2008 TRANSMISSION

Manual Transmission - Tremec 5-Speed (M96) - Cab & Chassis Sierra, Cab & Chassis Silverado, Sierra & Silverado

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Backup Lamp Switch	16-22 N.m	12-16 lb ft
Breather Support Screw	13-18 N.m	10-14 lb ft
Clutch Actuator Bolts	8 N.m	21 lb ft
Clutch Housing Cover Bolts	24-38 N.m	18-28 lb ft
Clutch Housing Screw	57-68 N.m	42-50 lb ft
Clutch Housing Stud Nut	57-68 N.m	42-50 lb ft
Control Cover Screw	20-24 N.m	18-22 lb ft
Drain Plug	13-27 N.m	10-20 lb ft
Drive Shaft Bearing Retaining Screw	16-21 N.m	12-16 lb ft
Fill Plug	13-27 N.m	10-20 lb ft
Flange Nut	150-170 N.m	110-125 lb ft
Front Bearing Retainer	14 N.m	10 lb ft
Main Shaft Nut	150-170 N.m	110-125 lb ft
Oil Drain Plug	16-27 N.m	12-20 lb ft
Oil Fill Plug	16-27 N.m	12-20 lb ft
Rear Bearing Retaining Screw	34-40 N.m	25-30 lb ft
Rear Cover	57-68 N.m	42-50 lb ft
Reverse Switch	16-21 N.m	12-16 lb ft
Shaft Support Plate Screw	16-21 N.m	12-16 lb ft
Shift Boot Screws	2 N.m	18 lb in
Shift Housing Screws	8-14 N.m	6-11 lb ft
Shift Lever Nut	47 N.m	35 lb ft
Shift Tower Screw	8-14 N.m	6-11 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 (VSS) Bolt	16-21 N.m	12-16 lb ft

LUBRICATION SPECIFICATIONS

Application	Metric	English
5W-30 Synthetic Oil P/N ET-M99	3.5 L	3.7 qt

AXIAL PLAY SPECIFICATIONS

The axial play should be maintained upon assembling the main shaft unit, the 5th gear assembly, the gear train, and the reverse gear.

Application	Specification	
	Metric	English
1st Gear	0.25-0.81 mm	0.010-0.032 in
2nd Gear	0.20-0.60 mm	0.008-0.024 in
3rd Gear	0.28-0.38 mm	0.011-0.015 in
5th Gear/Gear Train	0.15-0.68 mm	0.006-0.027 in
Drive Shaft	0.02-0.12 mm	0.001-0.005 in
Drive Shaft Reverse Gear	0.35-0.56 mm	0.014-0.022 in
Gear Train	0.02-0.12 mm	0.001-0.005 in
Reverse Idler Gear	0.10-0.35 mm	0.004-0.014 in

TRANSMISSION GEAR RATIO

Model	1st	2nd	3rd	4th	5th	Reverse
TR-4050 - GMM	5.81	2.94	1.61	1.00	0.77	5.6
TR-4050	6.16	3.11	1.71	1.00	0.76	6.03

COMPONENT LOCATOR

TRANSMISSION COMPONENT LOCATION

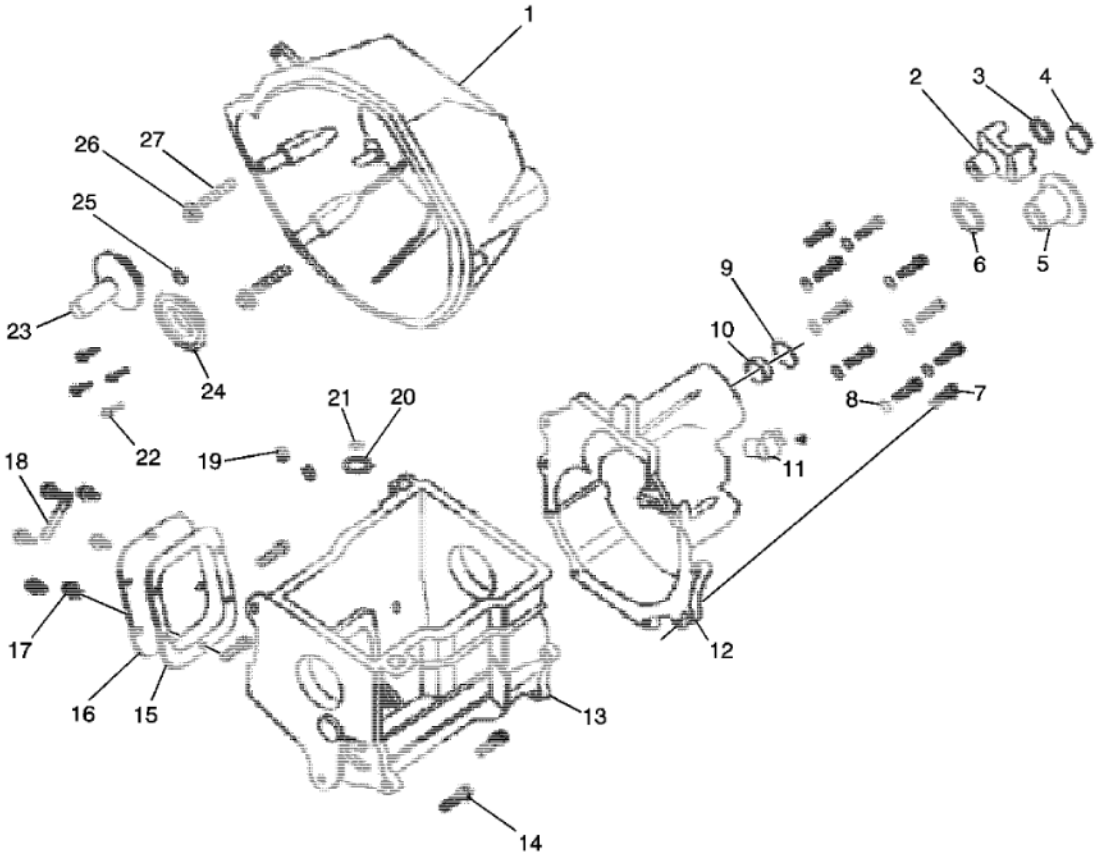


Fig. 1: Transmission Case and Related Components
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Clutch Housing
2	Yoke
3	Main Shaft Washer
4	Nut
5	Coupling Flange
6	Main Shaft Cover Oil Seal
7	Rear Cover Bolts
8	Rear Hub Screw Washer
9	Rear Cover Lock
10	Roller Bearing
11	Vehicle Speed Sensor (VSS)
12	Rear Cover

13	Transmission Case
14	Clutch Housing Screw
15	Power Take-Off (PTO) Gasket
16	PTO Cover
17	PTO Bolts
18	Identification Plate
19	Drain/Fill Plugs
20	Transmission Case Magnet
21	Magnetic Lock
22	Screws
23	Input Shaft Bearing Retainer Plug
24	Input Shaft Bearing Retainer
25	Input Shaft Bearing Retainer Oil Seal
26	Nut
27	Pin

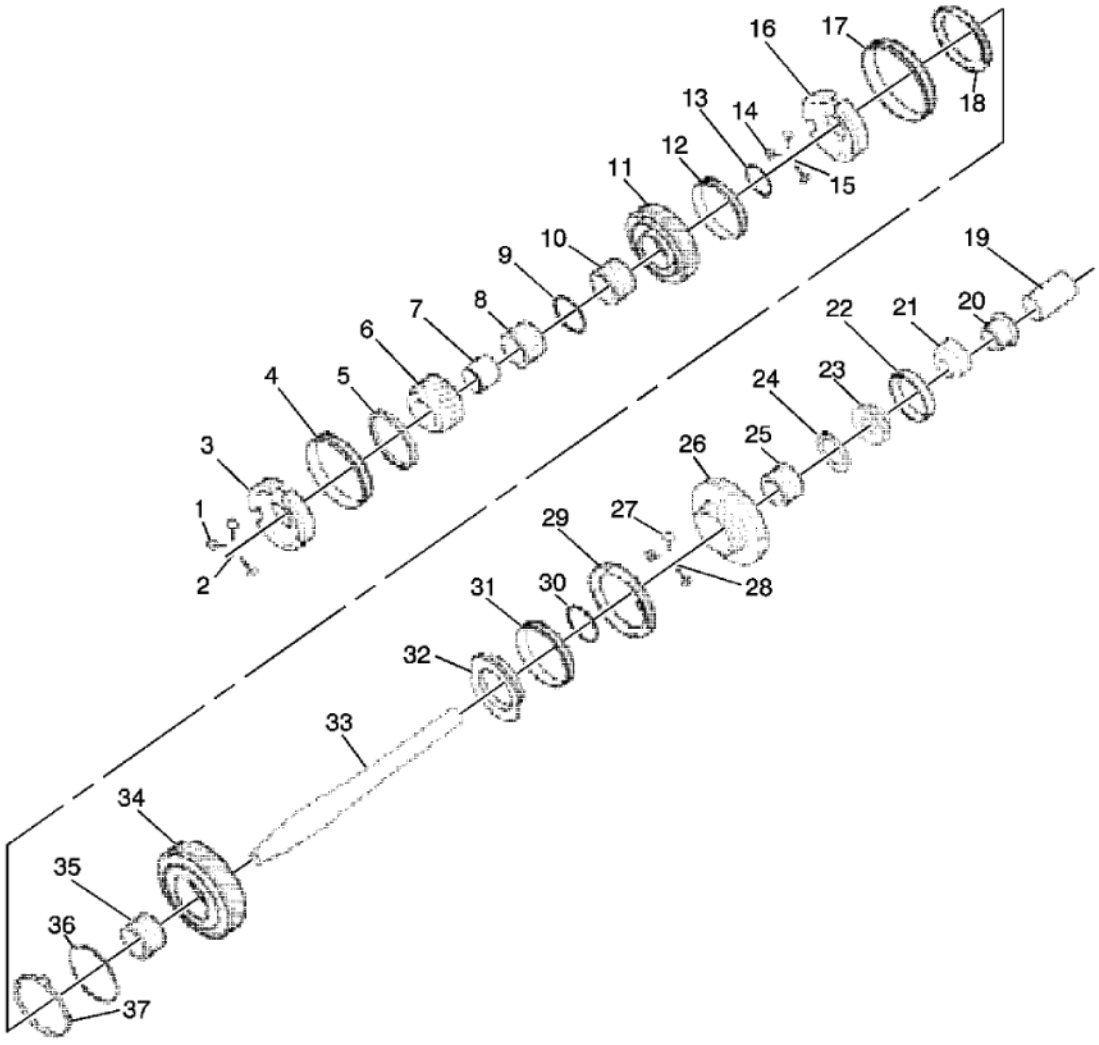


Fig. 2: Main Shaft and Components
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	1st/2nd and 3rd/4th Gear Synchronization Insert
2	Synchronization Spring
3	3rd-4th Gear Synchronization Hub
4	3rd-4th Gear Synchronization Collar
5	3rd/4th/5th Gear Synchronization Ring
6	Tapered Bearing Race
7	3rd Gear Hub
8	3rd/4th Gear and Reverse Roller Bearing

9	3rd Gear F.P. Push Pulley
10	3rd/4th Gear and Reverse Roller Bearing
11	2nd Gear Assemble
12	2nd Gear Synchronization Ring
13	1st/2nd Clutch Gear Hammer Lock Ring
14	1st/2nd and 3rd/4th Gear Synchronization Insert
15	Synchronization Spring
16	1st-2nd Synchronization Gear
17	1st-2nd Synchronization Collar
18	1st Gear Synchronization Ring
19	Spacer Flange
20	Speedometer Gear
21	5th Gear Main Shaft
22	Tapered Bearing Race
23	Bearing and Rollers
24	Reverse Gear Push Pulley
25	3rd/4th Gear and Reverse Roller Bearing
26	5th Gear Sub Assembly
27	5th/Reverse Gear Synchronization Insert
28	Synchronization Spring
29	Reverse Gear Synchronization Collar
30	1st/2nd Clutch Gear Synchronization Assembly
31	Reverse Synchronization Ring
32	Reverse Gear Clutch Ring
33	Main Shaft
34	Input Shaft 1st Gear Assembly
35	1st Gear Roller Bearing
36	1st Gear Synchronization Interior Ring
37	1st Gear Synchronization Intermediate Ring

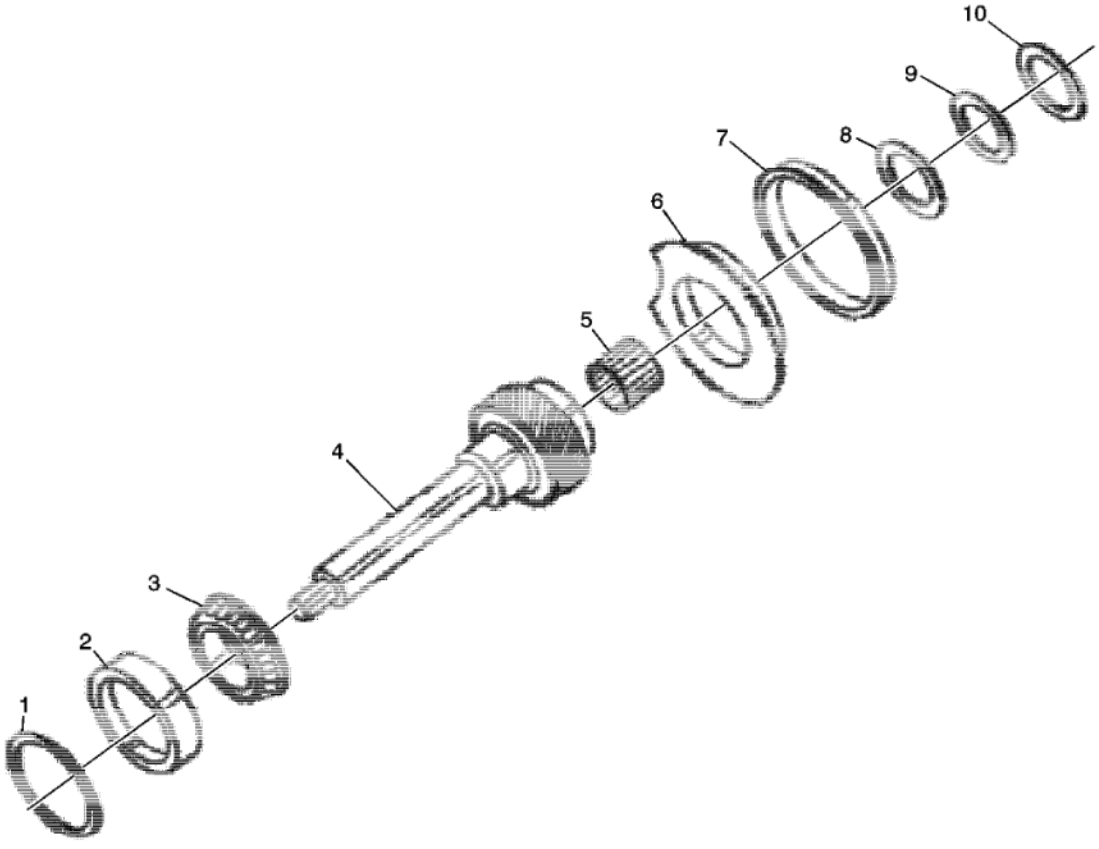


Fig. 3: Input Shaft and Components
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Bearing Retainer Spacer
2	Tapered Bearing Race
3	Bearing Taper and Rollers
4	Input Shaft
5	Input Shaft Guide Rollers
6	Clutch Ring
7	3rd/4th/5th Gear Synchronization Ring
8	Clutch Tapered Push Pulley
9	Axial Bearing
10	3rd-4th Gear Hammer Push Pulley

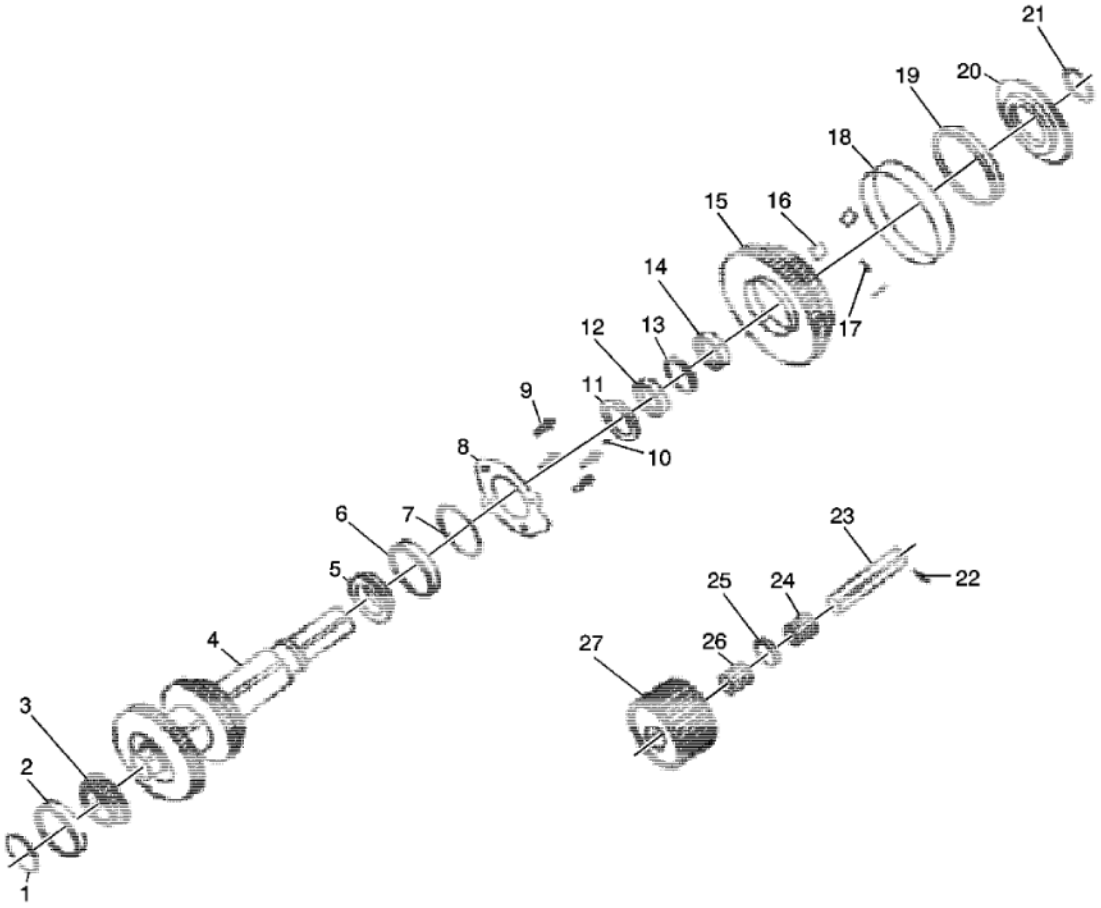


Fig. 4: Counter Gear Shaft and Components
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Front Bearing Cover
2	Front Bearing Race
3	Front Bearings and Rollers
4	Counter Shaft
5	Rear Bearing
6	Rear Bearing Race
7	Rear Bearing Adjuster Shim
8	Rear Bearing Retainer
9	Rear Bearing Retainer Bolts
10	5th Gear Push Pulley Sphere
11	5th Gear Push Pulley

12	5th Gear Roller Bearing
13	5th Gear Roller Bearing Separator
14	5th Gear Roller Bearing
15	5th Gear Sub Assembly
16	5th/Reverse Gear Synchronization Insert
17	Synchronization Spring
18	Reverse Gear Synchronization Collar
19	3rd/4th/5th Gear Synchronization Ring
20	5th Gear Clutch Ring
21	5th Gear Clutch Tapered Lock Ring
22	Reverse Shaft Safety Pin
23	Reverse Idler Gear Shaft
24	Reverse Idler Gear Roller Bearing
25	Reverse Idler Gear Spacer
26	Reverse Idler Gear Roller Bearing
27	Reverse Idler Gear

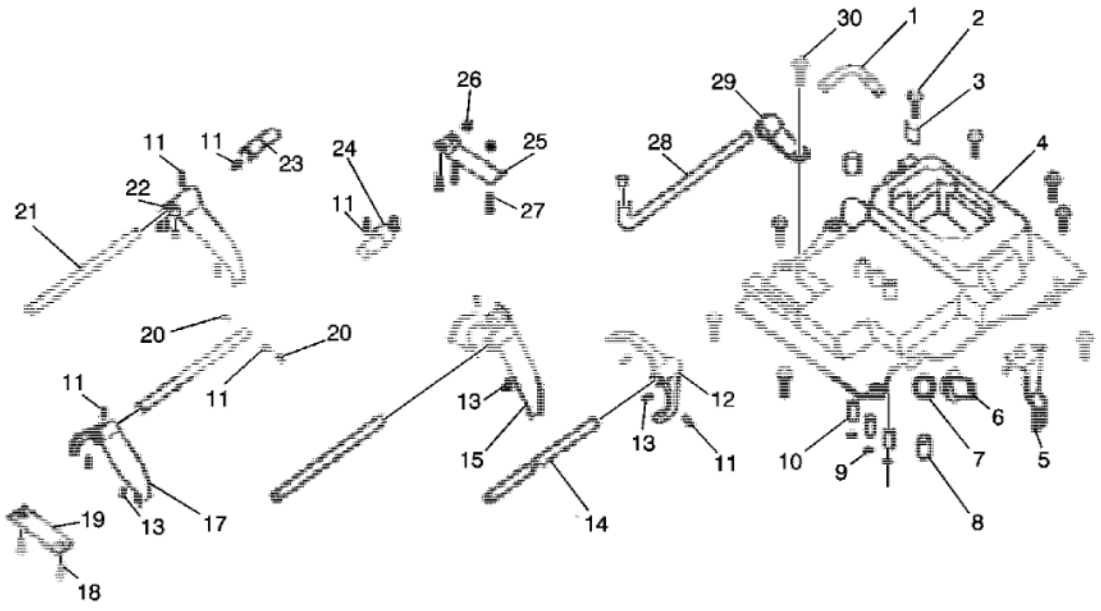


Fig. 5: Shift Control and Components
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name

1	Breather Connection
2	Control Cover Screws
3	Clip
4	Control Cover
5	Exhaust Tubing Support
6	Reverse Switch
7	Reverse Switch Gasket
8	Cap Guide Pin - Dowel
9	Insert Sphere
10	Insert Spring
11	Roll Pin
12	5th Gear Fork
13	Nylon Insert - Fork Leg
14	Reverse/5th Gear Shaft
15	5th-Reverse Gear Fork
16	5th-Reverse Gear Shift Lever
17	3rd-4th Gear Fork Assembly
18	Support Plate Bolt
19	Shaft Support Front Plate
20	Interlock Clutch/Gear Catch
21	1st-2nd Gear Shift Lever
22	1st-2nd Gear Fork
23	1st-2nd Gear Stop
24	3rd-4th Gear Stop
25	Shaft Support Rear Plate Assembly
26	Shaft Support Plate Nuts
27	Shaft Support Plate Bolts
28	Hose With Exhaust Valve
29	Hose Support Plate
30	Hose Support Plate Bolt
31	Cap Guide Pin - Dowel

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 68-8,192 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	Tighten the clutch housing bolts to specification. Refer to **Fastener Tightening Specifications** . Did you find and repair the condition?	System OK	Go to **Step 10**
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**
	Replace the engine mounts and/or transmission mounts. Refer to the appropriate procedure: • **Engine Mount Replacement - Right Side (1500 LH6, LMG, LY5, L76 and L92)** or **Engine Mount Replacement - Right Side (1500 LY2)** or **Engine Mount Replacement - Right Side (2500 LY6)**		

7	• **Engine Mount Replacement - Left Side (1500 LY2)** or **Engine Mount Replacement - Left Side (1500 LH6, LMG, LY5, L76 and L92)** or **Engine Mount Replacement - Left Side (2500LY6)** • **Transmission 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**
7	1. Inspect the clutch pilot bearing for 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**
3	1. Tighten the engine mounts to specifications. Refer to **Fastener Tightening Specifications** . 2. Replace the engine mounts. Refer to **Engine Mount Replacement - Right Side (1500 LH6, LMG, LY5, L76 and L92)** or **Engine Mount Replacement - Right Side (1500 LY2)** or **Engine Mount Replacement - Right Side (2500 LY6)** or **Engine Mount Replacement - Left Side (1500 LY2)** or **Engine Mount Replacement - Left Side (1500 LH6, LMG, LY5, L76 and L92)** or **Engine Mount Replacement - Left Side (2500LY6)** . 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

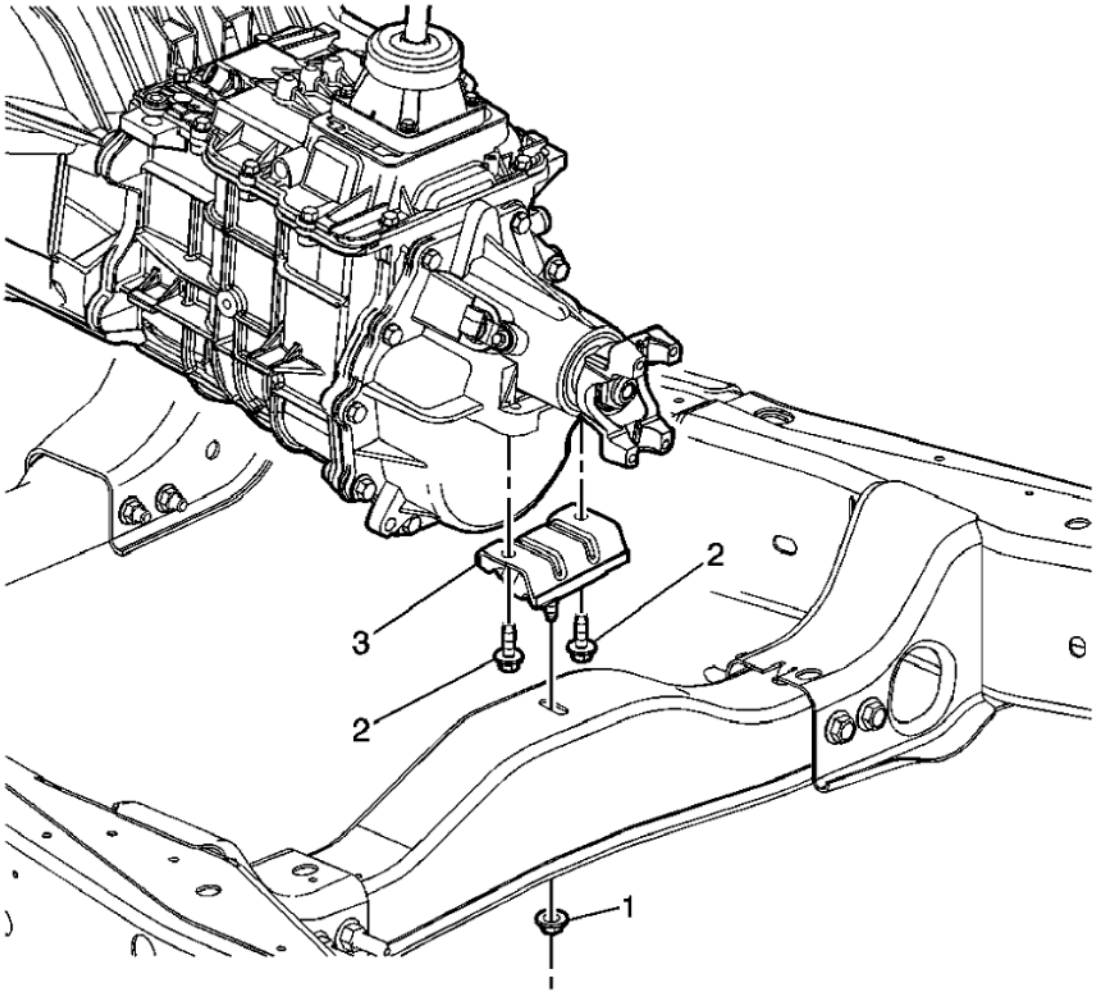


Fig. 6: Transmission Rear Mount
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Support the transmission with a transmission jack.	
1	Transmission Mount Nut **NOTE:** **Refer to Fastener Notice .** **Tighten::** 40 N.m (30 lb ft).
2	Transmission Mount Bolt (Qty: 2) **Tighten::** 50 N.m (37 lb ft).
3	Transmission Mount **Procedure:** Raise the transmission with the jack enough to remove the transmission mount.

TRANSMISSION CONTROL REPLACEMENT

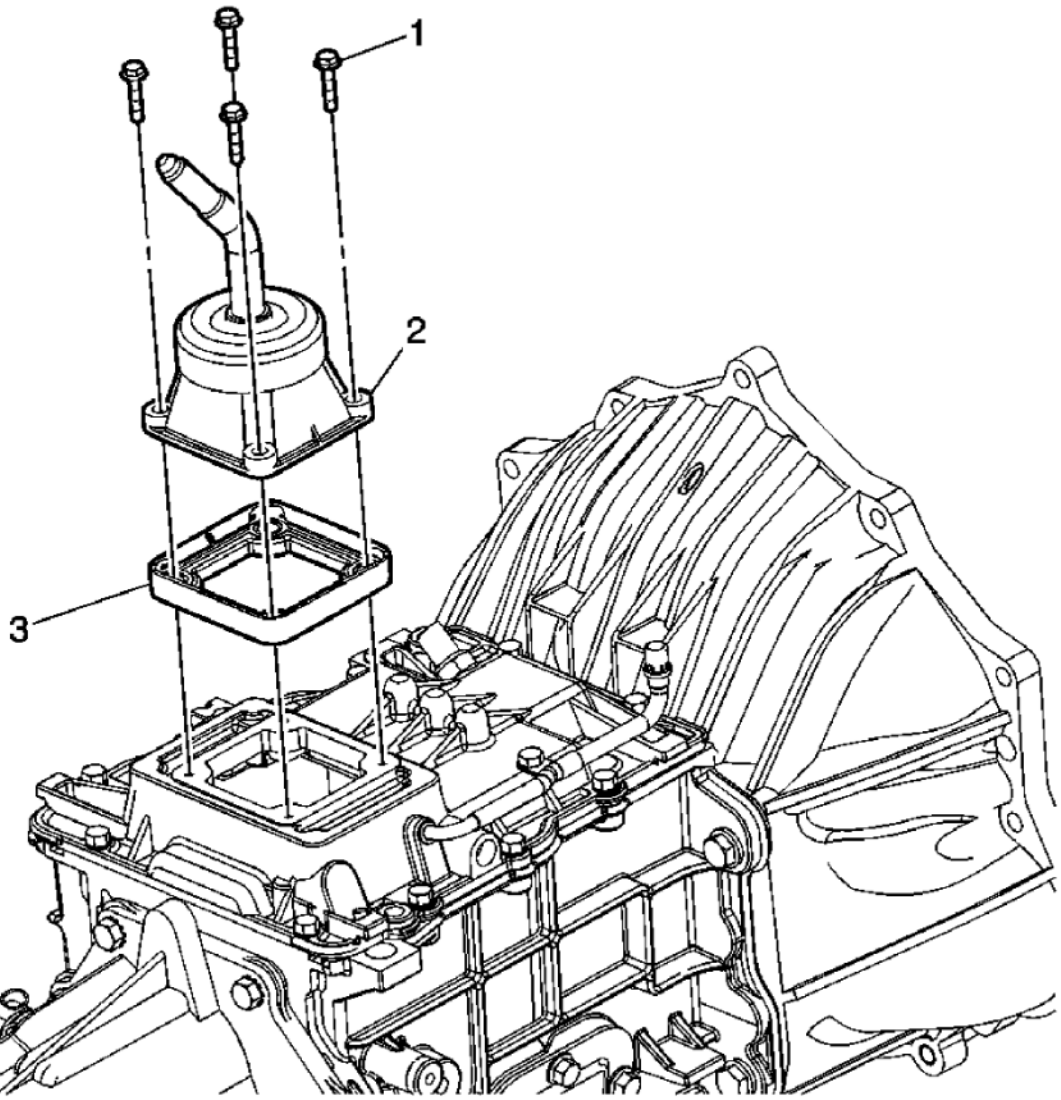


Fig. 7: Transmission Control
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name

Preliminary Procedures

1. Remove the control lever and boot. Refer to **Transmission Control Lever Boot Replacement**.
2. Remove the transmission support. 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)** . 3. Lower the transmission slightly to access the insulator. 4. Cut and remove the insulator. 5. Shift the transmission to neutral.
1	Transmission Control Bolt (Qty: 4) **NOTE:** **Refer to Fastener Notice .** **Tip:** Remove ONLY the exposed bolts at the base of the lever. **Tighten::** 11 N.m (97 lb in)
2	Transmission Control **Tip:** Do not disassemble the transmission shift lever. Internal parts for this shift lever are not available.
3	Transmission Control Spacer **Procedure:** Apply sealer GM P/N 12345739 (Canadian P/N 10953541) to the shift cover side of the shift tower spacer.

TRANSMISSION CONTROL LEVER BOOT REPLACEMENT

Removal Procedure

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

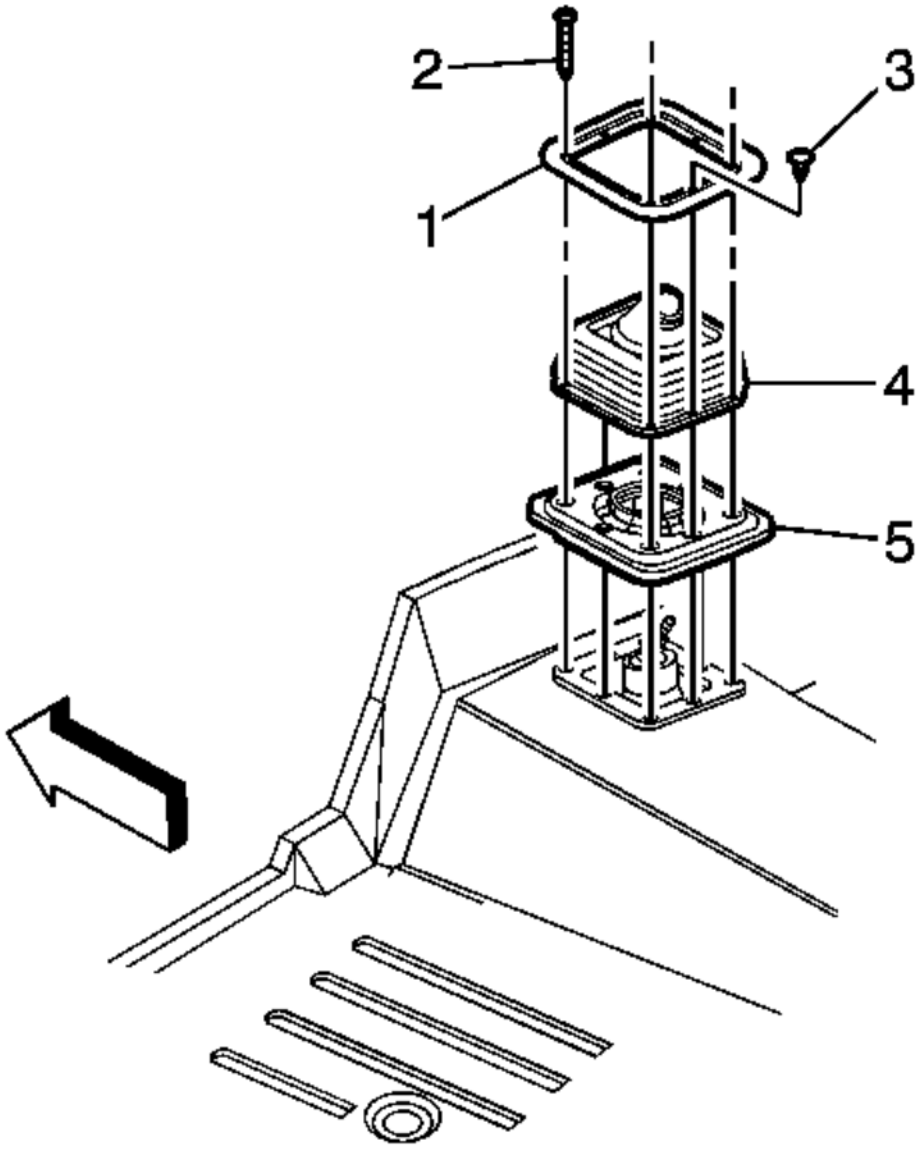


Fig. 8: Exploded View Of Transmission Control Lever Boot
Courtesy of GENERAL MOTORS CORP.

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

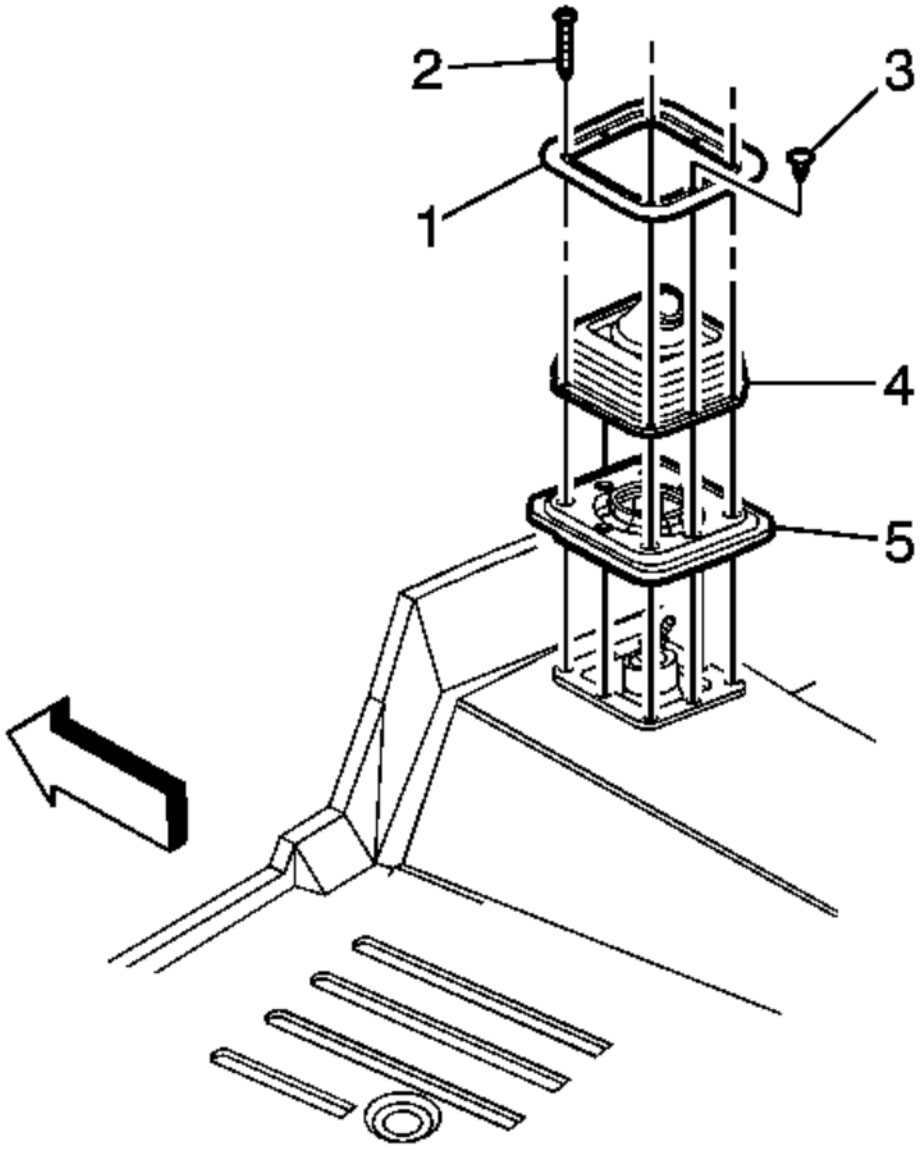


Fig. 9: Exploded View Of Transmission Control Lever Boot
Courtesy of GENERAL MOTORS CORP.

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.

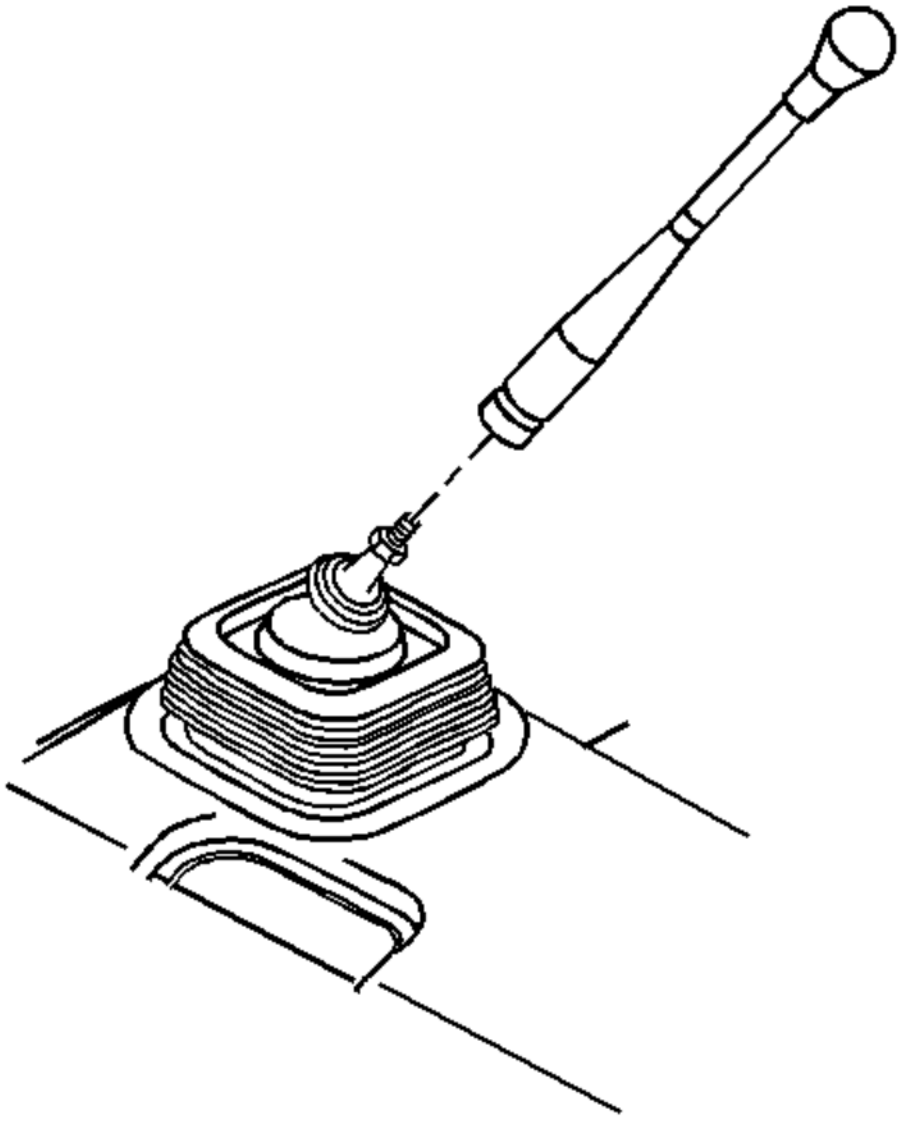


Fig. 10: View Of Control Lever
Courtesy of GENERAL MOTORS CORP.

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

2. Remove the control lever.

Installation Procedure

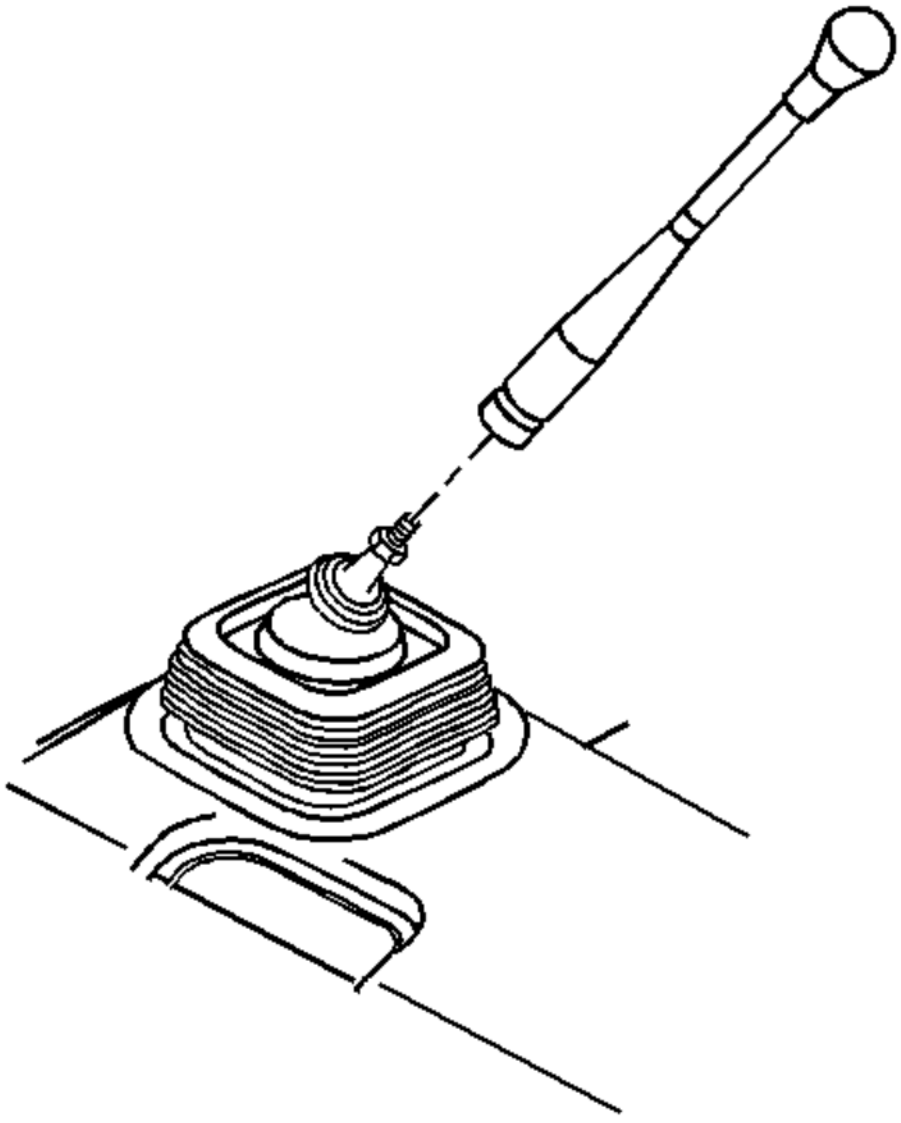


Fig. 11: View Of Control Lever
Courtesy of GENERAL MOTORS CORP.

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.

BACKUP LAMP SWITCH REPLACEMENT

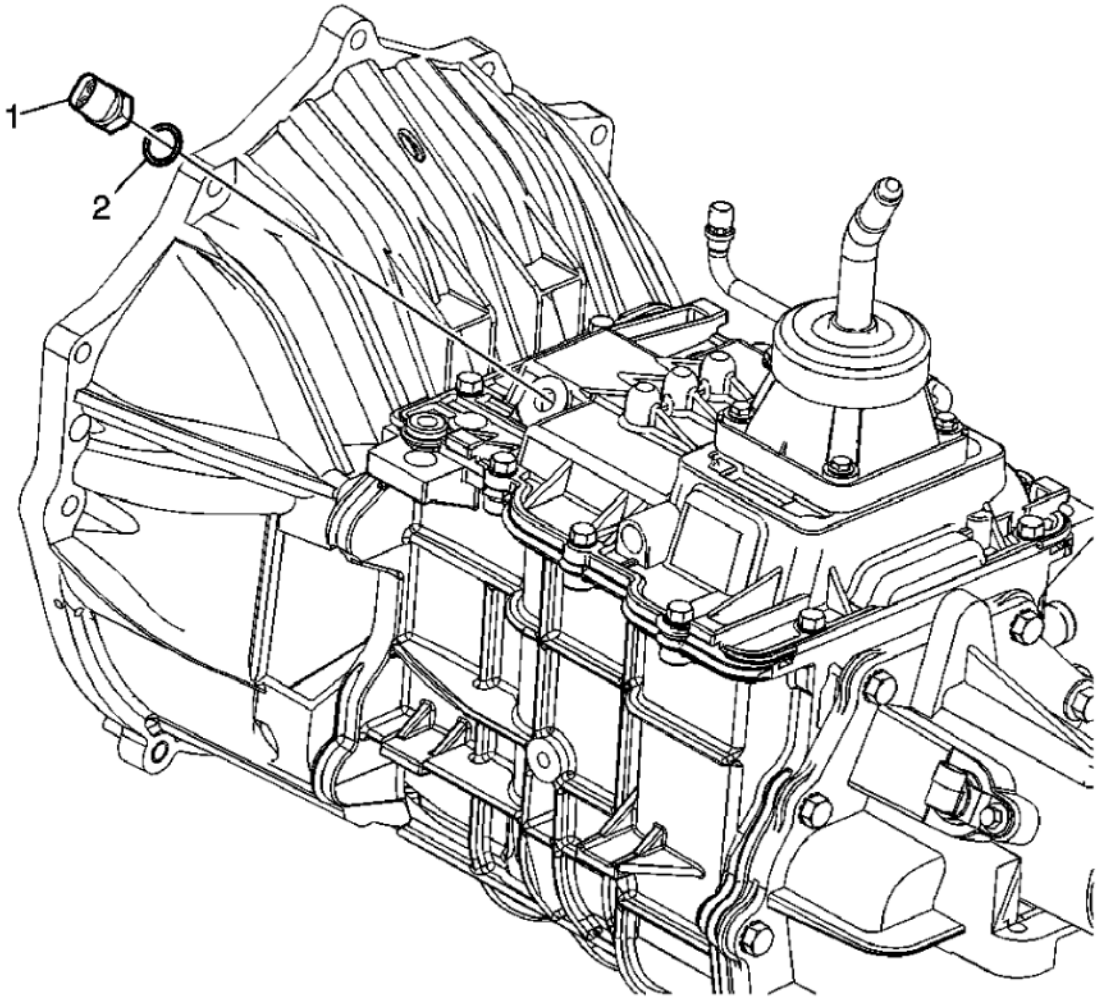


Fig. 12: Backup Lamp Switch
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .	
1	Backup Lamp Switch **NOTE:** **Refer to Component Fastener Tightening Notice .** **Procedure:** Disconnect the electrical connector from the backup lamp switch.

	Tighten:: 28 N.m (21 lb ft)
2	Backup Lamp Switch Seal

VEHICLE SPEED SENSOR REPLACEMENT

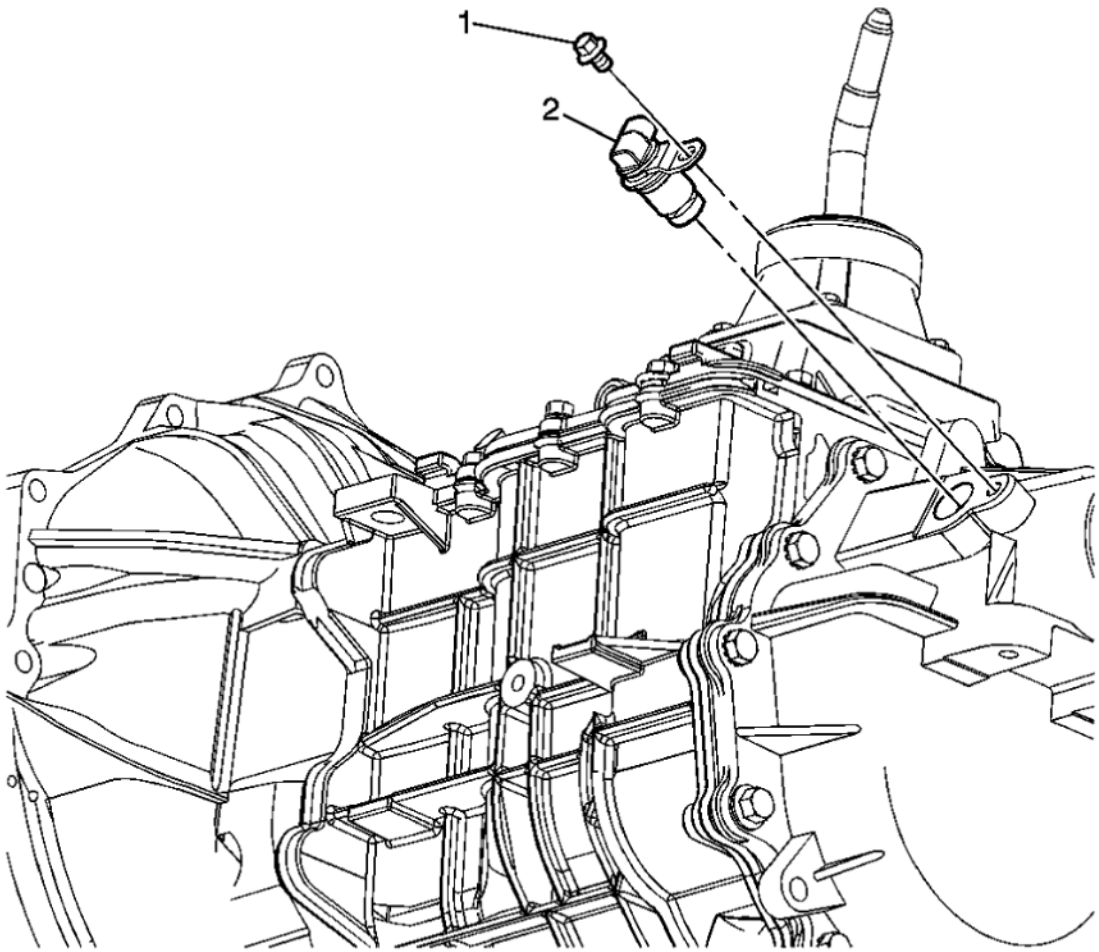


Fig. 13: Vehicle Speed Sensor
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .	
1	Vehicle Speed Sensor Bolt **NOTE:** **Refer to Fastener Notice .**

	Tighten:: 12 N.m (111 lb in).
2	Vehicle Speed Sensor **Procedure:** Disconnect the electrical connector from the vehicle speed sensor.

TRANSMISSION FLUID REPLACEMENT

Removal Procedure

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Place a suitable drain pan under the transmission in order to catch the drained transmission fluid.

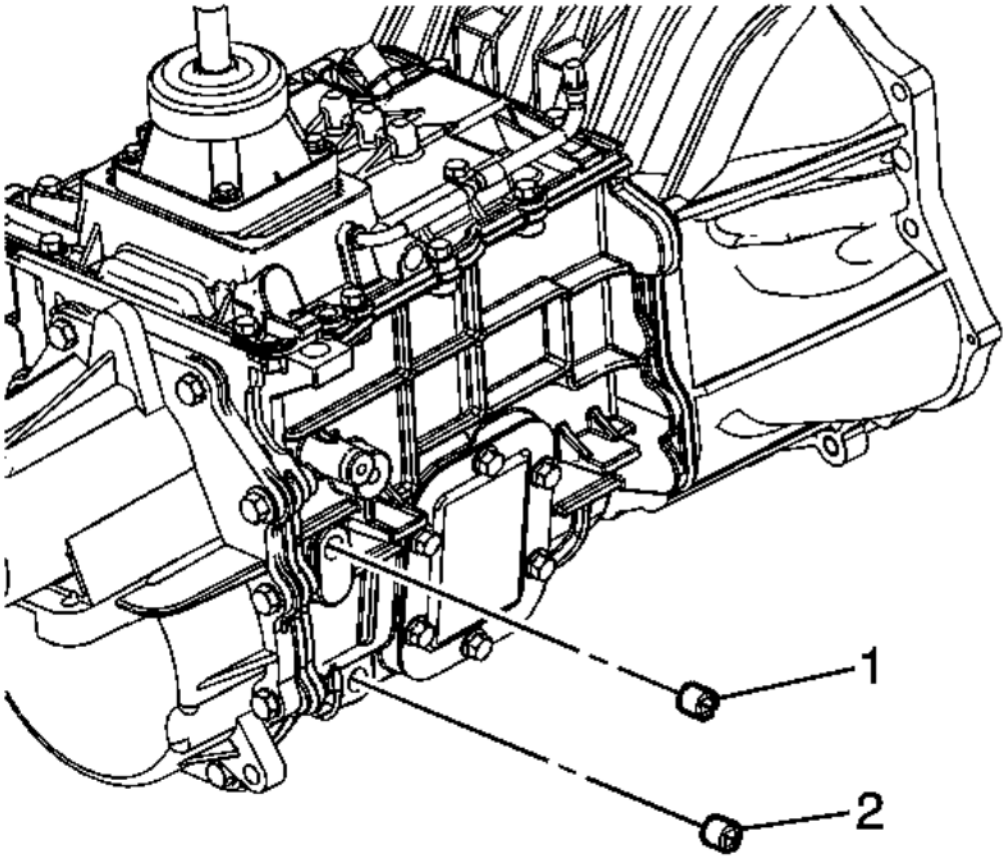


Fig. 14: View Of Drain And Fill Plugs
Courtesy of GENERAL MOTORS CORP.

3. Remove the oil fill plug (1).
4. Remove the oil drain plug (2).
5. Remove any old sealant from the transmission housing.

Installation Procedure

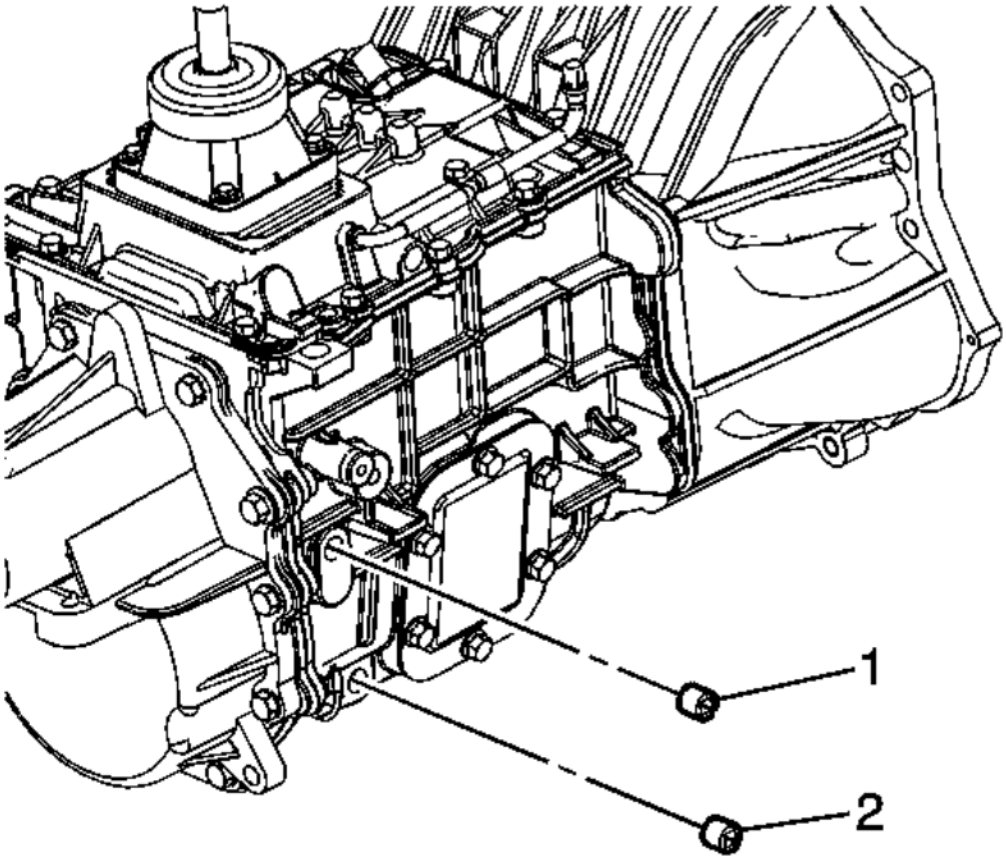


Fig. 15: View Of Drain And Fill Plugs
Courtesy of GENERAL MOTORS CORP.

1. Apply a thin bead of sealant GM P/N 12346004 (Canadian P/N 10953480), or equivalent to the oil drain plug threads.

NOTE: **Refer to Component Fastener Tightening Notice .**

2. Install the oil drain plug (2).

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

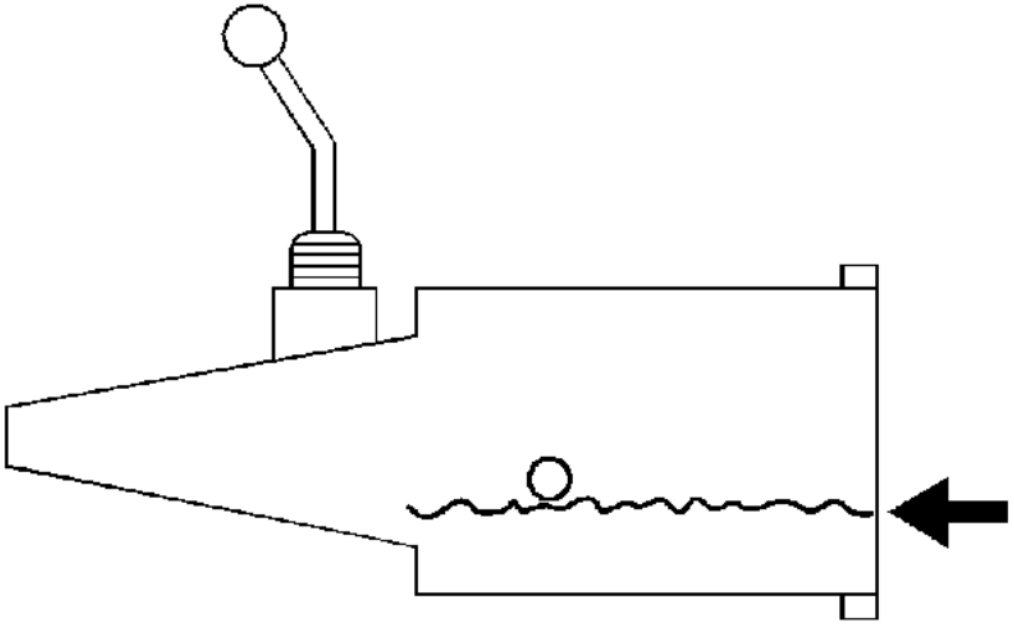


Fig. 16: Checking Transmission Fluid Level
Courtesy of GENERAL MOTORS CORP.

3. Fill the transmission with the proper fluid to just below the bottom of the fill plug hole.

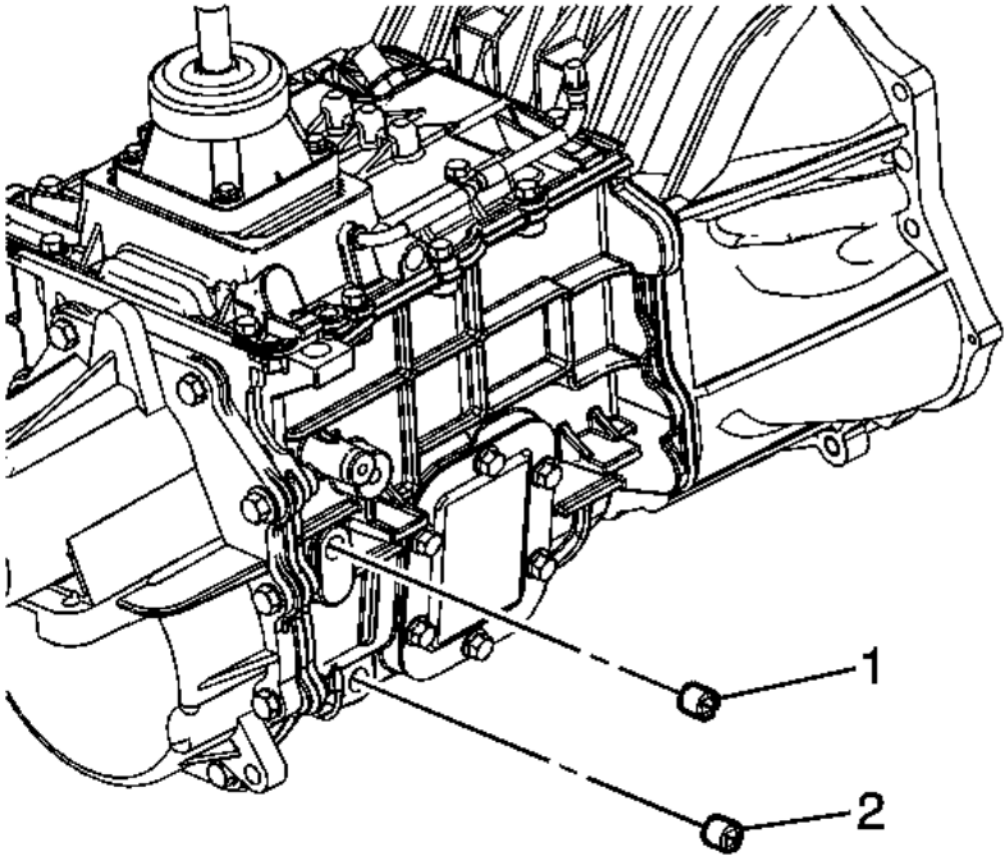


Fig. 17: View Of Drain And Fill Plugs
Courtesy of GENERAL MOTORS CORP.

4. Apply a thin bead of sealant GM P/N 12346004 (Canadian P/N 10953480), or equivalent to the oil fill plug threads.
5. Install the oil fill plug (1).

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

6. Lower the vehicle.

TRANSMISSION VENT PIPE REPLACEMENT

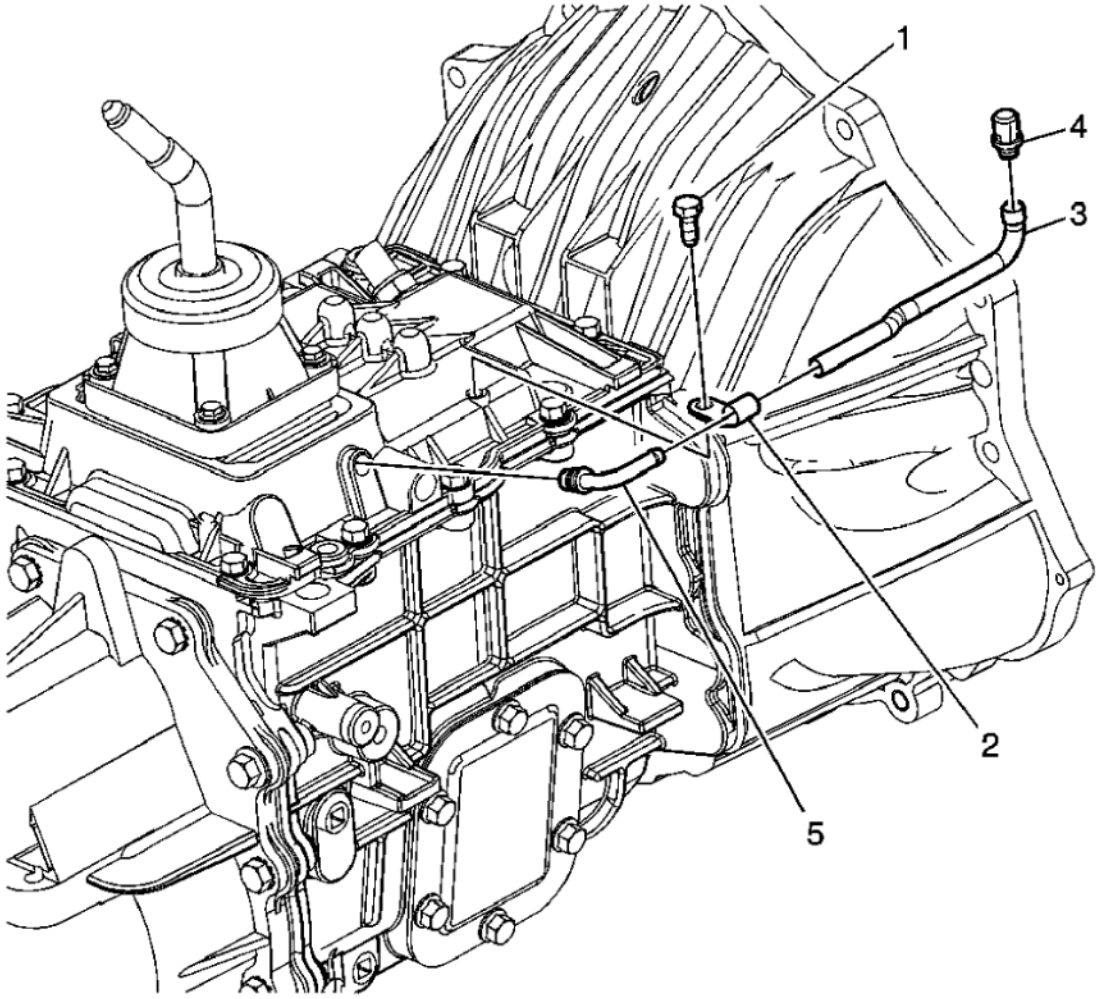


Fig. 18: Transmission Vent Pipe
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .	
1	Transmission Vent Pipe Bolt **NOTE:** **Refer to Fastener Notice .** **Tighten::** 11 N.m (97 lb in).
2	Transmission Vent Pipe Clip
3	Transmission Vent Pipe

4	Transmission Vent Pipe Breather
5	Transmission Vent Pipe

TRANSMISSION REPLACEMENT

Tools Required

J 42371 Hydraulic Clutch Line Separator. See **Special Tools**.

Removal Procedure

1. Remove the shift lever. Refer to **Transmission Control Lever Knob Replacement**.
2. Remove the propeller shaft. Refer to **One-Piece Propeller Shaft Replacement** or **Two-Piece Propeller Shaft Replacement** .

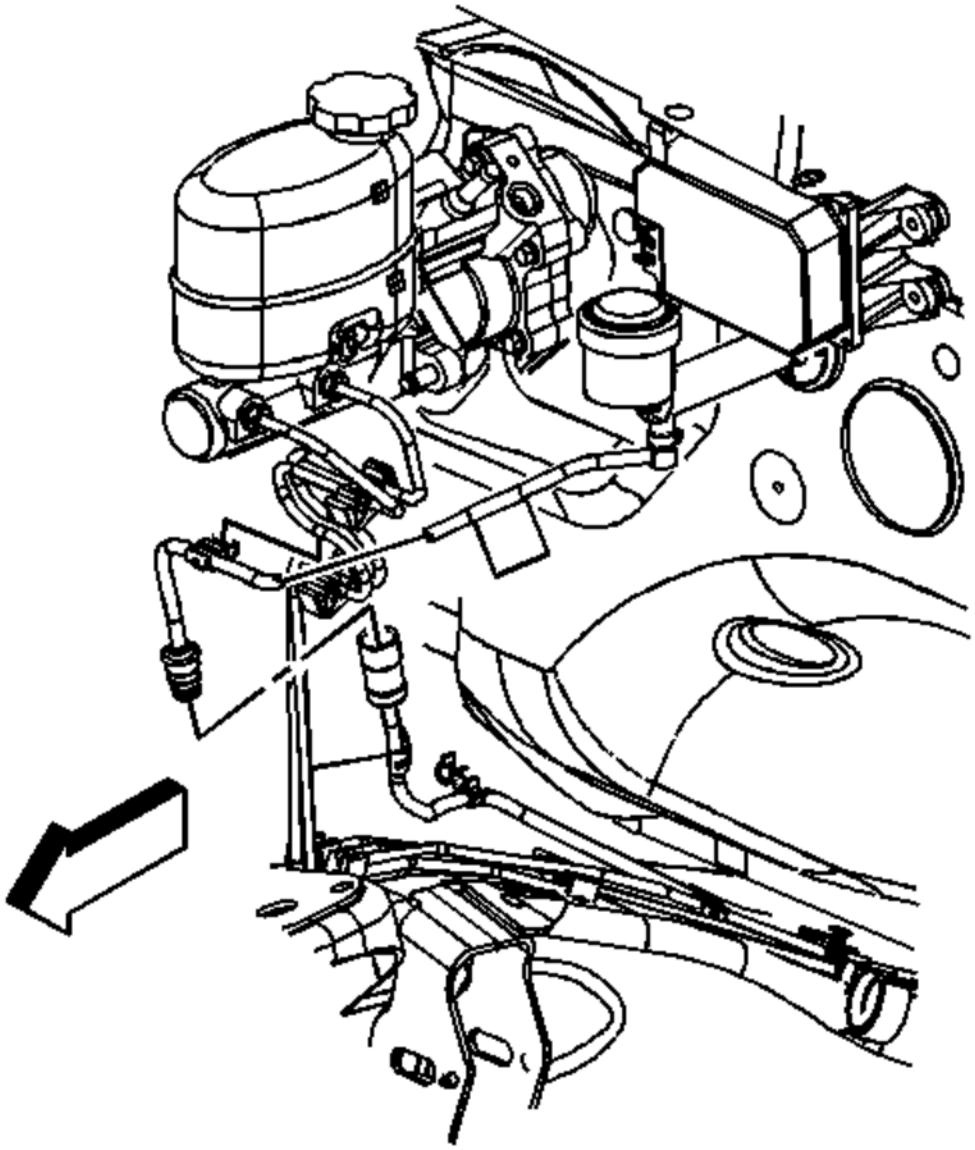


Fig. 19: Identifying Clutch Master Cylinder To Clutch Actuator Cylinder Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

3. Using **J 42371** push back on the sleeve on the quick connect in order to disconnect the clutch actuator cylinder to clutch master cylinder quick connect fitting. See **Special Tools**.

4. Disconnect the electrical wiring harness connector from the backup lamp switch.
5. Disconnect the electrical wiring harness connector from the vehicle speed sensor.
6. Remove the engine electrical wiring harness clip from the fuel pipe bracket.

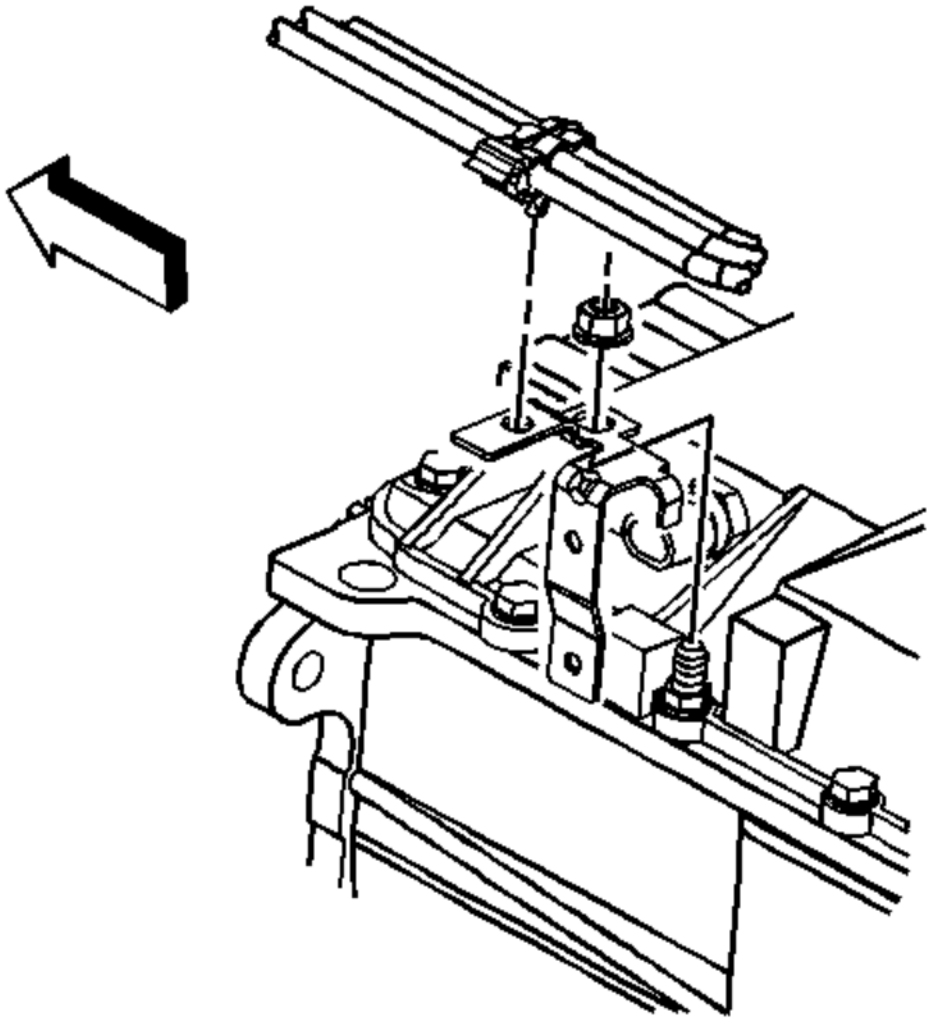


Fig. 20: View Of Fuel Feed/Return Hose Clip
Courtesy of GENERAL MOTORS CORP.

7. Remove the fuel pipes from the fuel pipe bracket.

8. Support the transmission using a suitable transmission jack.
9. Remove the transmission support. 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)** .

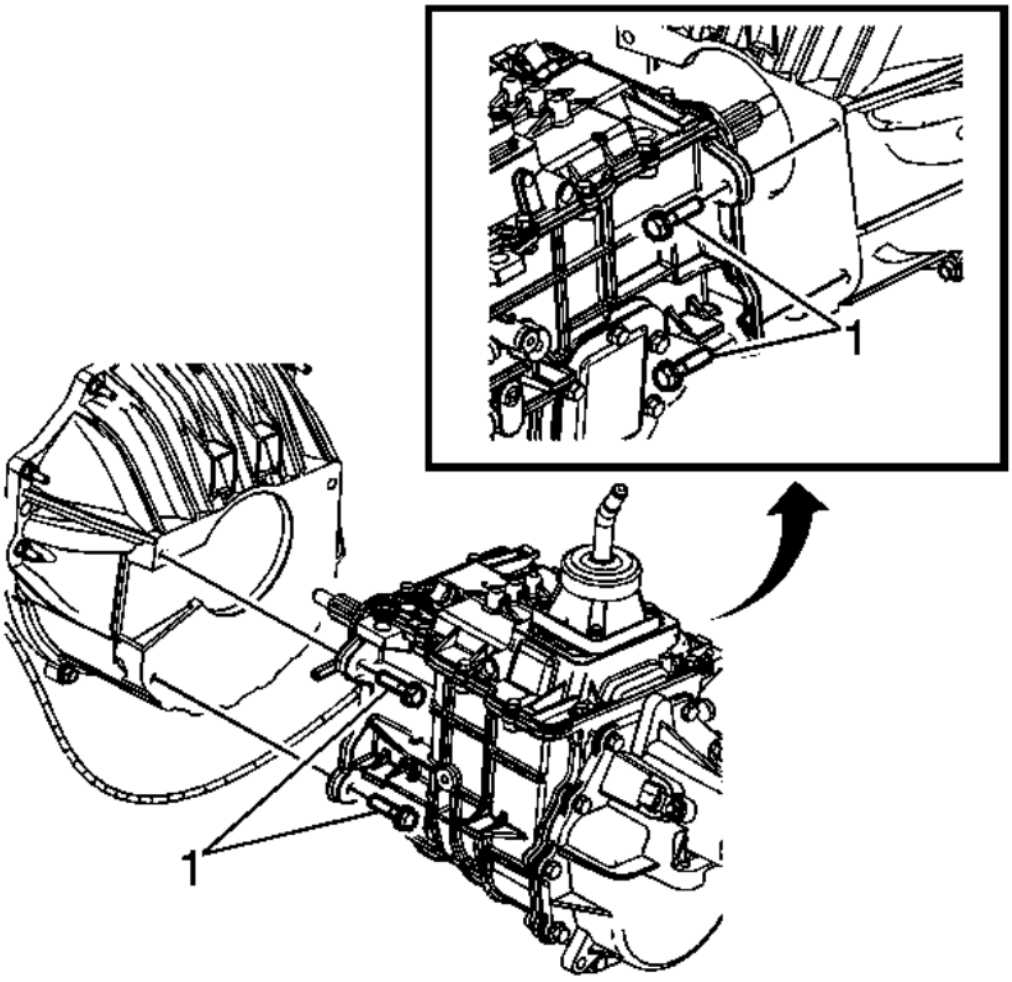


Fig. 21: Transmission To Clutch Housing Bolts
Courtesy of GENERAL MOTORS CORP.

10. Remove the transmission to clutch housing bolts (1).
11. Remove the transmission from the clutch housing.

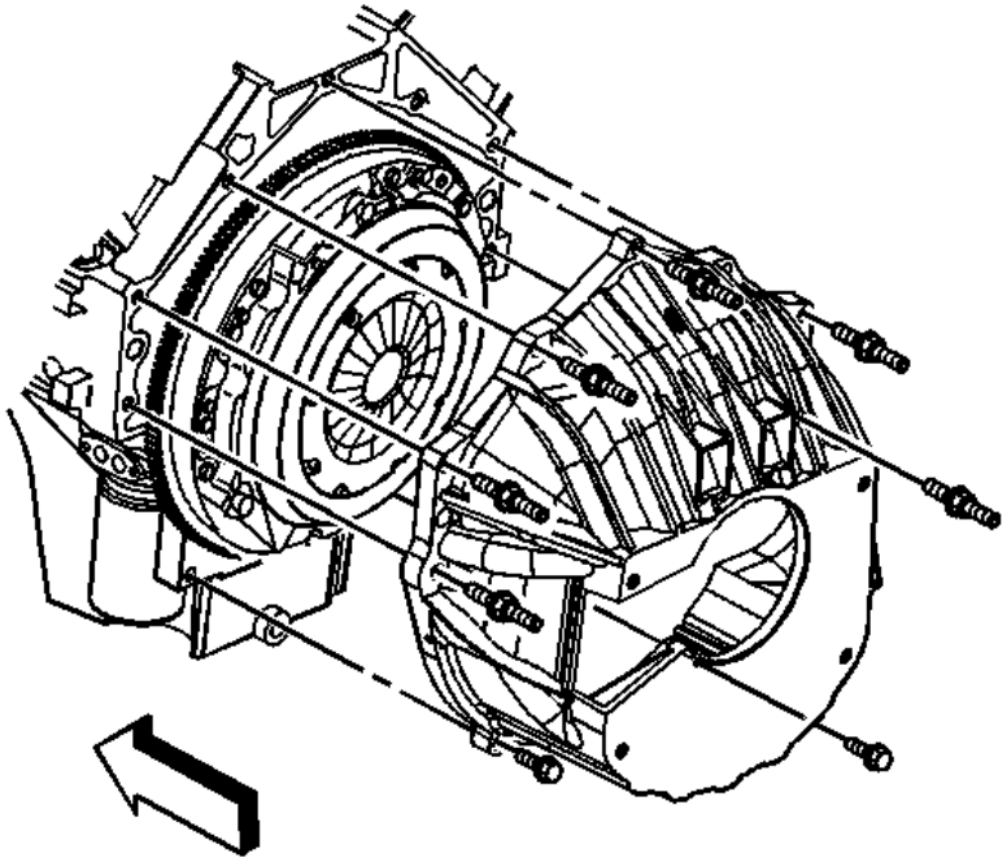


Fig. 22: Identifying Clutch Housing Bolts/Studs
Courtesy of GENERAL MOTORS CORP.

12. If servicing the clutch, remove the clutch housing bolts and studs.
13. Remove the clutch housing.

Installation Procedure

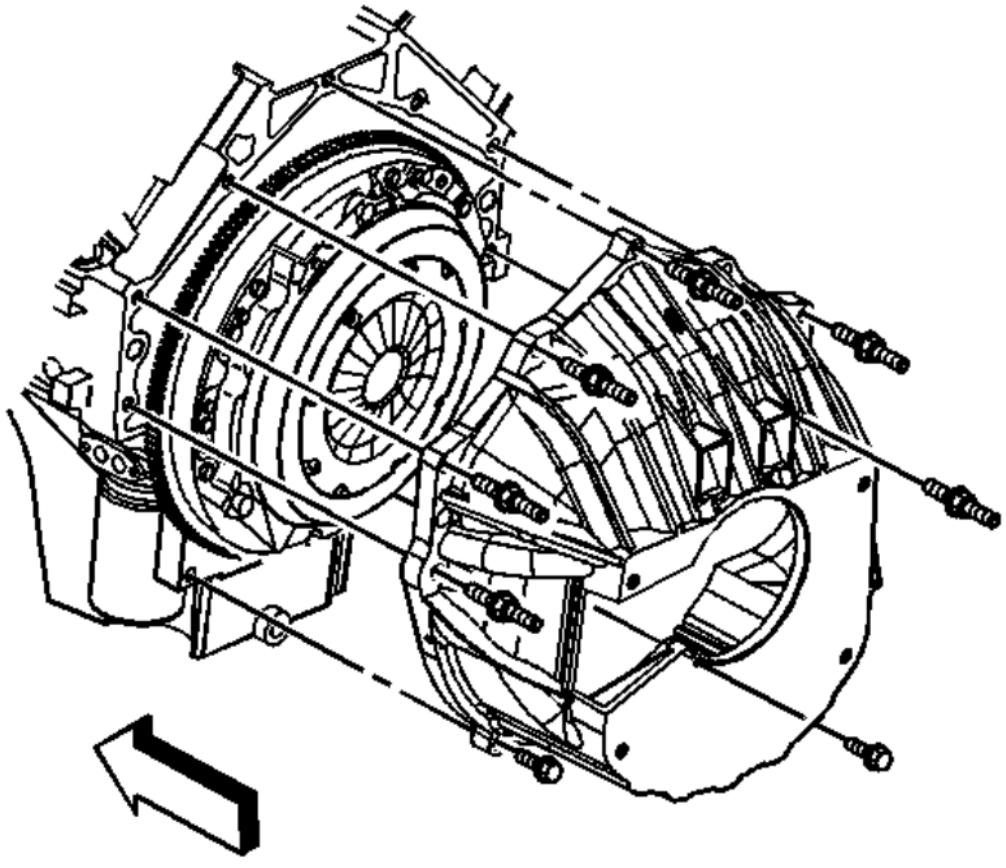


Fig. 23: Identifying Clutch Housing Bolts/Studs
Courtesy of GENERAL MOTORS CORP.

1. Install the clutch housing if previously removed.

NOTE: **Refer to Fastener Notice .**

2. Install the clutch housing bolts and studs.

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

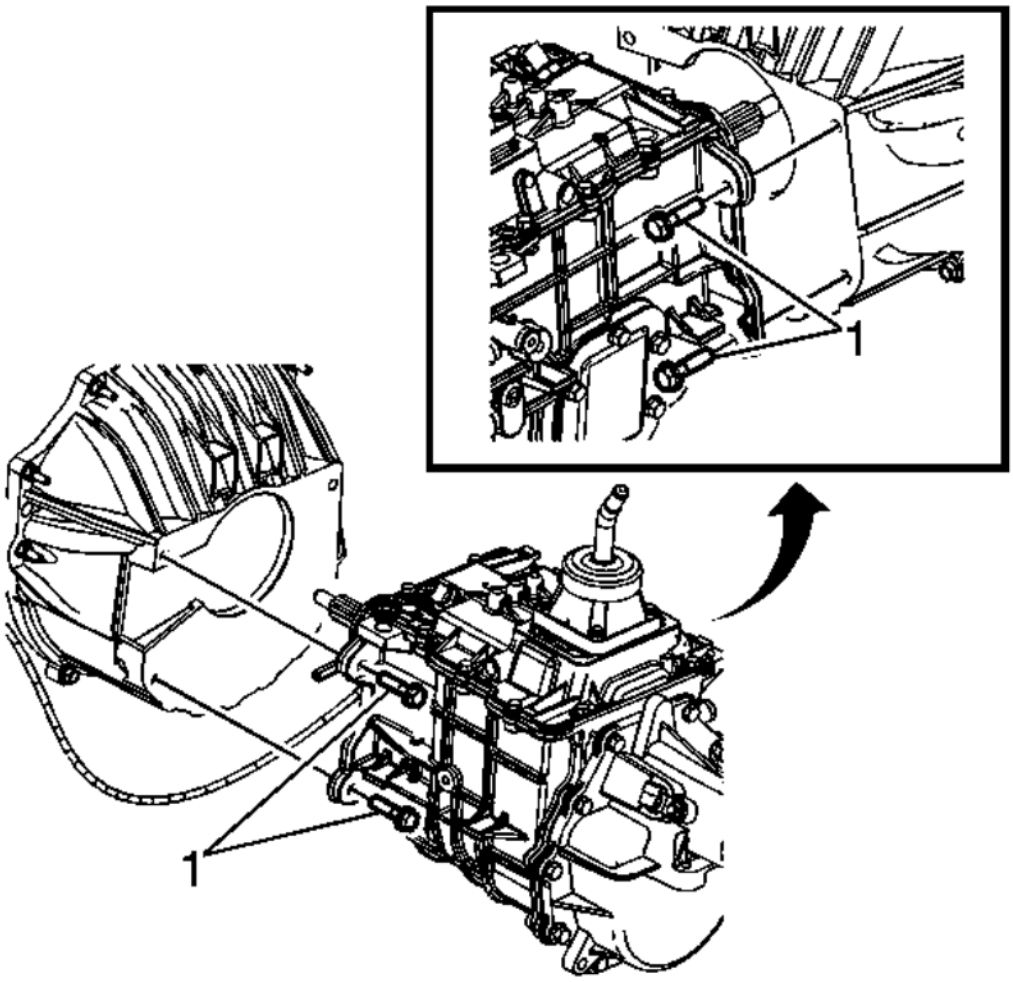


Fig. 24: Transmission To Clutch Housing Bolts
Courtesy of GENERAL MOTORS CORP.

3. Position the transmission to the clutch housing.
4. Install the transmission to clutch housing bolts (1).

   Tighten: Tighten the bolts to 100 N.m (74 lb ft).

5. Install the transmission support. 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.

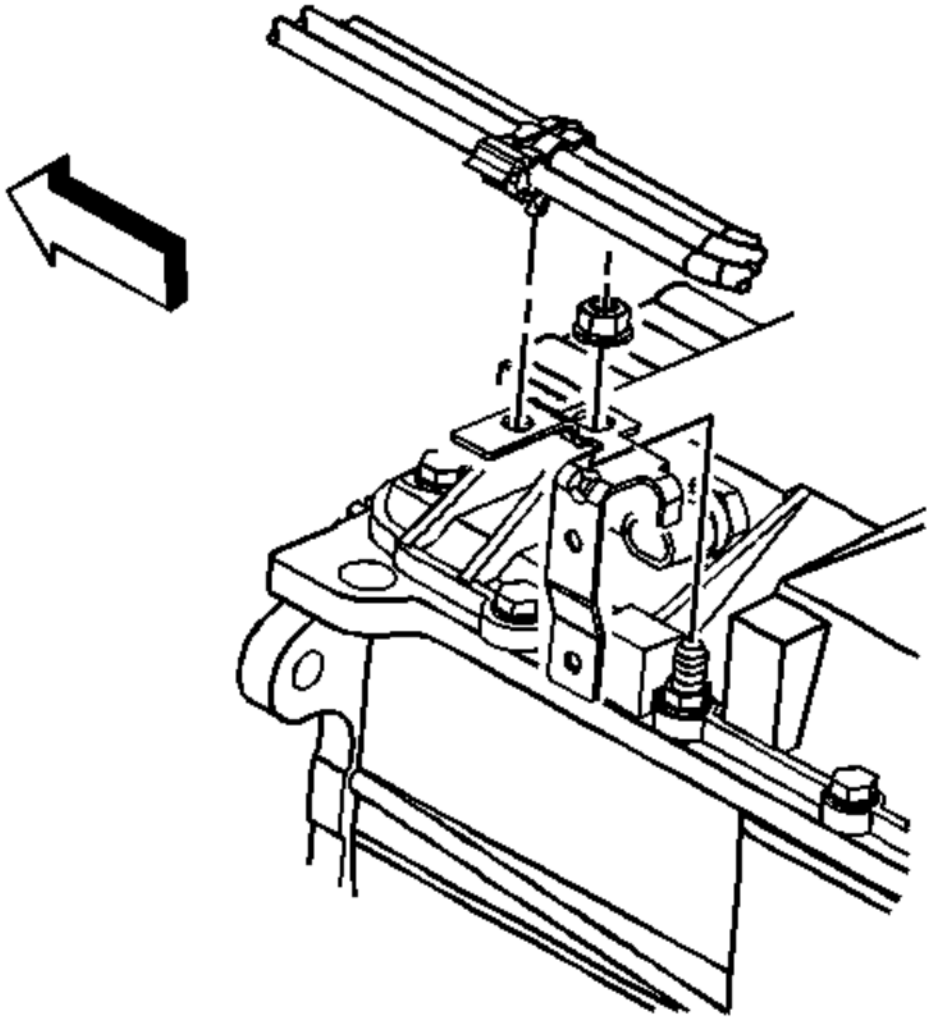


Fig. 25: View Of Fuel Feed/Return Hose Clip
Courtesy of GENERAL MOTORS CORP.

7. Install the fuel pipes to the fuel pipe bracket.

8. Install the engine electrical wiring harness clip to the fuel pipe bracket.
9. Connect the electrical wiring harness connector to the backup lamp switch.
10. Connect the electrical wiring harness connector to the vehicle speed sensor.

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

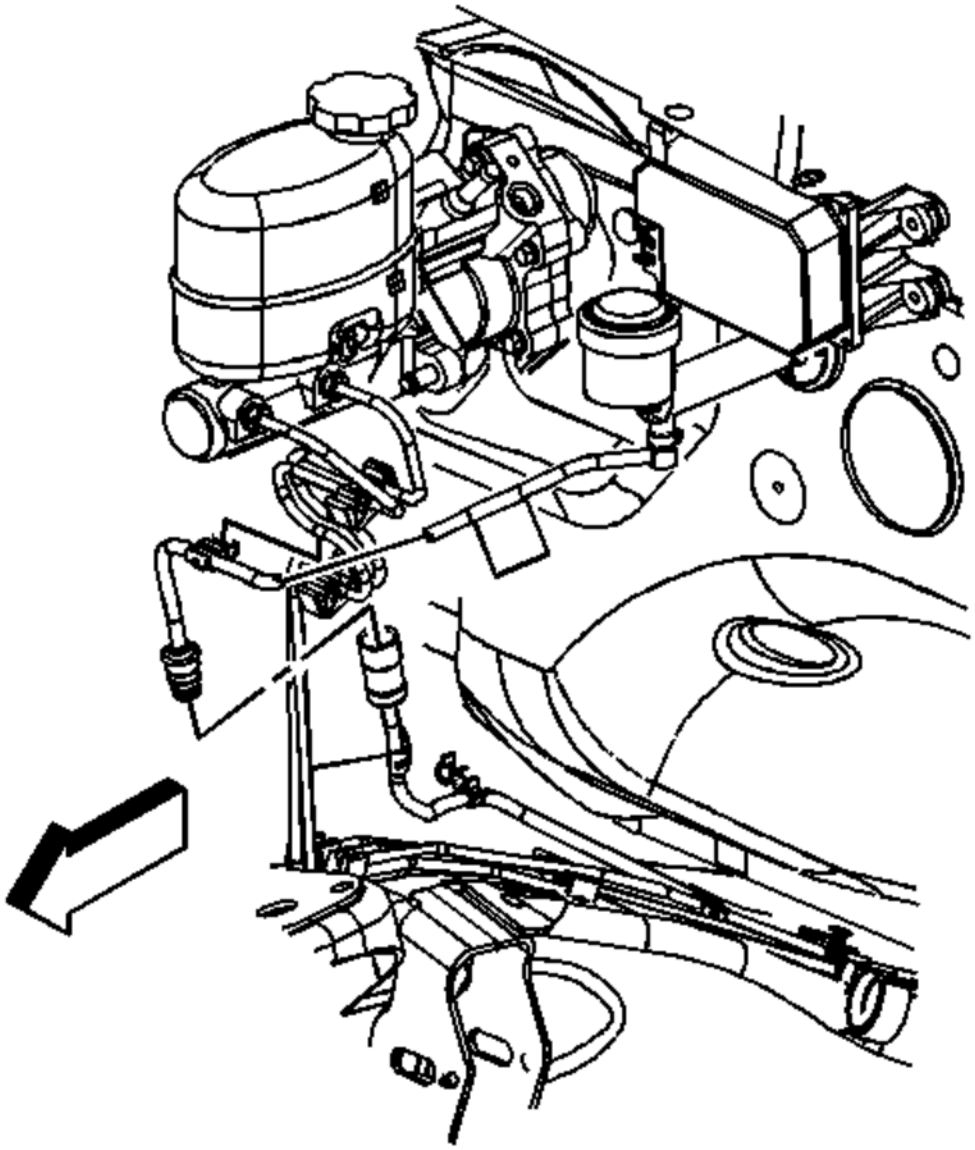


Fig. 26: Clutch Master Cylinder To Clutch Actuator Cylinder Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

11. Connect the clutch actuator cylinder hose to the clutch master cylinder hose.
12. Push together the clutch hydraulic hose quick connect fittings, then pull back on the fittings to verify engagement.

13. Check the clutch hydraulic hose for kinks or twists.
14. Install the propeller shaft. Refer to **One-Piece Propeller Shaft Replacement** or **Two-Piece Propeller Shaft Replacement** .
15. Fill the transmission with the proper fluid to the correct level.
16. Install the shift lever. Refer to **Transmission Control Lever Knob Replacement**.
17. Bleed the clutch hydraulic system. Refer to **Hydraulic Clutch Bleeding** .

POWER TAKE-OFF COVER REPLACEMENT

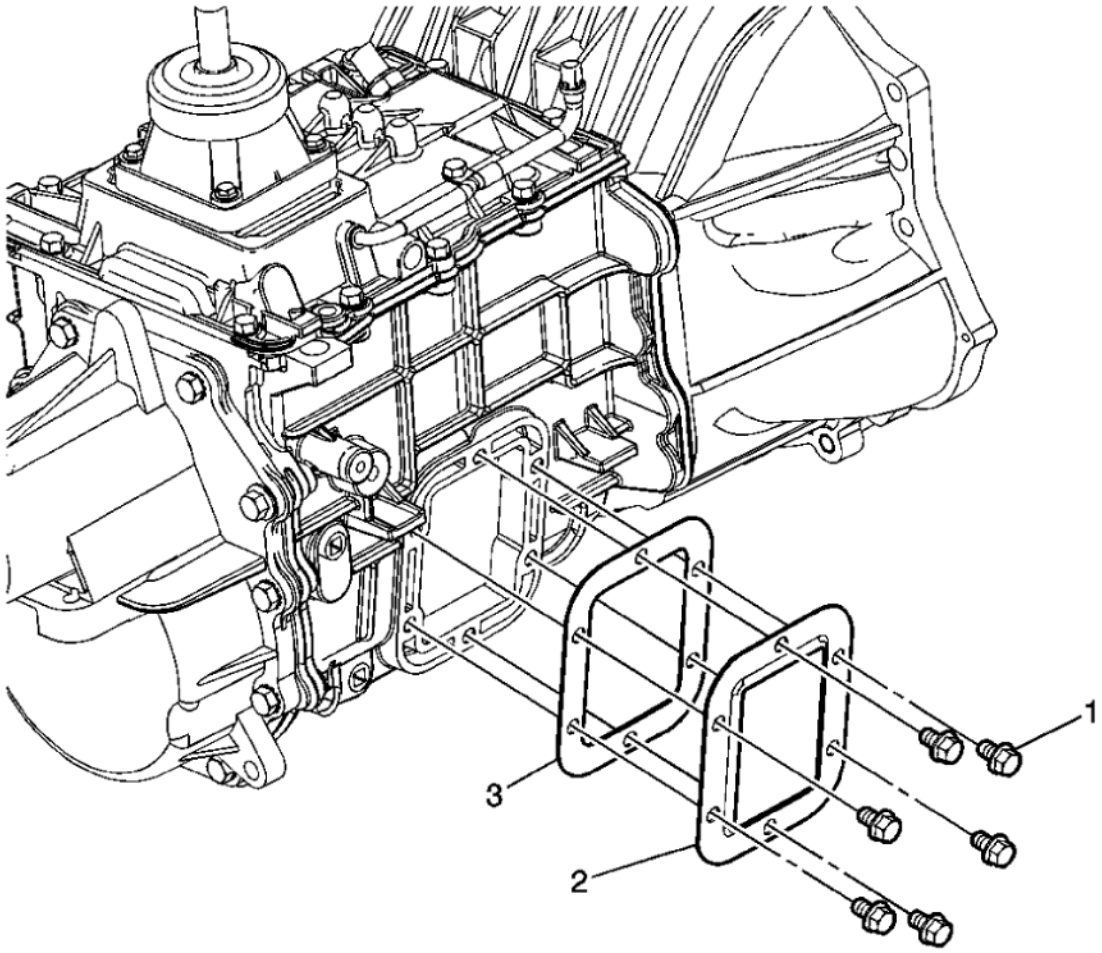


Fig. 27: Power Take-Off Cover
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures	

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Drain the transmission fluid. Refer to **Transmission Fluid Replacement**.	
1	Power Take Off Cover Bolts (Qty: 6) **NOTE:** **Refer to Fastener Notice .** **Tighten::** 30 N.m (22 lb ft).
2	Power Take Off Cover
3	Power Take Off Cover Gasket

MAIN SHAFT SEAL REPLACEMENT

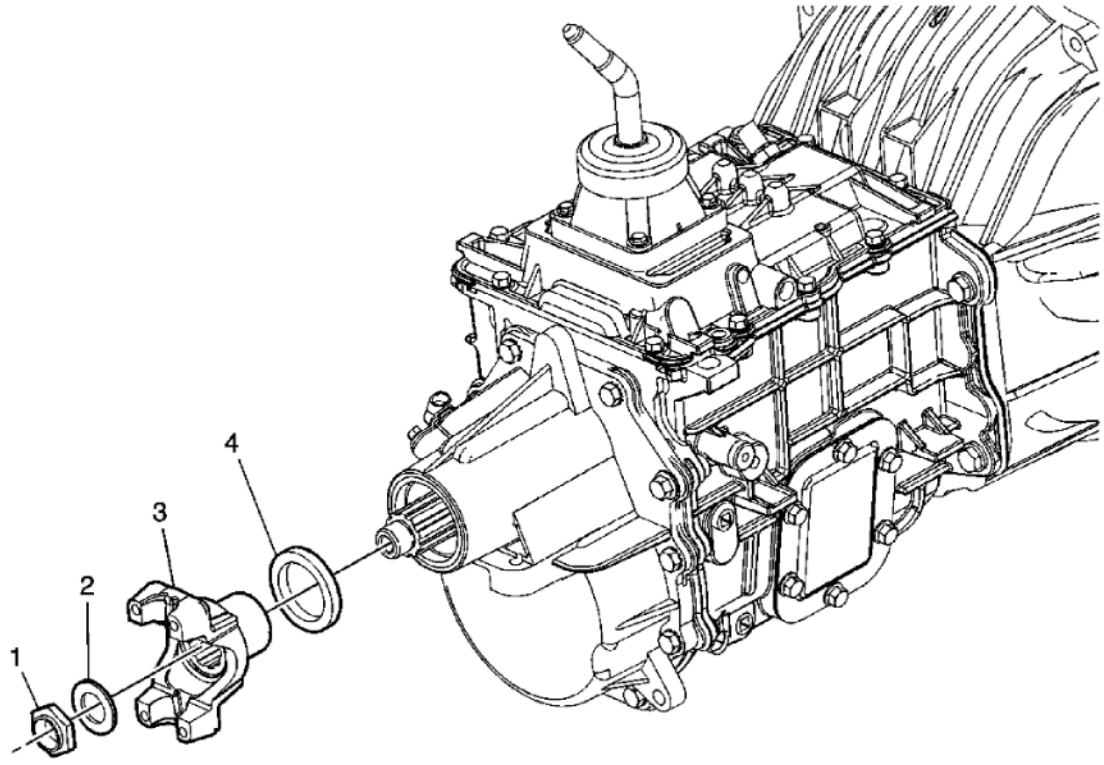


Fig. 28: Main Shaft Seal
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures	

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the propeller shaft. Refer to **One-Piece Propeller Shaft Replacement** or **Two-Piece Propeller Shaft Replacement** .
3. Position an appropriate container under the transmission to catch any lost fluid.

1	Main Shaft Nut **NOTE:** **Refer to Fastener Notice .** **Procedure:** Use the **J 8614-01** to hold the transmission end yoke while removing or installing the main shaft nut. **Tighten:** 441 N.m (325 lb ft) **Special Tool:** **J 8614-01** Flange and Pulley Holding Tool
2	Main Shaft Washer
3	Transmission End Yoke
4	Main Shaft Seal

REPAIR INSTRUCTIONS - OFF VEHICLE

TRANSMISSION DISASSEMBLE

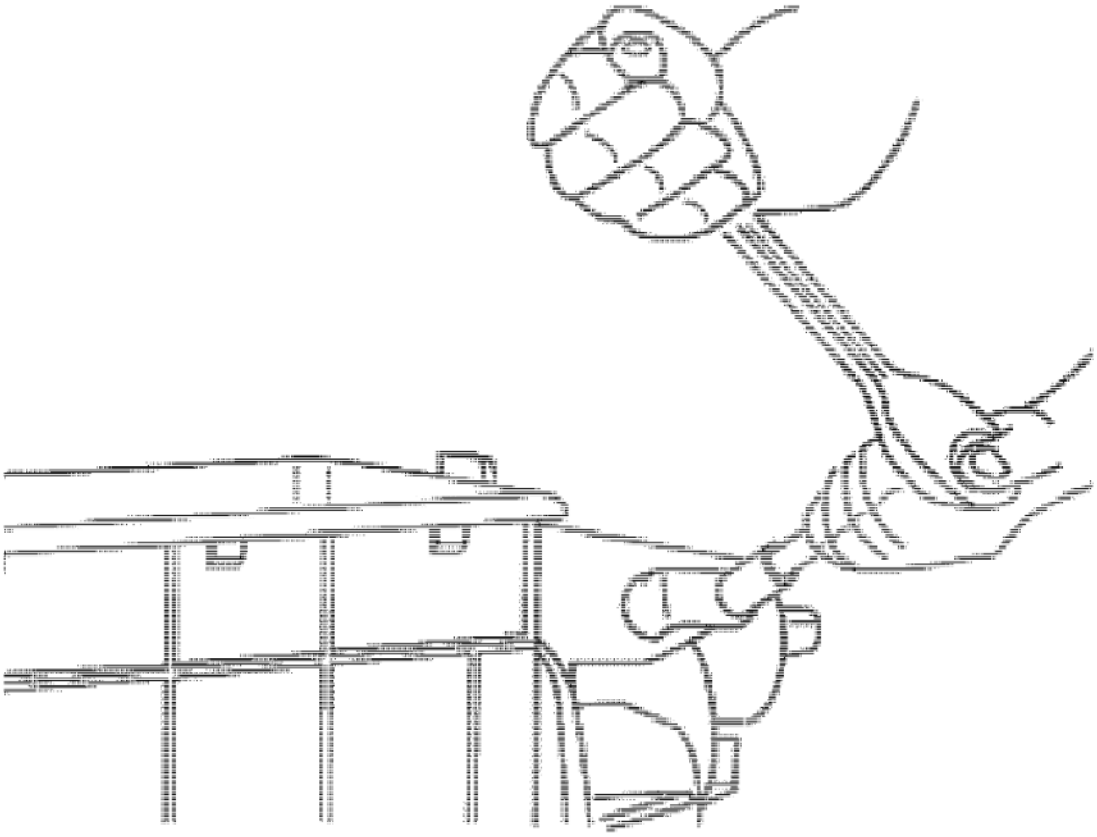


Fig. 29: Using Ratchet On Vehicle Speed Sensor (VSS) Screw
Courtesy of GENERAL MOTORS CORP.

1. Remove the vehicle speed sensor (VSS) screw.

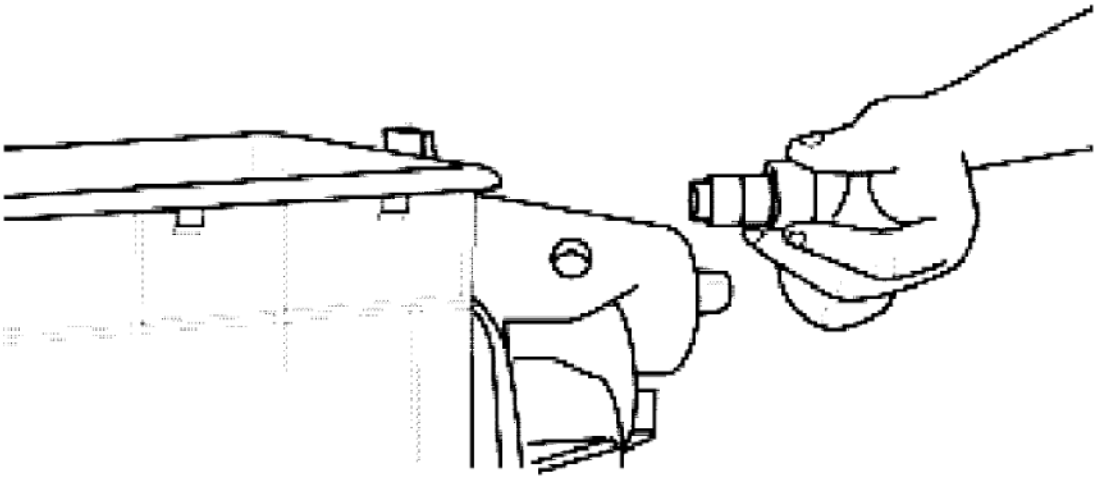


Fig. 30: VSS
Courtesy of GENERAL MOTORS CORP.

2. Remove the VSS.

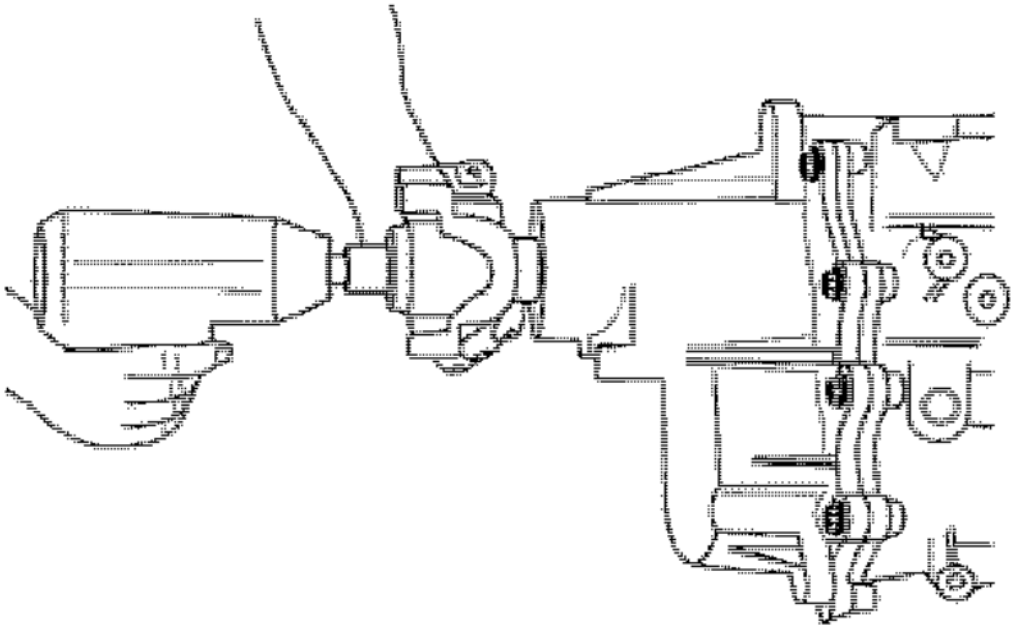


Fig. 31: Main Shaft Nut
Courtesy of GENERAL MOTORS CORP.

3. Remove the main shaft nut.

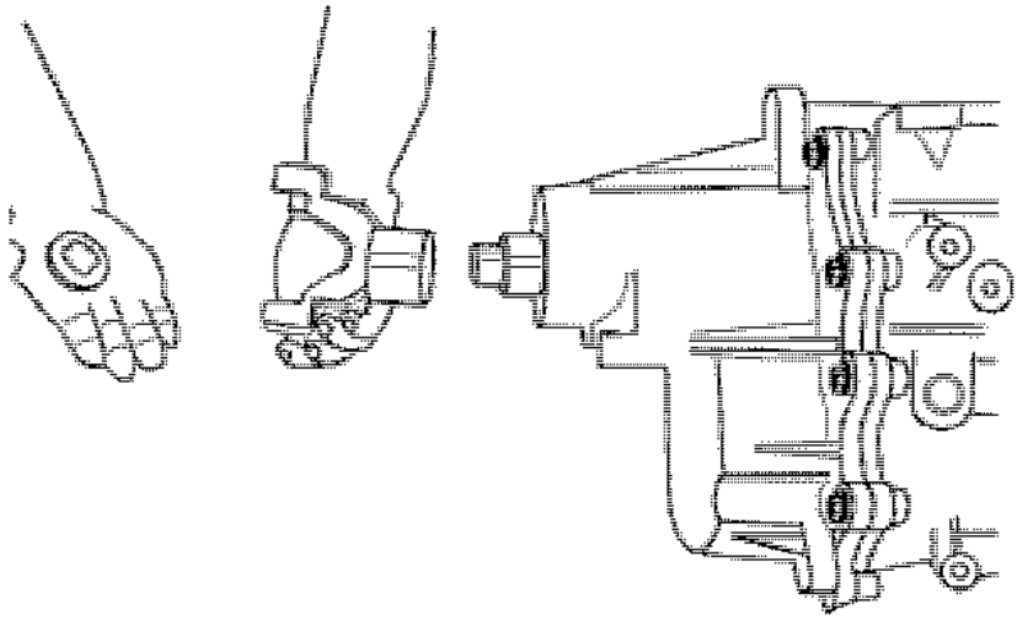


Fig. 32: Main Shaft Nut & Yoke
Courtesy of GENERAL MOTORS CORP.

4. Remove the main shaft nut from the main shaft.

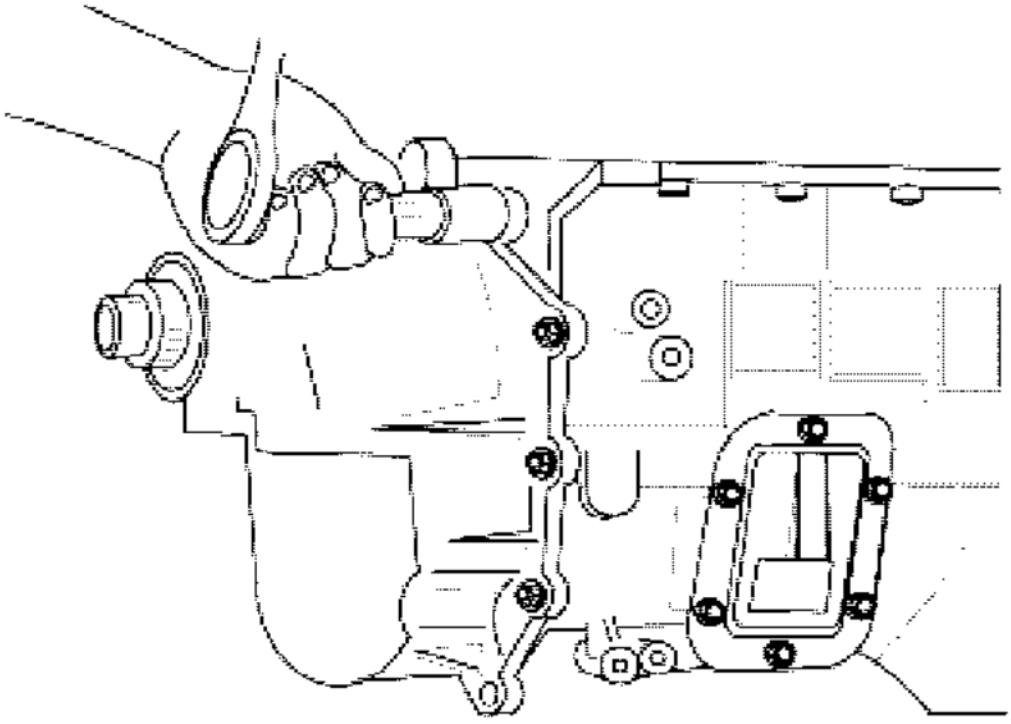


Fig. 33: Rear Cover Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the rear cover bolts.
6. Remove the rear cover.

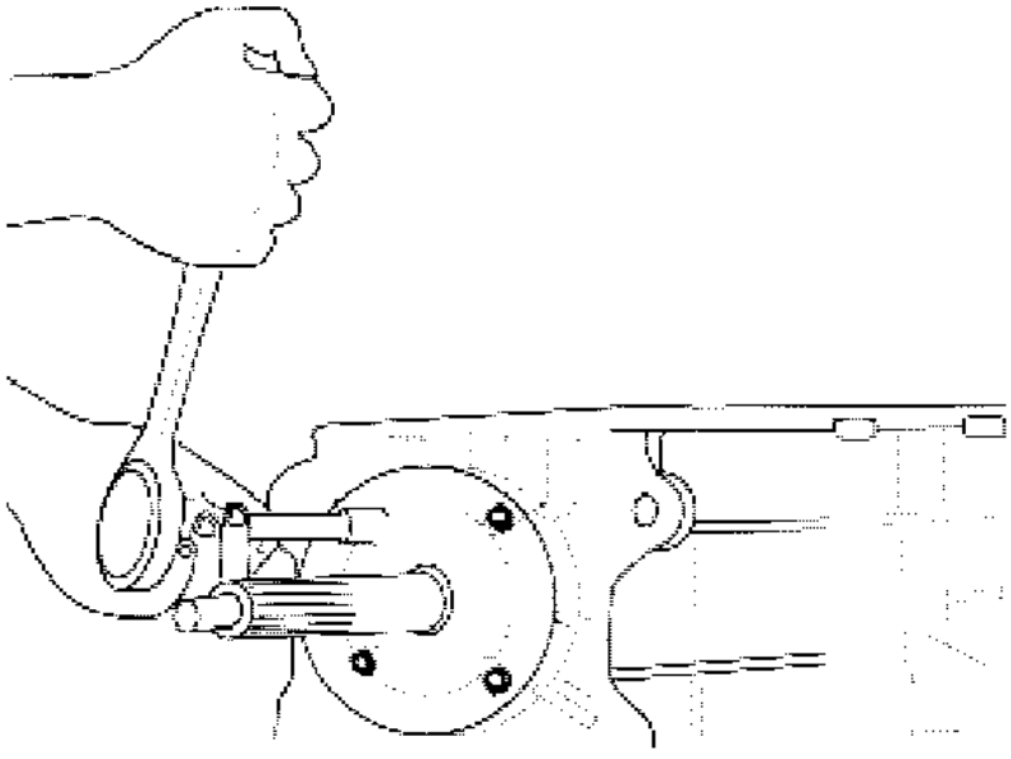


Fig. 34: Bearing Retainer Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the bolts from the bearing retainer.

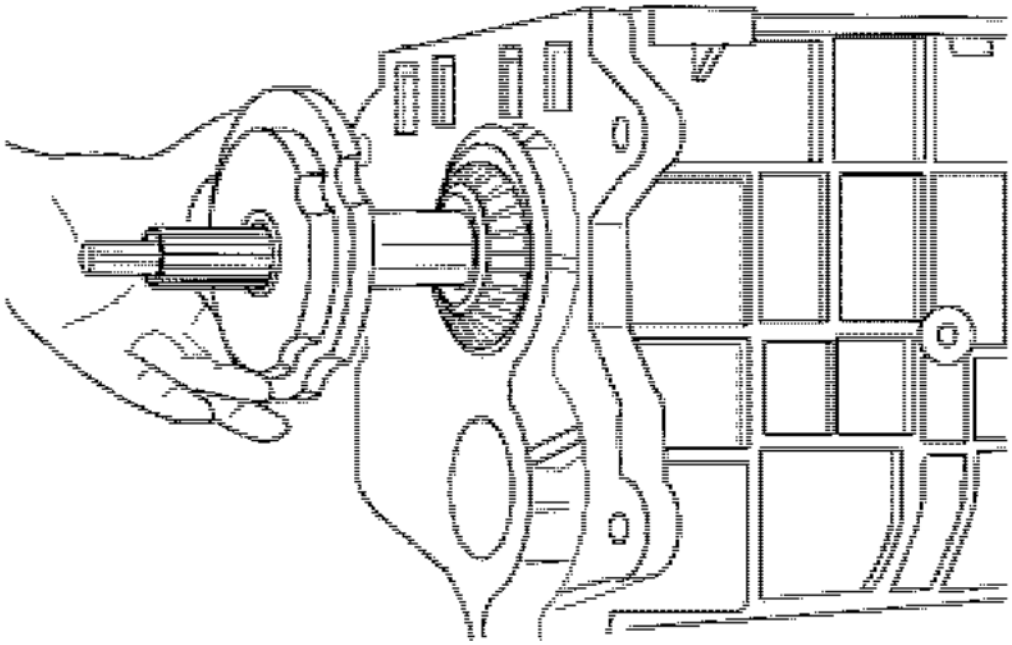


Fig. 35: Bearing Retainer
Courtesy of GENERAL MOTORS CORP.

8. Remove the bearing retainer.

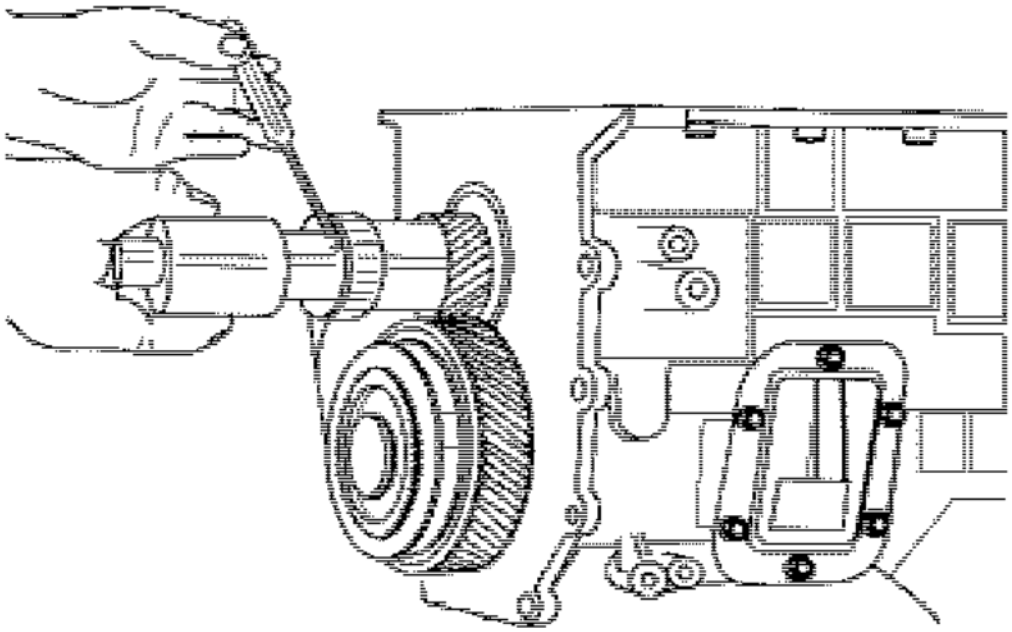


Fig. 36: Yoke Spacer
Courtesy of GENERAL MOTORS CORP.

9. Remove the yoke spacer.

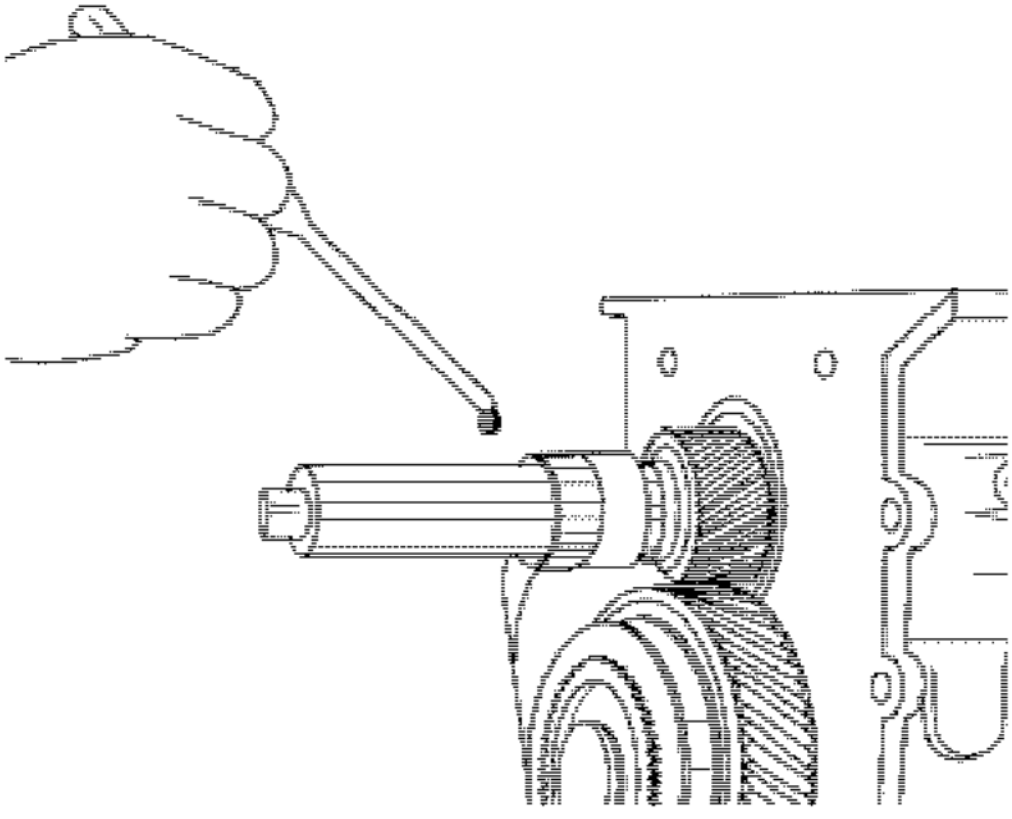


Fig. 37: Speedometer Tracking Balls
Courtesy of GENERAL MOTORS CORP.

10. Remove the speedometer tracking balls.
11. Remove the speedometer gear.

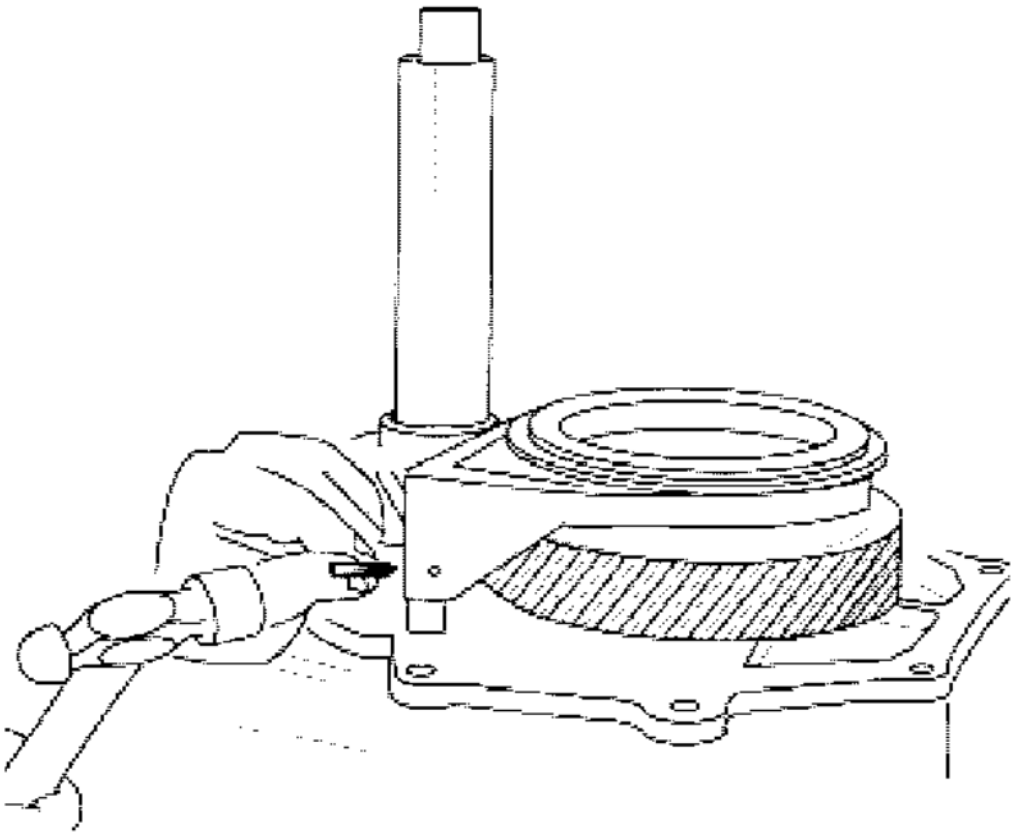


Fig. 38: Roll Pin
Courtesy of GENERAL MOTORS CORP.

12. Remove the roll pin.

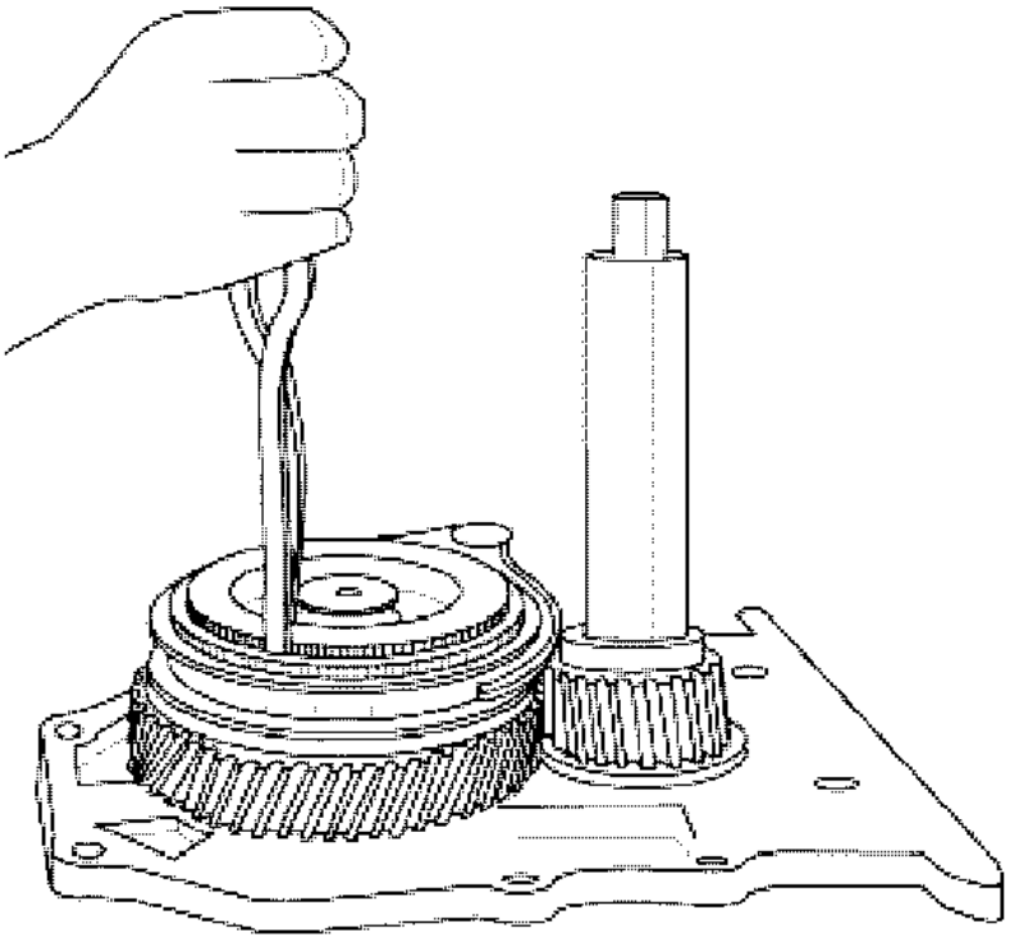


Fig. 39: Snap Ring
Courtesy of GENERAL MOTORS CORP.

13. Using locking pliers, remove the snap ring.

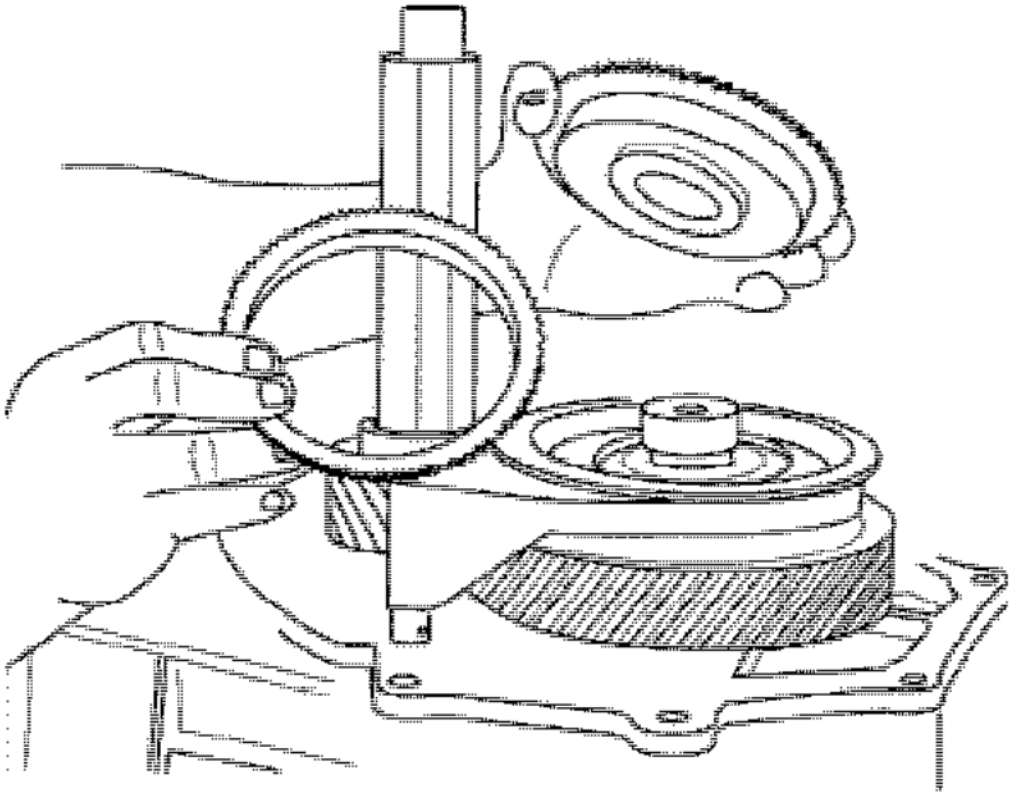


Fig. 40: Synchronizer Ring And 5th Gear
Courtesy of GENERAL MOTORS CORP.

14. Remove the synchronizer ring and the 5th gear.

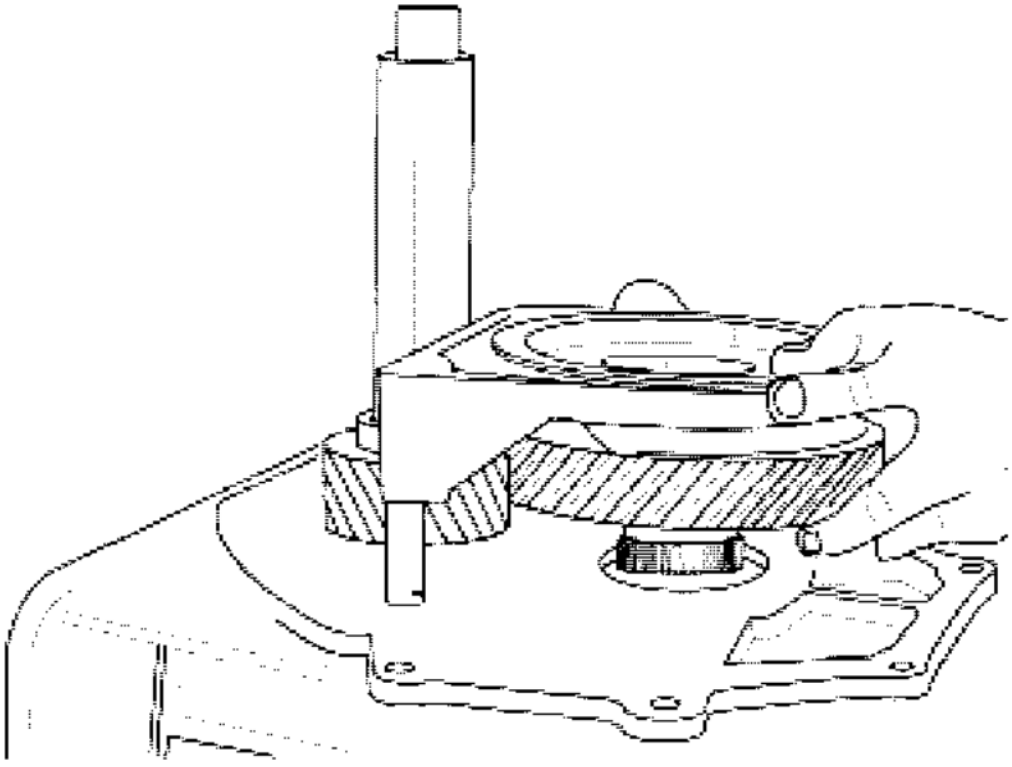


Fig. 41: 5th Gear Synchronizer And Fork
Courtesy of GENERAL MOTORS CORP.

15. Remove the 5th gear synchronizer and the fork.

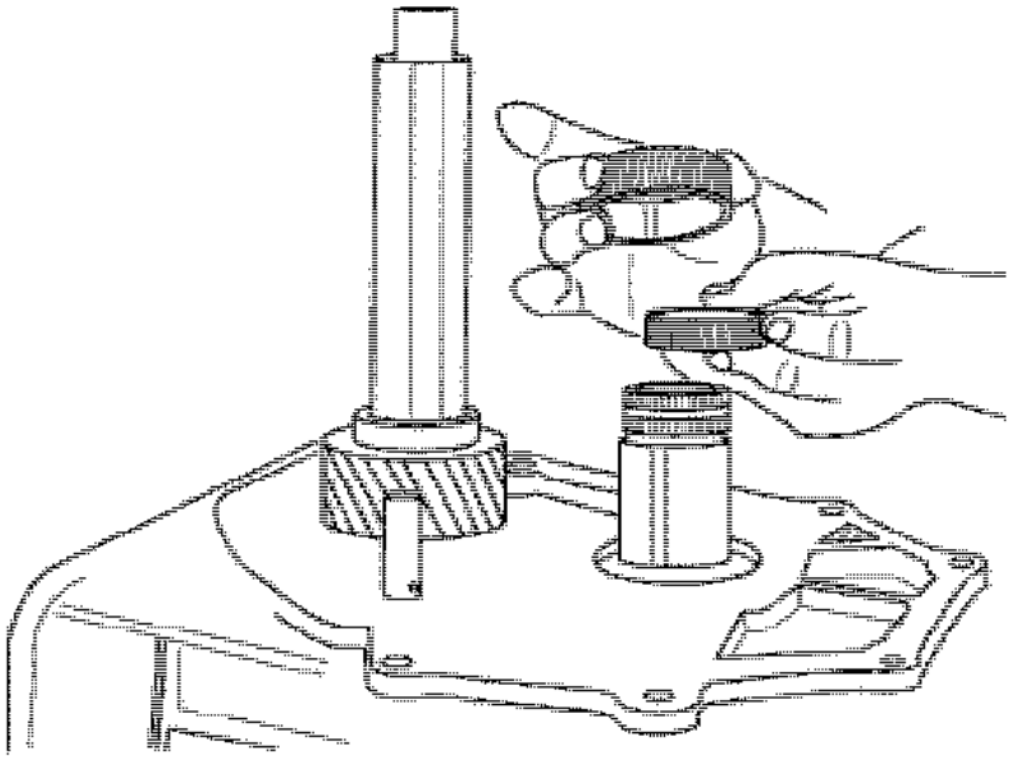


Fig. 42: Roller Bearings And Spacer
Courtesy of GENERAL MOTORS CORP.

16. Remove the 2 roller bearings and the spacer.

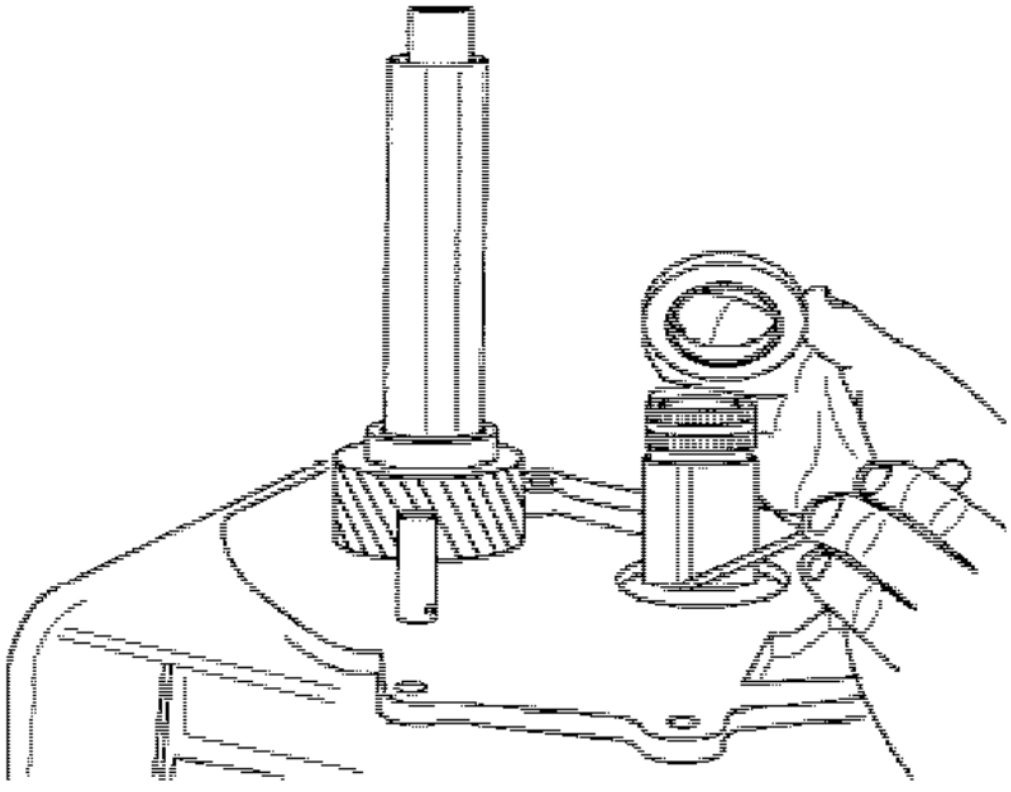


Fig. 43: Washer
Courtesy of GENERAL MOTORS CORP.

17. Remove the washer.

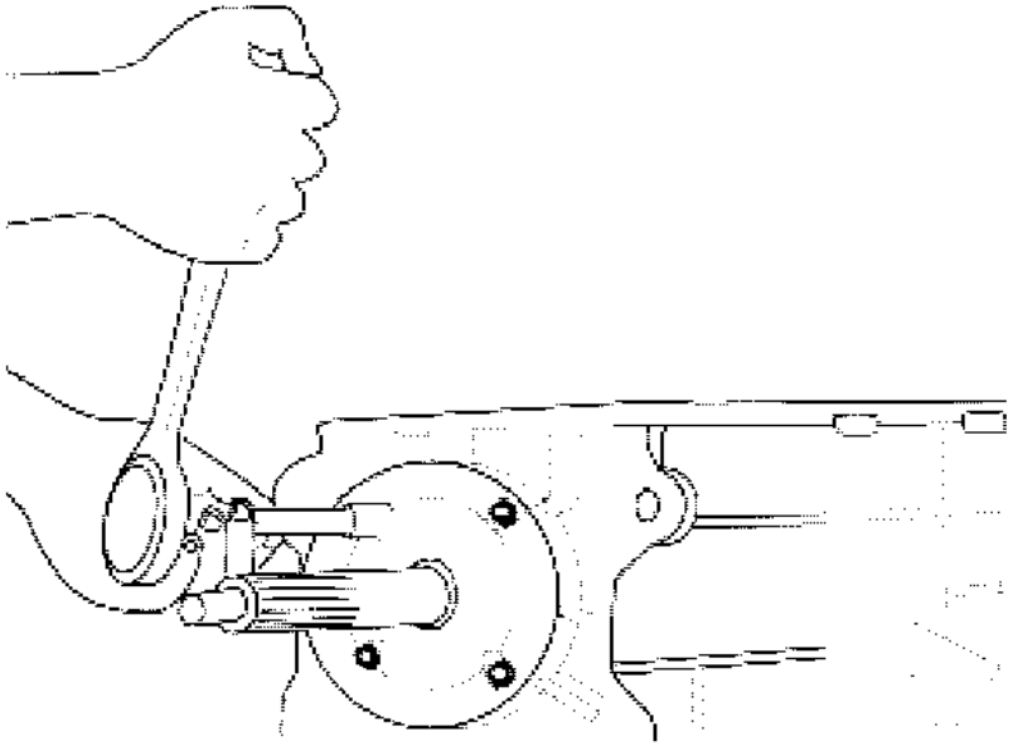


Fig. 44: Bearing Retainer Bolts
Courtesy of GENERAL MOTORS CORP.

18. Remove the bearing retainer bolts.

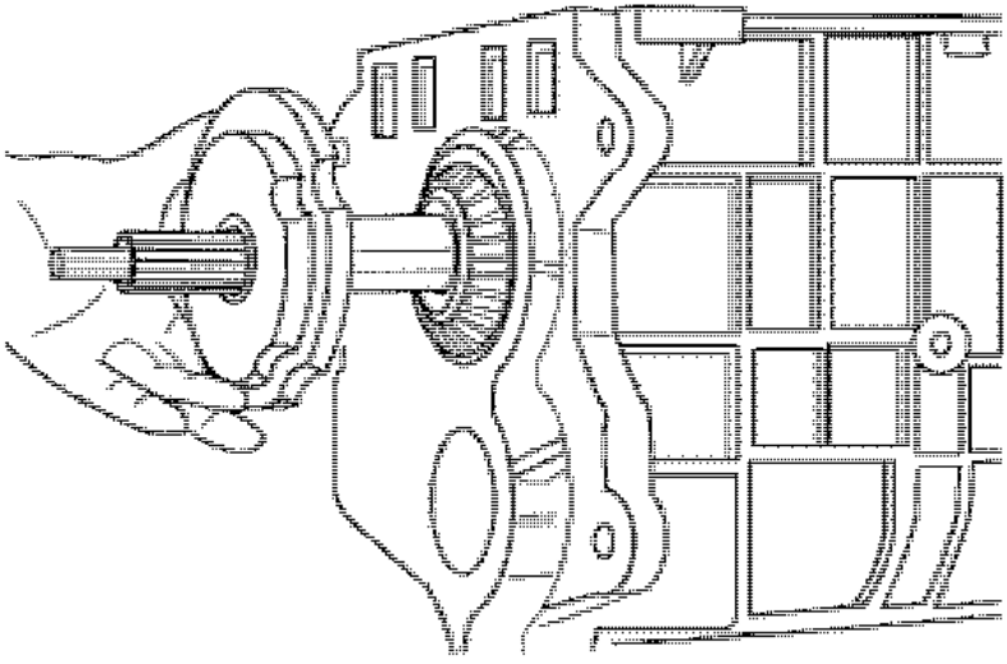


Fig. 45: Bearing Retainer
Courtesy of GENERAL MOTORS CORP.

19. Remove the bearing retainer.

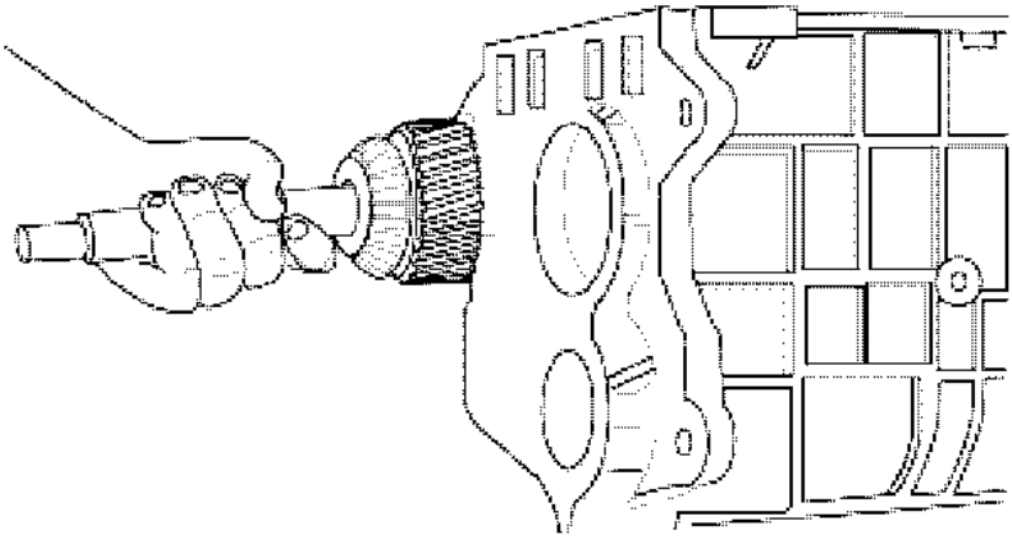


Fig. 46: Drive Shaft
Courtesy of GENERAL MOTORS CORP.

20. Remove the drive shaft.

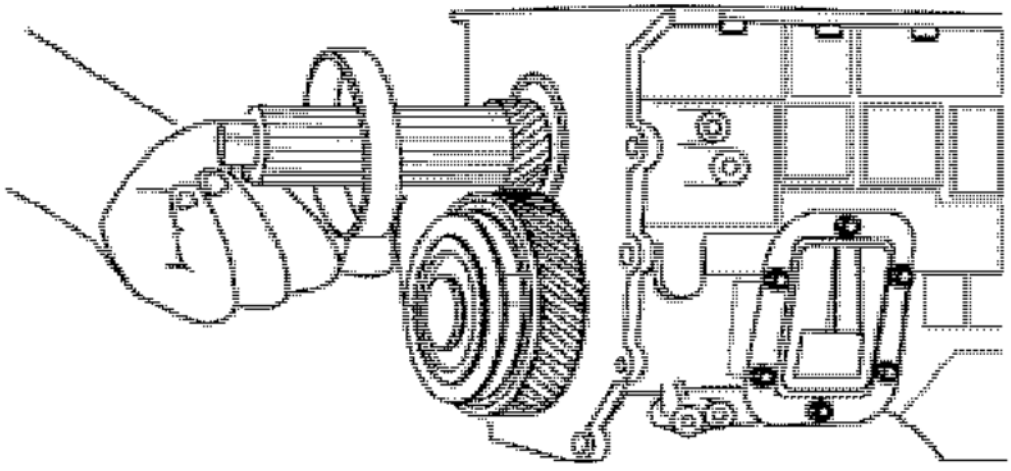


Fig. 47: Tapered Bearing Cup
Courtesy of GENERAL MOTORS CORP.

21. Remove the tapered bearing cup.

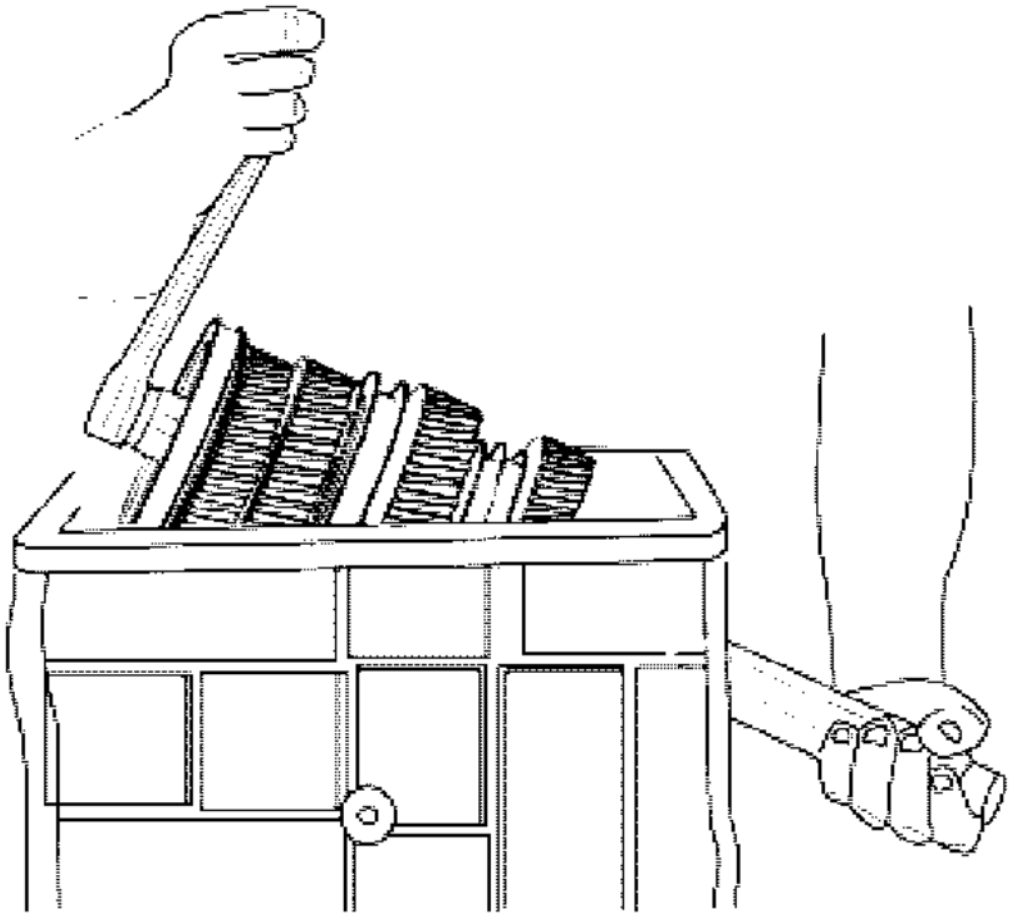


Fig. 48: Main Shaft Assembly
Courtesy of GENERAL MOTORS CORP.

22. Remove the main shaft assembly.

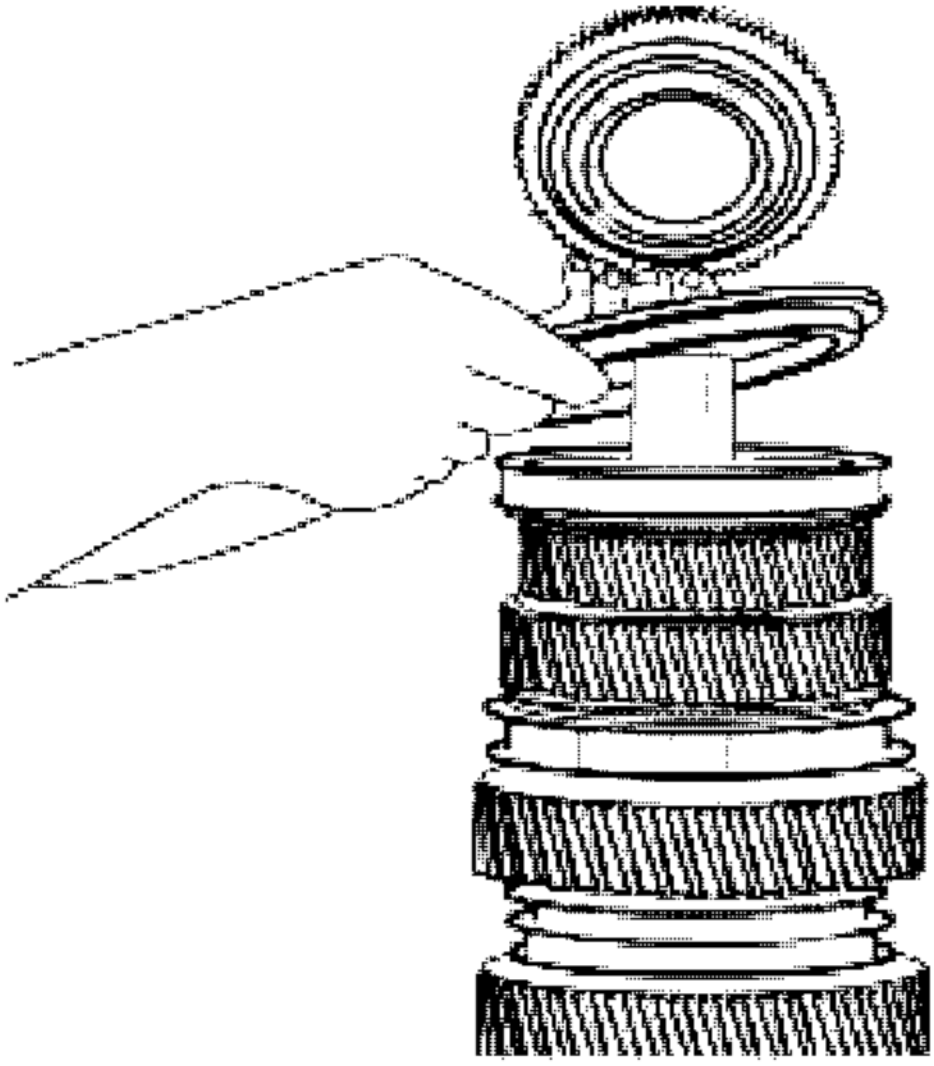


Fig. 49: Retaining Oil Seal
Courtesy of GENERAL MOTORS CORP.

23. Remove the retaining oil seal.

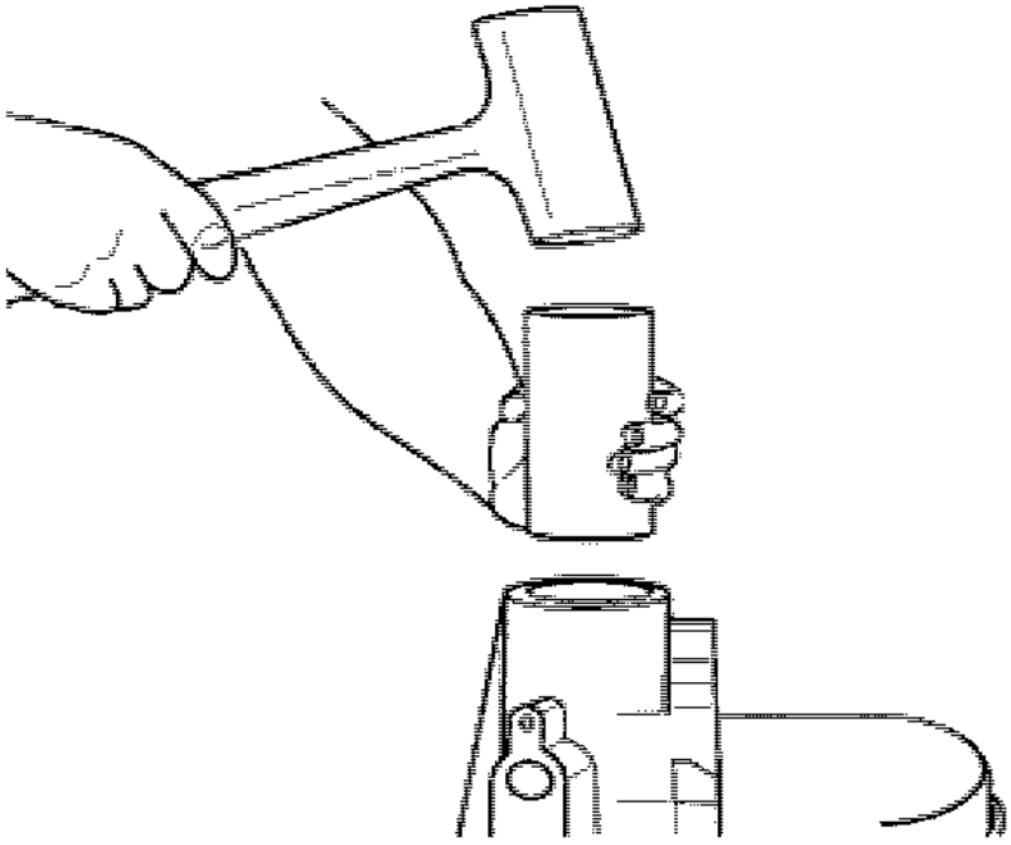


Fig. 50: Extension Housing Oil Seal
Courtesy of GENERAL MOTORS CORP.

24. Remove the extension housing oil seal.

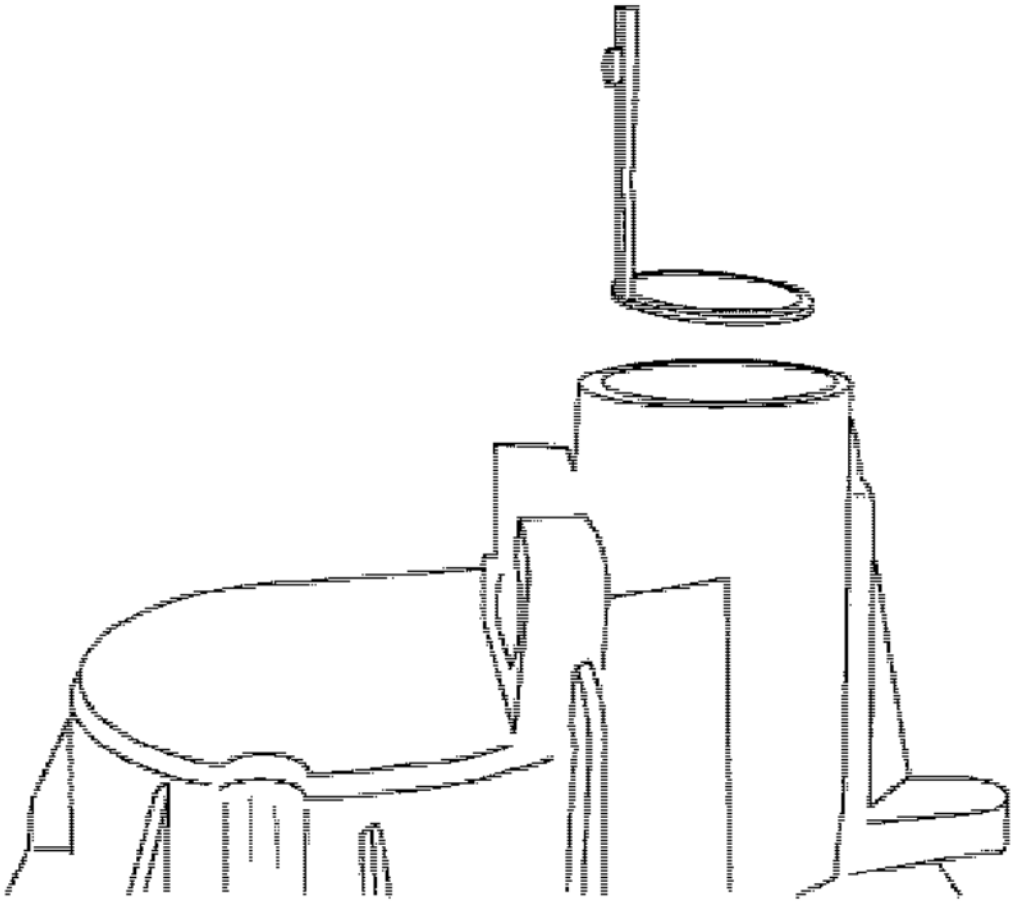


Fig. 51: Snap Ring
Courtesy of GENERAL MOTORS CORP.

25. Remove the bearing snap ring from the extension housing, if equipped.

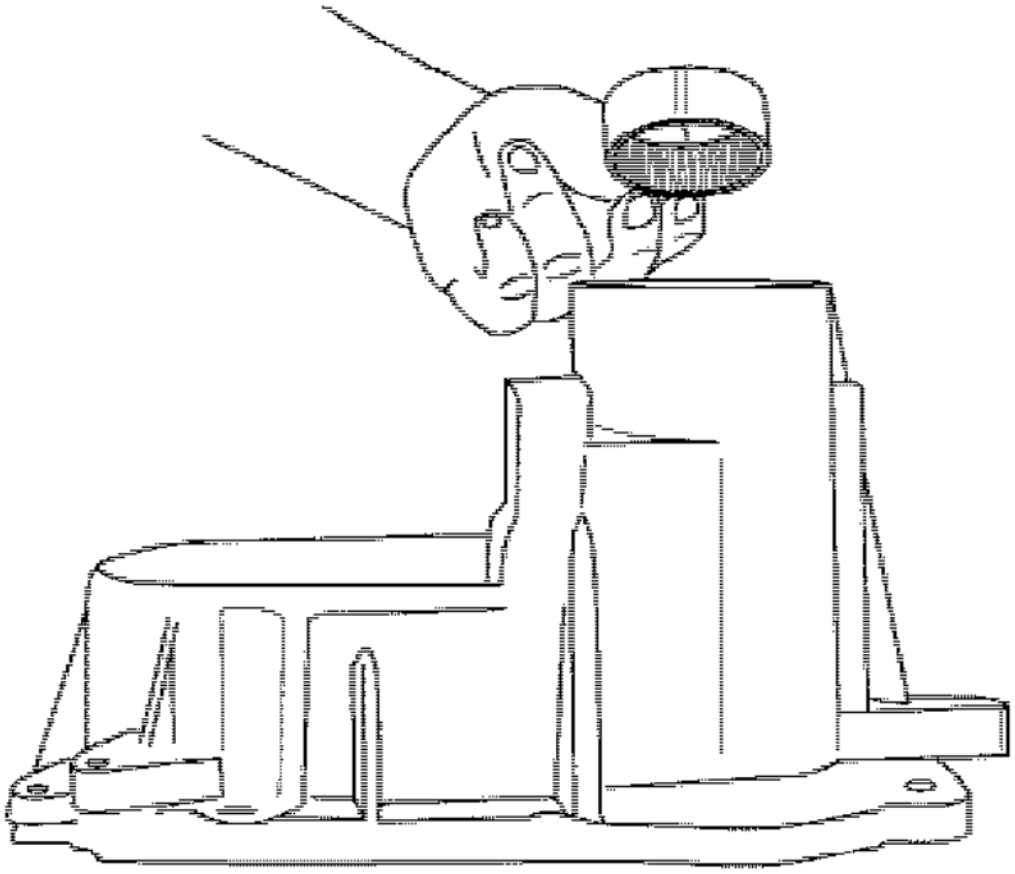


Fig. 52: Bearing
Courtesy of GENERAL MOTORS CORP.

26. Remove the bearing from the extension housing, if equipped.

MAIN SHAFT DISASSEMBLE

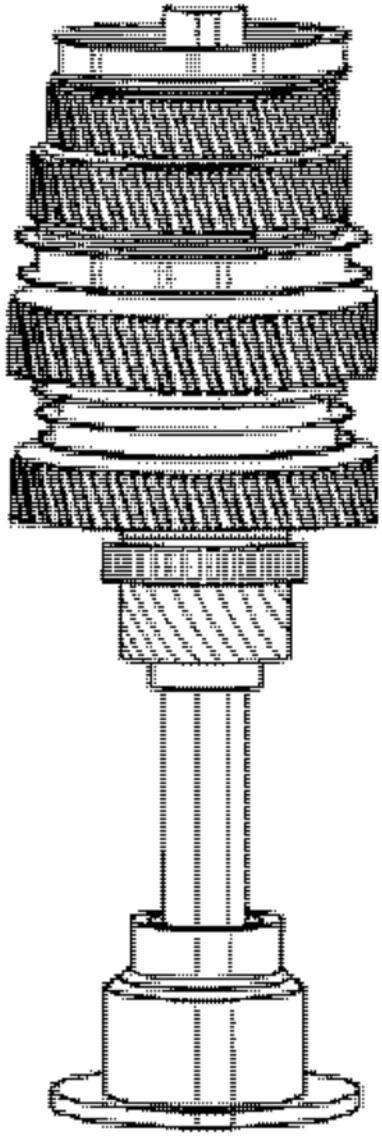


Fig. 53: Main Shaft Assembly In Vertical Position
Courtesy of GENERAL MOTORS CORP.

1. Use a flange or some other type of tool to place the assembly in a vertical position.

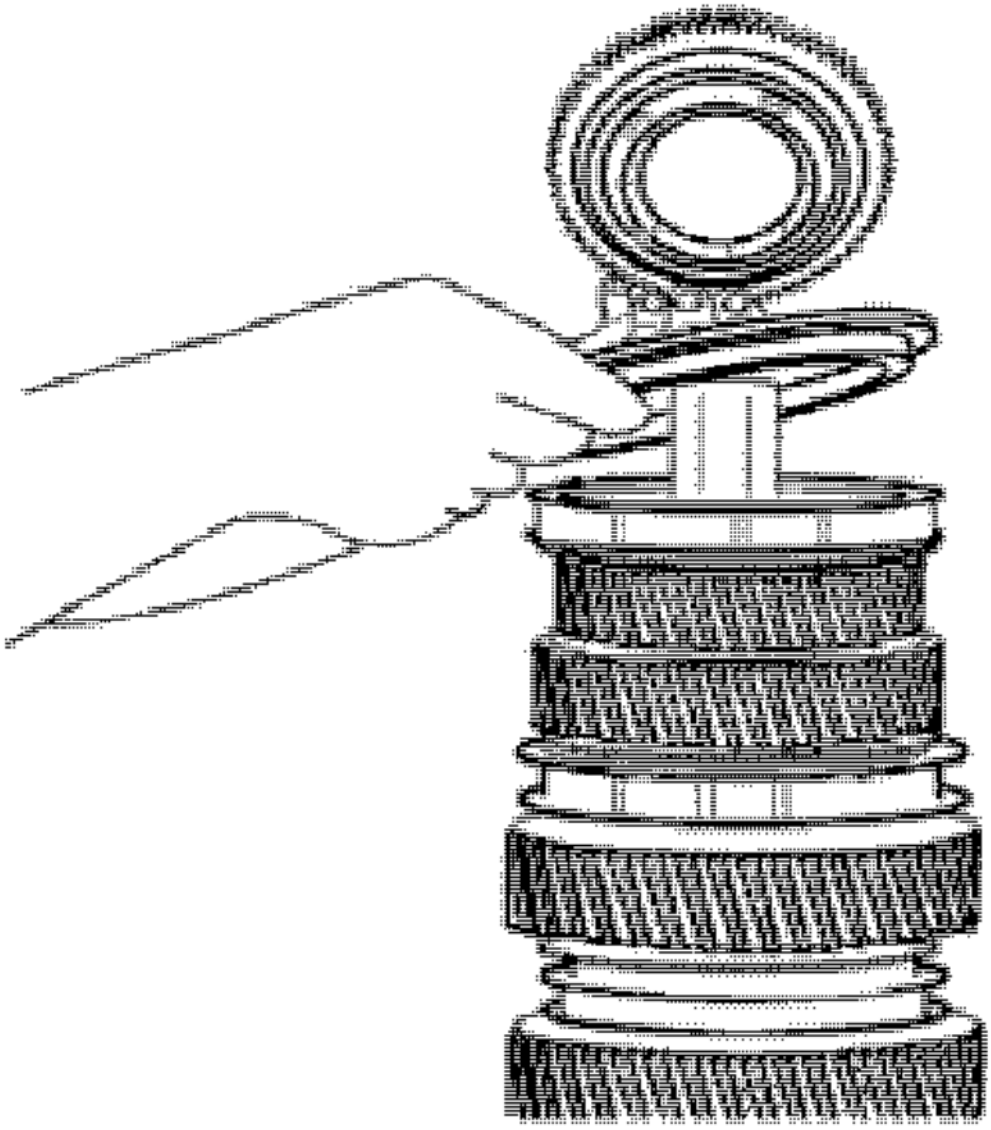


Fig. 54: Clutch Bearing
Courtesy of GENERAL MOTORS CORP.

2. Remove the clutch bearing from the drive shaft and the synchronizer ring.

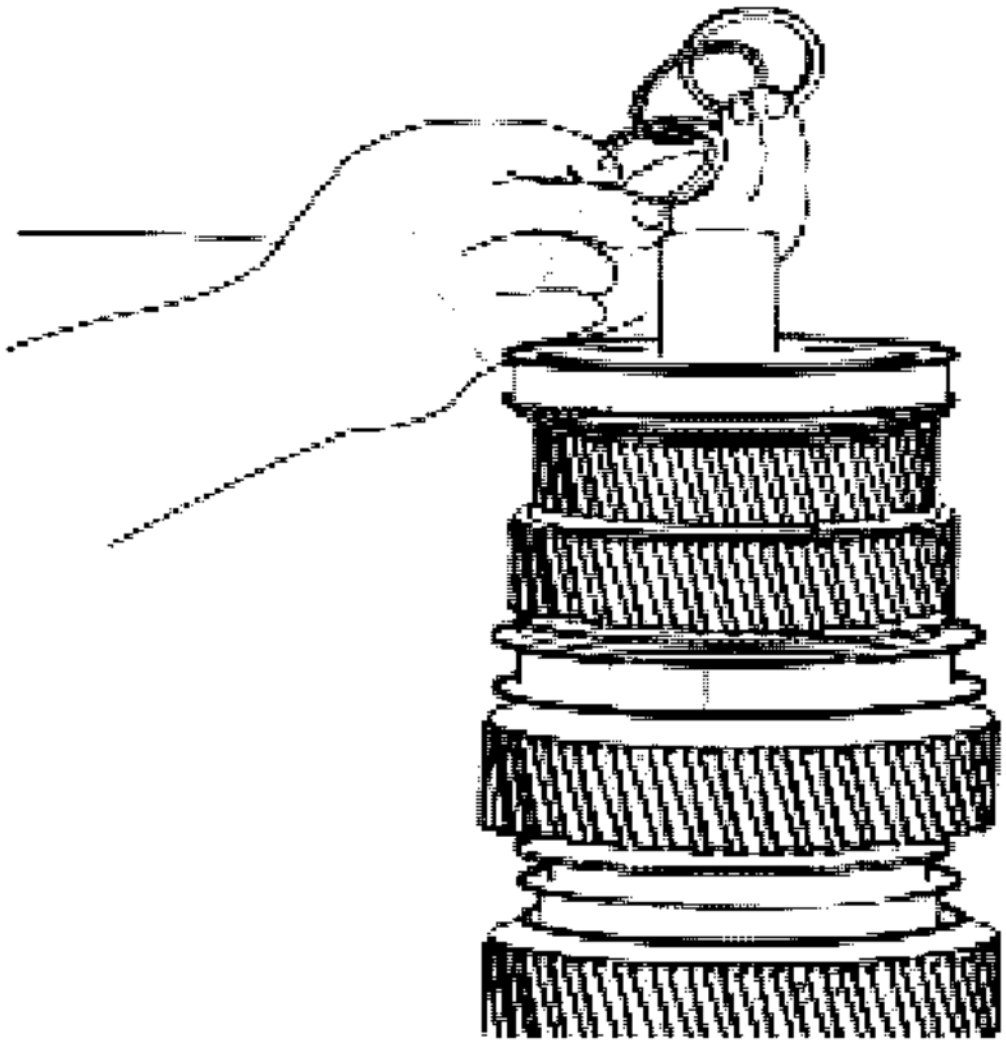


Fig. 55: Pulleys, Track And Push Bearing
Courtesy of GENERAL MOTORS CORP.

3. Remove the pulleys, the track, and the push bearing.

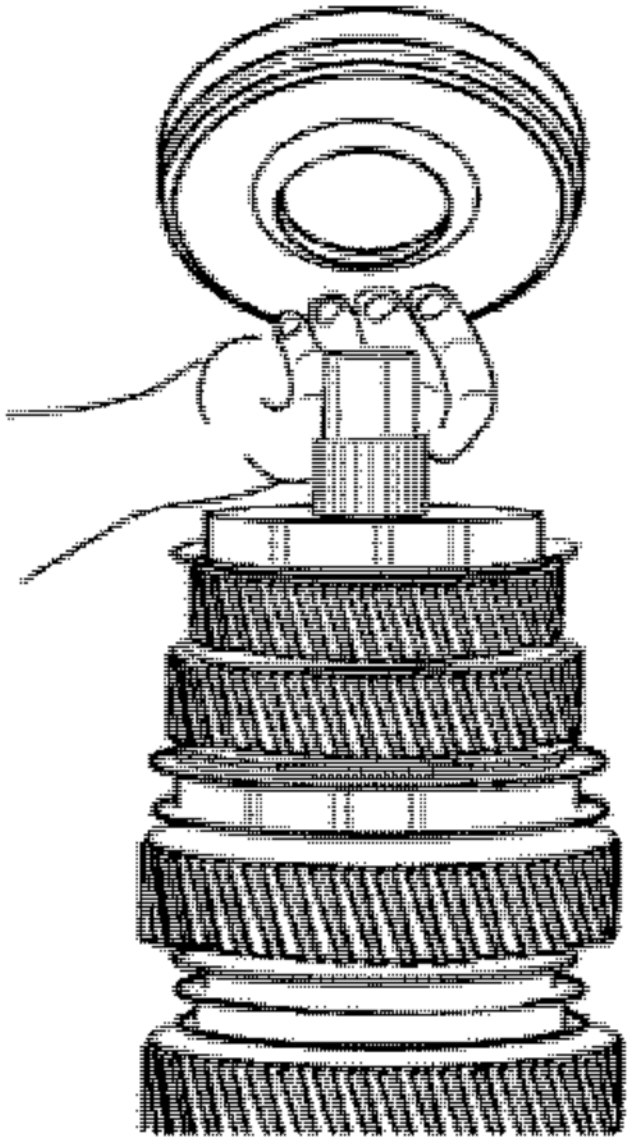


Fig. 56: 3rd And 4th Gear Synchronizer
Courtesy of GENERAL MOTORS CORP.

4. Remove the 3rd and 4th gear synchronizer.

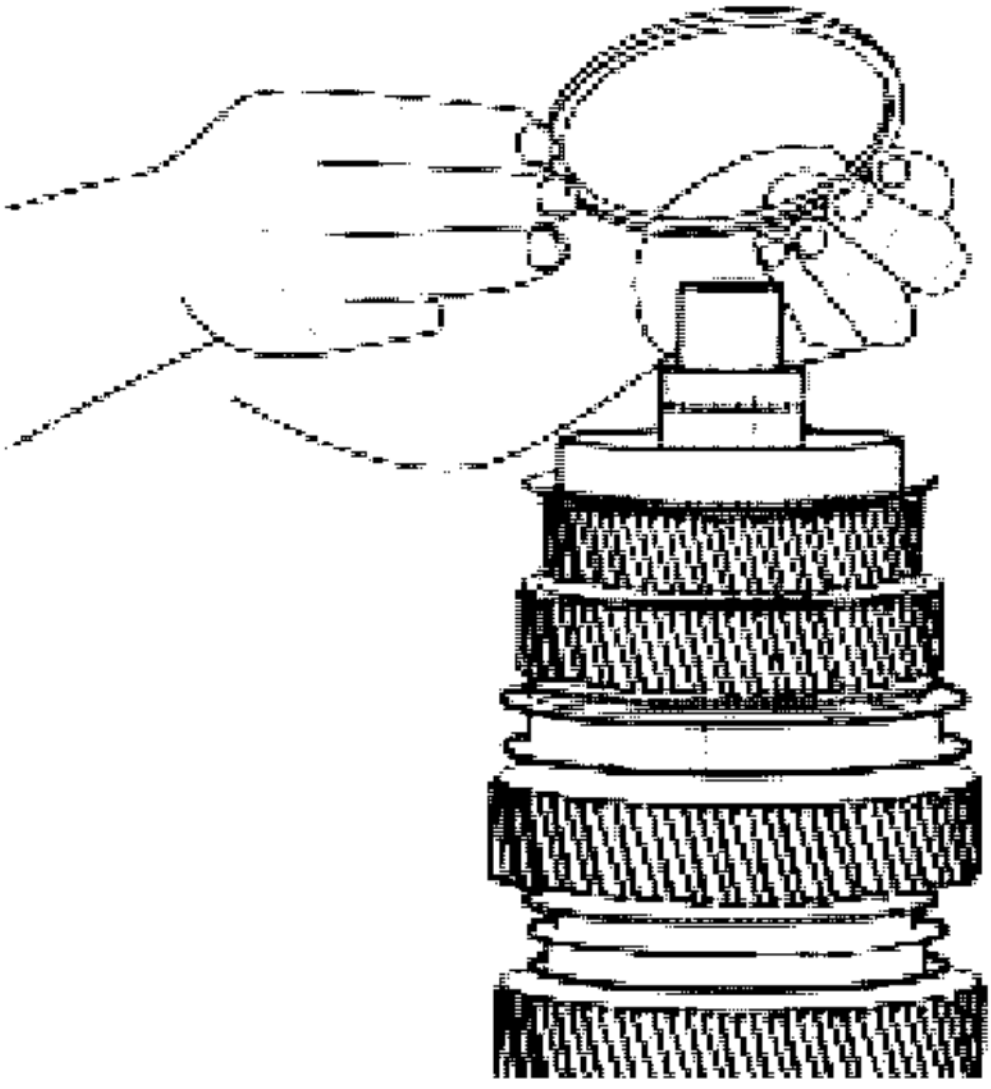


Fig. 57: 3rd Gear Synchronizer
Courtesy of GENERAL MOTORS CORP.

5. Remove the 3rd gear synchronizer.

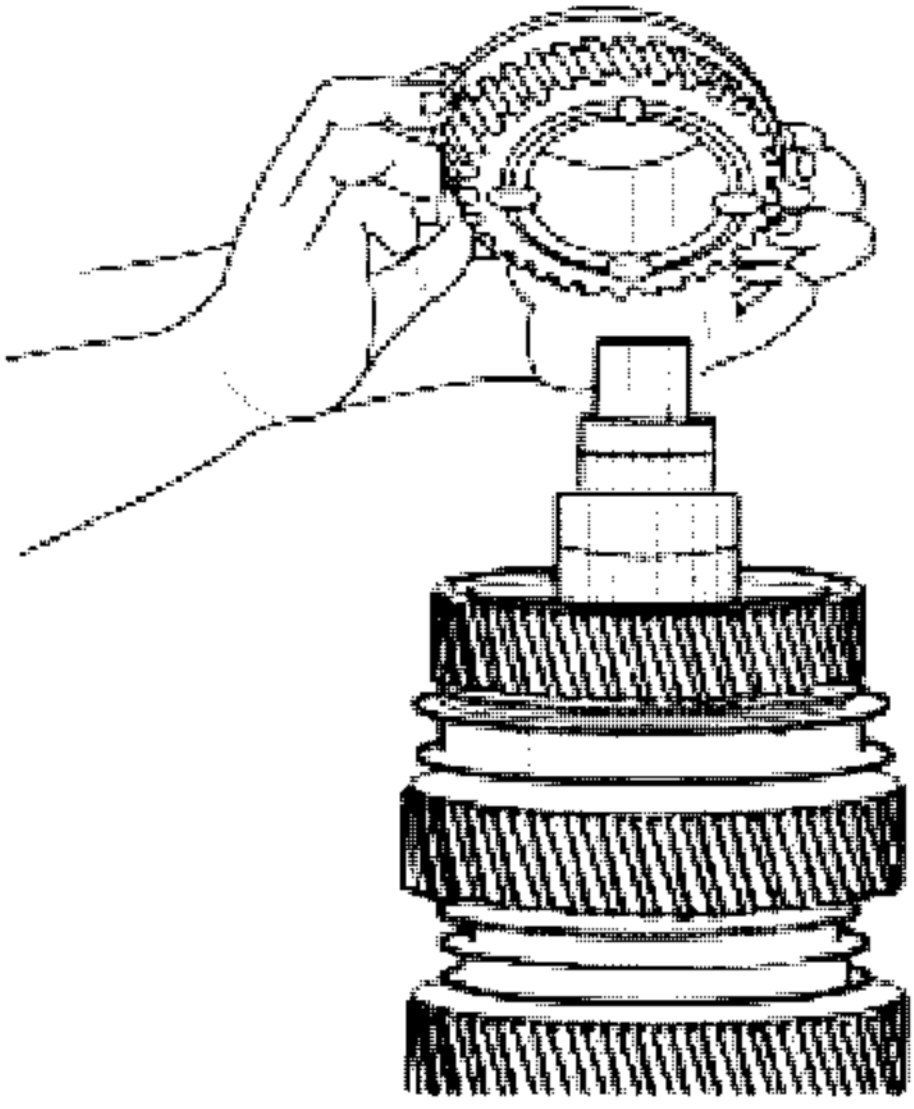


Fig. 58: 3rd Gear
Courtesy of GENERAL MOTORS CORP.

6. Remove the 3rd gear.

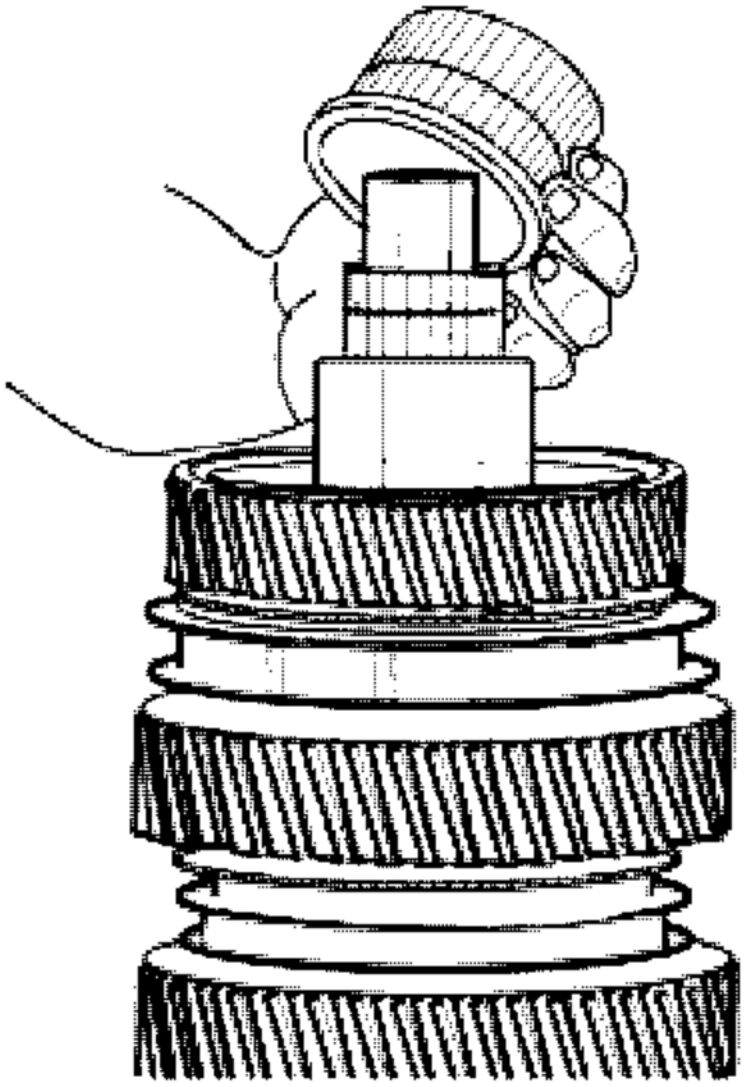


Fig. 59: 3rd Gear Rollers
Courtesy of GENERAL MOTORS CORP.

7. Remove the cage with the 3rd gear rollers.

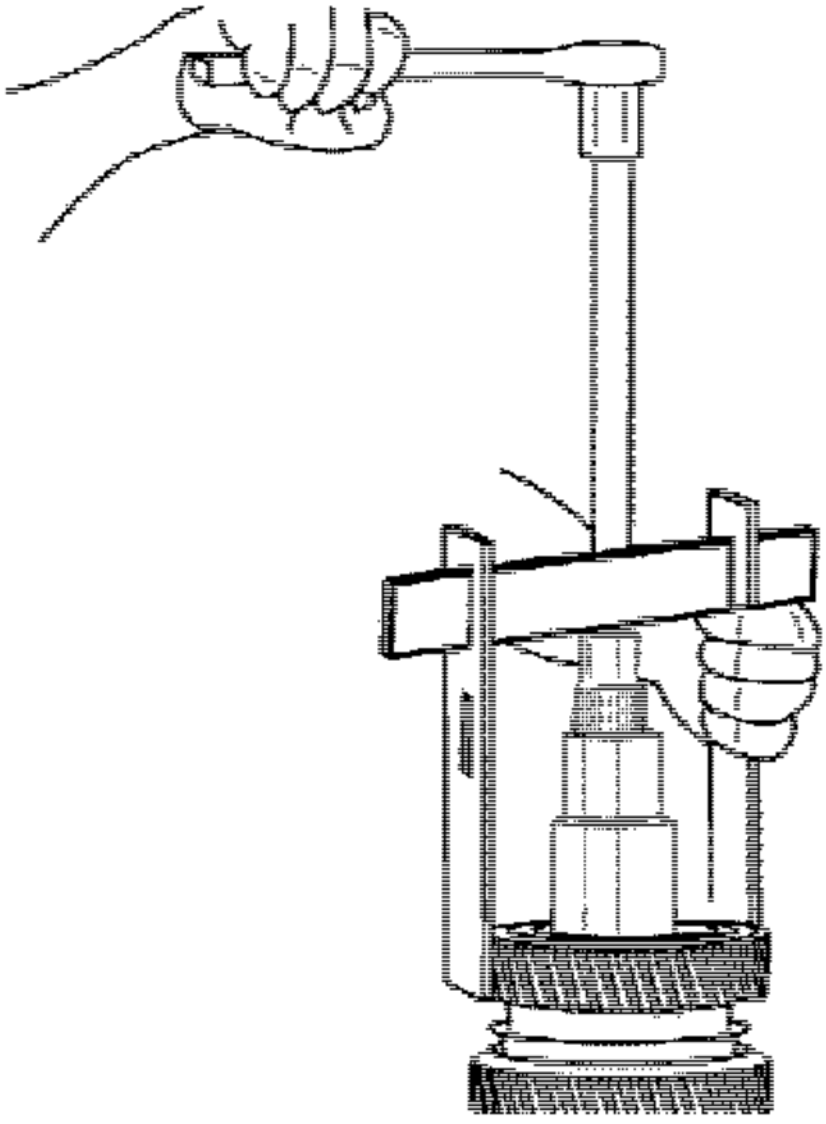


Fig. 60: Removing 3rd Gear Hub
Courtesy of GENERAL MOTORS CORP.

8. Using a bearing remover or press, remove the 3rd gear hub, supporting it on the 2nd gear.

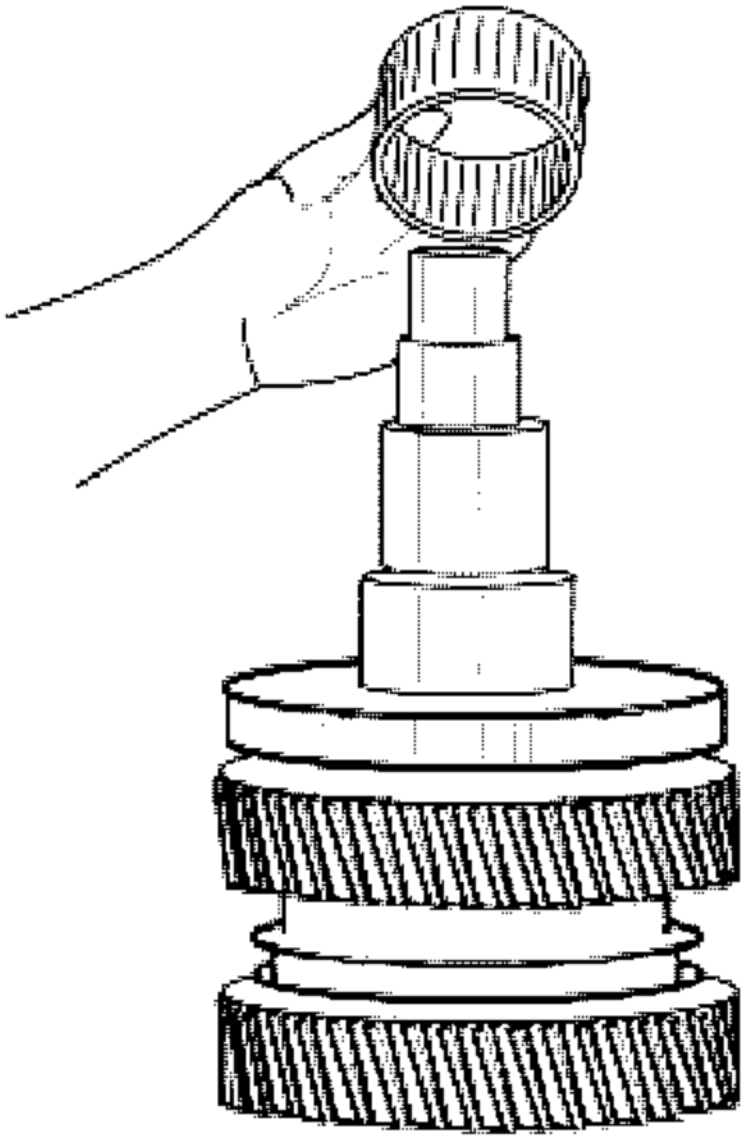


Fig. 61: 2nd Gear Roller Cage
Courtesy of GENERAL MOTORS CORP.

9. Remove the 2nd gear roller cage.

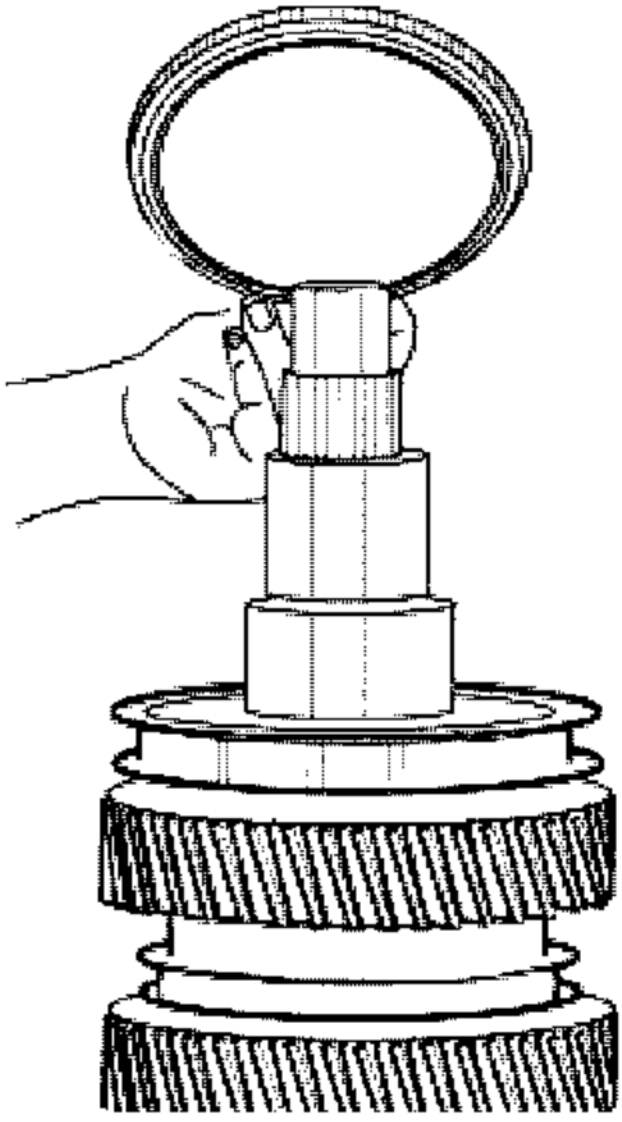


Fig. 62: 2nd Gear Synchronizer Ring
Courtesy of GENERAL MOTORS CORP.

10. Remove the 2nd gear synchronizer ring.

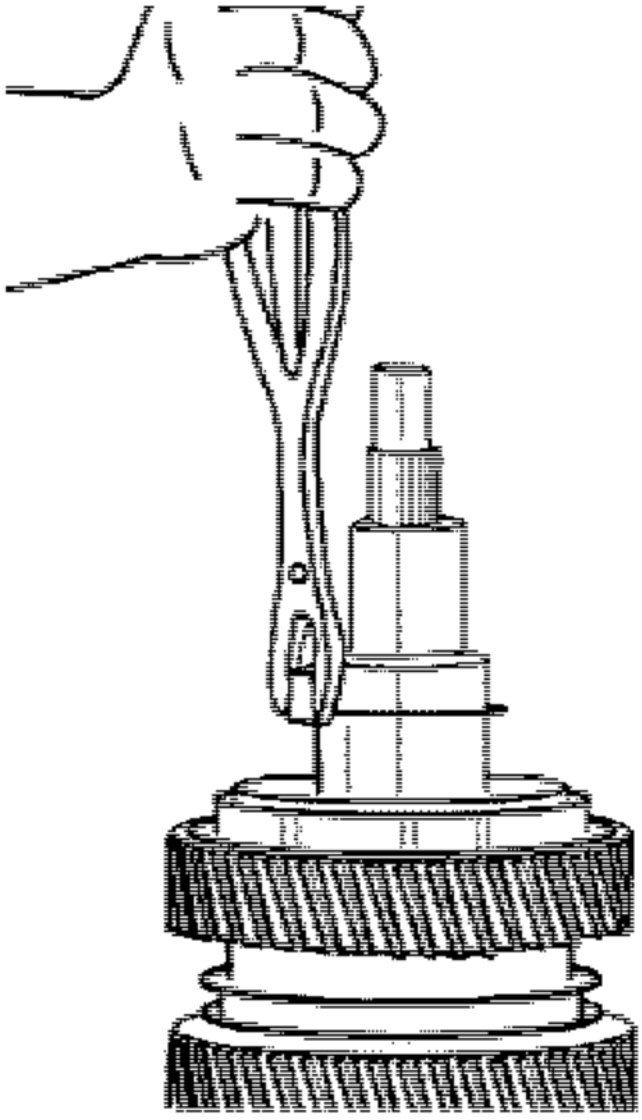


Fig. 63: Snap Ring Holding Synchronization Hammer Onto 1st And 2nd Gears
Courtesy of GENERAL MOTORS CORP.

11. Using locking pliers, remove the snap ring from the synchronization hammer on the 1st and 2nd gears.

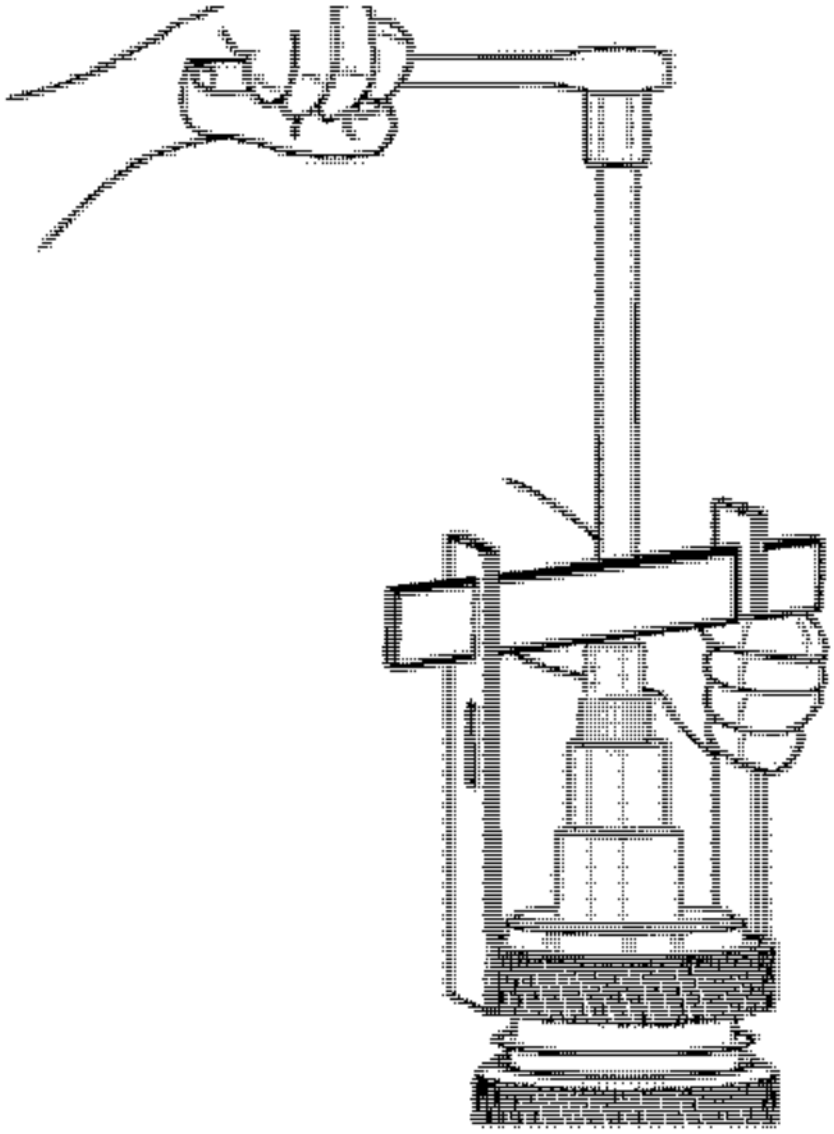


Fig. 64: Removing 1st Gear And Synchronizer
Courtesy of GENERAL MOTORS CORP.

12. Using a bearing press or remover, remove the 1st gear and the synchronizer.



Fig. 65: 1st And 2nd Gear Synchronizer
Courtesy of GENERAL MOTORS CORP.

13. Remove the 1st and 2nd gear synchronizer.

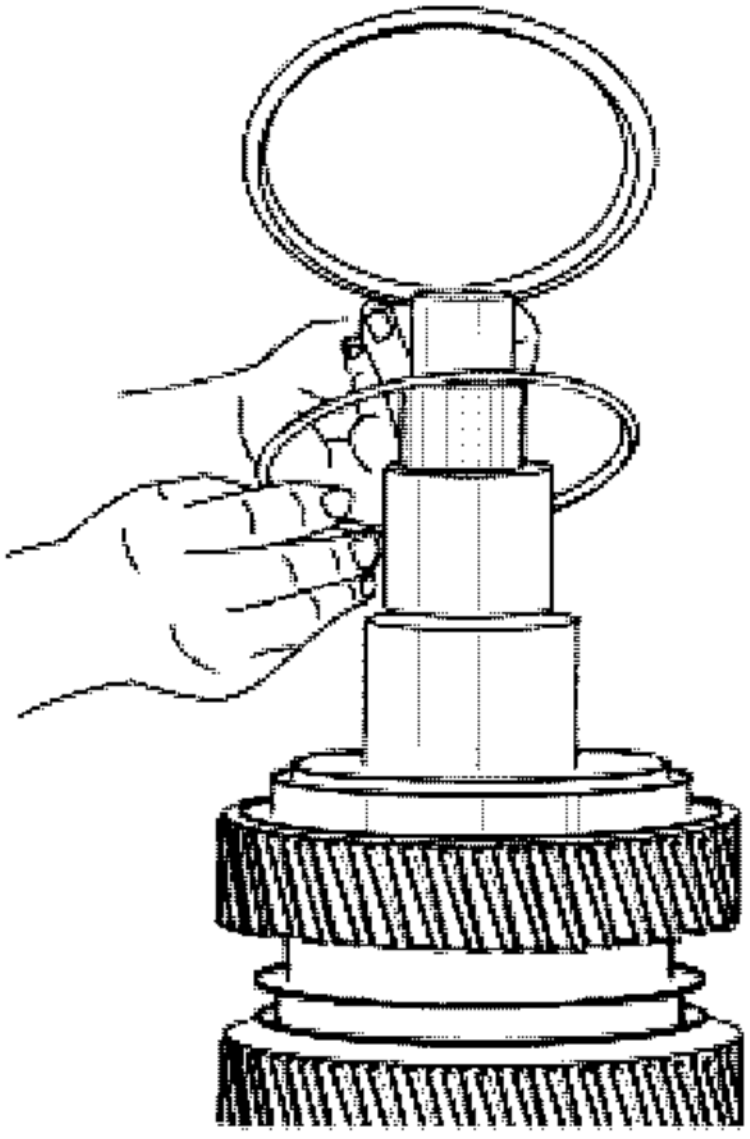


Fig. 66: Synchronizer Ring And Intermediate Ring
Courtesy of GENERAL MOTORS CORP.

14. Remove the synchronizer ring and intermediate ring from the 1st gear.

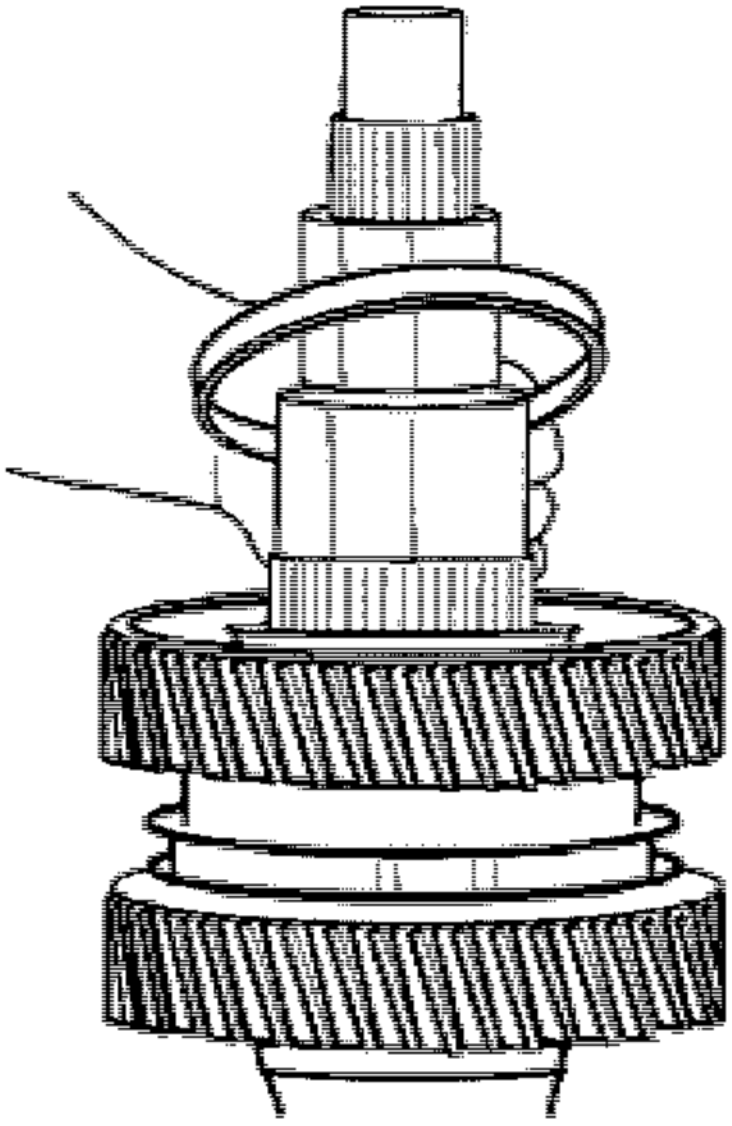


Fig. 67: 1st Gear Interior Taper Bearing
Courtesy of GENERAL MOTORS CORP.

15. Remove the 1st gear interior taper bearing.

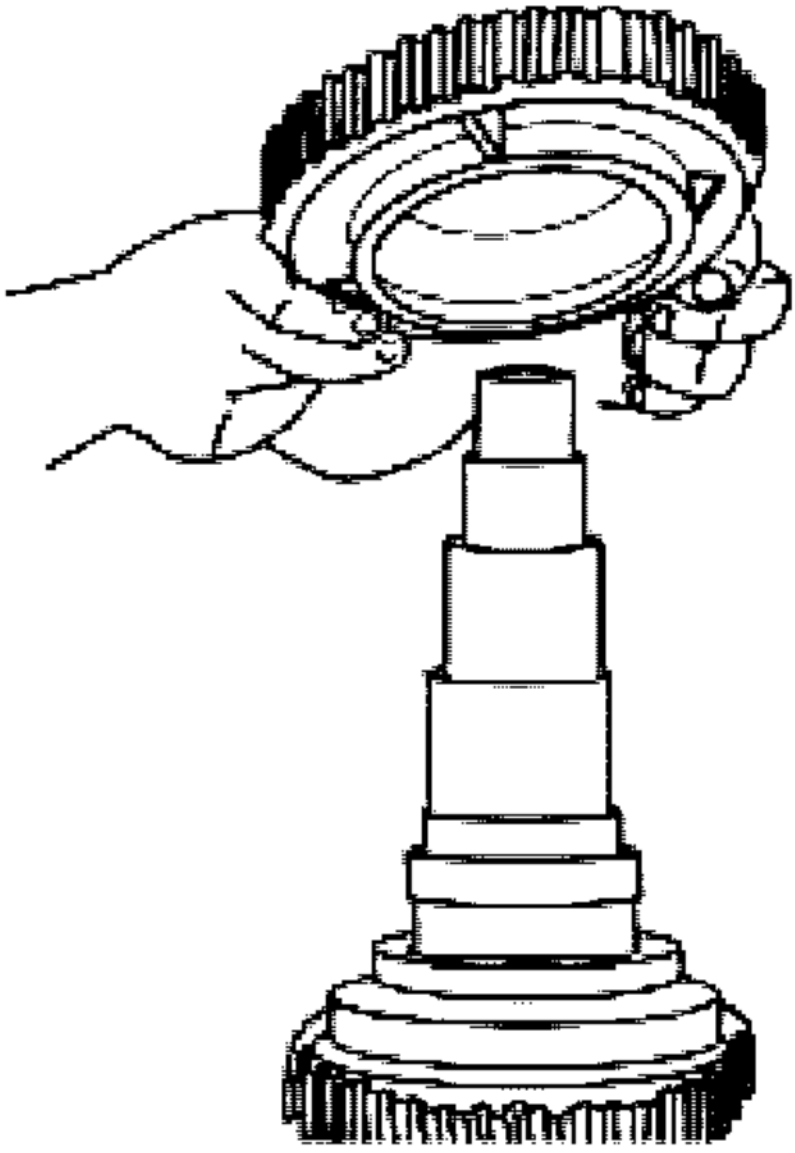


Fig. 68: 1st Gear
Courtesy of GENERAL MOTORS CORP.

16. Remove the 1st gear.

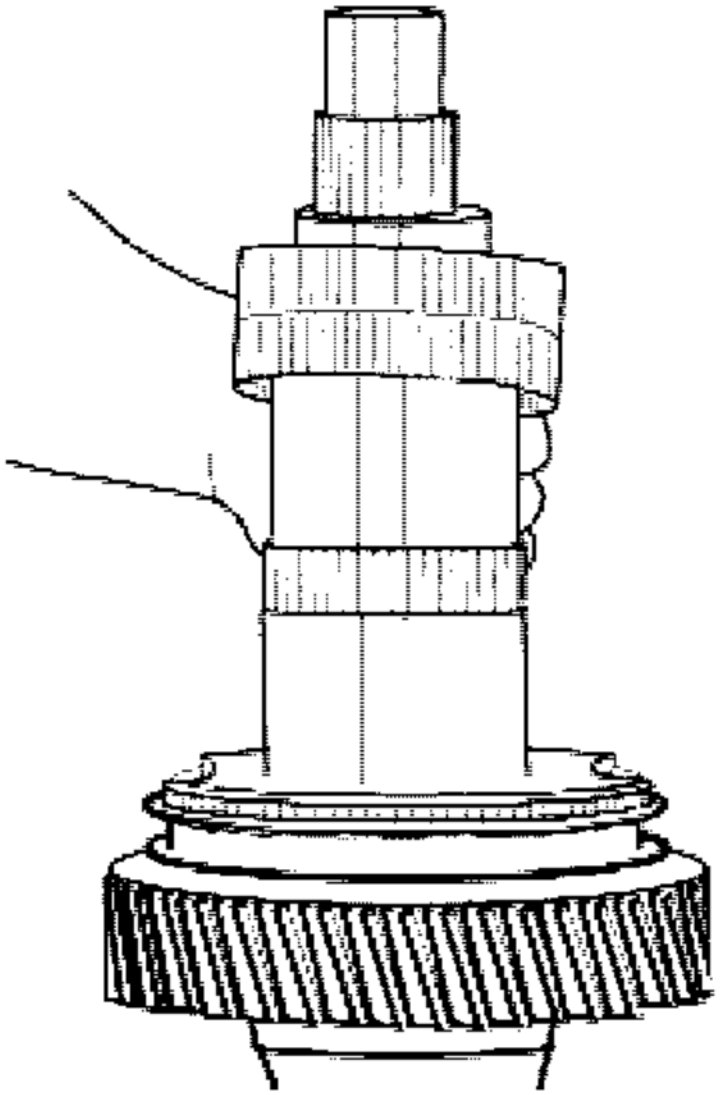


Fig. 69: 1st Gear Roller Cage
Courtesy of GENERAL MOTORS CORP.

17. Remove the 1st gear roller cage.

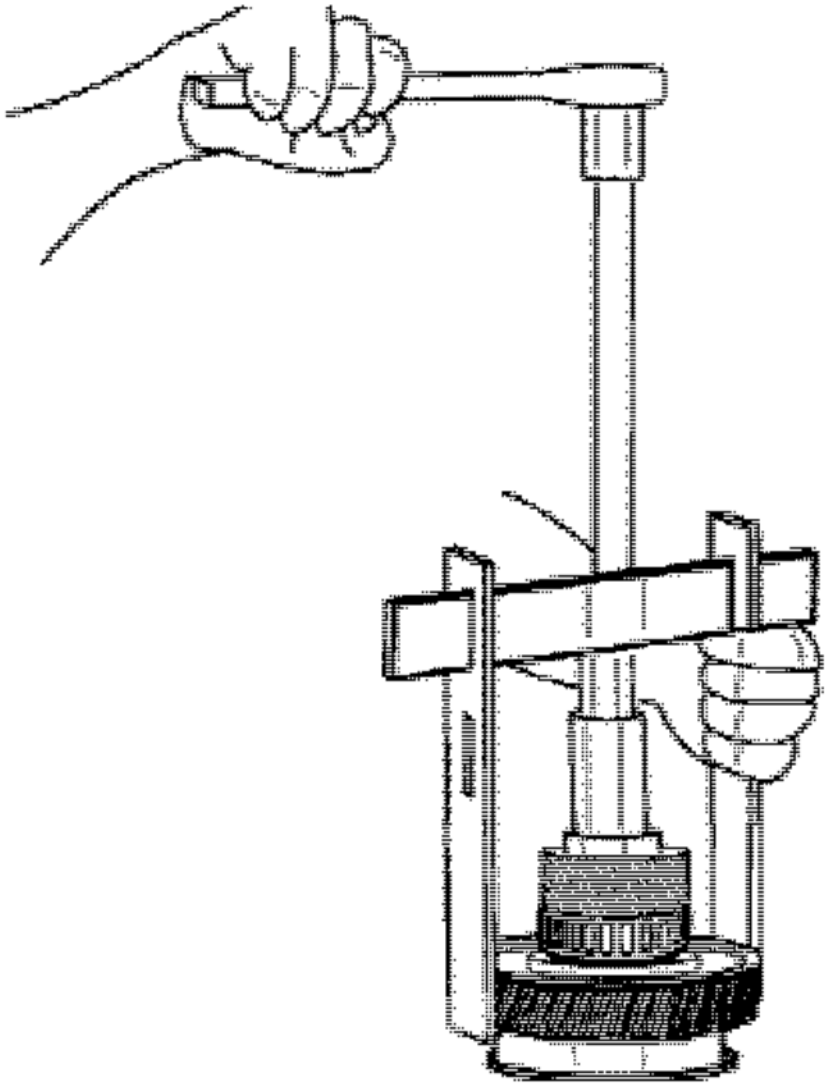


Fig. 70: Removing 5th Gear
Courtesy of GENERAL MOTORS CORP.

18. Invert the main shaft so the 5th gear is positioned upward.
19. Using a remover or a press, remove the 5th gear.

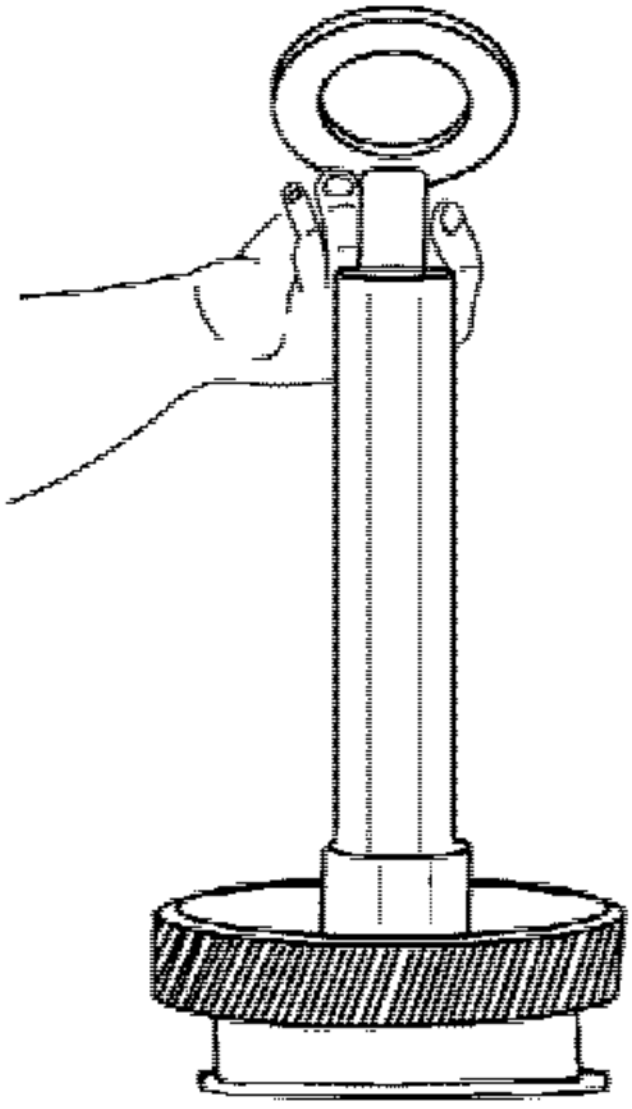


Fig. 71: Push Pulley
Courtesy of GENERAL MOTORS CORP.

20. Remove the push pulley from the reverse gear.

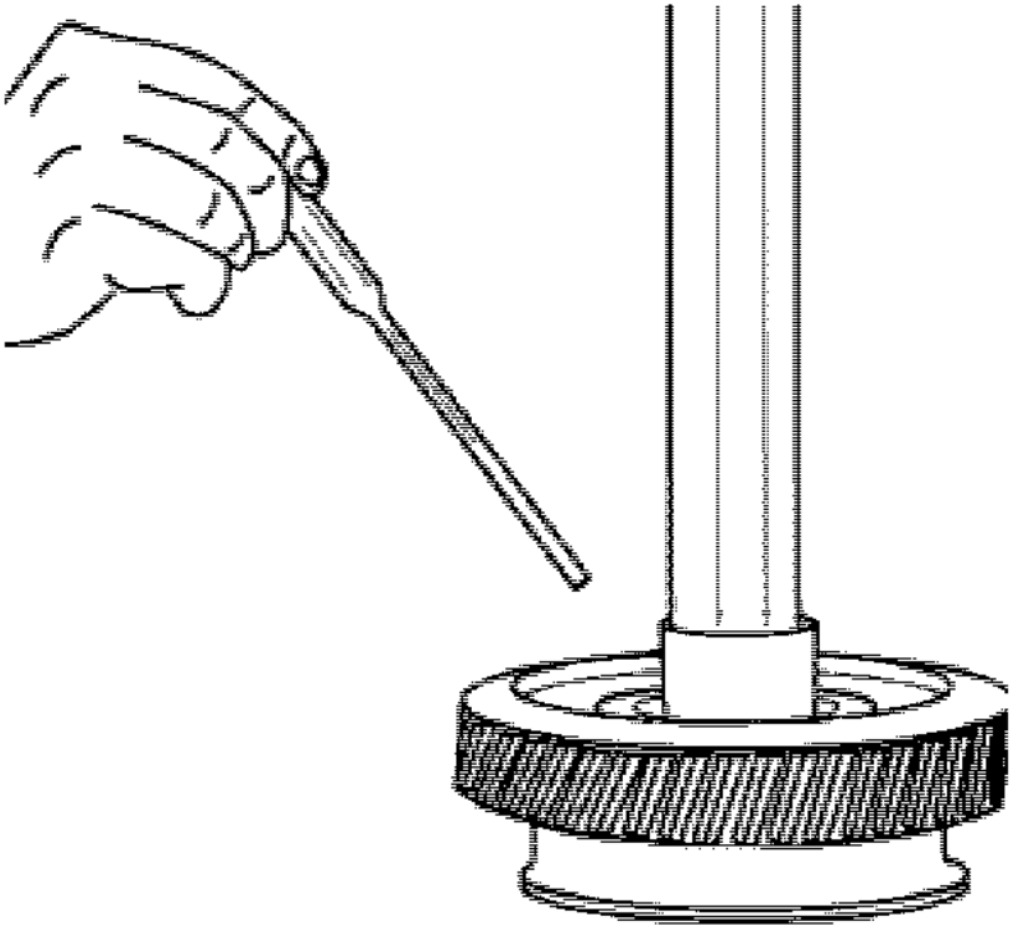


Fig. 72: Using A Magnet To Remove Pulley Sphere From Reverse Gear
Courtesy of GENERAL MOTORS CORP.

21. Using a magnet, remove the pulley sphere from the reverse gear.

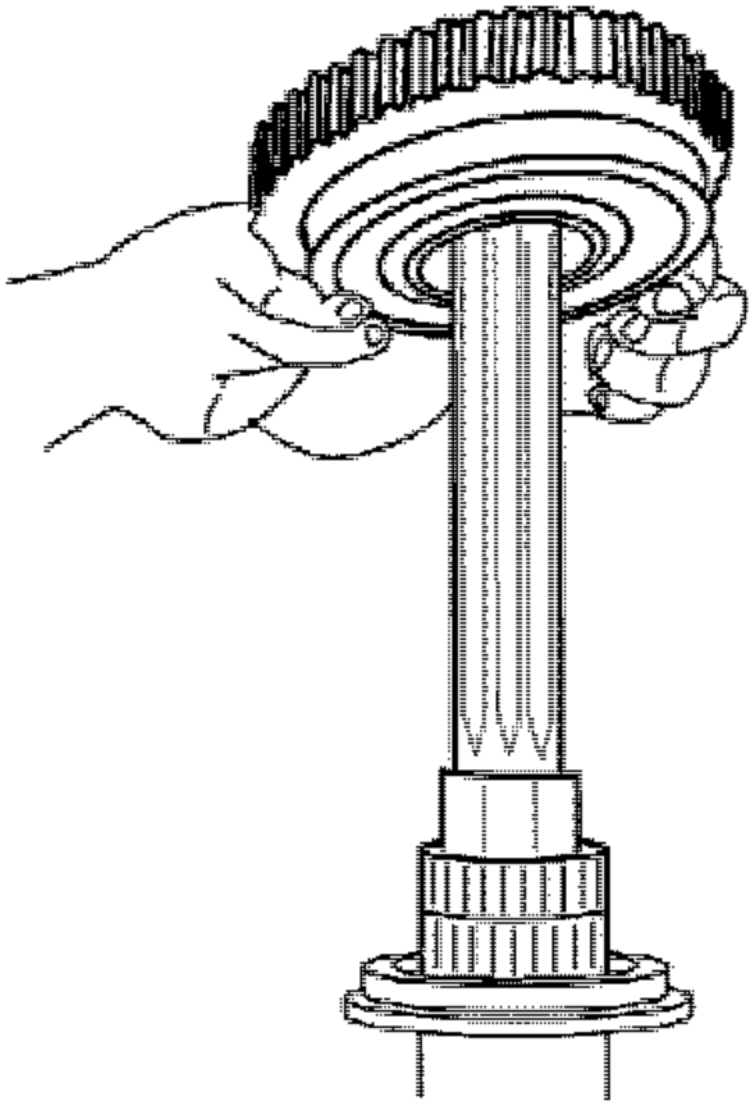


Fig. 73: Reverse Gear And Synchronizer
Courtesy of GENERAL MOTORS CORP.

22. Remove the reverse gear and the synchronizer.

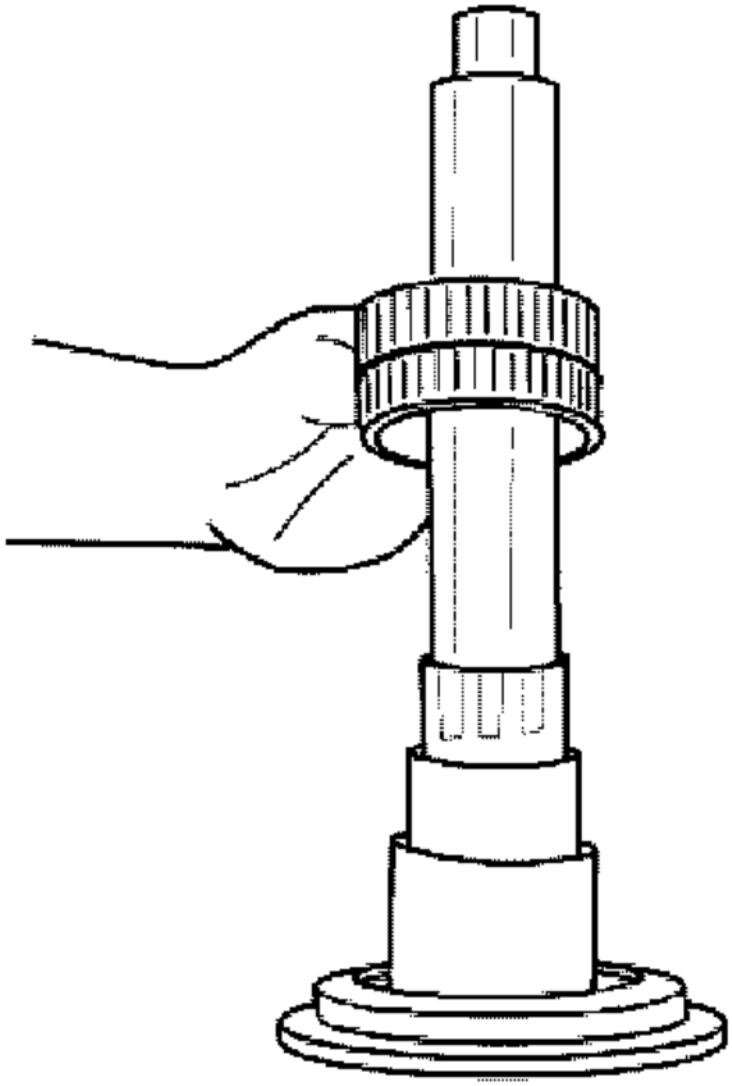


Fig. 74: Roller Cage
Courtesy of GENERAL MOTORS CORP.

23. Remove the roller cage from the reverse gear.

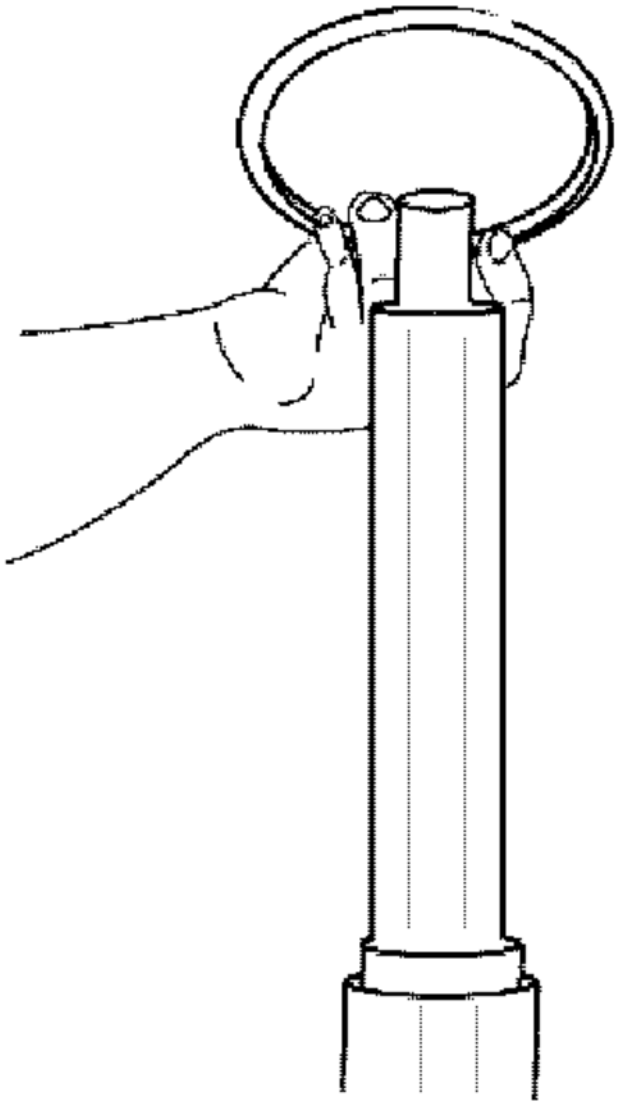


Fig. 75: Reverse Synchronizer Ring
Courtesy of GENERAL MOTORS CORP.

24. Remove the reverse synchronizer ring.

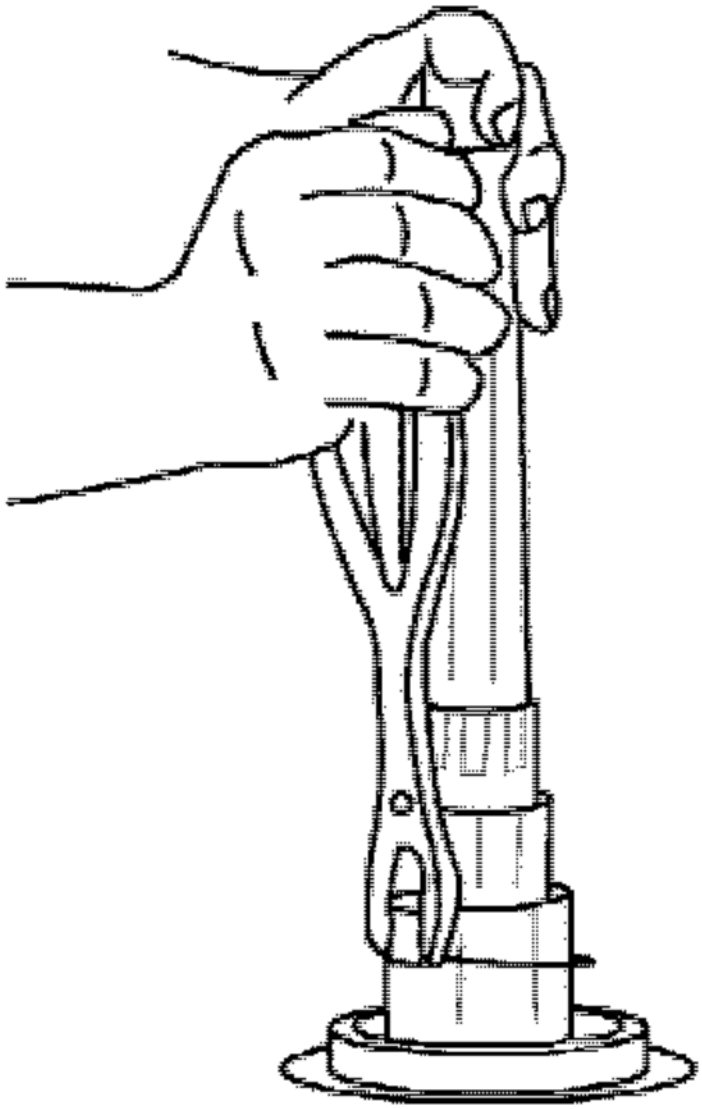


Fig. 76: Snap Ring Holding Reverse Clutch Ring
Courtesy of GENERAL MOTORS CORP.

25. Using locking pliers, remove the snap ring from the reverse clutch ring.

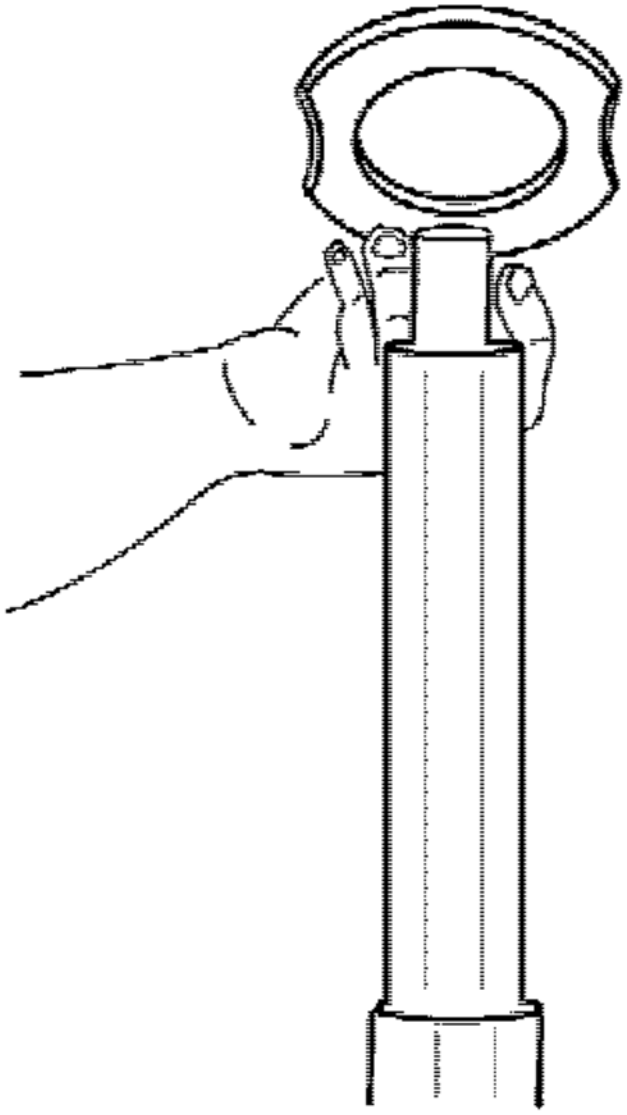


Fig. 77: Reverse Clutch Bearing
Courtesy of GENERAL MOTORS CORP.

26. Remove the reverse clutch bearing.

SHIFT SHAFT AND FORK ASSEMBLIES DISASSEMBLE

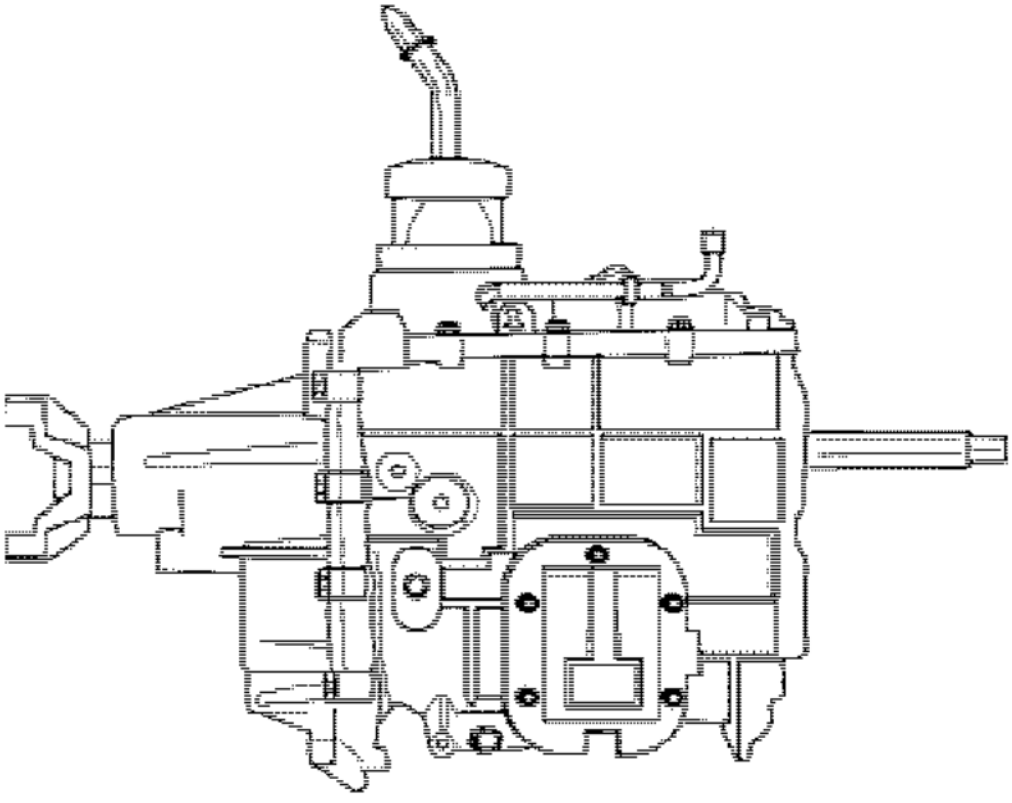


Fig. 78: Transmission
Courtesy of GENERAL MOTORS CORP.

1. Place the transmission on a workbench.

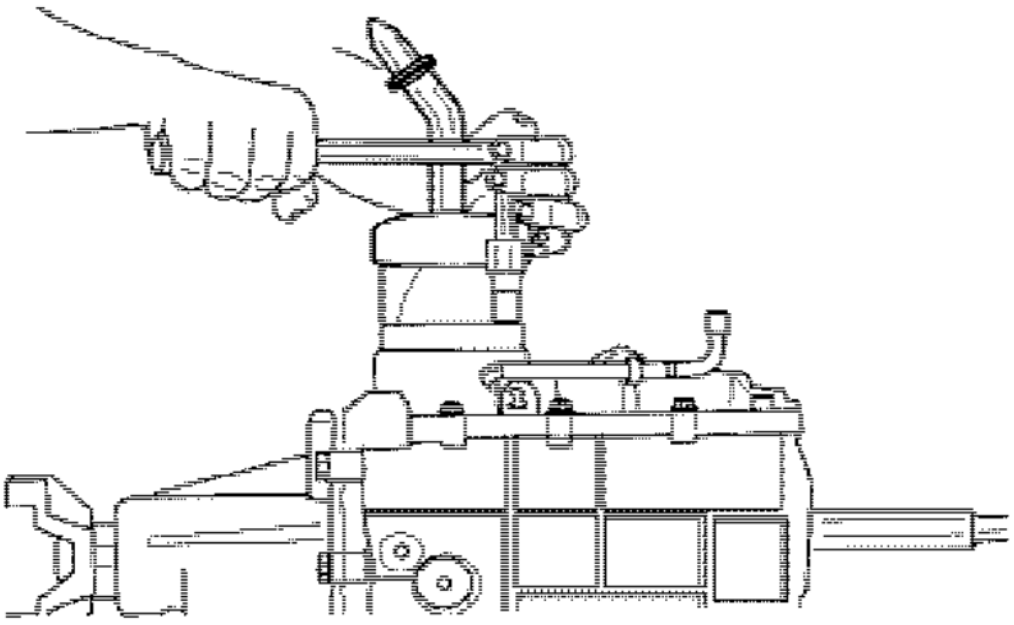


Fig. 79: Using Ratchet On Shift Tower Screws
Courtesy of GENERAL MOTORS CORP.

2. Remove the 4 screws from the shift tower.

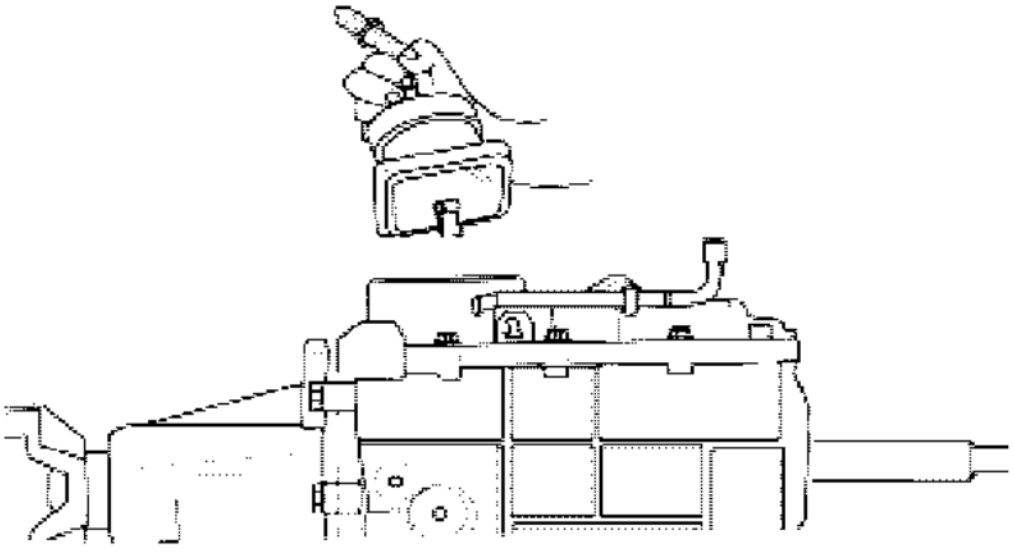


Fig. 80: Shift Tower
Courtesy of GENERAL MOTORS CORP.

3. Remove the shift tower.

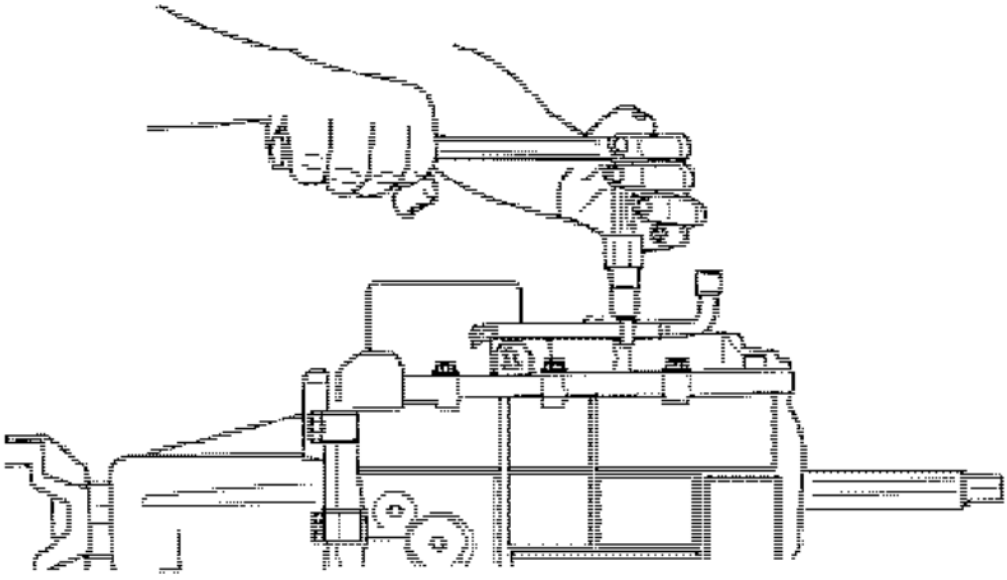


Fig. 81: Using Ratchet On Breather Support Screw
Courtesy of GENERAL MOTORS CORP.

4. Remove the breather support screw.

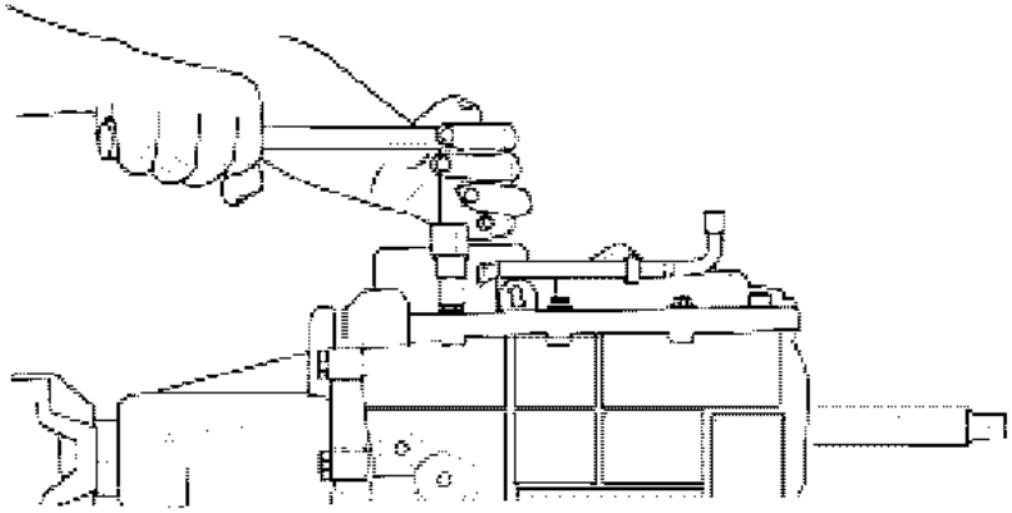


Fig. 82: Using 1/2 Socket On Screws Holding Control Cover
Courtesy of GENERAL MOTORS CORP.

5. Using a 1/2 socket, remove the 10 screws from the control cover.

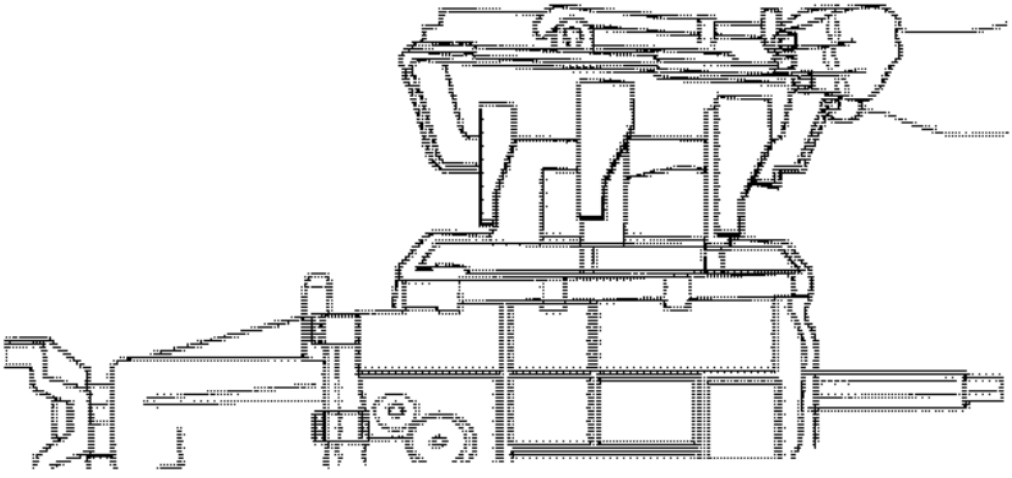


Fig. 83: Control Cover
Courtesy of GENERAL MOTORS CORP.

6. Lift the control cover.

   It may help to use a flat-head screwdriver.

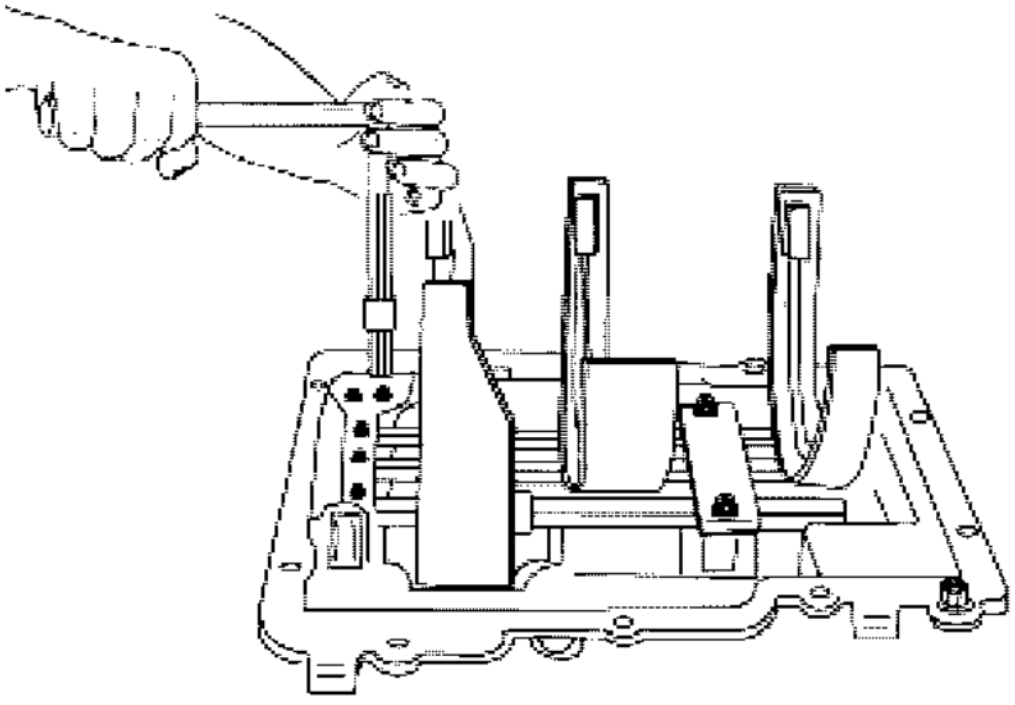


Fig. 84: Screws Retaining Support Plate On Block
Courtesy of GENERAL MOTORS CORP.

7. Place the control cover on a workbench.
8. Remove the 3 screws from the retaining support plate on the block.

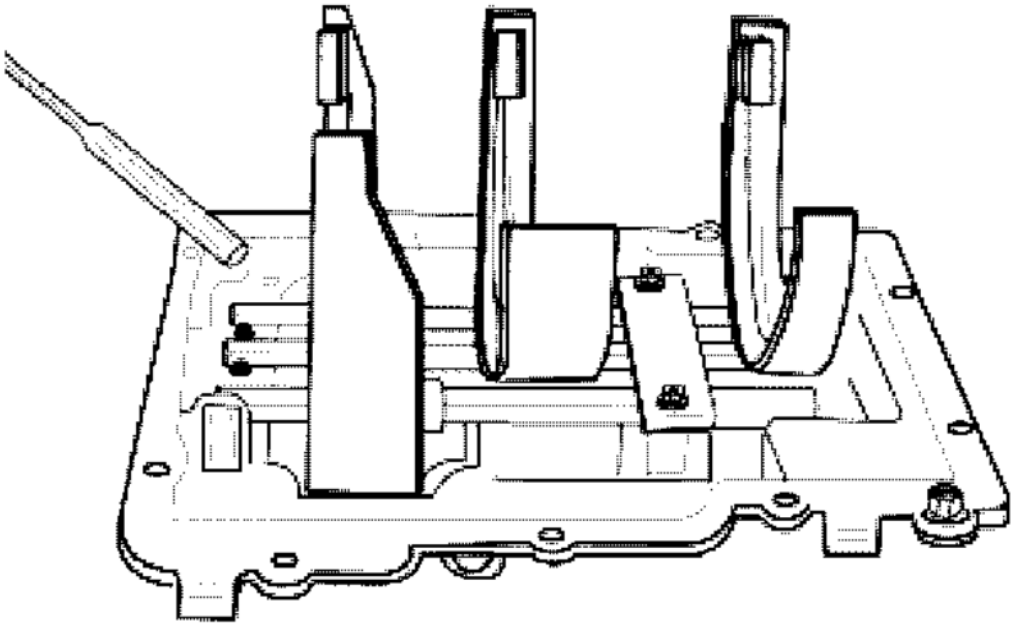


Fig. 85: Using Magnet To Remove Block Pins
Courtesy of GENERAL MOTORS CORP.

9. Using a magnet, remove the block pins.

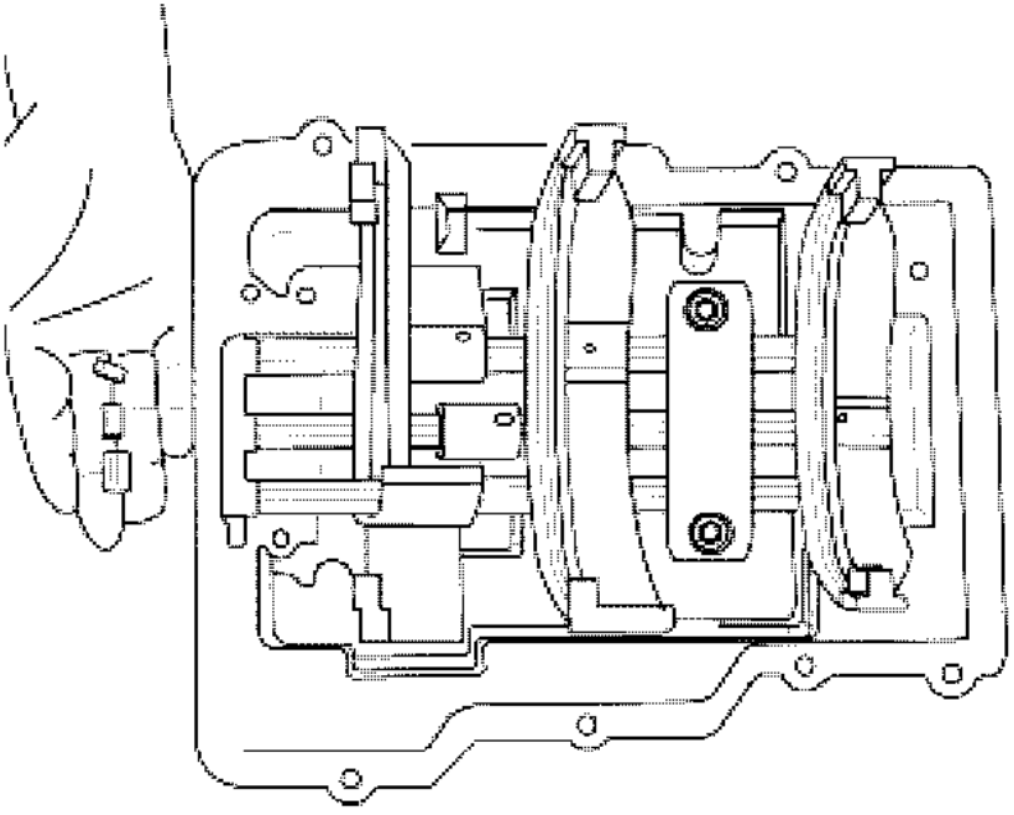


Fig. 86: Pins And Lock
Courtesy of GENERAL MOTORS CORP.

10. Remove the pins and the lock.

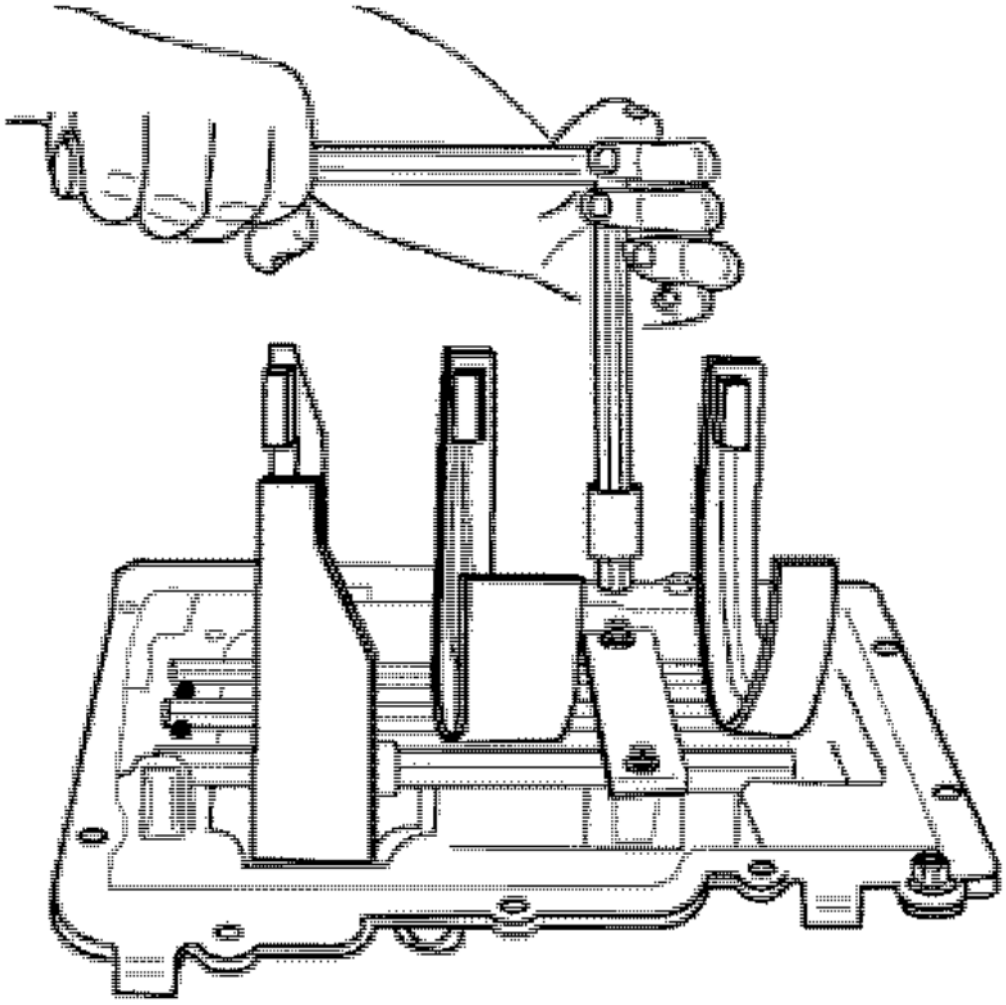


Fig. 87: Retaining Plate Screws
Courtesy of GENERAL MOTORS CORP.

11. Remove the 2 screws from the retaining plate.

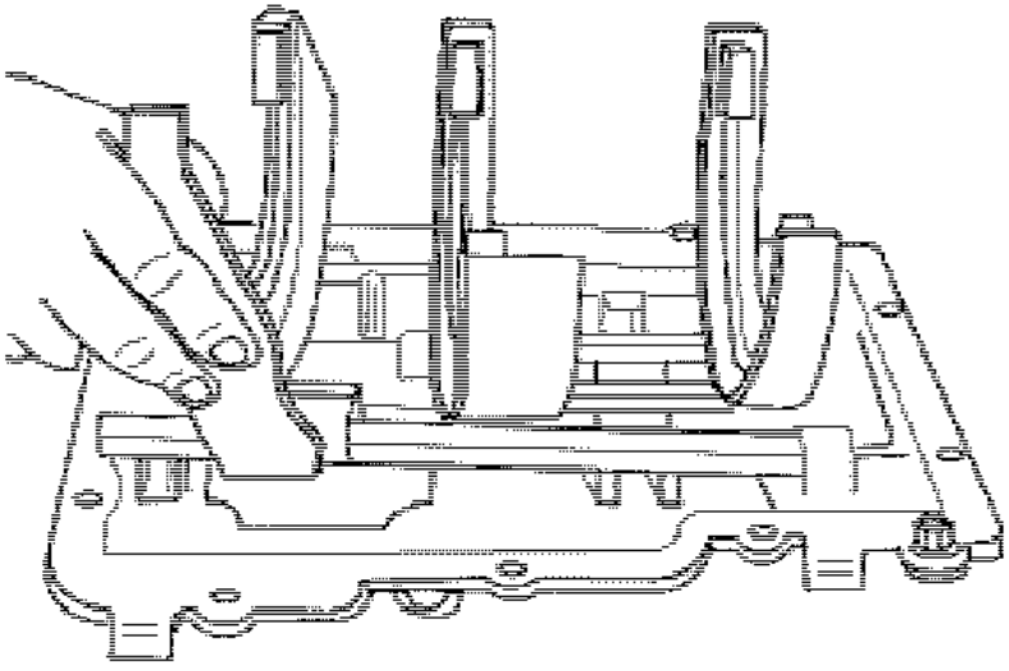


Fig. 88: 5th Gear, Reverse Shaft, And Fork Assembly
Courtesy of GENERAL MOTORS CORP.

12. Remove the 5th gear, reverse shaft, and fork assembly.

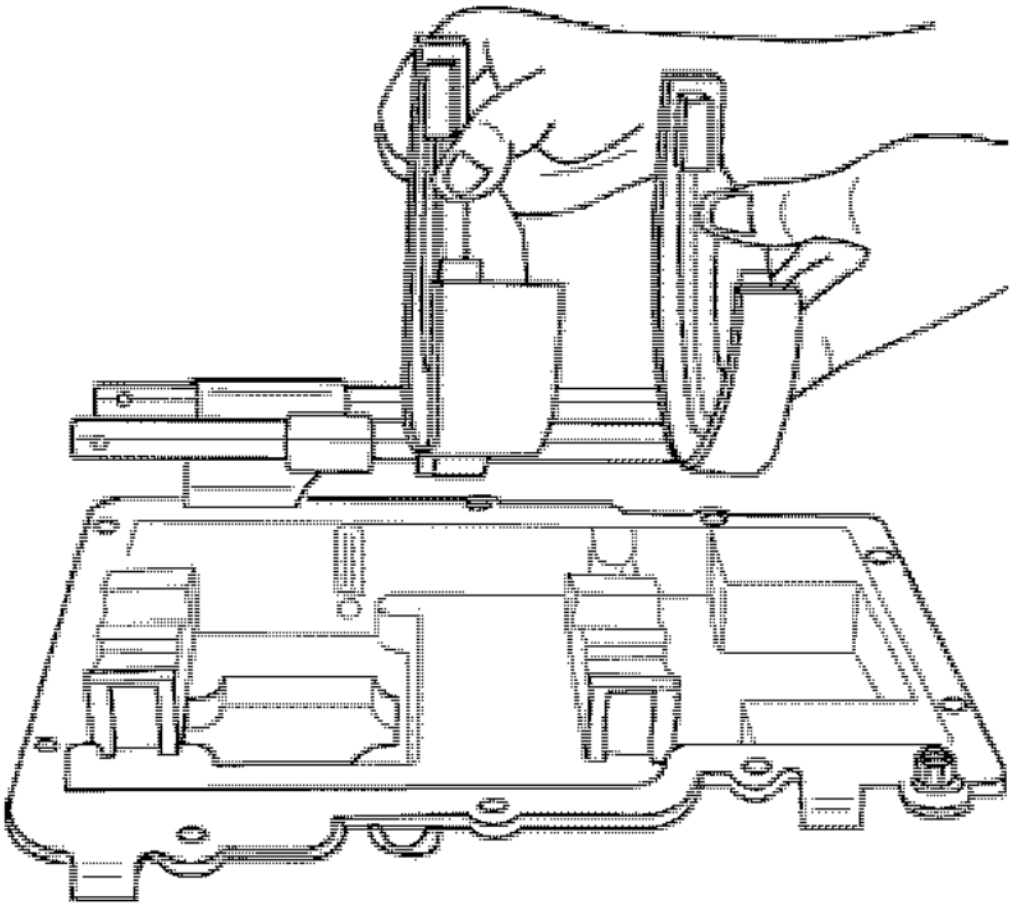


Fig. 89: Assembly With Shafts, Forks And Stops
Courtesy of GENERAL MOTORS CORP.

13. Remove the rest of the assembly with the shafts, forks and stops.

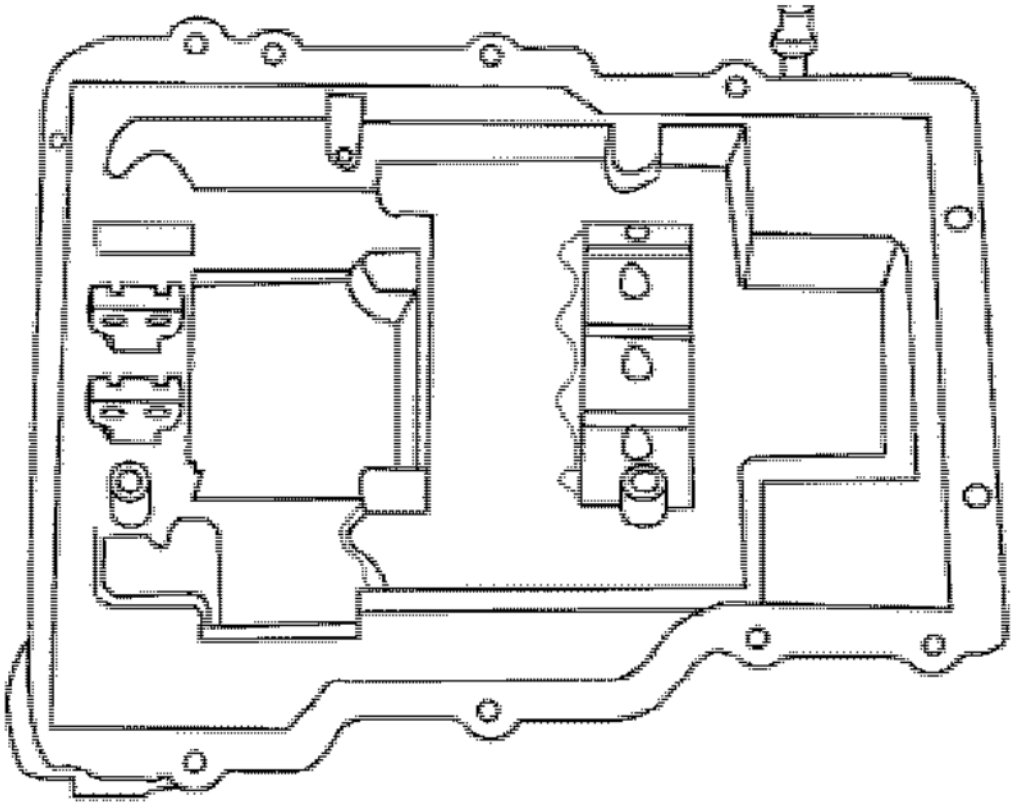


Fig. 90: 3 Spheres And 3 Springs
Courtesy of GENERAL MOTORS CORP.

14. Be careful not to lose the 3 spheres and the 3 springs.

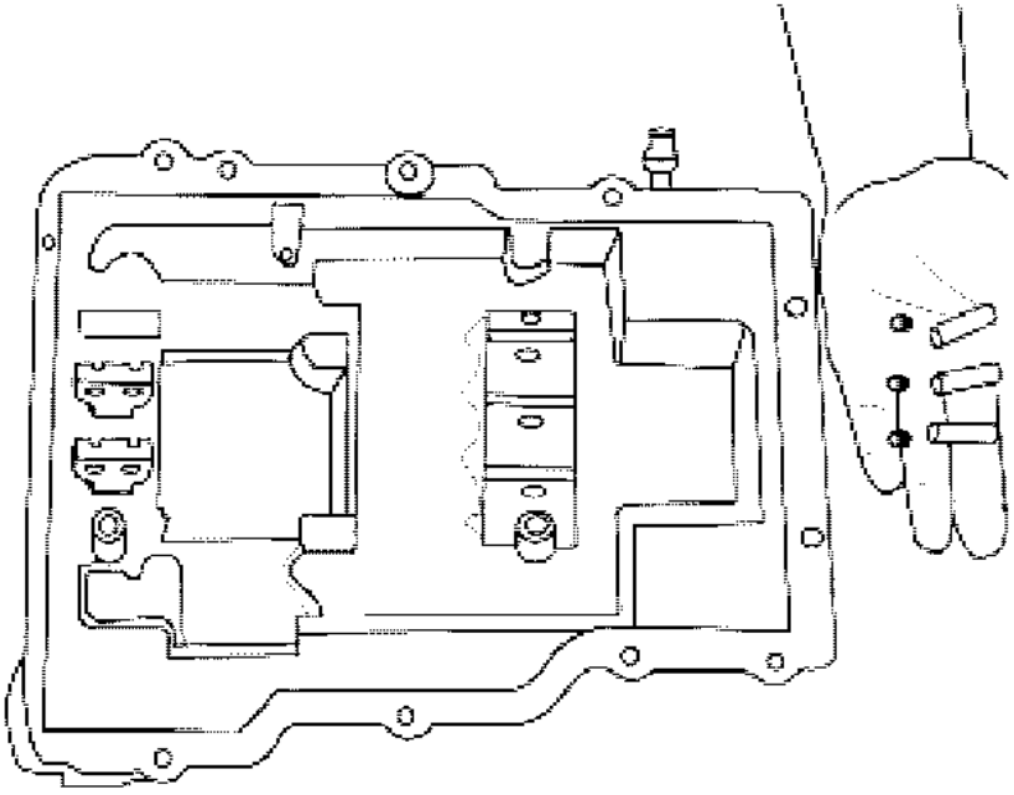


Fig. 91: Inserts
Courtesy of GENERAL MOTORS CORP.

15. Arrange the inserts.

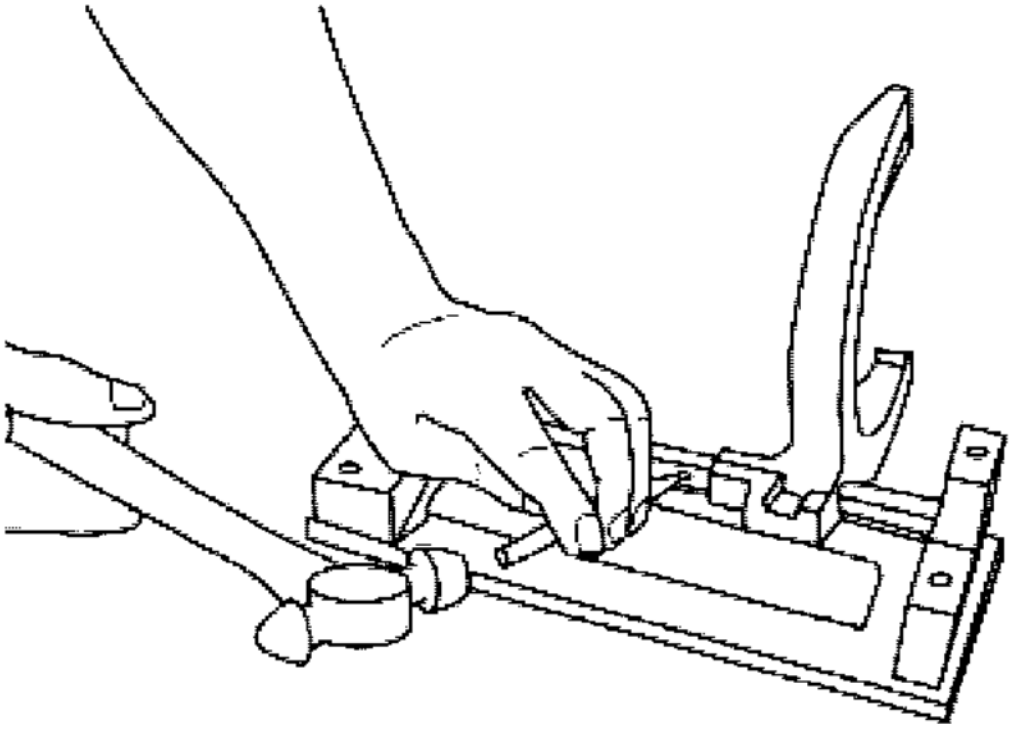


Fig. 92: Removing Fork Pin And Fork
Courtesy of GENERAL MOTORS CORP.

16. Using a punch and a hammer, remove the fork pin and fork, if necessary.

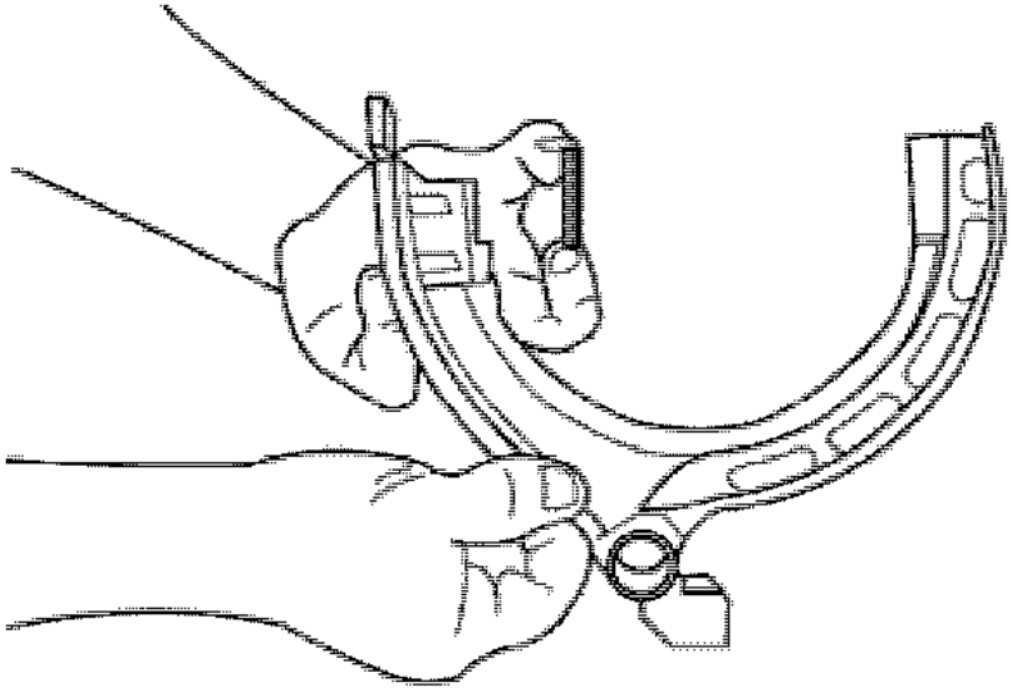


Fig. 93: Fork Inserts
Courtesy of GENERAL MOTORS CORP.

17. Remove the fork inserts if they are worn or scored. It may help to use a flat-head screwdriver.

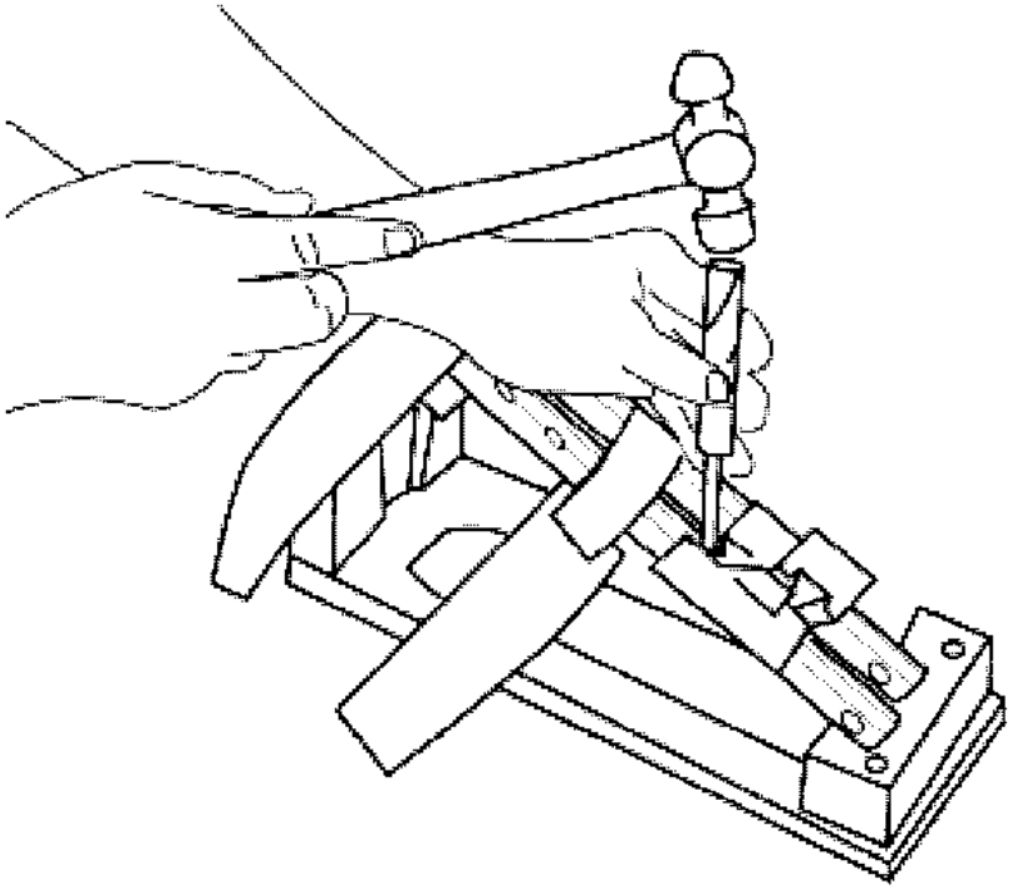


Fig. 94: Removing 3rd And 4th Gear Stop
Courtesy of GENERAL MOTORS CORP.

18. Remove the 3rd and 4th gear stop.

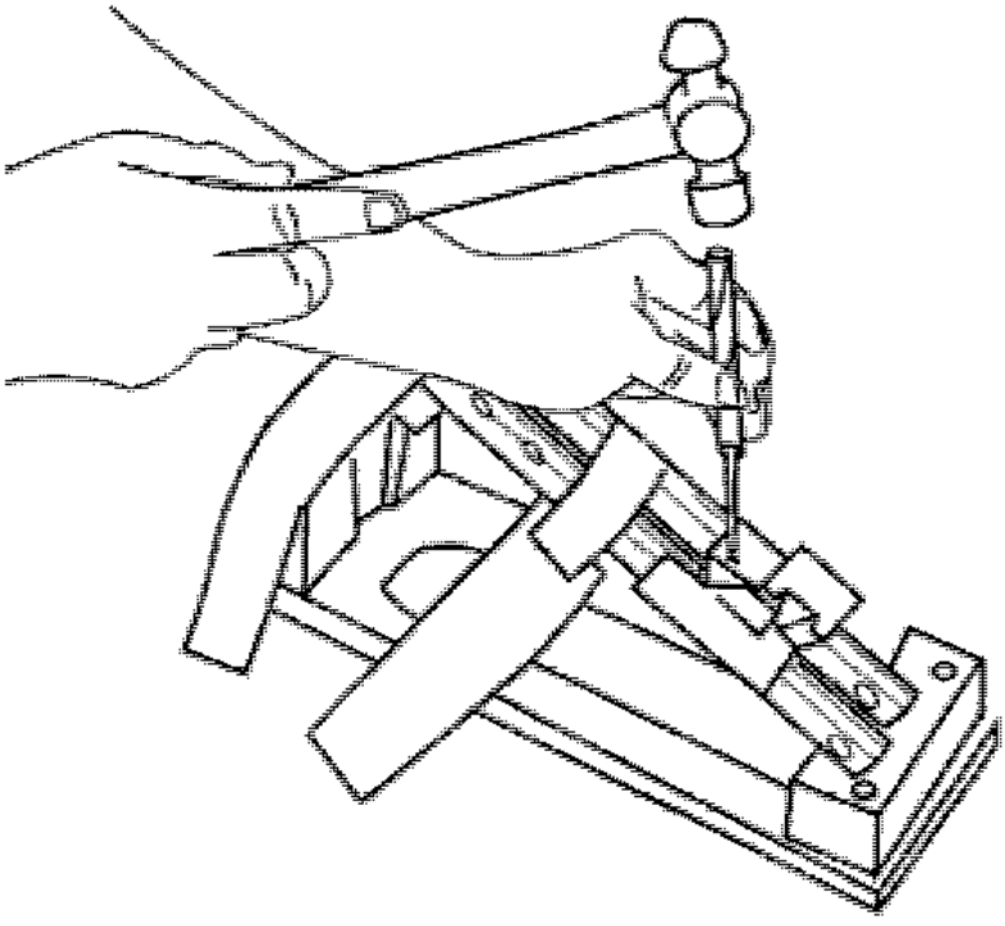


Fig. 95: Removing 1st And 2nd Gear Stop
Courtesy of GENERAL MOTORS CORP.

19. Remove the 1st and 2nd gear stop.

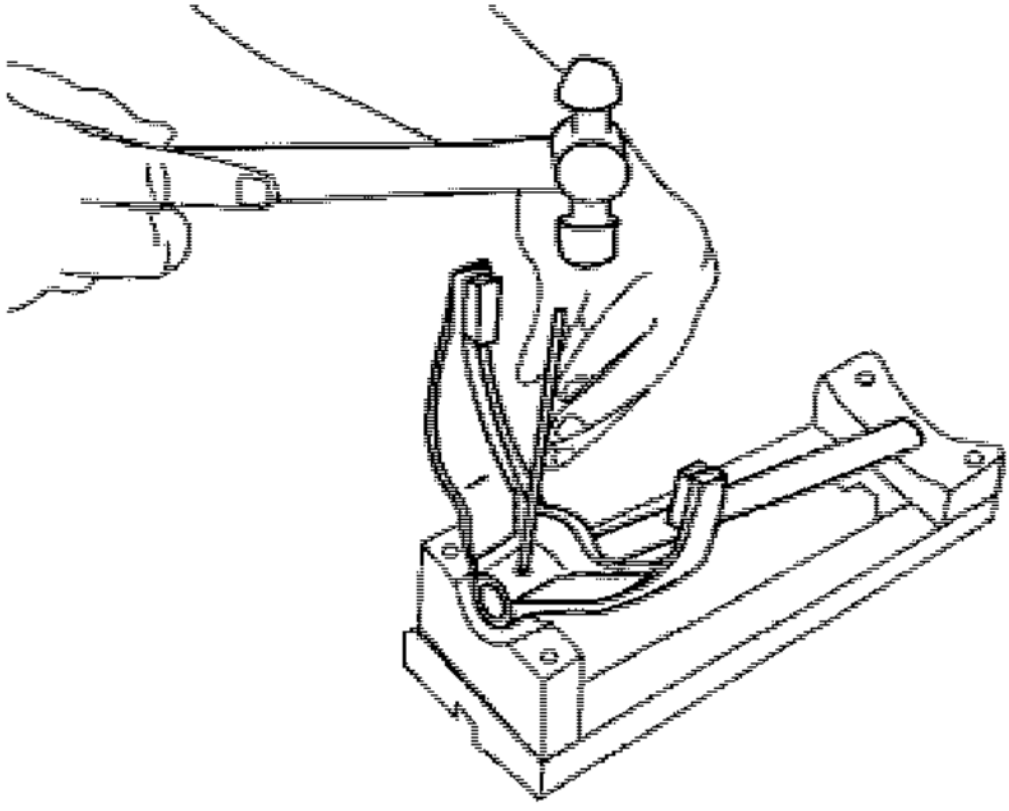


Fig. 96: Removing Fork Pin And Fork
Courtesy of GENERAL MOTORS CORP.

20. Using a punch and a hammer, remove the fork pin and the fork, if necessary.

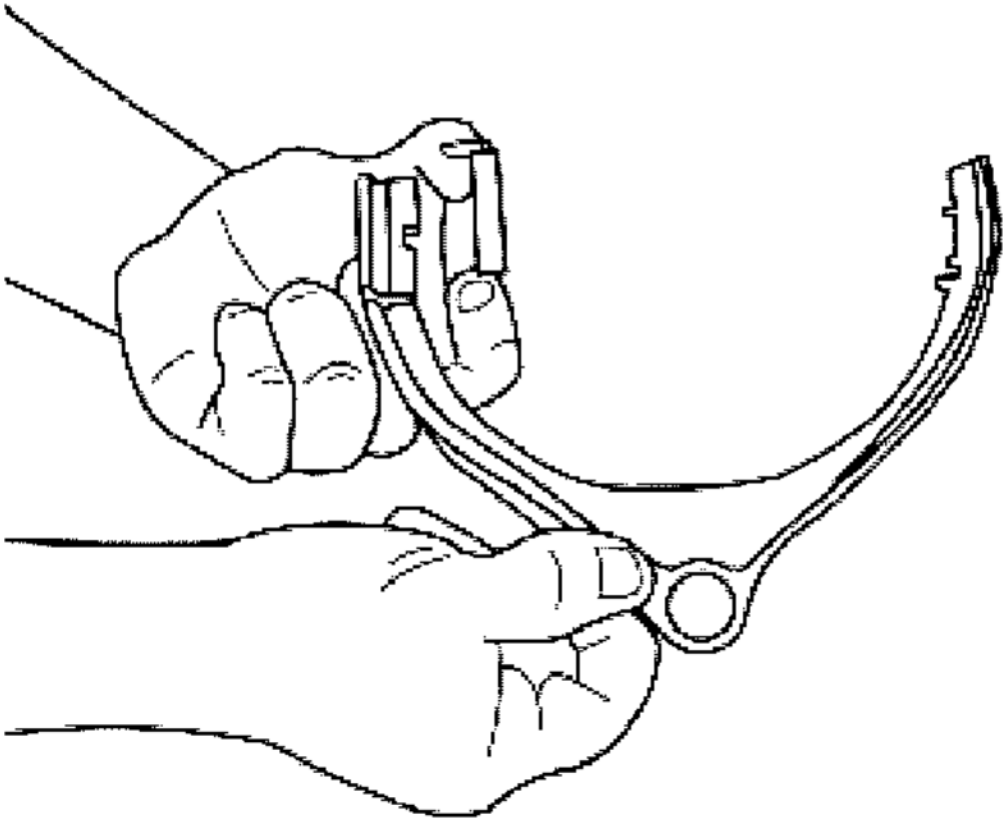


Fig. 97: Fork Inserts
Courtesy of GENERAL MOTORS CORP.

21. Remove the fork inserts if they are worn or have jagged edges.

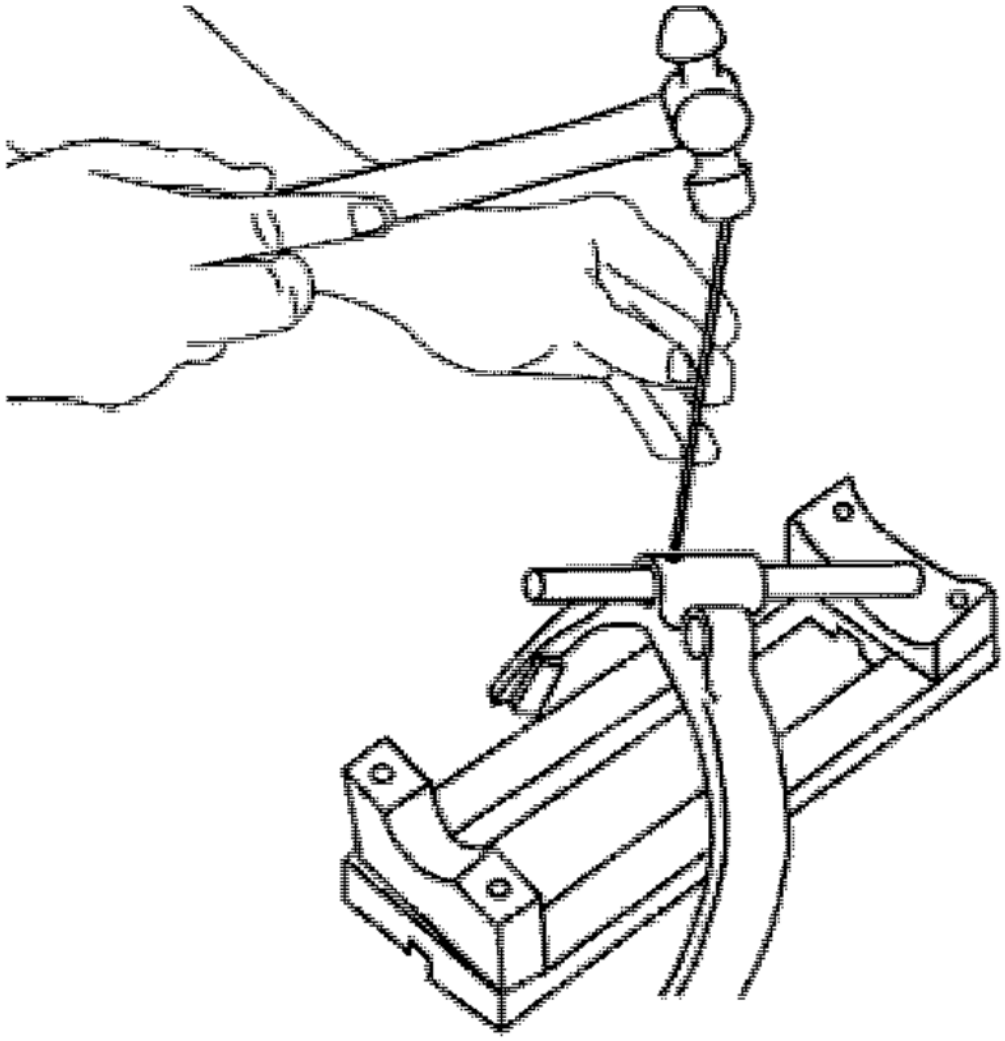


Fig. 98: Removing Fork Pin And Fork
Courtesy of GENERAL MOTORS CORP.

22. Using a punch and a hammer, remove the fork pin and the fork, if necessary.

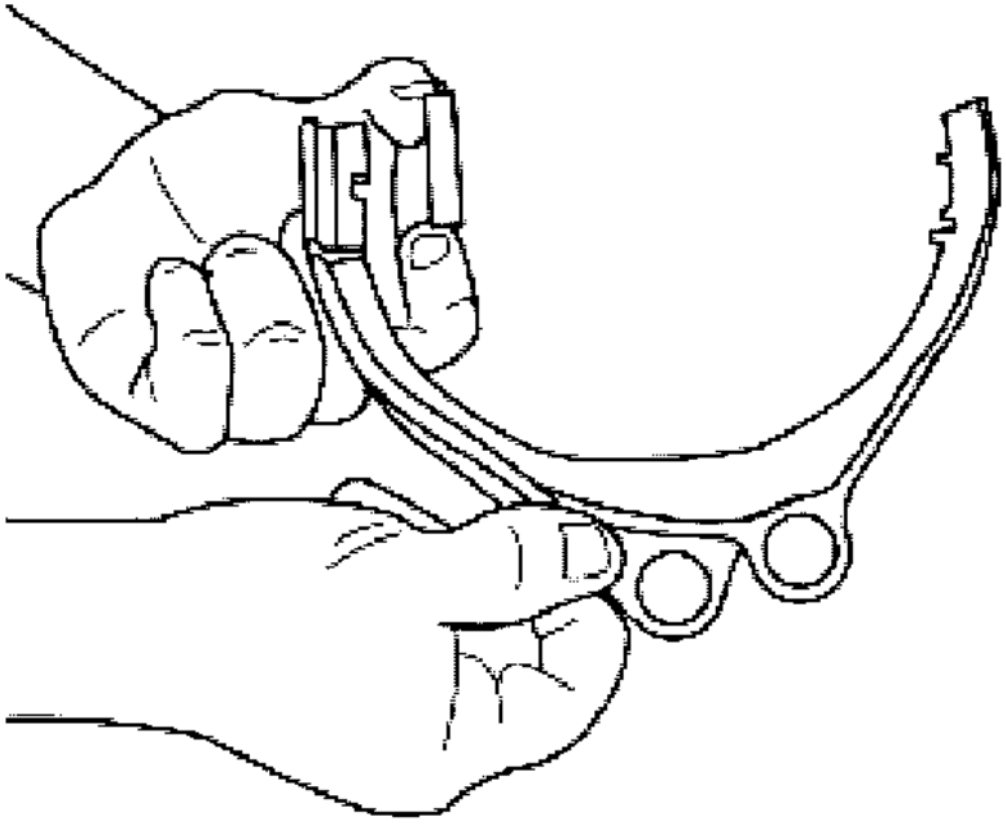


Fig. 99: Fork Inserts
Courtesy of GENERAL MOTORS CORP.

23. Remove the fork inserts if they are worn or have jagged edges.

REVERSE IDLER GEAR DISASSEMBLE

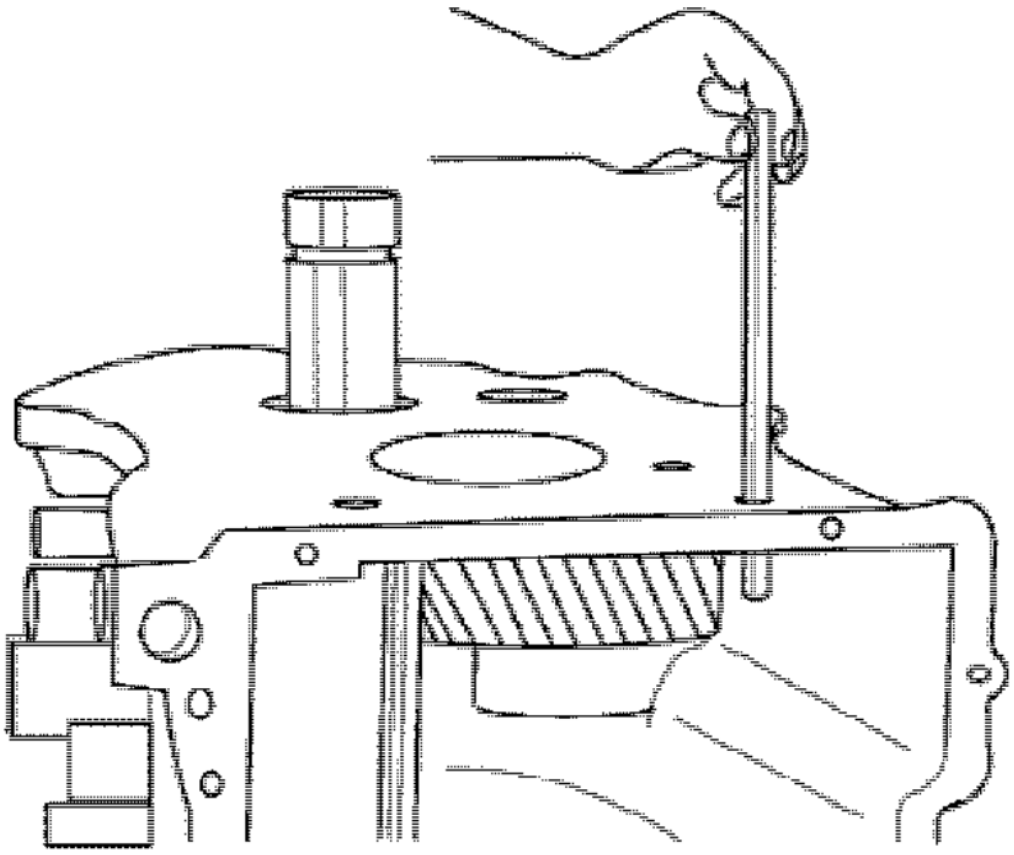


Fig. 100: 4th Gear Shaft
Courtesy of GENERAL MOTORS CORP.

1. Remove the 4th gear shaft from the case.

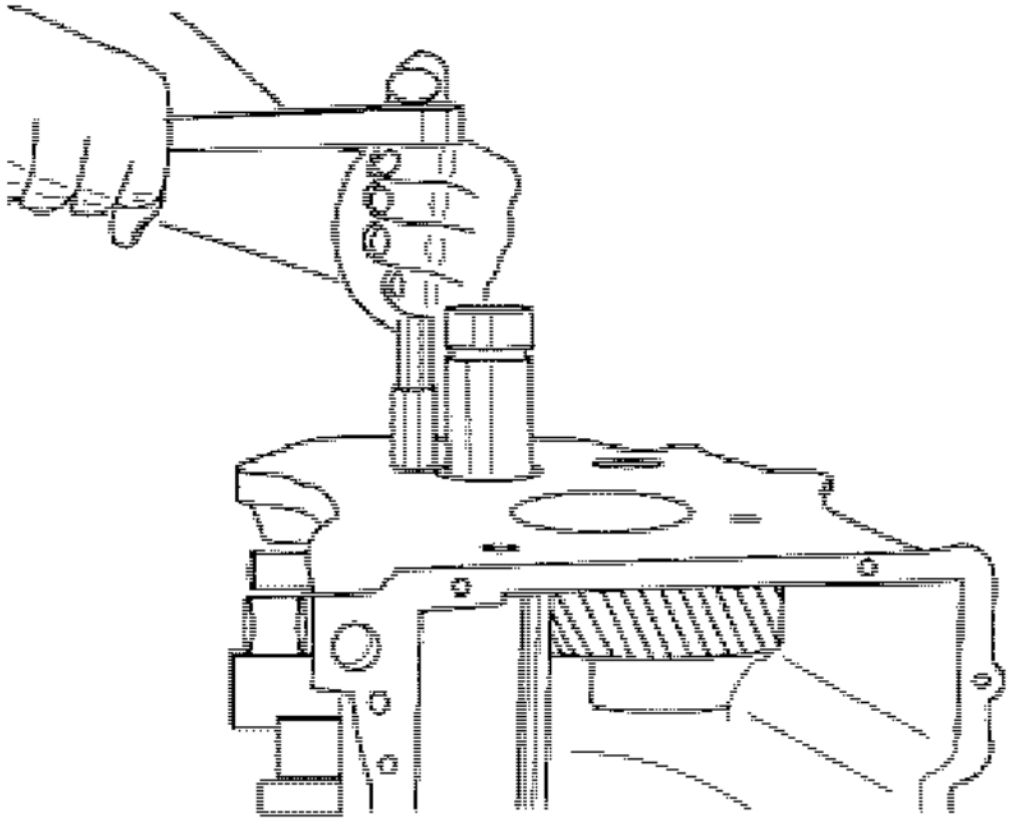


Fig. 101: Rear Retainer Screws
Courtesy of GENERAL MOTORS CORP.

2. Remove the 4 screws from the rear retainer.

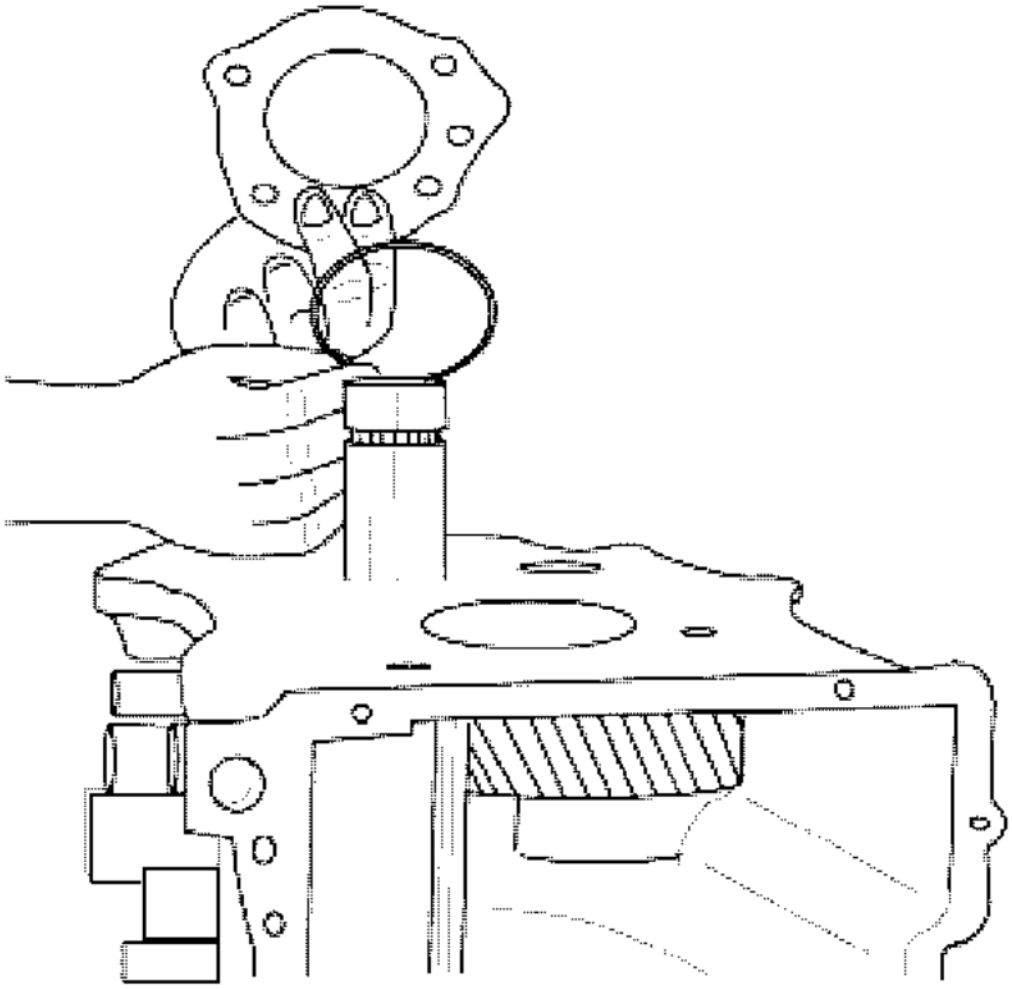


Fig. 102: Rear Retainer And Adjuster Shims
Courtesy of GENERAL MOTORS CORP.

3. Remove the rear retainer and the adjuster shims.

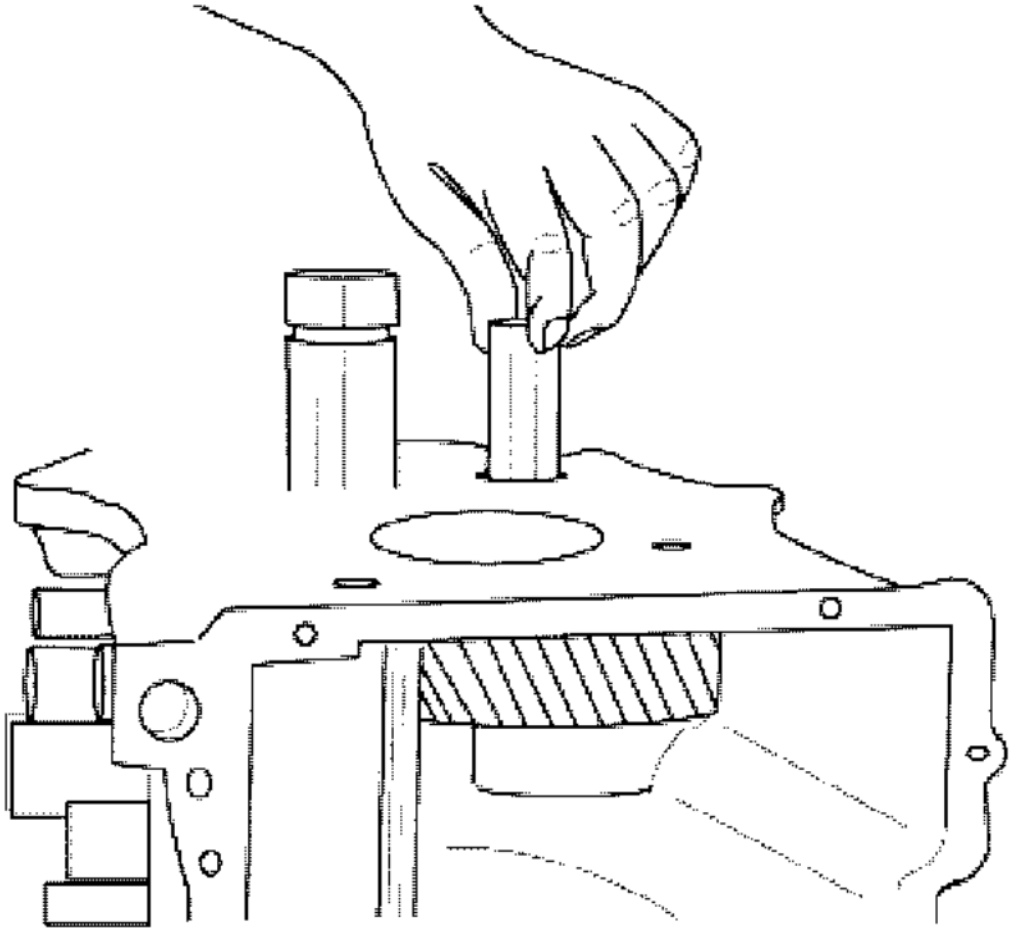


Fig. 103: Reverse Shaft
Courtesy of GENERAL MOTORS CORP.

4. Remove the reverse shaft.

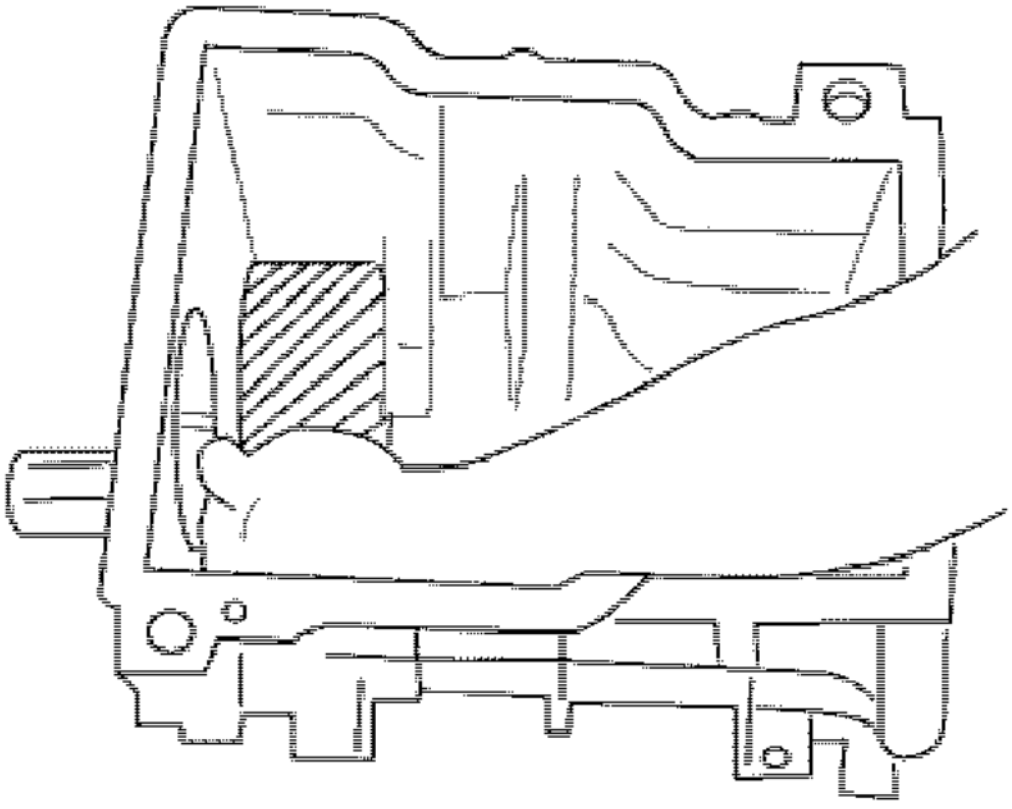


Fig. 104: Reverse Gear
Courtesy of GENERAL MOTORS CORP.

5. Remove the reverse gear.

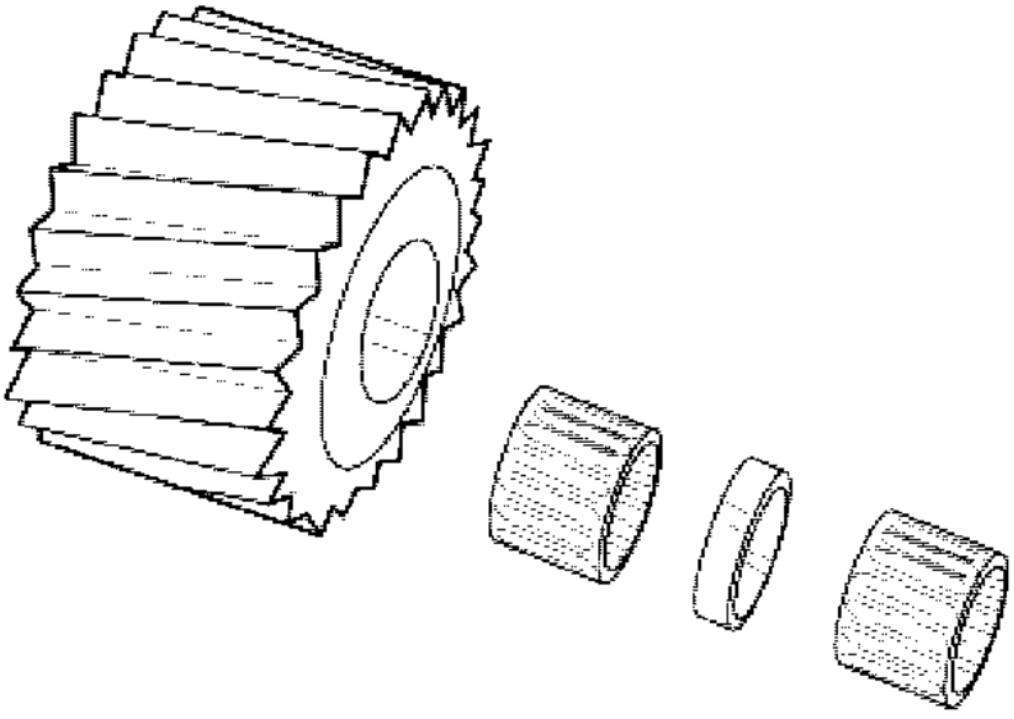


Fig. 105: Cages, Rollers And Spacer
Courtesy of GENERAL MOTORS CORP.

6. Remove the 2 cages with rollers and spacer.

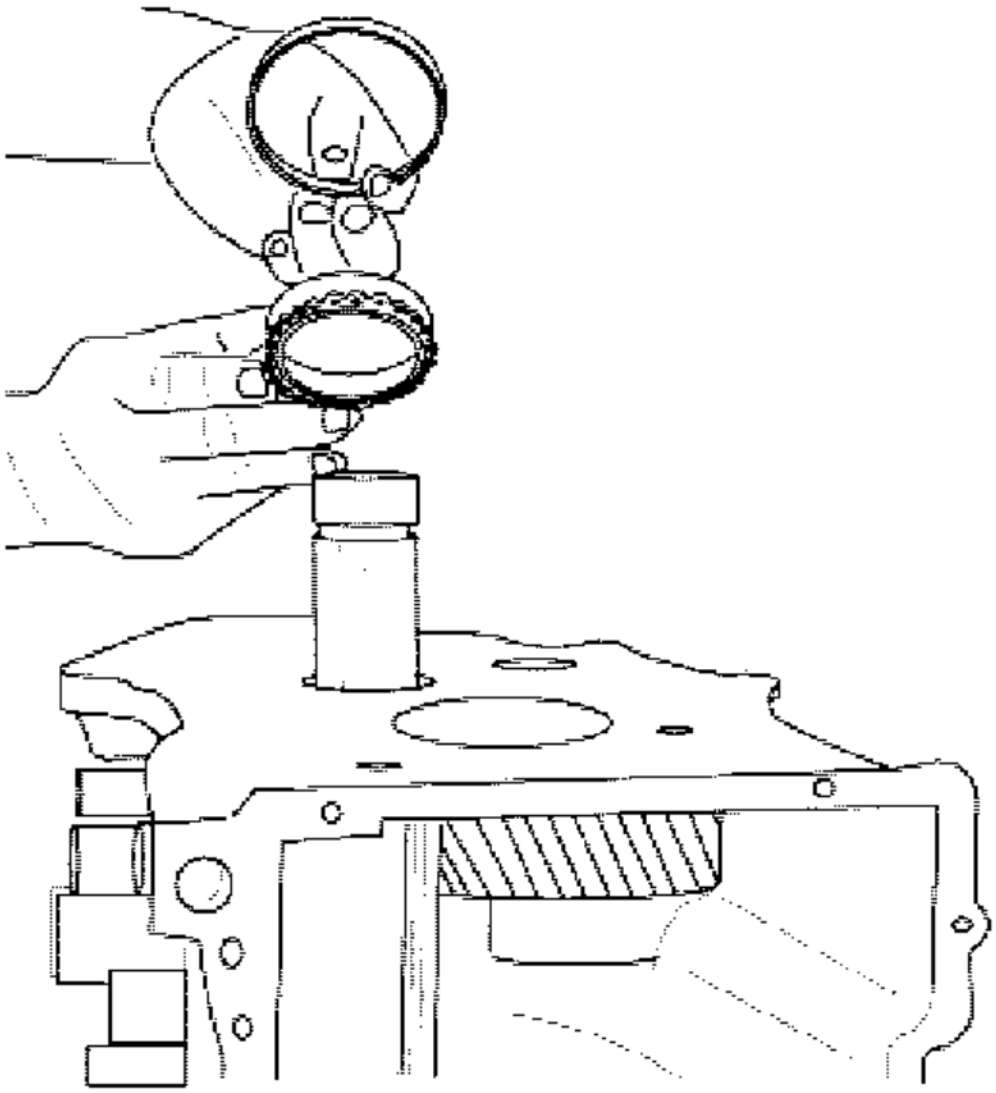


Fig. 106: Cup And Rear Bearing Race
Courtesy of GENERAL MOTORS CORP.

7. Remove the cup and rear bearing race from the gear assembly.

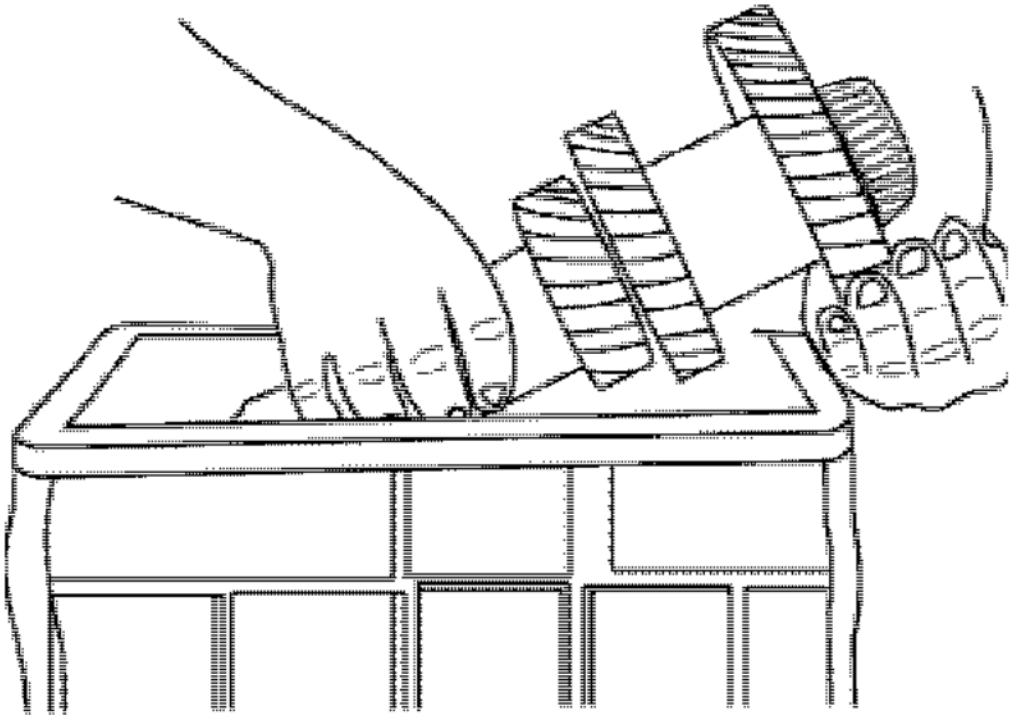


Fig. 107: Gear Assembly
Courtesy of GENERAL MOTORS CORP.

8. Slide the gear assembly backward and remove the gear assembly from the case.

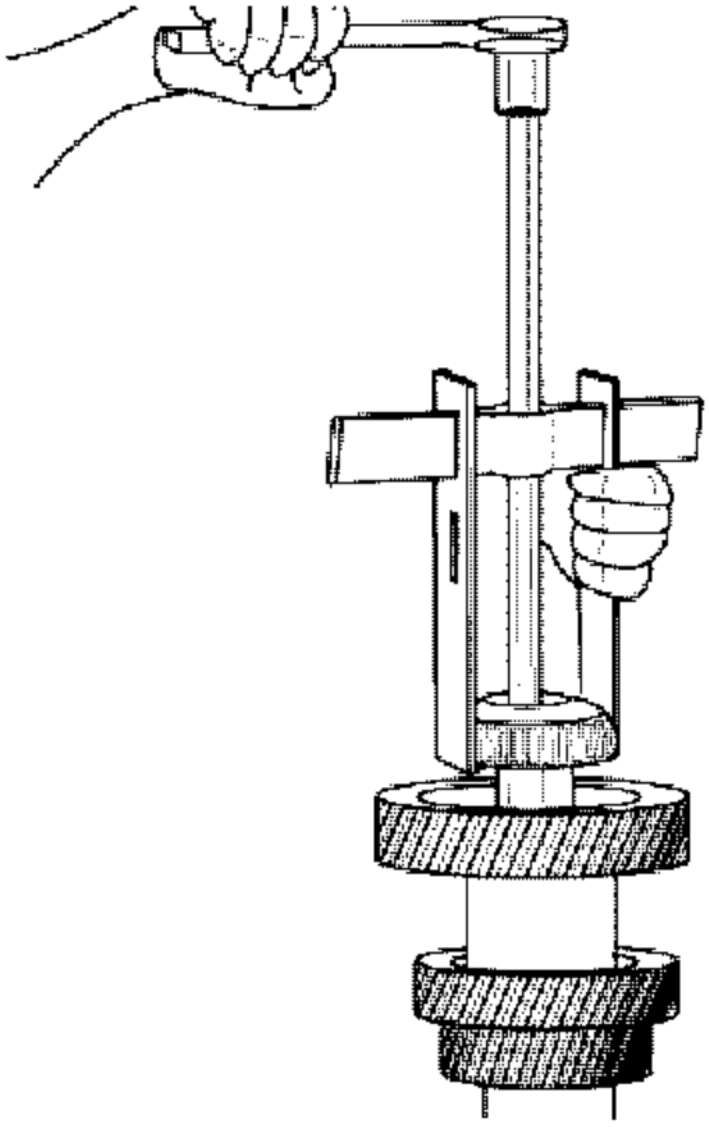


Fig. 108: Remove Bearing Race From Gear Assembly
Courtesy of GENERAL MOTORS CORP.

9. Using a bearing remover, remove the bearing race from the gear assembly.

COUNTER GEAR SHAFT DISASSEMBLE

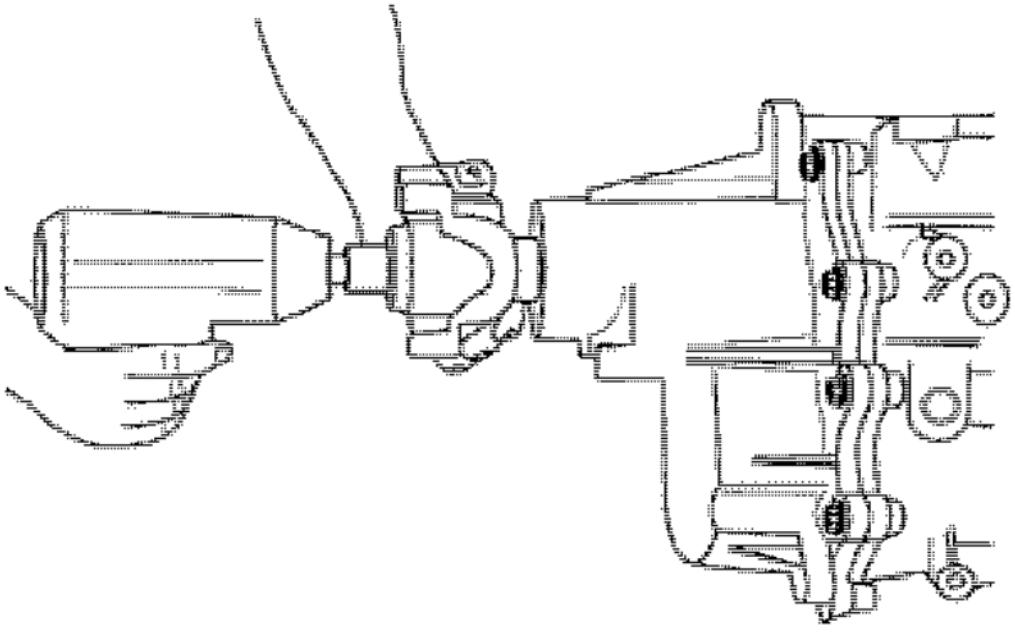


Fig. 109: Main Shaft Nut
Courtesy of GENERAL MOTORS CORP.

1. Use an impact gun to loosen and remove the nut from the main shaft.

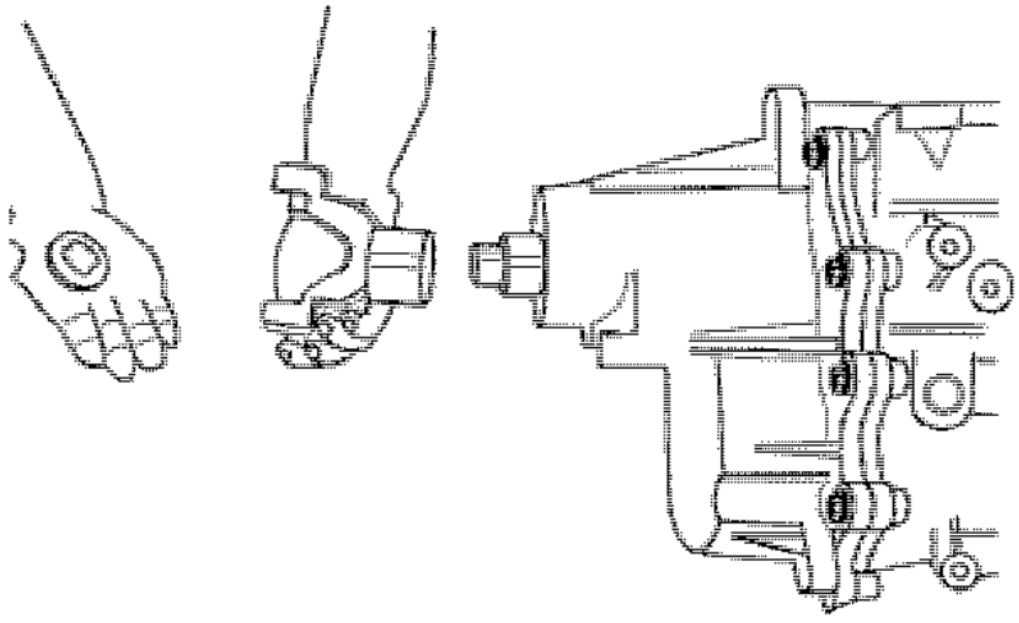


Fig. 110: Main Shaft Nut & Yoke
Courtesy of GENERAL MOTORS CORP.

2. Remove the yoke flange from the main shaft, as necessary.

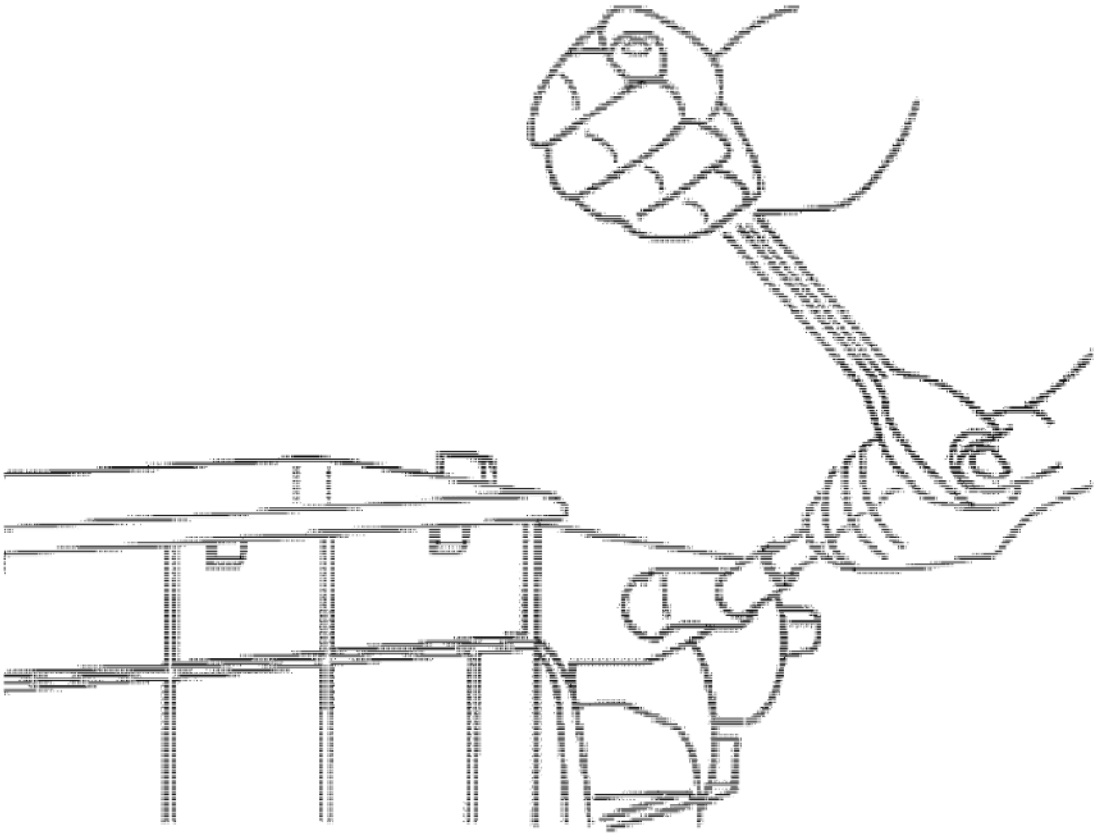


Fig. 111: Using Ratchet On Vehicle Speed Sensor (VSS) Screw
Courtesy of GENERAL MOTORS CORP.

3. Using a 10 mm socket, remove the vehicle speed sensor (VSS) screw.

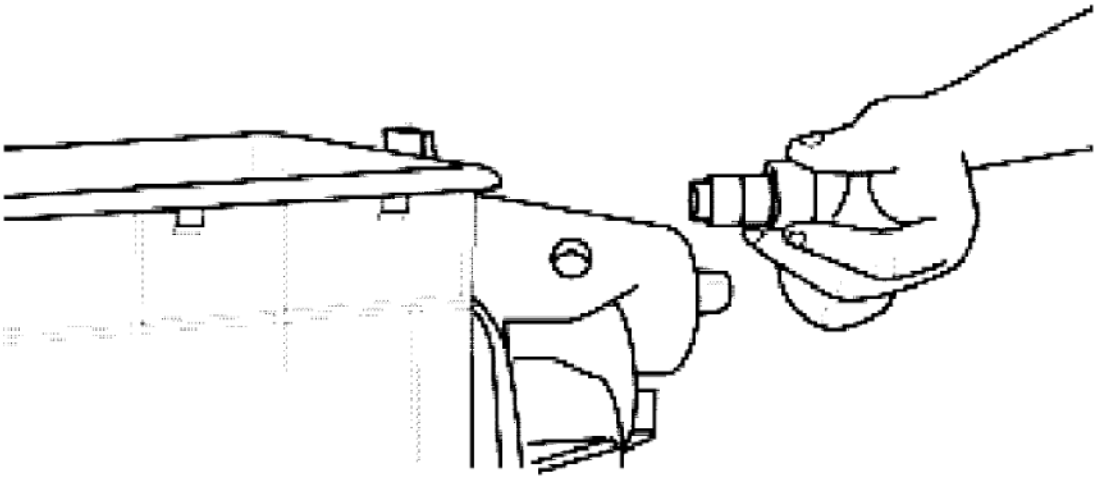


Fig. 112: VSS
Courtesy of GENERAL MOTORS CORP.

4. Remove the VSS.

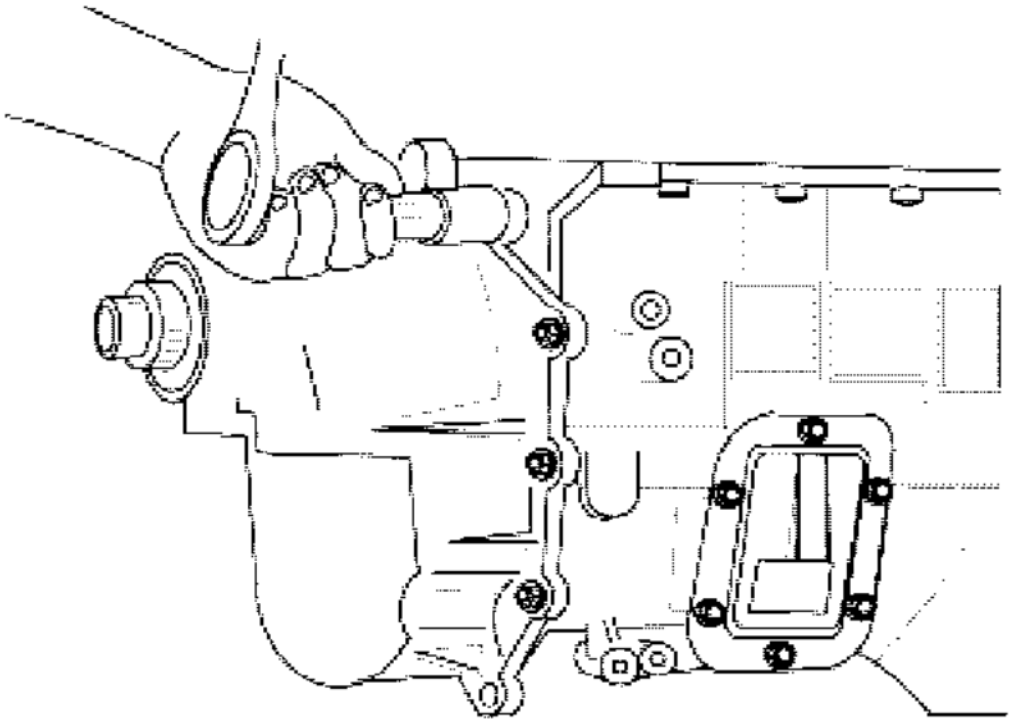


Fig. 113: Rear Cover Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the 10 cover screws.

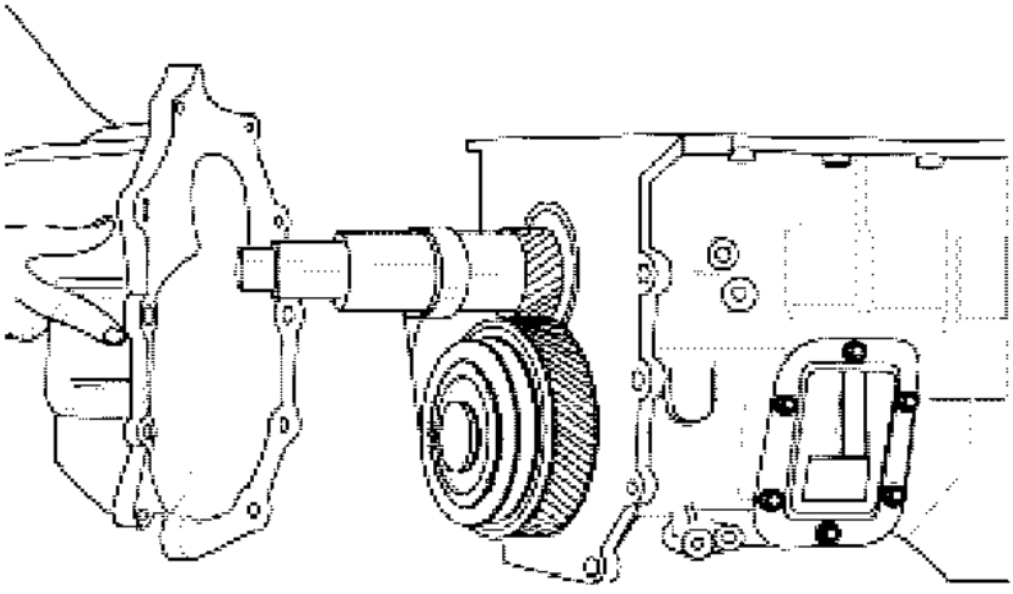


Fig. 114: Cover
Courtesy of GENERAL MOTORS CORP.

6. Remove the cover carefully, as oil may remain in the cover.

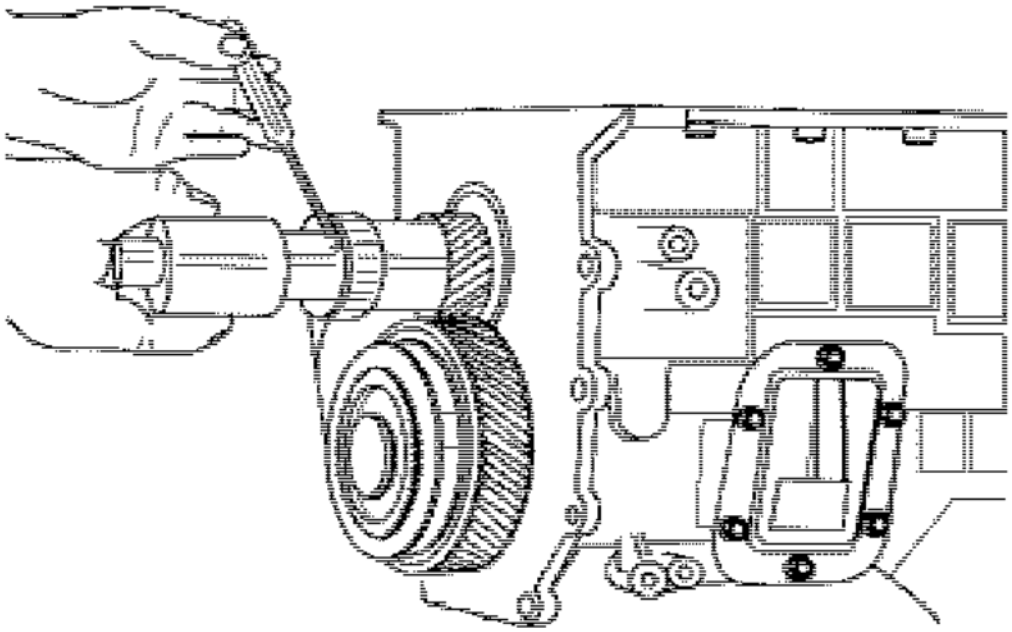


Fig. 115: Yoke Spacer
Courtesy of GENERAL MOTORS CORP.

7. Remove the spacer from the flange and yoke, as necessary.

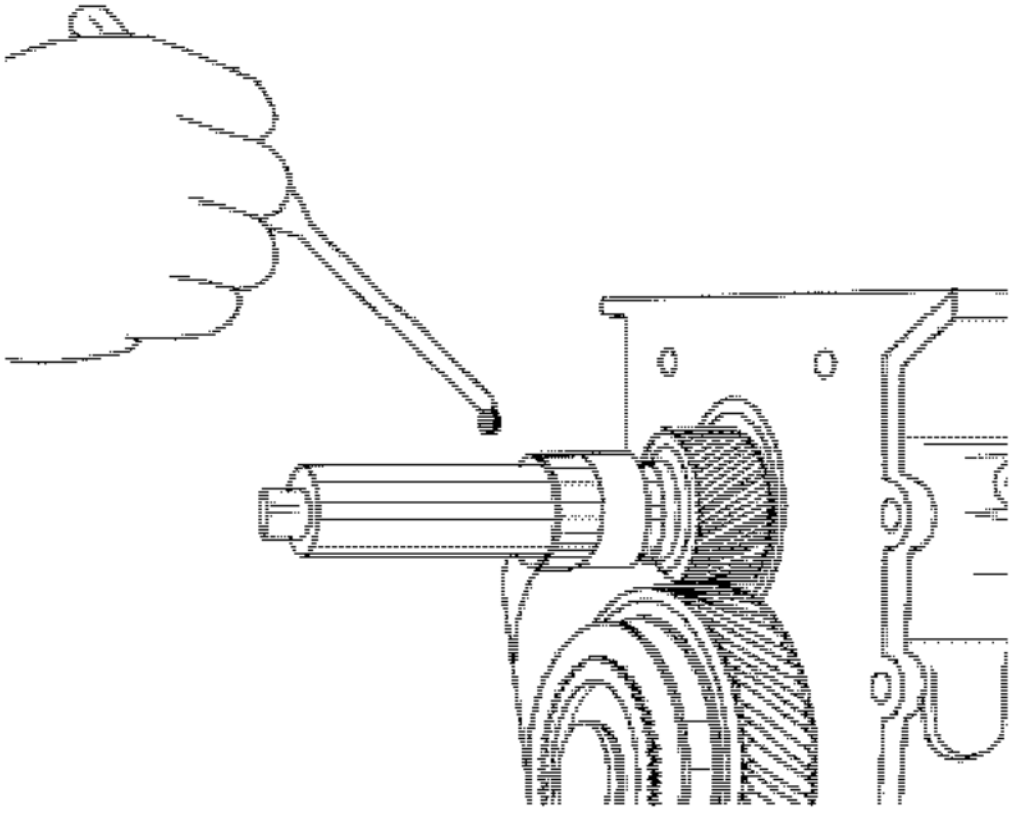


Fig. 116: Speedometer Tracking Balls
Courtesy of GENERAL MOTORS CORP.

8. Using a magnet, remove the pulling sphere out of the speedometer gear.
9. Remove the speedometer gear.

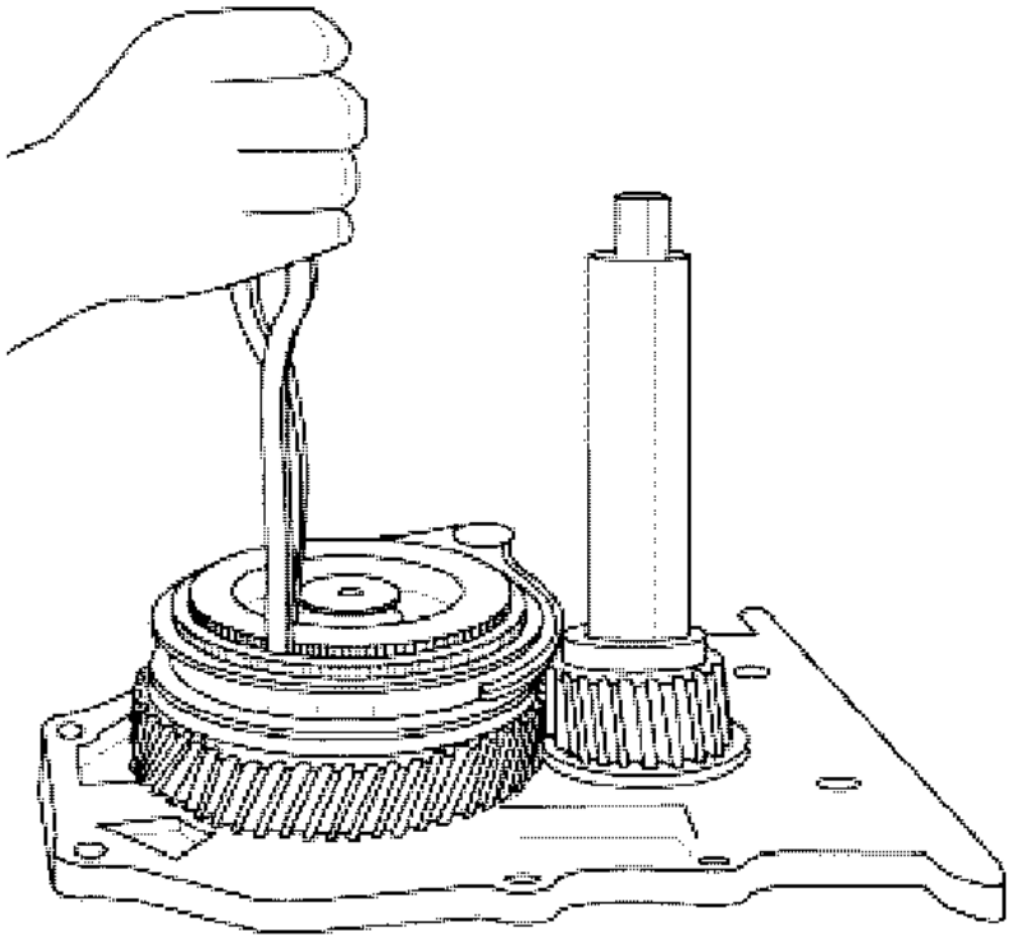


Fig. 117: Snap Ring
Courtesy of GENERAL MOTORS CORP.

10. Place the transmission over 2 pieces of wood.
11. Using locking pliers, remove the snap ring from the 5th gear bearing.

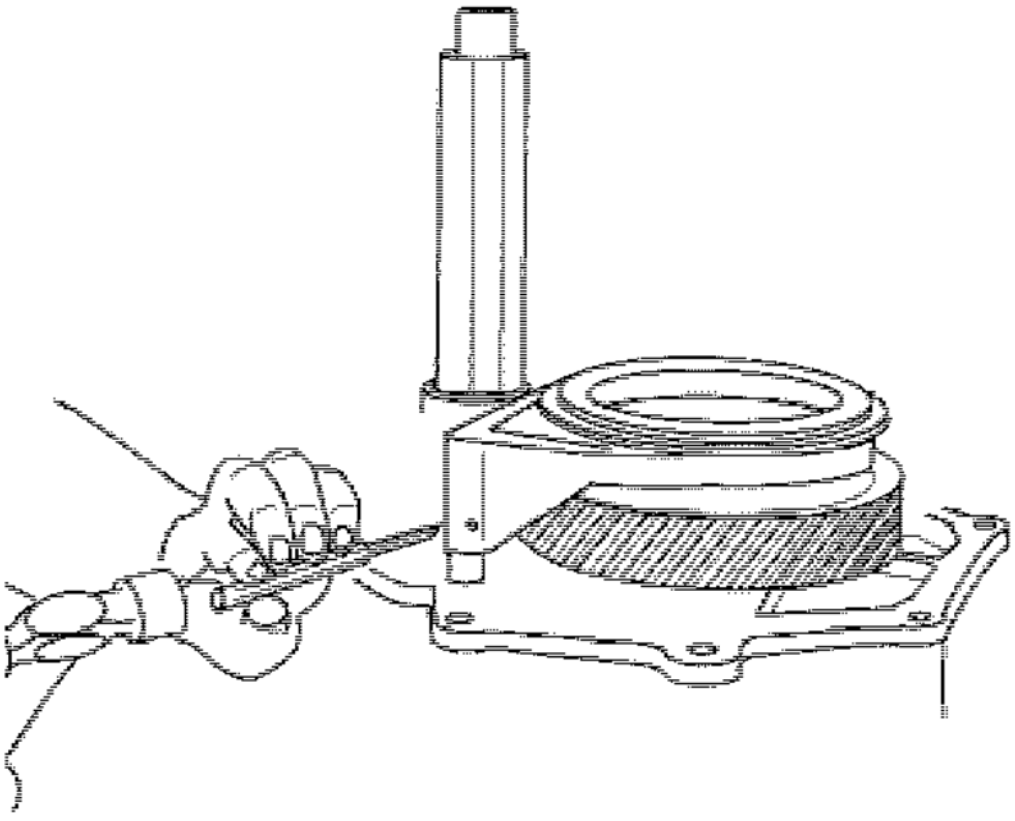


Fig. 118: Removing Roll Pin And 5th Gear Fork
Courtesy of GENERAL MOTORS CORP.

12. Using a hammer and punch, remove the roll pin and the 5th gear fork.

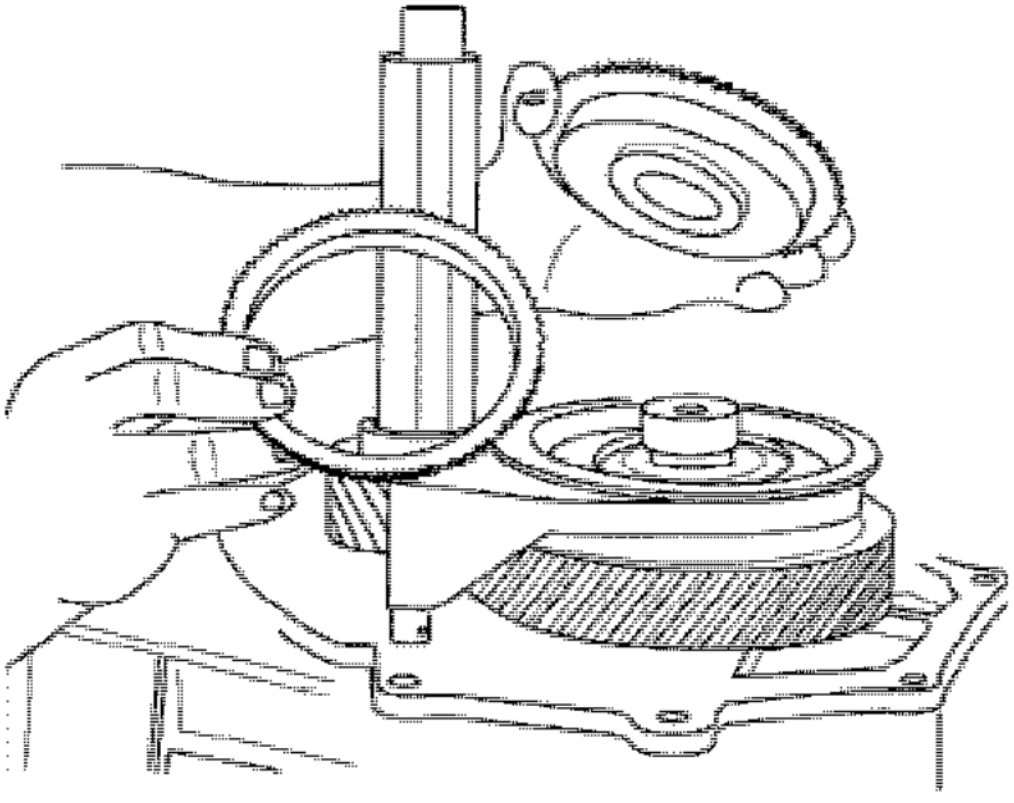


Fig. 119: Synchronizer Ring And 5th Gear
Courtesy of GENERAL MOTORS CORP.

13. Remove the taper and the synchronization ring from the 5th gear.

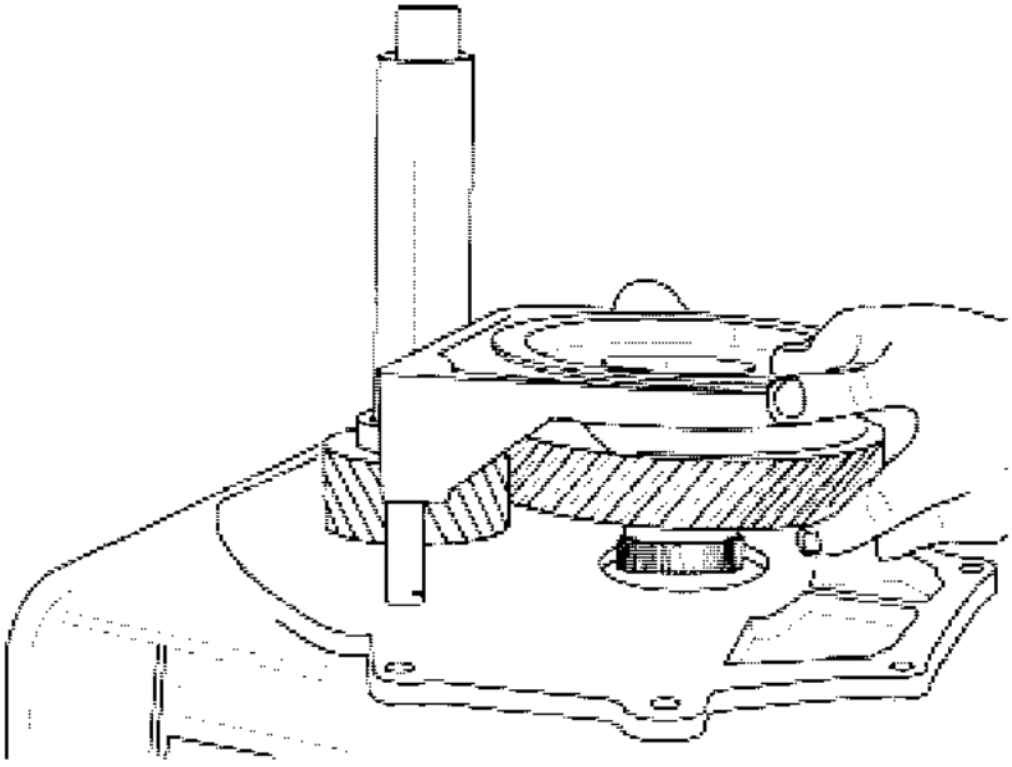


Fig. 120: 5th Gear Synchronizer And Fork
Courtesy of GENERAL MOTORS CORP.

14. Remove the 5th gear synchronizer assembly with the fork.

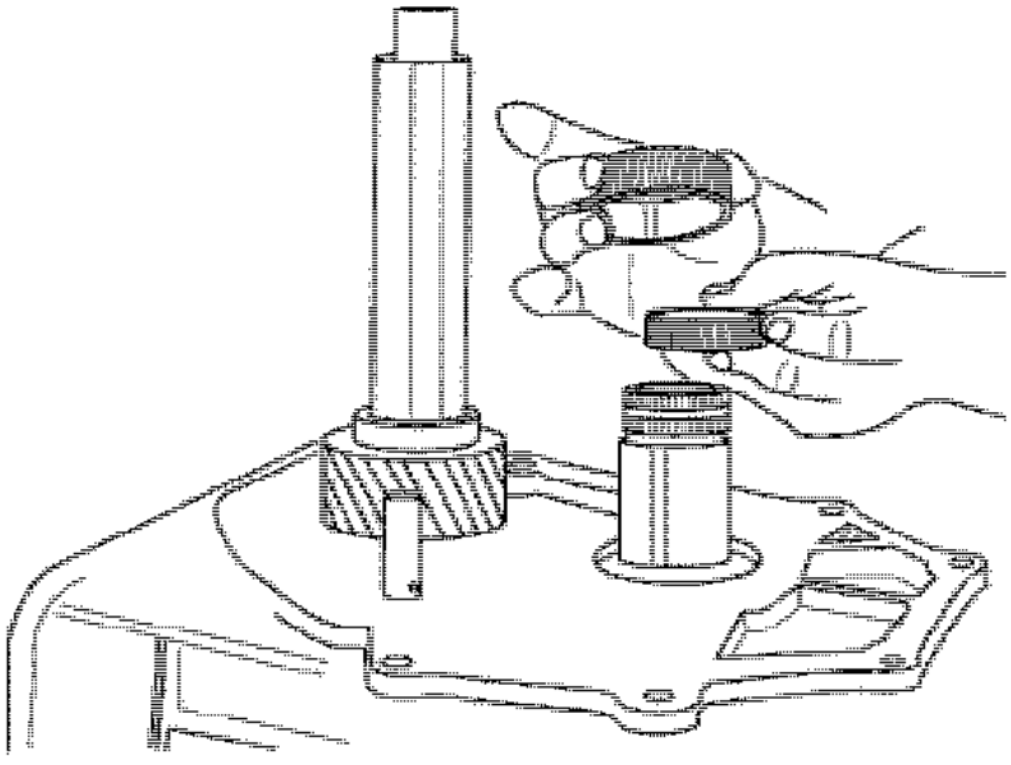


Fig. 121: Roller Bearings And Spacer
Courtesy of GENERAL MOTORS CORP.

15. Remove the 2 roller bearings and spacer.

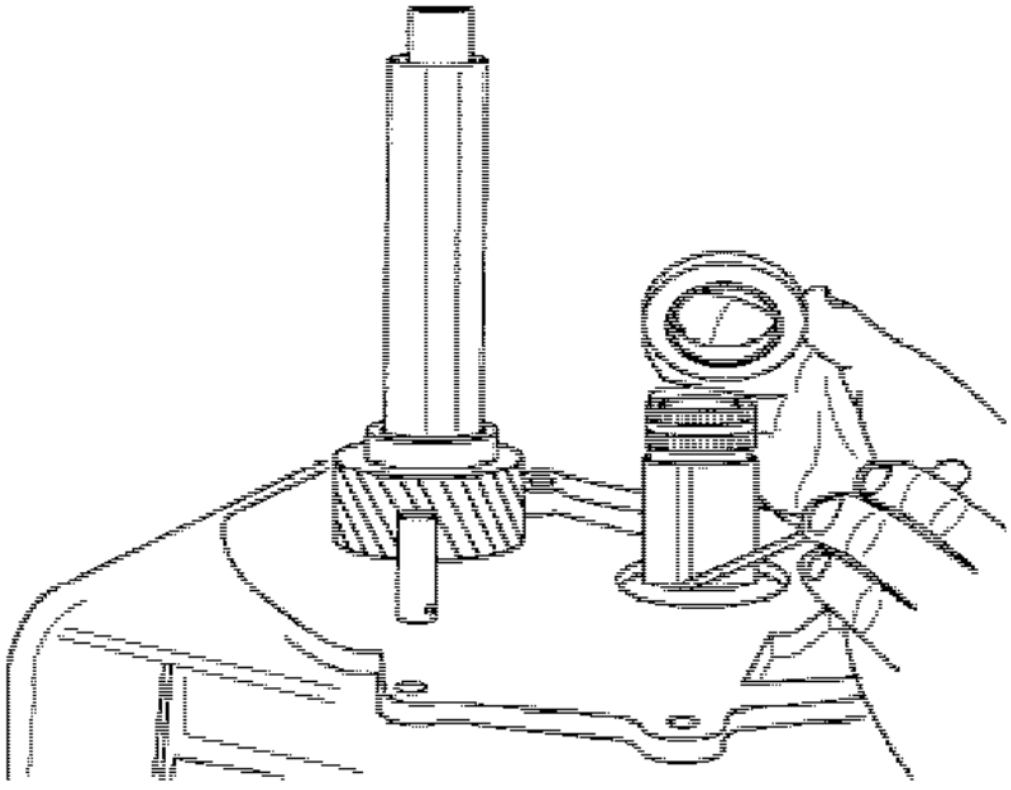


Fig. 122: Washer
Courtesy of GENERAL MOTORS CORP.

16. Remove the push pulley.

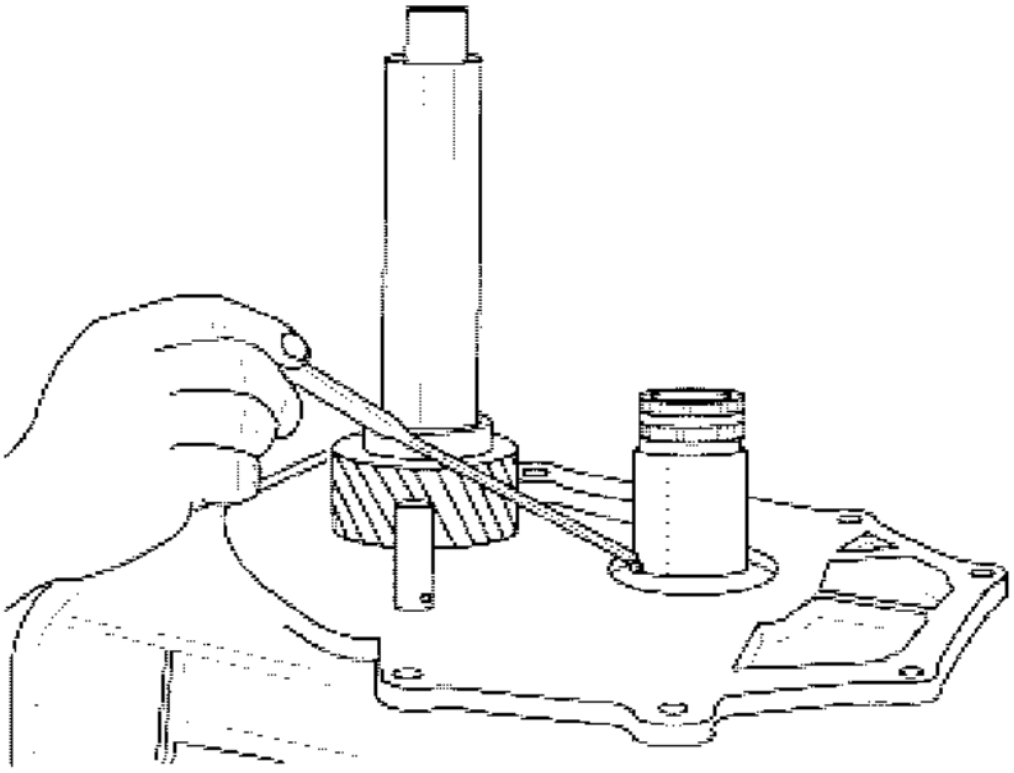


Fig. 123: Removing Pulley Sphere
Courtesy of GENERAL MOTORS CORP.

17. Using a magnet, remove the pulley sphere.

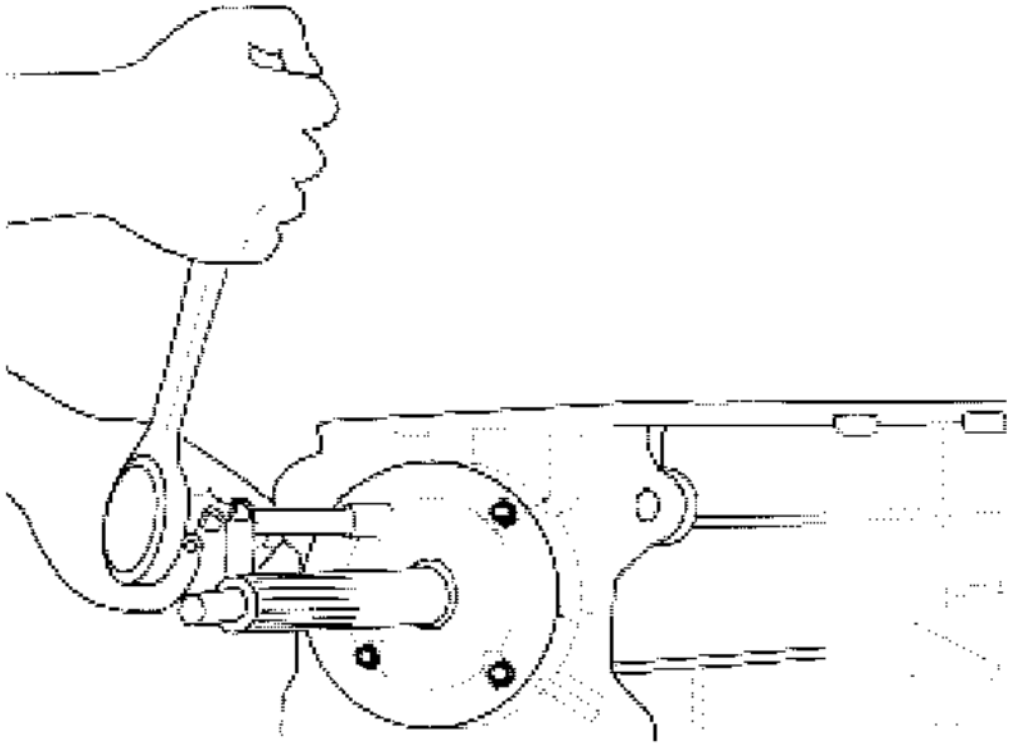


Fig. 124: Bearing Retainer Bolts
Courtesy of GENERAL MOTORS CORP.

18. Remove the 4 screws from the bearing retainer.

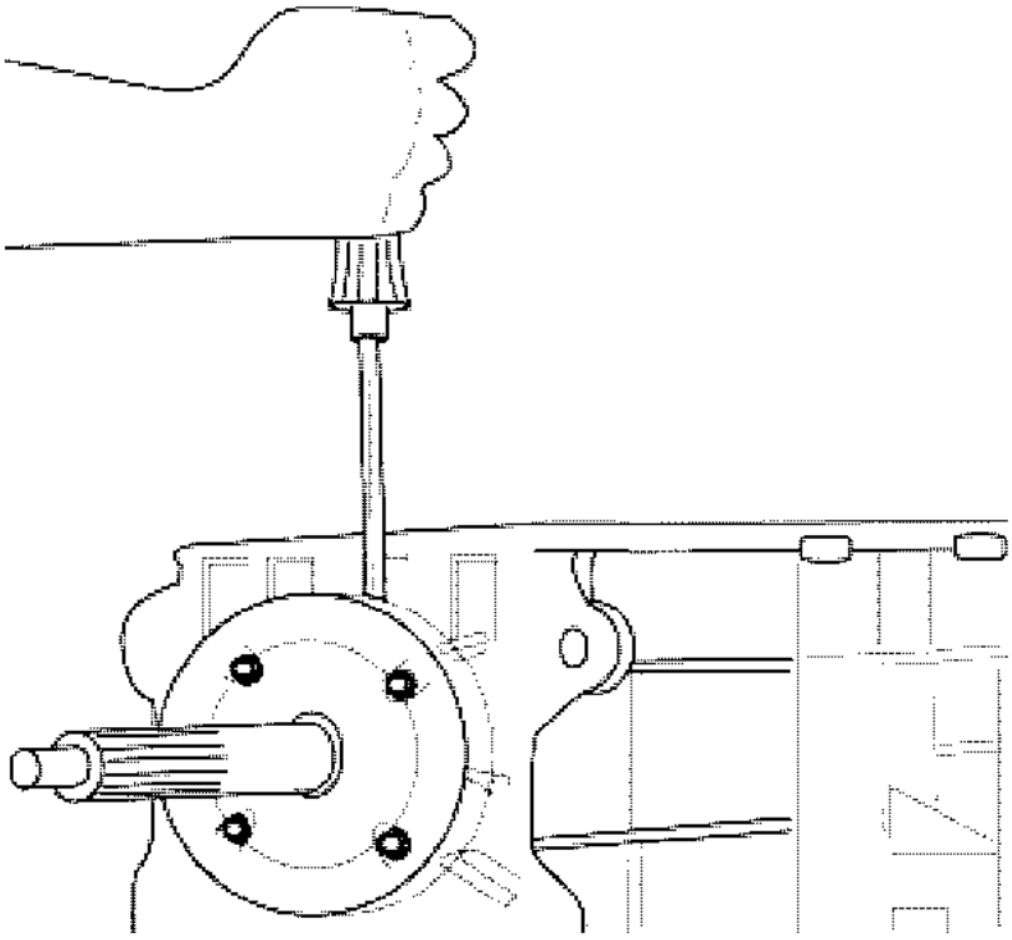


Fig. 125: Removing Retainer
Courtesy of GENERAL MOTORS CORP.

19. Using a screwdriver, carefully remove the retainer.

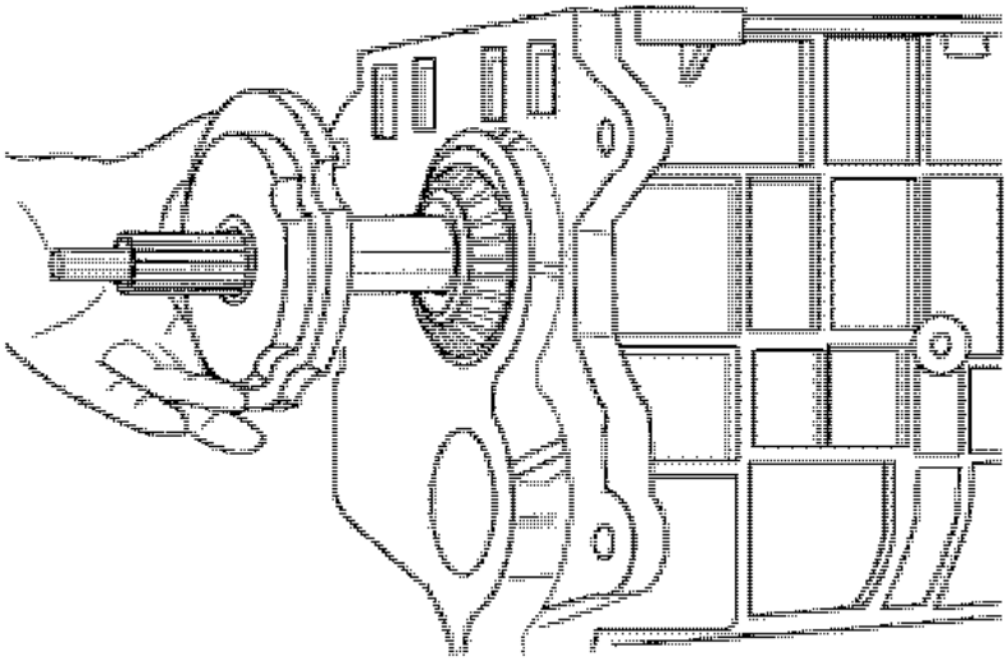


Fig. 126: Bearing Retainer
Courtesy of GENERAL MOTORS CORP.

20. Remove the retainer bearing.

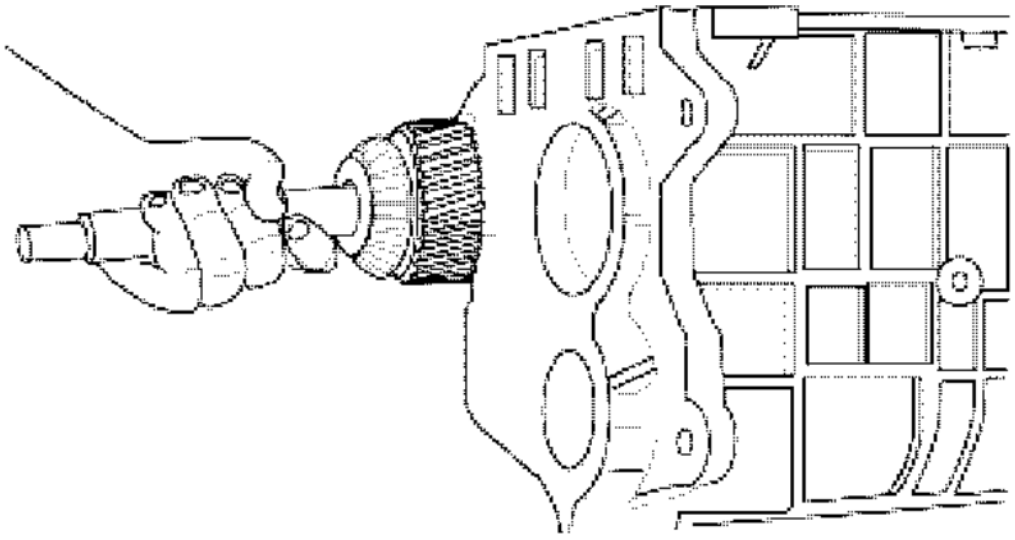


Fig. 127: Drive Shaft
Courtesy of GENERAL MOTORS CORP.

21. Remove the drive shaft.

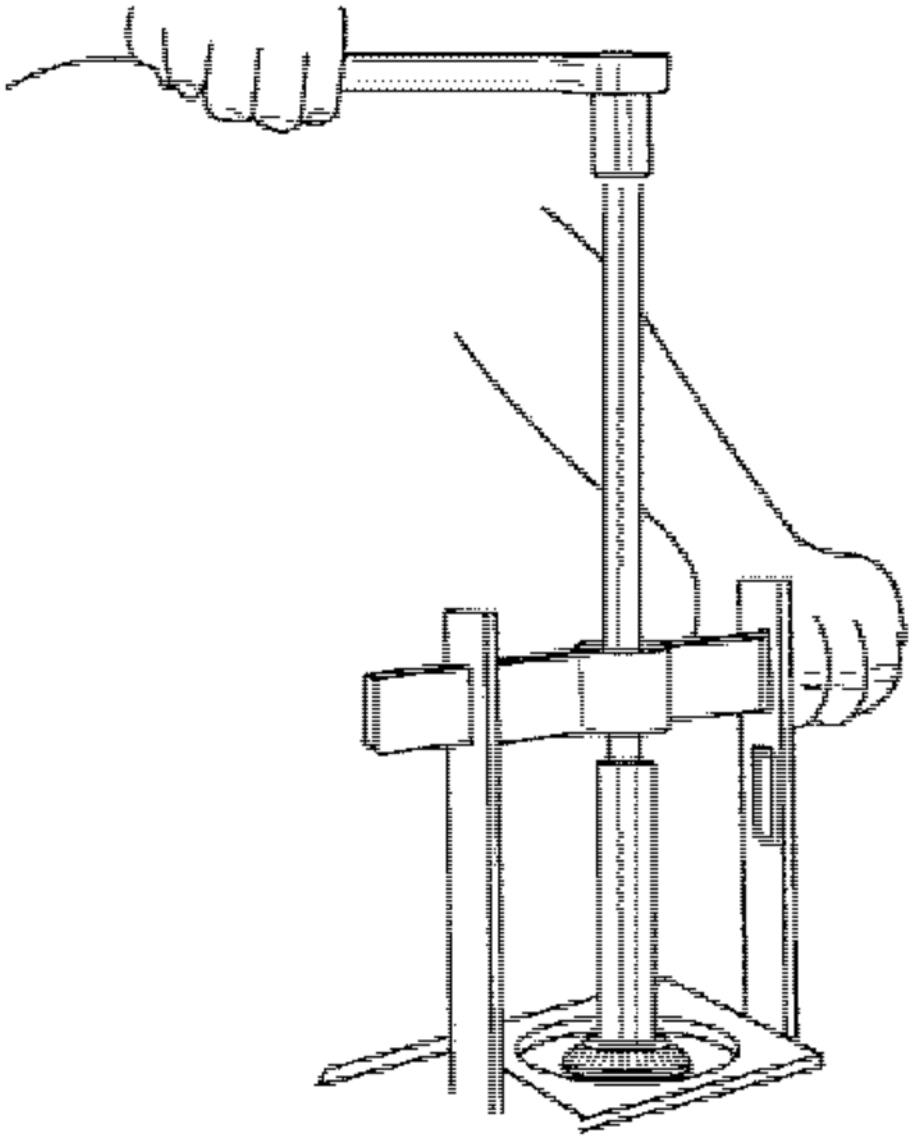


Fig. 128: Removing Bearing From Counter Shaft
Courtesy of GENERAL MOTORS CORP.

22. Using a hydraulic press or a remover, remove the bearing from the counter shaft, when necessary.

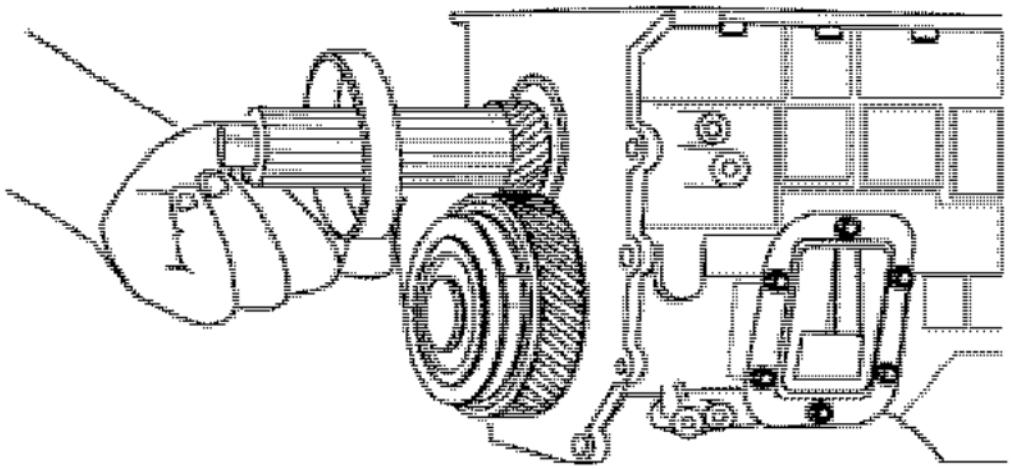


Fig. 129: Tapered Bearing Cup
Courtesy of GENERAL MOTORS CORP.

23. Remove the bearing race from the main shaft.

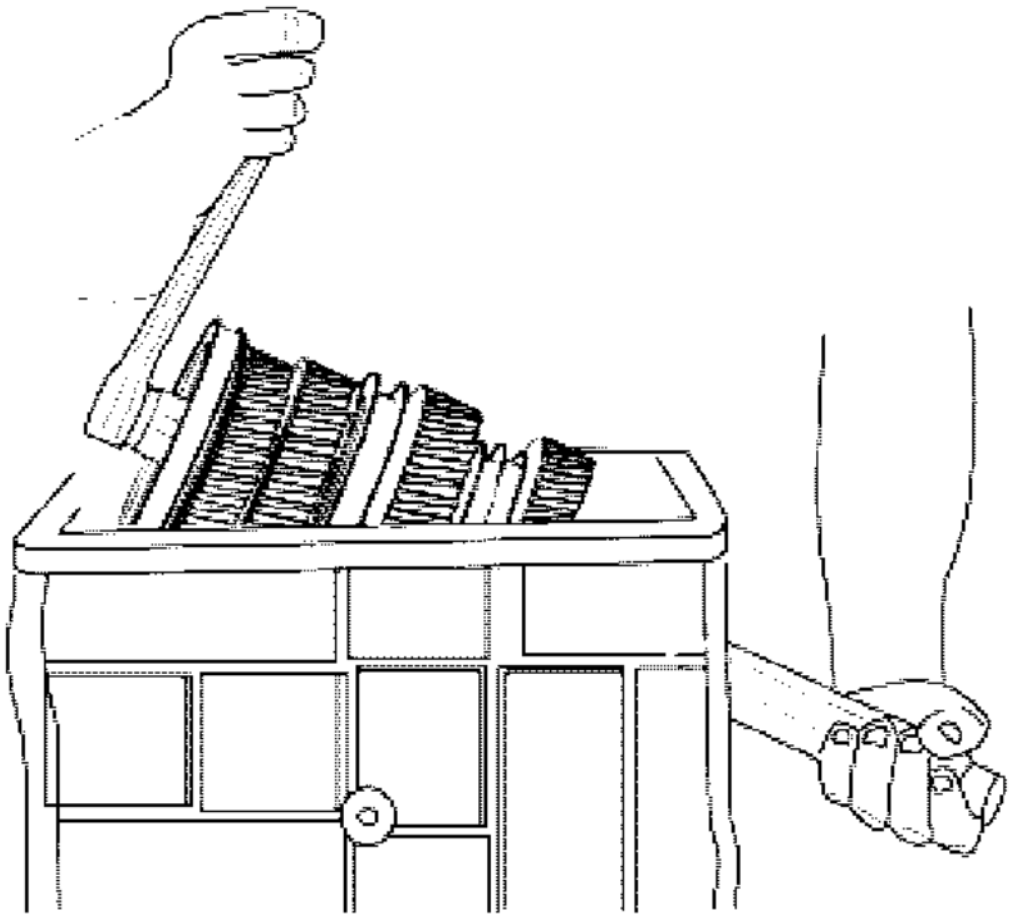


Fig. 130: Main Shaft Assembly
Courtesy of GENERAL MOTORS CORP.

24. In order to remove the main shaft bearing, fasten it to the synchronizer and pull up with one hand and push down with the other hand.

CLUTCH HOUSING DISASSEMBLE

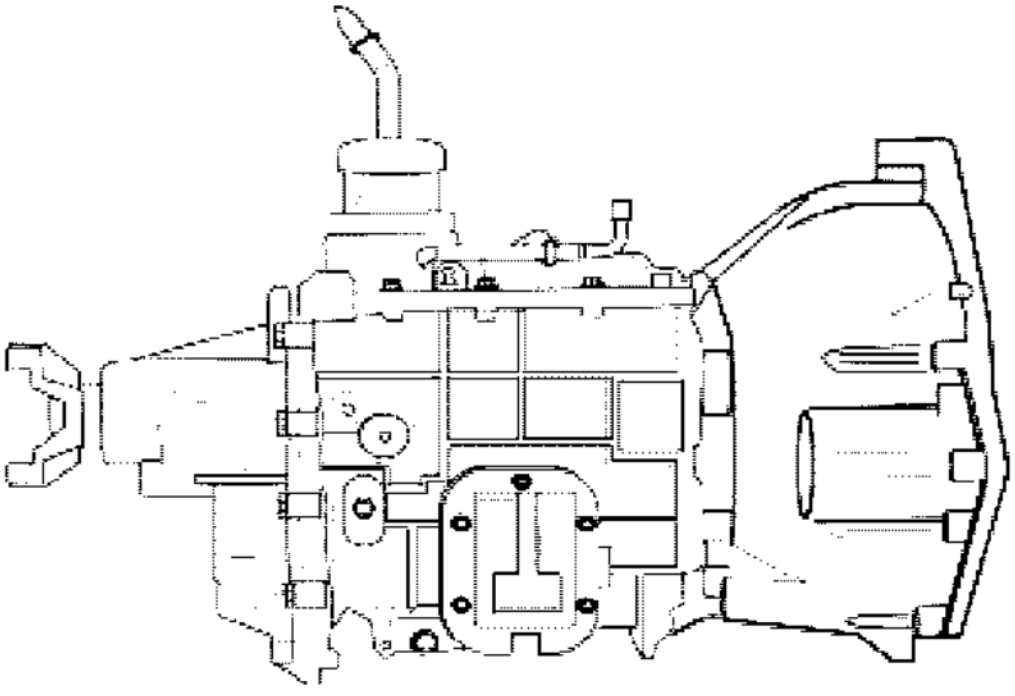


Fig. 131: Transmission
Courtesy of GENERAL MOTORS CORP.

1. Only some applications require the removal of the clutch housing.

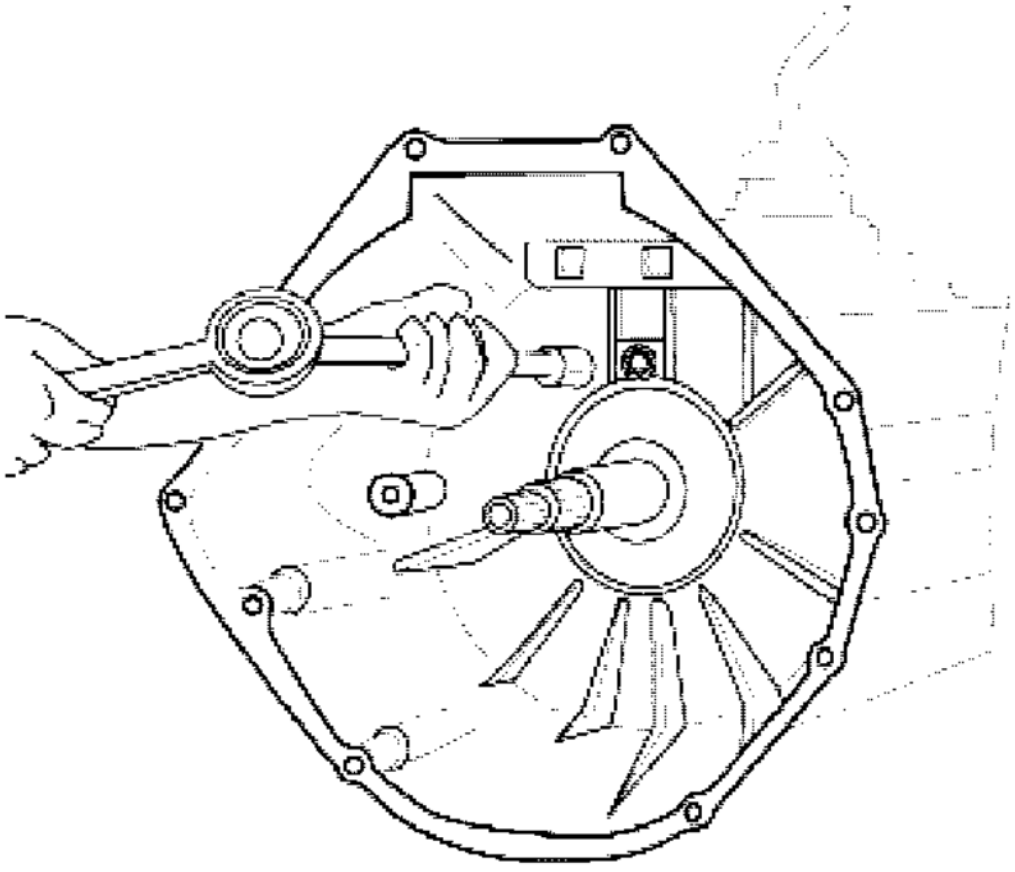


Fig. 132: Interior Clutch Housing Nuts
Courtesy of GENERAL MOTORS CORP.

2. Remove the 2 interior clutch housing nuts.

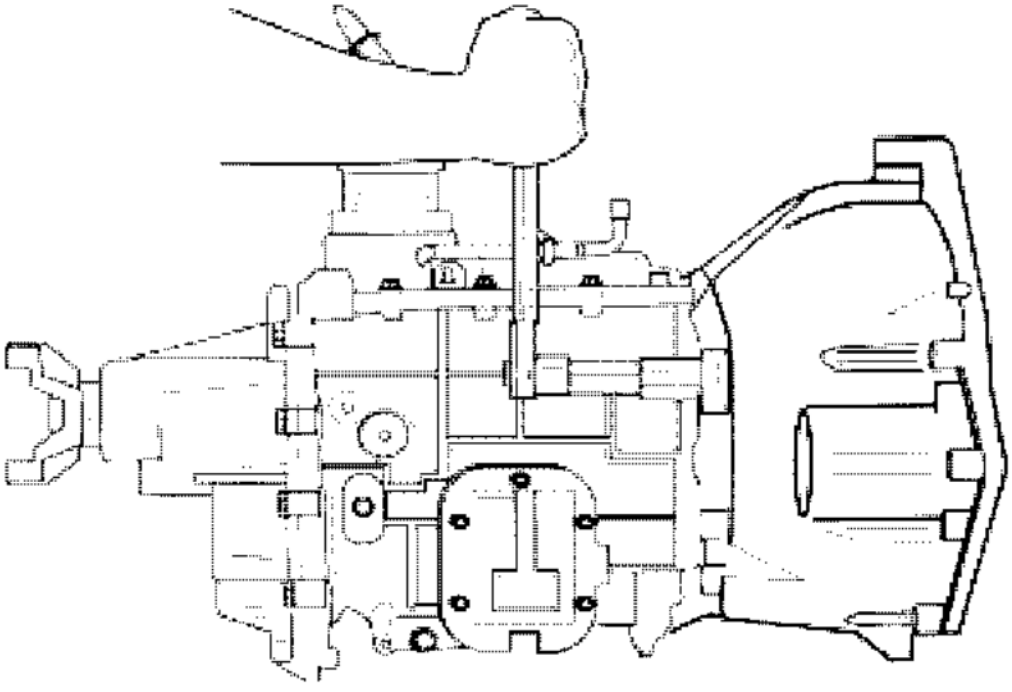


Fig. 133: Clutch Housing Screws
Courtesy of GENERAL MOTORS CORP.

3. Remove the 4 clutch housing screws.

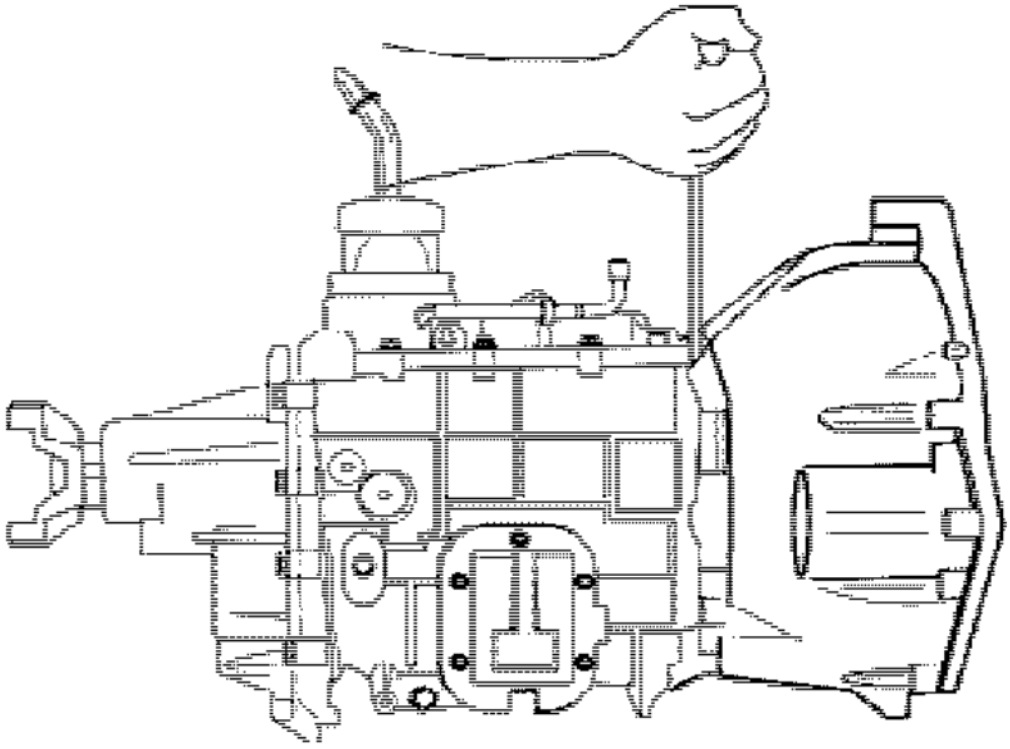


Fig. 134: Separating Case From Housing
Courtesy of GENERAL MOTORS CORP.

4. Using a screwdriver, carefully separate the housing from the case.

GEARS AND SHAFTS CLEANING AND INSPECTION

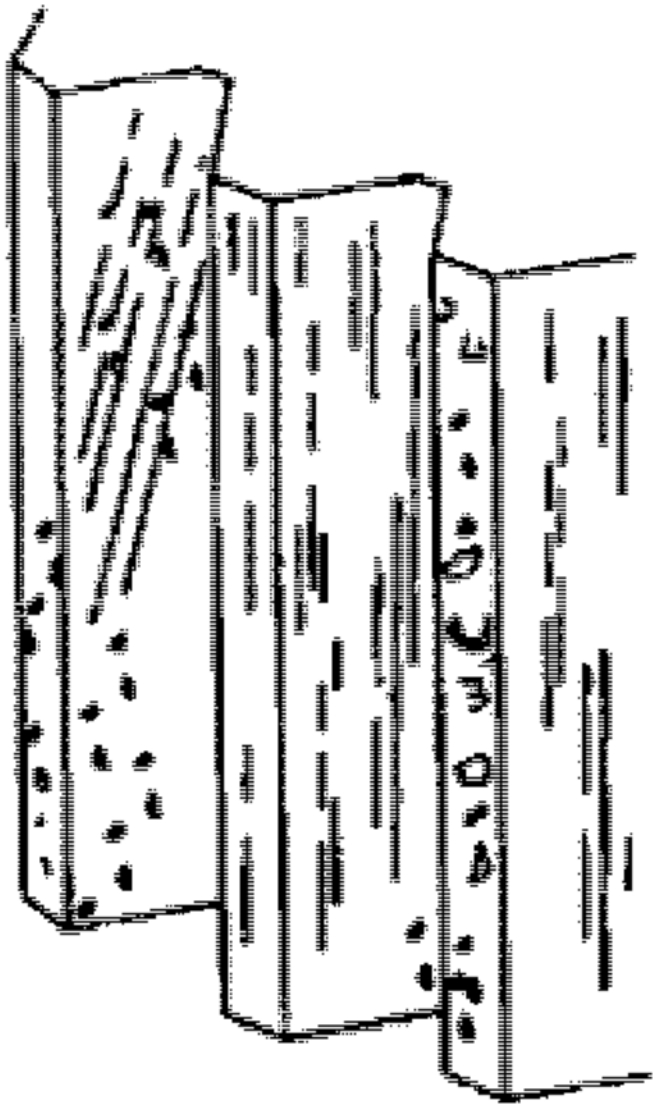


Fig. 135: Inspect Gears For Break-In-Wear - Running-In-Wear
Courtesy of GENERAL MOTORS CORP.

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.

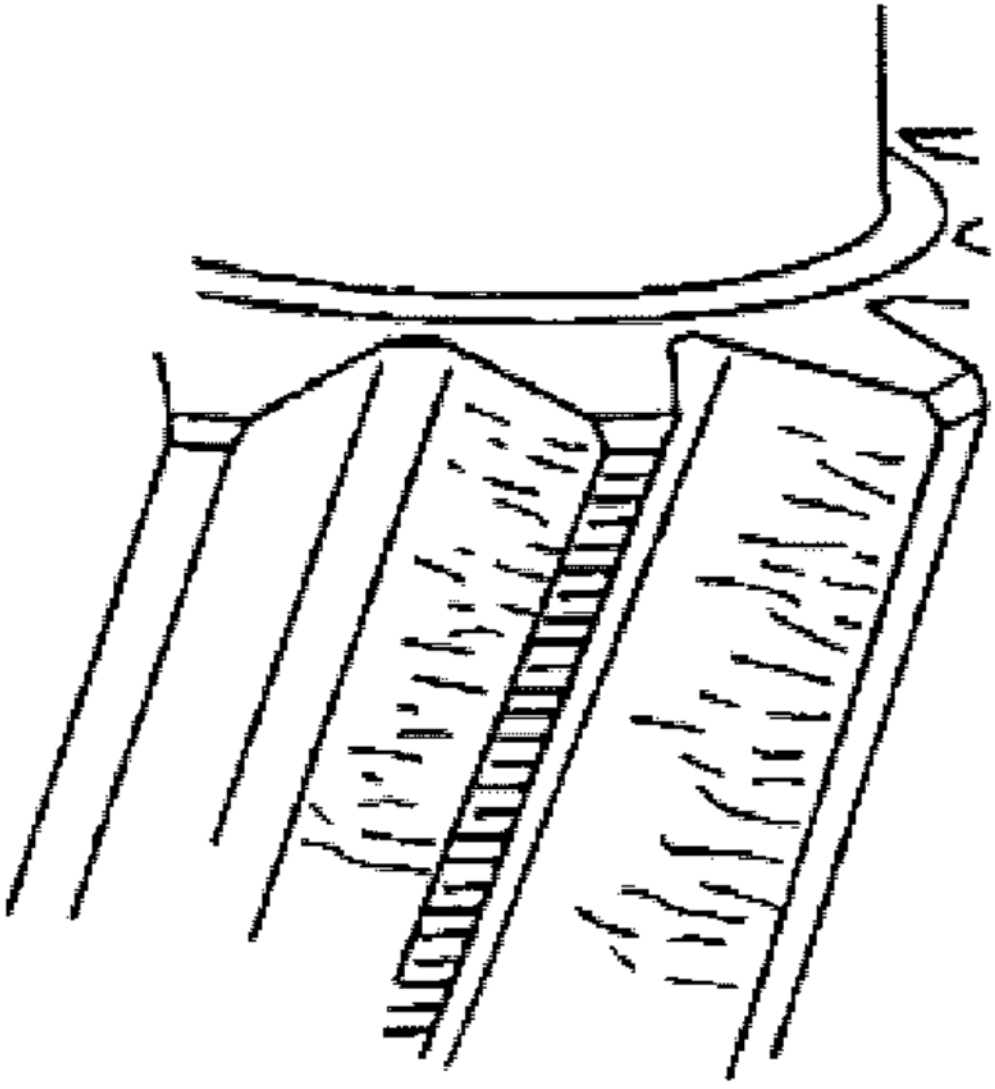


Fig. 136: Inspect Gear Teeth For Scratches
Courtesy of GENERAL MOTORS CORP.

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

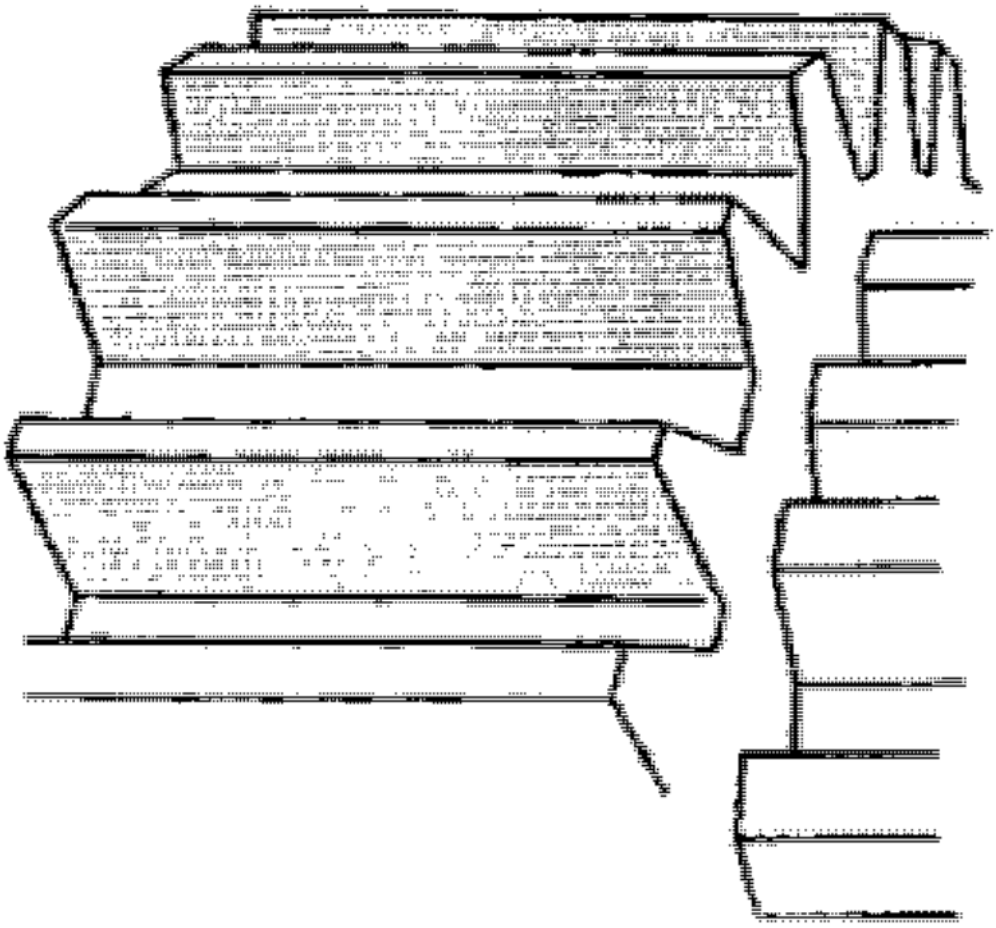


Fig. 137: Inspect Gear Teeth For Abrasive Wear
Courtesy of GENERAL MOTORS CORP.

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

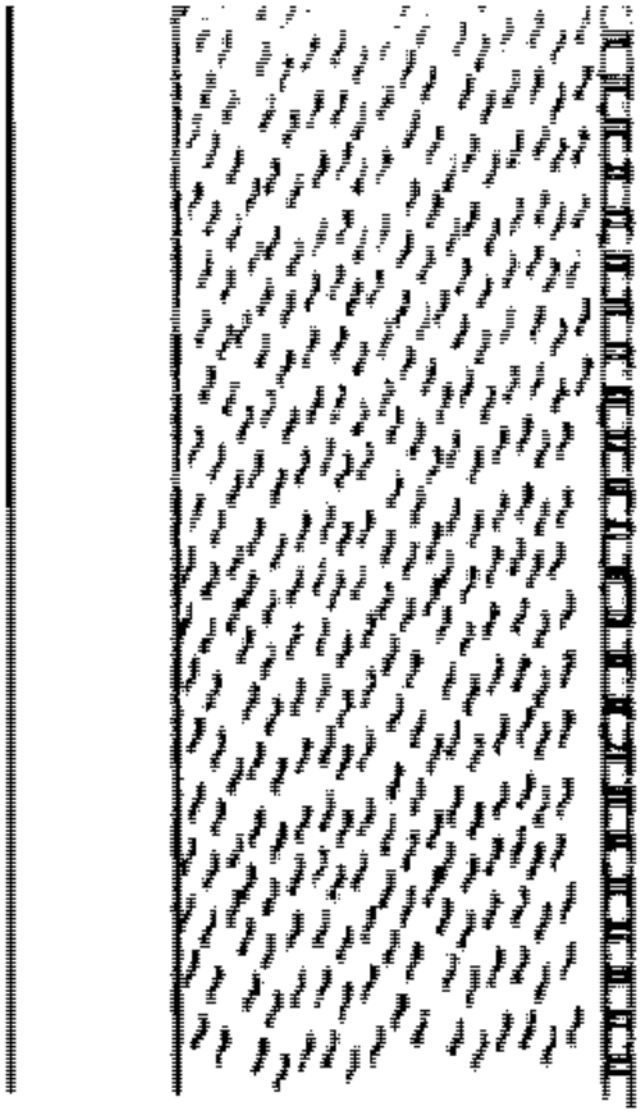


Fig. 138: Inspect Gear Teeth For Rippling Or Brinelling
Courtesy of GENERAL MOTORS CORP.

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

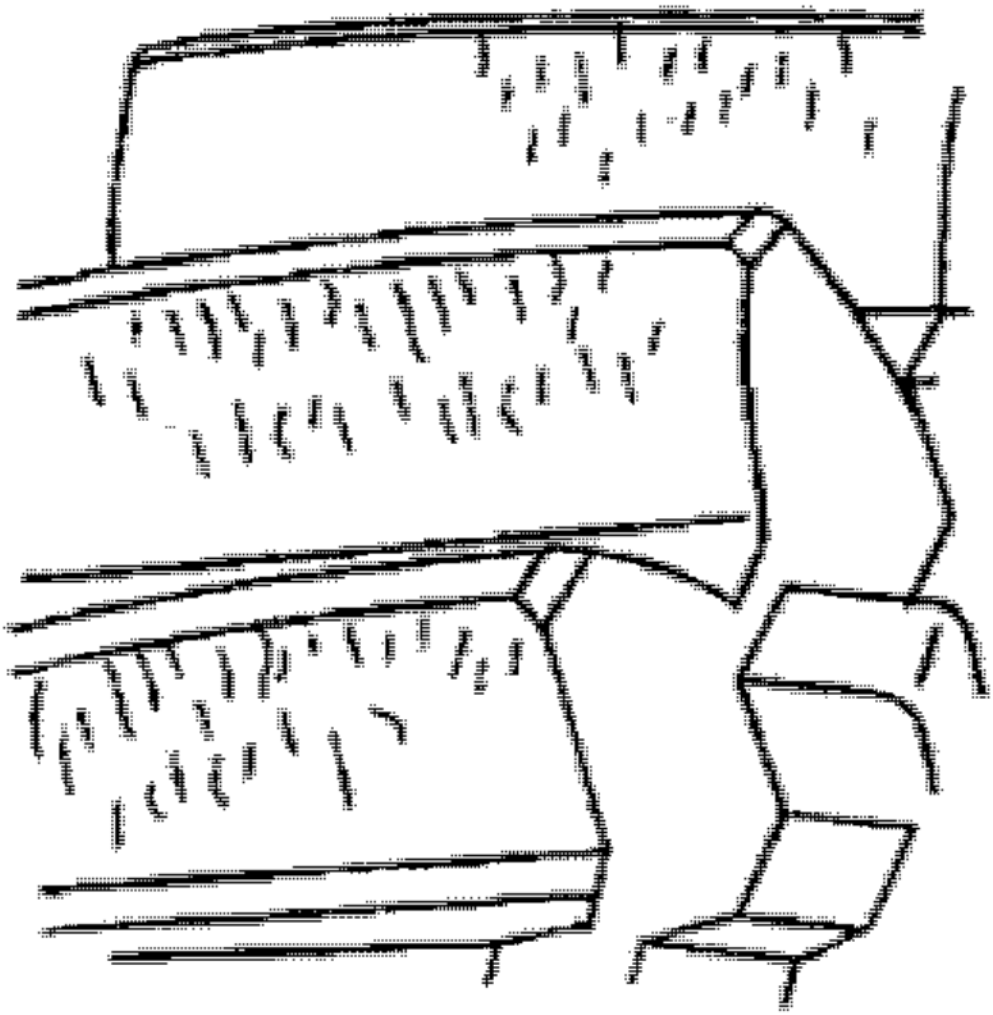


Fig. 139: Inspect Gear Teeth For Light Scoring - Rough Partially Porous Lines Or Areas Aligned In Direction Of Sliding

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

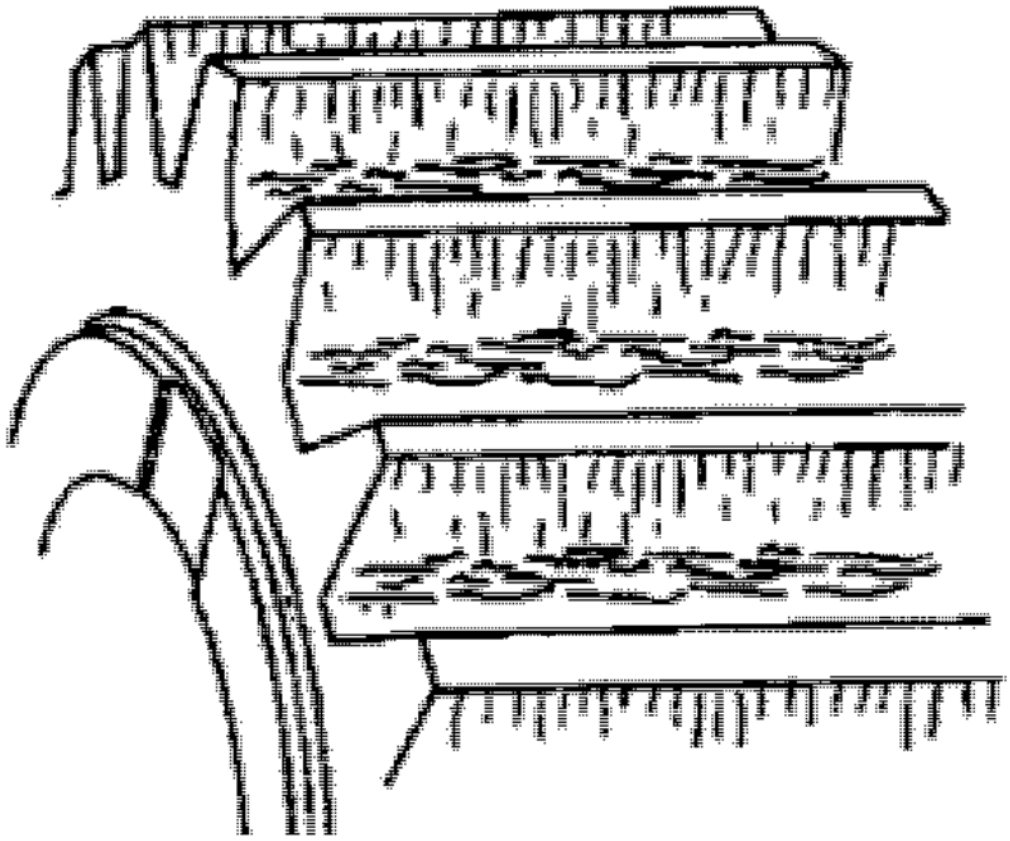


Fig. 140: Inspect Gear Teeth For Severe Scoring
Courtesy of GENERAL MOTORS CORP.

11. Inspect the gear teeth for severe scoring.

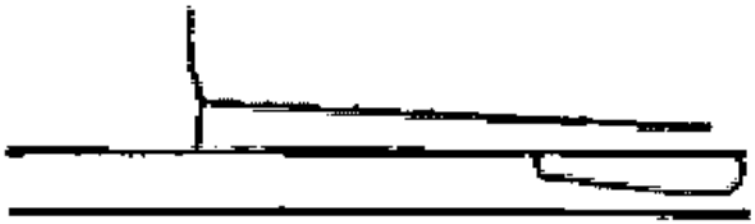
    Severe scoring is the same as light scoring except large areas of the tooth flank are affected. At an advanced stage, the flank may heat up to such an extent that localized discoloring occurs.

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





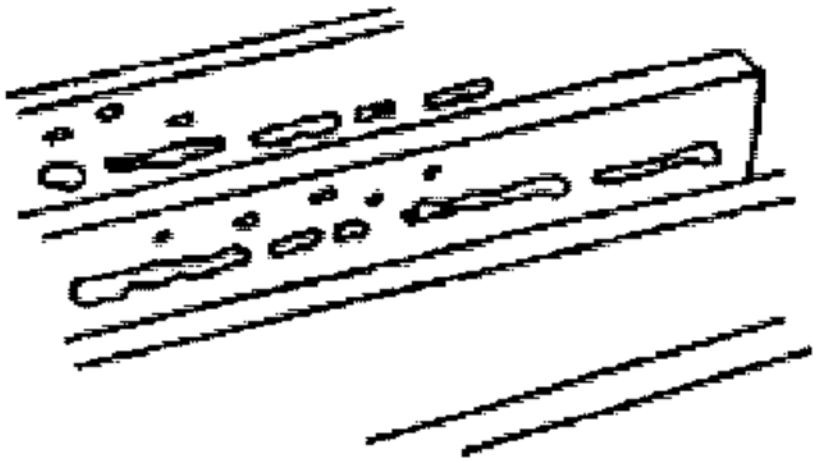


Fig. 141: Inspect Gears For Flank Fatigue Causing Gray Spots
Courtesy of GENERAL MOTORS CORP.

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

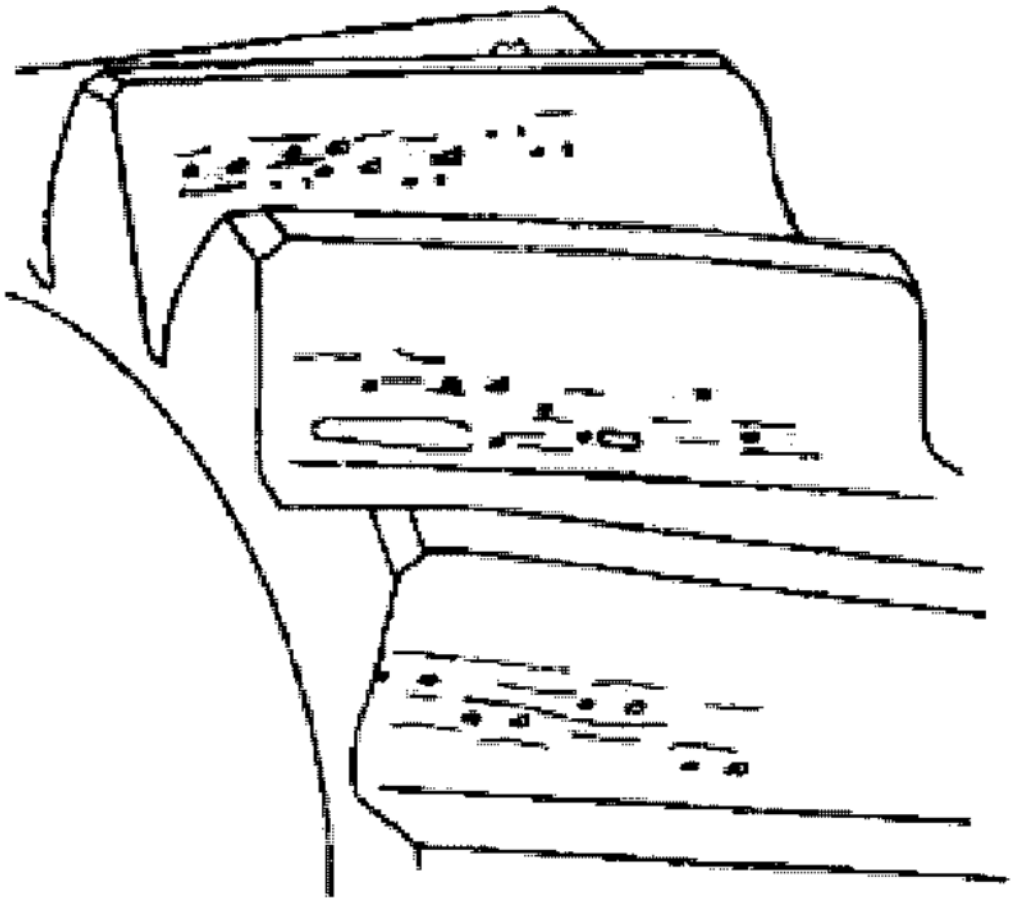


Fig. 142: Inspect Gear Teeth For Slight Pittings
Courtesy of GENERAL MOTORS CORP.

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.

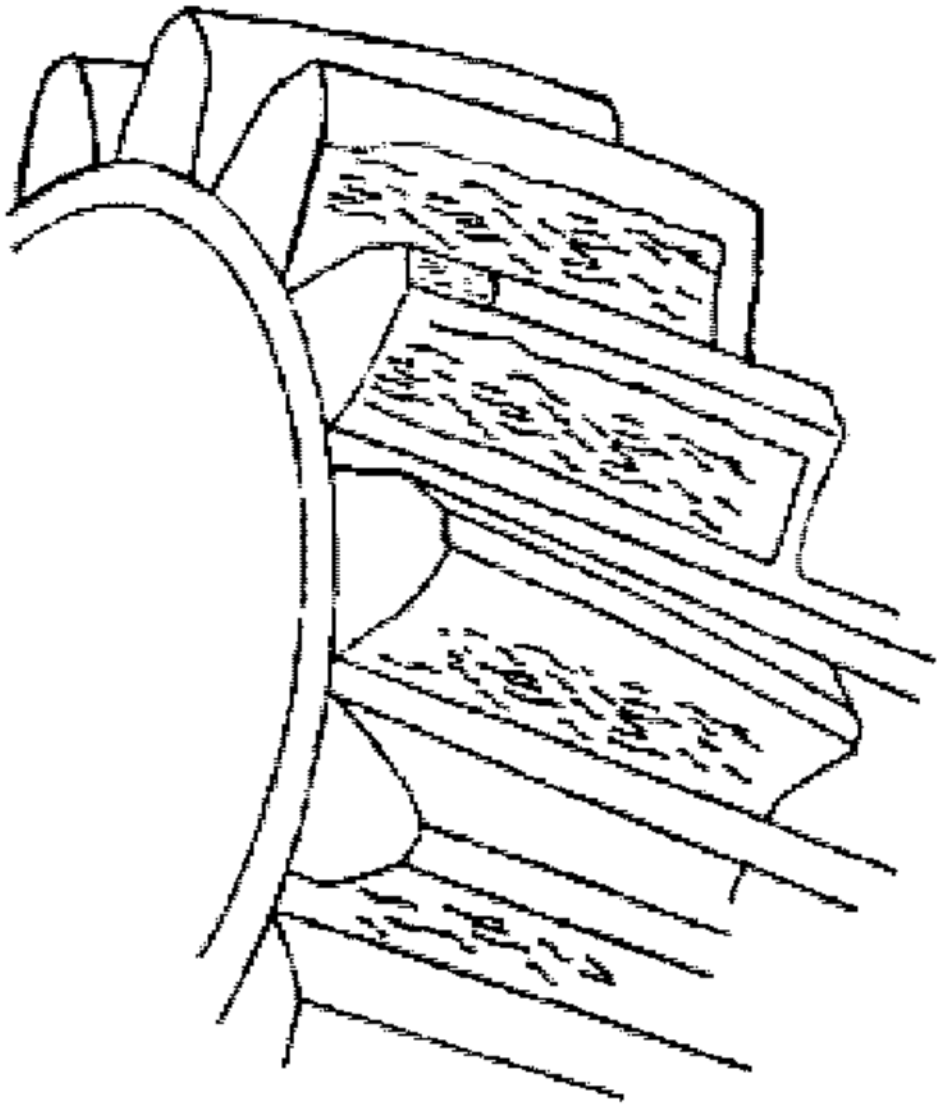


Fig. 143: Inspect Gear Teeth For Pittings
Courtesy of GENERAL MOTORS CORP.

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

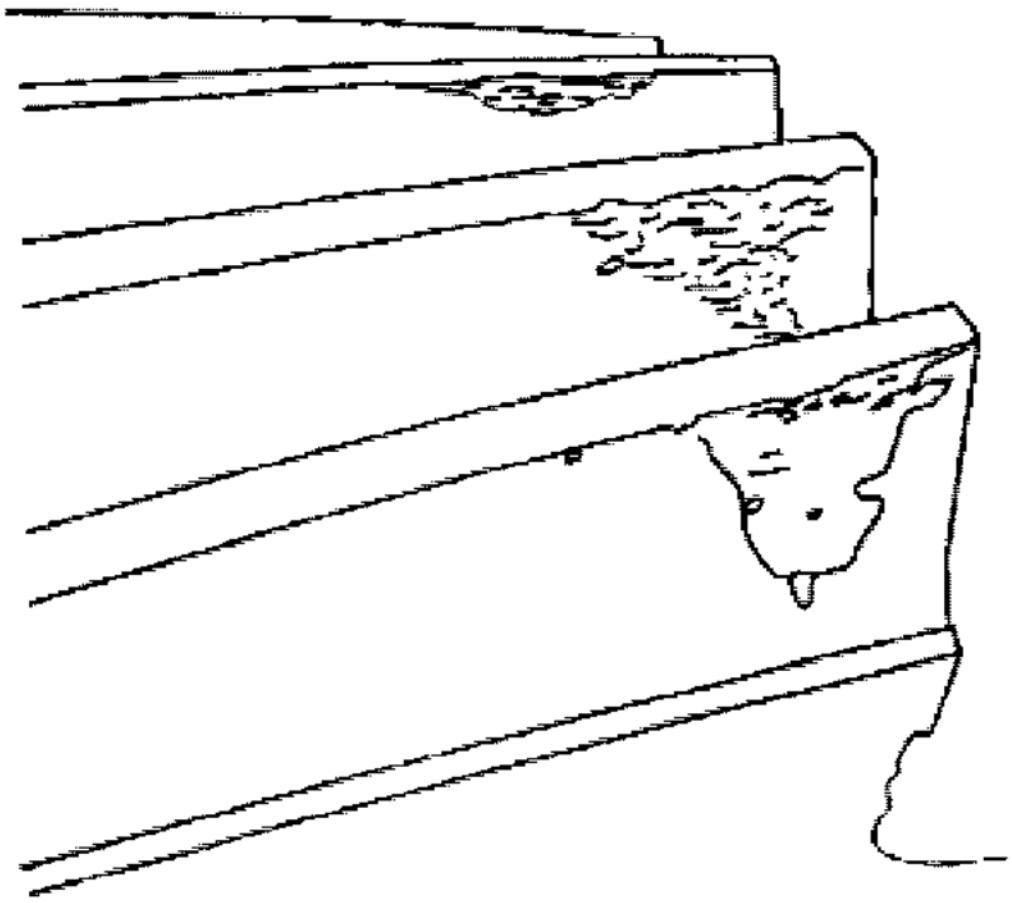


Fig. 144: Inspect Gears For Spalling
Courtesy of GENERAL MOTORS CORP.

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

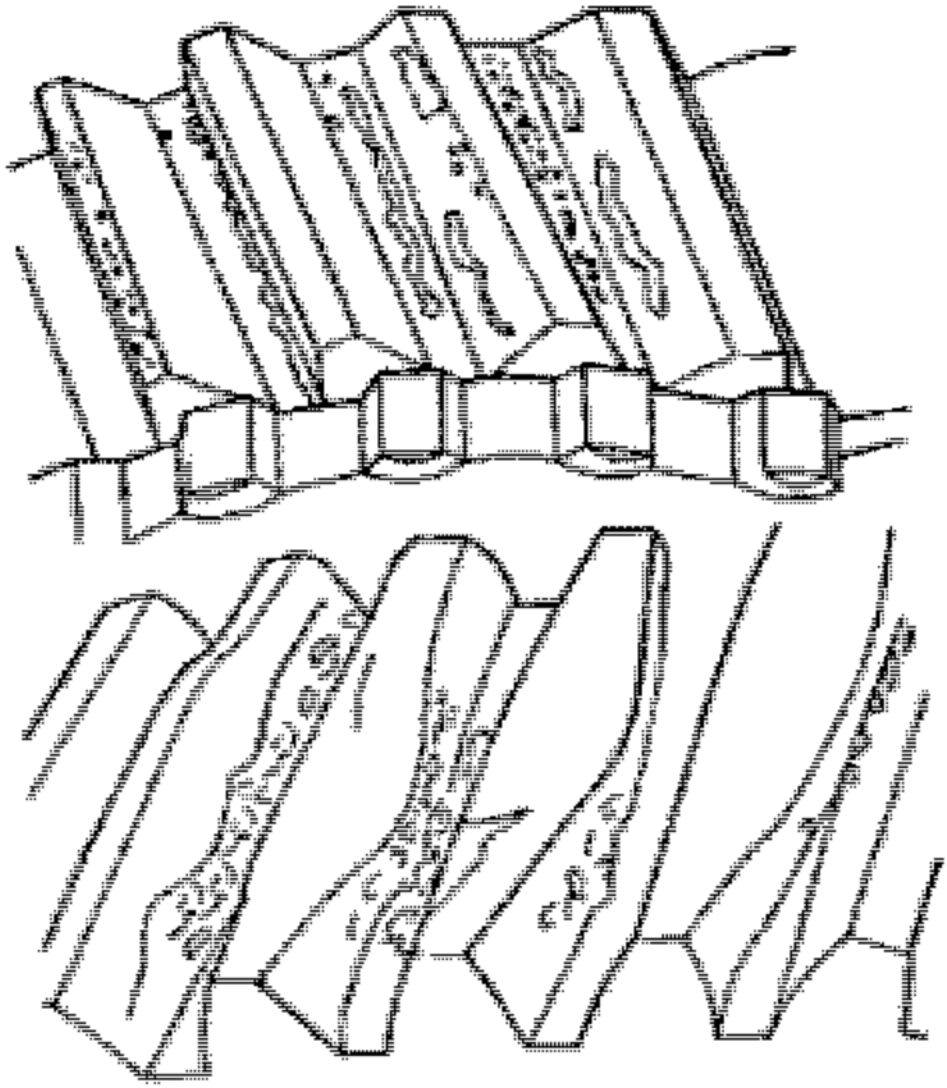


Fig. 145: Inspect Gears For Overheating
Courtesy of GENERAL MOTORS CORP.

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

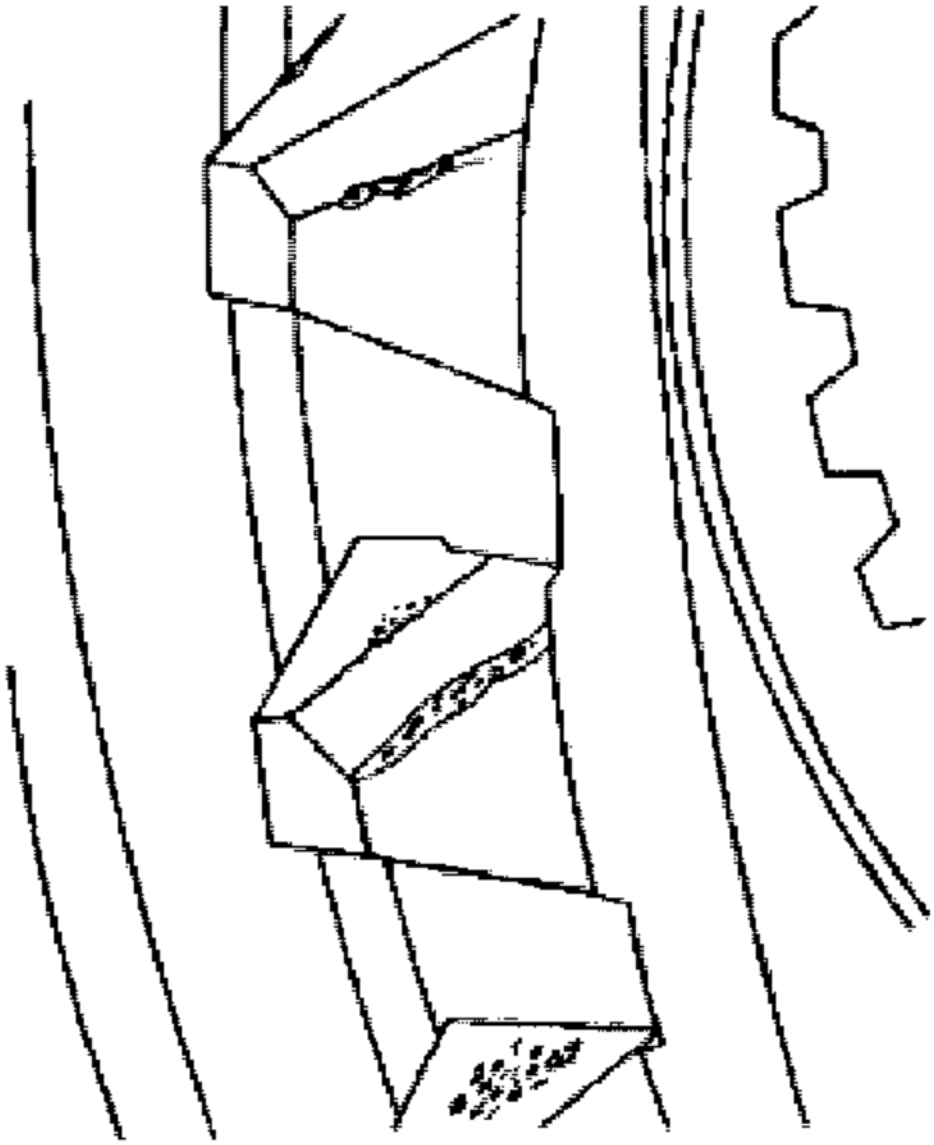


Fig. 146: Inspect Selector Teeth Of Gears For Gear Change Damage
Courtesy of GENERAL MOTORS CORP.

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

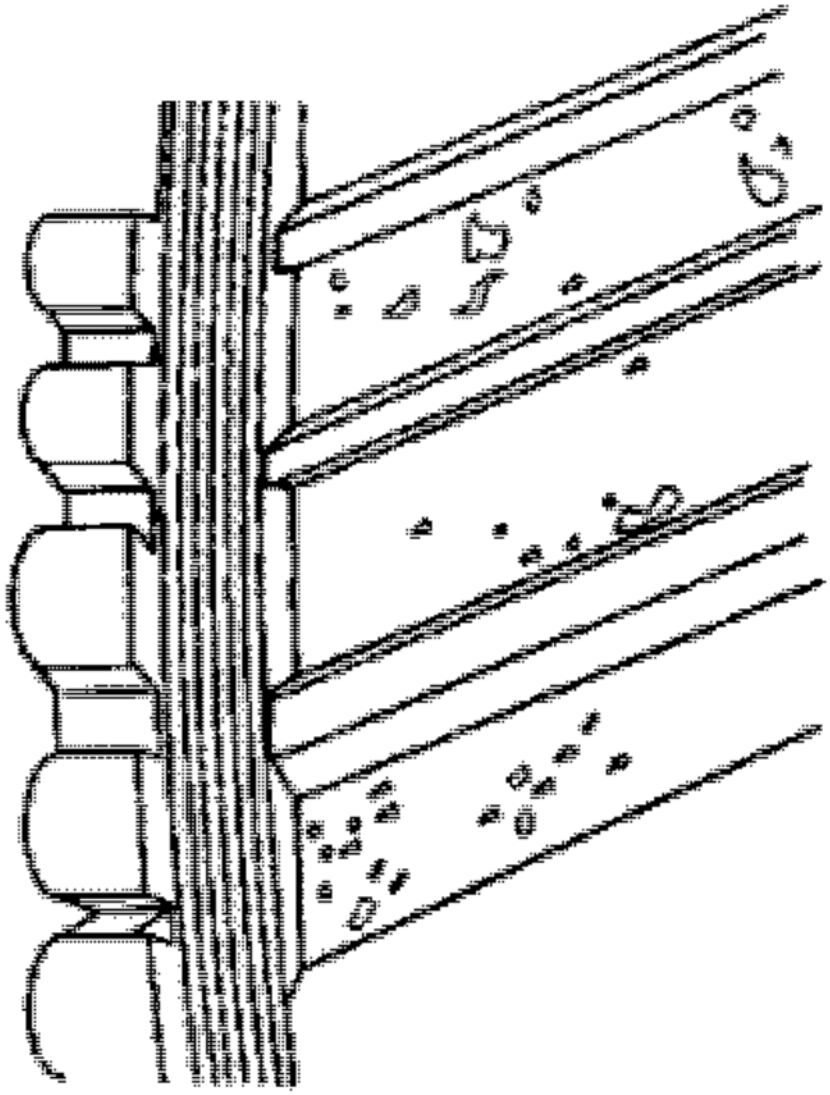


Fig. 147: Inspect Gears For Corrosion
Courtesy of GENERAL MOTORS CORP.

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

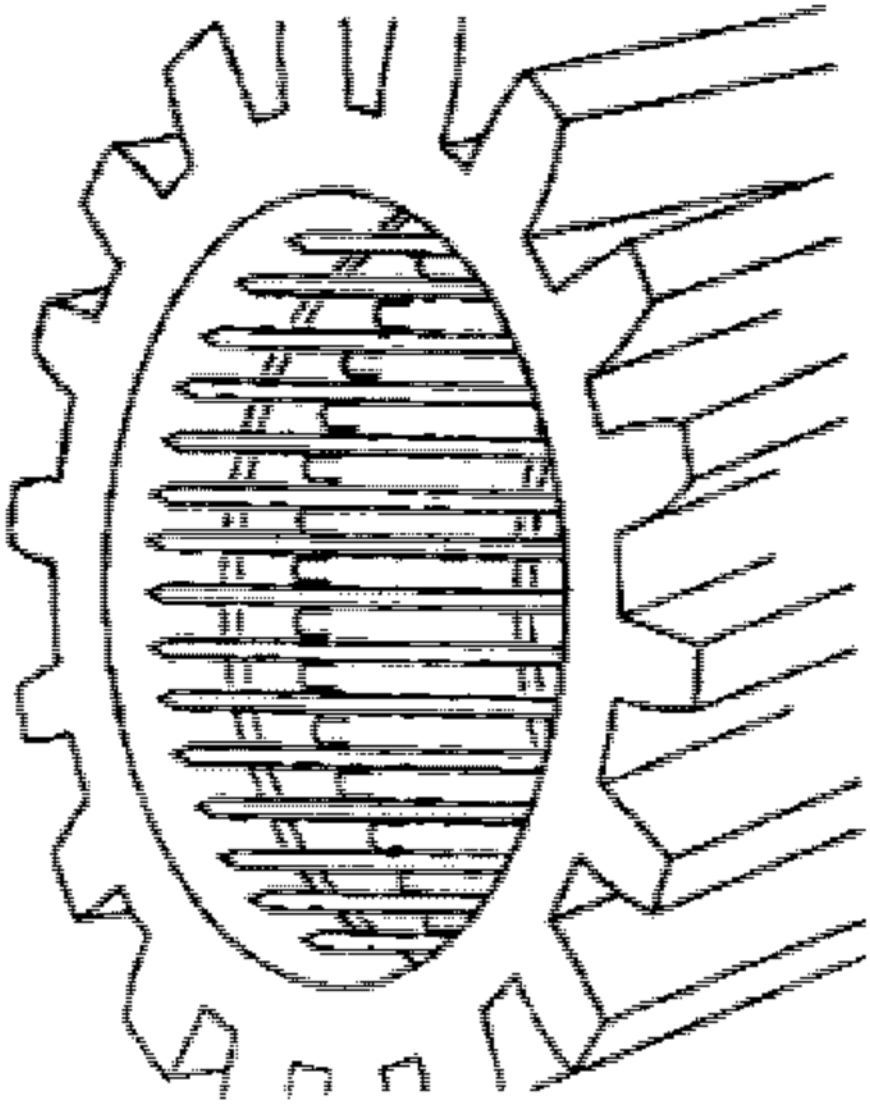


Fig. 148: Inspect Reverse Idler Gear For Brinelling
Courtesy of GENERAL MOTORS CORP.

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.

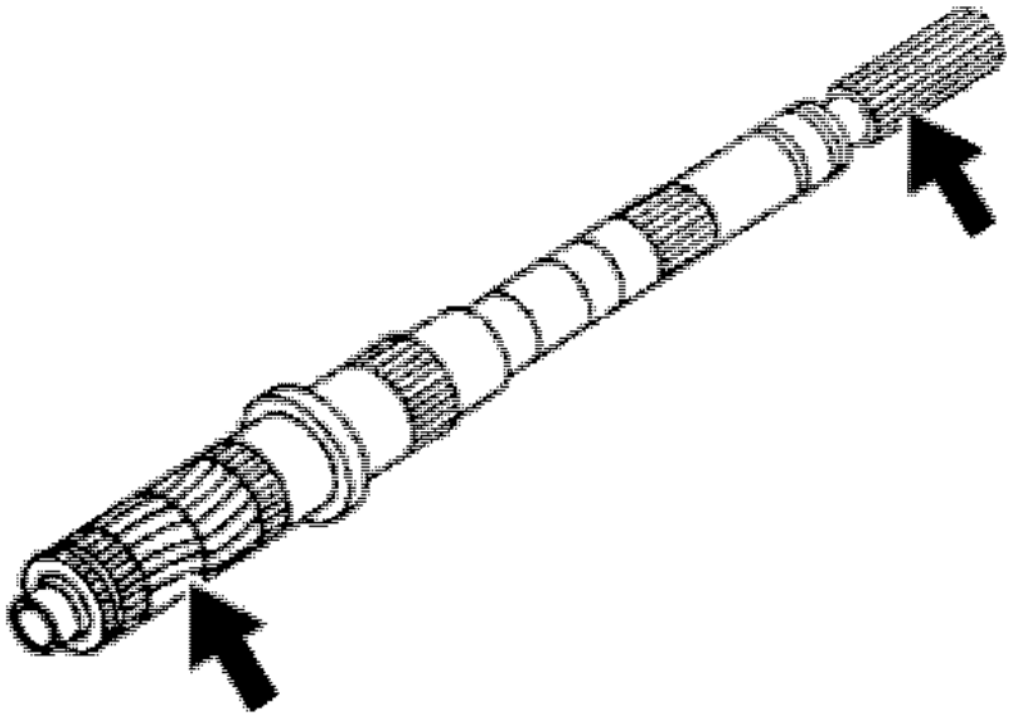


Fig. 149: Inspect Mainshaft Bearing Surfaces
Courtesy of GENERAL MOTORS CORP.

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

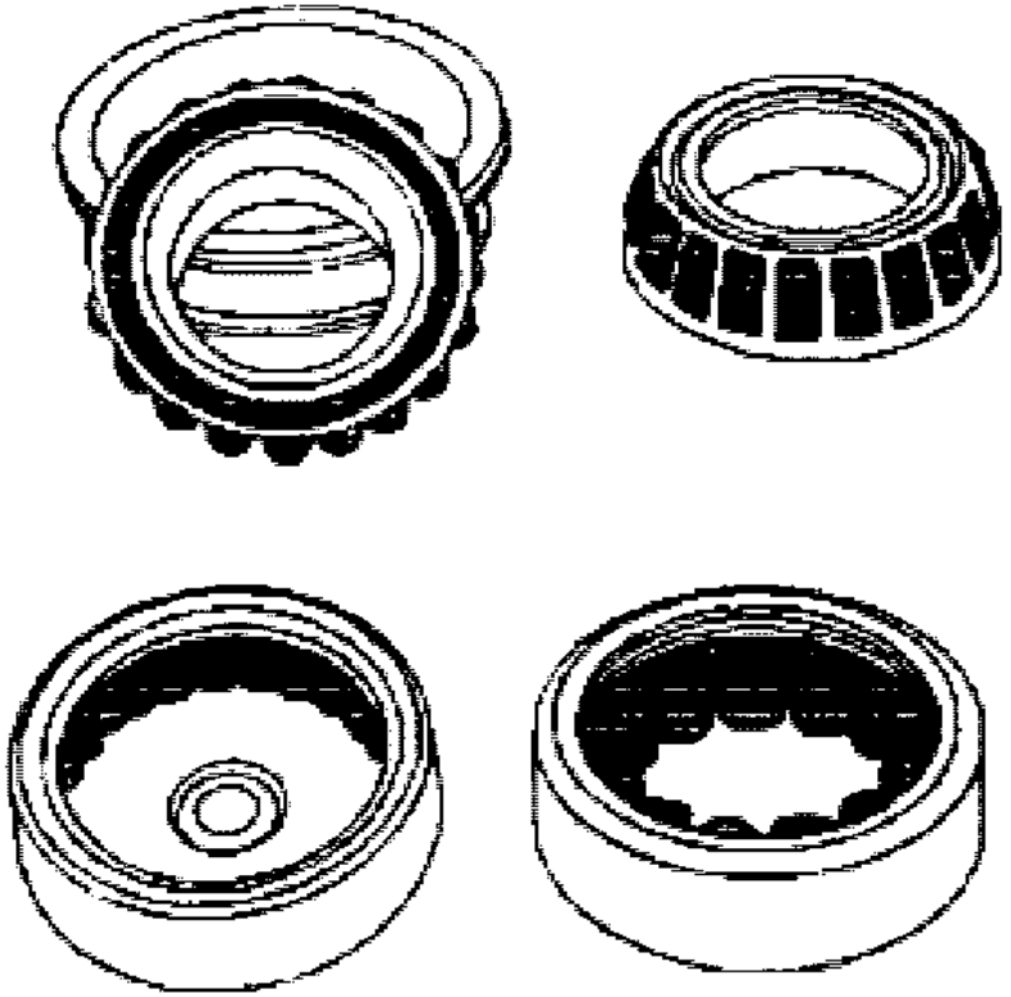


Fig. 150: Bearings
Courtesy of GENERAL MOTORS CORP.

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.

CLUTCH HOUSING ASSEMBLE

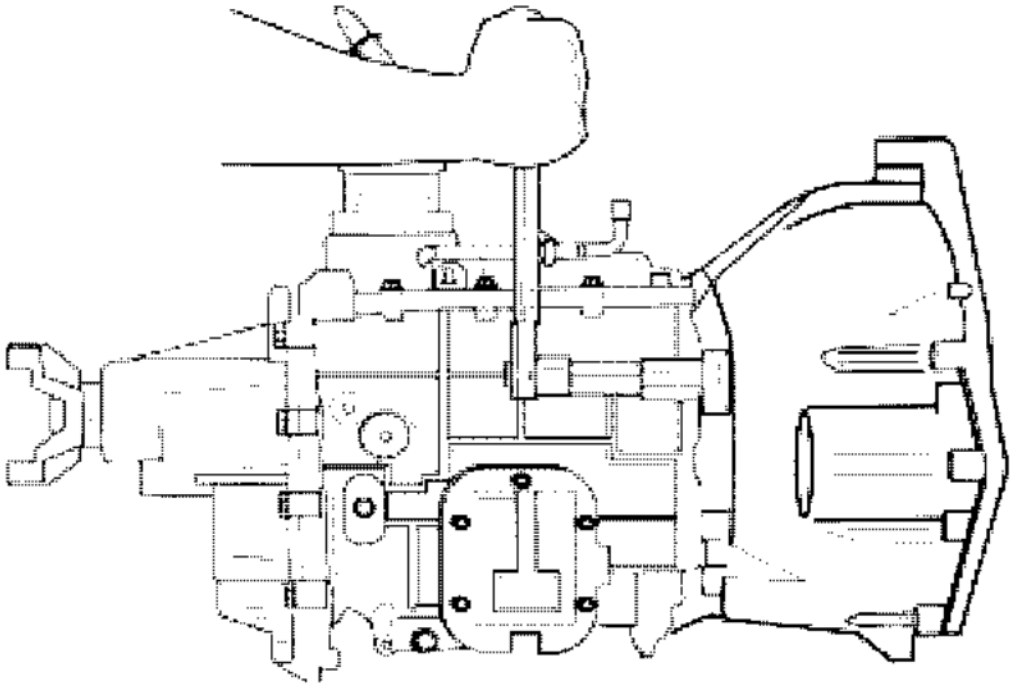


Fig. 151: Clutch Housing Screws
Courtesy of GENERAL MOTORS CORP.

1. Install the 4 clutch housing screws.

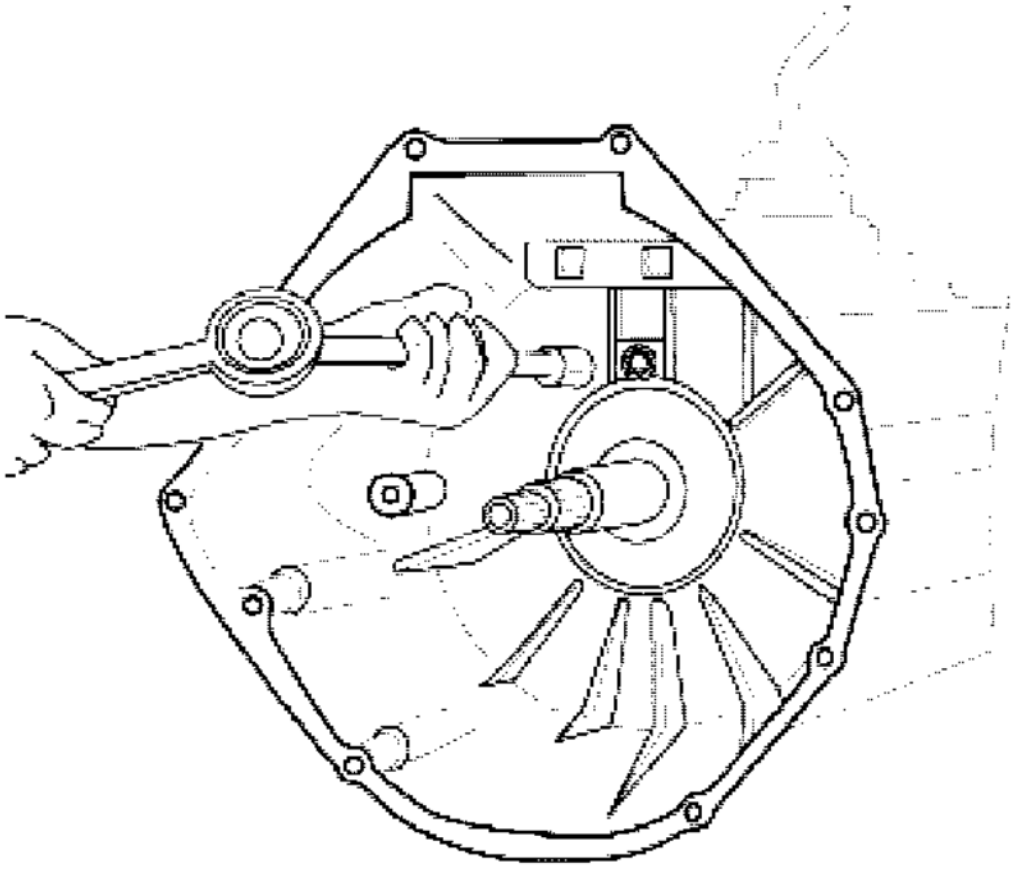


Fig. 152: Interior Clutch Housing Nuts
Courtesy of GENERAL MOTORS CORP.

2. Install the 2 interior housing nuts.

COUNTER GEAR SHAFT ASSEMBLE

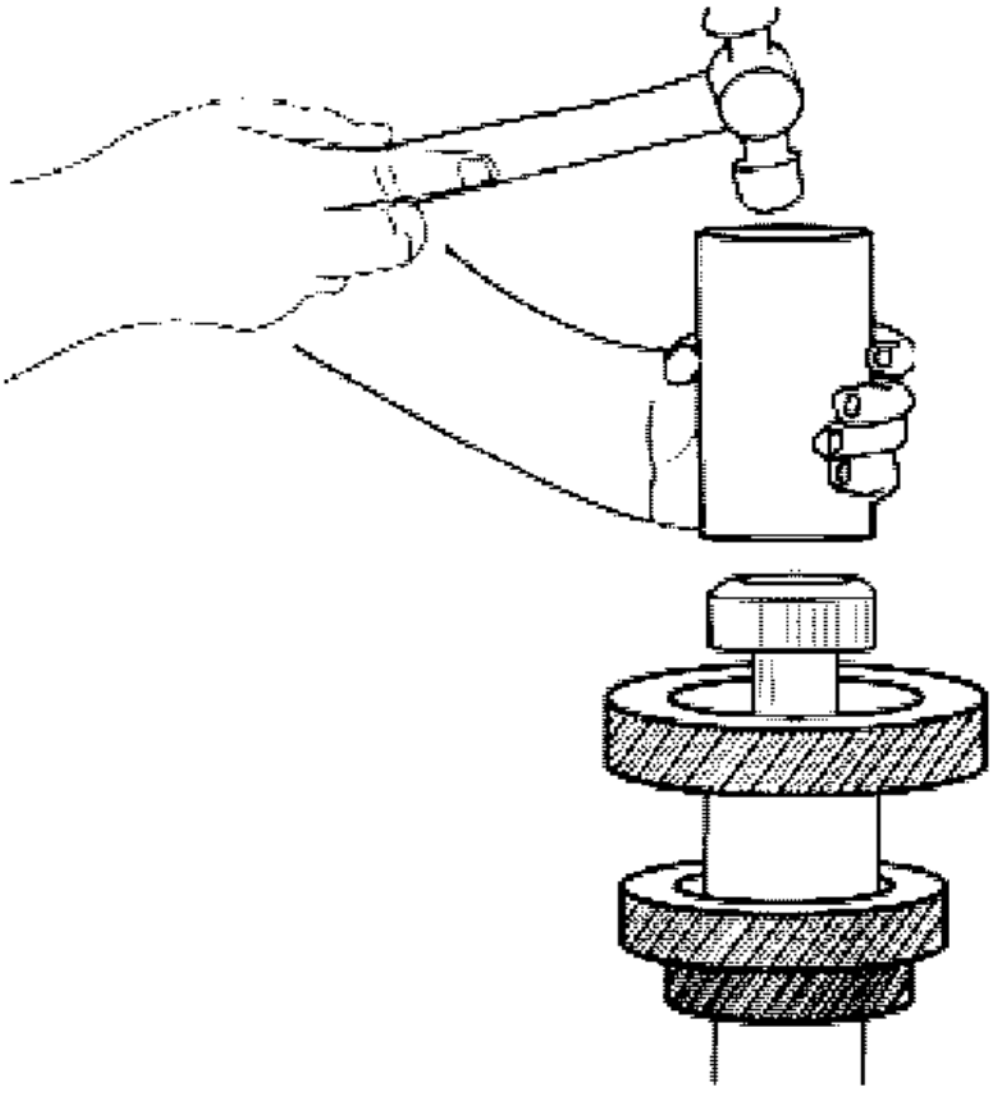


Fig. 153: Installing Bearing
Courtesy of GENERAL MOTORS CORP.

1. Using a driving tool, install the bearing.

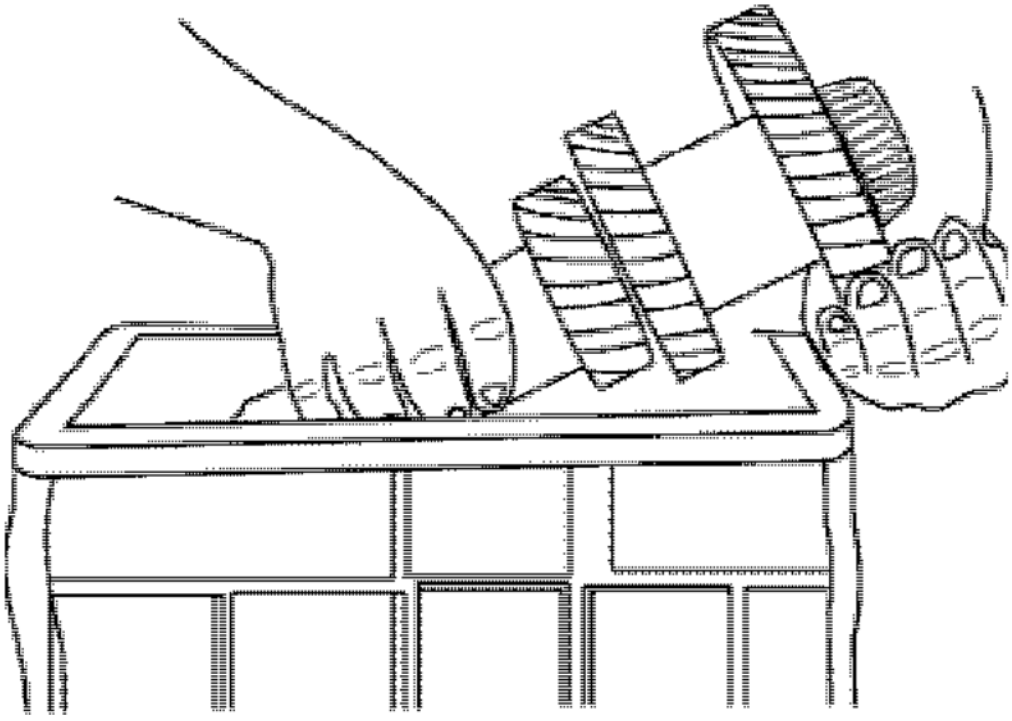


Fig. 154: Gear Assembly
Courtesy of GENERAL MOTORS CORP.

2. Install the gear assembly.

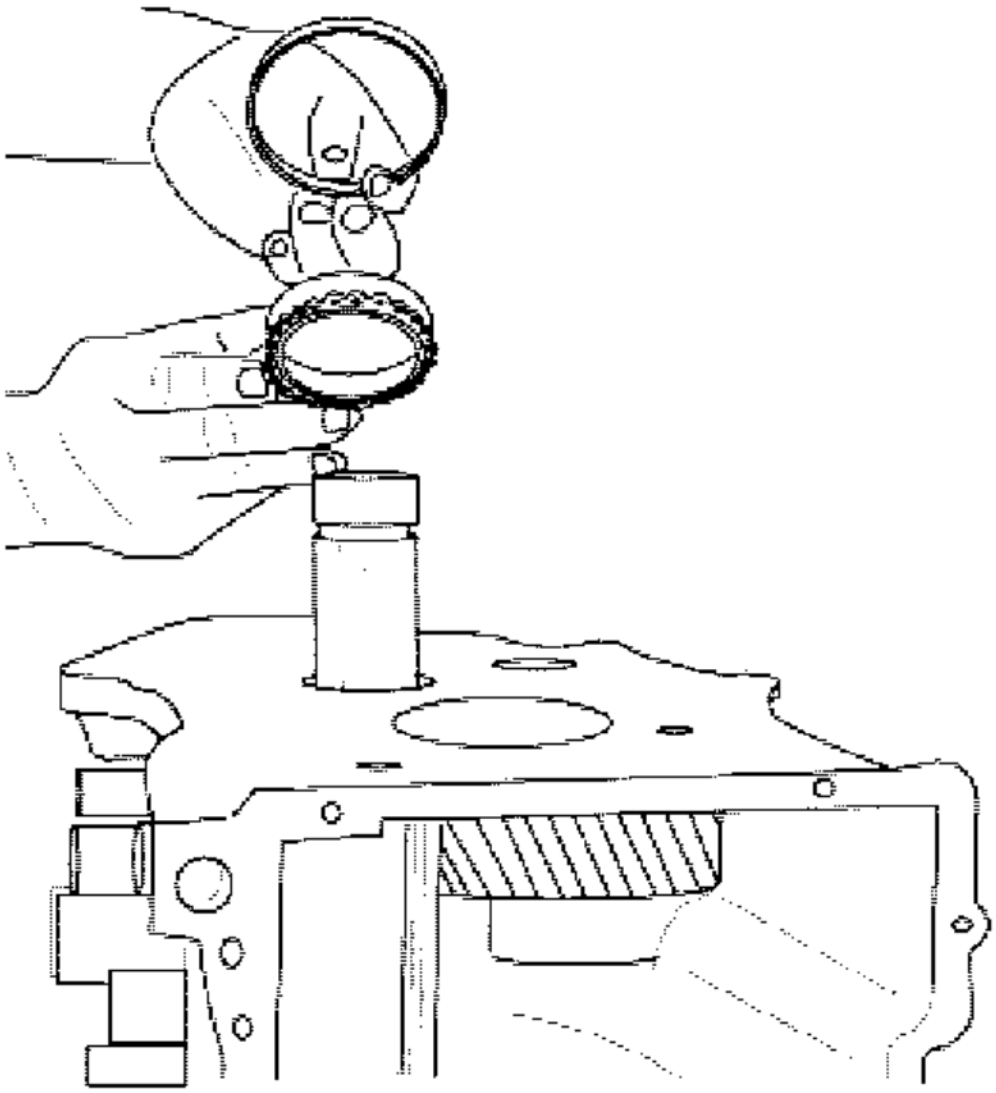


Fig. 155: Cup And Rear Bearing Race
Courtesy of GENERAL MOTORS CORP.

3. Install the bearing and the gear assembly bearing race.

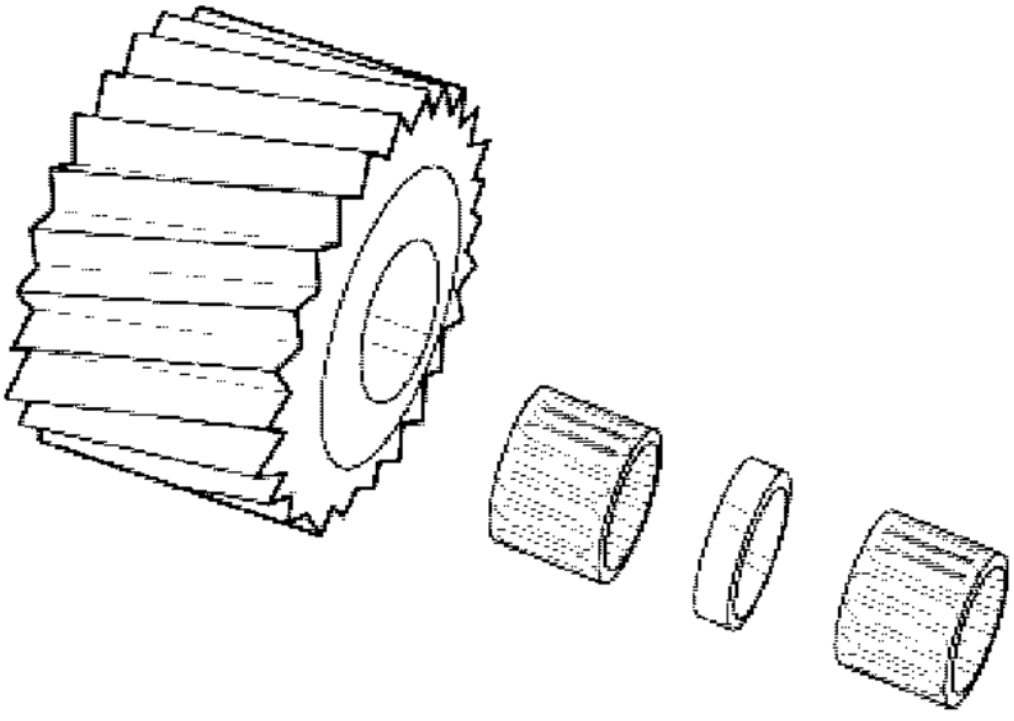


Fig. 156: Cages, Rollers And Spacer
Courtesy of GENERAL MOTORS CORP.

4. Install the 2 caged gears, with the rollers and spacer, into the reverse gear.

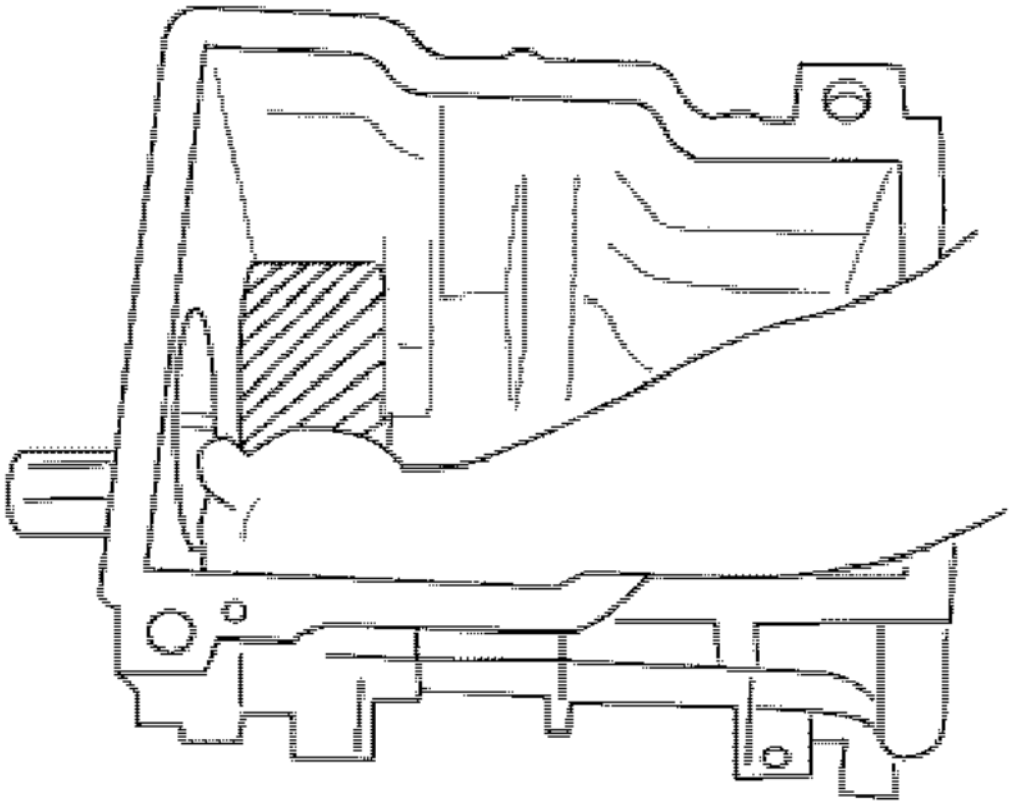


Fig. 157: Reverse Gear
Courtesy of GENERAL MOTORS CORP.

5. Install the reverse gear into the case.

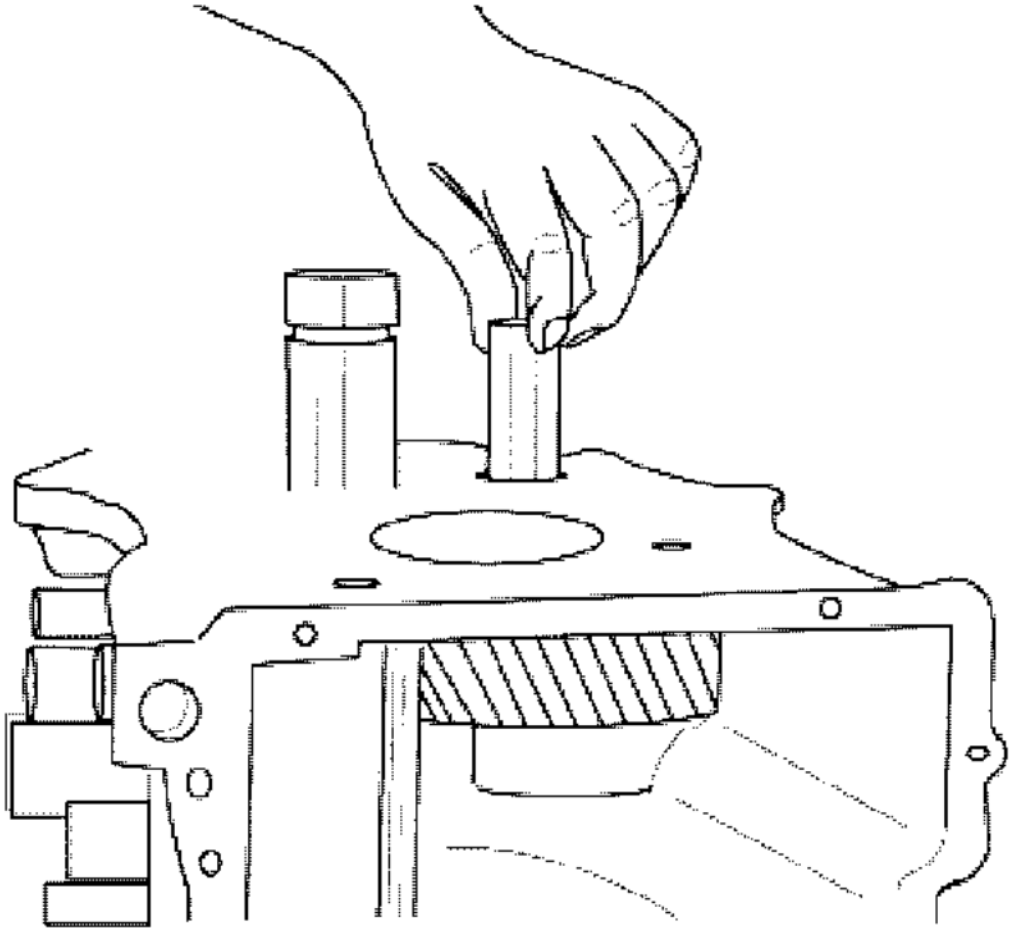


Fig. 158: Reverse Shaft
Courtesy of GENERAL MOTORS CORP.

6. Install the reverse gear shaft.

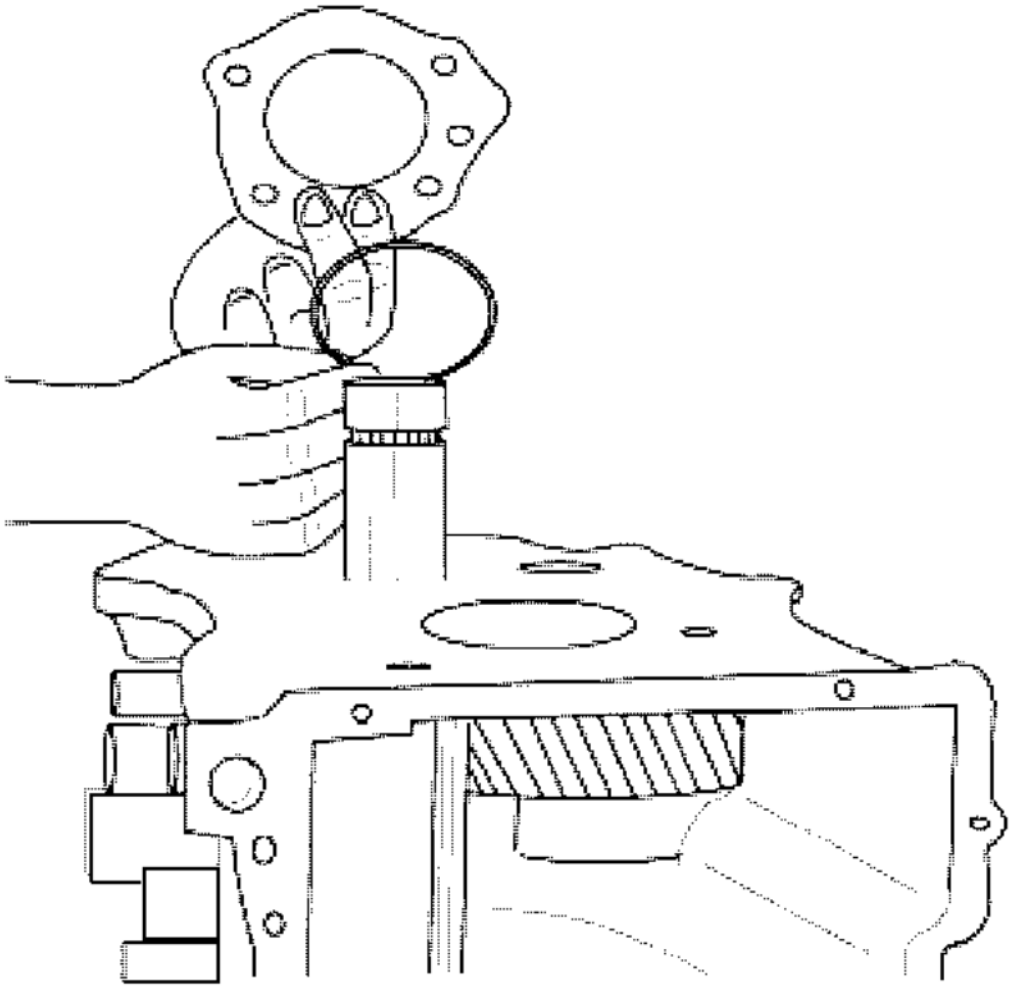


Fig. 159: Rear Retainer And Adjuster Shims
Courtesy of GENERAL MOTORS CORP.

7. Install the adjusting spacers and the rear bearing retainer.

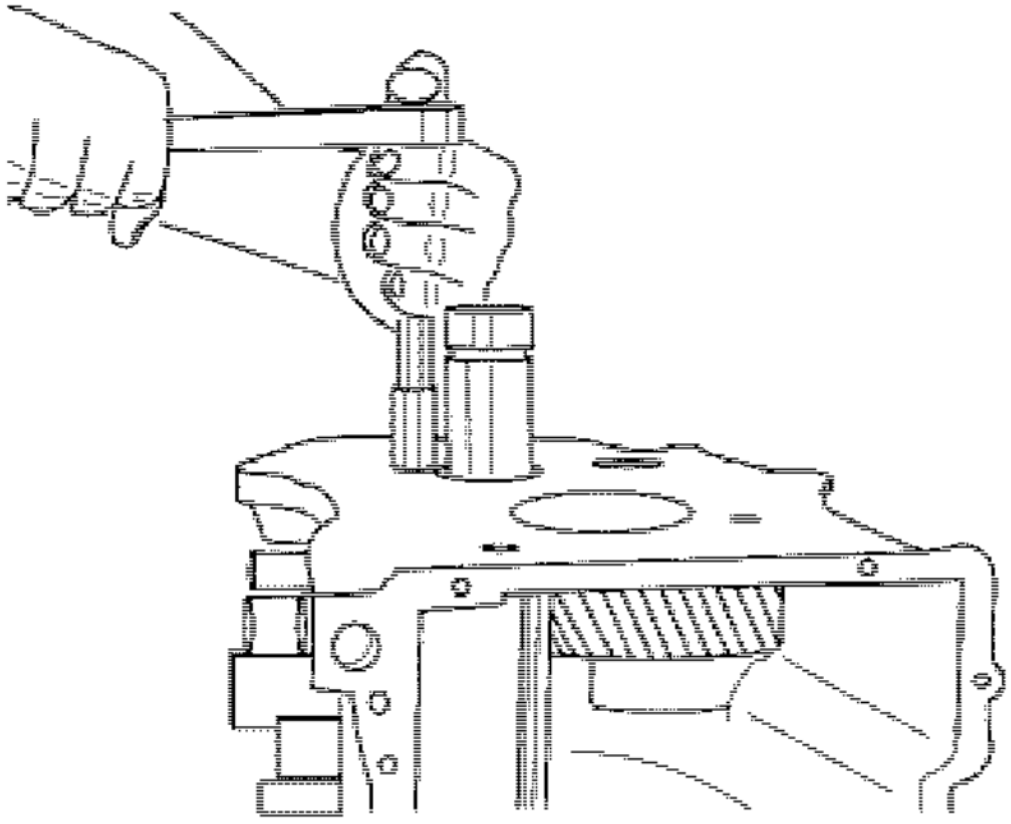


Fig. 160: Rear Retainer Screws
Courtesy of GENERAL MOTORS CORP.

8. Install the 4 rear retaining screws.

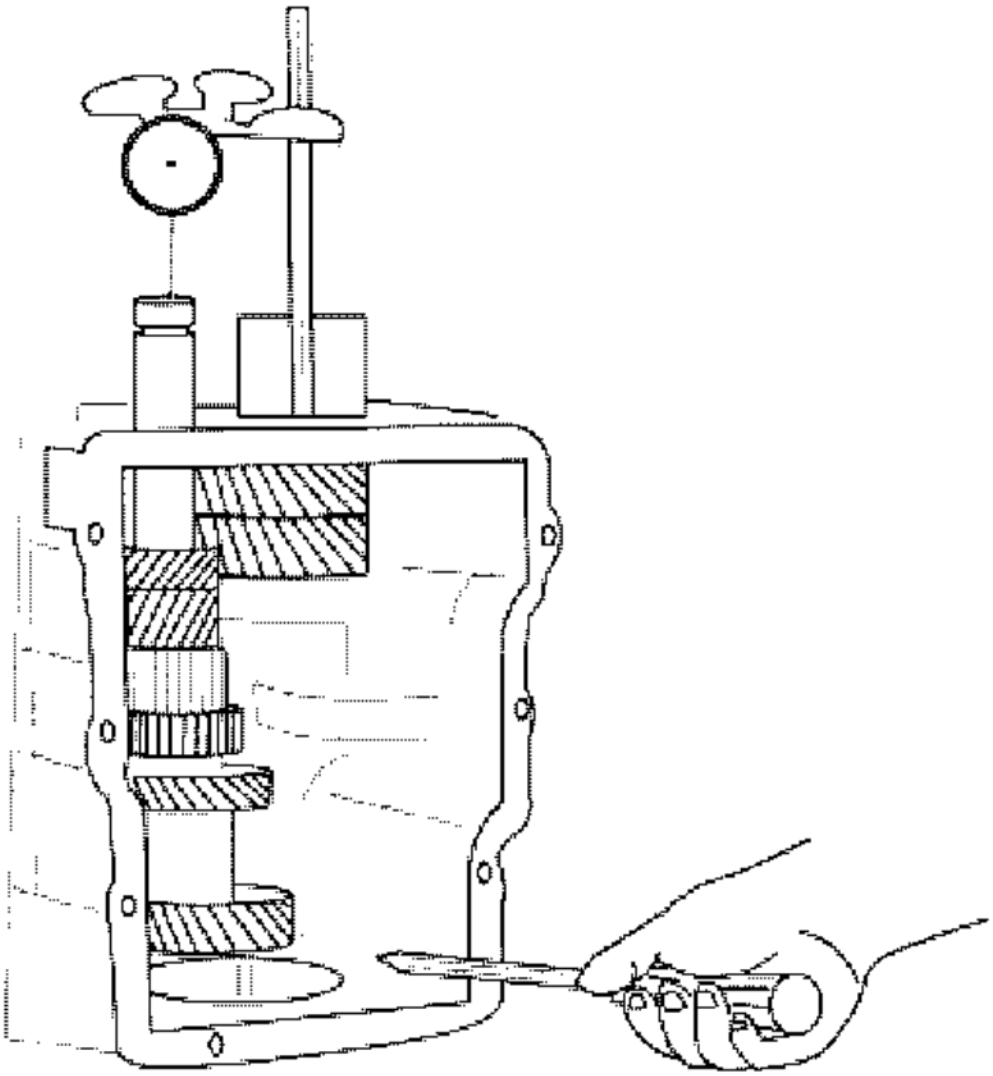


Fig. 161: Measuring Axial Play
Courtesy of GENERAL MOTORS CORP.

9. Turn the gear assembly in order to seat the bearings against the tracks.
10. Install a dial indicator and lift the gear assembly with a screwdriver in order to measure the axial play. Add spacers for more play and remove spacers for less play.

Specification: The axial play should be 0.025-0.127 mm (0.001-0.005 in).

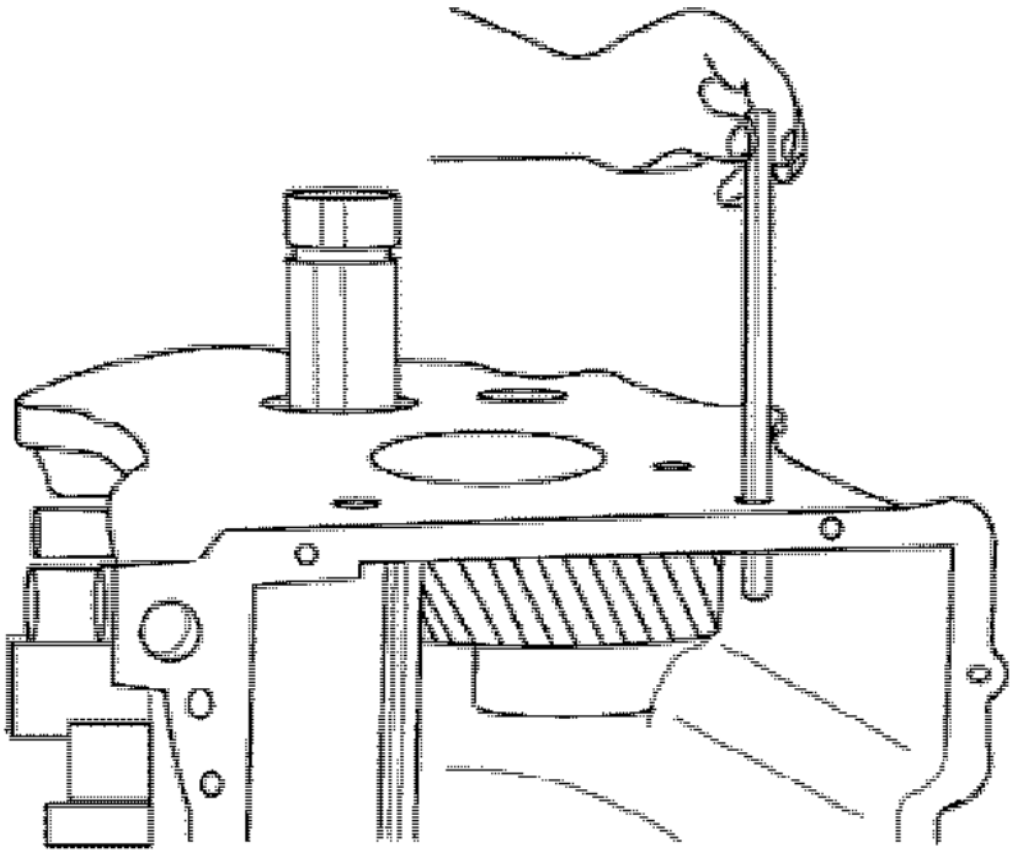


Fig. 162: Gear Shaft
Courtesy of GENERAL MOTORS CORP.

11. Install the reverse and 5th gear lever.

MAIN SHAFT ASSEMBLE

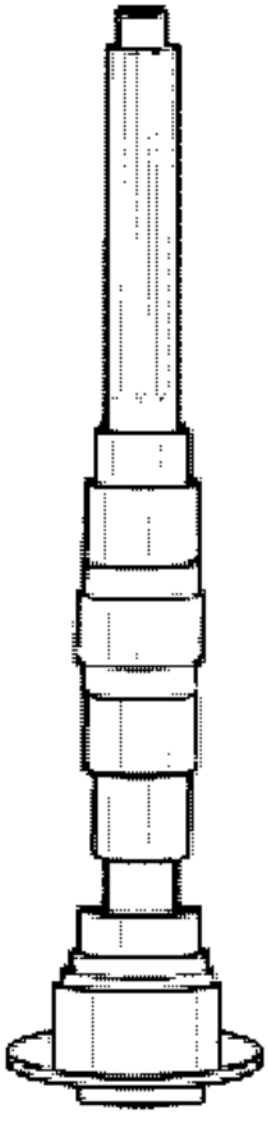


Fig. 163: Positioning Main Shaft Assembly Vertically
Courtesy of GENERAL MOTORS CORP.

1. Use a flange or other tool to position the main shaft assembly vertically.

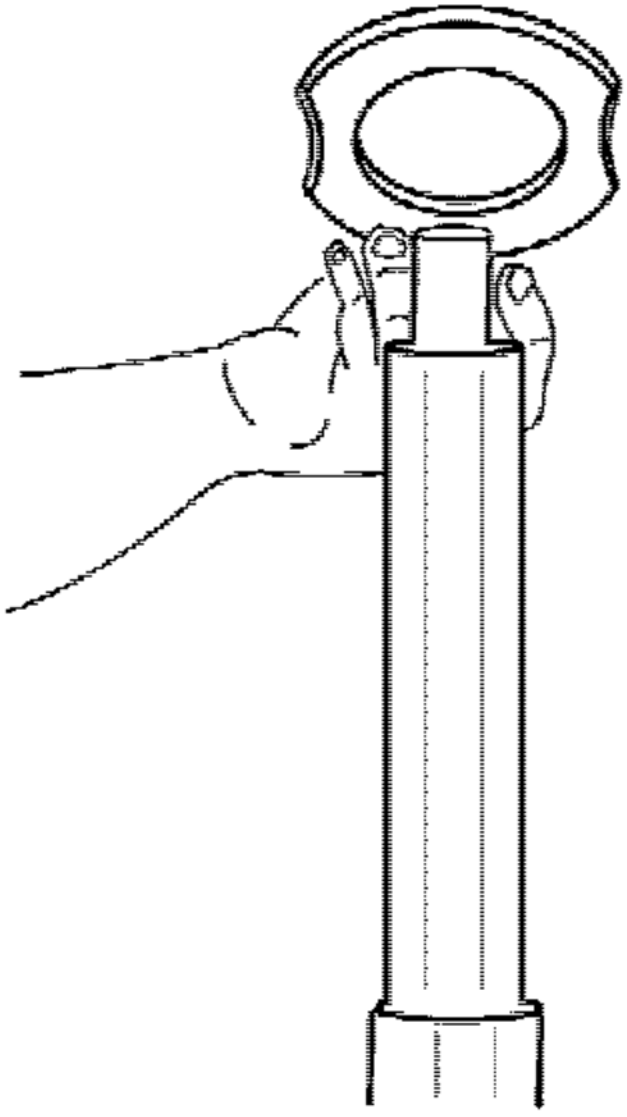


Fig. 164: Reverse Clutch Taper Bearing
Courtesy of GENERAL MOTORS CORP.

2. Install the reverse clutch taper.

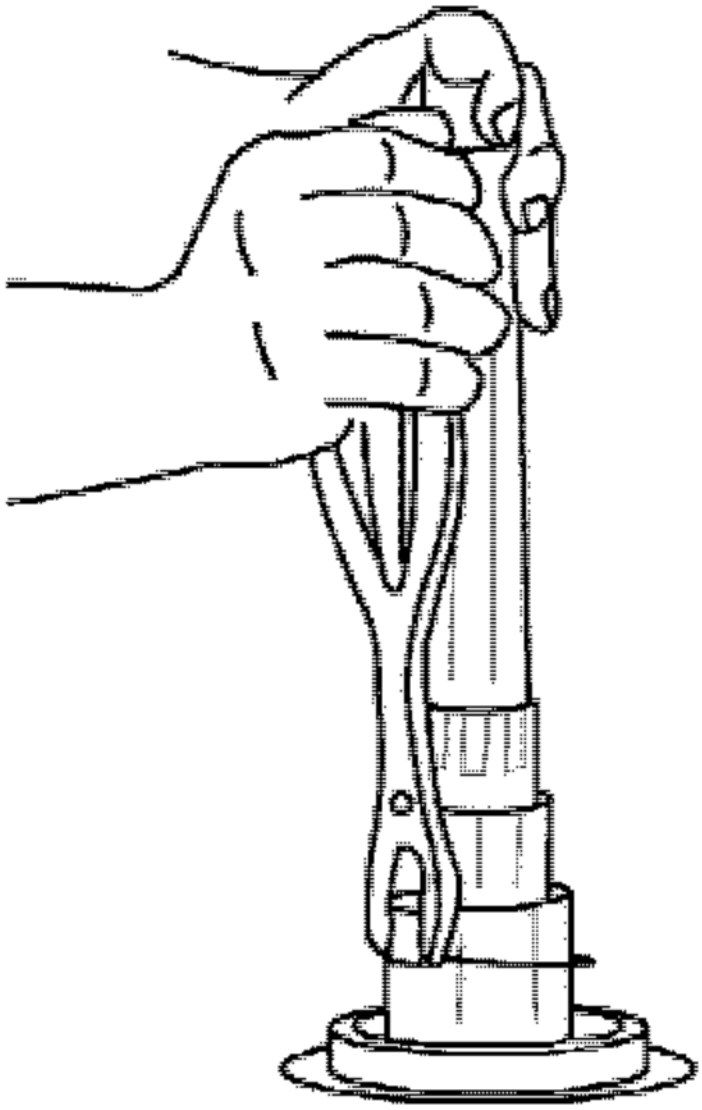


Fig. 165: Snap Ring
Courtesy of GENERAL MOTORS CORP.

3. Using locking pliers, position the clutch taper snap ring.

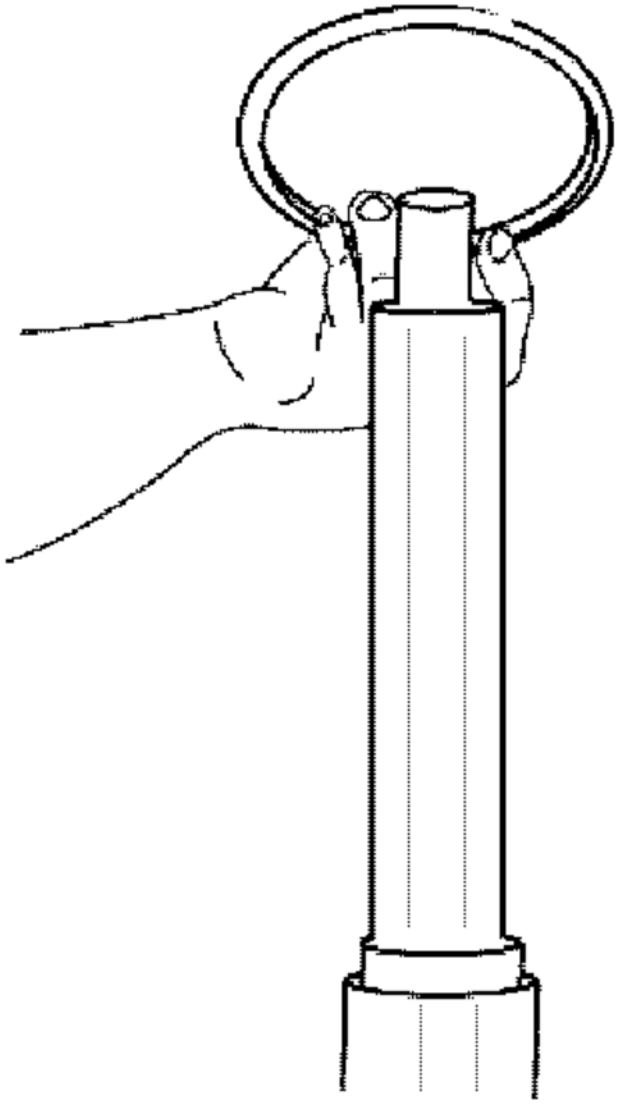


Fig. 166: Reverse Synchronizer Ring
Courtesy of GENERAL MOTORS CORP.

4. Install the lubricated reverse gear synchronizer ring.

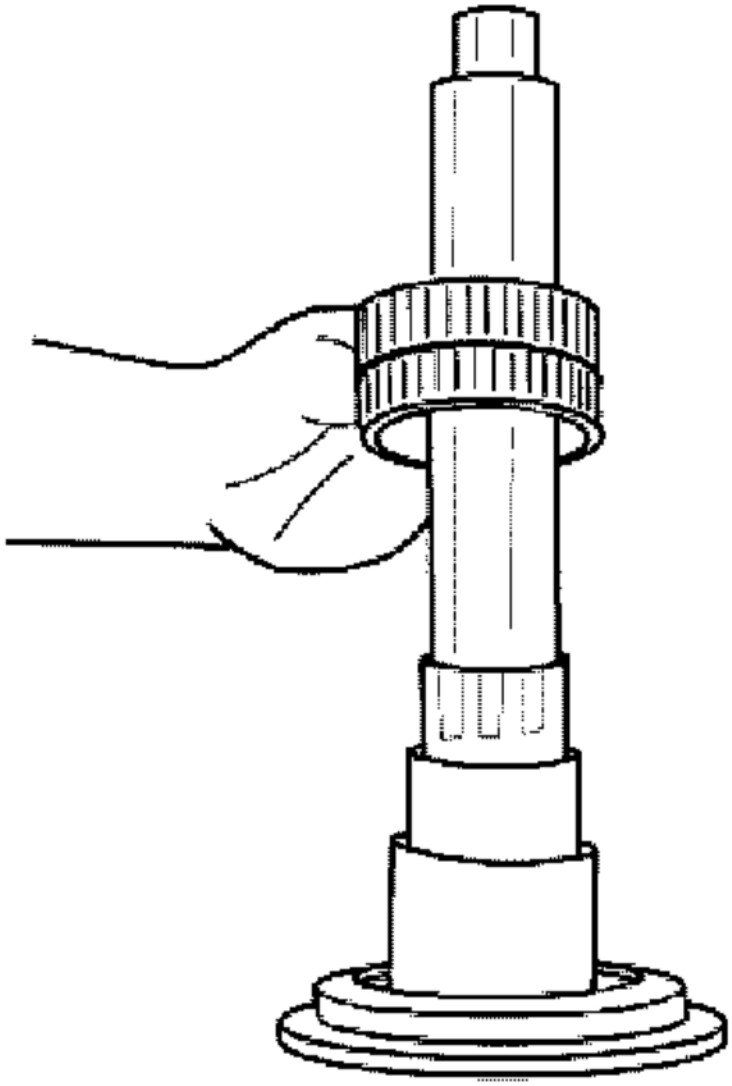


Fig. 167: Roller Cage
Courtesy of GENERAL MOTORS CORP.

5. Install the reverse gear roller cage.

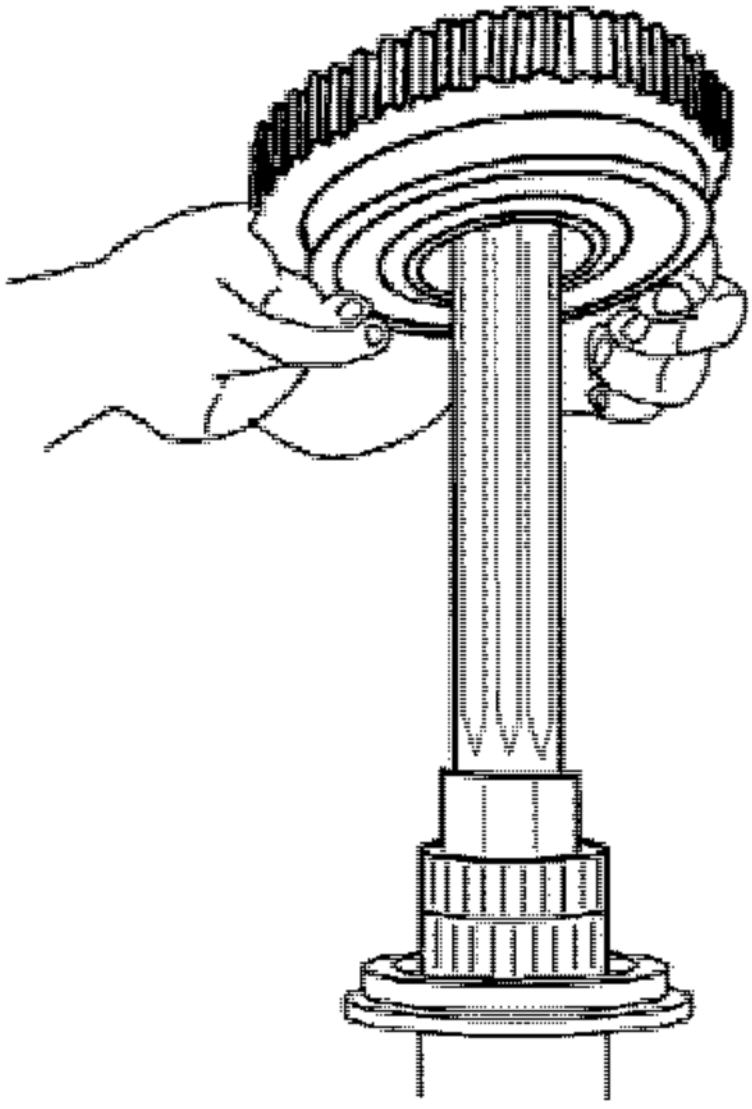


Fig. 168: Reverse Gear And Synchronizer
Courtesy of GENERAL MOTORS CORP.

6. Install the reverse gear and synchronizer.
7. Turn the reverse gear and synchronizer in order to seat them into the insert grooves.

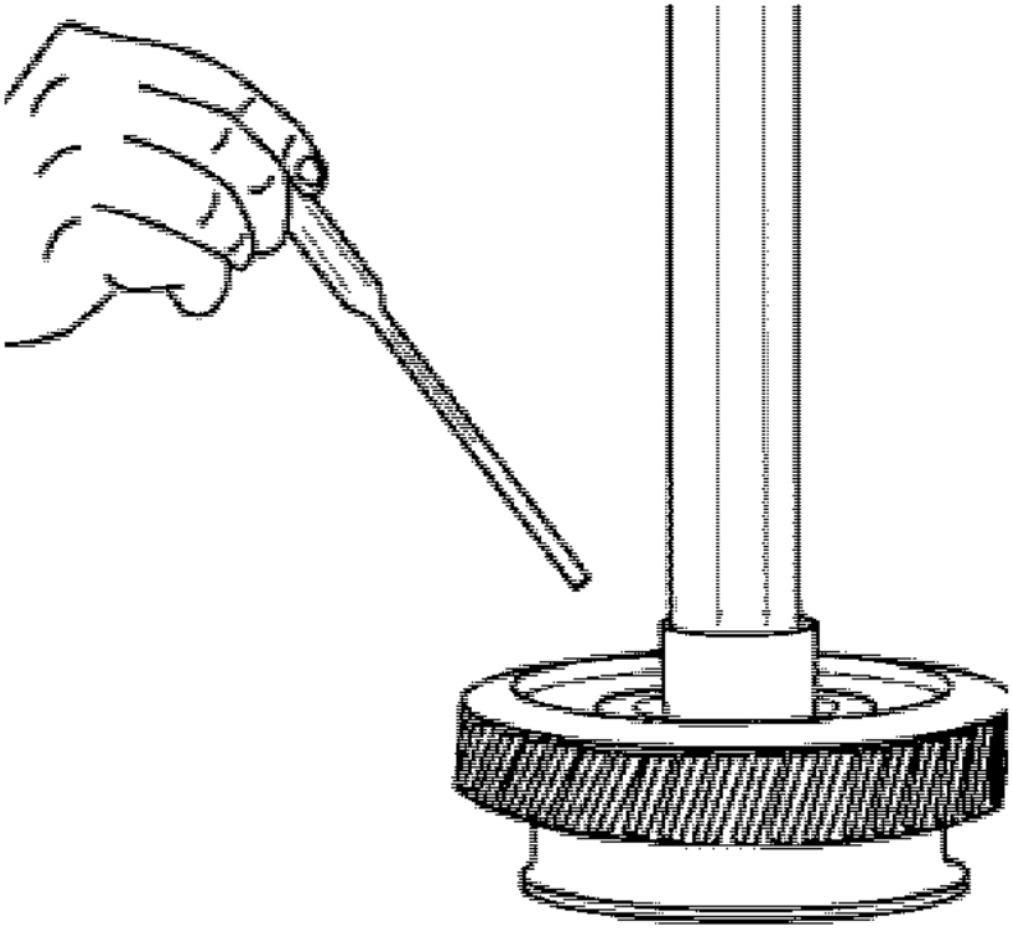


Fig. 169: Removing/Installing Pulley Sphere
Courtesy of GENERAL MOTORS CORP.

8. Install the pulley sphere for the reverse gear.

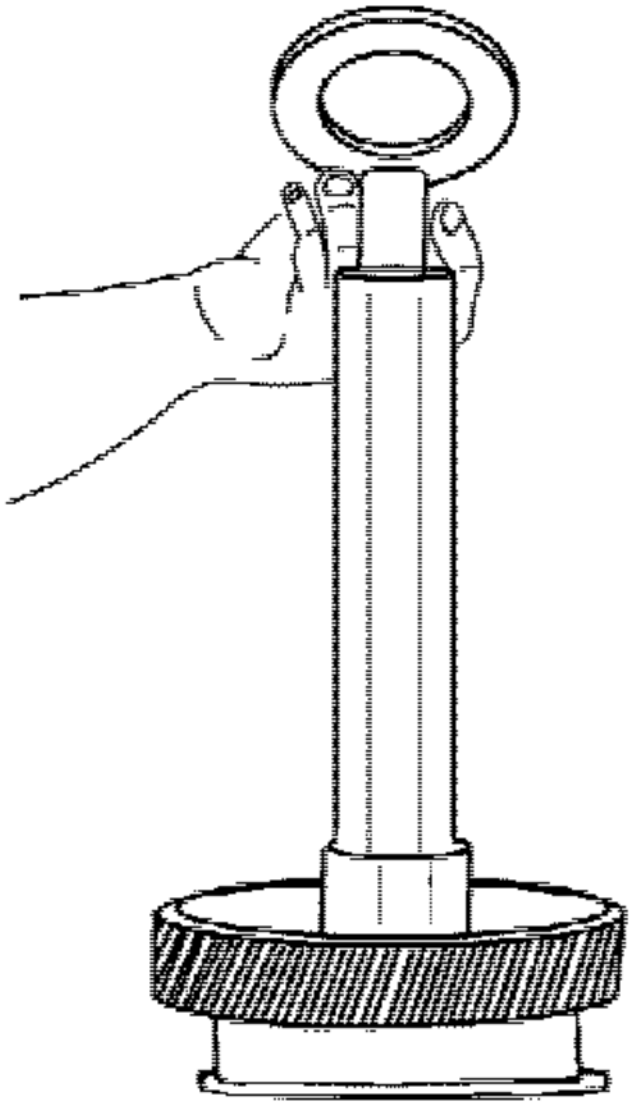


Fig. 170: Push Pulley
Courtesy of GENERAL MOTORS CORP.

9. Install the reverse gear push pulley.

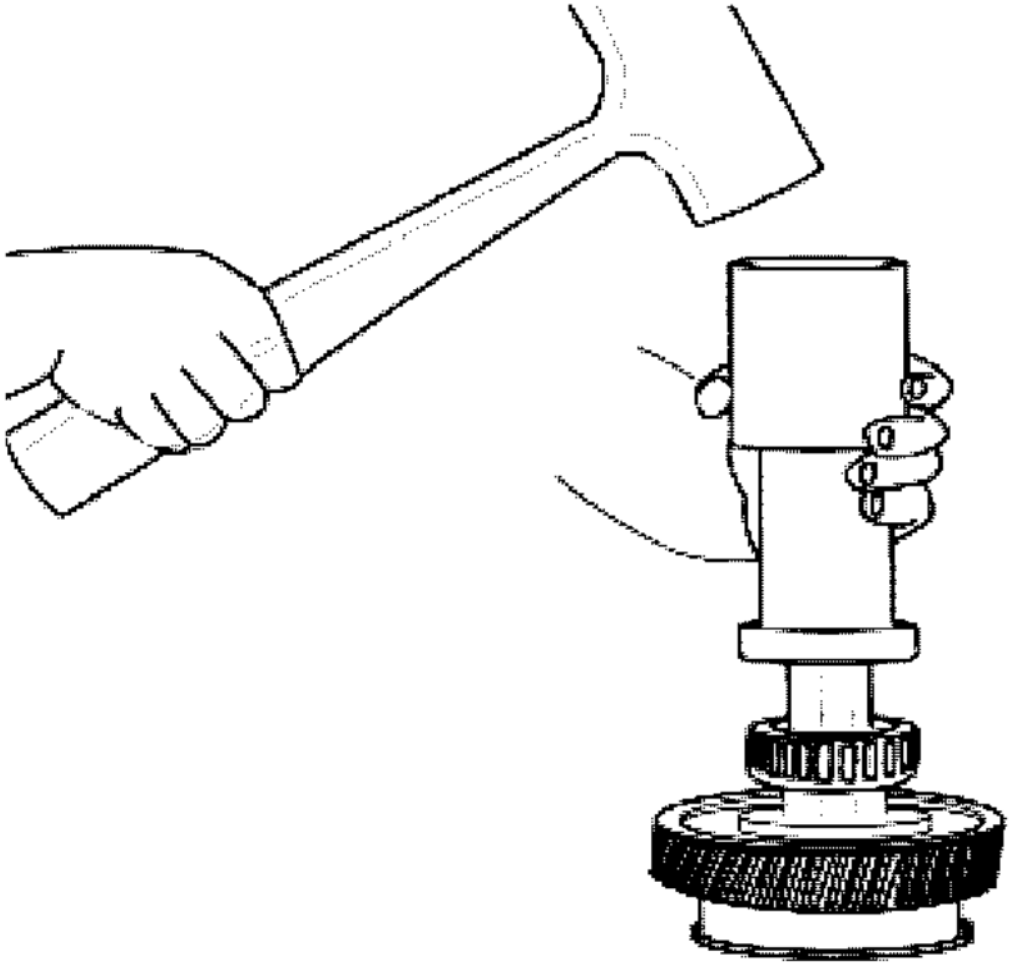


Fig. 171: Installing Bearing
Courtesy of GENERAL MOTORS CORP.

10. Using a driving tool or a hydraulic press, install the bearing.

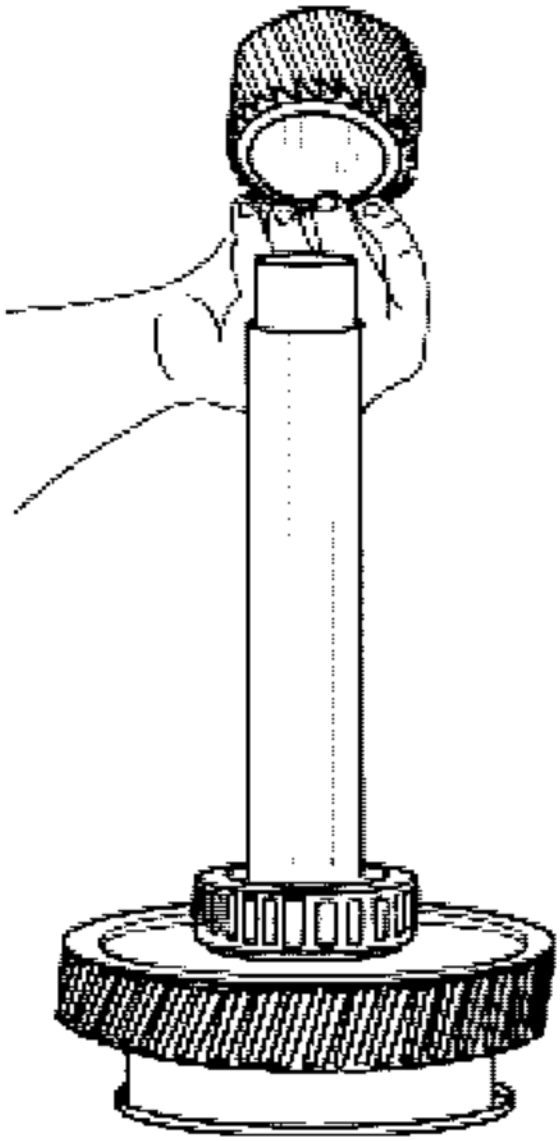


Fig. 172: 5th Gear
Courtesy of GENERAL MOTORS CORP.

11. Install the 5th gear onto the main shaft.

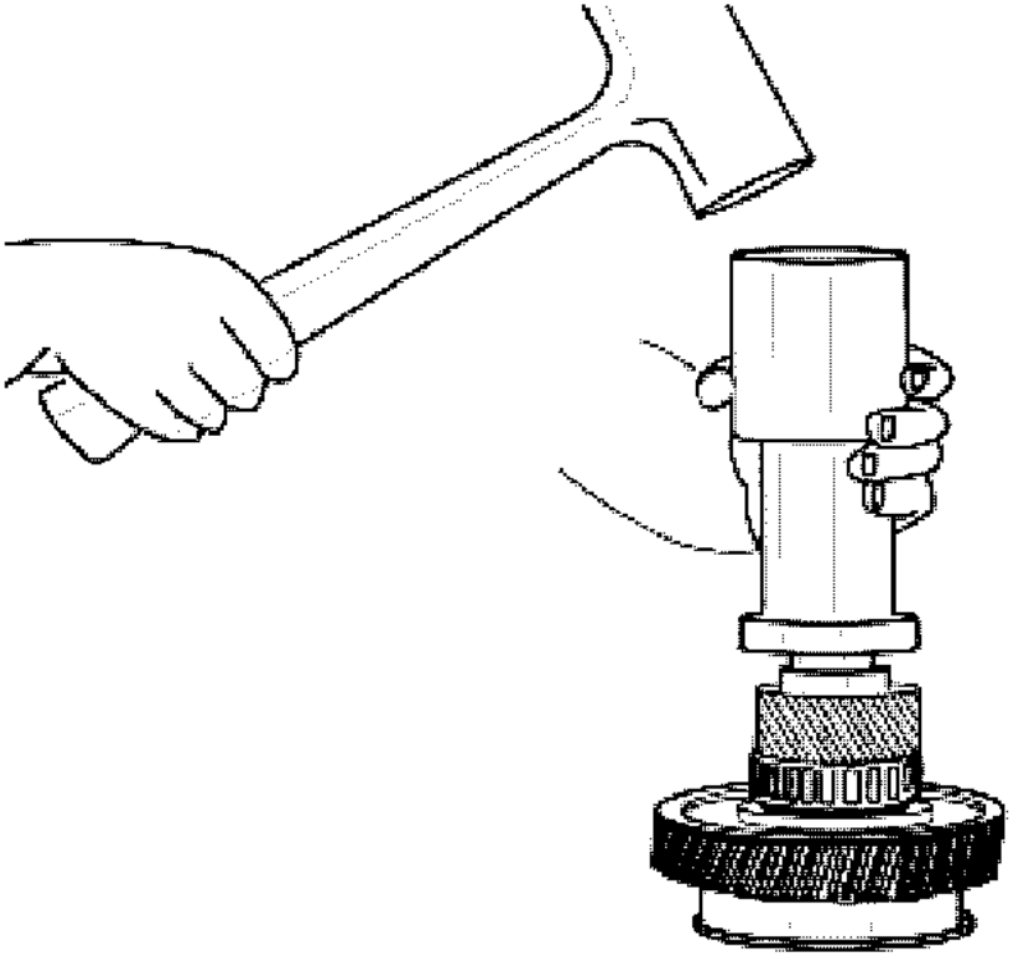


Fig. 173: Seating 5th Gear
Courtesy of GENERAL MOTORS CORP.

12. Using a drive tool or a hydraulic press, seat the 5th gear into position.

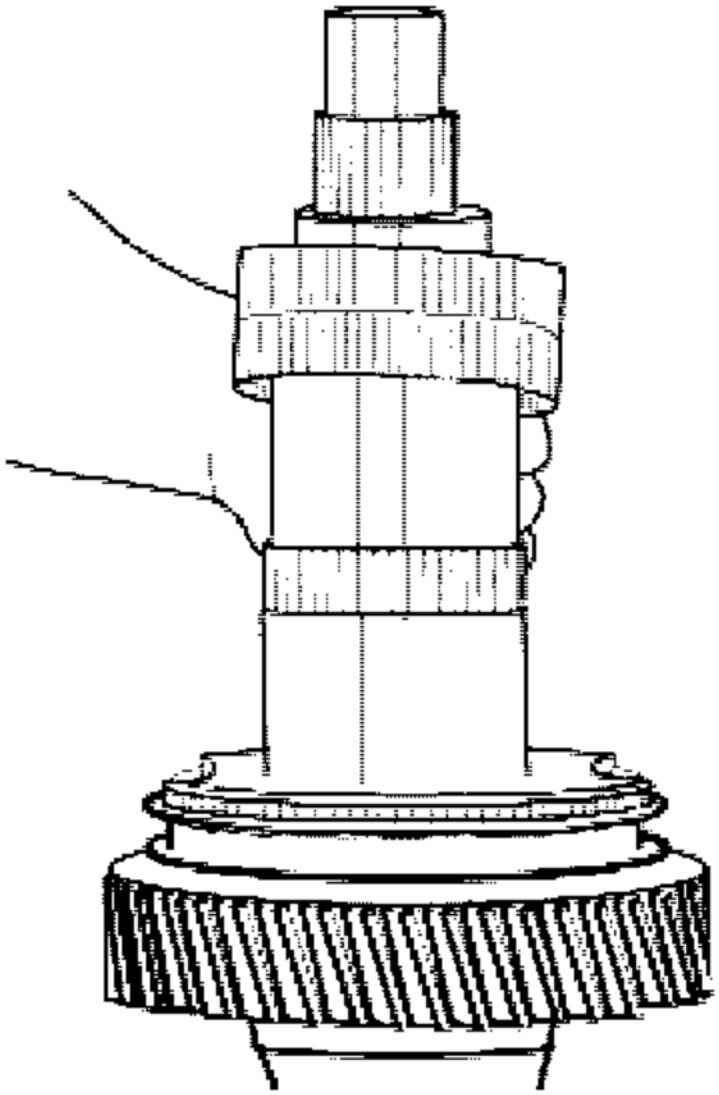


Fig. 174: Reverse Gear Drive Pulley
Courtesy of GENERAL MOTORS CORP.

13. Install the reverse gear drive pulley.

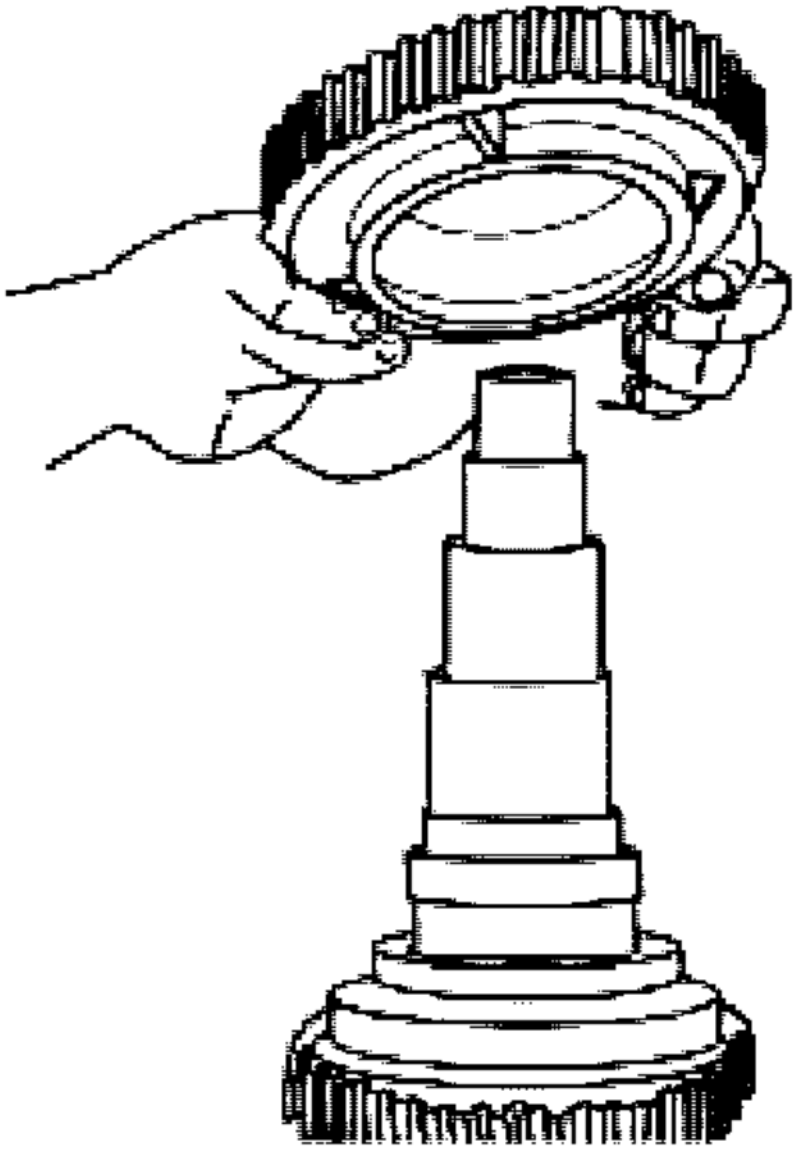


Fig. 175: 1st Gear
Courtesy of GENERAL MOTORS CORP.

14. Install the 1st gear onto the main shaft.

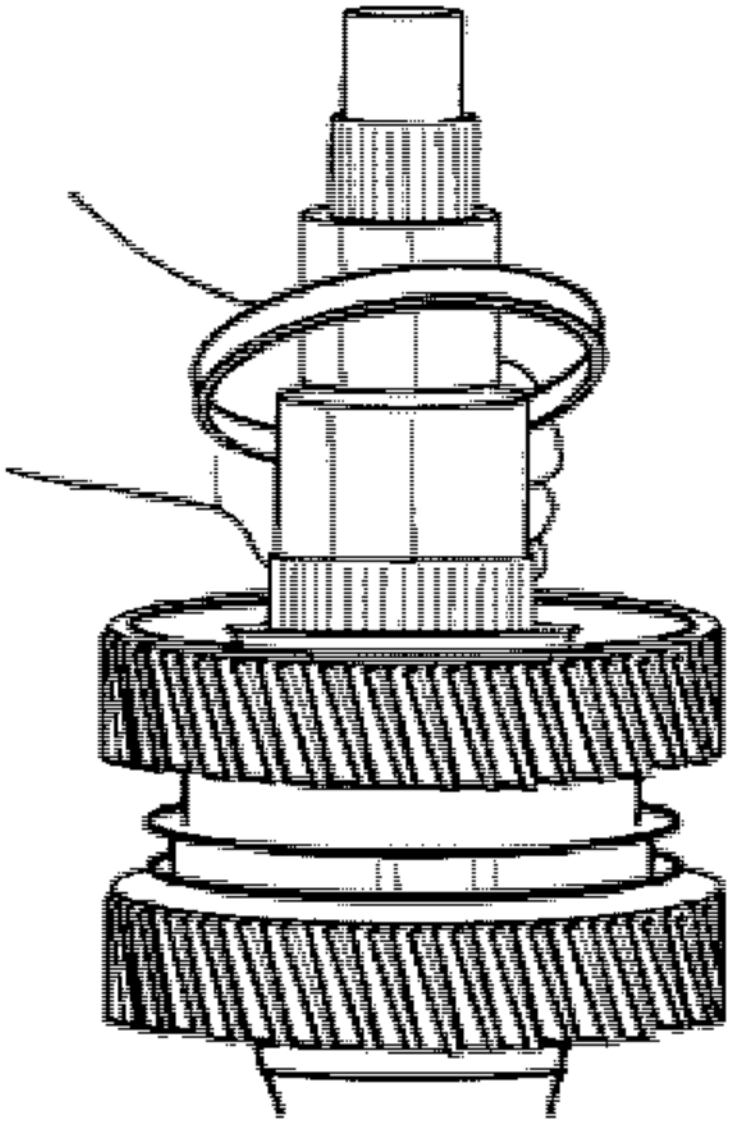


Fig. 176: 1st Gear Interior Taper Bearing
Courtesy of GENERAL MOTORS CORP.

15. Install the 1st gear interior taper.

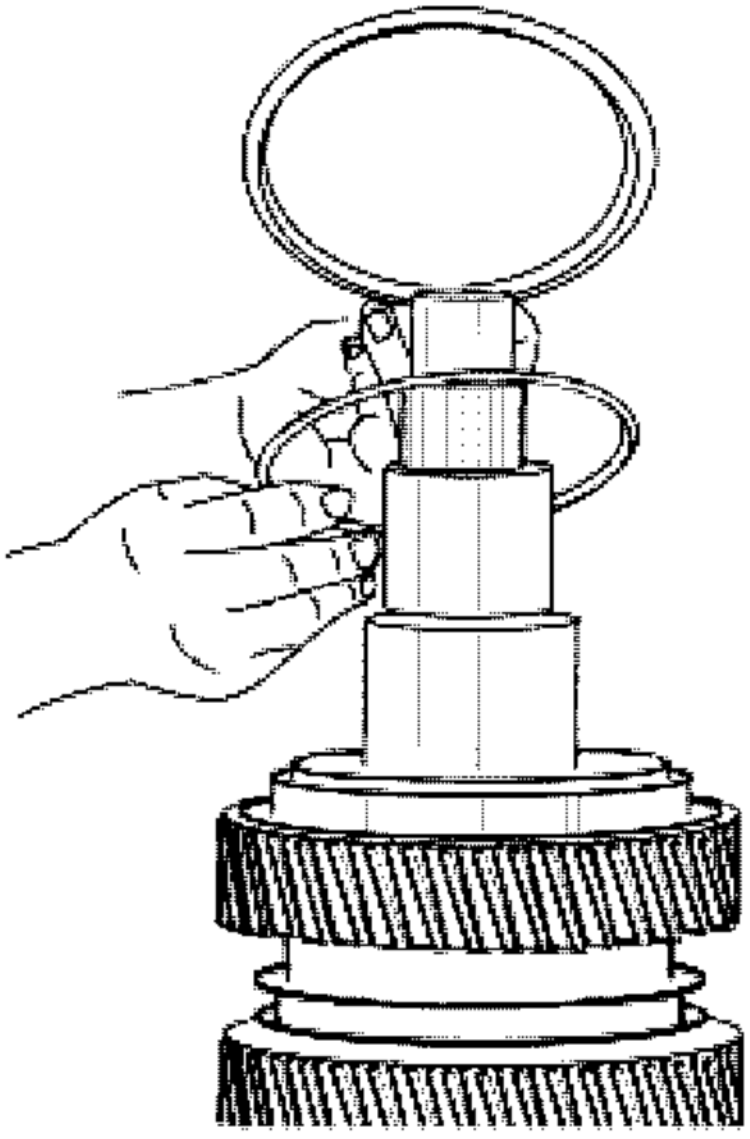


Fig. 177: Synchronizer Ring And Intermediate Ring
Courtesy of GENERAL MOTORS CORP.

16. Install the intermediate ring and the synchronizer ring.

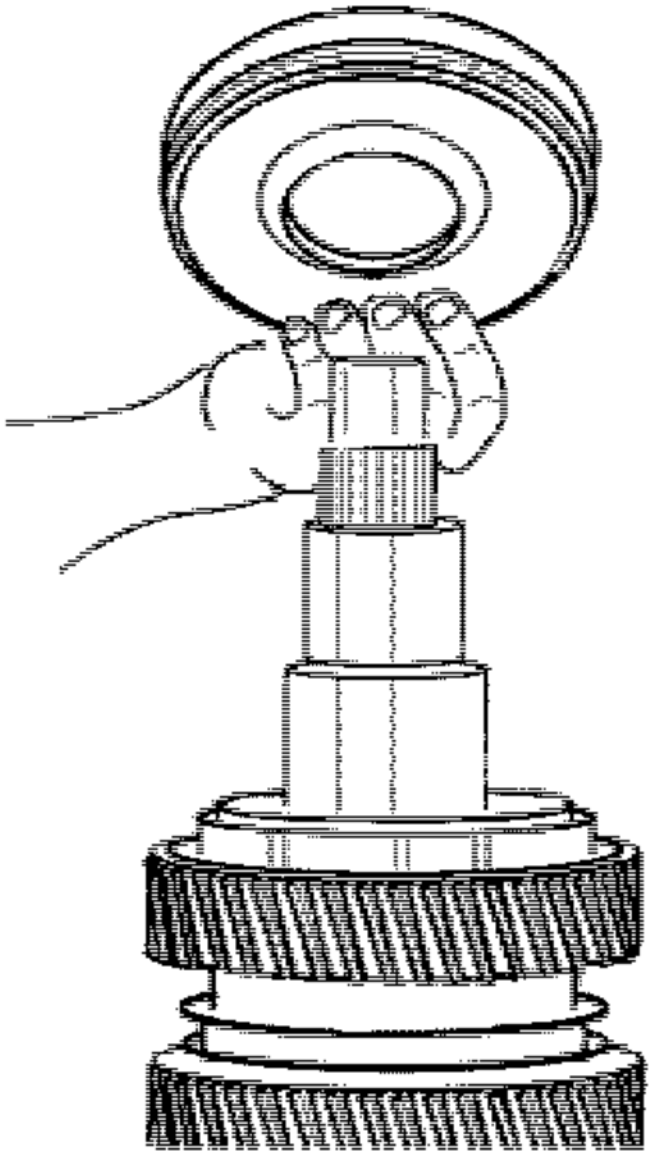


Fig. 178: 1st And 2nd Gear Synchronizer
Courtesy of GENERAL MOTORS CORP.

17. Install the 1st and 2nd gear synchronizer assembly.
18. Turn the 1st and 2nd gear synchronizer assembly in order to seat the insert grooves.

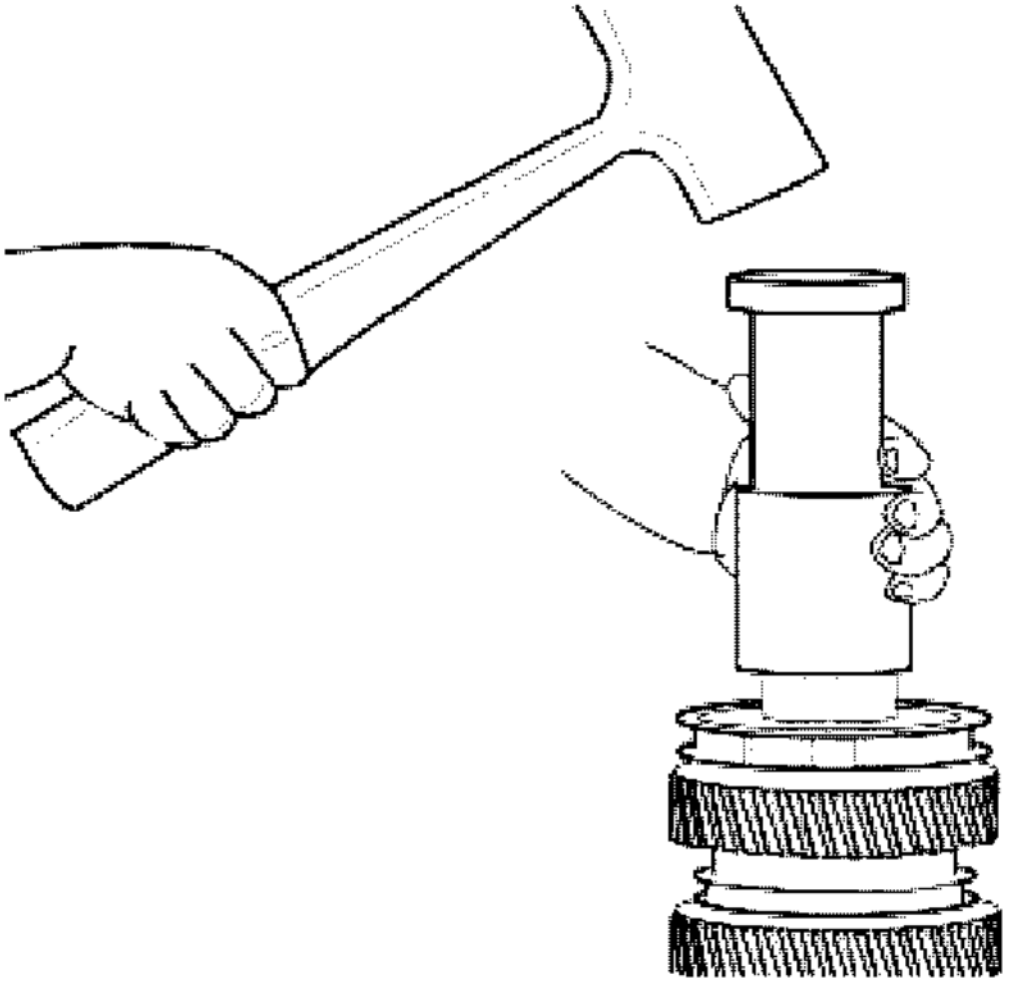


Fig. 179: Seating 1st And 2nd Gear Synchronization Assembly
Courtesy of GENERAL MOTORS CORP.

19. Using a driving tool, seat the 1st and 2nd gear synchronization assembly.

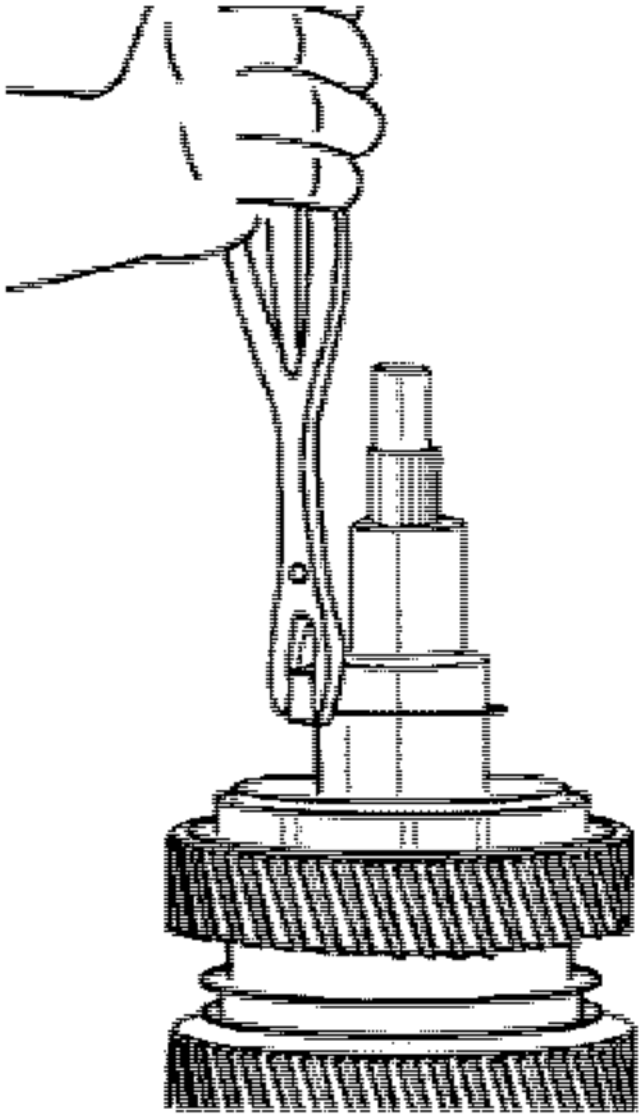


Fig. 180: View Of Snap Ring Holding Synchronization Hammer Onto 1st And 2nd Gears
Courtesy of GENERAL MOTORS CORP.

20. Using locking pliers, install the synchronizer hammer snap ring.

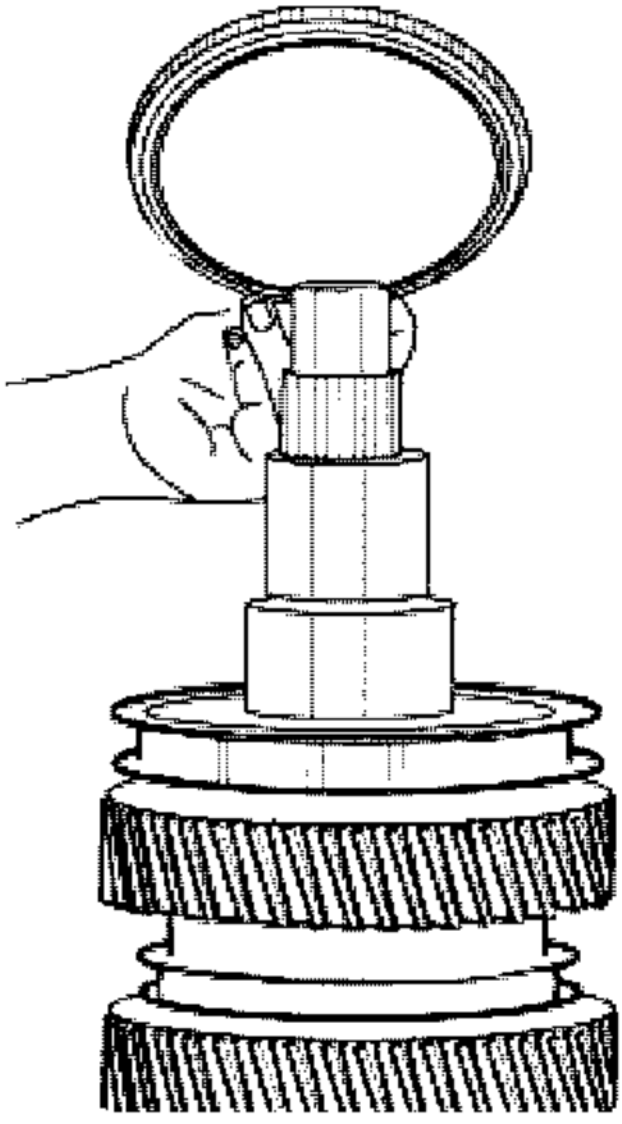


Fig. 181: 2nd Gear Synchronizer Ring
Courtesy of GENERAL MOTORS CORP.

21. Install the lubricated 2nd gear synchronization ring, and position the insert grooves.

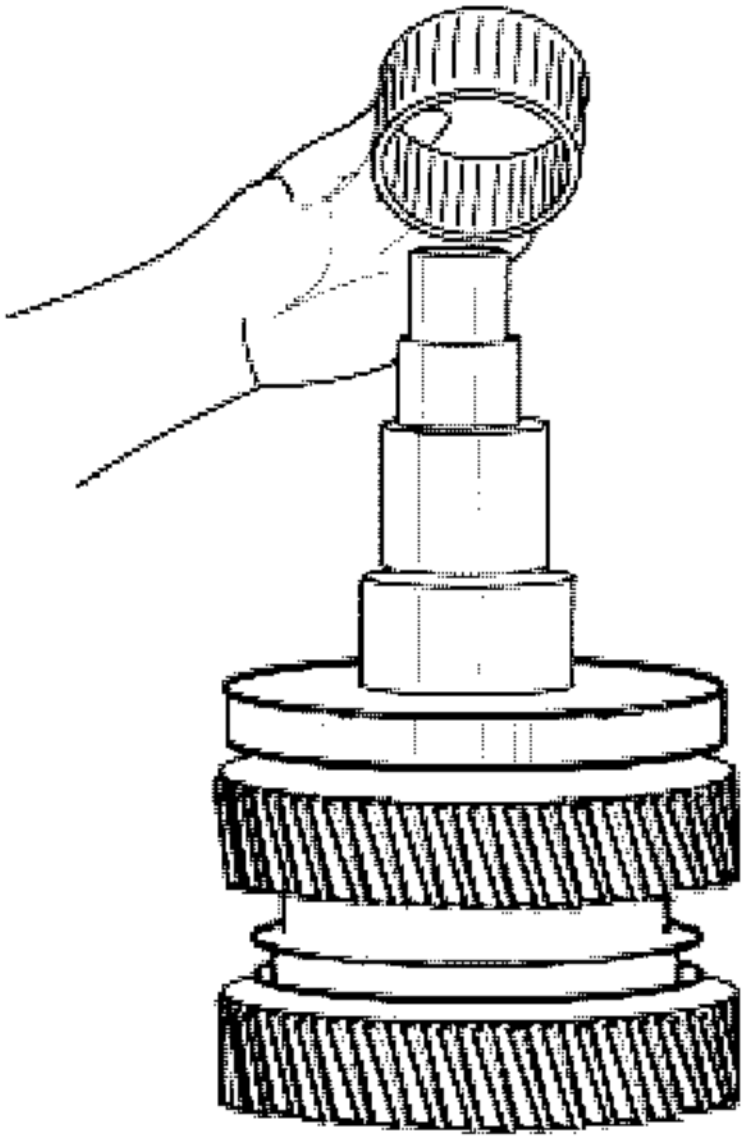


Fig. 182: 2nd Gear Roller Cage
Courtesy of GENERAL MOTORS CORP.

22. Install the 2nd gear roller cage.

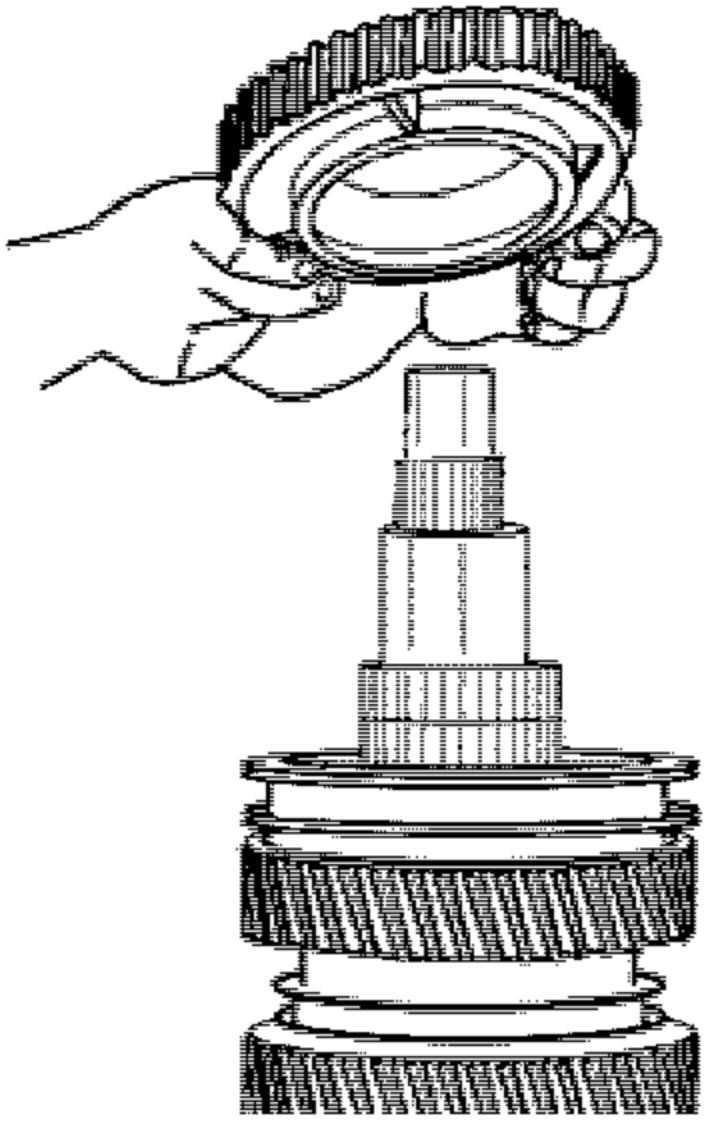


Fig. 183: 2nd Gear
Courtesy of GENERAL MOTORS CORP.

23. Install the 2nd gear onto the main shaft.

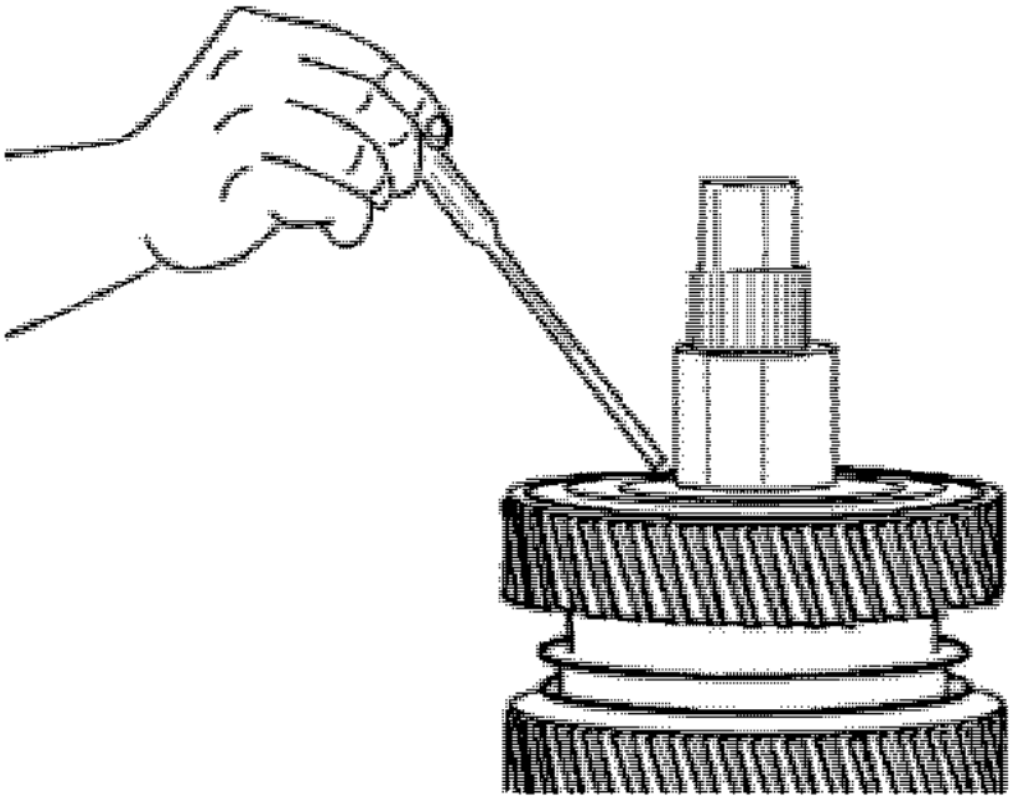


Fig. 184: Removing/Installing Pulley Sphere
Courtesy of GENERAL MOTORS CORP.

24. Install the 2nd gear pulley sphere.

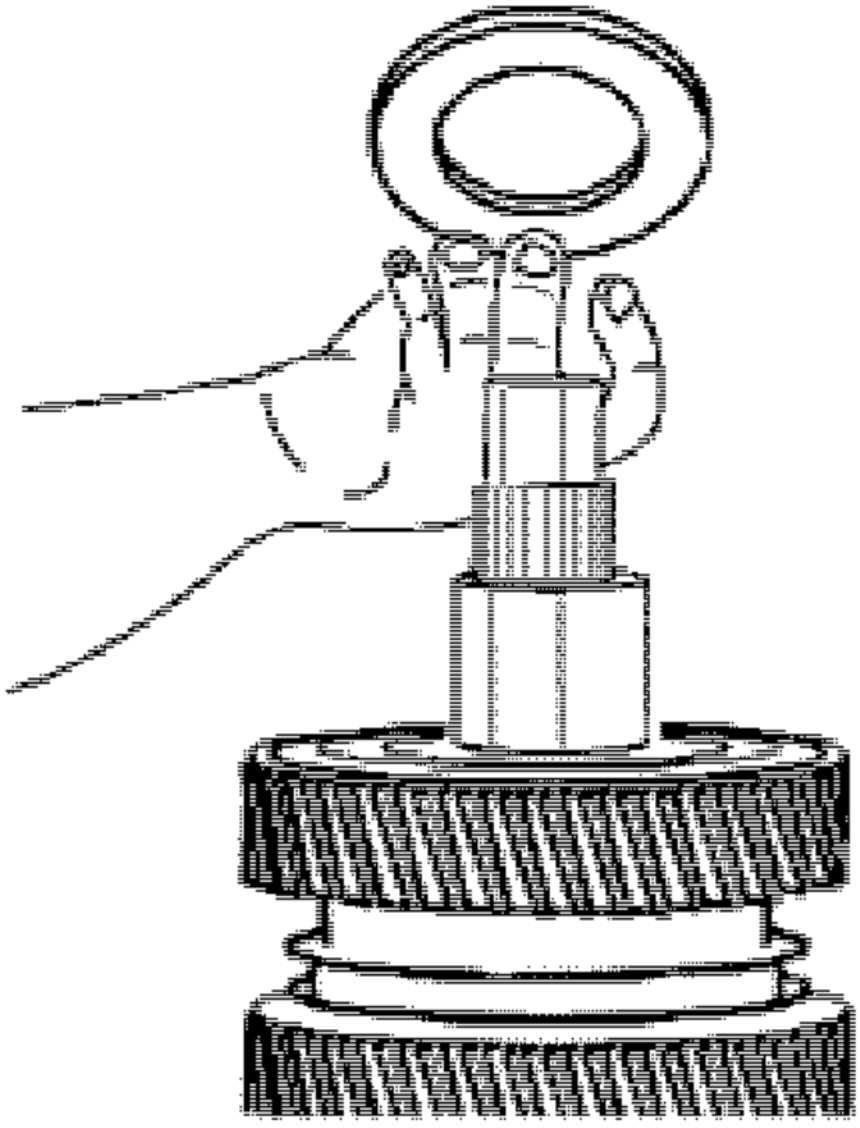


Fig. 185: 2nd Gear Push Pulley
Courtesy of GENERAL MOTORS CORP.

25. Install the 2nd gear push pulley onto the main shaft.

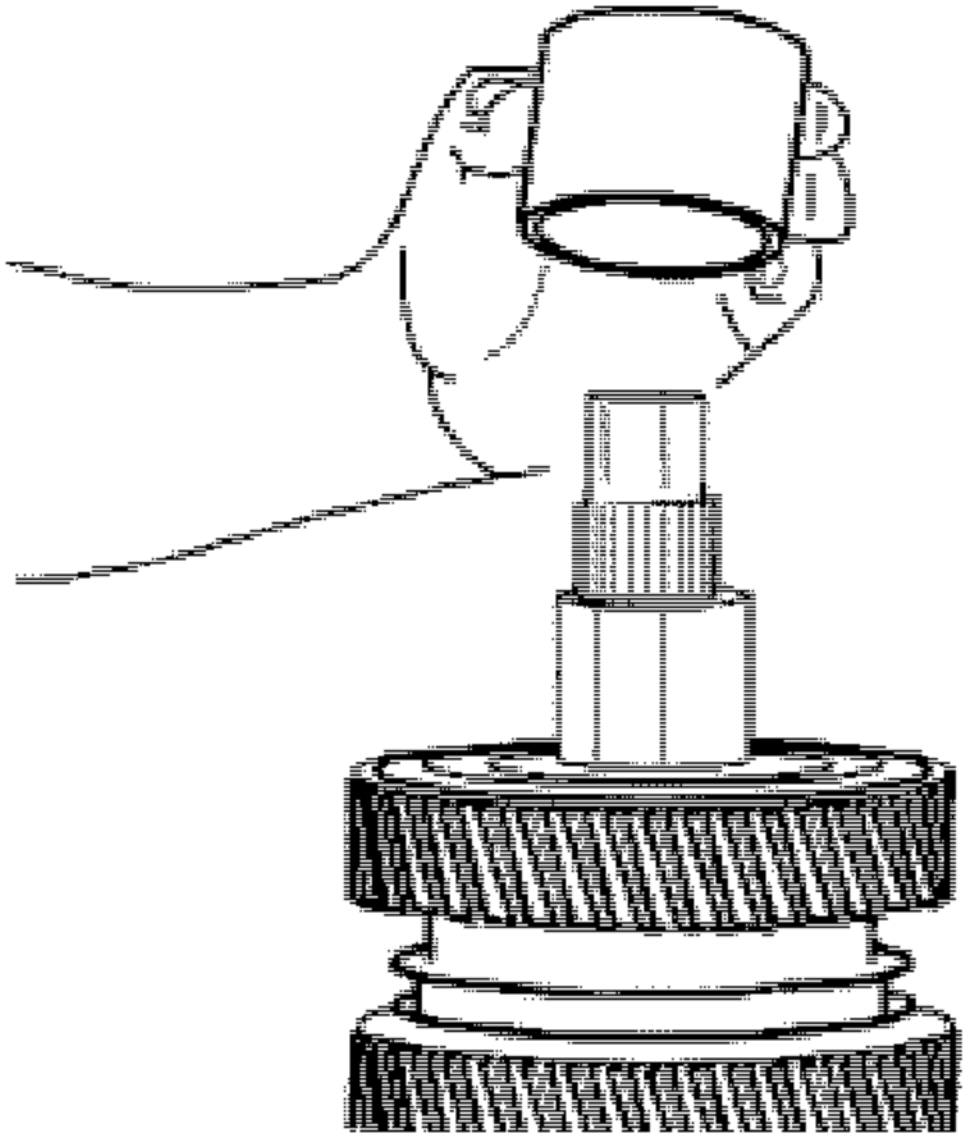


Fig. 186: 3rd Gear Hub
Courtesy of GENERAL MOTORS CORP.

26. Install the 3rd gear hub onto the main shaft.

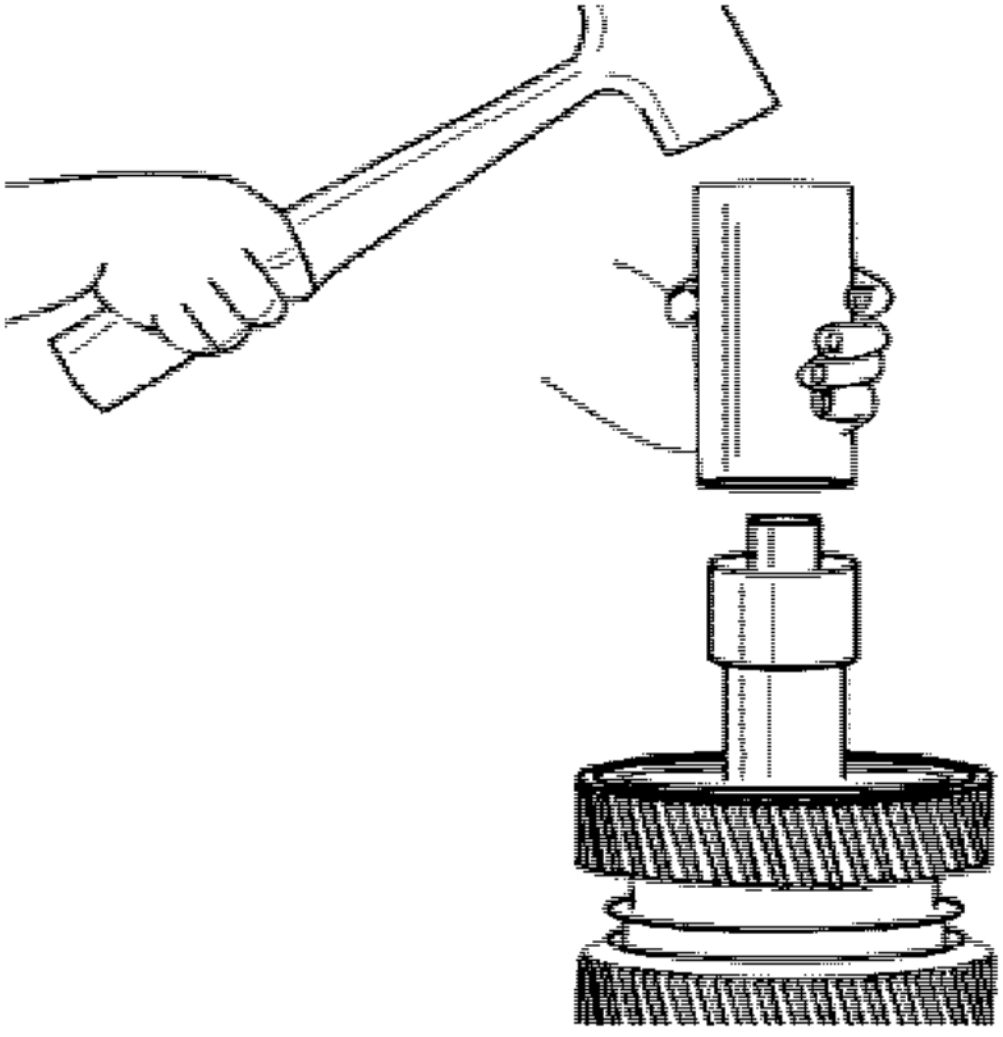


Fig. 187: Installing 3rd Gear Hub
Courtesy of GENERAL MOTORS CORP.

27. Using a driving tool or a hydraulic press, install the 3rd gear hub.

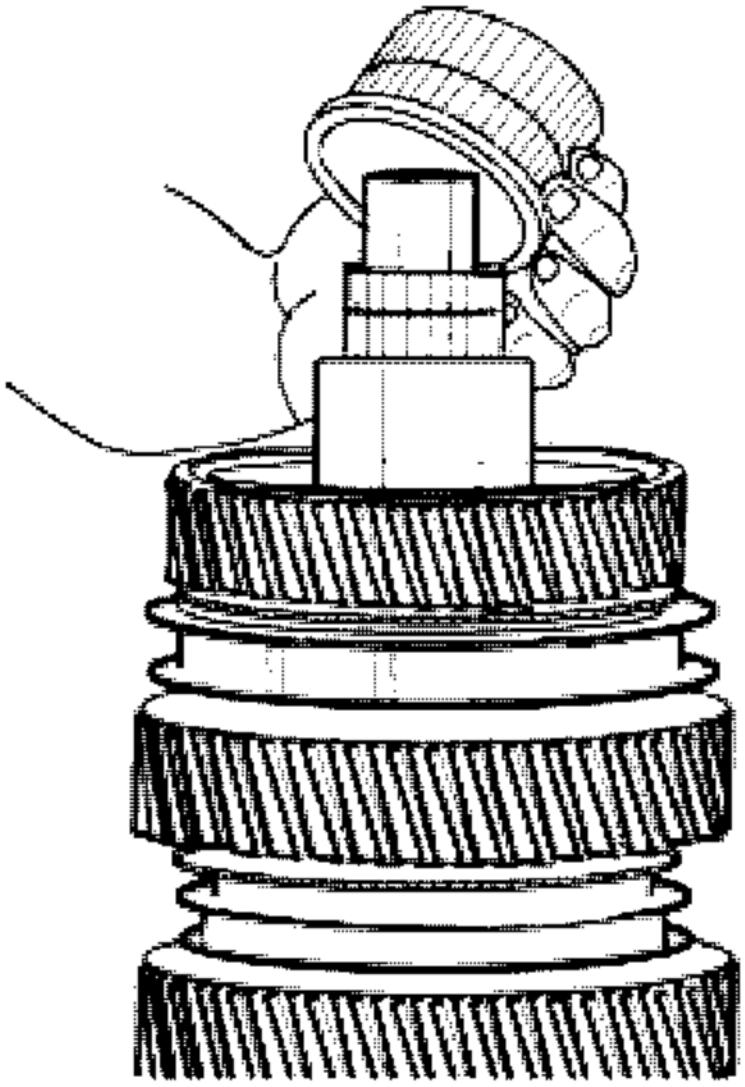


Fig. 188: 3rd Gear Rollers
Courtesy of GENERAL MOTORS CORP.

28. Install the 3rd gear roller cage onto the main shaft.

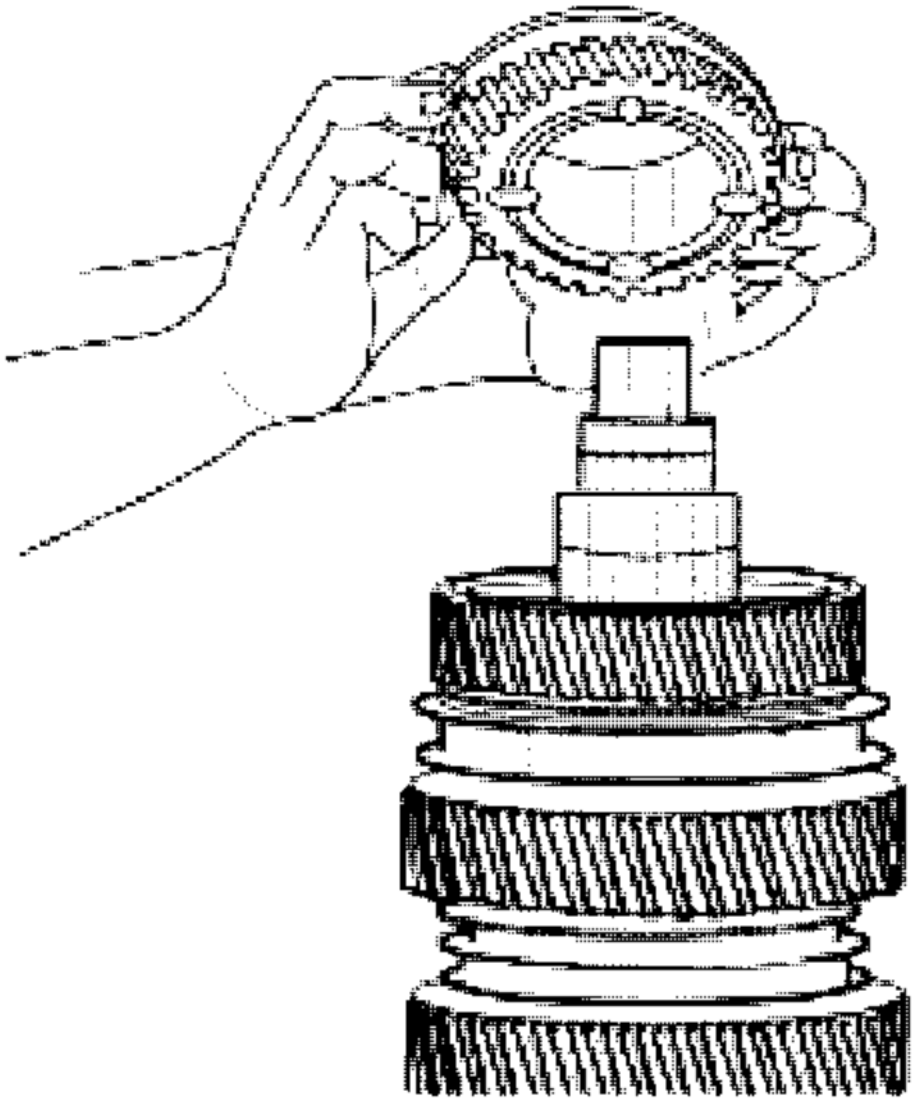


Fig. 189: 3rd Gear
Courtesy of GENERAL MOTORS CORP.

29. Install the 3rd gear onto the main shaft.

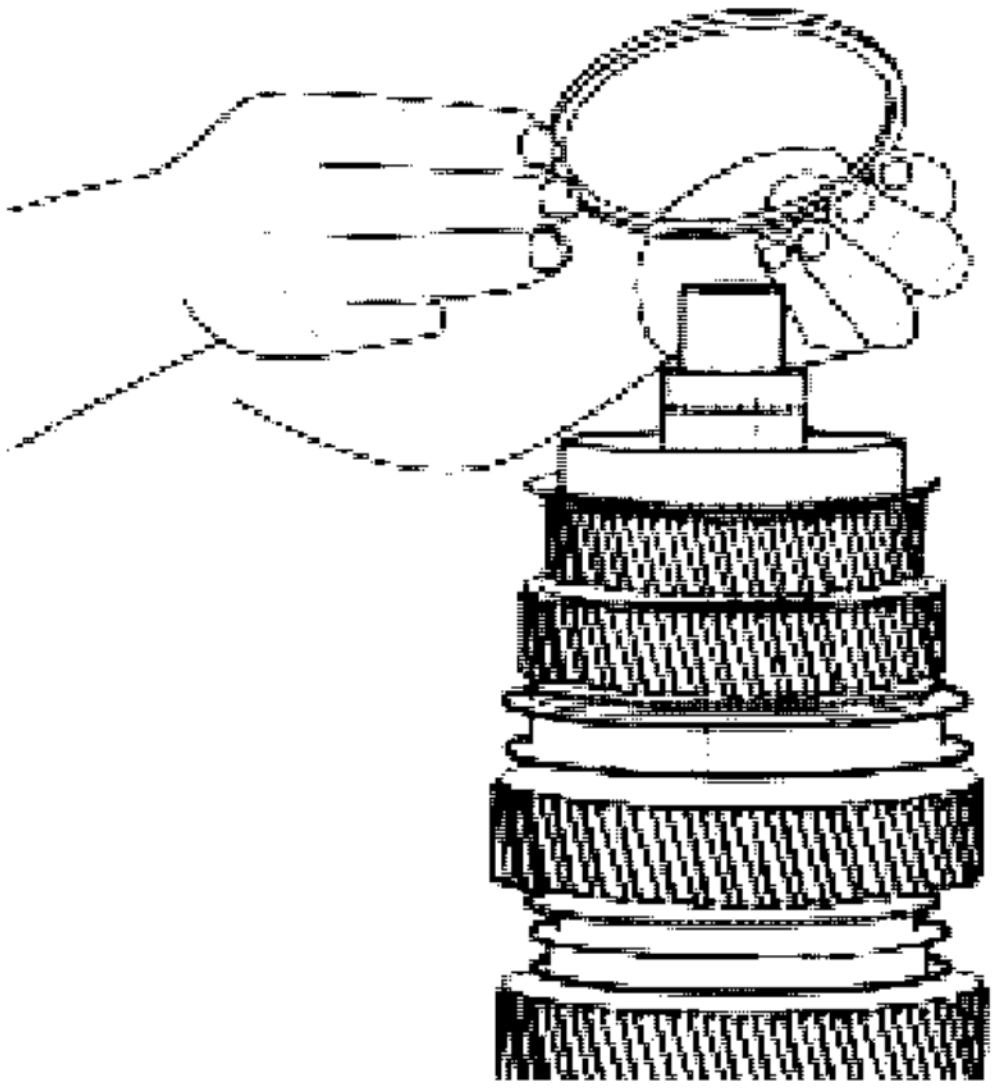


Fig. 190: 3rd Gear Synchronizer
Courtesy of GENERAL MOTORS CORP.

30. Install the lubricated 3rd gear synchronizer ring.

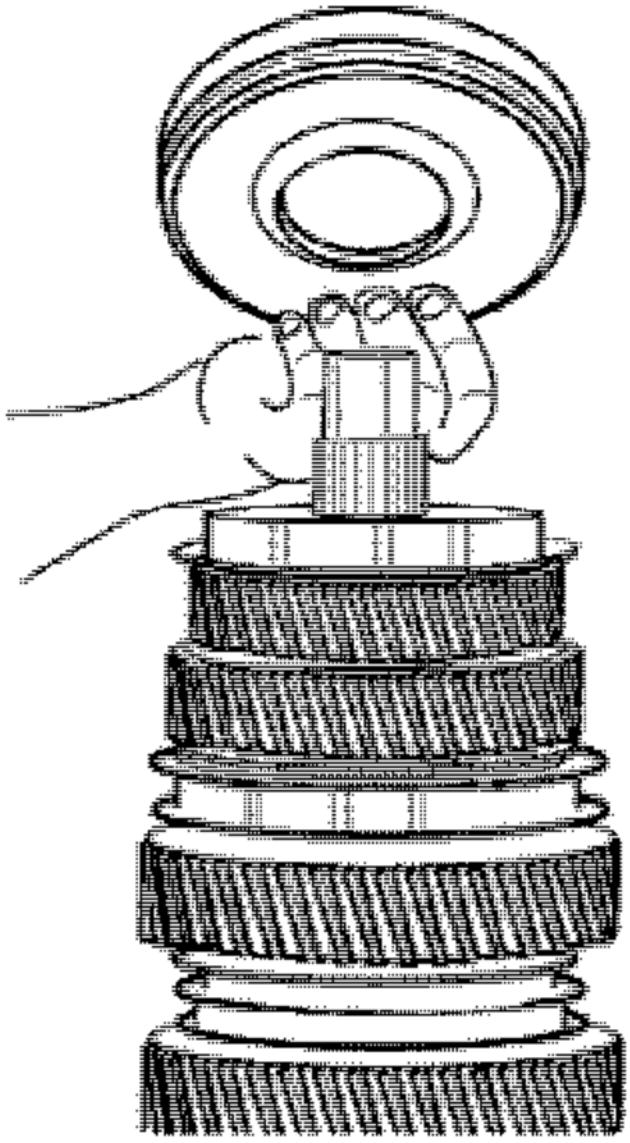


Fig. 191: 3rd And 4th Gear Synchronizer
Courtesy of GENERAL MOTORS CORP.

31. Install the 3rd and 4th gear synchronizer assembly.
32. Turn the 3rd and 4th gear synchronizer assembly in order to seat the insert grooves.

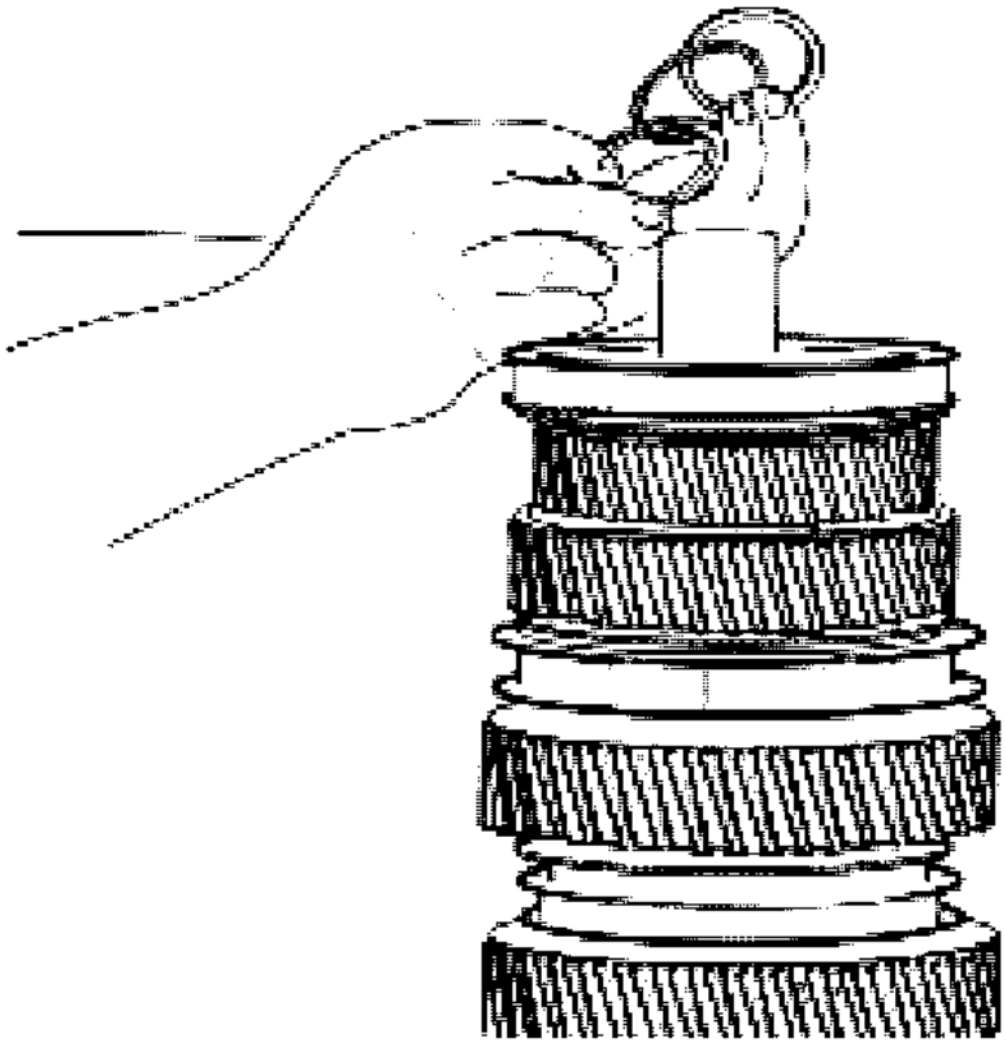


Fig. 192: Pulleys, Track And Push Bearing
Courtesy of GENERAL MOTORS CORP.

33. Install the pulley track and push bearing.

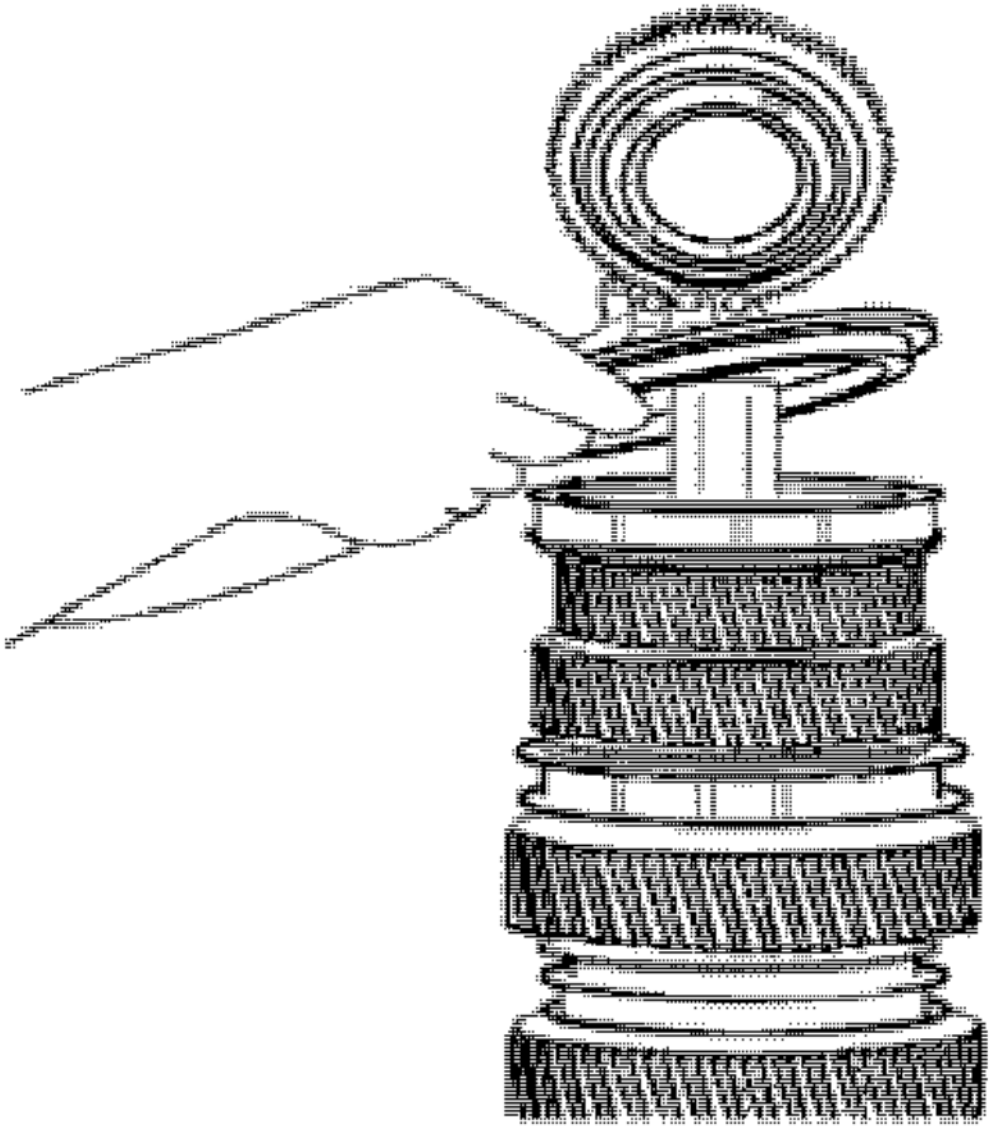


Fig. 193: Clutch Bearing
Courtesy of GENERAL MOTORS CORP.

34. Install the synchronization ring and the drive shaft clutch ring.

SHIFT SHAFT AND FORK ASSEMBLIES ASSEMBLE

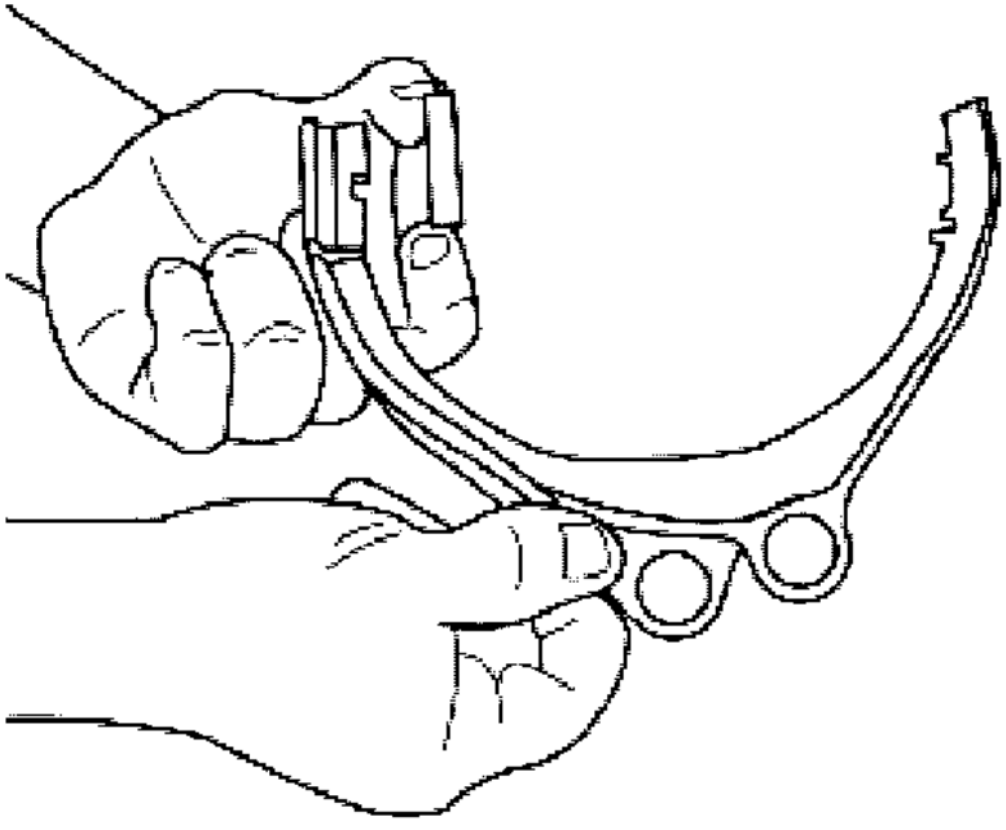


Fig. 194: Fork Inserts
Courtesy of GENERAL MOTORS CORP.

1. If the fork leg inserts must be replaced, you should press them in. Ensure they are centered in the housing.

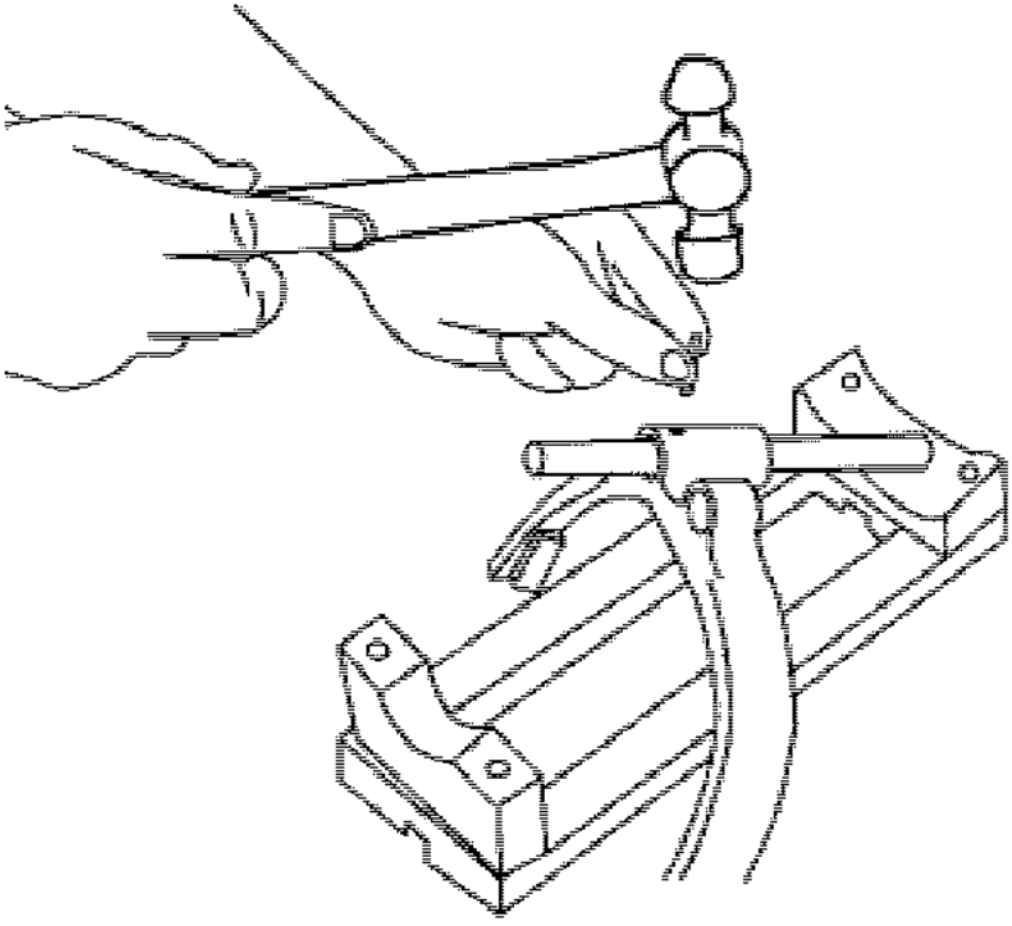


Fig. 195: Installing 1st And 2nd Gear Fork
Courtesy of GENERAL MOTORS CORP.

2. Assemble the 1st and 2nd gear fork, if removed, using a NEW roll pin.

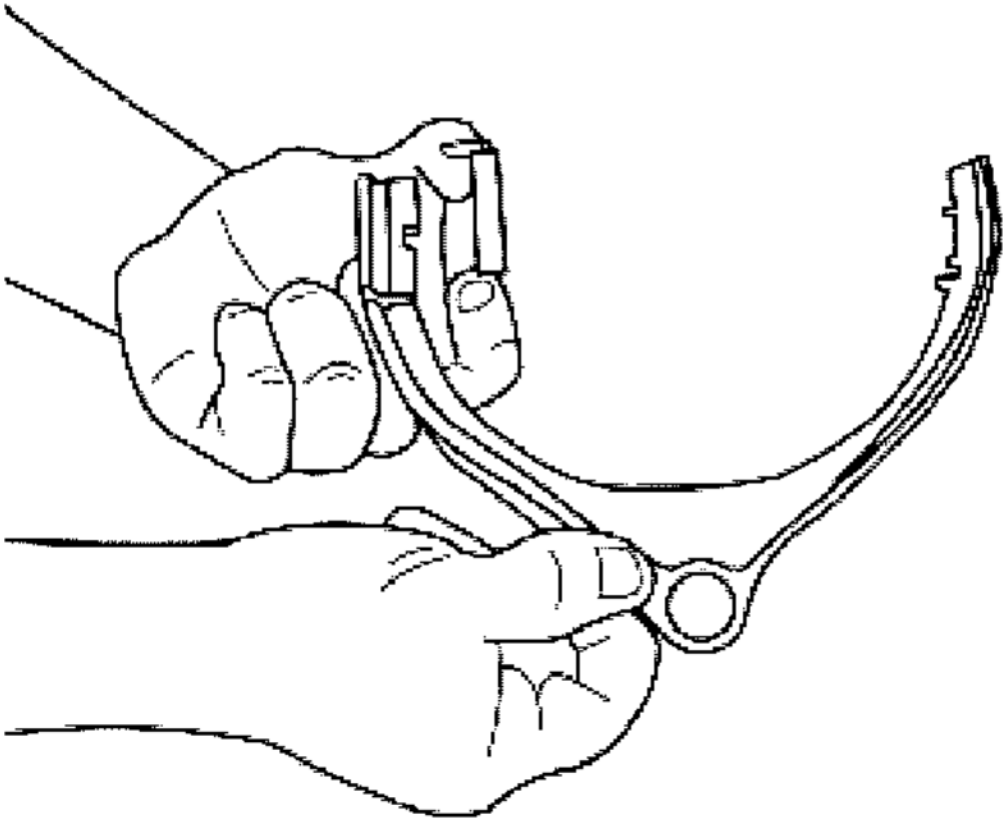


Fig. 196: Fork Inserts
Courtesy of GENERAL MOTORS CORP.

3. If the fork leg inserts must be replaced, you must press them into position.

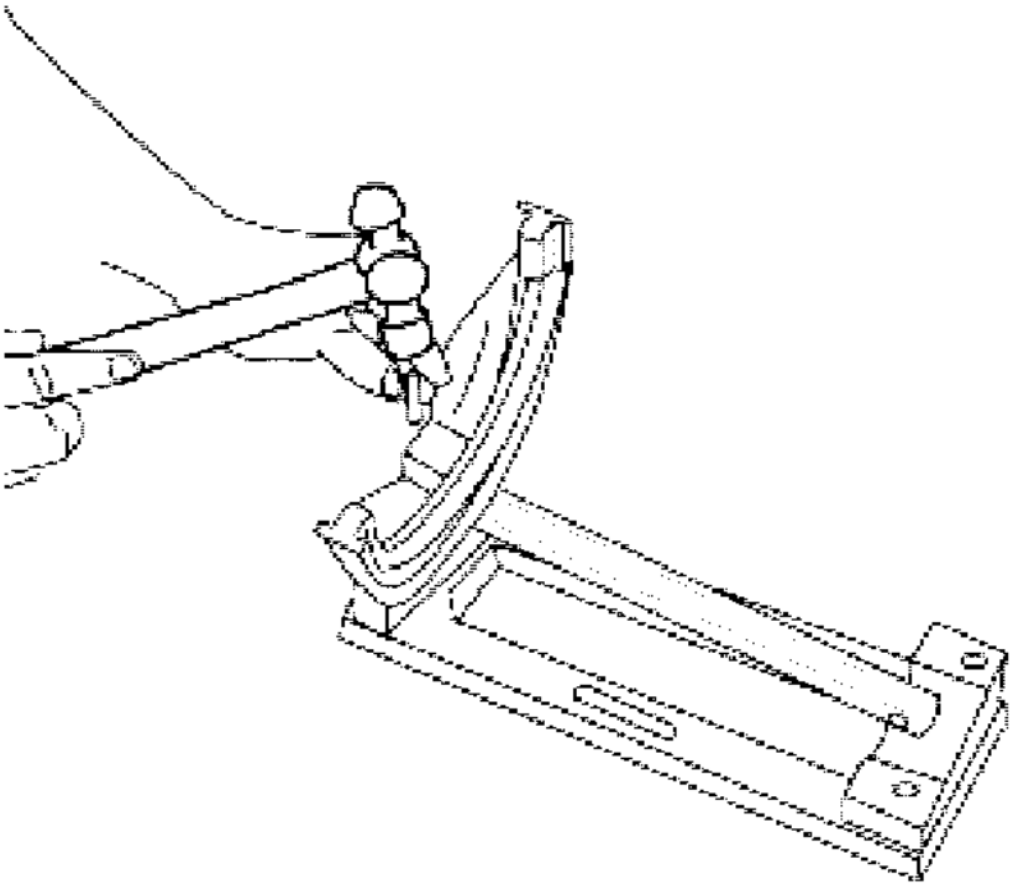


Fig. 197: Installing 3rd And 4th Gear Fork Roll Pin
Courtesy of GENERAL MOTORS CORP.

4. If the 3rd and 4th gear fork was removed, you must assemble and affix the fork with the 3rd and 4th gear fork roll pin.

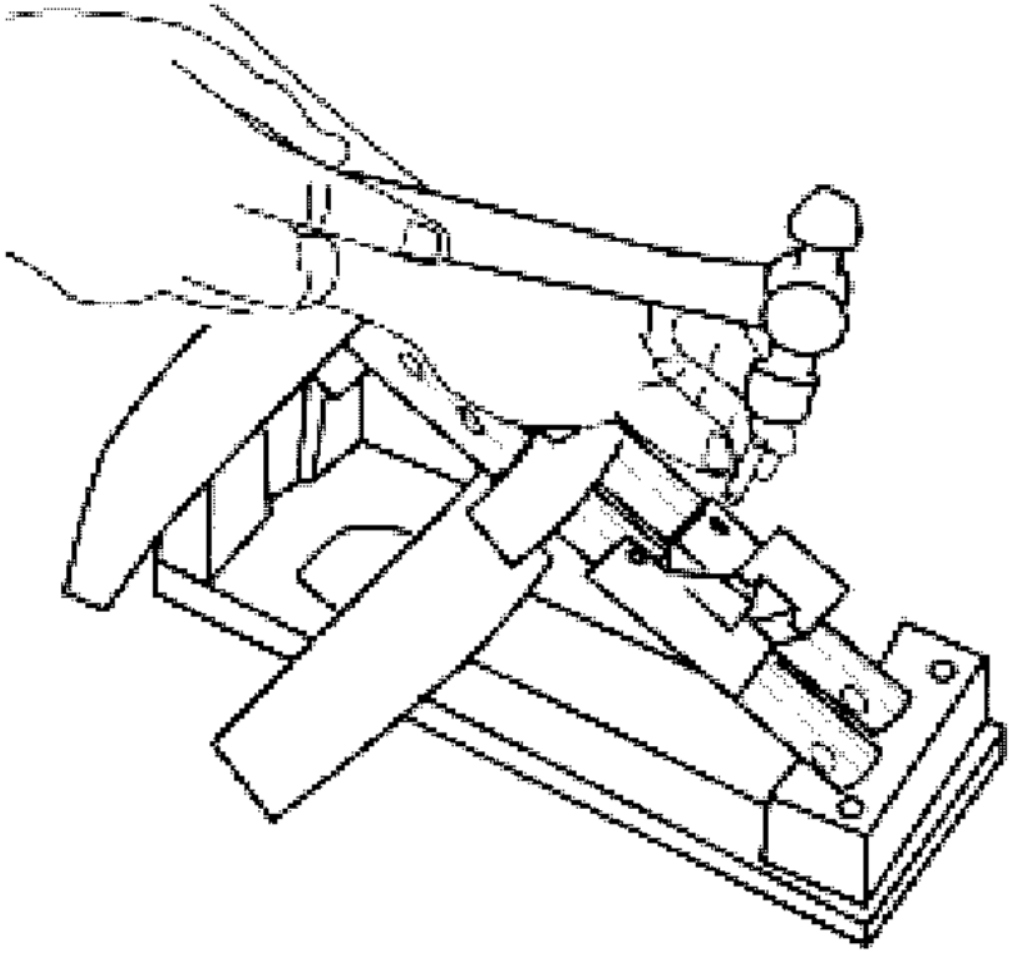


Fig. 198: Installing New Roll Pin Over 1st And 2nd Gear Stop
Courtesy of GENERAL MOTORS CORP.

5. Install the new roll pin over the 1st and 2nd gear stop. Screw the shaft and fork assembly in using the insert marks.

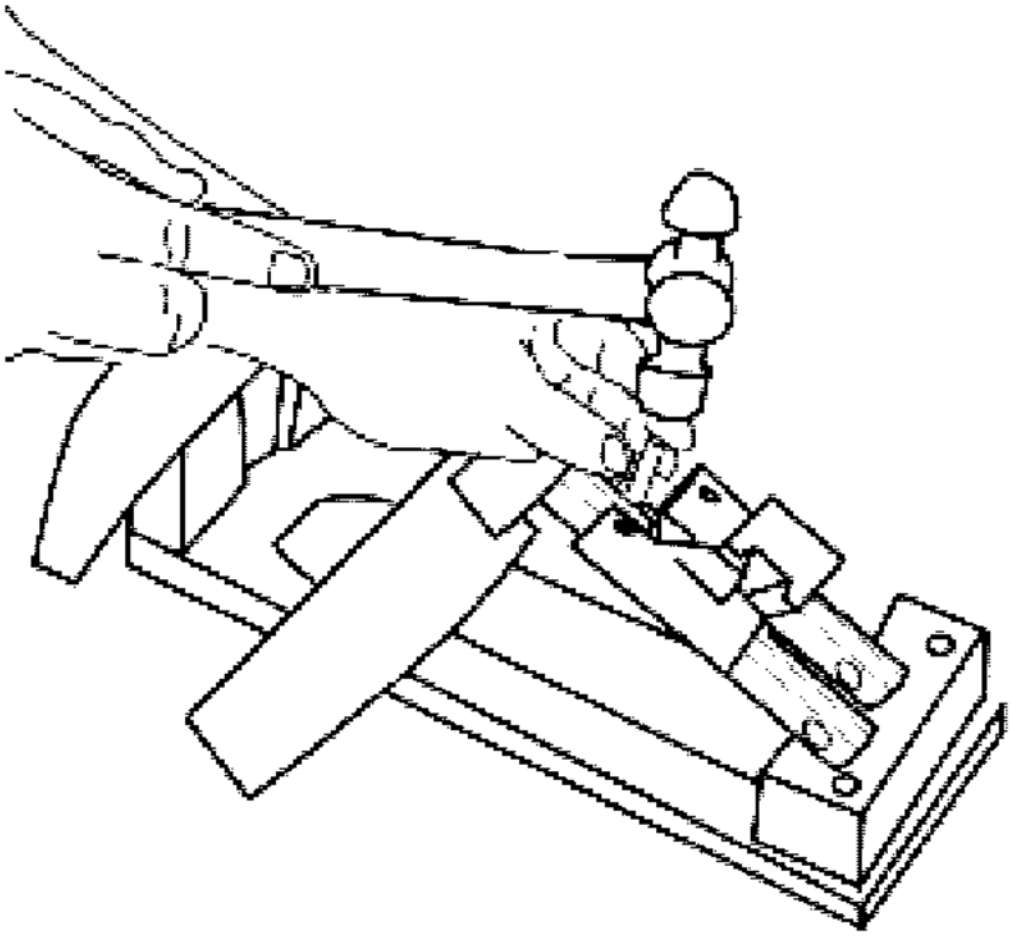


Fig. 199: Installing New Roll Pin On 3rd And 4th Gear Stop
Courtesy of GENERAL MOTORS CORP.

6. Install the new roll pin on the 3rd and 4th gear stop.

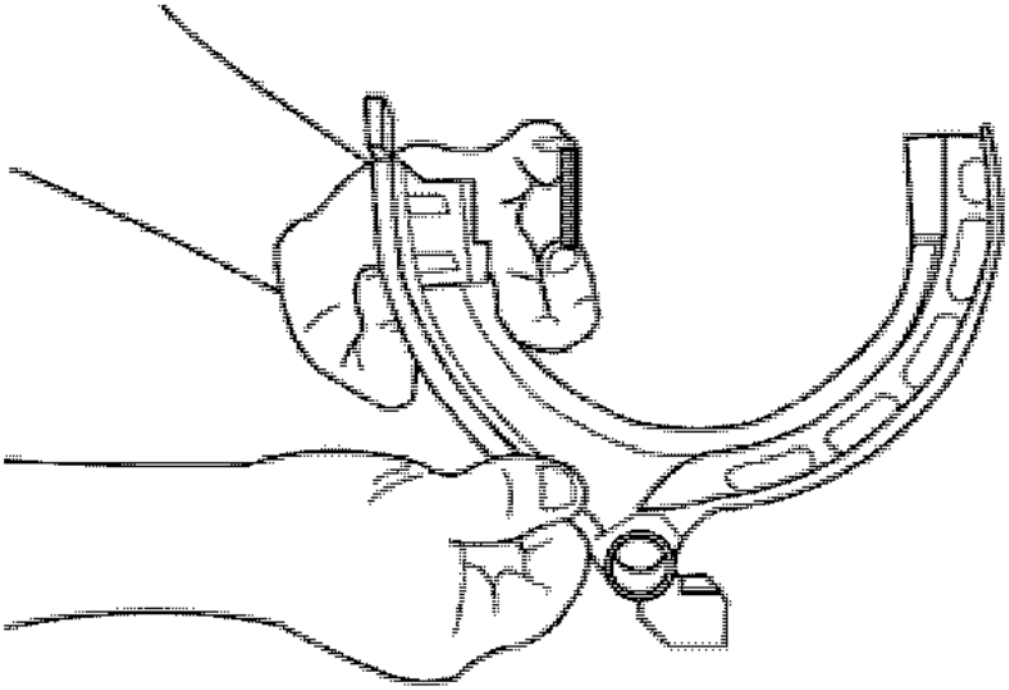


Fig. 200: Fork Inserts
Courtesy of GENERAL MOTORS CORP.

7. If the fork leg inserts must be replaced, press them in and ensure they enter into the housing.

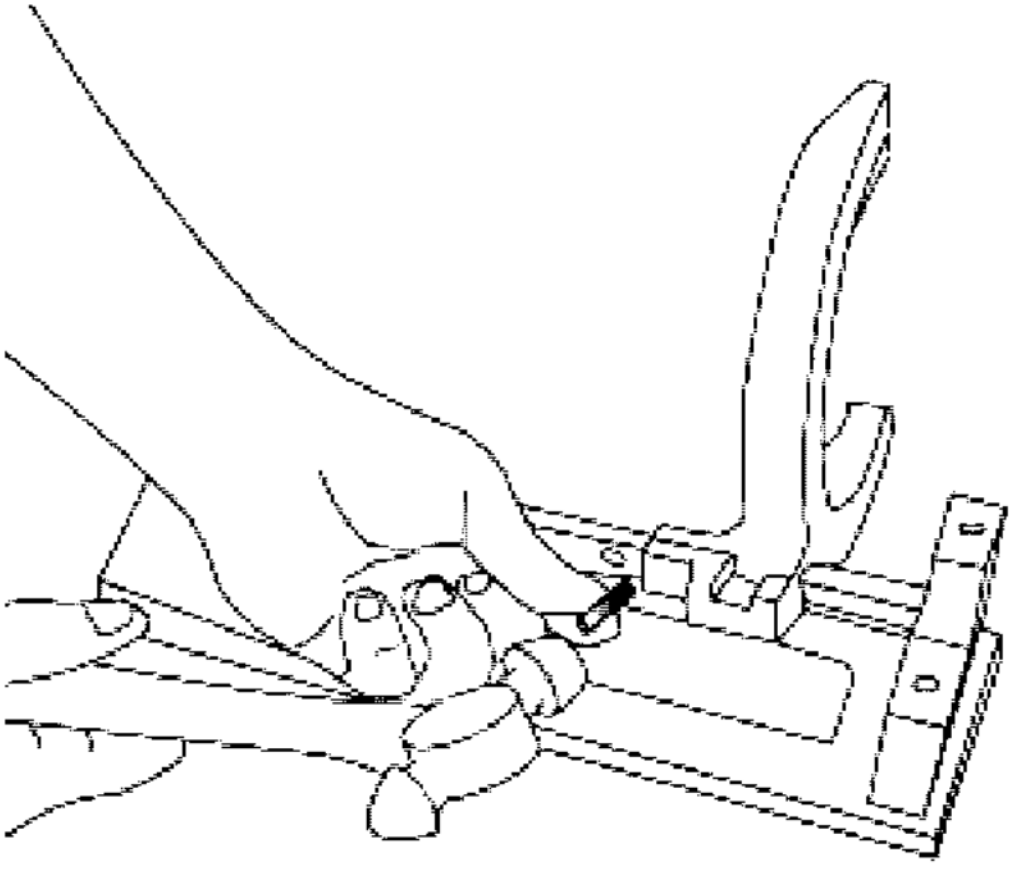


Fig. 201: Installing New Roll Pin Into 5th And Reverse Gear Fork
Courtesy of GENERAL MOTORS CORP.

8. Install the new roll pin into the 5th and reverse gear fork, using the insert marks as a reference.

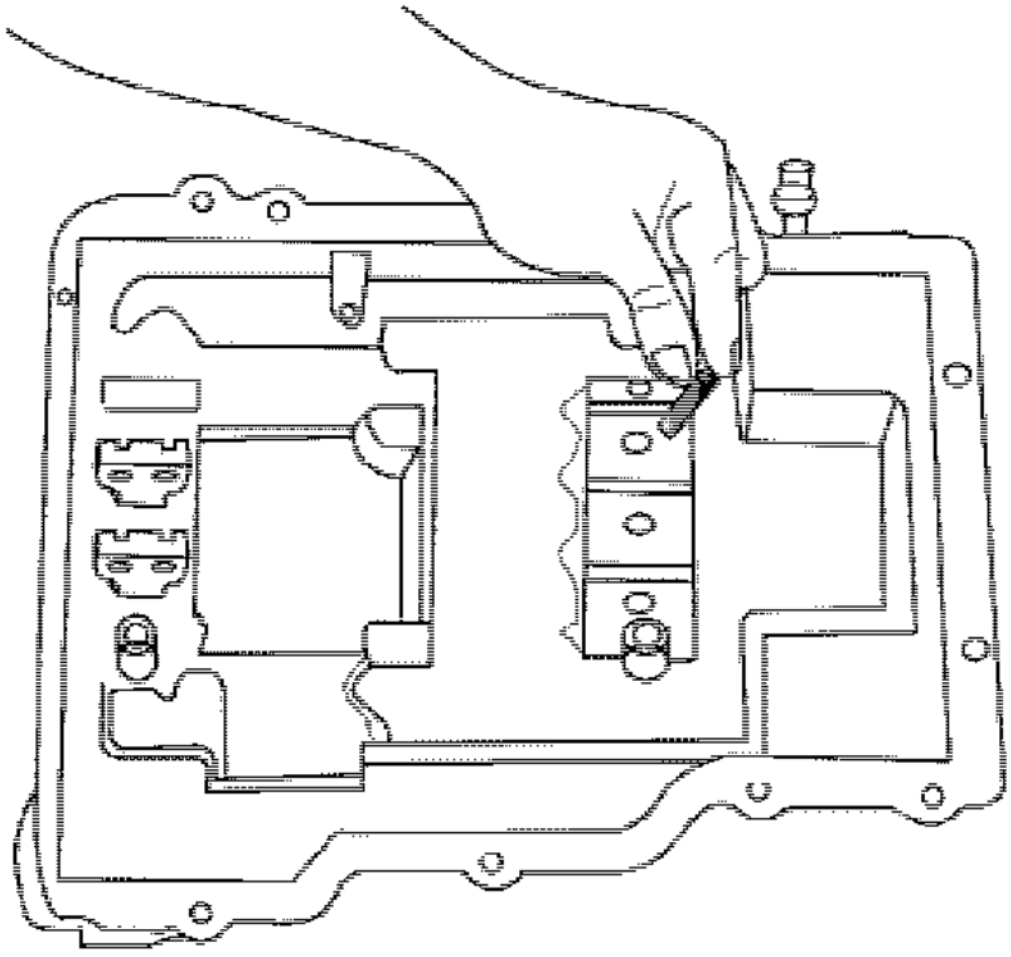


Fig. 202: Insert Springs
Courtesy of GENERAL MOTORS CORP.

9. Install the 3 insert springs.

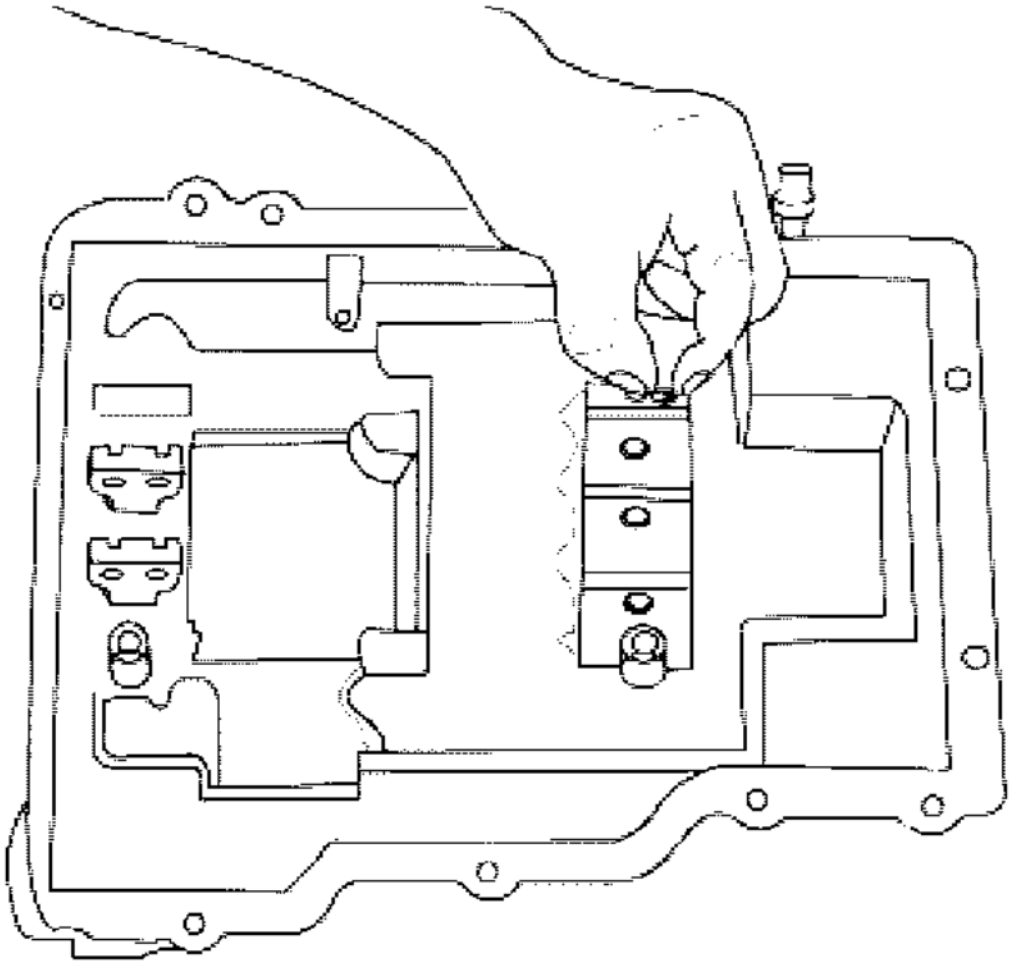


Fig. 203: Insert Spheres
Courtesy of GENERAL MOTORS CORP.

10. Install the 3 insert spheres.

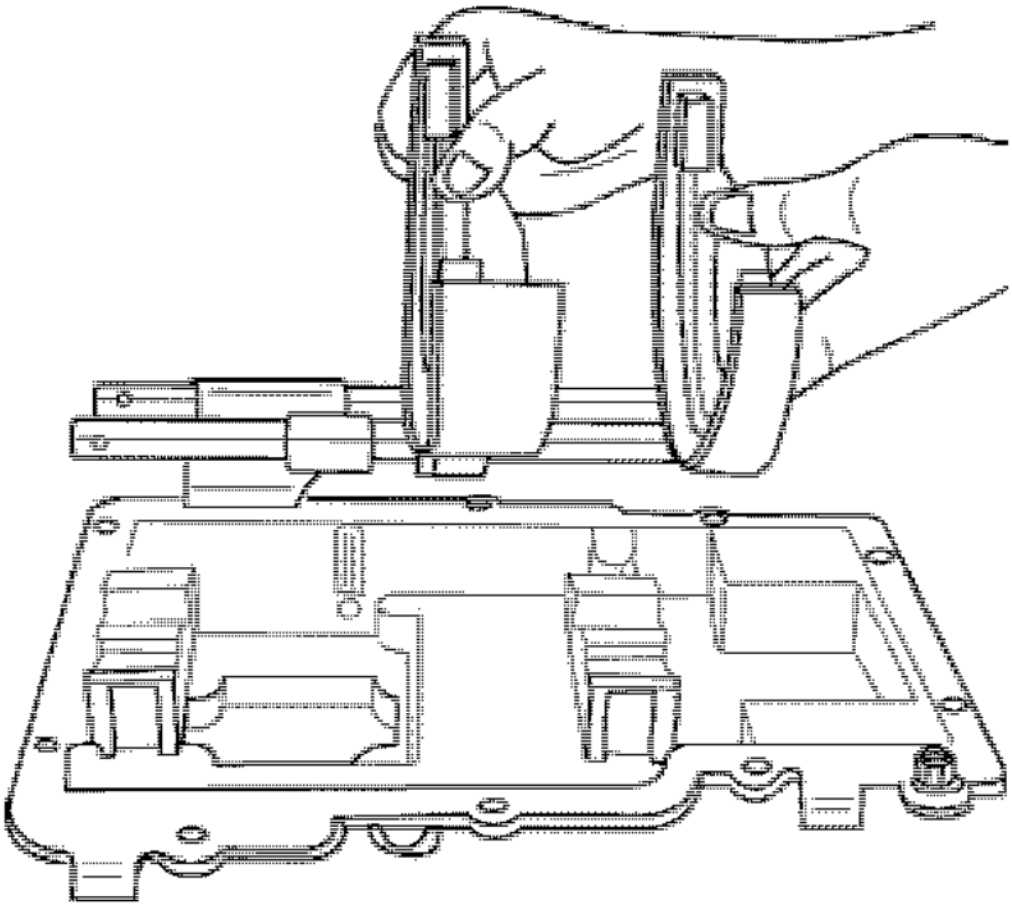


Fig. 204: Assembly With Shafts, Forks And Stops
Courtesy of GENERAL MOTORS CORP.

11. Install the previously assembled unit, shafts, and forks.

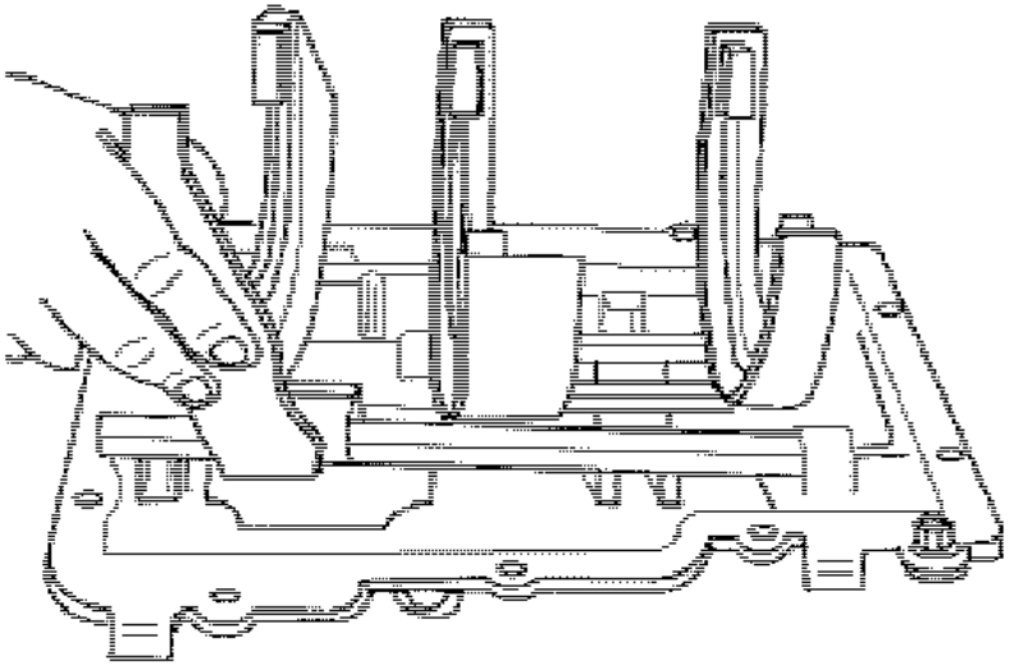


Fig. 205: 5th Gear, Reverse Shaft, And Fork Assembly
Courtesy of GENERAL MOTORS CORP.

12. Install the 5th and reverse gear fork and shaft, placing the spheres on the insert marks.

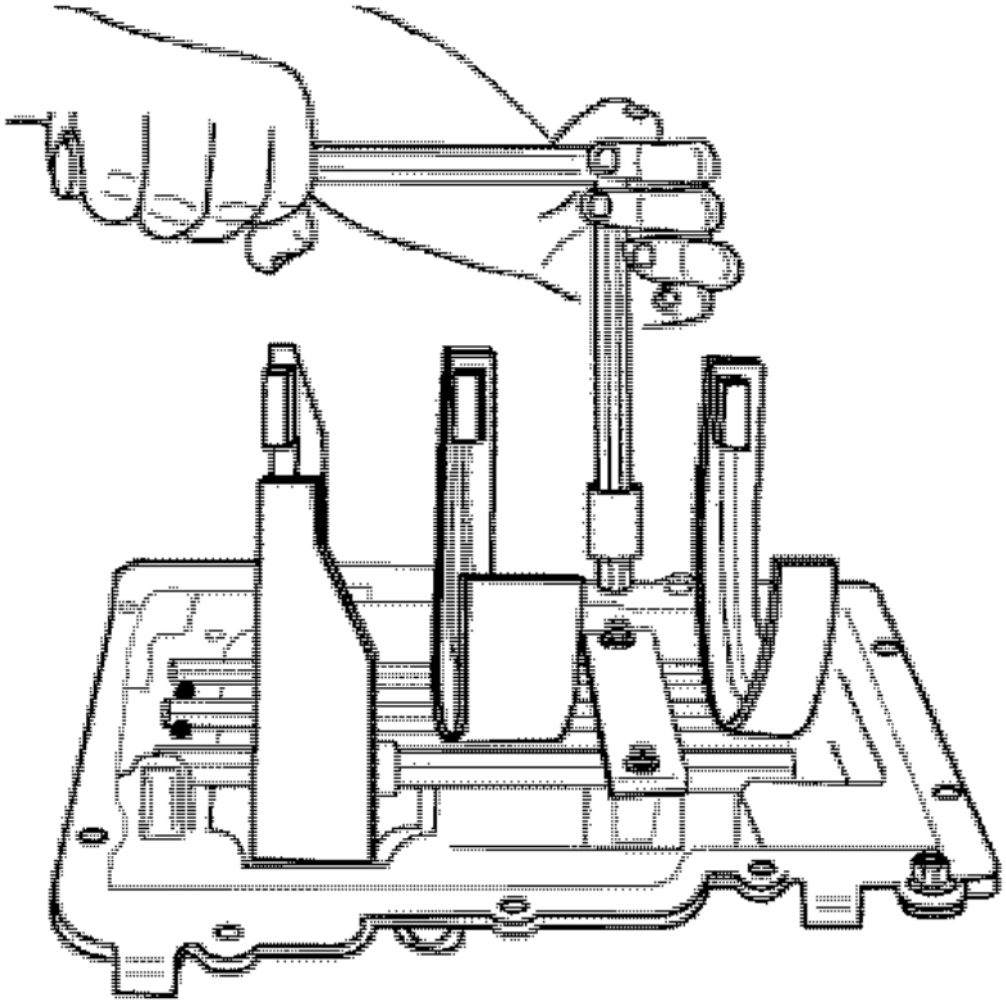


Fig. 206: Retaining Plate Screws
Courtesy of GENERAL MOTORS CORP.

13. Using a 1/2 socket, tighten the 2 screws on the insert system support plate.

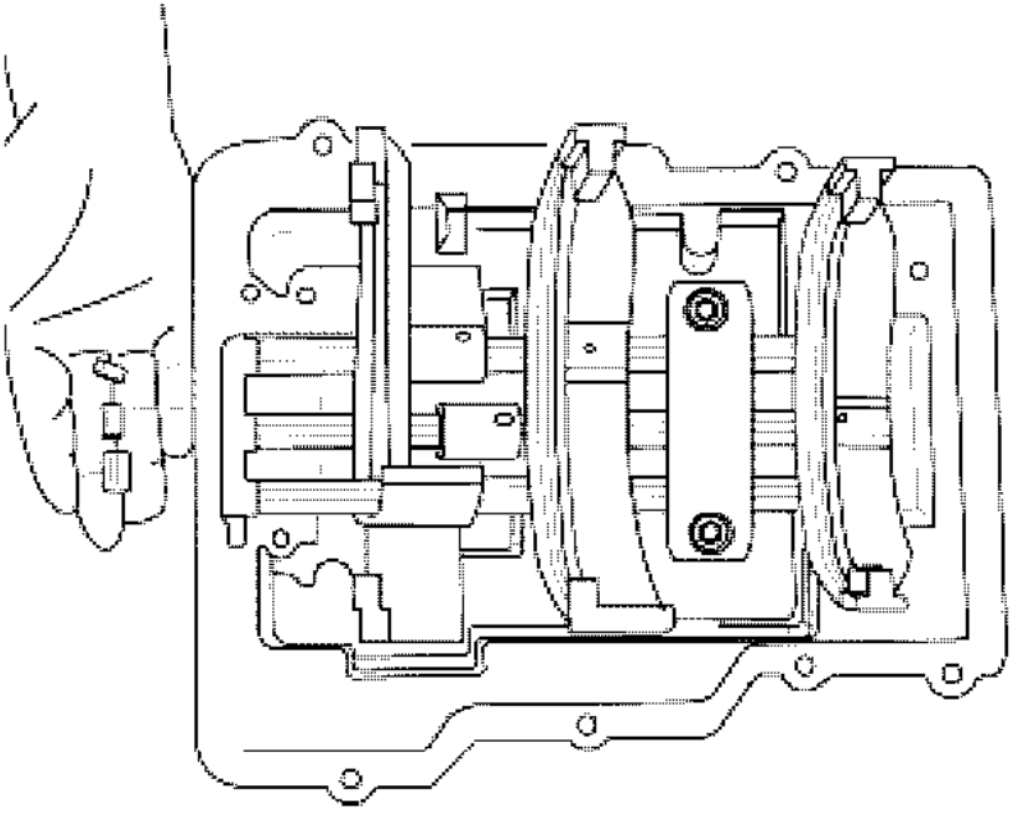


Fig. 207: Pins And Lock
Courtesy of GENERAL MOTORS CORP.

14. Install the roll pins .

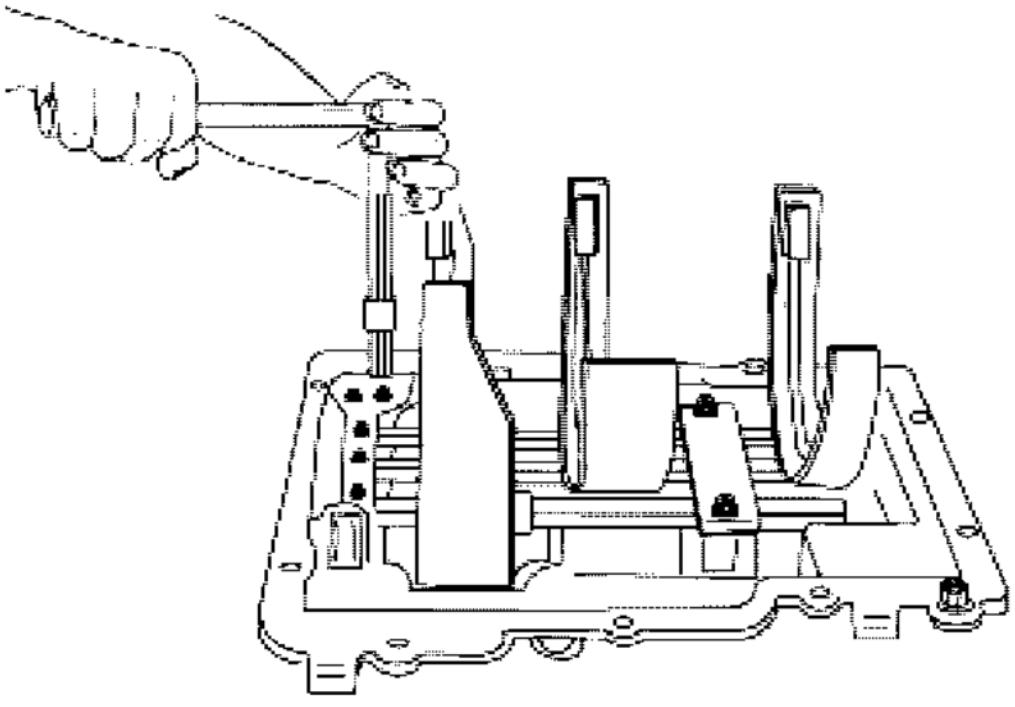


Fig. 208: Screws Retaining Support Plate On Block
Courtesy of GENERAL MOTORS CORP.

15. Using a 1/2 socket, tighten the 3 screws on the locking system support plate.

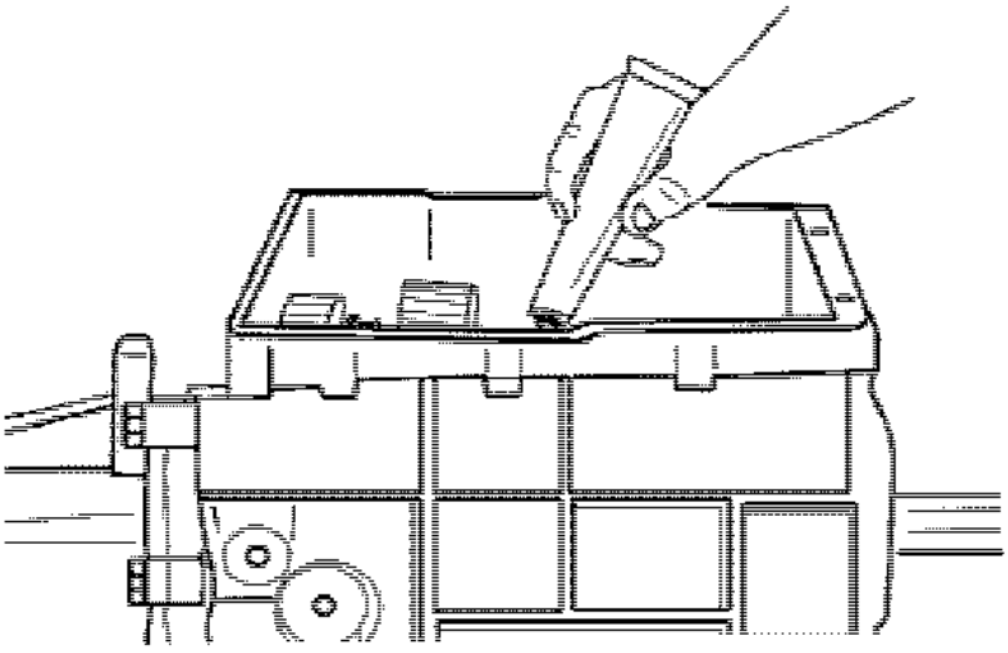


Fig. 209: Applying Gasket Maker
Courtesy of GENERAL MOTORS CORP.

16. Ensure the surface is free from dust and grease and apply gasket maker GMM P/N 1052943.

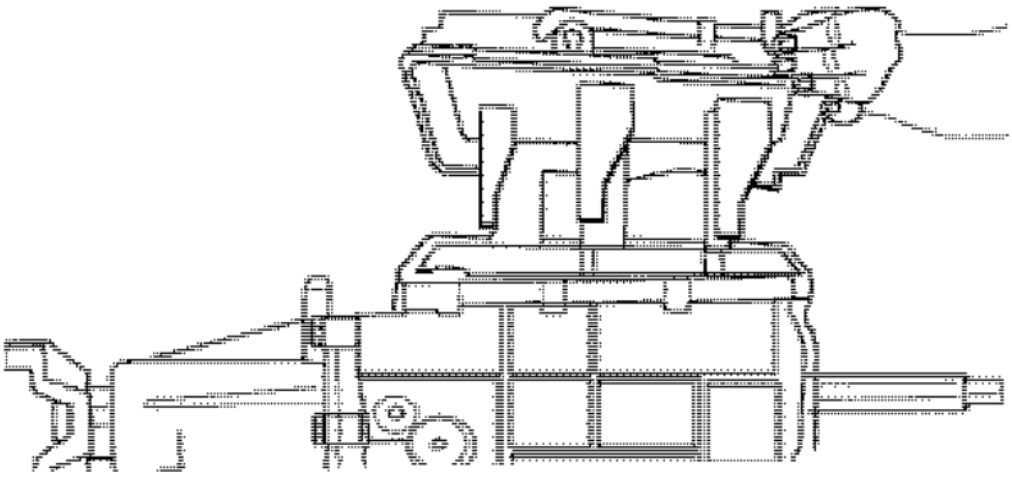


Fig. 210: Control Cover
Courtesy of GENERAL MOTORS CORP.

17. Install the control cover onto the case, assuring the shift forks are aligned with the corresponding synchronizers.

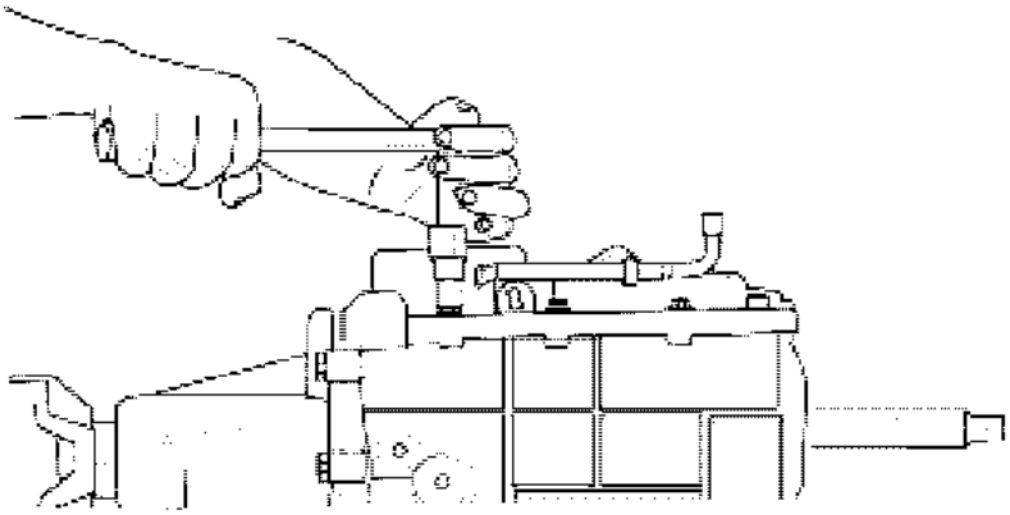


Fig. 211: Using 1/2 Socket On Screws Holding Control Cover
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

18. Using a 1/2 socket, tighten the 10 screws on the control cover.

    Tighten: Tighten the screws to 20-24 N.m (18-22 lb ft).

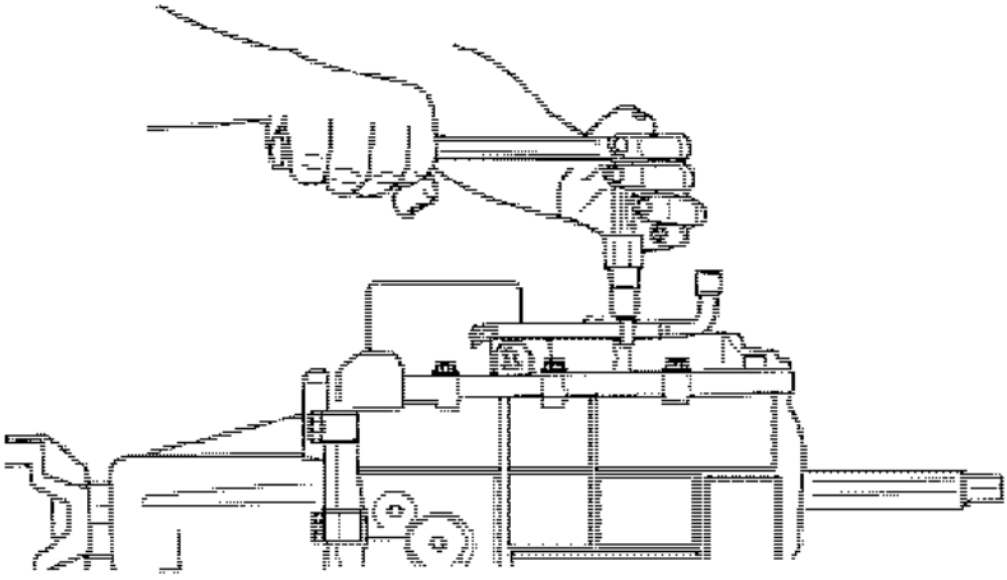


Fig. 212: Using Ratchet On Breather Support Screw
Courtesy of GENERAL MOTORS CORP.

19. Using a 13 mm socket, tighten the breather support screw.

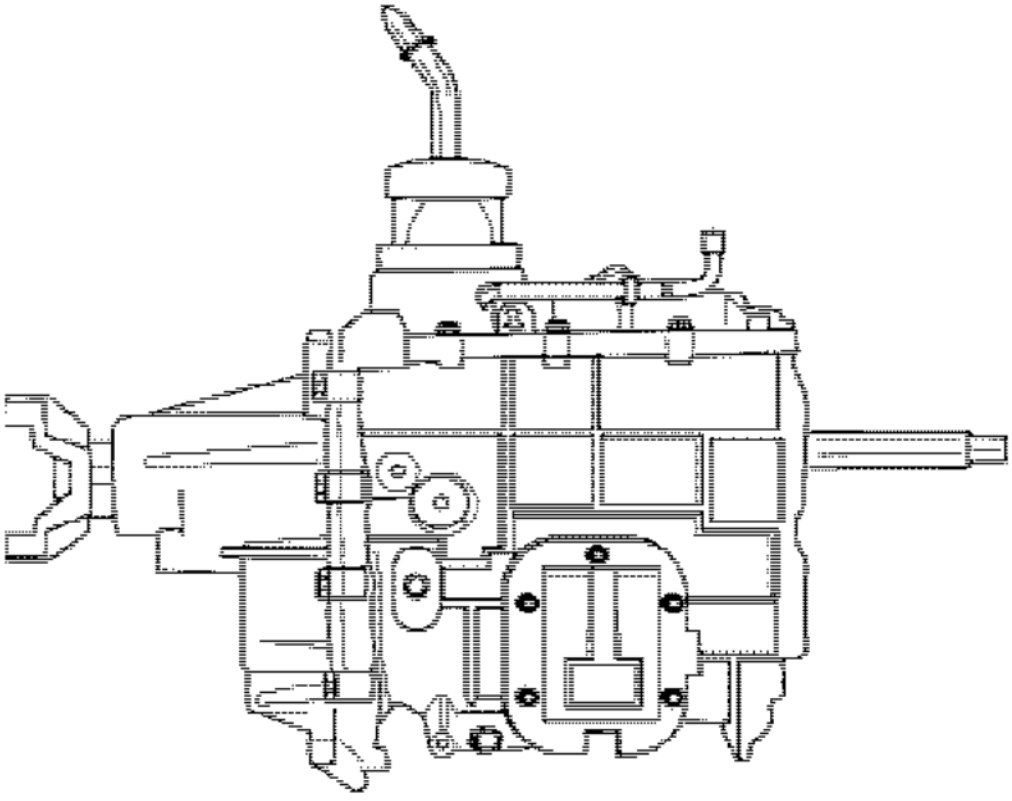


Fig. 213: Transmission
Courtesy of GENERAL MOTORS CORP.

20. Install the shift tower.

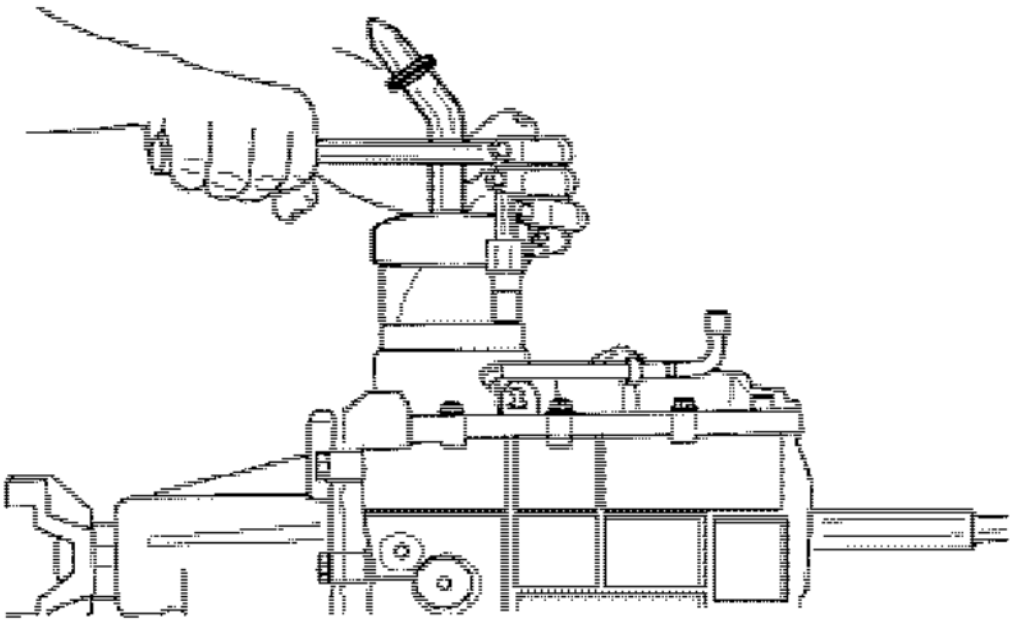


Fig. 214: Using Ratchet On Shift Tower Screws
Courtesy of GENERAL MOTORS CORP.

21. Using a 10 mm socket, tighten the 4 screws on the shift tower.

    Tighten: Tighten the screws to 8-14 N.m (6-11 lb ft).

TRANSMISSION ASSEMBLE

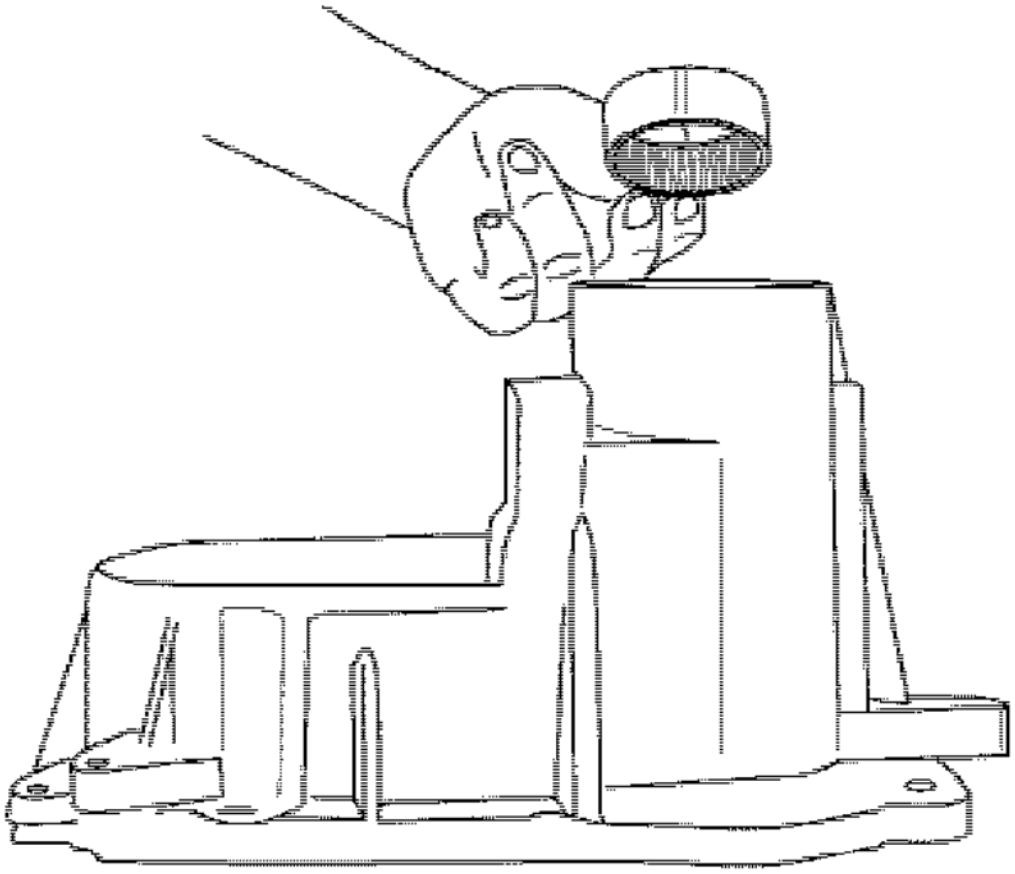


Fig. 215: Bearing
Courtesy of GENERAL MOTORS CORP.

1. Using a drive tool, install a new bearing, if equipped.

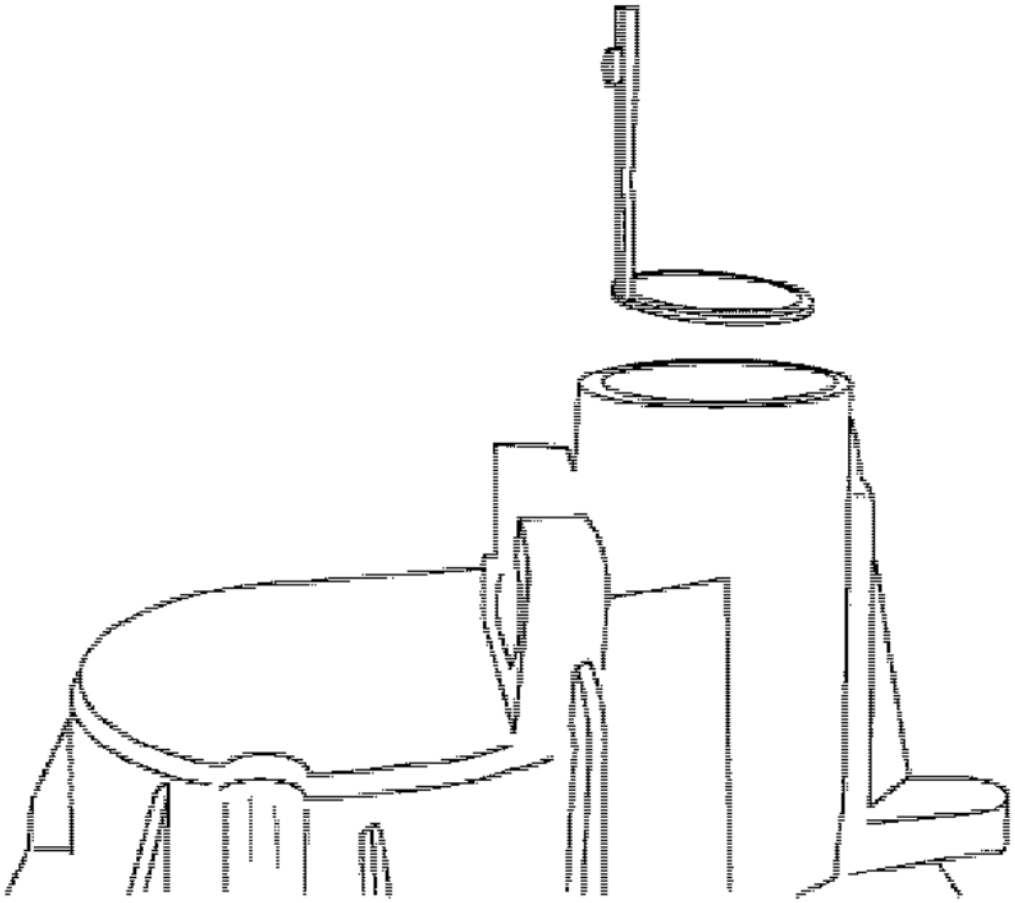


Fig. 216: Snap Ring
Courtesy of GENERAL MOTORS CORP.

2. Using locking pliers, install the bearing snap ring, if equipped.

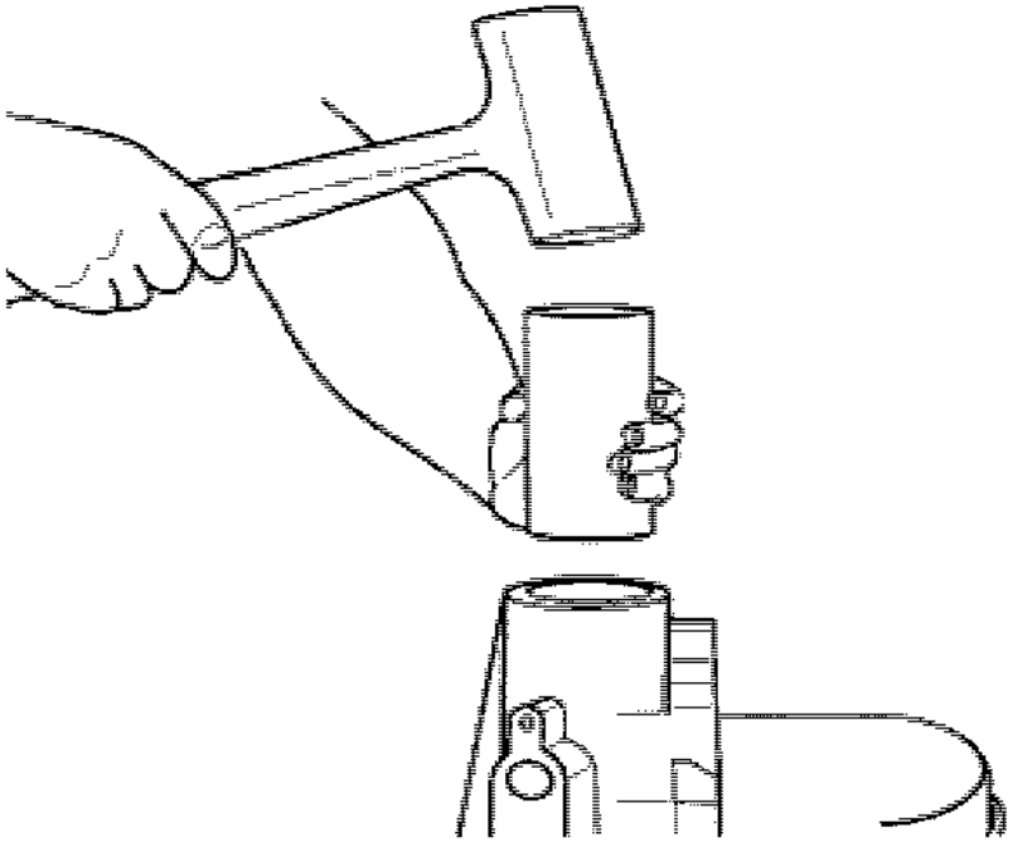


Fig. 217: Extension Housing Oil Seal
Courtesy of GENERAL MOTORS CORP.

3. Using a drive tool, if required, install a new extension oil seal.

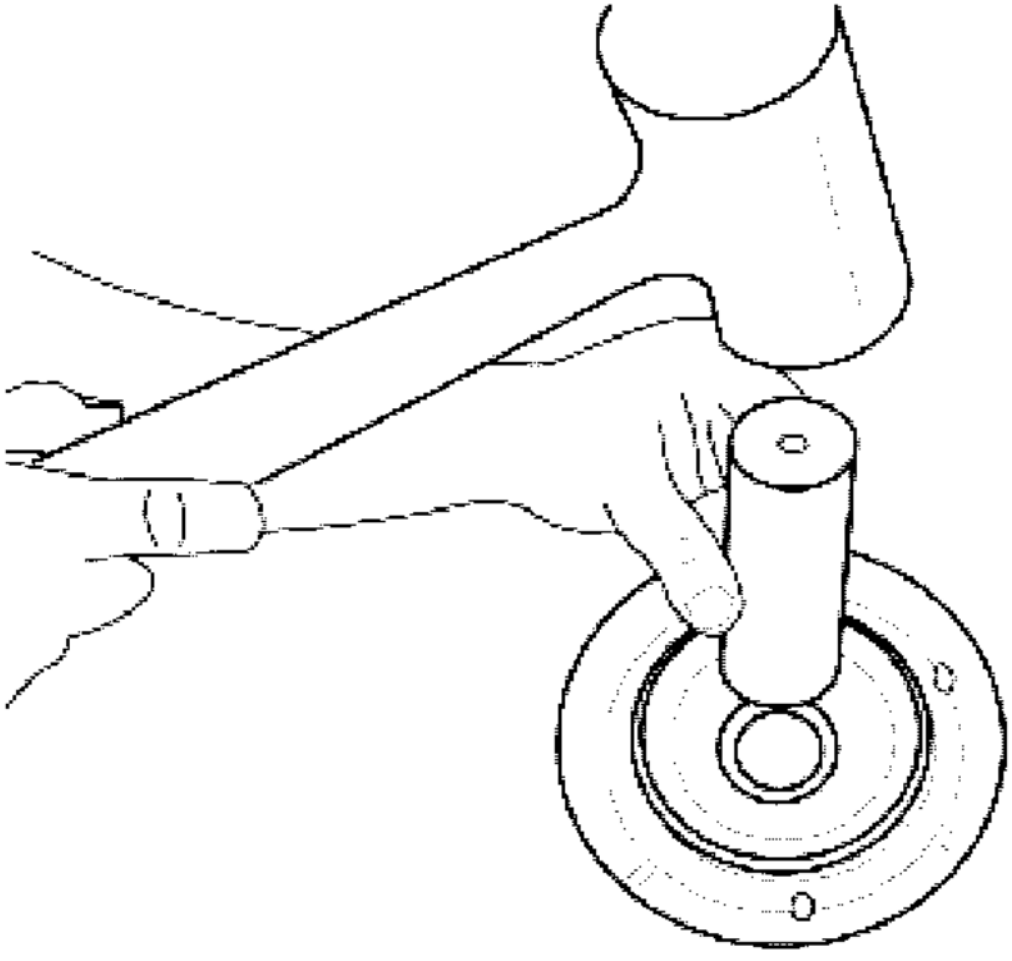


Fig. 218: Installing New Retaining Oil Seal
Courtesy of GENERAL MOTORS CORP.

4. Using a driving tool, install a new retaining oil seal, if required.

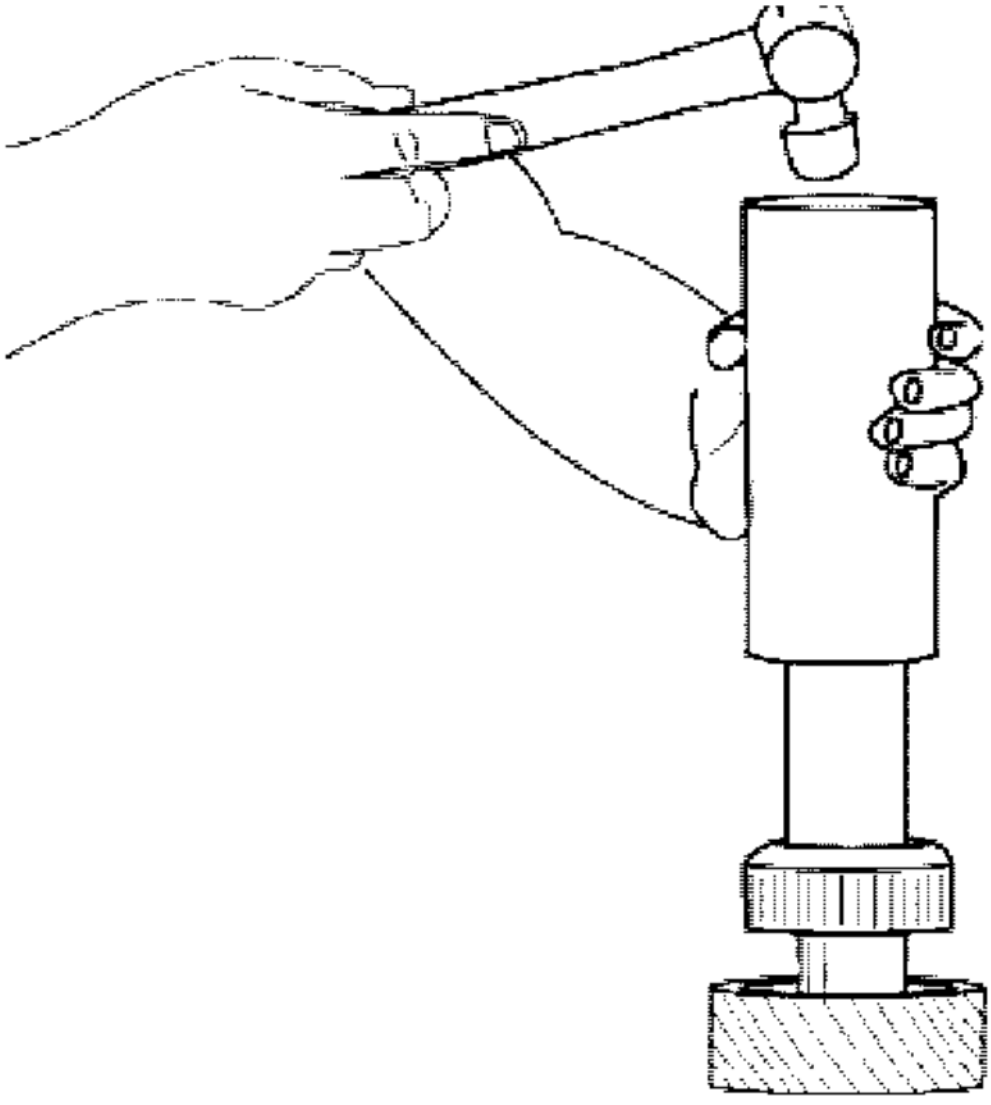


Fig. 219: Installing Drive Shaft Tapered Bearing Taper
Courtesy of GENERAL MOTORS CORP.

5. Using a drive tool or hydraulic press, install the drive shaft tapered bearing taper.

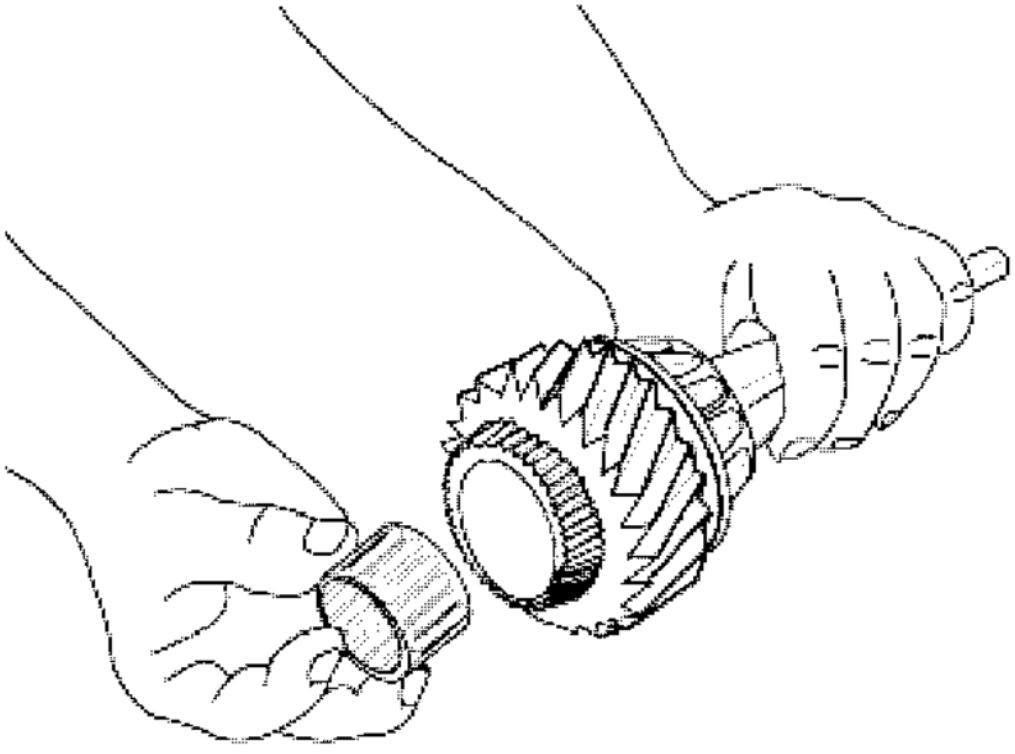


Fig. 220: Drive Shaft Interior Bearing Roller Cage
Courtesy of GENERAL MOTORS CORP.

6. Install the drive shaft interior bearing roller cage.

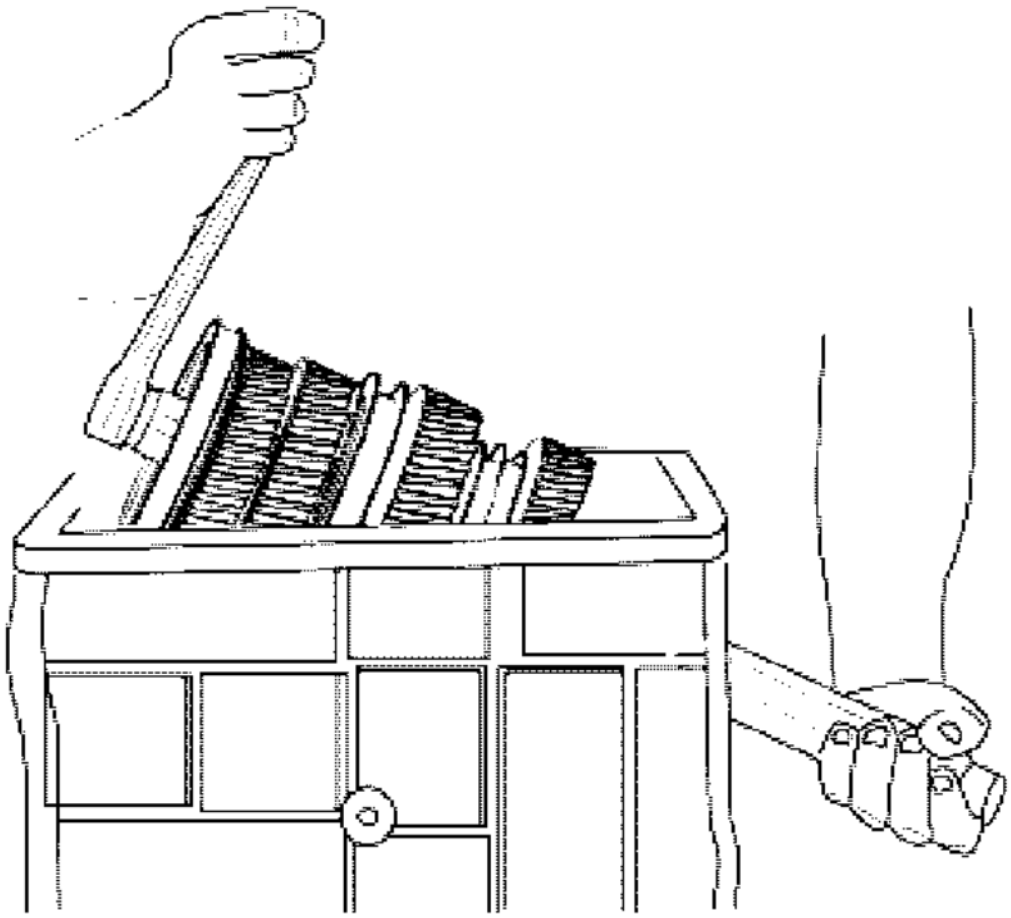


Fig. 221: Main Shaft Assembly
Courtesy of GENERAL MOTORS CORP.

7. Install the main shaft assembly. Fasten it to the synchronizer, lifting with the help of a cord in one hand and pushing with the other hand.

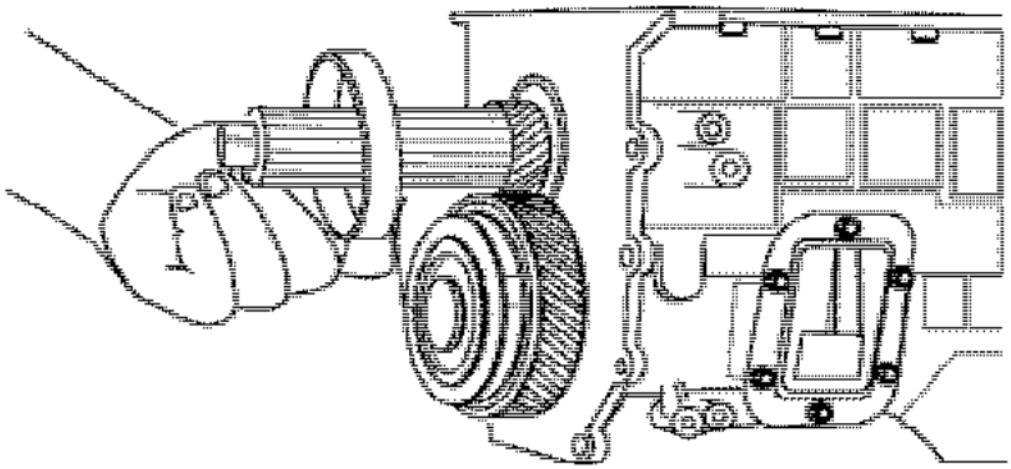


Fig. 222: Tapered Bearing Cup
Courtesy of GENERAL MOTORS CORP.

8. Install the tapered bearing race.

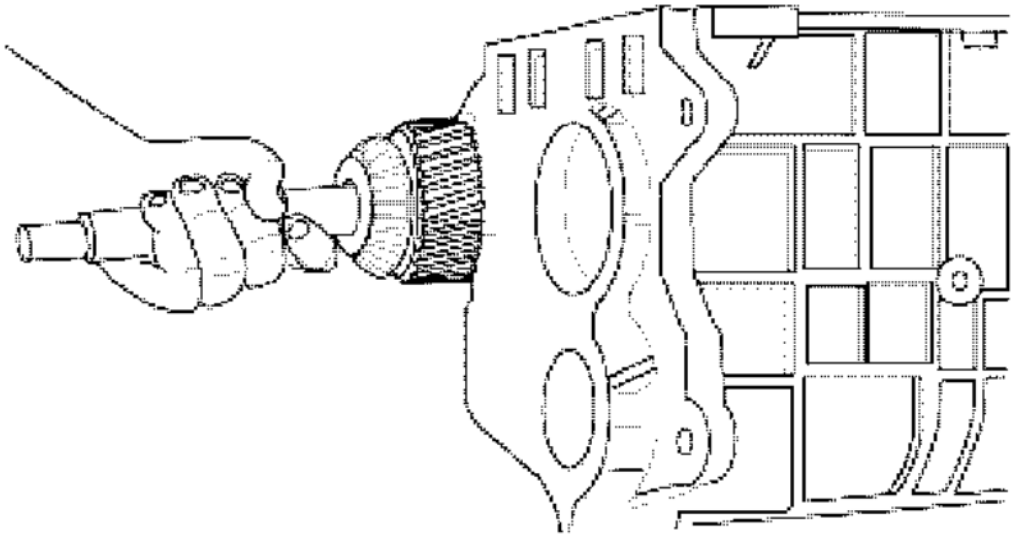


Fig. 223: Drive Shaft
Courtesy of GENERAL MOTORS CORP.

9. Install the drive shaft, positioning the shaft lubrication grooves with the clutch ring.

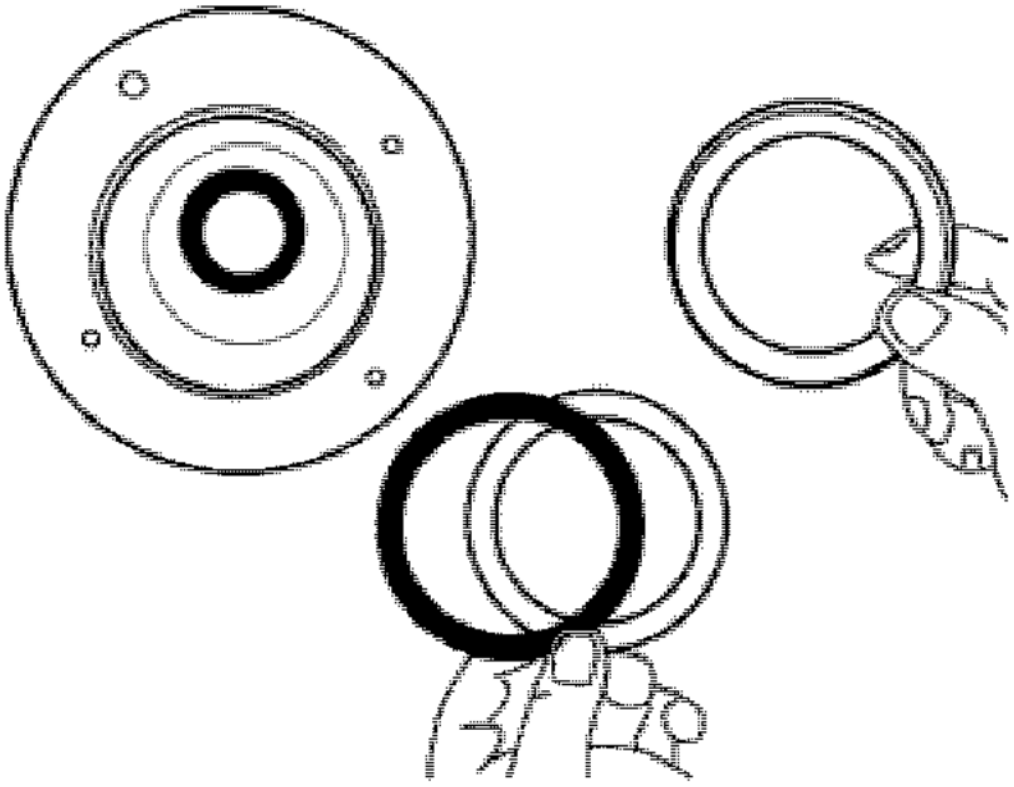


Fig. 224: Spacers And Bearing Race
Courtesy of GENERAL MOTORS CORP.

10. Install the new spacers and bearing race. Add spacers for more play and remove spacers for less play.

Specification: Axial play should be 0.025-0.127 mm (0.001-0.005 in).

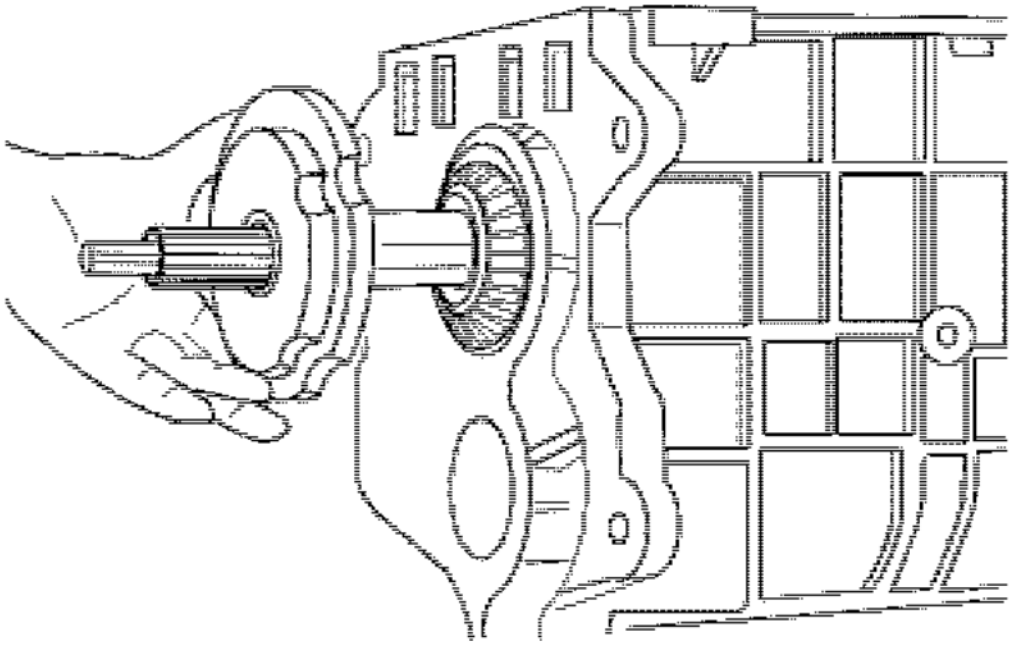


Fig. 225: Bearing Retainer
Courtesy of GENERAL MOTORS CORP.

11. Install the bearing retainer, locating the bearing retainer position to the bore holes, which are the position of the lubrication bores.

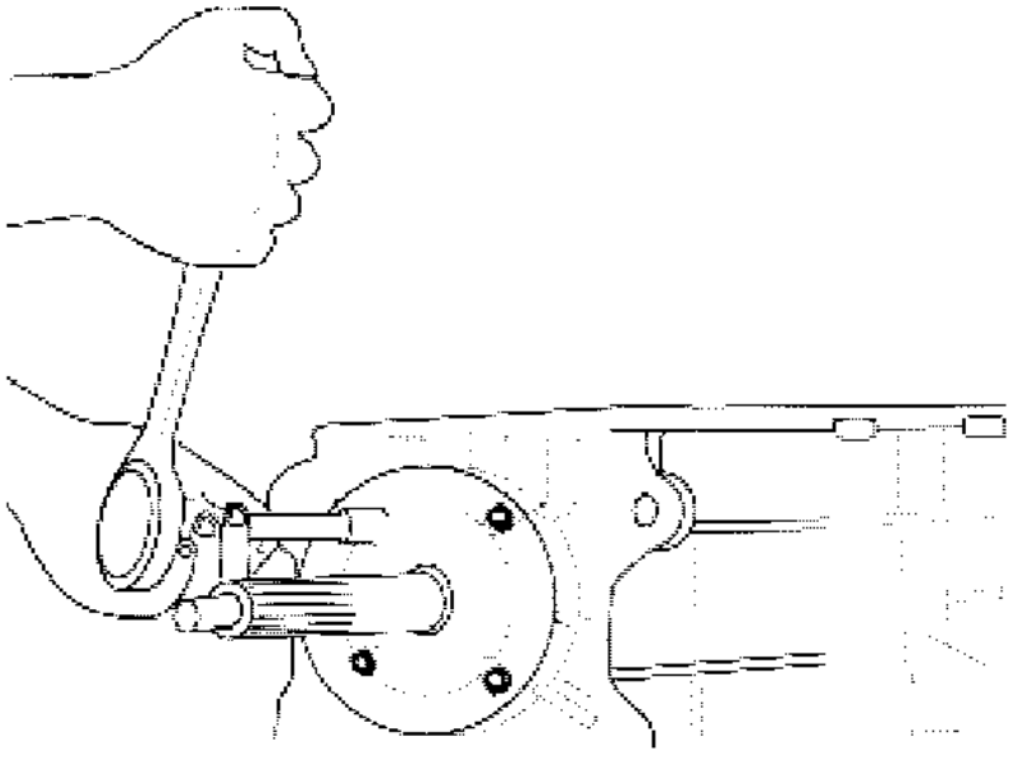


Fig. 226: Bearing Retainer Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

12. Tighten the 4 screws.

Tighten: Tighten the screws to 16-21 N.m (12-16 lb ft).

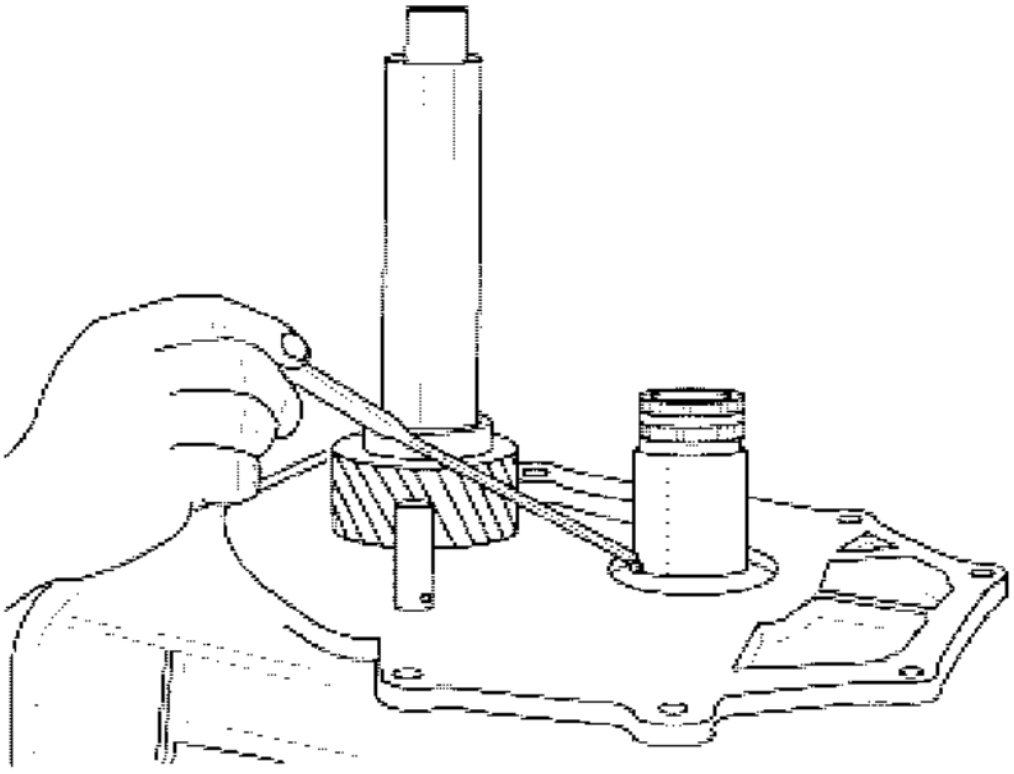


Fig. 227: Removing/Installing Pulley Sphere
Courtesy of GENERAL MOTORS CORP.

13. Install the transmission over 2 supports and attach the tracking sphere.

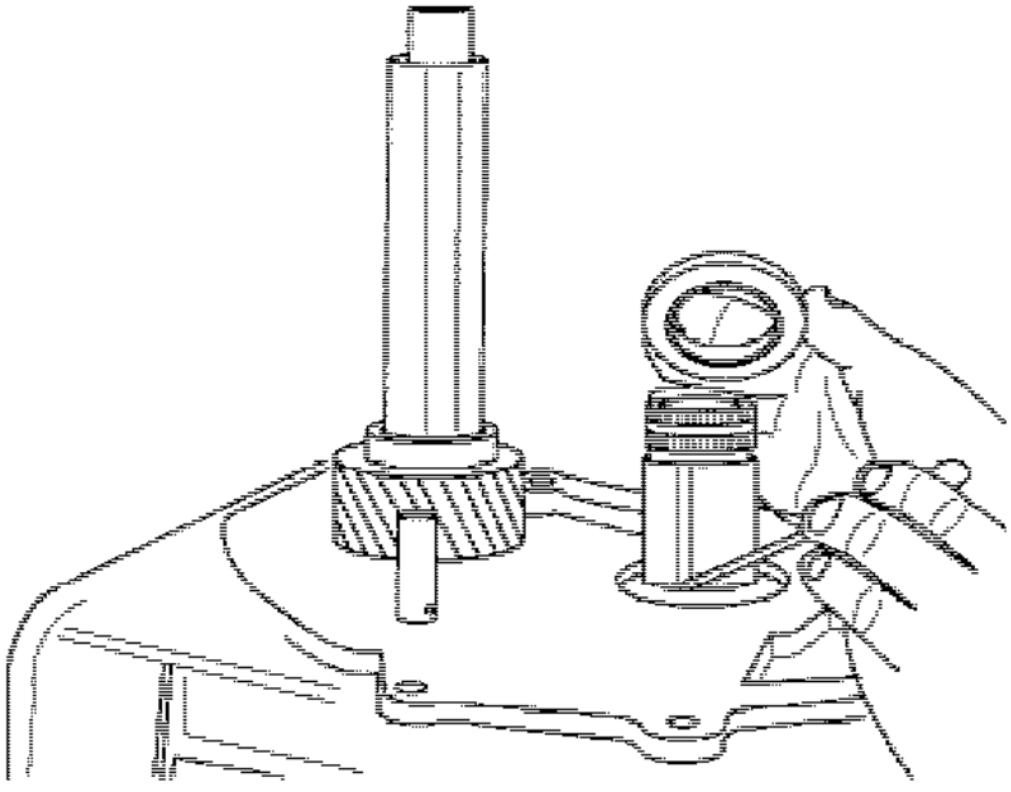


Fig. 228: Washer
Courtesy of GENERAL MOTORS CORP.

14. Install the washer.

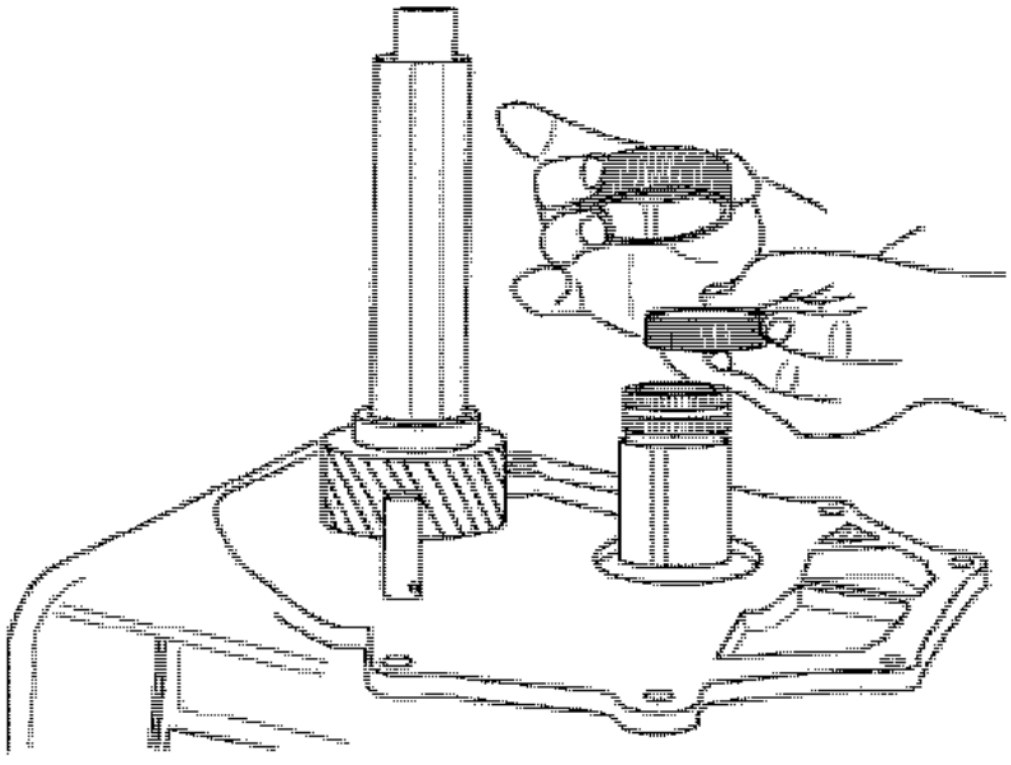


Fig. 229: Roller Bearings And Spacer
Courtesy of GENERAL MOTORS CORP.

15. Install the 2 roller bearings and the spacer.

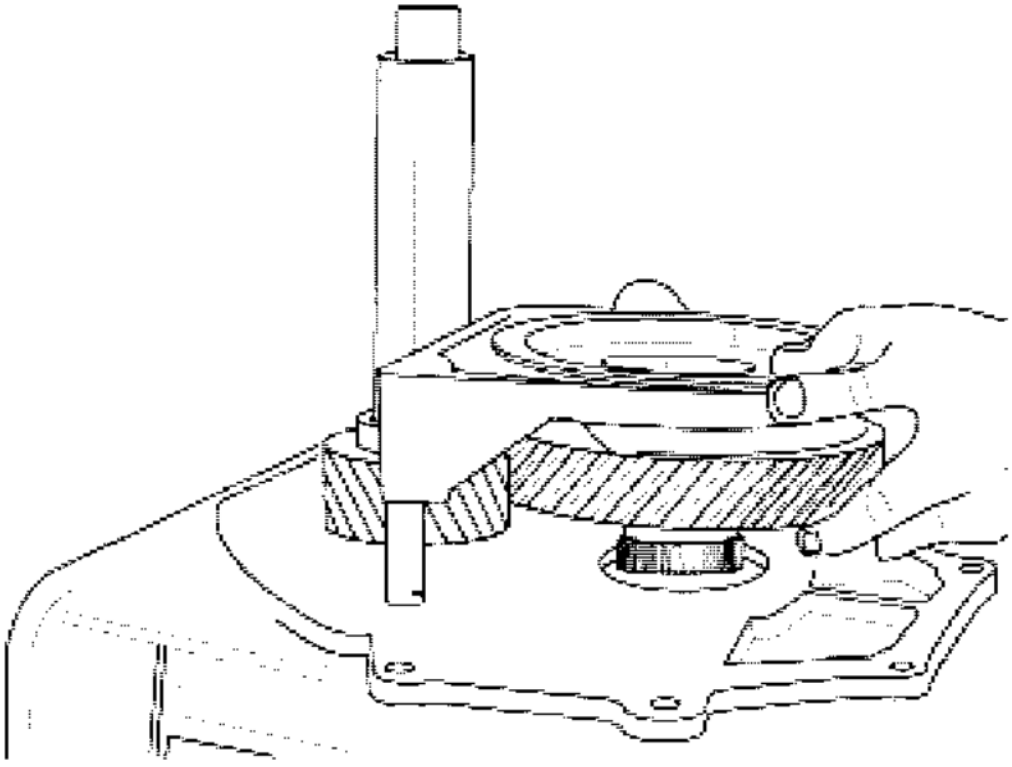


Fig. 230: 5th Gear Synchronizer And Fork
Courtesy of GENERAL MOTORS CORP.

16. Install the 5th gear synchronizer with the fork.

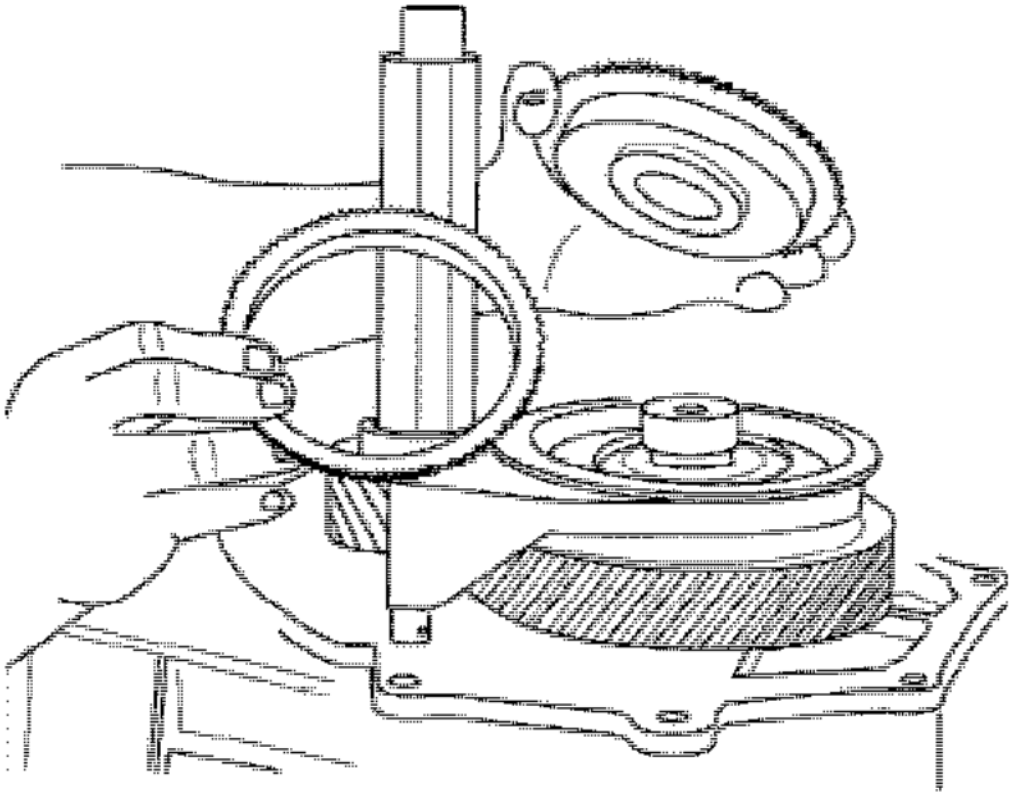


Fig. 231: Synchronizer Ring And 5th Gear
Courtesy of GENERAL MOTORS CORP.

17. Install the lubricated synchronization ring and the 5th gear taper.

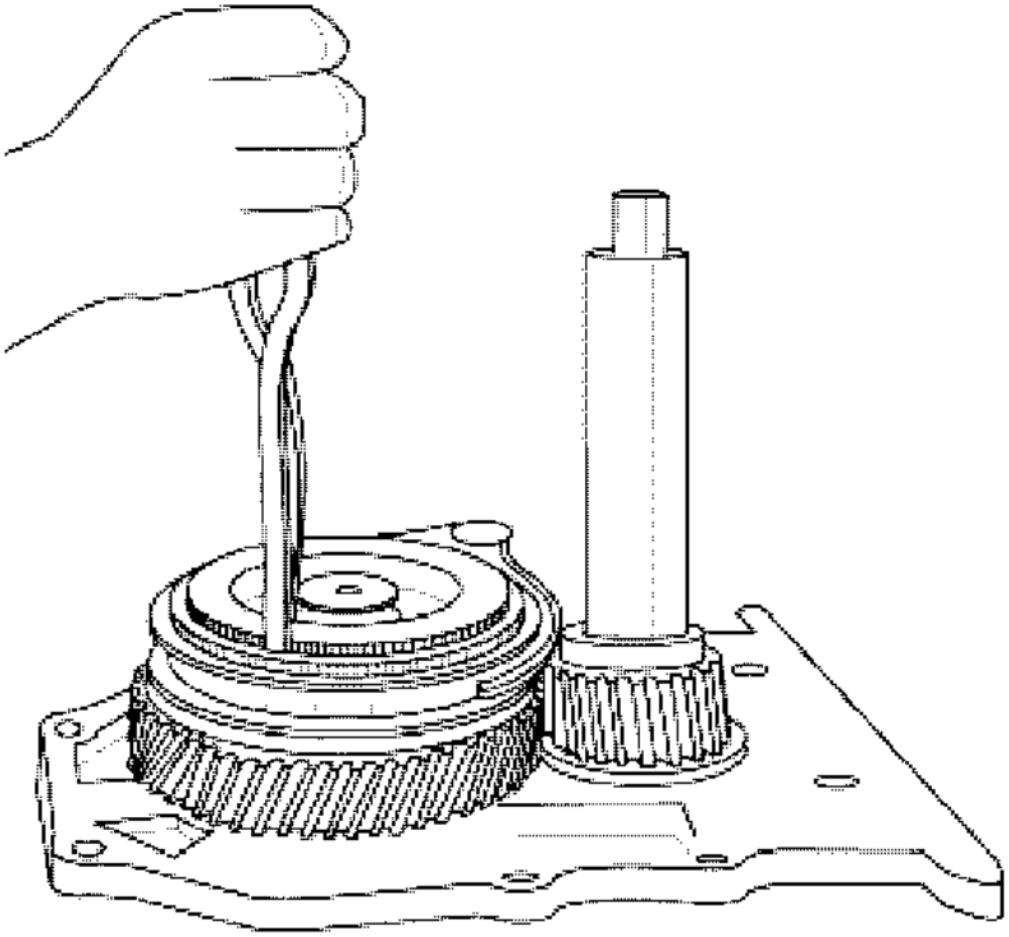


Fig. 232: Snap Ring
Courtesy of GENERAL MOTORS CORP.

18. Using locking pliers, install the 5th gear clutch ring.

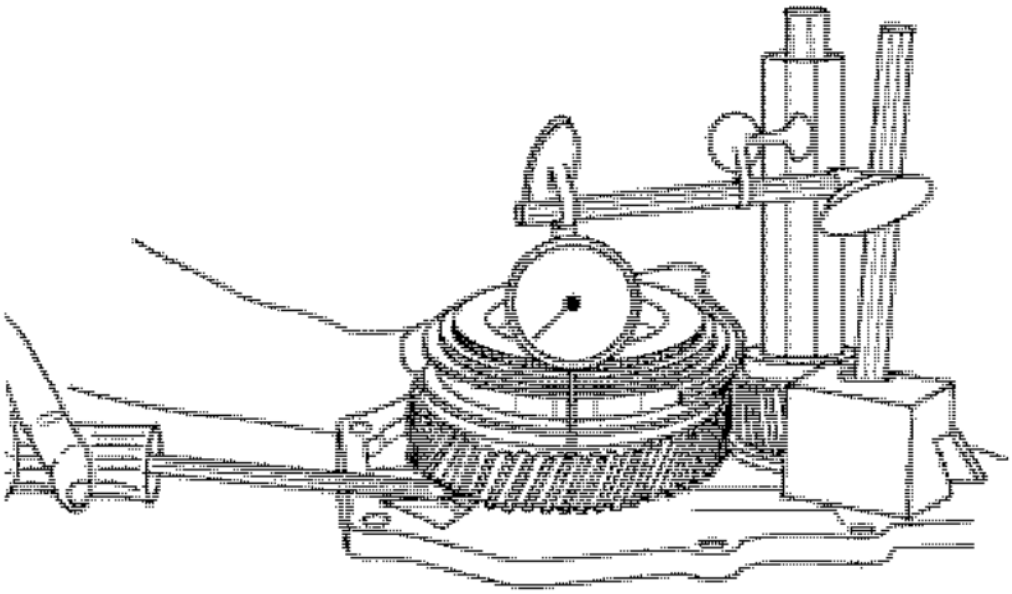


Fig. 233: Observing Axial Play
Courtesy of GENERAL MOTORS CORP.

19. Using a dial indicator, observe the axial play.

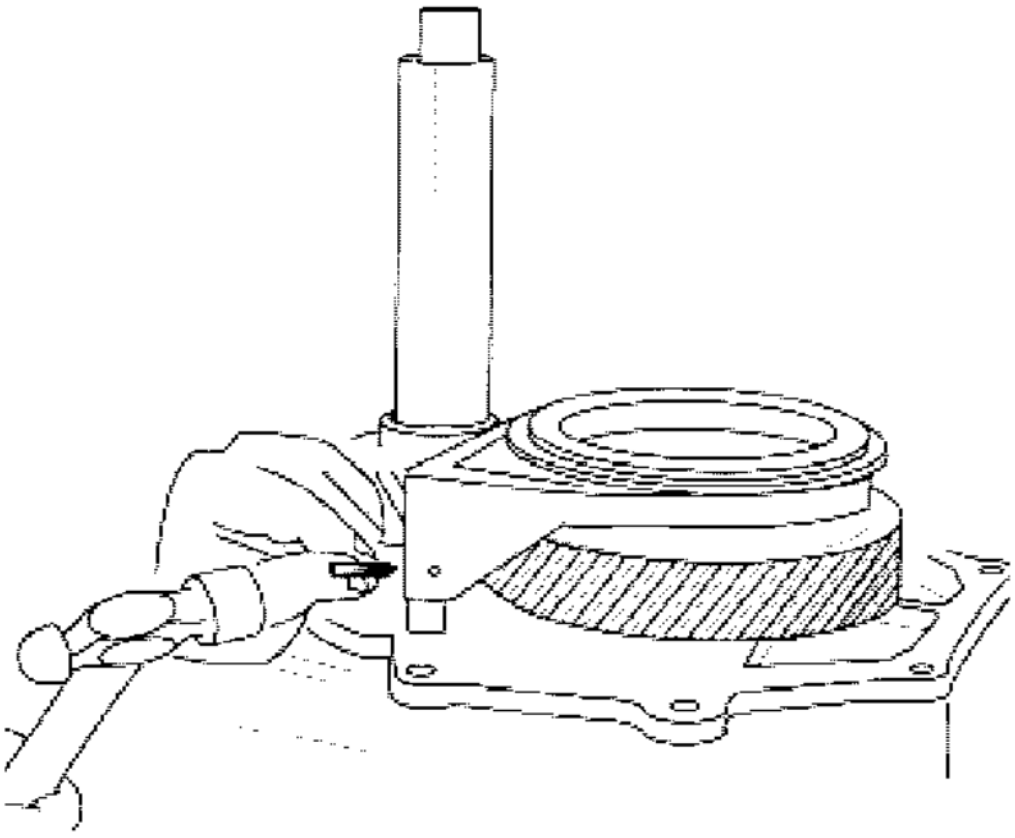


Fig. 234: Roll Pin
Courtesy of GENERAL MOTORS CORP.

20. Install the roll pin.
21. Position the speedometer gear.

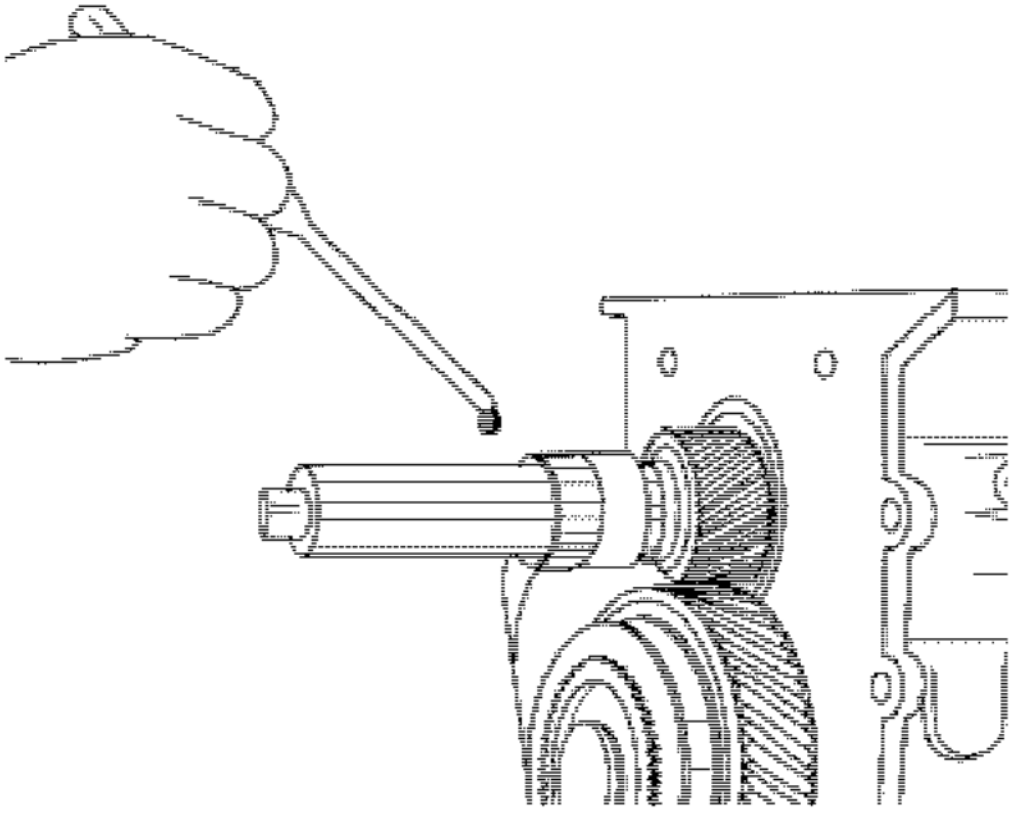


Fig. 235: Speedometer Tracking Balls
Courtesy of GENERAL MOTORS CORP.

22. Install the speedometer gear tracking sphere.

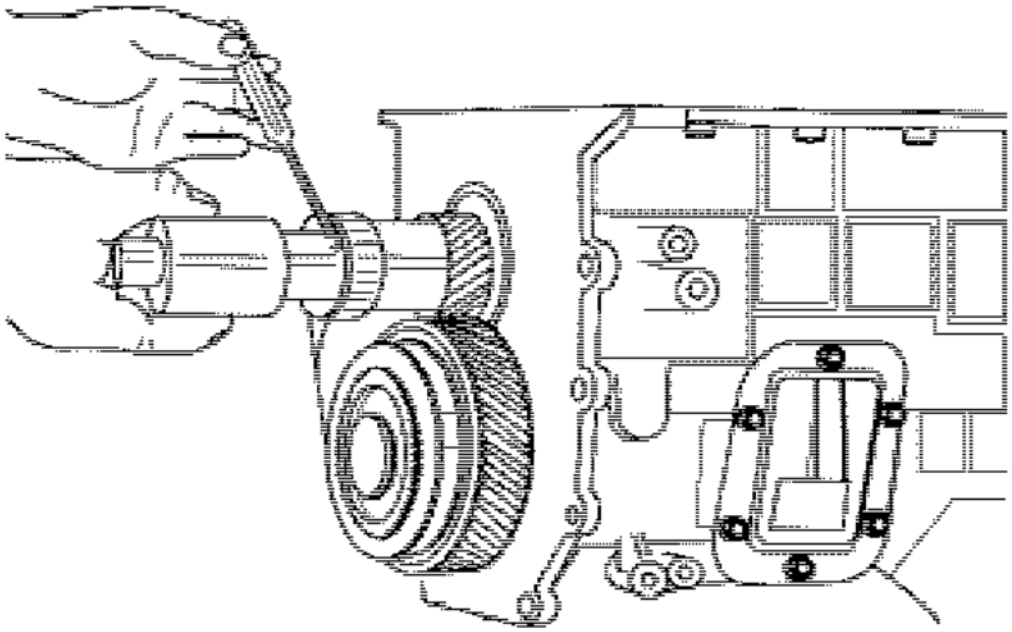


Fig. 236: Yoke Spacer
Courtesy of GENERAL MOTORS CORP.

23. Install the yoke spacer.

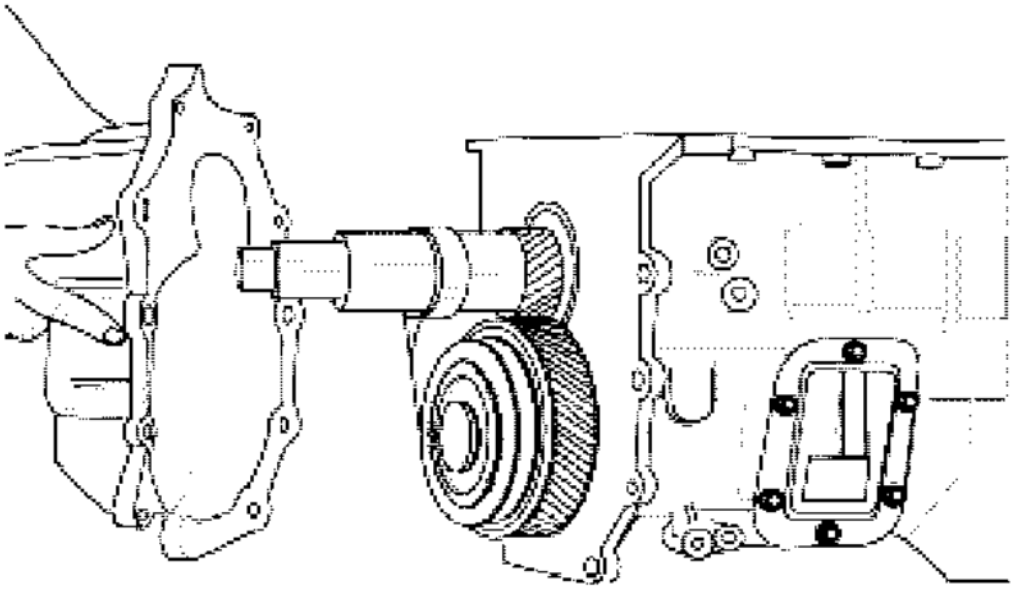


Fig. 237: Cover
Courtesy of GENERAL MOTORS CORP.

24. Install the cover.

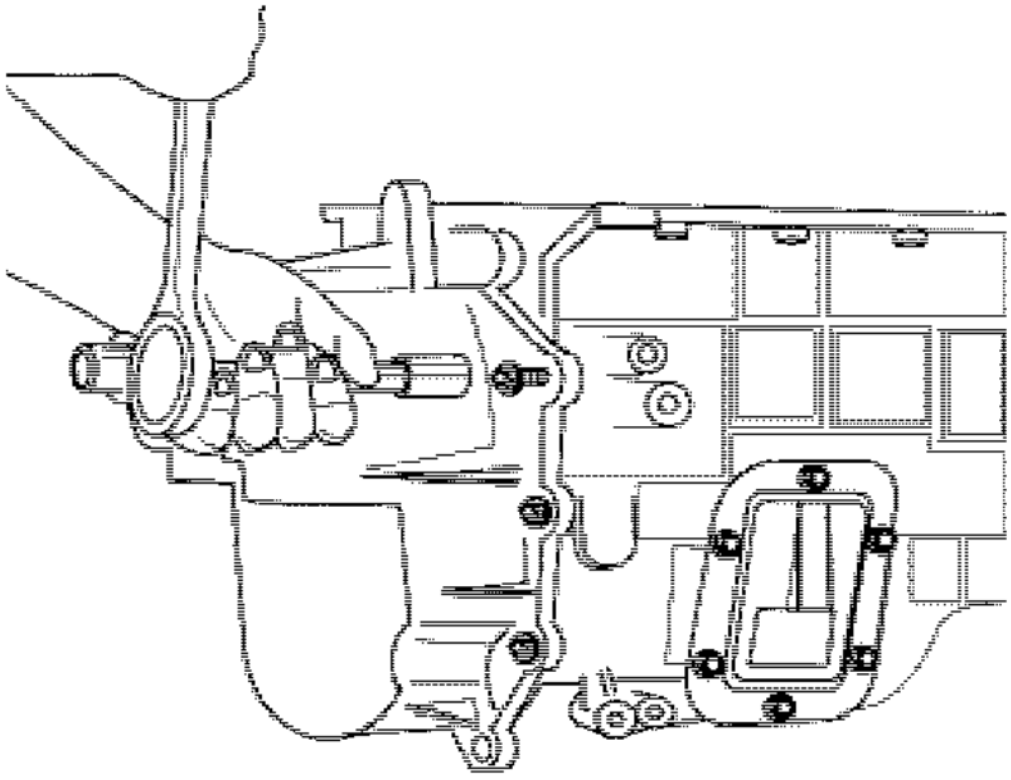


Fig. 238: Aligning Cover
Courtesy of GENERAL MOTORS CORP.

25. Install the 2 guide screws in order to align the cover.

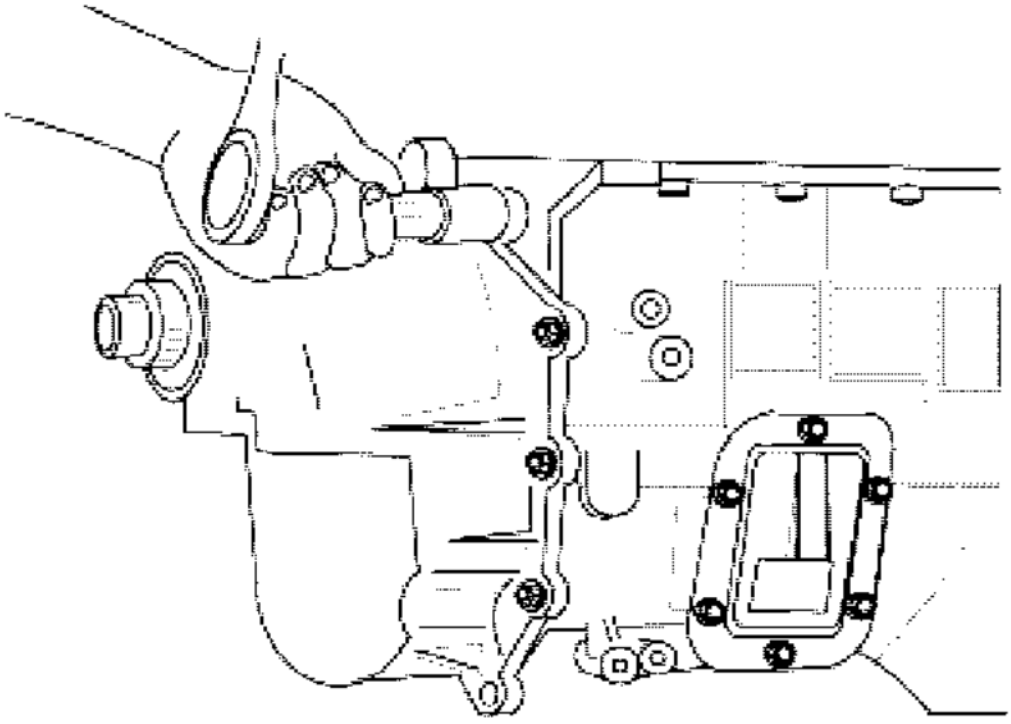


Fig. 239: Rear Cover Bolts
Courtesy of GENERAL MOTORS CORP.

26. Tighten the rest of the 8 screws.

Tighten: Tighten the screws to 57-68 N.m (42-50 lb ft).

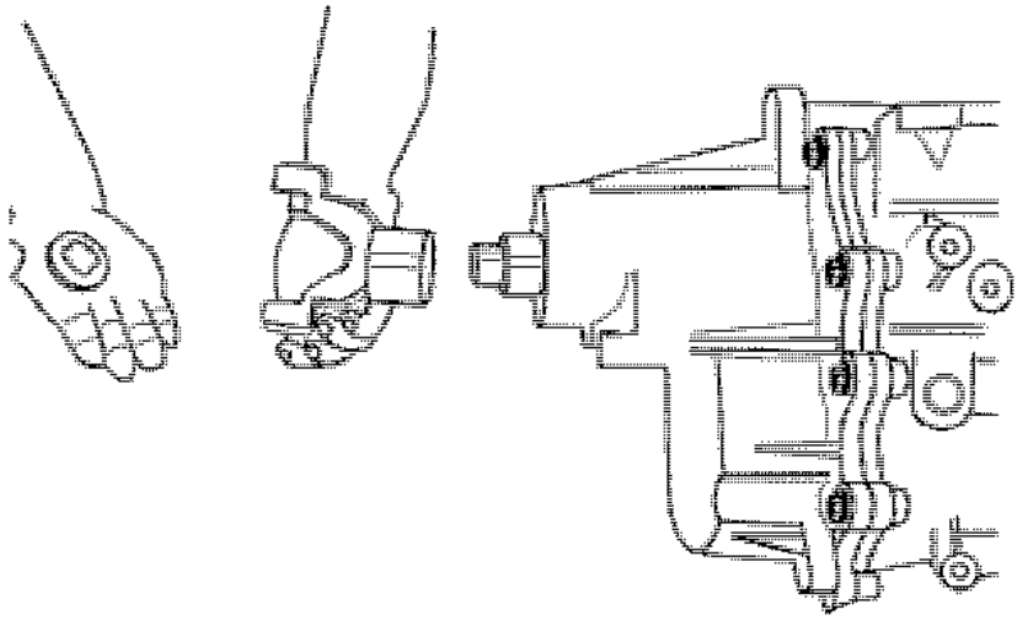


Fig. 240: Main Shaft Nut & Yoke
Courtesy of GENERAL MOTORS CORP.

27. Install the main shaft yoke washer and nut.

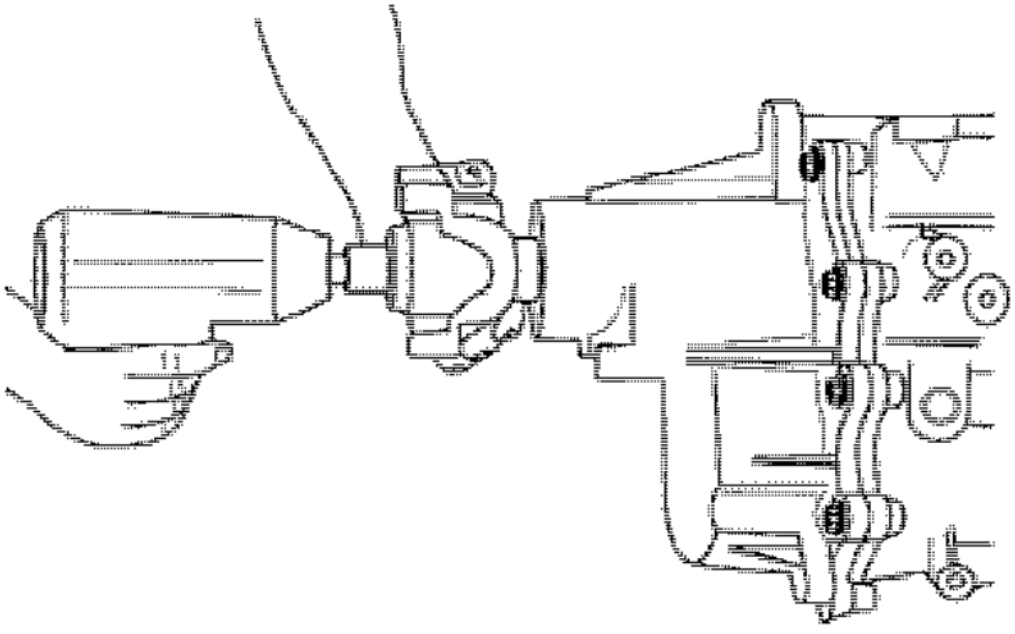


Fig. 241: Main Shaft Nut
Courtesy of GENERAL MOTORS CORP.

28. Tighten the main shaft nut.

    Tighten: Tighten the nut to 150-170 N.m (110-125 lb ft).

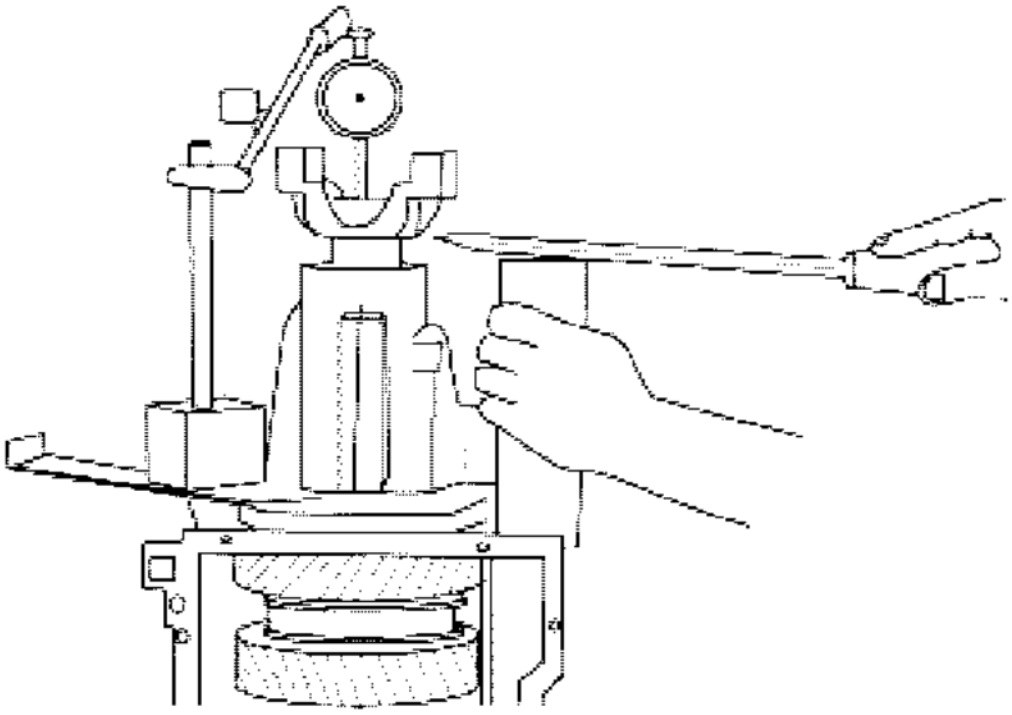


Fig. 242: Measuring Axial Play
Courtesy of GENERAL MOTORS CORP.

29. Position the transmission, and install a dial indicator in order to measure the axial play. Add spacers for more play and remove spacers for less play.

    Specification: The axial play should be 0.025-0.127 mm (0.001-0.005 in).

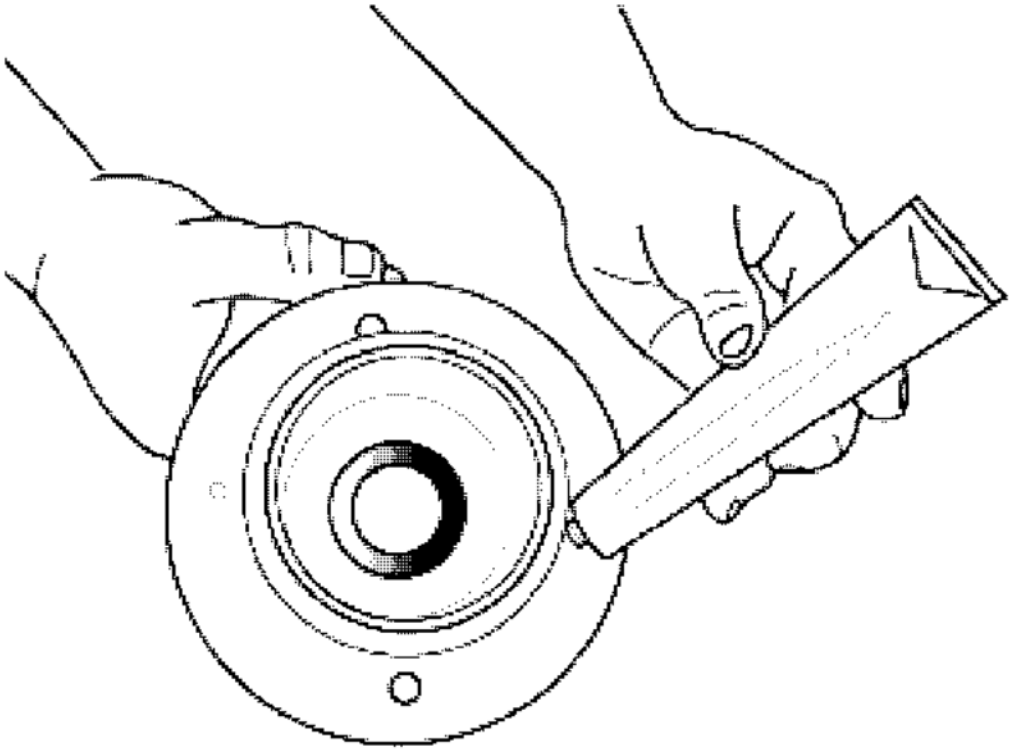


Fig. 243: Applying Gasket Maker
Courtesy of GENERAL MOTORS CORP.

30. Once you have achieved the axial play, proceed to the final assembly. Clean the bearing retainer surface and apply gasket maker.

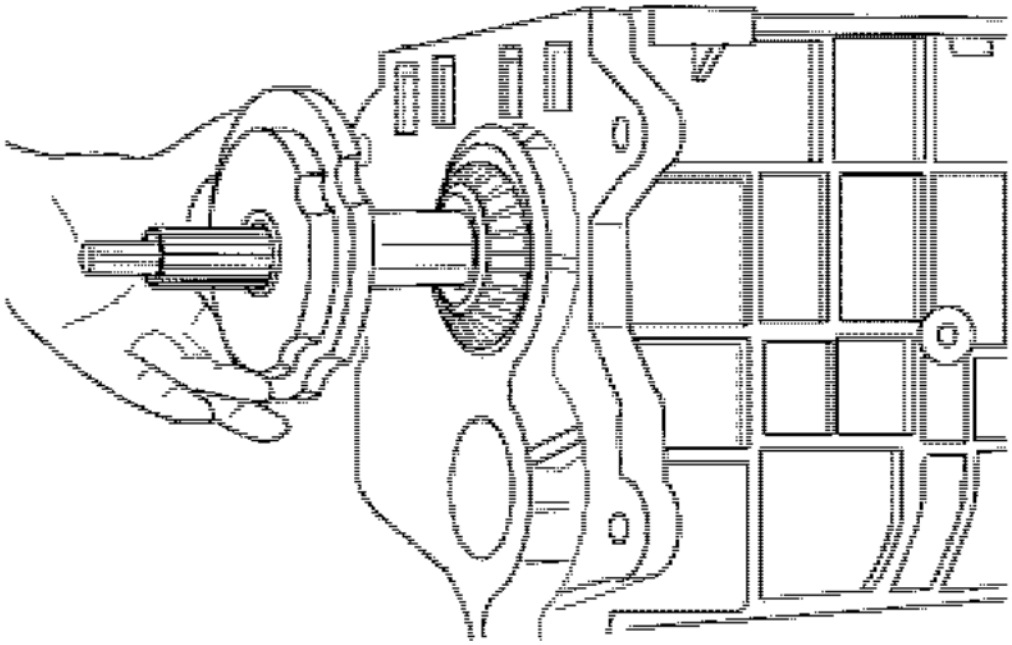


Fig. 244: Bearing Retainer
Courtesy of GENERAL MOTORS CORP.

31. Install the bearing retainer, for the final assembly.

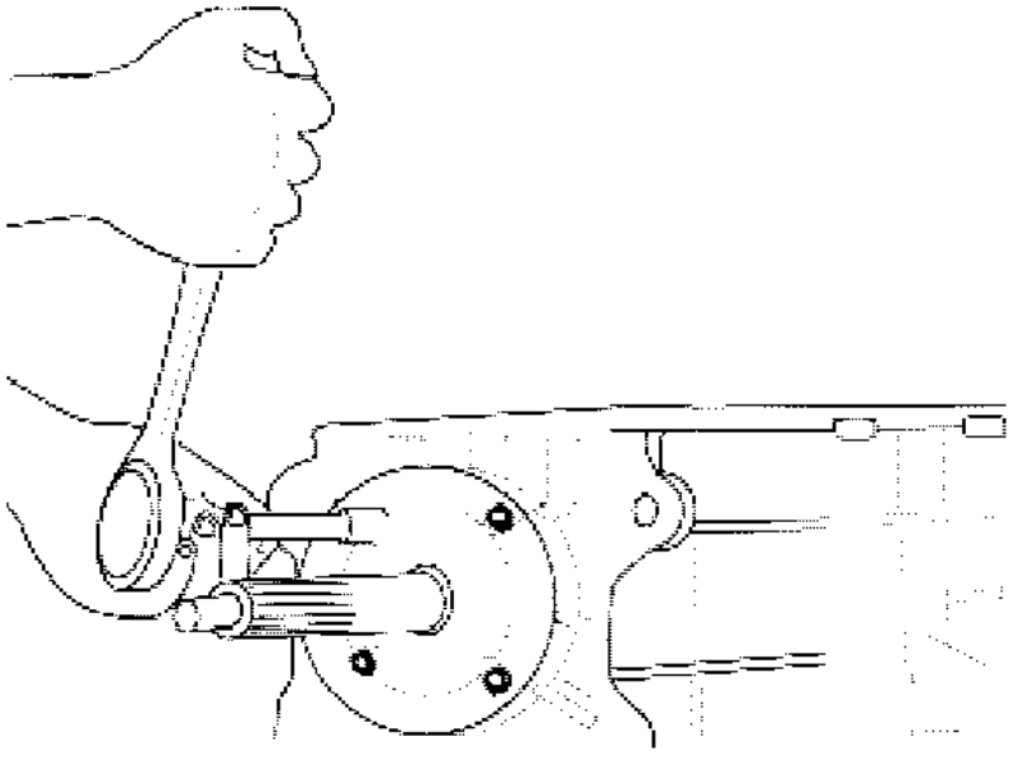


Fig. 245: Bearing Retainer Bolts
Courtesy of GENERAL MOTORS CORP.

32. Apply a Teflon® sealer to the screw threads.
33. Install the screws and tighten.

Tighten: Tighten to 34-40 N.m (25-30 lb ft).

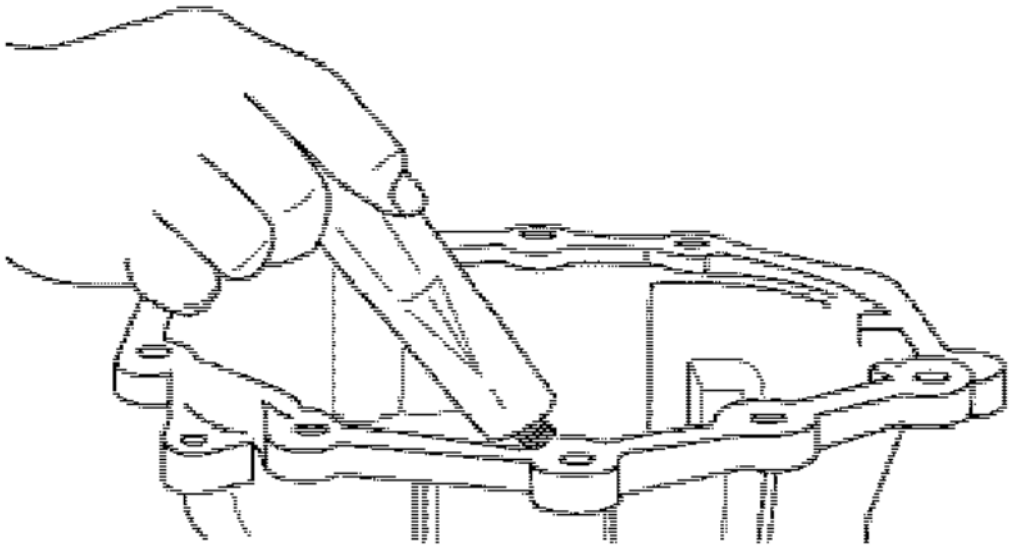


Fig. 246: Applying Gasket Maker
Courtesy of GENERAL MOTORS CORP.

34. Once the axial play is achieved, proceed to the final assembly. Clean the cover surface and apply gasket maker.

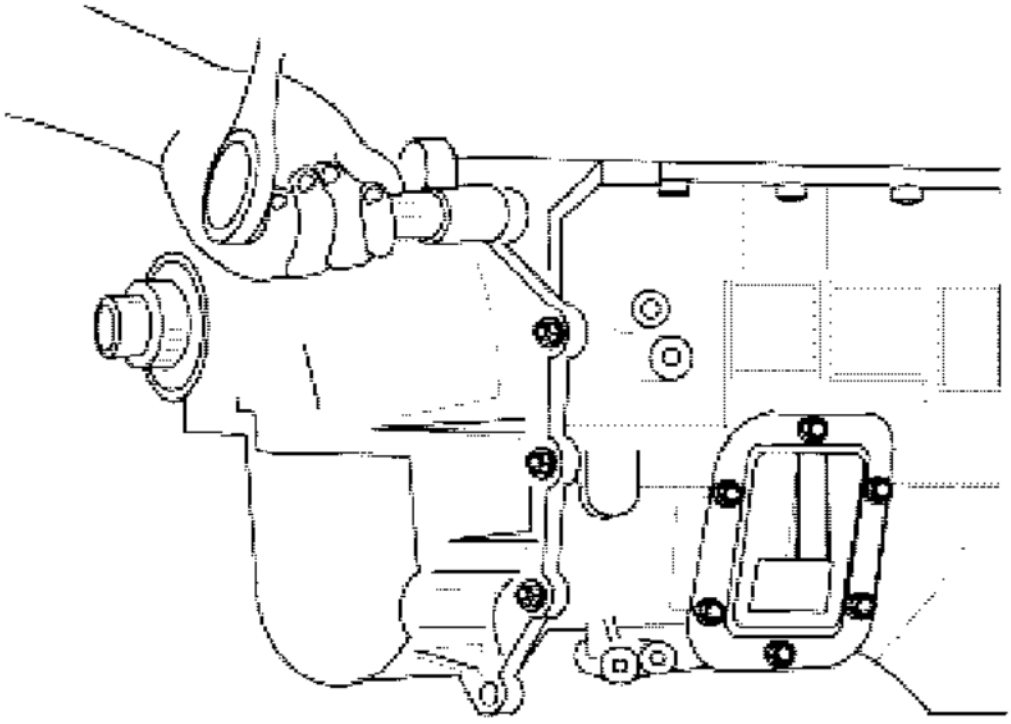


Fig. 247: Rear Cover Bolts
Courtesy of GENERAL MOTORS CORP.

35. Apply a Teflon® sealer to the screw threads.
36. Install the screws and tighten.

Tighten: Tighten to 57-68 N.m (42-50 lb ft).

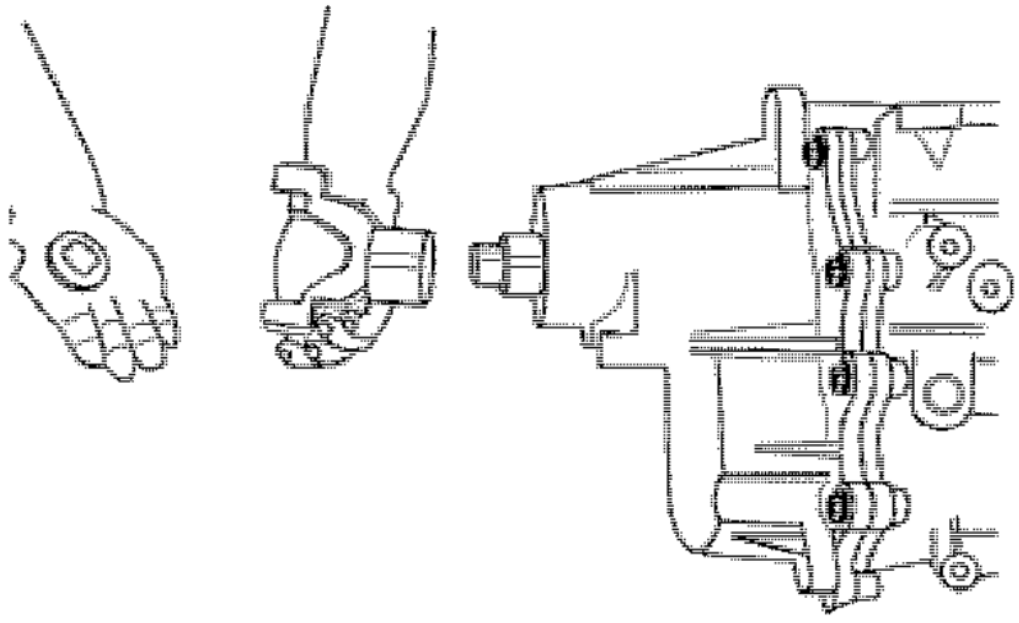


Fig. 248: Main Shaft Nut & Yoke
Courtesy of GENERAL MOTORS CORP.

37. Install the main shaft yoke onto the main shaft.

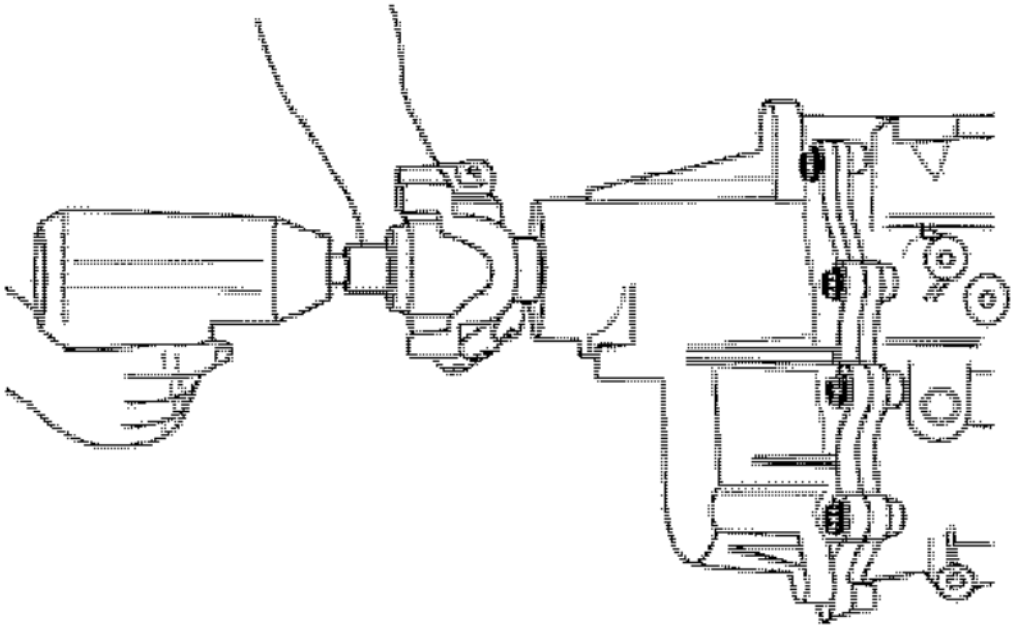


Fig. 249: Main Shaft Nut
Courtesy of GENERAL MOTORS CORP.

38. Tighten the NEW main shaft nut.

Tighten: Tighten the nut to 150-170 N.m (110-125 lb ft).

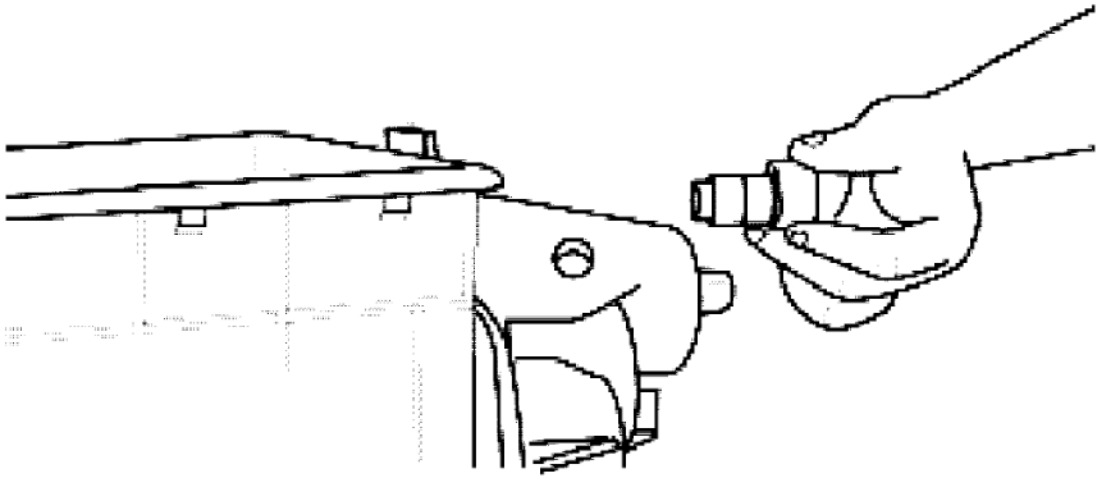


Fig. 250: VSS
Courtesy of GENERAL MOTORS CORP.

39. Install the vehicle speed sensor, if necessary.

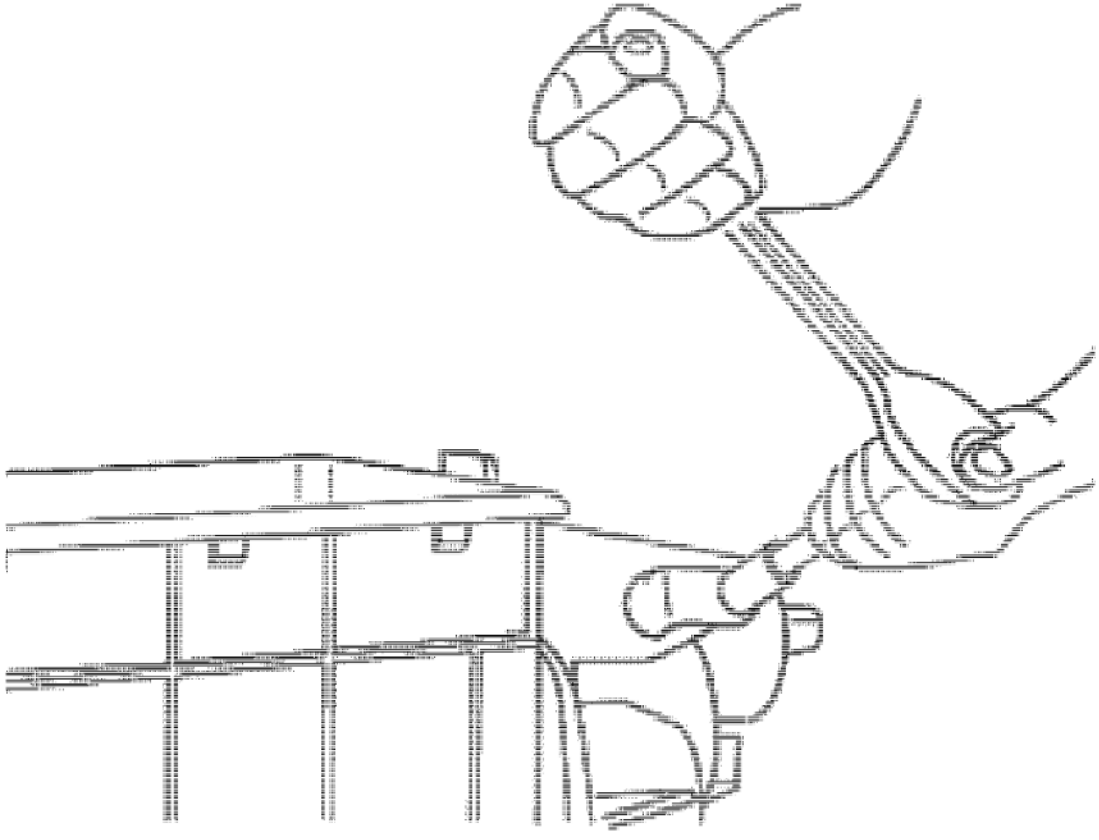


Fig. 251: Using Ratchet On Vehicle Speed Sensor (VSS) Screw
Courtesy of GENERAL MOTORS CORP.

40. Tighten the vehicle speed sensor.
41. **Notice** : Use the correct oil. The transmission could be severely damaged if the correct oil is not used.

    Add 3.5 liters (3.7 quart) of oil 1 ATF synthetic oil.

DESCRIPTION AND OPERATION

MANUAL TRANSMISSION DESCRIPTION AND OPERATION

TR-4050 Series transmissions have an advanced design with 5 synchronized forward gears and 1 synchronized reverse gear. This design offers a more efficient ratio of torque-weight than any other 5-speed transmission in its class. This transmission uses a gear mechanism provided as a 5th gear system inhibitor to the back and is located in the shifting tower of the transmission.

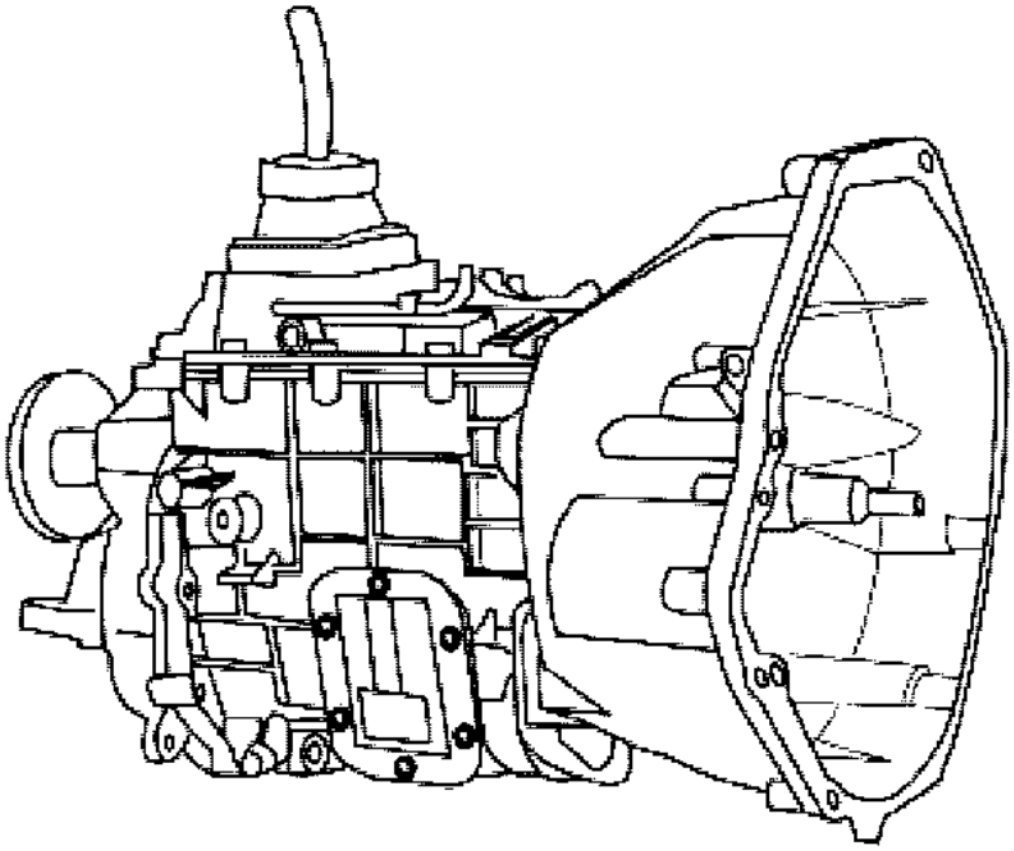


Fig. 252: Manual Transmission
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All TR-4050 transmissions are identified by model and series numbers as well as the date of manufacture. This information is stamped on the transmission identification plate and is affixed to the case.

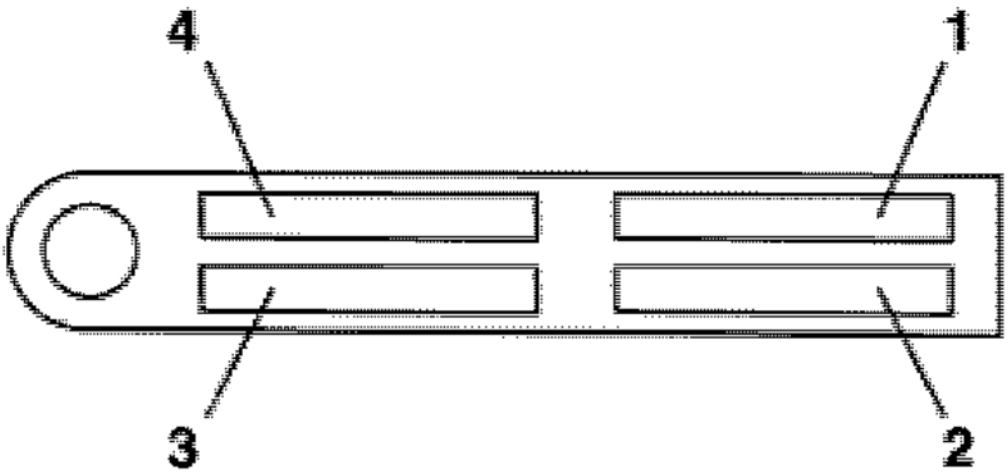


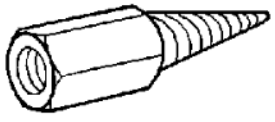
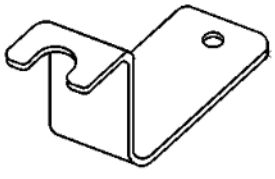
Fig. 253: Transmission Identification Plate
Courtesy of GENERAL MOTORS CORP.

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

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
	J 23907 Slide Hammer with Bearing Adapter

	
	J 36825 Output Shaft Oil Seal Remover (4WD Models Only)
	J 42371 Hydraulic Clutch Line Separator