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SERVICE TRAINING

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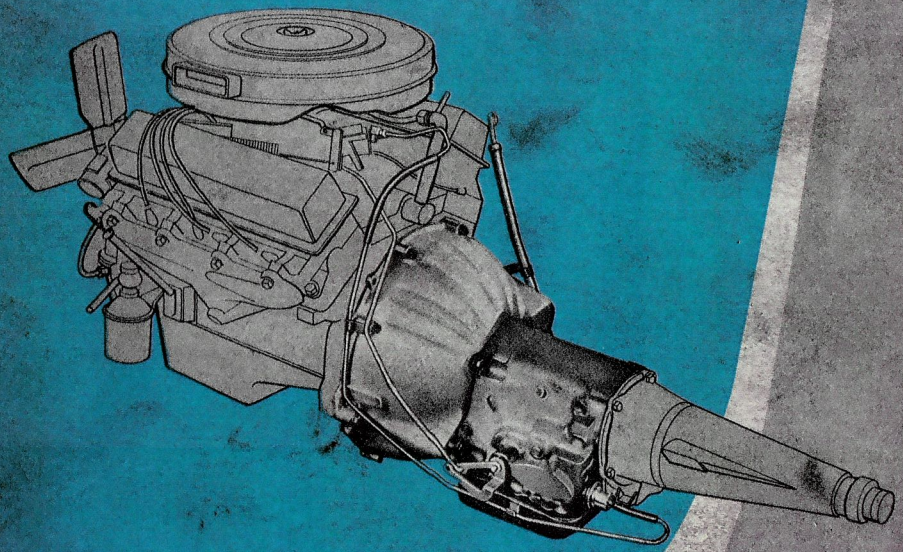
THE FORD

SERVICE TECHNICIAN



1961 FORD SERVICE FORUM • NO. 2

1961 FORD CAR CRUISE-O-MATIC SERVICE

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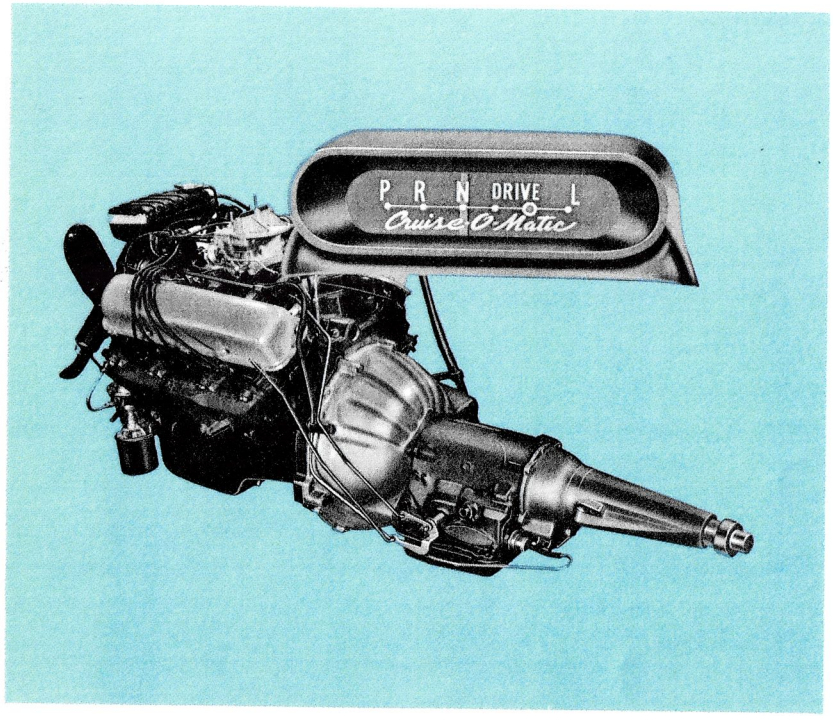
Introduction



This booklet contains complete service information for the Cruise-O-Matic transmission that is optional equipment on 1961 Ford Cars with either the 292, 352, or 390 V-8 engine.

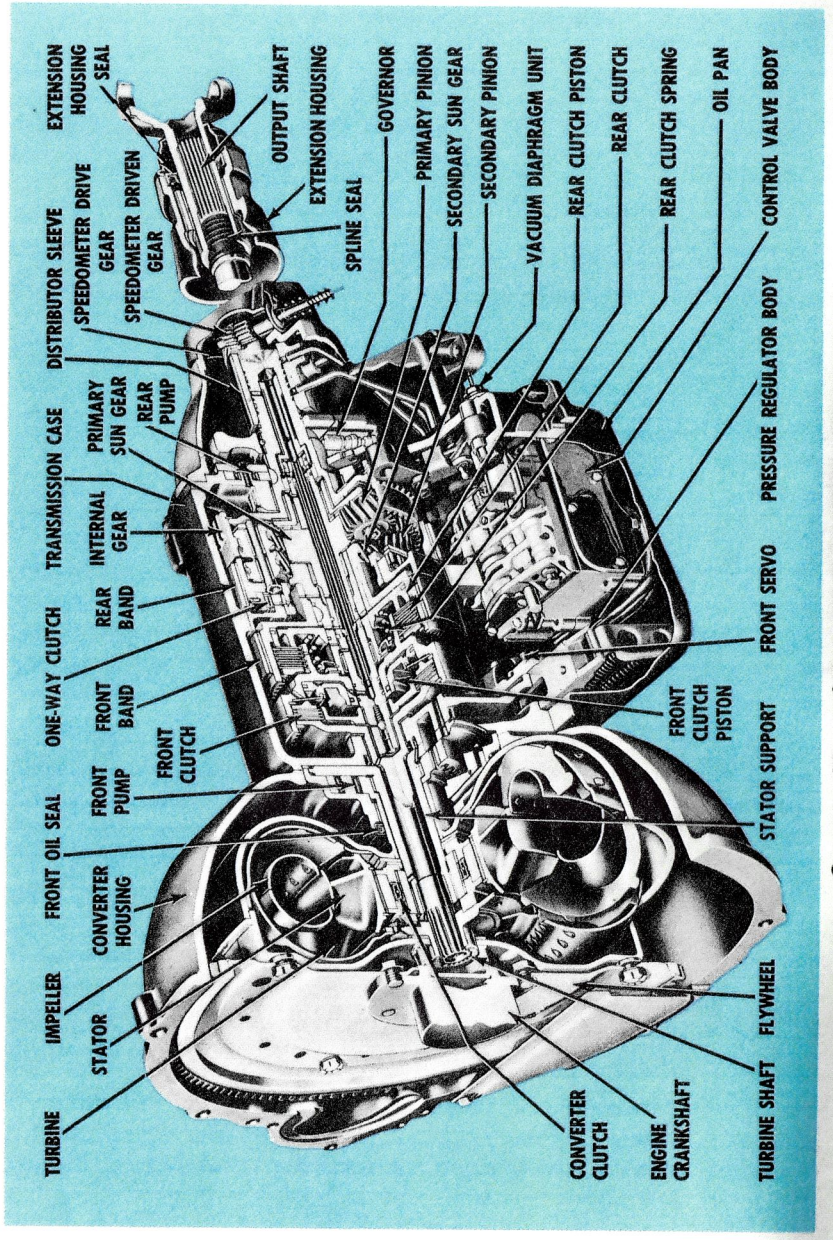
The Principles of Operation section explains the operation of each system of the transmission accompanied by cutaway drawings and flow diagrams.

All of the adjustment and maintenance procedures necessary for a smooth-operating transmission are detailed in the Adjustment and Maintenance sections.

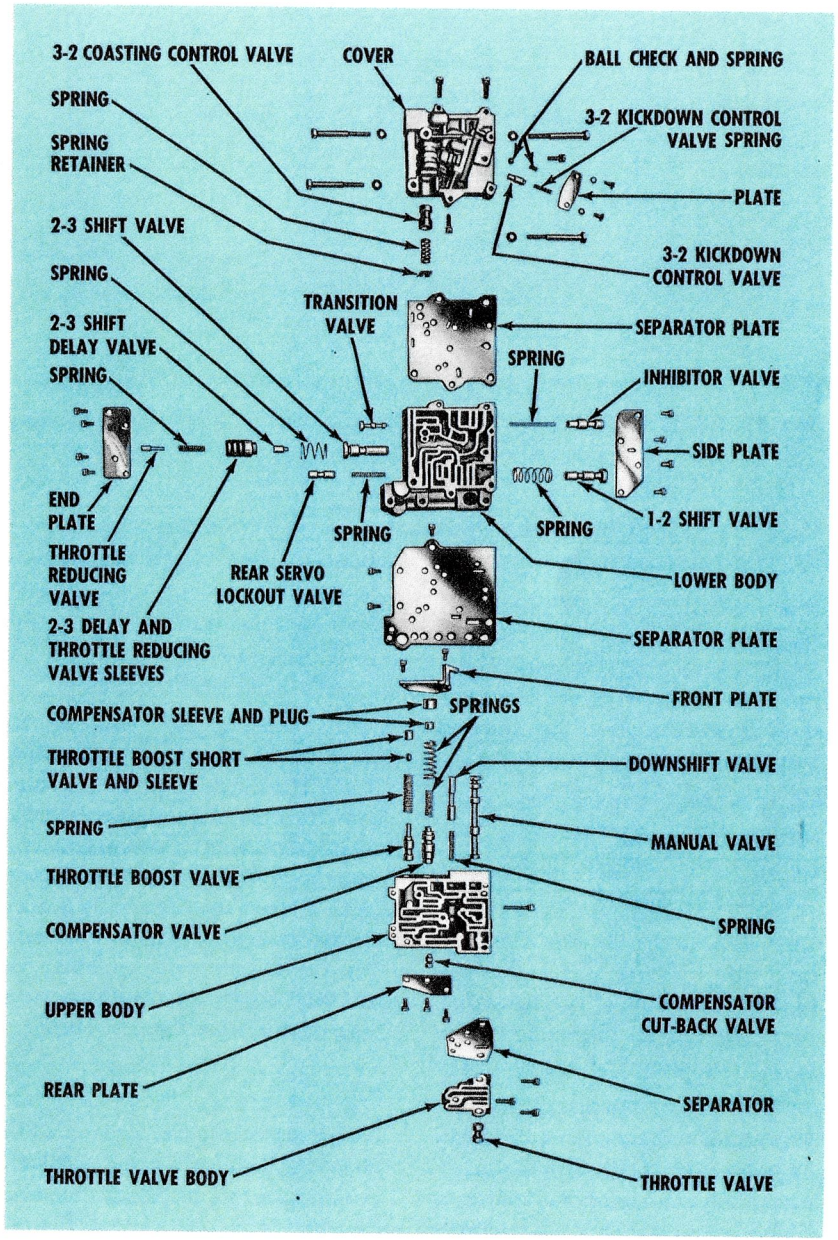
Trouble diagnosis procedures include all of the preliminary checks, pressure and vacuum checking methods, and performance checks for the various components of the 1961 Cruise-O-Matic.

The Service Guide lists the necessary specifications needed to perform efficient Cruise-O-Matic Transmission service.

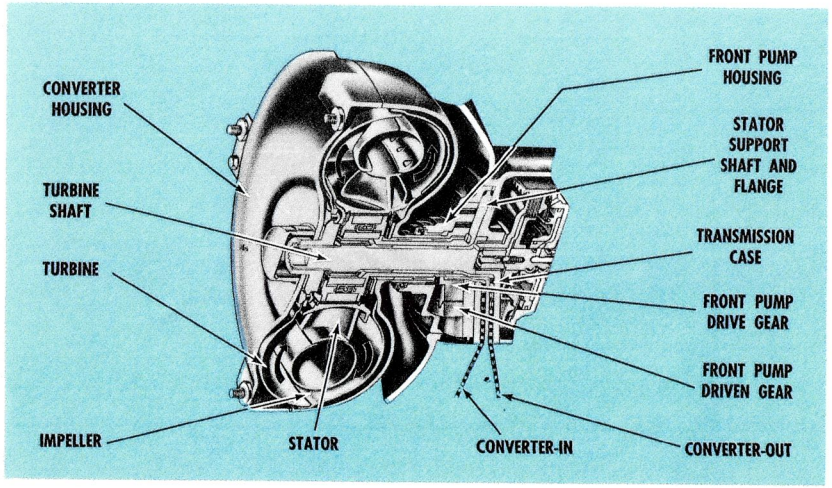
By following the instructions in this booklet, Service Technicians will be able to rapidly diagnose and remedy troubles that may occur.



Cutaway View of Cruise-O-Matic Transmission



Disassembled View of Control Valve Body



TORQUE CONVERTER

The hydraulic torque converter assembly is made up of an *impeller,* a *turbine,* and a *stator.* These three major elements are enclosed in a fluid-filled housing that is bolted to the engine fly-wheel.

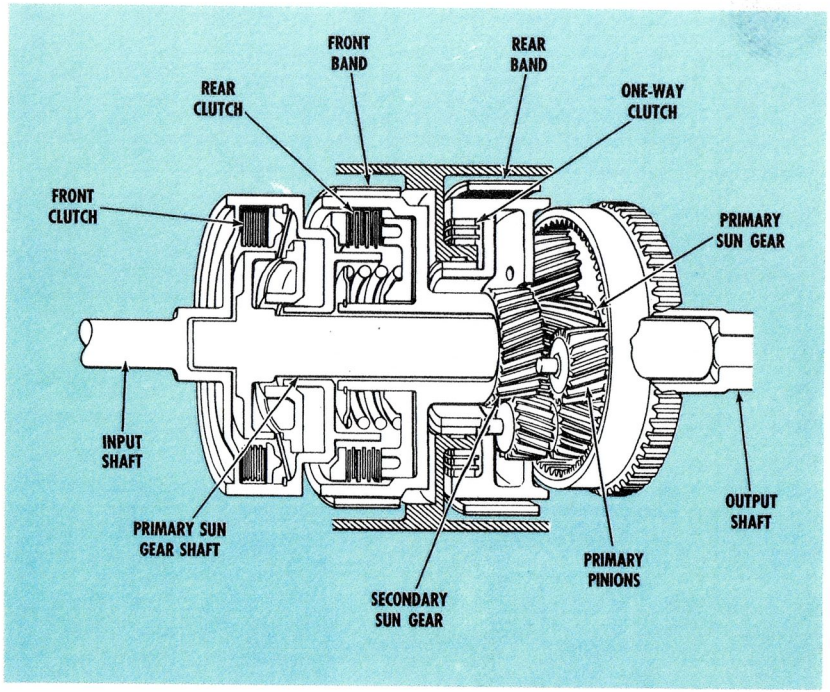
The *impeller,* or driving member, consists of curved vanes placed radially and welded within the converter housing.

The *turbine,* or driven member, faces the impeller and is splined to the input shaft of the transmission. There is no mechanical connection between the impeller and the turbine.

The *stator* is located between the impeller and the turbine, and is mounted on a stationary support which is an integral part of the front oil pump. The stator has a one-way roller clutch that permits it to turn only in the same direction as the impeller. The clutch locks the stator to the support to prevent a reversal of rotation.

When the engine is running, the fluid in the torque converter flows from the impeller to the turbine, and back to the impeller through the stator. This flow produces a maximum torque increase of about 2 to 1 when the turbine is stalled. When enough torque is developed by the engine and impeller, the turbine begins to rotate, turning the transmission input shaft.

The converter torque increase tapers off as turbine speed approaches impeller speed, and it becomes 1 to 1 when the turbine is being driven at 9/10 impeller speed.



PLANETARY GEAR TRAIN

The planetary gear system used in the Cruise-O-Matic transmission provides three forward gear ratios and one speed in reverse. Control of the gear train depends upon the application of the bands and clutches to hold or drive the various gears. Control of the bands and clutches is governed by throttle pressure and positioning of manual linkage.

The gear train consists of a primary sun gear, a secondary sun gear, three primary and three secondary pinions held in a common carrier, and an internal planet gear which is integral with the transmission output shaft.

FRONT CLUTCH

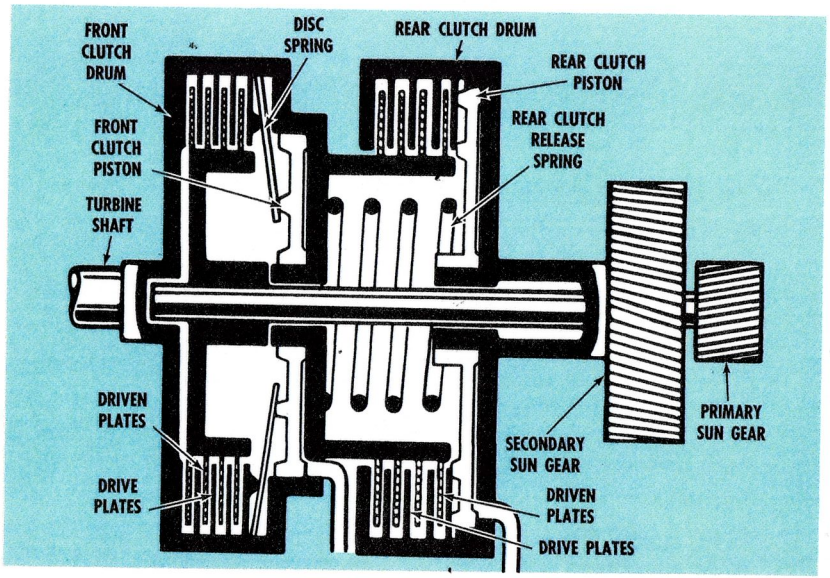
The front clutch assembly includes the clutch drum, a piston, three steel drive plates, four bronze driven plates, and a release spring. The drive plates are internally splined to engage the turbine (input) shaft. The driven plates are externally splined to engage the primary sun gear shaft through the clutch drum.

Principles of Operation

Front Clutch (Cont.)

The front clutch is hydraulically operated. Fluid pressure is applied at the rear of the clutch piston which moves the piston forward to lock the multiple disc clutch.

Whenever the clutch is applied, the primary sun gear is locked to the turbine shaft. The primary sun gear is driven in the direction of crankshaft rotation in all forward speeds.



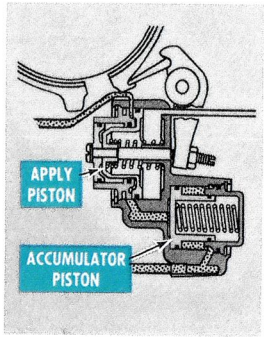
REAR CLUTCH

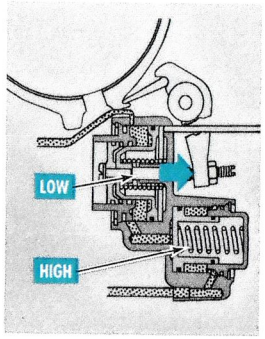
The rear clutch is hydraulically operated in the same manner as the front clutch. Movement of the piston compresses the release spring and locks the multiple disc clutch. The clutch drive plates are internally splined to the front clutch drum and the driven plates are externally splined to engage the secondary sun gear through the rear clutch drum. When the rear clutch is applied (in the reverse and third gear ratios) the secondary sun gear is driven in the direction of crankshaft rotation.

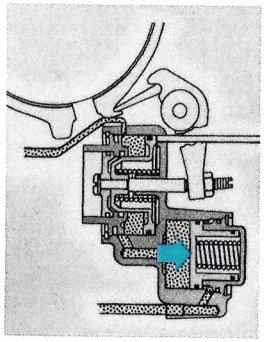
BANDS

The front and rear bands are made of steel and have composition linings bonded to the inside surfaces. The front band encircles the rear clutch drum. When the band is applied, by action of the front servo, the secondary sun gear is prevented from turning.

The rear band encircles the pinion carrier. When the band is applied, the pinion carrier is held stationary.



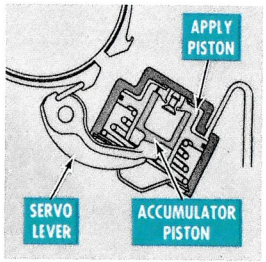


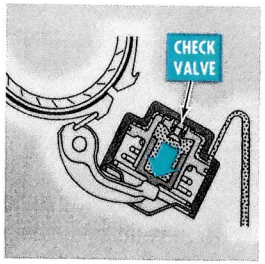


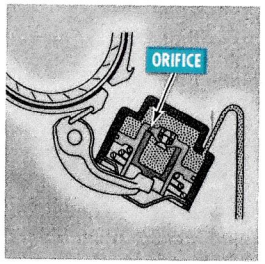
FRONT SERVO

The front servo piston is moved by fluid pressure which exerts force against the inner end of the servo actuating lever to tighten the front band around the rear clutch drum. The accumulator piston operates to delay the apply piston to cushion band application.

Control pressure in the servo housing works on the apply piston and the accumulator piston at the same time. Initial resistance at the apply piston is low, so it moves to tighten the band on the drum. Initial resistance at the accumulator piston is high, so it does not move.







REAR SERVO

The fast-acting rear servo decreases the time lag during low and reverse application for smoother shifting.

The accumulator, or fast-acting, piston is in direct contact with the servo lever, and is installed in the apply piston.

At a very low apply pressure and a small volume of flow, the accumulator piston, which is in direct contact with the apply piston, rapidly moves out to tighten the band on the pinion carrier.

Principles of Operation

FLUID PRESSURES

Several fluid pressures which vary with throttle opening, road speed, or manual selector position, are used in the Cruise-O-Matic control system.

Pressure Source

Two pumps deliver fluid to the control system. The front pump, driven by the torque converter impeller, operates whenever the engine runs. The rear pump, driven by the transmission output shaft, delivers fluid to the control system only when the car is in forward motion.

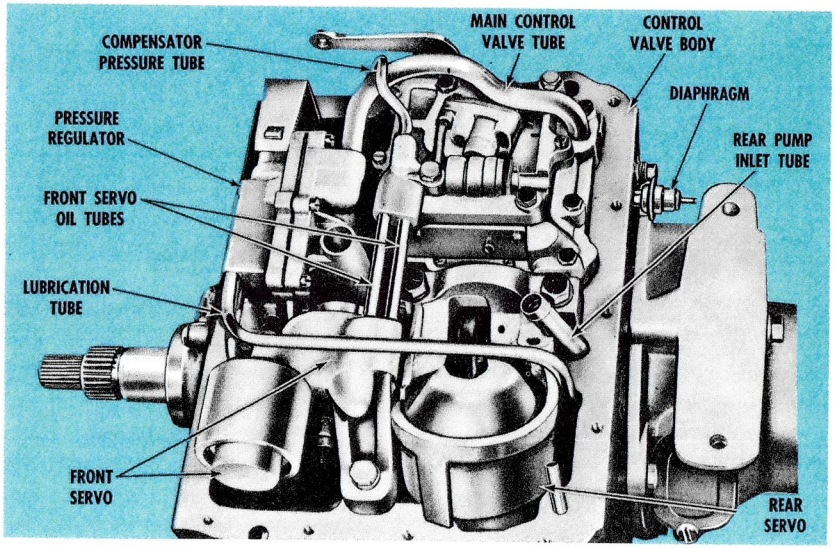
Throttle Pressure

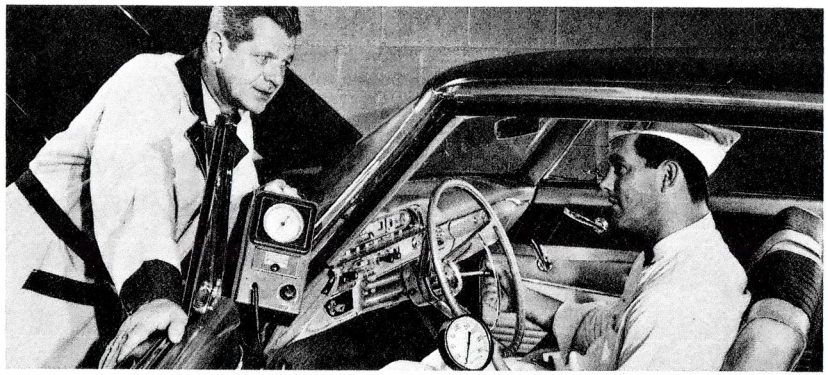
To adjust transmission operation to engine torque, throttle pressure is used in the control system. This pressure is produced from control pressure by the throttle valve, and is controlled by a spring-loaded, vacuum-operated diaphragm unit mounted in the transmission case.

Control Pressure and Compensator Pressure

Control pressure is regulated by the spring-loaded control pressure regulator valve, and is adjusted by compensator pressure.

In the P, R, and L selector lever positions, the compensator valve is locked-out by rear servo apply pressure. In these positions, control pressure is regulated entirely by the regulator valve spring, and control pressure is at its maximum.





Converter Pressure

Like control pressure, converter pressure is regulated by the converter pressure regulator valve spring. The pressure is adjusted to driving conditions by compensator pressure and selector lever positions.

Throttle Boost Pressure

To compensate for slight manifold vacuum changes with accelerator movements that result in 50° or greater carburetor throttle plate opening, a throttle pressure boost valve is used.

At 50° carburetor throttle plate opening, pressure at the transmission throttle valve will be about 51 psi to bring the spring-loaded boost valve into balance. Pressure below 51 psi will flow through the boost valve without interference. Pressure above 51 psi will actuate the boost valve to cut off throttle pressure flow to the shift valves and coasting control valve, and then a passage in the valve body will permit the new boosted throttle pressure to flow to the shift valves and the coasting control valve.

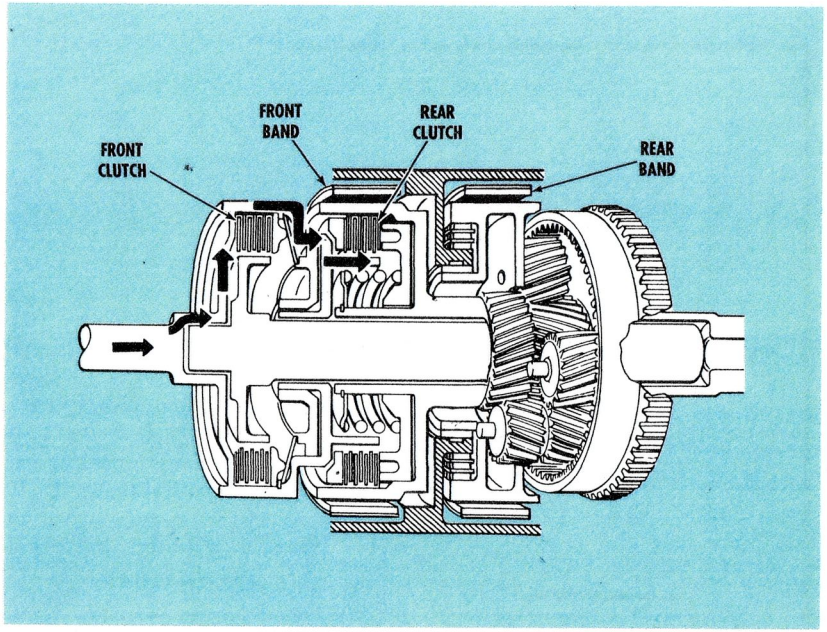
Shift Valve Plug Pressure

Before throttle pressure is admitted to the front face of the 2-3 shift valve, it must open a passage past the spring-loaded shift valve plug. Approximately 20 psi throttle pressure is required to move the plug against its spring far enough to open the passage, therefore the pressure past the plug is reduced.

Governor Pressure

Governor pressure is produced from control pressure by the governor valve operating in the governor body. The governor body rotates at output shaft speed. Governor pressure is proportional to road speed.

POWER FLOW IN NEUTRAL



When the transmission selector lever is in the neutral position, all bands and clutches are released and no power is transmitted to the output shaft.

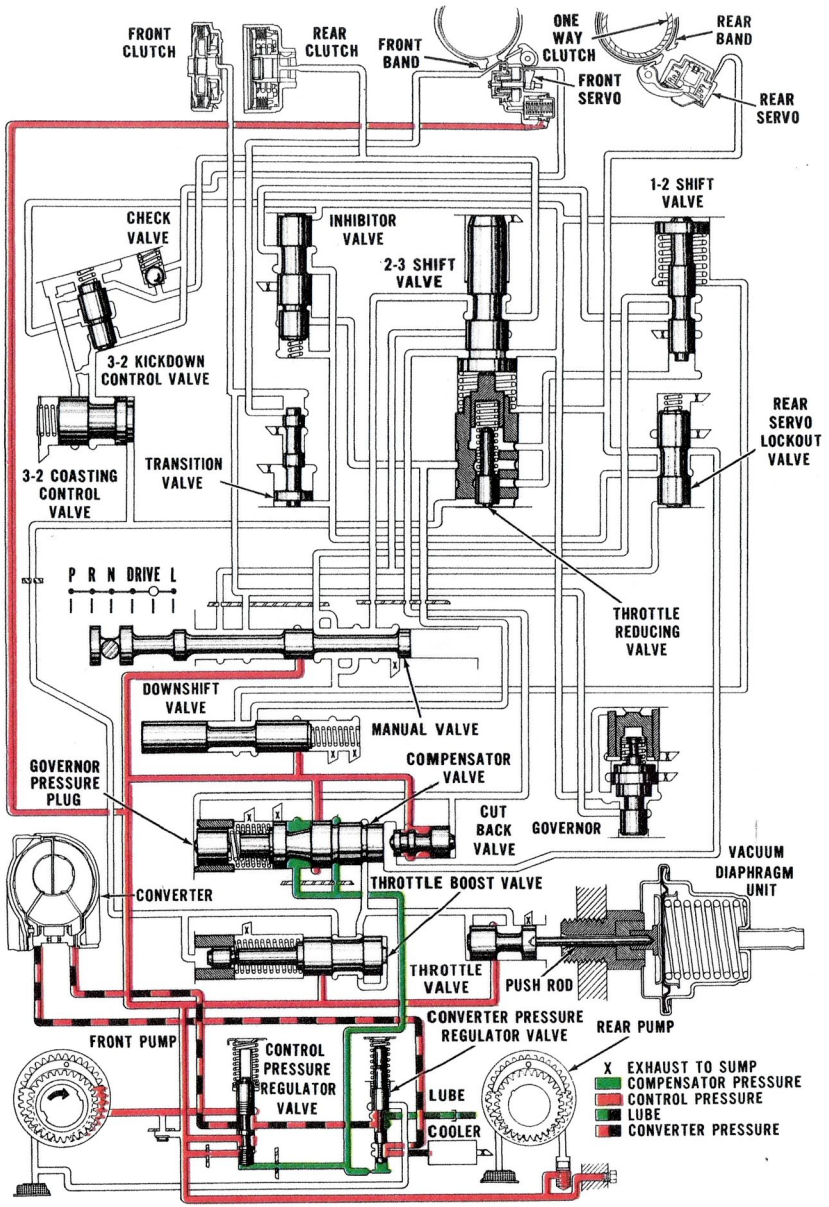
Gear roll-over is prevented by the one-way clutch between the pinion carrier and the center support.

HYDRAULIC OPERATION IN NEUTRAL

With the engine running at idle and the car standing still, the front pump supplies fluid pressure for the hydraulic system.

The schematic diagram on the facing page shows that the control pressure has been built up to its proper value, the converter has been charged, the transmission lubrication system has been filled, and oil is flowing through the cooling system.

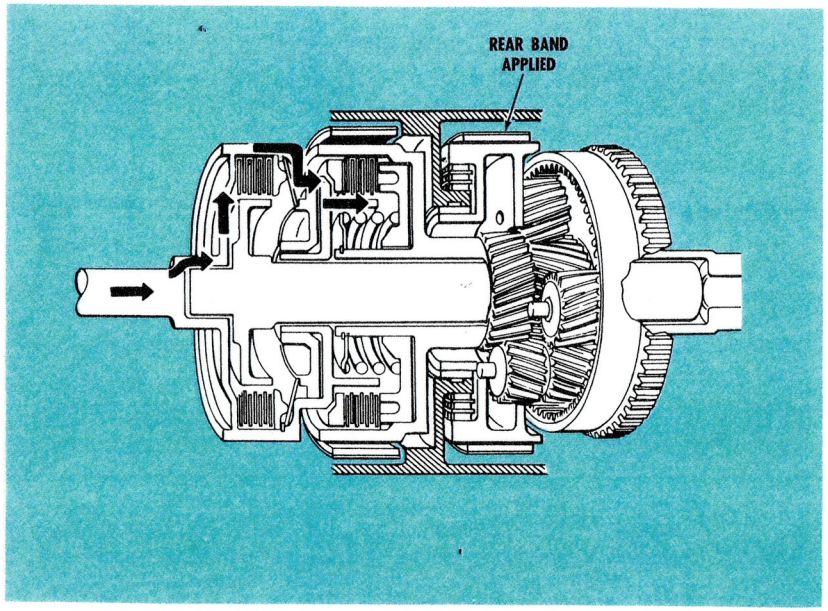
In neutral position, the manual valve blocks the fluid flow to both clutches and both servos. With no fluid pressure in the clutches or servos, both are released by spring pressure.



Hydraulic Control System in Neutral

POWER FLOW IN PARK

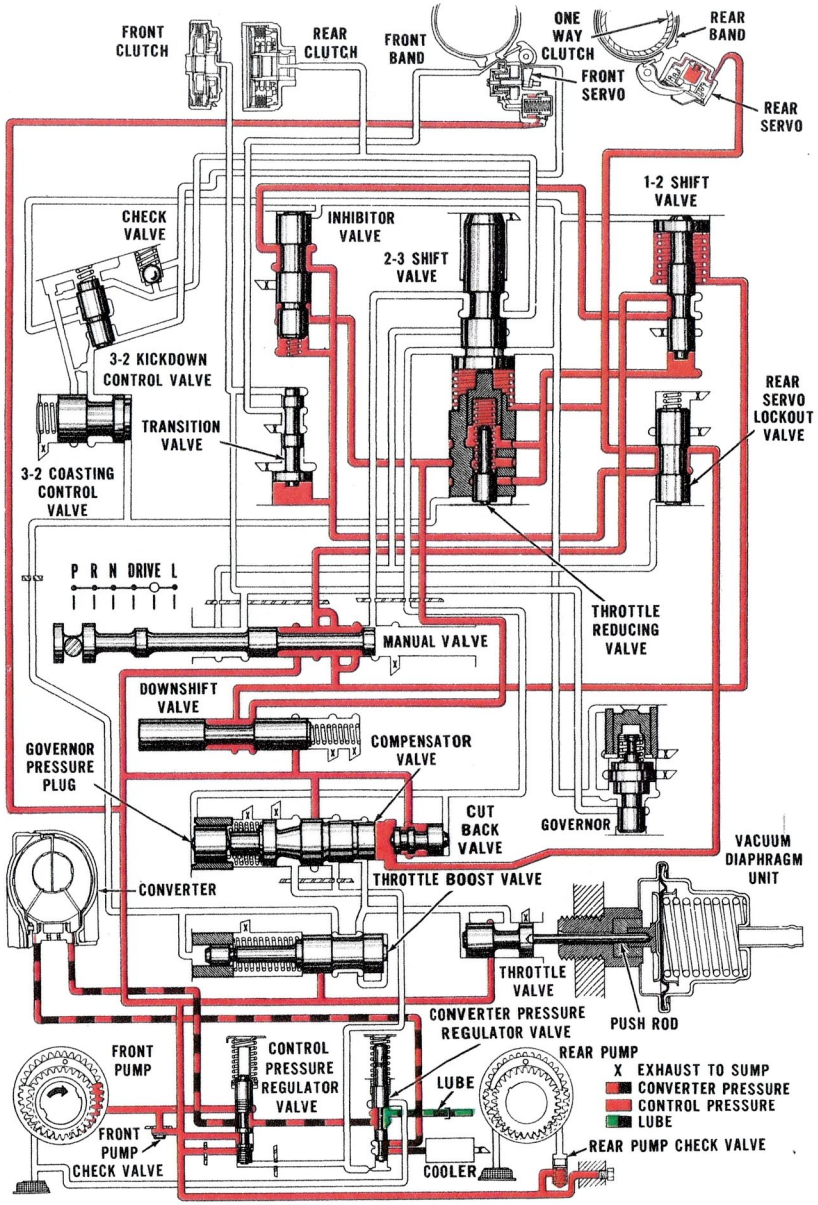
When the selector lever is in the park position, the parking pawl mechanically locks the internal gear to the transmission case, and all gear action within the transmission is positively stopped. This also locks the drive shaft to prevent movement of the rear wheels.



HYDRAULIC OPERATION IN PARK

With the engine running and the transmission selector lever in the park position, the manual valve directs control pressure to apply the rear band. With the rear band applied, the planet carrier is held stationary to prevent roll-over of the planetary gears.

Within the control valve body, the shift valves and the inhibitor valve are held in their "rest" positions. The transition valve is raised to prevent application of the front band. The compensator valve is locked-out, and control pressure is regulated entirely by the control pressure regulator valve and its spring to provide a control pressure range the same as for reverse and low range operation.



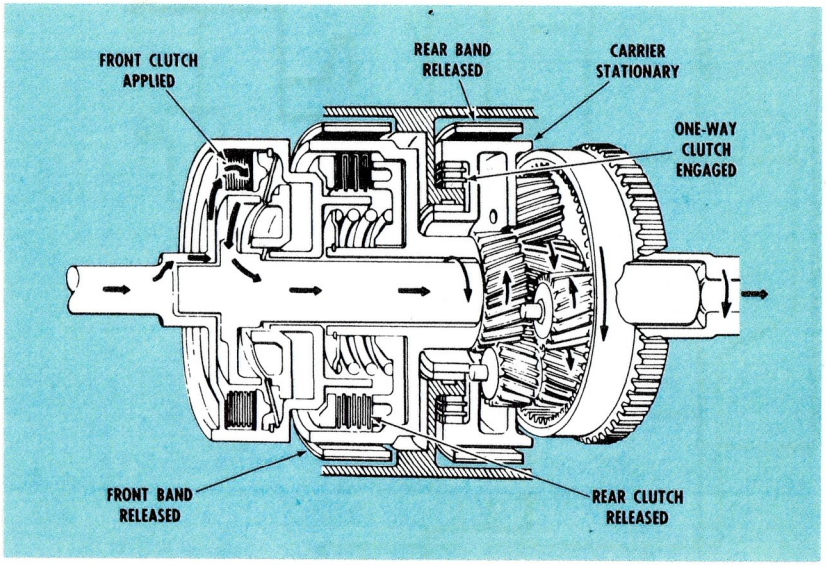
Hydraulic Control System in Park

Principles of Operation

When the transmission selector pointer is at the green dot in the DRIVE range, the car will always start in first gear. At light throttle, the car will shift to second gear at about 12 miles per hour, and to third gear at about 18 miles per hour. During a coast stop, a downshift from third to first will occur at about four miles per hour.

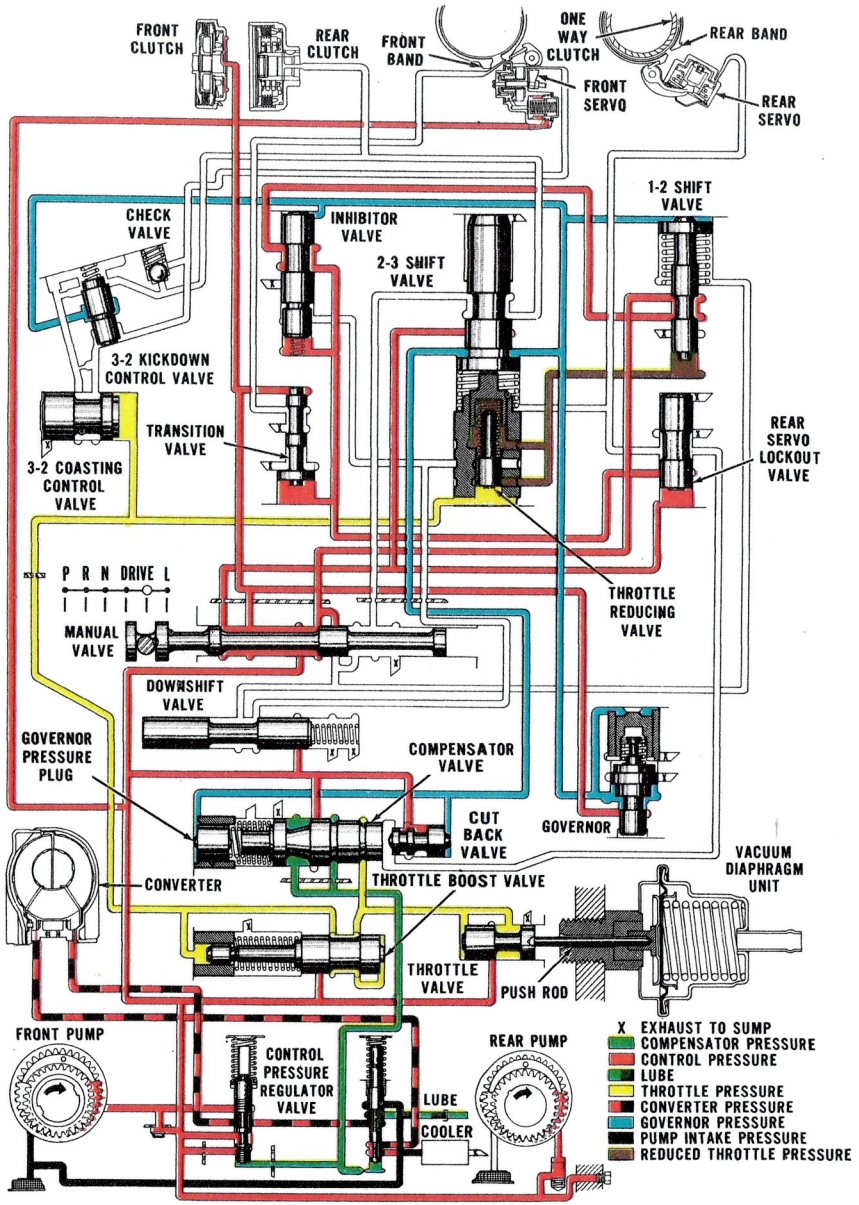
POWER FLOW IN DRIVE RANGE FIRST GEAR

The front clutch is applied and the one-way clutch rather than the rear band is holding the pinion carrier. First gear in the drive range is the only gear that uses the one-way clutch.



HYDRAULIC OPERATION IN DRIVE RANGE FIRST GEAR

When the manual valve is in drive range first gear, it opens three passages to control pressure. The first passage admits control pressure to supply the 2-3 shift valve and closes the rear servo lock-out valve. The second passage admits control pressure to apply the front clutch and supply the governor and transition valve. The third passage admits control pressure to flow through the 1-2 shift valve, the inhibitor valve, and it closes the transition valve.

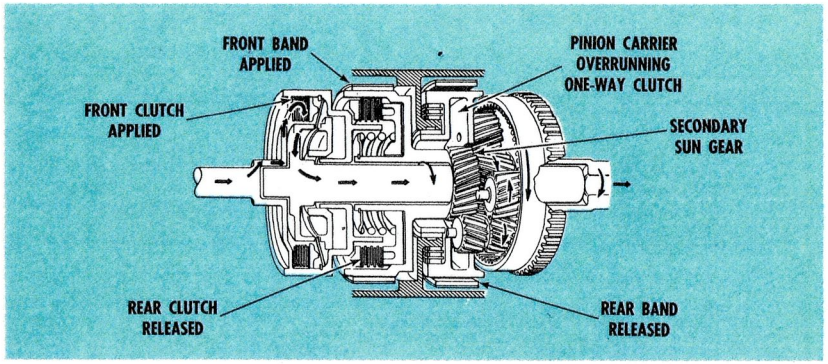


Hydraulic Control System in Drive Range First Gear

POWER FLOW IN DRIVE RANGE SECOND GEAR

In second gear, the front clutch and front band are applied. The power flow through the transmission is identical for either drive range selection.

Second gear ratio is obtained by driving the primary sun gear and holding the secondary sun gear. The primary pinions drive the secondary pinions, causing them to "walk" around the secondary sun gear and to carry the internal gear and output shaft around with them.



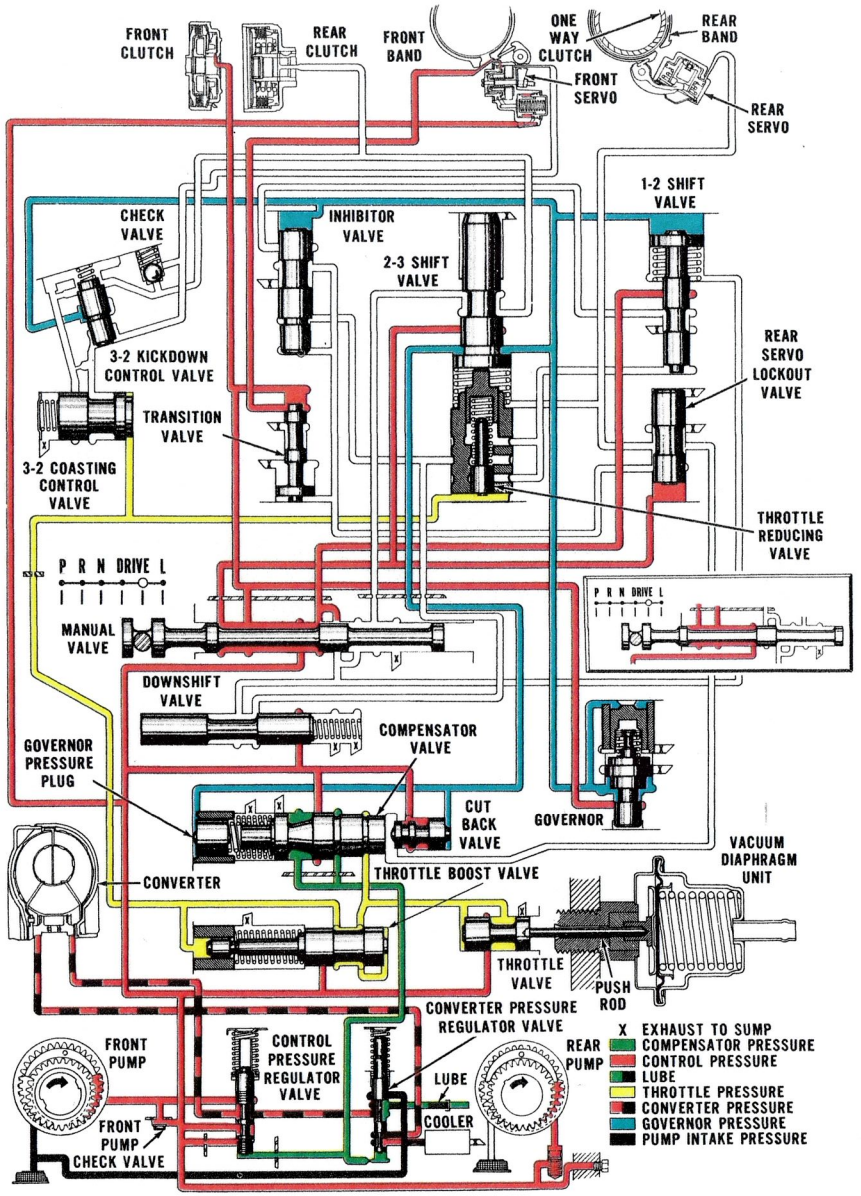
HYDRAULIC OPERATION IN DRIVE RANGE SECOND GEAR

When the transmission selector pointer is at the green dot in the DRIVE range, the car will start out in first gear and the 1-2 shift occurs when governor pressure force on the 1-2 shift valve overcomes shift plug pressure and spring forces. The 1-2 shift valve moves inward, exhausting the fluid which holds the transition valve closed. The transition valve opens and admits control pressure to apply the front band.

The front clutch remains on, and the front band applies to put the transmission in second gear.

When the selector lever pointer is positioned at the mark to the left of the green dot on the dial, control pressure to the 1-2 shift valve is cut off and control pressure flows through the transition valve to apply the front band.

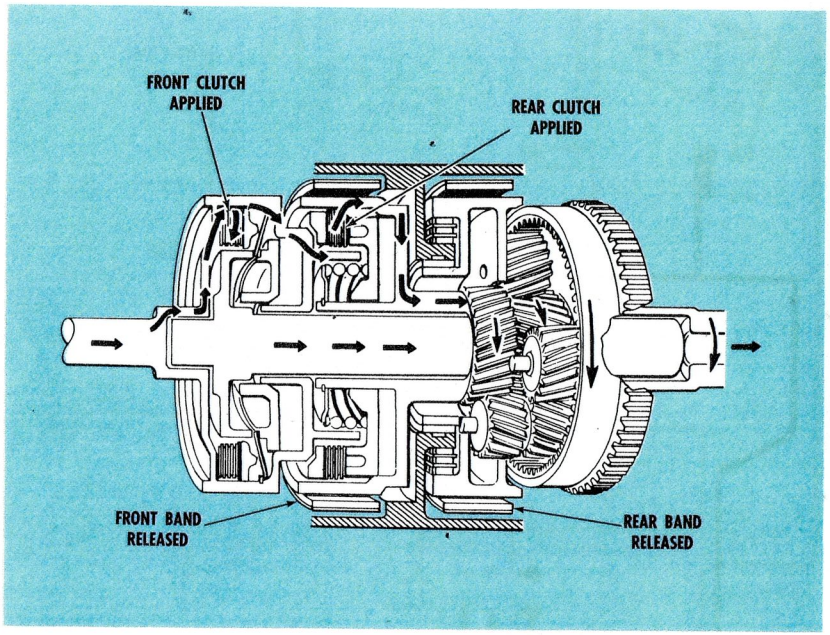
With the front band and the front clutch applied, the transmission operates in second gear.



Hydraulic Control System in Drive Range Second Gear

POWER FLOW IN DRIVE RANGE THIRD GEAR

In third gear, the primary and secondary sun gears are locked together and driven as a unit. The pinions cannot rotate, therefore the entire planetary train revolves as a unit to turn the output shaft at the same speed as the turbine shaft.

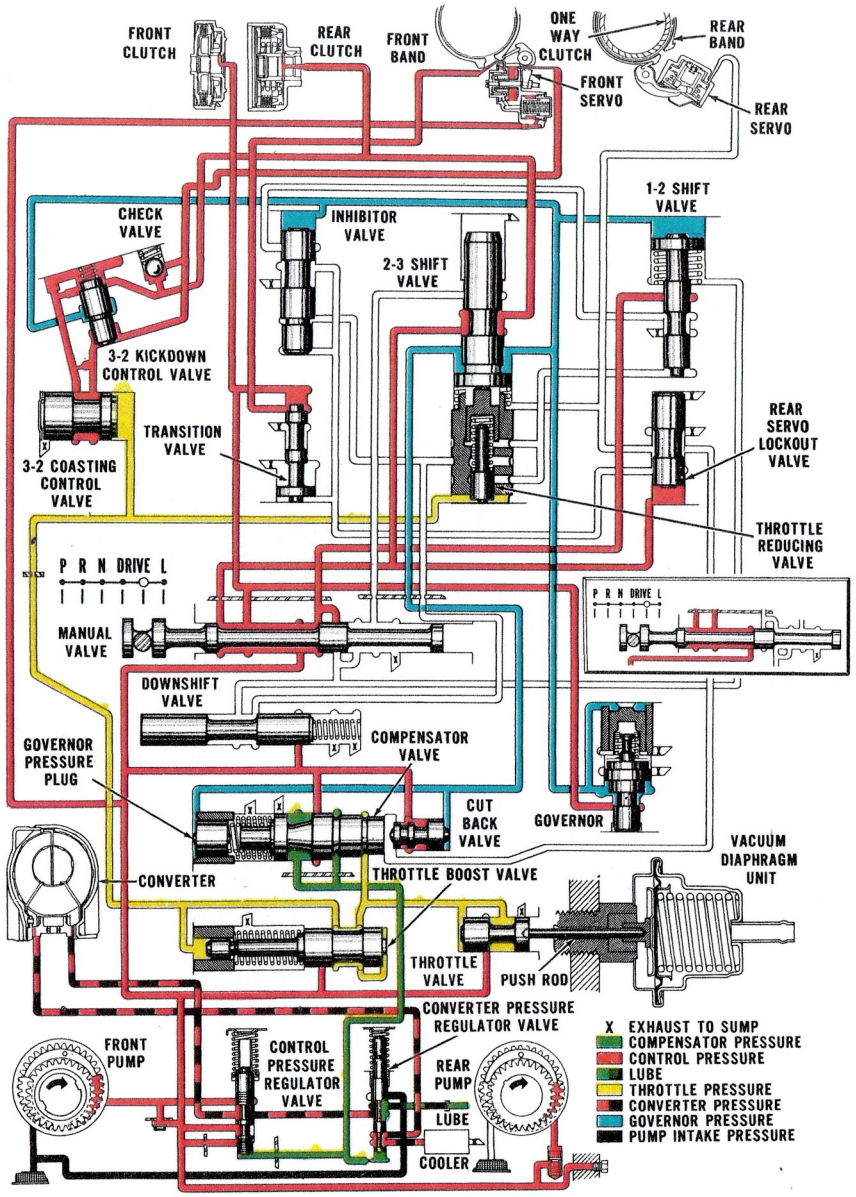


HYDRAULIC OPERATION IN DRIVE RANGE THIRD GEAR

The 2-3 shift occurs when governor pressure force overcomes spring and shift plug pressure force at the 2-3 shift valve. When the shift valve opens, control pressure flows through it to apply the rear clutch and release the front band. With both clutches applied, the transmission is in third gear.

When the transmission selector pointer is at the green dot in DRIVE range, the closed throttle downshift is from third to first.

When the pointer is positioned at the mark to the left of the green dot, the closed throttle downshift is from third to second.

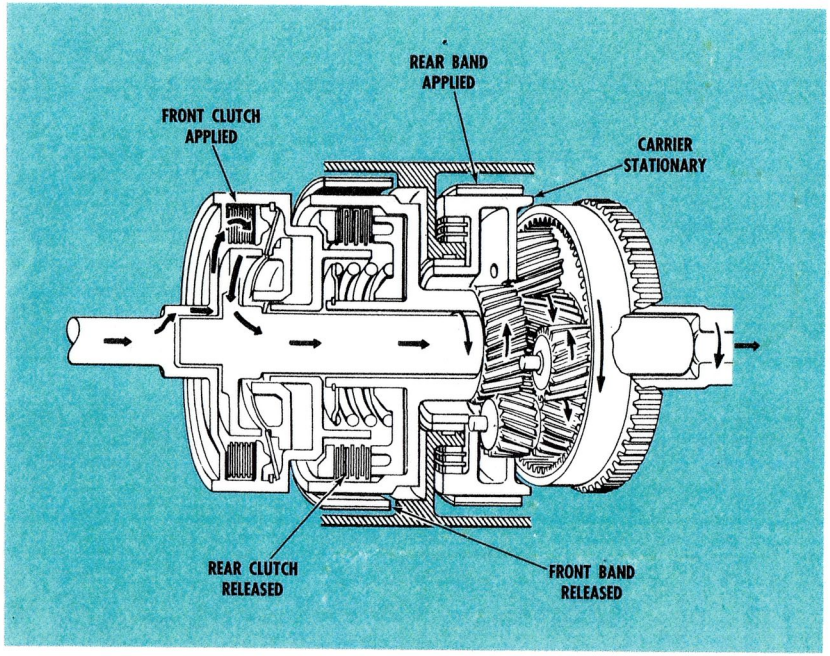


Hydraulic Control System in Drive Range Third Gear

POWER FLOW IN LOW RANGE

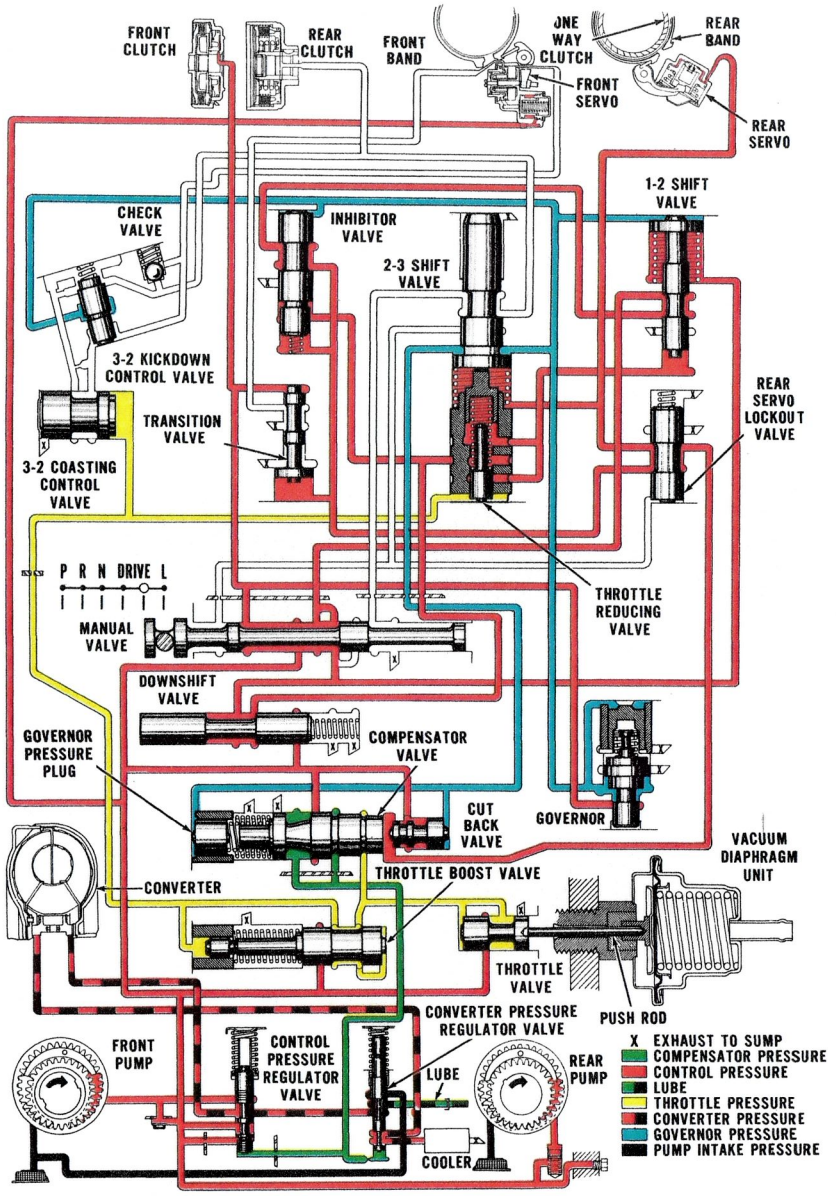
When the transmission selector lever pointer is positioned at L on the dial, the transmission will stay in first gear regardless of throttle position or road speed.

In the low range first gear operation, the front clutch and rear band are applied. By using the rear band, rather than the one way clutch as in the drive range first gear, the transmission can transmit drive from the engine to the rear wheels or from the rear wheels to the engine.



HYDRAULIC OPERATION IN LOW RANGE

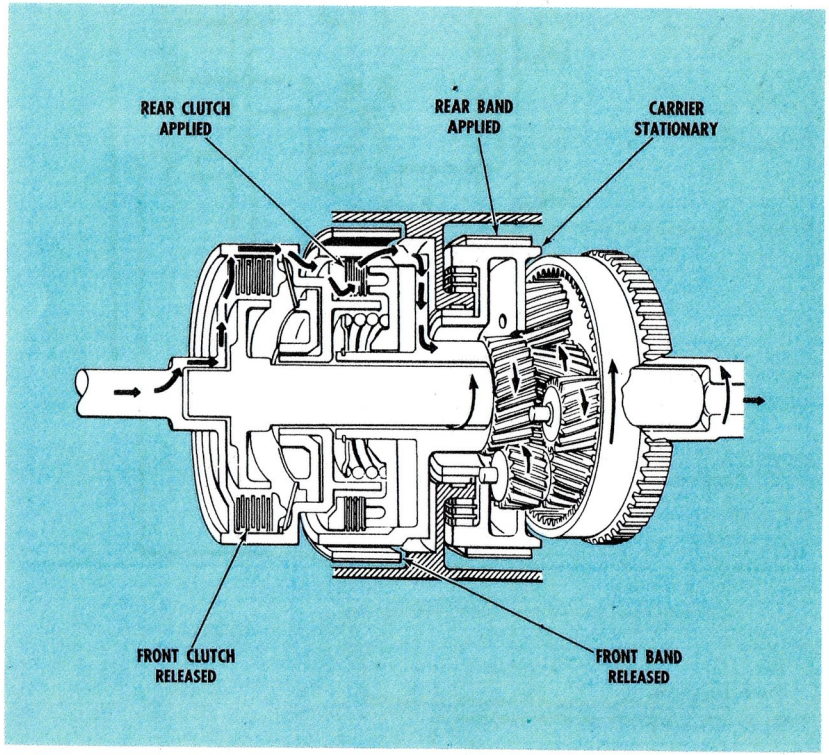
Control pressure is directed by the manual valve to apply the front clutch and rear band. Control pressure is also directed by the manual valve to lock the 1-2 and 2-3 shift valves and the inhibitor valve in their "rest" positions. Since neither shift valve can move, the transmission will stay in first gear.



Hydraulic Control System in Low Range

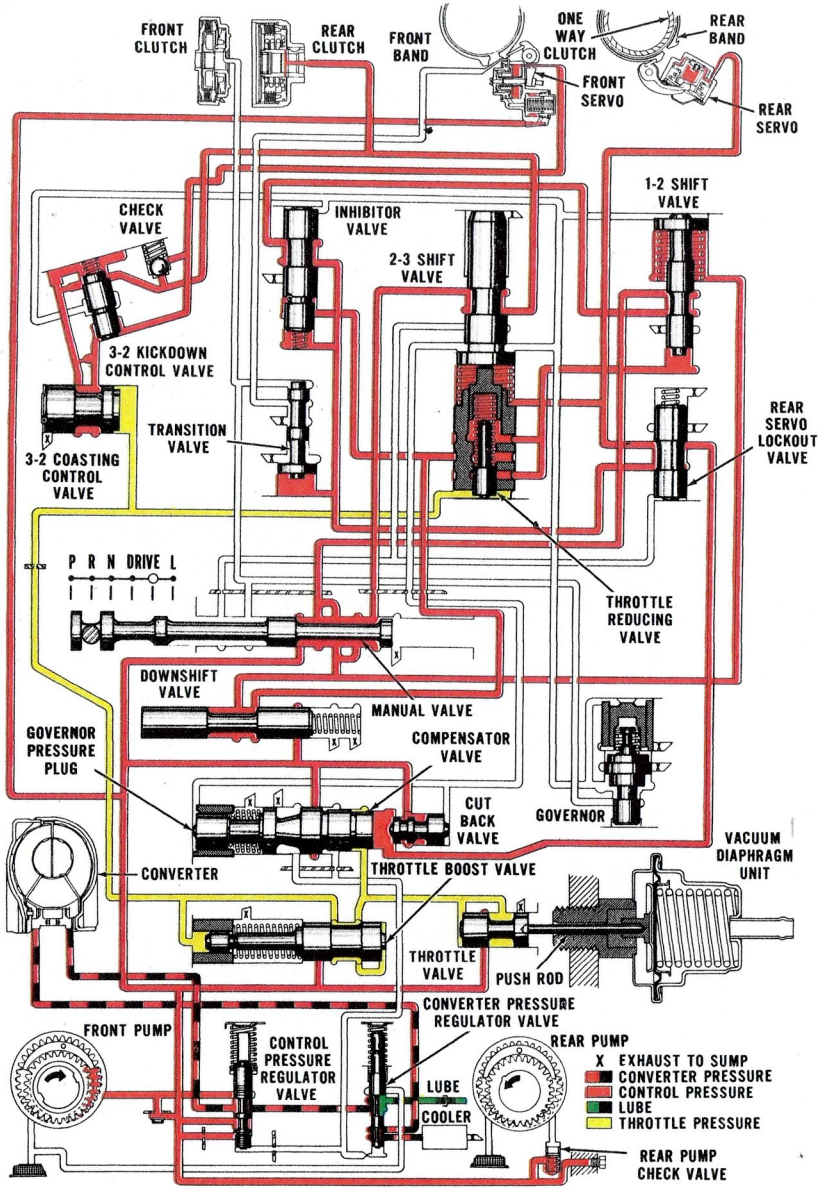
POWER FLOW IN REVERSE

In reverse, the rear clutch and the rear band are applied. Power flows through the turbine shaft, the front clutch housing, and through the turbine shaft, the front clutch housing, and through the rear clutch to the secondary sun gear and the secondary pinions. The pinion carrier is held by the rear band, and the secondary pinions drive the internal gear in a counter-clockwise rotation.



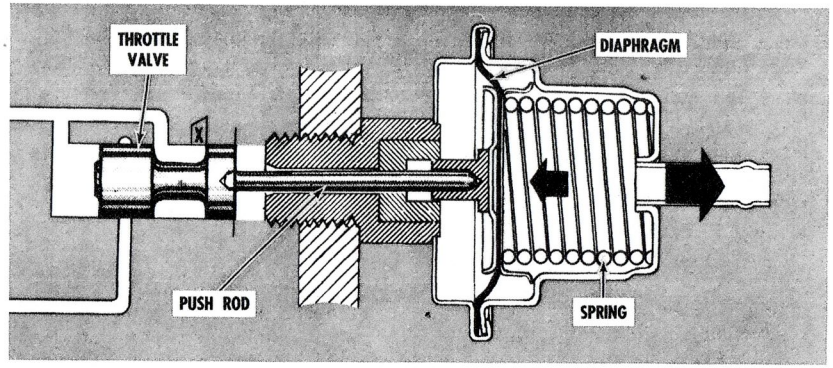
HYDRAULIC OPERATION IN REVERSE

With the manual valve in reverse, control pressure is directed to apply the rear clutch and the rear band. Governor supply pressure is cut off by the manual valve and the transmission will not shift.



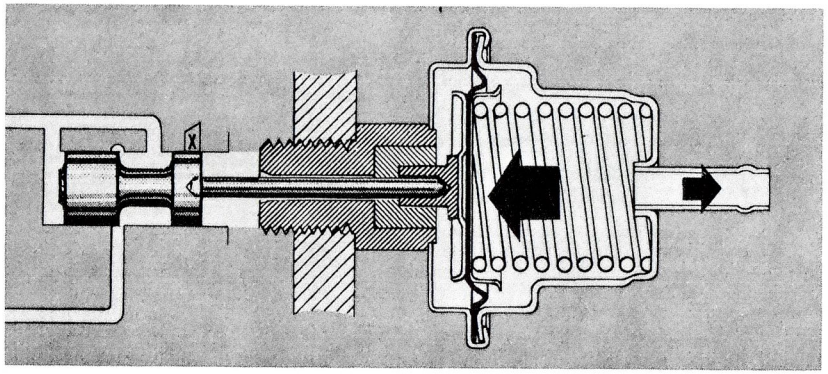
Hydraulic Control System in Reverse

VACUUM CONTROL

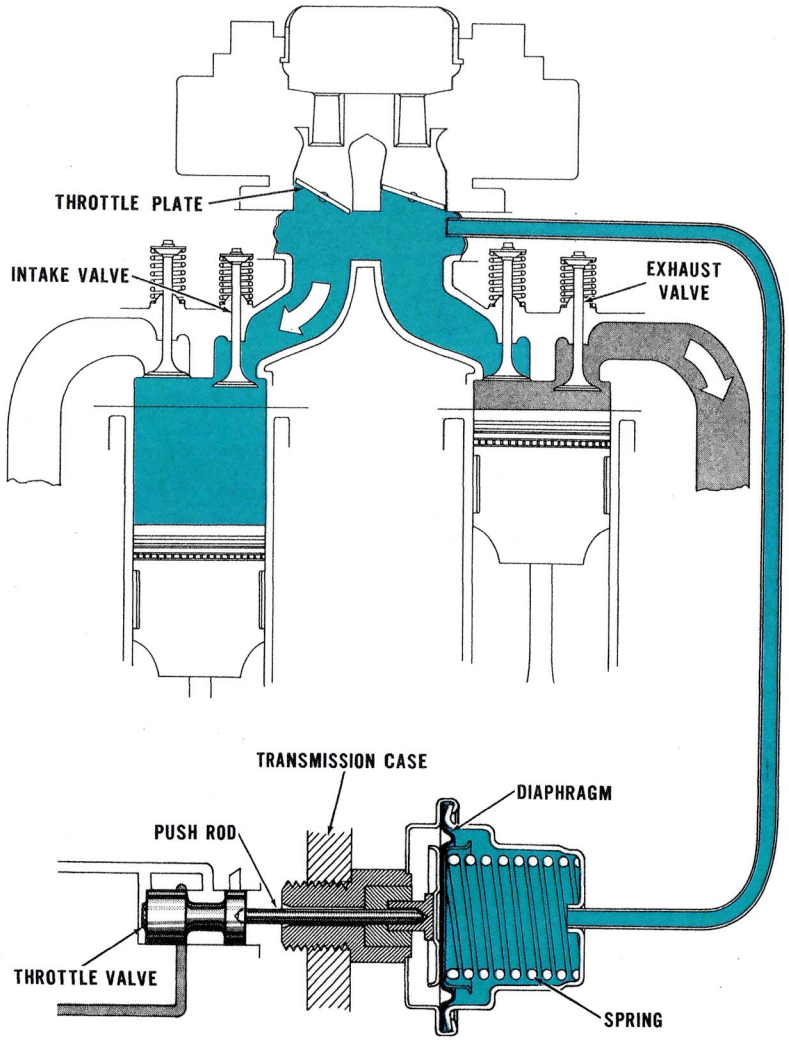


The vacuum side of the diaphragm valve is connected to the engine intake manifold. Movement of the diaphragm in response to changes in manifold vacuum is transmitted to the throttle valve by a push rod from the diaphragm.

When intake manifold vacuum is higher than about 15 inches, the suction on the diaphragm is greater than the force of the diaphragm spring, and the diaphragm is pulled away from the push rod to close the throttle valve. In this higher manifold vacuum range there will be no throttle pressure in the transmission.



As engine speed is increased, manifold vacuum is reduced, and the diaphragm will move against the push rod to open the throttle valve and increase the throttle pressure.

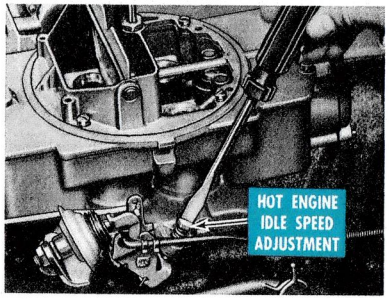


Diaphragm Unit Operation

IDLE SPEED

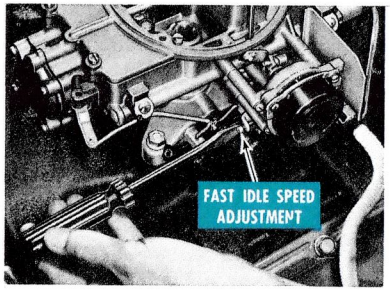
The hot engine idle speed must be adjusted first, before the fast idle adjustment can be made. The engine must be at normal operating temperature for both adjustments. Use a tachometer when making the idle speed adjustments.

Hot Engine Idle Speed



Set the parking brake, then start the engine and position the transmission selector lever in the drive range. Adjust the idle speed to 450-475 rpm.

Fast Idle Speed

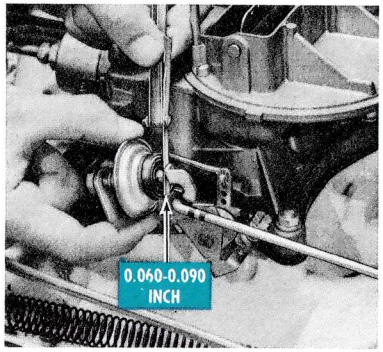


Adjust the hot engine idle speed to the specified rpm before setting the fast idle speed.

Turn the fast idle speed stop screw IN until it just touches the lowest step of the fast idle cam, then back the screw OUT 1/4 to 1/2 turn.

Do not back the screw out more than ½ additional turn when the normal setting of the fast idle speed may seem unnecessarily high.

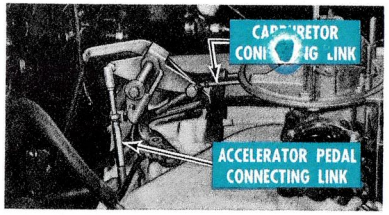
ANTI-STALL DASHPOT



With the hot engine idle and fast idle speed properly adjusted, and with the engine stopped and at normal operating temperature, loosen the anti-stall dashpot locknut. Hold the throttle in the closed position and depress the dashpot plunger with a screwdriver. Rotate the dashpot in a direction to provide 0.060-0.090 inch clearance between the dashpot plunger and the throttle lever, then tighten the locknut.

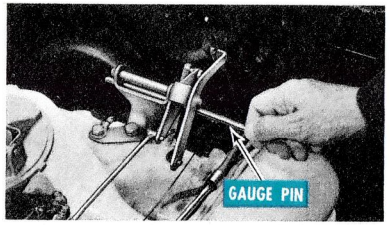
CONTROL LINKAGE

Before adjustment of the transmission control linkage is made, the hot engine idle and fast idle speed and the dashpot must be set to specifications.

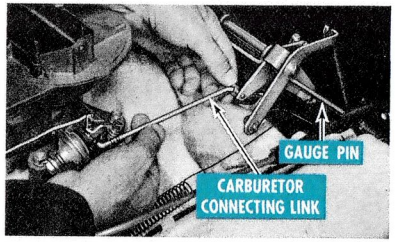


Throttle Linkage Adjustment

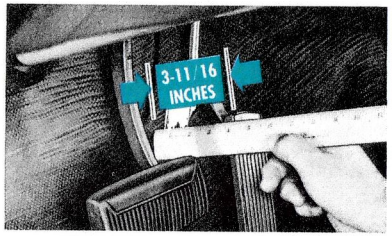
With the engine stopped, and at normal operating temperature, disconnect the carburetor connecting link from the accelerator assembly. Insert a gauge pin (1/4



inch drill rod) through the gauging holes. Lift the carburetor connecting link to its normal operating position. Maintain forward pressure on the link so that the carburetor throttle lever is held solidly against the idle adjusting screw. With forward pressure on the link, adjust its length so that the sleeve can be freely fitted into the accelerator assembly lever. From this free-fit position, rotate the sleeve one full turn counterclockwise to lengthen the link. Remove the gauge pin and connect the link to the accelerator lever assembly.

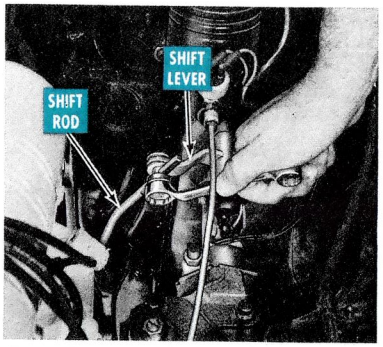


Check the alignment of the gauge pin holes. Open the throttle, then release it to permit the spring to return the linkage to the hot idle position. The gauge pin holes should return to their aligned position. Check the alignment by inserting the gauge pin into the holes.

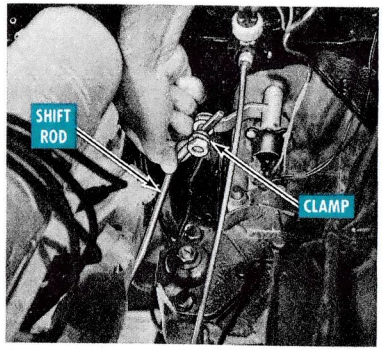


Adjust the accelerator connecting link to obtain a pedal height of 3-11/16 inches. Measure from the top corner of the pedal to the floor mat.

Manual Linkage Adjustment



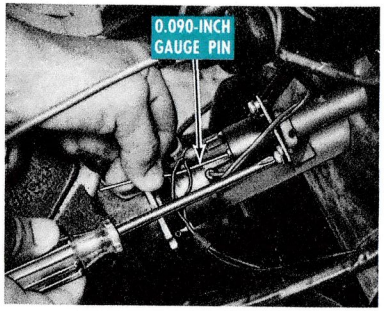
With the engine stopped, loosen the clamp at the shift lever so that the shift rod is free to slide in the clamp. Position the selector lever in the normal drive range (green dot on the dial), then shift the manual lever on the transmission into the detent position that is second from the rear. Tighten the



clamp on the shift rod, then check the pointer alignment for all manual lever detent positions. Reset the pointer alignment for all detent positions individually, if necessary.

Starter Neutral Switch

Check the starter circuit in all selector lever positions. The circuit must be open in all selector lever positions except neutral (N) and park (P).



To adjust the switch, loosen the neutral switch-to-steering column attaching screws, then shift the selector lever to neutral. Move the switch in the elongated mounting holes until a 0.090 inch gauge pin can be inserted through the switch housing and into the switch plate.

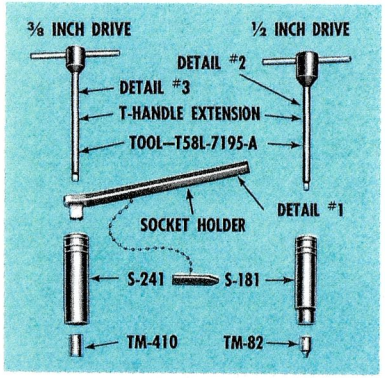
With the gauge pin in place, tighten the attaching screws, then remove the gauge pin.

Check the starter circuit in all selector lever positions to make sure it is closed only in neutral and park. *Do not drive the car if the neutral switch is defective.*

BAND ADJUSTMENTS

The bands, front and rear should be adjusted at 12,000 mile intervals during normal operation.

Front Band



Disconnect the filler tube from the transmission oil pan and drain the fluid into a clean container. *If the fluid is to be used again after the band adjustment, strain the fluid through a 100-mesh screen.*

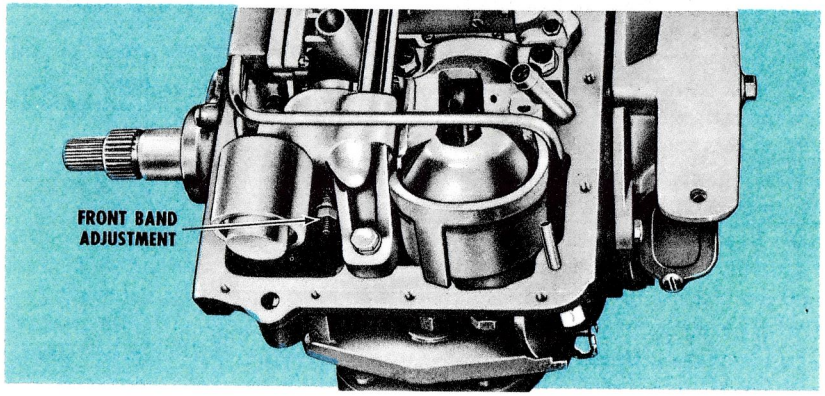
Remove, and thoroughly clean the oil pan and screen. Discard the oil pan gasket.

Loosen the front servo adjusting screw locknut two full turns, using a 9/16-inch wrench. Check the adjusting screw for free rotation in the actuating lever after the locknut is loosened.

Pull the adjusting screw end of the actuating lever away from the servo body, and insert the adjusting tool gauge block between the servo piston stem and the adjusting screw.

Install the socket handle on the 9/16-inch socket, then insert the T-handle extension through the socket handle and socket and install the screwdriver socket on the T-handle extension.

Place the tool on the adjusting screw so that the screwdriver engages the screw, and the socket engages the locknut.



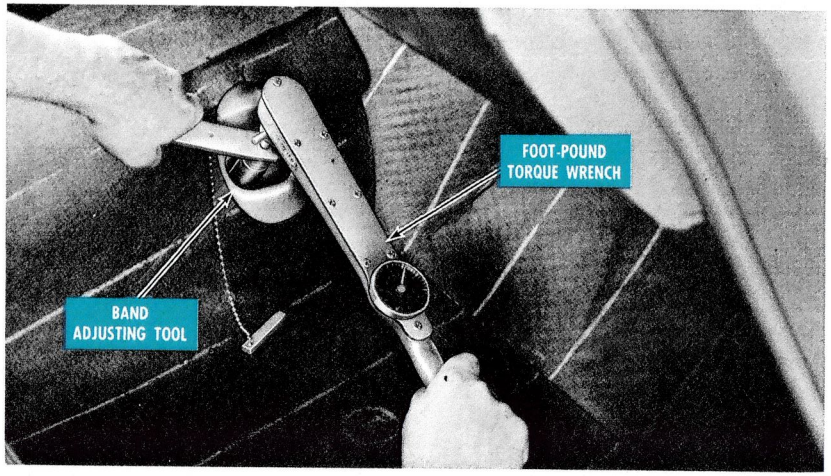
Adjustments

Front Band (Cont.)

Install a torque wrench that registers in inch pounds on the T-handle extension, then tighten the adjusting screw to 10 inch-pounds torque. Back-off the adjusting screw one full turn, then hold the adjusting screw stationary and tighten the locknut securely. *Severe damage may result if the adjusting screw is not backed off exactly one full turn.*

Remove the tool gauge block from the transmission, then place a new gasket on the oil pan and install the screen and pan on the transmission. Connect the filler tube to the pan, then fill the transmission with fluid.

Rear Band

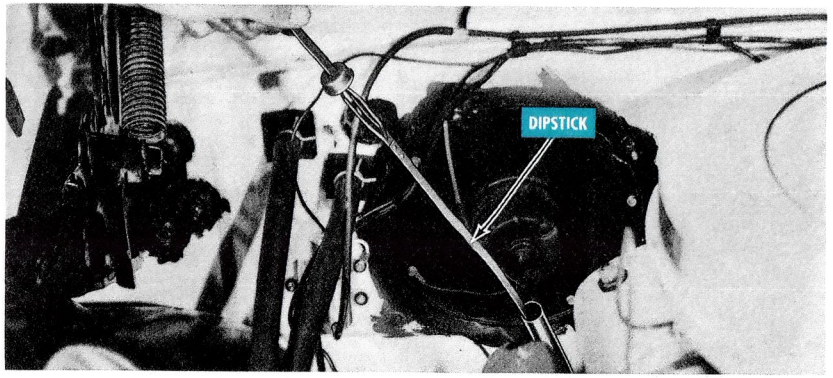


Fold back the floor mat to expose the rear band adjusting screw access cover, then remove the cover. Remove all dirt from the adjusting screw threads, then lubricate the threads.

Assemble the band adjusting tool and insert it in the access hole so that it engages the adjusting screw and locknut, then loosen the locknut. Using a torque wrench on the T-handle, tighten the adjusting screw to 10 foot-pounds torque. Remove the torque wrench from the T-handle, then back-off the adjusting screw exactly 1-1/2 turns. *Severe damage may result if the adjusting screw is not backed off exactly one and one-half turns.* Hold the adjusting screw stationary, tighten the locknut, then remove the tool and install the access hole cover and floor mat.

Maintenance

FLUID LEVEL CHECK



Make sure that the car is standing level. Then firmly apply the parking brake.

If the transmission fluid is cold, run the engine at fast idle speed (about 1200 rpm) until the fluid reaches its normal operating temperature. When the fluid is warm, slow the engine down to normal idle speed.

Shift the selector lever through all positions, and place the lever at P. Do not turn off the engine during the fluid level checks.

Clean all dirt from the transmission fluid dipstick cap before removing the dipstick from the filler tube.

Pull the dipstick out of the tube wipe it clean, and push it all the way back into the tube. Pull the dipstick out of the tube again, and check the fluid level. If necessary, add enough of the specified fluid to the transmission through the filler tube to raise the fluid level to the F (full) mark on the dipstick. *Do not overfill the transtransmission.*

Use Ford Automatic Transmission Fluid C1AZ-19582-A. *Other automatic transmission fluids marked "Type A" may not meet the operating requirements of the 1961 Cruise-O-Matic transmission.*

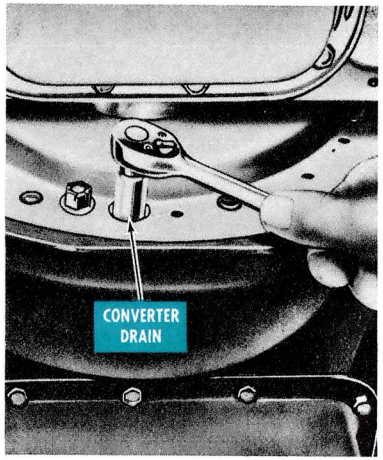
FLUID LEAKAGE CHECK

Oil-soluble aniline or fluorescent dyes premixed at the rate of 1/2 teaspoon of dye powder to 1/2 pint of transmission fluid have proved helpful in locating the source of the fluid leakage. Such dyes may be used to determine whether an engine oil or transmission fluid leak is present, or if the fluid in the oil cooler leaks into the engine coolant system.

FLUID CHANGE

Raise the car on a hoist, then remove the cover from the lower front side of the converter housing.

Remove one of the converter drain plugs, rotate the converter 180° and remove the other plug. *Do not attempt to turn the converter with a wrench on the converter stud nuts.*



Disconnect the fluid filler tube from the transmission oil pan, and drain the fluid.

When the fluid has stopped draining from the transmission and converter, remove and thoroughly clean the oil pan and screen. Discard the oil pan gasket.

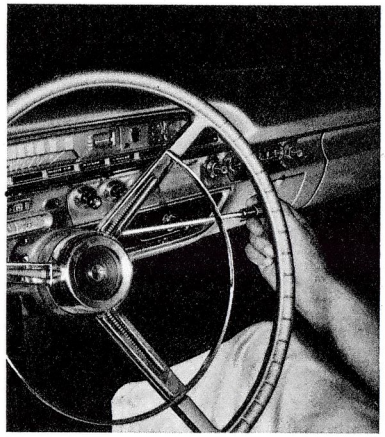
Place a new gasket on the oil pan, and install the screen and pan on the transmission, then connect the filler tube to the oil pan, and tighten the filling securely.

Install both drain plugs in the converter cover, and tighten them to 15-28 foot-pounds torque.

Install the converter housing cover.

Add five quarts of the specified fluid to the transmission.

Run the engine at idle speed for about two minutes, and add five more quarts of fluid. Run the engine at fast idle speed (about 1200 rpm) until it reaches its normal operating temperature. *Do not race the engine.*



Shift the selector lever through all the positions, place it at P, and check the fluid level. If necessary, add enough fluid to the transmission to raise the level to the F (full) mark on the dipstick. *Do not overfill the transmission.*

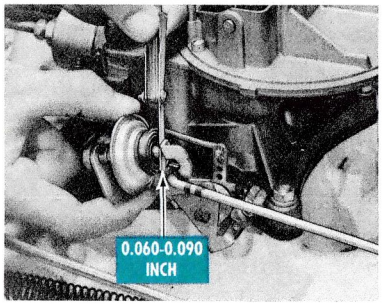
PRELIMINARY CHECKS

The following preliminary checks should be made in the order given before proceeding with any other diagnosis procedures.

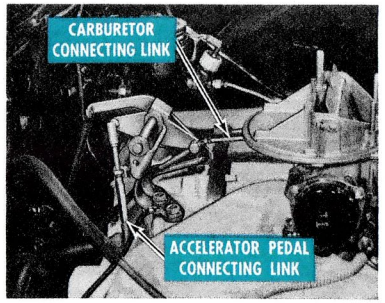
Instructions for performing the preliminary checks are given in the Adjustments and Maintenance sections of this booklet.

- **Transmission Fluid Level** - Low fluid level can affect the operation of the transmission, and may indicate fluid leaks. Fluid level that is too high will cause the fluid to become aerated, resulting in low control pressure.

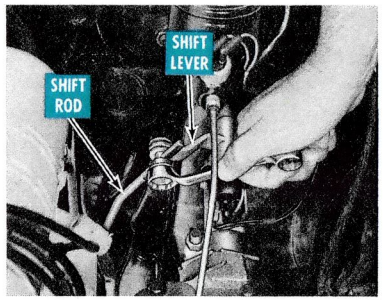
- **Engine Idle Speed** - If the engine idle speed is too low, the engine will run roughly and stall when the car is stopped in the drive range. An idle speed that is too fast will cause the car to creep when the transmission is shifted out of neutral.



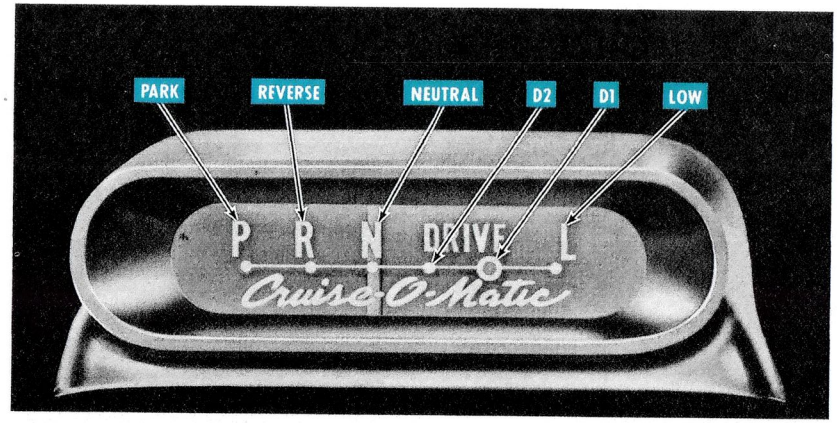
- **Anti-stall Dashpot** - Proper operating clearance is necessary to prevent the engine from stalling during rapid deceleration.



- **Throttle Linkage** - Smooth shifting and accelerator pedal height are dependent on the correct throttle linkage adjustment.



- **Manual Linkage** - Correct manual linkage adjustment is necessary to position the manual valve for proper fluid direction to the various transmission components. Improperly adjusted manual linkage may cause cross-leakage in the hydraulic system and result in transmission failure.



The control dial for the 1961 Cruise-O-Matic designates the D1 drive range with the green dot on the indicator in the instrument panel. The D2 drive range is the first mark to the left of the D1 designation.

Stall Test

The stall test is made to determine if the bands and clutches in the transmission are engaging and holding properly. The test is made in all forward ranges and in reverse with the engine at full throttle and the parking and service brakes applied.

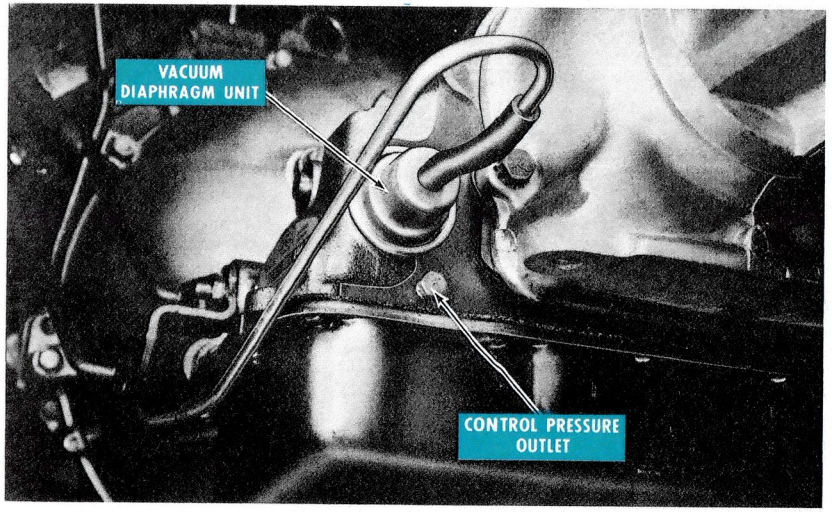
Connect a tachometer, and run the engine at idle speed until normal operating temperature is reached. *Apply both the parking and service brakes securely.*

Place the selector lever in the D1 designation and depress the accelerator to the floor. Note the tachometer reading. Now, repeat this procedure for D2, low, and reverse. If the engine speed is 300-400 rpm below the limits shown in the table in the Service Guide section, and the engine is properly tuned, the probable trouble is in the stator clutch of the converter. If the engine speed exceeds the maximum limits shown in the table, release the accelerator immediately, because clutch or band slippage is indicated.

CAUTION: While making a stall test in any range, do not hold the throttle wide open for more than five seconds at a time.

The Gear Ratio table in the Service Guide section shows the combinations of clutches and bands which are engaged in each selector lever position. Reference to these combinations will indicate which clutch or band may be causing the slippage.

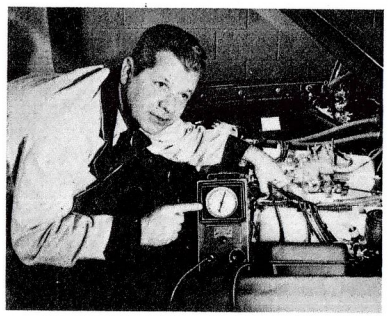
CONTROL PRESSURE AND VACUUM DIAPHRAGM UNIT

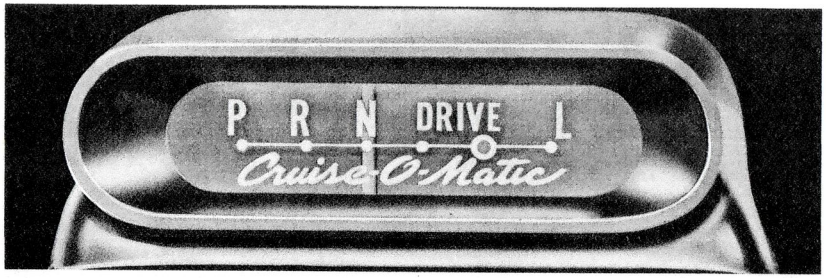


When the throttle linkage is correctly adjusted and the vacuum diaphragm unit is operating properly, all transmission shifts should occur within the road speed limits shown in the Shift Points table in the Service Guide section of this booklet. If the automatic shifts do not occur within limits, the following will serve to isolate the trouble to the engine, transmission, linkage, or vacuum diaphragm unit.

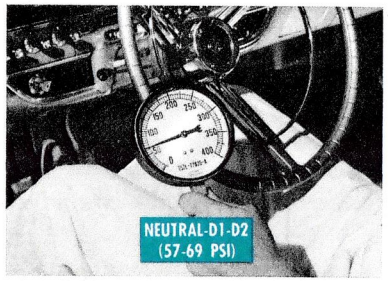
Install a tachometer and a vacuum gauge on the engine and connect a pressure gauge to the control pressure outlet at the rear of the transmission.

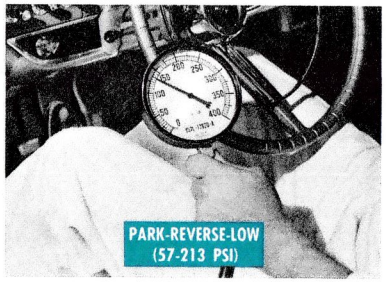
Firmly apply the parking brake, and start the engine. With the engine at normal operating temperature, and at idle speed, manifold vacuum should read a minimum of 18.0 inches. If the vacuum gauge reading is lower than 18.0 inches, the engine is not operating at peak efficiency, and should be repaired.

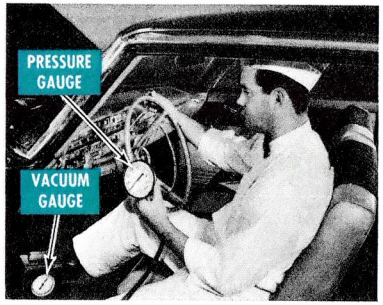




The transmission control pressure gauge at engine idle should read between 57 and 69 psi in N, D1 and D2, and between 57 and 213 in P, R, and L. If transmission control pressure is within limits, shift the transmission into D1 or D2 and firmly apply the service brakes. Advance the throttle until the engine vacuum gauge reading falls below 16-13.7 inches. As the vacuum gauge reading passes through the 16-13.7 inches range, transmission control pressure should start to rise and continue to rise with throttle opening, until maximum control pressure for stall in D1 or D2 is obtained. In P, R and L, control pressure rise is not dependent on the diaphragm unit. When the selector lever is shifted into these positions and engine rpm is increased, control pressure should rise immediately and reach its maximum before engine speed reaches stall rpm. If the vacuum and pressure gauge readings follow the pattern described, the diaphragm unit and transmission control pressure regulation system are operating properly.







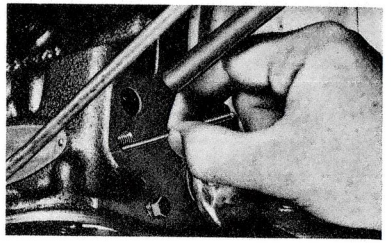
PRESSURE AND VACUUM

If transmission control pressure is too low, too high, fails to rise with throttle opening, or is extremely erratic, follow the procedure given under the appropriate heading.

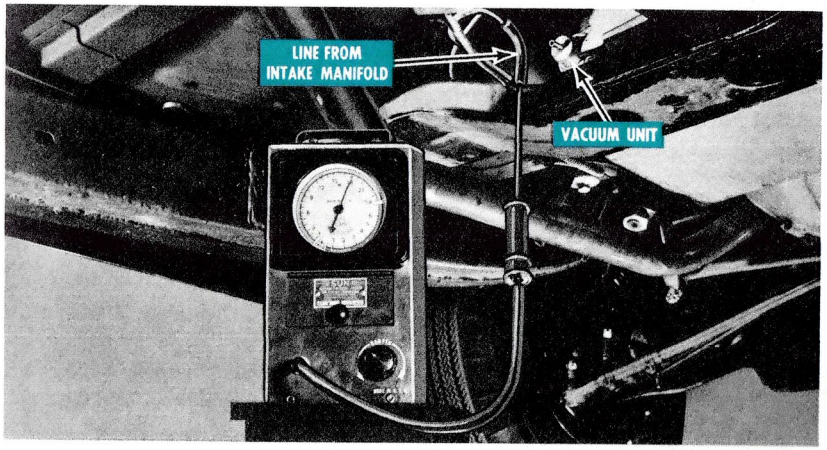
- **Control Pressure Is Low** - When control pressure at engine idle is low in all ranges, check for excessive leakage in the front oil pump, case, and control valve body.

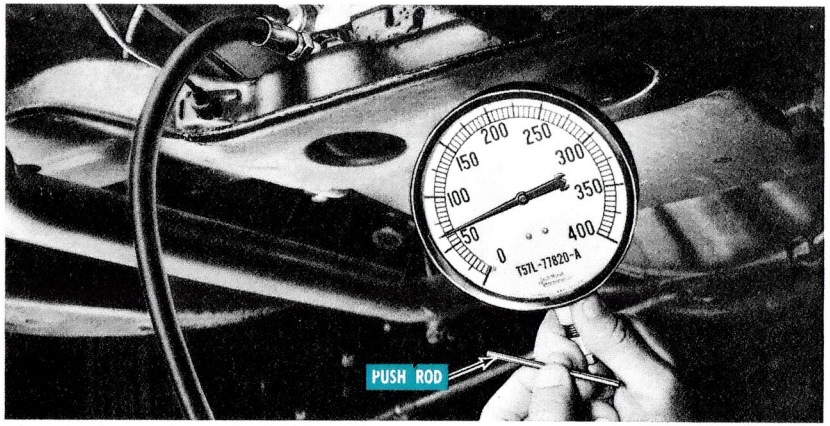
- **Control Pressure Is High** - When the transmission control pressure at engine idle is too high in N, D1 and D2, the trouble may be in the diaphragm unit or its connecting tubes and hoses.

If there is a minimum of 18 inches of vacuum at the intake manifold when the engine is at idle speed, position the car on a hoist, set the parking brake, and operate the engine at idle speed with the transmission in neutral. Raise the hoist, then remove the vacuum hose from the diaphragm unit, and connect a vacuum gauge to the hose. The vacuum reading should be the same as at the intake manifold. If the vacuum is low, check for a leak in the line from the manifold to the diaphragm unit.



If the vacuum is within specifications, remove the diaphragm unit and push rod. Inspect the push rod for a bent condition and for corrosion.





Install the diaphragm unit in the case to prevent fluid loss, but leave the push rod out. With the push rod removed, the diaphragm unit cannot affect transmission control pressure. Start the engine and check control pressure at engine idle in N, D1 and D2. If control pressure is still too high, the trouble is in the transmission control system. If the pressure is now within limits, the diaphragm unit was not operating properly and should be replaced.

- **Control Pressure Does Not Rise With Throttle Opening** - If transmission control pressure does not rise in D1 and D2 as engine vacuum falls below 16-13.7 inches, check the transmission's pressure rise capacity by shifting to R or L. In these positions, maximum control pressure should be obtained at not more than engine stall rpm.

If pressure rise is normal in R and L, remove the hose from the diaphragm unit and check the hose and tubes. If the vacuum reading at the diaphragm end of the hose is 18 inches or greater, change the diaphragm unit and again check for pressure rise with throttle opening in D1 and D2. If control pressure does not rise now, the trouble is in the transmission. Check for excessive leakage in those components which have control pressure in them in D1 and D2 but do not have control pressure in them in R and L.

- **Control Pressure Is Extremely Erratic** - If transmission control pressure is extremely erratic in N, D1 and D2, check the diaphragm unit, tubes, hoses, and diaphragm push rod. If the vacuum source is satisfactory, replace the diaphragm unit and repeat the tests for transmission control pressure.

PERFORMANCE CHECKS

Performance checks should be made after all preliminary checks have been completed, and the trouble has not been found.

Initial Engagement

Initial engagement checks are made to determine if initial band and clutch engagements are smooth.

Run the engine until normal operating temperature is reached. With the engine running at the specified hot idle speed, shift the selector lever from N to D2, and from N to D1. Band and clutch engagements should be smooth in both positions. Rough initial engagements in D1 or D2 are caused by high engine idle speed, high control pressure, faulty operation of the pressure regulator valve or of the main control valve.

Shift Points

Check the light throttle upshifts in D1. The transmission should start in first gear and shift to second at about 8 MPH, and then shift to third at about 18 MPH.

While the transmission is in third gear, depress the accelerator pedal through the detent (to the floor). The transmission should shift from third to second or third to first, depending on the car speed.

Check the closed throttle downshift from third to first by coasting down from about 30 MPH in third gear. The shift should occur at about 8 MPH. A 3-2-1 shift may be experienced under the above conditions.

Partial-throttle downshifts in D1 may be checked by using the service brakes as a load. With the transmission in third gear, D1, and car speed at about 30 MPH, depress and hold the accelerator at a half-throttle position. At the same time, apply the service brakes to the point that road speed is slowly reduced. The third to second and then second to first shifts should occur as road speed decreases.

When the selector lever is at D2, the transmission can operate only in second and third gears. Shift points for second to third and third to second are the same in both D2 and D1.

If the transmission is in third gear and road speed is above about 28 MPH, the transmission should shift to second gear when the selector lever is moved from D2 or D1 to L. When the same manual shift is made below about 25 MPH, the transmission will shift from second or third to first.

Operation

Operational checks are made to supplement stall test data.

When the stall test speeds are low and the engine is properly tuned, converter stator clutch problems are indicated. A road test must be performed to determine the exact cause of the trouble.

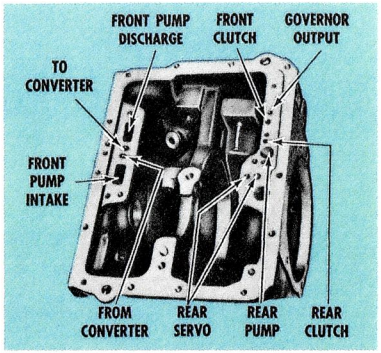
If the stall test speeds are 300 to 400 RPM below the values shown in the Stall Speed table in the Service Guide Section, and the car cruises properly but has very poor acceleration, the stator clutch is slipping.

If the stall test speeds are 300 to 400 rpm below specifications, and the car drags at cruising speeds, and acceleration is poor, the stator clutch may be installed backwards.

When the stall test shows normal speeds, the acceleration is good, but the car drags at cruising speeds, the difficulty may be due to a seized stator assembly. If the stator is defective, replace the converter.

Air Pressure

A *no drive* condition can exist, even with correct transmission fluid pressure, because of inoperative clutches or bands. The inoperative units can be located through a series of checks by substituting air pressure for the fluid pressure to determine the location of the malfunction.



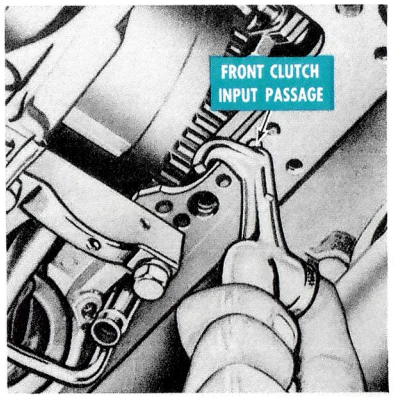
When the selector lever is at D2, a *no drive* condition may be caused by an inoperative front clutch or front band. A *no drive* condition at D1 may be caused by an inoperative front clutch or one-way clutch. When there is no drive in L. the difficulty could be caused by improper functioning of the front clutch, the rear band, or the one-way clutch. Failure to drive in reverse range could be caused by a malfunction of the rear clutch or rear band. Erratic shifts could be caused by a malfunction of the governor.

To make the air pressure checks, drain the transmission fluid, then remove the oil pan and the control valve assembly.

The inoperative units can be located by introducing air pressure into the transmission case passages leading to the clutches, rear servo, and governor, and into the front servo apply, release, and accumulator tubes.

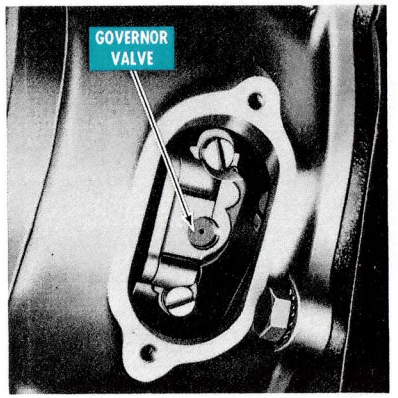
Front Clutch

Apply air pressure to the front clutch passage. A dull thud will be heard when the clutch piston is applied. If no noise is heard, place the finger tips on the drum, and again apply air pressure to the front clutch passage. Movement of the clutch piston can be felt as the clutch is applied.



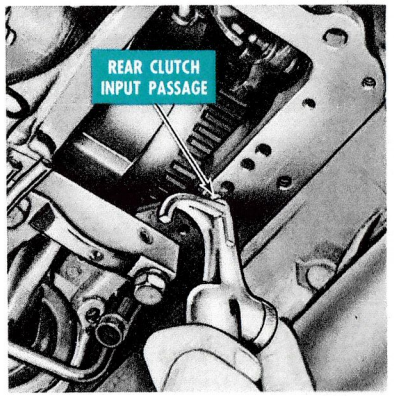
Governor

Remove the governor inspection cover from the transmission extension housing. Apply air pressure to the front clutch passage, listen for a sharp click, and watch to see if the governor weight snaps inward. Movement of the weight inward indicates proper governor valve operation.



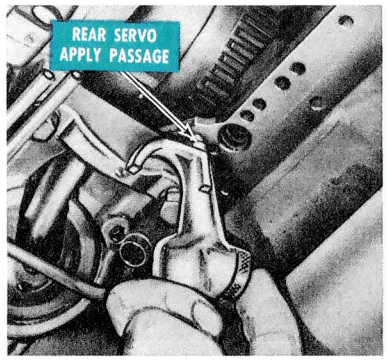
Rear Clutch

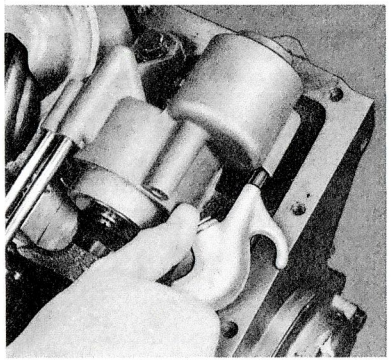
Apply air pressure to the rear clutch passage. A dull thud indicates that the rear clutch piston has moved to the applied position. If no noise is heard, place the finger tips on the rear drum and again apply air pressure to detect movement of the piston.



FRONT SERVO

Hold the air nozzle in the front servo apply tube. Operation of the front servo is indicated by the tightening of the front band around the drum. Continue to apply air pressure to the front servo apply passage, then introduce air pressure into the front servo release passage.



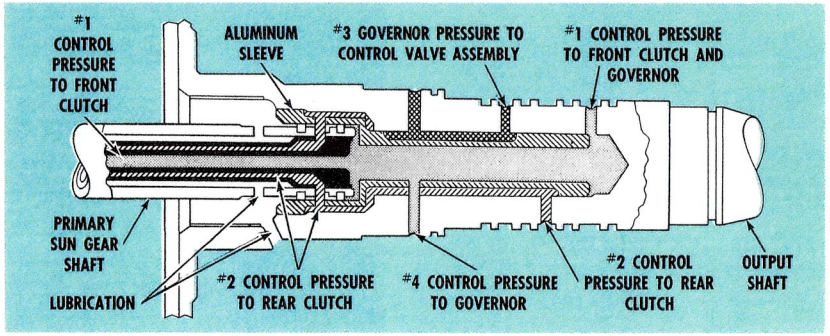


REAR SERVO

Apply air pressure to the rear servo apply passage. The rear band should tighten around the drum if the rear servo is operating properly.

If air pressure applied to either of the clutch passages fails to operate a clutch or operates both clutches at once, remove and, with air pressure, check the fluid passages at the output shaft aluminum sleeve for correct indexing with the shaft holes. Check the primary sun gear shaft assembly passages with air pressure.

If the output shaft and primary sun gear shaft passages are clear, remove the clutch assemblies, and clean and inspect the clutch.



GEAR RATIOS

Gear	Selector Lever Position	Clutch Applied	Band Applied	Gear Ratio
Neutral	N	None	None	—
First	D1 or L	Front	Rear*	2.40:1
Second	D1 or D2	Front	Front	1.47:1
Third	D1 or D2	Front and Rear	Front	1.00:1
Reverse	R	Rear	Rear	2.00:1

*In first gear D1, the planet carrier is held against rotation by the one-way clutch.

STALL SPEEDS

Selector Lever Position	Engine Speed (rpm)		
	292 Engine	352 Engine	390 Engine
R, D2, D1, L	1500-1700	1600-1800	1800-2000

FLUID PRESSURE LIMITS

Manifold Vacuum Hg	Engine Speed (RPM)	Selector Position	Gauge Reading (PSI)
18 Minimum	450-475	N-D1-D2 P-R-L	57-69 57-213
1.5 or Less	Stall	D1-D2 R-L	145-170 201-213

SHIFT POINTS

Rear Axle Ratio	Atomatic Shift Speeds (mph)								Manual Shift Speeds (mph)
	D1		D1 or D2		D1	D1 or D2	D1	D2	L
	1-2 Minimum Throttle	1-2 Maximum Throttle	2-3 Minimum Throttle	2-3 Maximum Throttle	3-1 Minimum Throttle	3-2 Maximum Throttle	2-1 Maximum Throttle	3-2 Minimum Throttle	2-1 Minimum Throttle
3.56:1	6-8	31-38	12-20	50-59	6-7	47-55	22-30	6-9	16-22
3.10:1	7-9	35-44	14-23	58-69	6-8	54-64	26-36	6-10	18-26
2.91:1	8-10	38-48	15-25	62-74	7-9	58-69	27-38	7-11	19-27

CHECKS AND ADJUSTMENTS

Operation	Specification
Transmission End Play Check	0.010-0.029 inch Selective Thrust Washers Available: 0.063-0.061 inch, 0.069-0.067 inch 0.076-0.074 inch, 0.083-0.081 inch
Turbine and Stator End Play Check	0.060 inch (maximum)
Front Band Adjustment (Use ¼-inch spacer between adjustment screw and servo piston stem)	Adjust screw to 10 inch-pounds torque, and back off one full turn
Rear Band Adjustment	Adjust screw to 10 foot-pounds torque, and back off 1½ turns
Primary Sun Gear Shaft Ring End Gap Check	0.002-0.009 inch
Accelerator Pedal Height Adjustment	3 11/16 inches above floor mat
Rear Clutch Steel Plate Coning Clearance Check	0.010 inch (maximum)

TRANSMISSION FLUID

Specification	C1AZ-19582-A
Capacity (approximate)	10 Quarts

The Cruise-O-Matic Diagnosis Guide lists the most common trouble symptoms that may occur, and it gives the items that should be checked, in the order given, to find the cause of the trouble.

The items are arranged in a logical sequence which should be followed for early detection of the trouble. The letter symbols for each item are explained in the legend following the guide.

The letter symbols are keyed to the trouble symptoms, and are explained in the key following the guide.

If items A, B, C, and K have already been checked, they need not be repeated when they appear in the suggested checking sequence.

DIAGNOSIS GUIDE

Trouble Symptom	Items to Check	
	Transmission in Car	Transmission Out of Car
Rough Initial Engagement IN D1 & D2	K B W F E	
1-2 or 2-3 Shift Points Incorrect	A B C D W E L	
Rough 2-3 Shift	B G F E J	r
Engine Overspeeds on 2-3 Shift	B G E	r
No 1-2 or 2-3 Shift	D E C	b c f
No 3-1 Shift	K B E	
No Forced Downshifts	L W E	
Runaway Engine on Forced Downshift	G F E J	c
Rough 3-2 or 3-1 Shift at Closed Throttle	K B E	
Creeps Excessively in D1 or D2	K	
Slips or Chatters in First Gear, D1	A B W F E	a c f i
Slips or Chatters in Second Gear	A B G W F E J	a c
Slips or Chatters in R	A H W F E I	b c f
No Drive in D1	C E	i
No Drive in D2	G E R	a c f
No Drive in L	C H I E R	c f
No Drive in R	H I E R	b c f
No Drive in Any Selector Lever Position	A C W F E R	c
Lockup in D1	C I J	b g c
Lockup in D2	C H I	b g c i
Lockup in L	G J E	b g c
Lockup in R	G J	a g c
Parking Lock Binds or Does Not Hold	C	g

DIAGNOSIS GUIDE (Cont'd)

Trouble Symptom	Items to Check	
	Transmission in Car	Transmission Out of Car
Engine Does Not Start by Pushing Car	A C F E	e c
Transmission Overheats	O F	n
Maximum Speed Too Low, Poor Acceleration		n
Transmission Noisy in N	F	a d
Transmission Noisy in First, Second, Third, or Reverse Gear	F	h a b d
Transmission Noisy in P	F	d
Transmission Noisy During Coast at 30-20 mph in N, Engine Stopped		e
Fluid Leak at Converter Housing	M	j m p
Fluid Leak at Transmission Oil Pan	N	
Fluid Leak at Left Side of Case	P Q T	
Fluid Leak at Right Side of Case	Q T O	
Fluid Leak at Front of Extension Housing	S V	
Fluid Leak at Rear of Extension Housing	U	
Fluid Leak at Speedometer Driven Gear Adapter	X	

KEY TO DIAGNOSIS GUIDE

A. Fluid Level
B. Vacuum Diaphragm Unit
C. Manual Linkage
D. Governor
E. Valve Body
F. Pressure Regulator
G. Front Band
H. Rear Band
I. Rear Servo
J. Front Servo
K. Engine Idle Speed
L. Throttle and Downshift Linkage
M. Converter Drain Plugs
N. Oil Pan Gasket, Drain Plug or Tube
O. Oil Cooler and Connections
P. Manual or Throttle Lever Shaft Seal
Q. ⅛-inch Pipe Plug in Side of Case
R. Perform Air-Pressure Check
S. Extension Housing to Case Gaskets and Lockwashers
T. Center Support Bolt Lockwashers
U. Extension Housing Rear Oil Seal
V. Governor Inspection Cover Gasket
W. Perform Control Pressure Check
X. Speedometer Driven Gear Adapter Seal

a. Front Clutch
b. Rear Clutch
c. Leakage in Hydraulic System
d. Front Pump
e. Rear Pump
f. Fluid Distributor Sleeve in Output Shaft
g. Parking Linkage
h. Planetary Assembly
i. Planetary One-Way Clutch
j. Engine Rear Oil Seal
m. Front Pump Oil Seal
n. Converter One-Way Clutch
p. Front Pump to Case Gasket
r. Rear Clutch Piston Air Bleed Valve