Student's Name: _____

Date: 10-

1956 CADILLAC HYDRA-MATIC COURSE

STUDENT'S JOB SHEET

SESSION NO. 1

MECHANICAL FEATURES

The 1956 Hydra-Matic Drive, while providing the same basic performance and desirable features as previous units, differs from them in many ways. Many parts are completely new, and all require thorough study.

1956 vs. EARLIER TRANSMISSIONS

Similarities: 4 speeds forward, smooth torque application for upshifting and downshifting; automatic selection of most favorable ratio; parking lock; uses planetary gearsets.

1956 Differences: Sprag clutches used in place of servos and bands; a fluid clutch used in place of disc clutch in front unit for direct drive; split-torque direct drive for both units; separate neutral clutch; reverse mechanism new; parking mechanism new; over-run clutch and over-run band new.

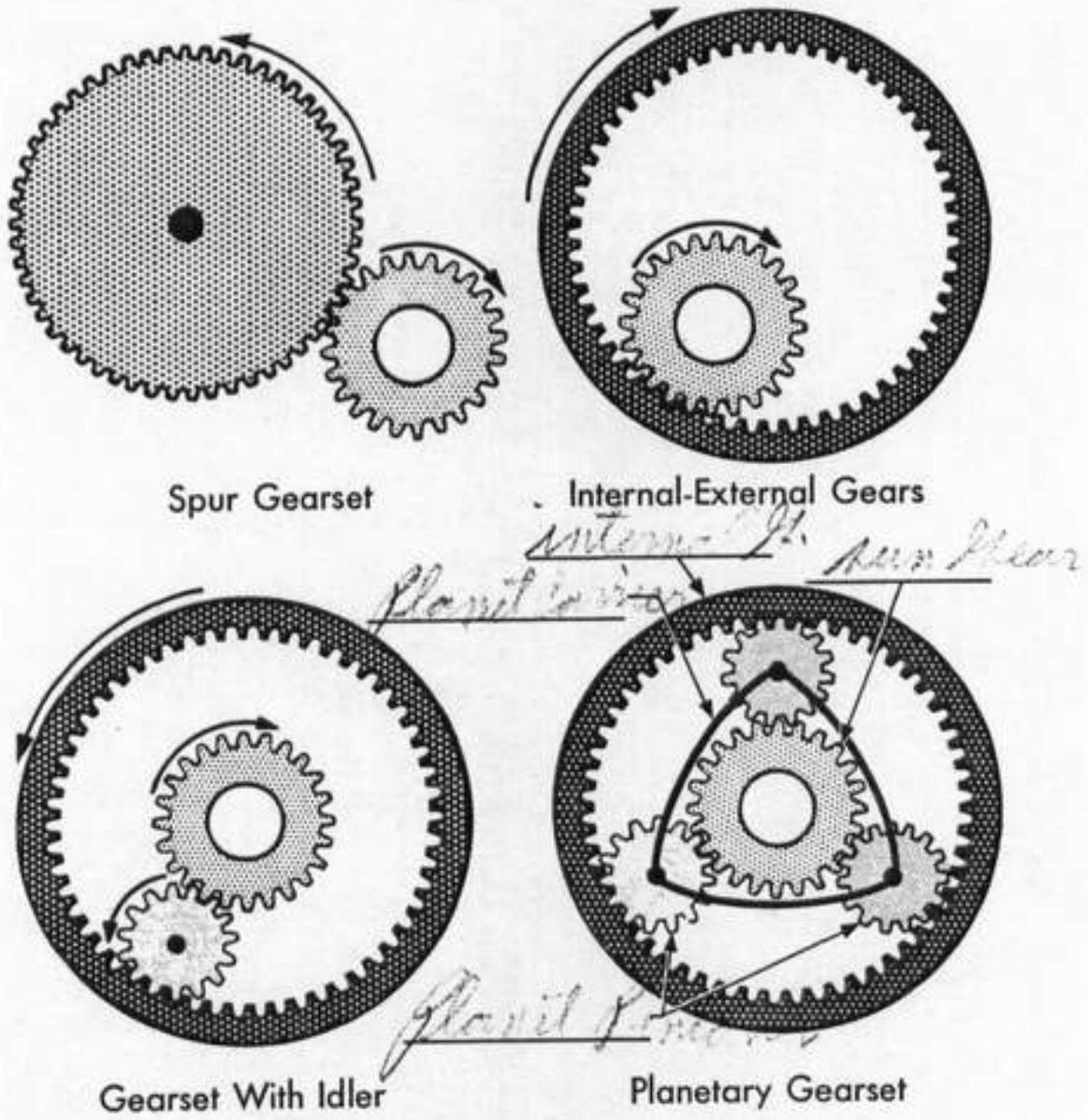
TRANSMISSION GEARSETS

Power is developed by a gasoline engine in the form of _____ and _____. Starting requires high torque, low speed; cruising requires lower torque, higher speed. The transmission, through its various _____, provides the right combinations of speed and torque for all driving conditions.

1956 CADILLAC HYDRA-MATIC COURSE

Torque can be increased by Reducing speed. A reduction in speed always provides a proportionate increase in torque. Relative sizes determine the gear ratio -- the smaller the driving gear, the easier it is to turn. To determine the gear ratio of a gearset, count the teeth in the meshing gears, and divide.

PLANETARY GEARSETS



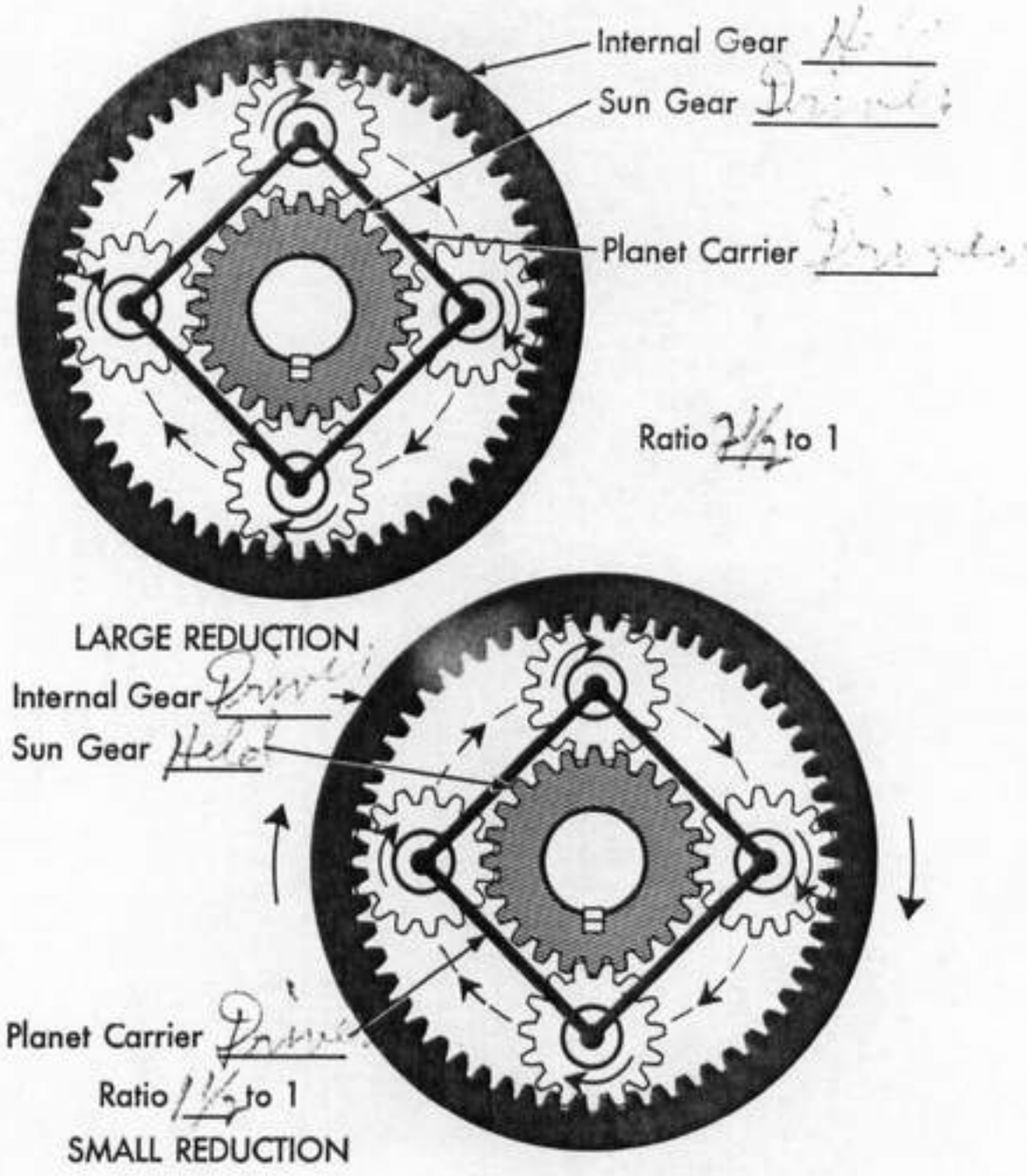
GEAR ARRANGEMENTS

Types of gearsets: spur, internal-external, planetary. An idler gear changes the direction of rotation, but not the ratio.

Advantages of planetary gearsets: (1) Gears always in mesh; (2) Gearset compact and sturdy; (3) Shafts all in line.

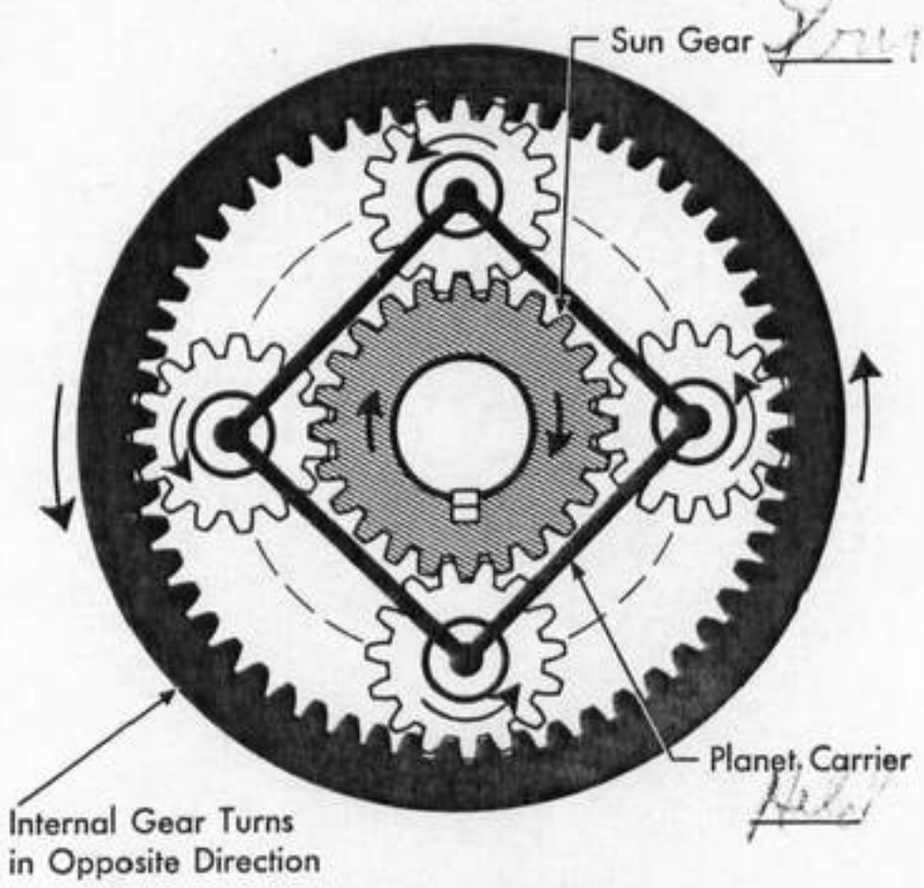
Uses of planetary gearsets: (1) To provide increased torque, through either a larger or a smaller reduction; (2) To reverse direction of rotation; (3) To serve as a coupling in direct drive.

LARGE AND SMALL REDUCTIONS



Each planetary gearset has two possible gear reductions: the larger, with the _____ driving, and the smaller, with the _____ driving. The planet carrier is always the driven member for a forward gear reduction.

REVERSE



GEARSET IN REVERSE

1956 CADILLAC HYDRA-MATIC COURSE

DIRECT DRIVE

A planetary gearset will provide direct drive if two members are clamped together to provide a coupling action. This method is used on transmissions prior to 1956.

A planetary gearset also will provide direct drive if torque is applied to two members -- the sun gear and the internal gear -- in the proper proportions. This method, called the "split-torque" method, is used in 1956 units.

NEUTRAL

When none of the planetary members are Held, the gearset is in neutral and will not transmit power. If the sun gear is turned, the internal gear will spin Backwards.

PLANETARY GEARSET REVIEW

1. Reduction of 1-1/2 to 1:

   Internal Gear — Driven

   Sun Gear — Held

   Planet Carrier — Driven

2. Reduction of 2-1/2 to 1:

   Internal Gear — Held

   Sun Gear — Driven

   Planet Carrier — Driven

3. Direct drive:

   a. Two members Locked Together

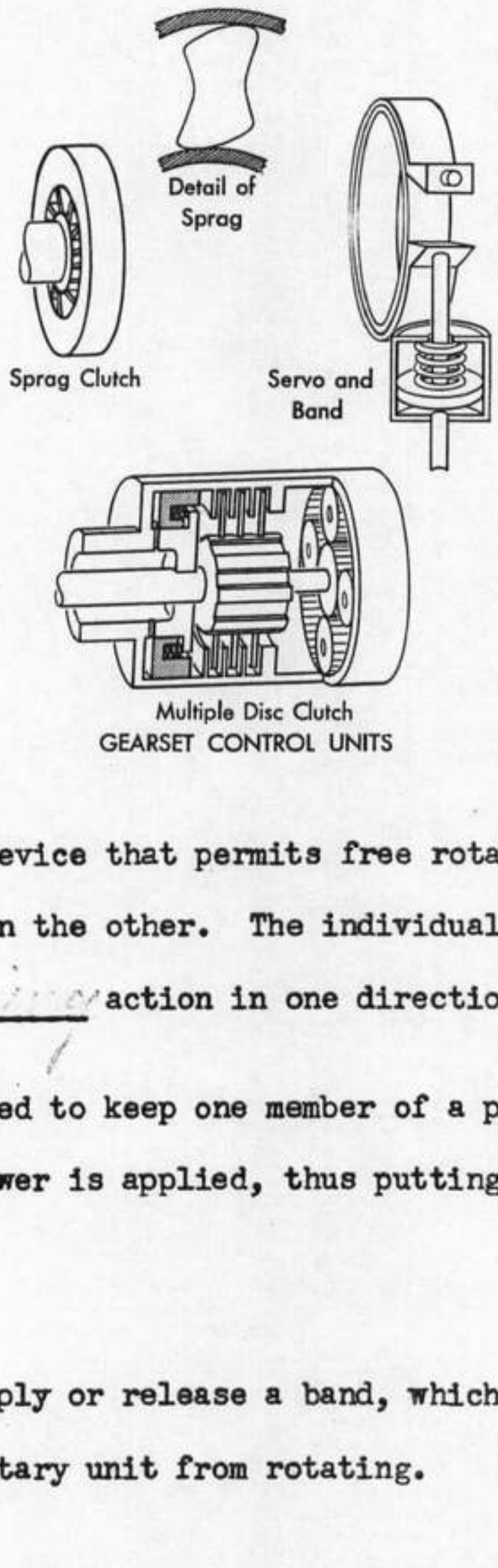
   b. Any Two Planetary Parts

4. Neutral:

   No member Held

CONTROL UNITS FOR PLANETARY GEARSETS

Control units are needed to keep one member from rotating and thus provide reduction, and to clamp members together or apply power to two of them so the gearset acts as a coupling.



GEARSET CONTROL UNITS

SPRAG CLUTCH

A sprag clutch is a device that permits free rotation in one direction and _____ in the other. The individual sprags are so shaped that they have a _____ action in one direction only.

Sprag clutches are used to keep one member of a planetary unit from rotating backwards when power is applied, thus putting the unit in reduction.

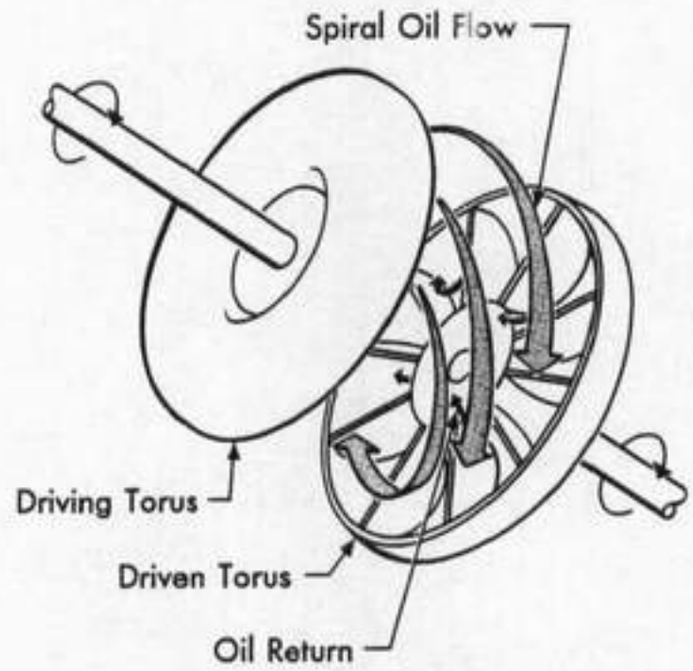
SERVO AND BAND

Servos are used to apply or release a band, which acts on a drum to keep one member of a planetary unit from rotating.

MULTIPLE DISC CLUTCH

Multiple disc clutches are used to lock two members of a planetary unit together, causing them to rotate as a unit.

FLUID COUPLING



FLUID COUPLING ACTION

A fluid coupling consists of two toruses, alike except for the Hub, fitted with Vanes, and mounted about 1/8-inch apart in a housing filled with oil.

When the driving torus turns very slowly, it doesn't move enough oil to transmit power. As speeds increase, the driving torus whirls the oil against the vanes of the driven torus with sufficient force to turn it.

At low speeds, the driven torus turns more slowly than the driving torus, providing a good _____ engaging action; at higher speeds, the two toruses turn more and more nearly at the same speed. Thus, efficiency is low at low speeds; is high at higher speeds.

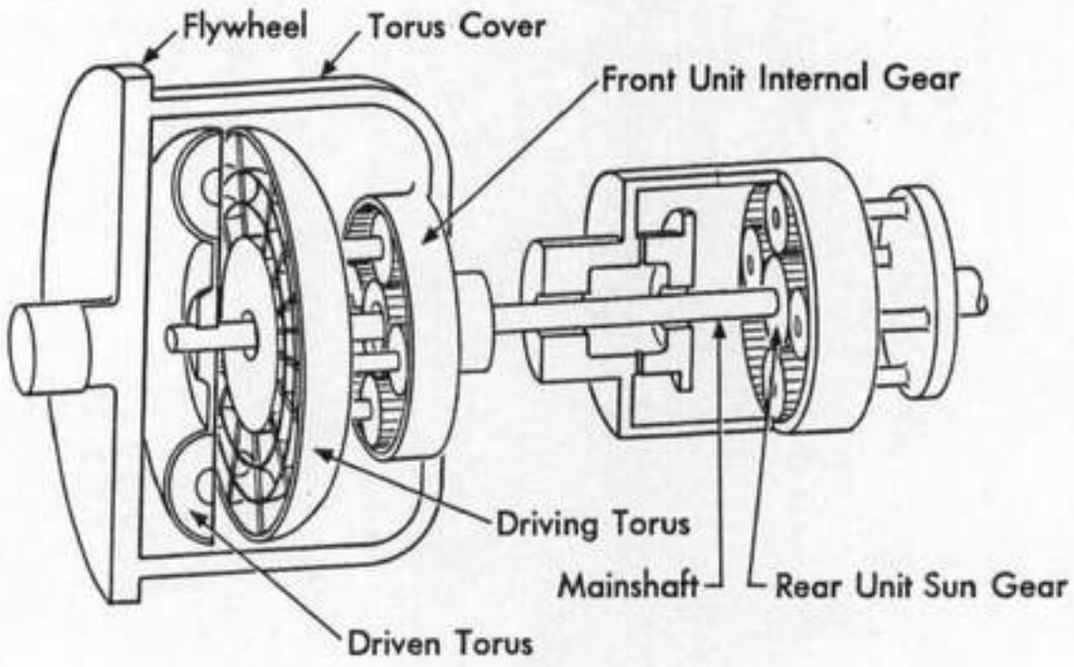
HYDRA-MATIC GEARSET COMBINATIONS

Two planetary gearsets, called the front unit and the rear unit, are used to provide four forward speeds. The front unit provides a Reduction reduction and direct drive. The rear unit provides a Reduction reduction and direct drive. Here is how we get four speeds:

	Front Unit	Rear Unit	Ratio
First Speed	Red.	Red.	3.97 to 1
Second Speed	Direct	Red.	2.55 to 1
Third Speed	Red	Direct	1.55 to 1
Fourth Speed	Direct	Direct	1 to 1

FLUID COUPLING FUNCTION AND LOCATION

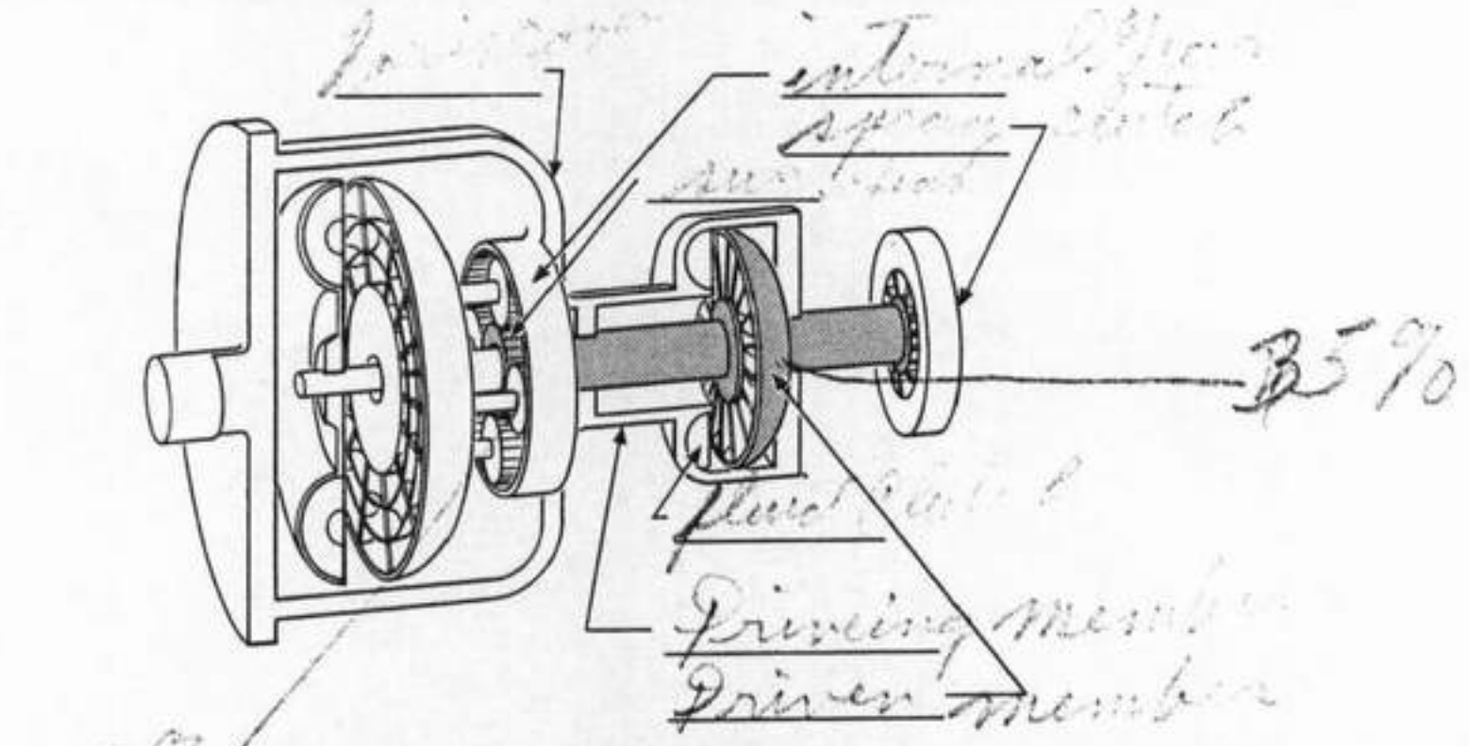
To keep high efficiency, yet minimize "creep," the fluid coupling is functionally Between the front and rear units. Power flows through the engine flywheel and the torus cover to the front unit internal gear, through the front unit gearset to the rearward torus, which is the driving torus; then through the coupling to the driven torus and back to the rear unit through the mainshaft.



FLUID COUPLING LOCATION

1956 CADILLAC HYDRA-MATIC COURSE

FRONT UNIT



FRONT UNIT OPERATION

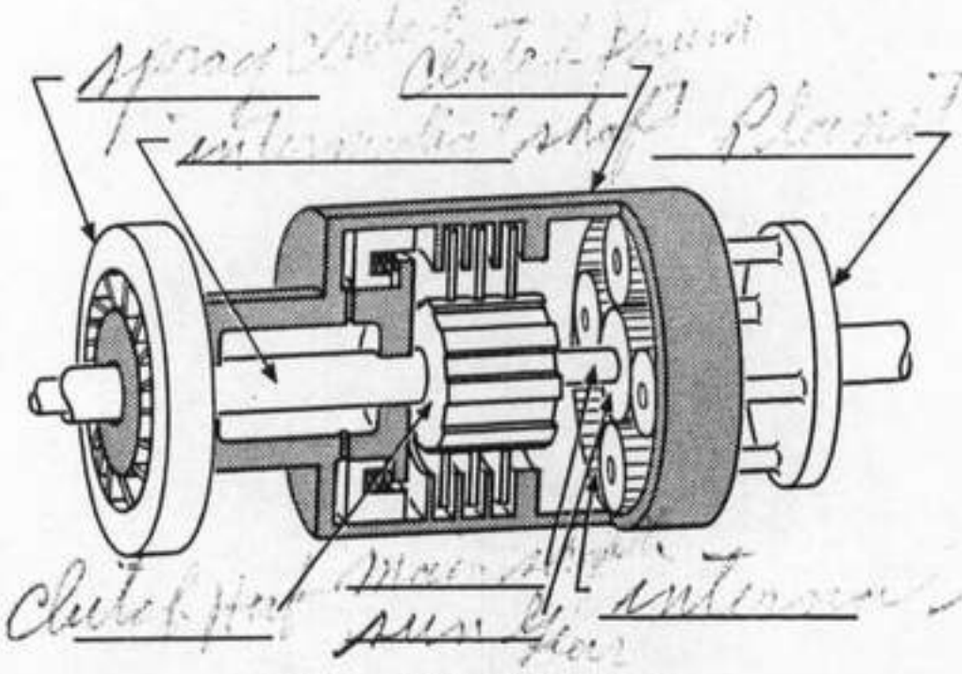
The front unit consists of a planetary gearset in which the internal gear is the Driven member, a sprag clutch prevents reverse rotation of the sun gear, and a Fluid clutch provides operation in direct drive.

For reduction, there is no oil in the fluid clutch housing, the sprag clutch is on, holding the sun gear, and the planet pinions walk around the sun gear to make the gearset function as a torque-increasing, speed reducing unit.

For direct drive, the clutch housing is filled with oil, and the fluid clutch transmits torque to the sun gear, as the sprag clutch Free wheels clockwise. The internal gear, also rotating clockwise, transmits about 65% of the engine torque, and the sun gear, operated by the fluid clutch, transmits the remaining 35%. With the internal gear and the sun gear turning in the same direction at about the same speed, the front unit is in direct drive.

To return the front unit to reduction, it is necessary only to dump the oil from the fluid clutch housing. The front unit itself cannot be put in neutral.

REAR UNIT



REAR UNIT OPERATION

The rear unit consists of a planetary gearset in which the _____ is the input member, a sprag clutch prevents reverse rotation of the internal gear, and a multiple disc clutch provides direct drive.

In reduction, the disc clutch is _____ and the sprag clutch is on. The mainshaft turns the sun gear clockwise, the internal gear is held from turning counter-clockwise, and the planet pinions walk around the internal gear, making the gearset operate in reduction.

In direct drive, the disc clutch is applied by oil pressure, and transmits torque from the intermediate shaft to the internal gear, as the sprag clutch free-wheels clockwise. Torque from the main fluid coupling continues to turn the sun gear clockwise. 60% of the torque passes through the disc clutch and internal gear, and 40% through the fluid coupling and sun gear.

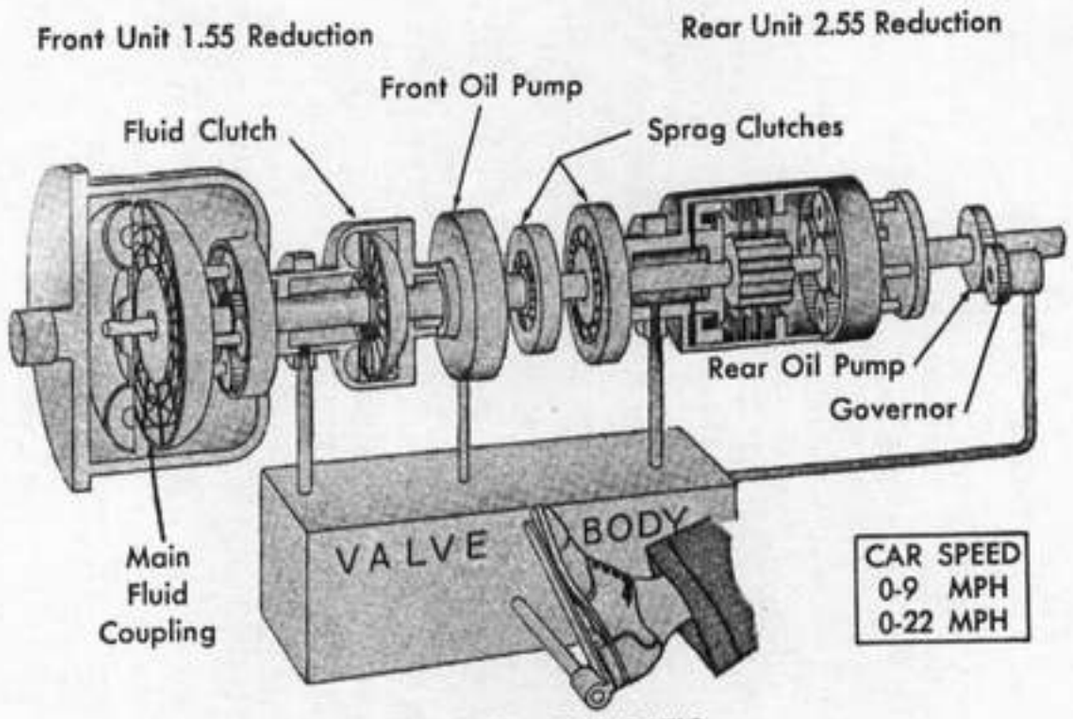
4-SPEED PLANETARY TRANSMISSIONS

By combining a front planetary unit and a rear planetary unit with a fluid coupling, a 4-speed planetary transmission with automatic clutch and shifting can be secured.

NEUTRAL

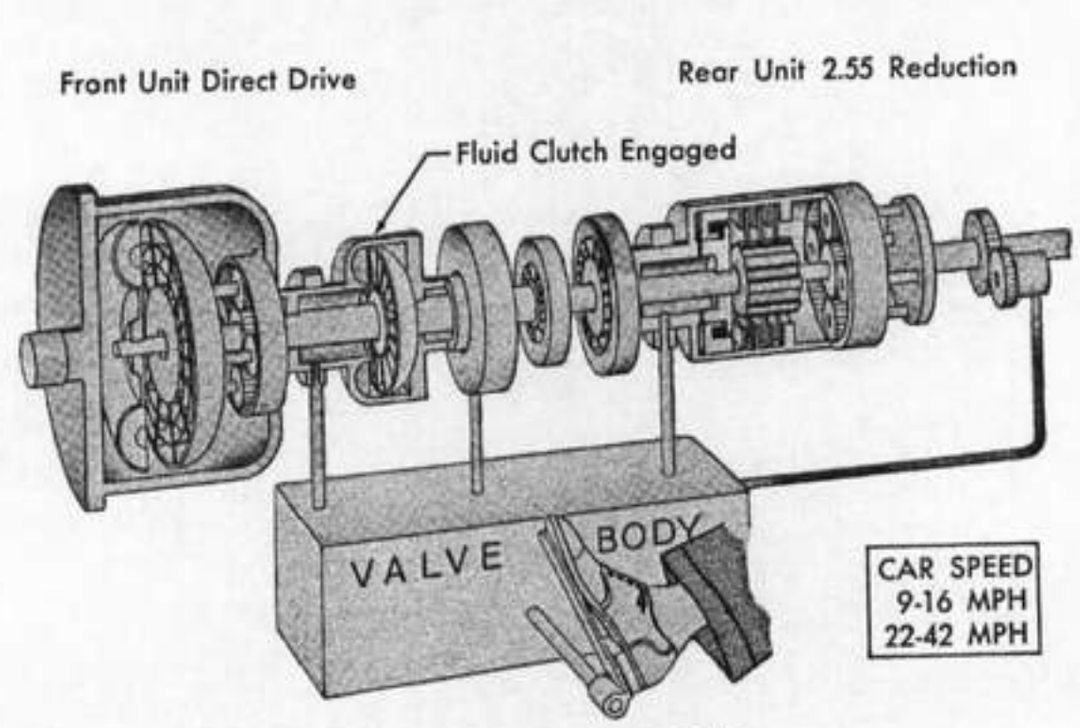
A separate multiple-disc neutral clutch is provided, which disconnects the rear unit sprag clutch from the transmission _____. The internal gear can now turn freely in _____ direction, so the rear unit -- and the transmission -- are in neutral.

POWER FLOW



FIRST SPEED — 3.97 RATIO

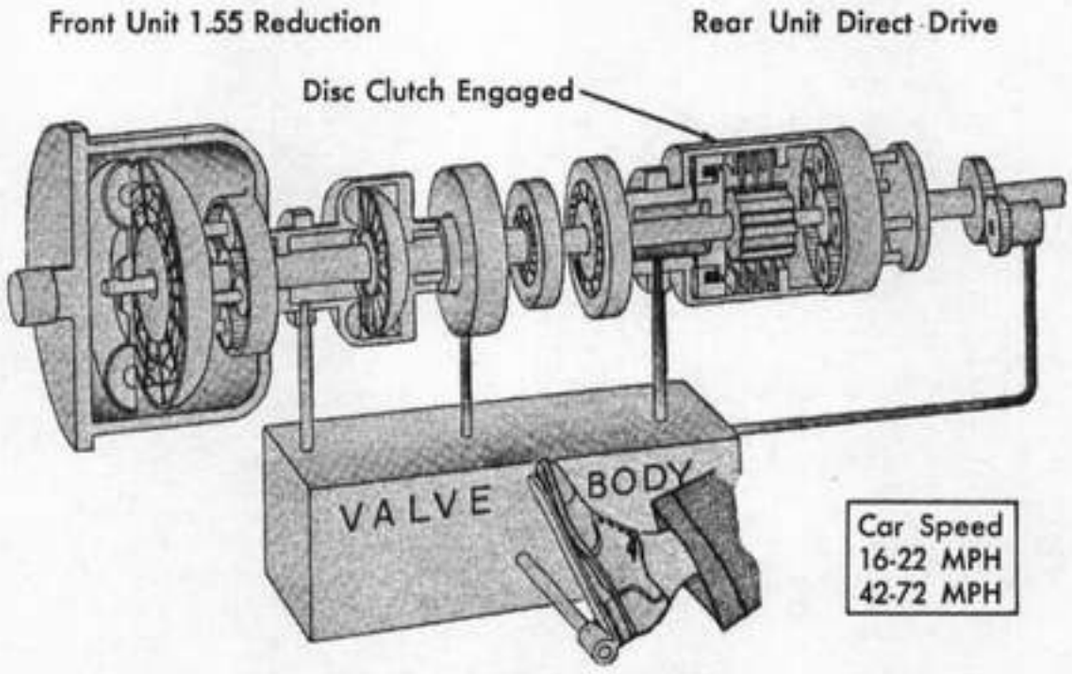
For FIRST SPEED, there is no oil in the front unit clutch, so it is released and the front unit is in reduction. No oil pressure applies the rear unit disc clutch, so the rear unit is in reduction. The 1.55 gear reduction of the front unit is multiplied by the 2.55 reduction of the rear unit.



SECOND SPEED — 2.55 RATIO

For SECOND SPEED, oil pressure fills the front unit fluid clutch housing,

putting the front unit in direct drive, while the rear unit remains in reduction, providing an overall 2.55 reduction. 65% of the torque passes from the front unit internal gear directly to the planet pinions, while the remaining 35% passes through the front unit clutch to the sun gear and then to the planet pinions.



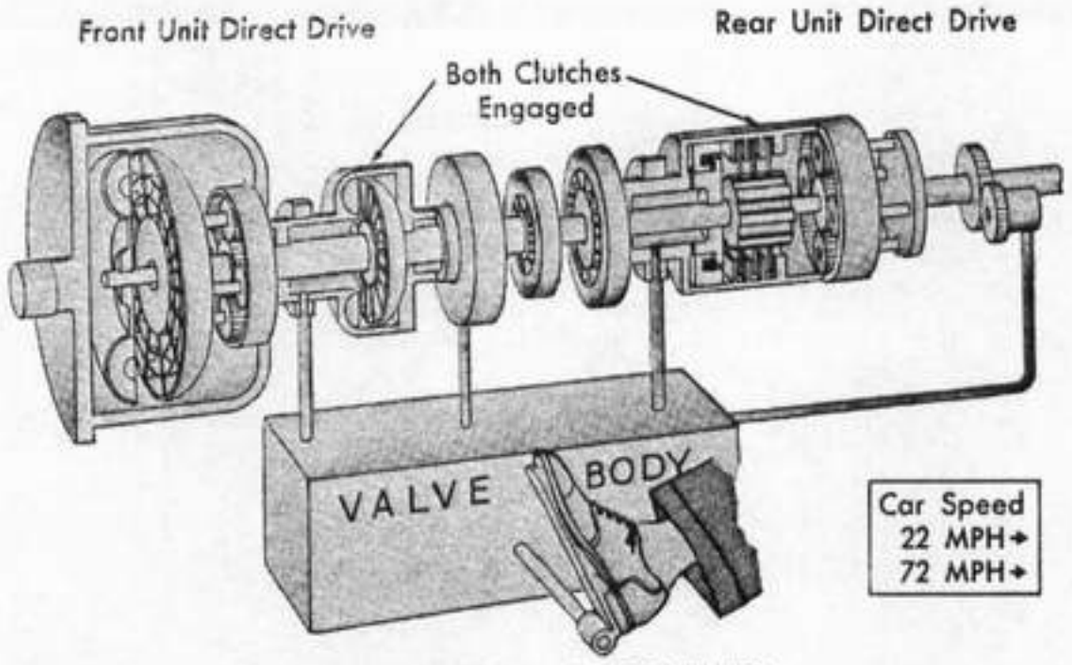
THIRD SPEED – 1.55 RATIO

For THIRD SPEED, two changes occur: the oil pressure to the front unit fluid clutch is cut off and the fluid clutch thus disconnected. The sprag clutch then stops the sun gear from turning backwards, and the front unit goes back into reduction, providing a 1.55 reduction.

At the same time, oil pressure applies the rear unit multiple disc clutch, clamping the internal gear to the intermediate shaft, and putting the rear unit in direct drive. 60% of the torque from the front unit passes through the intermediate shaft to the rear unit internal gear and then to the planet pinions; the remaining 40% passes through the main fluid coupling, the mainshaft, and the rear unit sun gear to the planet pinions.

The split torque arrangement isolates road vibrations, minimizes the effect of fluid coupling slippage, and cushions rear clutch application. An accumulator further cushions clutch application.

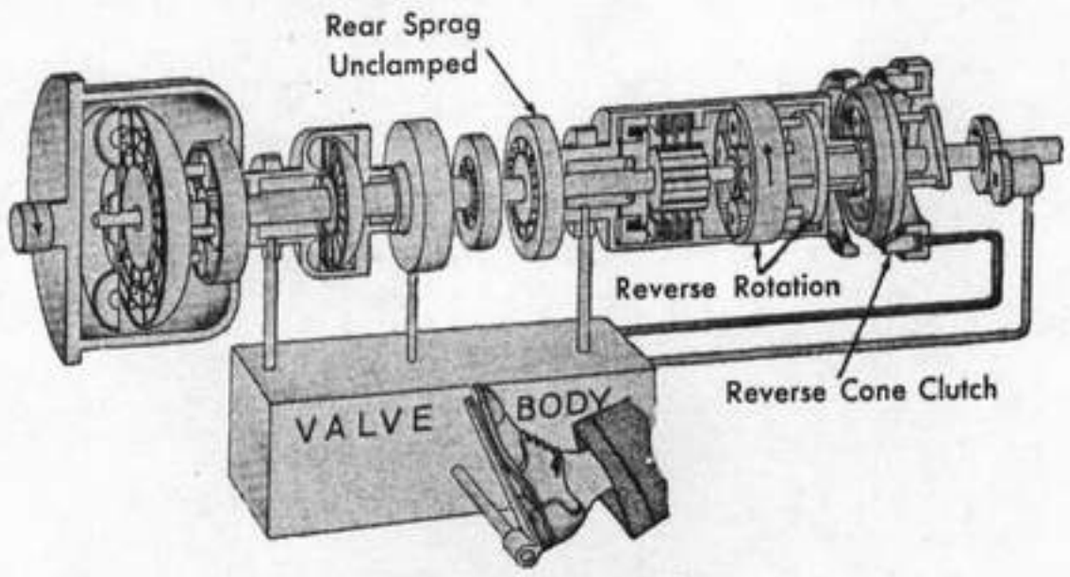
1956 CADILLAC HYDRA-MATIC COURSE



FOURTH SPEED – 1 TO 1 RATIO

For FOURTH SPEED, oil pressure is again directed into the front unit fluid clutch housing, changing the front unit to direct drive, and providing a 1 to 1 ratio for the entire transmission.

REVERSE



REVERSE – 4.30 RATIO

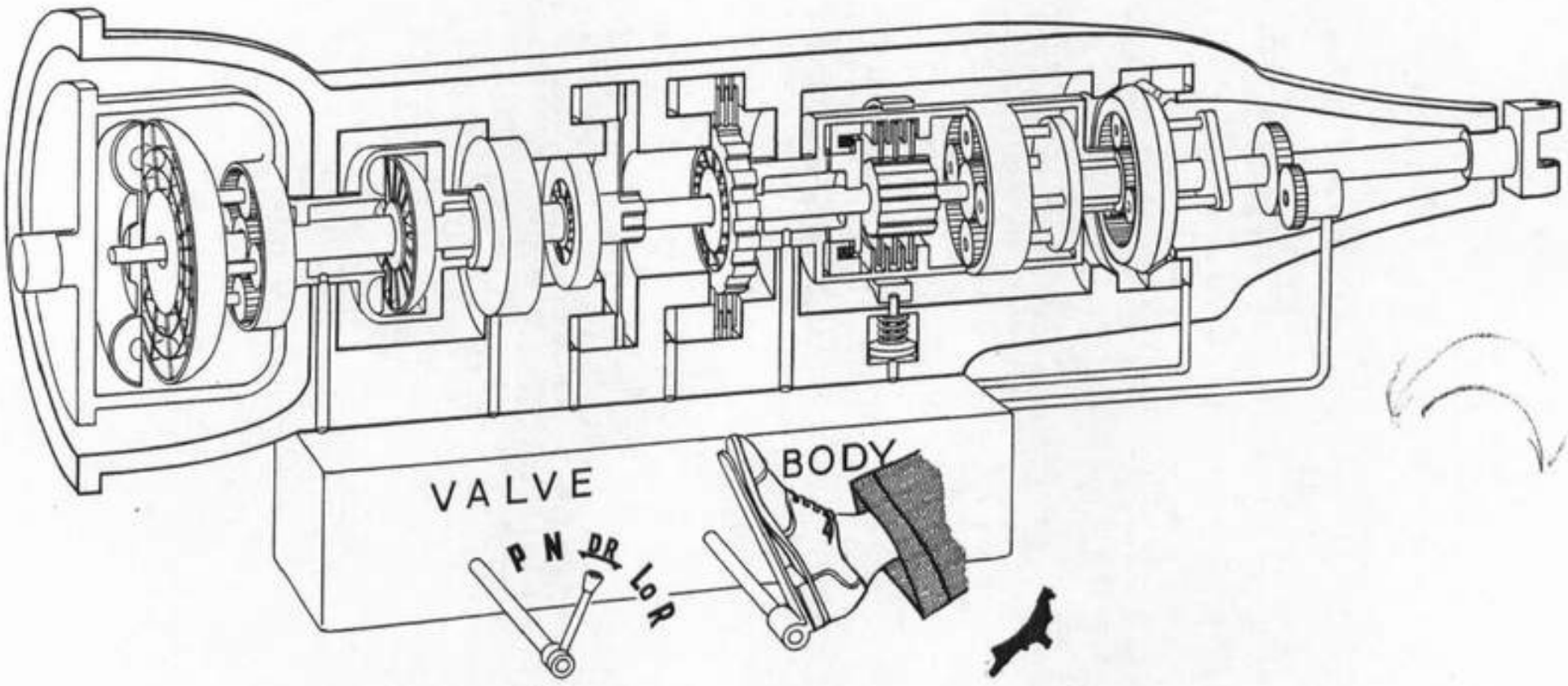
Two units interact to provide reverse: the Rear unit provides the actual reversal of direction, and the Reverse planetary gearset provides the extra gear reduction needed to permit this reversal. The rear unit is put in neutral, and the reverse unit into reduction to provide this action.

SPECIALIZED ENGINE BRAKING ARRANGEMENTS

An over-run clutch is applied in DR-3 or Lo range to keep the front unit in reduction in first and third speeds. It is also applied in reverse.

An <u>over-run band</u> is applied in Lo range to keep the rear unit in reduction.

In "park" position, a pawl engages teeth cut in the reverse unit planet carrier, which is splined to the output shaft.



SCHEMATIC TRANSMISSION CROSS-SECTION

CLUTCH APPLICATION CHART

RANGE	SPEED	FRONT UNIT			REAR UNIT			REVERSE	
		FLUID CLUTCH	SPRAG CLUTCH	OVERRUN CLUTCH	NEUTRAL CLUTCH	SPRAG CLUTCH	REAR CLUTCH	OVERRUN BAND	CONE CLUTCH
NEUTRAL	-	off	ON	off	off	ON	off	off	off
DR-4	1	off	ON	off	ON	ON	off	off	off
	2	ON	off	off	ON	ON	off	off	off
	3	off	ON	off	ON	off	ON	off	off
	4	ON	off	off	ON	off	ON	off	off
DR-3	1	off	ON	ON	ON	ON	off	off	off
	2	ON	off	off	ON	ON	off	off	off
	3	off	ON	ON	ON	off	ON	off	off
LO	1	off	ON	ON	ON	ON	off	ON	off
	2	ON	off	off	ON	ON	off	ON	off
REVERSE	-	off	ON	ON	off	ON	off	off	ON

SESSION NUMBER 2

DISASSEMBLY INTO MAJOR UNITS

REMOVAL OF FLYWHEEL AND FLUID COUPLING

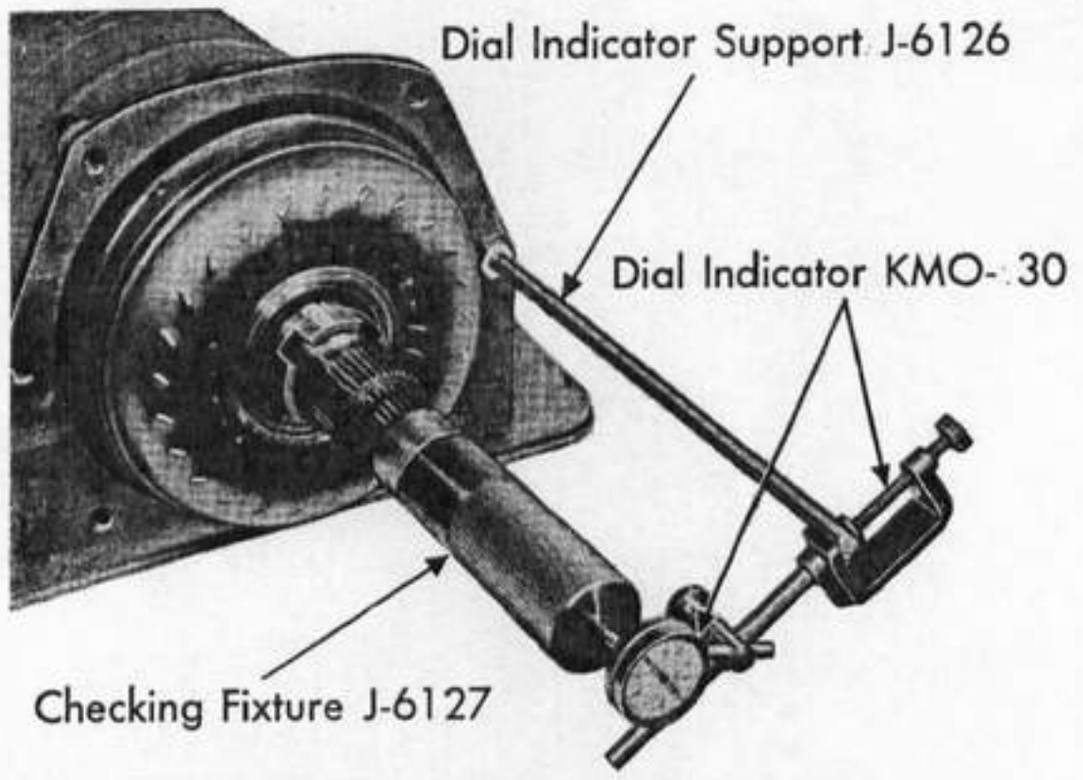
Flywheel is removed from engine as part of transmission assembly and is removed from Torq Pump after taking out cap screws.

Tru-Arc Pliers, Tool No. J-4880, are used to remove torus member positioning snap rings.

Don't try to pull off driving torus and torus cover together. Work torus cover off gently to avoid damage to seal.

Use Sleeve, Tool No. J-6119, to protect oil seal in Bell Housing housing while removing housing.

CHECKING REAR UNIT END PLAY

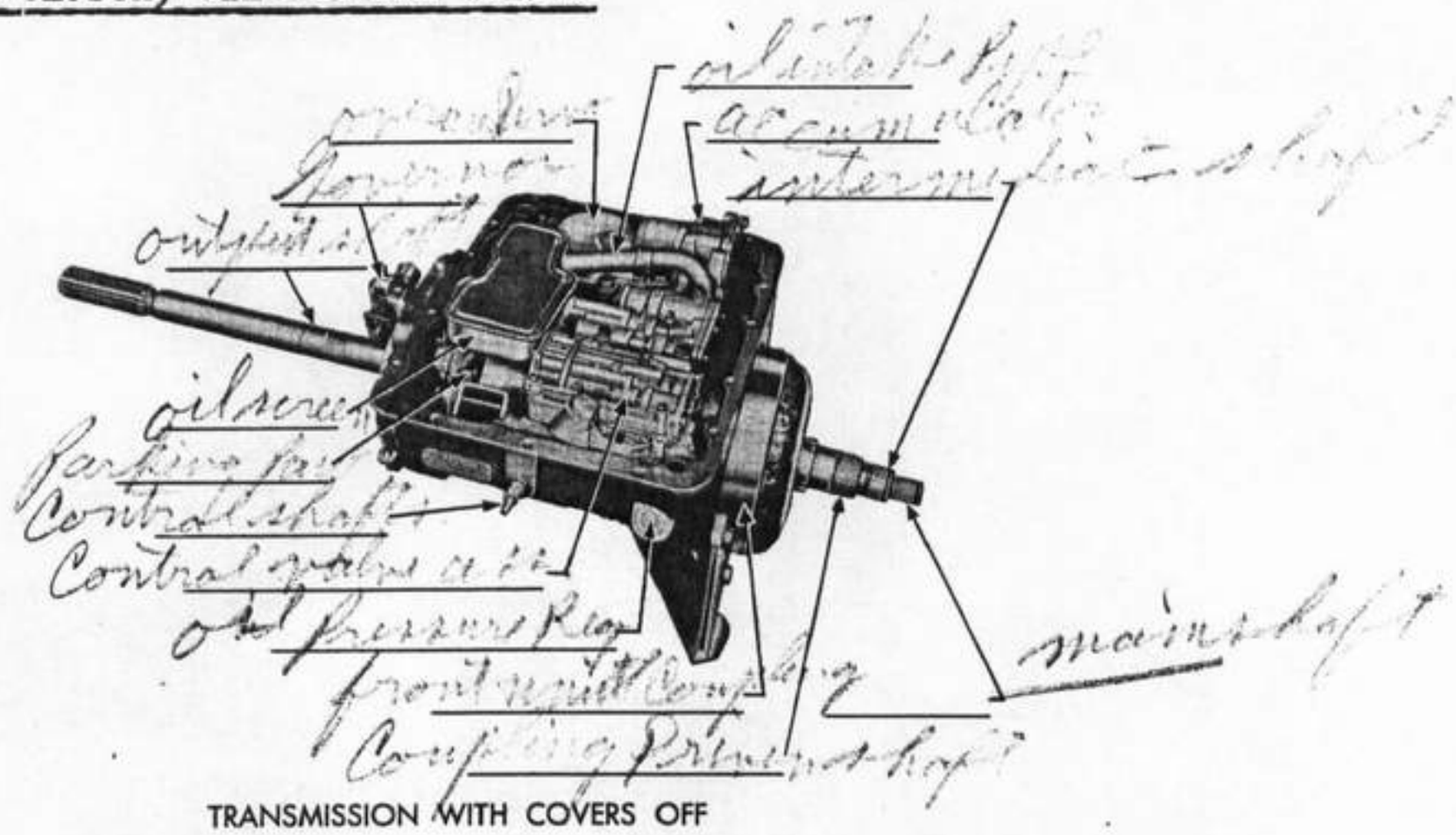


CHECKING REAR UNIT END PLAY

Collar, Tool No. J-6127, Gage J-6126 and Dial Indicator KMO- 30, are used in this operation.

Record the end play, which should be between .4 and .18 inch.

REMOVAL OF FLUID CLUTCH, OIL PAN AND COOLER



TRANSMISSION WITH COVERS OFF

Mount transmission in Holding Stand, J-6115. Two men should lift transmission to insert in base of Stand. Turn transmission with oil pan up, and insert lock pin in base.

Pull fluid clutch assembly straight out at front, then remove oil pan, screen, pipes and cooler parts.

REMOVE ACCUMULATOR AND CONTROL VALVE ASSEMBLY

Two cap screws hold accumulator; six hex head cap screws, five on top and one on side, hold control valve assembly and channel body.

Don't let control valve assembly rest on end of separator plate; don't let manual valve fall out of its bore.

REMOVE FRONT PUMP AND OVERRUN CLUTCH

Be sure to remove oil pressure regulator before trying to remove front

oil pump.

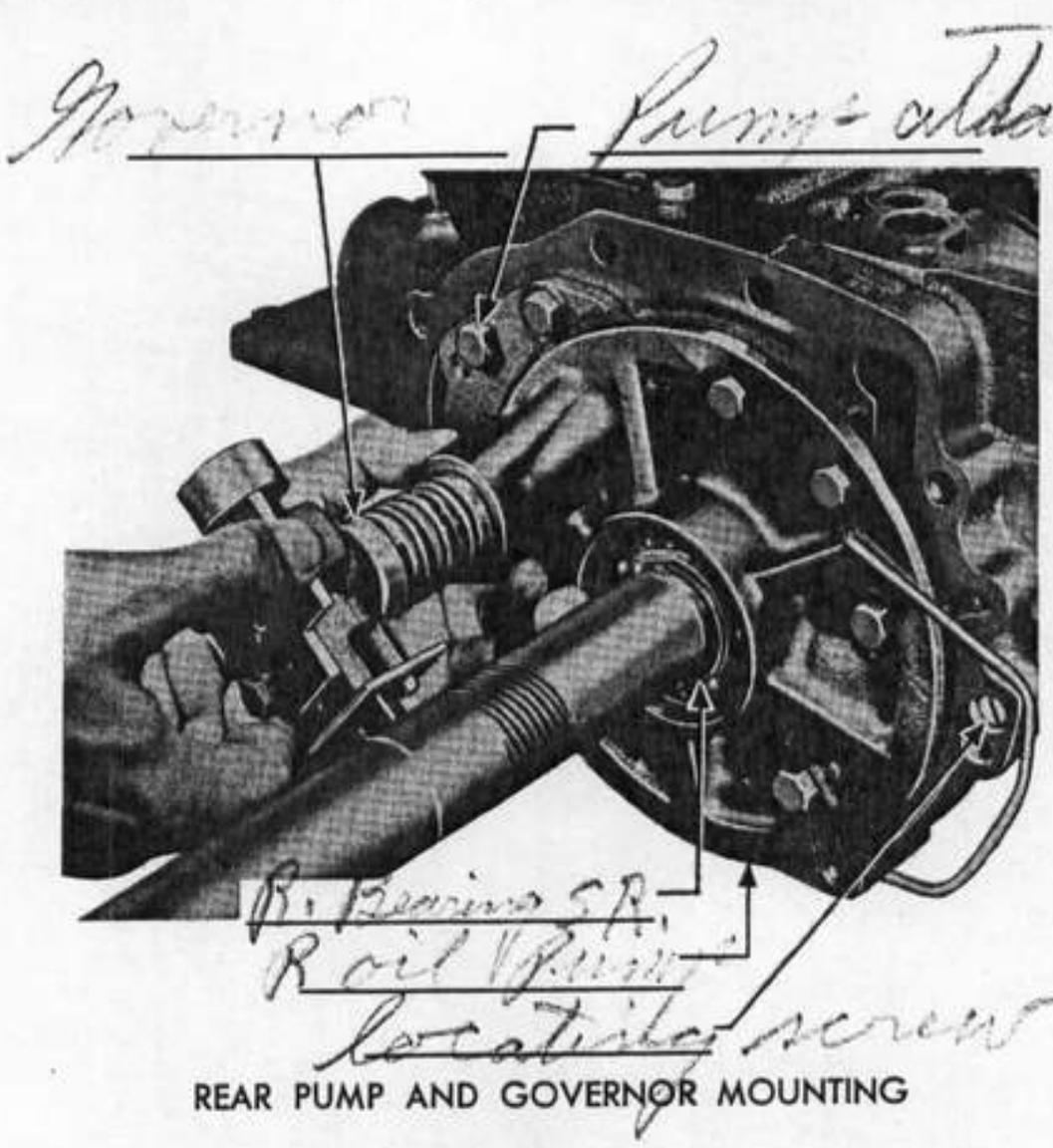
After taking out three screws, use Slide Hammers, Tool No. J-6125, to remove front pump.

Lift out overrun clutch plate, release spring and bronze thrust washer.

REMOVE NEUTRAL CLUTCH, CASE SUPPORT AND REAR UNIT

First install Holding Collar, J-6135, over intermediate shaft.

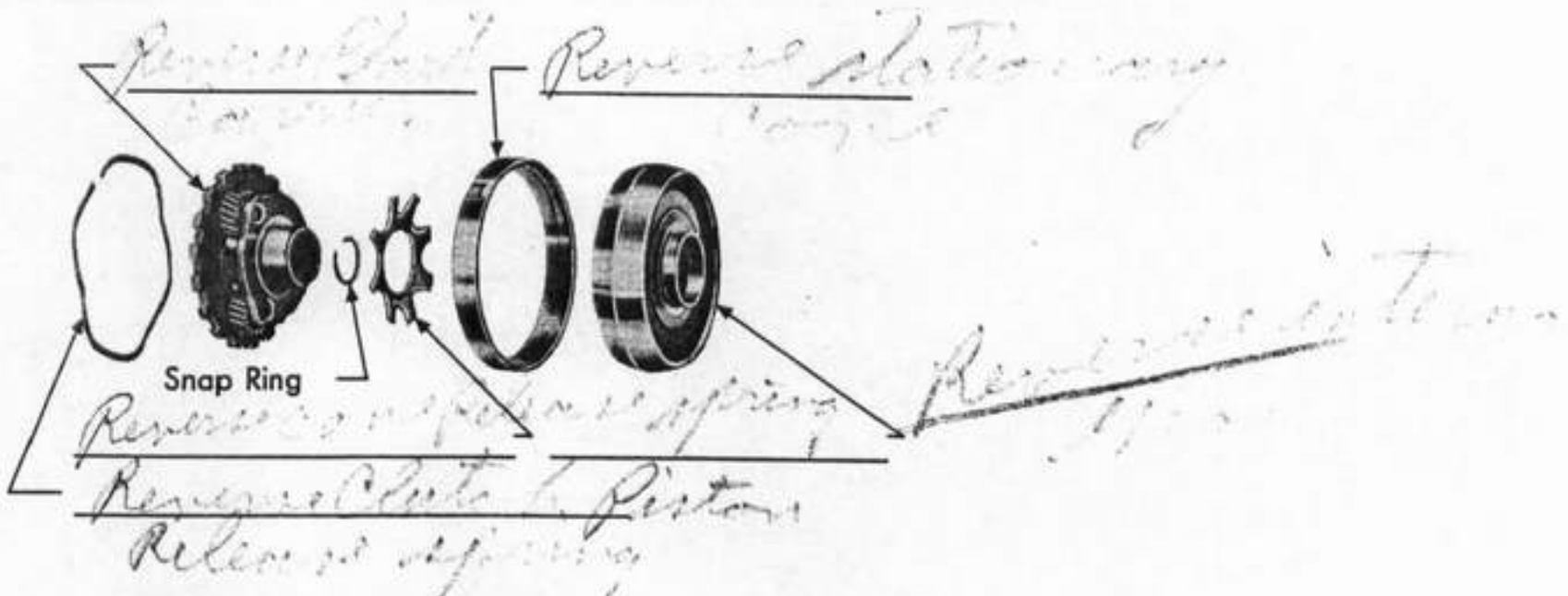
Don't forget to remove snap ring that holds case support.



REAR PUMP AND GOVERNOR MOUNTING

Pull governor assembly from rear pump casting after extension housing is removed.

Take out slotted screw and hex head screw, and use Slide Hammers, J-6125, again to remove rear pump and reverse clutch piston assembly from case.



REVERSE UNIT PARTS, EXPLODED

Follow Shop Manual procedures in taking out reverse unit parts. Observe carefully how they go together.

Adapters permit use of Slide Hammers, J-6125, to pull entire case support and rear unit assembly forward out of case.

Place assembly, output shaft down, in Holding Stand, J-6116.

REMOVE REMAINING PARTS FROM CASE

Turn overrun band to horizontal position with ends facing rearward, and pull out through front of case.

Unsnap ring, then remove lever assembly, inner and outer washers, and O-ring from counterbore in case.

Adapter for J-6125 is used again, to take out parking pawl pivot pin and permit removing spring and parking bracket assembly from pivot.

1956 CADILLAC HYDRA-MATIC COURSE

SESSION NUMBER 3

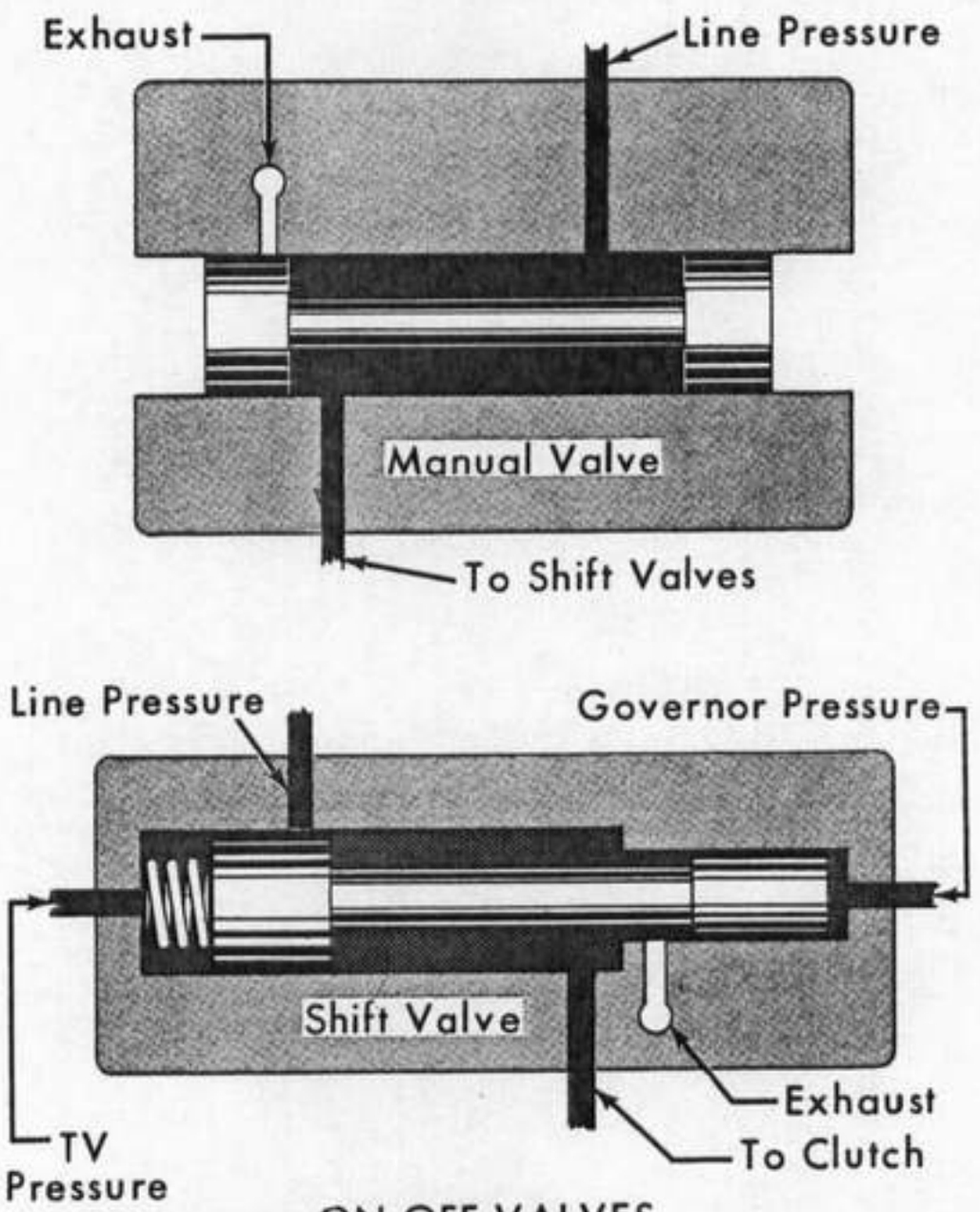
OPERATION OF HYDRAULIC CONTROLS

VALVE BODY ASSEMBLY

The 1956 valve body is made up of [illegible] major units connected to an adapter plate that contains major oil passages.

Study of valve body functions provides essential knowledge for diagnosis of improperly operating transmissions.

Two types of valves are used, on-off valves and regulator valves.



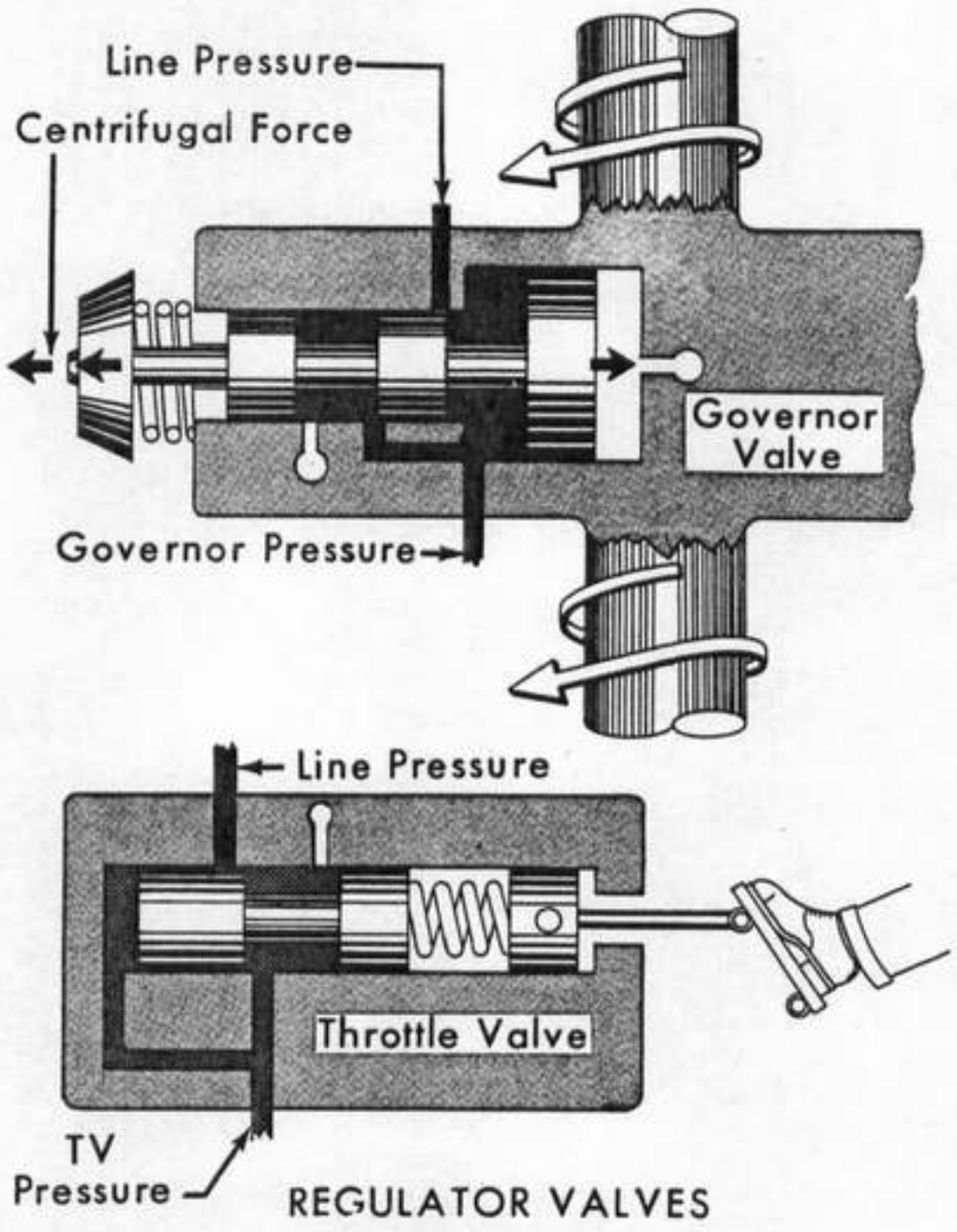
ON-OFF VALVES

The manual valve and the shift valve are examples of the two types of "on-off" valves.

A shift valve is positioned by [illegible] pressure and variable [illegible] pressure acting on the left end of the valve, opposed by [illegible] pressure acting on the right end of the valve.

Snap action of shift valves is provided by having a larger shoulder at one end on which the line pressure can act to help in opening the valve.

REGULATOR VALVES



REGULATOR VALVES

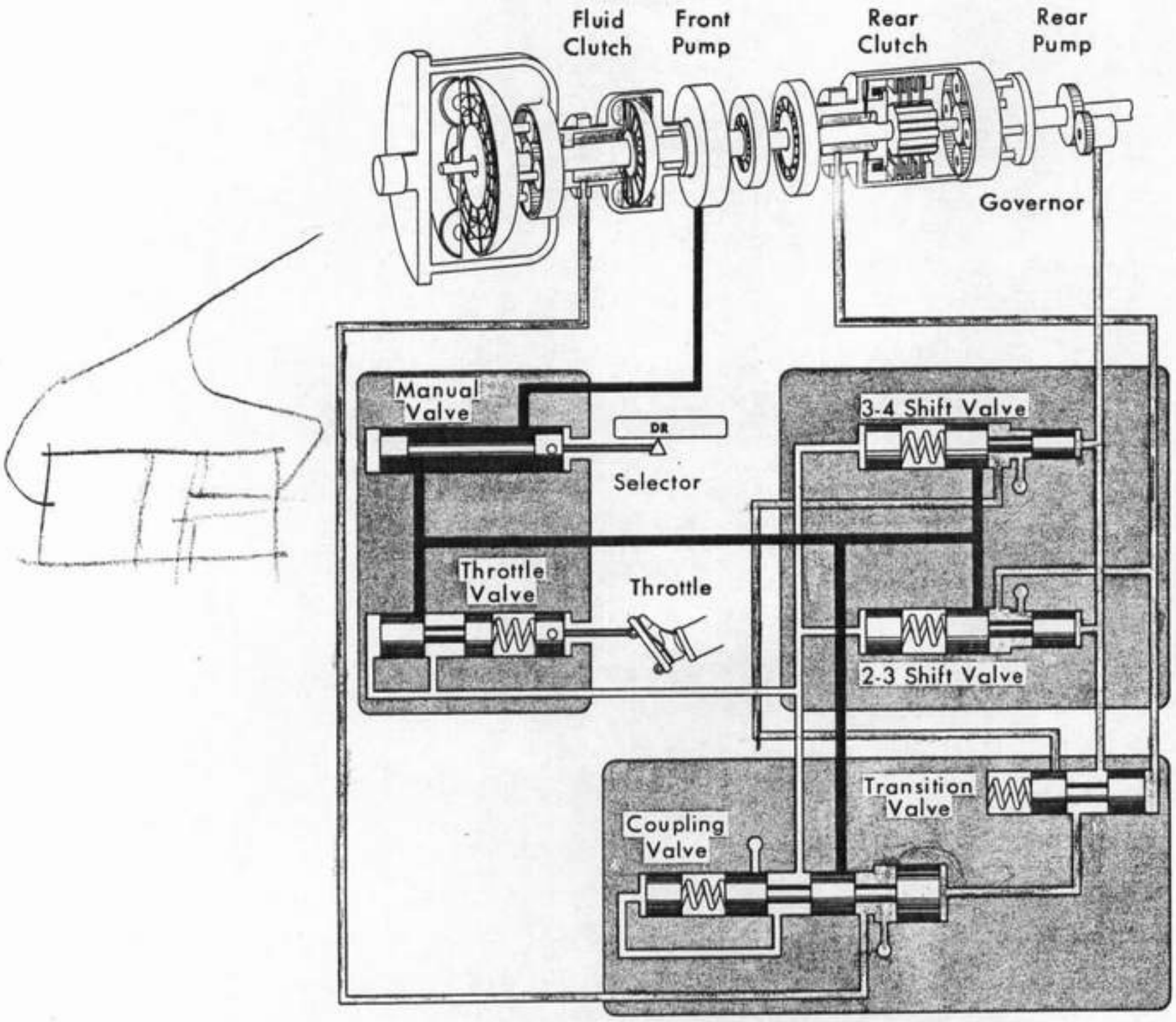
Regulator valves are arranged so that their output acts <u>against</u> their opening, so that they supply a variable pressure.

In the governor valve, centrifugal force tends to open the valve, and governor pressure -- the output of the valve, tends to close it. The valve is thus <u>balanced</u> between centrifugal force and its own output. Its output is thus always proportional to car speed.

The throttle valve is balanced between accelerator pedal position and its own output. It provides an output directly proportional to the amount of throttle opening called for by the accelerator pedal.

FOUR SPEEDS FORWARD

This diagram shows an arrangement of shift valves, manual valve and throttle valve that could control a simple 4-speed transmission. It also includes a coupling valve and a transition valve.



BASIC 4-SPEED SYSTEM

Key to oil passage colors: Black, line pressure; Blue, governor pressure; Yellow, TV pressure; Red, upshift pressure.

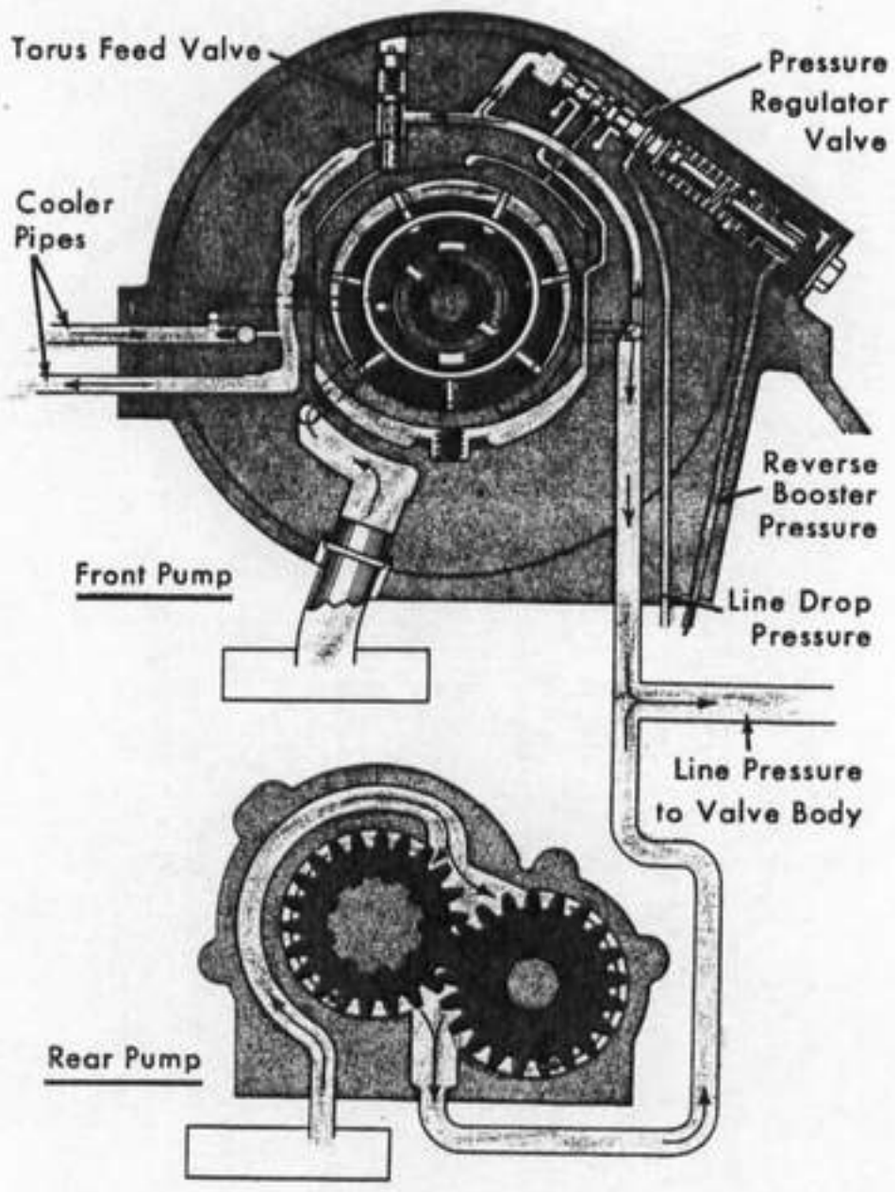
Four speeds forward require three upshifts: 1-2, 2-3, 3-4, and three shift valves: the coupling valve, the 2-3 shift valve and the 3-4 shift valve.

Governor pressure opens these valves to apply the clutches that put the front and rear units in direct drive, as required for second, third and fourth speeds. The transition valve shuts off governor pressure to allow the coupling valve to close, putting the front unit in reduction for third speed.

SPECIALIZED CIRCUITS

1. Pump Operation -- front pump, rear pump, pressure regulator, lubrication
2. Manual Valve Positions -- Park, Neutral, DR-3, Lo, and Reverse
3. Wider Governor Range -- two governor valves; two pressures
4. Other Clutches -- Neutral clutch, overrun clutch, reverse cone clutch, overrun band.
5. Accumulator Operation
6. Throttle Valve and Forced Downshifts
7. Fluid Clutch Exhaust -- signal pressure, feed pressure
8. Line Drop Valve and Limit Valve

FRONT AND REAR OIL PUMPS



FRONT AND REAR OIL PUMPS

The rear oil pump is a positive displacement Gear type pump; the front pump is of the Vane type, permitting variable capacity along with positive displacement. The position of a sliding Pump Slide determines the pump output, and this position is controlled by the pressure regulator valve, which moves the slide toward the center, or minimum output position when pressure is high, and to the outer, or maximum output position when pressure is low.

Normal line pressure is 95 pounds. The reverse booster plug increases this to 180 pounds for reverse operation. In fourth gear, part throttle operation, line drop pressure from the 3-4 shift valve lowers line pressure to 65 pounds.

Oil flows to the main fluid coupling through the torus feed valve and the oil cooler. The torus check valve holds the pressure to 30 pounds. Excess oil is directed into the lubrication passages.

Pressure regulation of the front pump also controls the rear pump, as they both feed into the main pressure line on which the pressure regulator operates.

ACTUAL HYDRA-MATIC OIL CIRCUITS

(Refer to colored chart of oil circuits)

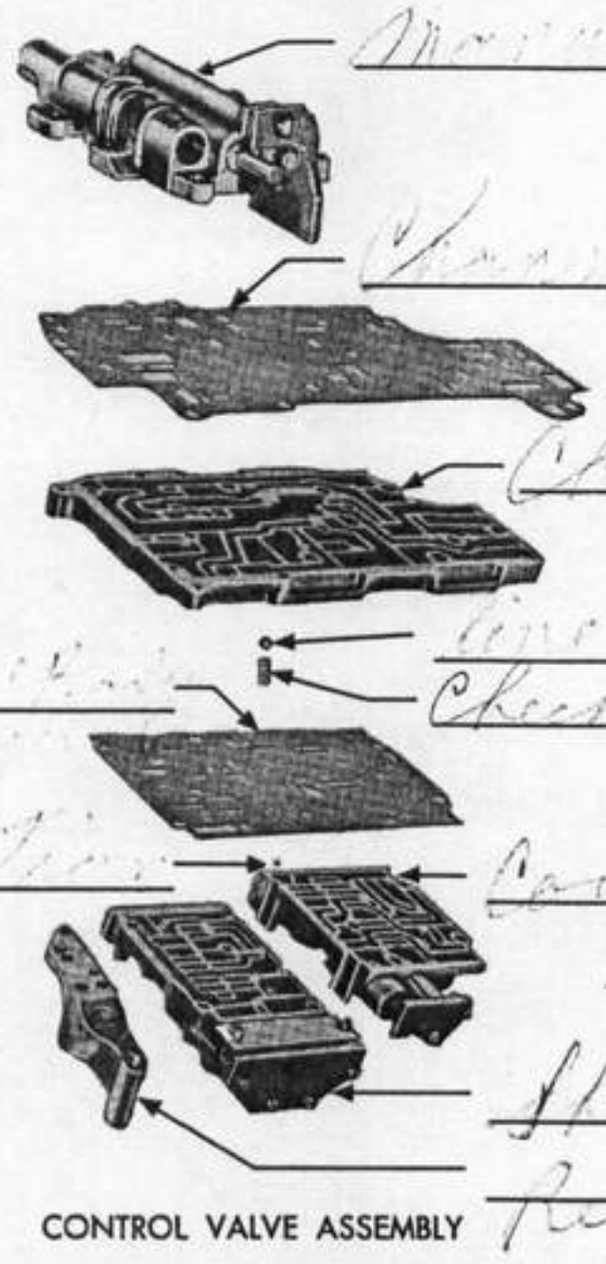
The control valve assembly is made up of three major valve bodies attached to the channel body.

Manual valve positions, in addition to DR-4, are Neutral, Park, DR-3, Lo and Reverse.

SESSION NUMBER 4

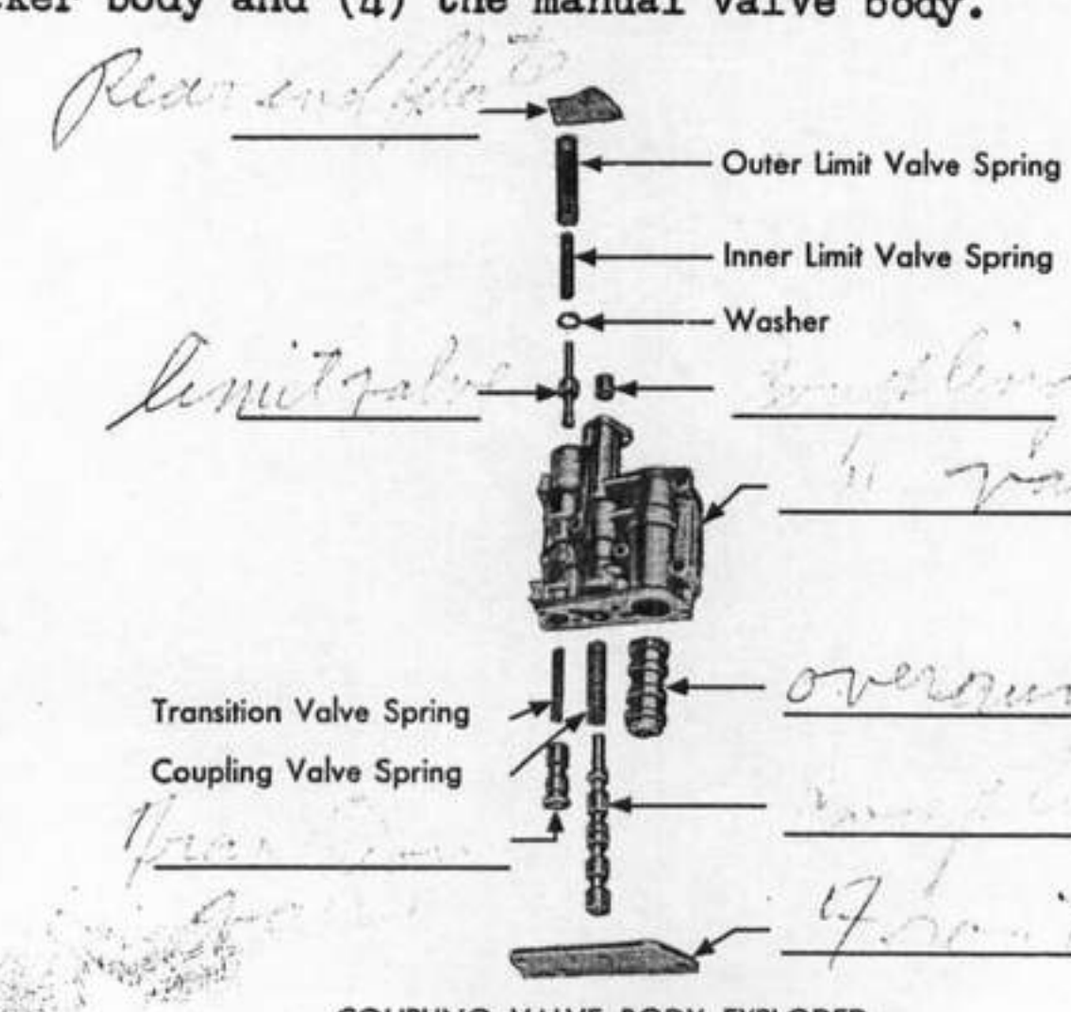
OVERHAUL OF CONTROL VALVE BODIES

CONTROL VALVE ASSEMBLY



CONTROL VALVE ASSEMBLY

This assembly consists of a main casting, called the channel body, on which are mounted (1) the coupling valve body (2) the shift valve body (3) the reverse blocker body and (4) the manual valve body.



COUPLING VALVE BODY, EXPLODED

Disassembly and cleaning of valve bodies often will correct hydraulic malfunctions. Parts are fitted to very close tolerances, and must be handled carefully and kept free of dust or grit. Never let parts drop, and never put castings into a vise.

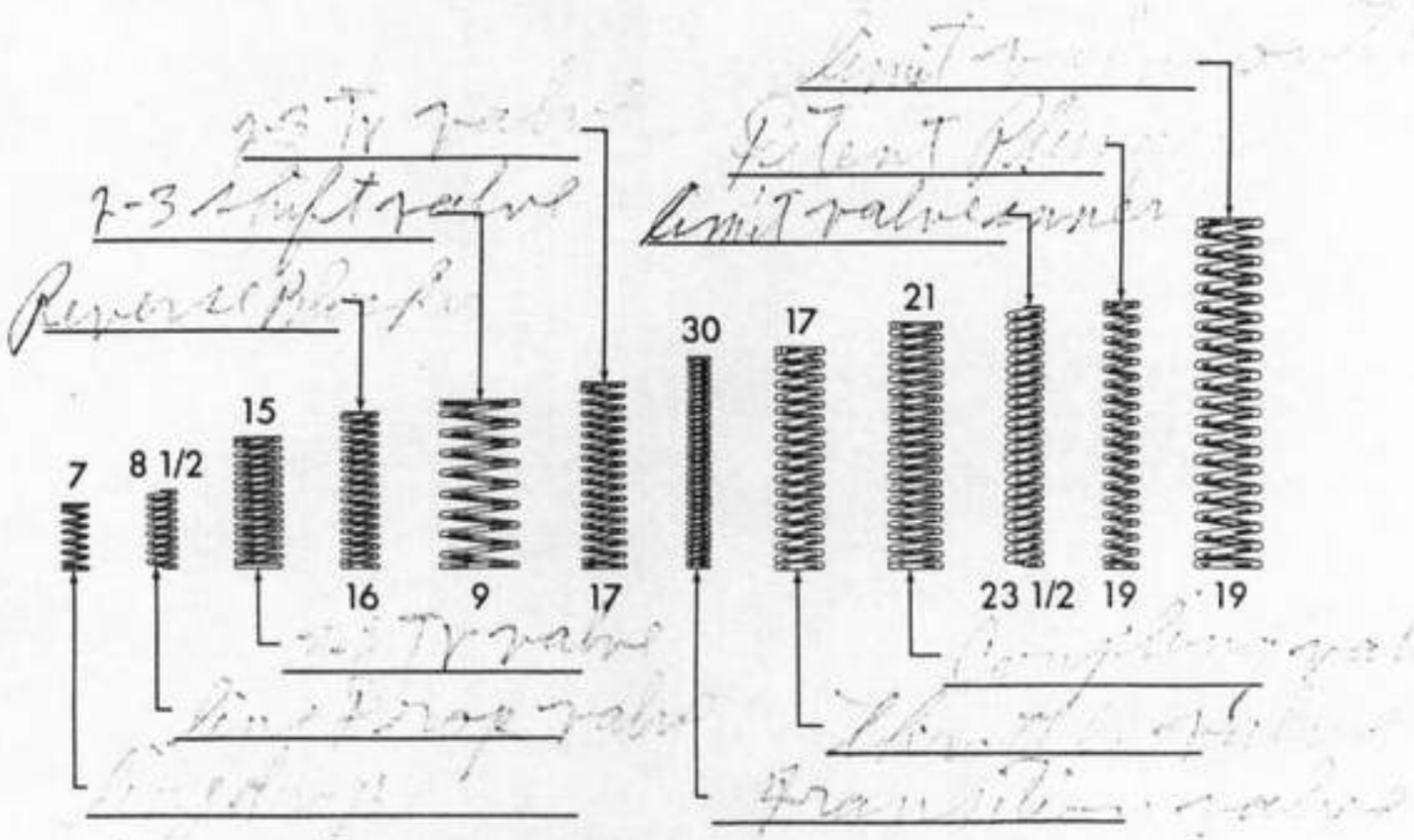
When removing coupling valve body from channel body, take care not to lose transition check ball.

Hold end plates carefully against spring tension when removing them.

Wash castings, valves and other parts individually in solvent. Never wash them together, as bumping contact would cause nicks and burrs. Keep them separated on a tray.

Inspect valves for burrs, scratches or other damage. Use a fine stone or fine crocus cloth to remove burrs, but do not round off valve shoulders.

Make sure that springs are not twisted, sprung, or set; and that correct spring is used in each bore.



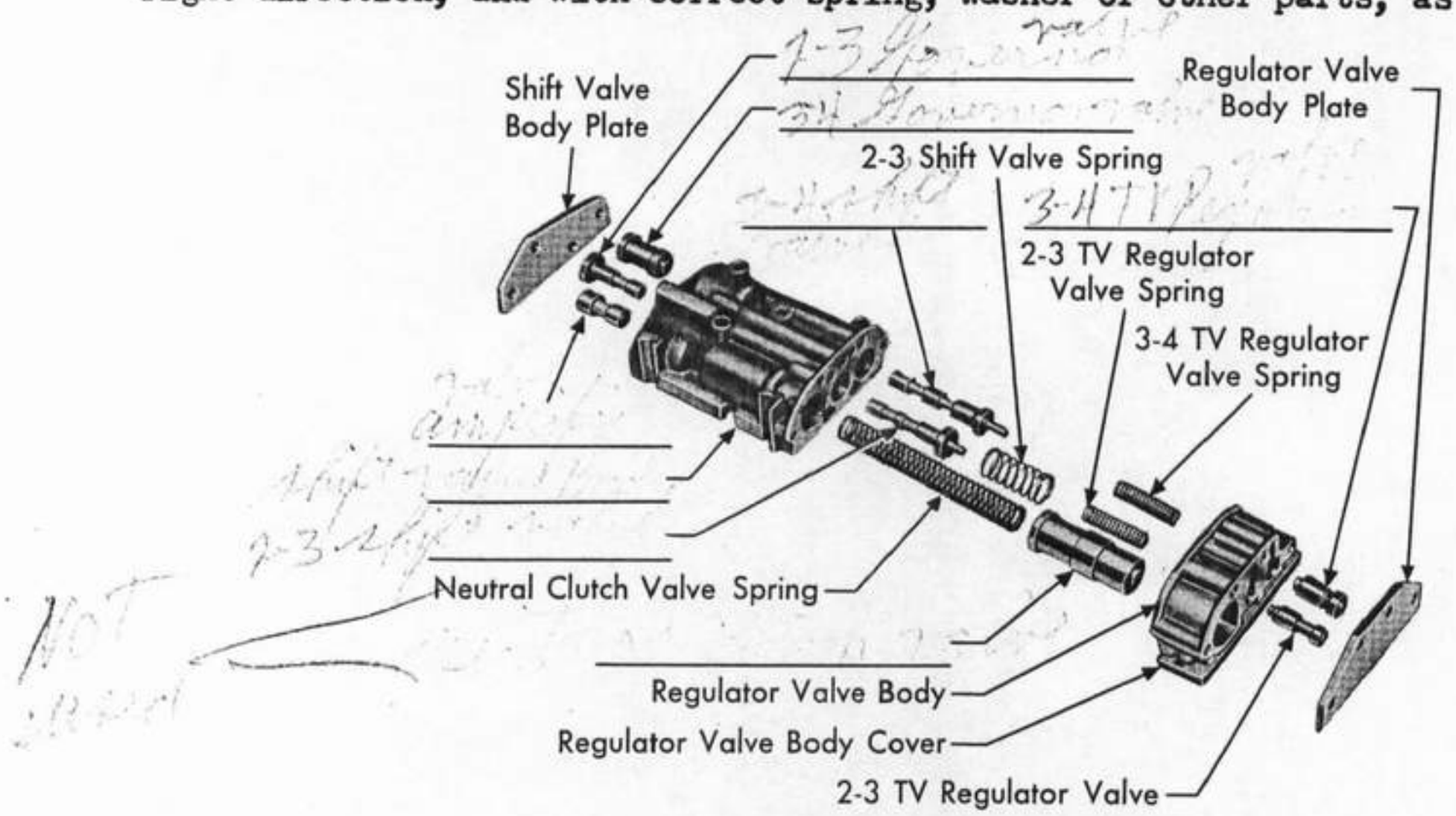
VALVE BODY SPRINGS

Inspect castings for nicks or scores. Test for warpage on a surface plate.

Check valves and plugs for free movement in casting bores without oiling. Valves should fall of their own weight when casting is tilted.

When assembling coupling valve body, first insert overrun clutch valve into large bore.

Double check to be sure that each valve is inserted in its bore in the right direction, and with correct spring, washer or other parts, as illustrated.



SHIFT VALVE BODY, EXPLODED

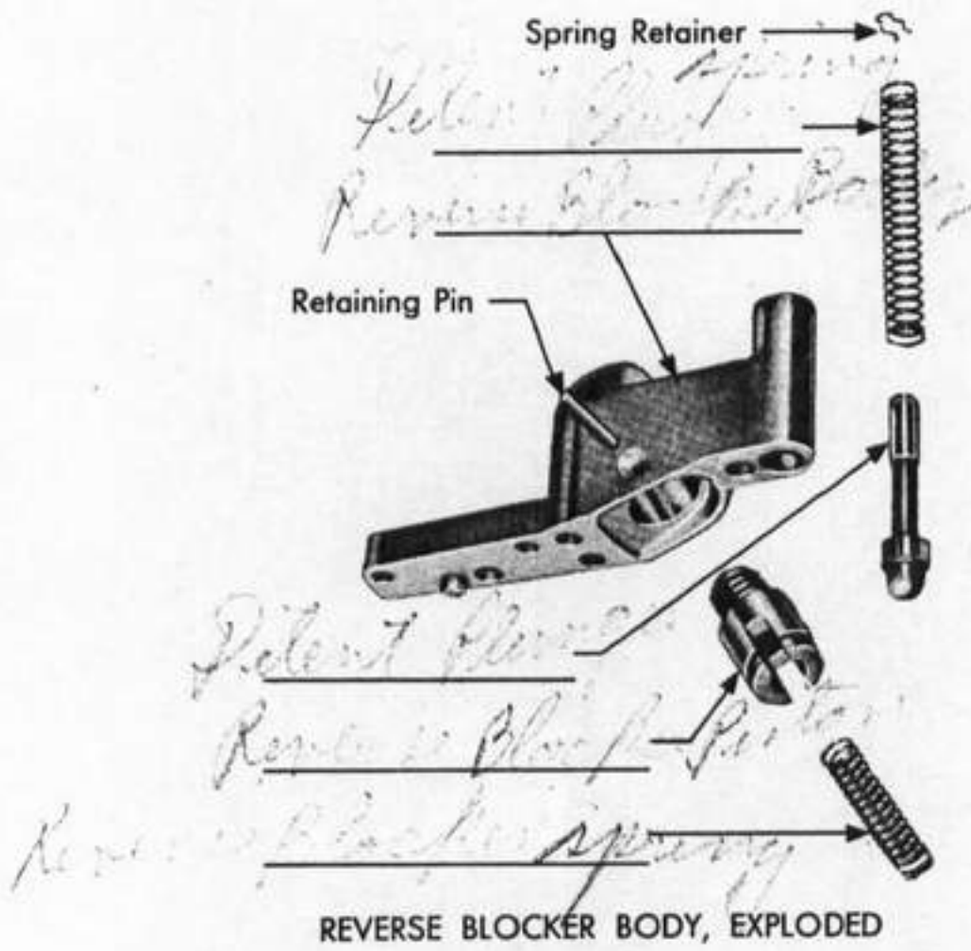
The shift valve body is the second unit removed from the control valve assembly. With coupling valve body also off, separator plate can be removed, taking care not to lose check valve and spring.

Hold regulator valve body end plate tightly against spring pressure when removing. Be careful not to drop valves or lose parts.

Remove all springs from casting bores.

Clean and inspect valves and other parts the same as for coupling valve body parts.

Start reassembly of shift valve body by inserting heavy neutral clutch valve spring in large bore, then installing 2-3 shift valves and springs and 3-4 shift valves and springs. Follow detailed procedures to complete the assembly.



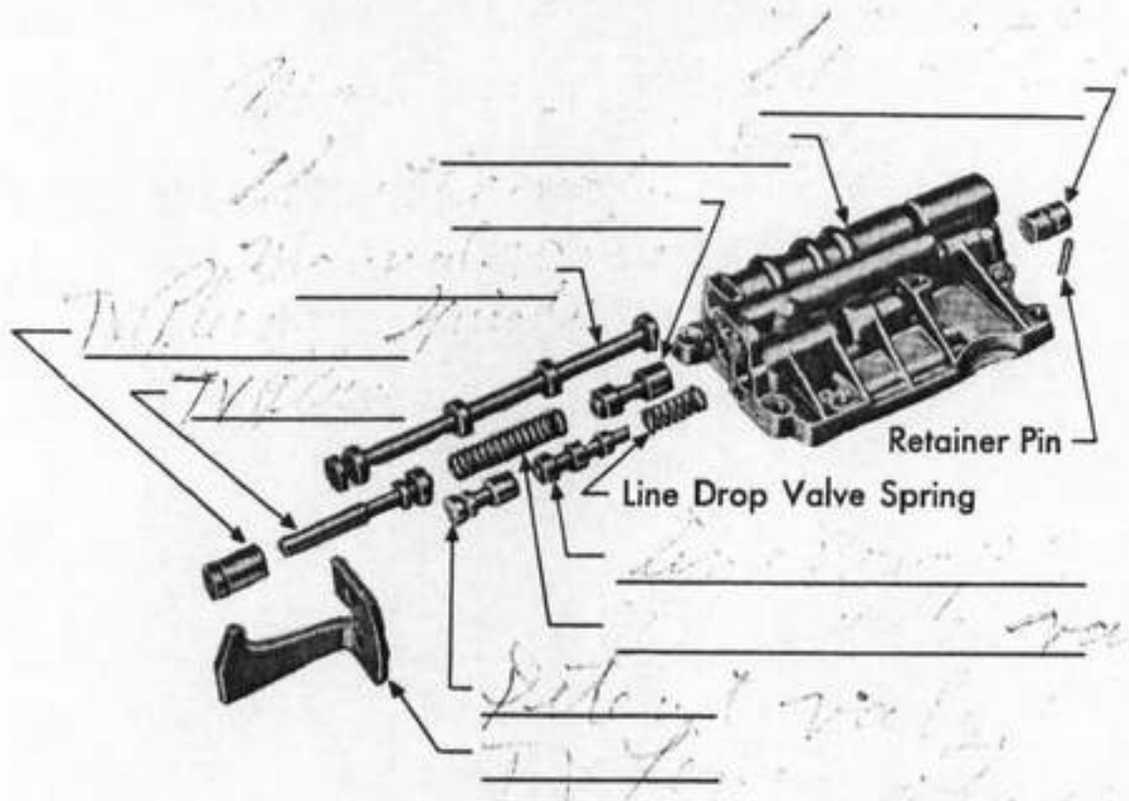
REVERSE BLOCKER BODY, EXPLODED

Remove reverse blocker body from manual valve body.

Disassemble by unsnapping hairpin clip to remove detent plunger and spring, and filing off peened pin to remove reverse blocker spring and piston.

Clean and inspect parts according to familiar procedures.

Refer to illustration for correct assembly arrangement. Peen blocker retaining pin.



MANUAL VALVE BODY, EXPLODED

Inner separator plate comes off of channel body after manual valve body is removed.

Taking off TV stop plate permits removal of valves and springs, except that retaining pin must be knocked out to remove throttle valve plug.

Careful cleaning and inspection is required for these parts also.

Swedge retaining pin after installing throttle valve plug.

Assemble TV plunger guide and plunger and install as a unit.

Line up spring carefully before inserting line drop valve and detent valve.

Reassemble units in following order: inner separator plate, manual valve body, reverse blocker body, outer separator plate, shift valve body, coupling valve body, and manual valve.

SESSION NUMBER 5

OIL CIRCUITS AND AUTOMATIC SHIFTING

G-1 pressure, delivered by the large governor weight, provides for low speed upshifts, G-2 pressure from the small governor weight provides for high speed shifts. Amplified G-1 pressure is used to overcome the stiff coupling valve spring.

G-1 pressure operates the reverse blocker piston at car speeds of 10 MPH or more.

Two passages lead from the coupling valve to the fluid clutch: one carries the signal pressure that closes the exhaust valves; the other carries the feed pressure that fills the coupling.

The accumulator absorbs the shock of applying the rear unit multiple-disc clutch when 2-3 upshift occurs, by providing an expansion space in which a spring-loaded piston slows down the flow of clutch apply oil.

TV pressure directed through power throttle passages, helps to maintain normal accelerator pedal effort.

The detent valve supplies the extra oil pressure required to provide forced downshifts at wide-open throttle.

The line drop valve shuts off line drop pressure whenever TV pressure reaches 50 pounds, to assure adequate line pressure for medium-to-wide open throttle conditions in fourth speed.

The limit valve has two functions: (1) to keep line pressure from flowing to the front unit fluid clutch until the pressure is high enough to fill it quickly; (2) to relieve excess line pressure which might occur when pushing the car to start the engine.

MANUAL AND AUTOMATIC SHIFTING

The hydraulic circuits in Neutral and Park are _____. Pump pressure is present, but valves are closed and all circuits are blocked off or exhausted.

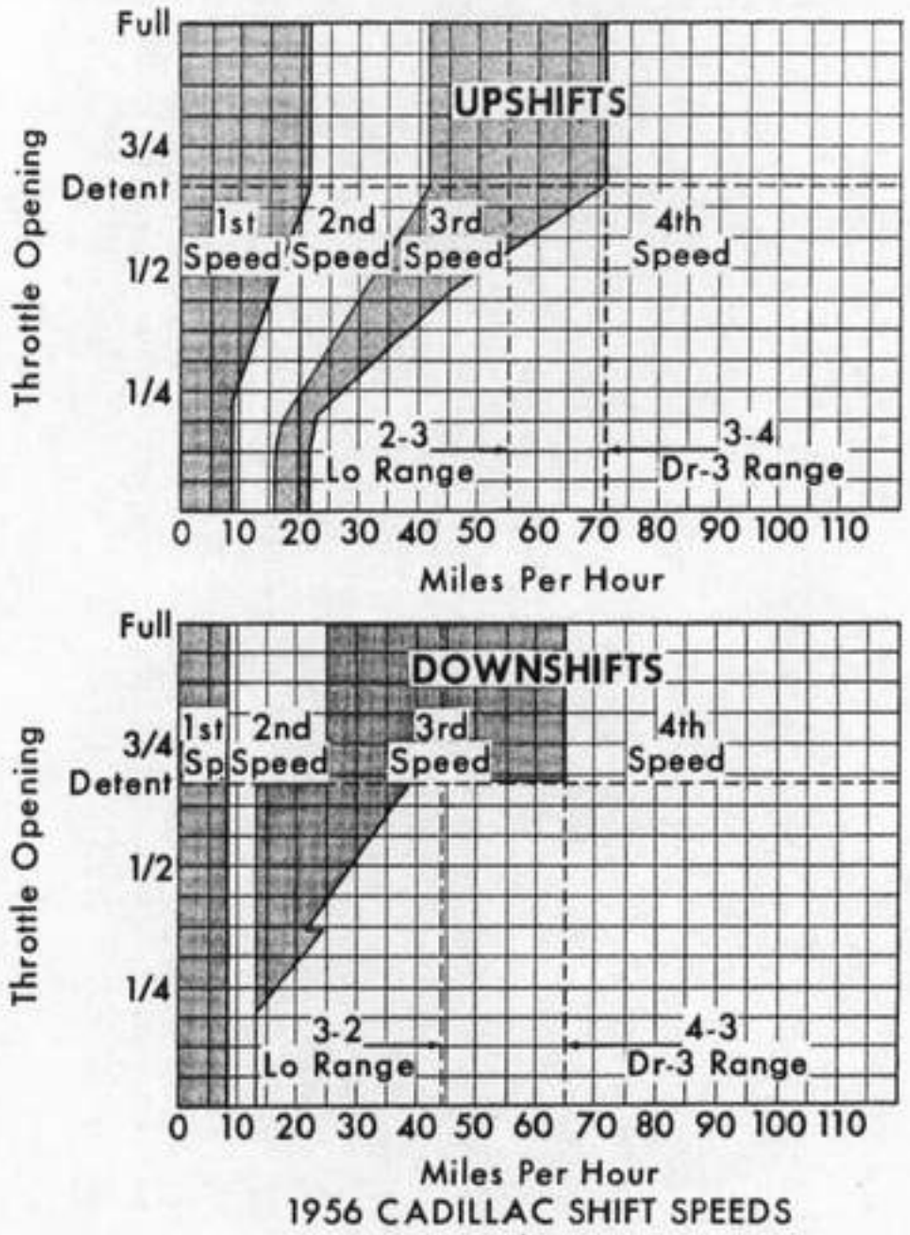
With engine running, car standing, selector in DR-4, engine speeds up when accelerator is depressed, and car moves forward in first speed; the shift to second occurs at 9 to 22 mph, depending on throttle opening; the 2-3 shift occurs between 16 and 42 mph; and the 3-4 shift occurs between 22 and 72 mph.

In fourth gear, with TV pressure less than 50 pounds, _____ pressure reduces main line pressure to 65 pounds. If throttle is opened more than half-way, 95 pounds line pressure is restored.

DOWNSHIFTS

A part throttle 4-3 downshift can occur at speeds from 39 mph down to 13 mph. The part throttle 3-2 downshift occurs at 13 mph, and, at zero throttle, the 3-4 and 2-3 shift valves both close at 13 mph, providing a 4-2 downshift. The 2-1 downshift always occurs at 8 mph.

1956 CADILLAC HYDRA-MATIC COURSE



1956 CADILLAC SHIFT SPEEDS

A forced 4-3 downshift will occur at full throttle at car speeds up to 65 mph. A forced 3-2 downshift will occur at speeds from 13 to 25 mph. There is no forced 1-2 downshift.

In DR-3 the car will not shift above third speed unless it is speeded up to 72 mph. DR-3 pressure also passes across the coupling valve in first and third speeds to apply the overrun _____.

In Lo Range, the car will not shift above second speed unless it is speeded up to 55 mph, when it will shift into third. Lo oil pressure also passes around the 2-3 shift valve in first and second speeds to apply the overrun _____.

In reverse, all manual valve circuits are exhausted except reverse (and line drop pressure, which is blocked at the 3-4 valve). Reverse pressure applies the reverse cone clutch, boosts line pressure to 185 pounds, closes the coupling valve to prevent an upshift, and applies the overrun _____

The selector lever can be moved to Reverse only at car speeds below 10 mph, because of the reverse blocker piston, which is operated by C-1 pressure.

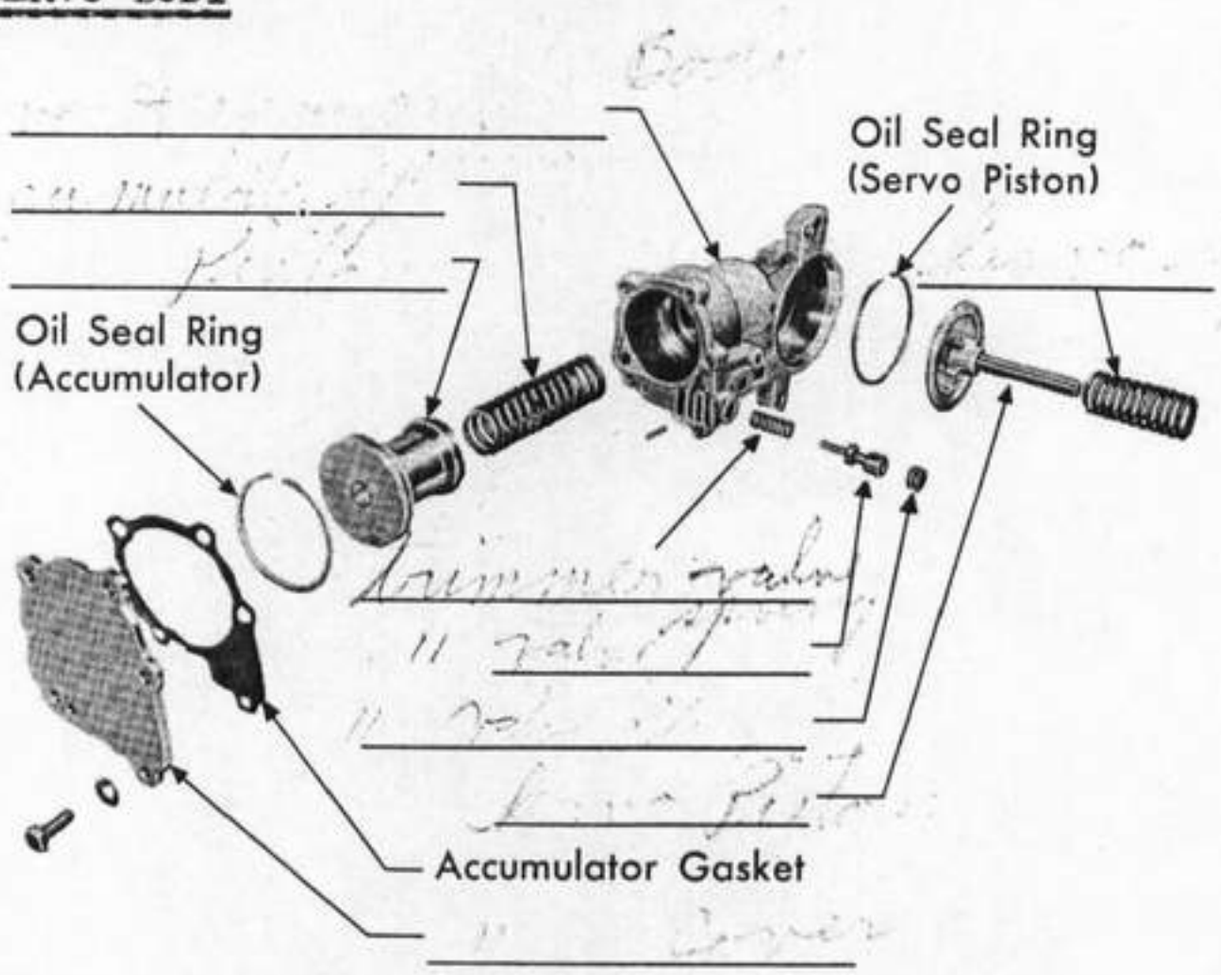
If selector is put into DR-4 with engine stopped and car pushed or coasting, transmission will engage same gear it would choose for normal driving at that same speed and throttle opening.

Recommended push-start procedure is to push car up to 25-35 mph, then put selector in D 3 range. Front overrun clutch and rear unit disc clutch will prevent transmission slippage, and line drop pressure will not be present.

SESSION NUMBER 6

OVERHAUL OF COMPONENTS

ACCUMULATOR AND SERVO BODY



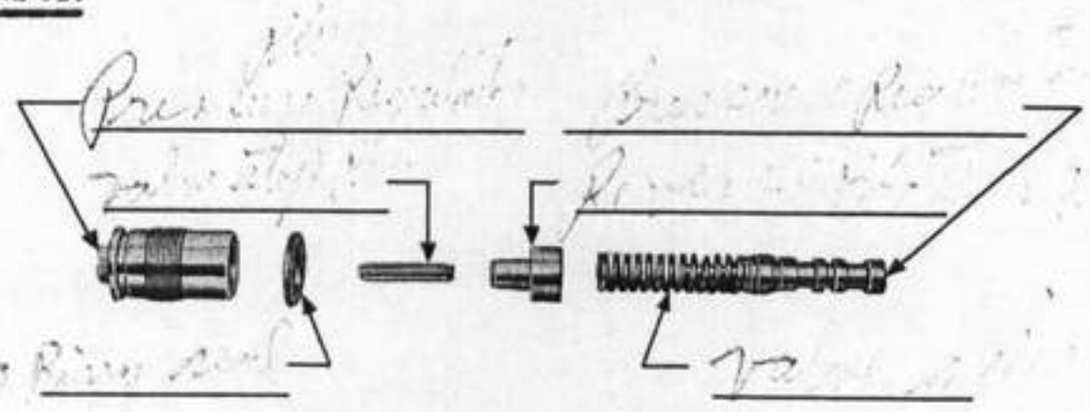
ACCUMULATOR AND SERVO, EXPLODED

Use Tool J-6124 to compress accumulator spring while removing cover. Knock out pin to remove plug, spring and trimmer valve.

Inspect all parts for wear, distortion and physical damage.

Position accumulator spring, piston, new gasket and cover, and install compressor Tool J-6124. See that aluminum piston ring does not bind.

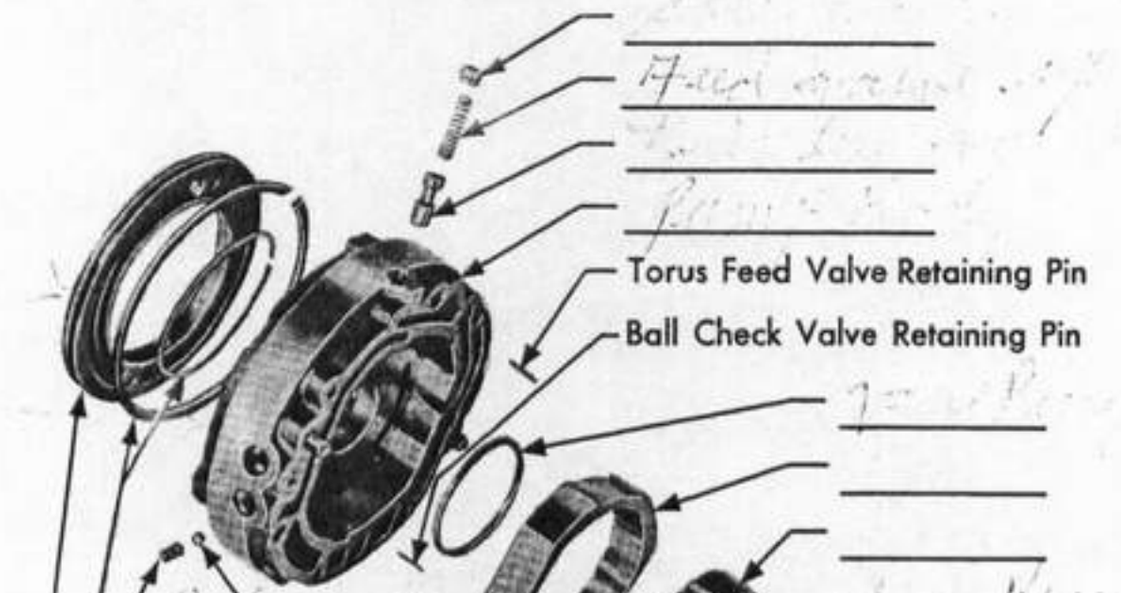
OIL PRESSURE REGULATOR



OIL PRESSURE REGULATOR PARTS

Separate parts for careful inspection. See that all oil passages are clear. Keep parts in clean tray until time for reassembly.

FRONT OIL PUMP



FRONT OIL PUMP, EXPLODED

Torus feed valve and spring, and check valve spring and ball are removed from opposite sides of pump body, after removing retaining pins.

Vanes rings, rotor and vanes are removed simply by lifting out. Remove pump slide by pushing toward priming springs and lifting end opposite springs.

Mark overrun clutch piston and pump body for proper reassembly, and remove piston from body. Easiest way is with air hose at clutch apply hole.

Remove piston inner seal ring by holding one end tightly in groove and pressing other end outward to disengage interlocking ends.

Inspect outer race of front unit sprag. If it is damaged, entire front pump assembly must be replaced.

Inspect all oil passages for dirt or obstructions, checking with tag wire.

Examine pump slide, rotor, vane rings and vanes for wear or damage. Vanes will be polished on side that bears against slide. Check vanes on surface plate for flatness.

Bushing in pump body will be bright, but wear should be even. Scoring or uneven wear requires replacement of pump body.

Insert one end of oil seal ring in bore, then work around until ring is completely inserted.

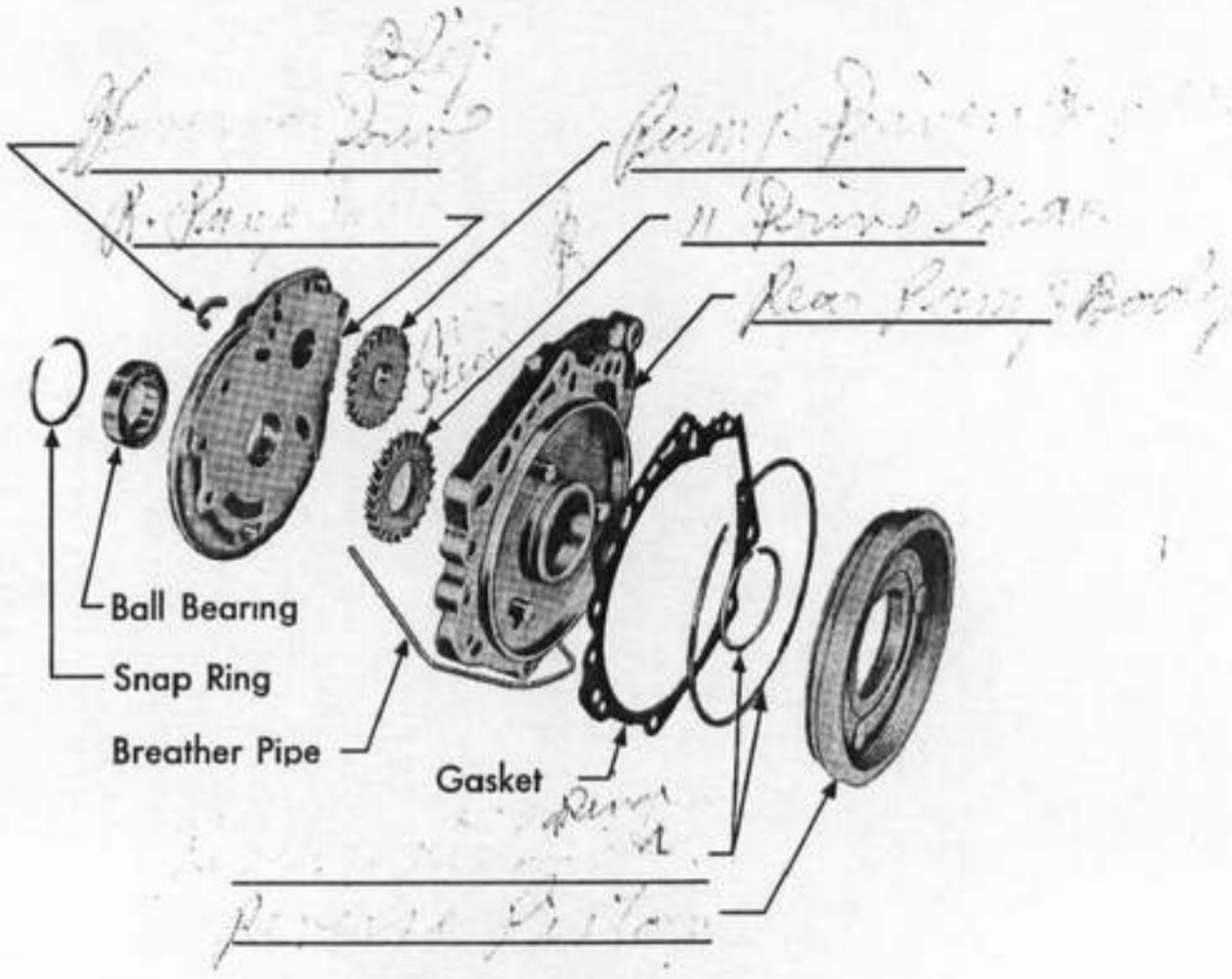
Install sprag assembly into outer race in rear of pump body, with flanged rim facing up. Insert inner race to check for counter-clockwise rotation.

Install in order: priming springs, pump slide, lower vane ring, rotor, vanes -- with bright edges outward -- and top vane ring.

Insert torus feed valve, spring and cap, and check valve ball and spring in their respective bores, and secure with retaining pins.

Check all pump parts for free operation before installing pump cover.

REAR OIL PUMP



REAR OIL PUMP, EXPLODED

Pry out vent pipe with screwdriver.

Work reverse cone clutch piston off of dowels and out of pump body.

Remove cover from pump body by tapping with plastic hammer.

Mark pump gears before removing to permit matched reassembly.

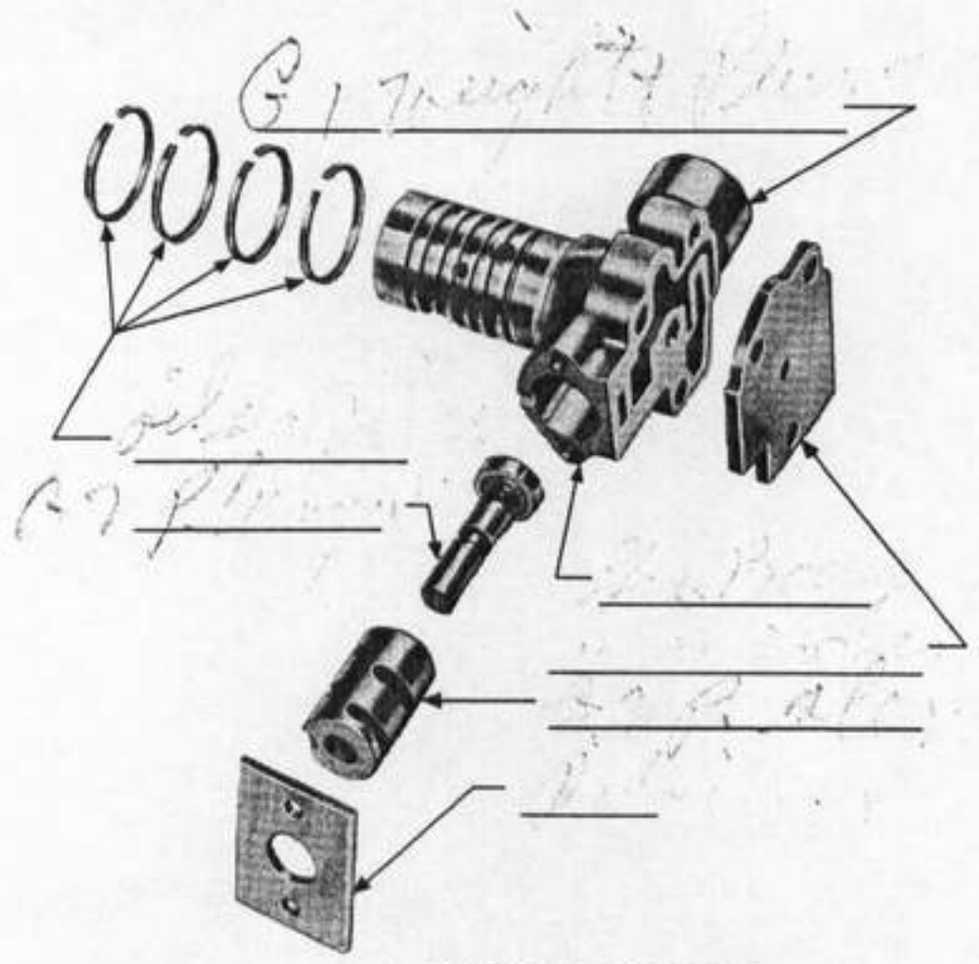
Examine gear teeth, pump body and cover for wear or damage. Gear teeth or machined area may show some polish, but there should be no scores or scratches. Replace any damaged parts.

Make certain that governor drive key is properly seated in driven gear.

Index dowels with dowel holes, and tap cover in place on pump body.

Insert reverse cone clutch piston in its bore, seat large oil seal ring at one end, and gradually work seal around, applying light pressure, until piston is forced into the bore.

GOVERNOR



GOVERNOR, EXPLODED

Use Snap Ring Pliers KMO-630 to remove oil seal rings. Be very careful

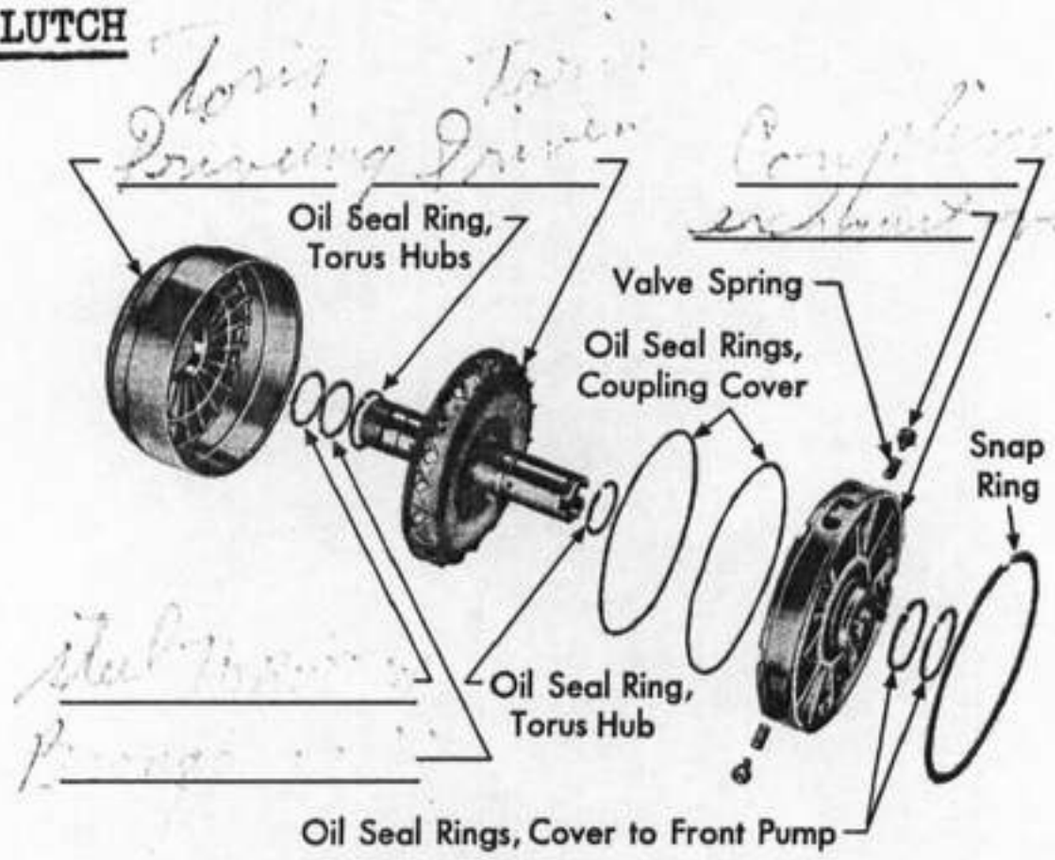
not to raise any burrs on ring lands.

Shake G-2 valve and bushing from governor body. G-1 valve cannot be disassembled.

Check rings and grooves for wear or scratches. Check castings for damage and blocked passages. Test valves and bushing for free movement.

When installing oil seal rings, use Pliers KMO-630, and again be very careful not to nick or scratch the ring lands.

FRONT UNIT FLUID CLUTCH



FRONT UNIT COUPLING, EXPLODED

With front unit in holding stand J-6116, use Front Unit Clutch Tool No. J-6121, first to compress unit for snap ring removal, then to pull cover from driving member. Mark cover and driving member for matching in assembling.

Exhaust Valve Clips J-6122 are needed to hold valves during disassembly.

Inspect torus members for physical damage, especially for loose vanes. Inspect all parts for scores, roughness or damage.

Use same special tools for assembly as were used for disassembly.

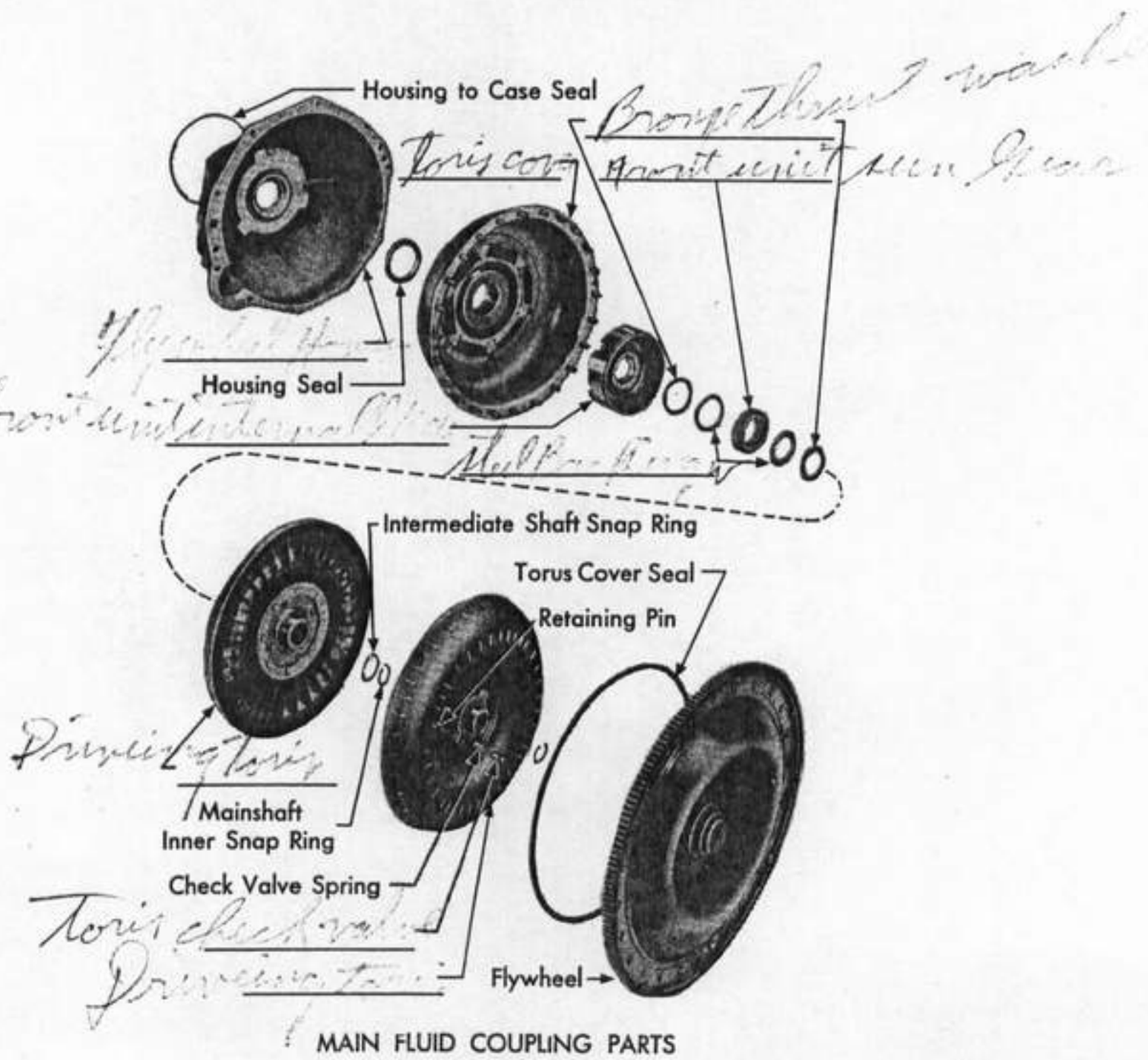
Two new square rubber oil seals must be used in the clutch cover.

Tap clutch cover into place with plastic hammer, until snap ring groove shows evenly. Install snap ring.

MAIN FLUID COUPLING

Inspect driving and driven torus members for loose vanes, score marks, worn splines or other damage.

Check front unit planet carrier and planet pinions for wear or damage. The entire driving torus assembly must be replaced if any of these items are unserviceable.

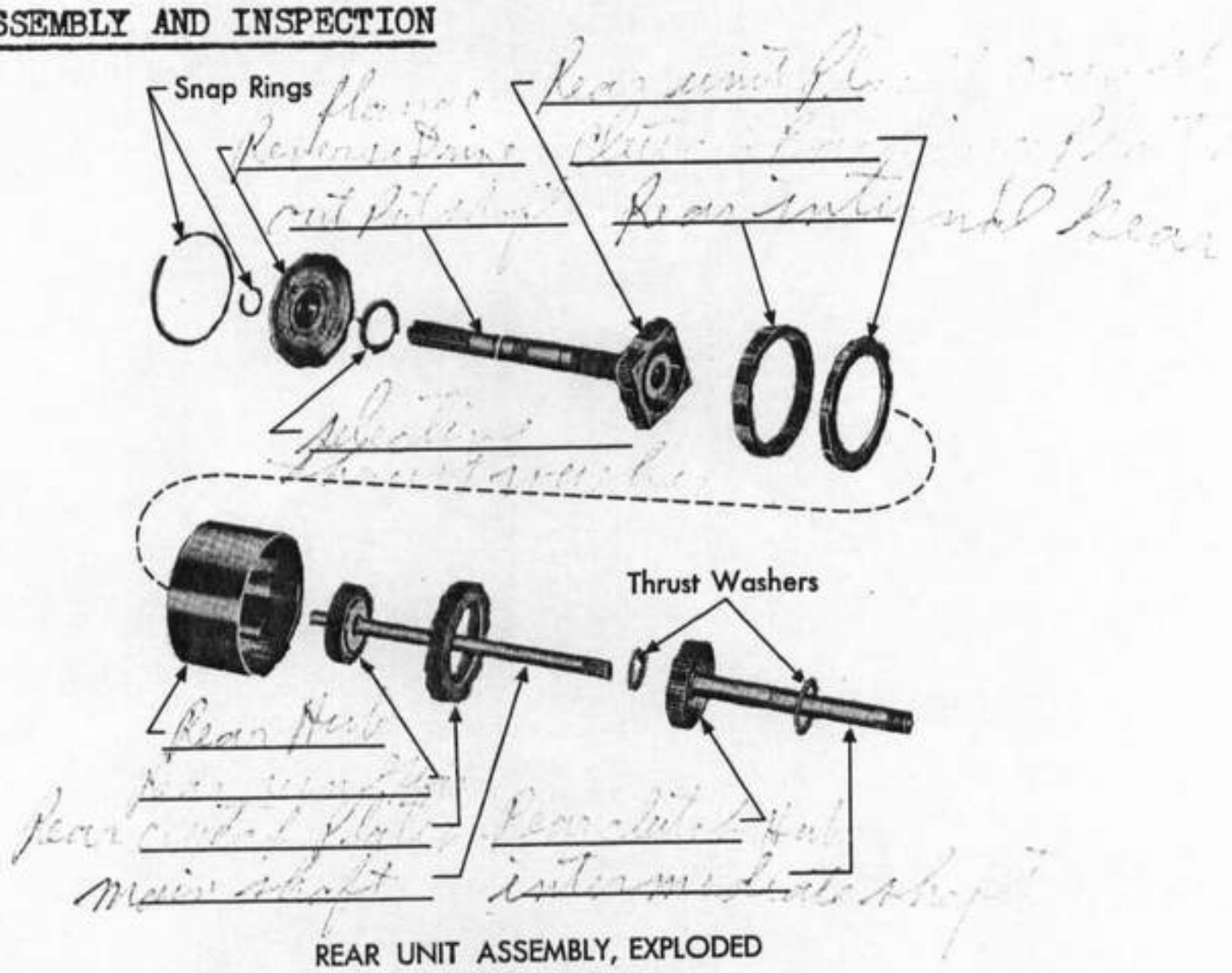


MAIN FLUID COUPLING PARTS

Take torus check valve and spring from hub of driven torus, and inspect valve, spring and bore.

Check oil seal neck and hub splines when inspecting torus cover.

REAR UNIT DISASSEMBLY AND INSPECTION



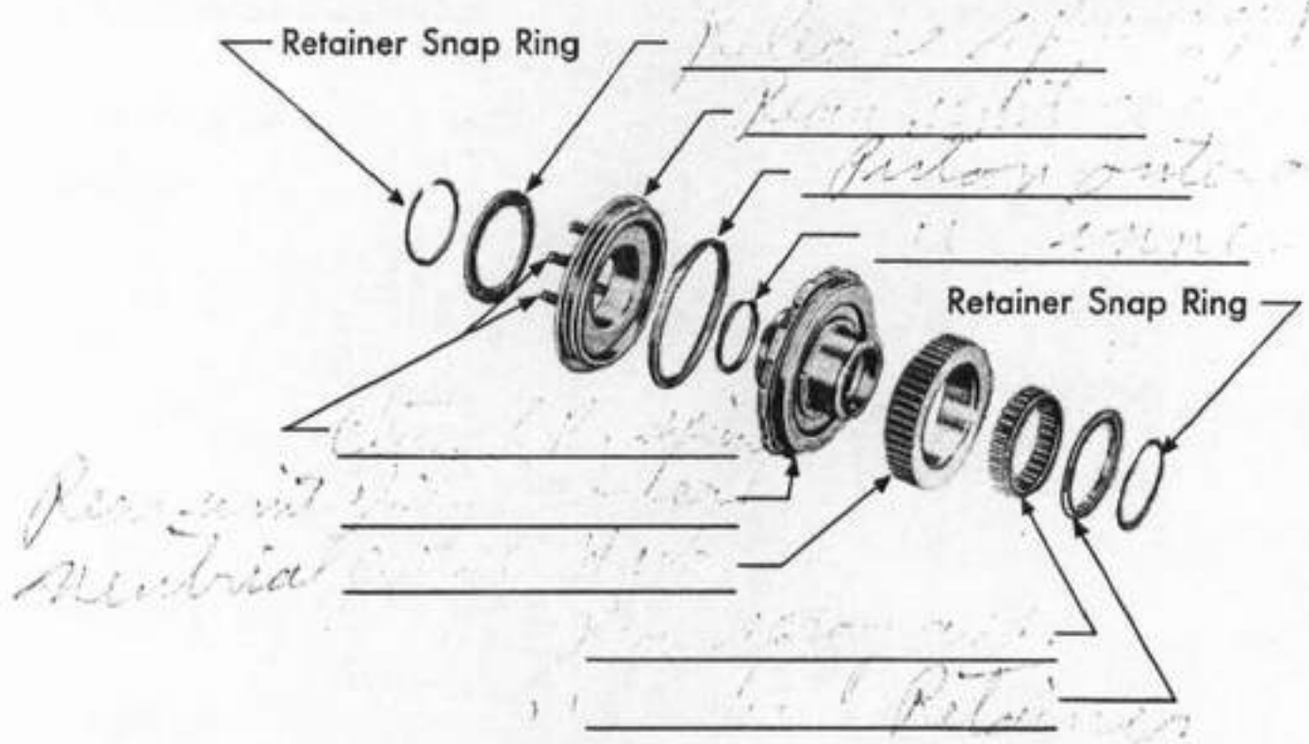
REAR UNIT ASSEMBLY, EXPLODED

Use Holding Stand J-6116 for disassembly.

Follow step-by-step procedures for disassembly.

Mark internal gear and rear drum to permit matching in reassembly.

Use Tool J-6129 to compress rear clutch release springs for snap ring removal and clutch disassembly.



REAR UNIT CLUTCH, EXPLODED

Remove spiral snap ring and rotate neutral clutch hub counter-clockwise to remove hub from rear clutch cover.

Inspect all gears and shafts for damage to splines, gear teeth, or thrust or bearing surfaces.

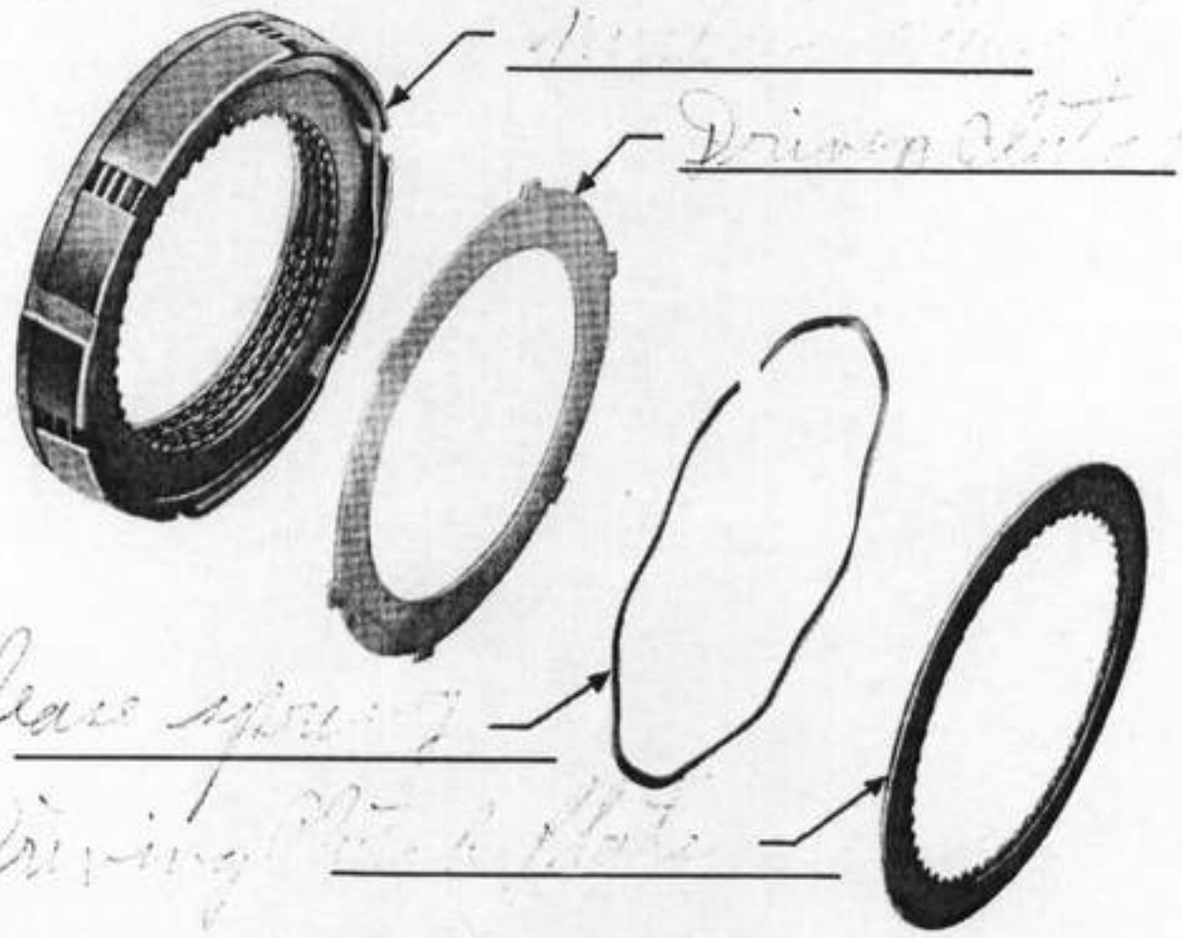
Inspect composition-faced clutch driving plates for damaged surfaces, worn teeth and six waves, .010-inch deep. Inspect steel driven plates for scored surfaces and damaged lugs, and for flatness, using a surface plate.

Inspect rear unit drum, clutch hub, clutch cover, and reverse drive flange for excess wear, or damage. Reverse drive flange and sun gear must be replaced as a unit, if either is damaged.

Check clutch release springs for distortion or collapsed coils.

Inspect sprag assembly for damaged lands, broken springs, or scored sprags. Complete assembly must be replaced if any parts are unserviceable.

NEUTRAL CLUTCH ASSEMBLY INSPECTION



NEUTRAL CLUTCH PARTS, EXPLODED

Inspect clutch hub for cracks or damaged splines. Check inner surface of hub, as it is outer sprag race. Replace if scored.

Check clutch piston and rings for scores, burrs or damaged ring lands.

Inspect clutch driving and driven plates in the same manner as the rear unit plates.

Check the five wave type release springs for distortion.

REAR UNIT ASSEMBLY

Start by assembling rear sprag into neutral clutch hub with flanged edge outward.

Use spiral snap ring to hold neutral clutch hub on hub of rear clutch cover.

Use Compressor J-6129 to compress clutch springs and permit installing

snap ring for spring retainer.

Install clutch backing plate and rear unit internal gear into rear unit drum.

Thrust washers for mainshaft endplay are available in the following thicknesses:

1. .055 - .059
2. .060 - .064
3. .065 - .069
4. .070 - .074
5. .075 - .079
6. .080 - .084
7. .085 - .089
8. .090 - .094
9. .095 - .099

Mount Drive Flange Holder J-6120 on output shaft before installing in rear drum assembly. Place entire unit in Holding Stand J-6116, with output shaft down.

Apply Hydra-Matic Oil to faces of rear unit clutch plates when installing. Start with a composition-faced plate.

Use Petrolatum to hold thrust washers in place during assembly operations.

Assemble neutral clutch units as follows: (1) composition plate (2) wave type spring (3) steel plate, etc.

Install Holding Collar J-6135 over intermediate shaft as a final sub-assembly step. Neutral clutch release springs must be compressed when collar set screw is tightened.

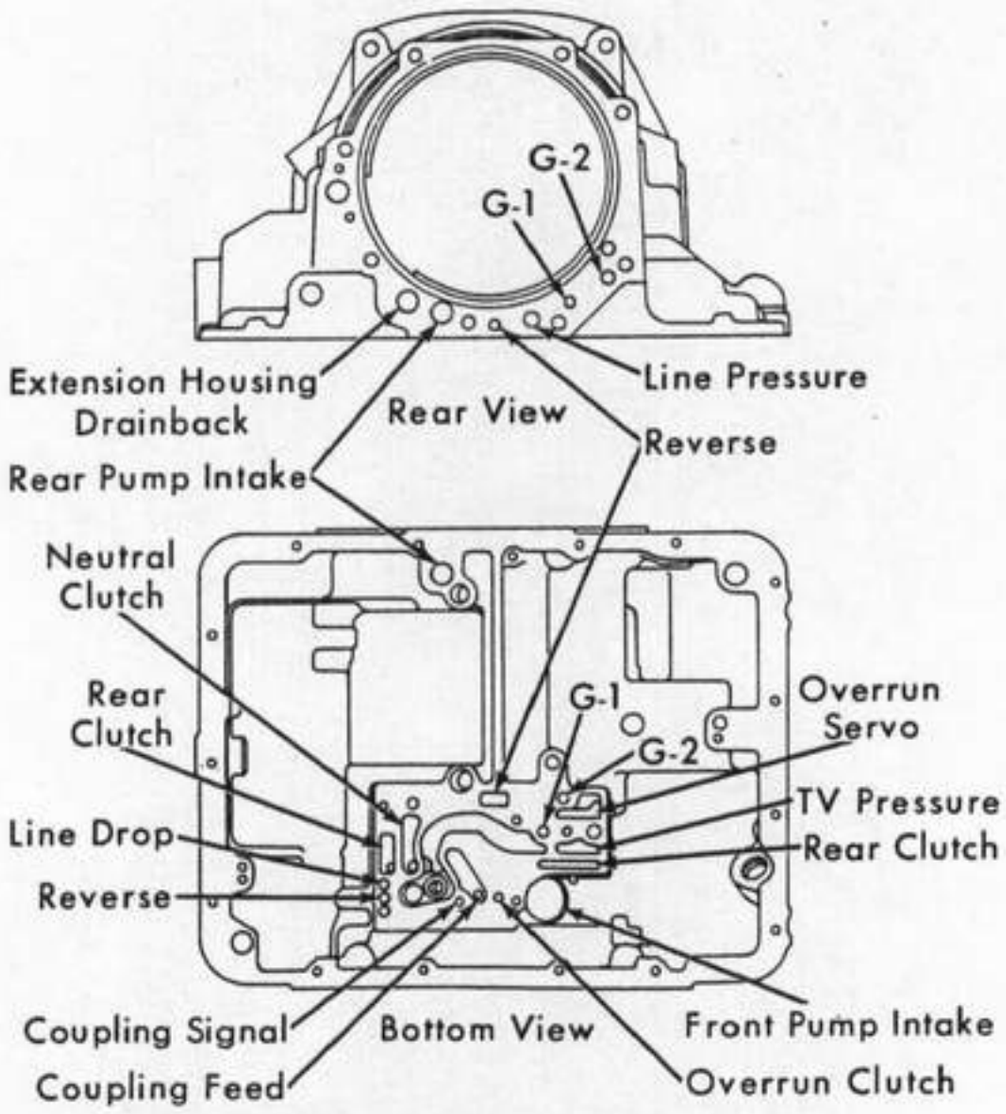
SESSION NUMBER 7

ASSEMBLY OF TRANSMISSION

CLEANING AND INSPECTION OF TRANSMISSION CASE

Examine all flat machined surfaces for flatness and freedom from burrs and scratches.

Blow out all oil passages with compressed air. Make sure they are clear.



TRANSMISSION CASE OIL PASSAGES

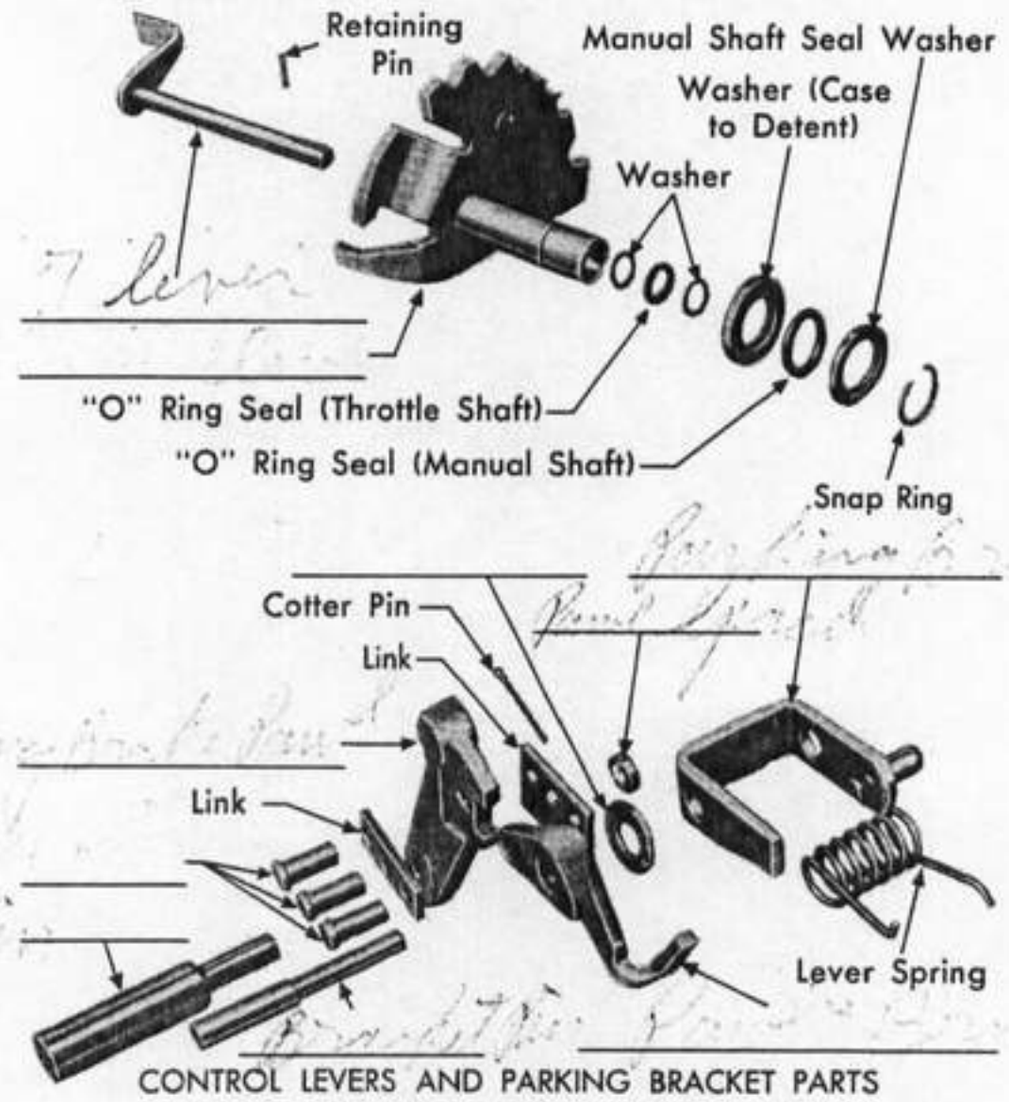
Familiarity with the oil passages will help in diagnosing troubles.

Mechanical defects in mating surfaces will cause leakage, and loss of pressure.

INSTALLATION OF LINKAGE AND OVERRUN BAND

Inspect parking pawl and lever for free operation and for freedom from wear or damage before installing.

After inspecting detent and throttle control levers for operation, install them through case from the inside.



CONTROL LEVERS AND PARKING BRACKET PARTS

Insert overrun band, open end first, into front of case, then rotate to normal position and engage anchor pin.

Don't forget neutral clutch locating key.

INSTALL DRIVE LINE PARTS

Insert neutral clutch and rear unit assembly in case from the front.

Lift by grasping output shaft and intermediate shaft. Align neutral clutch drum with locating key, and bearing support hole with hole in case.

Position drive line parts as far to the rear as possible.

Be careful not to scratch machined bore in case when installing snap ring for center bearing support.

After removing Holding Collar J-6135, make sure that neutral clutch springs seat center bearing support against snap ring.

Position transmission horizontally and remove Drive Flange Holder J-6120.

Be careful to align stationary cone with locating key when installing in transmission case.

Install cone clutch release spring with tangs pointing upward.

Make sure, when installing rear oil pump and reverse cone clutch piston assembly, that clutch piston fits over internal gear and plug in pump body points downward. Engage pump driving gear splines by rotating output shaft.

When installing governor in rear pump cover, compress each oil seal ring with fingers, being careful to avoid damage to rings or ring lands. Test installation by rotating output shaft; governor should turn in opposite direction.

CHECKING REAR UNIT END PLAY

Recheck end play, using Gage J-6126, Collar J-6127, and Indicator KMO-30. If end play is not within .004-.018 inch limits, unit must be disassembled to change selective washer.

INSTALL FRONT PUMP AND FLUID CLUTCH

In these steps, be sure to line up tangs of thrust washer with tangs of overrun clutch plate and tangs of front sprag inner race.

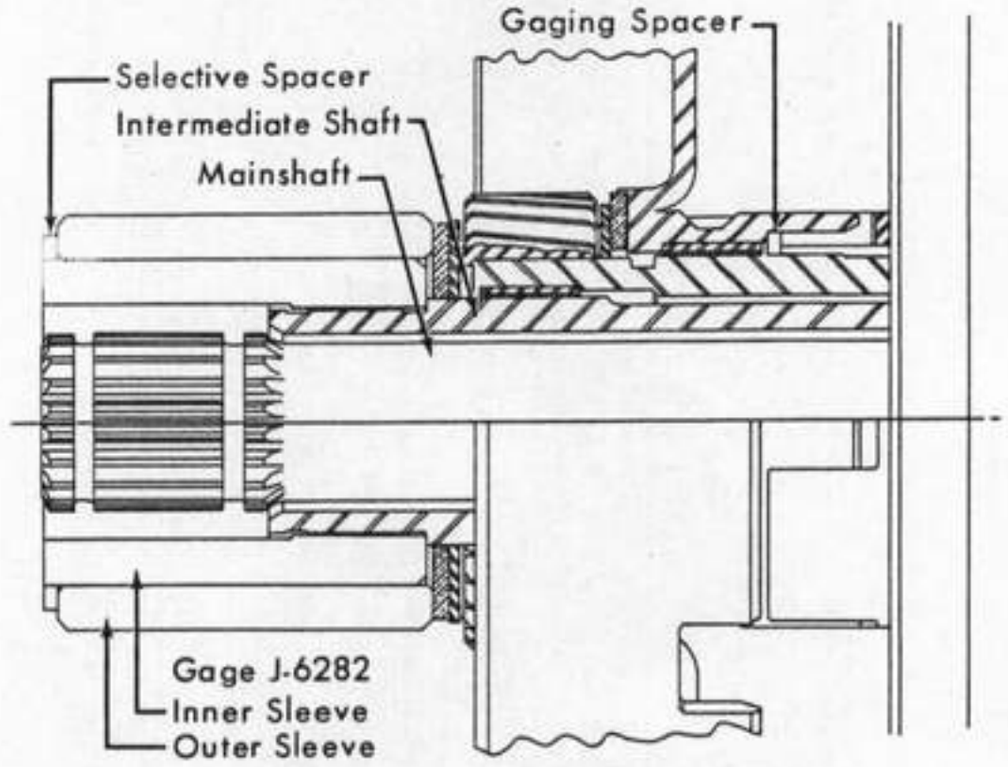
Use Slide Hammers J-6125 in opposite screw holes to lower front pump into case. Make sure pressure regulator bores line up.

Install front pump locating screw before installing hex head attaching screws, but tighten it after tightening those screws. Torque tightnesses: hex head screws 25-30 foot-pounds; locating screw 22-27 foot-pounds; remaining screws, 15-18 foot-pounds.

In installing pressure regulator valve and spring, make sure spring enters counterbore in reverse booster plug. Tighten regulator plug to 10-15 foot-pounds.

Slip fluid clutch assembly over intermediate shaft; rotate driven shaft to engage inner sprag race, and rotate driving member to engage tangs of clutch cover in front pump rotor slots.

CHECKING FRONT UNIT END PLAY



CHECKING FRONT UNIT END PLAY

Use a No. 1 selective spacer in back of End Play Checking Gage J-6282, and select by trial the spacer that is flush with the inner sleeve when mounted on the outer sleeve. Be sure fluid clutch driven shaft and intermediate shaft are pushed tightly rearward.

INSTALLATION OF REMAINING UNITS

Install control valve body, accumulator body, pump intake pipe and screen, and oil pan, in that order.

Remove transmission from holding stand and place on bench or hoist basket for fluid coupling and flywheel installation.

Use Front Seal Sleeve J-6119 to protect flywheel housing seal from sharp edges of shaft splines.

Start pipe fittings into adapter while mounting oil cooler assembly on flywheel housing.

Place selective washer chosen during end play check against fluid clutch driving member hub, and install torus cover.

Be sure to install bronze and steel thrust washers for internal gear and sun gear correctly.

Use Pliers J-4880 for installing torus retaining snap rings.

Torque flywheel-to-torus cover nuts to 20-25 foot-pounds. Remember to leave off the 4 nuts for the driving plate.

SESSION NUMBER 8

TRANSMISSION REMOVAL, INSTALLATION AND ADJUSTMENT

REMOVAL

Some type of transmission hoist is necessary for transmission removal. Floor models are most suitable.

Perform all "in-car" operations before raising car on hoist. The two upper flywheel housing attaching screws are reached from inside the car.

Drain transmission before removal, for easier handling. Replace drain plugs.

Starter must be taken off to permit flywheel housing removal.

Have container handy to catch first surge of water when disconnecting oil cooler hoses. Be careful if engine and coolant are hot.

An engine stand that mounts between the frame side-bars must be used to support engine when engine rear support is removed.

Follow detailed procedures in order for efficient removal.

Remove transmission and flywheel housing together. Move toward rear to disengage crankcase locating dowels, tilt downward at front end, and lower the assembly while disengaging extension housing from frame X-member.

INSTALLATION

After working extension housing into frame X-member, raise transmission and turn flywheel to align bare torus cover studs with holes in flywheel drive plate.

Install 4 lower flywheel housing screws, tightening to 40-50 foot-pounds, then install 4 self-locking nuts for flywheel drive plate, tightening to 20-25 foot-pounds. Avoid overtightening screws that hold flywheel front cover.

Lift engine and transmission one inch above normal height to permit installing engine rear support and its frame cross member.

Make other connections according to Shop Manual procedures. Line up serrations carefully when installing manual lever and throttle lever.

Remember to install two upper flywheel housing screws from inside car, and to replenish engine coolant as well as refilling transmission.

Use only transmission fluid bearing the AQ-ATF label. Always check level on dipstick, with engine idling.

ADJUSTMENTS

Adjust manual linkage in DR-4 position, by adjusting clevis on lower end of manual rod.

Adjust throttle linkage according to Shop Manual procedures. Make these adjustments with great care, because they have an important effect on shift points and on overall car performance.

SESSION NUMBER 9

HYDRA-MATIC DIAGNOSIS METHODS

DIAGNOSIS is a systematic method of approach planned to help us use our knowledge of transmission operation, together with common sense and logic, to find the cause of transmission trouble.

Our training and experience in overhaul methods usually enable us to fix any trouble we can find. Before we start repairs, however, the following steps are recommended:

DIAGNOSIS PROCEDURE

1. Get the Facts
   a. Get the Owner's story
   b. Road-test the car
   c. Find and identify all symptoms

2. Decide What to Do
   a. List possible causes
   b. Cross-check and eliminate
   c. Decide sequence for investigation

3. Inspect, Test, and Overhaul
   a. Check preliminary items
   b. Perform operational tests
   c. Examine all suspected parts

A Shop Manual-type Diagnosis Chart of familiar symptoms, their probable causes, and the recommended corrections may save time by replacing Step 2 of the above procedure. Steps 1 and 3, however, depend on the mechanic's knowledge, judgment, and skill with or without a Diagnosis Chart.

It is your job to correct rare conditions as well as familiar conditions. Some cars will have unique troubles not duplicated by any other car.

These are handled best by the general Diagnosis Procedure. Some short-cuts are possible in diagnosing familiar conditions.

POSSIBLE HYDRA-MATIC TROUBLES

1. Slipping
   a. No drive
   b. Misses gears
   c. Engine overspeeds

2. Shift Conditions
   a. Misses shifts (See 1b)
   b. Rough or jerky shifts
   c. Shifts at wrong speeds
   d. Erratic shifts

3. Response to Controls
   a. No drive (See 1a)
   b. Locks up
   c. Selects wrong range
   d. No forced downshifts

4. Noise or Vibration
   a. Varies with engine speed
   b. Varies with car speed
   c. Varies with gear ratio
   d. Comes and goes

5. Oil Leakage
   a. Within flywheel housing
   b. Side or bottom
   c. At extension housing

FIND AND IDENTIFY SYMPTOMS

Classify trouble according to its type. Decide on best description.

Compare with normal transmission operation under same conditions, and decide which functions are affected.

Associate trouble with transmission units responsible for those functions, such as a pump, gearset, clutch, or hydraulic circuit.

Cross-check operation of suspected units by testing car under other conditions. Try different engine speeds, car speeds, gear ratios, upshifts and downshifts, throttle openings, and selector ranges. Note operation each time, whether normal or abnormal.

DECIDE SEQUENCE FOR INVESTIGATION

Form opinion as to what is wrong with suspected units, including all logical possibilities.

Cross-check each possibility by determining the related symptoms which would result, and matching these against the transmission's actual operation. Eliminate those possibilities which do not agree with observed symptoms.

For each remaining possibility, decide which performance tests and overhaul operations are necessary to determine and correct the actual cause of the trouble.

Arrange these in a logical sequence, starting with the quick, easy tests, and ending with the more time-consuming overhaul operations.

Perform the necessary work as planned, until the trouble is corrected.

EXAMINE ALL SUSPECTED PARTS

Every hydraulic trouble has a mechanical cause. Keep a sharp eye out for warpage, scratches, excessive clearances, or faulty seals and gaskets which might cause leakage between parts.

Check visually or with air pressure for casting defects which might cause leakage within a part. Check for obstructions which might block off a passage.

Check for dirt, varnish deposits, burrs, or mechanical binding which might cause a valve or a clutch piston to stick.

Check for worn gear teeth, bearing surfaces, thrust washers, snap rings, or ring grooves which might be responsible for trouble. Check also for distorted springs, rings, or clutch plates.

Continue inspections until some condition is found which logically appears to have caused original trouble. Correct this, as well as other questionable conditions for which authorization can be secured.

Re-test car under original conditions, after assembly and installation of transmission, to verify correction of trouble.

DIAGNOSIS TESTS WITH TRANSMISSION IN CAR

PRELIMINARY CHECKS should be made on every car with a transmission complaint, before road tests are attempted:

Transmission Oil Level - should be less than 1/4 inch below "F" mark on dipstick.

Engine Idle Operation - should be smooth at 400 RPM in either Drive range, without any tendency to "creep".

Throttle Linkage Operation - should be smooth, without looseness or binding, throughout limits of travel.

PERFORMANCE TESTS may be combined with the initial road tests to the tent that they do not interfere with owner relations. A second road test be necessary to establish needed corrective work, providing another

opportunity to make these tests:

Oil Pressure Tests - made with Gage J-2540-A connected to line pressure at underside of rear pump body. Individual tests can be made for:

Front Pump Output - should be 50 pounds minimum in DR-4 range, car standing, engine running at hot idle speed. Should not read less in any other selector position.

Rear Pump Output - should be 65 pounds minimum in Neutral at 40 MPH with engine stopped. Should not exceed 200 pounds.

Line Pressure - should be 90-100 pounds in DR-4 range, 4th gear, detent throttle, at 40 MPH.

Line Drop Pressure - should be 60-70 pounds in DR-4 range, 4th gear, zero throttle, at 40 MPH.

Reverse Booster Pressure - should be 155-185 pounds in Reverse, car standing, at half-throttle.

Internal Leakage - indicated by momentary drop in reading as shifts occur.

Stall Tests - make with portable tachometer connected to engine, to determine transmission slippage. Use foot brakes to hold car. Do not run test longer than 15 seconds without idling

engine several minutes to dissipate heat. Take speed readings within 5 seconds, for best accuracy.

Slippage of individual units will occur as follows:

Unit Slipping	Range	Speeds Affected
Front sprag clutch	DR-4	First and third
Rear sprag clutch	DR-4	First and second
Front unit coupling	DR-4, DR-3, Lo	Second and fourth
Rear unit clutch	DR-4, DR-3, Lo	Third and fourth
Neutral clutch	DR-4, DR-3, Lo	First and second
Overrun clutch	DR-3, Lo, Rev.	First and third(coast)
Overrun band	Lo	First and second(coast)
Reverse cone clutch	Rev.	—

Tests are performed as follows:

First Speed - with car standing in DR-4 range, engine speed should not exceed 1800 RPM at full throttle. Tests front and rear sprag clutches, neutral clutch.

Reverse - with car standing in Reverse, engine speed should not exceed 1800 RPM at full throttle. Tests front sprag clutch and reverse cone clutch.

Second Speed - with transmission in Lo range, second speed, at constant car speed, engine should not increase speed appreciably when throttle is opened fully. Tests front unit coupling and rear sprag clutch, neutral clutch.

Third Speed - with transmission in DR-3 range, third speed, at constant car speed, engine should not increase speed appreciably when throttle is opened fully. Tests front sprag clutch and rear unit clutch.

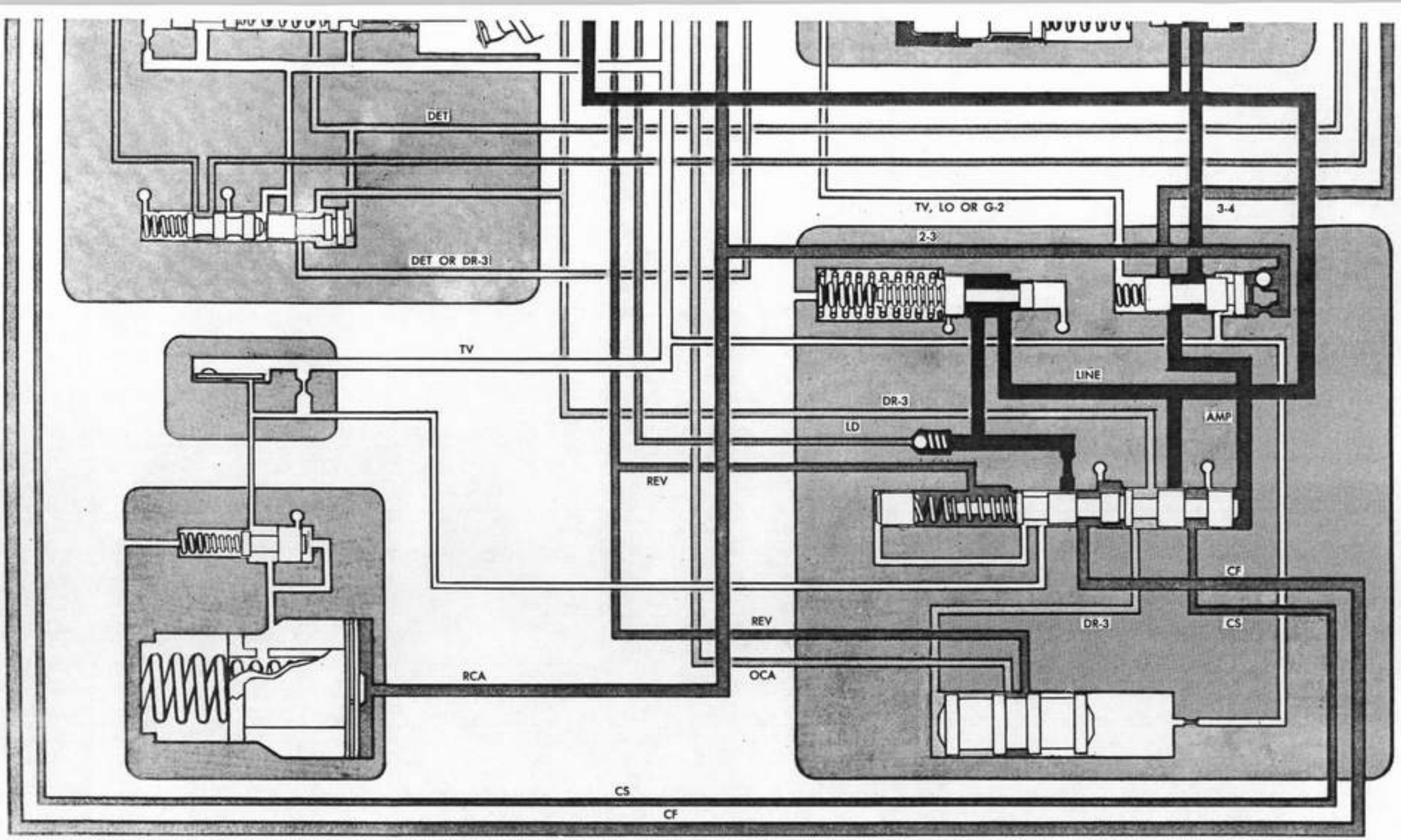
Third Speed (coast) - with car travelling 40 MPH at zero throttle, a noticeable retarding of car speed should be felt when selector is moved from DR-4 to DR-3 range. Tests overrun clutch.

Second Speed (coast) - with car travelling 40 MPH at zero throttle, a definite jar should be felt when selector is moved from DR-4 to Lo range. Tests overrun band.

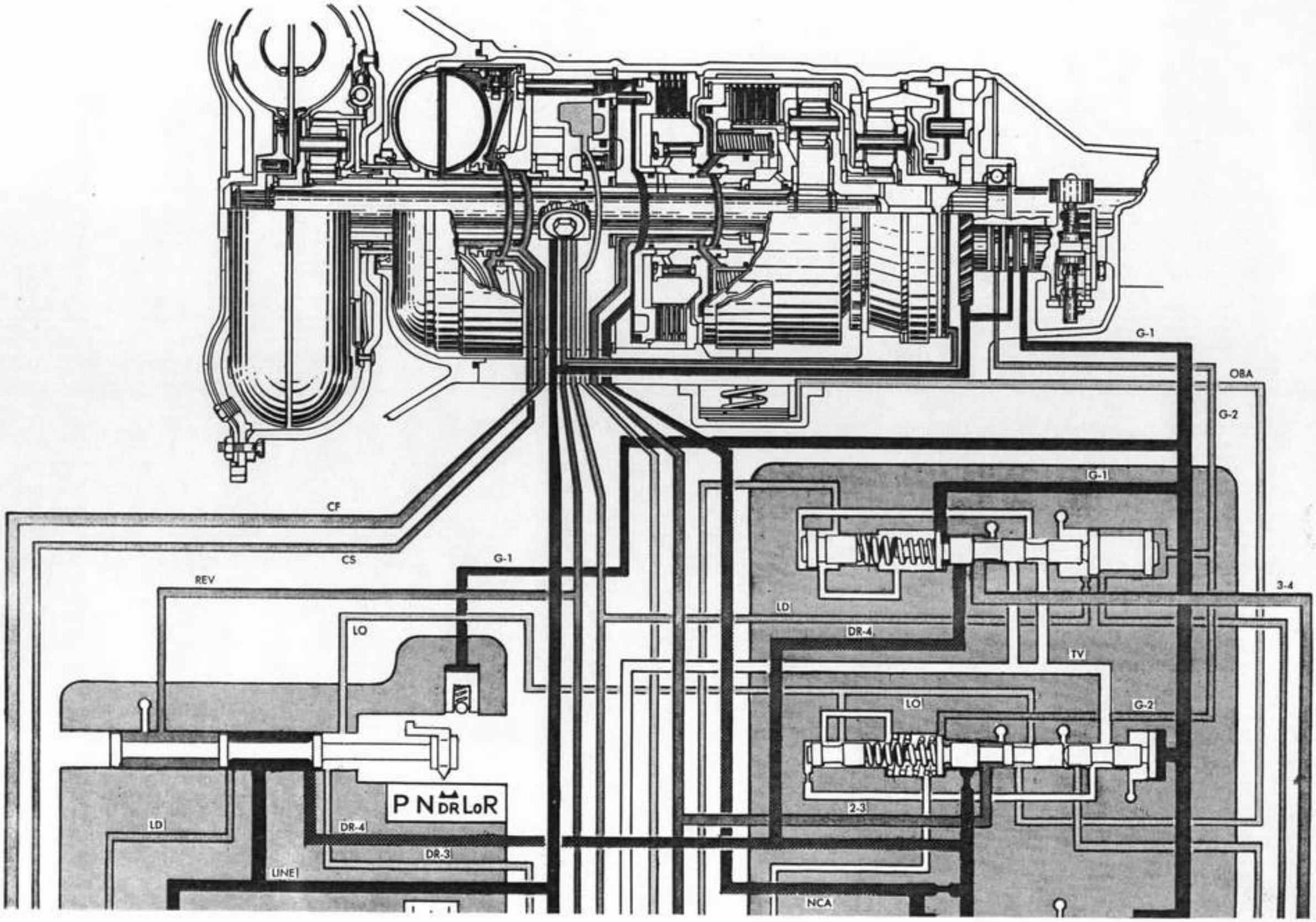
Neutral - with car standing in Neutral, there should be no tendency to move forward or backward when engine is speeded up. Tests disengagement of neutral and reverse cone clutches.

Engine Performance Test - made during First Speed Stall Test. If engine speed fails to reach 1550 RPM, an engine tune-up is indicated. If speed fails to reach 1200 RPM, transmission is probably in second speed.

Shift Speed Tests - made with portable tachometer connected, to establish exact moment that shifts occur. Use car speed limits for each shift as found in Shop Manual. If shifts occur at wrong speeds with throttle linkage correctly adjusted, valve body or governor trouble is indicated.



1956 CADILLAC HYDRA-MATIC OIL CIRCUITS


G-1
OBA
G-2
CF
CS
G-1
REV
LO
P N DR LoR
LD
DR-4
DR-3
LINE
G-1
LD
DR-4
3-4
TV
LO
G-2
2-3
NCA