2008 TRANSMISSION

Manual Transmission - Tremec 5-Speed (TZ0)

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Anchor Support Screw	18-37 N.m	13-27 lb ft
Backup Lamp Switch	16-22 N.m	12-16 lb ft
Bearing Retainer Screw	16-27 N.m	12-20 lb ft
Case to Extension Bolt	24-38 N.m	18-28 lb ft
Clutch Actuator Bolts	8 N.m	71 lb in
Clutch Cover Screws	8-10 N.m	71-89 lb in
Clutch Housing Cover Bolts	24-38 N.m	18-28 lb ft
Control Tower Screw	11-17 N.m	8-13 lb ft
Drive Shaft Bearing Retainer Bolt	16-27 N.m	12-20 lb ft
Feed Support Screw	16-27 N.m	12-20 lb ft
Lining to Case Bolt	24-38 N.m	18-28 lb ft
Oil Drain Plug	16-27 N.m	12-20 lb ft
Oil Fill Plug	16-27 N.m	12-20 lb ft
Reverse Axle Pin Bolt	24-30 N.m	18-22 lb ft
Reverse Switch	16-22 N.m	12-16 lb ft
Shift Boot Screws	2 N.m	18 lb in
Shift Lever Nut	47 N.m	35 lb ft
Shift Tower Bolt	11-17 N.m	8-13 lb ft
Speed Sensor Screw	16-22 N.m	12-16 lb ft
Transmission Mount Bolt	50 N.m	37 lb ft
Transmission Mount Nut	45 N.m	33 lb ft
Transmission-to-Engine Bolts	40-60 N.m	30-45 lb ft
Vehicle Speed Sensor Bolt	16-22 N.m	12-16 lb ft
Apply Teflon® sealant to the screws before installation.		

LUBRICATION SPECIFICATIONS

Application	Metric	English
1874 MTX Fluid 12550 ET-M81	4.4 L	4.6 qt

AXIAL PLAY SPECIFICATIONS

Application	Specification	
	Metric	English
1st Gear	0.05-0.20 mm	0.002-0.008 in
2nd Gear	0.10-0.35 mm	0.004-0.014 in
3rd Gear	0.10-0.35 mm	0.004-0.014 in
5th Gear Countershaft	0.127-0.53 mm	0.005-0.021 in
Drive Shaft	0.02-0.12 mm	0.001-0.005 in
Gear Train	0.02-0.12 mm	0.001-0.005 in
Reverse Gear	0.10-0.35 mm	0.004-0.014 in
Reverse Idler Gear	0.02-0.43 mm	0.001-0.017 in

TRANSMISSION GEAR RATIO

1st	2nd	3rd	4th	5th	Reverse
3.82	2.31	1.42	1.00	0.83	3.82

COMPONENT LOCATOR

TRANSMISSION COMPONENT LOCATION

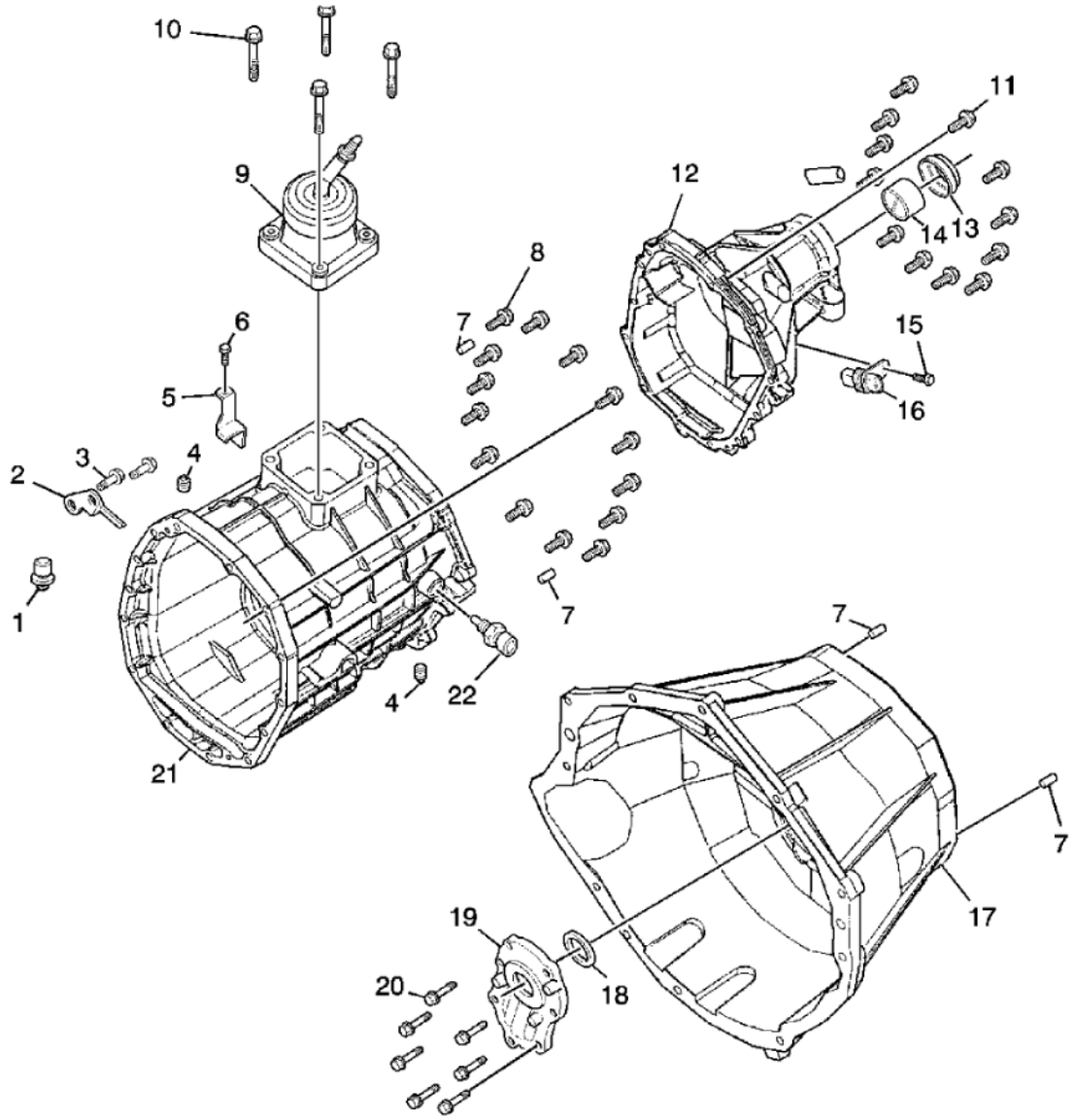


Fig. 1: Transmission Case and Related Components
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Shift Housing Vent Breather
2	Modulator Cable Anchor Bracket
3	Transmission Brace Bracket Bolt
4	Transmission Lubricant Fill Plug Cap
4	Transmission Lubricant Fill Plug Cap
5	Deflector

6	Deflector Bolt
7	Transmission Case Locating Pin
7	Transmission Case Locating Pin
7	Transmission Case Locating Pin
8	Shift Bar Support Retainer Bolt
9	Shift Control Cover
10	Shift Control Housing Bolt
11	Shift Bar Support Retainer Bolt
12	Transmission Rear Case
13	Transmission Cover Seal
14	Transmission Extension Bushing
15	Vehicle Speed Sensor Housing Bolt
16	Vehicle Speed Sensor
17	Transmission Front Case
18	Clutch Housing Cover Seal
19	Transmission Main Drive Gear Bearing Retainer
20	Transmission Bearing Retainer Bolt
21	Transmission Case
22	Park/Neutral Position and Backup Lamp Switch

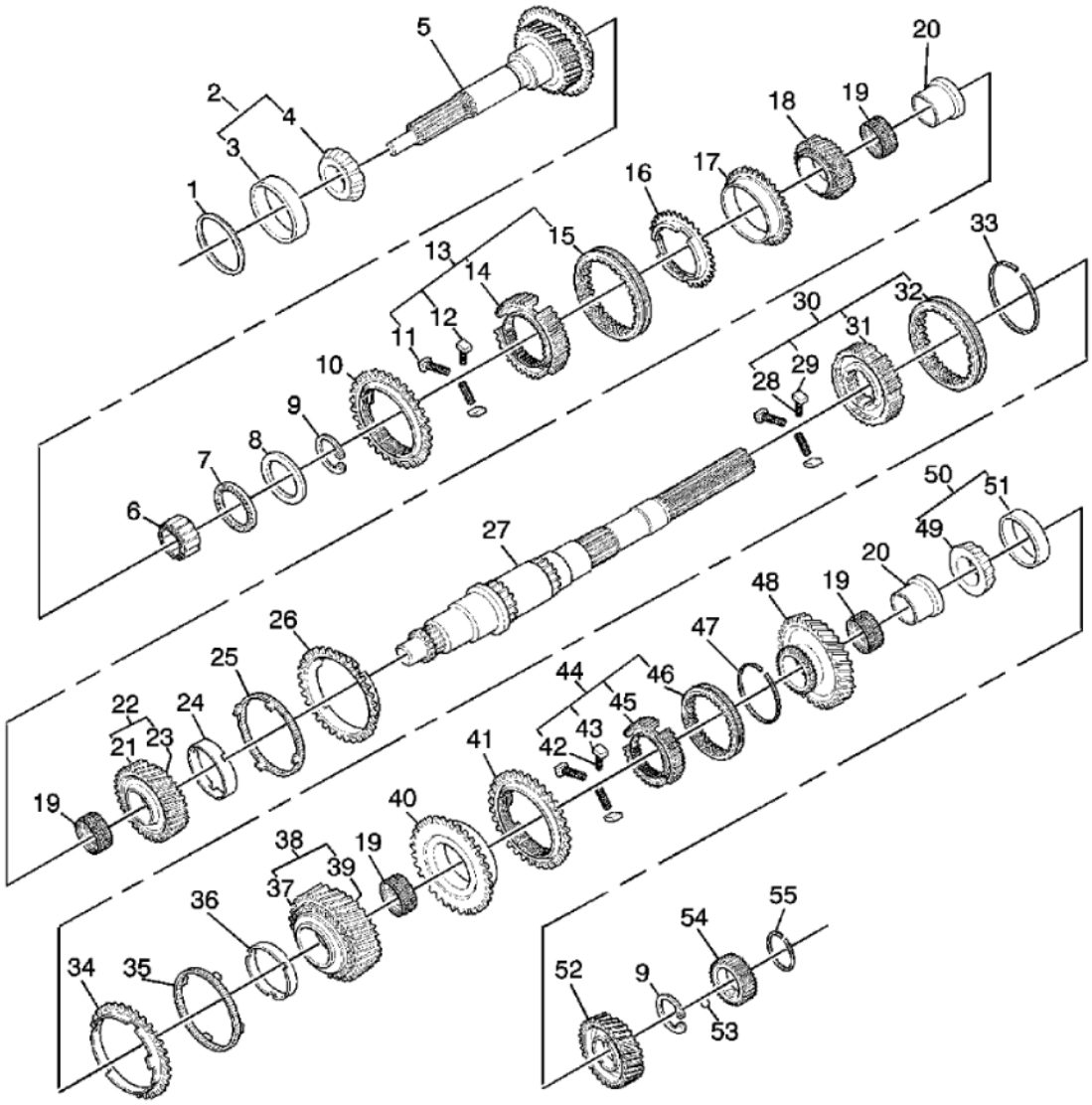


Fig. 2: Main Shaft, Input Shaft, and Components
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Counter Gear Bearing Shim
2	Input Shaft Bearing Assembly
3	Input Shaft Bearing
4	Input Shaft Bearing
5	Input Shaft
6	Main Shaft Bearing Roller
7	Input Shaft Thrust Bearing

8	3rd and 4th Gear Synchronizer Hub Thrust Washer
9	Main Shaft Bearing Shim
9	Main Shaft Bearing Shim
10	4th and 5th Gear Synchronizer Gear
11	Gear Synchronizer Insert Spring
12	3rd and 4th Gear Synchronizer Insert
13	3rd and 4th Gear Synchronizer
14	3rd and 4th Gear Synchronizer Hub
15	3rd and 4th Gear Synchronizer Sleeve
16	3rd Gear Blocking Ring
17	Transmission Drive Gear Clutch - 3rd and 4th Gear Synchronizer - Gear
18	3rd Gear
19	Main Shaft Bearing
19	Main Shaft Bearing
19	Main Shaft Bearing
20	3rd Gear Bushing
20	3rd Gear Bushing
21	2nd Gear
22	2nd Gear Assembly
23	2nd Synchronizer Clutch Gear
24	Transmission Main Shaft Synchronizer Inner Ring
25	Transmission Main Shaft Synchronizer Outer Ring
26	Transmission Main Shaft Synchronizer Center Ring
27	Main Shaft
28	Gear Synchronizer Insert Spring
29	3rd and 4th Gear Synchronizer Insert
30	1st and 2nd Gear Synchronizer Assembly
31	1st and 2nd Gear Synchronizer Hub
32	1st and 2nd Gear Synchronizer Sleeve
33	Main Shaft Bearing Retainer Ring
34	Transmission Main Shaft Synchronizer Center Ring
35	Transmission Main Shaft Synchronizer Outer Ring
36	Transmission Main Shaft Synchronizer Inner Ring
37	2nd Synchronizer Clutch Gear
38	1st Gear Assembly

	1st Gear
40	Transmission Drive Gear Clutch - 5th Gear Synchronizer - Gear
41	4th and 5th Gear Synchronizer Gear
42	Gear Synchronizer Insert Spring
43	3rd and 4th Gear Synchronizer Insert
44	Reverse Gear Synchronizer Assembly
45	5th and Reverse Gear Synchronizer Hub
46	1st and Reverse Gear Synchronizer Sleeve
47	Reverse Gear Retainer Ring
48	Reverse Gear
49	Main Shaft Bearing
50	Main Shaft Bearing Assembly
51	Main Shaft Bearing
52	5th Input Gear
53	Speedometer Gear Ball
54	Speedometer Drive Gear
55	Reverse Gear Blocking Ring

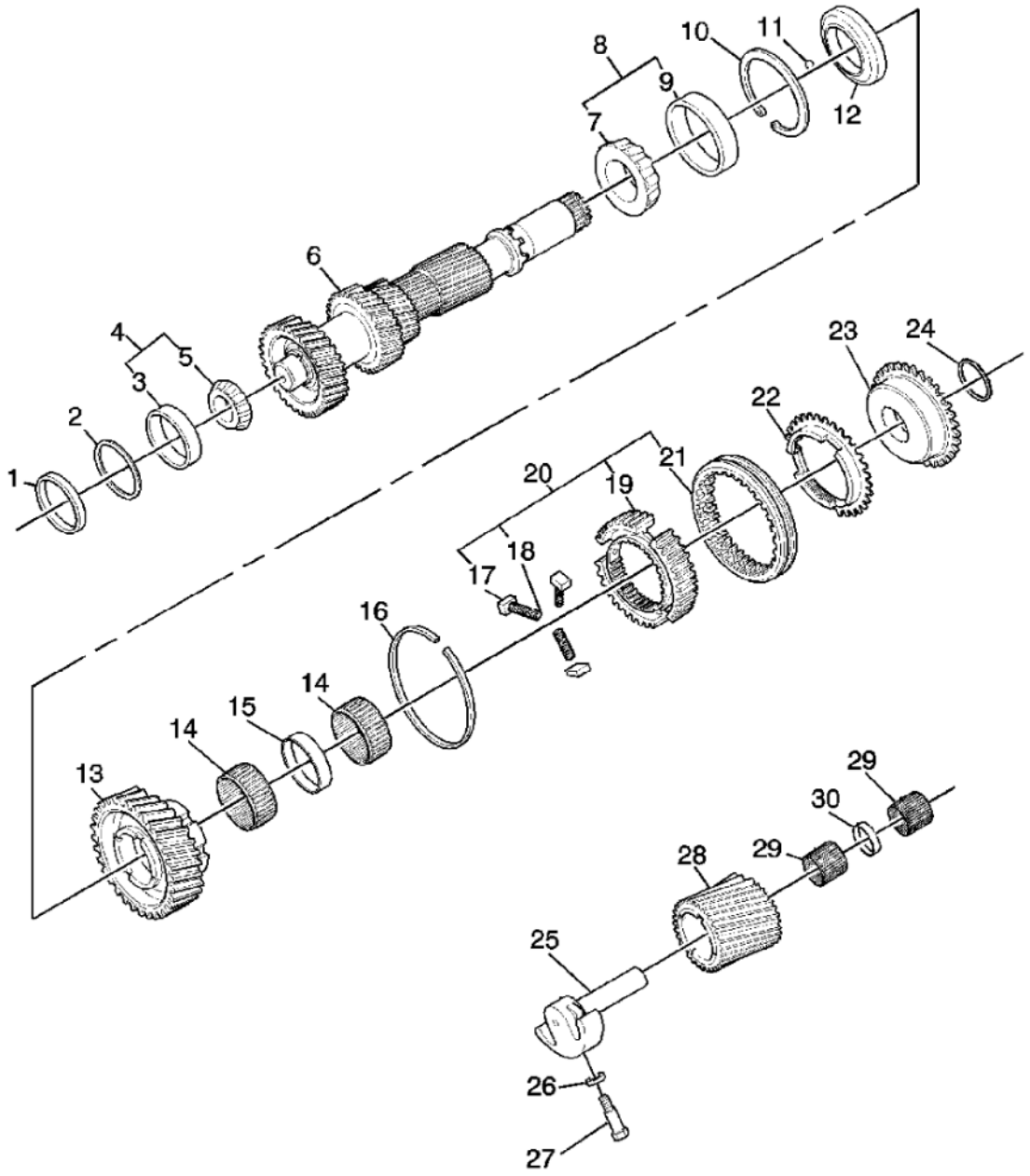


Fig. 3: Counter Gear Shaft, Reverse Idler, and Components
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Center Gear Front Bearing Spacer
2	Center Gear Bearing Shim
3	Center Gear Front Bearing
4	Center Gear Front Bearing Assembly

5	Center Gear Front Bearing
6	Center Gear Shaft
7	Center Gear Rear Bearing
8	Center Gear Rear Bearing Assembly
9	Center Gear Rear Bearing
10	Center Gear Rear Bearing Retainer Ring
11	2nd Gear Thrust Washer Location Ball
12	5th Gear Thrust Washer
13	5th Center Gear
14	5th Gear Bearing
15	Center Gear Front Bearing Spacer
16	Reverse Gear Retainer Ring
17	3rd and 4th Gear Synchronizer Insert
18	Gear Synchronizer Insert Spring
19	5th and Reverse Gear Synchronizer Hub
20	5th Gear Synchronizer
21	5th and Reverse Gear Synchronizer Sleeve
22	4th and 5th Gear Synchronizer Gear
23	Transmission Clutch Gear
24	Main Shaft Bearing Shim
25	Reverse Idler Gear Shaft
26	Reverse Idler Gear Shaft O-Ring Seal
27	Reverse Idler Shaft Lock Bolt
28	Reverse Idler Gear
29	Reverse Gear Bearing
29	Reverse Gear Bearing
30	Center Gear Front Bearing Spacer

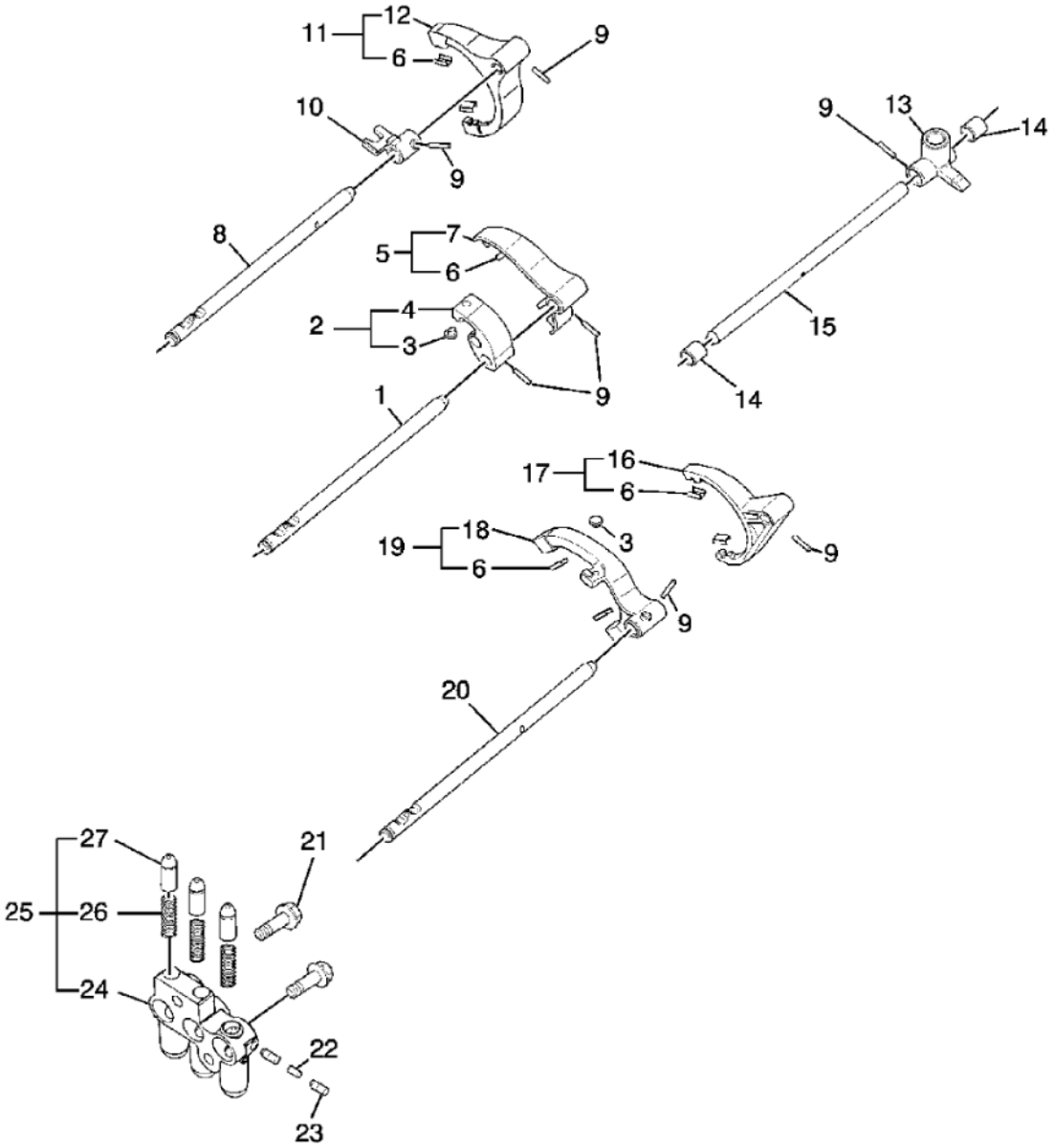


Fig. 4: Shift Control and Components
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	1st and 2nd Shift Shaft
2	1st and 2nd Shift Block Assembly
3	Transmission Shift Fork Pad Insert
4	1st and 2nd Shift Block
5	1st and 2nd Shift Fork Assembly

6	Transmission Shift Fork Pad Insert
6	Transmission Shift Fork Pad Insert
6	Transmission Shift Fork Pad Insert
6	Transmission Shift Fork Pad Insert
7	1st and 2nd Shift Fork
8	3rd and 4th Shift Shaft
9	Shift Fork Lock Pin
9	Shift Fork Lock Pin
9	Shift Fork Lock Pin
9	Shift Fork Lock Pin
9	Shift Fork Lock Pin
9	Shift Fork Lock Pin
9	Shift Fork Lock Pin
10	3rd and 4th Shift Block
11	3rd and 4th Shift Fork Assembly
12	3rd and 4th Shift Fork
13	Shift Control Shaft Block
14	Shift Shaft Bearing
15	Shift Control Shaft
16	5th Shift Fork
17	5th Shift Fork Assembly
18	Reverse Shift Fork
19	Reverse Shift Fork Assembly
20	5th and Reverse Shift Shaft
21	Shift Bar Support Retainer Bolt
22	Shift Shaft Interlock Pin
23	Transmission Shift Interlock Plunger
24	Shift Bar Support
25	Shift Bar Support Assembly
26	Shift Shaft Lever Spring
27	Shift Interlock Detent

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC P0502 or P0503	P0502: Vehicle Speed Sensor (VSS) Circuit Low Voltage P0503: Vehicle Speed Sensor (VSS) Circuit Intermittent
DTC P0806	P0806: Clutch Pedal Position (CPP) Sensor Circuit Performance
DTC P0807 or P0808	P0807: Clutch Pedal Position (CPP) Sensor Circuit Low Voltage P0808: Clutch Pedal Position (CPP) Sensor Circuit High Voltage
DTC P080A	P080A: Clutch Pedal Position (CPP) Not Learned

DTC P0502 OR P0503

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0502

Vehicle Speed Sensor (VSS) Circuit Low Voltage

DTC P0503

Vehicle Speed Sensor (VSS) Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
VSS Low Signal	-	P0502, P0503	-	-
VSS High Signal	P0502, P0503	P0502, P0503	P0502, P0503	-

Circuit/System Description

The vehicle speed information is provided to the engine control module (ECM) by the vehicle speed sensor (VSS). The VSS is a permanent magnet generator that is mounted to the transmission and produces a pulsing voltage. The AC voltage amplitude and frequency increases with vehicle speed. The ECM converts the pulsing voltage into km/h (mph). The ECM supplies the VSS signal to the following components:

- The instrument panel for speedometer and odometer operation
- The cruise control module

Conditions for Running the DTC

P0502

- DTC P0120, P0220 or P0503 are not set.
- The TP sensor angle is more than 3.5 percent.
- The engine is running.
- The system voltage is 8-18V.
- TFT is more than -40°C (-40°F)
- The engine speed is 1,500-6,500 RPM.
- Vehicle speed is less than 200 km/h (124 mph).
- Engine torque is 68-8192 N.m (50-6,042 lb ft).
- The PTO is not active.

P0503

- The system voltage is 8-18V.
- The engine speed is 500-7,500 RPM.
- Transmission out speed change is less than 146 RPM for 2 seconds.
- The PTO is not active.
- The OSS is at least 292 RPM for 2 seconds.
- The OSS has not changed more than 146 RPM for 2 seconds.
- The 4WD range has not changed within 6 seconds.

Conditions for Setting the DTC

P0502

The transmission output speed is 58 RPM or less for 5 seconds.

P0503

The transmission output speed drops 351 RPMs in less than 3 seconds.

Action Taken When the DTC Sets

P0502 and P0503 are Type B DTCs.

Conditions for Clearing the DTC

P0502 and P0503 are Type B DTCs.

Reference Information

Schematic Reference

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Connector End View Reference

Component Connector End Views

Description and Operation

Manual Transmission Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Special Tools

J 35616 GM-Approved Terminal Test Kit

Circuit/System Verification

1. Raise and support the drive wheels.
2. Start and idle the engine.
3. Place the transmission in second gear and release the clutch pedal.
4. Monitor VSS parameter on the scan tool. The VSS parameter should increase as the drive wheel speed increases.
5. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that are captured in the Freeze Frame/Failure Records List.

Circuit/System Testing

1. Disconnect the ECM harness connector X1.
2. Measure for 1,300-1,500 ohms at 25°C (77°F) between the VSS high signal circuit terminal 71 and the VSS low signal circuit terminal 72.
   - If the value is greater than 1,500 ohms test the VSS high signal circuit and the VSS low signal circuit for an open/high resistance. If the circuits/connections test normal, replace the vehicle speed sensor.
   - If the value is less than 1,300 ohms test the VSS high signal and the VSS low signal circuits for a shorted together condition. If the circuits/connections test normal, replace the vehicle speed sensor.
3. Measure for more than 10 ohms of resistance between the VSS high signal circuit terminal 71 and ground.
   - If the value is less than the specified range, repair the short to ground.
4. Measure for more than 10 ohms of resistance between the VSS low signal circuit terminal 72 and ground.
   - If the value is less than the specified range, repair the short to ground.
5. Reconnect the ECM connector. Disconnect the VSS connector.
6. Ignition ON, test the VSS high signal circuit terminal B for a short to voltage.
   - If all circuits/connections test normal, test or replace the VSS.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Vehicle Speed Sensor Replacement**

- **Control Module References** for ECM replacement, setup and programming.

DTC P0806

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0806

Clutch Pedal Position (CPP) Sensor Circuit Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
CPP Sensor Signal	P0807	P0807	P0808	P0806
CPP Sensor 5-Volt Reference	P0651, P0807	P0807	P0651, P0808	-
CPP Sensor Low Reference	-	P0808	P0808	-

Typical Scan Tool Information

CPP Sensor Voltage

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON. CPP Sensor Voltage Parameter Normal Range: 0-volts with clutch pedal applied to 5-volts when clutch pedal is released.			
CPP Sensor 5-Volt Reference	0 volts	0 volts	5 volts
CPP Sensor Signal	0 volts	0 volts	5 volts
CPP Sensor Low Reference	-	5 volts	-

CPP Sensor Percentage

Circuit	Short to Ground	Open	Short to Voltage

Operating Conditions: Ignition ON. CPP Sensor Percent Parameter Normal Range: 0% with clutch pedal released to 100% when clutch pedal is applied.			
CPP Sensor 5-Volt Reference	100%	100%	0-100%
CPP Sensor Signal	100%	100%	100%
CPP Sensor Low Reference	-	0%	-

Circuit/System Description

The clutch pedal position (CPP) sensor is a three wire sensor, connected to a 5-volt reference circuit, a low reference circuit, and a signal circuit. The engine control module (ECM) supplies 5-volts to the CPP sensor, and also provides a sensor ground path on the low reference circuit. The CPP sensor sends a voltage signal to the ECM on the signal circuit. The voltage on the signal circuit will vary from a voltage less than or equal to 5-volts when the clutch pedal is released, to a voltage less than or equal to 1.5-volt when the clutch pedal is applied.

Conditions for Running the DTC

DTCs P0335, P0336, P0502, P0503, P0607, P0808, or P080A are not set.

Conditions for Setting the DTC

The CPP sensor is stuck in range.

Action Taken When the DTC Sets

P0806 is a Type A DTC.

Conditions for Clearing the MIL/DTC

P0806 is a Type A DTC.

Reference Information

Schematic Reference

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Connector End View Reference

Component Connector End Views

Description and Operation

Manual Transmission Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Ignition ON, observe the scan tool CPP sensor percent parameter. The percentage should vary from 0% when the clutch pedal is released, to 100% when the clutch pedal is in the apply position.
2. Perform the CPP learn procedure. Refer to **Clutch Pedal Position Sensor Learn**.
3. Operate the vehicle within the conditions for running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector of the CPP sensor.
2. Ignition ON, observe the scan tool CPP sensor voltage parameter for 0.1-volt.
    - If the voltage is below the specified value, replace the CPP sensor.

- If the voltage is above the specified value, replace the ECM.

Component Testing

1. Ignition OFF, disconnect the harness connector of the CPP sensor.
2. Measure the resistance between the signal terminal B and the low reference terminal A of the CPP sensor. Sweep the CPP sensor through the entire range. The resistance should vary

low to high and high to low without any spikes or dropouts.

- If the resistance is erratic with spikes or dropouts, replace the CPP sensor.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Clutch Pedal Replacement**
- **Control Module References** for ECM replacement, setup and programming

DTC P0807 OR P0808

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0807

Clutch Pedal Position (CPP) Sensor Circuit Low Voltage

DTC P0808

Clutch Pedal Position (CPP) Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
CPP Sensor Signal	P0807	P0807	P0808	P0806
CPP Sensor 5-Volt Reference	P0651, P0807	P0807	P0651, P0808	-
CPP Sensor Low Reference	-	P0808	P0808	-

Typical Scan Tool Information

CPP Sensor Voltage

	Short to		Short to

Circuit	Ground	Open	Voltage
Operating Conditions: Ignition ON. CPP Sensor Voltage Parameter Normal Range: 0-volts with clutch pedal applied to 5-volts when clutch pedal is released.			
CPP Sensor 5-Volt Reference	0 volts	0 volts	5 volts
CPP Sensor Signal	0 volts	0 volts	5 volts
CPP Sensor Low Reference	-	5 volts	-

CPP Sensor Percentage

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON. CPP Sensor Percentage Parameter Normal Range: 0% with clutch pedal released to 100% when clutch pedal is applied.			
CPP Sensor 5-Volt Reference	100%	100%	0-100%
CPP Sensor Signal	100%	100%	100%
CPP Sensor Low Reference	-	0%	-

Circuit/System Description

The clutch pedal position (CPP) is a three wire sensor, connected to a 5-volt reference circuit, a low reference circuit, and a signal circuit. The engine control module (ECM) supplies 5-volts to the CPP sensor, and also provides a sensor ground path on the low reference circuit. The CPP sensor sends a voltage signal to the ECM on the signal circuit. The voltage on the signal circuit will vary from a voltage less than or equal to 5-volts when the clutch pedal is released to a voltage less than or equal to 1.5-volts when the clutch pedal is applied.

Conditions for Running the DTC

- DTCs P0641 or P0651 are not set.
- The system voltage is more than 9 volts.
- The ignition is in the RUN position.

Conditions for Setting the DTC

P0807

The CPP sensor voltage is less than 0.1 volt for more than 1 second.

P0808

The CPP sensor voltage is more than 5.2 volts for more than 1 second.

Action Taken When the DTC Sets

P0807 and P0808 are Type A DTCs.

Conditions for Clearing the MIL/DTC

P0807 and P0808 are Type A DTCs.

Reference Information

Schematic Reference

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Connector End View Reference

Component Connector End Views

Description and Operation

Manual Transmission Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. If DTC P0641 or P0651 is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

2. Ignition ON, observe the scan tool CPP sensor percent parameter. The percentage should vary from 0 percent when the clutch pedal is released, to 100 percent when the clutch pedal is in the apply position.
3. Perform the CPP learn procedure. Refer to **Clutch Pedal Position Sensor Learn**.
4. Operate the vehicle within the conditions for running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector of the CPP sensor.
2. Ignition OFF, test for less than 1 ohm between the low reference circuit terminal A and the negative post of the battery.
   - If greater than the specified value, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the ECM.
3. Ignition ON, test for 4.8-5.2 volts between the 5-volt reference circuit terminal C and ground.
   - If less than the specified range, test the 5-volt reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the ECM.
   - If greater than the specified range, test the 5-volt reference circuit for a short to voltage. If the circuit tests normal, replace the ECM.
4. Ignition ON, verify that the scan tool CPP sensor parameter is less than 0.1 volts.
   - If greater than the specified value, test the signal circuit for a short to voltage. If the circuit tests normal, replace the ECM.
5. Install a 3-amp fused jumper wire between the signal circuit terminal B and the 5-volt reference circuit terminal C. Verify that the scan tool CPP sensor parameter is between 4.8-5.2 volts.
   - If less than the specified range, test the signal circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the ECM.
6. If all circuits test normal, test or replace the CPP sensor.

Component Testing

1. Ignition OFF, disconnect the harness connector of the CPP sensor.
2. Measure the resistance between the signal terminal B and the low reference terminal A of the CPP sensor. Sweep the CPP sensor through the entire range. The resistance should vary low to high and high to low without any spikes or dropouts.

- If the resistance is erratic with spikes or dropouts, replace the CPP sensor.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Clutch Pedal Replacement**
- **Control Module References** for ECM replacement, setup and programming

DTC P080A

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P080A

Clutch Pedal Position (CPP) Not Learned

Circuit/System Description

The clutch pedal position (CPP) is a three wire sensor, connected to a 5-volt reference circuit, a low reference circuit, and a signal circuit. The engine control module (ECM) supplies 5-volts to the CPP sensor, and also provides a sensor ground path on the low reference circuit. The CPP sensor sends a voltage signal to the ECM on the signal circuit. The voltage on the signal circuit will vary from a voltage less than or equal to 5-volts when the clutch pedal is released to a voltage less than or equal to 1.5-volts when the clutch pedal is applied.

Conditions for Running the DTC

Clutch pedal fully applied.

Conditions for Setting the DTC

Clutch pedal position not learned.

Action Taken When the DTC Sets

P080A is a Type B DTC.

Conditions for Clearing the MIL/DTC

P080A is a Type B DTC.

Reference Information

Schematic Reference

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Connector End View Reference

Component Connector End Views

Description and Operation

Manual Transmission Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

Perform the clutch pedal position sensor learn procedure.

Circuit/System Testing

Perform the clutch pedal position sensor learn procedure.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Clutch Pedal Position Sensor Learn**
- **Control Module References** for ECM replacement, setup and programming

CLUTCH PEDAL POSITION SENSOR LEARN

IMPORTANT: The clutch pedal position (CPP) sensor learn procedure is required when the following service procedures have been performed regardless of whether DTC P080A is set:

- **An engine control module (ECM) replacement**
- **A CPP sensor replacement**
- **Any repairs which affect the CPP sensor relationship**

1. Install a scan tool.
2. Monitor the ECM for DTCs with a scan tool. If other DTCs are set, except DTC P080A, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for the applicable DTC that set.
3. With a scan tool, select Clutch Pedal Position Learn under Module Setup in Manual Transmission, and perform the following instructions displayed on the scan tool screen.

IMPORTANT: The CPP sensor learn procedure cannot be performed more than once per ignition cycle. The clutch pedal needs to be fully depressed and held steady throughout this procedure in order to perform a correct learning.

4. The scan tool will display under CPP Learn Status: Not Learned, In Process, Complete, Fail - Low Volt, Fail - High Volt, or Fail Moving. The scan tool will display under CPP Learn Status Complete if the process was successful.
5. If the scan tool indicates that DTC P080A ran and passed this ignition the CPP sensor learn procedure is complete. If the scan tool indicates DTC P080A failed or did not run this ignition, refer to **DTC P080A**. If any other DTC is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for the applicable DTC.
6. Turn OFF the ignition for 30 seconds after the learn procedure has successfully completed in order to store the CPP sensor variation values in ECM history.

SYMPTOMS - MANUAL TRANSMISSION

Strategy Based Diagnostics

Review the system operations in order to familiarize yourself with the system functions. Refer to **Manual Transmission Description and Operation**.

Visual/Physical Inspection

- Inspect the manual transmission for excessive wear or damage.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the manual transmission for the correct fluid level.
- Inspect the manual transmission for fluid leaks.
- Inspect the manual transmission for broken or loose transmission mounts.

Intermittent

Test the vehicle under the same conditions that the customer reported in order to verify the system is operating properly.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Transmission Shifts Hard**
- **Transmission Shifts Hard into Reverse**
- **Transmission Gear Clash When Shifting Gears**
- **Transmission Noisy**
- **Transmission Jumps Out of Gear**
- **Transmission Does Not Shift into One Gear**
- **Transmission Locked in One Gear**
- **Transmission Clunk on Acceleration or Deceleration**
- **Diagnostic Starting Point - Vibration Diagnosis and Correction**
- **Vibration Analysis - Driveline**
- **Driveline Working Angles Measurement**

TRANSMISSION SHIFTS HARD

Diagnostic Aids

Hard shifting can be diagnosed easily. You should perform a static and dynamic shift test also.

Many simple factors could occur such as, excessive clutch pedal free travel, insufficient fluid, excessive fluid, or the wrong transmission lubricant. A misaligned transmission can also cause hard shifting, as well as a worn or defective clutch, binding of the shift control. Many internal components can also play a factor in hard shifting such as, the front bearing retainer loose or cracked, the synchronizer worn, damaged, or improperly assembled. Failure to fully depress the clutch pedal while shifting causes hard shifting.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: This step inspects for air in the hydraulic lines, which also causes the transmission to shift hard.

6: This step inspects for a faulty shift control.

10: This step inspects for a faulty or worn clutch pressure plate or clutch driven plate.

Step	Action	Yes	No
DEFINITION: The transmission does not shift smoothly or without difficulty from one gear to another.			
1	Did you review the **Symptoms - Manual Transmission** operations and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Manual Transmission**
2	Inspect the clutch pedal travel. Is there sufficient clutch pedal travel?	Go to **Step 3**	Go to **Step 4**
3	Remove any clutch pedal restrictions. Does the transmission shift hard?	Go to **Step 4**	System OK
4	Test for air in the clutch hydraulic system. Is there air in the hydraulic system?	Go to **Step 5**	Go to **Step 6**
5	Bleed the air from the clutch hydraulic system. Refer to **Hydraulic Clutch Bleeding** . Did you find and repair the condition?	System OK	Go to **Step 6**
6	Inspect the transmission shift control for binding. Is the transmission shift control binding?	Go to **Step 7**	Go to **Step 8**
7	Replace the transmission shift tower. Did you find and repair the condition?	System OK	Go to **Step 8**
8	Inspect the transmission for the correct type of transmission fluid. Is the correct type of transmission fluid being		

	used?	Go to **Step 10**	Go to **Step 9**
9	Drain the transmission fluid and fill the transmission with the correct type of fluid. Refer to **Transmission Fluid Replacement**. Did you find and repair the condition?	System OK	Go to **Step 10**
10	Inspect the clutch pressure plate and/or clutch driven plate. Is the clutch pressure plate and/or clutch driven plate worn or faulty?	Go to **Step 11**	Go to **Step 12**
11	Replace the clutch pressure plate and/or clutch driven plate. Refer to **Clutch Assembly Replacement** . Did you find and repair the condition?	System OK	Go to **Step 12**
12	1. Remove the transmission. Refer to **Transmission Replacement**. 2. Inspect the transmission for an internal bind, possibly caused by one of the following components: • Shift forks • Selector plates • Synchronizers Is there an internal bind?	Go to **Step 13**	System OK
13	1. Replace worn or damaged components, as necessary. 2. Install the transmission. Refer to **Transmission Replacement**. Did you find and repair the condition?	Go to **Step 14**	Go to Diagnostic Aids
14	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 1**

TRANSMISSION SHIFTS HARD INTO REVERSE

Diagnostic Aids

Hard shifting in reverse can be diagnosed easily. You should perform a static shift and dynamic shift test also. Many simple factors could occur such as, excessive clutch pedal free travel,

insufficient fluid, excessive fluid, or the wrong transmission lubricant. A misaligned transmission can also cause hard shifting, as well as a worn or defective clutch, binding of the shift control. Many internal components can also play a factor in hard shifting such as, the front bearing retainer loose or cracked, the synchronizer worn, damaged, or improperly assembled. A failure to fully depress the clutch pedal when shifting causes hard shifting in reverse.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: This step inspects for air in the hydraulic lines, which also causes the transmission to shift hard in reverse.

6: This step inspects for a faulty shift control.

10: This step inspects for a faulty or worn clutch pressure plate or clutch driven plate.

Step	Action	Yes	No
DEFINITION: The transmission does not shift smoothly or without difficulty from one gear to another.			
1	Did you review the **Symptoms - Manual Transmission** operations and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Manual Transmission**
2	Inspect the clutch pedal travel. Is there sufficient clutch pedal travel?	Go to **Step 3**	Go to **Step 4**
3	Remove any clutch pedal restrictions. Does the transmission shift hard in reverse?	Go to **Step 4**	System OK
4	Test for air in the clutch hydraulic system. Is there air in the hydraulic system?	Go to **Step 5**	Go to **Step 6**
5	Bleed the air from the clutch hydraulic system. Refer to **Hydraulic Clutch Bleeding** . Did you find and repair the condition?	System OK	Go to **Step 6**
6	Inspect the transmission shift control for binding. Is the transmission shift control binding?	Go to **Step 7**	Go to **Step 8**
7	Replace the transmission shift tower. Did you find and repair the condition?	System OK	Go to **Step 8**
8	Inspect the transmission for the correct type of transmission fluid. Is the correct type of transmission fluid being used?	Go to **Step 10**	Go to **Step 9**

9	Drain the transmission fluid and fill the transmission with the correct type of fluid. Refer to **Transmission Fluid Replacement**. Did you find and repair the condition?	System OK	Go to **Step 10**
10	Inspect the clutch pressure plate and/or clutch driven plate. Is the clutch pressure plate and/or clutch driven plate worn or faulty?	Go to **Step 11**	Go to **Step 12**
11	Replace the clutch pressure plate and/or clutch driven plate. Refer to **Clutch Assembly Replacement** . Did you find and repair the condition?	System OK	Go to **Step 12**
12	1. Remove the transmission. Refer to **Transmission Replacement**. 2. Inspect the transmission for an internal bind, possibly caused by one of the following components: • Shift forks • Selector plates • Synchronizers Is there an internal bind?	Go to **Step 13**	System OK
13	1. Replace worn or damaged components, as necessary. 2. Install the transmission. Refer to **Transmission Replacement**. Did you find and repair the condition?	Go to **Step 14**	Go to Diagnostic Aids
14	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 1**

TRANSMISSION GEAR CLASH WHEN SHIFTING GEARS

Diagnostic Aids

Gear clash is a grinding noise that is made while shifting gears. You should perform a static shift and dynamic shift test. If the transmission develops gear clash, first inspect the clutch adjustment or for a faulty clutch condition. A clutch that drags or does not fully engage is the most common

cause of gear clash. If the clutch is at fault, the clash should occur in every gear. If the clutch is operating properly or the clash does not occur in all gears, remove the transmission and inspect for worn or damaged synchronizers, including the sleeves, hubs, and the blocking rings. Also inspect for loose mounting bolts or misalignment.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step inspects for proper clutch operations.

5: This step inspects for air the hydraulic clutch system.

12: This step inspects for worn or damaged internal components.

Step	Action	Yes	No
DEFINITION: The transmission gears clash while shifting from one gear into another gear.			
1	Did you review the **Symptoms - Manual Transmission** and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Manual Transmission**
2	Inspect for proper clutch operation. Refer to **Symptoms - Clutch** . Does the clutch operate properly?	Go to **Step 3**	Go to **Step 3**
3	Verify that the clutch is releasing properly. Refer to **Clutch System Description and Operation** . Is the clutch releasing properly?	Go to **Step 5**	Go to **Step 4**
4	Repair the clutch system. Refer to **Clutch Assembly Replacement** . Did you find and repair the condition?	System OK	Go to **Step 5**
5	Test for air in the clutch hydraulic system. Is there air in the hydraulic system?	Go to **Step 6**	Go to **Step 7**
6	Bleed the clutch hydraulic system. Refer to **Hydraulic Clutch Bleeding** . Did you find and repair the condition?	System OK	Go to **Step 7**
7	Inspect the transmission control for wear. Is the transmission control worn?	Go to **Step 8**	Go to **Step 9**
8	Replace the transmission shift tower. Did you find and repair the condition?	System OK	Go to **Step 9**
	Inspect the transmission fluid level. Refer to		

9	**Transmission Fluid Replacement**. Do the gears still clash?	Go to **Step 9**	System OK
10	Inspect for the correct type of transmission fluid. Is the correct type of transmission fluid being used?	Go to **Step 12**	Go to **Step 11**
11	Drain the transmission fluid and fill the transmission with the correct type of fluid. Refer to **Transmission Fluid Replacement**. Did you find and repair the condition?	System OK	Go to **Step 12**
12	1. Remove the transmission. Refer to **Transmission Replacement**. 2. Disassemble the gear shift components. 3. Inspect the gear shift components and/or synchronizers for damage or wear. Are the gear shift and/or synchronizers worn or damaged?	Go to **Step 13**	Go to **Step 14**
13	1. Replace worn and/or damaged components, as necessary. 2. Inspect for other gear train damaged components, as necessary. Did you find and repair the condition?	System OK	Go to **Step 14**
14	Inspect the clutch pilot bearing for binding. Is the pilot bearing binding?	Go to **Step 15**	System OK
15	1. Replace the clutch pilot bearing. Refer to **Clutch Pilot Bearing Replacement** . 2. Install the transmission. Refer to **Transmission Replacement**. Did you find and repair the condition?	Go to **Step 16**	Go to Diagnostic Aids
16	Operate the system and verify the repair. Did you correct the condition?	System OK	Go to **Step 1**

TRANSMISSION NOISY

Diagnostic Aids

The manual transmission can be noisy for a number of reasons. It can be noisy in neutral, low, high, and/or reverse gear. Diagnose the transmission, including the level of fluid and the correct type of fluid in the transmission. Inspect for misalignment or loose bolts to the engine. The transmission could be noisy internally. Gears, synchronizers, and bearings should be inspected for worn or damaged components. These are only a few areas that may cause the transmission to be noisy. You should inspect all possibilities that could lead you to the noise of these concerns.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step inspects for the correct fluid level.

4: This step inspects for the correct type of transmission fluid.

10: This step is inspects for internal damage or worn components.

Step	Action	Yes	No
DEFINITION: The transmission is noisy and the noise carries into the passenger compartment.			
1	Did you review the **Symptoms - Manual Transmission** operations and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Manual Transmission**
2	Inspect the transmission fluid level. Is the fluid level correct?	Go to **Step 4**	Go to **Step 3**
3	Add transmission fluid. Refer to **Transmission Fluid Replacement**. Is the transmission noisy?	Go to **Step 4**	System OK
4	Inspect the transmission for the correct type of fluid. Is the transmission fluid the correct type?	Go to **Step 6**	Go to **Step 5**
5	Drain the transmission fluid and fill the transmission with the correct type of fluid. Refer to **Transmission Fluid Replacement**. Did you find and repair the condition?	System OK	Go to **Step 6**
6	Inspect the shift control closeout boot. Is the closeout boot loose or damaged?	Go to **Step 7**	Go to **Step 8**
7	Position and tighten the shift tower to specification or replace the shift control closeout boot, as necessary. Did you find and repair the condition?	System OK	Go to **Step 8**

8	Inspect the clutch housing for loose bolts and/or misalignment with the engine. Did you find any loose bolts or misalignment with the engine?	Go to **Step 9**	Go to **Step 10**
9	Inspect the shift tower boot. Is the closeout boot loose or damaged?	Go to **Step 10**	Go to **Step 11**
10	1. Remove the transmission. Refer to **Transmission Replacement**. 2. Disassemble and inspect the following transmission components for wear or damage: • Gear shift • Transmission gears • Bearings Did you find any wear or damage?	Go to **Step 11**	System OK
11	1. Replace worn or damaged components, as necessary. 2. Install the transmission. Refer to **Transmission Replacement**. Did you find and repair the condition?	Go to **Step 12**	Go to Diagnostic Aids
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 1**

TRANSMISSION JUMPS OUT OF GEAR

Diagnostic Aids

You should perform a static shift test and a dynamic shift test. The manual transmission can have many conditions that make it jump out of gear. Some of the most common conditions are misalignment of the transmission to engine, a loose clutch housing, or misalignment. The transmission should also be inspected for worn or damaged input bushing to flywheel or worn or damaged input and output shaft bearings. A bent input shaft could also be the result of the transmission jumping out of gear. While inspecting the internal part of the transmission, also inspect for worn detent springs, synchronizers, worn teeth on the gears, or worn thrust washers.

Inspect all internal components for being worn or damaged.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step inspects for the shift control closeout boot position.
6: This step inspects for worn or damaged transmission or engine mounts.
12: This step inspects for worn or damaged internal components.

Step	Action	Yes	No
DEFINITION: Gear disengagement occurs during normal operation.			
1	Did you review the **Symptoms - Manual Transmission** operations and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Manual Transmission**
2	Inspect the transmission shift tower. Is the boot out of position?	Go to **Step 3**	Go to **Step 3**
3	Reposition or replace the shift tower. Did you find and repair the condition?	System OK	Go to **Step 4**
4	Inspect the transmission shift control. Is the shift lever loose or damaged?	Go to **Step 5**	Go to **Step 6**
5	Replace the transmission shift lever. Refer to **Transmission Control Lever Knob Replacement** and **Transmission Control Lever Boot Replacement** . Did you find and repair the condition?	System OK	Go to **Step 6**
6	Inspect the engine and/or transmission mounts. Are the engine and/or transmission mounts worn or damaged?	Go to **Step 7**	Go to **Step 8**
7	Replace the engine mounts and/or transmission mounts. Refer to the appropriate procedure: • **Engine Mount Replacement - Left Side** • **Engine Mount Replacement - Right Side** • **Transmission Rear Mount Replacement** Did you find and repair the condition?	System OK	Go to **Step 8**

8	Inspect the engine and/or transmission mounts for loose fasteners. Did you find any loose fasteners?	Go to **Step 9**	Go to **Step 10**
9	Tighten the engine mount and/or transmission mount fasteners to specifications. Refer to **Fastener Tightening Specifications**. Did you find and repair the condition?	System OK	Go to **Step 10**
10	Inspect the clutch housing for loose bolts or misalignment. Did you find any loose bolts or misalignment?	Go to **Step 11**	Go to **Step 12**
11	Tighten any loose housing bolts and/or align the housing. Refer to **Fastener Tightening Specifications**. Did you find and repair the condition?	System OK	Go to **Step 12**
12	1. Remove the transmission. Refer to **Transmission Replacement**. 2. Disassemble and inspect the following internal components for wear or damage: • Gearshift • Transmission gears • Bearings Did you find any worn or damaged components?	Go to **Step 13**	System OK
13	1. Replace worn or damaged components, as necessary. 2. Install the transmission. Refer to **Transmission Replacement**. Did you find and repair the condition?	Go to **Step 14**	Go to Diagnostic Aids
14	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 1**

TRANSMISSION DOES NOT SHIFT INTO ONE GEAR

Diagnostic Aids

When the manual transmission will not transmit power from the engine to the wheels and one gear

will not shift, it is possible that the gear is stripped. You should also perform a static shift and dynamic shift test. If the transmission will not shift in all gears, it is possible the input or countershaft gears are stripped or there is a broken input or output shaft. Sometimes the transmission shift control may not be operating properly.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

- **2:** This step inspects for worn or damaged shift control components.
- **4:** This step inspects for any conditions with the hydraulic system.
- **8:** This step inspects for worn or damaged internal components.

Step	Action	Yes	No
DEFINITION: The transmission does not shift into a gear.			
1	Did you review the **Symptoms - Manual Transmission** and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Manual Transmission**
2	Inspect the transmission shift lever operation. Is the control worn, binding, or damaged?	Go to **Step 3**	Go to **Step 3**
3	Replace the transmission shift lever. Refer to **Transmission Control Lever Knob Replacement** and **Transmission Control Lever Boot Replacement** . Did you find and repair the condition?	System OK	Go to **Step 4**
4	Inspect the hydraulic clutch operation. Refer to **Symptoms - Clutch** . Is the clutch operating properly?	Go to **Step 6**	Go to **Step 5**
5	Replace the concentric slave cylinder. Did you find and repair the condition?	System OK	Go to **Step 6**
6	1. Remove the transmission. Refer to **Transmission Replacement**. 2. Inspect the transmission input shaft and the clutch pilot bearing. Is there signs of the input shaft binding in the pilot bearing?	Go to **Step 7**	Go to **Step 8**
	1. Inspect the clutch pilot bearing for		

7	damage. 2. Replace the clutch pilot bearing. Refer to **Clutch Pilot Bearing Replacement** . Did you find and repair the condition?	System OK	Go to **Step 8**
8	Disassemble and inspect the following transmission internal components for wear or damage: • Gearshift components • Transmission gears • Bearings Did you find any worn or damaged components?	Go to **Step 9**	System OK
9	1. Replace worn or damaged components, as necessary. 2. Install the transmission. Refer to **Transmission Replacement**. Did you find and repair the condition?	Go to **Step 10**	Go to Diagnostic Aids
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 1**

TRANSMISSION LOCKED IN ONE GEAR

Diagnostic Aids

If the transmission is locked, engaging the clutch will stop the engine. If the shift control components and the clutch system operations are operating properly, the condition is caused by internal damage, such as a dented or damaged shift fork. The transmission must be removed from the vehicle for repairs. You should also perform a static shift test and dynamic shift test.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

6: This step inspects for a faulty actuator cylinder.

8: This step inspects for a dented or damaged shift fork.

Step	Action	Yes	No
DEFINITION: The transmission cannot be shifted out of a gear.			
1	Did you review the **Symptoms - Manual Transmission** and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Manual Transmission**
2	Inspect the transmission fluid level. Refer to **Transmission Fluid Replacement**. Is the transmission fluid level correct?	Go to **Step 4**	Go to **Step 3**
3	Add transmission fluid, if necessary. Can you shift the transmission out of gear?	System OK	Go to **Step 5**
4	Inspect for the correct type of transmission fluid. Is the correct type of transmission fluid being used?	Go to **Step 6**	Go to **Step 5**
5	Drain the transmission fluid and fill the transmission with the correct type of fluid. Refer to **Transmission Fluid Replacement**. Did you find and repair the condition?	System OK	Go to **Step 6**
6	Inspect the concentric slave cylinder operation. Refer to **Symptoms - Clutch** . Is the clutch actuator operating properly?	Go to **Step 8**	Go to **Step 7**
7	Replace the concentric slave cylinder. Did you find and repair the condition?	System OK	Go to **Step 8**
8	1. Remove the transmission. Refer to **Transmission Replacement**. 2. Disassemble and inspect the transmission for a dented or damaged shift fork. Did you find a dented or damaged shift fork?	Go to **Step 9**	Go to **Step 10**
9	1. Replace worn or damaged components, as necessary. 2. Install the transmission. Refer to **Transmission Replacement**. Did you find and repair the condition?	System OK	Go to **Step 10**

10	Disassemble and inspect the transmission for an incorrectly assembled or broken shift mechanism. Did you find an incorrectly assembled or broken shift mechanism?	Go to **Step 11**	System OK
11	1. Replace worn or damaged components, as necessary. 2. Install the transmission. Refer to **Transmission Replacement**. Did you find and repair the condition?	Go to **Step 12**	Go to Diagnostic Aids
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 1**

TRANSMISSION CLUNK ON ACCELERATION OR DECELERATION

Diagnostic Aids

There are a few factors to know when there is a clunk in acceleration or deceleration. You should always inspect the engine mounts for being loose or damaged. Inspect for a worn or damaged clutch driven plate. The clunk noise may also come from worn or damaged universal joints.

Test Description

The number below refers to the step number on the diagnostic table.

2: This step inspects for loose or damaged engine mounts.

4: This step inspects for a worn or damaged clutch driven plate.

6: This step inspects for worn or damaged universal joints.

Step	Action	Yes	No
DEFINITION: A clunk is heard and/or felt on acceleration or deceleration.			
1	Did you review the **Symptoms - Manual Transmission** and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Manual Transmission**
2	Inspect the engine mounts for being loose or damaged. Refer to **Engine Mount Inspection** . Did you find loose or damaged engine mounts?	Go to **Step 3**	Go to **Step 4**
	1. Tighten the engine mounts to		

3	specifications. Refer to **Fastener Tightening Specifications** . 2. Replace the engine mounts. Refer to **Engine Mount Replacement - Left Side** or **Engine Mount Replacement - Right Side** . Did you find and repair the condition?	System OK	Go to **Step 4**
4	1. Remove the transmission. Refer to **Transmission Replacement**. 2. Inspect the clutch driven plate hub for wear or damage. Is the clutch driven plate worn or damaged?	Go to **Step 5**	System OK
5	1. Replace the clutch driven plate. Refer to **Clutch Assembly Replacement** . 2. Install the transmission. Refer to **Transmission Replacement**. Did you find and repair the condition?	System OK	Go to **Step 6**
6	Inspect the universal joints for wear or damage. Are the universal joints worn or damaged?	Go to **Step 7**	System OK
7	Replace the universal joints. Refer to **Universal Joint Replacement - Nylon Injected Ring** or **Universal Joint Replacement - External Snap Ring** . Did you find and repair the condition?	Go to **Step 8**	Go to Diagnostic Aids
8	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 1**

REPAIR INSTRUCTIONS - ON VEHICLE

TRANSMISSION REAR MOUNT REPLACEMENT

Removal Procedure

NOTE: Broken or deteriorated mounts can cause misalignment and destruction of certain drive train components. When a single mount

breaks, the remaining mounts are subjected to abnormally high stresses.

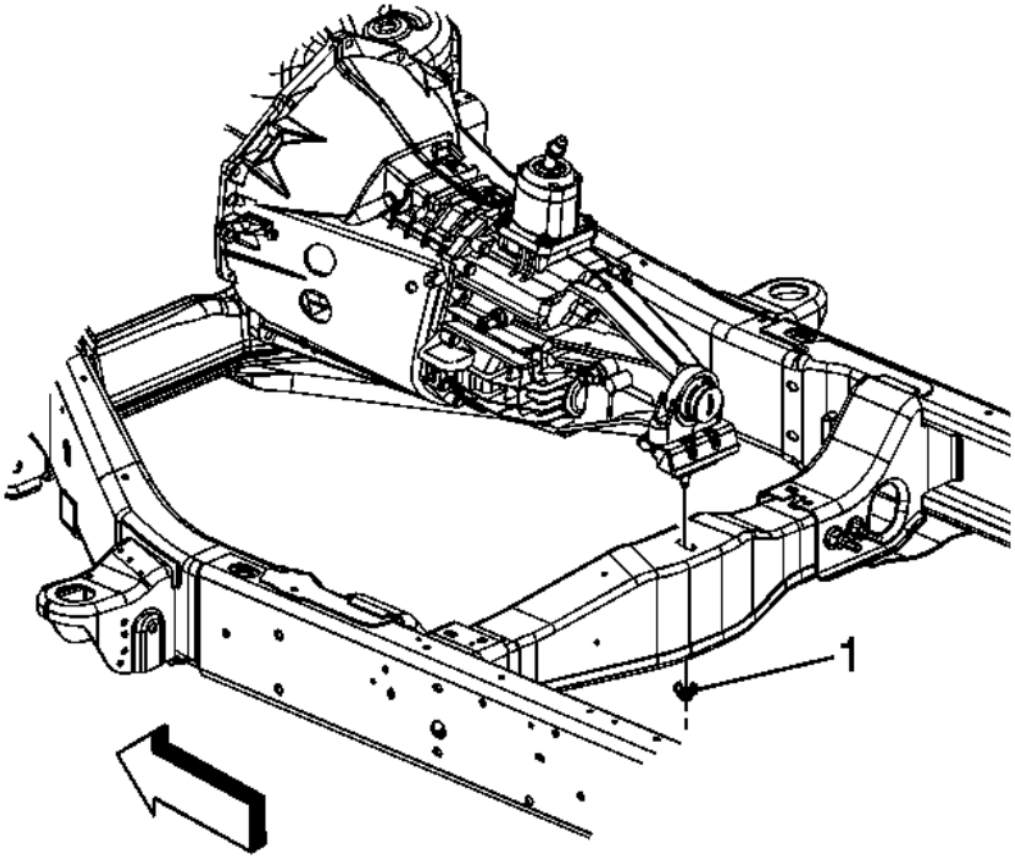


Fig. 5: Transmission Mount To Crossmember Nut
Courtesy of GENERAL MOTORS CORP.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the transmission mount to crossmember nut (1).

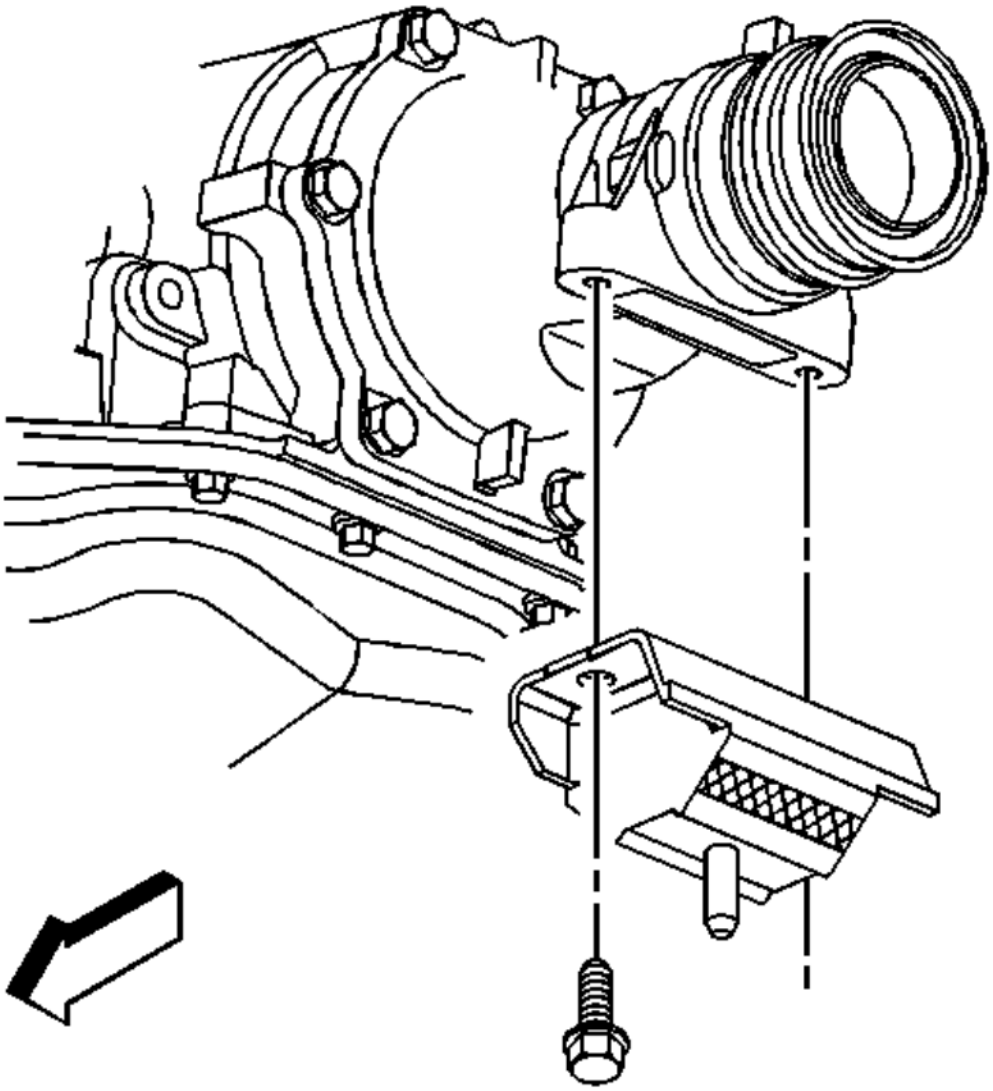


Fig. 6: Identifying Transmission Mount To Transmission Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the transmission mount to transmission bolts.
4. Raise the transmission just enough in order to permit removal of the mount using a suitable transmission jack.
5. Remove the transmission mount.

Installation Procedure

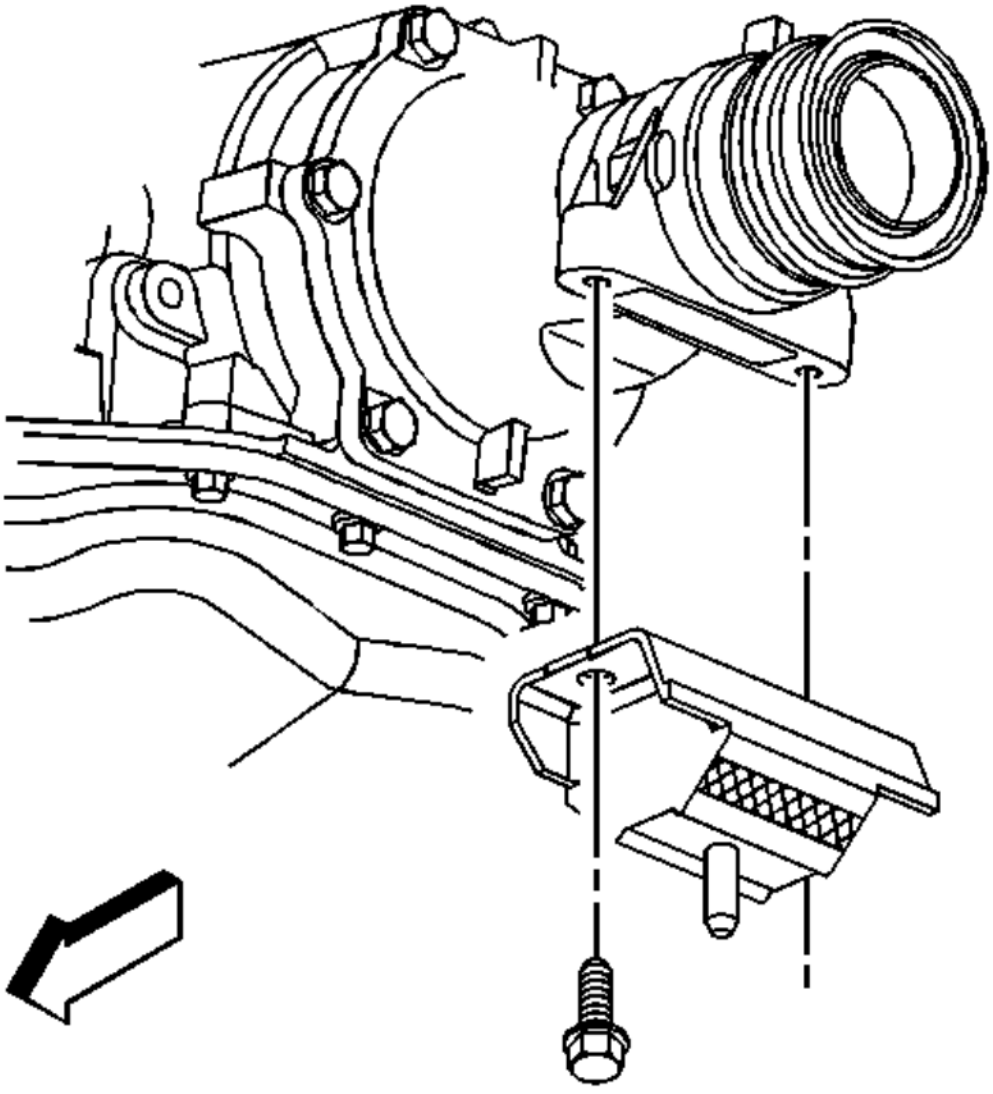


Fig. 7: Identifying Transmission Mount To Transmission Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

1. Position the transmission mount.

2. Install the transmission mount to transmission bolts.

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

3. Lower the transmission and remove the transmission jack.

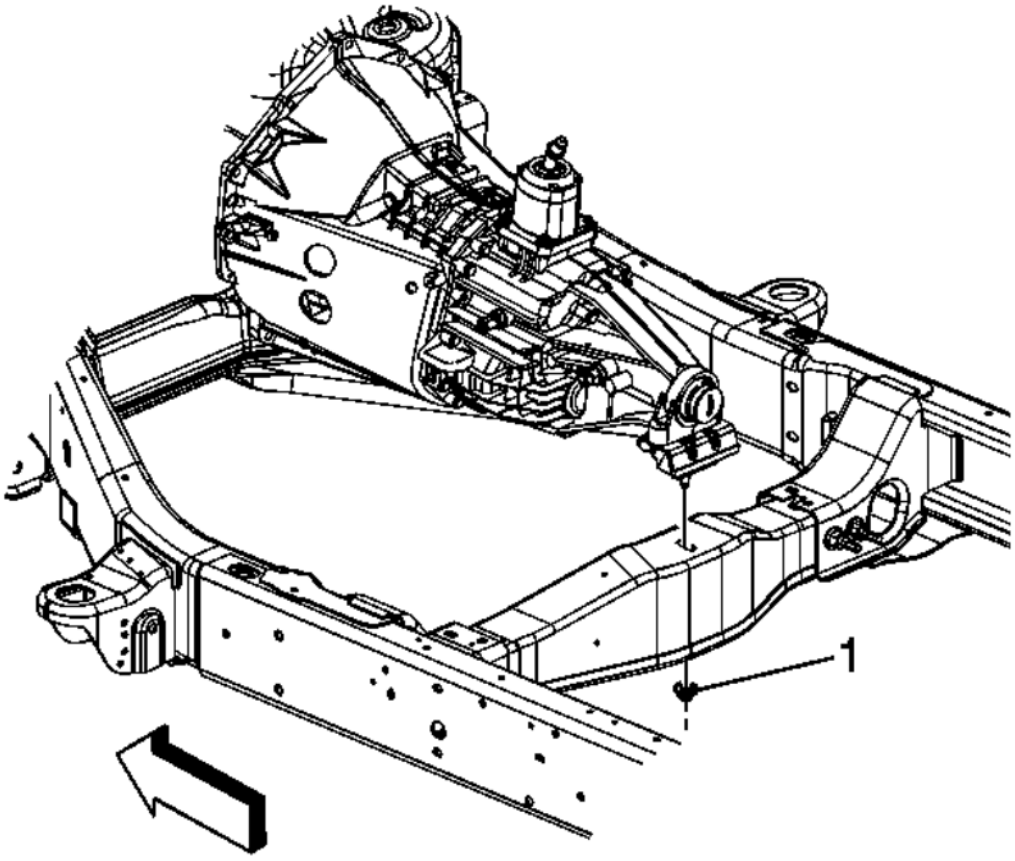


Fig. 8: Transmission Mount To Crossmember Nut
Courtesy of GENERAL MOTORS CORP.

4. Install the transmission mount to crossmember nut (1).

   Tighten: Tighten the nut to 40 N.m (30 lb ft).

5. Lower the vehicle.

TRANSMISSION CONTROL LEVER BOOT REPLACEMENT

Removal Procedure

1. Remove the transmission control lever. Refer to **Transmission Control Lever Knob Replacement** .

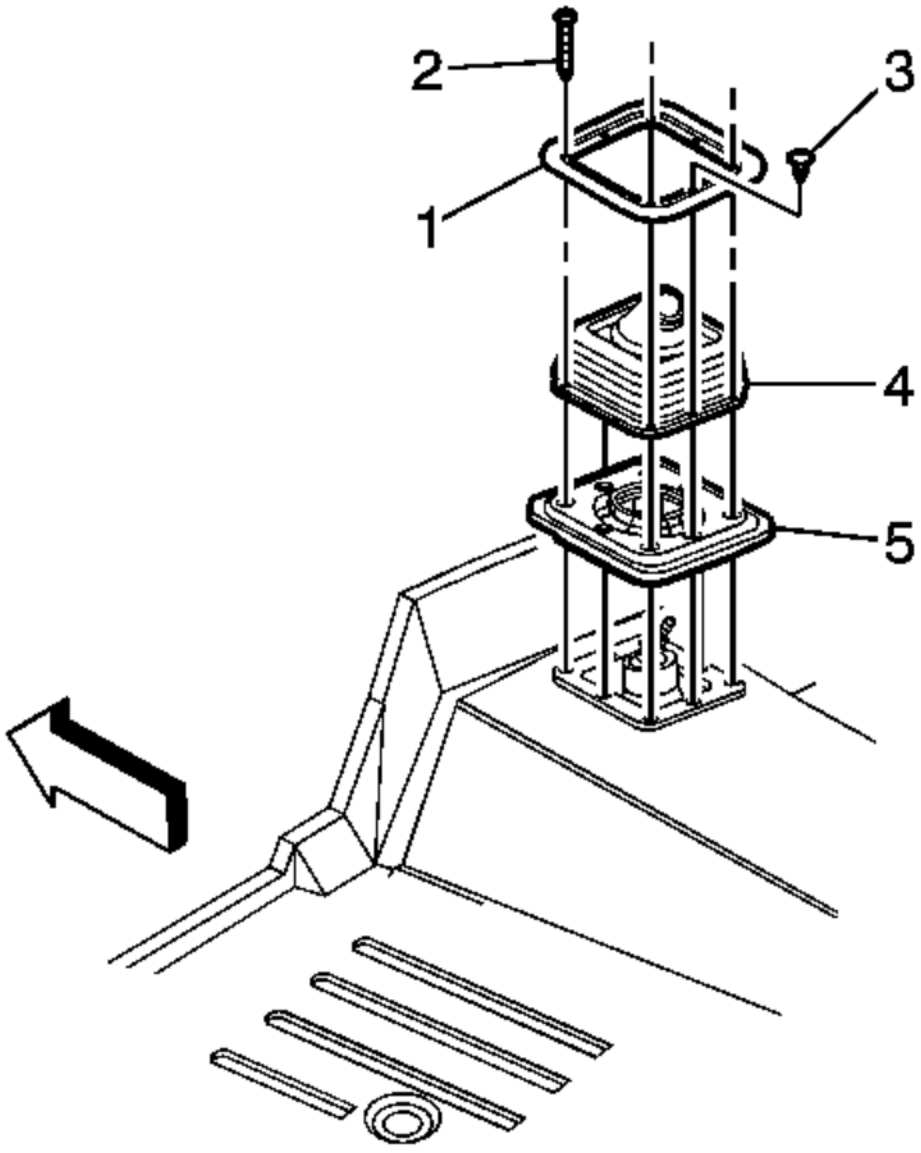


Fig. 9: Exploded View Of Transmission Control Lever Boot
Courtesy of GENERAL MOTORS CORP.

2. Lift and push the lower edge of the control lever boot as necessary in order to expose the retaining screws
3. Remove the 4 control lever boot retaining screws (2).
4. Carefully release the 4 plastic retainers (3) from the floor and remove the control lever boot retaining bezel (1), boot (4), and retainers (3) as an assembly.
5. Remove the 4 plastic retainers (3) in order to separate the control lever boot retaining bezel (1) from the boot (4).
6. Remove the control lever insulator (5) from the floor.

Installation Procedure

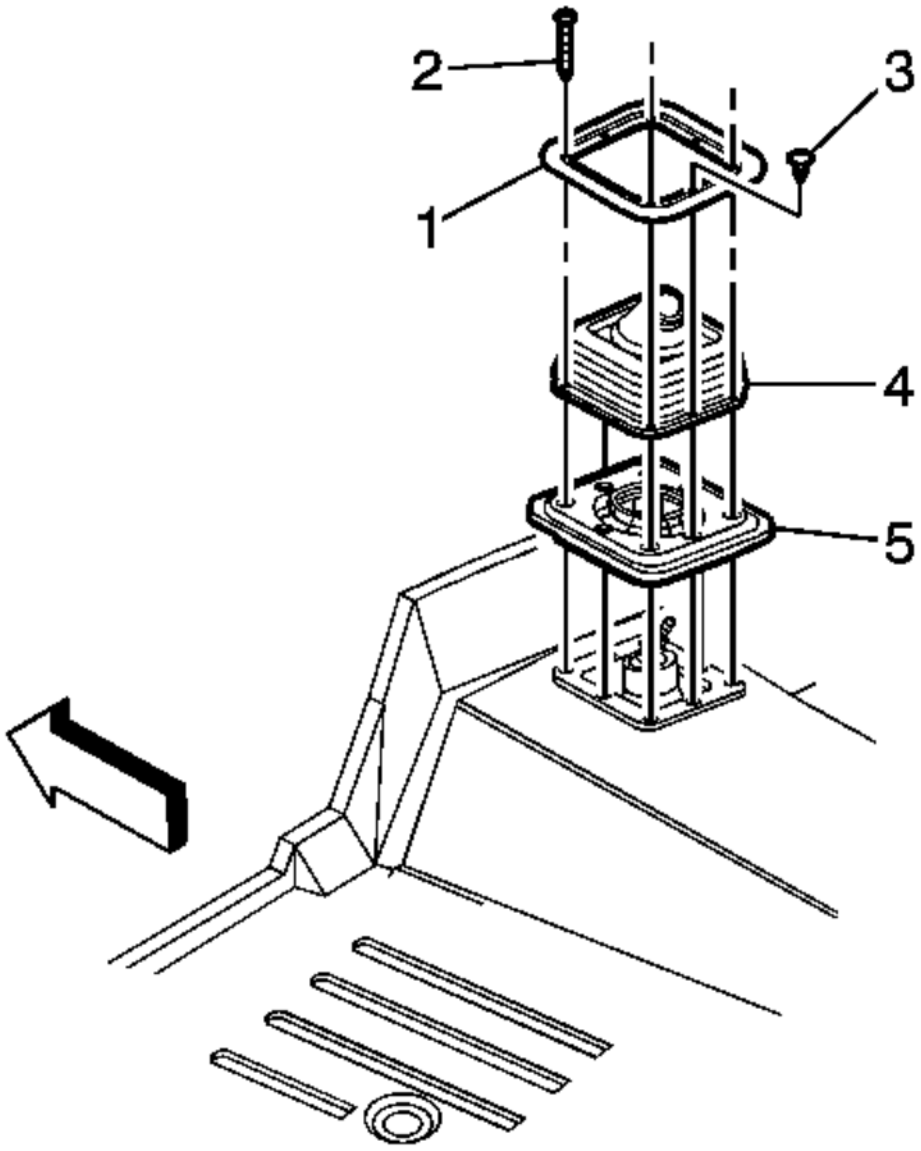


Fig. 10: Exploded View Of Transmission Control Lever Boot
Courtesy of GENERAL MOTORS CORP.

1. Install the control lever insulator (5) to the floor.
2. Assemble the control lever boot retaining bezel (1) to the boot (4) and insert the 4 plastic retainers (3).

3. Install the control lever boot retaining bezel (1), boot (4) and secure the 4 plastic retainers (3) to the floor.
4. Lift and push the lower edge of the control lever boot as necessary in order to install the 4 retaining screws (2).

NOTE: Refer to Fastener Notice .

Tighten: Tighten the screws to 1.6 N.m (14 lb in).

5. Install the transmission control lever. Refer to **Transmission Control Lever Knob Replacement** .

TRANSMISSION CONTROL LEVER KNOB REPLACEMENT

Removal Procedure

1. Remove the control lever boot from the control lever.

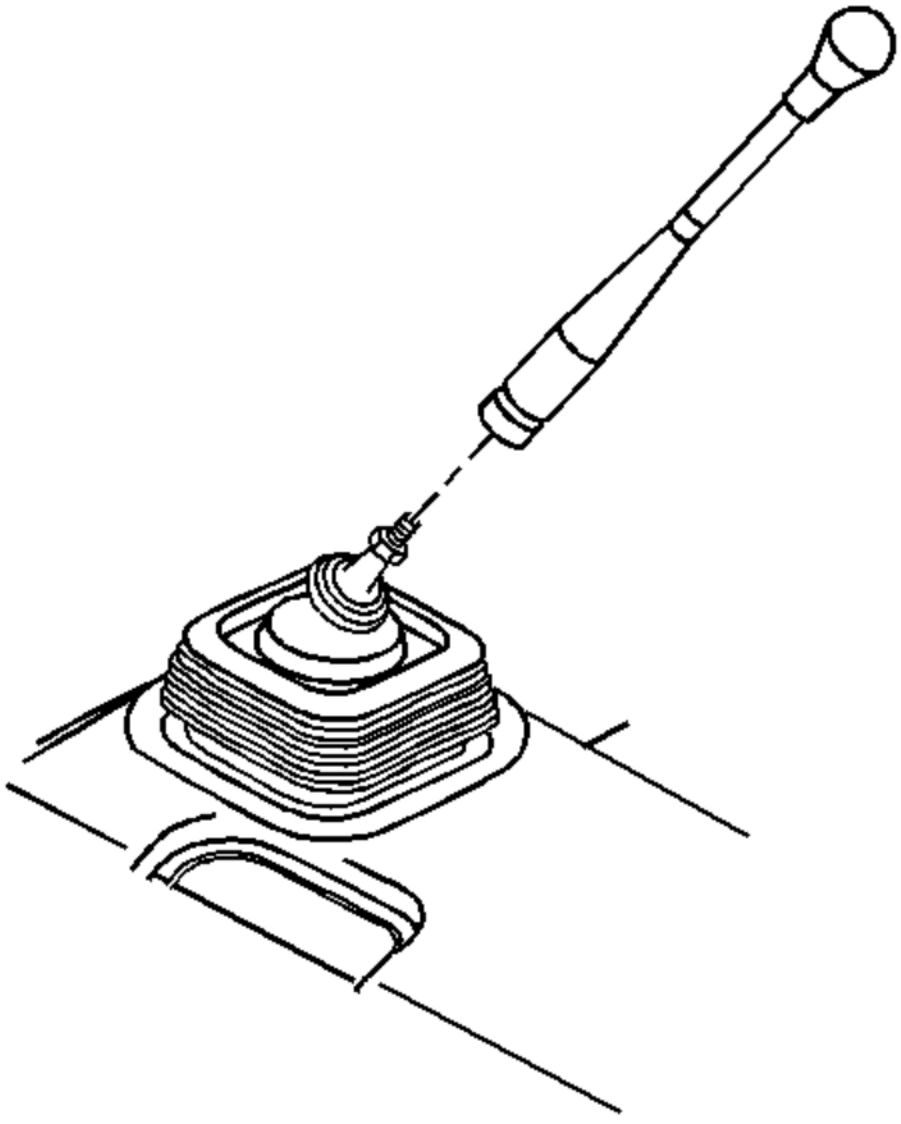


Fig. 11: View Of Control Lever
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: DO NOT move the shift lever assembly adjustment nut if replacing the control lever.

2. Remove the control lever.

Installation Procedure

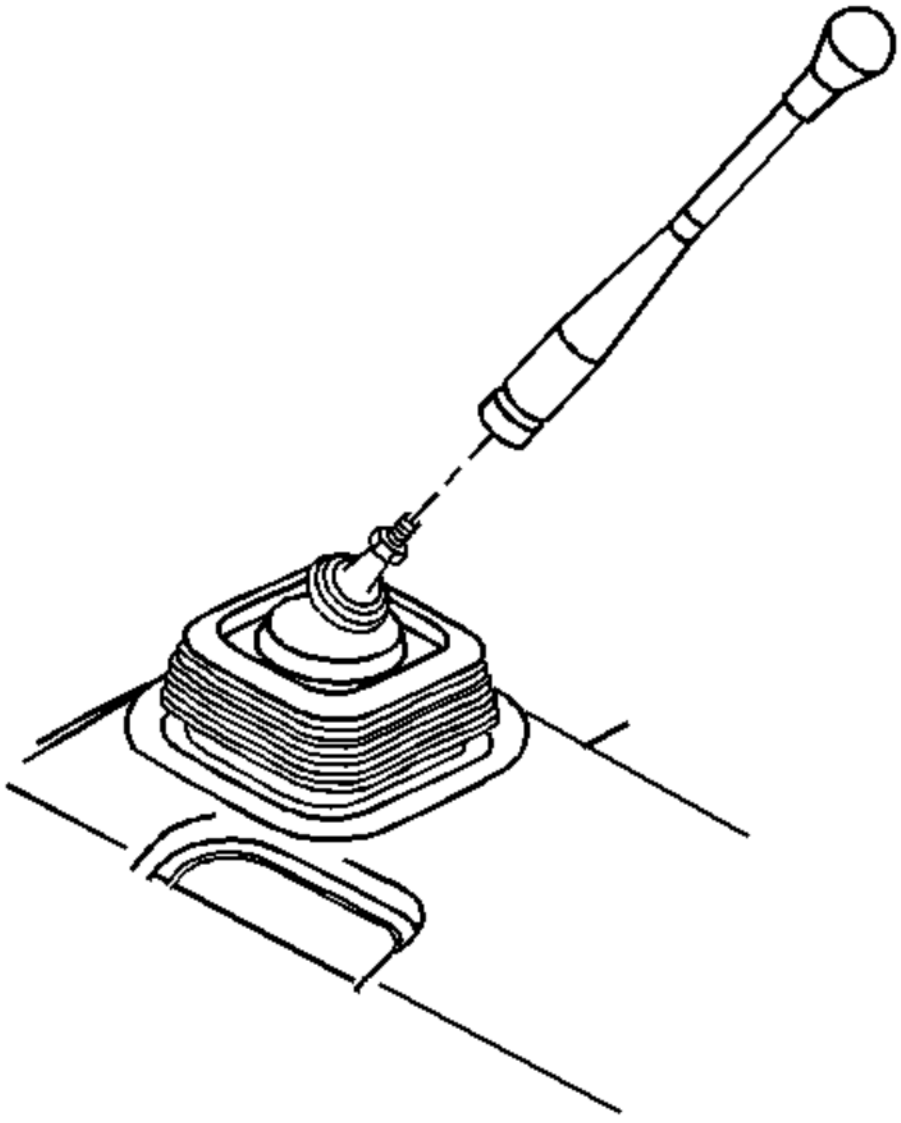


Fig. 12: View Of Control Lever
Courtesy of GENERAL MOTORS CORP.

1. Install the control lever.
2. If alignment of the control lever is necessary, or if the shift lever assembly was replaced perform the following:
    1. The nut must be seated at the bottom of the thread runout on the shift lever.
    2. Seat the control lever against the shift lever assembly adjustment nut.
    3. Back the control lever off the nut in order to align the index mark on the control lever perpendicular to the edge of the control lever boot retainer.
    4. Ensure that the index mark is located on the passenger side and that the shift pattern is aligned parallel to the vehicle centerline or rotated no more than 6 degrees clockwise.

    NOTE: Refer to Fastener Notice .

    5. Hold the control lever and tighten the shift lever assembly nut against the control lever.

    Tighten: Tighten the nut to 37 N.m (27 lb in).

    6. Install the control lever boot to the control lever.

TRANSMISSION CONTROL REPLACEMENT

Removal Procedure

IMPORTANT:

- **Ensure that the control lever is positioned into the mechanical third or fourth gear prior to removal of the shift lever from the transmission. The transmission must remain in this state when the shift lever is removed.**
- **Do not disassemble the transmission shift lever. Internal parts for this shift lever are not available. Opening the shift lever voids the warranty.**
- **When removing the shift lever from the transmission, use the exposed bolts on the base of the lever.**

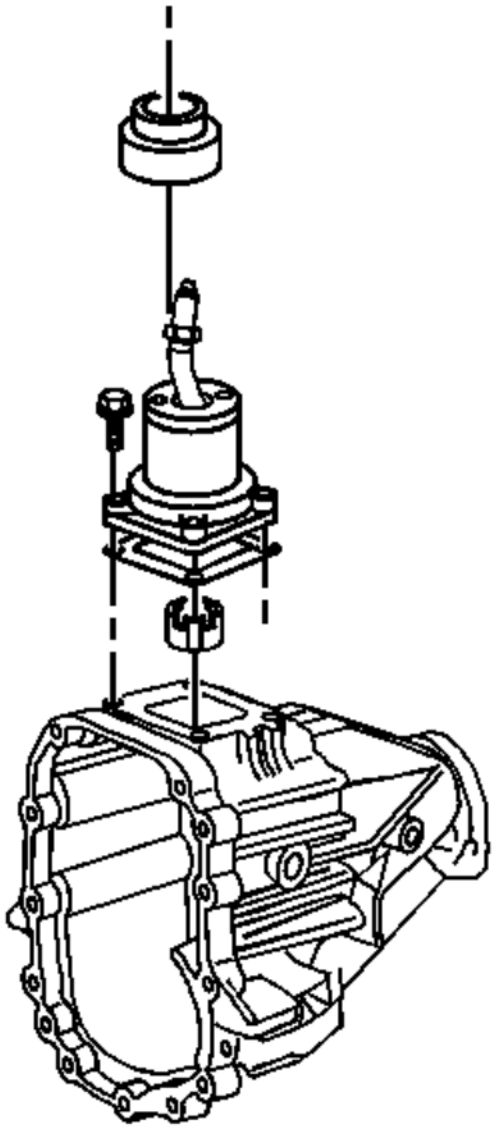


Fig. 13: View Of Control Lever And Boot
Courtesy of GENERAL MOTORS CORP.

1. Remove the control lever and boot. Refer to **Transmission Control Lever Boot Replacement** .
2. Remove the boot.

3. Remove the shift lever bolts.
4. Remove the shift lever and seal.
5. Remove the shift lever insulator.

Installation Procedure

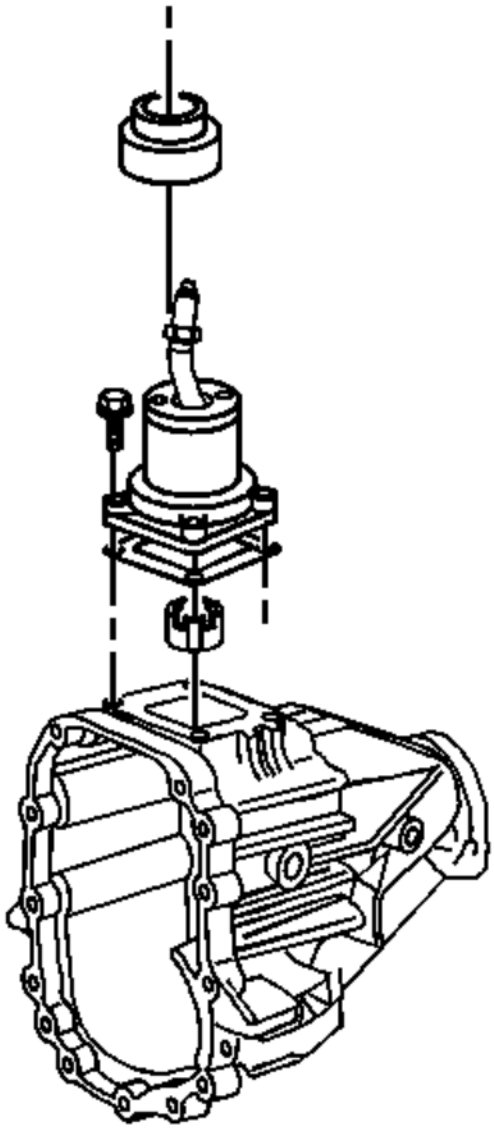


Fig. 14: View Of Control Lever And Boot
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW shift lever insulator.
2. Install the shift lever seal and lever.

NOTE: Refer to Fastener Notice .

3. Install the shift lever bolts.

   Tighten: Tighten the bolts to 20 N.m (15 lb ft).

4. Install the boot.
5. Install the control lever and boot. Refer to **Transmission Control Lever Boot Replacement** .

MAINSHAFT REAR OIL SEAL REPLACEMENT

Tools Required

- **J 23129** Universal Seal Remover
- **J 6125-1B** Slide Hammer
- **J 36503** Extension Housing Seal Installer

Removal Procedure

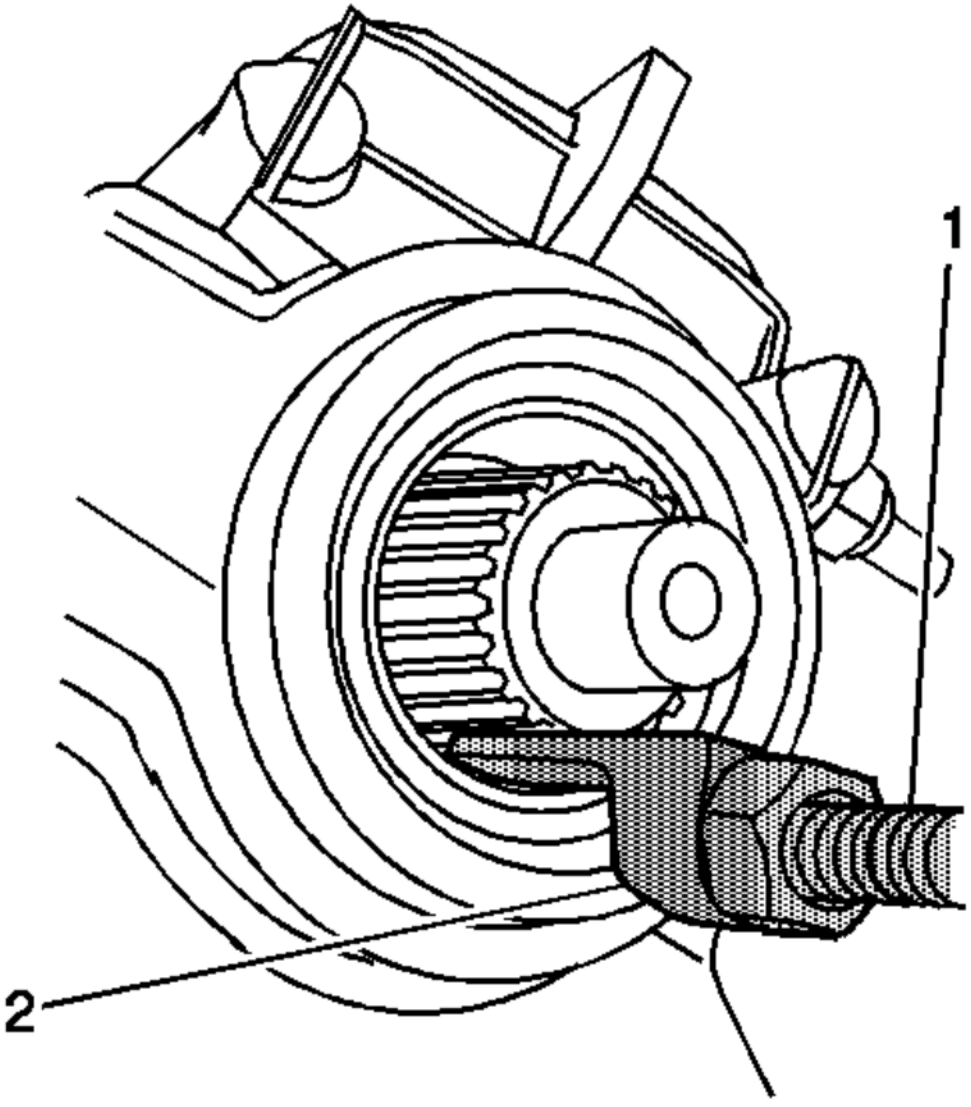


Fig. 15: View Of Rear Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Remove the rear propeller shaft. Refer to **One-Piece Propeller Shaft Replacement** or **Two-Piece Propeller Shaft Replacement** .
2. Remove the rear oil seal using **J 6125-1B** (1) and **J 23129** (2).

Installation Procedure

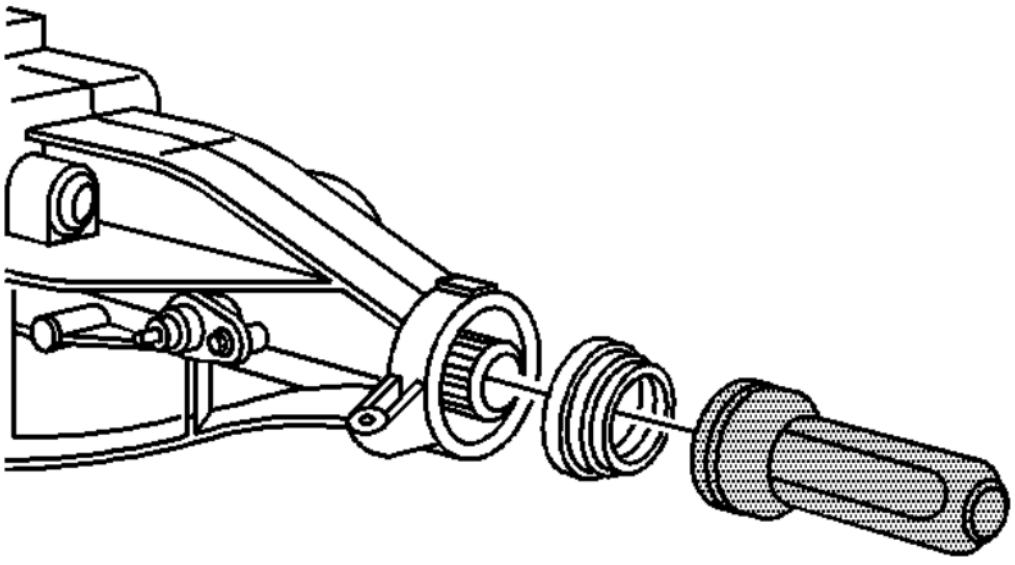


Fig. 16: Installing The New Rear Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Using **J 36503** install the NEW rear oil seal.
2. Install the rear propeller shaft. Refer to **One-Piece Propeller Shaft Replacement** or **Two-Piece Propeller Shaft Replacement** .
3. Check to transmission fluid level. Add if necessary.
4. Lower the vehicle.

BACKUP LAMP SWITCH REPLACEMENT

Removal Procedure

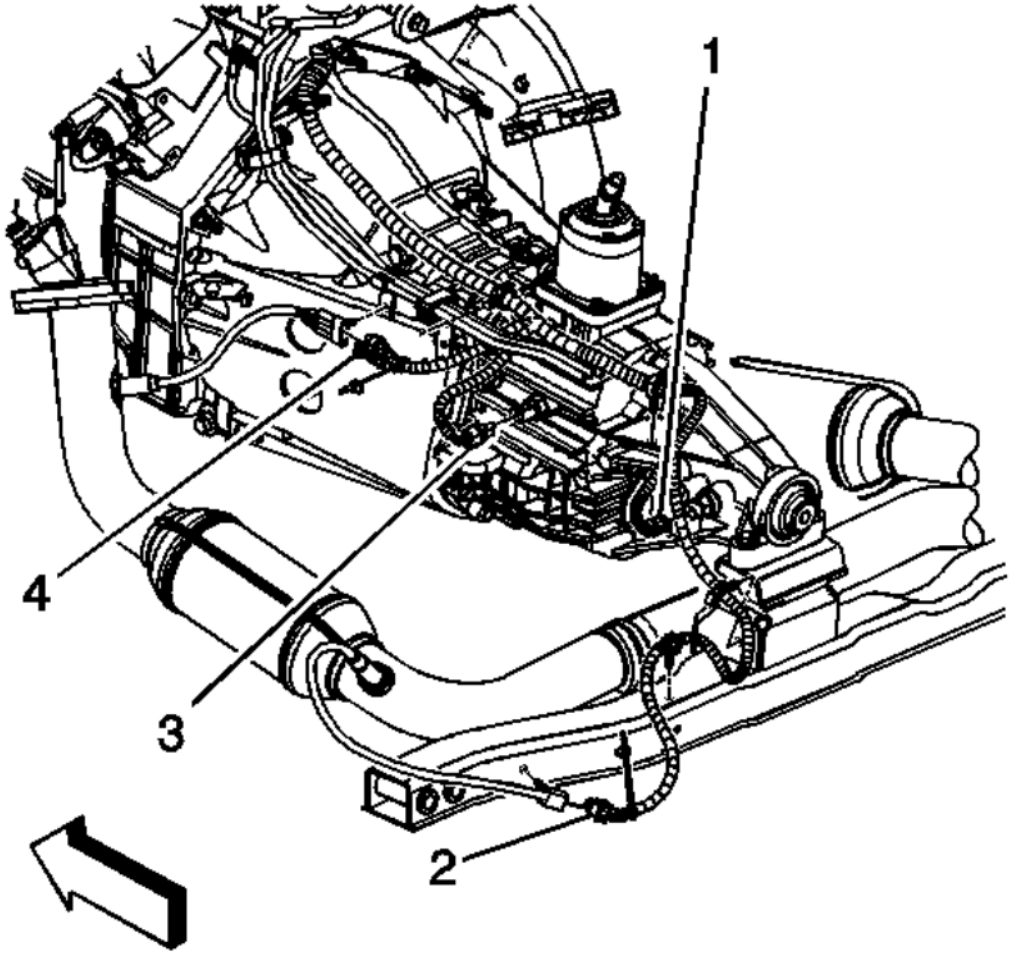


Fig. 17: Locating HO2S Electrical Connector At Harness (Manual 2WD)
Courtesy of GENERAL MOTORS CORP.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Disconnect the backup lamp switch electrical connector (3).

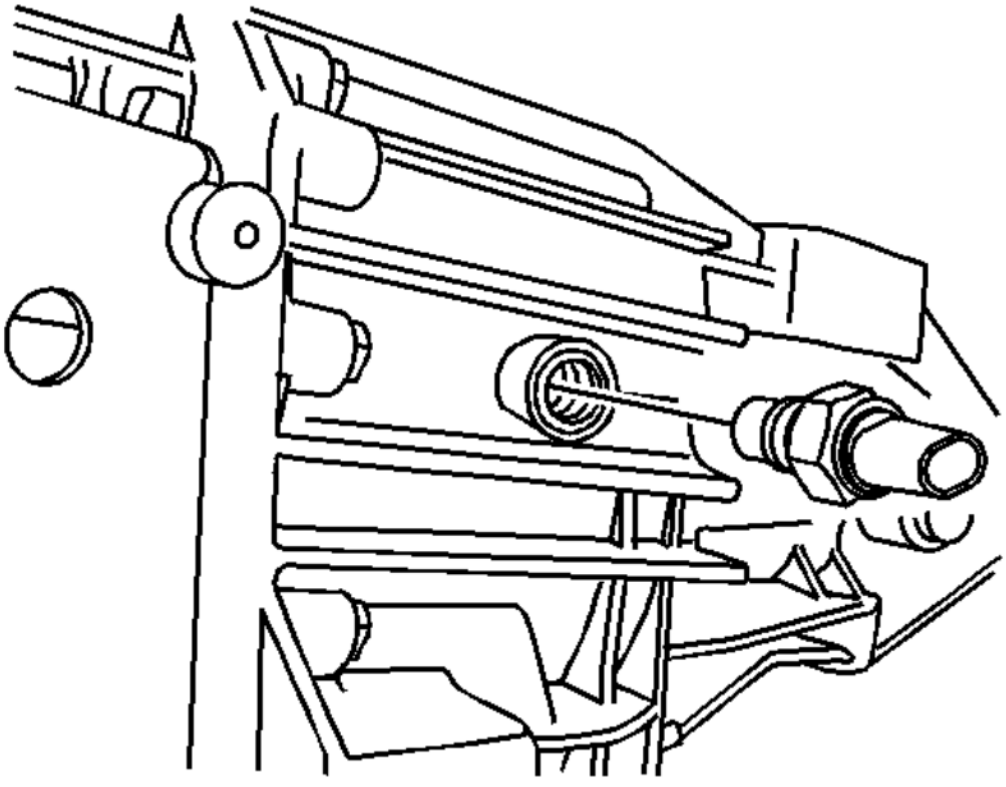


Fig. 18: View Of Backup Lamp Switch
Courtesy of GENERAL MOTORS CORP.

3. Remove the backup lamp switch.

Installation Procedure

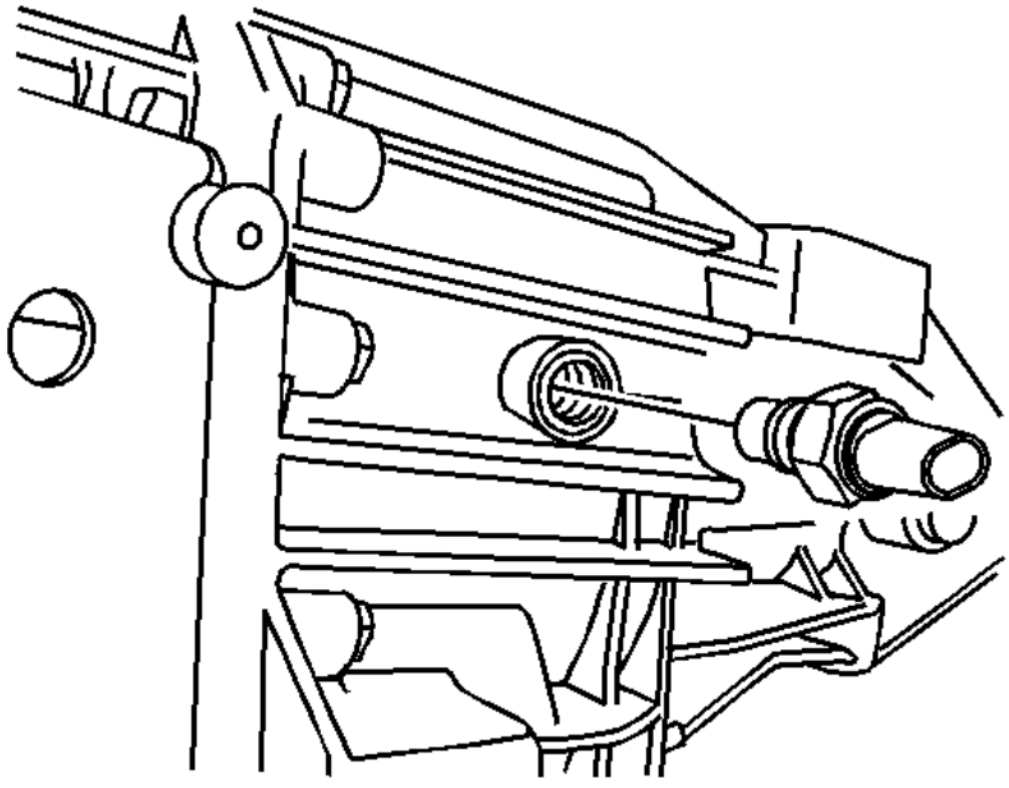


Fig. 19: View Of Backup Lamp Switch
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Component Fastener Tightening Notice .

IMPORTANT: The backup lamp switch has pre-applied thread sealant on the threads.

1. Install the backup lamp switch.

   Tighten: Tighten the switch to 37 N.m (27 lb ft).

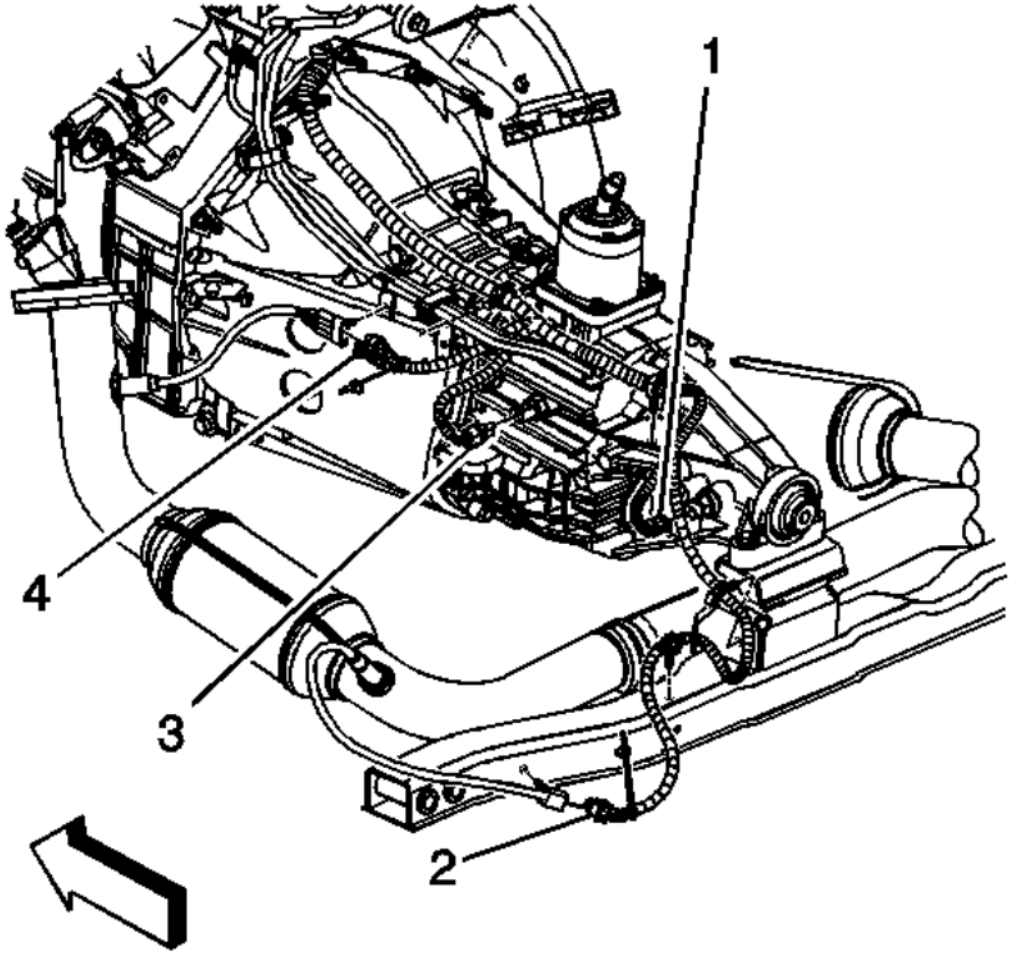


Fig. 20: Locating HO2S Electrical Connector At Harness (Manual 2WD)
Courtesy of GENERAL MOTORS CORP.

2. Connect the backup lamp switch electrical connector (3).
3. Lower the vehicle.

VEHICLE SPEED SENSOR REPLACEMENT

Removal Procedure

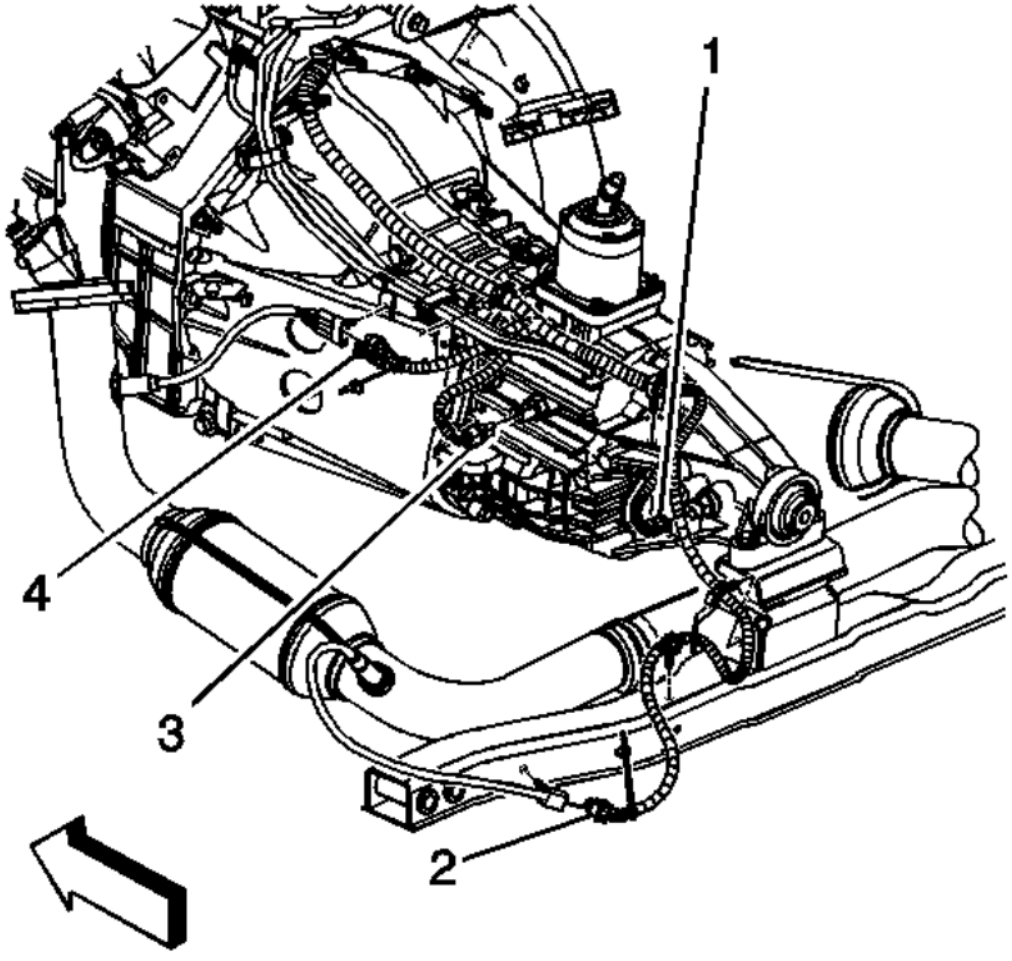


Fig. 21: Locating HO2S Electrical Connector At Harness (Manual 2WD)
Courtesy of GENERAL MOTORS CORP.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Disconnect the vehicle speed sensor (VSS) electrical connector (1).

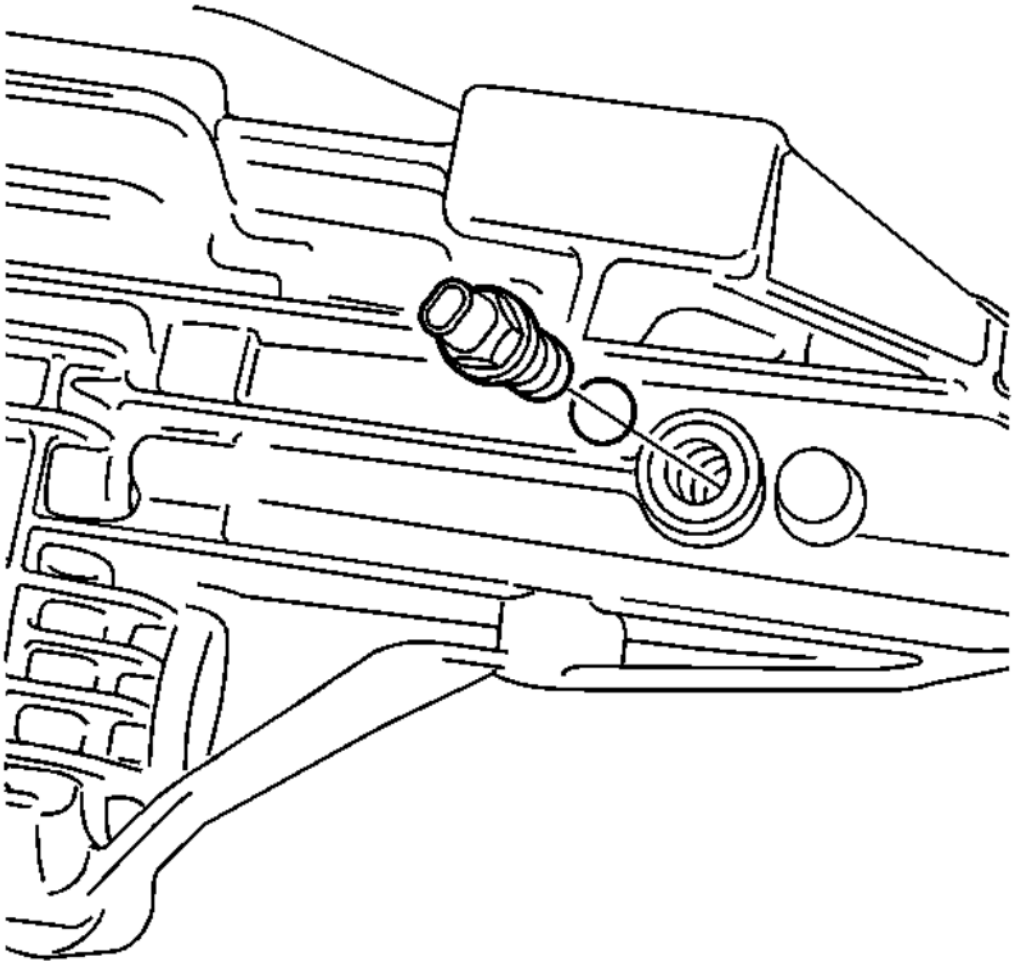


Fig. 22: Identifying VSS And O-Ring Seal
Courtesy of GENERAL MOTORS CORP.

3. Remove the VSS and O-ring seal.

Installation Procedure

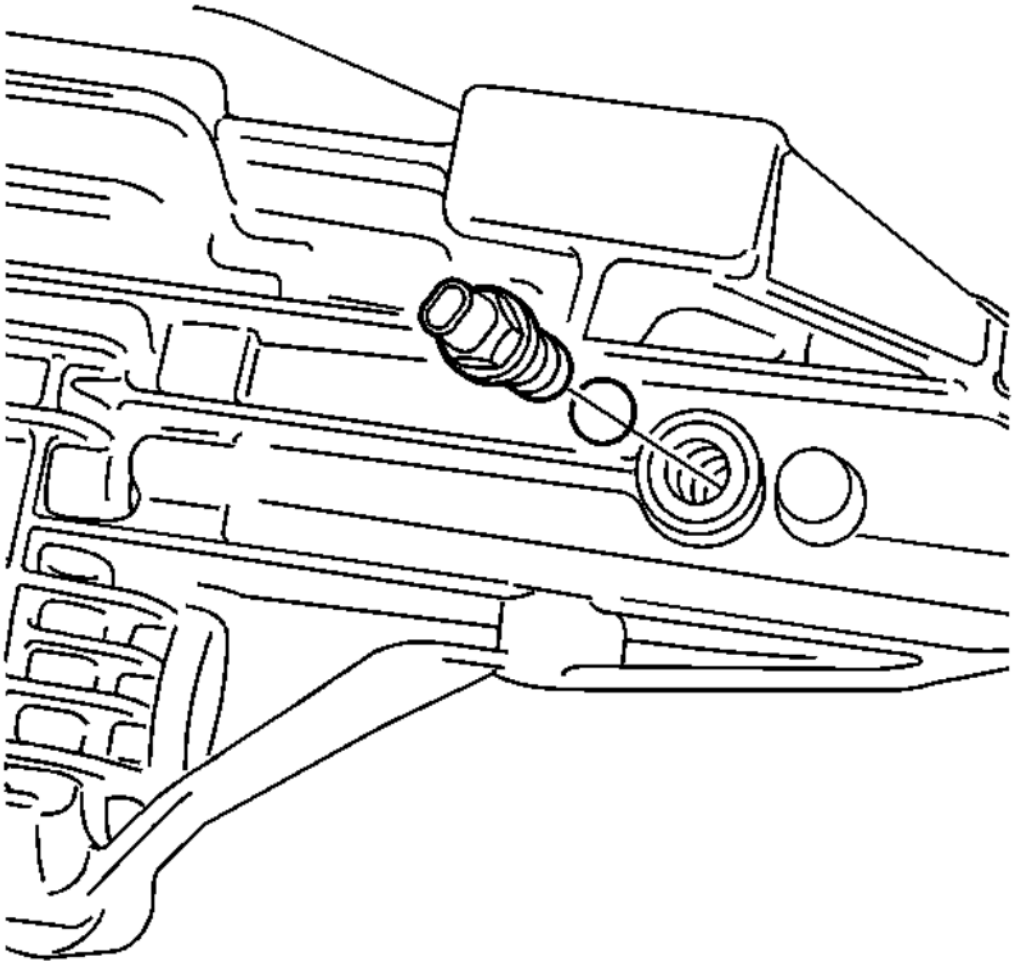


Fig. 23: Identifying VSS And O-Ring Seal
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Component Fastener Tightening Notice .

1. Coat a NEW O-ring seal with a thin film of Synchro-mesh transmission fluid GM P/N 12345349 (Canadian P/N 10953465), or equivalent.
2. Install the VSS and O-ring seal.

Tighten: Tighten the VSS to 16 N.m (12 lb ft).

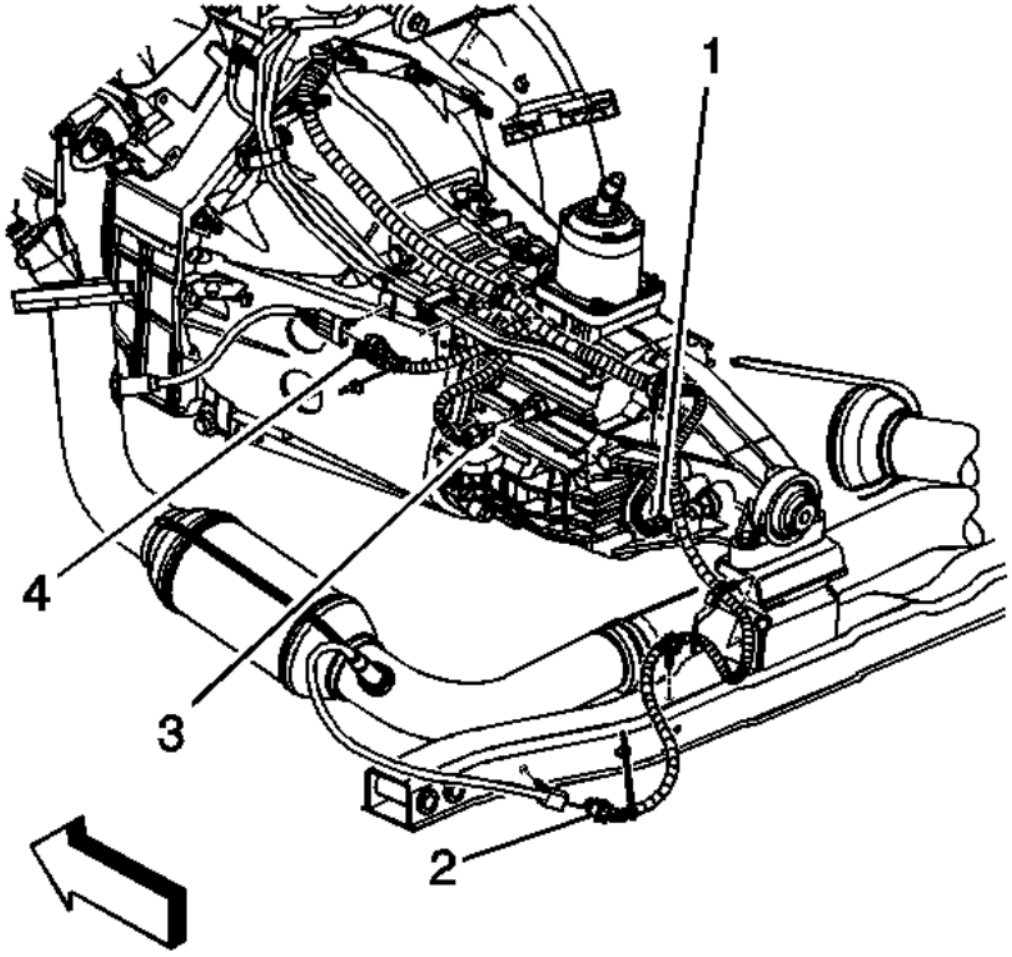


Fig. 24: Locating HO2S Electrical Connector At Harness (Manual 2WD)
Courtesy of GENERAL MOTORS CORP.

3. Connect the VSS electrical connector (1).
4. Lower the vehicle.

TRANSMISSION FLUID REPLACEMENT

Tools Required

J 36511 Oil Fill/Drain Plug Hex Bit (17 mm)

Removal Procedure

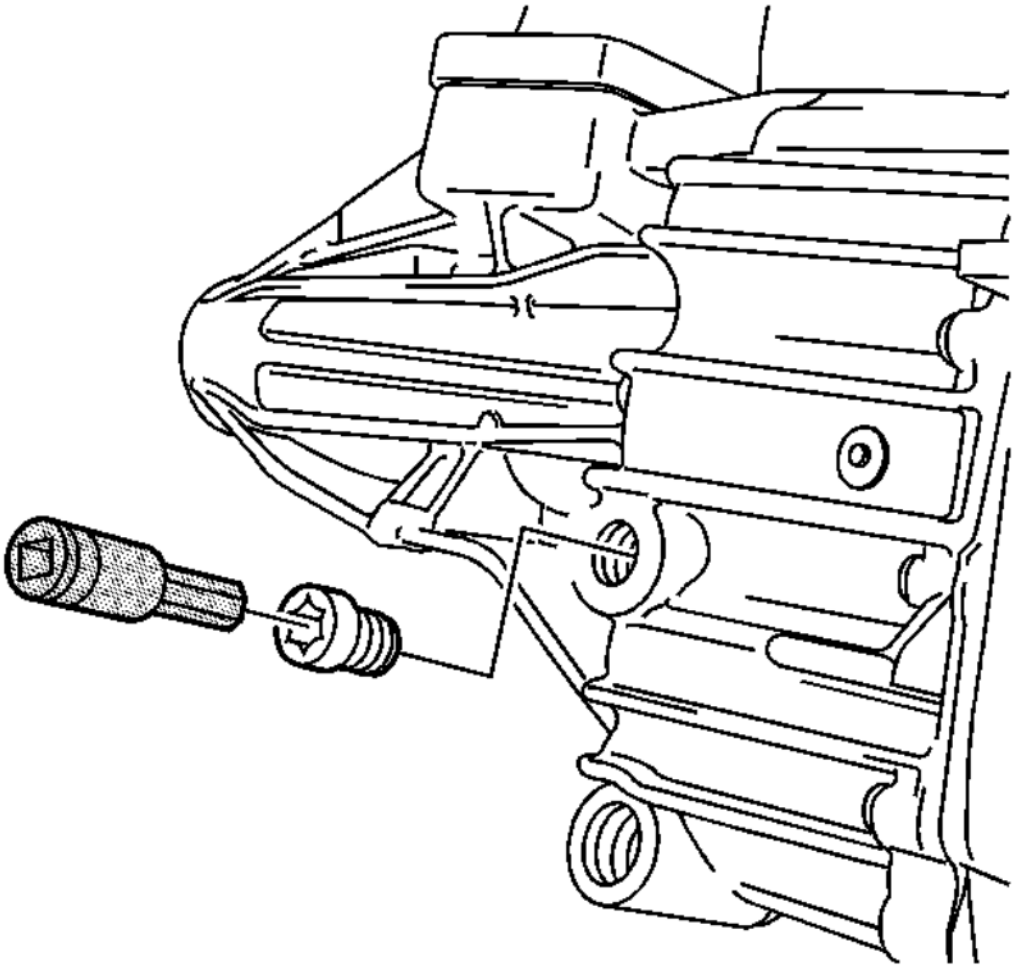


Fig. 25: View Of Oil Fill Plug
Courtesy of GENERAL MOTORS CORP.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Using **J 36511** remove the oil fill plug.

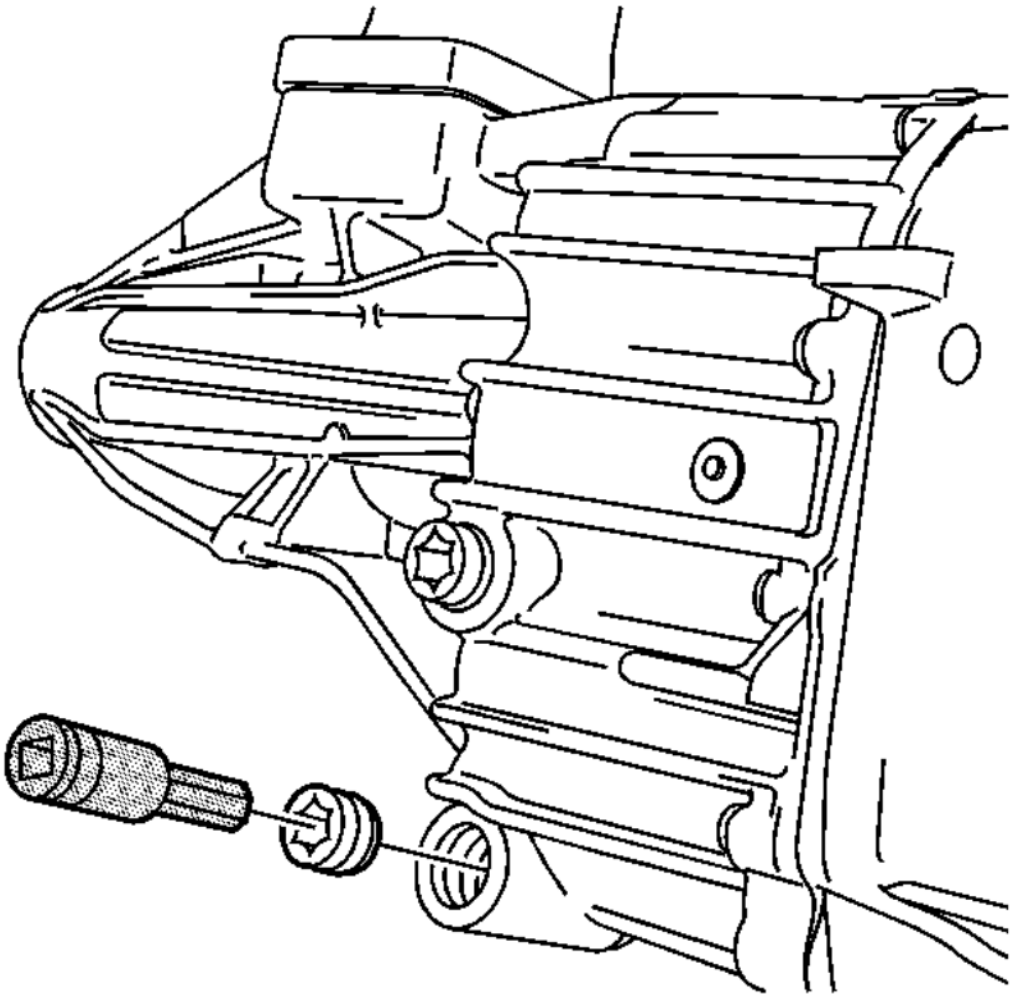


Fig. 26: View Of Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

3. Place a suitable drain pan under the transmission in order to catch the drained transmission fluid.
4. Using **J 36511** remove the oil drain plug.
5. Remove any old sealant from the transmission housing.

Installation Procedure

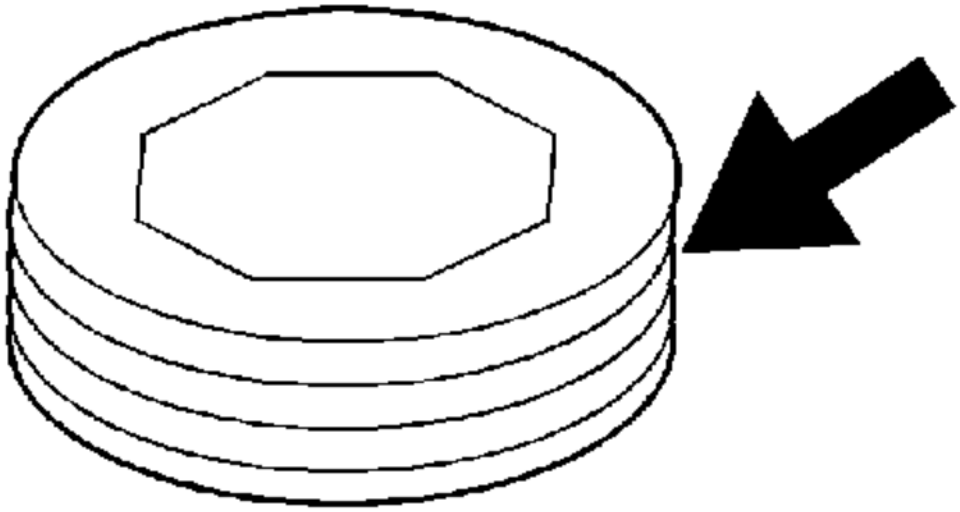


Fig. 27: Applying Sealant GM P/N 12346004 (Canadian P/N 10953480) To The Oil Drain Plug Threads
Courtesy of GENERAL MOTORS CORP.

1. Apply sealant GM P/N 12346004 (Canadian P/N 10953480), or equivalent to the oil drain and fill plug threads.

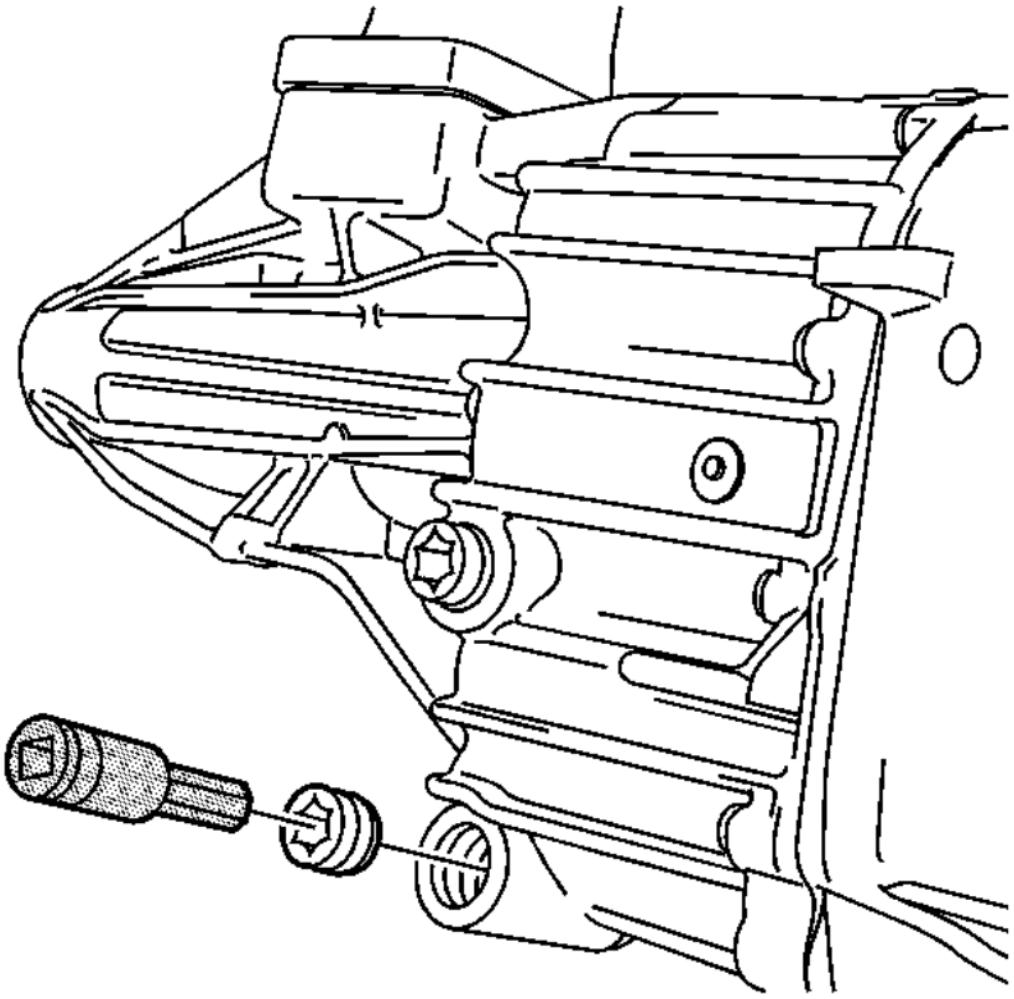


Fig. 28: View Of Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Component Fastener Tightening Notice .

2. Using **J 36511** install the oil drain plug.

   Tighten: Tighten the plug to 30 N.m (22 lb ft).

3. Remove and drain the drain pan used to catch the used transmission fluid.

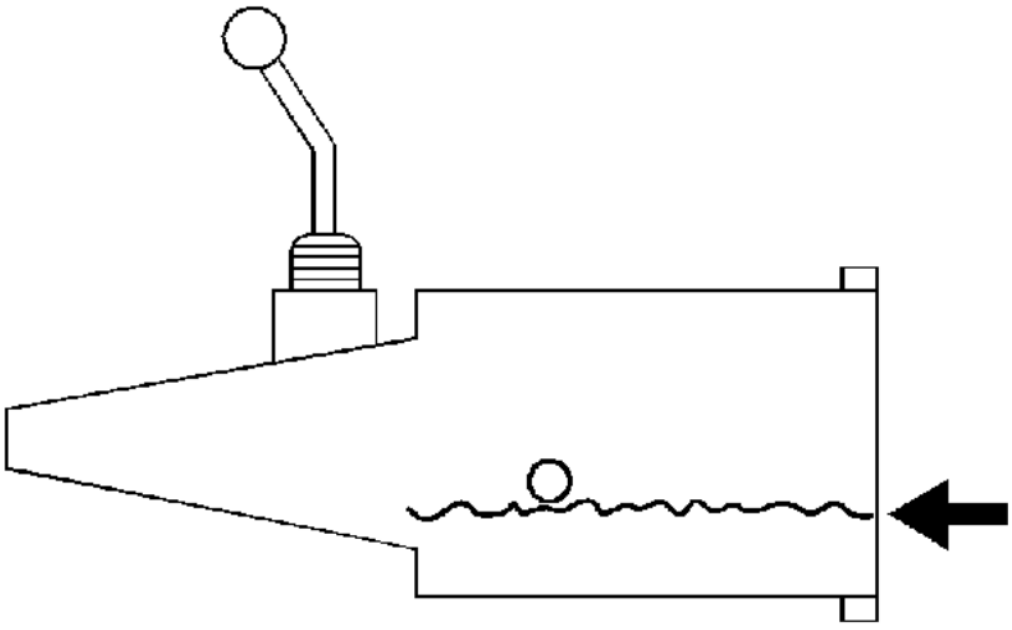


Fig. 29: Checking Transmission Fluid Level
Courtesy of GENERAL MOTORS CORP.

4. Fill the transmission to just below the bottom of the fill plug hole. Refer to **Lubrication Specifications**.

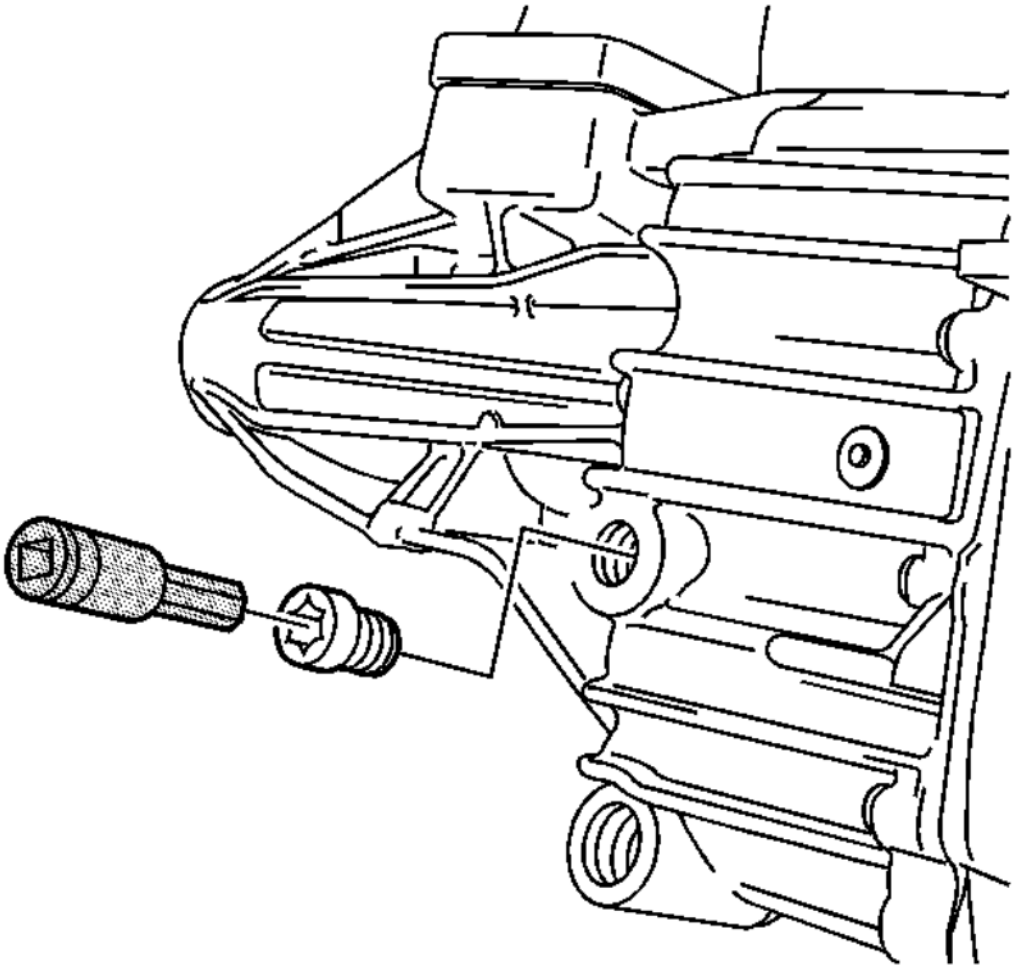


Fig. 30: View Of Oil Fill Plug
Courtesy of GENERAL MOTORS CORP.

5. Using **J 36511** install the oil fill plug.

   Tighten: Tighten the plug to 30 N.m (22 lb ft).

6. Lower the vehicle.

TRANSMISSION REPLACEMENT

Tools Required

J 42371 Hydraulic Clutch Line Separator

Removal Procedure

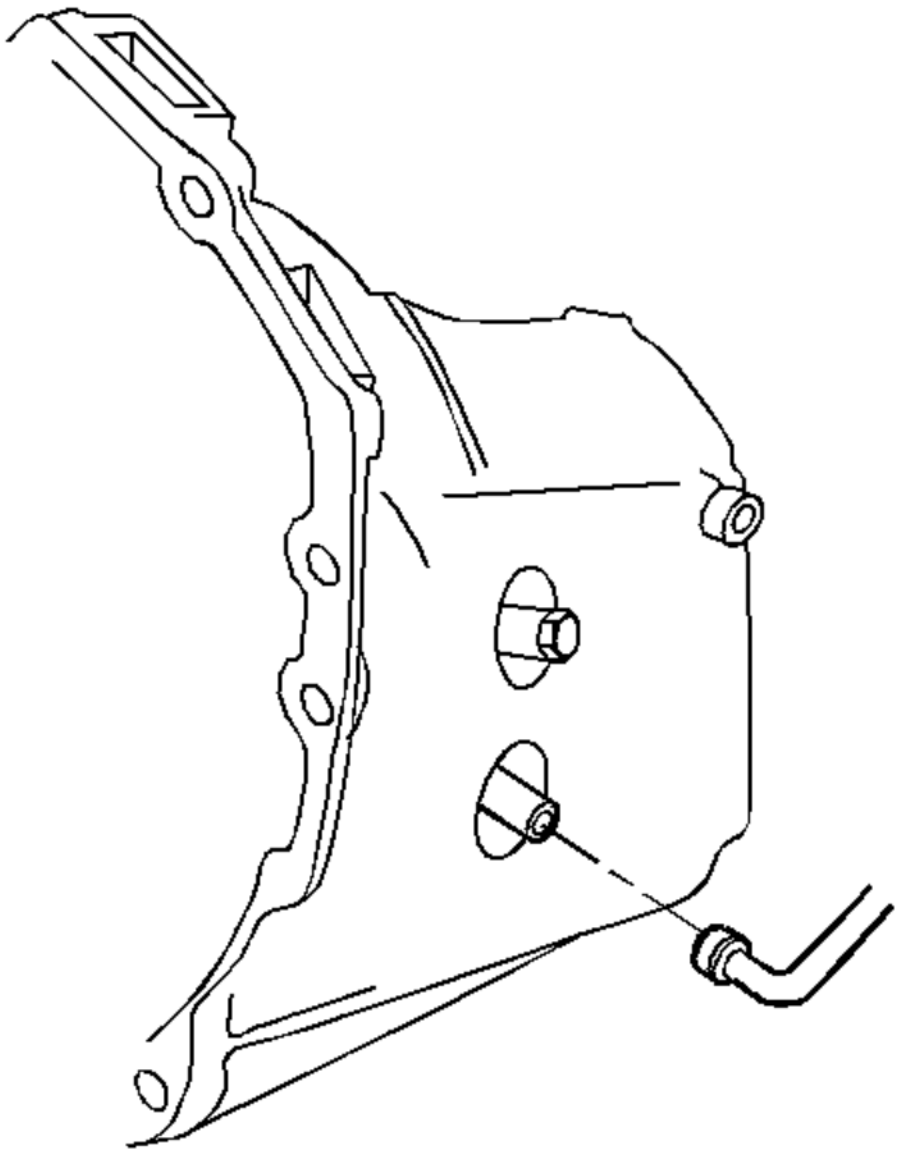


Fig. 31: Identifying Hydraulic Clutch Line At Clutch Actuator Quick Connect
Courtesy of GENERAL MOTORS CORP.

1. Shift the transmission into 3rd or 4th gear.
2. Remove the shift lever assembly. Refer to **Transmission Control Replacement**.
3. Remove the propeller shaft. Refer to **One-Piece Propeller Shaft Replacement** or **Two-Piece Propeller Shaft Replacement** .
4. Using **J 42371** , push back on the white plastic sleeve on the quick connect in order to separate the hydraulic clutch line from the clutch actuator quick connect.

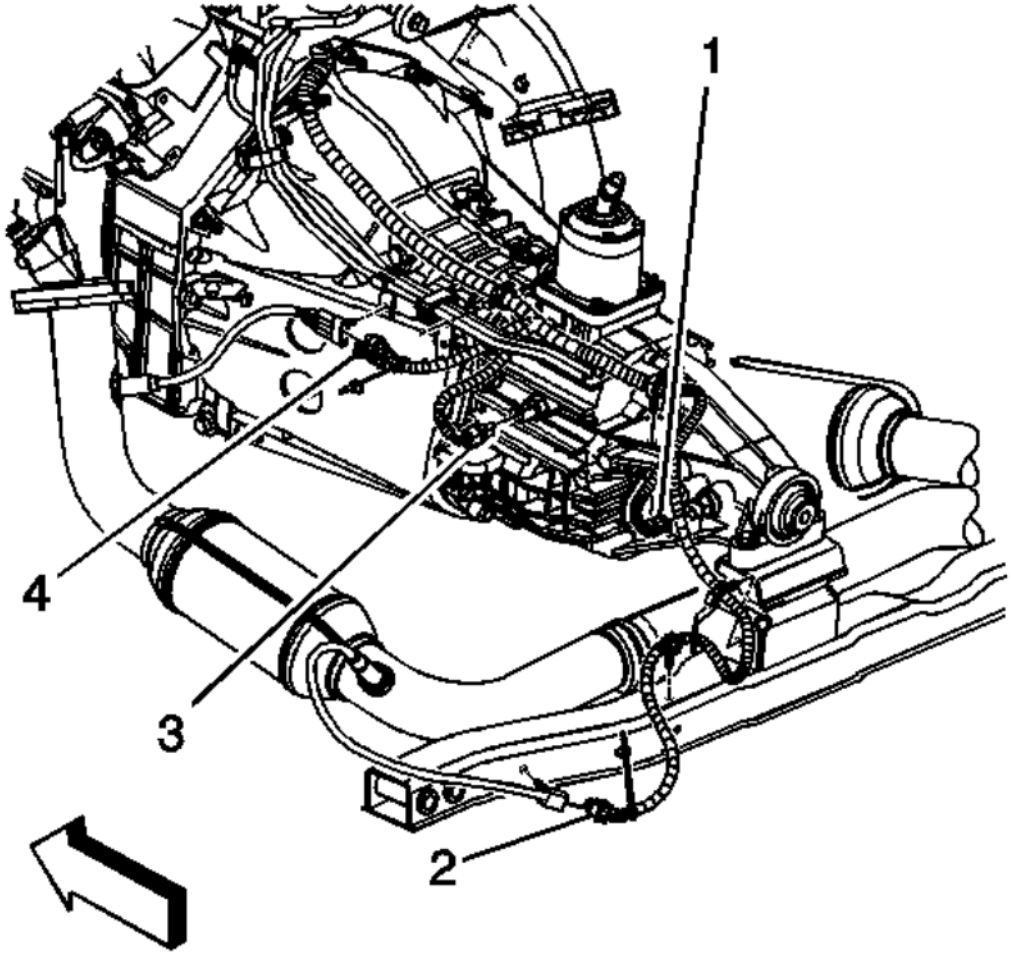


Fig. 32: Locating HO2S Electrical Connector At Harness (Manual 2WD)
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the following engine wiring harness electrical connectors:
   - Vehicle speed sensor (VSS) (1)
   - Backup lamp switch (3)
   - Oxygen sensor (4)
6. Remove the engine harness clips from the fuel feed/return line clips and transmission.
7. Remove the starter motor. Refer to **Starter Motor Replacement (4.3L)** or **Starter Motor Replacement (4.8L, 5.3L, 6.0L, and 6.2L)** or **Starter Motor Replacement (6.6L)** .
8. Support the transmission using a suitable transmission jack.
9. Remove the transmission support crossmember. Refer to **Transmission Support Crossmember Replacement (2WD 2500 HD/3500)** or **Transmission Support Crossmember Replacement (2WD 1500/2500)** or **Transmission Support Crossmember Replacement (4WD 1500/2500)** or **Transmission Support Crossmember Replacement (4WD 2500 HD/3500)** .

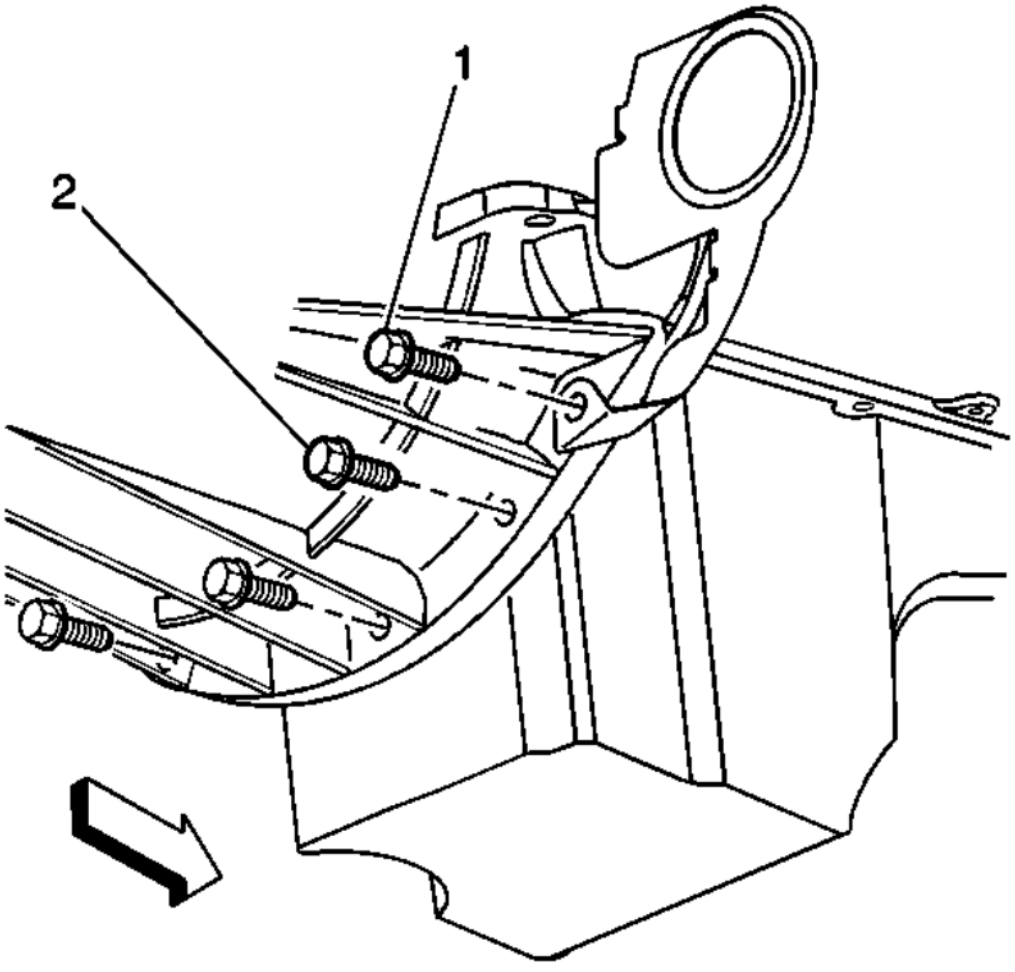


Fig. 33: Removing/Installing The Bolts Securing The Bottom Right Side Of The Transmission To The Engine
Courtesy of GENERAL MOTORS CORP.

10. Remove the bolts (1, 2) securing the bottom right side of the transmission to the engine.
11. Remove the transmission cover.

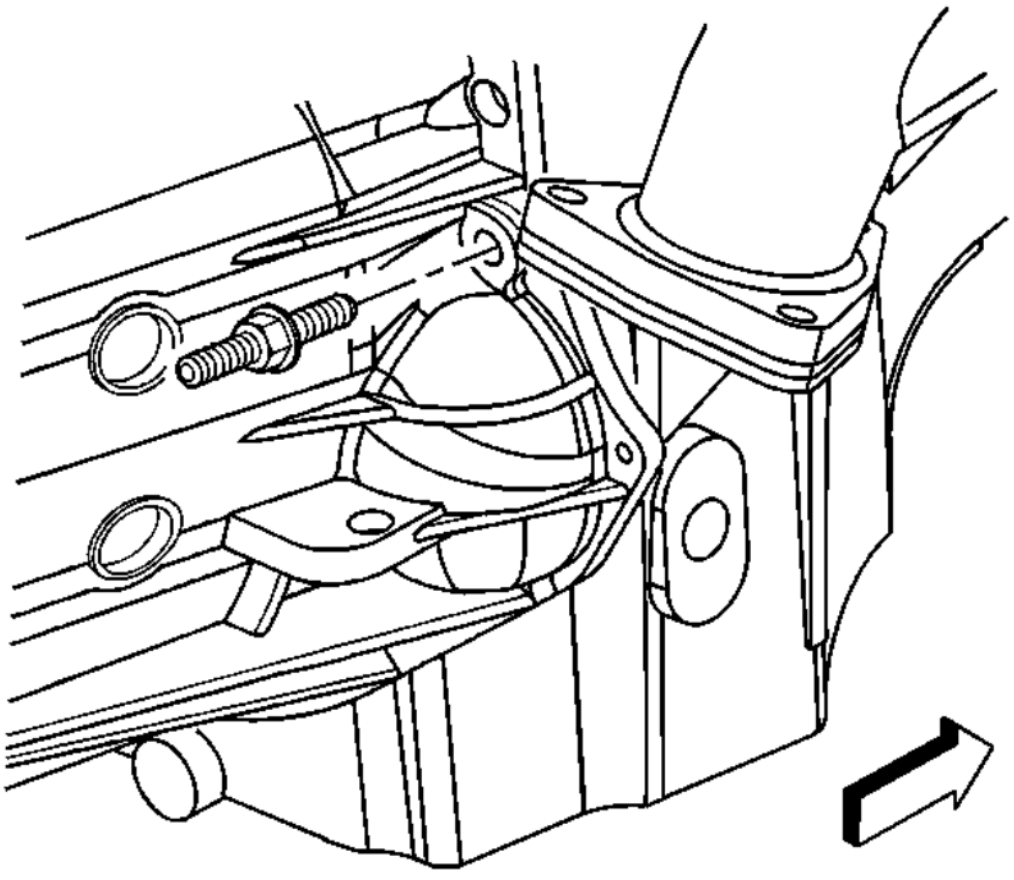


Fig. 34: View Of Manual Transmission Stud (Right Side)
Courtesy of GENERAL MOTORS CORP.

12. Remove the stud securing the right side of the transmission to the engine.

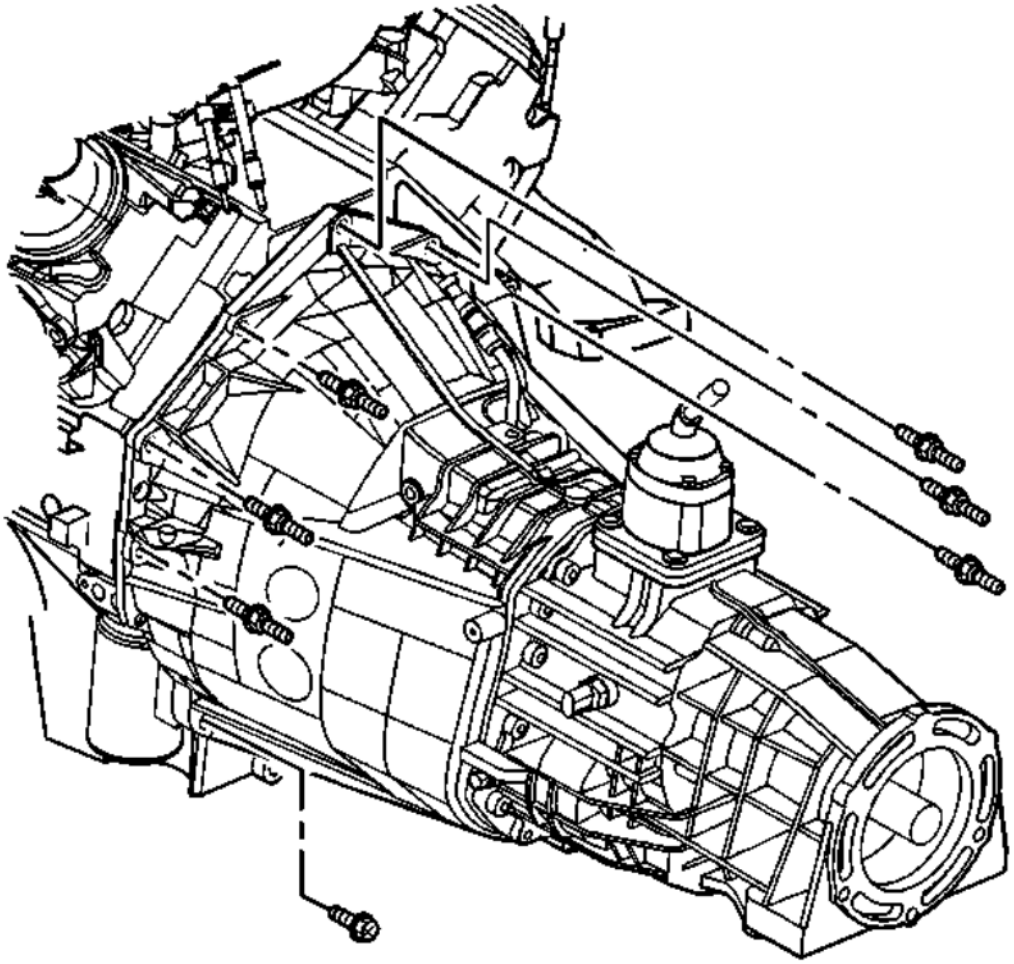


Fig. 35: View Of Transmission Mounting Bolts (Manual Transmission)
Courtesy of GENERAL MOTORS CORP.

13. Remove the bolt and studs securing the transmission to the engine.
14. Pull the transmission straight back off the clutch hub splines. Do not let the transmission hang from the clutch assembly.
15. Remove the transmission from the vehicle.

Installation Procedure

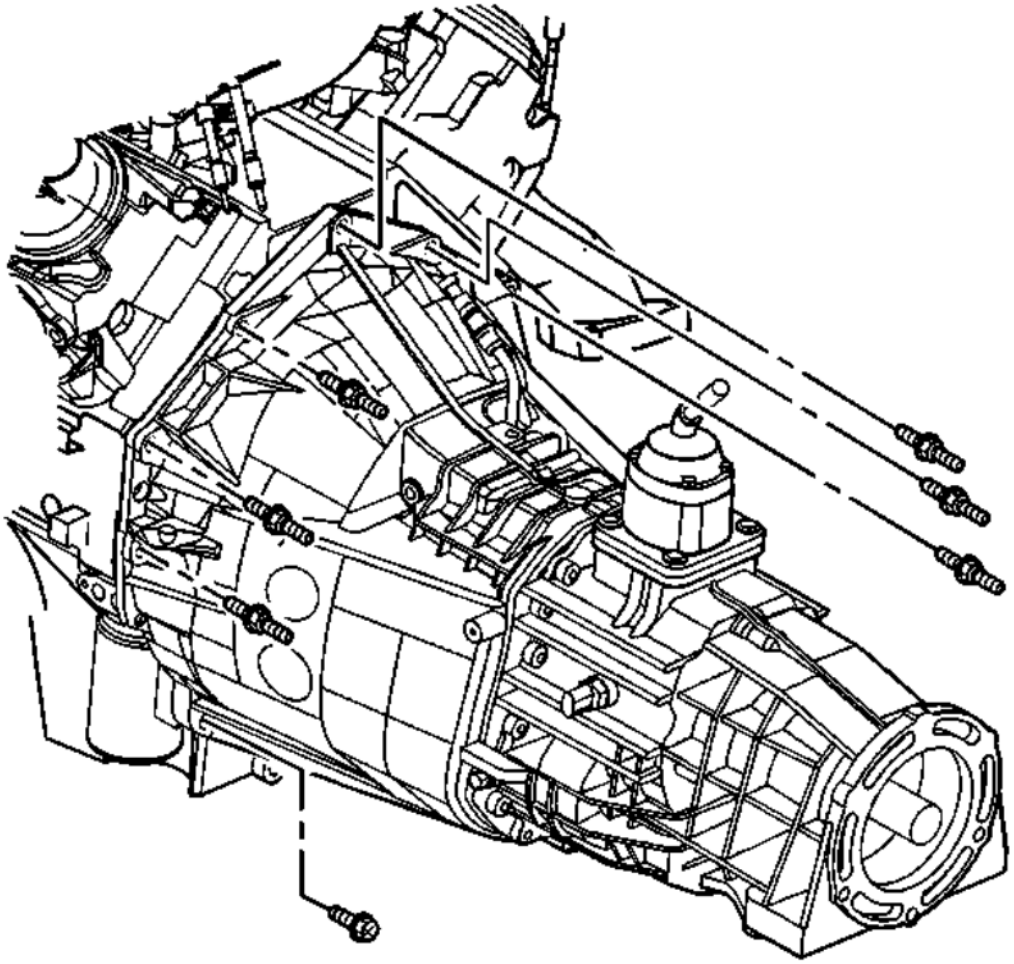


Fig. 36: View Of Transmission Mounting Bolts (Manual Transmission)
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

1. Install the transmission to the vehicle:
    1. Ensure the transmission is positioned in the 3rd or 4th gear.
    2. Rotate the transmission clockwise onto the clutch hub splines.
    3. Install the bolt and studs securing the transmission to the engine.

    Tighten: Tighten the bolt/studs to 50 N.m (37 lb ft).

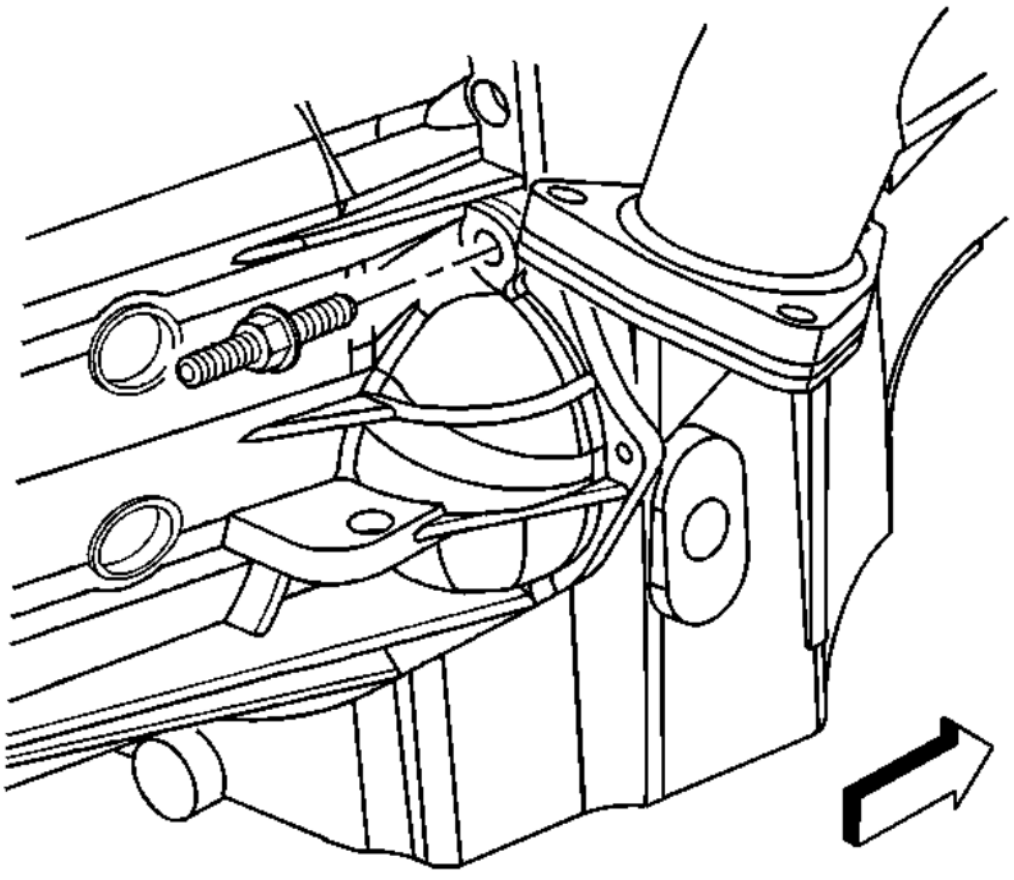


Fig. 37: View Of Manual Transmission Stud (Right Side)
Courtesy of GENERAL MOTORS CORP.

2. Install the stud securing the right side of the transmission to the engine.

   Tighten: Tighten the stud to 50 N.m (37 lb ft).

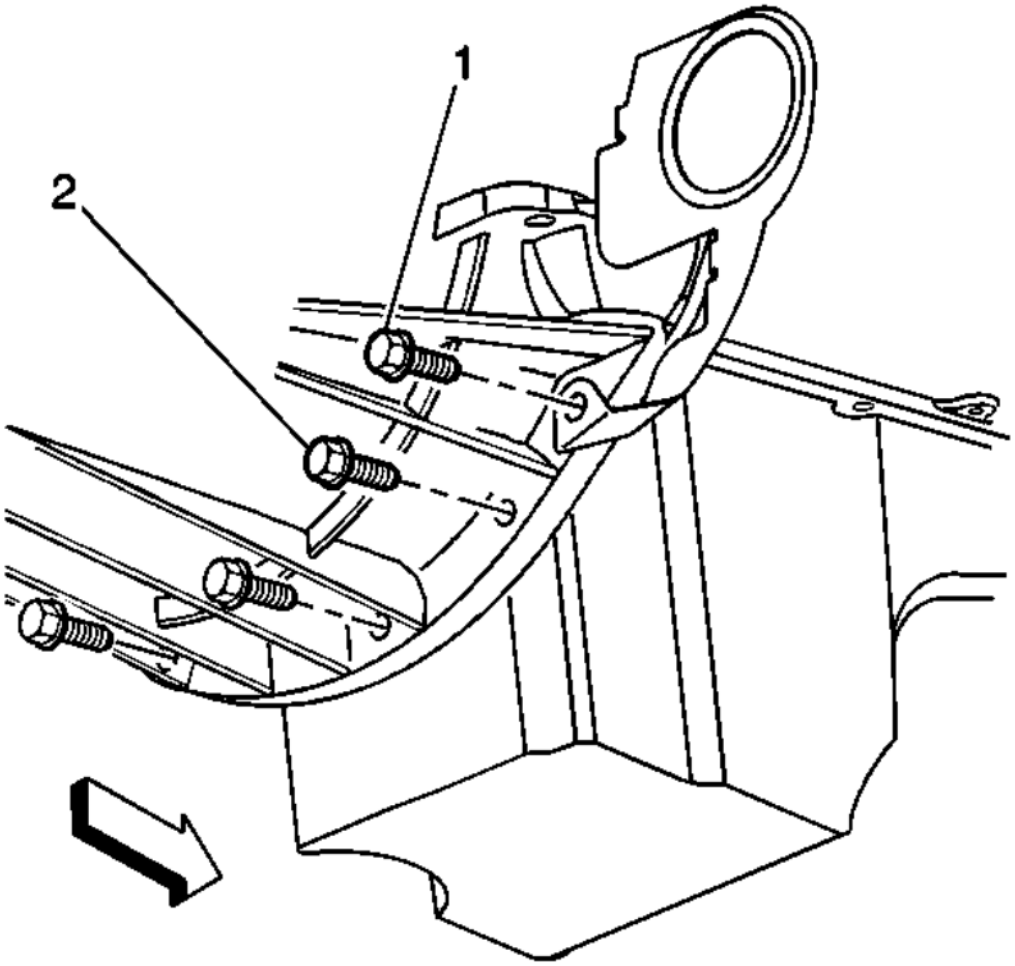


Fig. 38: Removing/Installing Bolts Securing Bottom Right Side Of Transmission To Engine
Courtesy of GENERAL MOTORS CORP.

3. Install the transmission cover.
4. Install the bolts (1 2) securing the bottom right side of the transmission to the engine.

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

5. Install the transmission support crossmember. Refer to **Transmission Support Crossmember Replacement (2WD 2500 HD/3500)** or **Transmission Support**

Crossmember Replacement (2WD 1500/2500) or **Transmission Support Crossmember Replacement (4WD 1500/2500)** or **Transmission Support Crossmember Replacement (4WD 2500 HD/3500)** .

6. Remove the transmission jack.
7. Install the starter motor. Refer to **Starter Motor Replacement (4.3L)** or **Starter Motor Replacement (4.8L, 5.3L, 6.0L, and 6.2L)** or **Starter Motor Replacement (6.6L)** .

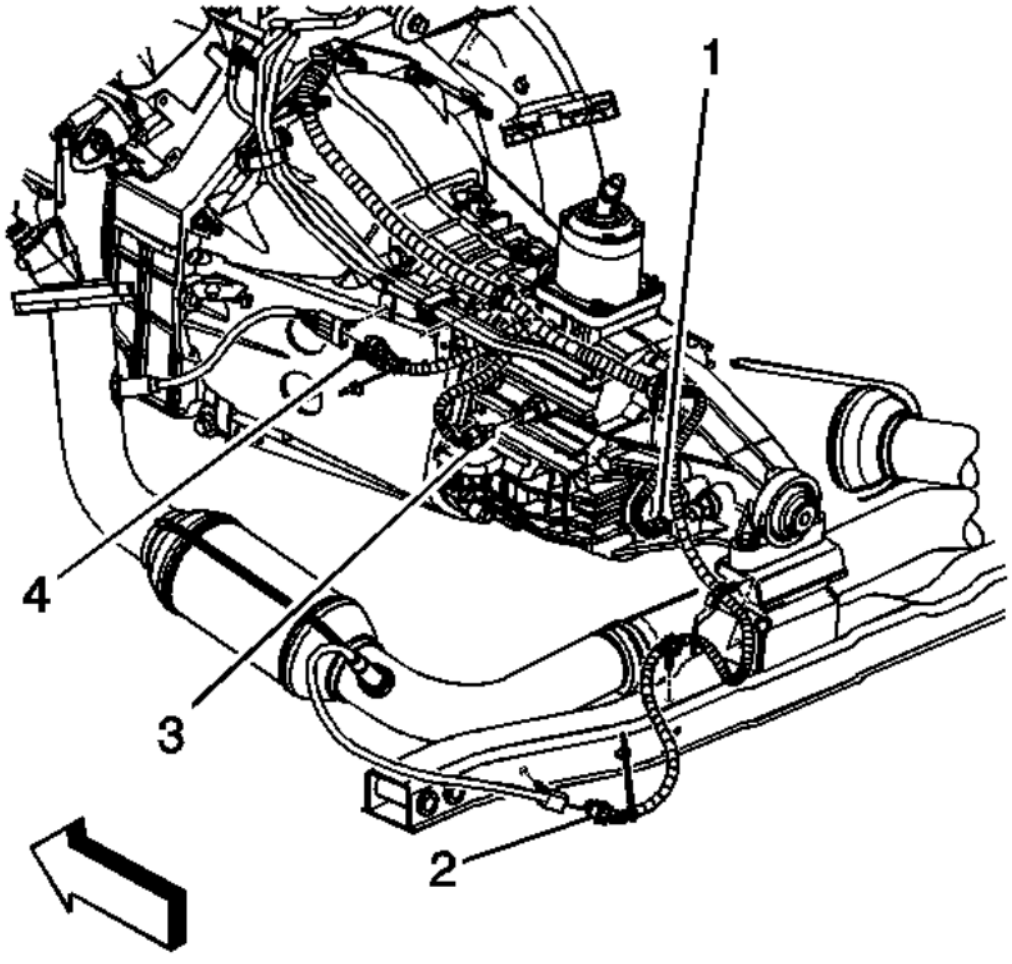


Fig. 39: Locating HO2S Electrical Connector At Harness (Manual 2WD)
Courtesy of GENERAL MOTORS CORP.

8. Install the engine harness clips to the fuel feed/return line clips and transmission.

9. Connect the following engine harness electrical connectors:
   - VSS (1)
   - Backup lamp switch (3)
   - Oxygen sensor (4)

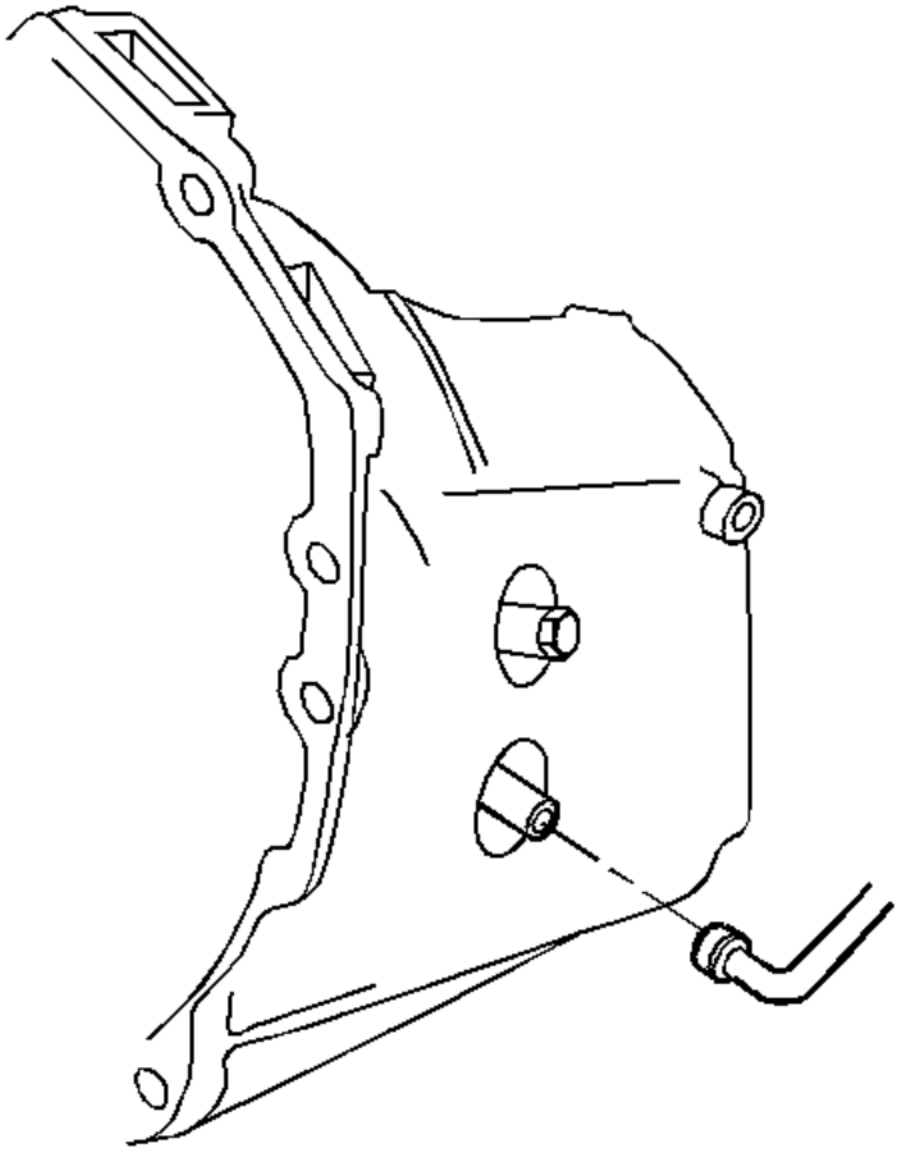


Fig. 40: Identifying Hydraulic Clutch Line At Clutch Actuator Quick Connect
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: DO NOT rely on an audible click or a visual verification on the clutch hydraulic hose quick connect fitting connection.

10. Connect the clutch actuator cylinder hose to the clutch master cylinder hose.
11. Push together the clutch hydraulic hose quick connect fittings, then pull back on the fittings to verify engagement.
12. Check the clutch hydraulic hoses for kinks or twists.
13. Install the propeller shaft. Refer to **One-Piece Propeller Shaft Replacement** or **Two-Piece Propeller Shaft Replacement** .
14. Fill the transmission with fluid.
15. Install the shift lever assembly. Refer to **Transmission Control Replacement**.
16. Bleed the clutch hydraulic system. Refer to **Hydraulic Clutch Bleeding** .

REPAIR INSTRUCTIONS - OFF VEHICLE

TRANSMISSION DISASSEMBLE

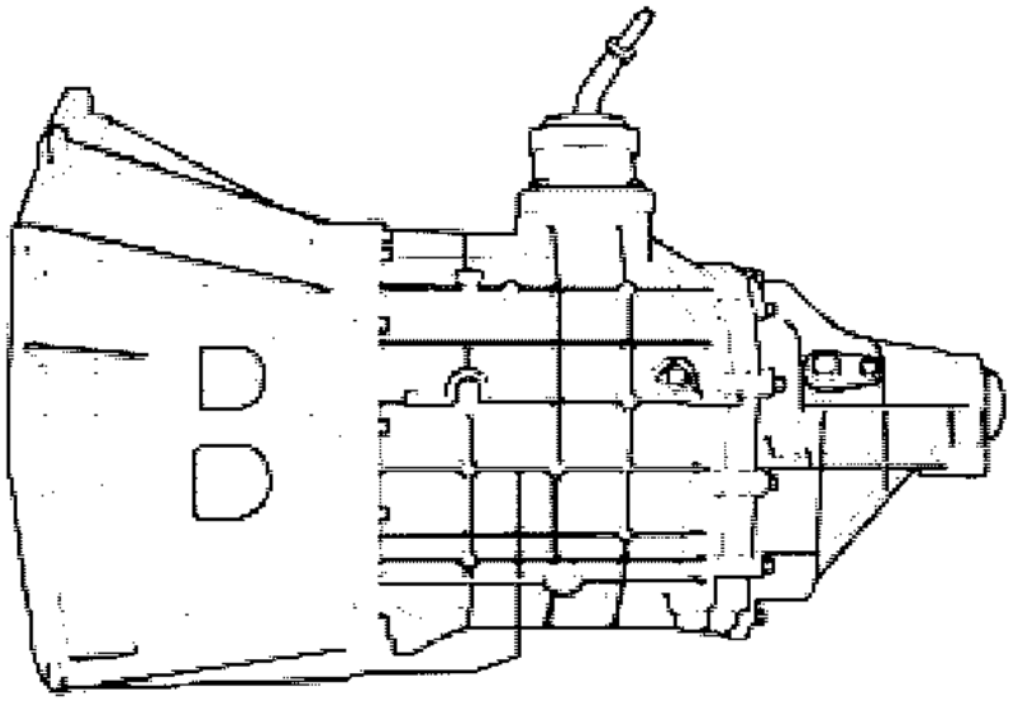


Fig. 41: Transmission
Courtesy of GENERAL MOTORS CORP.

1. Place the transmission on a workbench.

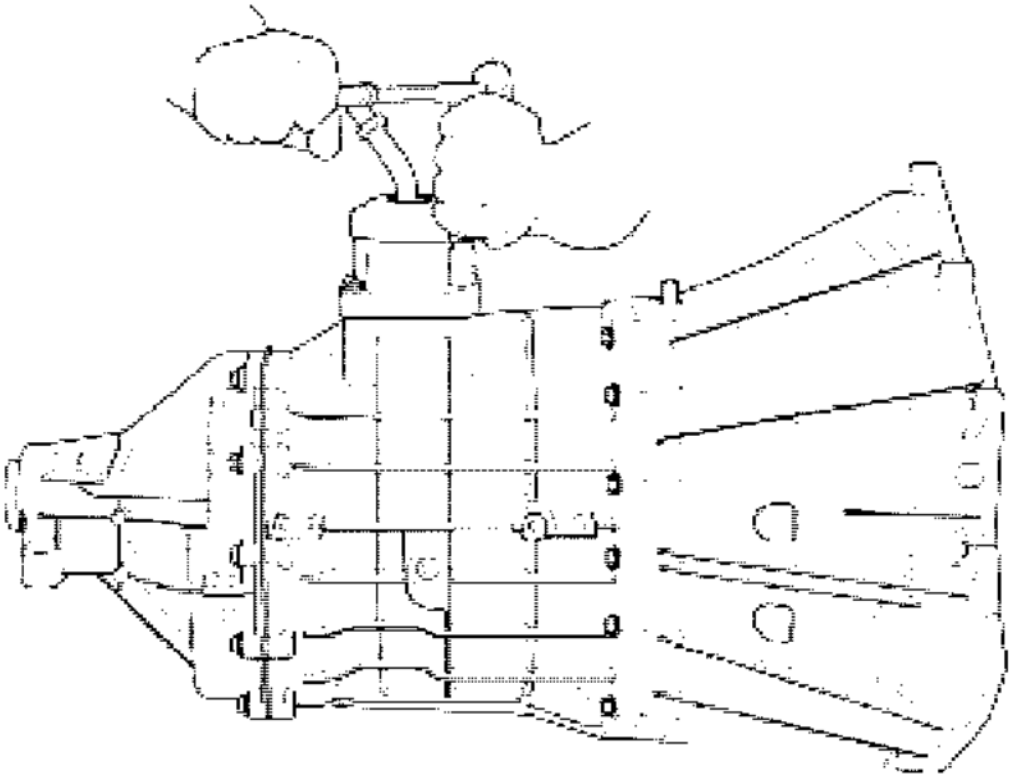


Fig. 42: Using 10 Mm Socket On Shift Control Housing Bolt
Courtesy of GENERAL MOTORS CORP.

2. Using a 10 mm socket, remove the shift control housing bolt.

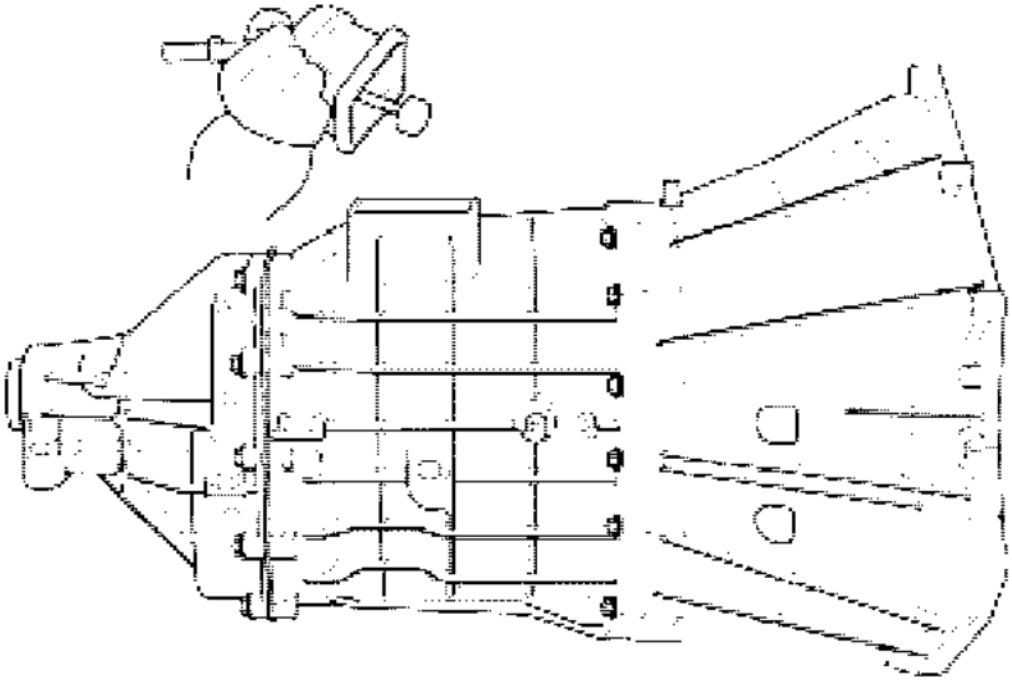


Fig. 43: Shift Control Cover
Courtesy of GENERAL MOTORS CORP.

3. Remove the shift control cover.

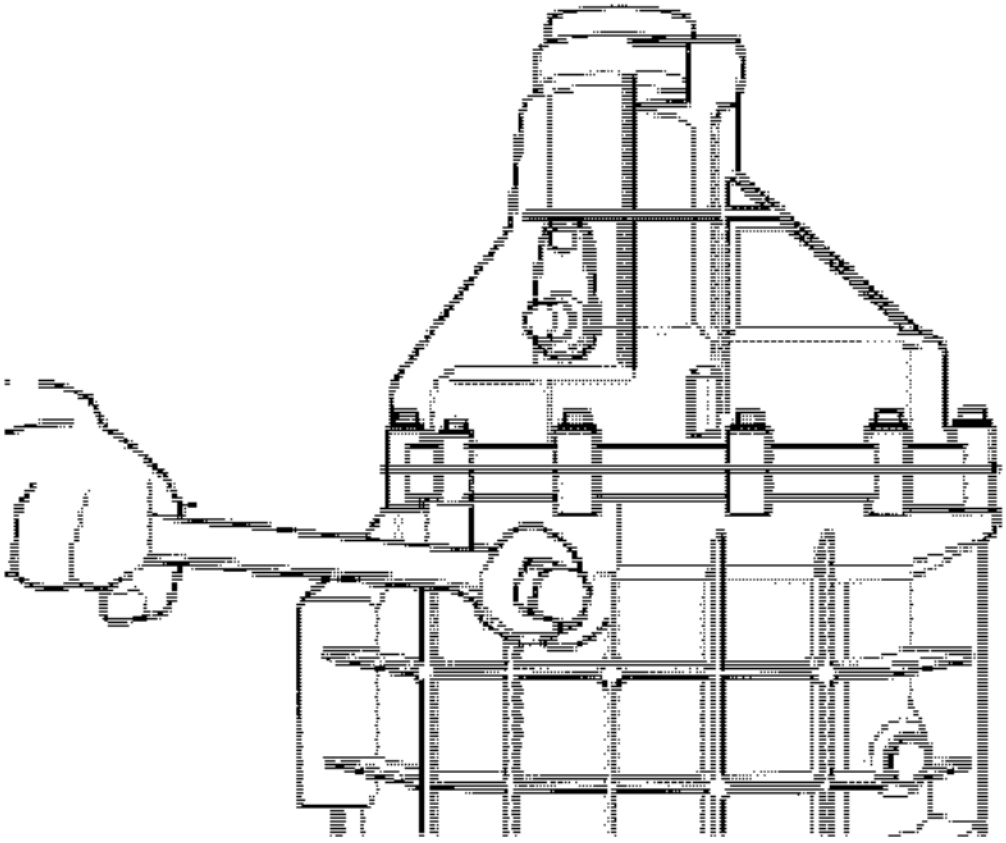


Fig. 44: Park/Neutral Position And Backup Lamp Switch
Courtesy of GENERAL MOTORS CORP.

4. Remove the park/neutral position and backup lamp switch.

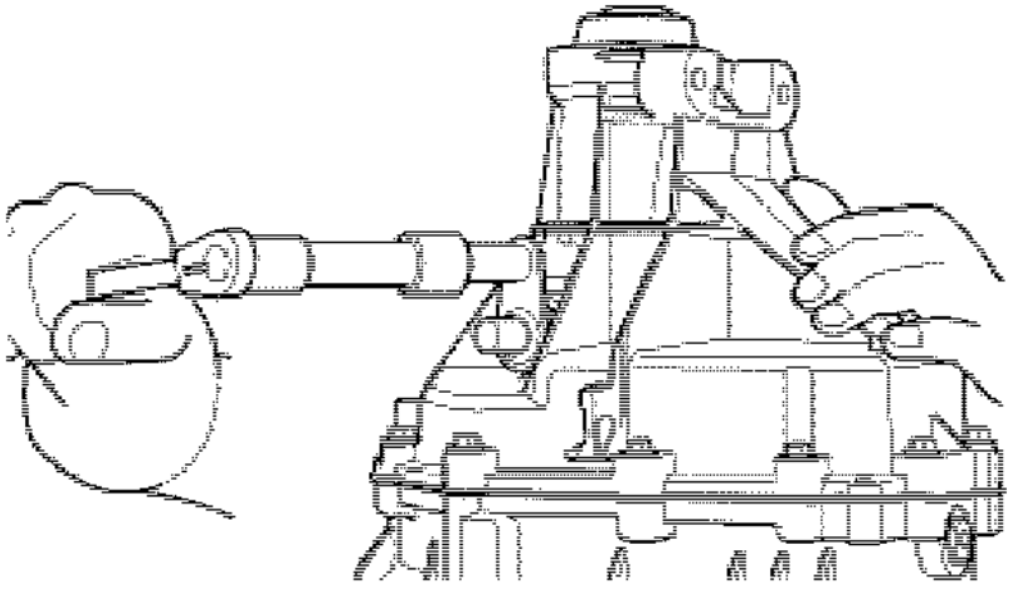


Fig. 45: Using 10 Mm Socket On Vehicle Speed Sensor Housing Bolt
Courtesy of GENERAL MOTORS CORP.

5. Using a 10 mm socket, remove the vehicle speed sensor housing bolt.
6. Remove the vehicle speed sensor.

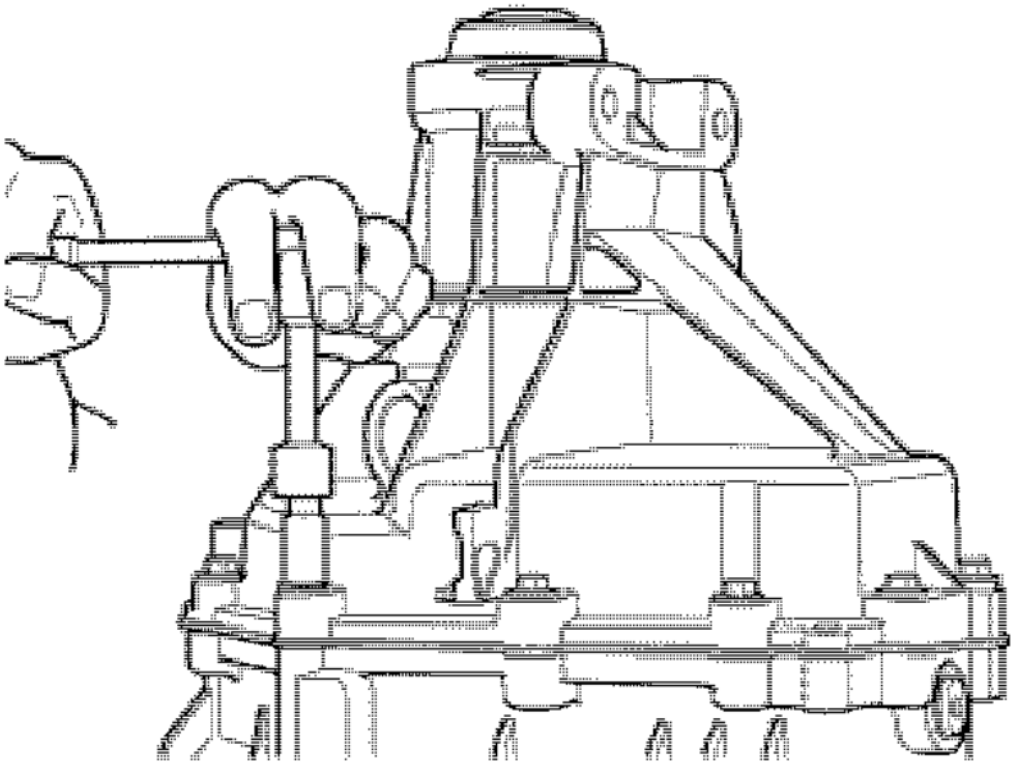


Fig. 46: Using 10 Mm Socket On 12 Bolts At Transmission Rear Case
Courtesy of GENERAL MOTORS CORP.

7. Using a 10 mm socket, remove the 12 bolts from the transmission rear case.

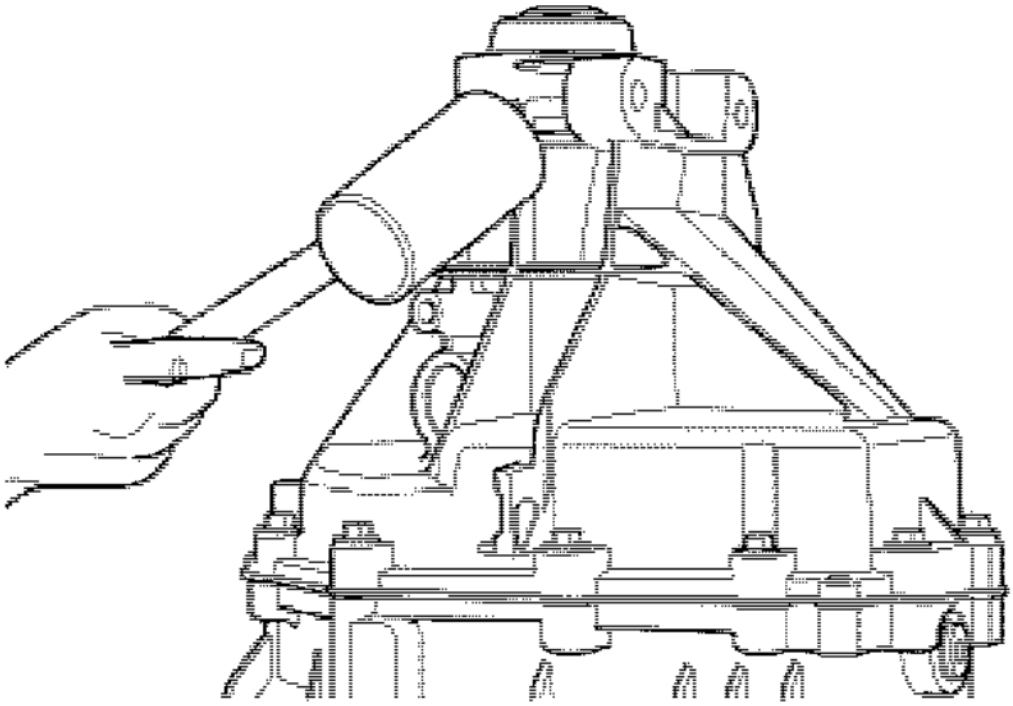


Fig. 47: Separating Transmission Rear Case From Transmission Case
Courtesy of GENERAL MOTORS CORP.

8. Using a rubber hammer, tap lightly in order to separate the transmission rear case from the transmission case.

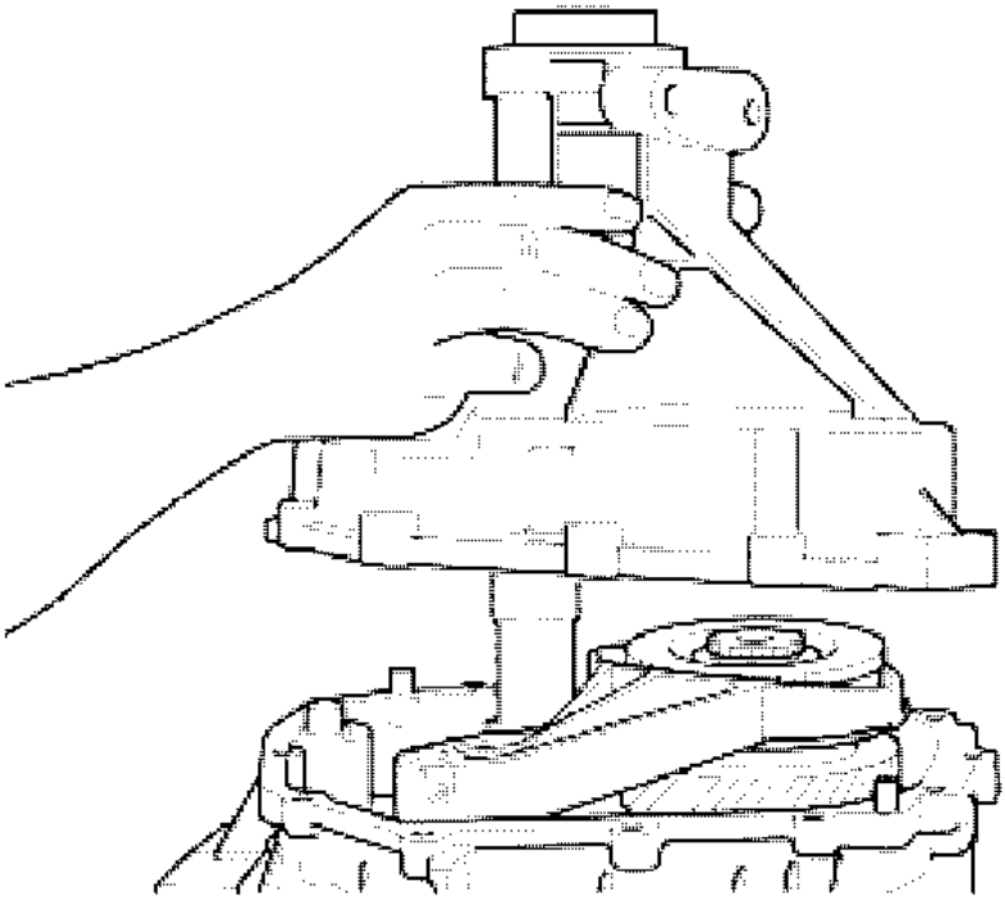


Fig. 48: Transmission Rear Case
Courtesy of GENERAL MOTORS CORP.

9. Remove the transmission rear case.

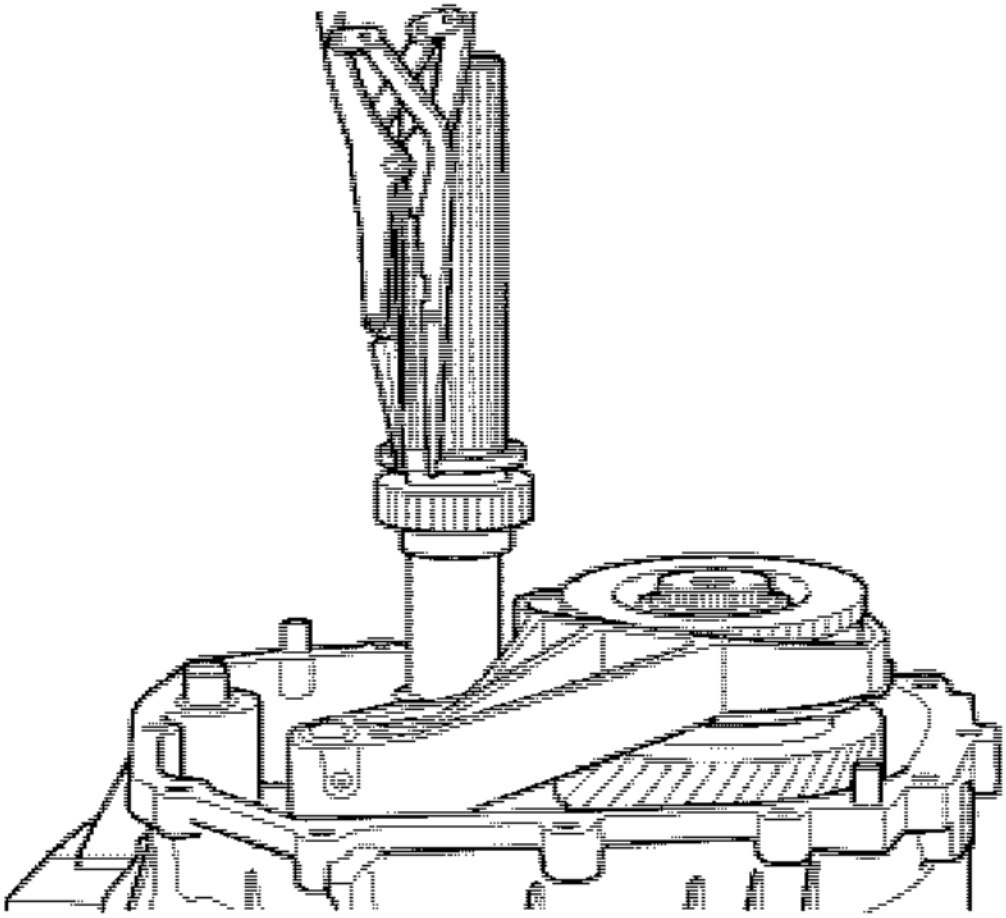


Fig. 49: Reverse Gear Blocking Ring
Courtesy of GENERAL MOTORS CORP.

10. Using pliers, remove the reverse gear blocking ring that secures the speedometer drive gear.

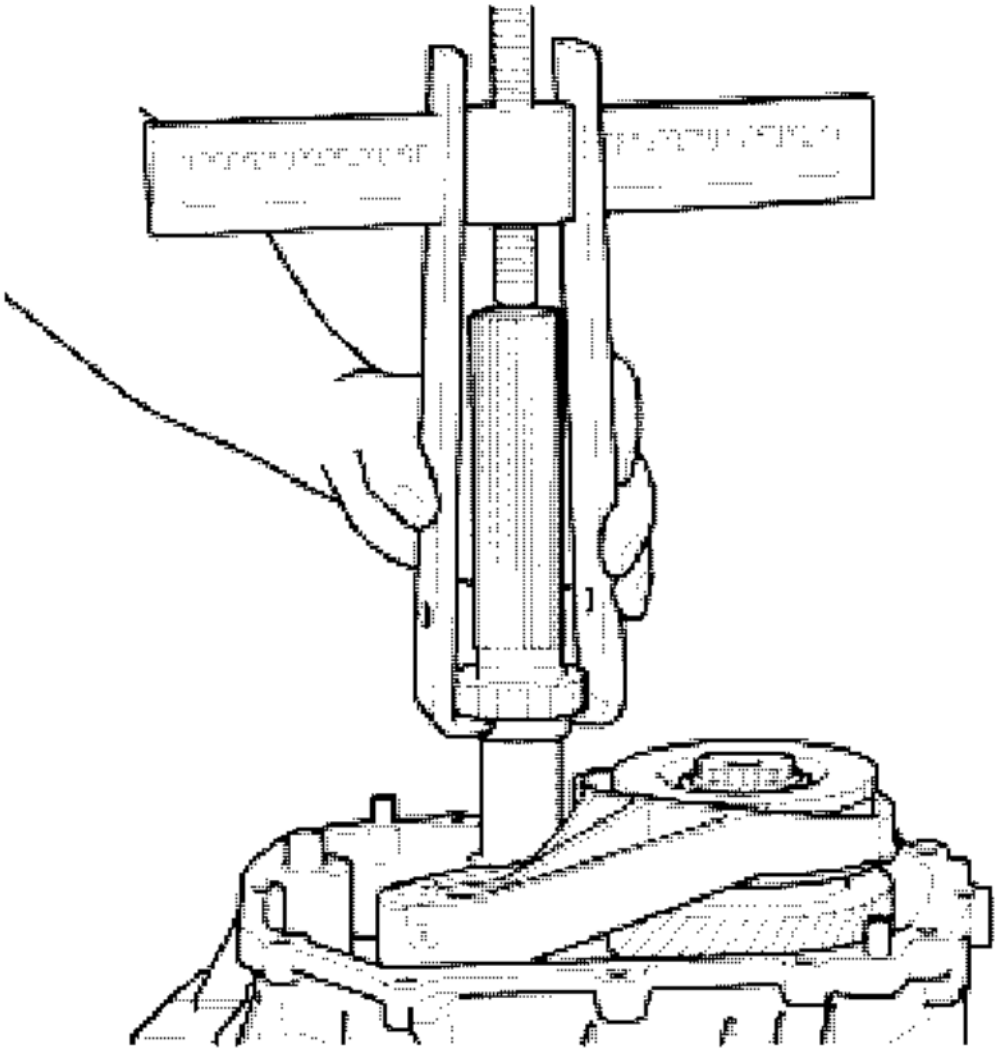


Fig. 50: Removing Speedometer Drive Gear
Courtesy of GENERAL MOTORS CORP.

11. Using a bearing puller, remove the speedometer drive gear.
12. Using a magnet, remove the speedometer gear ball.

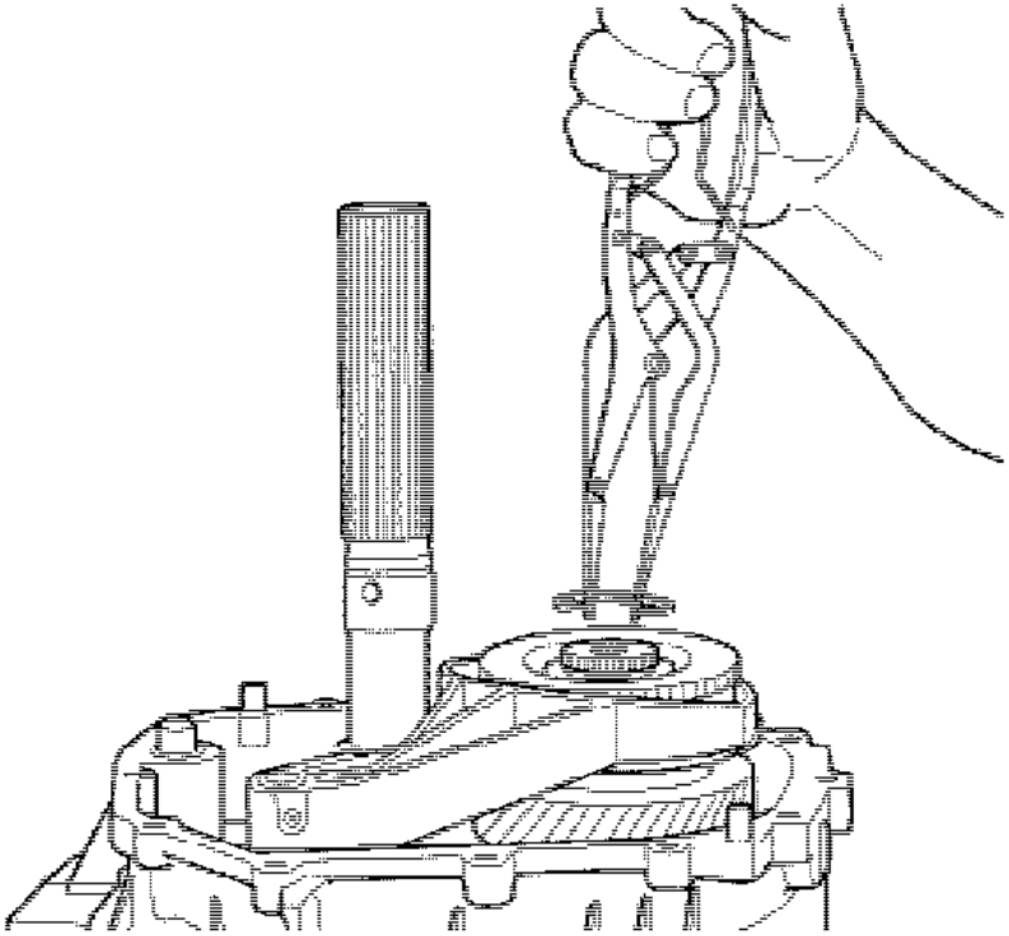


Fig. 51: 5Th Gear Retainer
Courtesy of GENERAL MOTORS CORP.

13. Using retaining pliers, remove the 5th gear retainer from the main shaft.

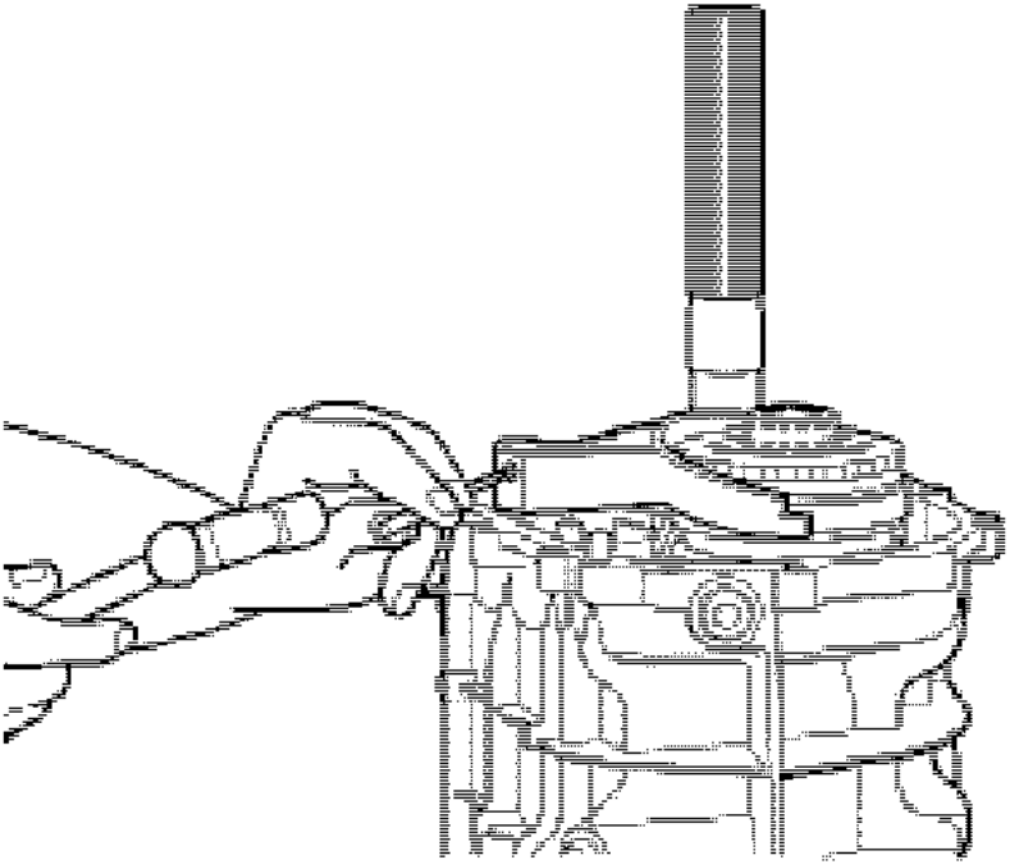


Fig. 52: Removing 5Th Shift Fork
Courtesy of GENERAL MOTORS CORP.

14. Using a punch and a hammer, remove the 5th shift fork.

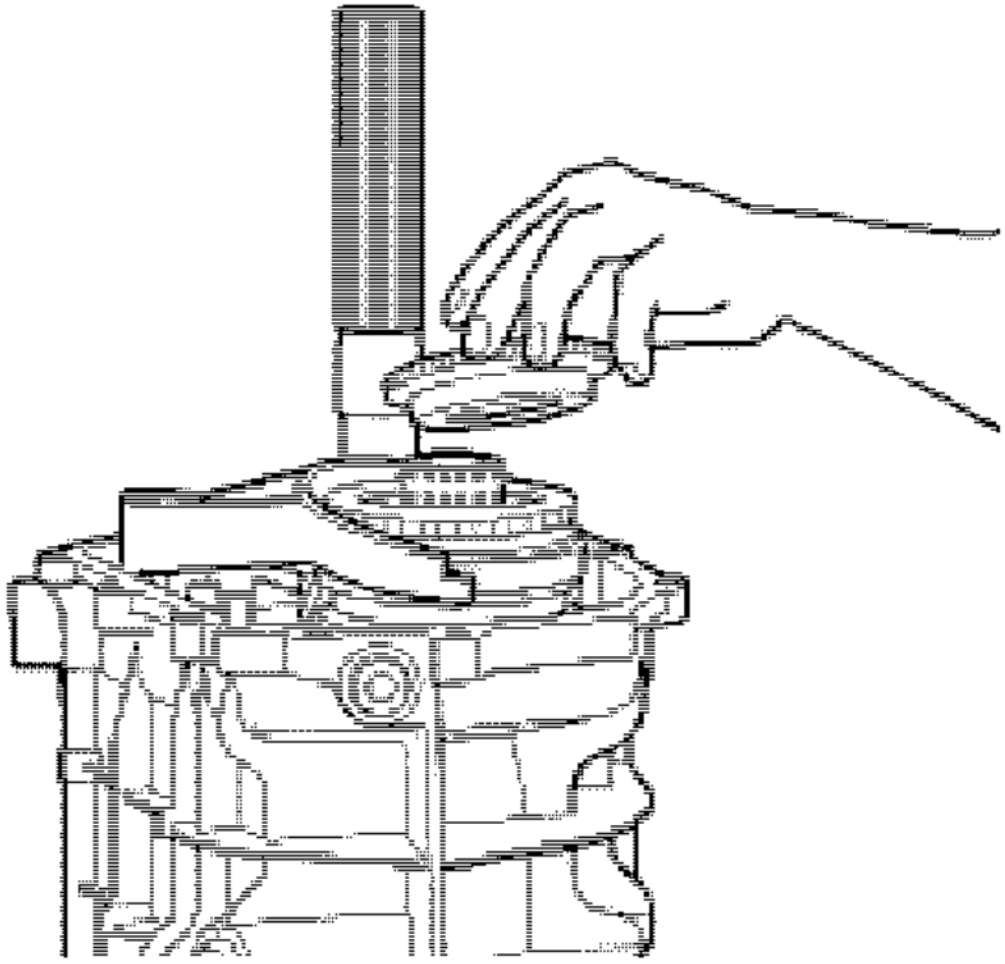


Fig. 53: Coupling Cone
Courtesy of GENERAL MOTORS CORP.

15. Remove the coupling cone from the 5th speed synchronizer assembly.

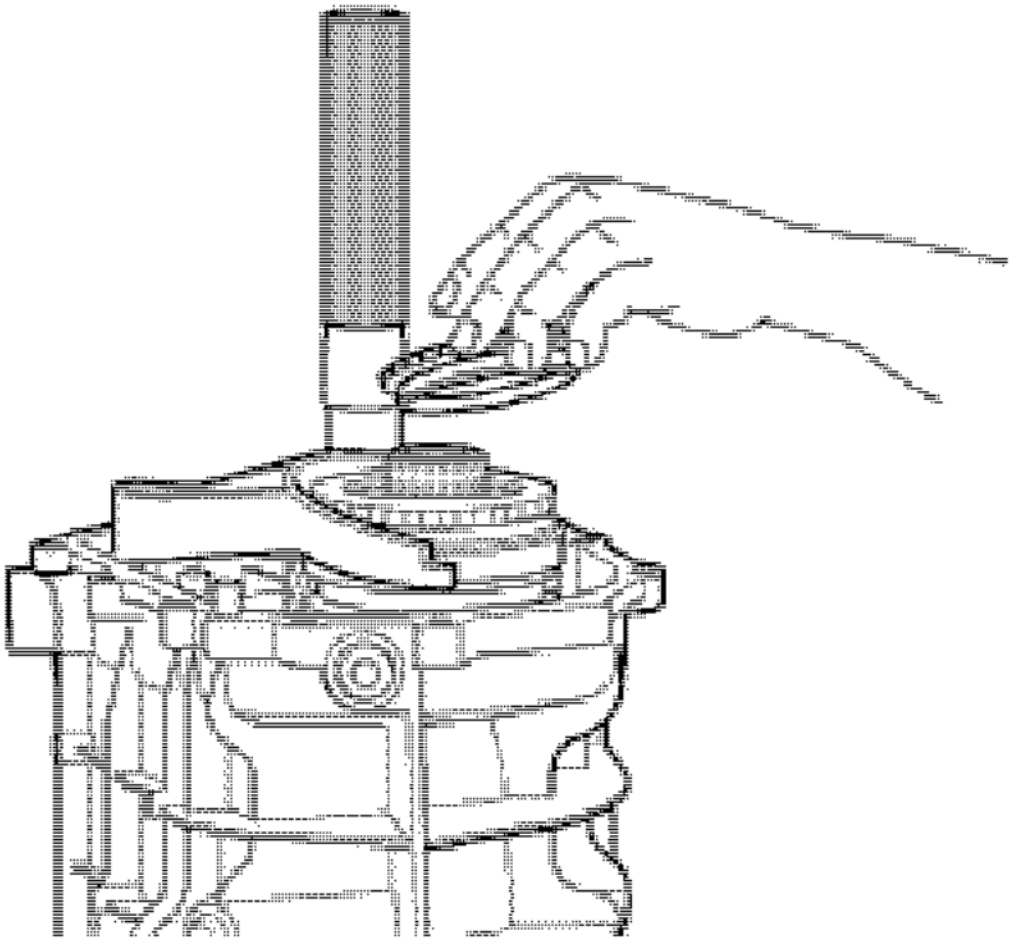


Fig. 54: Synchronizer Ring
Courtesy of GENERAL MOTORS CORP.

16. Remove the synchronizer ring.

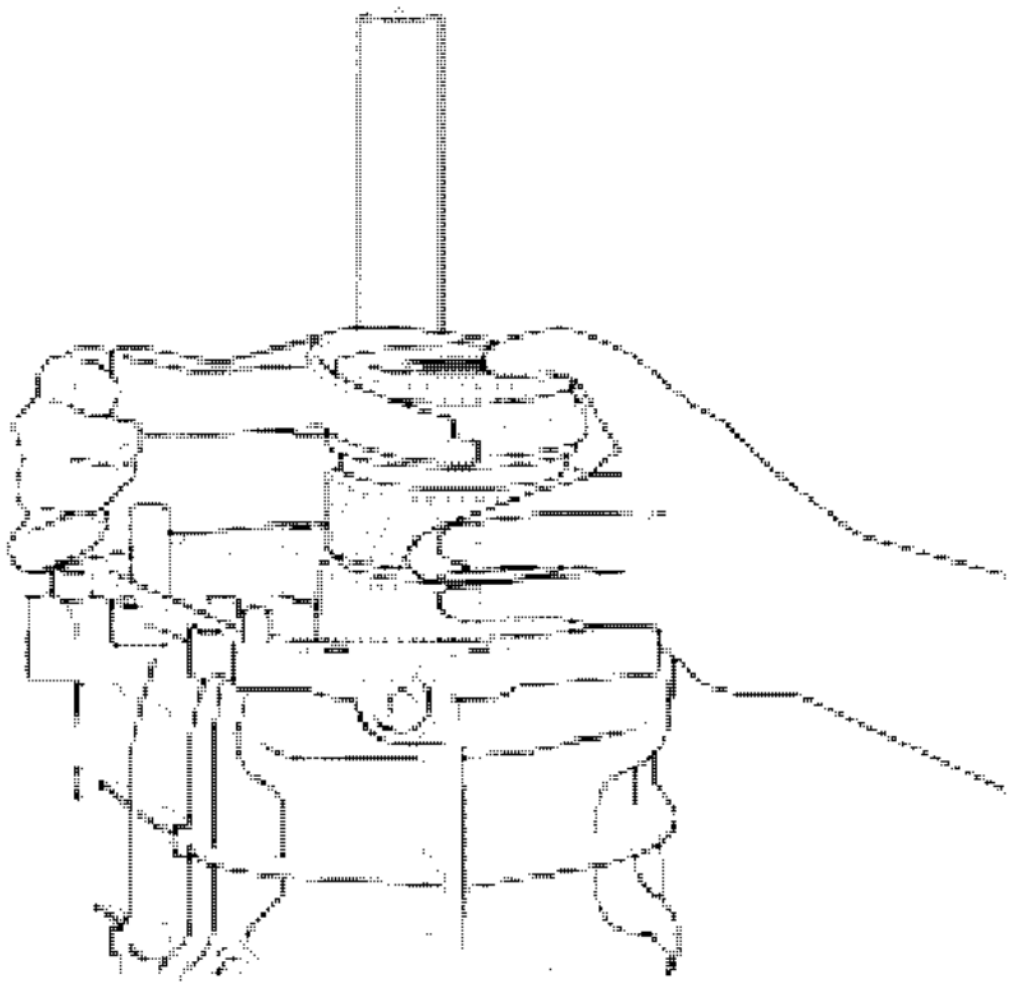


Fig. 55: 5Th Speed Synchronizer Assembly& Fork
Courtesy of GENERAL MOTORS CORP.

17. Remove the 5th speed synchronizer assembly together with the fork.

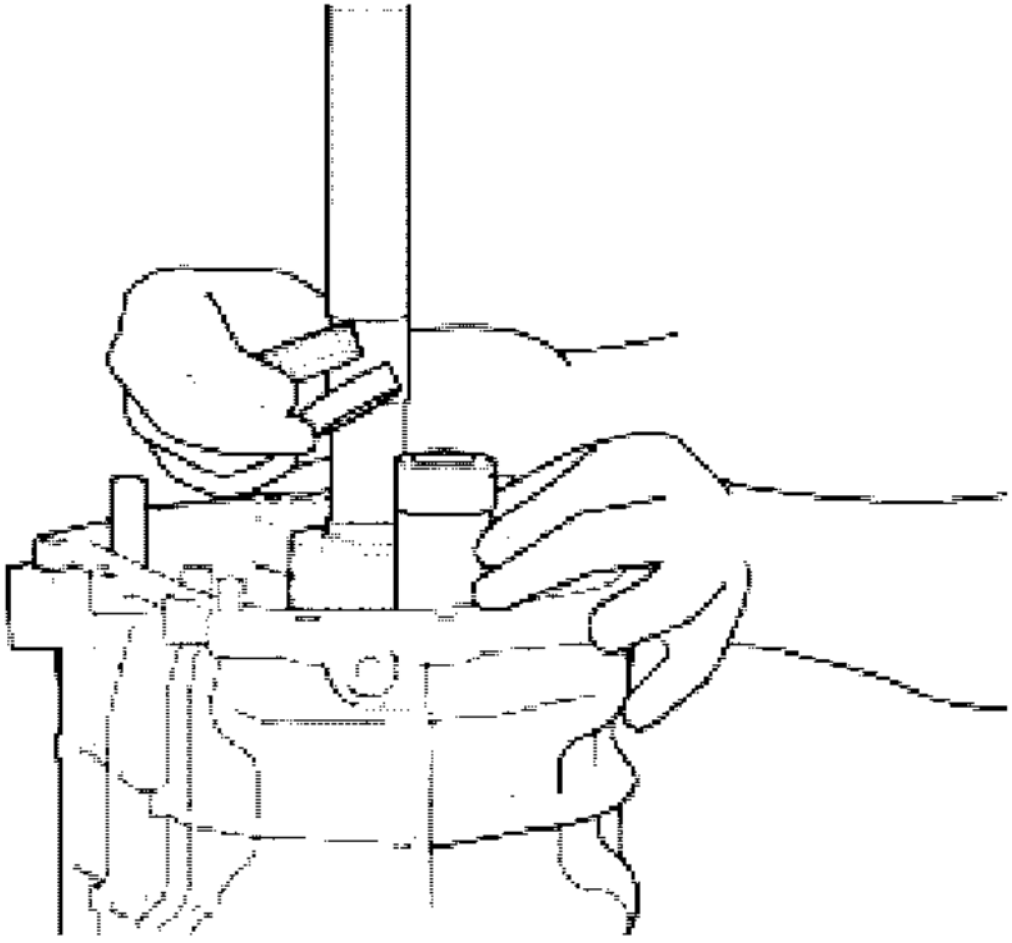


Fig. 56: 2 Roller Bearings
Courtesy of GENERAL MOTORS CORP.

18. Remove the 2 roller bearings and spacer.

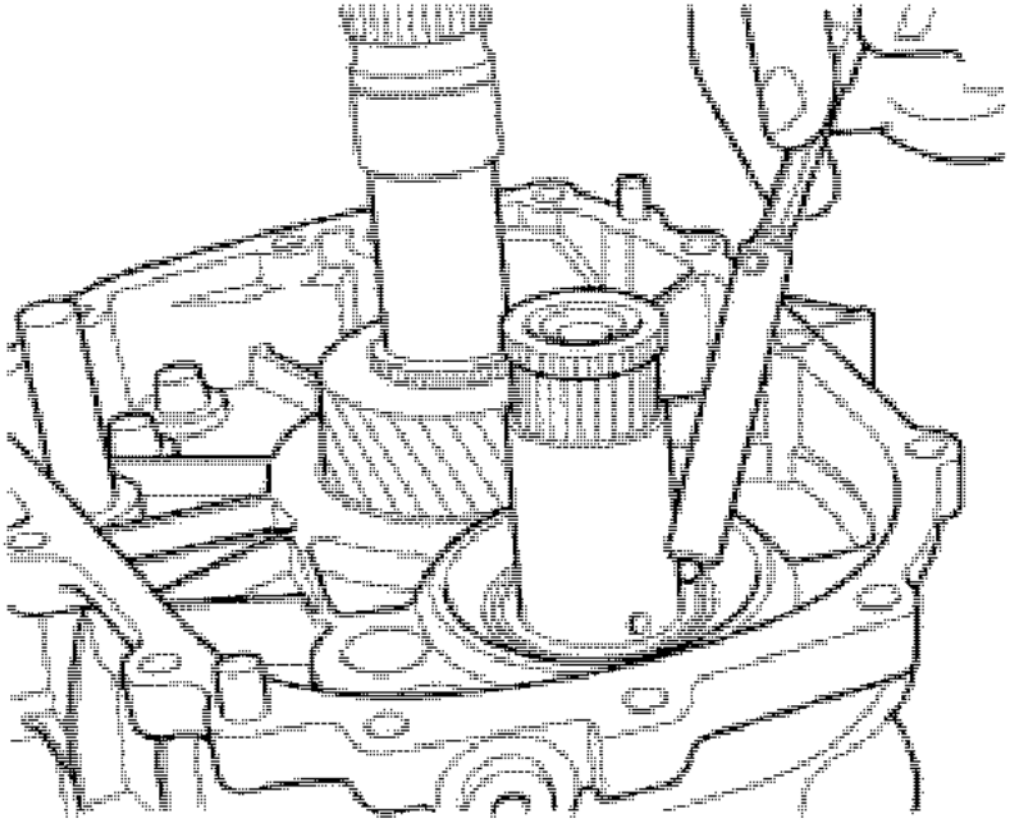


Fig. 57: Using Magnet To Remove Drag Ball
Courtesy of GENERAL MOTORS CORP.

19. Using a magnet, remove the drag ball.

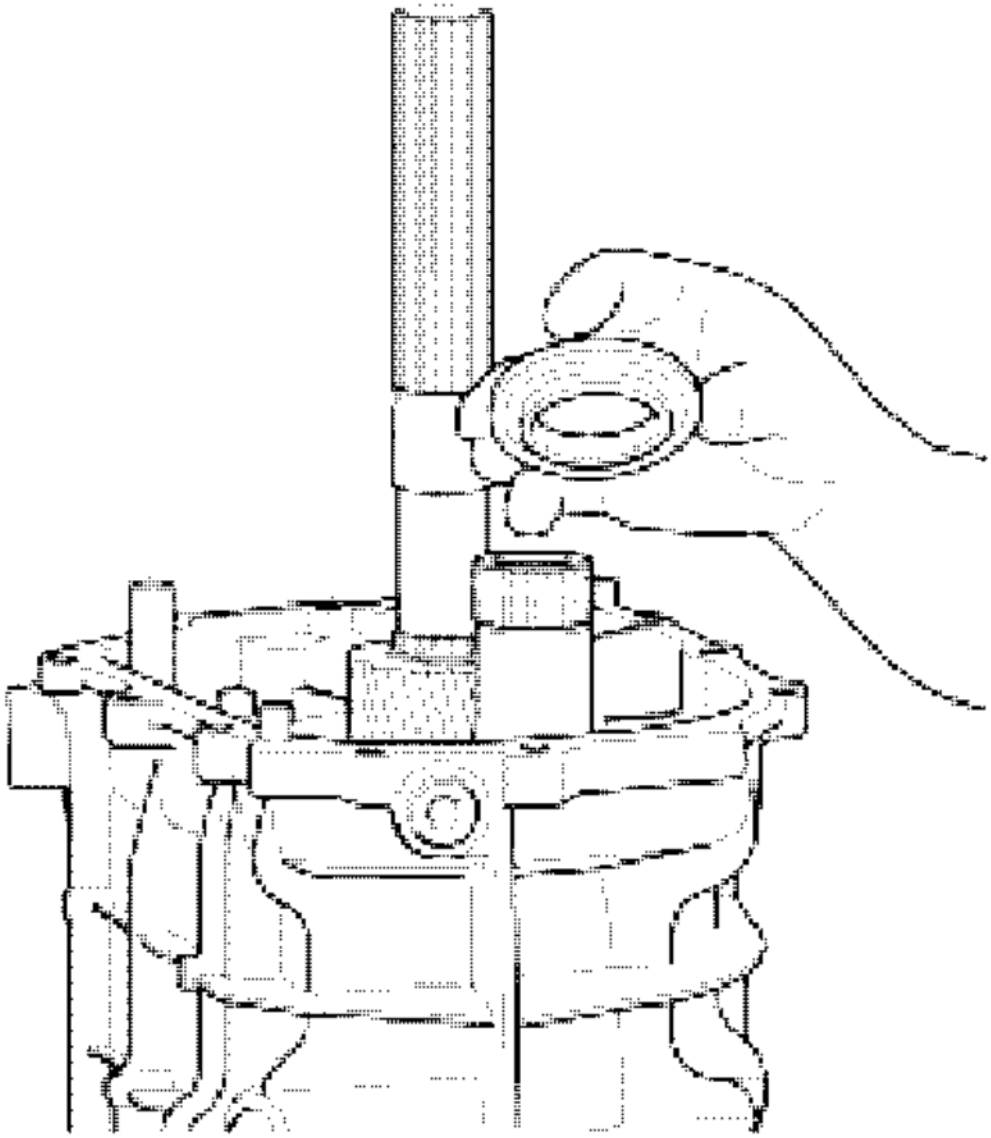


Fig. 58: Drive Wheel
Courtesy of GENERAL MOTORS CORP.

20. Remove the drive wheel.

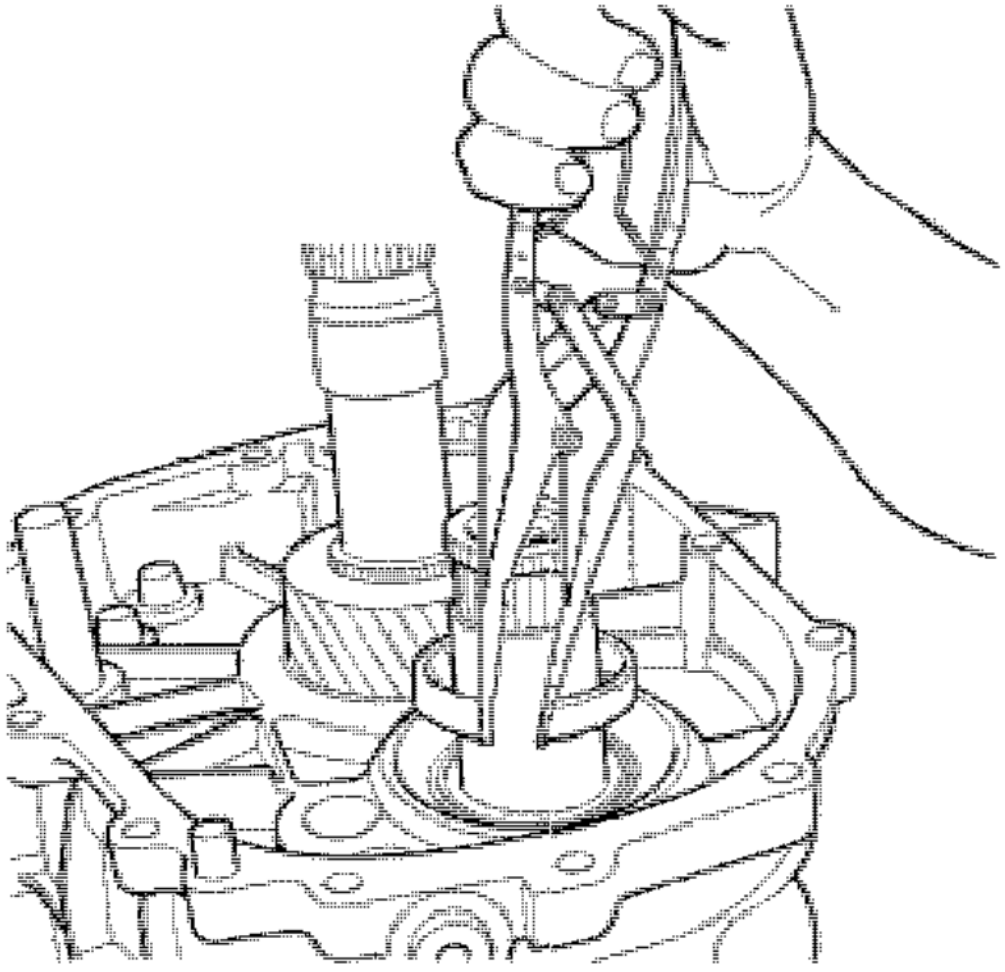


Fig. 59: Retainer Securing Gear Train Bearing Race
Courtesy of GENERAL MOTORS CORP.

21. Using retainer pliers, remove the retainer that secures the gear train bearing race.

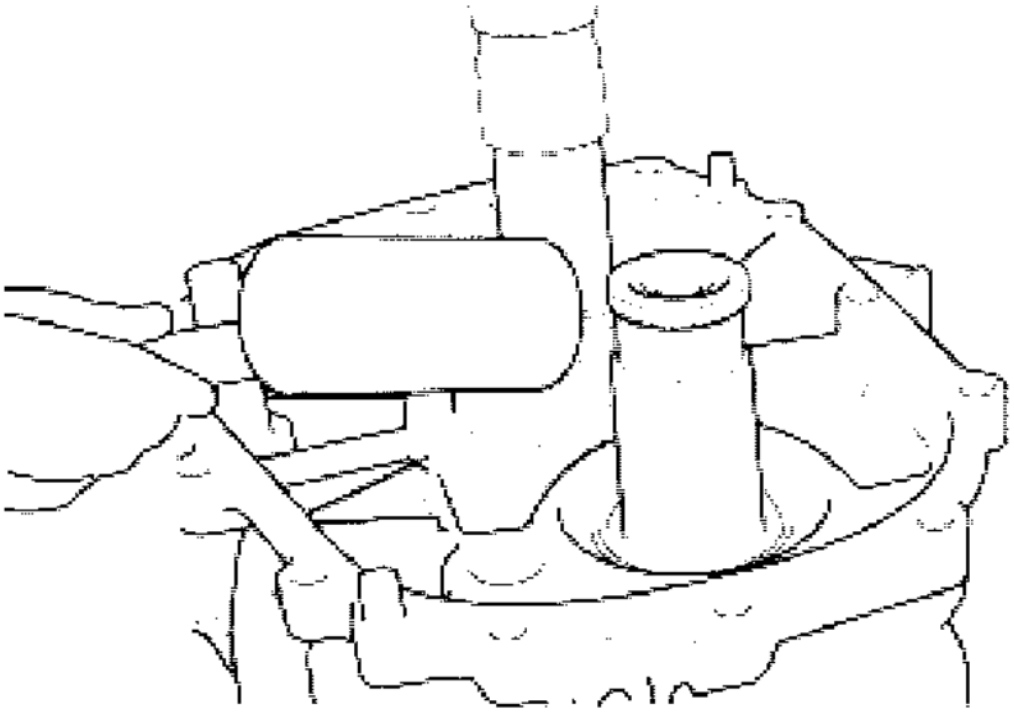


Fig. 60: Removing Bearing Race
Courtesy of GENERAL MOTORS CORP.

22. Using a rubber hammer, tap lightly on the gear train to remove the bearing race.

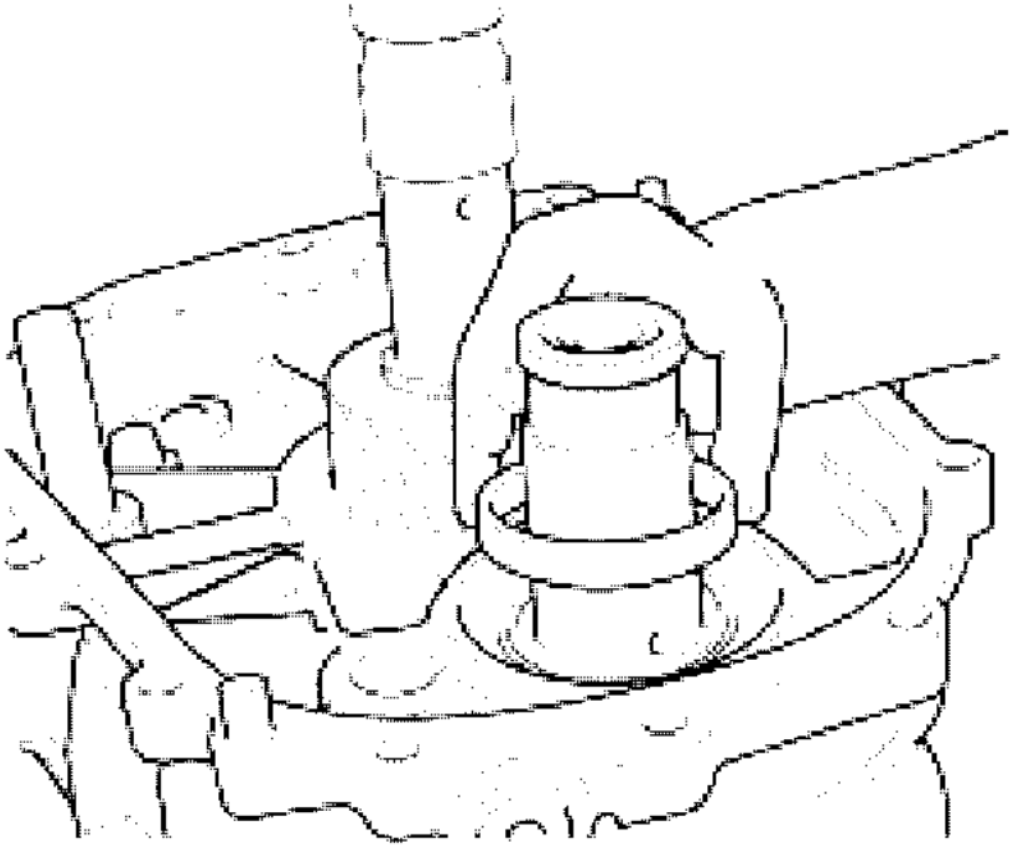


Fig. 61: Bearing Race
Courtesy of GENERAL MOTORS CORP.

23. Remove the bearing race from the gear train.

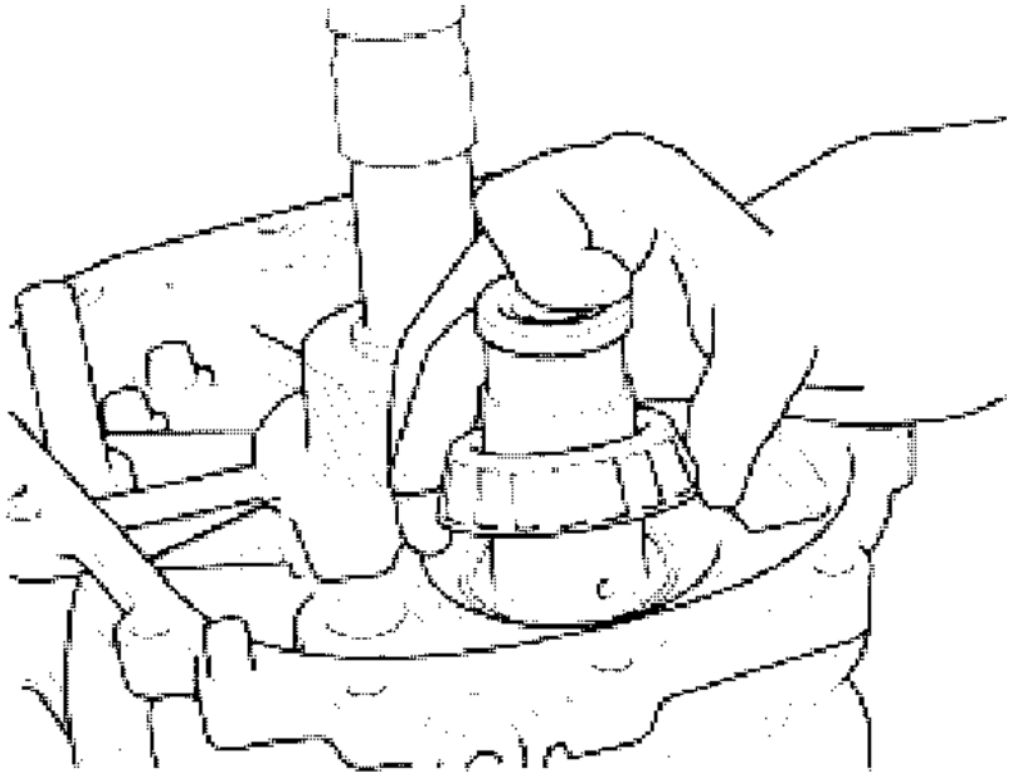


Fig. 62: Bearing
Courtesy of GENERAL MOTORS CORP.

24. Remove the bearing.

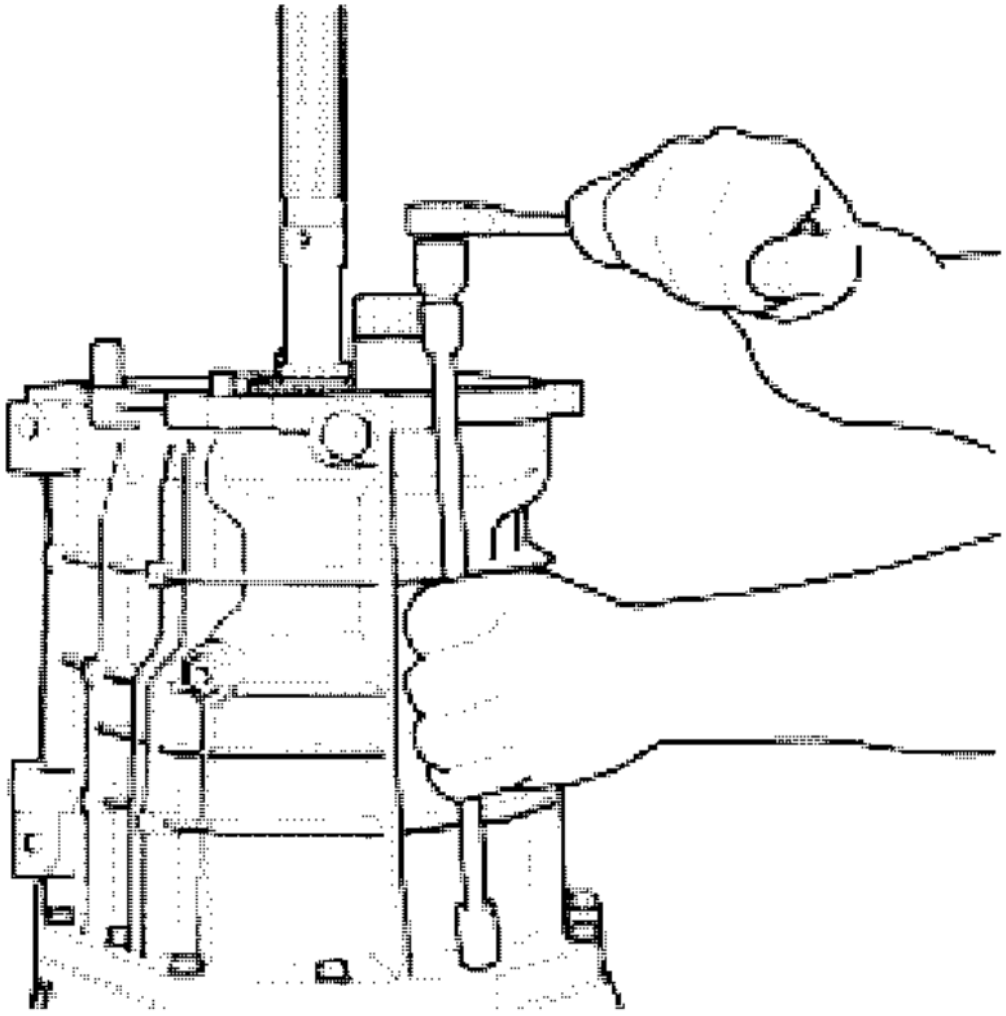


Fig. 63: Casing Bolts Securing Housing
Courtesy of GENERAL MOTORS CORP.

25. Using a 10 mm wrench, remove casing bolts that secure the housing.

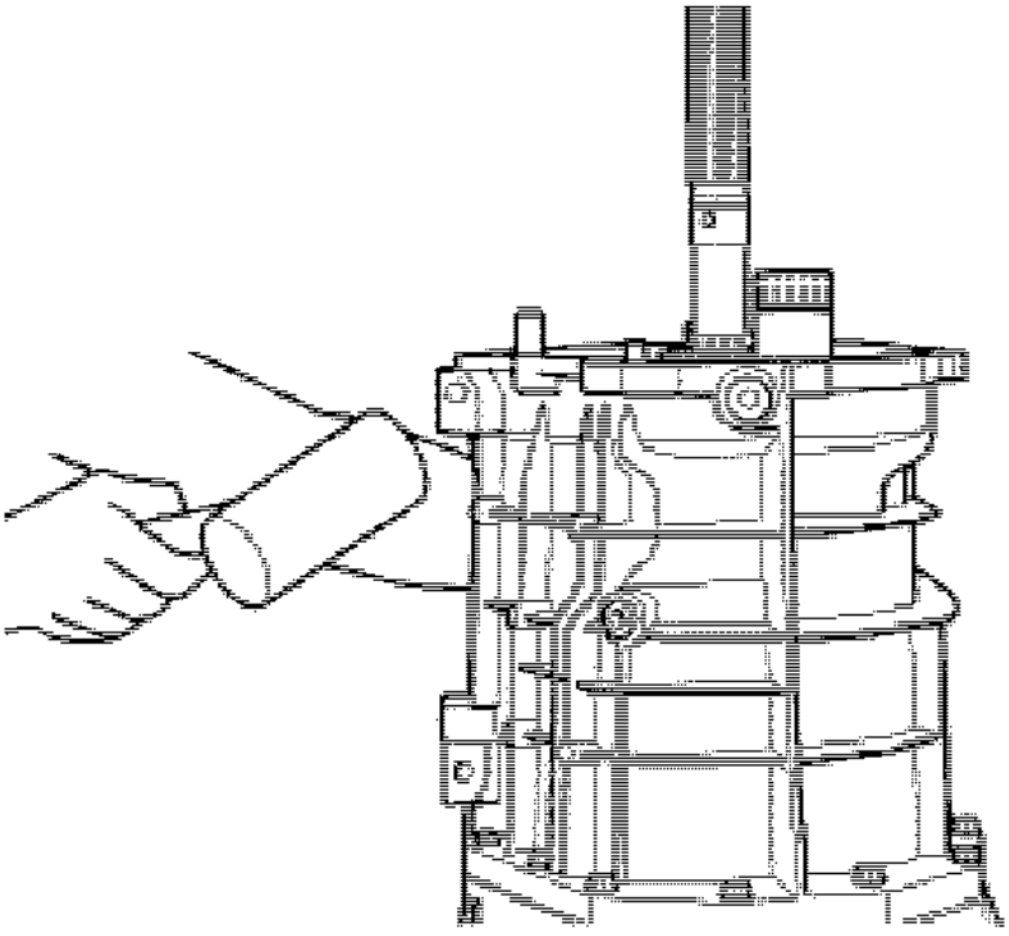


Fig. 64: Tapping Lightly On Casing
Courtesy of GENERAL MOTORS CORP.

26. Using a rubber hammer, tap lightly on the casing to remove the sealer.

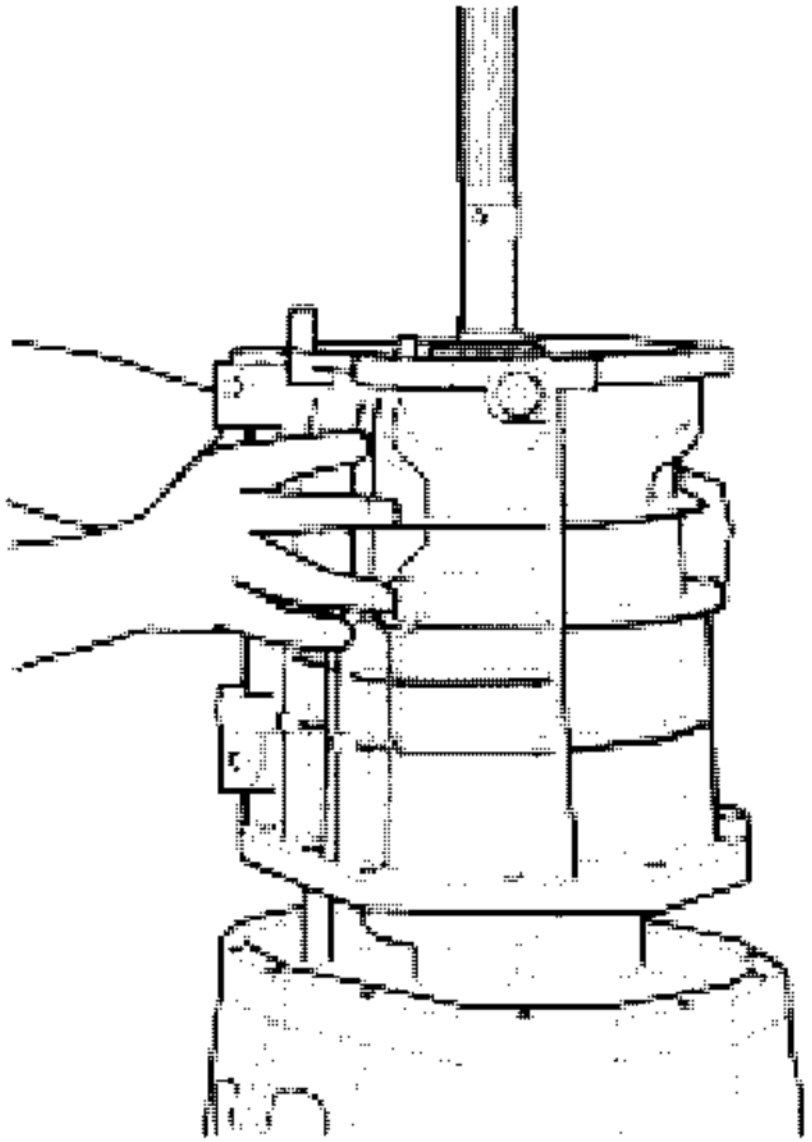


Fig. 65: Casing
Courtesy of GENERAL MOTORS CORP.

27. Remove the casing.

MAIN SHAFT DISASSEMBLE

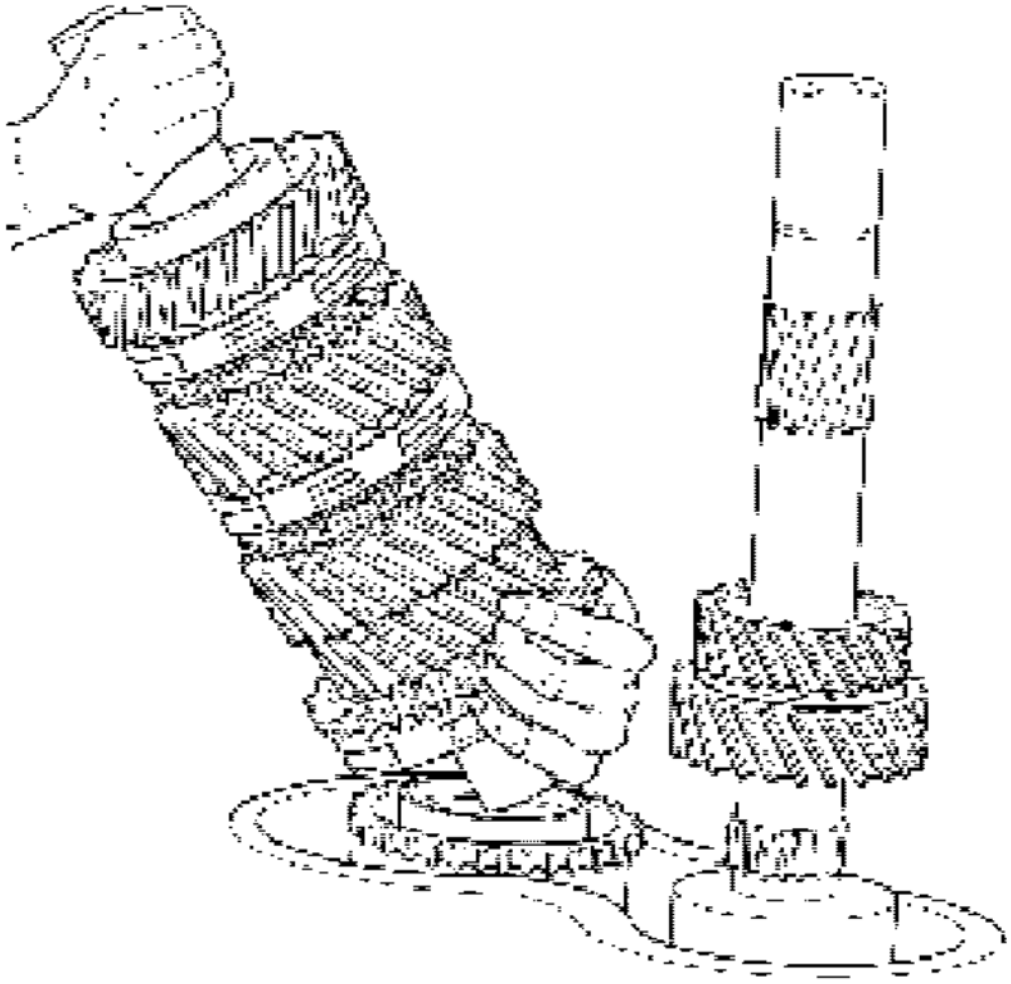


Fig. 66: Primary Shaft At Transmission
Courtesy of GENERAL MOTORS CORP.

1. Remove the primary shaft from the transmission.

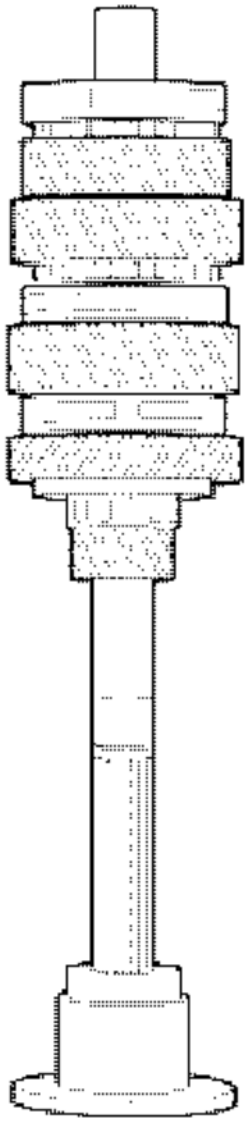


Fig. 67: Primary Shaft
Courtesy of GENERAL MOTORS CORP.

2. Place the primary shaft on a workbench.

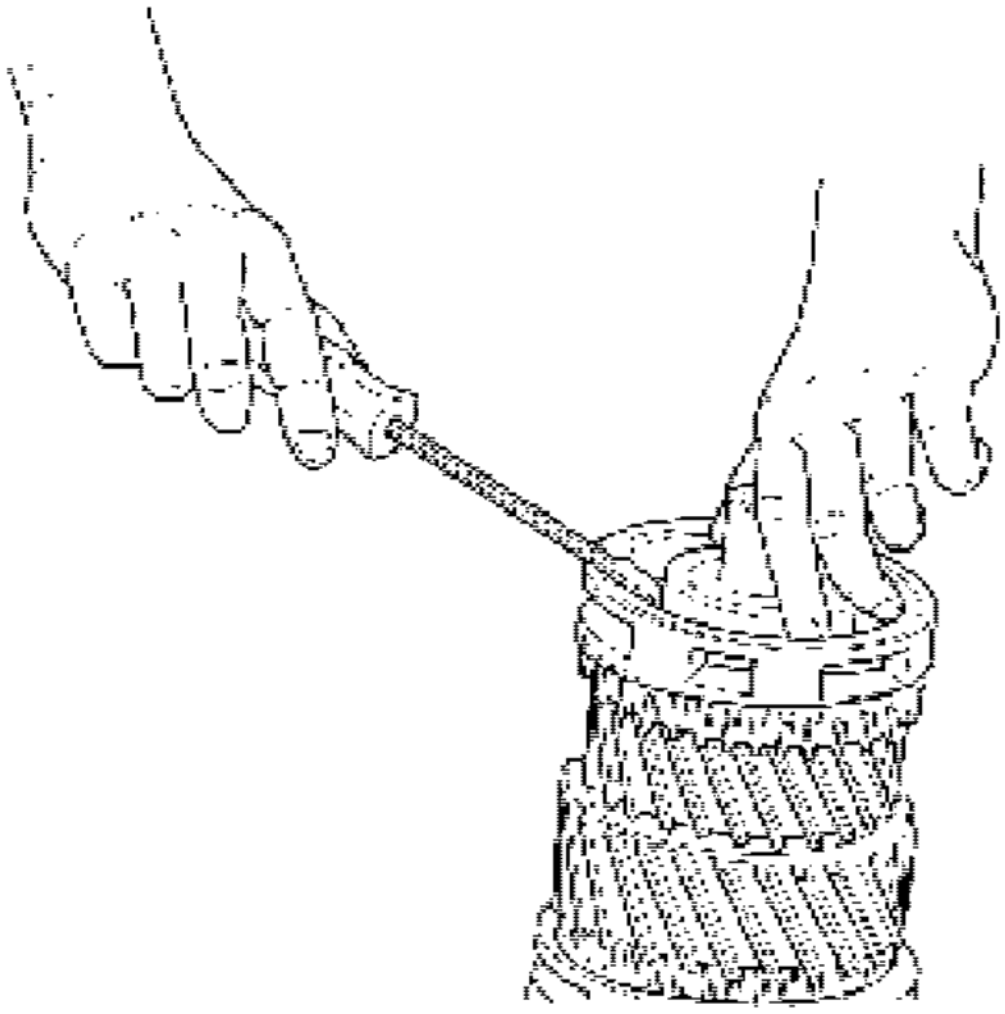


Fig. 68: Removing Drive Wheel
Courtesy of GENERAL MOTORS CORP.

3. Using a screwdriver, remove the drive wheel.

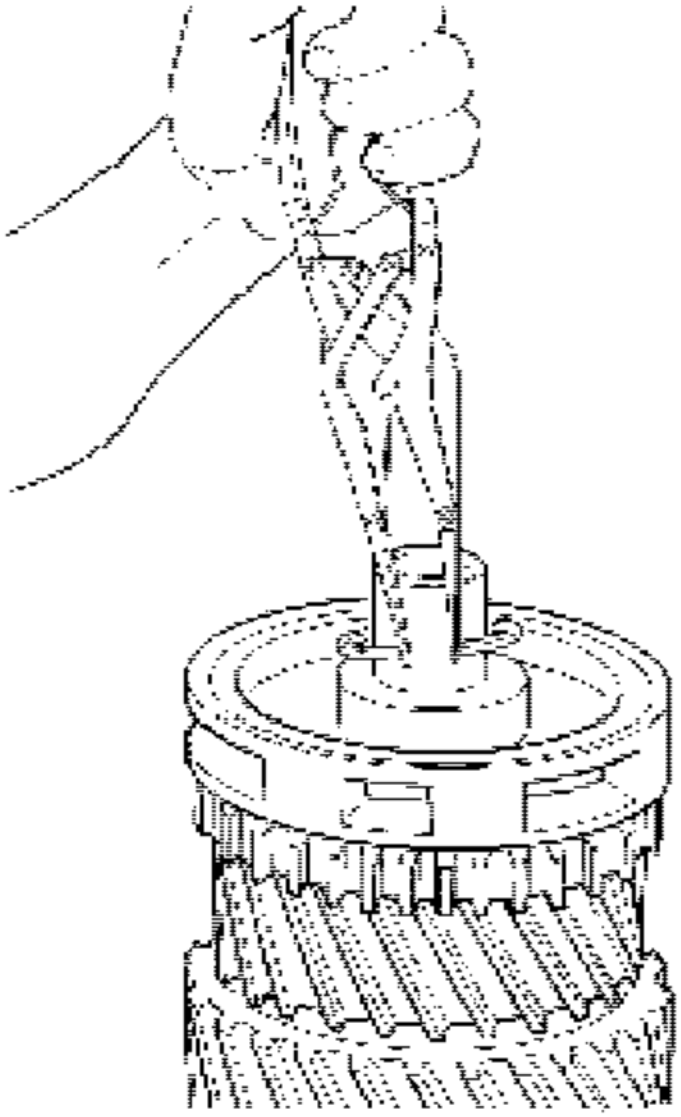


Fig. 69: Drum Retainer
Courtesy of GENERAL MOTORS CORP.

4. Using retainer pliers, remove the drum retainer.

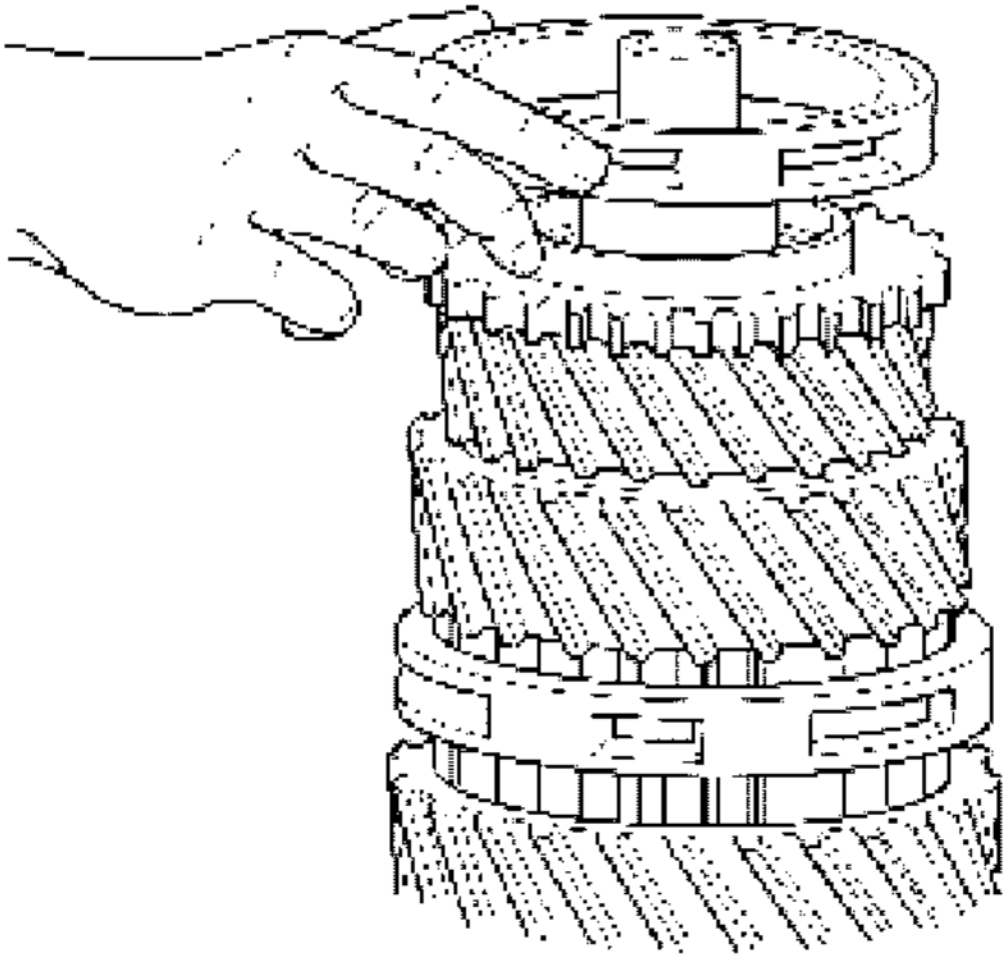


Fig. 70: 3rd And 4th Synchronizer Assembly
Courtesy of GENERAL MOTORS CORP.

5. Remove the 3rd and 4th synchronizer assembly.

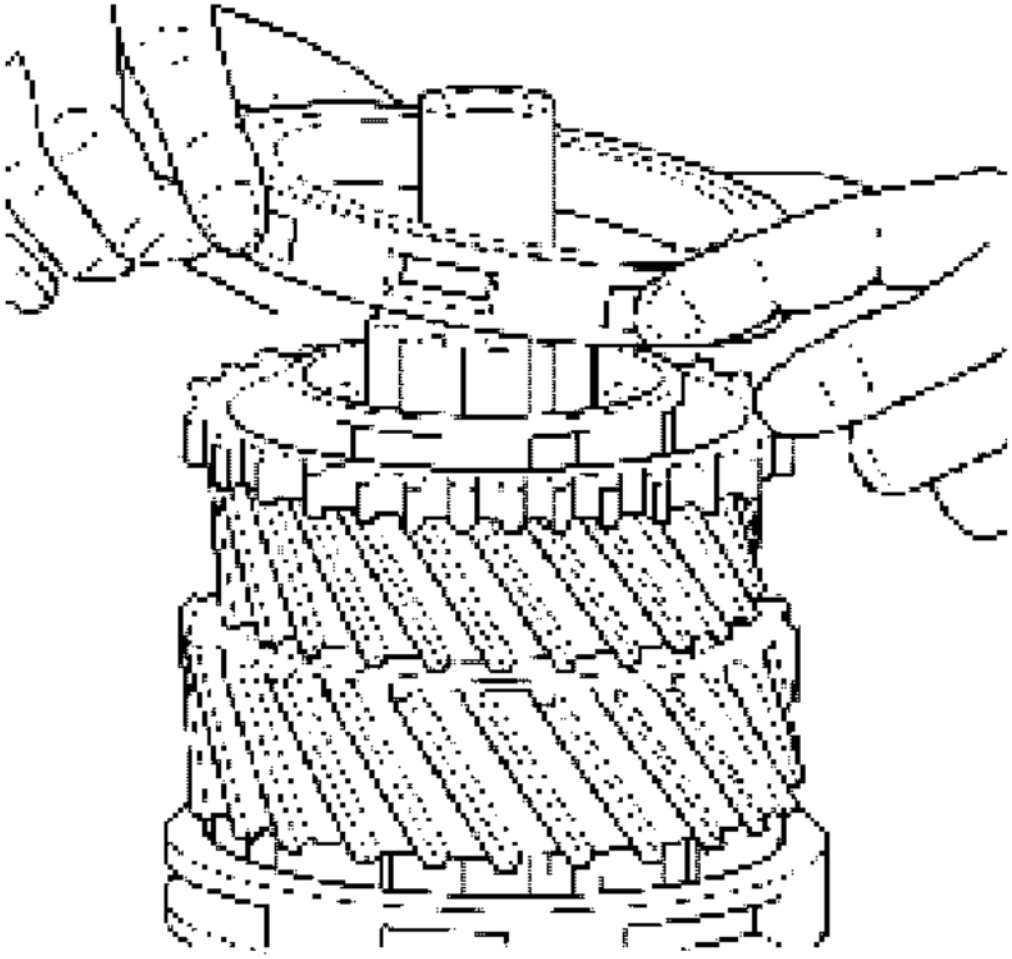


Fig. 71: 3rd And 4th Synchronizer Ring
Courtesy of GENERAL MOTORS CORP.

6. Remove the 3rd and 4th synchronizer ring.

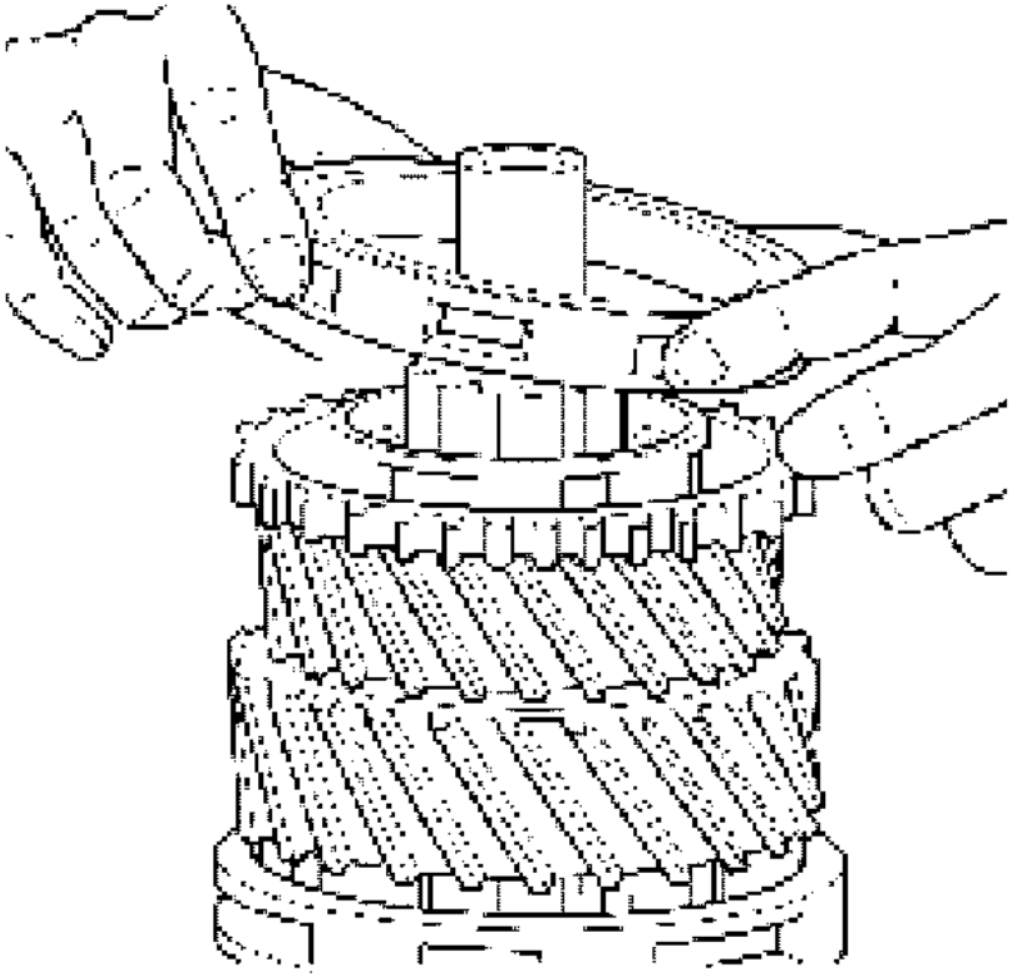


Fig. 72: Lifting 3rd Speed Coupling Cone
Courtesy of GENERAL MOTORS CORP.

7. Using a screwdriver, carefully lift the 3rd speed coupling cone.

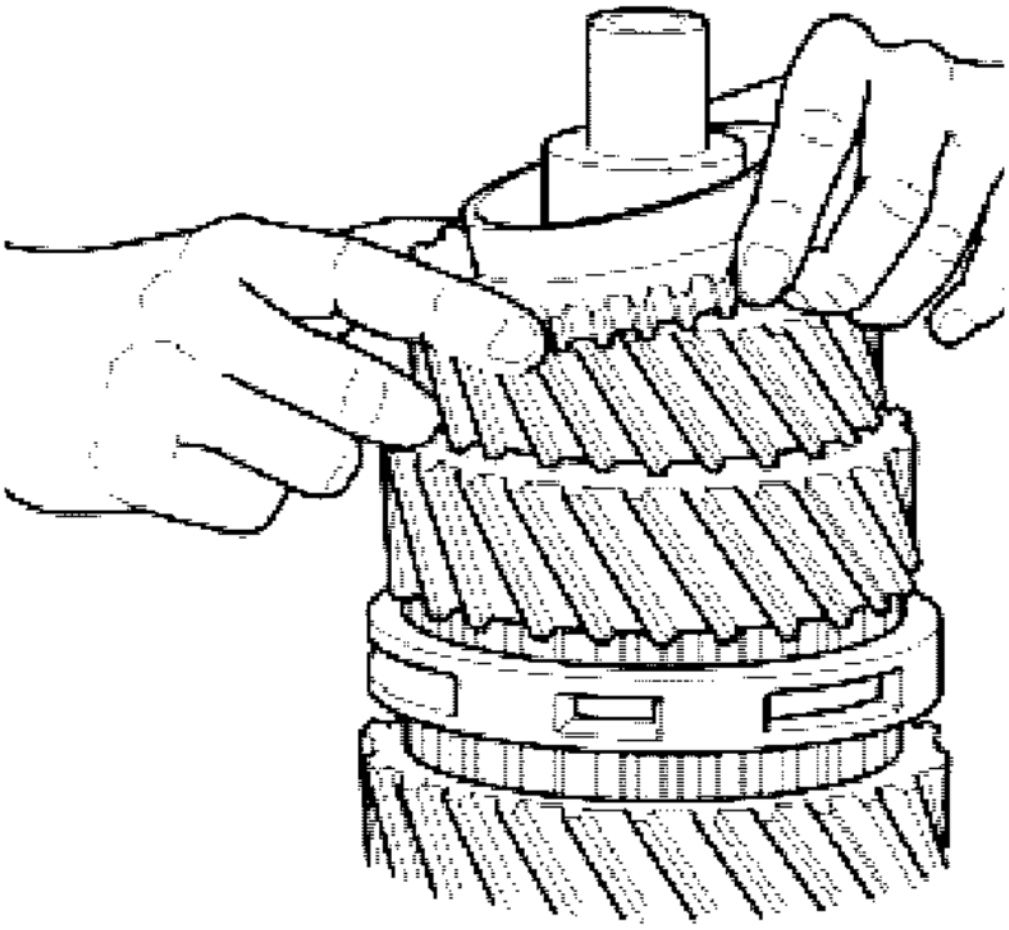


Fig. 73: 3rd Speed Coupling Cone
Courtesy of GENERAL MOTORS CORP.

8. Remove the 3rd speed coupling cone.

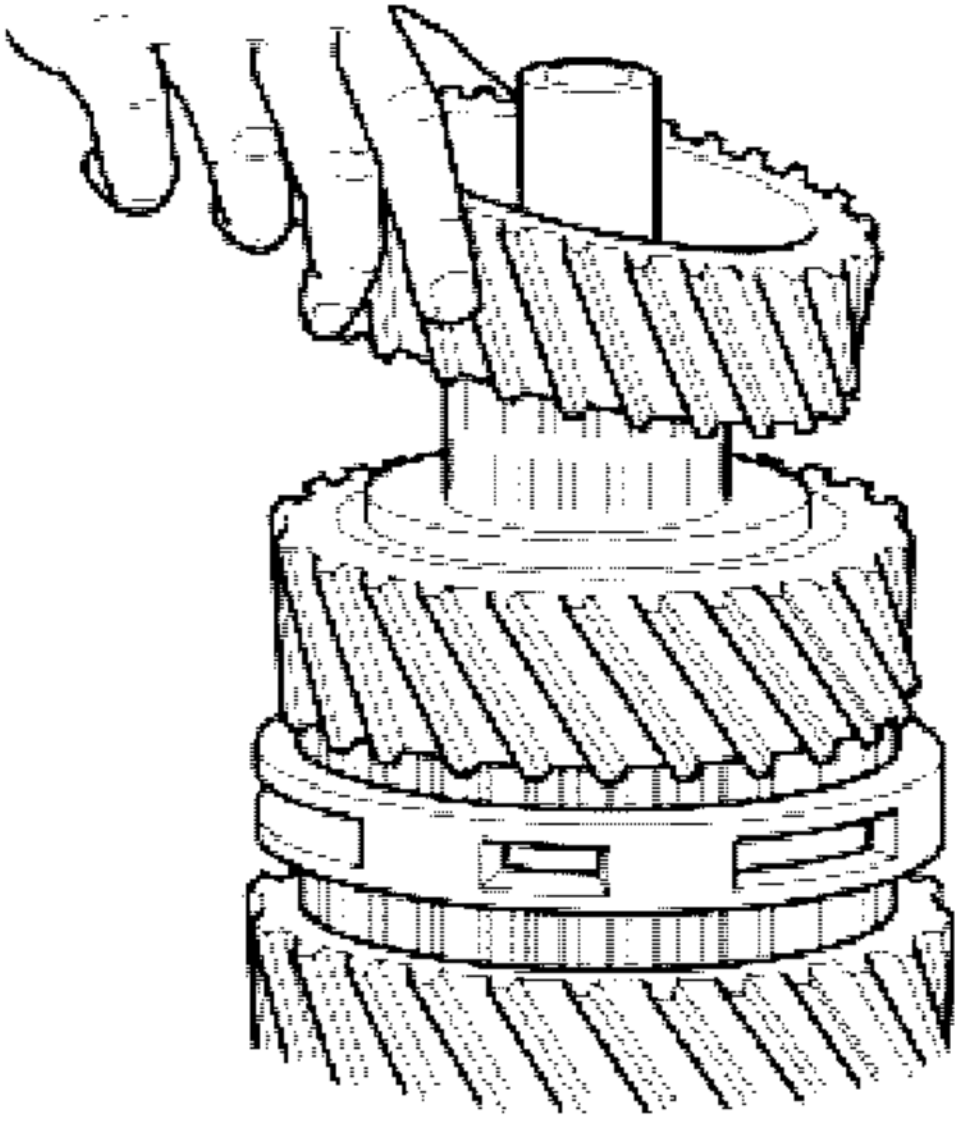


Fig. 74: 3rd Speed Gear
Courtesy of GENERAL MOTORS CORP.

9. Remove the 3rd speed gear.

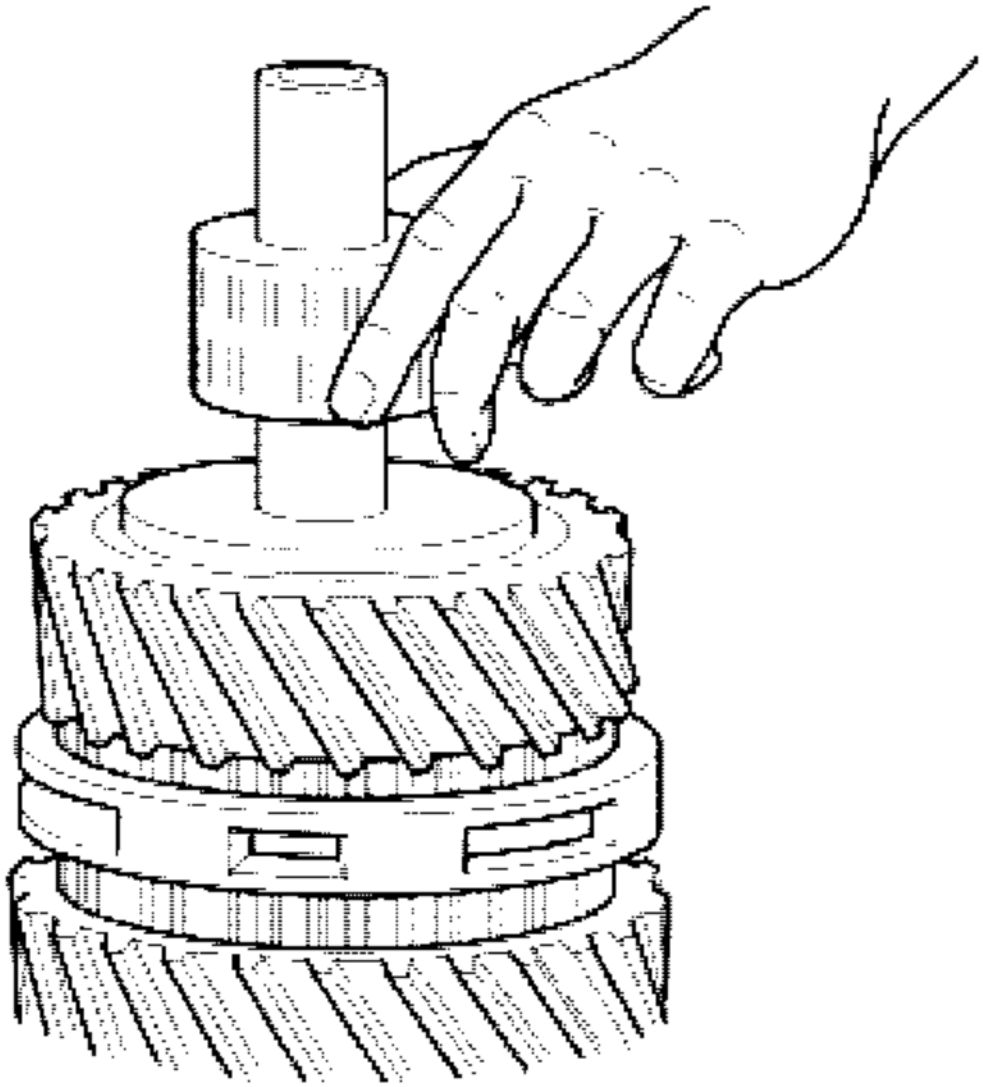


Fig. 75: 3rd Speed Roller Cage
Courtesy of GENERAL MOTORS CORP.

10. Remove the 3rd speed roller cage.

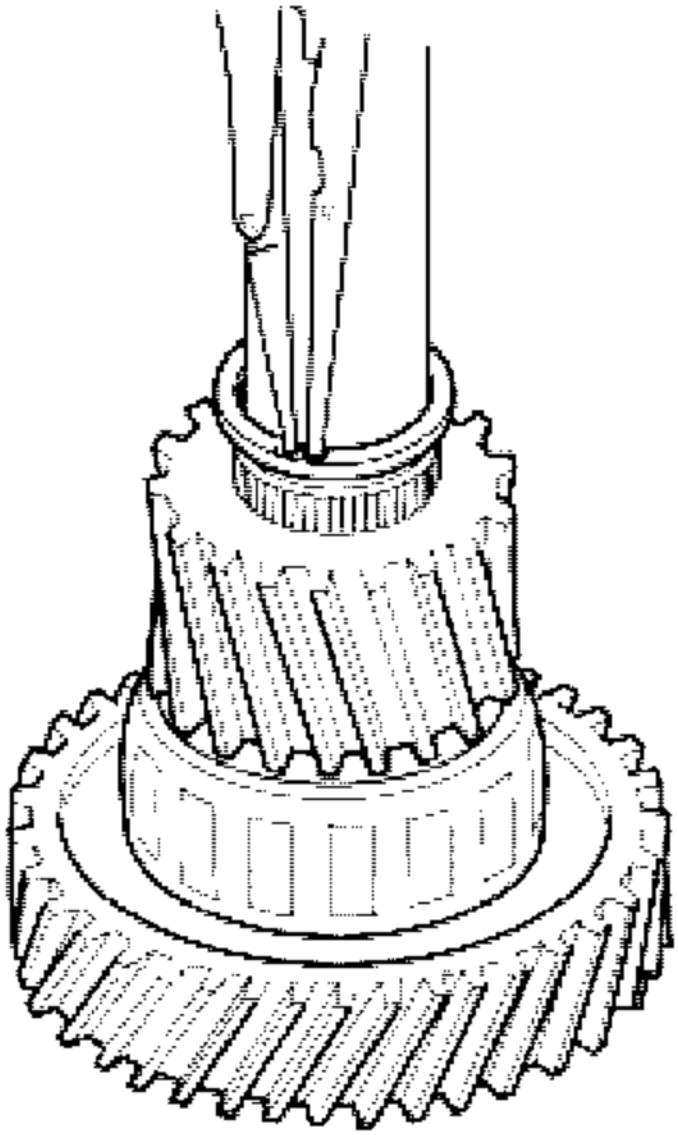


Fig. 76: 5th Speed Gear Retainer
Courtesy of GENERAL MOTORS CORP.

11. Using retainer pliers, turn the primary shaft assembly and remove the 5th speed gear retainer.

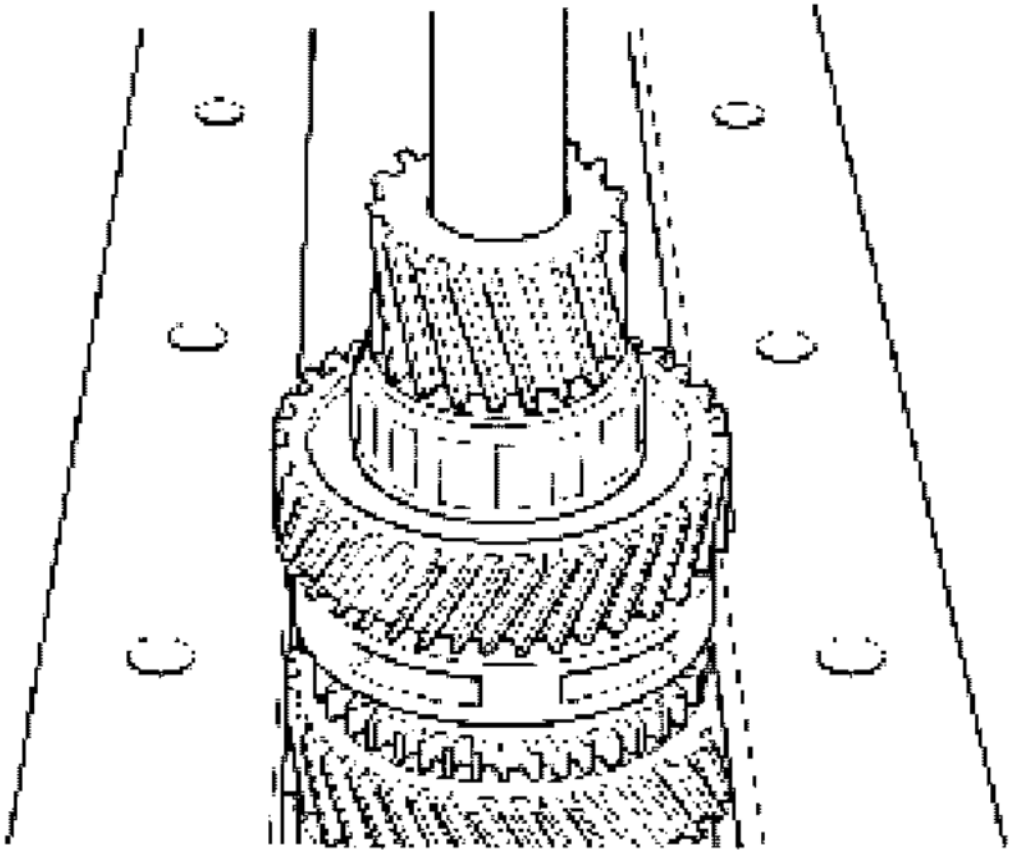


Fig. 77: Removing 5th Speed Gear Using Press
Courtesy of GENERAL MOTORS CORP.

12. Using a press, remove the 5th speed gear leaning it on the reverse gear.

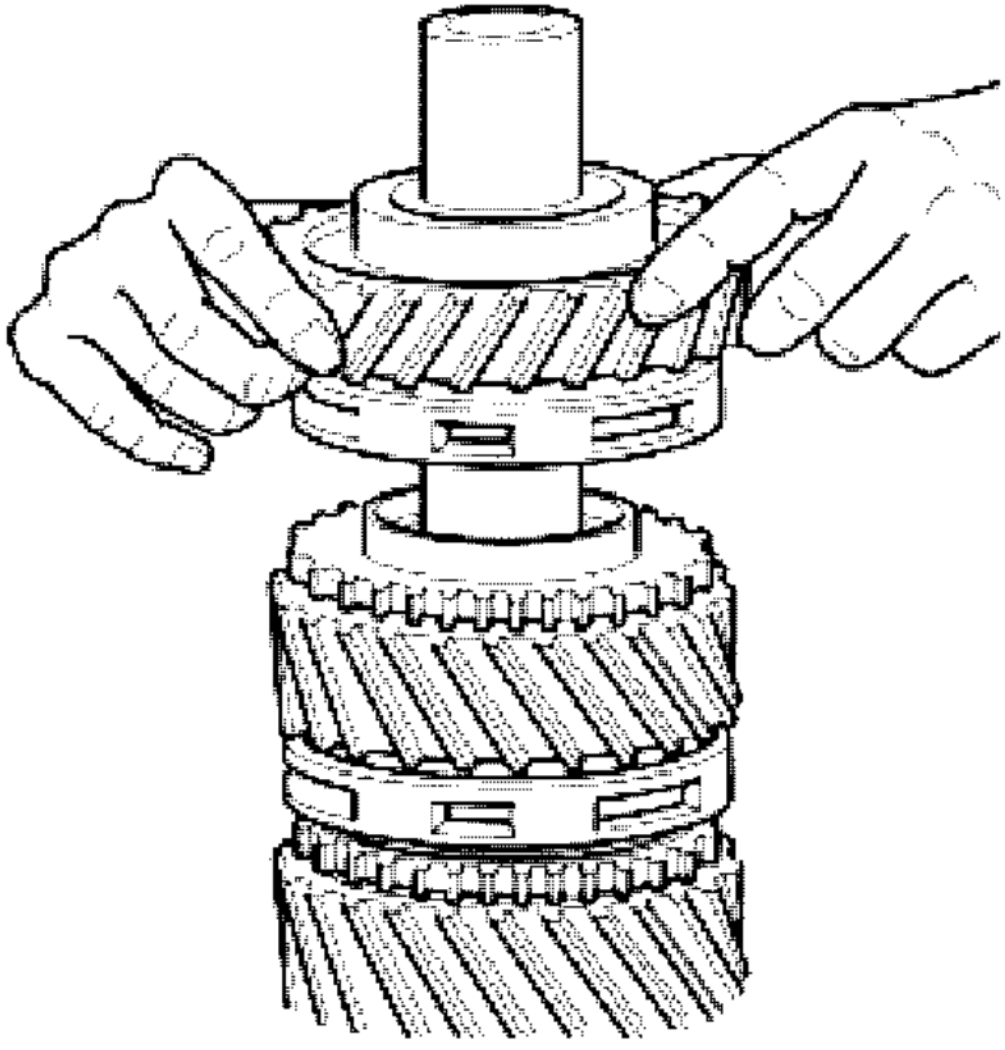


Fig. 78: Removing 5th Speed Gear, Taper Bearings, Bushing, Roller Cage, And Reverse Synchronizer Assembly
Courtesy of GENERAL MOTORS CORP.

13. When removing the 5th speed gear, the taper bearings, bushing, roller cage, and reverse synchronizer assembly will also come out.

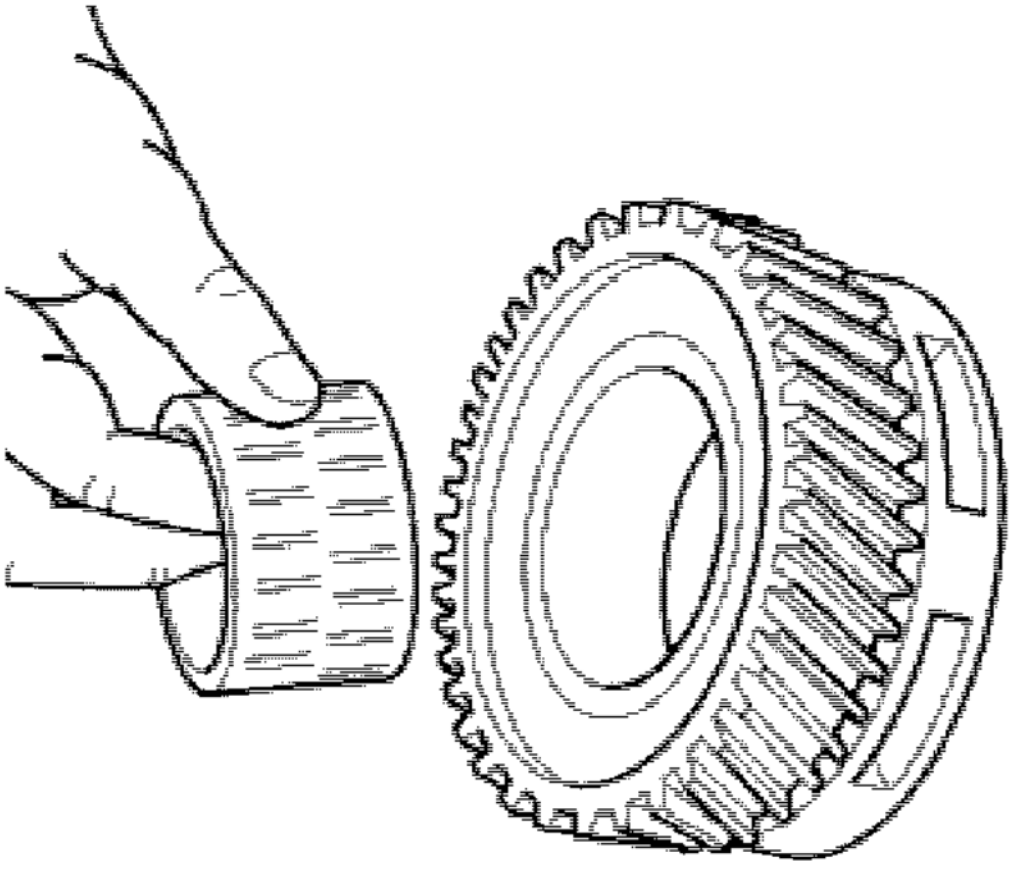


Fig. 79: Reverse Gear Cage
Courtesy of GENERAL MOTORS CORP.

14. Remove the reverse gear cage.

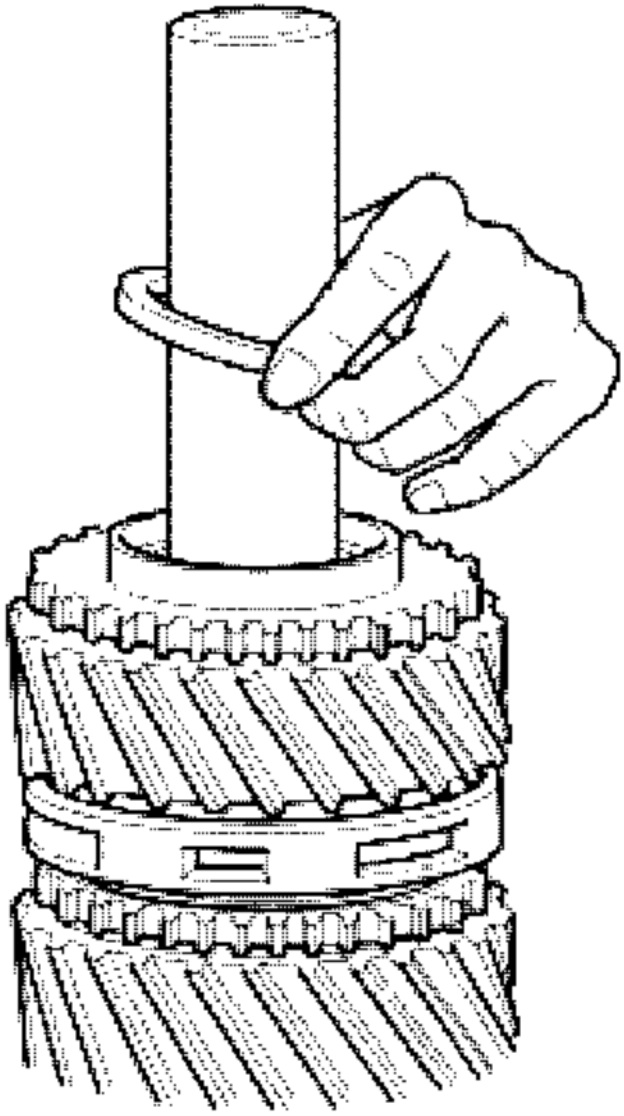


Fig. 80: Reverse Synchronizer Ring
Courtesy of GENERAL MOTORS CORP.

15. Remove the reverse synchronizer ring.

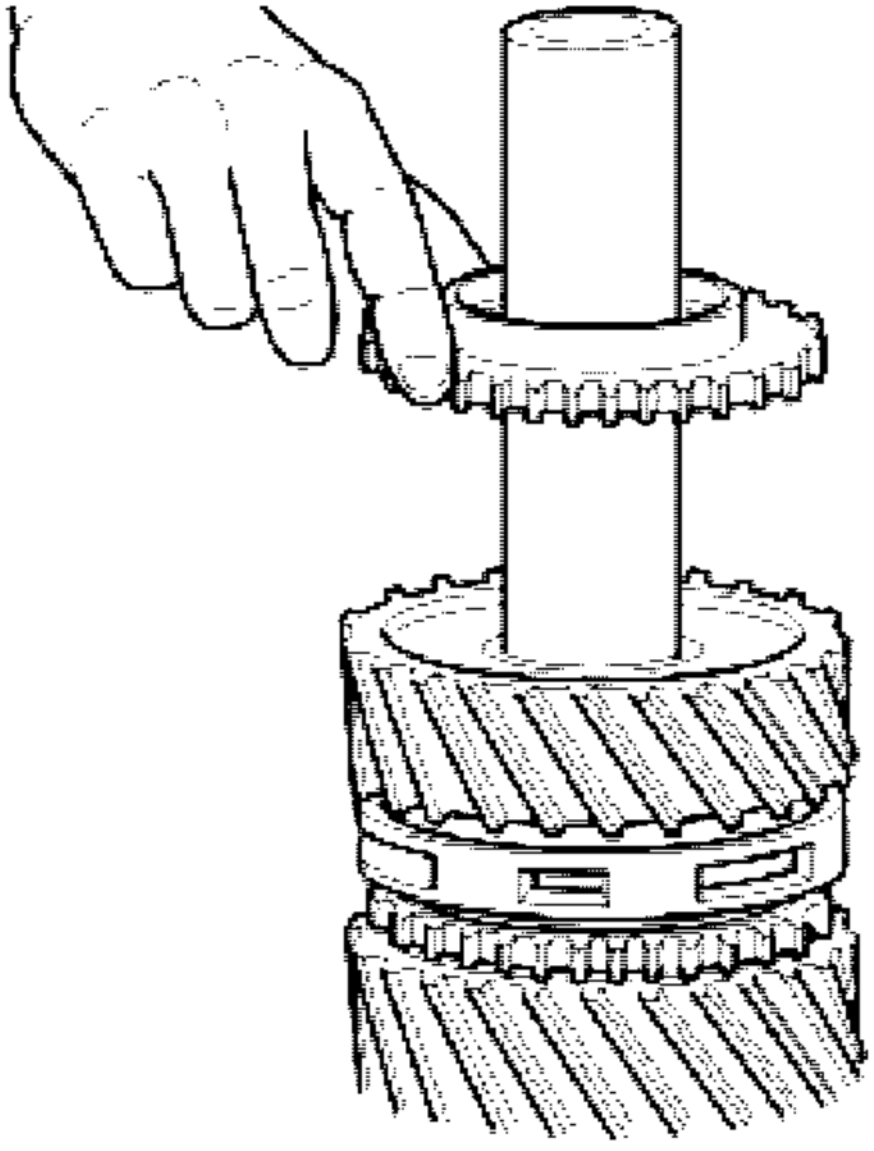


Fig. 81: Coupling Cone
Courtesy of GENERAL MOTORS CORP.

16. Remove the coupling cone from the reverse gear.

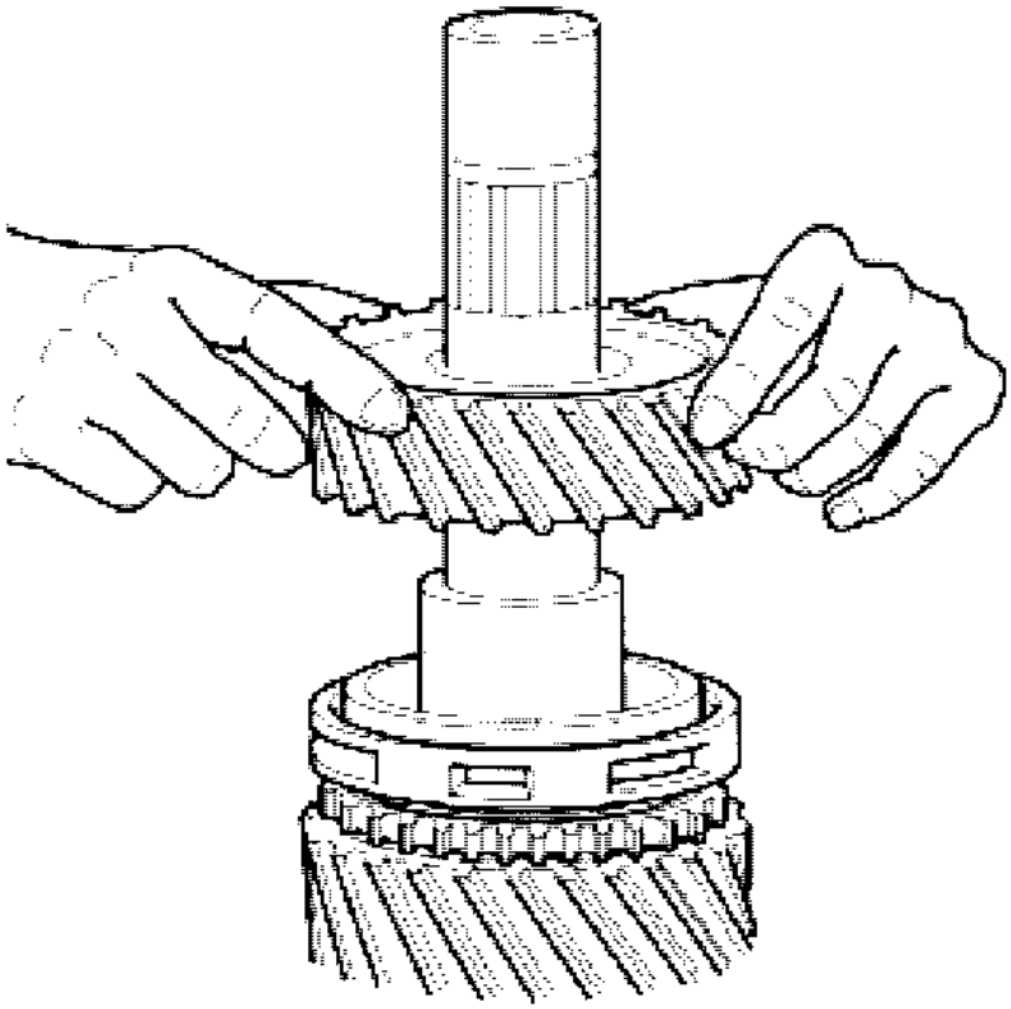


Fig. 82: 1st Speed Gear
Courtesy of GENERAL MOTORS CORP.

17. Remove the 1st speed gear.

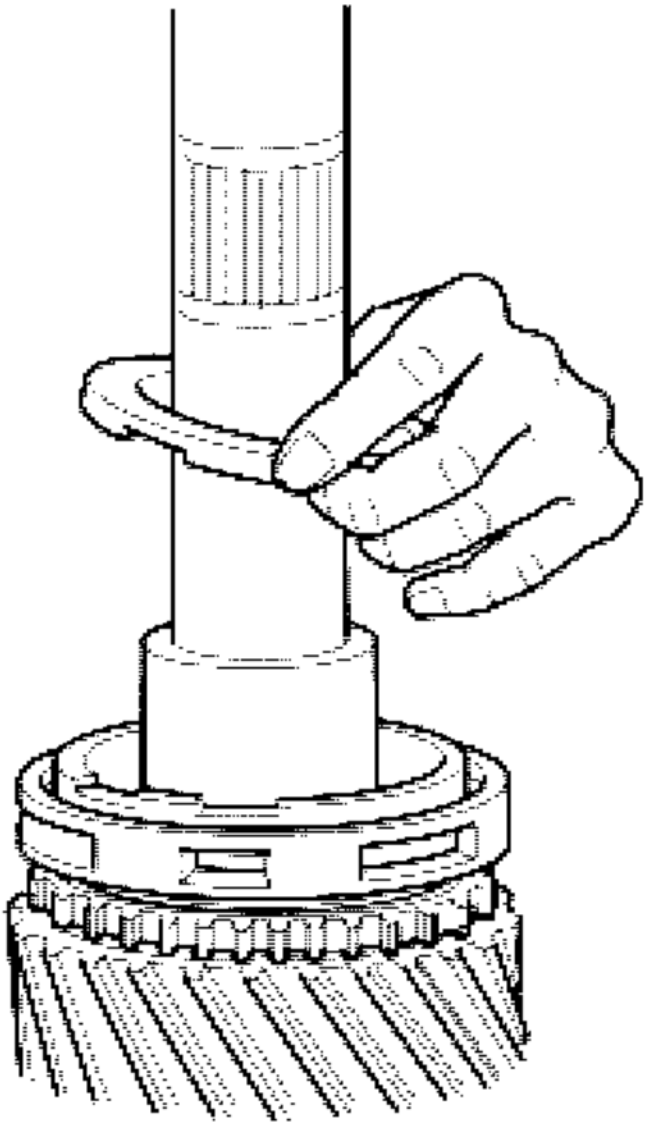


Fig. 83: 1St Speed Gear Inner Cone
Courtesy of GENERAL MOTORS CORP.

18. Remove the 1st speed gear inner cone.

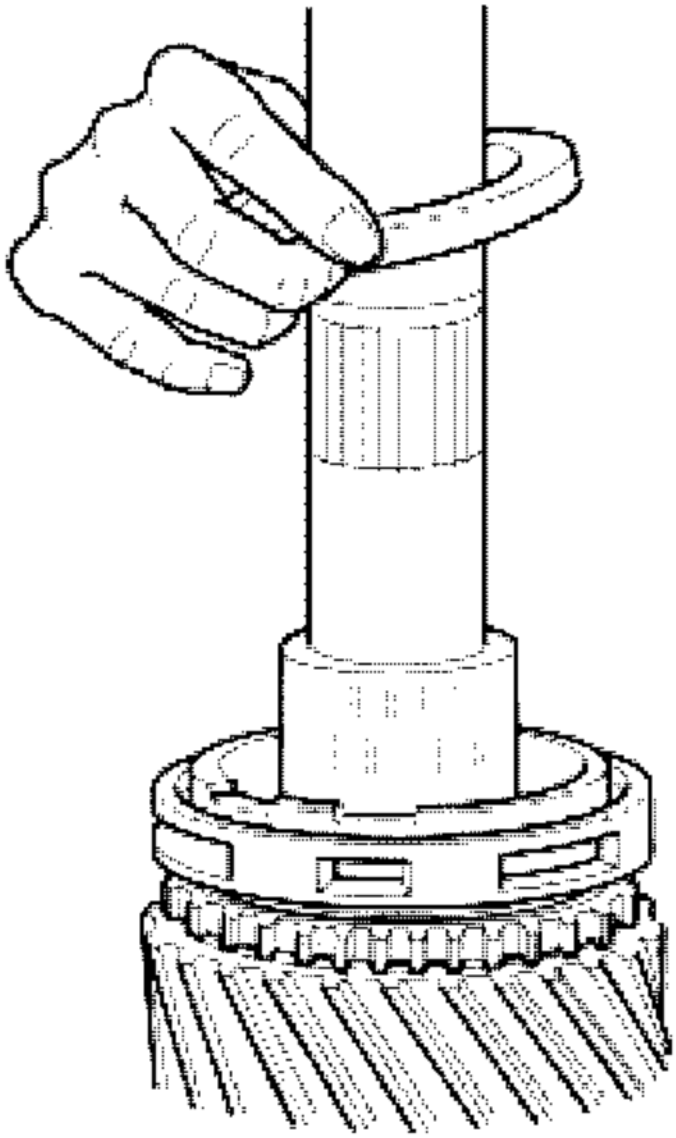


Fig. 84: 1st Speed Gear Intermediate Cone
Courtesy of GENERAL MOTORS CORP.

19. Remove the 1st speed gear intermediate cone.

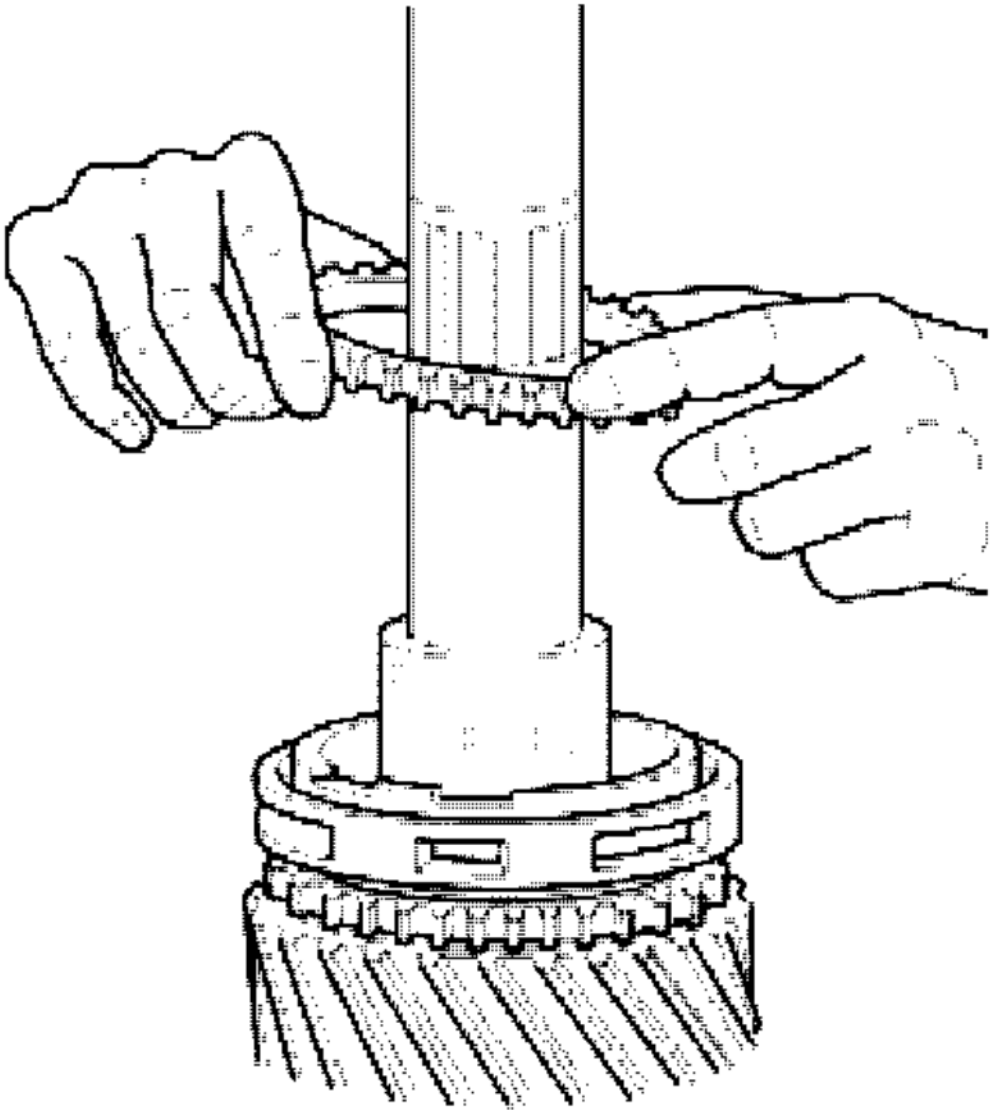


Fig. 85: 1st Speed Gear Synchronizer Ring
Courtesy of GENERAL MOTORS CORP.

20. Remove the 1st speed gear synchronizer ring.

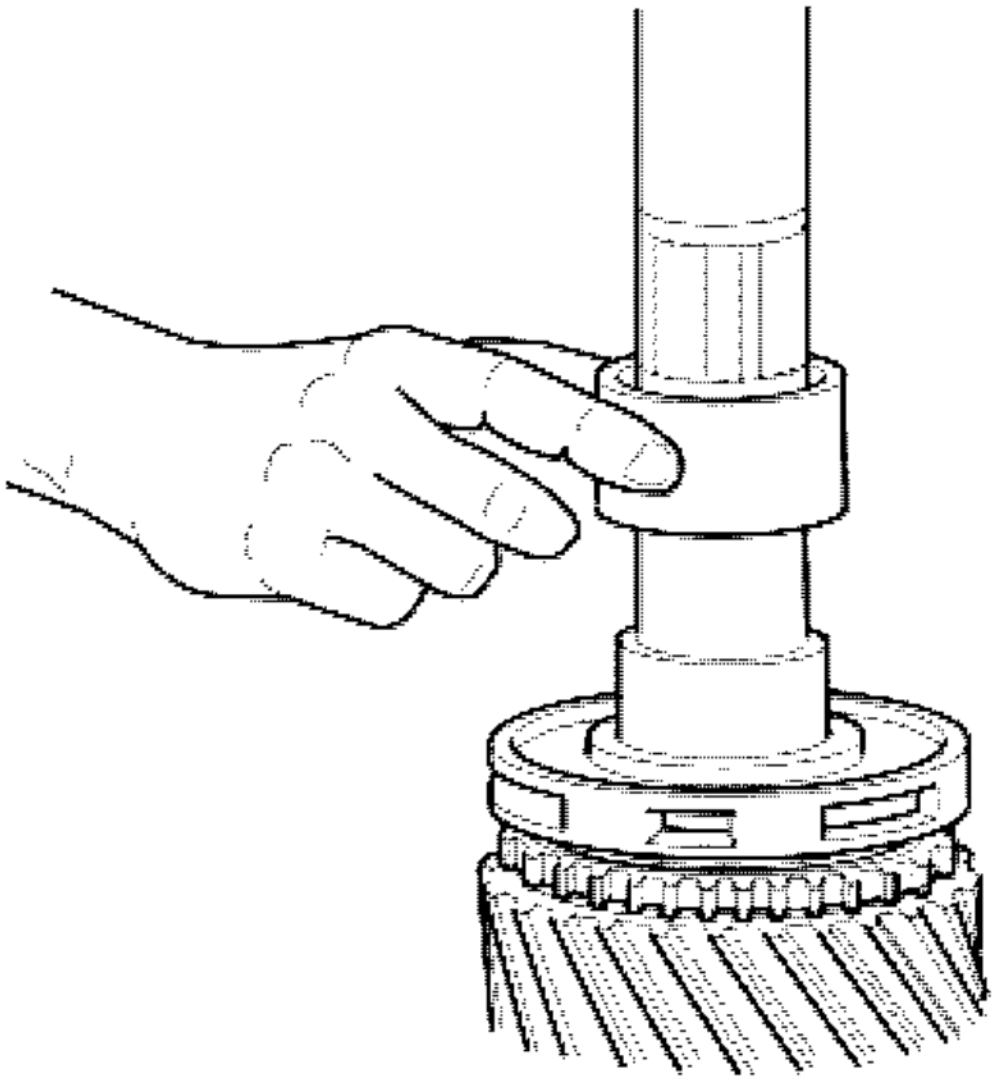


Fig. 86: 1st Speed Gear Roller Cage
Courtesy of GENERAL MOTORS CORP.

21. Remove the 1st speed gear roller cage.

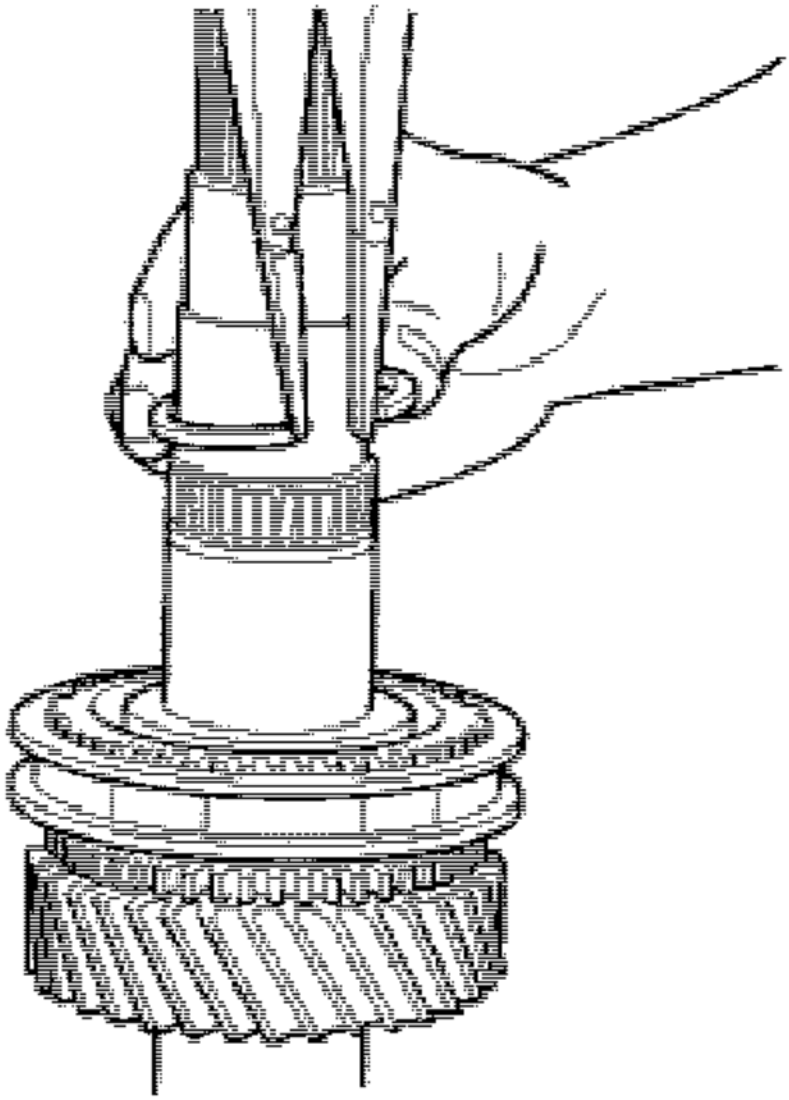


Fig. 87: Retainer Securing Synchronizer Drum
Courtesy of GENERAL MOTORS CORP.

22. Using retainer pliers, remove the retainer securing the synchronizer drum.

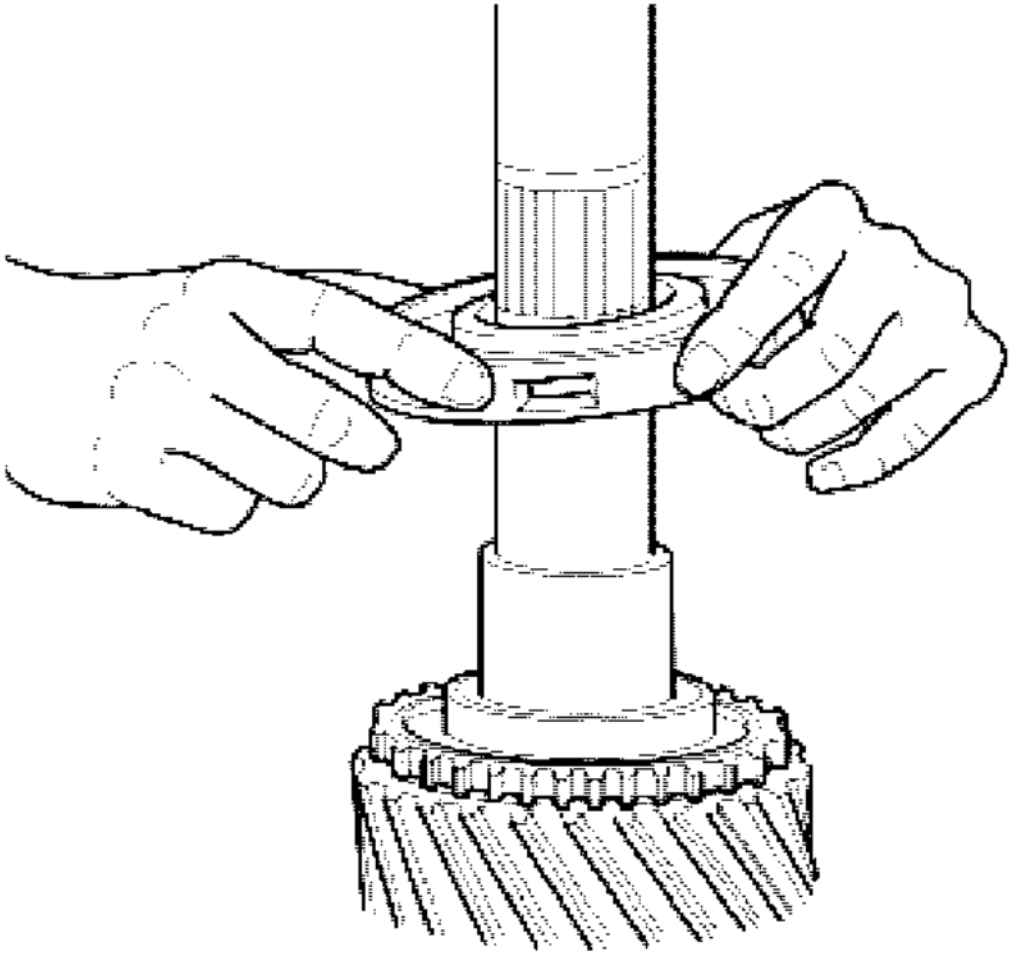


Fig. 88: 1st And 2nd Speed Synchronizer Assembly
Courtesy of GENERAL MOTORS CORP.

23. Remove the 1st and 2nd speed synchronizer assembly.

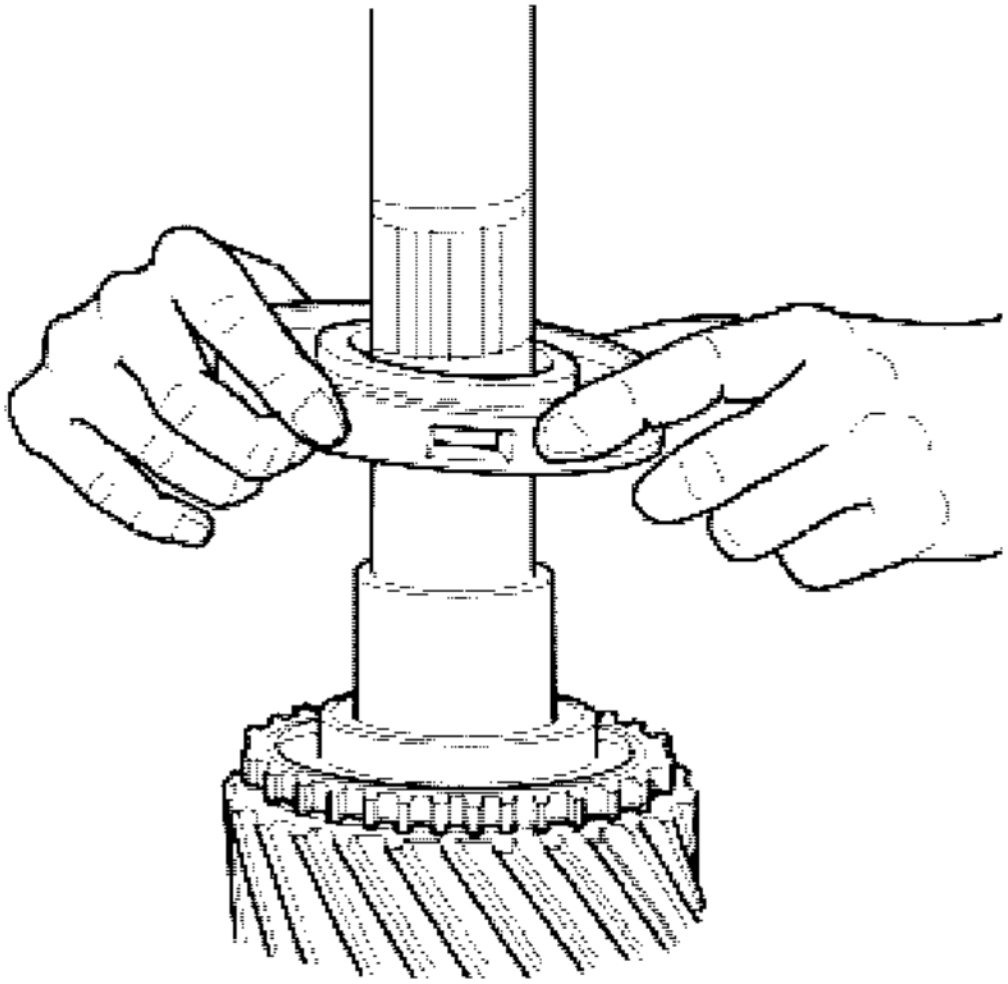


Fig. 89: 2nd Speed Synchronizer Ring
Courtesy of GENERAL MOTORS CORP.

24. Remove the 2nd speed synchronizer ring.

SHIFT SHAFT AND FORK ASSEMBLIES DISASSEMBLE

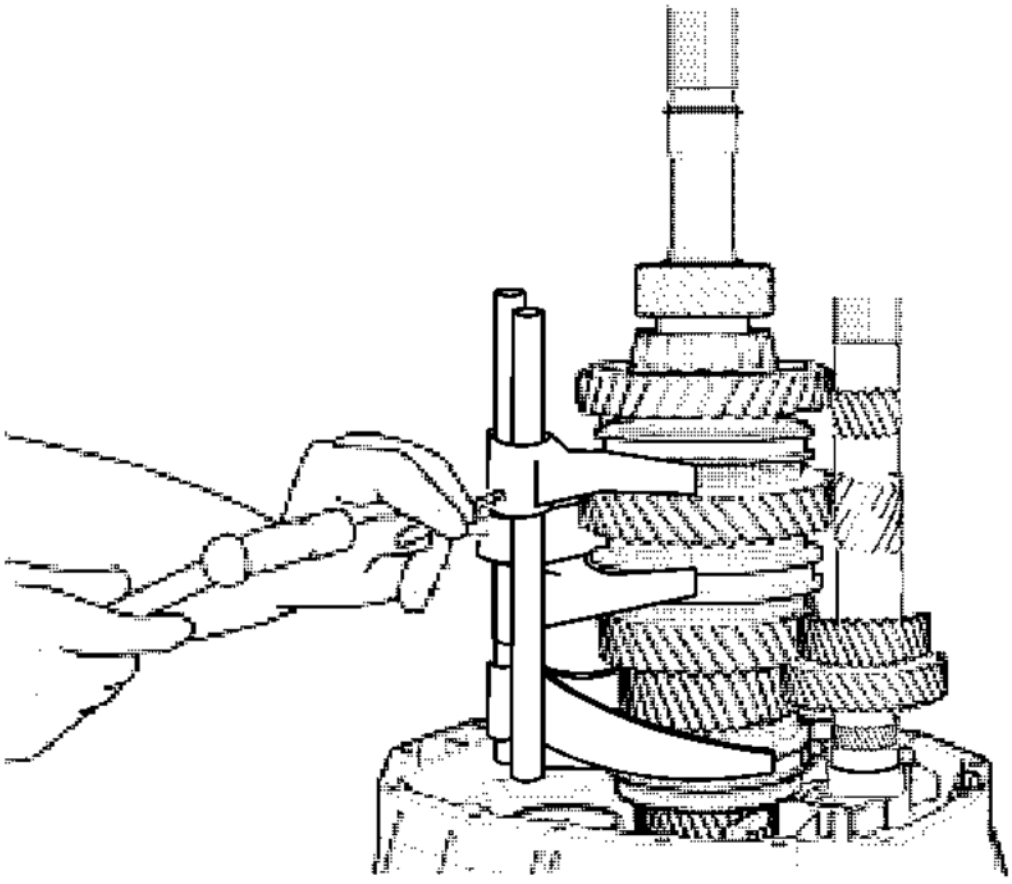


Fig. 90: Removing Roll Pin From Yoke And Reverse Gearshift Lever
Courtesy of GENERAL MOTORS CORP.

1. Using a hammer and a punch, remove the roll pin from the yoke and the reverse gearshift lever.

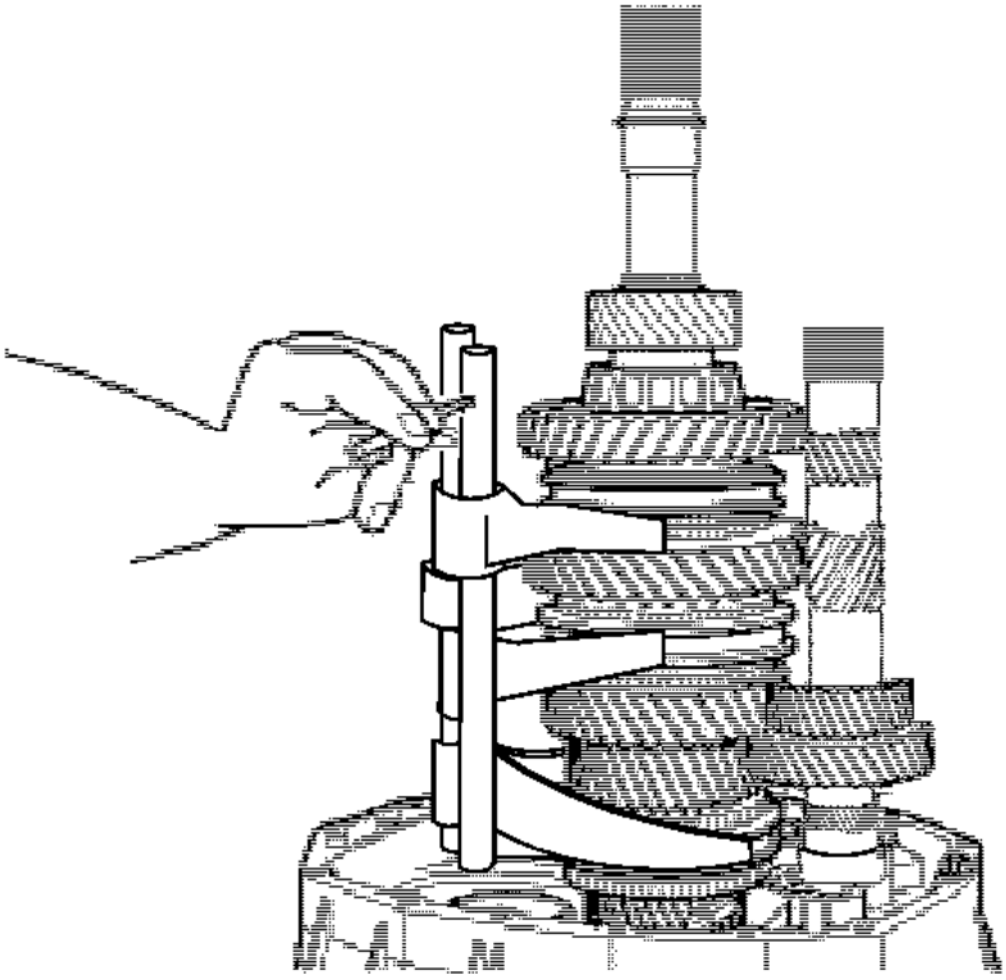


Fig. 91: Turning Reverse Gearshift Lever Usiing Punch
Courtesy of GENERAL MOTORS CORP.

2. Using a punch, turn the reverse gearshift lever to free it from the roll pin and remove.

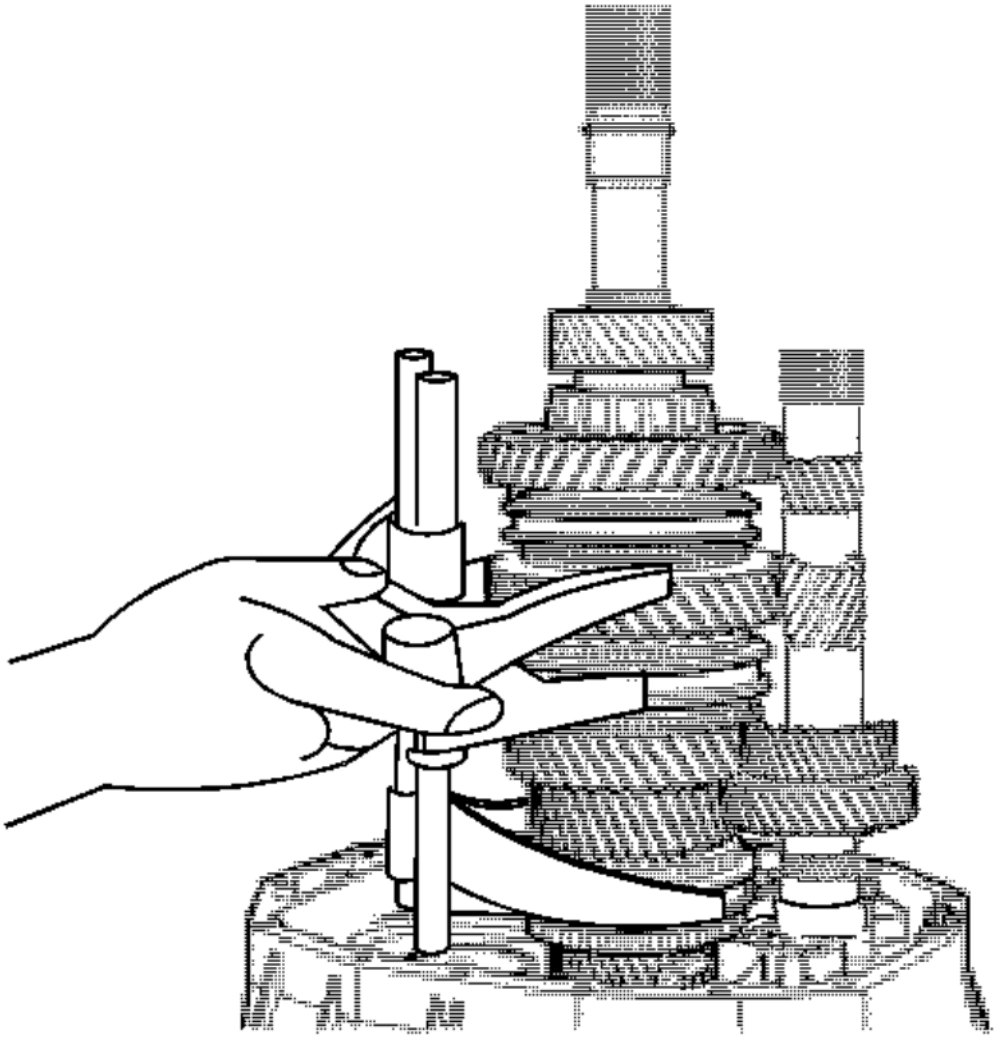


Fig. 92: Reverse Fork
Courtesy of GENERAL MOTORS CORP.

3. Remove the reverse fork.

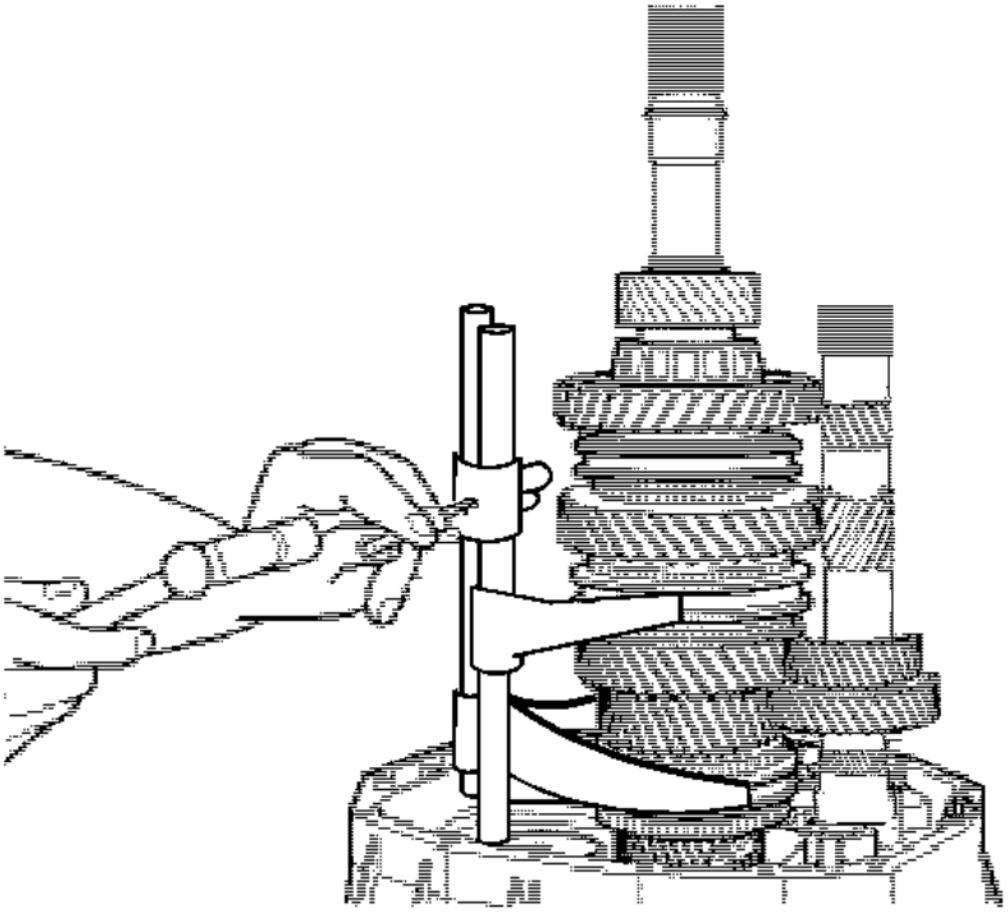


Fig. 93: Remove 1st And 2nd Speed Stop Pin
Courtesy of GENERAL MOTORS CORP.

4. Remove the 1st and 2nd speed stop pin. Use care with the anchor bolt.

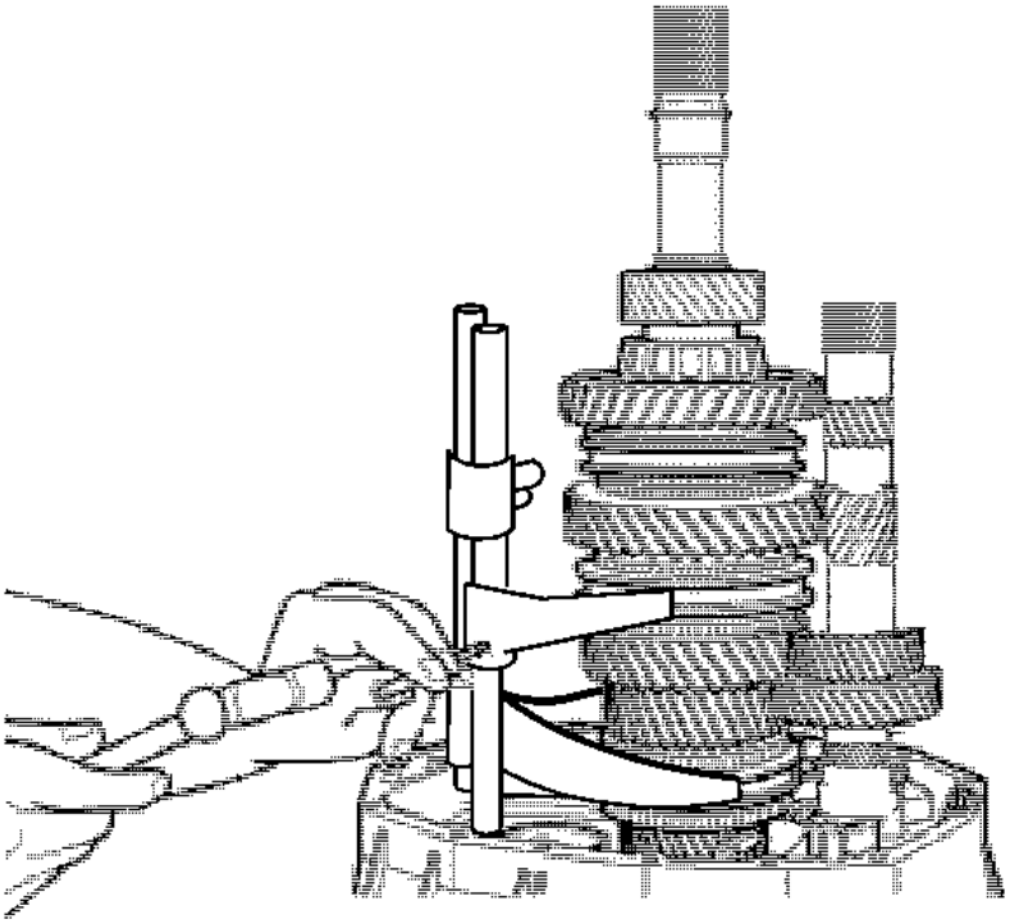


Fig. 94: Removing Retaining Bolt From Fork And 1st And 2nd Lever
Courtesy of GENERAL MOTORS CORP.

5. Using a punch and hammer, remove the retaining bolt from the fork and the 1st and 2nd lever.

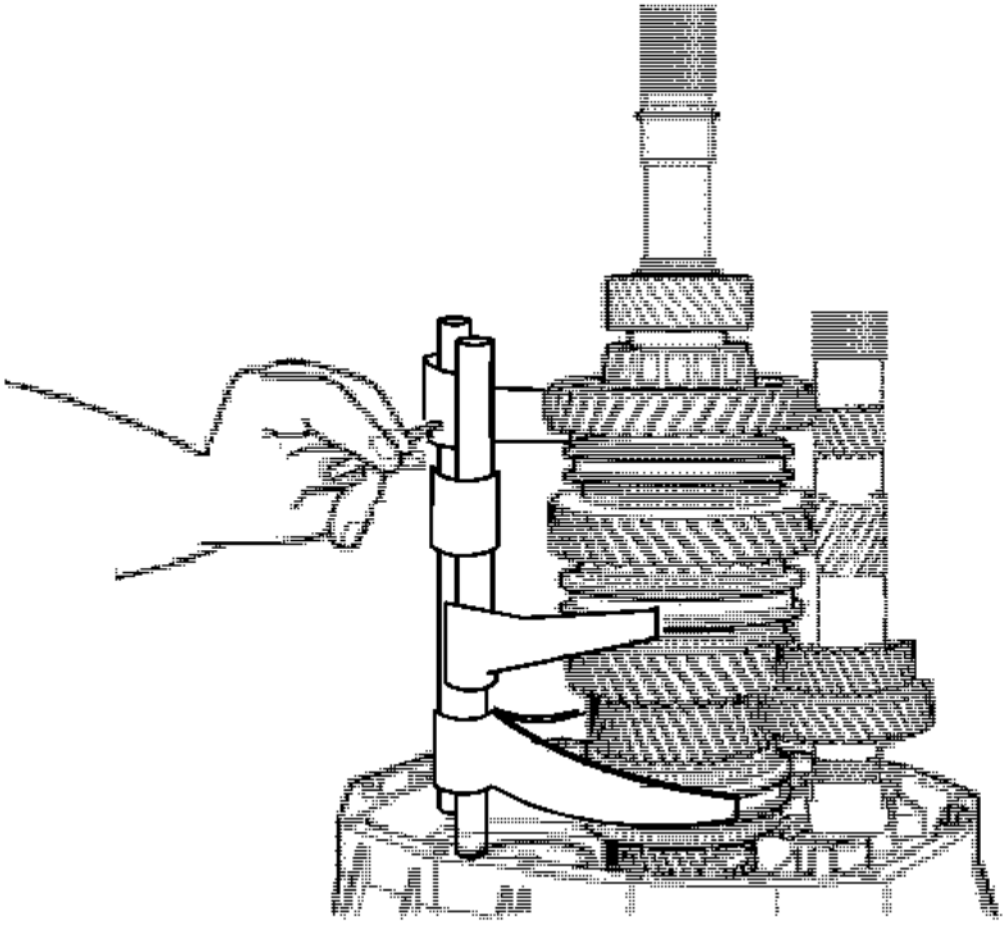


Fig. 95: Turning 1st And 2nd Lever Using Punch
Courtesy of GENERAL MOTORS CORP.

6. Using a punch, turn the 1st and 2nd lever to release it from the anchor bolt and remove it.

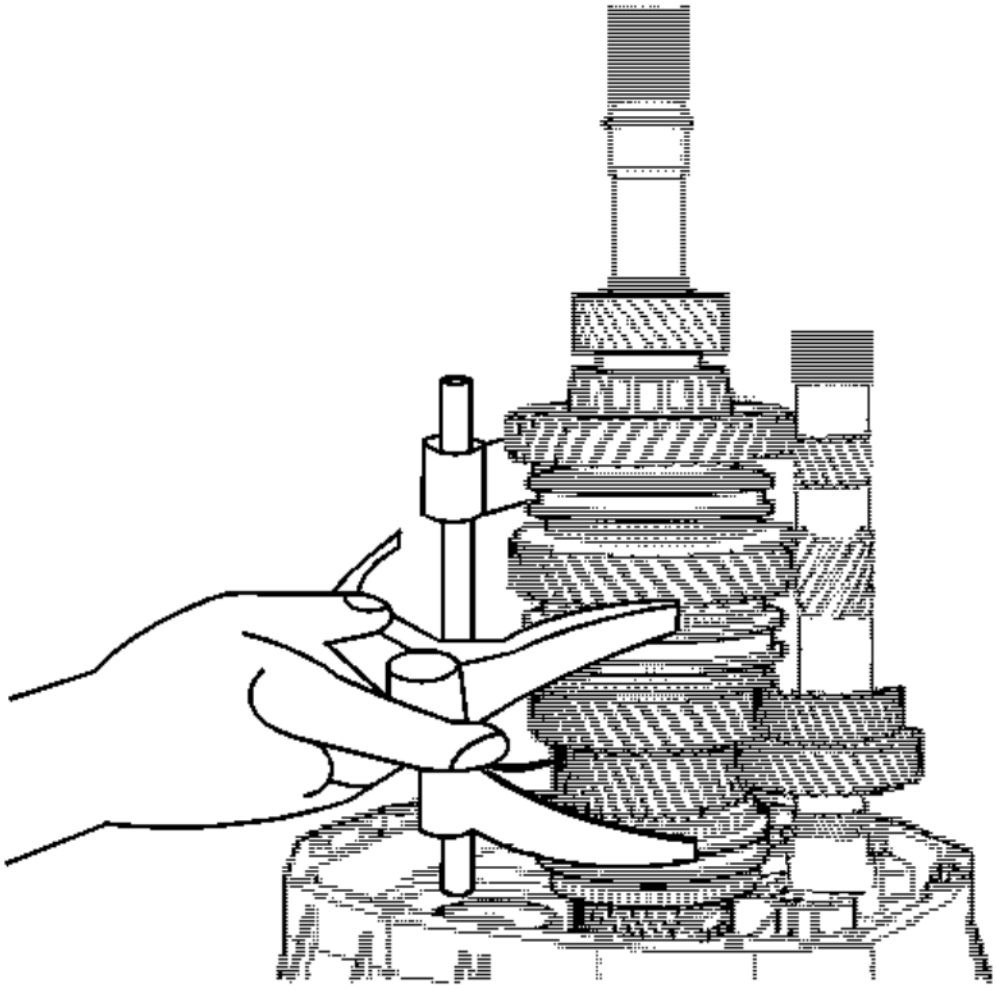


Fig. 96: 1st And 2nd Fork
Courtesy of GENERAL MOTORS CORP.

7. Remove the 1st and 2nd fork.

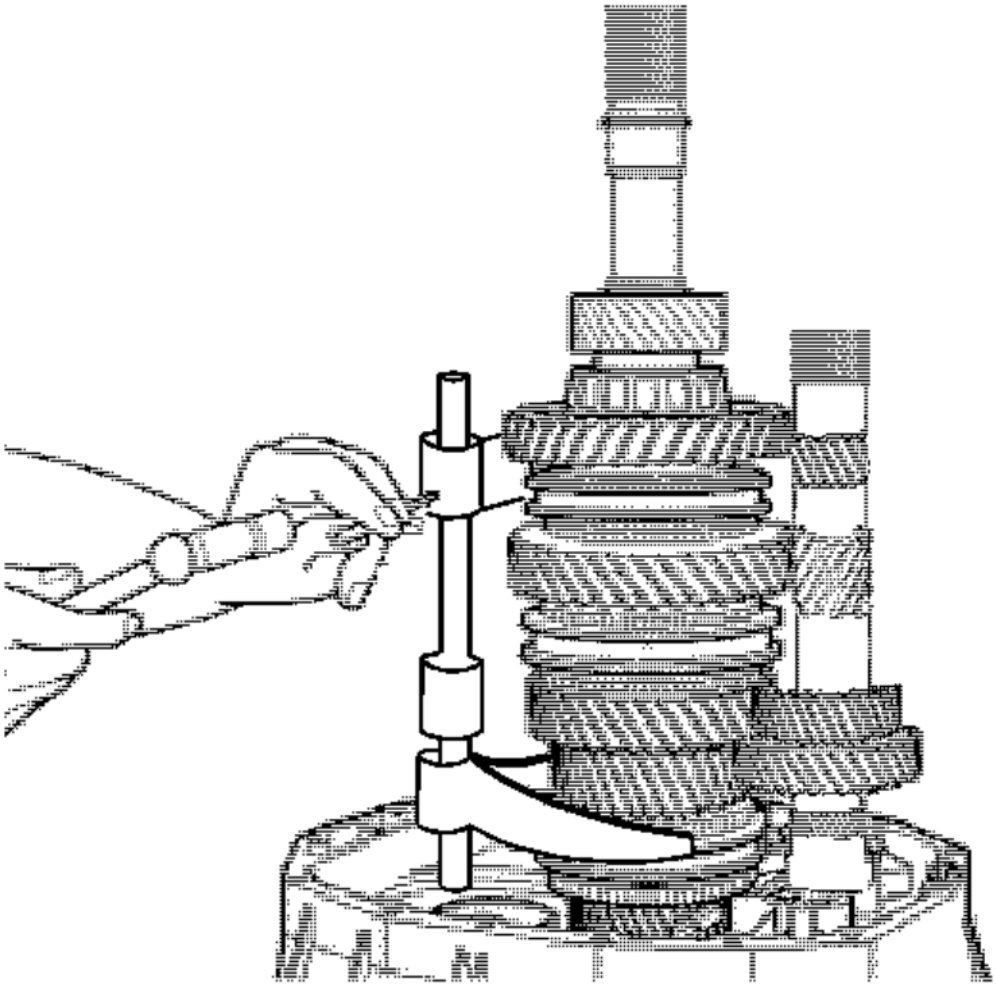


Fig. 97: Removing Retaining Bolt From 3rd And 4th Stop
Courtesy of GENERAL MOTORS CORP.

8. Using a punch and a hammer, remove the retaining bolt from the 3rd and 4th stop.

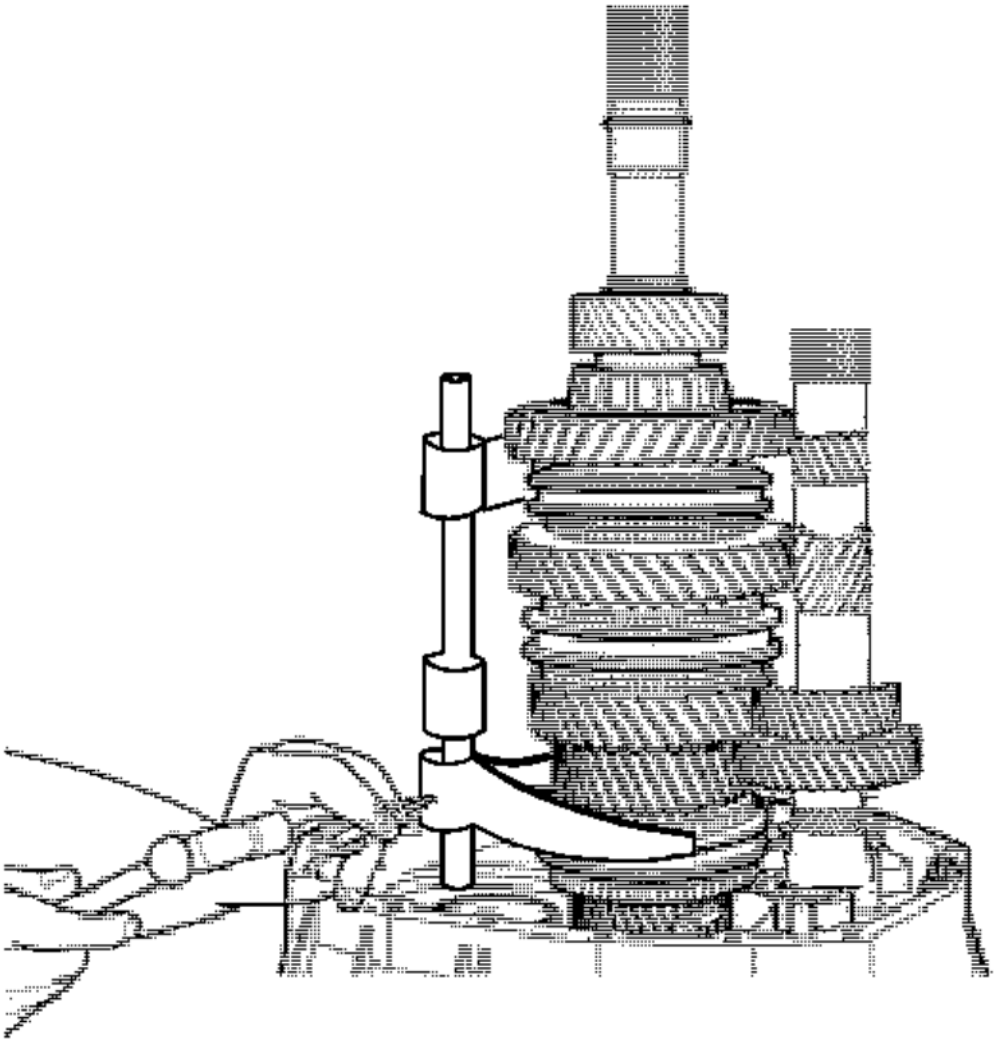


Fig. 98: Removing Retaining Bolt From 3rd And 4th Fork
Courtesy of GENERAL MOTORS CORP.

9. Using a punch and a hammer, remove the retaining bolt from the 3rd and 4th fork.

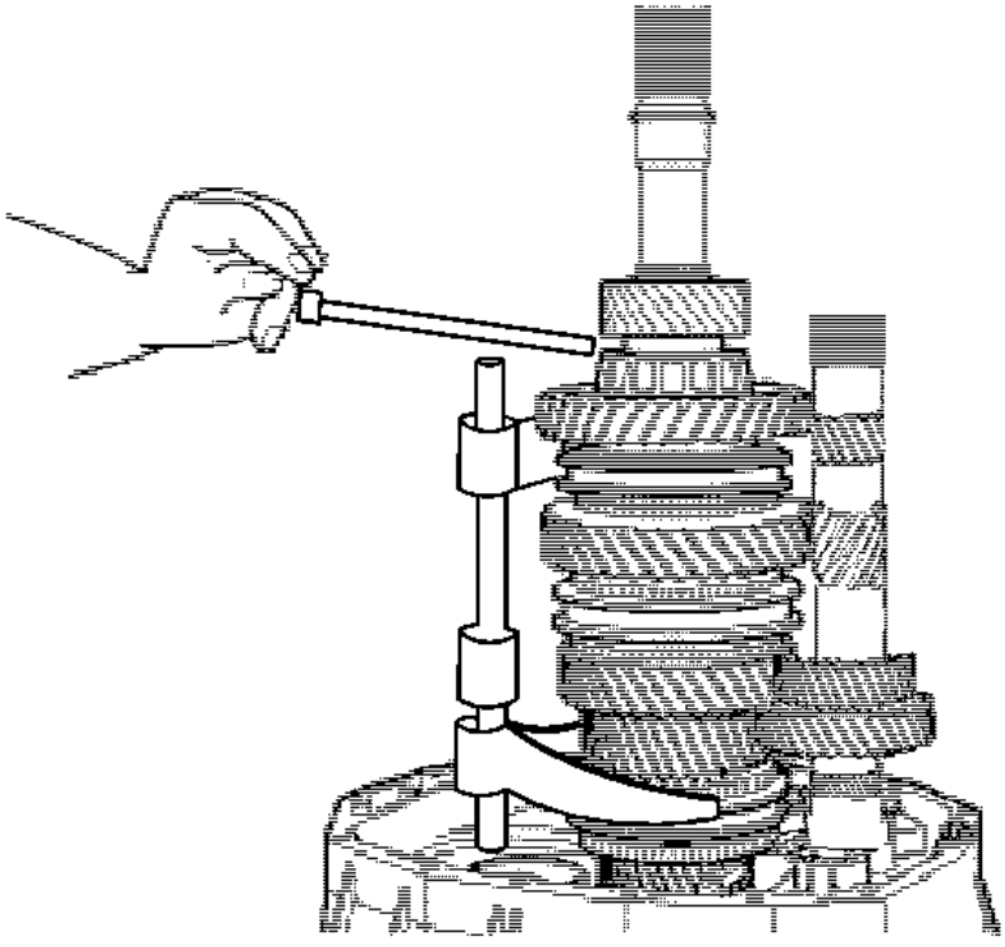


Fig. 99: Using A Punch To Turn 3rd And 4th Lever
Courtesy of GENERAL MOTORS CORP.

10. Using a punch, turn the 3rd and 4th lever to release it from the anchor bolt and remove it.

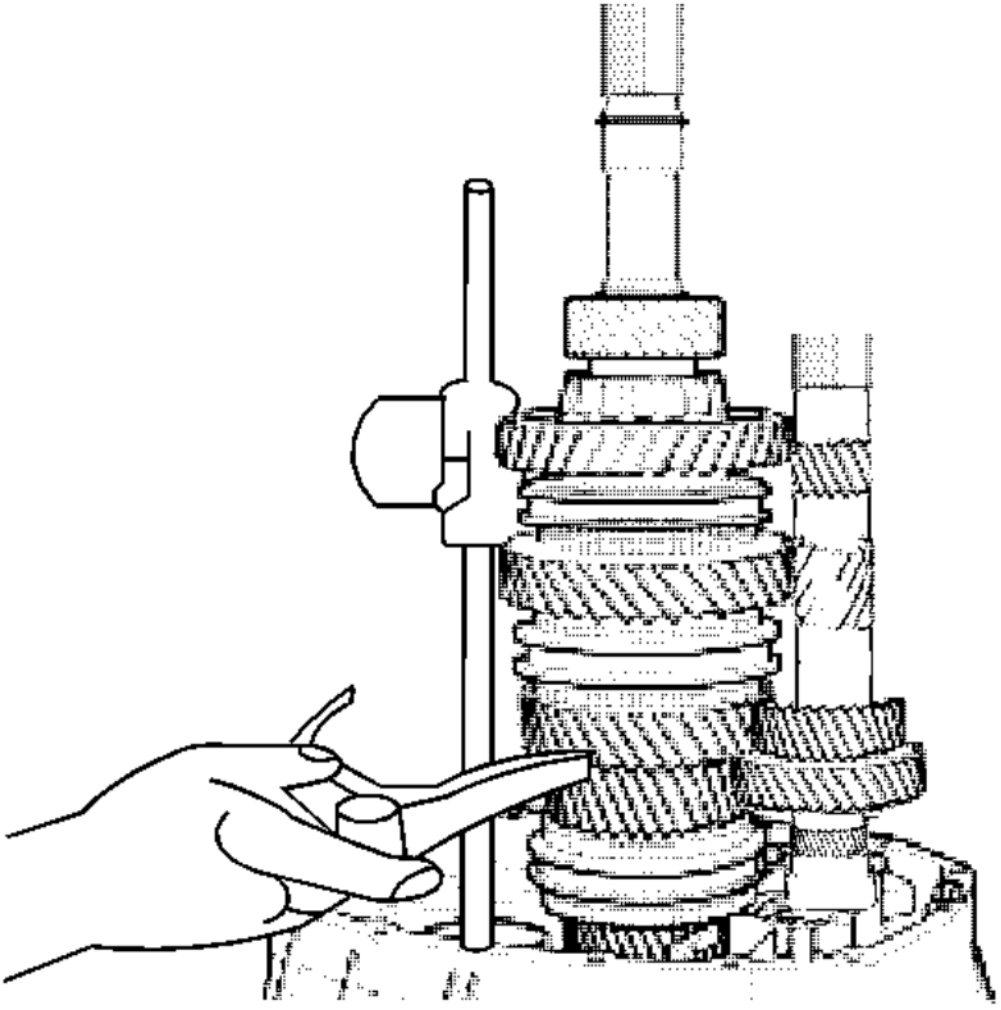


Fig. 100: 3rd And 4th Fork
Courtesy of GENERAL MOTORS CORP.

11. Remove the 3rd and 4th fork.

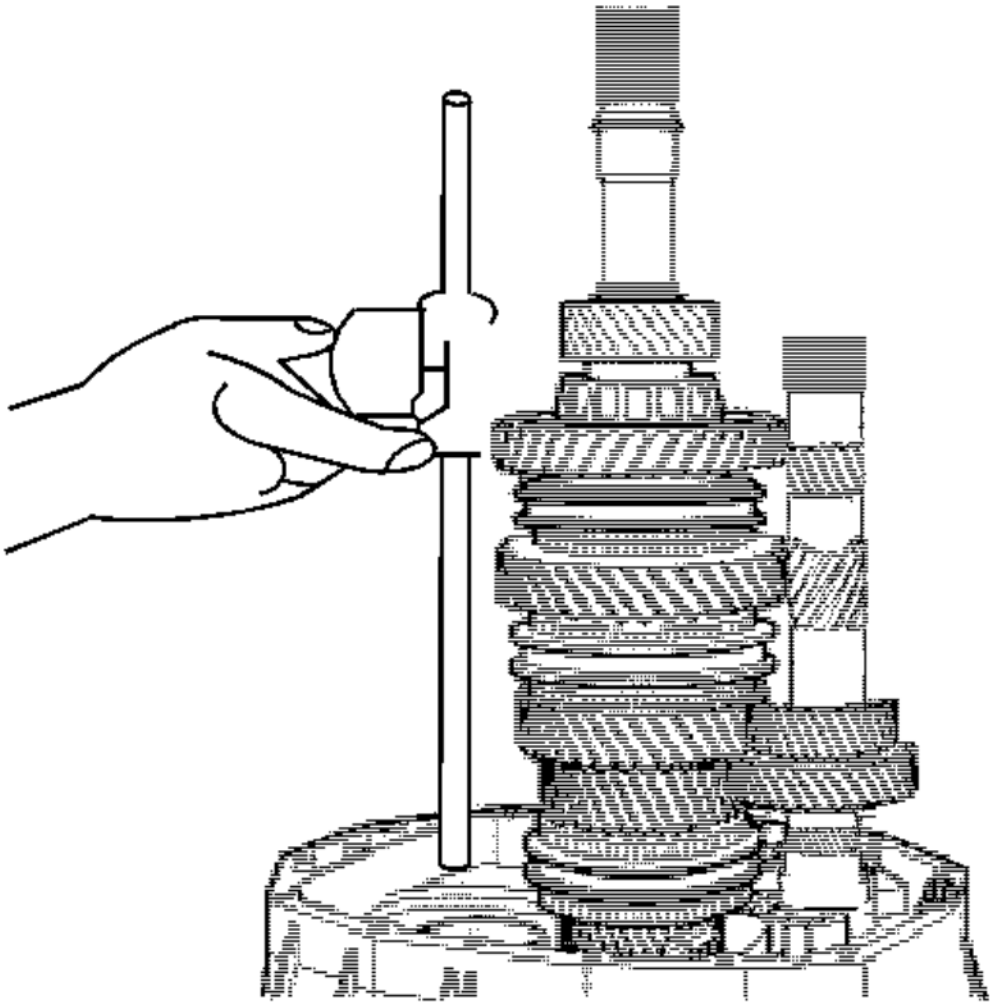


Fig. 101: Control Lever
Courtesy of GENERAL MOTORS CORP.

12. Remove the control lever.

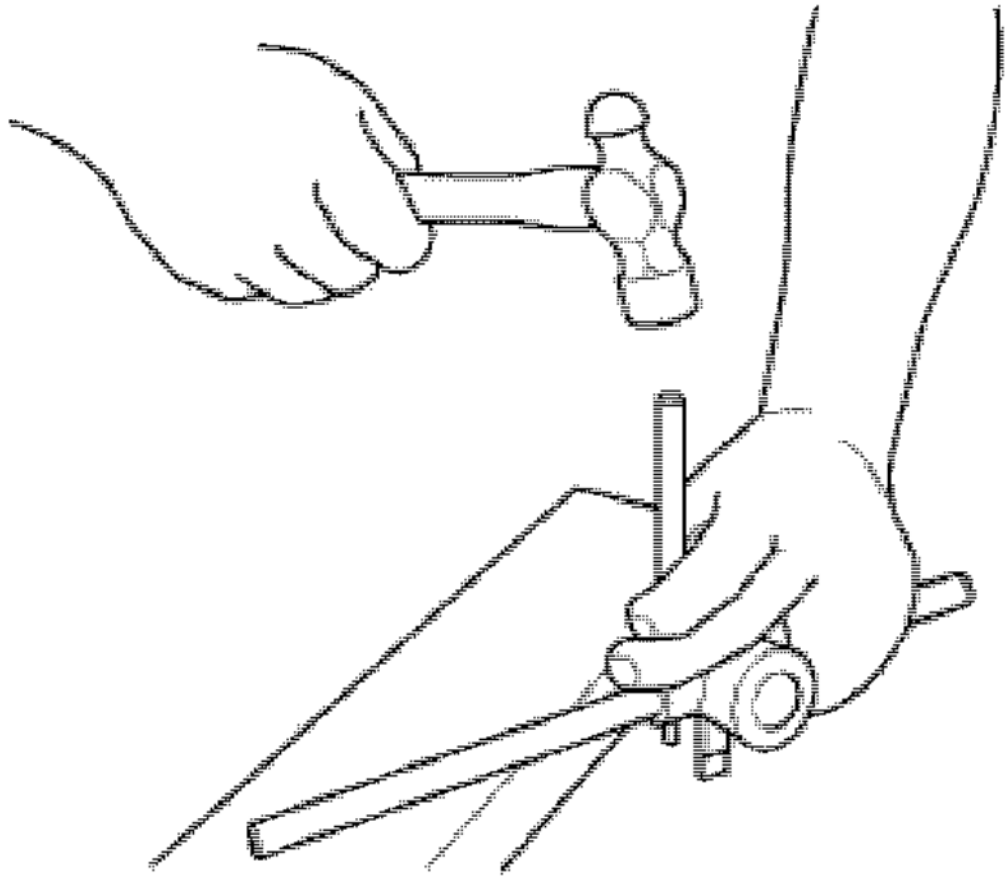


Fig. 102: Removing Speed Selector Stop Pin
Courtesy of GENERAL MOTORS CORP.

13. Remove the speed selector stop pin, if necessary.

TRANSMISSION FRONT CASE DISASSEMBLE

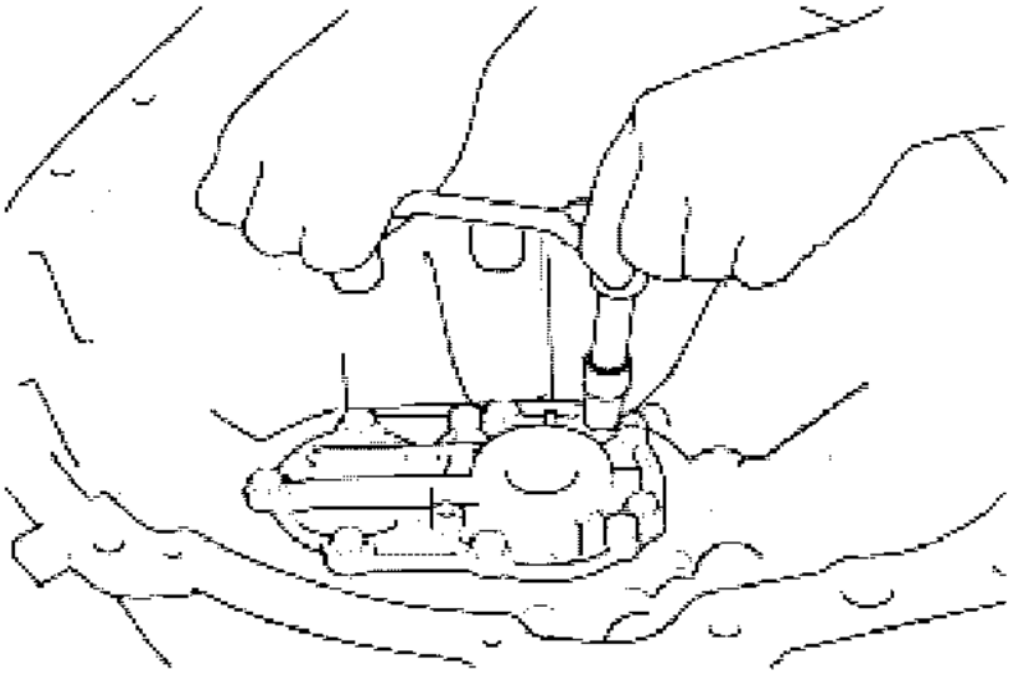


Fig. 103: Screws Securing Bearing Retainer
Courtesy of GENERAL MOTORS CORP.

1. Using a 13 mm wrench, remove the 7 screws from the bearing retainer.

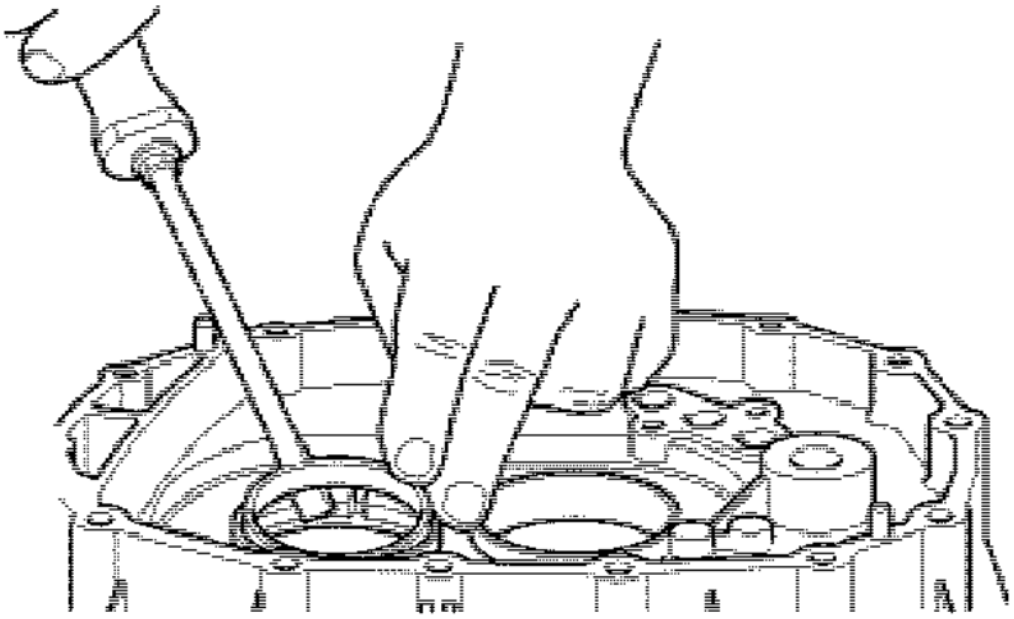


Fig. 104: Gear Train Cup
Courtesy of GENERAL MOTORS CORP.

2. Using a screwdriver, remove the gear train cup.

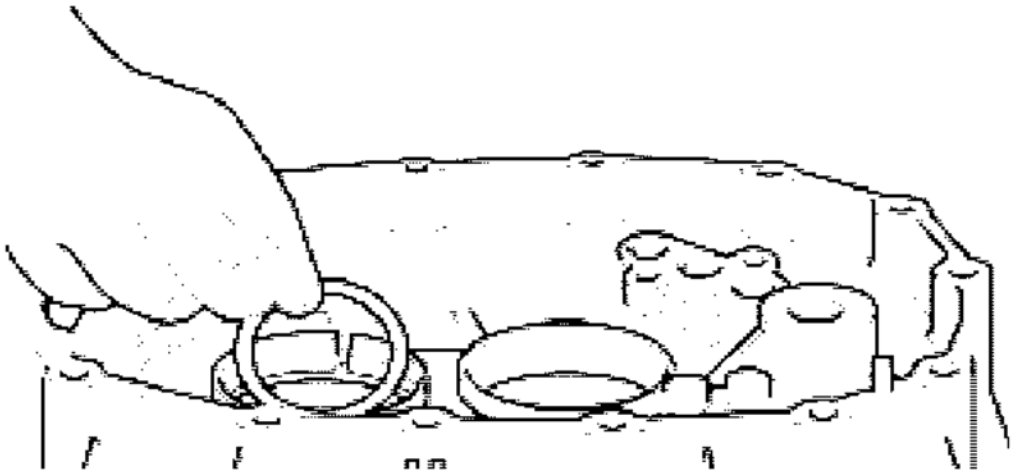


Fig. 105: Gear Train Adjustment Shims
Courtesy of GENERAL MOTORS CORP.

3. Remove the gear train adjustment shims.

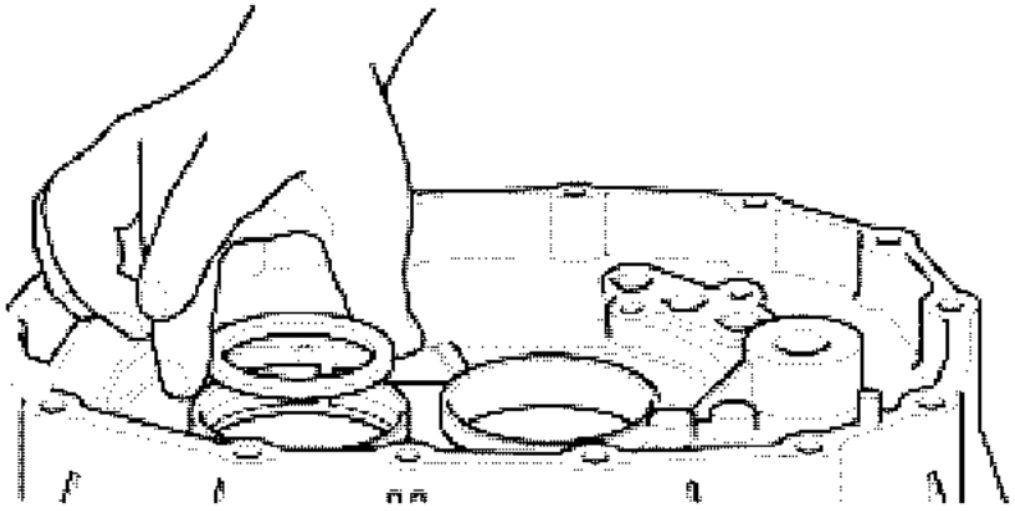


Fig. 106: Gear Train Spacer
Courtesy of GENERAL MOTORS CORP.

4. Remove the gear train spacer.

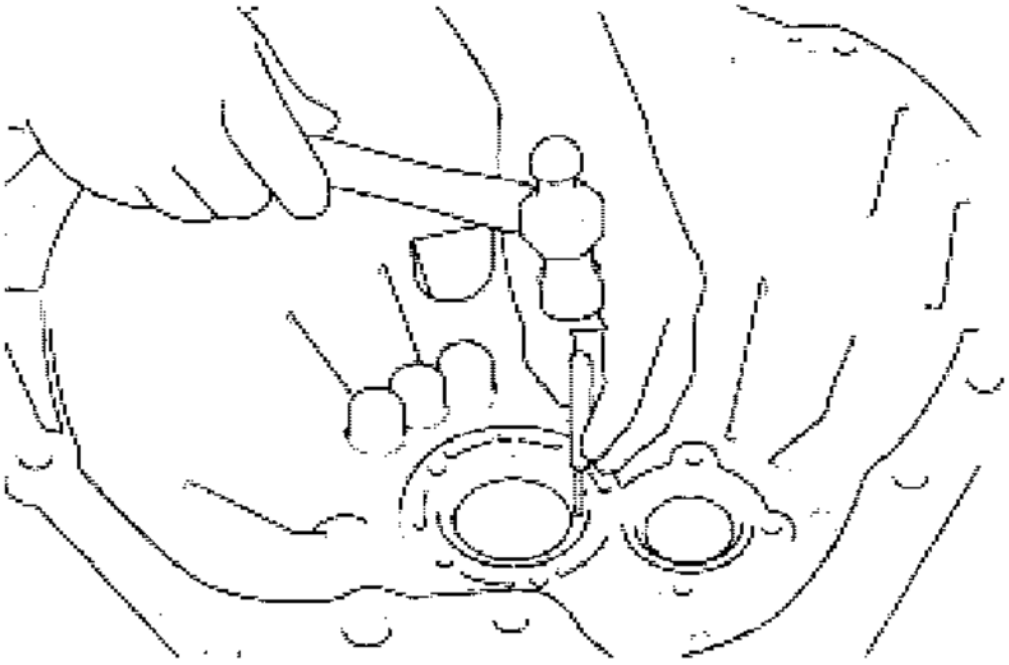


Fig. 107: Removing Drive Shaft Cup
Courtesy of GENERAL MOTORS CORP.

5. Using a punch and a hammer, remove the drive shaft cup.

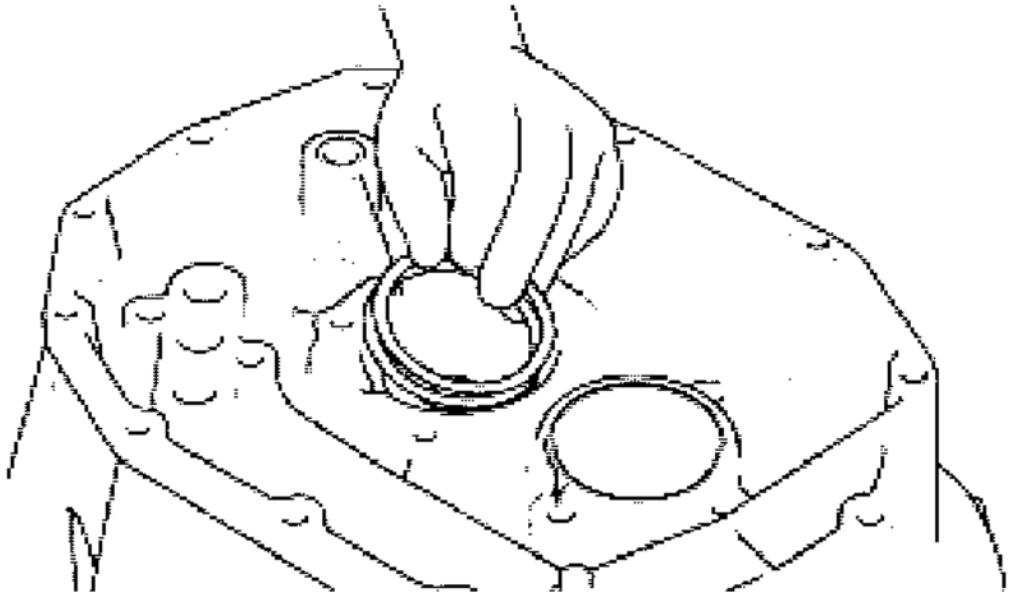


Fig. 108: Drive Shaft Adjusting Shims
Courtesy of GENERAL MOTORS CORP.

6. Remove the drive shaft adjusting shims.

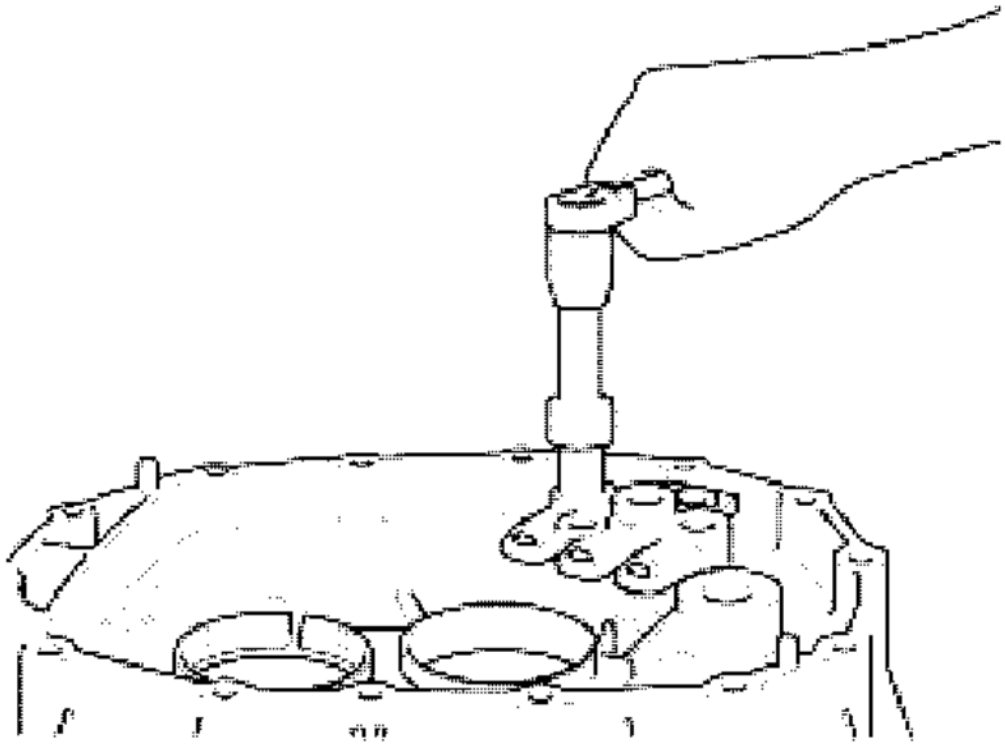


Fig. 109: Screws Securing Anchor Support Assembly
Courtesy of GENERAL MOTORS CORP.

7. Using a 10 mm wrench, remove the 2 screws from the anchor support assembly.

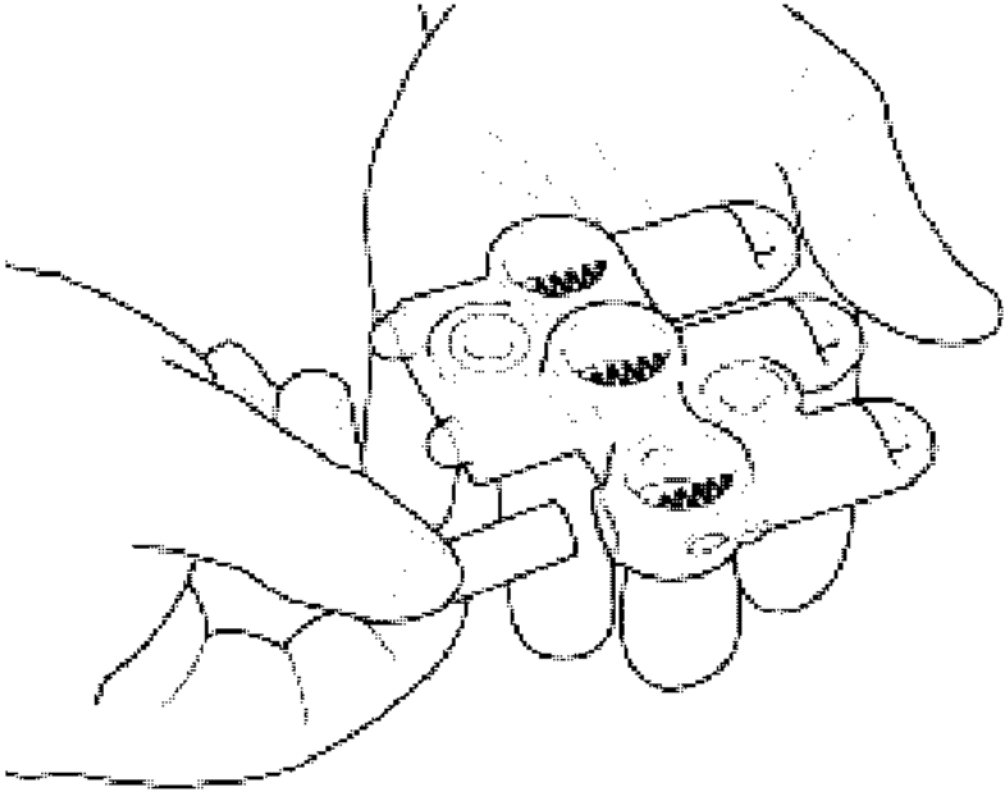


Fig. 110: Anchor Bushings, Springs, Pistons And Anchor Bolt
Courtesy of GENERAL MOTORS CORP.

8. Remove 3 anchor bushings and 3 springs, 2 pistons and anchor bolt.

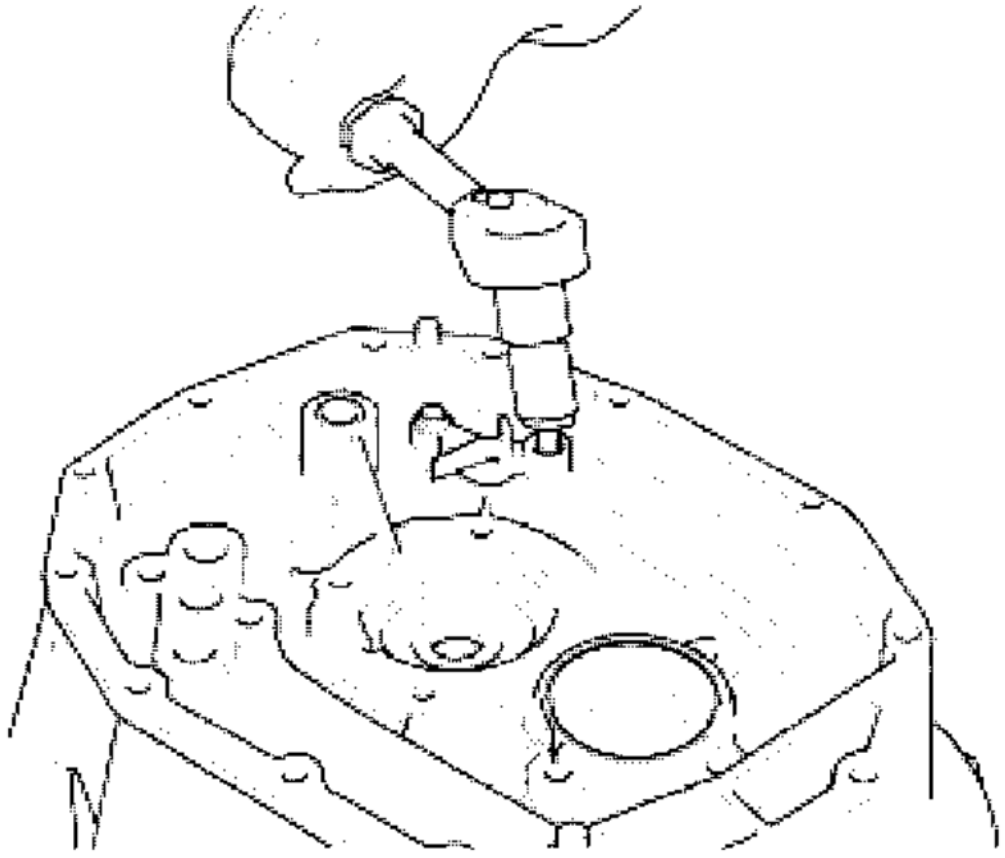


Fig. 111: Screws Securing Oil Baffle
Courtesy of GENERAL MOTORS CORP.

9. Using a 13 mm wrench, remove 2 screws from the oil baffle.

TRANSMISSION REAR CASE DISASSEMBLE

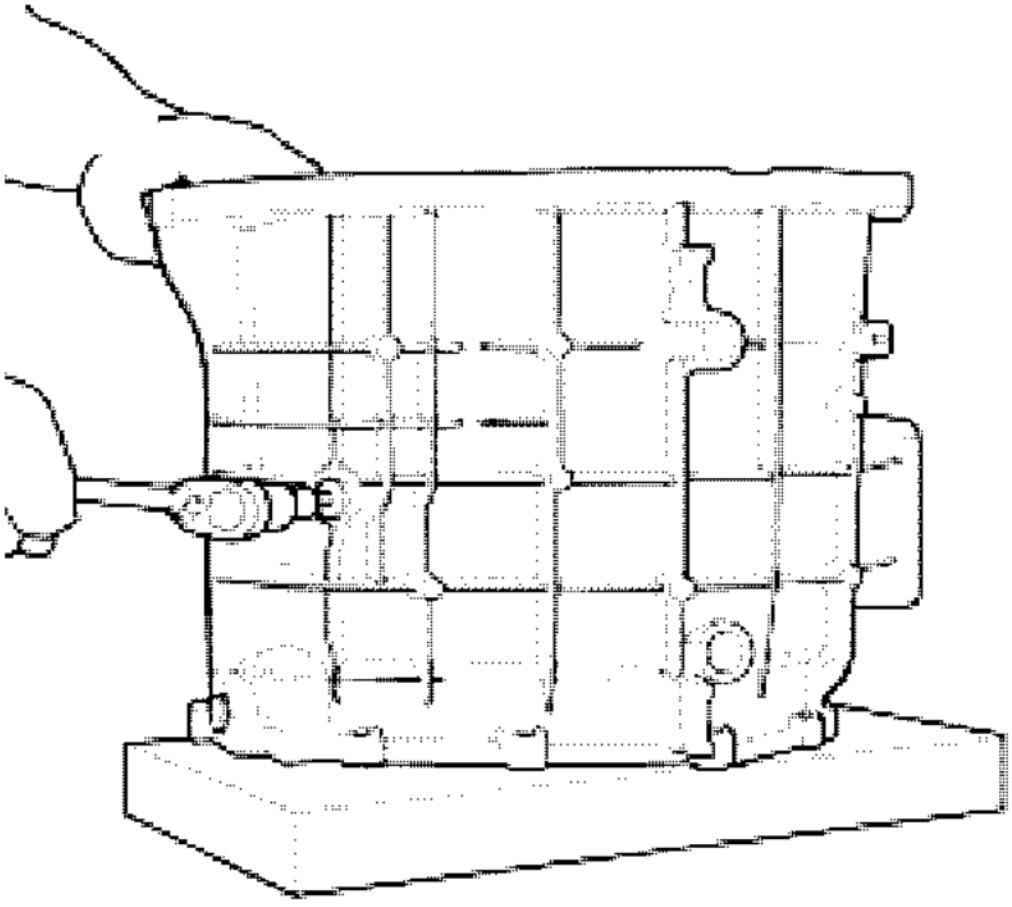


Fig. 112: Reverse Gear Support Screw
Courtesy of GENERAL MOTORS CORP.

1. Using a GMM Allen wrench, remove the reverse gear support screw.

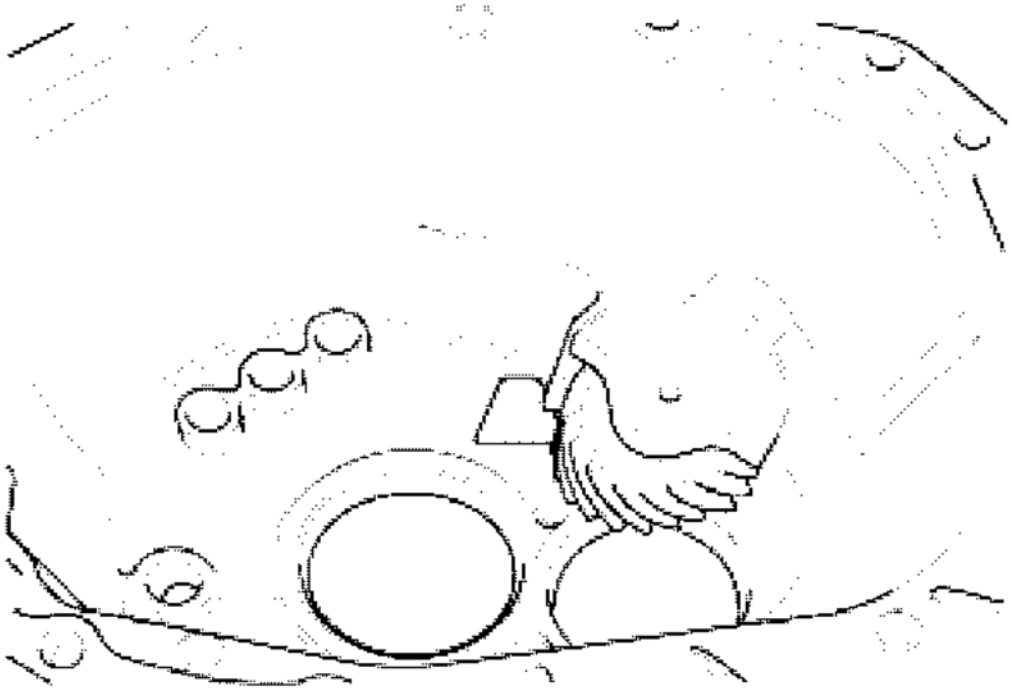


Fig. 113: Reverse Shaft Support
Courtesy of GENERAL MOTORS CORP.

2. Remove the reverse shaft support.

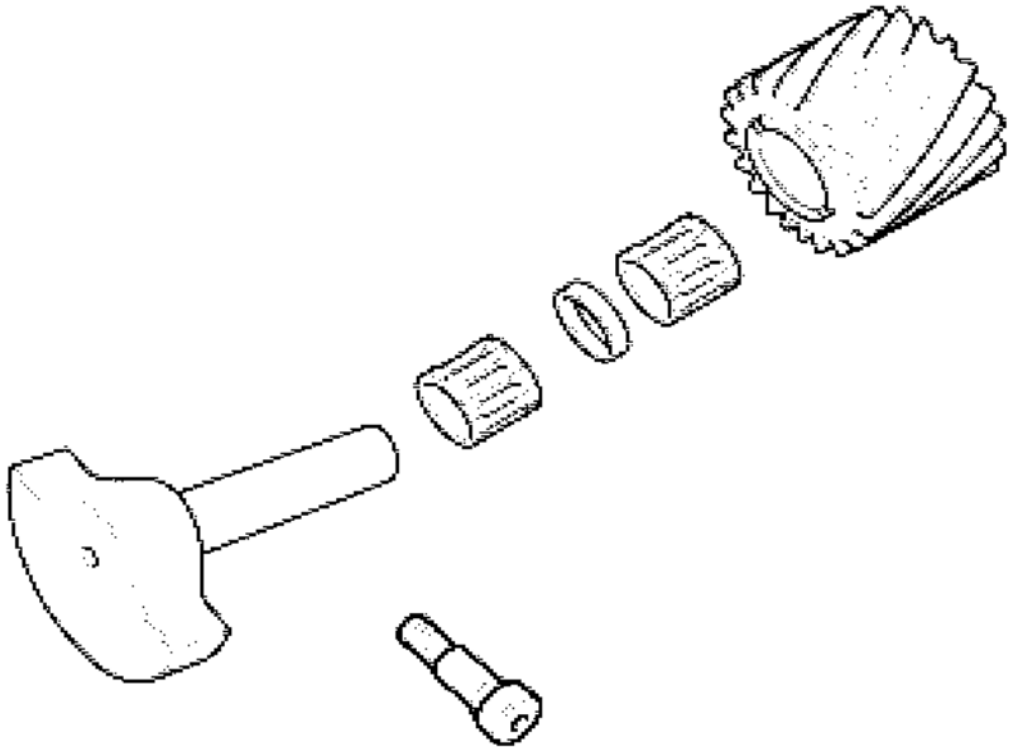


Fig. 114: Reverse Gear, Roller Cages And Spacer
Courtesy of GENERAL MOTORS CORP.

3. Remove the reverse gear, 2 roller cages, and spacer.

GEARS AND SHAFTS CLEANING AND INSPECTION

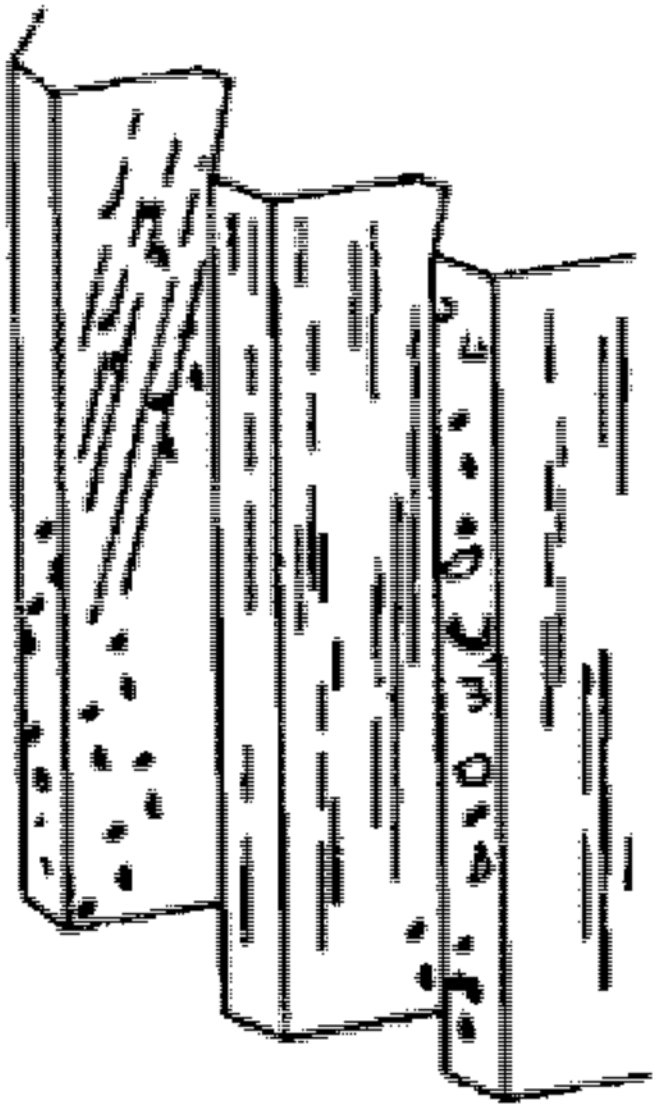


Fig. 115: Inspect Gears For Break-In-Wear - Running-In-Wear
Courtesy of GENERAL MOTORS CORP.

1. Clean all the components in a suitable solvent and air dry.
2. Inspect the gears for break-in-wear - running-in-wear.

Break-in-wear is not considered to be damage because it usually ceases after the running-in-

period has expired, without damaging the components. Rough peaks produced during manufacture are worn away or, to some extent, are rolled into the surface. The surface structure, grinding and shaving marks, are still visible.

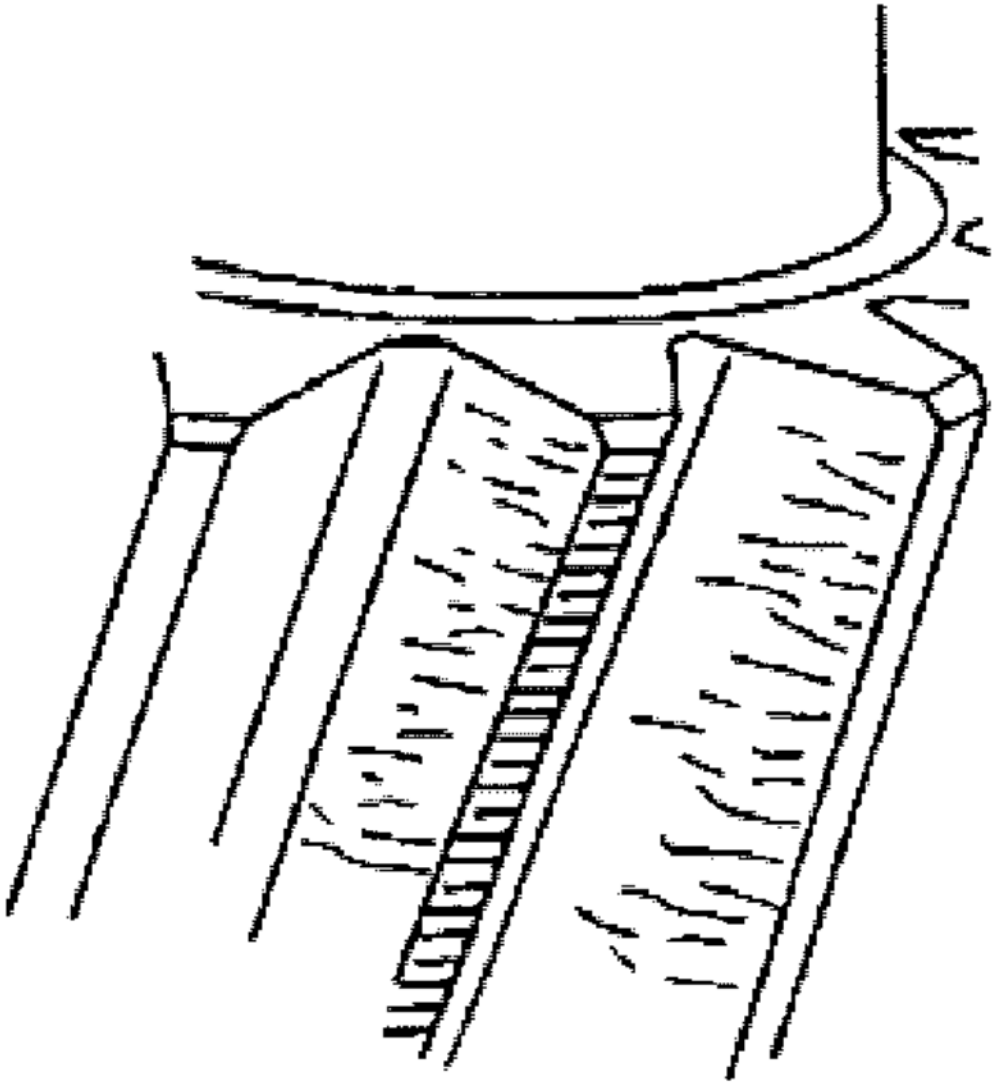


Fig. 116: Inspect Gear Teeth For Scratches
Courtesy of GENERAL MOTORS CORP.

3. Inspect the gear teeth for scratches.

Scratches are linear indentations on the flank, running in the direction of sliding.

4. If scratches are present, replace the affected components.

   Scratches can be caused by the following conditions:

   - Dust and abrasive particles, including those caused by flank contact, in the lubricating oil
   - The sliding action of the flanks

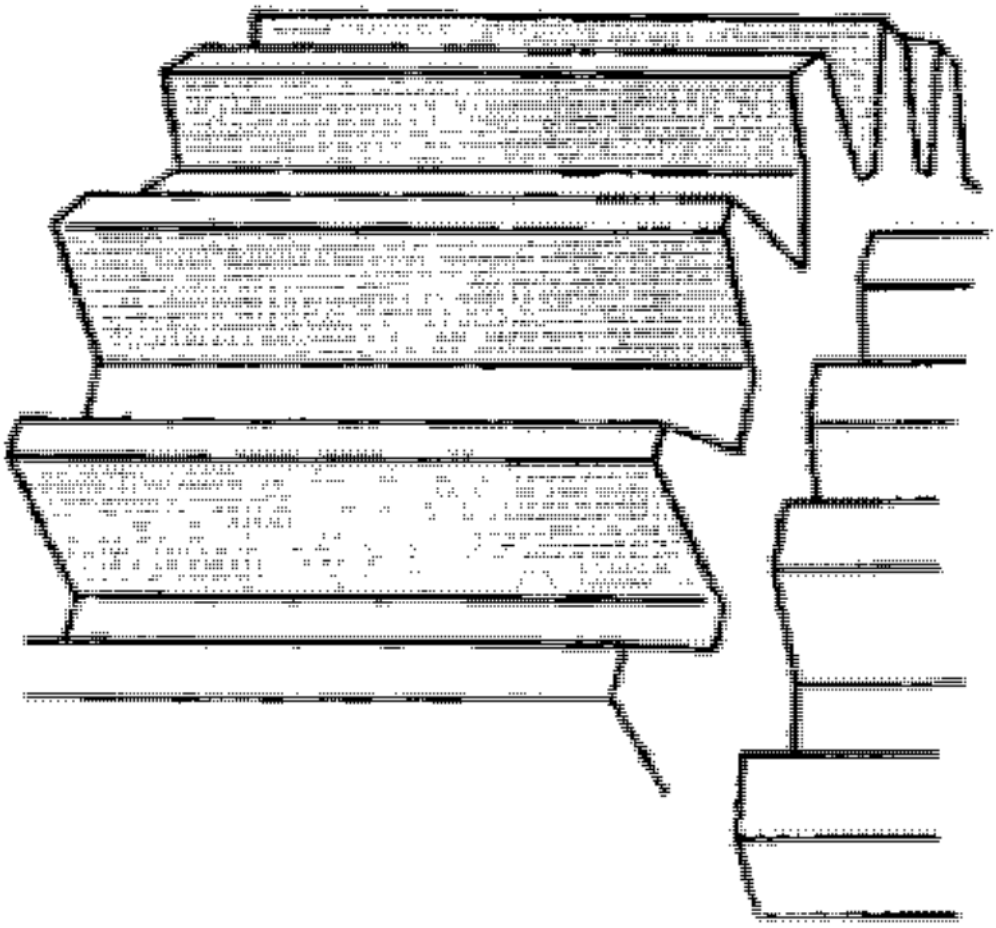


Fig. 117: Inspect Gear Teeth For Abrasive Wear
Courtesy of GENERAL MOTORS CORP.

5. Inspect the gear teeth for abrasive wear.

   The marks left by the machining process are erased from the active flank. Instead, the entire flank takes on a matte gray appearance. Substantial changes take place in the tooth profile and clearance once abrasive wear has reached an advanced stage. This not only increases the noise level, but can cause secondary damage.

6. If abrasive wear is present, replace the affected components.

   Abrasive wear is caused by the following conditions:

   - Oil contamination resulting from wear or surface fatigue in other areas of the transmission
   - Sand, sludge, etc. penetrating into the transmission from the outside

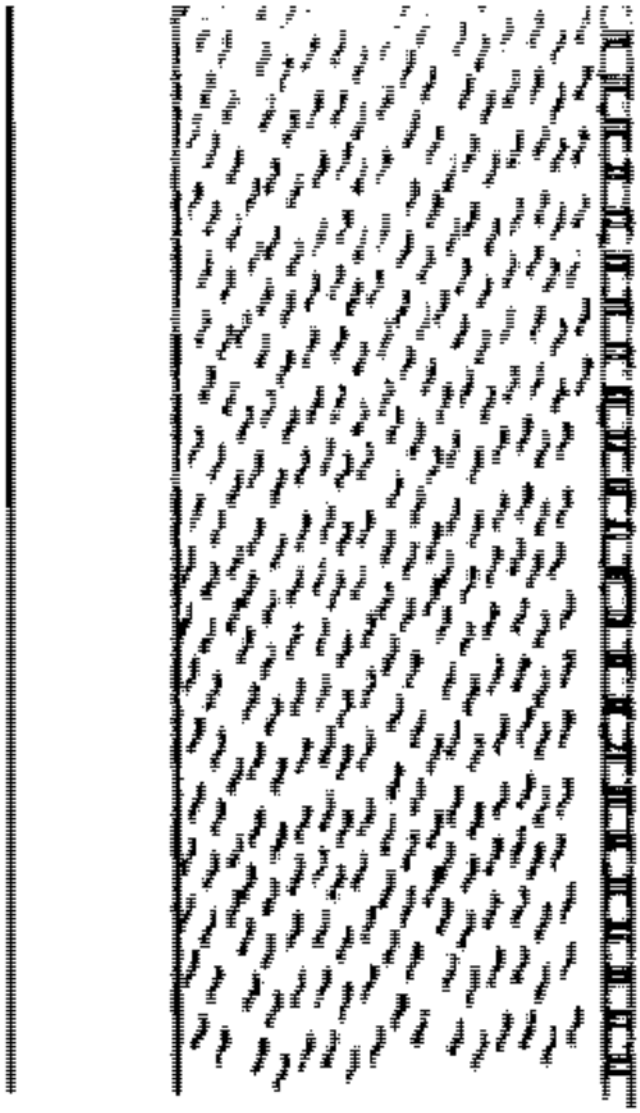


Fig. 118: Inspect Gear Teeth For Rippling Or Brinelling
Courtesy of GENERAL MOTORS CORP.

7. Inspect the gear teeth for rippling or brinelling.

   The polished tooth flanks show signs of ripple-like alterations in the surface structure which run perpendicular to the direction of sliding, resembling a washboard.

8. If rippling or brinelling is present, replace the affected components.

   Rippling or brinelling is caused by the following conditions:

   - A combination of inadequate lubrication, high flank loads, and low peripheral speeds
   - Friction-induced vibration

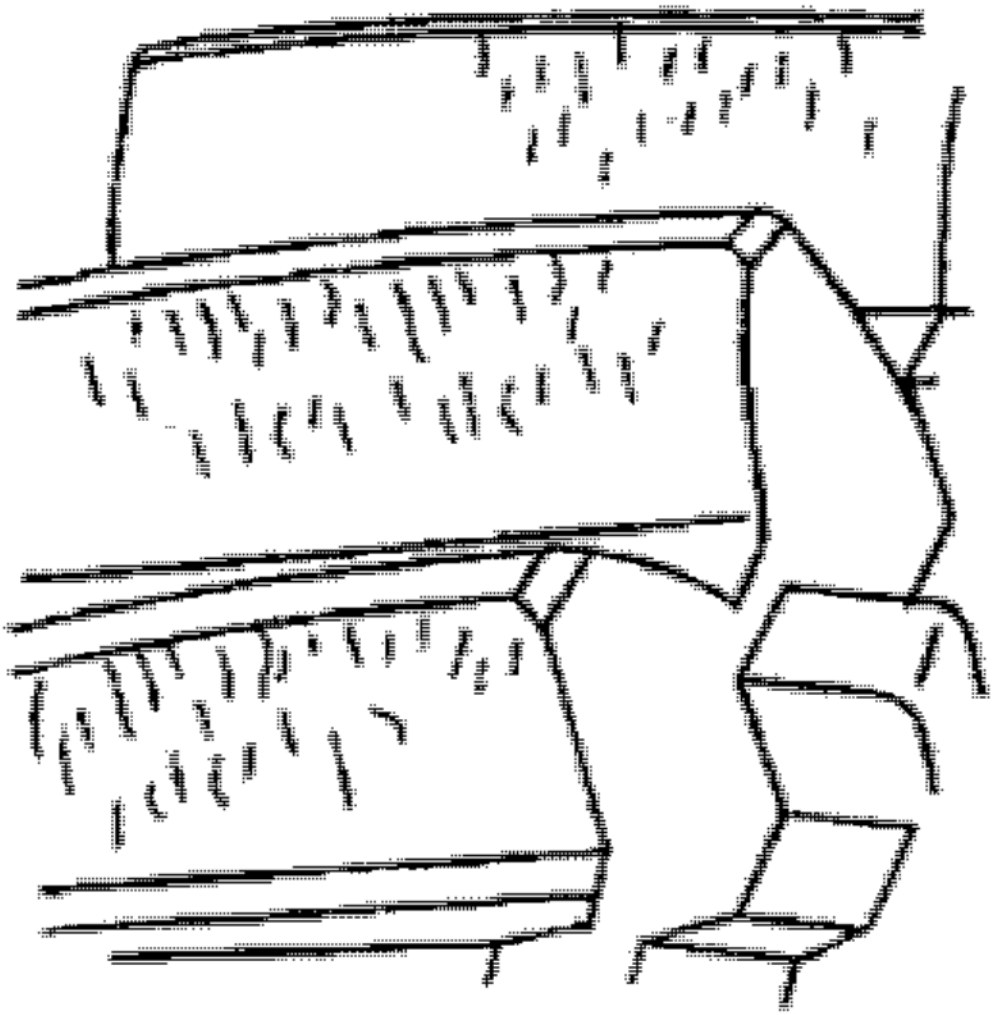


Fig. 119: Inspect Gear Teeth For Light Scoring - Rough Partially Porous Lines Or Areas Aligned In Direction Of Sliding

Courtesy of GENERAL MOTORS CORP.

9. Inspect the gear teeth for light scoring - rough partially porous lines or areas aligned in the direction of sliding.

   When the film of lubricant is torn away between the flanks, this permits direct metal-to-metal contact causing seizure or welding. These welded zones are immediately torn apart again, producing the damage associated with scoring. Scoring initially occurs in areas subjected to high hertz frequency stresses and high sliding speeds usually along the tooth root and tooth tip. Light scoring only covers part of the entire surface of the flank, or is not strongly developed and has caused only insignificant wear after smoothing.

10. If light scoring is present, replace the affected components.

    Light scoring is caused by the following conditions:

    - Inadequate oil viscosity
    - Unfavorable gear geometry
    - Temporary lack of lubricant
    - Surface roughness
    - Faulty heat treatment of the gears

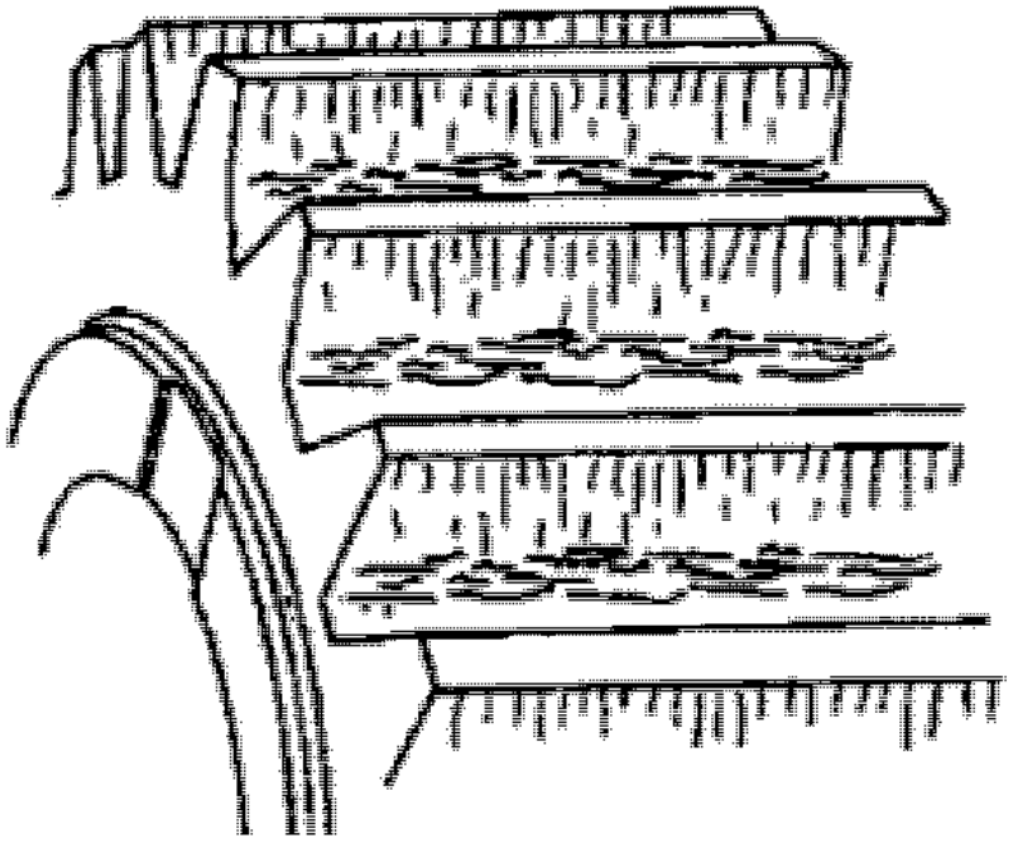


Fig. 120: Inspect Gear Teeth For Severe Scoring
Courtesy of GENERAL MOTORS CORP.

11. Inspect the gear teeth for severe scoring.

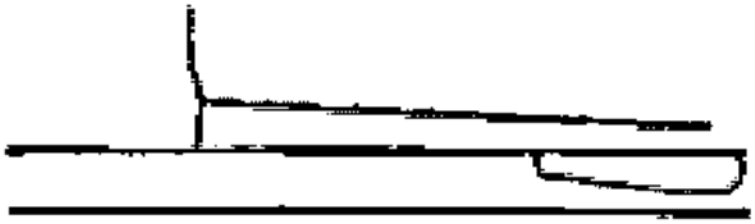
    Severe scoring is the same as light scoring except large areas of the tooth flank are affected. At an advanced stage, the flank may heat up to such an extent that localized discoloring occurs.

12. If severe scoring is present, replace the affected components.

    Severe scoring is caused by the following conditions:

    - Inadequate oil viscosity

- Unfavorable gear geometry
- Temporary lack of lubricant
- Surface roughness
- Faulty heat treatment of the gears





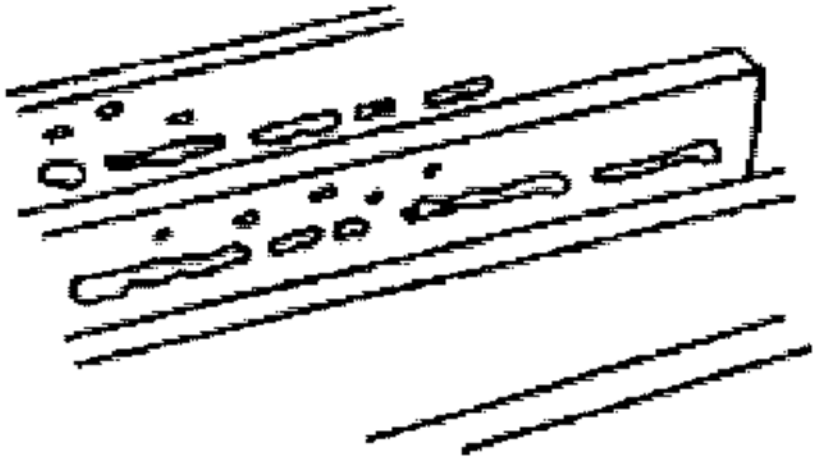


Fig. 121: Inspect Gears For Flank Fatigue Causing Gray Spots
Courtesy of GENERAL MOTORS CORP.

13. Inspect the gears for flank fatigue causing gray spots.

    Gray spots are localized pittings on the flank caused by material fatigue or extremely fine pittings formed on the load-bearing flanks. If they are in a cluster, they appear to the naked eye as matte gray staining. Under high magnification, a large number of microscopic cracks become visible on the flank. Pittings originating from these cracks may create the appearance of local flank wear. Most of the gray spots are located in the root zone of the gear teeth.

14. If gray spots are present, replace the affected components.

    Gray spots are caused by the following conditions:

    - Material fatigue
    - Contact pressure
    - Sliding movement
    - Composite friction

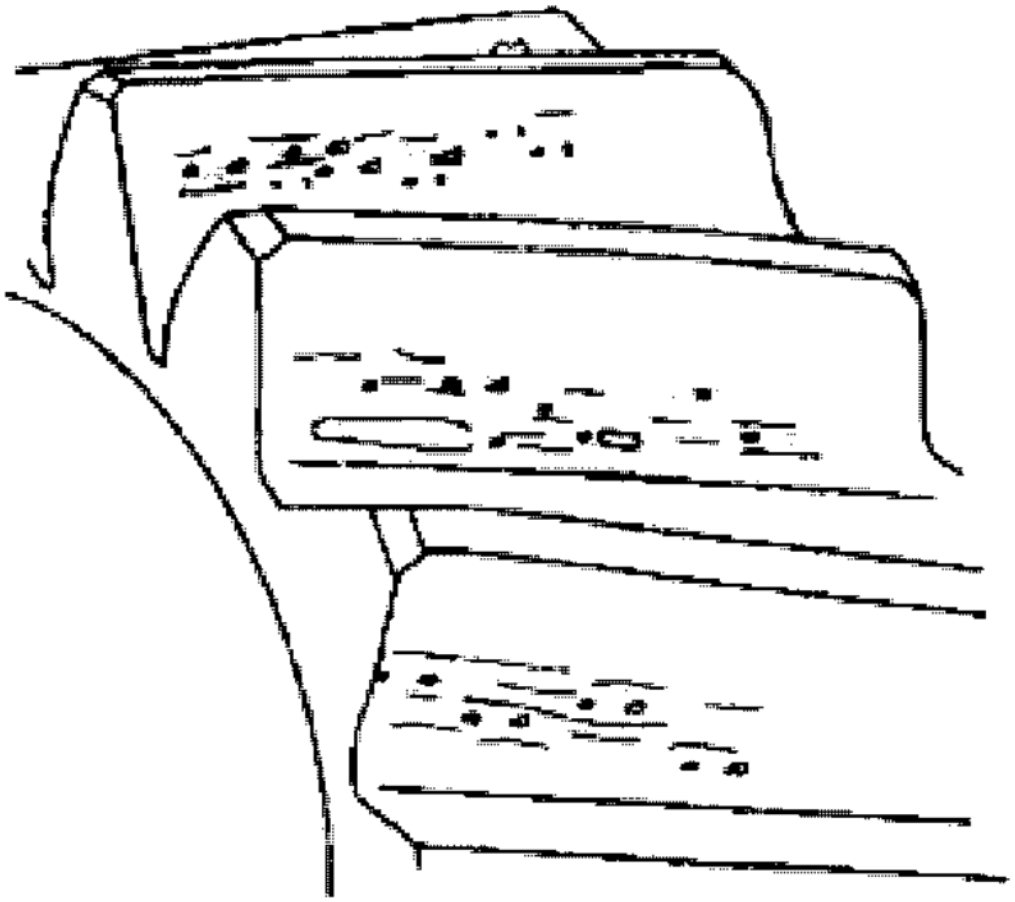


Fig. 122: Inspect Gear Teeth For Slight Pittings
Courtesy of GENERAL MOTORS CORP.

15. Inspect the gear teeth for slight pittings.

    Slight pittings or pore-like areas of individual pittings on the flank caused by material fatigue. Usually slight pittings are only present in the root zone of the flank. Slight pittings may cease after the run-in. A change in operating conditions may also stop continued development of slight pitting.

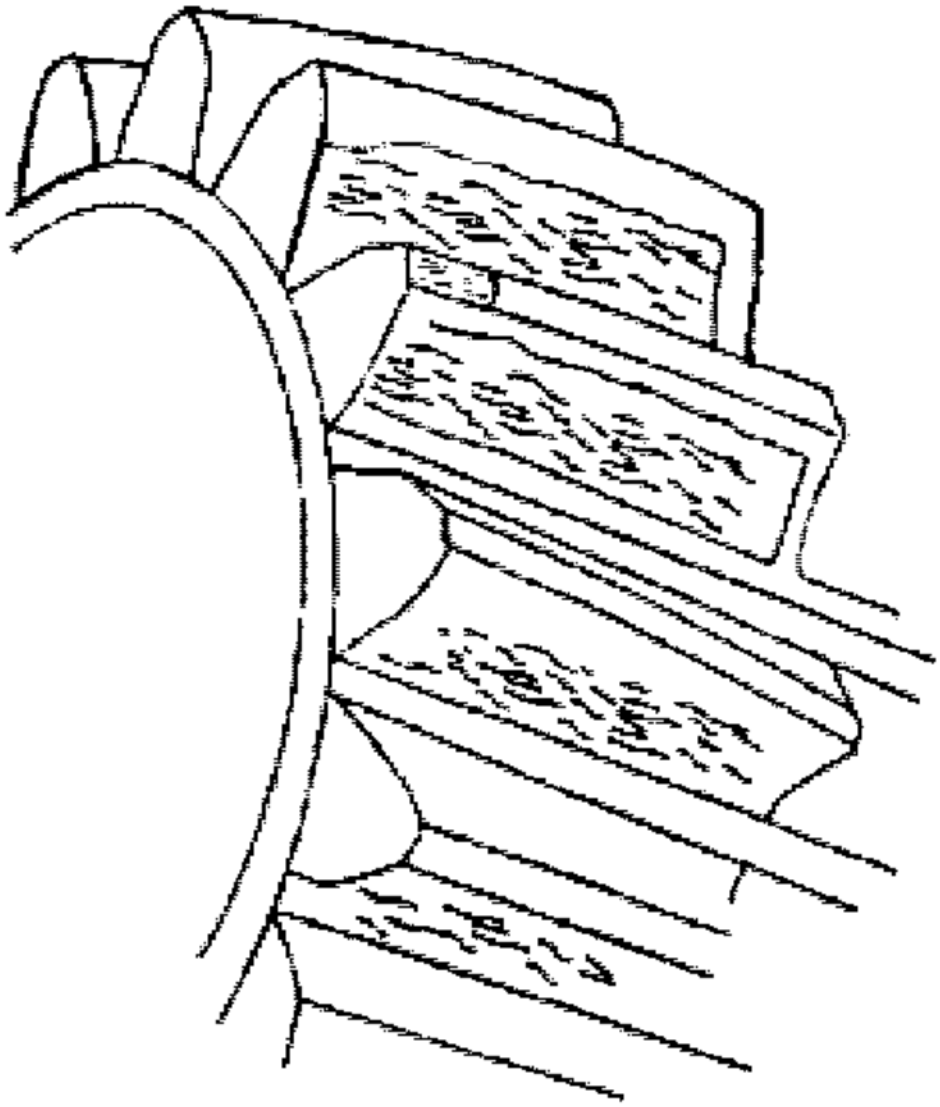


Fig. 123: Inspect Gear Teeth For Pittings
Courtesy of GENERAL MOTORS CORP.

16. Inspect the gear teeth for pittings.

    Pittings are material fatigue on the flank. The total pitting surface may become so large that smooth running is considerably impaired or the remaining flank face, still bearing the load,

will soon be destroyed by wear.

17. If pittings are present, replace the affected components.

    Pitting is caused by the following conditions:

    - Exceeding the sliding and rolling stresses for the material
    - Incorrect oil viscosity
    - Excessive operating temperature

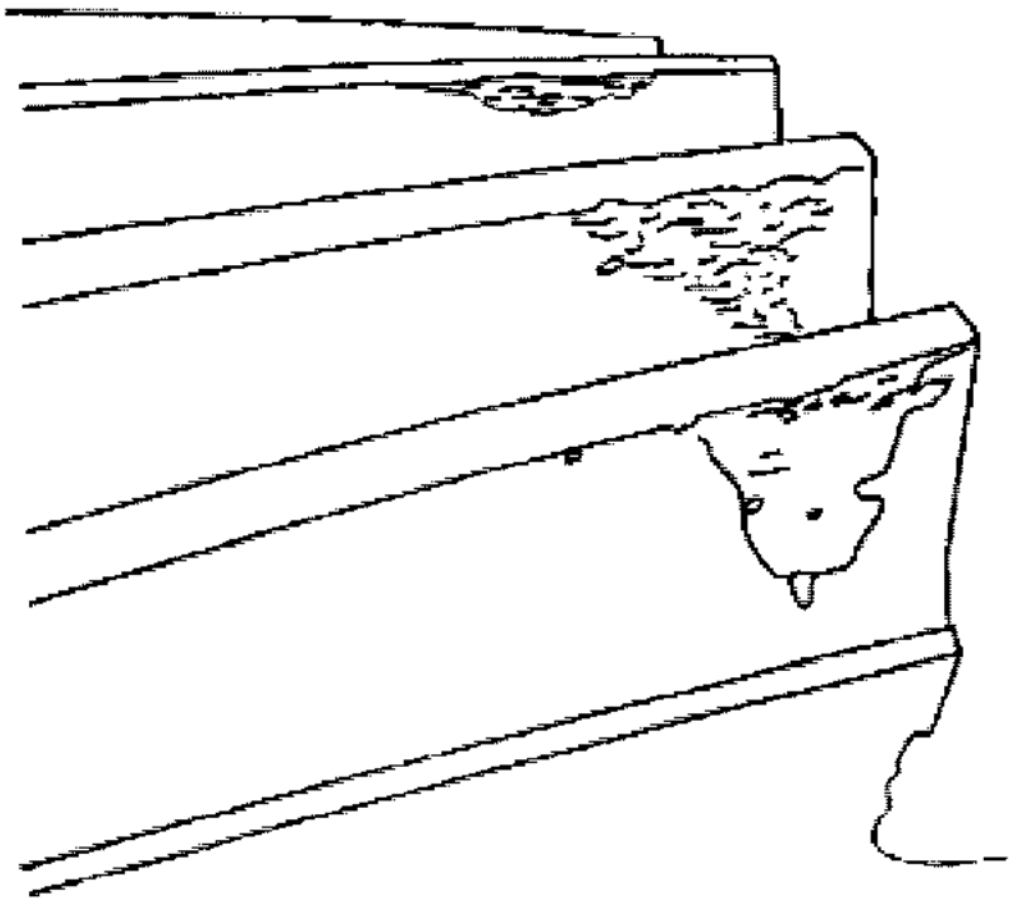


Fig. 124: Inspect Gears For Spalling
Courtesy of GENERAL MOTORS CORP.

18. Inspect the gears for spalling.

    Spalling is extensive triangular pits on the flank, spreading from a zone of gray spots or a fine line of pits at the root. The depth of the exposed surface is relatively constant throughout. Further cracks may extend from the pits at an angle. In some cases, the damage may even progress into the tip zone, causing tip damage.

19. If spalling is present, replace the affected components.

    Spalling is caused by the following conditions:

    - Exceeding the sliding and rolling stresses for the material
    - Incorrect oil viscosity
    - Excessive operating temperature

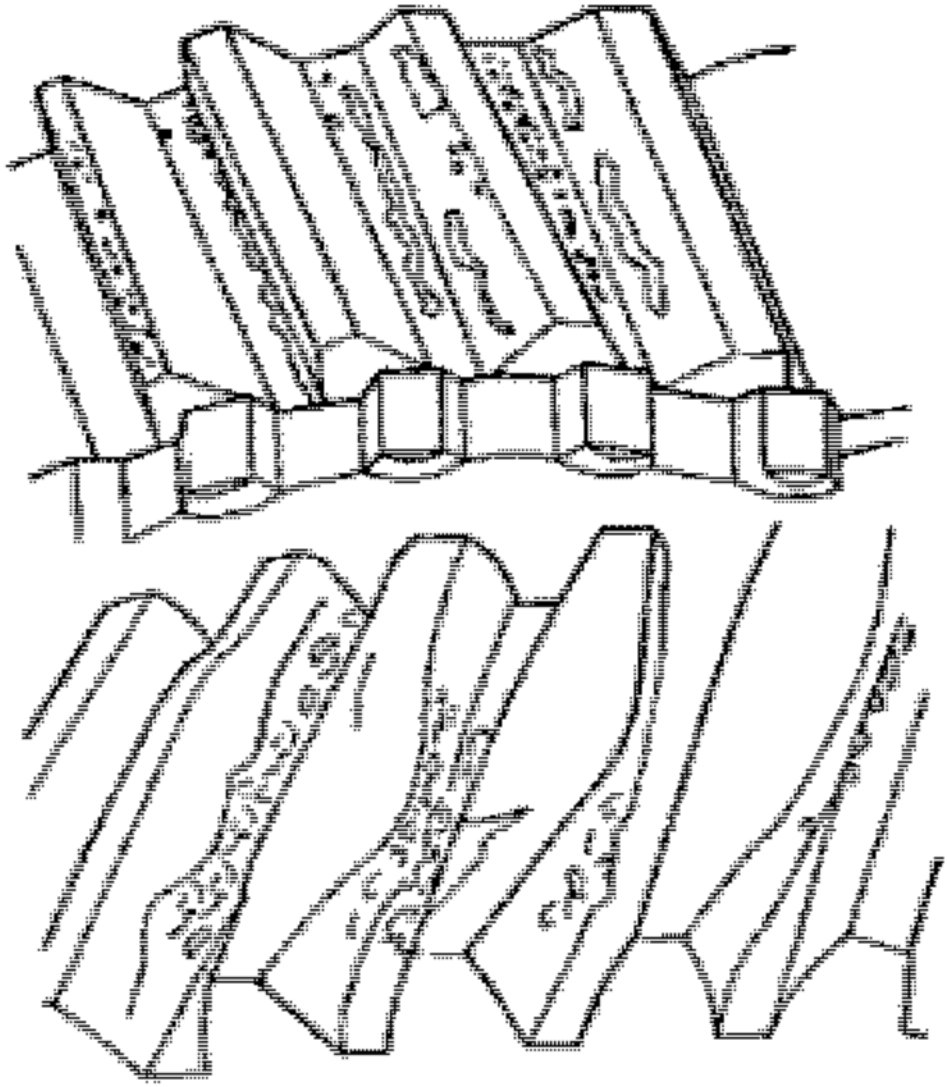


Fig. 125: Inspect Gears For Overheating
Courtesy of GENERAL MOTORS CORP.

20. Inspect the gears for overheating.

    Grayish to bluish black discoloration of the gear, burnt oil, and reduced hardness is caused by overheating. Due to the reduction in hardness, there is scored or grooved flank wear in

the direction of sliding, particularly in the tip and root zones. If there is extreme overheating, the material softens, causing distortion of the gear teeth such as, bent teeth - thermal deformation.

21. If damage from overheating is present, replace or repair the affected components.

    Overheating is caused by the following conditions:

    - Temporary or complete lack of lubrication - low oil level
    - Very high peripheral speeds
    - Insufficient tooth clearance

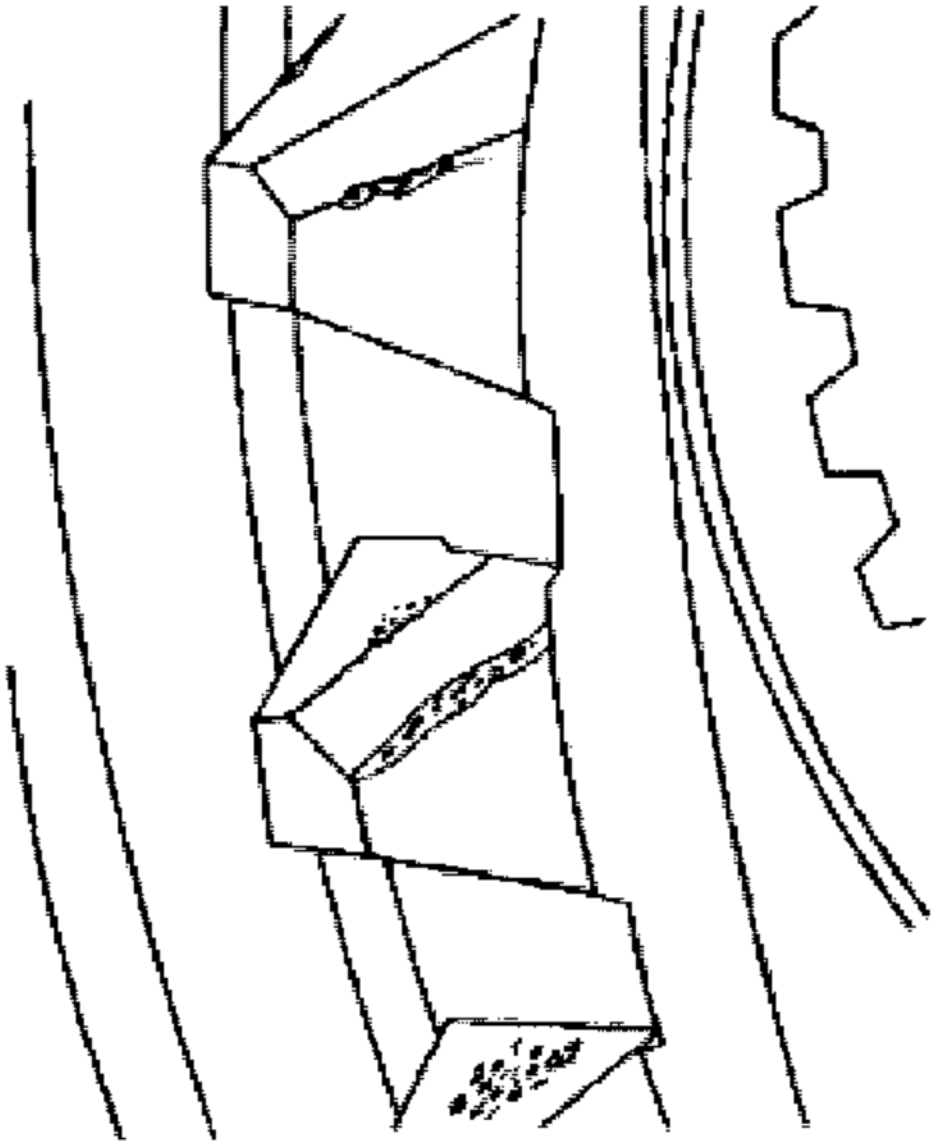


Fig. 126: Inspect Selector Teeth Of Gears For Gear Change Damage
Courtesy of GENERAL MOTORS CORP.

22. Inspect the selector teeth of the gears for gear change damage.

    The tooth edges are worn and chipped and, in some cases, affected by plastic deformation as

a result of high shift loads - ragged edges. Such severe deformation of the selector teeth edges will cause hard gear shift changes. The spline flanks may also show signs of wear resembling fretting corrosion.

23. If gear change damage is present, replace or repair the affected components.

    Gear change damage is caused by the following conditions:

    - Corresponding speeds of gears not adequately matched
    - Operating the transmission incorrectly
    - Incorrect clutch operation

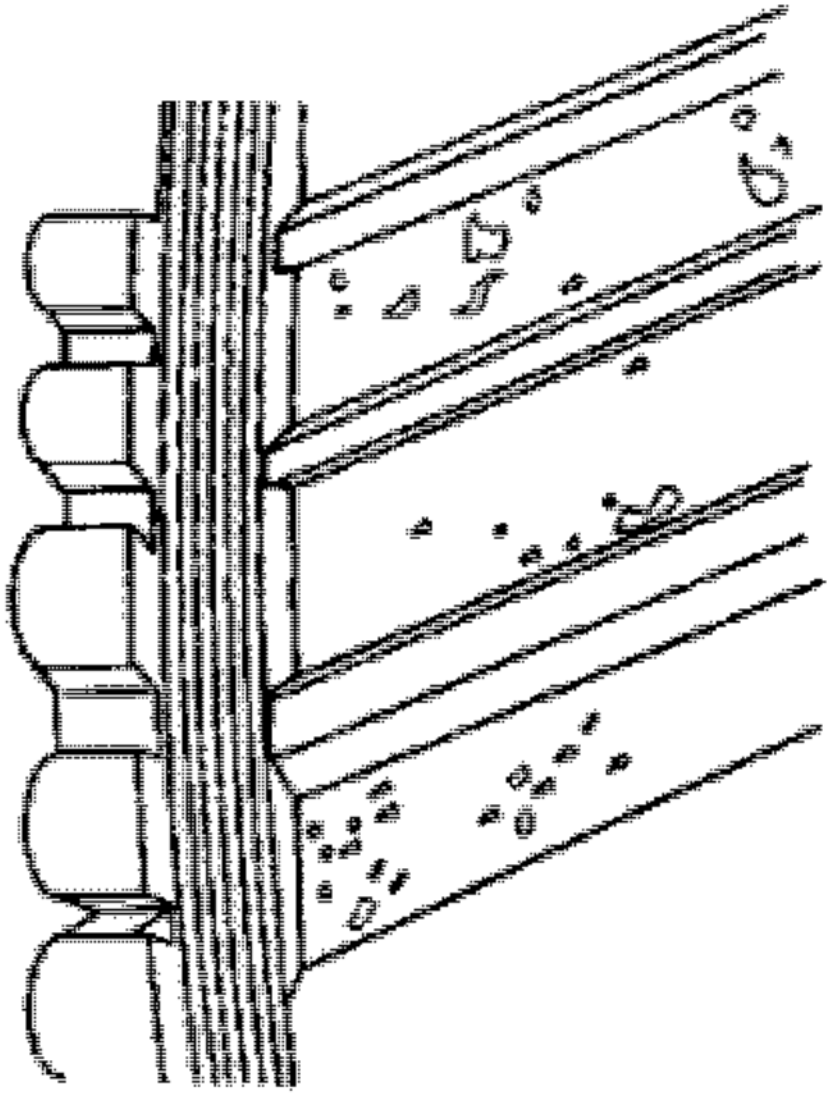


Fig. 127: Inspect Gears For Corrosion
Courtesy of GENERAL MOTORS CORP.

24. Inspect the gears for corrosion.

    Corrosion may appear as brownish red to black spots, sometimes with local material loss on the flank. If corrosion has not caused material loss to the flank, the sliding and rolling action

of the flank can help to remove some of the corrosion.

25. If corrosion is severe, replace the affected components.

    Corrosion is caused by the following conditions:

    - Water or slat water entering the transmission
    - Condensation forming under unfavorable operating conditions
    - Oil aging and the decomposition of corrosion inhibitors

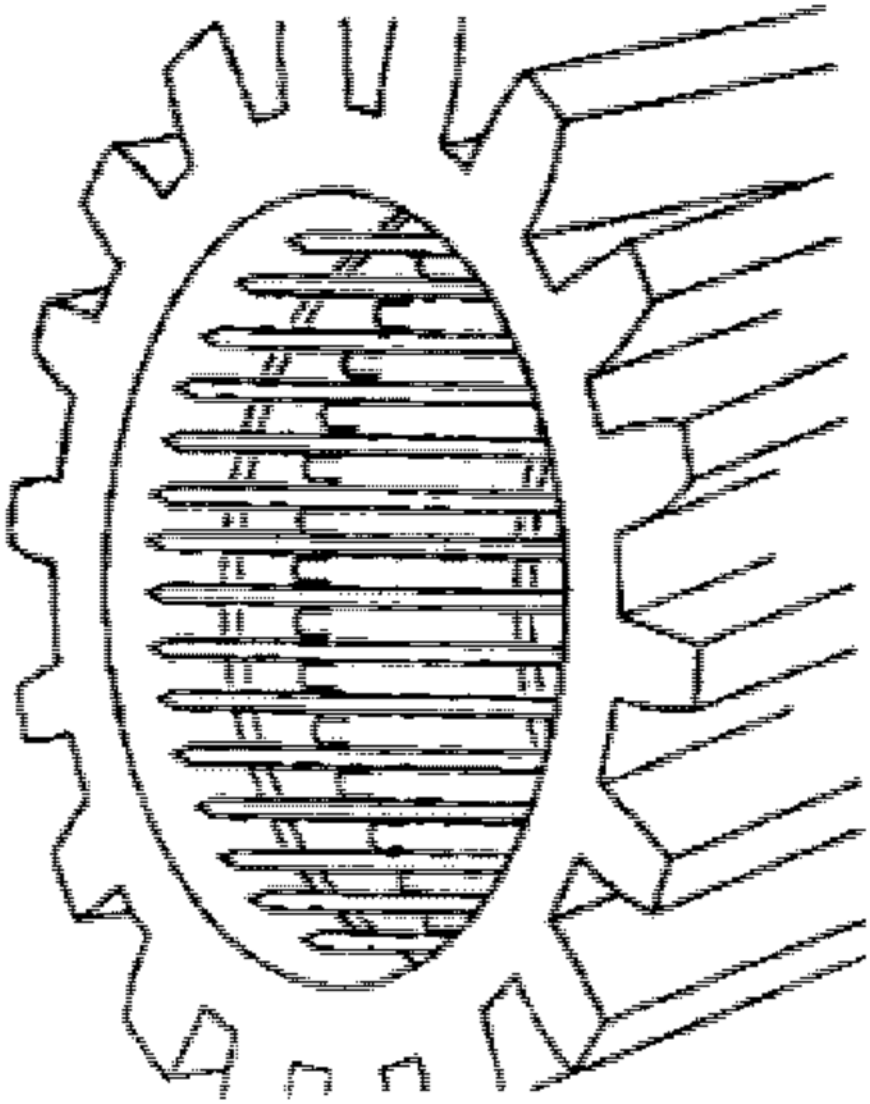


Fig. 128: Inspect Reverse Idler Gear For Brinelling
Courtesy of GENERAL MOTORS CORP.

26. Inspect the reverse idler gear for brinelling.

    This type of damage occurs on the roller races of the idler gear. This type of damage is characterized by what appears to be the impression of the bearing rollers. If the bearing only

performs a supporting function over a long period of time, there is not movement between the gear and the supporting shaft, and the bearing contact areas may show signs of fretting corrosion.

27. Replace any gears showing brinelling.

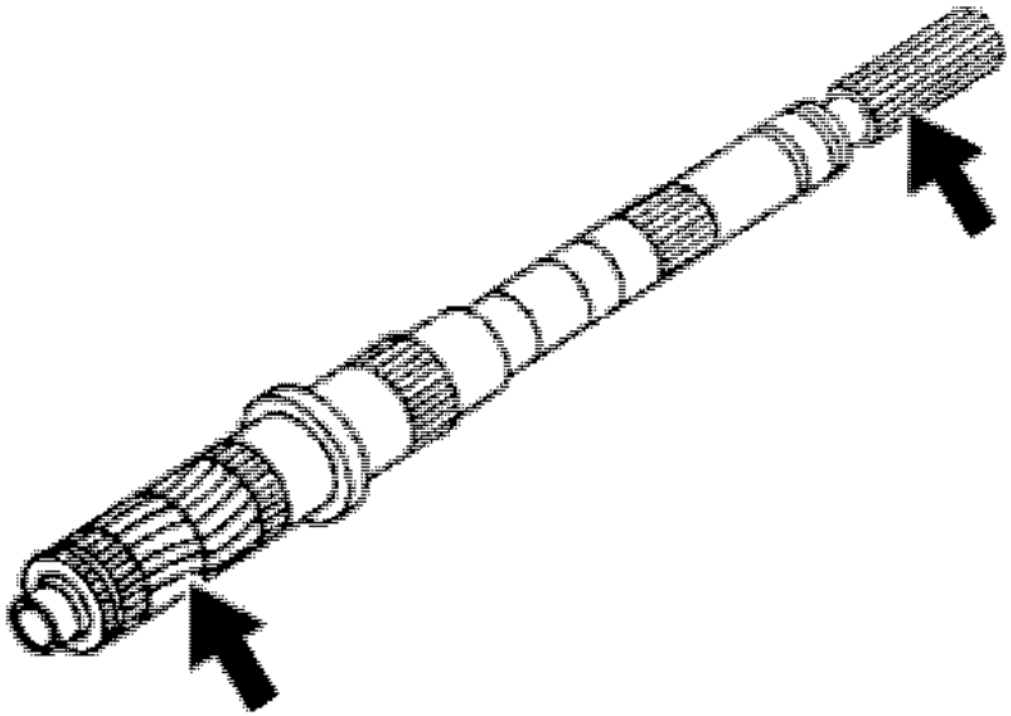


Fig. 129: Inspect Mainshaft Bearing Surfaces
Courtesy of GENERAL MOTORS CORP.

28. Inspect the mainshaft bearing surfaces for the following conditions:
    - Wear
    - Lack of lubricant
    - Debris embedded in the oil grooves
29. Inspect the main shaft splines for wear or damage.
30. Replace the main shaft if any of the above conditions are found.

BEARINGS AND SPACERS CLEANING AND INSPECTION

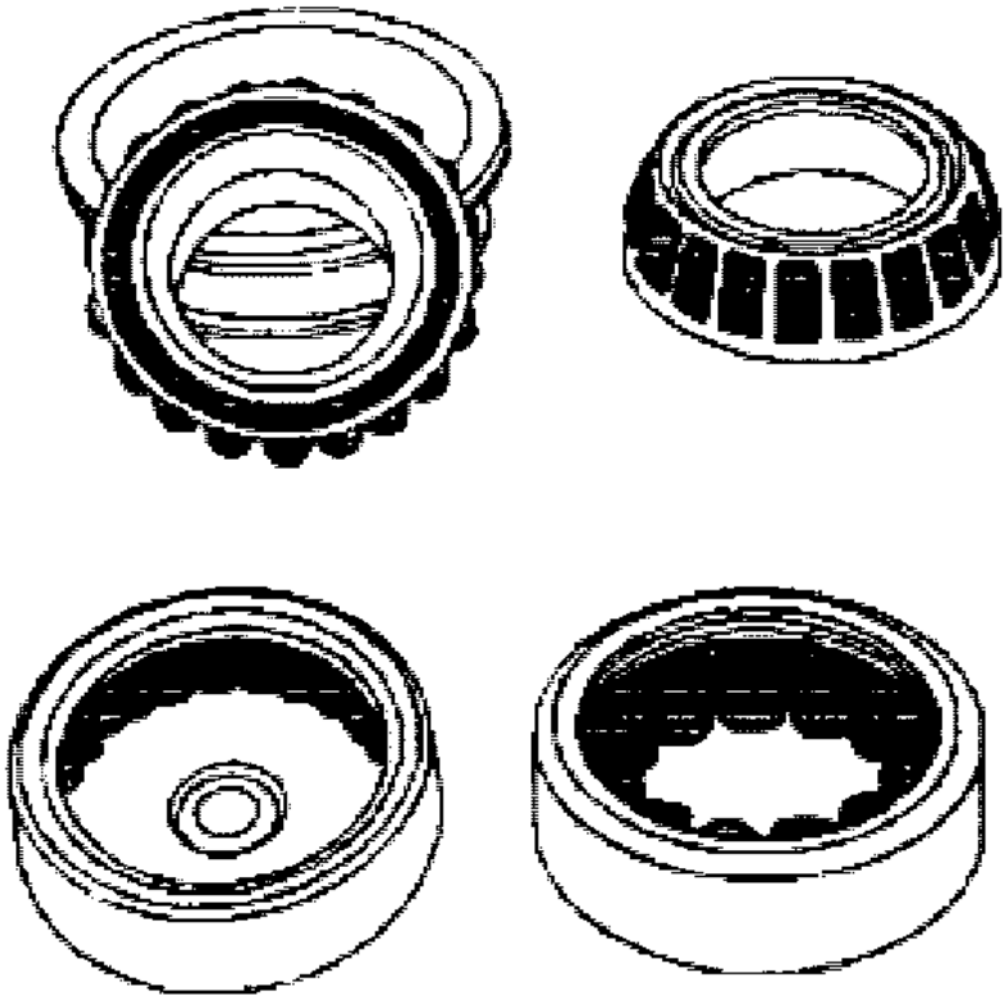


Fig. 130: Bearings
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not allow the bearings to spin. Turn them slowly by hand. Spinning the bearings may damage the race and the rollers.

1. Clean all bearing components in a suitable solvent and air dry.
2. Inspect the bearings and journals for roughness and unusual wear or damage.

3. Inspect the main shaft bearing journals for wear.
4. Inspect the main shaft speed gear bearings for wear.
5. Inspect the main drive gear pilot bearing rollers for wear.
6. Replace components which show signs of excessive wear.
7. Do not file surfaces which have been hardened and precision ground.
8. Replace worn or damaged bearings.
9. Replace mated bearing components when only one part is damaged.

TRANSMISSION REAR CASE ASSEMBLE

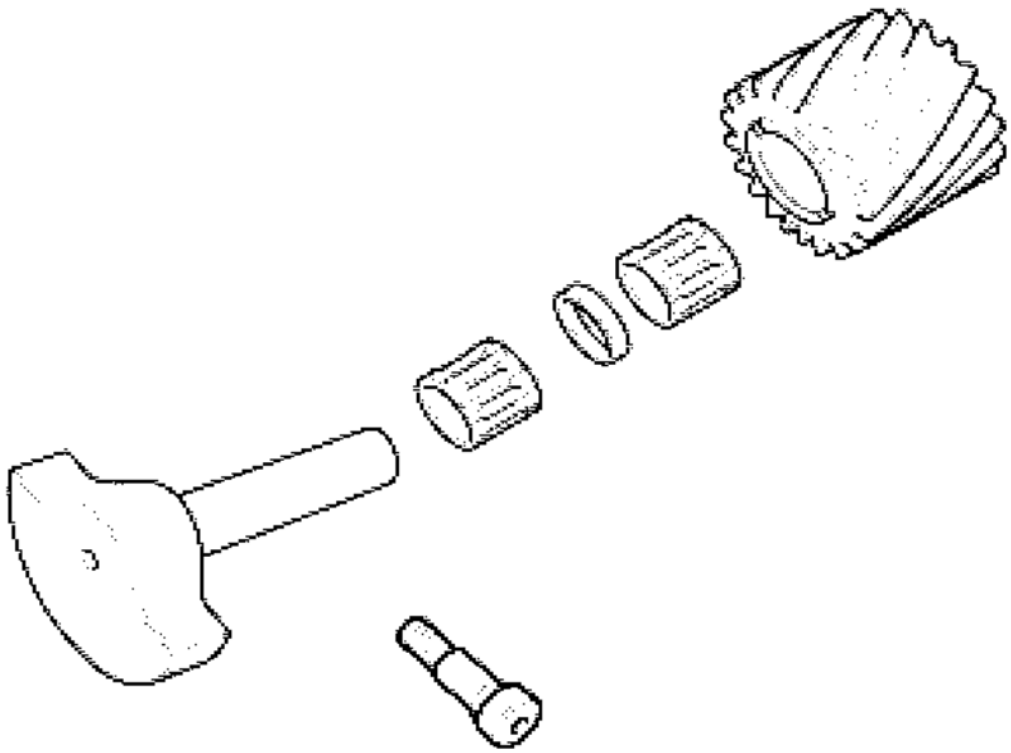


Fig. 131: 2 Roller Cages, Spacer And Reverse Gear And Screw
Courtesy of GENERAL MOTORS CORP.

1. The reverse assembly arrangement and support shows 2 roller cages, a spacer, and the reverse gear and screw.

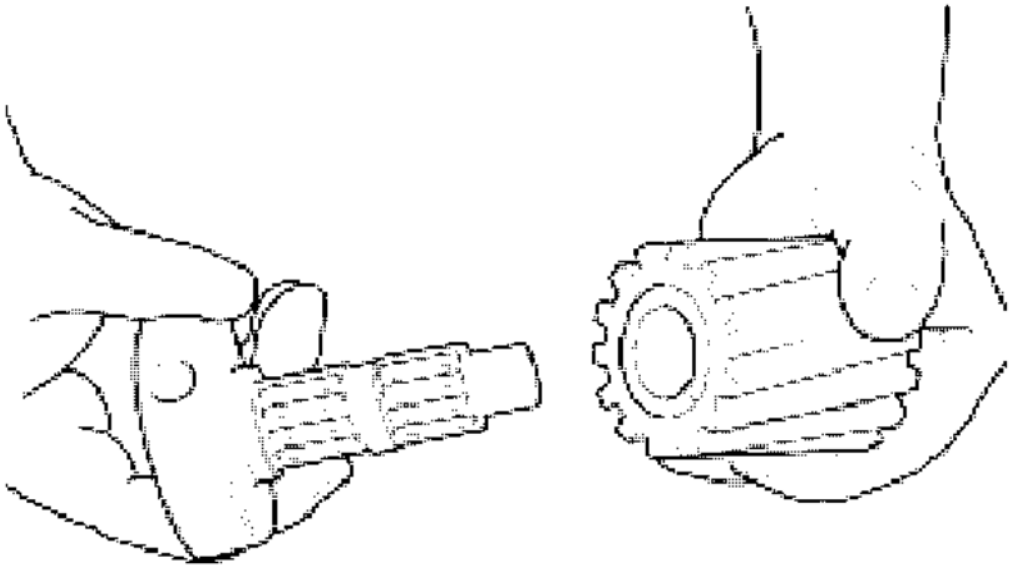


Fig. 132: Roller Cages, Spacer And Gear
Courtesy of GENERAL MOTORS CORP.

2. Place the roller cages and spacer inside the gear.

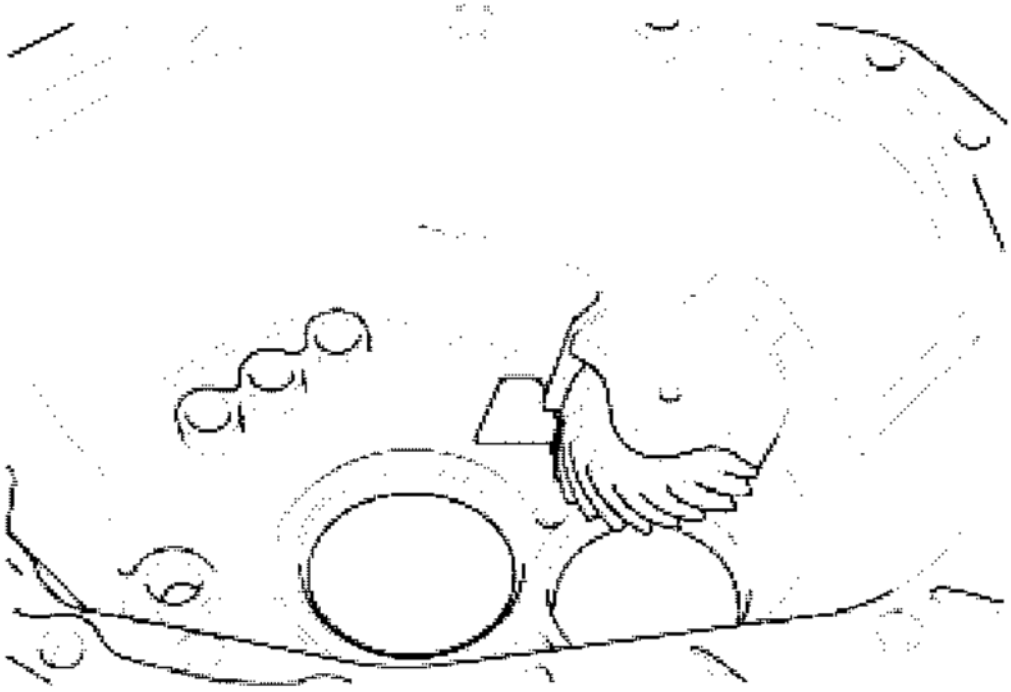


Fig. 133: Assembly Inside Case
Courtesy of GENERAL MOTORS CORP.

3. Install the assembly inside the case.

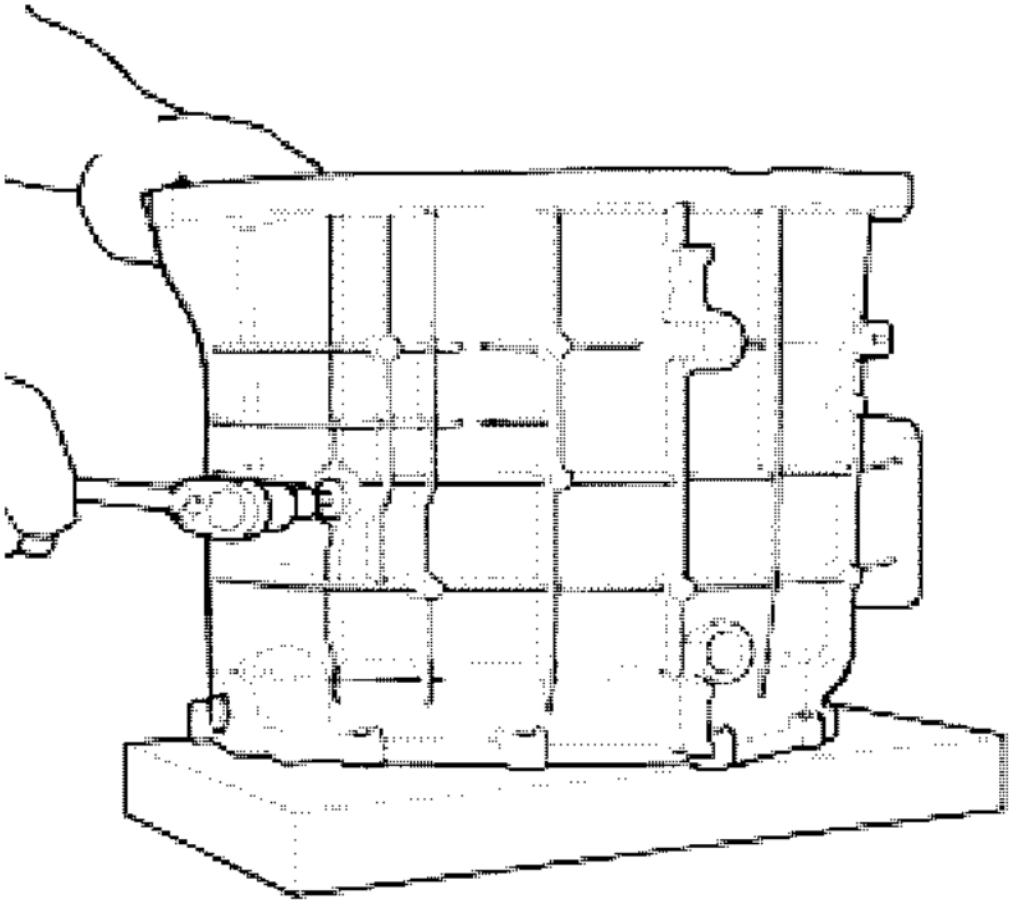


Fig. 134: Reverse Gear Support Screw
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

4. Using a 6 mm Allen wrench, tighten the support screw.

Tighten: Tighten the support screw to 18-37 N.m (13-27 lb ft).

TRANSMISSION FRONT CASE ASSEMBLE

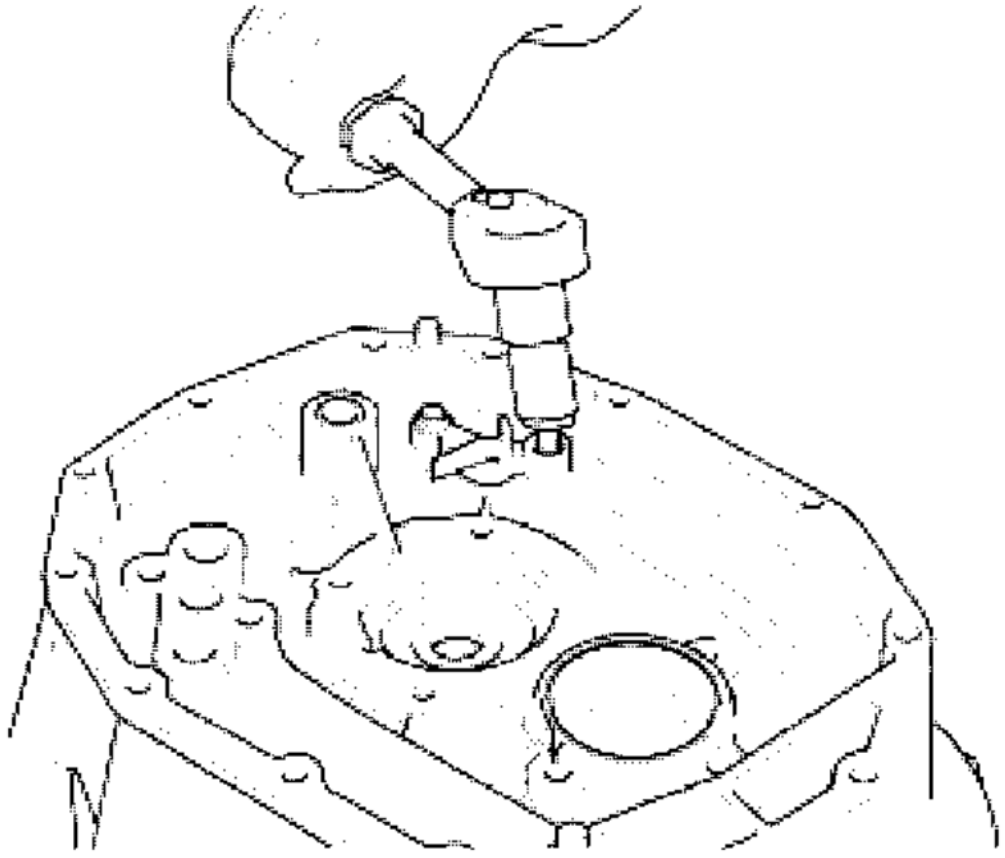


Fig. 135: Screws Securing Oil Baffle
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

1. Using a 13 mm socket, install the 2 oil baffle screws and tighten them to the recommended torque. Refer to **Fastener Tightening Specifications**.

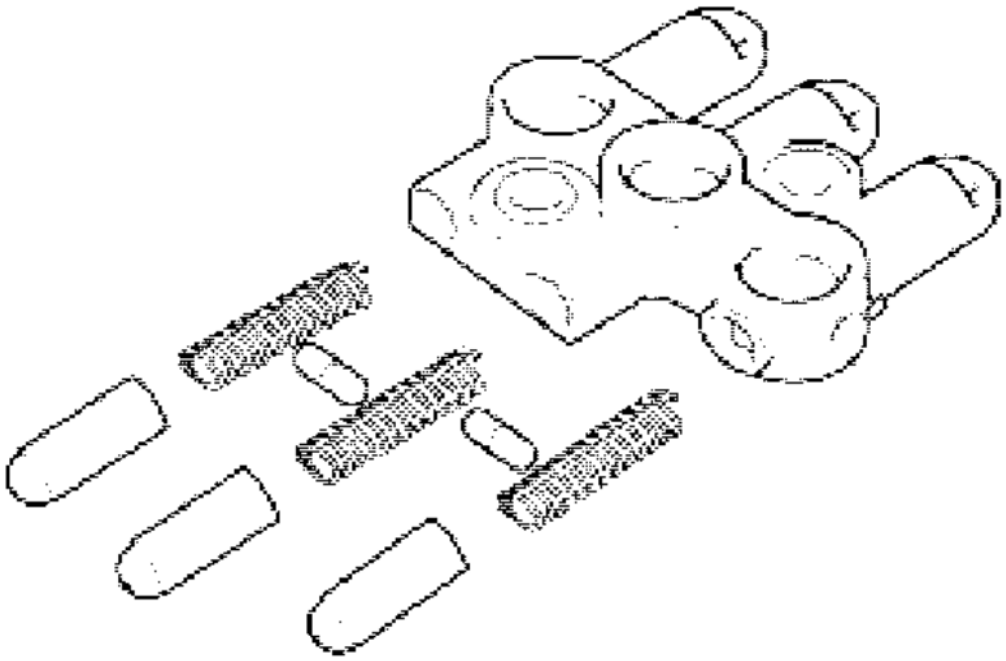


Fig. 136: 3 Springs, 3 Bushings, 2 Pistons And 1 Support
Courtesy of GENERAL MOTORS CORP.

2. The anchor support assembly shows, 3 springs, 3 bushings, 2 pistons, and 1 support.

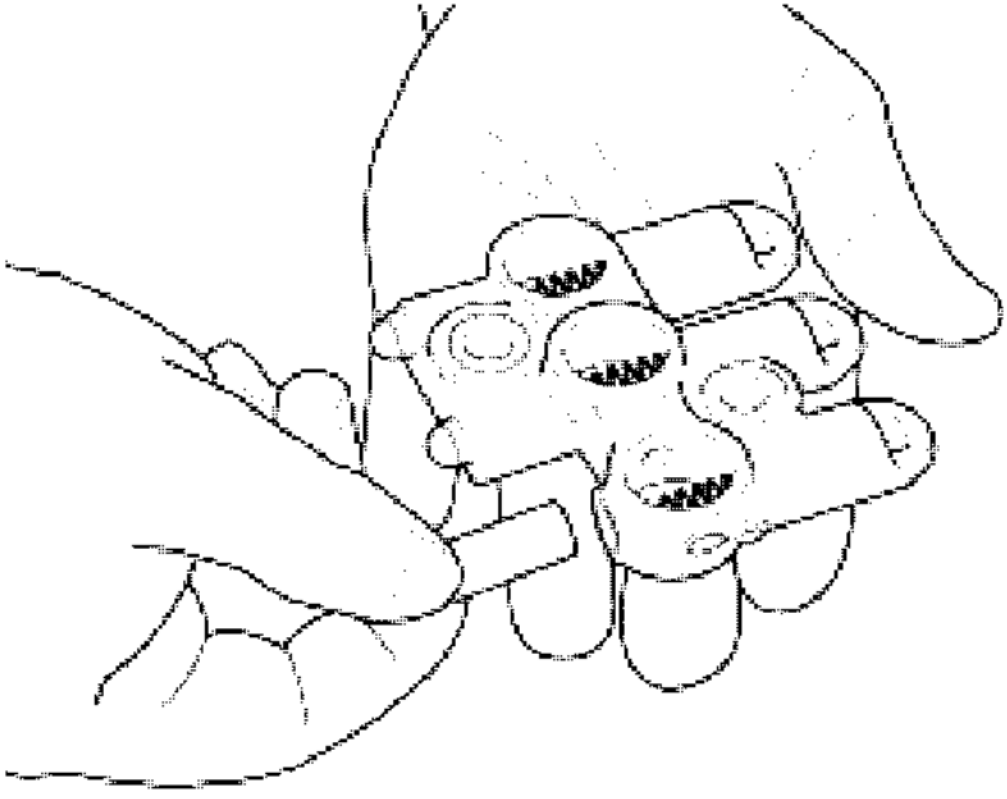


Fig. 137: 3 Springs And 3 Bushings
Courtesy of GENERAL MOTORS CORP.

3. Assemble the 3 springs and 3 bushings.

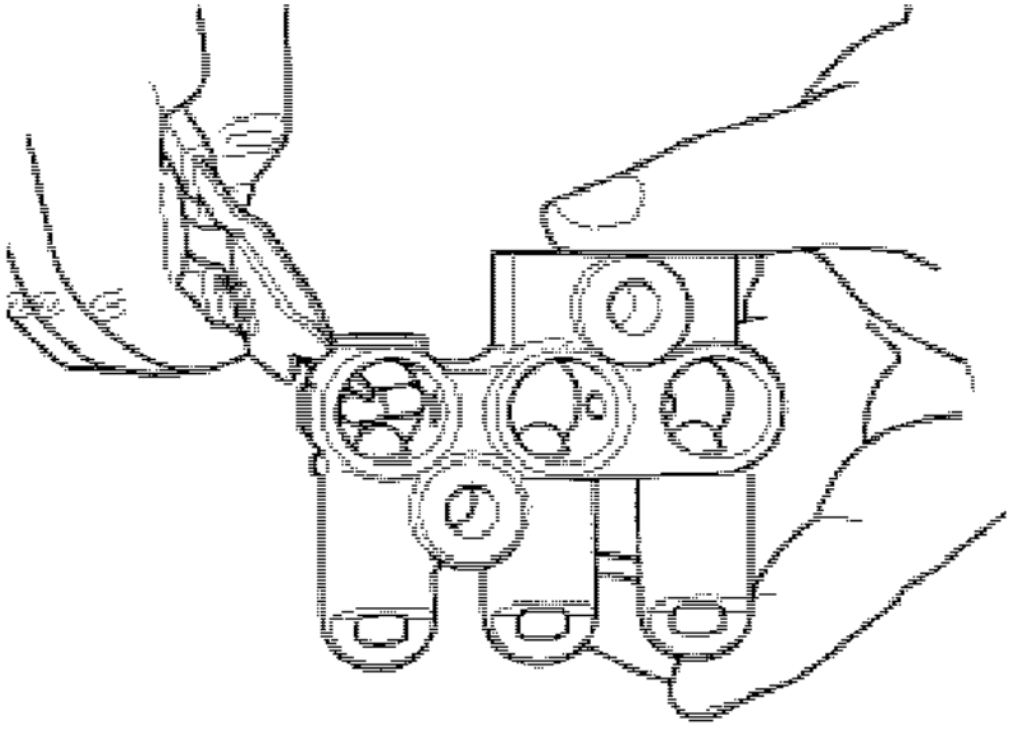


Fig. 138: 2 Anchor Pistons
Courtesy of GENERAL MOTORS CORP.

4. Using pliers, install the 2 anchor pistons.

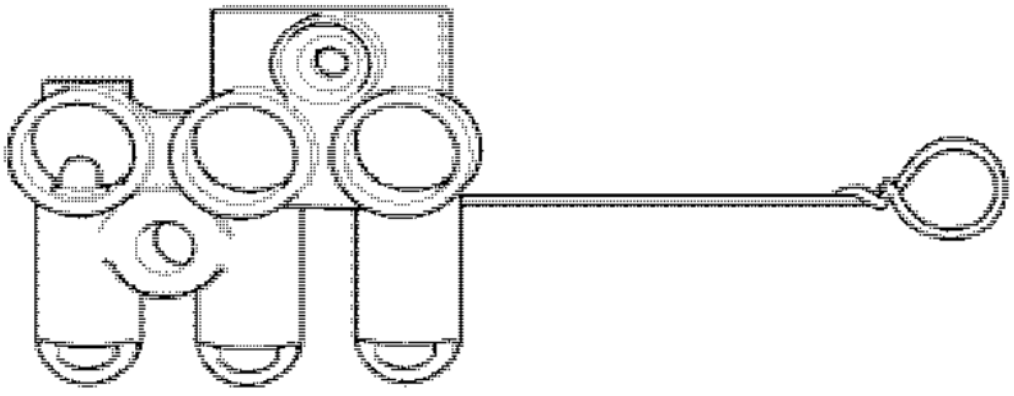


Fig. 139: Blocking Anchor Bushings
Courtesy of GENERAL MOTORS CORP.

5. Using a wire, block the anchor bushings in order to ease in the assembly of the shift levers.

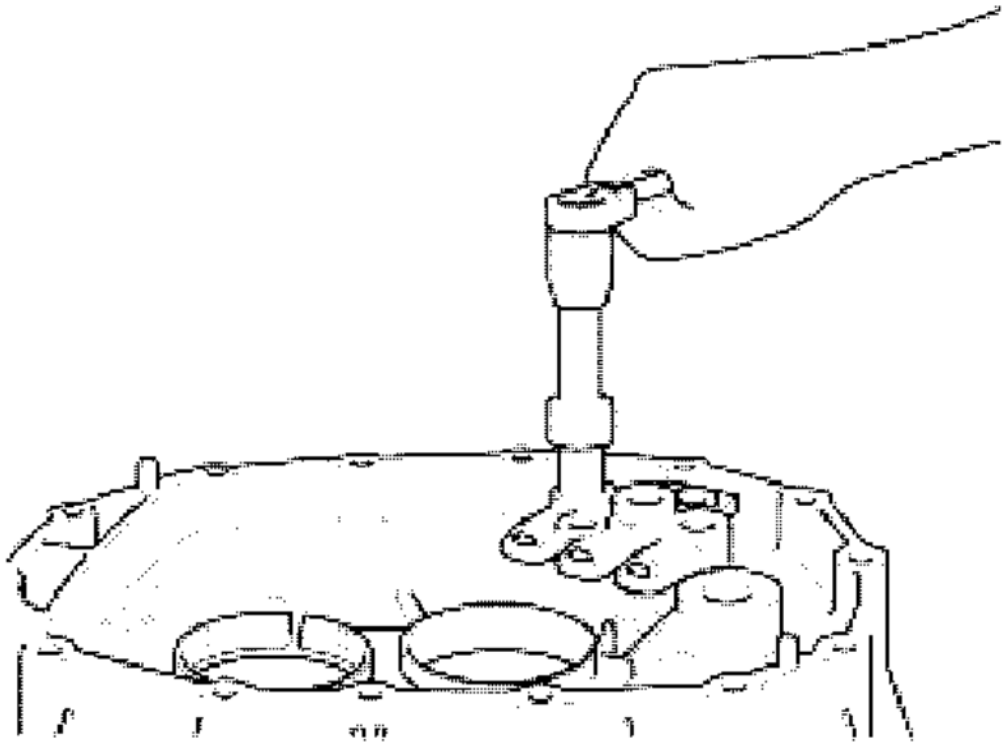


Fig. 140: Screws Securing Anchor Support Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

6. Using a 10 mm socket, install the anchor support assembly screws.

   Tighten: Tighten the support assembly screws to 18-37 N.m (18-27 lb ft).

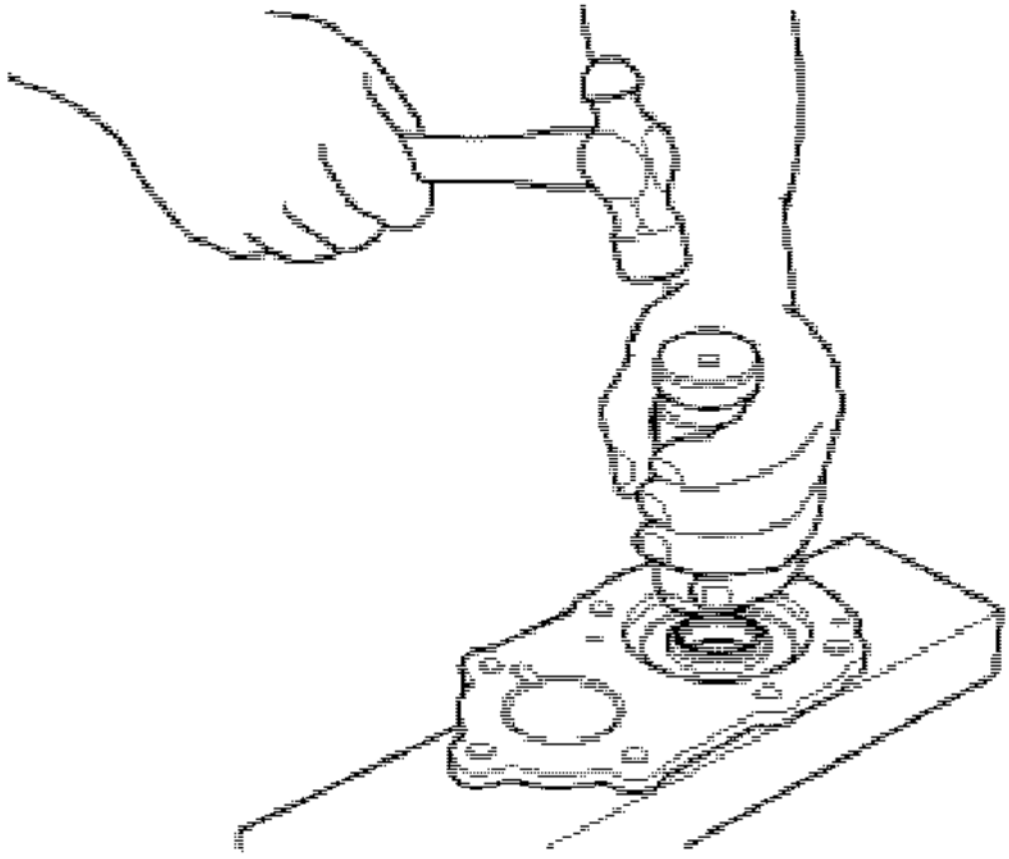


Fig. 141: Installing Oil Seal
Courtesy of GENERAL MOTORS CORP.

7. Using a driving tool, install a new oil seal if it was removed.

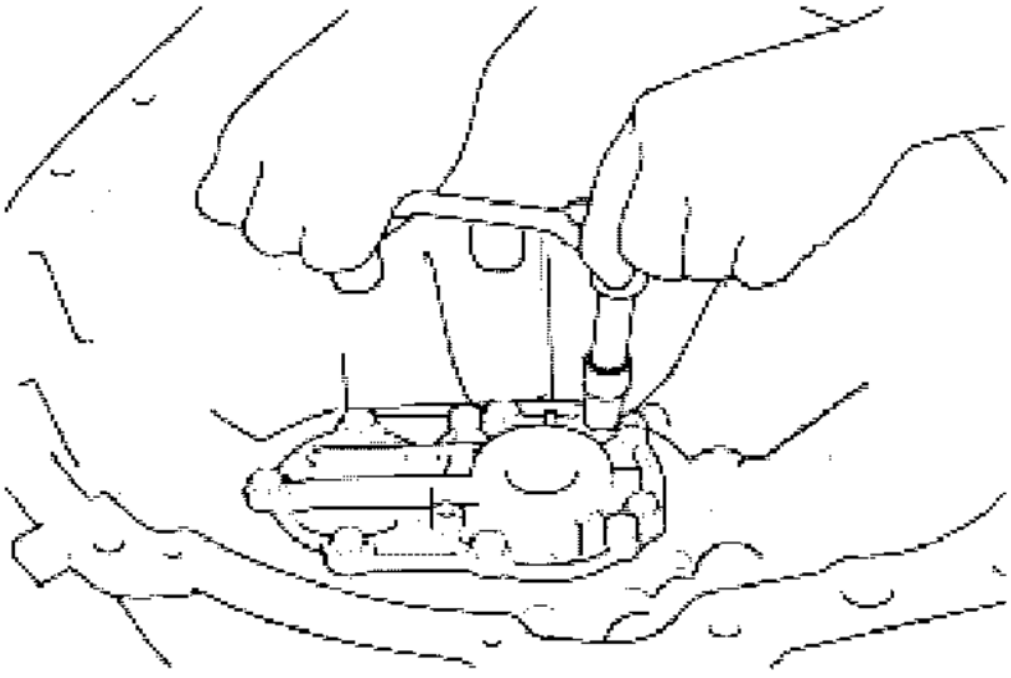


Fig. 142: Screws Securing Bearing Retainer
Courtesy of GENERAL MOTORS CORP.

8. Using a 13 mm socket, temporarily install 7 bearing retaining bolts in the clutch housing.

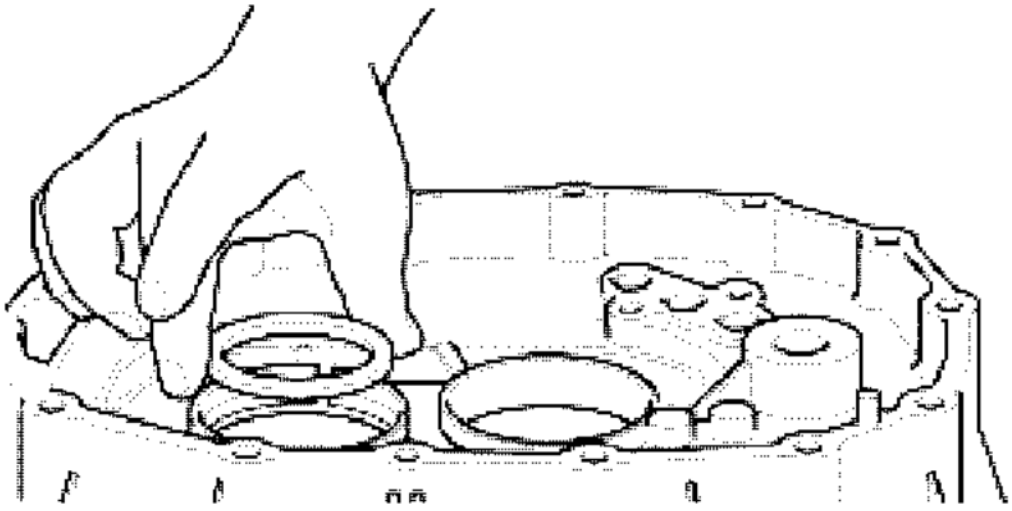


Fig. 143: Gear Train Spacer
Courtesy of GENERAL MOTORS CORP.

9. Install the gear train spacer.

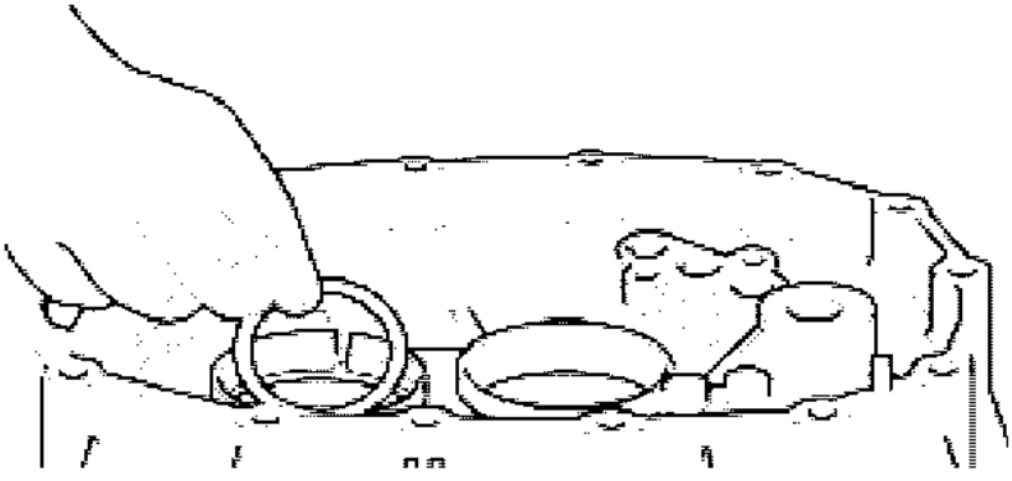


Fig. 144: Gear Train Adjustment Shims
Courtesy of GENERAL MOTORS CORP.

10. In the gear train housing, temporarily install new shims until the axial play is correct.

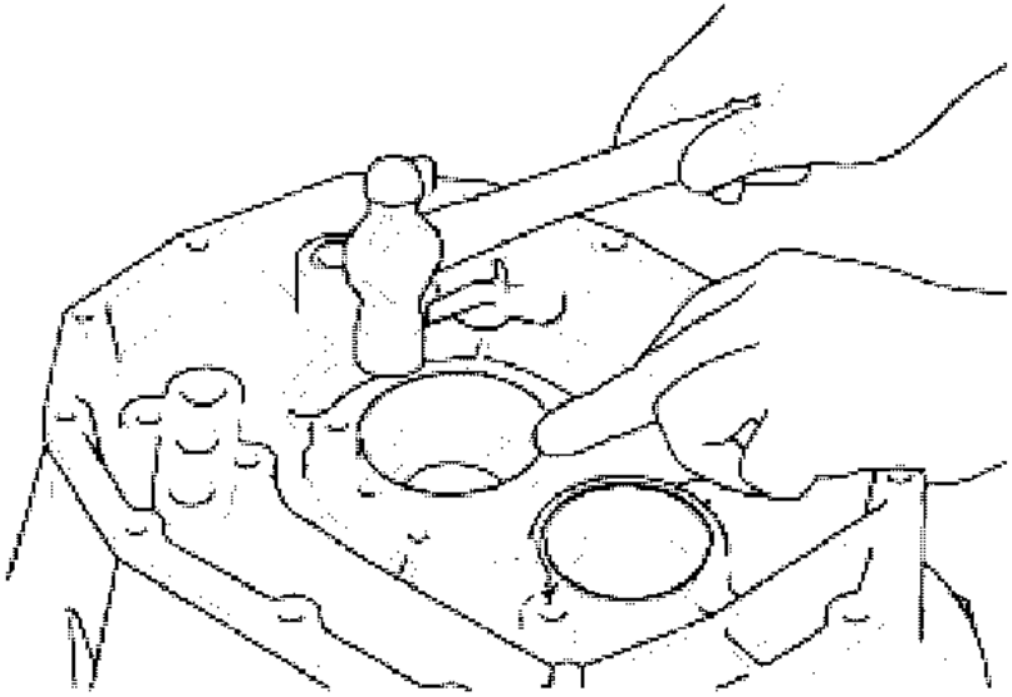


Fig. 145: Installing Drive Shaft Bearing Race
Courtesy of GENERAL MOTORS CORP.

11. Using a hammer, install the drive shaft bearing race.

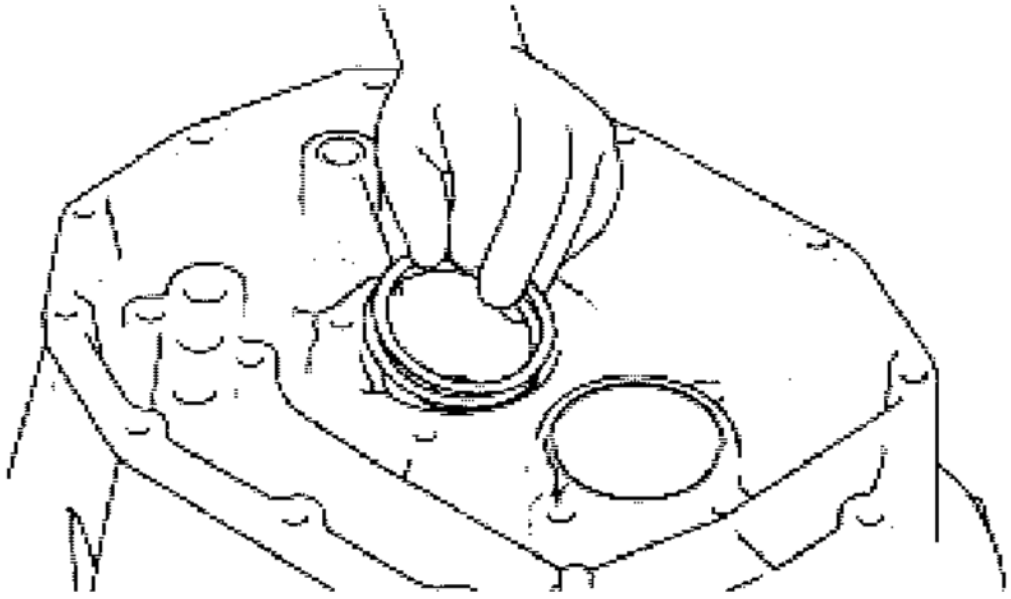


Fig. 146: Drive Shaft Adjusting Shims
Courtesy of GENERAL MOTORS CORP.

12. In the drive shaft housing, temporarily install new shims until the axial play is correct.
13. Install the roller cage inside the drive shaft.

MAIN SHAFT ASSEMBLE

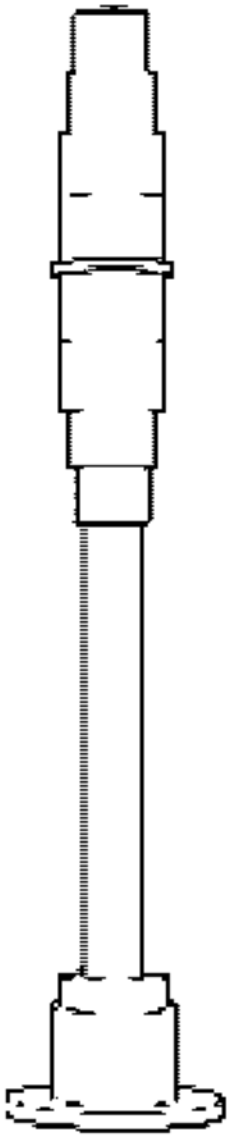


Fig. 147: Main Shaft On Workbench
Courtesy of GENERAL MOTORS CORP.

1. Place the main shaft on a workbench.

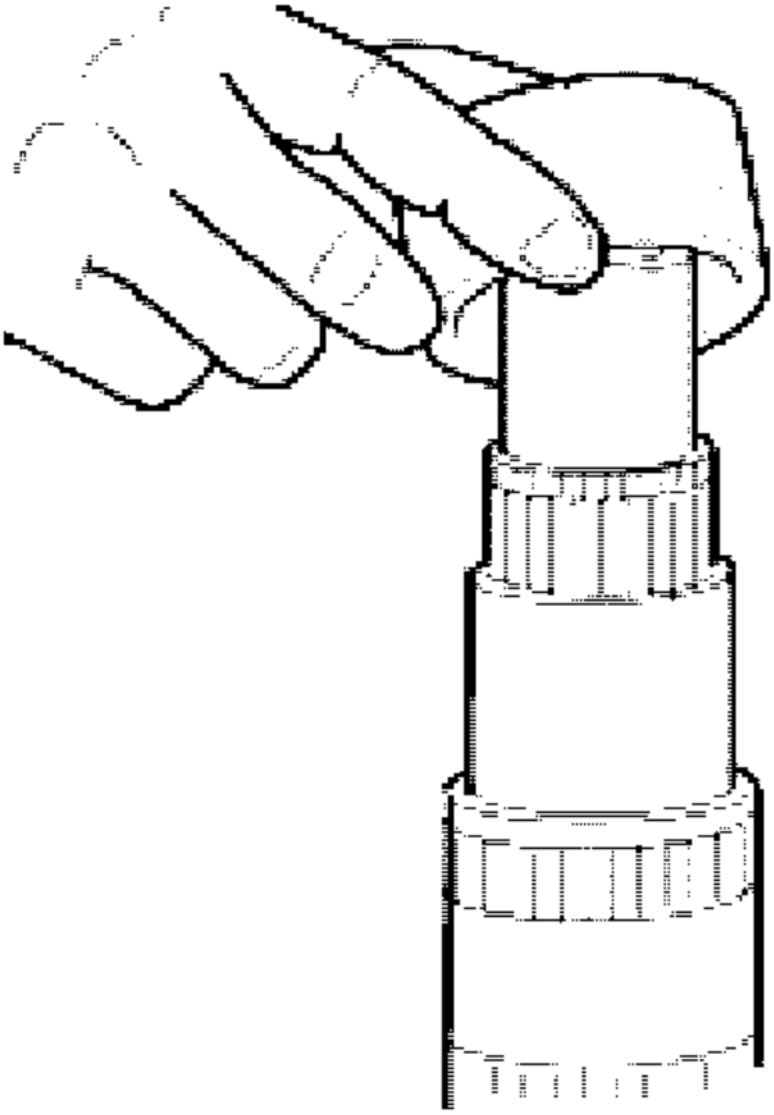


Fig. 148: 2Nd Speed Gear Roller Cage
Courtesy of GENERAL MOTORS CORP.

2. Install the 2nd speed gear roller cage.

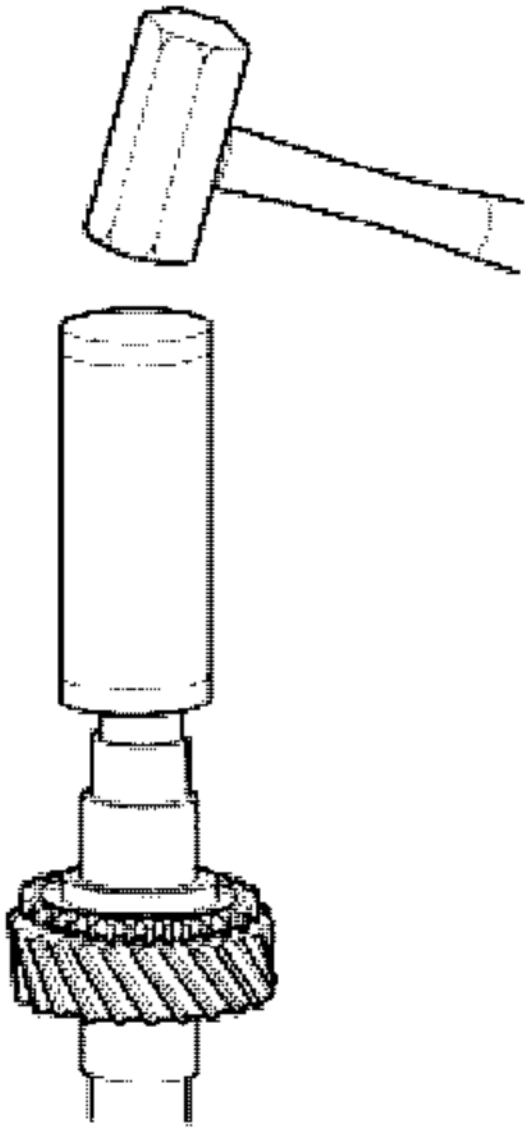


Fig. 149: Adjusting 2nd Speed Gear And 3rd Speed Bushing
Courtesy of GENERAL MOTORS CORP.

3. Using a press or driving tool, adjust 2nd speed gear and 3rd speed bushing.

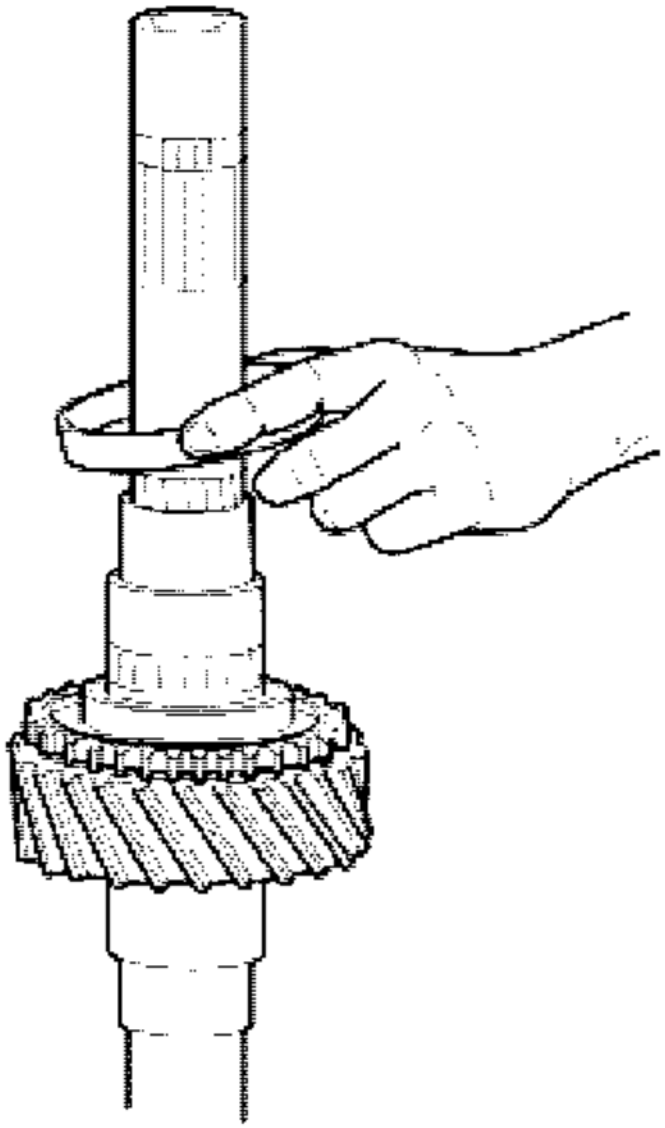


Fig. 150: 2nd Speed Gear Inner Ring
Courtesy of GENERAL MOTORS CORP.

4. Install the 2nd speed gear inner ring.

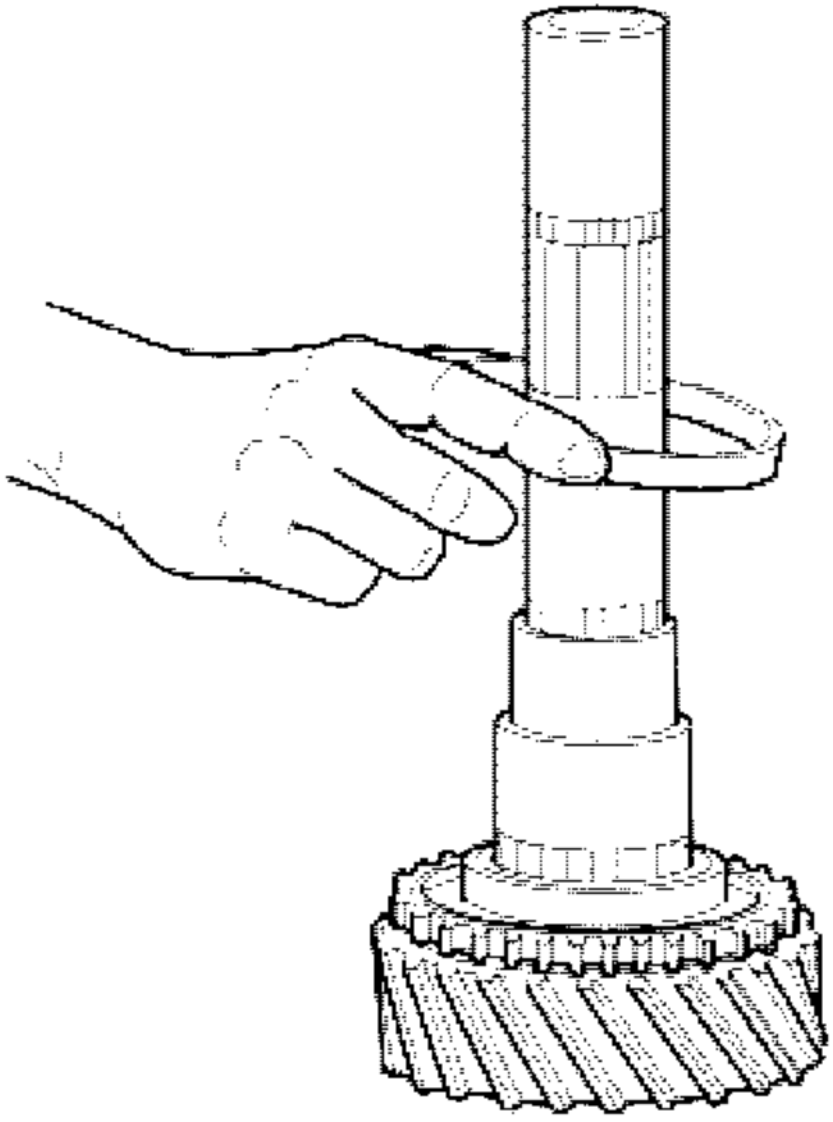


Fig. 151: 2nd Speed Gear Intermediate Ring
Courtesy of GENERAL MOTORS CORP.

5. Install the 2nd speed gear intermediate ring.

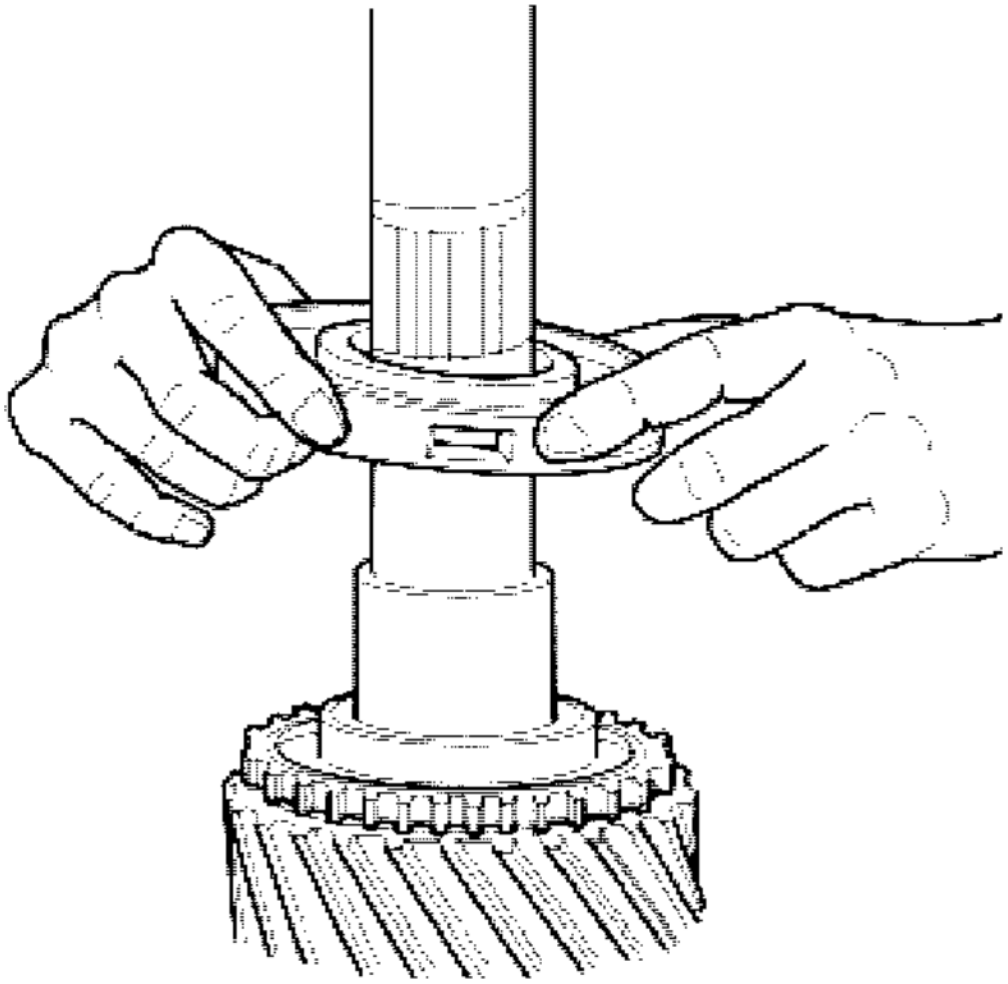


Fig. 152: 2nd Speed Synchronizer Ring
Courtesy of GENERAL MOTORS CORP.

6. Install the 2nd speed gear synchronizer ring.

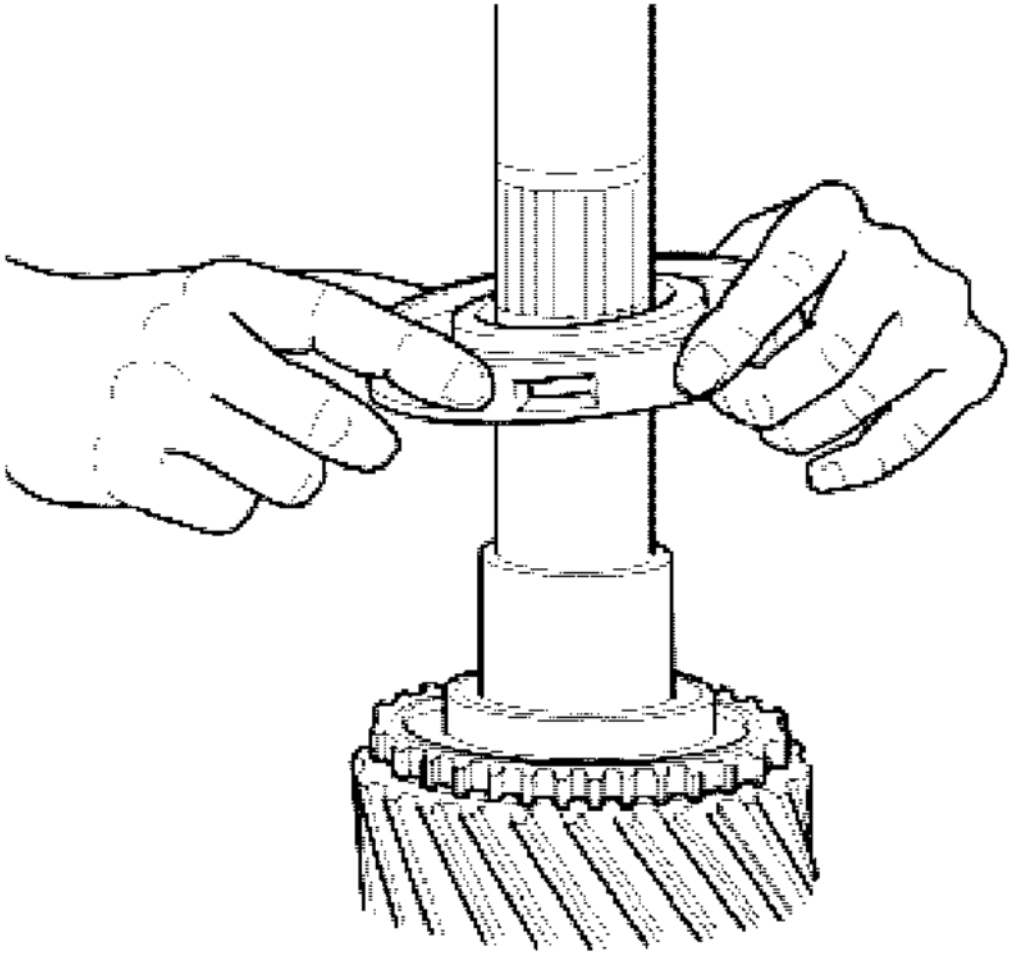


Fig. 153: 1st And 2nd Speed Synchronizer Assembly
Courtesy of GENERAL MOTORS CORP.

7. Install the 1st and 2nd speed synchronizer assembly.

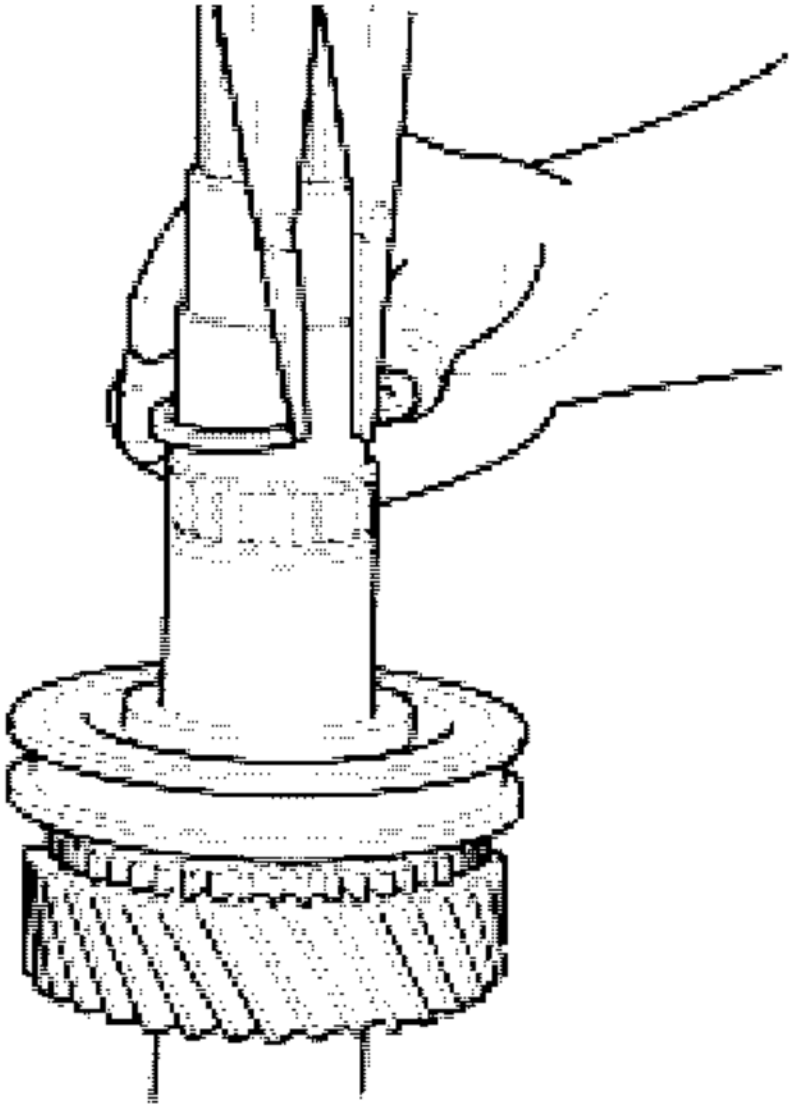


Fig. 154: Retainer Securing 1st And 2nd Speed Synchronizer Drum
Courtesy of GENERAL MOTORS CORP.

8. Using retainer pliers, install the retainer that secures the 1st and 2nd speed synchronizer drum.

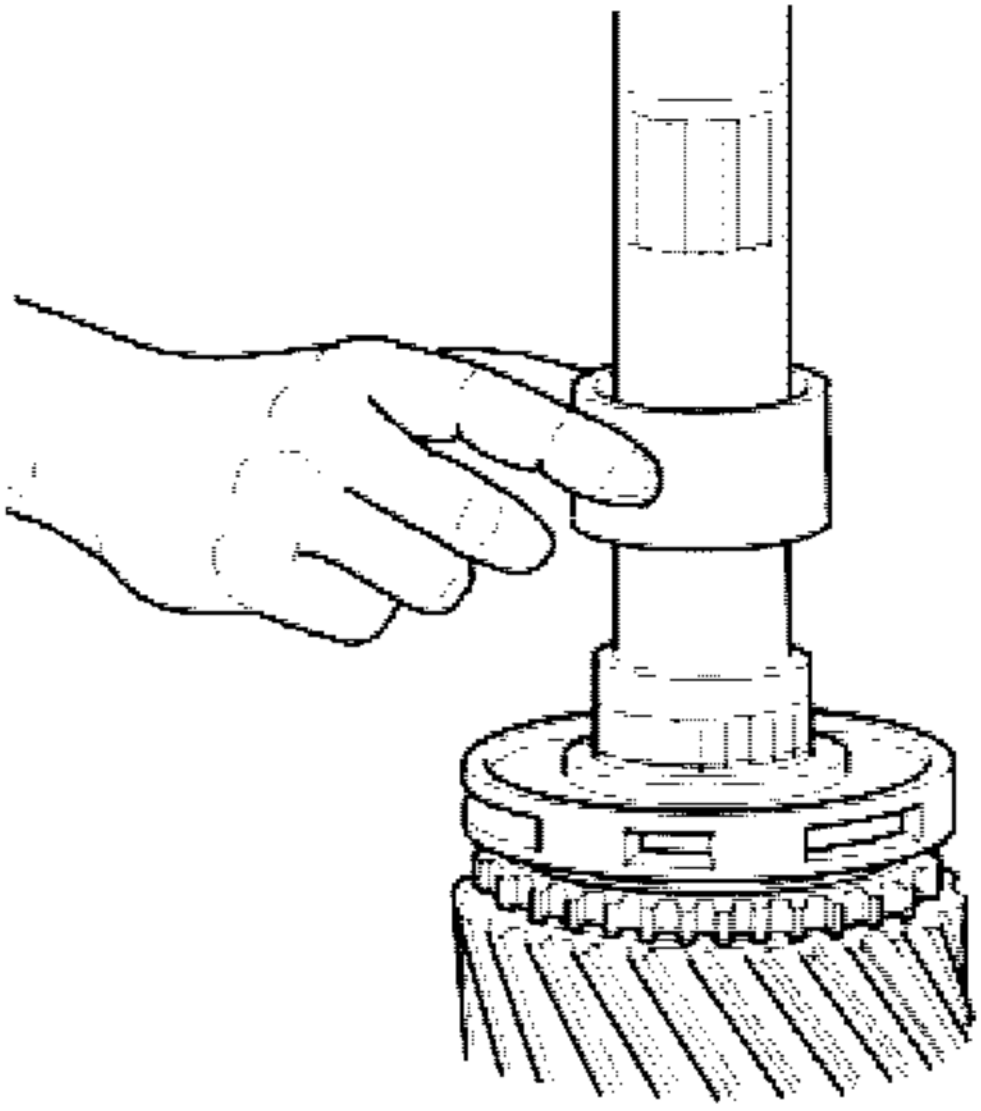


Fig. 155: 1st Speed Gear Roller Cage
Courtesy of GENERAL MOTORS CORP.

9. Install the 1st speed gear roller cage.

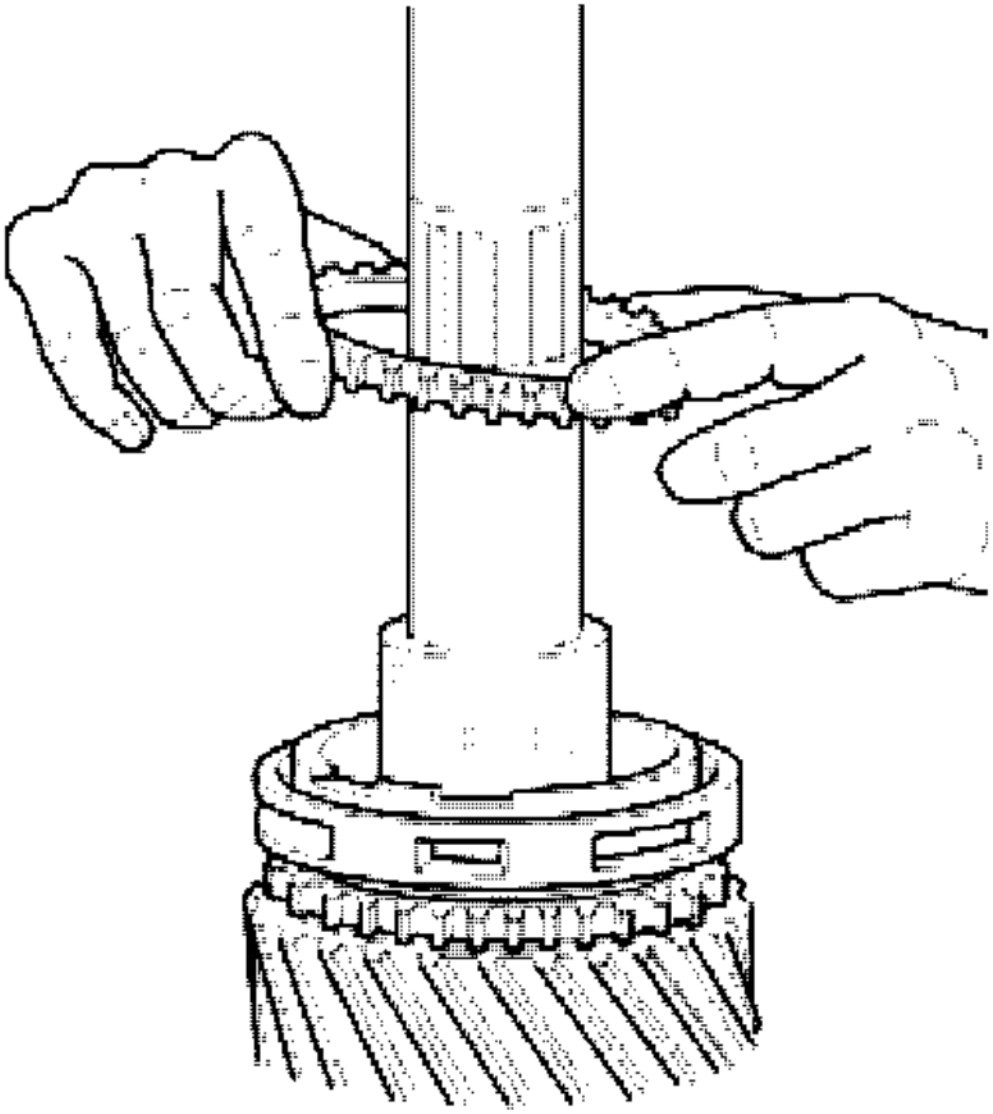


Fig. 156: 1st Speed Gear Synchronizer Ring
Courtesy of GENERAL MOTORS CORP.

10. Install the 1st speed gear synchronizer ring.

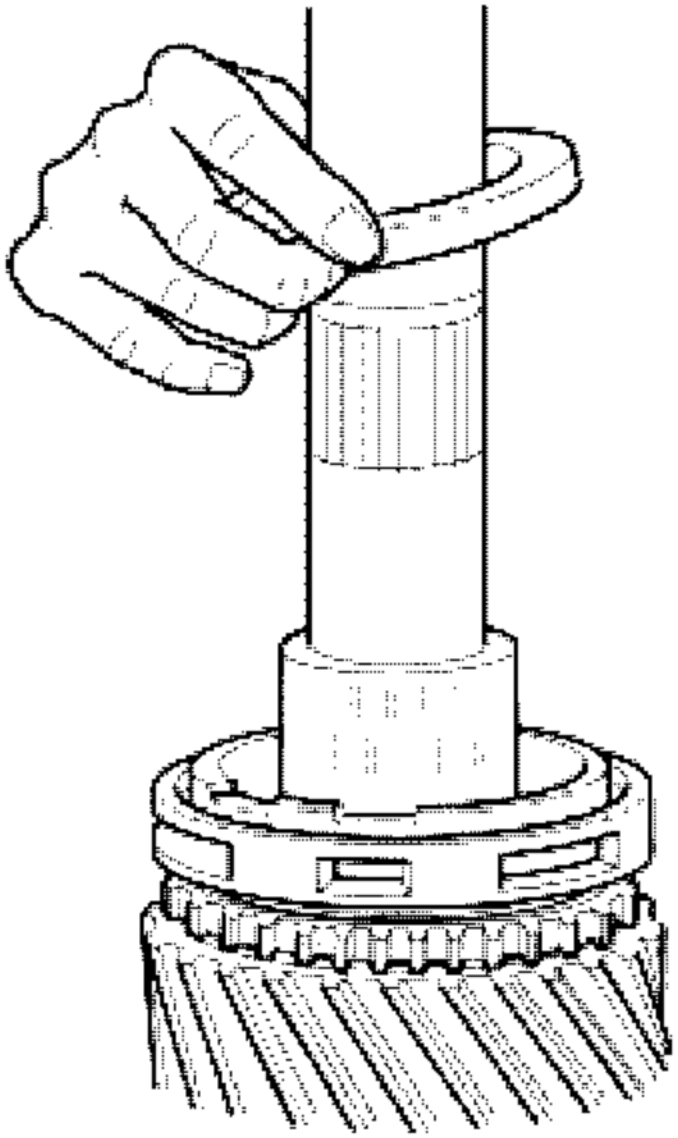


Fig. 157: 1st Speed Gear Intermediate Cone
Courtesy of GENERAL MOTORS CORP.

11. Install the 1st speed gear intermediate cone.

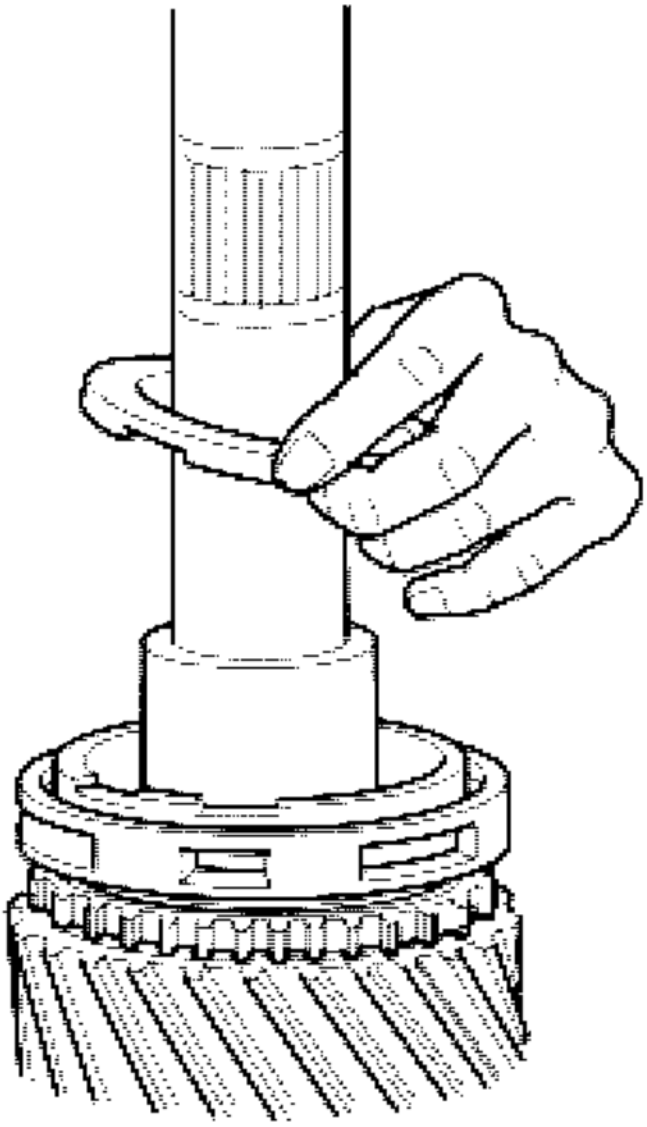


Fig. 158: 1St Speed Gear Inner Cone
Courtesy of GENERAL MOTORS CORP.

12. Install the 1st speed gear inner cone.

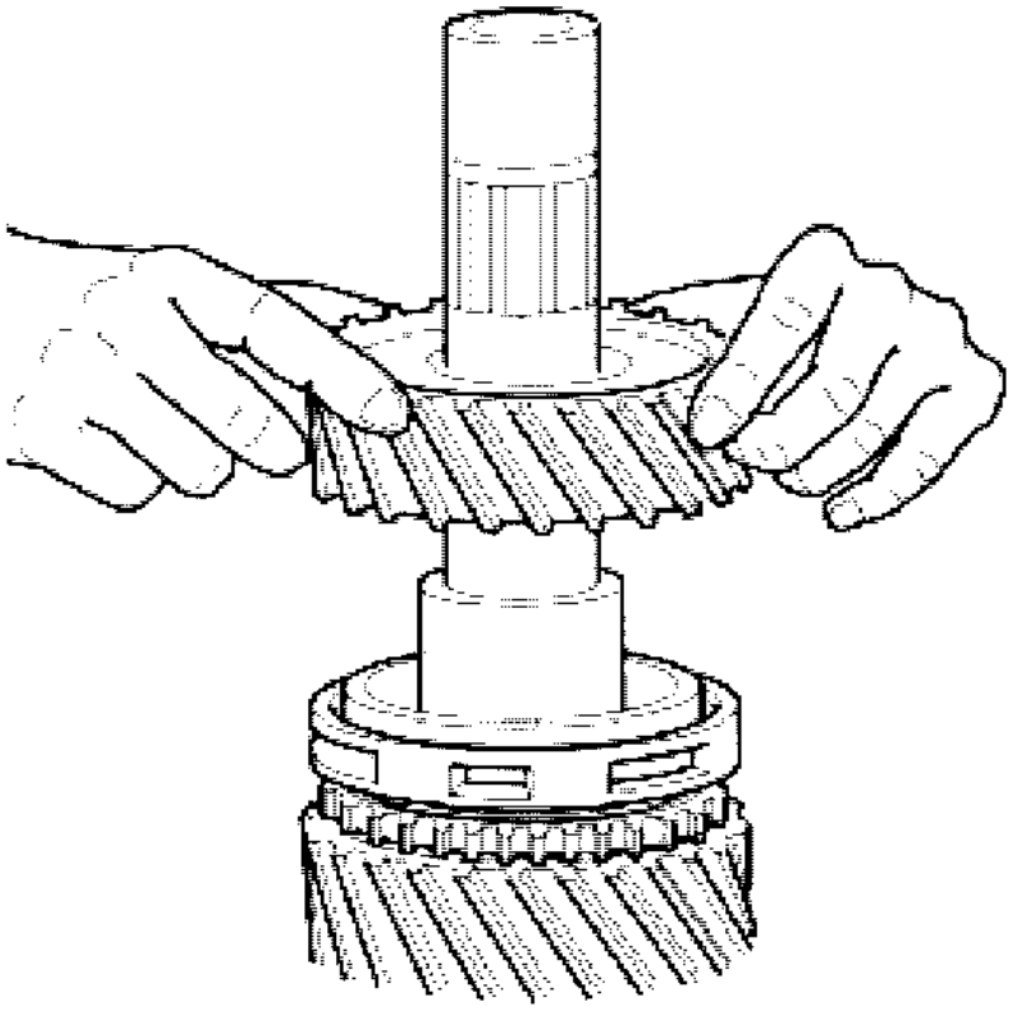


Fig. 159: 1st Speed Gear
Courtesy of GENERAL MOTORS CORP.

13. Install the 1st speed gear.

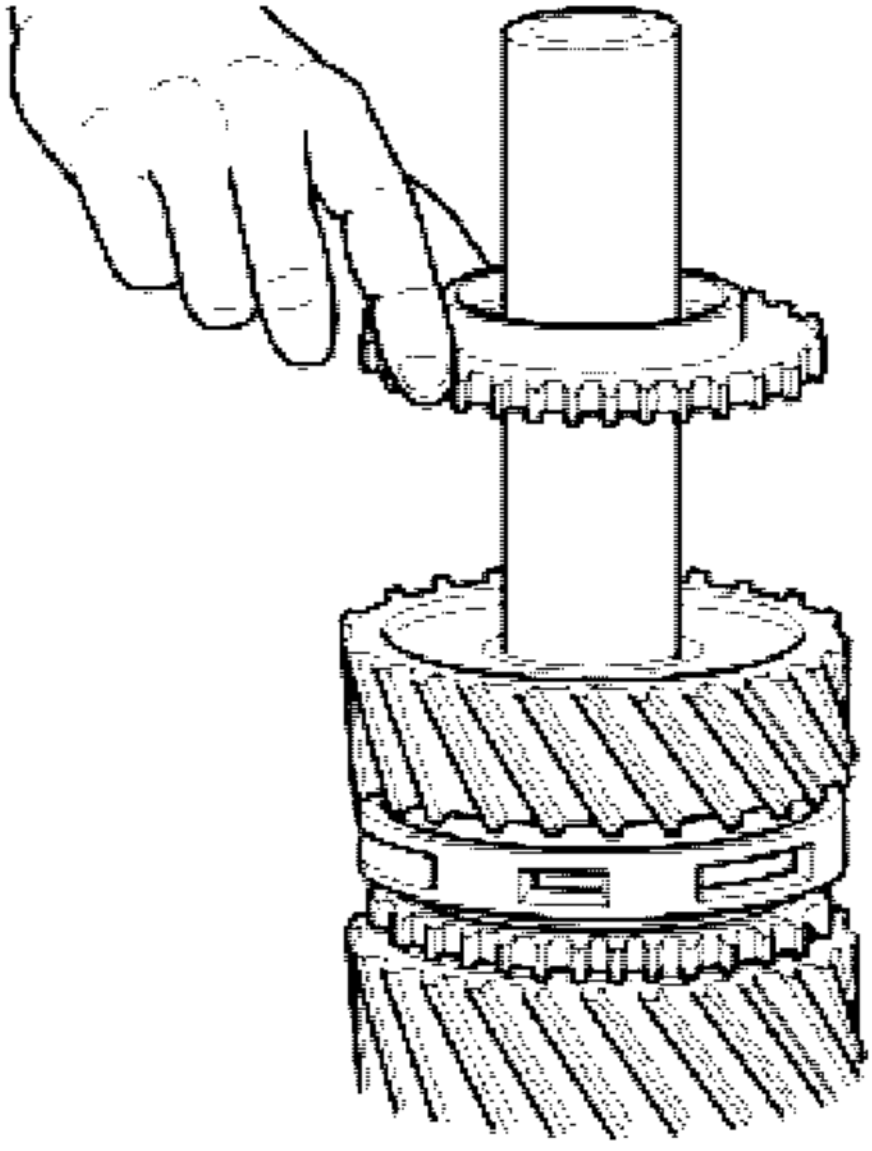


Fig. 160: Coupling Cone
Courtesy of GENERAL MOTORS CORP.

14. Install the reverse gear assembly coupling cone.

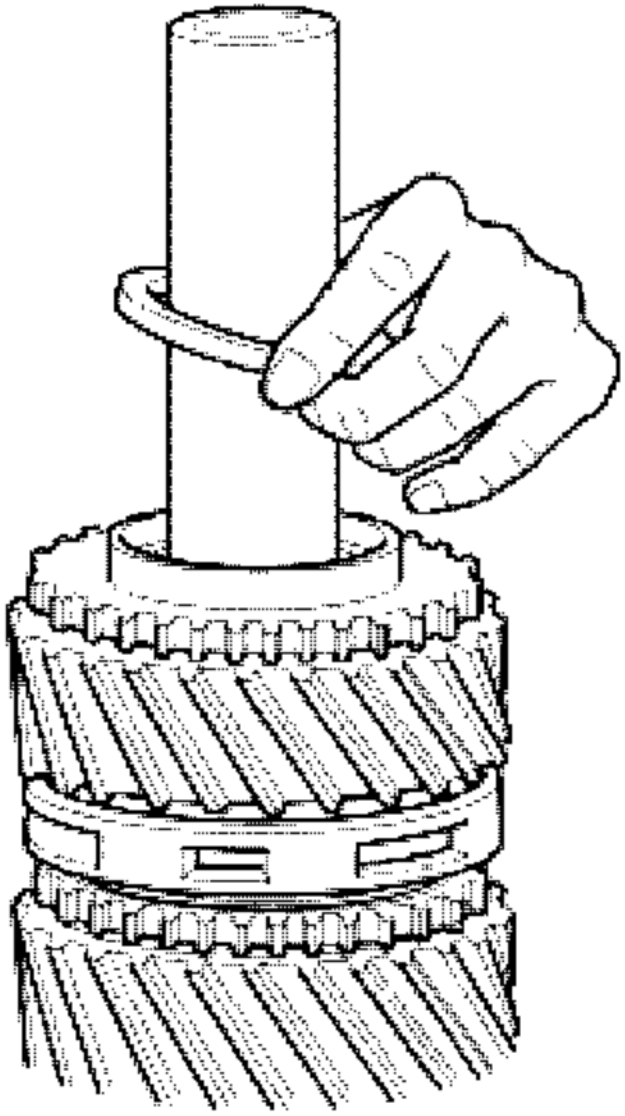


Fig. 161: Reverse Synchronizer Ring
Courtesy of GENERAL MOTORS CORP.

15. Install the reverse gear assembly synchronizer ring.

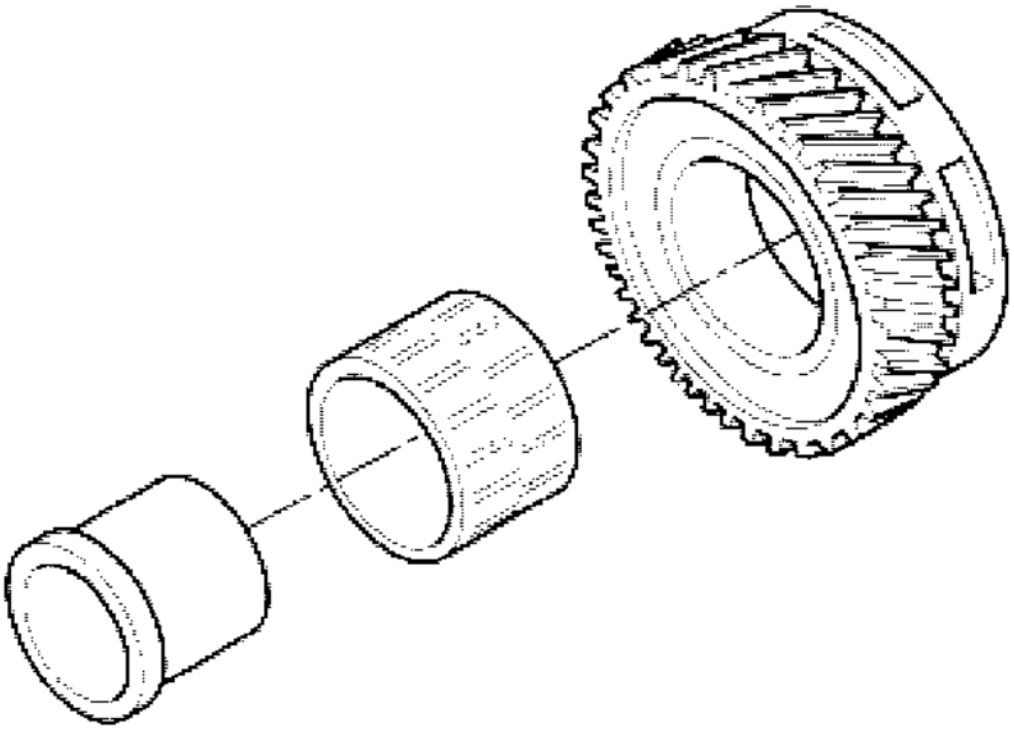


Fig. 162: Bushing, Roller Cage, And Reverse Gear Assembly
Courtesy of GENERAL MOTORS CORP.

16. The reverse gear assembly arrangement shows the bushing, roller cage, and reverse gear assembly.

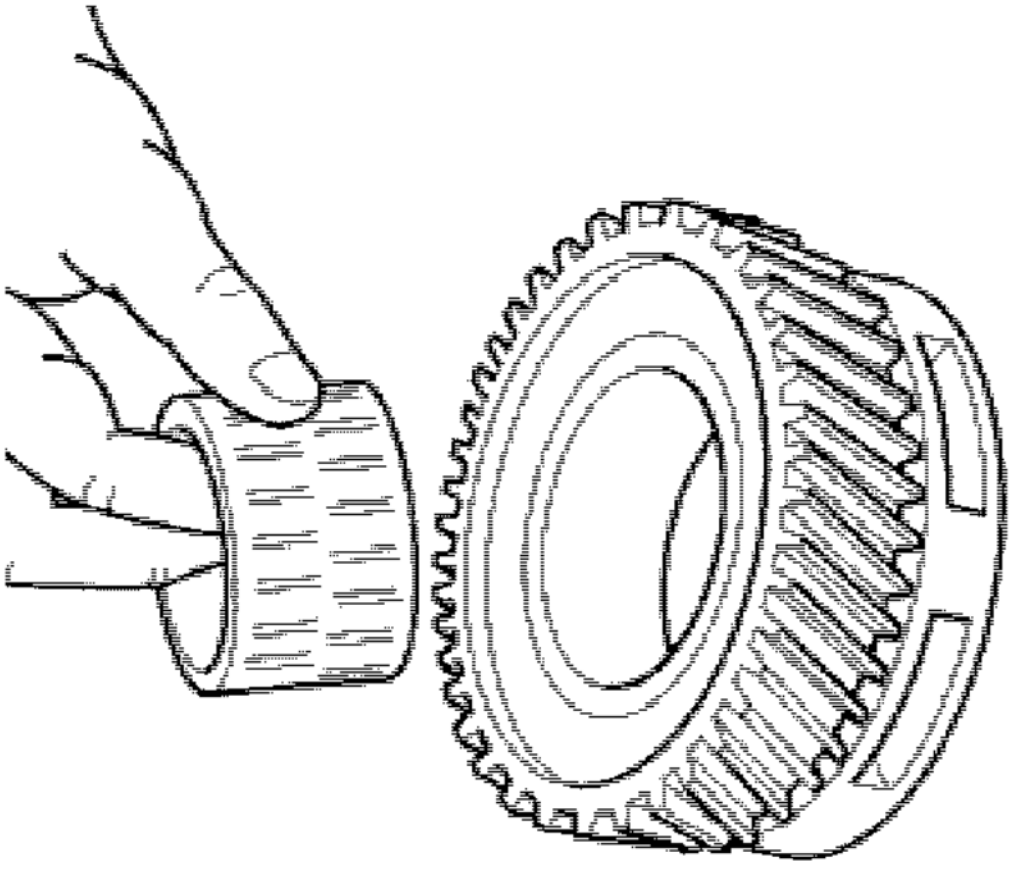


Fig. 163: Reverse Gear Cage
Courtesy of GENERAL MOTORS CORP.

17. Install the reverse gear assembly cage.

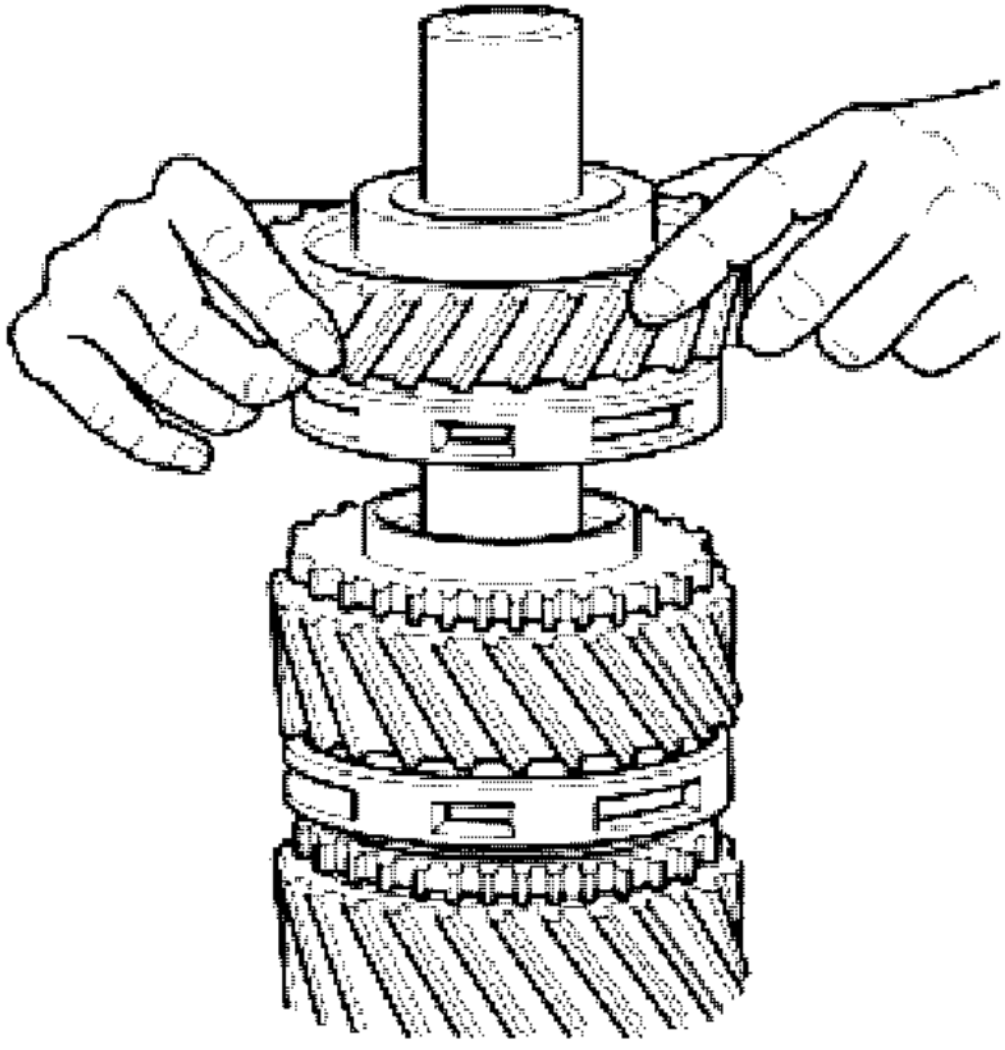


Fig. 164: 5th Speed Gear, Taper Bearings, Bushing, Roller Cage, And Reverse Synchronizer Assembly
Courtesy of GENERAL MOTORS CORP.

18. Install the reverse gear assembly bushing.

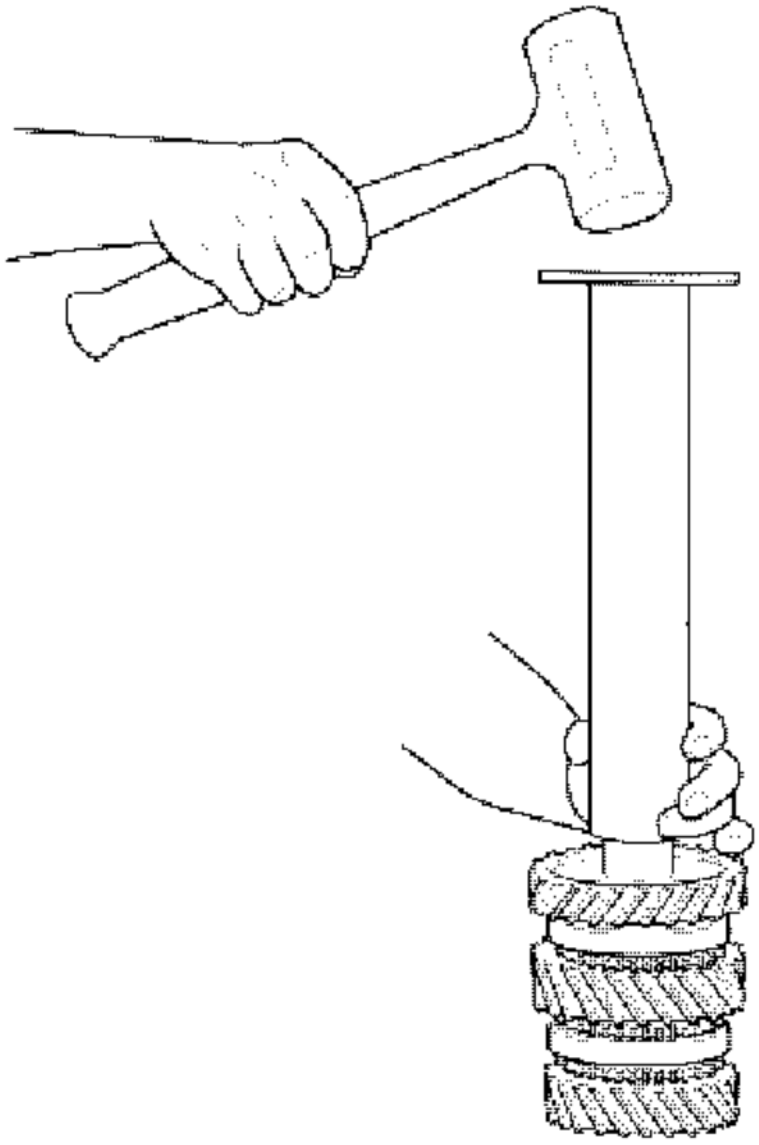


Fig. 165: Installing Reverse Gear Assembly Bushing
Courtesy of GENERAL MOTORS CORP.

19. Using a press or a driving tool, install the reverse gear assembly bushing.

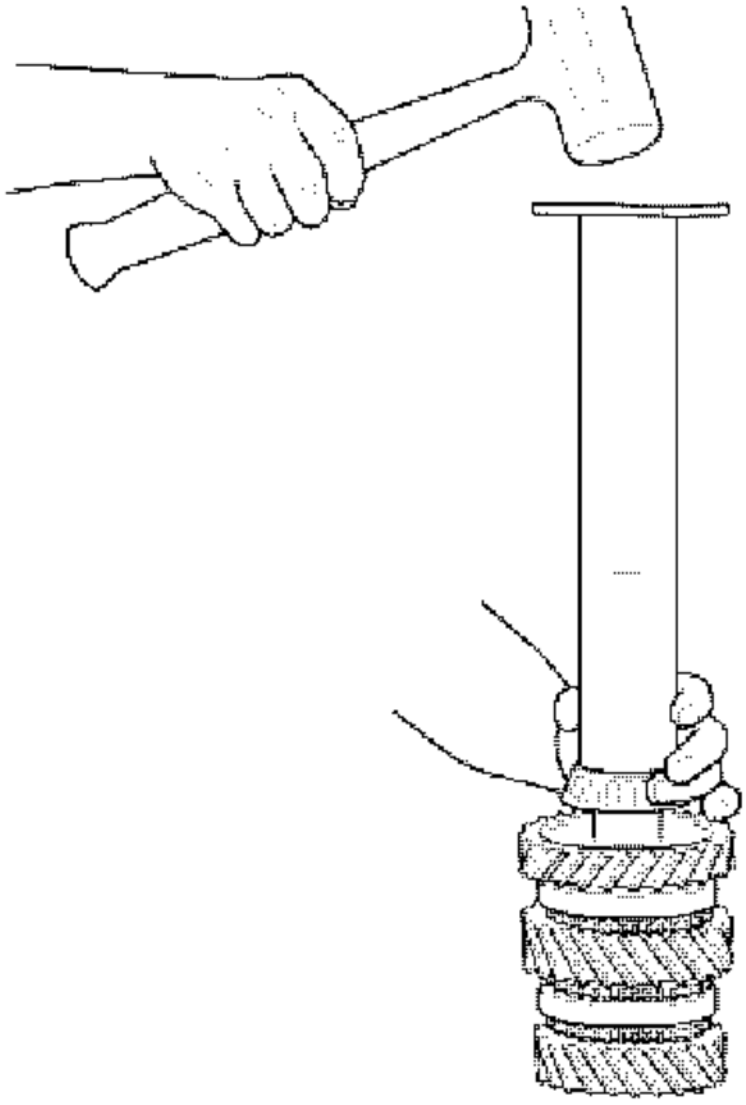


Fig. 166: Installing Bearing Cone
Courtesy of GENERAL MOTORS CORP.

20. Using a press or driving tool, install the bearing cone.

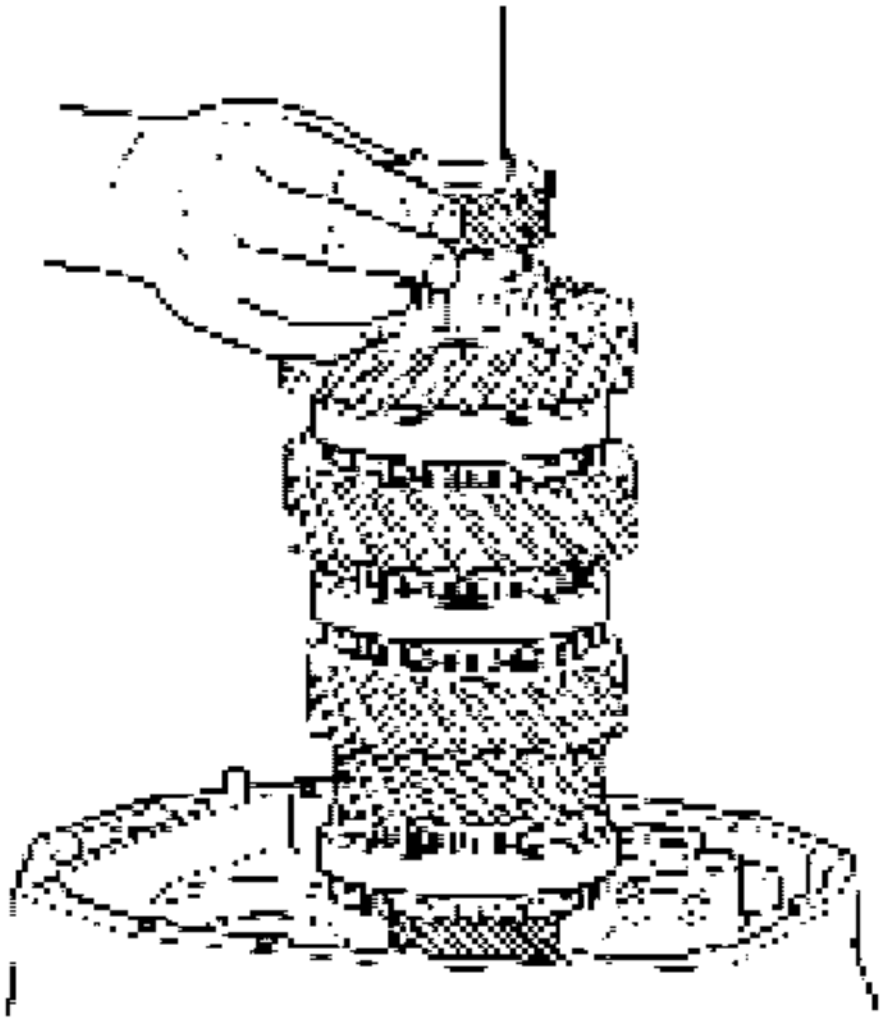


Fig. 167: Placing 5th Speed Gear
Courtesy of GENERAL MOTORS CORP.

21. Install 5th speed gear.

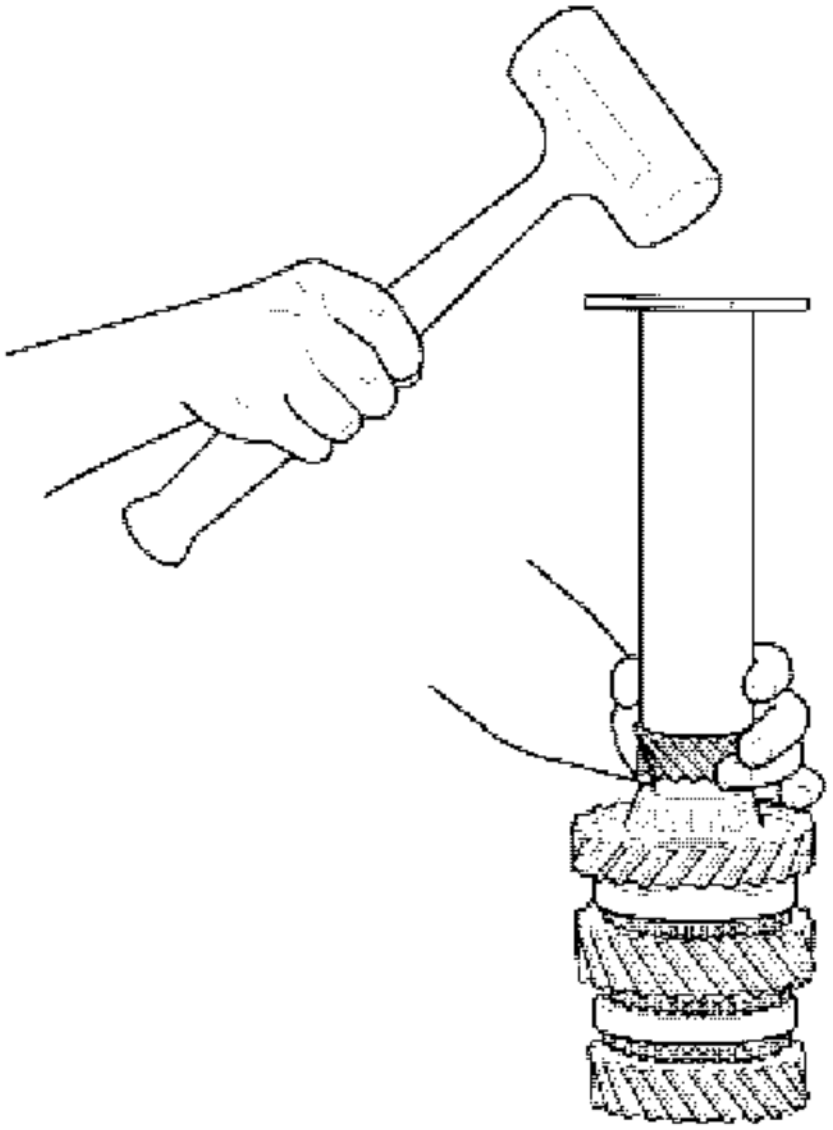


Fig. 168: Installing 5th Speed Gear
Courtesy of GENERAL MOTORS CORP.

22. Using a press or driving tool, install 5th speed gear.

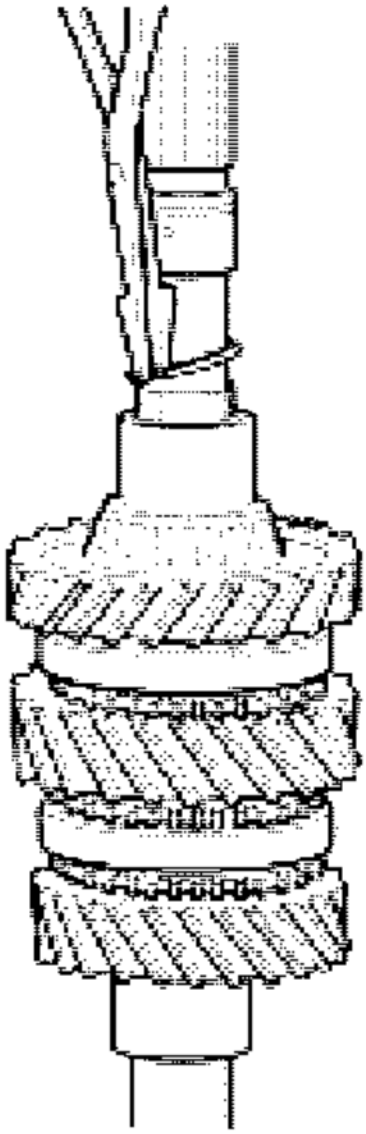


Fig. 169: Installing Bushing Instead Of 5th Speed Gear (4-speed)
Courtesy of GENERAL MOTORS CORP.

23. In the case of a 4 speed transmission, install the bushing instead of 5th speed gear.

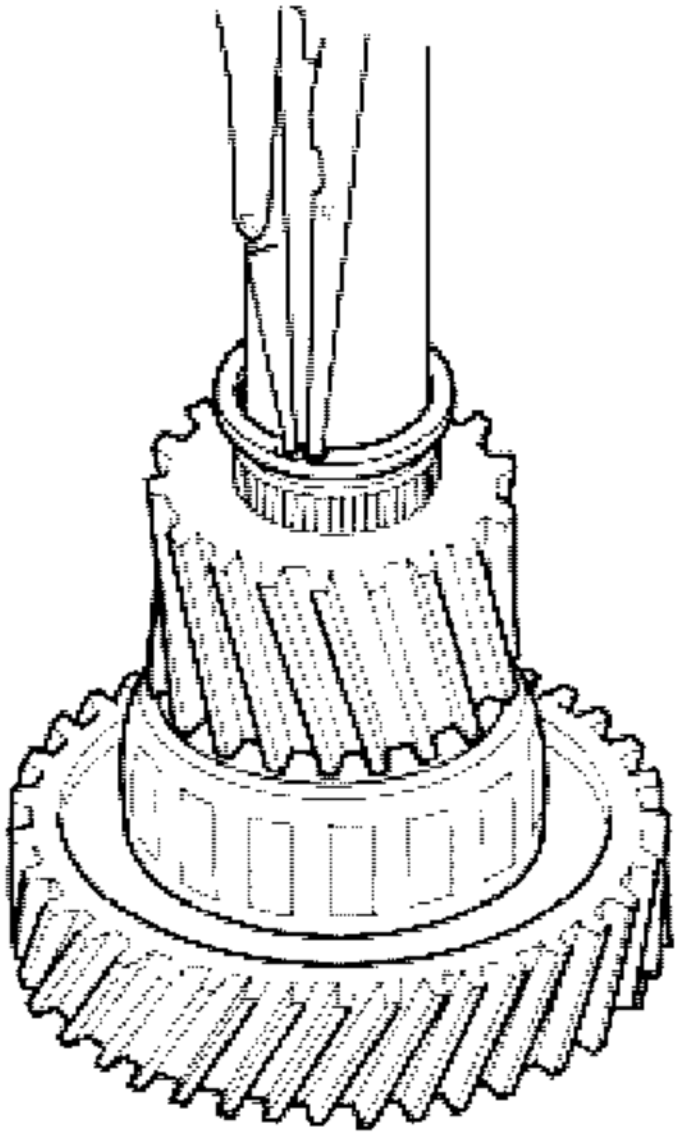


Fig. 170: 5th Speed Gear Retainer
Courtesy of GENERAL MOTORS CORP.

24. Using retainer pliers, install the 5th speed gear retainer.

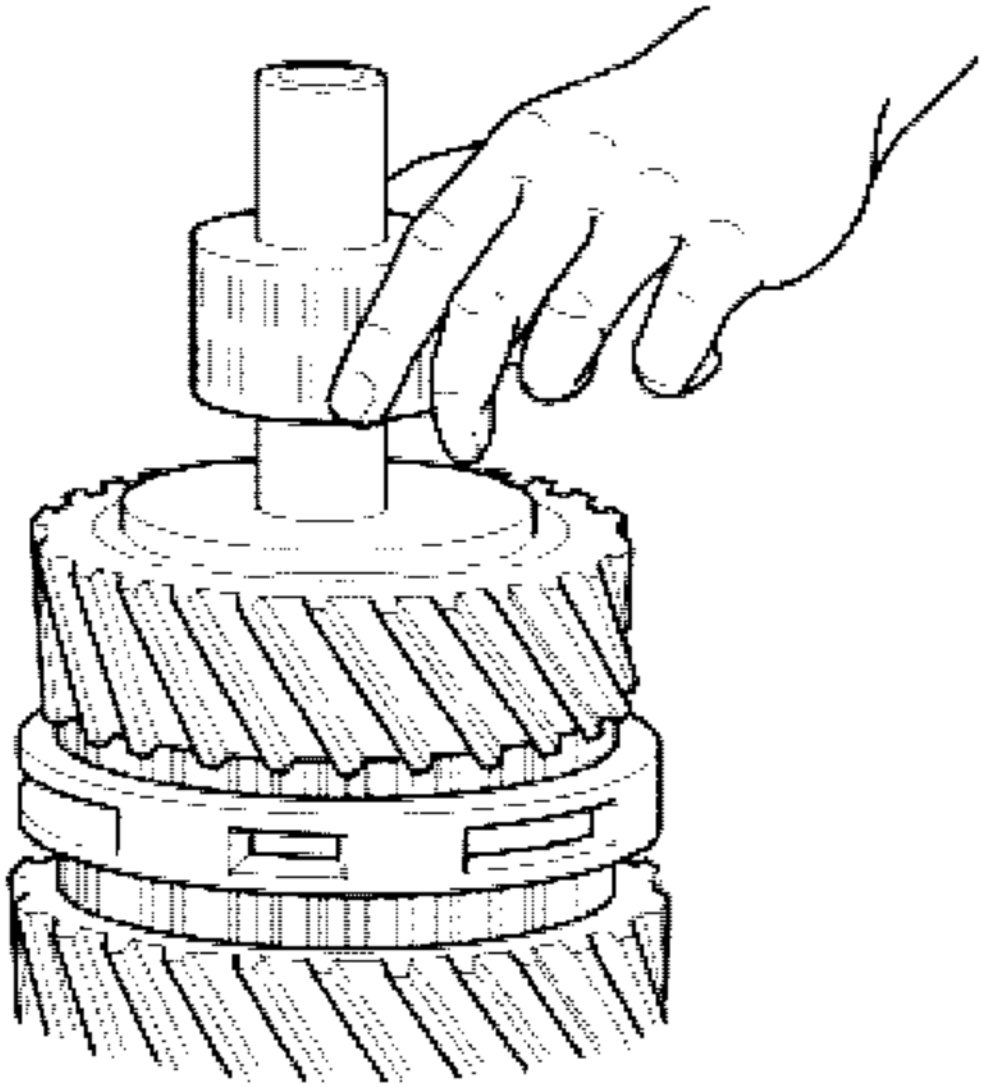


Fig. 171: 3rd Speed Roller Cage
Courtesy of GENERAL MOTORS CORP.

25. Turn the primary shaft assembly and install the 3rd speed gear roller cage.

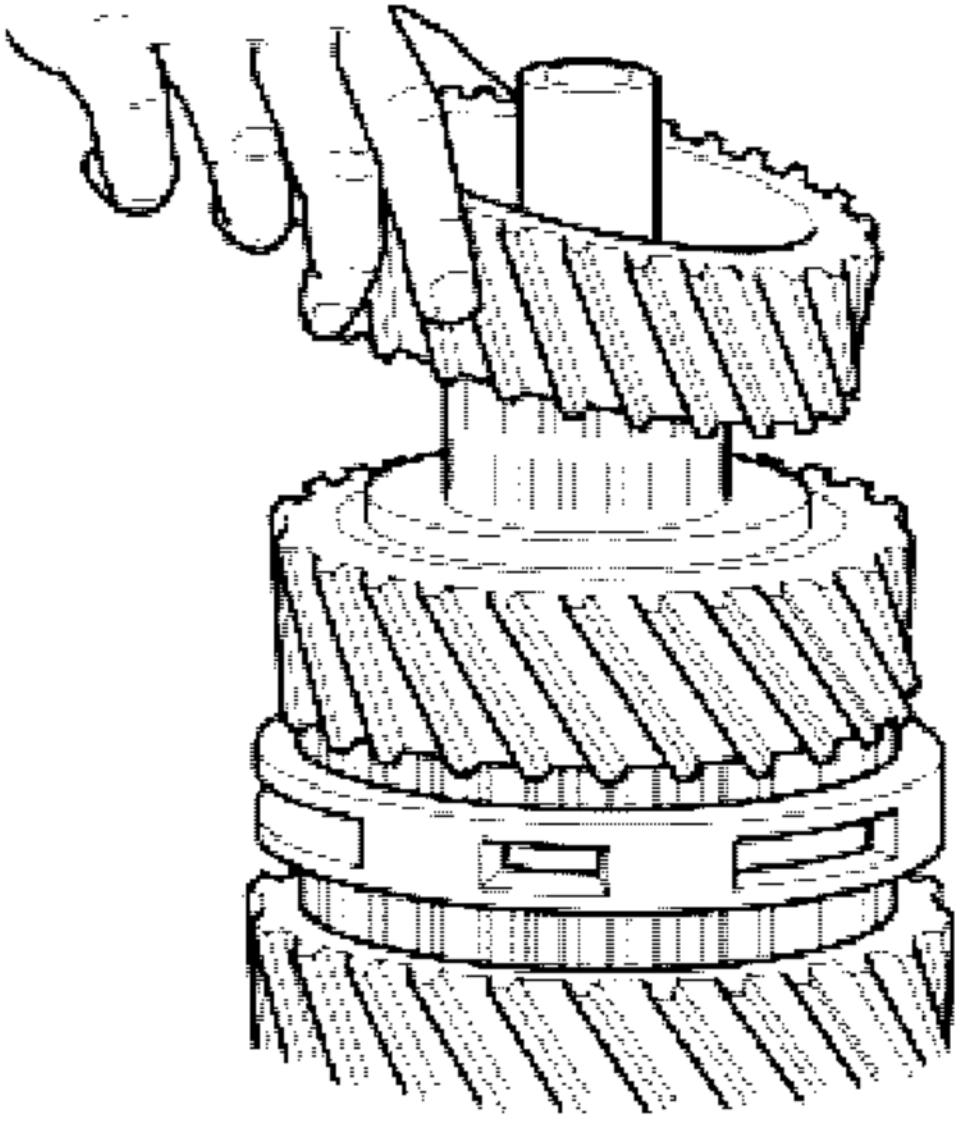


Fig. 172: 3rd Speed Gear
Courtesy of GENERAL MOTORS CORP.

26. Install 3rd speed gear.

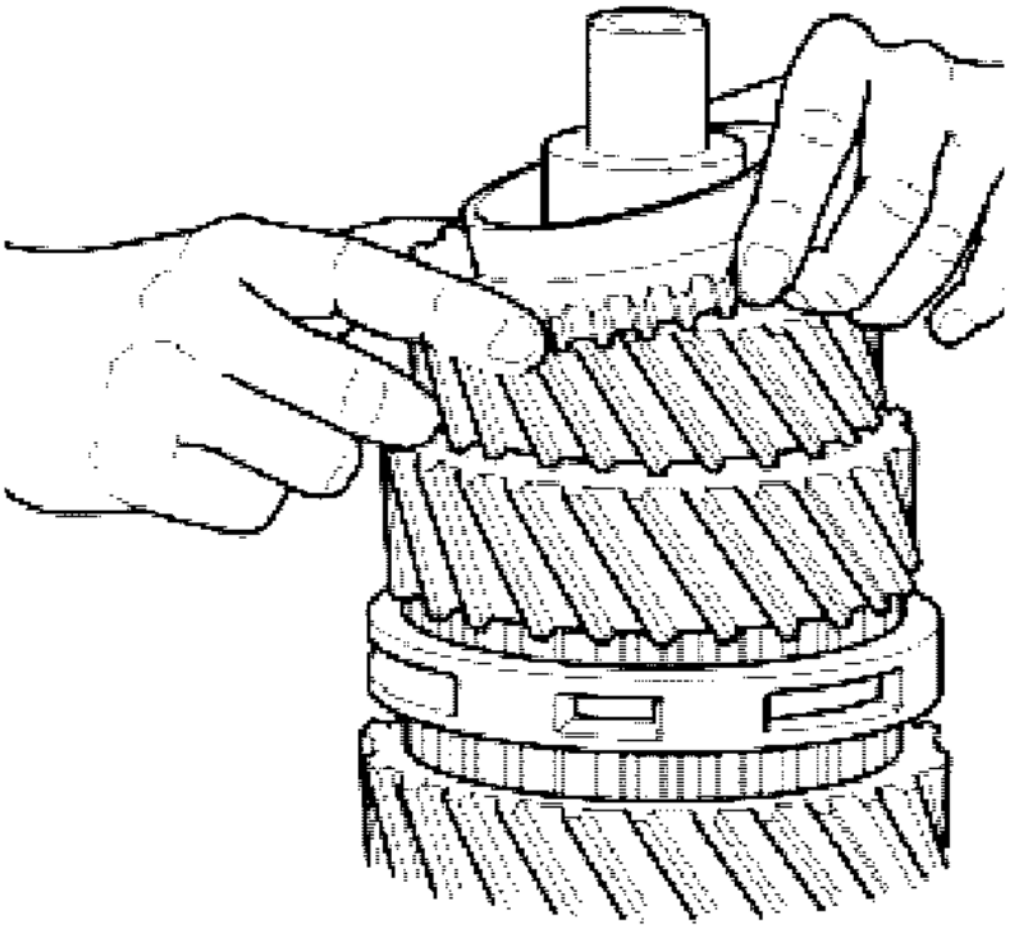


Fig. 173: 3rd Speed Coupling Cone
Courtesy of GENERAL MOTORS CORP.

27. Install the 3rd speed gear cone.

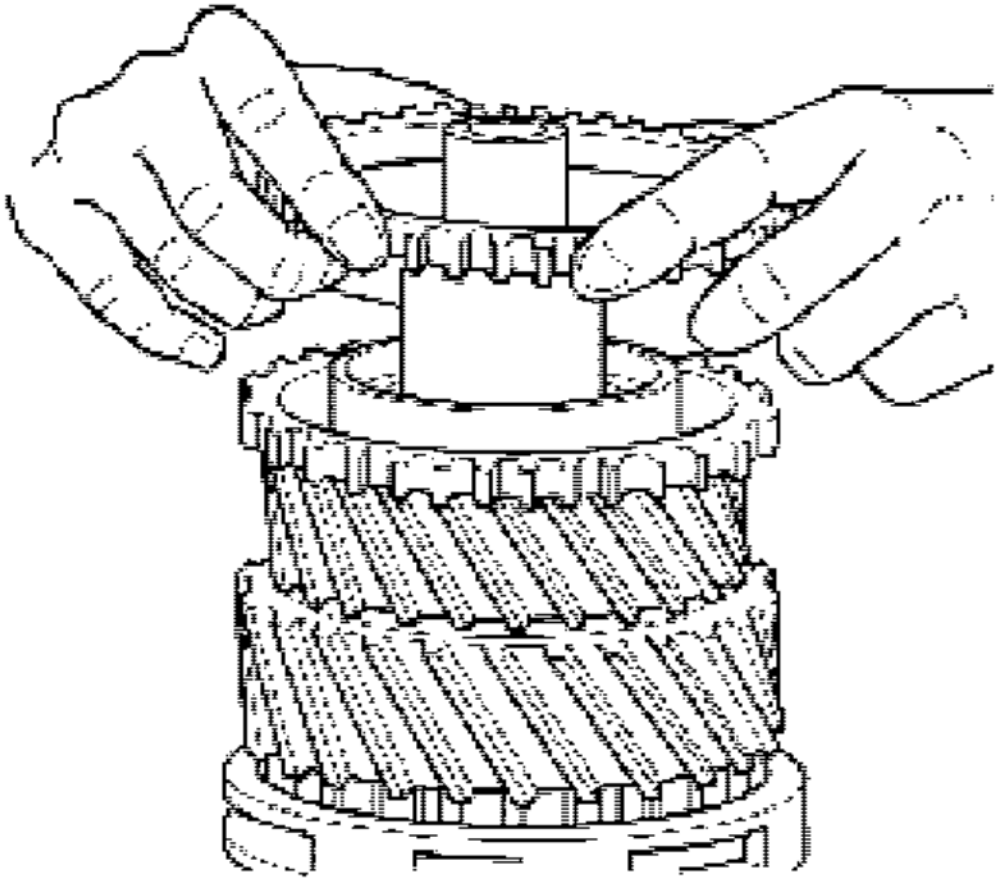


Fig. 174: 3rd Speed Gear Synchronizer Ring
Courtesy of GENERAL MOTORS CORP.

28. Install the 3rd speed gear synchronizer ring.

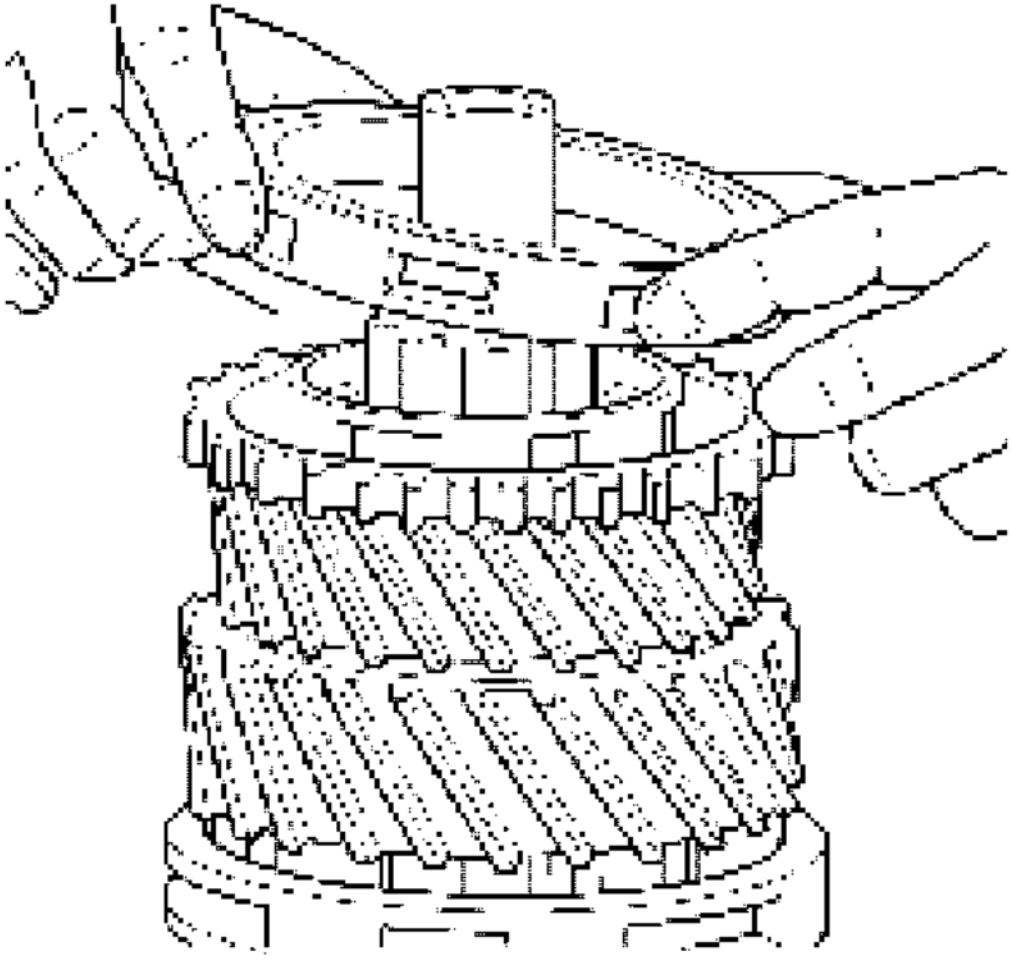


Fig. 175: 3rd And 4th Synchronizer Ring
Courtesy of GENERAL MOTORS CORP.

29. Install the 3rd and 4th speed synchronizer assembly.

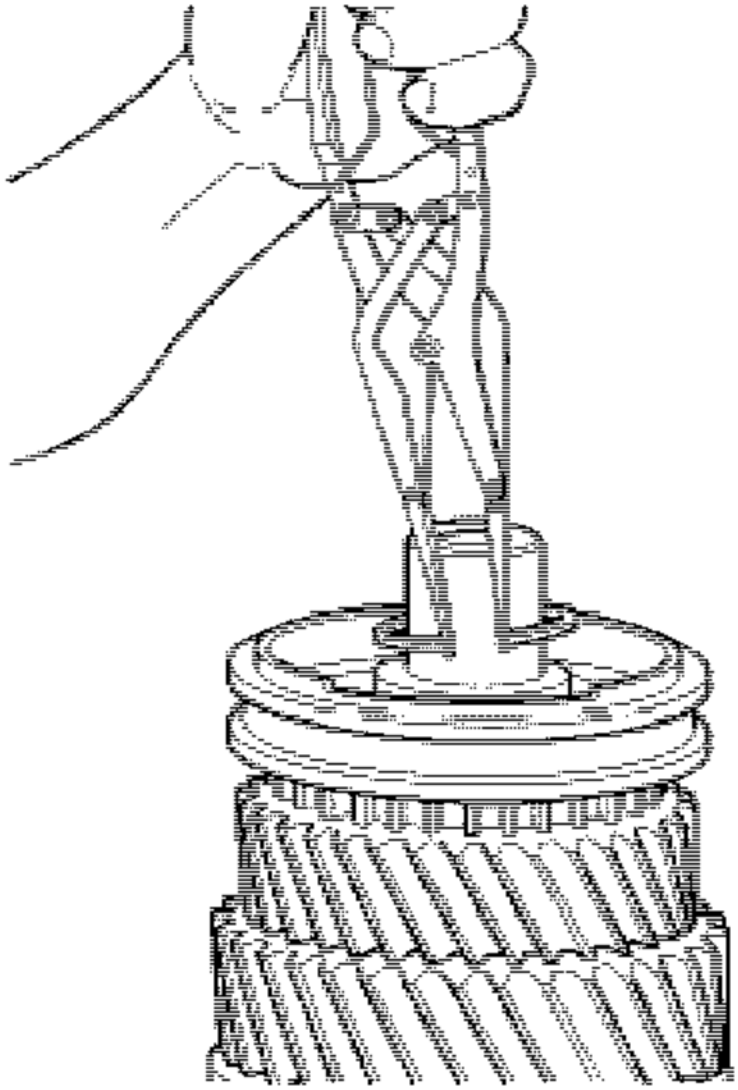


Fig. 176: 3rd And 4th Synchronizer Drum Retainer
Courtesy of GENERAL MOTORS CORP.

30. Using retainer pliers, install the 3rd and 4th synchronizer drum retainer.

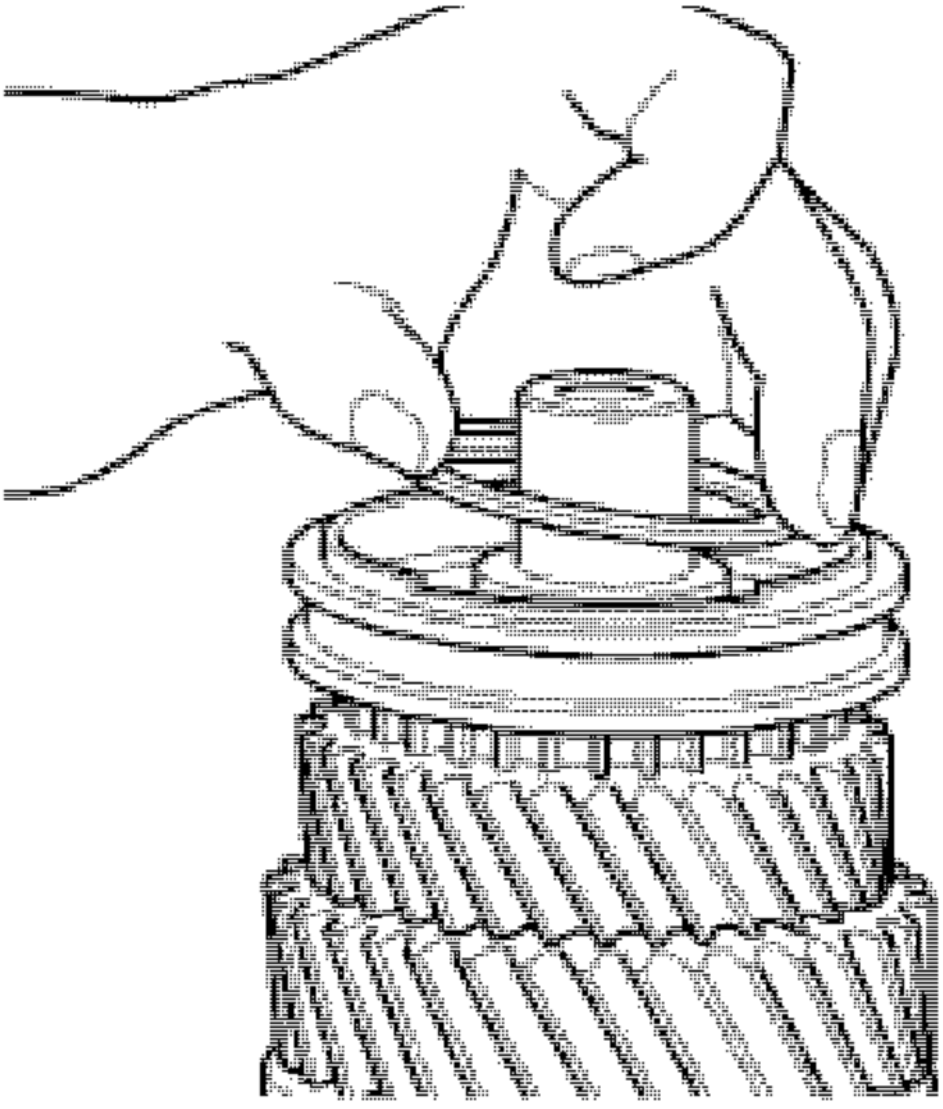


Fig. 177: Drive Wheel
Courtesy of GENERAL MOTORS CORP.

31. Install the drive wheel.

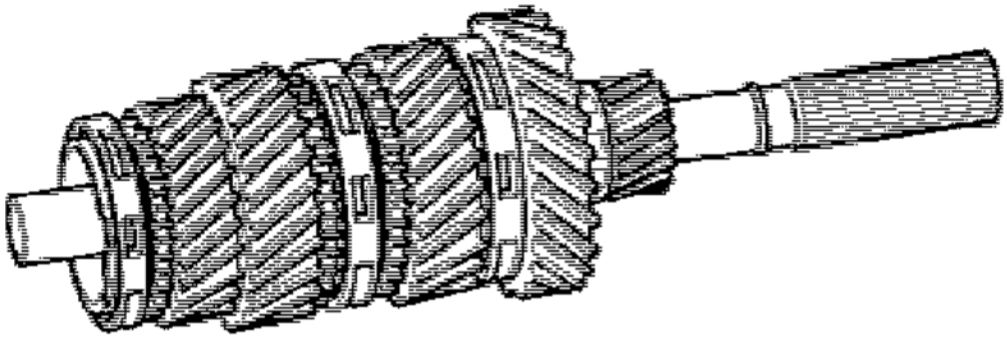


Fig. 178: Main Shaft Assembly
Courtesy of GENERAL MOTORS CORP.

32. Installed main shaft assembly.

SHIFT SHAFT AND FORK ASSEMBLIES ASSEMBLE

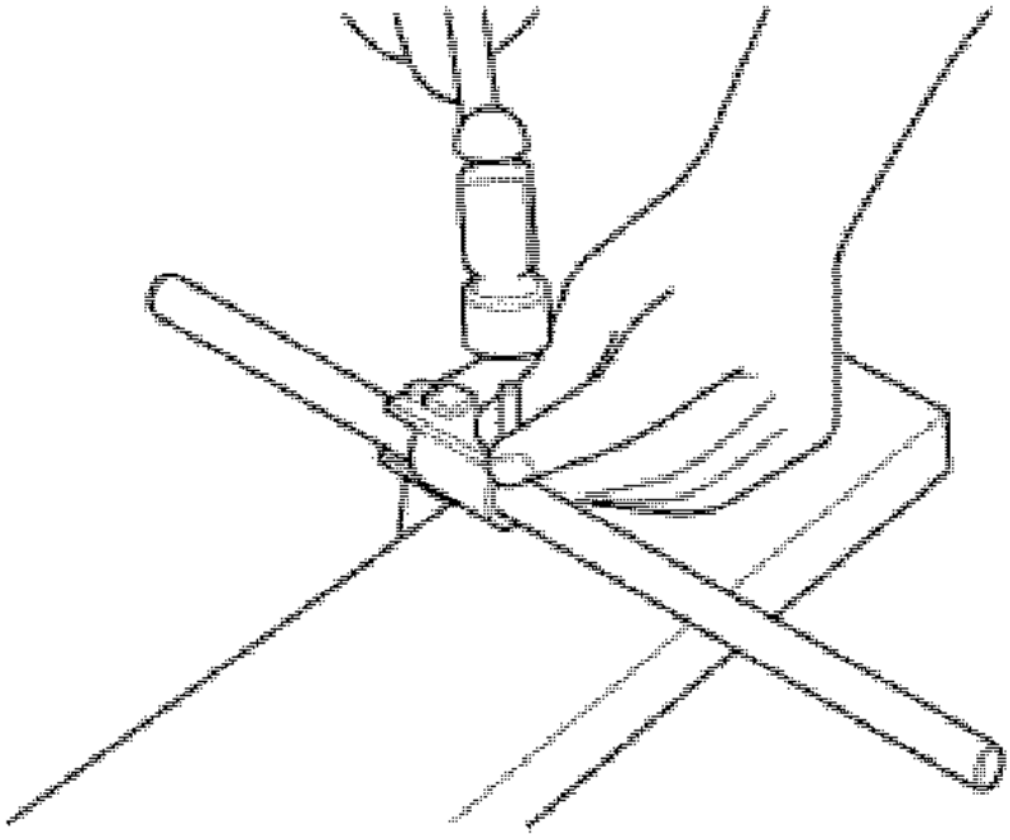


Fig. 179: Installing Speed Selector Stop Pin
Courtesy of GENERAL MOTORS CORP.

1. Using a hammer, install the speed selector stop pin if it was removed.

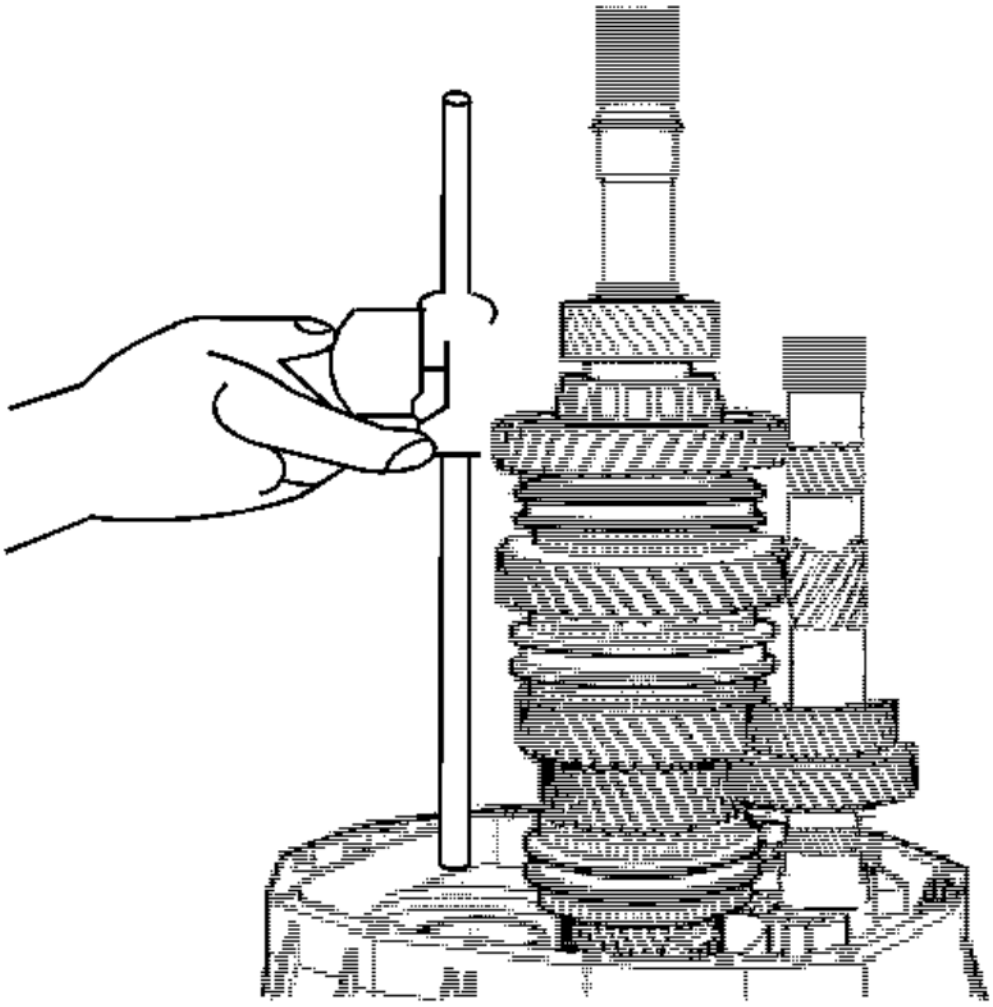


Fig. 180: Control Lever
Courtesy of GENERAL MOTORS CORP.

2. Install the shift lever.

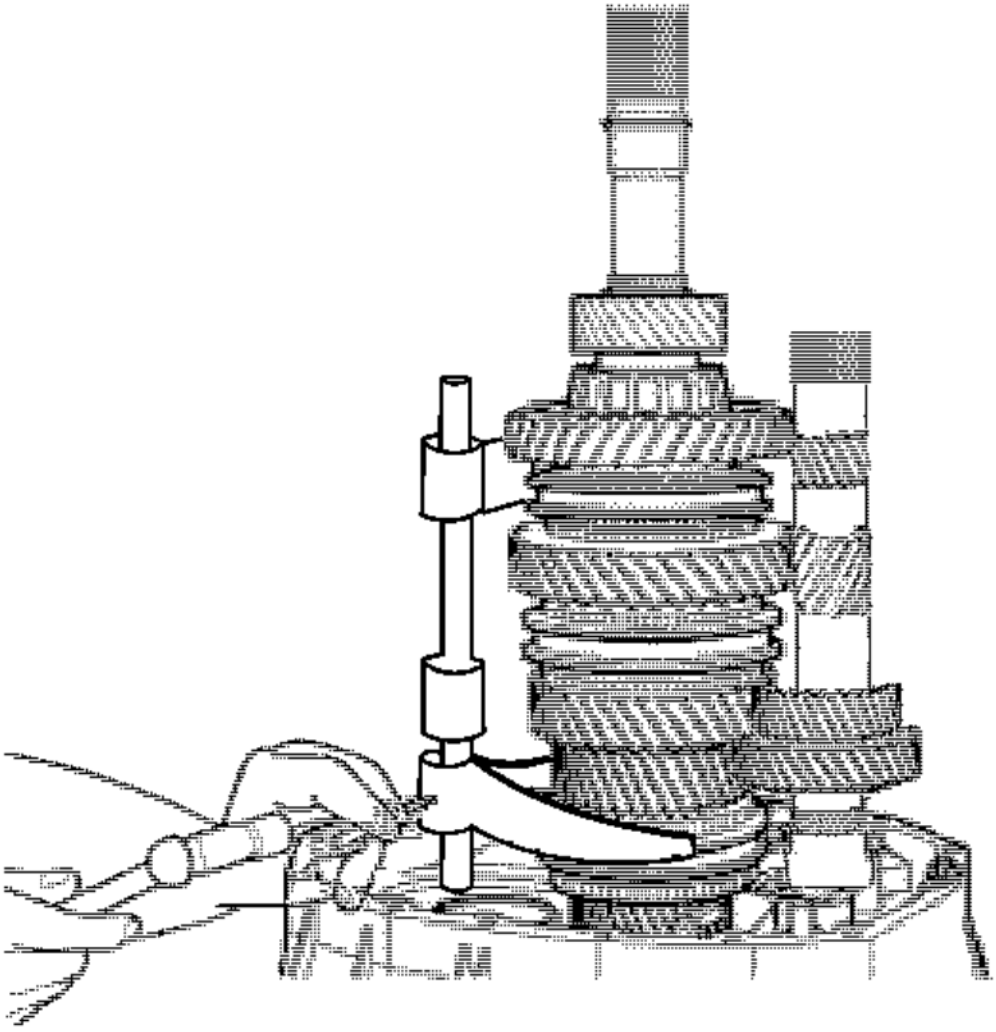


Fig. 181: Installing 3rd And 4th Fork
Courtesy of GENERAL MOTORS CORP.

3. Using a hammer, install the 3rd and 4th fork.

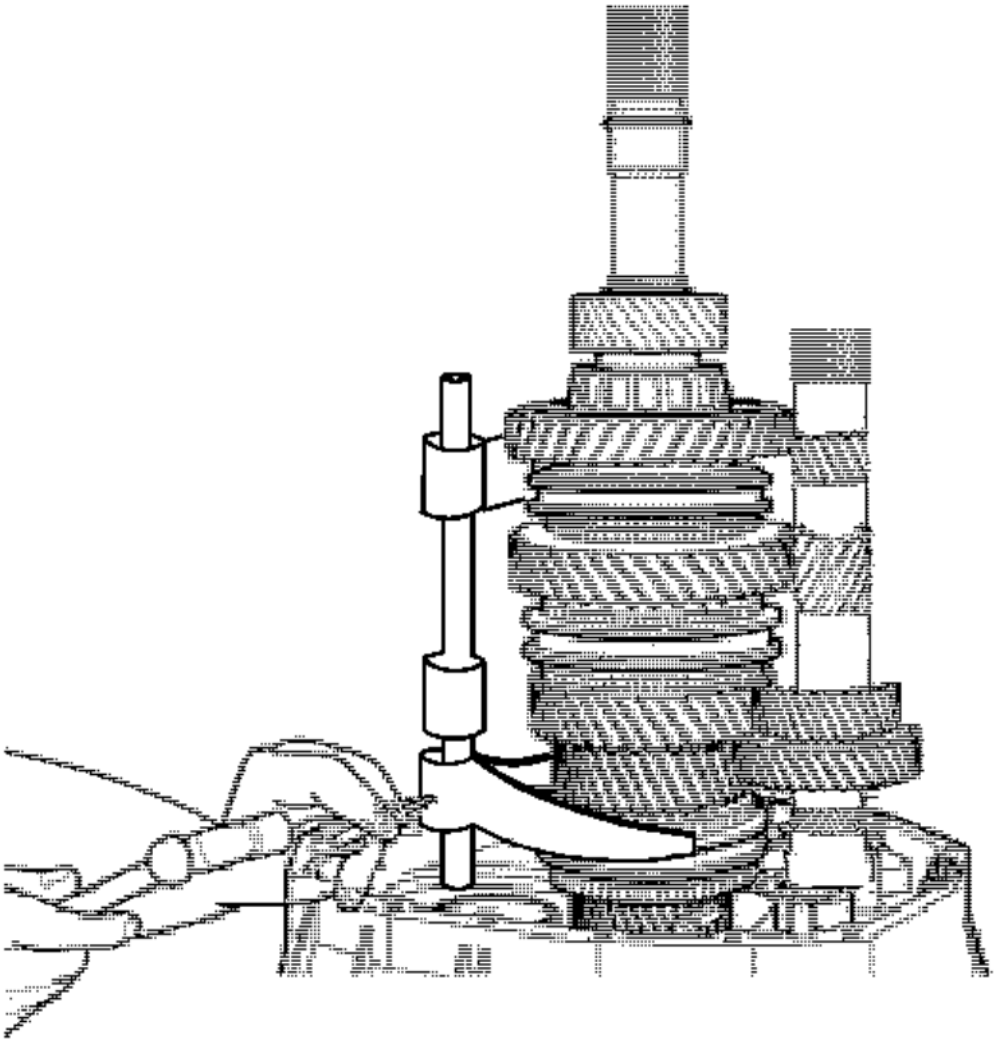


Fig. 182: Installing Fork Retaining Bolt
Courtesy of GENERAL MOTORS CORP.

4. Using a hammer, install the fork retaining bolt on the 3rd and 4th shift lever.

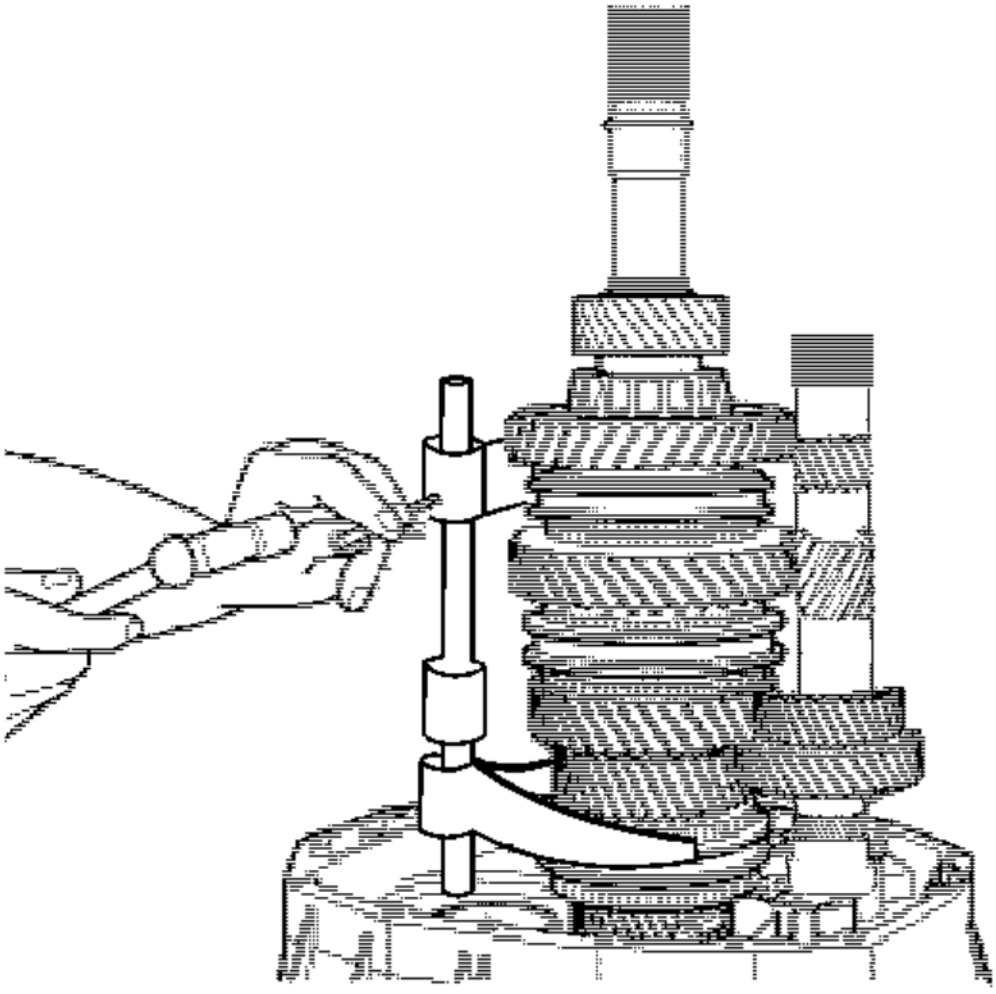


Fig. 183: Installing Stop Pin On 3rd And 4th Shift Lever
Courtesy of GENERAL MOTORS CORP.

5. Using a hammer, install the stop pin on the 3rd and 4th shift lever.

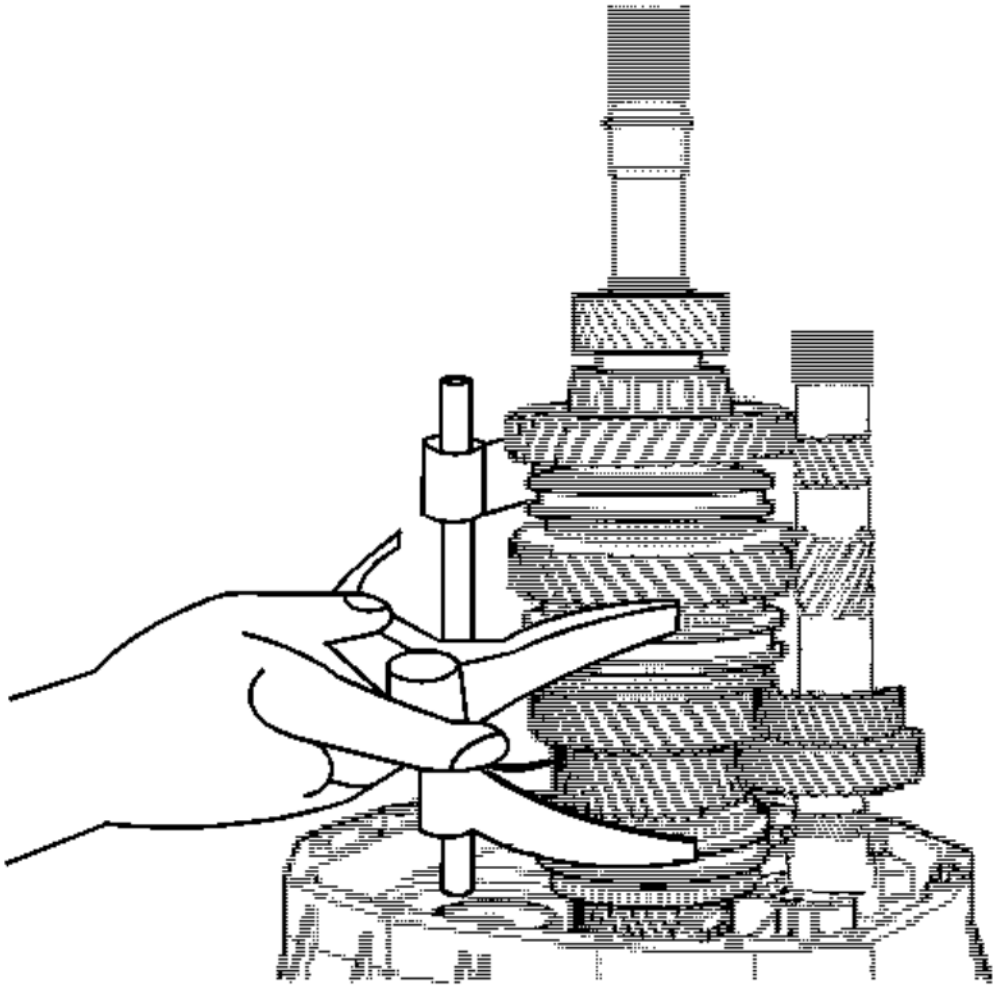


Fig. 184: 1st And 2nd Fork
Courtesy of GENERAL MOTORS CORP.

6. Install the 1st and 2nd fork.

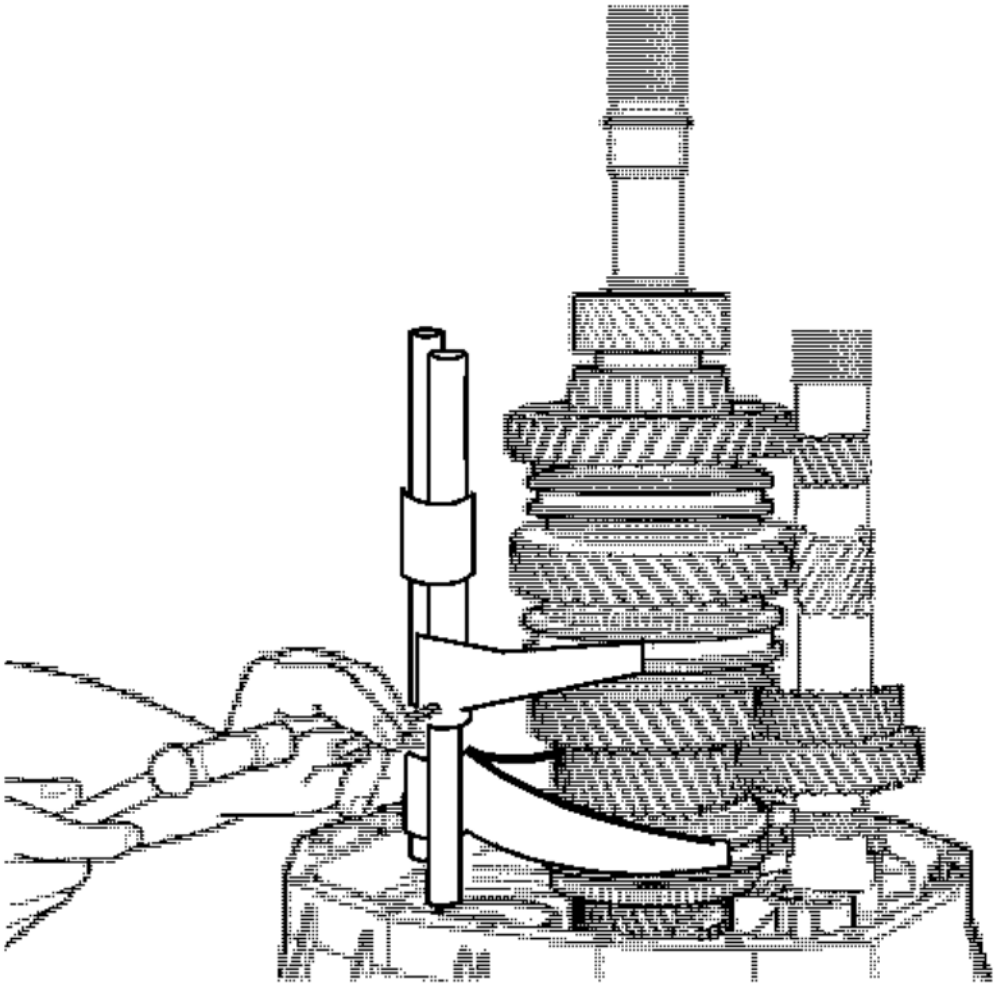


Fig. 185: Installing Fork Pin In 1st And 2nd Shift Lever
Courtesy of GENERAL MOTORS CORP.

7. Using a hammer, install the fork pin in the 1st and 2nd shift lever. Be careful with the anchor bolt that goes on the bar.

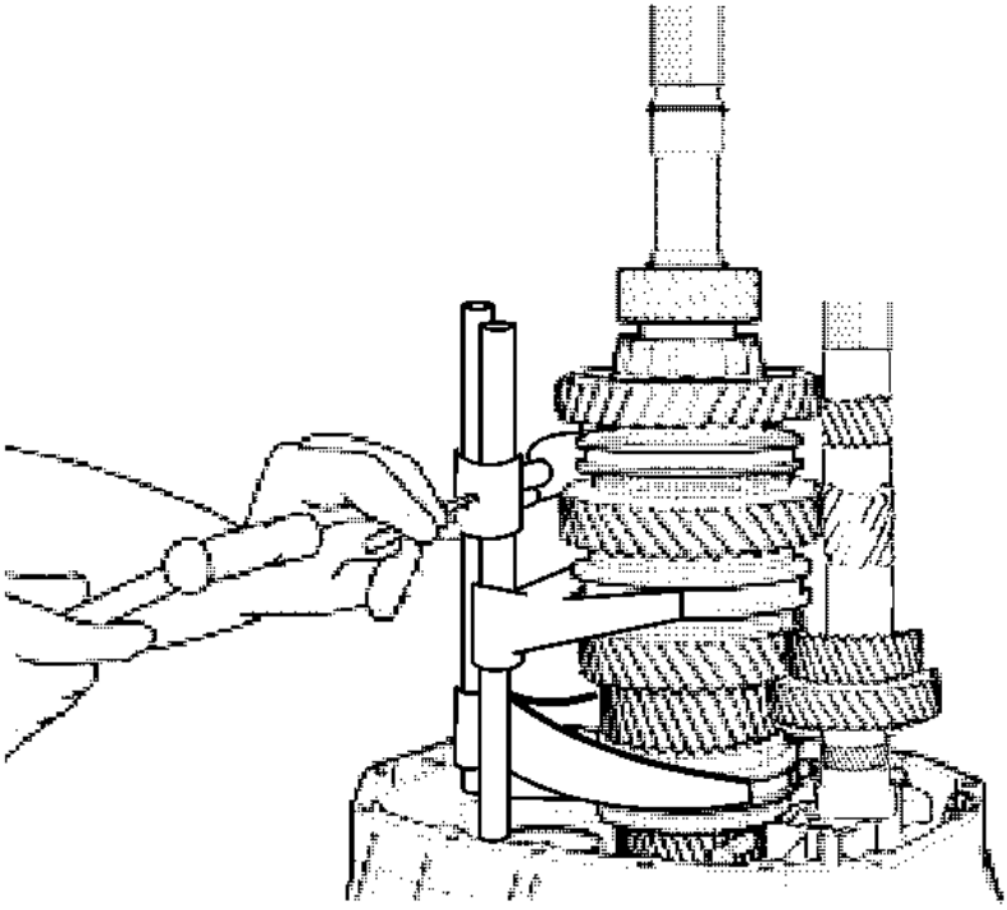


Fig. 186: Installing 1st And 2nd Speed Stop Pin
Courtesy of GENERAL MOTORS CORP.

8. Using a hammer, install the 1st and 2nd speed stop pin on the shift lever.

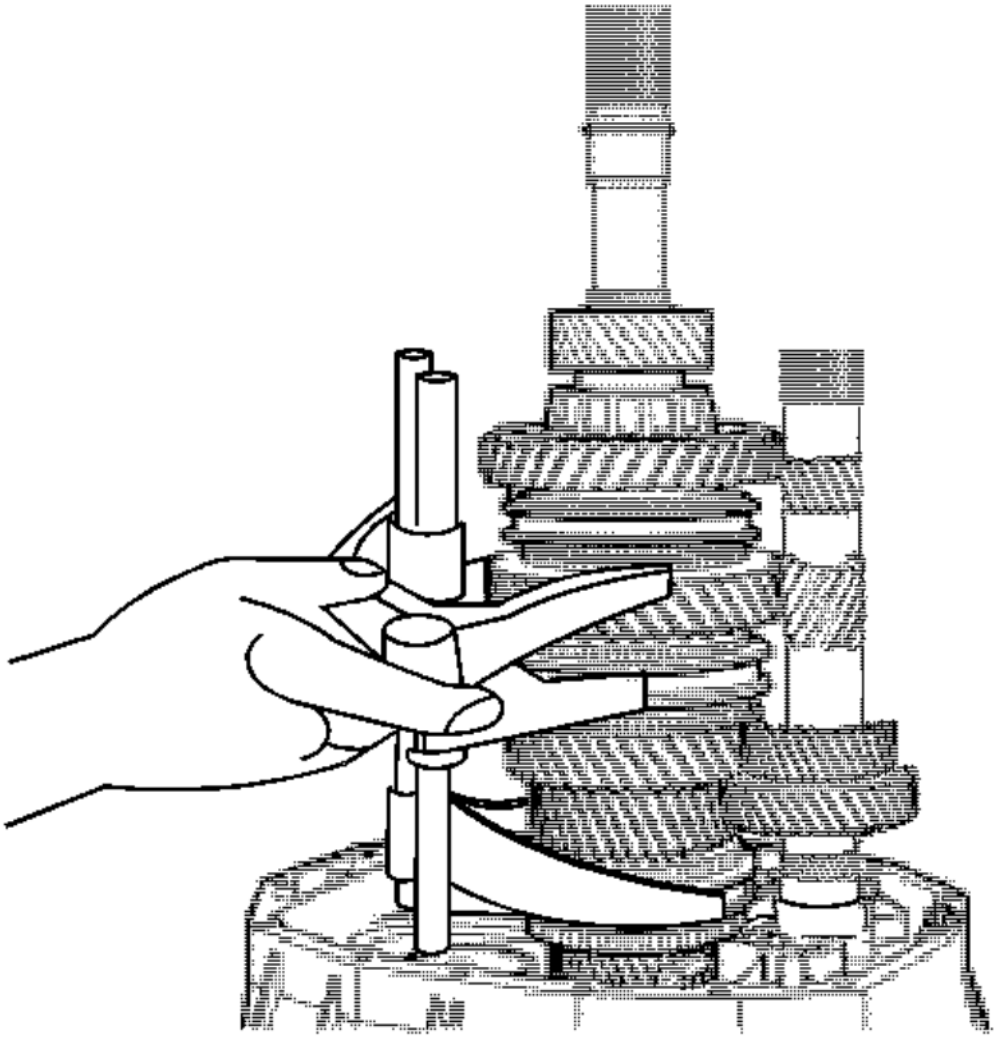


Fig. 187: Reverse Fork
Courtesy of GENERAL MOTORS CORP.

9. Install the reverse fork.

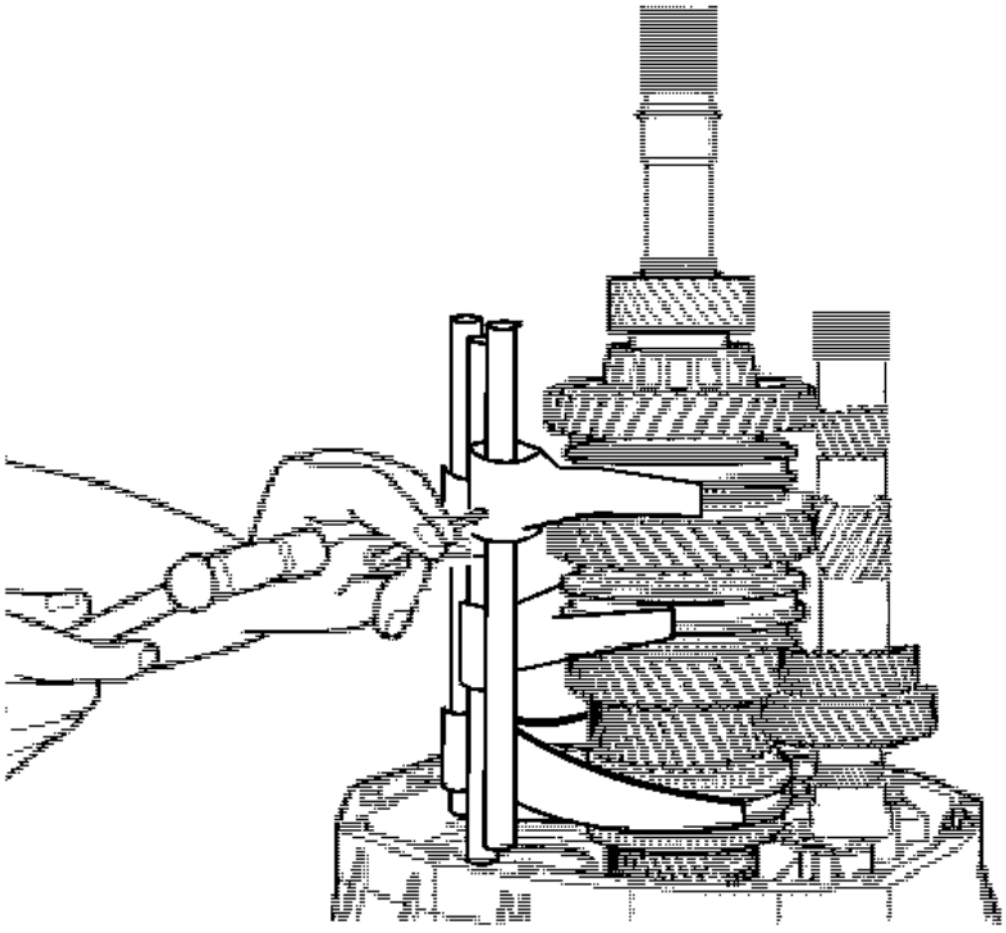


Fig. 188: Installing Fork Pin On 5th Speed And Reverse Shift Lever
Courtesy of GENERAL MOTORS CORP.

10. Using a hammer, install the fork pin on the 5th speed and reverse shift lever.

MAIN SHAFT AND COUNTER GEAR SHAFT AXIAL PLAY MEASUREMENT

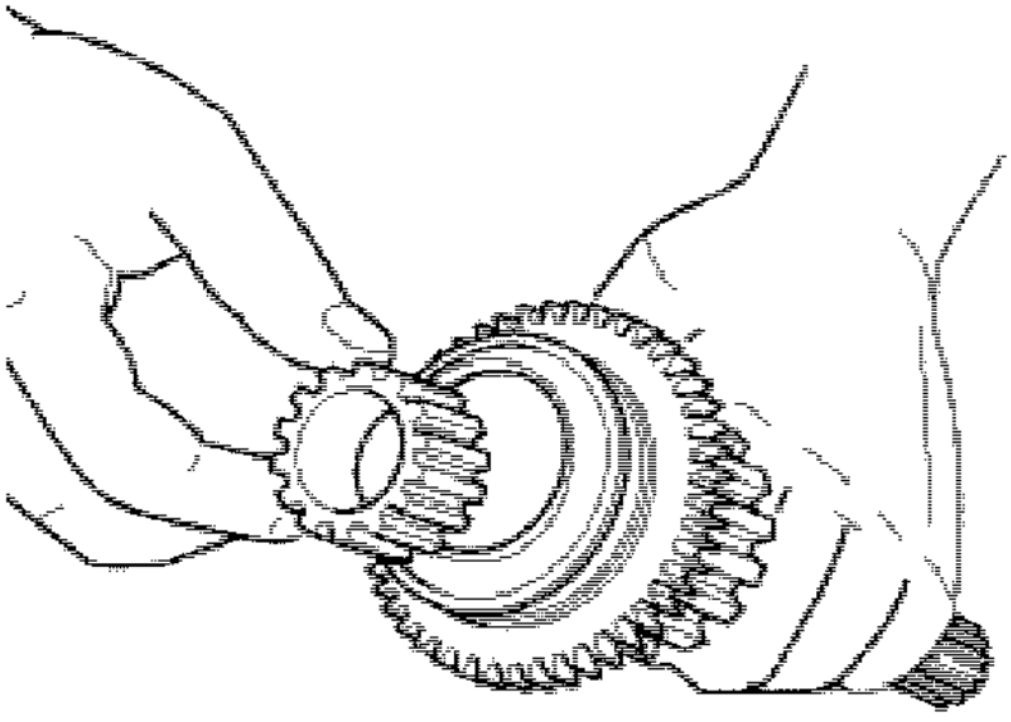


Fig. 189: Axial Bearing
Courtesy of GENERAL MOTORS CORP.

1. Install the axial bearing.

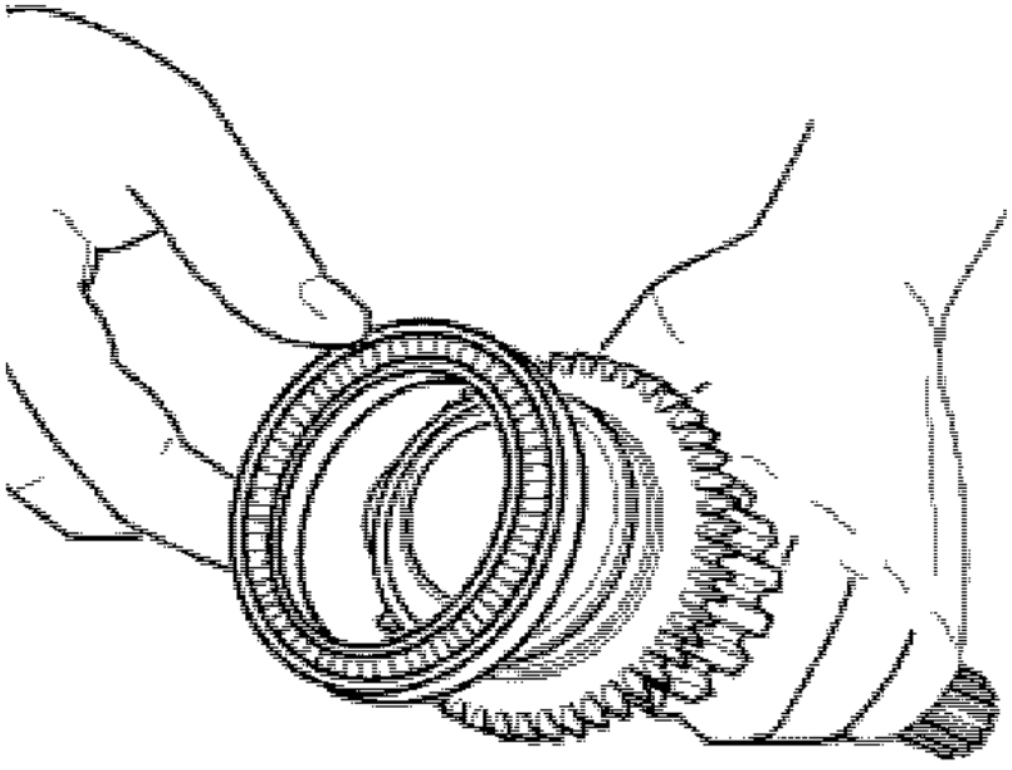


Fig. 190: Input Shaft Thrust Bearing
Courtesy of GENERAL MOTORS CORP.

2. Install the input shaft thrust bearing.

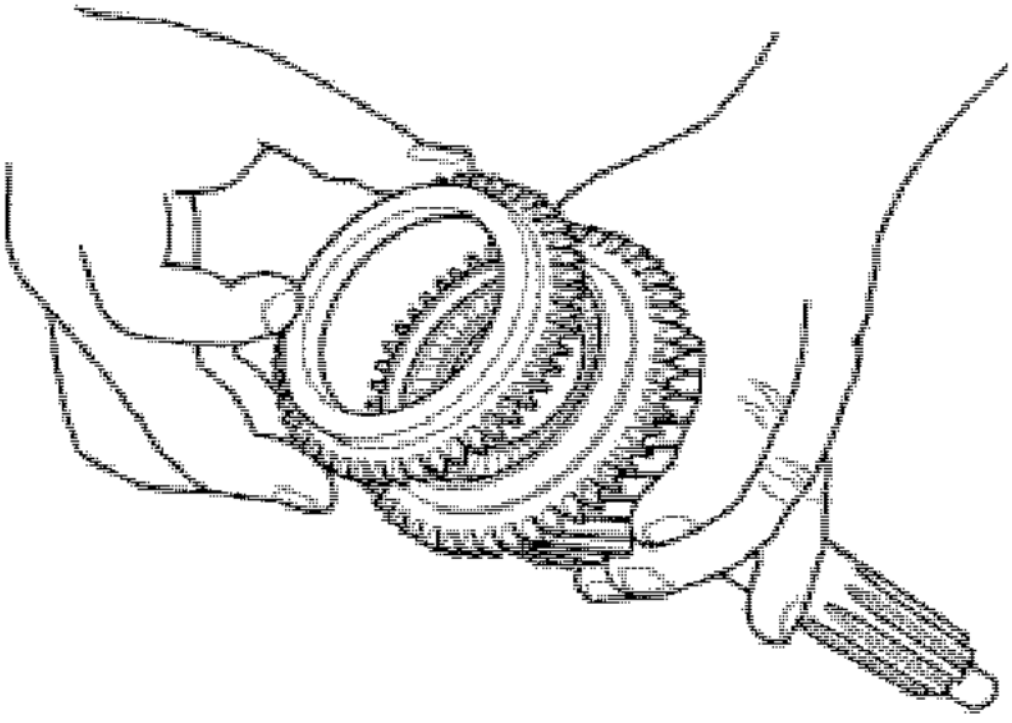


Fig. 191: Input Shaft Synchronizer Ring
Courtesy of GENERAL MOTORS CORP.

3. Install the input shaft synchronizer ring.

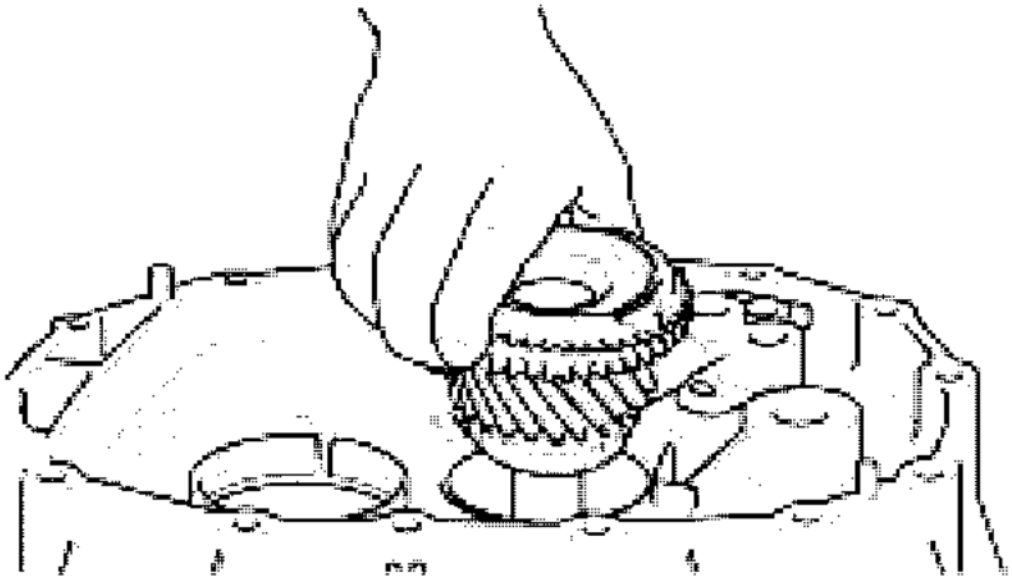


Fig. 192: Input Shaft
Courtesy of GENERAL MOTORS CORP.

4. Install the input shaft.

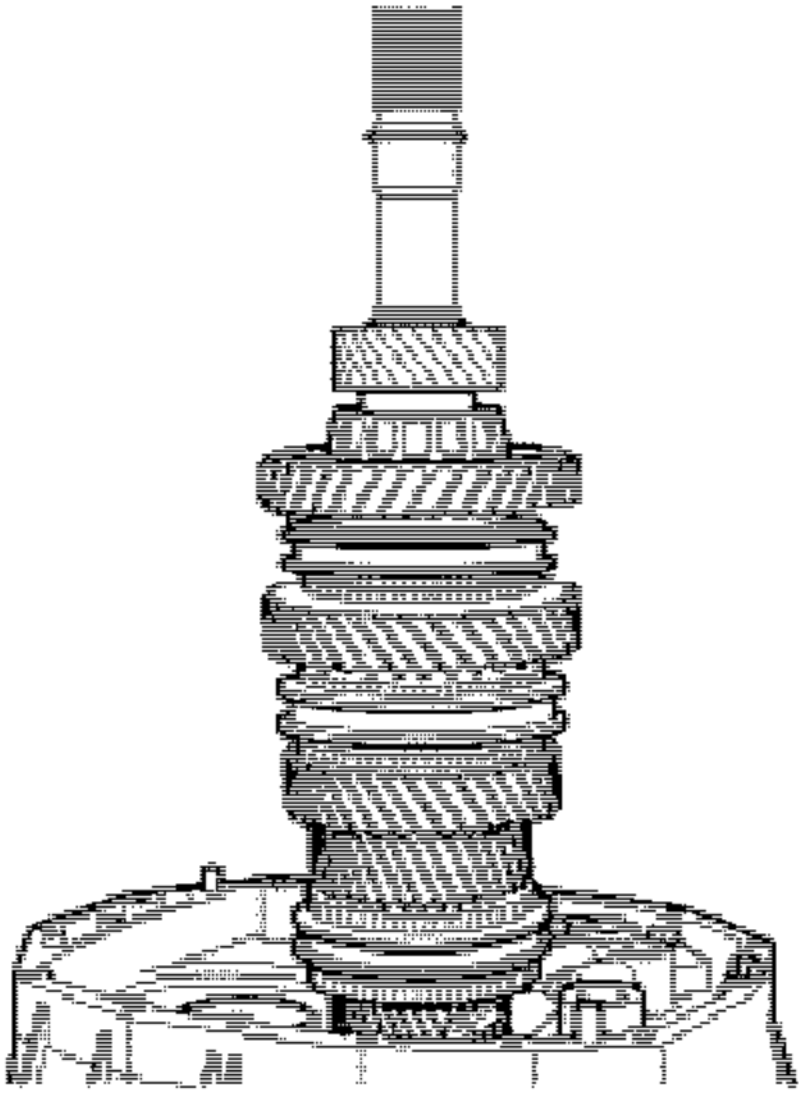


Fig. 193: Primary Shaft Arrangement
Courtesy of GENERAL MOTORS CORP.

5. Install the primary shaft arrangement.

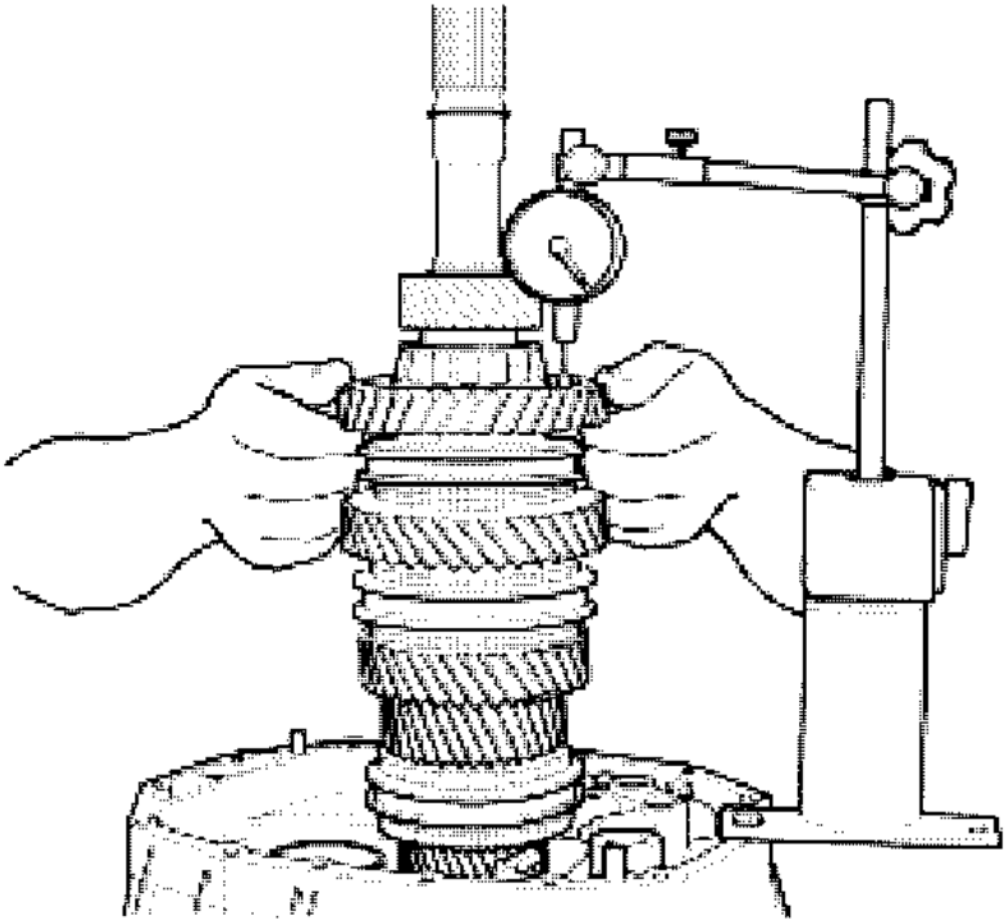


Fig. 194: Inspecting Axial Play Of Reverse Gear
Courtesy of GENERAL MOTORS CORP.

6. Inspect the axial play of the reverse gear.

   Specification: 0.0101-0.0355 cm (0.004-0.014 in)

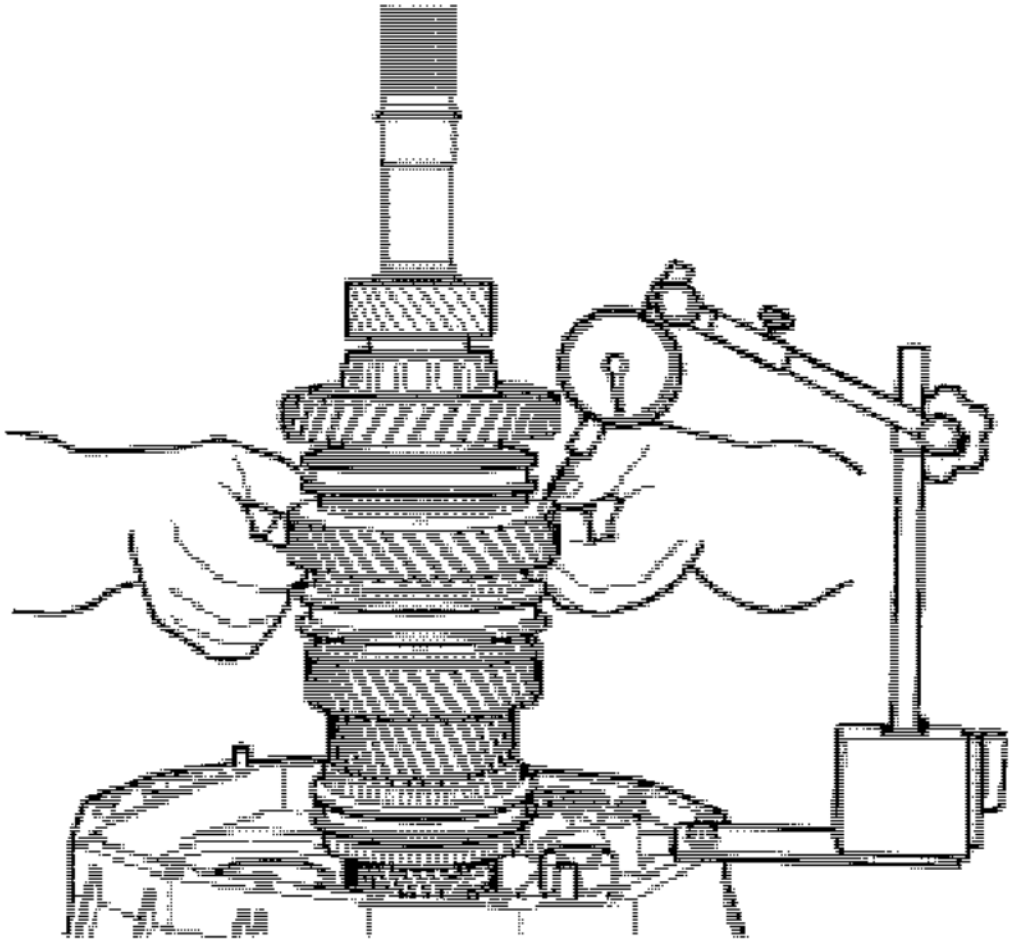


Fig. 195: Inspecting Axial Play Of 1st Speed Gear
Courtesy of GENERAL MOTORS CORP.

7. Inspect the axial play of the 1st speed gear.

   Specification: 0.0203-0.0406 cm (0.008-0.016 in)

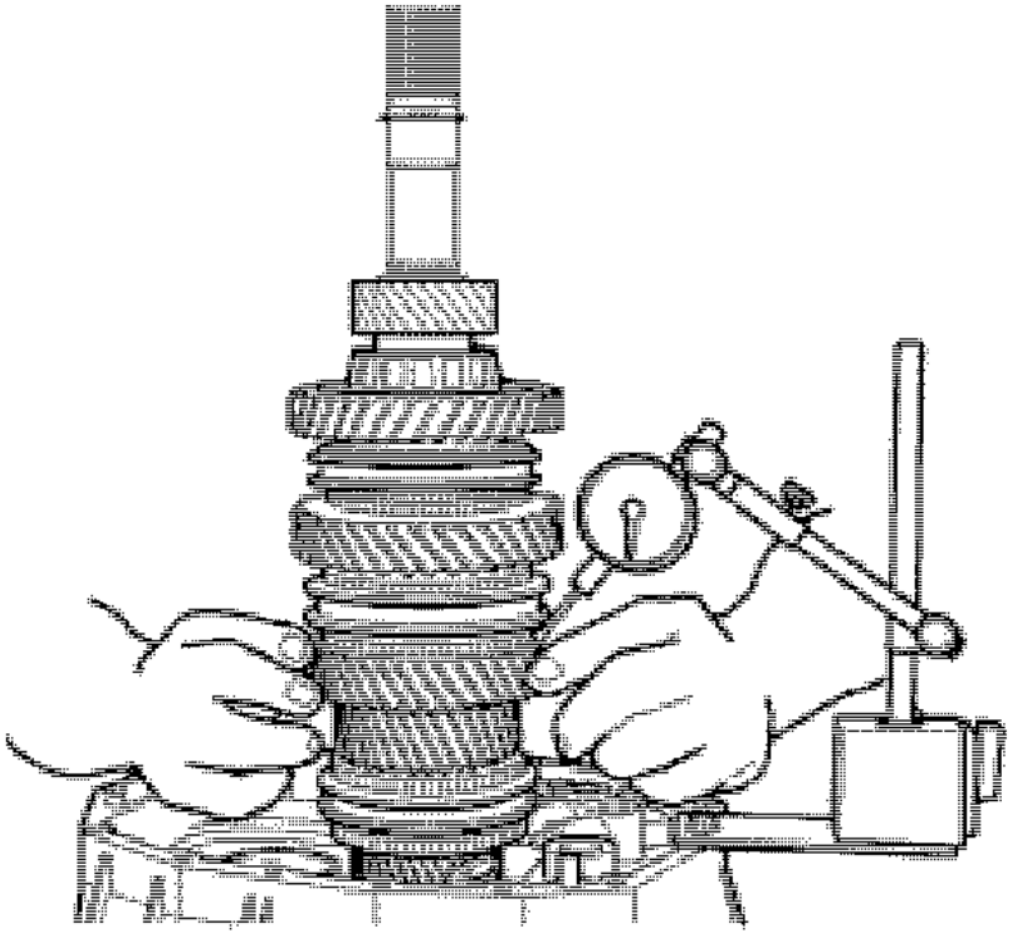


Fig. 196: Inspecting Axial Play Of 2nd Speed Gear
Courtesy of GENERAL MOTORS CORP.

8. Inspect the axial play of the 2nd speed gear.

   Specification: 0.0101-0.0355 cm (0.004-0.014 in)

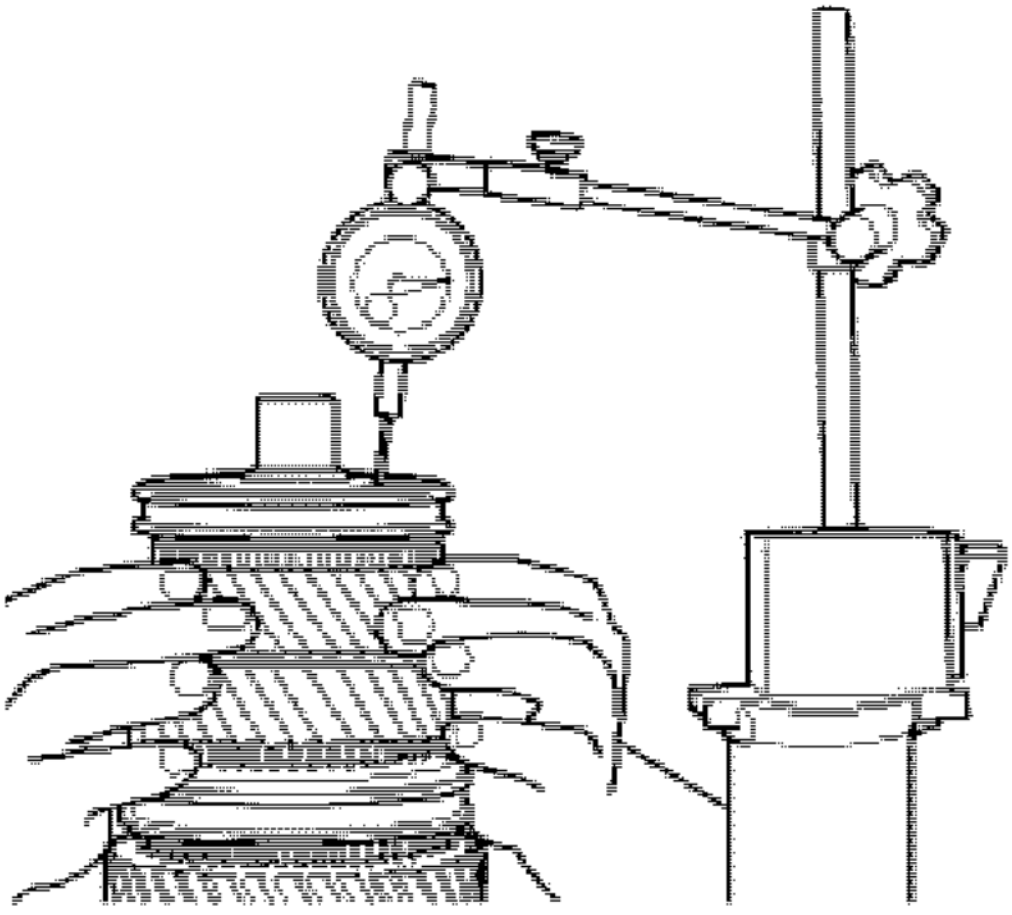


Fig. 197: Inspecting Axial Play Of 3rd Speed Gear
Courtesy of GENERAL MOTORS CORP.

9. Inspect the axial play of the 3rd speed gear. There are 4 retainer thicknesses to select from.

   Specification: 0.0101-0.0355 cm (0.004-0.014 in)

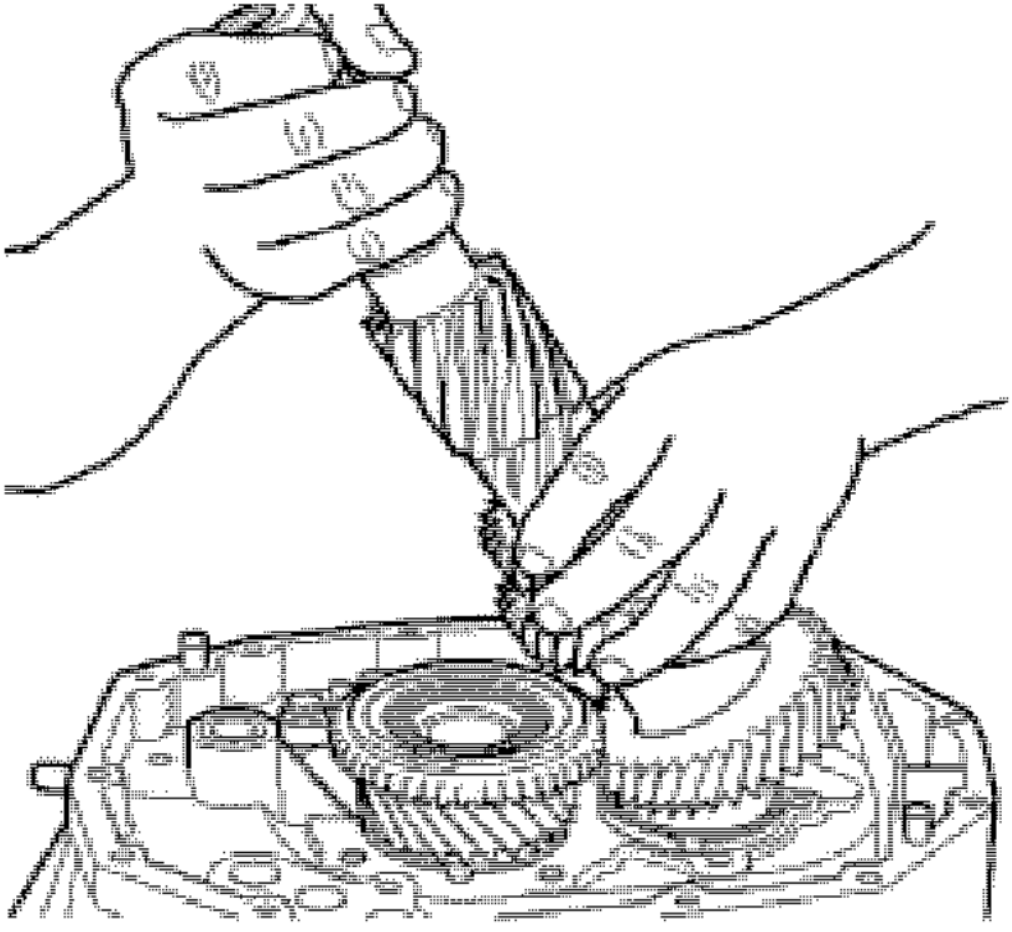


Fig. 198: Gear Train Assembly
Courtesy of GENERAL MOTORS CORP.

10. Install the gear train assembly.

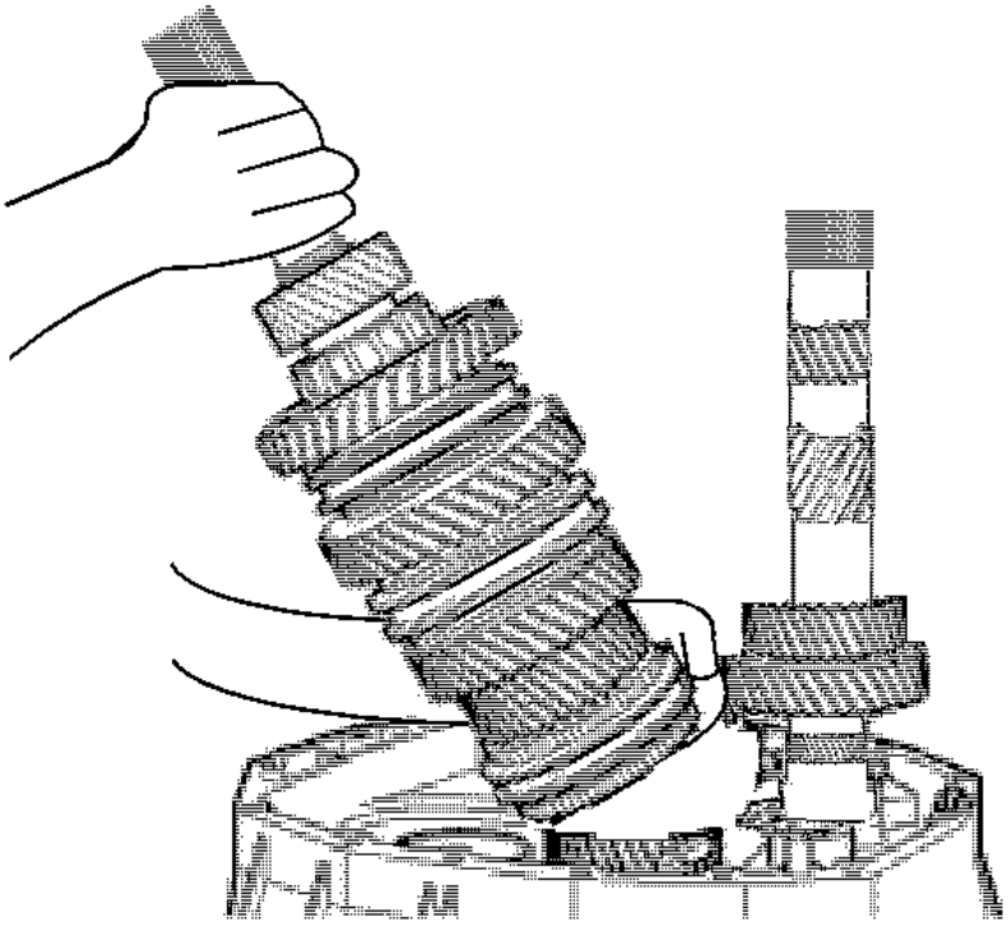


Fig. 199: Primary Shaft Assembly And Casing
Courtesy of GENERAL MOTORS CORP.

11. Once the primary shaft assembly axial plays have been inspected, install the primary shaft assembly in the casing.

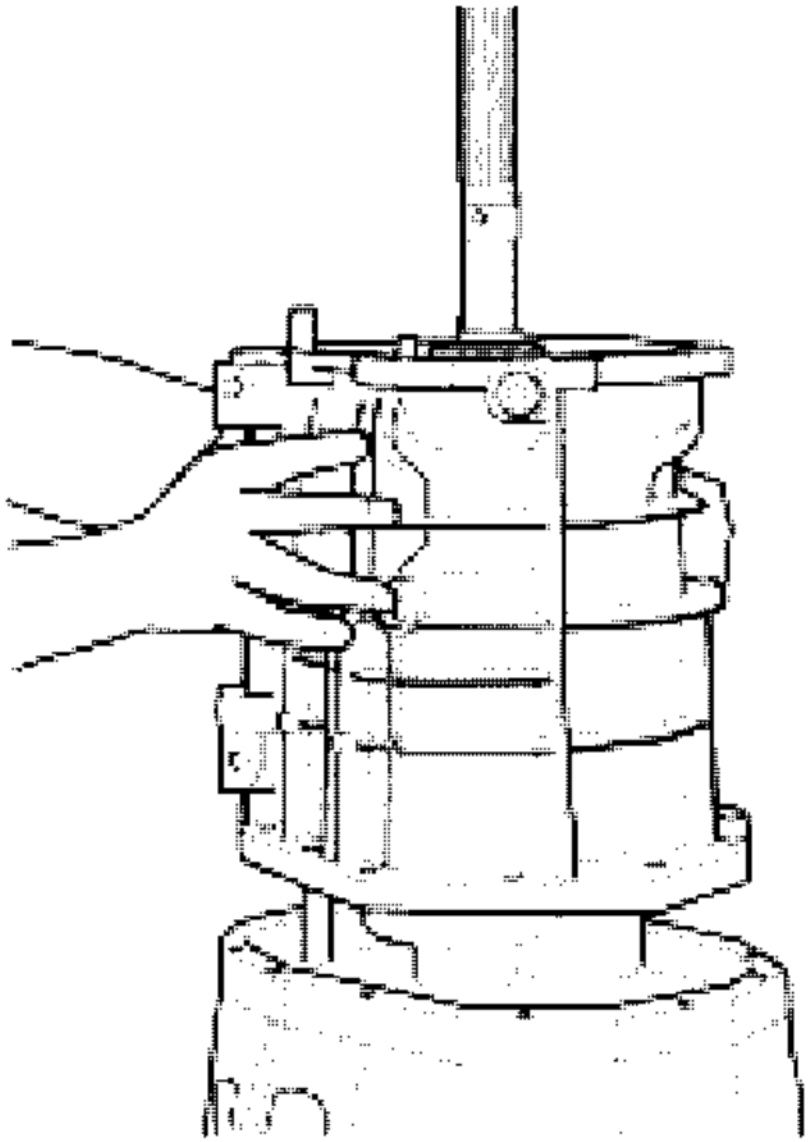


Fig. 200: Casing
Courtesy of GENERAL MOTORS CORP.

12. Install the transmission casing.

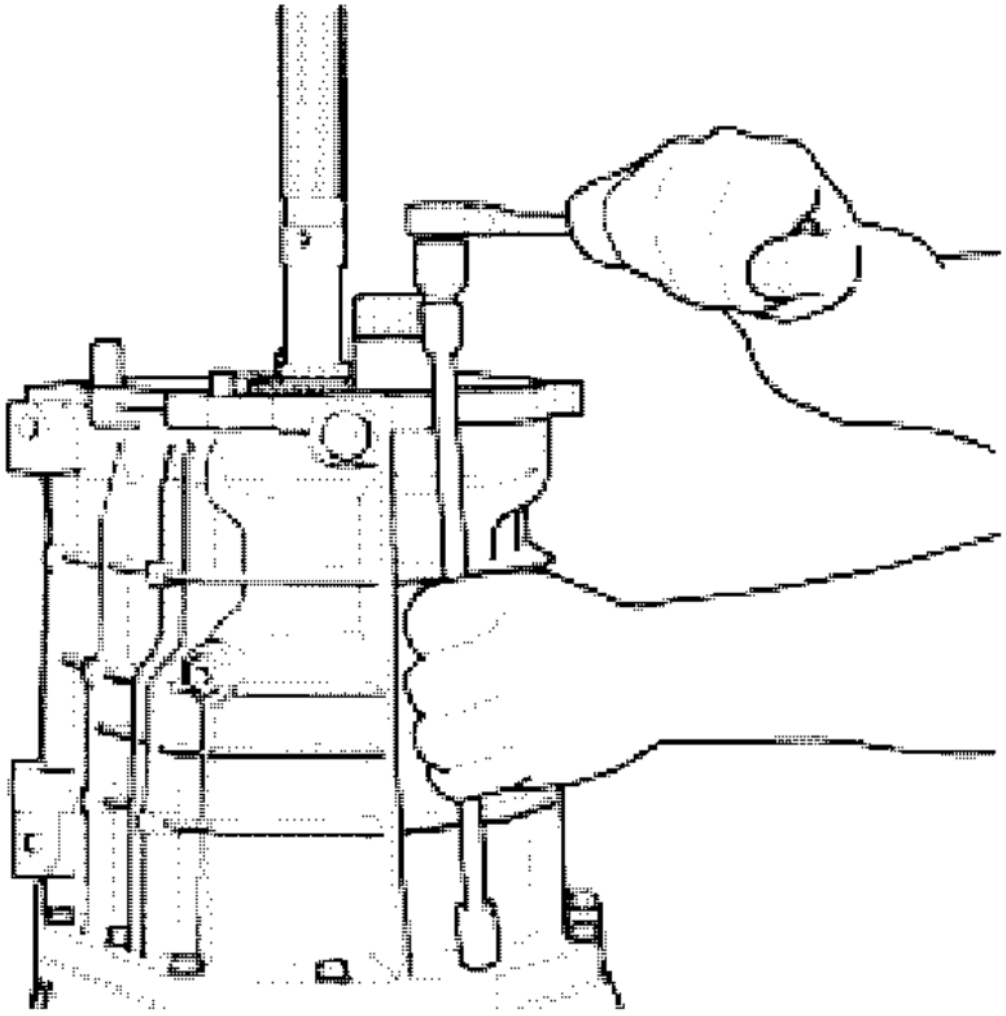


Fig. 201: Casing Bolts Securing Housing
Courtesy of GENERAL MOTORS CORP.

13. Using a 10 mm wrench, install the bolts that secure the casing.

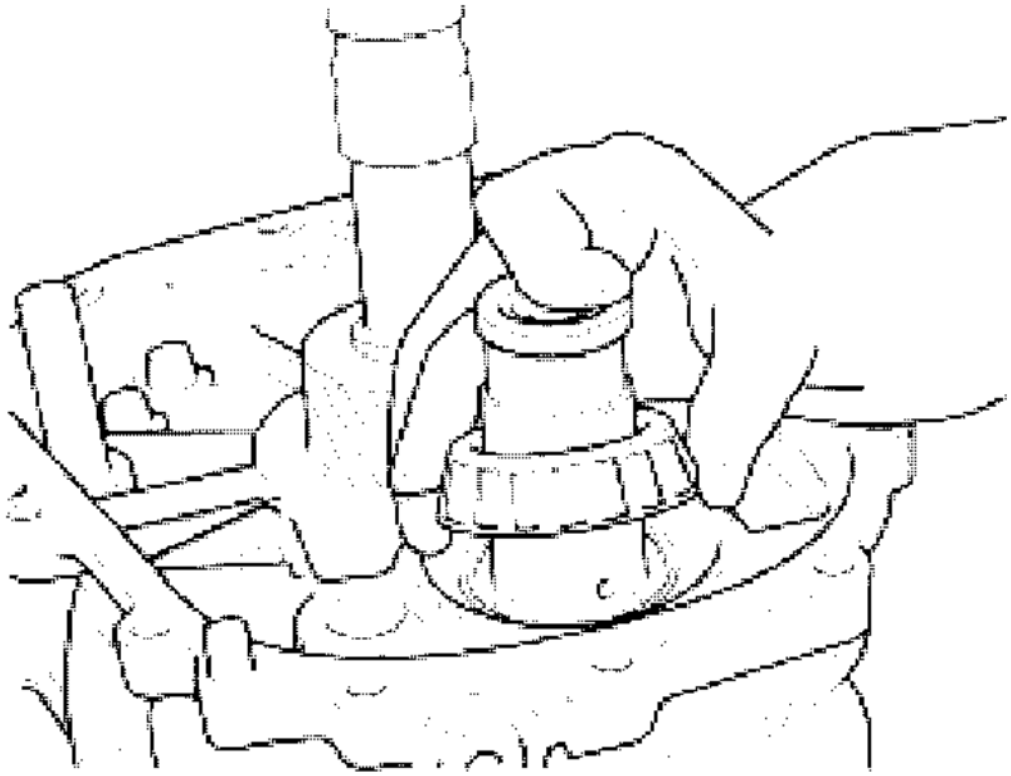


Fig. 202: Bearing
Courtesy of GENERAL MOTORS CORP.

14. Install the bearing cone.

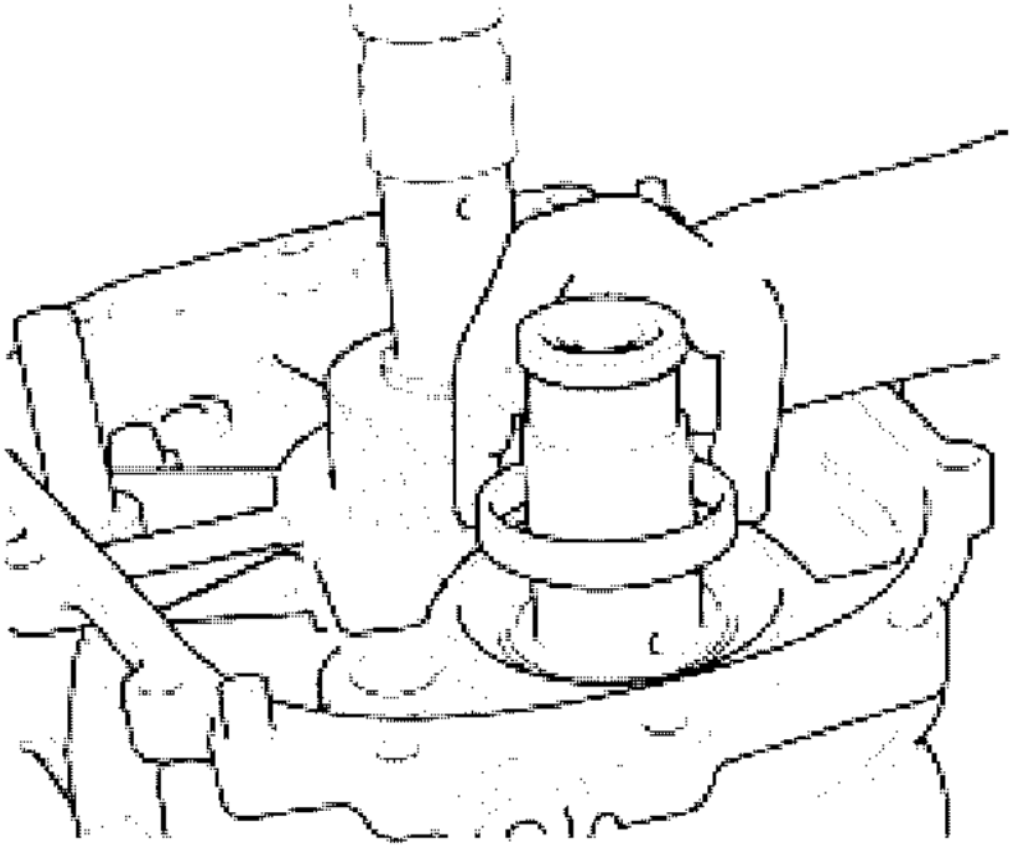


Fig. 203: Bearing Race
Courtesy of GENERAL MOTORS CORP.

15. Install the gear train taper bearing cup.

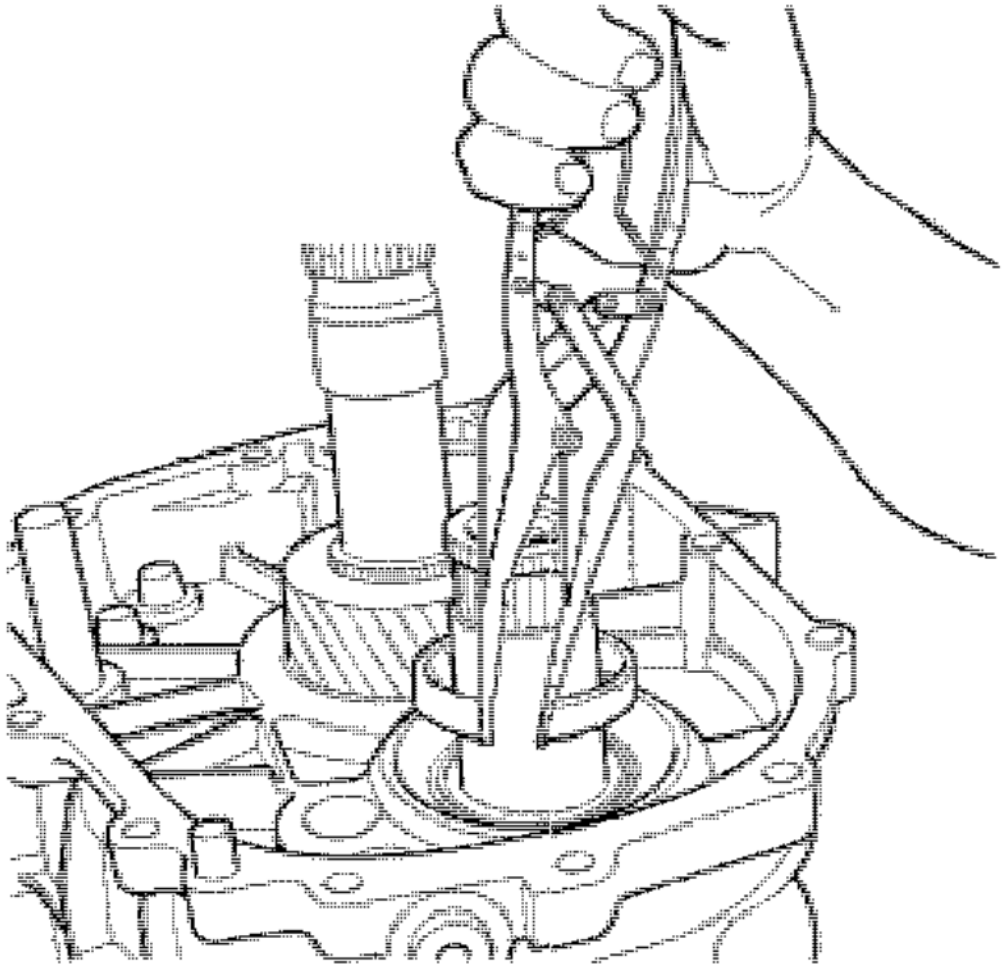


Fig. 204: Retainer Securing Gear Train Bearing Race
Courtesy of GENERAL MOTORS CORP.

16. Using retainer pliers, install the retainer that secures the gear train bearing cup.

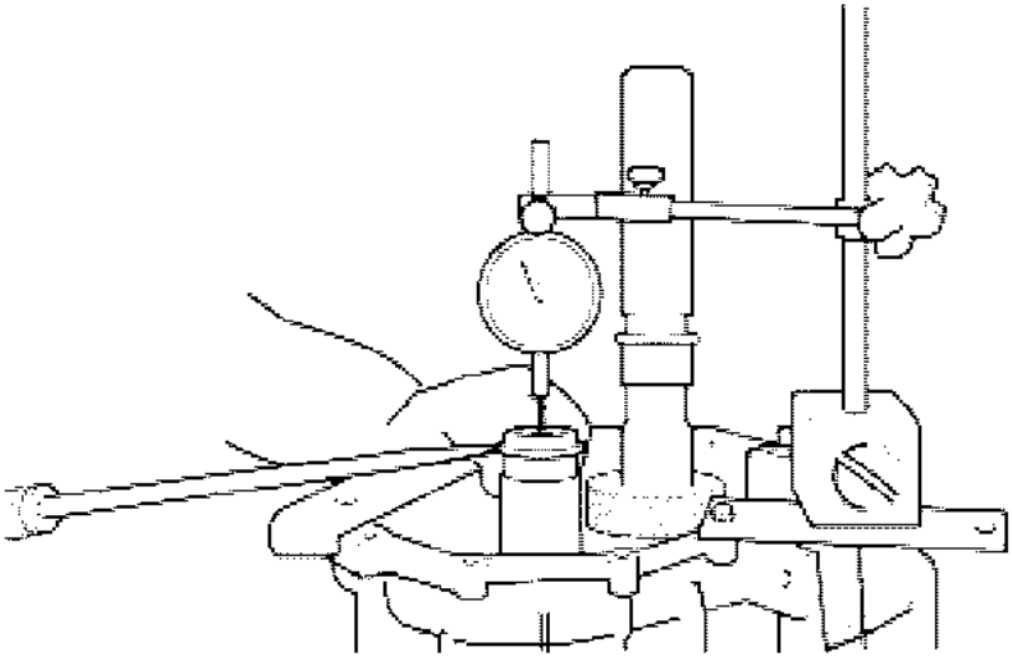


Fig. 205: Inspecting Axial Play Of Gear Train
Courtesy of GENERAL MOTORS CORP.

17. Inspect the axial play of the gear train.

    Specification: 0.0025-0.0127 cm (0.001-0.005 in)

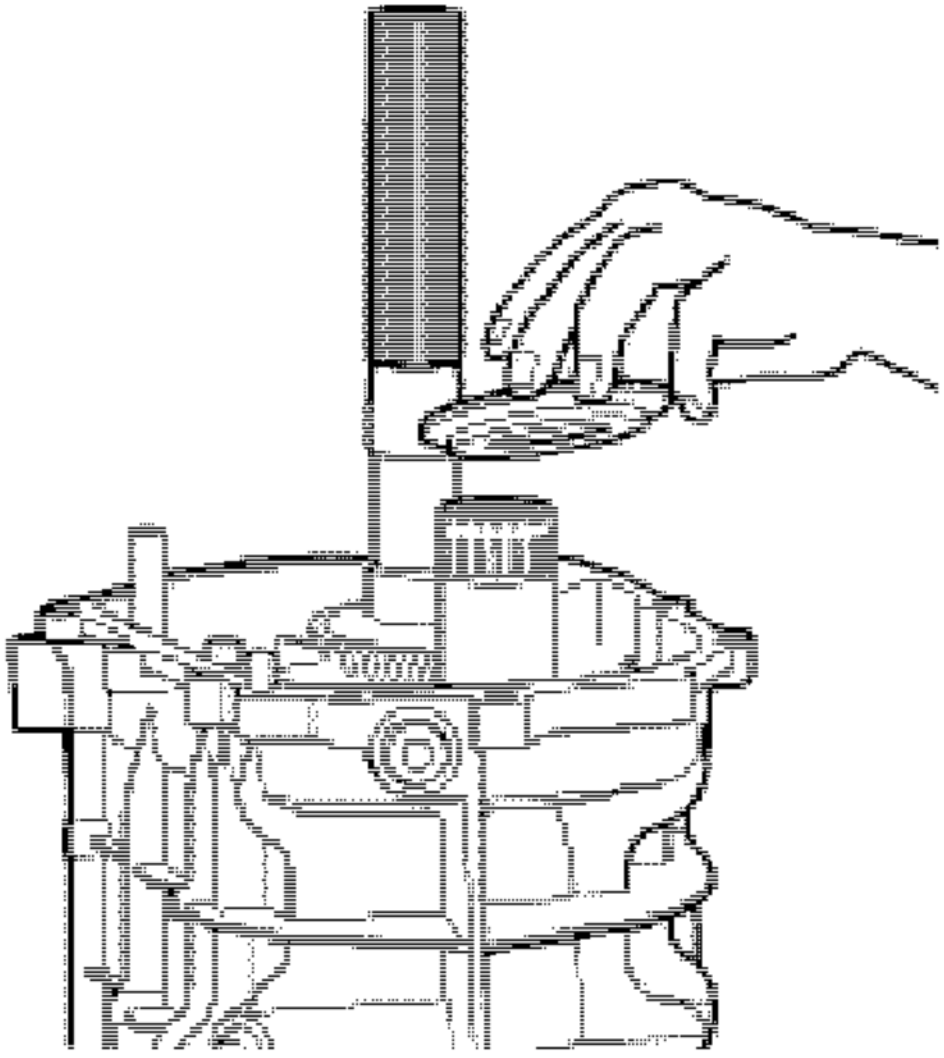


Fig. 206: Drive Wheel
Courtesy of GENERAL MOTORS CORP.

18. Install the drive wheel.

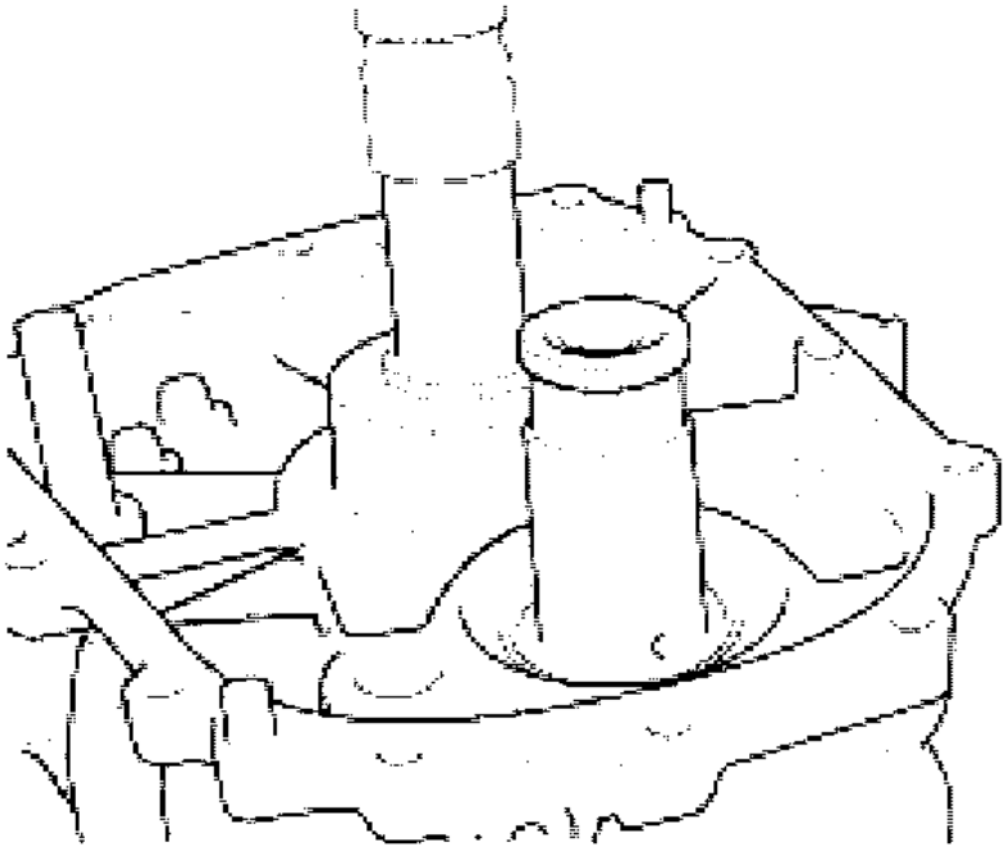


Fig. 207: Installing Drag Ball
Courtesy of GENERAL MOTORS CORP.

19. Install the drag ball.

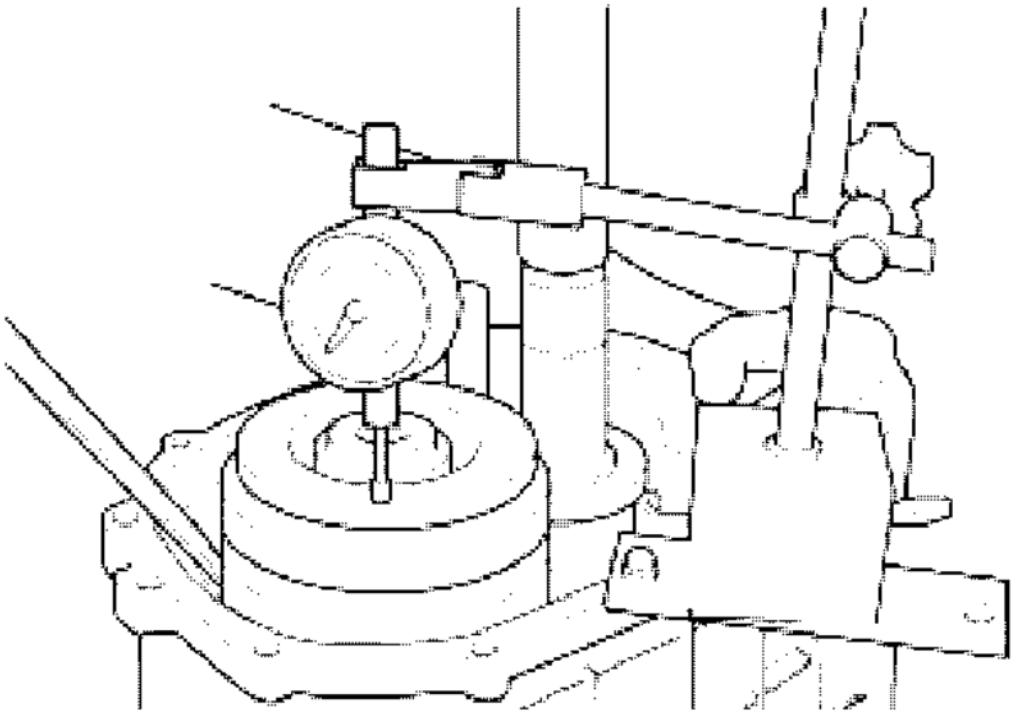


Fig. 208: Inspecting Axial Play
Courtesy of GENERAL MOTORS CORP.

20. Install the gear train 5th gear synchronizer assembly and inspect the axial play. The retainer is optional.

    Specification: 0.0127-0.0533 cm (0.005-0.021 in)

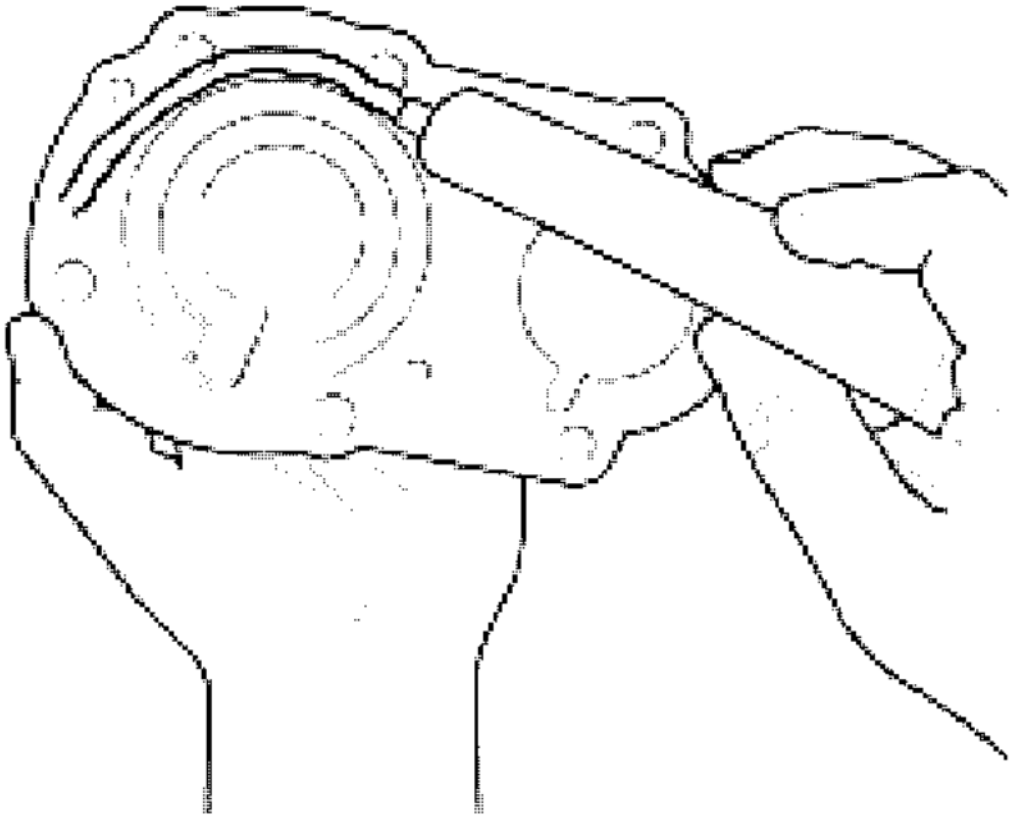


Fig. 209: Applying Sealant
Courtesy of GENERAL MOTORS CORP.

21. Clean the surface and apply sealant.

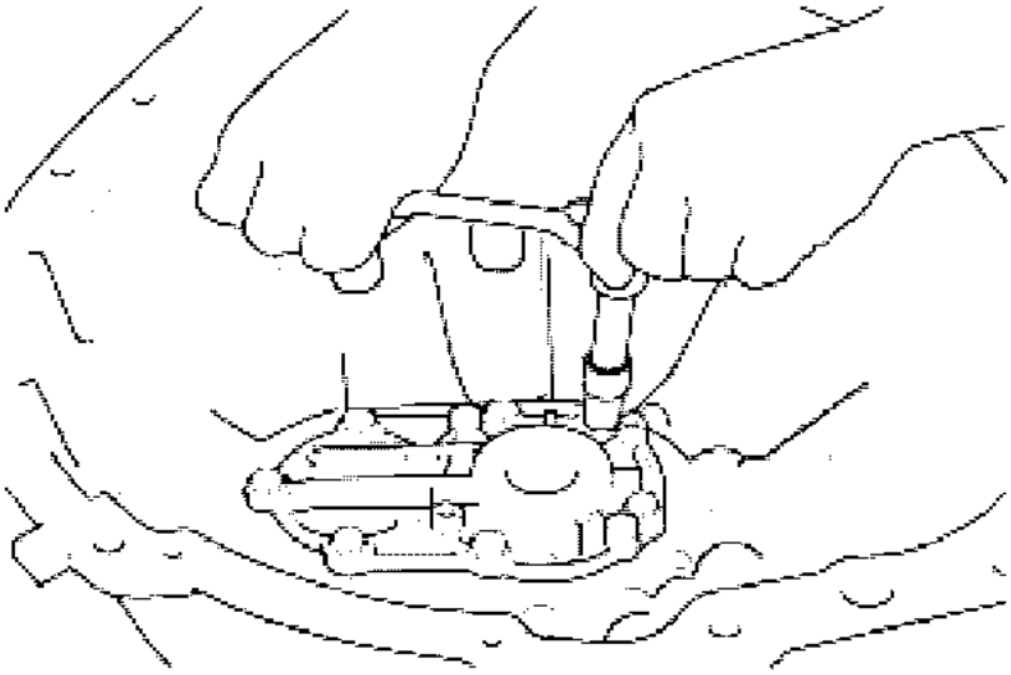


Fig. 210: Screws Securing Bearing Retainer
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

22. Tighten the 7 screws.

Tighten: Tighten the screws to 16-27 N.m (12-20 lb ft).

TRANSMISSION ASSEMBLE

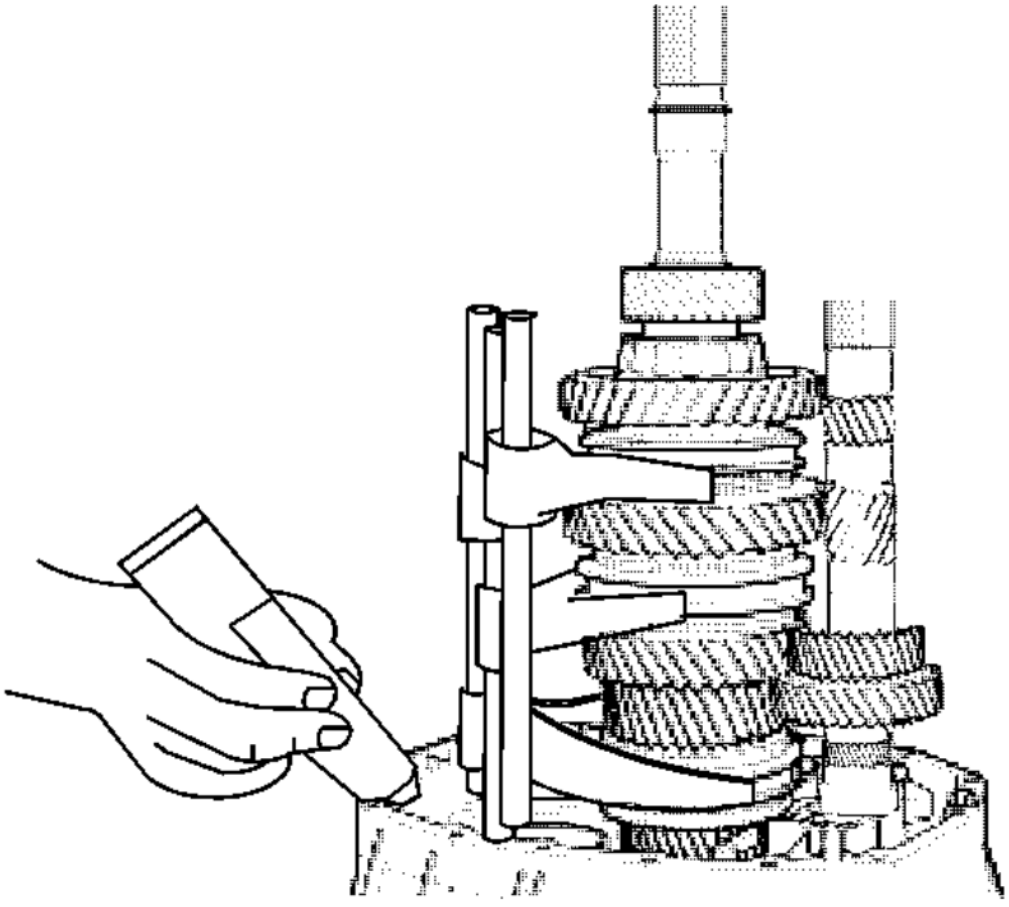


Fig. 211: Applying Sealant
Courtesy of GENERAL MOTORS CORP.

1. Clean the gasket surface and apply sealant.

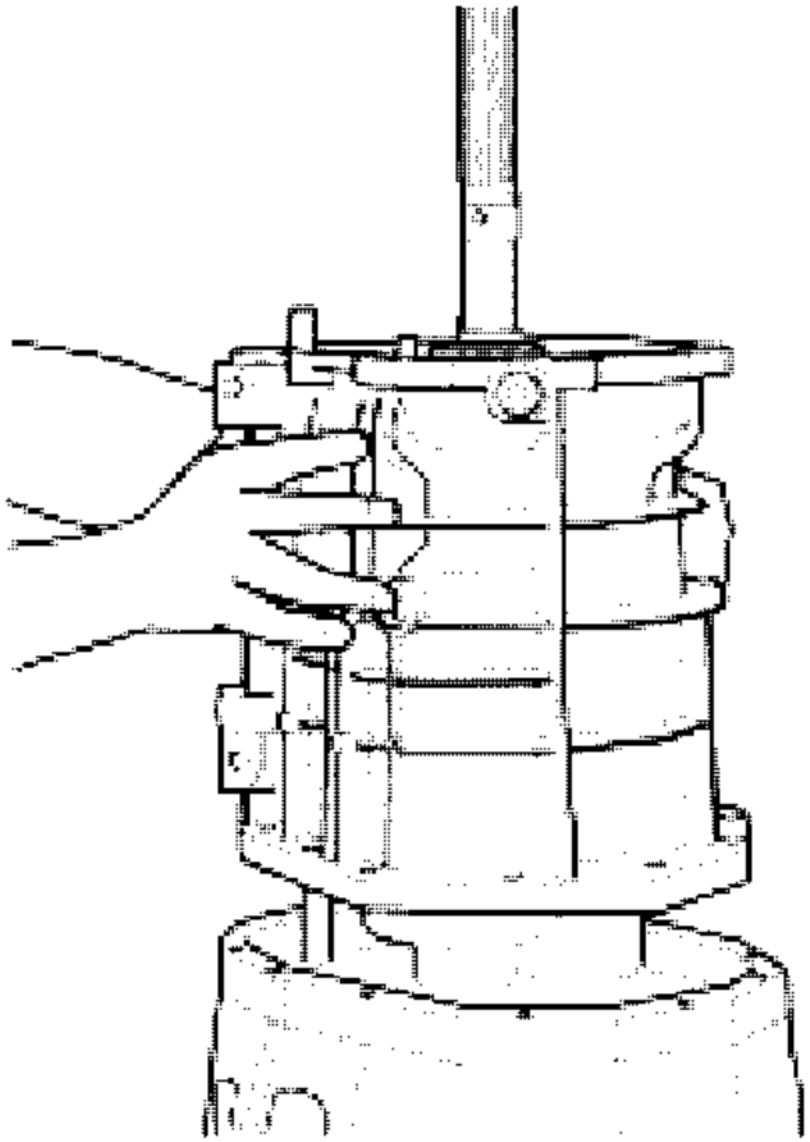


Fig. 212: Casing
Courtesy of GENERAL MOTORS CORP.

2. Install the casing.

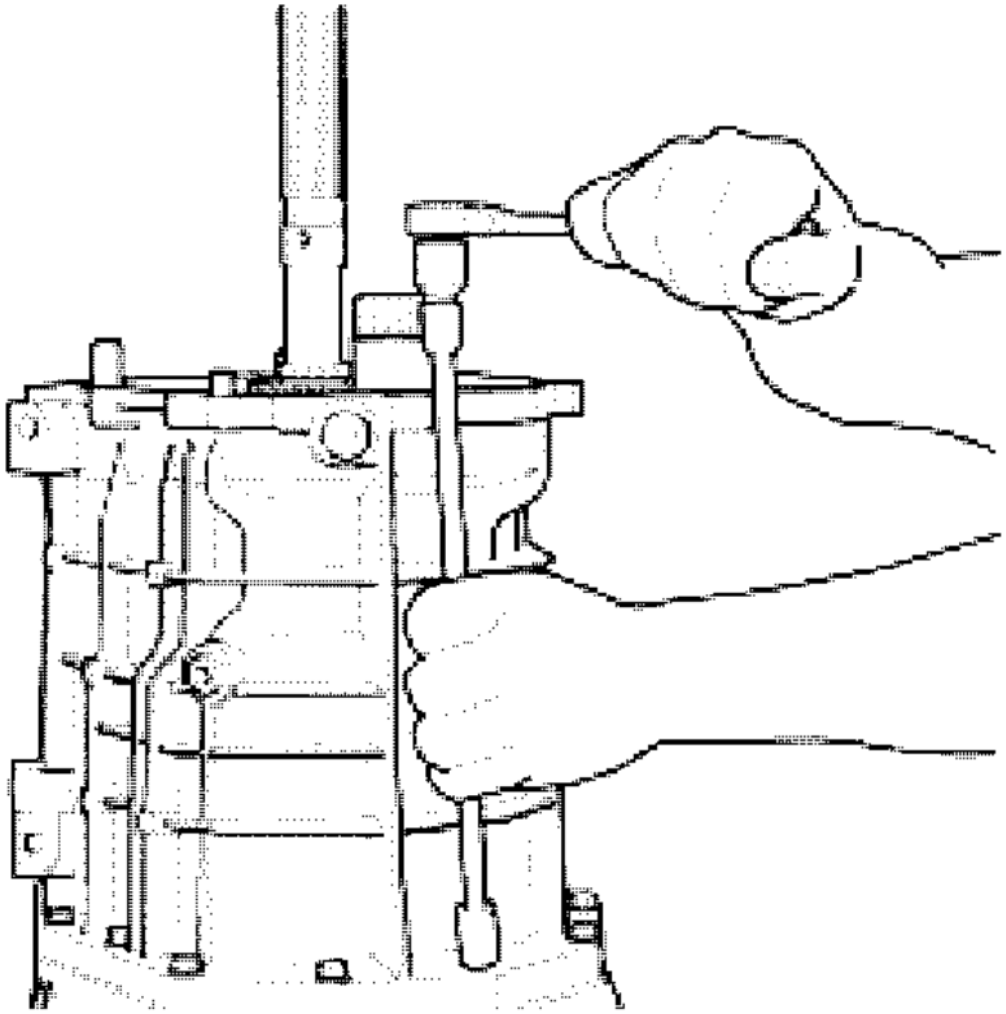


Fig. 213: Casing Bolts Securing Housing
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

3. Using a 10 mm wrench, install the 14 screws that secure the casing.
4. Tighten the screws.

Tighten: Tighten the screws to 24-37 N.m (18-28 lb ft.)

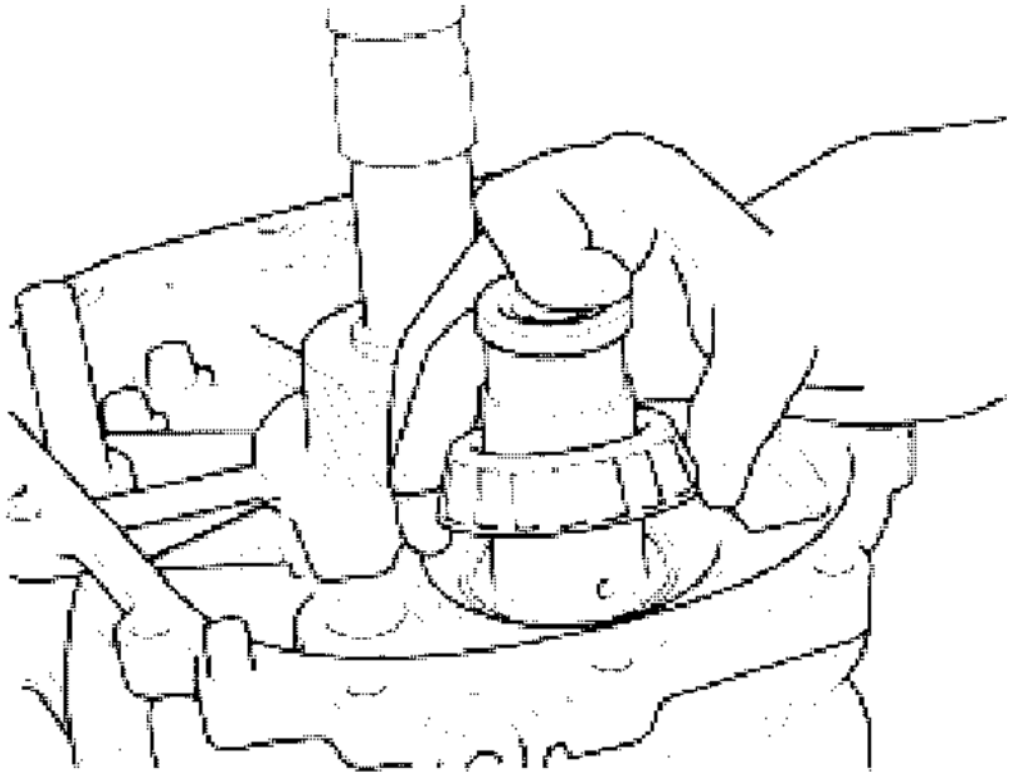


Fig. 214: Bearing
Courtesy of GENERAL MOTORS CORP.

5. Install the bearing cone.

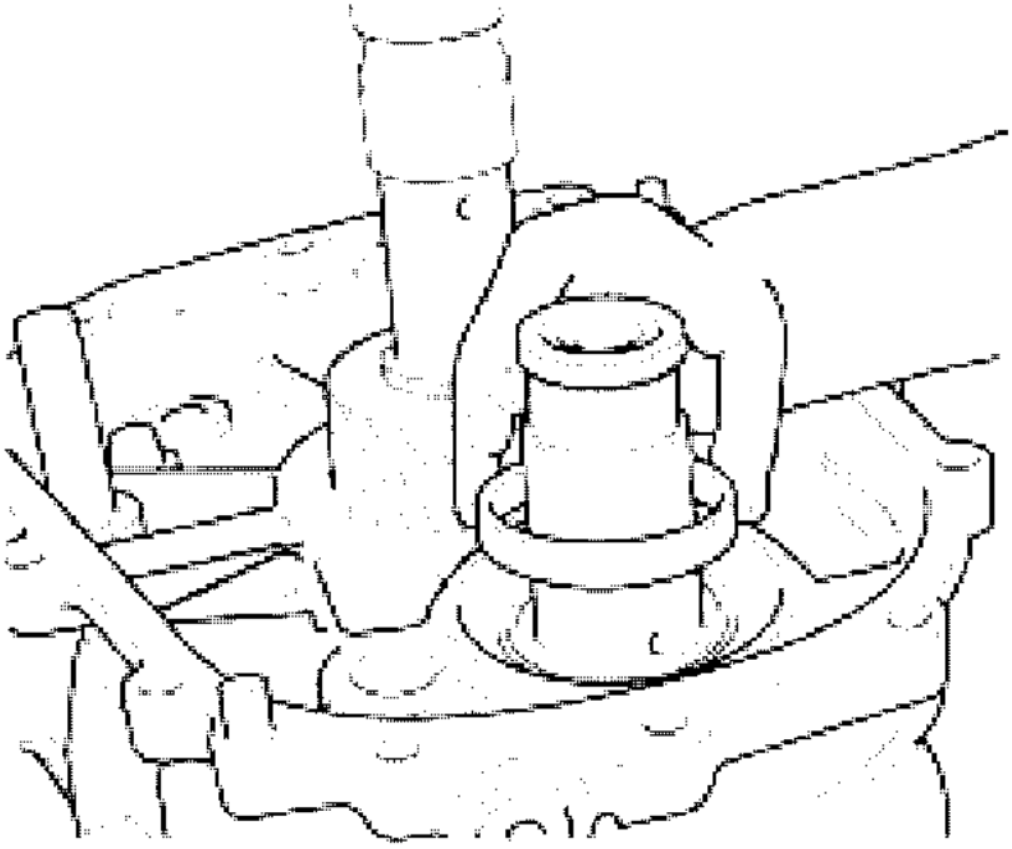


Fig. 215: Bearing Race
Courtesy of GENERAL MOTORS CORP.

6. Install the gear train taper bearing cup.

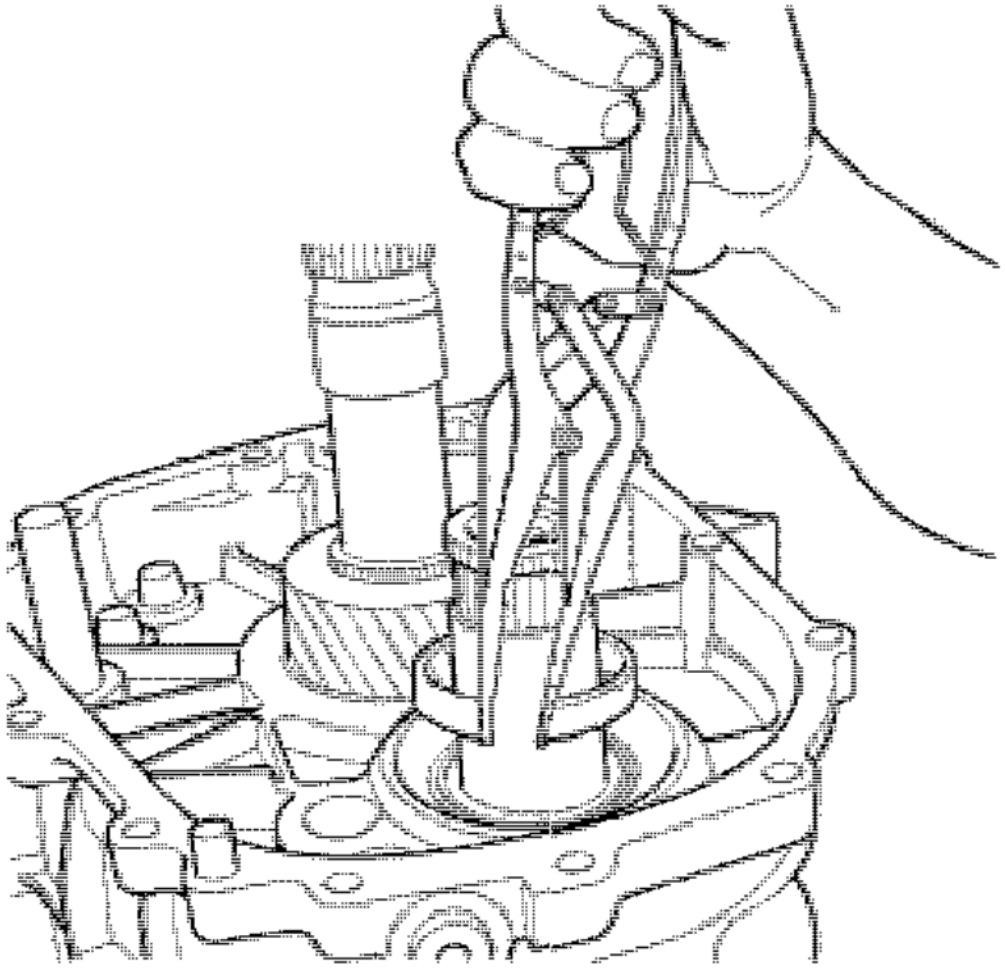


Fig. 216: Retainer Securing Gear Train Bearing Race
Courtesy of GENERAL MOTORS CORP.

7. Using retainer pliers, install the retainer securing the gear train bearing race.

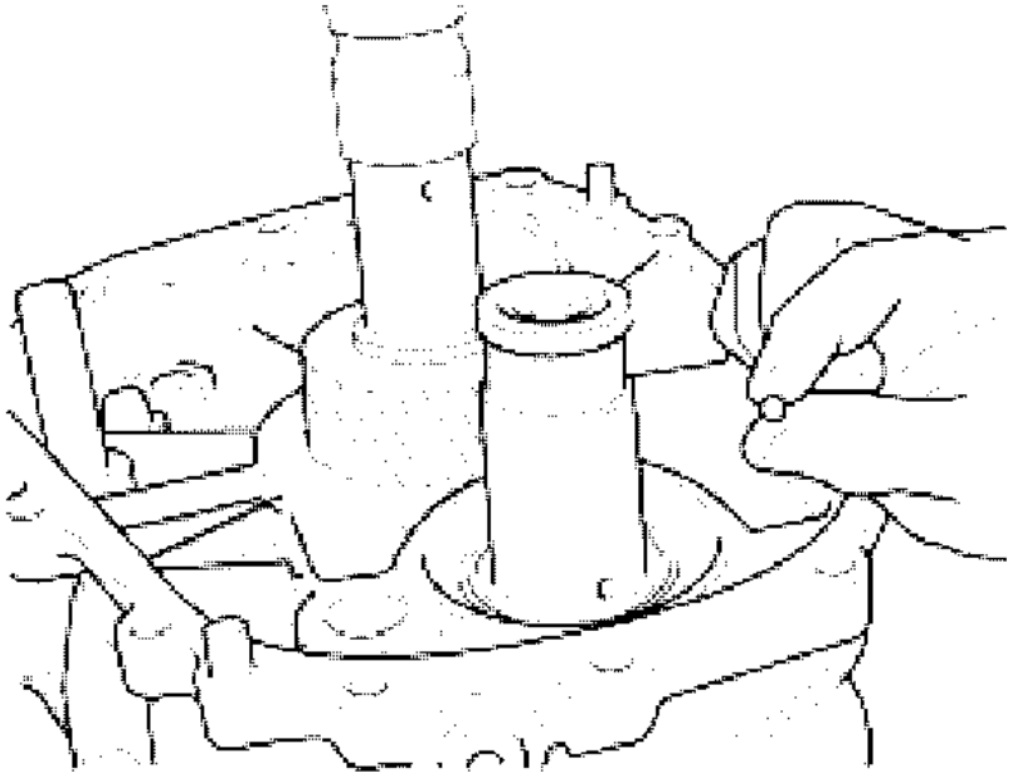


Fig. 217: Installing Drag Ball
Courtesy of GENERAL MOTORS CORP.

8. Install the drag ball.

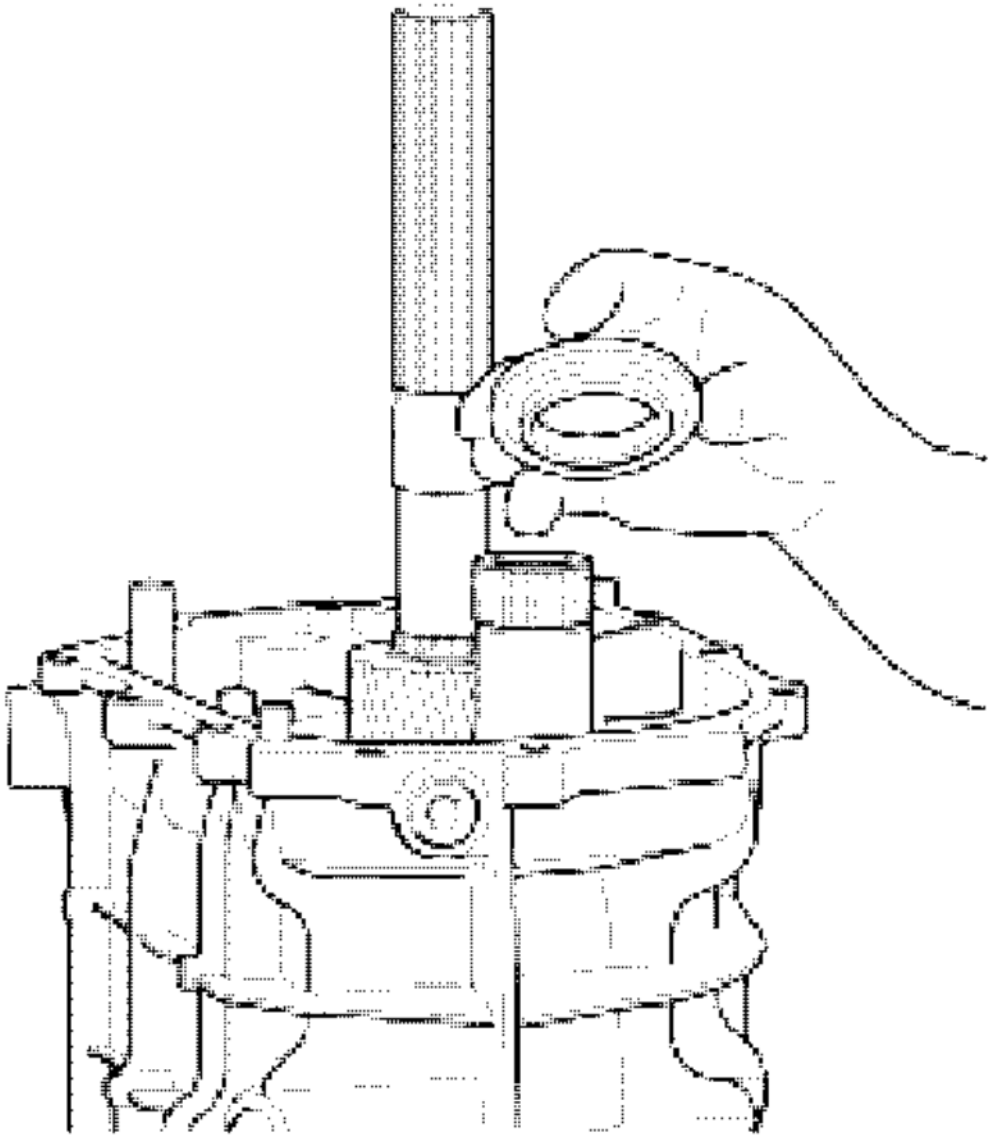


Fig. 218: Drive Wheel
Courtesy of GENERAL MOTORS CORP.

9. Install the drive wheel.

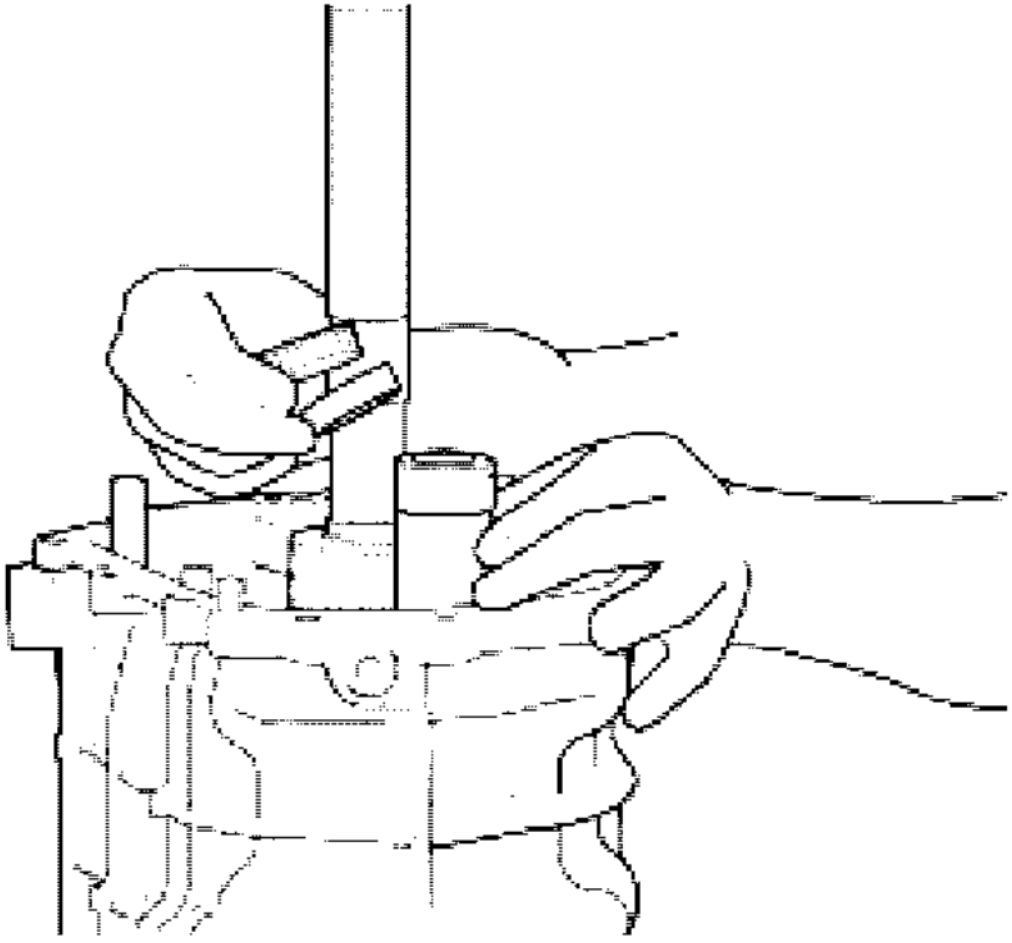


Fig. 219: 2 Roller Bearings
Courtesy of GENERAL MOTORS CORP.

10. Install the 2 roller bearings and spacer.

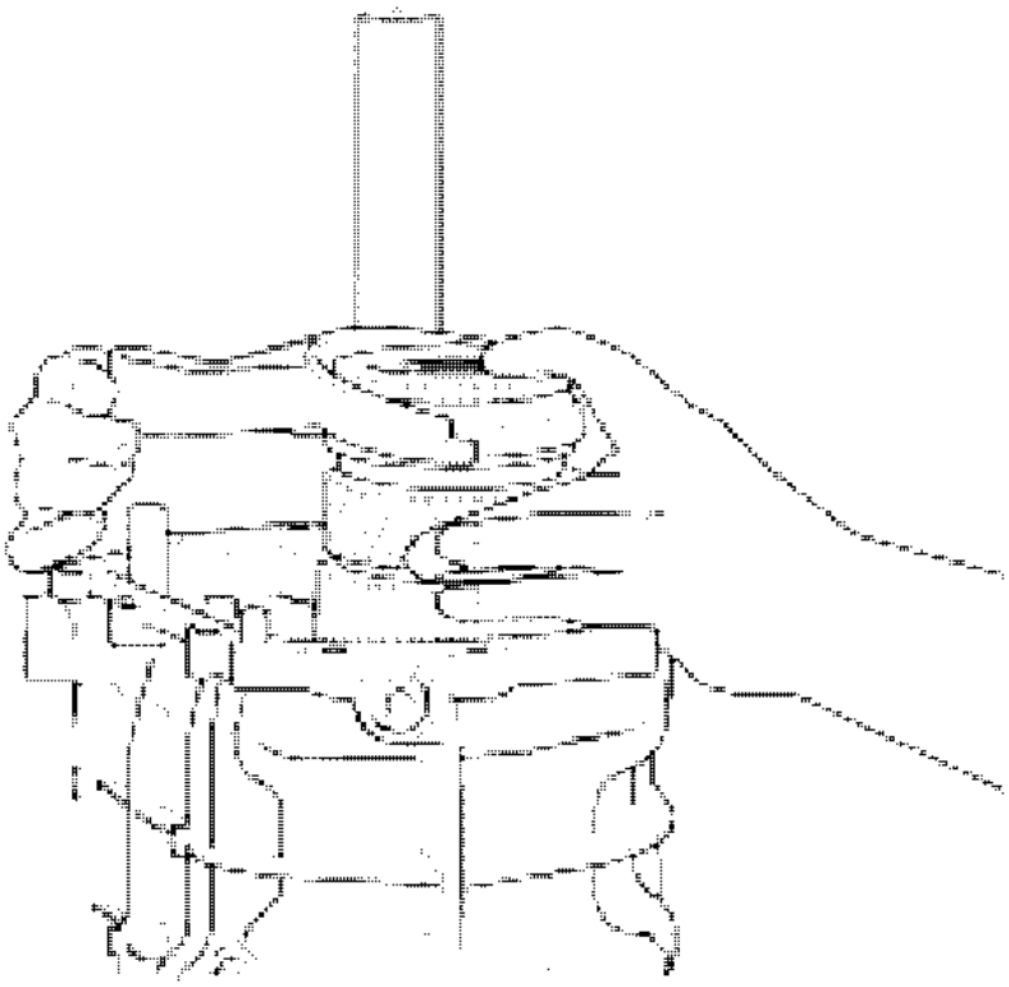


Fig. 220: 5Th Speed Synchronizer Assembly & Fork
Courtesy of GENERAL MOTORS CORP.

11. Install the 5th speed synchronizer assembly next to the fork.

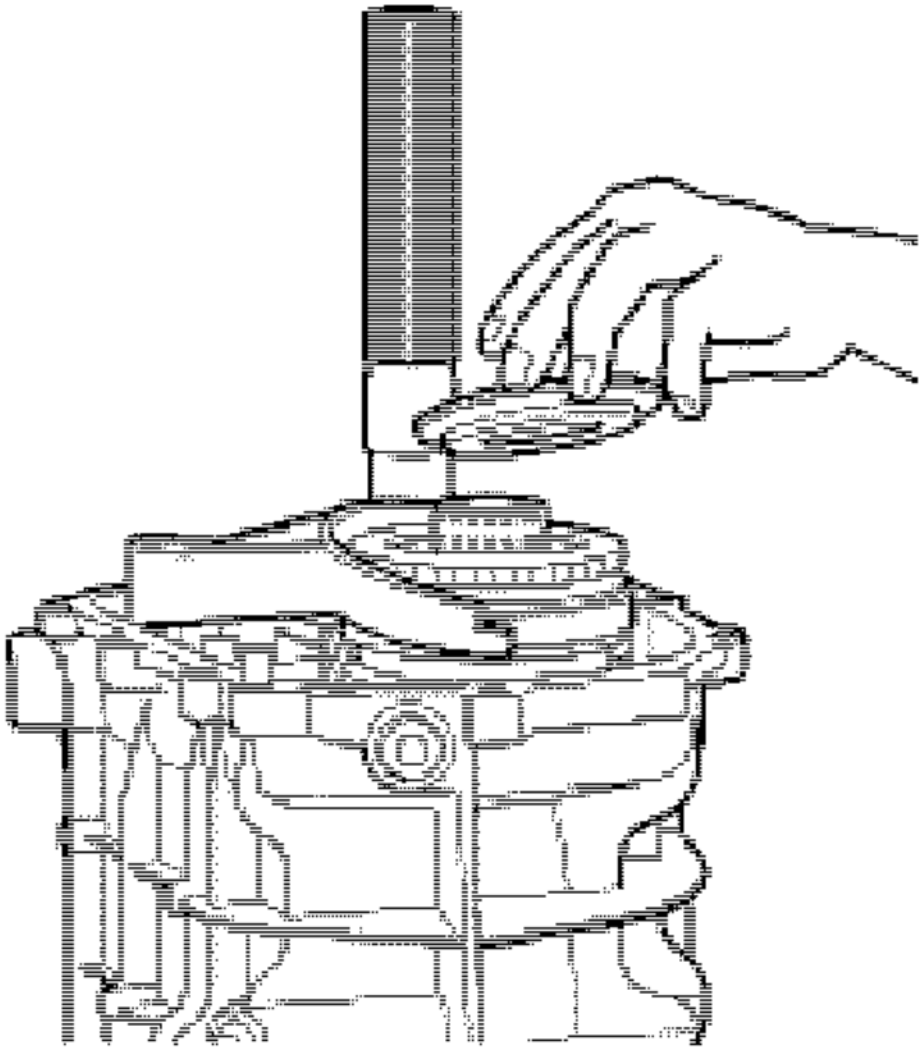


Fig. 221: Synchronizer Ring
Courtesy of GENERAL MOTORS CORP.

12. Install the synchronizer ring.

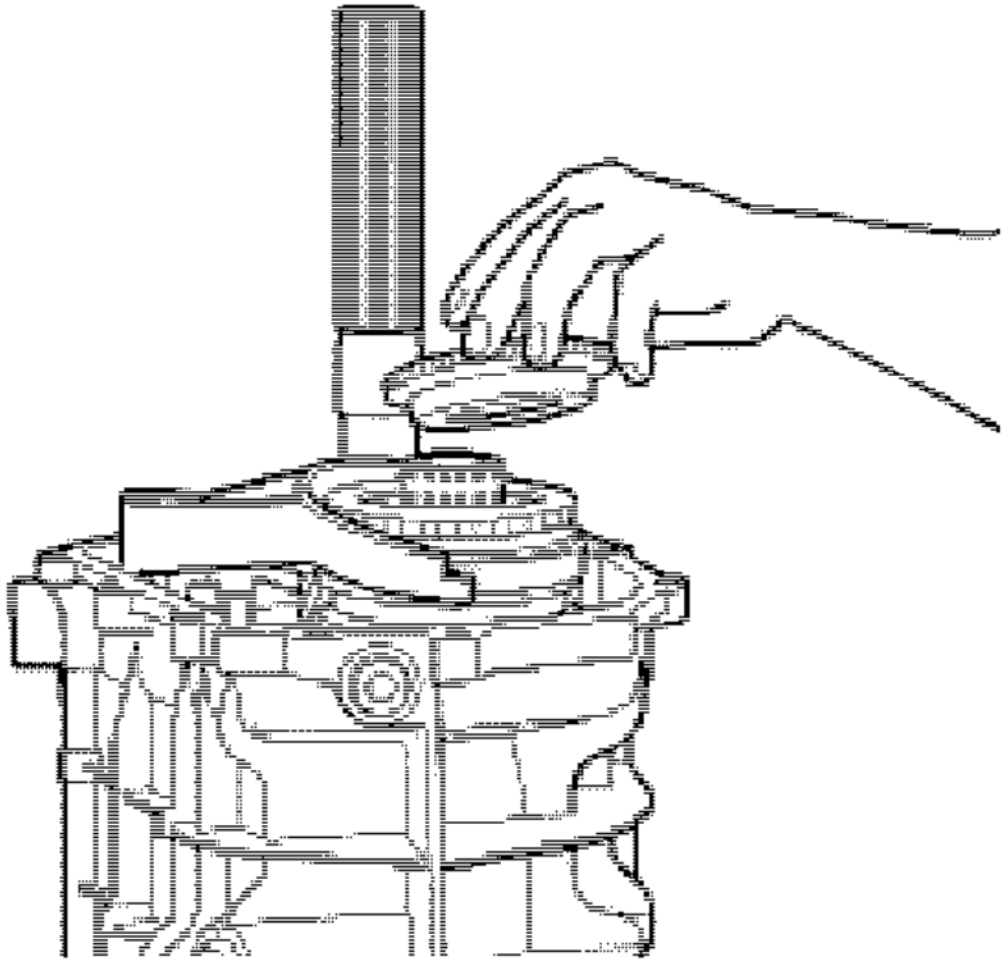


Fig. 222: Coupling Cone
Courtesy of GENERAL MOTORS CORP.

13. Install the 5th speed synchronizer assembly coupling cone.

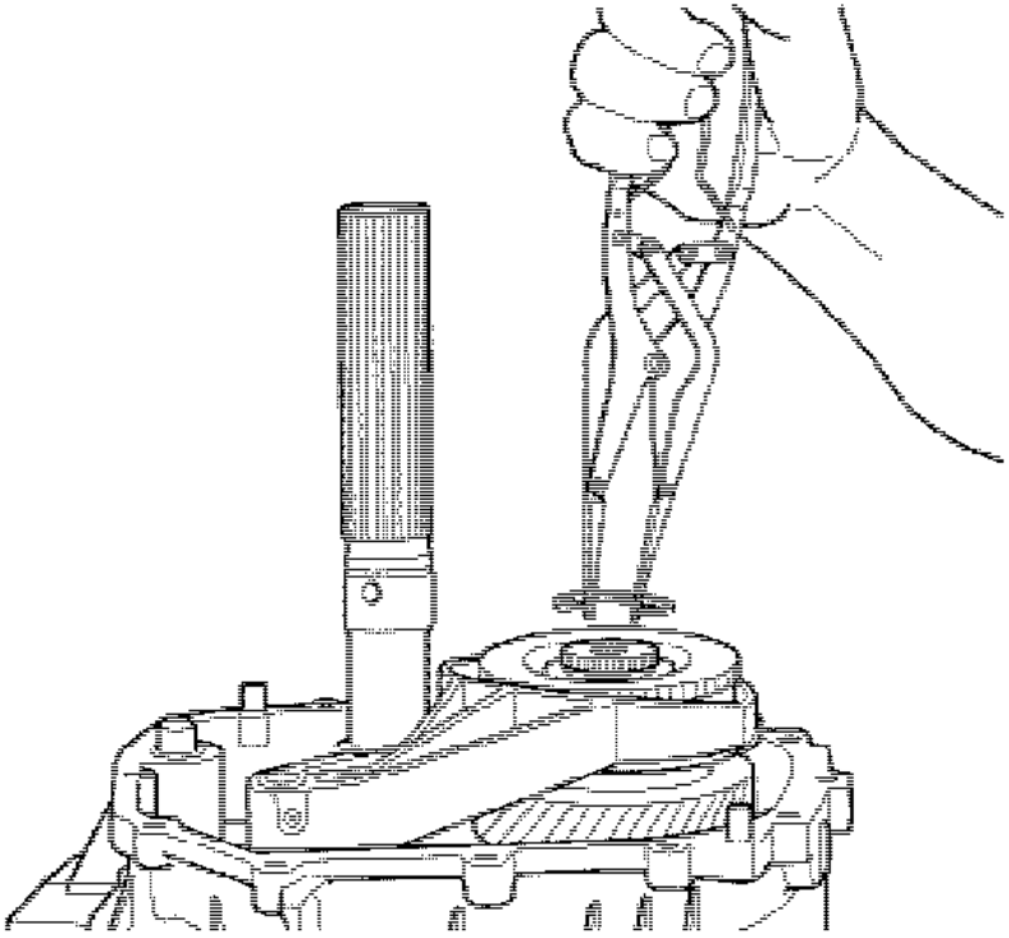


Fig. 223: 5Th Gear Retainer
Courtesy of GENERAL MOTORS CORP.

14. Using retainer pliers, install the gear train 5th speed gear retainer.

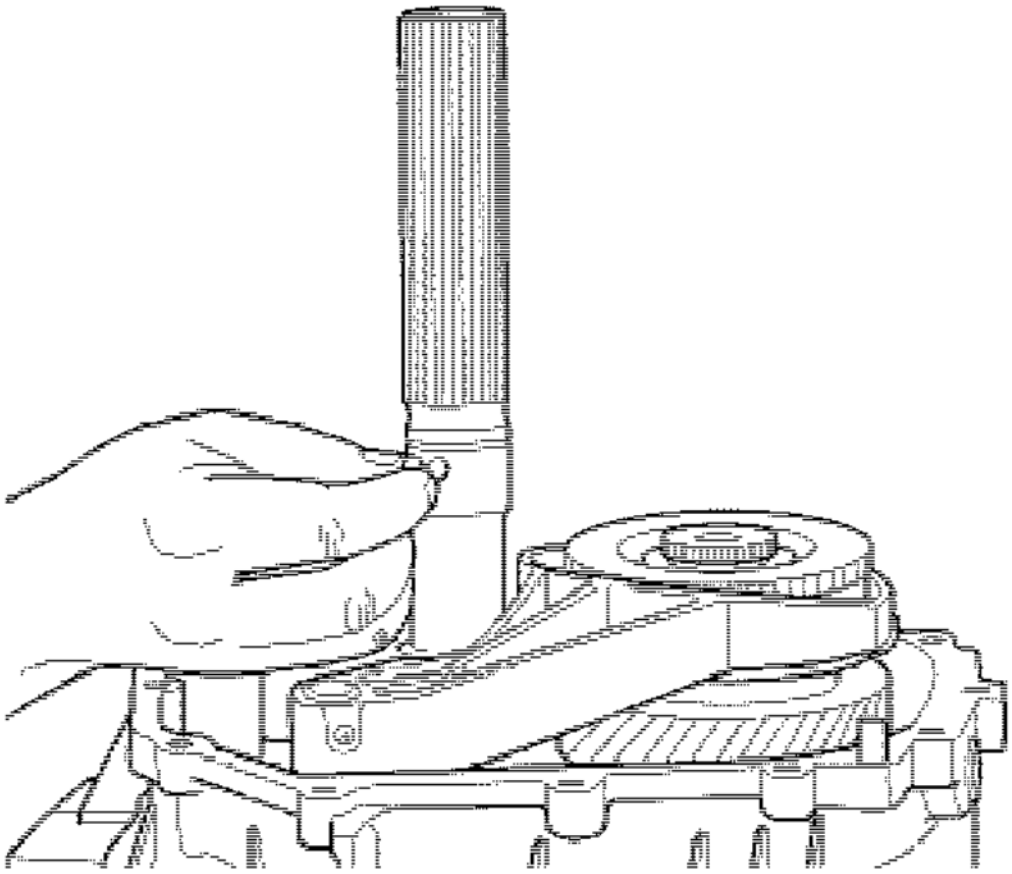


Fig. 224: Speedometer Drag Ball
Courtesy of GENERAL MOTORS CORP.

15. Install the speedometer drag ball.

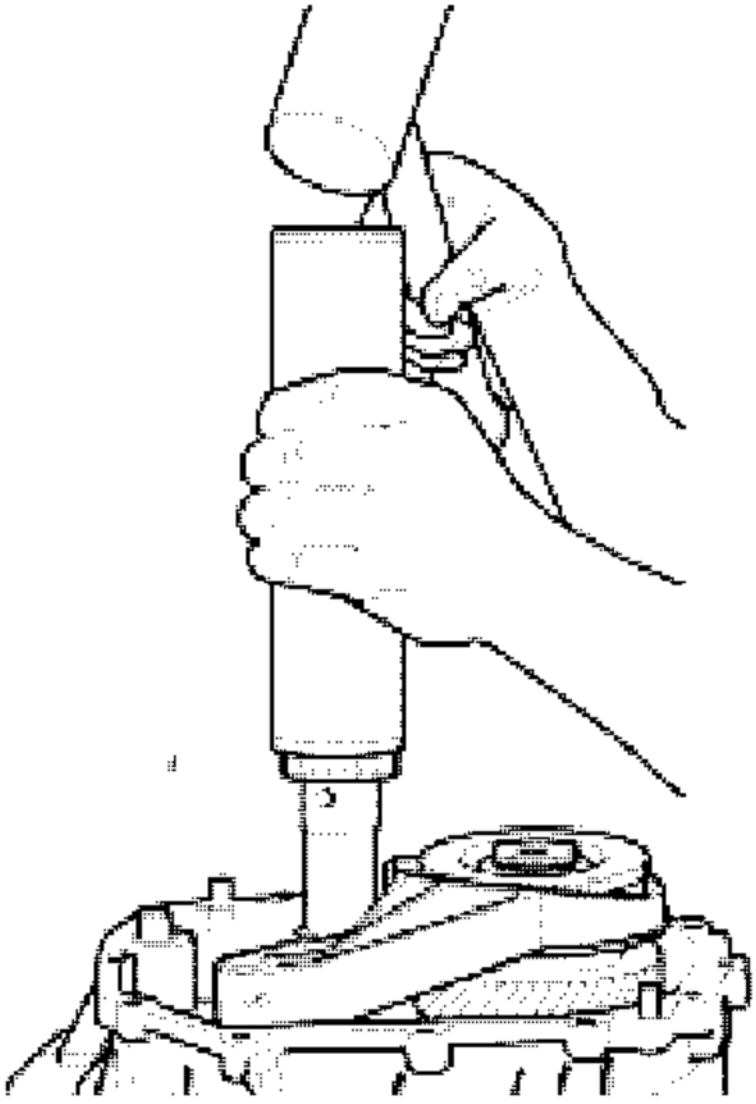


Fig. 225: Installing Speedometer Gear
Courtesy of GENERAL MOTORS CORP.

16. Using a driving tool, install the speedometer gear.

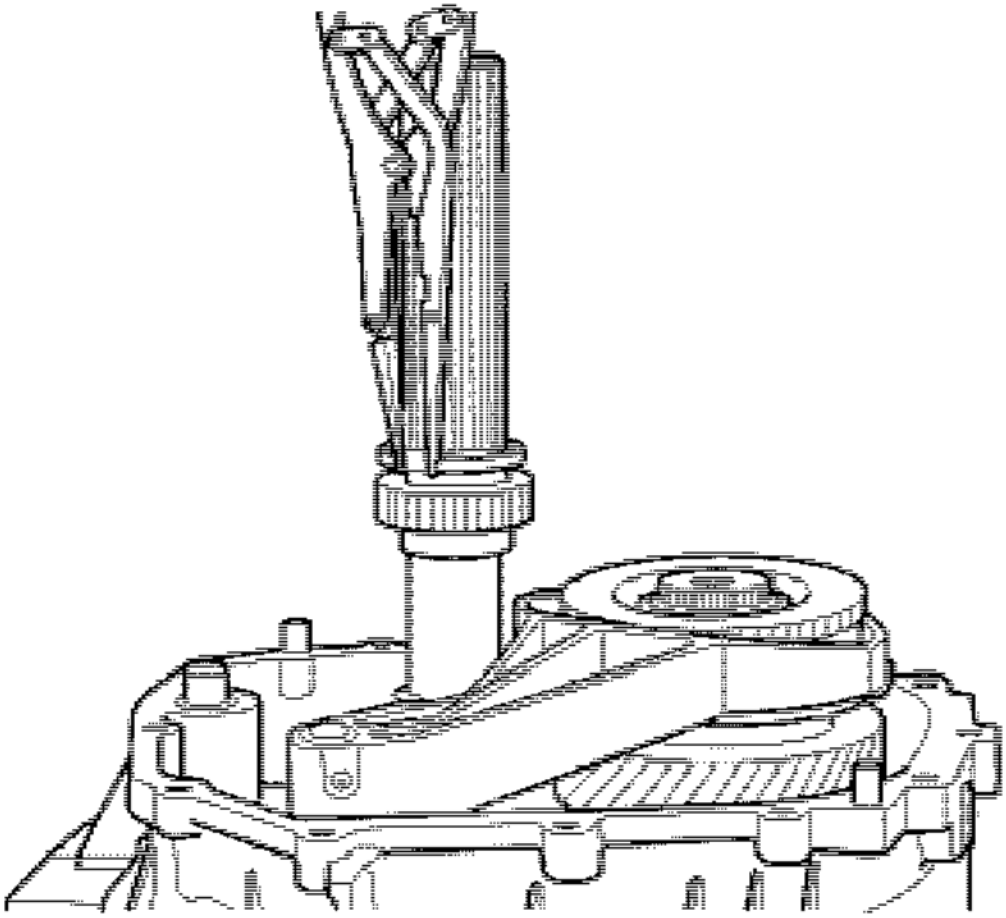


Fig. 226: Speedometer Gear Retainer
Courtesy of GENERAL MOTORS CORP.

17. Using retainer pliers, install the retainer that secures the speedometer gear.

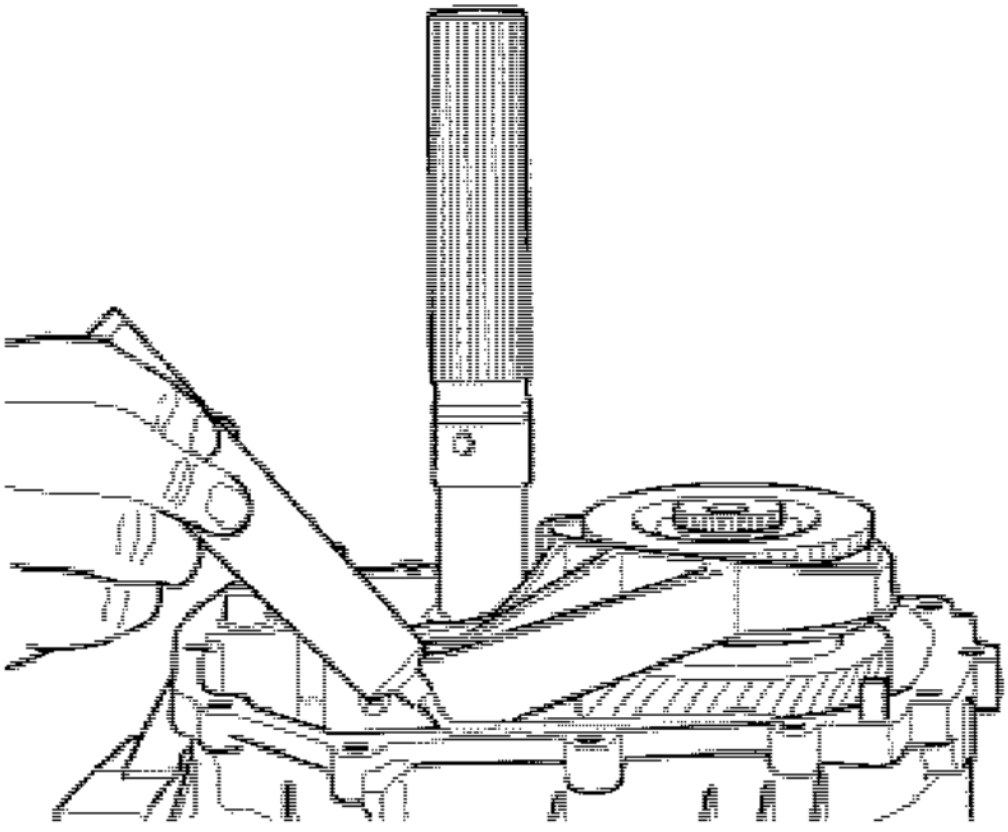


Fig. 227: Applying Sealant
Courtesy of GENERAL MOTORS CORP.

18. Clean the surface and apply sealant.

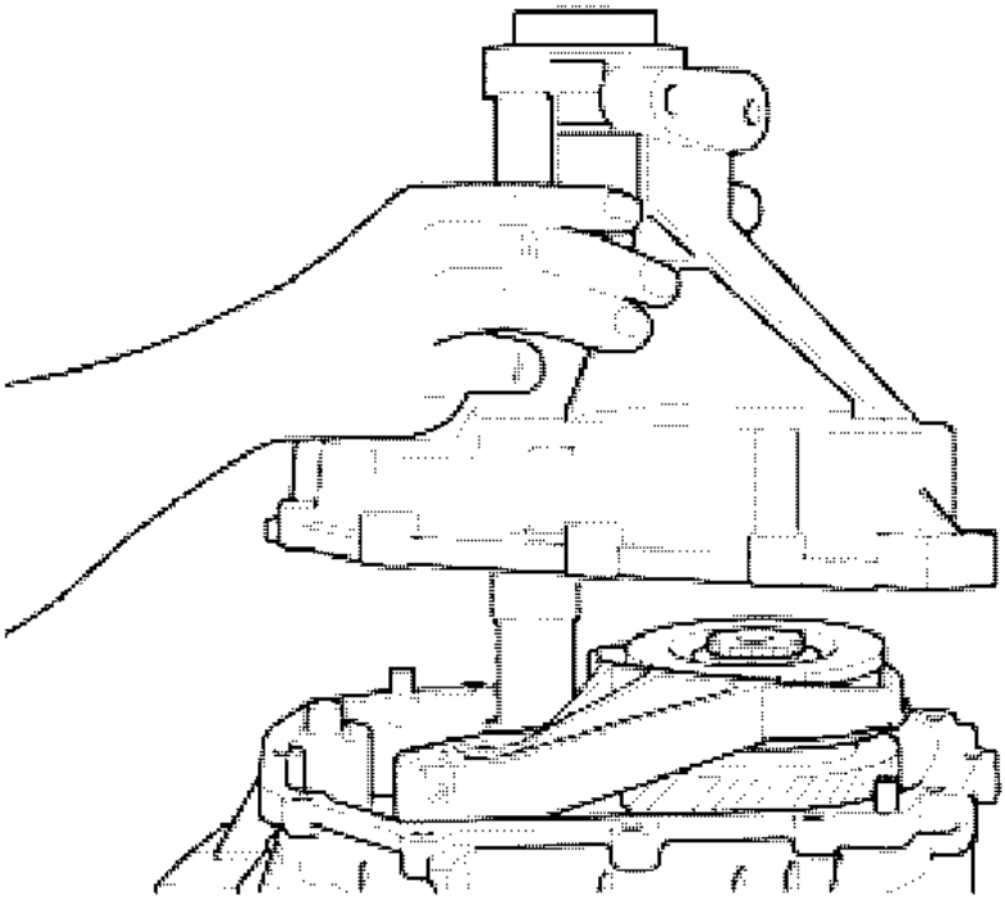


Fig. 228: Extension
Courtesy of GENERAL MOTORS CORP.

19. Install the extension, as shown.

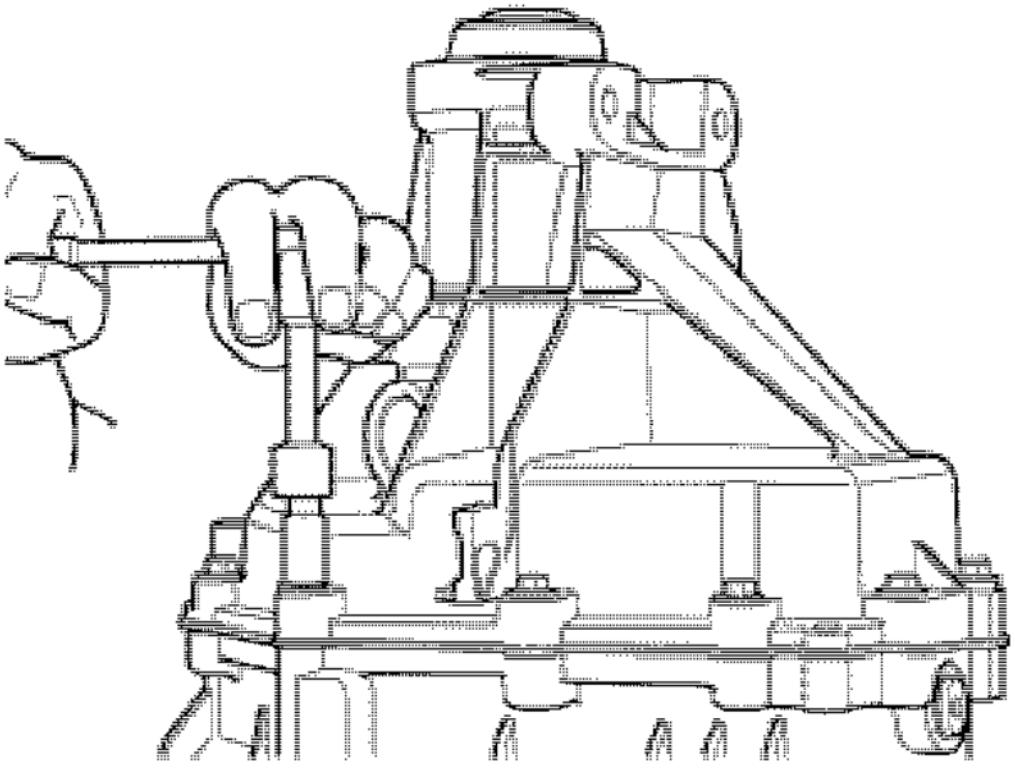


Fig. 229: Using 10 Mm Socket On 12 Bolts At Transmission Rear Case
Courtesy of GENERAL MOTORS CORP.

20. Using a 10 mm wrench, install the 12 screws that secure the casing.
21. Tighten the screws.

Tighten: Tighten the screws to 24-37 N.m (18-28 lb ft).

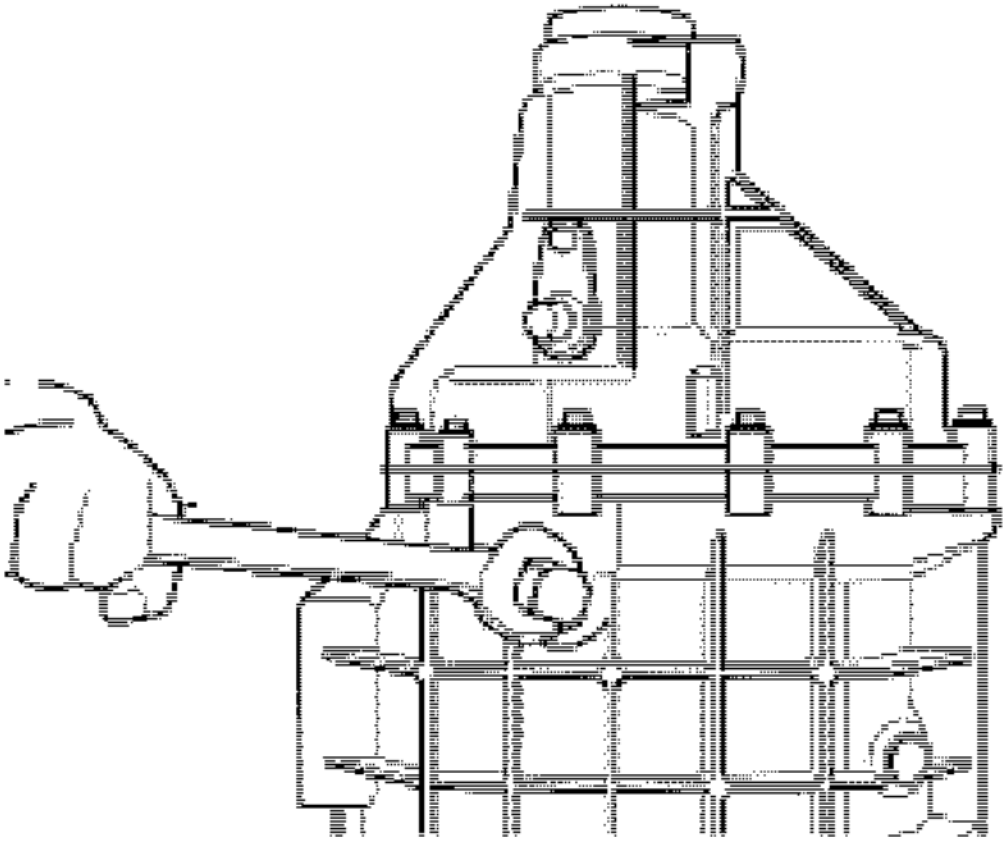


Fig. 230: Park/Neutral Position And Backup Lamp Switch
Courtesy of GENERAL MOTORS CORP.

22. If removed, install the reverse lamp switch.
23. Tighten the reverse lamp switch.

Tighten: Tighten the reverse lamp switch to 16-21 N.m (12-16 lb ft).

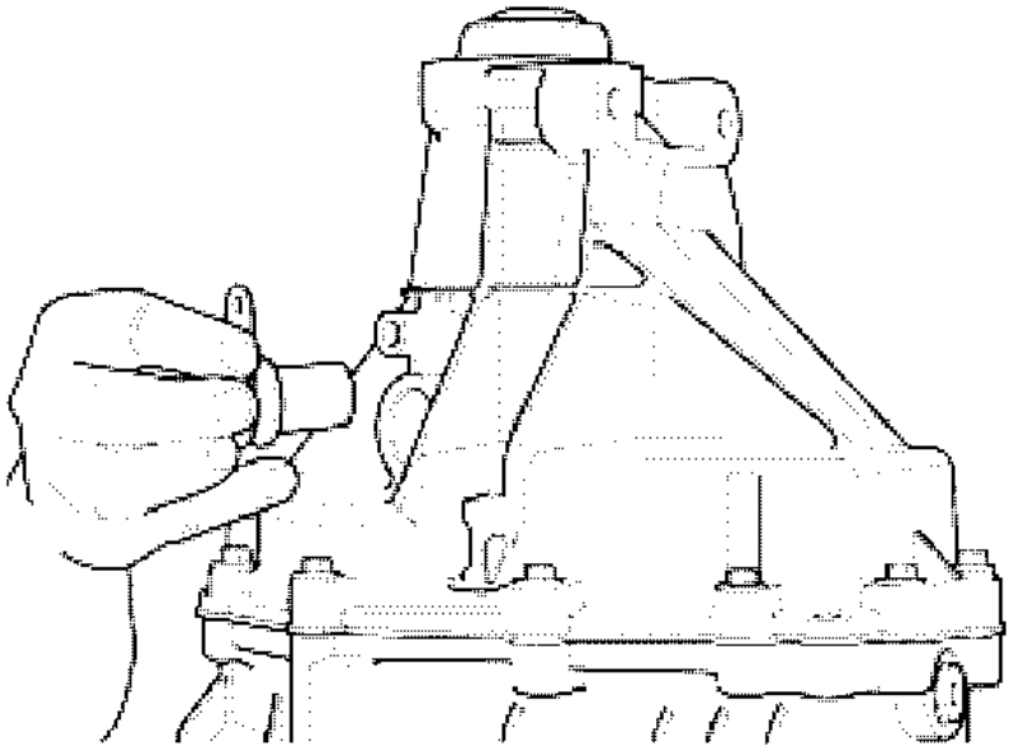


Fig. 231: Vehicle Speed Sensor
Courtesy of GENERAL MOTORS CORP.

24. Install the vehicle speed sensor.

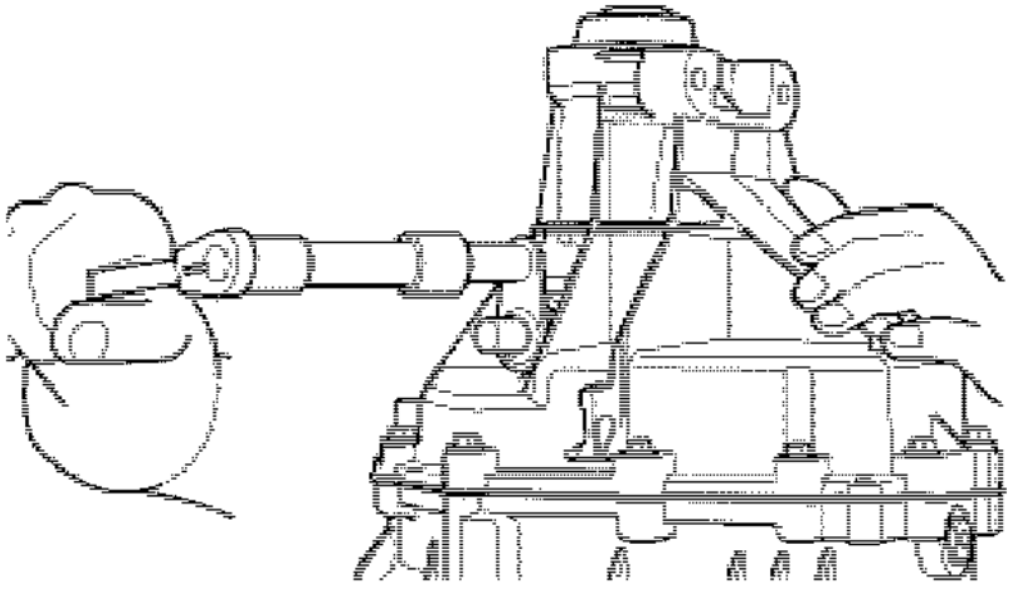


Fig. 232: Using 10mm Wrench On Vehicle Speed Sensor Bolt
Courtesy of GENERAL MOTORS CORP.

25. Using a 10 mm wrench, tighten the vehicle speed sensor bolt.

    Tighten: Tighten the vehicle speed sensor bolt to 16-21 N.m (12-16 lb ft).

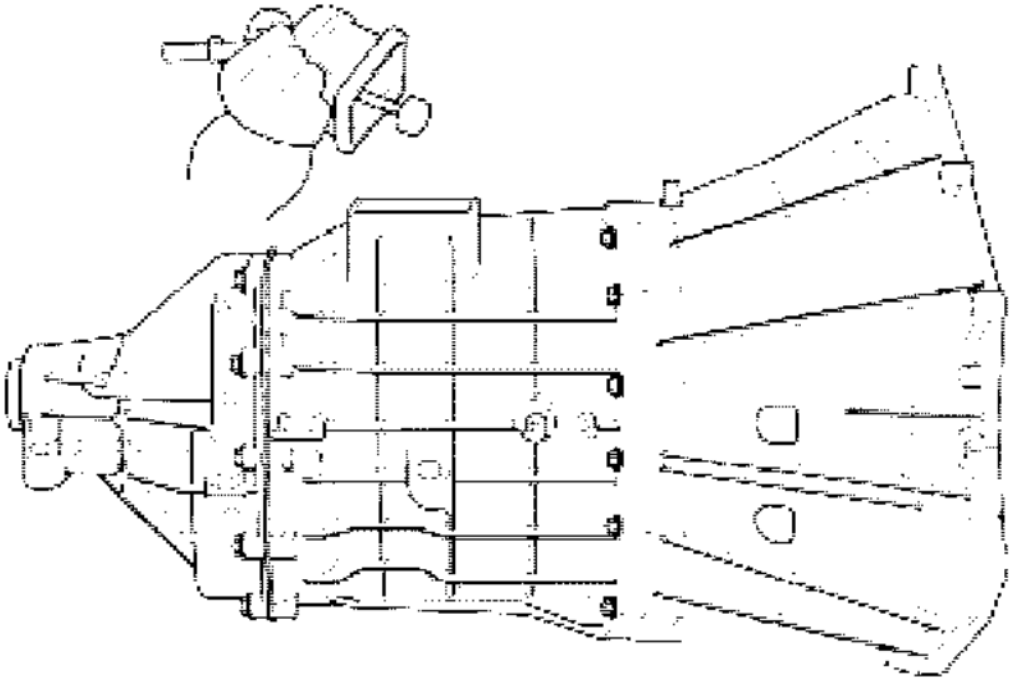


Fig. 233: Shift Tower
Courtesy of GENERAL MOTORS CORP.

26. Install the shift tower.

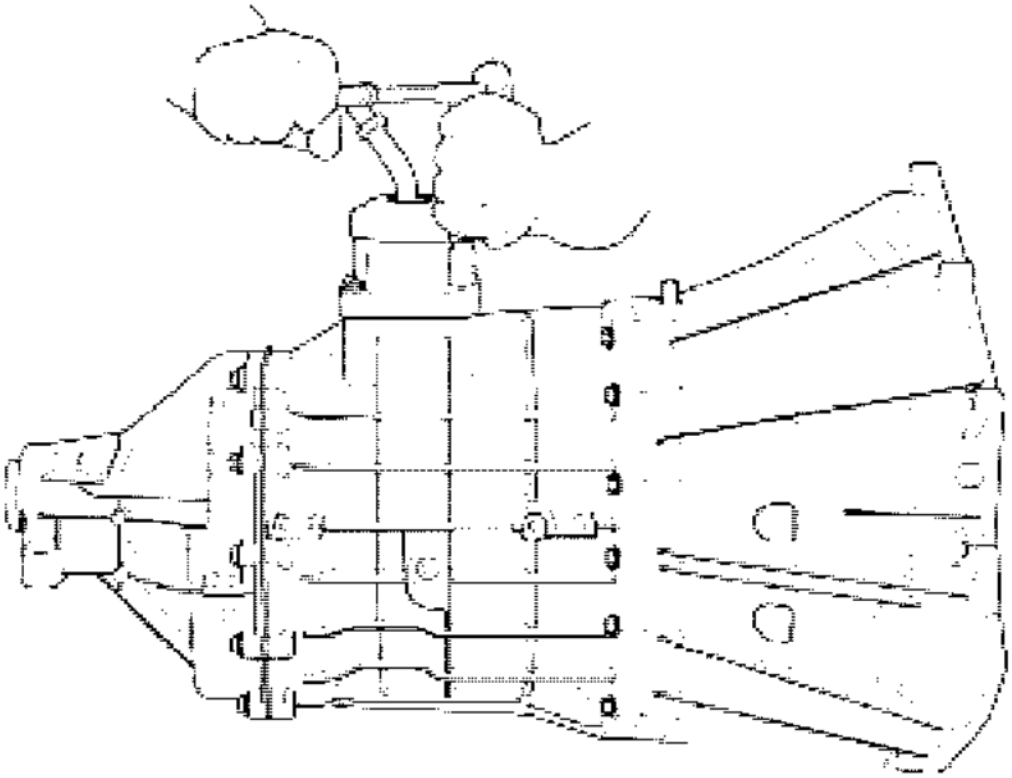


Fig. 234: Using 10mm Wrench On Shift Tower Screws
Courtesy of GENERAL MOTORS CORP.

27. Using a 10 mm wrench, tighten the 4 shift tower screws.

    Tighten: Tighten the screws to 10-17 N.m (8-13 lb ft).

DESCRIPTION AND OPERATION

MANUAL TRANSMISSION DESCRIPTION AND OPERATION

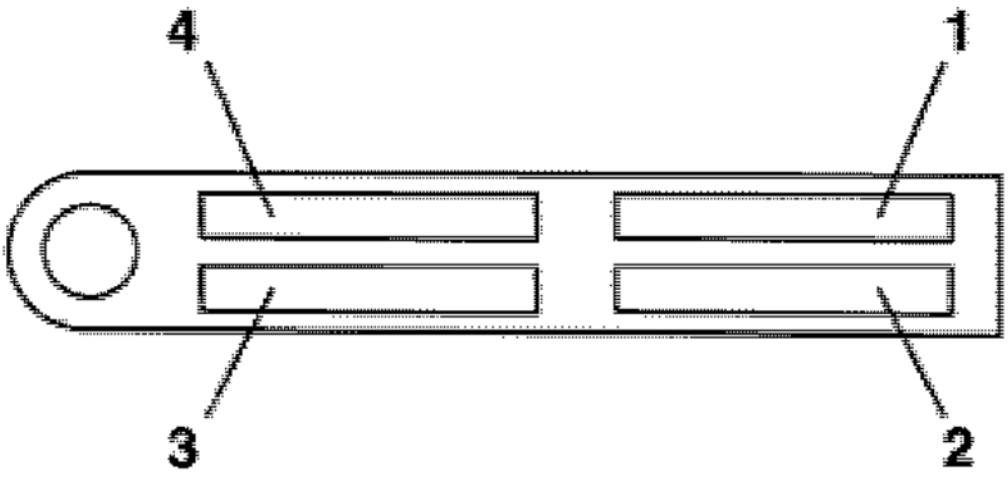


Fig. 235: Transmission Identification Plate
Courtesy of GENERAL MOTORS CORP.

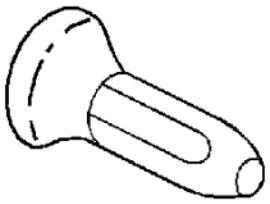
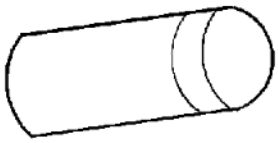
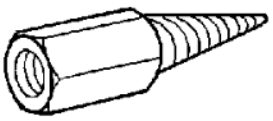
Callout	Component Name
1	Transmission Model
2	Transmission Number
3	Assembly Date
4	Series Number

IMPORTANT: All TR-3450 transmissions are identified by a model number and a series number, as well as a manufacture date. This information is stamped on the transmission identification plate and fastened on the case.

The TR-3450 series transmissions have an advanced design with 5 forward gears and 1 reverse gear that offers a greater efficient torque-weight capacity than any other 5 speed transmission in its class.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	J 23907 Slide Hammer with Bearing Adapter
	J 36502 Output Shaft Oil Seal Installer (4WD)
	J 36502-2A Output Shaft Oil Seal Protector (4WD)
	J 36825 Output Shaft Oil Seal Remover (4WD Models Only)
	J 42371 Hydraulic Clutch Line Separator

