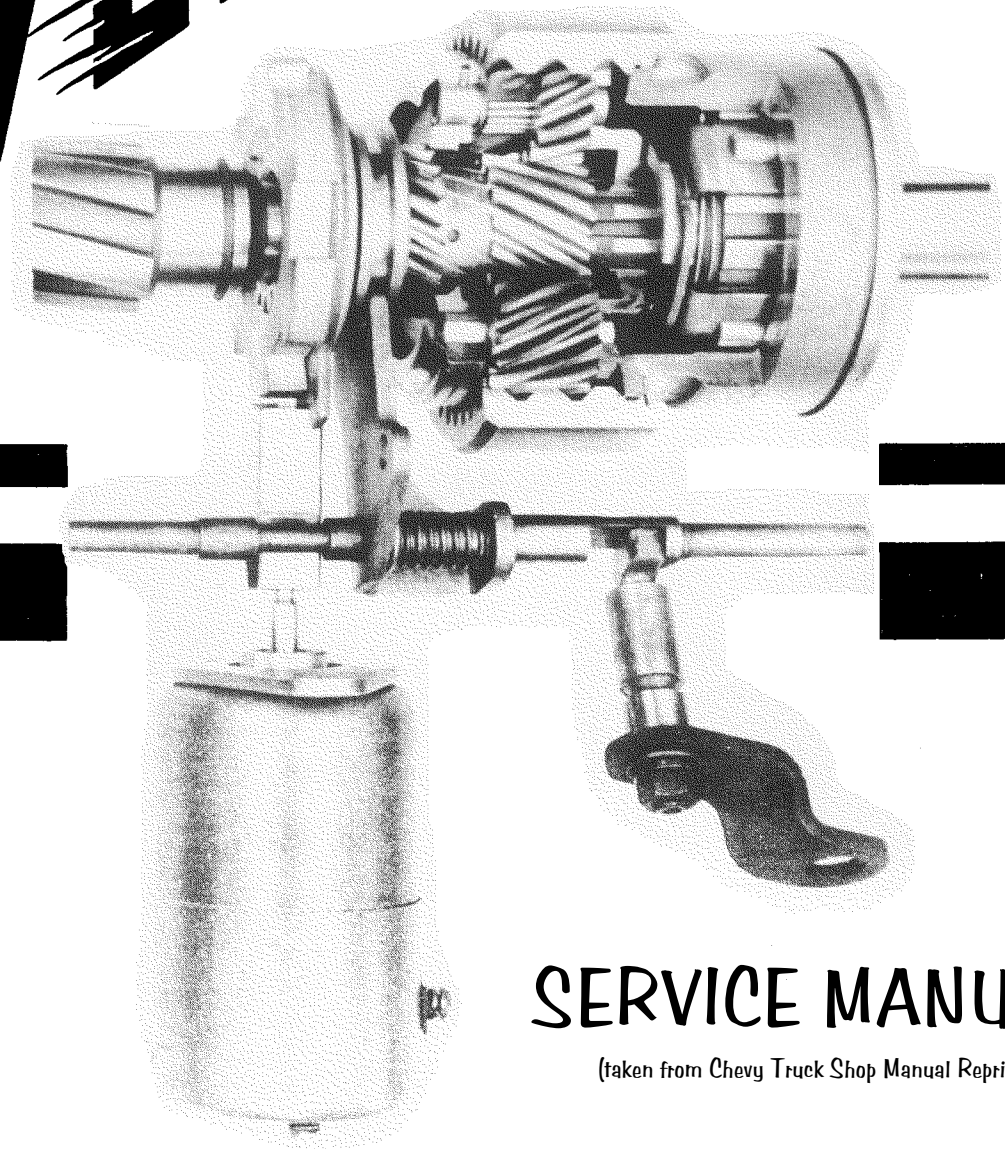


# The OVERDRIVE



## SERVICE MANUAL

(taken from Chevy Truck Shop Manual Reprint)

**WARNER GEAR DIVISION**

BORG-WARNER CORPORATION

MANUFACTURERS OF

**AUTOMOTIVE TRANSMISSIONS**

MUNCIE, INDIANA, U.S.A.

PRICE 50¢

# TRANSMISSION—OVERDRIVE

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## TRANSMISSION — OVERDRIVE

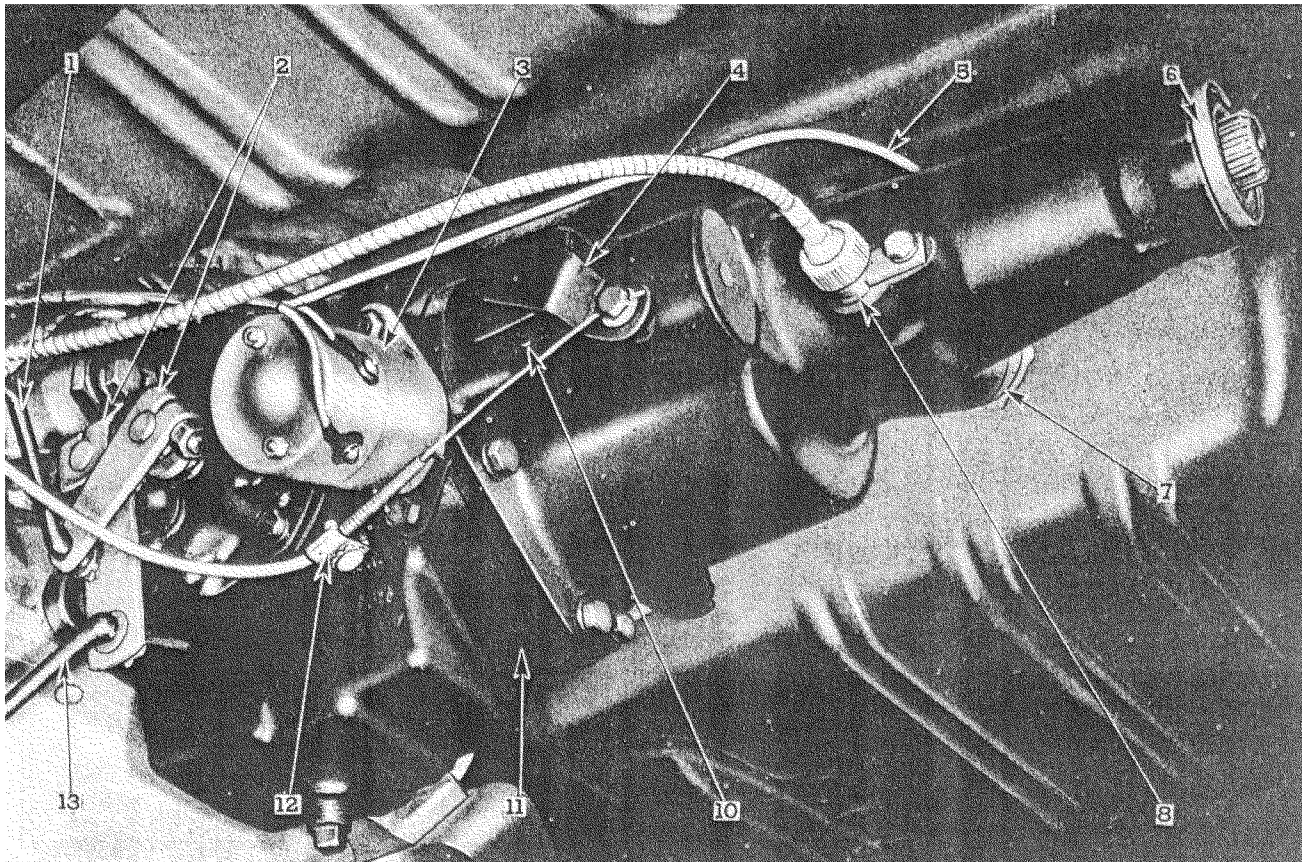


Fig. 20—Transmission Overdrive Mounting

- |                                  |                  |                               |                                  |
|----------------------------------|------------------|-------------------------------|----------------------------------|
| 1. First and Reverse Shifter Rod | 4. Control Lever | 7. Governor Switch            | 11. Adapter                      |
| 2. Shifter Levers                | 5. Governor Wire | 8. Speedometer Shaft Fitting  | 12. Control Cable Bracket        |
| 3. Sun Gear Solenoid             | 6. Oil Seal      | 10. Control Shaft Tapered Pin | 13. Second and Third Shifter Rod |

The overdrive unit (figs. 20 and 21) is essentially a two-speed planetary transmission attached to the rear of a conventional three-speed transmission. In overdrive, engine speed is approximately 30 per cent slower at a given road speed since the drive train includes planetary gears which provide a lower overall gear ratio than that obtained in high gear with the conventional transmission.

The electrical equipment which controls the automatic action of the mechanical portion of the overdrive unit consists of a solenoid, a speed-sensitive governor switch, a relay and a kickdown switch. The circuit including this equipment

makes it possible to operate in overdrive above a pre-set cut-in speed, or in conventional drive at any speed.

**OPERATION**

**Highway Driving**

When the car is operated below a predetermined "cut-in" speed, varying from 26 to 30 mph, the direct drive is used, making available the acceleration so desirable at lower speeds. As the car speed increases above the cut-in point the overdrive unit will shift into the overdrive ratio, but only when the driver desires no further

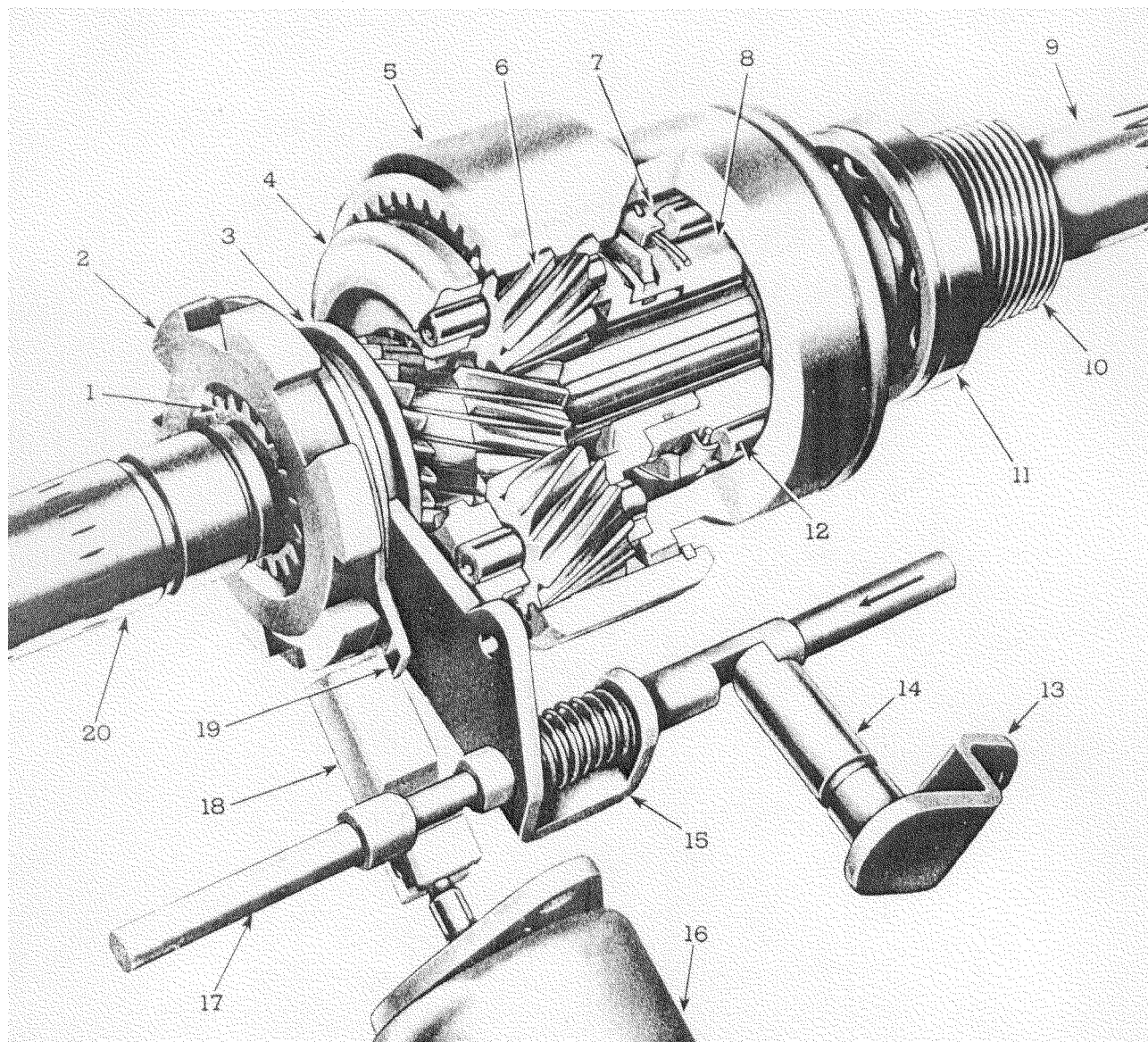


Fig. 21—Overdrive Cross Section

- |                           |                               |                             |                            |
|---------------------------|-------------------------------|-----------------------------|----------------------------|
| 1. Sun Gear               | 6. Pinion                     | 11. Output Shaft Bearing    | 16. Solenoid Assembly      |
| 2. Sun Gear Control Plate | 7. Clutch Cam Roller Retainer | 12. Clutch Cam Roller       | 17. Shift Rail             |
| 3. Sun Gear Shift Collar  | 8. Cam                        | 14. Control Shaft and Lever | 18. Sun Gear Pawl          |
| 4. Pinion Cage Assembly   | 9. Output Shaft               | 15. Shift Fork              | 19. Blocker Ring           |
| 5. Output Shaft Ring Gear | 10. Speedometer Drive Gear    |                             | 20. Transmission Mainshaft |

acceleration; when consciously, or unconsciously, he lifts his foot from the accelerator, whereupon the shift is completed. Thereafter, the overdrive remains in effect until the car speed falls below the "cut-out" point, when the overdrive is released.

However, at high speeds, the driver while operating in overdrive may require additional acceleration, beyond that available by opening the throttle wide. His natural impulse is to press the accelerator further, and this act releases the overdrive, making available the full acceleration of direct drive. The direct drive is retained so long as the full acceleration is required; when the driver no longer requires it he unconsciously lifts his foot from the accelerator, whereupon the overdrive is resumed. If the driver so desires, he may retain the direct drive indefinitely by maintaining a small amount of throttle opening.

### City Traffic Driving

Much city driving is under conditions which permit speeds up to 35 mph, with frequent stops. Many drivers are accustomed to start in second gear under such conditions. With overdrive-equipped cars, the driver may start in second gear, accelerate up to the cut-in speed, and, by merely lifting the foot from the accelerator pedal, engage the overdrive-second gear combination. At the first traffic stop, it is merely necessary to release the clutch; the gearshift lever is not touched. Furthermore, if a special burst of acceleration is needed in a tight traffic spot, the full power of second gear may be had by pressing

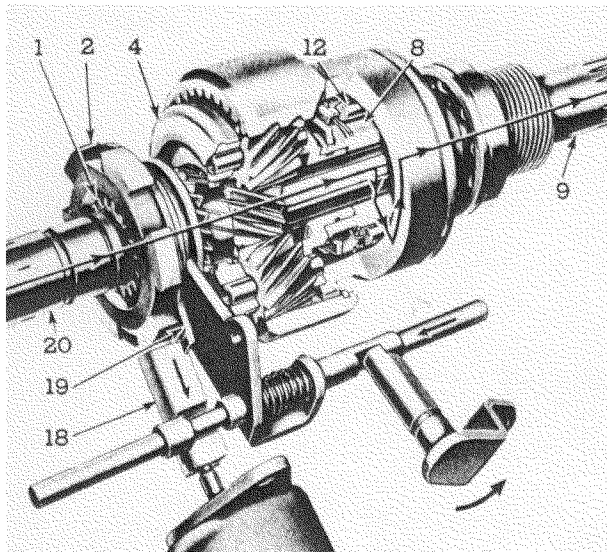


Fig. 22—Drive Through Free-Wheeling Clutch

- |                           |                            |
|---------------------------|----------------------------|
| 1. Sun Gear               | 12. Clutch Cam Roller      |
| 2. Sun Gear Control Plate | 18. Sun Gear Pawl          |
| 4. Pinion Cage Assembly   | 19. Blocker Ring           |
| 8. Cam                    | 20. Transmission Mainshaft |
| 9. Output Shaft           |                            |

the accelerator to the floor, resuming the overdrive-second by the usual method of closing the throttle.

### Use of Clutch Pedal

At speeds below the overdrive cut-in point, the free-wheeling action of the overdrive unit makes it possible to do all gearshifting without releasing the main clutch. Above cut-in speed, it is necessary to release the clutch for shifting gears, and likewise, the clutch must be released when the car is being started from standstill, and whenever it is being brought to a stop.

## MECHANICAL

### Free-Wheeling Direct Drive

The transmission mainshaft (fig. 22) extends thru the sun gear and is splined into the pinion cage and roller clutch cam. The latter has 12 cam surfaces, and 12 clutch rollers located against these surfaces by means of the roller retainer and the roller retainer spring. When a driving torque is applied against the cam, the rollers are forced outward into wedging contact with the outer race (fig. 23), thus driving the car. Under such driving

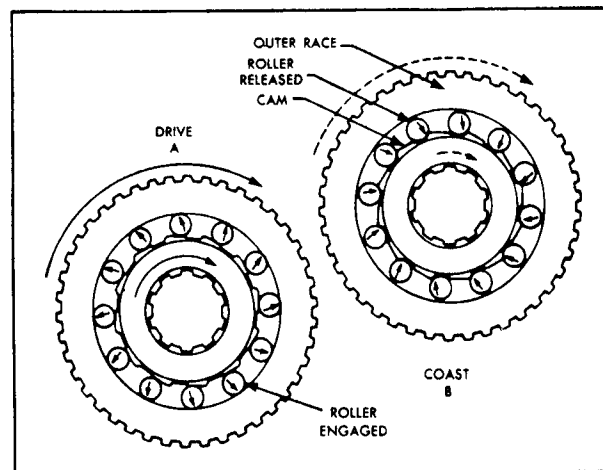


Fig. 23—Clutch Cam and Roller Positions

conditions, all the overdrive gears and their directly-associated control parts revolve together as a unit.

When the driving torque is removed from the cam, the rollers release their wedging contact (fig. 23), permitting the roller clutch to overrun, with the mainshaft, pinion cage, and engine turning at a slower speed than the ring gear, output shaft, and propeller shaft. Under such conditions, the ring gear will turn faster than the pinion cage, and the sun gear will turn slower. In fact, the sun gear may turn forward, stand still, or turn backward, depending solely upon the relative speeds of the transmission mainshaft,

and the output shaft. If the mainshaft is turning at exactly 70% of the speed of the output shaft, the sun gear will stand still; if it turns faster than this, relatively, the sun gear will turn forward; and if it turns slower, the sun gear will turn backward. If the engine is idling with the car moving forward, this reverse rotation may be quite fast.

**Overdrive**

At car speeds below 26 to 30 mph (the "cut-in" speed), the electrical control system is completely inactive. Assuming that the car is being accelerated below the 26 to 30 mph cut-in speed with the dash control pushed in (fig. 22), the sun gear control plate revolves along with the sun gear at the speed of the transmission mainshaft. Under such circumstances, the blocker ring, by its frictional drag upon the hub of the control plate, is rotated into such a position as to latch the control pawl against inward movement (fig. 24).

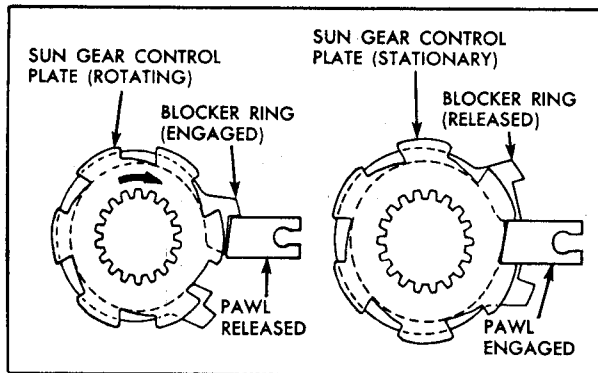


Fig. 24—Control Plate, Blocker Ring, and Pawl Positions

When the car reaches the cut-in speed, the governor contacts close, acting through the overdrive electrical circuits to energize the solenoid. The latter sets up a spring pressure against the pawl, tending to push it into engagement. This movement is prevented by the blocker. However, the driver, either unconsciously, or consciously, and according to his own choice, may momentarily close the throttle, whereupon the roller clutch releases, and the engine slows down. At the same time, the sun gear slows down, more rapidly, so that the sun gear passes through the standstill condition when the engine speed has fallen 30%, and then reverses its motion. Upon the instant of reversal, the blocker ring, moved by its frictional drive from the control plate hub, also rotates slightly in this direction and releases the pawl which snaps into the first notch of the backwardly-rotating control plate (fig. 24). With the sun gear thus held against rotation, (fig. 25), the pinion cage, and hence, the engine, will revolve

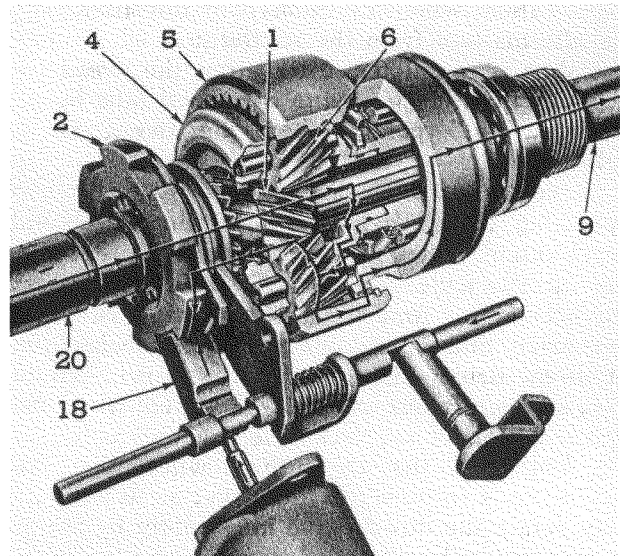


Fig. 25—Drive with Overdrive Engaged

- |                           |                            |
|---------------------------|----------------------------|
| 1. Sun Gear               | 6. Pinion                  |
| 2. Sun Gear Control Plate | 9. Output Shaft            |
| 4. Pinion Cage Assembly   | 18. Sun Gear Pawl          |
| 5. Output Shaft Ring Gear | 20. Transmission Mainshaft |

through only 0.7 turn for each turn of the propeller shaft (fig. 26).

The extreme rapidity of the pawl engagement insures that the control plate cannot rotate backward more than 1/3 turn at the most; usually, it will be less. This engagement, at nearly perfect synchronism, accounts for the smooth action of this control. Once engaged, under the conditions of normal driving, the overdrive is in action until the car speed falls to a value 4 or 5 mph lower than the cut-in speed, when the governor contacts open, releasing the solenoid, which withdraws the pawl (if throttle is closed), whereupon

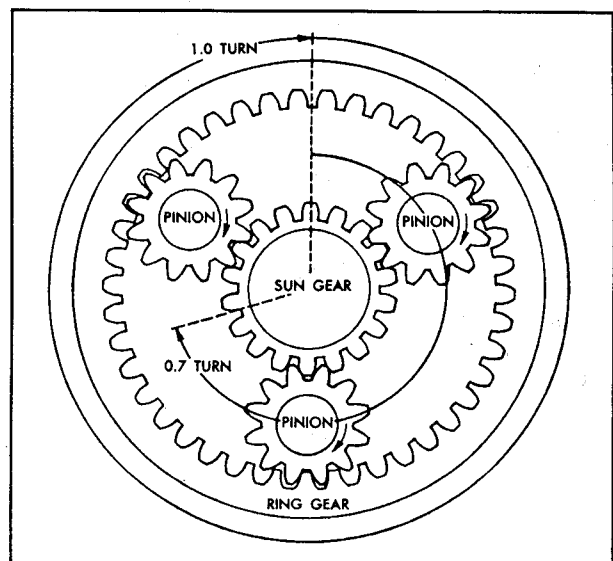


Fig. 26—Pinion Cage vs Ring Gear Travel

the condition of free-wheeling direct drive is resumed.

### Driver Controlled Downshift (Kickdown)

It has been noted, above, that when the overdrive is engaged, the engine turns only 0.7 as fast as when in direct drive. This reduces the power available (excepting at high car speeds) and although this reduced power is usually sufficient for all purposes, there are times when it is desirable to return to direct drive, for more power, without reducing the car speed to the point where the overdrive would normally release.

Under such circumstances, the driver merely presses the accelerator pedal to the wide-open position. Through suitable electrical controls, this releases the solenoid, urging the pawl toward release from the control plate. However, due to the driving torque reaction, the pawl is held, and cannot move to release until the torque is momentarily relieved. This is accomplished by interrupting the ignition, whereupon the pawl snaps to release, which immediately restores the ignition. When the overdrive has been thus disengaged the roller clutch carries the direct drive, and the driver may hold it in this condition at his pleasure, until he chooses to re-engage overdrive by merely lifting his foot from the accelerator, momentarily. Thereupon the overdrive is resumed, unless the car speed has in the meantime fallen below the overdrive release point.

### Conventional Drive

Although the normal procedure is to operate the unit as above, taking advantage of the free-wheeling and the overdrive, there are times, as when descending long, steep grades, where it may be desirable to use the frictional drag of the engine as a brake. Under such circumstances, the overdrive dash control may be pulled out, swinging the control lever (fig. 27) forward, thus moving the shift rail and shift fork backwards, shifting the sun gear so that the lockup teeth will engage the corresponding teeth of the pinion cage. This causes the entire group of working parts to revolve as a unit, duplicating in all respects the action of the conventional transmission. In order to thus lock up the unit, if the car is in motion, it is necessary to open the throttle, to assure that all parts revolve together, or to release the overdrive, if engaged, by pressing the accelerator pedal to the floor pulling out the overdrive dash control at the same time. Thereafter, the car will have the usual conventional drive until the driver chooses to push the overdrive dash control in, which may be easily done at any time.

Since the roller clutch will not transmit a

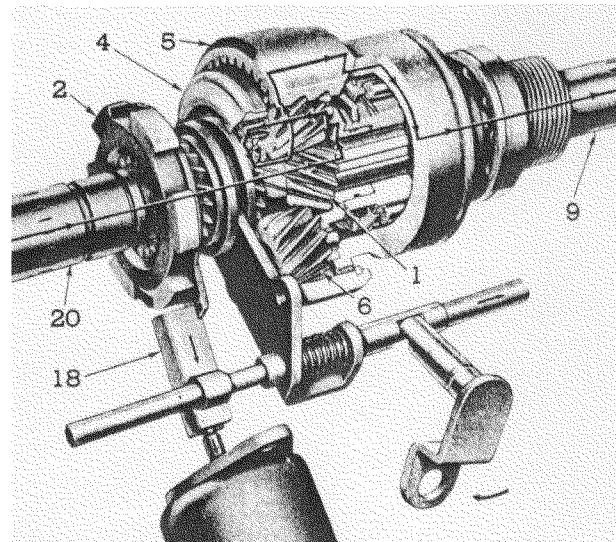


Fig. 27—Drive with Overdrive Locked-Out

- |                           |                            |
|---------------------------|----------------------------|
| 1. Sun Gear               | 6. Pinion                  |
| 2. Sun Gear Control Plate | 9. Output Shaft            |
| 4. Pinion Cage Assembly   | 18. Sun Gear Pawl          |
| 5. Output Shaft Ring Gear | 20. Transmission Mainshaft |

reverse drive, it is necessary for the lock up mechanism to be used whenever reverse drive is desired. This is done, automatically, by the transmission reverse shift mechanism, which pushes the shift rail to the rear, independently of the overdrive control lever, whenever the transmission is shifted into reverse.

### Parking

When the overdrive control handle is pushed in, engine compression for "in gear" parking will be effective only in the reverse position. To park in any other gear the control handle should be pulled out. Always apply the hand brake when parking a vehicle.

## ELECTRICAL

### Solenoid

The overdrive solenoid is mounted on the left side of the overdrive adapter. The solenoid contains two windings, a hold-in and pull-winding. The hold-in winding (dashed line, figure 28) consists of many turns of fine wire and remains energized as long as the overdrive is in operation. The pull-in winding (solid line) contains fewer turns of heavier wire and is necessary to create a magnetic field strong enough to start and complete the solenoid plunger movement. Once this movement is completed the hold-in winding alone is sufficiently strong to maintain the plunger in the "bottomed" position. Therefore, as the plunger moves into the "bottomed" position, the pull-in circuit is broken by a built-in stop which opens a pair of spring-loaded contact points which are

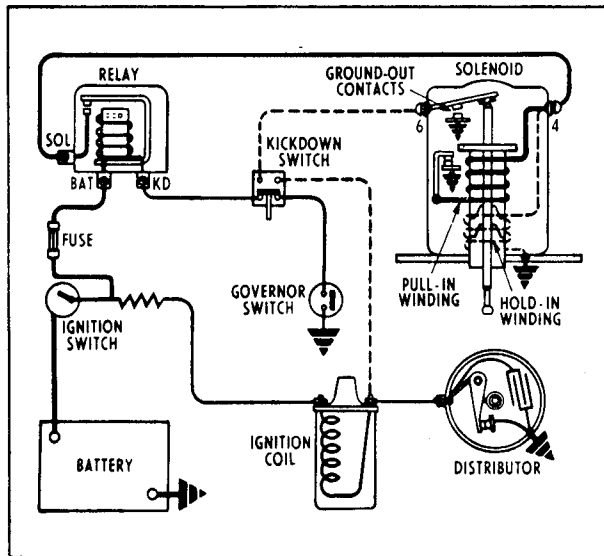


Fig. 28—Overdrive Electrical Circuit Wiring Diagram

normally closed. Another pair of contact points within the solenoid, also spring-loaded but normally open, are permitted to close by movement of the "pawl rod" when the overdrive becomes engaged. The pawl rod is a part of the solenoid plunger assembly which extends outside the solenoid case.

The end of this rod is shaped to interlock with a movable pawl (fig. 24) in the overdrive unit. Solenoid operation causes the pawl alternately to engage or disengage with a control plate which is a part of the overdrive unit. The control plate, when engaged by the pawl holds the sun gear of the overdrive unit against rotation to permit overdrive operations. The control plate, when not engaged by the pawl, rotates freely with the sun gear and conventional operation of the transmission is obtained.

### Governor

The governor switch mounted on the right side of the overdrive housing, is operated by centrifugal force. It prohibits overdrive operation until the car has reached a predetermined cut-in speed at which time the electrical contacts close.

### Relay

The solenoid relay mounted on the left front of the dash panel is essentially a switch which is operated electromagnetically. When current flows through a winding in the relay, contacts in the relay are closed by the magnetic pull created by the winding.

### Kickdown Switch

The kickdown switch is mounted on a bracket secured to a carburetor mounting stud. It is a mechanical switch containing two sets of electrical contacts. One set of contacts is normally open and the other normally closed. When this switch is actuated by the driver pushing the accelerator down to the wide open position, the normally-closed contacts are opened and the normally-open contacts are closed.

### WIRING

There are three separate circuits within the overdrive circuit (fig. 28); (1) control circuit, (2) solenoid circuit, and (3) ground-out circuit.

#### Control Circuit

The control circuit includes the relay winding and the electrical contacts located in the kickdown, and governor switches. Both sets of contacts must be closed to permit solenoid operation. When this circuit is completed, the relay becomes energized and the relay contacts close. As long as both sets of contacts remain closed, the relay contacts remain closed.

#### Solenoid Circuit

The solenoid circuit includes the relay contacts and the solenoid windings. With the closing of the relay contacts, the solenoid becomes energized and moves the pawl toward the slot in the control plate until blocked from further movement by the blocker ring within the overdrive gear case (fig. 24). The pawl becomes spring-loaded by the final movement of the solenoid plunger which compresses the pawl rod spring. Under these conditions, the blocker ring will slide from under the pawl whenever the driver momentarily lifts his foot off the accelerator. This brief reduction in engine torque allows the pawl to engage the control plate (fig. 24) and the overdrive becomes operative.

As the solenoid plunger completes its movement, it opens a set of contacts in series with the pull-in winding as already described. Since the hold-in winding alone is sufficiently strong to maintain the plunger in the "bottomed" position, the amount of current drawn by the solenoid thus is reduced during overdrive operation. As the pawl moves into engagement with the control plate, completion of the pawl rod travel permits closing of the spring-loaded solenoid contacts in series with the ground-out circuit. The overdrive system will remain in operation as long

as the solenoid remains energized. The relay opens and the solenoid is de-energized when the control circuit is broken at the kickdown, or governor switch.

#### Ground-Out Circuit

The ground-out circuit (dashed line, figure 28) is connected in parallel electrically with the distributor contact points and includes the normally-open contacts within the kickdown switch, as well as the normally-open solenoid contacts (connected to the No. 6 terminal of the solenoid) which close

as the overdrive becomes operative. When the kickdown switch is actuated during overdrive operation, the ignition coil primary winding is grounded through these two sets of contacts, and the control circuit is opened at the same time. The momentary grounding of the ignition circuit causes the engine to miss and, since the overdrive control circuit is open, allows disengagement of the overdrive. As the overdrive disengages and the pawl rod retracts, the ground-out circuit is opened within the solenoid and conventional car operation is resumed.

## MAINTENANCE, CARE AND ADJUSTMENTS

Servicing of the overdrive governor switch and pinion, the sun gear solenoid, oil seal and cable bracket, the output shaft rear oil seal, the control shaft lever, and the speedometer driven gear (fig. 20) may be accomplished without removing the overdrive from the vehicle, as discussed in the following paragraphs:

### GOVERNOR SWITCH AND PINION

To remove governor switch, disconnect wires at governor switch and screw governor out of housing, using tool J-4653 on the flat hexagonal surface of governor case. The pinion may be separated from the governor by removing the snap ring on the shaft.

### SUN GEAR SOLENOID, OIL SEAL AND CONTROL CABLE BRACKET

Remove the solenoid by taking out the two mounting bolts and lock washers, removing the cable bracket with the lower bolt. Turn the solenoid  $\frac{1}{4}$  turn and pull solenoid plunger out of adapter. The oil seal may be pried out of the adapter.

### OUTPUT SHAFT OIL SEAL

#### Removal

1. Remove nuts and U-bolts retaining rear universal joint trunnion bearings to the drive flange. Lower the rear of the propeller shaft and slide to the rear to bring the universal joint front flange off the output shaft.
2. Insert oil seal remover, tool J-5859 in oil seal and tap tool to seat it against shoulder in housing. Tighten set screw to spread tool, then hammer seal from housing.

#### Installation

1. Coat outside of new oil seal with a suitable sealant and start seal into bore in overdrive housing.
2. Using oil seal driver J-5154A, drive oil seal into bore.
3. Install propeller shaft by sliding universal joint front flange on output shaft and installing rear universal joint trunnion bearing nuts and U-bolts.

### CONTROL SHAFT LEVER AND OIL SEAL

To remove the control shaft oil seal, disconnect the control cable, remove tapered pin and pull lever out. Then pry out oil seal with a sharp punch.

Coat outside of new oil seal with suitable sealant and start seal straight into counterbore in housing. Using a suitable driver having an outside diameter of  $1\frac{5}{16}$ " , drive seal into place. Insert shaft through seal and install tapered pin. Connect control wire to lever and adjust (see Overdrive Housing Installation, page 28).

### SPEEDOMETER DRIVEN GEAR

Disconnect speedometer cable, remove lock plate to housing bolt and lock washer and remove lock plate. Insert screw driver in lock plate slot in fitting and pry fitting, gear and shaft from housing. Pry "O" ring from groove in guide.

Install new "O" ring in groove in fitting and insert shaft.

Hold the assembly so slot in fitting is toward lock plate boss on housing and install in housing. Push fitting into housing until lock plate can be inserted in groove and attached to housing.



## MAJOR SERVICE OPERATIONS

With the overdrive assembly removed from the transmission, service operations on the transmission proper are the same as for the standard three-speed transmission.

Repairs to the overdrive housing, output shaft, ring gear assembly, clutch cam, roller retainer, pinion cage, sun gear, shift rail, sun gear control plate, output shaft bearing, oil seal, speedometer drive gear, solenoid pawl and interlock plunger may be performed underneath the car by removing the overdrive housing without disturbing the transmission.

If the transmission mainshaft, overdrive adapter or transmission rear bearing which is retained in adapter require replacement, the entire transmission and overdrive assembly should be removed and overhauled on the bench.

**NOTE:** Due to X-member interference on convertible models, the transmission and overdrive assembly must be removed.

### OVERDRIVE HOUSING

#### Removal

1. Place car on stand jacks.
2. Remove drain plugs and drain transmission and overdrive.
3. Disconnect wires from solenoid and from governor switch.
4. Disconnect speedometer cable from driven gear fitting.
5. Remove nuts and U-bolts retaining rear universal joint trunnion bearings to the drive flange. Lower the rear of the propeller shaft and slide shaft to rear to bring the universal joint front flange off the output shaft.
6. Remove speedometer driven gear fitting, gear and shaft.
7. Disconnect control cable from control lever.
8. Drive out the control shaft tapered pin (fig. 29) and pull control shaft out.
9. Remove seven bolts and lock washers at-

taching the overdrive housing to the transmission case and adapter.

10. Pull overdrive housing including overdrive output shaft and ring gear assembly to rear, being careful to keep adapter from pulling away from transmission case (fig. 30) (catch the clutch rollers as they drop out of the retainer).

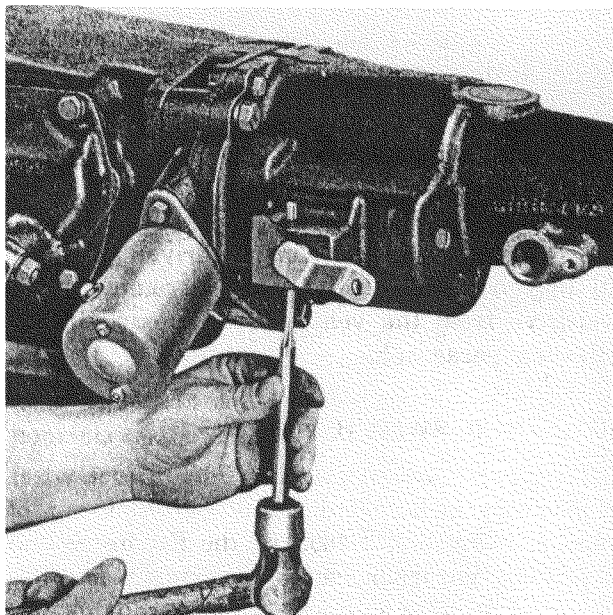


Fig. 29—Removing Control Shaft Tapered Pin

**CAUTION:** If adapter moves away from transmission case the transmission mainshaft pilot needle bearings will drop out of clutch gear and necessitate disassembly of transmission.

11. Remove gasket from adapter and install one

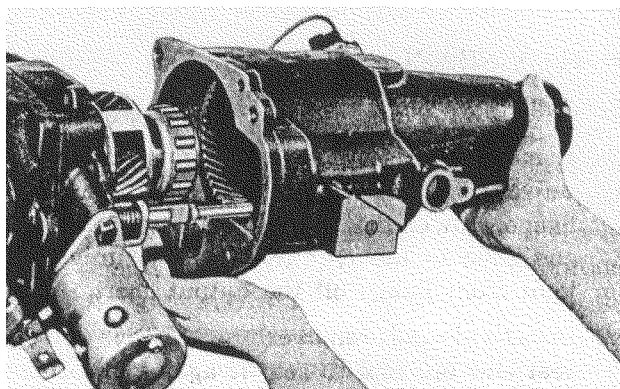


Fig. 30—Removing Overdrive Housing and Shaft Assembly

bolt removed from housing to hold the adapter to the transmission case.

### Disassembly

1. Remove governor and pinion if not previously removed.
2. Pierce plug in rear bearing snap ring access hole in top of housing and pry plug out of housing.
3. Spread rear bearing snap ring with snap ring pliers and lightly tap end of shaft with a soft hammer to free bearing from snap ring (fig. 31), then pull shaft, including ring gear, speedometer drive gear and rear bearing, from housing.

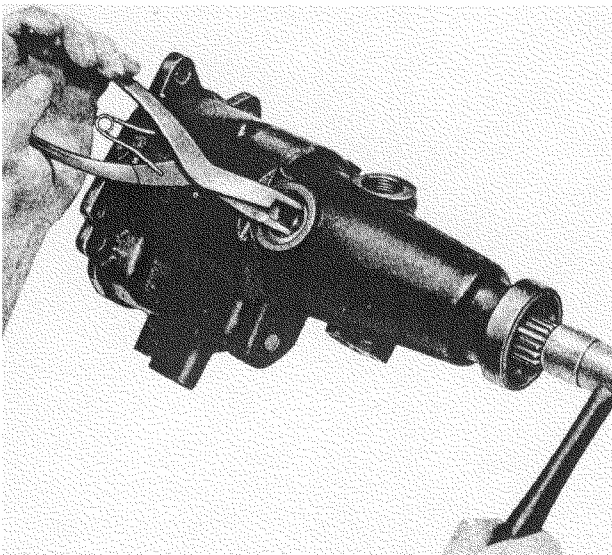


Fig. 31—Removing Output Shaft from Housing

4. Remove shift rail retractor spring from housing.
5. Remove output shaft rear bearing snap ring from housing.
6. Press bushing from rear of housing, using tool J-5778.
7. Remove ring gear snap ring (large) and slide ring gear off shaft (fig. 32). The oil collector ring is spun securely to the shaft to form an oil tight seal.
8. Remove speedometer drive gear (small) snap ring from output shaft.
9. Support front face of bearing and tap end of shaft to start speedometer drive gear off shaft. If necessary to use arbor press to start gear (fig. 33) do not press shaft more than

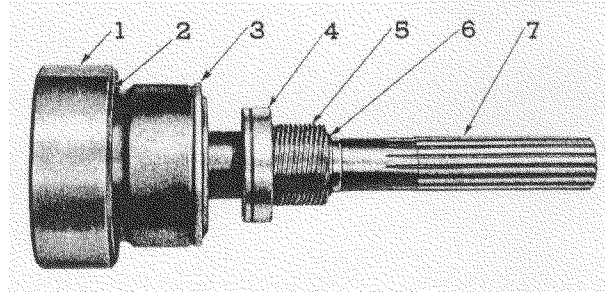


Fig. 32—Overdrive Output Shaft Assembly

- |                       |                           |
|-----------------------|---------------------------|
| 1. Ring Gear          | 5. Speedometer Drive Gear |
| 2. Snap Ring          | 6. Snap Ring              |
| 3. Oil Collector Ring | 7. Output Shaft           |
| 4. Rear Bearing       |                           |

$\frac{3}{8}$ " through bearing or woodruff key in shaft may gouge bearing. Pull gear off shaft.

10. Remove woodruff key and slide bearing off shaft.

### Cleaning and Inspection

As each part is removed from the housing assembly, wash in cleaning solvent, dry, and protect from subsequent dirt accumulation.

Inspect housing, shift rail retractor spring, snap rings, gears and bearings for cracks, defects or damage and substitute new parts where necessary.

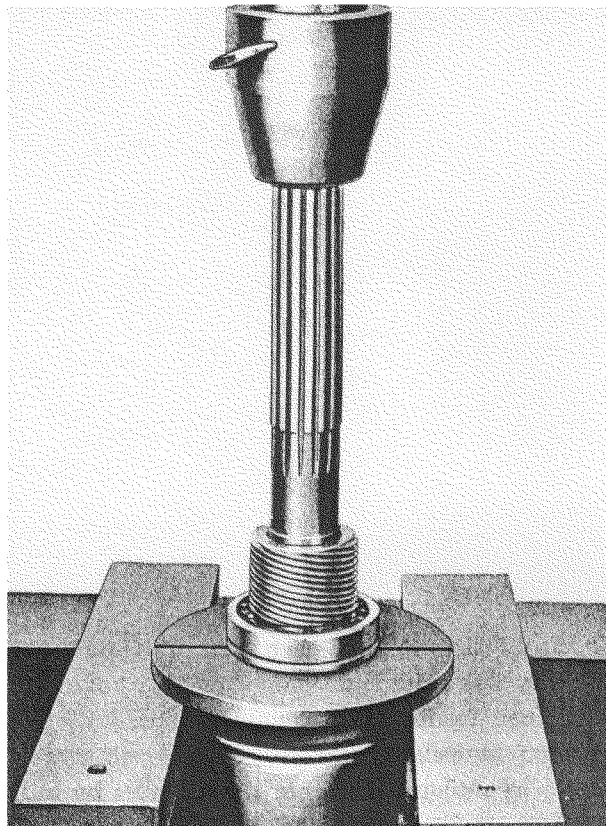


Fig. 33—Removing Speedometer Drive Gear

If clutch rollers show surface markings of any kind they should be replaced.

A general inspection of the overdrive parts remaining on the transmission mainshaft, particularly the clutch cam and roller retainer assembly and the shift rail and fork assembly, should be made at this time.

### Assembly

1. Slide rear bearing straight on shaft with snap ring slot in bearing closer to ring gear end of shaft.
2. Install woodruff key in shaft, start speedometer drive gear onto shaft and align keyway in gear with key in shaft. Tap gear tight against bearing and install small snap ring.
3. Engage ring gear on teeth of overdrive shaft and install large snap ring in ring gear.
4. Using tool J-5778, press bushing into housing flush with bore for seal.
5. Install output shaft rear bearing snap ring in slot in housing.
6. Install shift rail retractor spring inside housing and insert long  $\frac{3}{8}$ " drift pin through spring to align spring with holes in housing.
7. Slide output shaft assembly into housing until rear bearing contacts snap ring. Spread snap ring and push shaft in until snap ring engages bearing.
8. Install new plug in snap ring access hole in top of housing.

### PARTS AT REAR OF ADAPTER

#### Removal

1. Remove overdrive housing, output shaft and ring gear assemblies as outlined in preceding pages.
2. Pull "U" clips at each end of clutch cam (fig. 34) and slide the cam and roller retainer from pinion cage hub and transmission mainshaft. If roller retainer or cam is to be replaced separate these pieces by pulling retainer out until the hooked ends of spring can be pulled out of holes in cam.

3. Slide pinion cage assembly off sun gear and mainshaft.
4. Remove sun gear and shift rail assemblies from shaft (fig. 35). Shift rail collar may be separated from sun gear by removing snap

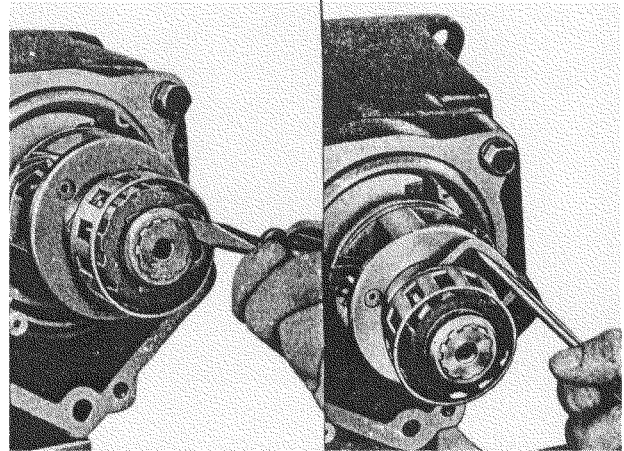


Fig. 34—Removing Clutch Cam Retaining Clips

rings at either end of collar. Shift rail, fork, and spring may be separated by removing snap ring between cupped washer and shift fork.

5. Remove sun gear solenoid, oil seal and cable bracket (fig. 36).
6. Remove large snap ring from adapter (fig. 37) and remove sun gear control plate retainer. Then slide control plate and blocker ring out of adapter (fig. 38). If control plate

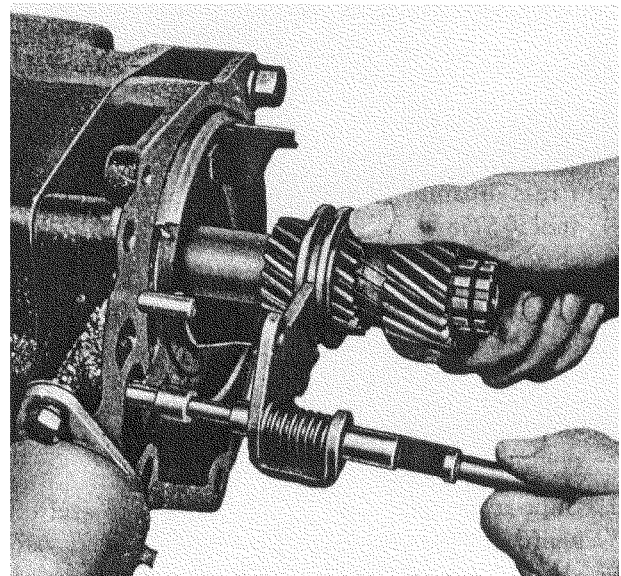


Fig. 35—Removing Sun Gear and Shift Rail Assemblies

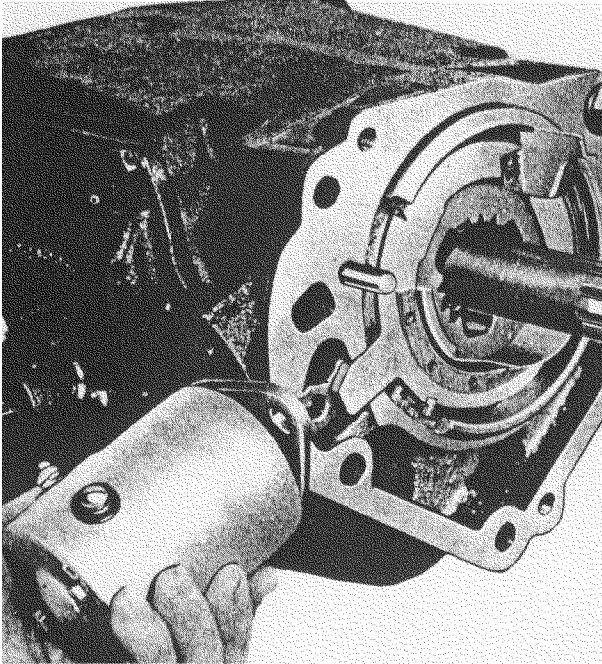


Fig. 36—Removing Solenoid

or blocker ring is to be replaced they may be separated by pulling blocker ring off plate.

7. Lift sun gear pawl out of adapter.

### Cleaning and Inspection

As each part is removed from the rear of the transmission, wash in cleaning solvent, dry, and protect from subsequent dirt accumulation.

1. Inspect "U" clips, control plate retainer, control plate, blocker ring and pawl for defects or damage and substitute new parts where necessary.

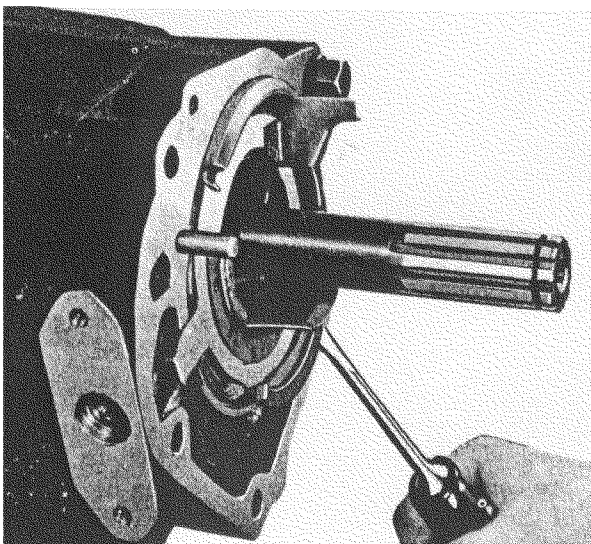


Fig. 37—Removing Control Plate Retainer Snap Ring

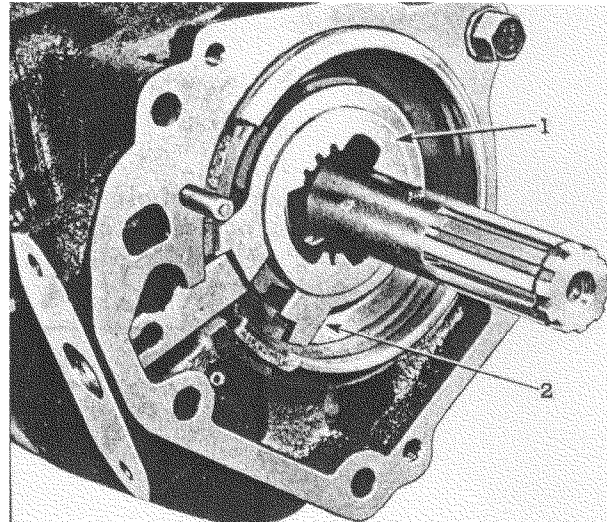


Fig. 38—Control Plate, Blocker Ring and Pawl Positions for Assembly

1. Control Plate

2. Blocker Ring

2. Inspect the fit and tension of the blocker ring on hub as follows:

- a. Push one end of ring toward the other. The ring should grip and hold to the hub. If the ring does not hold when correctly installed (flat surface of ring facing out), it should be replaced.
- b. Push one end of ring away from opposite end and check the frictional drag required to slide the ring around the hub as follows:

- (1) Hold one lug of control plate in a soft jawed vise and hook a spring balance

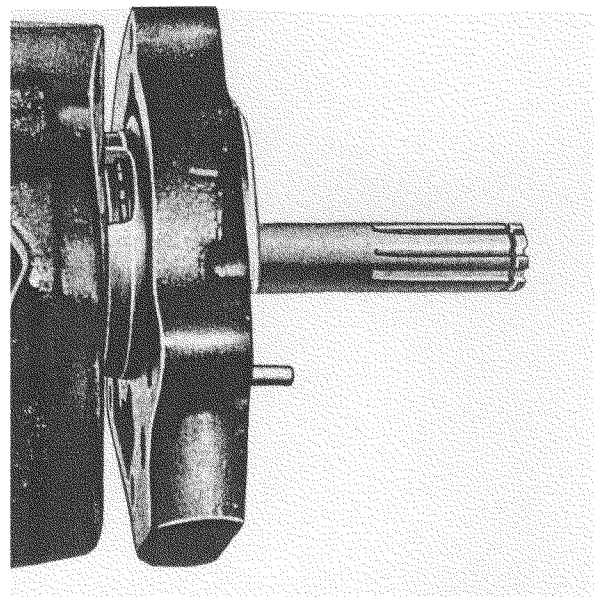


Fig. 39—Removing Adapter from Transmission Case

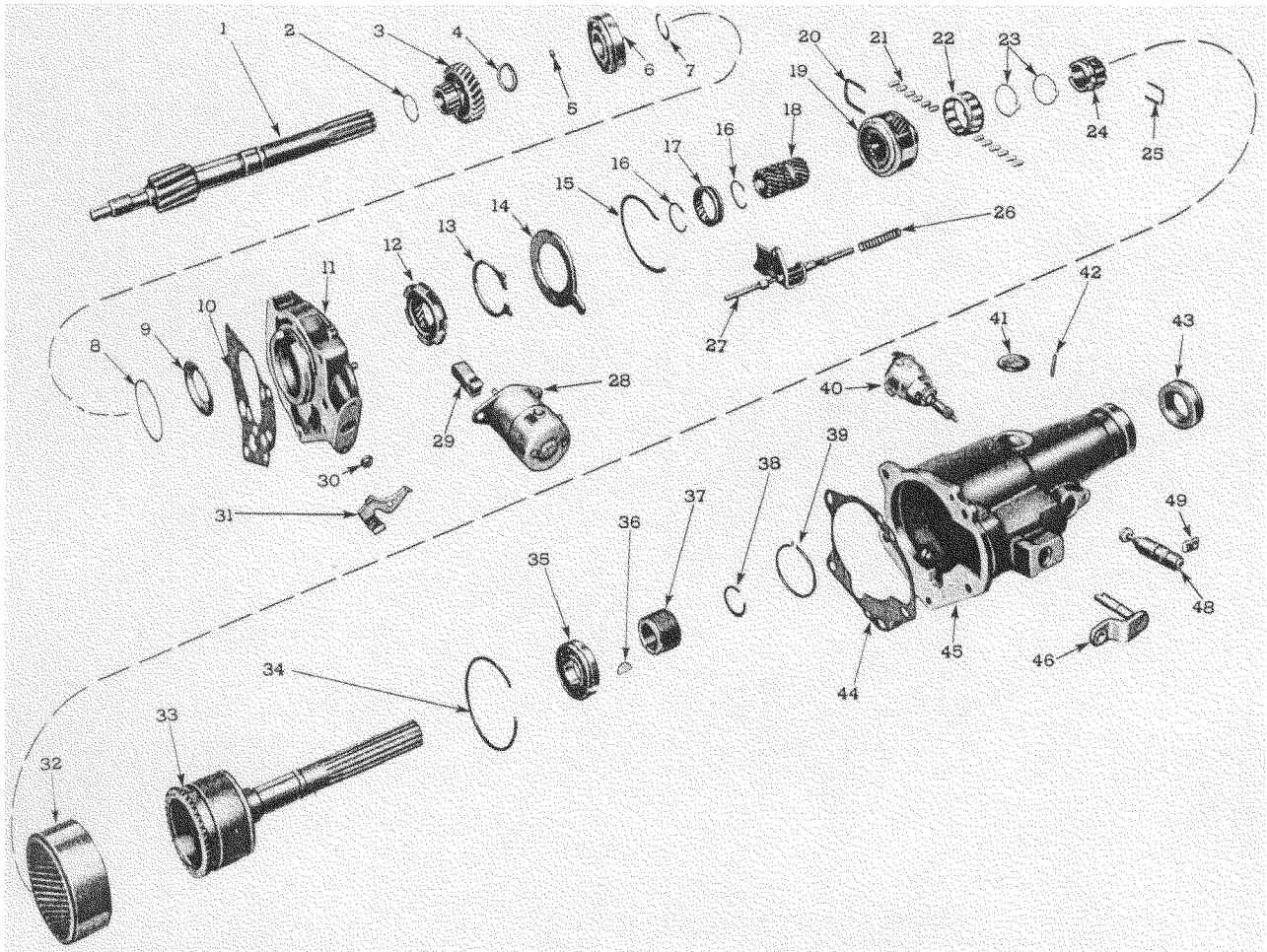


Fig. 40—Layout of Overdrive Parts

- |  |   |   |
|--|---|---|
| <ul style="list-style-type: none"> <li>1. Transmission Mainshaft</li> <li>2. Energizing Spring</li> <li>3. Second Speed Gear</li> <li>4. Thrust Washer</li> <li>5. Thrust Washer Drive Pin</li> <li>6. Mainshaft Bearing</li> <li>7. Snap Ring</li> <li>8. Snap Ring</li> <li>9. Oil Baffle</li> <li>10. Gasket</li> <li>11. Adapter</li> <li>12. Sun Gear Control Plate</li> <li>13. Blocker Ring</li> <li>14. Control Plate Retainer</li> <li>15. Control Plate Retainer Snap Ring</li> <li>16. Shift Rail Collar Snap Ring</li> </ul> | <ul style="list-style-type: none"> <li>17. Shift Rail Collar</li> <li>18. Sun Gear</li> <li>19. Pinion Cage Assembly</li> <li>20. Cam Retaining "U" Clip (Large)</li> <li>21. Cam Rollers</li> <li>22. Cam Roller Cage</li> <li>23. Roller Cage Retracting Spring</li> <li>24. Free-Wheeling Cam</li> <li>25. Cam Retaining "U" Clip (Small)</li> <li>26. Shift Rail Retractor Spring</li> <li>27. Shift Rail Assembly</li> <li>28. Sun Gear Solenoid</li> <li>29. Sun Gear Pawl</li> <li>30. Sun Gear Pawl Rod Oil Seal</li> <li>31. Control Cable Bracket</li> <li>32. Ring Gear</li> </ul> | <ul style="list-style-type: none"> <li>33. Output Shaft</li> <li>34. Ring Gear Snap Ring</li> <li>35. Output Shaft Bearing</li> <li>36. Woodruff Key</li> <li>37. Speedometer Drive Gear</li> <li>38. Drive Gear Snap Ring</li> <li>39. Bearing Snap Ring</li> <li>40. Governor Switch</li> <li>41. Plug</li> <li>42. Control Shaft Locating Pin</li> <li>43. Oil Seal</li> <li>44. Gasket</li> <li>45. Overdrive Housing</li> <li>46. Shift Rail Control Shaft and Lever</li> <li>48. Speedometer Driven Gear and Fitting</li> <li>49. Lock Plate</li> </ul> |
|--|---|---|

into the notch of the nearest blocker ring lug (fig. 41).

- (2) Measure the pull required to rotate the ring after it has started moving. The pull should be 4-6 pounds on new parts, which will fall to 1-1½ pounds when thoroughly broken in. While low friction may be corrected by squeezing the ring together for a tighter fit, installation of new parts is recommended.

- 3. Inspect the clutch cam and if the 12 flat surfaces show slight lengthwise indentations, replace the cam. If rollers show markings of any kind, they should all be replaced.
- 4. Test the tension of the cam retaining springs after the assembly has been thoroughly washed. (The springs are designed to twist the cam to return the rollers to the high side of the cam). Hold hub of cam and turn roller retainer counterclockwise, then release retainer. The retainer should snap back

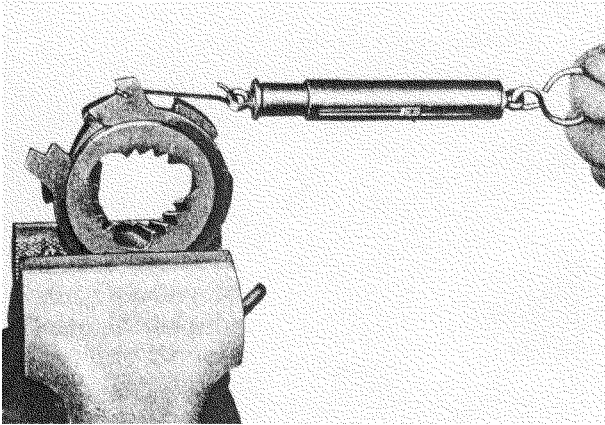


Fig. 41—Measuring Blocker Ring Tension

quickly. If the action is slow or retarded, replace the springs or the complete assembly.

**NOTE:** If the spring tension is weak or retarded, the unit will free-wheel at all times.

- When installing springs be sure both springs are coiled in the same direction (clockwise when looking toward flanged end of retainer), with "S" end of springs hooked into holes in retainer (fig. 42) and opposite ends hooked into holes in cam.

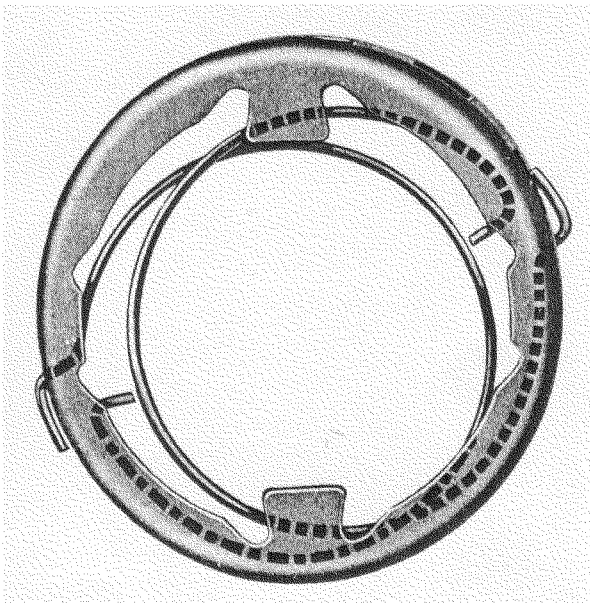


Fig. 42—Installation of Cam Roller Retaining Springs

- Inspect the shift rail, fork, and spring for cracks, burrs or damage and replace defective parts.
- When shift rail, fork and spring are assembled, make sure the parts bear the correct

relationship as shown in fig. 43, with snap ring inside cupped washer.

#### Installation

- Insert sun gear pawl in adapter with notched side up.
- If blocker ring was removed from control plate, position ring on plate with flat surface of ring facing out, then start the assembly over transmission mainshaft with ring

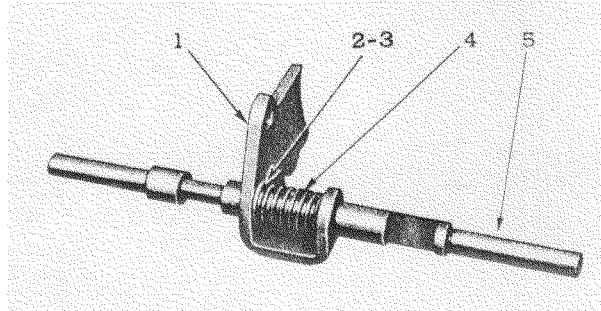


Fig. 43—Shift Rail, Fork and Spring Assembly

- |         |              |               |           |
|---------|--------------|---------------|-----------|
| 1. Fork | 2. Snap Ring | 3. Washer     | 4. Spring |
|         |              | 5. Shift Rail |           |

toward rear. Slide the assembly into position with slot in ring toward sun gear pawl (fig. 38).

- Slide control plate retainer over mainshaft, against control plate and install snap ring in adapter.
- Install solenoid oil seal, solenoid, and cable bracket.
- Start the sun gear onto the mainshaft. Hold shift rail so arm of fork fits in collar on sun gear and forward end of shift rail enters opening in adapter and transmission case (fig. 35). Slide both assemblies forward so pin in adapter locates the fork, and sun gear engages control plate.
- Install pinion cage assembly over mainshaft and sun gear, turning cage assembly clockwise to engage sun gear.
- If free wheeling cam and roller retainer were separated, assemble these parts by positioning springs so both are coiled clockwise when looking at flanged end of retainer (fig. 42), then place retainer over slotted end of cam, hook free ends of springs in holes in cam, turn retainer clockwise and push springs into place around cam.
- Slide cam and roller retainer assembly over mainshaft and pinion cage hub. Install "U" clips at each end of free wheeling cam.

## OVERDRIVE HOUSING

### Installation

1. Snap a tight fitting rubber band around clutch cam roller retainer, insert rollers under rubber band in retainer and, with low gear of transmission engaged, turn retainer and rollers counterclockwise until rollers are in their low position.
2. Remove the one bolt holding adapter to transmission case and install gasket on case.
3. Position shift rail so flat for control shaft faces outward, then start housing, output

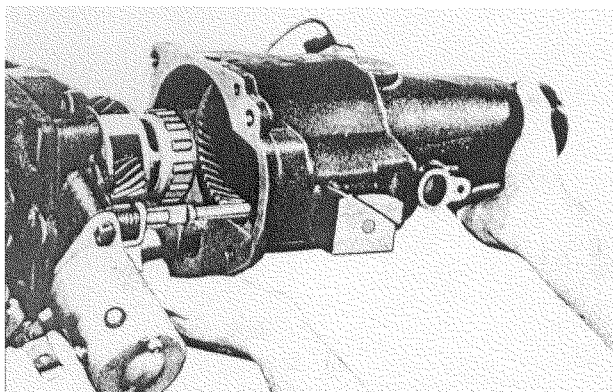


Fig. 44—Installing Housing and Shaft Assembly

shaft and ring gear assembly into place with shift rail entering spring in housing (fig. 44). Slide housing against adapter. Install seven bolts and lockwashers to adapter and case.

4. Install control shaft lever oil seal, shaft and lever and connect control wire to lever.

**NOTE:** Bolt and swivel must be installed with head, or large end, facing away from housing to assure swivel action.

5. Adjust control wire as follows:
  - a. Pull dash control knob out  $\frac{1}{4}$ ".
  - b. Move control lever all the way to the rear.
  - c. Tighten nut and bend control wire at right angle.
6. Install governor assembly and speedometer driven gear, shaft and fitting.
7. Install propeller shaft.

### Lubrication

The transmission and overdrive unit are connected with oil passages so the same oil is used for both. However, the following precautions must be used in the filling, in order that the proper amount of oil may be carried.

1. In making the initial filling, first fill the overdrive unit with the proper oil, until oil runs out the filling hole, then replace plug. Fill the transmission with the same type of oil, until oil runs out the filling hole, then replace plug.
2. In subsequent filling (at each chassis lubrication), inspect the transmission only, for oil level, and fill as necessary.

## ELECTRICAL UNIT CHECKS

### OVERDRIVE RELAY

The operation and purpose of this relay is discussed within the write-up on the Overdrive Circuit and its operation. Specifications and checking procedures for this relay are as follows:

#### Specifications\*

Air Gap .....	.011 inch minimum
Point Opening .....	.025 inch
Closing Voltage .....	8.3-10.7 volts
Armature Sealing	
Voltage .....	11.2 volts maximum

\*Preliminary figures subject to revision.

Three checks and adjustments are required on the overdrive relay: air gap, point opening and closing voltage. The air gap and contact point opening checks and adjustments should be made with the battery disconnected.

#### Air Gap

The air gap should not normally require adjustment unless the relay has been misadjusted. Check the air gap with the points barely touching and adjust if necessary by bending the lower point support (fig. 45).

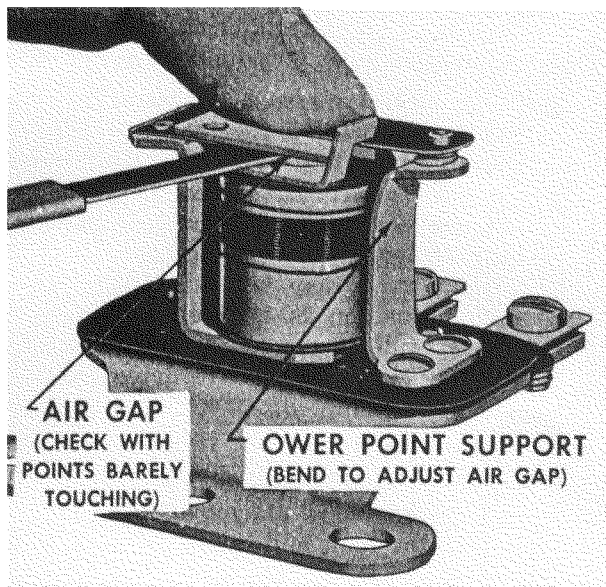


Fig. 45—Checking Relay Air Gap

#### Point Opening

Check the contact point opening and adjust by bending the upper armature stop (fig. 46).

#### Closing Voltage

To check the relay closing voltage, connect a potentiometer or variable resistance of sufficient value (not less than 50 ohms) in series with the "KD" terminal, connect a voltmeter to the

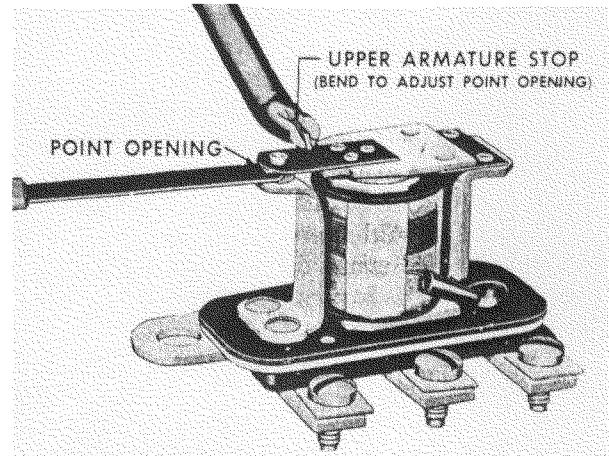


Fig. 46—Adjusting Relay Point Opening

"IGN" and "KD" terminals. With the ignition switch on, slowly decrease the amount of resistance in order to check the relay closing voltage (the overdrive solenoid and relay should click when the relay closes). Adjust the closing voltage by bending the armature spring post (fig. 47). Bend down to increase the closing voltage and bend up to decrease the closing voltage.

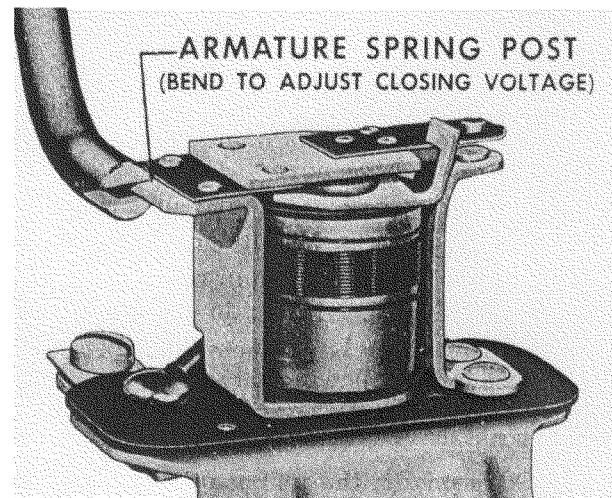


Fig. 47—Adjusting Relay Closing Voltage

To check the sealing voltage, increase the voltage after the relay closes until the armature seals against the core. Decrease the sealing voltage by reducing the relay air gap.

### SOLENOID

#### Closing Coil

Remove solenoid from transmission, connect a jumper wire between positive terminal of battery and mounting flange of solenoid. Connect a second jumper wire between the battery negative terminal and solenoid terminal No. 4; this should



cause the solenoid pawl to move out. If solenoid chatters, Hold-In Coil is defective.

#### Engaging Spring

With jumper wire connected as in paragraph above, (solenoid energized, plunger extended) place ball end of solenoid against bench. Push down on solenoid. The pawl rod should move in  $\frac{3}{8}$ " under a load of not less than 8 lbs. nor more than 12. Pawl should move out to extended position when load is removed.

#### Ignition Grounding Contact

Place a test lamp between negative battery terminal and solenoid terminal No. 6. Lamp should light when this connection is made. Remove jumper from between negative battery terminal and solenoid terminal No. 4. Pawl rod should snap "in" and test lamp should go out.

#### GOVERNOR SWITCH

Remove overdrive wire at governor and connect test lamp between governor overdrive termi-

nal and negative terminal of battery. Drive car on road or raise on jacks. The lamp should light at a car speed of between 26 to 30 mph. Upon decreasing speed, the lamp should go out at between 28 and 23.5 mph. The car speed differential between light "on" and light "off" should be 2 or 3 mph.

#### KICKDOWN SWITCH

Disconnect wires at kickdown switch and install test harness to kickdown switch but do not connect test harness to overdrive harness.

1. Connect test lamp between "SW" terminal and negative terminal of battery; with switch in normal position, lamp should light when "REL" terminal is grounded but should not light when "IGN" or "SOL" terminals or switch case is grounded.
2. Connect test lamp between "IGN" terminal and negative terminal of battery; with switch stem pushed in, lamp should light when "SOL" terminal is grounded, but should not light when "SW" or "REL" terminals or switch case is grounded.

## TRANSMISSION — OVERDRIVE

### TROUBLES AND REMEDIES

#### MECHANICAL

Any one of the following general complaints may be due to non-standard mechanical conditions in the overdrive unit:

1. Does not drive unless locked up manually.
2. Does not engage, or lock-up does not release.
3. Engages with a severe jolt, or noise.
4. Free-wheels at speeds over 30 mph.

These troubles may be diagnosed and remedied as described in the following paragraphs.

1. **Does not drive unless locked up manually.**
  - a. Occasionally, the unit may not drive the car forward in direct drive, unless locked up by pulling the dash control. This may be caused by one or more broken rollers in the roller clutch, the remedy for which is the replacement of the entire set of rollers.
  - b. This may also be caused by sticking of the roller retainer upon the cam. This retainer must move freely to push the rollers into engaging position, under the pressure of the two actuating springs.
  - c. Sometimes this is due to slight indentations, worn in the cam faces by the rollers spinning, remedied by replacement of the cam.

2. **Does not engage, or lock-up does not release.**

- a. Dash control improperly connected—Unless the overdrive dash control wire is connected to the lockup lever on the left side of the overdrive housing in such a manner as to move the lever all the way back when the dash control knob is pushed in, it may hold the shift rail in such a position as to interlock the pawl against full engagement resulting in a buzzing noise when overdrive engagement is attempted.

To correctly make this connection, loosen binding post at lever, pull dash control knob out  $\frac{1}{4}$  in., move lever all the way to the rear, and tighten binding post.

- b. Transmission and overdrive improperly aligned—The same symptoms as above may also result from misalignment, at assembly, of the overdrive housing to the transmission case, resulting in binding of the overdrive shift rail, so that the retractor spring cannot move the rail fully forward, when the dash control knob is pushed in, and the transmission is not in reverse. Under such conditions, the unit may remain fully locked up.

To test for this, be sure that the transmission is not in reverse; disconnect the dash control wire from the lockup lever, and feel the lever for free forward movement. If the lever can be moved forward more than  $\frac{1}{4}$  in., it indicates that misalignment probably exists. To correct this, loosen the capscrews between the overdrive housing and transmission case, and tap the adapter plate and overdrive housing until a position is found where the rail shifts freely; tighten capscrews.

- c. Kickdown switch improperly adjusted—The position of the kickdown switch should be adjusted, by means of the two large nuts which clamp the switch shank, so the switch plunger travels  $\frac{3}{16}$  in. before the throttle lever touches its stop.
- Occasionally the large nuts which clamp the switch through the switch bracket are tightened sufficiently to bend the switch shank, thus preventing free motion of the switch stem. This may usually be remedied by loosening the upper of the two nuts.
- d. Improper installation of solenoid—If car cannot be rolled backward under any circumstances and there is no relay click when the ignition is turned on, it probably indicates that the solenoid has been installed directly, without twisting into the bayonet lock between solenoid stem and pawl, thus jamming the pawl permanently into overdrive engagement. If the car will occasionally roll backwards, but not always, (and there is no relay click when the ignition switch is turned on) it may indicate that, upon installation, the bayonet lock was caught, and the solenoid forcibly twisted into alignment with the attaching flange, thus shearing off the internal keying of the solenoid. Under these circumstances, the end of the solenoid stem may not catch in the pawl, and upon release of the solenoid, the pawl will not be withdrawn promptly from engagement, but may simply drift out. If the solenoid stem end has its two flats exactly facing the two solenoid flange holes, it will not withdraw the pawl properly. If the stem can be rotated when grasped by a pair of pliers, it indicates that the internal keying has been sheared.
- e. Improper positioning of blocker ring—Occasionally, either in assembly at the factory, or in service operations in the field, the internal parts of the overdrive

unit may have been rotated with the solenoid pawl removed, causing the blocker ring to rotate, so that its two lugs are not located with respect to the pawl as shown in figs. 24 and 38. In other words, the solid portion of the blocker ring may be in alignment with the pawl, which will prevent full engagement of the pawl with the sun gear control plate.

To test for this condition, remove solenoid cover, pull dash control knob out, roll car 2 ft. forward. Push dash control in, turn ignition switch on. Then ground the "KD" terminal of relay, and watch movement of center stem of solenoid. It should not move more than  $\frac{1}{8}$  in. when the solenoid clicks. Then, with the relay terminal still grounded, shift into low gear, and roll car forward by hand. Solenoid stem should then move an additional  $\frac{3}{8}$  in., as the pawl engages fully. These two tests indicate proper blocker action. Unless both tests are met, the blocker ring is probably not in the correct position.

### 3. Engages with a severe jolt or noise.

Insufficient blocker ring friction may cause the ring to lose its grip on the hub of the sun gear control plate. Check the fit and tension of the ring as described under "Cleaning and Inspection."

### 4. Free-wheels at speeds over 30 mph.

If cam roller retainer spring tension is weak the unit will free-wheel at all times. Check spring action as described under "Cleaning and Inspection."

## ELECTRICAL

Any one of the following general complaints may be due to electrical trouble in the overdrive circuit.

1. Does not engage.
2. Does not release.
3. Does not kickdown from overdrive.

These troubles may be traced and remedied as described in the following paragraphs.

### 1. Does not engage.

- a. With the ignition switch on, ground the "KD" terminal of the solenoid relay with a jumper lead. If the solenoid clicks, the relay and solenoid circuits are in operating condition. If no click is heard in the relay, check the fuse and replace if defective.

- b. If the fuse is good, use a second jumper lead to connect the "SOL" and "BAT" terminals of the relay. If a click is now heard in the solenoid, the relay is probably at fault and should be repaired or replaced.
  - c. If the solenoid does not click in Step b, check the wiring to the No. 4 terminal of the solenoid and replace if necessary. If the wiring is not defective, the trouble is probably in the solenoid. Remove the solenoid cover, examine the solenoid contacts in series with the pull-in winding and clean if necessary. Test again for clicks, as in Step b, after replacing solenoid cover and lead wires. Replace the solenoid if trouble has not been corrected.
  - d. If the relay and solenoid circuits are in good condition as determined in Step a, leave the ignition switch on and make sure the manual control knob is in the overdrive position. Ground one and then the other of the two terminals next to the stem of the kickdown switch (identified as "SW" and "REL"). If the solenoid clicks when one terminal is grounded but not the other, replace the switch. If the solenoid does not click when either of the terminals is grounded, check the wiring between the relay and the kickdown switch and replace if defective.
  - e. If the solenoid clicks as each terminal is grounded in Step d, ground the governor switch terminal. If the solenoid clicks, the governor switch may be defective. If the solenoid does not click, check the wiring between the kickdown and governor switches and replace if necessary.
- 2. Does not release**
- a. Remove the connection to the "KD" terminal of the relay. If this releases overdrive, look for a grounded control circuit between the relay and governor switch.
  - b. If the overdrive is not released in Step a, disconnect the lead to the "SOL" terminal of relay. If this releases the overdrive, replace the relay.
- 3. Does not kickdown from overdrive**
- a. With the engine running, connect a jumper lead between the No. 6 terminal of the solenoid and ground. Operate the kickdown switch by hand. This should stop the engine. If it does, the solenoid is probably defective and it should be checked for dirty ground-out contacts or other defects within the ground-out circuit of the solenoid (fig. 28). Clean the contacts or replace the contact plate as required.
  - b. If the engine does not stop in Step a, ground one and then the other of the two terminals (Identified as "IGN" and "SOL") farthest from the stem of the kickdown switch. The engine should stop when one of the two terminals (IGN) is grounded. If the engine does not stop when either of the terminals is grounded, the wiring or connections to the switch between the switch and coil are defective. When the other terminal (SOL) is grounded, the engine should stop when the kickdown switch is operated. If the engine does not stop when the kickdown switch is operated with the second terminal grounded, the kickdown switch is defective. If the trouble is in the kickdown switch, adjust the linkage to give more travel of the switch rod. If this does not correct the trouble, replace the kickdown switch.  
 If the kickdown switch operates as it should, check for an open circuit in the wiring between the kickdown switch and the No. 6 terminal of the solenoid.
  - c. If the trouble is not located by the above checks, the upper contacts of the kickdown switch may not be opening. To check for this condition, ground the overdrive control circuit at the governor switch. This should cause the solenoid to click. Operate the kickdown switch by hand. This should cause a second click as the solenoid releases. If there is no second click, adjust the linkage to give more travel of the switch rod. If this does not correct the trouble, replace the kickdown switch.

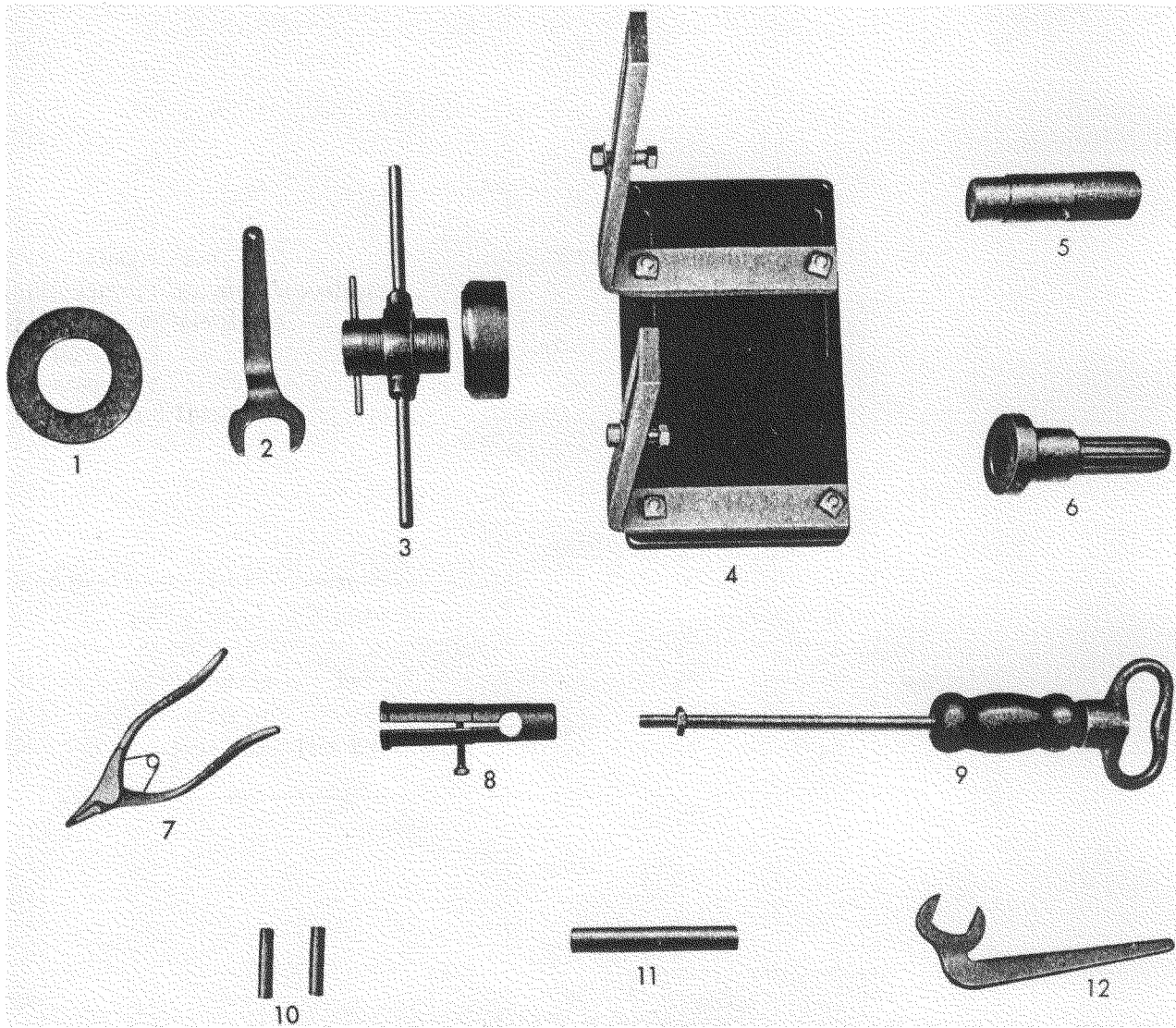


Fig. 48—Transmission and Overdrive Special Tools

- |   |  |
|---|--|
| 1. Clutch Gear Bearing Remover—J-936                      | 7. Synchronizer Ring Retaining Spring Remover and Replacer—J-932 |
| 2. Clutch Gear Bearing Retainer Wrench—J-933              | 8. Extension Housing Oil Seal Remover—J-5859                     |
| 3. Clutch Gear and Bearing Puller—J-937                   | 9. Slide Hammer Assembly—J-2654                                  |
| 4. Transmission Holding Fixture—J-5750                    | 10. Transmission Guide Pins—J-1126                               |
| 5. Extension Housing Bushing Remover and Installer—J-5778 | 11. Countergear Assembly Tool—J-5777                             |
| 6. Rear Bearing Retainer Seal Installer—J-5154A           | 12. Overdrive Governor Wrench—J-4653                             |

# SPECIFICATIONS

## (THREE-SPEED TRANSMISSION)

**Type**

Selective Synchromesh

**Speeds**

Three forward—one reverse.

**Location**

In unit with engine

**Gears—Type**

All helical

**Bearings**

Clutch Gear .....Ball Bearing  
 Countershaft .....50 Rollers— $\frac{1}{8}$ " Dia. x  $\frac{3}{4}$ "  
 Idler Gear Thrust .....Radial Needle

**Mainshaft**

Front Pilot .....14 Rollers— $\frac{3}{16}$ " dia. x  $\frac{33}{64}$ "  
 Rear Pilot .....24 Rollers— $\frac{1}{8}$ " dia. x  $\frac{1}{2}$ "  
 Mainshaft Rear .....Ball Bearing  
 Reverse Idler Bushing (front and rear) Bronze

**Gear Ratio: 1**

1st.	2nd.	3rd.	Rev.	Engine
2.94	1.68	1.00	2.94	L-6, 235 cu. in.
2.94	1.68	1.00	2.94	All with overdrive
2.47	1.53	1.00	2.80	V-8, 283 cu. in.
2.21	1.32	1.00	2.51	V-8, 348 cu. in.

**Service Data**

Mainshaft Rear Bearing End Play... .003" max.  
 Reverse Idler Gear Bushing  
 Clearance ..... .002"-.004"  
 Second Speed Gear End Play ... Approx. .010"