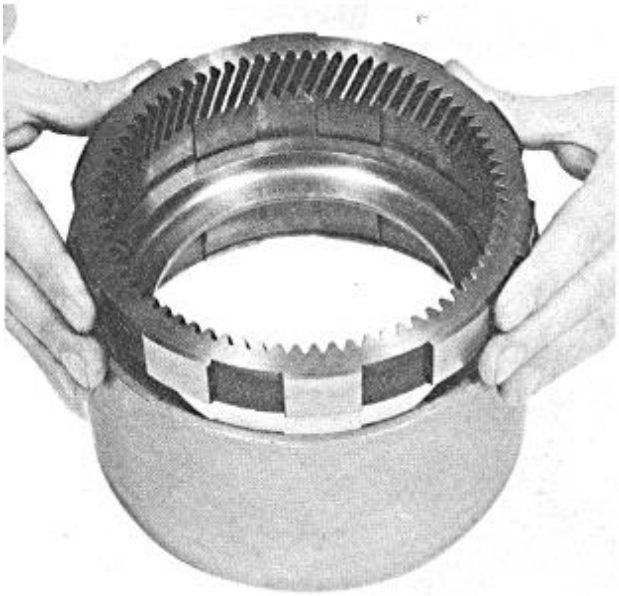


FIGURE 76—*Installing Rear Unit Internal Gear*

Install output shaft and reverse drive flange asembly into rear unit drum and secure with large snap ring (Fig. 77).

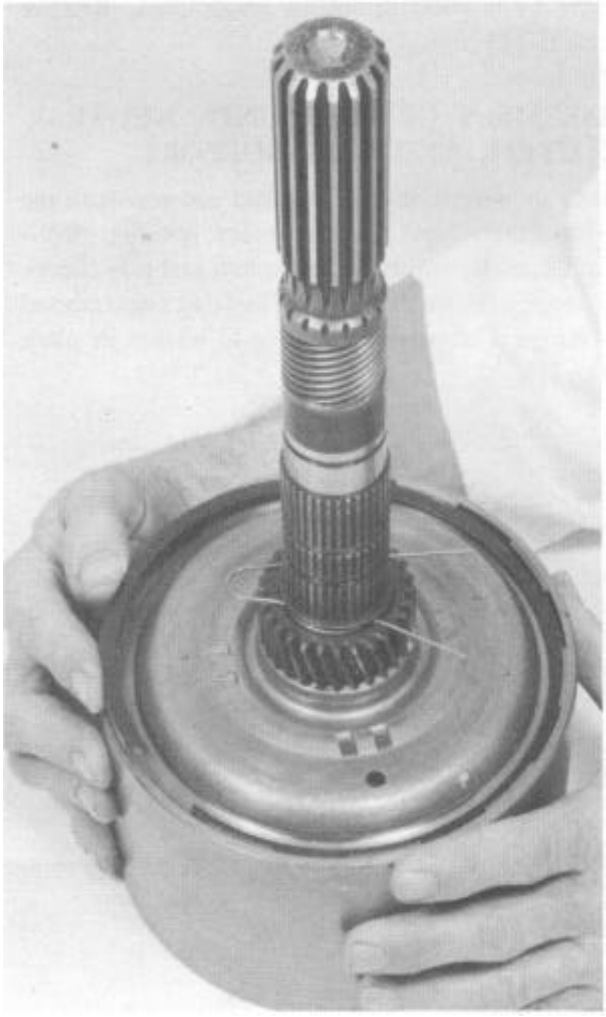


FIGURE 77—*Installing Output Shaft and Reverse Drive Flange Snap Ring*

Set rear unit assembly into holding fixture J-6116 with shaft end down. As unit is lowered into fixture, lift up on drum and remove drive flange retainer J-6120.

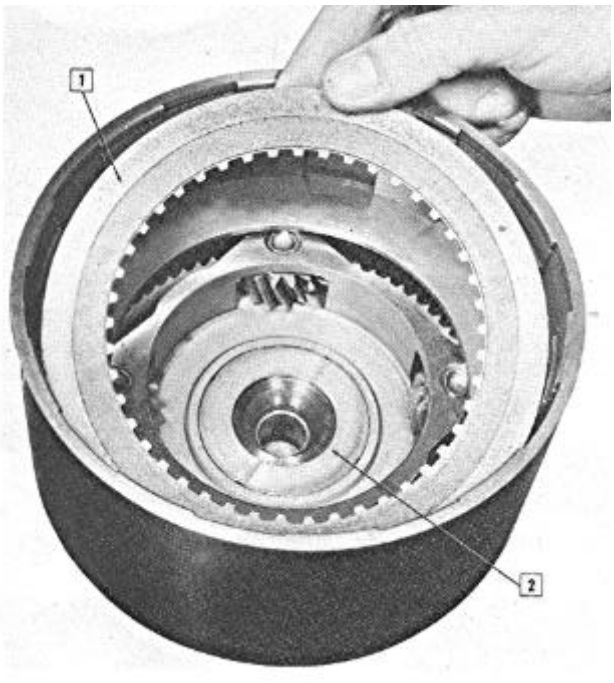
CAUTION: *Do not lift on output shaft after J-6120 is removed.*

Position thrust washer in counterbore of output shaft and retain with petrolatum (Fig. 78).

Apply Hydra-Matic oil to faces of the seven drive and seven driven plates, and alternately install them in rear unit drum. Start with drive (composition) and finish with driven (steel). Install all drive plates with same side up. Assemble driven plates with lugs in rear unit drum slots so that notches in lugs are all in line (Fig. 79).

NOTE: *Indexing the notches nests the plates together so that the waves are all in the same direction (no gaps between plates).*

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



1. Rear Clutch Drive Plate
2. Rear Unit Sun Gear Thrust Washer

FIGURE 78—*Installing Rear Unit Clutch Plates*

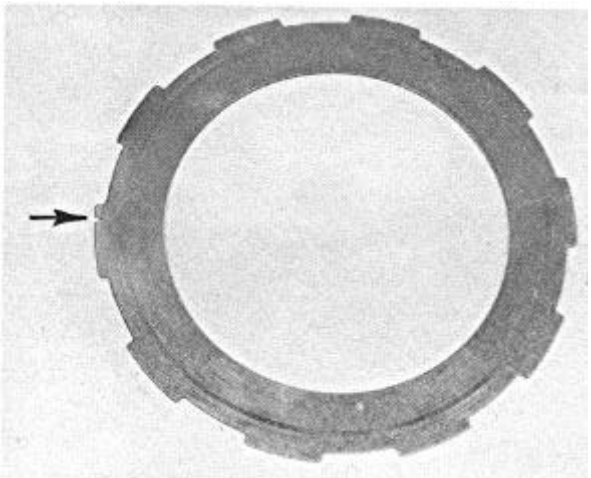


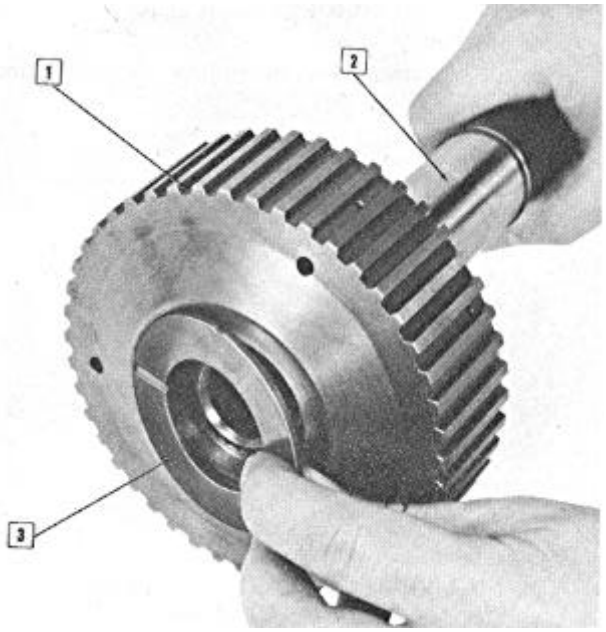
FIGURE 79—*Notches in Rear Unit Clutch Driven Plates*

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

Install two bronze thrust washers on rear unit clutch hub, one on each side, and retain with petrolatum (Fig. 80).

Install intermediate shaft and rear clutch hub and thrust washers into rear drum (Fig. 81).

NOTE: *Pick up clutch drive plates by rotating intermediate shaft. Do not drive or force rear unit clutch hub into rear unit drum.*



1. Rear Unit Clutch Hub
2. Intermediate Shaft
3. Rear Clutch Hub Thrust Washer

IGURE 80—*Installing Rear Clutch Hub Thrust Washer*

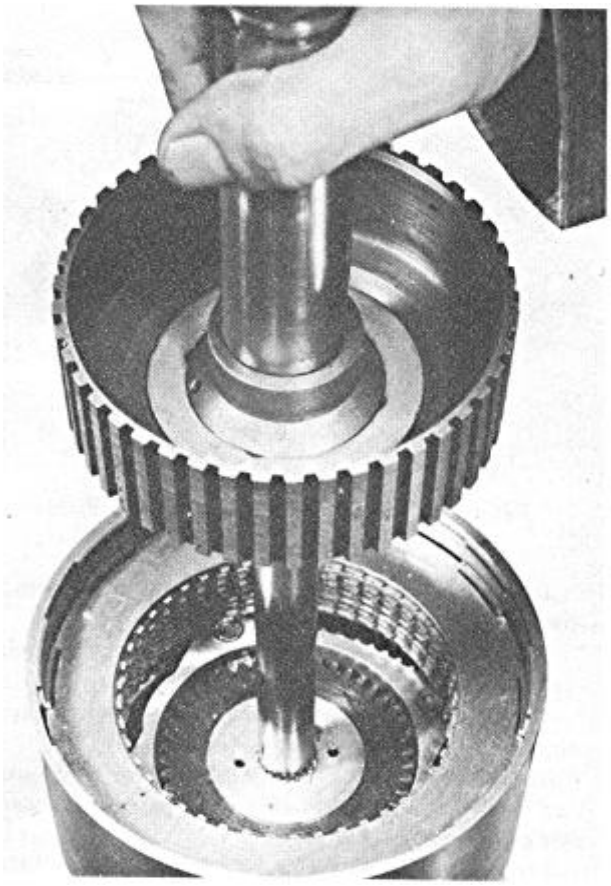


FIGURE 81—*Installing Intermediate Shaft and Clutch Hub into Plates*

Assemble rear clutch piston into rear clutch cylinder as follows:

Install new inner seal on hub of clutch cylinder with lip down (Fig. 821.

FIGURE 82—*Seal Installed on Hub of Rear Clutch Cylinder*

Install new outer seal on piston with lip facing away from spring bore side.

Install piston into cylinder using flat edge of screw driver to start seal into cylinder (Fig. 83).

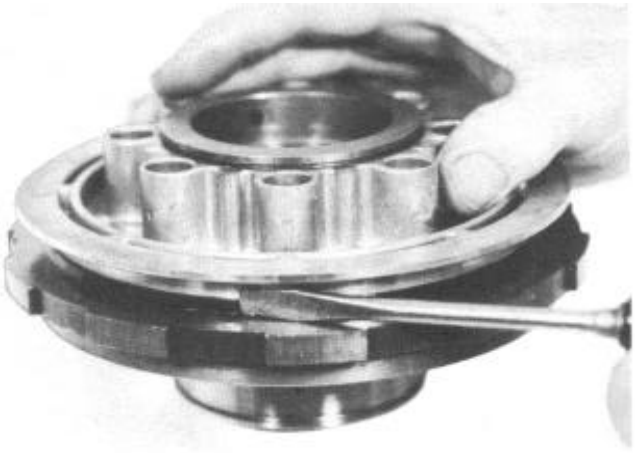


FIGURE 83—*Installing Rear Clutch Piston into Cylinder*

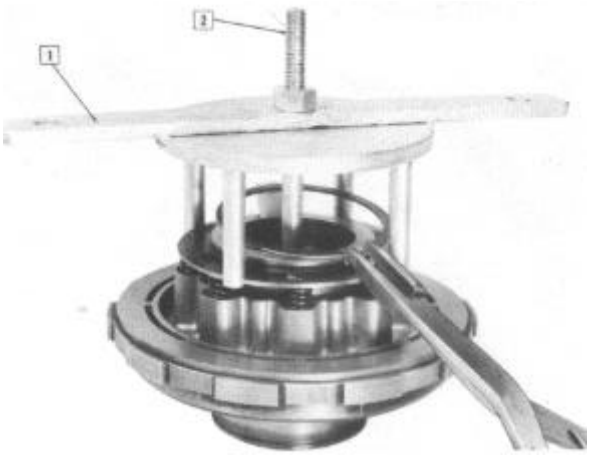
Install eight clutch release springs into bores in piston.

Place spring retainer on springs with tangs facing up. Compress springs using tool J-4670 and J-6129.

Install snap ring which holds release spring retainer and remove compressor tools (Fig. 84).

Install rear unit sprag assembly in rear unit outer race with shoulder side of sprag on counterbored side of outer race (Fig. 85)

Install sprag and outer race on rear unit inner race. Push sprag part way down through outer race; then rotate sprag counterclockwise to assemble (Fig. 86)..



l. Tool J-4670 2. Tool J-6129

FIGURE 84—*Installing Rear Clutch Release Spring Retainer Snap Ring*

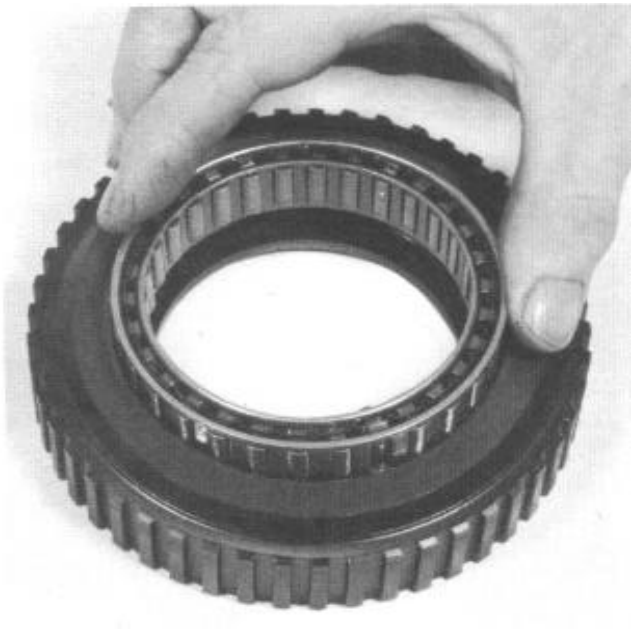


FIGURE 85—*Install Rear Unit Sprag in Outer Race*

Install rear unit sprag retainer in rear unit outer race with large outside diameter "up." Push retainer down to expose snap ring groove.

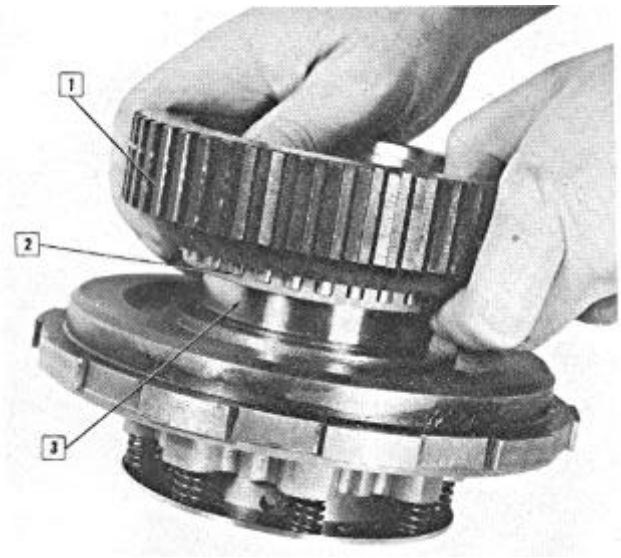
Install spiral snap ring on rear unit clutch hub (Fig. 87).

Install rear unit cylinder and sprag assembly into rear clutch drum with sprag side up.

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

Install neutral clutch drum on rear unit with driven clutch plate lug slots "up" (Fig. 88).

Apply Hydra-Matic oil to five clutch drive plates (composition) and four driven plates (steel). Install plates



1. Rear Sprag Outer Race
2. Sprag Assembly
3. Rear Sprag Inner Race

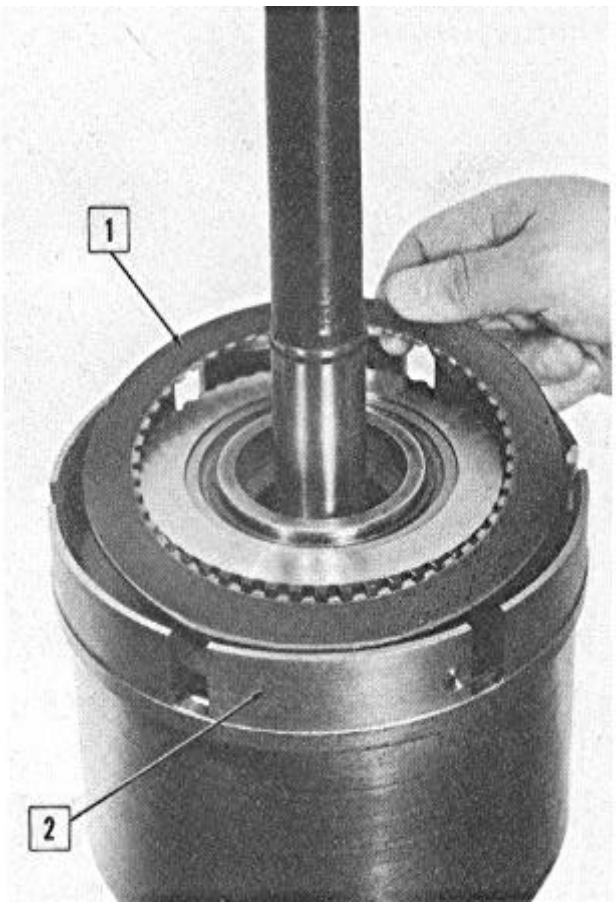
FIGURE 86—*Install Sprag and Outer Race on Inner Race*

FIGURE 87—*Installing Rear Unit Sprag Retainer Snap Ring*

alternately using a release spring between steel plates. Start with composition plate and release spring then steel plate, end with composition plate and spring.

Install oil ring on neutral clutch piston and make sure that the lower ring is in place in the case center support hub. Install neutral clutch piston into case center support, compressing piston ring with fingers.

NOTE: *Index dowel pins in case center support with dowel pin holes in neutral clutch piston. Indexing clutch piston. Indexing can be facilitated by marking dowel location on side of drum and piston.*



1. Neutral Clutch Drive Plate
2. Neutral Clutch Drum

FIGURE 88—*Installing Neutral Clutch Plates*

Install two oil rings in ring grooves of case support hub. Center rings around hub and install case support assembly into neutral clutch drum in rear unit using care not to damage bushing when lowering support over intermediate shaft. If properly centered, oil rings on hub of case support will be compressed by taper on hub of rear clutch cylinder.

Install hook type oil seal ring on intermediate shaft (Fig. 89).

Install case support holding tool J-6135 with screw end up; apply pressure to compress clutch springs, and tighten lock bolt on J-6135 (Fig. 90).

DISASSEMBLY OF FRONT UNIT COUPLING

Remove large snap ring that retains cover to drive torus. Install tool J-6122-1 to retain the two exhaust valves. Then install tool J-6121 to- front unit coupling cover and tighten the four studs securely.

Place the assembly in holding fixture tool J-6116 and tighten center nut. Tighten the four nuts alternately to pull the cover out of the drive torus evenly. When removing the cover, the two square "O" rings will sheer when passing the

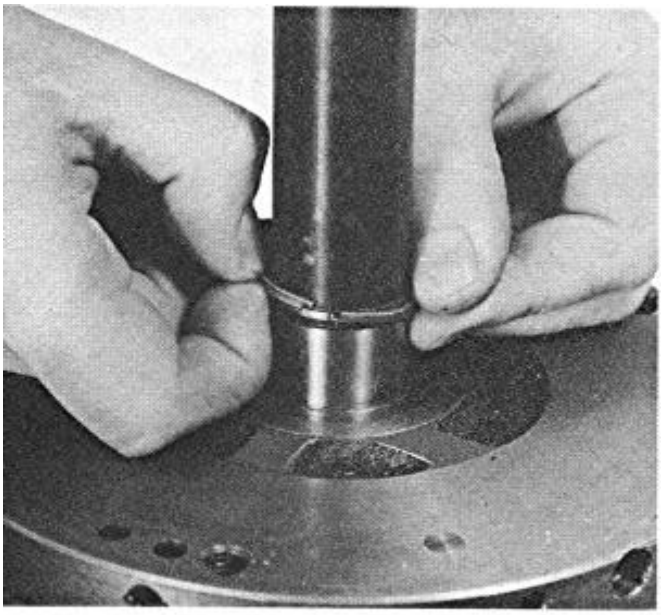


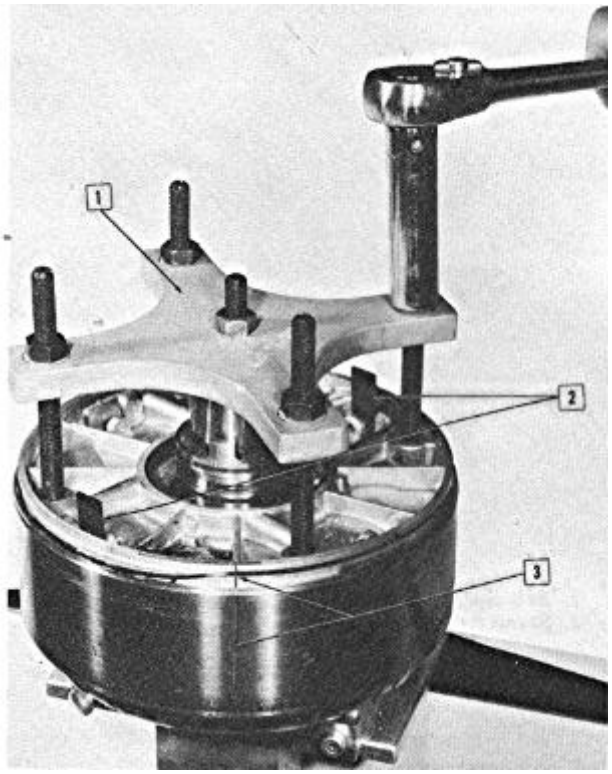
FIGURE 89—*Installing Hook Type Oil Seal Ring on Intermediate Shaft*

FIGURE 90—*Case Support Holding Tool J-6135*

snap ring groove.

After the cover is partially removed, pencil scribe both cover and drive torus (Fig. 91).

Remove the four nuts and studs from tool J-6121 after the cover is free and lift unit from holding fixture and remove center nut. Then remove the cover and the two special

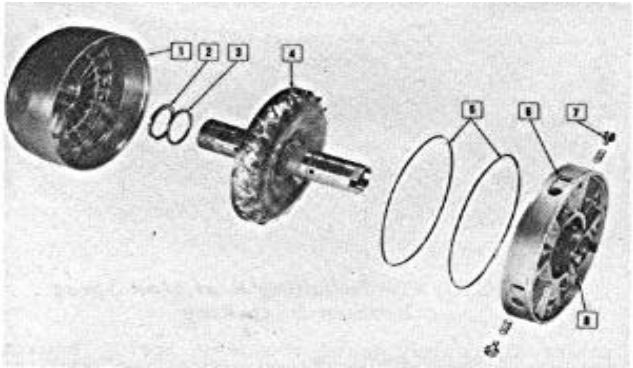


1. Front Unit Removing Tool J-6121
2. Coupling Valve Retainers J-6122-1
3. Pencil Scribe Mark

FIGURE 91—Removing Front Unit Cover

tools J-6122-1 that retain the exhaust valves.

Remove the driven torus, bronze and steel thrust washers and clean and inspect all parts (Fig. 92).



1. Drive Torus
2. Steel Thrust Washer
3. Bronze Thrust Washer
4. Driven Torus
5. "O" Rings
6. Cover
7. Exhaust Valve and Spring
8. Oil Rings

FIGURE 92—*Front Unit Coupling*

ASSEMBLY OF FRONT UNIT COUPLING

Place the drive torus in the holding fixture and install the steel thrust washer in the counterbore on the vane side of the

drive torus. Then install the bronze thrust washer.

Install driven torus into the drive torus.

Install new "0" rings on the front unit coupling cover. Be sure that the "0" rings are not twisted in the groove.

Lubricate the "0" rings on the cover arld the snap ring groove in the drive torus with petrolatum (Fig. 93).

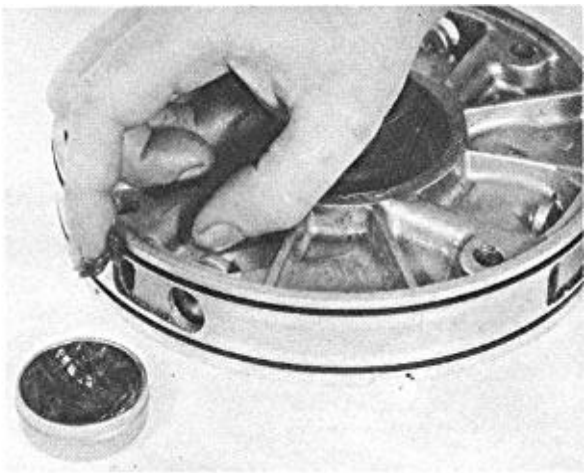


FIGURE 93—*Lubricate "0" Rings*

Install springs and exhaust valves in cover and retain with tools J-6122-1.

Place cover on drive torus with pencil scribe marks aligned. The notches in the cover must be aligned with the locating pins in the drive torus.

Push the cover as far as possible into the coupling and tap into place with a composition hammer until the snap ring can be installed (Fig. 94).

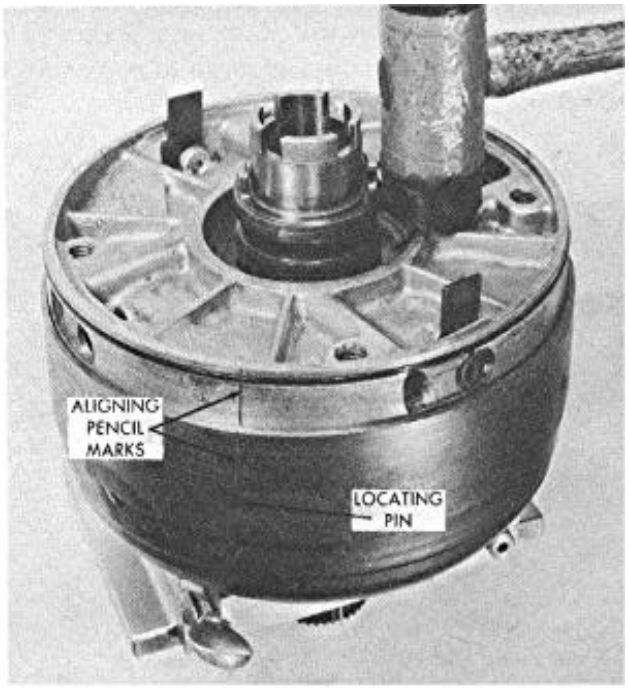


FIGURE 94—*Installing Coupling Cover*

NOTE: *Tap on alternate sides of cover on puller bolt hole bosses to prevent binding of cover.*

Inspect snap ring groove. If part of "0" ring is visible, the cover will have to be removed and new "0" rings installed.

Install large snap ring and remove exhaust valve retaining tools.

DISASSEMBLY OF FRONT PUMP

Remove the two remaining pump cover bolts and lift the cover from the pump body.

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

Remove retaining pin, retainer, spring and torus feed valve (Fig. 95).

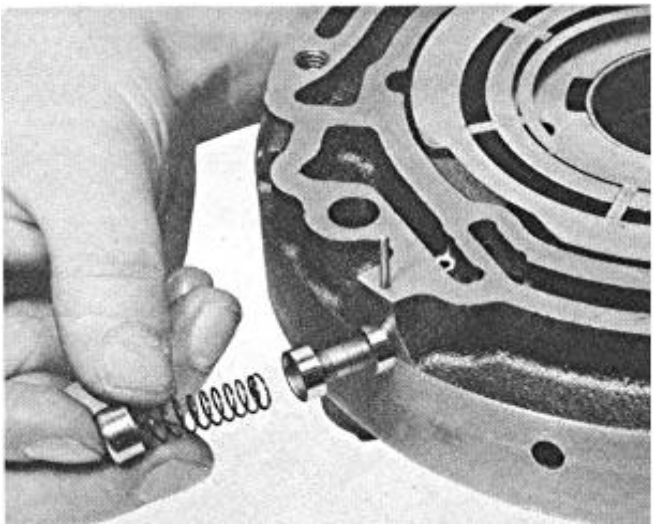


FIGURE 95—*Removing Torus Feed Valve*

Remove cooler check valve, pin, spring, and ball (Fig. 96).

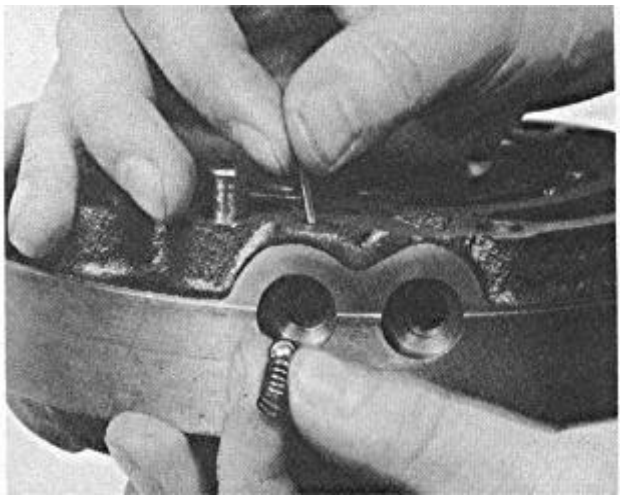


FIGURE 96—Removing Cooler Check Valve

Remove front pump rotor and top vane ring. Then remove the seven vanes and bottom vane ring.

Remove front pump slide and priming springs by pushing slide toward priming springs. Then lift out of body at opposite end (Fig. 97).

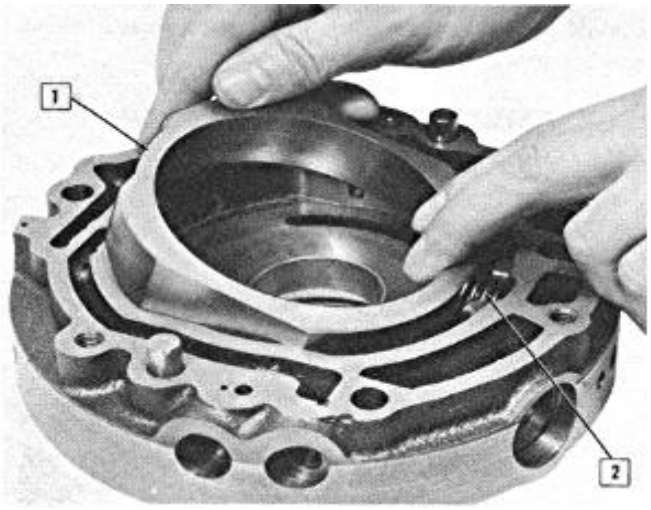


FIGURE 97—*Removing Front Pump Slide and Priming Springs*

Turn pump over and remove front sprag spiral retaining ring using small screw driver or needle nose pliers (Fig. '98).

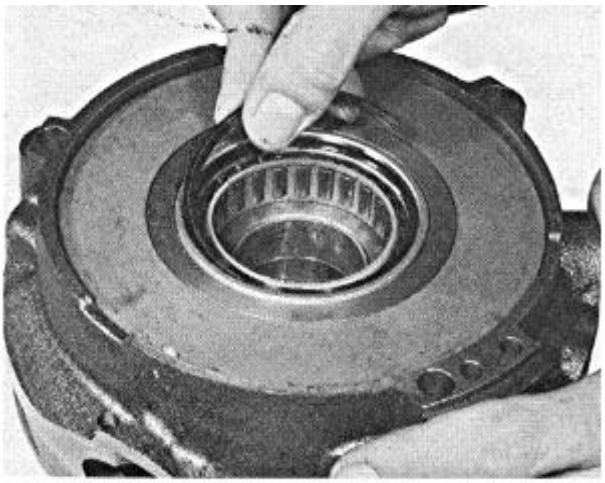


FIGURE 98—*Removing Front Sprag Retaining Ring*

Remove sprag assembly from front pump. Do not attempt to disassemble sprag assembly; if the assembly is damaged, a new one must be installed (Fig. 99).

Remove overrun clutch piston from its bore by gently tapping on outer diameter of piston side of pump with soft hammer (Fig. 100).

ASSEMBLY OF FRONT PUMP

Install inner and outer priming springs in recess of front pump body. Position slide into front pump body toward

FIGURE 99—*Removing Front Sprag Assembly*

FIGURE 100—*Overrun Clutch Piston Removed*

priming springs and compress slide against springs so slide will drop into pocket of pump. Then work slide up and down to make sure that springs are properly seated (Fig. 101).

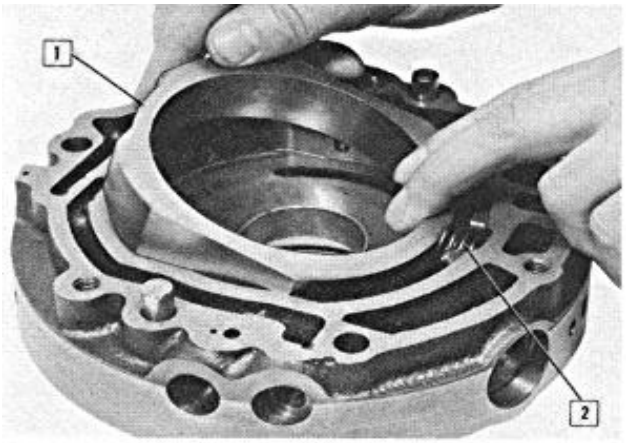


FIGURE 101—Installing Front Pump Priming, Springs and Slide

Install torus feed valve into large bore on side of pump opposite priming springs with long land entering first (Fig. 102).

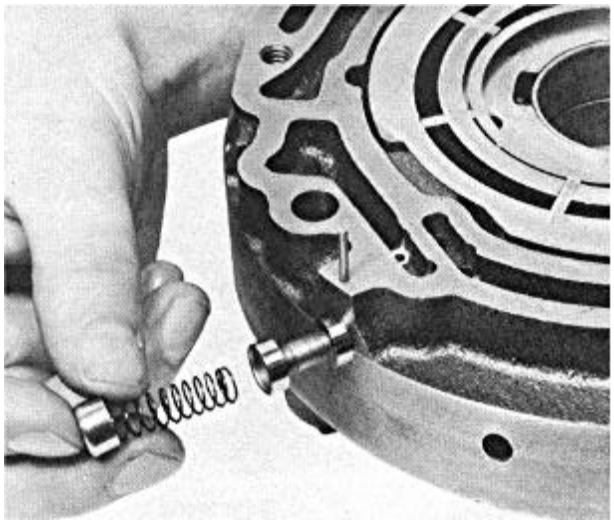


FIGURE 102—*Installing Torus Feed Valve Assembly*

After torus feed valve assembly is installed, make sure that free movement of the valve can be obtained by moving the slide.

Install oil cooler ball into oil cooler passage which is nearest to dowel. Then install the spring and spring retainer pin (Fig. 103).

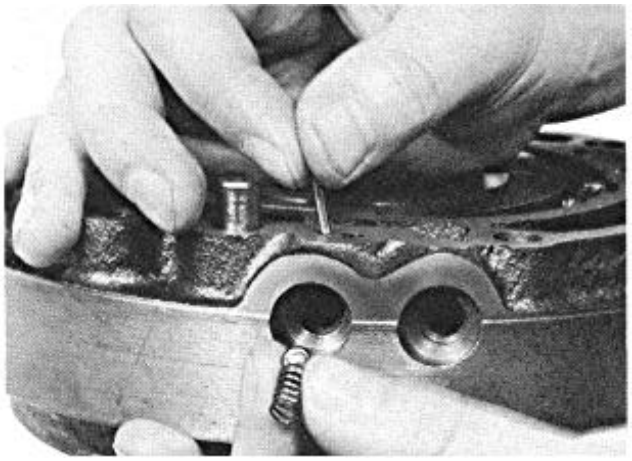


FIGURE 103—*Installing Cooler Check Valve Assembly*

Install bottom vane ring into front pump cavity locating it in the center of the slide. Then install the rotor with drive slots up. Install the seven vanes with proper side against vane rings. The vanes will have polished areas where they contact the vane rings. Install top vane ring on rotor and check to see that rotor rotates freely (Fig. 104).

The total clearance between vanes and slide, with the vane rings installed, should be .000"-.003".

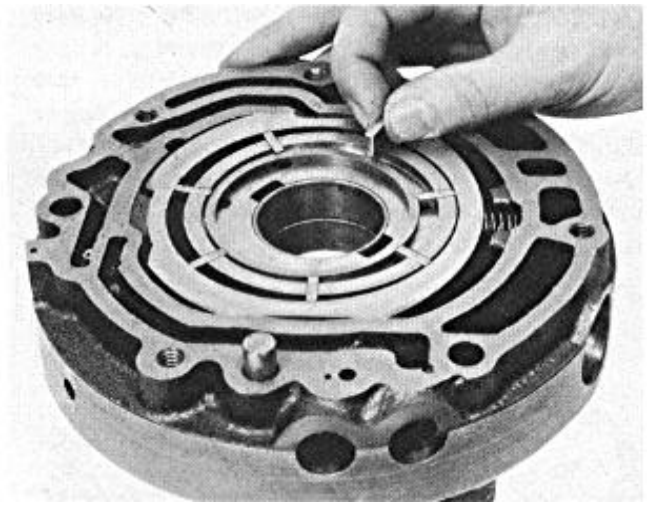


FIGURE 104—*Installing Vanes in Rotor*

Check with feeler gauge between each vane and inside diameter of slide to make certain that clearance does not exceed .003".

NOTE: *With vanes contacting slide on one side, clearance should not exceed .003" on opposite side. If clearance is excessive, pump must be replaced.*

Install front cover to pump body with four attaching screws using short screw in hole nearest top of pump, opposite intake pipe hole.

Turn pump over and make sure oil rings are in place on overrun clutch piston and hub in front pump body. Put location marks on front body and overrun clutch piston opposite dowel so piston can be aligned with dowels.

Align piston with dowels and install overrun clutch piston into front pump cavity compressing piston ring with fingers (Fig. 105).

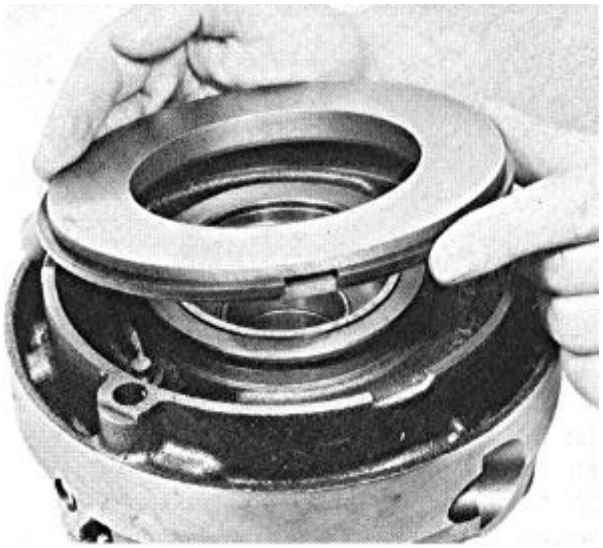


FIGURE 105—*Installing Overrun Clutch Piston in Front Pump*

Do not force clutch piston into cavity. If it does not fit freely, the dowels and holes are not in proper alignment. After piston is installed, check to see that it is properly engaged with dowels by attempting to rotate it.

Install sprag assembly into rear of pump with shoulder "up" rotating sprag counterclockwise while installing it (Fig. 106).

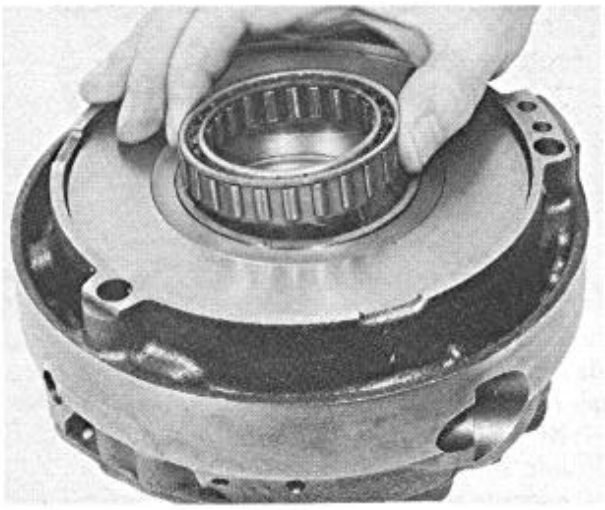


FIGURE 106—*Installing Front Sprag in Hub of Pump Body*

Install sprag inner race into sprag with lug side up. Inner race should rotate counterclockwise from top. Secure sprag assembly with spiral snap ring (Fig. 107).

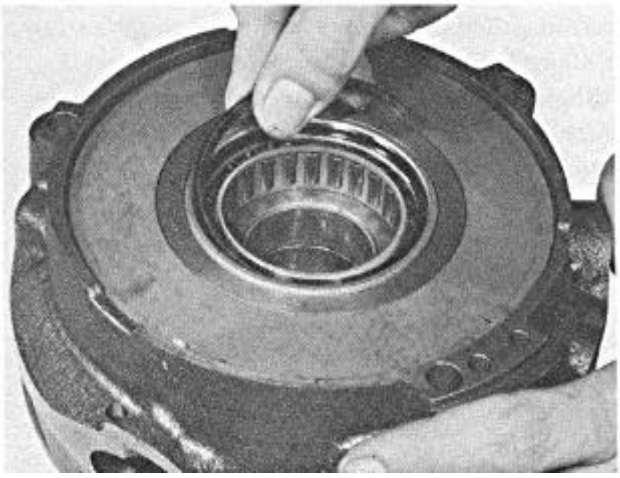
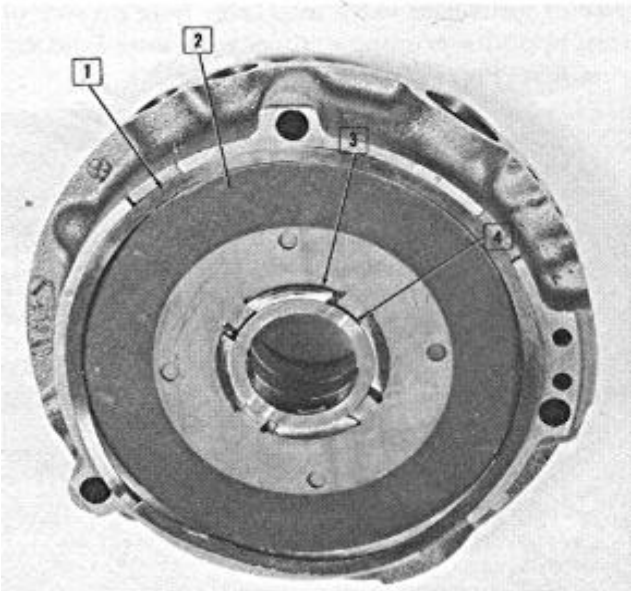


FIGURE 107—*Installing Front Sprag Retaining Snap Ring*

Before installing the overrun clutch plate, thrust washer, and release spring, coat one side of each with petrolatum to hold them in place during installation of unit into case.

Install the overrun clutch plate on top of piston indexing drive lugs with sprag inner race. Install the bronze thrust washer on sprag inner race with drive lugs down indexing with sprag inner race. Install the clutch release spring on top of piston (Fig. 108).

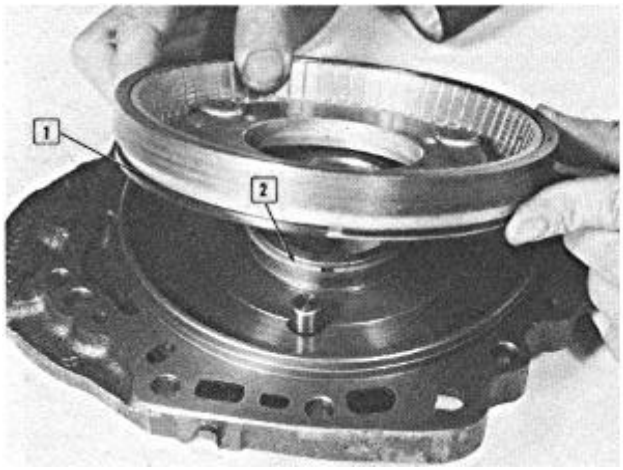


1. Release Spring
2. Overrun Clutch Plate
3. Front Sprag Inner Race
4. Bronze Thrust Washer

FIGURE 108—*Overrun Clutch Parts Installed in Front Pump*

DISASSEMBLY OF REAR PUMP

Remove reverse piston from bore of rear pump assembly by lifting out (Fig. 109).



1. Reverse Piston Ring
2. Hub Ring

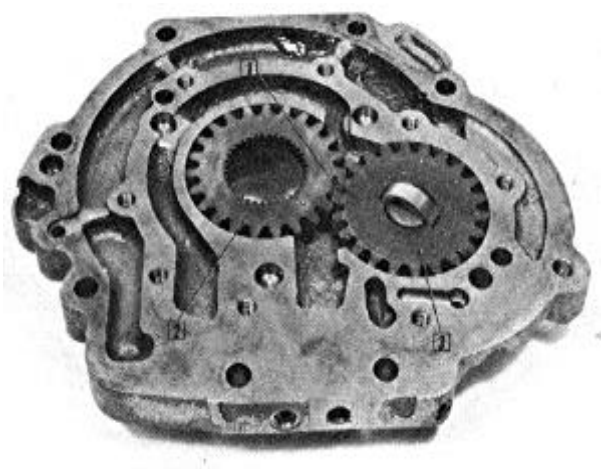
FIGURE 109—*Removing Reverse Piston from Rear Pump*

Remove rear pump cover to body attaching screws. Remove rear cover by holding cover and tapping body with composition hammer.

Mark both drive and driven gears so they can be replaced with same side "up" (Fig. 110).

CAUTION: *Do not scratch gears*.

Remove governor drive key and drive and driven gears. Remove rear bearing snap ring and slide bearing out of the pump cover.



1. Indexing Mark on Gears
2. Drive Gear
3. Driven Gear

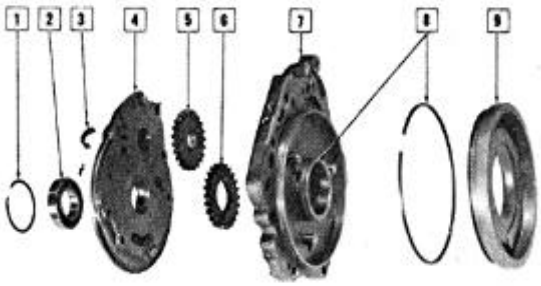
FIGURE 110—*Rear Pump Drive and Driven Gears*

ASSEMBLY OF REAR PUMP

Install rear pump drive and driven gears indexing marks which were made for identification during disassembly.

Install governor drive key into driven gear, making sure key is properly seated. Use petrolatum to hold key in place.

Install cover on pump body indexing dowels in cover with dowel holes in body. Then secure cover with eight attaching screws (Fig. 11,1).



1. Snap Ring
2. Rear Bearing
3. Governor Drive Key
4. Rear Pump Cover
5. Driven Gear
6. Drive Gear
7. Rear Pump Body
8. Oil Rings
9. Reverse Piston

FIGURE 111—*Exploded View Rear Oil Pump*

Turn pump over and install reverse piston in cavity in rear pump. Make sure oil rings are installed on reverse piston and hub in pump and that ring on hub is centered. Place piston into cavity indexing it with dowels. Compress outer ring with fingers and push piston into cavity.

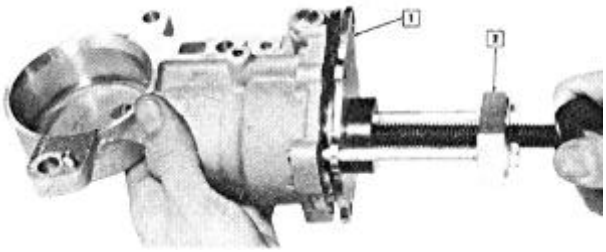
CAUTION: *Inner ring must be centered on hub in order for taper of piston to compress ring.*

NOTE: *Rear bearing and snap ring will be installed in rear pump after rear pump is attached to transmission case.*

DISASSEMBLY OF SERVO AND ACCUMULATOR

Remove servo piston from accumulator body. Remove two opposite screws from accumulator cover and install special tool J-6124. Turn screw down against accumulator cover and remove remaining cover screws.

Back off screw of tool to remove tension on accumulator springs and remove tool and cover (Fig. 112).



l. Accumulator Cover
2. Special Tool J-6124

FIGURE 112—*Removing Accumulator Cover*

Remove accumulator piston, inner and outer springs, and cover gasket.

Remove seal from small end of accumulator piston. Remove trimmer valve retainer plug pin from accumulator body using a small punch or nail. Then remove the plug, trimmer valve and spring.

NOTE: The hole in which pin enters is tapered so pin will be retained by cover and not fall out of opposite end (Fig. 113).

ASSEMBLY OF SERVO AND ACCUMULATOR

Install trimmer valve spring, trimmer valve, retainer plug, and pin. Compress plug against the spring tension so that pin will enter groove of plug.

Install new neoprene seal on small end of accumulator piston with lip toward large end. Make sure oil ring is in place on large end.

Install outer and inner accumulator springs in piston. Install accumulator cover and gasket on special tool J-6124. Install springs and piston in accumulator body and place special tool, cover, and gasket against piston and thread tool studs into body. Then tighten center screw until cover is pressed against accumulator body.

NOTE: *Make sure that piston is centered when entering bore of body when compressing springs. The oil ring will be compressed by taper in bore of body.*

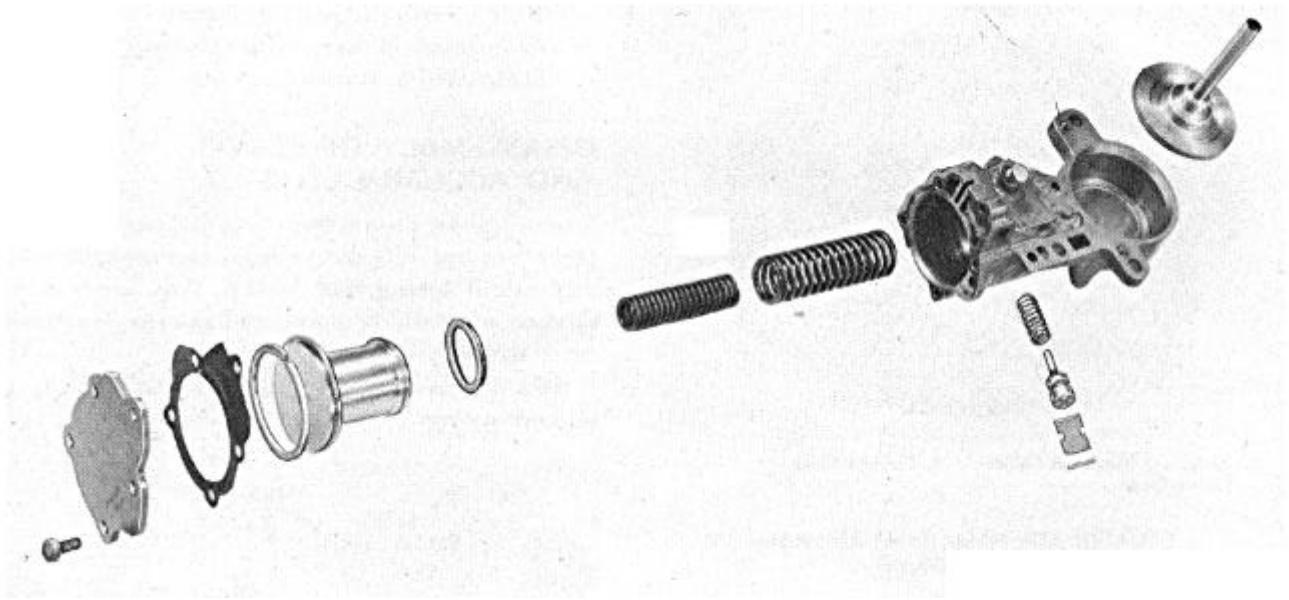


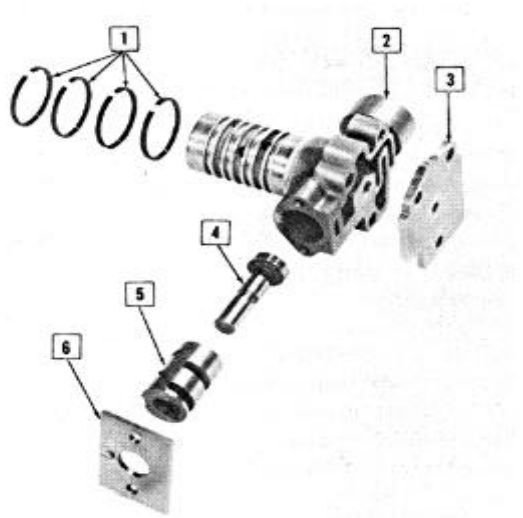
FIGURE 113—*Exploded View of Servo and Accumulator*

Install three cover screws and lockwashers and remove special tool and install the remaining screws and lockwashers.

Install servo apply piston with oil ring in place in servo body.

DISASSEMBLY OF
GOVERNOR ASSEMBLY

Remove three cover attaching screws and washers and remove cover. Remove G-2 valve retainer plate attaching screws and remove G-2 valve and sleeve (Fig. 114).



1. Governor Rings
2. G-1 Valve
3. Governor Cover
4. G-2 Valve
5. G-2 Sleeve
6. G-2 Retainer Plate

FIGURE 114—*Exploded View of Governor*

ASSEMBLY OF GOVERNOR

Install G-2 valve in sleeve, then install the G-2 valve and sleeve assembly in the governor with locating notches aligned in the sleeve and body.

Install cover and retainer plates with attaching screws and washers aligning the G-2 retaining plate dowel in governor body.

**DISASSEMBLY OF
CONTROL VALVE ASSEMBLY**

The complete control valve assembly consists of four individual assemblies, overrun clutch body, shift valve body, reverse blocker, manual valve body, and two spacer plates connected to a channel body (Fig. 115).

Each valve body should be disassembled, cleaned, inspected, and assembled individually. This should be done to avoid confusion of parts.

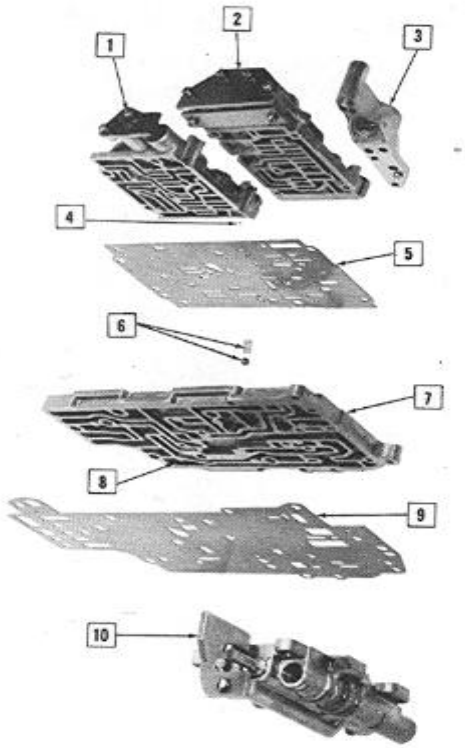
The individual valve bodies are outlined separately in the following operational procedures.

**DISASSEMBLY OF
OVERRUN CLUTCH VALVE BODY**

Remove the two overrun clutch valve body attaching screws, but do not remove body. After the screws are removed, hold body in' place turning complete assembly over, to avoid -losing the 1/4" check ball from the overrun clutch valve body.

Remove the 1/4" check ball. Then remove the four front plate attaching screws and plate (Fig. 116).

Remove overrun clutch valve, coupling valve and spring, and transition valve and spring.



1. Overrun Clutch Body
2. Shift Valve Body
3. Reverse Blocker
4. 1/4" Check Ball
5. Channel Plate to Valve Body
6. 1/4" Check Ball and Spring
7. Channel Body
8. By-pass Check Valve (In Body)
9. Channel Plate to Case
10. Manual Valve Body

While holding pressure on the rear plate to keep the limit valve springs compressed, remove the two screws and plate. Then remove the two springs and washer, limit valve and coupling valve plug; clean and inspect parts.

ASSEMBLY OF OVERRUN CLUTCH VALVE BODY

Install limit valve into bore with spring stem facing out.

Install limit valve inner spring, washer, and outer spring. Inner spring seats on limit valve and outer spring seats on washer.

Coat coupling valve plug with petrolatum and insert in valve body bore and install rear plate and attaching screws.

Install the overrun clutch valve in body, then insert coupling valve into coupling valve spring and install in body.

Install transition valve spring, transition valve, front plate, and attaching screws.

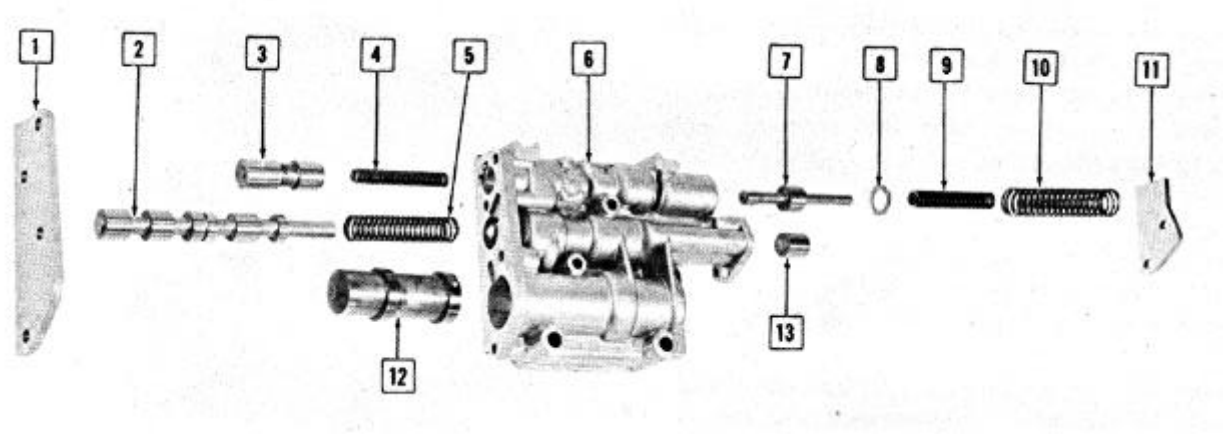
DISASSEMBLY OF SHIFT VALVE BODY

Remove four attaching screws and shift valve body from channel body.

Remove separator plate and check ball and spring from channel body.

Remove governor valve end plate and remove 3-4 governor valve, 2-3 governor valve, and governor booster valve.

Remove the regulator body and plate, holding pressure against plate when removing the four attaching screws.



1. Front Plate
2. Coupling Valve
3. Transition Valve
4. Transition Valve Spring
5. Coupling Valve Spring
6. Valve Body
7. Limit Valve
8. Limit Valve Spring Washer
9. Inner Limit Valve Spring
10. Outer Limit Valve Spring
11. Rear Plate
12. Overrun Clutch Valve
13. Coupling Valve Plug

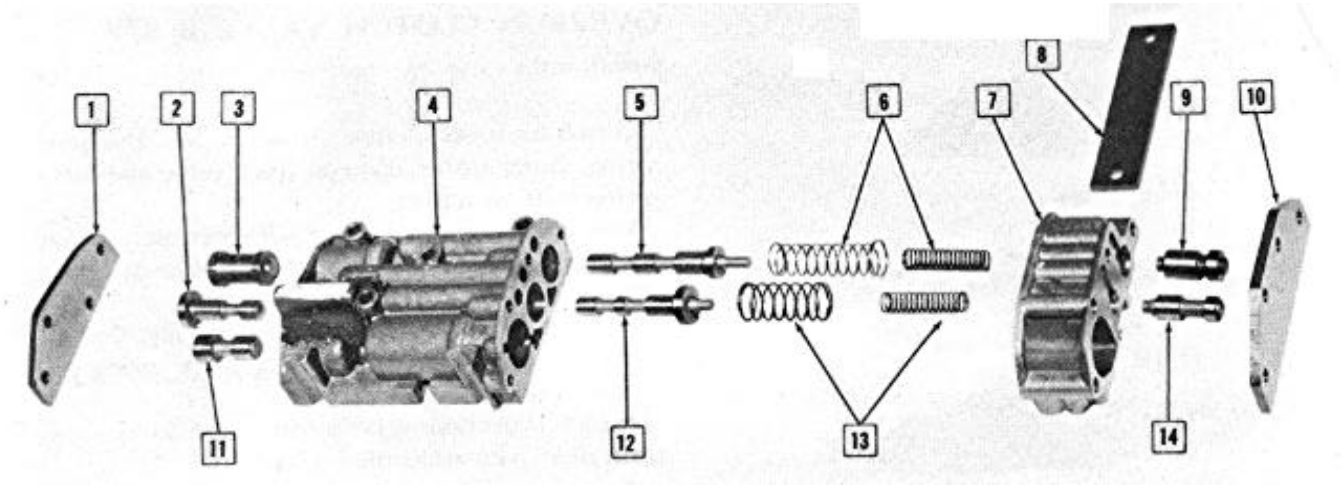
FIGURE 115—*Control Valve Assembly*

Remove the 3-4 regulator valve, 2-3 regulator valve, 3-4 shift and regulator valve springs, 2-3 shift and regulator valve springs, 3-4 shift valve and 2-3 shift valve from the shift valve body.

Remove the regulator body cover and clean and inspect parts (Fig. 117).

DISASSEMBLY OF REVERSE BLOCKER ASSEMBLY

Remove two reverse blocker body to manual valve body attaching screws and remove reverse blocker assembly. Remove hairpin detent plunger retainer and remove detent plunger and spring.



1. Governor Valve Body End Plate
2. 2-3 Governor Valve
3. 3-4 Governor Valve
4. Shift Valve Body
5. 3-4 Shift Valve
6. 3-4 Valve Springs
7. Regulator Valve Body
8. Regulator Body Cover
9. 3-4 Regulator Valve
10. Regulator Body Plate
11. Governor Booster Valve
12. 2-3 Shift Valve
13. 2-3 Shift Valve Springs
14. 2-3 Regulator Valve

FIGURE 117—Shift Valve Body Assembly

ASSEMBLY OF SHIFT VALVE BODY

Install the 2-3 shift valve with spring stem end out. Install inner and outer 2-3 shift valve and regulator springs.

Install 3-4 shift valve with spring stem out; install the inner and outer 3-4 shift and regulator valve springs with large coil end of outer spring out, to seat against regulator body.

Install regulator body cover to regulator body. Install 3-4 regulator valve into regulator body with spring stem end in first.

Install 2-3 regulator valve with spring stem end first.

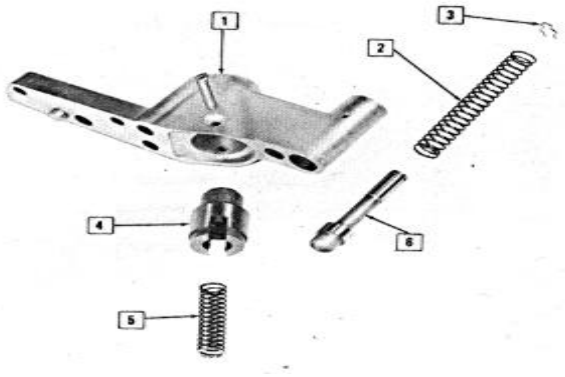
Attach regulator body and plate to the shift valve body by inserting two of the attaching screws in the regulator body plate and position on the regulator body.

Then install the regulator body and plate assembly on the shift valve body assembly and start the two screws.

Install the remaining two screws and tighten all four, making sure that all springs are correctly aligned.

Install the 3-4 and 2-3 governor valves and governor booster valve in the shift valve body. Then fasten the governor valve end plate to the shift valve body with the four attaching screws.

Remove reverse blocker piston retaining pin, spring, and piston (Fig. 118).



1. Reverse Blocker Body
2. Detent Plunger Spring
3. Detent Plunger Retainer
4. Reverse Blocker Piston
5. Reverse Blocker Piston Spring
6. Detent Plunger

FIGURE 118—Reverse Blocker Assembly

ASSEMBLY OF REVERSE BLOCKER ASSEMBLY

Install reverse blocker piston and spring; install retaining pin from counter-sunk side of hole.

Install detent plunger spring and detent plunger into bore in body with spring stern down and compress plunger and install retaining hairpin on end of plunger.

DISASSEMBLY OF MANUAL VALVE BODY

Remove manual valve body by removing the six screws. Then remove the manual valve.

Remove the two screws that retain the T.V. lever stop to manual body and remove stop.

CAUTION: *Do not attempt to adjust or remove T.V. stop pin retained in lever by fluster head screw. This is a factory setting and should not be disturbed.*

Remove T.V. plunger and guide from center bore of body and separate.

Remove T.V. spring and throttle valve from center bore of body.

Remove detent valve and spring; clean and inspect parts (Fig. 119).

NOTE: *It is not necessary to remove T.V. plug and in from T.V. bore.*

install the detent valve with large land end out.

Install T.V. lever stop with two attaching screws and install manual valve.

DISASSEMBLY OF PRESSURE REGULATOR

Remove pressure regulator valve stop pin.

Remove reverse booster plug.

Remove valve spring and pressure regulator valve.

Remove "0" ring seal from pressure regulator plug and discard (Fig. 120).

ASSEMBLY OF PRESSURE REGULATOR

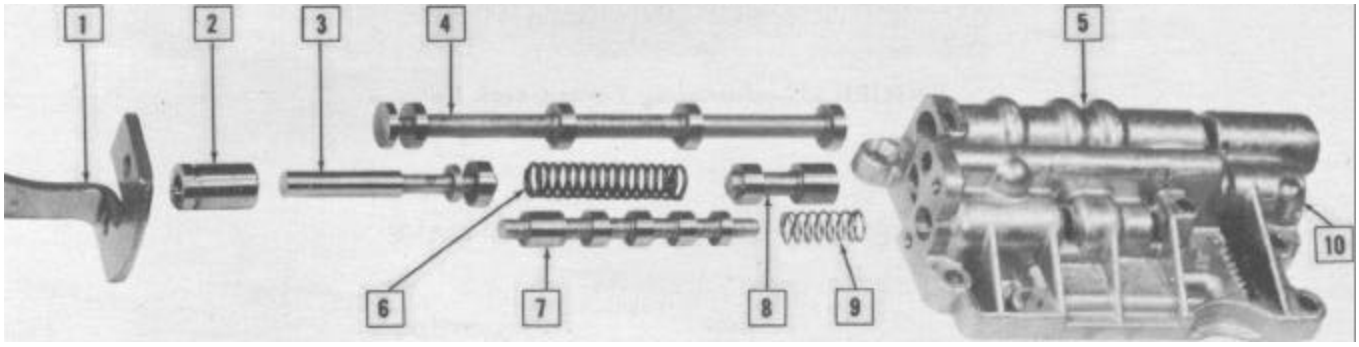
Apply a small amount of petrolatum in bore of pressure regulator plug and in bore of reverse booster plug.

Install booster plug in pressure regulator plug bore.

Install pressure regulator valve stop pin in reverse booster plug.

DISASSEMBLY AND ASSEMBLY OF TORUS CHECK VALVE FROM DRIVEN TORUS

Hold finger on cloth over torus check valve bore and



1. T.V. Lever Stop
2. T.V. Plunger Guide
3. 2. T.V. Plunge
4.. Manual Valve
5. Manual Vavle Body
6. T. V. Spring
7. Detent Valve
8. Throttle Valve
9. Detent Valve Spring
10. T.V. Plug (In Body)

Figure 119—Manual Valve Body

ASSEMBLY OF MANUAL VALVE BODY

Install throttle valve in middle bore with long land first and install T.V. spring.

Install T.V. plunger guide and T.V. plunger as a unit in middle bore of body, long stem out. Short land of plunger guide does not enter valve body.

Insert detent spring in bore, lining up spring to assure that spring is fully positioned in the bottom of the bore and

remove cotter pin retainer.

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

At time of assembly, install spring and torus check valve into torus member making sure valve fully seats in bore..

Push valve down against the spring and retain with cotter pin (Fig. 121).

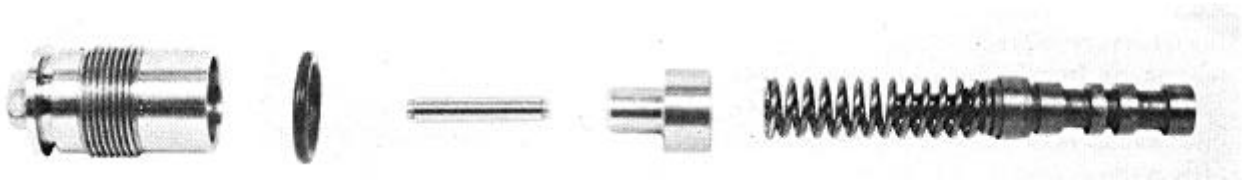


FIGURE 120—*Pressure Regulator Assembly*

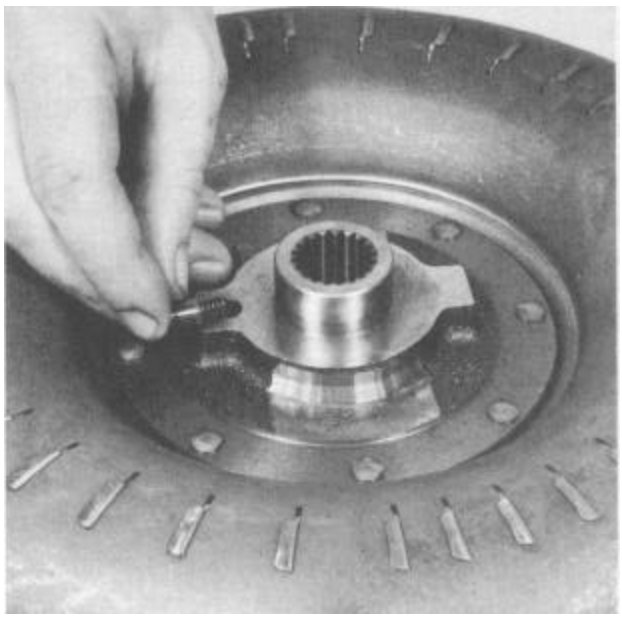


FIGURE 121—*Installing Torus Check Valve*

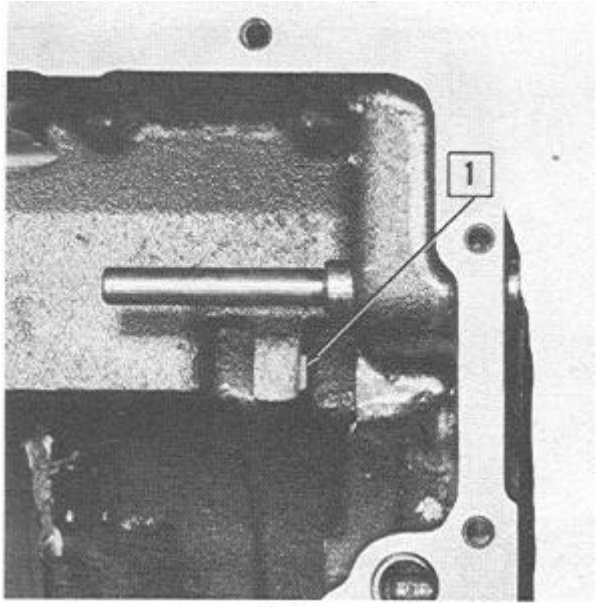
ASSEMBLY OF UNITS INTO CASE

INSTALLATION OF PARKING BRAKE ASSEMBLY

Place parking pawl pivot shaft spacer in recess of case (Fig. 122).

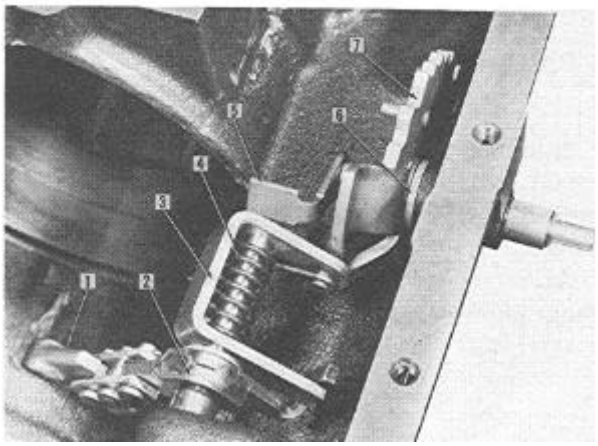
Position parking brake pawl and lever assembly in case with upper lever on pivot in case. Locate parking pawl at pivot shaft hole and insert pivot shaft through case; then through pawl and spacer until end of shaft is flush with rear of case.

Slide spacer washer onto pivot shaft against parking brake lever. Position parking brake lever spring in bracket with long end toward rear. Slide bracket and spring assembly onto pivot shaft with end of spring under parking lever. Hook other end of spring over pin at front of bracket (Fig. 123).



1. Spacer

FIGURE 122—*Parking Pawl Pivot Shaft Spacer in Place*



1. Parking Pawl
2. Parking Brake Lever
3. Parking Brake Bracket
4. Spring
5. Inside Throttle Control Lever
6. Spacer Washer
7. Inside Detent Control Lever

FIGURE 123—*Parking Brake Lever Assembly*

INSTALLATION OF INSIDE DETENT AND THROTTLE LEVERS

With throttle and detent levers assembled, place spacer washer over detent shaft against detent lever.

Insert lever and shaft assembly through hole in case from inside with parking brake tang below pin in parking brake bracket.

Install "0" seal and special washer which fits into bore of case over detent lever shaft.

Install snap ring to retain seal and washer as shown in Figure 59.

INSTALLATION OF LOW BAND

Install low band through front end of transmission case with the band ends facing rearward in a horizontal position (anchor support hole should face right hand side, Fig. 124).

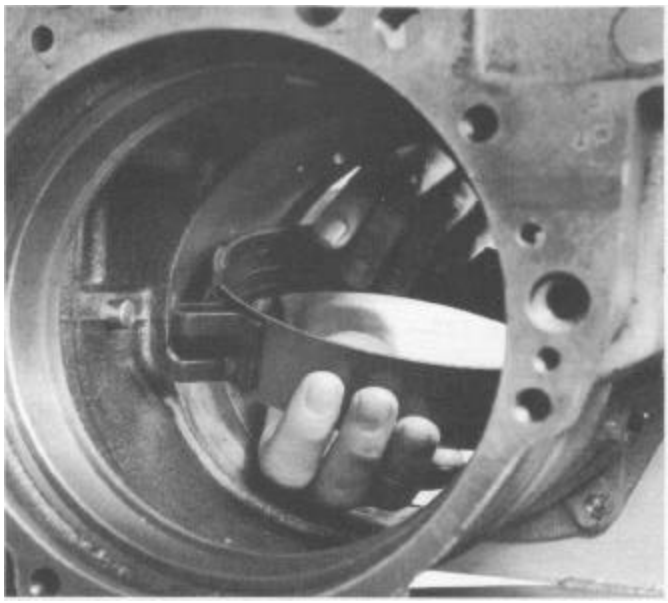


FIGURE 124—**Installing Low Band**

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

INSTALLATION OF REAR UNIT, NEUTRAL CLUTCH, AND CASE SUPPORT

Install neutral clutch key in case using petrolatum to hold it in place. Position rounded side toward front to provide lead for guiding neutral clutch drum over key (Fig. 125).

Position case support lock bolt hole with center of clutch plate drive lugs and mark rear drum with a pencil so that machined slot in neutral clutch drum can be guided into case to align with key and case support lock bolt (Fig. 126).

Install assembly into case aligning pencil marks with neutral clutch key and push complete assembly into case and install large snap ring. If case support fits tight into case, it may be necessary to tap into place (Fig. 12.7).

Install case support lock bolt and torque 25-30 ft. lbs.

INSTALLATION OF REVERSE ASSEMBLY AND REAR PUMP

Install reverse planet carrier on the output shaft aligning splines

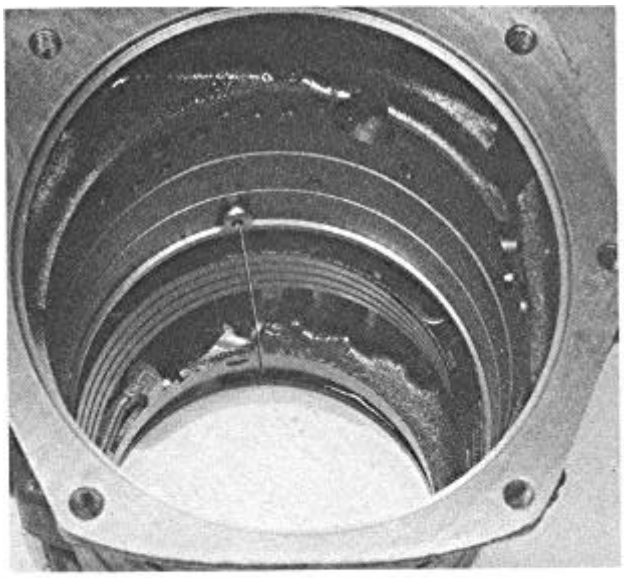
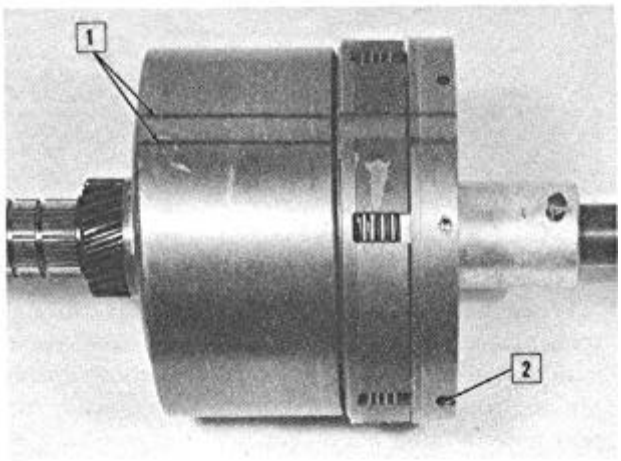


FIGURE 125—*Neutral Clutch Key in Place*



1. Pencil Marks
2. Case Support Lock Bolt Hole

FIGURE 126—*Correct Alignment of Rear Drum and Neutral Clutch Drum*

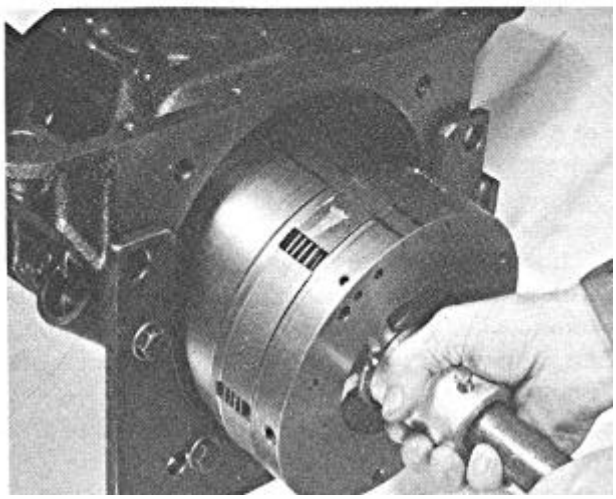


FIGURE 127—***Installing Rear Unit, Neutral Clutch, and Case Support***

and pinions. Install snap ring on output shaft (Fig. 128).

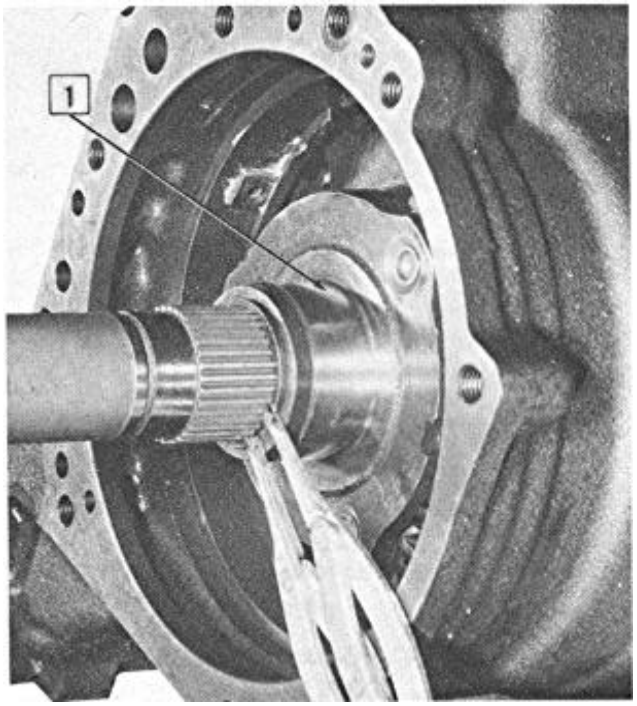


FIGURE *128—Installing Reverse Planet Carrier Snap Ring*

Install reverse stationary cone lock key in case and retain with petrolatum. Install reverse stationary cone in the case. Make sure cone seats on shoulder in case.

Install reverse clutch release spring on carrier with tangs pointing out. Install wave release spring and reverse internal gear on carrier (Fig. 129).

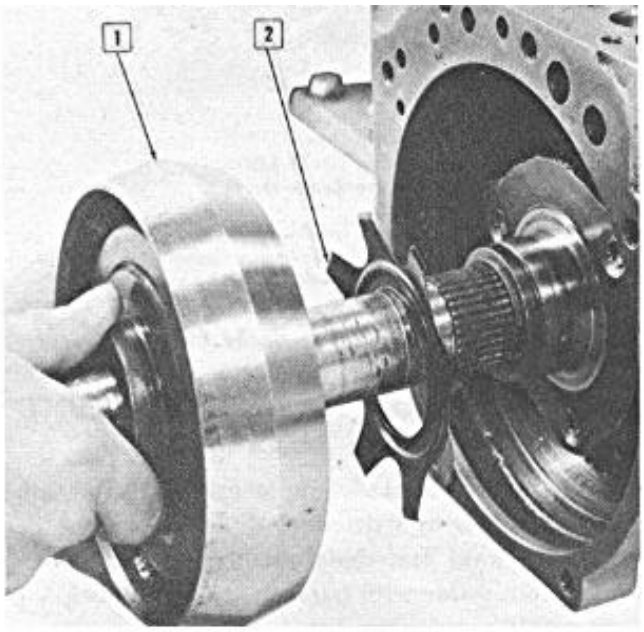
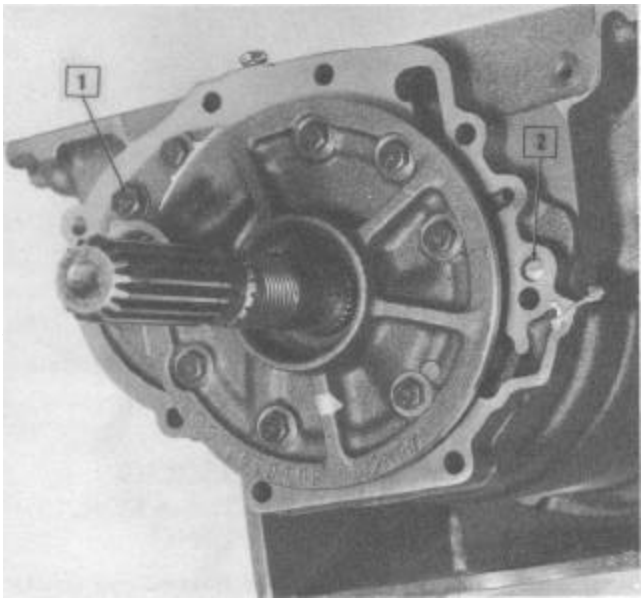


FIGURE 129—Installing Reverse Clutch Release Spring

Install thrust washer on reverse internal gear.

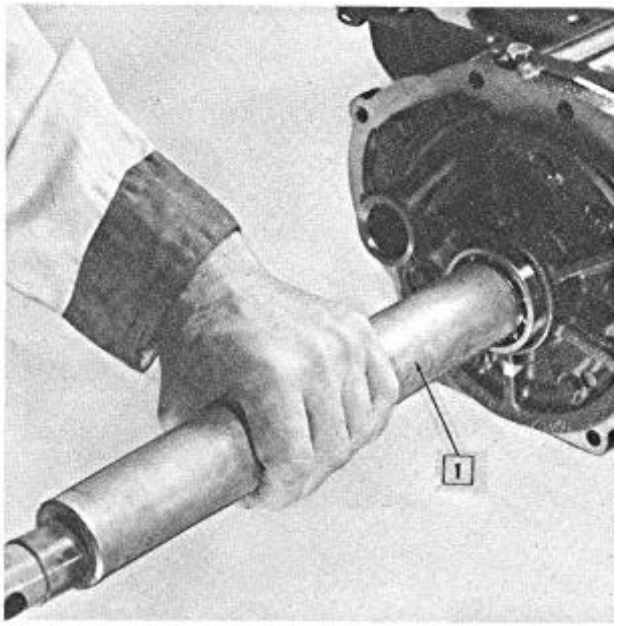
Install gasket on rear pump and retain with petrolatum. Install the rear pump assembly on transmission case. Install locating screw and attaching screw (Fig. 130).



l. Attaching Screw 2. Locating Screw

FIGURE 130—Rear Pump Attaching Screws

Remove case support tool J-6135 from intermediate shaft. Place rear bearing over output shaft and into pump cover. Use tool J-2995 to complete installation of the bearing. Install rear bearing to pump cover and output shaft to bearing snap rings (Fig. 131).



1. Tool J-2995

FIGURE 131—*Installing Rear Bearing*

CHECKING MAIN SHAFT END PLAY

Remove collar from special tool J-6127 and install on main shaft securing collar with Truarc snap ring (Fig. 132).

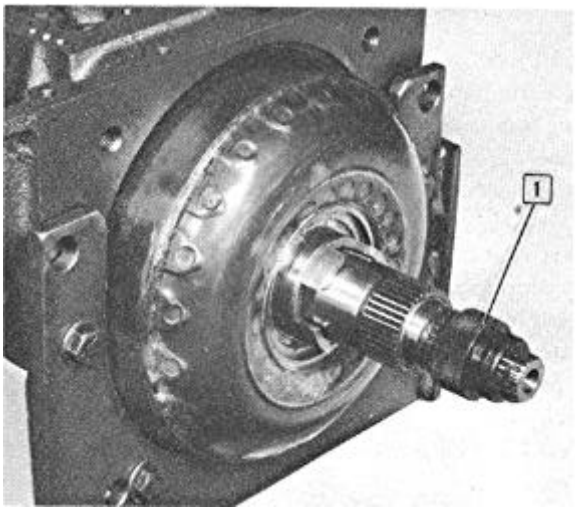


FIGURE 132—*Main Shaft End Play Tool J-6127*

Attach fixture to collar of tool by threading collar into fixture. Install dial indicator support tool J-6126 and dial indicator (Fig. 133).

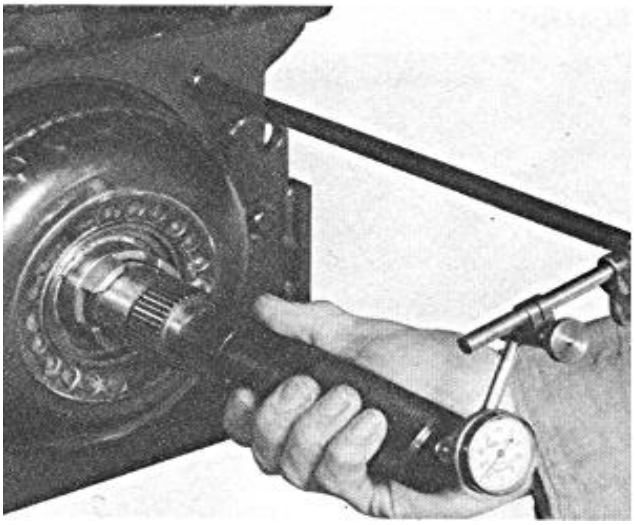


FIGURE 133—*Checking Main Shaft End Play*

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

The actual main shaft end play should be .004".018". If outside these limits, it will be necessary to remove and disassemble the clutch unit so that the correct selective thrust washer can be installed between the rear unit planet carrier and the reverse drive flange. Remove end play checking tool.

Align rings so they will be upward when governor sleeve is installed in rear pump cover. Compress each ring by hand and work into governor bore. Then rock governor back and forth to engage drive key. Test to see that governor turns when output shaft is turned.

Install new rear extension housing gasket on rear pump with petrolatum, and install rear extension housing on case with eight attaching screws and washers.

Install speedometer gear in rear extension housing.

Insert vent pipe into hole in top of rear pump and clamp pipe to case.

If rear oil seal was removed, coat new seal with permatex and drive into housing until seal bottoms. Tool J-4485 or J-5154A will facilitate installation of the seal.

NOTE: *Felt portion of seal must be toward rear.*

INSTALLATION OF FRONT PUMP AND OVERRUN CLUTCH

Install front pump and overrun clutch plate assembly over intermediate shaft. At the same time, align the intake pipe holes in the front pump and case (Fig. 134).

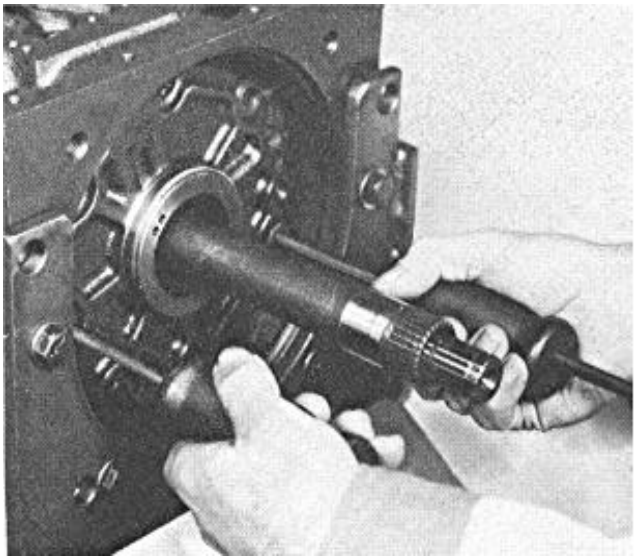


FIGURE 134—*Installing Front Pump and Overrun Clutch*

Install and tighten three front pump to case center screws; then back them off one turn.

Install front pump locking screw through case into pump and tighten securely (Fig. 135). Then tighten front pump to case support attaching screws.

NOTE: *Locking screw must be tightened up first to draw pump tightly against case and eliminate the possibility of excessive oil leaks between pump and case.*

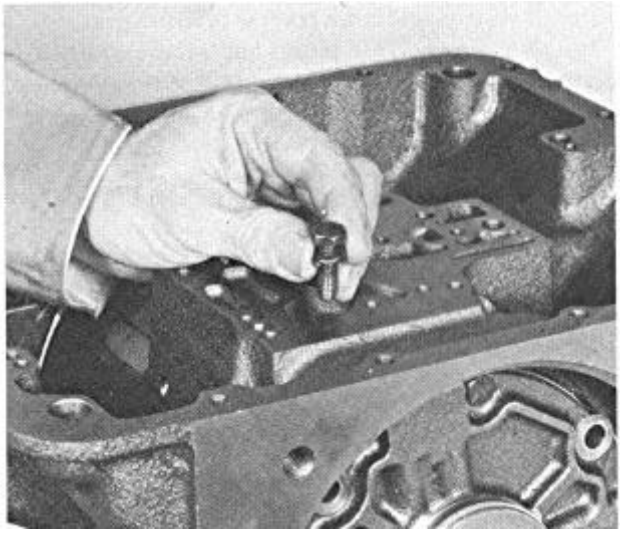


FIGURE 135—*Installing Front Pump Locking Screw*

INSTALLATION OF OIL COOLER ADAPTER, PRESSURE REGULATOR, AND FRONT UNIT COUPLING

Install seals on ends of oil cooler sleeves and insert sleeves in case with seal end first. Place oil cooler adapter with gasket on case over oil cooler sleeves; install two attaching screws with copper washers and tighten securely.

With spring in place on pressure regulator valve, install valve and spring into case. Install pressure regulator plug assembly and tighten to five foot pounds torque (Fig. 136).

CAUTION: *Do not over-torque as pressure regulator may push pump away from case and cause an internal oil leak.*

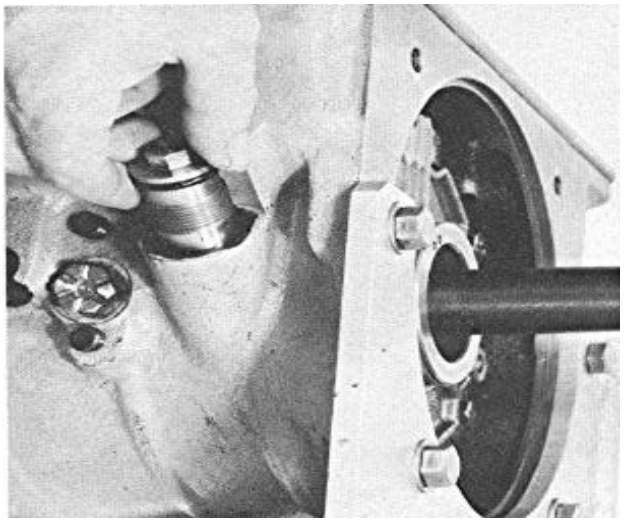


FIGURE 136—*Pressure Regulator Assembly*

Rotate transmission to vertical position with front pump "up."

First install front unit coupling assembly cover into transmission. Then "rock" drive torus shell to make sure that the drive hub engages front pump and rotor and "rock" driven torus shaft to make sure lugs on shaft engage front unit sprag inner race. Driven torus shaft should turn clockwise freely and not turn counterclockwise.

NOTE: *For measurement of front unit end clearance, refer to Figures 29 and 30.*

INSTALLATION OF CONTROL VALVE ASSEMBLY, AND SERVO AND ACCUMULATOR ASSEMBLY

Rotate transmission to horizontal position.

Attach control valve assembly to transmission with five attaching screws, leaving out screws which will position front pump intake pipe retainer. (The four outer screws have star washers and the center two have flat washers.)

NOTE: *Position detent lever so it will engage detent plunger and manual valve.*

Install new front pump "0" ring in intake pipe hole at front of case.

Install servo and accumulator assembly and servo spring.

Install front pump intake pipe into case and secure with clip and valve body attaching screw.

Install new rear pump "0" ring on rear pump intake pipe.

Install oil screen on front pump intake pipe. Install rear pump intake pipe into screen and case. Install oil pan with new gasket and tighten attaching screws securely.

REPLACEMENT OF FLYWHEEL HOUSING SEAL

If seal is to be replaced, clean up "staking" and remove front oil seal from front side of housing.

CAUTION: *Do not damage torus cover hub bushing while removing seal.*

Replace seal by starting seal into bore in flywheel housing with lip facing toward bushing. Drive seal into place using tool J-6118.

NOTE: *Do not use sealer.*

Stake housing against seal in three places.

INSTALLATION OF FLYWHEEL HOUSING AND TORUS ASSEMBLY

Remove transmission with holding fixture J-6115 from bench collet and position on jack adapter J-6130 or bench in horizontal position with pan down. Remove holding fixture.

Install steel thrust washer in recess in front unit drive torus shell (Fig. 137).

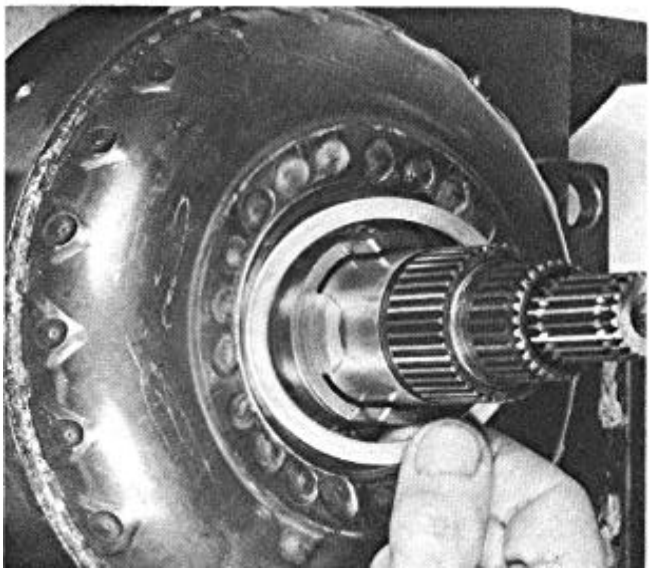


FIGURE 137—*Installing Steel Thrust Washer*

Position flywheel housing bushing and seal protector J-6119 over intermediate shaft.

Install flywheel housing to case "0" ring seal on flywheel housing (Fig. 138) and flywheel housing on case. Attach with six screws, tightening to 45 foot pounds torque. Then remove bushing and seal protector.

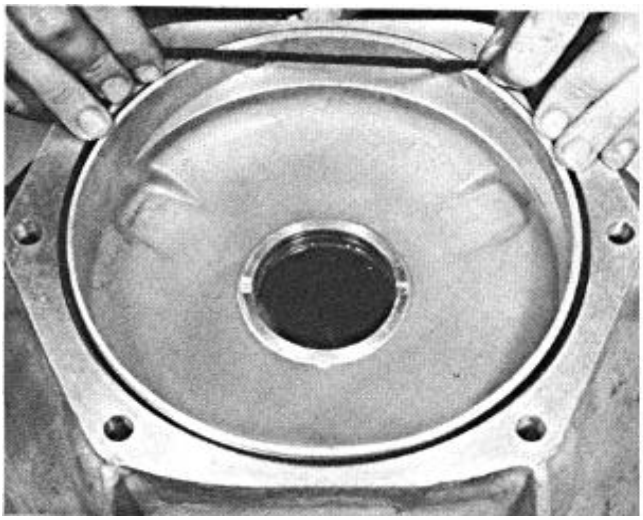


FIGURE 138—*Installing "0" Ring*

Install proper selective washer on drive shaft of front unit as determined when checking front unit end clearance (Fig. 139).

Install torus cover. Push cover on evenly, without rocking, to prevent damage to seal and bushing.

Install internal gear assembly into cover, indexing with torus cover and front unit drive torus hub.

Install bronze thrust washer, then steel backing washer in internal gear. Steel backing washer must

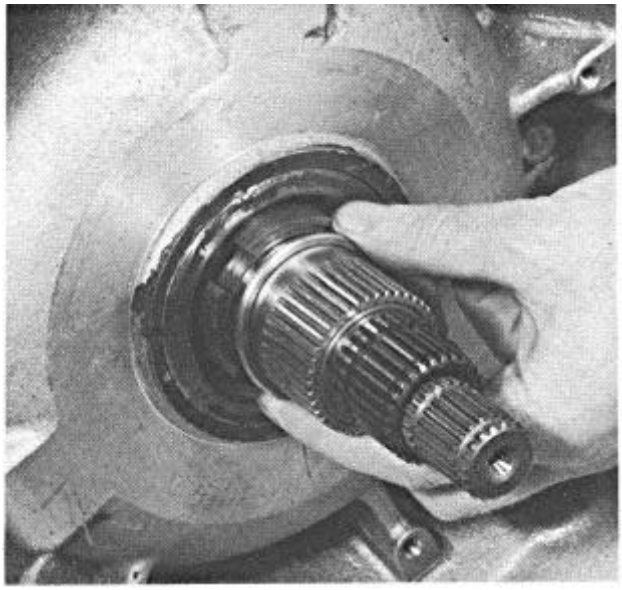


FIGURE 139—*Installing Proper Selective Washer*

be indexed with splines of front unit driven torus shaft.

Install sun gear over front unit driven torus shaft, chamfered side first.

Install steel backing washer and bronze thrust washer against sun gear.

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

Secure drive torus to intermediate shaft with Truarc snap ring (Fig. 140).

FIGURE 140—*Installing Drive Torus Snap Ring*

Install driven torus rear Truarc snap ring on main shaft.

Install driven torus on main shaft (Fig. 141)

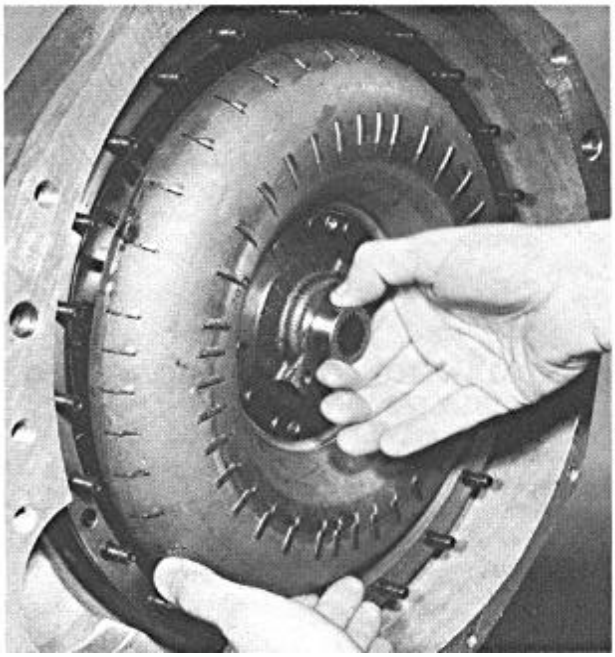
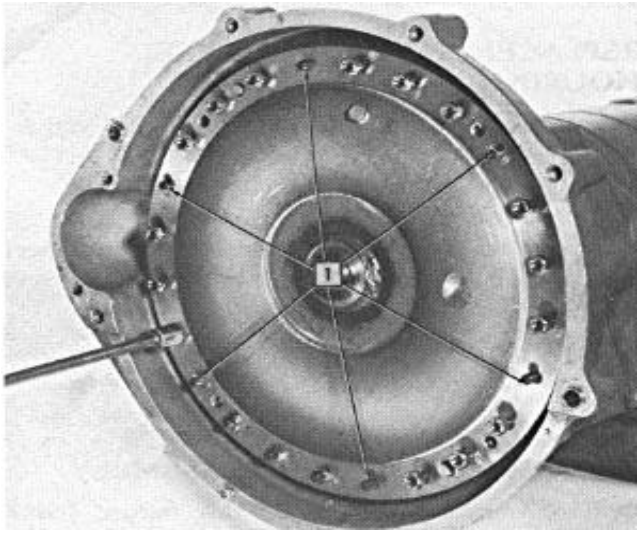


FIGURE 141—*Installing Driven Torus*

Install driven torus front Truarc snap ring on main shaft to secure torus member.

Install flywheel "0" ring seal on flywheel. Position flywheel against torus cover, indexing with dowels. (Flywheel can be installed in only one position since the dowels are of different sizes.)

Install and tighten to 25 foot pounds torque, 18 flywheel to torus cover nuts leaving six of the nuts off the bolts (Fig. 142). These six bolts will be used for attaching the flywheel and torus cover to the engine flex plate.



l. Flex Plate Attaching Bolts

FIGURE 142—*Installing Flywheel*

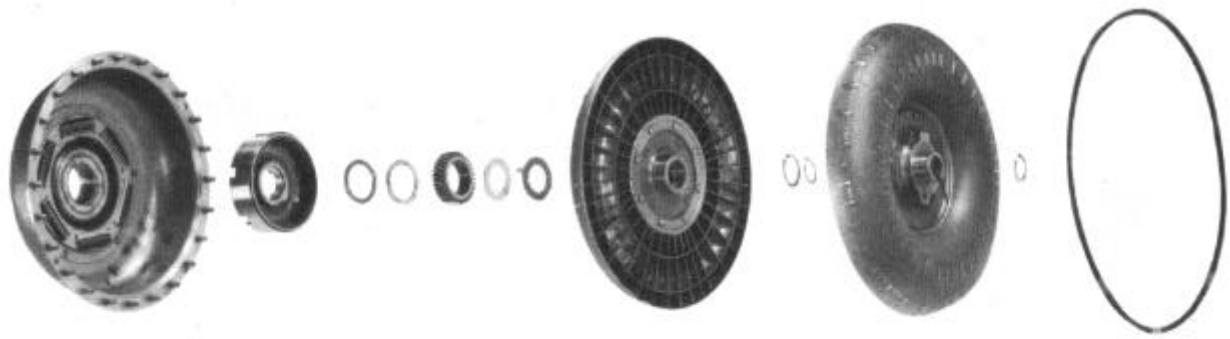


FIGURE 143—***Exploded View of Torus Assembly***

REPLACING THE FLASHAWAY HYDRA-MATIC TRANSMISSION

Line up crankshaft flex plate in relation to the six bolts on transmission torus cover.

Lift transmission into place with a hydraulic floor jack and align transmission to engage the six bolts into the flex plate.

Install the six nuts and torque tighten to 25 to 30 foot pounds.

Install flywheel housing to engine bolts.

Install cross member and connect torque tube to rear transmission housing.

Replace speedometer cable, and manual and T.V. linkage.

Connect oil cooler tubes and replace oil filler tube. Connect brake hose bracket.

Install lower flywheel housing to engine cover. Remove engine support and recheck T.V. and manual control linkage adjustment.

Fill transmission to proper level by following procedure outlined under "Transmission Fluid, Draining, and Filling."

TRANSMISSION FLUID, DRAINING, AND REFILLING

TRANSMISSION FLUID

Fluid level should be checked every 1000 miles at the time chassis lubrication is performed. In order to make an accurate check, transmission should be at normal operating temperature, engine should be idling at 425 R.P.M., selector lever should be in "P" (Park) position, and car should be on level floor.

With engine idling, remove the fluid level indicator and wipe clean, reinsert it and remove the indicator and note reading.

When refilling or adding fluid, use only Automatic Transmission Fluid (Type A) from containers bearing Armour Institute qualification number "AQATF."

Transmission oil should be changed every 25,000 miles at which time it is recommended that the oil pan be removed and the oil screen cleaned.

The torus drain plug is located in the flywheel.

TRANSMISSION FILLING PROCEDURE

Pour in eight quarts of Hydra-Matic fluid.

Operate engine with transmission in neutral for about 11/2 minutes to fill fluid coupling.

Add 21/2 quarts Hydra-Matic fluid.

Warm up engine thoroughly (oil will expand as it is heated and oil level indicator is calibrated for oil at normal operating temperature).

Place selector lever in "P" (Park) position and recheck fluid level indicator and add oil as necessary to bring level to full mark on indicator.

NOTE: *DO NOT OVERFILL TRANSMISSION AT ANY TIME.*

THROTTLE AND SELECTOR LEVER LINAGE ADJUSTMENTS

THROTTLE LINKAGE ADJUSTMENT

Check the adjustment of the T.V. lever at the transmission by disconnecting the lower T.V. rod from the lever. Disconnect the vent pipe at the lower left rear of the tranmisson case.

While holding the T.V. lever all the way back against the stop, the measurement should be 5%6" from the machined surface at the rear of the case to

the center of the pin on the T.V. lever. Bend lever to conform to this measurement (Fig. 144).

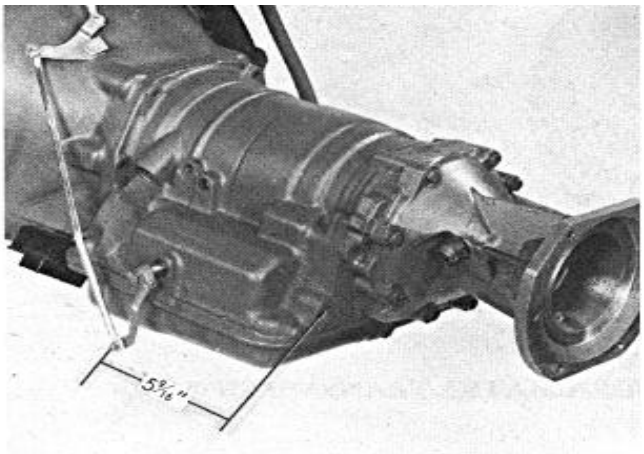


FIGURE 144—*T.V. Lever Measurement*

With the carburetor set off of fast idle, adjust the upper T.V. rod at the carburetor throttle rod bracket to engage the hole in the bracket freely. Then remove move the rod from the bracket and turn the adjusting end of the T.V. rod to the left one lull turn; this lengthens the rod. Replace and fasten the T.V. rod to the carburetor throttle rod bracket. Tighten the hexagon nut to secure the adjusting end of the T.V. rod (Fig. 145).

SELECTOR LEVER LINKAGE ADJUSTMENT

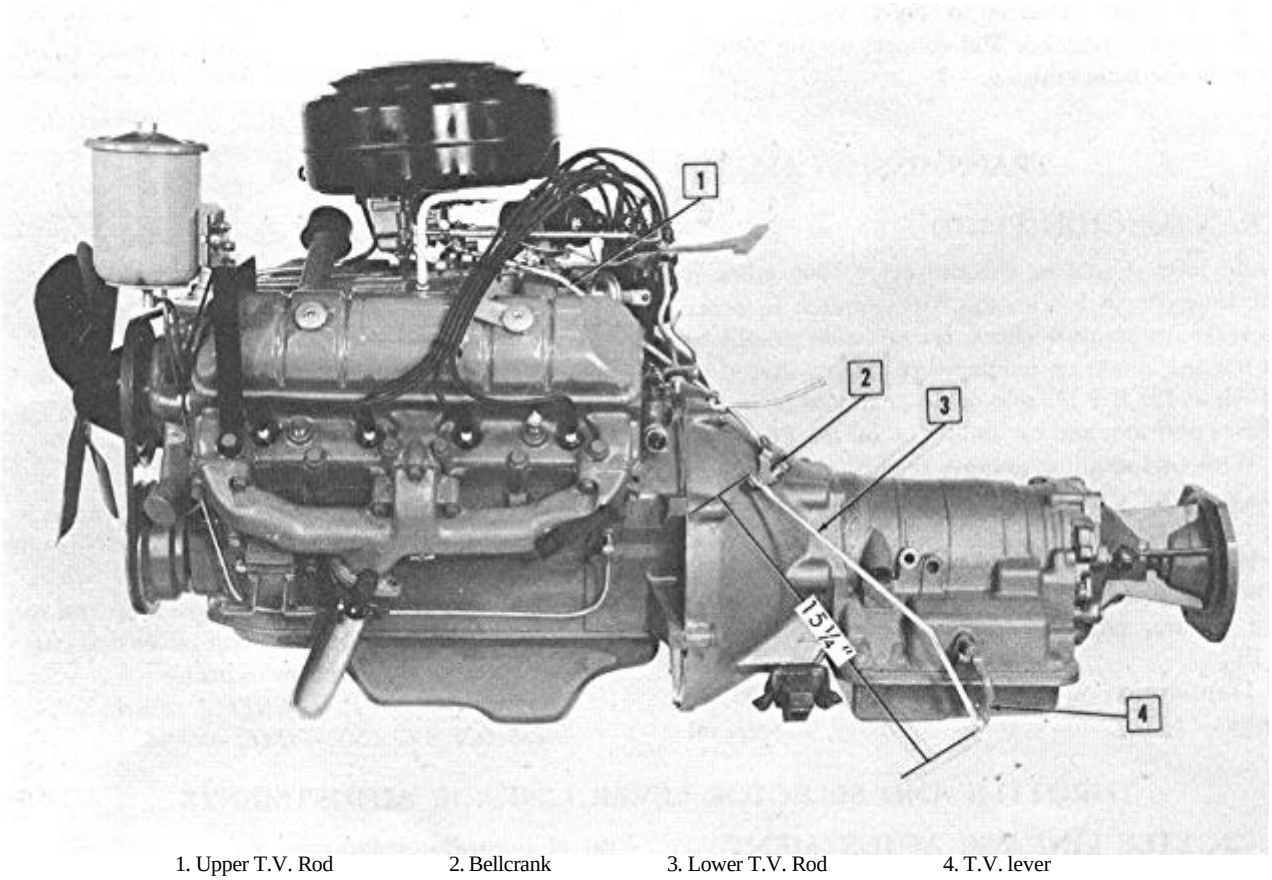
Place selector lever in the D-3 position and set the operating lever against the stop on the starter switch bracket.

Remove clevis pin from the gear shift control rod at side of transmission case and remove clevis from shift lever.

Place the transmission outer shift lever in the D-3 range position.

Adjust clevis so that clevis pin passes freely through hole in lever with the operating lever against the stop on the starter switch bracket. Then remove clevis and lengthen the control rod two full turns and replace clevis and clevis pin.

NOTE: *This adjustment will insure proper detent location in the transmission with a full reverse engagement.*



1. Upper T.V. Rod 2. Bellcrank 3. Lower T.V. Rod 4. T.V. lever

FIGURE 145—*T.V. Linkage*

TESTING AND DIAGNOSIS

"STALL" OR TORQUE TEST

A "Stall" or Torque test may be made to determine engine and transmission performance. This test must be used with moderation because considerable strain is exerted on the drive line, differential gears, and axles. To perform "Stall" test, proceed as follows:

Start engine and warm up to operating temperature.

Connect electric tachometer.

Set hand brake lever tightly and apply foot brake firmly.

Place selector lever in "D" position.

Depress accelerator pedal to floor.

Action has placed transmission in first speed. Brakes are applied, therefore the car cannot move. Opening the throttle and speeding up the engine is comparable to slipping a mechanical clutch, as the driving torus is turning and trying to turn the driven torus which is held stationary by the transmission being in first speed and brakes locked.

The engine will speed up until the friction created between the torus members equals the power output of the engine. Engine speed will denote efficiency and should compare to specifications outlined in Figure 146.

If engine R.P.M. is less than the low limit, the engine is in need of a tune-up.

If engine continues to speed up to approximately 200 to 350 R.P.M. above the high limit, it indicates that clutch sprags are not holding properly or that there is slippage in fluid coupling, damaged torus members, or defective front pump.

> CAUTION: *Extreme care must be used in making this test. DO NOT HOLD THROTTLE OPEN MORE THAN ONE MINUTE. If engine speeds up to 350 R.P.M. over specifications, close throttle immediately to avoid possible damage to transmission.*

Sometimes, it is desirable to know which unit is slipping. After making test with selector lever in "D" position, place lever in "R" position and test again. If slippage still occurs, fault is with front unit or both. If slippage does not occur, then all slippage is in the rear unit. Since this transmission starts in 1st speed in "L" range, the stall speed should be exactly the same in "L" range as it is in Drive and Reverse.

Check Cause for Slipping Under "Stall Test"

Set hand brake lever tightly.

Start engine and run at a speed equivalent to 20 M.P.H for approximately 11/2 minutes. Then, with engine IDLING, selector lever in "N" range, check the fluid level in the transmission.

See that fluid is at the "Full" mark on the indicator.

After level has been checked, shut off engine and wait 10 minutes. If the fluid level in the transmission has not raised more than 1/2", the driven torus check valve is operating satisfactorily.

If check valve is operating satisfactorily, road test car using Diagnosis Guide.

OIL PRESSURE TEST

Connect oil pressure gauge j-2540 to take-off hole at bottom of rear pump using hose and fitting.

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

When transmission is thoroughly warm, check pressure in all ranges. Pressure should be 50 lbs. minimum in "P," "N," D-4, D-3, and "L" ranges with a maximum variation of 10 lbs. between ranges. The pressure, however, may be higher in reverse.

Check pressure in D-3 position at approximately 25 M.P.H. while driving car. Pressure should be 90-100 P.S.I.

> NOTE: *Pressure at any speed is constant regardless of throttle position. T.V. pressure is not used to modulate line pressure.*

While driving at 25 M.P.H., move selector lever back to D-4 position so transmission will shift into fourth speed. Oil pressure should drop to 60-70 P.S.I. in fourth speed.

> NOTE: *To reduce the amount of work done by the front pump, pressure is directed from the 3-4 shift valve to the pressure regulator to reduce line pressure in fourth speed when in D-4 position. In D-3 position, line pressure remains at 90-100 P.S.I. in fourth speed.*

To check pressure in reverse, stop car and set hand brake firmly. Then place selector lever in "R" range and apply foot brake and open accelerator to half throttle. Pressure should increase to 145-190 P.S.I.

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

ROAD TEST

A road test can be made using the shift speed chart in Figure 146. It will be observed, however, that the closed throttle downshifts in D-4 and the 3-2 downshift in D-3 cannot be distinguished. The reason is that in D-4, the sprags in both

HYDRAMATIC SHIFT POINTS IN M.P.H.

DRIVE 4 RANGE

SHIFT	LIGHT THROTTLE	FULL THROTTLE	MAXIMUM PART THROTTLE KICKDOWN	MAXIMUM FULL THROTTLE KICKDOWN	CLOSED THROTTLE DOWNSHIFT
1-2	5-9	21-25			
2-3	11-15	41-45			
3-4	18-22	71-65			
4-3			34-31	67-63	13-9
3-2				22-18	10-6
2-1					4-2

DRIVE 3 RANGE

SHIFT	LIGHT THROTTLE	FULL THROTTLE	MAXIMUM PART THROTTLE KICKDOWN	MAXIMUM FULL THROTTLE KICKDOWN	CLOSED THROTTLE DOWNSHIFT
1-2	5-9	21-25			
2-3	11-15	41-45			
3-4		70-74			
3-2				22-18	10-6
2-1					4-2

"L" RANGE

SHIFT	LIGHT THROTTLE	FULL THROTTLE	MAXIMUM PART THROTTLE KICKDOWN	MAXIMUM FULL THROTTLE KICKDOWN	CLOSED THROTTLE DOWNSHIFT
1-2	7-9				
2-3		35-49			
3-4		70-74			
4-3					
3-2					42-38
21					4-2

"STALL TEST"

TESTING CONDITION FLASHAWAY TRANSMISSION	EINGINE R.P.M 1625 1825	ENGINE R.P.M. UNDER 1625	ENGINE R.P.M. OVER 1825
With engine at operating tem-pretures, set control lever in D-4 range. Fully applie hand brake and foot brake, and ac-celerate engine to wide open throttle.	Normal	Poor engine performance. Tune up, etc.	Transmission slipping or excessiver coupling slippage. (Do not hold throttle open.)

power input is from the rear wheels. The free wheeling of the front unit is eliminated in D-3 by the use of the overrun clutch in order to provide engine braking on hills or when desirable. In "L" range, the low band applies to prevent free wheeling of the rear sprag and provide further engine braking.

DIAGNOSIS GUIDE

Malfunctions	Possible Causes
Slips in 1st and 3rd	Al, A2
Slips in or misses 2nd and 4th	B1, B2, B3, B4, NI, K2, K5
Slips in all "D" Ranges	Dl, D2, D3, N1
Slips in 1st and 2nd	El, E2
Slips in 3rd or 4th	Fl, F2, F3
Slips in 3rd in D-3 on Coast	C1, C2, K5
Slips in 1st and 2nd in "L" Range on Coast	G1, G2, G3, G4
No Drive in "D" Range	A2, A3, B3, M3, E2, M4, N1
No Upshifts	J1, J3, K5
Misses 2nd	K3, K4, K5
Misses 3rd	K4, K5
Locks Up in 2nd and 4th	A2
Locks Up in 3rd and 4th	E2
Rough 2-3	P1, P2, P3, P4, P5, P6
Upshifts High	J1, J2, j3, M2, K5
Upshifts Low	J1, J3, Ml, K5
No Reverse, Slips	H1, N1, Ml, M4
Selector Lever Won't Go into "R"	J1, J3, L1
Reverse Drive in "N"	H3

Legend for Diagnosis Guide

A. Front Sprag Clutch
1. Clutch Slipping
2. Clutch Broken
3. Clutch Incorrectly Installed

B. Front Unit Torus Cover
1. Cover Seals Leaking
2. Cover Exhaust Valves Sticking or Missing
3. Cover Feed Restriction or Leak
4. Cover Signal Restriction or Leak

C. Overrun Clutch
1. Clutch Slipping or Burned
2. Clutch Apply Restricted or Leaking

D. Neutral Clutch
1. Clutch Slipping or Burned
2. Clutch Apply Restricted or Leaking
3. Incorrect Number of Clutch Plates

E. Rear Sprag Clutch
1. Clutch Slipping
2. Clutch Broken
3. Clutch Incorrectly Installed

F. Rear Unit
1. Clutch Slipping or Burned
2. Clutch Apply Restricted or Leaking
3. Incorrect Number of Clutch Plates

G. Low Servo
1. Low Servo Apply Restricted or Leaking
2. Low Band Not Anchored to Case or Broken
3. Low Servo Piston and Rod Bind in Case or Servo and Accumulator Body
4. Band Facing Worn or Loose

H. Reverse Unit
1. Reverse Piston Apply Restricted or Leaking
2. Stationary Cone Key Missing
3. Stationary Cone Sticking

J. Governor
1. Governor Valves Sticking
2. Leaking or Restricted Main Line Feed to Governor
3. Broken Governor Rings

K. Control Valve Assembly
1. Limit Valve Sticking
2. Coupling Valve Sticking
3. G-5 Valve Sticking
4. Transition Valve Sticking
5. Sticking Valves or Dirt in Valve Body

L. Reverse Blocker Assembly
1. Reverse Blocker Piston Stuck

M. Linkage
1. Throttle Linkage Adjusted Long
2. Throttle Linkage Adjusted Short
3. Manual Linkage Incorrectly Adjusted
4. Manual Valve Not Engaged with Drive Pin

N. Oil Pressure
1. Low Oil Pressure

P. Accumulator
1. Trimmer Valve Stuck
2. Accumulator Piston Stuck
3. Accumulator Gasket Broken or Leaking
4. Restricted or Leaking Oil Passages
5. Broken Accumulator Spring
6. Broken or Leaking Piston Oil Seal Rings

NOISE

Occurs Under Following Conditions	Possible Causes
"P," "N," "D," "R," 1st and 3rd	Front Unit Planetary Gears
"P," "N," "R," 1st and 2nd	Rear Unit Planetary Gears
All Ranges Especially Cold Idle	Front Pump
All Ranges—Loaded Only in "R"	Reverse Planetary Gears
Any Time Car Is in Motion	Rear Pump

OIL LEAKS

Possible Points of Oil Leaks	Possible Causes
Oil around inside of bell housing and in line with torus drain plug.	Torus drain plug in flywheel.
Oil on inside of bell housing in line with torus cover seal.	Torus cover to flywheel bolts not torqued to specification. Damaged torus cover to flywheel seal ring.
Oil on torus cover and inside of bell housing.	Front oil seal. Faulty torus hub weld.
Oil between bell housing and transmission case.	Rear extension housing to transmission bolts not properly torqued. Damaged "0" ring between bell housing and case.
Oil between rear pump and case.	Rear extension housing to transmission bolts not properly torqued. Damaged rear extension housing to rear pump gasket.
Oil between rear extension housing and rear pump.	Rear extension housing to case bolts not properly torqued. Damaged rear extension housing to rear pump gasket.
Oil at "U" joint slip yoke.	Rear seal.
Oil left side of transmission case in line with throttle and manual lever shafts.	"0" ring seal between inner T.V. shaft and inner manual lever shaft. Seal between inner manual lever shaft and transmission case.
Center support bolt.	Not torqued to specifications.
Bottom pan gasket.	Damaged gasket. Attaching bolts not properly torqued.
Drain plug.	Damaged gasket. Not torqued to specifications.
Pressure regulator plug.	Damaged gasket. Not torqued to specifications.
Cooler connectors.	Damaged gasket. Attaching bolts not torqued to specifications.

GENERAL SPECIFICATIONS

Rear Unit End Play (Mainshaft End Play Minus Rear Unit Sun Gear to Mainshaft End Play)	.004"-.018"
Front Unit End Play	.024"-.031"
Neutral Clutch Ring Gap (When Installed in Piston Bore of Case Support)	.002"-.007"
Fluid	
Type	Hydra-Matic Fluid or Automatic Transmission Fluid (Type A) Bearing Armour Institute Qualification No. "AQ-ATF."
Capacity	
Drain and Refill	Approx. 10-1/2 Qts.
Refill after Overhaul	Approx. 12 Qts.
Change Transmission Oil Every	25,000 Miles

NOTE: *Correct amount of fluid should always be determined by indication on oil level indicator with transmisson warm, car level, and engine idling with control lever in "P" (park).*

THRUST WASHER SPECIFICATIONS

Location	Outside Diameter	Inside Diameter	Thicknes S	Material
Reverse Internal Gear to Rear Pump Body Thrust Washer	2.73	2.165 2.175	.087 .091	Bronze
Front Sun Gear to Carrier Thrust Backing Washer	2.04	1.253 1.263	.049 .051	Steel
Rear Unit Clutch Drum to Clutch Hub Thrust Washer	2.94	2.115 2.122	.087 .091	Bronze
Rear Unit Sun Gear Thrust Washer (One Each Side)	2.377	1.44	.087 .091	Bronze
Front Sprag Overrun Clutch Inner Race Thrust Washer	1.783 1.788	1.41	.087 .091	Bronze
Front Unit Drive Torus Thrust Backing Washer	1.990 1.995	1.675 1.685	.049 .051	Steel
Front Unit Drive Torus Thrust Washer	1.990 1.995	1.675 1.685	.087 .091	Bronze
Front Unit Coupling to Flywheel Rear Housing Bushing	2.880 2.886	2.42	.060 .064	Steel
Front Internal Gear Hub Thrust Washer	2.204 2.210	1.675 1.685	.087 .091	Bronze
Front Internal Gear Hub Thrust Backing Washer	2.182 2.192	1.675 1.685	.060 .064	Steel
Front Sun Gear to Carrier Thrust Washer	2.02	1.253 1.263	.087 .091	Bronze

Rear Unit Planet Carrier to Reverse Drive Flange Selective Thrust Washer				
No. 1	2.94	2.12	.055 .059	Bronze
No 2	2.94	2.12	.060 .064	Bronze
No. 3	2.04	2.12	.065 .069	Bronze
No. 4	2.94	2.12	.070 .074	Bronze
No. 5	2.94	2.12	.075 .079	Bronze
No. 6	2.94	2.12	.080 .084	Bronze
No. 7	2.94	2.12	.085 .089	Bronze
No. 8	2.94	2.12	.090 .094	Bronze
No. 9	2.94	2.12	.095 .099	Bronze

SPRING SPECIFICATIONS

Name	Approx. Free Length	No. Coils	Diameter
Front Pump			
Inner Priming Spring	525	5	.440
Outer Pump Priming Spring	862	6-3/4	.604
Check Valve Spring	.54	8	.245
Torus Feed Valve Spring	627	8	.310
Rear Clutch Release	1 57	14	.44
Servo and Accumulator Assembly			
Accumulator Trimmer Valve	97	9-1/2	.41
Accumulator Inner Spring	5 54	35-1/2	.790
Accumulator Outer Spring	4 61	17	1.10
Servo Release	2 50	11	1.625
Pressure Regulator Spring	2 19	14-1/4	.59
Front Coupling Exhaust Valve	72	7	.34
Torus Check Valve	.69	14	.187
Control Valve Assembly	.	.	
Coupling Valve	1 92	21	.43
Detent Plunger	2 04	19	.035
Detent Valve	80	8-1/2	.35
Limit Valve Inner	2.03	23-1/2	.35
Limit Valve Outer	2.79	19	.59

Reverse Blocker	1 27	16	.32
Throttle Valve	1.680	17	.39
Transition Valve	1 69	30	.26
2-3 Shift Valve (Outer)	1 30	9	.58
2-3 Shift Valve (Inner)	1 36	17	.33
3-4 Shift Valve (Outer) .	1 76	12	.50
3-4 Shift Valve (Inner)	1 23	17-1/2	.34

TORQUE TIGHTNESS

Location	Torque Lb. Ft.	Location	Torque Lb. Ft.
Control Valve Assembly Screws	2-3	Torus Cover to Flywheel (Nut)	25
Flywheel Drain Plug	6-7	Servo to Case	25
Rear Pump Oil Pressure Take-Off	6-7	Rear Pump Assembly to Case	25
Cover to Accumulator Body	12-15	Rear Extension Housing to	
Governor Cover to Body	6-8	Rear Pump and Case .	25
Control Valve 'to Case	6-8	Front Pump Assembly to	
Rear Pump Body to Case	10-12	Center Support	25
Case to Front Pump Body	25	Flywheel Housing to Case	45
Front Pump Cover to Body	15-18	Case to Center Support	25
Rear Pump Cover to Body	15-18	Oil Pan Drain Screw	40
Cooler Adapter to Case	15-18	Pressure Regulator Plug	5
Oil Pan to Case	10-13		

TECHNICAL SERVICE LETTER REFERENCE

Date	Letter No.	Subject	Changes Information on Page No.

BRAKES AND WHEELS – HUBS AND DRUMS

The brake system incorporated in this series is the Bendix Servo type identical to the system used on the 1956 40 Series.

BRAKE SPECIFICATIONS

Type of Mechanism	Lockheed Hydraulic
Make	Bendix Servo
Total Foot Braking Area	165 Sq. In.
Lining Size—	
Width x Length	
Primary—Front	2" x 8-7/8"
Rear	1-3/4" x 8-7/16"
Secondary—Front	2-1/2" x 10-31/32"
Rear	1-3/4" x 10-25/32"
Pedal Free Play Without Power Brakes	1/4" to 1/2"
Drum Diameter, Inches	10"
Front Wheel Cylinder Bore, Diameter	1-1/2"
Rear Wheel Cylinder Bore, Diameter	7/8"
Master Cylinder Bore, Diameter	1"
Piston Clearance, Inches,	
Wheel and Master Cylinder	.001" to .003"
Master Cylinder Piston Rod Diameter,	
Inches (Power Brake Treadle-Vac)	21/32”

WHEELS AND TIRES

Wheel Size	15"
Tire Size	6.70 x 15"
Tire Pressure (Cold)	
Front and Rear Wheels	24 Lbs.

REAR AXLE

The rear axle assembly (Spicer type) disassembly and assembly procedures are similar to those outlined in the 1955 Technical Service Manual. Variations in procedures and adjustments are outlined as follows:

DIFFERENTIAL ASSEMBLY AND DRIVE PINION REMOVAL

Place axle assembly in suitable stands to facilitate overhaul. Thoroughly clean assembly, removing all dirt and accumulated grease. Note metal tag denoting axle ratio under one of the cover screws. This tag should be reinstalled after assembly is overhauled.

An axle flushing solution can be used in the axle to degrease the parts before the actual disassembly is started. This practice will save time during disassembly as the parts will be free from lubricant and may be handled and inspected easily.

Remove carrier cover and gasket.

Before further disassembly, check the ring gear back face for runout. Mount a dial indicator as shown in Figure 1 and slowly turn the rear axle drive pinion. Total indicator reading in excess of .006" might indicate loose ring gear, sprung case, or nicks and burrs between ring gear and flange.

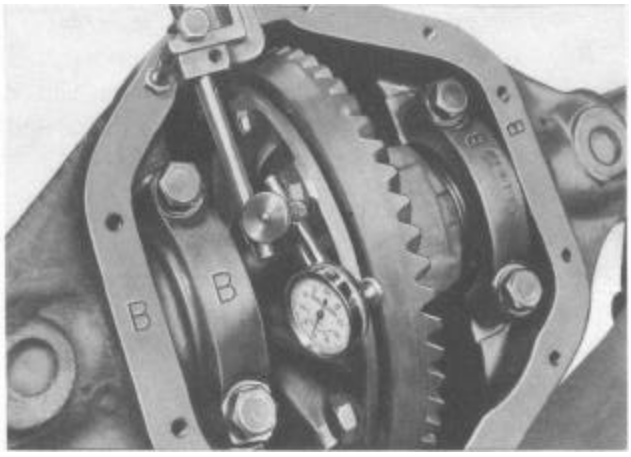


FIGURE l—*Check Ring Gear Runout*

A .003" feeler should not enter between differential bearing cap and cup. If the feeler does enter, it could denote the differential bearing cup had turned in the carrier.

Remove differential bearing caps. Note matching marks on carrier flange and differential bearing caps (Fig. 1).

> NOTE: *Both caps and each side of housing are stamped with an identifying number or letter. On one side, the markings will be parallel with each other; on the opposite side, they will be vertical to each other.*

Install axle housing spreader J-5231 in place on housing making sure tool hold-down clamp screws are tight. Mount dial indicator as shown in Figure 2.

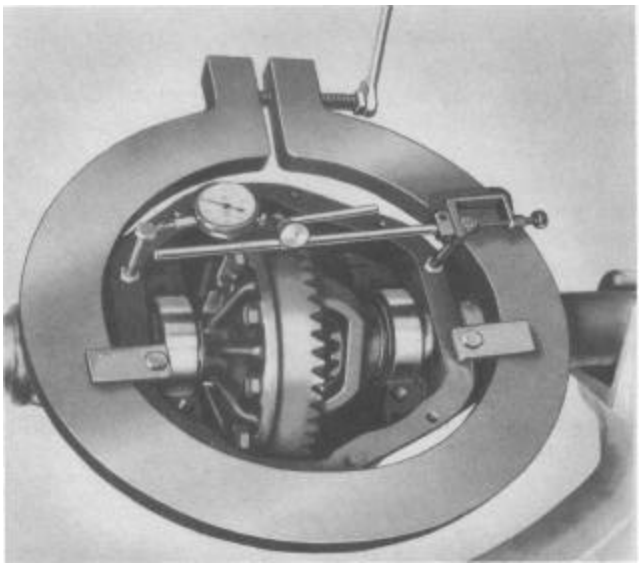


FIGURE 2—*Spread Housing to Remove Differential Carrier Assembly*

The axle assembly must be free in stands or holding fixture when housing is being spread. Spread housing .020" maximum indicator reading. Do not exceed this limit as it will result in permanent damage. It is necessary to spread the housing for removal or installation of the differential as the differential bearings have an initial preload of from .005" to .009".

Remove indicator fixture. Remove the differential assembly by prying upward and outward with two large screw drivers or pry bars.

Remove bearing cups from side bearing; if cups or cones are not damaged or excessively worn, be sure mating parts are kept together for proper reassembly.

Differential Side Bearing Removal

Bearing puller J-2497 is used to remove side bearing cones from the differential case. When using this tool, be sure it pulls on the bearing cone in such a manner that the rollers are free. Recesses are cast in the carrier case to allow the tool to bear on the cone.

> NOTE: -11 ring gear and pinion are to be reassembled, note position of shims and replace accordingly.

Ring Gear Removal

Remove the cap screws that attach the ring gear to the

differential case.
Use a brass drift, tap the ring gear from the case. Do not nick the ring gear face of the differential case or drop the ring gear.

Differential Pinion Gears and Shaft Removal

Use a suitable punch to drive out lock pin that holds differential pinion shaft in place.

The pinion shaft can then be driven out and the thrust block can be dropped out through the differential side gear.

Roll the differential pinion gears around on the side gears until they can be lifted out through the holes in the case.

Then lift out the side gears and their thrust washers.

Pinion Gear and Shaft Removal

Inspect the rear axle companion flange for face run- out using a dial indicator (Fig. 3). The runout should not exceed .002".

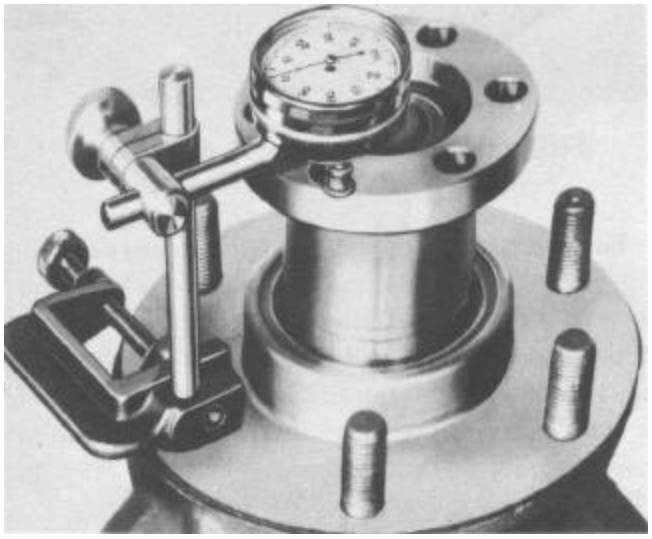


FIGURE 3—Inspect Rear Axle Companion Flange Face Runout

Remove the pinion shaft nut while holding the pinion shaft flange. The flange can be held by installing two of the flange bolts and holding with a large screw driver blade, pry bar, or with a suitable spanner type wrench. Use extreme care to avoid damage to the flange surfaces.

Remove the companion flange. This is a press fit, use flange puller J-2984 (Fig. 4). *Do not drive the flange off the shaft.*

The oil seal and retainer may now be removed. Remove the pinion shaft oil slinger.

Tap the end of the pinion shaft with a fibre hammer to free the front bearing cone from the pinion shaft and remove the bearing.

The shim pack located between the bearing and a shoulder

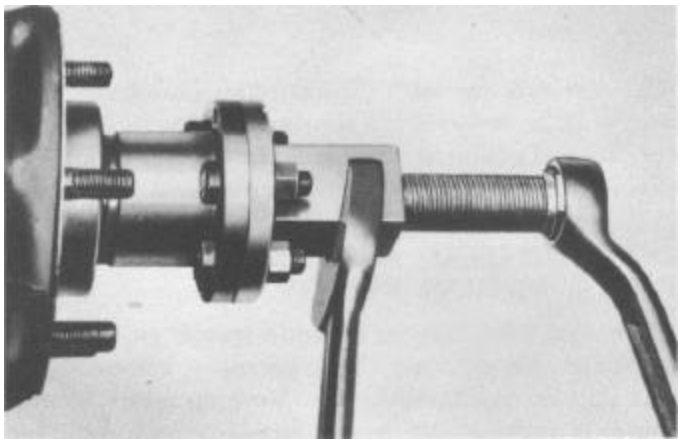


FIGURE 4—*Remove the Rear Axle Pinion Flange with Tool J-2984*

on the pinion shaft controls the pinion bearing preload. Therefore, tag to identify it at time of reassembly.

The pinion gear and rear bearing may now be removed from the rear of the housing.

Pinion Bearing Cups

Recesses are located behind each pinion bearing cup to provide a means of driving the cup from the housing. The cups should be driven out of the housing using a brass punch.

CAUTION: *Keep the cups square in the bore to prevent damaging the cup bores.*

Remove shims used to adjust the pinion depth in the housing from behind rear bearing cup. Check thickness of each shim, record total thickness, and tie shims together for reinstallation.

Pinion Rear Bearing Removal

The pinion bearing is a press fit on the pinion shaft. Attach pinion bearing remover J-2245-A in holder J-358-1 and use an arbor press to remove the pinion bearing.

DIFFERENTIAL AND DRIVE PINION ASSEMBLY AND ADJUSTMENTS

To insure a uniform method of adjusting rear axles, all specifications for correct adjustment are established on the basis of dry parts.

New thrust washers and oil seals should be installed at time of assembly.

Assembling the Differential Gears

Install thrust washers on the side gears and install the gears in the bores of the differential case.

Install thrust washers behind the differential pinion gears and mesh the gears with the side gears so the holes are opposite and in line with each other.

Roll the gears around until the gear holes are aligned with the differential pinion shaft hole in the case.

The pinion gear shaft is installed with the lock pin hole in line with the lock pin hole in the differential case.

Install the thrust block through a side gear, aligning the hole in the block with the differential pinion shaft. Press differential pinion shaft in place and measure the clearance between the differential side gear and case. This clearance should not exceed .008". However, the side gears should not fit tight enough to require more than eight foot pounds torque to turn the differential gears. This may be checked by installing an axle shaft and using a torque wrench to turn the shaft. Then drive the lock pin into place and upset pin.

Ring Gear Installation

Place the ring gear on the differential case.

Bolt the ring gear to the differential case with cap screws. In some cases, two of the cap screws installed in opposite holes may be used as guides to pull the gear into position.

Tighten the cap screws to 50-55 foot pounds torque. Be certain the ring gear is being pulled down evenly and that there are no nicks or burrs to prevent the gear from being installed evenly all the way around.

Adjusting Side Bearings

Install the differential bearing cones on the differential case hubs without installing shims, using side bearing replacer tool j-2646 or J-2104.

Install differential bearing Cups. Clean bearing bores in housing and install the differential assembly.

Install the bearing caps. Be sure identification marks on cap (Fig. 1) are in same position as identification marks on housing. Tighten bolts finger tight.

Mount a dial indicator with the button against the back face of the ring gear (Fig. 5). Insert two screw drivers between the bearing cup and housing. Force the differential assembly to one side as far as possible.

Set dial indicator to zero and shift differential as far as possible to opposite side; note and record reading.

This reading denotes the shim requirements to be installed later between the differential assembly and the bearing cones. Shims are available in .003", .005", .010", and .030" thicknesses.

Remove the side bearing caps and remove the differential assembly.

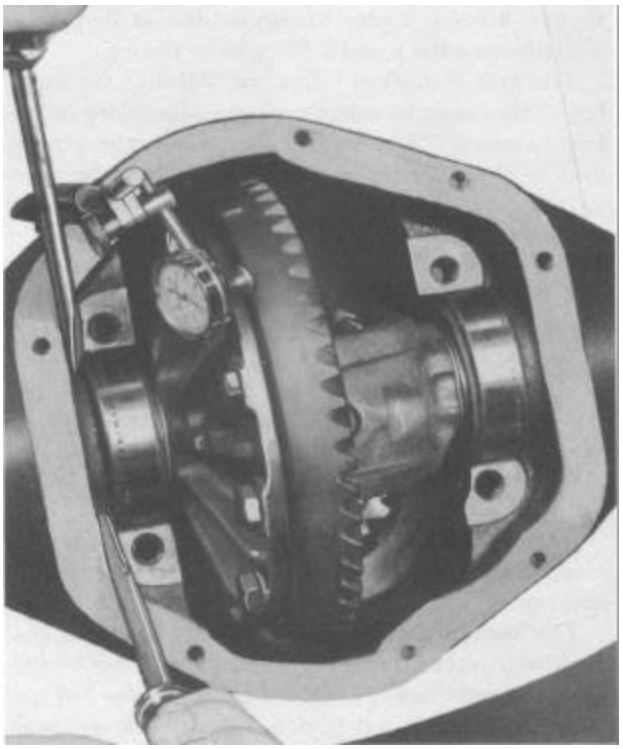


FIGURE 5—*Determining Shim Pack for Side Bearing Adjustment*

Pinion Depth Adjustment

To compensate for machining tolerances, the pinion and ring gears are factory tested for tooth contact and quietness. This test is conducted at a standard cone setting and varied to obtain correct tooth contact and quietness.

Note the figures etched on the rear end of the drive pinion. One set will be found identical on both the ring gear and pinion. This denotes a matched set. Another figure will be found on the end of the drive pinion which shows a plus or minus sign (Fig. 6).

FIGURE 6—*Matched Gear Set Numbers and Pinion Setting Number*

This indicates the position of the pinion in relation to the center line of the axle. If there are no figures showing a plus or minus sign, it denotes a zero pinion setting and a "0" will be shown.

The gear is marked "Plus" or "Minus" the number of thousandths that the gear varies above or below standard. Thus "Plus" (+) means the pinion gear is closer to the center line of the axle than standard and the "Minus" (—) means farther from the center line.

When installing a new ring and pinion set or a new rear bearing, use new adjusting shims. Adjusting shims are available in .003", .005", and .010" shims to obtain various thickness combinations.

Use bearing replacing tool J-2995; press the rear pinion bearing cone tight against the rear face of the gear.

The large diameter of the bearing should be toward the gear.

Install rear pinion bearing cup with bearing replacer tool J-2531, placing shims between cup and housing.
The amount of shims used is determined by the amount of shims removed at disassembly and by the plus or minus figure etched on the pinion. For example, if the original pinion was marked +2 and had a shim pack of .035" behind the rear bearing cup and the new pinion to be installed is marked —1, the shim pack must be increased by .003" to bring the new pinion to its correct position. The new shim pack will, therefore, be .038" thick.

Install the drive pinion front bearing cup with replacer J-2534 or J-5367. Insert the drive pinion in position and install the front bearing cone and rollers.

Clean differential bearing bores in housing are necessary to make the following check. Mount discs J-2499-2 on gauge arbor J-6482-1 or discs J-5223-5 on gauge arbor J-5223.

Install gauge seated squarely in housing bores (Fig. 7). Place bearing caps in position and tighten bolts finger tight.

The gauge block J-5223-16 is held in position against the end of the drive pinion by clamp bar and screw J-5223-6 and J-5223-14. Loosen the thumb screw in end of gauge block and move plunger out of block until head contacts gauge arbor as shown in Figure 7. Lock plunger by tightening thumb screw. Be certain not to disturb plunger position.

Loosen screw in clamp holding gauge block against pinion and remove gauge block. Measure the distance from end of anvil to top of plunger head with a two to three inch micrometer (Fig. 8).

This measurement represents the distance from the rear face of the drive pinion to the center line of the rear axle and should be 2.625".

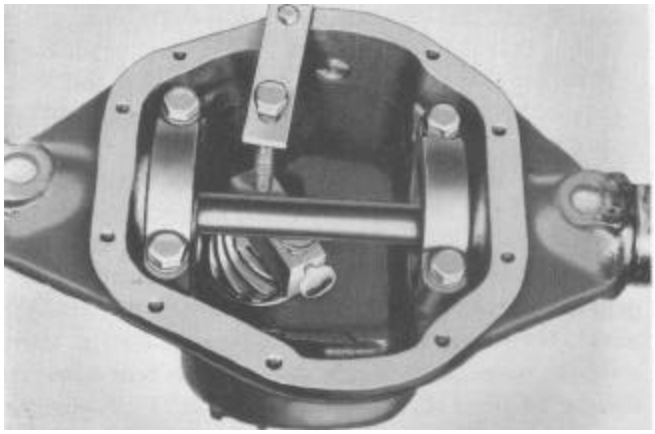


FIGURE 7—*Checking Pinion Depth Adjustment with Pinion Setting Gauge*

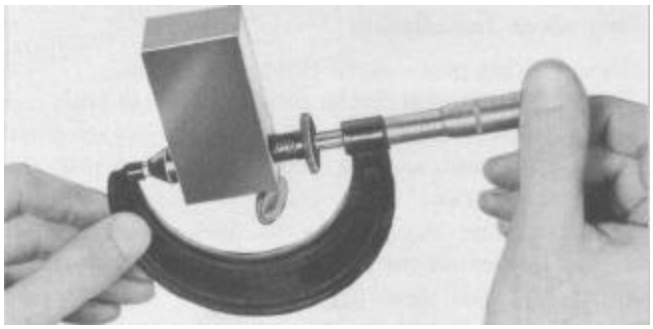


FIGURE 8—*Measuring Gauge Block to Determine Distance from Rear Face of Pinion Gear to Rear Axle Center Line*

This measurement applies only to correctly adjusted pinions marked "0." On a pinion marked +2, the reading should be .002" less than this figure and with a pinion marked —3, the reading should be .003" greater.

If the micrometer reading shows the pinion setting is incorrect by more than .002" plus or minus from the given figures, shims equal to that difference must either be added to or removed from the shim pack between the rear bearing cup or housing.

When changing shim packs, it is advisable to check each shim separately to avoid unnecessary removal and installation of pinion and depth gauge.

Preloading Pinion Bearings

After the correct pinion setting is accomplished, remove front pinion bearing cone and rollers. Install preload shims on shaft and install front pinion bearing cones and rollers. Install oil slinger, companion flange, and nut. Tighten pinion nut to 200-220 foot pounds.

A "T" handle wrench, socket, and spring scale can be

used to determine the amount of pinion bearing preload. The spring scale is attached to the "T" handle at a distance of six inches from the center of the pinion shaft. Pull on the spring scale and note the reading in pounds on the scale as the pinion starts to move and multiply by six. To eliminate the effect of gravity, turn the assembly so that the pulling effort is on a horizontal plane. The specified preload is twenty-five to thirty-five inch pounds. Five pound pull at six inches would indicate thirty inch pounds of preload.

If the reading varies more than the specified preload, add shims to those previously placed in drive pinion to reduce turning torque. If torque reading is low, remove shims. Shims are available in the following thicknesses: .003", .005", .010", and .030".

When the proper preload is set, remove the pinion nut, washer, and companion flange. Install oil seal and retainer. Reinstall companion flange, washer, and nut; torque to 200-220 foot pounds.

Preloading the Differential Side Bearings and Adjusting Backlash

Install differential assembly in housing.

Replace bearing caps in their proper position according to markings and tighten bolts finger tight.

Insert two screw drivers between bearing cup and housing on the side opposite the ring gear and move the differential assembly and ring gear away from the pinion until the opposite bearing cup is seated firmly against the housing. Move the screw drivers to the ring gear side and move the assembly over until the ring gear teeth contact the pinion teeth.

Refer to the shim requirements established by indicator reading outlined in "Adjusting Side Bearings" and install shims between bearing cups and housing. Divide the total amount of shims between sides in such a manner that all ring gear and pinion backlash is eliminated.

Remove bearing caps and take out differential assembly. Keep each shim pack separate. Remove the side bearings from differential with bearing remover tool J-2497 and install shim packs on their respective hubs. Install an additional .015" thickness of shims behind the differential bearing on the tooth side of the ring gear to provide the proper backlash between the gear and pinion and proper bearing preload.

Install bearing with bearing replacer tool J-2646 or J-2104.

Place axle housing spreader J-5231 in position. Mount the dial indicator, and spread housing .020" maximum to permit installation of the differential assembly.

Install the bearing caps and use sealing compound on the bolt threads. Be certain the identifying marks on caps and housing are aligned.

Remove housing spreader. Torque bearing cap screws to 70-90 foot pounds.

Install the dial indicator on housing with contact button resting against edge of gear tooth and check the backlash between ring gear and pinion. Backlash tolerance is .002" to .006" and should not vary more than .002" between positions checked; check at four different locations on ring gear (Fig. 9).

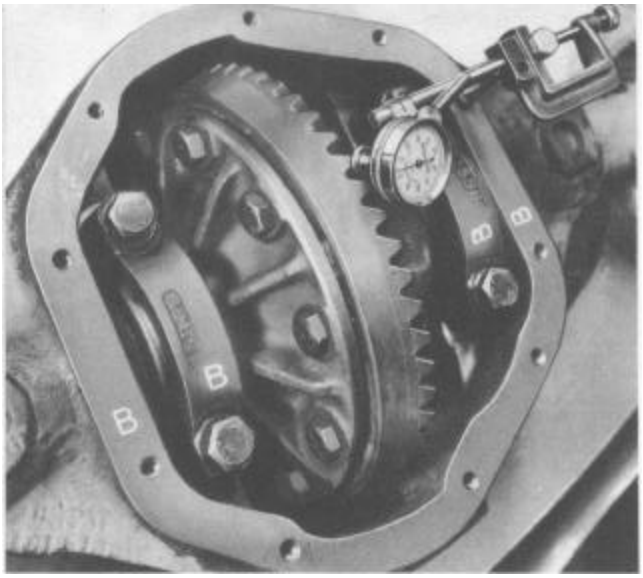


FIGURE 9—*Checking Ring Gear and Pinion Backlash*

Install the inspection cover using a new gasket. Replace the ratio tag under one of the cap screws.

TORQUE CHART

Description	Recommended Torque to Ft. Lb. (All Parts Clean and Dry)
Ring Gear to Case Screw	50-55
Differential Bearing Cap Screw	70-90
Drive Pinion Nut	200-220
Propeller Shaft Coupling Flange Screw Nut	30-35
Wheel to Hub Nut	70-80
Rear Wheel Hub to Shaft Nut	180-190
Rear Brake Support Plate Screw Nut	50-55

SPECIFICATIONS

Type	Semi-Floating
Drive Gear Type	Hypoid
Ring Gear and Pinion Backlash	.002"-.006"
Axle Shaft End Play (Adjust on Right Hand Side Only)	.001"-.004"

Pinion Shaft Bearing Tension	25-35 Inch Pounds
Pinion Bearing Adjustment	Shims
Differential Side Bearing Preload	.005"-.009"
Lubrication Capacity	3-1/2 Pts.
Type of Lubricant	SAE 90 HYPOID*
Rear Axle Ratio (Standard)	4.1:1 (11-45)
Rear Axle Ratio (With Overdrive)	4.5:1 (11-50)
Rear Axle Ratio (With Hydra-Matic)	3.5:1 (13-46)

NOTE: *HYPOID REAR AXLE LUBRICANT IS TO BE USED IN ALL NEW ASSEMBLIES OR FOLLOWING THE INSTALLATION OF REPLACEMENT PARTS. After the rear axle has been runin, or at the recommended drain and refill period, an SAE No. 90 All-Purpose, MultiPurpose, or other brand designation lubricant may be used as long as it is suitable for Hypoid Rear Axle Service. Naturally, the results of such use are the responsibility of the lubricant supplier or servicing dealer.*

TECHNICAL SERVICE LETTER REFERENCE

Date	Letter No.	Subject	Changes Information on Page No.

1956 "HORNET SPECIAL" V-8 Lubrication Service Chart

Lubricate at each arrow point every 1,000 miles except as noted

ENGINE COMPARTMENT

Oil Filter—Replace element every 5,000 miles

Power Steering Reservoir (Check level) ..... **ATF**
Fill to ½" from top

Distributor
- Shaft Oil Cup ..... **EO**
- Wick under Rotor SAE 10 every 5,000 miles ..... **EO**
- Cam (coat surface lightly) every 5,000 miles ..... **PJ**
- Breaker Pivot SAE 10 every 5,000 miles ..... **EO**
- Felt Wick between plates of vacuum advance assembly SAE 10 every 5,000 miles ..... **EO**

Steering Gear (plug)—SAE 90 ..... **EPL**
- Gear Shift Control Lever (fitting) ..... **CL**
- Hydra-Matic models, no lubrication

Throttle Linkage ..... **EO**
felt wick and all pivot points

Oil Cap Filter—every 2,000 miles ..... **EO**
(Clean and re-oil)

AIR CLEANER ..... **EO**
- Clean and re-oil at crankcase drain intervals
- Oil-Bath
  - Capacity 1 Pint
  - Summer—SAE 50
  - Winter—SAE 20
- Wire Gauze Type
  - Spray with crankcase grade oil

Generator (1 oiler) SAE 20 ..... **EO**

CRANKCASE (check level) ..... **EO**
- Above +32°F ..... SAE 20
- Above +10°F ..... SAE 20W
- Above −10°F ..... SAE 10W
- Below −10°F ..... SAE 5W
- Drain and refill every 2,000 miles

Hydra-Matic Transmission (dip stick check level)

UNDER CHASSIS

Control Arms (2 fittings on each side) ..... **CL**

Clutch Beam Lever (fitting) ..... **CL**
Not on Hydra-Matic models

Tie Rod (fitting) ..... **CL**

Pitman Arm (fitting) ..... **CL**
Power steering models only

Clutch and Brake Pedal Shaft (2 fittings) ..... **CL**
Hydra-Matic models (1 fitting)

Brake Master Cylinder (check level) ..... **HBF**
Accessible through hole in floor

Power Brake Air Cleaner
Clean every 10,000 miles

Control Arms (2 fittings on each side) ..... **CL**

King Pin (fitting on each side) ..... **CL**

Tie Rod (fitting) ..... **CL**

Drag Link (fitting on each side) ..... **CL**

Steering Idler Arm (fitting) ..... **CL**
Not on power steering models

TRANSMISSION (check level)
- Synchromesh and Overdrive ..... **MGL**
  - Above +32° F. ..... SAE 90
  - Below +32° F. ..... SAE 80
  - Drain and refill every 10,000 miles
  - Overdrive drained and refilled through separate plugs
- Hydra-Matic—Drain and refill every 25,000 miles .. **ATF**

Hand Brake Bell Crank ..... **EO**

Wheel Bearings (repack) ..... **WBL**
- Front, every 10,000 miles
- Rear, when dismantled for other service reasons

DIFFERENTIAL (check level, SAE 90 ..... **HGL**
Drain and refill every 10,000 miles

LUBRICANT SYMBOLS

ATF	Automatic Transmission Fluid, Type A, AQ, ATF
CL	Chassis Lubricant
EPL	Extreme Pressure Gear Lubricant
MGL	Mineral Gear Lubricant
HBF	Hydraulic Brake Fluid, Lockheed 21B (SAE 70 R-1)
HGL	Hypoid Gear Lubricant—Suitable Type
EO	Engine Oil
WBL	Wheel Bearing Lubricant
PJ	Petroleum Jelly

TIRE PRESSURE (COLD)

Front and Rear ..... **24 Lbs.**

ALL-SEASON AIR CONDITIONING SYSTEM

Once a year—leak test, check oil level in compressor, recharge system if necessary

CAPACITIES

MEASURE SYSTEM	CRANKCASE	TRANSMISSION			DIFFERENTIAL	COOLING SYSTEM		GAS TANK
		Flashaway Hydra-Matic	Synchromesh	With Overdrive		With Heater	Without Heater	
	Quarts	Pints	Pints	Pints	Pints	Quarts	Quarts	Gallons
U.S.A.	5	23	2.25	3.5	3.5	22	21	20
British Imperial	4.2	19.2	1.9	2.9	2.9	18.3	17.5	16.7