

2010 Chevrolet Camaro LS

2010 TRANSMISSION Manual Transmission - Aisin AY6 - Camaro

2010 TRANSMISSION

Manual Transmission - Aisin AY6 - Camaro

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Backup Lamp Switch	44 N.m	32 lb ft
Bearing Lock Plate Bolt	11.3 N.m	100 lb in
Clutch Release Cylinder Bolts	16.5 N.m	12 lb ft
Clutch Release Cylinder Piping Bolt	8.5 N.m	75 lb in
Drain Plug	37 N.m	27 lb ft
Fill Plug	37 N.m	27 lb ft
Front Case to Middle Case Bolts	40 N.m	29 lb ft
Shift Control Lever Bracket Bolts	21 N.m	15 lb ft
Middle Case to Rear Case Bolts	40 N.m	29 lb ft
Oil Trough Bolts	8.5 N.m	75 lb in
Rear Case to Housing Extension Bolts	29 N.m	21 lb ft
Reverse Idler Shaft Bolt	28 N.m	20 lb ft
Service Hole Plug	39.2 N.m	29 lb ft
Shift Fork Bolts	19.5 N.m	14 lb ft
Shift and Select Lever Bolt	33.3 N.m	24 lb ft
Shift Shaft Detent Plug	24.5 N.m	18 lb ft
Speed Sensor Bolt	8 N.m	71 lb in

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
1st/2nd Gear Synchronizer Sleeve	Lubricant	88862475	88862476
2nd Gear	Lubricant	88862475	88862476
2nd Gear Bearings	Lubricant	88862475	88862476
2nd Gear Outer Blocker Ring	Lubricant	88862475	88862476
2nd Gear Synchronizer Inner Cone	Lubricant	88862475	88862476
2nd Gear Synchronizer Outer Cone	Lubricant	88862475	88862476
3rd Gear Bearings	Lubricant	88862475	88862476
3rd Gear Blocking Ring	Lubricant	88862475	88862476
3rd/4th Gear Spacer	Lubricant	88862475	88862476
4th Gear Bearings	Lubricant	88862475	88862476

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5th Gear Blocking Ring	Lubricant	88862475	88862476
6th Gear Bearings	Lubricant	88862475	88862476
6th Gear Blocking Ring	Lubricant	88862475	88862476
Case to Case	Sealant	89020326	89021188
Control Select Arm	Lubricant	88862475	88862476
Internal Shift Control Lever	Lubricant	88862475	88862476
Service Hole Plug	Pipe Sealant	12346004	10953480
Shift and Select Lever Bolt	Threadlocker	12345382	10953489
Shift Fork Bolts	Threadlocker	12345382	10953489
Shift Shaft Detent Plug	Pipe Sealant	12346004	10953480
Transmission Fluid	SAE 75W-90 (GL-5)	88862475	88862476

LUBRICATION SPECIFICATIONS

Application	Specification	
	Metric	English
Manual Transmission Fluid GL-5 SAE 75W-90 GM P/N 88862475 (Canadian P/N 88862476)	1.8 liters	1.9 quarts

TRANSMISSION CLEARANCE SPECIFICATIONS

Gear Axial Clearance

Application	Standard Clearance Metric	Standard Clearance English
1st Countershaft Gear	0.10-0.43 mm	0.0039-0.0169 in
2nd Countershaft Gear	0.10-0.43 mm	0.0039-0.0169 in
3rd Gear	0.09-0.52 mm	0.0035-0.0204 in
4th Gear	0.12-0.38 mm	0.0047-0.0150 in
6th Gear	0.20-0.49 mm	0.0079-0.0193 in
Reverse Countershaft Gear	0.125-0.375 mm	0.0049-0.0148 in
Reverse Idler Gear	0.10-0.55 mm	0.0039-0.0216 in

Gear Radial Clearance

Application	Standard Clearance Metric	Standard Clearance English
1st Countershaft Gear	0.015-0.067 mm	0.0006-0.0026 in
2nd Countershaft Gear	0.015-0.067 mm	0.0006-0.0026 in
3rd Gear	0.015-0.067 mm	0.0006-0.0026 in
4th Gear	0.015-0.067 mm	0.0006-0.0026 in
6th Gear	0.015-0.065 mm	0.0006-0.0025 in
Reverse Countershaft Gear	0.015-0.065 mm	0.0006-0.0025 in

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Reverse Idler Gear	0.015-0.050 mm	0.0006-0.0020 in
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Output Shaft

Application	Specification	
	Metric	English
Runout - Maximum	0.136 mm	0.0053 in
Flange Thickness - Maximum	11.3 mm	0.4449 in

Input Shaft Bearing Journals - Minimum Diameter

Application	Specification	
	Metric	English
3rd Gear	44.985 mm	1.7710 in
4th Gear	44.985 mm	1.7710 in
6th Gear	41.985 mm	1.6529 in

Countershaft Bearing Journals - Minimum Diameter

Application	Specification	
	Metric	English
1st Countershaft Gear Bearing	47.985 mm	1.8891 in
2nd Countershaft Gear Bearing	53.985 mm	2.1254 in
Reverse	44.985 mm	1.7710 in
Reverse Idler Gear	27.937 mm	1.0999 in

Synchronizer Blocker Ring to Gear - Minimum Clearance

Application	Specification	
	Metric	English
1st, 2nd	0.88 mm	0.035 in
3rd	0.8 mm	0.031 in
4th, 5th, 6th	0.7 mm	0.027 in
Reverse	0.9 mm	0.035 in

Synchronizer Sleeve to Shift Fork - Maximum Clearance

Application	Specification	
	Metric	English
1st/2nd	0.35 mm	0.014 in
3rd/4th, 5th/6th, Reverse	0.84 mm	0.033 in

1ST AND 2ND GEAR SYNCHRONIZER RETAINING RING SPECIFICATIONS

Mark	Thickness (mm)	Thickness (in)
A	2.28-2.33	0.0898-0.0917

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B	2.33-2.38	0.0917-0.0937
C	2.38-2.43	0.0937-0.0957
D	2.43-2.48	0.0957-0.0976
E	2.48-2.53	0.0976-0.0996
F	2.53-2.58	0.0996-0.1016
G	2.58-2.63	0.1016-0.1035

3RD AND 4TH GEAR SYNCHRONIZER RETAINING RING SPECIFICATIONS

Mark	Thickness (mm)	Thickness (in)
A	1.80-1.85	0.0709-0.0728
B	1.85-1.90	0.0728-0.0748
C	1.90-1.95	0.0748-0.0768
D	1.95-2.00	0.0768-0.0787
E	2.00-2.05	0.0787-0.0807
F	2.05-2.10	0.0807-0.0827
G	2.10-2.15	0.0827-0.0846

5TH GEAR SYNCHRONIZER RETAINING RING SPECIFICATIONS

Mark	Thickness (mm)	Thickness (in)
A	2.10-2.15	0.0827-0.0846
B	2.15-2.20	0.0846-0.0866
C	2.20-2.25	0.0866-0.0886
D	2.25-2.30	0.0886-0.0906
E	2.30-2.35	0.0906-0.0925
F	2.35-2.40	0.0925-0.0945
G	2.40-2.45	0.0945-0.0965

COUNTERSHAFT FRONT AND REAR BEARING RETAINING RING SPECIFICATIONS

Mark	Thickness (mm)	Thickness (in)
A	2.35-2.40	0.0925-0.0945
B	2.40-2.45	0.0945-0.0965
C	2.45-2.50	0.0965-0.0984
D	2.50-2.55	0.0984-0.1004
E	2.55-2.60	0.1004-0.1024
F	2.60-2.65	0.1024-0.1043
G	2.65-2.70	0.1043-0.1062
H	2.70-2.75	0.1062-0.1083
J	2.75-2.80	0.1083-0.1102

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K	2.80-2.85	0.1102-0.1122
L	2.85-2.90	0.1122-0.1142
M	2.90-2.95	0.1142-0.1161

INPUT SHAFT BEARING RETAINING RING SPECIFICATIONS

Mark	Thickness (mm)	Thickness (in)
A	2.65-2.70	0.1043-0.1062
B	2.70-2.75	0.1062-0.1083
C	2.75-2.80	0.1083-0.1102
D	2.80-2.85	0.1102-0.1122
E	2.85-2.90	0.1122-0.1142
F	2.90-2.95	0.1142-0.1161

6TH GEAR RETAINING RING SPECIFICATIONS

Mark	Thickness (mm)	Thickness (in)
A	2.07-2.12	0.0815-0.0835
B	2.12-2.17	0.0835-0.0854
C	2.17-2.22	0.0854-0.0874
D	2.22-2.27	0.0874-0.0894
E	2.27-2.32	0.0894-0.0913
F	2.32-2.37	0.0913-0.0933

SCHEMATIC AND ROUTING DIAGRAMS

MANUAL TRANSMISSION SCHEMATICS

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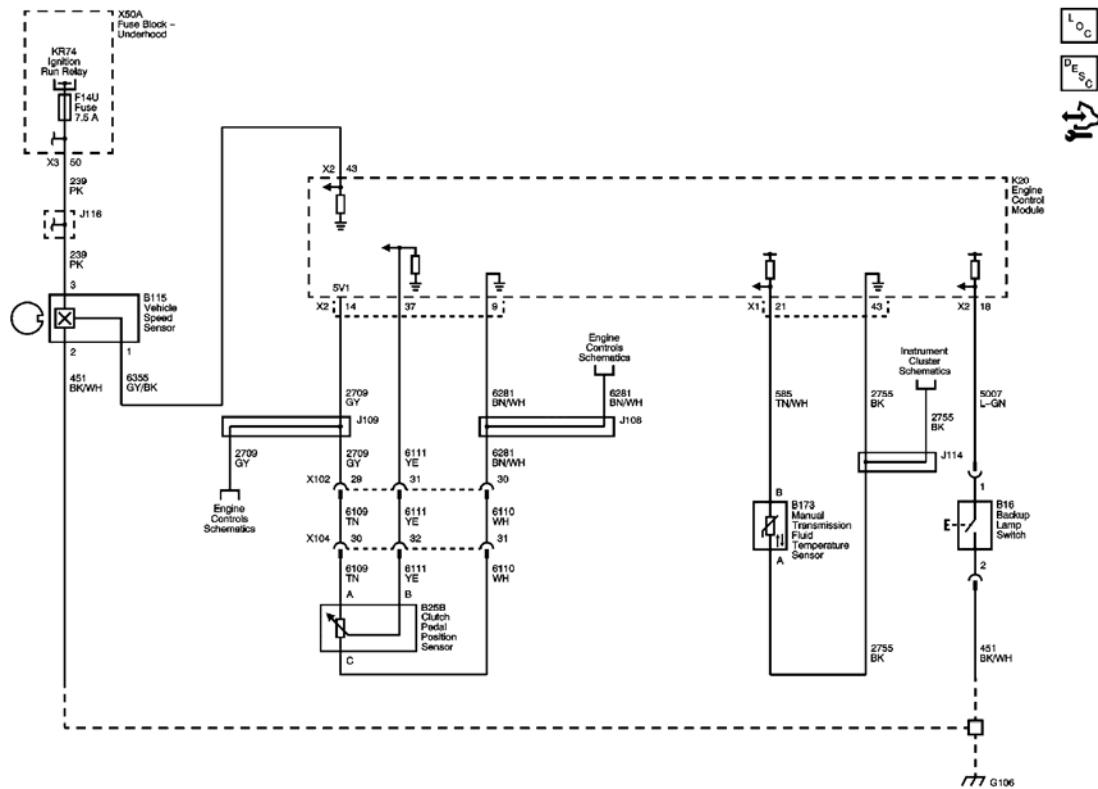


Fig. 1: Manual Transmission

Courtesy of GENERAL MOTORS CORP.

VISUAL IDENTIFICATION

DISASSEMBLED VIEWS

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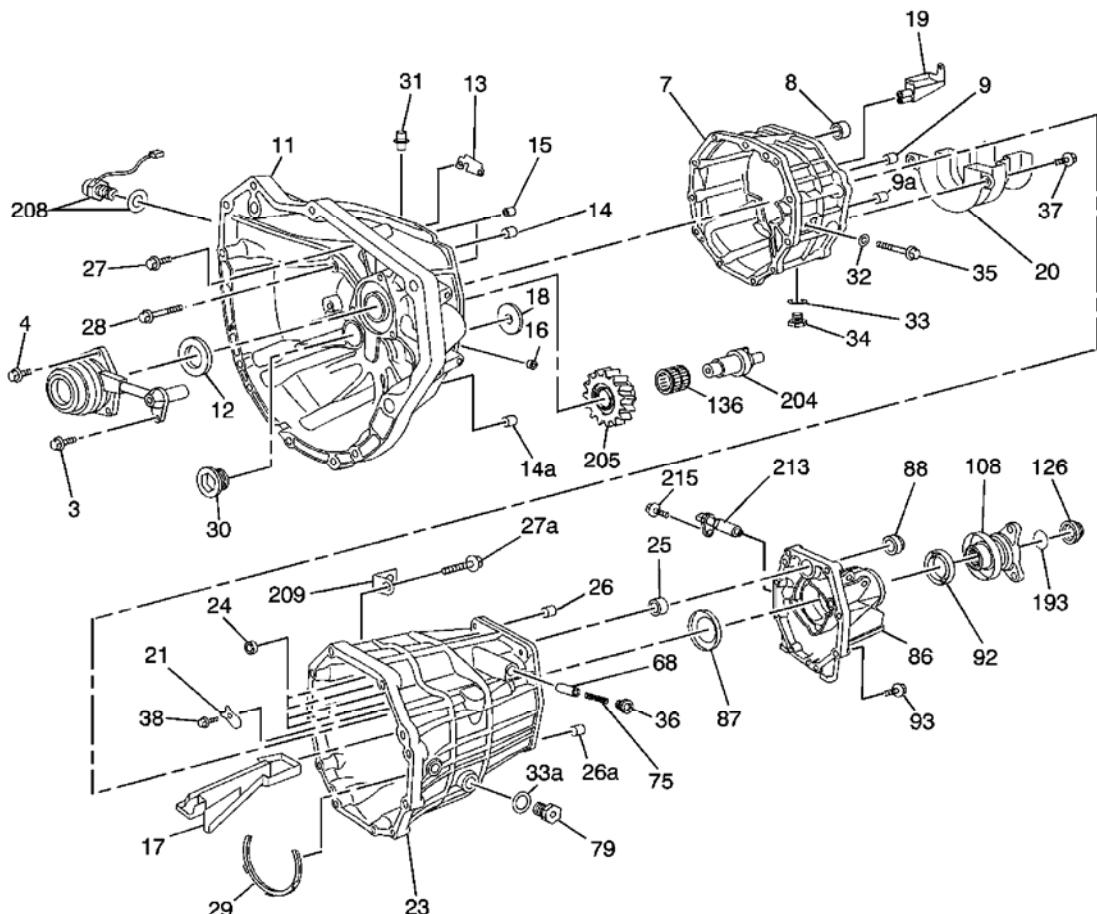


Fig. 2: Case Components

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
3	Clutch Actuator Bolt/Screw - M6 x 1.0
4	Clutch Actuator Bolt/Screw - M8 x 1.0
7	Transmission Intermediate Case
8	Shift Shaft Bearing Assembly
9	Transmission Rear Case Locating Pin
9a	Transmission Rear Case Locating Pin
11	Transmission Front Case
12	Input Shaft Seal
13	Input Shaft Bearing Oil Shield
14	Select Control Lever Bracket Pin
14a	Transmission Case Intermediate Locating Pin
15	Transmission Case Locating Pin
16	Transmission Case Hole Plug

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17	Transmission Rear Case Oil Trough
18	Input Shaft Bearing Oil Slinger - Front
19	Oil Trough
20	Transmission Intermediate Case Oil Trough
21	Counter Gear Bearing Retainer
23	Transmission Rear Case
24	Shift Shaft Bushing
25	Shift Shaft Bearing Assembly
26	Transmission Extension Locating Pin
26a	Transmission Extension Locating Pin
27	Transmission Intermediate Case Bolt/Screw - M10 x 1.25
27a	Backup Switch Bracket Bolt/Screw
28	Transmission Intermediate Case Bolt/Screw - M10 x 1.25
29	Transmission Rear Case Oil Trough Gasket
30	Clutch Housing Hole Plug
31	Vent Assembly
32	Reverse Idler Gear Shaft Bolt Gasket
33	Oil Drain Plug Gasket
33a	Oil Fill Plug Gasket
34	Oil Drain Plug
35	Reverse Idler Gear Shaft Retainer Bolt/Screw
36	Shift Shaft Detent Plug
37	Transmission Intermediate Case Oil Trough Bolt/Screw
38	Counter Gear Bearing Retainer Bolt/Screw
68	Shift Shaft Detent Pin
75	Shift Shaft Detent Spring
79	Oil Fill Plug
86	Transmission Extension
87	Main Shaft Bearing Rear Oil Slinger
88	Shift Control Shaft Seal
92	Rear Output Shaft Seal Assembly
93	Transmission Extension Bolt/Screw
108	Propshaft Transmission Flange Assembly
126	Propshaft Transmission Flange Nut
136	Reverse Idler Gear Bearing Assembly
193	Propshaft Transmission Flange Fluid Seal
204	Reverse Idler Gear Shaft
205	Reverse Idler Gear
208	Backup Lamp Switch Assembly
209	Backup Lamp Switch Retainer
213	Output Sensor Assembly

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Vehicle Speed Sensor Bolt/Screw

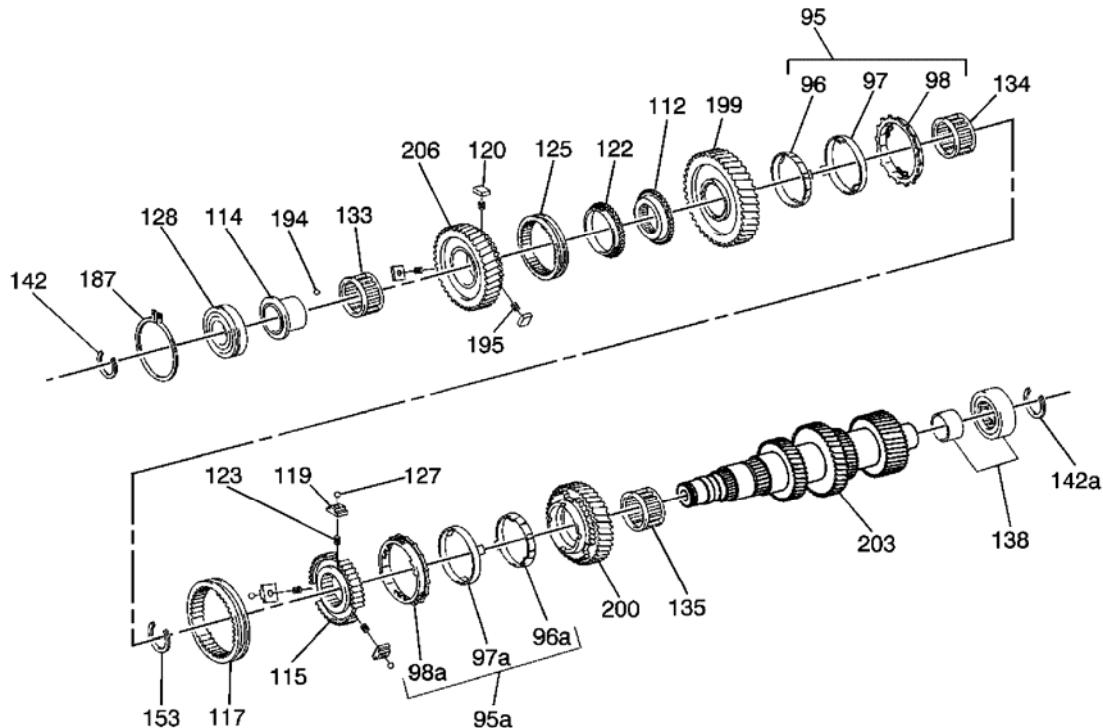


Fig. 3: Countershaft Components

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
95	1st Gear Blocking Ring Set
95a	2nd Gear Blocking Ring Set
96	1st Gear Synchronizer Inner Cone
96a	2nd Gear Synchronizer Inner Cone
97	1st Gear Synchronizer Outer Cone
97a	2nd Gear Synchronizer Outer Cone
98	1st Gear Outer Blocking Ring
98a	2nd Gear Outer Blocking Ring
112	Reverse Drive Gear
114	Reverse Gear Bearing Bushing w/Thrust Washer
115	1st/2nd Gear Synchronizer Hub
117	1st/2nd Gear Synchronizer Sleeve
119	1st/2nd Gear Synchronizer Insert
120	Reverse Gear Synchronizer Insert
122	Reverse Gear Blocking Ring

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123	1st/2nd Gear Synchronizer Spring
125	Reverse Gear Synchronizer Sleeve
127	1st/2nd Gear Synchronizer Detent Ball
128	Counter Gear Front Bearing Assembly
133	Reverse Gear Bearing Assembly
134	1st Gear Bearing Assembly
135	2nd Gear Bearing Assembly
138	Counter Gear Rear Bearing Assembly
142	Counter Gear Front Bearing Retainer Ring
142a	Counter Gear Rear Bearing Retainer Ring
153	1st/2nd Gear Synchronizer Retaining Ring
187	Counter Gear Front Bearing Retainer
194	Reverse Gear Thrust Washer Locking Ball
195	Reverse Gear Synchronizer Spring
199	1st Gear
200	2nd Gear
203	Counter Gear
206	Reverse Gear

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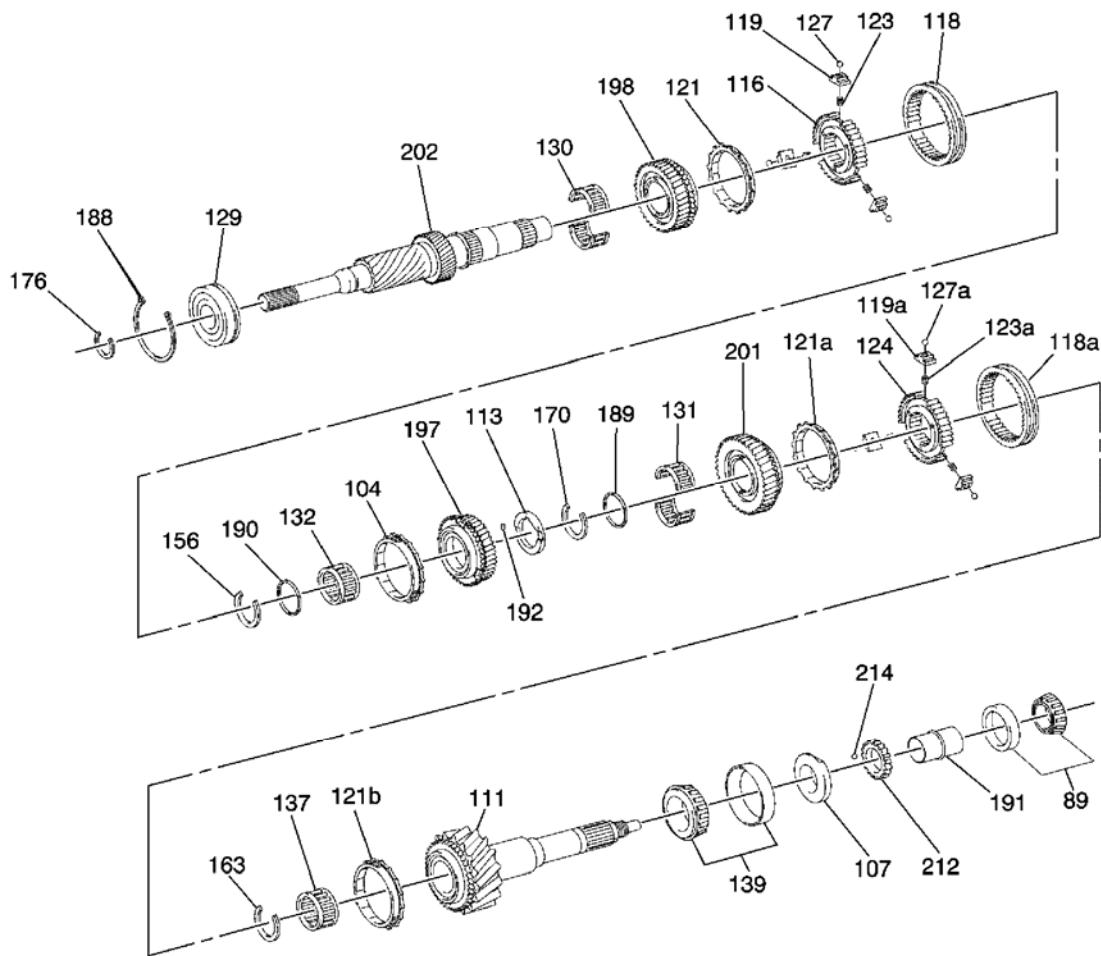


Fig. 4: Input Shaft Components

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
89	Rear Output Shaft Roller Bearing Assembly
104	3rd Gear Blocking Ring
107	Main Shaft Bearing Oil Slinger
111	Rear Output Shaft
113	3rd Gear Thrust Washer
116	3rd/4th Gear Synchronizer Hub
118	3rd/4th Gear Synchronizer Sleeve
118a	5th/6th Gear Synchronizer Sleeve
119	3rd/4th Gear Synchronizer Insert
119a	5th/6th Gear Synchronizer Insert
121	4th Gear Blocking Ring
121a	6th Gear Blocking Ring

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121b	5th Gear Blocking Ring
123	3rd/4th Gear Synchronizer Spring
123a	5th/6th Gear Synchronizer Spring
124	5th/6th Gear Synchronizer Hub
127	3rd/4th Gear Synchronizer Detent Ball
127a	5th/6th Gear Synchronizer Detent Ball
129	Input Shaft Bearing Assembly
130	4th Gear Bearing Assembly
131	6th Gear Bearing Assembly
132	3rd Gear Bearing Assembly
137	Input Shaft Bearing
139	Rear Output Shaft Front Bearing Assembly
156	3rd Gear Retaining Ring
163	5th/6th Gear Synchronizer Hub Retaining Ring
170	6th Gear Retaining Ring
176	Input Shaft Bearing Retainer
188	Input Shaft Bearing Retainer Ring
189	6th Gear Bearing Spacer
190	3rd/4th Gear Spacer
191	Rear Output Shaft Rear Bearing Spacer
192	Gear Thrust Washer Locating Pin
197	3rd Gear
198	4th Gear
201	6th Gear
202	Input Shaft
212	Vehicle Speed Sensor Drive Gear
214	Speedometer Drive Gear Locking Ball

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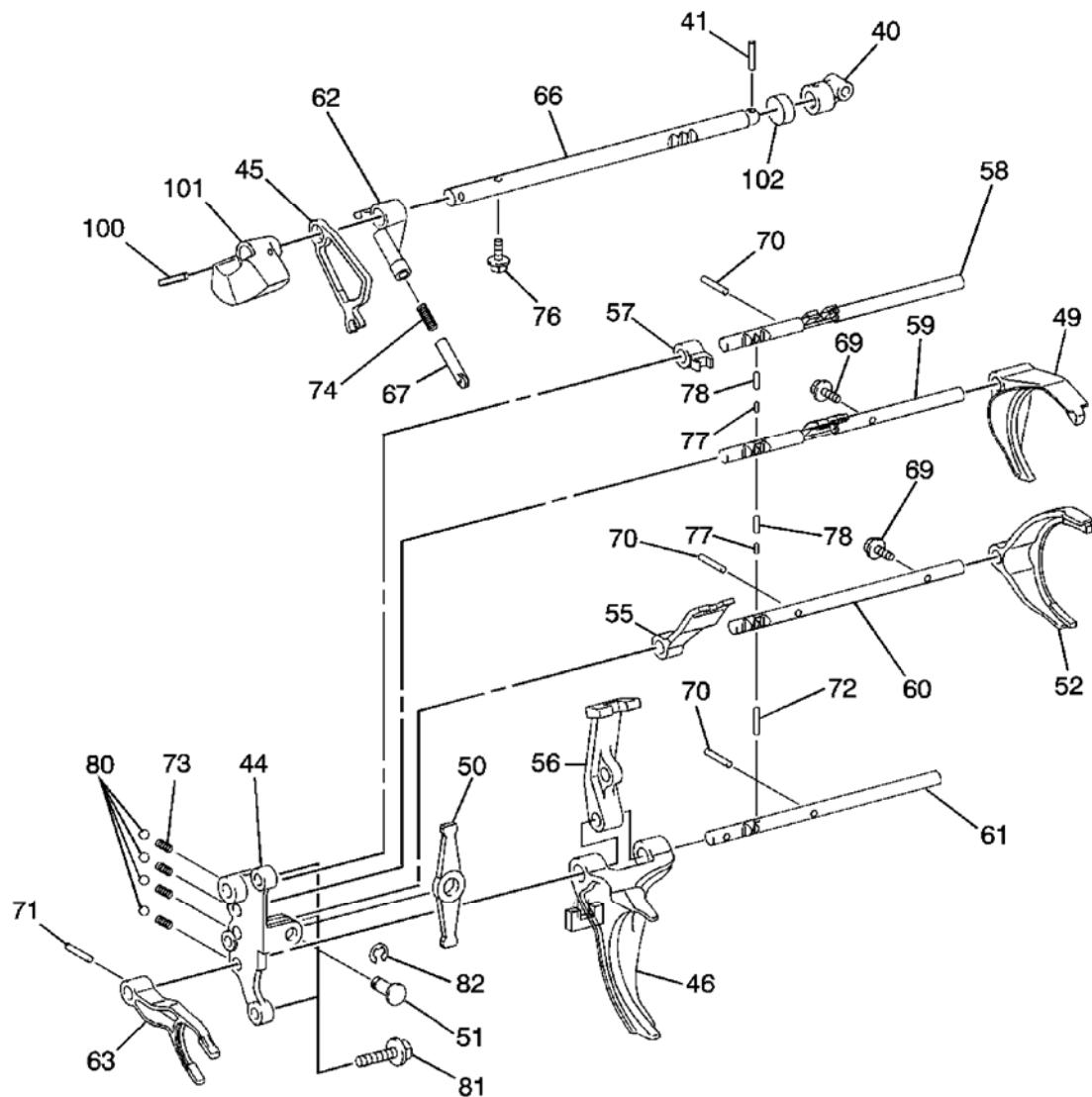


Fig. 5: Shift Rail Components

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
40	Shift Lever Rod Universal Joint Assembly
41	Shift Lever Pin
44	Shift Control Lever Bracket
45	Shift Shaft Detent Cam
46	1st/2nd Shift Fork Assembly w/Bushings
49	3rd/4th Shift Fork Assembly w/Inserts
50	Control Selector Arm
51	Control Selector Arm Pin

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52	5th/6th Shift Fork Assembly w/Inserts
55	Shift Lever Assembly
56	Internal Shift Control Lever
57	Selector Control Lever Assembly
58	1st/2nd Shift Shaft
59	3rd/4th Shift Shaft
60	5th/6th Shift Shaft
61	Reverse Shift Shaft
62	Shift Shaft Detent Lever
63	Reverse Shift Fork Assembly w/Inserts
66	Shift Control Shaft
67	Shift Shaft Detent
69	3rd/4th Shift Fork Bolt/Screw
69	5th/6th Shift Fork Bolt/Screw
70	1st/2nd Shift Fork Pin
71	Reverse Shift Fork Pin
72	Shift Shaft Detent Roller
73	Shaft Detent Ball Spring
74	Shift Shaft Detent Spring
76	Shift Shaft Detent Lever Bolt/Screw
77	Shift Shaft Interlocking Pin
78	Shift Shaft Interlocking Pin
80	Shift Detent Ball
81	Shift Control Lever Bracket Bolt/Screw
82	Selector Control Lever Pin Retainer
100	Slotted Spring Pin
101	Dynamic Damper Weight
102	Damper

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC P0501 or P0502</u>	P0501: Vehicle Speed Sensor (VSS) Performance P0502: Vehicle Speed Sensor (VSS) Circuit Low Voltage
<u>DTC P0712 or P0713</u>	P0712: Transmission Fluid Temperature (TFT) Sensor Circuit Low Voltage P0713: Transmission Fluid Temperature (TFT) Sensor Circuit High Voltage
<u>DTC P0806</u>	P0806: Clutch Pedal Position (CPP) Sensor Circuit Performance

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DTC P0807 or P0808	P0807: Clutch Pedal Position (CPP) Sensor Circuit Low Voltage P0808: Clutch Pedal Position (CPP) Sensor Circuit High Voltage
DTC P080A	P080A: Clutch Pedal Position (CPP) Not Learned

DTC P0501 OR P0502

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 P0501

Vehicle Speed Sensor (VSS) Performance

DTC P0502

Vehicle Speed Sensor (VSS) Circuit Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0502	P0502	-	P0501
Signal	P0502	P0502	P0502	P0501
Ground	-	P0502	-	P0501

Typical Scan Tool Information

Vehicle Speed Sensor Parameter

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running, in gear, drive wheels rotating. Parameter Normal Range: Displays km/h (mph)			
Ignition Voltage			
Ignition Voltage	0 km/h (mph)	0 km/h (mph)	-
Signal	0 km/h (mph)	0 km/h (mph)	0 km/h (mph)
Ground	0 km/h (mph)	0 km/h (mph)	-

Circuit/System Description

Vehicle speed information is provided to the engine control module (ECM) by the vehicle speed sensor (VSS). The VSS consists of a hall-effect sensor mounted to the transmission case which interfaces with a rotor pressed

onto the transmission output shaft. The hall-effect sensor contains a permanent magnet and a semiconductor plate to which ignition voltage is applied. As the output shaft spins, the rotor directs the field of the permanent magnet either toward or away from the plate. The VSS produces a frequency signal that is proportional to vehicle speed. The ECM converts the VSS signal to vehicle speed, displayed on the scan tool in kilometers per hour or miles per hour. The ECM also uses the VSS signal to generate the 4,000 pulses per mile vehicle speed signal used by the instrument cluster.

Conditions for Running the DTC

- The engine speed is greater than 1800 RPM for 3 seconds.
- The engine coolant temperature (ECT) is greater than 40°C (104°F).

Conditions for Setting the DTC

The VSS indicates a speed of less than 0 km/h (0 mph) for 4 seconds.

Action Taken When the DTC Sets

- P0501 and P0502 are Type B DTCs.
- The ECM disables cruise control.

Conditions for Clearing the MIL/DTC

P0501 and P0502 are Type B DTCs.

Diagnostic Aids

The battery must be fully charged and pass a battery test. Refer to [Battery Inspection/Test](#).

Reference Information**Schematic Reference****Manual Transmission Schematics****Connector End View Reference****Component Connector End Views****Description and Operation****Transmission System 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

Engine Control Module Scan Tool Information (LS3, L99) or Engine Control Module Scan Tool Information (w/LLT)

Circuit/System Verification

1. Operate the vehicle on the road at 64 km/h (40 mph). Observe the transmission vehicle speed sensor parameter with a scan tool. The VSS signal should match the instrument panel speedometer indicator.
2. Operate the vehicle within the Conditions for Running the DTC, to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.

Circuit/System Testing

1. Ignition OFF, disconnect the X2 harness connector at the ECM.
2. Disconnect the VSS harness connector.
3. Ignition OFF, test for less than 5 ohms between the ground circuit at the VSS harness connector terminal 3 and ground.
 - If greater than the specified value, repair the open/high resistance condition.
4. Ignition ON, test for less than 1 V between the signal circuit terminal 1 and ground at the VSS harness connector.
 - If greater than the specified value, test the signal circuit for a short to voltage.
5. Ignition ON, test for greater than 11 V between the ignition voltage circuit, at the VSS harness connector terminal 3, and ground.
 - If less than the specified value, test the ignition voltage circuit for a short to ground or an open/high resistance.
6. Ignition ON, install a 3 A fused jumper wire between the ignition voltage circuit terminal 3 and the signal circuit terminal 1 at the VSS harness connector. Test for greater than 11 V at X2, terminal 43 of the ECM harness connector.
 - If less than the specified value, test the VSS signal circuit for a short to ground, or an open/high resistance.
7. Remove the 3 A fused jumper wire.
8. Ignition ON, engine OFF, transmission in NEUTRAL.
9. Install a 3 A fused jumper wire between the ignition voltage circuit terminal 1 on the VSS harness connector and terminal 1 on the VSS. Connect a second jumper wire between the ground circuit terminal

- 2 on the VSS harness connector and terminal 2 on the VSS.
10. Test for greater than 0.15 V AC, at terminal 1 on the VSS sensor, while rotating the rear wheels by hand.
 - o If less than the specified value, replace the VSS.
 11. If all circuits test normal, replace the ECM.

Component Testing

1. Remove the VSS sensor. Refer to [**Vehicle Speed Sensor Replacement**](#).
2. Inspect and repair the VSS or the transmission for the following conditions:
 - Loose or damaged VSS
 - Excessive VSS to rotor gap
 - Incorrect VSS rotor alignment
 - Loose or damaged VSS rotor

Repair Procedures

Perform the [**Diagnostic Repair Verification**](#) after completing the diagnostic procedure.

- [**Vehicle Speed Sensor Replacement**](#)
- [**Engine Control Module Programming and Setup \(LS3, L99\)**](#) or [**Engine Control Module Programming and Setup \(LLT\)**](#)
- [**Engine Control Module Replacement**](#)

DTC P0712 OR P0713

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 P0712

Transmission Fluid Temperature (TFT) Sensor Circuit Low Voltage

DTC P0713

Transmission Fluid Temperature (TFT) Sensor Circuit High Voltage

Diagnostic Fault Information

	Short to	Open/High	Short to	Signal
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Circuit	Ground	Resistance	Voltage	Performance
TFT Sensor Signal	P0712	P0713	P0713 ¹	-
Low Reference	-	P0713	P0713 ¹	-

¹ Internal ECM damage may occur if the circuit is shorted to B+.

Circuit/System Description

The transmission fluid temperature (TFT) sensor is a variable resistor that measures the temperature of the transmission fluid. The engine control module (ECM) supplies 5 V to the TFT signal circuit and supplies a ground to the low reference circuit.

The following table illustrates the difference between temperature, resistance, and voltage:

TFT	TFT Resistance	TFT Signal Voltage
Cold	High	High
Warm	Low	Low

Conditions for Running the DTC

P0712

- The engine speed is above 1,000 RPM for 7 seconds.
- This DTC runs continuously when the above condition is met.

P0713

- The engine speed is above 1,000 RPM for 7 seconds.
- This DTC runs continuously when the above condition is met.

Conditions for Setting the DTC

P0712

The TFT is greater than 145°C (299°F) for more than 5 seconds.

P0713

The TFT is less than -35°C (-31°F) for more than 5 seconds.

Action Taken When the DTC Sets

DTC P0712 and P0713 are Type C DTCs.

Conditions for Clearing the MIL/DTC

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DTC P0712 and P0713 are Type C DTCs.

Reference Information

Schematic Reference

Manual Transmission Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Transmission System 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

Engine Control Module Scan Tool Information (LS3, L99) or Engine Control Module Scan Tool Information (w/LT)

Circuit/System Verification

1. Engine running, DTC P0712 or P0713 should not set.
2. If the vehicle passes the Circuit/System Verification Test, then operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that are captured in the Freeze Frame/Failure Records List.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the B173 TFT sensor.
2. Ignition OFF, test for less than 5 ohms between the low reference circuit terminal A and ground.
 - If greater than 5 ohms, test the low reference circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the K20 ECM.

3. Ignition ON, using a scan tool verify that the B173 TFT sensor parameter is at -40°C (-40°F).
 - o If greater than -40°C (-40°F), test the signal circuit terminal B for a short to ground. If the circuit tests normal, replace the ECM.

NOTE: **If the signal circuit of the B173 TFT sensor is shorted to voltage the TFT sensor may be damaged.**

4. Install a 3 A fused jumper wire between the signal circuit terminal B and the low reference circuit terminal A. Verify the B173 TFT sensor parameter is greater than 128°C (262°F).
 - o If less than 128°C (262°F), test the signal circuit of the B173 TFT sensor for a short to voltage or an open/high resistance. If the circuit test normal, replace the K20 ECM.
5. If all circuits test normal, test or replace the B173 TFT sensor.

Repair Procedures

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

- **Transmission Fluid Temperature Sensor Replacement**
- **Engine Control Module Replacement**
- **Engine Control Module Programming and Setup (LS3, L99)** or **Engine Control Module Programming and Setup (LLT)**

DTC P0806

Diagnostic Instructions

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

DTC Descriptor

DTC P0806

Clutch Pedal Position (CPP) Sensor Circuit Performance

Diagnostic Fault Information

CPP Sensor

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

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Typical Scan Tool Information

CPP Sensor Voltage

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

Circuit/System Description

The clutch pedal position (CPP) sensor is a three wire sensor, connected to a 5 V reference circuit, a low reference circuit, and a signal circuit. The engine control module (ECM) 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 less than or equal to 5 V when the clutch pedal is released, to a voltage less than or equal to 1.5 V when the clutch pedal is applied.

Conditions for Running the DTC

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

Conditions for Setting the DTC

The CPP sensor is stuck in range.

Action Taken When the DTC Sets

P0806 is a Type A DTC.

Conditions for Clearing the MIL/DTC

P0806 is a Type A DTC.

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Reference Information

Schematic Reference

Manual Transmission Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Transmission System 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

Engine Control Module Scan Tool Information (LS3, L99) or Engine Control Module Scan Tool Information (w/LT)

Circuit/System Verification

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

Circuit/System Testing

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

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- If greater than the specified value, replace the ECM.

Component Testing

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

Repair Procedures

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

- **Clutch Pedal Position Sensor Replacement**
- **Engine Control Module Replacement**
- **Engine Control Module Programming and Setup (LS3, L99) or Engine Control Module Programming and Setup (LLT)**

DTC P0807 OR P0808

Diagnostic Instructions

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

DTC Descriptors

DTC P0807

Clutch Pedal Position (CPP) Sensor Circuit Low Voltage

DTC P0808

Clutch Pedal Position (CPP) Sensor Circuit High Voltage

Diagnostic Fault Information

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

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Typical Scan Tool Information

CPP Sensor Voltage

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

CPP Sensor Percentage

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

Circuit/System Description

The clutch pedal position (CPP) is a three wire sensor, connected to a 5 V reference circuit, a low reference circuit, and a signal circuit. The engine control module (ECM) 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 less than or equal to 5 V when the clutch pedal is released to a voltage less than or equal to 1.5 V when the clutch pedal is applied.

Conditions for Running the DTC

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

Conditions for Setting the DTC

P0807

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

P0808

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

Action Taken When the DTC Sets

P0807 and P0808 are Type A DTCs.

Conditions for Clearing the MIL/DTC

P0807 and P0808 are Type A DTCs.

Reference Information

Schematic Reference

Manual Transmission Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Transmission System 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

Engine Control Module Scan Tool Information (LS3, L99) or **Engine Control Module Scan Tool Information (w/LT)** for scan tool information

Circuit/System Verification

1. If DTC P0641 or P0651 is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle**.
2. Ignition ON, observe the scan tool CPP sensor percent parameter. The percentage should vary from 0 percent when the clutch pedal is released, to 100 percent when the clutch pedal is in the apply position.
3. Perform the CPP learn procedure. Refer to **Clutch Pedal Position Sensor Learn**.
4. Operate the vehicle within the conditions for running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records

data.

Circuit/System Testing

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

Component Testing

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

Repair Procedures

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

- **Clutch Pedal Position Sensor Replacement**
- **Engine Control Module Replacement**
- **Engine Control Module Programming and Setup (LS3, L99) or Engine Control Module Programming and Setup (LLT)**

DTC P080A

Diagnostic Instructions

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

DTC Descriptor

DTC P080A

Clutch Pedal Position (CPP) Not Learned

Circuit/System Description

The clutch pedal position (CPP) is a three wire sensor, connected to a 5 V reference circuit, a low reference circuit, and a signal circuit. The engine control module (ECM) 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 less than or equal to 5 V when the clutch pedal is released to a voltage less than or equal to 1.5 V when the clutch pedal is applied.

Conditions for Running the DTC

Clutch pedal fully applied.

Conditions for Setting the DTC

Clutch pedal position not learned.

Action Taken When the DTC Sets

P080A is a Type B DTC.

Conditions for Clearing the MIL/DTC

P080A is a Type B DTC.

Reference Information

Schematic Reference

Manual Transmission Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Transmission System 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

[Engine Control Module Scan Tool Information \(LS3, L99\)](#) or [Engine Control Module Scan Tool Information \(w/LLT\)](#) for scan tool information.

Circuit/System Verification

Perform the clutch pedal position sensor learn procedure. Refer to [Clutch Pedal Position Sensor Learn](#).

Repair Procedures

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- [Clutch Pedal Position Sensor Learn](#)
- [Engine Control Module Replacement](#)
- [Engine Control Module Programming and Setup \(LS3, L99\)](#) or [Engine Control Module Programming and Setup \(LLT\)](#)

CLUTCH PEDAL POSITION SENSOR LEARN

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

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

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

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

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

SYMPTOMS - MANUAL TRANSMISSION

Strategy Based Diagnostics

Review the system operations in order to familiarize yourself with the system functions. Refer to [**Transmission System Description and Operation**](#).

Visual/Physical Inspection

- 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.
- Inspect the shifter for damage or excessive freeplay.

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 Gear Clash When Shifting Gears**](#)
- [**Transmission Noisy**](#)
- [**Transmission Does Not Shift into One Gear**](#)
- [**Transmission Locked in One Gear**](#)
- [**Transmission Jumps Out of Gear**](#)

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- Transmission Clunk on Acceleration or Deceleration
- Transmission Fluid Leak Diagnosis

TRANSMISSION SHIFTS HARD

Diagnostic Aids

An intermittent hard shift may be caused by an intermittent clutch condition. With a self adjusting clutch, the clutch may be between adjustments and not give full clutch release. This might be felt by a low clutch pedal. After several applications, the clutch may adjust properly, to give the proper pedal feel.

Test Description

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

3: A static shift test is performed by shifting into all of the gear positions with the engine not operating. While performing the test one should note how the shift lever movement is felt. Also while shifting from one gear to the other feel for binding in the shift rails. You should be able to feel the detent plungers operating when coming out of a gear and going into a gear.

5: A dynamic shift test is performed by shifting into the gear positions with the engine operating. Test for the correct mesh of the synchronizers and for the clutch releasing correctly. When shifting into and out of a gear, feel for the shift detent plungers and for the synchronizers sleeve for moving freely.

7: The transmission uses a synthetic transmission fluid that allows proper synchronizer operation. The incorrect fluid may cause hard shifting by varnish build up, or not enough lubrication for proper synchronizer operation.

Step	Action	Yes	No
DEFINITION: The transmission does not shift smoothly, or without difficulty, from one gear to the other.			
1	Did you review the Symptoms - Manual Transmission, and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Manual Transmission</u>
2	Inspect the clutch system for proper operation. Refer to Clutch System Description and Operation . Did you find or repair the condition?	Go to Step 11	Go to Step 3
3	<ol style="list-style-type: none">1. Perform a static shift test on the transmission.2. Test for the following:<ul style="list-style-type: none">• Blockage preventing full shift lever movement• Excessive movement in the shift lever• Binding in the shift lever• Detent plungers or shift rails binding		
	Are you able to shift into all gears?	Go to Step 5	Go to Step 4

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4	Remove the shifter and inspect for worn or faulty components. Refer to <u>Shift Control Assembly Replacement</u> . Did you find and repair the condition?	Go to Step 11	Go to Step 5
5	1. Perform a dynamic shift test on the transmission. 2. Test for the following: <ul style="list-style-type: none"> • Detent plungers or shift rails binding • Synchronizer sleeve binding • Gear clash into only one gear • Gear clash into all gears Did the transmission shift hard into all gears?	Go to Step 6	Go to Step 10
6	Inspect the transmission for the correct fluid level and type of the transmission fluid. Refer to <u>Transmission Fluid Replacement</u> . Is the transmission at the correct level and proper fluid being used?	Go to Step 8	Go to Step 7
7	Drain and refill the transmission with the correct type fluid. Refer to <u>Transmission Fluid Replacement</u> . Did you find and repair the condition?	Go to Step 11	Go to Step 8
8	1. Remove the transmission. Refer to <u>Transmission Replacement</u> . 2. 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 9	Go to Step 10
9	Replace the clutch assembly. Refer to <u>Clutch Assembly Replacement</u> . Did you find and repair the condition?	Go to Step 11	Go to Step 10
10	Replace the transmission. Refer to <u>Transmission Replacement</u> . Is the replacement complete?	Go to Step 11	-
11	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 clashing may be caused by shifting at too high of an engine RPM or by rushing the shift. If gear clashing is occurring in more than one gear, the clutch may not be releasing properly for proper synchronizer operation.

Test Description

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

2: This step tests for the proper releasing of the clutch. If the clutch reserve is not proper, the mainshaft gears may still be turning causing the gear clashing.

5: This step inspects for the proper transmission fluid. A special fluid is required for the correct lubrication of the synchronizers.

7: A static shift test is performed by shifting into all of the gear positions with the engine not operating. While performing the test, you should note how the shift lever movement is felt. Also, while shifting from one gear to another, feel for binding in the shift rails. You should be able to feel the detent plungers operating when coming out of a gear and going into a gear. Excessive play in the gear shift lever may prevent the shift forks from fully engaging the synchronizer.

9: A dynamic shift test is performed by shifting into all of the gear positions with the engine operating. Test for the correct mesh of the synchronizers, and for the clutch releasing correctly. Move the shift lever and feel for the synchronizer sleeve to just release from the gear, then let up on the clutch pedal. Depress the clutch pedal and move the shift lever to re-engage that gear. If it shifts back into the gear without clashing, the clutch is releasing correctly and the synchronizer is working. If clashing occurs, test on another gear. If all gears clash, the clutch is not releasing correctly.

Step	Action	Yes	No
DEFINITION: Noise from the transmission when shifting gears. A grinding or grating sound, when the synchronizer sleeve is engaging with the selector teeth on the speed gear. A suspected internal transmission condition, if the noise only occurs in one gear.			
1	Did you review the Symptoms - Manual Transmission, and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Manual Transmission</u>
2	With the engine operating, does the transmission shift from neutral to any gear, without the vehicle lurching or gear clashing?	Go to Step 5	Go to Step 3
3	Inspect for proper clutch operation. Refer to <u>Clutch System Description and Operation</u> . Does the clutch operate properly?	Go to Step 5	Go to Step 4
4	Repair the clutch system. Refer to <u>Symptoms - Clutch</u> . Did you find and repair the condition?	Go to Step 11	Go to Step 5
5	Inspect for the correct transmission fluid level and the proper fluid. Refer to <u>Transmission Fluid Replacement</u> . Is the transmission fluid level correct and at the proper level?	Go to Step 7	Go to Step 6
6	Fill the transmission to the correct level, or change the transmission fluid if it is not the correct type. Does the transmission still have gear clash?	Go to Step 7	Go to Step 11
	1. Perform a static shift test on the transmission. 2. Test for the following:		

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	<ul style="list-style-type: none"> • Blockage preventing full shift lever movement • Excessive movement in the shift lever • Binding in the shift lever • Detent plungers or shift rails binding 		
7	Did the transmission shift smoothly into the gear that is clashing?	Go to Step 9	Go to Step 8
8	Remove the shifter and inspect for damage or worn components. Refer to <u>Shift Control Assembly Replacement</u> . Did you find and repair the condition?	Go to Step 11	Go to Step 9
9	1. Perform a dynamic shift test on the transmission. 2. Test for the following: <ul style="list-style-type: none"> • Detent plungers or shift rails binding • Synchronizer sleeve binding • Gear clashing in more than the suspected gear Is the transmission hard to shift into all gears?	Go to Transmission Shifts Hard	Go to Step 10
10	Replace the transmission. Refer to <u>Transmission Replacement</u> . Is the replacement complete?	Go to Step 11	-
11	Operate the system and verify the repair. Did you correct the condition?	System OK	Go to Step 1

TRANSMISSION NOISY

Diagnostic Aids

If the vehicle is equipped with the 2.8L and 3.6L engine, the transmission is in neutral with the engine operating, and a whirling kind of a noise, neutral gear rattle, is heard outside the vehicle, this is a normal condition.

Test Description

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

3: This step inspects for vibration causing a noise.

5: This step inspects for the correct transmission fluid level. If the transmission fluid level is excessively low, damage may have occurred to the transmission components.

7: This step inspects for the correct type of transmission fluid. The transmission uses a special fluid. If the incorrect fluid was used, there may have been an overheating problem. Overheating may cause damage to

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the transmission components.

11: This step tests to determine if clutch components are making the noise. Depress the clutch pedal slowly and listen for the change in noise. If the noise changes while pressing the pedal, it may be a faulty clutch component. If the noise does not change until the clutch is completely disengaged, the transmission component is faulty. Improper sealing of the shifter may be allowing normal transmission noise to be heard by the driver.

Step	Action	Yes	No
DEFINITION: The transmission is making a noise. The different noises may be a whine or a growl from faulty bearings or gears. The noise may also be caused from a faulty component causing a vibration noise or rattle.			
1	Did you review the Symptoms - Manual Transmission, and perform the necessary inspections?	Go to Step 2	<u>Go to Symptoms - Manual Transmission</u>
2	Is the noise present at a certain road speed, or with a certain load?	Go to Step 3	Go to Step 4
3	Is the noise present in all gears?	Go to Step 5	Go to Step 4
4	Is the noise present in just one gear?	Go to Step 13	Go to Step 5
5	Inspect the transmission fluid level. Is the fluid level correct?	Go to Step 7	Go to Step 6
6	Add transmission fluid. Refer to <u>Transmission Fluid Replacement</u> . Did you find and repair the condition?	Go to Step 14	Go to Step 7
7	Inspect the transmission for the correct fluid type. Refer to <u>Lubrication Specifications</u> . Is the transmission fluid the correct type?	Go to Step 9	Go to Step 8
8	Drain and refill the transmission with the correct type fluid. Refer to <u>Transmission Fluid Replacement</u> . Did you find and repair the condition?	Go to Step 14	Go to Step 9
9	<ol style="list-style-type: none"> 1. Inspect for engine to transmission alignment. 2. Inspect for loose transmission mounting bolts. Are there any loose transmission mounting bolts?	Go to Step 10	Go to Step 11
10	Replace and tighten the transmission mounting bolts. Refer to <u>Transmission Mount Replacement</u> . Is the noise still present?	Go to Step 11	Go to Step 14
11	With the engine operating, depress the clutch pedal. Is the noise still present?	Go to Step 12	Go to Step 13
	<ol style="list-style-type: none"> 1. Remove the clutch. Refer to <u>Clutch Assembly Replacement</u>. 2. Inspect the following components for being the cause of the noise. <ul style="list-style-type: none"> • The release bearing 		

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12	<ul style="list-style-type: none"> • The dual mass flywheel • The pressure plate • The clutch disc • The engine crankshaft end play <p>Did you find and repair the condition?</p>	Go to Step 14	Go to Step 13
13	<p>Replace the transmission. Refer to <u>Transmission Replacement</u>.</p> <p>Is the replacement complete?</p>	Go to Step 14	-
14	<p>Operate the system in order to verify the repair.</p> <p>Did you correct the condition?</p>	System OK	Go to Step 1

TRANSMISSION DOES NOT SHIFT INTO ONE GEAR

Diagnostic Aids

If the transmission shifts into gear and then jumps out of gear, refer to [Transmission Jumps Out of Gear](#). If the vehicle is equipped with a transfer case, during certain load conditions, the transfer case may fail. If it is an intermittent condition, other driveline components may be faulty.

Test Description

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

2: This step is to confirm that the clutch is not slipping. During certain conditions, the clutch may slip, and feel as though the transmission is not in gear.

3: A static shift test is performed by shifting into all gears with the engine not operating. While performing the test, you should note how the shift lever movement feels. Also, feel for the shift rails moving freely, the detent plungers operating when coming out of a gear and going in the next gear, and the synchronizer sleeve movement.

5: A dynamic shift test is performed by shifting into all gears with the engine operating. Test for the correct mesh of the synchronizers sleeve and the speed gear selector teeth. Move the shift lever and feel for the synchronizer sleeve to just release from the gear, then let up on the clutch pedal. Depress the clutch pedal and move the shift lever to re-engage that gear, to ensure full travel of the shift components.

Step	Action	Yes	No
DEFINITION: The shift lever will not move into a particular gear position, or when it is in a gear position, power is not delivered through the transmission.			
1	<p>Did you review the Symptoms - Manual Transmission, and perform the necessary inspections?</p>	Go to Step 2	<u>Symptoms - Manual Transmission</u>
2	<p>Inspect the clutch system for slipping. Refer to <u>Clutch Slipping</u>.</p> <p>Is the clutch working properly?</p>	Go to Step 3	<u>Clutch Assembly Replacement</u>

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3 1. Perform a static shift test on the transmission. 2. Test for the following: <ul style="list-style-type: none"> • Blockage preventing full shift lever movement • Excessive movement in the shift lever • Binding in the shift lever • Detent plungers or shift rails binding • Synchronizer sleeve movement Were you able to shift into the gear position that has the concern?	Go to Step 5	Go to Step 4
4 Remove the shifter and inspect for worn or faulty components Refer to <u>Shift Control Assembly Replacement</u> . Did you find and repair the condition?	Go to Step 7	Go to Step 5
5 1. Perform a dynamic shift test on the transmission. 2. Test for the following: <ul style="list-style-type: none"> • Detent plungers or shift rails binding • Synchronizer sleeve binding • Synchronizer sleeve engaging on the speed gear selector teeth Were you able to shift into the gear position that has the concern?	Go to Step 7	Go to Step 6
6 Replace the transmission. Refer to <u>Transmission Replacement</u> . Is the replacement complete?	Go to Step 7	-
7 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

If the transmission jumps out of gear during deceleration, inspect the components that may allow for the gears or shafts to tip. If the gears or shafts tip, the synchronizer sleeve can disengage from the selector teeth on the speed gear. If the transmission jumps out of gear during acceleration, inspect the components that may not allow full engagement of the synchronizer sleeve to the selector teeth on the speed gear. Insufficient engagement of the selector teeth under torque may cause the transmission to jump out of gear.

Test Description

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

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2: A static shift test is performed by shifting into all gear positions with the engine not operating. While performing the test, slowly move the shift lever. Feel for proper movement of the shift lever and transmission internal shift components.

4: A dynamic shift test is performed by shifting into all gear positions with the engine operating. Test for the correct mesh of the synchronizers sleeve and the speed gear selector teeth. Move the shift lever to NEUTRAL and then let up on the clutch pedal. Depress the clutch pedal and move the shift lever to re-engage the gear, to ensure full travel of the shift components.

5: This step inspects for worn or damaged transmission or engine mounts. Loose mounts may cause a shock on the transmission allowing for gear disengagement.

Step	Action	Yes	No
DEFINITION: Gear disengagement occurs during acceleration or deceleration.			
1	Did you review the Symptoms - Manual Transmission, and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Manual Transmission</u>
2	1. Perform a static shift test. 2. Test for the following: <ul style="list-style-type: none"> • Blockage preventing full shift lever movement • Excessive movement in the shift lever • Detent plungers engaging in the shift rails • Synchronizer sleeve movement Did the transmission shift completely into all gears?		
3	Remove the shifter and inspect for worn or faulty components. Refer to <u>Shift Control Assembly Replacement</u> . Did you find and repair the condition?	Go to Step 4	Go to Step 3
4	1. Perform a dynamic shift test on the transmission. 2. Test for the following: <ul style="list-style-type: none"> • Synchronizer sleeve engagement to the speed gear selector teeth • Detent plungers engaging in the shift rails Did the transmission shift completely into all gears?		
5	Inspect the engine and/or transmission mounts. Refer to <u>Transmission Mount Replacement</u> . Did you find and repair the condition?	Go to Step 8	Go to Step 6
6	1. Align the housing, if required. 2. Tighten any loose housing bolts. Refer to <u>Transmission Replacement</u> .		

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	Did you find and repair the condition?	Go to Step 8	Go to Step 7
7	Replace the transmission. Refer to <u>Transmission Replacement</u> . Is the replacement complete?	Go to Step 8	-
8	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

Test Description

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

2: This step is to ensure the use of the proper transmission fluid. A special fluid is used to ensure proper synchronizer operation, and for sufficient lubrication. Improper fluid may cause the synchronizers to stick or the transmission components to overheat.

4: A static shift test is performed by shifting into all gears with the engine not operating. By confirming that the transmission can be shifted into all positions, ensures that the shift lever is not excessively worn or damaged.

6: A dynamic shift test is performed by shifting into all of the gear positions with the engine operating. Test to ensure that the internal shift components are functioning properly.

Step	Action	Yes	No
DEFINITION: The transmission cannot be shifted out of a gear, or the vehicle will not move because the transmission is locked.			
1	Did you review the Symptoms - Manual Transmission, and perform the necessary inspections?	Go to Step 2	<u>Go to Symptoms - Manual Transmission</u>
2	Inspect for the correct type of transmission fluid. Is the correct type transmission fluid being used?	Go to Step 4	Go to Step 3
3	Drain the transmission, and refill with the correct type of fluid. Refer to <u>Transmission Fluid Replacement</u> . Did you find and repair the condition?	Go to Step 8	Go to Step 4
4	1. Perform a static shift test on the transmission. 2. Test for the shift lever moving to all positions. Were you able to shift into all positions?	Go to Step 6	Go to Step 5
5	1. Remove the shifter. 2. Inspect for worn or faulty components. Refer to <u>Shift Control Assembly Replacement</u> . Did you find and repair the conditions?	Go to Step 8	Go to Step 6
	1. Perform a dynamic shift test on the transmission.		

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6	2. Test for being able to shift in and out of the gear with the concern.		
	Were you able to shift the transmission correctly?	Go to Step 8	Go to Step 7
7	Replace the transmission. Refer to <u>Transmission Replacement</u> . Is the replacement complete?	Go to Step 8	-
8	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

All manual transmissions and axles have gear play that might cause a clunk. If the transmission is suspected of causing the clunk, compare it with a similar vehicle. An internal clunk in the transmission is the natural response of the driveline to an impact, but may also be caused by improper assembly, which would also cause other symptoms.

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	<u>Symptoms - Manual Transmission</u>
2	Inspect the engine mounts for being loose or damaged. Refer to <u>Engine Mount Inspection</u> . Did you find and repair the condition?	Go to Step 7	Go to Step 3
3	Inspect the transmission mounts for being loose or damaged. Refer to <u>Transmission Mount Replacement</u> . Did you find and repair the condition?	Go to Step 7	Go to Step 4
4	Inspect the transmission to engine fasteners for being loose or missing. Refer to <u>Fastener Tightening Specifications</u> . Did you find and repair the condition?	Go to Step 7	Go to Step 5
5	Inspect the driveline for causing the clunk. Refer to <u>Diagnostic Starting Point - Vehicle</u> . Did you find and repair the condition?	Go to Step 7	Go to Step 6
6	Replace the transmission. Refer to <u>Transmission Replacement</u> . Is the replacement complete?	Go to Step 7	-
7	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 1

TRANSMISSION FLUID LEAK DIAGNOSIS

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Diagnostic Aids

Using the incorrect type of transmission fluid may affect the sealing ability of the seals. Ensure the use of the correct type of transmission fluid. The incorrect type of sealer may not be compatible with the transmission fluid or may not have the correct characteristics for sealing the affected components. Ensure the use of the correct type of sealers. Refer to [**Adhesives, Fluids, Lubricants, and Sealers**](#).

Test Description

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

5: Use an approved method to clean the transmission to ensure the leak location is correctly identified. If using a powder method or dye method ensure the products are compatible with the transmission fluid.

Step	Action	Yes	No
DEFINITION: Visible sign of the transmission fluid leaking from the transmission.			
1	Did you review the Symptoms - Manual Transmission, and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Manual Transmission
2	1. Inspect for the transmission fluid level higher than the recommended level. Refer to Transmission Fluid Level Inspection . 2. Adjust the transmission level if incorrect. Was the transmission fluid level too high?	Go to Step 25	Go to Step 3
3	Inspect the transmission vent for a blockage. Is the transmission vent blocked?	Go to Step 4	Go to Step 5
4	Repair or replace the transmission vent. Did you find and repair the condition?	Go to Step 25	Go to Step 5
5	Verify the location of the leak. 1. Clean the transmission assembly. 2. Operate the vehicle for 24 km (15 mi), or until normal operating temperatures are reached. 3. Visual inspect or use the powder method or dye and black light method to locate the leak. Is the leak occurring at the drain or fill plug?	Go to Step 6	Go to Step 7
6	Replace the drain or fill plug. Refer to Transmission Fluid Replacement . Did you find and repair the condition?	Go to Step 25	Go to Diagnostic Aids
7	Is the leak at the transmission output shaft seal?	Go to Step 8	Go to Step 9
	Remove the mainshaft rear oil seal and inspect for the following. Refer to Extension Disassemble .		

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	<ul style="list-style-type: none"> • Damaged or worn seal • Damaged seal bore • Improper installation • Cracks in the component • Output flange sealing surface is scratched, nicked, damaged, or worn • Loose or worn bearing causing excessive seal wear • Output flange nut loose 		
8	Did you find and repair the condition?	Go to Step 25	Go to Diagnostic Aids
9	Is the leak at the shift rail area?	Go to Step 10	Go to Step 11
10	Inspect the shift rail seal for damage. Did you find and repair the condition?	Go to Step 25	Go to Diagnostic Aids
11	Is the leak at the front of the transmission?	Go to Step 12	Go to Step 15
12	<ol style="list-style-type: none"> 1. Remove the transmission. Refer to <u>Transmission Replacement</u>. 2. Inspect the input shaft for leaking. 3. Remove the CSC assembly. Refer to <u>Clutch Concentric Actuator Cylinder Replacement (Aisin)</u> or <u>Clutch Concentric Actuator Cylinder Replacement (Tremec)</u>. Did you find and repair the condition?		
		Go to Step 25	Go to Step 13
13	<ol style="list-style-type: none"> 1. Inspect for the leak at the input shaft seal. 2. Inspect for the following if the input shaft seal is leaking: <ul style="list-style-type: none"> • Damaged or worn seal • Damaged seal bore • Improper installation • Cracks in the component • Input shaft sealing surface is scratched, nicked, damaged, or worn • Loose or worn bearing causing excessive seal wear 3. Replace the CSC assembly. Refer to <u>Clutch Concentric Actuator Cylinder Replacement (Aisin)</u> or <u>Clutch Concentric Actuator Cylinder Replacement (Tremec)</u>. 		

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	Did you find and repair the condition?	Go to Step 25	Go to Step 14
14	<ol style="list-style-type: none"> 1. Inspect the case for cracks or porosity. 2. If cracks and or porosity are found replace the transmission. Refer to <u>Transmission Replacement</u>. <p>Did you find and repair the condition?</p>		
15	Is the leak at the vehicle speed sensor (VSS)?	Go to Step 25	Go to Diagnostic Aids
16	<ol style="list-style-type: none"> 1. Remove the VSS. Refer to <u>Vehicle Speed Sensor Replacement</u>. 2. Inspect for the following: <ul style="list-style-type: none"> • Cut or damaged O-ring seal • VSS over tightened causing deformation in the VSS • VSS bore scratched or damaged <p>Did you find and repair the condition?</p>	Go to Step 16	Go to Step 17
17	Is the leak at the backup light switch?	Go to Step 18	Go to Step 19
18	<ol style="list-style-type: none"> 1. Remove the backup light switch. Refer to <u>Backup Lamp Switch Replacement</u>. 2. Inspect for the following: <ul style="list-style-type: none"> • Cross threaded or damaged threads • Insufficient sealant • Leaking switch • Improper installation <p>Did you find and repair the condition?</p>		
19	Is the leak at the shift shaft plunger plug?	Go to Step 20	Go to Step 21
20	<ol style="list-style-type: none"> 1. Remove the shift shaft detent plug. Refer to <u>Transmission Disassemble</u> and <u>Transmission Assemble</u>. 2. Inspect for the following: <ul style="list-style-type: none"> • Loose, not installed properly • Insufficient sealant • Cracked case • Improper installation <p>Did you find and repair the condition?</p>		
21	Is the leak at the sealing flanges of the transmission cases?	Go to Step 22	Go to Step 23

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	<ol style="list-style-type: none">1. Remove the transmission. Refer to Transmission Replacement.2. Disassemble the transmission. Refer to Transmission Disassemble.3. Inspect the sealing surfaces. Refer to Transmission Case Cleaning and Inspection.		
22	Did you find and repair the condition?	Go to Step 25	Go to Step 23
23	Is the leak coming from a crack or porosity in the transmission case?	Go to Step 24	Go to Diagnostic Aids
24	<ol style="list-style-type: none">1. Remove the transmission. Refer to Transmission Replacement.2. Disassemble the transmission. Refer to Transmission Disassemble.3. Replace the faulty case. Refer to Transmission Assemble. Did you find and repair the condition?		Go to Diagnostic Aids
25	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 FLUID TEMPERATURE SENSOR REPLACEMENT

Removal Procedure

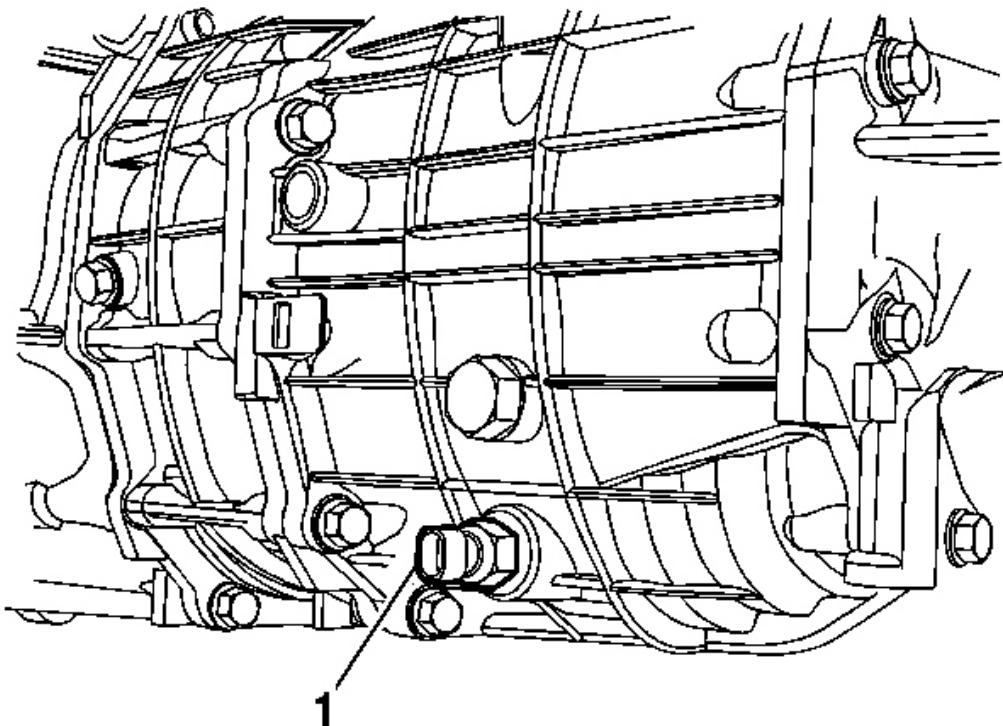


Fig. 6: TFT Sensor

Courtesy of GENERAL MOTORS CORP.

1. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
2. Disconnect the transmission fluid temperature (TFT) sensor electrical connector.
3. Clean away all dirt and debris from the TFT sensor.
4. Place a suitable drain pan under the transmission.
5. Remove the TFT sensor (1).

Installation Procedure

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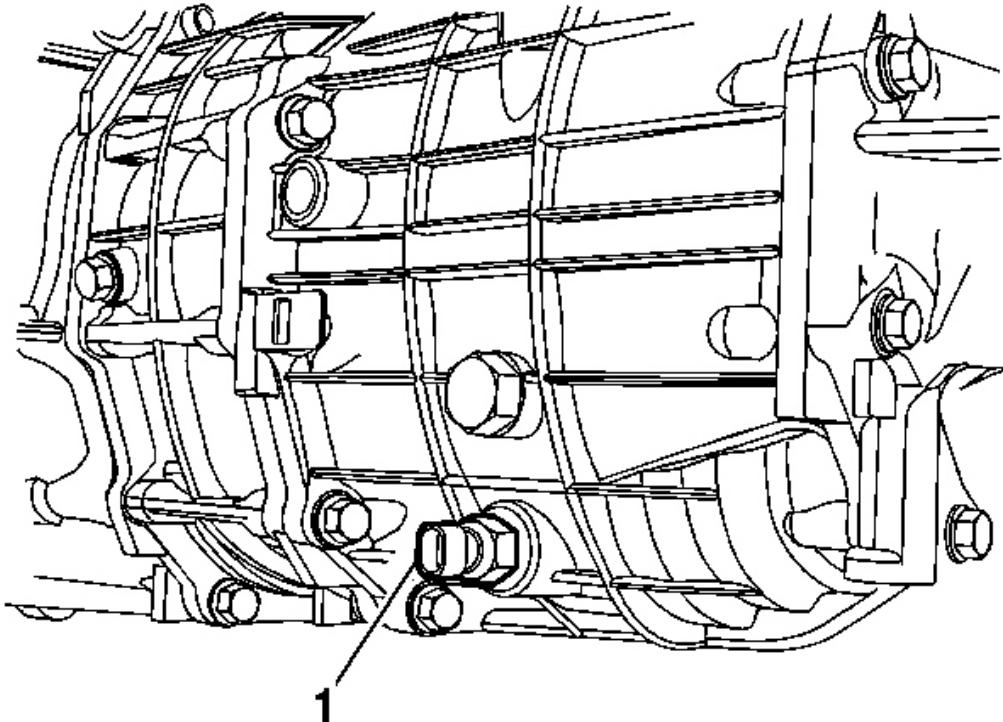


Fig. 7: TFT Sensor

Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Install the TFT sensor (1) and tighten the sensor to 18 N.m (13 lb ft).
2. Connect the TFT sensor electrical connector.
3. Fill the transmission to the proper level.
4. Remove the drain pan.
5. Lower the vehicle.

TRANSMISSION FLUID LEVEL INSPECTION

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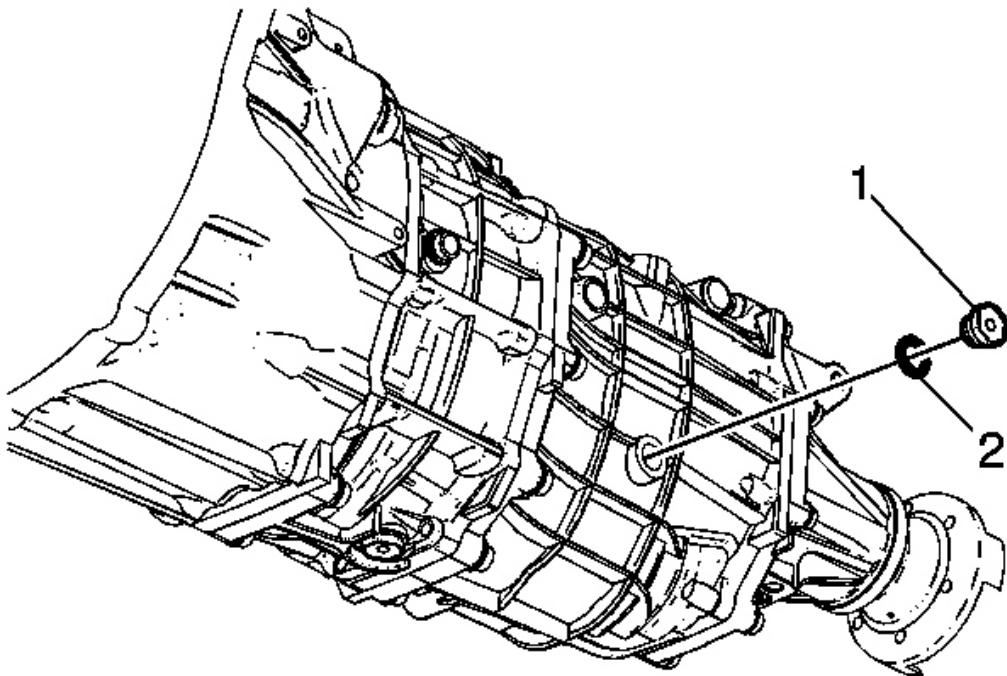


Fig. 8: Identifying Transmission Fill Plug & Washer
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
2. Clean any dirt from around the fill plug (1).
3. Remove the transmission fill plug (1) and washer (2) from the transmission.

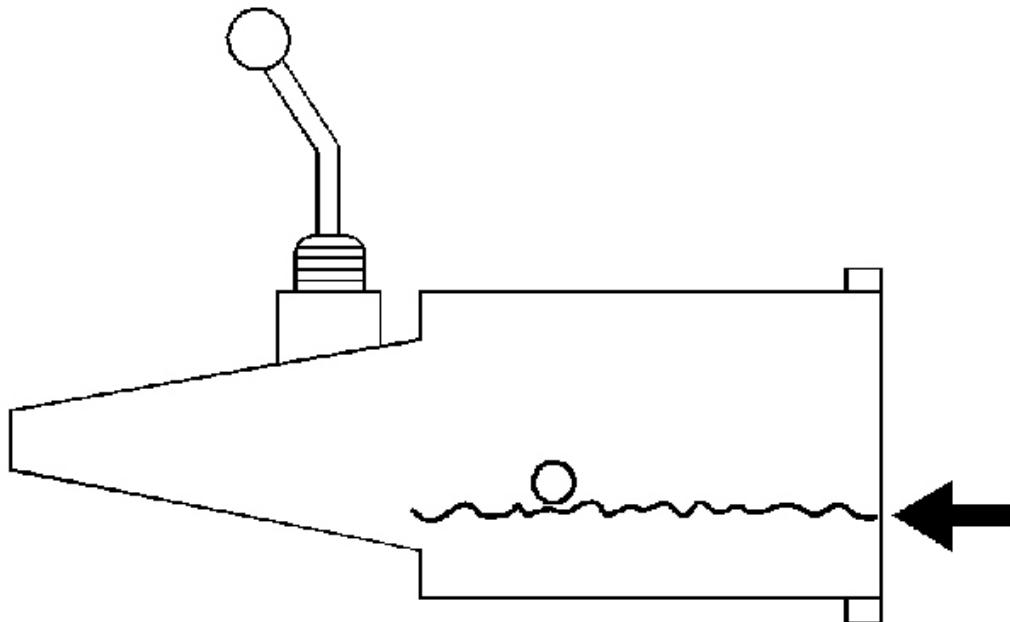


Fig. 9: Transmission Fluid Level

Courtesy of GENERAL MOTORS CORP.

4. Check that the transmission fluid level is even with the bottom of the fill plug hole.
5. Add transmission fluid, if necessary.

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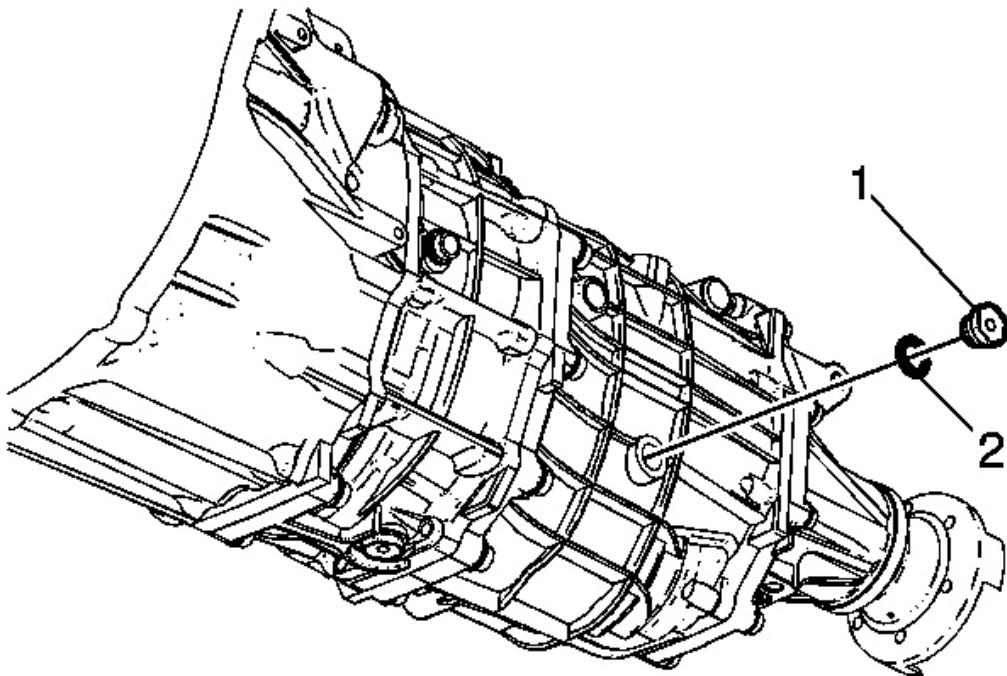


Fig. 10: Identifying Transmission Fill Plug & Washer
Courtesy of GENERAL MOTORS CORP.

6. Inspect the fill plug washer (2) and replace if necessary.

CAUTION: Refer to Component Fastener Tightening Caution .

7. Install the transmission fill plug (1) and washer (2) then tighten to 37 N.m (27 lb ft).
8. Lower the vehicle.

TRANSMISSION FLUID REPLACEMENT

Draining Procedure

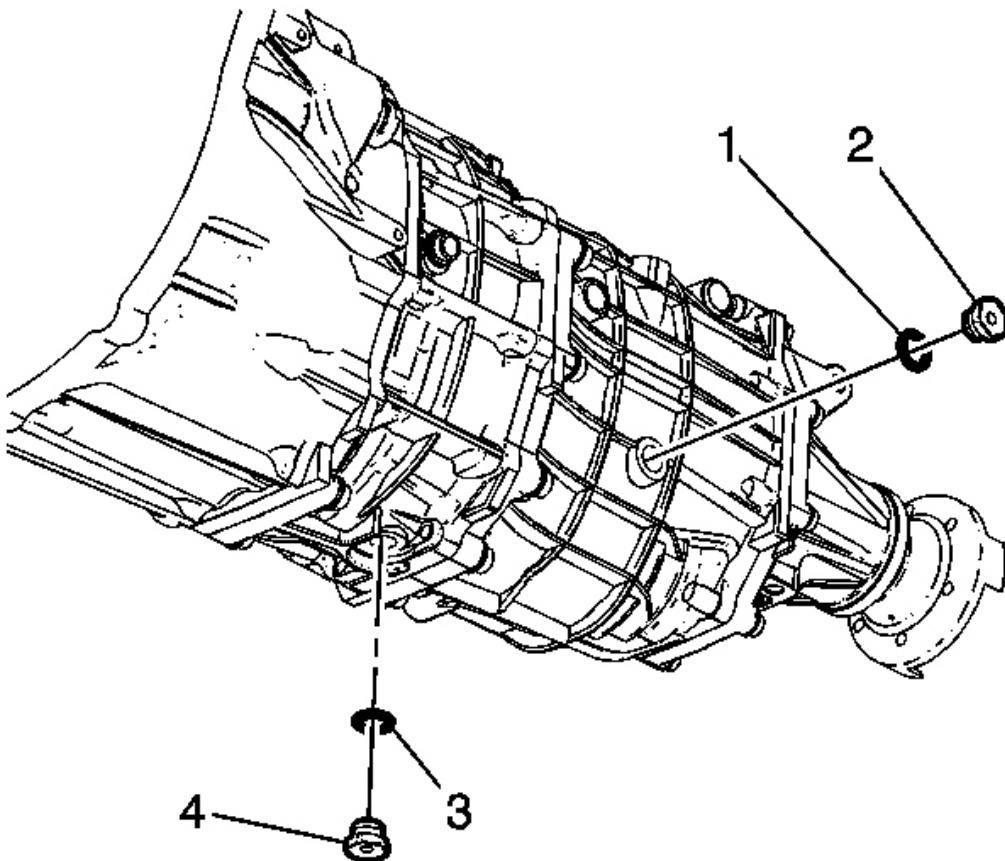


Fig. 11: Identifying Transmission Fluid Plugs & Washers
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
2. Clean away any dirt and debris from around the transmission fluid drain plug area.
3. Position an appropriate container below the transmission drain plug.
4. Remove the transmission fluid drain plug (4) and washer (3). Discard the washer.
5. Allow the transmission fluid to drain into the container.

CAUTION: Refer to Component Fastener Tightening Caution .

6. Install the transmission fluid drain plug (4) and a NEW washer (3) then tighten to 37 N.m (27 lb ft).
7. Remove the container used to catch the used transmission fluid from under the vehicle.

Filling Procedure

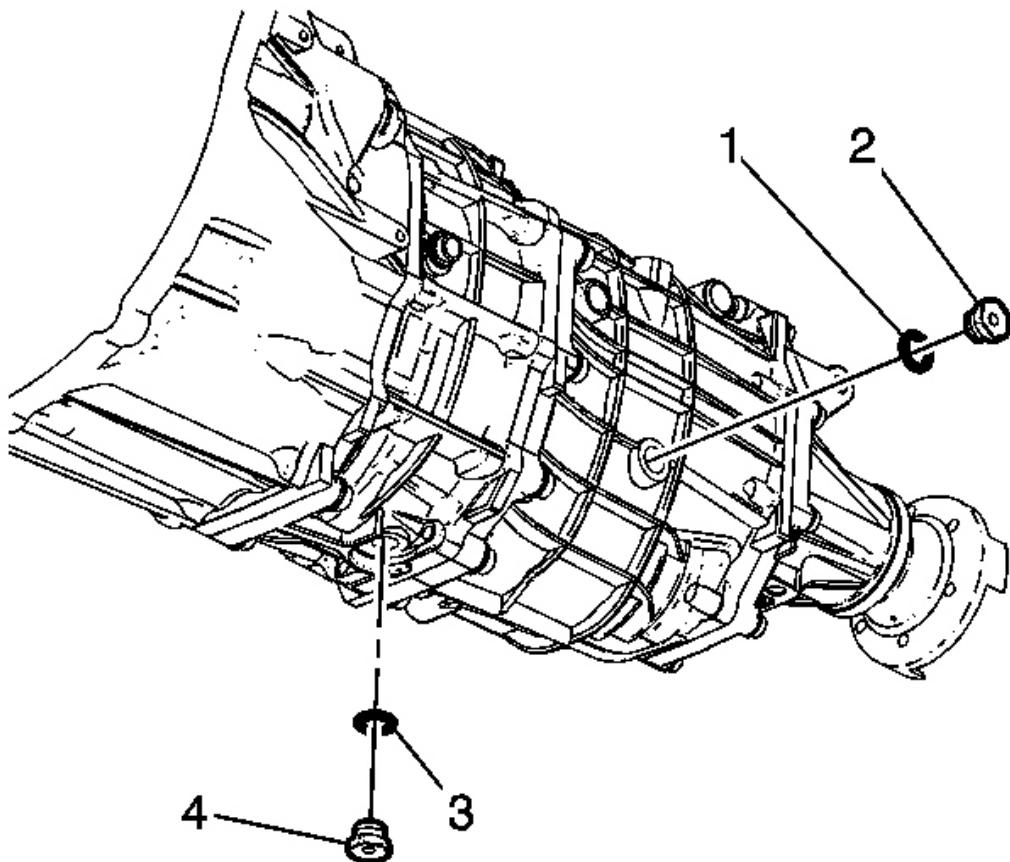


Fig. 12: Identifying Transmission Fluid Plugs & Washers

Courtesy of GENERAL MOTORS CORP.

1. Clean away any dirt and debris from the transmission fluid fill plug area.
2. Remove the transmission fluid fill plug (2) and washer (1). Discard the washer.

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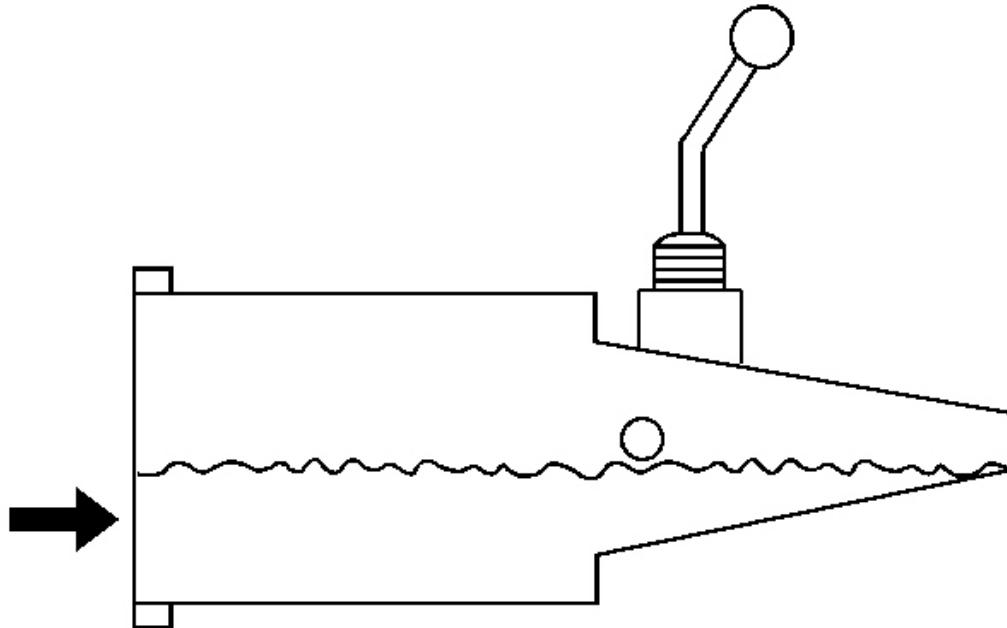


Fig. 13: Identifying Transmission Fluid Level

Courtesy of GENERAL MOTORS CORP.

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

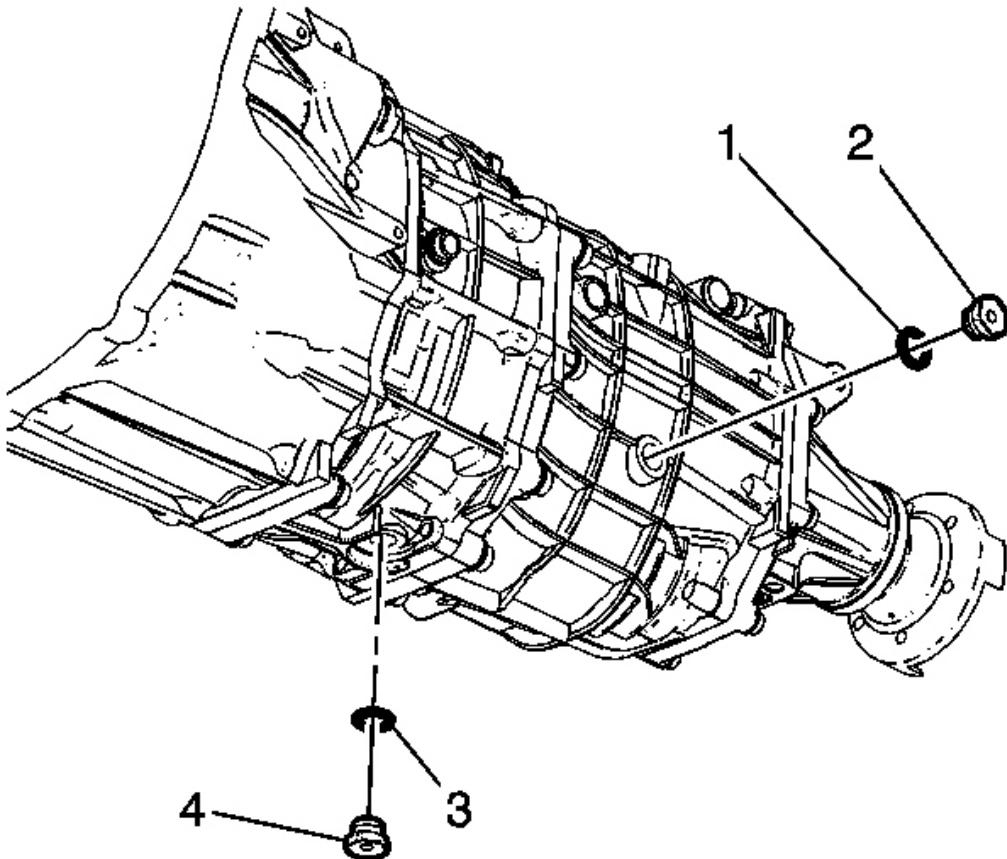


Fig. 14: Identifying Transmission Fluid Plugs & Washers
Courtesy of GENERAL MOTORS CORP.

4. Install the transmission fluid fill plug (2) and a NEW washer (1) then tighten to 37 N.m (27 lb ft).
5. Lower the vehicle.

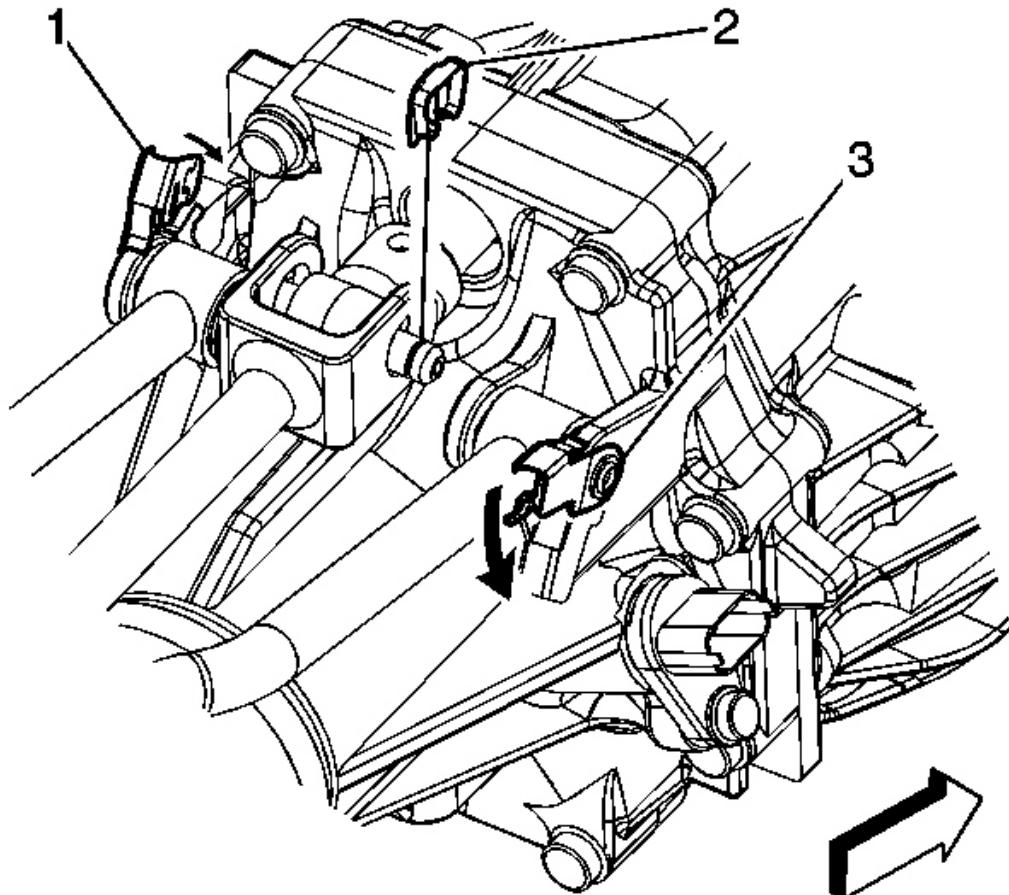
SHIFT CONTROL ASSEMBLY REPLACEMENT

Removal Procedure

1. Remove the front floor console front cover. Refer to [Front Floor Console Front Cover Replacement \(Without UMQ\)](#) or [Front Floor Console Front Cover Replacement \(With UMQ\)](#)
2. Remove the transmission control lever knob. Refer to [Transmission Control Lever Knob Replacement](#)
3. Remove the exhaust system. Refer to [Exhaust Muffler with Resonator, Exhaust, and Tail Pipe Replacement \(H-Pipe\)](#) or [Exhaust Muffler with Resonator, Exhaust, and Tail Pipe Replacement](#)

(Vehicle Service)

4. Disconnect the propeller shaft from the transmission and position out of the way. Refer to **Two-Piece Propeller Shaft Replacement**
5. Support the transmission with a suitable jack.
6. Remove the transmission support.
7. Lower the rear of the transmission in order to gain access to the top of the transmission.

**Fig. 15: Identifying Shift Control Rod Pin Retainers**

Courtesy of GENERAL MOTORS CORP.

8. Using a flat-blade tool, release the left and right side shift control rod pin retainers (1,3).
9. Using a flat-blade tool, release the center shift control rod pin retainer (2).

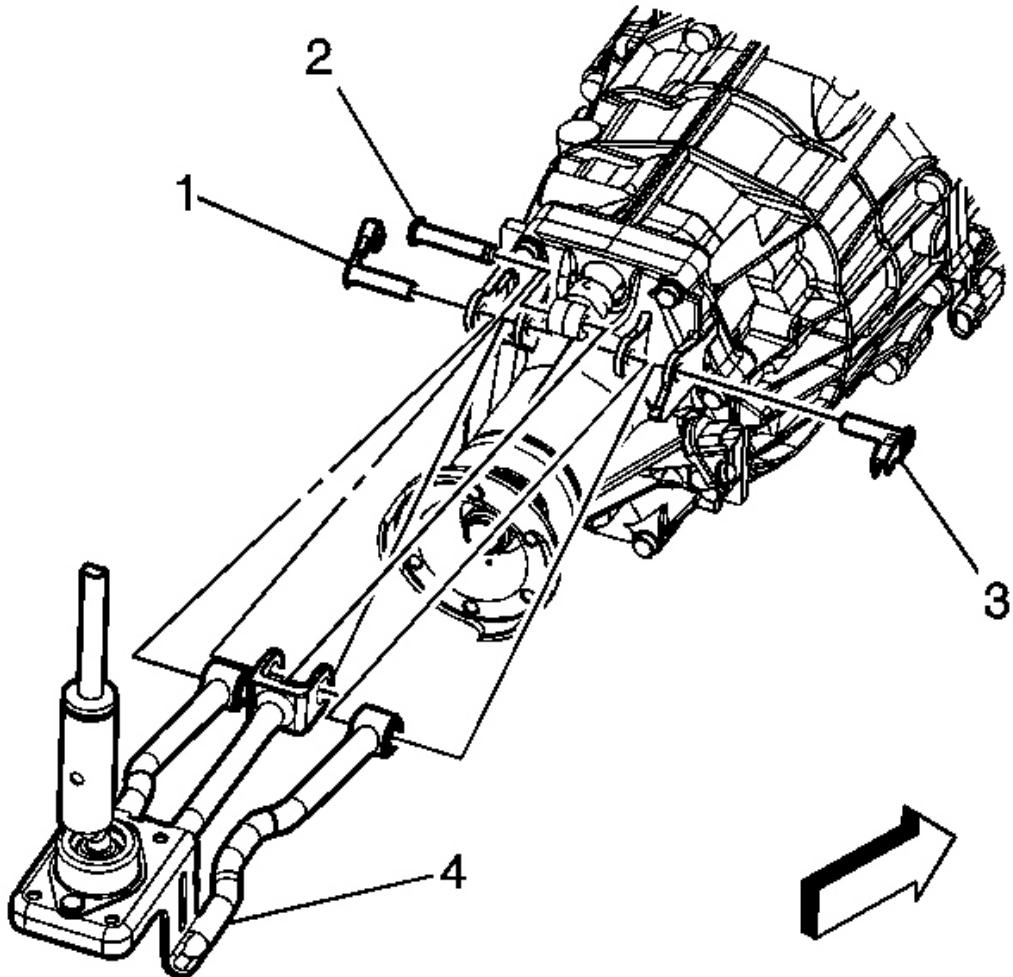


Fig. 16: Identifying Shift Control Rod Pins

Courtesy of GENERAL MOTORS CORP.

10. Remove the left and right side shift control rod pins (1, 3).
11. Remove the center shift control rod pin (2).
12. Remove the shift control mounting nuts.
13. Remove the manual transmission control assembly from the vehicle.

Installation Procedure

1. Position the manual transmission control assembly into the vehicle.

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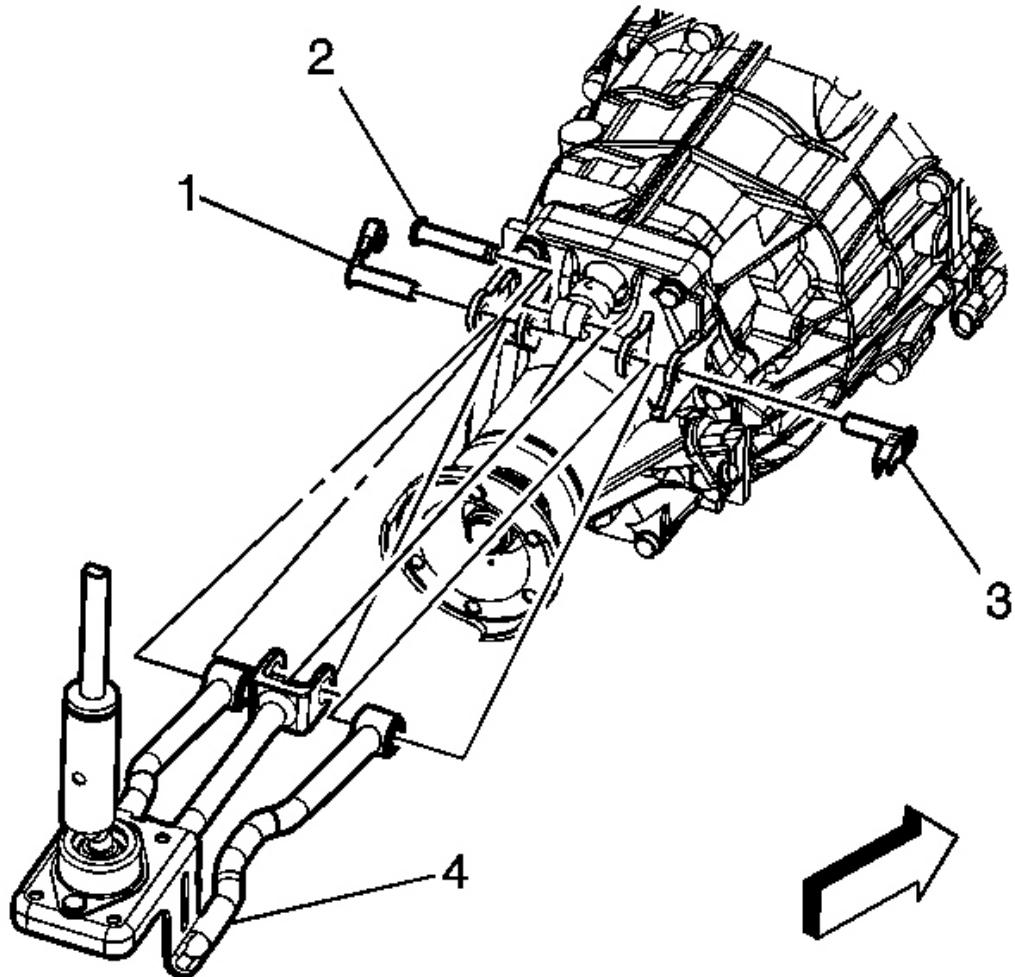


Fig. 17: Identifying Shift Control Rod Pins

Courtesy of GENERAL MOTORS CORP.

2. Install the center shift control rod pin (2).
3. Install the left and right side shift control rod pins (1,3).

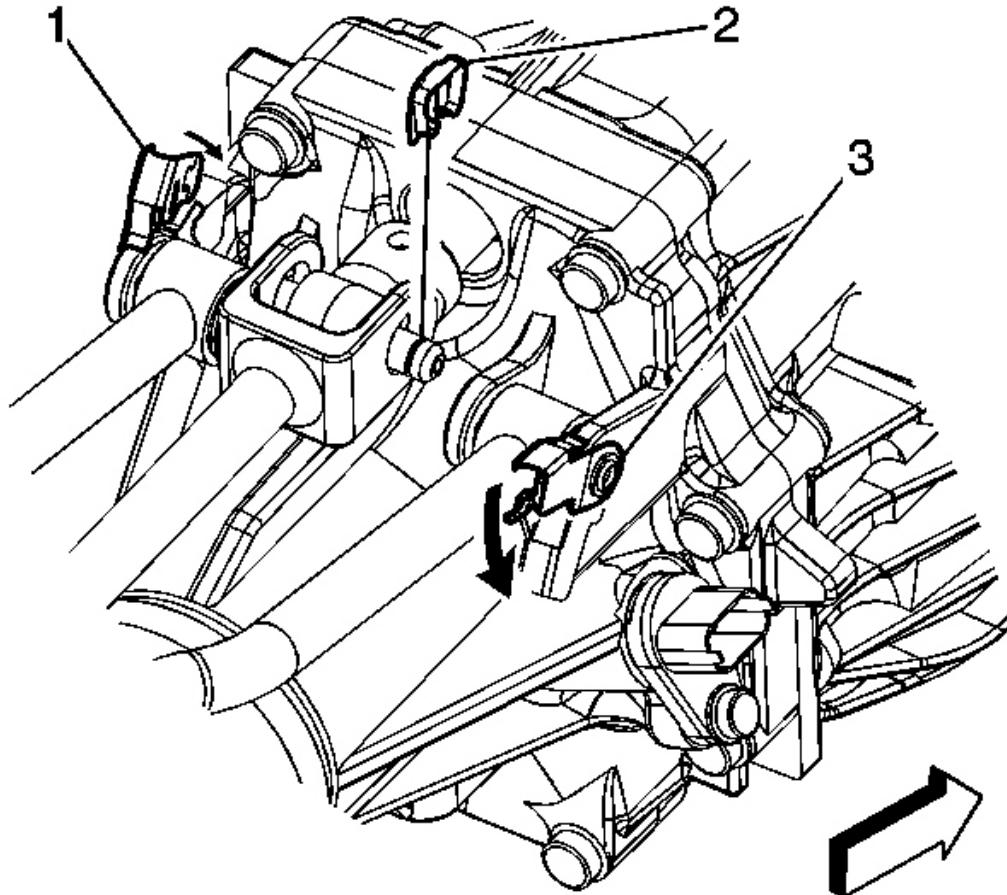
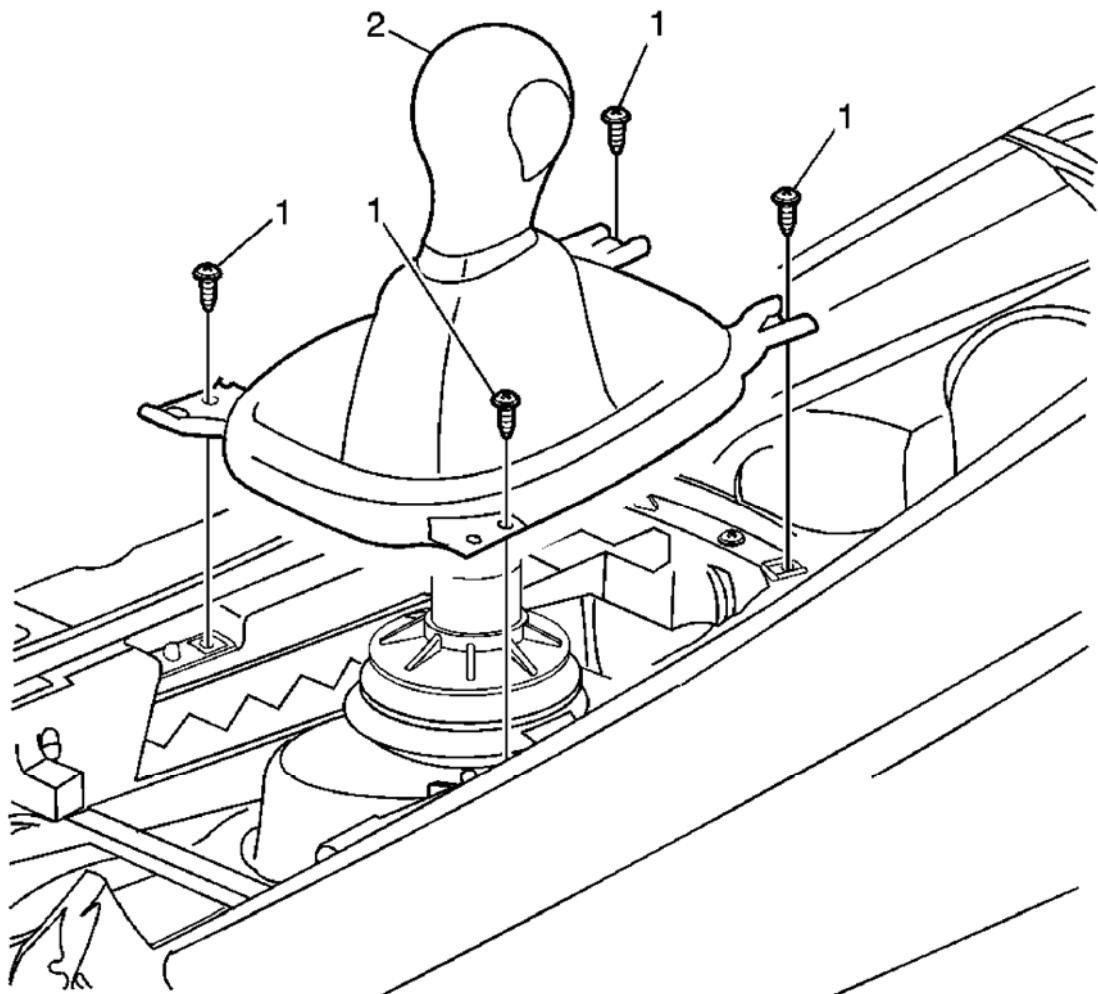


Fig. 18: Identifying Shift Control Rod Pin Retainers
Courtesy of GENERAL MOTORS CORP.

4. Install the center shift control rod pin retainer (2).
5. Rotate the left and right side shift control rod pins (1,2) in order to lock the retainers into place on the transmission.
6. Install the shift control mounting nuts.
7. Raise the transmission.
8. Install the transmission support. Refer to [Transmission Mount Replacement](#)
9. Remove the jack supporting the transmission.
10. Install the propeller shaft. Refer to [Two-Piece Propeller Shaft Replacement](#)
11. Install the exhaust system. Refer to [Exhaust Muffler with Resonator, Exhaust, and Tail Pipe Replacement \(H-Pipe\)](#) or [Exhaust Muffler with Resonator, Exhaust, and Tail Pipe Replacement](#)

(Vehicle Service)

12. Lower the vehicle.
13. Install the front floor console front cover. Refer to [**Front Floor Console Front Cover Replacement \(Without UMQ\)**](#) or [**Front Floor Console Front Cover Replacement \(With UMQ\)**](#)
14. Install the transmission control lever knob. Refer to [**Transmission Control Lever Knob Replacement**](#)

TRANSMISSION CONTROL LEVER KNOB REPLACEMENT**Fig. 19: Transmission Control Lever Knob**

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure:	
Remove the front floor console front cover. Refer to Front Floor Console Front Cover Replacement (Without UMQ) or Front Floor Console Front Cover Replacement (With UMQ) .	

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1	Transmission Control Lever Knob Assembly Fastener (Qty: 4)
2	<p>Manual Transmission Control Lever Knob Assembly</p> <p>Procedure:</p> <p>First remove the 4 fasteners securing the manual transmission control lever knob assembly to the front floor console.</p> <p>Tip: Firmly pull upward until knob is released from control assembly.</p> <p>Tighten:</p> <p>9 N.m (80 lb in)</p>

VEHICLE SPEED SENSOR REPLACEMENT

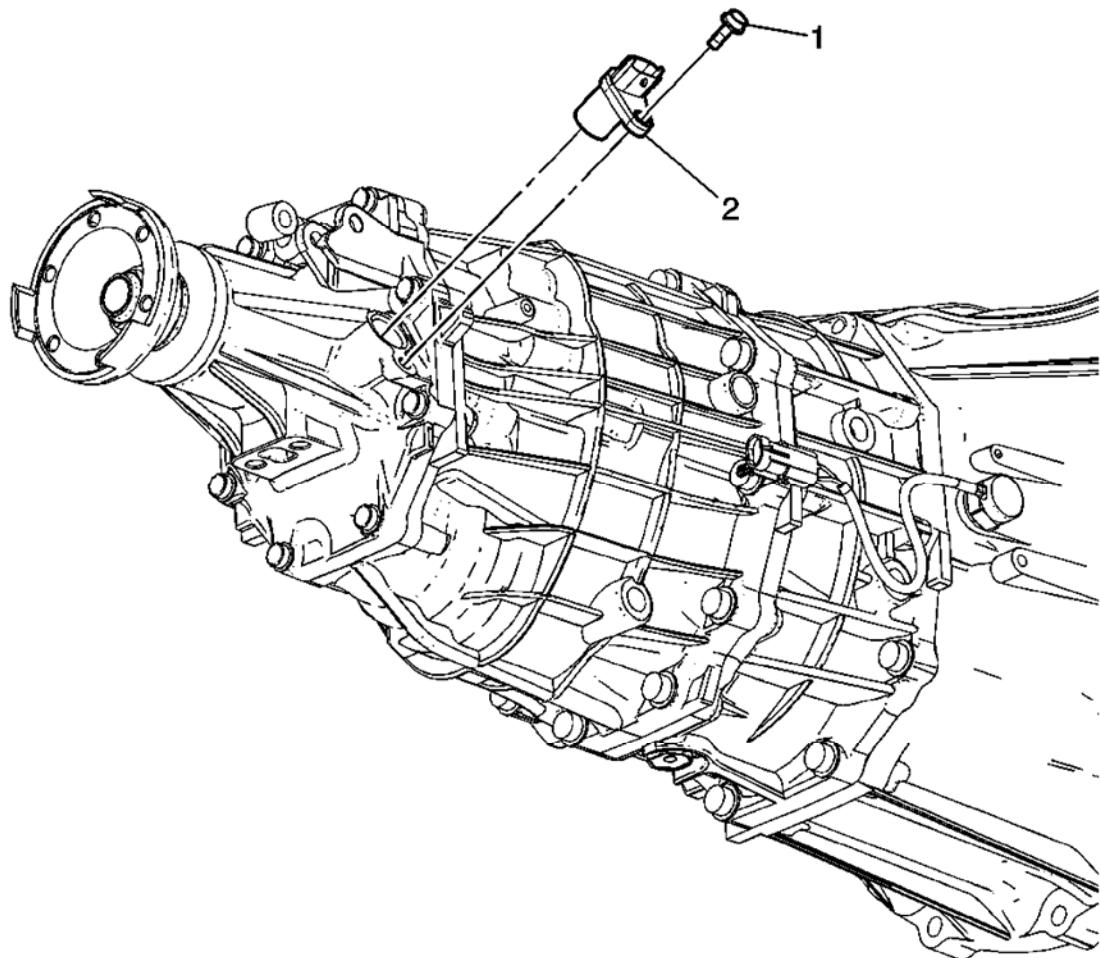


Fig. 20: Vehicle Speed Sensor

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
	Preliminary Procedures

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1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
2. Remove the transmission support. Refer to [Transmission Mount Replacement](#)
3. Lower the rear of the transmission.

1	Vehicle Speed Sensor Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten: 8 N.m (71 lb in)
2	Vehicle Speed Sensor Procedure: Disconnect the electrical wire harness from the vehicle speed sensor.

TRANSMISSION MOUNT REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .

NOTE: **The engine mounts must NOT bend or deflect from the vertical position, damage to the mount will occur.**

2. Support the transmission with a suitable jack and a block of wood.

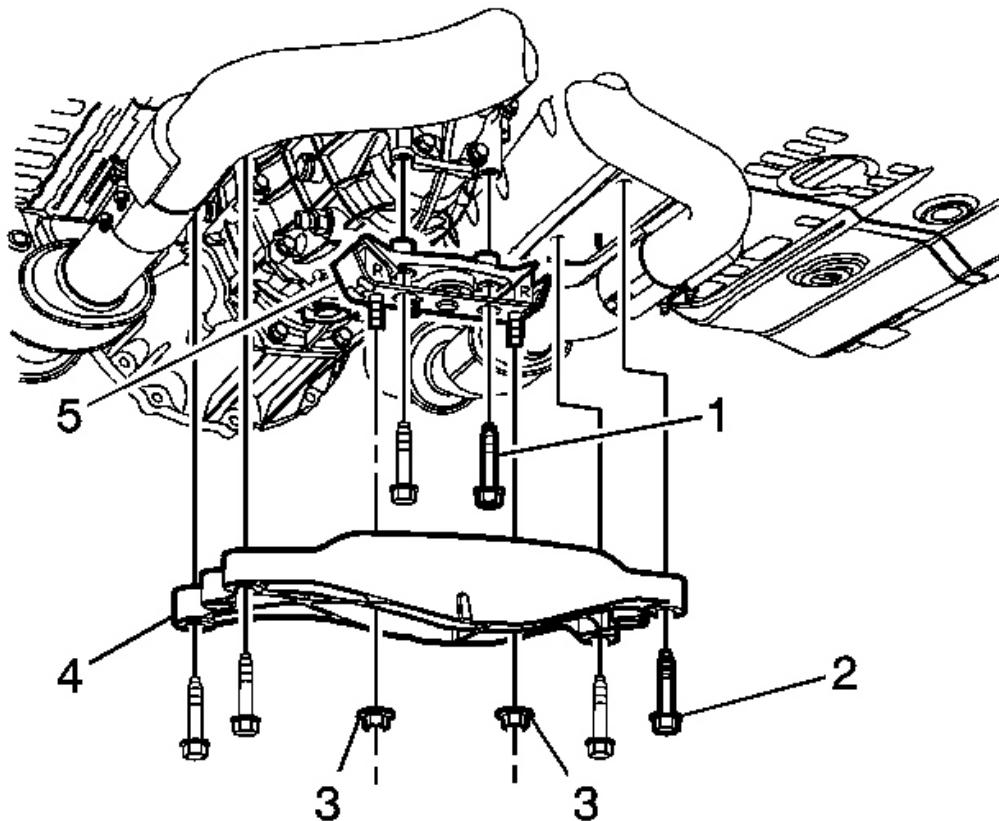


Fig. 21: Transmission Mount Components

Courtesy of GENERAL MOTORS CORP.

3. Remove the two transmission mount nuts (3).
4. Remove the four transmission support retaining bolts (2), then remove the transmission support (4) from the vehicle.
5. Remove the two transmission mount bolts (1).
6. Remove the transmission mount (5) from the transmission.

Installation Procedure

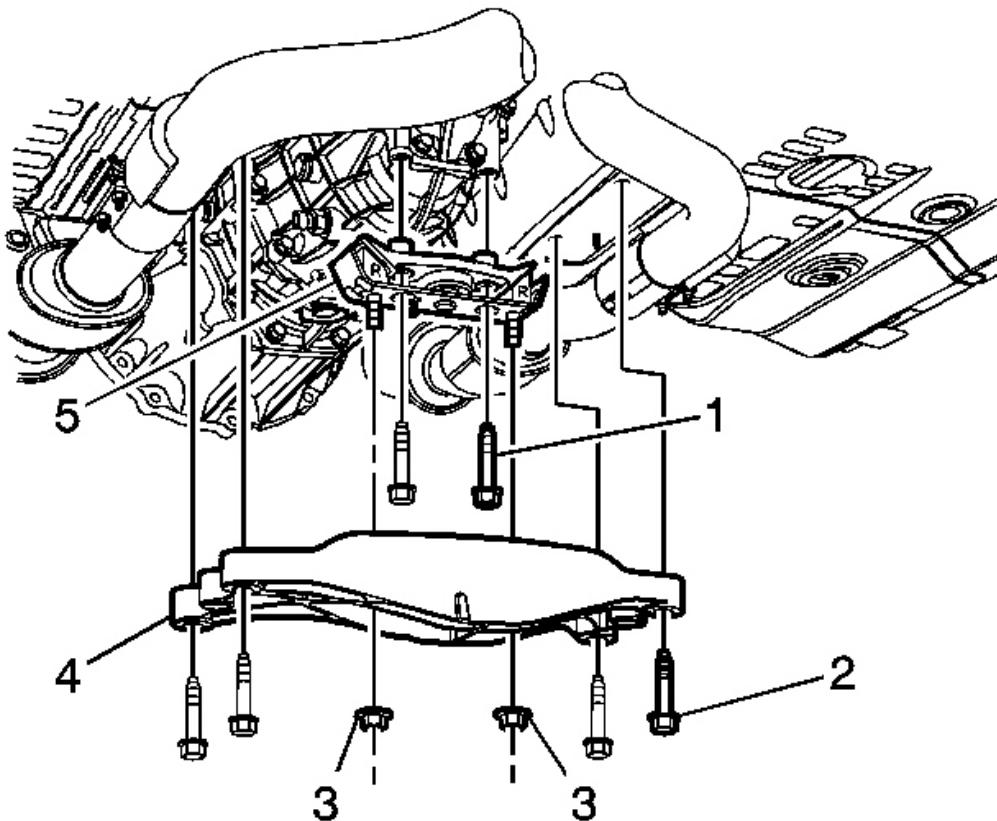


Fig. 22: Transmission Mount Components

Courtesy of GENERAL MOTORS CORP.

NOTE: The engine mounts must NOT bend or deflect from the vertical position, damage to the mount will occur.

1. Install the transmission mount (5) to the transmission.

CAUTION: Refer to Fastener Caution .

2. Install the two transmission mount bolts (1) and tighten to 58 N.m (43 lb ft).
3. Install the transmission support (4).
4. Install the four transmission support bolts (2) and tighten to 58 N.m (43 lb ft).
5. Install the transmission mount nuts (3) and tighten to 58 N.m (43 lb ft).

6. Remove the support from under the transmission.
7. Lower the vehicle.

BACKUP LAMP SWITCH REPLACEMENT

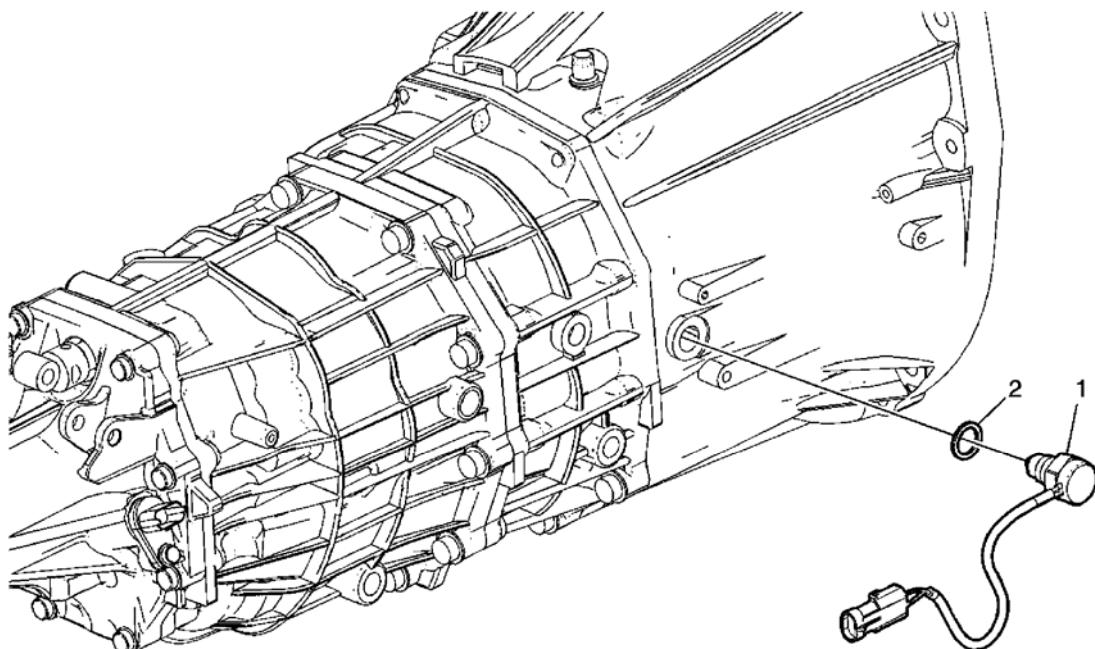


Fig. 23: Backup Lamp Switch

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures: Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u>	
1	<p>Backup Lamp Switch</p> <p>CAUTION: Refer to <u>Component Fastener Tightening Caution</u> .</p> <p>Procedure: Disconnect the electrical wire harness from the backup lamp switch.</p> <p>Tighten: 44 N.m (32 lb ft)</p>
2	<p>Backup Lamp Switch Washer</p> <p>Tip: Use a NEW backup lamp switch washer.</p>

CAUTION: In order to avoid oil pan damage and possible engine failure, insert a block of wood that spans the width of the oil pan bottom between the oil pan and the jack support.

1. Raise and support the vehicle.

NOTE: Before replacing any transmission mount due to suspected fluid loss, verify that the source of the fluid is the transmission mount, not the engine, transmission or accessories.

2. Raise the transmission in order to remove the weight from the transmission mount and create slight tension in the rubber.
3. Observe the transmission mount while raising the transmission. Replace the transmission mount if the transmission mount exhibits any of the following conditions:
 - The hard rubber surface is covered with heat check cracks.
 - The rubber is separated from the metal plate of the transmission mount.
 - The rubber is split through the center of the transmission mount.
4. If there is movement between the metal plate of the transmission mount and its attaching points, lower the transmission on the transmission mount. Tighten the bolts or nuts attaching the transmission mount to the frame or transmission mount bracket.
5. Lower the vehicle.

TRANSMISSION REPLACEMENT

Removal Procedure

1. Turn the steering wheel so that the front wheels are pointing straight ahead.
2. Turn the ignition lock cylinder to the lock position and remove the key.
3. Remove the heater inlet and outlet pipes from the vehicle. Refer to [Heater Inlet And Outlet Pipe Replacement \(LLT\)](#)
4. Remove the shift control rods from the transmission. Refer to [Shift Control Assembly Replacement](#).
5. Remove the exhaust system. Refer to [Exhaust Muffler with Resonator, Exhaust, and Tail Pipe Replacement \(H-Pipe\)](#) or [Exhaust Muffler with Resonator, Exhaust, and Tail Pipe Replacement \(Vehicle Service\)](#) .
6. Remove the propeller shaft. Refer to [Two-Piece Propeller Shaft Replacement](#) .

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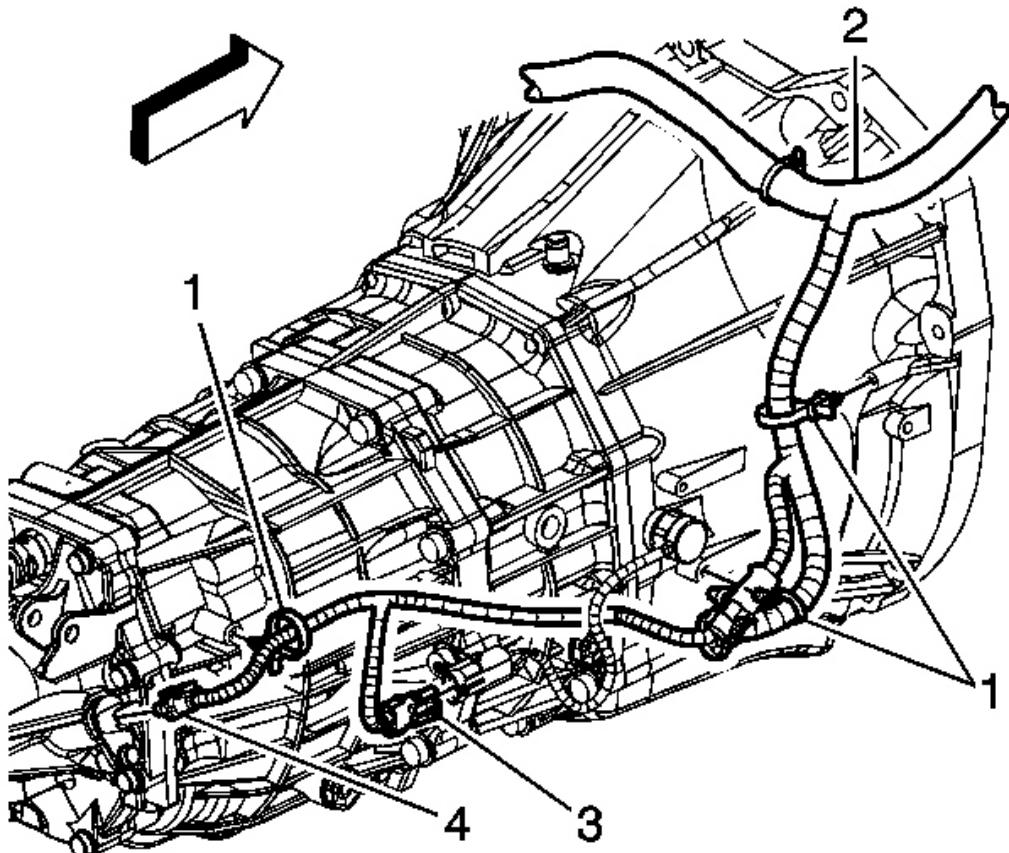


Fig. 24: Identifying Electrical Connectors & Harness Retainers
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the electrical connector from the vehicle speed sensor.
8. Disconnect the electrical connector (4) from the backup lamp switch.
9. Remove the electrical harness retainers (1) from the transmission.
10. Position the electrical harness (2) out of the way.

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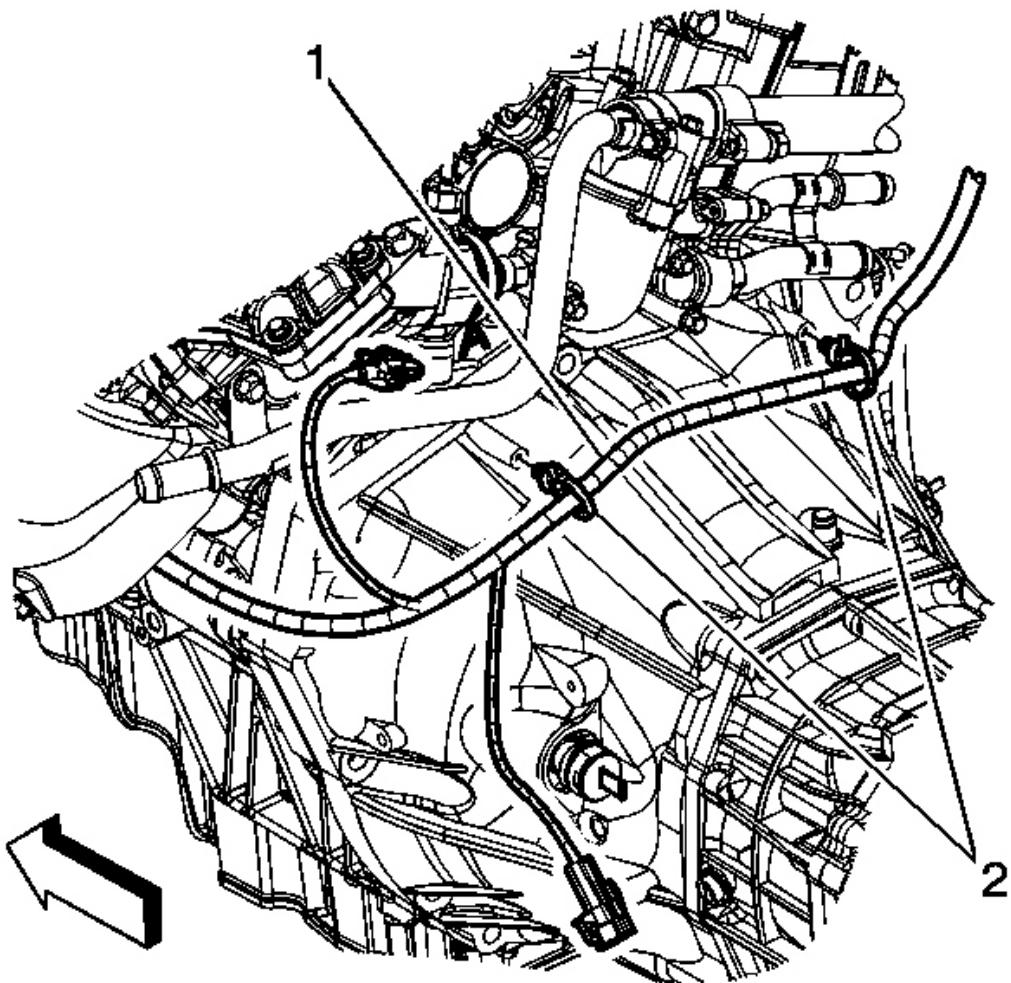


Fig. 25: Identifying Electrical Harness & Retainers

Courtesy of GENERAL MOTORS CORP.

11. Remove the electrical harness retainers (2) from the transmission.
12. Position the electrical harness (1) out of the way.
13. Support and secure the transmission with a suitable transmission jack.
14. Remove the transmission support. Refer to **Transmission Mount Replacement**.

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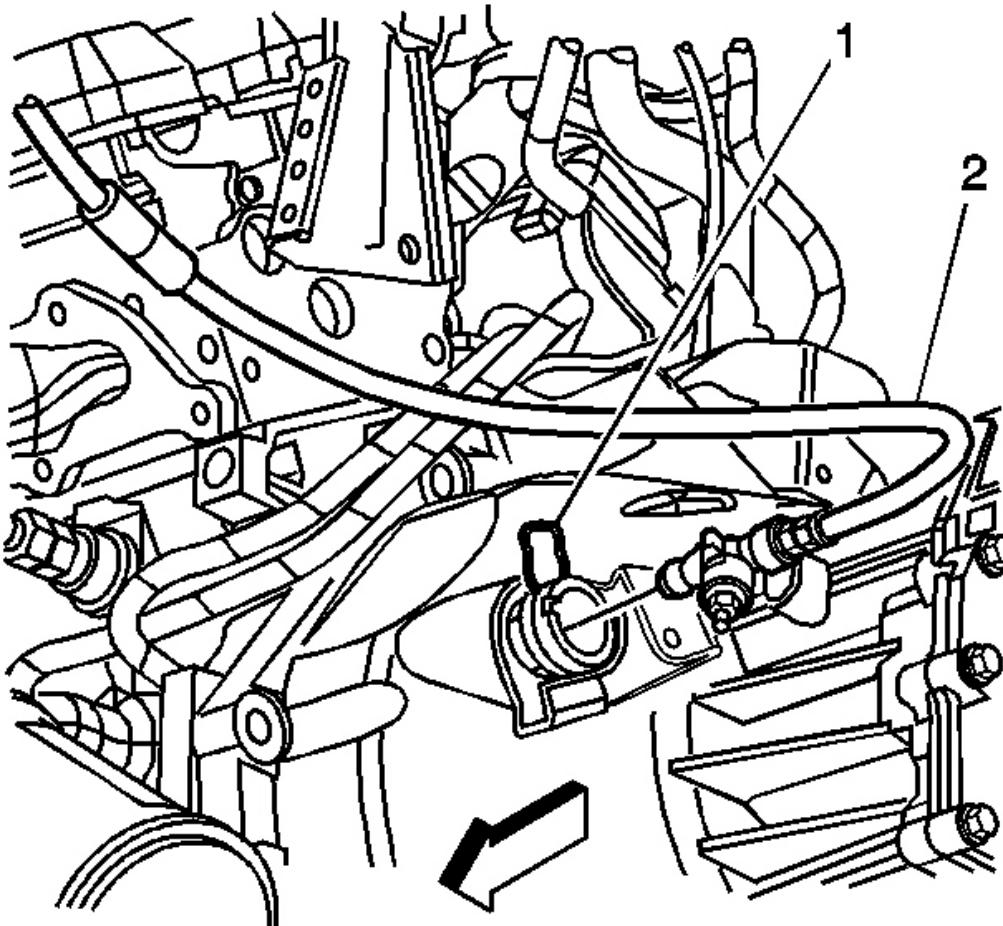


Fig. 26: Identifying Clutch Retaining Hose Retaining Clip & Clutch Hydraulic Hose
Courtesy of GENERAL MOTORS CORP.

15. Remove the clutch hydraulic hose retaining clip (1) from the clutch slave cylinder.
16. Disconnect the clutch hydraulic hose (2) from the clutch slave cylinder. Plug the lower hose end to prevent fluid loss.

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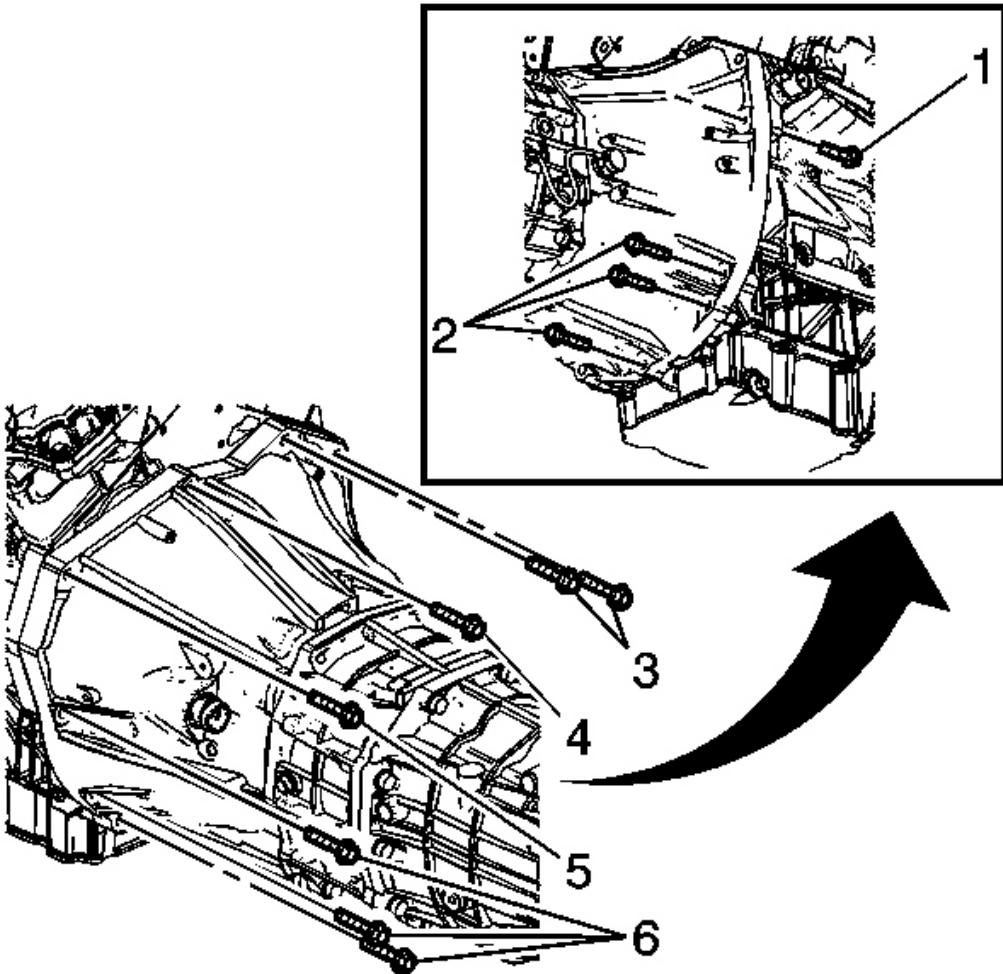


Fig. 27: Identifying Transmission Bolts
Courtesy of GENERAL MOTORS CORP.

17. Remove the transmission bolts (1-6).
18. Pull the transmission free from the engine dowels.

NOTE: Ensure clearance is maintained between the transmission and the following:

- The clutch assembly
- The input shaft

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- **The catalytic converters**
- **The wiring harnesses**
- **The propeller shaft**

19. Using the transmission jack, carefully lower the transmission from the vehicle.

Installation Procedure

NOTE: **Ensure clearance is maintained between the transmission and the following:**

- **The clutch assembly**
- **The input shaft**
- **The catalytic converters**
- **The wiring harnesses**
- **The propeller shaft**

1. Using the transmission jack, carefully raise the transmission to the vehicle.

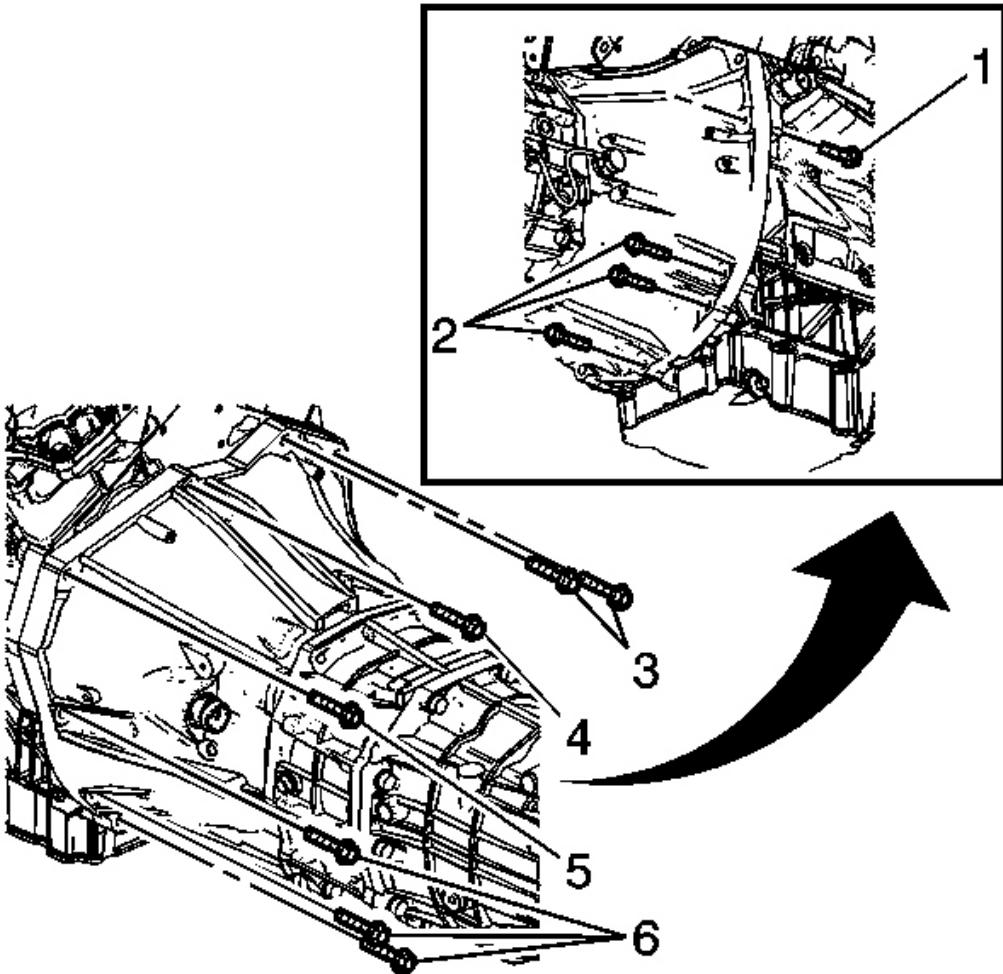


Fig. 28: Identifying Transmission Bolts
Courtesy of GENERAL MOTORS CORP.

2. Align the transmission with the engine dowels.

CAUTION: Refer to Fastener Caution .

3. Install the transmission bolts (1-6) and tighten to 50 N.m (37 lb ft).

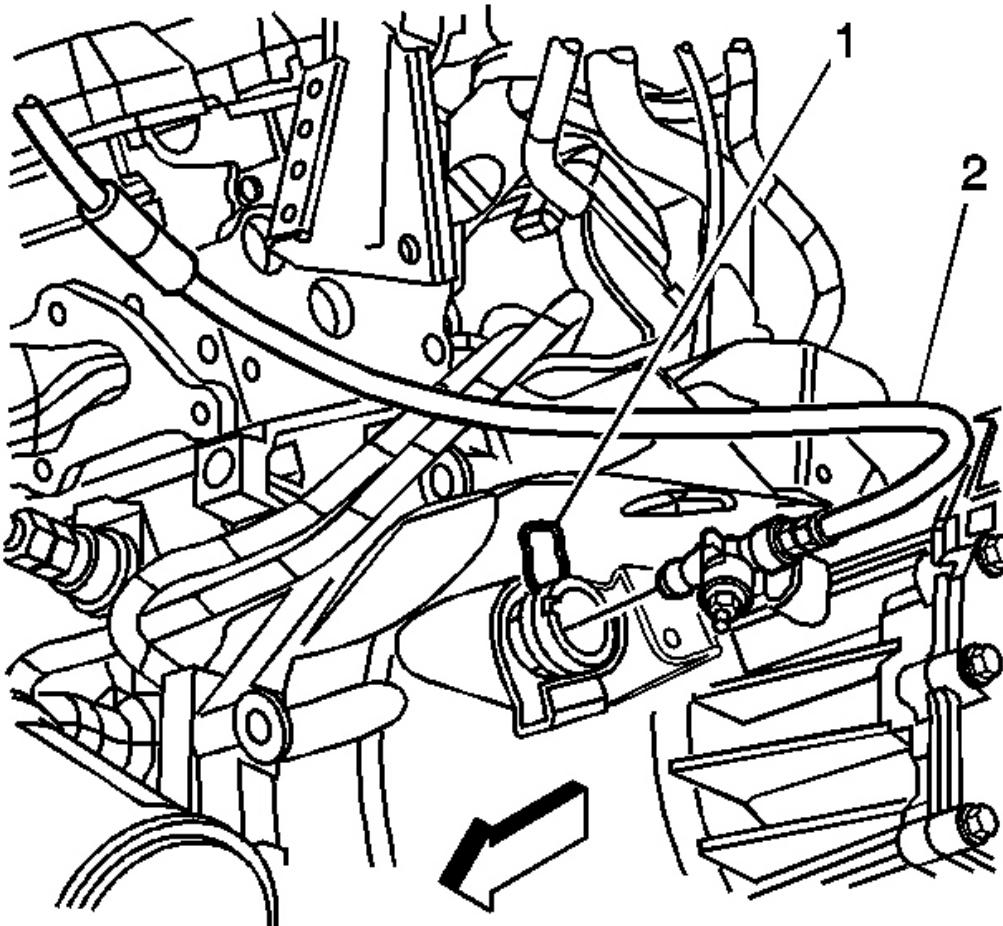


Fig. 29: Identifying Clutch Retaining Hose Retaining Clip & Clutch Hydraulic Hose
Courtesy of GENERAL MOTORS CORP.

4. Install the clutch hydraulic hose retaining clip (1) to the clutch slave cylinder.

NOTE: Ensure the clutch hydraulic hose is routed in an upward direction above the clutch slave cylinder with no sharp bends, kinks, or downward loops. Ensure the clutch hydraulic hose does not come in contact with any sharp or potentially hot surfaces.

5. Install the clutch hydraulic hose to the vehicle.
6. Align the clutch hydraulic hose locating tab with the notch in the slave cylinder hose fitting.
7. Push the clutch hydraulic hose (2) into the clutch slave cylinder until a "click" is heard.

8. Tug gently on the clutch hydraulic hose (2) to ensure proper retention to the clutch slave cylinder.
9. Install the shift control rods to the transmission. Refer to **Shift Control Assembly Replacement**.
10. Remove the transmission jack.
11. Install the transmission support. Refer to **Transmission Mount Replacement**.

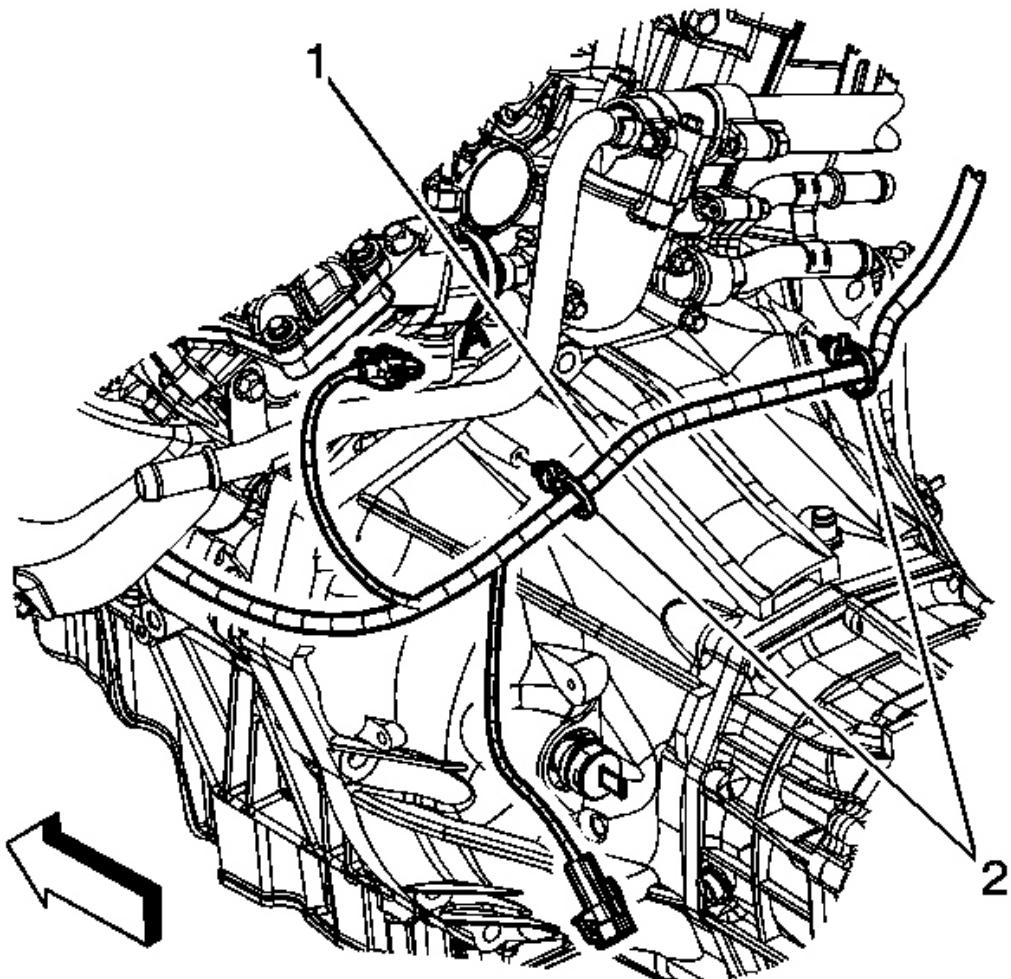


Fig. 30: Identifying Electrical Harness & Retainers
Courtesy of GENERAL MOTORS CORP.

12. Install the electrical harness retainers (2) to the transmission.

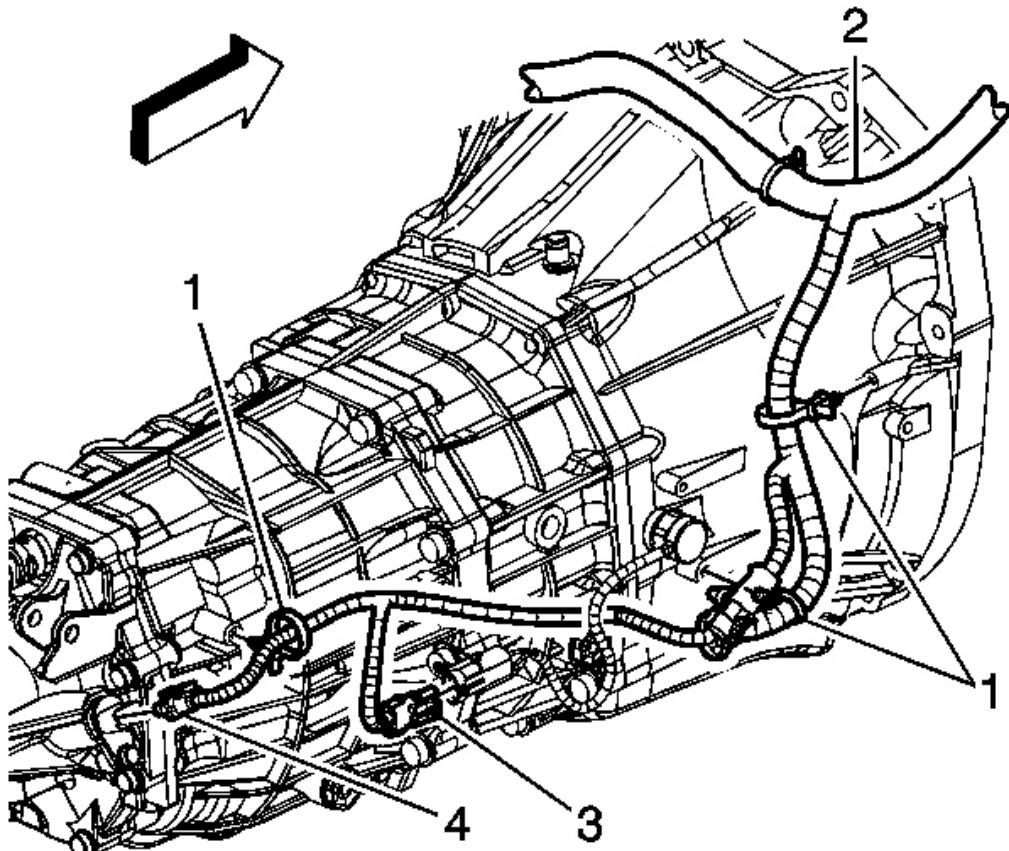


Fig. 31: Identifying Electrical Connectors & Harness Retainers
Courtesy of GENERAL MOTORS CORP.

13. Install the electrical harness retainers (1) to the transmission.
14. Connect the electrical connector (4) to the backup lamp switch.
15. Connect the electrical connector to the vehicle speed sensor.
16. Install the propeller shaft. Refer to [Two-Piece Propeller Shaft Replacement](#).
17. Install the exhaust system. Refer to [Exhaust Muffler with Resonator, Exhaust, and Tail Pipe Replacement \(H-Pipe\)](#) or [Exhaust Muffler with Resonator, Exhaust, and Tail Pipe Replacement \(Vehicle Service\)](#).
18. Inspect the transmission fluid level.
19. Lower the vehicle.
20. Install the heater inlet and outlet pipes in the vehicle. Refer to [Heater Inlet And Outlet Pipe Replacement \(LLT\)](#)

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21. Install the transmission control lever knob. Refer to [**Transmission Control Lever Knob Replacement**](#).
22. Bleed the clutch hydraulic system. Refer to [**Hydraulic Clutch System Bleeding**](#).

Transmission Final Test and Inspection

Complete the following procedure after the transmission is installed in the vehicle:

1. With the ignition OFF or disconnected and clutch pedal depressed, crank the engine several times. Listen for any unusual noises or evidence that any parts are binding.
2. Place transmission in neutral, start the engine and listen for any unusual noises or evidence that any parts are binding.
3. While the engine continues to idle raise and support the vehicle.
4. Perform a final inspection for the proper fluid level.
5. Lower the vehicle.
6. Road test the vehicle.

REPAIR INSTRUCTIONS - OFF VEHICLE

TRANSMISSION DISASSEMBLE

Special Tools

- **DT-47678:** Transmission Holding Fixture
- **DT-47678-10:** Transmission Holding Fixture Adapter
- **DT-49027:** Coil Pin Remover and Installer
- **J 3289-20:** Holding Fixture
- **J 6125-1B:** Slide Hammer with Adapter
- **J 8433:** Two Jaw Puller
- **J 35467:** One-Way Clutch Tester
- **J 41816:** Crankshaft Balancer Remover
- **J 45012:** Holding Fixture

For equivalent regional tools, refer to [**Special Tools**](#).

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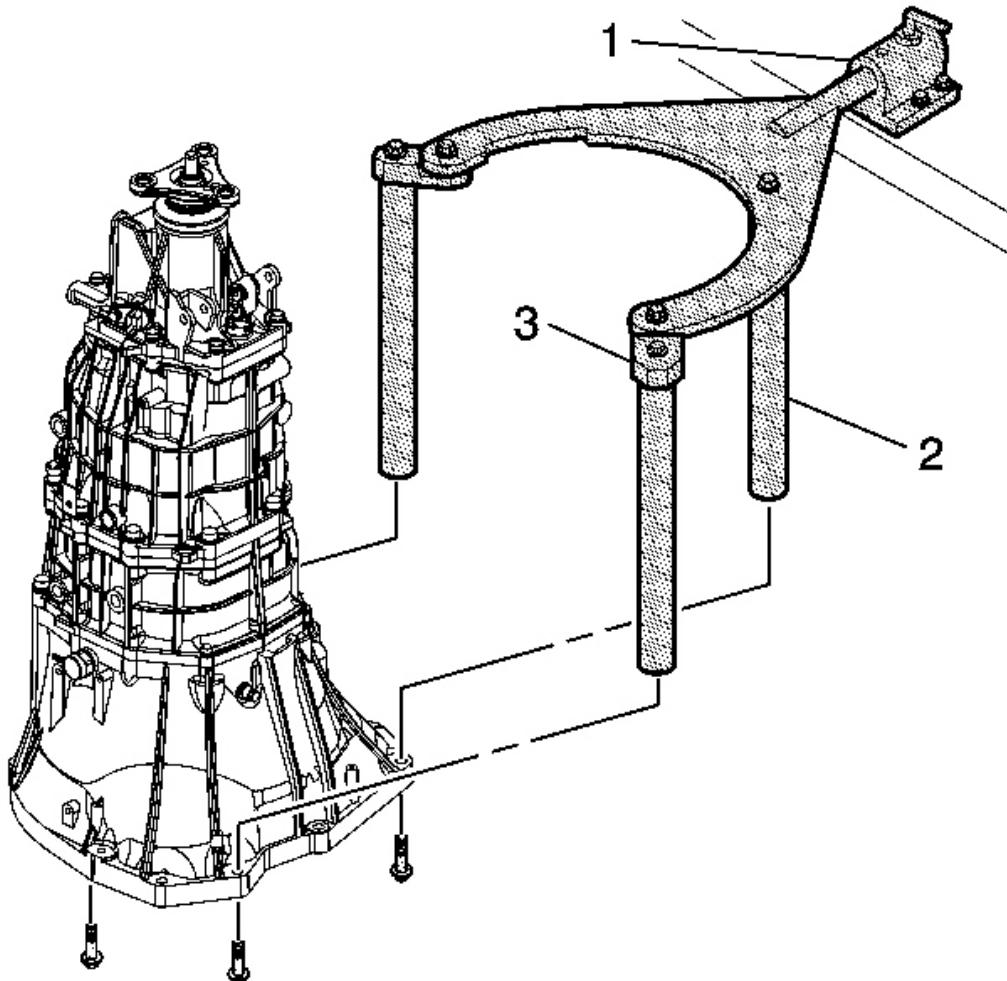


Fig. 32: Transmission Mounting Fixture & Adapters

Courtesy of GENERAL MOTORS CORP.

1. Install **DT-47678**: fixture (2) and **DT-47678-10**: adapters (3) to the transmission clutch housing.
2. Mount the transmission to a workbench using **J 3289-20**: fixture (1).
3. Remove the clutch release cylinder bolts and the clutch release cylinder. Refer to [Clutch Concentric Actuator Cylinder Replacement \(Aisin\)](#) or [Clutch Concentric Actuator Cylinder Replacement \(Tremec\)](#).

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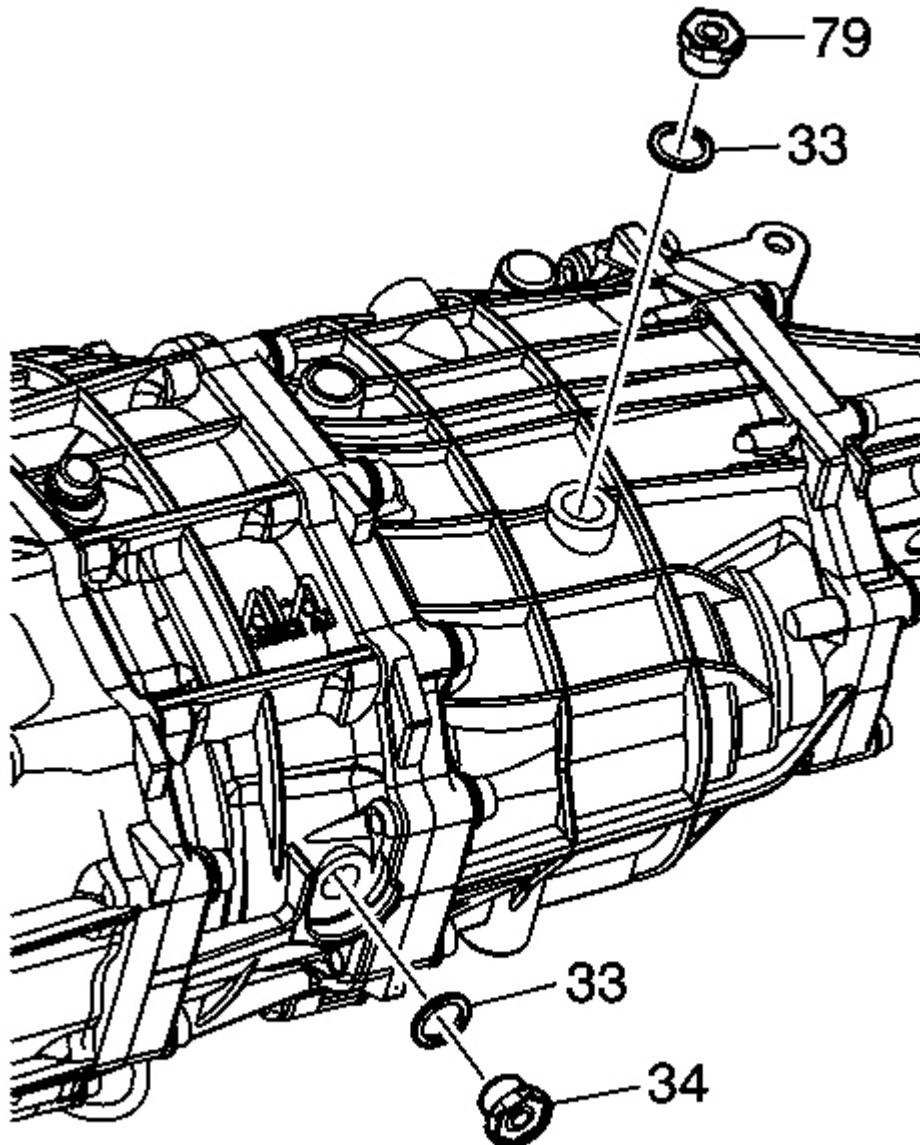


Fig. 33: Identifying Fill Plug, Drain Plug & Washers

Courtesy of GENERAL MOTORS CORP.

4. Remove the fill plug (79) and the washer (33).
5. Remove the drain plug (34) and the washer (33) then drain the transmission fluid.

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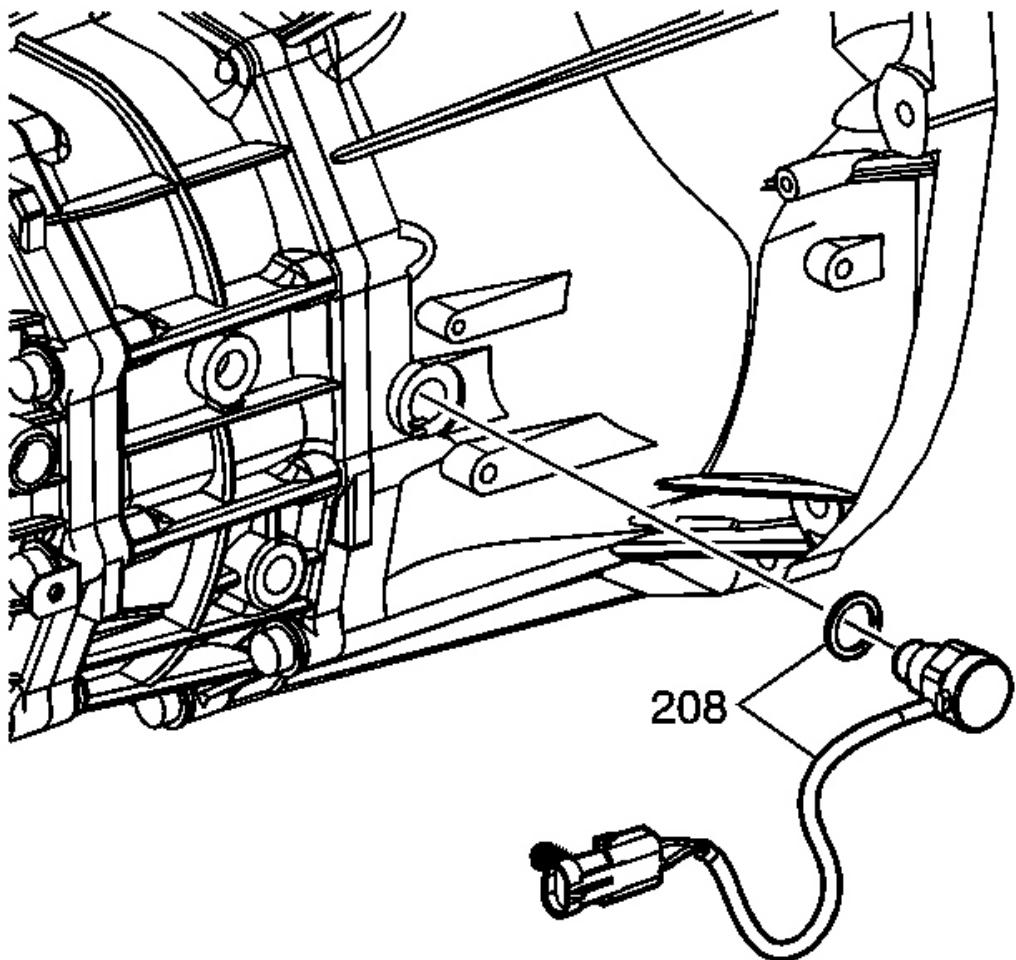


Fig. 34: Identifying Backup Lamp Switch & Washer
Courtesy of GENERAL MOTORS CORP.

6. Remove the backup lamp switch and washer (208) from the case.

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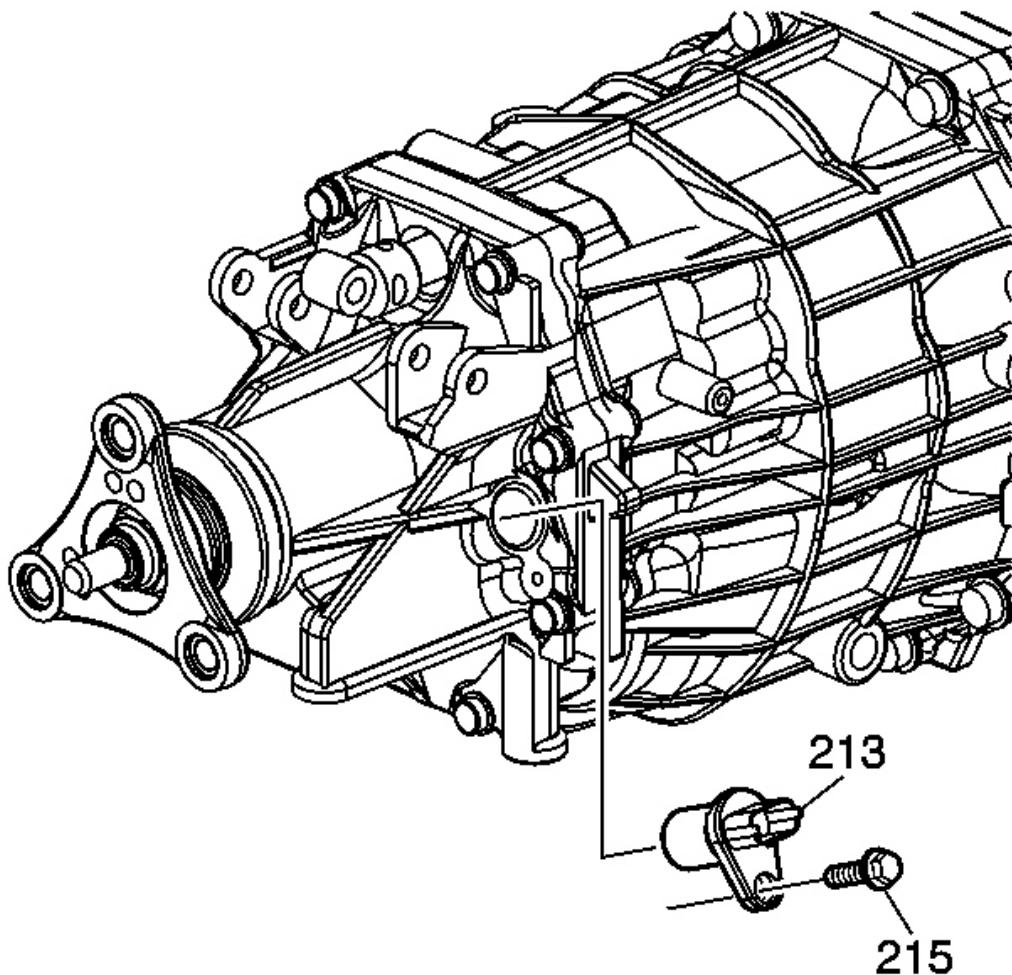


Fig. 35: Output Sensor & Bolt

Courtesy of GENERAL MOTORS CORP.

7. Remove the output sensor (213) and bolt (215) from the rear extension housing.

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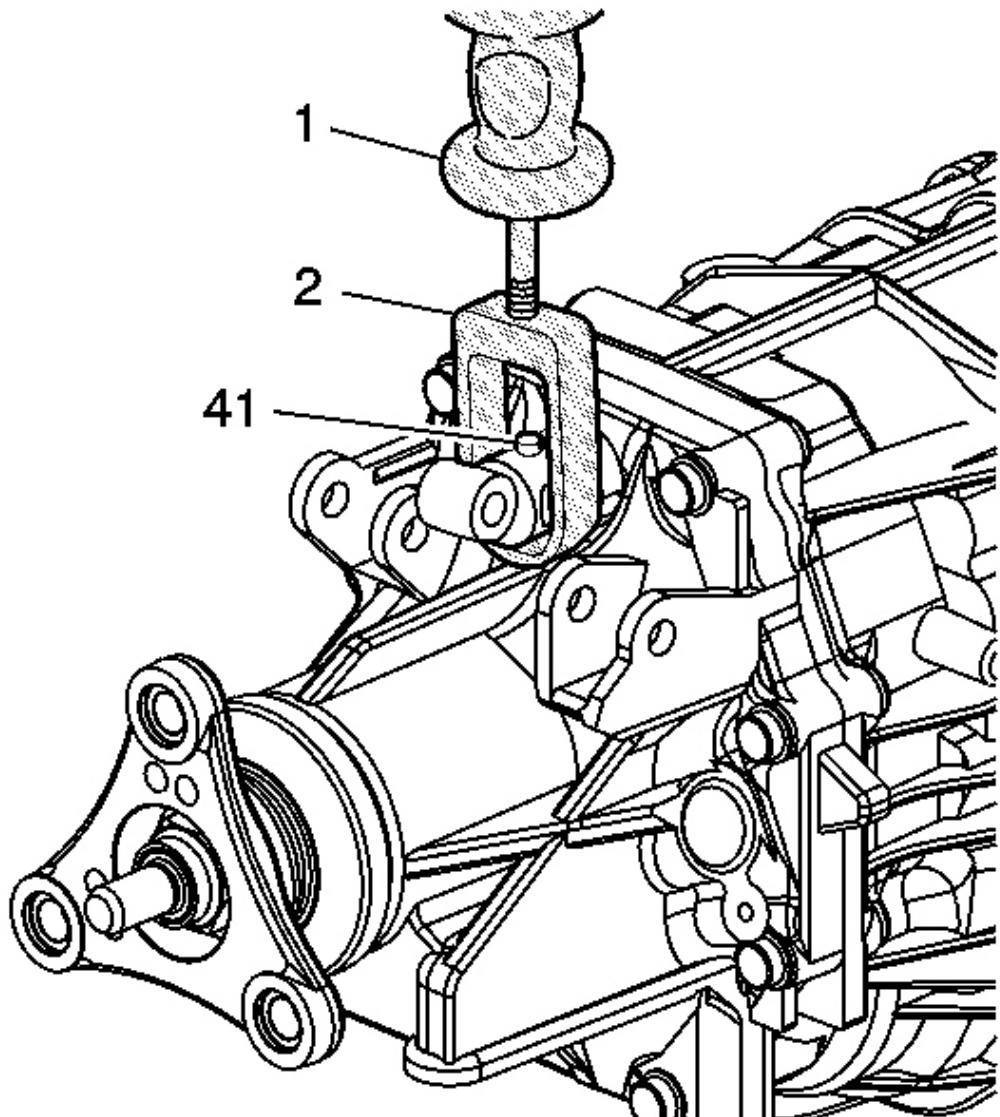


Fig. 36: Coil Pin Puller & Slide Hammer

Courtesy of GENERAL MOTORS CORP.

NOTE: Prior to the shift lever pin removal, the shift control shaft must be shifted forward into the transmission.

8. Install **DT-49027-1**: coil pin puller (2) onto **J 6125-1B**: slide hammer (1).

9. Position **DT-49027-1**: puller (2) directly beneath the shift lever pin (41), then repeatedly pull up on the slide hammer handle until the bottom of the shift lever pin is flush with the machined O.D. of the shift lever rod universal joint.

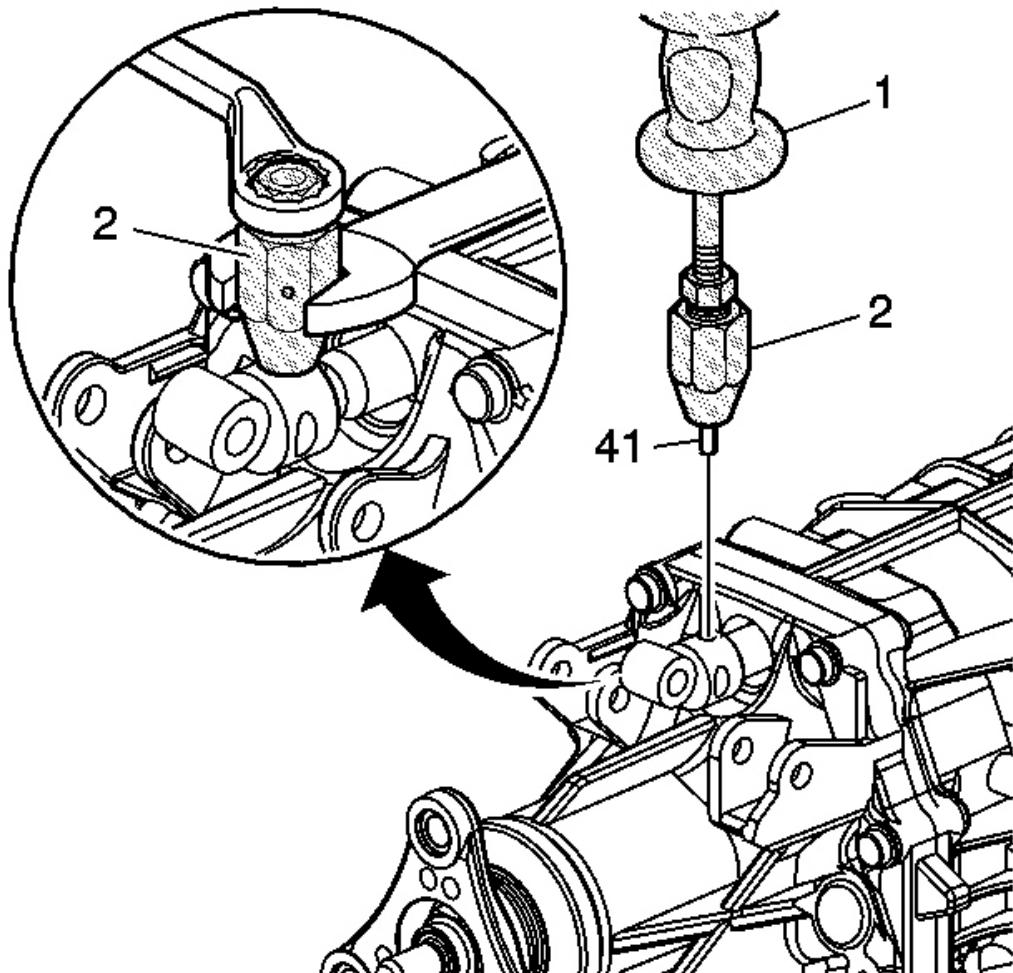


Fig. 37: Tightening Coil Pin Remover
Courtesy of GENERAL MOTORS CORP.

NOTE: Only rotate the wrench attached to the outer body of DT-49027-2: coil pin remover. The wrench attached to the inner body must remain stationary.

10. Install **DT-49027-2**: coil pin remover (2) onto the top of the shift lever pin (41) and tighten.
11. Install **J 6125-1B**: slide hammer (1) onto **DT-49027-2**: coil pin remover (2). Repeatedly, pull up on the

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slide hammer handle until the shift lever pin (41) is removed from the shift lever rod universal joint.

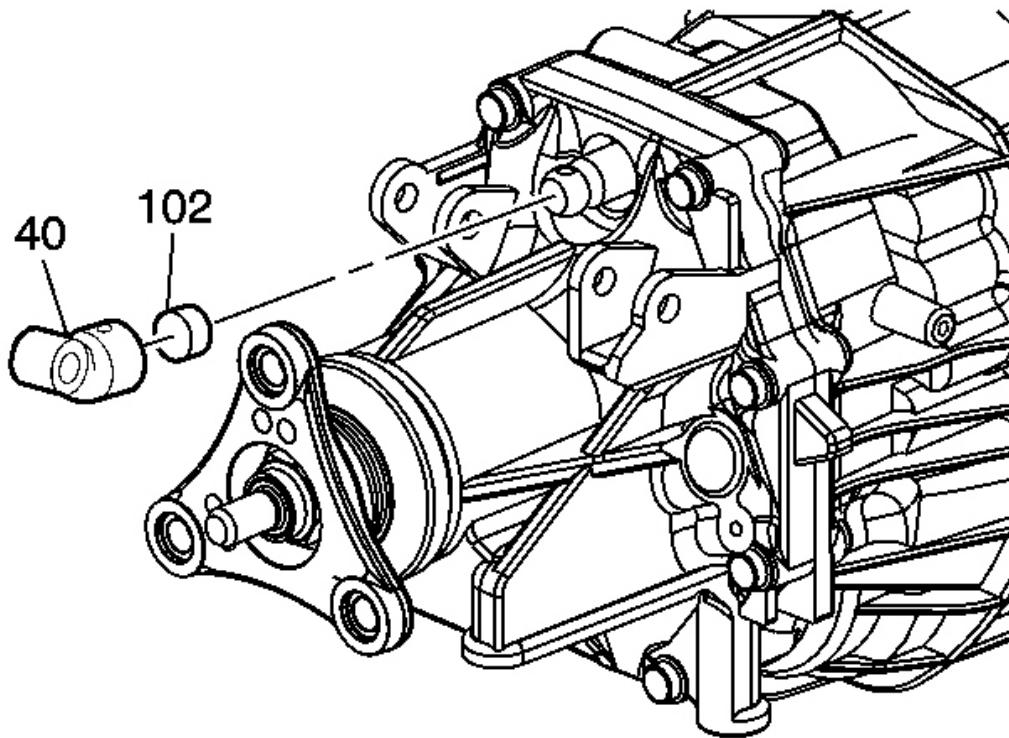


Fig. 38: Shift Lever Rod Universal Joint & Dampener

Courtesy of GENERAL MOTORS CORP.

12. Remove the shift lever rod universal joint (40) and dampener (102) from the end of the shift control shaft.

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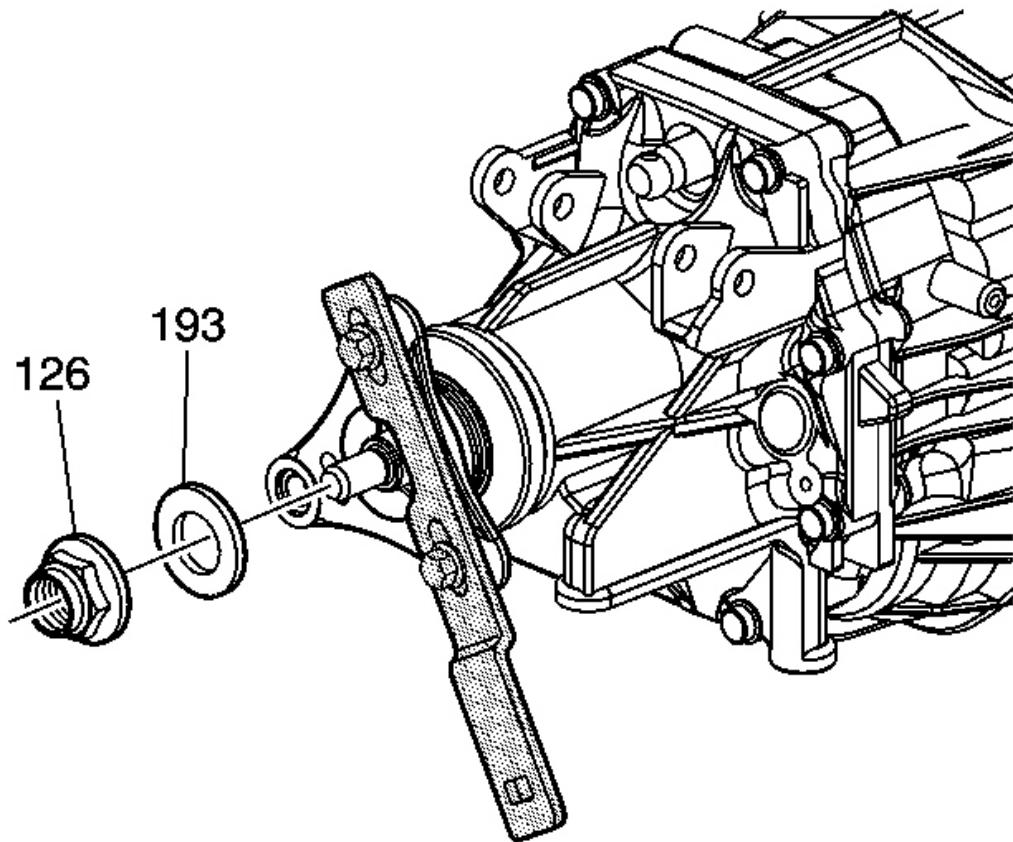


Fig. 39: Removing Propshaft Flange Nut & Propshaft Flange Fluid Seal
Courtesy of GENERAL MOTORS CORP.

13. Using a screwdriver, release the staking of the propshaft flange nut (126).
14. Install **J 45012**: fixture to the propshaft flange (108) to remove the propshaft flange nut (126) and propshaft flange fluid seal (193).

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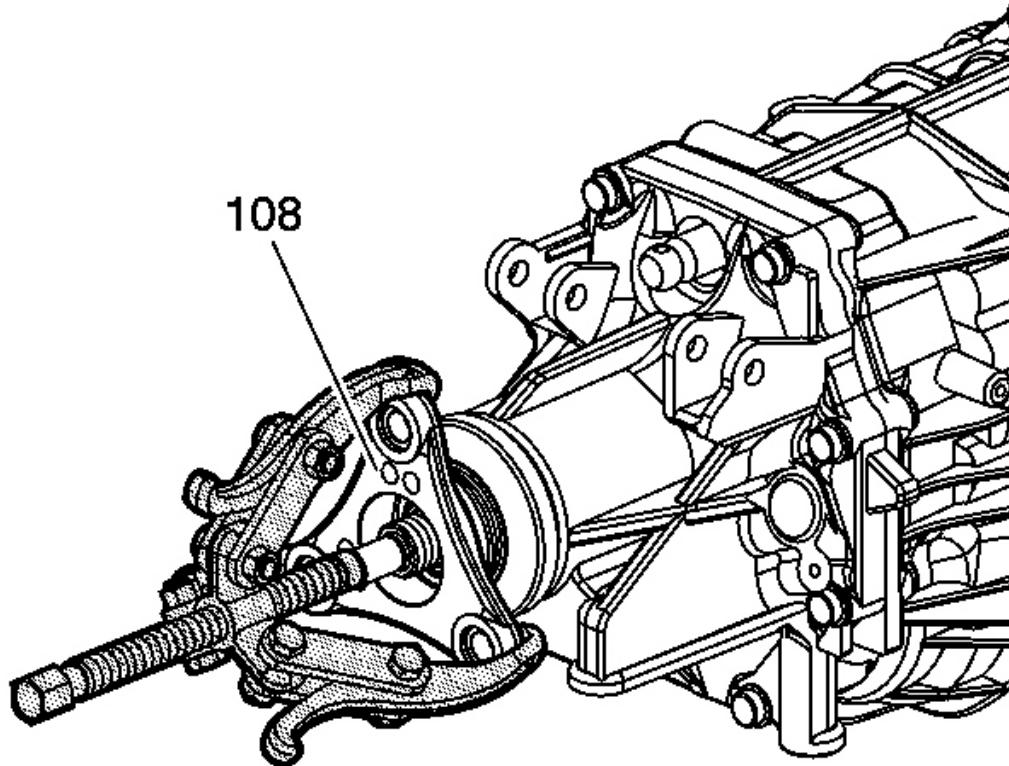


Fig. 40: Removing Propshaft Flange
Courtesy of GENERAL MOTORS CORP.

15. Using **J 41816**: remover to remove the propshaft flange (108).

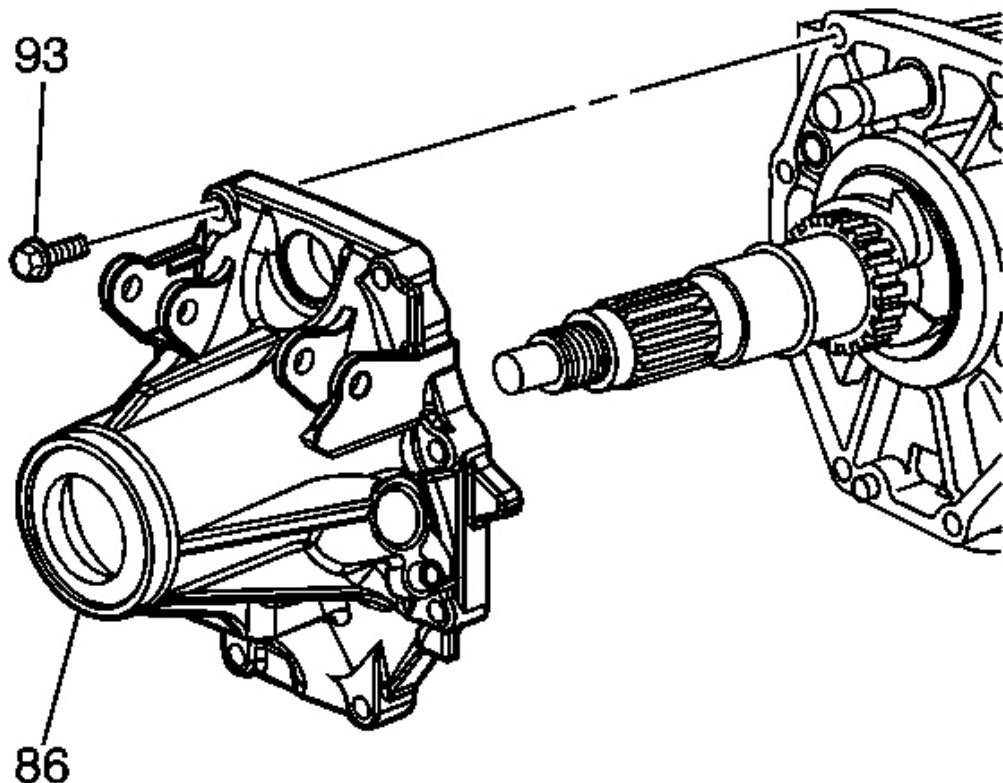


Fig. 41: Identifying Extension Housing & Bolts

Courtesy of GENERAL MOTORS CORP.

16. Remove the 8 bolts (93) from the extension housing (86).
17. Remove the extension housing.

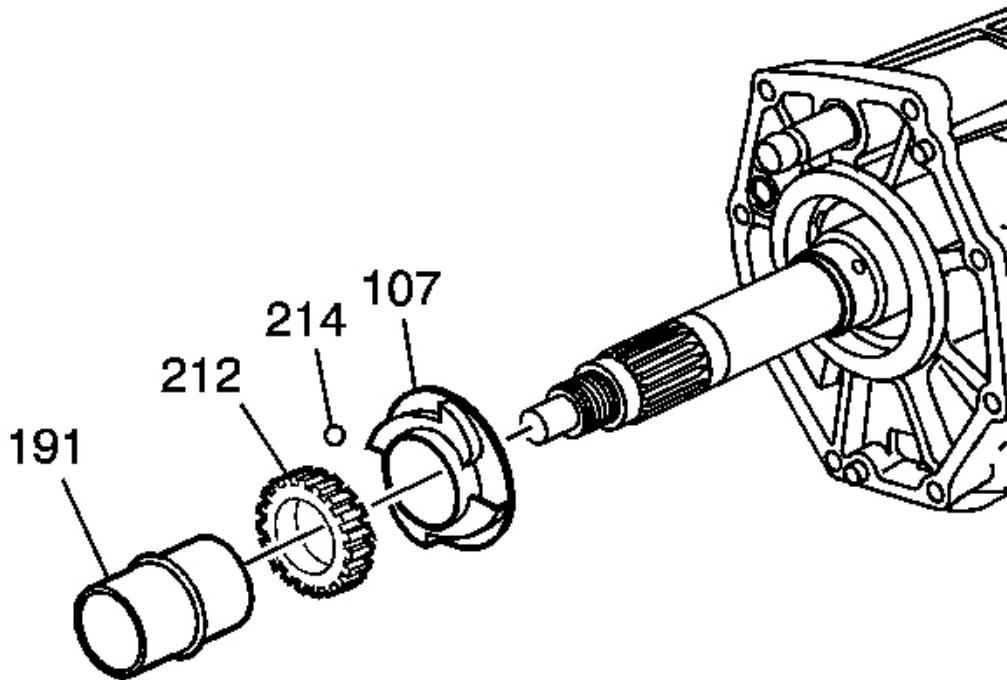


Fig. 42: View Of Vehicle Speed Sensor Drive Gear, Spacer, Locking Ball & Main Shaft Bearing Oil Slinger

Courtesy of GENERAL MOTORS CORP.

18. Remove the rear output shaft rear bearing spacer (191).
19. Remove the vehicle speed sensor drive gear (212).
20. Remove the locking ball (214).
21. Remove the main shaft bearing oil slinger (107).

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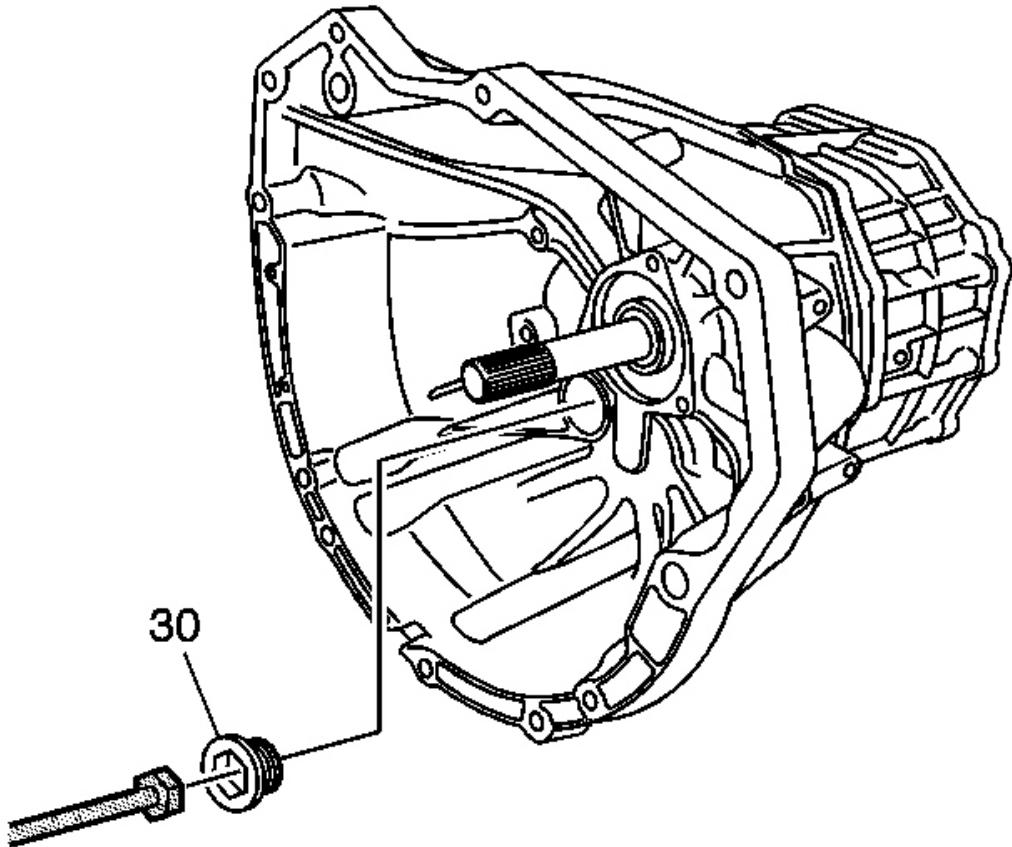


Fig. 43: Removing/Installing Clutch Housing Hole Plug
Courtesy of GENERAL MOTORS CORP.

22. Using **J 35467**: clutch tester, remove the clutch housing hole plug (30) from the clutch housing.

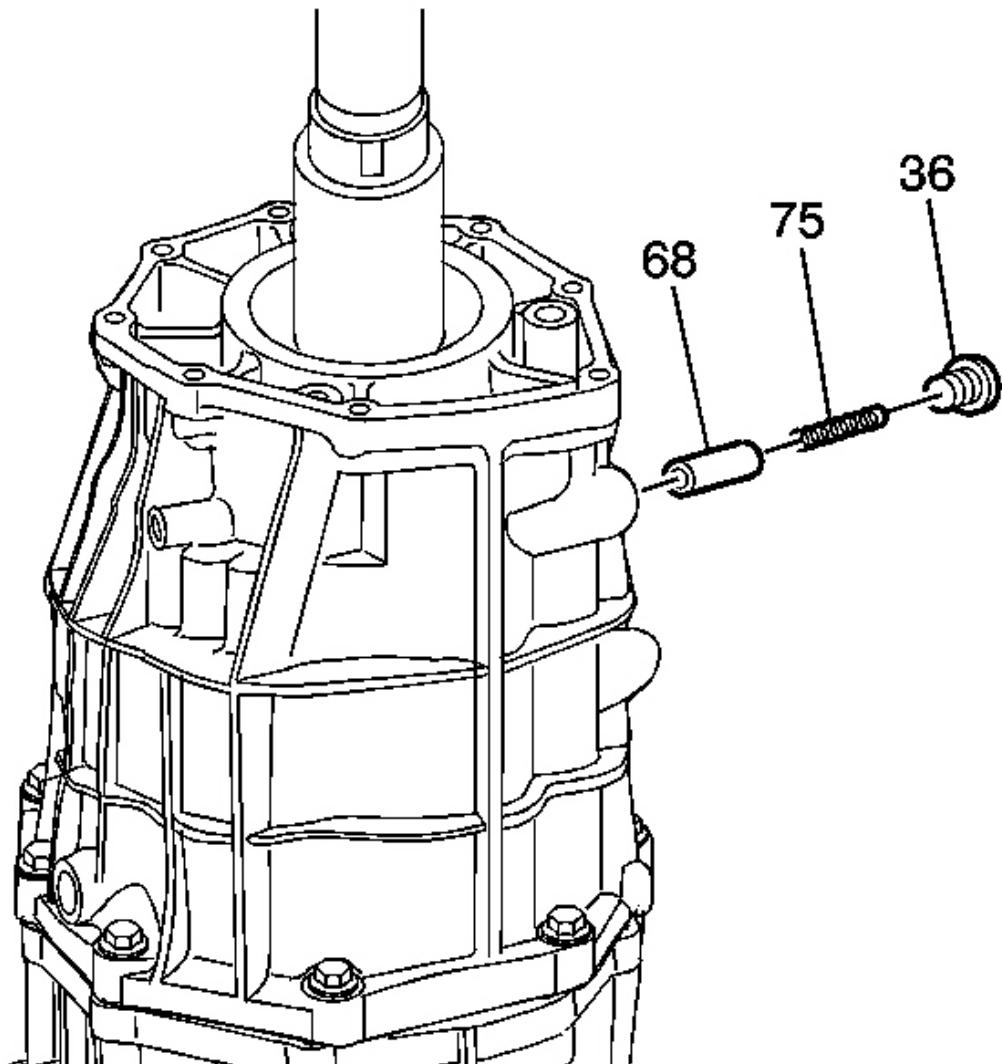


Fig. 44: View Of Shift Shaft Detent Plug, Spring & Pin
Courtesy of GENERAL MOTORS CORP.

23. Remove the following components:
 - The shift shaft detent plug (36)
 - The shift shaft detent spring (75)
 - The shift shaft detent pin (68)

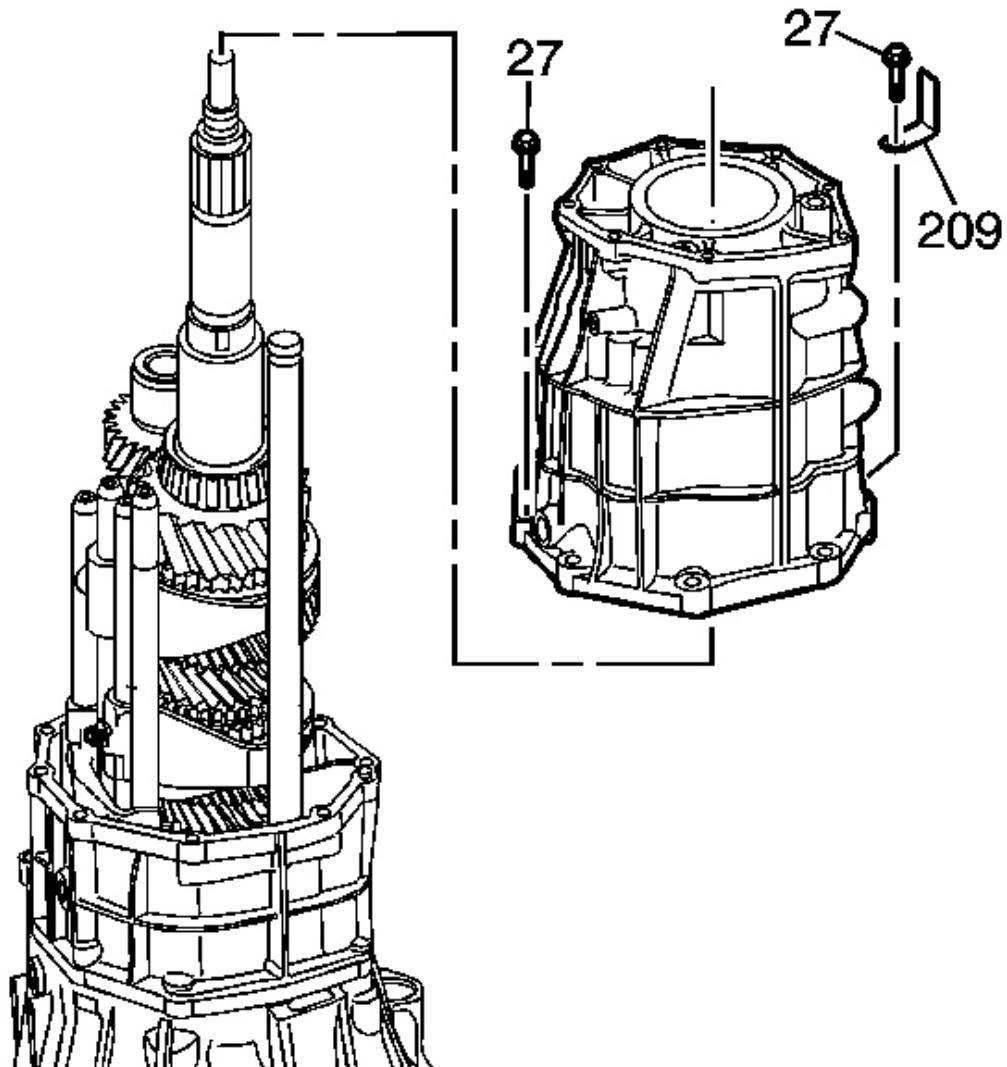


Fig. 45: View Of Rear Case Housing Retainer & Bolts
Courtesy of GENERAL MOTORS CORP.

24. Remove the 10 bolts (27) and retainer (209) from the rear case housing.

CAUTION: Refer to Machined Surface Damage Caution .

25. Using a soft-face hammer, separate the rear case housing from the intermediate case housing.

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26. Remove the rear case housing.

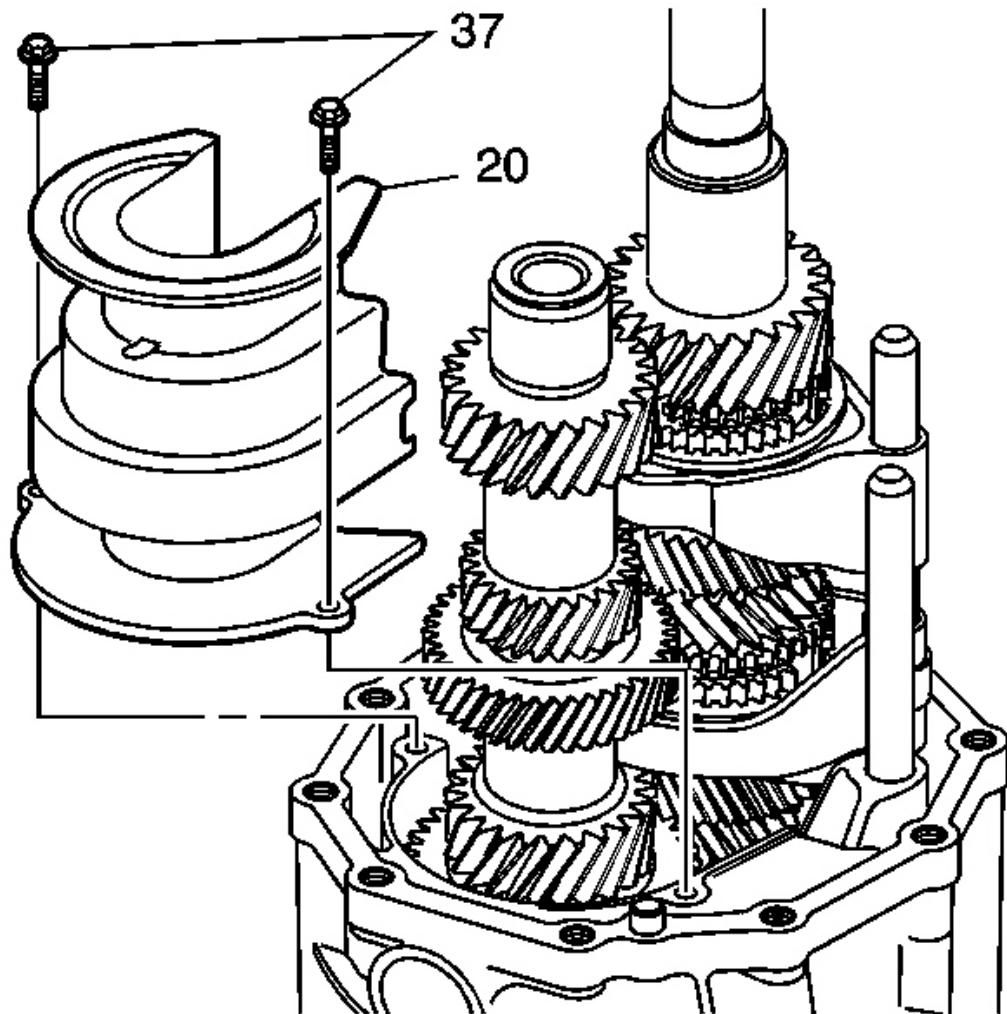


Fig. 46: Oil Trough Bolts & Oil Trough
Courtesy of GENERAL MOTORS CORP.

27. Remove the 2 oil trough bolts (37) and oil trough (20).

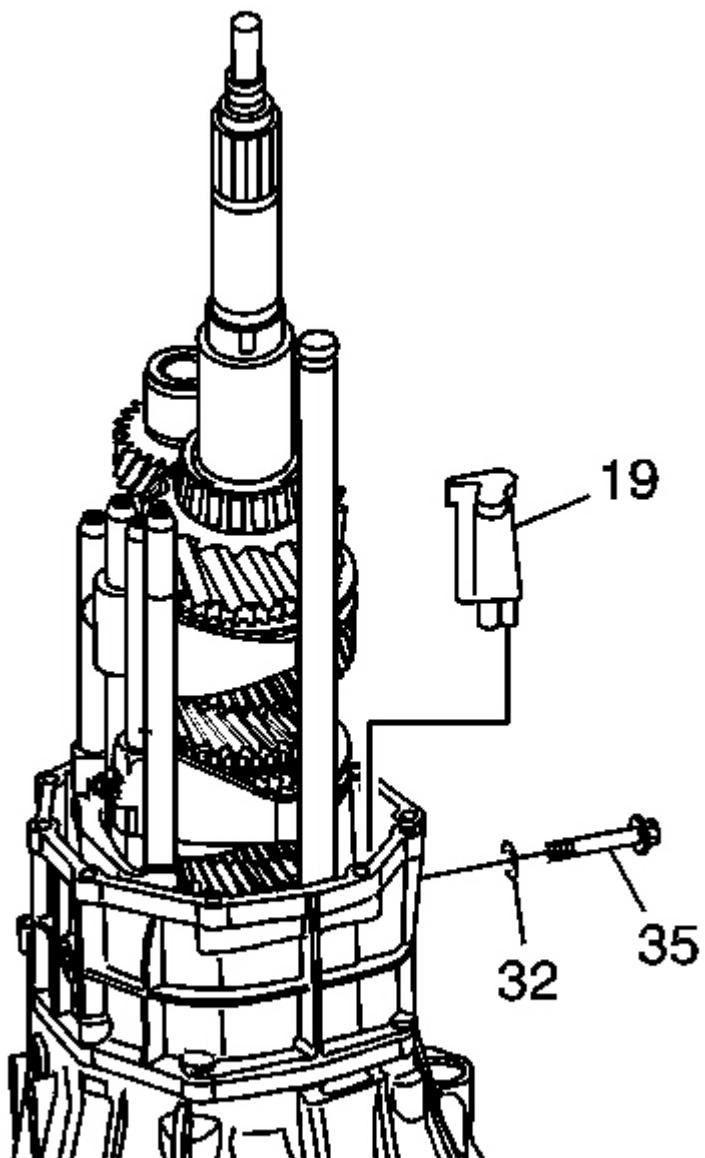


Fig. 47: Identifying Oil Trough Pipe, Reverse Idler Gear Shaft Bolt & Gasket
Courtesy of GENERAL MOTORS CORP.

28. Remove the oil trough pipe (19).
29. Remove the reverse idler gear shaft bolt (35) and gasket (32).

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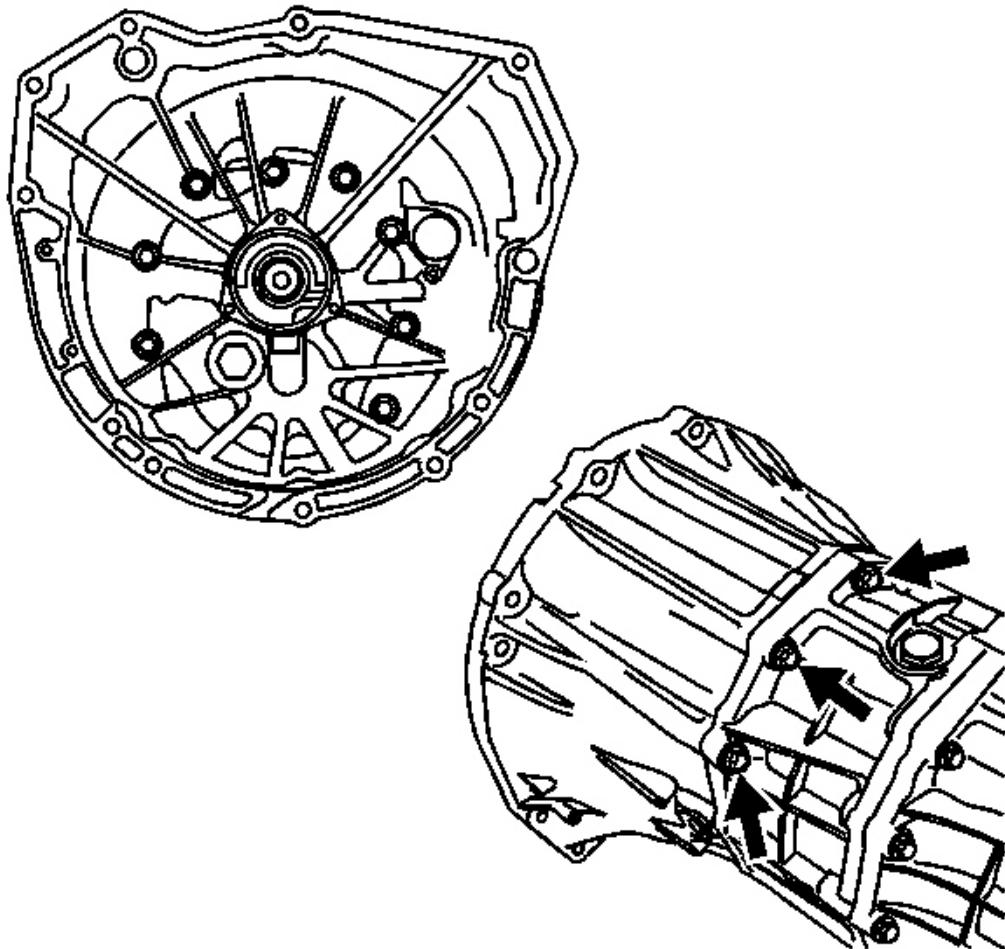


Fig. 48: View Of Clutch Housing Bolts

Courtesy of GENERAL MOTORS CORP.

30. Remove the 11 flange bolts retaining the clutch housing. This includes 8 bolts from the front and 3 bolts from the rear.

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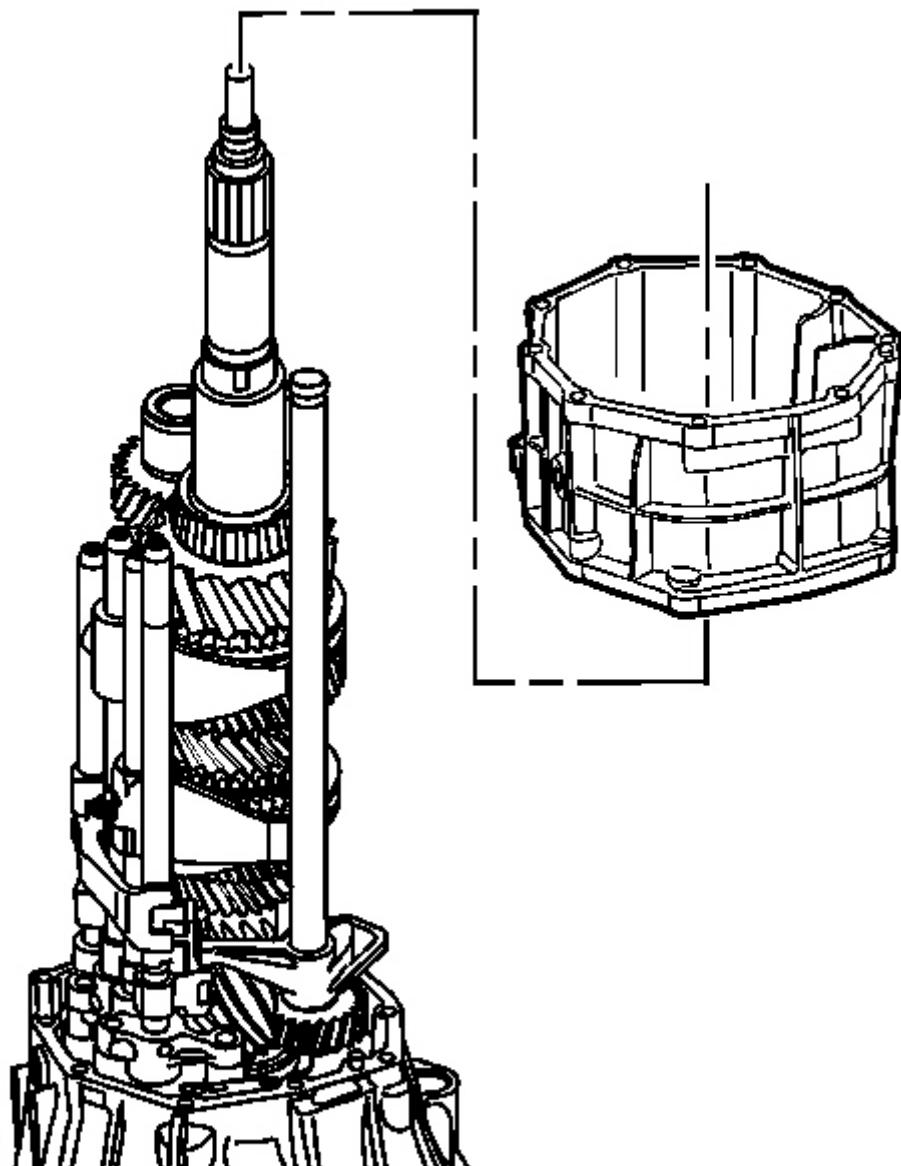


Fig. 49: View Of Intermediate Case Housing
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Machined Surface Damage Caution .

NOTE: **Rotate case to avoid interference with shift fork.**

31. Using a soft-face hammer, separate the intermediate case from the front clutch housing.
32. Remove the intermediate case housing.

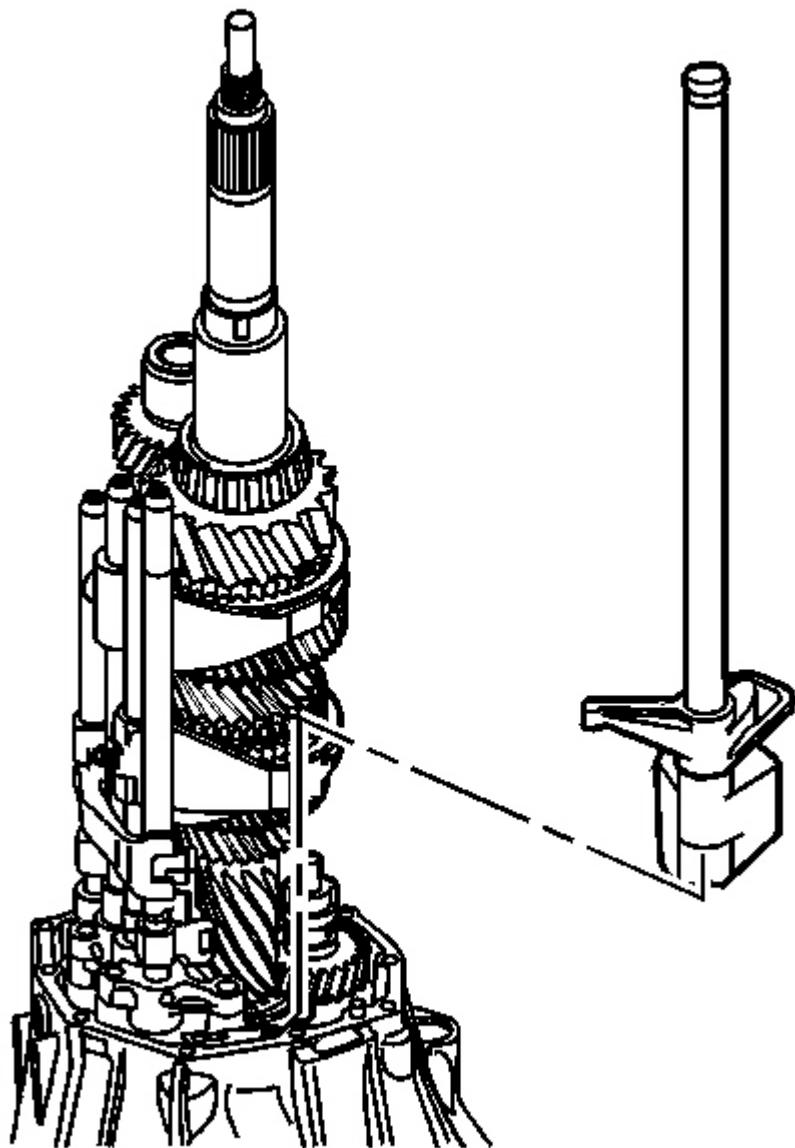


Fig. 50: View Of Shift Shaft Selector Lever

Courtesy of GENERAL MOTORS CORP.

33. Remove the shift shaft selector lever.

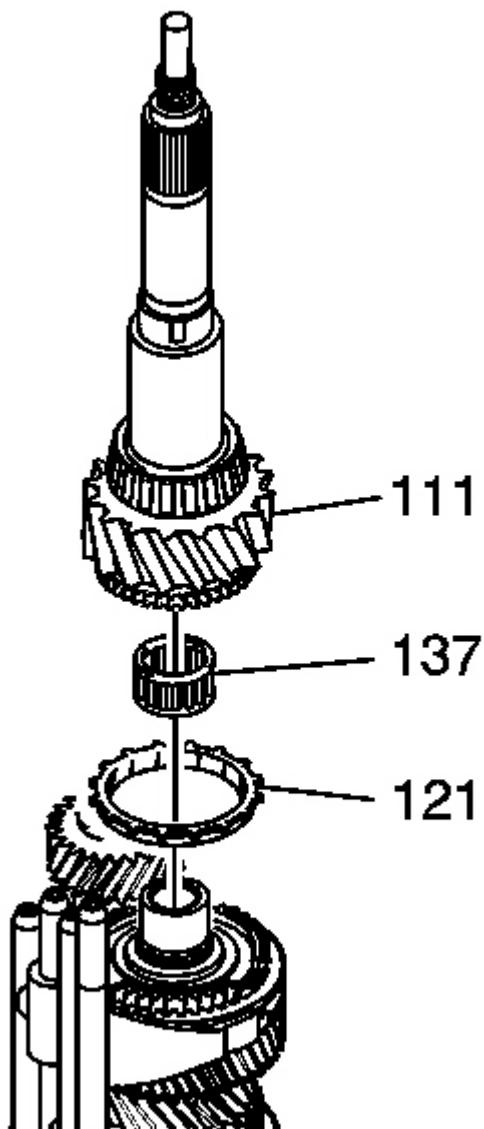


Fig. 51: View Of Rear Output Shaft, Input Shaft Bearing & Blocking Ring
Courtesy of GENERAL MOTORS CORP.

34. Remove the rear output shaft (111), input shaft bearing (137) and blocking ring (121) from the 6th gear synchronizer assembly.

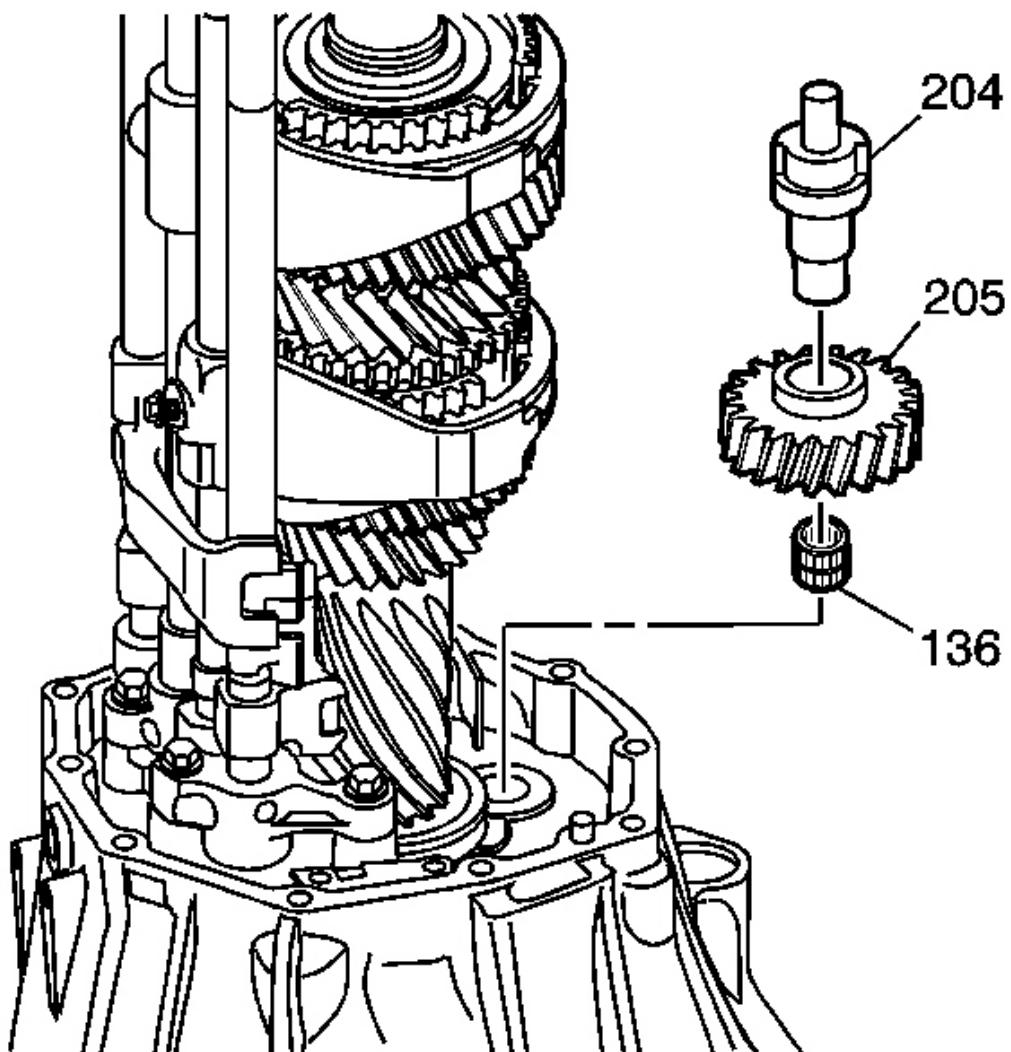


Fig. 52: View Of Reverse Idler Gear, Bearing & Shaft

Courtesy of GENERAL MOTORS CORP.

35. Remove the reverse idler gear bearing (136), reverse idler gear (205) and the reverse idler gear shaft (204).

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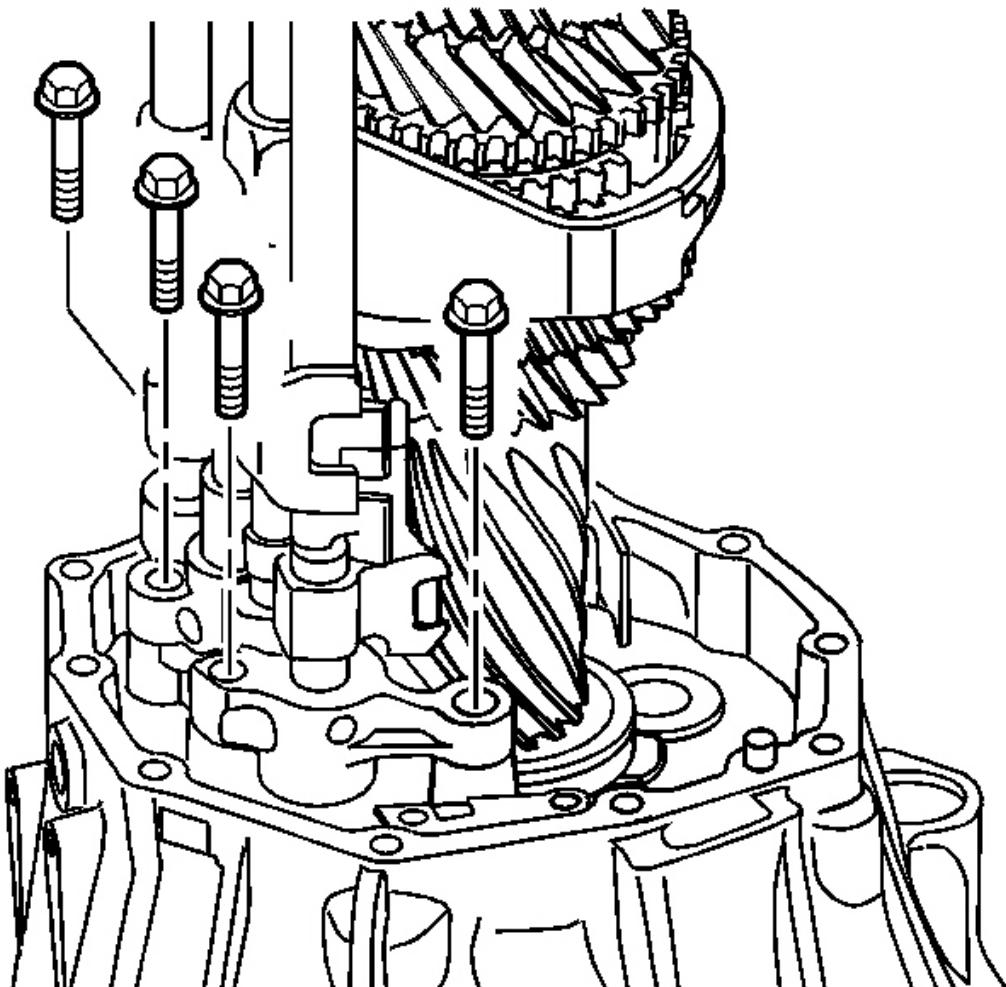


Fig. 53: View Of Shift Counter Lever Bracket Bolts

Courtesy of GENERAL MOTORS CORP.

36. Remove the 4 bracket bolts from the shift counter lever bracket.

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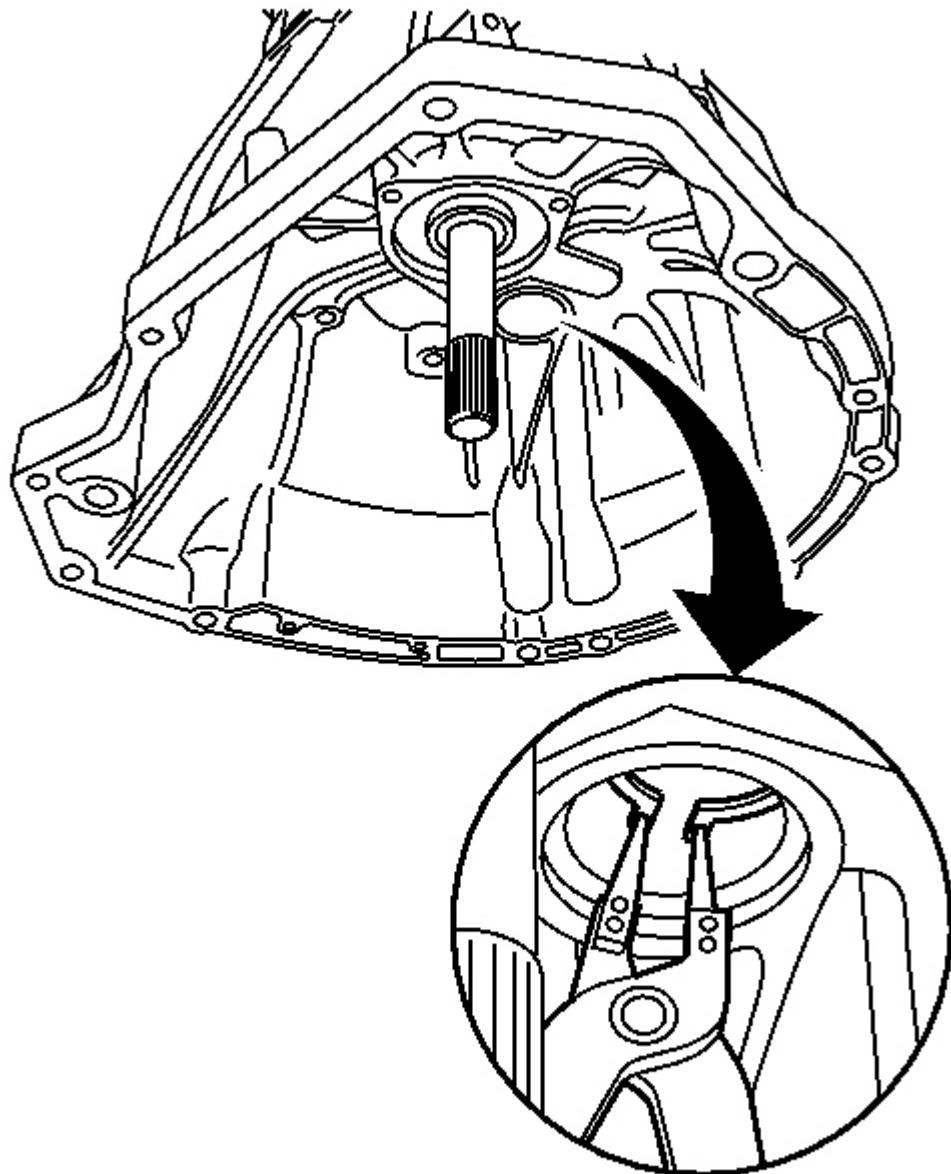


Fig. 54: Front Countershaft Bearing Snap Ring
Courtesy of GENERAL MOTORS CORP.

NOTE: The removal of the input shaft and counter shaft assemblies will require an assistant.

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37. Expand and hold the snap ring on the front countershaft bearing.

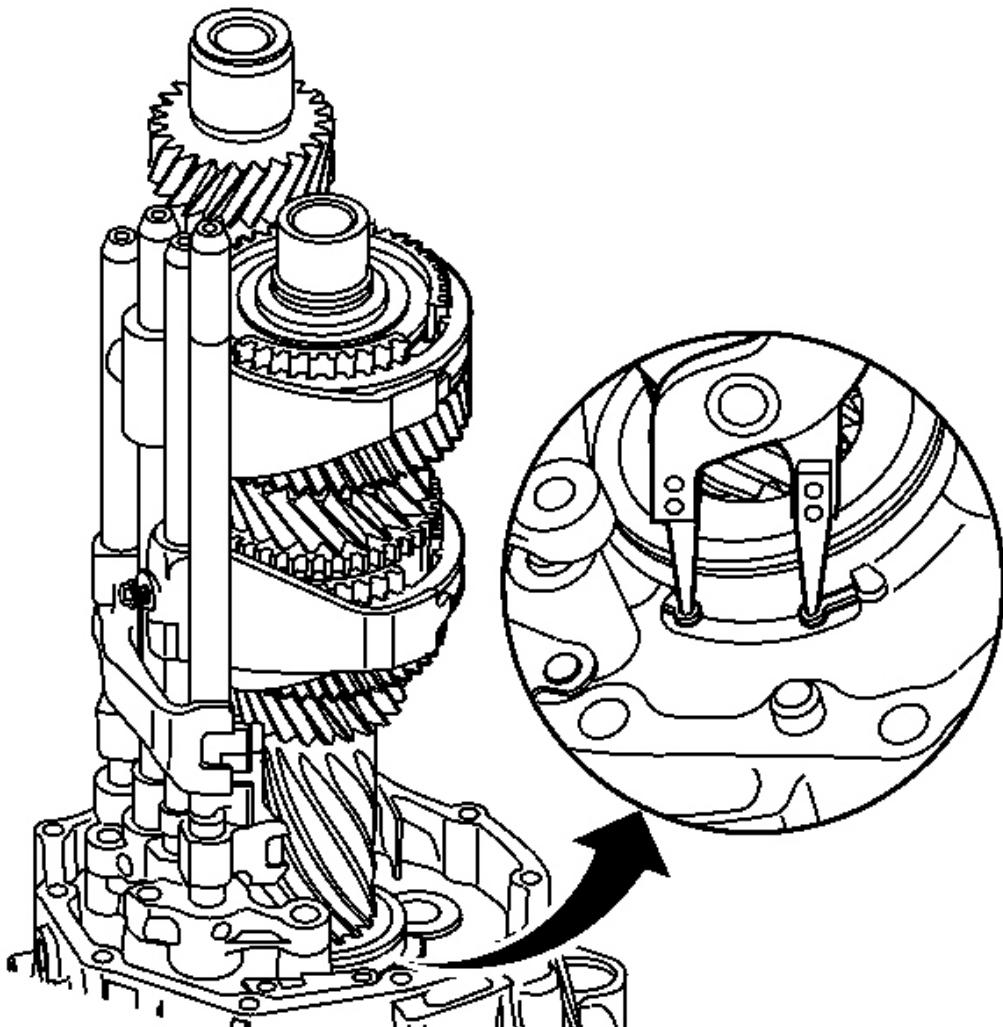


Fig. 55: Holding Snap Ring On Rear Input Shaft Bearing
Courtesy of GENERAL MOTORS CORP.

38. Expand and hold the snap ring on the rear input shaft bearing.

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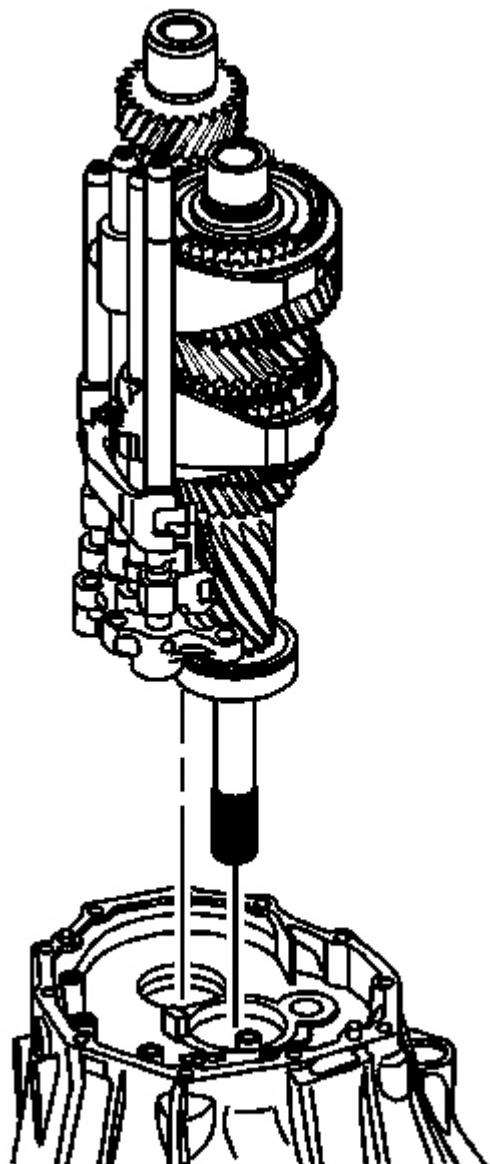


Fig. 56: View Of Input Shaft, Countershaft & Shift Rail Assembly
Courtesy of GENERAL MOTORS CORP.

39. Remove the input shaft, countershaft and shift rails as an assembly.

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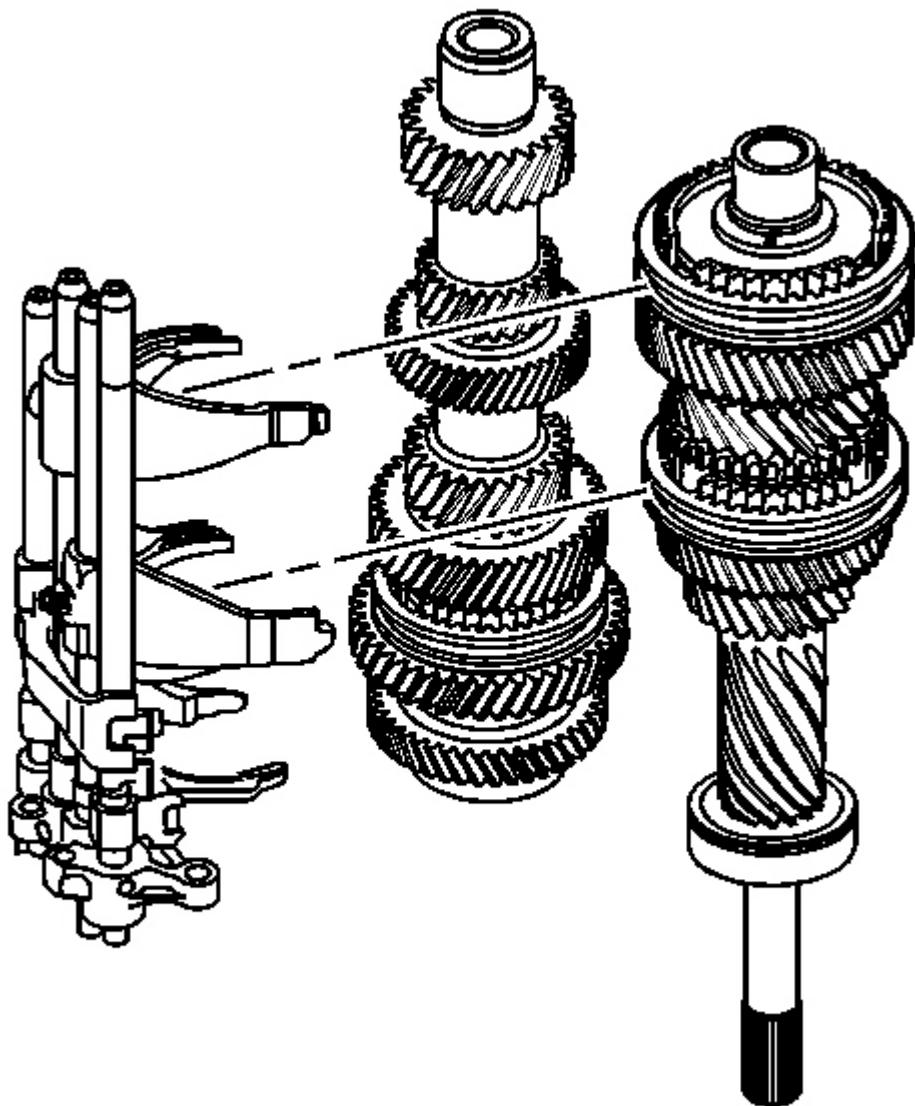


Fig. 57: Disassembling/Assembling Shift Rails, Input Shaft & Countershaft
Courtesy of GENERAL MOTORS CORP.

40. Separate the shift rails, the input shaft and countershaft.

OUTPUT SHAFT DISASSEMBLE

Tools Required

J 22912-B Split Plate Bearing Puller

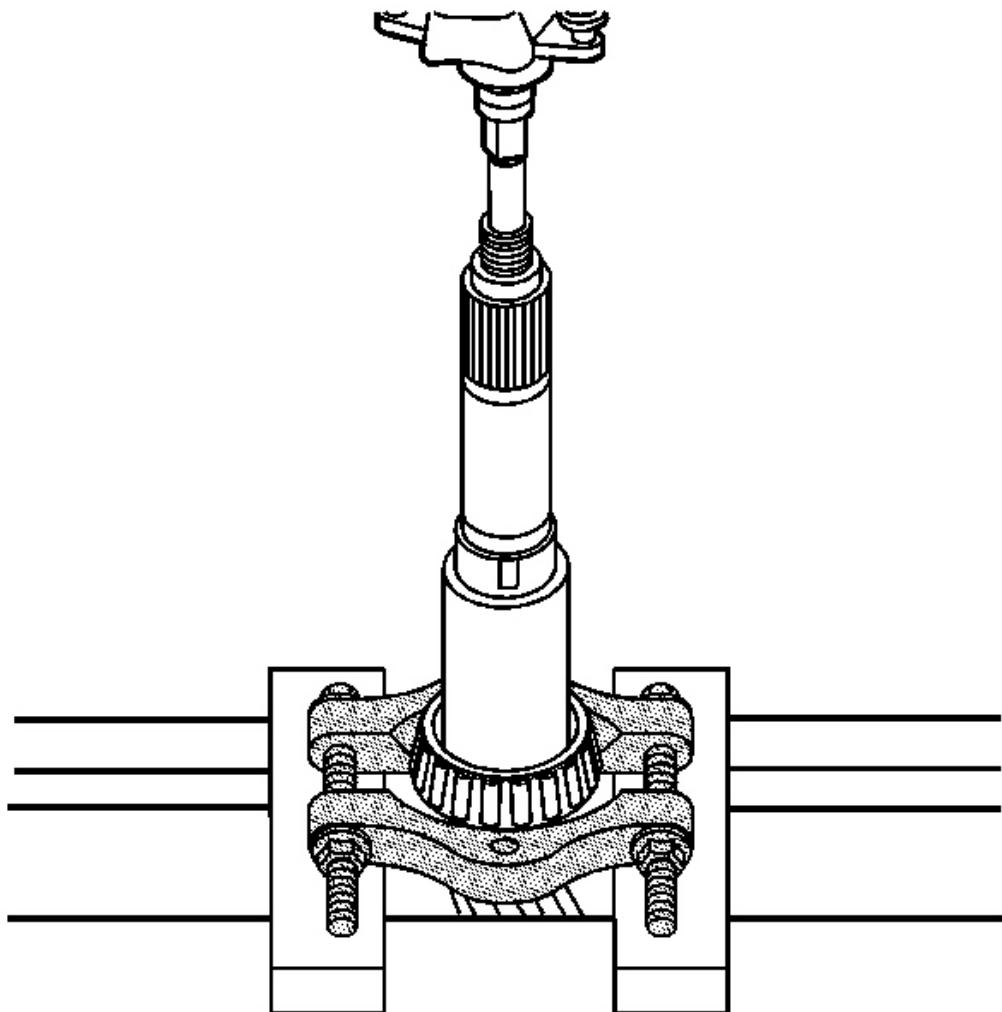


Fig. 58: Removing Tapered Roller Bearing
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Inspect the output shaft gear subassembly before disassemble. Refer to Gears and Shafts Cleaning and Inspection.

Using a hydraulic press and **J 22912-B**, remove the tapered roller bearing.

INPUT SHAFT DISASSEMBLE

Special Tools

- **J 22912-B:** Split Plate Bearing Puller
- **J 44749:** Split Plate Bearing Gear Puller

For equivalent regional tools, refer to [Special Tools](#).

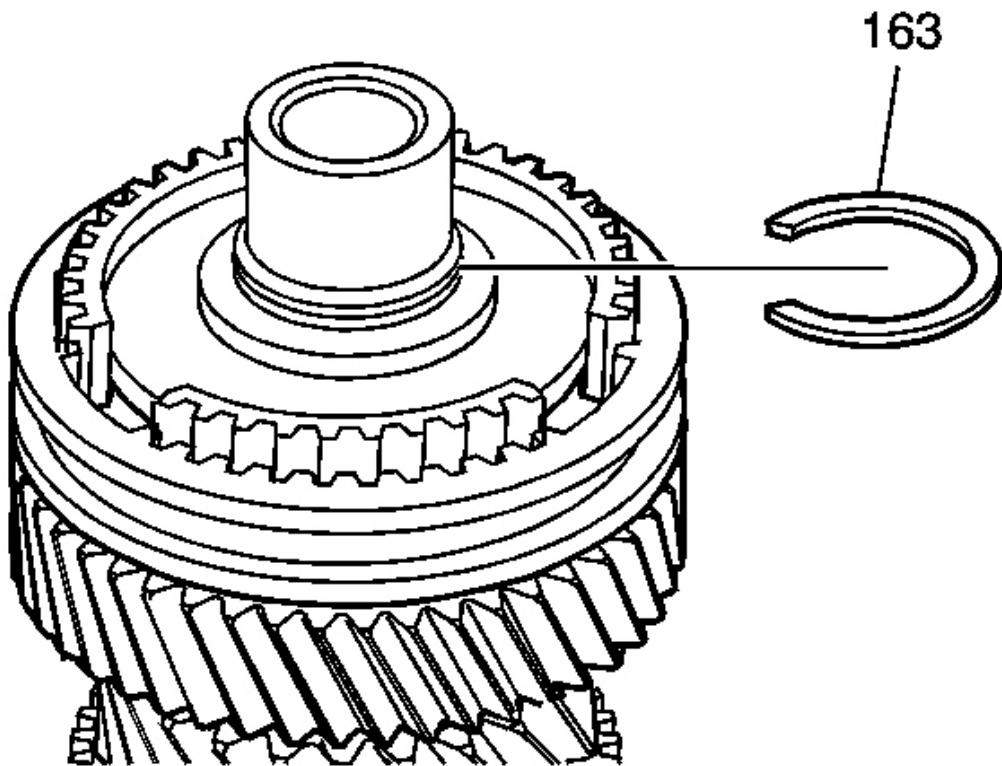


Fig. 59: View Of 5th/6th Gear Synchronizer Hub Snap Ring
Courtesy of GENERAL MOTORS CORP.

NOTE: Inspect the input shaft subassembly before disassemble. Refer to [Gears and Shafts Cleaning and Inspection](#).

1. Remove the 5th/6th gear synchronizer hub snap ring (163).

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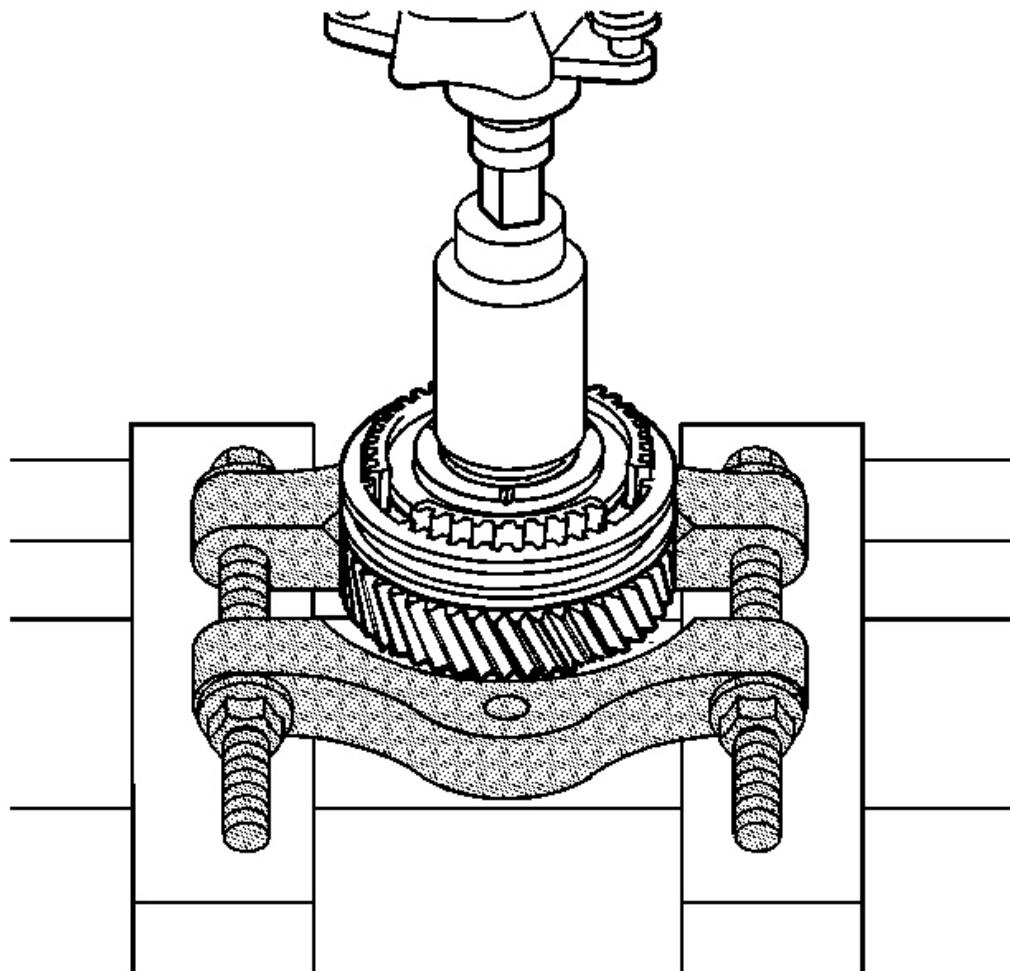


Fig. 60: Removing 6th Gear & Synchronizer
Courtesy of GENERAL MOTORS CORP.

NOTE: Place the edge of gear on press plate.

2. Using a hydraulic press and **J 44749:** bearing gear puller, remove the 6th gear and the synchronizer as a unit.

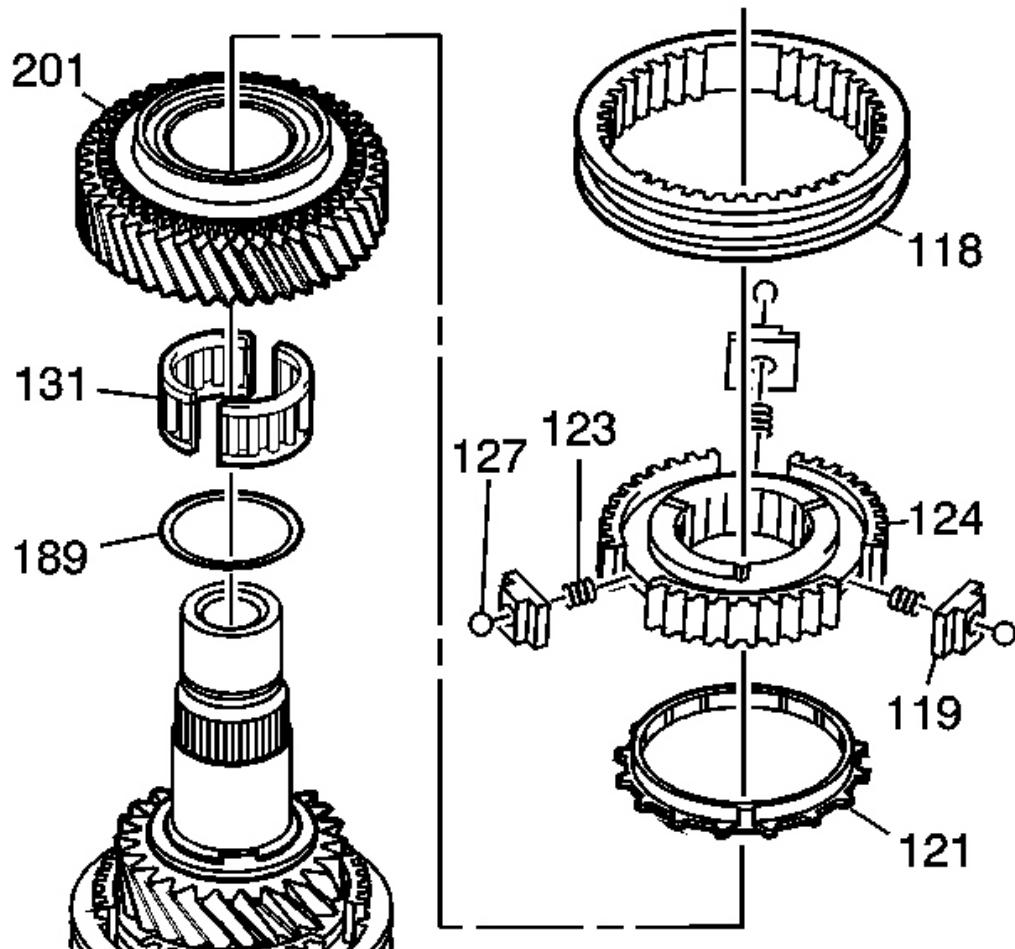


Fig. 61: View of 5th/6th Gear Assembly

Courtesy of GENERAL MOTORS CORP.

NOTE: Before removing sleeve (118), cover components in order to keep the ball and spring from ejecting loose.

3. Remove the following components as an assembly:

- The 5th/6th gear synchronizer sleeve (118)
- The 5th/6th gear synchronizer hub (124) including insert (119), detent ball (127) and spring (123)
- The 5th gear synchronizer blocking ring (121)
- The 6th gear (201)
- The 6th gear bearing (131)

- The 6th gear bearing spacer (189)

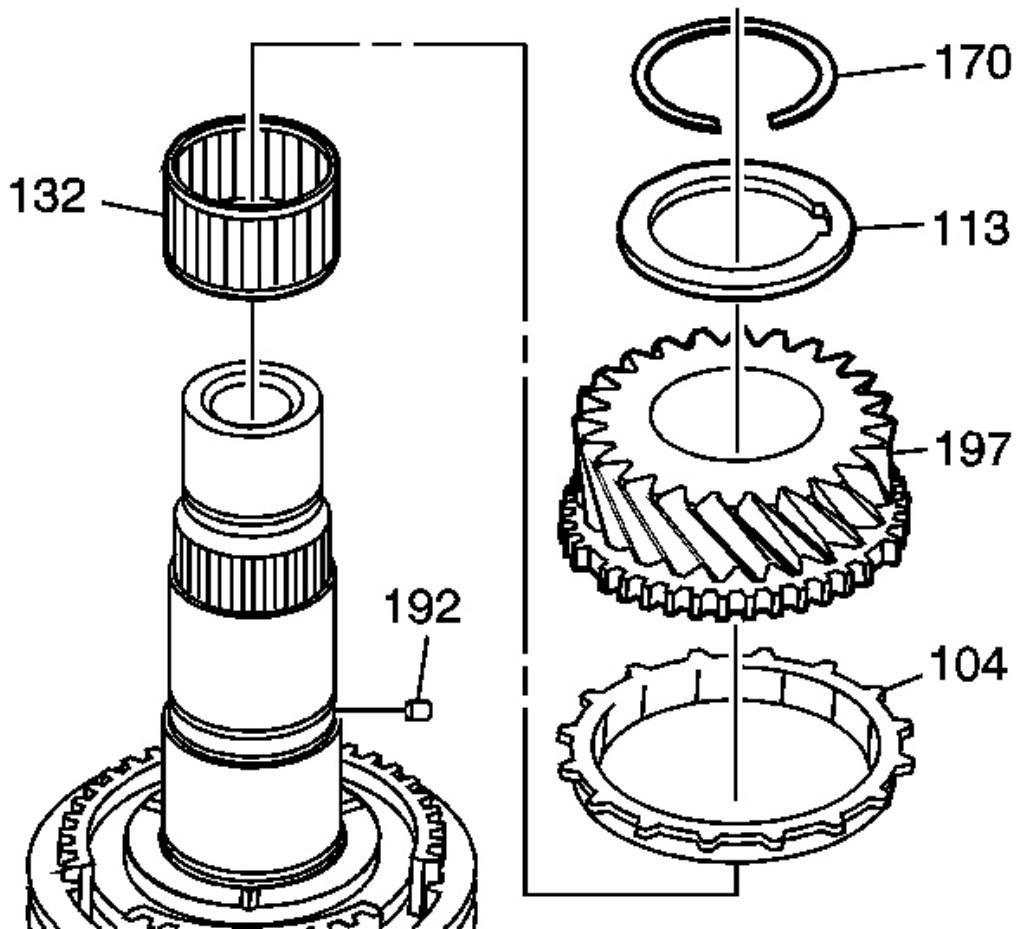


Fig. 62: View Of 3rd Gear & Components
Courtesy of GENERAL MOTORS CORP.

4. Remove the 6th gear snap ring (170).
5. Remove the 3rd gear thrust washer (113).
6. Remove the locating pin (192).
7. Remove the 3rd gear assembly which includes:
 - The 3rd gear (197)
 - The 3rd gear blocking ring (104)
8. Remove the 3rd gear bearing (132).

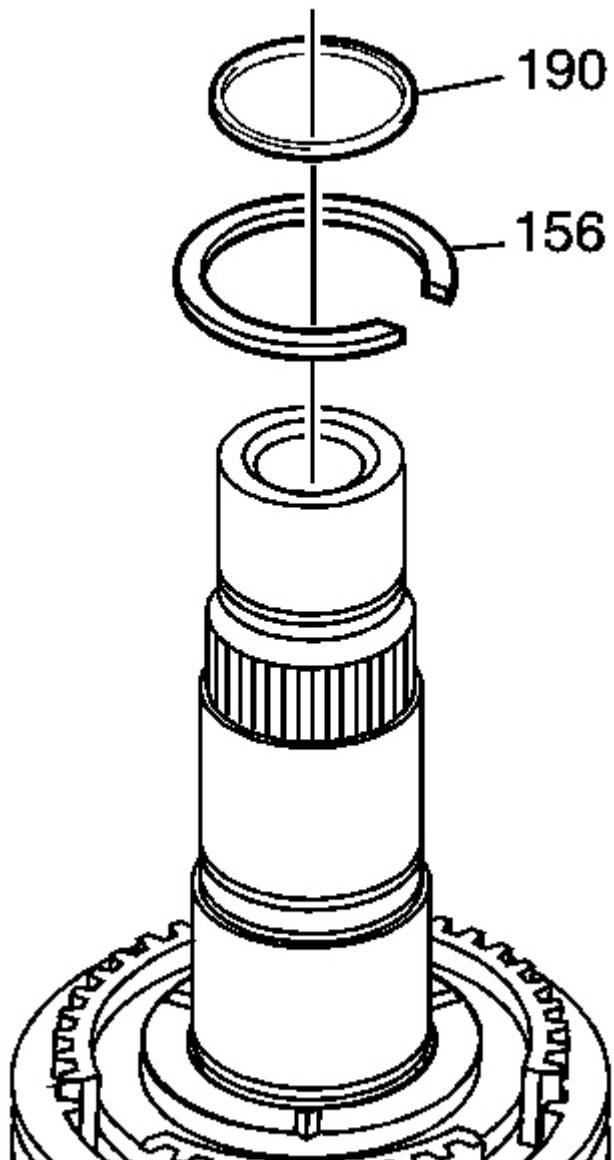


Fig. 63: View Of 3rd/4th Gear Spacer & Snap Ring
Courtesy of GENERAL MOTORS CORP.

9. Remove the 3rd/4th gear spacer (190).
10. Remove the snap ring (156) and discard.

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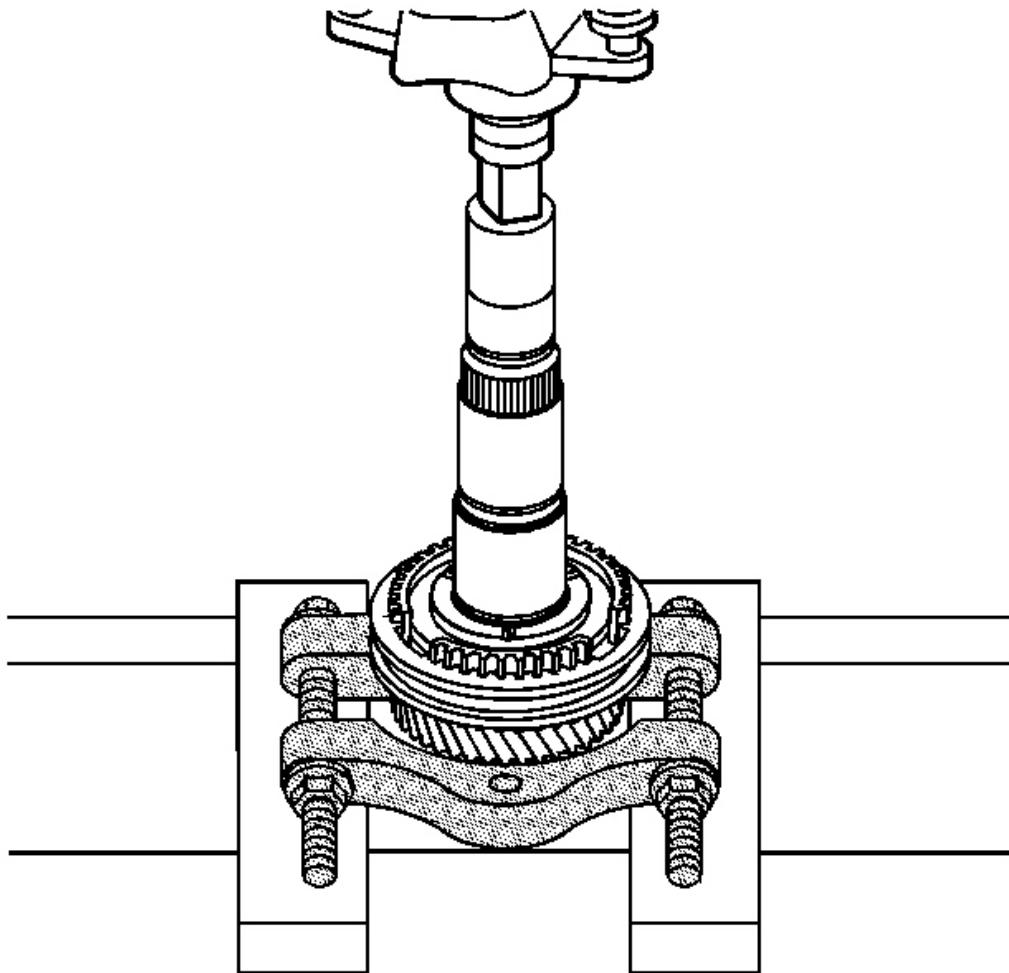


Fig. 64: Removing 4th Gear & Synchronizer

Courtesy of GENERAL MOTORS CORP.

NOTE: Place the edge of gear on press plate.

11. Using a hydraulic press and **J 22912-B:** bearing puller, remove the 4th gear and the synchronizer as a unit.

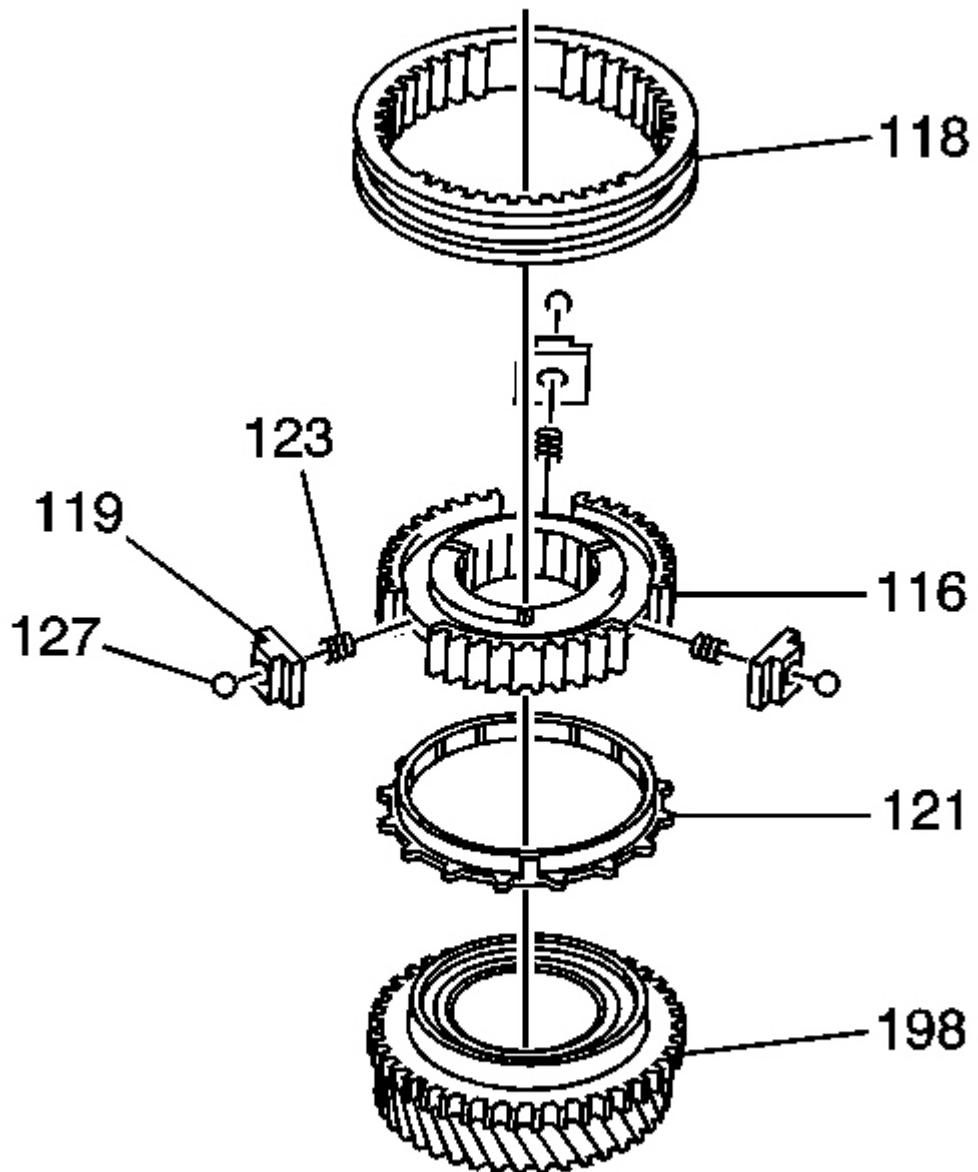


Fig. 65: View of 3rd/4th Gear Assembly

Courtesy of GENERAL MOTORS CORP.

NOTE: Before removing sleeve (118), cover components in order to keep the ball and spring from ejecting loose.

12. Remove the following components as an assembly:

- The 3rd/4th gear synchronizer sleeve (118)
- The 3rd/4th gear synchronizer hub (116) including insert (119), detent ball (127) and spring (123)
- The 4th gear blocking ring (121)
- The 4th gear (198)

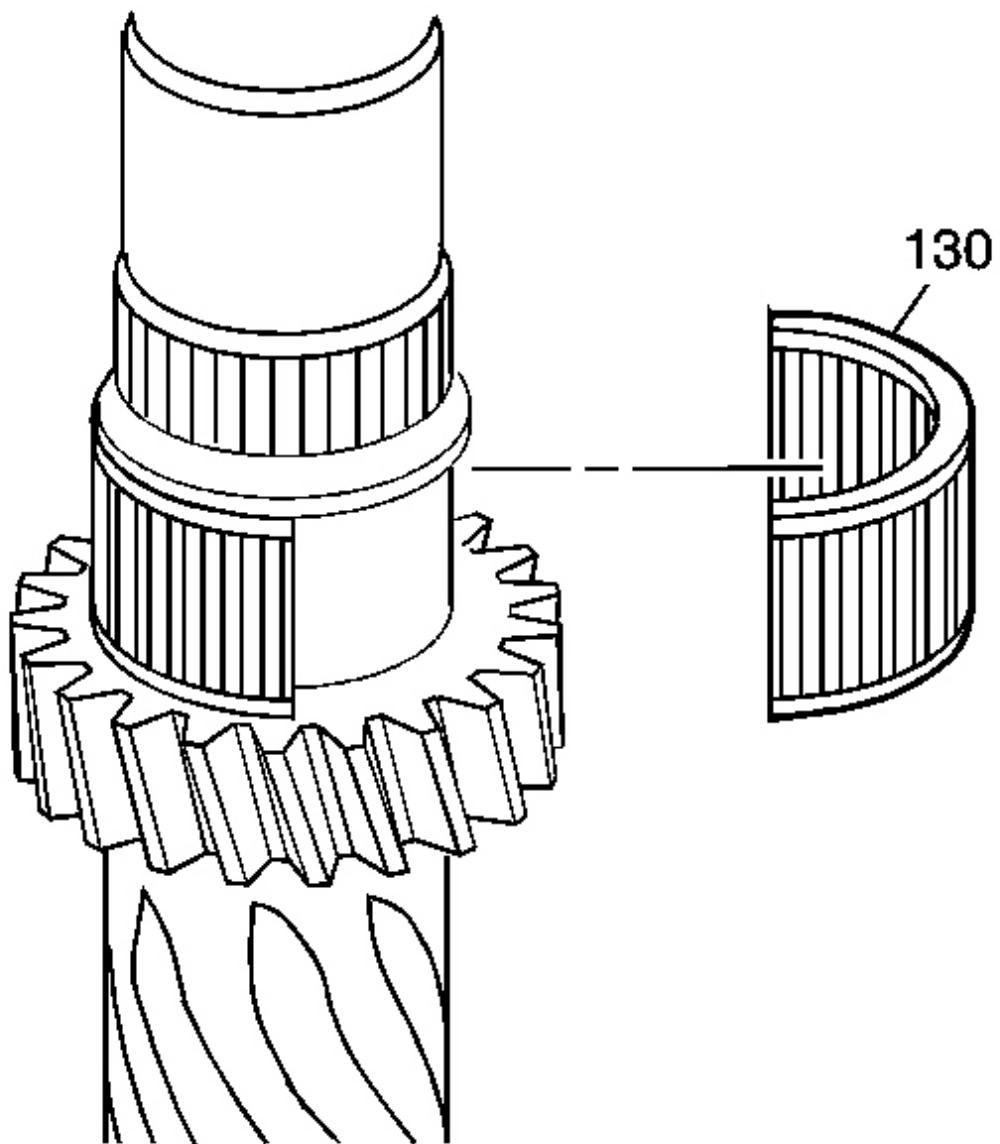


Fig. 66: View Of 4th Gear Bearing
Courtesy of GENERAL MOTORS CORP.

13. Remove the 4th gear bearing (130) from the input shaft.

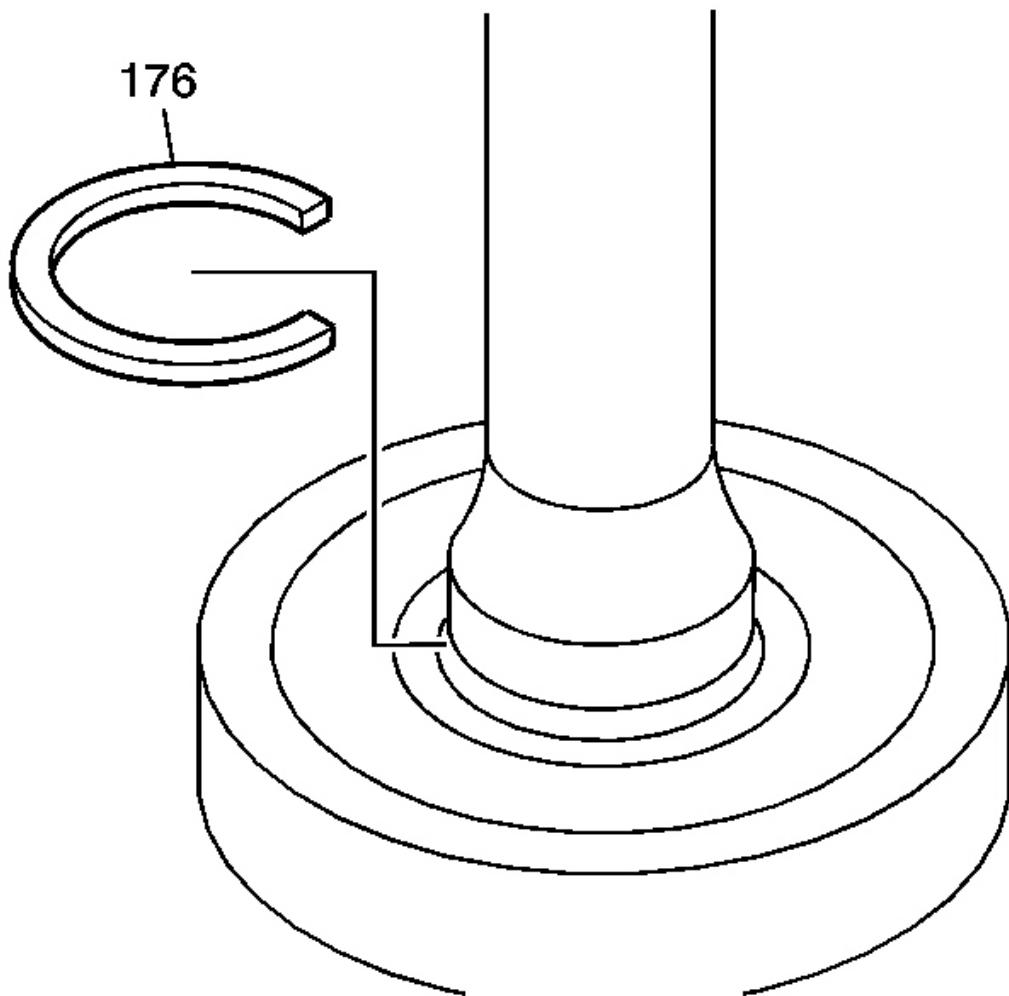


Fig. 67: View Of Snap Ring
Courtesy of GENERAL MOTORS CORP.

14. Remove the snap ring (176) and discard.

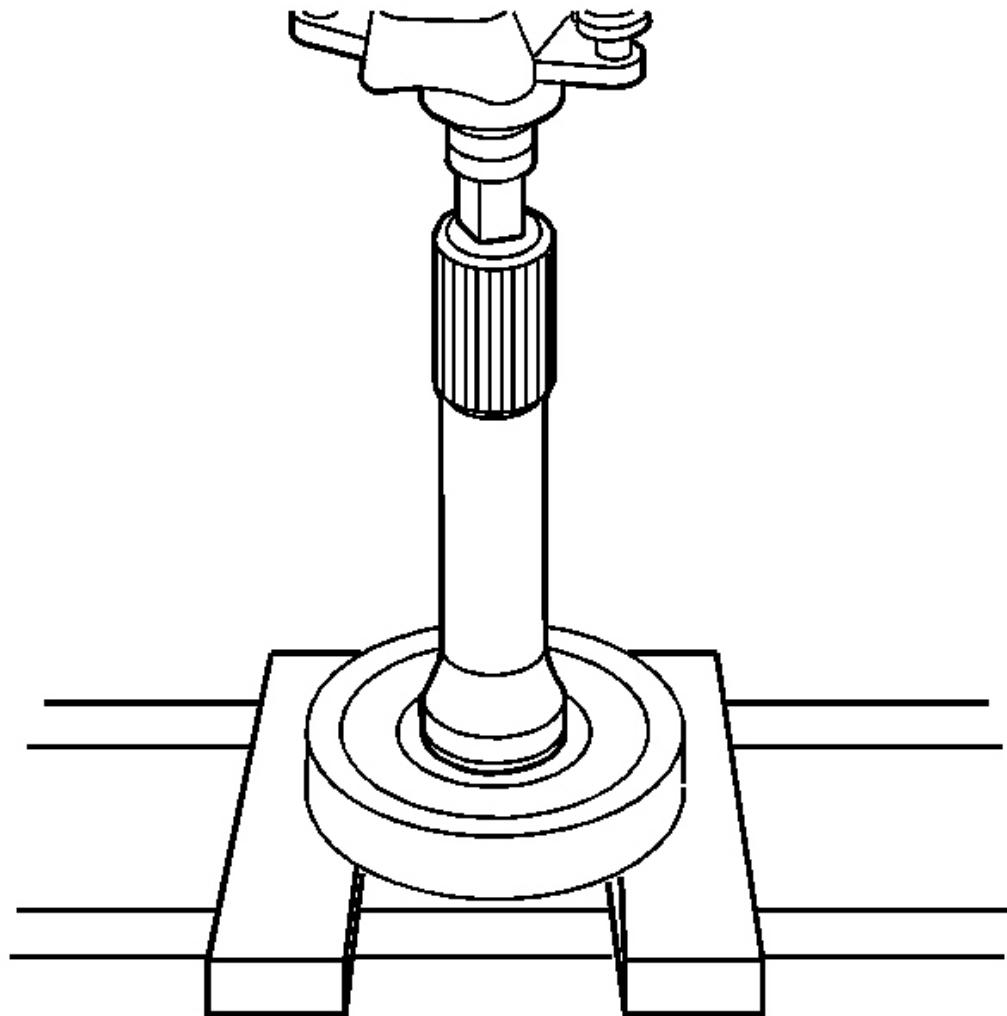


Fig. 68: Removing Counter Gear Front Bearing
Courtesy of GENERAL MOTORS CORP.

15. Using a hydraulic press, remove the counter gear front bearing from the input shaft.

COUNTER GEAR SHAFT DISASSEMBLE

Special Tools

J 44749: Split Plate Bearing Gear Puller

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

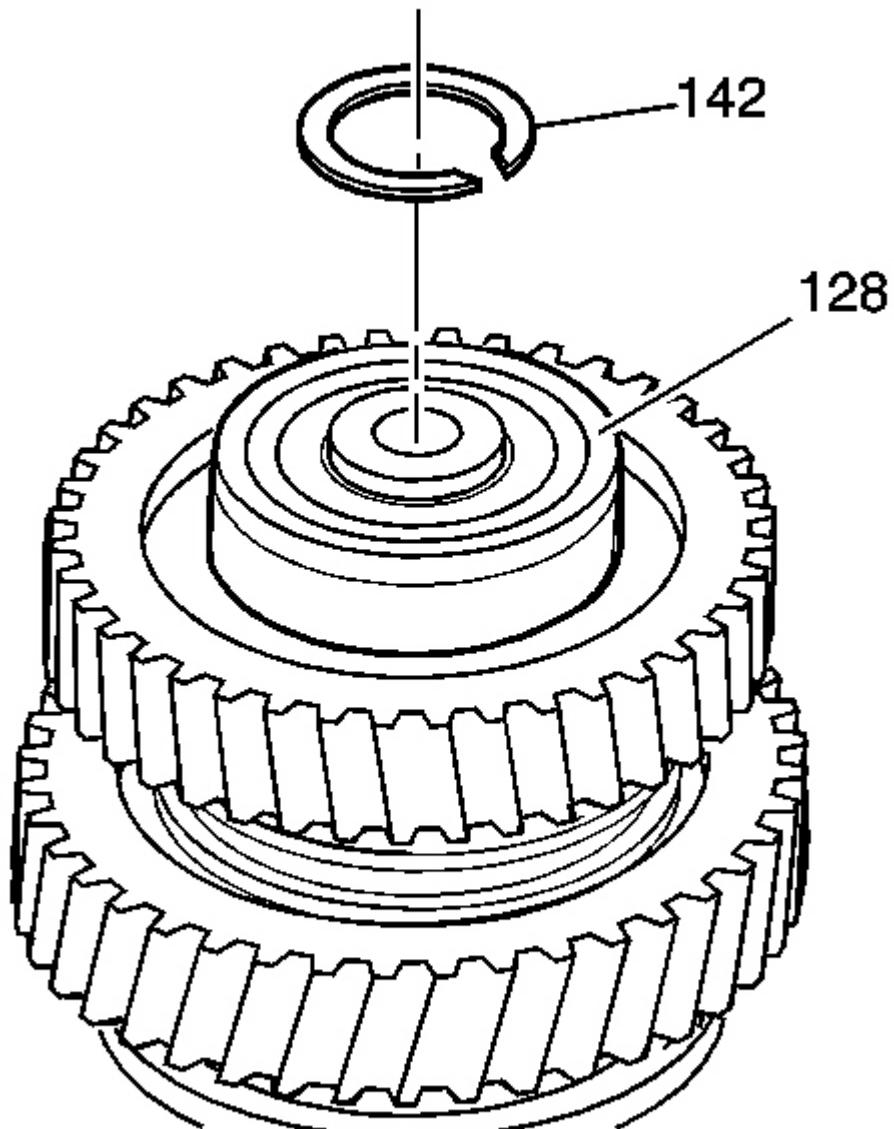


Fig. 69: View Of Counter Gear Front Bearing & Snap Ring

Courtesy of GENERAL MOTORS CORP.

NOTE: Inspect the countershaft gear subassembly before disassemble. Refer to Gears and Shafts Cleaning and Inspection.

1. Remove the snap ring (142) from the countershaft above the counter gear front bearing (128). Discard the

snap ring (142).

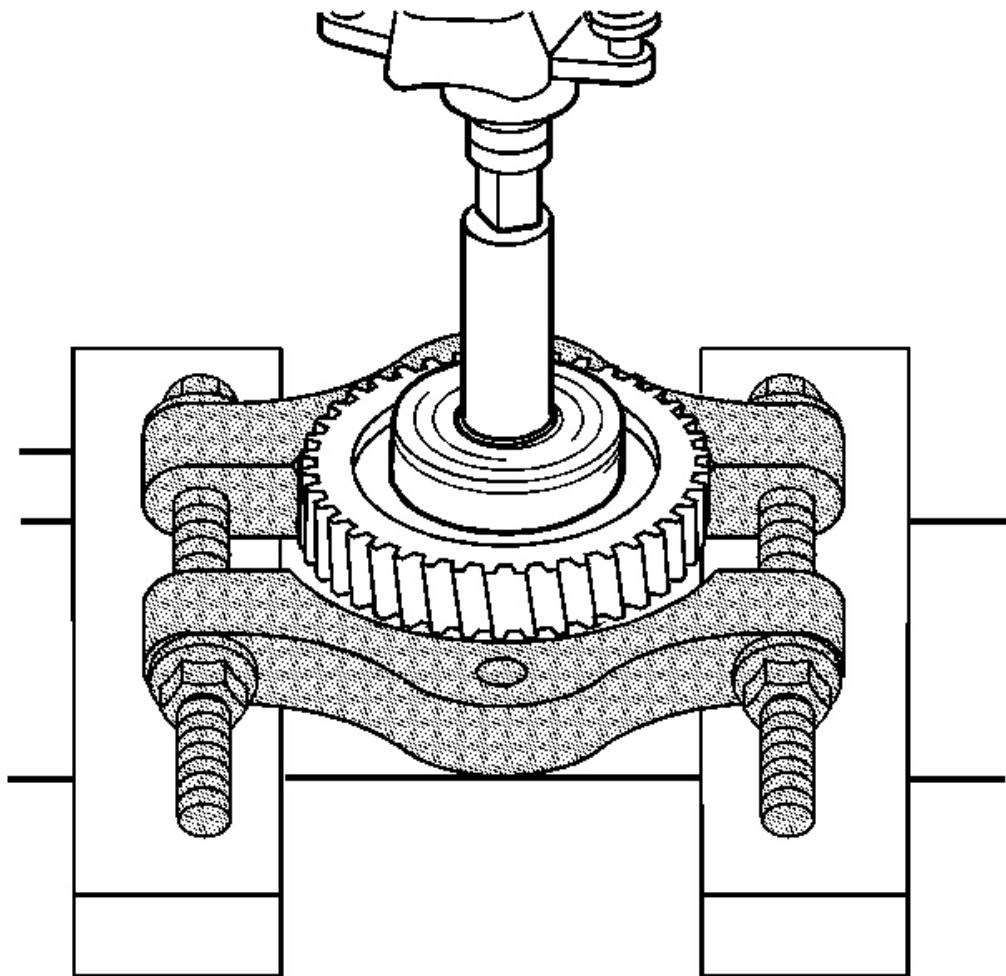


Fig. 70: Removing Counter Gear Front Bearing & Reverse Synchronizer Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: Place the edge of gear on press plate.

2. Using a hydraulic press and **J 44749**: gear puller, remove the counter gear front bearing and reverse synchronizer assembly as a unit.

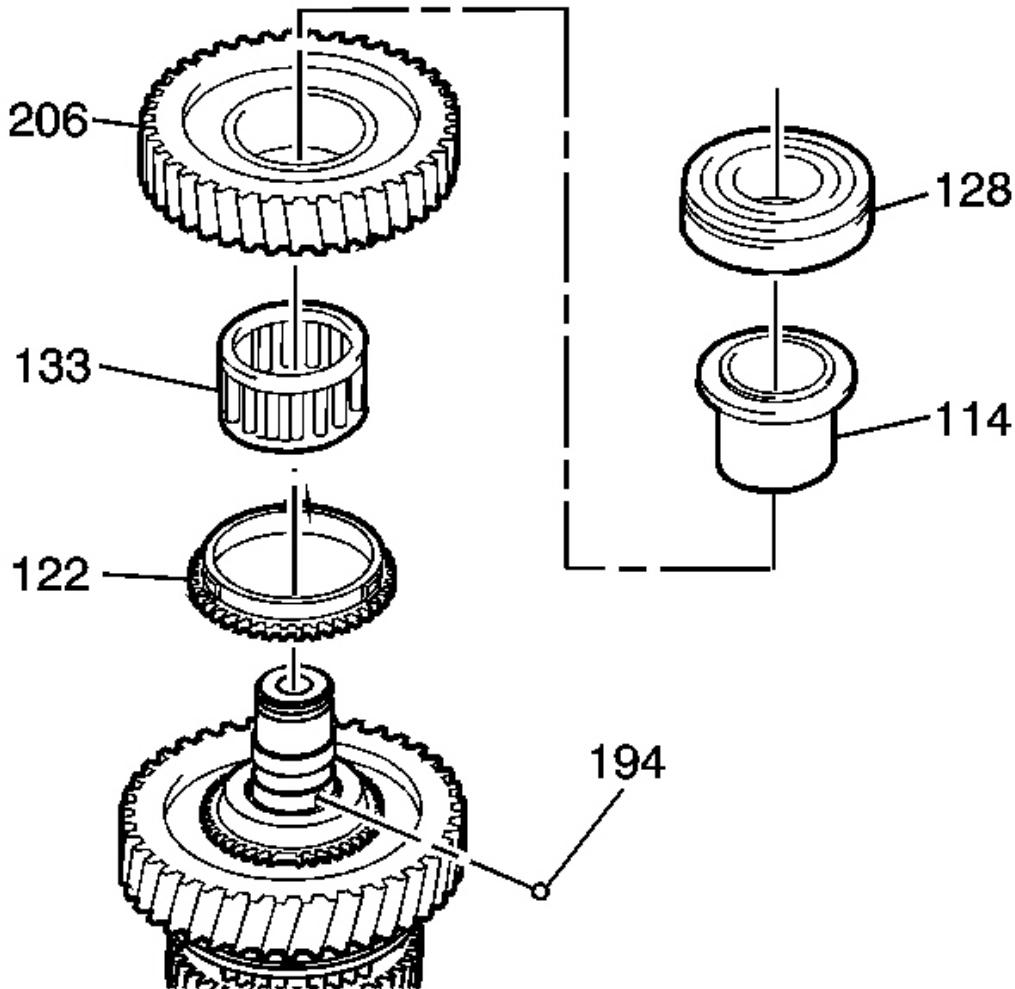


Fig. 71: Identifying Reverse & Counter Gear Components

Courtesy of GENERAL MOTORS CORP.

3. Remove the following components as an assembly:

- The counter gear front bearing (128)
- The reverse gear bushing (114)
- The reverse gear (206)
- The reverse gear bearing (133)
- The reverse gear blocking ring (122)

4. Using a magnet, remove the locking ball (194) from the countershaft.

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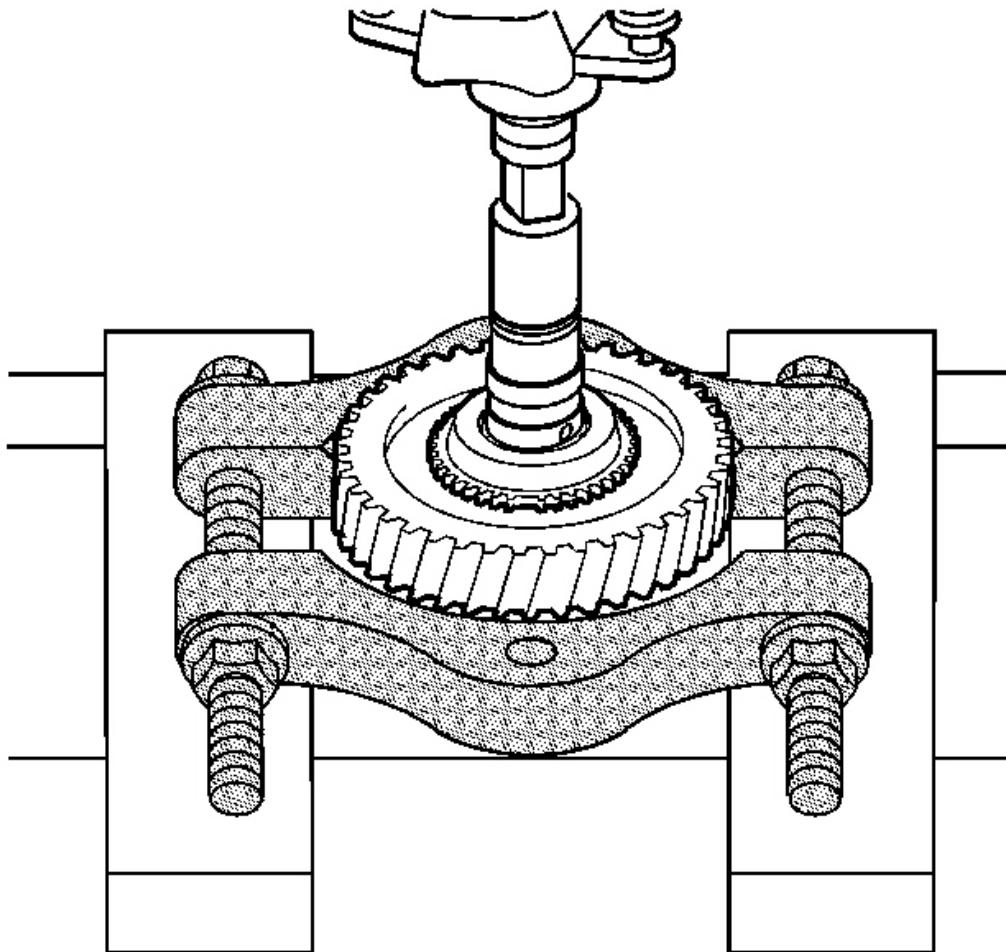


Fig. 72: Removing Reverse Gear Spline & 1st Gear
Courtesy of GENERAL MOTORS CORP.

5. Using a hydraulic press and **J 44749:** gear puller, remove the reverse gear spline and 1st gear as a unit.

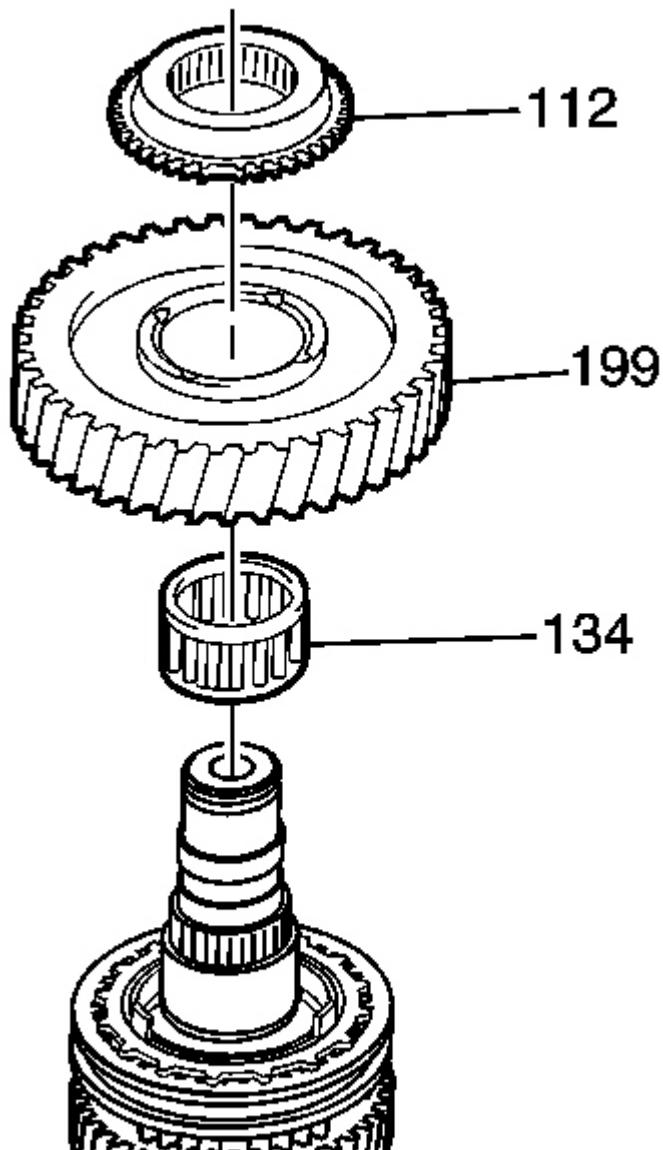


Fig. 73: View Of Reverse Gear Spline, 1st Gear & Bearing
Courtesy of GENERAL MOTORS CORP.

6. Remove the reverse gear spline (112).
7. Remove the 1st gear (199).
8. Remove the 1st gear bearing (134).

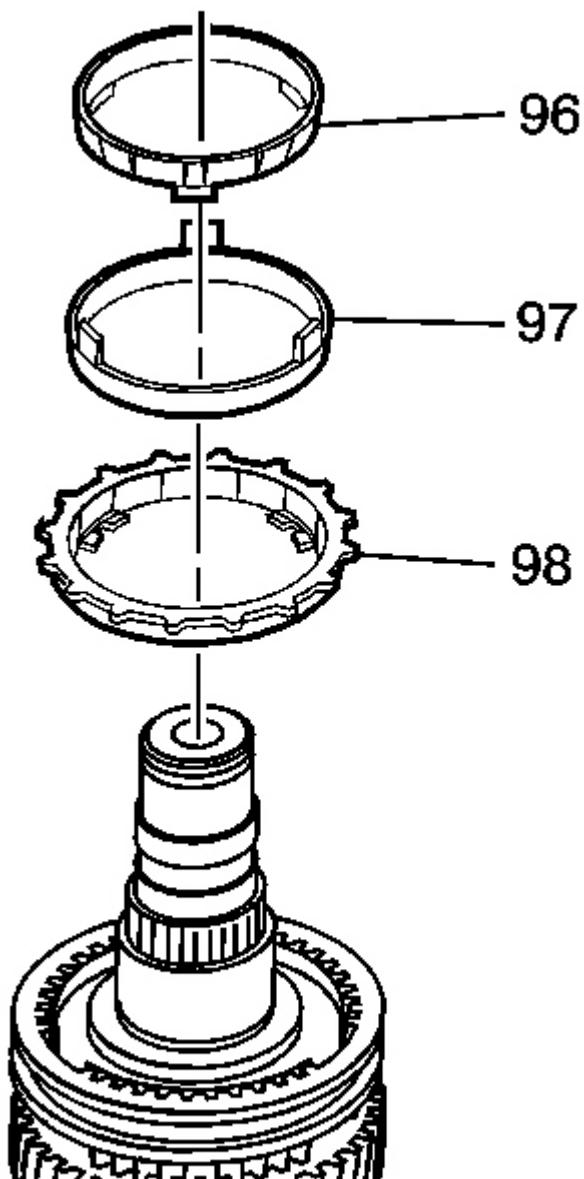


Fig. 74: View Of 1st Gear Synchronizer Cones & 1st Gear Outer/Inner Blocking Ring
Courtesy of GENERAL MOTORS CORP.

9. Remove the 1st gear synchronizer inner cone (96).
10. Remove the 1st gear synchronizer outer cone (97).

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11. Remove the 1st gear outer blocking ring (98).

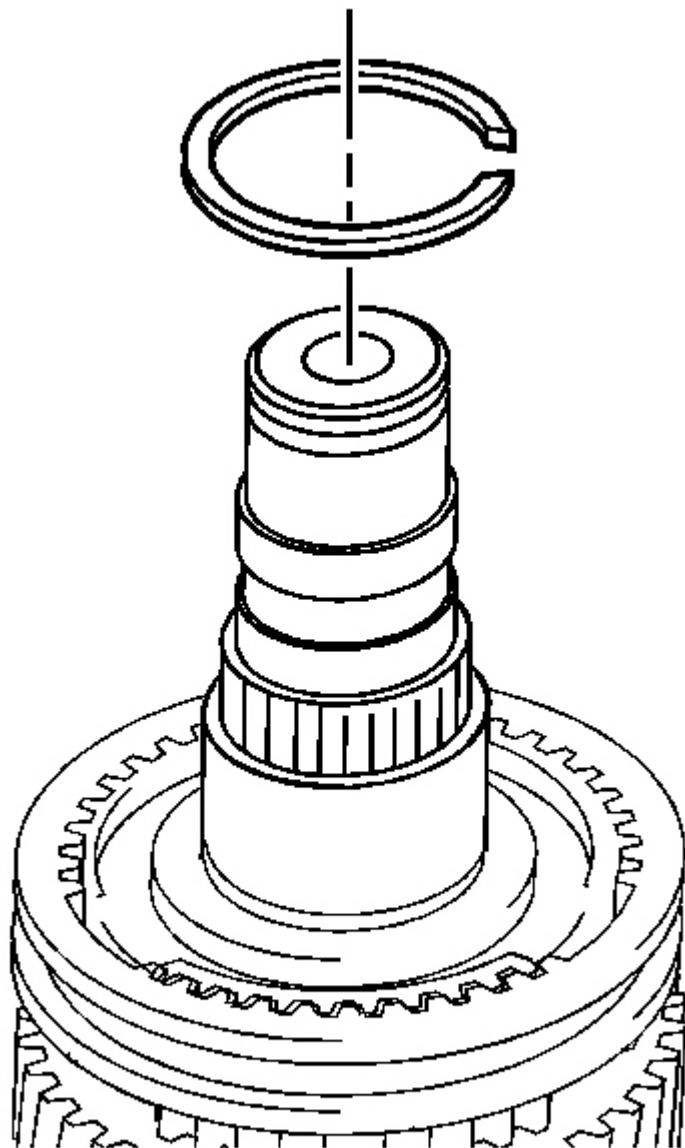


Fig. 75: View Of Snap Ring

Courtesy of GENERAL MOTORS CORP.

12. Remove the snap ring and discard.

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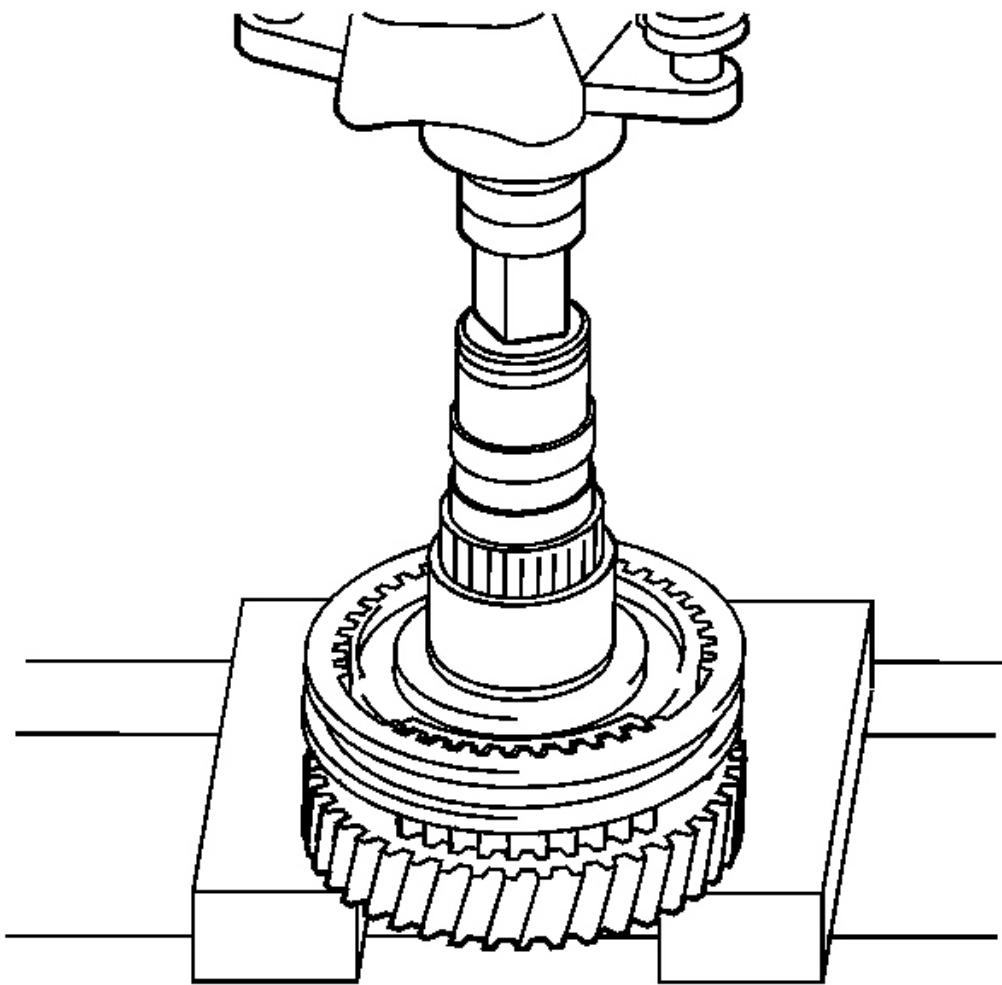


Fig. 76: Removing 2nd Gear & 1-2 Synchronizer Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: Place the edge of gear on press plate.

13. Using a hydraulic press, remove the 2nd gear and the 1-2 synchronizer assembly as a unit.

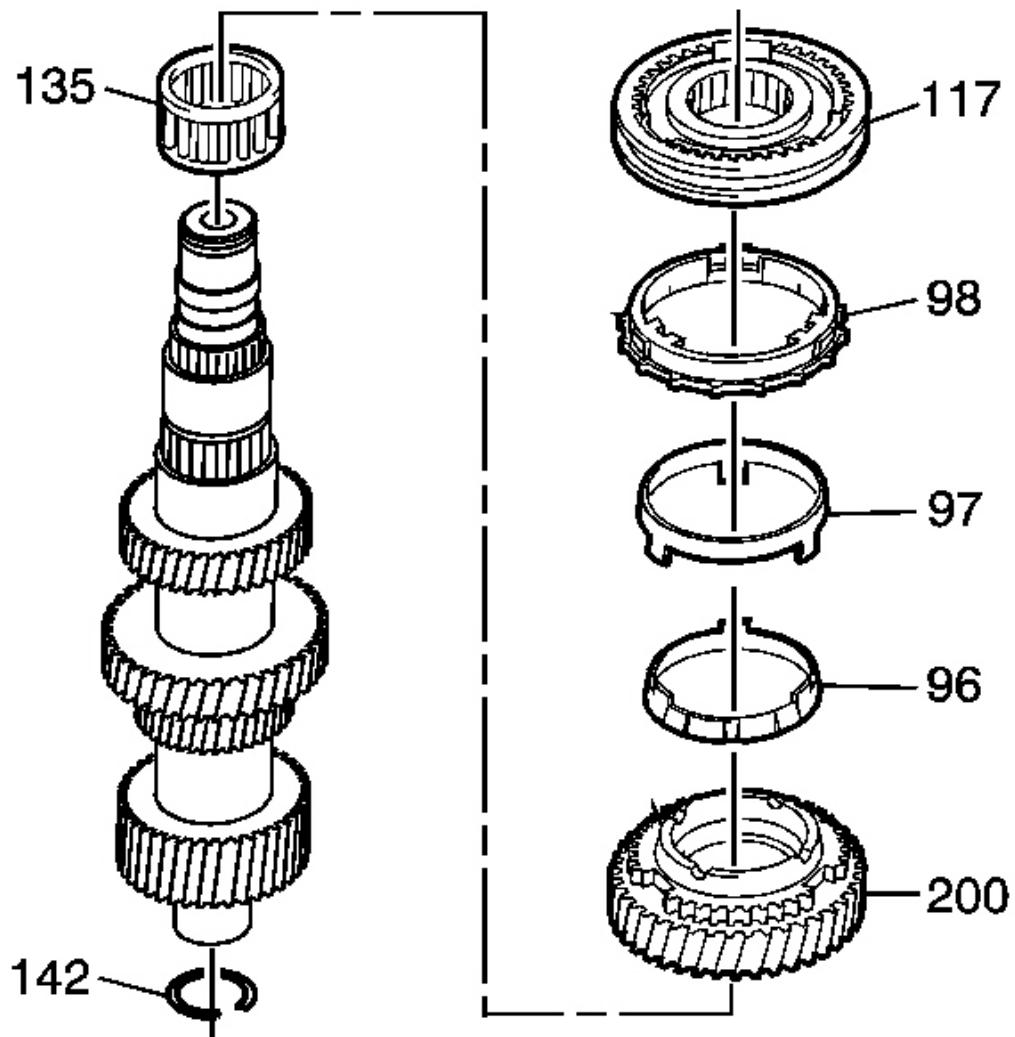


Fig. 77: View of 1st/2nd Gear Assembly
Courtesy of GENERAL MOTORS CORP.

14. Remove the following components as an assembly:

- The 1st/2nd gear synchronizer sleeve (117)
- The 2nd gear outer blocking ring (98)
- The 2nd gear synchronizer outer cone (97)
- The 2nd gear synchronizer inner cone (96)
- The 2nd gear (200)

- The 2nd gear bearing (135)
- The snap ring (142)

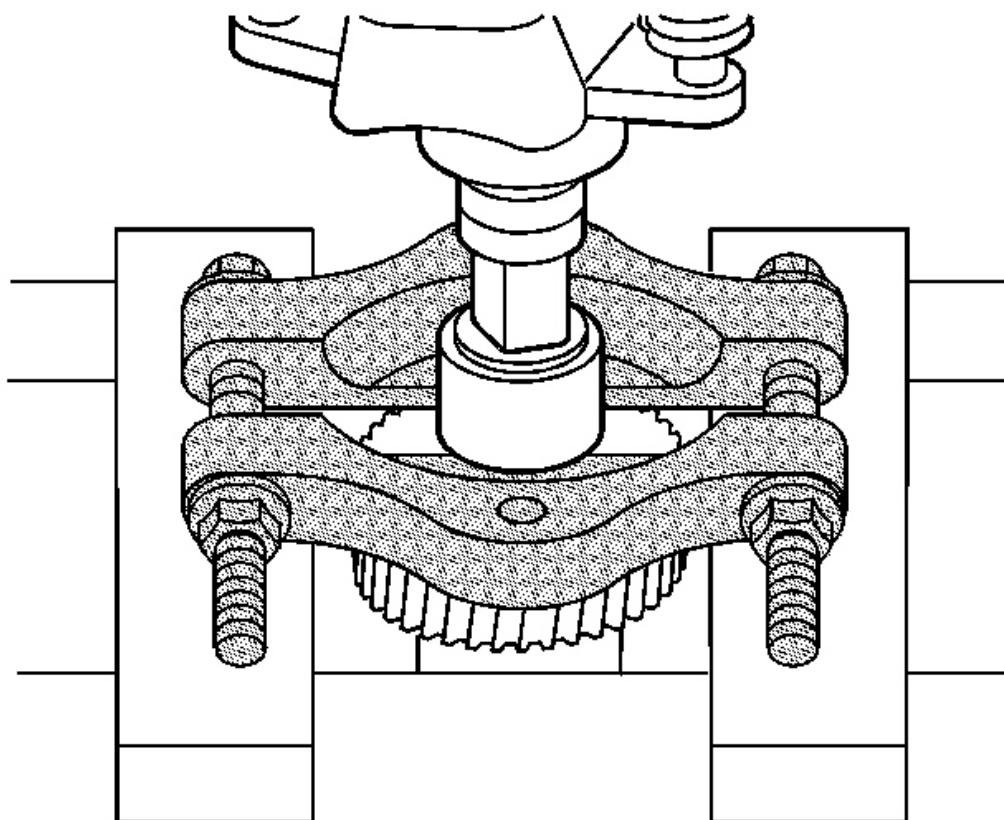


Fig. 78: Removing Cylindrical Roller Bearing Inner Race
Courtesy of GENERAL MOTORS CORP.

15. Using **J 44749**: gear puller and a hydraulic press, remove the cylindrical roller bearing inner race.

TRANSMISSION CASE DISASSEMBLE

Special Tools

- **DT-47722**: Shift Rail Bushing Remover and Installer
- **J 2619-01**: Slide Hammer
- **J 26941**: Bushing and Bearing Remover 3-4 in

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

Rear Case Disassemble

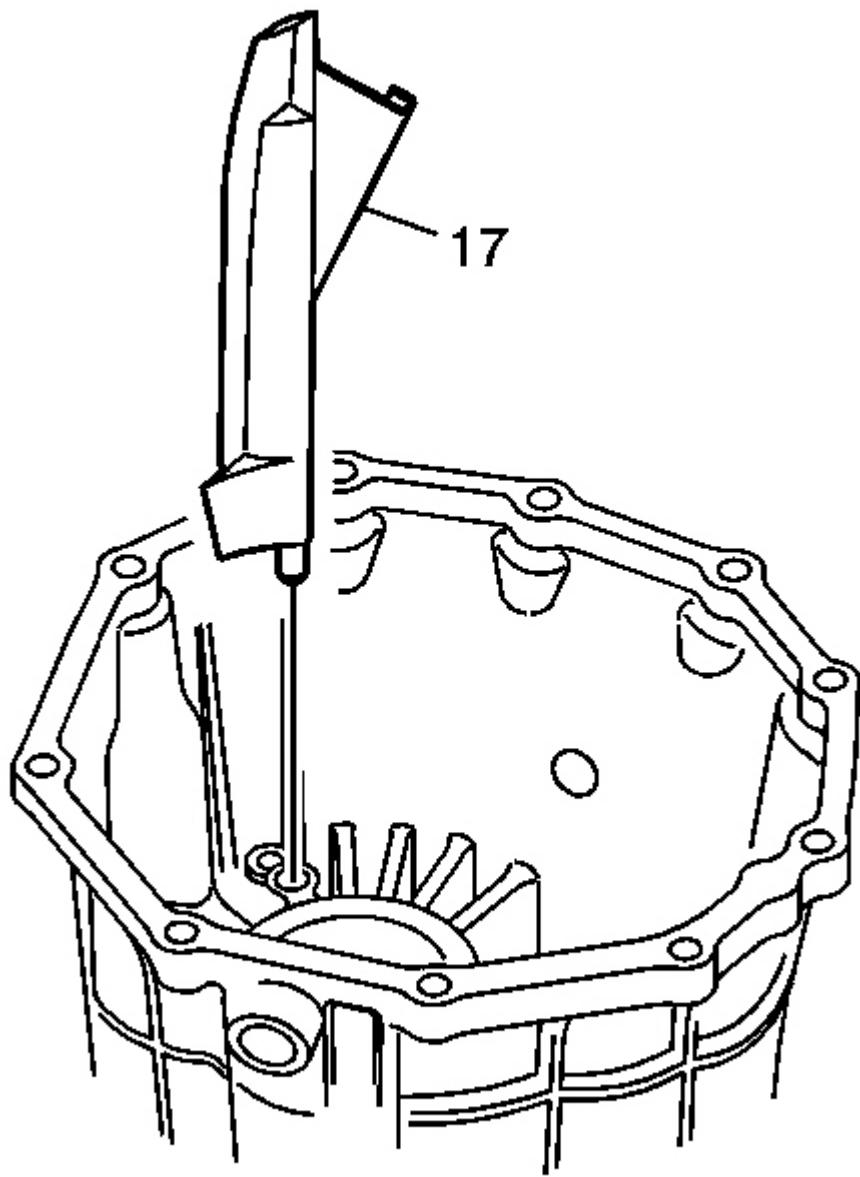


Fig. 79: View Of Oil Trough

Courtesy of GENERAL MOTORS CORP.

1. Remove the oil trough (17).

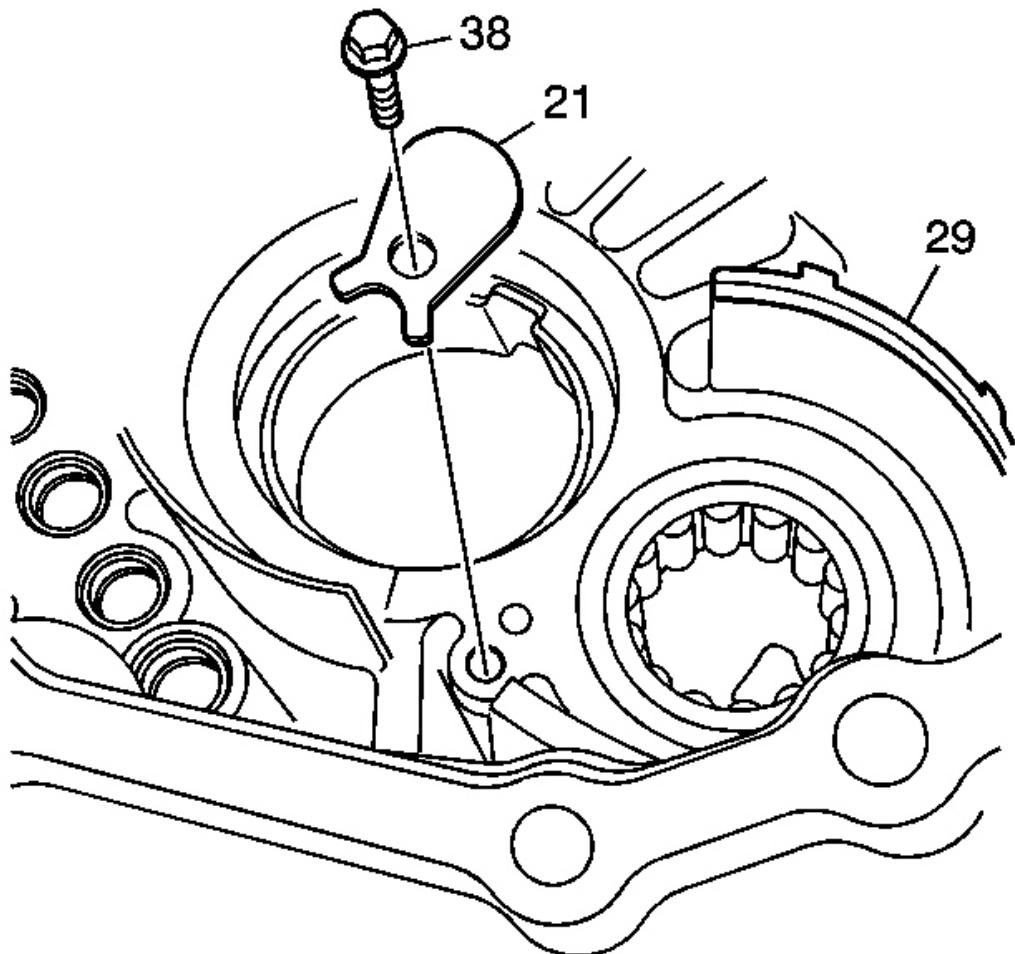


Fig. 80: View Of Bearing Retainer, Bolt & Gasket
Courtesy of GENERAL MOTORS CORP.

2. Remove the bolt (38) and retainer (21).
3. Remove the gasket (29).

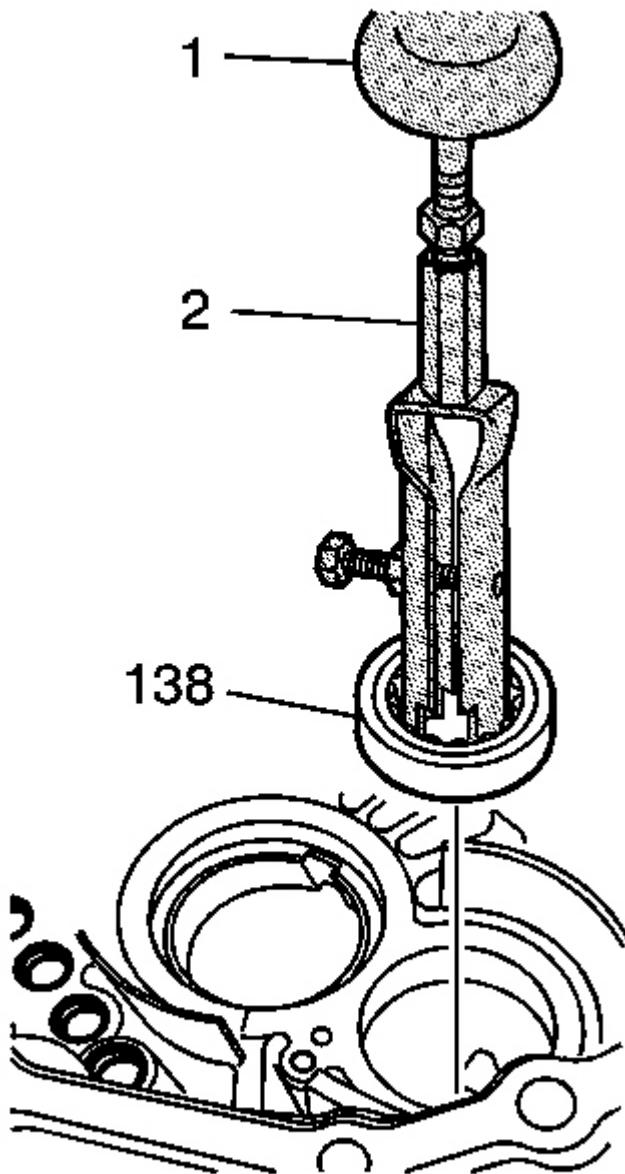


Fig. 81: Removing Counter Gear Roller Bearing
Courtesy of GENERAL MOTORS CORP.

NOTE: Case must be held down firmly to remove the bearing.

4. Using J 26941: remover (2) and J 2619-01: slide hammer (1), remove and discard the counter gear roller

bearing (138).

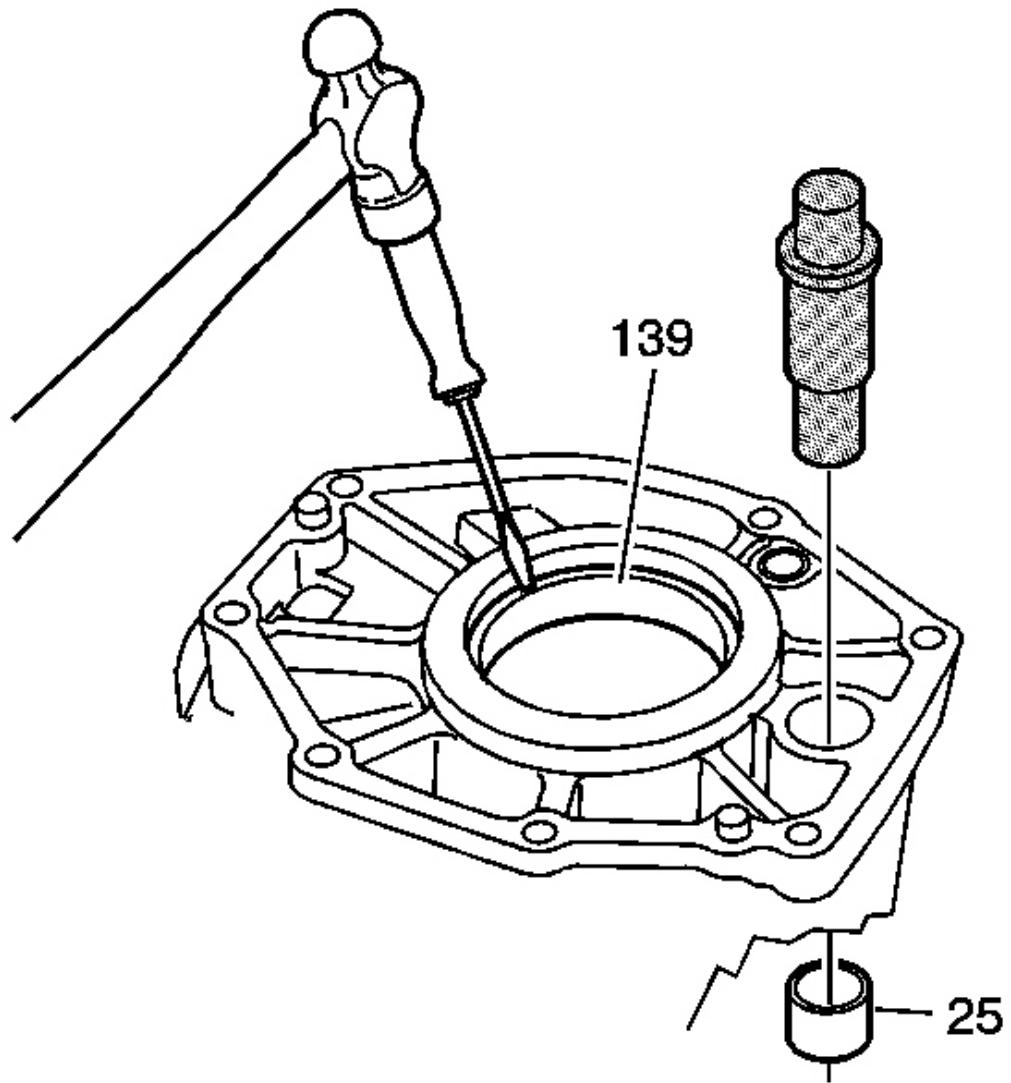


Fig. 82: Removing Shift Shaft Bearing & Output Shaft Bearing Race From Rear Case
Courtesy of GENERAL MOTORS CORP.

5. Using **DT-47722**: bushing remover, remove the shift shaft bearing (25) from the case.
6. Remove the output shaft bearing race (139).

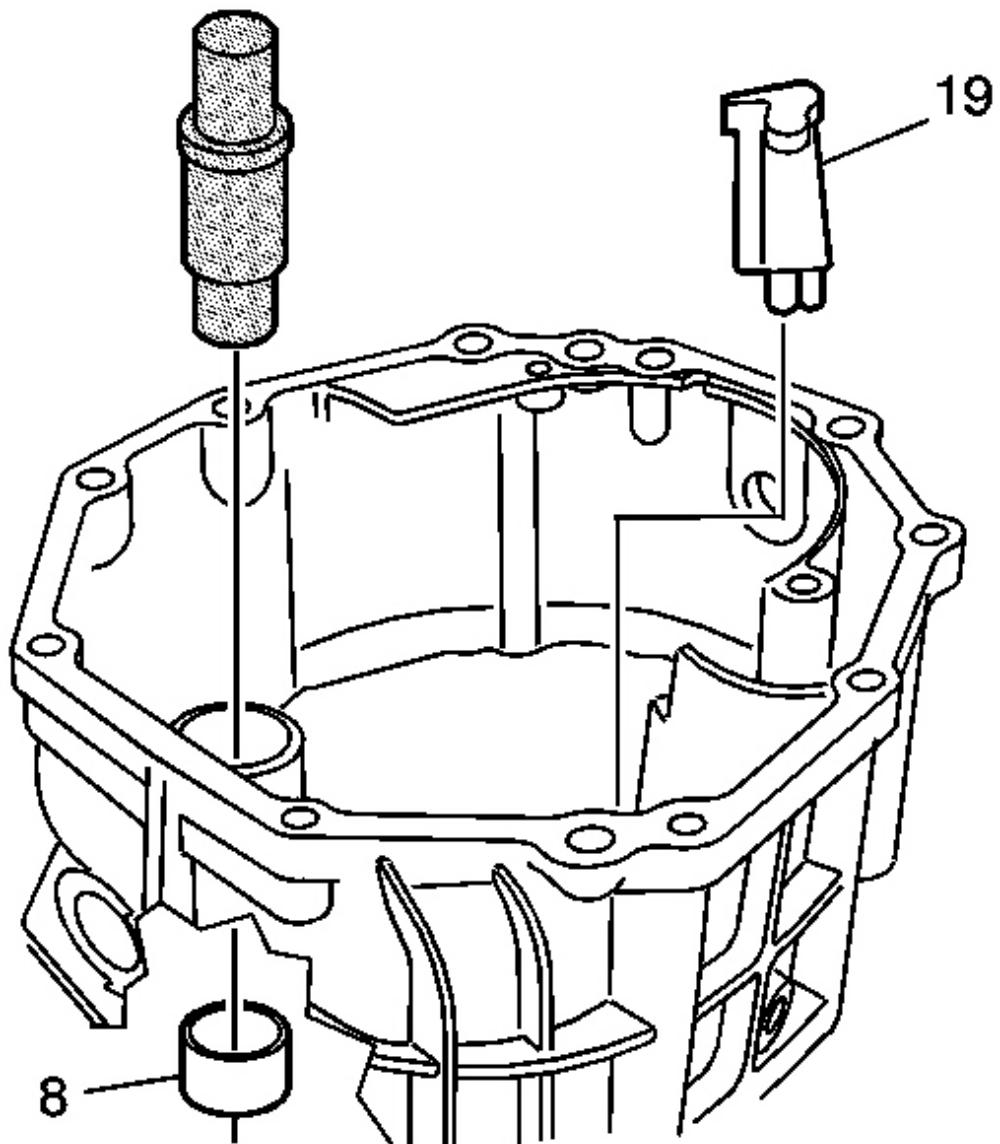


Fig. 83: Middle Case Oil Trough & Shift Shaft Bearing

Courtesy of GENERAL MOTORS CORP.

1. Using DT-47722: bushing remover, remove the shift shaft bearing (8) from the middle case.
2. Remove the oil trough (19) from the middle case.

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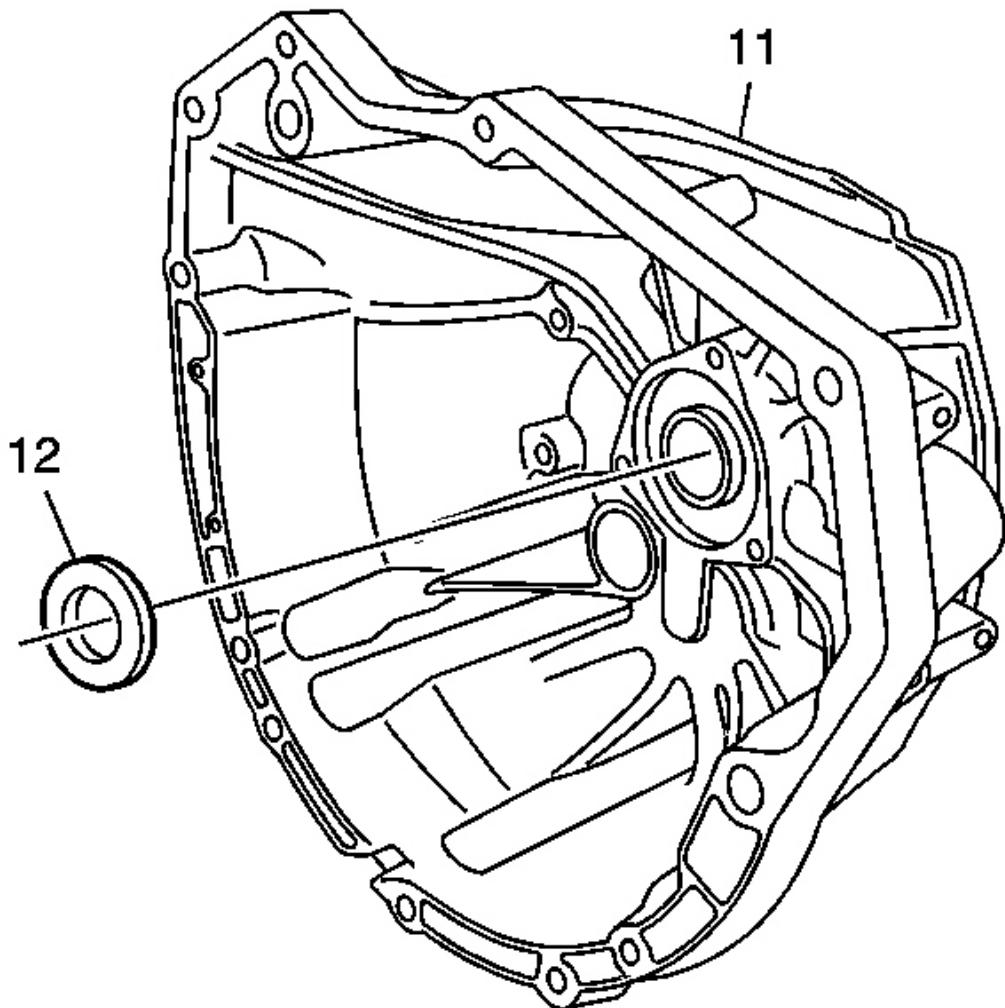


Fig. 84: Front Case Input Shaft Seal
Courtesy of GENERAL MOTORS CORP.

1. Remove and discard the input shaft seal (12) from the front case (11).

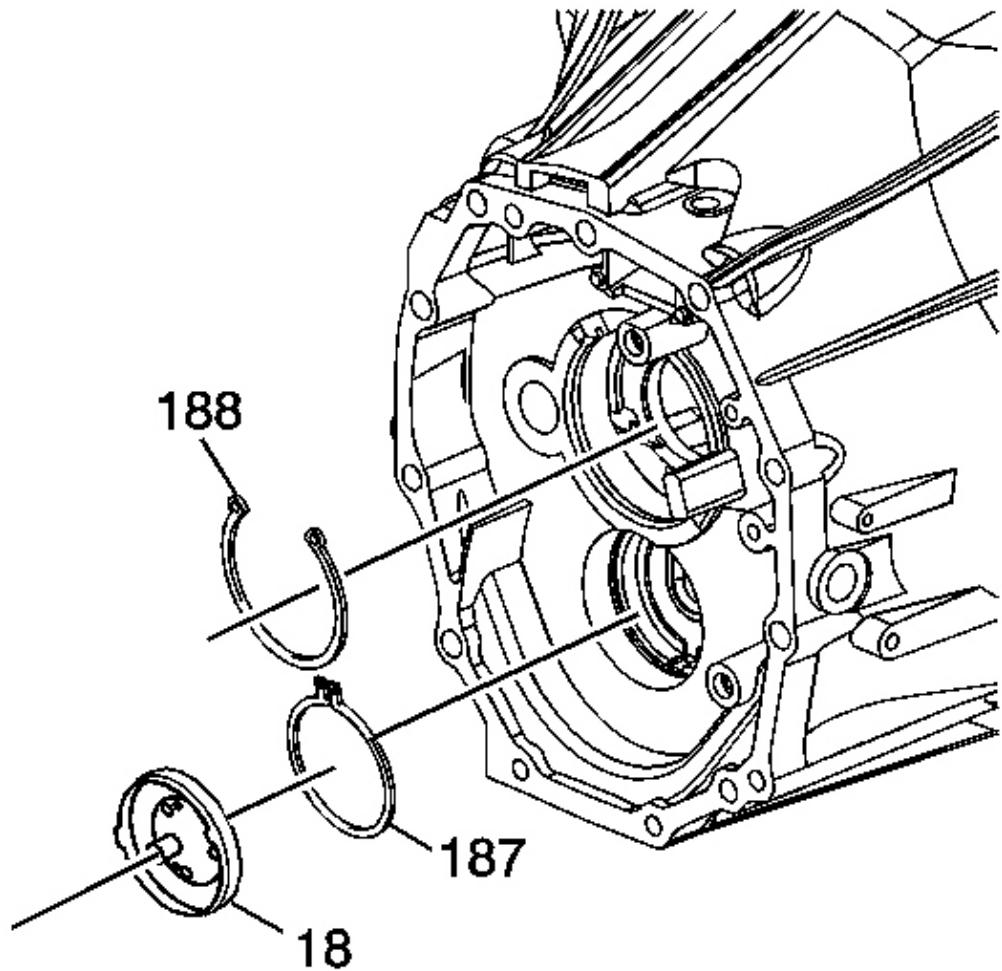


Fig. 85: Front Input Shaft Oil Slinger & Retainers

Courtesy of GENERAL MOTORS CORP.

2. Pry the front input shaft oil slinger (18) from the transmission front case using a suitable tool.
3. Remove the front input shaft oil slinger (18).
4. Remove the input shaft bearing front retainer (188).
5. Remove the counter shaft bearing front retainer (187).

EXTENSION DISASSEMBLE

Special Tools

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- **DT-47722:** Shift Shaft Seal Installer
- **J 2619-01:** Slide Hammer
- **J 26941:** Bushing and Bearing Remover 3-4 in

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

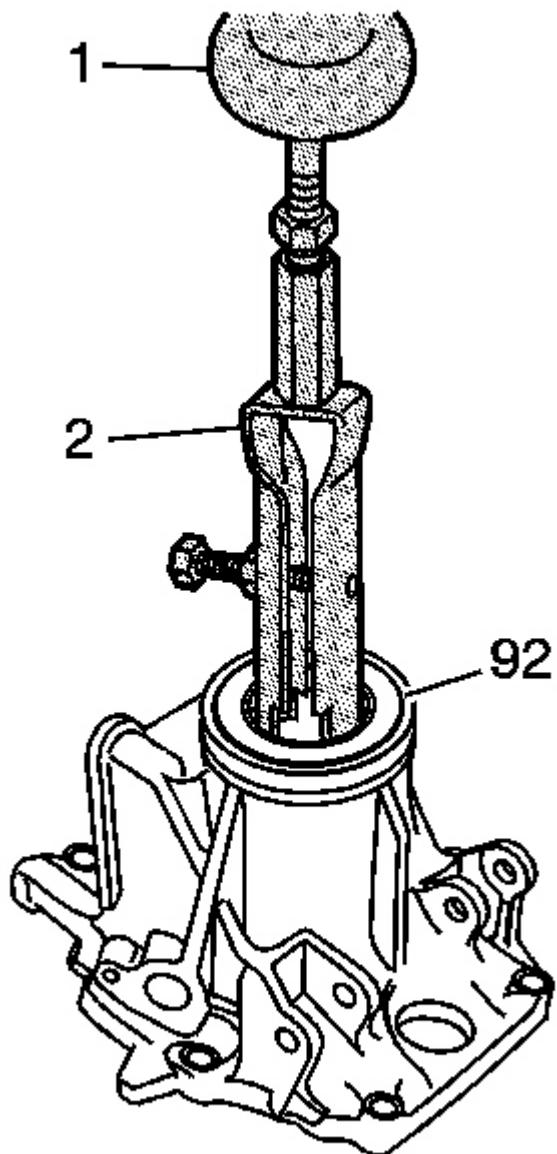


Fig. 86: Removing Rear Output Shaft Seal
Courtesy of GENERAL MOTORS CORP.

NOTE: The extension must be held down firmly to remove the output shaft seal.

1. Using **J 2619-01**: slide hammer (1) and **J 26941**: remover (2), remove the rear output shaft seal (92).

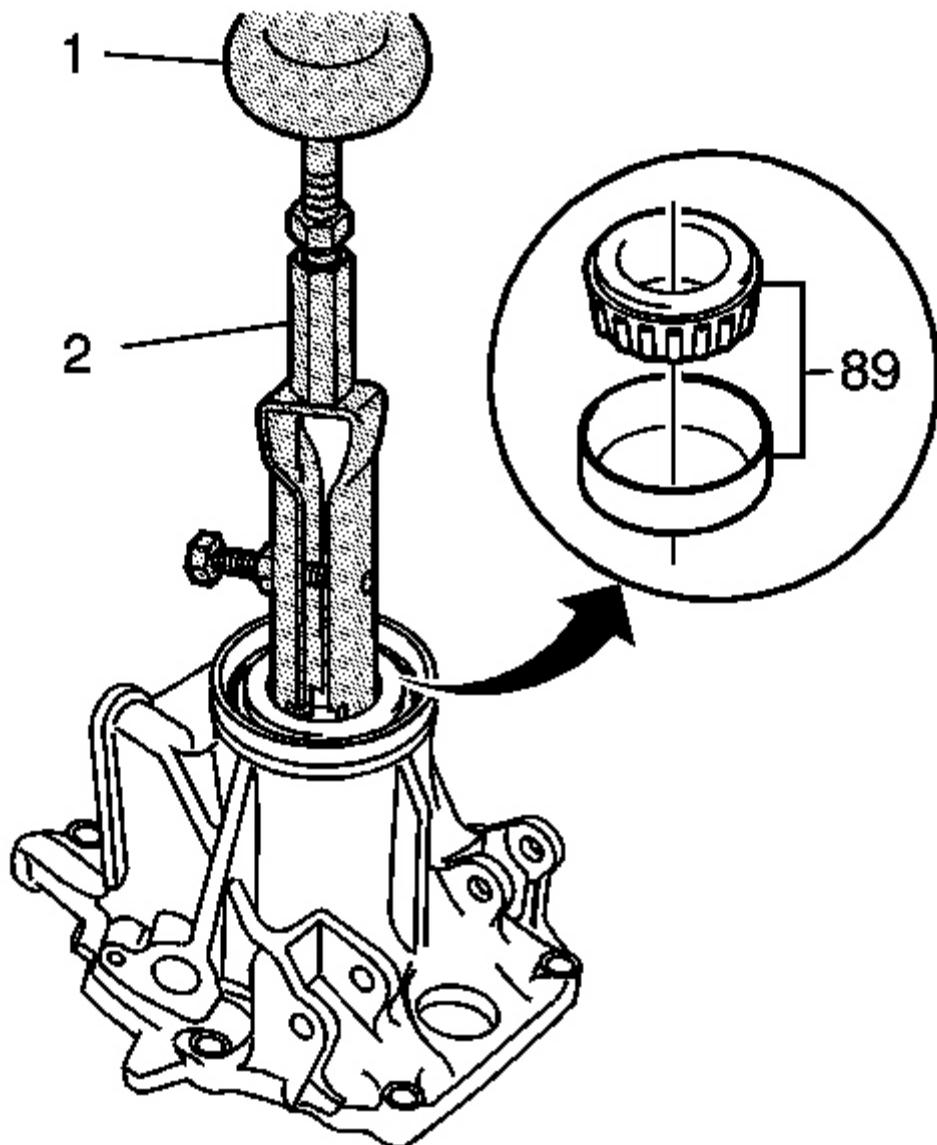


Fig. 87: Removing Rear Output Shaft Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: The extension must be held down firmly to remove the output shaft bearing.

2. Using **J 2619-01**: slide hammer (1) and **J 26941**: remover (2), remove the rear output shaft bearing assembly (89).

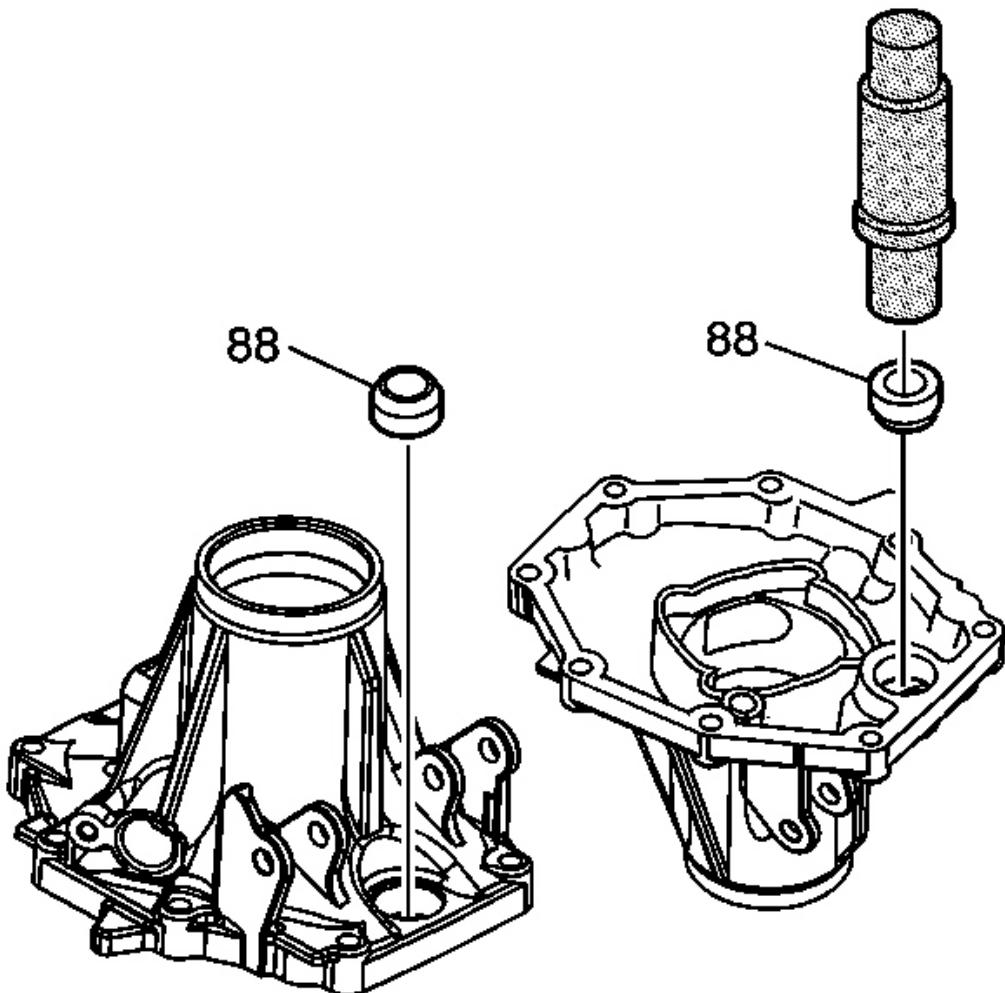


Fig. 88: Identifying Shift Shaft Seal
Courtesy of GENERAL MOTORS CORP.

3. Using tool DT-47722: seal installer, remove the shift shaft seal (88).

SYNCHRONIZERS DISASSEMBLE

1st/2nd, 3rd/4th Gear Synchronizer

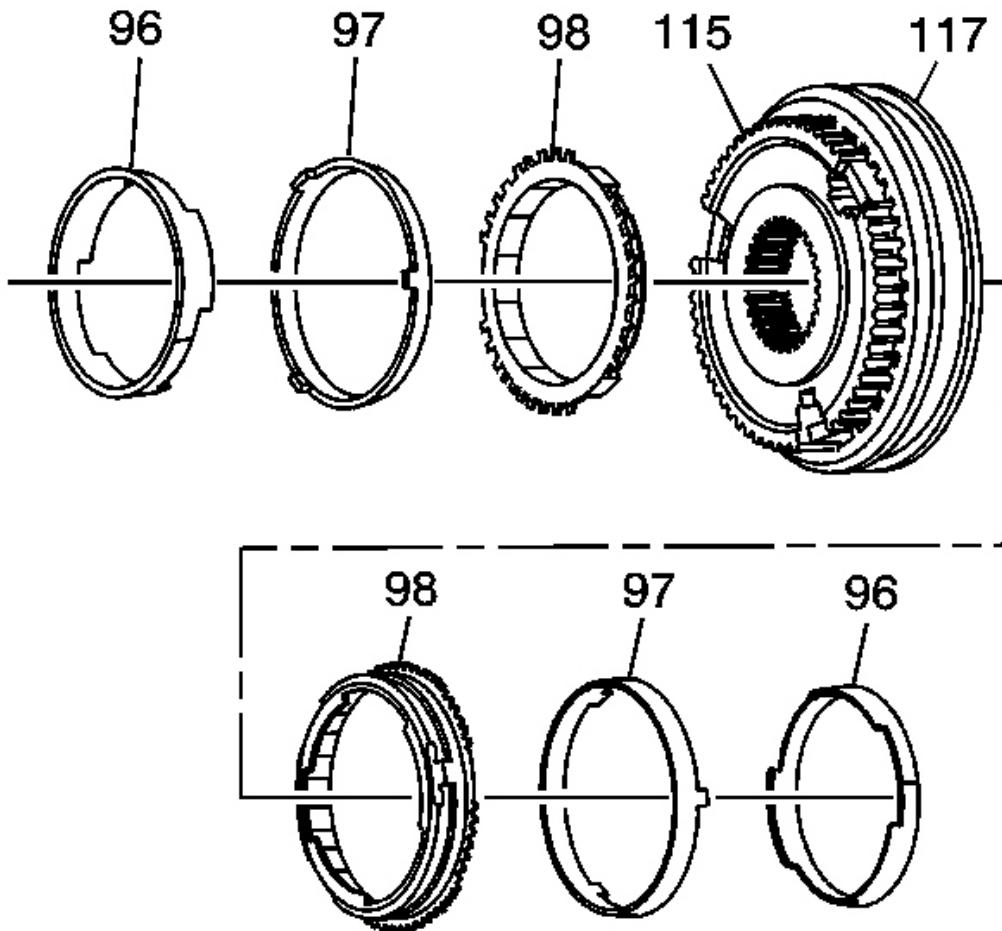


Fig. 89: View Of 1st Gear Synchronizer Components

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: When you service the synchronizers, retain them in the same order that they are removed. Keep the synchronizer components together and mark them to identify correct location.

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1. Remove the following components from the 1st/2nd gear synchronizer hub (115/117):

- the 1st gear synchronizer inner cone (96)
- the 1st gear synchronizer outer cone (97)
- the 1st gear synchronizer outer blocking ring (98)
- the 1st gear synchronizer outer blocking ring (98)
- the 1st gear synchronizer outer cone (97)
- the 1st gear synchronizer inner cone (96)

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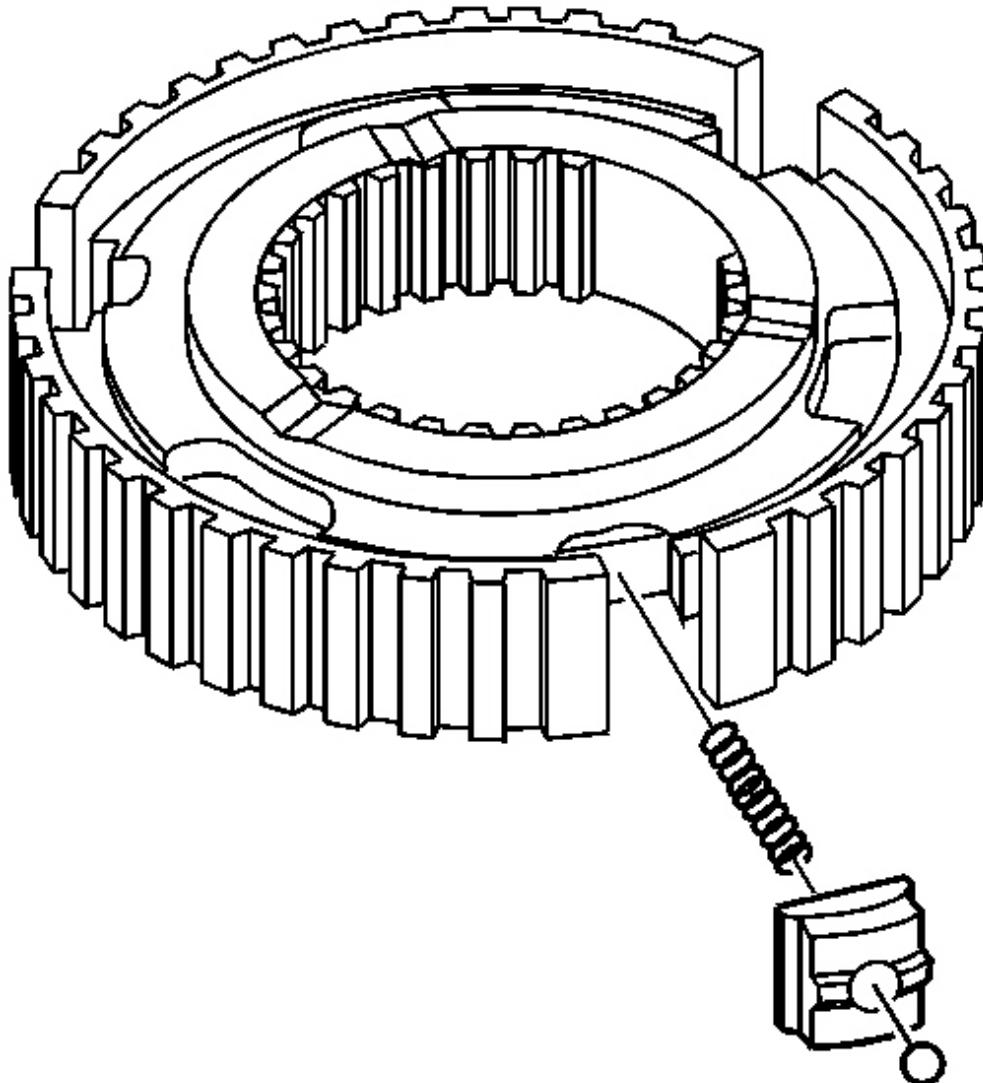


Fig. 90: View Of Synchronizer Insert & Spring
Courtesy of GENERAL MOTORS CORP.

2. Remove the synchronizer insert and spring from the synchronizer hub. Press the spring and slide the insert out.

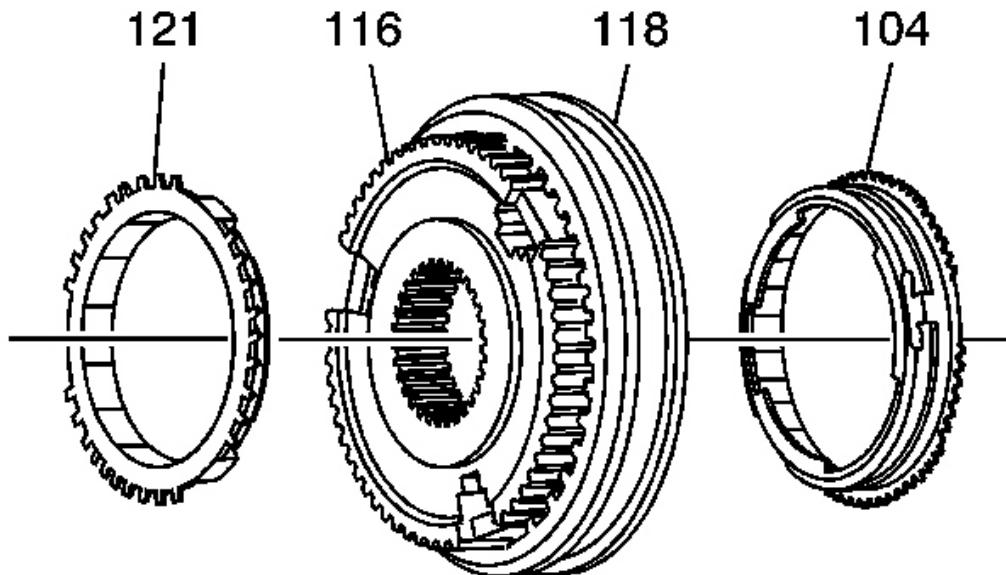


Fig. 91: View Of 3rd/4th Gear Synchronizer Hub & Blocking Rings
Courtesy of GENERAL MOTORS CORP.

3. Remove the following components from the 3rd/4th gear synchronizer hub (116/118):
 - the 4th gear blocking ring (121)
 - the 3rd gear blocking ring (104)

5th/6th Gear Synchronizer

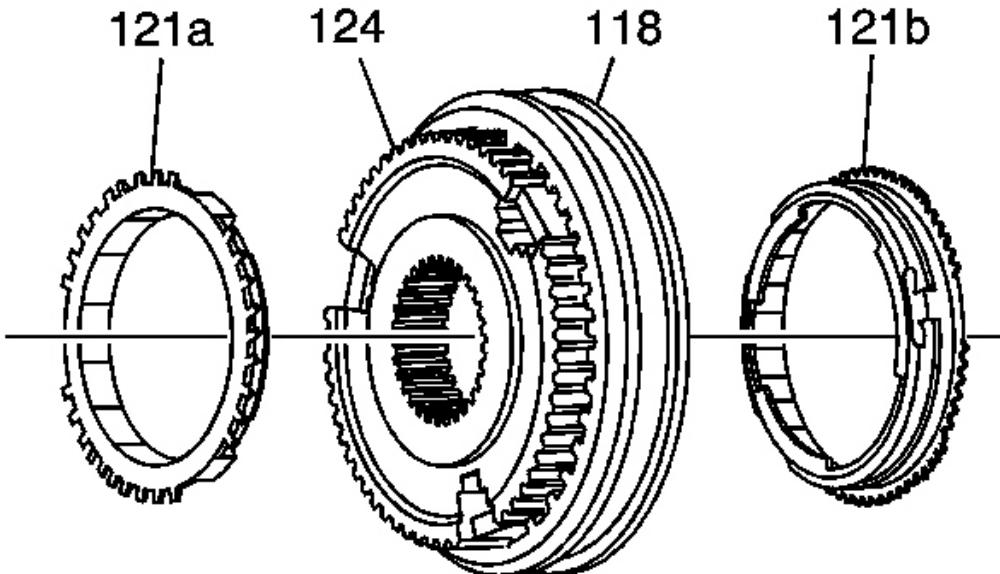


Fig. 92: View Of 5th/6th Synchronizer Hub & Blocking Rings
Courtesy of GENERAL MOTORS CORP.

1. Remove the following components from the 5th/6th synchronizer hub (124/118):
 - The 6th gear blocking ring (121a)
 - The 5th gear blocking ring (121b)

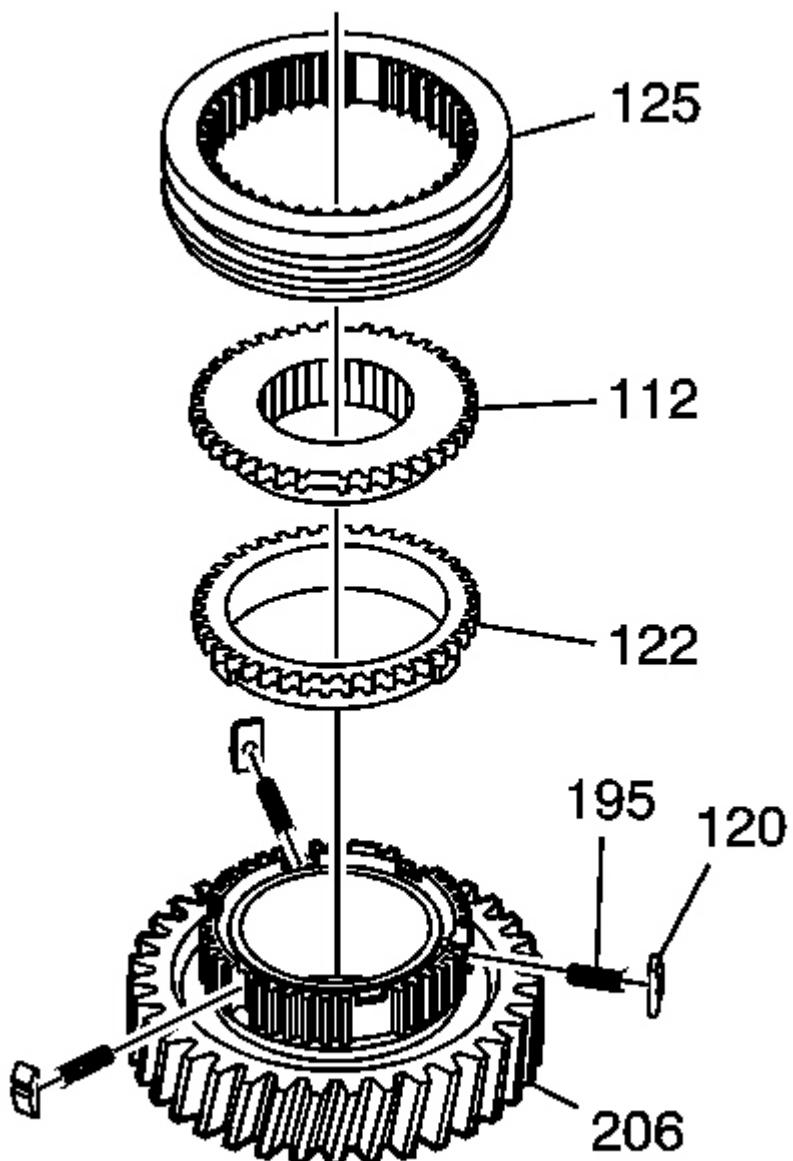


Fig. 93: View Of Reverse Gear Components

Courtesy of GENERAL MOTORS CORP.

2. Remove the following components from the reverse gear (206):

- the synchronizer sleeve (125)
- the reverse driven gear (112)

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- the reverse gear blocking ring (122)
- the reverse gear synchronizer insert (120) and the spring (195)

GEARS AND SHAFTS CLEANING AND INSPECTION

Tools Required

- **J 8001-3** Dial Indicator. See [Special Tools](#).
- **J 26900-12** Dial Indicator - 1-10 mm. See [Special Tools](#).
- **J 26900-13** Magnetic Indicator Base

Input Shaft

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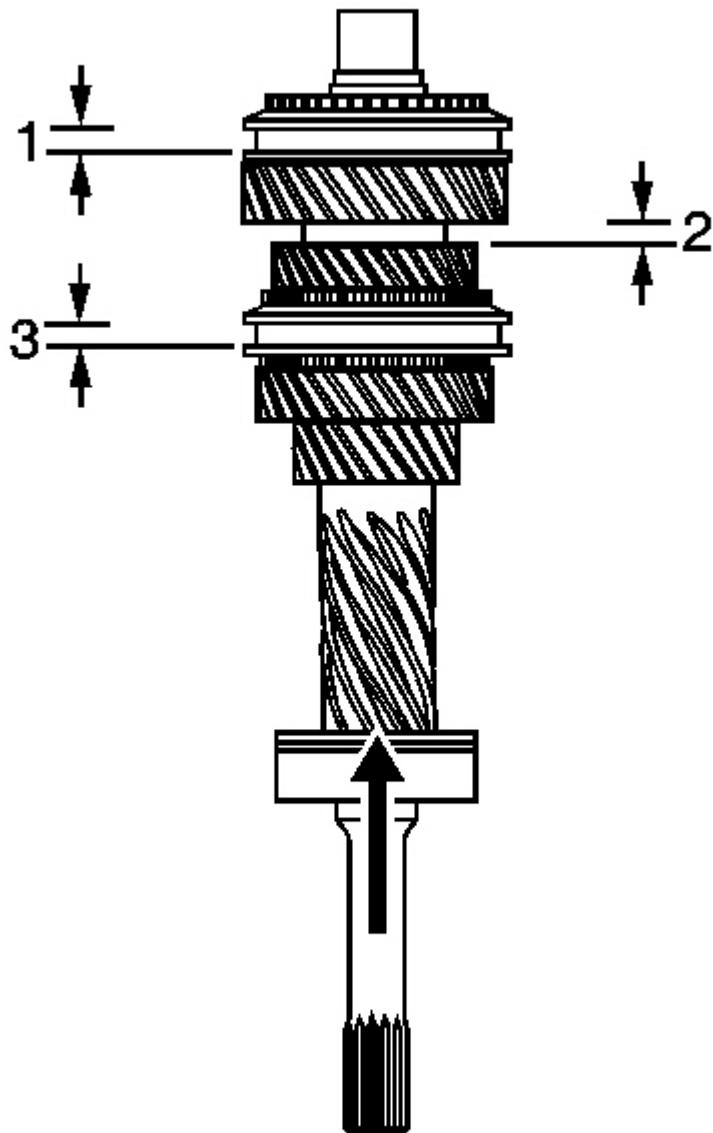


Fig. 94: Inspecting 3rd, 4th & 6th Gear Axle Clearance

Courtesy of GENERAL MOTORS CORP.

1. Inspect 3rd (2), 4th (3), and 6th gear (1) for axial clearance. Lift up on the gear from the settled position and measure travel. Refer to **Transmission Clearance Specifications**, Gear Axial Clearance table.

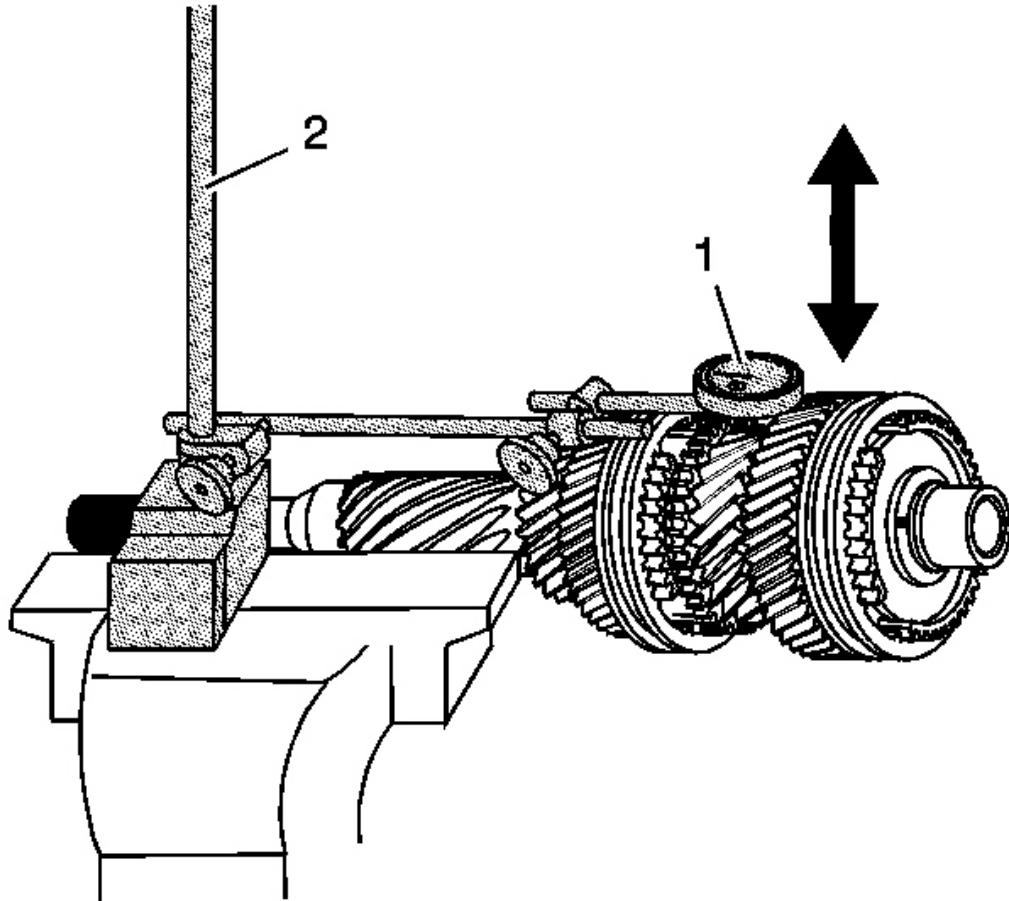


Fig. 95: Measuring Radial Clearance
Courtesy of GENERAL MOTORS CORP.

2. Measure the radial clearance for each of the speed gears.
 1. Place the speed gear, with the needle roller bearing, on the input shaft at the correct journal.
 2. Use **J 8001-3** or **J 26900-12** (1) and **J 26900-13** (2). See Special Tools.
 3. Position **J 8001-3** or **J 26900-12** on the gear. See Special Tools.
 4. Move the gear up and down.

Specification:

- Standard Clearance 1st gear: 0.02-0.073 mm (0.0008-0.0029 in)
- Standard Clearance 2nd and 3rd gear: 0.015-0.068 mm (0.0006-0.0027 in)
- Maximum Clearance 1st gear: 0.160 mm (0.0063 in)

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- Maximum Clearance 2nd and 3rd gear: 0.160 mm (0.0063 in)
3. If the clearance exceeds the maximum, replace either the gear, the needle roller bearing, or the input shaft.

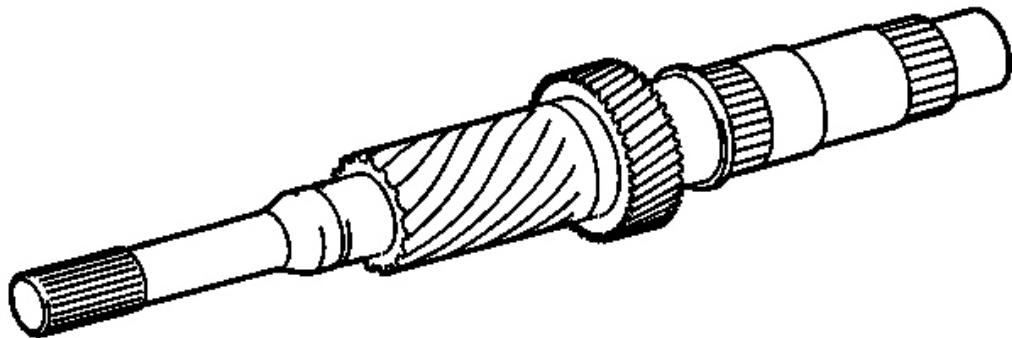


Fig. 96: View Of Input Shaft
Courtesy of GENERAL MOTORS CORP.

4. Clean the input shaft in a suitable solvent.
5. Clean and air dry the oil gallery.
6. Inspect the input shaft bearing surfaces for the following conditions:
 - Wear
 - Lack of lubricant
 - Debris embedded in the oil grooves
 - Brinelling
7. Inspect the input shaft splines for wear or damage.
8. Replace the input shaft if any of the above conditions are found.

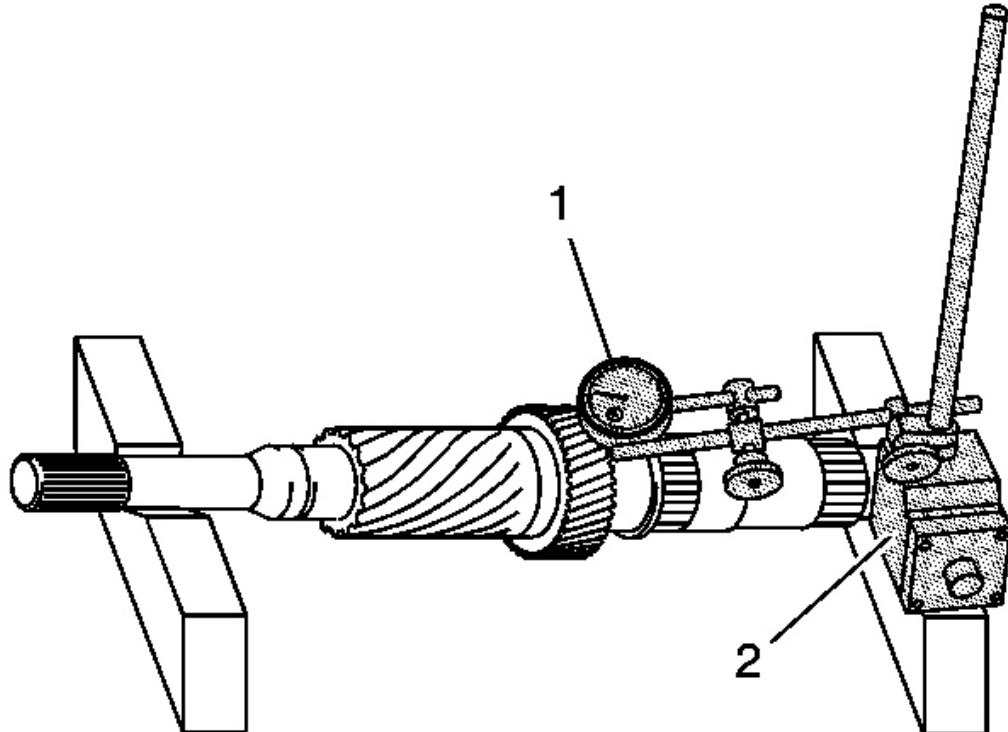


Fig. 97: Inspecting Input Shaft Runout

Courtesy of GENERAL MOTORS CORP.

9. Using **J 8001-3** or **J 26900-12** (1), **J 26900-13** (2) and V-blocks, inspect the input shaft for runout. See **Special Tools**.

Specification: Maximum runout: 0.06 mm (0.0024 in)

10. If the runout exceeds the maximum, replace the input shaft.

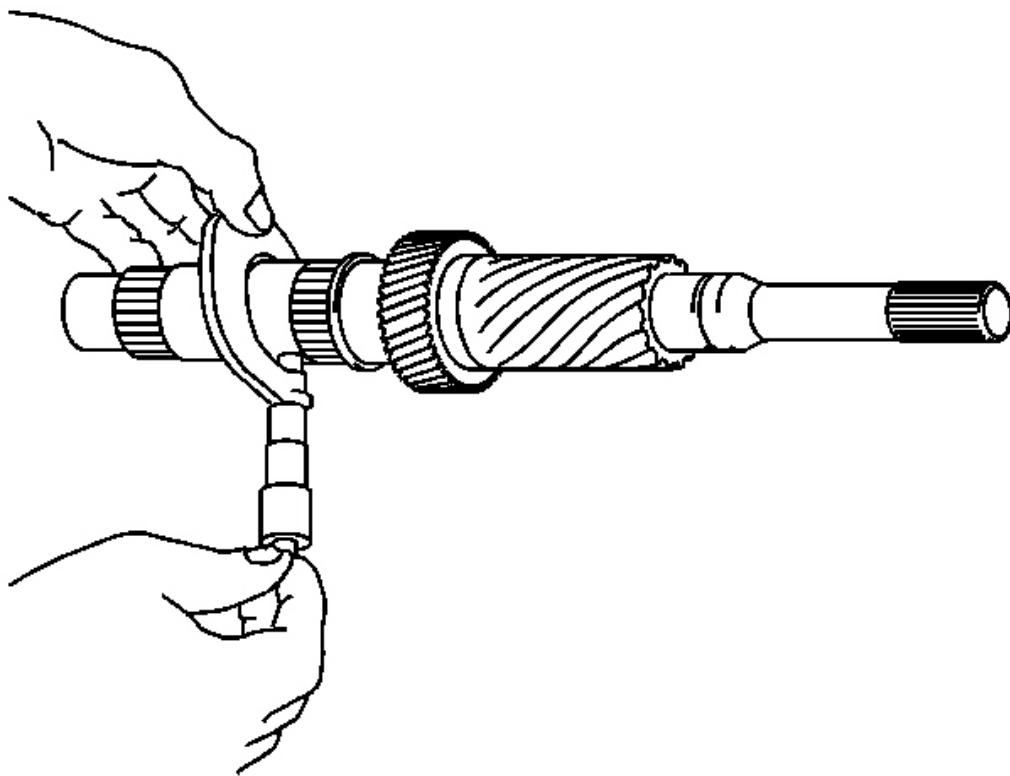


Fig. 98: Measuring Diameter Of Input Shaft Journals

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: To calculate the radial clearance, measure shaft diameter, needle roller bearing diameter and gear inner diameter.

11. Using a micrometer, measure the diameter of the input shaft journals.

Specification:

- Minimum diameter 1st gear (a): 38.860 mm (1.5299 in)
- Minimum diameter 2nd gear (b): 46.860 mm (1.8449 in)
- Minimum diameter 3rd gear (c): 37.869 mm (1.4905 in)

12. If the journal diameter is less than the minimum, replace the input shaft.

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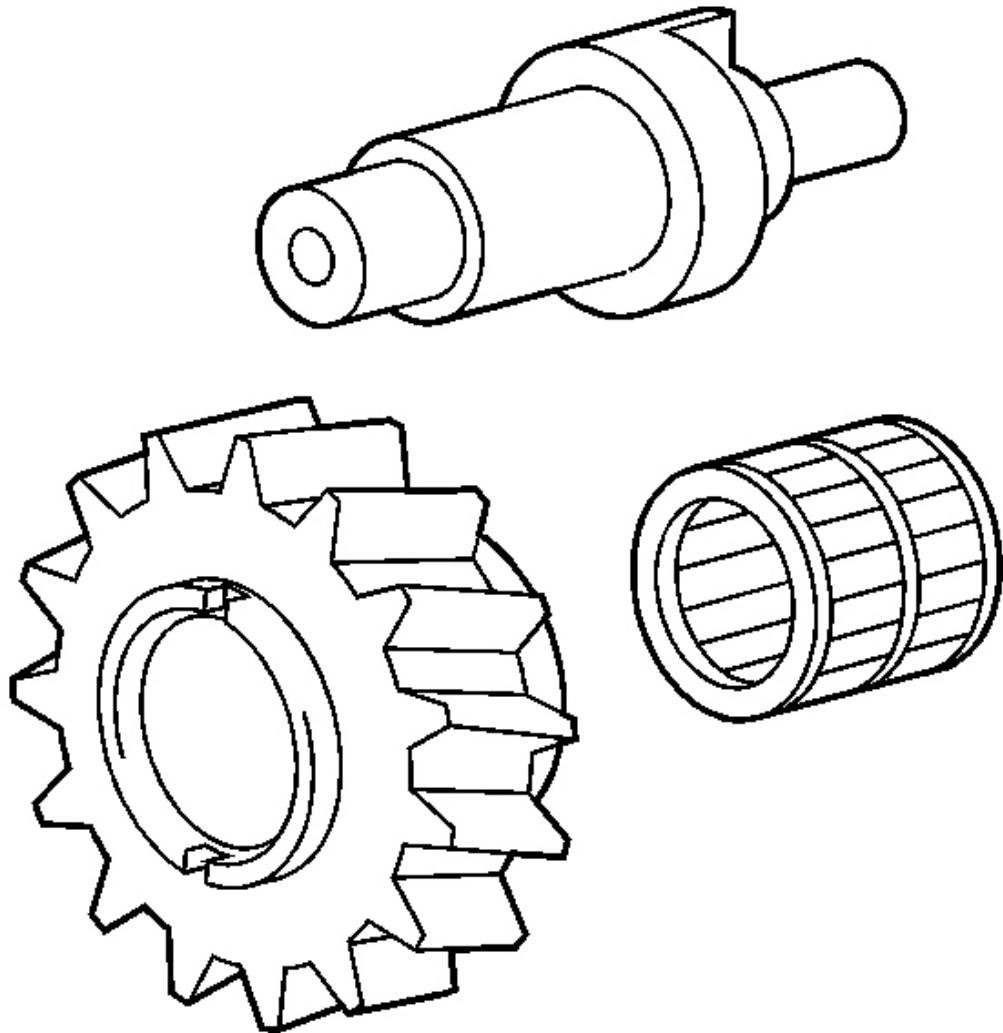


Fig. 99: View Of Reverse Idler Gear, Shaft & Bushing
Courtesy of GENERAL MOTORS CORP.

1. Clean the reverse idler gear and shaft in a suitable solvent and air dry all the parts.
2. Inspect the bushing in the reverse idler gear for the following conditions:
 - Excessive wear
 - Scoring
 - Pitting
3. Replace the reverse idler gear if the bushing is faulty.

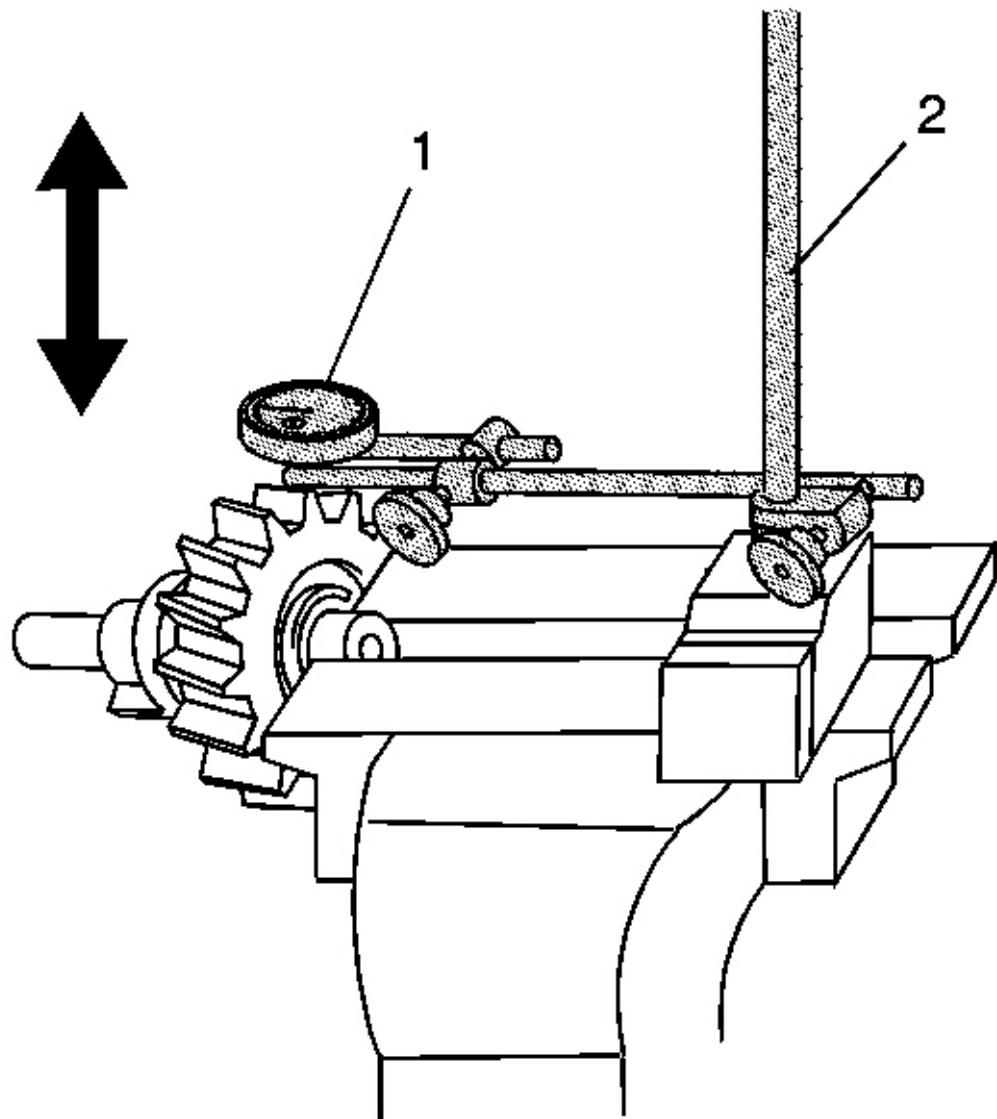
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4. Inspect the reverse idler gear shaft for the following conditions:

- Excessive wear
- Scoring
- Pitting

5. Replace the reverse idler gear shaft if it is faulty.



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Fig. 100: Measuring Reverse Idler Gear Radial Clearance

Courtesy of GENERAL MOTORS CORP.

6. Using **J 8001-3** or **J 26900-12** (1) and **J 26900-13** (2), measure the reverse idler gear radial clearance. See **Special Tools**.

Specification:

- Standard Clearance: 0.040-0.082 mm (0.0016-0.0032 in)
- Maximum Clearance: 0.130 mm (0.0051 in)

7. If the clearance exceeds the maximum, replace the reverse idler gear or the reverse idler gear shaft.

Countershaft

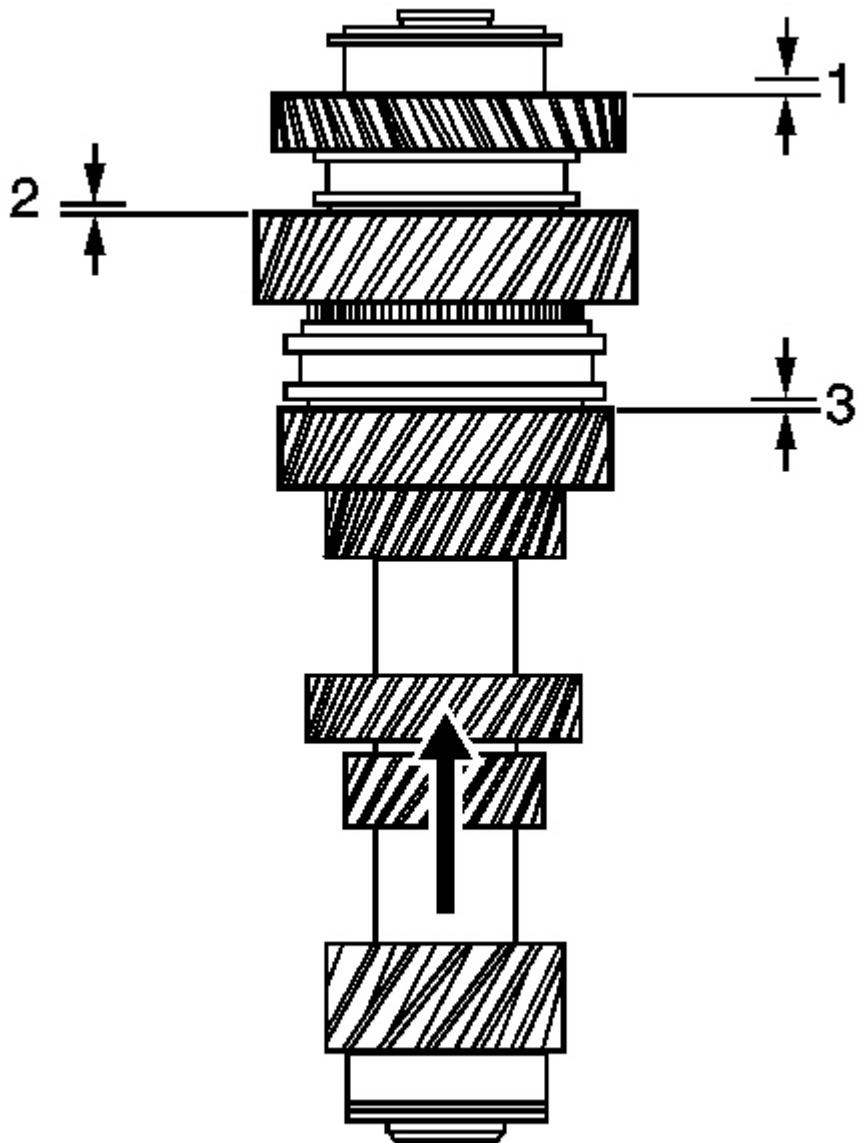


Fig. 101: Inspecting 1st, 2nd & Reverse Gear Axial Clearance

Courtesy of GENERAL MOTORS CORP.

1. Inspect 1st (2), 2nd (3), and reverse gear (1) for axial clearance. Lift up on the gear from the settled position and measure travel. Refer to **Transmission Clearance Specifications**, Gear Axial Clearance table.

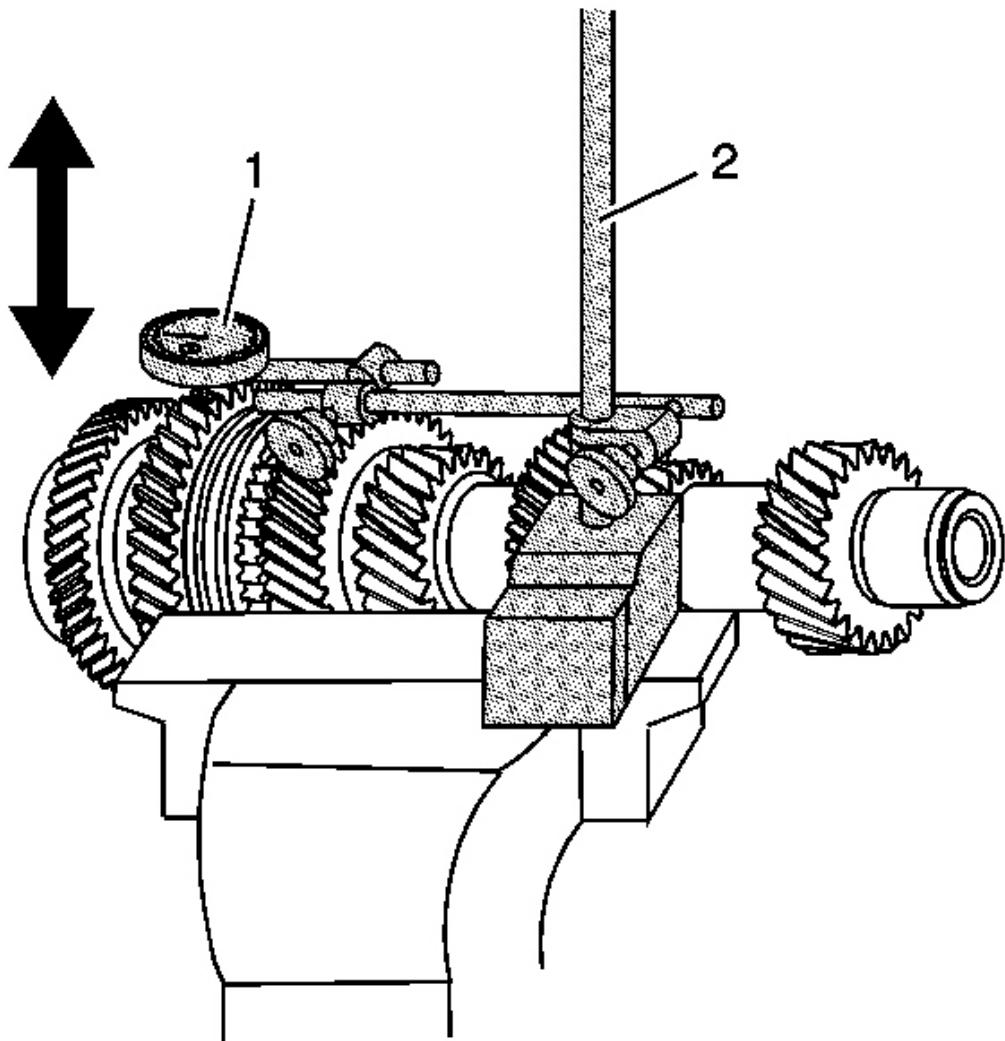


Fig. 102: Measuring Radial Clearance For 5th Countershaft Gear
Courtesy of GENERAL MOTORS CORP.

2. Measure the radial clearance for 5th countershaft gear.
 1. Place the 5th countershaft gear, with the needle roller bearing, on the countershaft journal.
 2. Use **J 8001-3** or **J 26900-12** (1) and **J 26900-13** (2). See **Special Tools**.
 3. Position **J 8001-3** or **J 26900-12** on the gear. See **Special Tools**.
 4. Move the gear up and down.

Specification:

- Standard Clearance: 0.015-0.068 mm (0.0006-0.0027 in)
- Maximum Clearance: 0.160 mm (0.0063 in)

3. If the clearance exceeds the maximum, replace the gear, the roller bearing, or the countershaft.

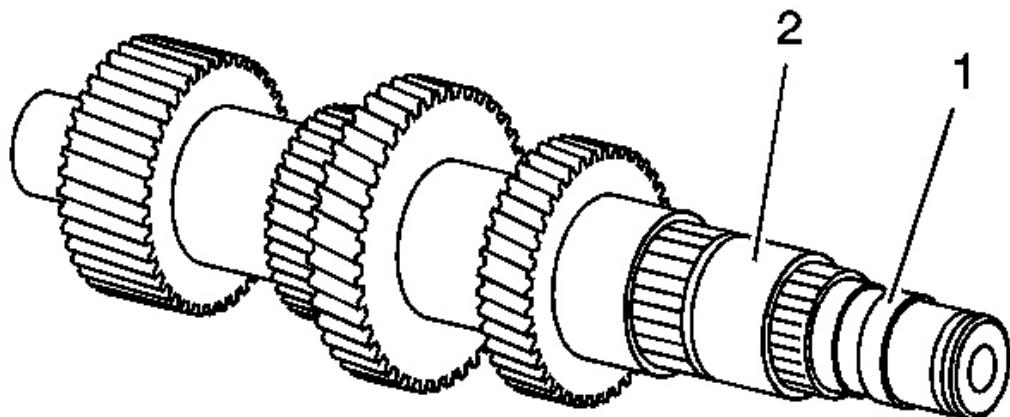


Fig. 103: Inspecting Rear Bearing Race On Countershaft

Courtesy of GENERAL MOTORS CORP.

4. Clean the countershaft in a suitable solvent and air dry all the parts.
5. Inspect the rear bearing race (1) on the countershaft for the following conditions:
 - Brinelling
 - Wear
 - Scoring
6. Inspect the 5th countershaft gear bearing race (2) for the following conditions:
 - Brinelling
 - Wear
 - Scoring

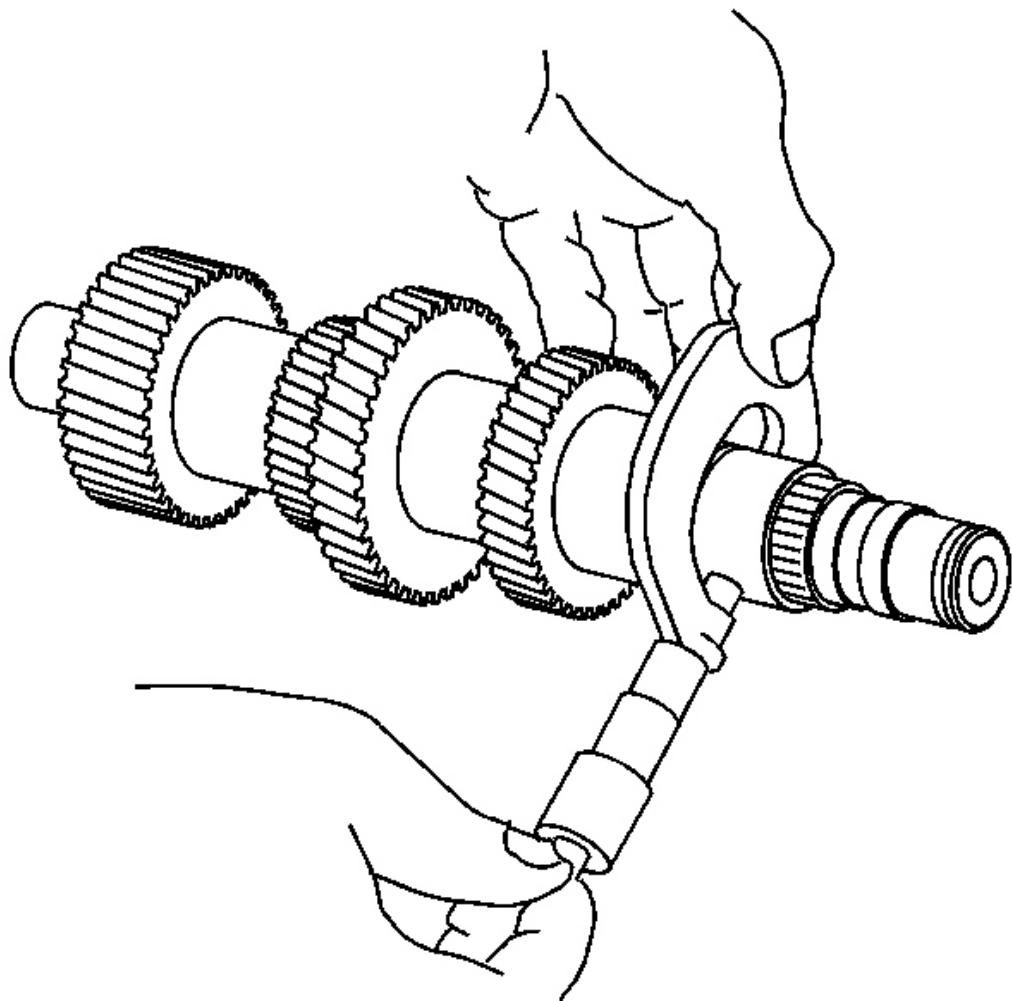


Fig. 104: Measuring Outer Diameter Of Countershaft Journal
Courtesy of GENERAL MOTORS CORP.

7. Using a micrometer, measure the outer diameter of the countershaft journal.

Specification: Minimum diameter: 29.860 mm (1.1756 in)

8. Inspect all of the countershaft gears for being faulty following the gear inspection steps.
9. Replace the countershaft if it is faulty.

Output Shaft

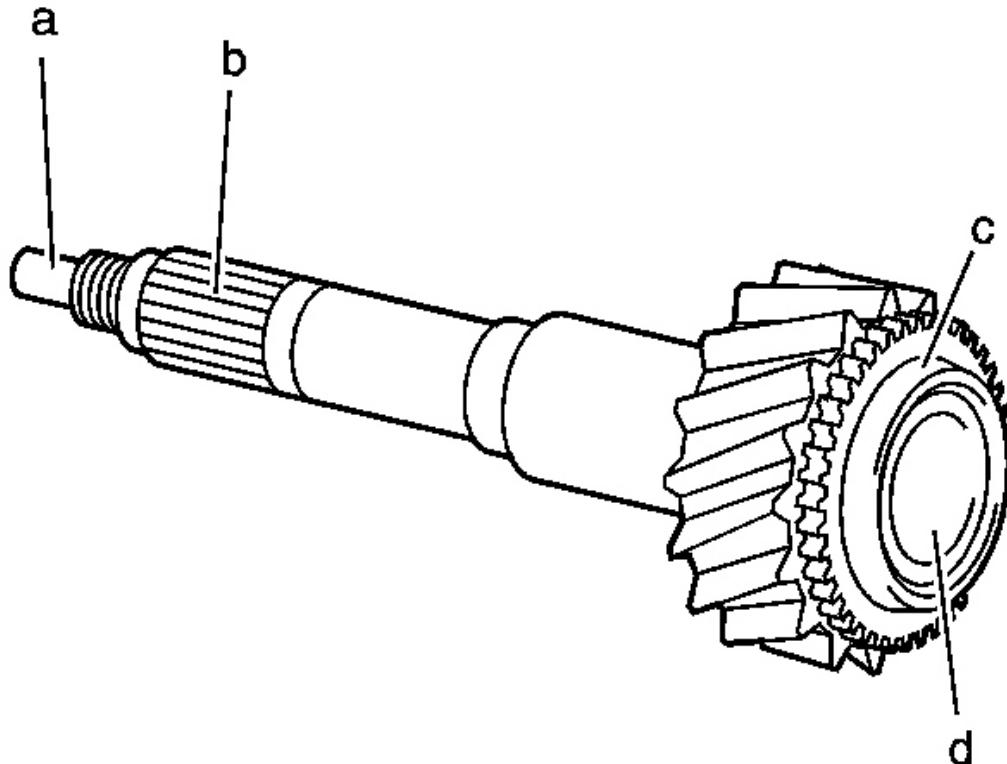


Fig. 105: Inspecting Output Shaft

Courtesy of GENERAL MOTORS CORP.

1. Clean the output shaft in a suitable solvent and air dry all the parts.
2. Inspect the pilot bearing journal (a) for wear or scoring.
3. Inspect the clutch disc splines (b) for wear. Steps in the splines may cause concerns with clutch operation.
4. Inspect the synchronizer blocking ring surface (c) for the following conditions:
 - Grooves
 - Excessive wear
 - Heat marks
 - Scoring
5. Inspect the input shaft front support bearing journal (d) for the following conditions:
 - Brinelling
 - Pitting
 - Excessive wear

6. Inspect the gear teeth and selector teeth for being faulty following the gear inspections steps.
7. Replace the output shaft if any of the above conditions are found.

Gears

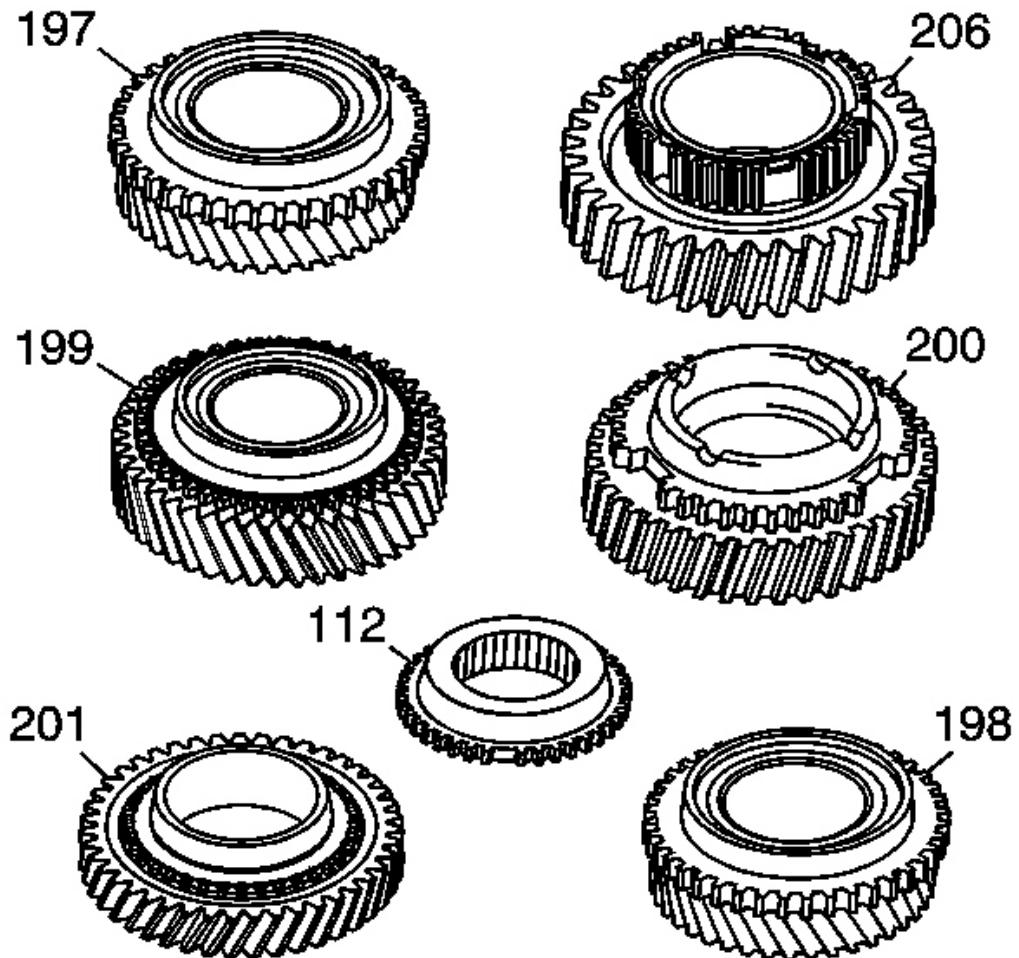


Fig. 106: Gears

Courtesy of GENERAL MOTORS CORP.

1. Clean the 1st gear (199), the 2nd gear (200), the 3rd gear (197), the 4th gear (198), reverse drive gear (112), the 6th gear (201), the reverse gear (206), and the countershaft gear in a suitable solvent and air dry all the parts.

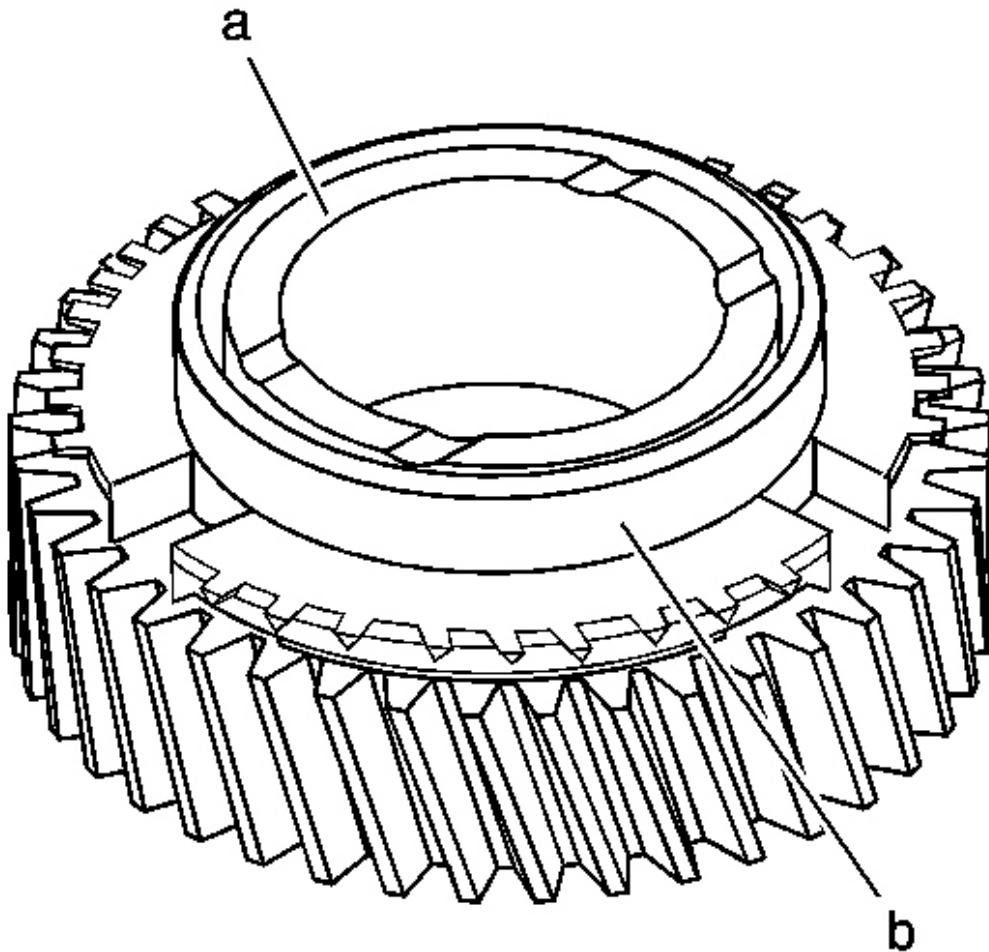


Fig. 107: Inspecting Thrust Surfaces Of Gears

Courtesy of GENERAL MOTORS CORP.

2. Inspect the thrust surfaces (a) on both sides of the gears for the following conditions:
 - Wear
 - Galling
 - Scoring
3. Replace any gears that have faulty thrust surfaces. Worn thrust surfaces may cause gear clashing or hard shifting, by not allowing full engagement of the synchronizer blocking rings. Worn thrust surfaces may also cause gear noise or may cause clunking during acceleration or deceleration.
4. Inspect the synchronizer blocking ring surface (b) for the following conditions:

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- Grooves
- Excessive wear
- Heat marks
- Scoring

5. Replace any gear that has a faulty blocking ring surface.

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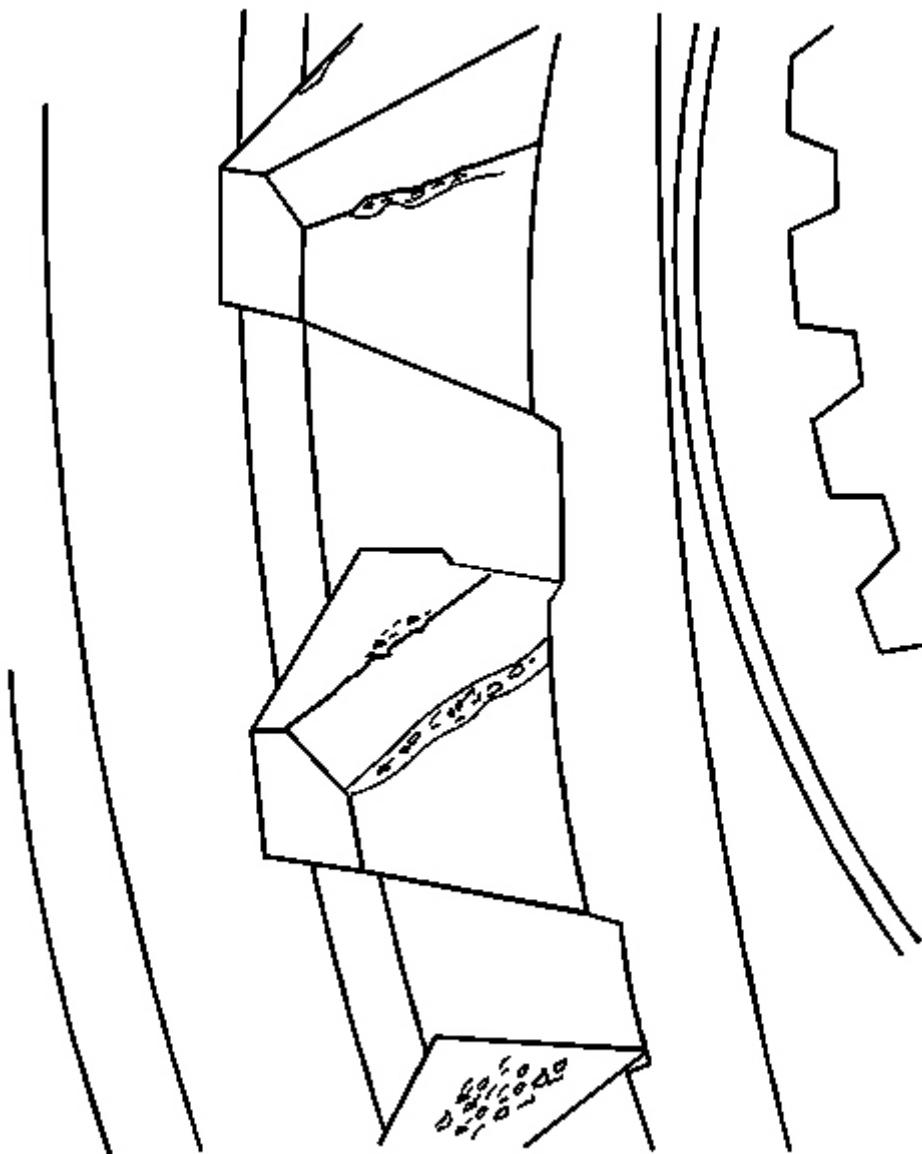


Fig. 108: View Of Gear Change Damage On Selector Teeth
Courtesy of GENERAL MOTORS CORP.

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

If there is gear change damage, the tooth edges are worn and chipped and, in some cases, affected by plastic deformation because of high shift loads that resemble ragged edges. Such severe deformation of

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the selector teeth edges causes hard gearshift changes. The spline flanks may also show signs of wear resembling fretting corrosion.

7. If gear change damage is present, replace or repair the affected parts. Gear change damage is caused by any of the following conditions:
 - Corresponding speeds of gears not adequately matched
 - Operating the transmission incorrectly
 - Incorrect clutch operation

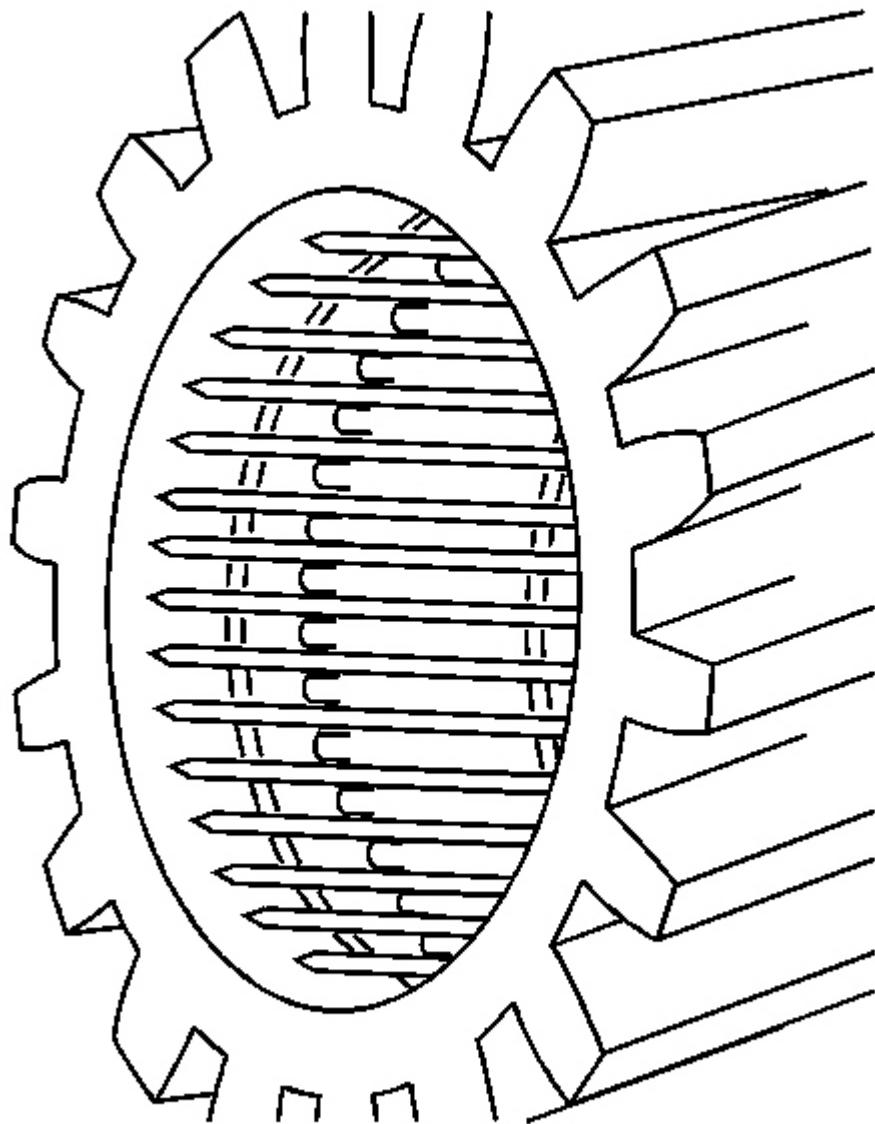


Fig. 109: Brinelling On Roller Races Of Gears

Courtesy of GENERAL MOTORS CORP.

8. Inspect the gears for brinelling.

Brinelling occurs on the roller races of the gears and is characterized by what appears to be the impression of the bearing rollers.

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9. Replace any gears showing brinelling.

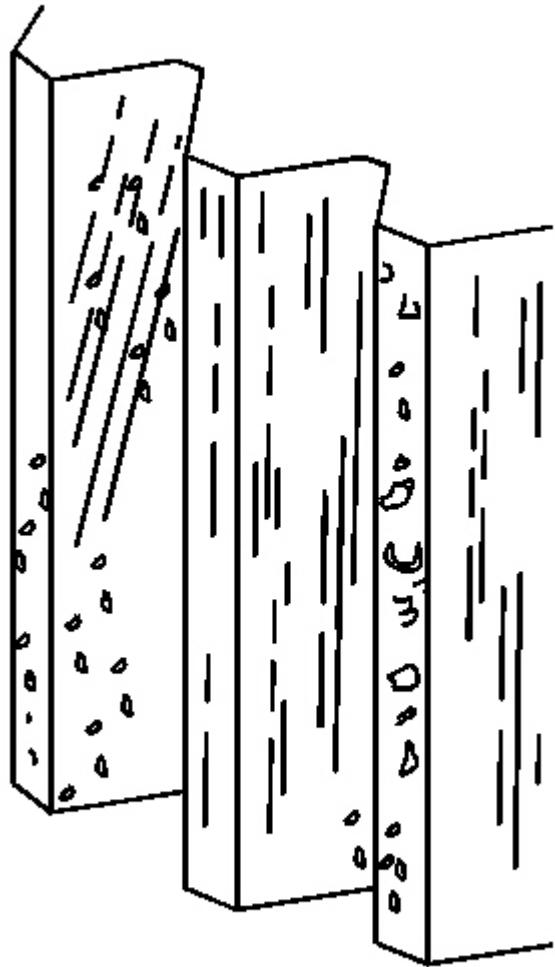


Fig. 110: View Of Break-in-Wear Or Running-In-Wear On Gears
Courtesy of GENERAL MOTORS CORP.

10. Inspect the gears for break-in-wear or running-in-wear.

Break-in-wear is not considered 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 grinding and shaving marks on the surface are still visible.

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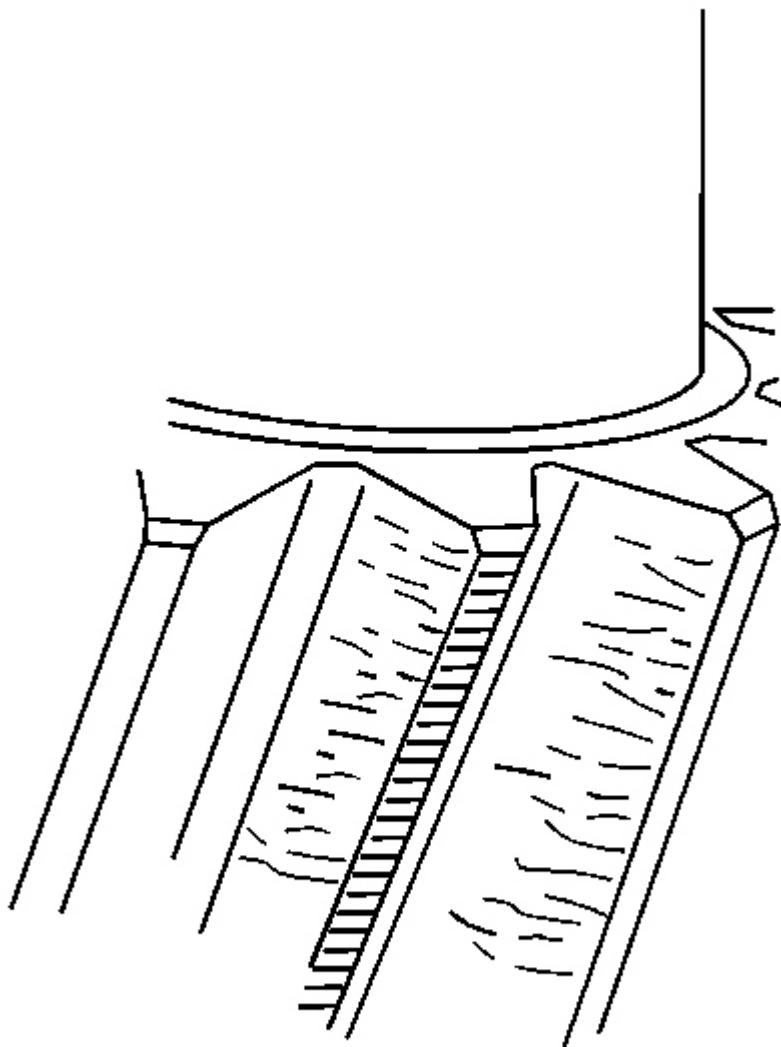


Fig. 111: View Of Scratched Gear Teeth
Courtesy of GENERAL MOTORS CORP.

11. Inspect the gear teeth for scratches.

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

12. If scratches are present, replace the affected parts.

Scratches can be caused by the following conditions:

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

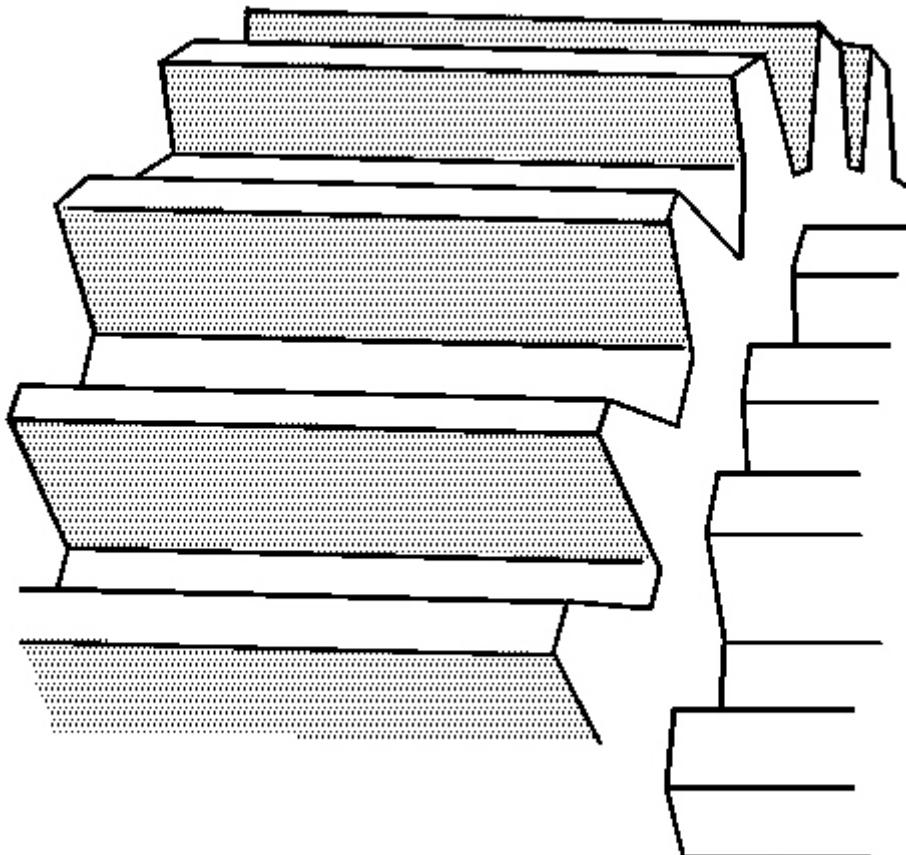


Fig. 112: Abrasive Wear On Gear Teeth
Courtesy of GENERAL MOTORS CORP.

13. 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 also cause secondary damage.

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14. If abrasive wear is present, replace the affected parts.

Abrasive wear is caused by the following conditions:

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

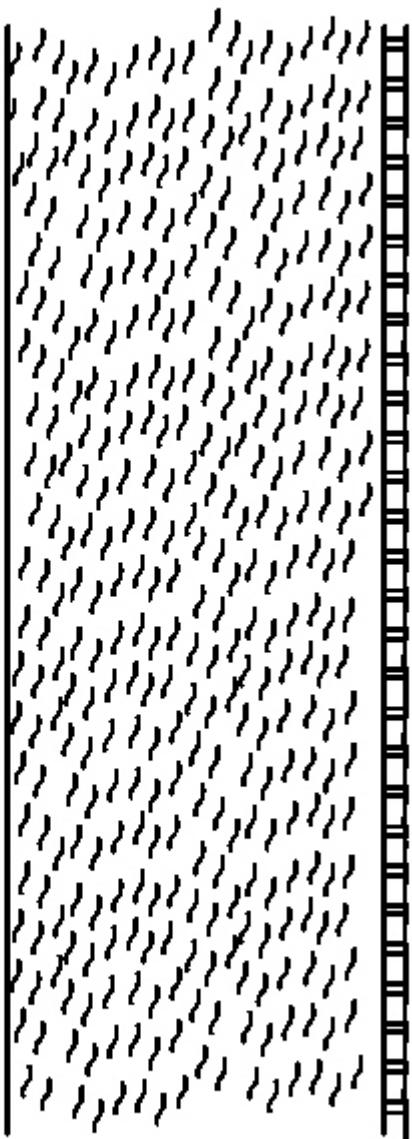


Fig. 113: View Of Rippling Or Brinelling On Gear Teeth
Courtesy of GENERAL MOTORS CORP.

15. 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, and may resemble a washboard.

16. If rippling or brinelling is present, replace the affected parts.

Rippling or brinelling is caused by the following conditions:

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

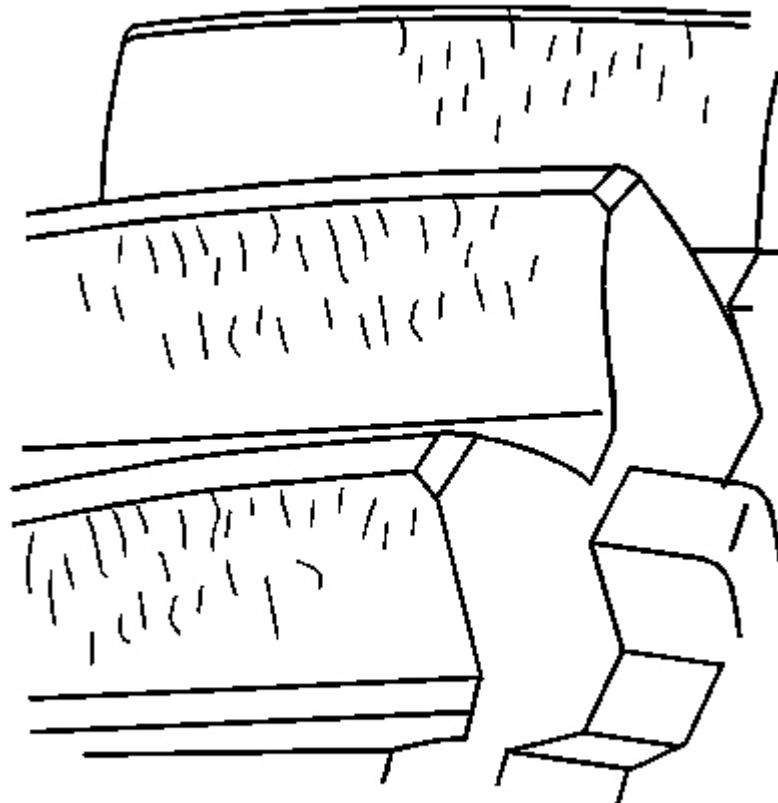


Fig. 114: Light Scoring On Gear Teeth

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Courtesy of GENERAL MOTORS CORP.

17. Inspect the gear teeth for light scoring.

Light scoring is identified as 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 a part of the entire surface of the flank, or is not strongly developed and has caused only insignificant wear after smoothing.

18. If light scoring is present, replace the affected parts.

Light scoring is caused by the following conditions:

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

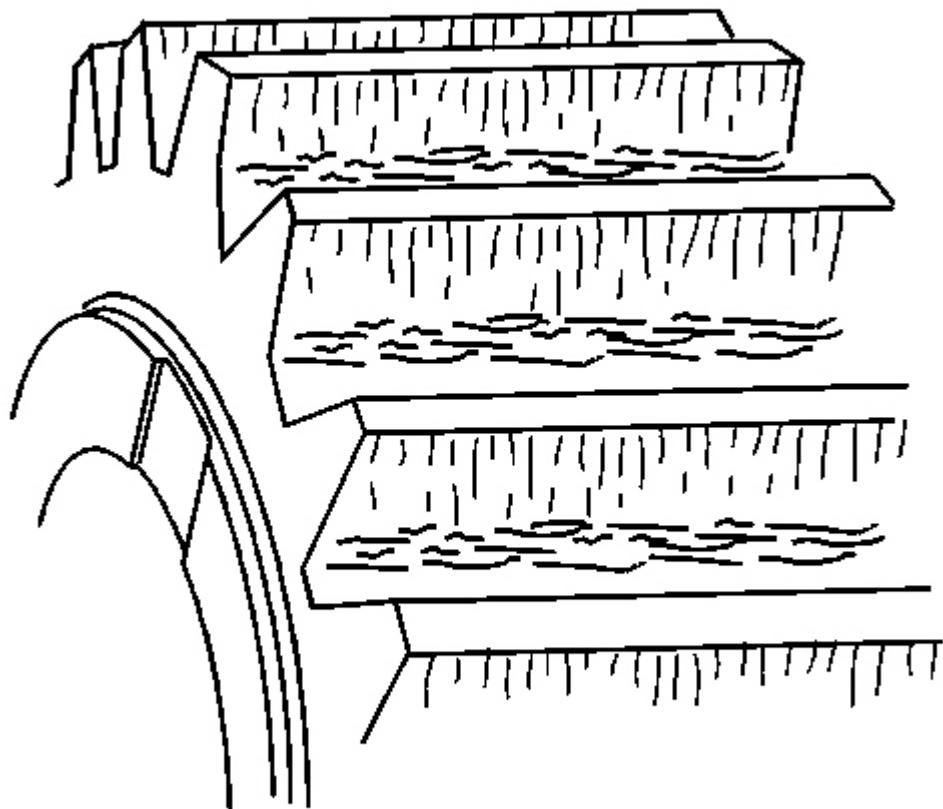


Fig. 115: Severe Scoring On Gear Teeth
Courtesy of GENERAL MOTORS CORP.

19. 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.

20. If severe scoring is present, replace the affected parts.

Severe scoring is caused by the following conditions:

- Inadequate oil viscosity
- Unfavorable gear geometry
- Temporary lack of lubricant

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- Surface roughness
- Faulty heat treatment of the gears

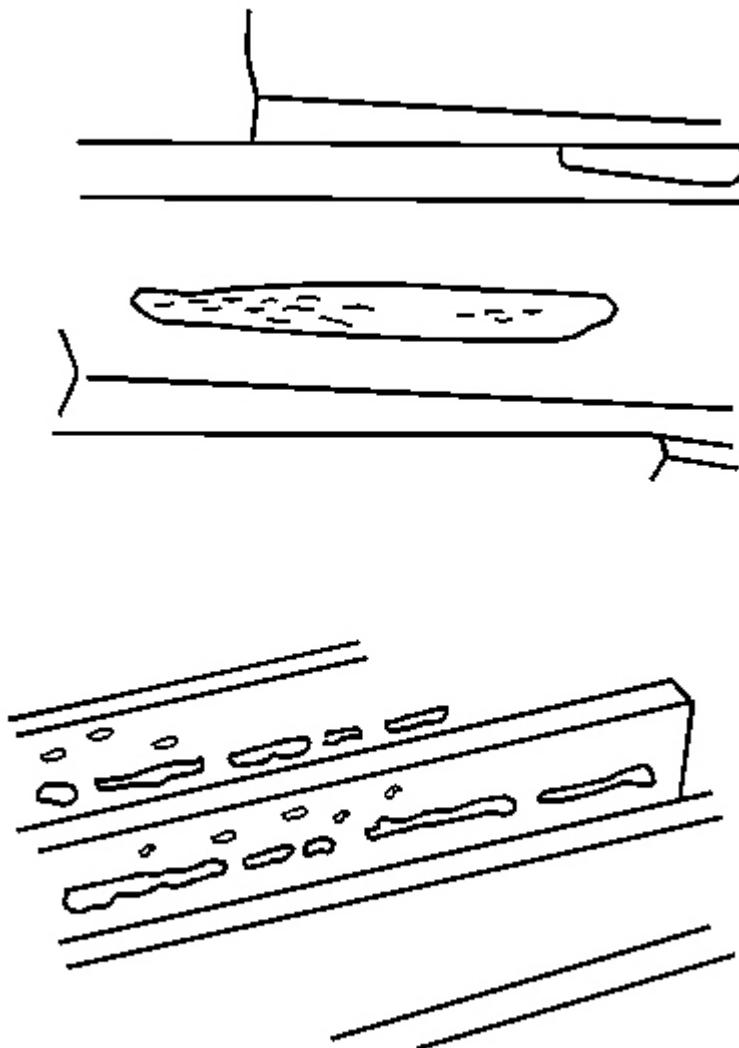


Fig. 116: View Of Flank Fatigue On Gears
Courtesy of GENERAL MOTORS CORP.

21. Inspect the gears for flank fatigue, causing gray spots.

Gray spots are localized pittings on the flank caused by material fatigue and extremely fine pittings

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formed on the load-bearing flanks. If they are in 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.

22. If gray spots are present, replace the affected parts.

Gray spots are caused by the following conditions:

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

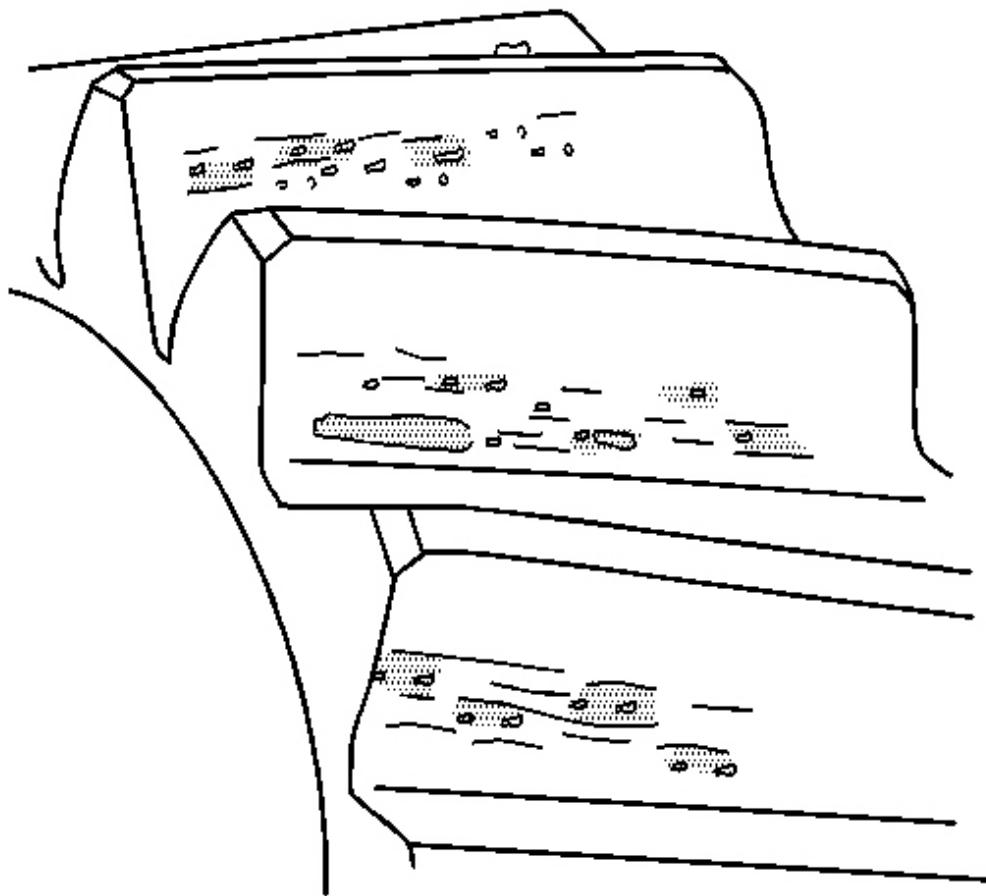


Fig. 117: Slight Pitting On Gear Teeth
Courtesy of GENERAL MOTORS CORP.

23. Inspect the gear teeth for slight pittings.

Slight pittings are identified as 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 run-in. A change in operating conditions may also stop continued development of slight pitting.

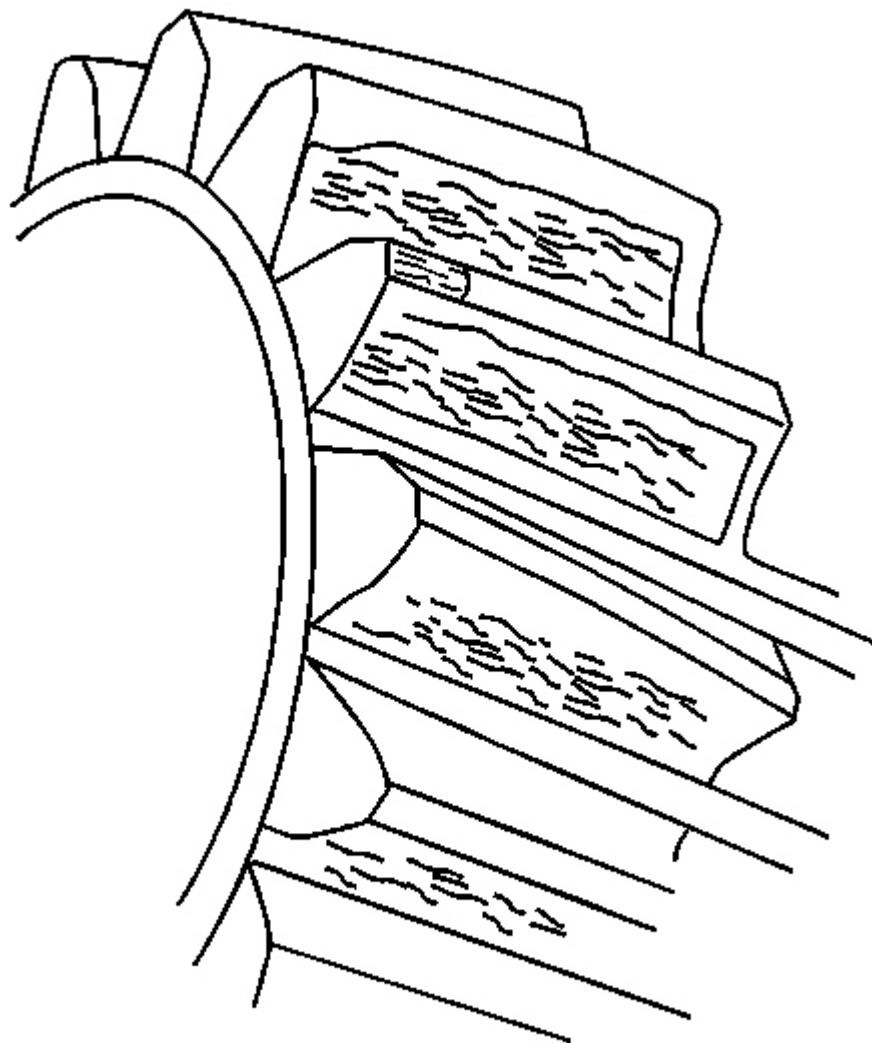


Fig. 118: Pitted Gear Teeth

Courtesy of GENERAL MOTORS CORP.

24. 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.

25. If pittings are present, replace the affected parts.

Pitting is caused by the following conditions:

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

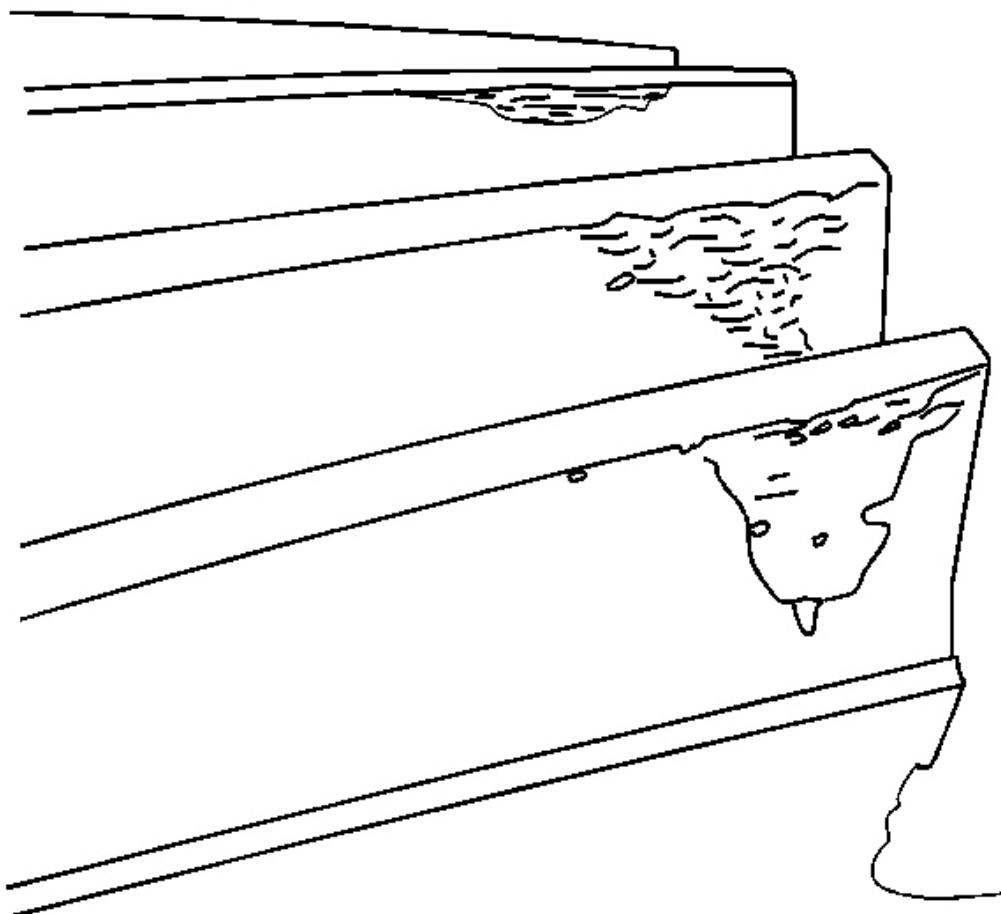


Fig. 119: Identifying Spalling On Gears
Courtesy of GENERAL MOTORS CORP.

26. 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

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damage.

27. If spalling is present, replace the affected parts.

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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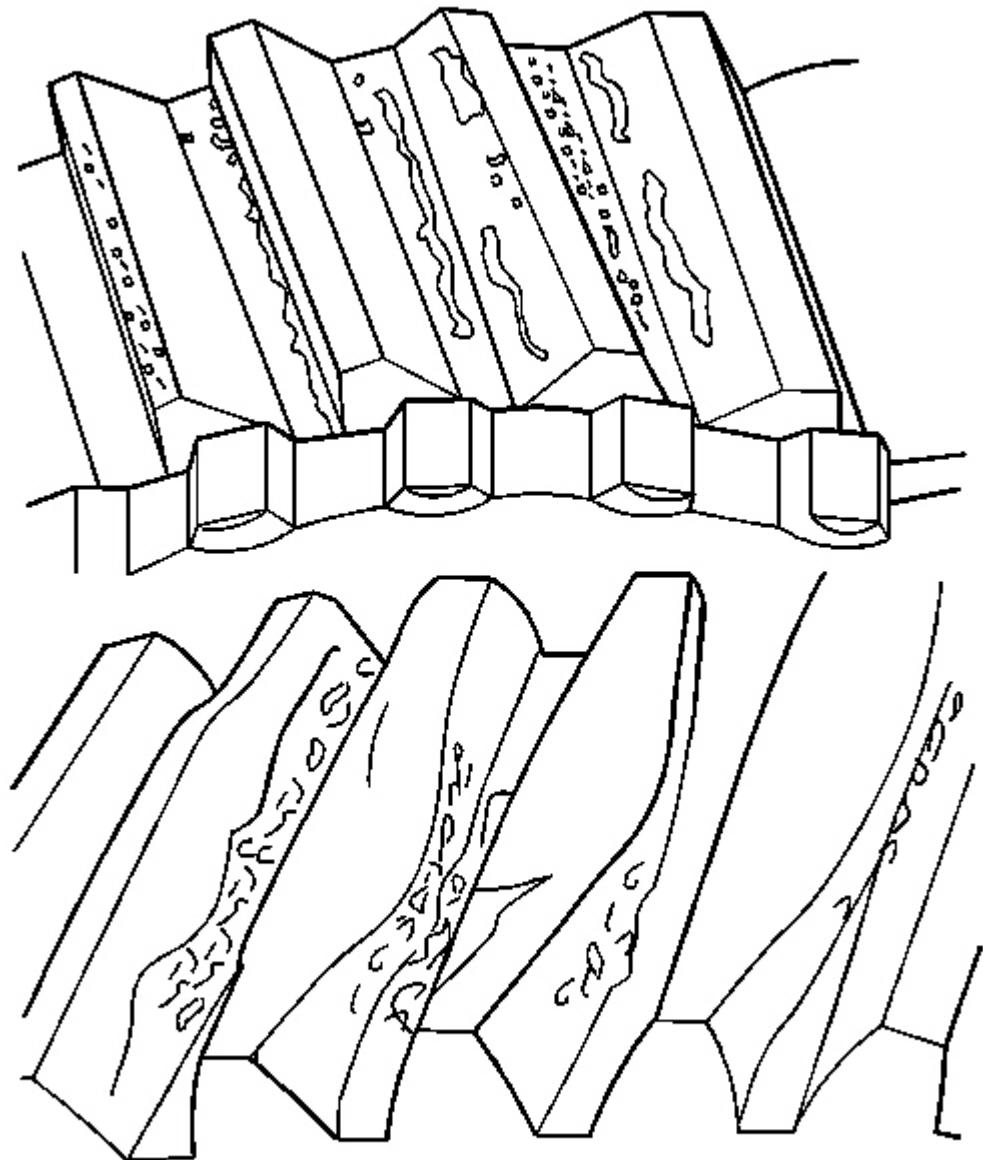


Fig. 120: View Of Overheated Gears
Courtesy of GENERAL MOTORS CORP.

28. Inspect the gears for damage from overheating.

Overheating damage is identified by grayish to bluish black discoloration of the gear, burnt oil, and

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reduced hardness. 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, bending the teeth from thermal distortion.

29. If damage from overheating is present, replace or repair the affected parts.

Overheating is caused by the following conditions:

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

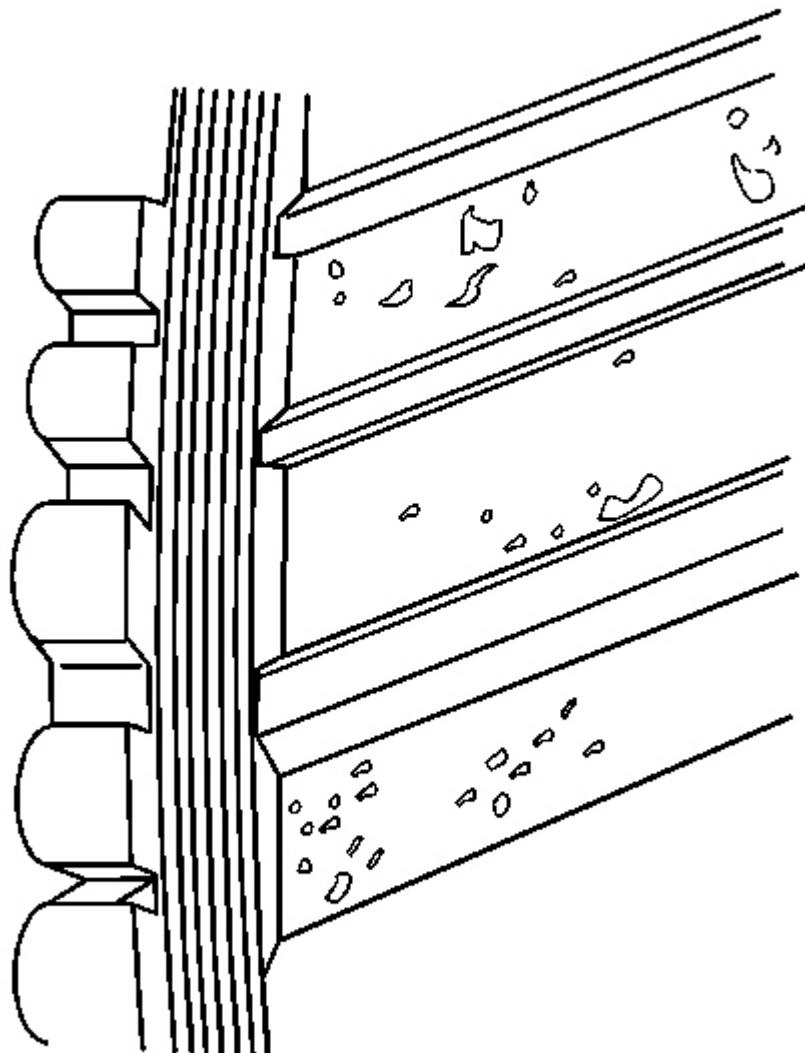


Fig. 121: Identifying Gear Corrosion
Courtesy of GENERAL MOTORS CORP.

30. Inspect the gears for corrosion.

Corrosion is 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.

31. If corrosion is severe, replace the affected parts.

Corrosion is caused by the following conditions:

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

BEARINGS AND SPACERS CLEANING AND INSPECTION

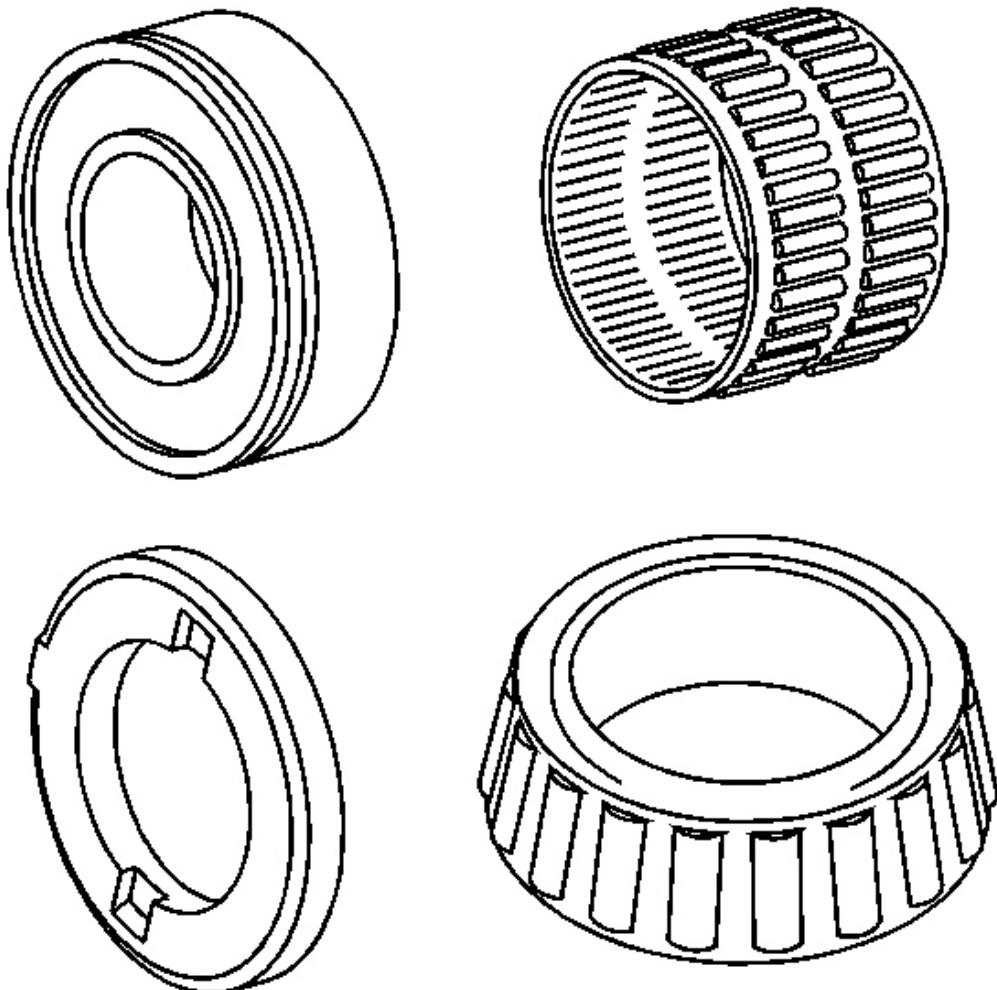


Fig. 122: Inspecting Bearings & Spacers

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Courtesy of GENERAL MOTORS CORP.

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

1. Mark or tag the bearings in order to ensure they are properly installed in the correct location.
2. Clean all of the roller bearings, needle bearings, and ball bearings in a suitable solvent and air dry all the parts.
3. Inspect the bearings and races for the following conditions:
 - Roughness
 - Brinelling
 - Pitting
4. Inspect the cage bearings for being bent or for having damaged cages.
5. Replace the bearings with any of the above conditions.
6. Replace mated bearing parts when only one part is damaged.
7. Inspect the thrust washers for scoring or wear.
8. Replace any faulty thrust washers.
9. Do not file surfaces which have been hardened and precision ground.

SYNCHRONIZERS CLEANING AND INSPECTION

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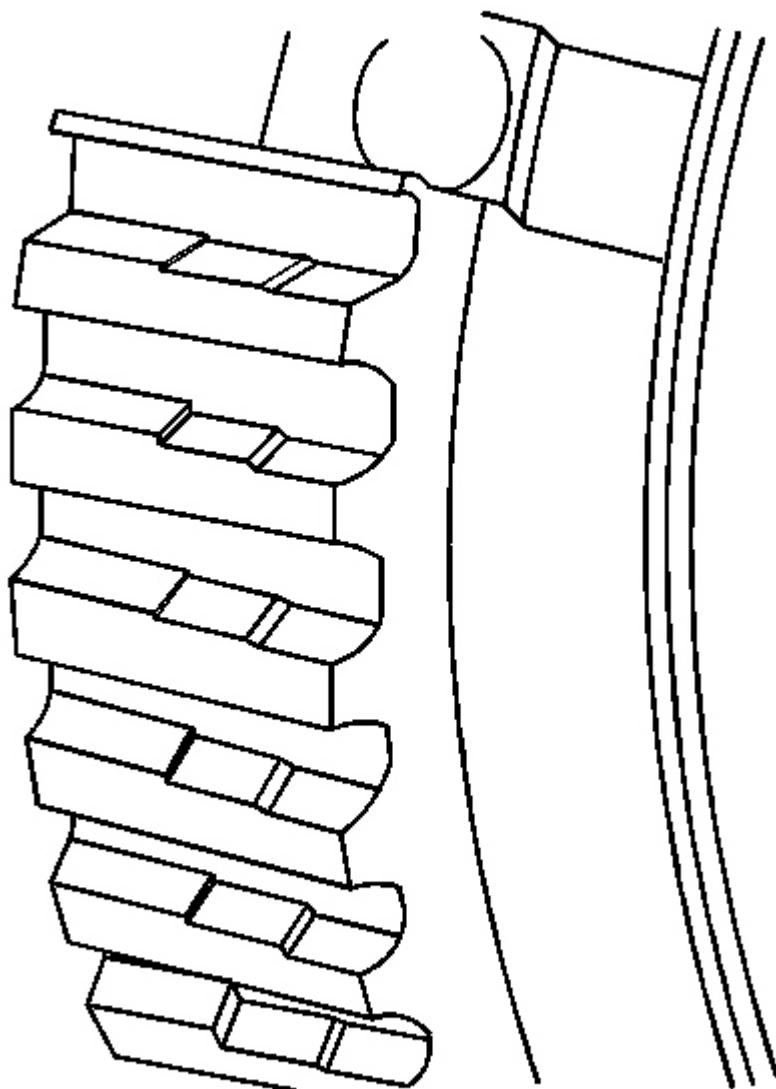


Fig. 123: View Of Stepped Effect On Synchronizer Teeth
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: When you service the synchronizers, retain them in the order that they are removed. Mark the parts to ensure the correct position for inspection and assembly.

1. Clean all the synchronizer parts in a suitable cleaning solvent and air dry all the parts.

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2. Inspect the 1st/2nd gear and the 3rd/4th gear synchronizer hubs for a force fit on the output shaft.
3. Replace synchronizer hubs that do not require a force fit.
4. Inspect the synchronizer hub for wear on the external splines. A stepped effect on the teeth, due to wear, may cause shift concerns.
5. Replace a worn hub.
6. Correct the cause, such as, but not limited to the following conditions:
 - Engine related vibrations
 - Driving at a low speed in a high gear
 - Defective vibration damper or crankshaft

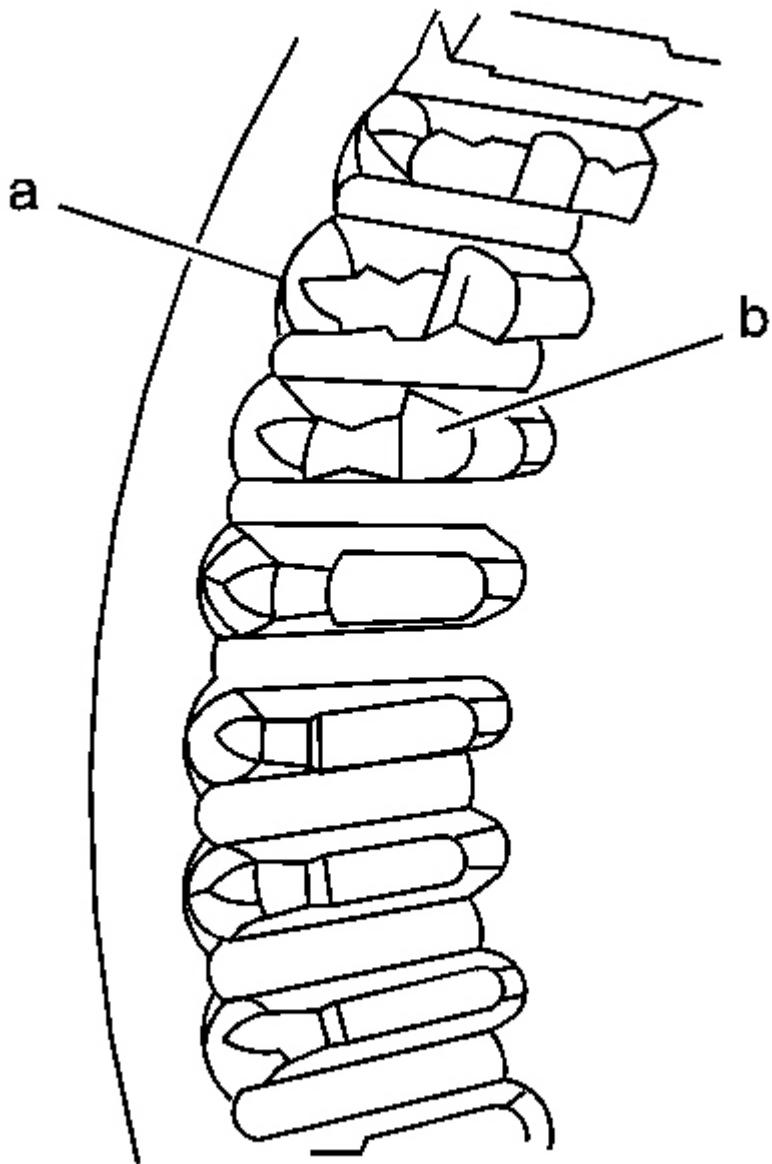


Fig. 124: Identifying Damage On Synchronizer Sleeve Teeth
Courtesy of GENERAL MOTORS CORP.

7. Inspect the synchronizer sleeve teeth (a) for the following conditions, which may cause shift concerns:

- Grated teeth
- Chipped off teeth

- Blunted teeth
8. Inspect the synchronizer sleeve detent stops (b) for wear or for being chipped off.
 9. Replace the synchronizer assembly if the teeth or stops show the above conditions.

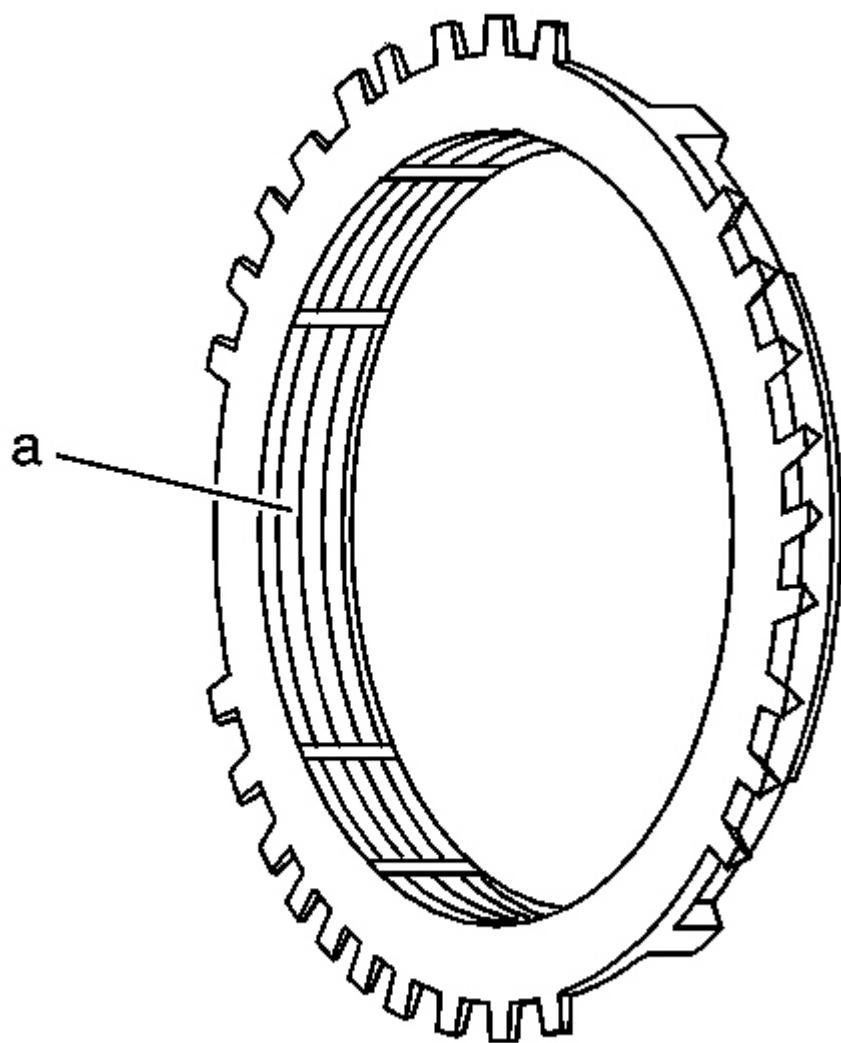


Fig. 125: View Of Synchronizer Blocker Ring Grooves
Courtesy of GENERAL MOTORS CORP.

10. Inspect the synchronizer blocker rings for worn away grooves (a).
11. Replace the blocker ring assembly if the blocker ring grooves are worn.

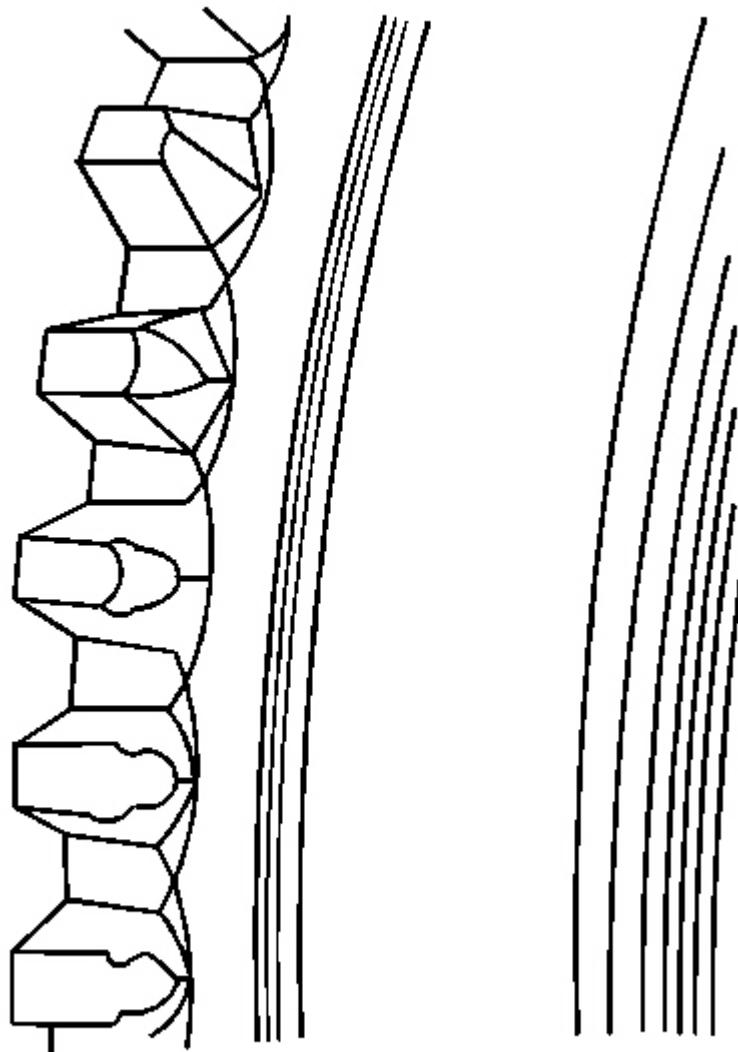


Fig. 126: Inspecting Synchronizer Blocker Rings For Wear Or Damage
Courtesy of GENERAL MOTORS CORP.

12. Inspect the synchronizer blocker rings for worn shift teeth.
13. Inspect the internal ring for being warped or damaged.
14. Inspect the outer ring for worn grooves.
15. Replace the synchronizer assembly for any of the above conditions.

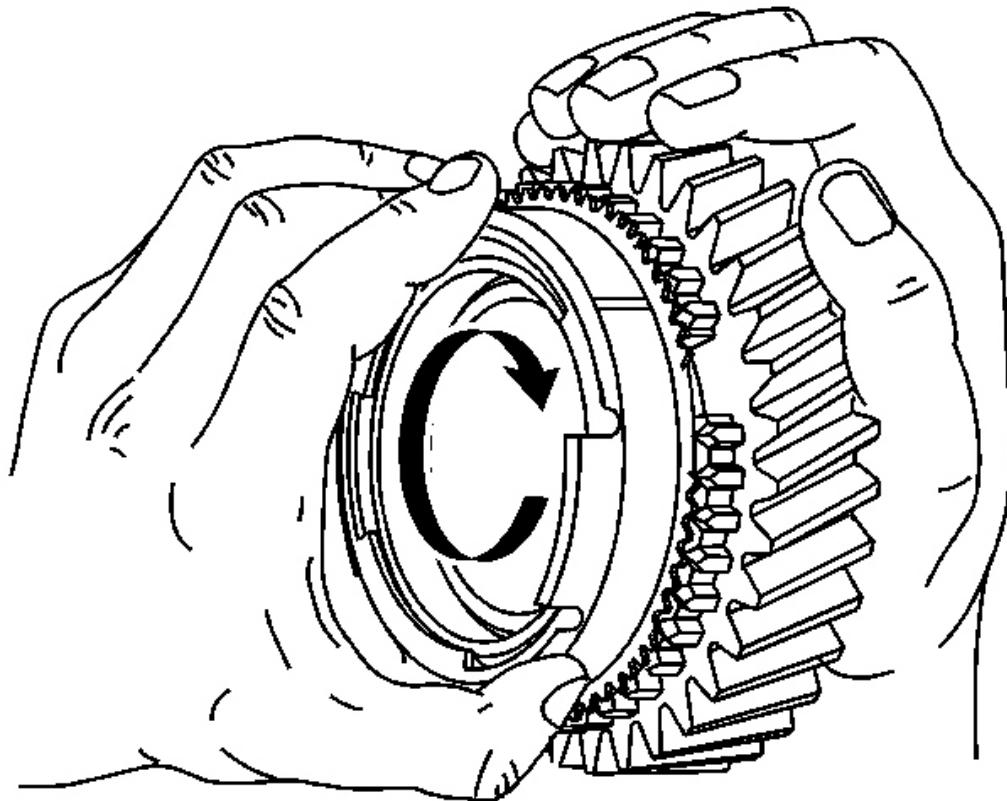


Fig. 127: Ensuring Blocking Ring Locks
Courtesy of GENERAL MOTORS CORP.

16. Install the synchronizer blocking rings to the correct speed gear.
17. Inspect the braking effect of the blocking ring. Turn the blocking ring in one direction while pushing to the gear cone. Ensure the ring locks.
18. If the ring does not lock, replace the synchronizer assembly.

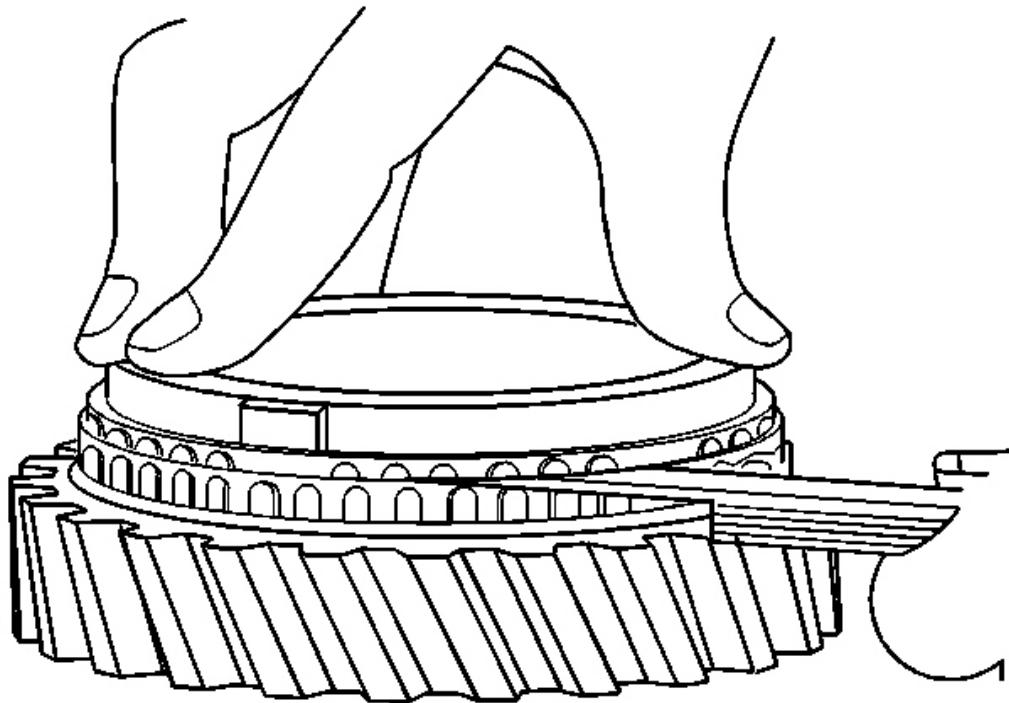


Fig. 128: Measuring Blocker Ring To Gear Clearance
Courtesy of GENERAL MOTORS CORP.

19. Except for 5th gear, measure the blocker ring to gear clearance.
 1. Assemble the correct blocker ring to the correct gear.
 2. Apply pressure to the blocker ring to fully seat the ring.
 3. Using a feeler gauge, measure between the blocker ring teeth and the teeth on the gear.

Specification:

- Minimum Clearance 4th Gear: 0.8 mm (0.031 in)
- Minimum Clearance 3rd Gear: 0.8 mm (0.031 in)
- Minimum Clearance 2nd Gear: 0.8 mm (0.031 in)
- Minimum Clearance 1st Gear: 0.8 mm (0.031 in)

20. If using a NEW blocker ring and the standard clearance can not be obtained, replace the gear.

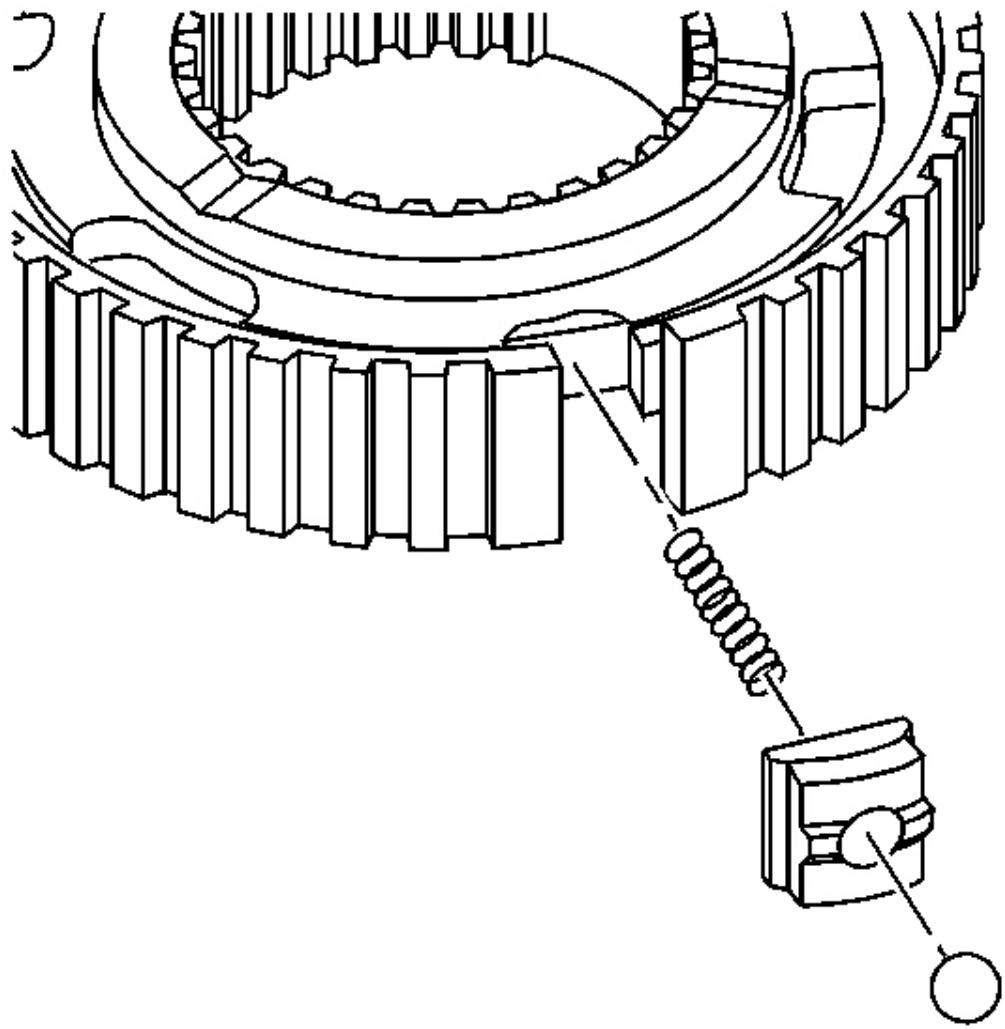


Fig. 129: View Of Pressure Pieces & Springs
Courtesy of GENERAL MOTORS CORP.

21. Inspect the pressure pieces for wear or damage.
22. Inspect the springs for distortion.
23. Replace the worn pressure pieces or faulty springs.

SHIFT SHAFT AND SHIFT FORK CLEANING AND INSPECTION

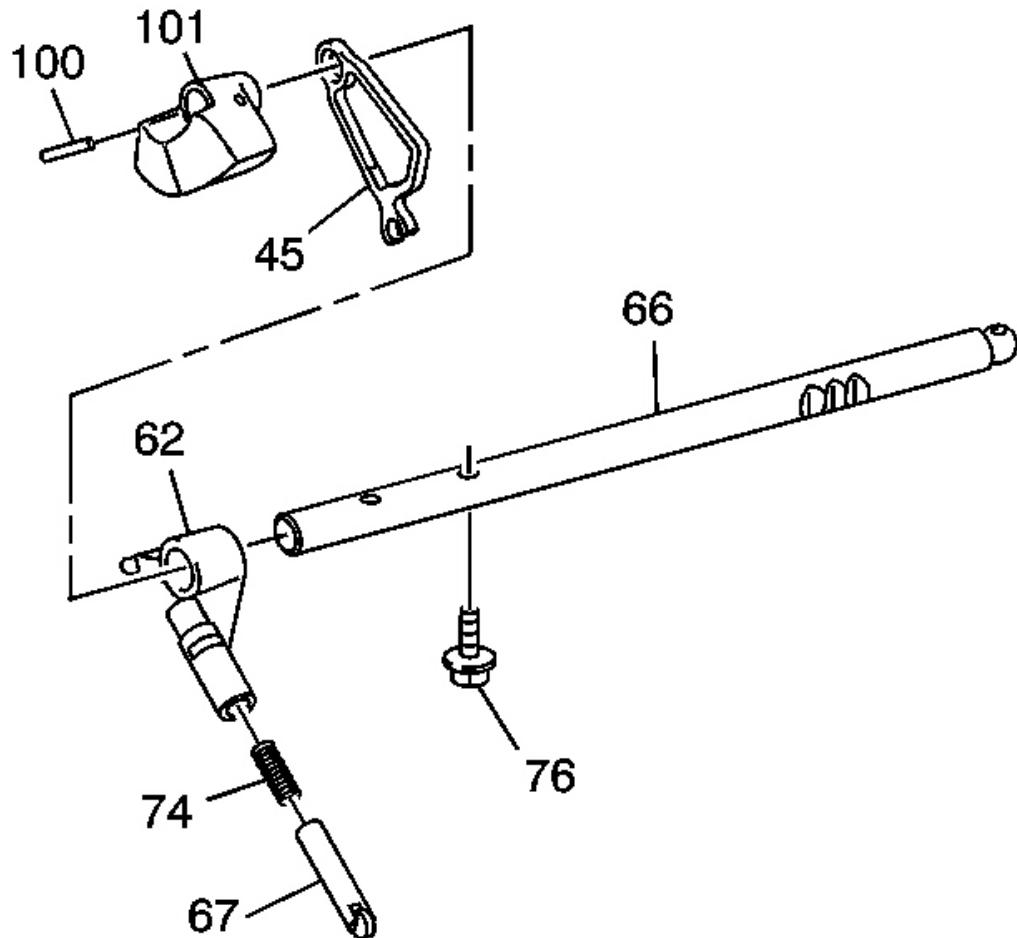


Fig. 130: View Of Shift Control Shaft, Shift Shaft Detent & Components

Courtesy of GENERAL MOTORS CORP.

NOTE: There are many small springs and detent balls within the shift shaft and shift fork assemblies. Use care when performing disassembly of these components.

1. Using a suitable punch and hammer, remove the pin (100) from the dynamic damper weight (101).
2. Remove the shift shaft detent cam (45) and the weight (101) from the shift control shaft (66).
3. Remove the shift shaft detent (67) and the shift shaft detent spring (74).
4. Remove the bolt (76) from the shift shaft detent lever (62).
5. Remove the shift shaft detent lever (62) from the shift control shaft (66).

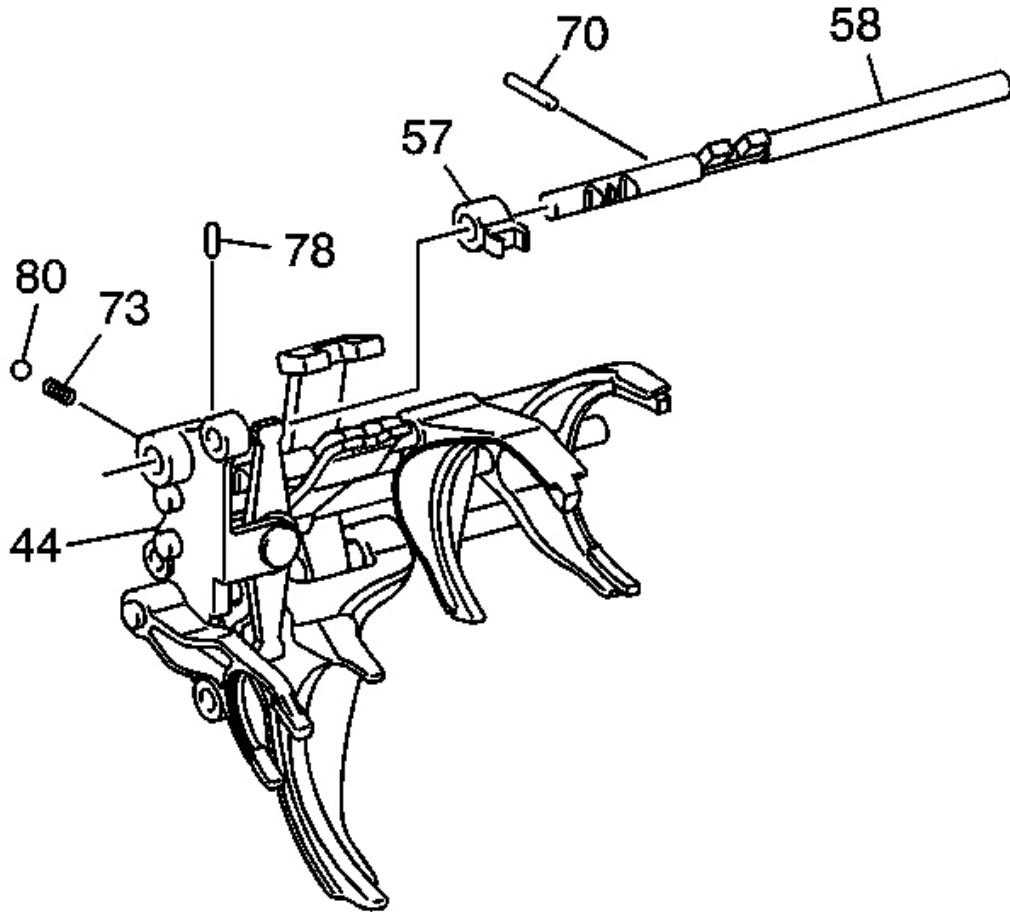


Fig. 131: View Of 1st/2nd Shift Shaft & Components
Courtesy of GENERAL MOTORS CORP.

NOTE: The shift detent ball (80) and spring (73) will come out of the shift control lever when the 1st/2nd shift shaft (58) is removed.

6. Remove the 1st/2nd shift fork pin (70).
7. Remove the 1st/2nd shift shaft (58).
8. Remove the slotted pin (70) from the select control lever assembly (57). Slide the select control lever assembly (57) from the 1st/2nd shift shaft (58).
9. Using a suitable punch and hammer, remove the pin (78) from the shift control lever bracket (44).

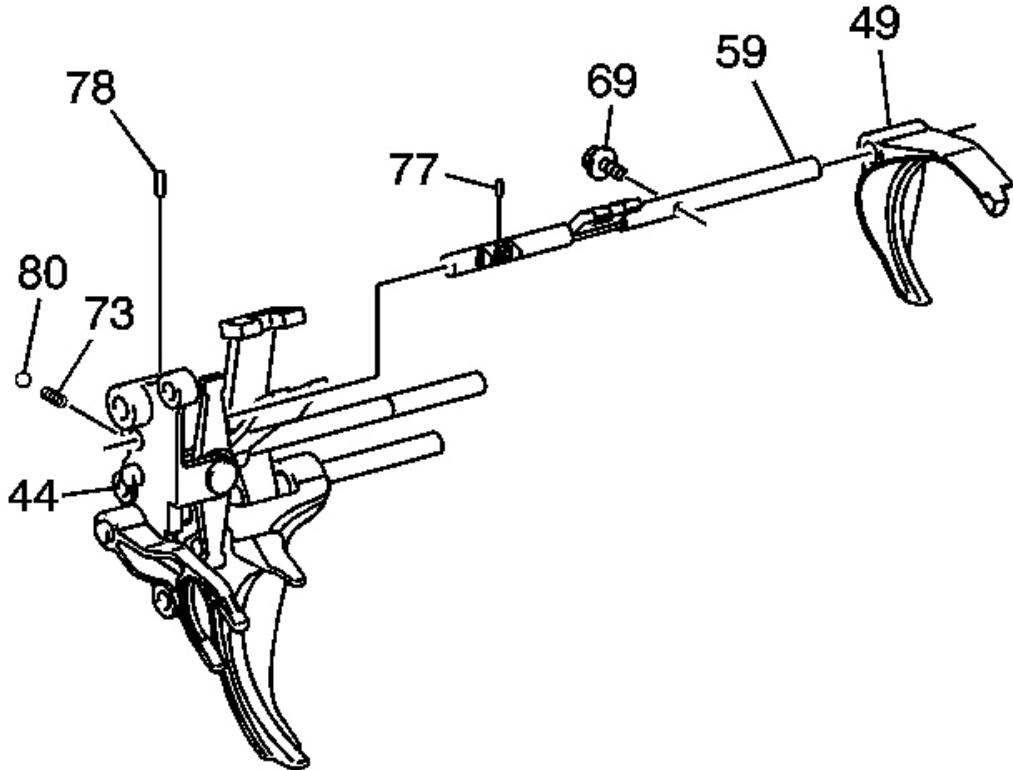


Fig. 132: View Of 3rd/4th Shift Shaft & Components

Courtesy of GENERAL MOTORS CORP.

NOTE:

- The shift detent ball (80) and spring (73) will come out of the shift control lever bracket (44) when the 3rd/4th shift shaft (59) is removed.
- Please note the proper orientation of the 3rd/4th shift fork (49) prior to removal.

10. Remove the bolt (69) from the 3rd/4th shift fork (49).
11. Remove the 3rd/4th shift shaft (59).
12. Remove the shift fork (49).
13. Use a magnet to remove pins (77 and 78).

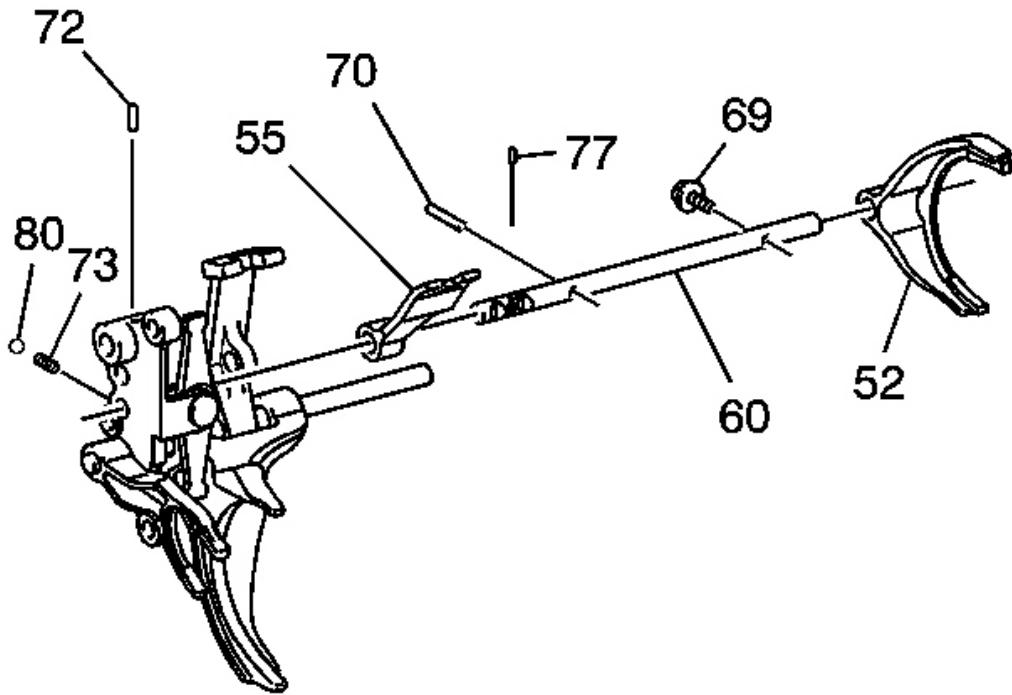


Fig. 133: View Of 5th/6th Shift Shaft & Components

Courtesy of GENERAL MOTORS CORP.

NOTE:

- The shift detent ball (80) and spring (73) will come out of the shift control lever bracket (44) when the 5th/6th shift shaft (60) is removed.
- Please note the proper orientation of the 5th/6th shift fork (52) prior to removal.

14. Remove the bolt (69) from the 5th/6th shift fork (52). Slide the 5th/6th shift fork (52) from the 5th/6th shift shaft (60).
15. Remove the 5th/6th shift shaft (60).
16. Using a suitable punch and hammer, remove the pin (70) from the shift lever assembly (55). Slide the shift lever assembly (55) from the 5th/6th shift shaft (60).
17. Using a suitable punch and hammer, remove pins (77 and 72).

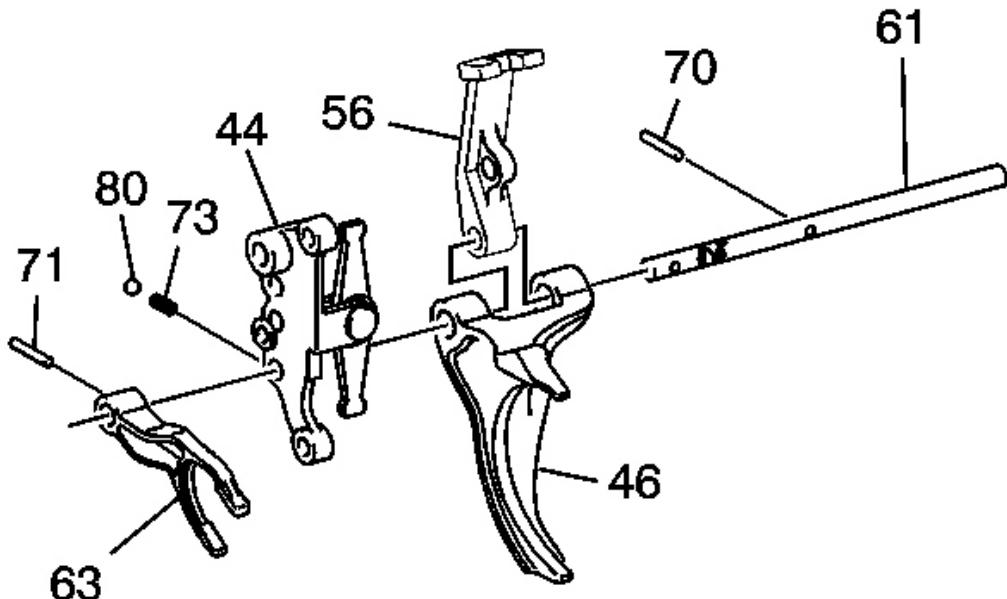


Fig. 134: View Of 1st/2nd Shift Fork Assembly, Reverse Shift Shaft & Components
Courtesy of GENERAL MOTORS CORP.

NOTE: The shift detent ball (80) and spring (73) will come out of the shift control lever bracket (44) when the reverse shift shaft (61) is removed.

18. Using a suitable punch and hammer, remove the slotted pin (71) from the reverse shift fork (63). Slide the reverse shift fork (63) off the reverse shift shaft (61).
19. Remove the reverse shift shaft assembly.

NOTE: Please note the proper orientation of the 1st/2nd shift fork (46) prior to removal.

20. Using a suitable punch and hammer, remove the long, slotted pin (70) from the internal shift control lever (56). Slide the internal shift control lever (56) and 1st/2nd shift fork assembly (46) from the reverse shift shaft (61).

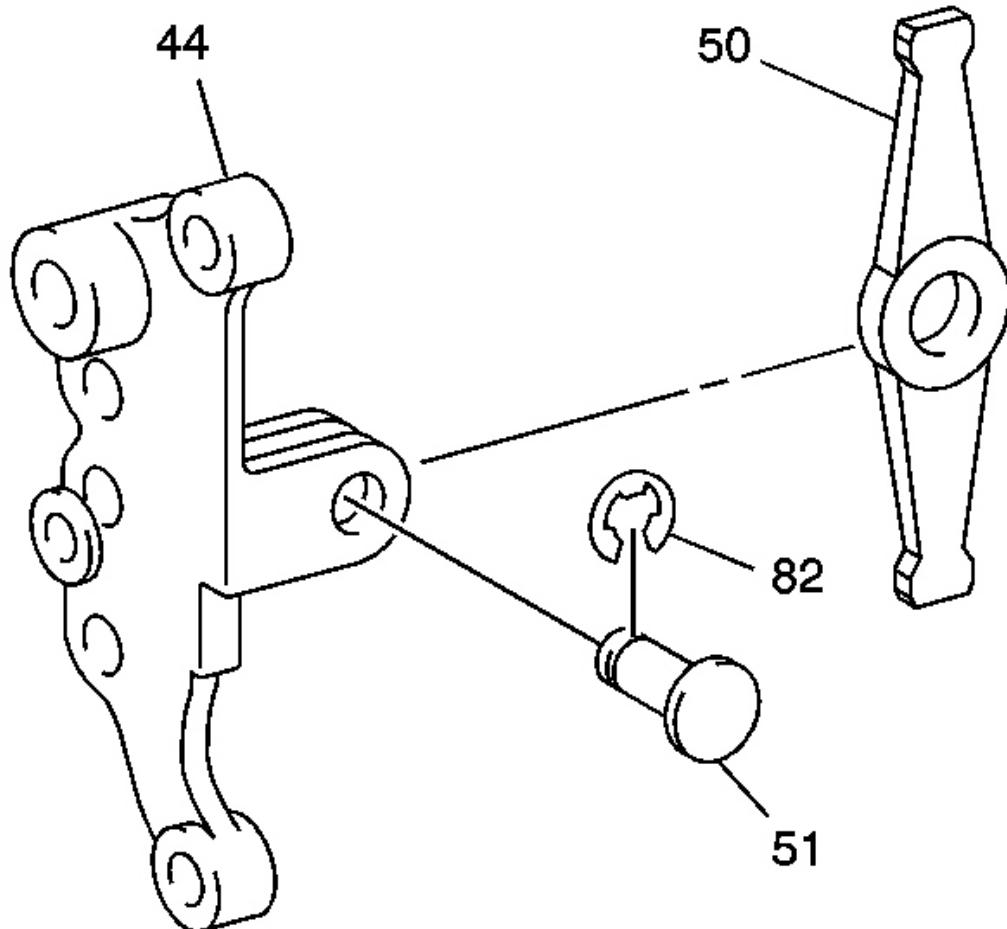


Fig. 135: View Of Control Select Arm Pin, Shift Control Lever Bracket & E-Ring
Courtesy of GENERAL MOTORS CORP.

21. Remove the selector control lever pin retainer (82) and pull the control select arm pin (51) from the shift control lever bracket (44).
22. Remove the control select arm (50) from the shift control lever bracket (44).

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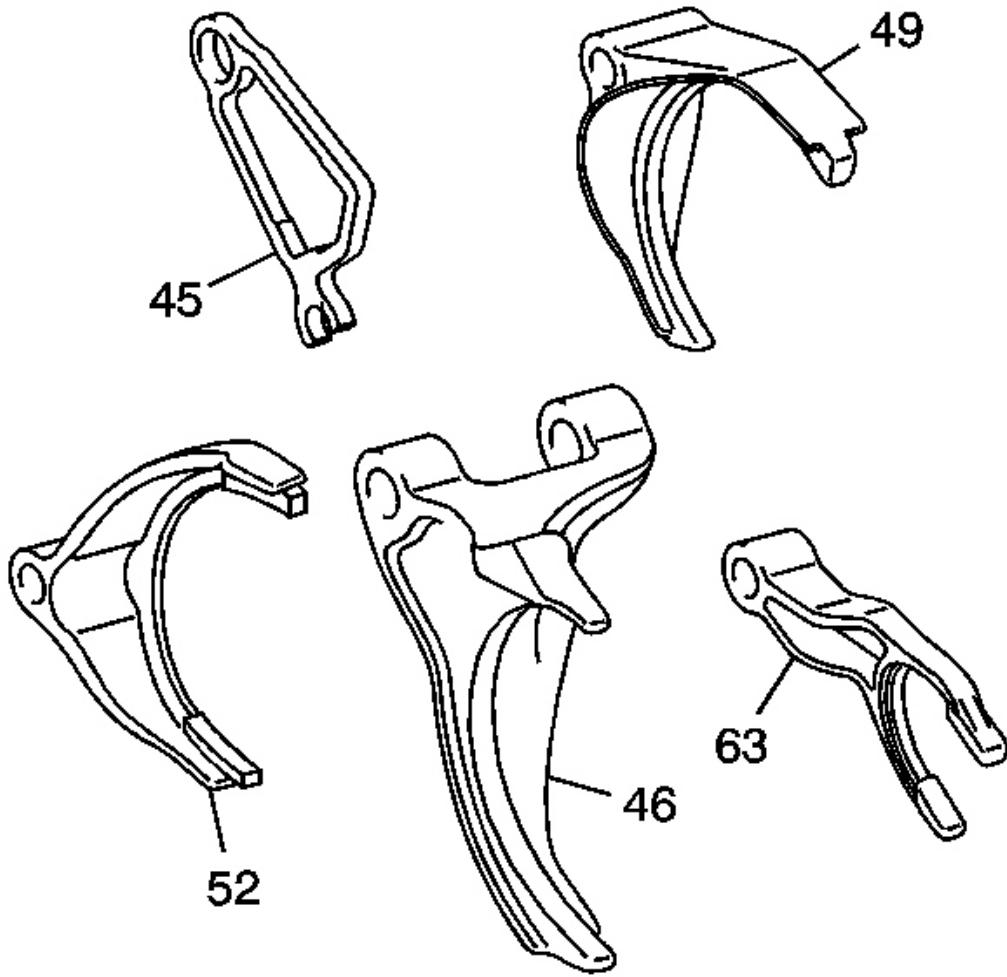


Fig. 136: Inspecting Cam, Shift Forks & Assembly
Courtesy of GENERAL MOTORS CORP.

23. Inspect the cam (45), shift forks (49), (52), (63) and assembly (46) for:

- Bent fork
- Hole for wear
- Cracks

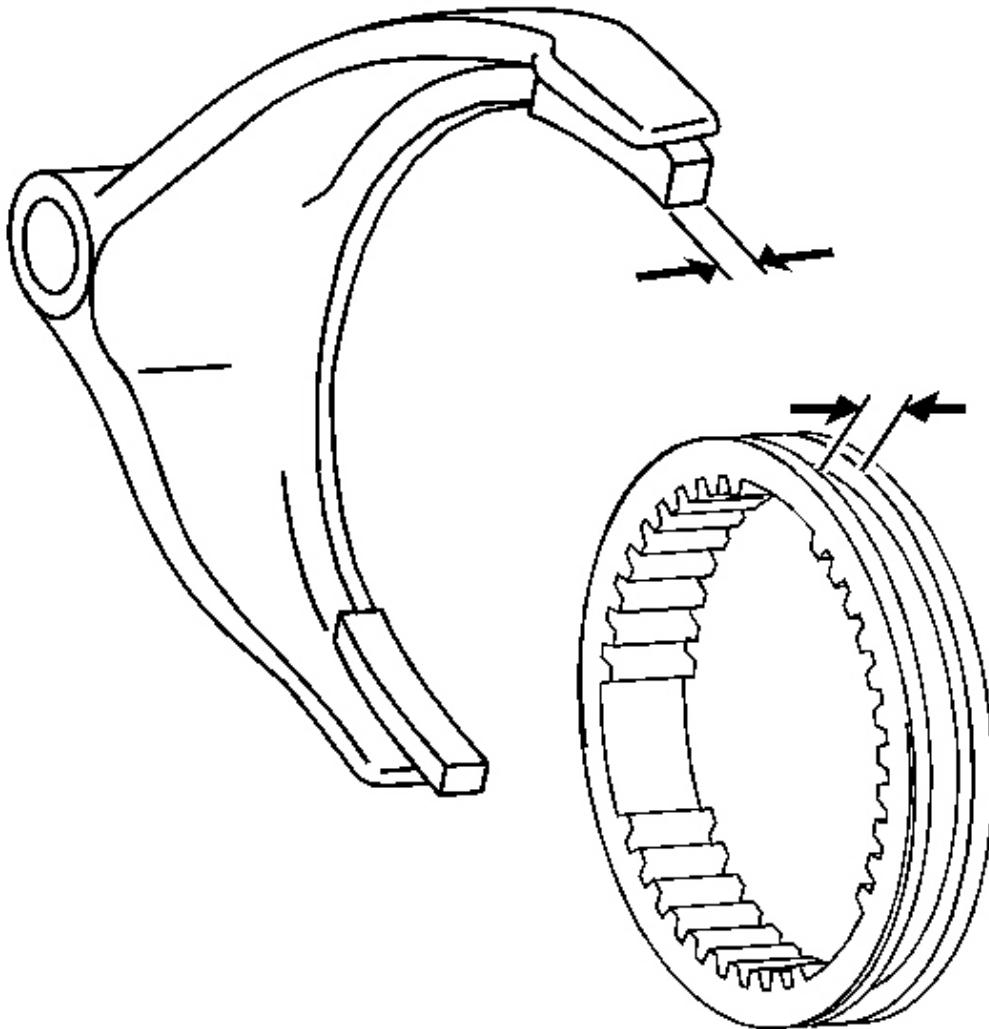


Fig. 137: Measuring Fork Width & Sleeve Groove Width
Courtesy of GENERAL MOTORS CORP.

24. Measure the fork width and sleeve groove width for wear. If synchronizer sleeve to shift fork width clearance exceeds the maximum, replace the synchronizer sleeve and/or shift fork. Refer to **Transmission Clearance Specifications** and see Synchronizer Sleeve to Shift Fork Clearance - Maximum Clearance table.

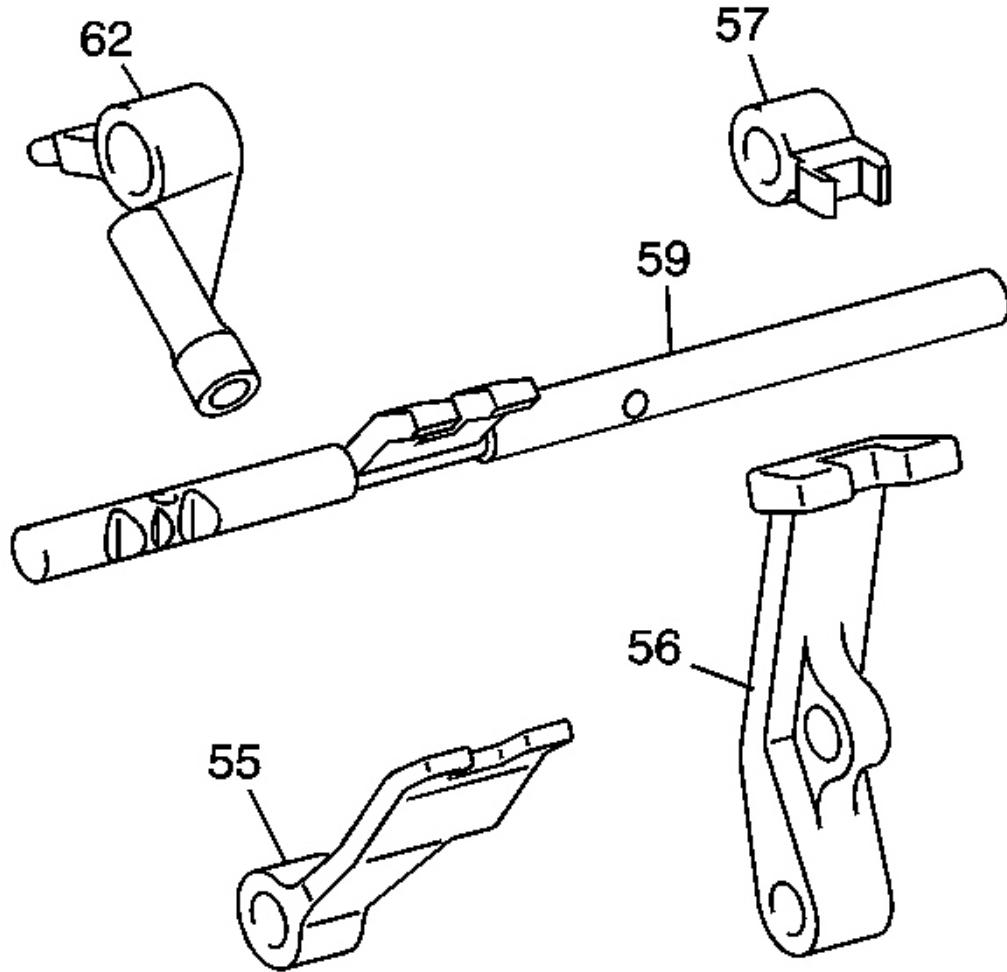


Fig. 138: Inspecting Detent Lever, Assembly, Shift Shaft & Control Lever
Courtesy of GENERAL MOTORS CORP.

25. Inspect the detent lever (62), assembly (56 and 57), shift shaft (59) and control lever (56) for:
- Bent fork
 - Hole for wear
 - Cracks

Shift Shaft and Shift Forks Assemble

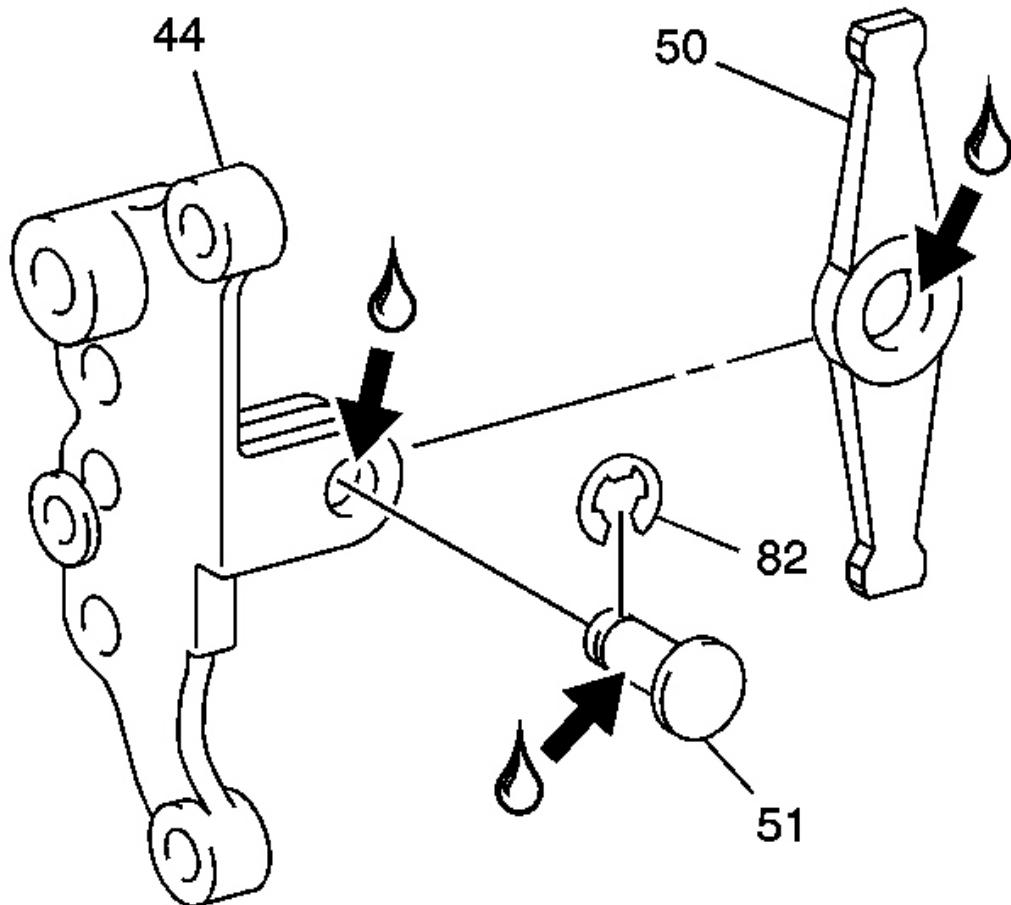


Fig. 139: View Of Control Select Arm, Shift Control Lever Bracket, Control Select Arm Pin & E-Ring

Courtesy of GENERAL MOTORS CORP.

1. Apply lubricant and install the control select arm (50) into the shift control lever bracket (44). Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).
2. Apply lubricant and install the control select arm pin (51).
3. Install the selector control lever pin retainer (82).

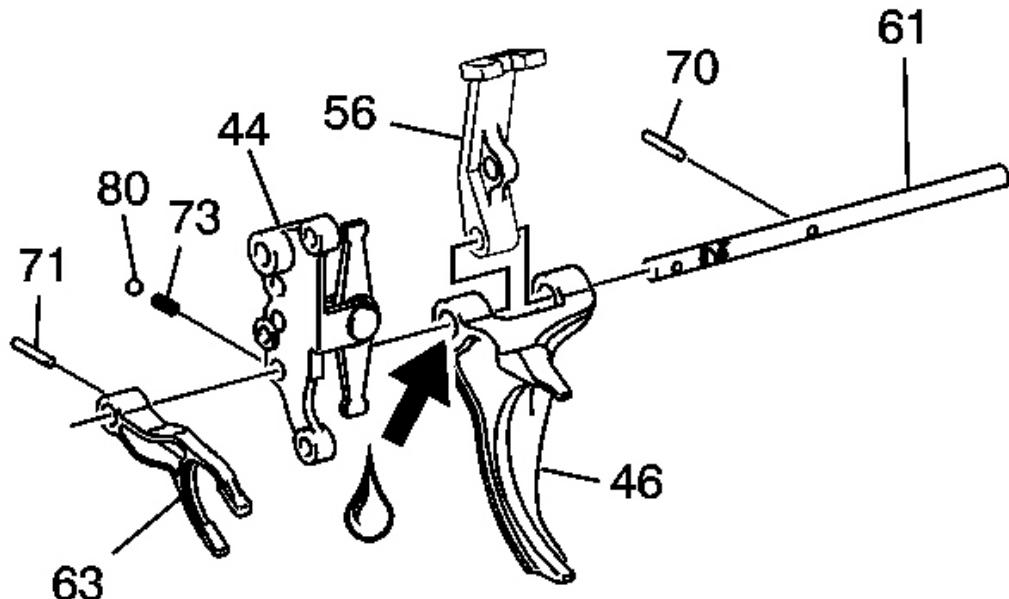


Fig. 140: View Of Reverse Shift Shaft Components

Courtesy of GENERAL MOTORS CORP.

4. Apply lubricant and slide the internal shift control lever (56) and 1st/2nd shift fork assembly (46) onto the reverse shift shaft (61). Refer to Adhesives, Fluids, Lubricants, and Sealers. Install the slotted pin (70) into the lever (56).
5. Install the shift control lever bracket (44) onto the reverse shift shaft (61).
6. Slide the reverse shift fork (63) onto the reverse shift shaft (61). Install the long, slotted pin (71) into the reverse shift fork (63).
7. Install the spring (73) and shift detent ball (80) into the bracket (44).

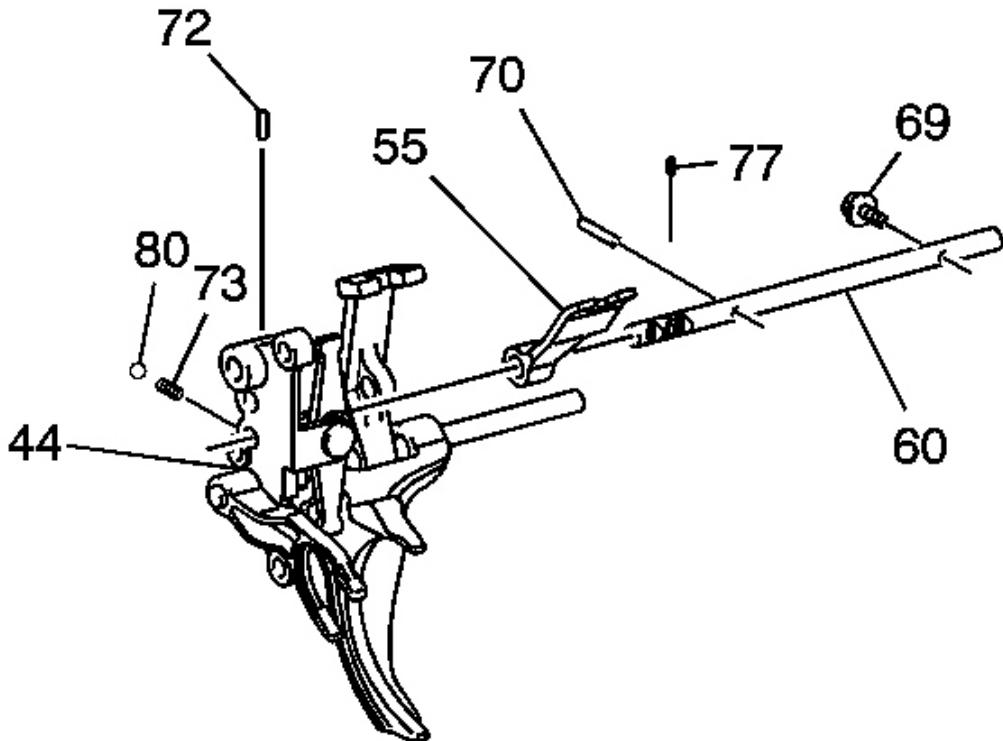


Fig. 141: View Of 5th/6th Shift Shaft Components

Courtesy of GENERAL MOTORS CORP.

8. Install the pin (72) into the shift control lever bracket (44).
9. Install the pin (77) into the 5th/6th shift shaft (60).
10. Install the 5th/6th shaft (60) into the hole in the shift lever assembly (55).

CAUTION: Refer to Fastener Caution .

11. Install a new bolt (69) into the shift lever assembly (55). Tighten the bolt to 19.5 N.m (14 lb ft).
12. Install the 5th/6th shift shaft (60) into the shift control lever bracket (44).

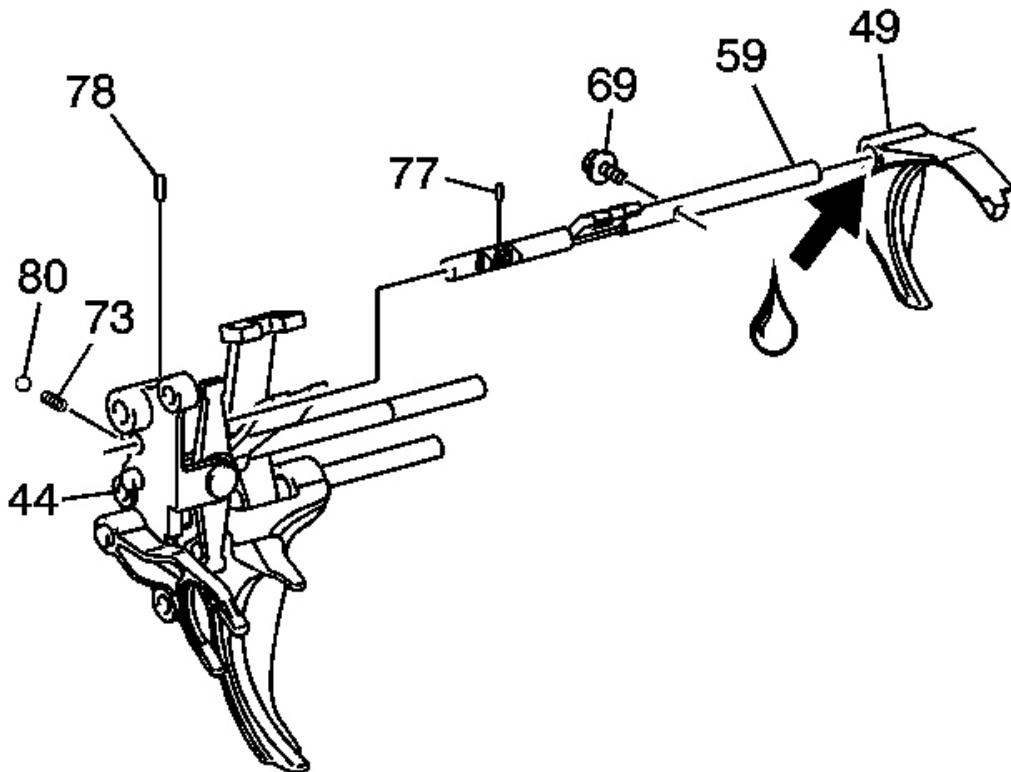


Fig. 142: View Of 3rd/4th Shift Shaft Components

Courtesy of GENERAL MOTORS CORP.

13. Apply lubricant and slide the 3rd/4th shift fork (49) onto the 3rd/4th shift shaft (59). Install a new bolt (69) into the 3rd/4th shift fork (49). Tighten the bolt to 19.5 N.m (14 lb ft).
14. Insert the spring (73) and the shift detent ball (80) into the shift control lever bracket (44).
15. Install the pin (77) into the 3rd/4th shift shaft (59).
16. Install pin (78) into the shift control lever bracket (44).
17. Install the 3rd/4th shift shaft (59) into the shift control lever (44).

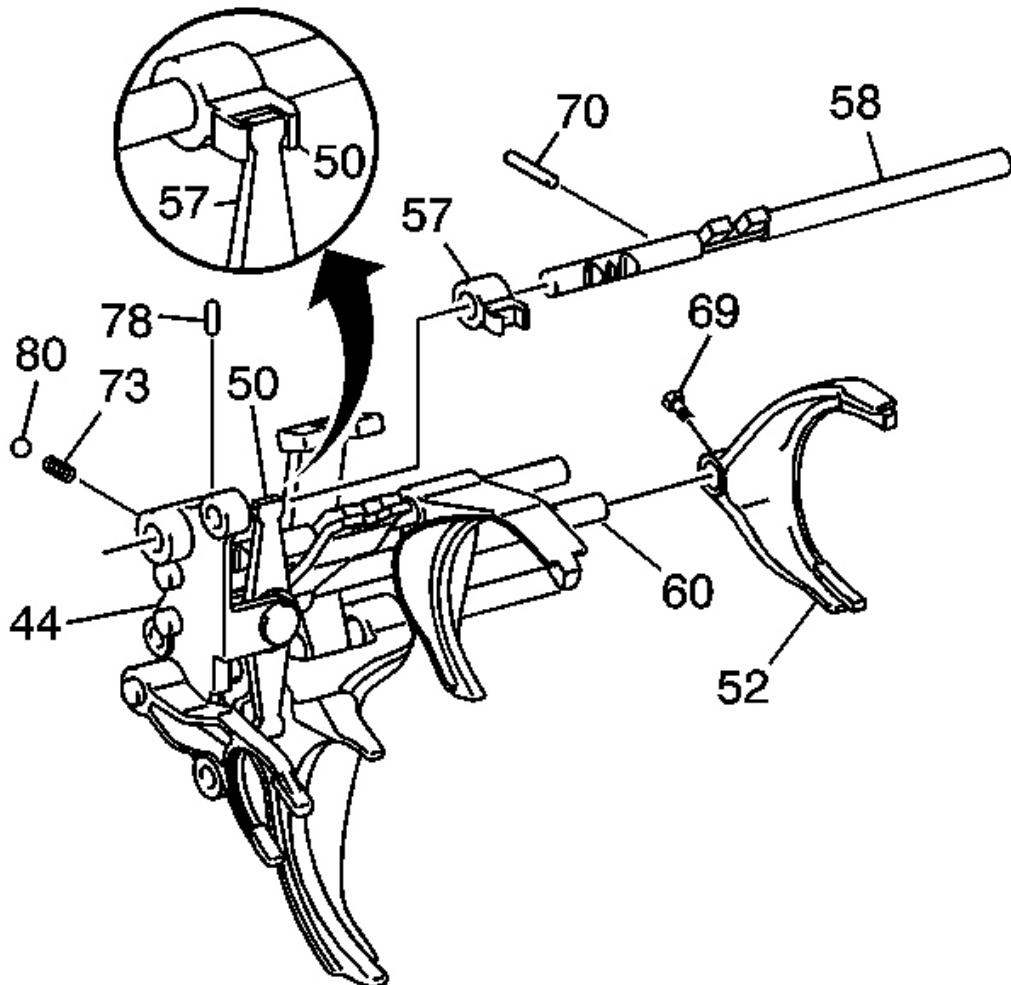


Fig. 143: View Of 1st/2nd Shift Shaft Components

Courtesy of GENERAL MOTORS CORP.

18. Install the spring (73) and detent ball (80) into the shift control lever bracket (44).
19. Install the pin (78) into the shift control lever bracket (44).
20. Install the groove of select control lever assembly (57) into the projection of the control select arm (50).
21. Slide the 1st/2nd shift shaft (58) into the shift control lever (57), and the shift control lever bracket (44).
22. Install pin (70) into the 1st/2nd shift shaft (58).
23. Install the 5th/6th shift fork (52) onto the 5th/6th shift shaft (60) and retain with a new bolt (69). Tighten the bolt to 19.5 N.m (14 lb ft).

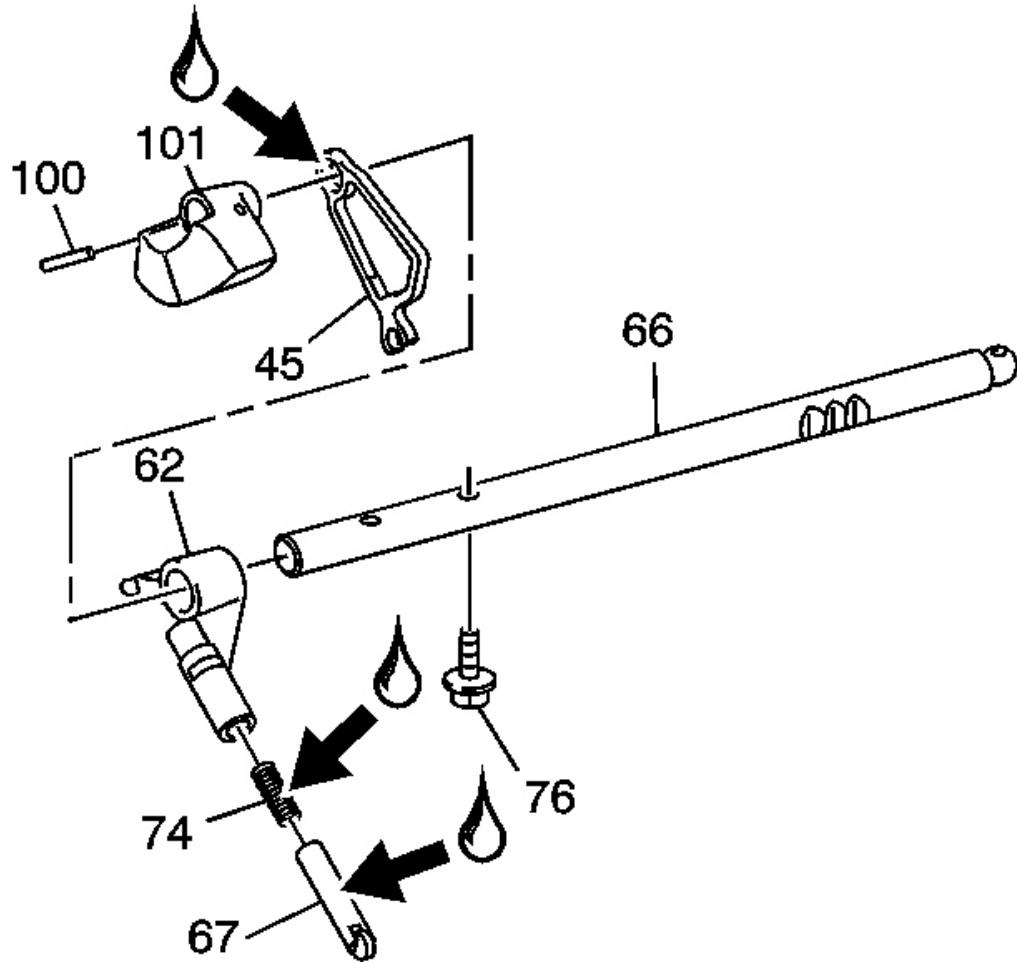


Fig. 144: View Of Shift Shaft Detent Lever & Shift Control Shaft Components
Courtesy of GENERAL MOTORS CORP.

24. Slide the shift shaft detent lever (62) onto the shift control shaft (66).
25. Install a new bolt (76) into the shift shaft detent lever (62). Tighten the bolt to 38 N.m (28 lb ft).
26. Apply lubricant and insert the shift shaft detent spring (74) and the shift shaft detent (67) into the lever (62).
27. Apply lubricant and slide the shift shaft detent cam (45) onto the shift control shaft (66).
28. Insert the assembled shift shaft detent lever (62, 74, 67) into the opening in the shift shaft detent cam (45).
29. Install the dynamic damper weight (101) onto the shift control shaft (66).
30. Insert the pin (100) into the dynamic damper weight (101).

31. Check the function of assembled components. The shift shaft detent (67) should slide on the shift shaft detent cam (45).

TRANSMISSION CASE CLEANING AND INSPECTION

Clutch Housing

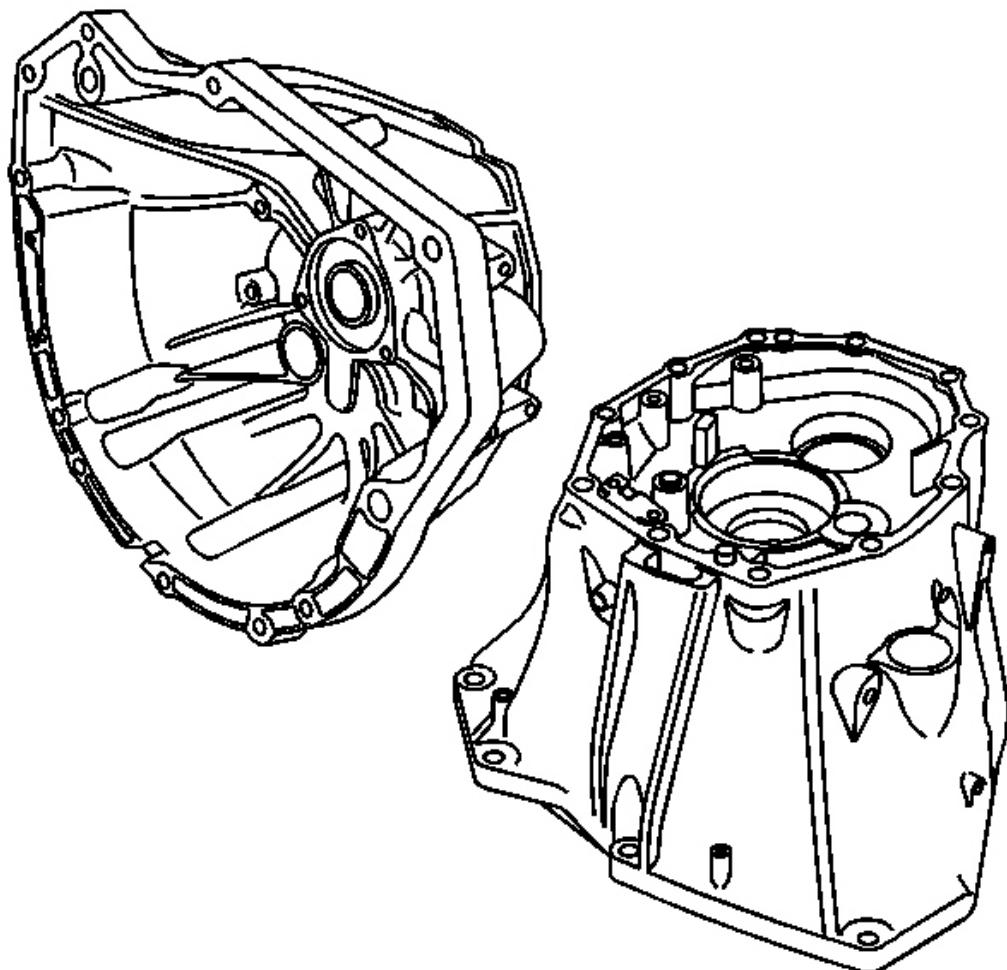


Fig. 145: Inspecting Clutch Housing

Courtesy of GENERAL MOTORS CORP.

1. Clean the clutch housing in a suitable cleaning solvent and air dry.
2. Inspect the clutch housing for the following conditions:

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- Cracks
- Damaged mounting flanges
- Damaged bolt holes

CAUTION: Refer to Machined Surface Damage Caution .

3. Remove the sealer from the case sealing surfaces.
4. Inspect the case for being broken or cracked.
5. Inspect the bearing bore for the following conditions:
 - A spun bearing
 - Cracks
6. Replace the case assembly if any of the above conditions are found.
7. Inspect the sealing surfaces for damage.
8. Repair small scratches or nicks with a soft stone.
9. Inspect the case threaded bolt holes for damage.
10. Repair any damaged threads.
11. Inspect the location pins for being loose or missing.
12. Repair or replace any damaged location pins.

Middle Case

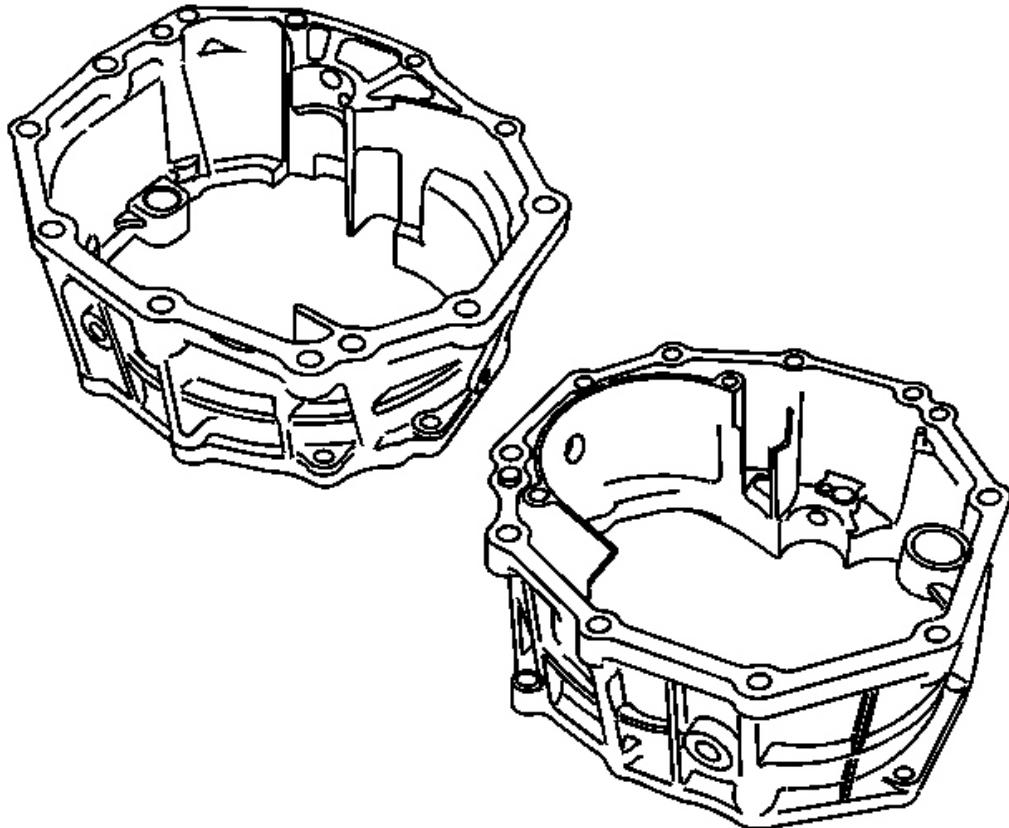


Fig. 146: Inspecting Middle Case
Courtesy of GENERAL MOTORS CORP.

1. Clean the middle case in a suitable cleaning solvent and air dry.

CAUTION: Refer to Machined Surface Damage Caution .

2. Remove the sealer from the case sealing surfaces.
3. Inspect the case for being broken or cracked.
4. Inspect the input shaft bearing bore for the following conditions:
 - A spun bearing
 - Cracks
5. Inspect the countershaft front bearing bore for the following conditions:
 - A spun bearing

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- Cracks

6. Replace the case assembly if any of the above conditions are found.
7. Inspect the sealing surfaces for damage.
8. Repair small scratches or nicks with a soft stone.
9. Inspect the case threaded bolt holes for damage.
10. Repair any damaged threads.
11. Inspect the location pins for being loose or missing.
12. Repair or replace any damaged location pins.

Rear Case

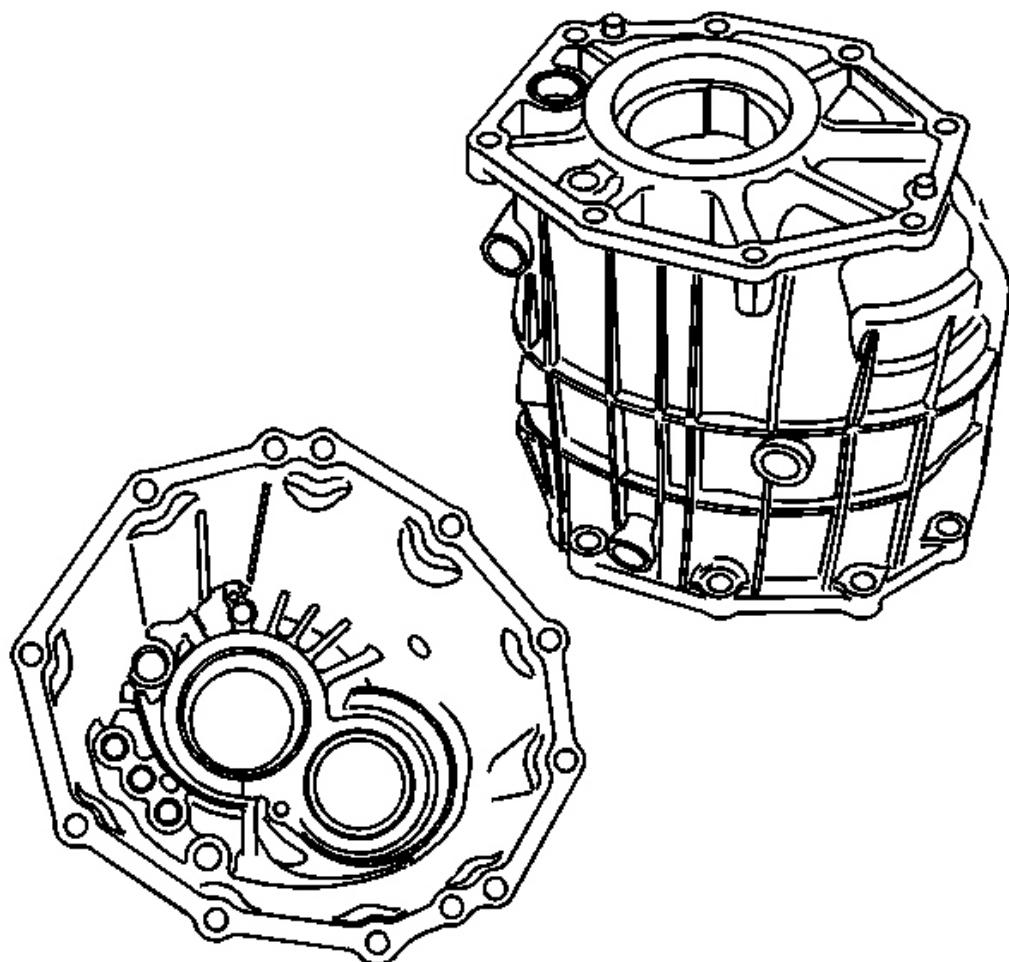


Fig. 147: Inspecting Rear Case

Courtesy of GENERAL MOTORS CORP.

1. Clean the rear case in a suitable cleaning solvent and air dry.

CAUTION: Refer to Machined Surface Damage Caution .

2. Remove the sealer from the case sealing surfaces.
3. Inspect the sealing surfaces for damage.
4. Inspect the case threaded bolt holes for damage.
5. Repair any damaged threads.
6. Inspect the location pins for being loose or missing.
7. Repair or replace any damaged location pins.
8. Inspect the shift shaft bushings for excessive wear.
9. Inspect the bearing bore.
10. Replace the case assembly if the shift shaft bushings are faulty.

Extension Housing

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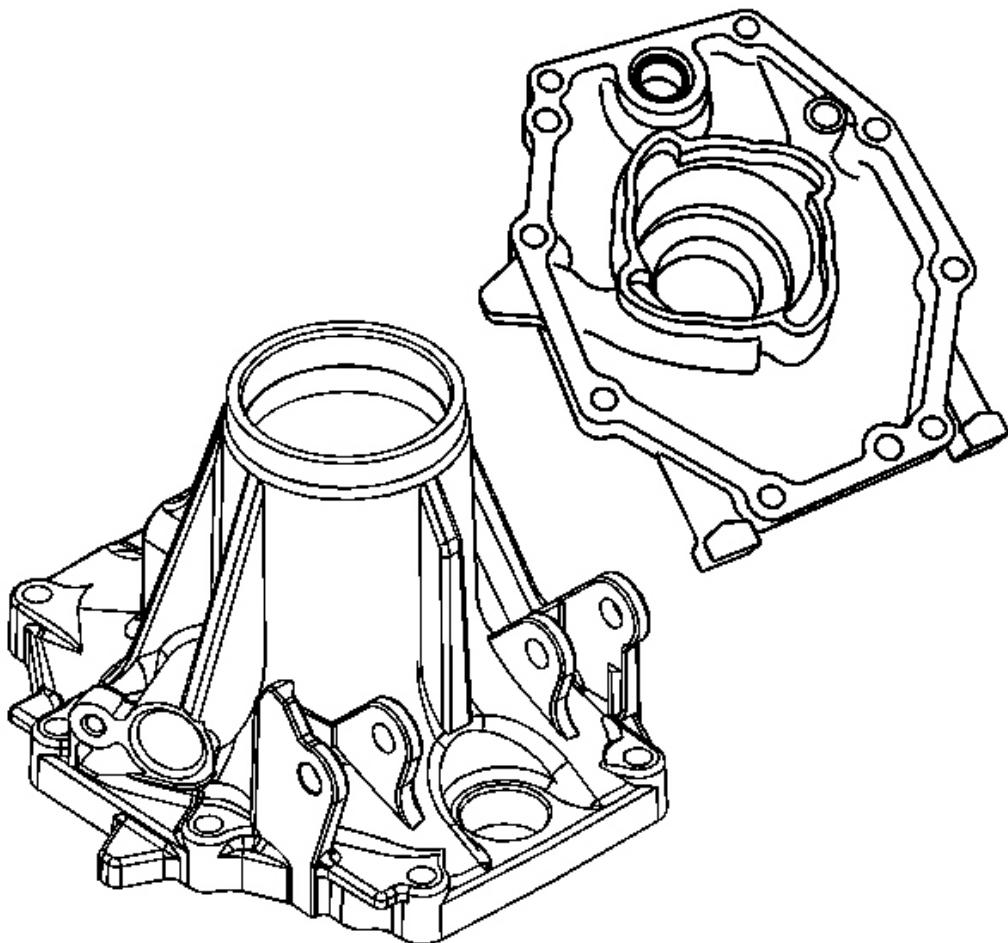


Fig. 148: View Of Extension Housing
Courtesy of GENERAL MOTORS CORP.

1. Clean the extension housing in a suitable cleaning solvent and air dry.

CAUTION: Refer to [Machined Surface Damage Caution](#) .

2. Remove the sealer from the extension sealing surfaces.
3. Inspect the sealing surfaces for damage.
4. Inspect the extension for being broken or cracked.
5. Inspect the oil seal for wear or damage. The oil seal is serviced only with the extension housing.

6. Inspect the bearing bore.
7. Replace the extension if any of the above conditions are found.
8. Inspect the case threaded bolt holes for damage.
9. Repair any damaged threads.
10. Repair or replace any damaged location pins.

SYNCHRONIZERS ASSEMBLE

5th/6th Gear Synchronizer

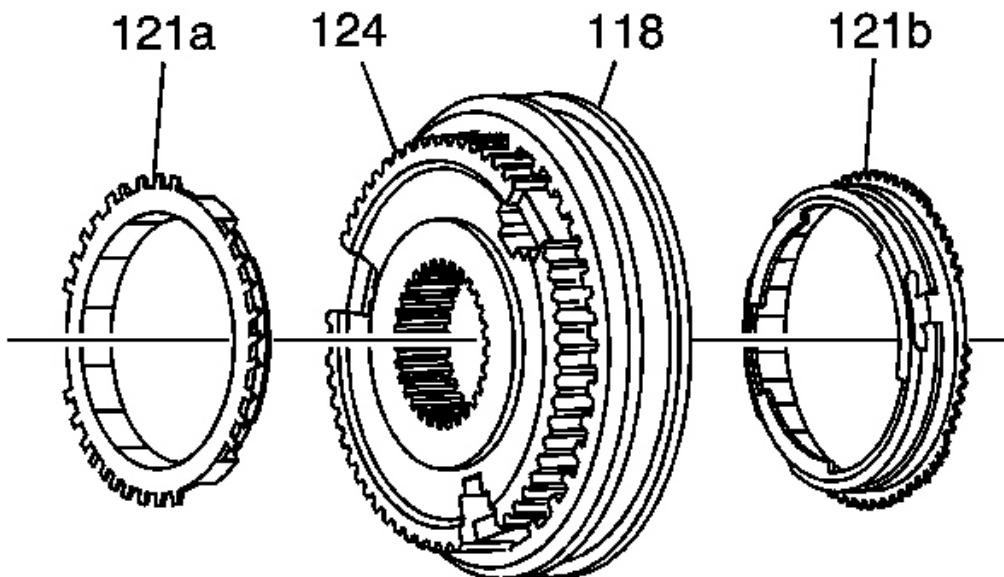


Fig. 149: View Of 5th/6th Synchronizer Hub & Blocking Rings
Courtesy of GENERAL MOTORS CORP.

NOTE: Ensure that the hub slides easily.

1. Apply lubricant and install the following components into the 5th/6th synchronizer hub (124/118):
 - The 5th gear blocking ring (121b)
 - The 6th gear blocking ring (121a)

Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).

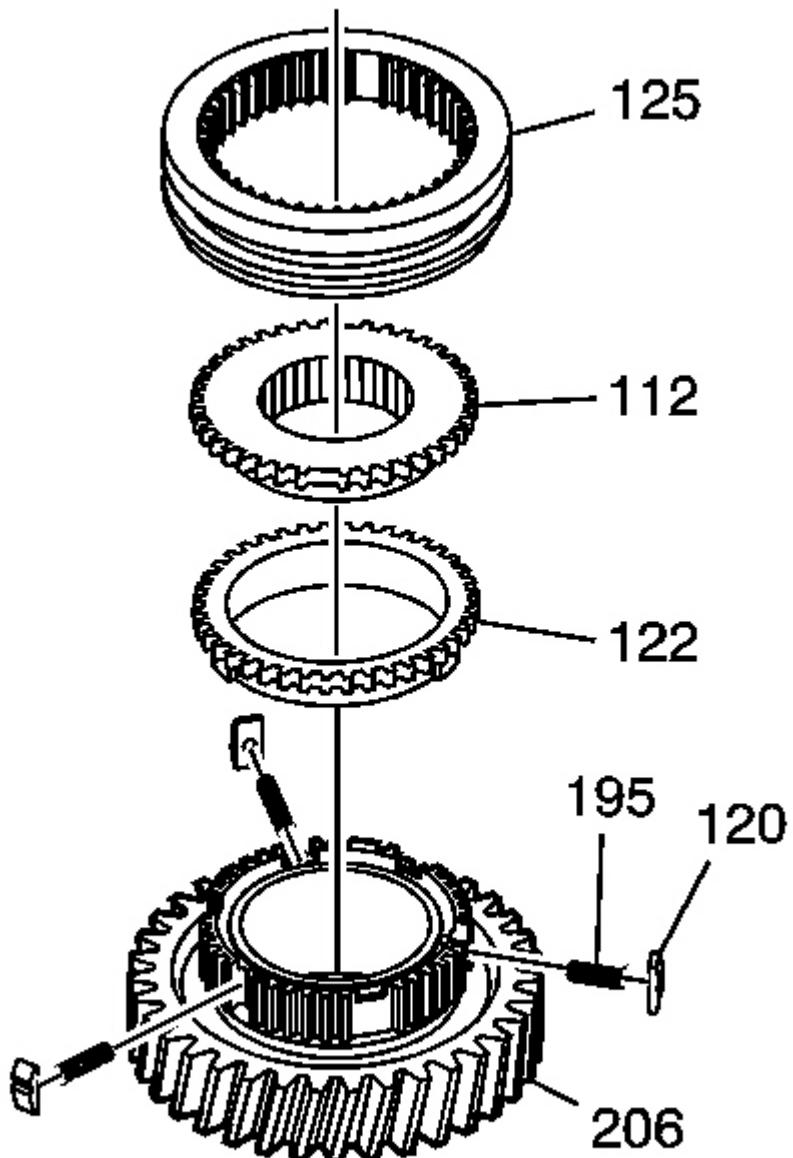


Fig. 150: View Of Reverse Gear Components
Courtesy of GENERAL MOTORS CORP.

2. Apply lubricant to the blocking ring, driven gear and sleeve. Install the following components into the reverse gear (206):
 - The reverse gear insert (120) and the spring (195)

- The reverse gear blocking ring (122)
- The reverse driven gear (112)
- The synchronizer sleeve (125)

1st/2nd, 3rd/4th Gear Synchronizer

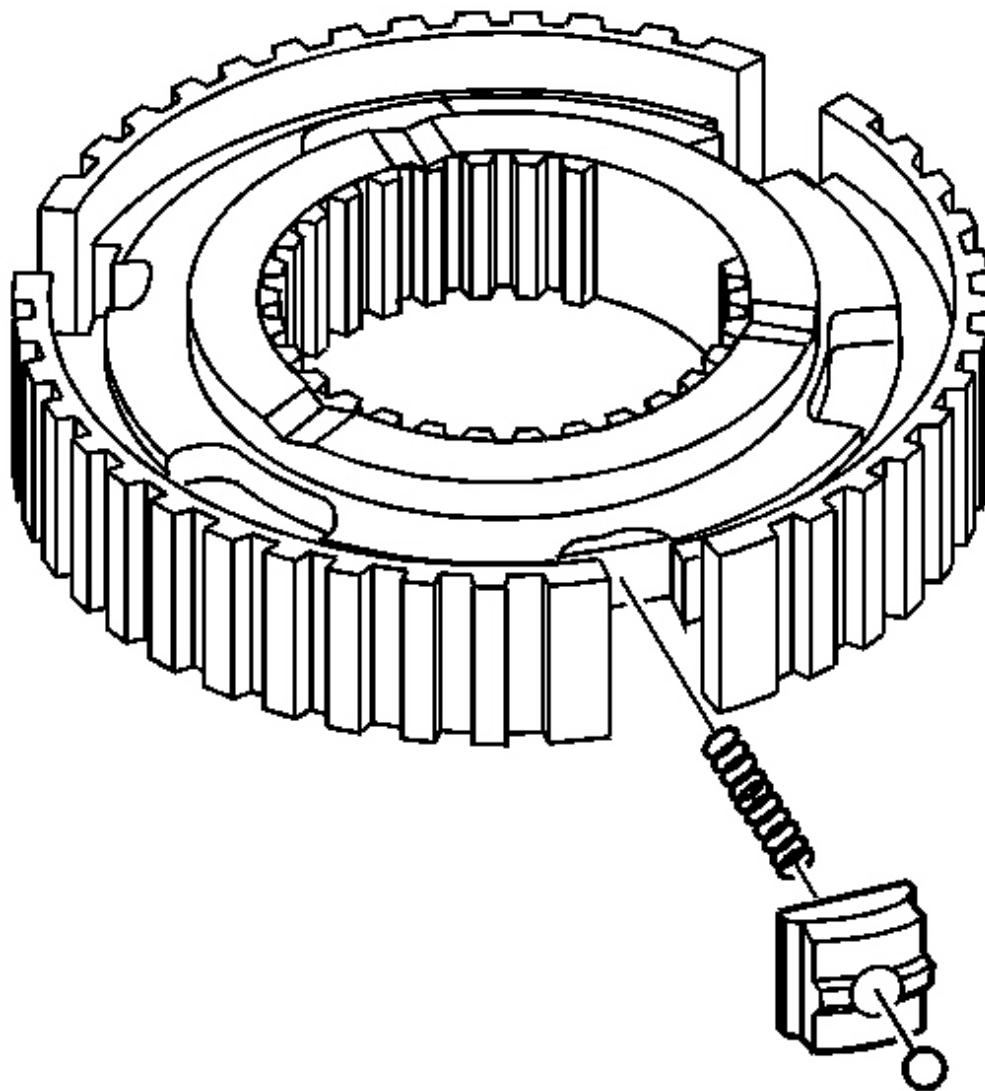


Fig. 151: View Of Synchronizer Insert & Spring

Courtesy of GENERAL MOTORS CORP.

1. Install the synchronizer insert and spring into the synchronizer hub. Press the spring and slide the insert in.

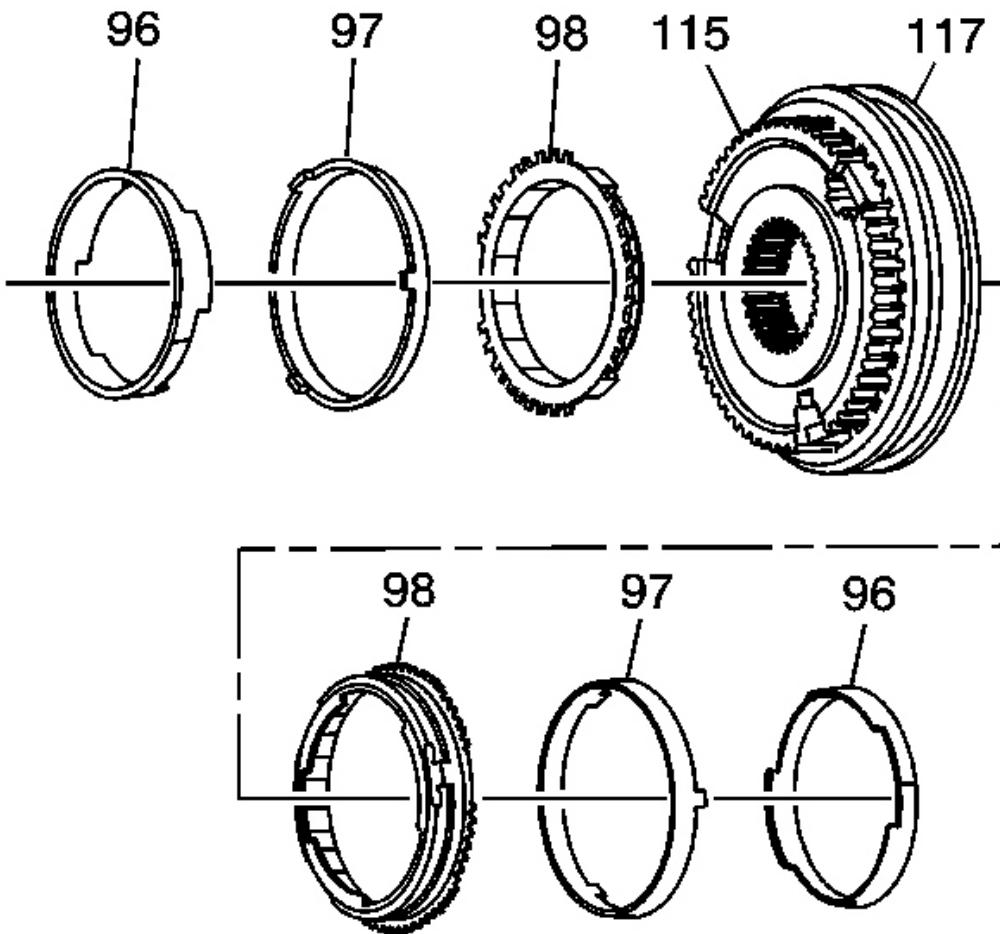


Fig. 152: View Of 1st Gear Synchronizer Components
Courtesy of GENERAL MOTORS CORP.

NOTE: When you service the synchronizers, retain them in the same order that they are removed. Keep the synchronizer components together and mark them to identify correct location.

2. Apply lubricant to the cones and blocking rings. Align and install the following components into the 1st/2nd gear synchronizer hub (115/117):

- The 1st gear synchronizer inner cone (96)

- The 1st gear synchronizer outer cone (97)
- The 1st gear outer blocking ring (98)
- The 2nd gear outer blocking ring (98)
- The 2nd gear synchronizer outer cone (97)
- The 2nd gear synchronizer inner cone (96)

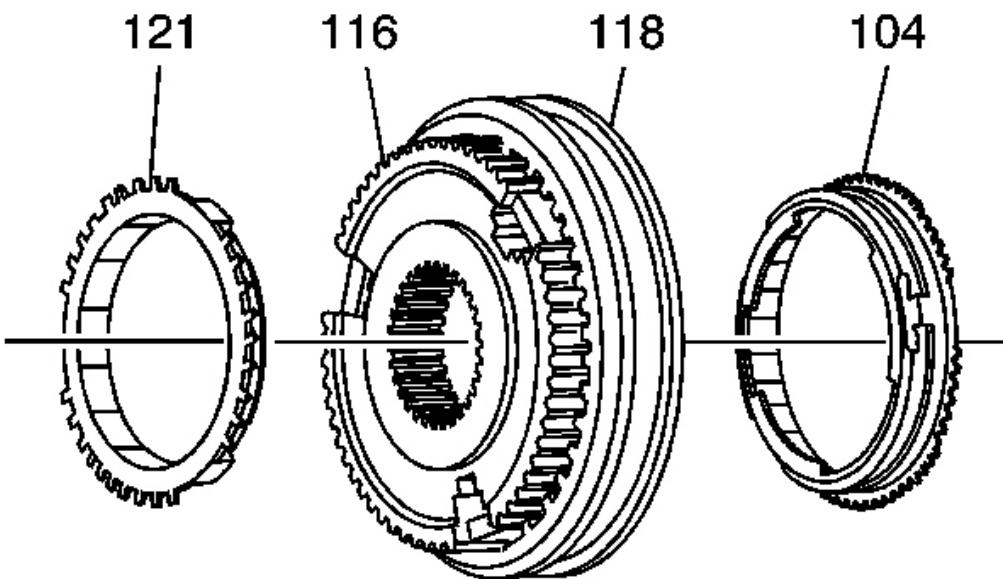


Fig. 153: View Of 3rd/4th Gear Synchronizer Hub & Blocking Rings

Courtesy of GENERAL MOTORS CORP.

3. Apply lubricant to the blocking rings. Install the following components into the 3rd/4th gear synchronizer hub (116/118):
 - The 3rd gear blocking ring (104)
 - The 4th gear blocking ring (121)

EXTENSION ASSEMBLE

Special Tools

- DT-47722 Shift Rail Bushing Remover and Installer. See Special Tools.
- DT-47724 Output Shaft Bearing Cup Installer. See Special Tools.
- J 8092 Driver Handle

- **J 44765** Seal Installer. See Special Tools.

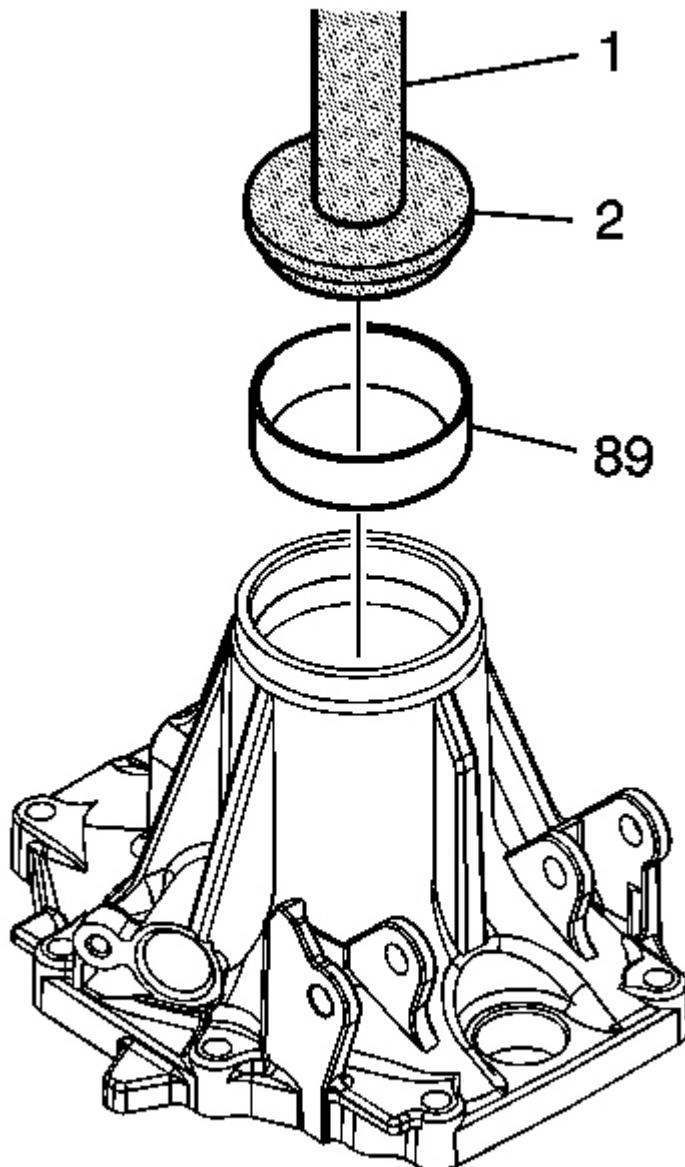


Fig. 154: Installing Tapered Bearing Race
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the extension housing installation surfaces are clean.

1. Using **DT-47724** (2) and **J 8092** (1), install the tapered bearing race (89). See **Special Tools**.

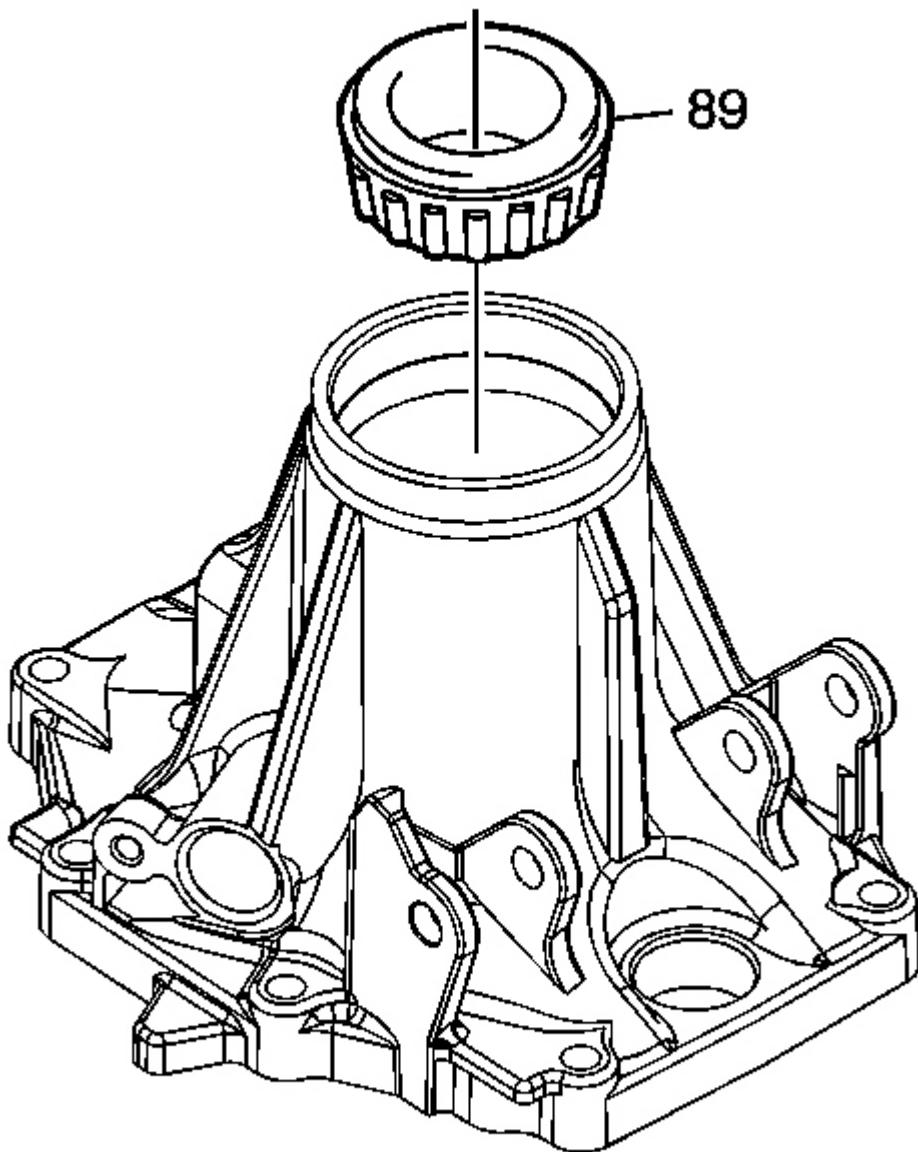


Fig. 155: Identifying Tapered Roller Bearing
Courtesy of GENERAL MOTORS CORP.

2. Apply gear oil and install the tapered roller bearing (89).

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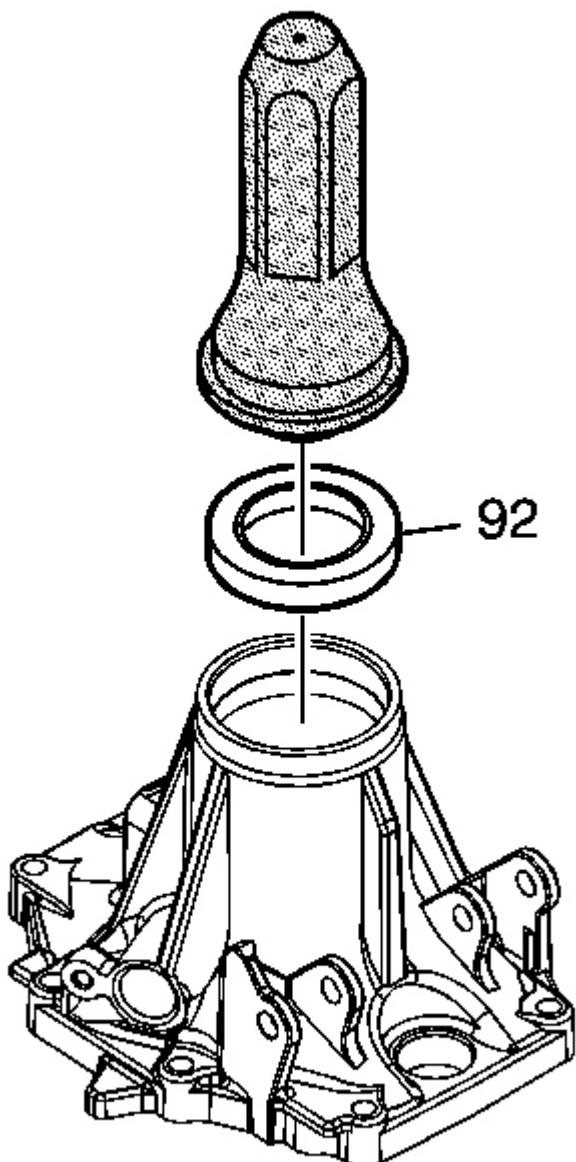


Fig. 156: View Of Output Shaft Oil Seal
Courtesy of GENERAL MOTORS CORP.

3. Using **J 44765**, install a NEW rear output shaft oil seal (92). See **Special Tools**.

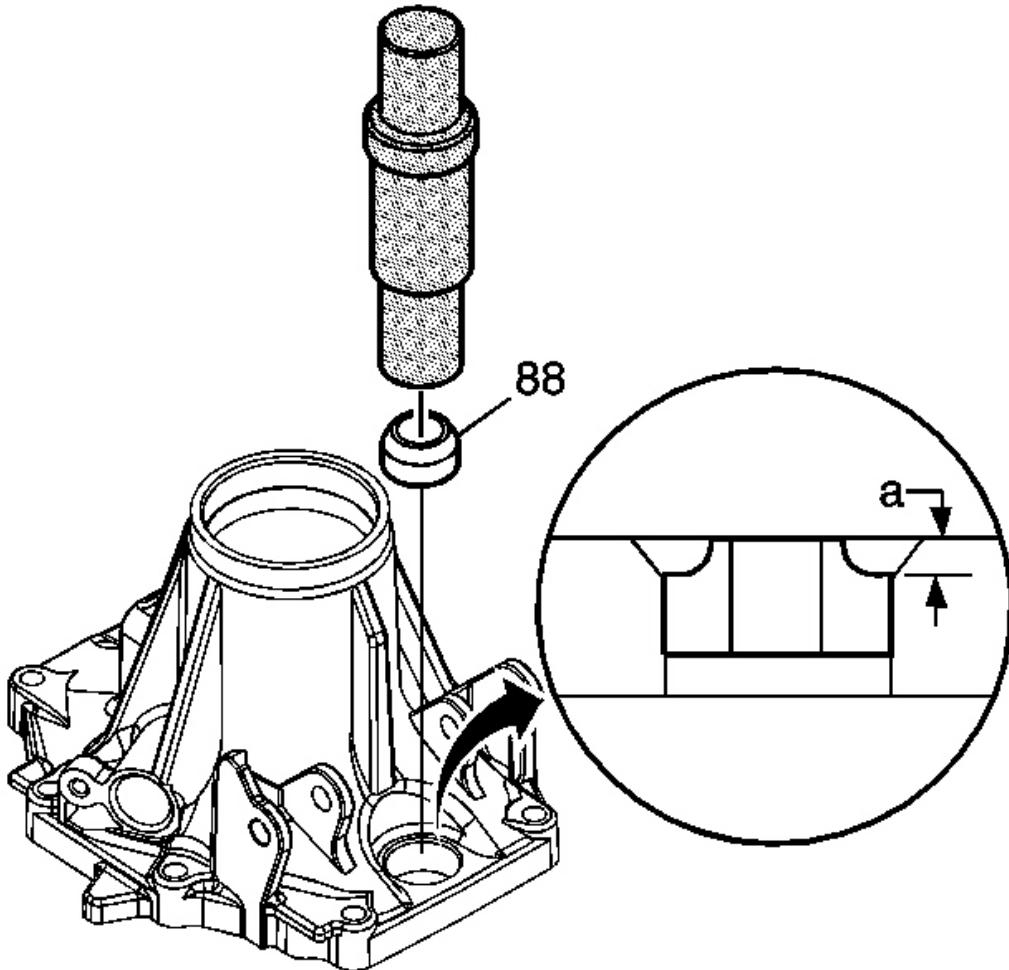


Fig. 157: Installing Shift Shaft Seal
Courtesy of GENERAL MOTORS CORP.

4. Using **DT-47722**, install a NEW shift shaft seal (88) to the specified depth (a). See **Special Tools**.

Depth: Drive the shift shaft seal to a depth of 4.6-5.4 mm below the surface of the extension housing.

TRANSMISSION CASE ASSEMBLE

Special Tools

- **DT-47722:** Shift Rail Bushing Remover and Installer
- **DT-47725:** Extension Housing Bearing Cup Installer

- DT-47726: Countershaft Rear Bearing Installer

Rear Case Assemble

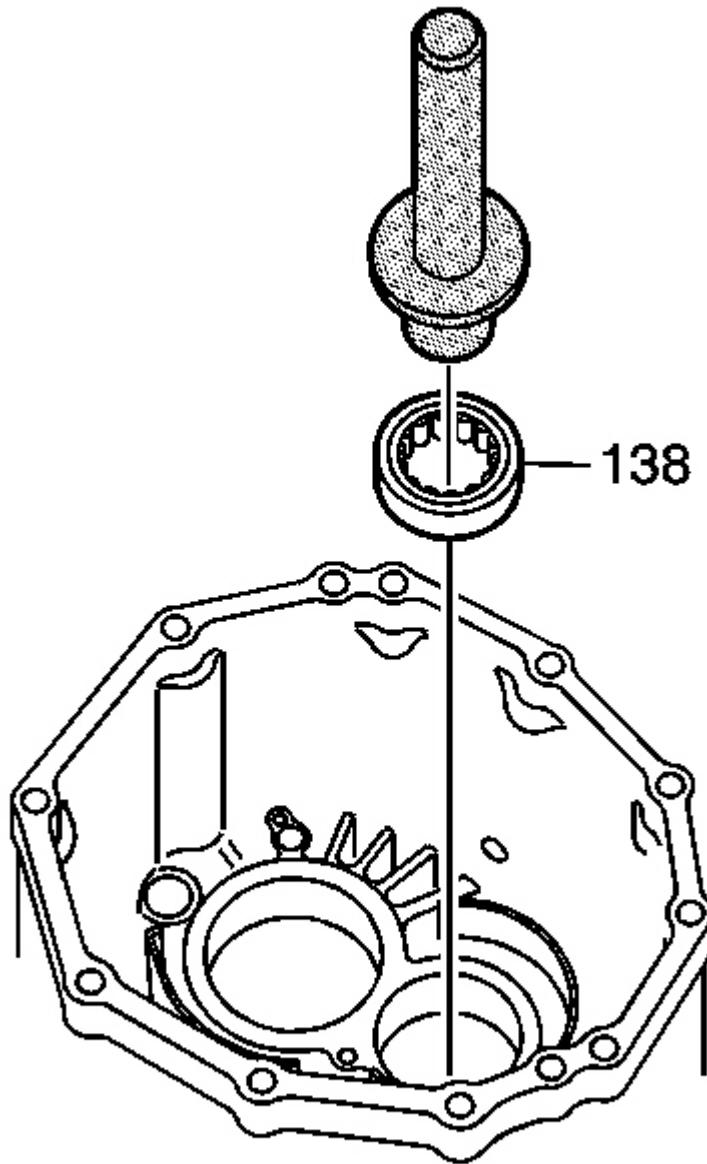


Fig. 158: Installing Bearing

Courtesy of GENERAL MOTORS CORP.

NOTE: Ensure that the rear case housing installation surfaces are free of dirt and sealant.

1. Apply gear oil to new bearing. Use **DT-47726**: installer to install new bearing (138).

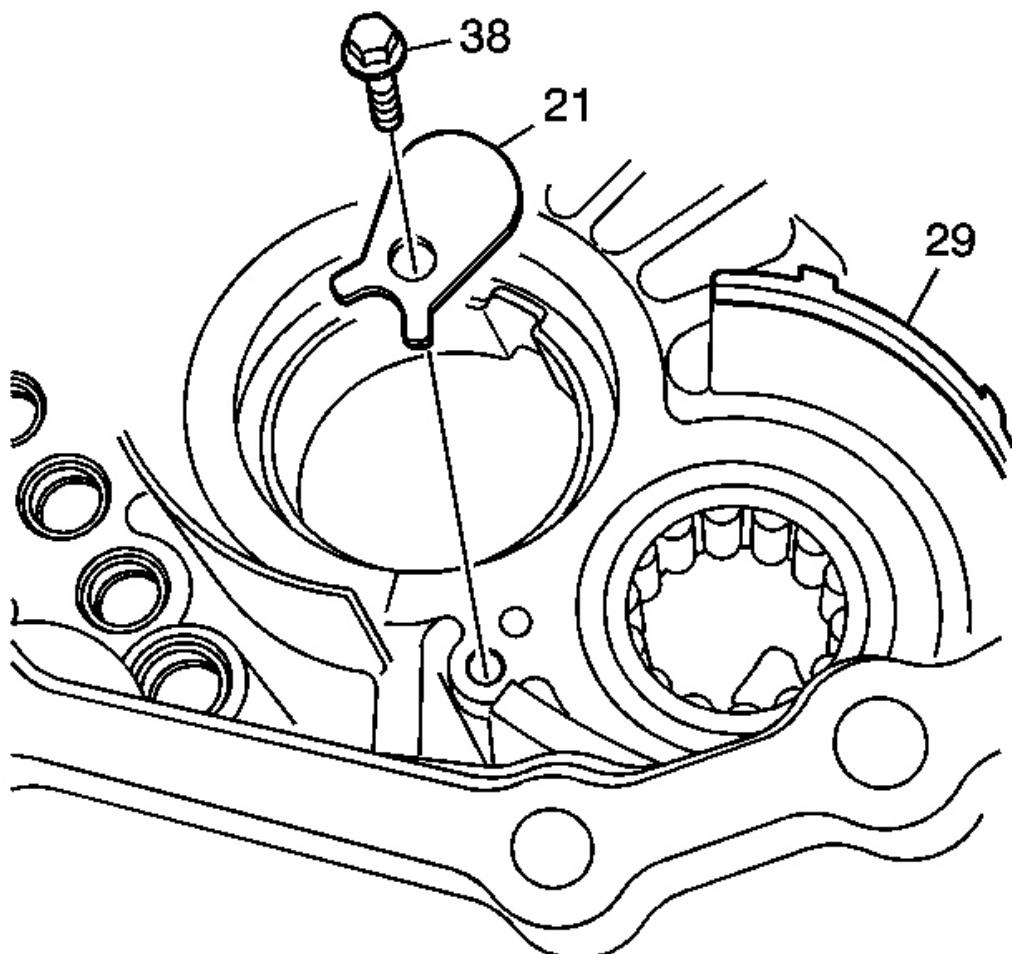


Fig. 159: View Of Bearing Retainer, Bolt & Gasket
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

2. Install the bearing retainer (21) and bolt (38) and tighten to 11.3 N.m (100 lb in).

3. Install the gasket (29).

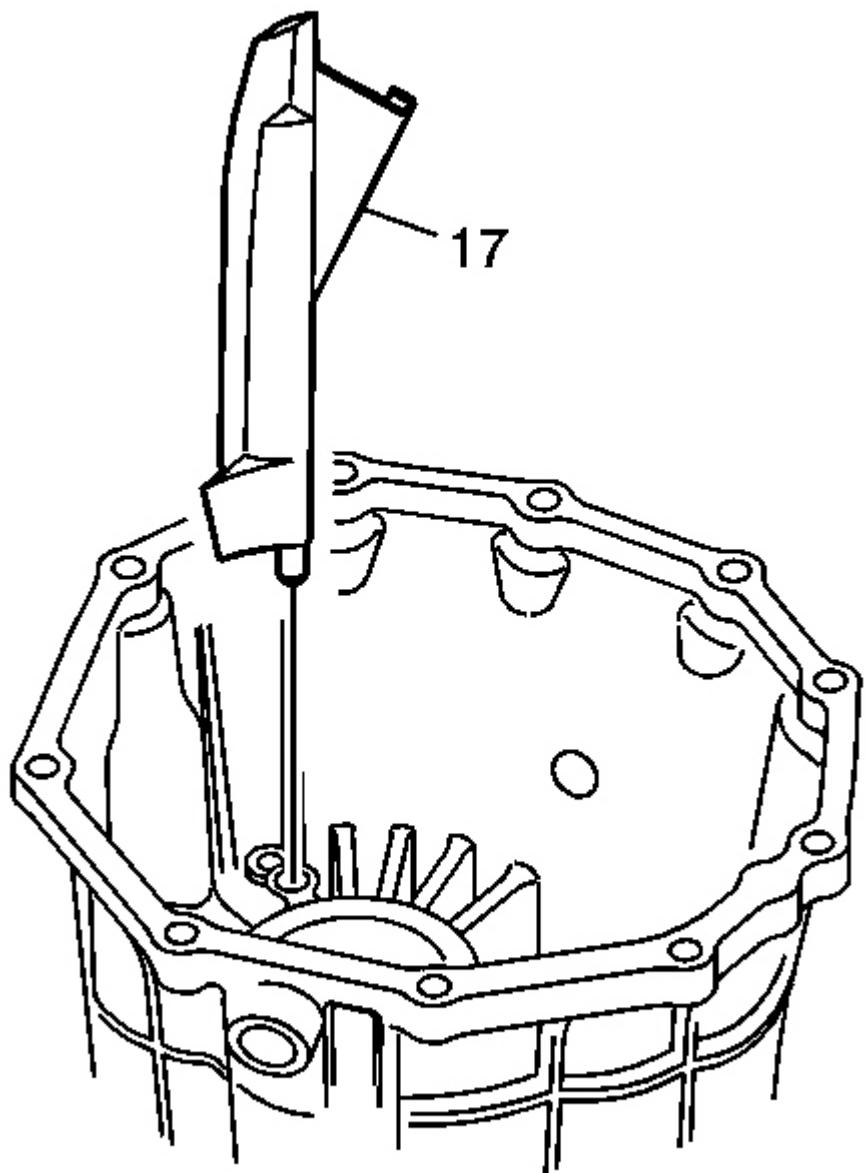


Fig. 160: View Of Oil Trough

Courtesy of GENERAL MOTORS CORP.

4. Install the oil trough (17).

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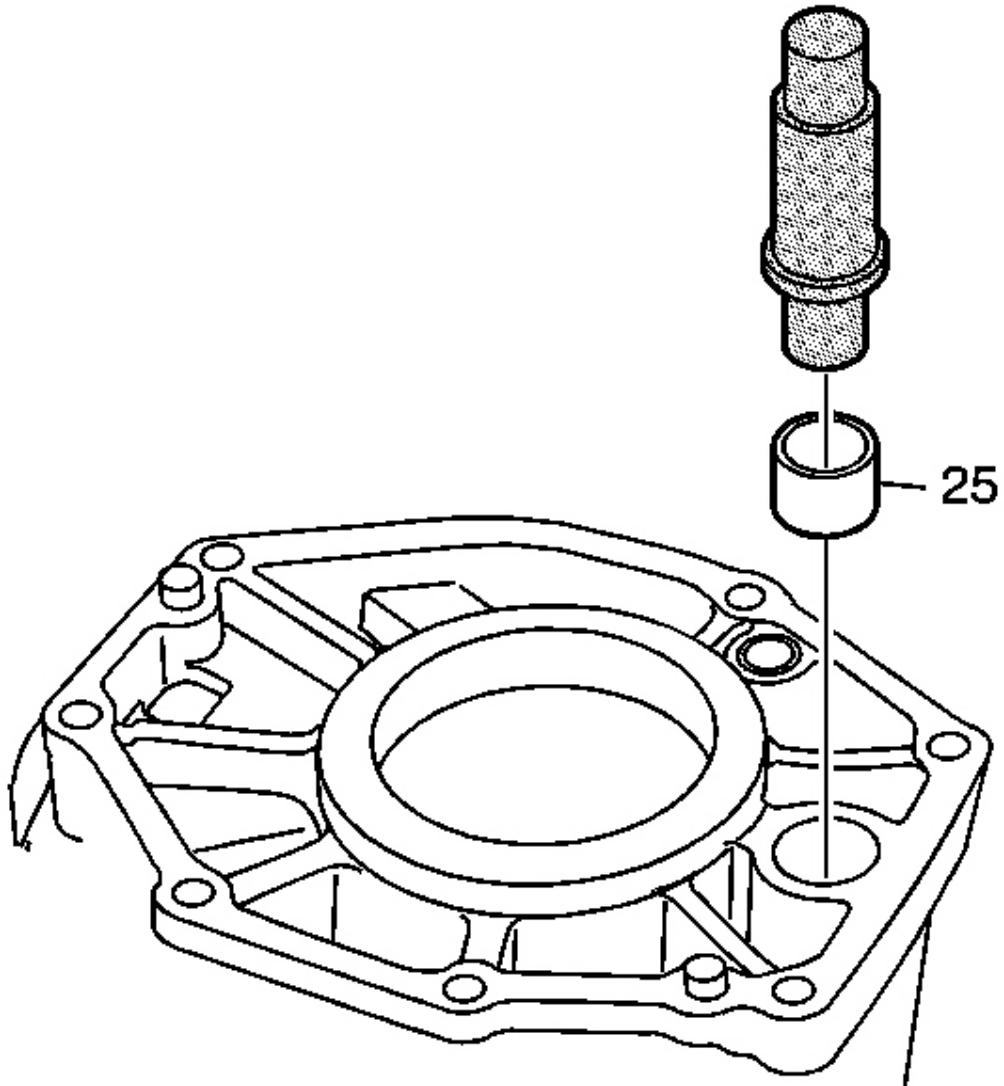


Fig. 161: Installing Bearing Into Rear Case
Courtesy of GENERAL MOTORS CORP.

5. Using **DT-47722**: remover/installer, install the bearing (25) in the rear case.

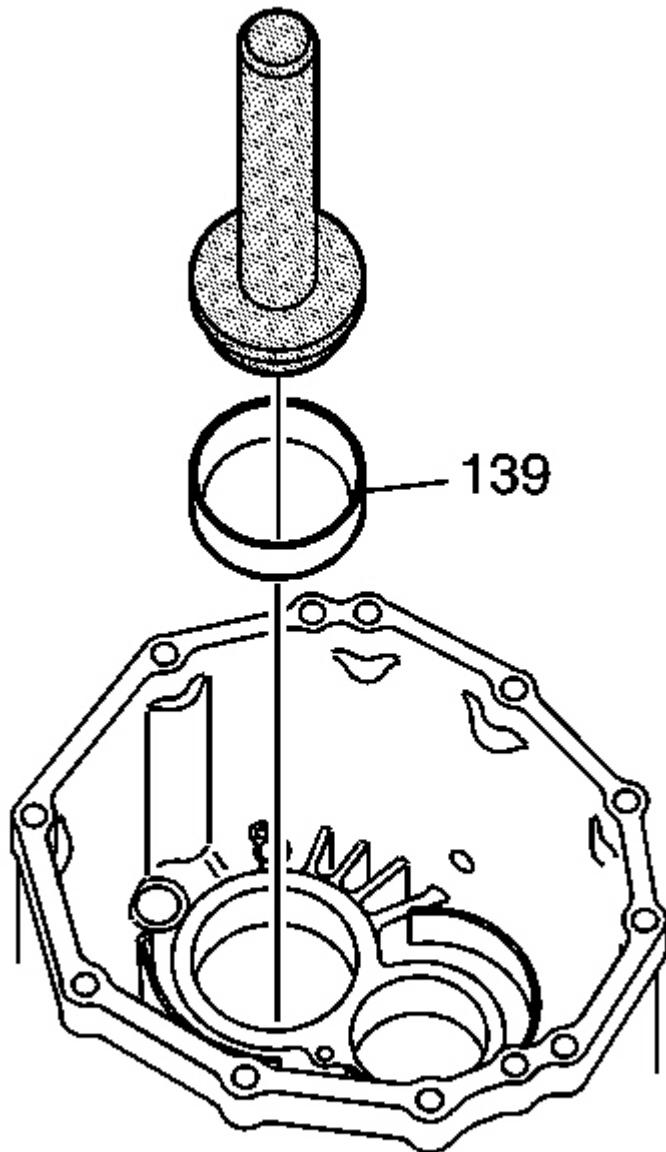


Fig. 162: Installing Tapered Bearing Race
Courtesy of GENERAL MOTORS CORP.

6. Using **DT-47725**: installer, install the tapered bearing race (139).

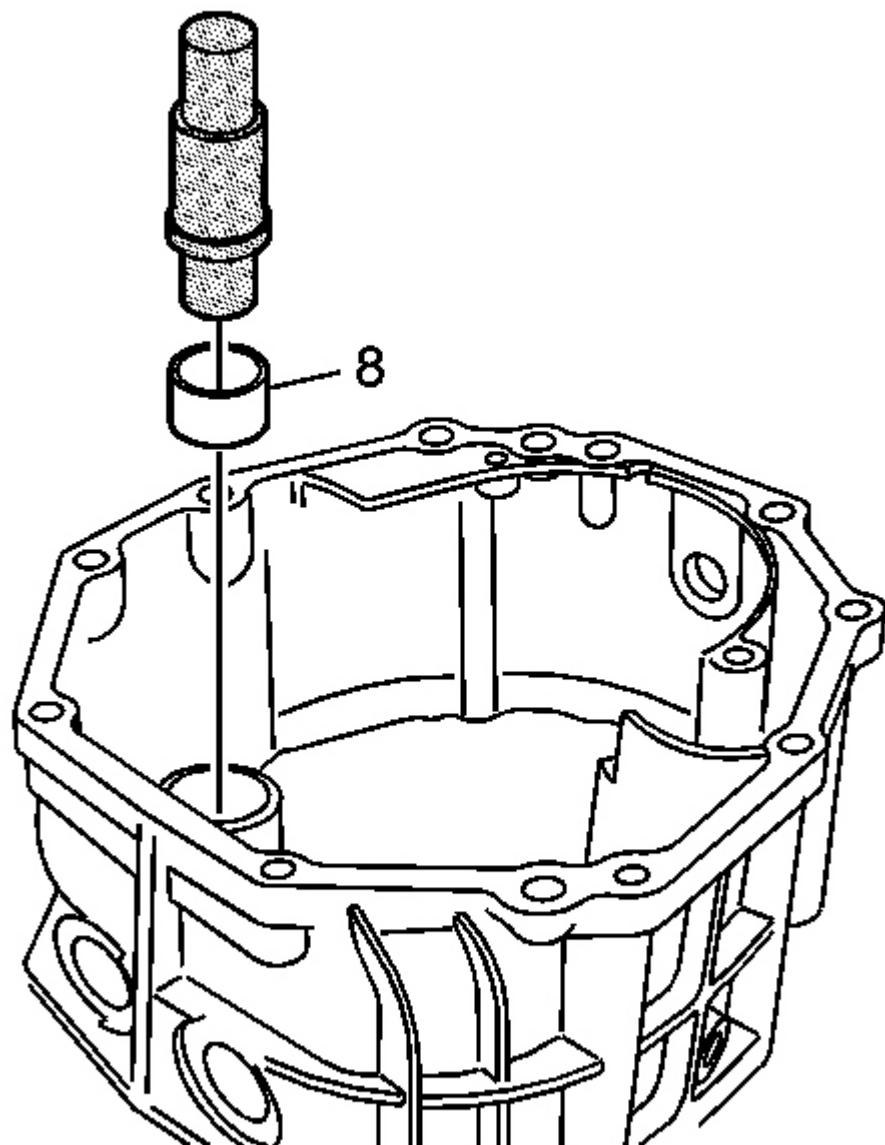


Fig. 163: Installing Bearing Into Middle Case

Courtesy of GENERAL MOTORS CORP.

Using **DT-47722**: remover/installer, install the bearing (8) in the middle case.

COUNTER GEAR SHAFT ASSEMBLE

Special Tools

- **J 5590:** Bearing and Seal Driver
- **J 36614:** Bearing Installer

For equivalent regional tools, refer to [Special Tools](#).

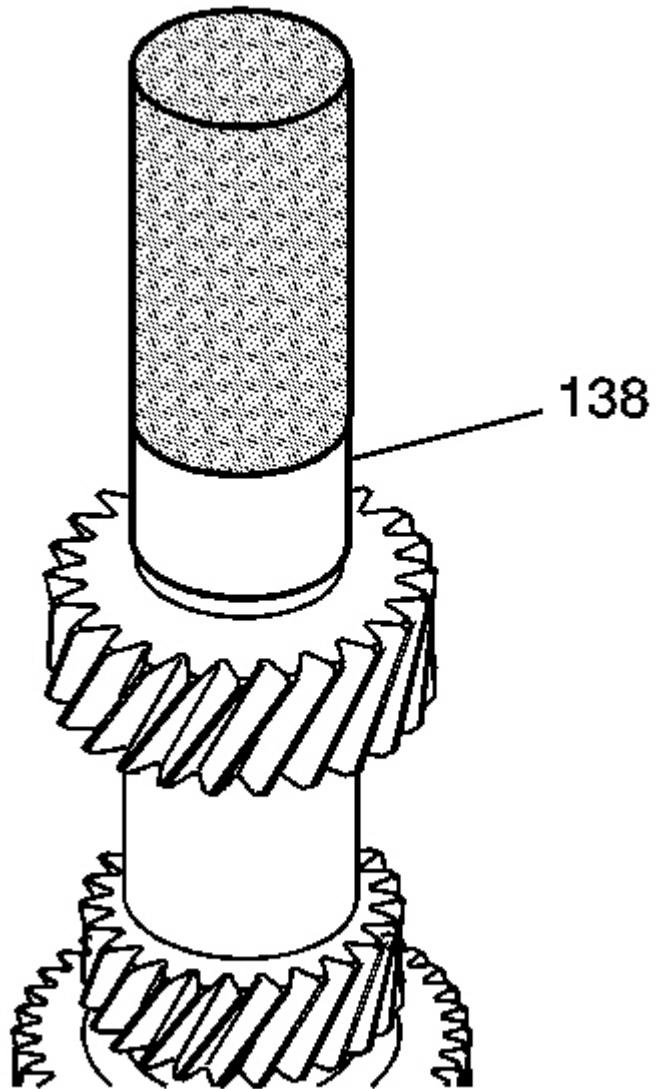


Fig. 164: View Of Inner Race

Courtesy of GENERAL MOTORS CORP.

1. Using **J 5590**: driver and a press or hammer install the inner race (138).

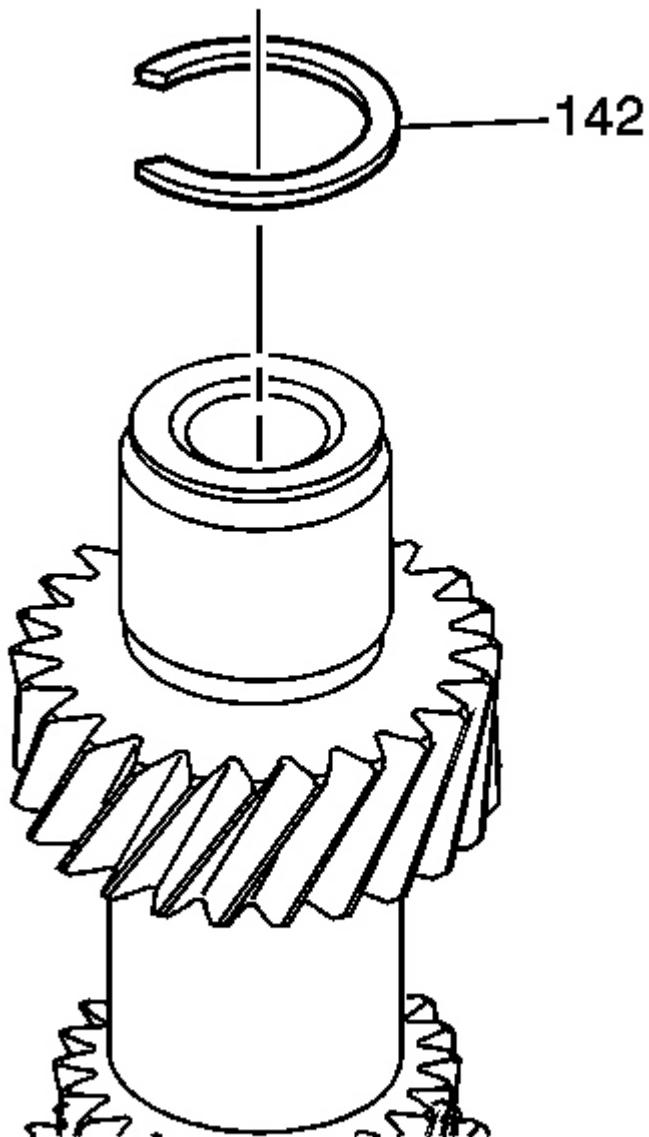


Fig. 165: Identifying Snap Ring

Courtesy of GENERAL MOTORS CORP.

2. Select and install a snap ring (142) with a maximum thickness that can be installed to the counter shaft.

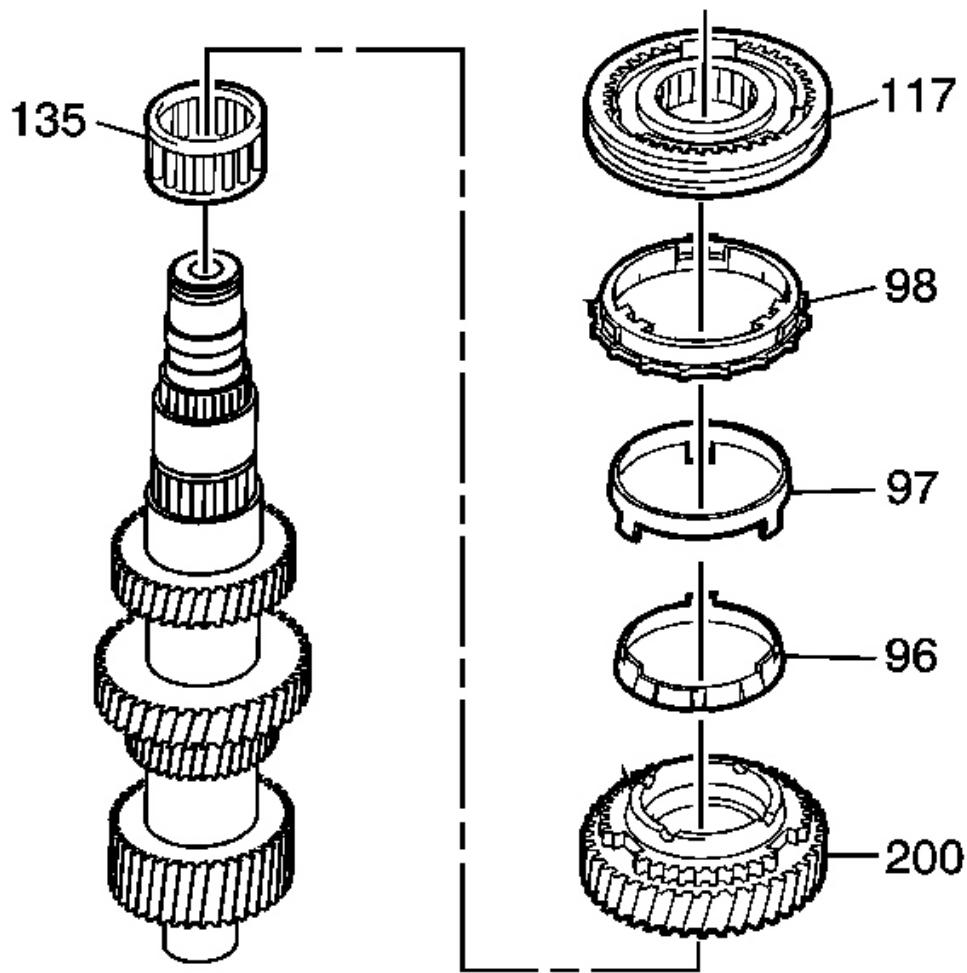


Fig. 166: View Of 2nd Gear Components
Courtesy of GENERAL MOTORS CORP.

3. Apply lubricant and install the following components:
 - The 2nd gear bearing (135)
 - The 2nd gear (200)
 - The 2nd gear synchronizer inner cone (96)
 - The 2nd gear synchronizer outer cone (97)

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- The 2nd gear outer blocker ring (98)
- The 1st/2nd gear synchronizer sleeve (117)

Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).

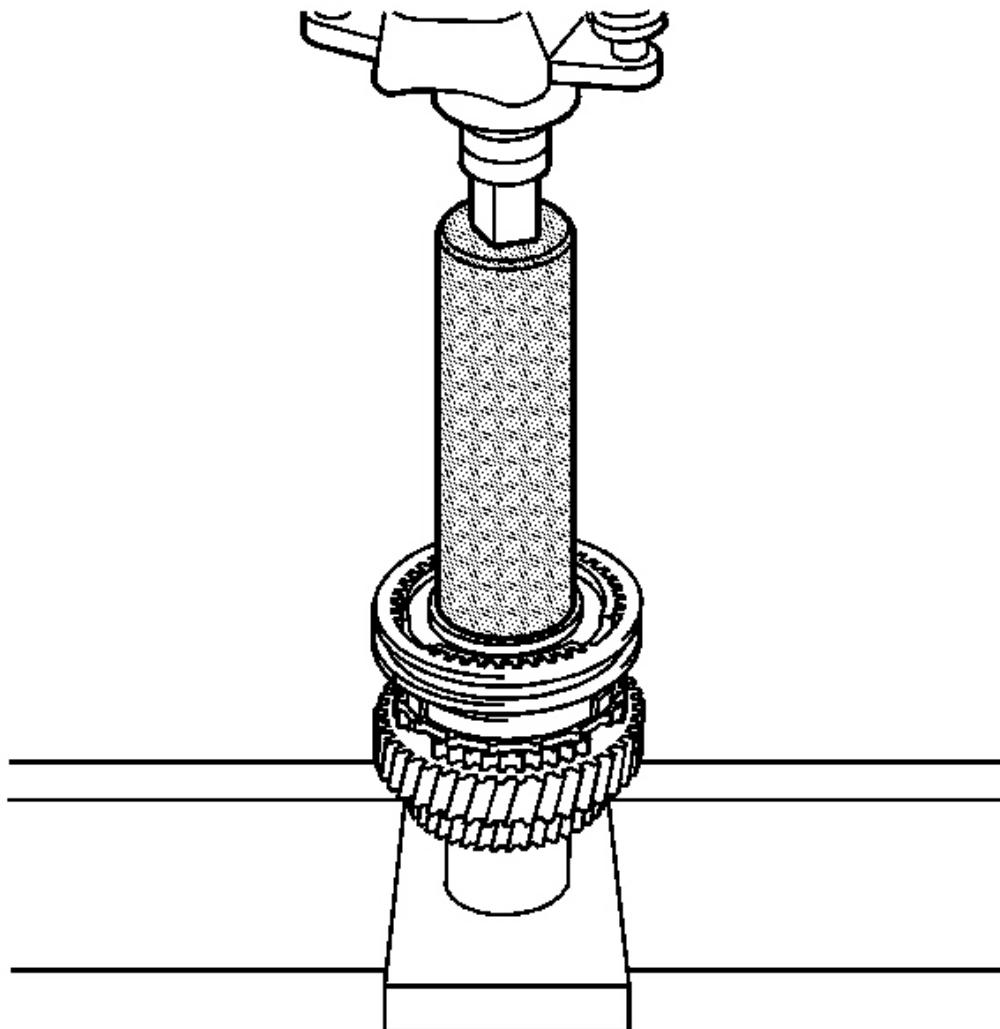


Fig. 167: Installing 1st/2nd Gear Synchronizer Sleeve
Courtesy of GENERAL MOTORS CORP.

4. Using a hydraulic press and **J 36614:** bearing installer, install the 1st/2nd gear synchronizer sleeve with the boss side facing 2nd gear. The synchronizer ring set and transmission clutch hub are to be aligned

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when installing the transmission clutch hub assembly.

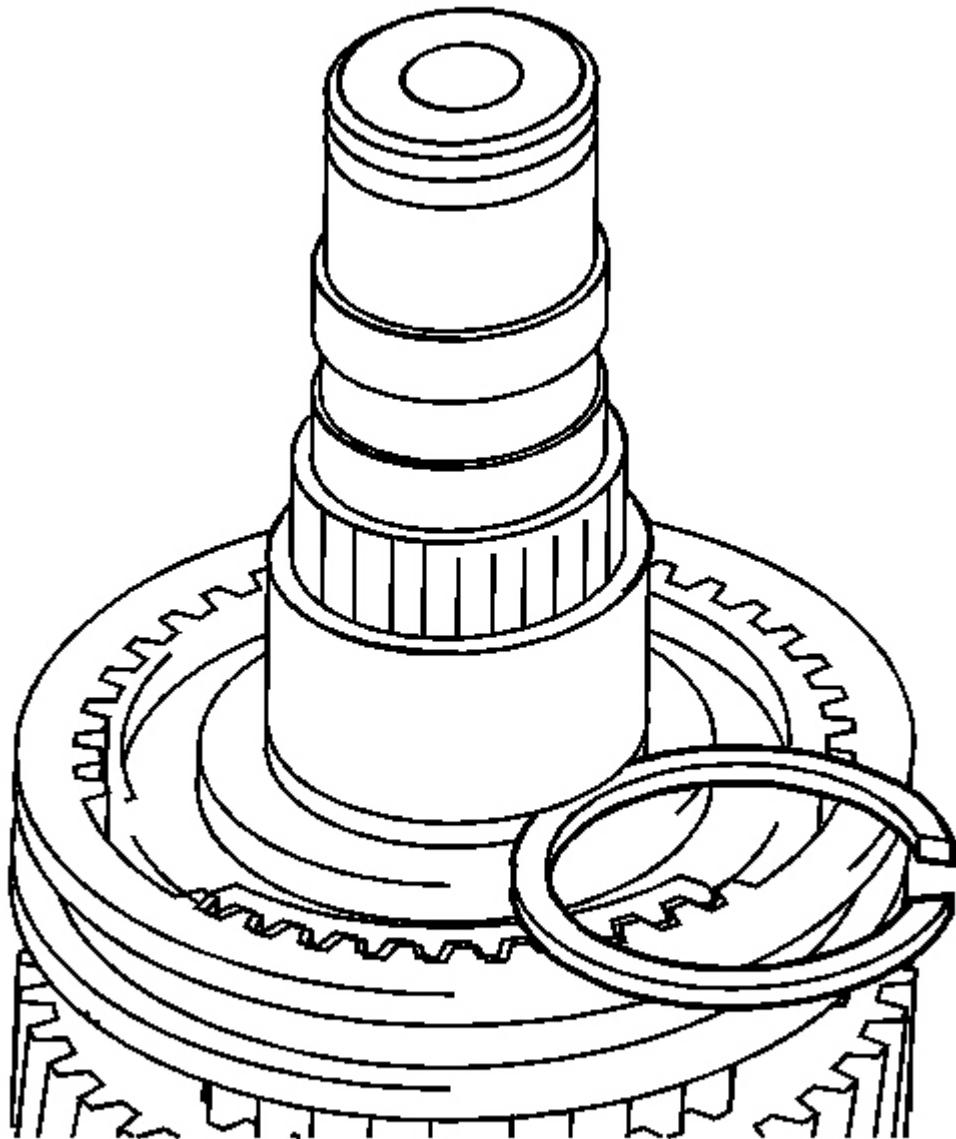


Fig. 168: View Of Retaining Ring

Courtesy of GENERAL MOTORS CORP.

NOTE: The retaining ring is a selected fit. Always install a NEW retaining ring.

5. Select the maximum thickness retaining ring that will fit in the groove. Refer to Countershaft Front and Rear Bearing Retaining Ring Specifications.

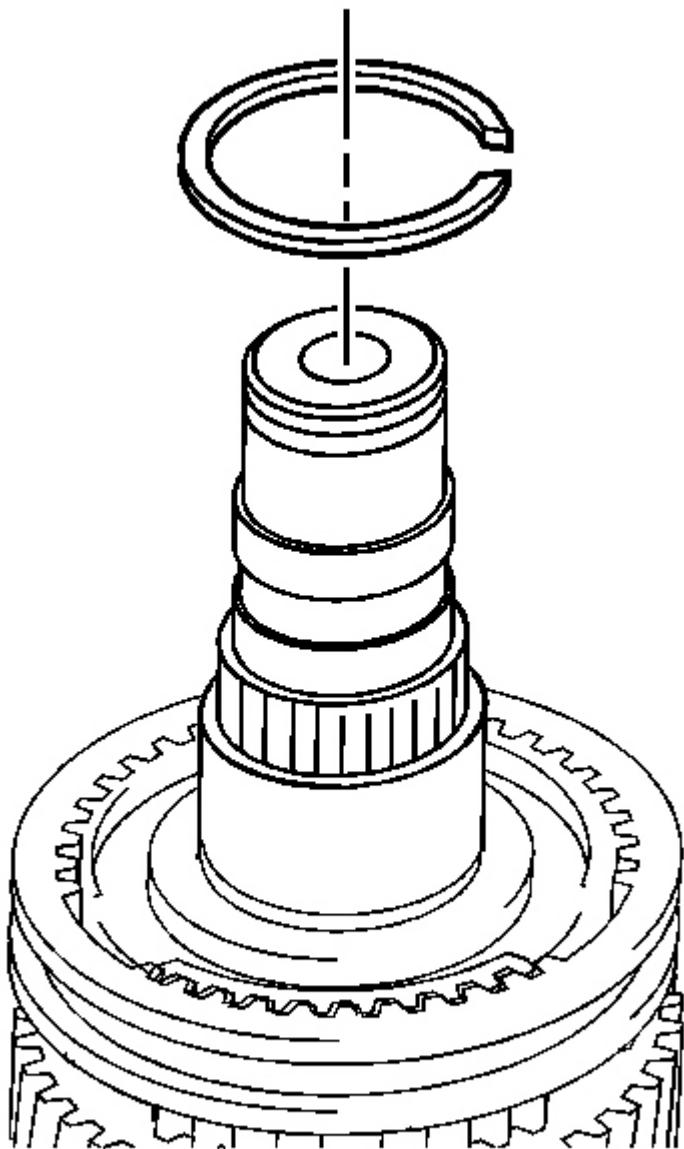


Fig. 169: View Of Snap Ring
Courtesy of GENERAL MOTORS CORP.

6. Install a NEW snap ring.

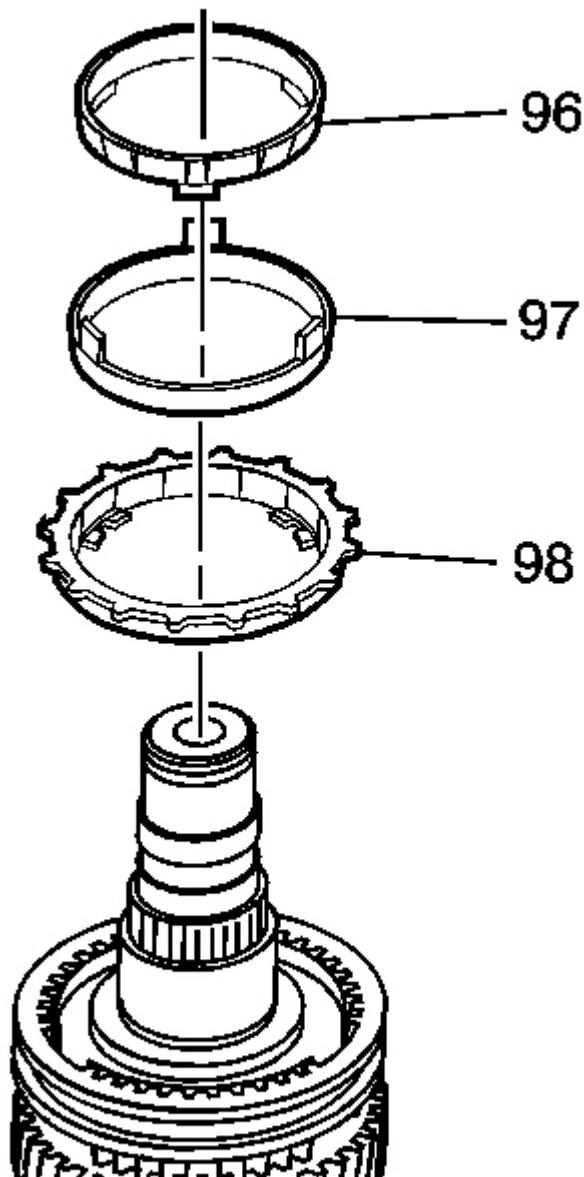


Fig. 170: View Of 1st Gear Synchronizer Cones & 1st Gear Outer/Inner Blocking Ring
Courtesy of GENERAL MOTORS CORP.

7. Apply lubricant and install the following components:

- The 1st gear outer blocking ring (98)
- The 1st gear synchronizer outer cone (97)
- The 1st gear synchronizer inner cone (96)

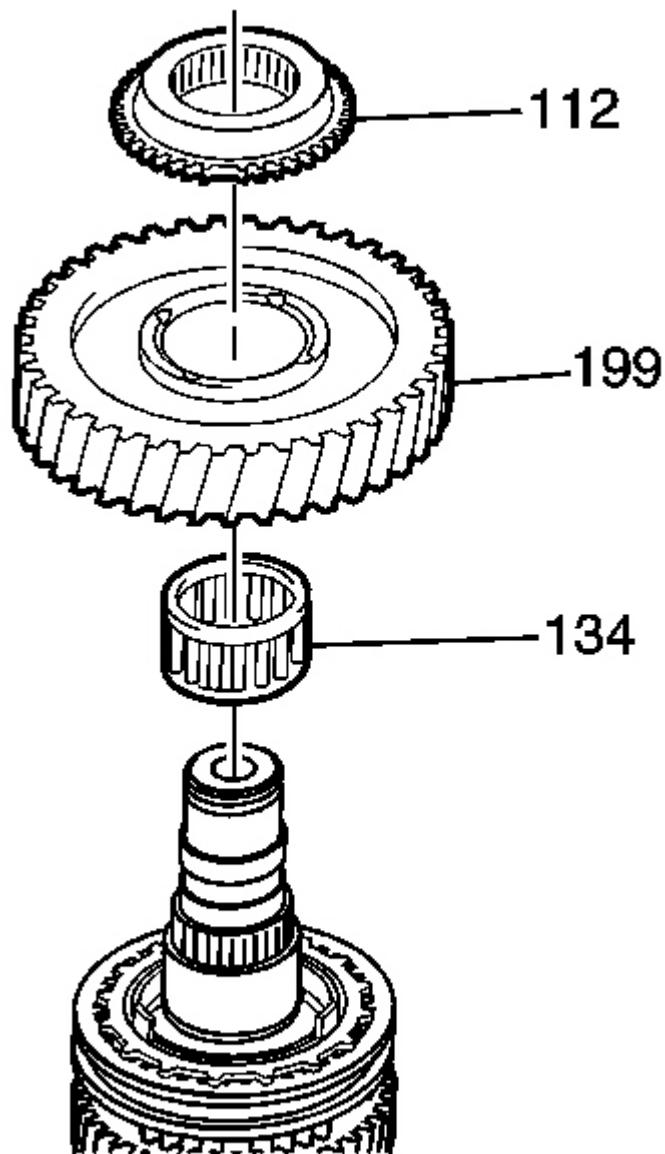


Fig. 171: View Of Reverse Gear Spline, 1st Gear & Bearing
Courtesy of GENERAL MOTORS CORP.

8. Apply lubricant, install and align the 1st gear bearing (134), 1st gear (199) and the reverse gear spline (112).

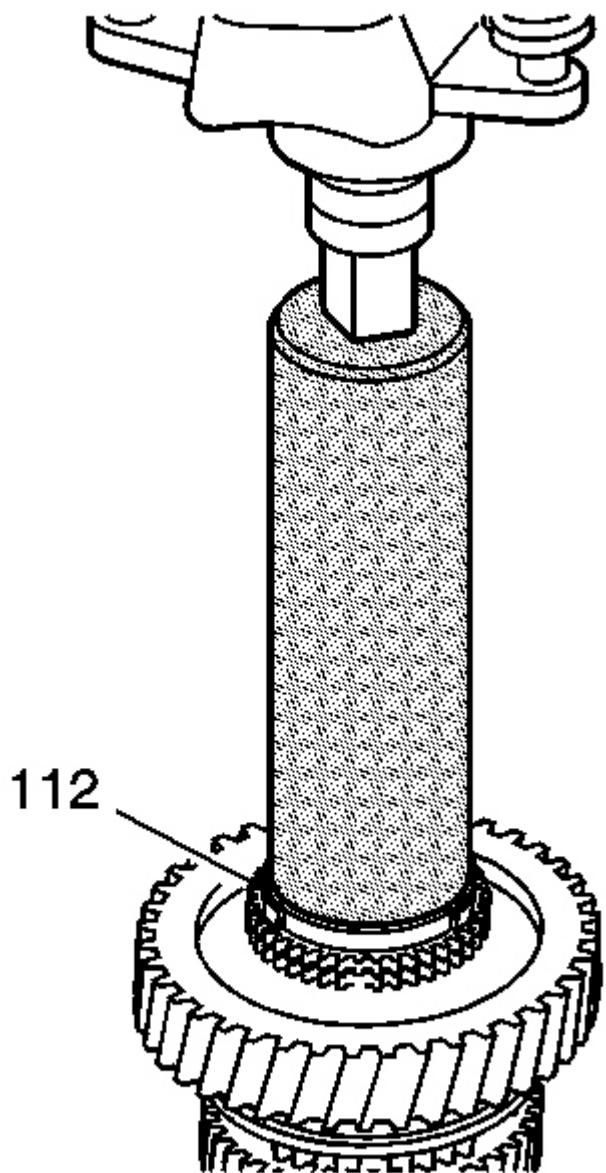


Fig. 172: Installing Reverse Gear Spline
Courtesy of GENERAL MOTORS CORP.

9. Using a hydraulic press and **J 36614**: bearing installer, install the reverse gear spline (112).

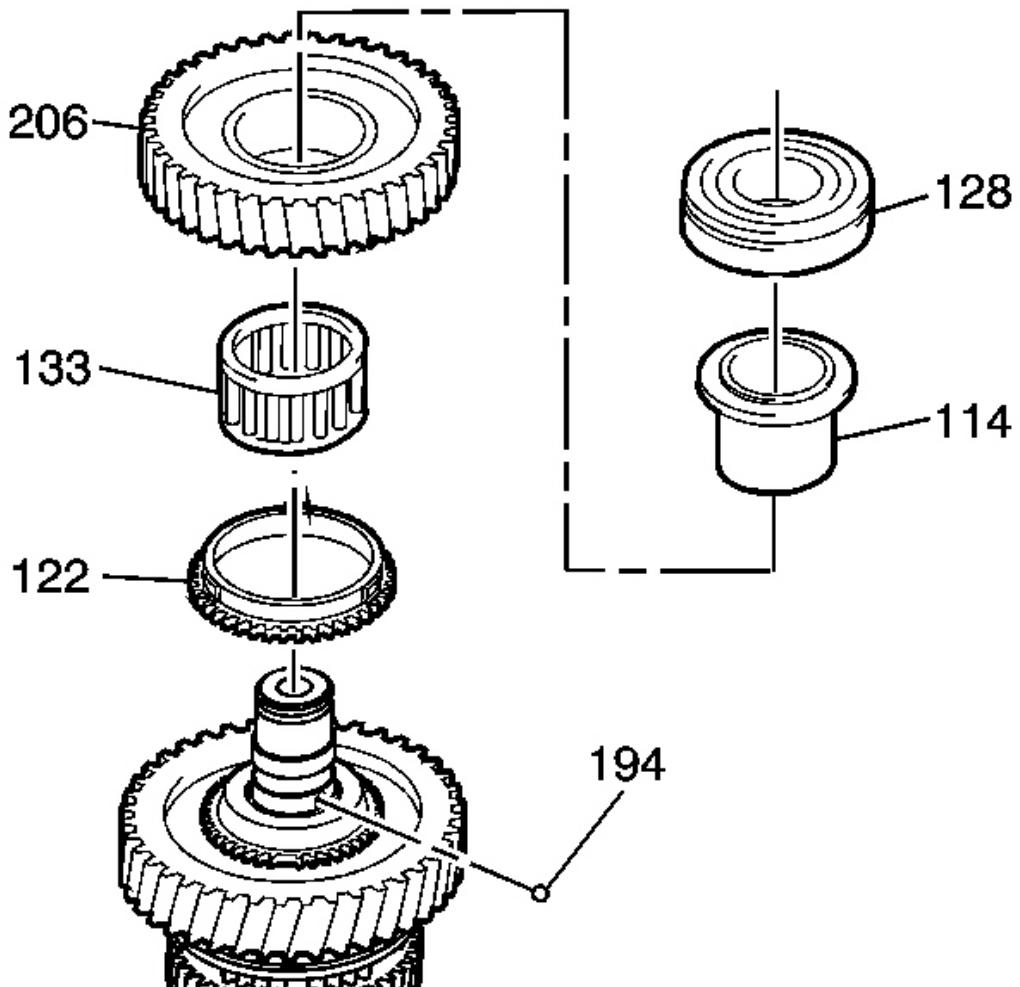


Fig. 173: Identifying Reverse & Counter Gear Components
Courtesy of GENERAL MOTORS CORP.

10. Apply lubricant and install the reverse gear blocking ring (122).
11. Install the ball (194) to the countershaft.
12. Apply lubricant and install the reverse gear bushing bearing (133).
13. Apply lubricant. Align and install the synchronizer sleeve and reverse gear (206) together.
14. Apply lubricant. Install the reverse gear bushing (114) with ball.
15. Install the counter gear front bearing (128) with groove facing forward.

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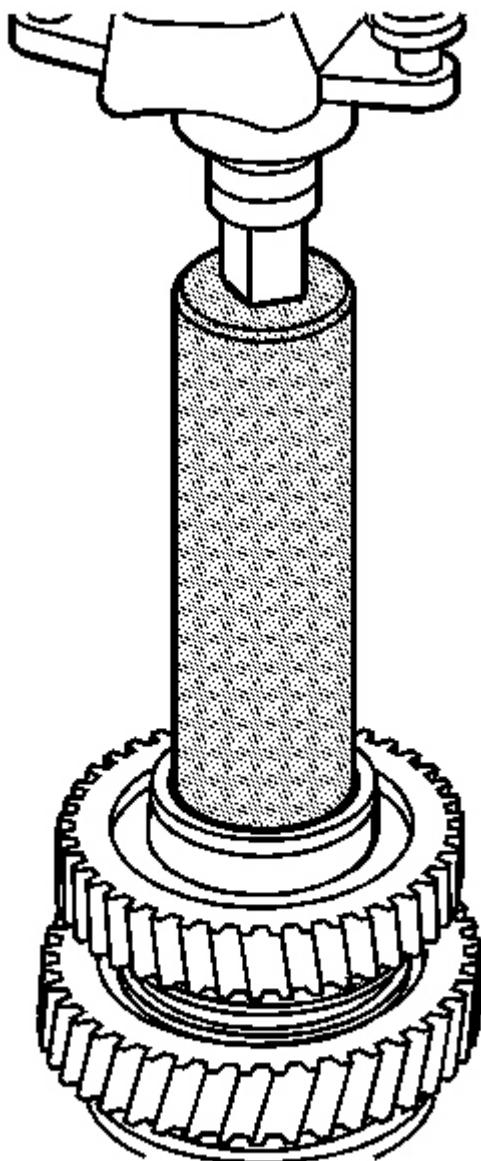


Fig. 174: Installing Counter Gear Front Bearing
Courtesy of GENERAL MOTORS CORP.

16. Using a hydraulic press and **J 5590:** driver, install the counter gear front bearing.

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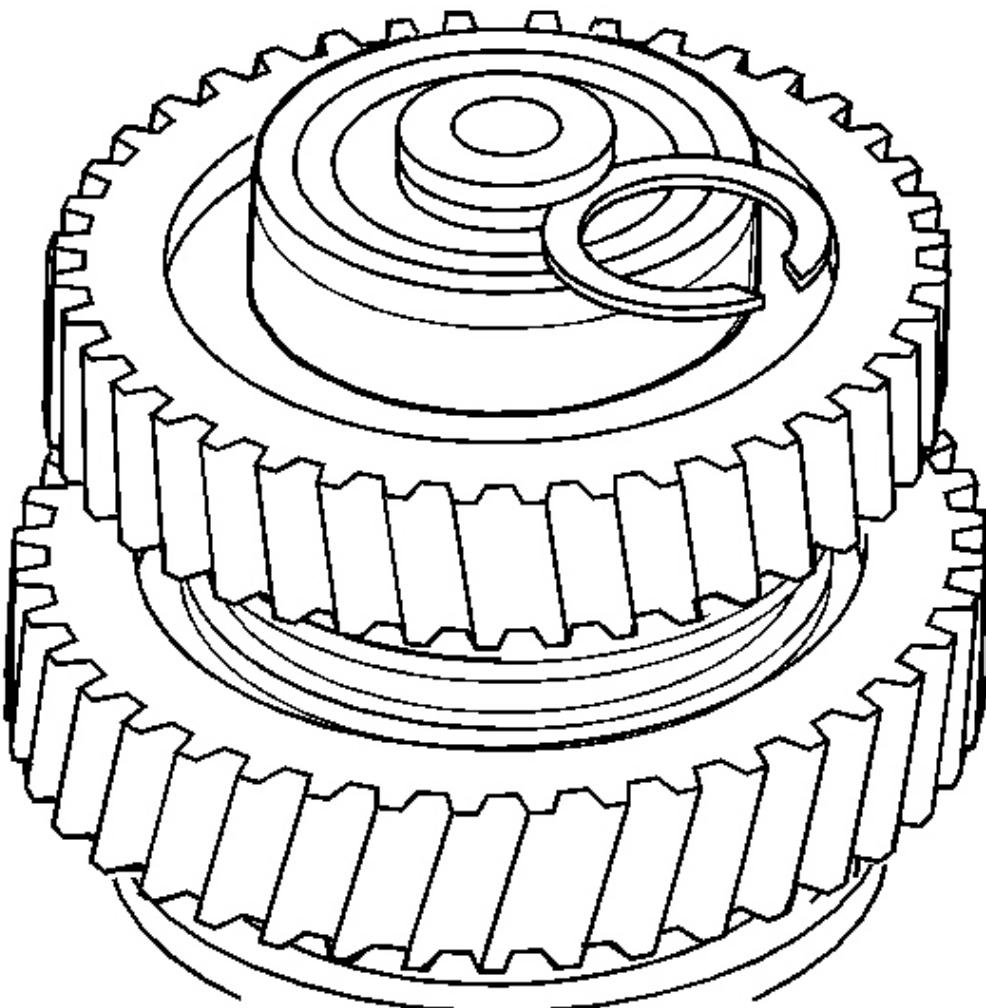


Fig. 175: View Of Retaining Ring

Courtesy of GENERAL MOTORS CORP.

NOTE: The retaining ring is a selected fit. Always install a NEW retaining ring.

17. Select the maximum thickness retaining ring that will fit in the groove. Refer to **1st and 2nd Gear Synchronizer Retaining Ring Specifications**.

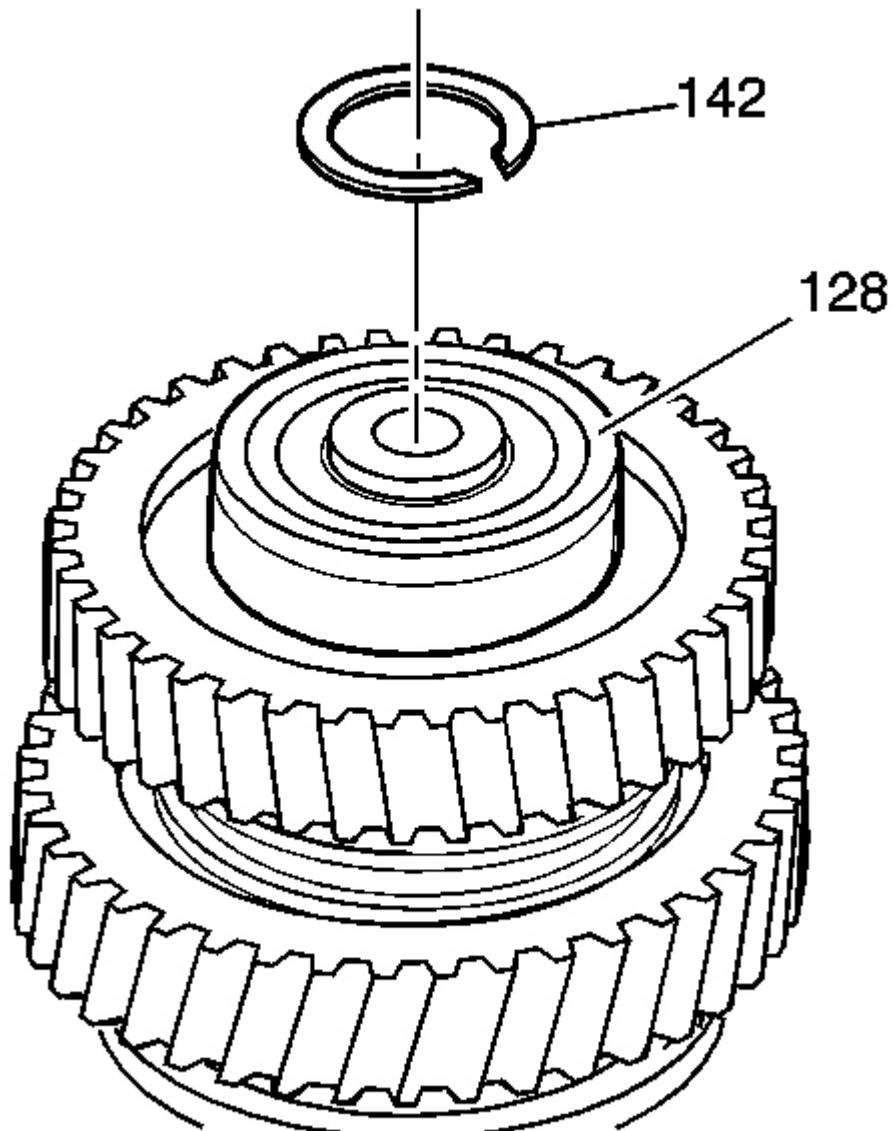


Fig. 176: View Of Counter Gear Front Bearing & Snap Ring

Courtesy of GENERAL MOTORS CORP.

18. Install a NEW snap ring (142).

INPUT SHAFT ASSEMBLE

Special Tools

- **DT-47723:** Output Shaft Bearing Installer
- **J 5590:** Bearing and Seal Driver

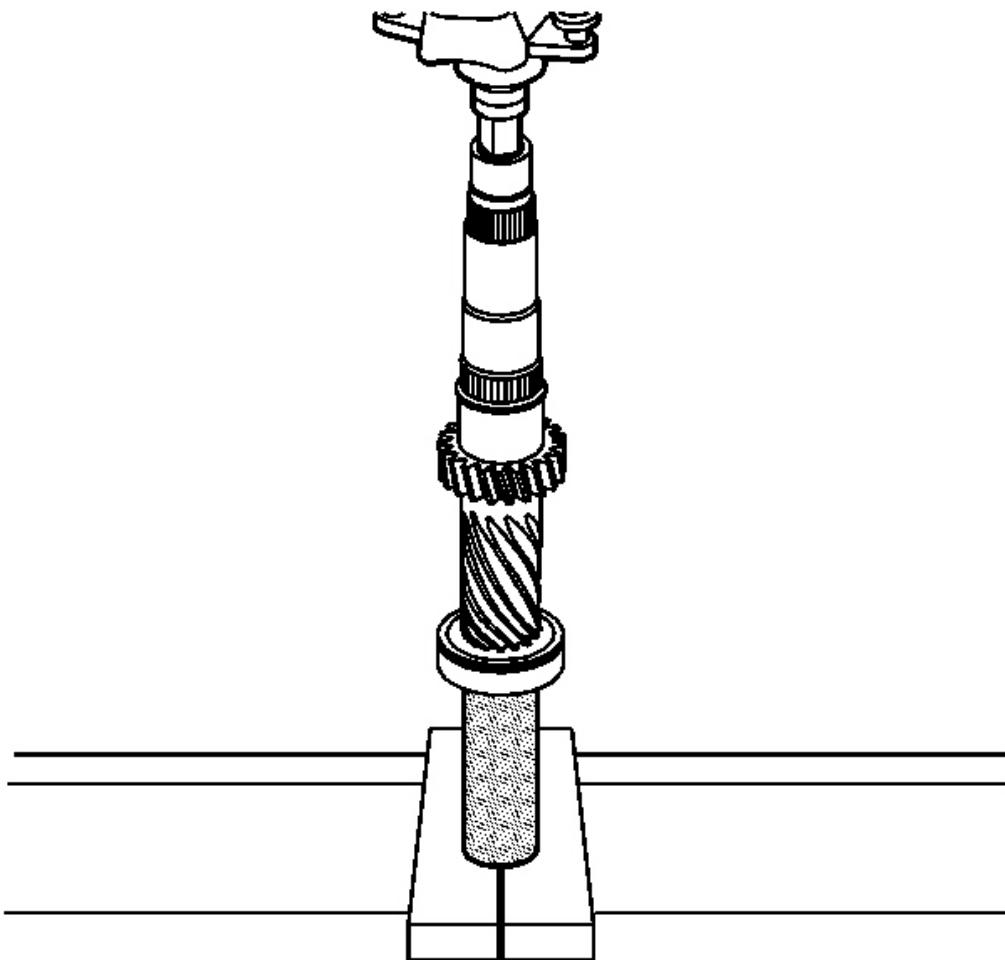


Fig. 177: Installing Counter Gear Front Bearing
Courtesy of GENERAL MOTORS CORP.

1. Using a hydraulic press and **J 5590:** driver, install the counter gear front bearing on the input shaft.

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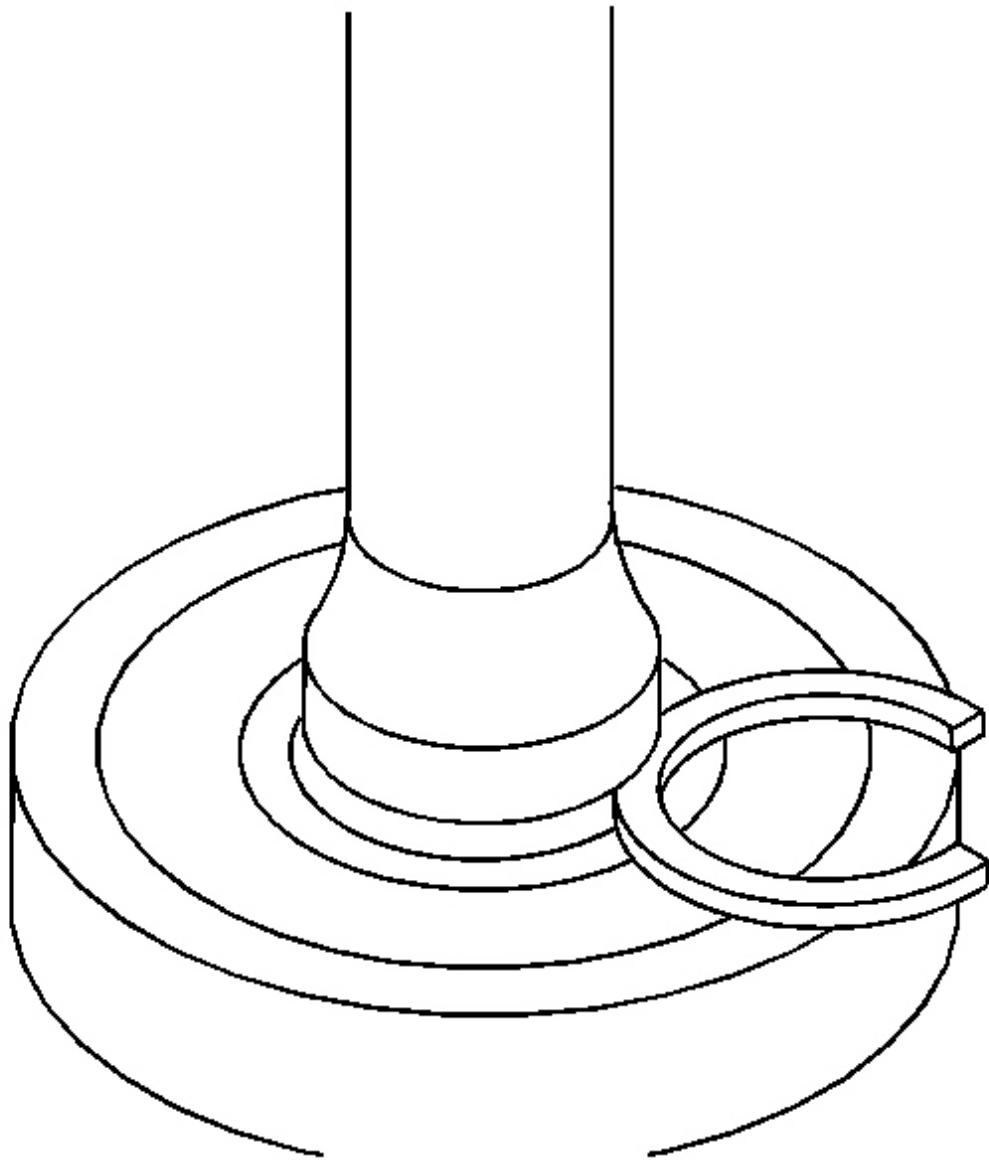


Fig. 178: View Of Retaining Ring

Courtesy of GENERAL MOTORS CORP.

NOTE: The retaining ring is a selected fit. Always install a NEW retaining ring.

2. Select the maximum thickness retaining ring that will fit in the groove. Refer to **Input Shaft Bearing**

Retaining Ring Specifications.

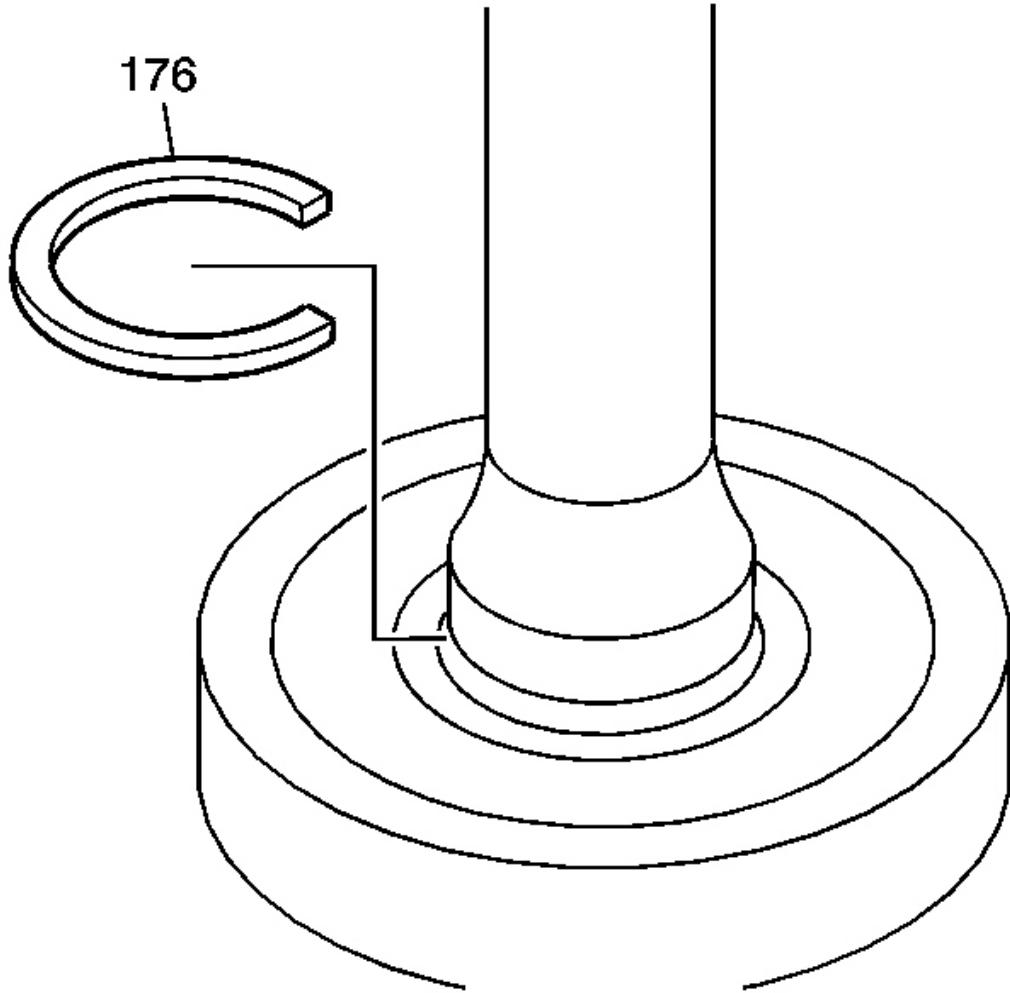


Fig. 179: View Of Snap Ring

Courtesy of GENERAL MOTORS CORP.

3. Install a NEW snap ring (176) and ensure that the radial bearing rotates smoothly.

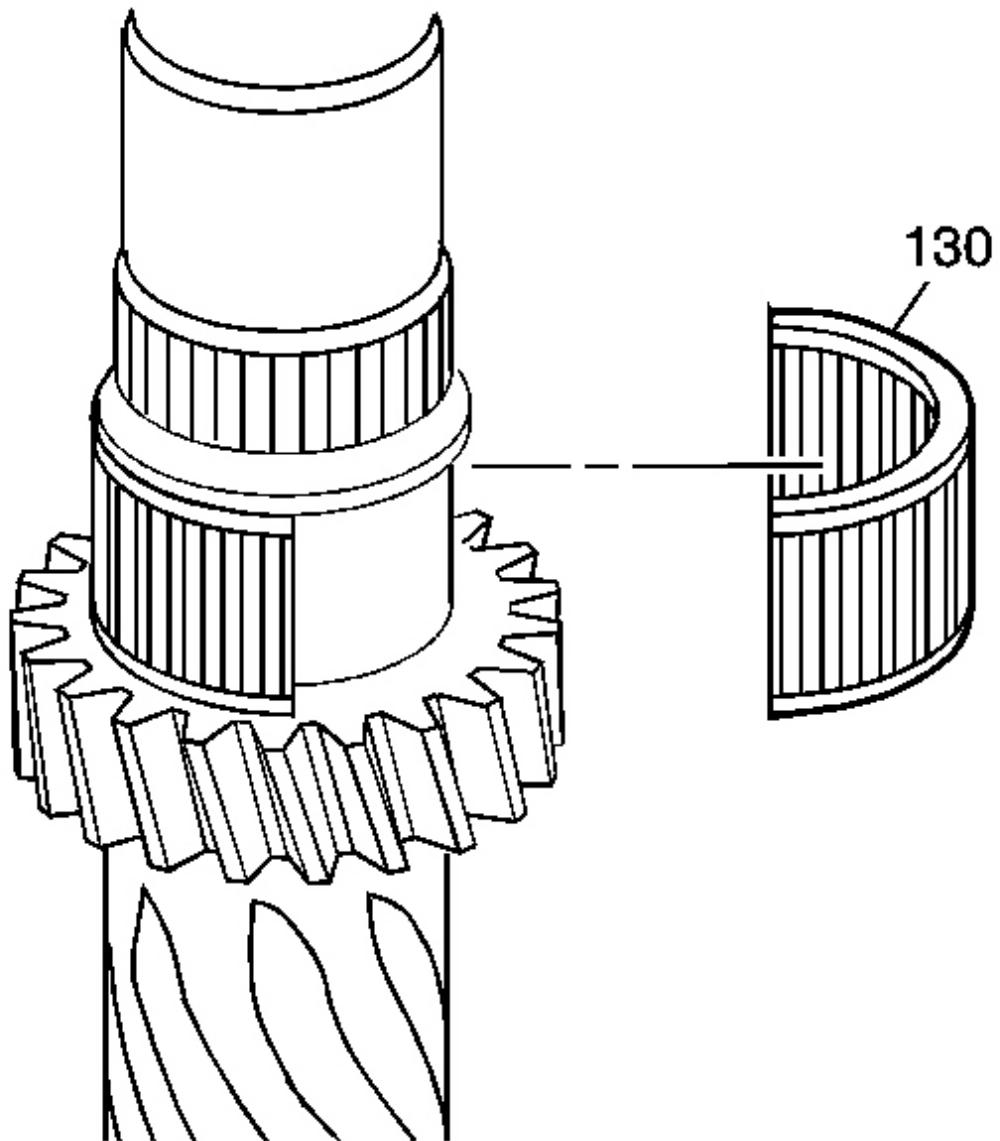


Fig. 180: View Of 4th Gear Bearing
Courtesy of GENERAL MOTORS CORP.

4. Apply lubricant and install the 4th gear bearing (130). Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).

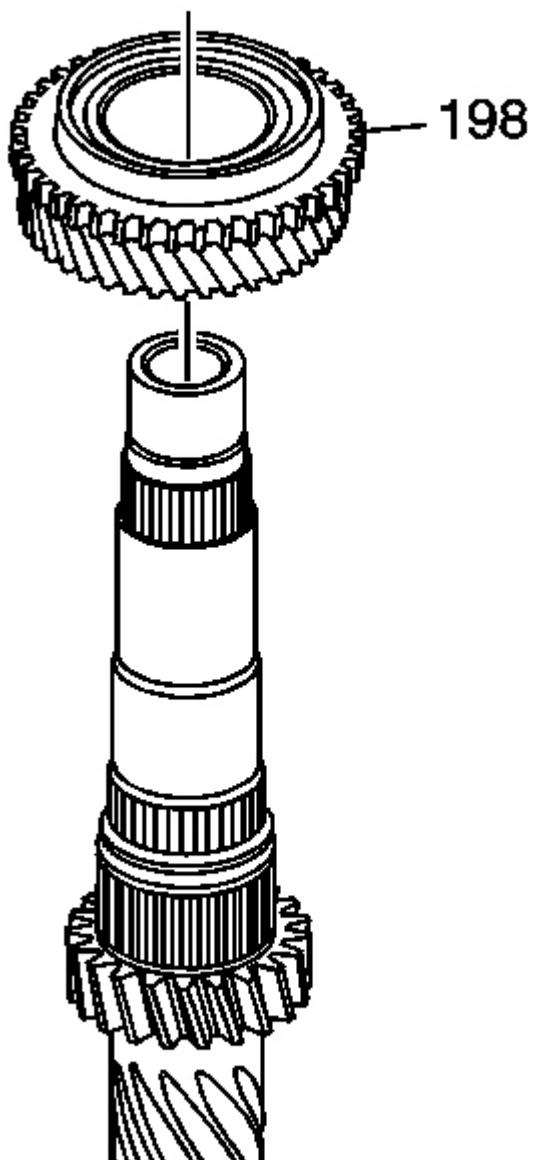


Fig. 181: View Of 4th Gear

Courtesy of GENERAL MOTORS CORP.

5. Apply lubricant and install the 4th gear (198).

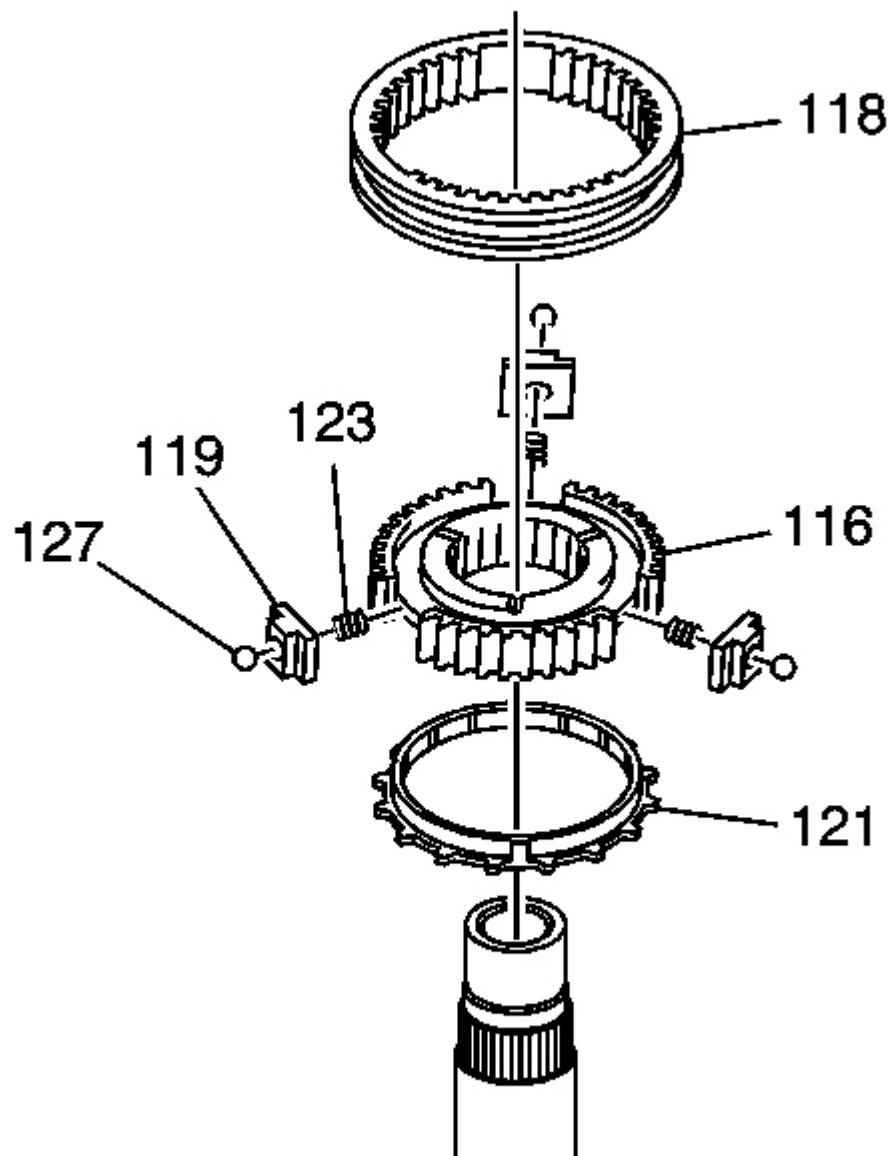


Fig. 182: View 3rd/4th Gear Assembly
Courtesy of GENERAL MOTORS CORP.

6. Apply lubricant and install the following components:

- The blocking ring (121)
- The 3rd/4th gear synchronizer hub (116) including the spring (123), detent ball (127) and insert

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(119)

- The 3rd/4th gear synchronizer sleeve (118) with the higher boss facing the front

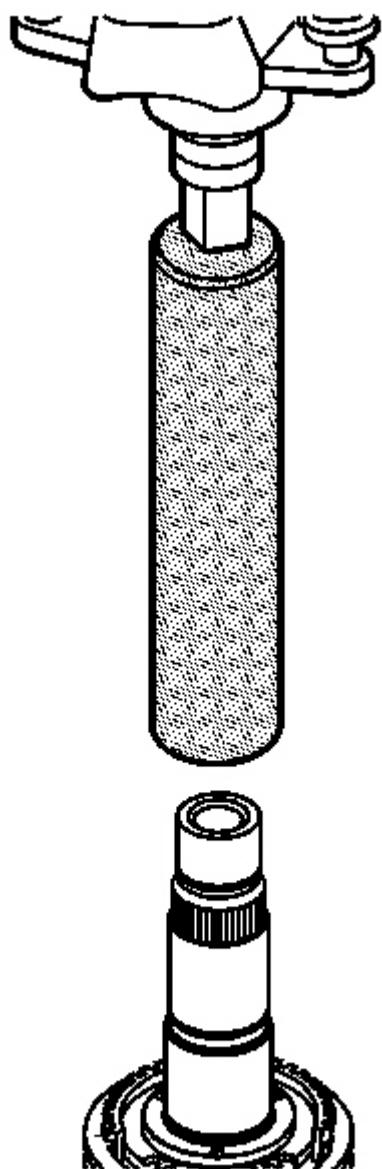


Fig. 183: Installing 3rd/4th Synchronizer Hub Assembly
Courtesy of GENERAL MOTORS CORP.

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7. Using a hydraulic press and **DT-47723**: installer, install the 3rd/4th synchronizer hub assembly. Ensure that the synchronizer ring and 3rd/4th synchronizer hub assembly are aligned when installing.

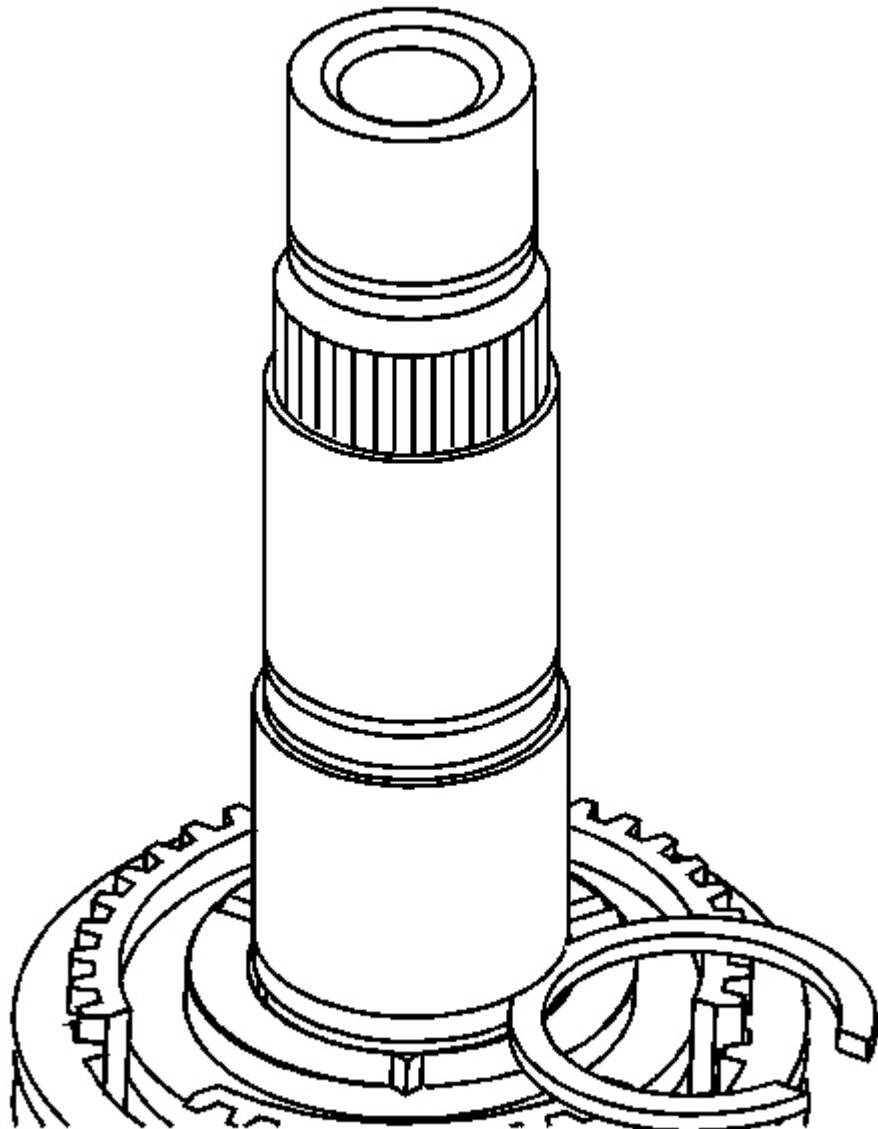


Fig. 184: View Of Retaining Ring

Courtesy of GENERAL MOTORS CORP.

NOTE: The retaining ring is a selected fit. Always install a NEW retaining ring.

8. Select the maximum thickness retaining ring that will fit in the groove. Refer to [3rd and 4th Gear Synchronizer Retaining Ring Specifications](#).

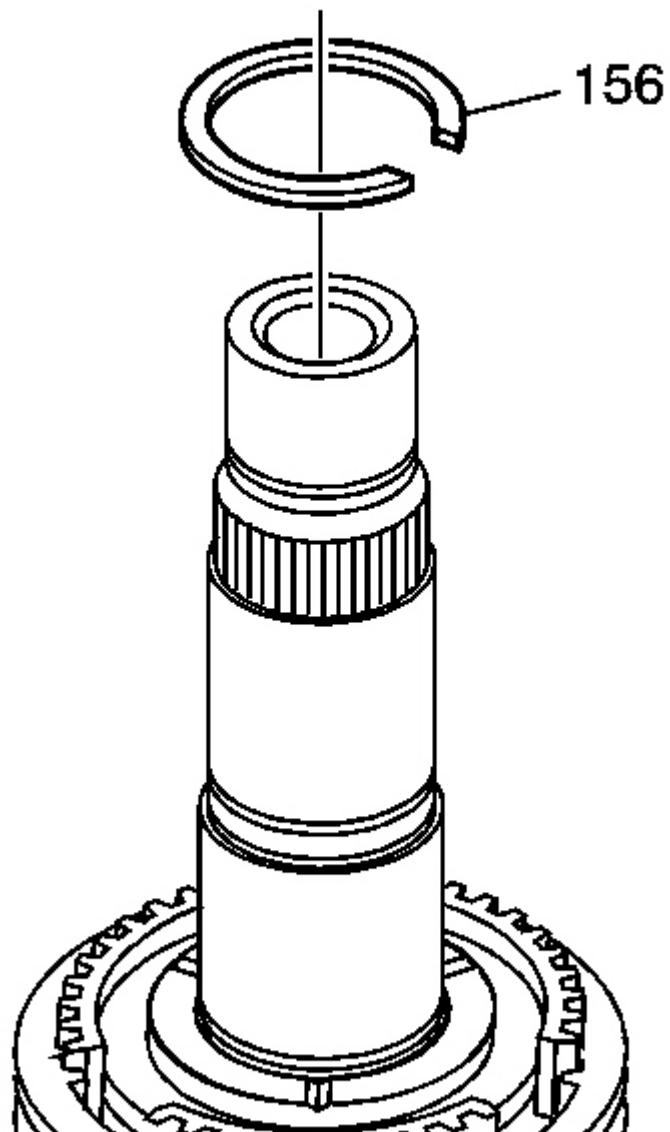


Fig. 185: View Of Snap Ring
Courtesy of GENERAL MOTORS CORP.

9. Install a NEW snap ring (156).

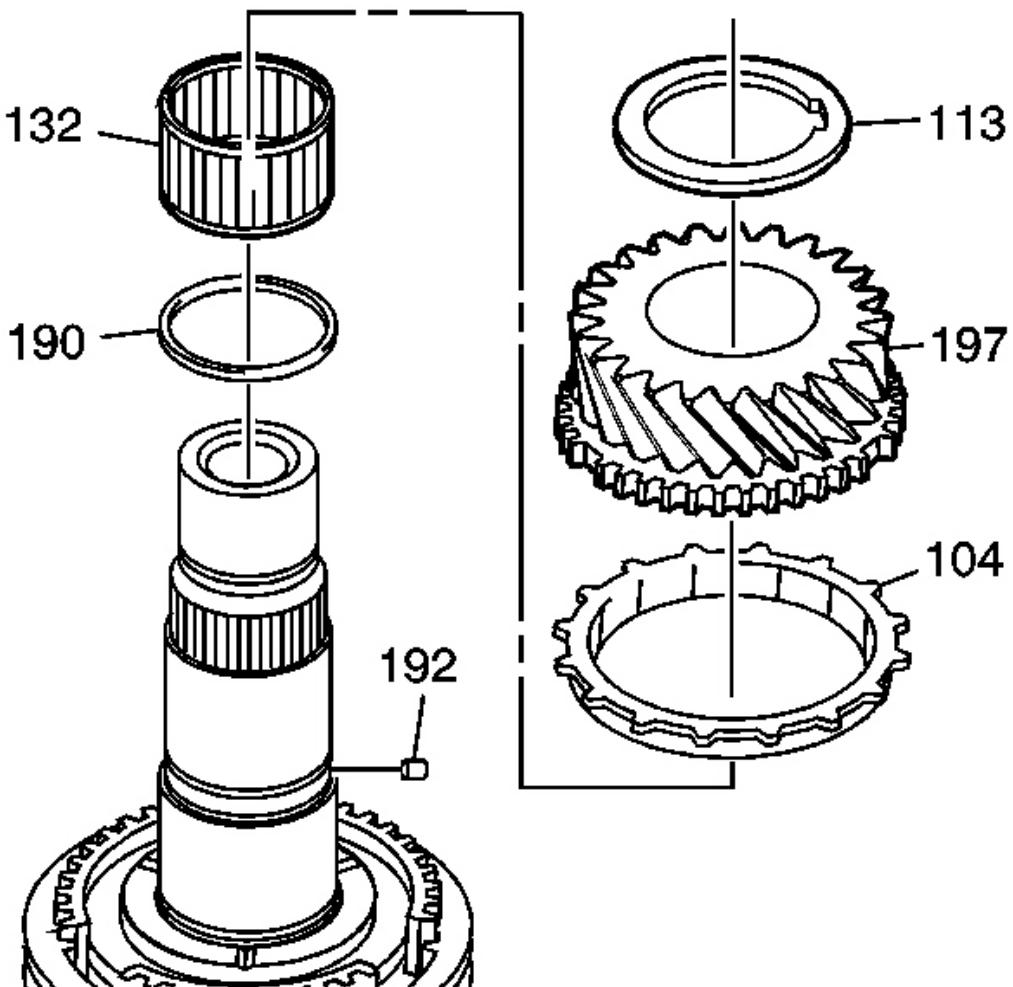


Fig. 186: View Of 3rd Gear Components
Courtesy of GENERAL MOTORS CORP.

10. Apply lubricant to components and install the following components:
 - 3rd/4th gear spacer (190)
 - 3rd gear bearing (132)
 - 3rd gear blocking ring (104)
 - Install and align the 3rd gear (197).
 - Locating pin (192)
 - Install and align the 3rd gear thrust washer (113) with the groove facing the front.

Refer to [Adhesives, Fluids, Lubricants, and Sealers](#) .

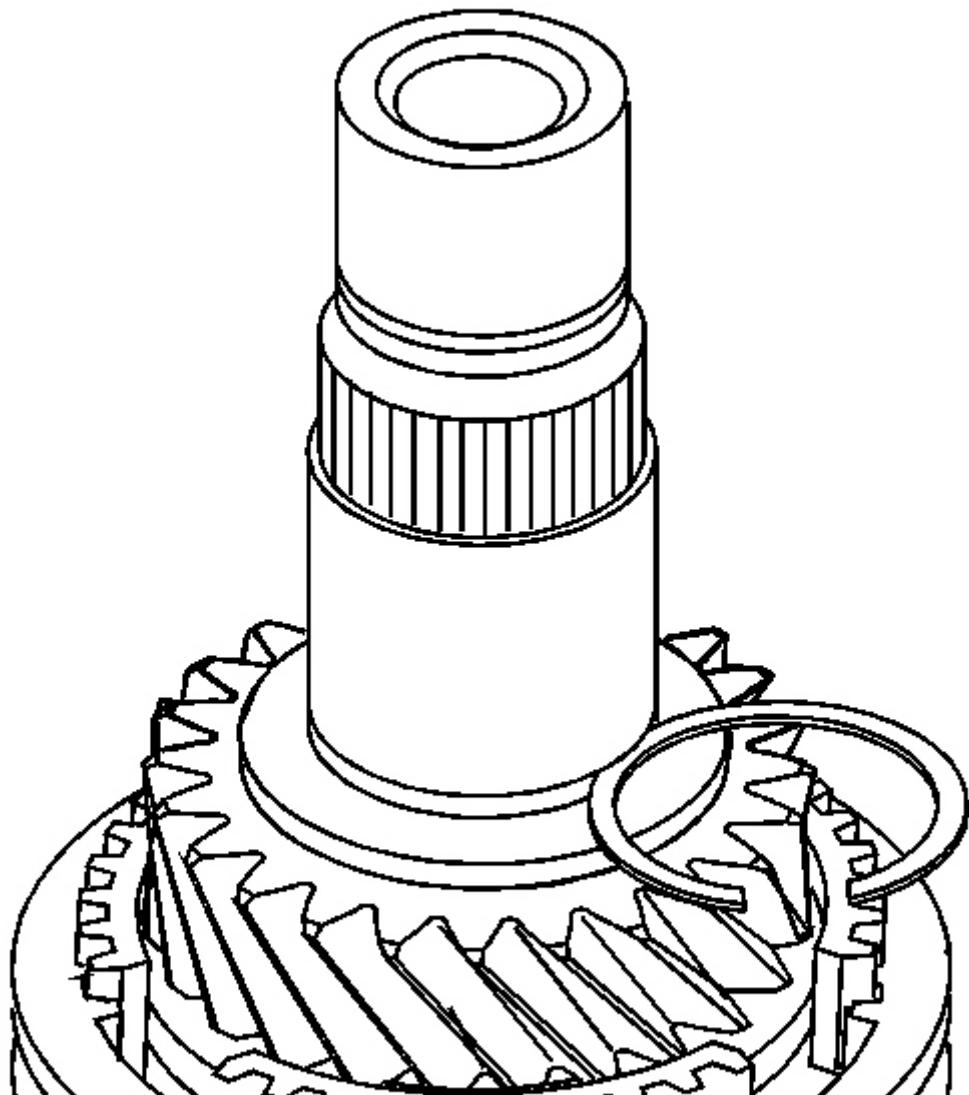


Fig. 187: View Of Retaining Ring

Courtesy of GENERAL MOTORS CORP.

NOTE: The retaining ring is a selected fit. Always install a NEW retaining ring.

11. Select the maximum thickness retaining ring that will fit in the groove. Refer to [3rd and 4th Gear](#)

Synchronizer Retaining Ring Specifications.

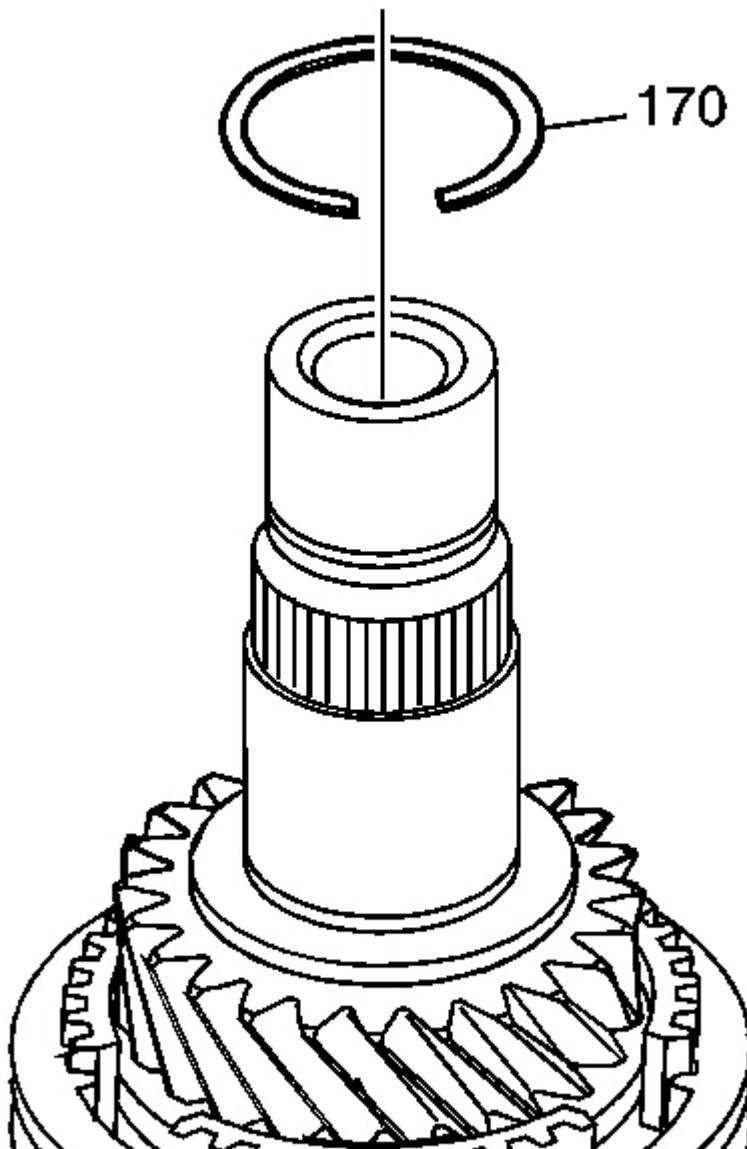


Fig. 188: View Of Snap Ring
Courtesy of GENERAL MOTORS CORP.

12. Install a NEW snap ring (170).

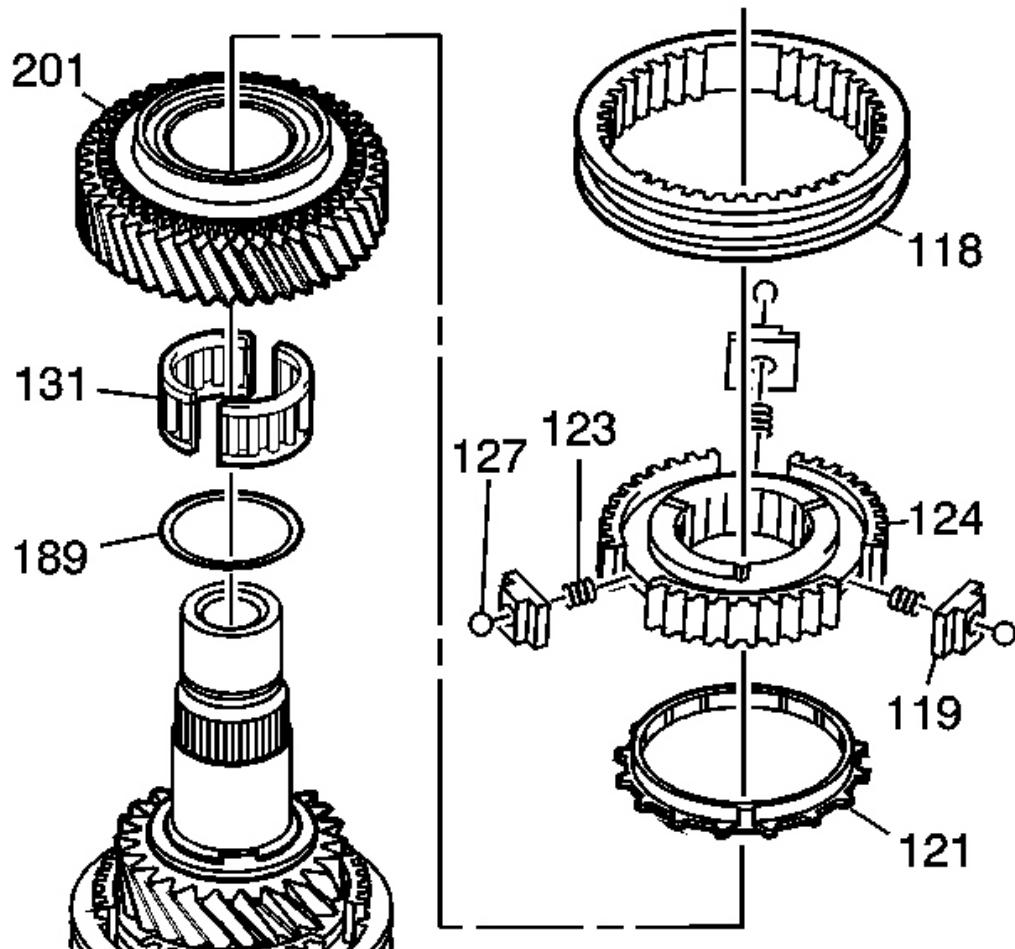


Fig. 189: View Of 5th/6th Gear Assembly

Courtesy of GENERAL MOTORS CORP.

13. Install the 6th gear bearing spacer (189).
14. Apply lubricant and install the 6th gear bearing (131). Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).
15. Apply lubricant and install the 6th gear (201).
16. Apply lubricant and install the 6th gear blocking ring (121).
17. Apply lubricant and install the 5th/6th gear synchronizer hub (124) including the spring (123), detent ball (127) and insert (119).
18. Apply lubricant and install the 5th/6th synchronizer sleeve (118) with higher boss of sleeve facing the rear.

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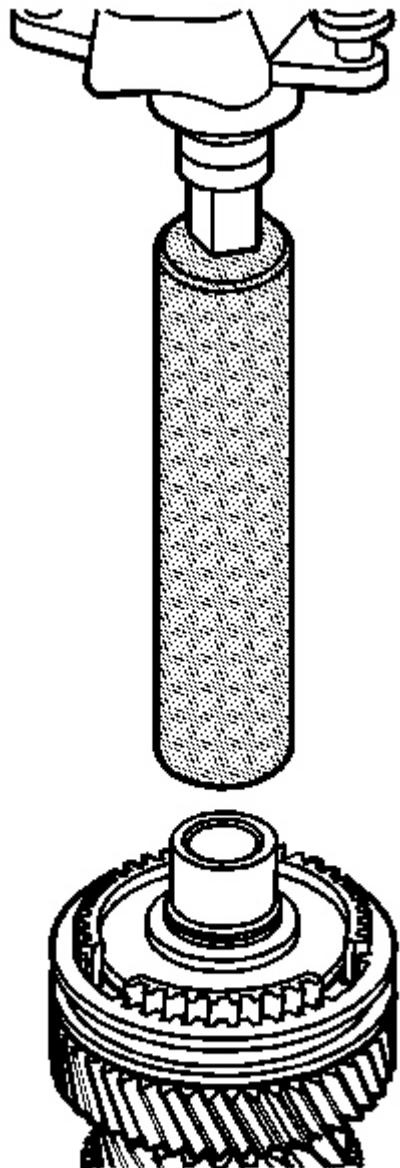


Fig. 190: Installing 5th/6th Synchronizer Hub Assembly
Courtesy of GENERAL MOTORS CORP.

19. Use a hydraulic press and **DT-47723**: installer to install the 5th/6th synchronizer hub assembly.

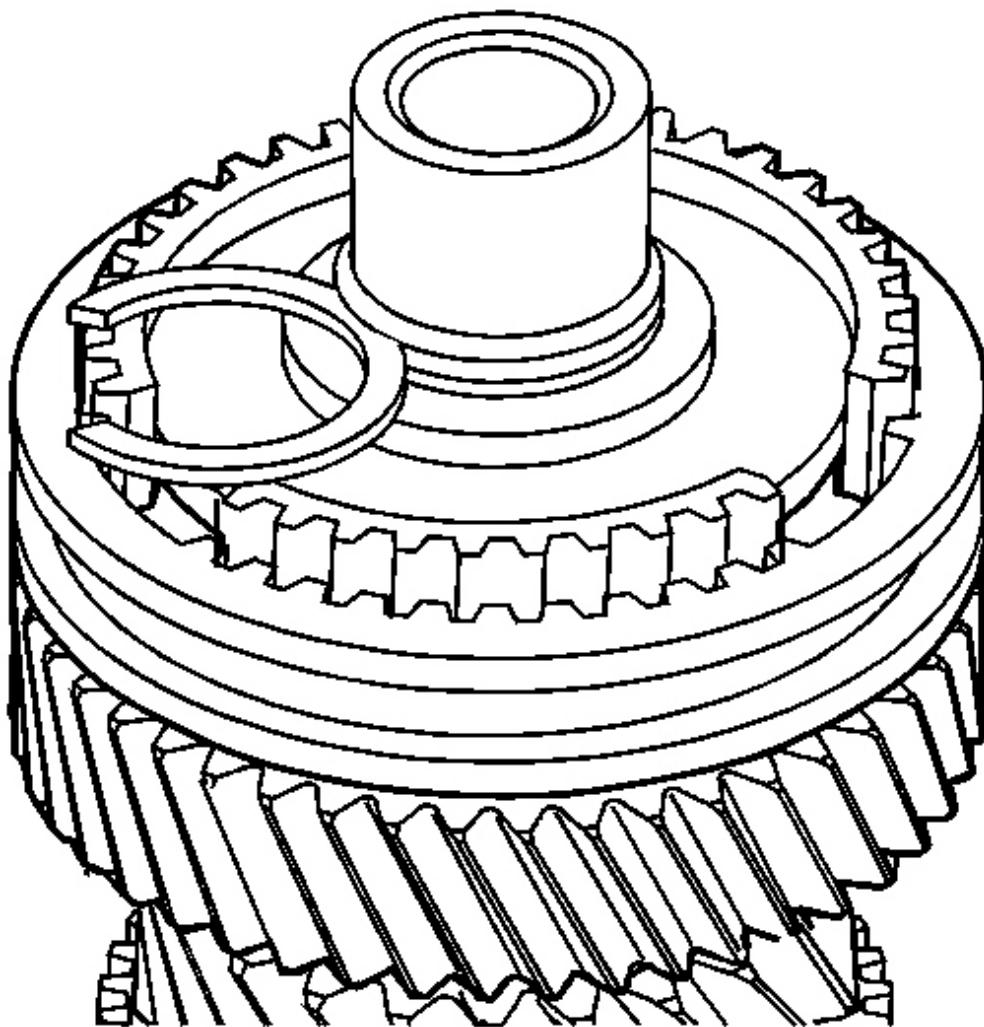


Fig. 191: View Of Retaining Ring

Courtesy of GENERAL MOTORS CORP.

NOTE: The retaining ring is a selected fit. Always install a NEW retaining ring.

20. Select the maximum thickness retaining ring that will fit in the groove. Refer to [6th Gear Retaining Ring Specifications](#).

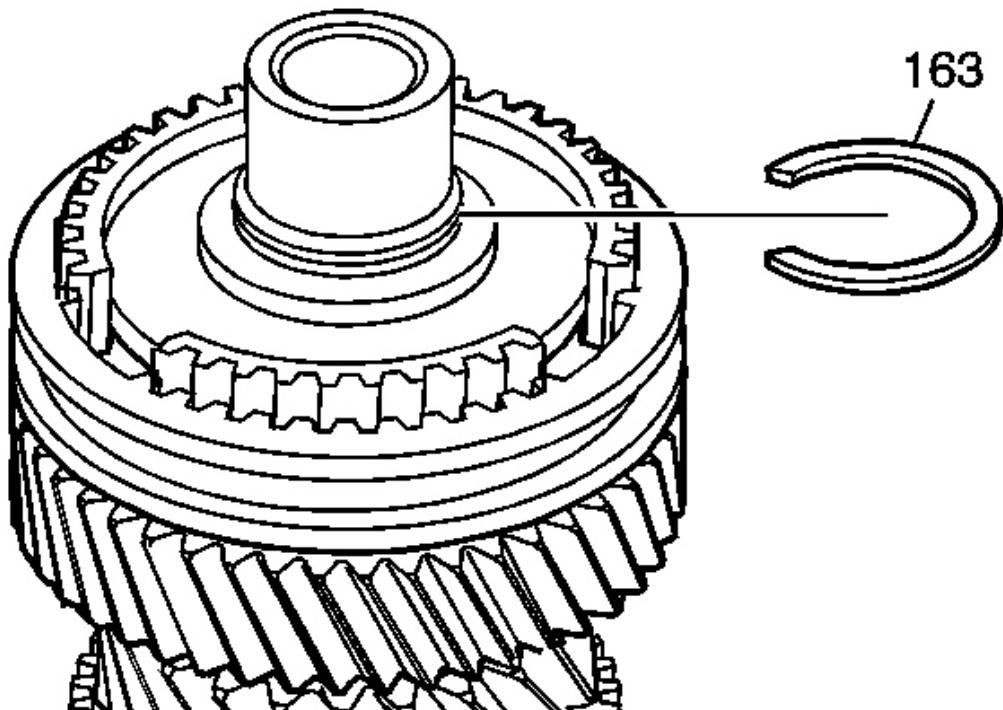


Fig. 192: View Of Snap Ring

Courtesy of GENERAL MOTORS CORP.

21. Install a NEW snap ring (163).

OUTPUT SHAFT ASSEMBLE

Tools Required

DT-47723 Output Shaft Bearing Installer. See **Special Tools**.

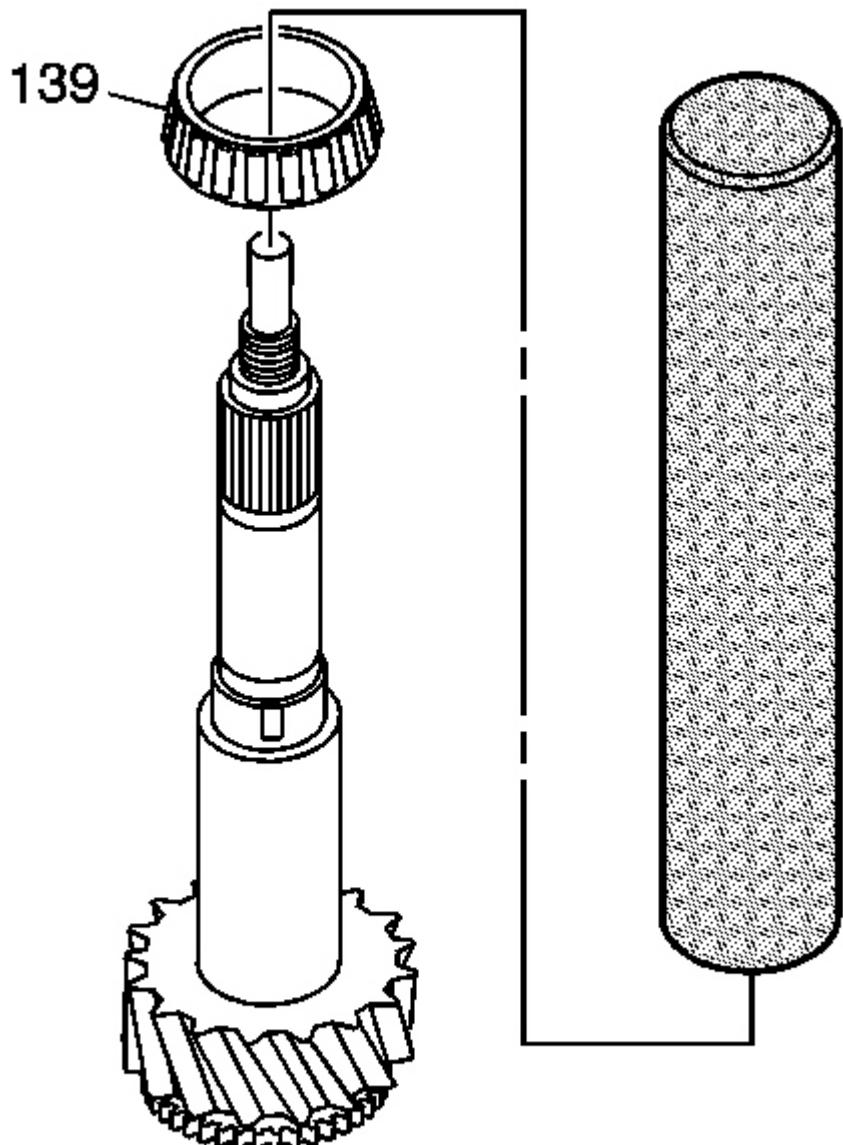


Fig. 193: Installing Output Shaft Bearing

Courtesy of GENERAL MOTORS CORP.

Using **DT-47723**, install the output shaft bearing (139). See **Special Tools**.

TRANSMISSION ASSEMBLE

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Special Tools

- **DT-47678:** Transmission Holding Fixture
- **DT-49027:** Coil Pin Remover and Installer
- **J 3289-20:** Holding Fixture
- **J 35467:** One-Way Clutch Tester
- **J 44731:** Input Shaft Seal Installer
- **J 45012:** Holding Fixture

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

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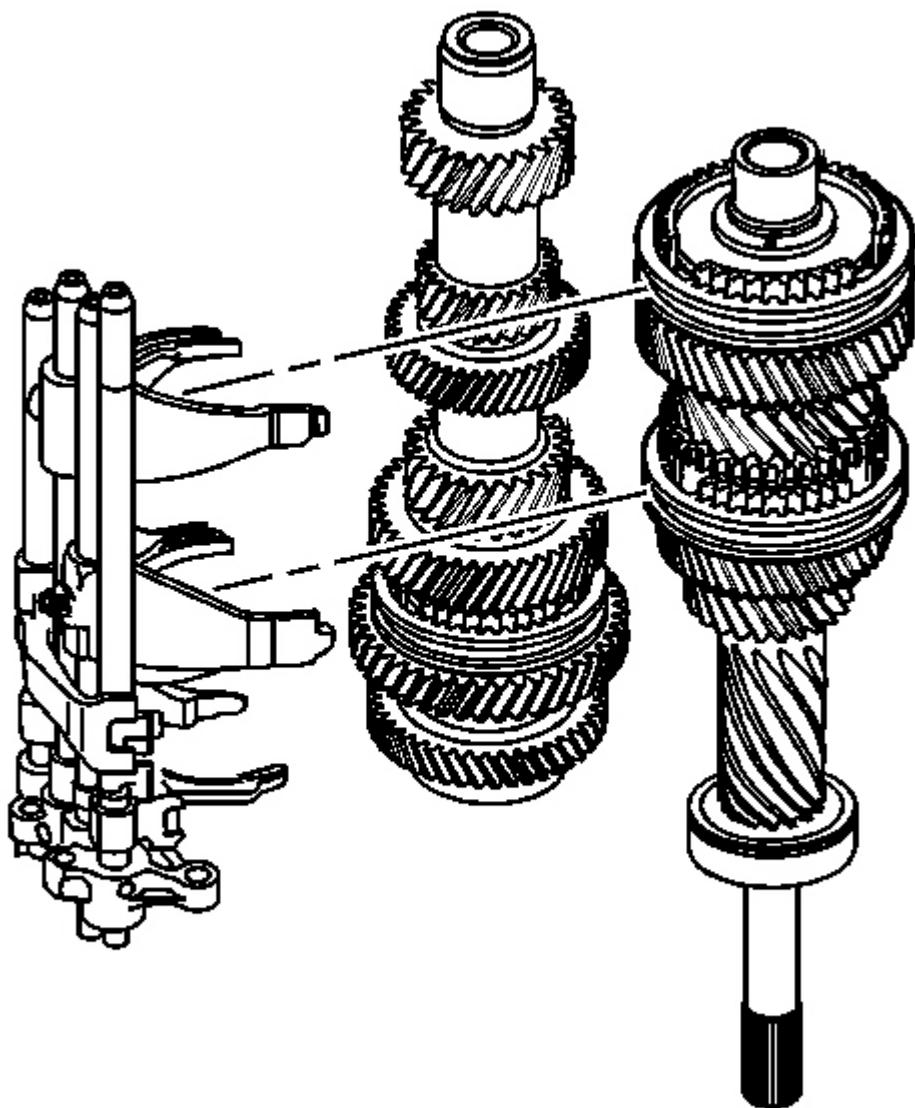


Fig. 194: Disassembling/Assembling Shift Rails, Input Shaft & Countershaft
Courtesy of GENERAL MOTORS CORP.

1. Apply lubricant GM P/N 88862475 (Canadian P/N 88862476) to each gear shift fork and gear shift head. Join the shift rail assembly to the input shaft and countershaft assembly.

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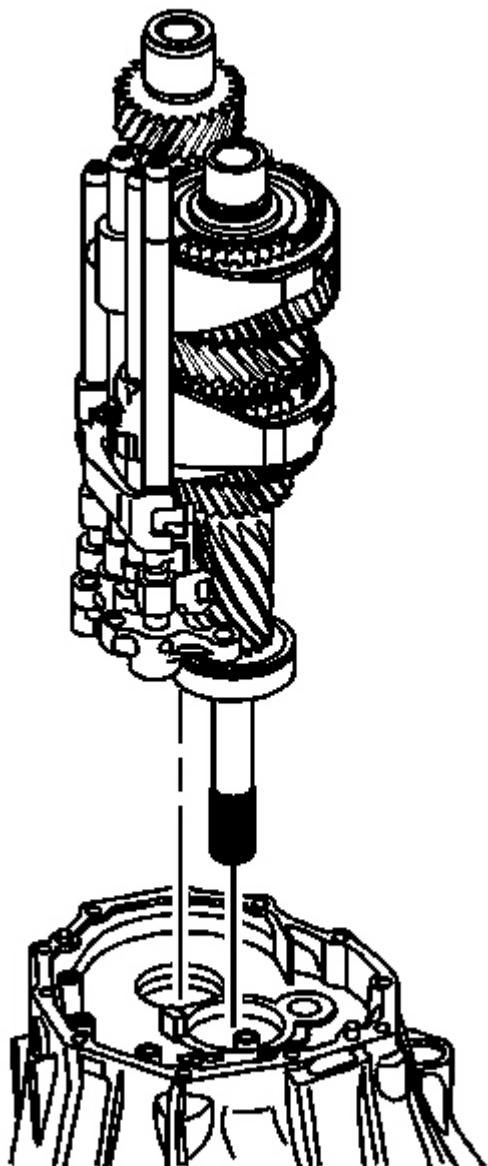


Fig. 195: View Of Input Shaft, Countershaft & Shift Rail Assembly
Courtesy of GENERAL MOTORS CORP.

2. With assistance install the input shaft, countershaft and shift rails as an assembly in the clutch housing.

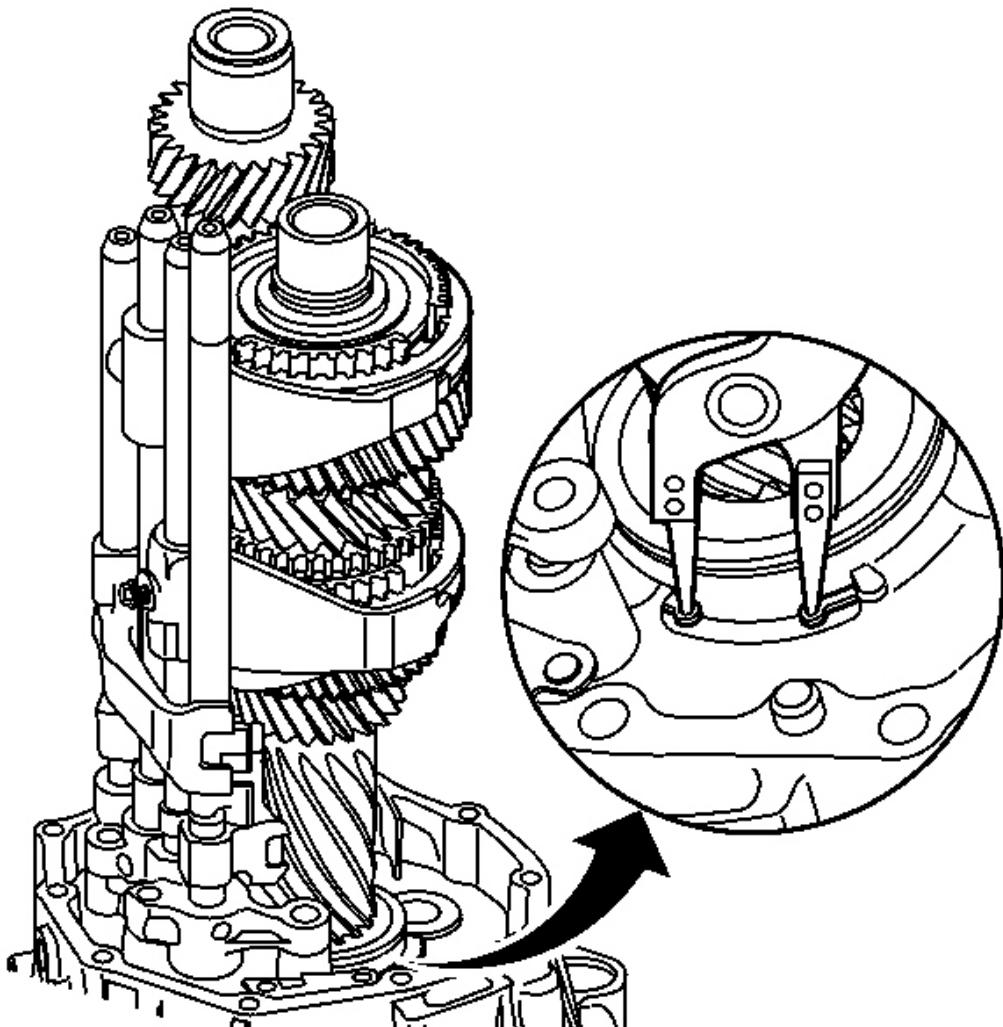


Fig. 196: Holding Snap Ring On Rear Input Shaft Bearing
Courtesy of GENERAL MOTORS CORP.

3. With assistance install the snap ring into the groove of the input shaft radial ball bearing.

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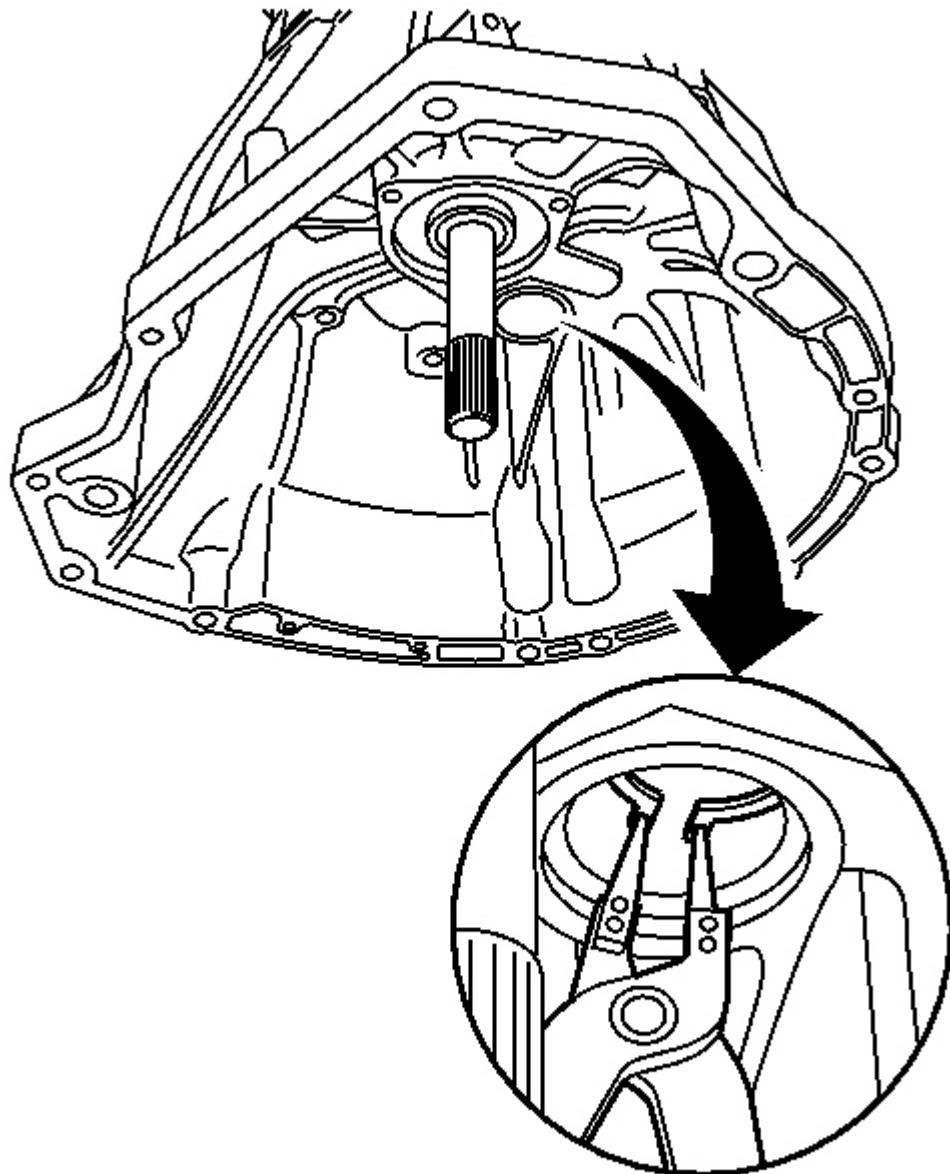


Fig. 197: Front Countershaft Bearing Snap Ring
Courtesy of GENERAL MOTORS CORP.

4. With assistance install the snap ring into the groove of the countershaft radial ball bearing.

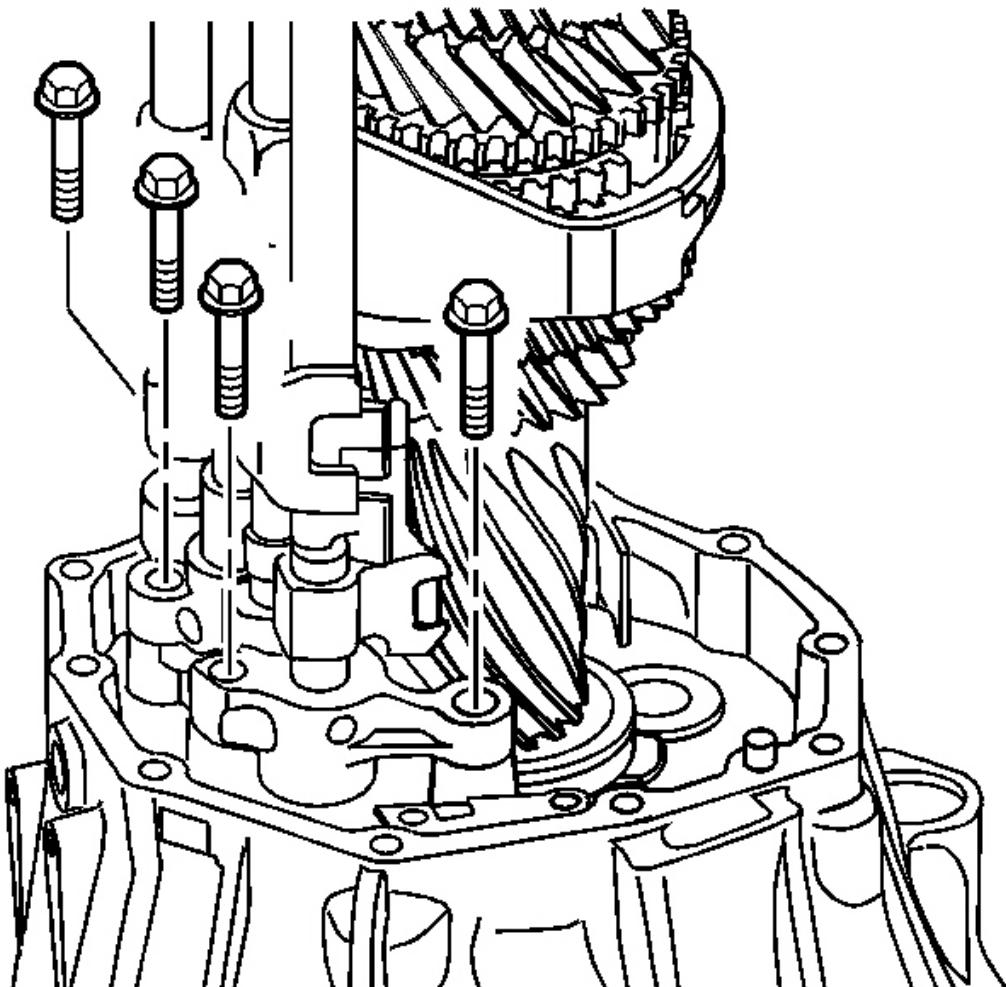


Fig. 198: View Of Shift Counter Lever Bracket Bolts

Courtesy of GENERAL MOTORS CORP.

5. Apply threadlocker GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the shift rail bolts.

CAUTION: Refer to Fastener Caution .

6. Install the 4 shift rail bolts and tighten to 21 N.m (15 lb ft).

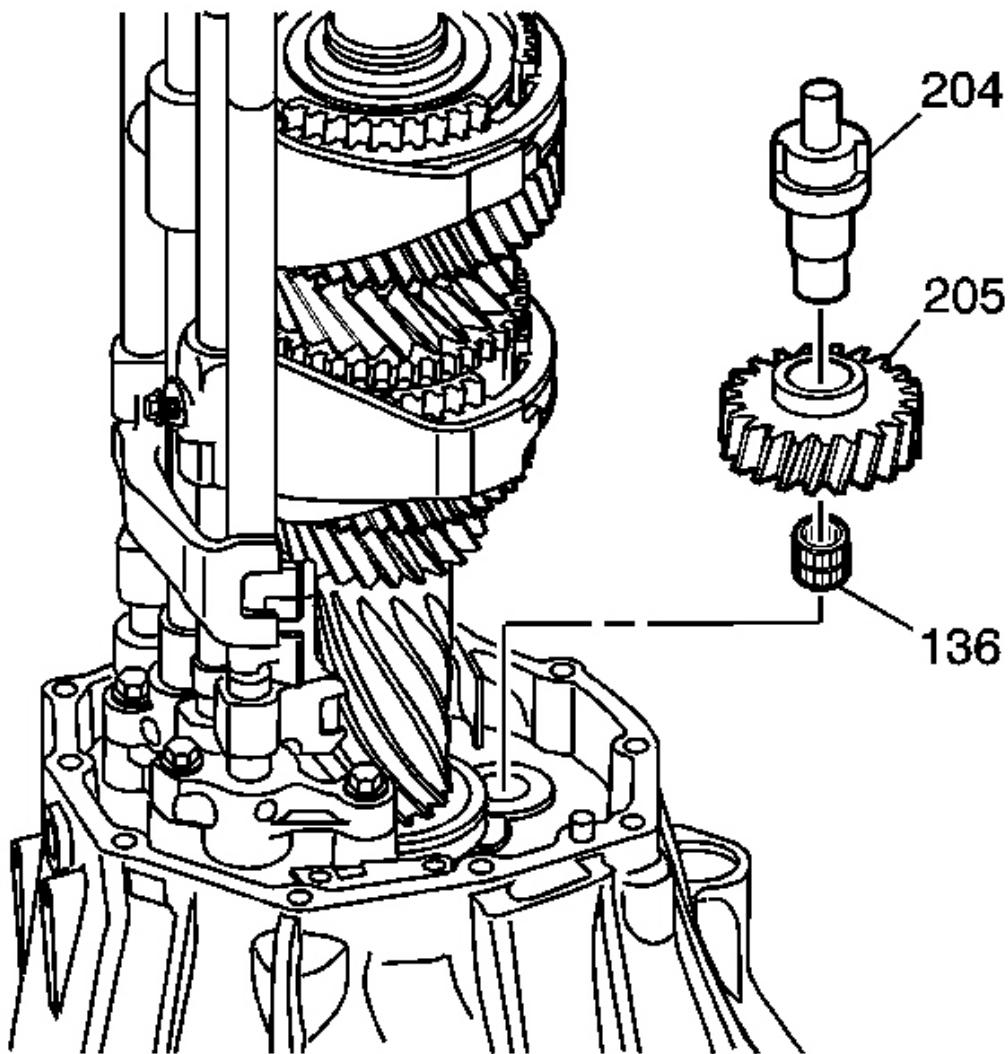


Fig. 199: View Of Reverse Idler Gear, Bearing & Shaft

Courtesy of GENERAL MOTORS CORP.

NOTE: During alignment, ensure that the thread hole of the reverse idler gear shaft (204) aligns with the thread hole of the middle case.

7. Apply lubricant GM P/N 88862475 (Canadian P/N 88862476) and install the following components:
 - The reverse idler gear bearing (136)
 - The reverse idler gear (205) with the higher boss facing the rear

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- The reverse idler gear shaft (204) with its hole facing outward

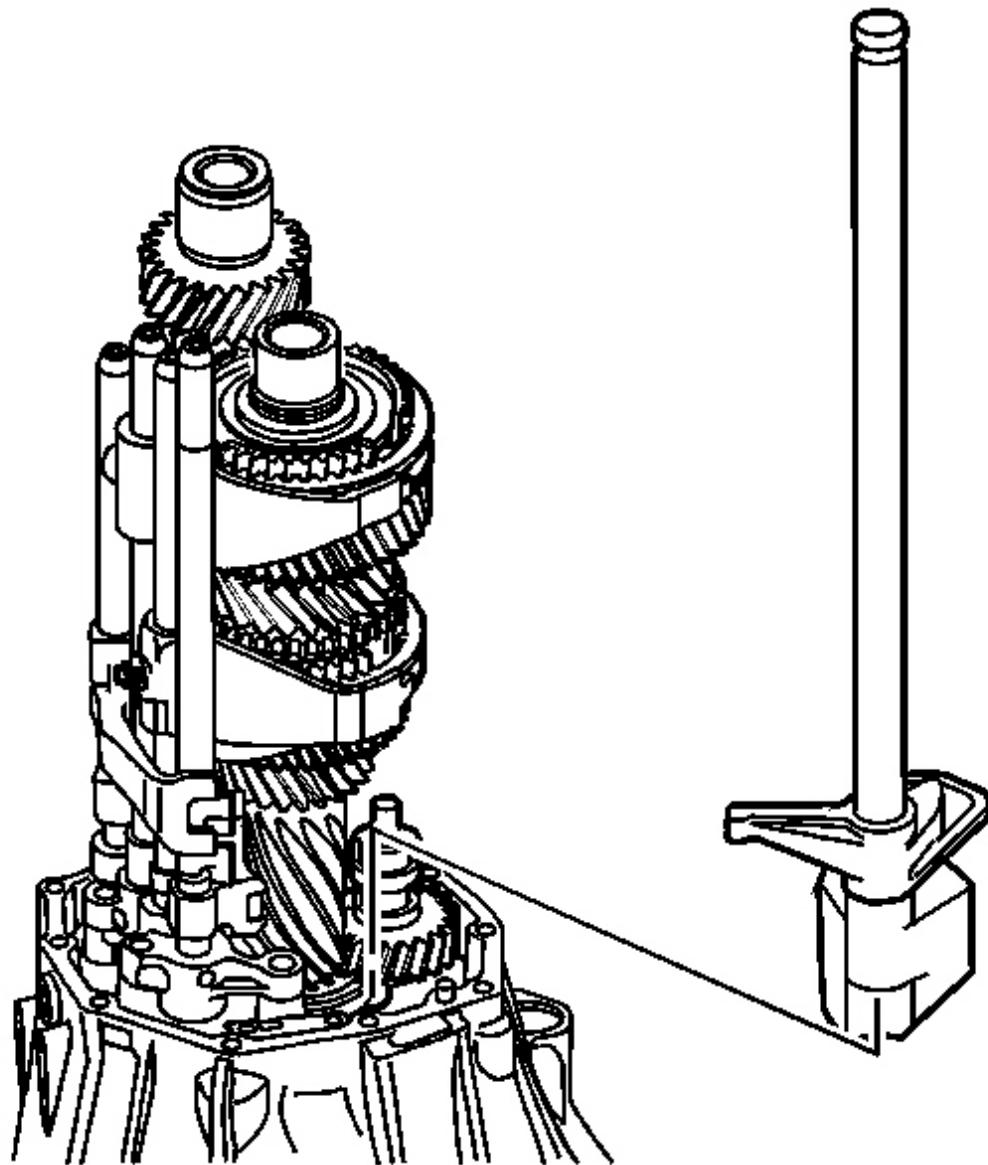


Fig. 200: Shift Shaft Selector Lever
Courtesy of GENERAL MOTORS CORP.

8. Apply sealer GM P/N 89020326 (Canadian P/N 89021188) or equivalent to the interface of either case.

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9. Install the shift shaft selector lever.

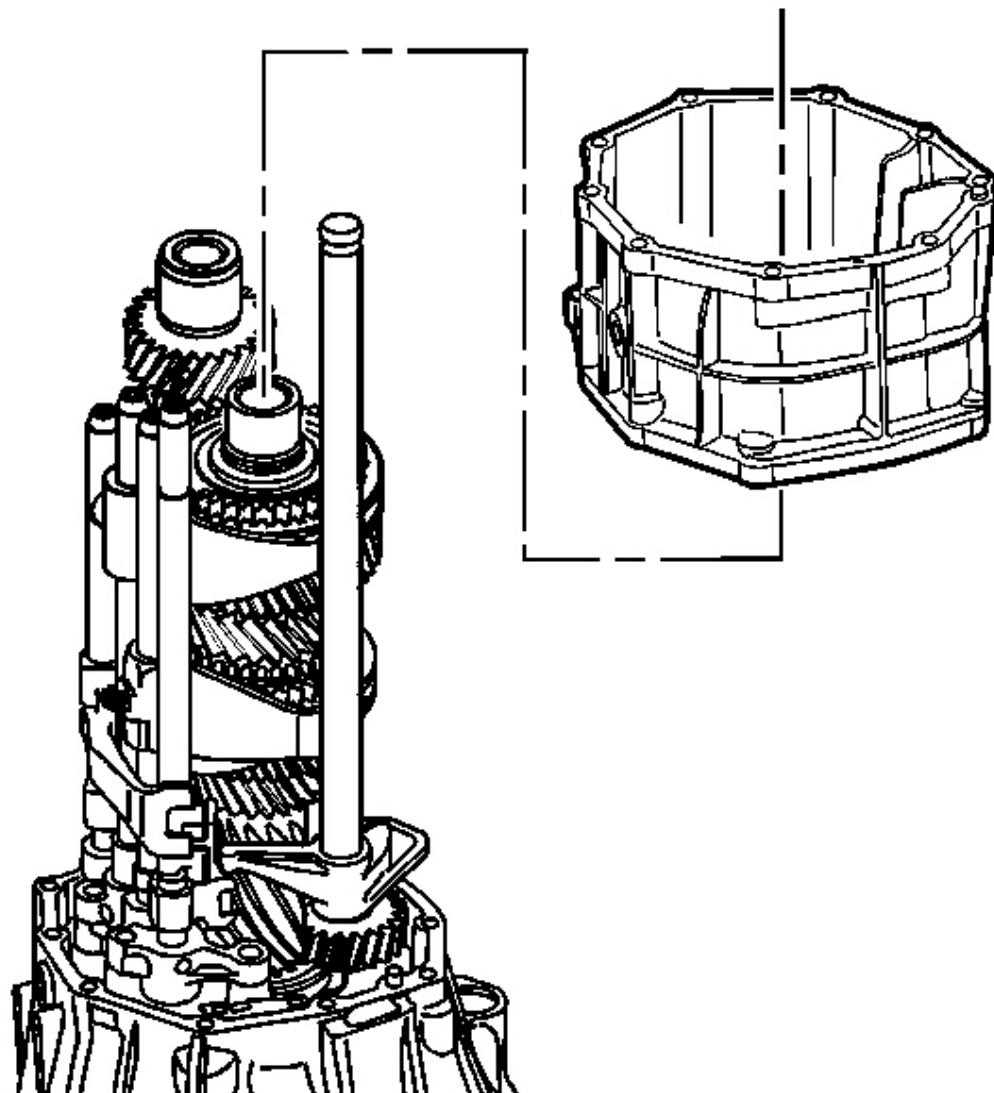


Fig. 201: Select Lever Shaft Bearing
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Machined Surface Damage Caution .

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NOTE: **Rotate case to avoid interference with shift fork.**

10. Apply sealer GM P/N 89020326 (Canadian P/N 89021188) or equivalent to the interface of either case.
11. Apply lubricant GM P/N 88862475 (Canadian P/N 88862476 to the shift and select lever shaft bearing.
12. Install the intermediate case housing.

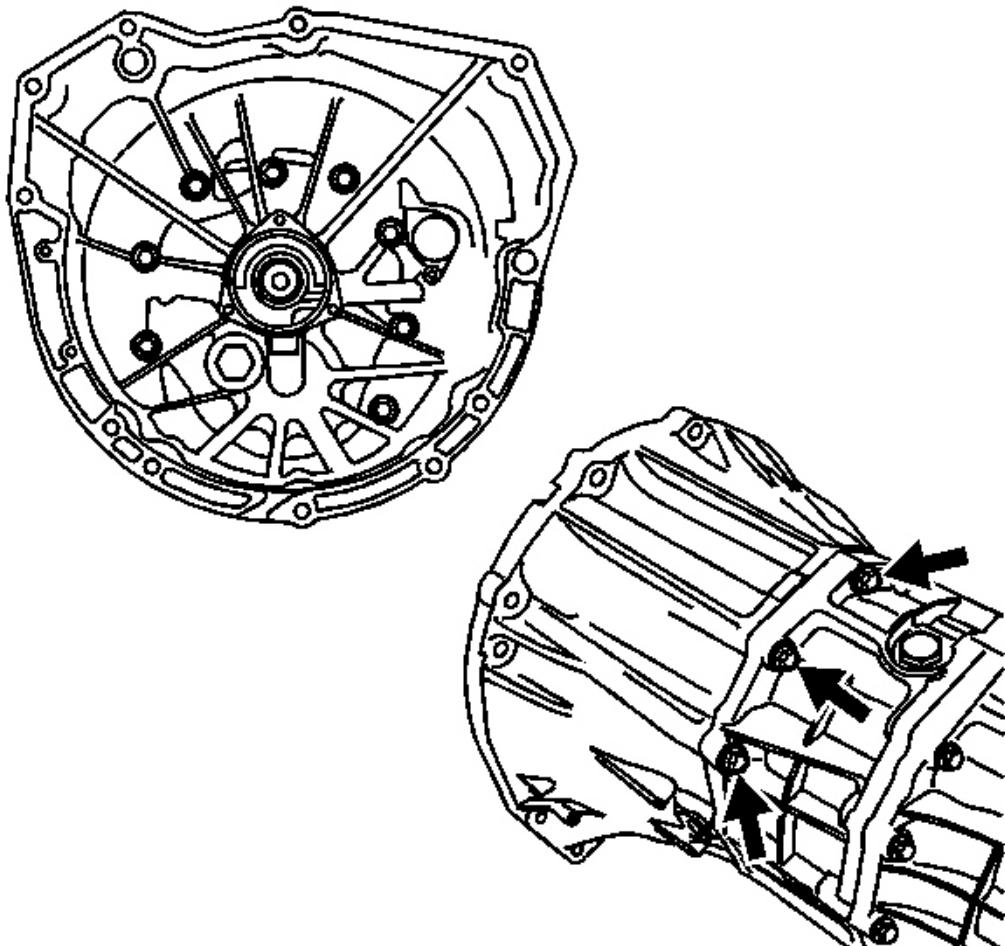


Fig. 202: View Of Clutch Housing Bolts
Courtesy of GENERAL MOTORS CORP.

13. Install the 8 bolts from the clutch housing and the 3 bolts from the middle case. Tighten the bolts to 40 N.m (29 lb ft).

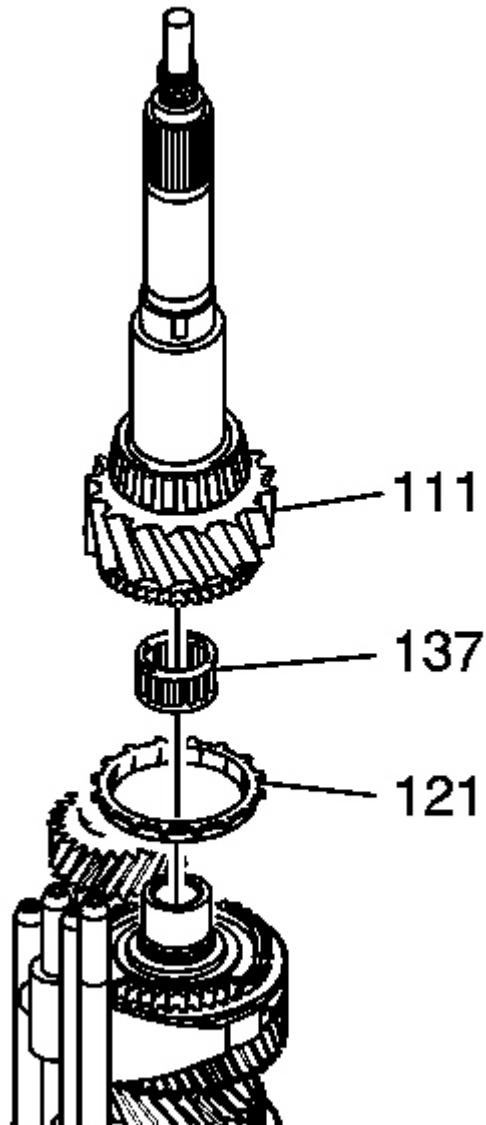


Fig. 203: View Of Rear Output Shaft, Input Shaft Bearing & Blocking Ring
Courtesy of GENERAL MOTORS CORP.

14. Apply lubricant GM P/N 88862475 (Canadian P/N 88862476) and install the input shaft bearing (137), blocking ring (121) and the rear output shaft (111).

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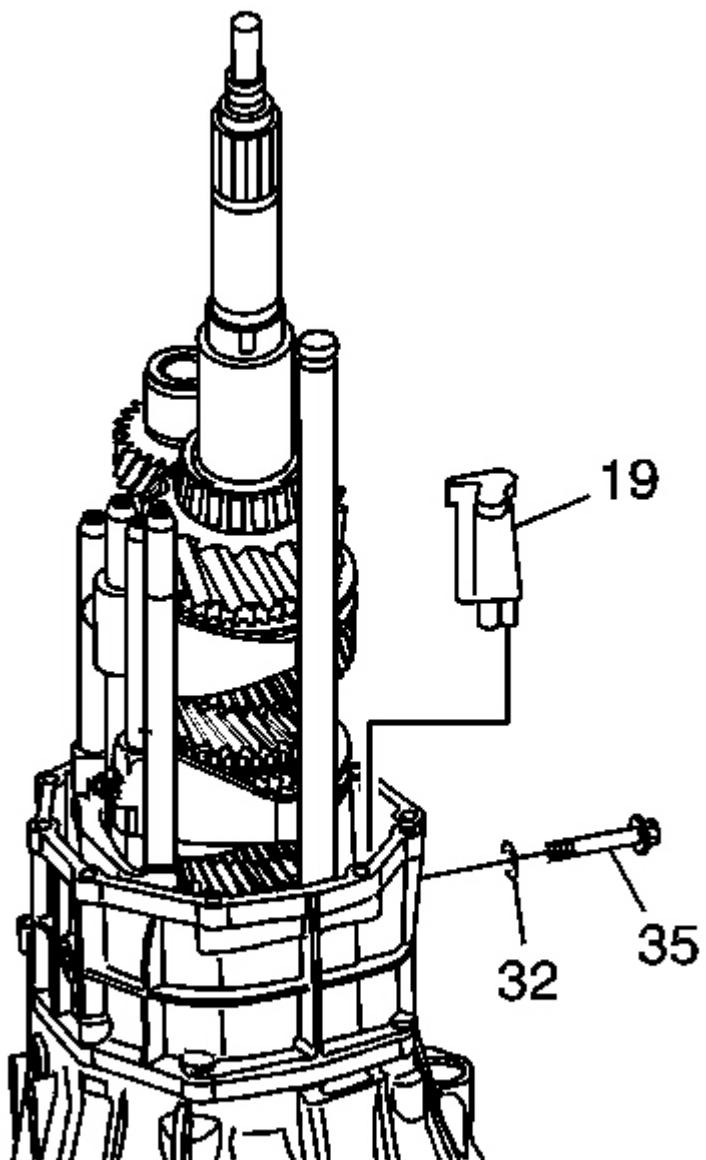


Fig. 204: Identifying Oil Trough Pipe, Reverse Idler Gear Shaft Bolt & Gasket
Courtesy of GENERAL MOTORS CORP.

15. Install the oil trough pipe (19).
16. Install a NEW gasket (32) and the bolt (35) to secure the reverse idler shaft. Tighten the bolt to 40 N.m (30 lb ft).

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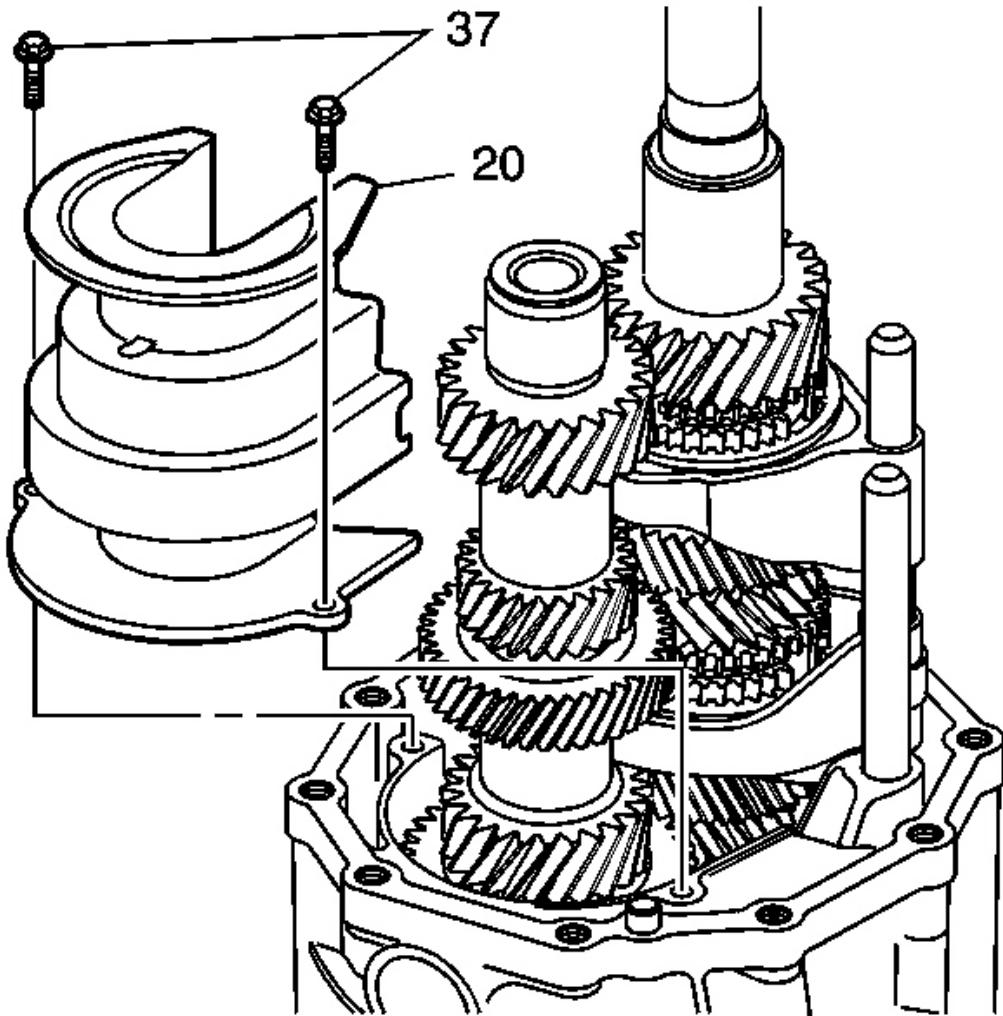


Fig. 205: Oil Trough Bolts & Oil Trough
Courtesy of GENERAL MOTORS CORP.

17. Install the oil trough (20) and the 2 oil trough bolts (37) and tighten to 8.5 N.m (75 lb in).

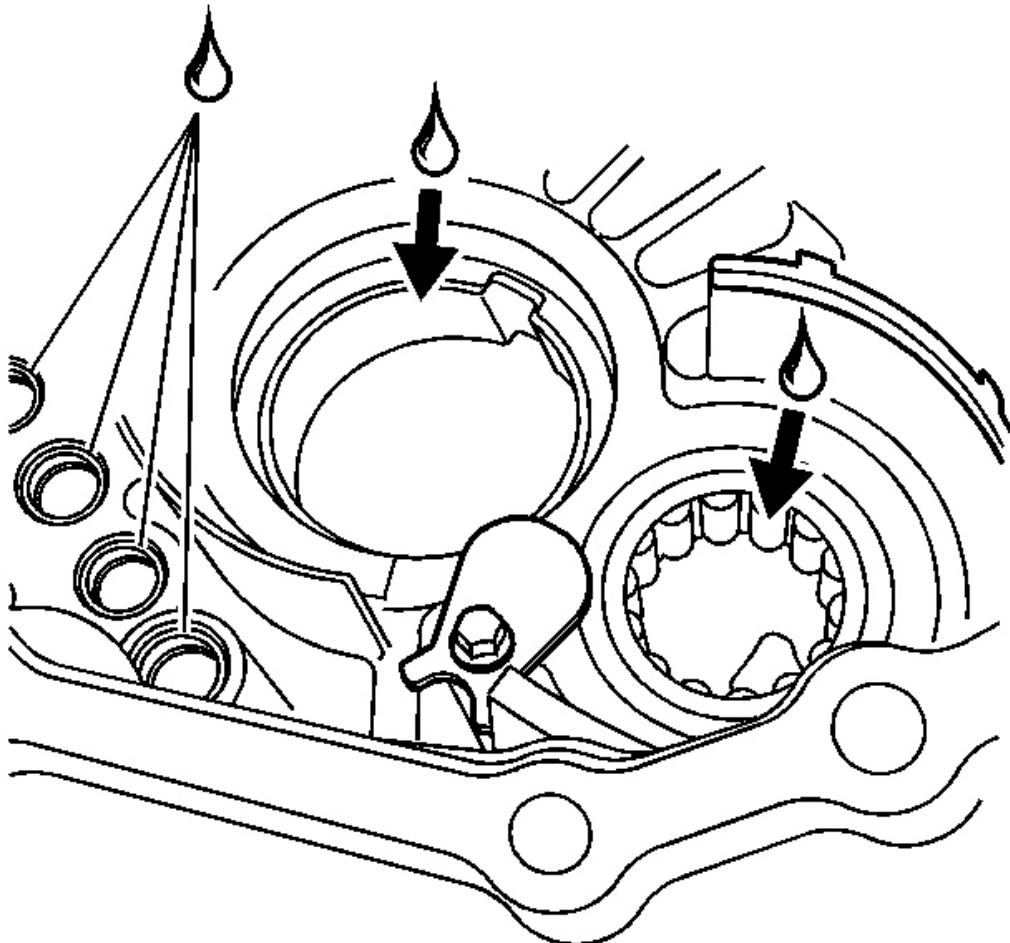


Fig. 206: Applying Lubricant To Cylindrical Roller Bearing, Outer Race & Control Sub-Assembly Holes

Courtesy of GENERAL MOTORS CORP.

18. Apply lubricant GM P/N 88862475 (Canadian P/N 88862476) to the following components:
 - The tapered roller bearing outer race
 - The cylindrical roller bearing
 - The control sub-assembly holes

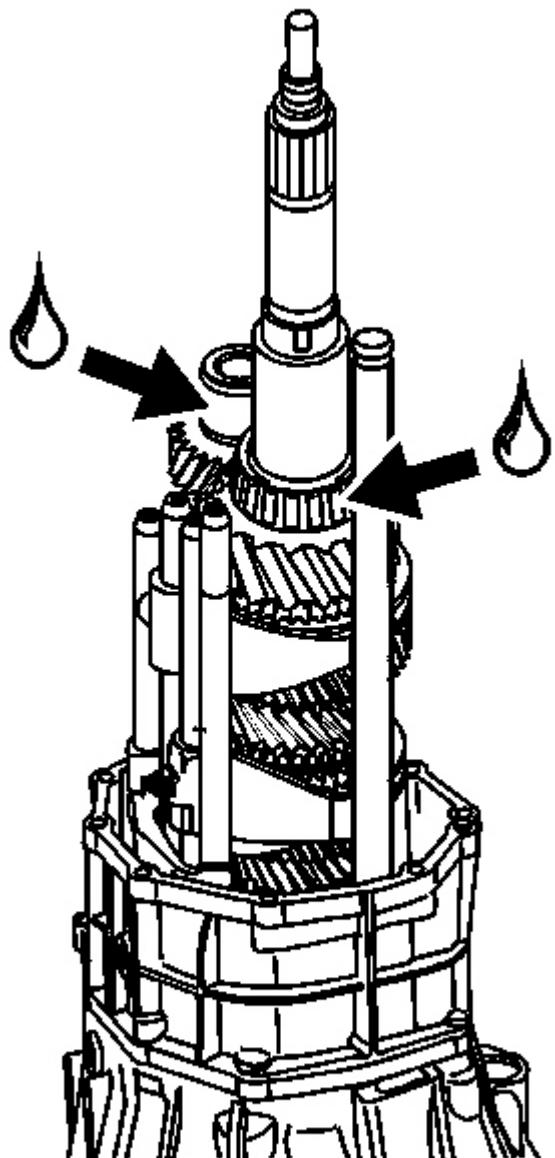


Fig. 207: Applying Lubricant To Tapered Roller Bearing & Cylindrical Roller Bearing Inner Race
Courtesy of GENERAL MOTORS CORP.

19. Apply lubricant GM P/N 88862475 (Canadian P/N 88862476) to the following components:

- The tapered roller bearing of the output shaft
- The cylindrical roller bearing inner race of counter gear

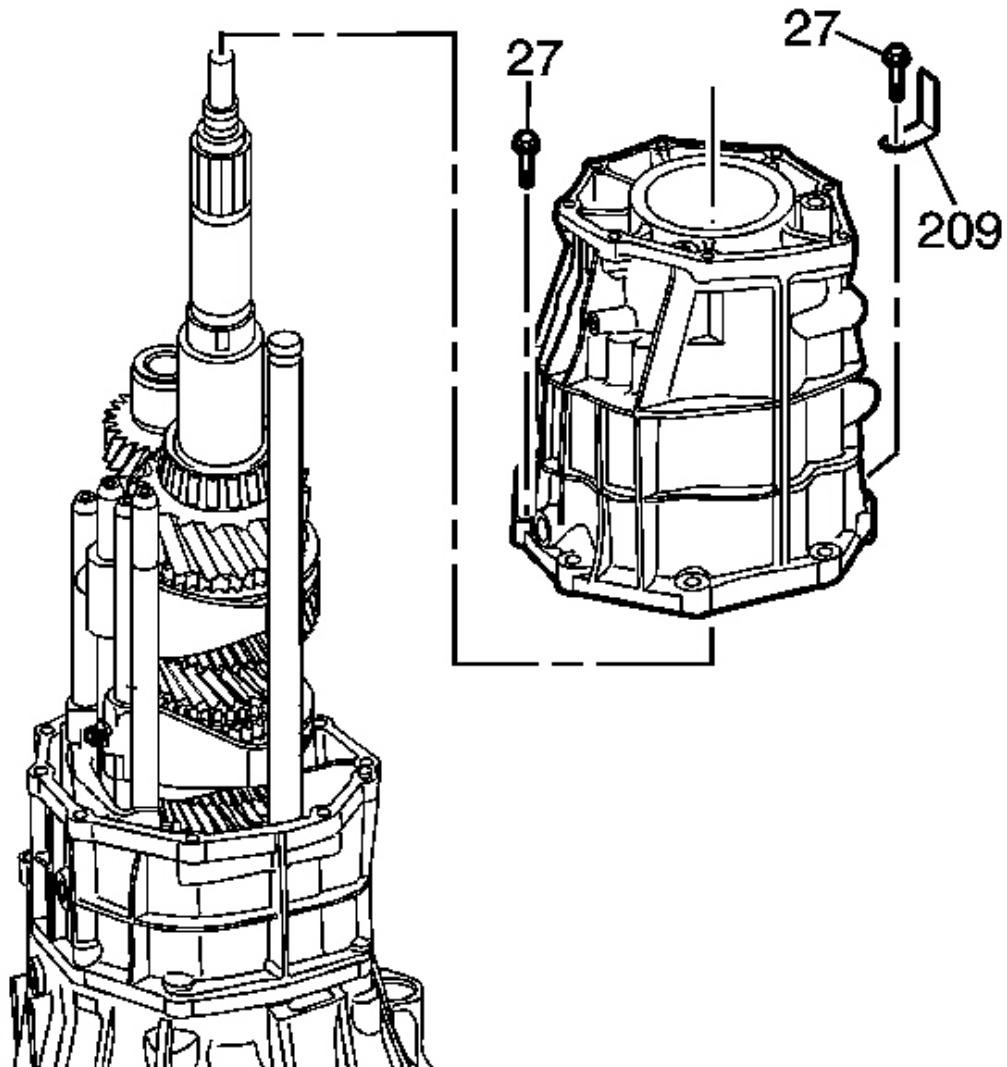


Fig. 208: View Of Rear Case Housing Retainer & Bolts
Courtesy of GENERAL MOTORS CORP.

20. Apply sealer GM P/N 89020326 (Canadian P/N 89021188) or equivalent to the clean interface of either case.

CAUTION: Refer to Machined Surface Damage Caution .

NOTE: Use care when installing the rear case housing so that the oil receiver is not damaged.

21. Install the rear case housing.
22. Install the 10 bolts (27) and retainer (209) to the rear case housing. Tighten the bolts to 40 N.m (29 lb ft).

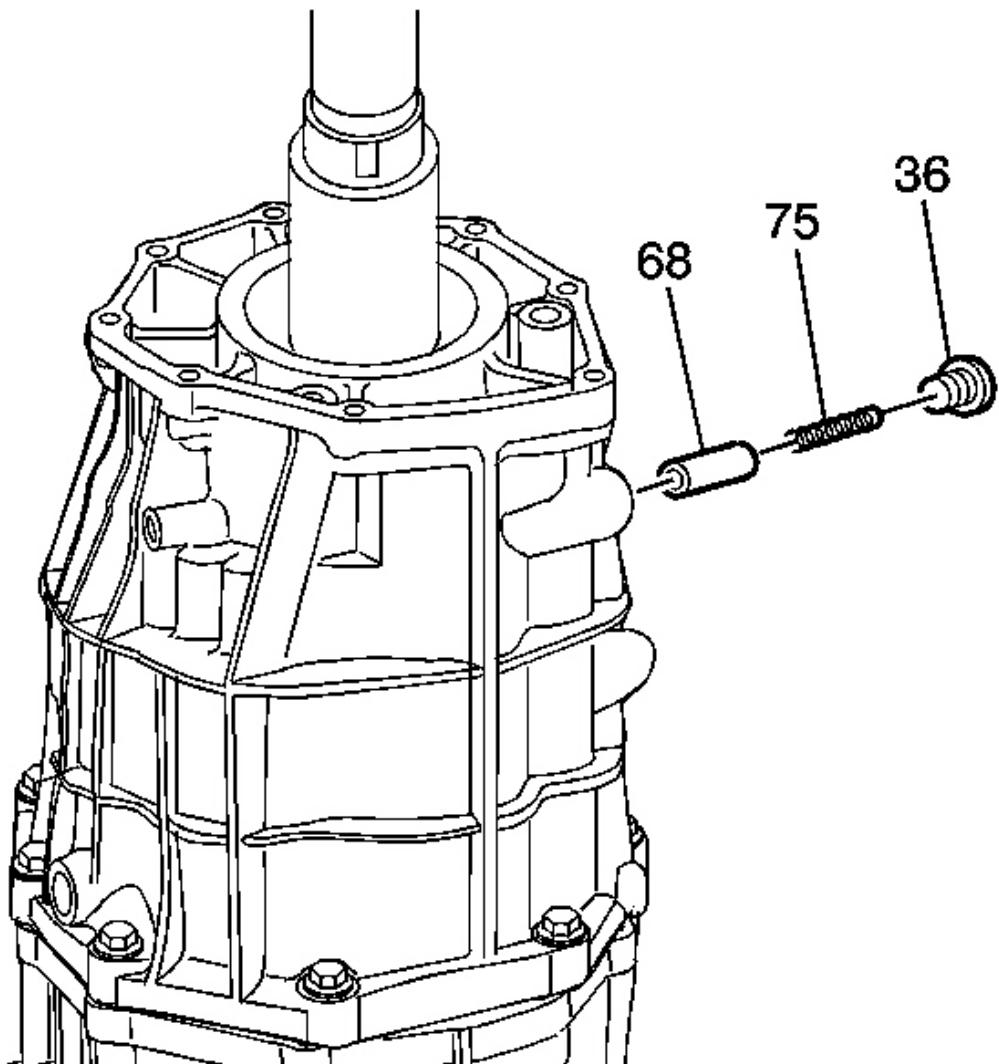


Fig. 209: View Of Shift Shaft Detent Plug, Spring & Pin
Courtesy of GENERAL MOTORS CORP.

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23. Apply lubricant GM P/N 88862475 (Canadian P/N 88862476) and install the lock ball pin (68).
24. Install the spring (75) and a NEW plug (36). Tighten the plug to 24.5 N.m (18 lb ft).

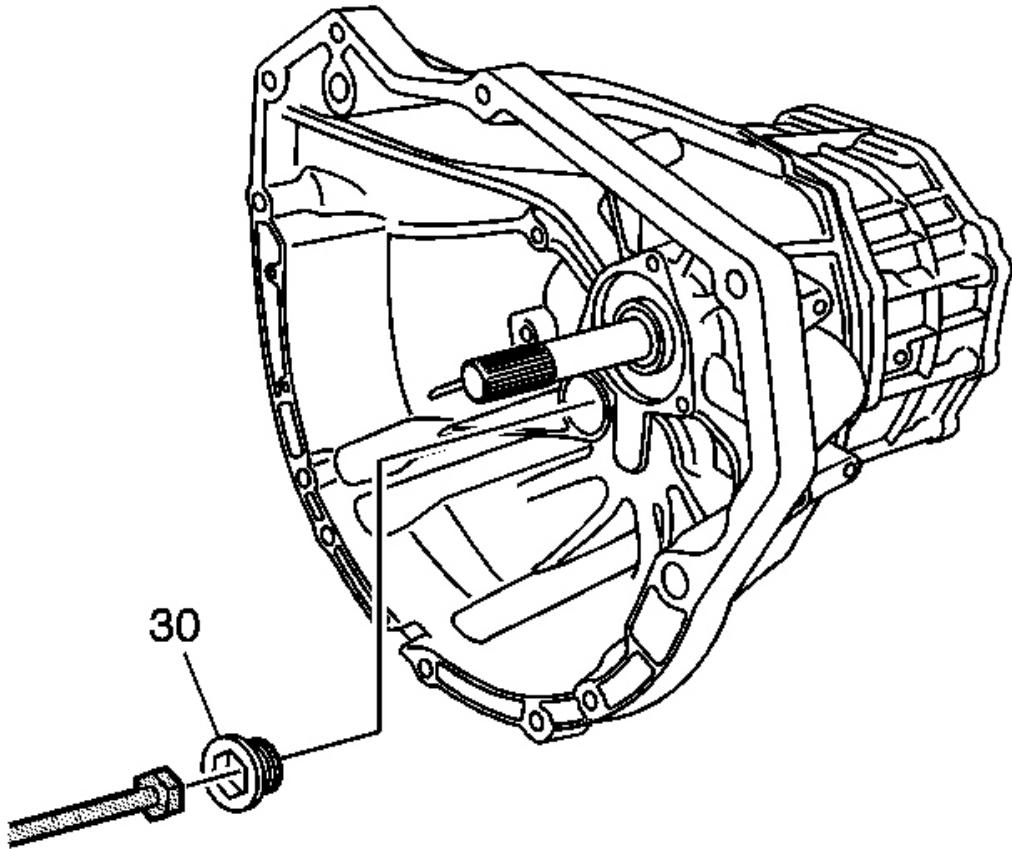


Fig. 210: Removing/Installing Clutch Housing Hole Plug
Courtesy of GENERAL MOTORS CORP.

25. Using **J 35467**: tester, install a NEW clutch housing hole plug (30) into the clutch housing. Tighten the bolt to 39.3 N.m (29 lb ft).

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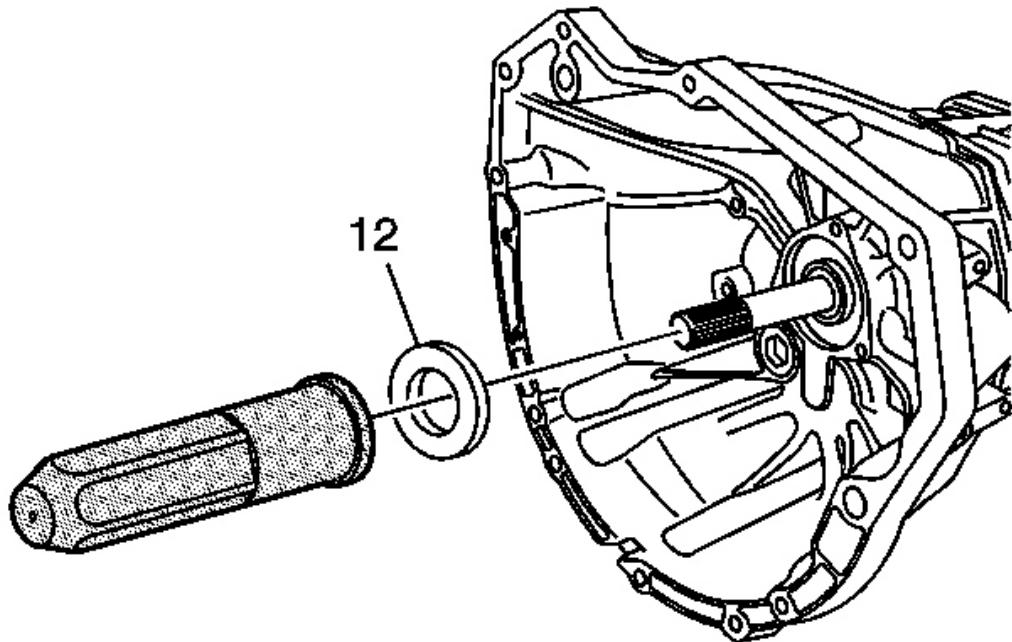


Fig. 211: Installing Input Shaft Seal
Courtesy of GENERAL MOTORS CORP.

26. Using **J 44731**: installer, install a NEW input shaft seal (12).

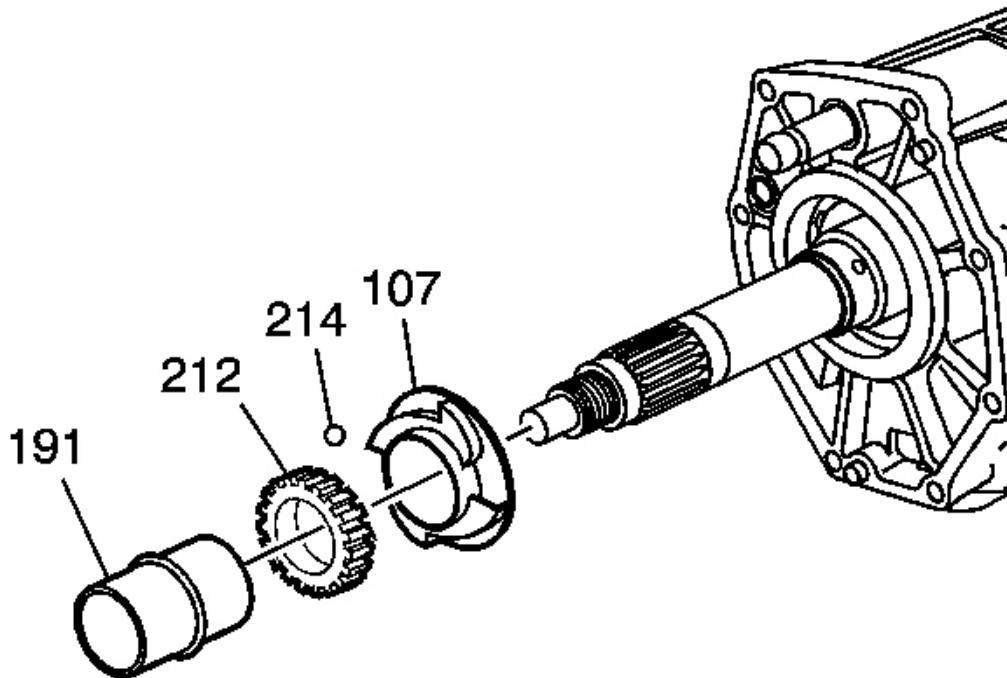


Fig. 212: View Of Vehicle Speed Sensor Drive Gear, Spacer, Locking Ball & Main Shaft Bearing Oil Slinger

Courtesy of GENERAL MOTORS CORP.

27. Align and install the main shaft bearing oil slinger (107).
28. Grease and install the locking ball (214).
29. Align and install the vehicle speed sensor drive gear (212).
30. Install a NEW rear output shaft rear bearing spacer (191).

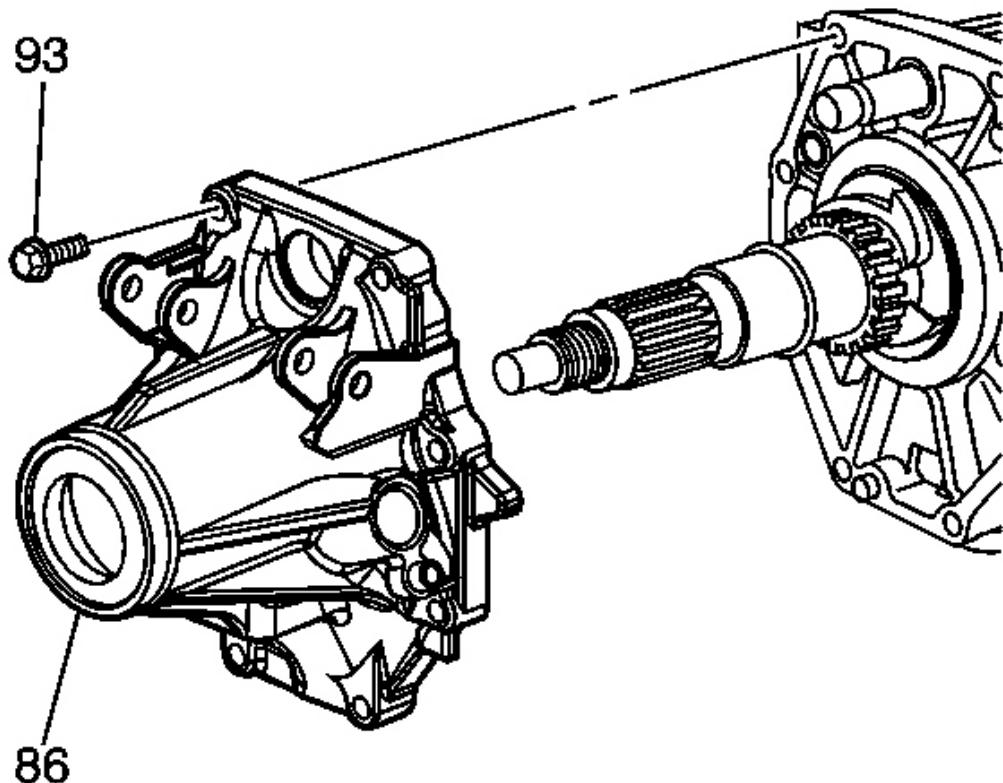


Fig. 213: Identifying Extension Housing & Bolts

Courtesy of GENERAL MOTORS CORP.

31. Apply sealer GM P/N 89020326 (Canadian P/N 89021188) or equivalent to the interface of either case.
32. Install the rear extension housing.
33. Install the 8 bolts (93) into the rear extension housing (86) and tighten to 29 N.m (21 lb ft).

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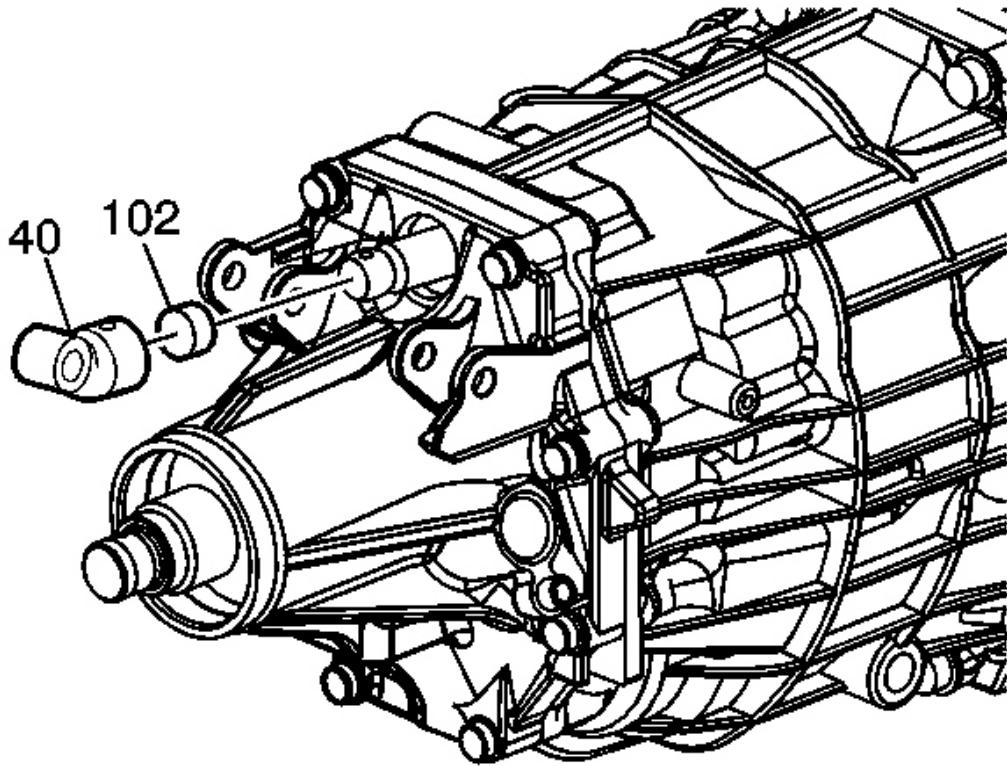


Fig. 214: Identifying Dampener & Shift Lever Rod Universal Joint
Courtesy of GENERAL MOTORS CORP.

34. Install the dampener (102) and shift lever rod universal joint (40) on the end of the shift control shaft.

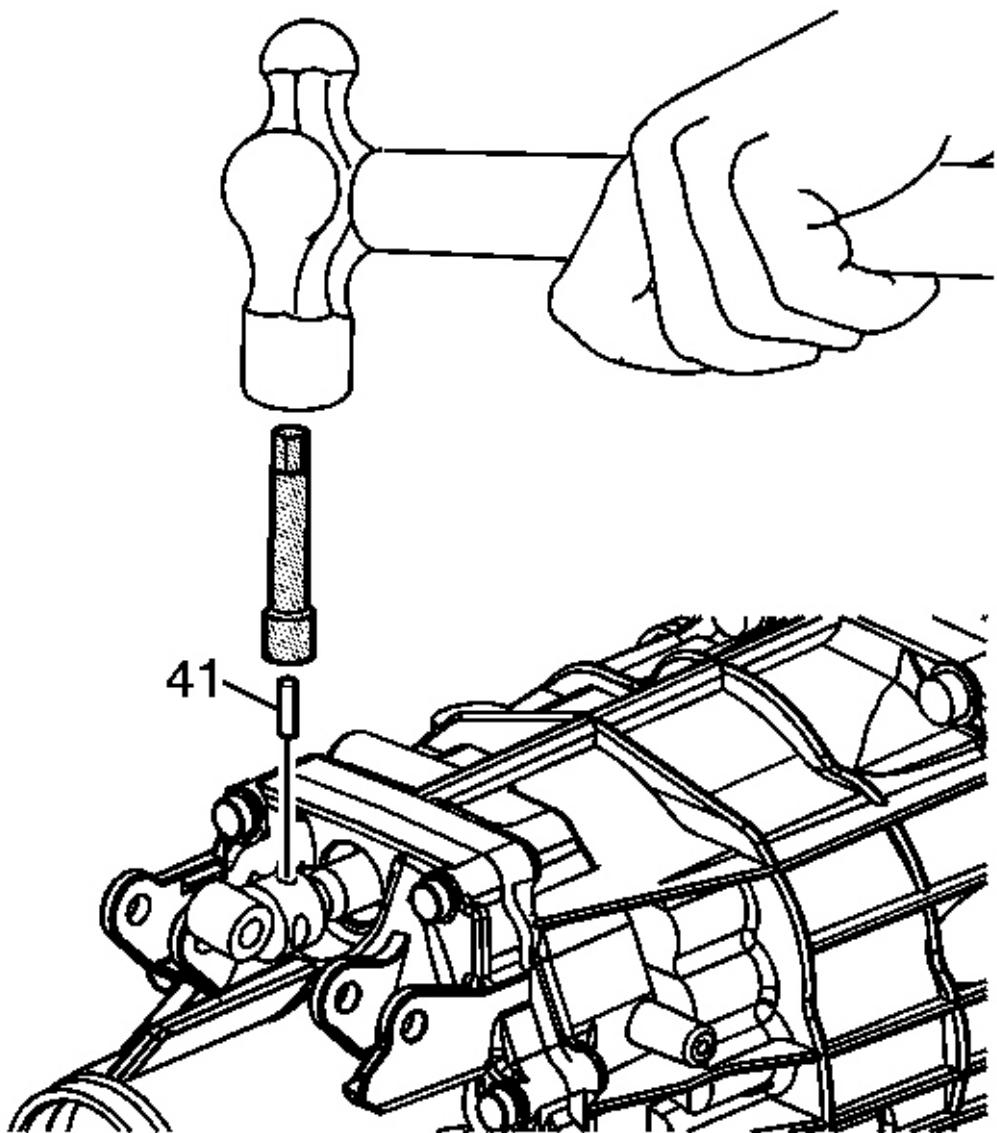


Fig. 215: Installing Shift Lever Pin
Courtesy of GENERAL MOTORS CORP.

NOTE: Prior to shift lever pin installation, the shift control shaft must be shifted forward into the transmission.

35. Position and align the shift lever pin (41) with the hole in the shift lever rod universal joint. Use DT-

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49027-3: coil pin installer and a mallet to install the pin (41) to the proper depth.

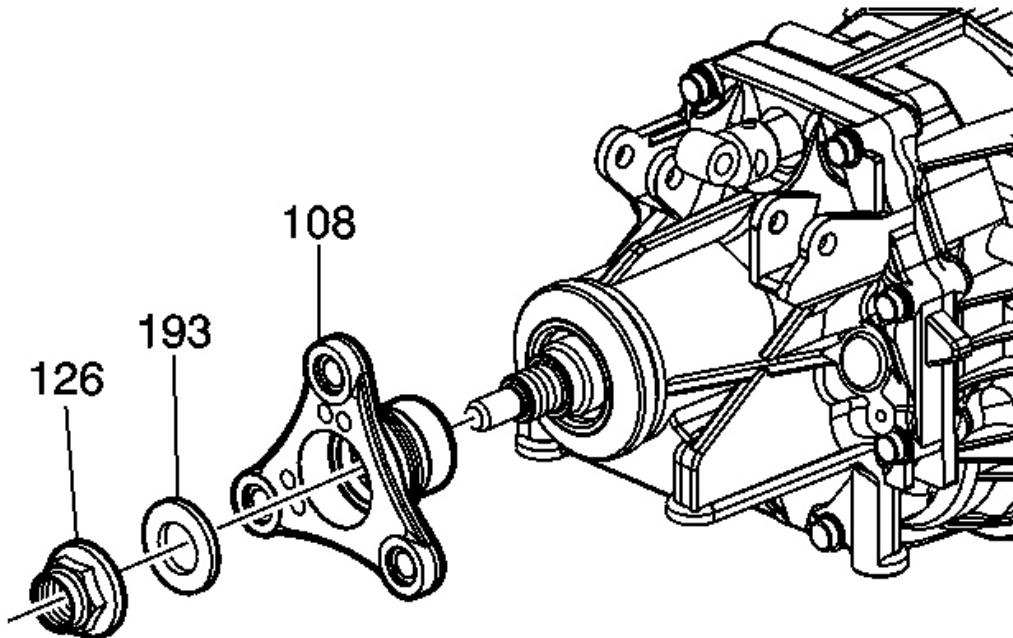


Fig. 216: Propshaft Flange Components

Courtesy of GENERAL MOTORS CORP.

36. Install the propshaft flange (108).
37. Grease and install a NEW propshaft flange fluid seal (193).
38. Install a NEW propshaft flange nut (126).

Preload Adjustment Procedure

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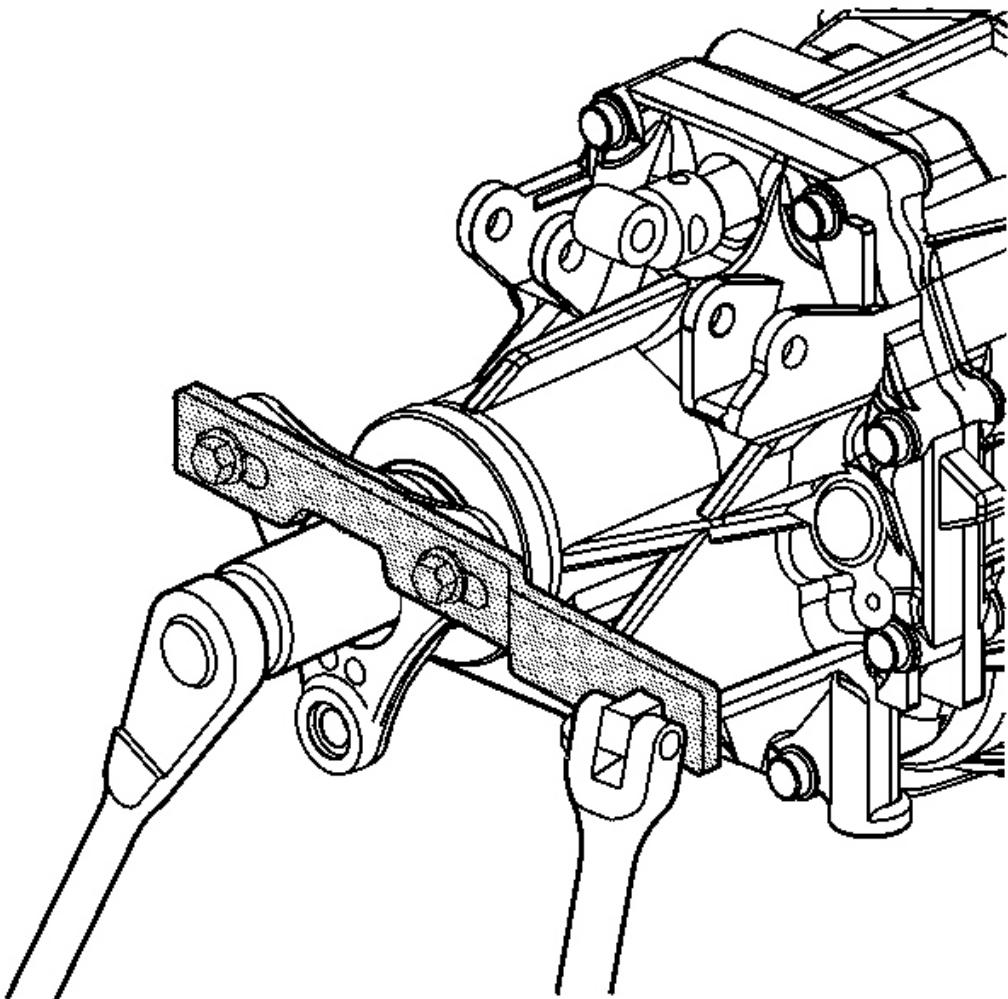


Fig. 217: Tightening Propshaft Flange Nut

Courtesy of GENERAL MOTORS CORP.

1. Shift the transmission into any gear.
2. Attach **J 45012:** holder to the propshaft flange.
3. Use **J 45012:** holder in order to prevent the propshaft flange from rotating. Install and tighten the propshaft flange nut. Tighten until the looseness is minimum.

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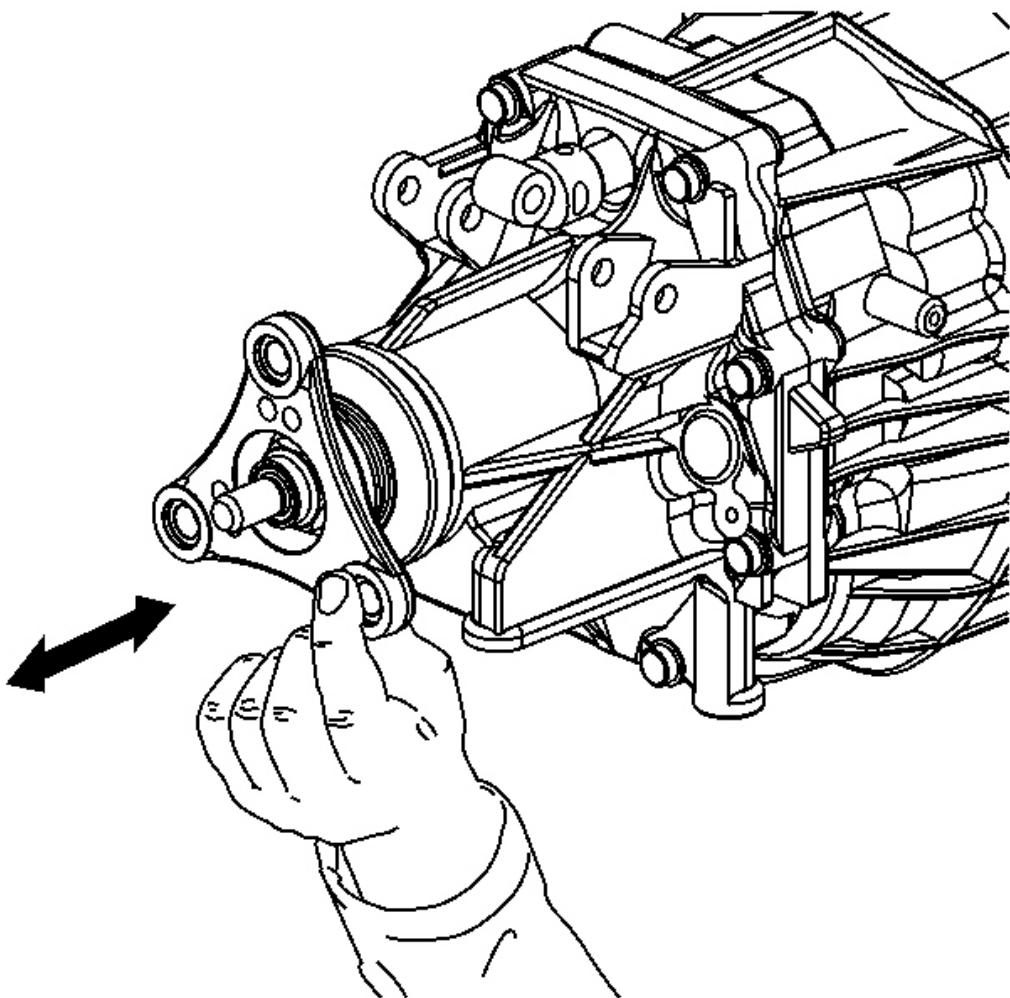


Fig. 218: Shaking Propshaft

Courtesy of GENERAL MOTORS CORP.

4. Verify looseness by shaking the propshaft longitudinally.

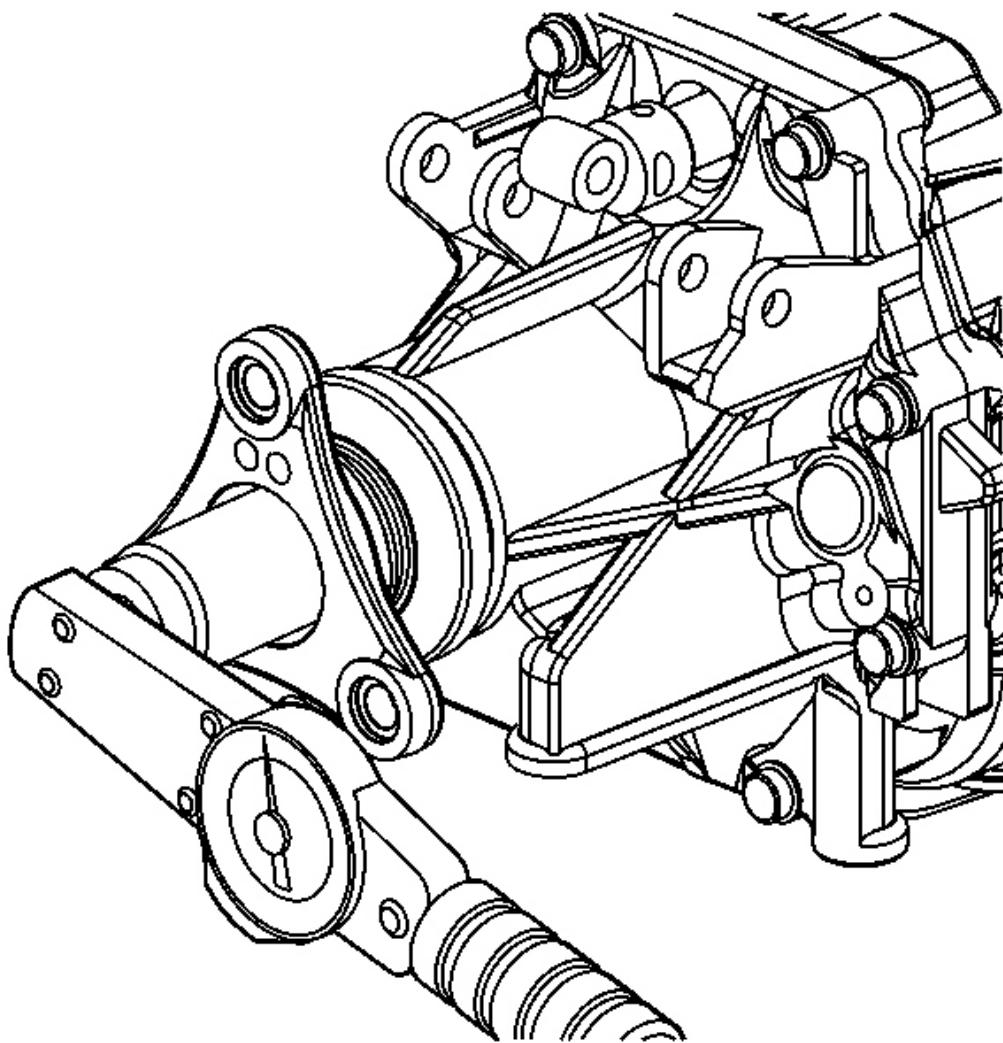


Fig. 219: Measuring Rotational Torque/Drag Torque Of Propshaft Flange
Courtesy of GENERAL MOTORS CORP.

5. Remove **J 45012:** holder from the propshaft flange.
6. Shift the transmission into NEUTRAL.
7. Rotate the propshaft flange several times in order to break in the gears, synchronizers and bearings.
8. Measure the rotational torque/drag torque of the propshaft flange by using a suitable tool. Record this initial rotational torque measurement as value A.

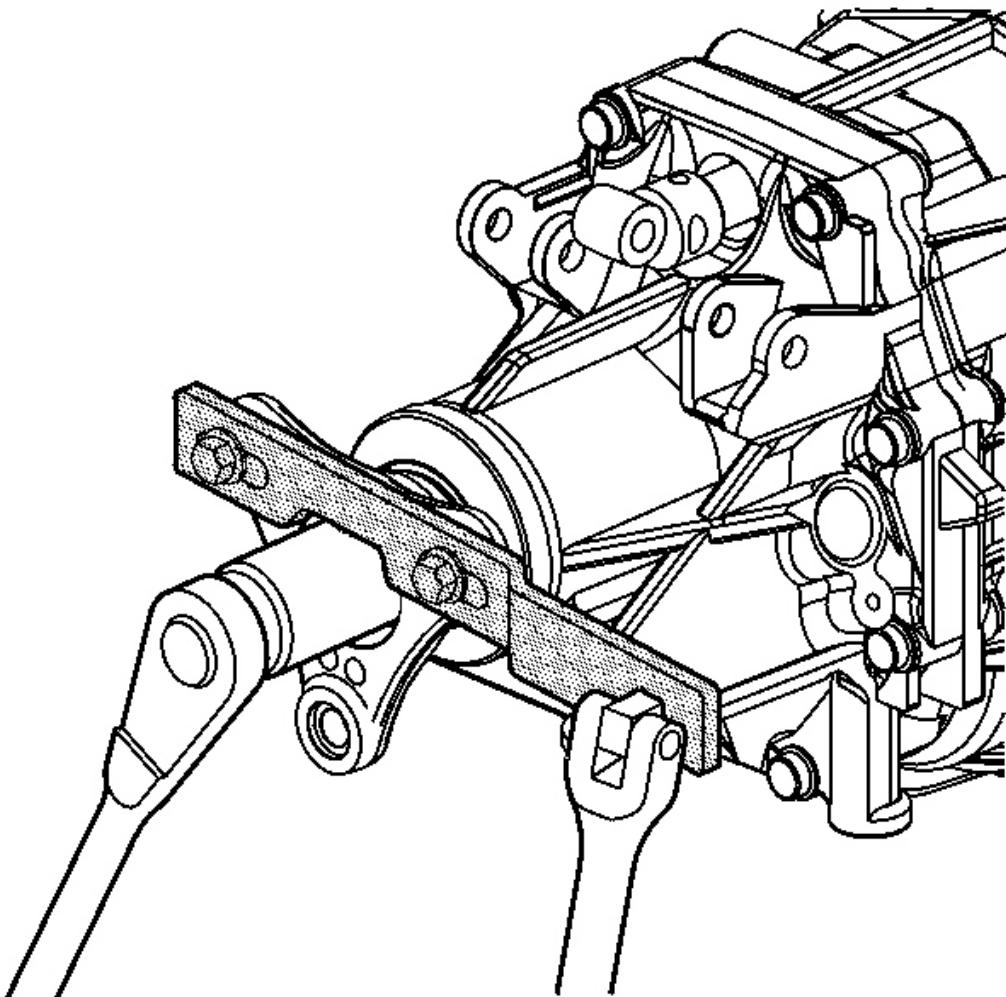


Fig. 220: Tightening Propshaft Flange Nut

Courtesy of GENERAL MOTORS CORP.

9. Attach **J 45012:** holder to the propshaft flange.
10. Shift the transmission into any gear.
11. Tighten the nut 220-565 N.m (162-417 lb ft).
12. Remove the **J 45012:** holder from the propshaft flange.
13. Shift the transmission into NEUTRAL.
14. Rotate the propshaft flange several times in order to seat the bearings.
15. Measure the rotational torque/drag torque of the propshaft flange by using a suitable tool. Record this measurement as value B.

16. Subtract value A from value B. Verify that the resulting measurement is within the specified range.

Specification: The rotational torque specification is 0.45-1.35 N.m (4-12 lb in).

17. Repeat the previous steps until you have confirmed that the rotational torque specification is reached then stake the nut in place. If the rotational torque requirement has been exceeded, replace the spacer and repeat steps 2-16.

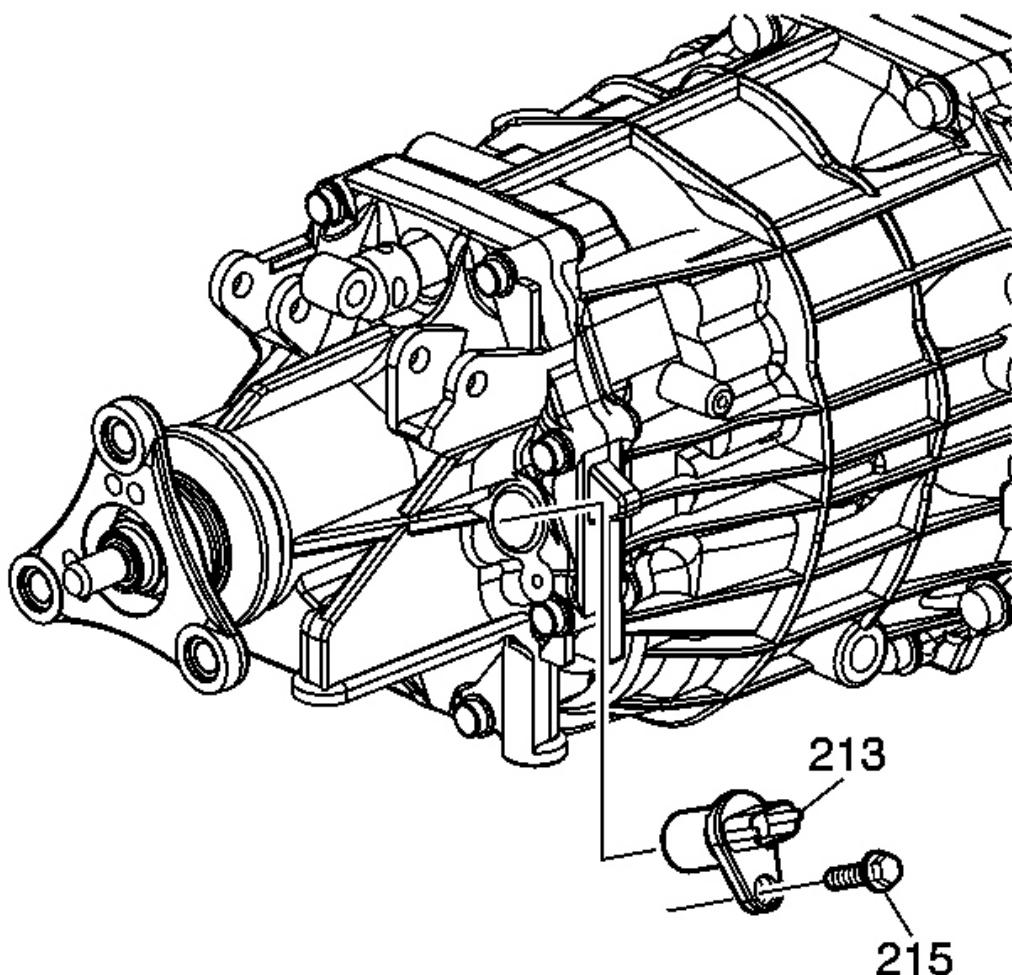


Fig. 221: Output Sensor & Bolt

Courtesy of GENERAL MOTORS CORP.

18. Install the output sensor (213) and bolt (215) into the rear extension housing and tighten to 8 N.m (71 lb in).

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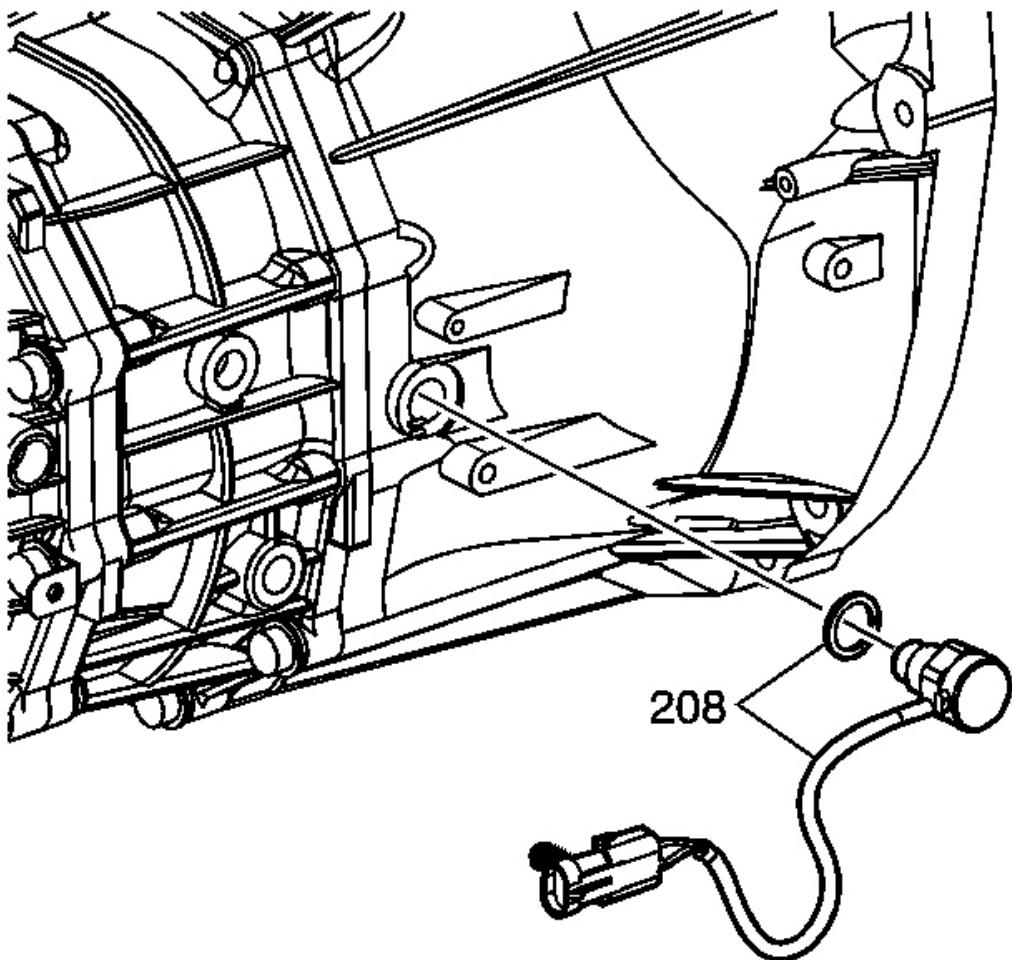


Fig. 222: Identifying Backup Lamp Switch & Washer
Courtesy of GENERAL MOTORS CORP.

19. Install a NEW backup lamp washer (208) and switch into the case. Tighten the switch to 44 N.m (32 lb ft).

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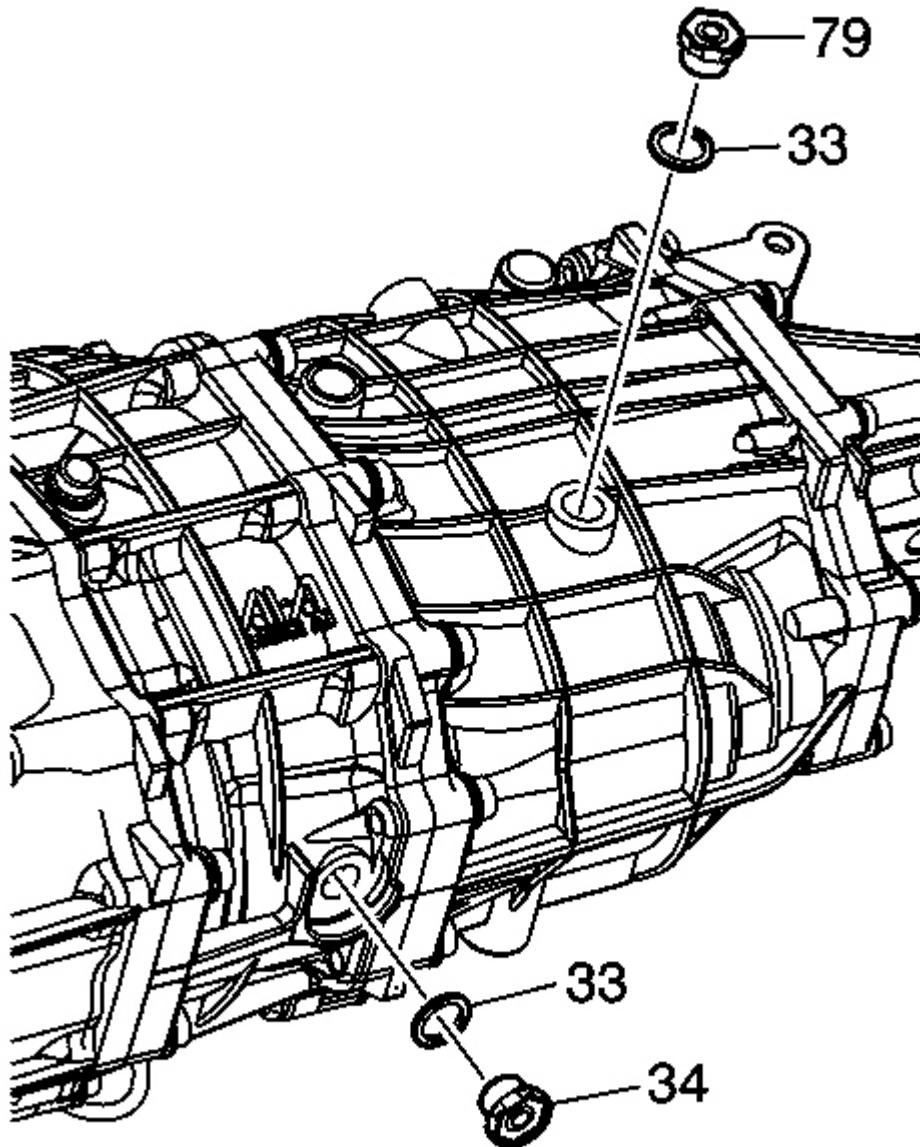


Fig. 223: Identifying Fill Plug, Drain Plug & Washers

Courtesy of GENERAL MOTORS CORP.

20. Install the NEW gaskets (33), drain plug (34) and fill plug (79). Tighten both plugs to 37 N.m (27 lb ft).
21. Install the clutch release cylinder and the clutch release cylinder bolts. Refer to [Clutch Concentric Actuator Cylinder Replacement \(Aisin\)](#) or [Clutch Concentric Actuator Cylinder Replacement](#)

(Tremec) .

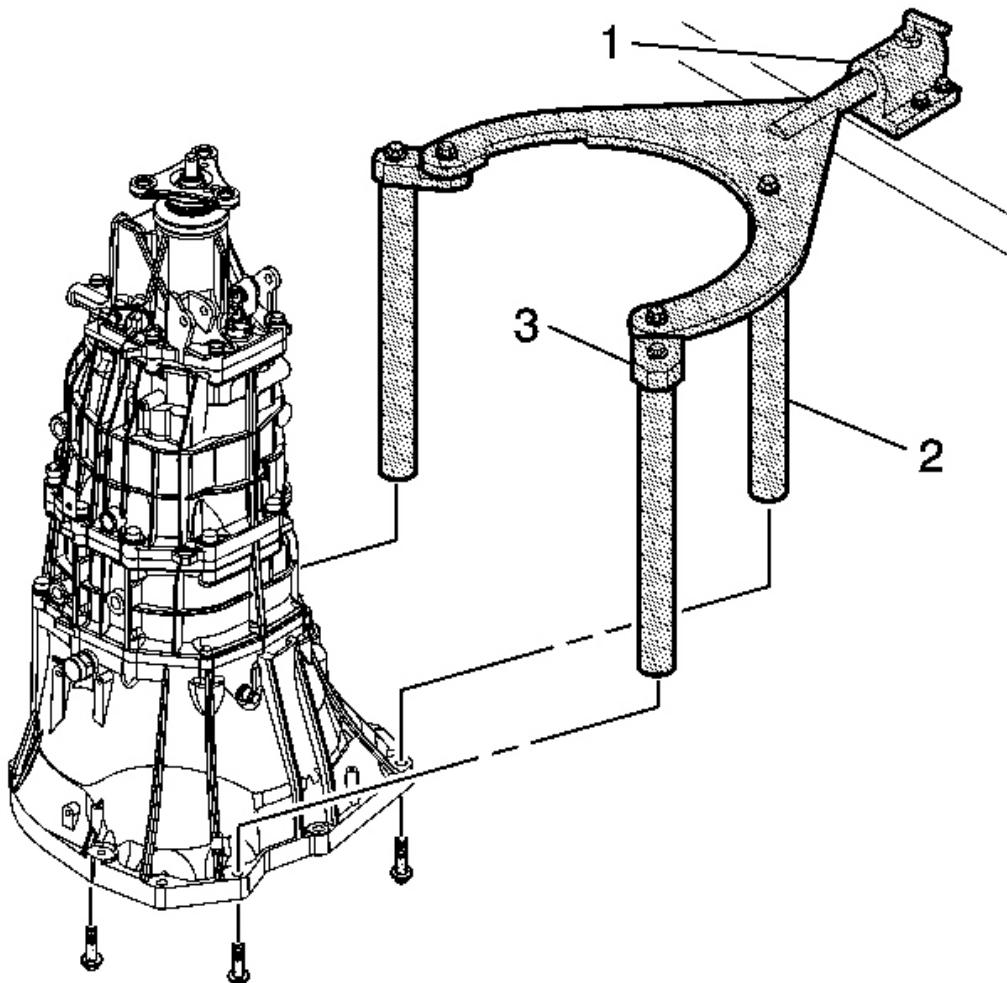


Fig. 224: Transmission Mounting Fixture & Adapters
Courtesy of GENERAL MOTORS CORP.

22. Remove the **DT-47678:** fixture (2) and **J 3289-20:** fixture (1) from the transmission clutch housing.

DESCRIPTION AND OPERATION

TRANSMISSION SYSTEM DESCRIPTION AND OPERATION

General Description

The Aisin AY6 is a 6-speed transmission with 6th gear being an overdrive ratio. All gear positions are synchronized. The transmission has a speed reflector wheel on the output shaft for the vehicle speed sensor. The transmission uses 4 aluminum housings. Roller, tapered roller, and ball bearings support the input shaft, countershaft, and output shaft. No shimming is required. For proper set up, selective thickness retaining rings are used. All of the speed gears use needle bearings. The AY6 uses a special 75W-90 transmission fluid.

Shifting Operation

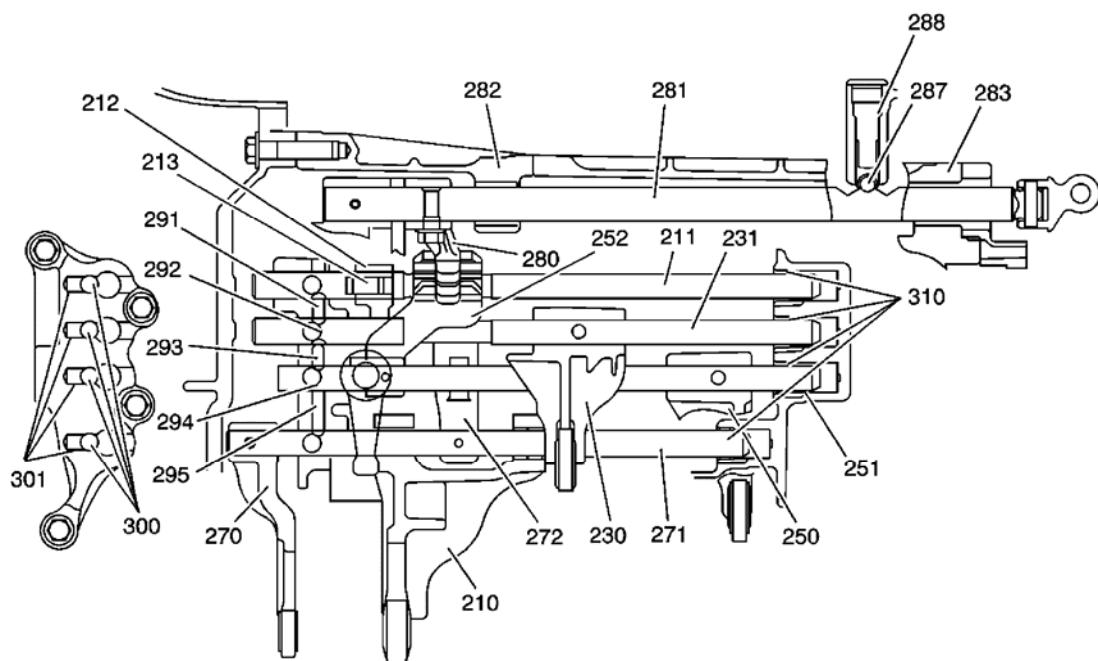


Fig. 225: Shifting Operation Diagram (AY6)

Courtesy of GENERAL MOTORS CORP.

The AY6 has a unique shift system. A single shift control shaft (281) operates 4 shift shafts. Shift control lever fits into a coupling on the shift control shaft (281). Positioning a bolt holds the lever (280) in place on the shift control shaft (281), in the gates of the shift shafts, operates the 1st/2nd shift shaft (211), the 3rd/4th shift shaft (231), the 5th/6th shift shaft (251) and the reverse shift shaft (271). Moving the shift control lever side to side allows the lever (280) on the shift control shaft (281) to engage into one of the 4 gates. Moving the shift control lever forward and reverse selects either position of the particular shift shaft. When shifted in position, a detent ball (300) and spring (301) located in the interlock bracket, holds the shift shaft, and a detent ball (287) and spring (288) located in the rear case, holds the shift control shaft (281). To aid in easy shift operation, the middle case shift control shaft bearing (282) and the rear case shift control shaft bearing (283) support the shift control shaft (281). In addition, the rear case shift shaft bushings (310) support the 1st/2nd shift shaft (211), the 3rd/4th shift shaft (231) and the 5th/6th shift shaft (251).

The 1st/2nd shift shaft (211) is the top shift shaft. A pin holds the no. 3 head (212) in place on the shift shaft. No. 3 head (212) links with 1st/2nd shift fork (210) via the reversal arm (213). The 1st/2nd shift fork (210) slides on the reverse shift shaft (271).

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The 3rd/4th shift shaft (231) is the second shaft from the top. A bolt holds the 3rd/4th shift fork (230) in place on the shift shaft. A small shift shaft interlock pin (292) in the 3rd/4th shift shaft (231) prevents the other shafts from moving. Interlock pins (291 or 293), located in the interlock bracket, contact the small interlock pin (292) and lock into a notch on the shift shaft, preventing multiple shift shaft movement.

The 5th/6th shift shaft (251) is located third from the top. A pin holds the 5th/6th shift head (252) in place on the shift shaft. A bolt holds the 5th/6th shift fork (250) in place on the shift shaft. A small shift shaft interlock pin (294) in the 5th/6th shift shaft (251) prevents the other shafts from moving. Interlock pins (293 or 295), located in the interlock bracket, contact the small interlock pin (294) and lock into a notch on the shift shaft, preventing multiple shift shaft movement.

The reverse shift shaft (271) is the bottom shift shaft. Pins hold the reverse shift head (272) and the reverse shift fork (270) in place on the shift shaft.

1st Gear Power Flow

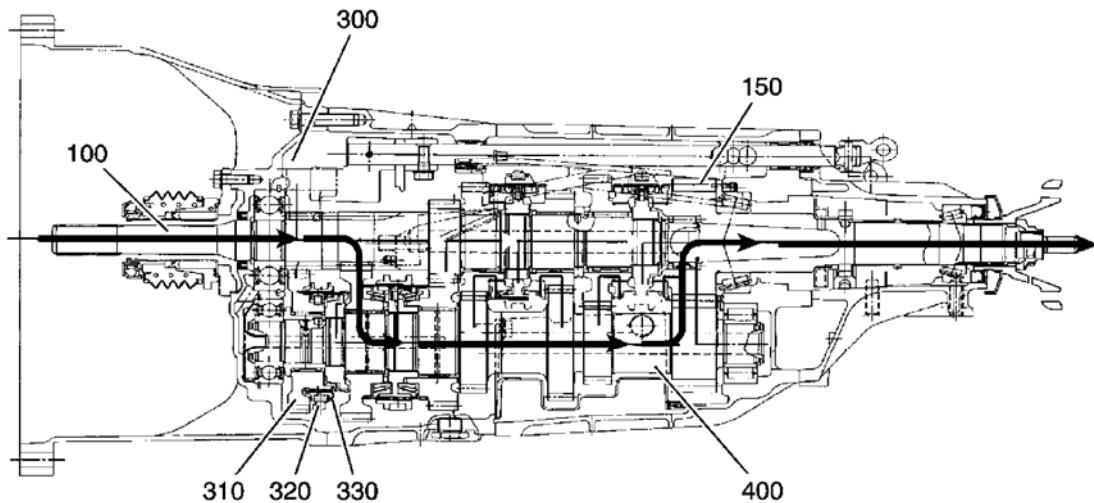


Fig. 226: 1st Gear Power Flow

Courtesy of GENERAL MOTORS CORP.

1st Gear

Moving the 1st/2nd shift fork (210) forward moves the 1st/2nd synchronizer sleeve (170). The synchronizer sleeve (170) slides on the synchronizer hub. The inner teeth on the synchronizer sleeve push against the synchronizer ring teeth, causing the synchronizer rings to contact, and the 1st gear (110) and the countershaft to match speeds. The synchronizer sleeve (170) then engages the selector teeth on 1st gear (110). The synchronizer hub is pressed on the countershaft (400). Power flow is now from the input shaft (100) to the 1st gear (110), through the synchronizer to the countershaft (400) and to the output shaft (150).

2nd Gear Power Flow

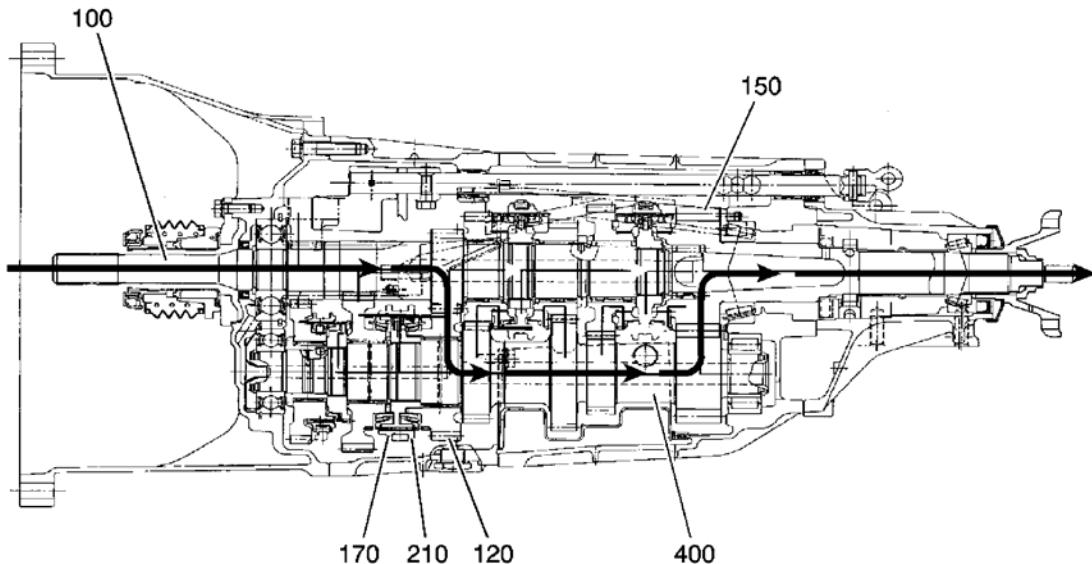


Fig. 227: 2nd Gear Power Flow

Courtesy of GENERAL MOTORS CORP.

2nd Gear

Moving the 1st/2nd shift fork (210) rearward moves the 1st/2nd synchronizer sleeve (170). The synchronizer sleeve (170) slides on the synchronizer hub. The inner teeth on the synchronizer sleeve push against the synchronizer ring teeth, causing the synchronizer rings to contact, and the 2nd gear (120) and the countershaft to match speeds. The synchronizer sleeve (170) then engages the selector teeth on 2nd gear (120). The synchronizer hub is pressed on the countershaft (400). Power flow is now from the input shaft (100) to the 2nd gear (120), through the synchronizer to the countershaft (400) and to the output shaft (150).

3rd Gear Power Flow

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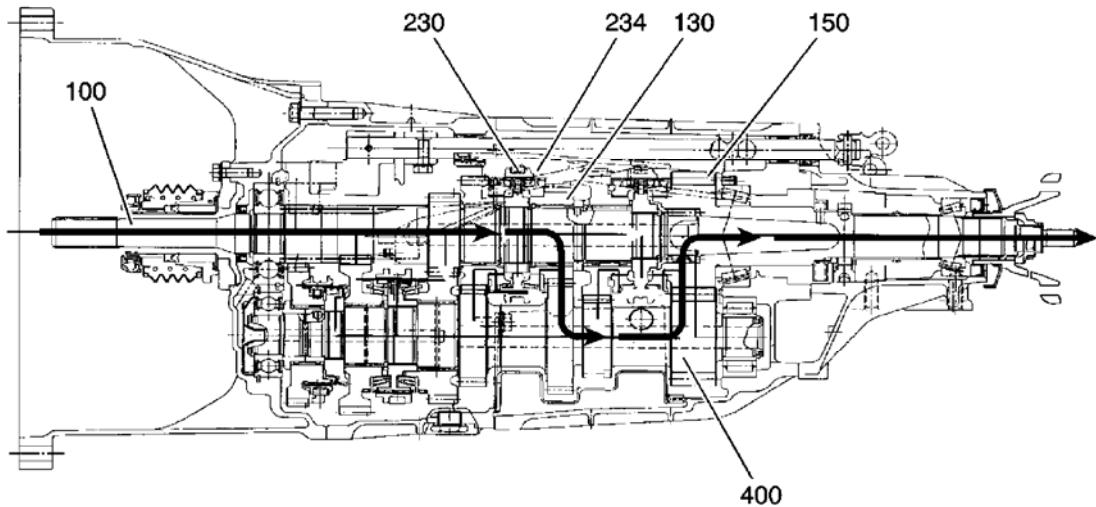


Fig. 228: 3rd Gear Power Flow

Courtesy of GENERAL MOTORS CORP.

3rd Gear

Moving the 3rd/4th shift fork (230) rearward moves the 3rd/4th synchronizer sleeve (234). The synchronizer sleeve (234) slides on the synchronizer hub. The inner teeth on the synchronizer sleeve push against the synchronizer ring teeth, causing the synchronizer ring to contact, and the 3rd gear (130) and the input shaft to match speeds. The synchronizer sleeve (234) then engages the selector teeth on 3rd gear (130). The synchronizer hub is pressed on the input shaft (100). Power flow is now from the input shaft (100) through the synchronizer, to the 3rd gear (130) to the countershaft (400) and to the output shaft (150).

4th Gear Power Flow

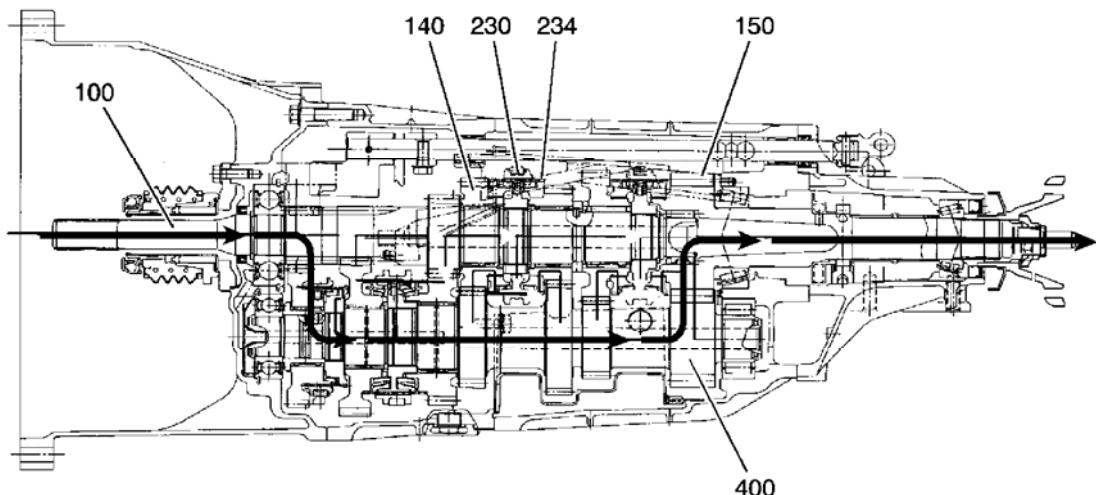


Fig. 229: 4th Gear Power Flow

Courtesy of GENERAL MOTORS CORP.

4th Gear

Moving the 3rd/4th shift fork (230) forward moves the 3rd/4th synchronizer sleeve (234). The synchronizer sleeve (234) slides on the synchronizer hub. The inner teeth on the synchronizer sleeve push against the synchronizer ring teeth, causing the synchronizer ring to contact, and the 4th gear (140) and the input shaft to match speeds. The synchronizer sleeve (234) then engages the selector teeth on 4th gear (140). The synchronizer hub is pressed on the input shaft (100). Power flow is now from the input shaft (100) through the synchronizer, to the 4th gear (140) to the countershaft (400) and to the output shaft (150).

5th Gear Power Flow

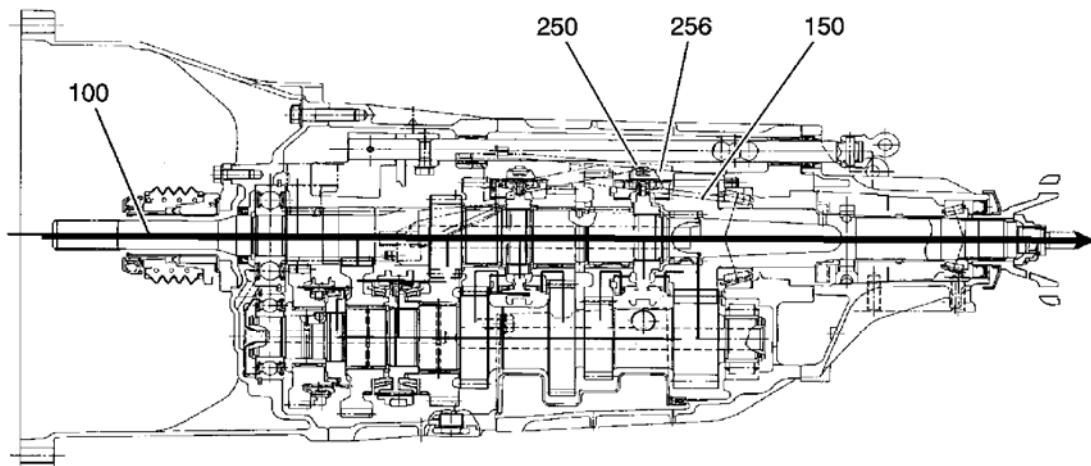


Fig. 230: 5th Gear Power Flow

Courtesy of GENERAL MOTORS CORP.

5th Gear

In 5th gear, the power flow goes directly from the input shaft (100) to the output shaft (150) through the 5th/6th synchronizer. This happens because 5th gear is the same ratio as the engine speed. Moving the 5th/6th shift fork (250) rearward moves the 5th/6th synchronizer sleeve (256). The synchronizer sleeve (256) slides on the synchronizer hub. The inner teeth on the synchronizer sleeve push against the synchronizer ring teeth for output shaft (150). Matching the input shaft (100) to the output shaft (150) allows the synchronizer sleeve to engage to the selector teeth on the output shaft (150). The synchronizer hub is pressed on the input shaft (100).

6th Gear Power Flow

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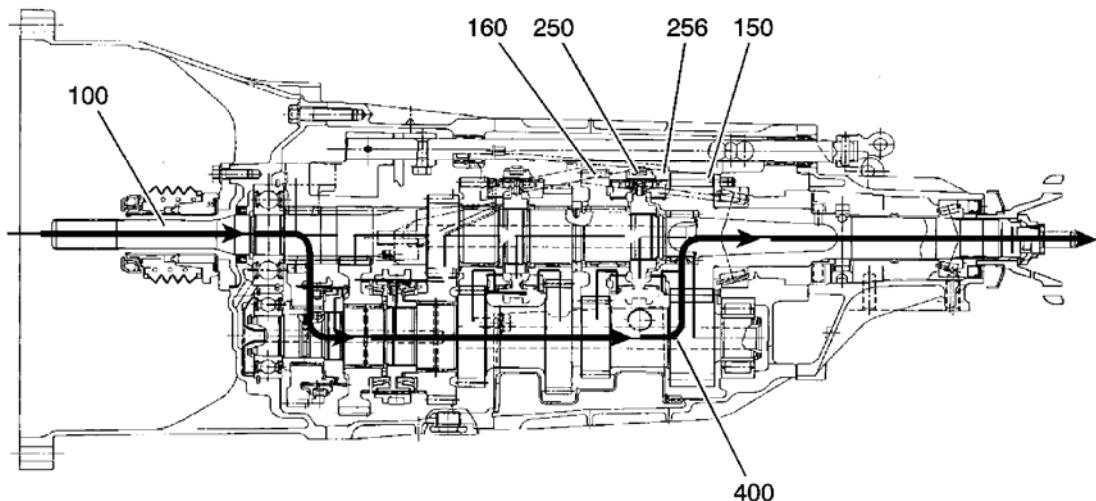


Fig. 231: 6th Gear Power Flow

Courtesy of GENERAL MOTORS CORP.

6th Gear

the 6th gear (160) is an overdrive ratio. Moving the 5th/6th shift fork (250) forward moves the 5th/6th synchronizer sleeve (256). The synchronizer sleeve (256) slides on the synchronizer hub. The inner teeth on the synchronizer sleeve push against the synchronizer ring teeth, causing the synchronizer ring to contact, and the 6th gear (160) and the input shaft to match speeds. The synchronizer sleeve (256) then engages the selector teeth on 6th gear (160). The synchronizer hub is pressed on the input shaft (100). Power flow is now from the input shaft (100) through the synchronizer to the 6th gear (160) to the countershaft (400) and to the output shaft (150), which now turns faster than the speed of the input shaft (100).

Reverse Gear Power Flow

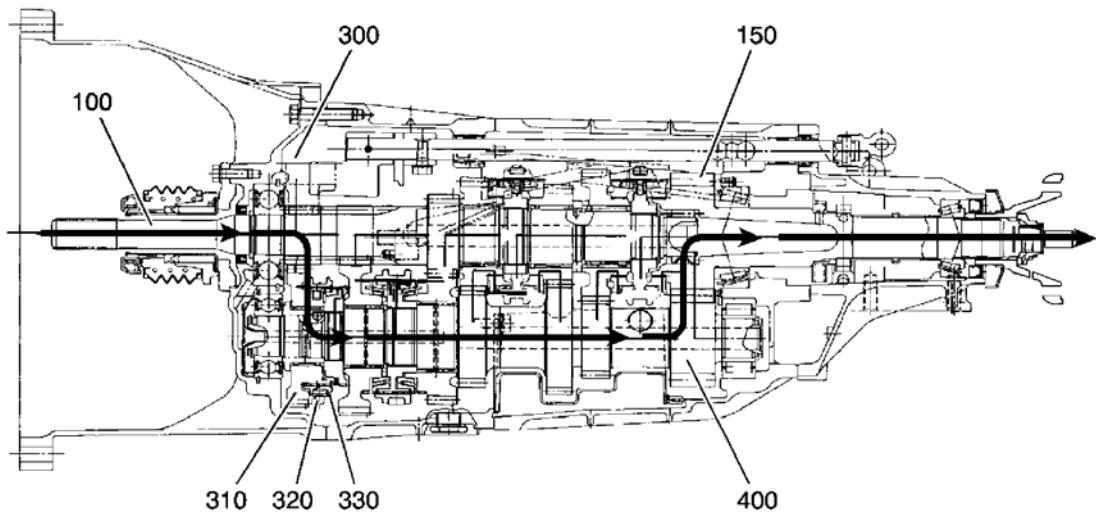


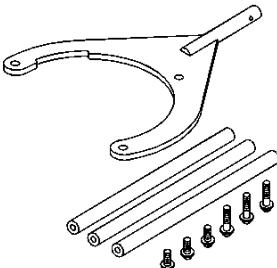
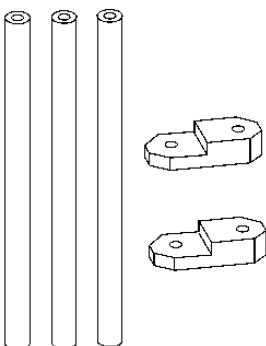
Fig. 232: Reverse Gear Power Flow

Courtesy of GENERAL MOTORS CORP.

Reverse Gear

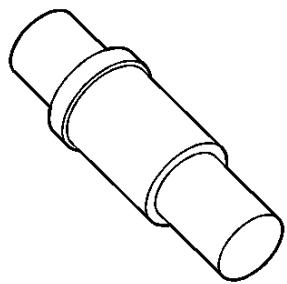
The reverse idler gear (300) is located on the reverse idler shaft and rotates on needle bearings. The reverse idler gear (300) engages with the input shaft (100) and with the reverse gear (310). Moving the reverse shift fork (320) rearward moves the reverse synchronizer sleeve (330). The synchronizer sleeve (330) slides on the spline of the reverse gear. The inner teeth on the synchronizer sleeve push against the synchronizer ring teeth, causing the synchronizer ring to contact, and the reverse gear (310) and the countershaft to match speeds. The synchronizer sleeve (330) then engages the selector teeth (340). The selector teeth are pressed on the countershaft (400). Power flow is now from the input shaft (100) to the reverse idler gear (300), to the reverse gear (310), through the synchronizer to the countershaft (400) and to the output shaft (150).

SPECIAL TOOLS AND EQUIPMENT**SPECIAL TOOLS**

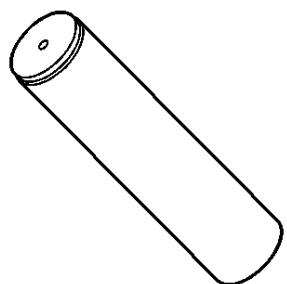
Illustration	Tool Number/ Description
	DT 47678 Transmission Holding Fixture
	DT 47678-10 Transmission Holding Fixture Adapters

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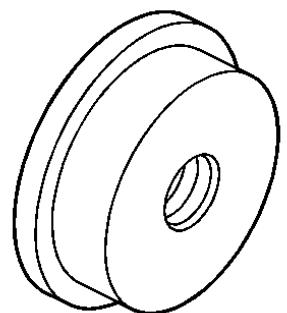
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DT 47722
Shift Rail Bushing Remover/Installer



DT 47723
Output Shaft Bearing Installer

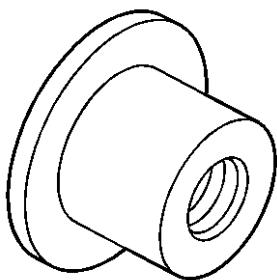
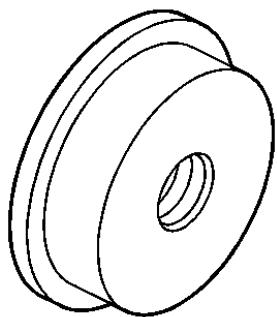


DT 47724
Output Shaft Bearing Cup Installer

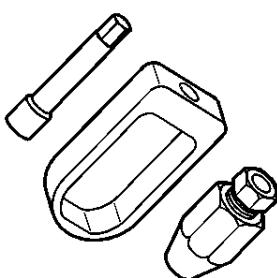
DT 47725
Extension Housing Bearing Cup Installer

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DT 47726
Counter Shaft Rear Bearing Installer



DT 49027
Coil Pin Remover and Installer

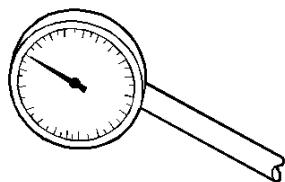


J 2619-01
Slide Hammer

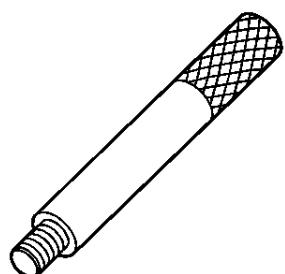
J 8001-3

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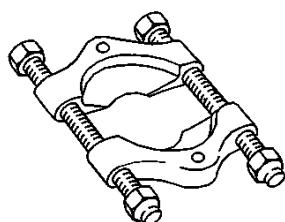
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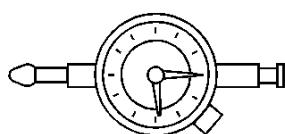
Dial Indicator



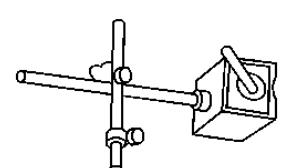
J 8092
Driver Handle



J 22912-B
Split Plate Bearing Puller



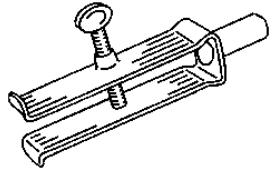
J 26900-12
Dial Indicator 1-10 mm



J 26900-13
Magnetic Indicator Base

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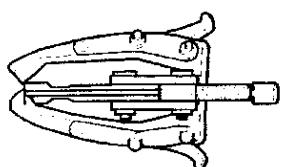
2010 TRANSMISSION Manual Transmission - Aisin AY6 - Camaro



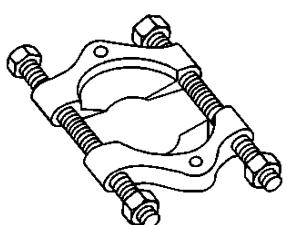
J 26941
Bushing and Bearing Remover 3-4 in



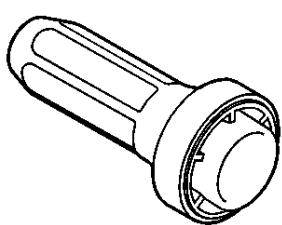
J 36614
Inner Pinion Bearing Installer



J 41816
Crankshaft Balancer Remover



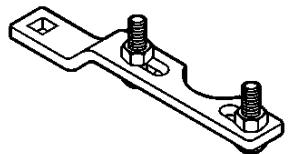
J 44749
Split Plate Bearing Gear Puller



J 44765
Seal Installer

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J 45012
Holding Fixture