SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

NOTE:
All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application
1st and 2nd Gear Fork Roll Pin
1st and 2nd Gear Stop Roll Pin
3rd and 4th Gear Stop Roll Pin
5th and Reverse Gear Fork Roll Pin
Extension Oil Seal

Single Use Threaded Fastener/Component Tightening Specifications

NOTE:
All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application	Specification
	Metric (English)
Main Shaft Nut	150-170 N.m (111-125 lb ft)

Reusable Threaded Fastener Tightening Specifications

NOTE:
All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Backup Lamp Switch	16-22 N.m (12-16 lb ft)
Breather Support Screw	13 N.m (115 lb in) - 18 N.m (13 lb ft)

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NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Clutch Actuator Bolts	8 N.m (71 lb in)
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 (15-18 lb ft)
Drain Plug	13 N.m (115 lb in) - 27 N.m (20 lb ft)
Drive Shaft Bearing Retaining Screw	16-21 N.m (12-15 lb ft)
Fill Plug	13 N.m (115 lb in) - 27 N.m (20 lb ft)
Flange Nut	150-170 N.m (111-125 lb ft)
Front Bearing Retainer	14 N.m (10 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 (12-15 lb ft)
Shaft Support Plate Screw	16-21 N.m (12-15 lb ft)
Shift Boot Screws	2 N.m (18 lb in)
Shift Housing Screws	8-14 N.m (71-124 lb in)
Shift Lever Nut	47 N.m (35 lb ft)
Shift Tower Screw	8-14 N.m (71-124 lb in)
Transmission Mount Bolt	67 N.m (49 lb ft)
Transmission Mount Nut	55 N.m (41 lb ft)
Transmission to Clutch Housing Bolts	100 N.m (74 lb ft)
Transmission-to-Engine Bolts	40-60 N.m (30-44 lb ft)
Vehicle Speed Sensor (VSS) Bolt	16-21 N.m (12-15 lb ft)

APPROXIMATE FLUID CAPACITIES

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

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
Sealant	-	12346004	10953480

AXIAL PLAY SPECIFICATIONS

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

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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-3655	4.23	2.34	1.47	1.00	0.81	4.23
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

SCHEMATIC WIRING DIAGRAMS

MANUAL TRANSMISSION WIRING SCHEMATICS

Manual Transmission (MQ7)

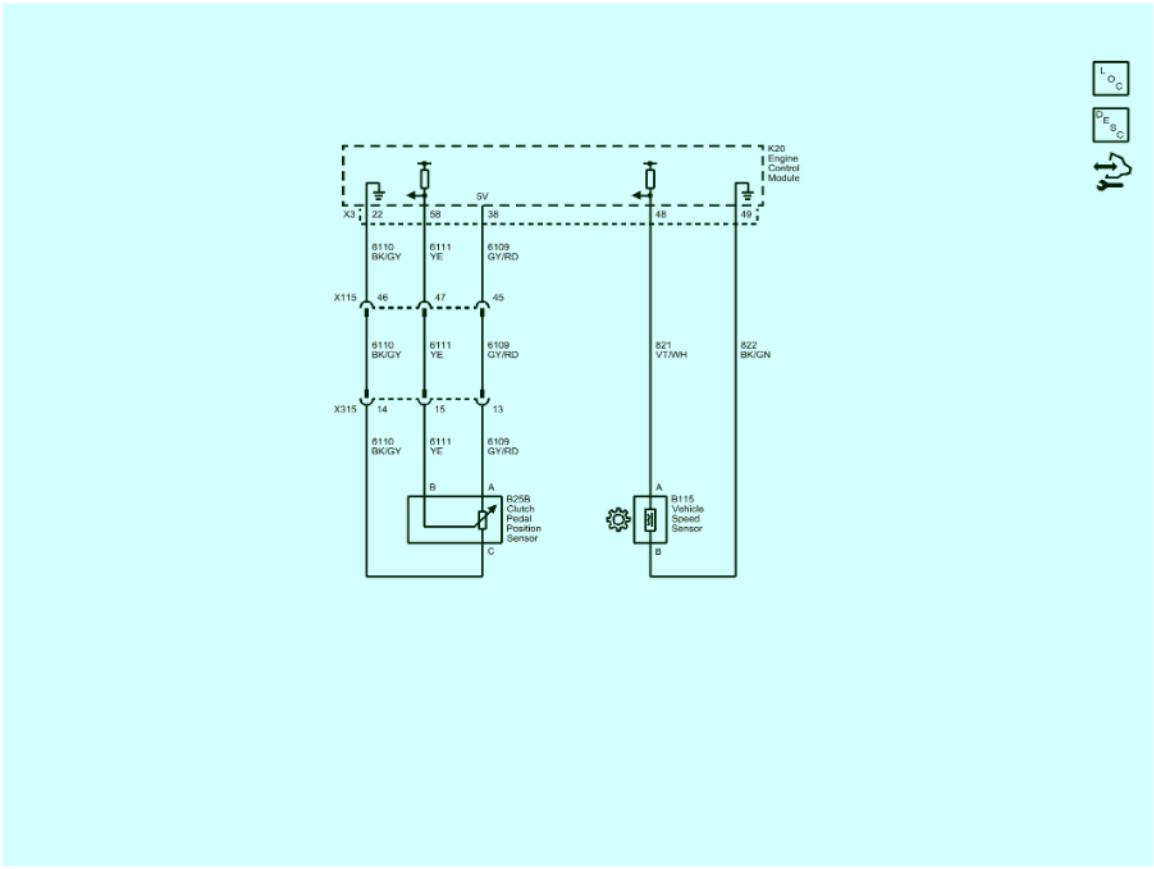


Fig. 1: Manual Transmission (MQ7)

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Courtesy of GENERAL MOTORS COMPANY

VISUAL IDENTIFICATION

DISASSEMBLED VIEWS

Transmission Case and Related Components

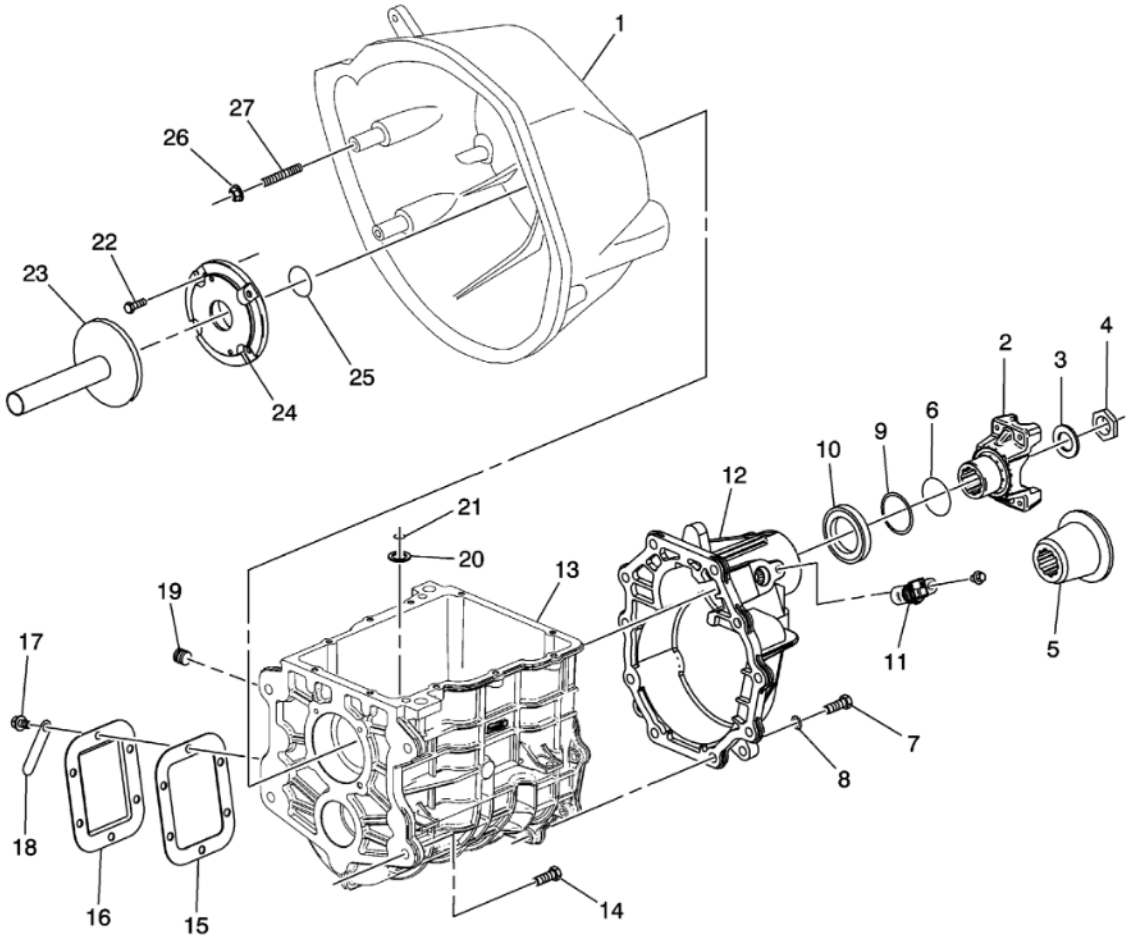


Fig. 2: Transmission Case and Related Components
Courtesy of GENERAL MOTORS COMPANY

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)

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Callout	Component Name
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

Main Shaft and Components

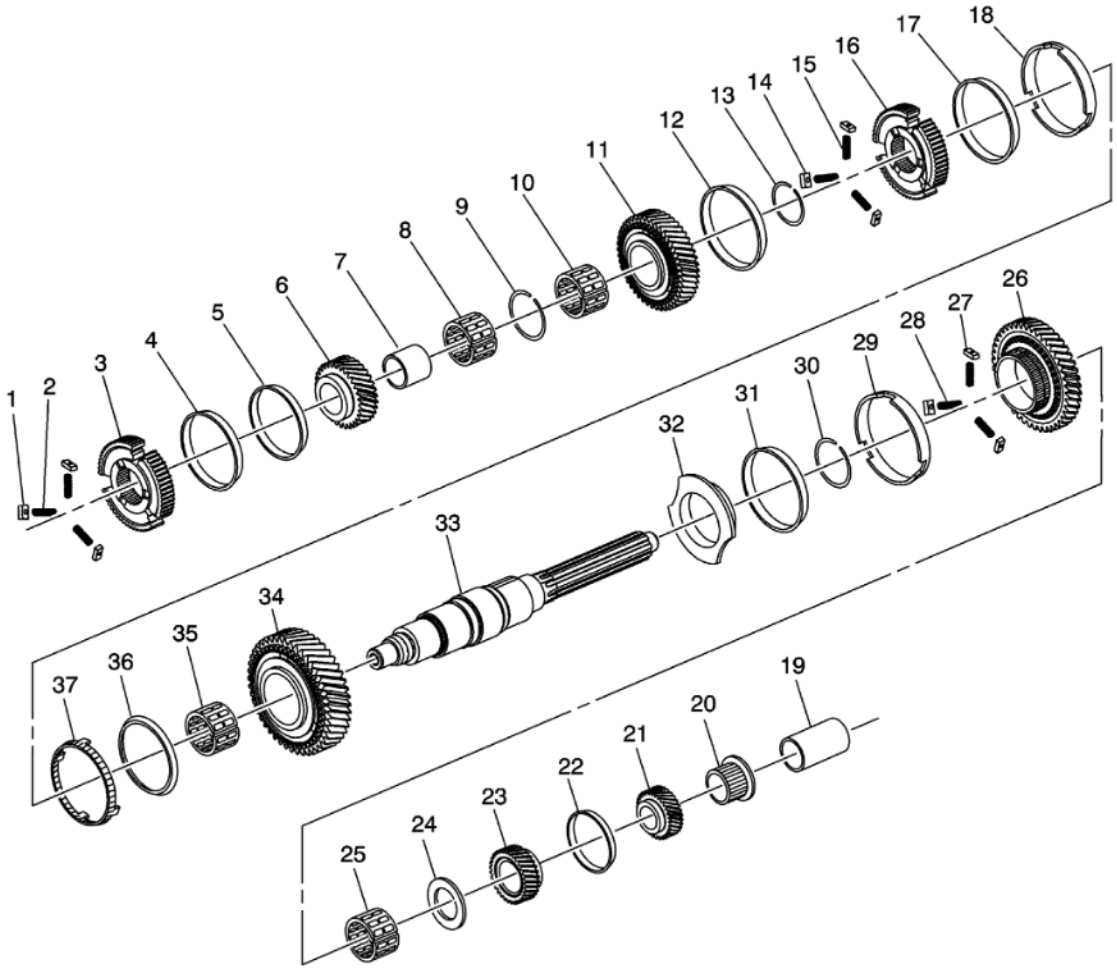


Fig. 3: Main Shaft and Components
Courtesy of GENERAL MOTORS COMPANY

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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

Input Shaft and Components

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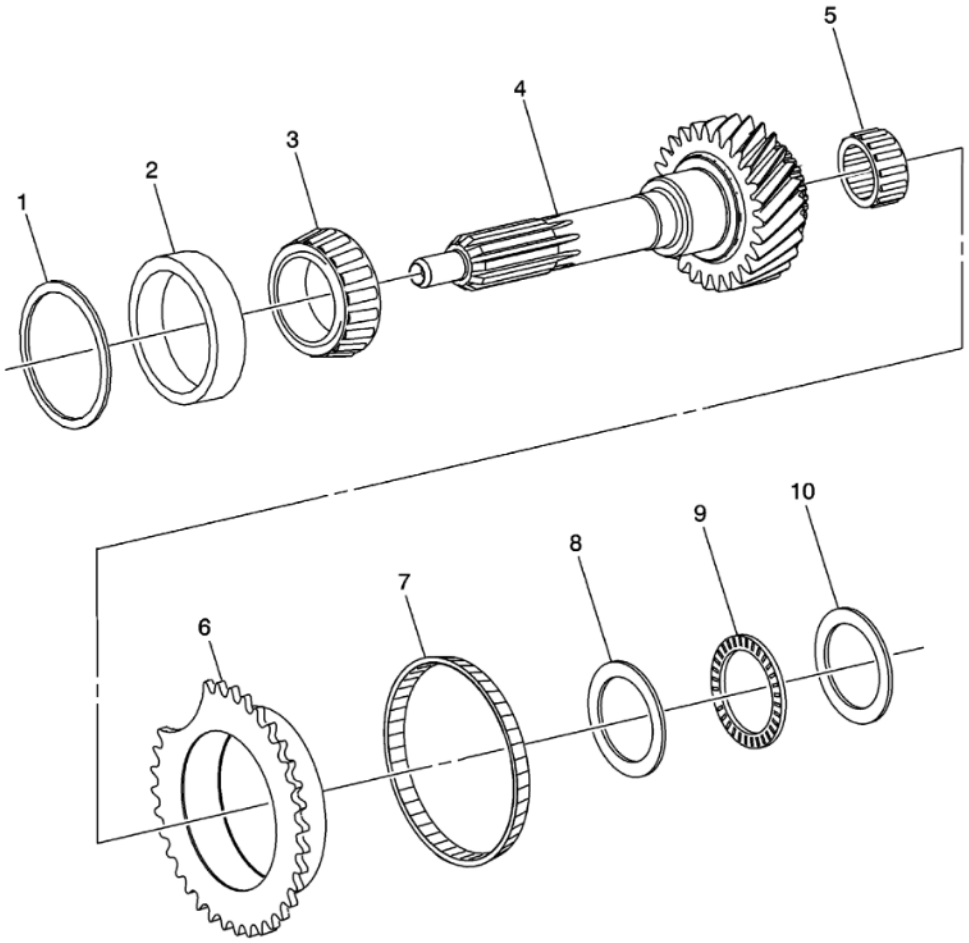


Fig. 4: Input Shaft and Components
Courtesy of GENERAL MOTORS COMPANY

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

Counter Gear Shaft and Components

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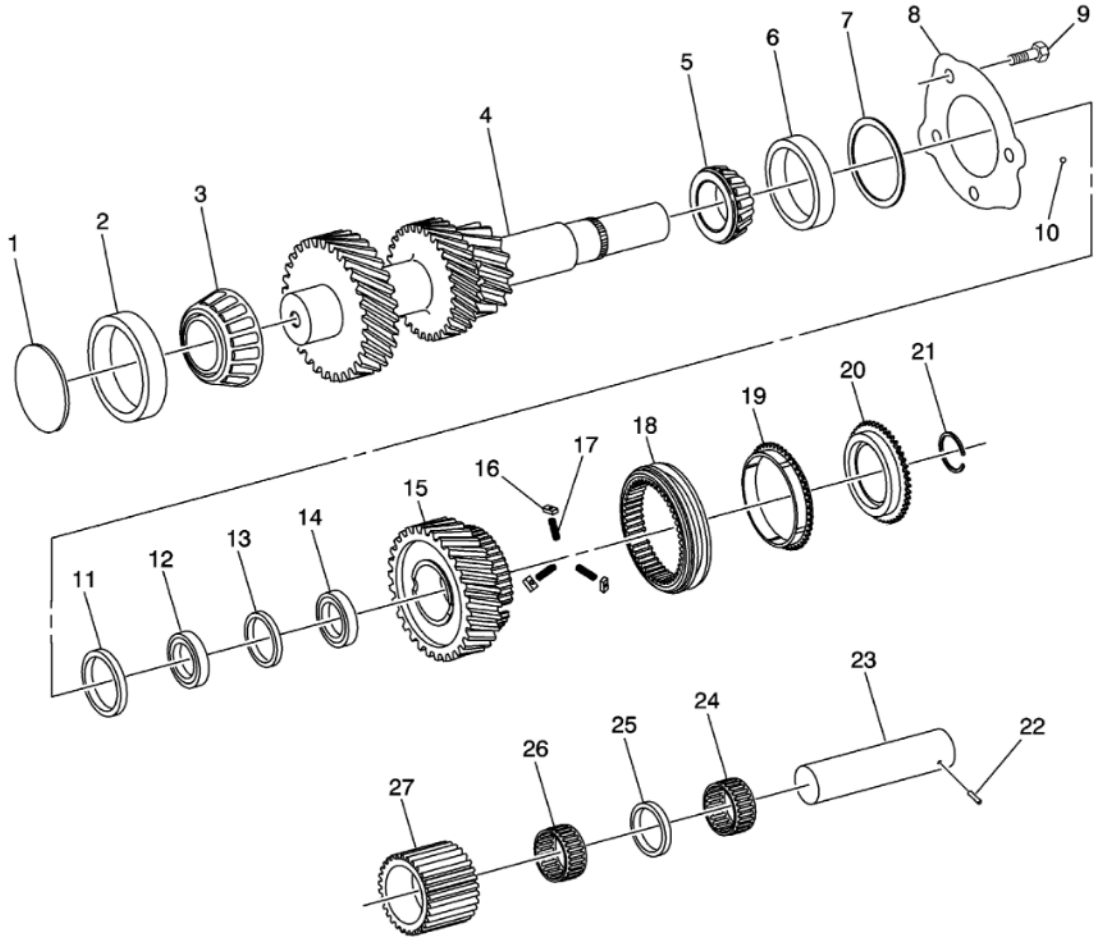


Fig. 5: Counter Gear Shaft and Components
Courtesy of GENERAL MOTORS COMPANY

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

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Callout	Component Name
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

Shift Control and Components

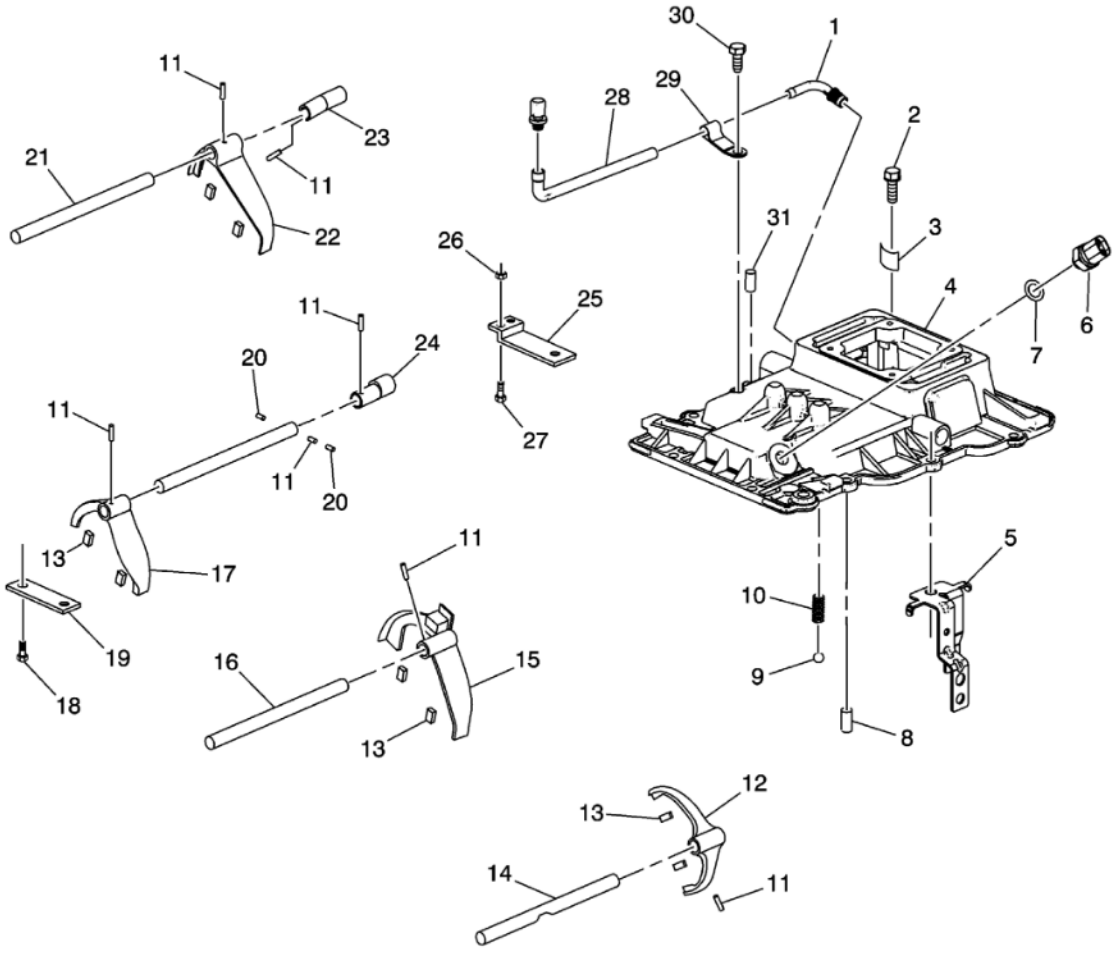


Fig. 6: Shift Control and Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Breather Connection
2	Control Cover Screws
3	Clip
4	Control Cover

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Callout	Component Name
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

DTC P0502 OR P0503: VEHICLE SPEED SENSOR

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 P0502

Vehicle Speed Sensor (VSS) Circuit Low Voltage

DTC P0503

Vehicle Speed Sensor (VSS) Circuit Intermittent

Diagnostic Fault Information

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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 8-18 V.
- 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 8-18 V.
- The engine speed is 500-7,500 RPM.
- 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

- {Model year 2014 and older}DTCs P0502, P0503 are Type B DTCs.
- {Model year 2015 and newer}DTCs P0502, P0503 are Type A DTCs.

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Conditions for Clearing the DTC

- {Model year 2014 and older}DTCs P0502, P0503 are Type B DTCs.
- {Model year 2015 and newer}DTCs P0502, P0503 are Type A DTCs.

Reference Information

Schematic Reference

Manual Transmission Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

1. Raise the vehicle off the ground.
2. Support the rear axle assembly so the propeller shaft is at the normal drive line angle.
3. Start and idle the engine.
4. Place the transmission in second gear and release the clutch pedal.
5. Monitor VSS parameter on the scan tool. The VSS parameter should increase as the drive wheel speed increases.
6. After performing the above steps, verify that the DTC does not reset by operating the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions you observe from the Freeze Frame/Failure Records data. If the vehicle passes the Circuit/System Verification procedure, then STOP. Do not perform the Circuit/System Testing or Component Testing as this may result in an unnecessary part replacement. Refer to **Testing for Intermittent Conditions and Poor Connections** .

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Circuit/System Testing

NOTE: **You must perform the Circuit/System Verification first.**

1. Disconnect the ECM harness connector X3.
2. Measure for 1,300-1,500 ohms at 25Â°C (77Â°F) between the VSS high signal circuit terminal 48 and the VSS low signal circuit terminal 49.
   - 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 48 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 49 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 OFF, test for less than 5 ohms between the low reference circuit at the VSS harness connector terminal B and ground.
   - If greater than the specified value, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the ECM.
7. Ignition ON, test for less than 6 volts between the signal circuit at the VSS harness connector terminal A and ground.
   - If greater than the specified value, test the signal circuit for a short to voltage. If the circuit tests normal, replace the ECM.

Repair Instructions

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

- **Vehicle Speed Sensor Replacement**
- **Control Module References** for ECM replacement, setup and programming.

DTC P0806-P0808: CLUTCH PEDAL POSITION (CPP) SENSOR

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 P0806

Clutch Pedal Position (CPP) Sensor Performance

DTC P0807

Clutch Pedal Position (CPP) Sensor Circuit Low Voltage

DTC P0808

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Clutch Pedal Position (CPP) Sensor Circuit High Voltage

Diagnostic Fault Information

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

Typical Scan Tool Data

CPP Sensor Voltage

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON. **CPP Sensor Voltage Parameter Normal Range:** 1 V with clutch pedal applied to 4 V when clutch pedal is released.			
5 V Reference	0 V	0 V	5 V
Signal	0 V	0 V	5 V
Low Reference	-	5 V	-

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.			
5 V Reference	100%	100%	0%
Signal	100%	100%	0%
Low Reference	-	0%	-

Circuit/System Description

The clutch pedal position (CPP) sensor is a three wire sensor, connected to a 5 V reference circuit, a low reference circuit, and a signal circuit. The engine control module supplies 5 V 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 near 4 V when the clutch pedal is released, to a voltage near 1 V when the clutch pedal is applied.

Conditions for Running the DTC

P0806

- DTC P0335, P0336, P0502, P0503, P0807, or P0808 is not set.
- Engine is providing torque to wheels.
- Engine speed to transmission output speed match a valid gear ratio.
- Vehicle speed is greater than 3 kmh (2 mph).
- Four-wheel drive not in Low range.
- DTC runs continuously when the above conditions are met.

P0807 and P0808

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- Ignition is ON.
- Engine is not cranking.
- System voltage is more than 9 V.
- DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P0806

CPP sensor is stuck in range.

P0807

CPP sensor voltage is less than 0.1 V for more than 1 s.

P0808

CPP sensor voltage is more than 4.9 V for more than 1 s.

Action Taken When the DTC Sets

DTC P0806 - P0808 are Type A DTCs.

Conditions for Clearing the DTC

DTC P0806 - P0808 are Type A DTCs.

Reference Information

Schematic Reference

Manual Transmission Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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Manual Transmission Description and Operation

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- **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

K20 Engine Control Module: Scan Tool Information (L5P) **K20 Engine Control Module: Scan Tool**

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Information (Except Diesel) for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC P0651 is not set
   - **If DTC P0651 is set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If DTC P0651 is not set**
3. Verify the scan tool CPP Sensor percent parameter varies from 0% when the clutch pedal is released, to 100% when the clutch pedal is in the apply position.
   - **If the percentage does not vary from 0% to 100%**

     Refer to Circuit/System Testing.

   - **If the percentage varies from 0% to 100%**
4. Operate the vehicle within the conditions for running the DTC to verify the DTC does not set. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
   - **If the DTC sets**

     Refer to Circuit/System Testing.

   - **If the DTC does not set**
5. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF. Disconnect the harness connector at the B25B Clutch Pedal Position Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the low reference circuit terminal C and ground:
   - **If 5 Ω or greater**
   1. Disconnect the X3 harness connector at the K20 Engine Control Module.
   2. Test for less than 2 Ω in the circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 Engine Control Module.
   - **If less than 5 Ω**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal A and ground:
   - **If less than 4.8 V**
   1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
   2. Test for infinite resistance between the 5 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the 5 V reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 Engine Control Module.

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- **If greater than 5.2 V**

1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
2. Test for less than 1 V between the 5 V reference circuit and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V, replace the K20 Engine Control Module.

- **If between 4.8-5.2 V**

5. Verify the scan tool CPP Sensor voltage parameter is less than 0.1 V.
    - **If 0.1 V or greater**

    1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module, Ignition ON.
    2. Test for less than 1 V between the signal circuit terminal B and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K20 Engine Control Module.

    - **If less than 0.1 V**

6. Install a 3 A fused jumper wire between the signal circuit terminal B and the 5 V reference circuit terminal A.
7. Verify the scan tool CPP Sensor voltage parameter is greater than 4.9 V.
    - **If 4.9 V or less**

    1. Ignition OFF, remove the jumper wire, disconnect the X3 harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit terminal B and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω , replace the K20 Engine Control Module.

    - **If greater than 4.9 V**

8. Test or replace the B25B Clutch Pedal Position Sensor.

Component Testing

Static Test

1. Ignition OFF, disconnect the harness connector of the B25B Clutch Pedal Position Sensor.
2. Measure the resistance between the signal terminal B and the low reference terminal C at the B25B Clutch Pedal Position Sensor. Depress the clutch pedal through the entire range. The resistance should vary from low to high and vice versa without any spikes or dropouts.
    - **If the resistance is erratic with spikes or dropouts**

      Replace the B25B Clutch Pedal Position Sensor.

    - **If the resistance is not erratic without spikes or dropouts**
3. All OK.

Repair Instructions

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

- **Clutch Pedal Position Sensor Replacement**

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

DTC P080A: CLUTCH PEDAL POSITION (CPP) NOT LEARNED

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 3-wire sensor, connected to a 5 V reference circuit, a low reference circuit, and a signal circuit. The engine control module supplies 5 V 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 near 4 V when the clutch pedal is released to a voltage near 1 V when the clutch pedal is applied.

Conditions for Running the DTC

Ignition is ON.

Conditions for Setting the DTC

CPP sensor learned apply position not learned.

Action Taken When the DTC Sets

P080A is a Type A DTC.

Conditions for Clearing the DTC

P080A is a Type A DTC.

Reference Information

Schematic Reference

Manual Transmission Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Manual Transmission Description and Operation

Electrical Information Reference

- **Circuit Testing**

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

K20 Engine Control Module: Scan Tool Information (L5P) **K20 Engine Control Module: Scan Tool Information (Except Diesel)**

Circuit/System Verification

1. Ignition ON.
2. Verify DTC P0651, P0806, P0807, or P0808 is not set.
   - **If DTC P0651, P0806, P0807, or P0808 is set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If DTC P0651, P0806, P0807, or P0808 is not set**
3. Perform the clutch pedal position sensor learn procedure.
   - **If the clutch pedal position sensor learn was not successful**

     Refer to Circuit/System Testing.

   - **If the clutch pedal position sensor learn was successful**
4. Ignition ON.
5. Verify DTC P080A ran and passed this ignition cycle. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.
   - **If the scan tool indicates DTC P080A failed**

     Refer to Circuit/System Testing.

   - **If the scan tool indicates DTC P080A ran and passed this ignition cycle**
6. All OK.

Circuit/System Testing

1. Verify the clutch pedal is not loose and is properly torqued. Refer to **Clutch Pedal Replacement** .
   - **If a condition is found with the clutch pedal**

     Repair or replace as necessary.

   - **If no condition is found with the clutch pedal**
2. Replace the K20 Engine Control Module.

Repair Instructions

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

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

CLUTCH PEDAL POSITION LEARN

NOTE: **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.

NOTE: **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 s after the learn procedure has successfully completed in order to store the CPP sensor variation values in ECM history.

VEHICLE SPEED SENSOR DIAGNOSIS

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.

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

Reference Information

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Schematic Reference

Manual Transmission Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Manual Transmission Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Raise the vehicle off the ground.
2. Support the rear axle assembly so that the propeller shaft is at the normal drive line angle.
3. Start and idle the engine.
4. Place the transmission in second gear and release the clutch pedal.
5. Monitor VSS parameter on the scan tool. The VSS parameter should increase as the drive wheel speed increases, and match the speedometer display on the instrument cluster.
6. If the vehicle passes the Circuit/System Verification procedure, then STOP. Do not perform the Circuit/System Testing or Component Testing as this may result in an unnecessary part replacement. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Circuit/System Testing

NOTE: **You must perform the Circuit/System Verification first.**

1. Disconnect the ECM harness connector X1.
2. Measure for 1,300-1,500 ohms at 25Â°C (77Â°F) between the VSS high signal circuit terminal 54 and the VSS low signal circuit terminal 34.
   - 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 54 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 34 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.

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6. Ignition OFF, test for less than 5 ohms between the low reference circuit at the VSS harness connector terminal B and ground.
    - If greater than the specified value, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the ECM.
7. Ignition ON, test for less than 6 V between the signal circuit at the VSS harness connector terminal A and ground.
    - If greater than the specified value, test the signal circuit for a short to voltage. If the circuit tests normal, replace the ECM.

Repair Instructions

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

- **Vehicle Speed Sensor Replacement**
- **Control Module References** for ECM replacement, setup and programming.

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**
- **Symptoms - Vibration Diagnosis and Correction**
- **Vibration Analysis - Driveline**

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- **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 System 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. Refer to **Transmission Control Replacement**. 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 Drain and Fill**.	System OK	Go to **Step 10**

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Step	Action	Yes	No
	Did you find and repair the condition?		
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

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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 System 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. Refer to **Transmission Control Replacement**. 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 Drain and Fill**. 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**.	Go to **Step 14**	Go to Diagnostic Aids

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Step	Action	Yes	No
	Did you find and repair the condition?		
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 System 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**

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Step	Action	Yes	No
8	Replace the transmission shift tower. Refer to **Transmission Control Replacement**. Did you find and repair the condition?	System OK	Go to **Step 9**
9	Inspect the transmission fluid level. Refer to **Transmission Fluid Drain and Fill**. 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 Drain and Fill**. 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.

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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 Drain and Fill**. 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 Drain and Fill**. 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. Refer to **Transmission Control Replacement**. 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 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

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Step	Action	Yes	No
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. Refer to **Transmission Control Replacement**. 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**.	System OK	Go to **Step 6**

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Step	Action	Yes	No
	Did you find and repair the condition?		
6	Inspect the engine and/or transmission mounts. Are the engine and/or transmission mounts worn or damaged?	Go to **Step 7**	Go to **Step 8**
7	Replace the engine mounts and/or transmission mounts. Refer to the appropriate procedure: • **Engine Mount Replacement - Right Side (Four Wheel Drive)** **Engine Mount Replacement - Right Side (Two Wheel Drive)** • **Engine Mount Replacement - Left Side (Two Wheel Drive)** **Engine Mount Replacement - Left Side (Four Wheel Drive)** • **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 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 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

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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. Refer to **Clutch Actuator Cylinder Replacement** . 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**

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Step	Action	Yes	No
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 Drain and Fill**. 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**

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Step	Action	Yes	No
5	Drain the transmission fluid and fill the transmission with the correct type of fluid. Refer to **Transmission Fluid Drain and Fill**. 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. Refer to **Clutch Actuator Cylinder Replacement** . 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.

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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 Specifications** . 2. Replace the engine mounts. Refer to **Engine Mount Replacement - Right Side (Four Wheel Drive)** **Engine Mount Replacement - Right Side (Two Wheel Drive)** , or **Engine Mount Replacement - Left Side (Two Wheel Drive)** **Engine Mount Replacement - Left Side (Four Wheel Drive)** . 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** . 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 CONTROL REPLACEMENT

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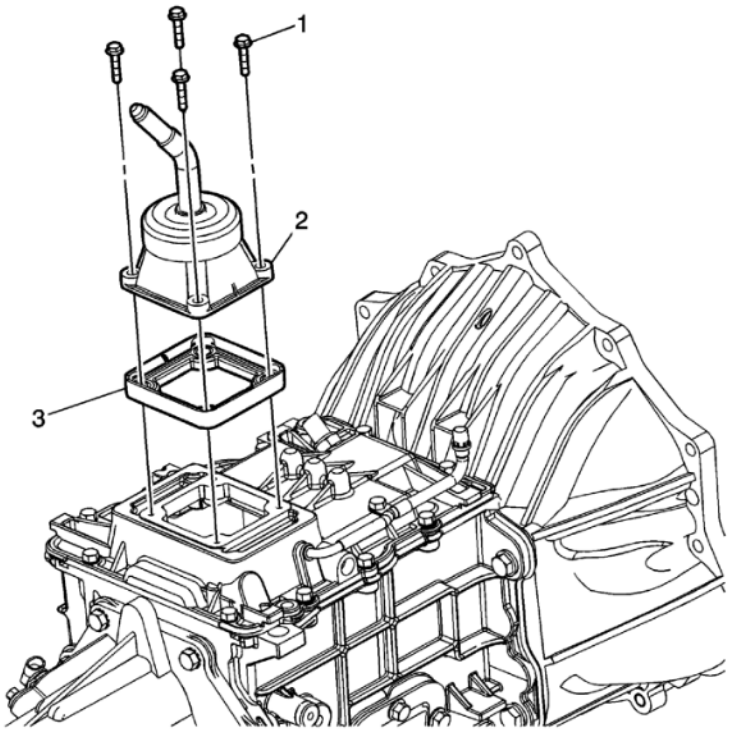


Fig. 7: Transmission Control
Courtesy of GENERAL MOTORS COMPANY

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 - Light Duty)** **Transmission Support Crossmember Replacement (2WD - Heavy Duty)** **Transmission Support Crossmember Replacement (4WD - Light Duty)** **Transmission Support Crossmember Replacement (4WD - Heavy Duty)** . 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) **CAUTION:** **Refer to Fastener Caution .** **NOTE:** **Remove ONLY the exposed bolts at the base of the**

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Callout	Component Name
	lever. **Tighten:** 22 N.m (20 lb ft)
2	Transmission Control **NOTE:** **Do not disassemble the transmission shift lever. Internal parts for this shift lever are not available.**
3	Transmission Control Spacer **Procedure** Apply sealer to the shift cover side of the shift tower spacer. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .

TRANSMISSION CONTROL LEVER BOOT REPLACEMENT

Removal Procedure

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

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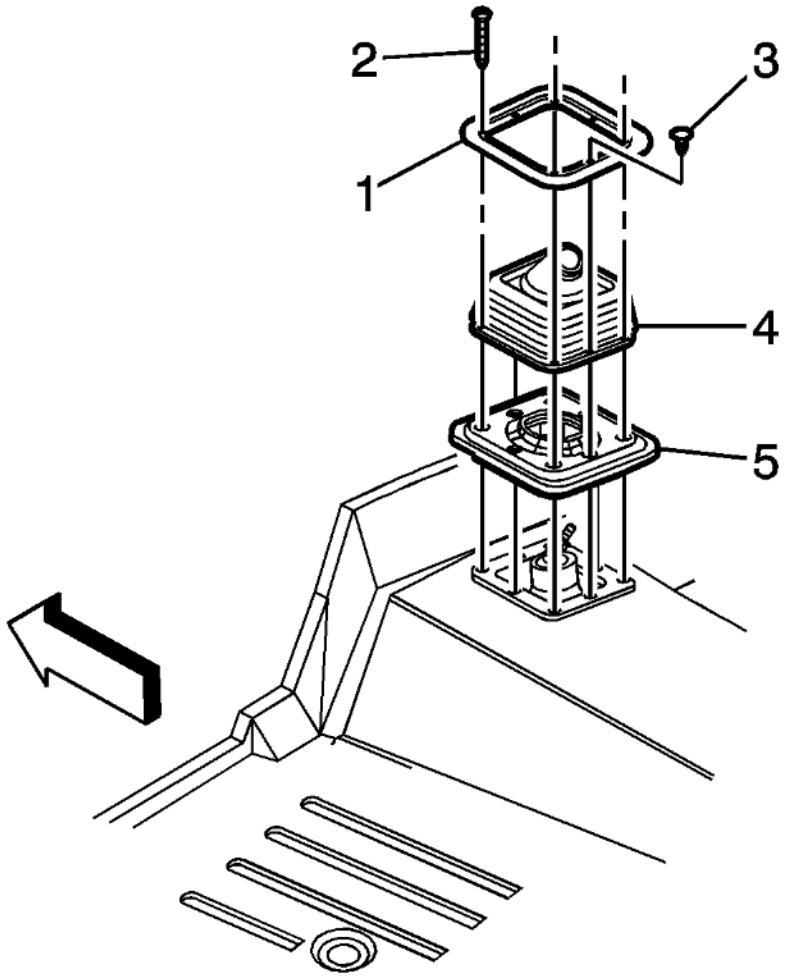


Fig. 8: Exploded View Of Transmission Control Lever Boot
Courtesy of GENERAL MOTORS COMPANY

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

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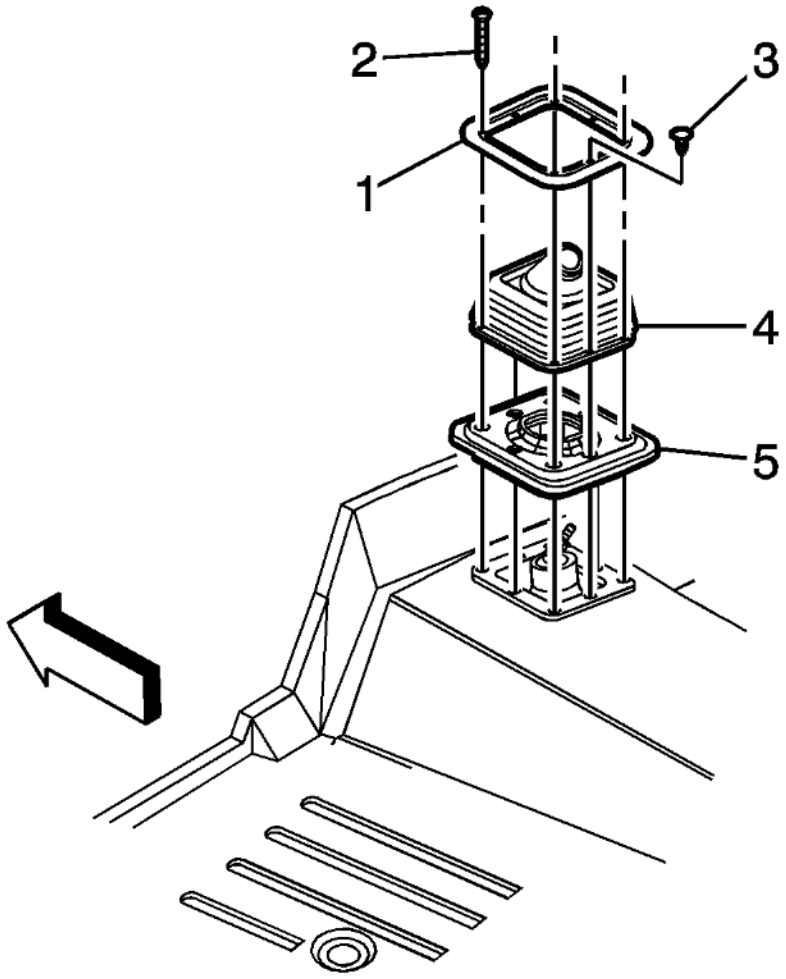


Fig. 9: Exploded View Of Transmission Control Lever Boot
Courtesy of GENERAL MOTORS COMPANY

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.

CAUTION: Refer to Fastener Caution .

4. Lift and push the lower edge of the control lever boot as necessary in order to install the 4 retaining screws (2). 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.

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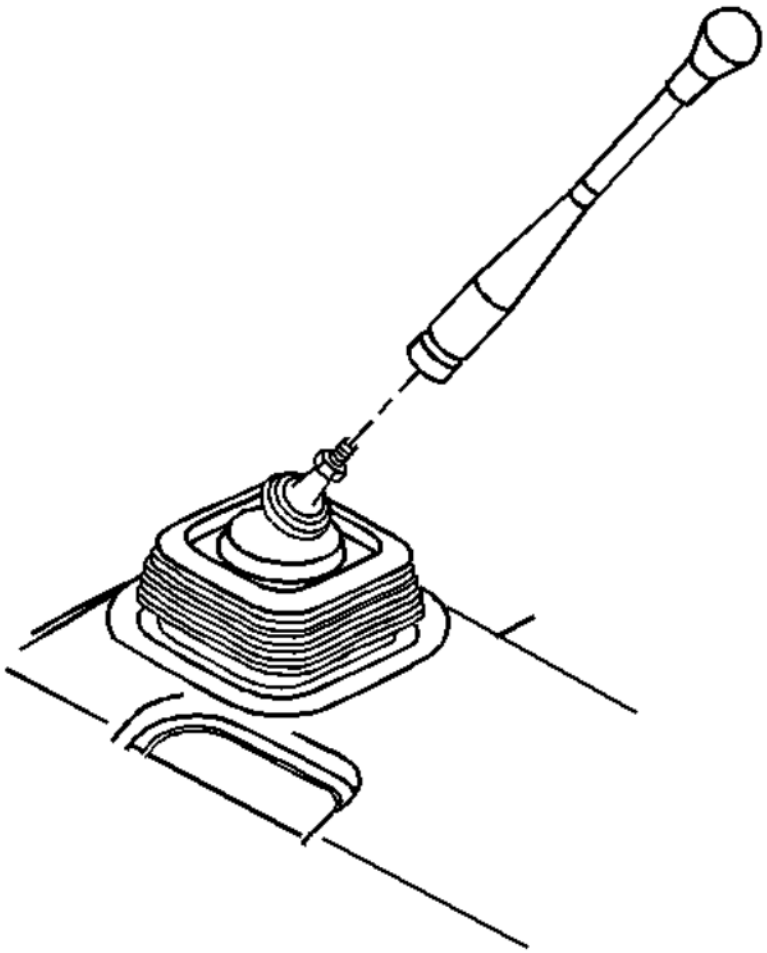


Fig. 10: Removing The Control Lever
Courtesy of GENERAL MOTORS COMPANY

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

2. Remove the control lever.

Installation Procedure

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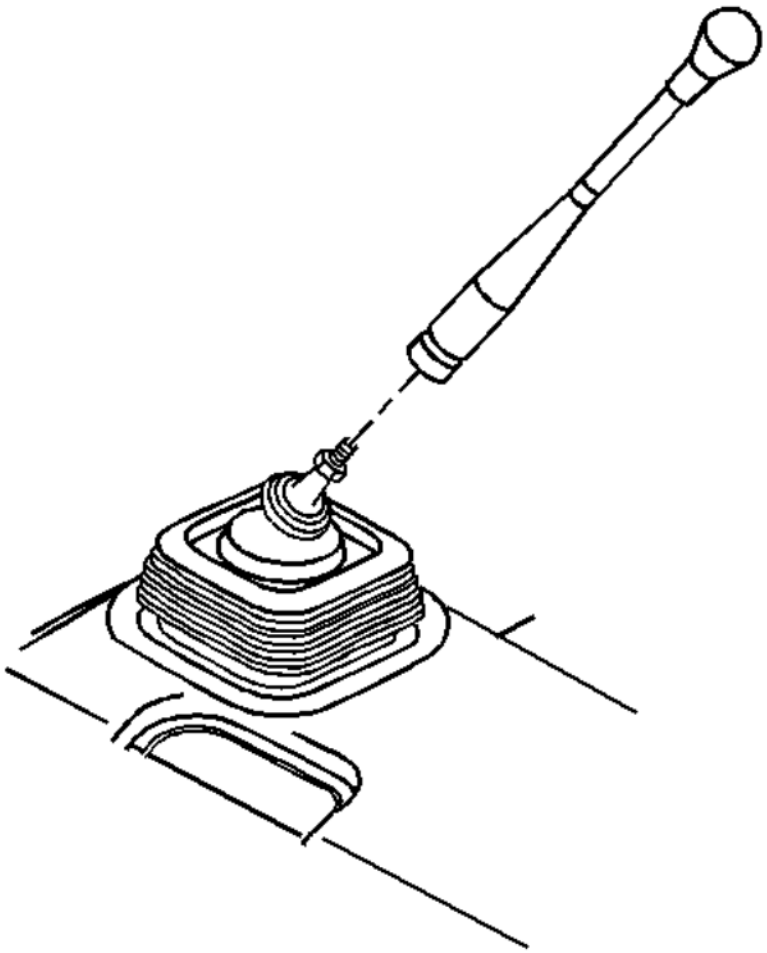


Fig. 11: Removing The Control Lever
Courtesy of GENERAL MOTORS COMPANY

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.

    CAUTION: Refer to Fastener Caution .

    5. Hold the control lever and tighten the shift lever assembly nut against the control lever. Tighten the nut to 37 N.m (27 lb in).
    6. Install the control lever boot to the control lever.

VEHICLE SPEED SENSOR REPLACEMENT

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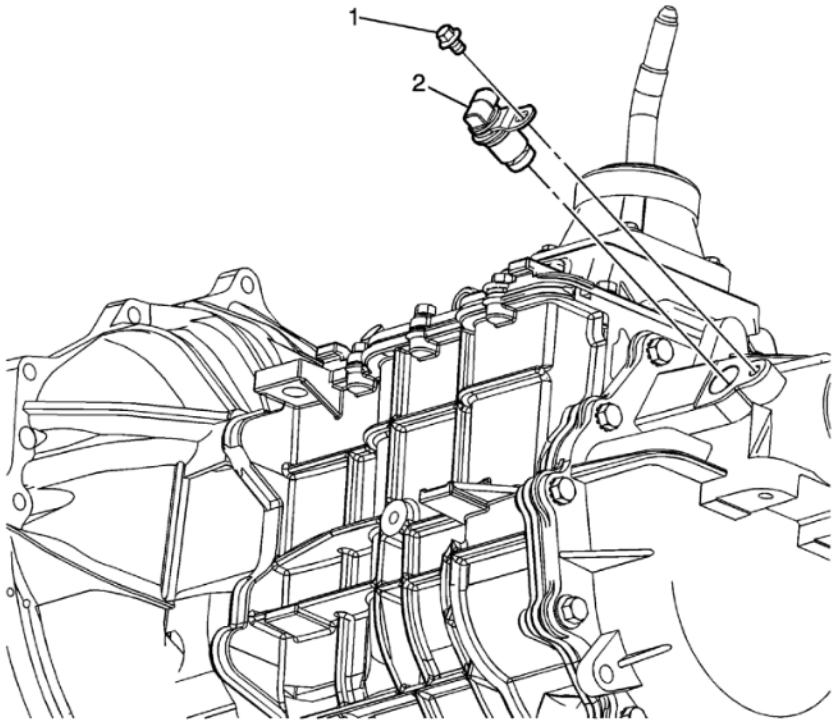


Fig. 12: Vehicle Speed Sensor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .	
1	Vehicle Speed Sensor Bolt **CAUTION:** **Refer to** **Fastener Caution** . **Tighten** 21 N.m (16 lb ft)
2	Vehicle Speed Sensor **Procedure** Disconnect the electrical connector from the vehicle speed sensor.

TRANSMISSION FLUID DRAIN AND FILL

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.

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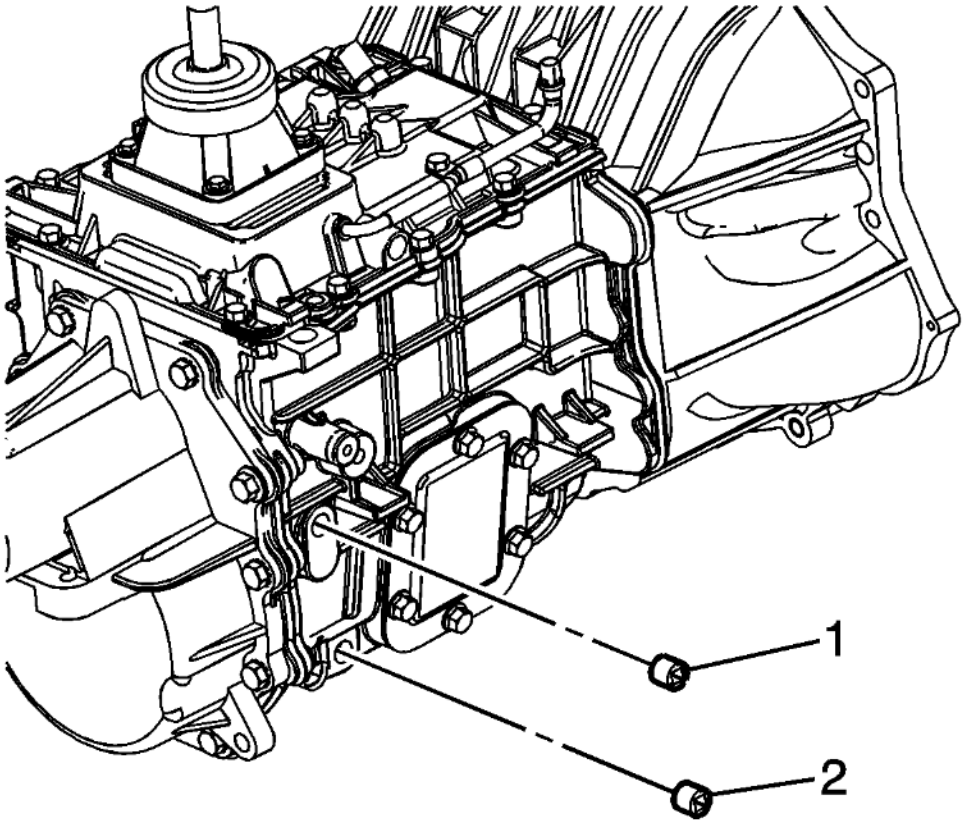


Fig. 13: View Of Drain And Fill Plugs
Courtesy of GENERAL MOTORS COMPANY

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

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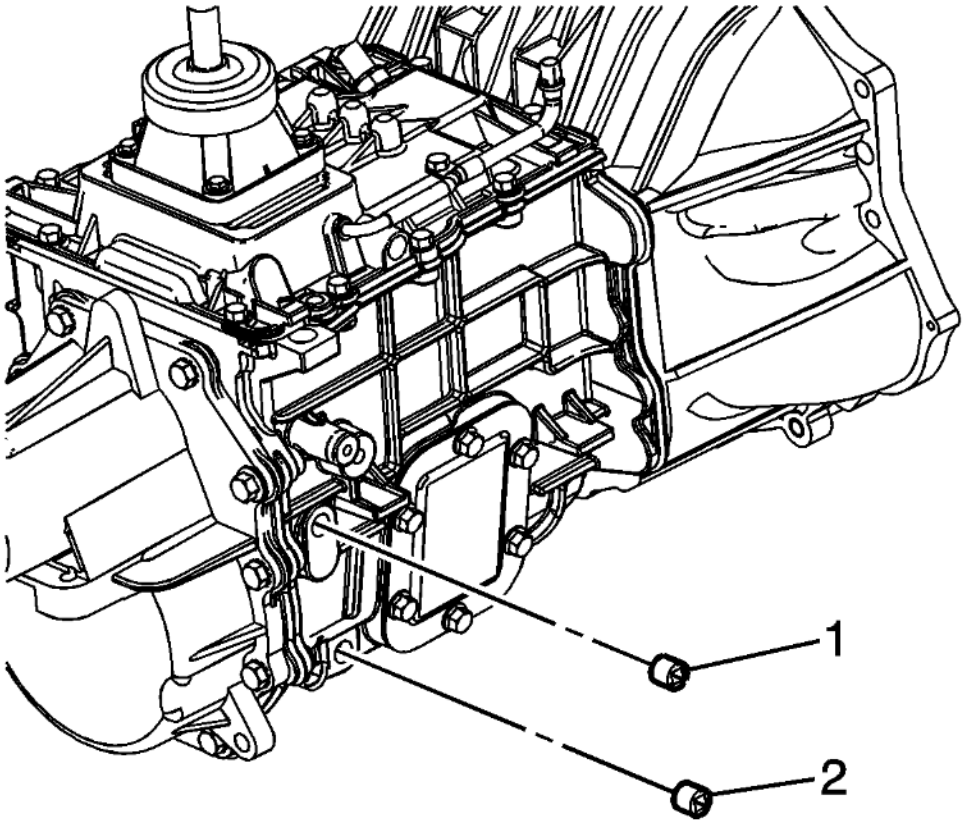


Fig. 14: View Of Drain And Fill Plugs
Courtesy of GENERAL MOTORS COMPANY

1. Apply a thin bead of sealant, or equivalent to the oil drain plug threads. Refer to **Adhesives, Fluids, Lubricants, and Sealers**.

CAUTION: **Refer to Component Fastener Tightening Caution .**

2. Install the oil drain plug (2). Tighten the plug to 21 N.m (16 lb ft).

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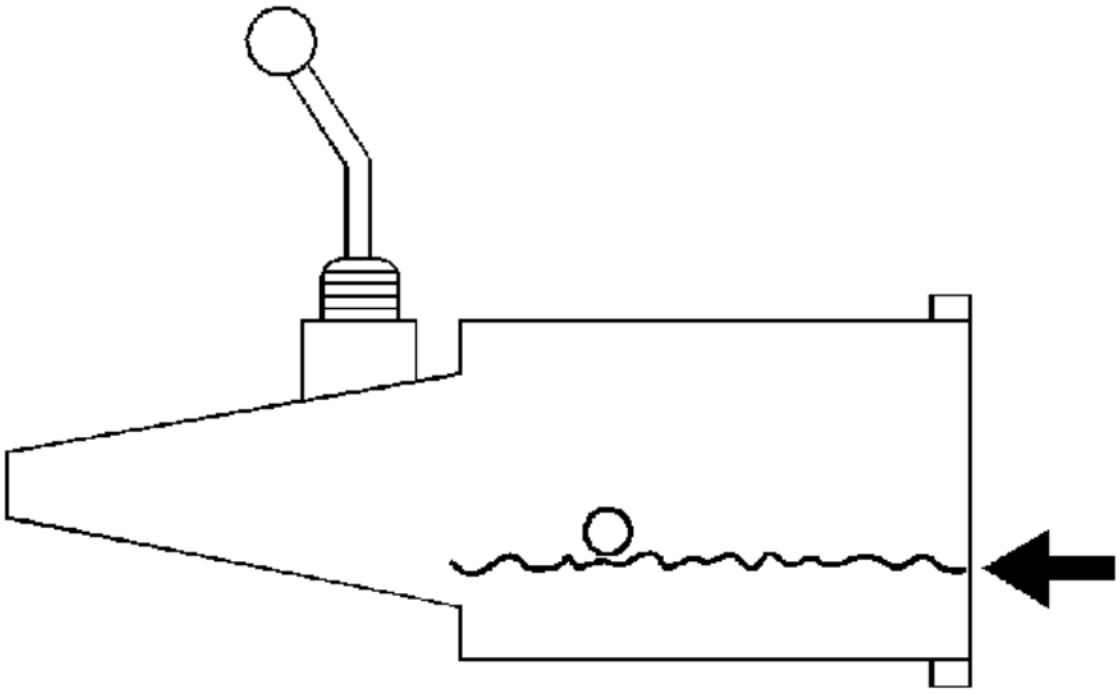


Fig. 15: Checking Transmission Fluid Level
Courtesy of GENERAL MOTORS COMPANY

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

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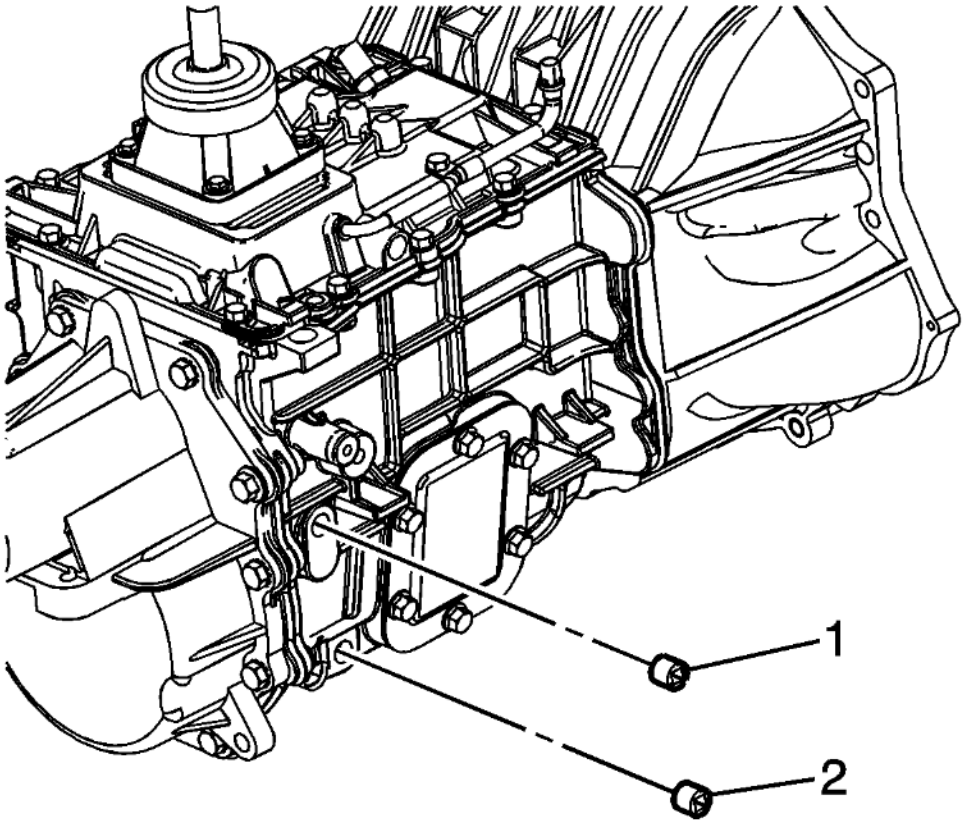


Fig. 16: View Of Drain And Fill Plugs
Courtesy of GENERAL MOTORS COMPANY

4. Apply a thin bead of sealant, or equivalent to the oil fill plug threads. Refer to **Adhesives, Fluids, Lubricants, and Sealers**.
5. Install the oil fill plug (1). Tighten the plug to 21 N.m (16 lb ft).
6. Lower the vehicle.

TRANSMISSION REPLACEMENT

Special Tools

J-42371 Hydraulic Clutch Line Separator

For equivalent regional tools, refer to **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 (MYC, M5U, MSX)** **Two-Piece Propeller Shaft Replacement (MW7)** .

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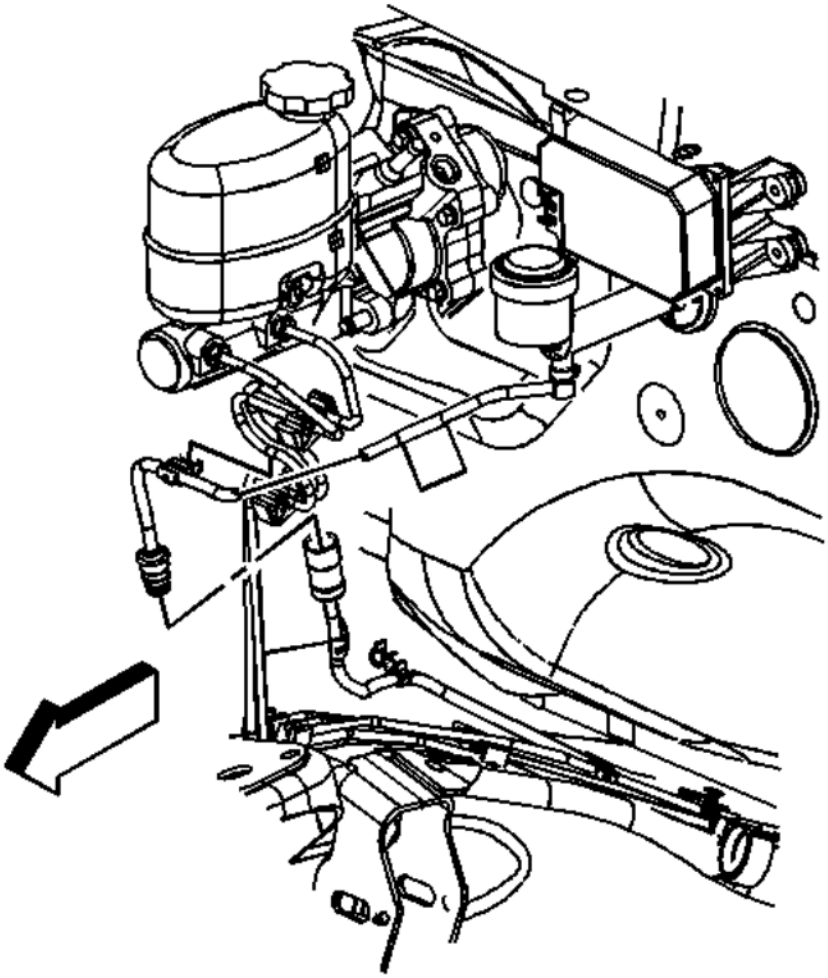


Fig. 17: Clutch Master Cylinder To Clutch Actuator Cylinder Quick Connect Fitting (NV 3500 or NV 4500 Transmission)
Courtesy of GENERAL MOTORS COMPANY

3. Using **J-42371** hydraulic clutch line separator push back on the sleeve on the quick connect in order to disconnect the clutch actuator cylinder to clutch master cylinder quick connect fitting.
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.

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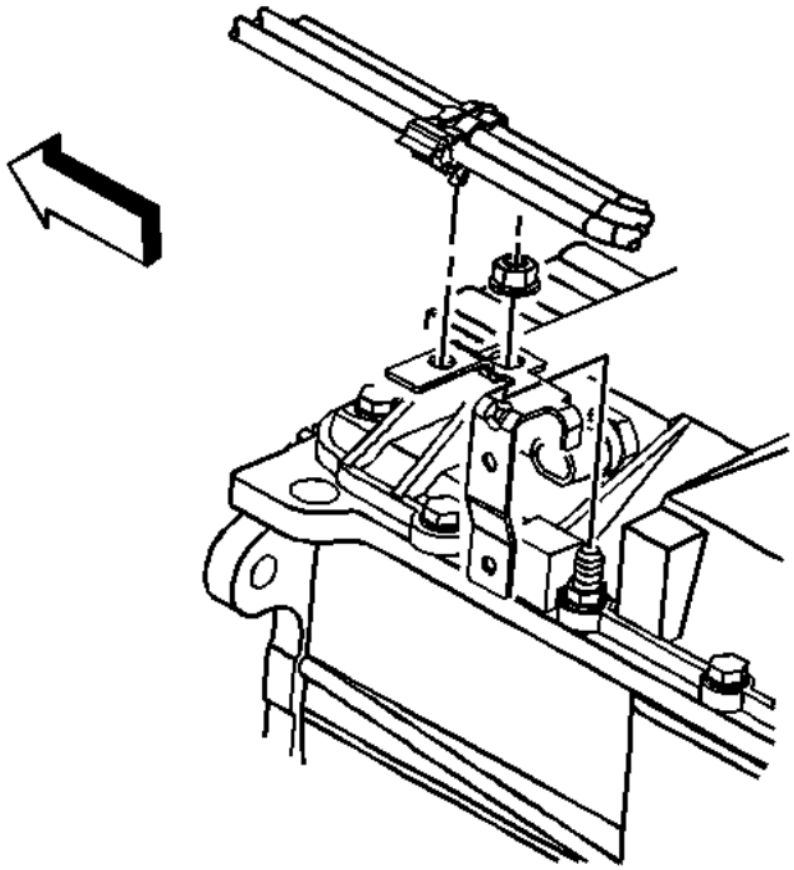


Fig. 18: Removing The Fuel Feed/Return Hose Clip From The Bracket (4WD)
Courtesy of GENERAL MOTORS COMPANY

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 - Light Duty)** **Transmission Support Crossmember Replacement (2WD - Heavy Duty)** **Transmission Support Crossmember Replacement (4WD - Light Duty)** **Transmission Support Crossmember Replacement (4WD - Heavy Duty)** .

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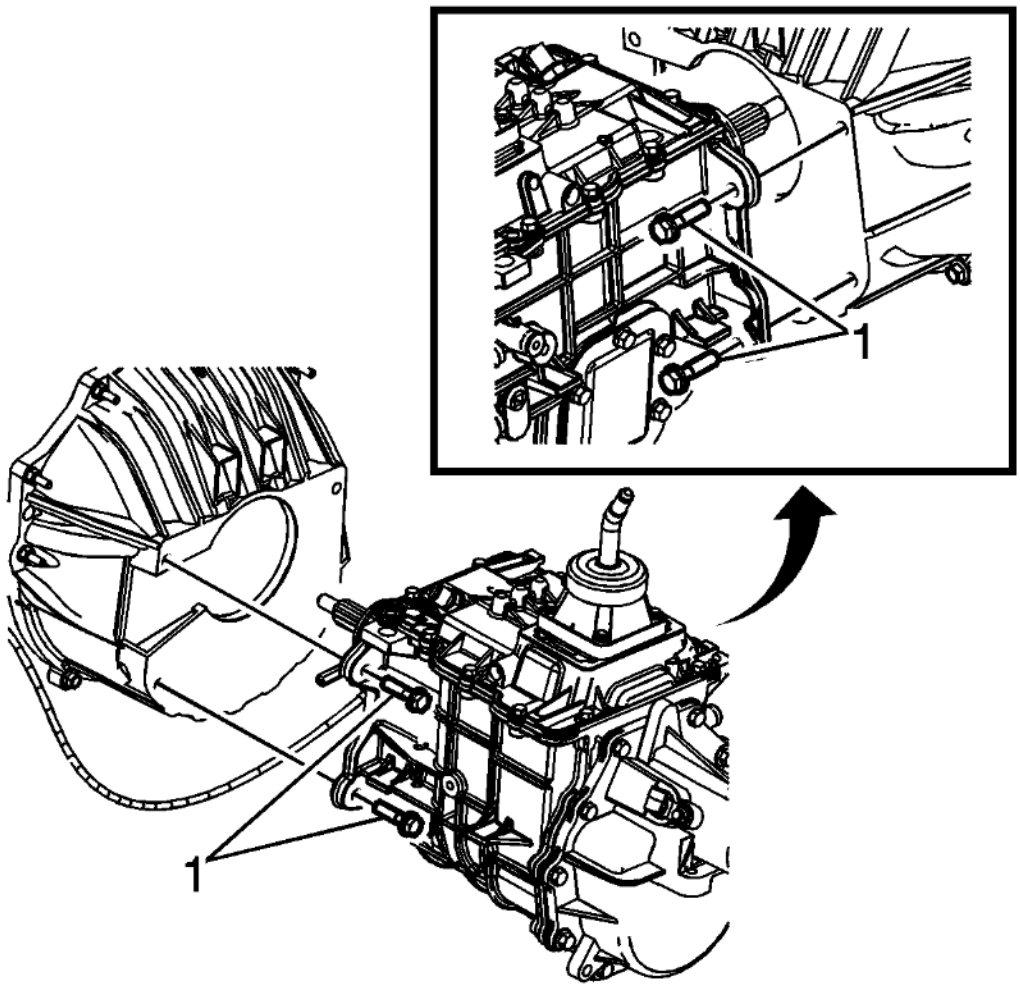


Fig. 19: Transmission To Clutch Housing Bolts
Courtesy of GENERAL MOTORS COMPANY

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

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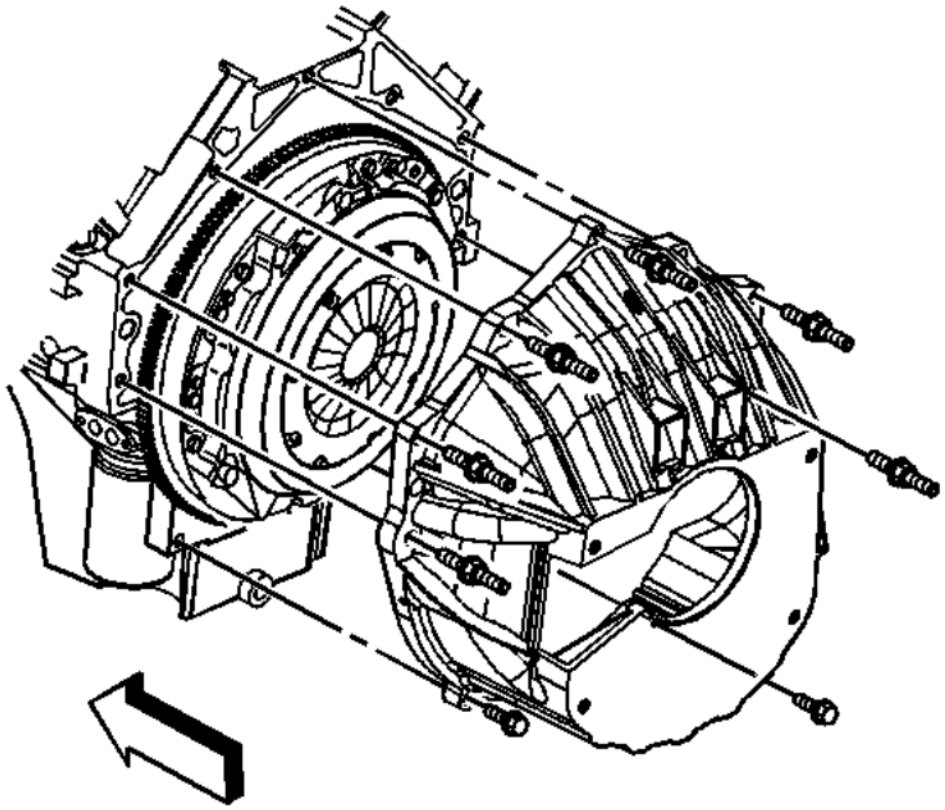


Fig. 20: Removing The Clutch Housing Bolts/Studs
Courtesy of GENERAL MOTORS COMPANY

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

Installation Procedure

WARNING: Use care when cleaning the clutch hub. The clutch hub may have sharp edges and can cause personal injury if contact is made. Wear protective gloves to avoid personal injury.

1. Clean the clutch hub and the input shaft from any debris and contaminates with a lint-free towel.

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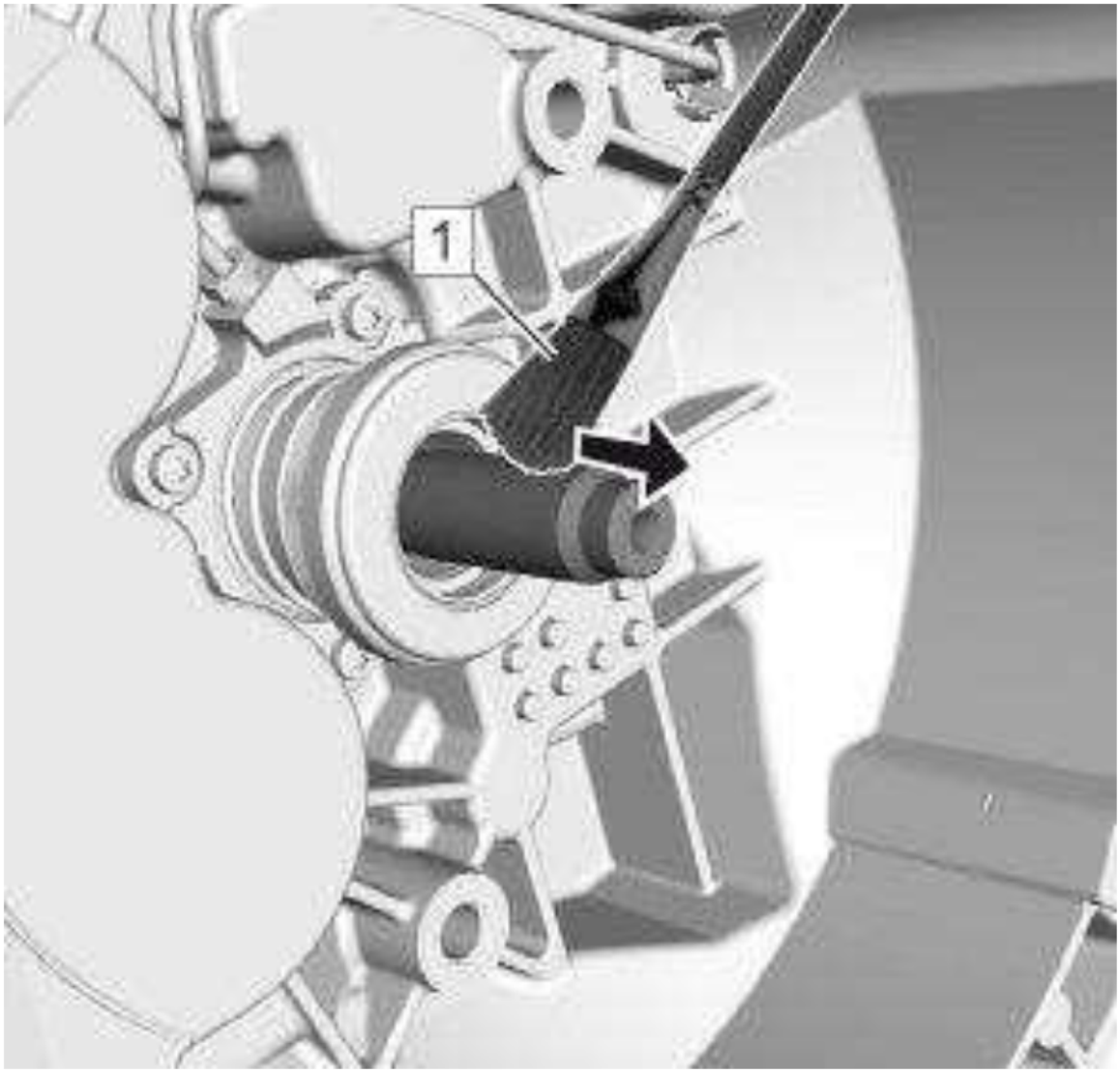


Fig. 21: Using Flat Brush To Apply Light Coating Of Multi-Purpose Grease
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Applying too much or the wrong type of grease on the transmission input shaft may cause damage, clutch slippage or failure. Always apply the correct type of grease. Never apply more grease than is necessary to coat the transmission input shaft with a very thin film of grease.

2. Use a clean flat brush (1) to apply very light coating of multi-purpose grease to input shaft until the metal is only shiny . No visible clumps of grease are permissible regardless of size. Smear away from the transmission in direction of the shown arrow.

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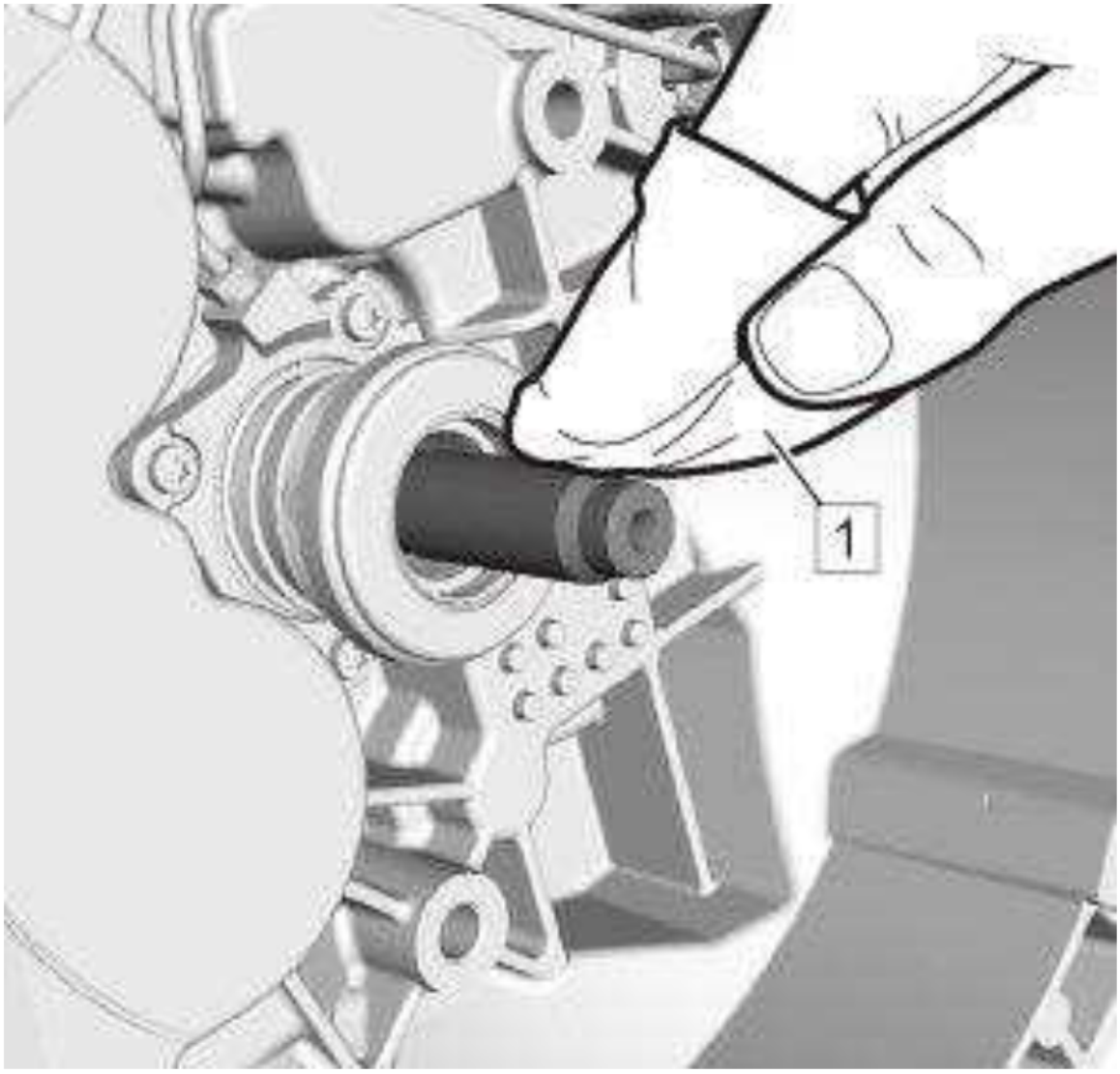


Fig. 22: Cleaning Lead Surface Of Input Shaft With Lint-Free Towel
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Ensure that no grease remains on the lead surface of the transmission input shaft. Clean the lead surface of the transmission input shaft prior to the assembly of the transmission to the engine. Failure to maintain a clean surface may cause clutch slippage or failure.

3. Clean the entire lead surface of the input shaft with a NEW, lint-free towel (1).

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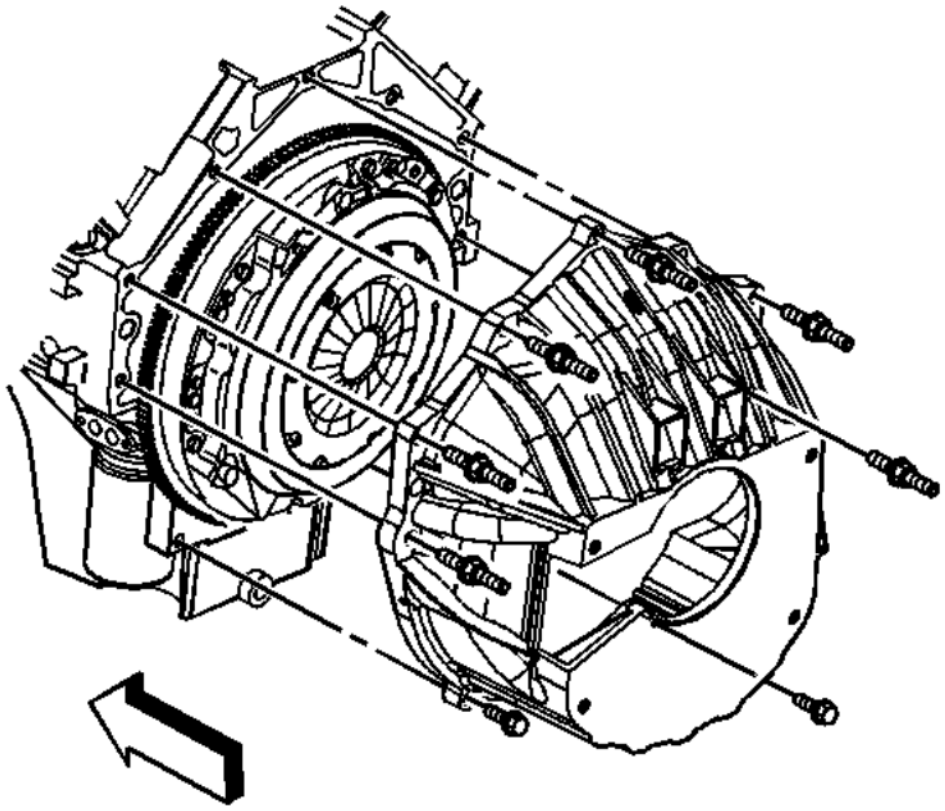


Fig. 23: Removing The Clutch Housing Bolts/Studs
Courtesy of GENERAL MOTORS COMPANY

4. Install the clutch housing if previously removed.

CAUTION: **Refer to Fastener Caution .**

5. Install the clutch housing bolts and studs and tighten to 50 N.m (37 lb ft).

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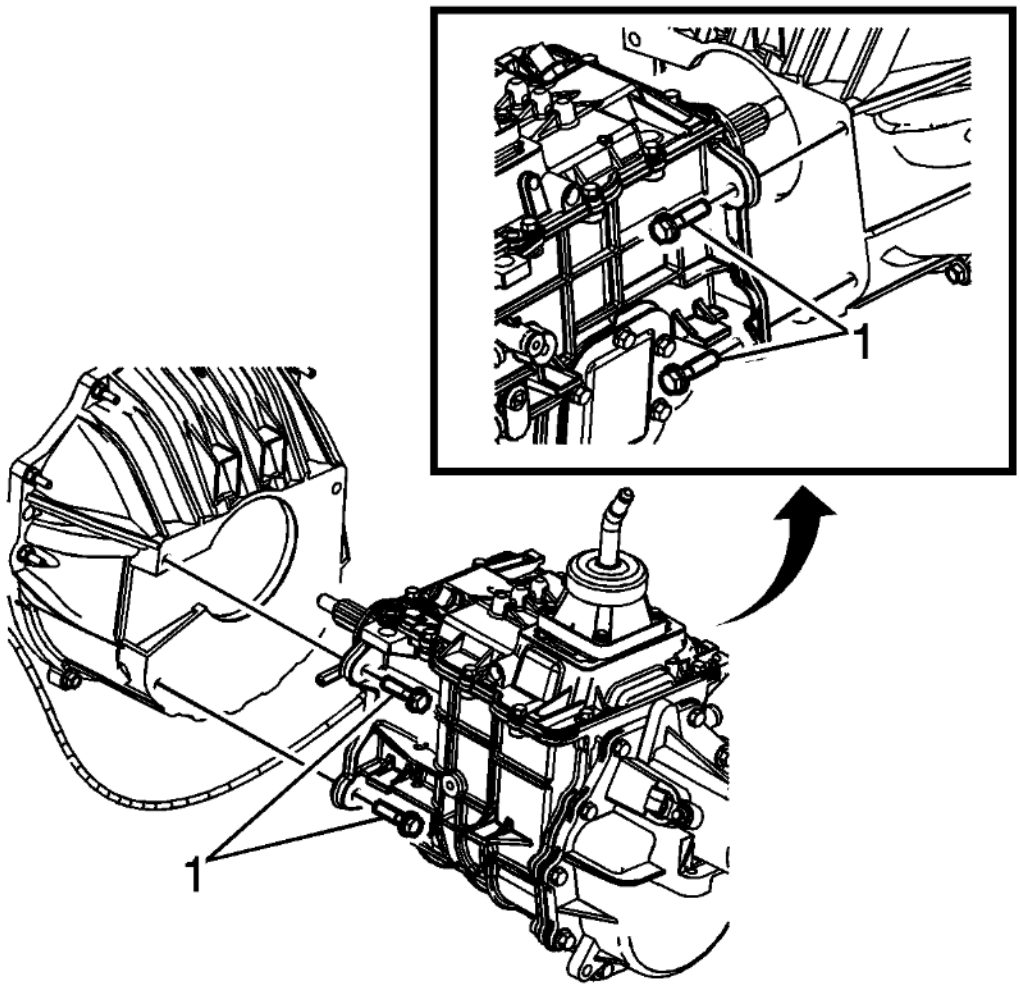


Fig. 24: Transmission To Clutch Housing Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Position the transmission to the clutch housing.
7. Install the transmission to clutch housing bolts (1) and tighten to 100 N.m (74 lb ft).
8. Install the transmission support. Refer to **Transmission Support Crossmember Replacement (2WD - Light Duty)** **Transmission Support Crossmember Replacement (2WD - Heavy Duty)** **Transmission Support Crossmember Replacement (4WD - Light Duty)** **Transmission Support Crossmember Replacement (4WD - Heavy Duty)** .
9. Remove the transmission jack.

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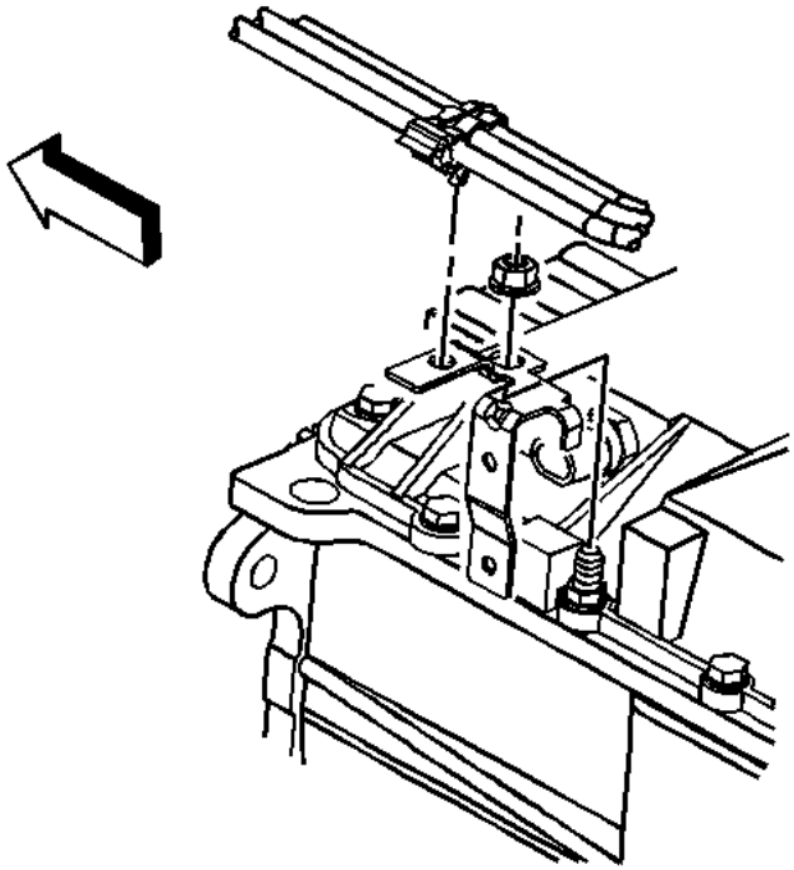


Fig. 25: Removing The Fuel Feed/Return Hose Clip From The Bracket (4WD)
Courtesy of GENERAL MOTORS COMPANY

10. Install the fuel pipes to the fuel pipe bracket.
11. Install the engine electrical wiring harness clip to the fuel pipe bracket.
12. Connect the electrical wiring harness connector to the backup lamp switch.
13. Connect the electrical wiring harness connector to the vehicle speed sensor.

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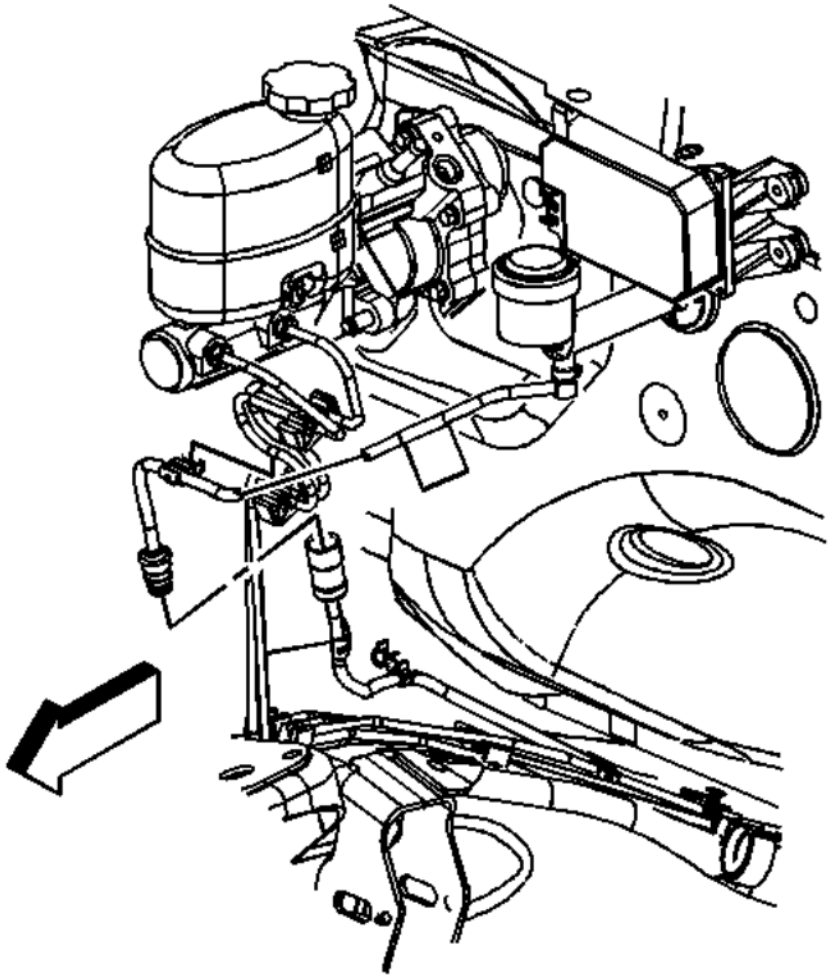


Fig. 26: Clutch Master Cylinder To Clutch Actuator Cylinder Quick Connect Fitting (NV 3500 or NV 4500 Transmission)
Courtesy of GENERAL MOTORS COMPANY

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

14. Connect the clutch actuator cylinder hose to the clutch master cylinder hose.
15. Push together the clutch hydraulic hose quick connect fittings, then pull back on the fittings to verify engagement.
16. Check the clutch hydraulic hose for kinks or twists.
17. Install the propeller shaft. Refer to **One-Piece Propeller Shaft Replacement** , or **Two-Piece Propeller Shaft Replacement (MYC, M5U, MSX)** **Two-Piece Propeller Shaft Replacement (MW7)** .
18. Fill the transmission with the proper fluid to the correct level.
19. Install the shift lever. Refer to **Transmission Control Lever Knob Replacement**.
20. Bleed the clutch hydraulic system. Refer to **Hydraulic Clutch System Bleeding** .

REPAIR INSTRUCTIONS - OFF VEHICLE

TRANSMISSION DISASSEMBLE

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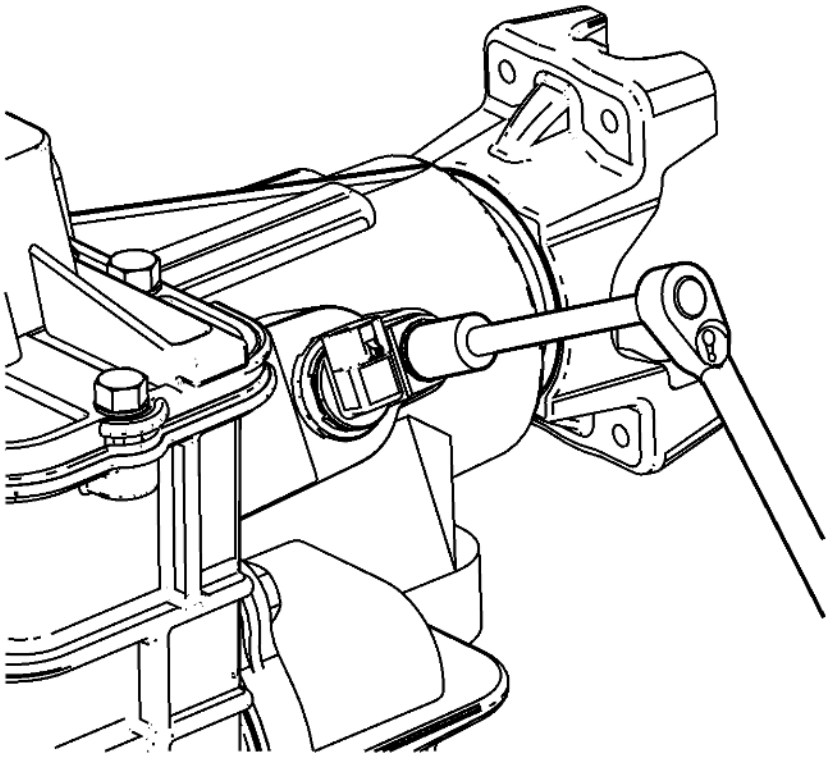


Fig. 27: Using Ratchet On Vehicle Speed Sensor (VSS) Screw
Courtesy of GENERAL MOTORS COMPANY

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

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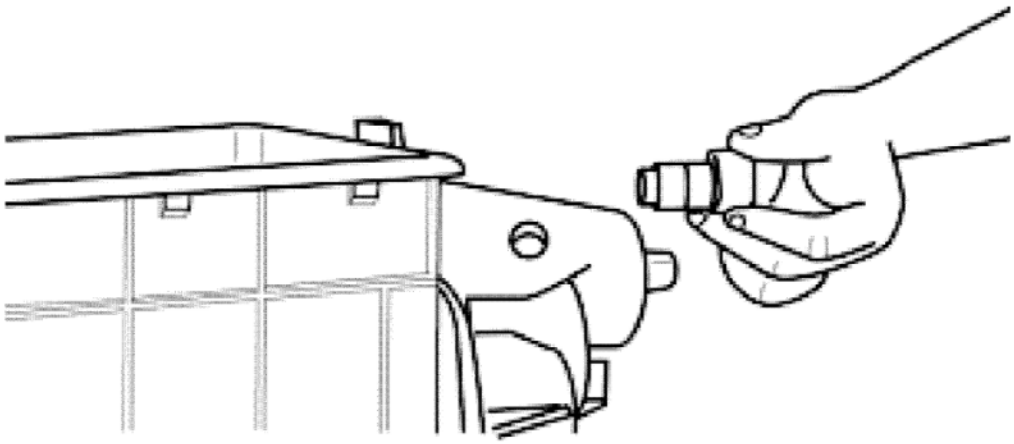


Fig. 28: VSS
Courtesy of GENERAL MOTORS COMPANY

2. Remove the VSS.

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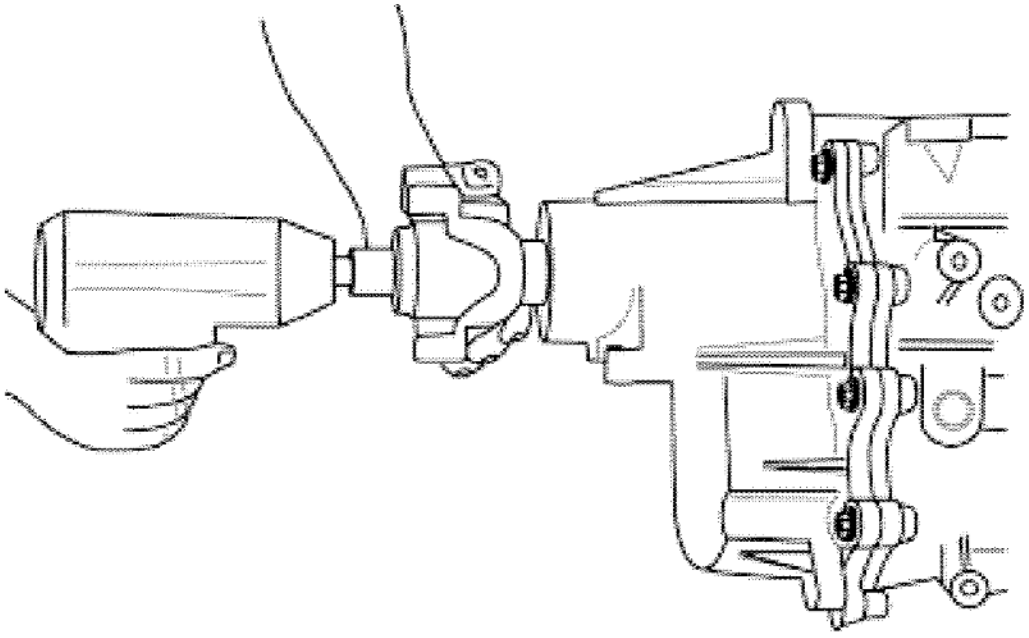


Fig. 29: Main Shaft Nut
Courtesy of GENERAL MOTORS COMPANY

3. Remove the main shaft nut.

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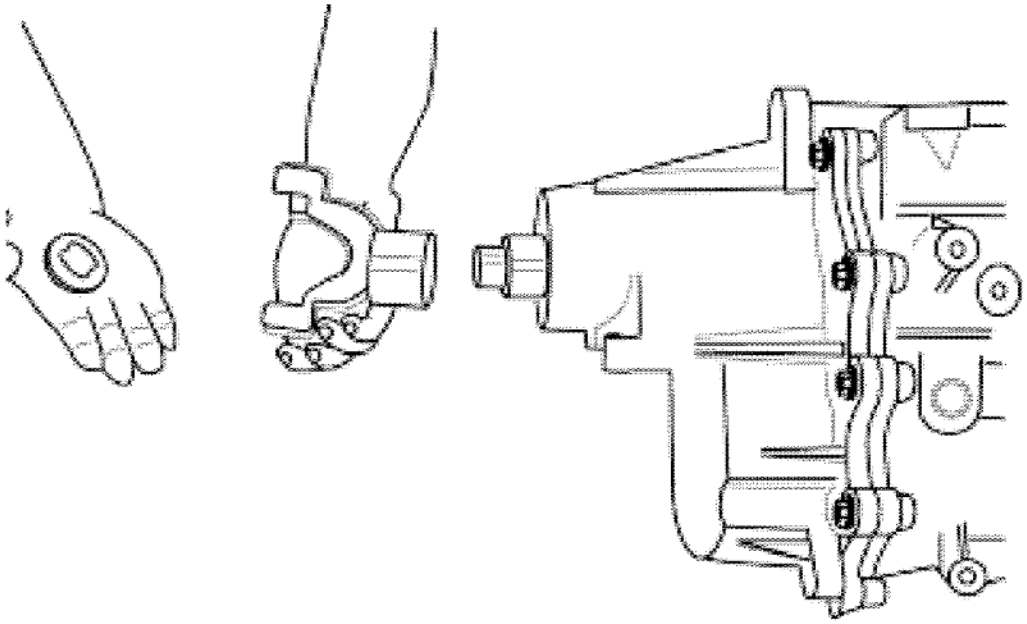


Fig. 30: Main Shaft Nut & Yoke
Courtesy of GENERAL MOTORS COMPANY

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

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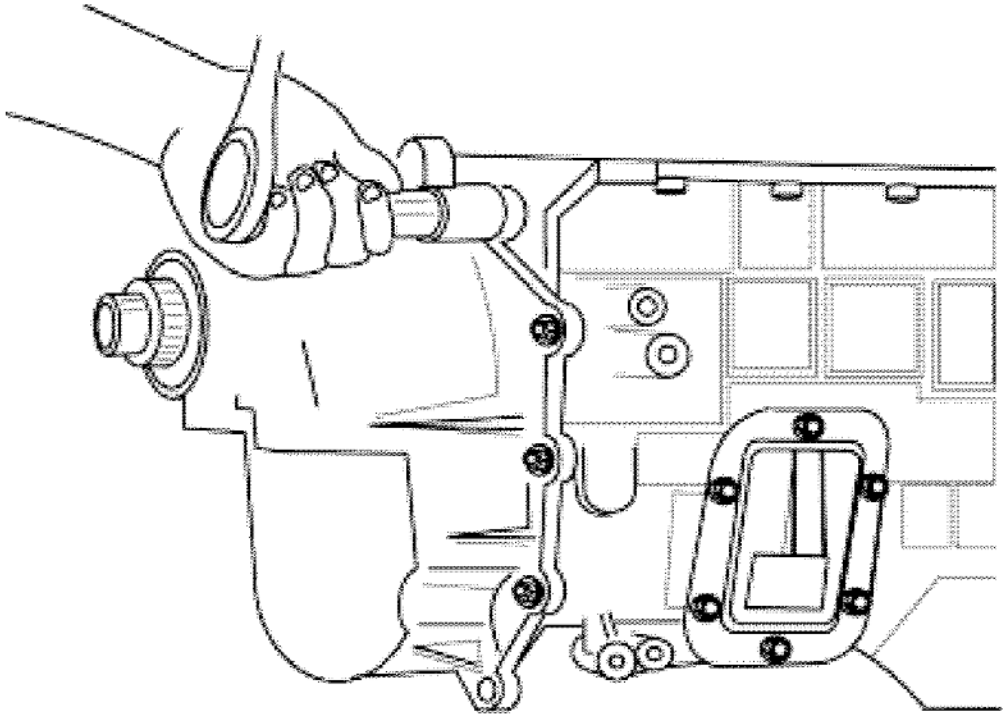


Fig. 31: Rear Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

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

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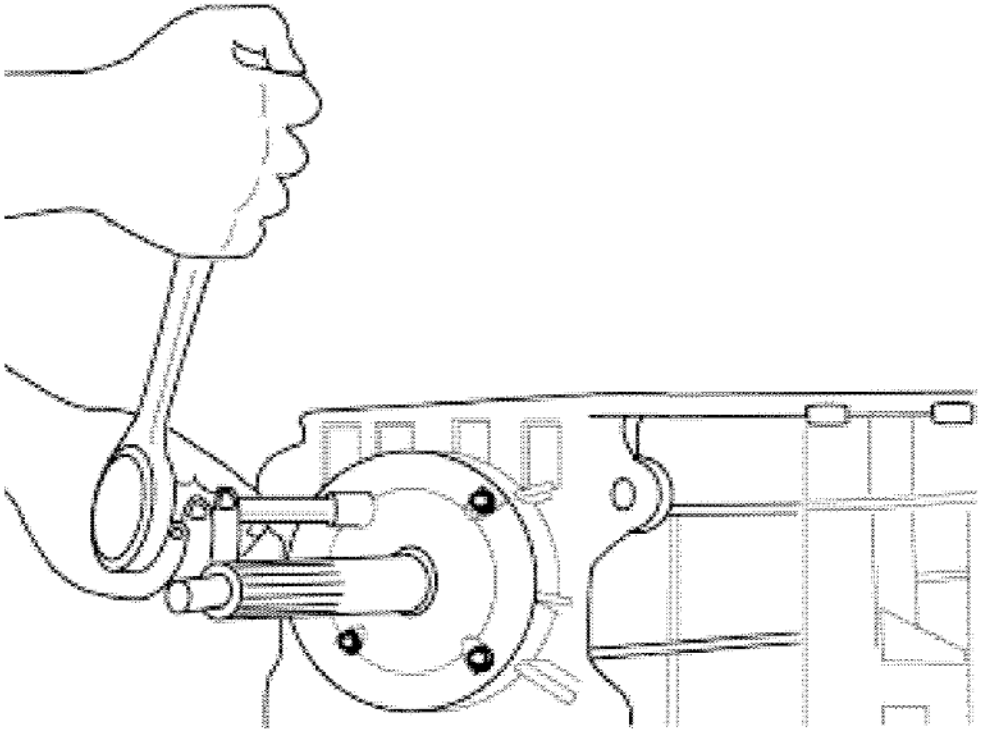


Fig. 32: Bearing Retainer Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove the bolts from the bearing retainer.

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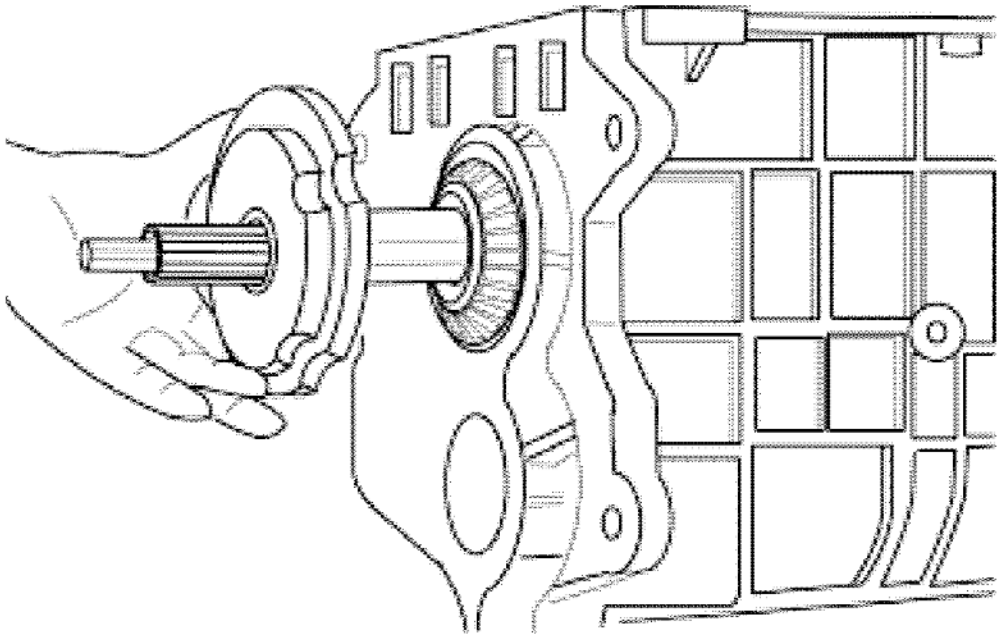


Fig. 33: Bearing Retainer
Courtesy of GENERAL MOTORS COMPANY

8. Remove the bearing retainer.

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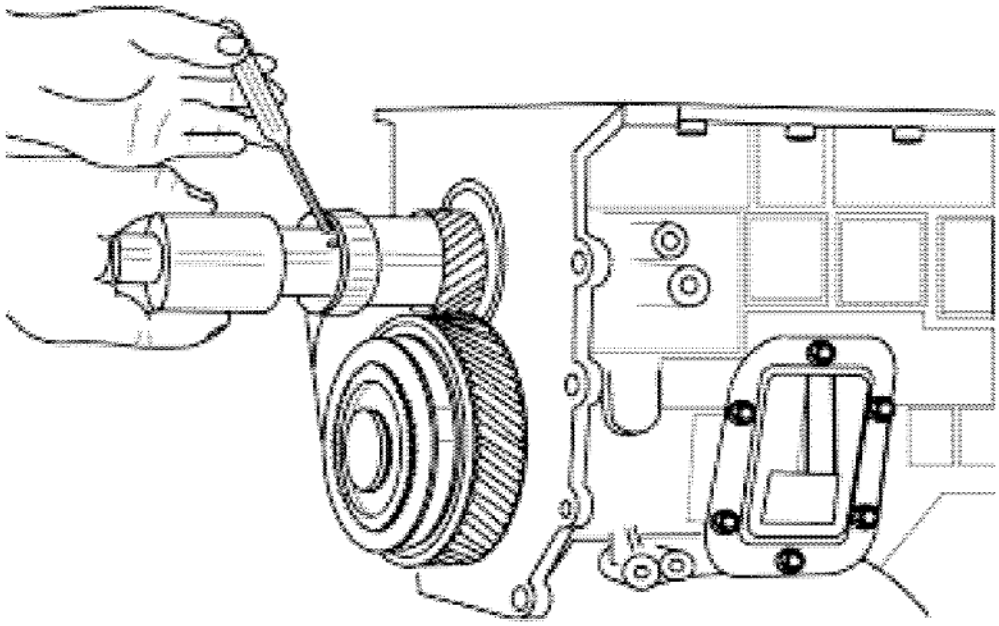


Fig. 34: Yoke Spacer
Courtesy of GENERAL MOTORS COMPANY

9. Remove the yoke spacer.

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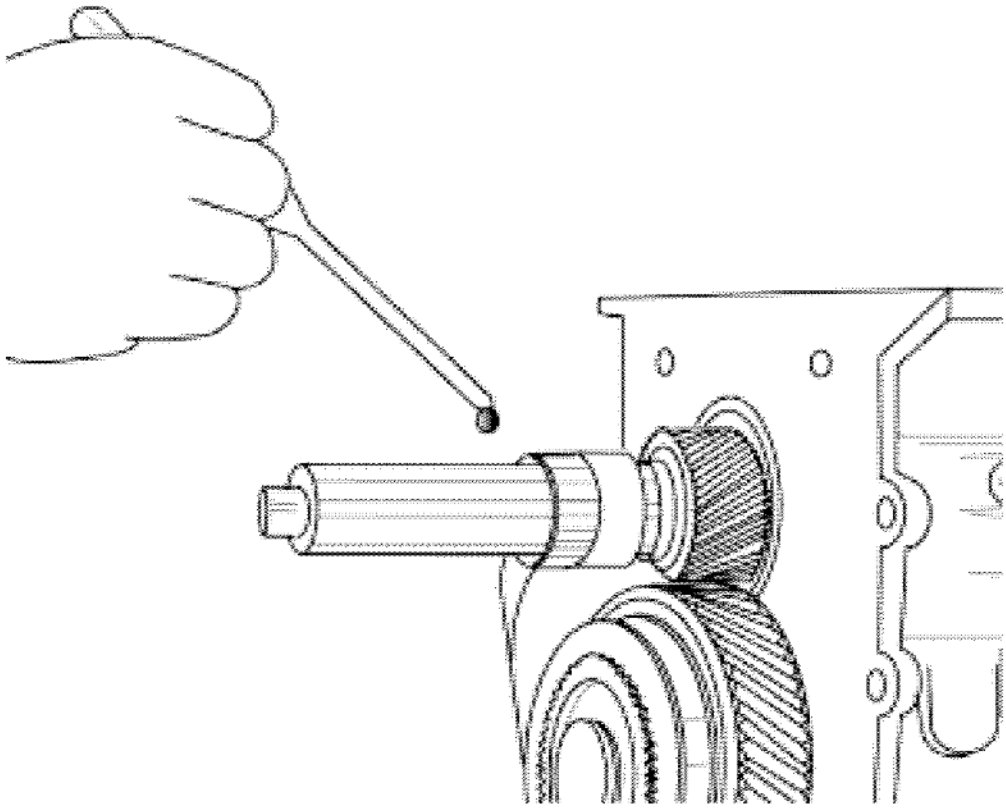


Fig. 35: Speedometer Tracking Balls
Courtesy of GENERAL MOTORS COMPANY

10. Remove the speedometer tracking balls.

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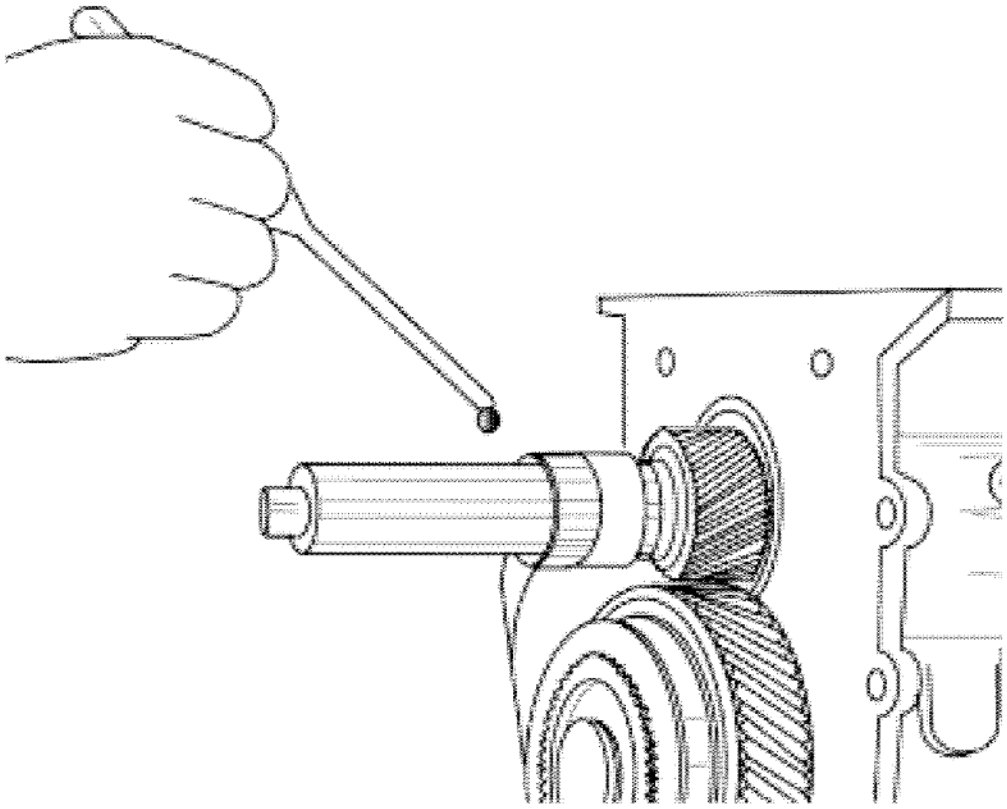


Fig. 36: Identifying Speedometer Gear
Courtesy of GENERAL MOTORS COMPANY

11. Remove the speedometer gear.

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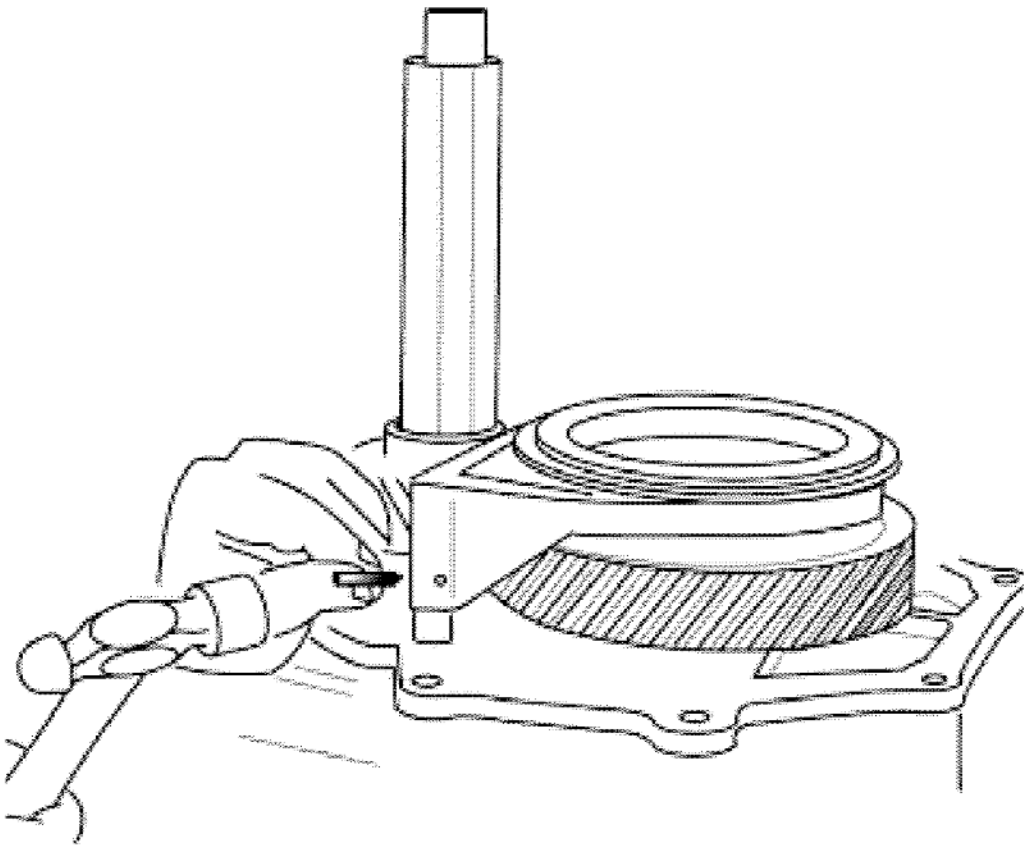


Fig. 37: Roll Pin
Courtesy of GENERAL MOTORS COMPANY

12. Remove the roll pin.

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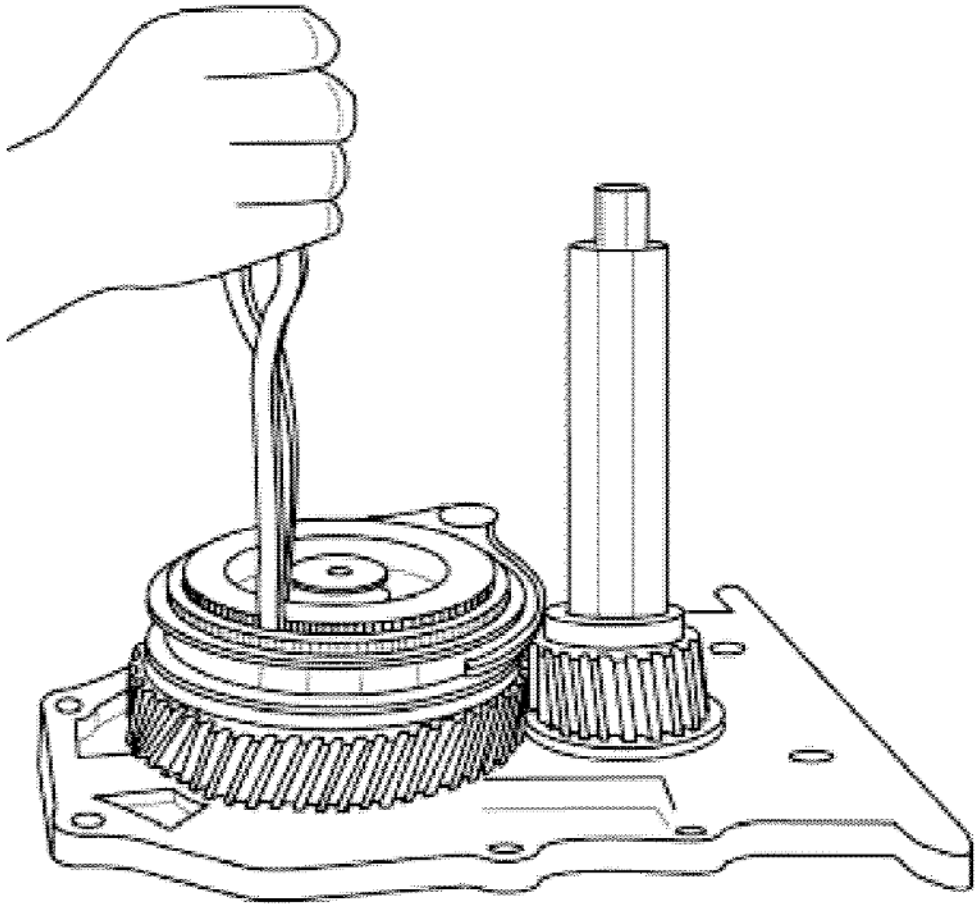


Fig. 38: Snap Ring
Courtesy of GENERAL MOTORS COMPANY

13. Using locking pliers, remove the snap ring.

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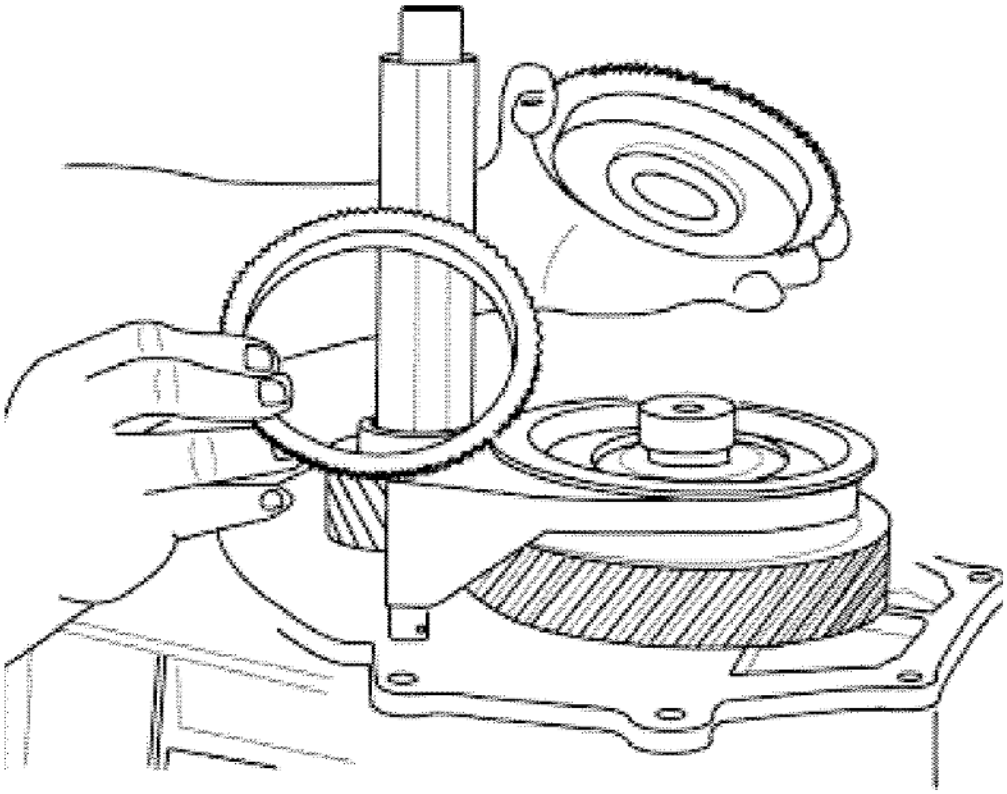


Fig. 39: Synchronizer Ring And 5th Gear
Courtesy of GENERAL MOTORS COMPANY

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

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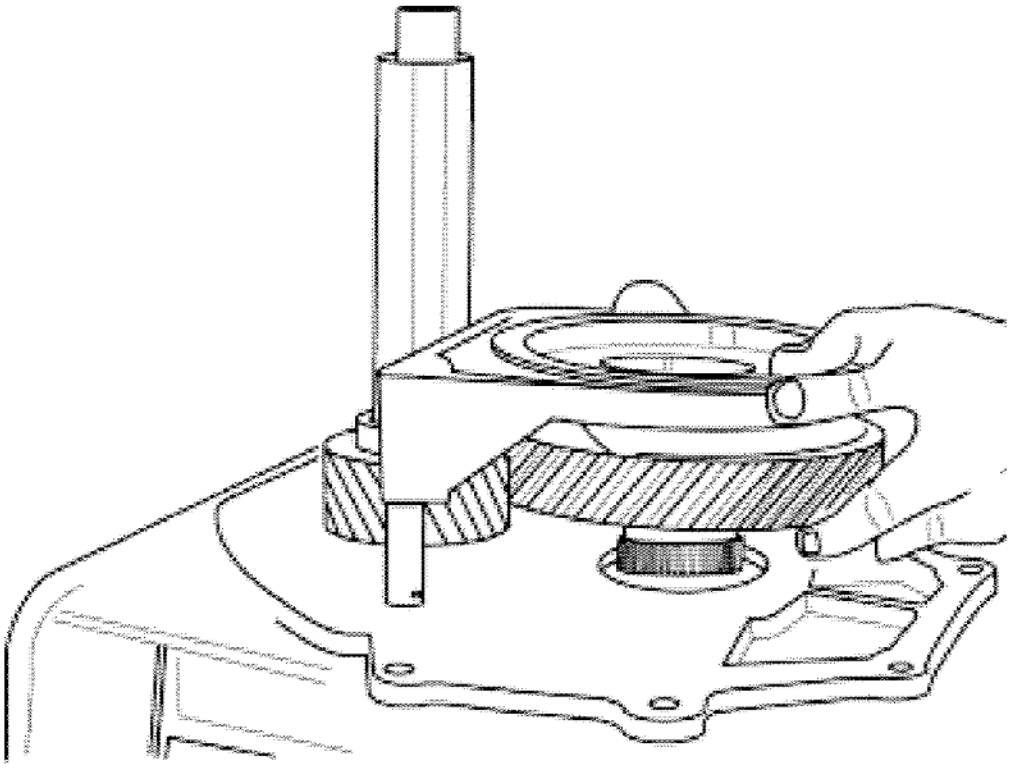


Fig. 40: 5th Gear Synchronizer And Fork
Courtesy of GENERAL MOTORS COMPANY

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

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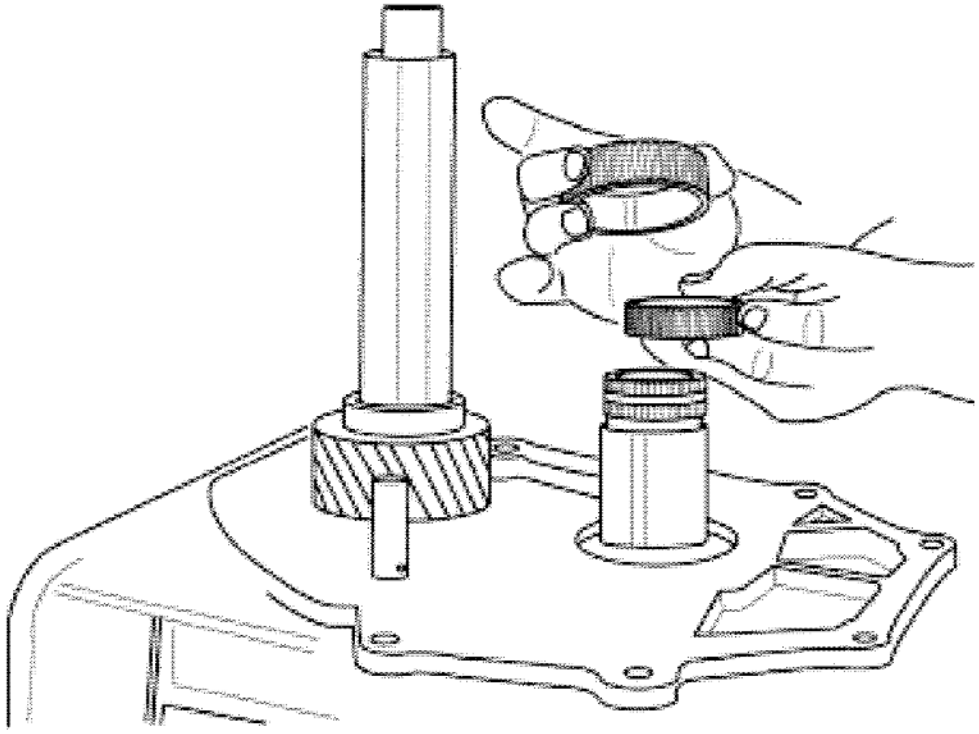


Fig. 41: Roller Bearings And Spacer
Courtesy of GENERAL MOTORS COMPANY

16. Remove the 2 roller bearings and the spacer.

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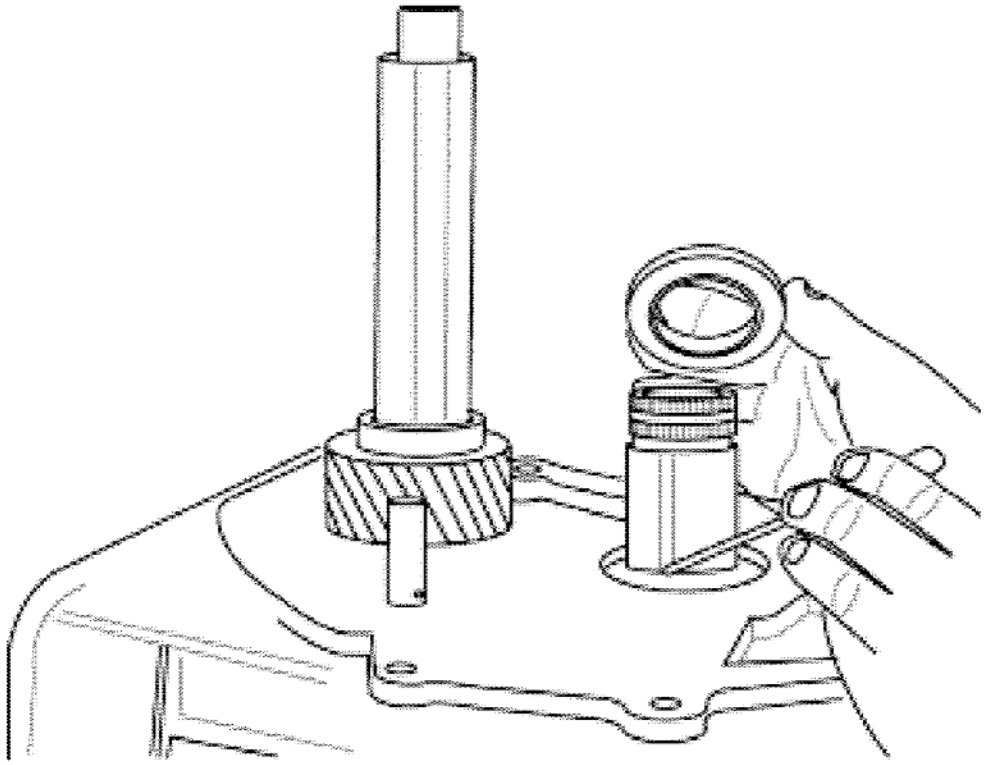


Fig. 42: Washer
Courtesy of GENERAL MOTORS COMPANY

17. Remove the washer.

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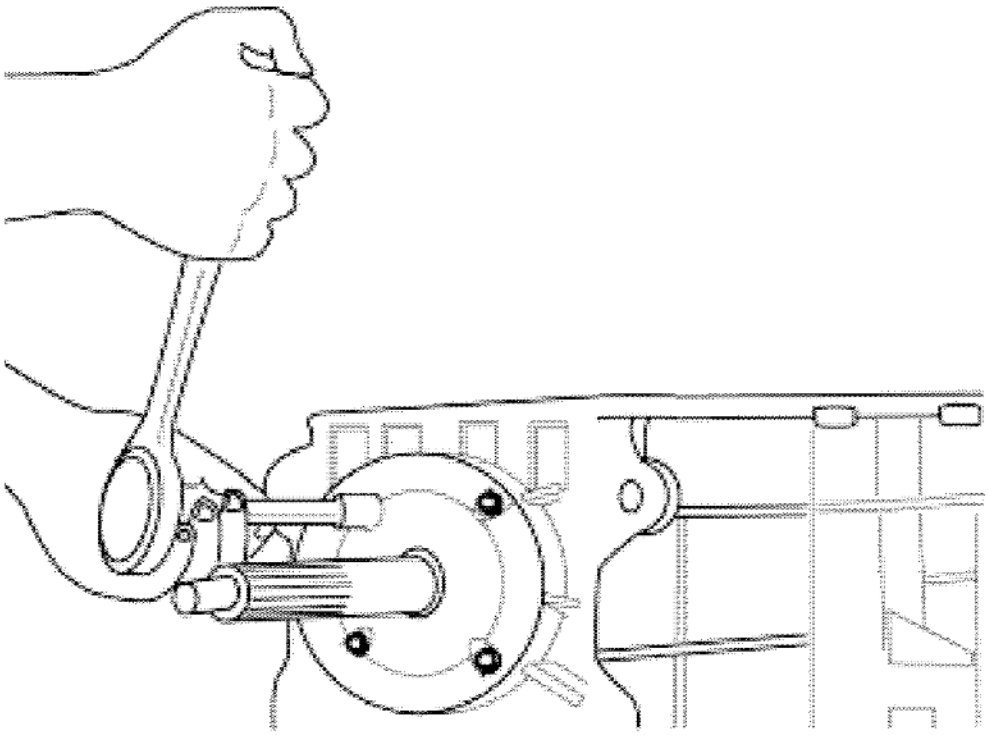


Fig. 43: Bearing Retainer Bolts
Courtesy of GENERAL MOTORS COMPANY

18. Remove the bearing retainer bolts.

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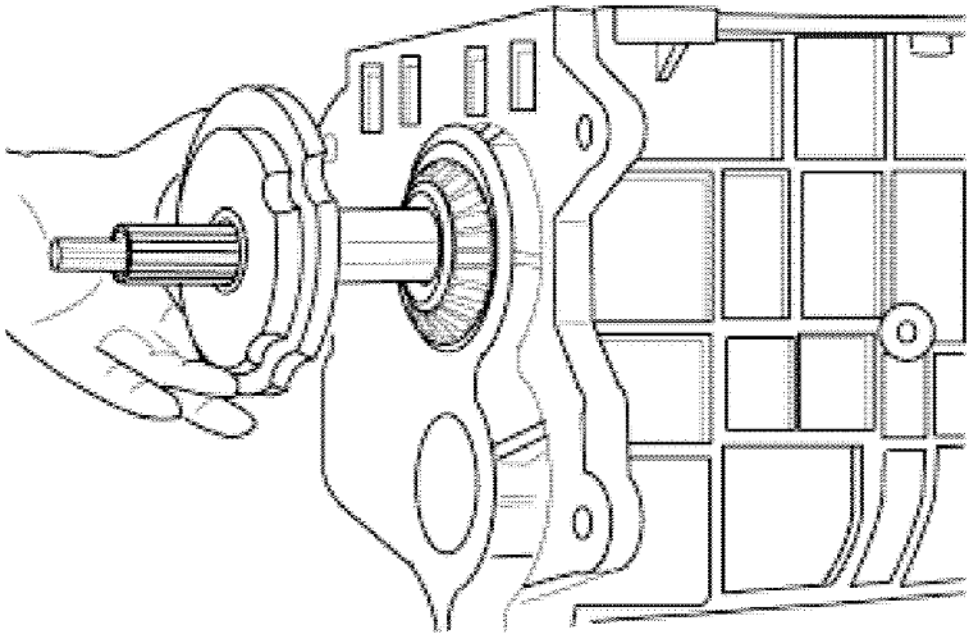


Fig. 44: Bearing Retainer
Courtesy of GENERAL MOTORS COMPANY

19. Remove the bearing retainer.

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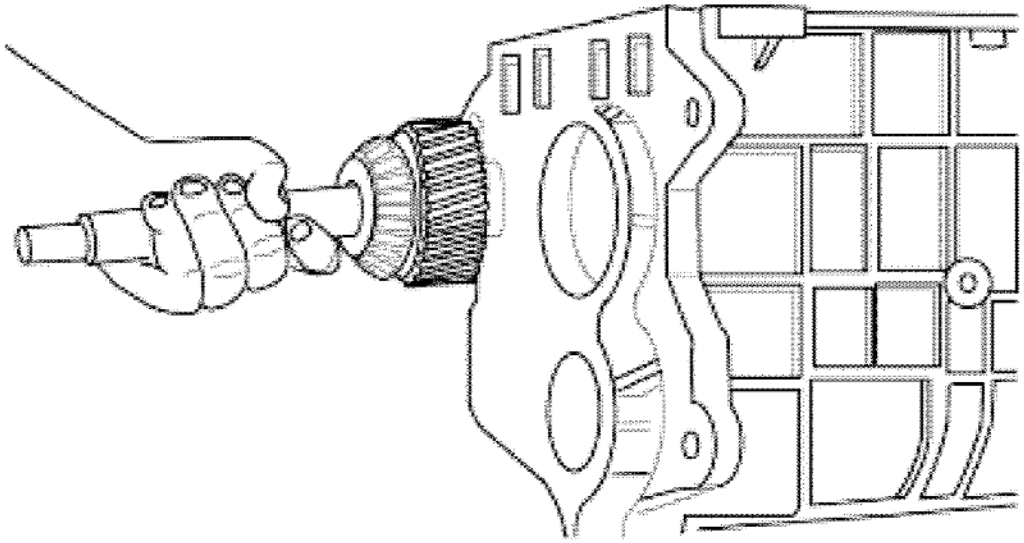


Fig. 45: Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

20. Remove the drive shaft.

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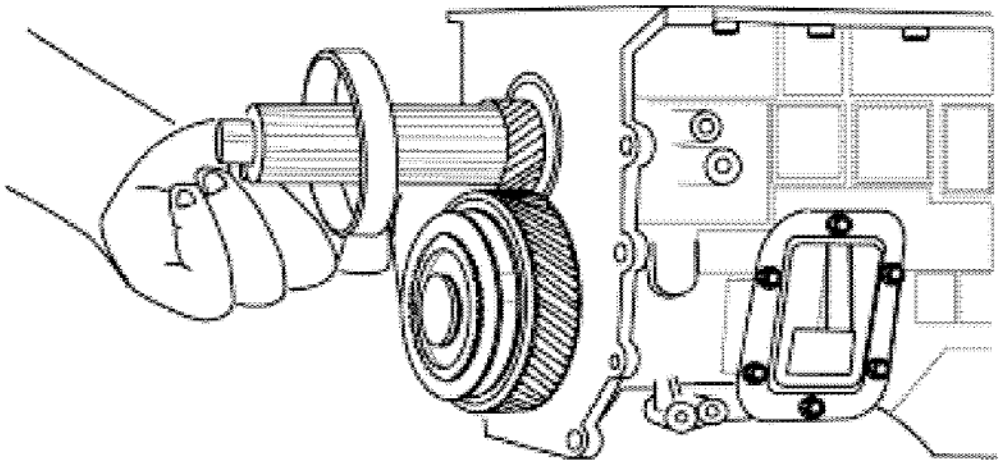


Fig. 46: Tapered Bearing Cup
Courtesy of GENERAL MOTORS COMPANY

21. Remove the tapered bearing cup.

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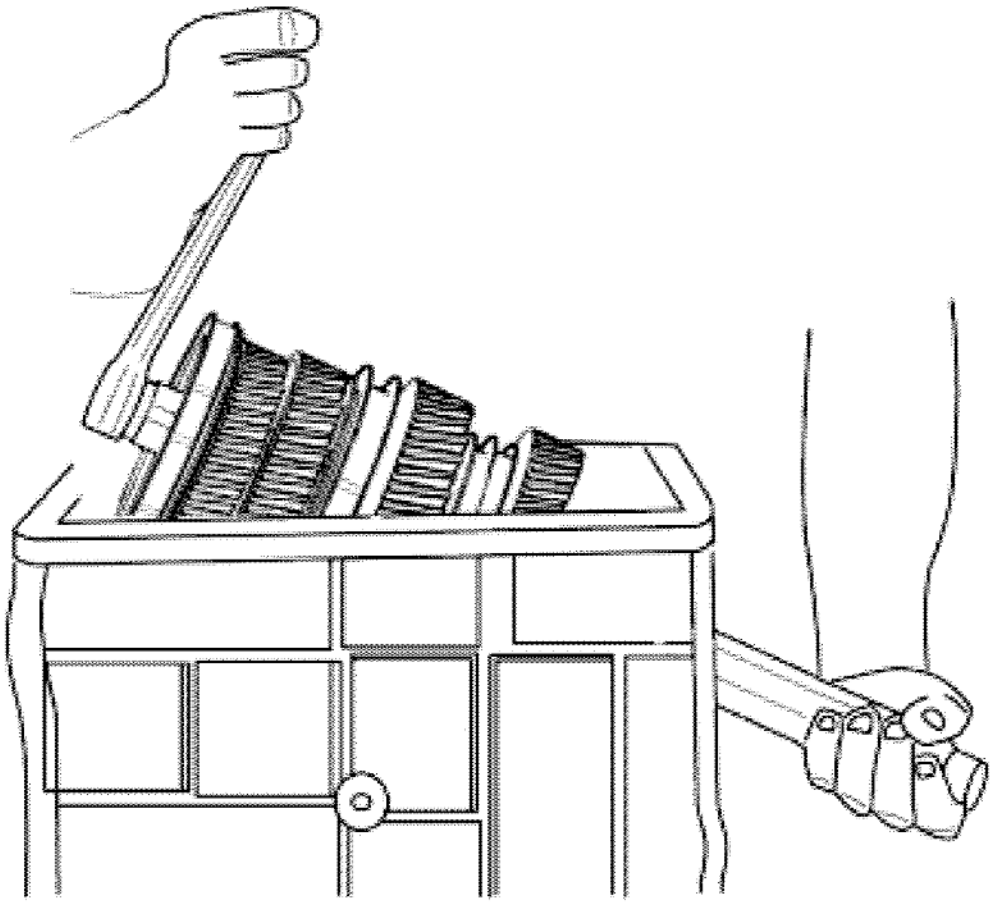


Fig. 47: Main Shaft Assembly
Courtesy of GENERAL MOTORS COMPANY

22. Remove the main shaft assembly.

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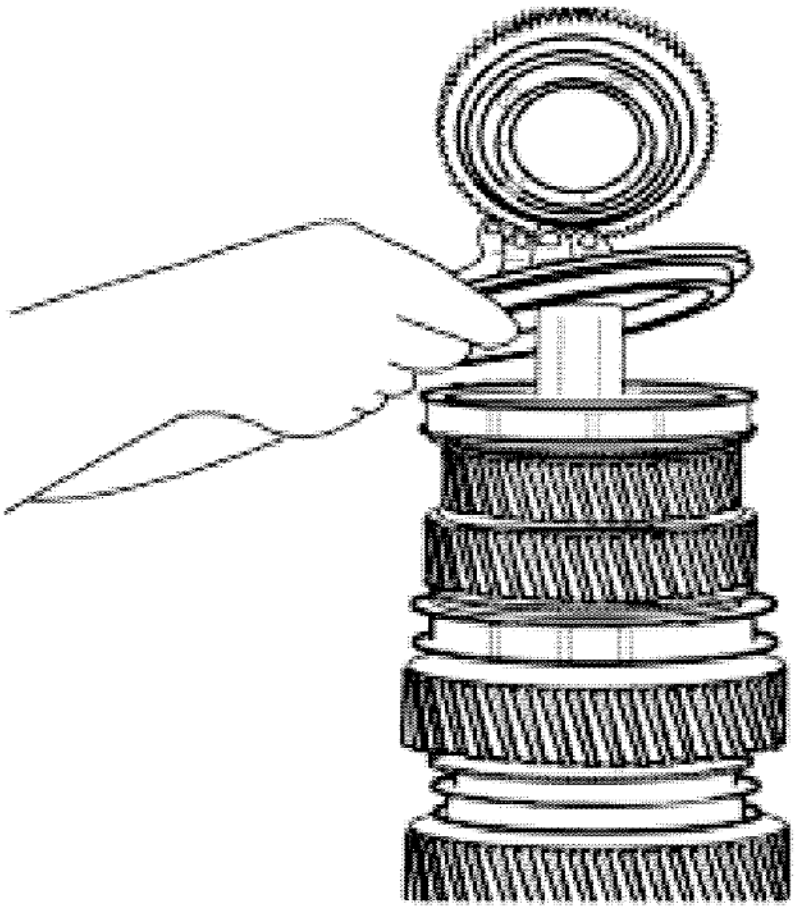


Fig. 48: Retaining Oil Seal
Courtesy of GENERAL MOTORS COMPANY

23. Remove the retaining oil seal.

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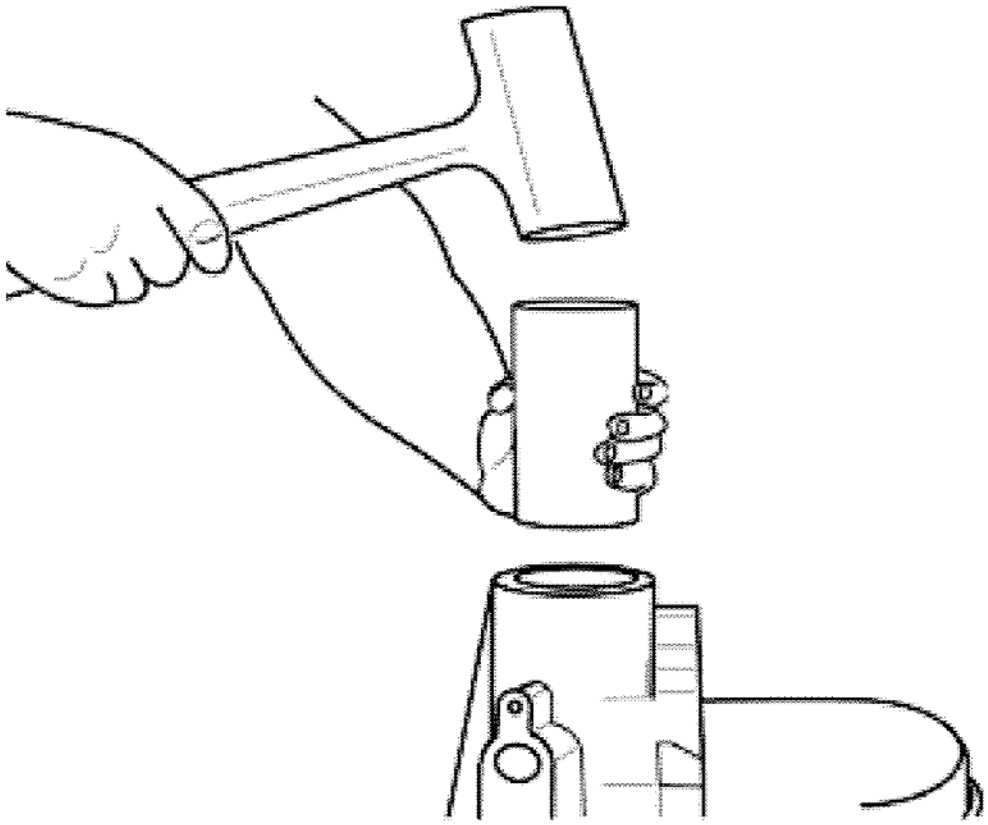


Fig. 49: Extension Housing Oil Seal
Courtesy of GENERAL MOTORS COMPANY

24. Remove the extension housing oil seal.

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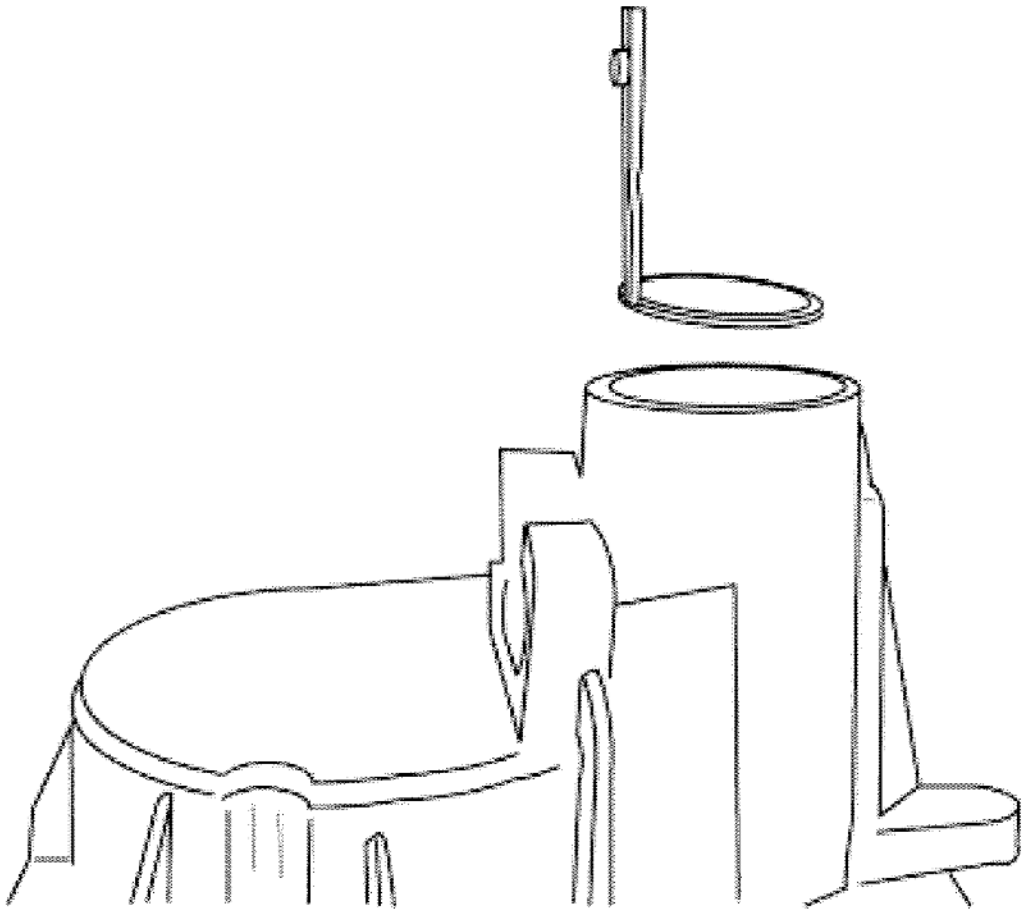


Fig. 50: Snap Ring
Courtesy of GENERAL MOTORS COMPANY

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

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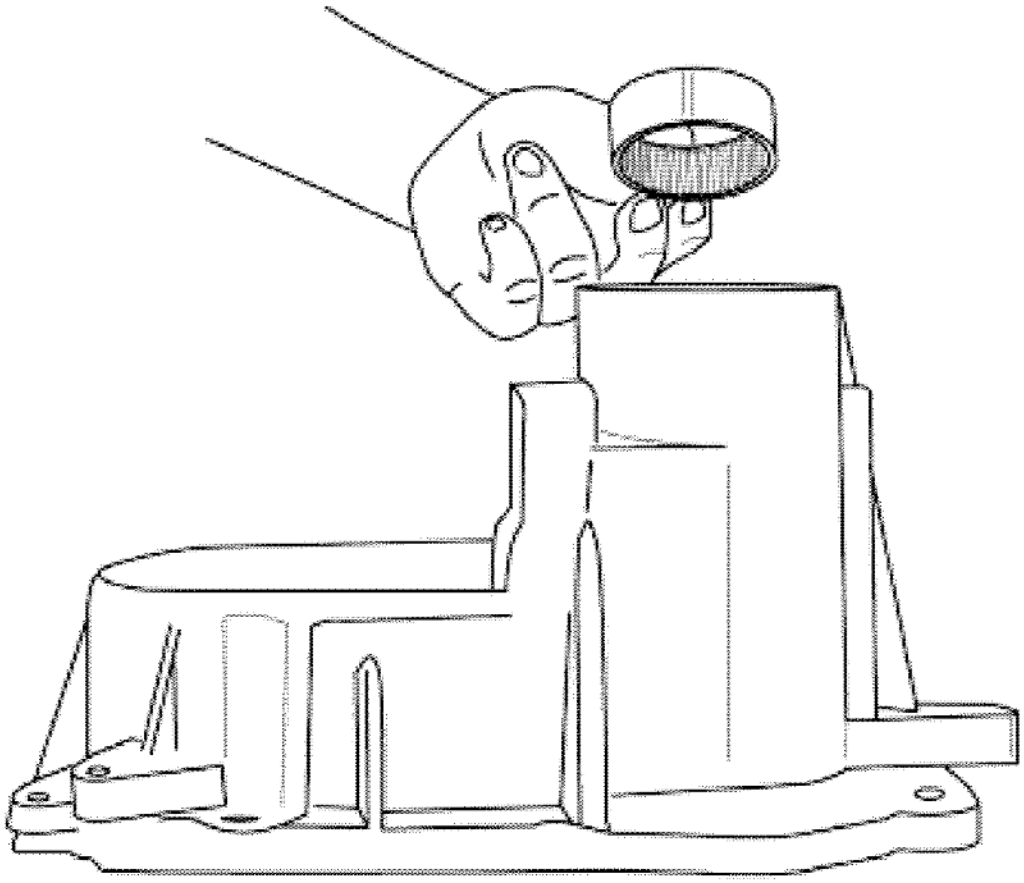


Fig. 51: Bearing
Courtesy of GENERAL MOTORS COMPANY

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

MAIN SHAFT DISASSEMBLE

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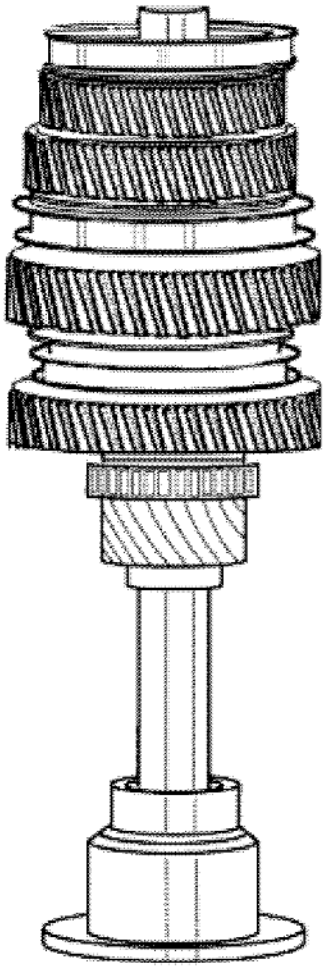


Fig. 52: Main Shaft Assembly In Vertical Position
Courtesy of GENERAL MOTORS COMPANY

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

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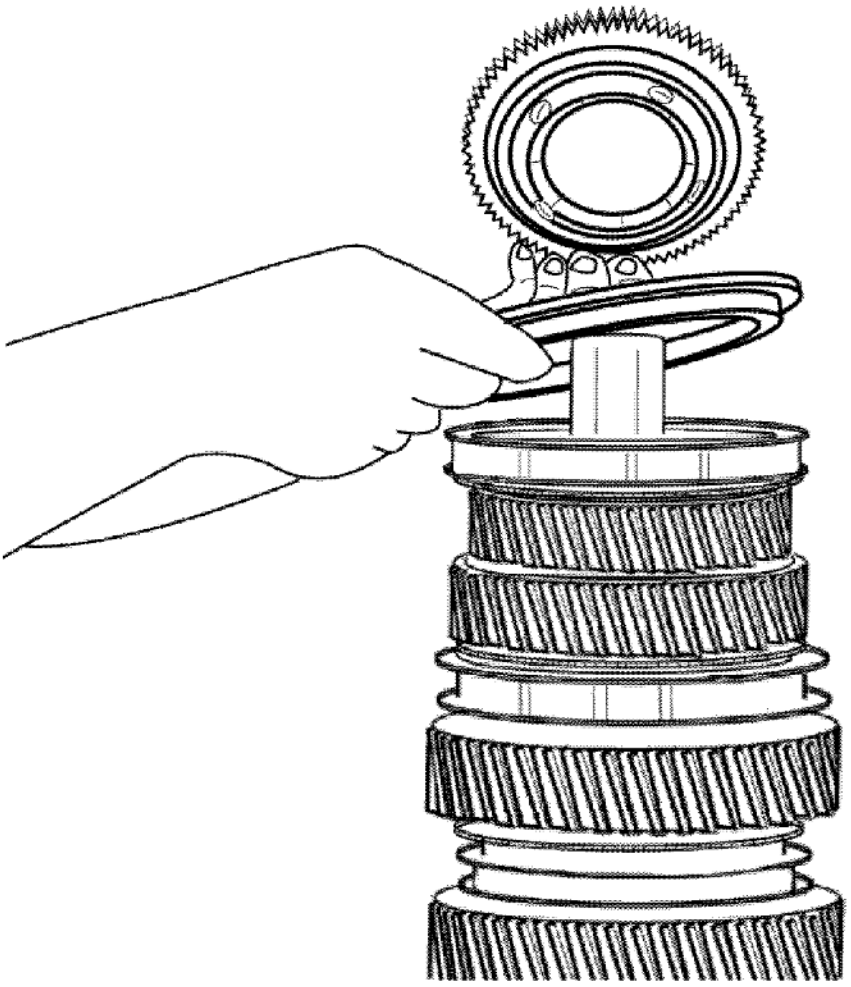


Fig. 53: Clutch Bearing
Courtesy of GENERAL MOTORS COMPANY

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

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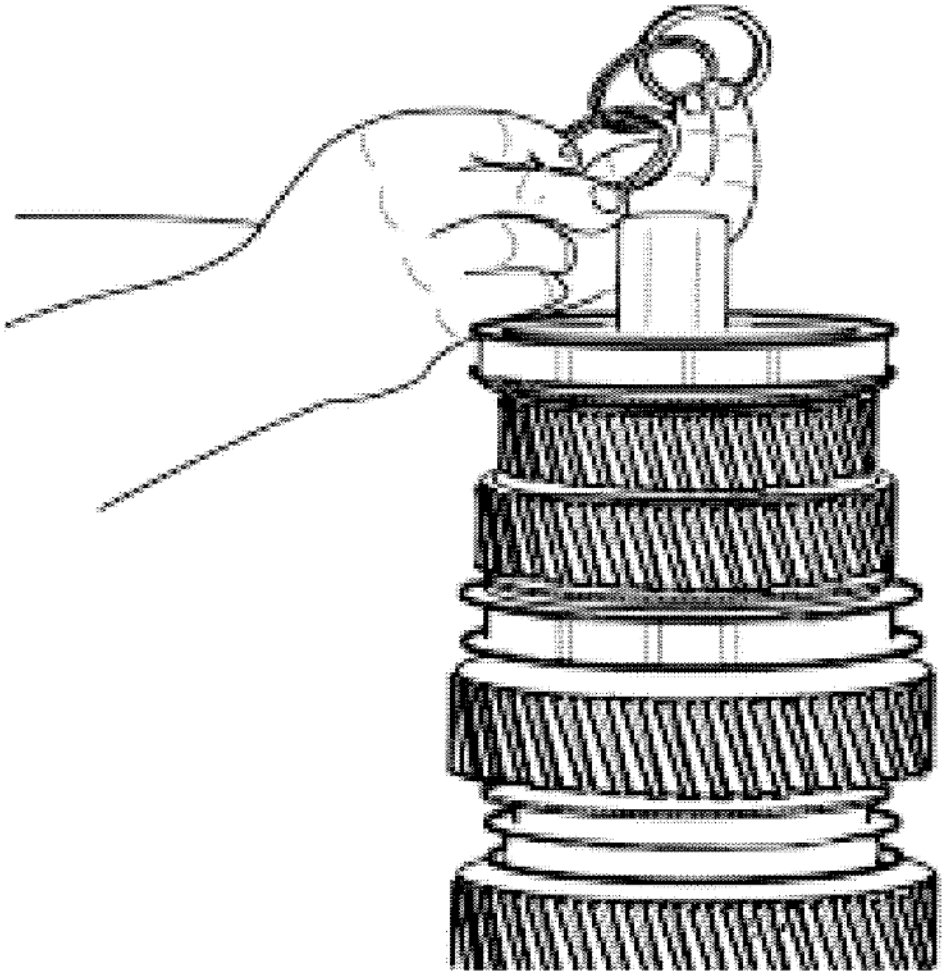


Fig. 54: Pulleys, Track And Push Bearing
Courtesy of GENERAL MOTORS COMPANY

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

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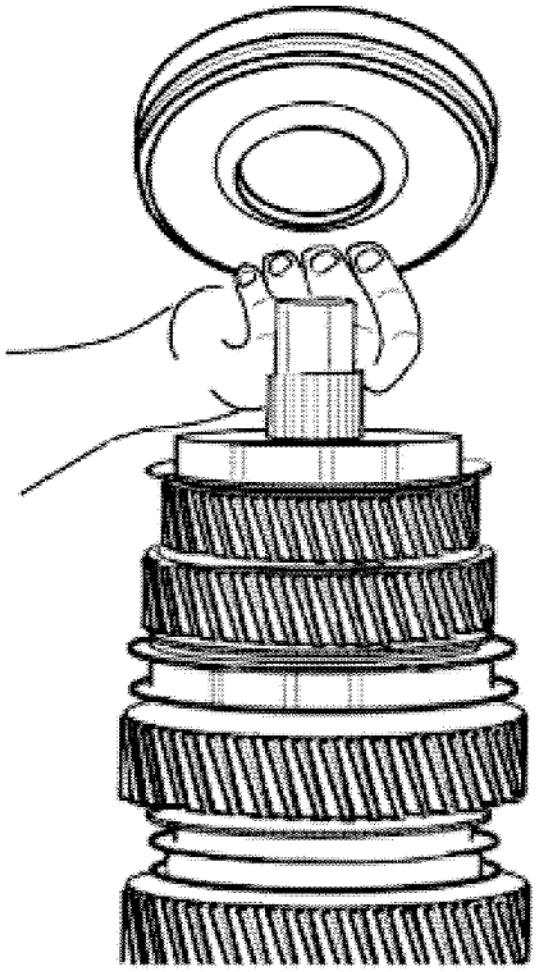


Fig. 55: 3rd And 4th Gear Synchronizer
Courtesy of GENERAL MOTORS COMPANY

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

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Fig. 56: 3rd Gear Synchronizer
Courtesy of GENERAL MOTORS COMPANY

5. Remove the 3rd gear synchronizer.

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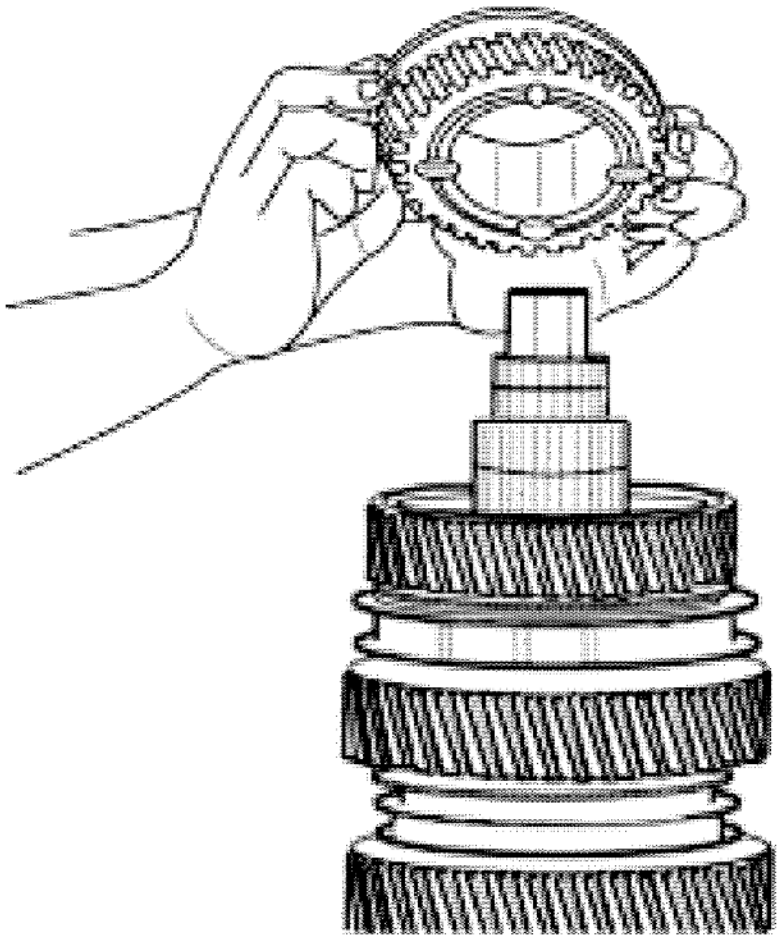


Fig. 57: 3rd Gear
Courtesy of GENERAL MOTORS COMPANY

6. Remove the 3rd gear.

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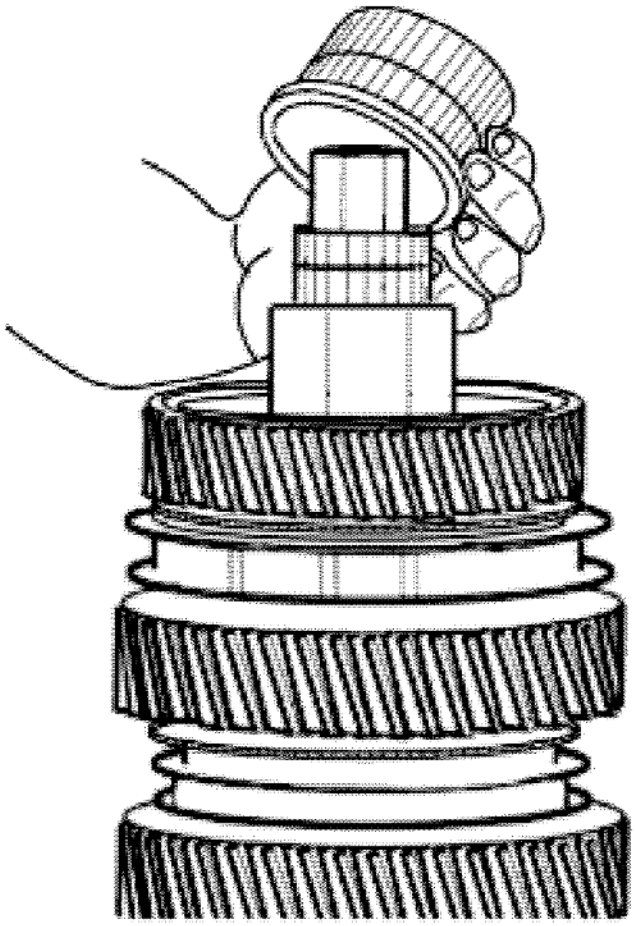


Fig. 58: 3rd Gear Rollers
Courtesy of GENERAL MOTORS COMPANY

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

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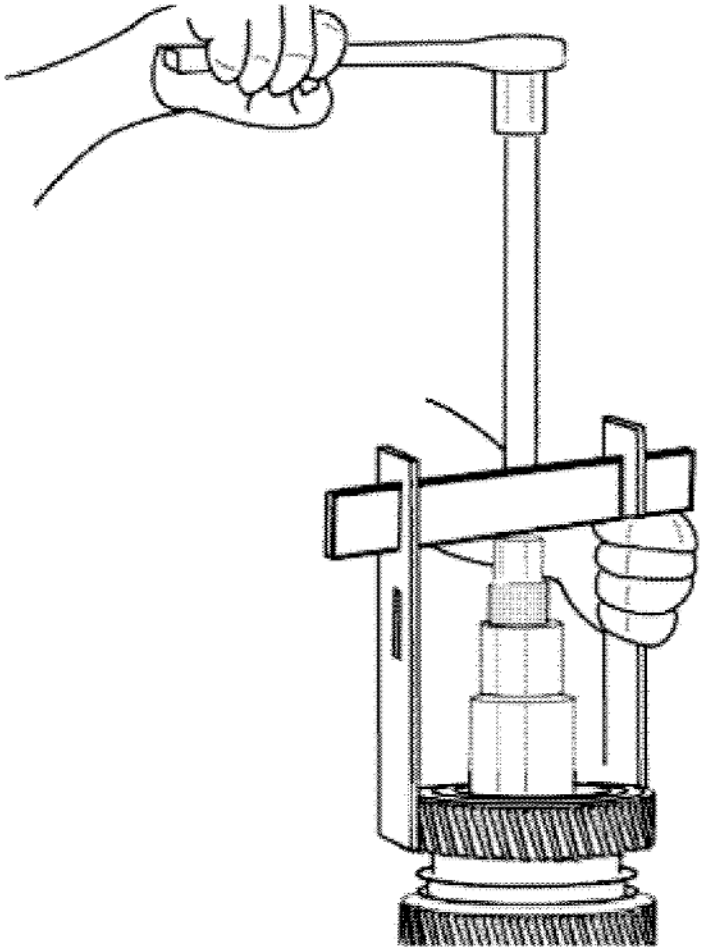


Fig. 59: Removing 3rd Gear Hub
Courtesy of GENERAL MOTORS COMPANY

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

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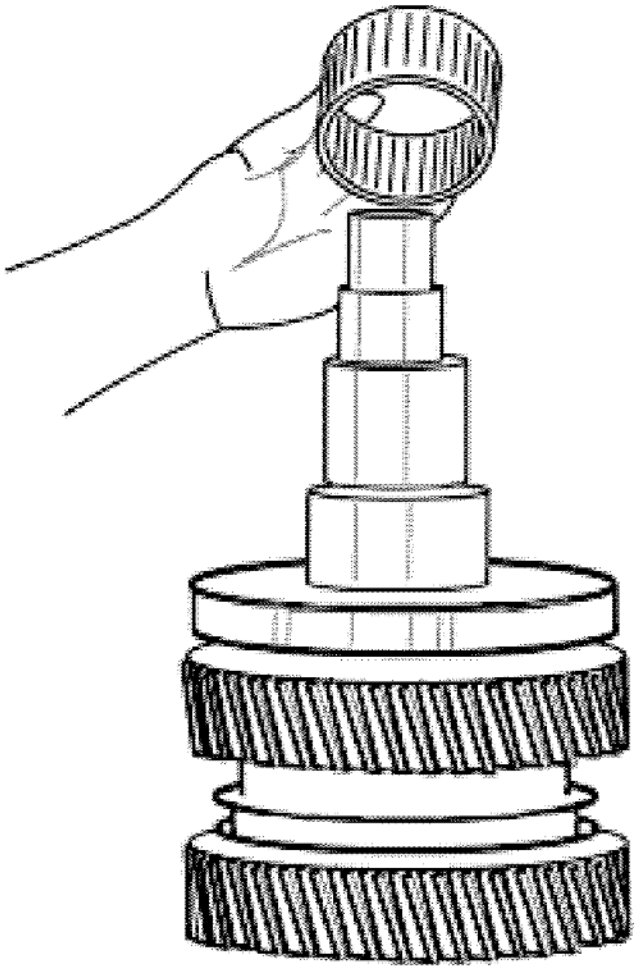


Fig. 60: 2nd Gear Roller Cage
Courtesy of GENERAL MOTORS COMPANY

9. Remove the 2nd gear roller cage.

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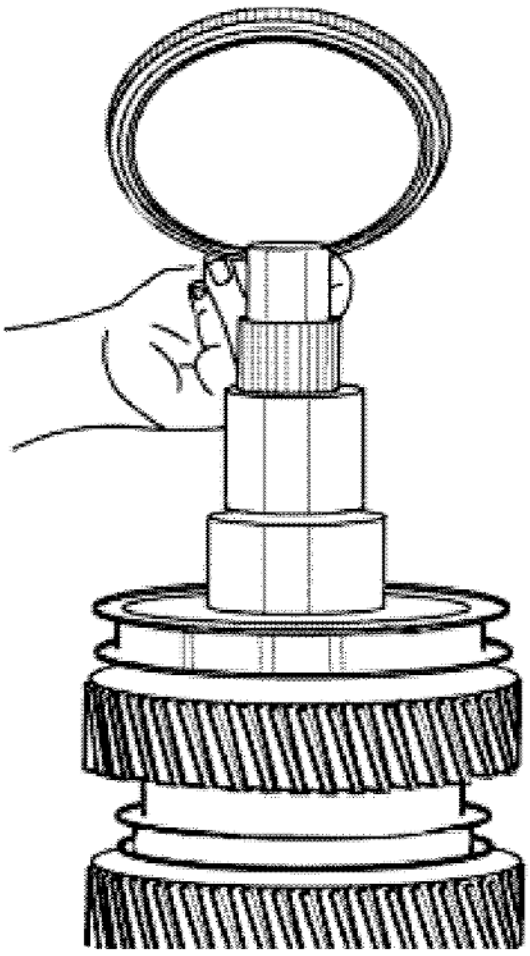


Fig. 61: 2nd Gear Synchronizer Ring
Courtesy of GENERAL MOTORS COMPANY

10. Remove the 2nd gear synchronizer ring.

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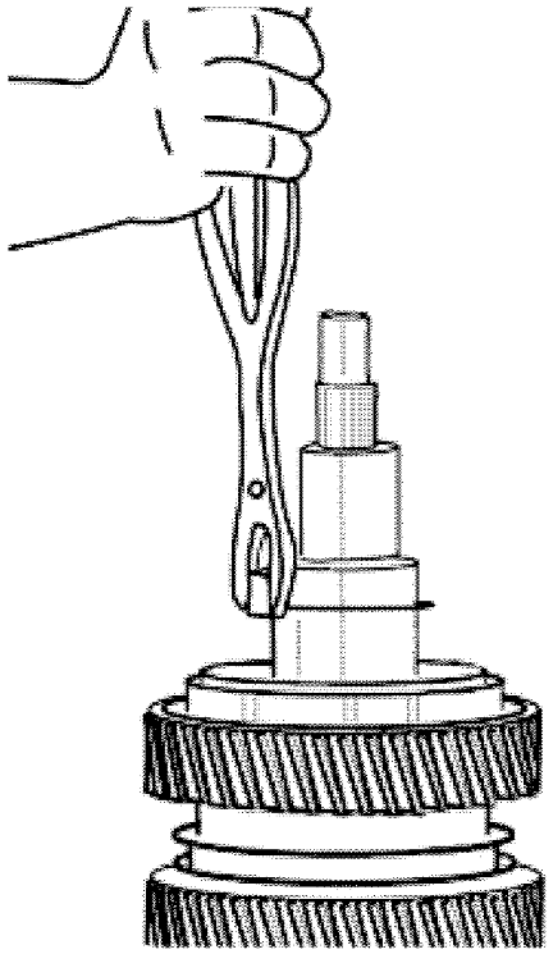


Fig. 62: View Of Snap Ring Holding Synchronization Hammer Onto 1st And 2nd Gears
Courtesy of GENERAL MOTORS COMPANY

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

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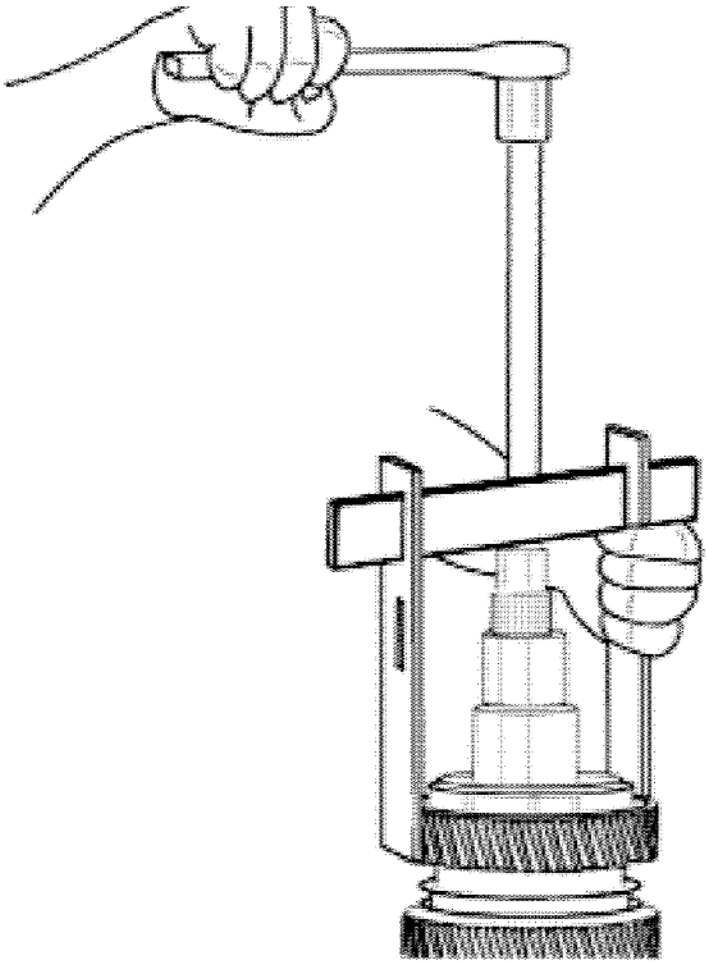


Fig. 63: Removing 1st Gear And Synchronizer
Courtesy of GENERAL MOTORS COMPANY

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

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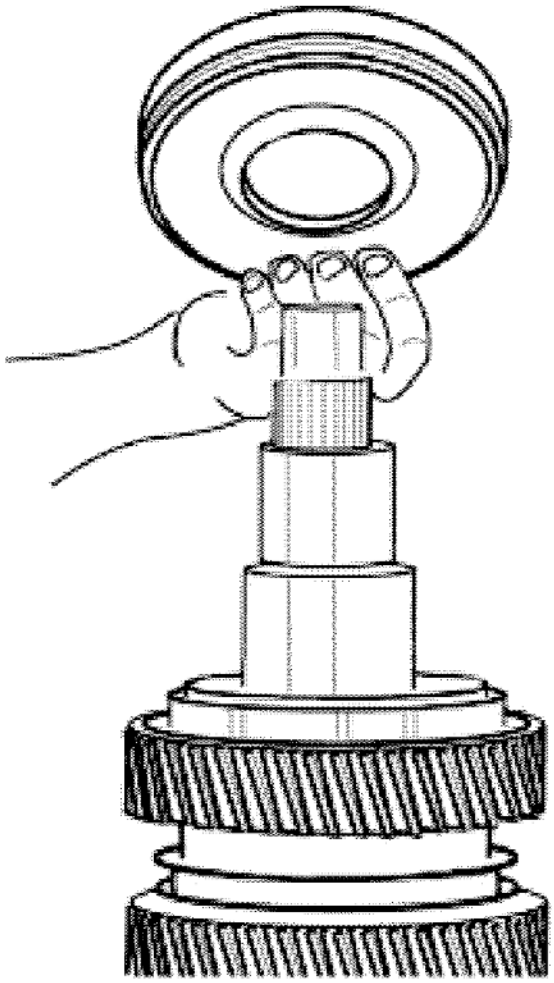


Fig. 64: 1st And 2nd Gear Synchronizer
Courtesy of GENERAL MOTORS COMPANY

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

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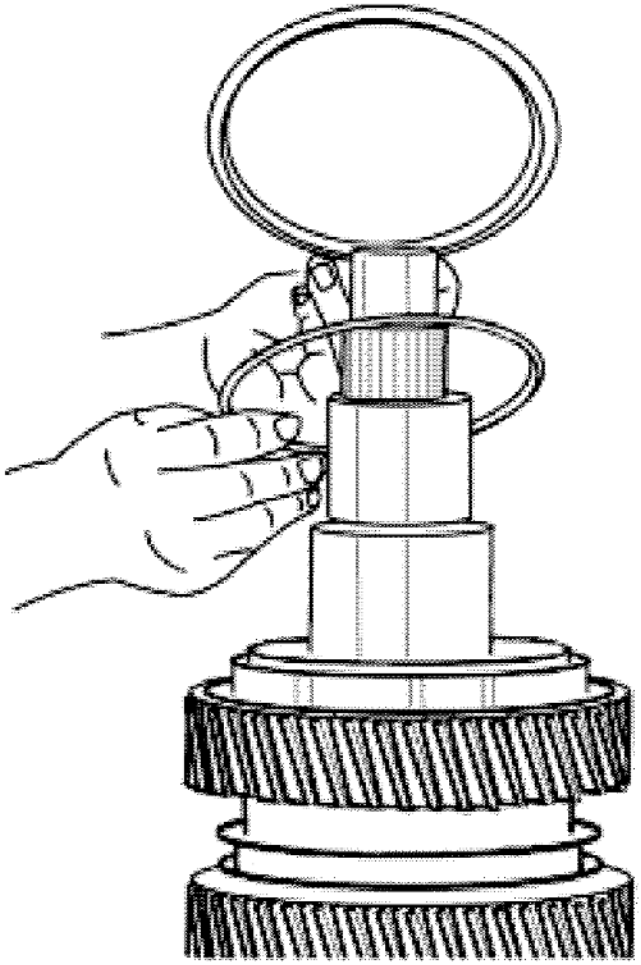


Fig. 65: Synchronizer Ring And Intermediate Ring
Courtesy of GENERAL MOTORS COMPANY

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

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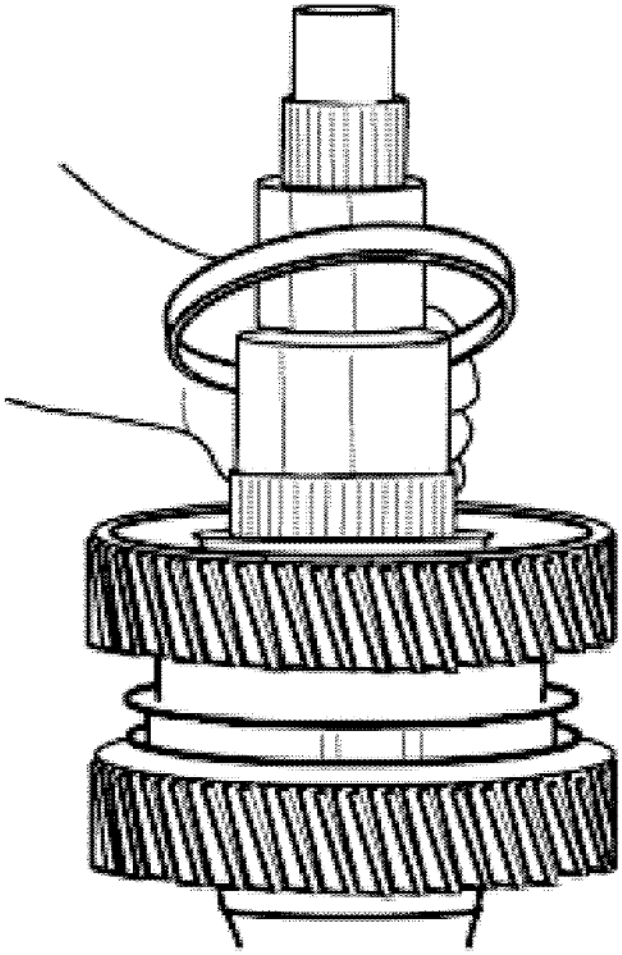


Fig. 66: 1st Gear Interior Taper Bearing
Courtesy of GENERAL MOTORS COMPANY

15. Remove the 1st gear interior taper bearing.

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Fig. 67: 1st Gear
Courtesy of GENERAL MOTORS COMPANY

16. Remove the 1st gear.

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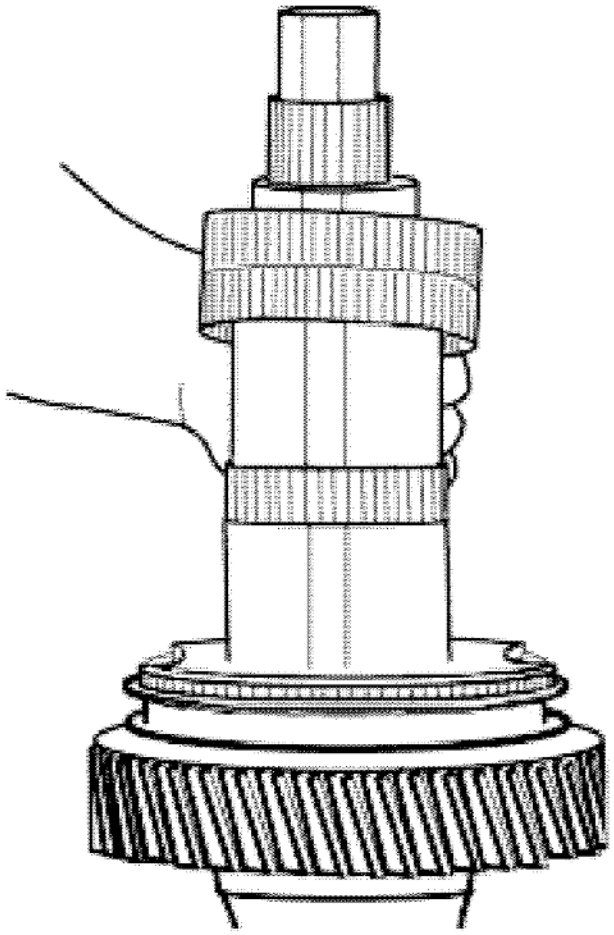


Fig. 68: View Of 1st Gear Roller Cage
Courtesy of GENERAL MOTORS COMPANY

17. Remove the 1st gear roller cage.

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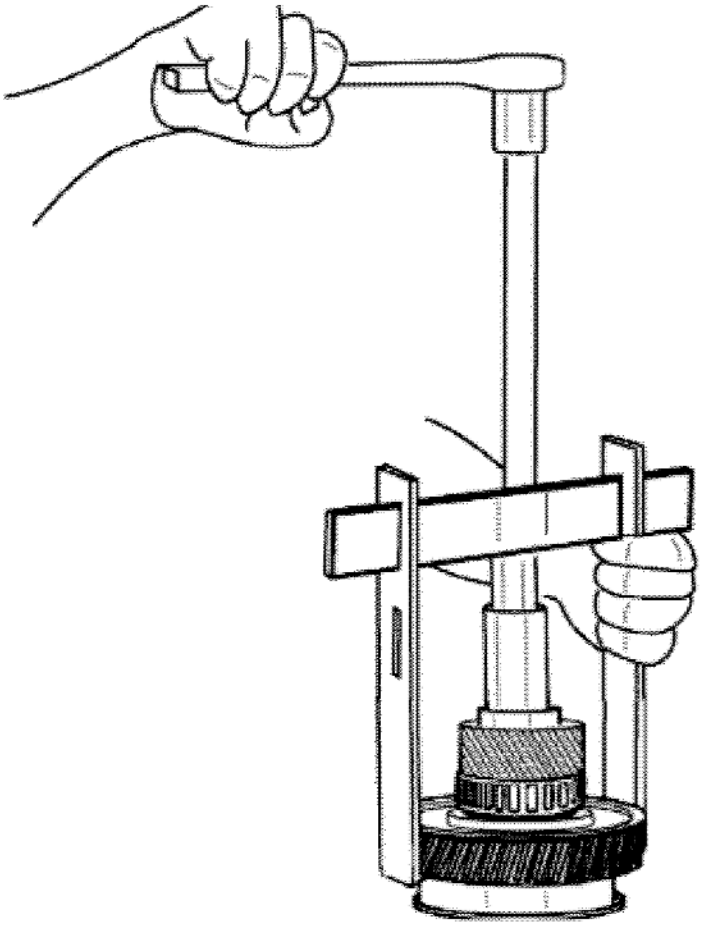


Fig. 69: Removing 5th Gear
Courtesy of GENERAL MOTORS COMPANY

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

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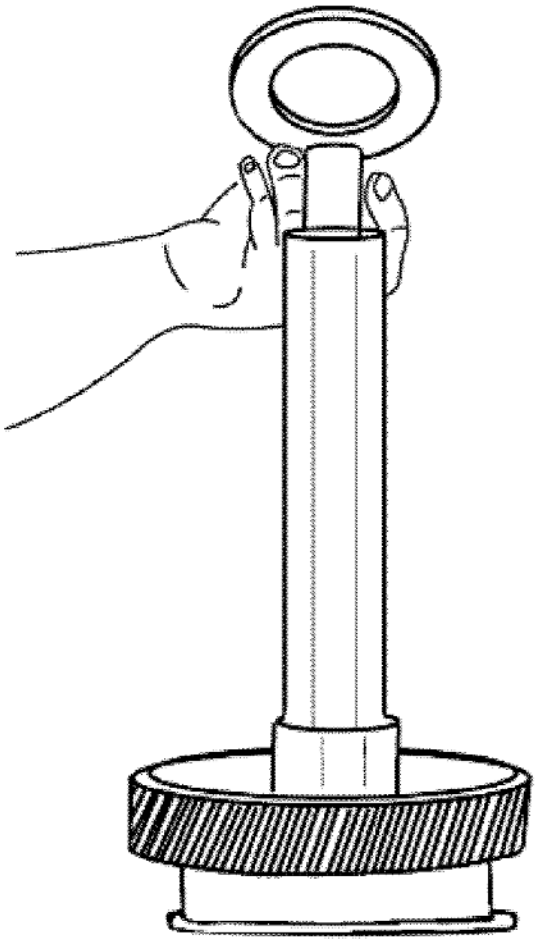


Fig. 70: Push Pulley
Courtesy of GENERAL MOTORS COMPANY

20. Remove the push pulley from the reverse gear.

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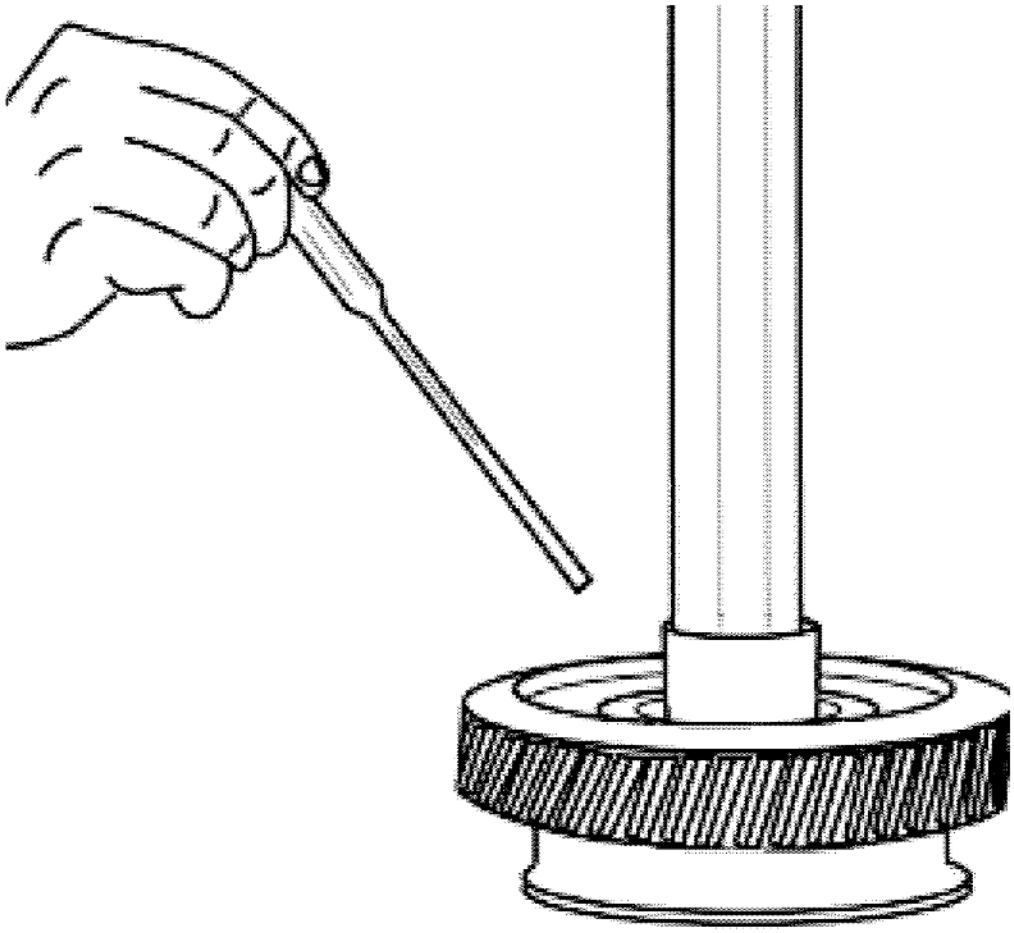


Fig. 71: Using A Magnet To Remove Pulley Sphere From Reverse Gear
Courtesy of GENERAL MOTORS COMPANY

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

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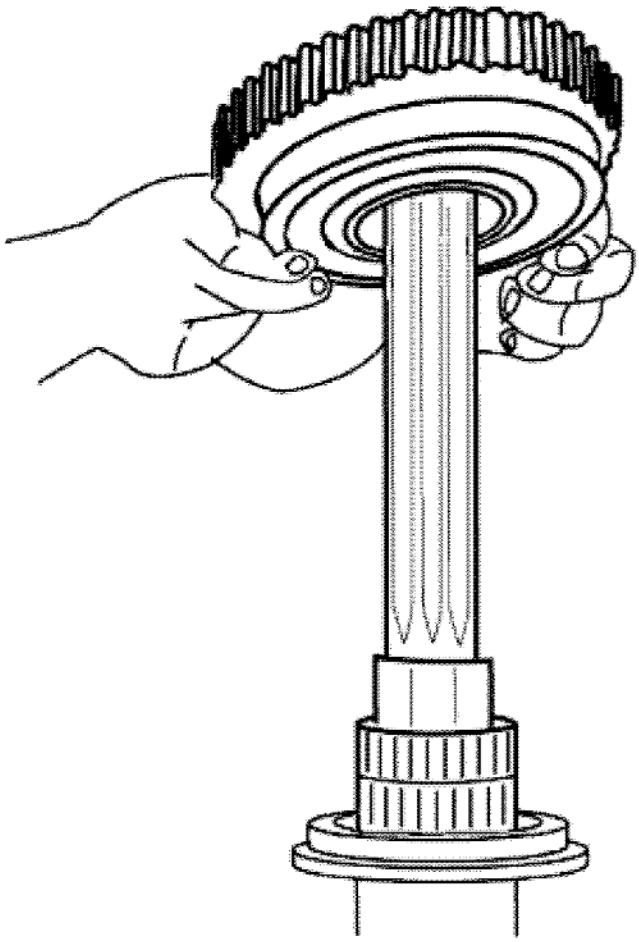


Fig. 72: Reverse Gear And Synchronizer
Courtesy of GENERAL MOTORS COMPANY

22. Remove the reverse gear and the synchronizer.

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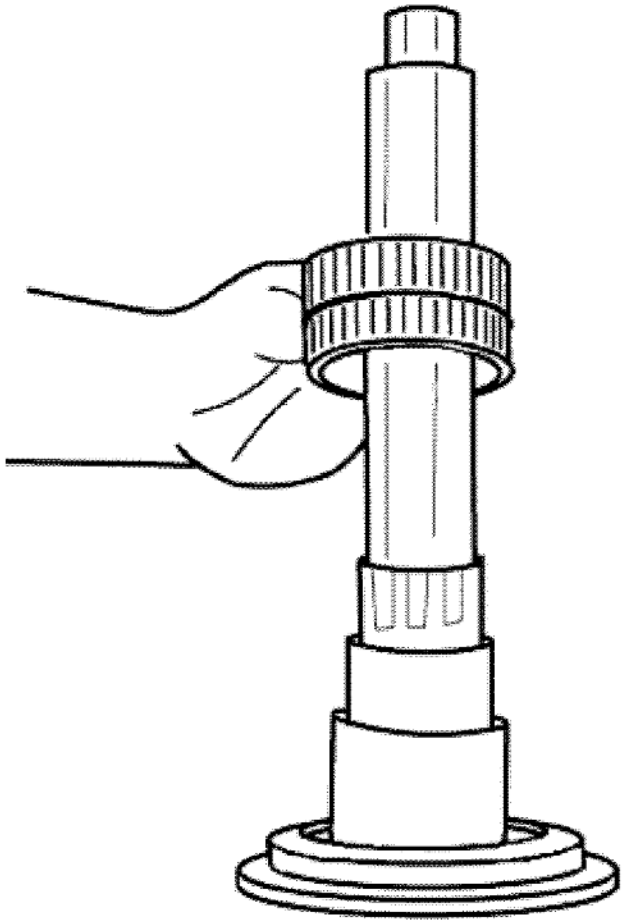


Fig. 73: Roller Cage
Courtesy of GENERAL MOTORS COMPANY

23. Remove the roller cage from the reverse gear.

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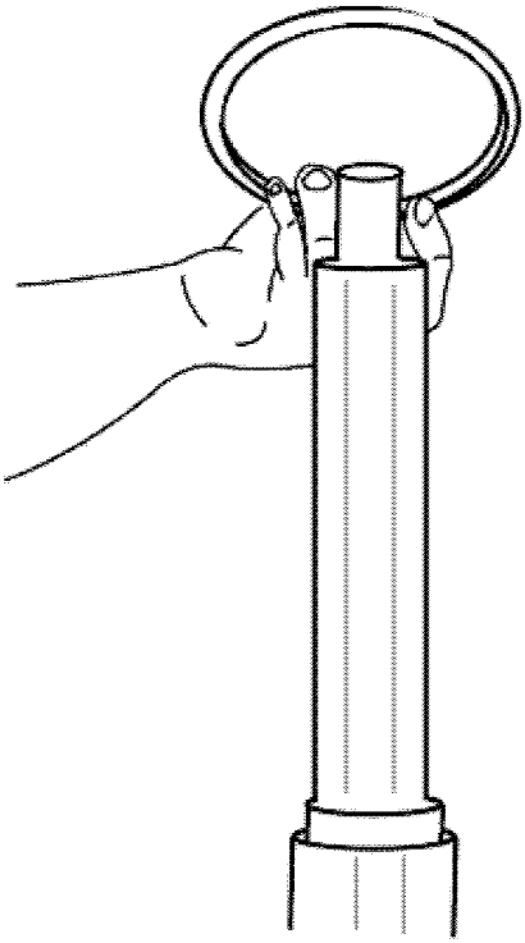


Fig. 74: Reverse Synchronizer Ring
Courtesy of GENERAL MOTORS COMPANY

24. Remove the reverse synchronizer ring.

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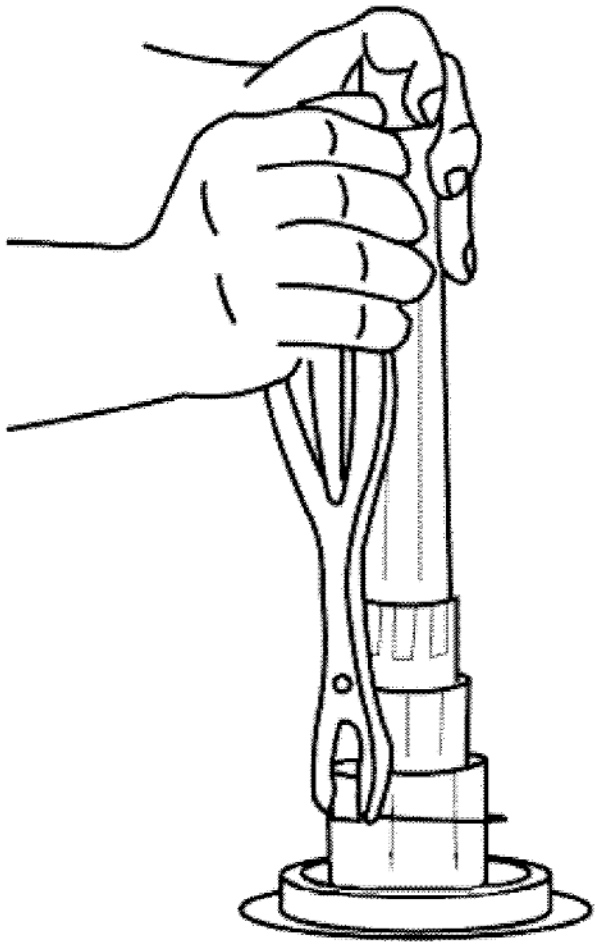


Fig. 75: Snap Ring
Courtesy of GENERAL MOTORS COMPANY

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

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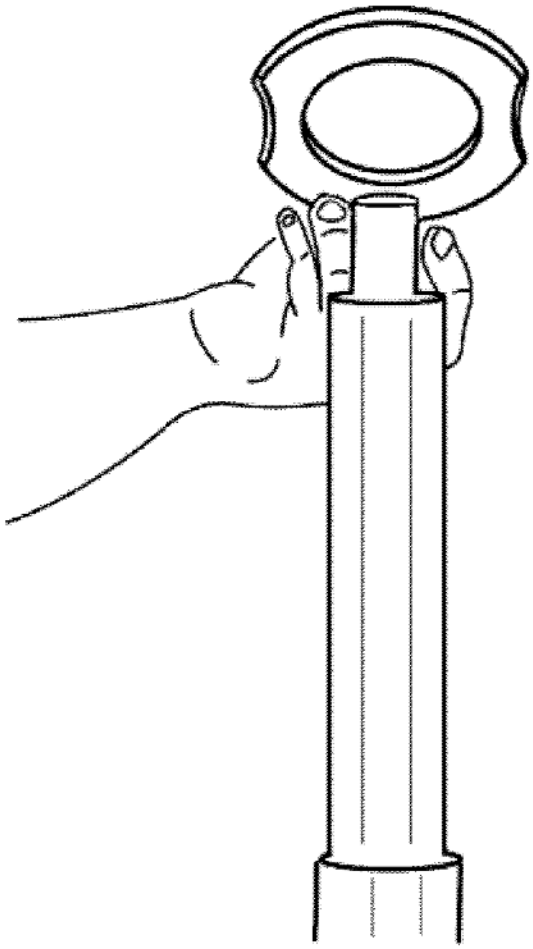


Fig. 76: Reverse Clutch Taper Bearing
Courtesy of GENERAL MOTORS COMPANY

26. Remove the reverse clutch bearing.

SHIFT SHAFT AND FORK ASSEMBLIES DISASSEMBLE

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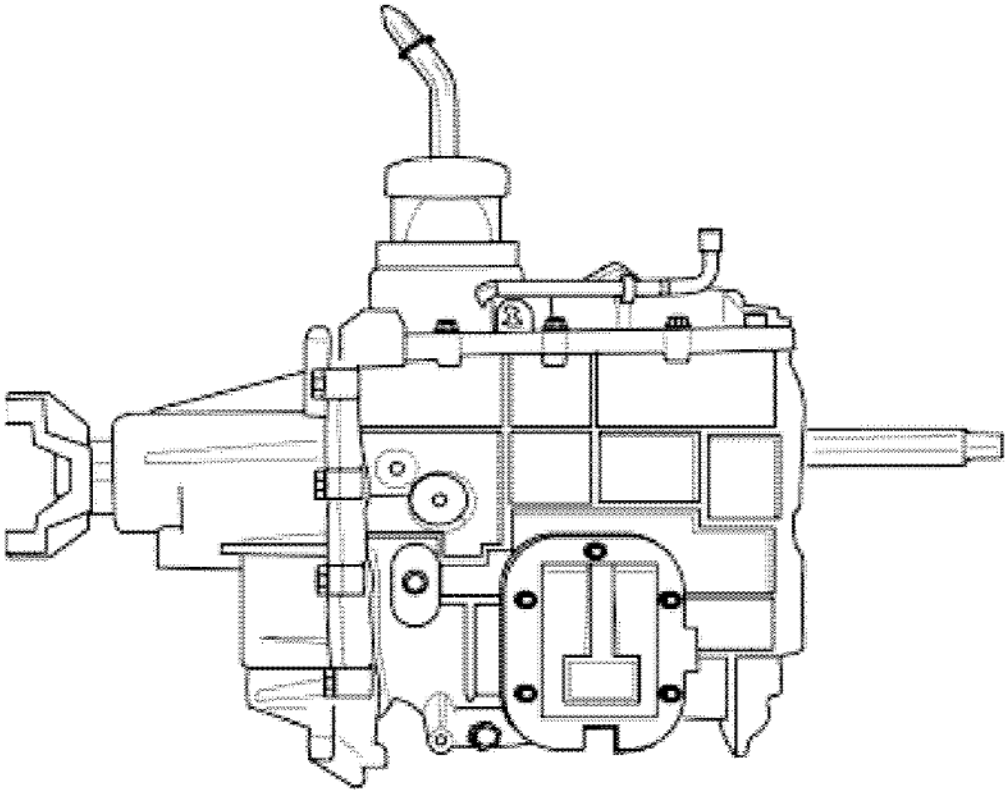


Fig. 77: Transmission
Courtesy of GENERAL MOTORS COMPANY

1. Place the transmission on a workbench.

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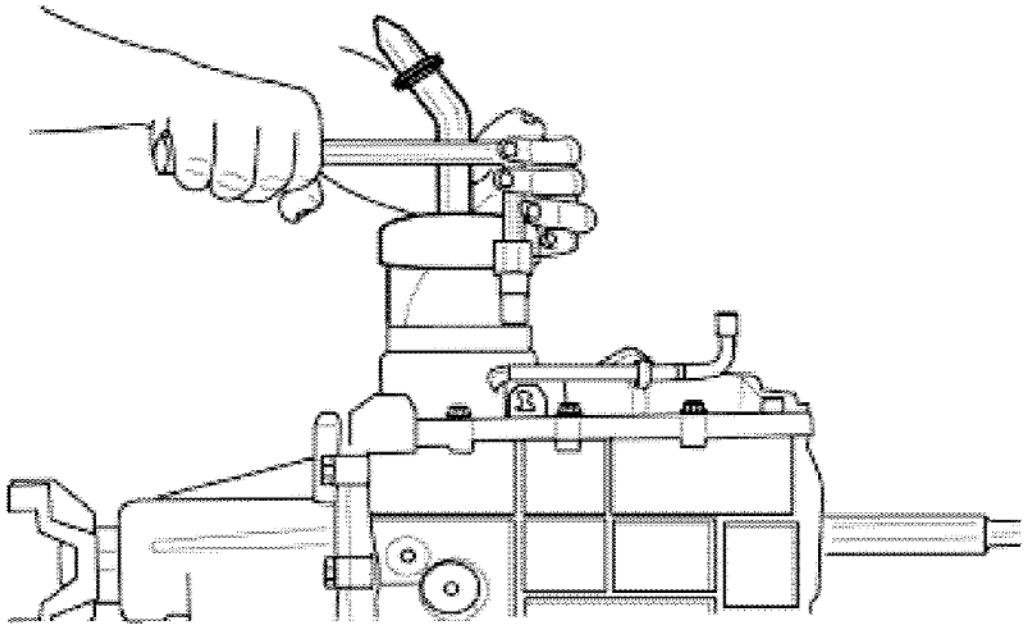


Fig. 78: Using Ratchet On Shift Tower Screws
Courtesy of GENERAL MOTORS COMPANY

2. Remove the 4 screws from the shift tower.

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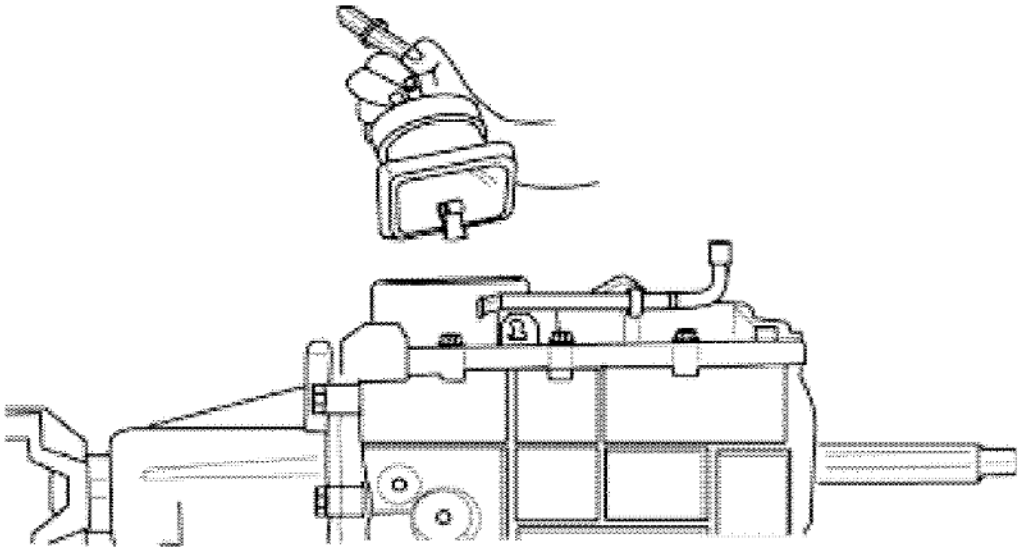


Fig. 79: Shift Tower
Courtesy of GENERAL MOTORS COMPANY

3. Remove the shift tower.

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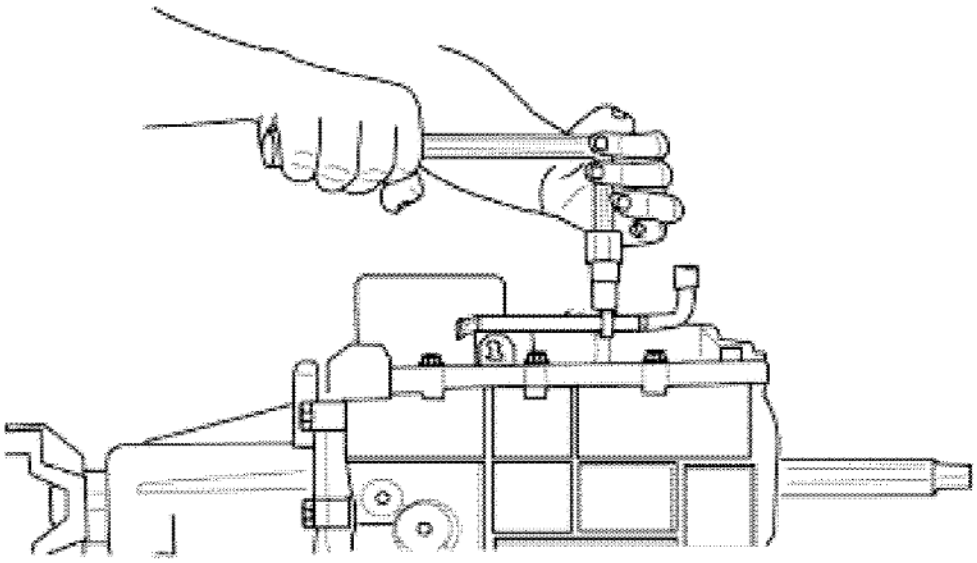


Fig. 80: Using Ratchet On Breather Support Screw
Courtesy of GENERAL MOTORS COMPANY

4. Remove the breather support screw.

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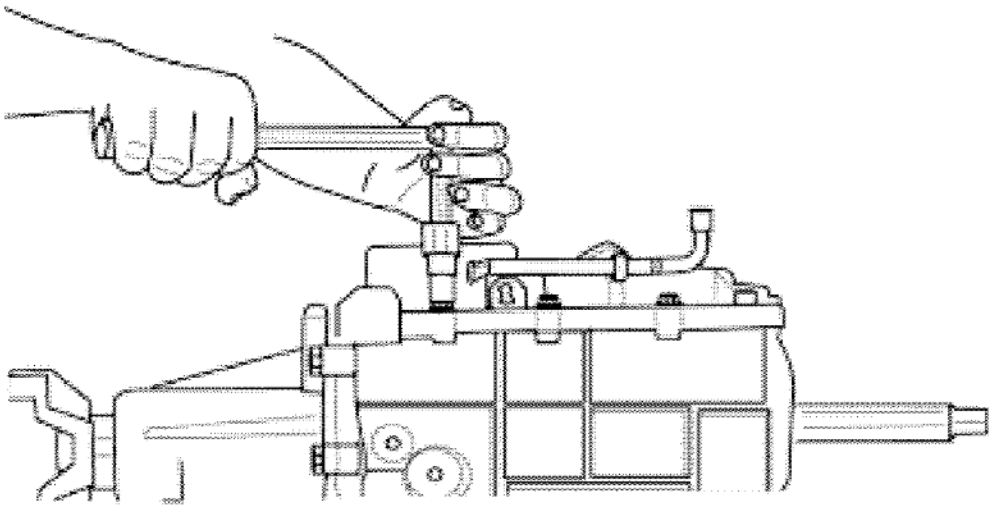


Fig. 81: Using 1/2 Socket On Screws Holding Control Cover
Courtesy of GENERAL MOTORS COMPANY

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

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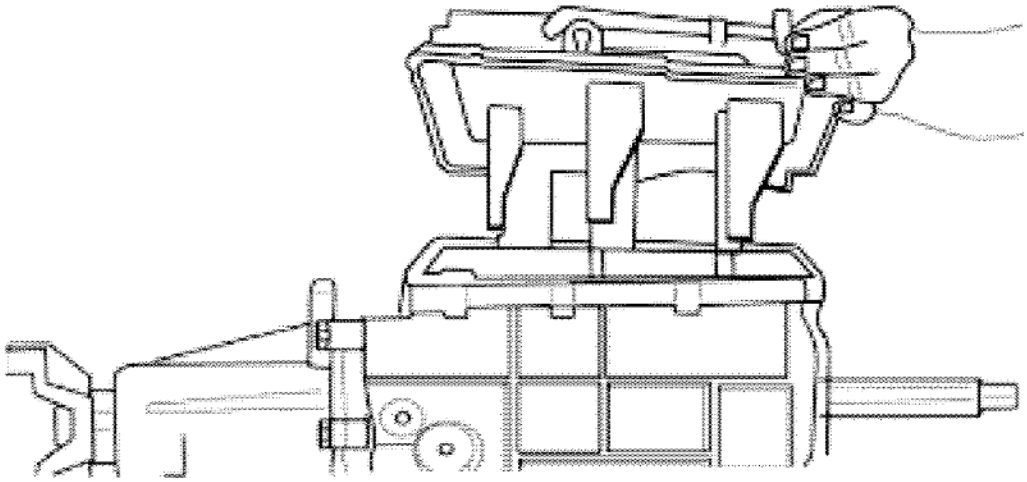


Fig. 82: Control Cover
Courtesy of GENERAL MOTORS COMPANY

6. Lift the control cover.

   It may help to use a flat-head screwdriver.

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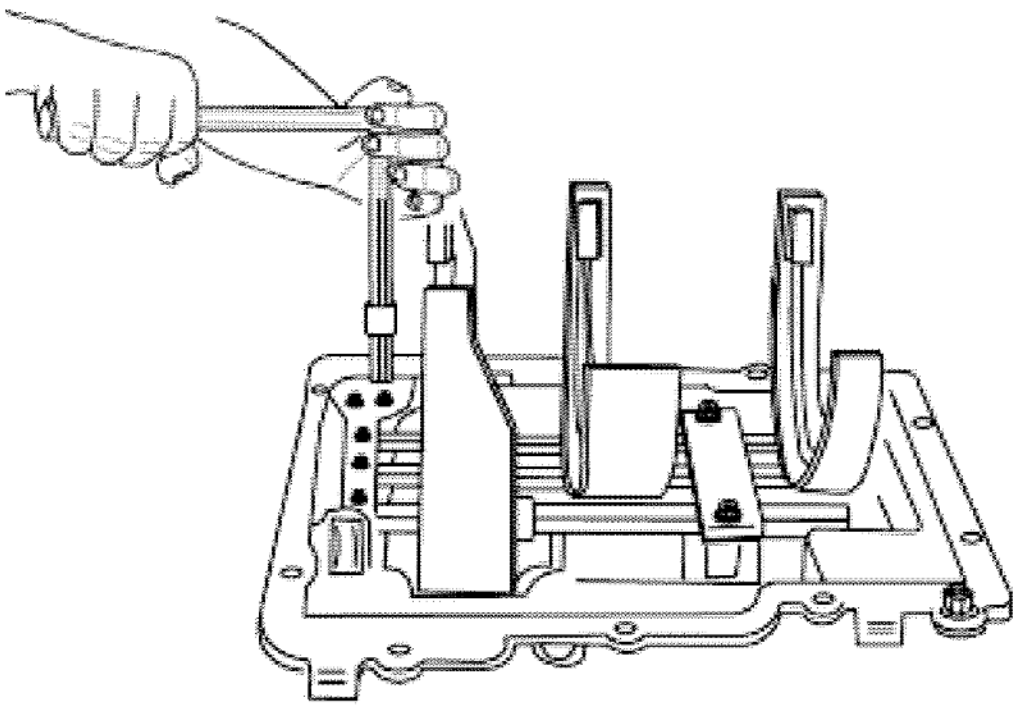


Fig. 83: Screws Retaining Support Plate On Block
Courtesy of GENERAL MOTORS COMPANY

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

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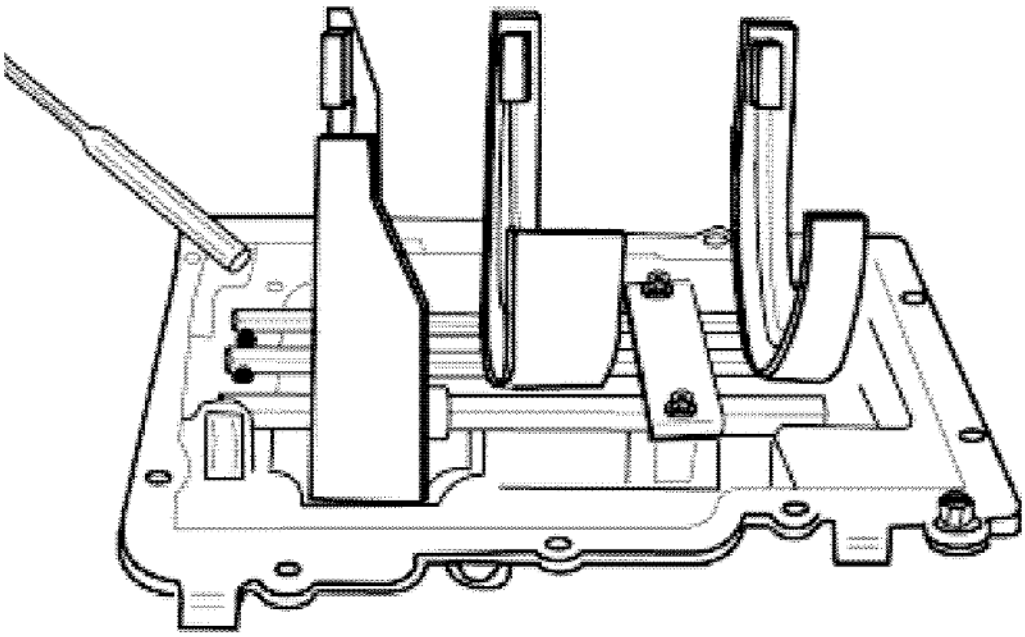


Fig. 84: Using Magnet To Remove Block Pins
Courtesy of GENERAL MOTORS COMPANY

9. Using a magnet, remove the block pins.

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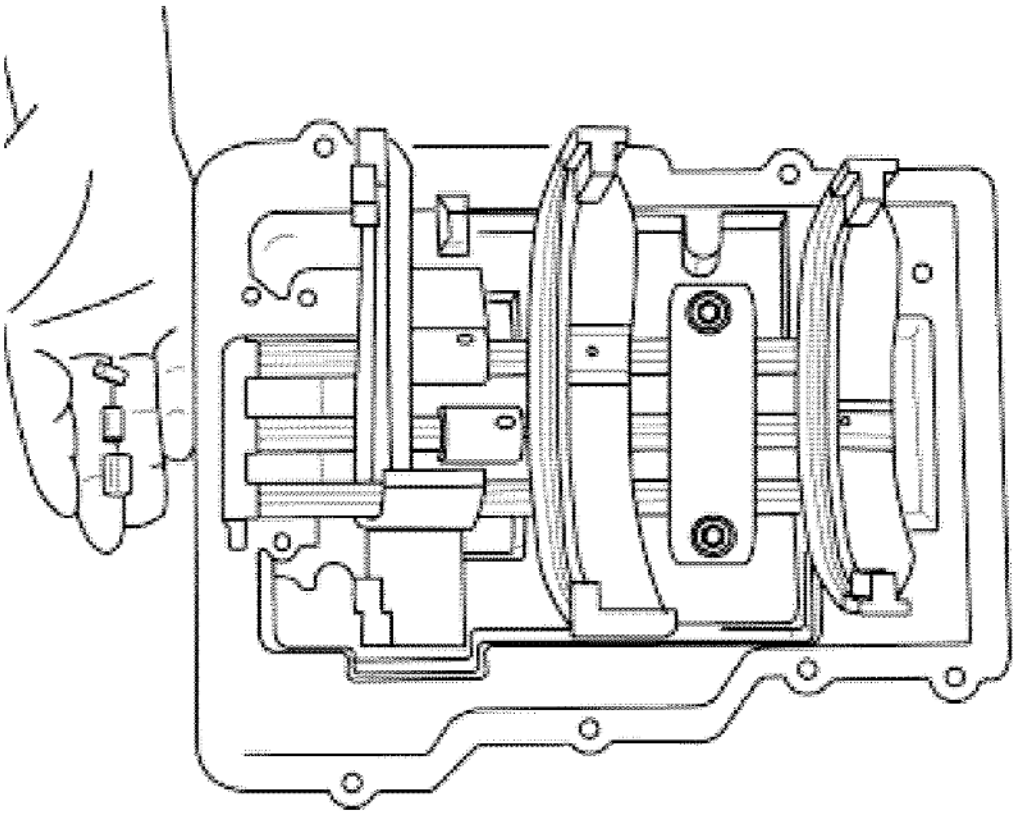


Fig. 85: Pins And Lock
Courtesy of GENERAL MOTORS COMPANY

10. Remove the pins and the lock.

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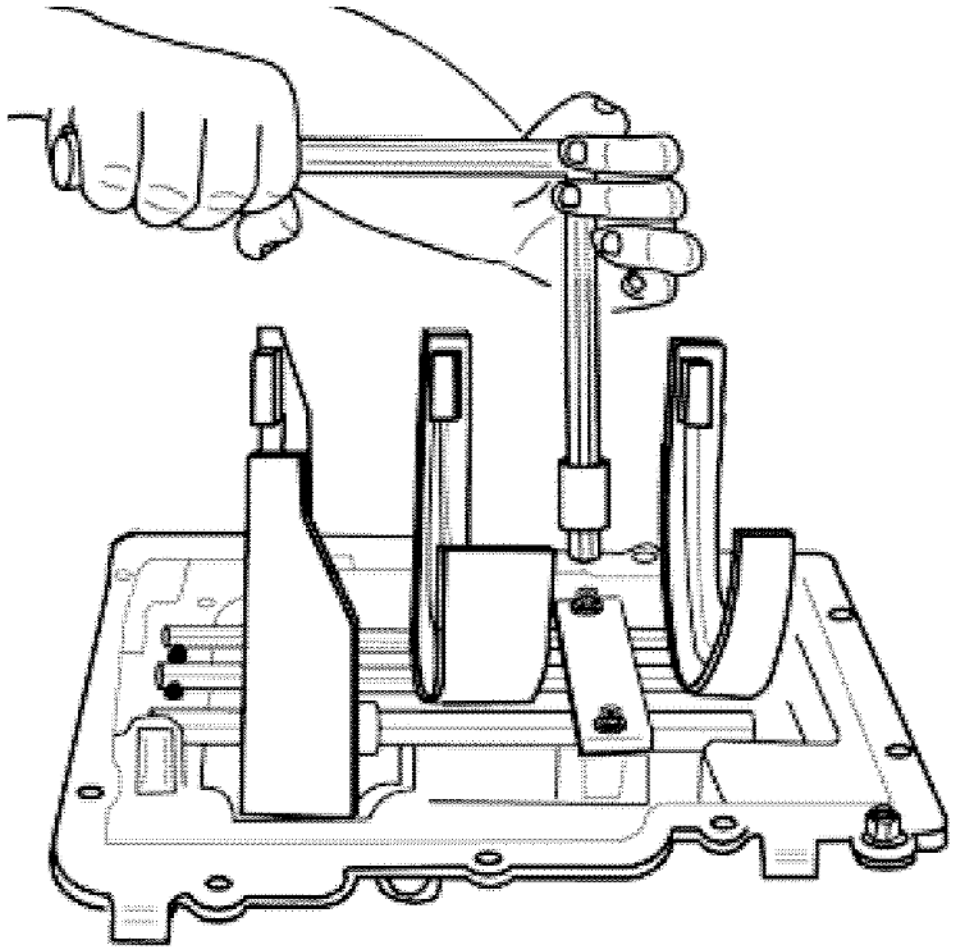


Fig. 86: Retaining Plate Screws
Courtesy of GENERAL MOTORS COMPANY

11. Remove the 2 screws from the retaining plate.

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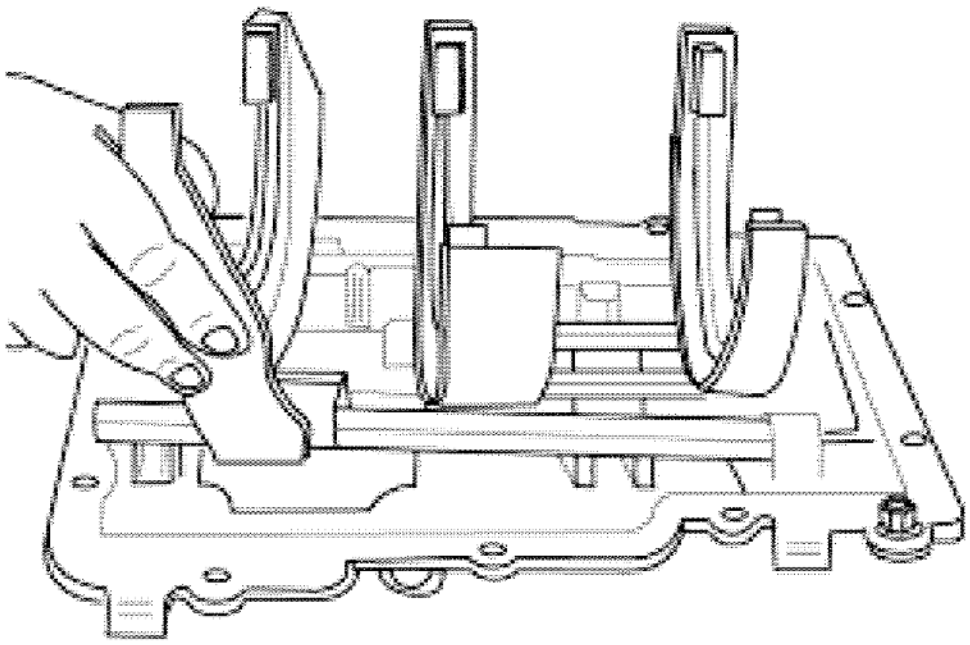


Fig. 87: 5th Gear, Reverse Shaft, And Fork Assembly
Courtesy of GENERAL MOTORS COMPANY

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

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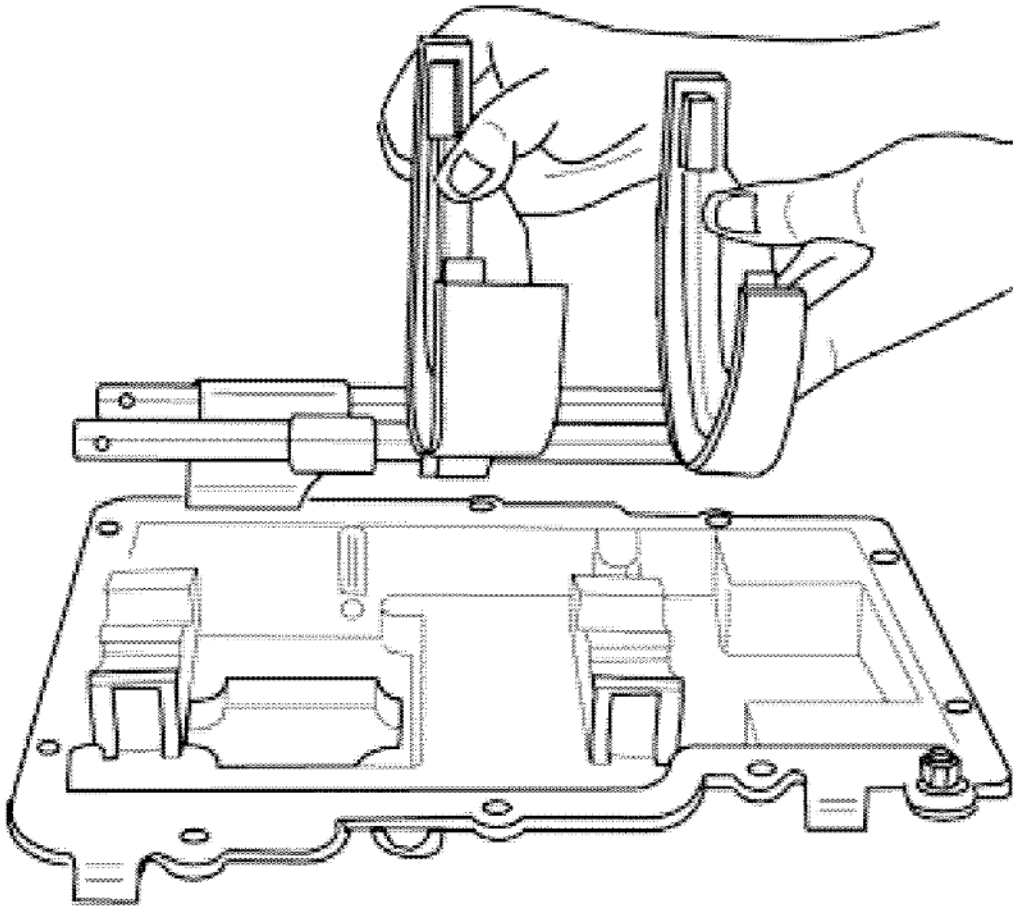


Fig. 88: Assembly With Shafts, Forks And Stops
Courtesy of GENERAL MOTORS COMPANY

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

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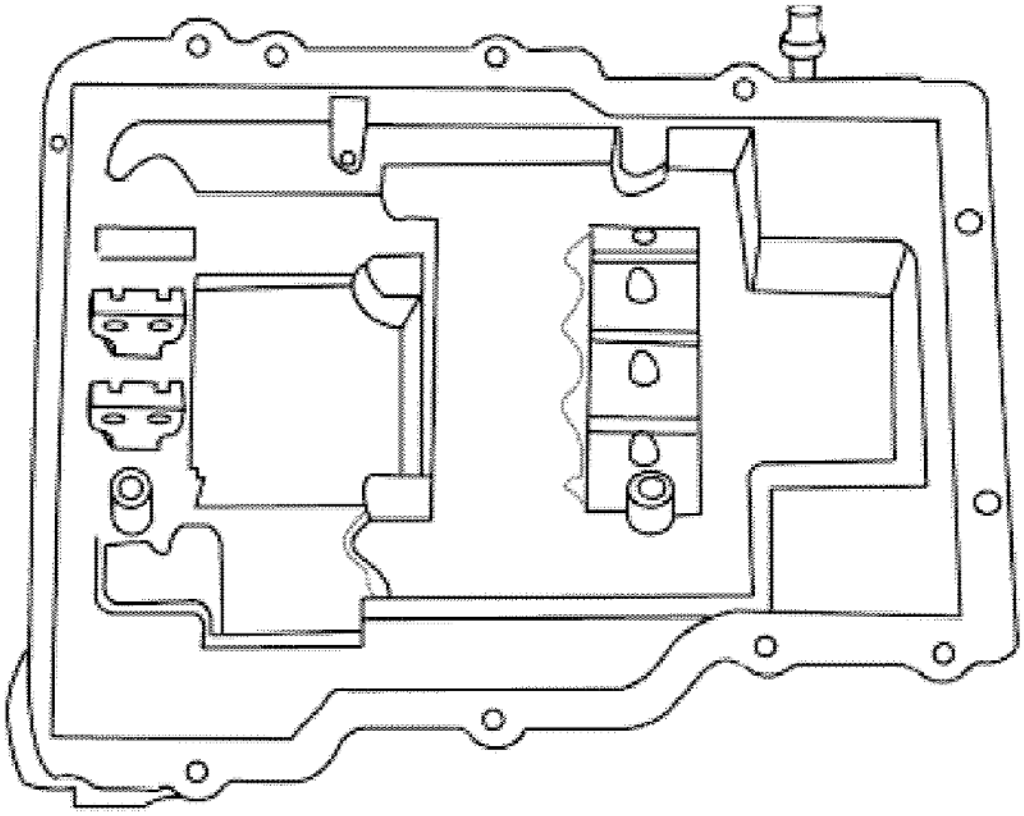


Fig. 89: 3 Spheres And 3 Springs
Courtesy of GENERAL MOTORS COMPANY

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

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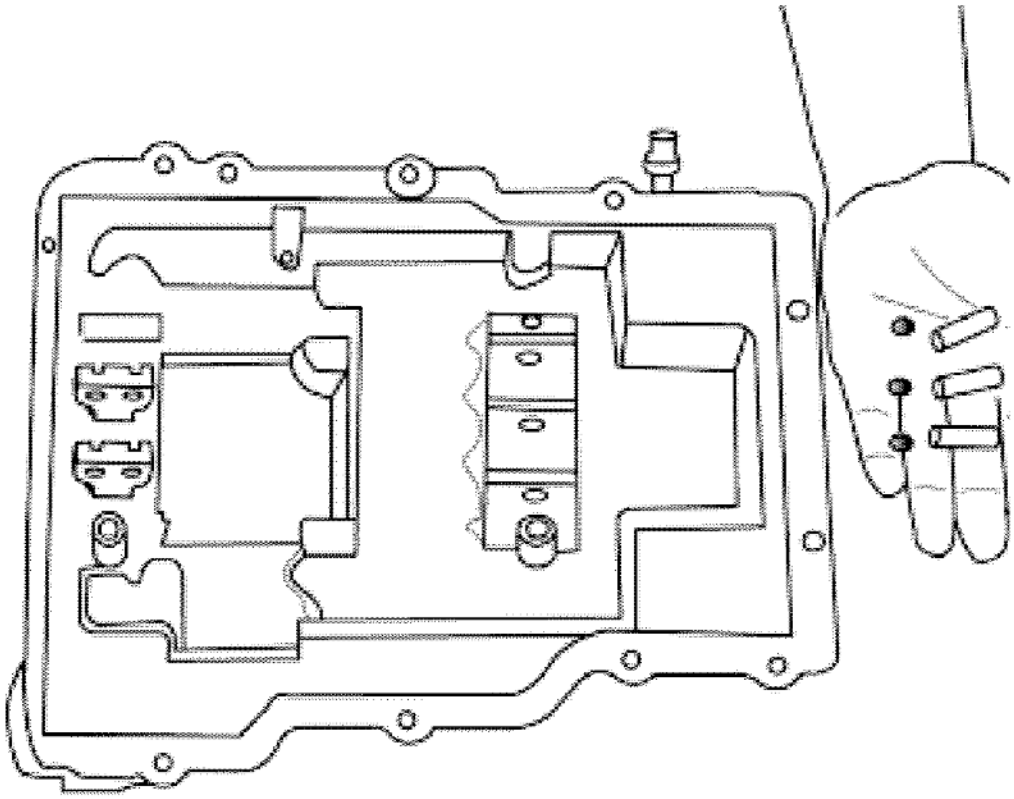


Fig. 90: Inserts
Courtesy of GENERAL MOTORS COMPANY

15. Arrange the inserts.

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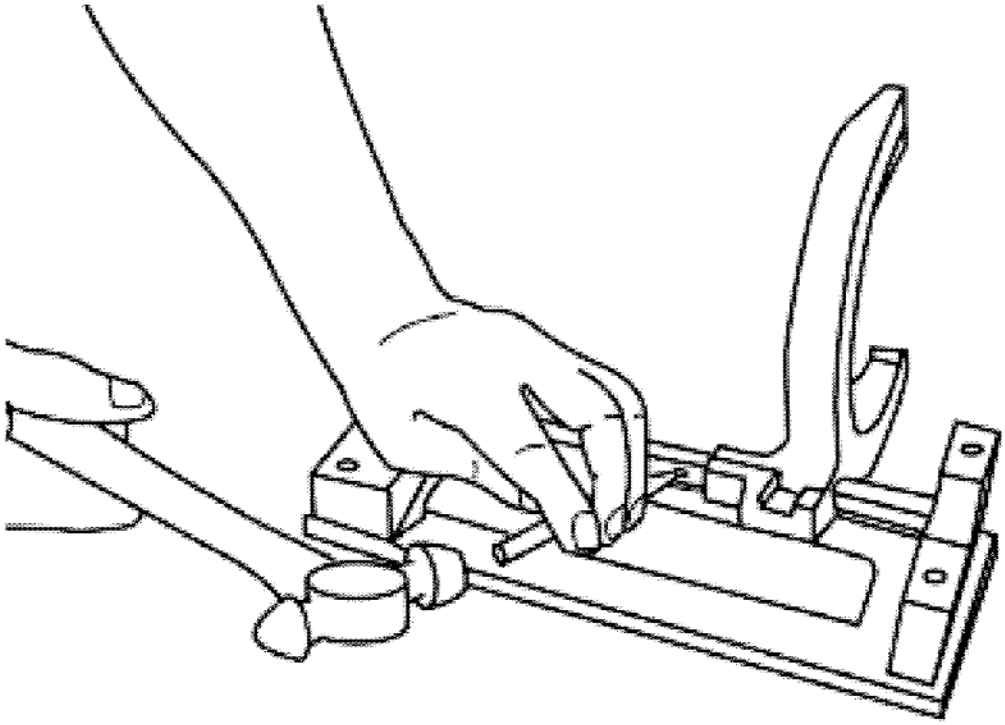


Fig. 91: Removing Fork Pin And Fork
Courtesy of GENERAL MOTORS COMPANY

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

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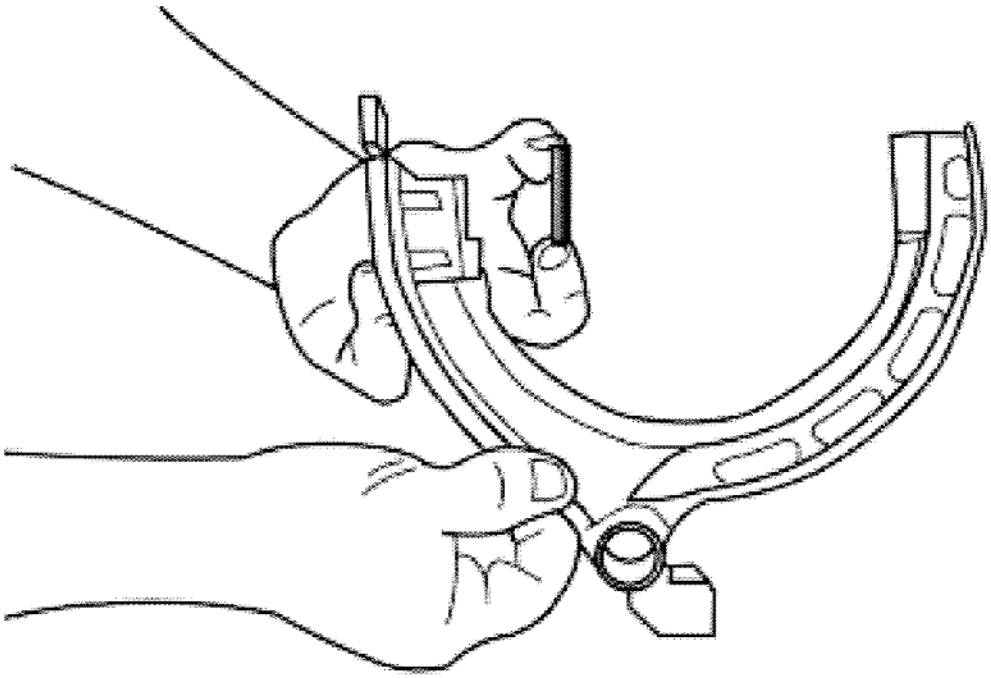


Fig. 92: Fork Inserts
Courtesy of GENERAL MOTORS COMPANY

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

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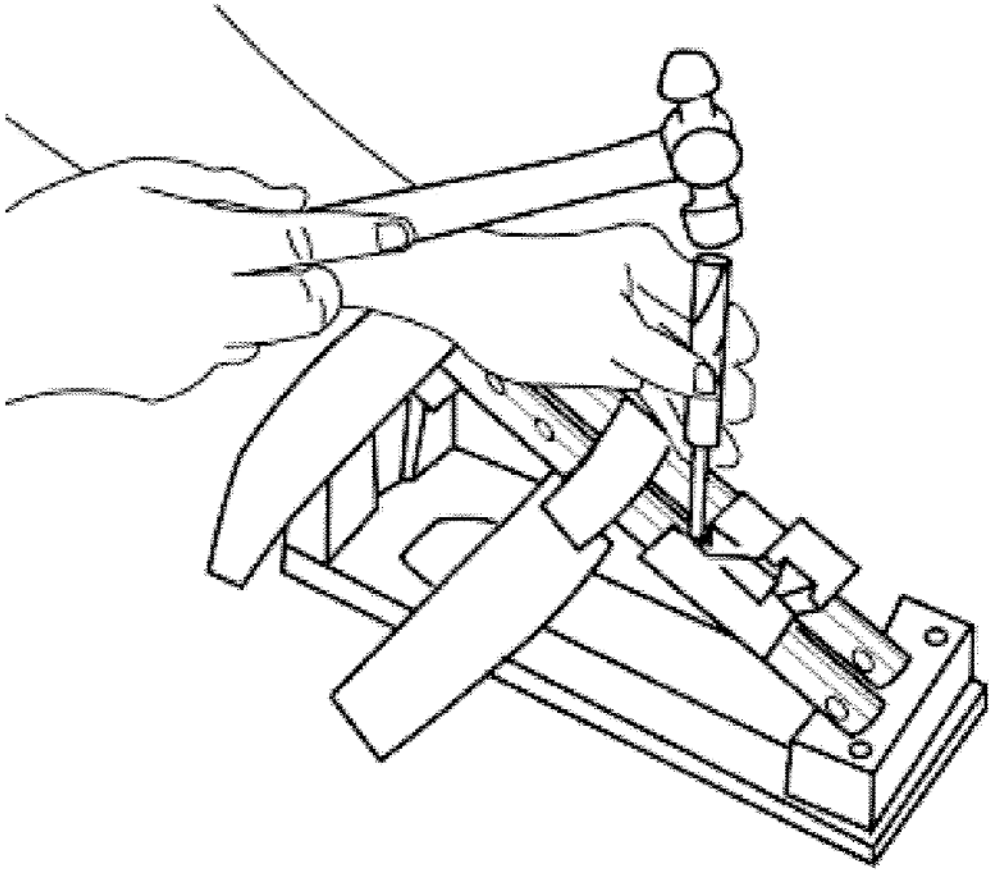


Fig. 93: Removing 3rd And 4th Gear Stop
Courtesy of GENERAL MOTORS COMPANY

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

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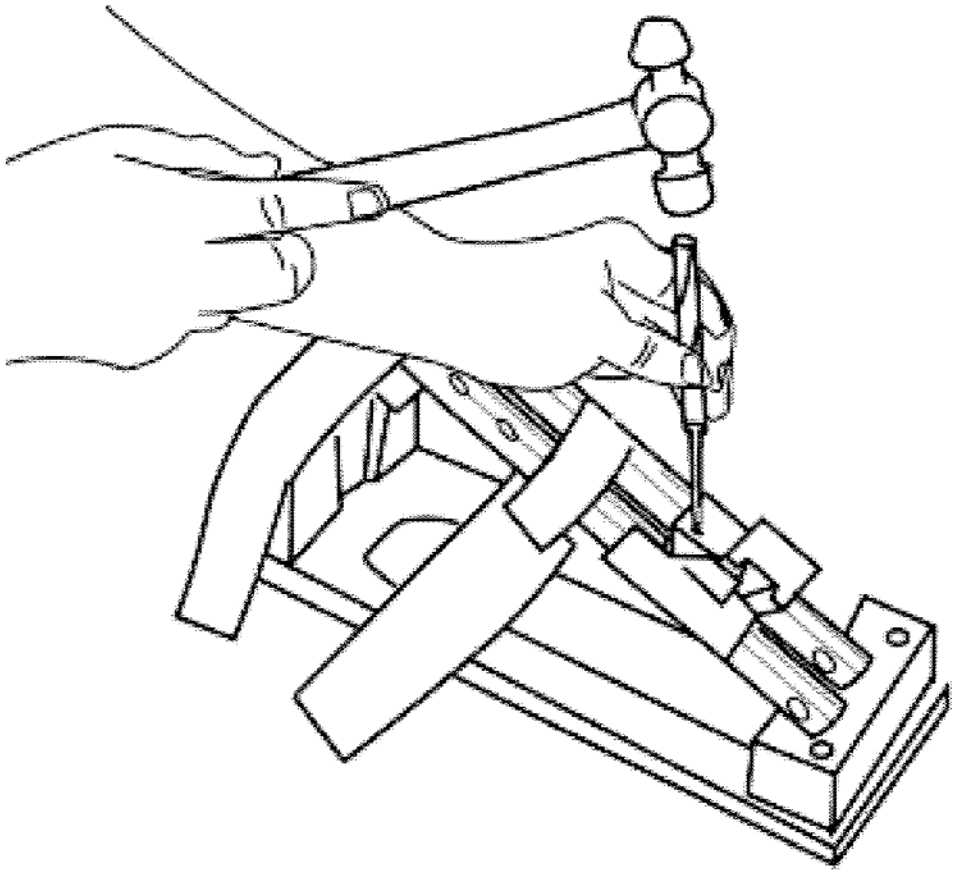


Fig. 94: Removing 1st And 2nd Gear Stop
Courtesy of GENERAL MOTORS COMPANY

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

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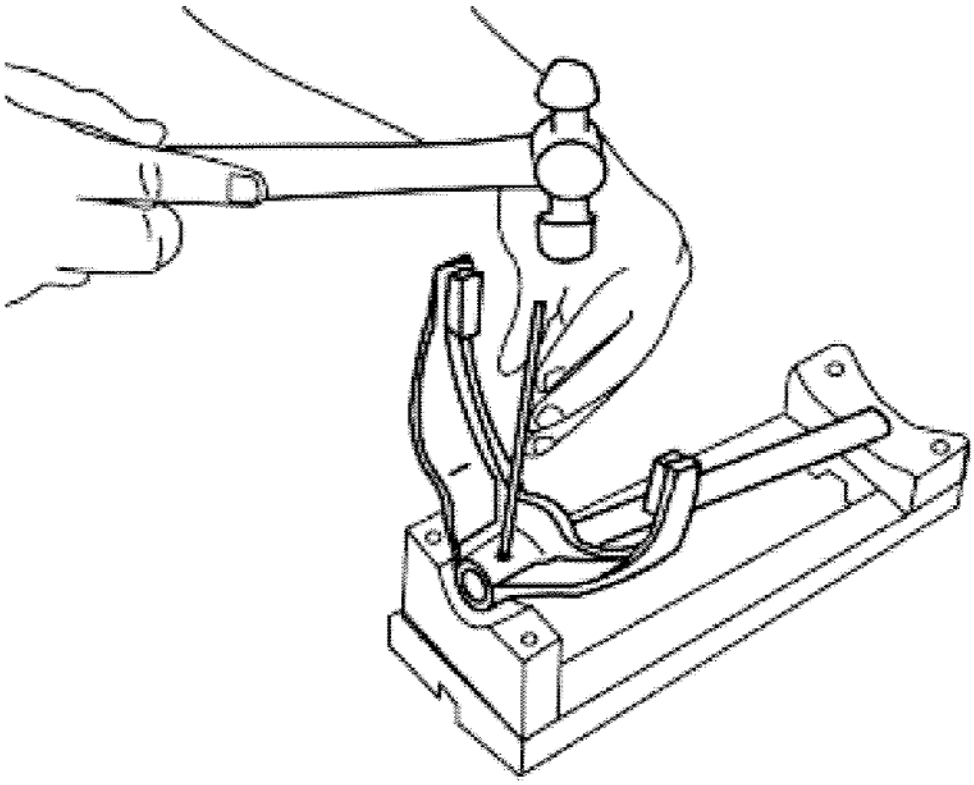


Fig. 95: Removing Fork Pin And Fork
Courtesy of GENERAL MOTORS COMPANY

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

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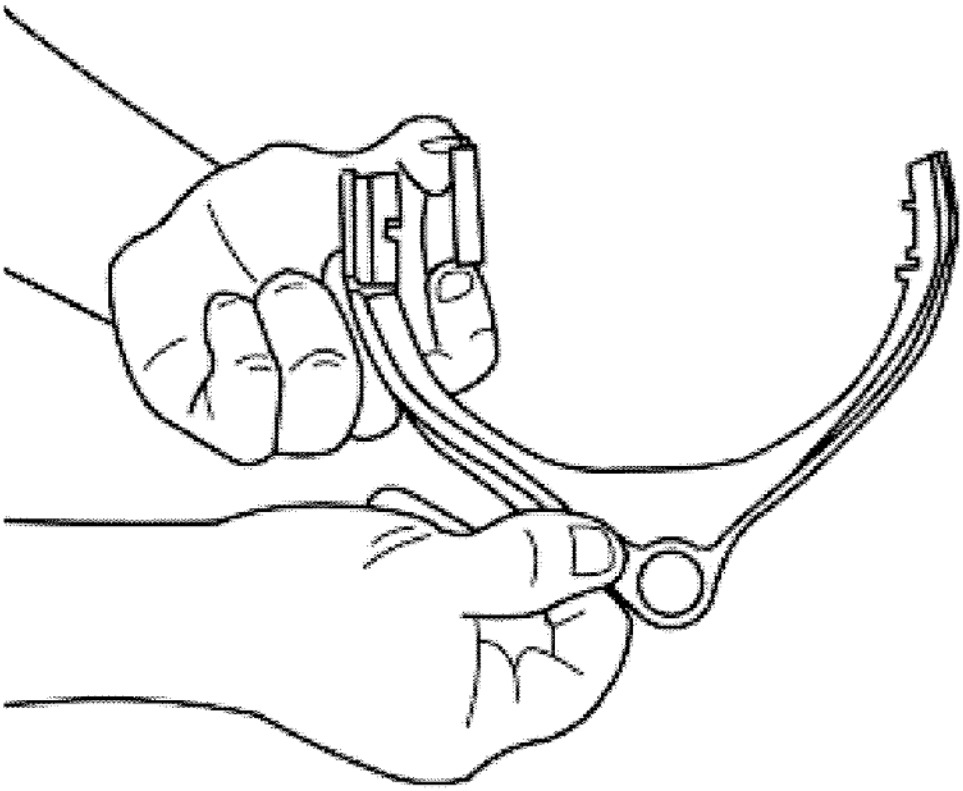


Fig. 96: Fork Inserts
Courtesy of GENERAL MOTORS COMPANY

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

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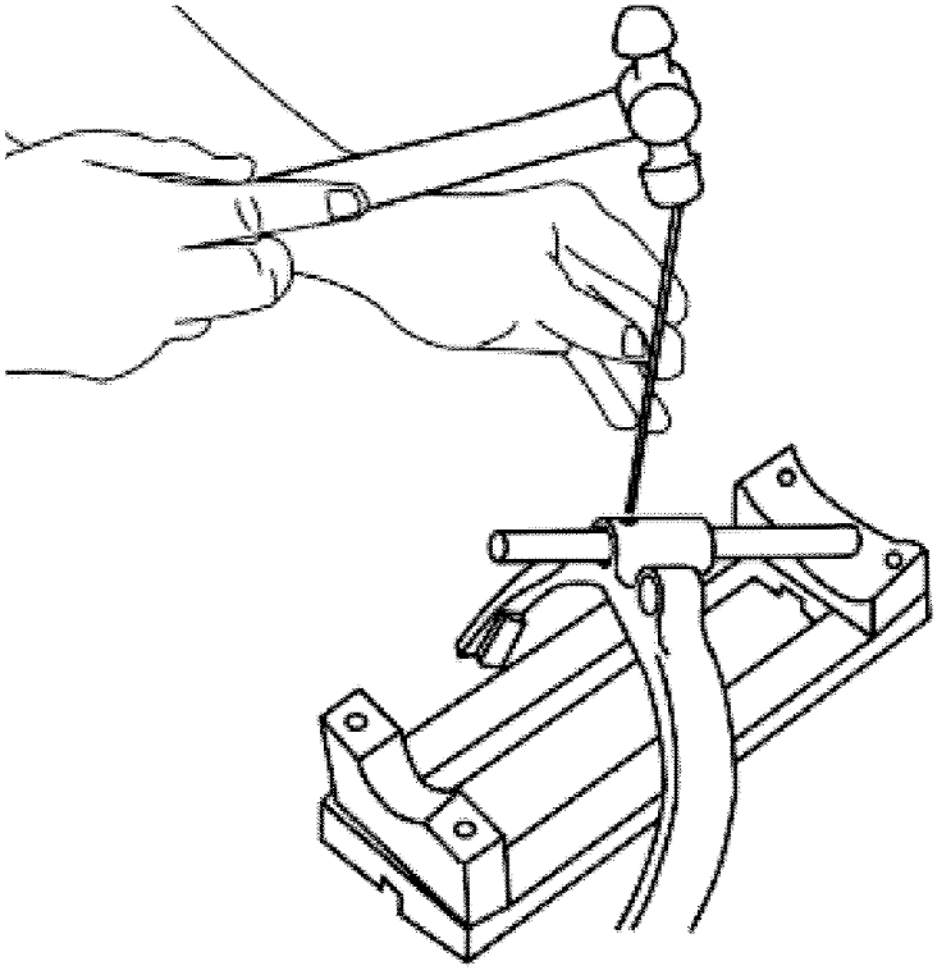


Fig. 97: Removing Fork Pin And Fork
Courtesy of GENERAL MOTORS COMPANY

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

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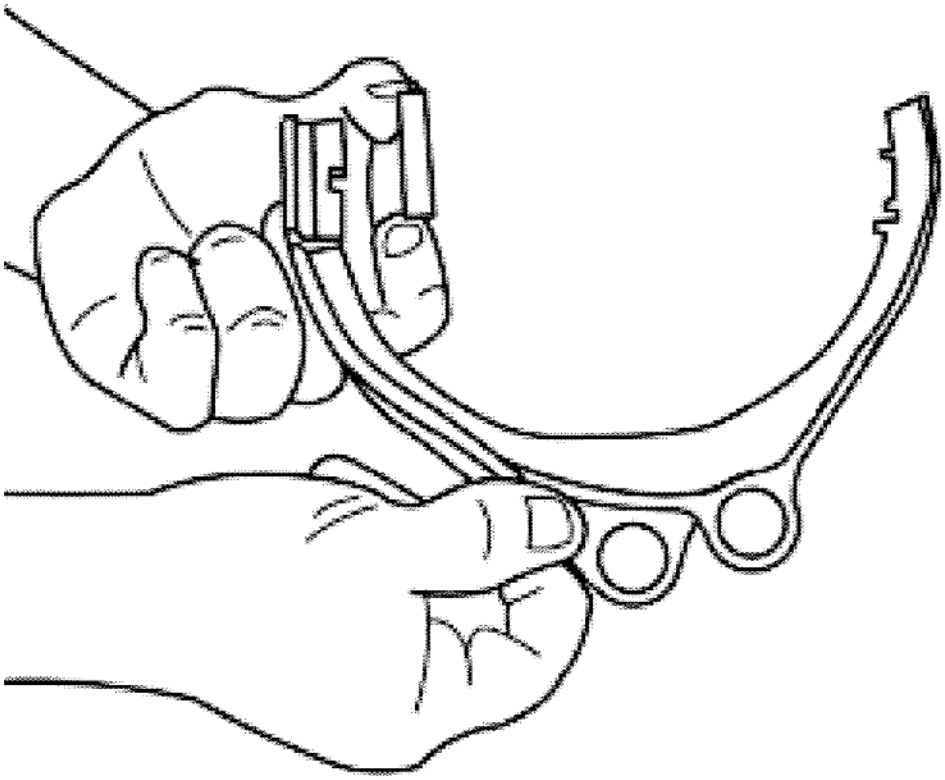


Fig. 98: Fork Inserts
Courtesy of GENERAL MOTORS COMPANY

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

REVERSE IDLER GEAR DISASSEMBLE

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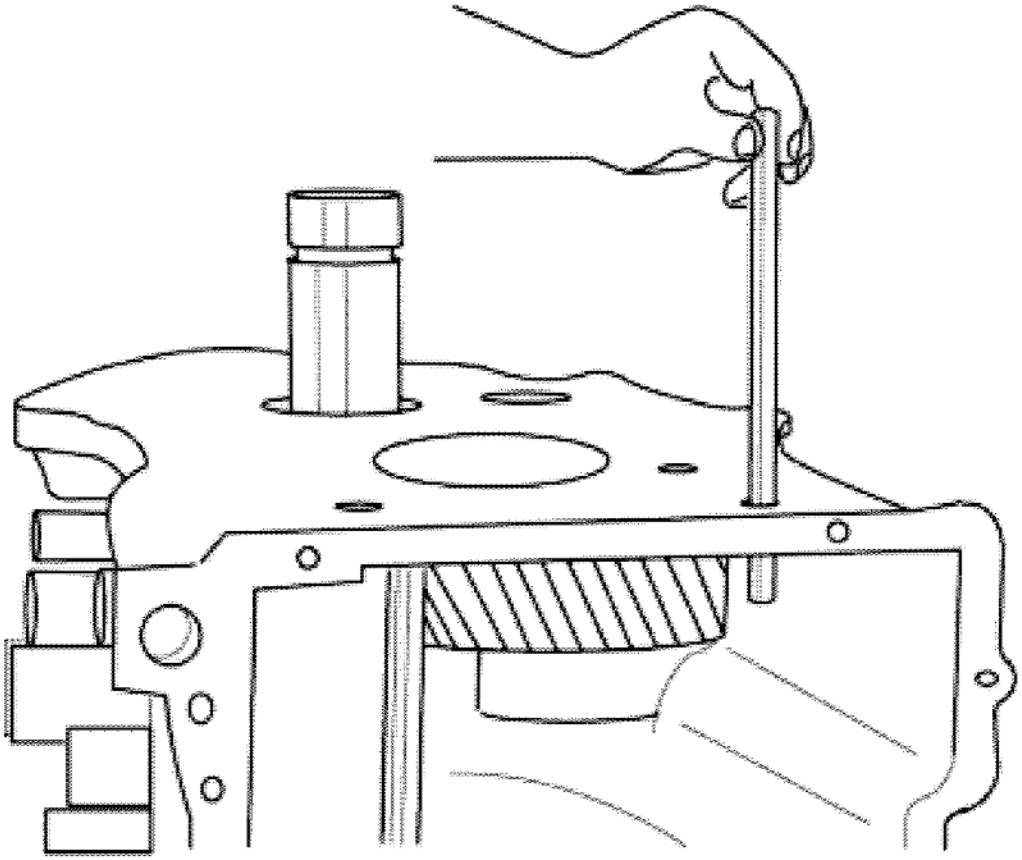


Fig. 99: 4th Gear Shaft
Courtesy of GENERAL MOTORS COMPANY

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

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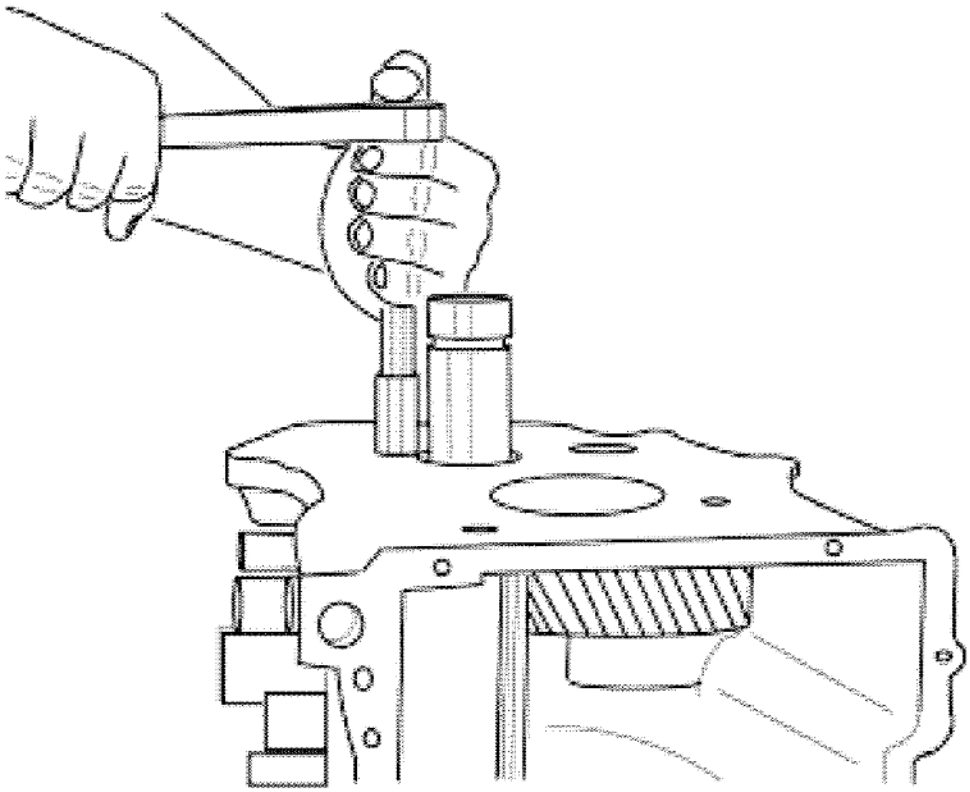


Fig. 100: Rear Retainer Screws
Courtesy of GENERAL MOTORS COMPANY

2. Remove the 4 screws from the rear retainer.

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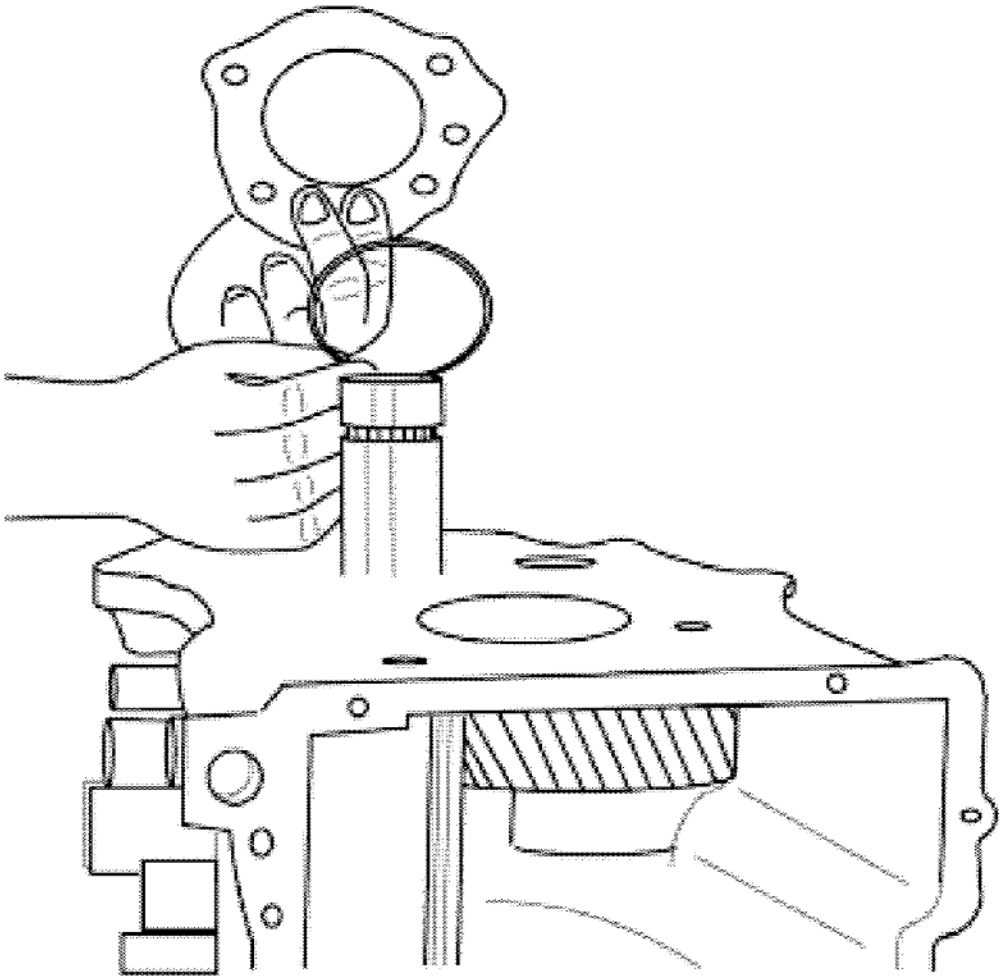


Fig. 101: Rear Retainer And Adjuster Shims
Courtesy of GENERAL MOTORS COMPANY

3. Remove the rear retainer and the adjuster shims.

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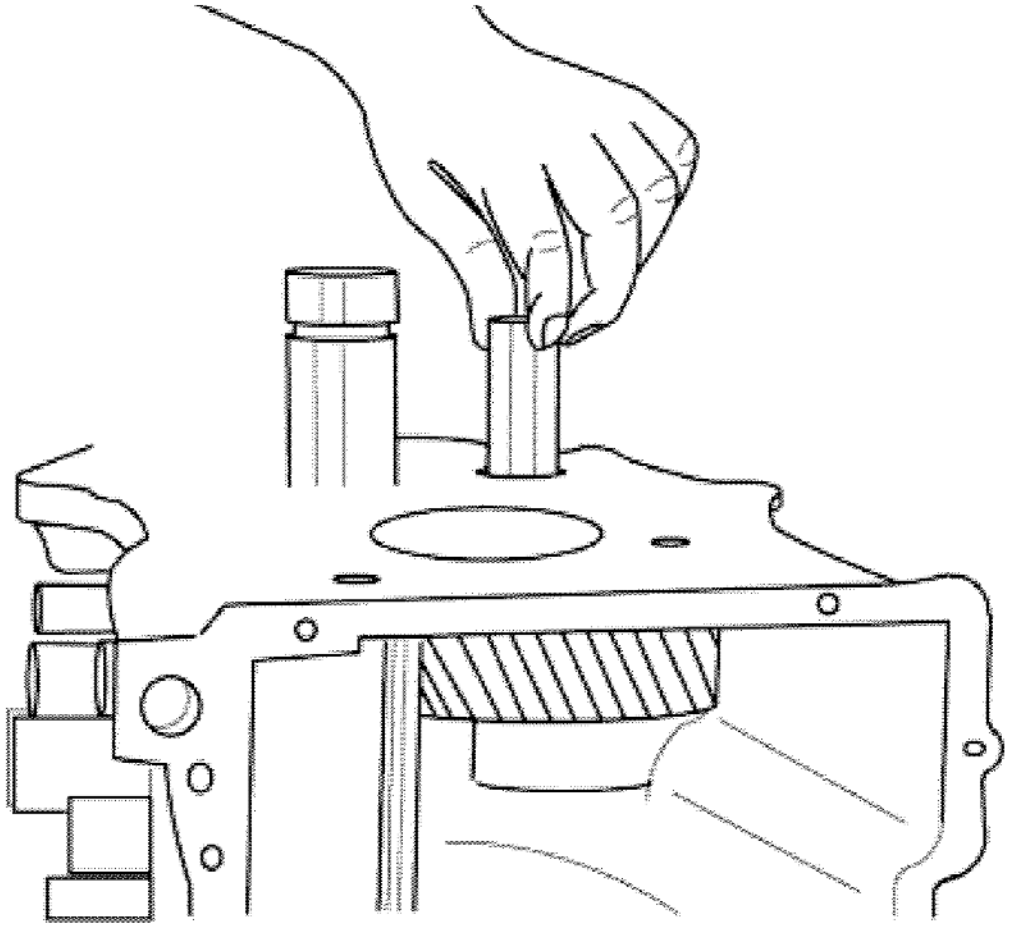


Fig. 102: Reverse Shaft
Courtesy of GENERAL MOTORS COMPANY

4. Remove the reverse shaft.

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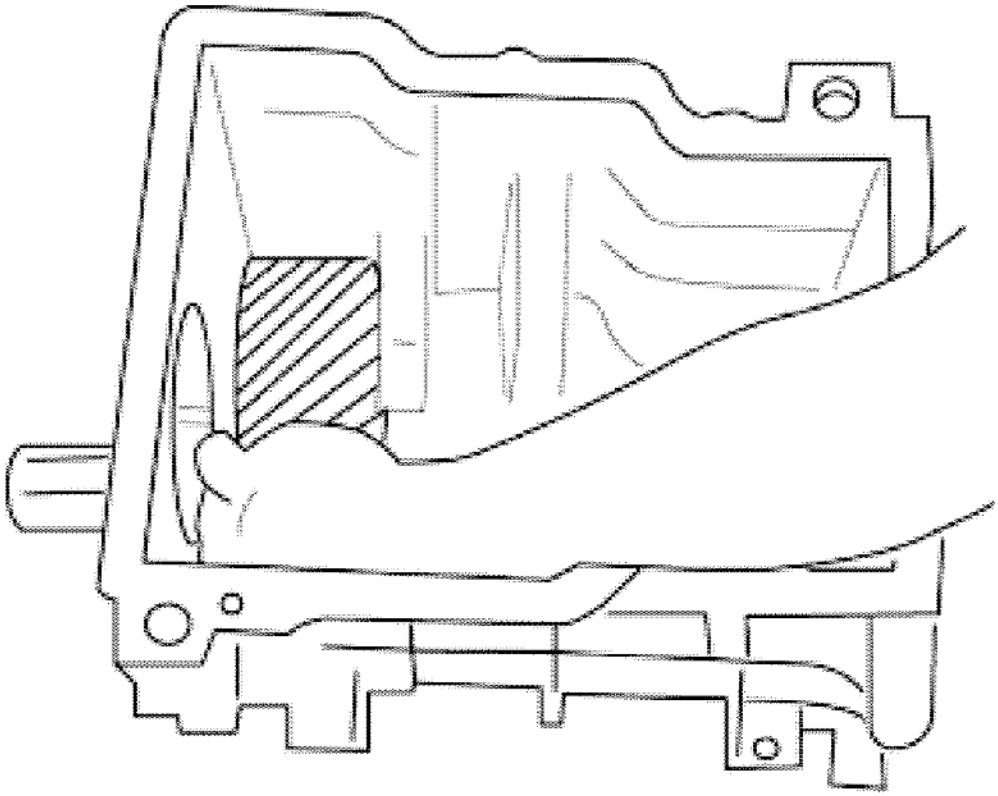


Fig. 103: Reverse Gear
Courtesy of GENERAL MOTORS COMPANY

5. Remove the reverse gear.

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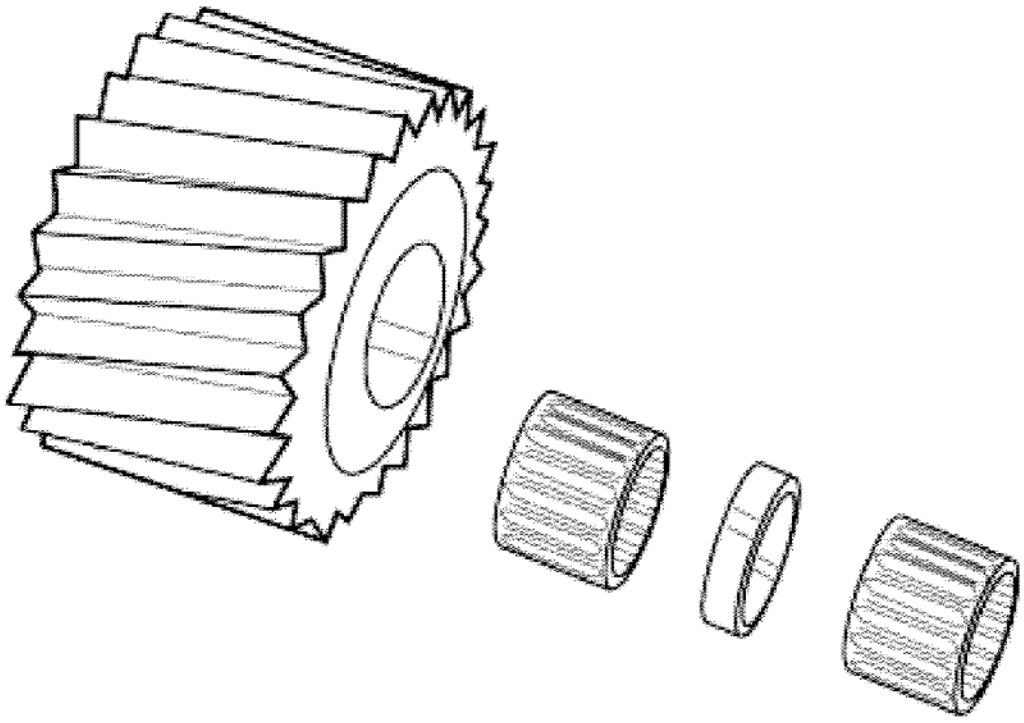


Fig. 104: Cages, Rollers And Spacer
Courtesy of GENERAL MOTORS COMPANY

6. Remove the 2 cages with rollers and spacer.

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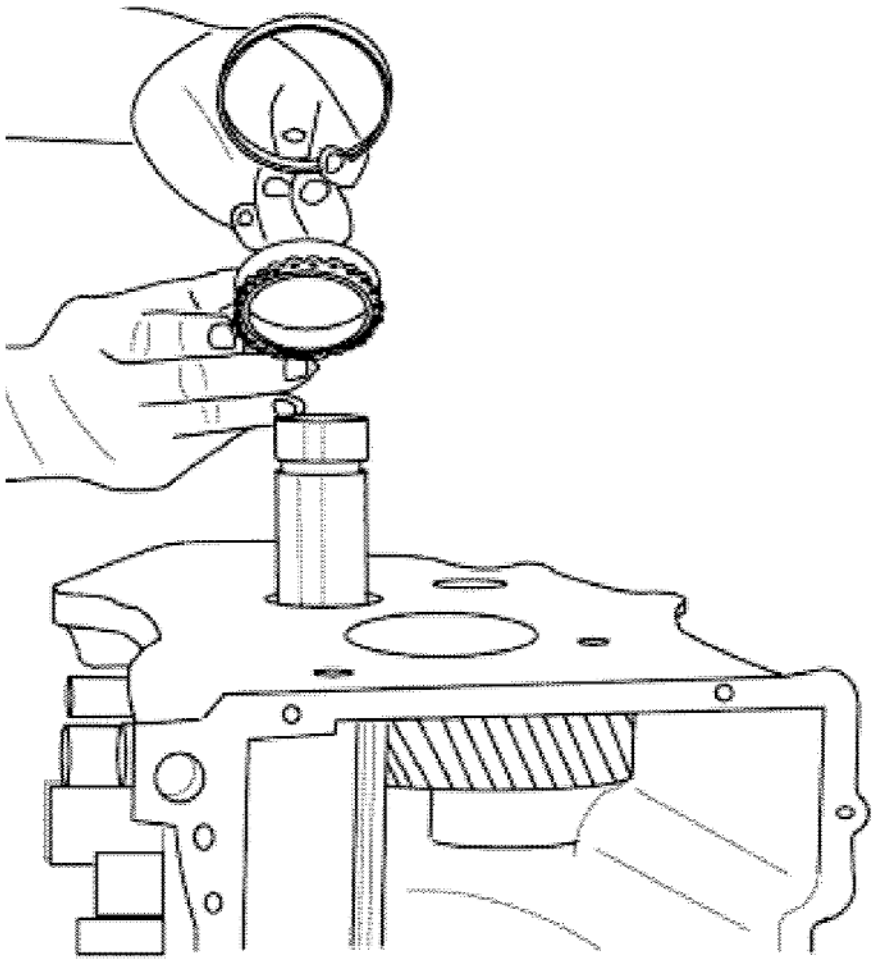


Fig. 105: Cup And Rear Bearing Race
Courtesy of GENERAL MOTORS COMPANY

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

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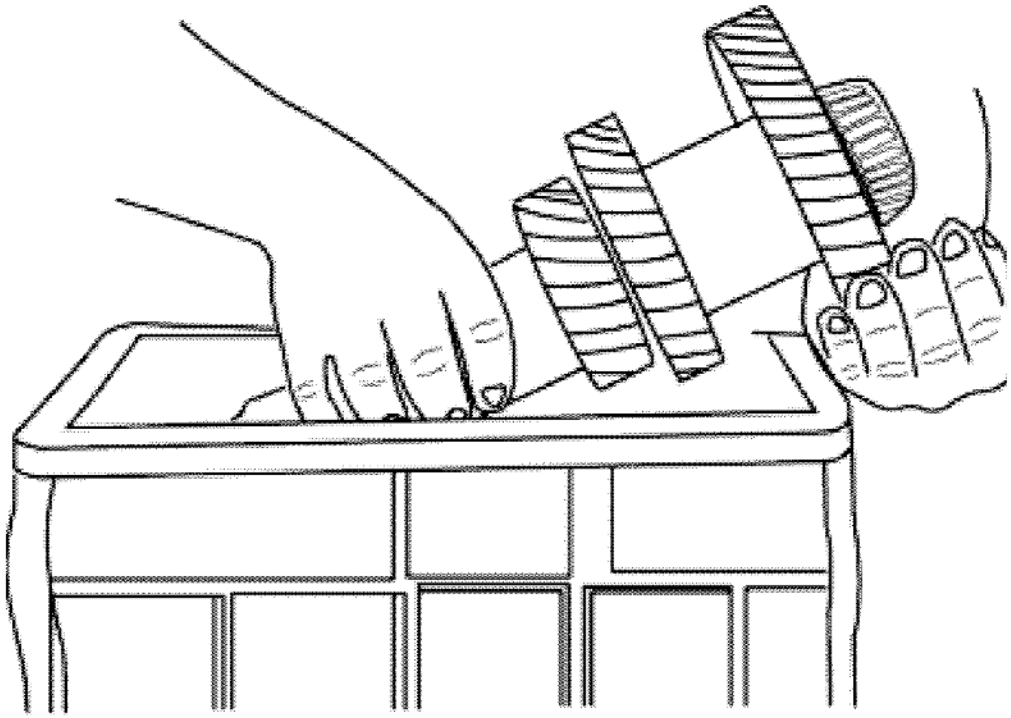


Fig. 106: Gear Assembly
Courtesy of GENERAL MOTORS COMPANY

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

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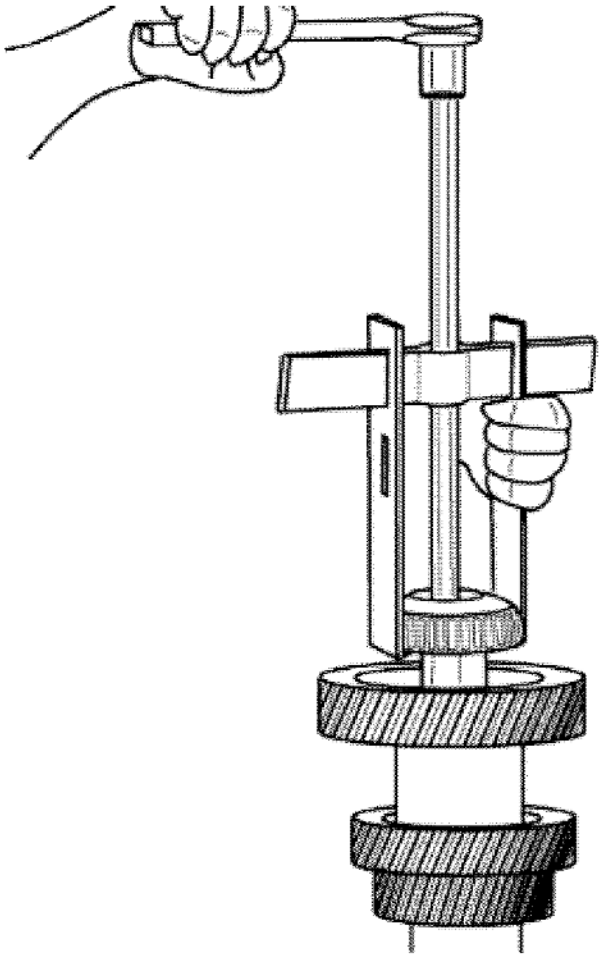


Fig. 107: Remove Bearing Race From Gear Assembly
Courtesy of GENERAL MOTORS COMPANY

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

COUNTER GEAR SHAFT DISASSEMBLE

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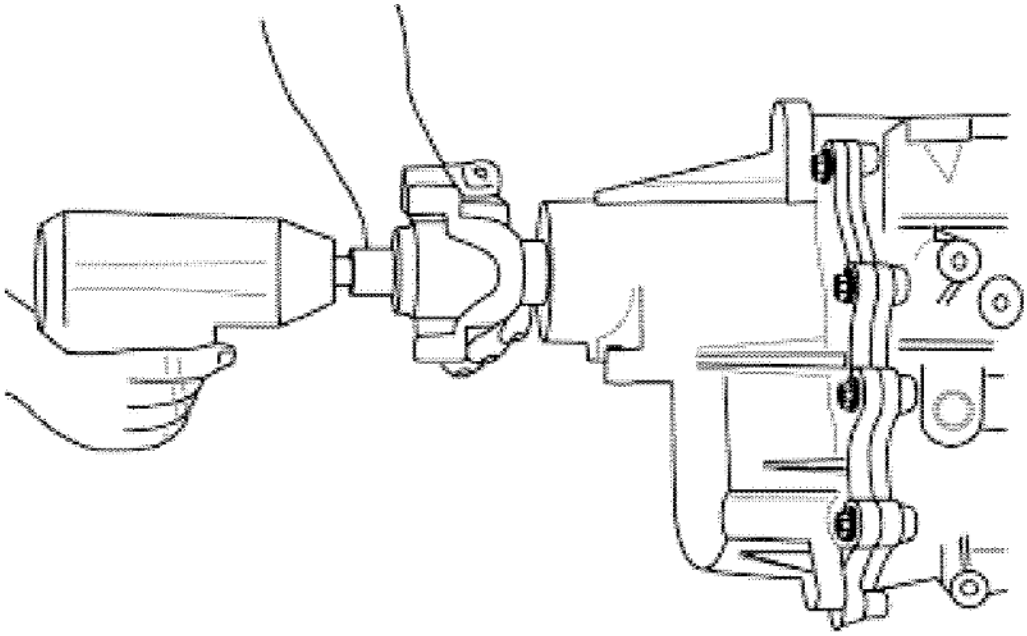


Fig. 108: Main Shaft Nut
Courtesy of GENERAL MOTORS COMPANY

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

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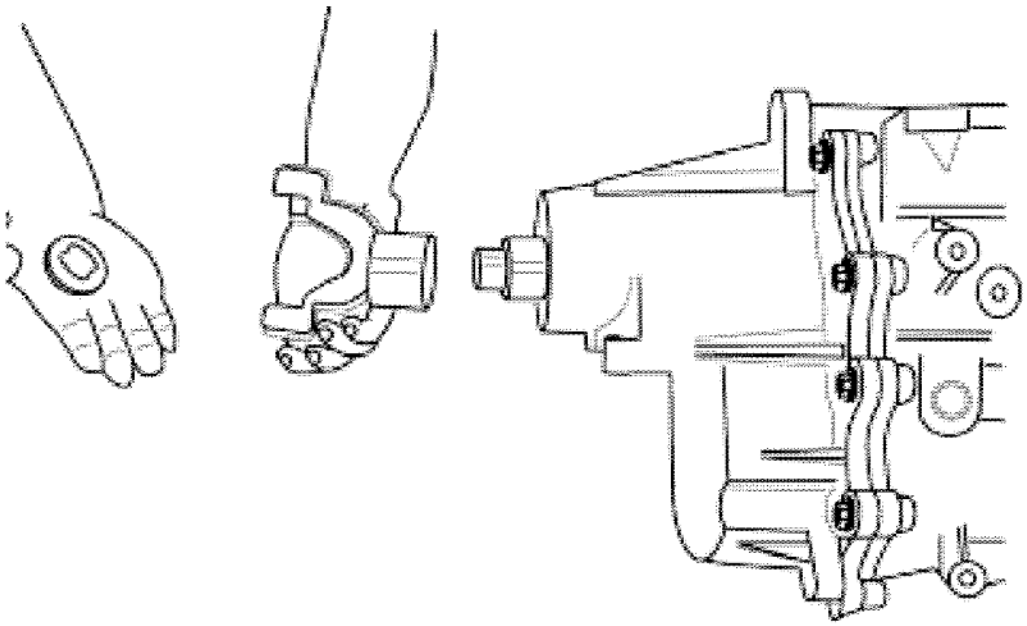


Fig. 109: Main Shaft Nut & Yoke
Courtesy of GENERAL MOTORS COMPANY

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

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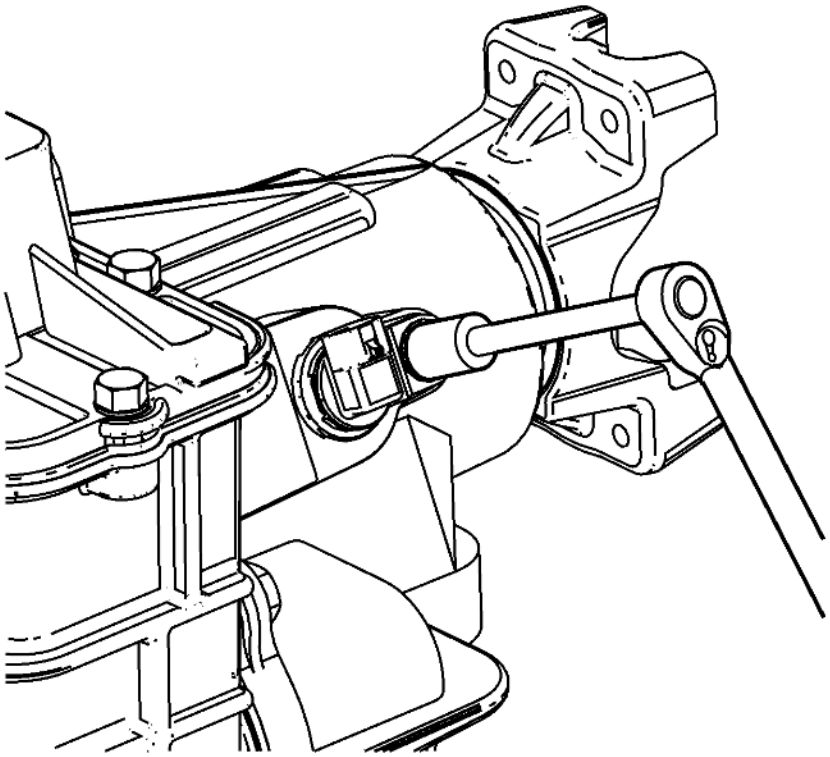


Fig. 110: Using Ratchet On Vehicle Speed Sensor (VSS) Screw
Courtesy of GENERAL MOTORS COMPANY

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

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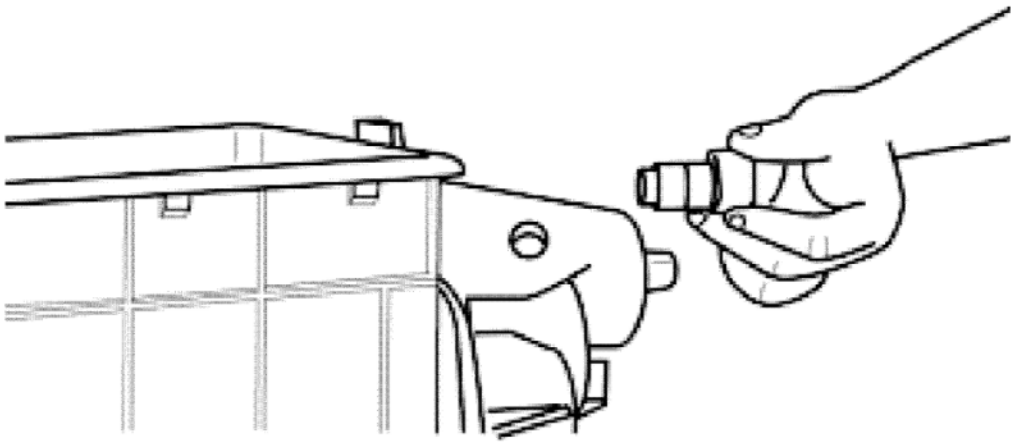


Fig. 111: VSS
Courtesy of GENERAL MOTORS COMPANY

4. Remove the VSS.

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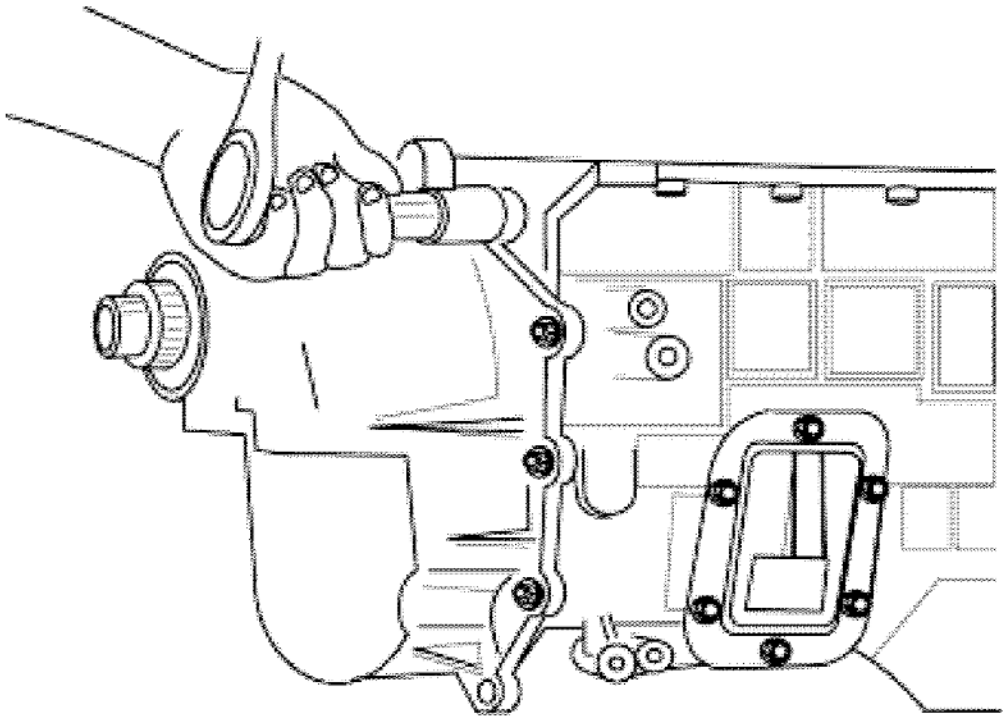


Fig. 112: Rear Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the 10 cover screws.

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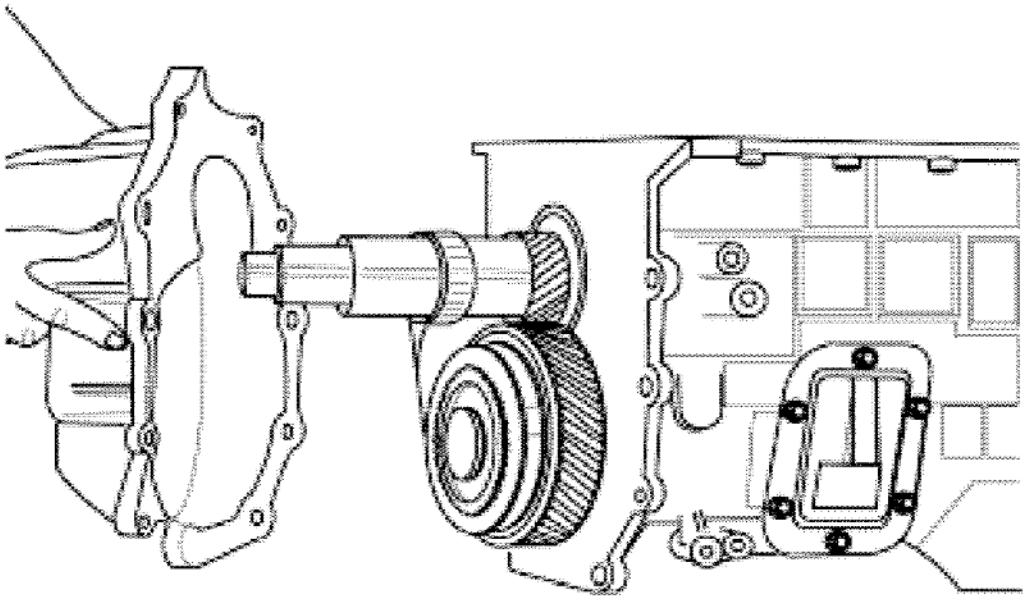


Fig. 113: Cover
Courtesy of GENERAL MOTORS COMPANY

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

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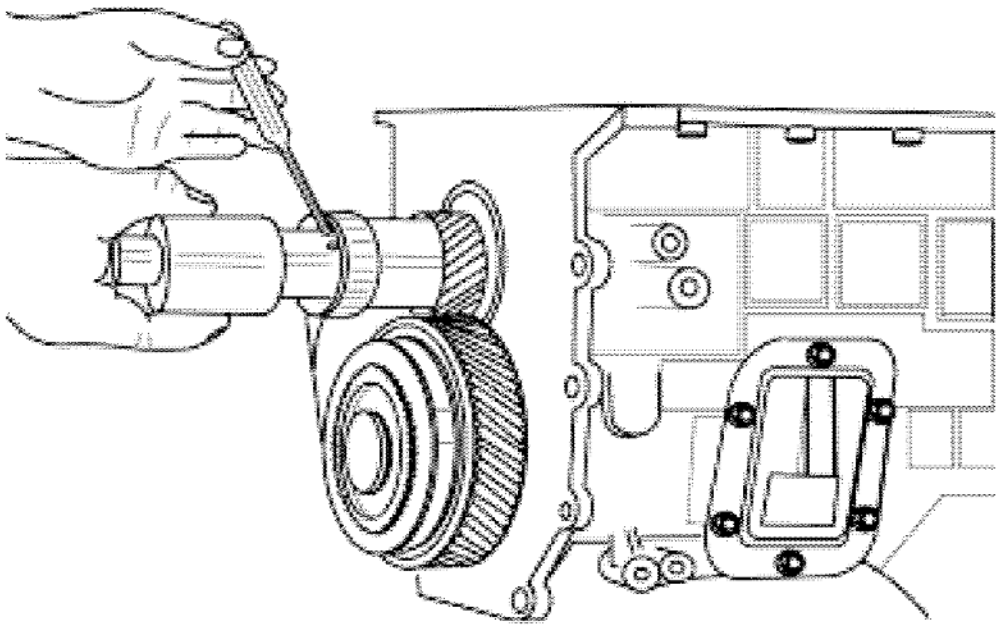


Fig. 114: Yoke Spacer
Courtesy of GENERAL MOTORS COMPANY

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

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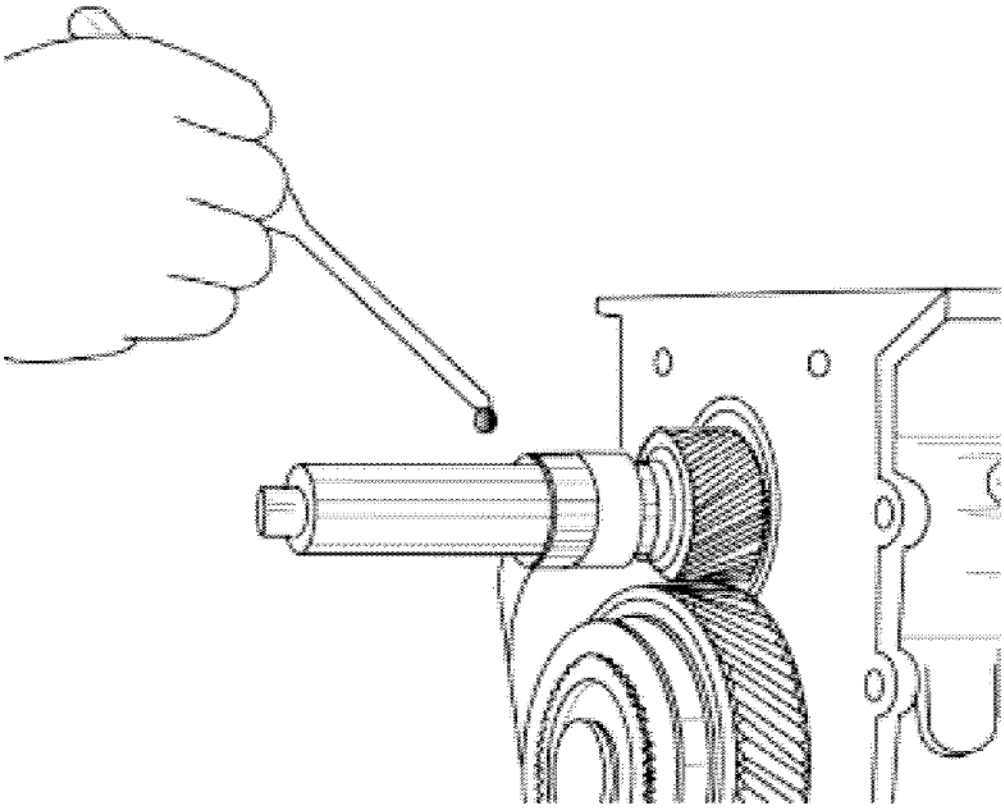


Fig. 115: Speedometer Tracking Balls
Courtesy of GENERAL MOTORS COMPANY

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

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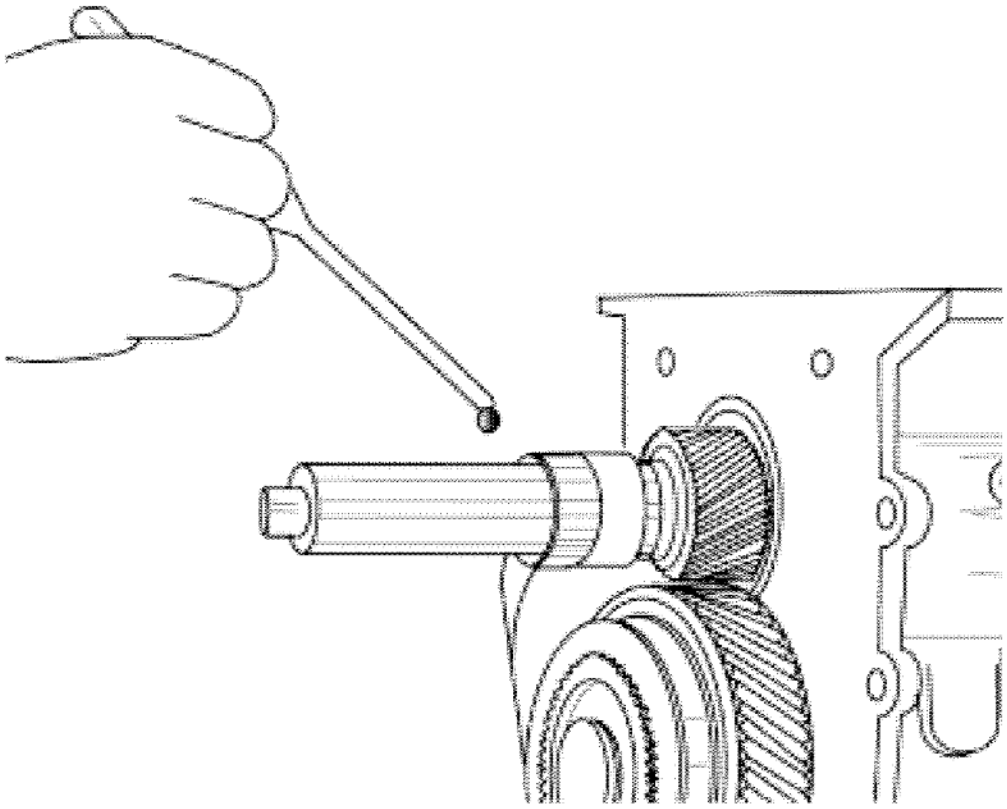


Fig. 116: Identifying Speedometer Gear
Courtesy of GENERAL MOTORS COMPANY

9. Remove the speedometer gear.

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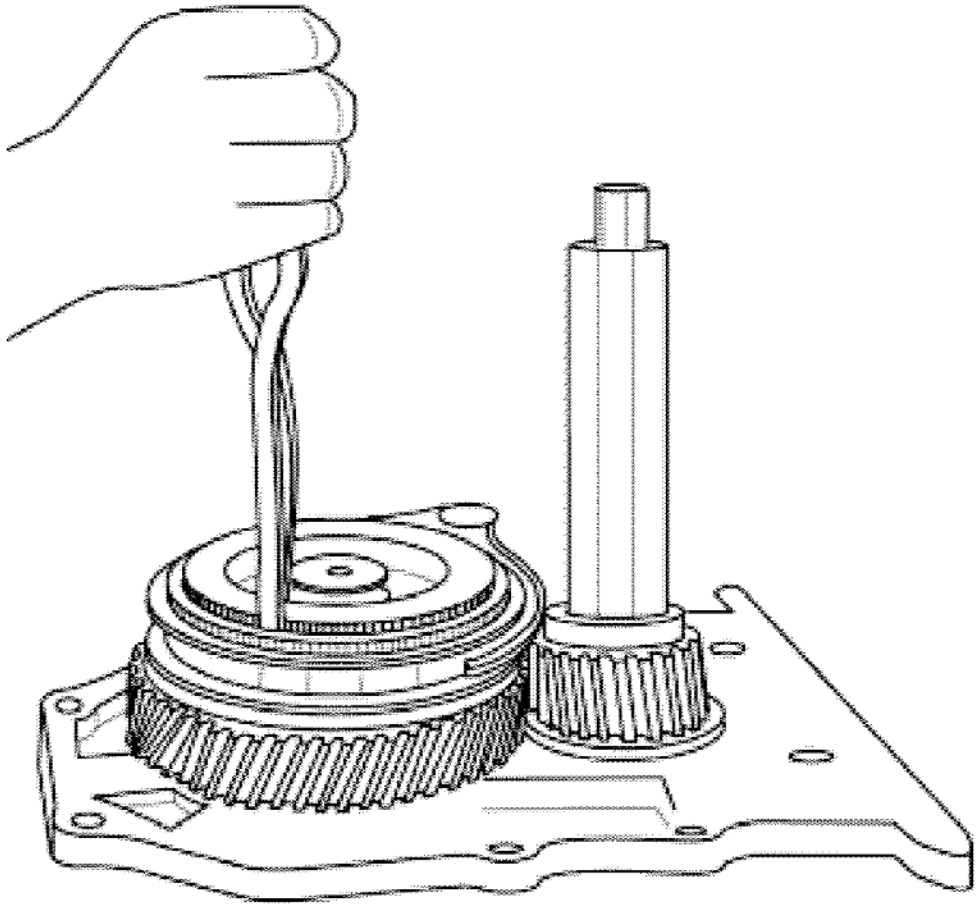


Fig. 117: Snap Ring
Courtesy of GENERAL MOTORS COMPANY

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

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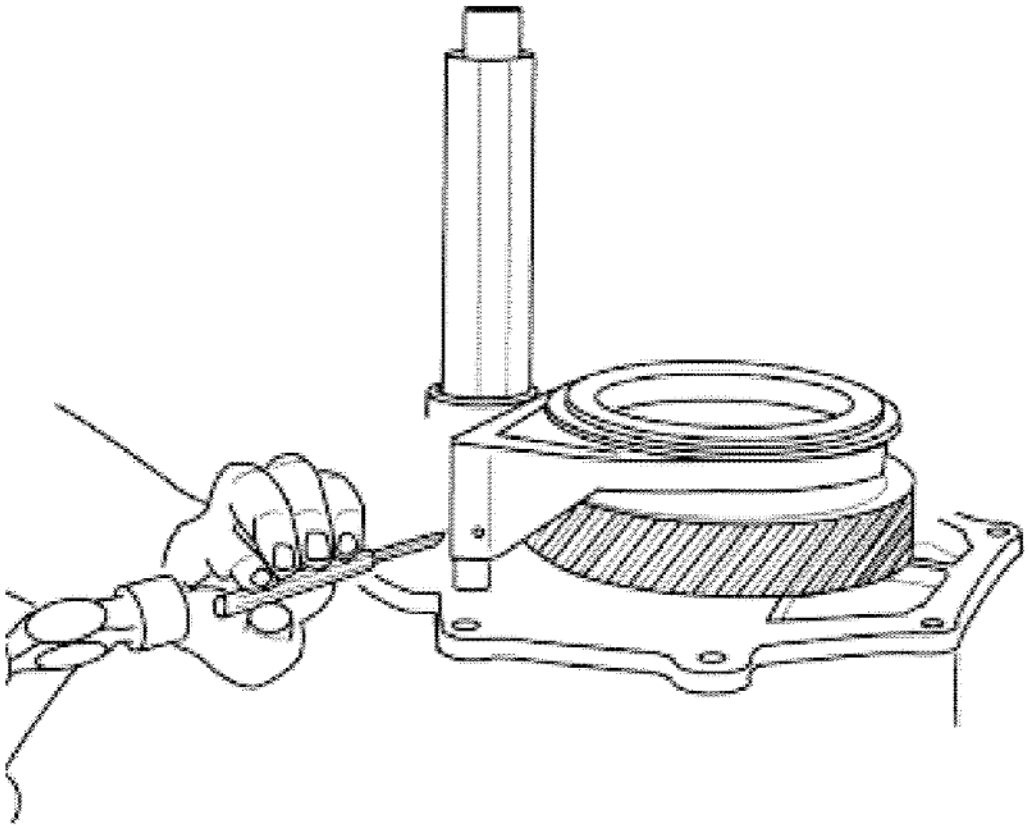


Fig. 118: Removing Roll Pin And 5th Gear Fork
Courtesy of GENERAL MOTORS COMPANY

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

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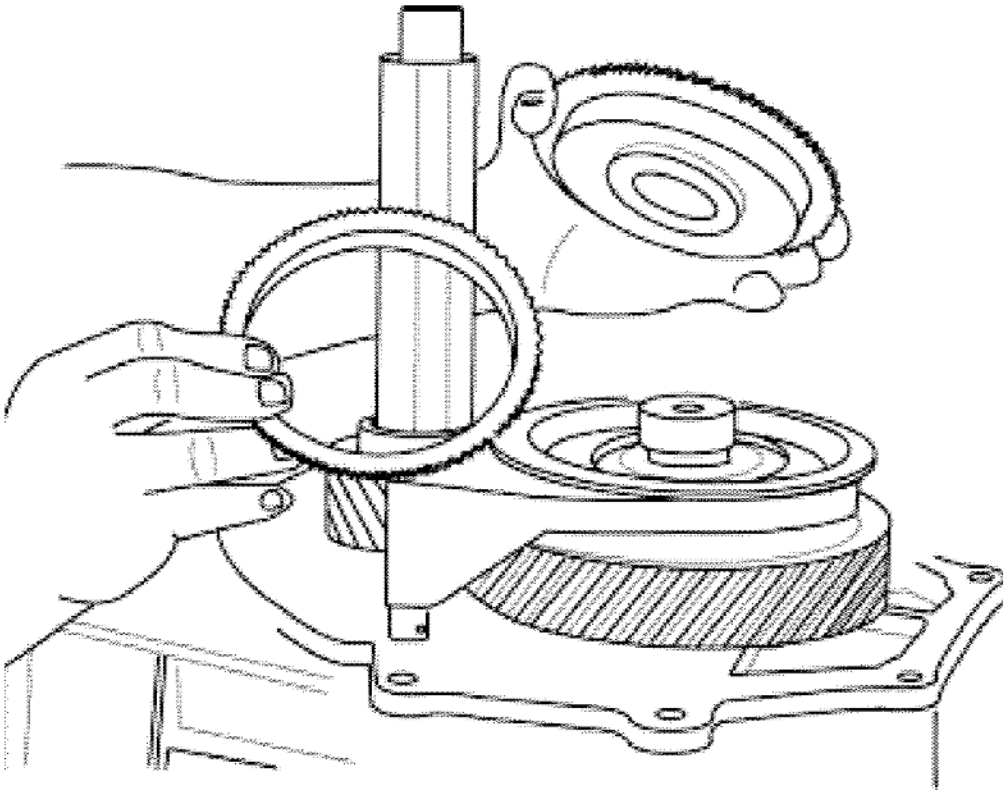


Fig. 119: Synchronizer Ring And 5th Gear
Courtesy of GENERAL MOTORS COMPANY

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

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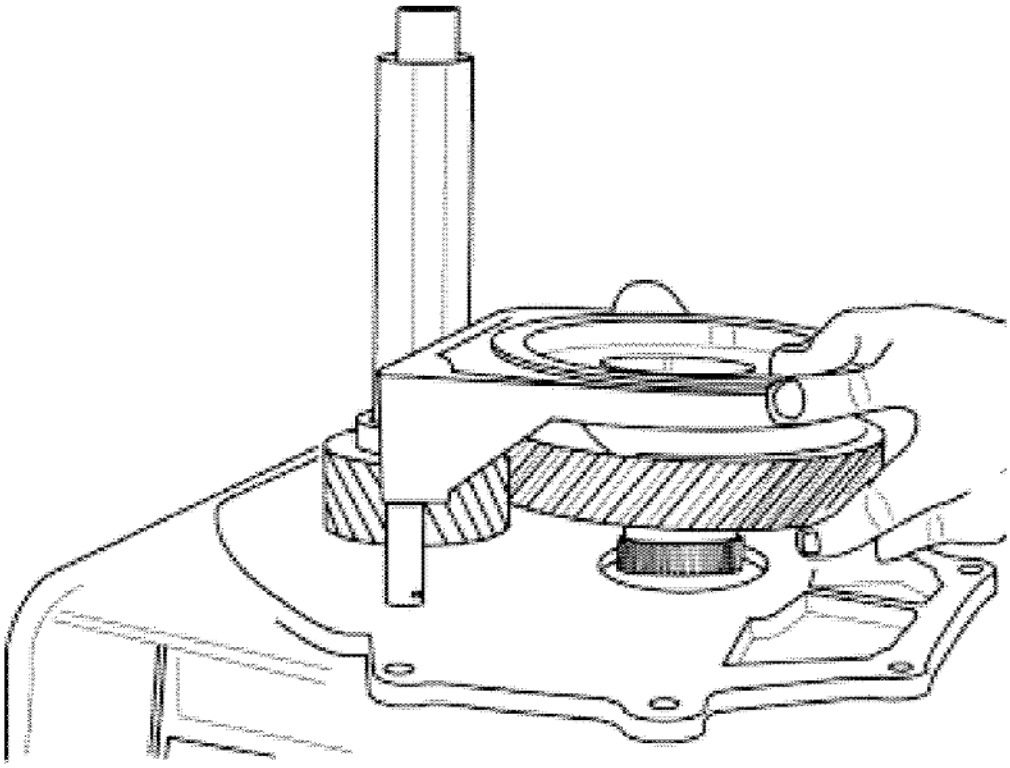


Fig. 120: 5th Gear Synchronizer And Fork
Courtesy of GENERAL MOTORS COMPANY

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

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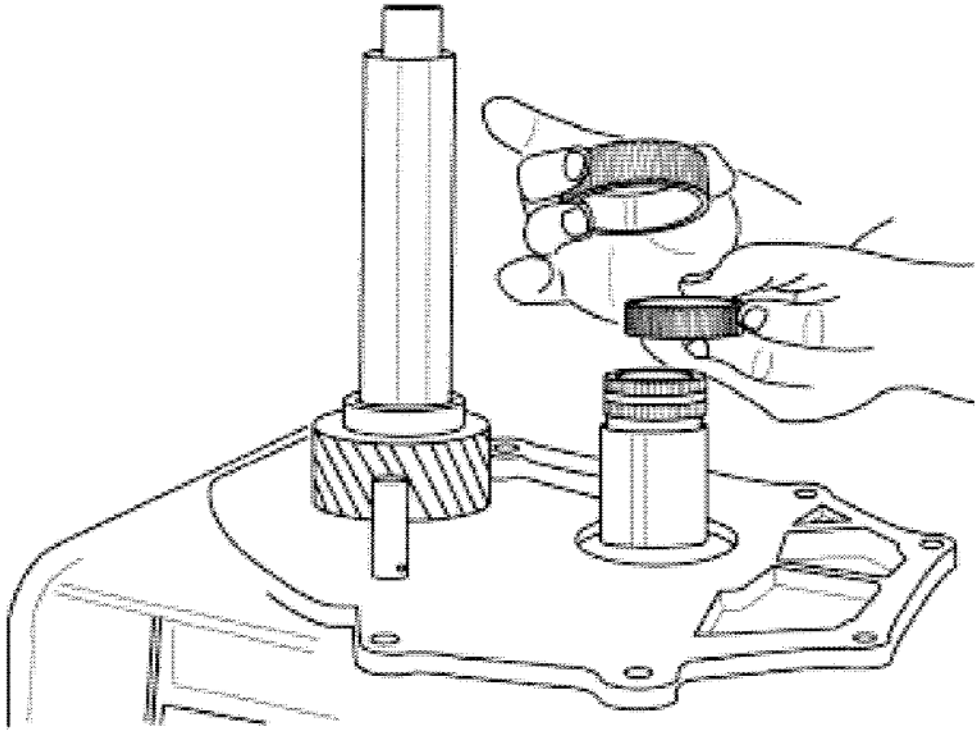


Fig. 121: Roller Bearings And Spacer
Courtesy of GENERAL MOTORS COMPANY

15. Remove the 2 roller bearings and spacer.

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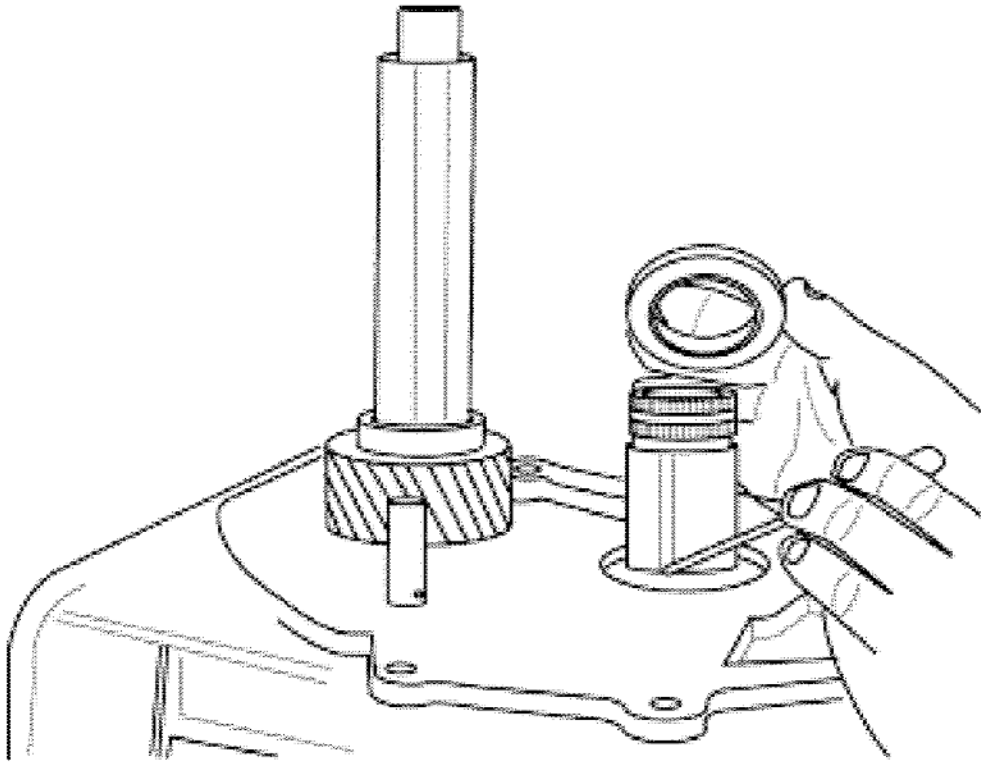


Fig. 122: Washer
Courtesy of GENERAL MOTORS COMPANY

16. Remove the push pulley.

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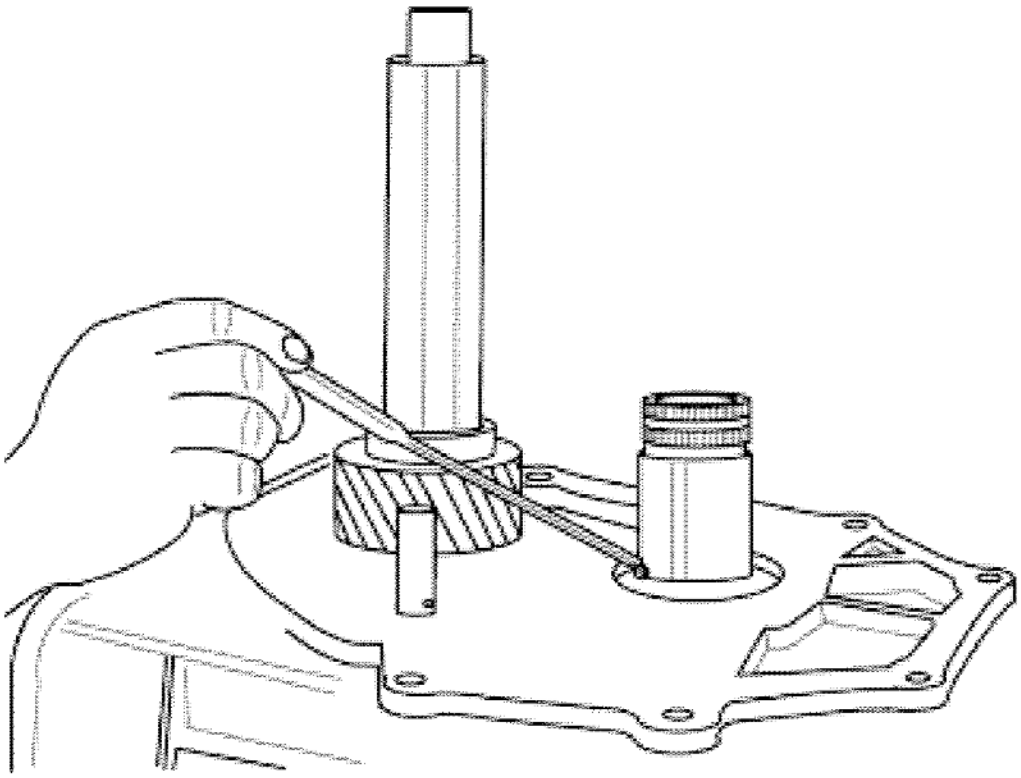


Fig. 123: Removing/Installing Pulley Sphere
Courtesy of GENERAL MOTORS COMPANY

17. Using a magnet, remove the pulley sphere.

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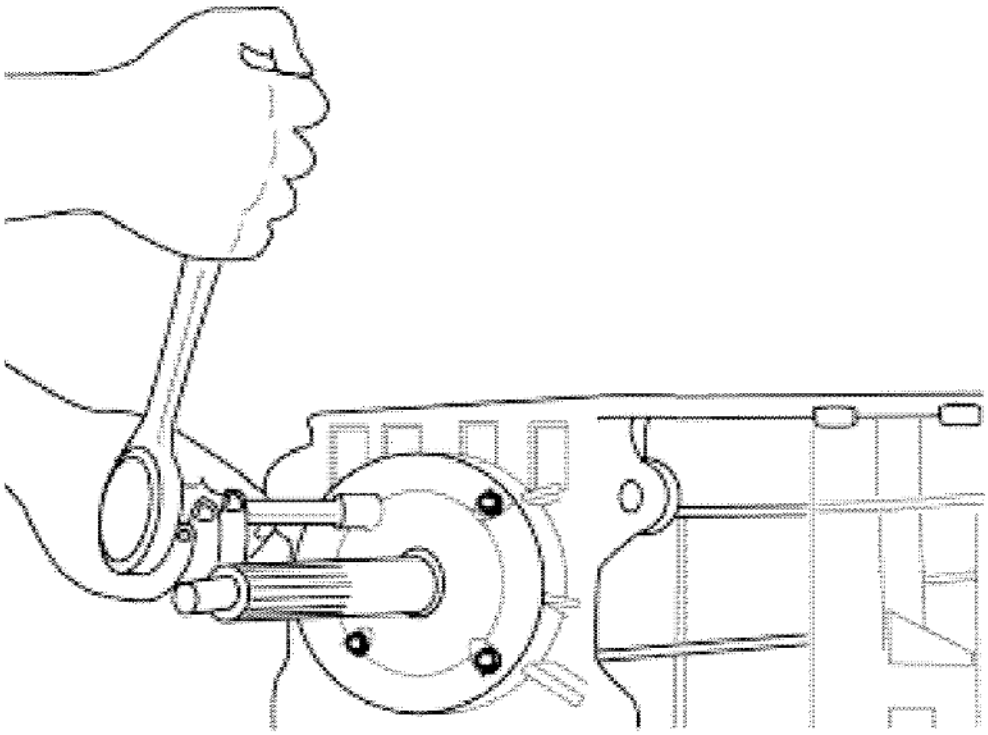


Fig. 124: Bearing Retainer Bolts
Courtesy of GENERAL MOTORS COMPANY

18. Remove the 4 screws from the bearing retainer.

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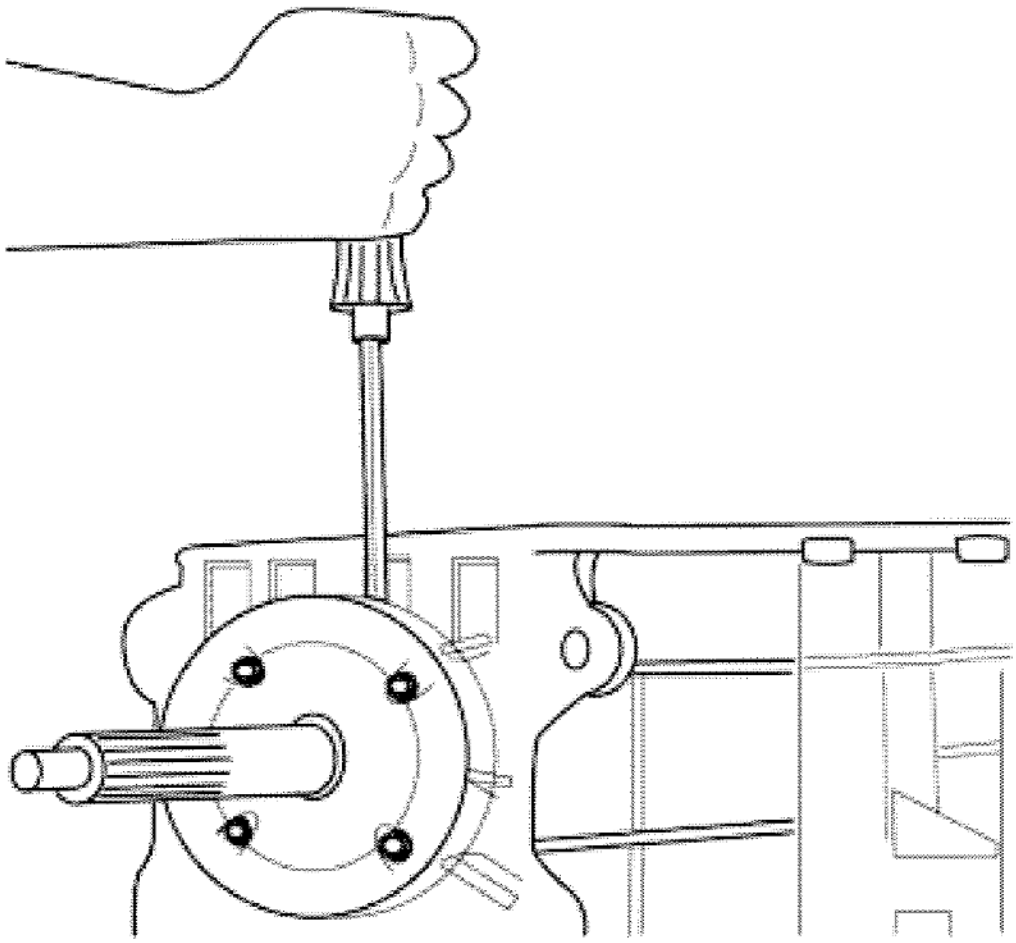


Fig. 125: Removing Retainer
Courtesy of GENERAL MOTORS COMPANY

19. Using a screwdriver, carefully remove the retainer.

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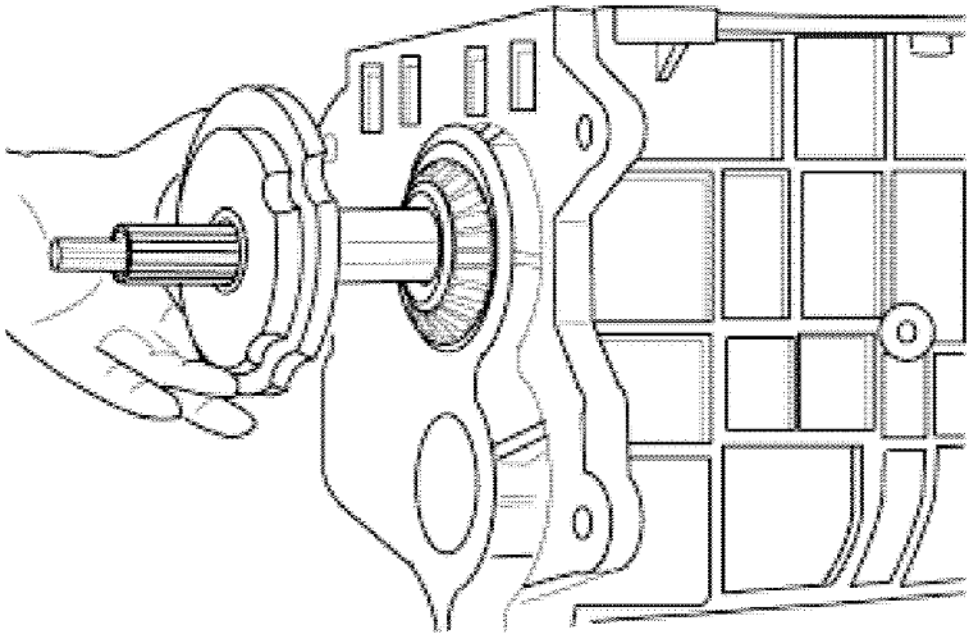


Fig. 126: Bearing Retainer
Courtesy of GENERAL MOTORS COMPANY

20. Remove the retainer bearing.

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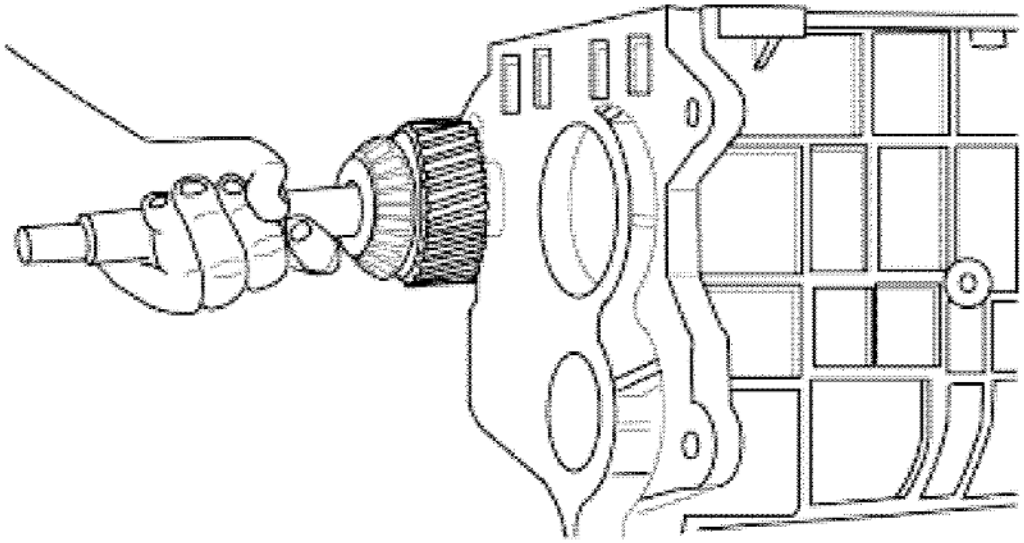


Fig. 127: Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

21. Remove the drive shaft.

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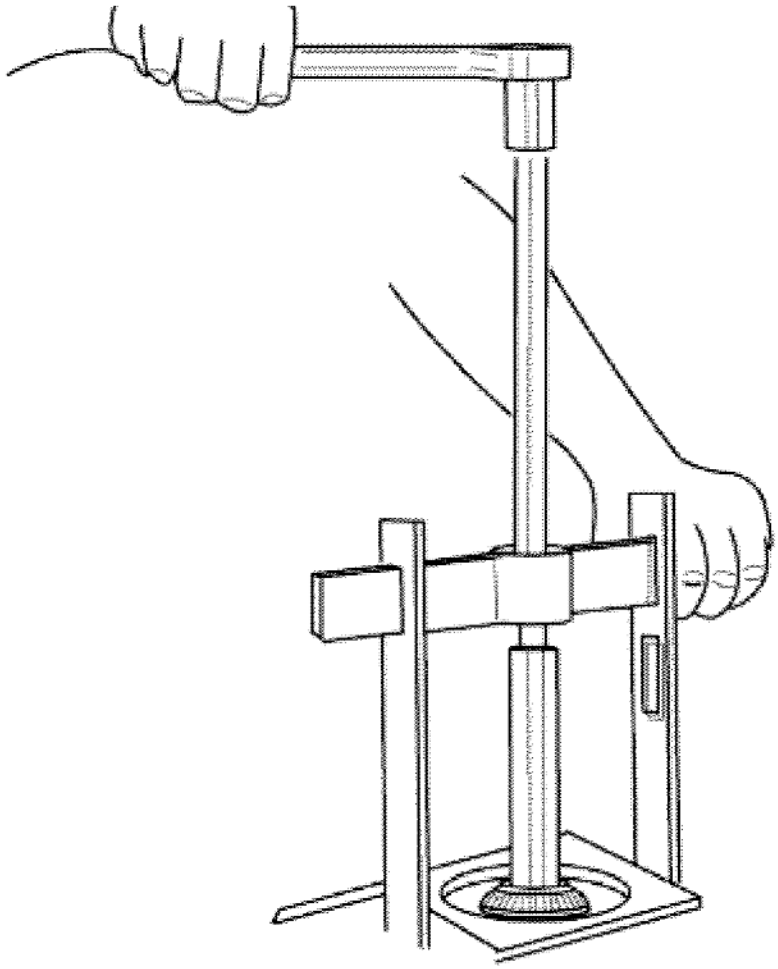


Fig. 128: Removing Bearing From Counter Shaft
Courtesy of GENERAL MOTORS COMPANY

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

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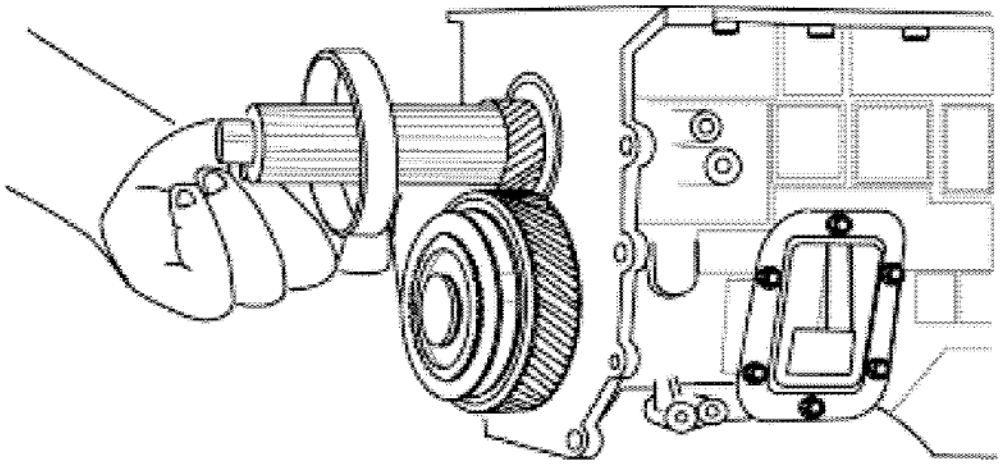


Fig. 129: Tapered Bearing Cup
Courtesy of GENERAL MOTORS COMPANY

23. Remove the bearing race from the main shaft.

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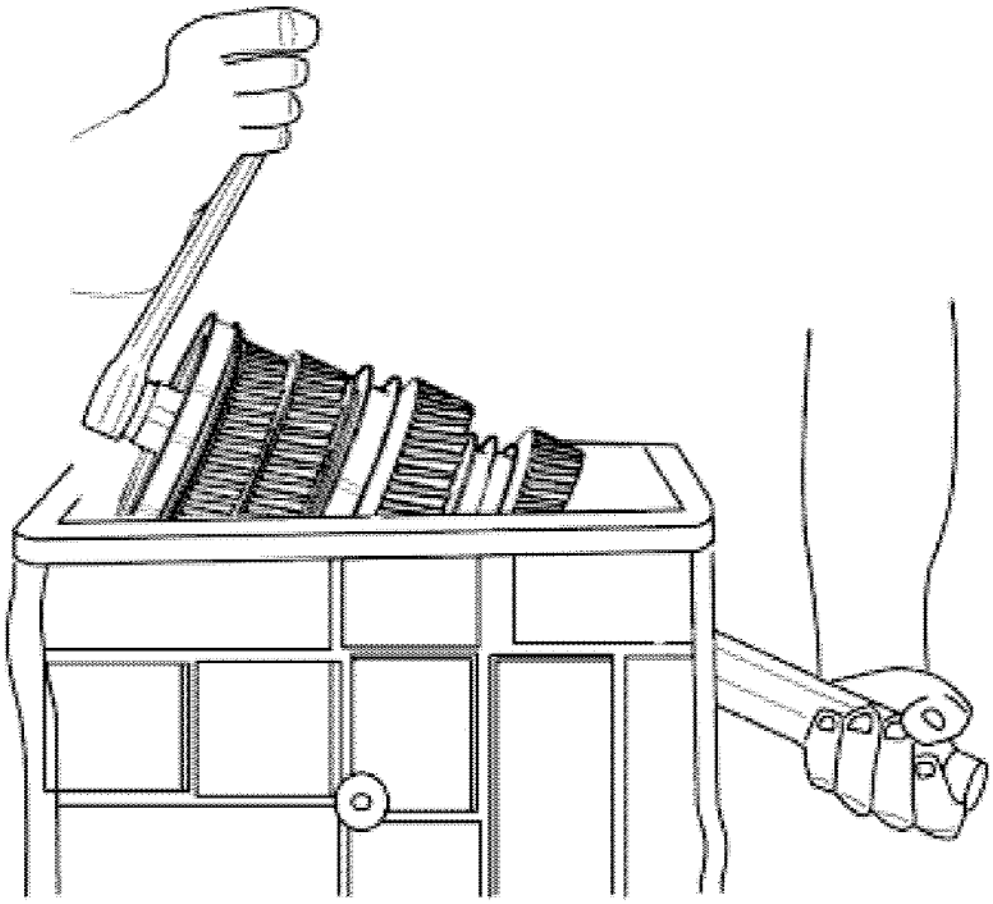


Fig. 130: Main Shaft Assembly
Courtesy of GENERAL MOTORS COMPANY

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

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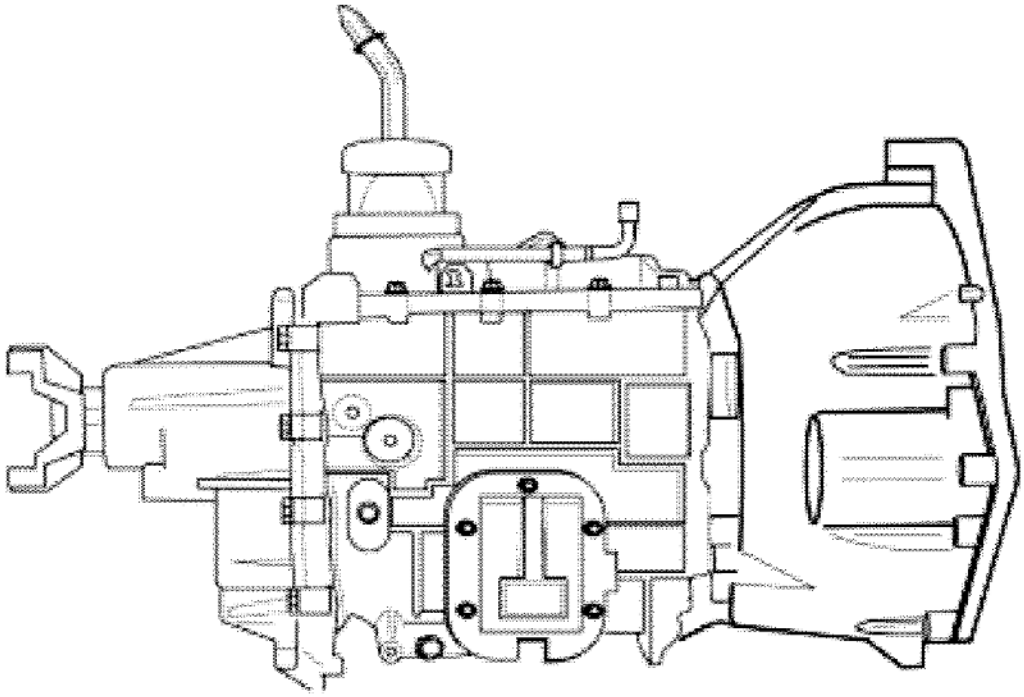


Fig. 131: Transmission
Courtesy of GENERAL MOTORS COMPANY

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

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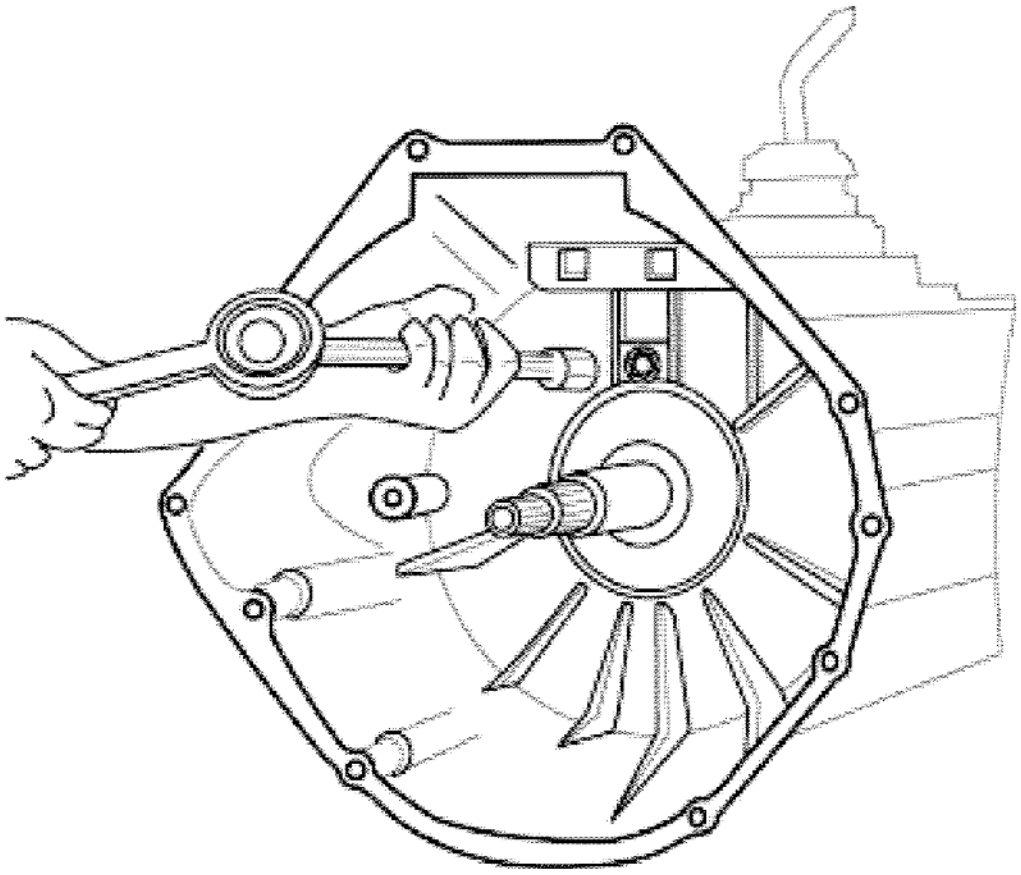


Fig. 132: Interior Clutch Housing Nuts
Courtesy of GENERAL MOTORS COMPANY

2. Remove the 2 interior clutch housing nuts.

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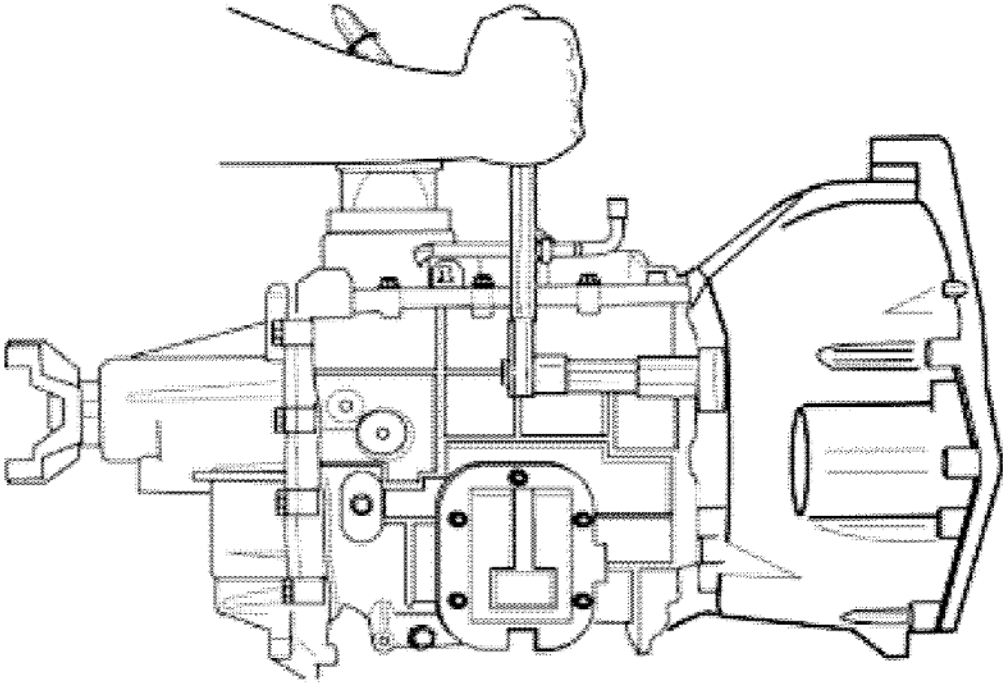


Fig. 133: Clutch Housing Screws
Courtesy of GENERAL MOTORS COMPANY

3. Remove the 4 clutch housing screws.

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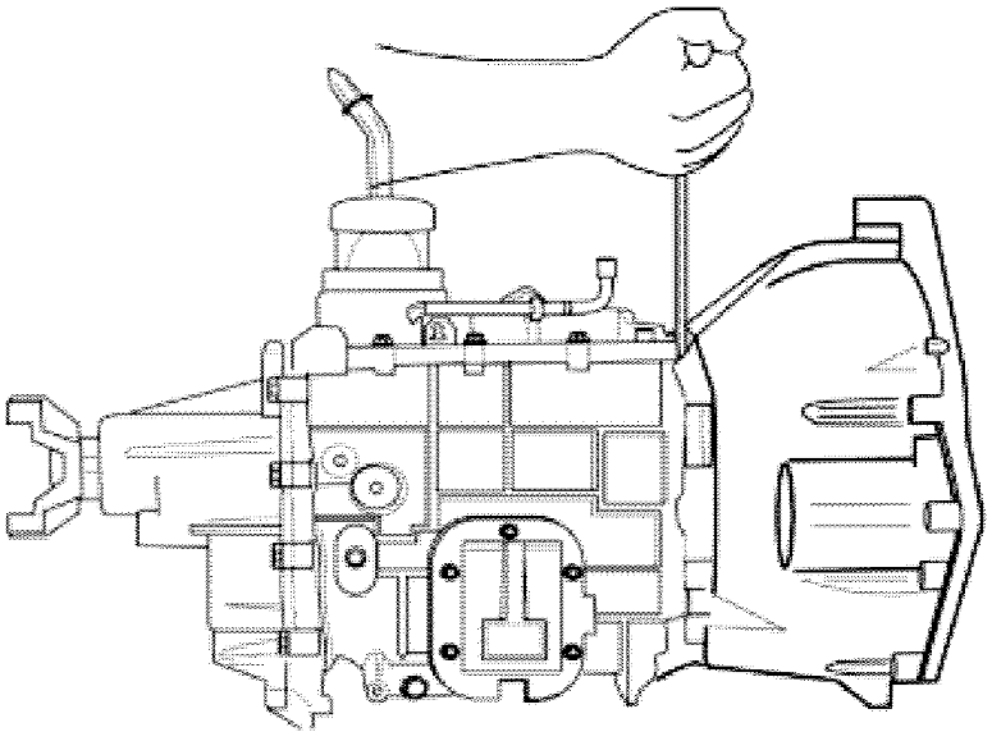


Fig. 134: Separating Case From Housing
Courtesy of GENERAL MOTORS COMPANY

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

GEARS AND SHAFTS CLEANING AND INSPECTION

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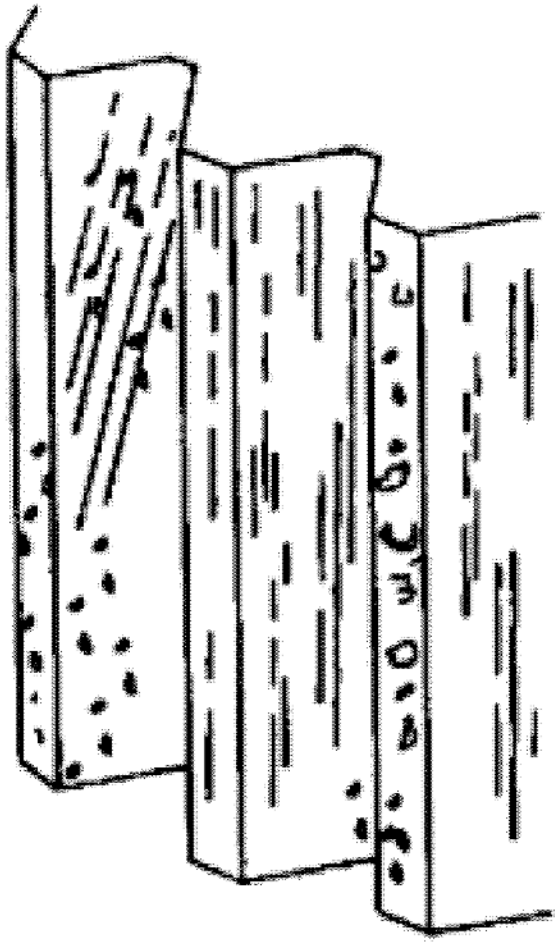


Fig. 135: Inspect Gears For Break-In-Wear - Running-In-Wear
Courtesy of GENERAL MOTORS COMPANY

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.

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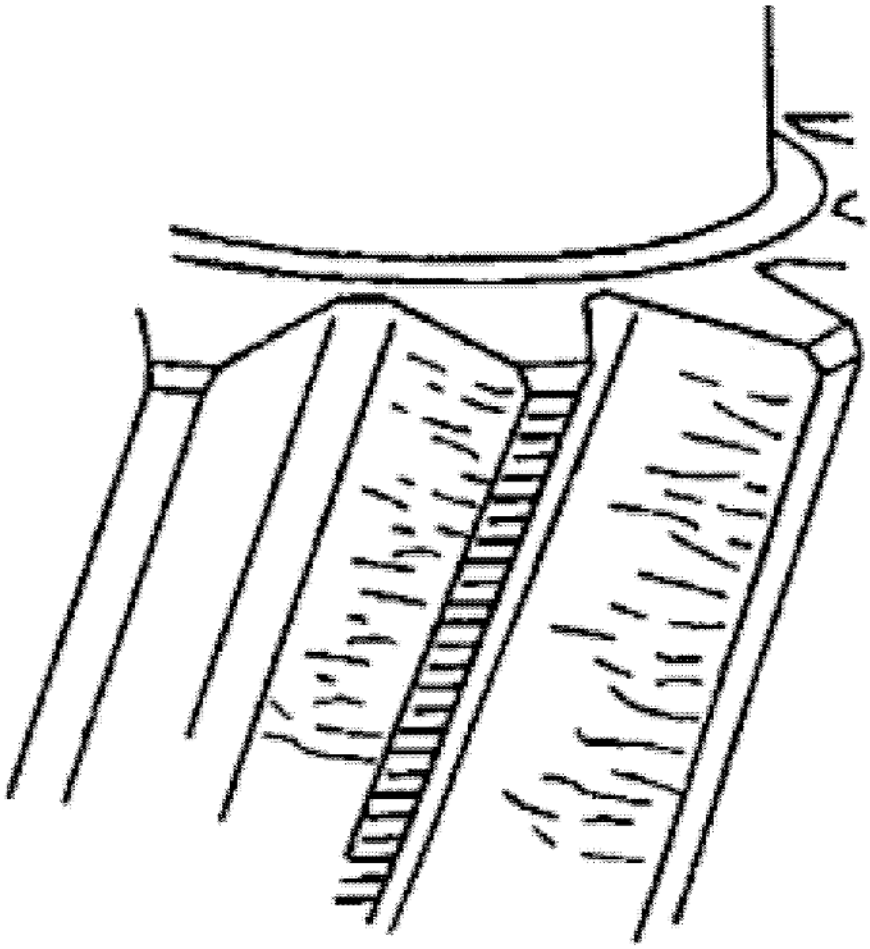


Fig. 136: Inspect Gear Teeth For Scratches
Courtesy of GENERAL MOTORS COMPANY

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

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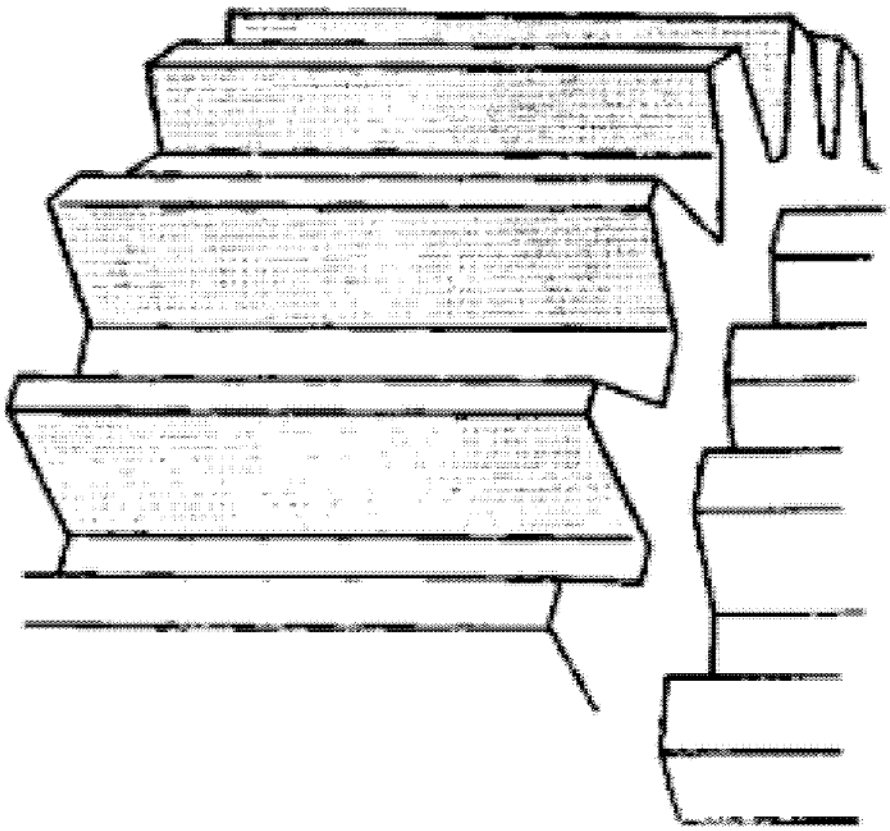


Fig. 137: Inspect Gear Teeth For Abrasive Wear
Courtesy of GENERAL MOTORS COMPANY

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

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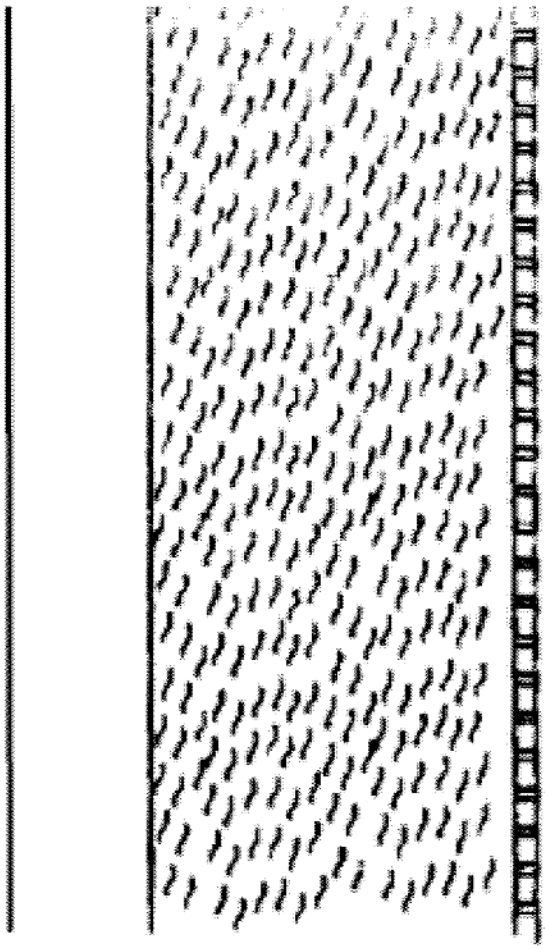


Fig. 138: Inspect Gear Teeth For Rippling Or Brinelling
Courtesy of GENERAL MOTORS COMPANY

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

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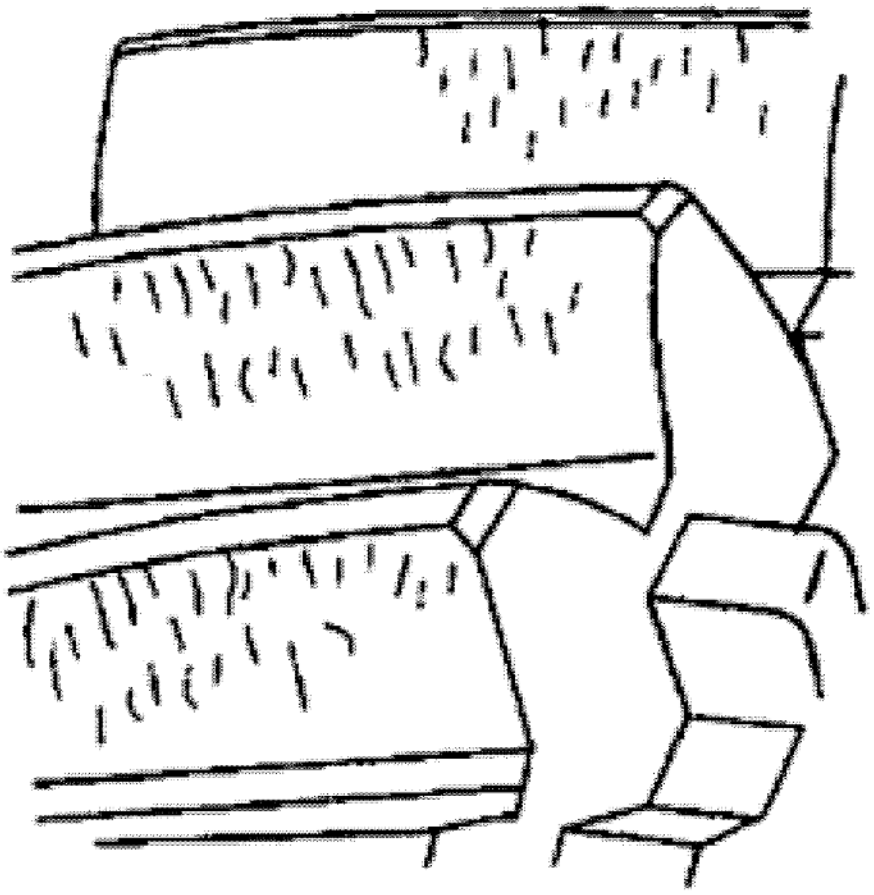


Fig. 139: Inspect Gear Teeth For Light Scoring - Rough Partially Porous Lines Or Areas Aligned In Direction Of Sliding
Courtesy of GENERAL MOTORS COMPANY

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

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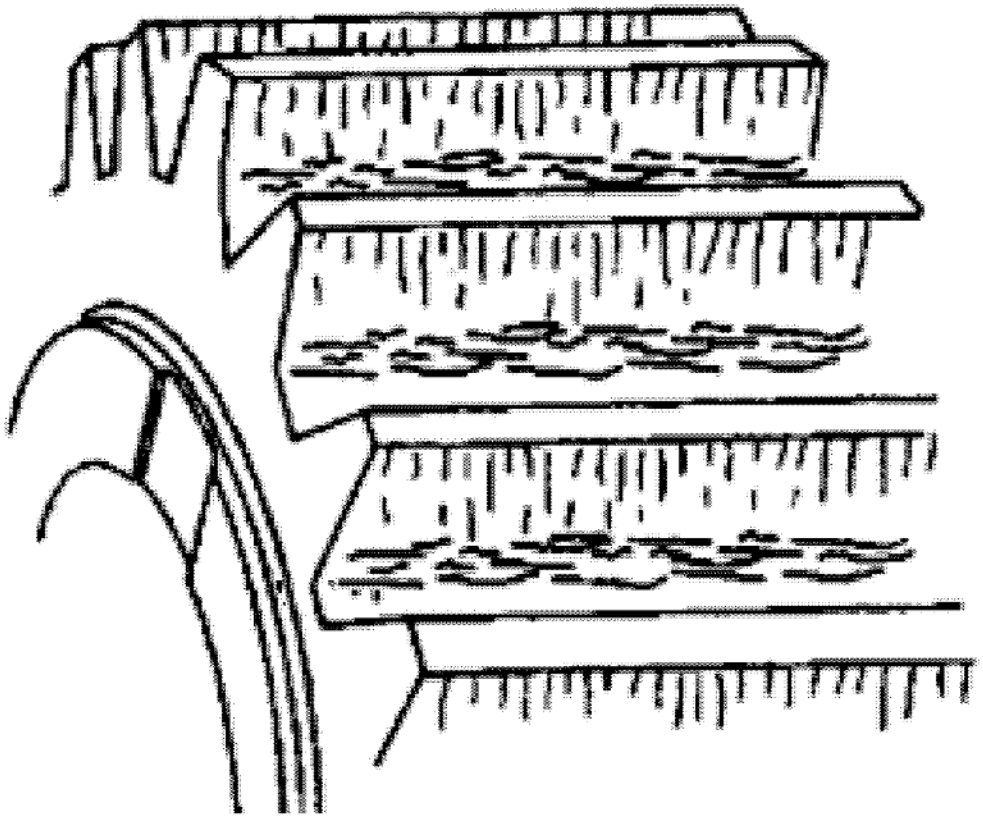


Fig. 140: Inspect Gear Teeth For Severe Scoring
Courtesy of GENERAL MOTORS COMPANY

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

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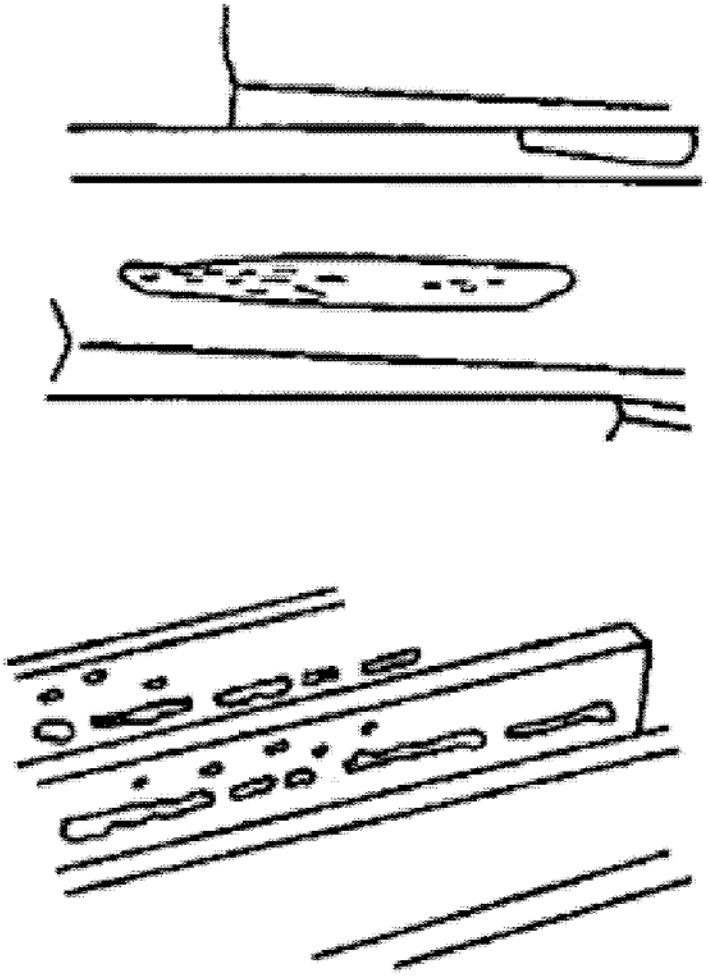


Fig. 141: Inspect Gears For Flank Fatigue Causing Gray Spots
Courtesy of GENERAL MOTORS COMPANY

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

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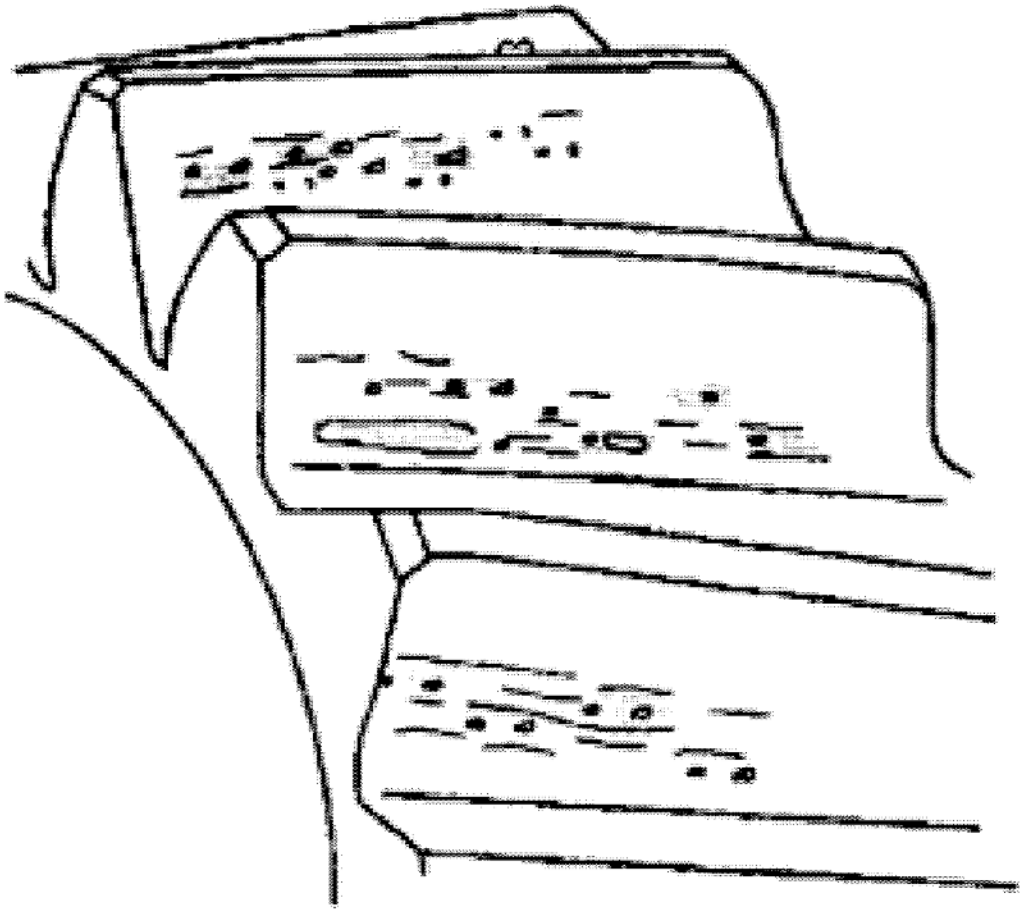


Fig. 142: Inspect Gear Teeth For Slight Pittings
Courtesy of GENERAL MOTORS COMPANY

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.

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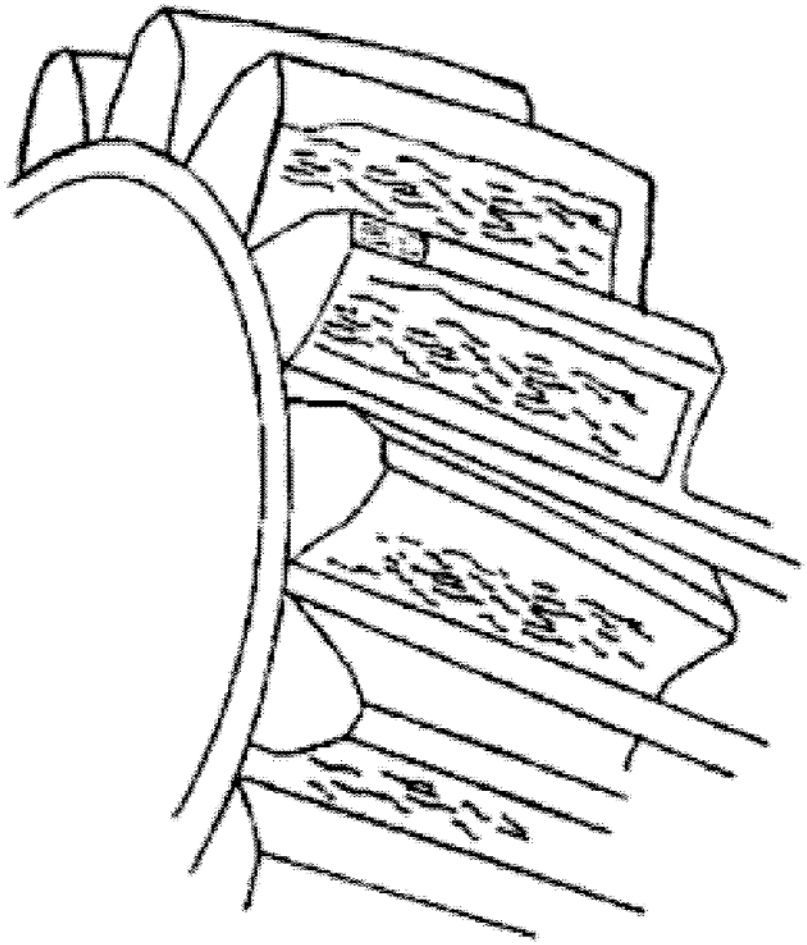


Fig. 143: Inspect Gear Teeth For Pittings
Courtesy of GENERAL MOTORS COMPANY

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

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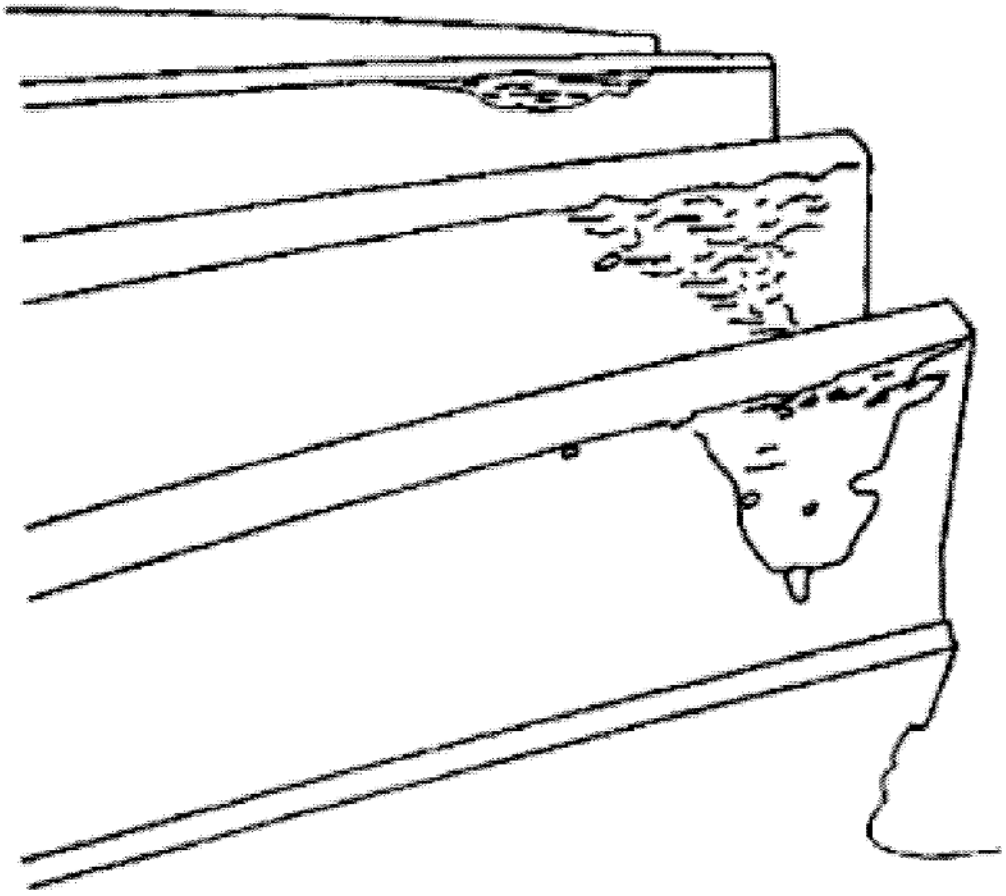


Fig. 144: Inspect Gears For Spalling
Courtesy of GENERAL MOTORS COMPANY

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

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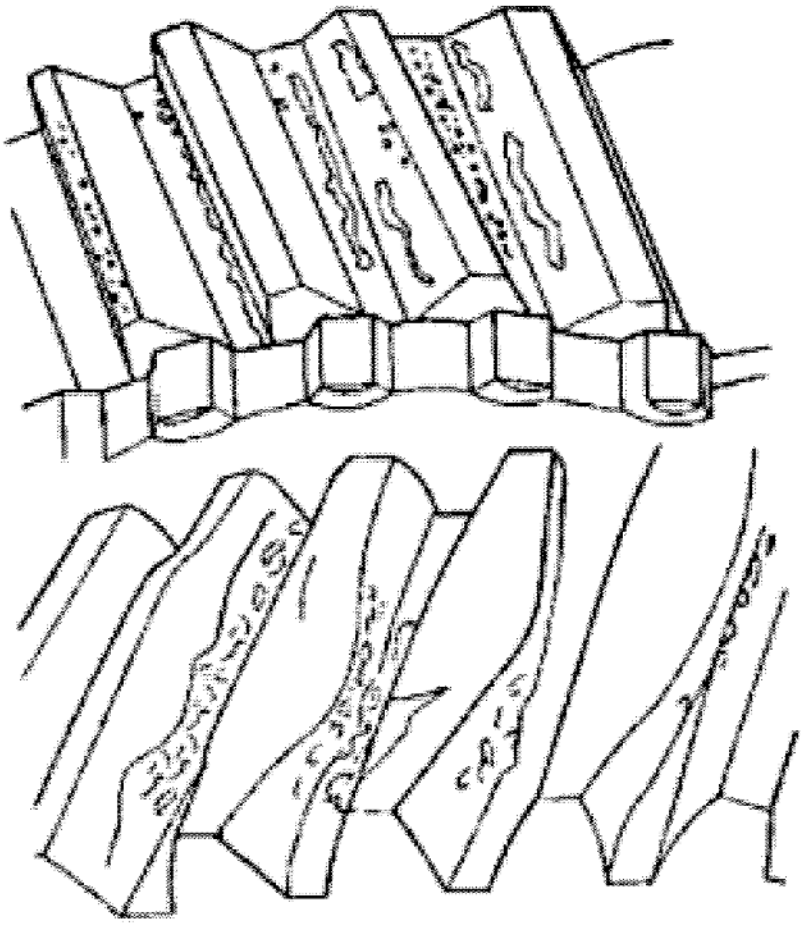


Fig. 145: Inspect Gears For Overheating
Courtesy of GENERAL MOTORS COMPANY

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

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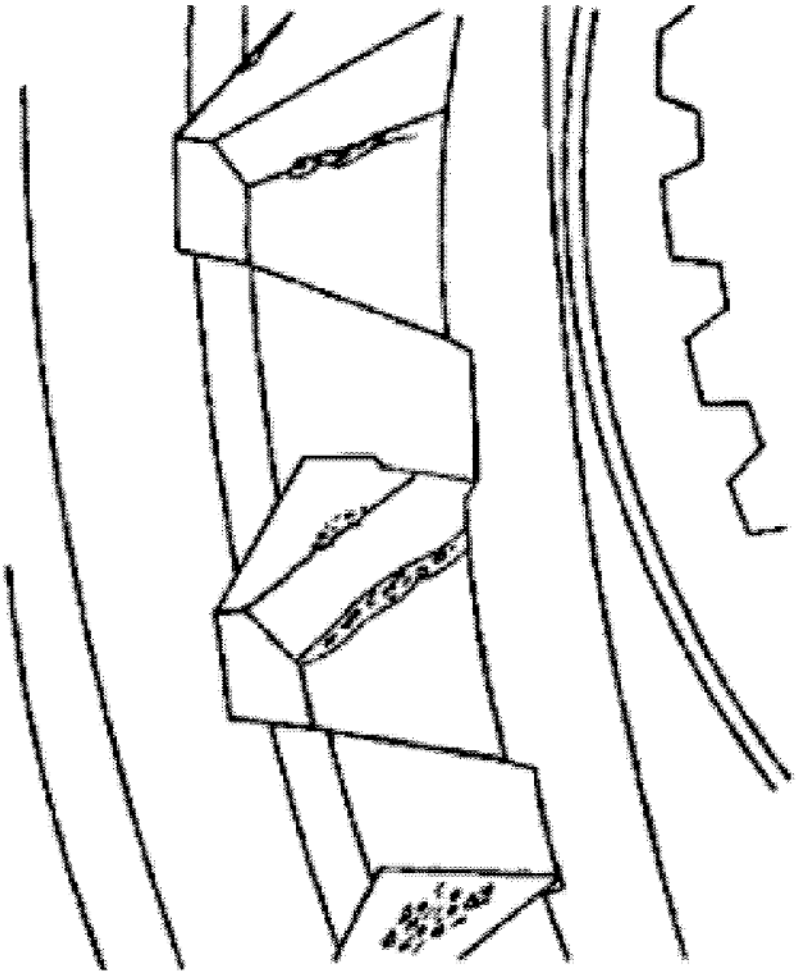


Fig. 146: Inspect Selector Teeth Of Gears For Gear Change Damage
Courtesy of GENERAL MOTORS COMPANY

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

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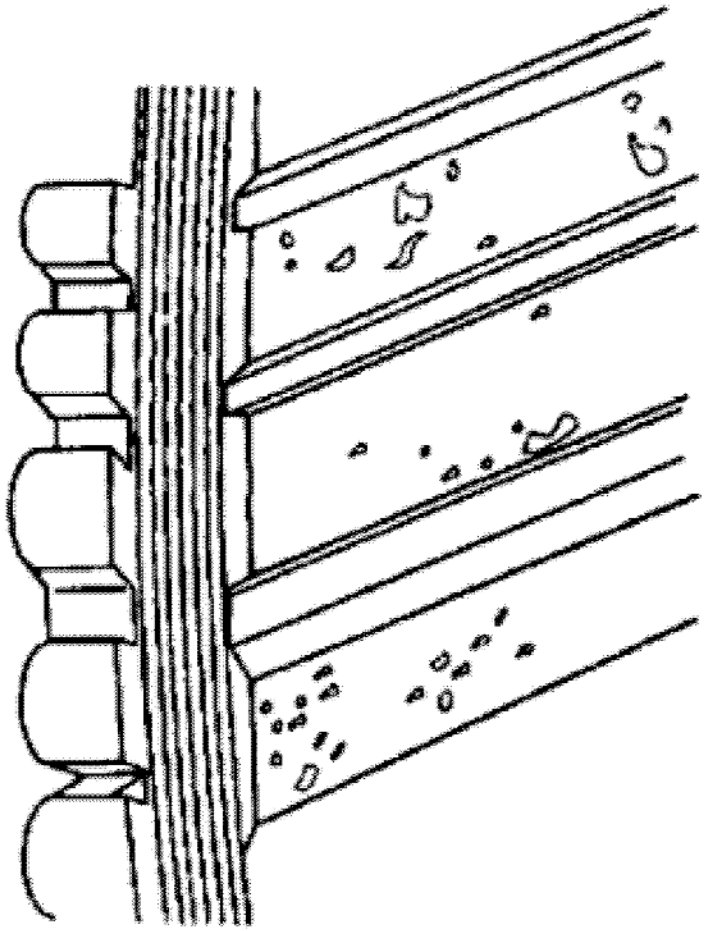


Fig. 147: Inspect Gears For Corrosion
Courtesy of GENERAL MOTORS COMPANY

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

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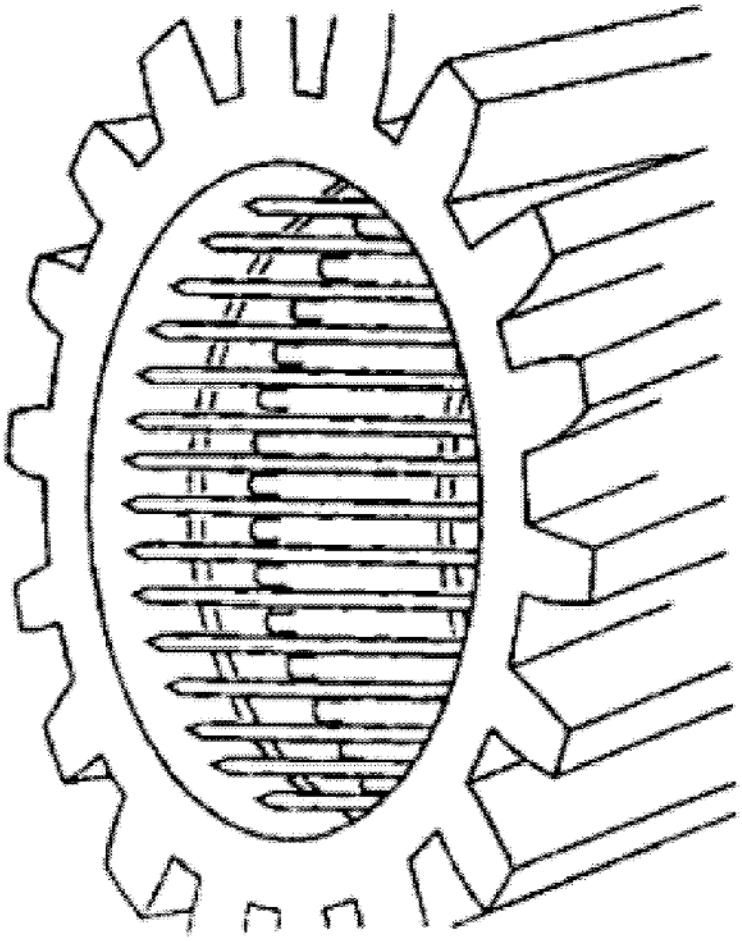


Fig. 148: Inspect Reverse Idler Gear For Brinelling
Courtesy of GENERAL MOTORS COMPANY

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.

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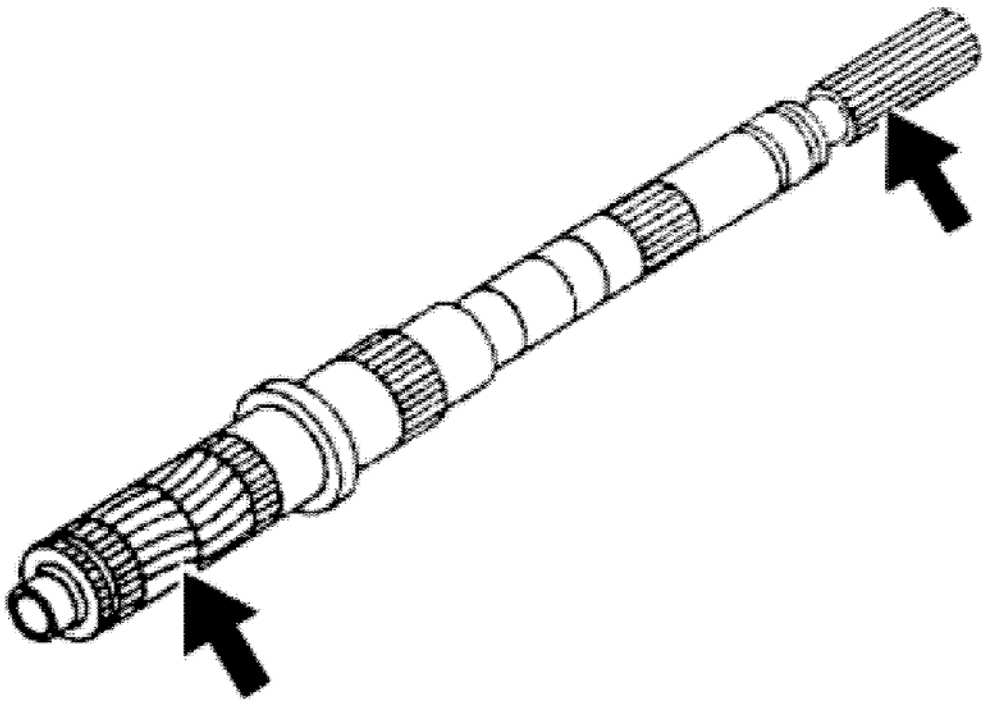


Fig. 149: Inspect Mainshaft Bearing Surfaces
Courtesy of GENERAL MOTORS COMPANY

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

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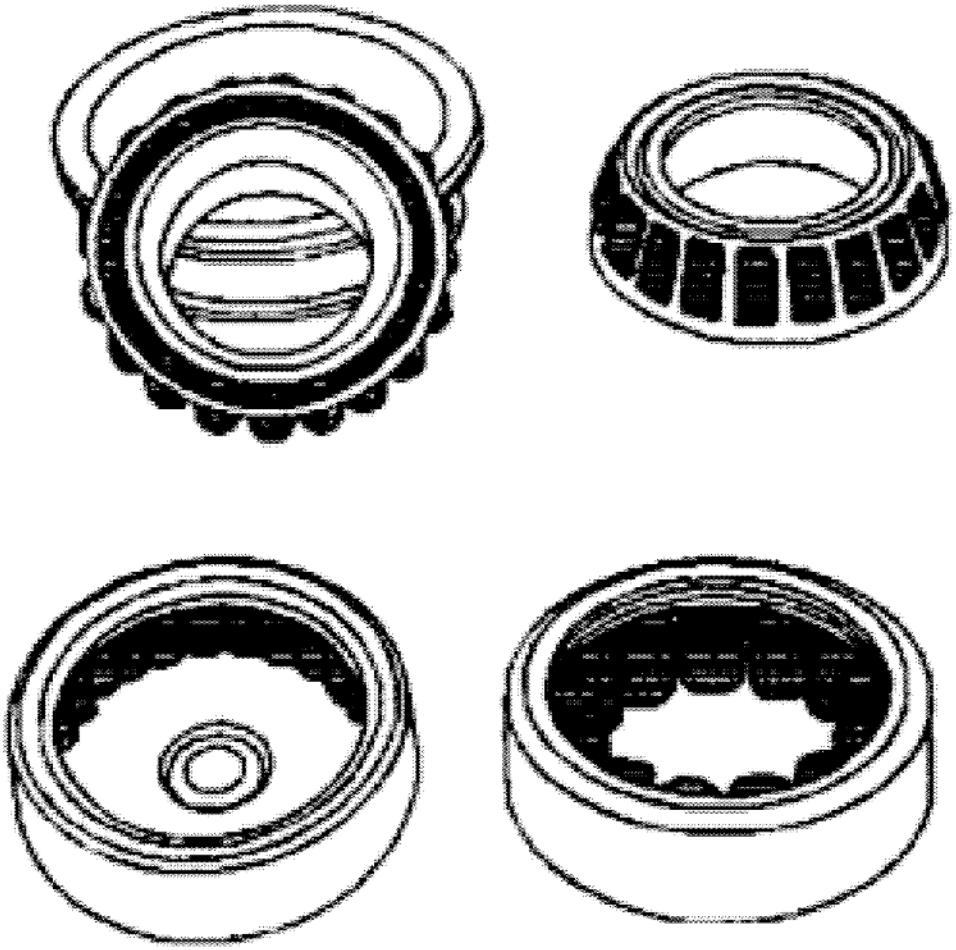


Fig. 150: Bearings
Courtesy of GENERAL MOTORS COMPANY

CAUTION: When you are jacking the vehicle at the front locations, be certain that the jack or the jack lift pad does not contact the front fascia, front fascia air dam, or the front fenders. If such contact occurs, vehicle damage may result. When jacking at selected front locations additional clearance may be required for the jacking points.

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

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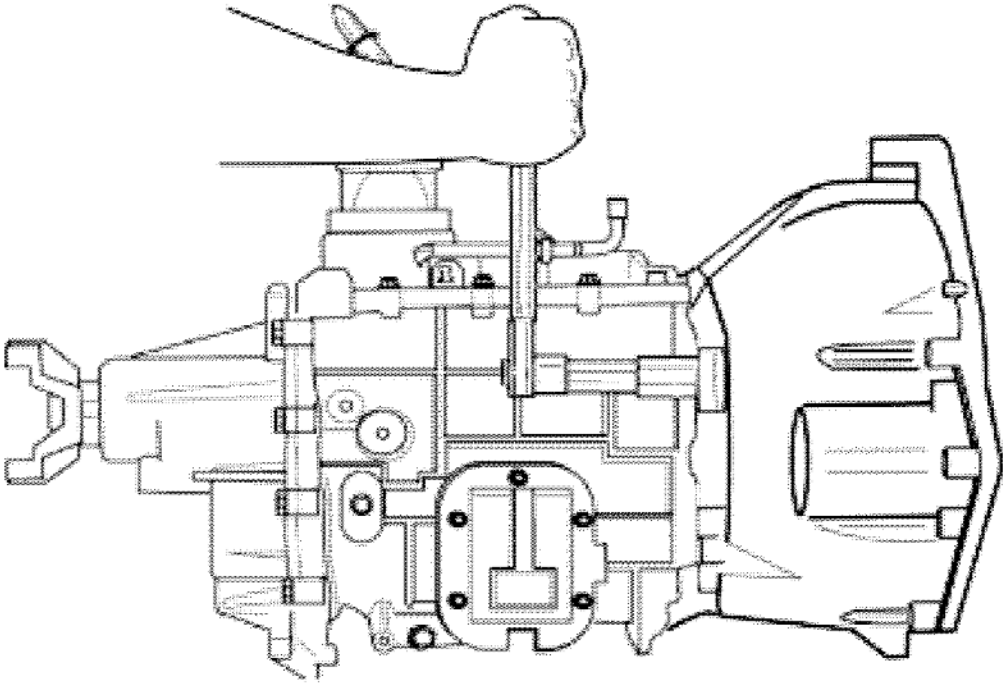


Fig. 151: Clutch Housing Screws
Courtesy of GENERAL MOTORS COMPANY

1. Install the 4 clutch housing screws.

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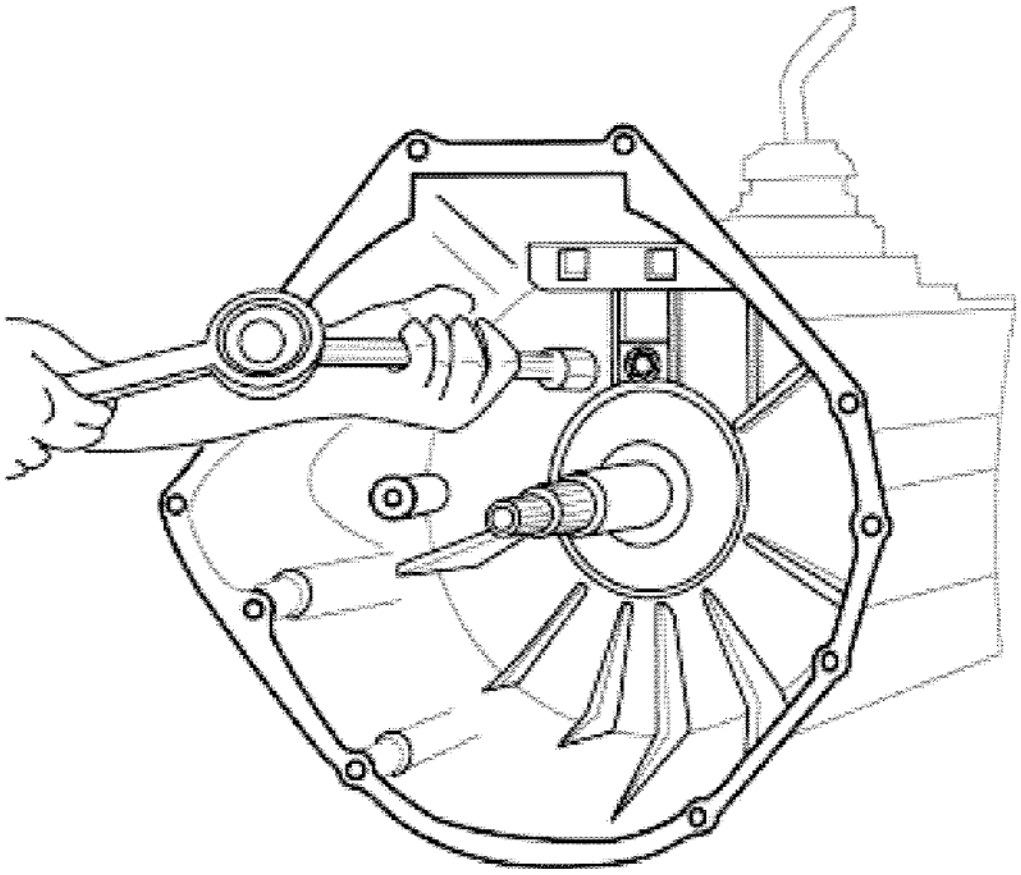


Fig. 152: Interior Clutch Housing Nuts
Courtesy of GENERAL MOTORS COMPANY

2. Install the 2 interior housing nuts.

COUNTER GEAR SHAFT ASSEMBLE

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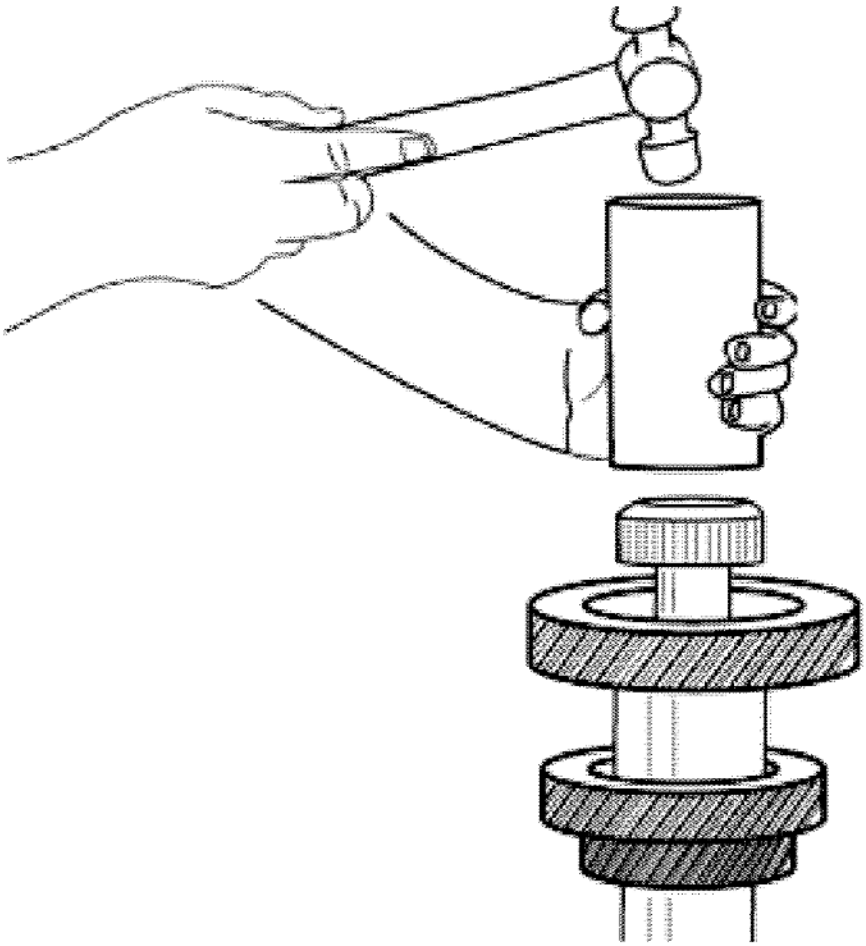


Fig. 153: Installing Bearing
Courtesy of GENERAL MOTORS COMPANY

1. Using a driving tool, install the bearing.

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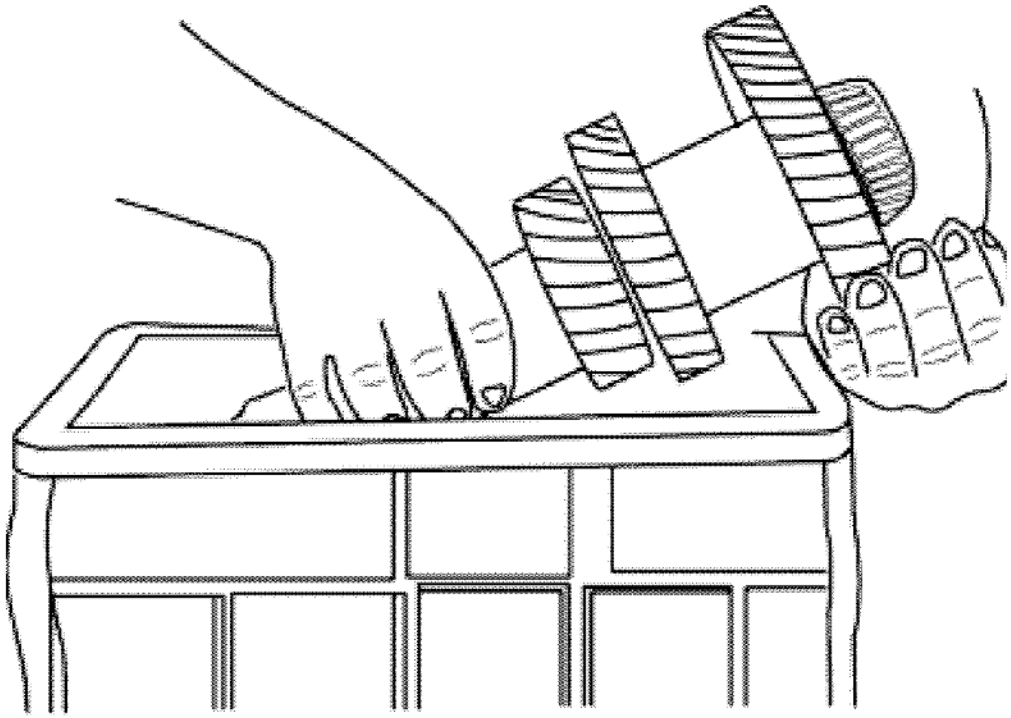


Fig. 154: Gear Assembly
Courtesy of GENERAL MOTORS COMPANY

2. Install the gear assembly.

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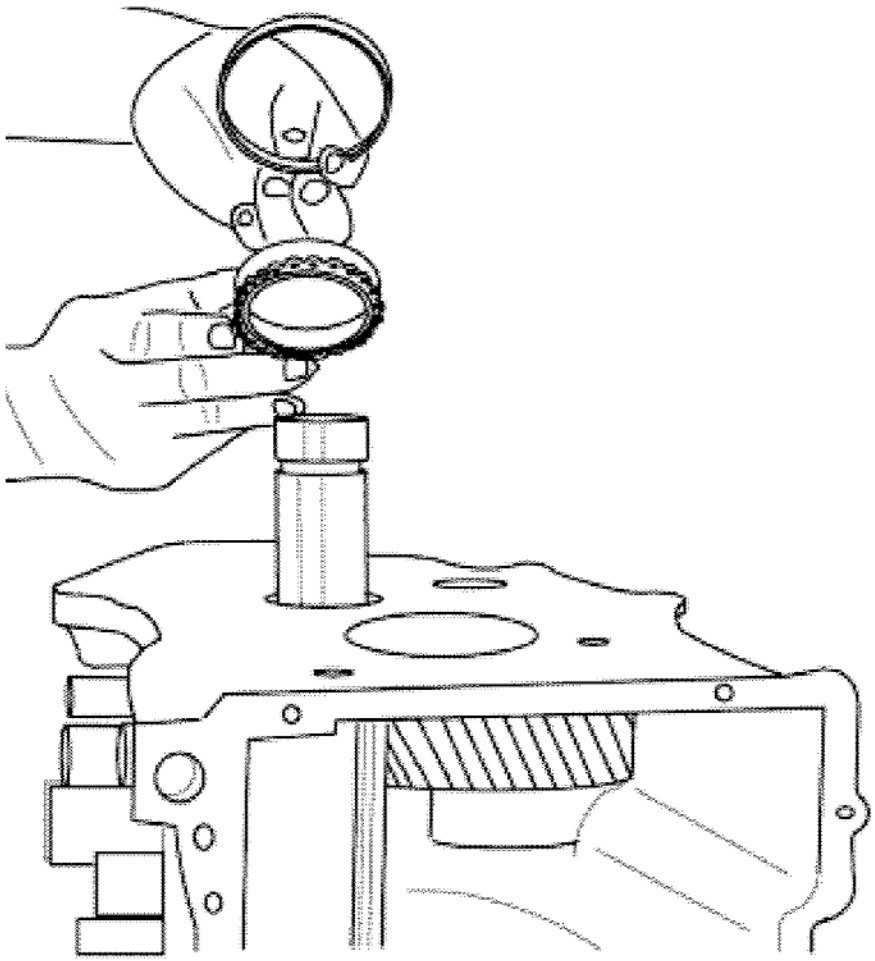


Fig. 155: Cup And Rear Bearing Race
Courtesy of GENERAL MOTORS COMPANY

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

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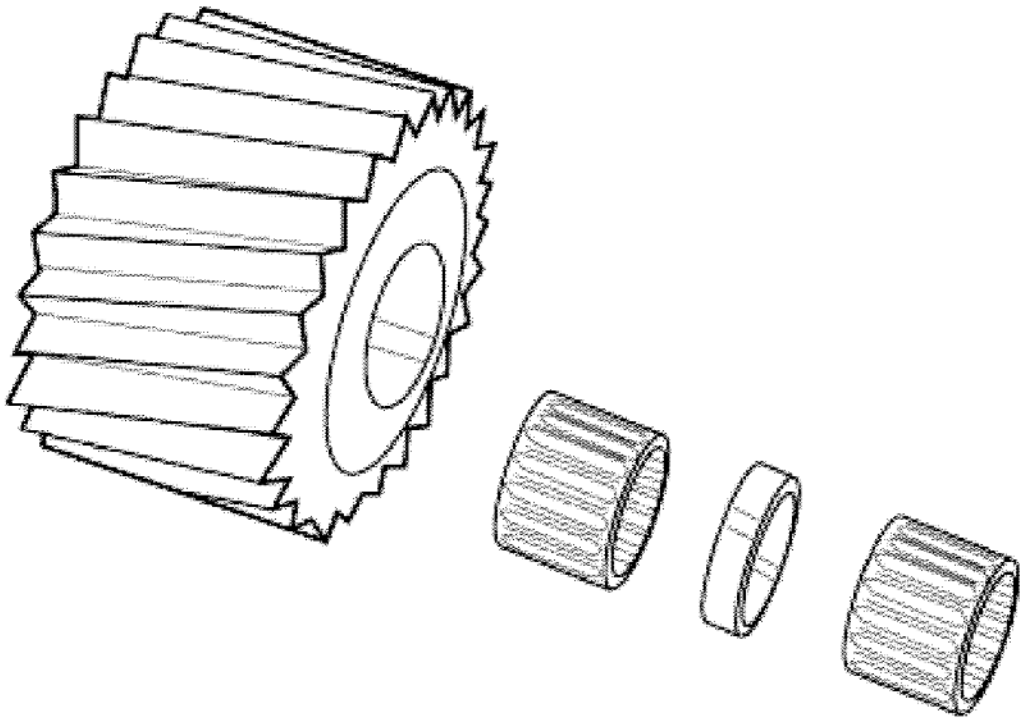


Fig. 156: Cages, Rollers And Spacer
Courtesy of GENERAL MOTORS COMPANY

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

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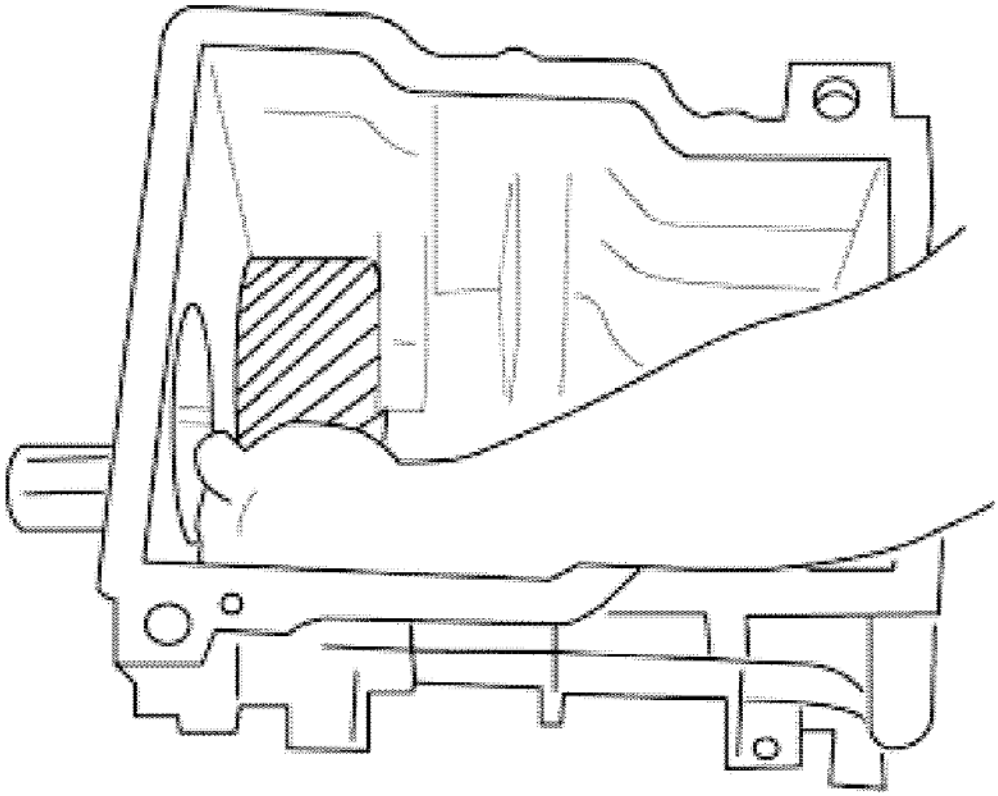


Fig. 157: Reverse Gear
Courtesy of GENERAL MOTORS COMPANY

5. Install the reverse gear into the case.

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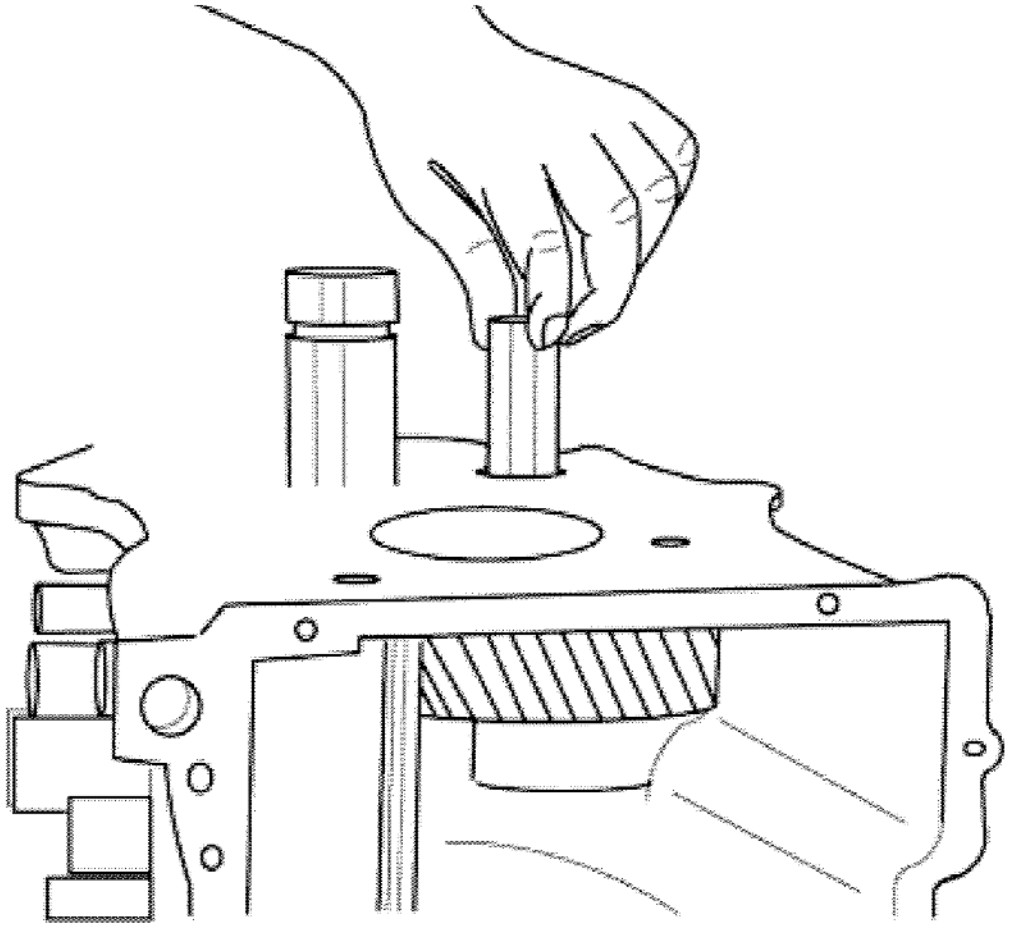


Fig. 158: Reverse Shaft
Courtesy of GENERAL MOTORS COMPANY

6. Install the reverse gear shaft.

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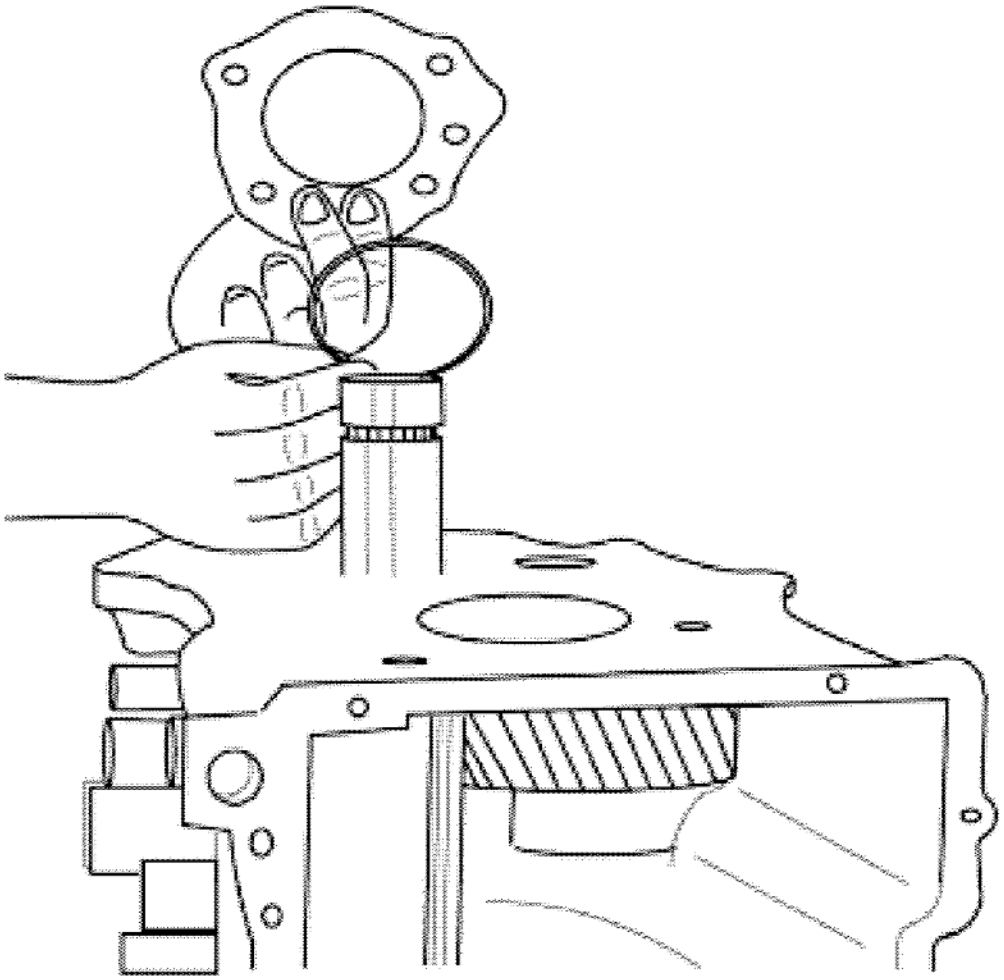


Fig. 159: Rear Retainer And Adjuster Shims
Courtesy of GENERAL MOTORS COMPANY

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

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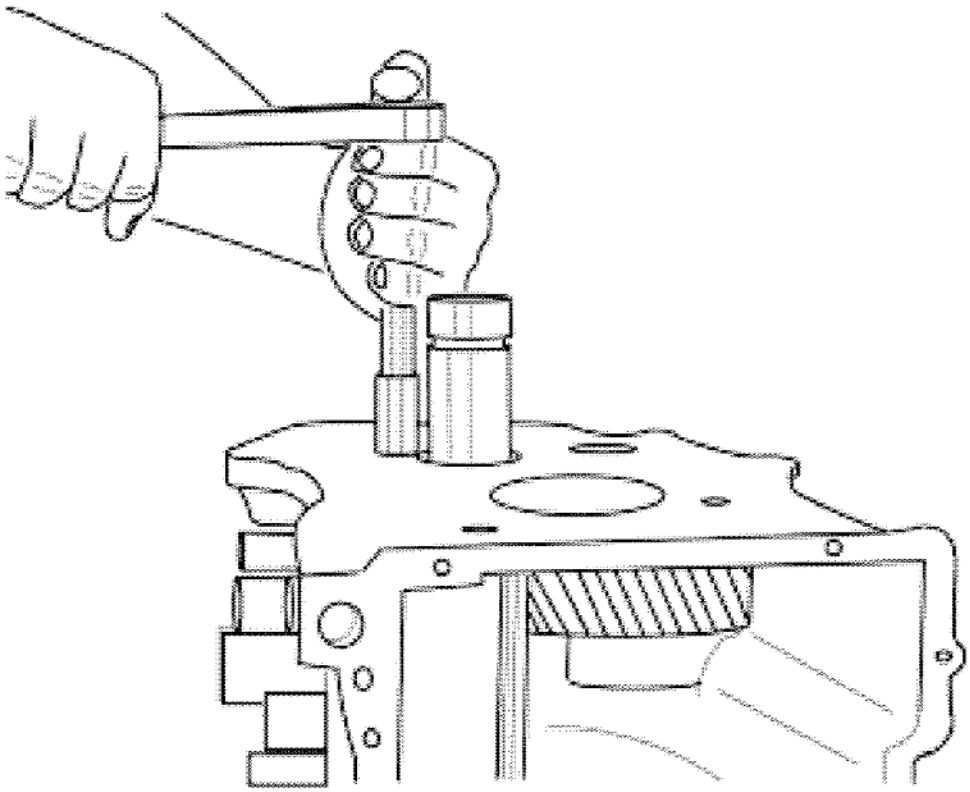


Fig. 160: Rear Retainer Screws
Courtesy of GENERAL MOTORS COMPANY

8. Install the 4 rear retaining screws.

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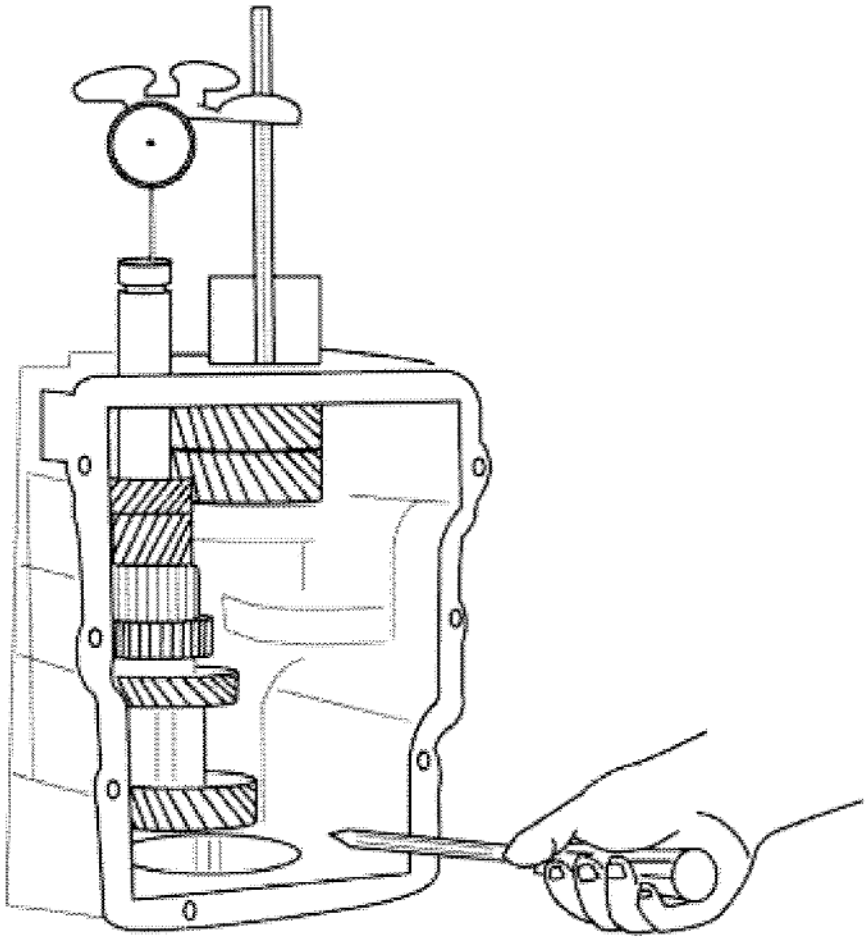


Fig. 161: Measuring Axial Play
Courtesy of GENERAL MOTORS COMPANY

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).

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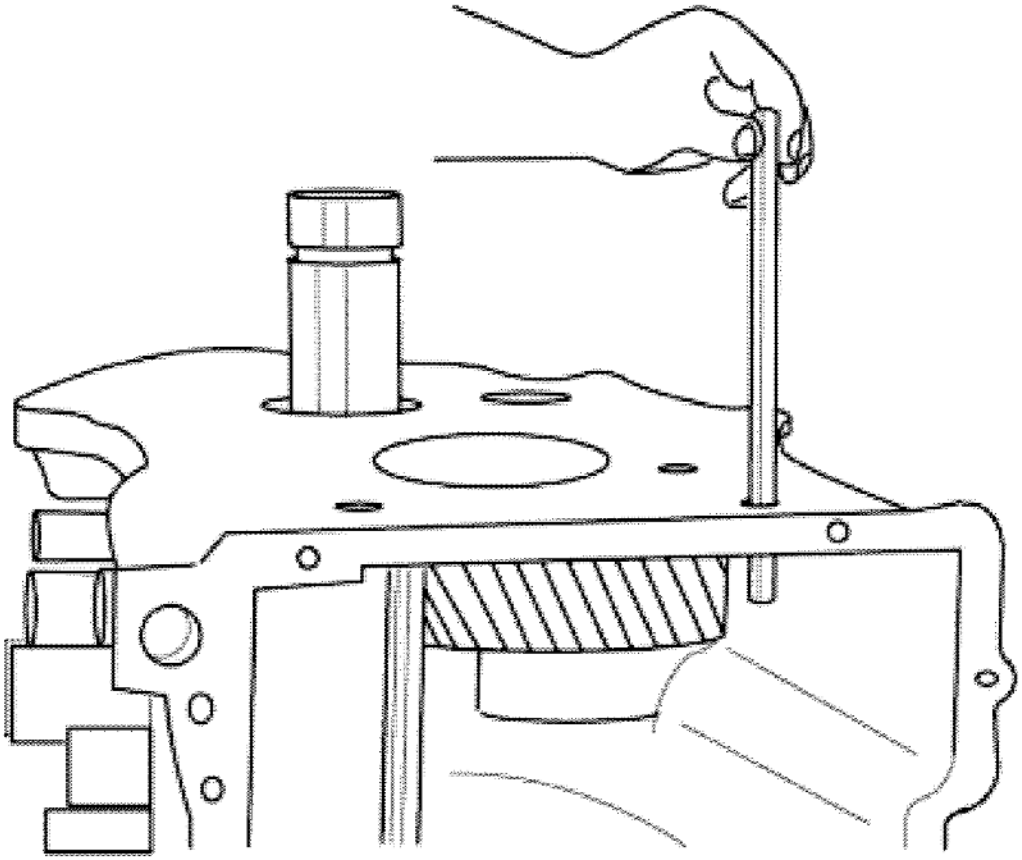


Fig. 162: 4th Gear Shaft
Courtesy of GENERAL MOTORS COMPANY

11. Install the reverse and 5th gear lever.

MAIN SHAFT ASSEMBLE

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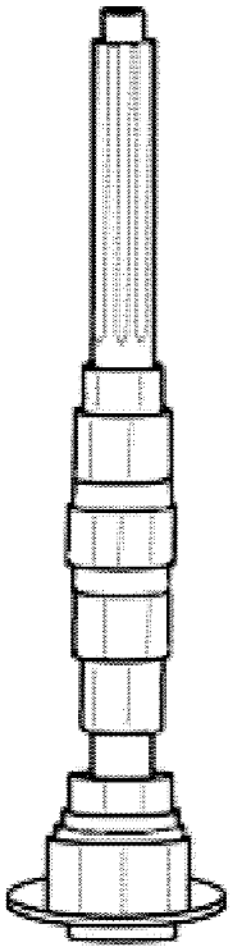


Fig. 163: Positioning Main Shaft Assembly Vertically
Courtesy of GENERAL MOTORS COMPANY

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

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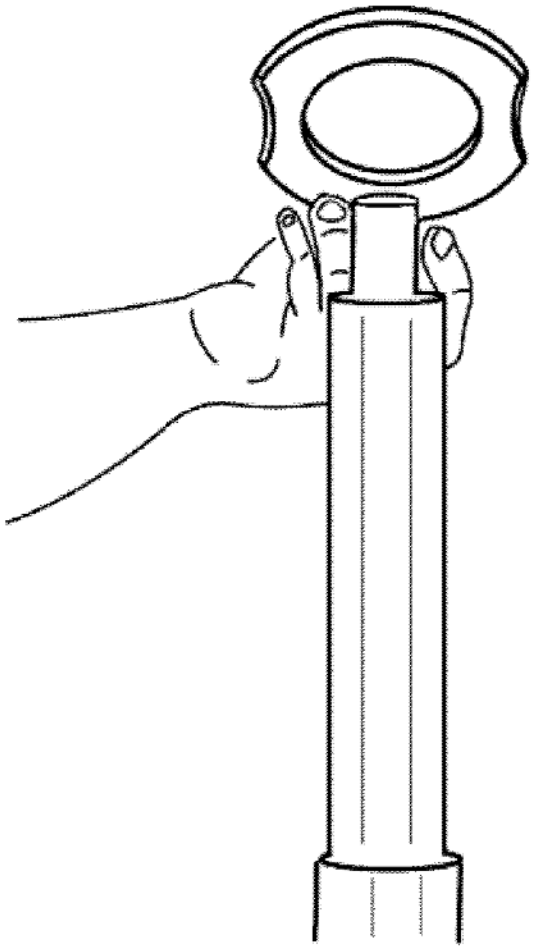


Fig. 164: Reverse Clutch Taper Bearing
Courtesy of GENERAL MOTORS COMPANY

2. Install the reverse clutch taper.

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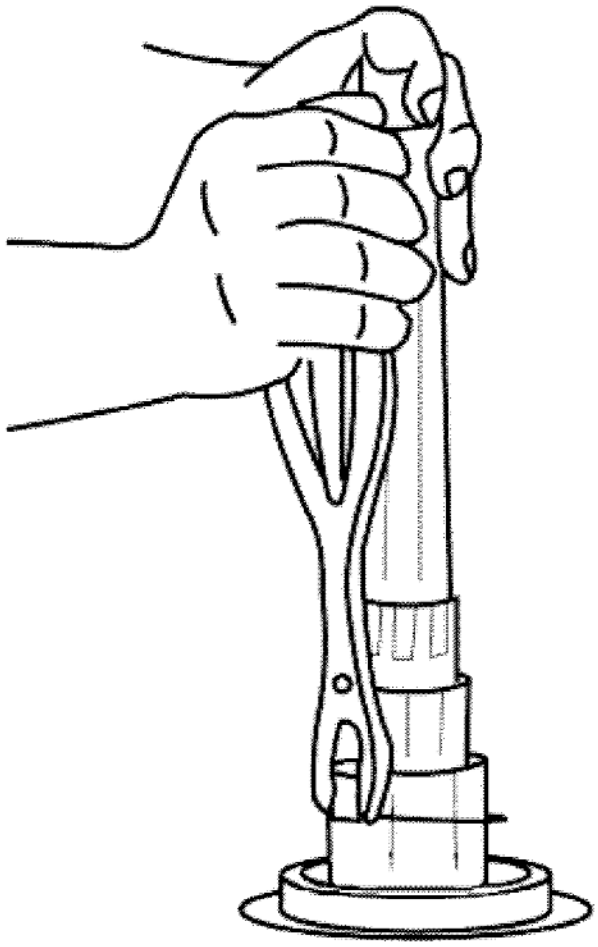


Fig. 165: Snap Ring
Courtesy of GENERAL MOTORS COMPANY

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

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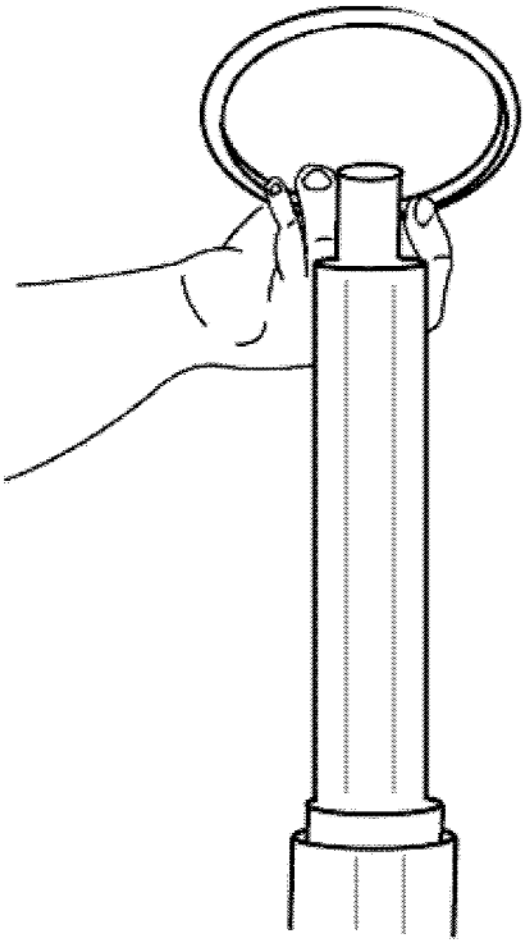


Fig. 166: Reverse Synchronizer Ring
Courtesy of GENERAL MOTORS COMPANY

4. Install the lubricated reverse gear synchronizer ring.

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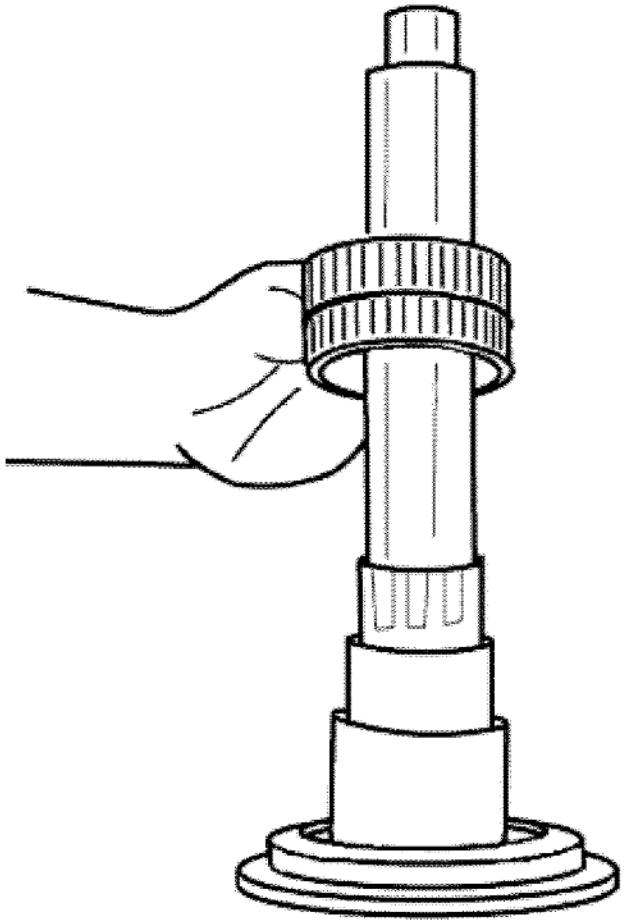


Fig. 167: Roller Cage
Courtesy of GENERAL MOTORS COMPANY

5. Install the reverse gear roller cage.

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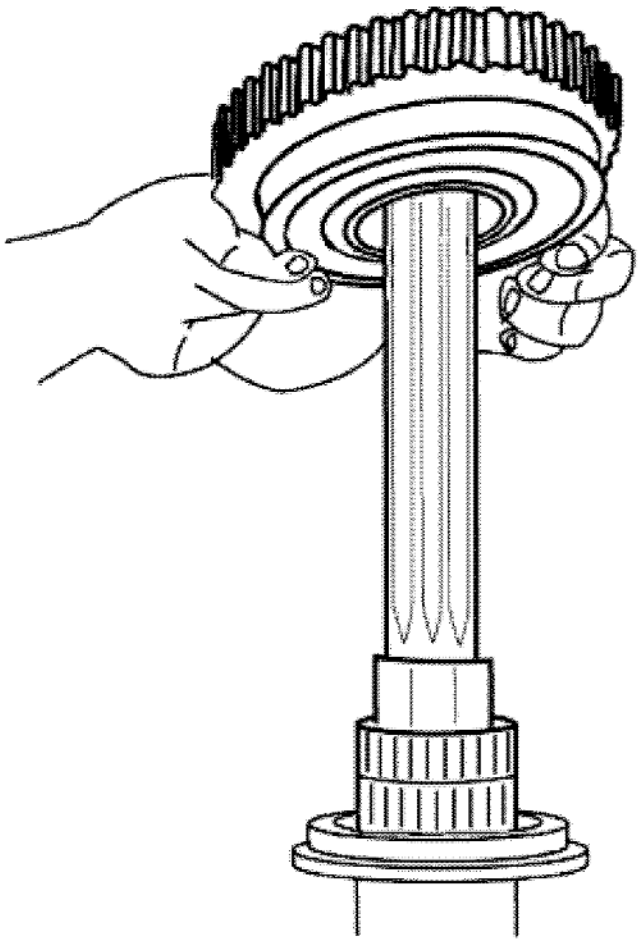


Fig. 168: Reverse Gear And Synchronizer
Courtesy of GENERAL MOTORS COMPANY

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

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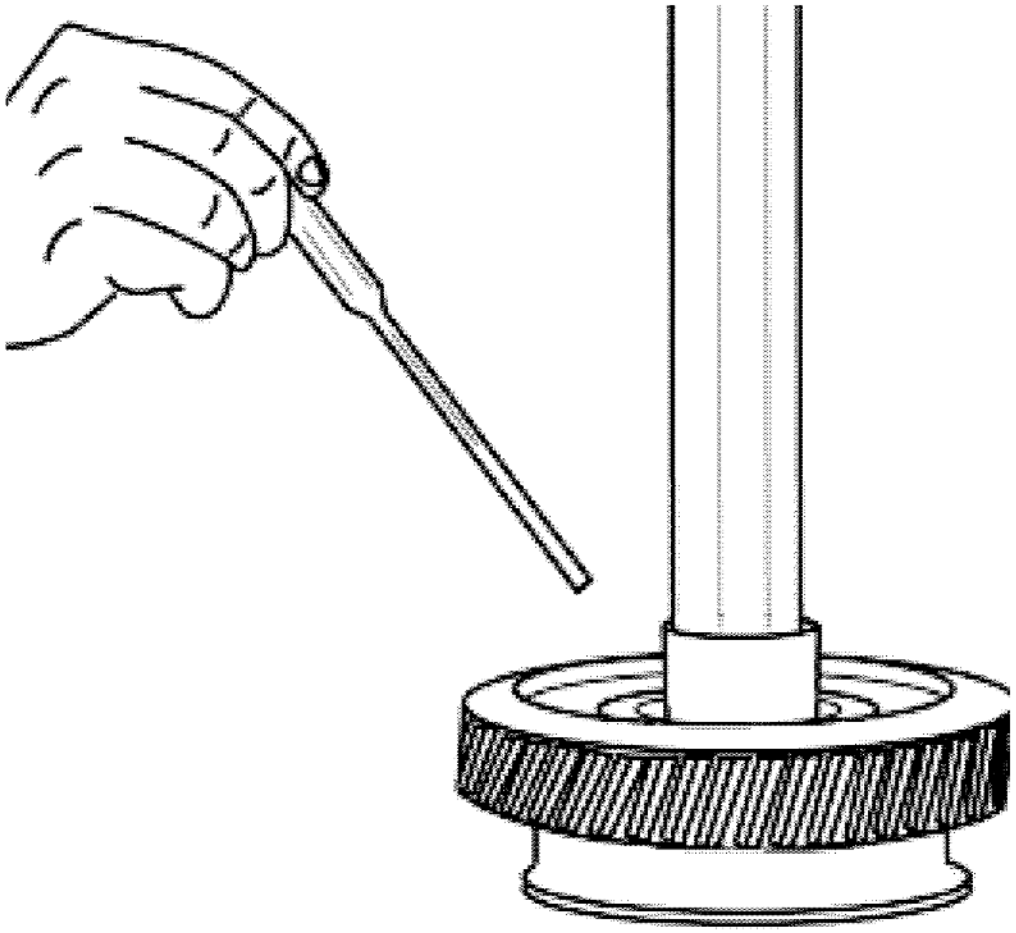


Fig. 169: Using A Magnet To Remove Pulley Sphere From Reverse Gear
Courtesy of GENERAL MOTORS COMPANY

8. Install the pulley sphere for the reverse gear.

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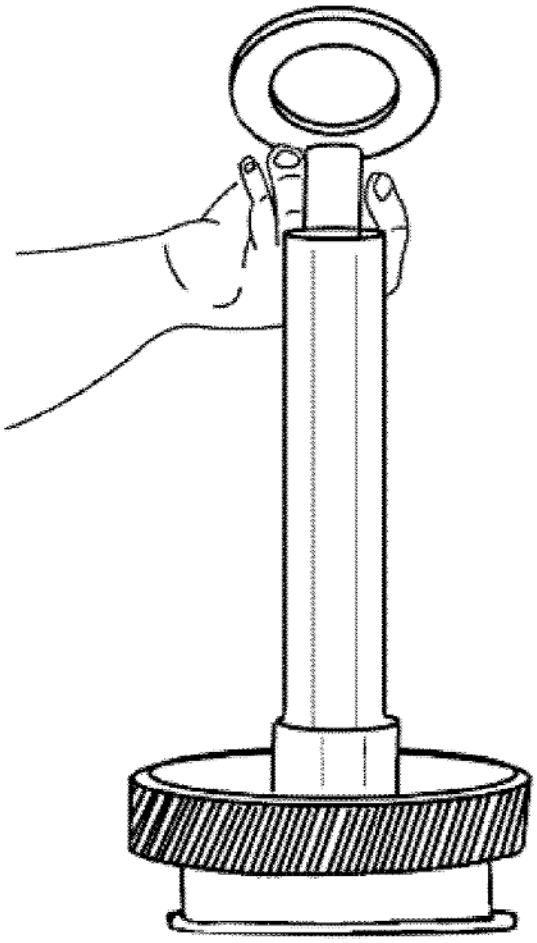


Fig. 170: Push Pulley
Courtesy of GENERAL MOTORS COMPANY

9. Install the reverse gear push pulley.

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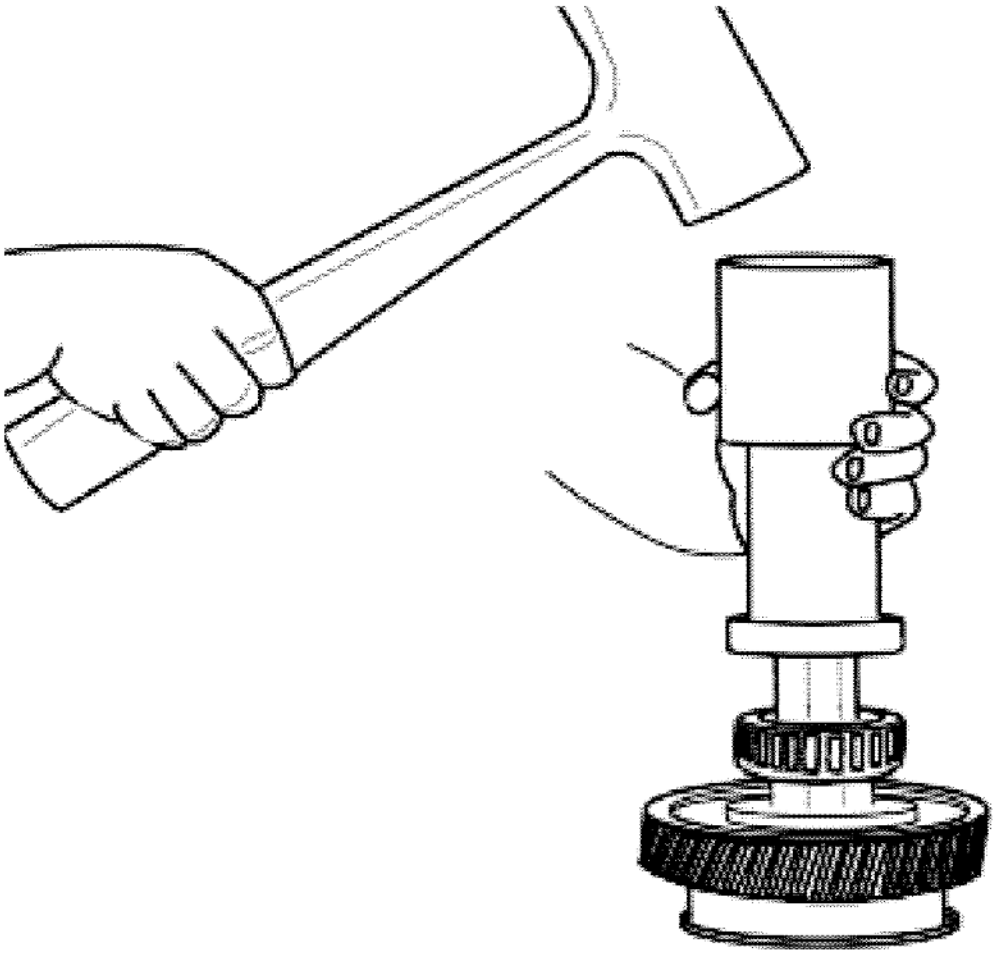


Fig. 171: Installing Bearing
Courtesy of GENERAL MOTORS COMPANY

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

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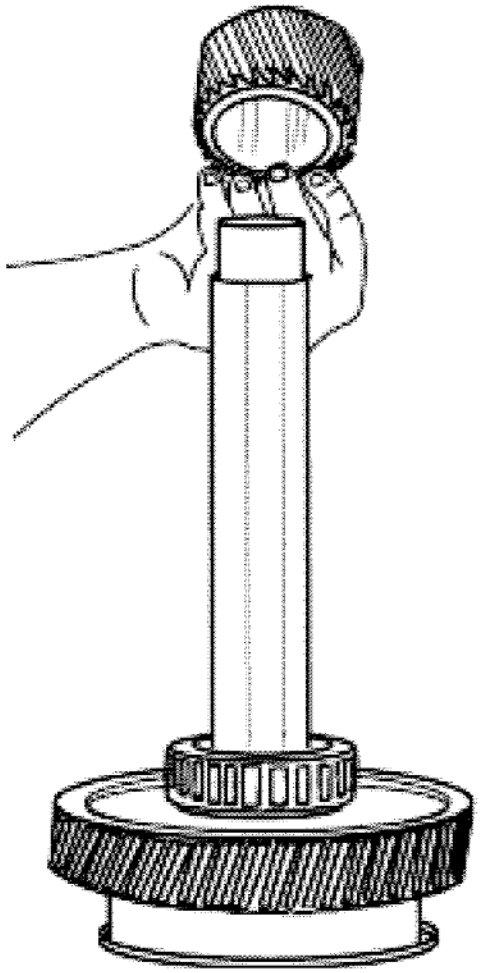


Fig. 172: 5th Gear
Courtesy of GENERAL MOTORS COMPANY

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

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

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

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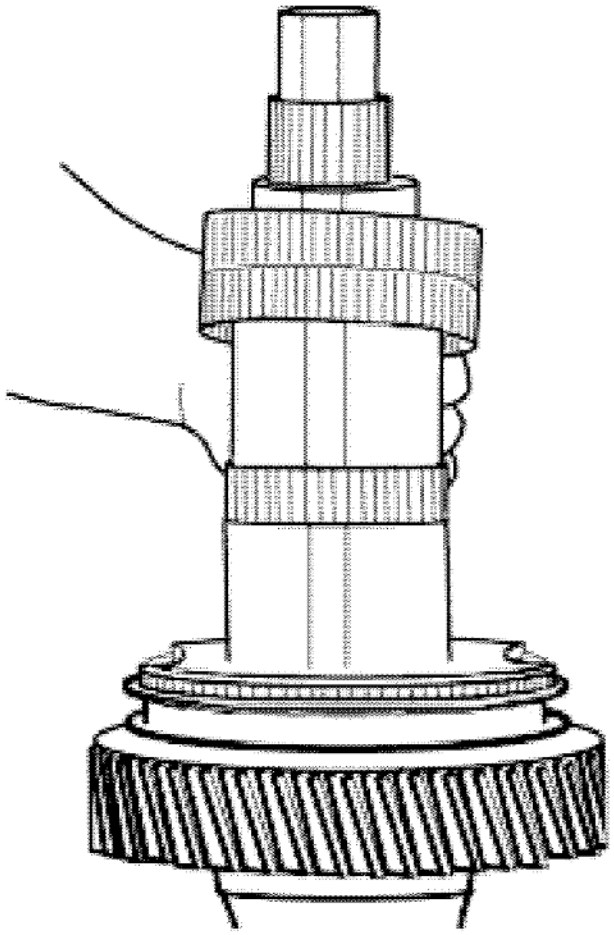


Fig. 174: View Of 1st Gear Roller Cage
Courtesy of GENERAL MOTORS COMPANY

13. Install the reverse gear drive pulley.

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

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

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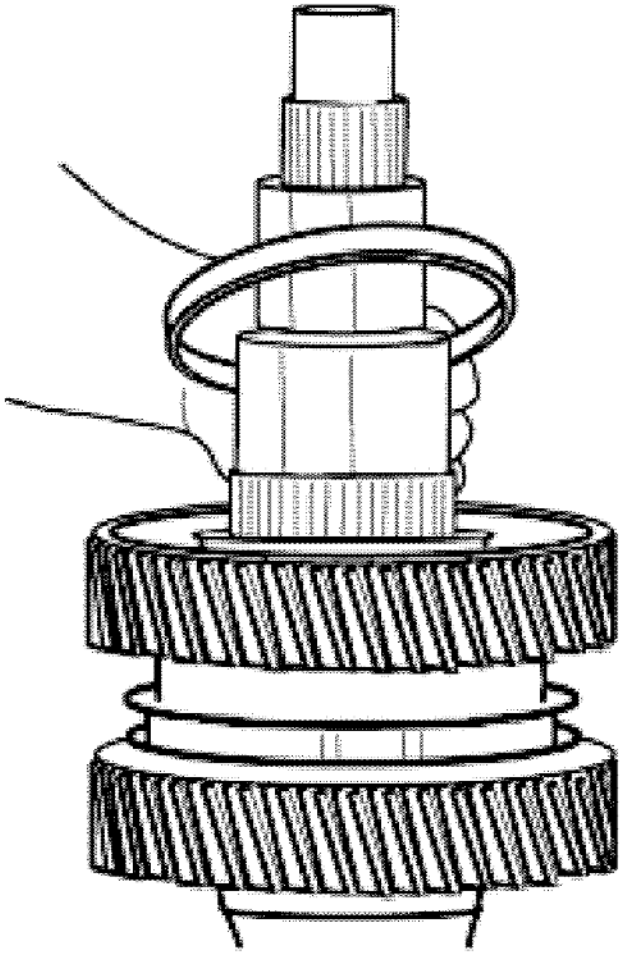


Fig. 176: 1st Gear Interior Taper Bearing
Courtesy of GENERAL MOTORS COMPANY

15. Install the 1st gear interior taper.

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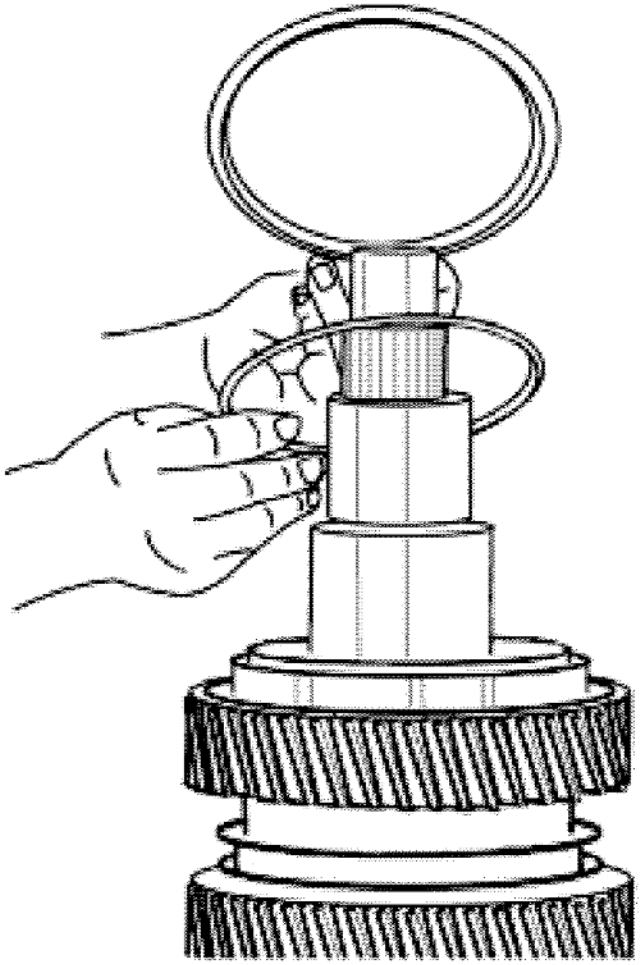


Fig. 177: Synchronizer Ring And Intermediate Ring
Courtesy of GENERAL MOTORS COMPANY

16. Install the intermediate ring and the synchronizer ring.

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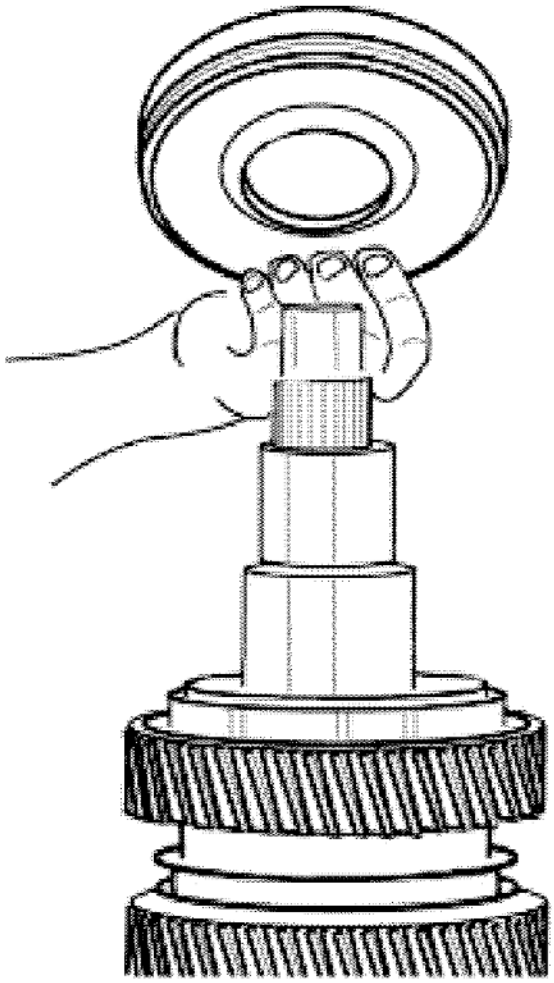


Fig. 178: 1st And 2nd Gear Synchronizer
Courtesy of GENERAL MOTORS COMPANY

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.

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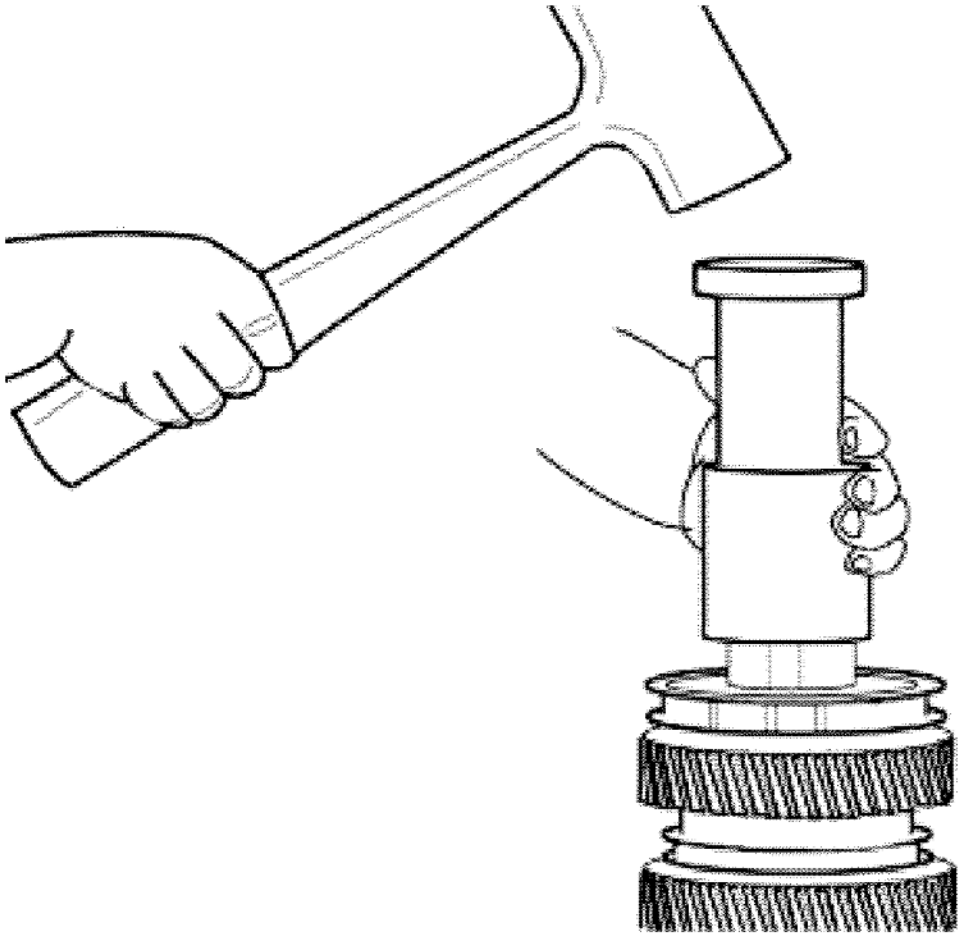


Fig. 179: Seating 1st And 2nd Gear Synchronization Assembly
Courtesy of GENERAL MOTORS COMPANY

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

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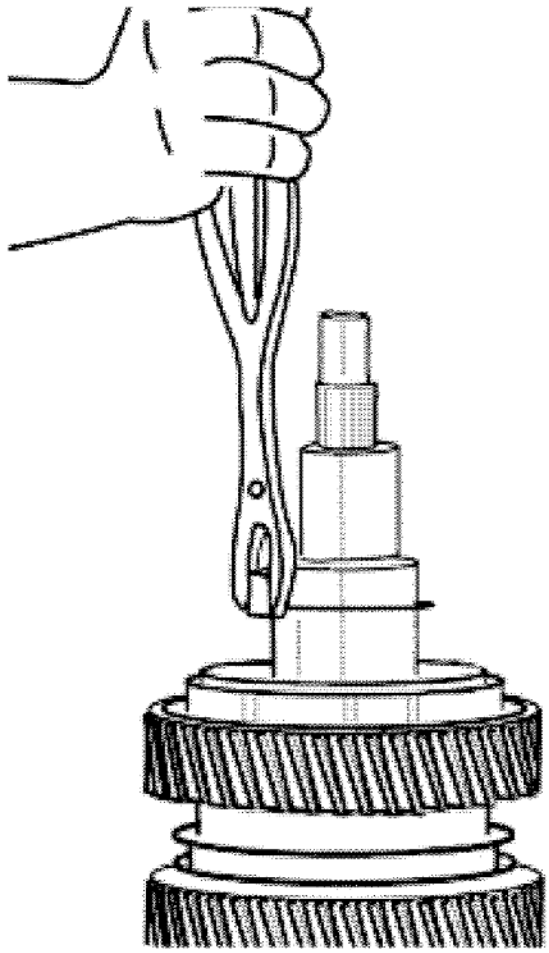


Fig. 180: View Of Snap Ring Holding Synchronization Hammer Onto 1st And 2nd Gears
Courtesy of GENERAL MOTORS COMPANY

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

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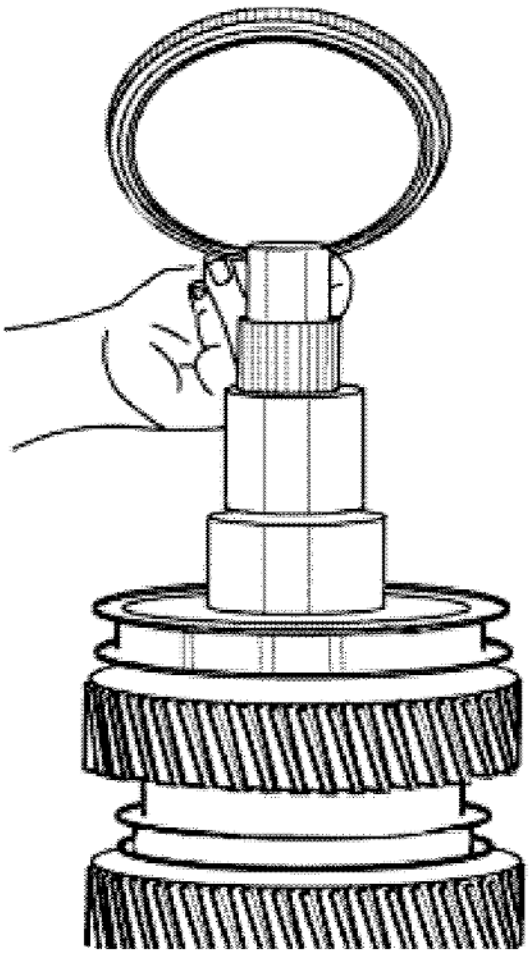


Fig. 181: 2nd Gear Synchronizer Ring
Courtesy of GENERAL MOTORS COMPANY

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

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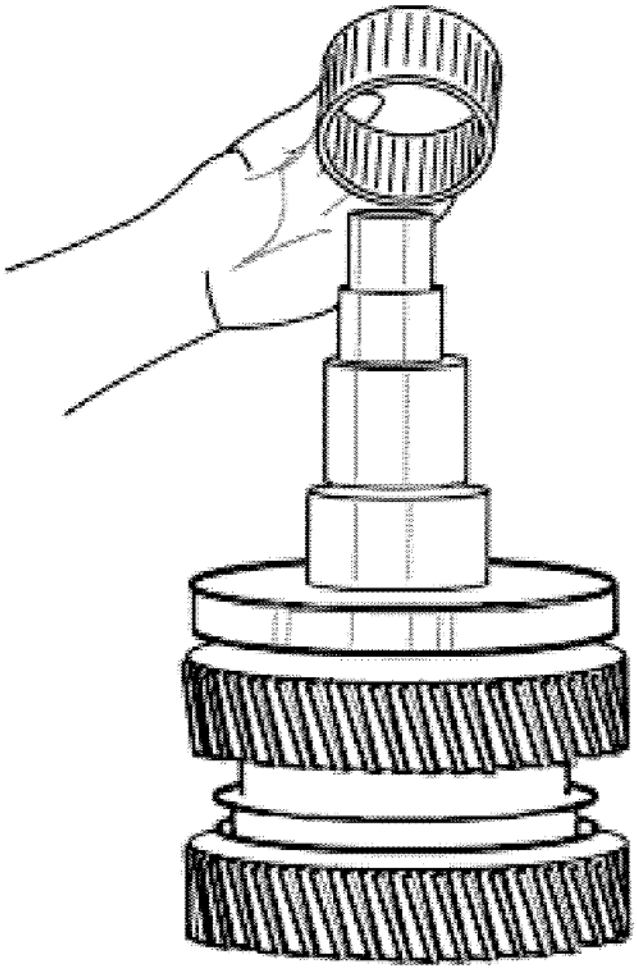


Fig. 182: 2nd Gear Roller Cage
Courtesy of GENERAL MOTORS COMPANY

22. Install the 2nd gear roller cage.

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

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

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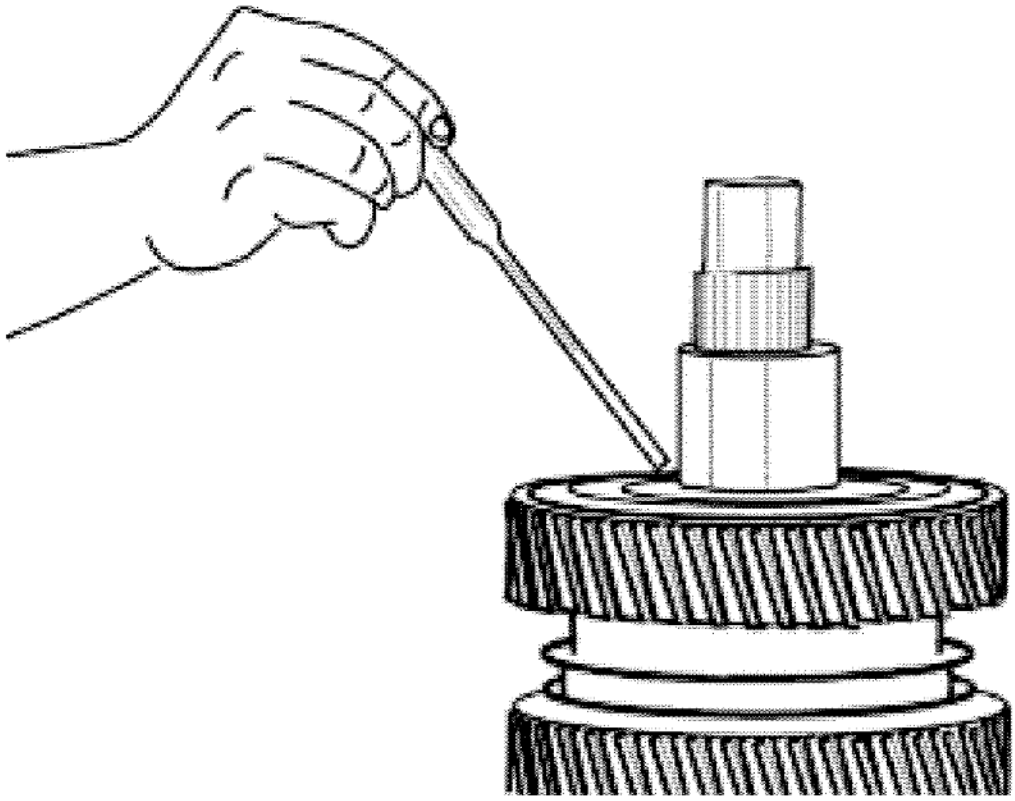


Fig. 184: Removing/Installing Pulley Sphere
Courtesy of GENERAL MOTORS COMPANY

24. Install the 2nd gear pulley sphere.

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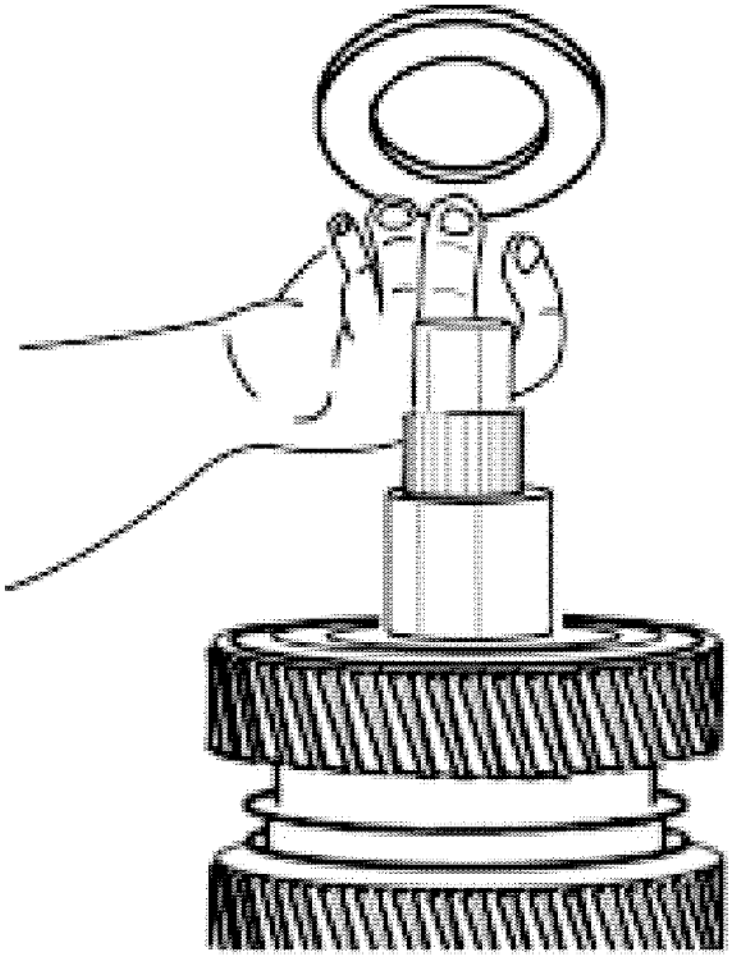


Fig. 185: 2nd Gear Push Pulley
Courtesy of GENERAL MOTORS COMPANY

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

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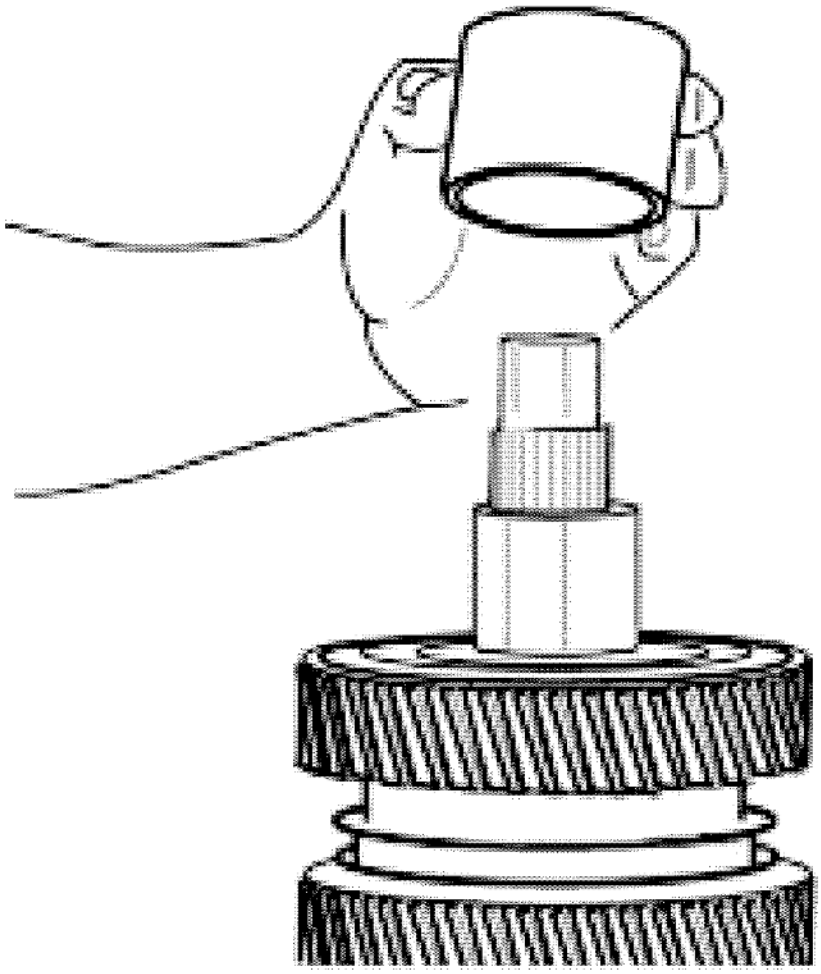


Fig. 186: 3rd Gear Hub
Courtesy of GENERAL MOTORS COMPANY

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

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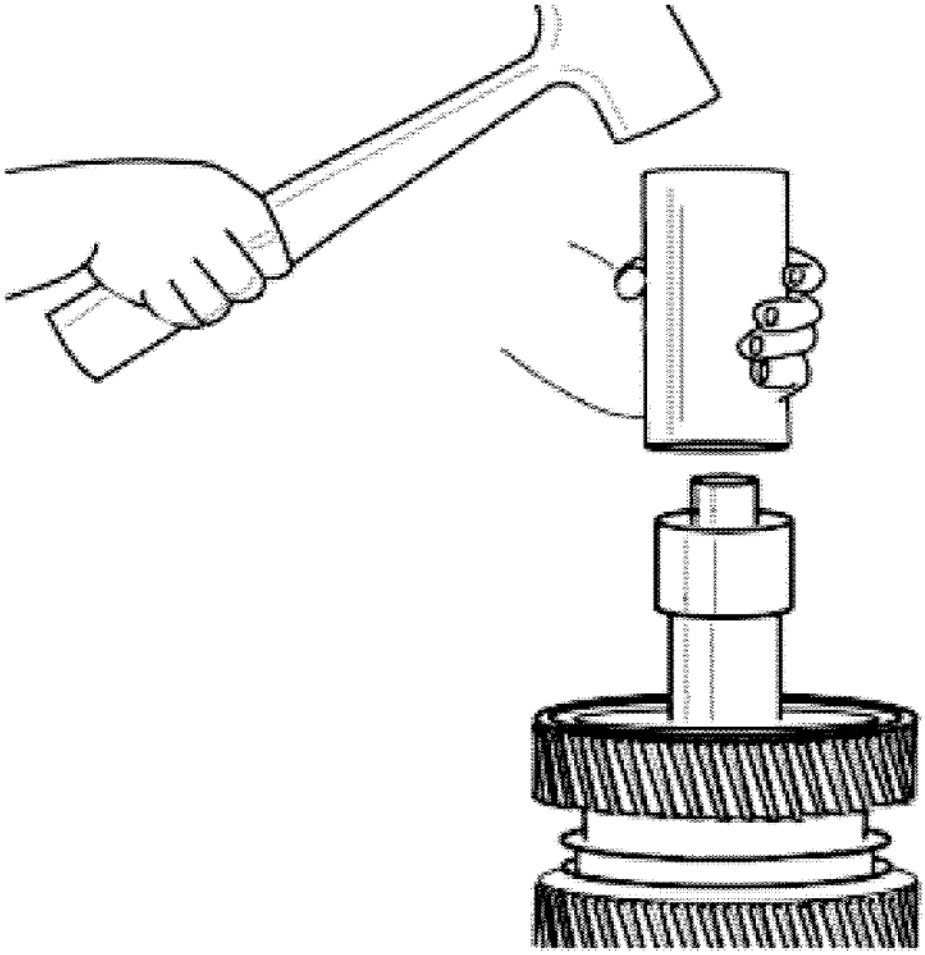


Fig. 187: Installing 3rd Gear Hub
Courtesy of GENERAL MOTORS COMPANY

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

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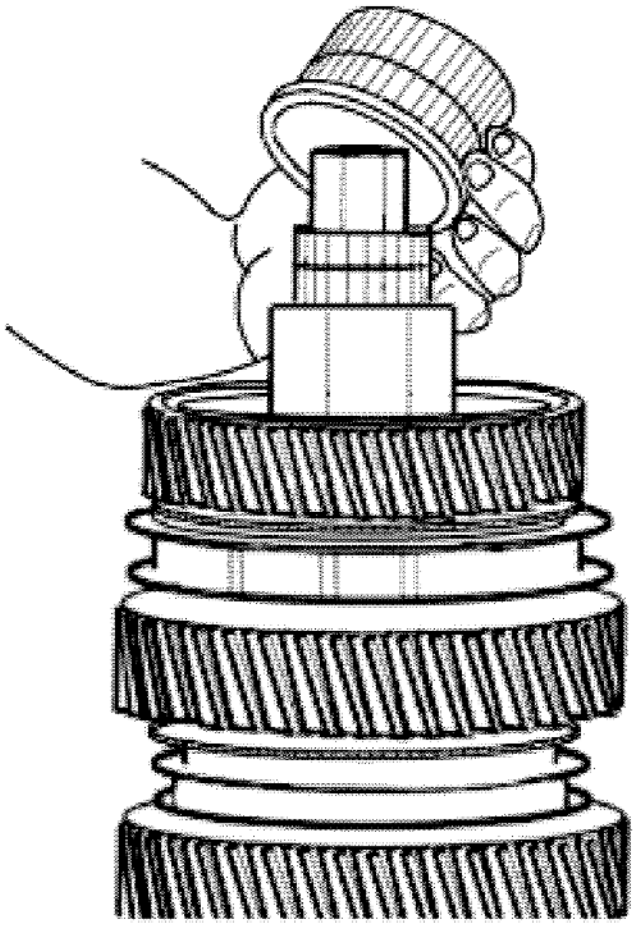


Fig. 188: 3rd Gear Rollers
Courtesy of GENERAL MOTORS COMPANY

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

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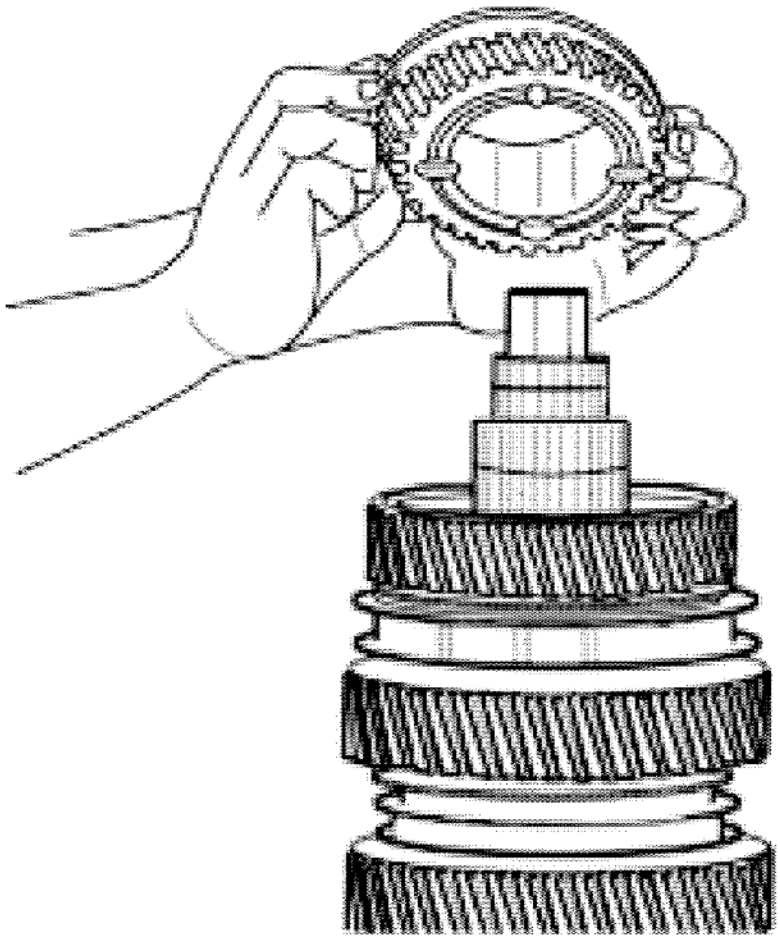


Fig. 189: 3rd Gear
Courtesy of GENERAL MOTORS COMPANY

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

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

30. Install the lubricated 3rd gear synchronizer ring.

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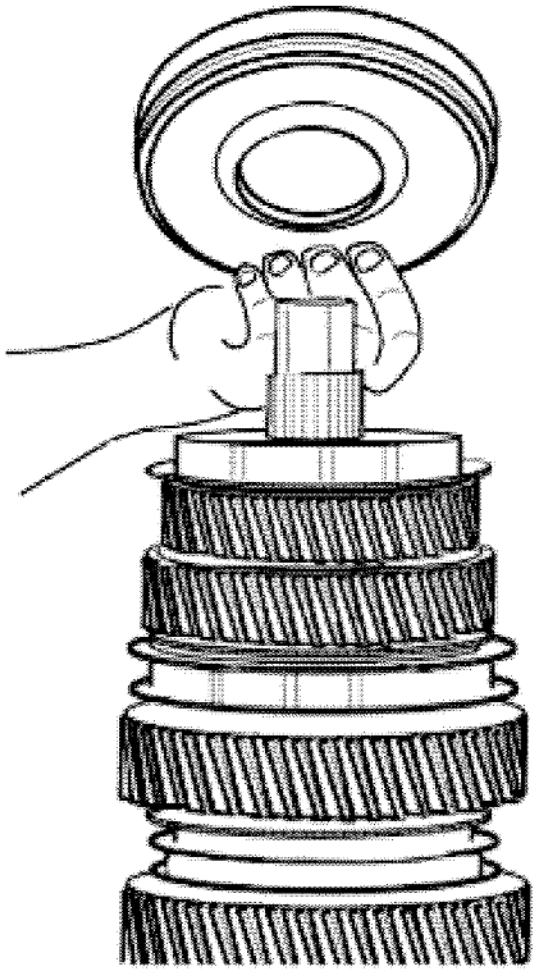


Fig. 191: 3rd And 4th Gear Synchronizer
Courtesy of GENERAL MOTORS COMPANY

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.

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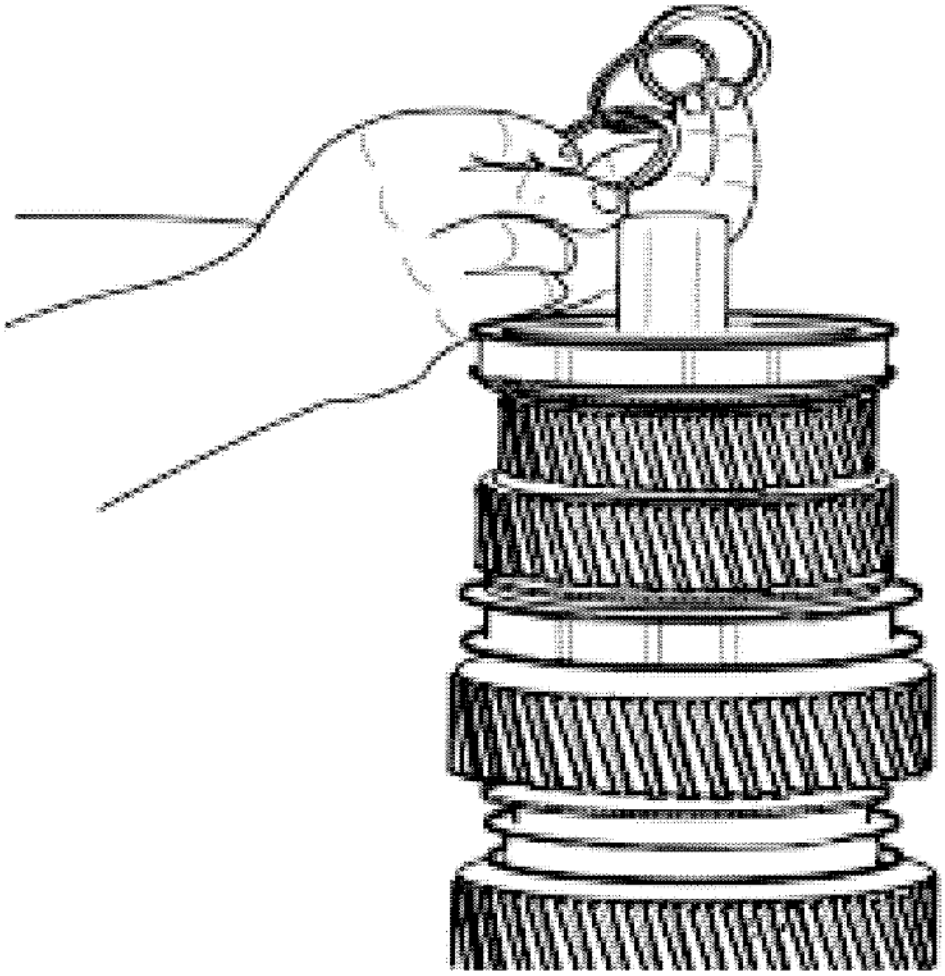


Fig. 192: Pulleys, Track And Push Bearing
Courtesy of GENERAL MOTORS COMPANY

33. Install the pulley track and push bearing.

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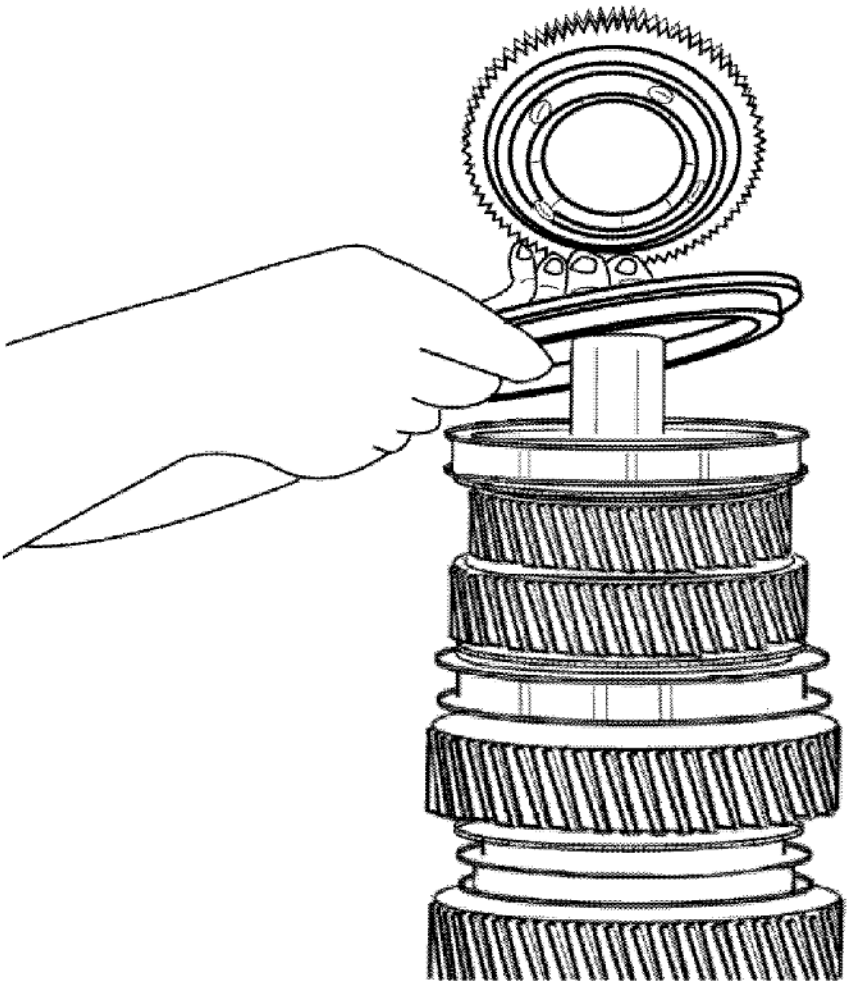


Fig. 193: Clutch Bearing
Courtesy of GENERAL MOTORS COMPANY

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

SHIFT SHAFT AND FORK ASSEMBLIES ASSEMBLE

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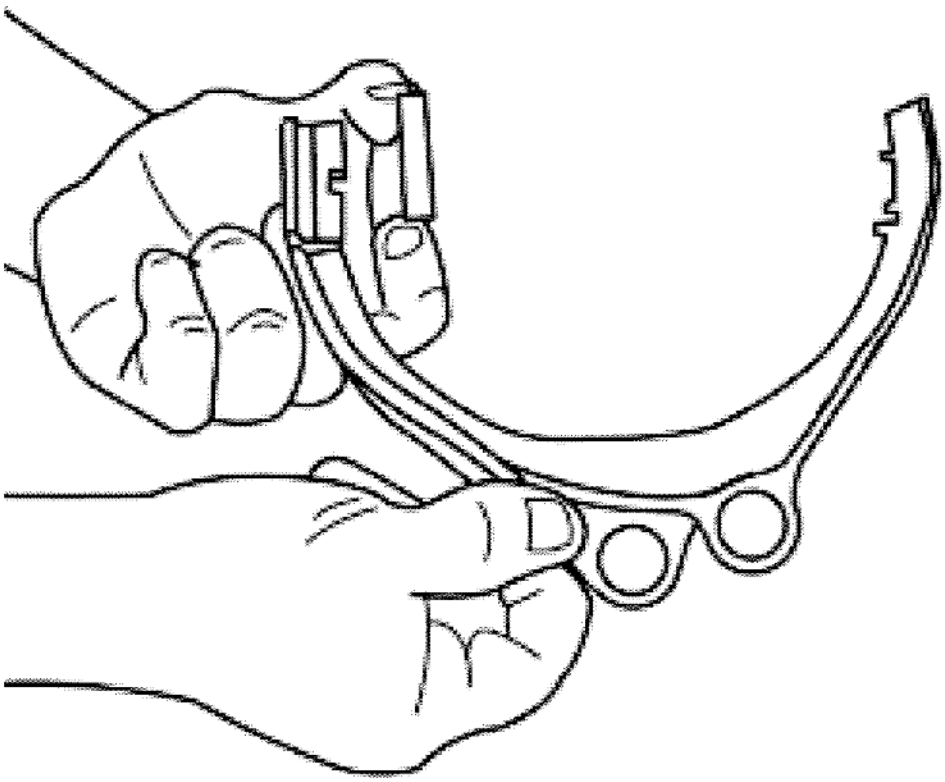


Fig. 194: Fork Inserts
Courtesy of GENERAL MOTORS COMPANY

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

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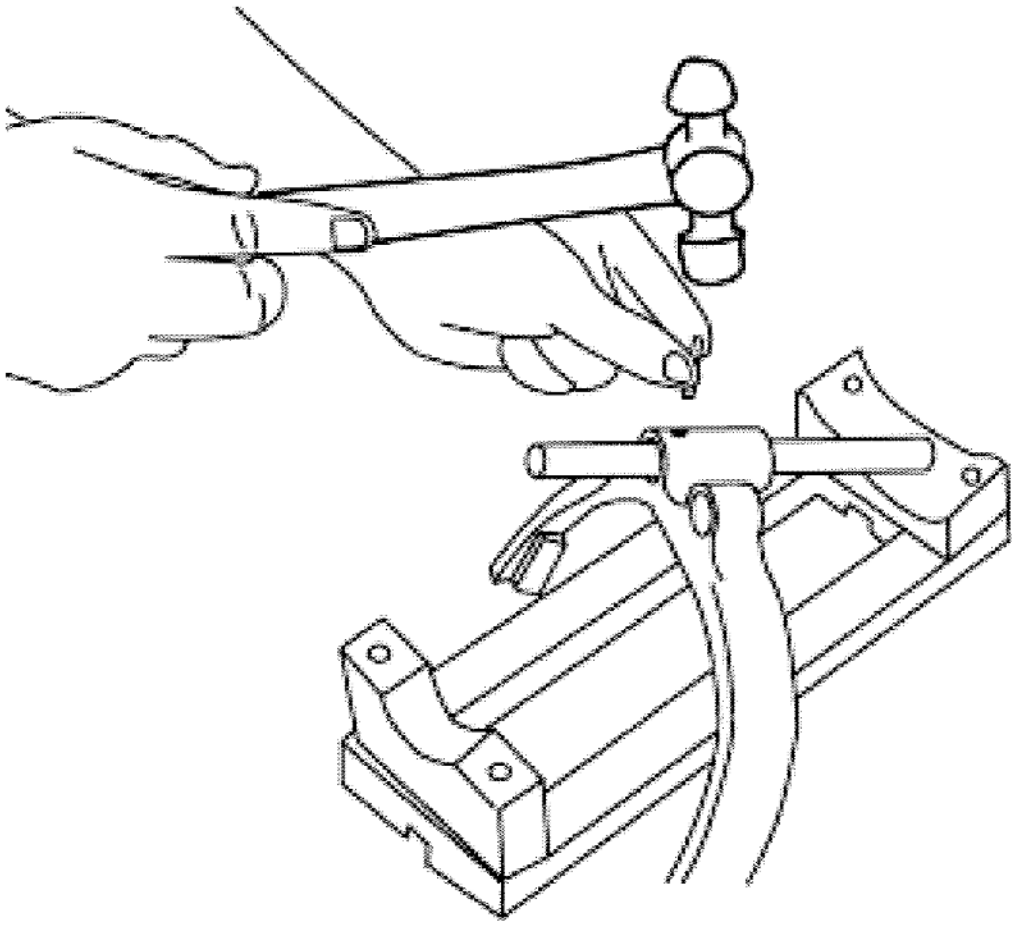


Fig. 195: Installing 1st And 2nd Gear Fork
Courtesy of GENERAL MOTORS COMPANY

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

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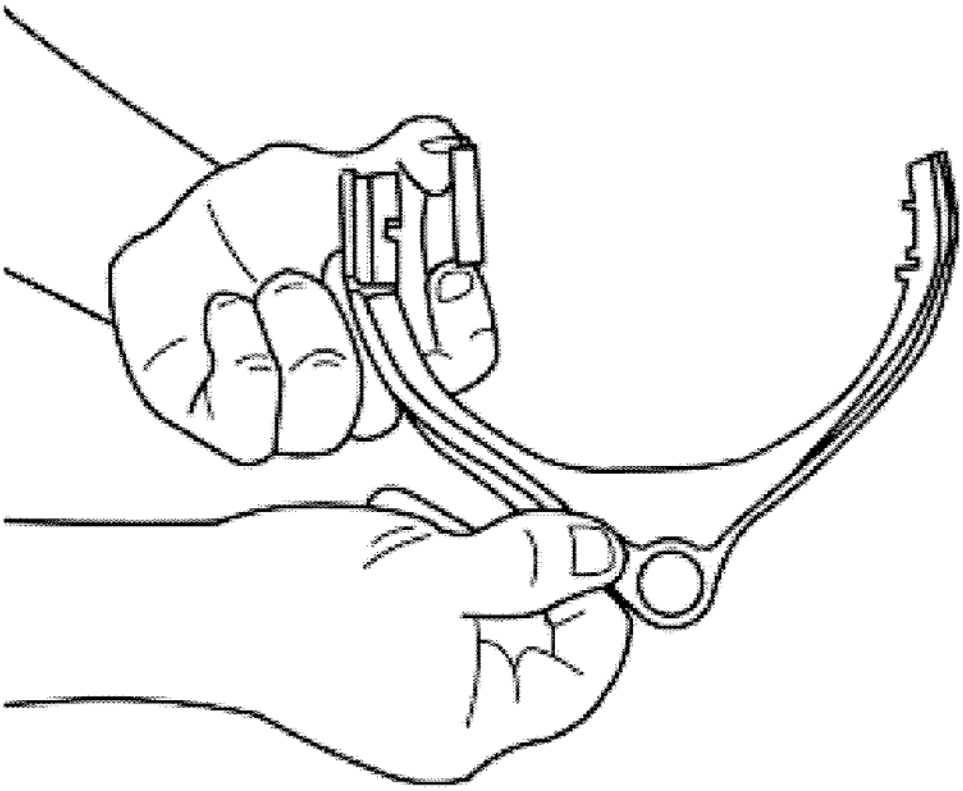


Fig. 196: Fork Inserts
Courtesy of GENERAL MOTORS COMPANY

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

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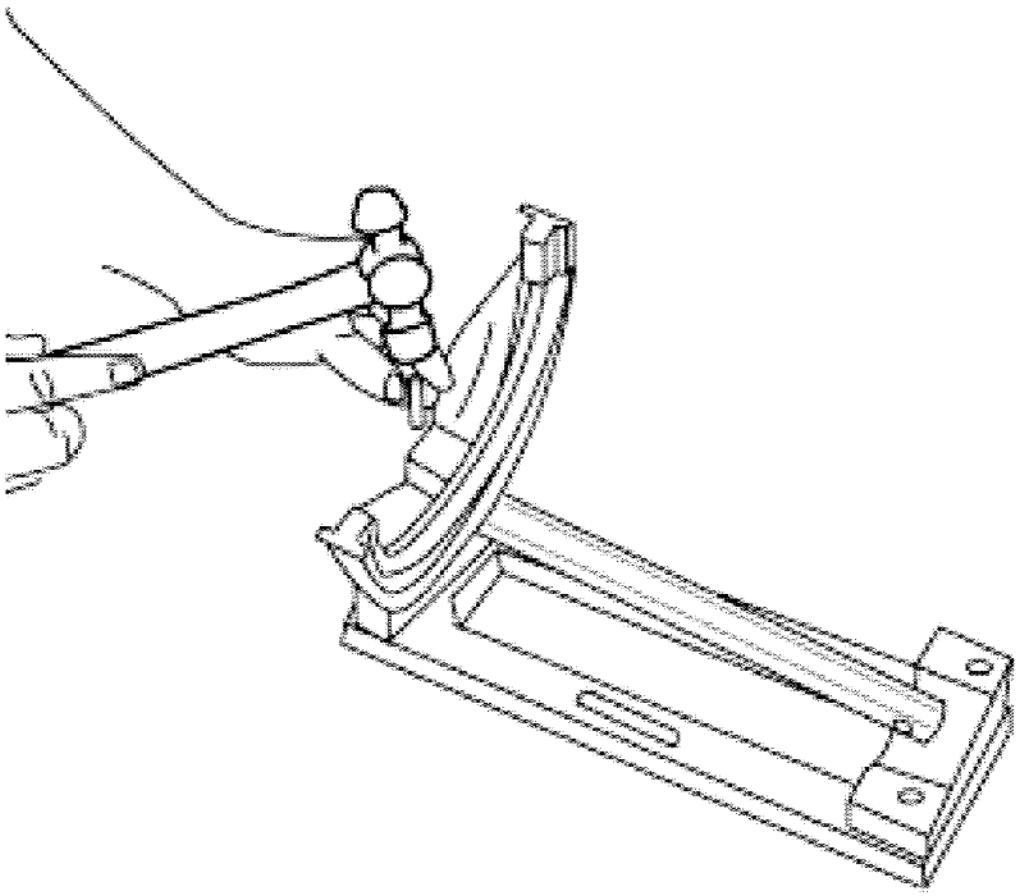


Fig. 197: Installing 3rd And 4th Gear Fork Roll Pin
Courtesy of GENERAL MOTORS COMPANY

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.

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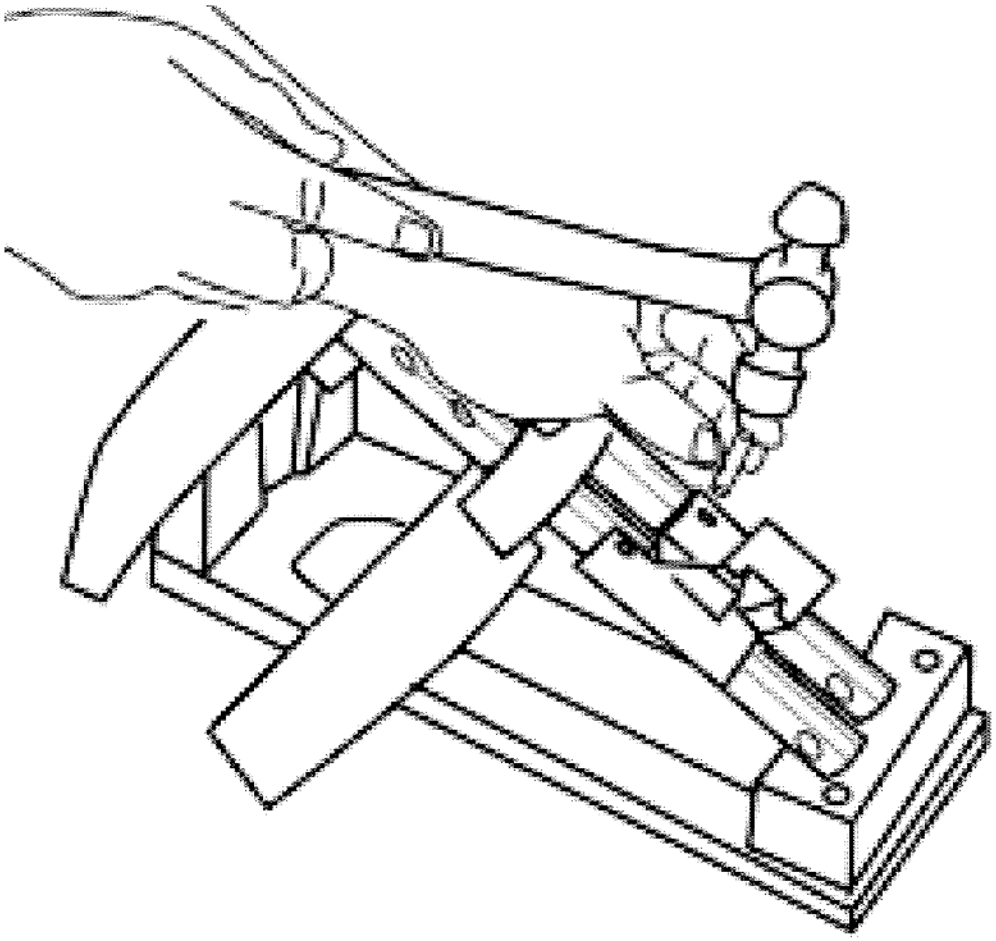


Fig. 198: Installing New Roll Pin Over 1st And 2nd Gear Stop
Courtesy of GENERAL MOTORS COMPANY

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

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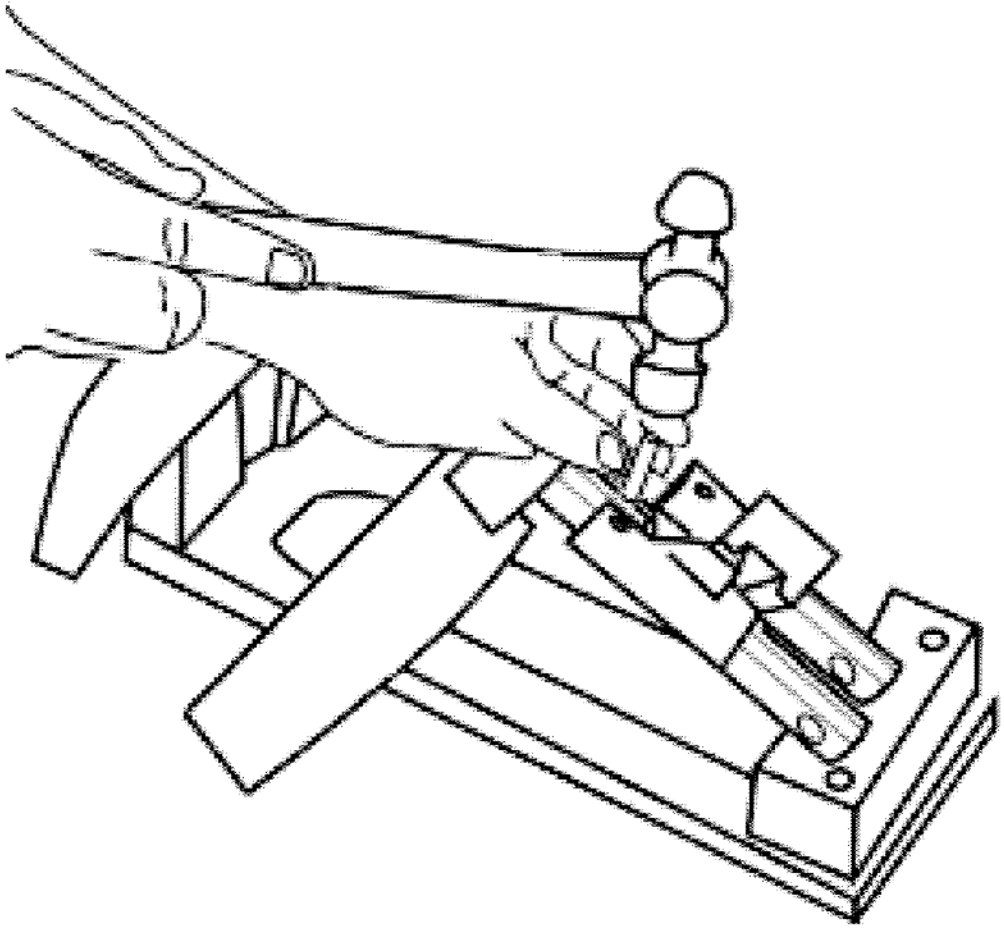


Fig. 199: Installing New Roll Pin On 3rd And 4th Gear Stop
Courtesy of GENERAL MOTORS COMPANY

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

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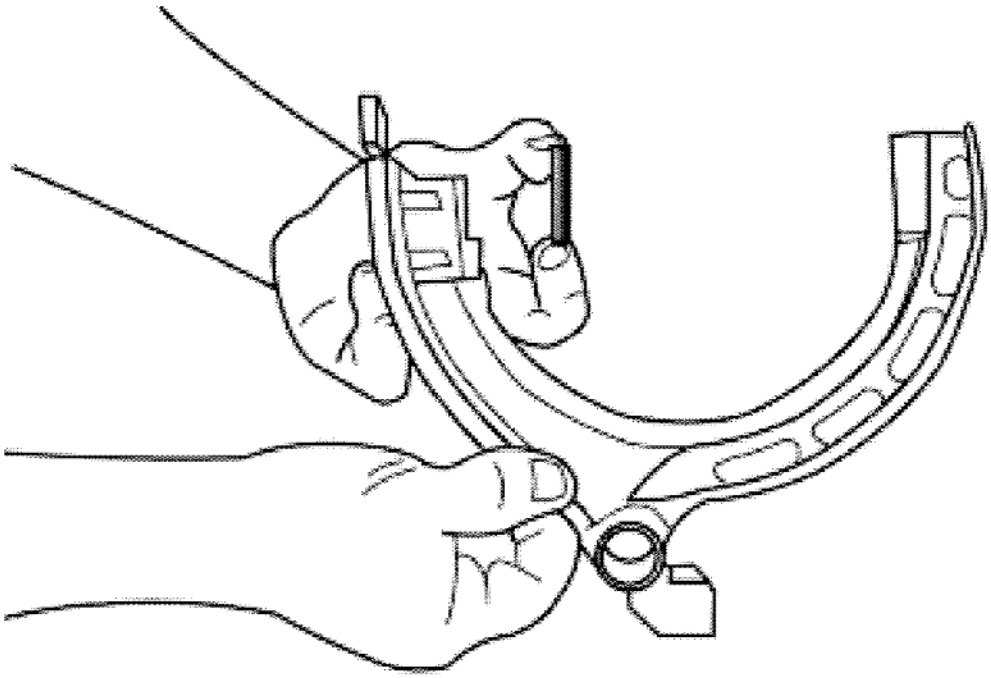


Fig. 200: Fork Inserts
Courtesy of GENERAL MOTORS COMPANY

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

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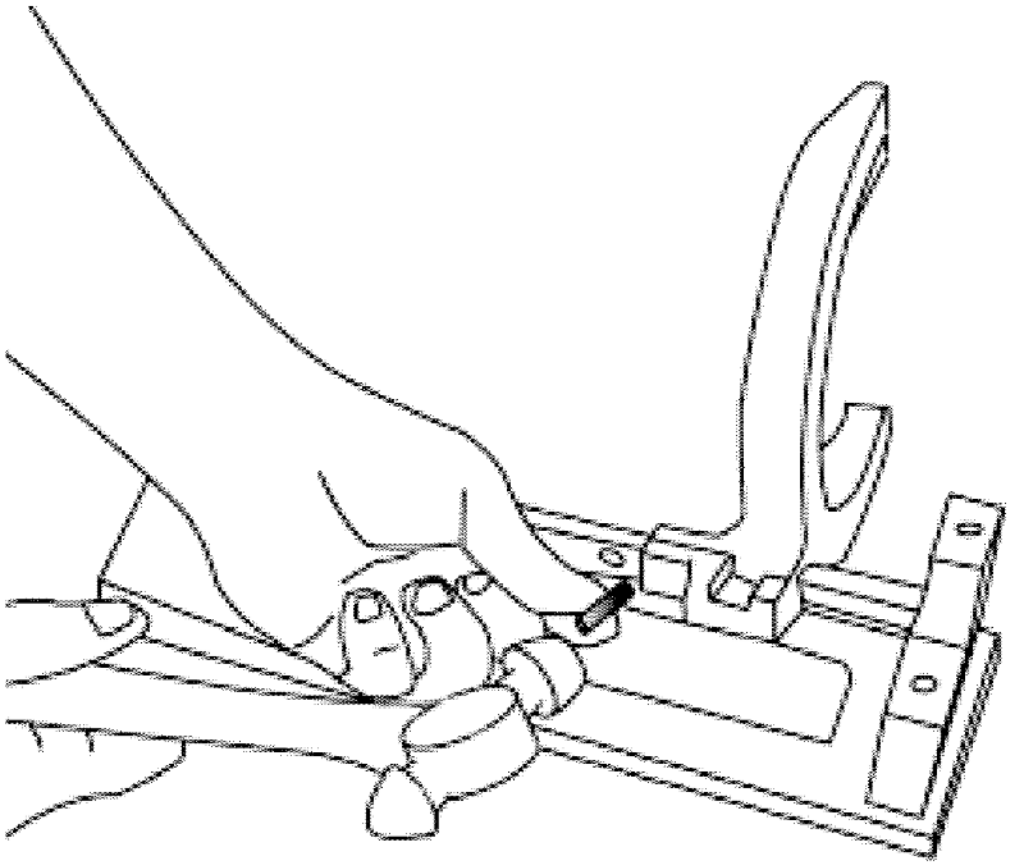


Fig. 201: Installing New Roll Pin Into 5th And Reverse Gear Fork
Courtesy of GENERAL MOTORS COMPANY

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

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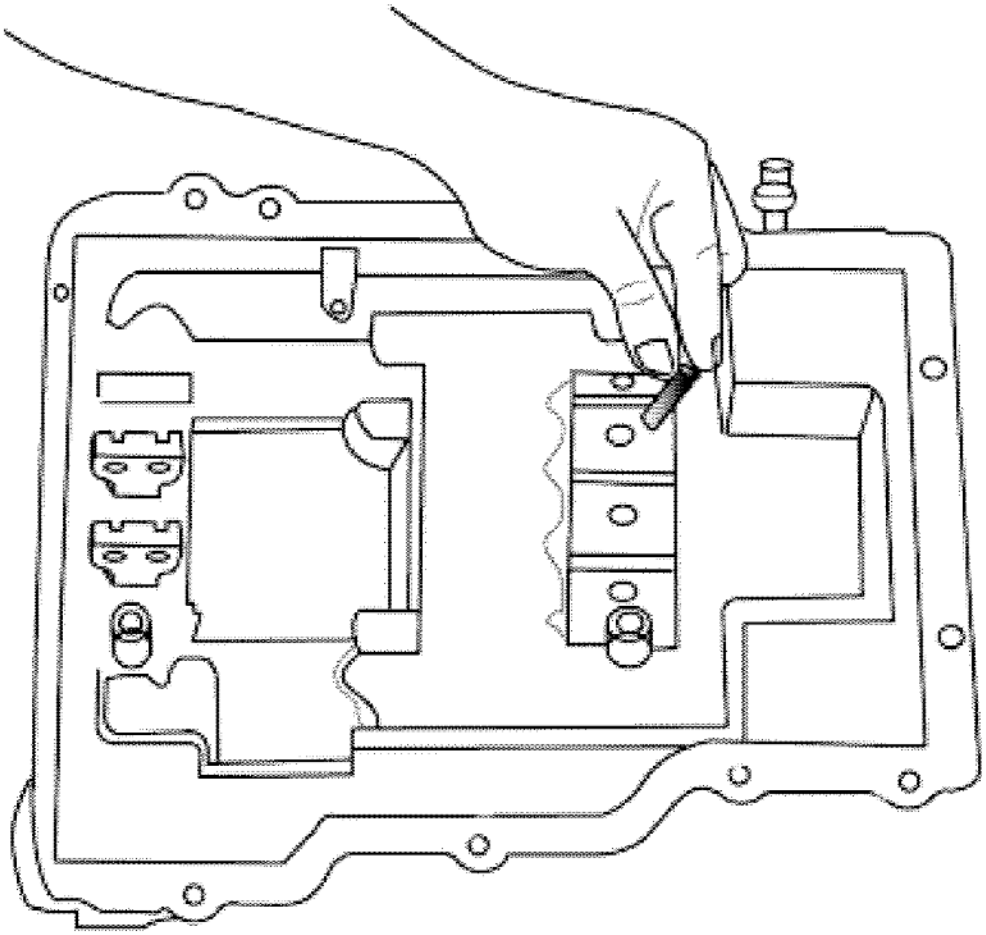


Fig. 202: Insert Springs
Courtesy of GENERAL MOTORS COMPANY

9. Install the 3 insert springs.

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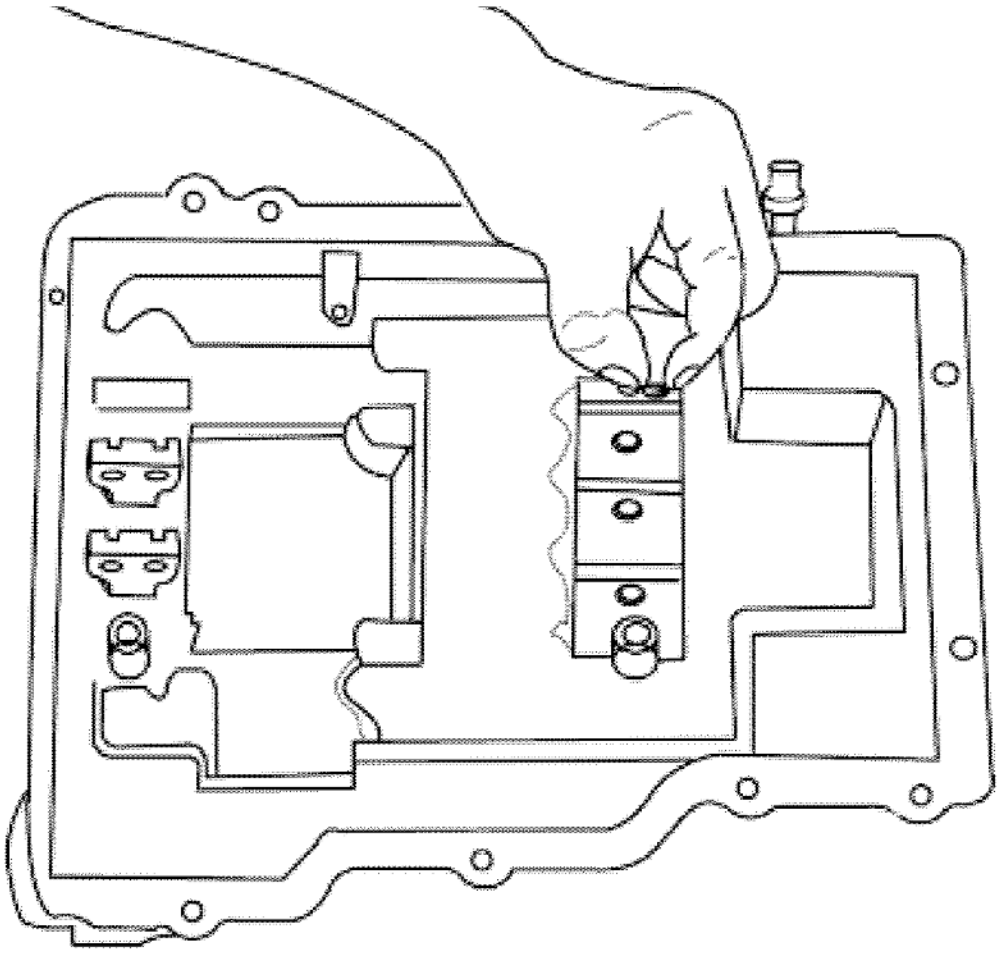


Fig. 203: Insert Spheres
Courtesy of GENERAL MOTORS COMPANY

10. Install the 3 insert spheres.

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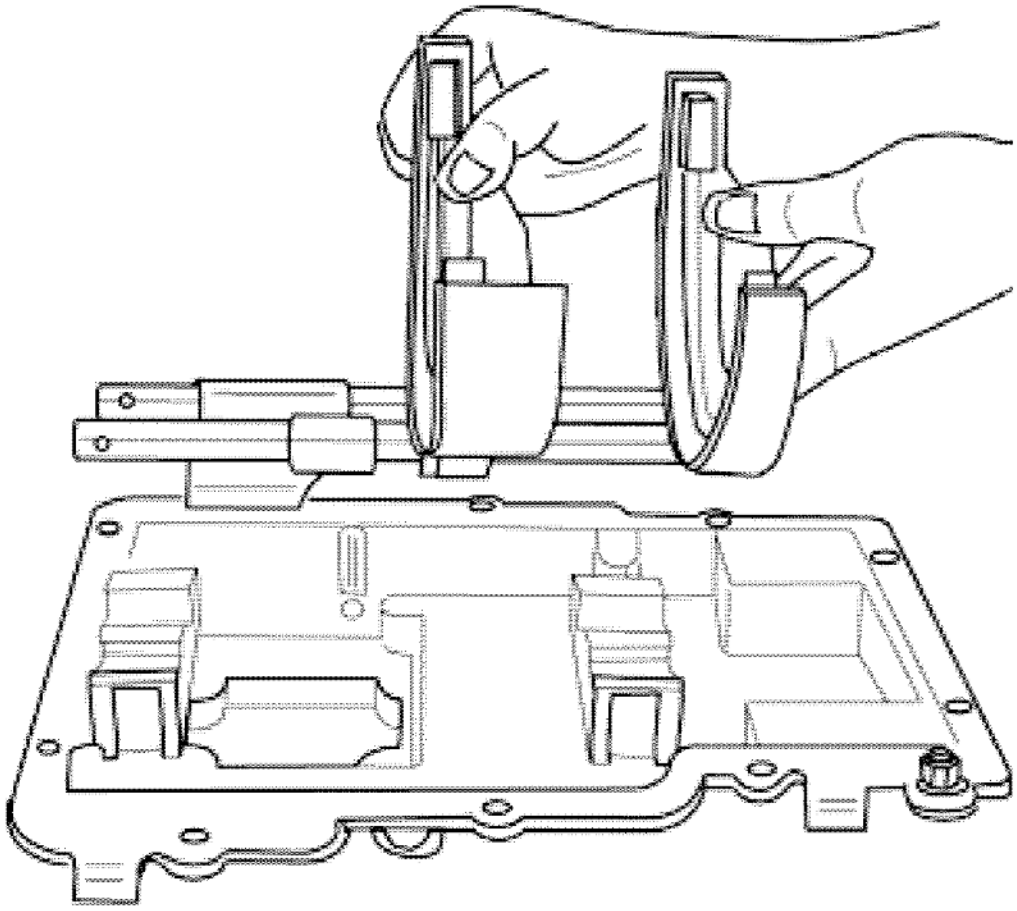


Fig. 204: Assembly With Shafts, Forks And Stops
Courtesy of GENERAL MOTORS COMPANY

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

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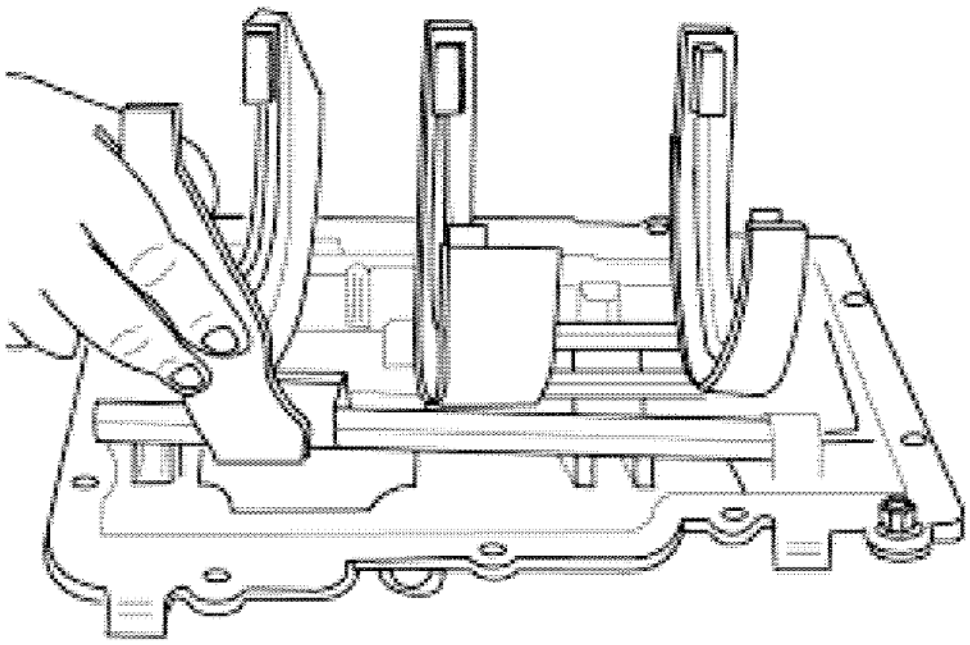


Fig. 205: 5th Gear, Reverse Shaft, And Fork Assembly
Courtesy of GENERAL MOTORS COMPANY

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

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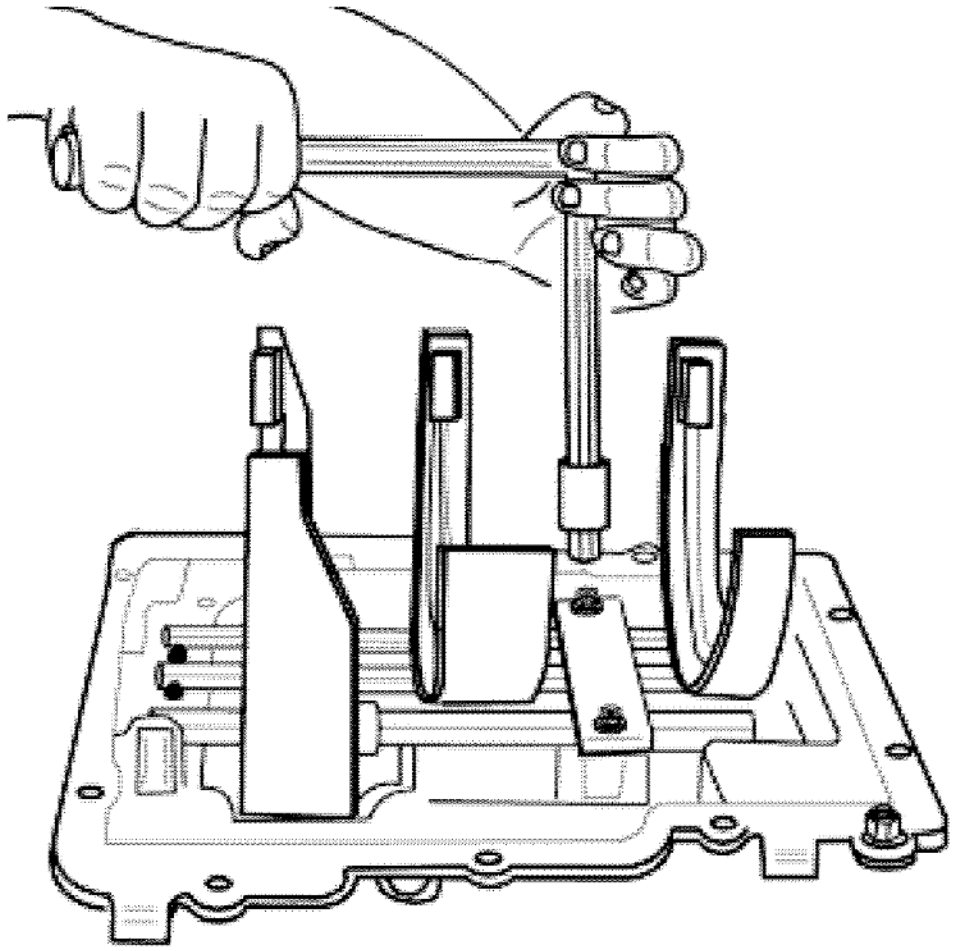


Fig. 206: Retaining Plate Screws
Courtesy of GENERAL MOTORS COMPANY

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

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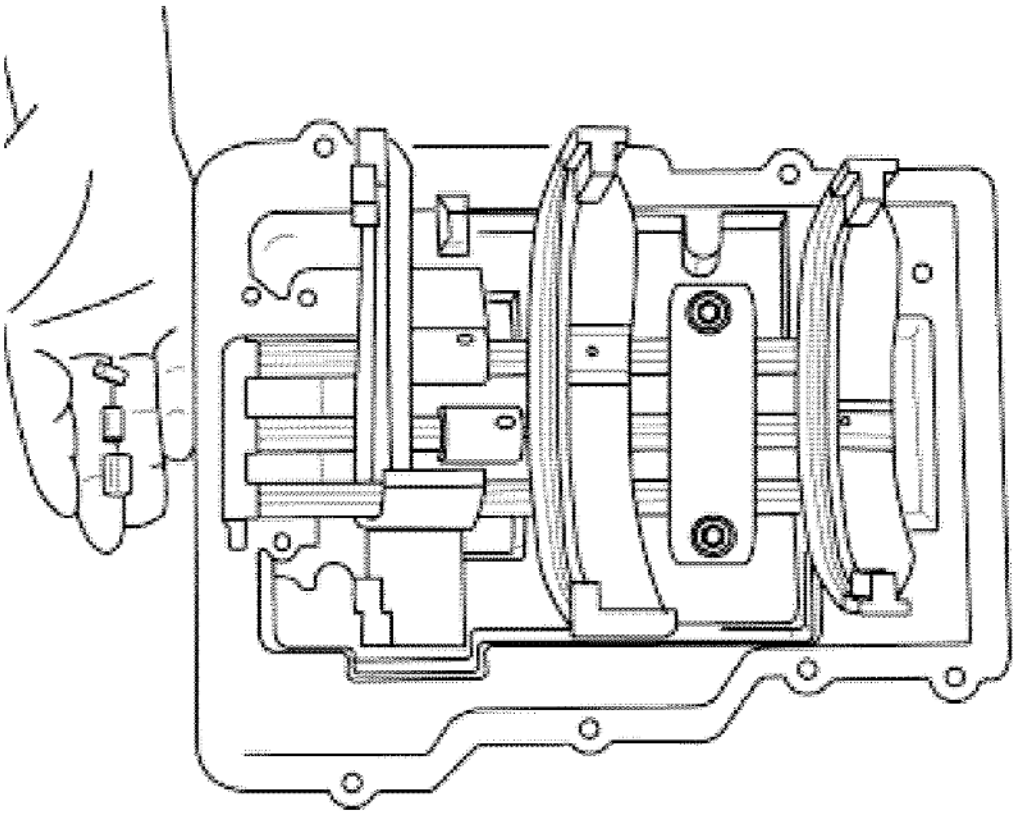


Fig. 207: Pins And Lock
Courtesy of GENERAL MOTORS COMPANY

14. Install the roll pins in the order indicated.

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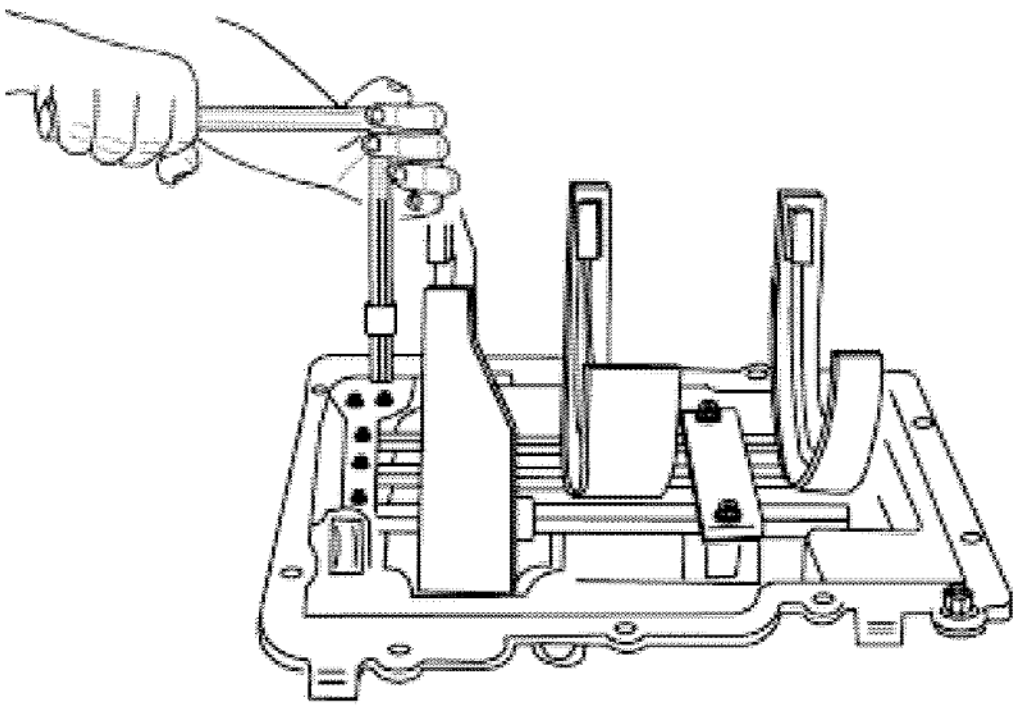


Fig. 208: Screws Retaining Support Plate On Block
Courtesy of GENERAL MOTORS COMPANY

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

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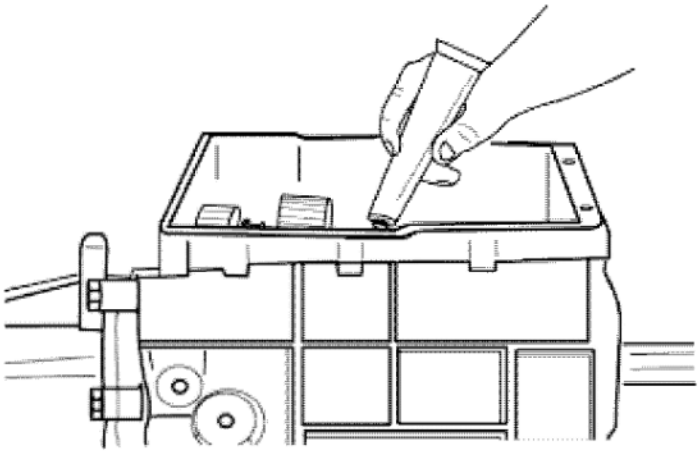


Fig. 209: Applying Gasket Maker
Courtesy of GENERAL MOTORS COMPANY

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

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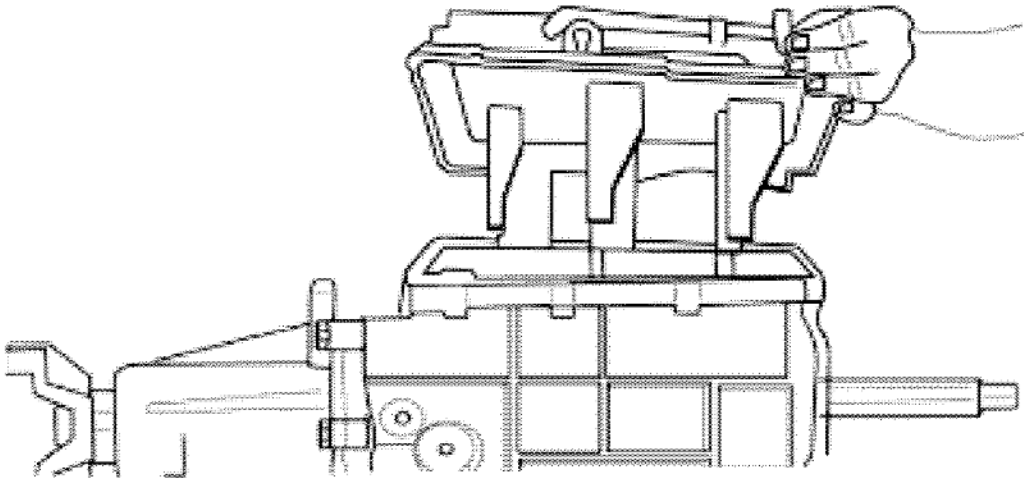


Fig. 210: Control Cover
Courtesy of GENERAL MOTORS COMPANY

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

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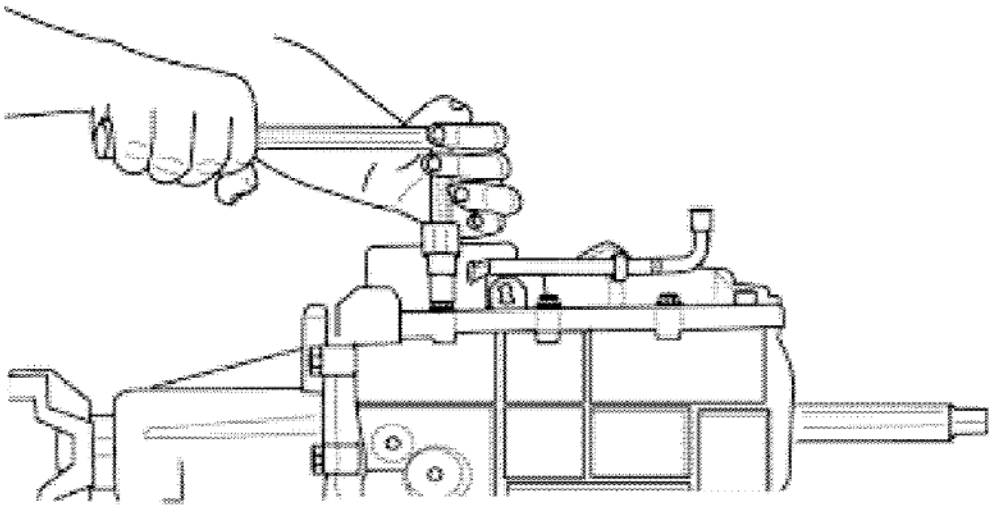


Fig. 211: Using 1/2 Socket On Screws Holding Control Cover
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

18. Using a 1/2 socket, tighten the 10 screws on the control cover to 20-24 N.m (18-22 lb ft).

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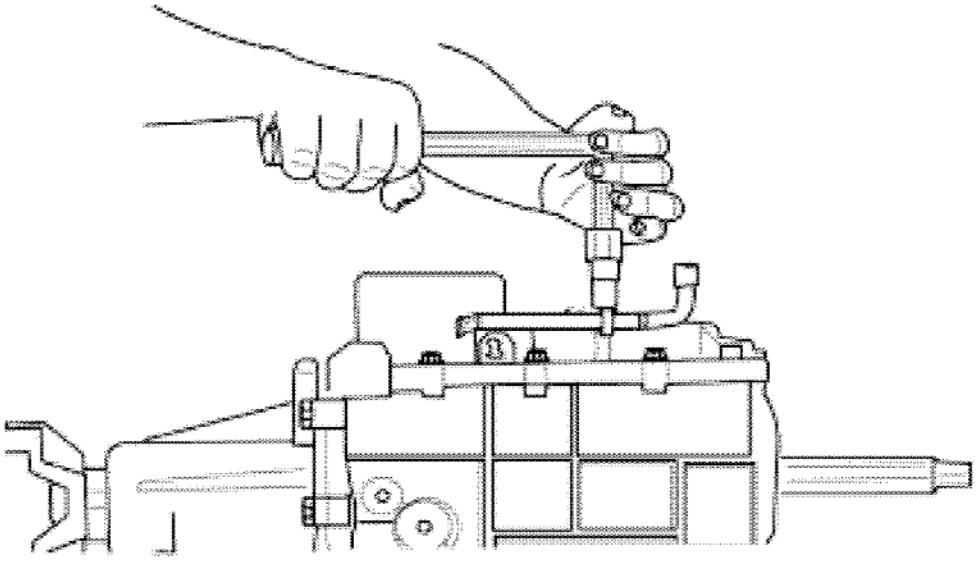


Fig. 212: Using Ratchet On Breather Support Screw
Courtesy of GENERAL MOTORS COMPANY

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

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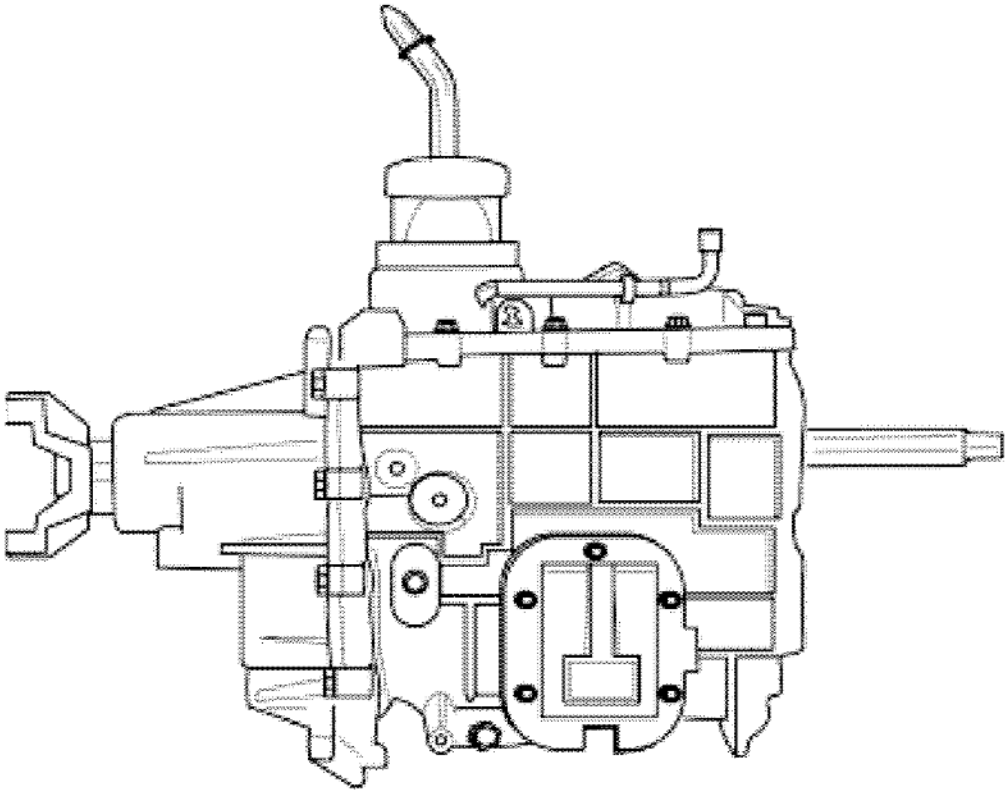


Fig. 213: Transmission
Courtesy of GENERAL MOTORS COMPANY

20. Install the shift tower.

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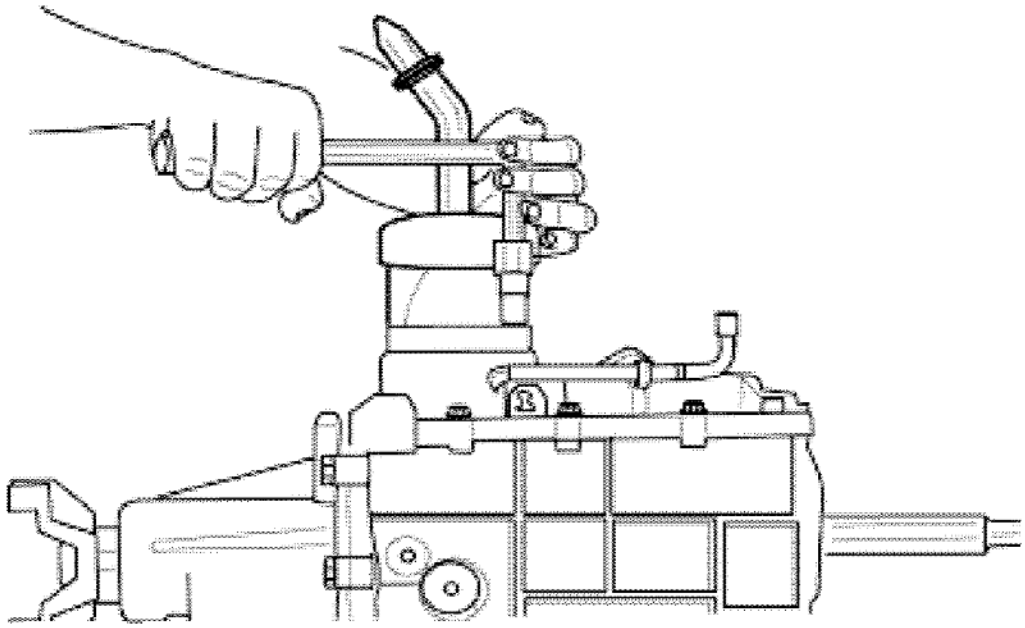


Fig. 214: Using Ratchet On Shift Tower Screws
Courtesy of GENERAL MOTORS COMPANY

21. Using a 10 mm socket, tighten the 4 screws on the shift tower to 8-14 N.m (6-11 lb ft).

TRANSMISSION ASSEMBLE

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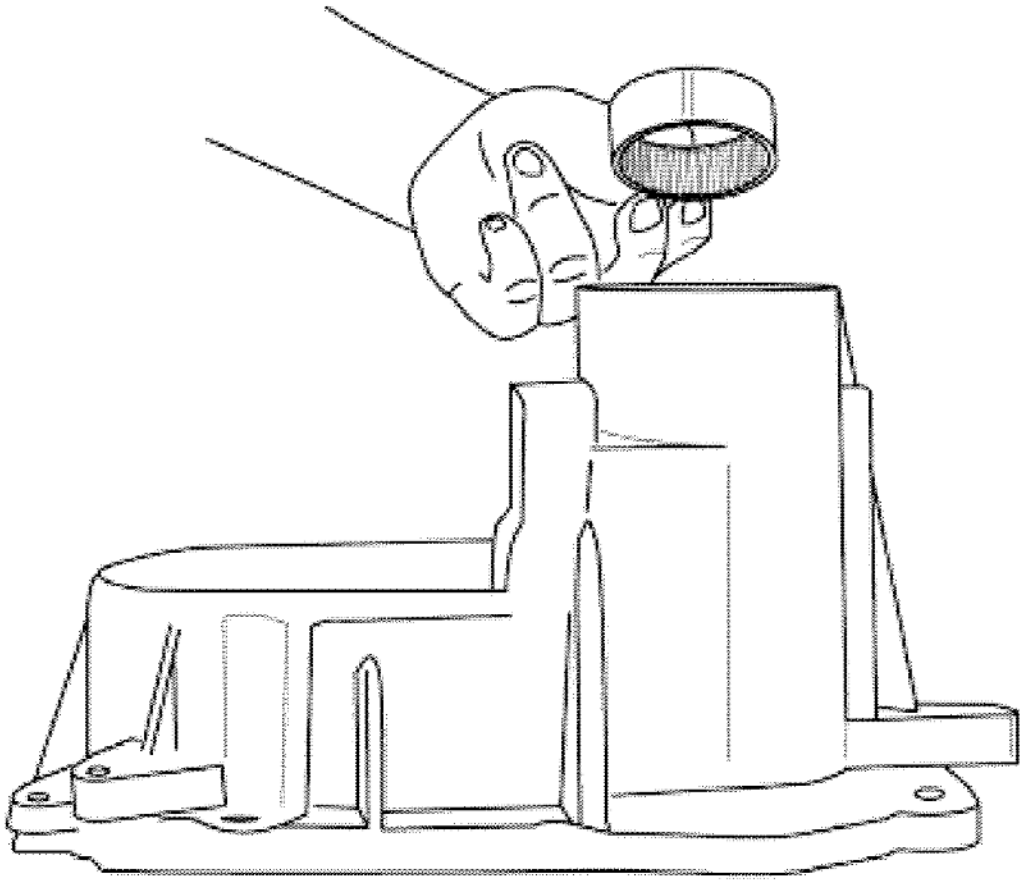


Fig. 215: Bearing
Courtesy of GENERAL MOTORS COMPANY

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

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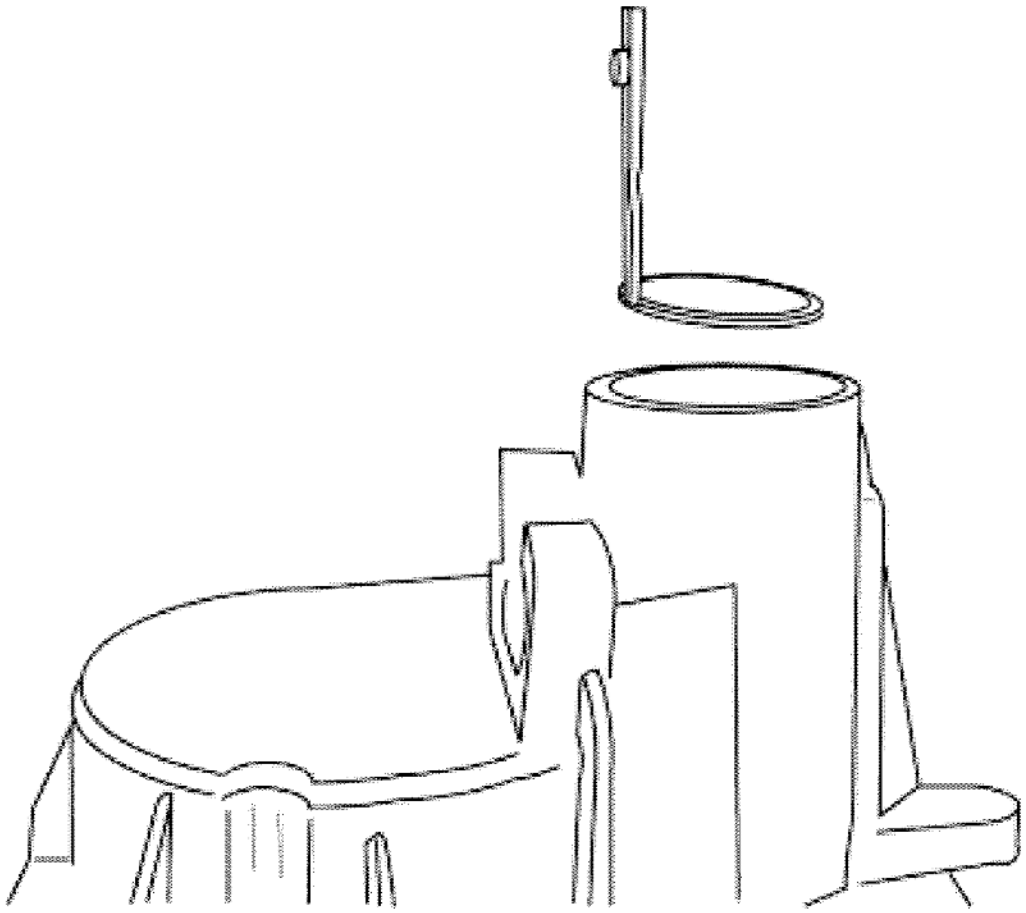


Fig. 216: Snap Ring
Courtesy of GENERAL MOTORS COMPANY

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

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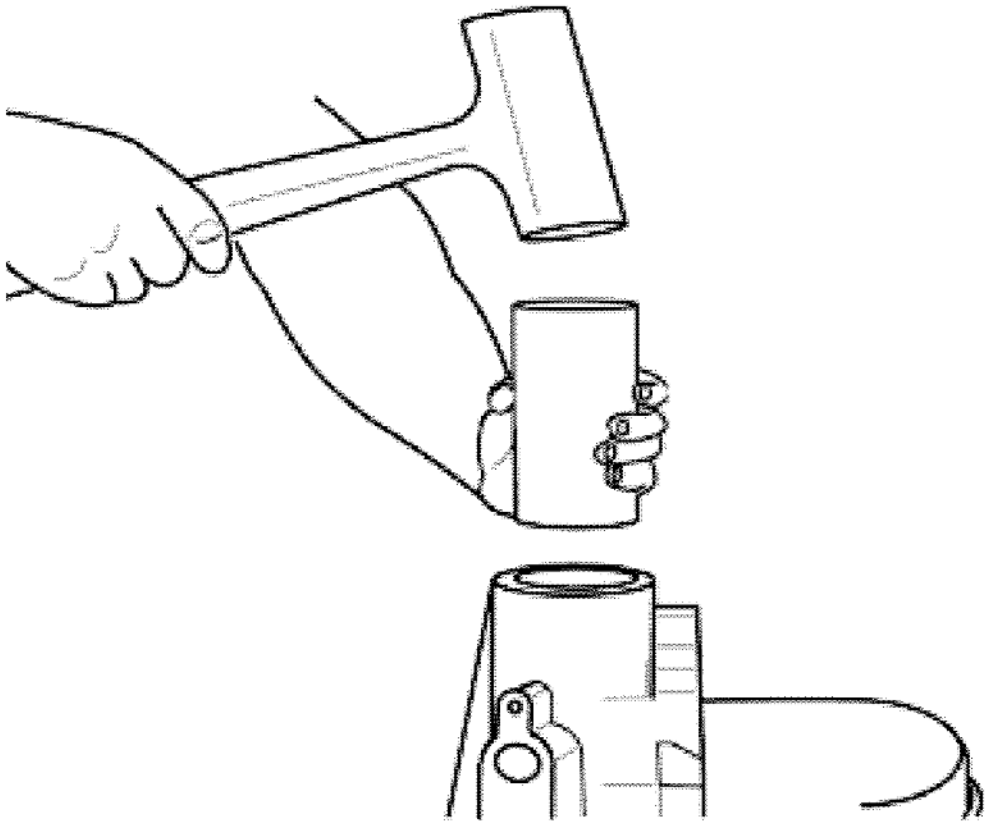


Fig. 217: Extension Housing Oil Seal
Courtesy of GENERAL MOTORS COMPANY

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

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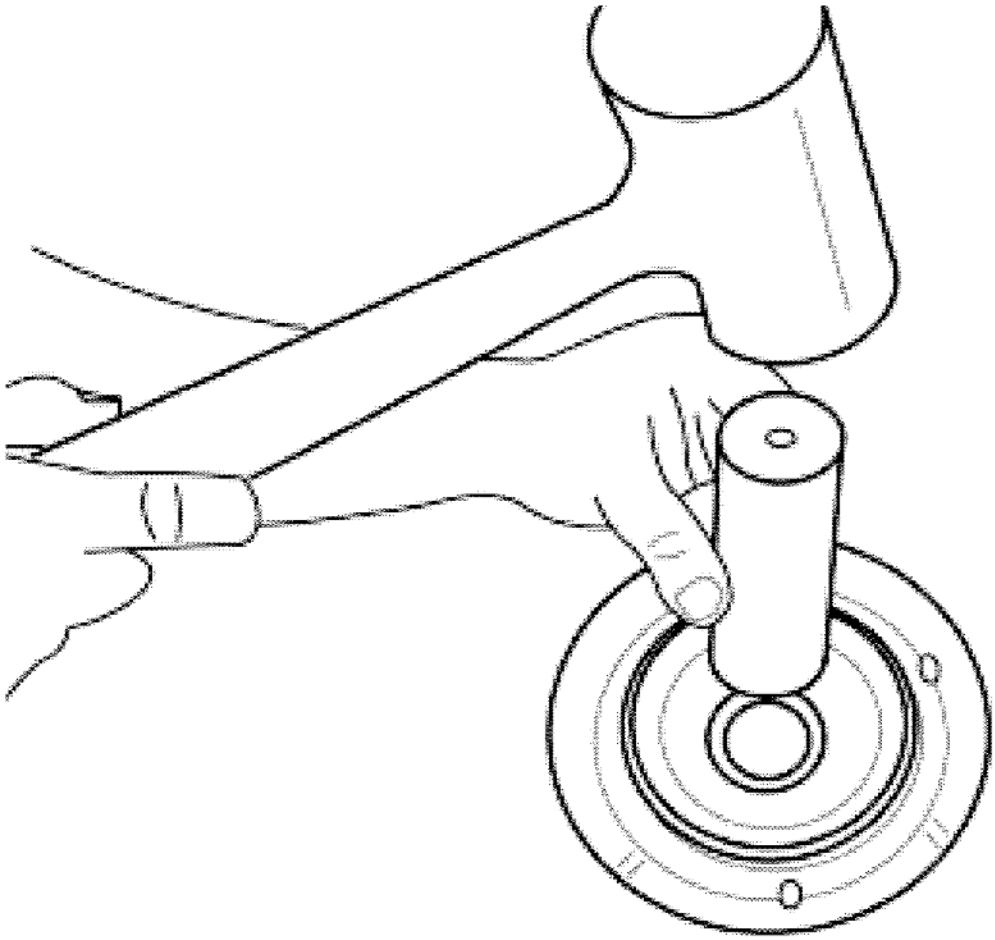


Fig. 218: Installing New Retaining Oil Seal
Courtesy of GENERAL MOTORS COMPANY

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

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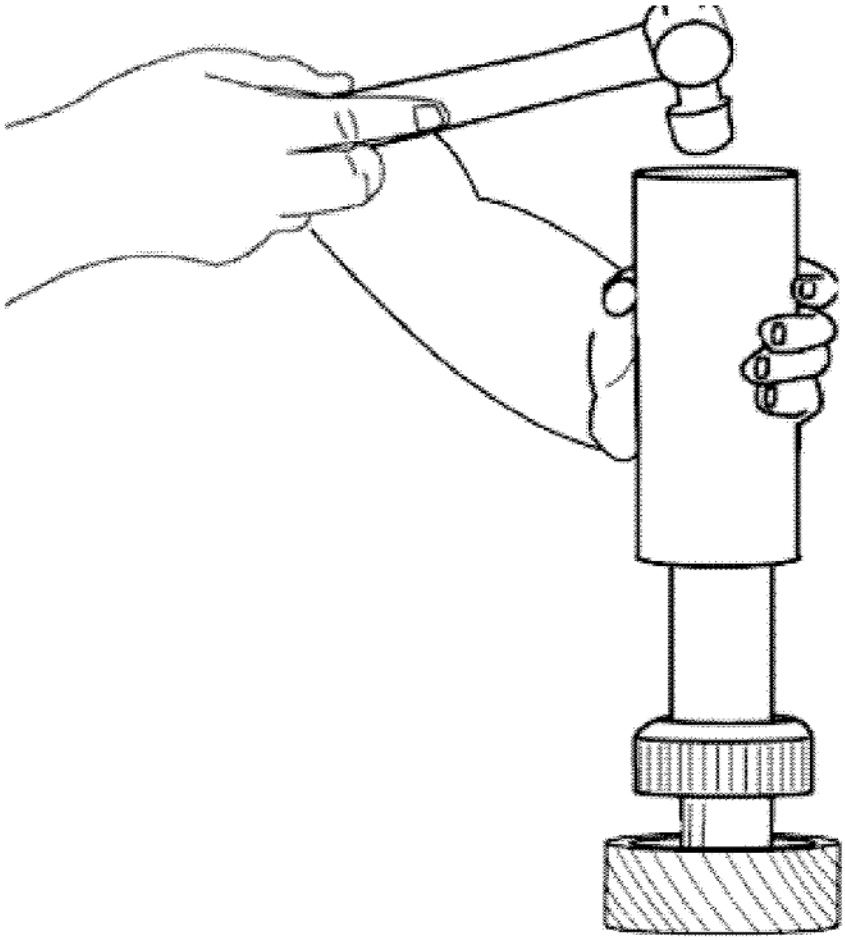


Fig. 219: Installing Drive Shaft Tapered Bearing Taper
Courtesy of GENERAL MOTORS COMPANY

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

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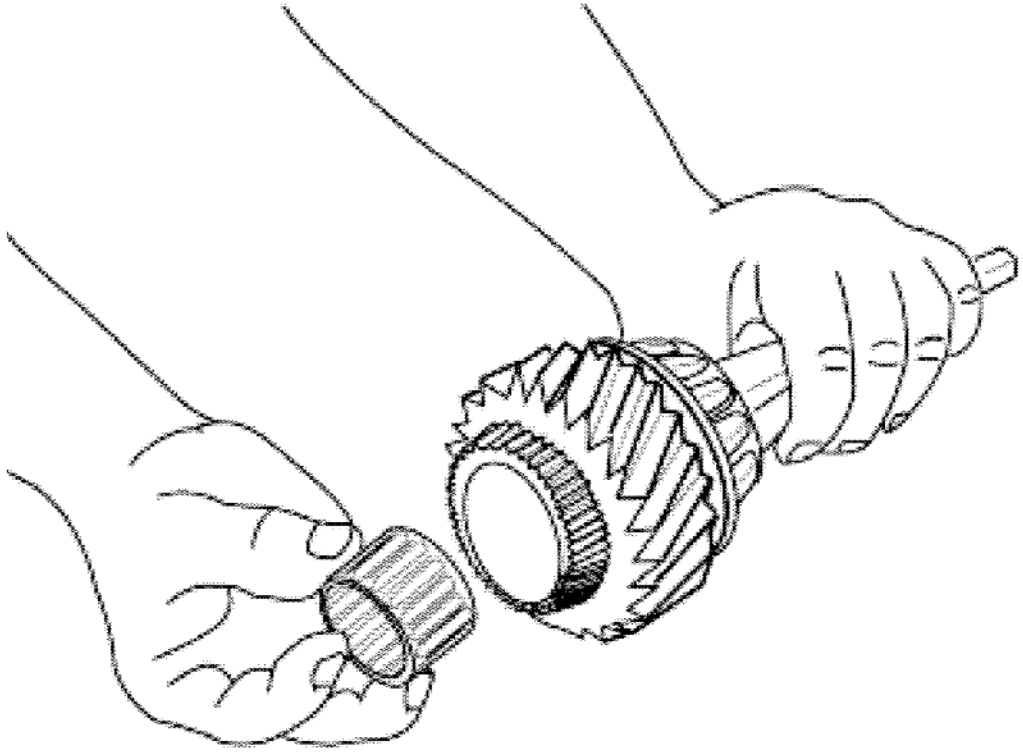


Fig. 220: Drive Shaft Interior Bearing Roller Cage
Courtesy of GENERAL MOTORS COMPANY

6. Install the drive shaft interior bearing roller cage.

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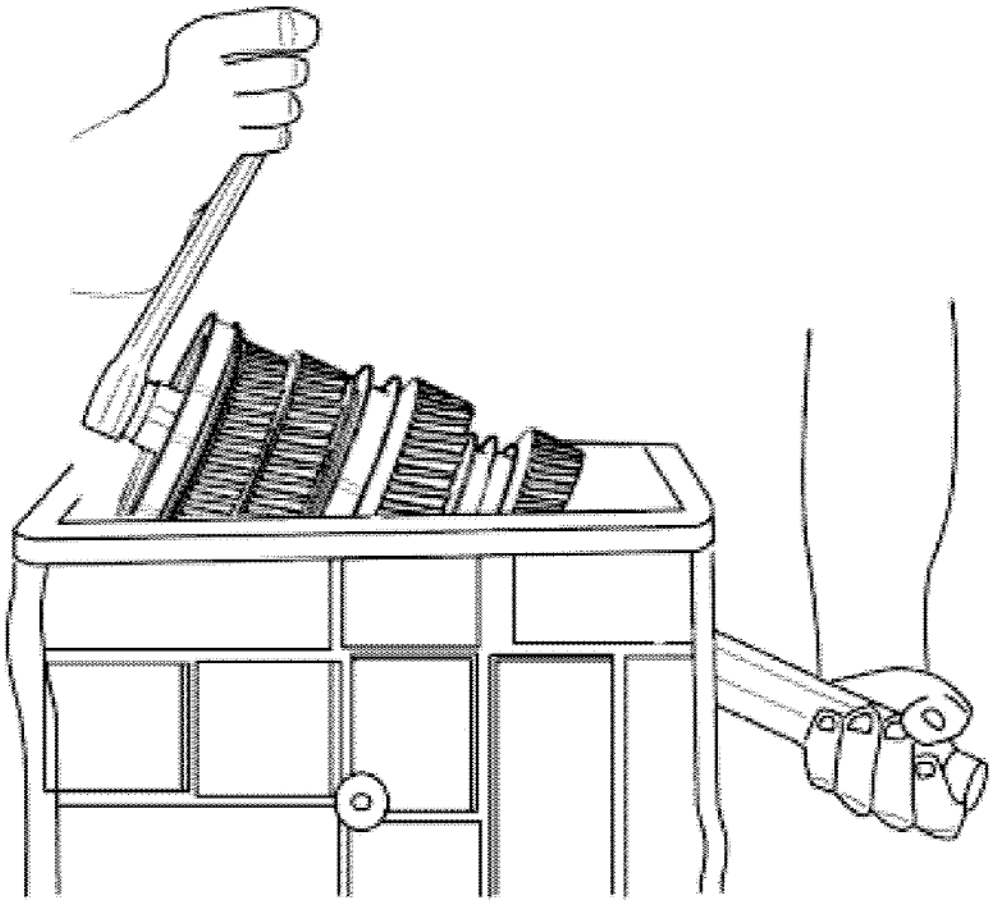


Fig. 221: Main Shaft Assembly
Courtesy of GENERAL MOTORS COMPANY

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.

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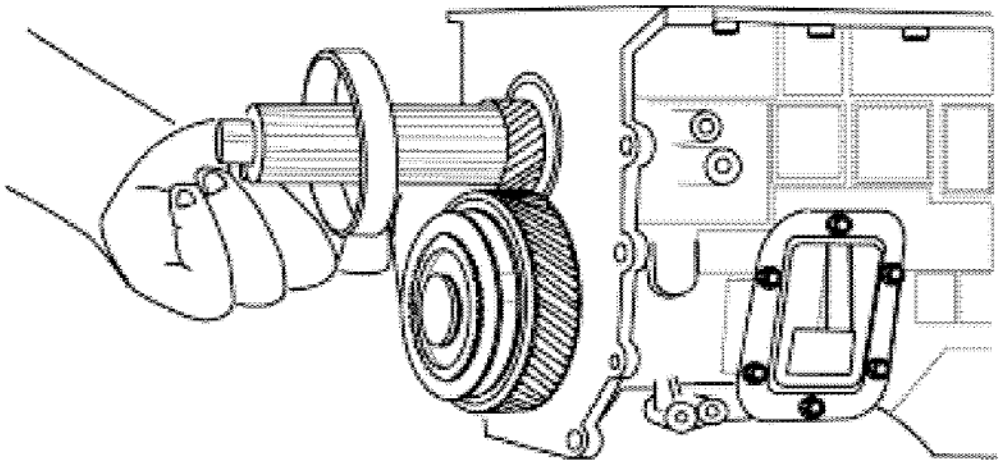


Fig. 222: Tapered Bearing Cup
Courtesy of GENERAL MOTORS COMPANY

8. Install the tapered bearing race.

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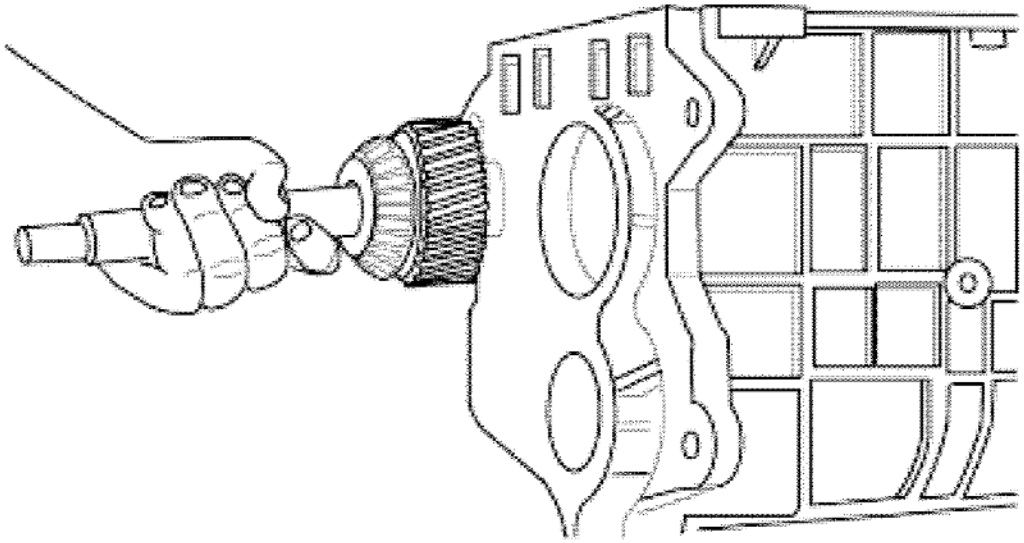


Fig. 223: Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

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

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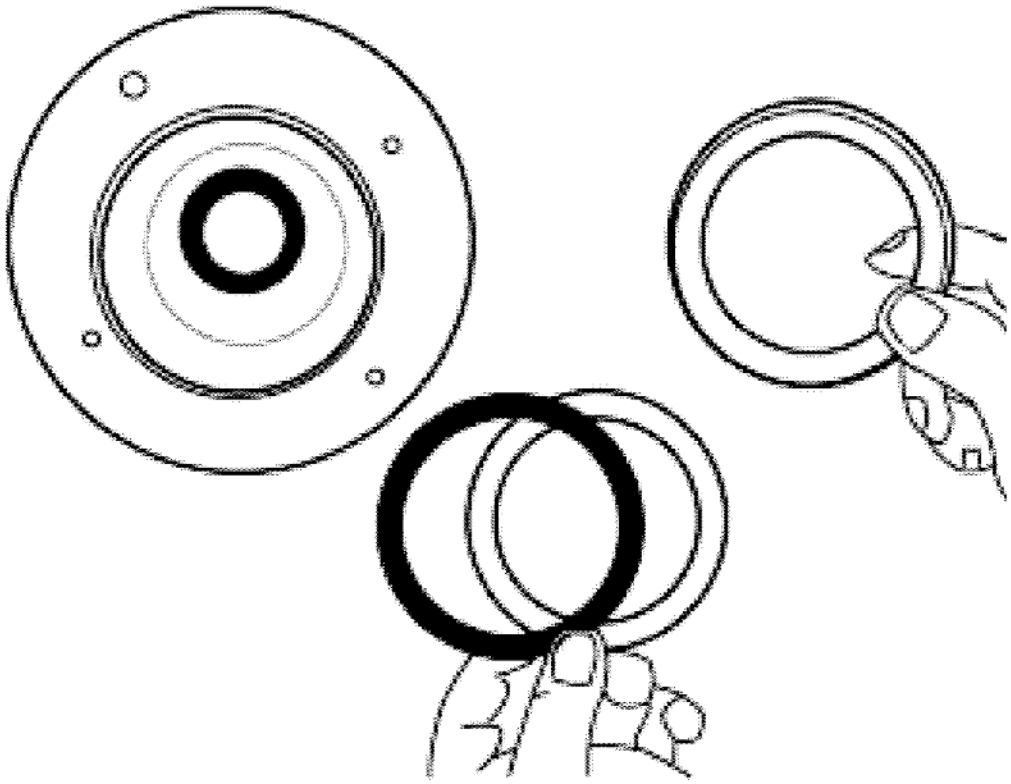


Fig. 224: Spacers And Bearing Race
Courtesy of GENERAL MOTORS COMPANY

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).

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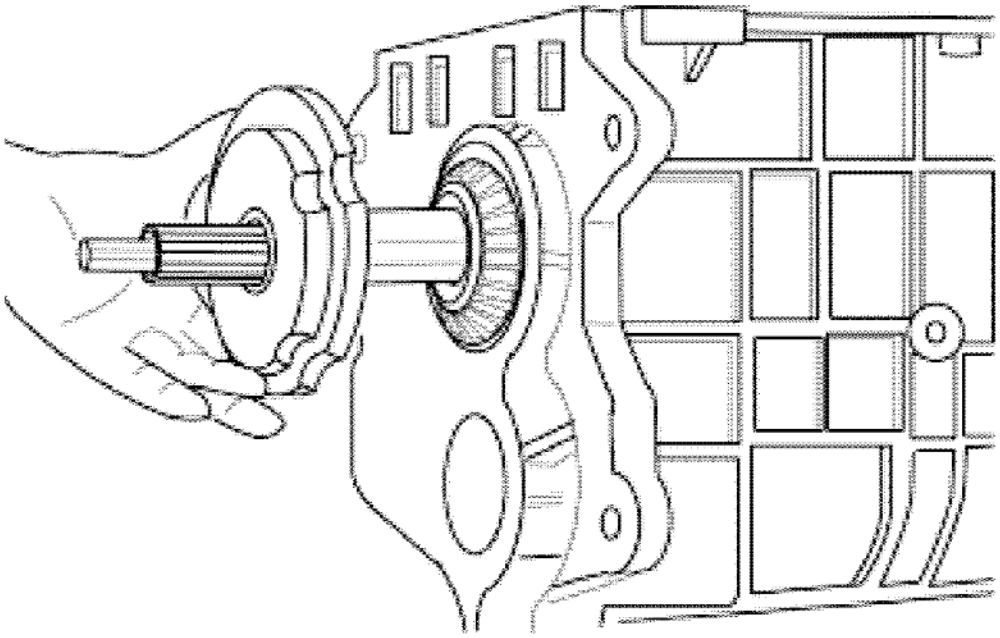


Fig. 225: Bearing Retainer
Courtesy of GENERAL MOTORS COMPANY

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

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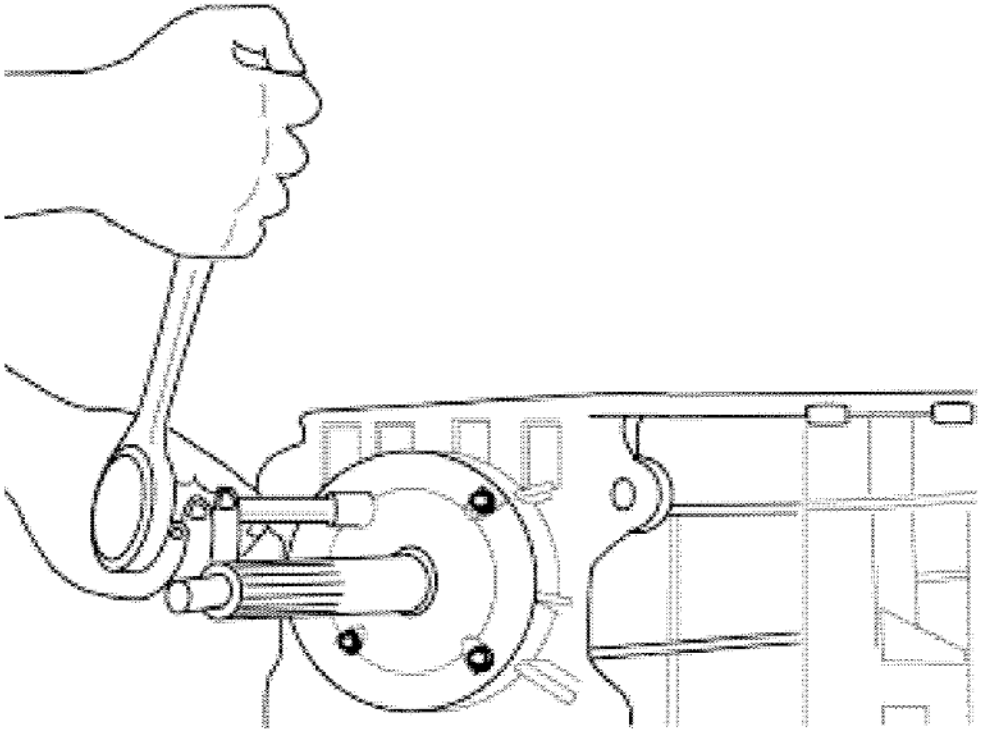


Fig. 226: Bearing Retainer Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

12. Tighten the 4 screws to 16-21 N.m (12-16 lb ft).

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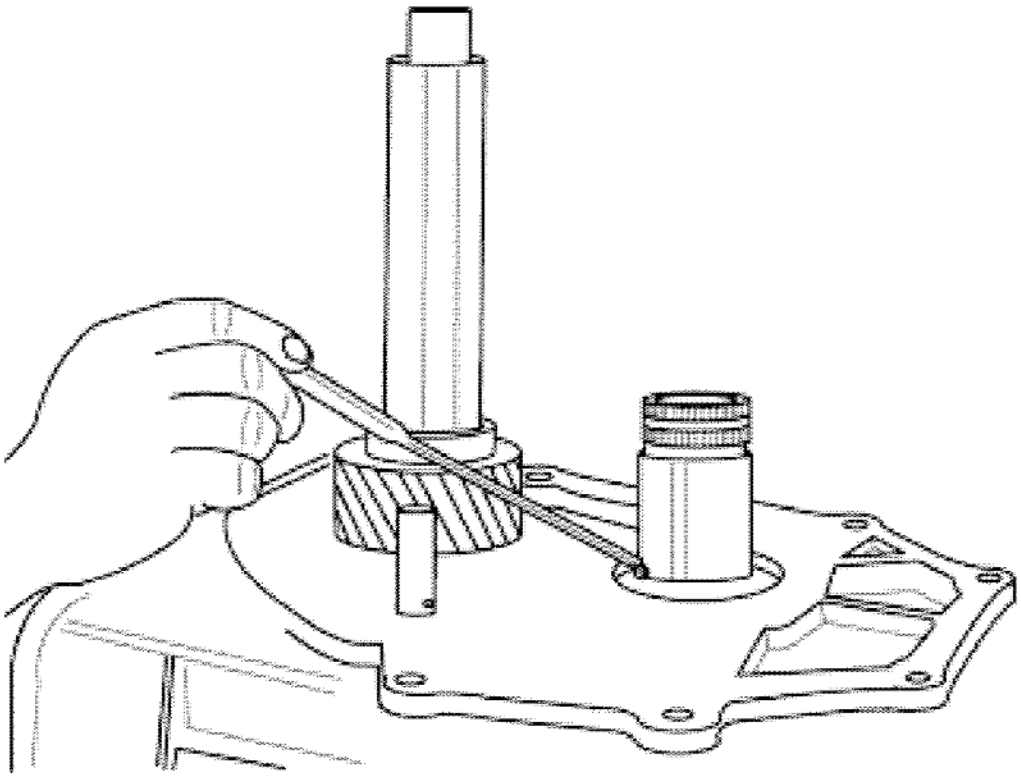


Fig. 227: Removing/Installing Pulley Sphere
Courtesy of GENERAL MOTORS COMPANY

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

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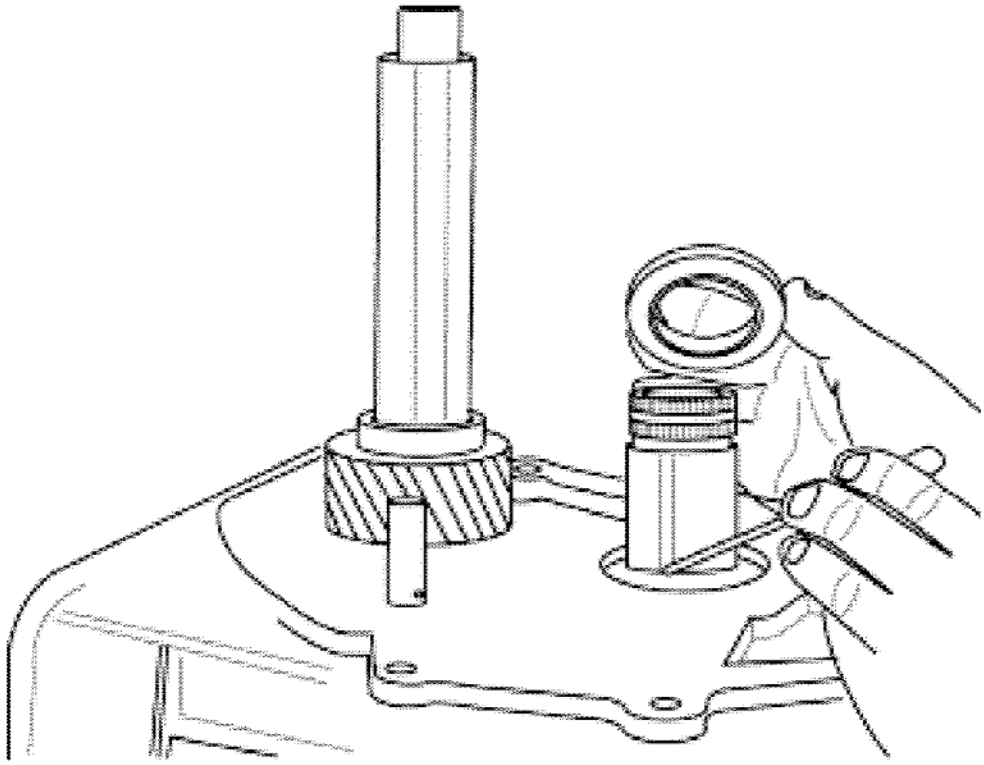


Fig. 228: Washer
Courtesy of GENERAL MOTORS COMPANY

14. Install the washer.

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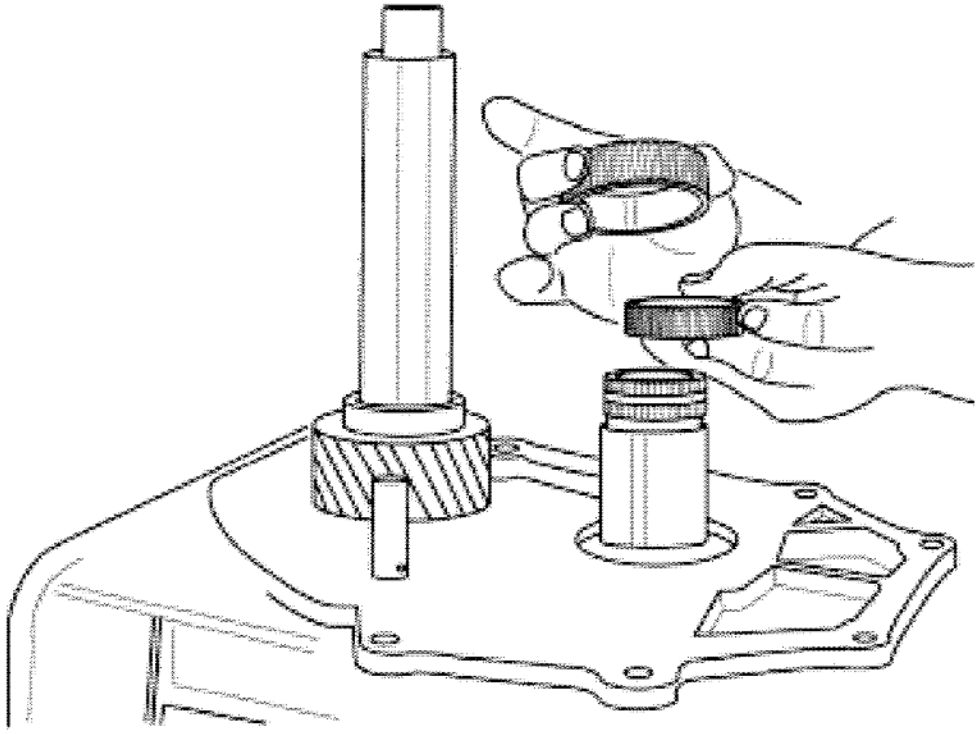


Fig. 229: Roller Bearings And Spacer
Courtesy of GENERAL MOTORS COMPANY

15. Install the 2 roller bearings and the spacer.

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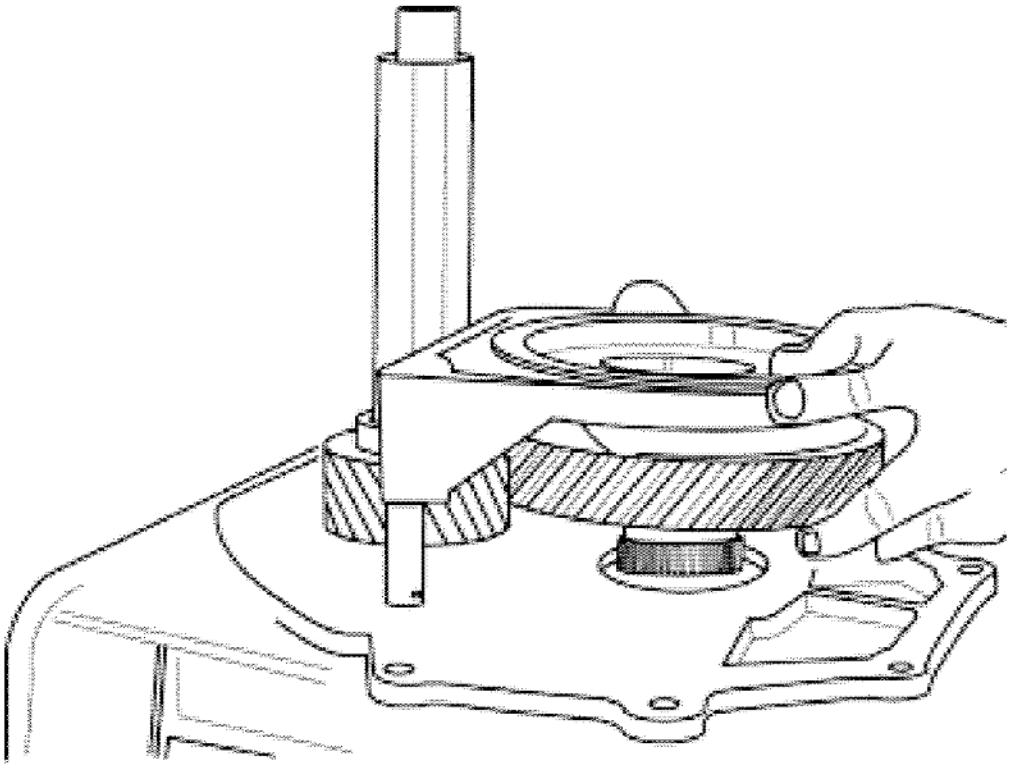


Fig. 230: 5th Gear Synchronizer And Fork
Courtesy of GENERAL MOTORS COMPANY

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

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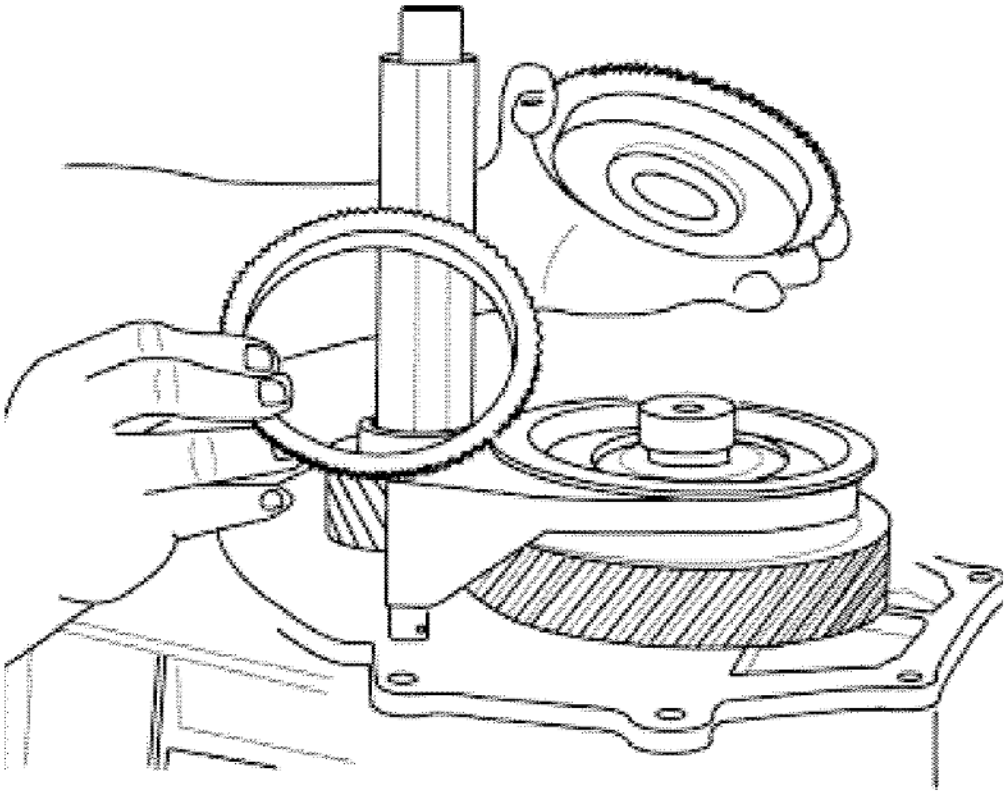


Fig. 231: Synchronizer Ring And 5th Gear
Courtesy of GENERAL MOTORS COMPANY

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

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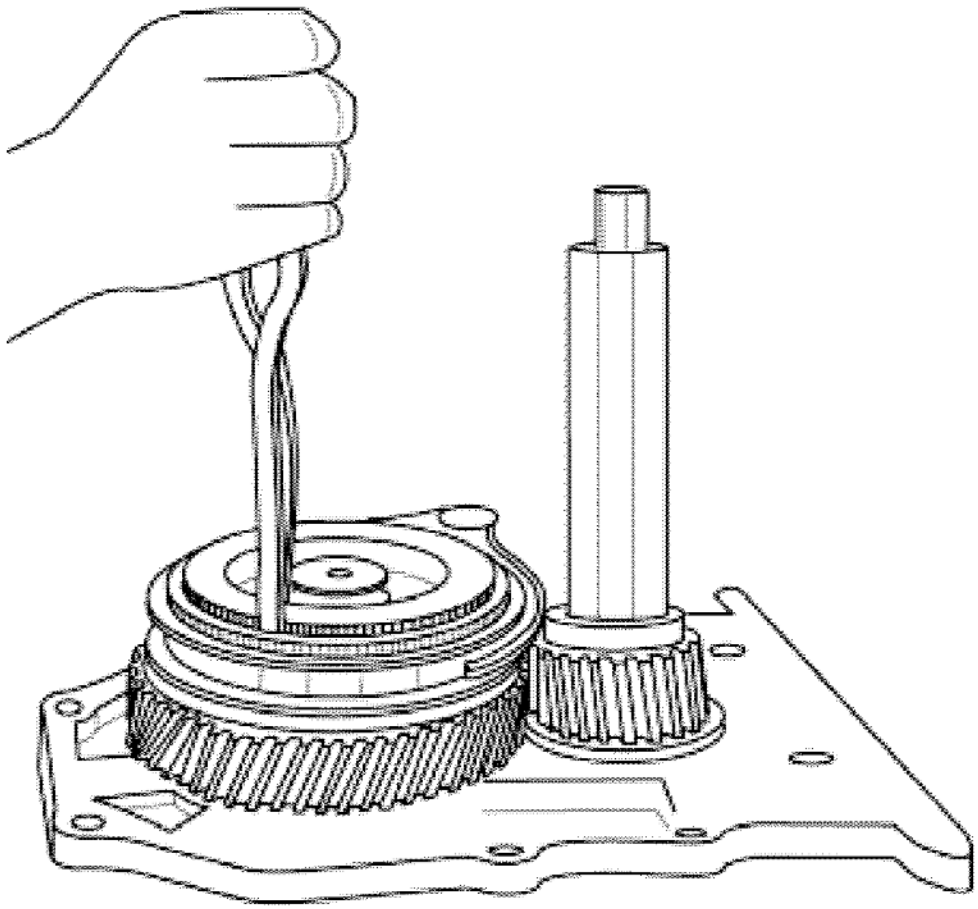


Fig. 232: Snap Ring
Courtesy of GENERAL MOTORS COMPANY

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

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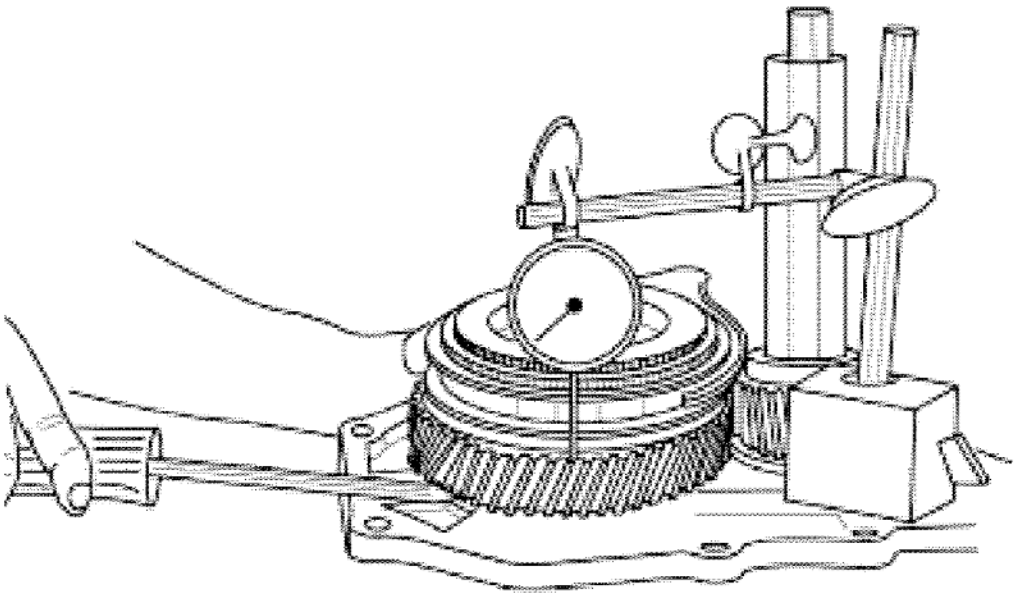


Fig. 233: Observing Axial Play
Courtesy of GENERAL MOTORS COMPANY

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

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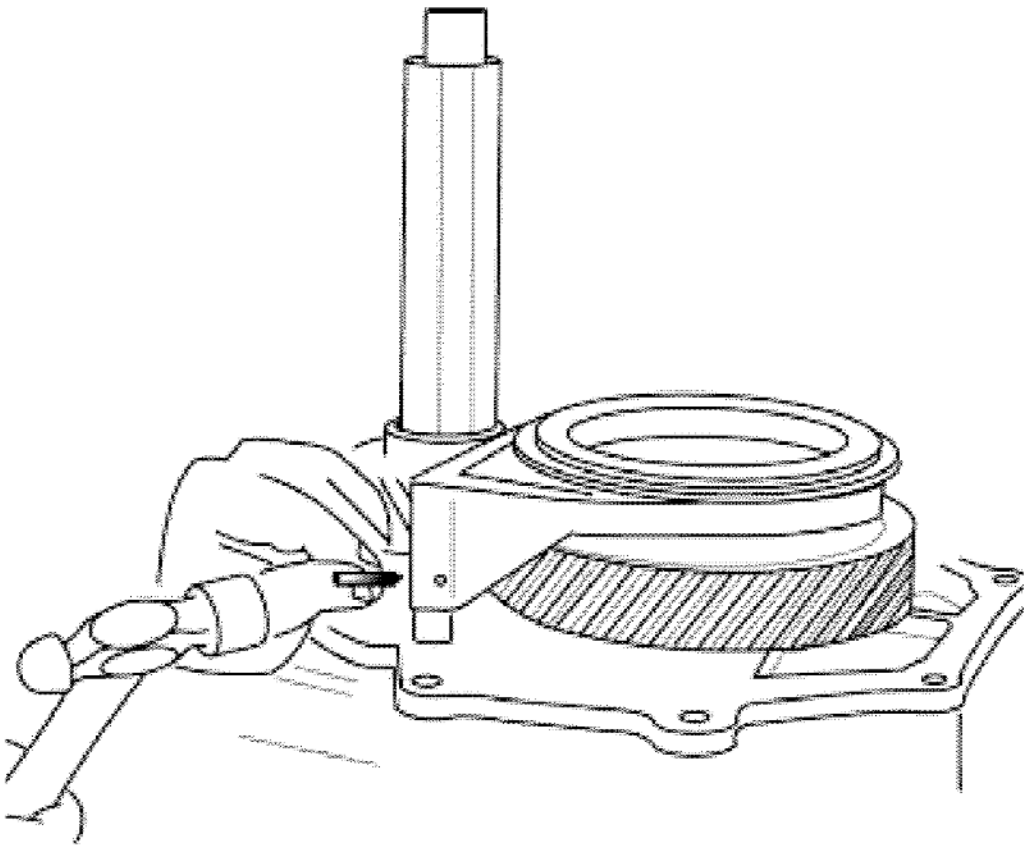


Fig. 234: Roll Pin
Courtesy of GENERAL MOTORS COMPANY

20. Install the roll pin.

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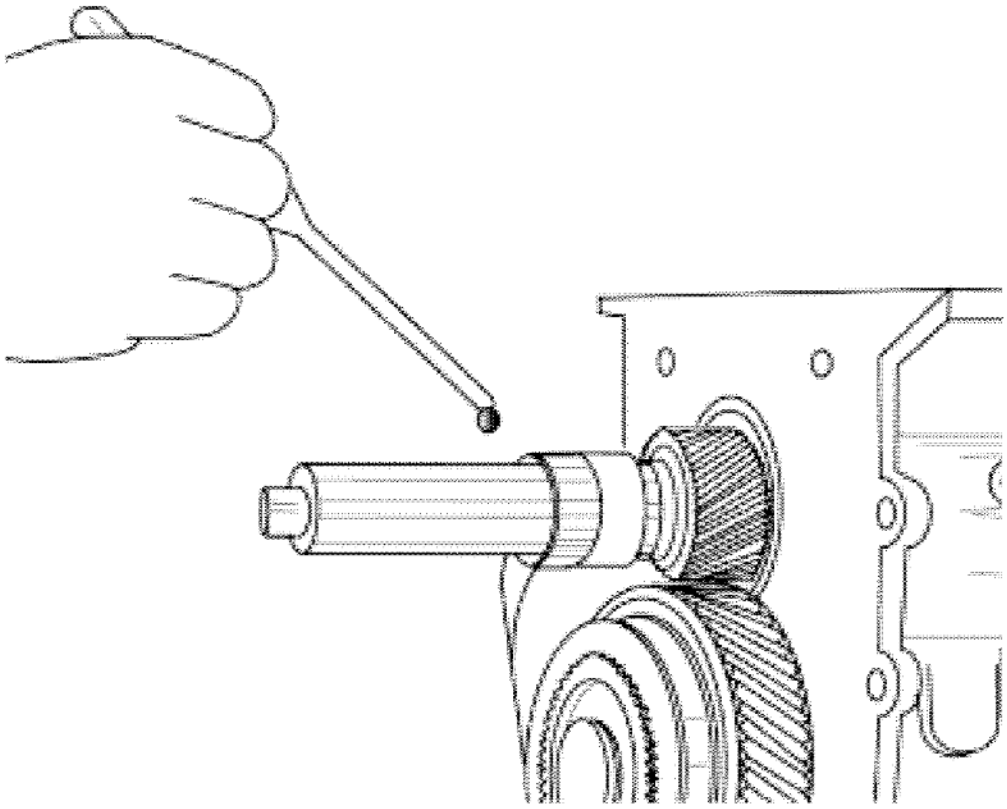


Fig. 235: Identifying Speedometer Gear
Courtesy of GENERAL MOTORS COMPANY

21. Position the speedometer gear.

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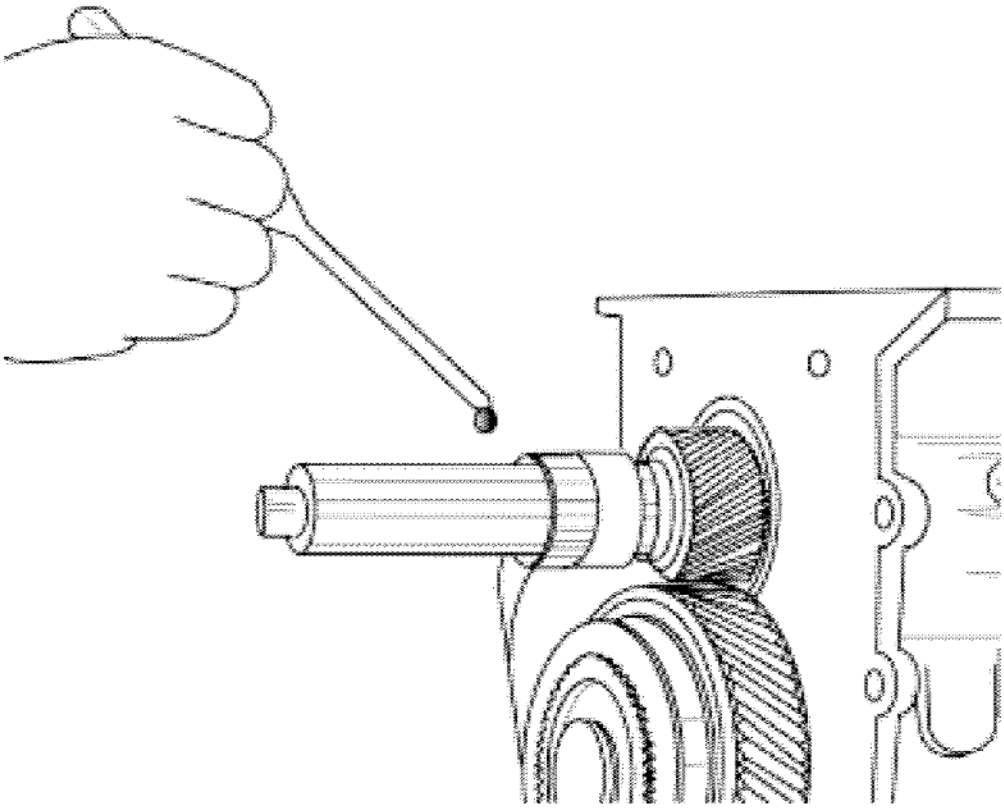


Fig. 236: Speedometer Tracking Balls
Courtesy of GENERAL MOTORS COMPANY

22. Install the speedometer gear tracking sphere.

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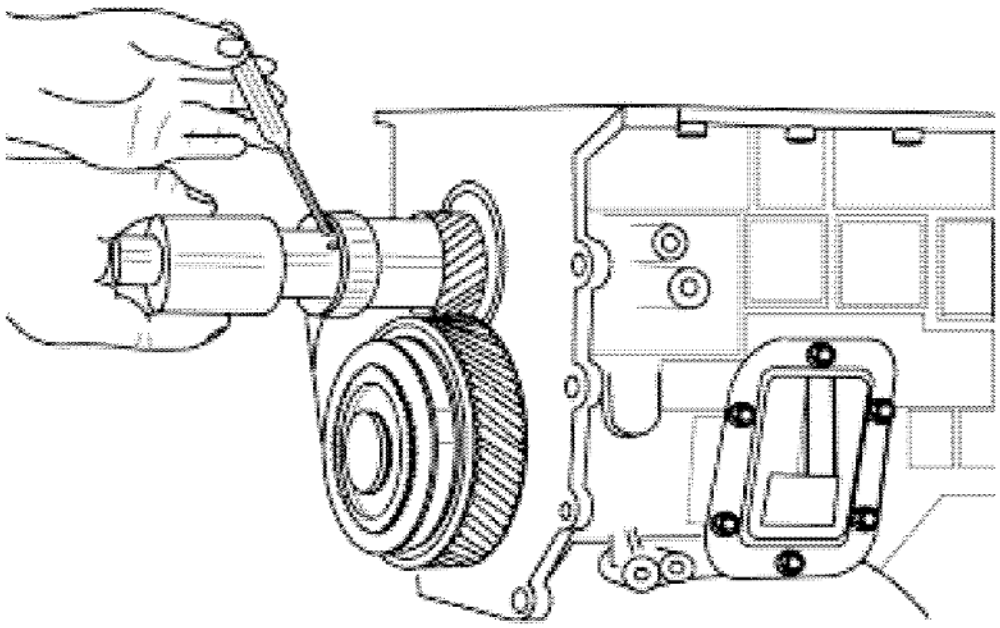


Fig. 237: Yoke Spacer
Courtesy of GENERAL MOTORS COMPANY

23. Install the yoke spacer.

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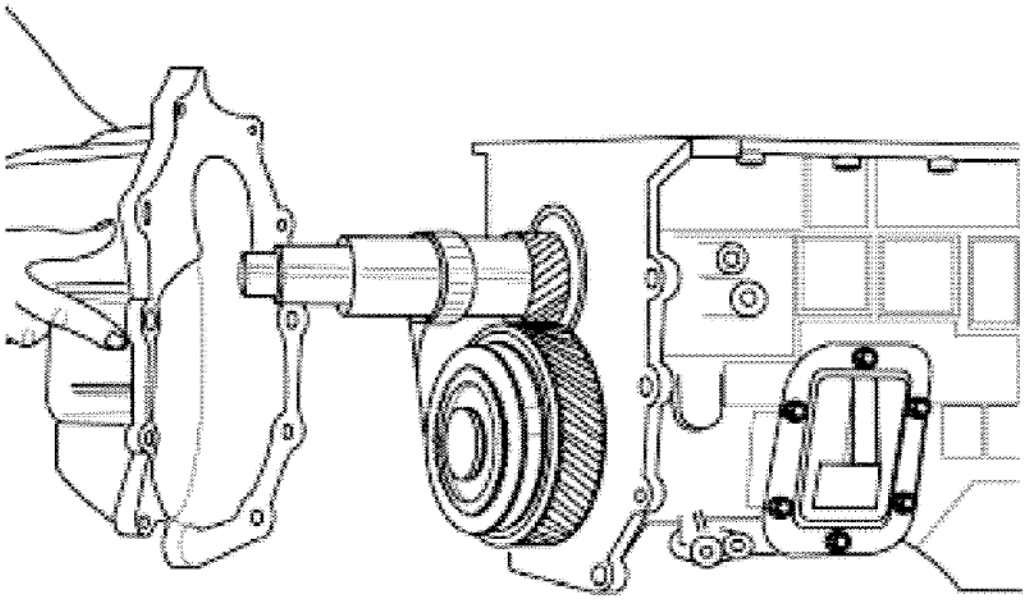


Fig. 238: Cover
Courtesy of GENERAL MOTORS COMPANY

24. Install the cover.

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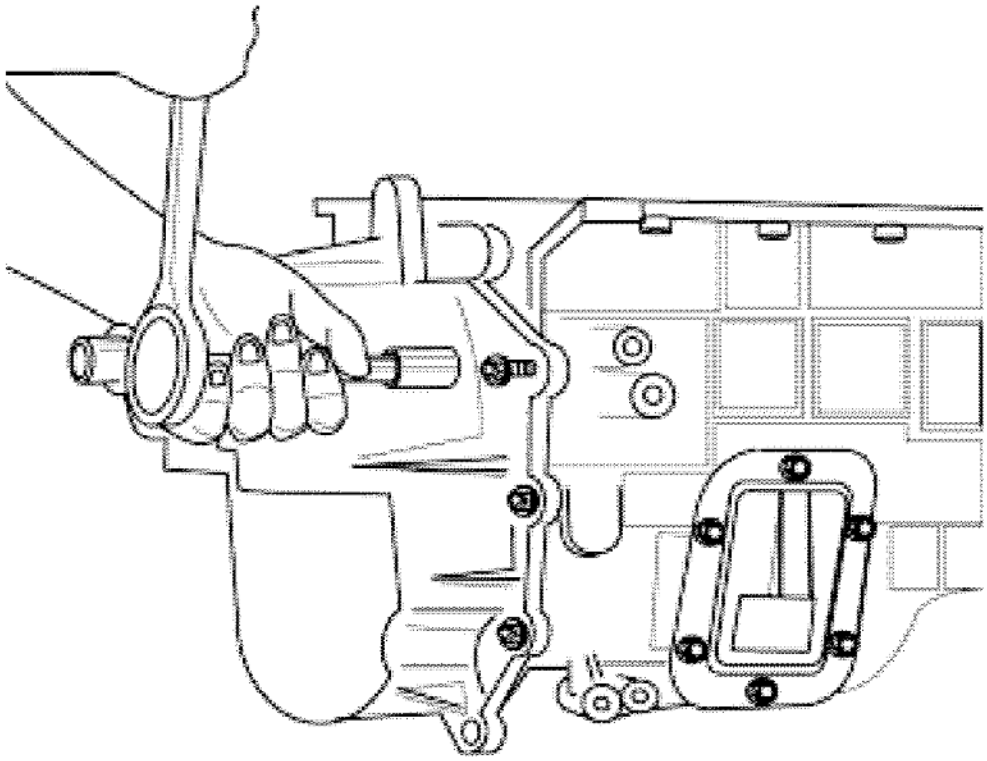


Fig. 239: Aligning Cover
Courtesy of GENERAL MOTORS COMPANY

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

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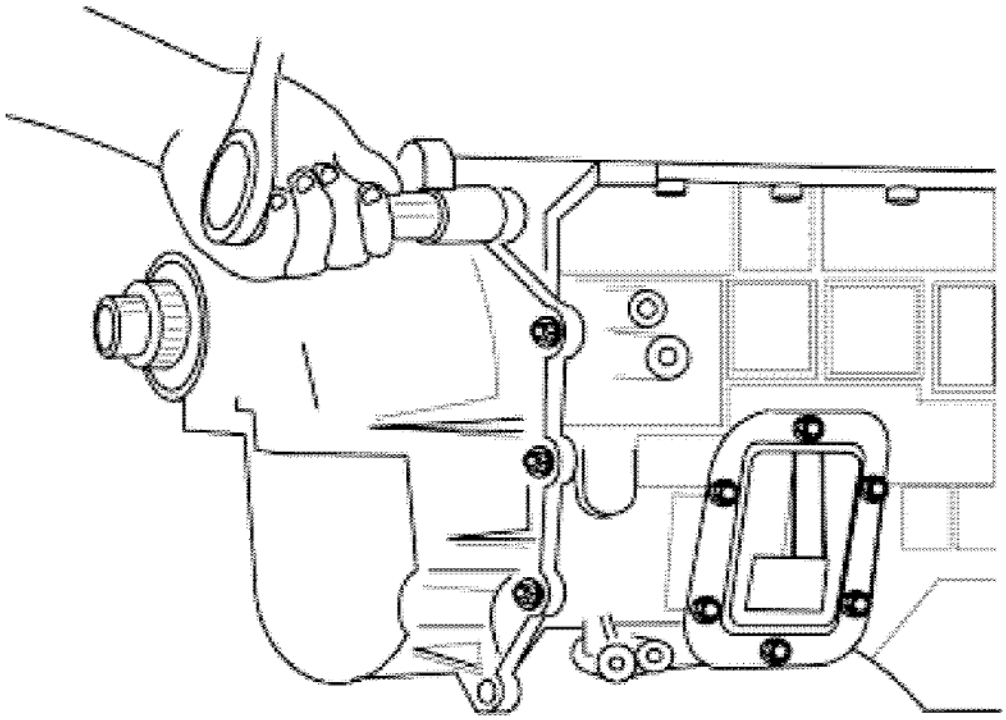


Fig. 240: Rear Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

26. Tighten the rest of the 8 screws to 57-68 N.m (42-50 lb ft).

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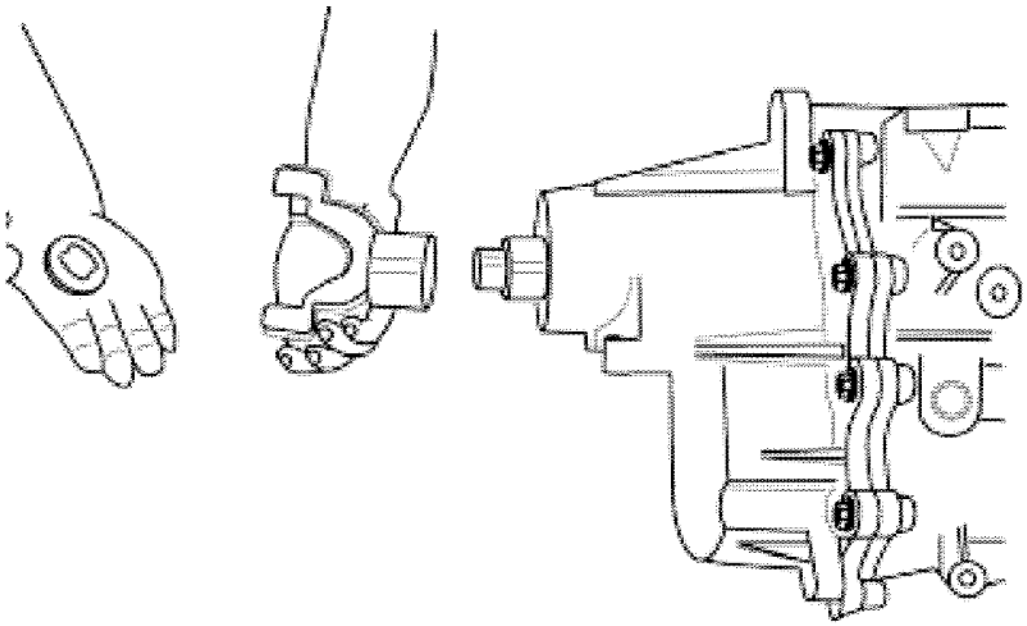


Fig. 241: Main Shaft Nut & Yoke
Courtesy of GENERAL MOTORS COMPANY

27. Install the main shaft yoke washer and nut.

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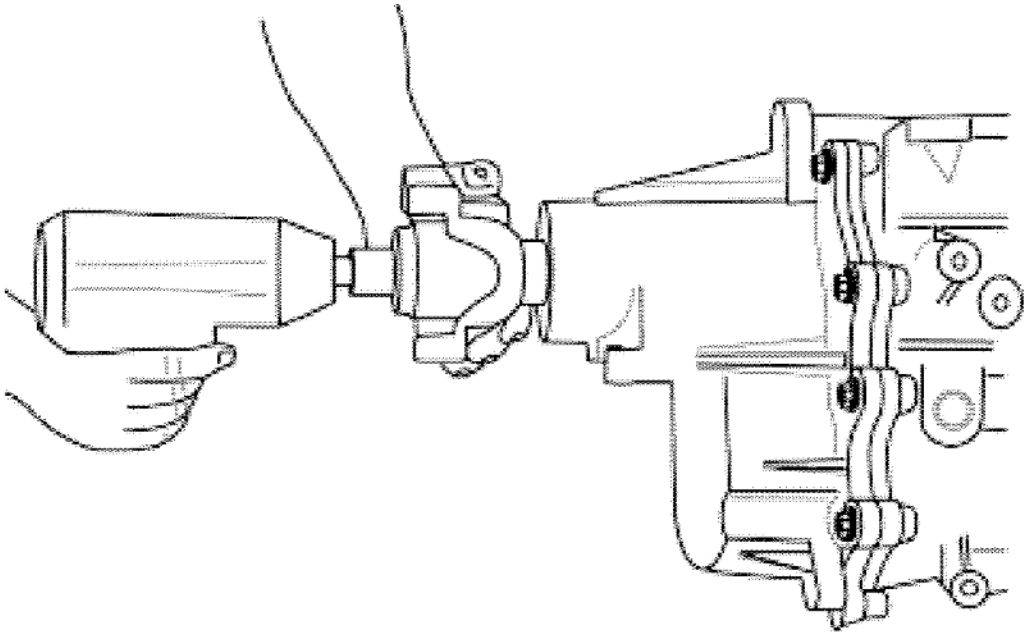


Fig. 242: Main Shaft Nut
Courtesy of GENERAL MOTORS COMPANY

28. Tighten the main shaft nut to 150-170 N.m (110-125 lb ft).
29. Use a punch to peen the main shaft nut to the output shaft.

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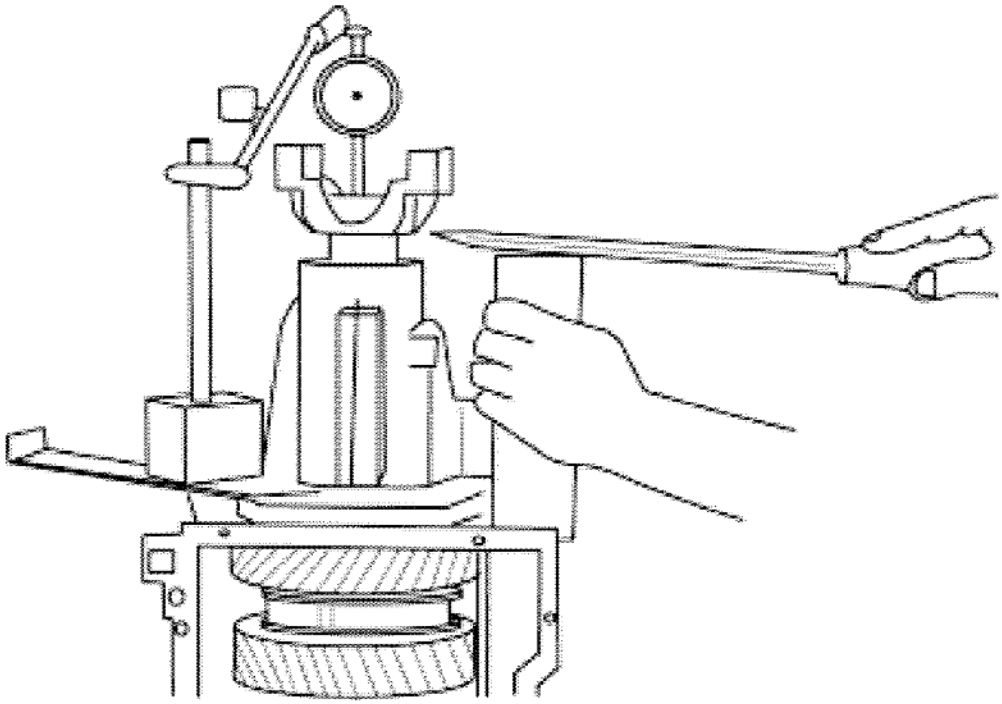


Fig. 243: Measuring Axial Play
Courtesy of GENERAL MOTORS COMPANY

30. 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).

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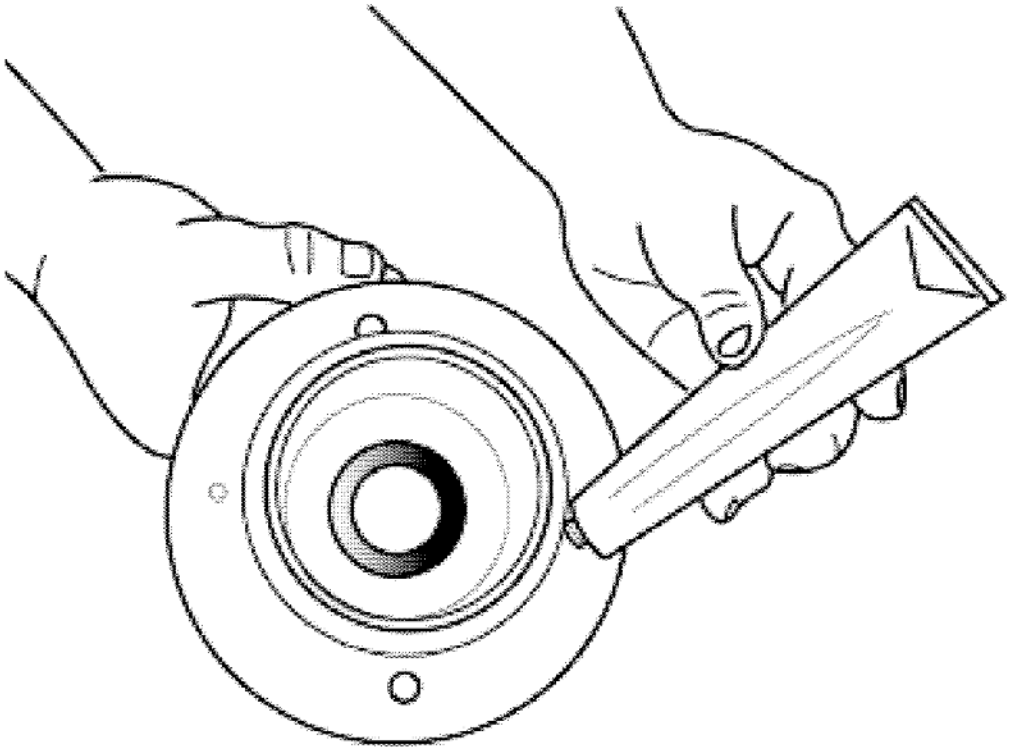


Fig. 244: Applying Gasket Maker
Courtesy of GENERAL MOTORS COMPANY

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

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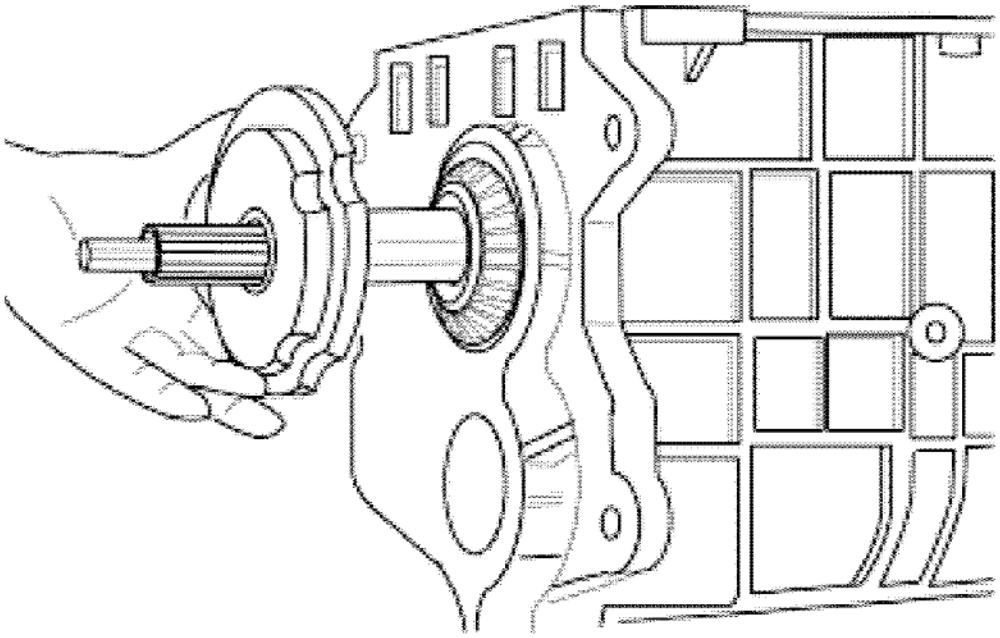


Fig. 245: Bearing Retainer
Courtesy of GENERAL MOTORS COMPANY

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

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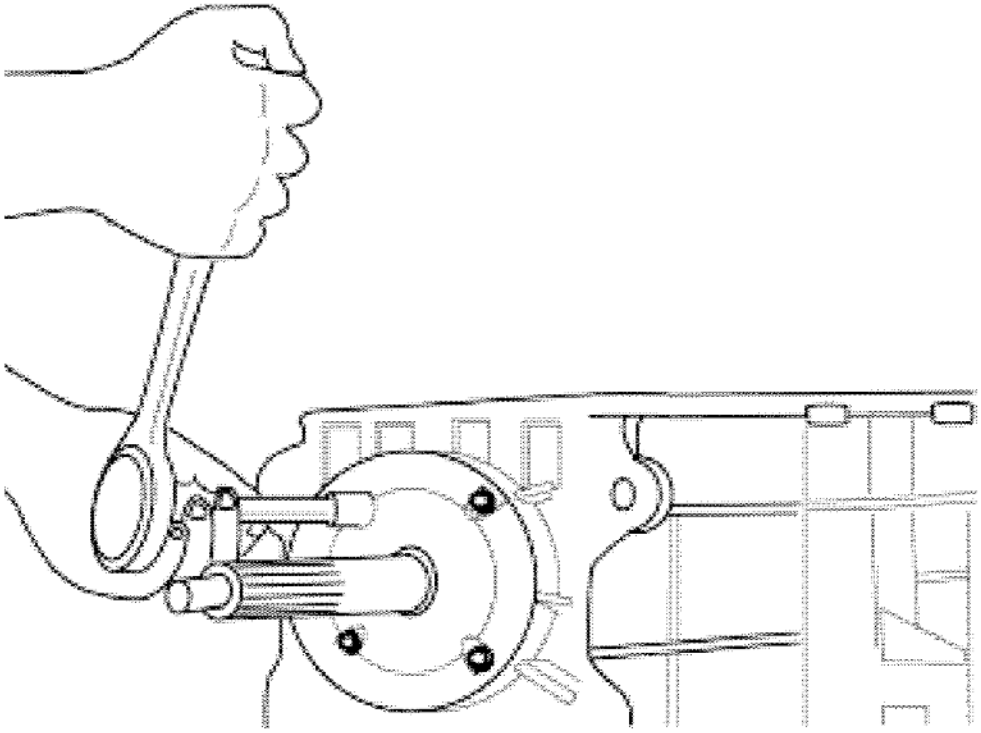


Fig. 246: Bearing Retainer Bolts
Courtesy of GENERAL MOTORS COMPANY

33. Apply a TeflonÂ® sealer to the screw threads.
34. Install the screws and tighten to 34-40 N.m (25-30 lb ft).

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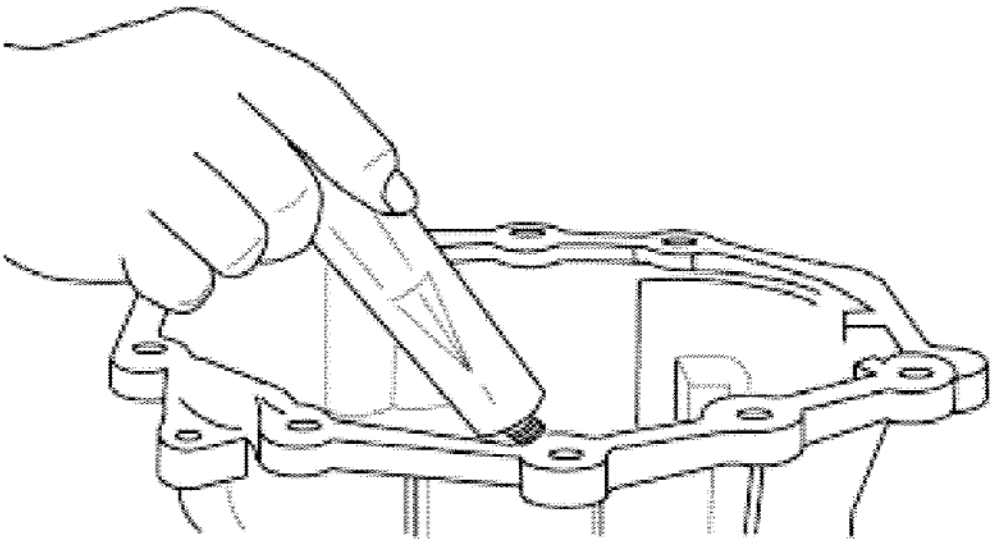


Fig. 247: Applying Gasket Maker
Courtesy of GENERAL MOTORS COMPANY

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

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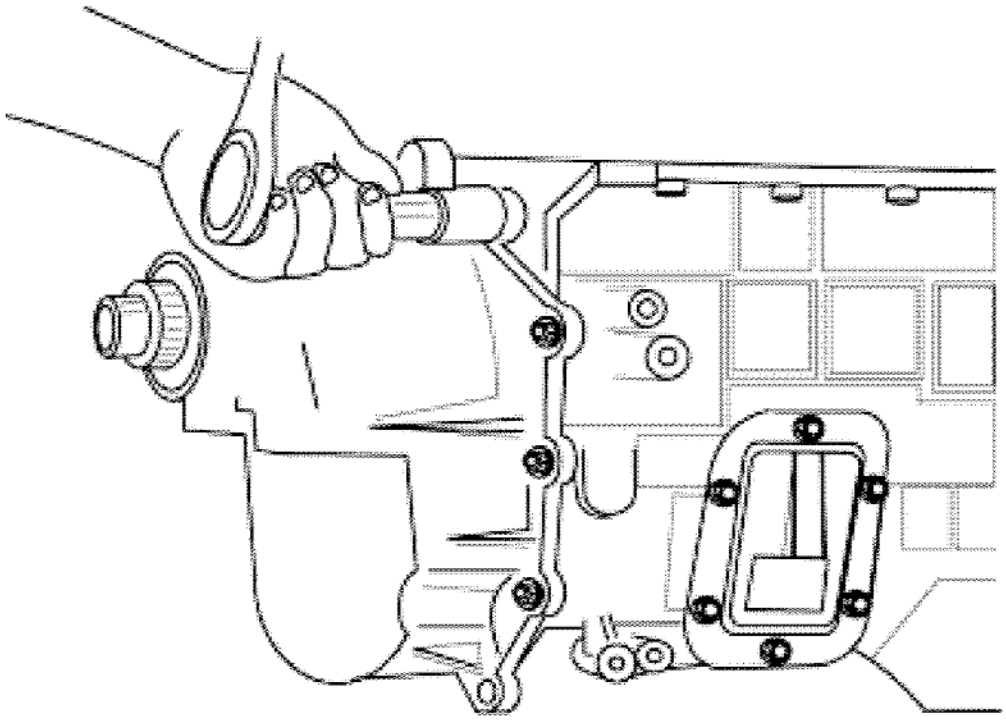


Fig. 248: Rear Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

36. Apply a TeflonÂ® sealer to the screw threads.
37. Install the screws and tighten to 57-68 N.m (42-50 lb ft).

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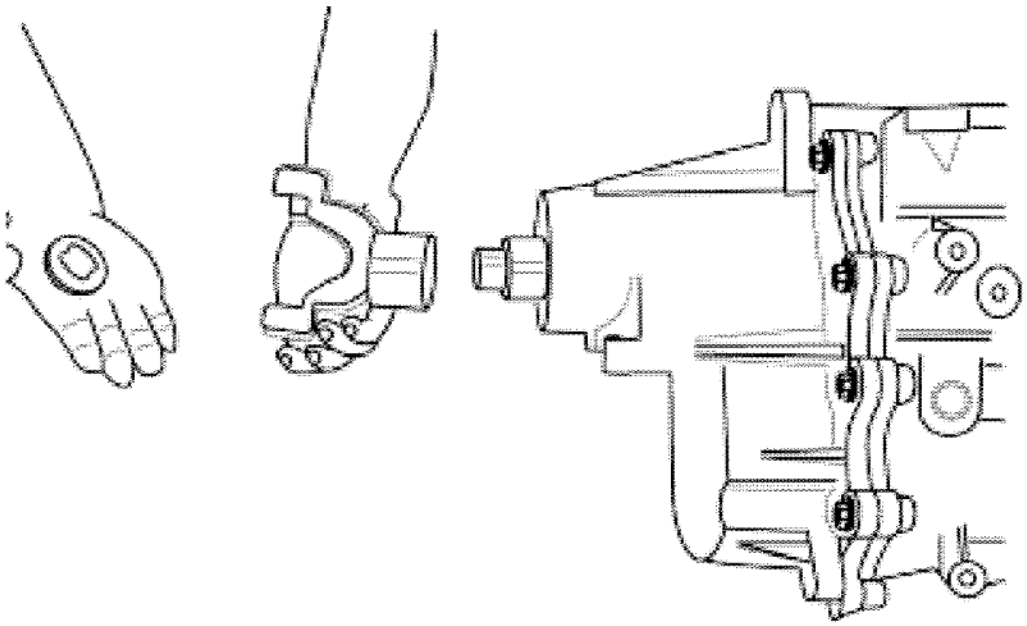


Fig. 249: Main Shaft Nut & Yoke
Courtesy of GENERAL MOTORS COMPANY

38. Install the main shaft yoke onto the main shaft.

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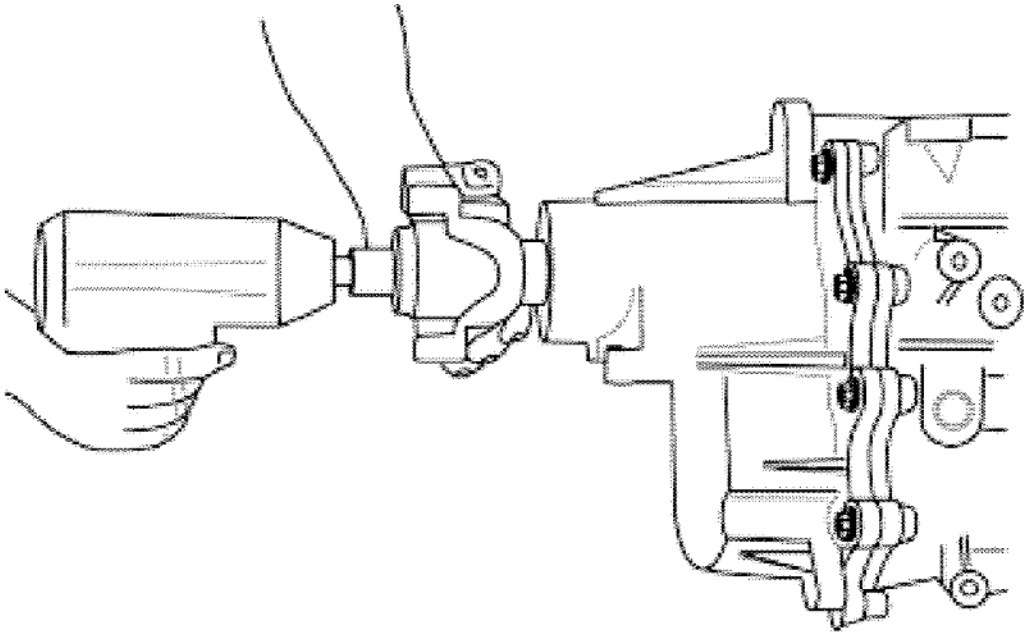


Fig. 250: Main Shaft Nut
Courtesy of GENERAL MOTORS COMPANY

39. Tighten the NEW main shaft nut to 150-170 N.m (110-125 lb ft).

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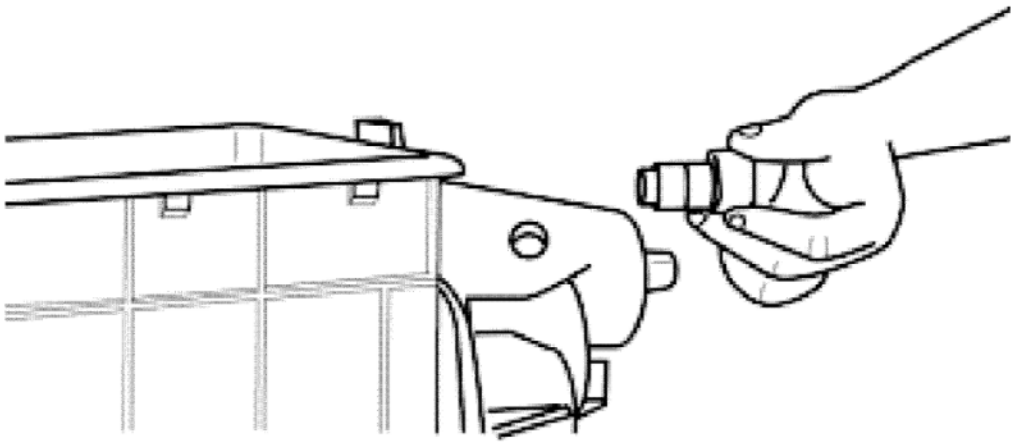


Fig. 251: VSS
Courtesy of GENERAL MOTORS COMPANY

40. Install the vehicle speed sensor, if necessary.

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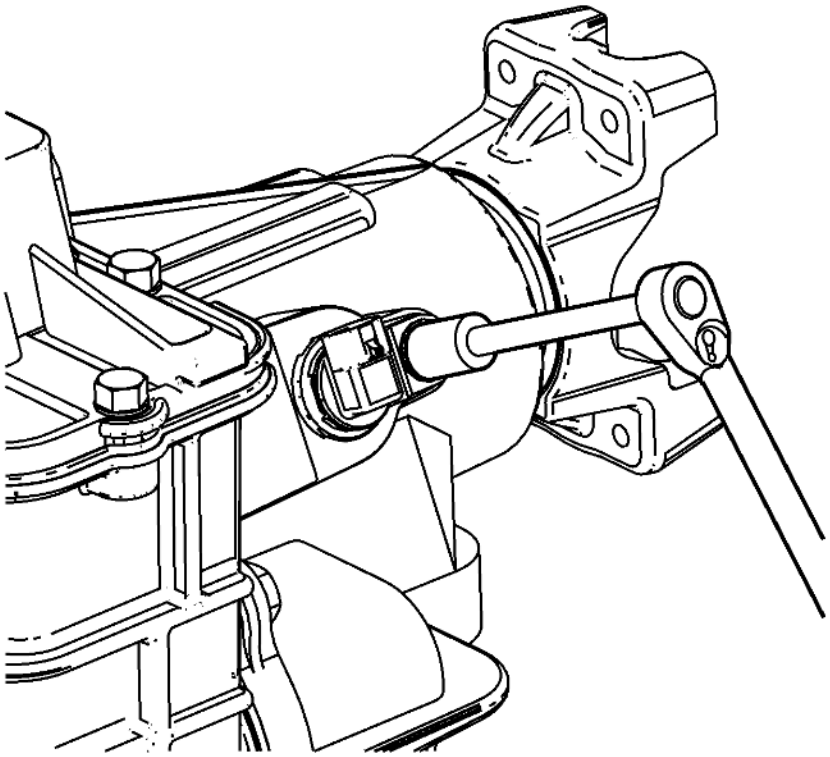


Fig. 252: Using Ratchet On Vehicle Speed Sensor (VSS) Screw
Courtesy of GENERAL MOTORS COMPANY

41. Tighten the vehicle speed sensor.

CAUTION: Use the correct oil. The transmission could be severely damaged if the correct oil is not used.

42. 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.

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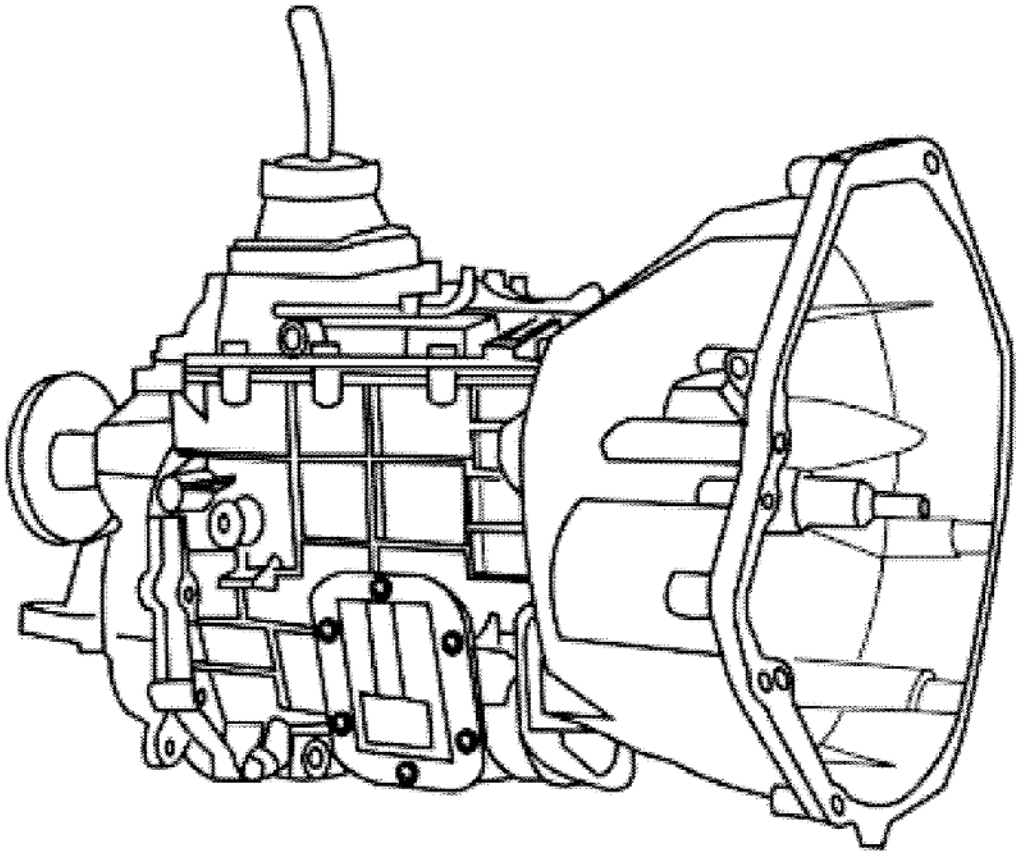


Fig. 253: Manual Transmission
Courtesy of GENERAL MOTORS COMPANY

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.

NO TITLE

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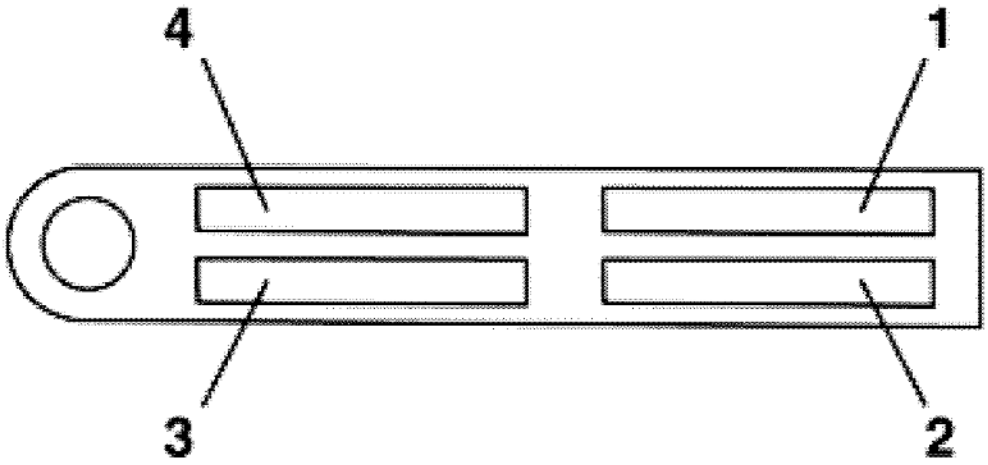


Fig. 254: Transmission Identification Plate
Courtesy of GENERAL MOTORS COMPANY

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

SPECIAL TOOLS AND EQUIPMENT

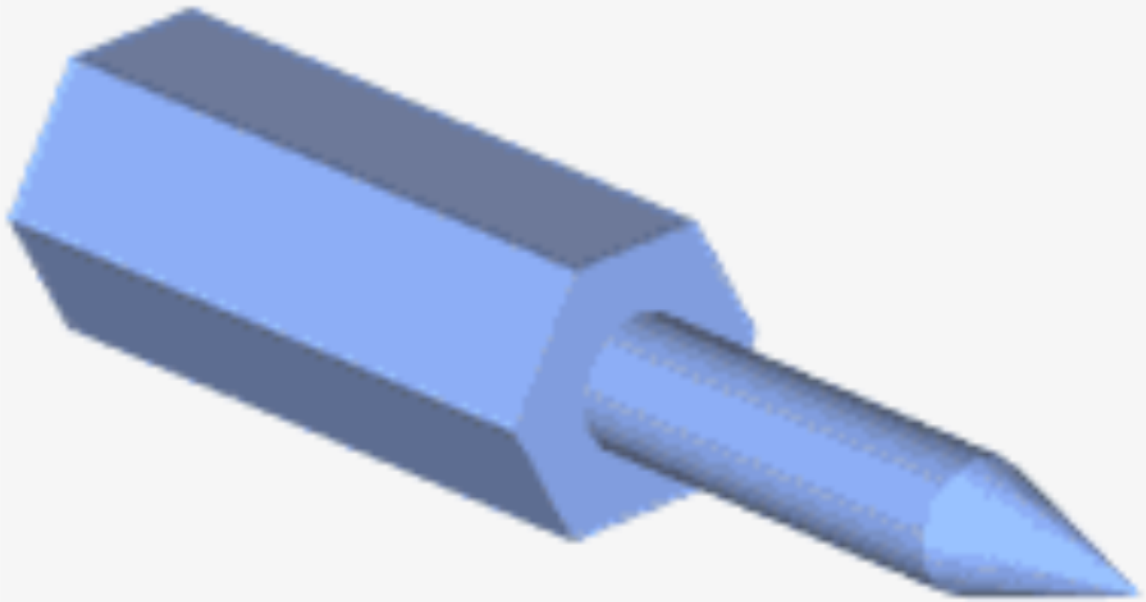
SPECIAL TOOLS

Illustration	Tool Number/Description

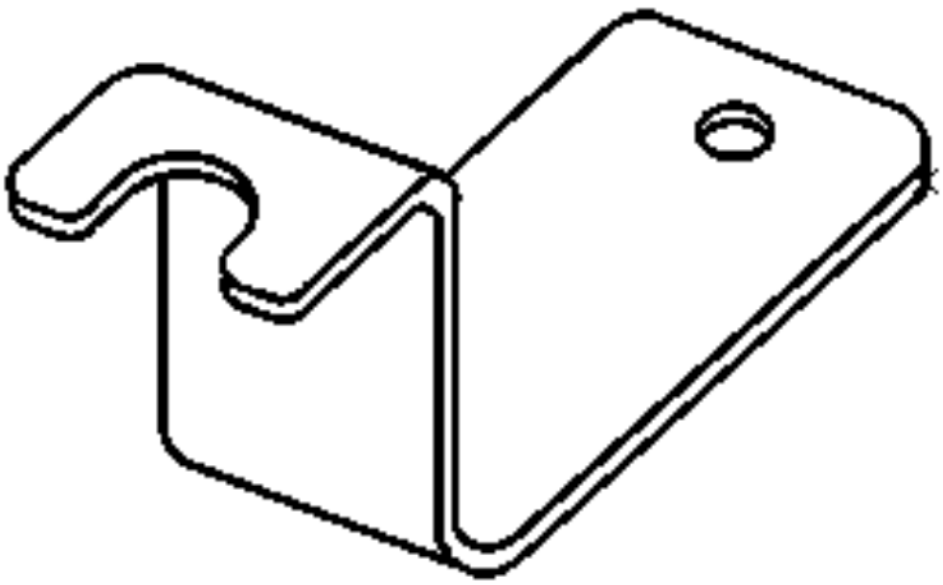
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Illustration	Tool Number/Description
	J 23907 Slide Hammer with Bearing Adapter

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Illustration	Tool Number/Description
	J 36825 Output Shaft Oil Seal Remover (4WD Models Only)

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Illustration	Tool Number/Description
	J 42371 Hydraulic Clutch Line Separator

Article GUID: A00854535

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