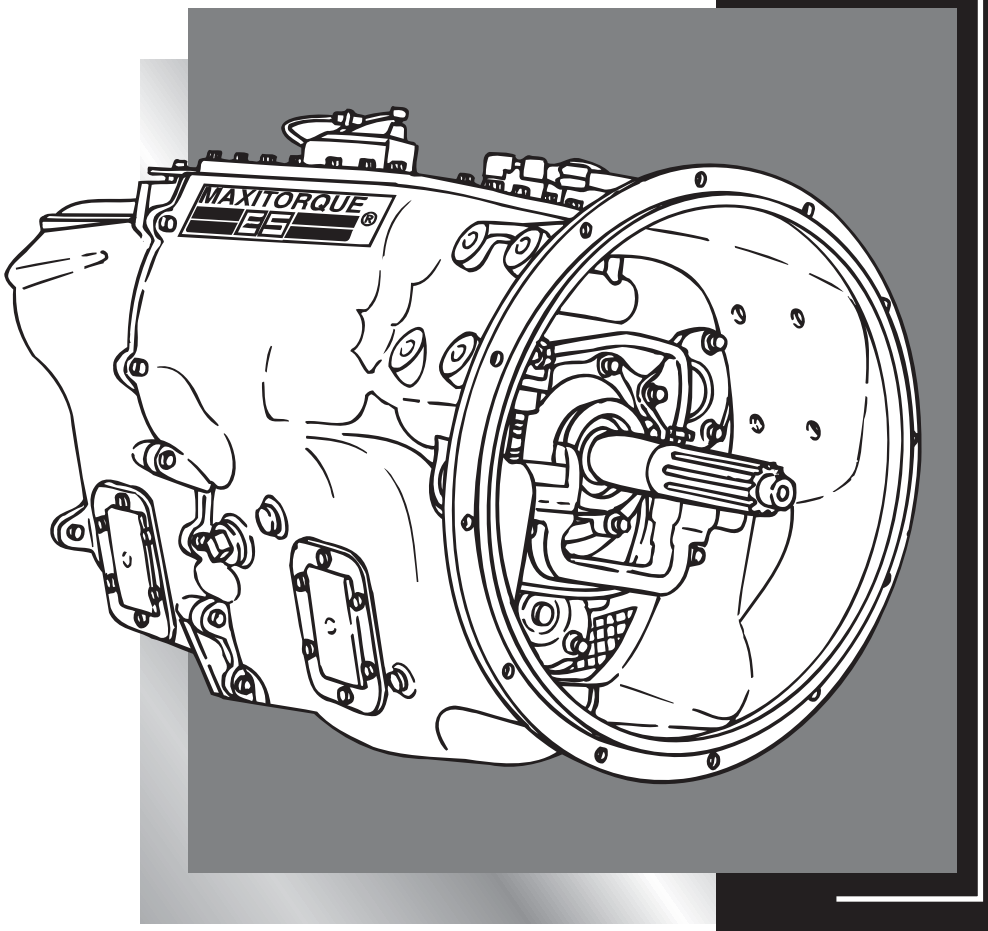
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T313—T318(L)(LR)(21)(L21)(LR21)

SERVICE MANUAL

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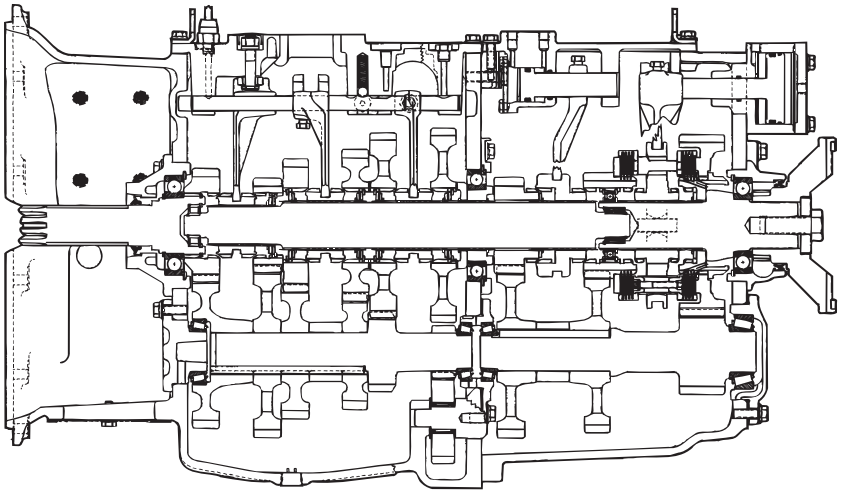
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TRANSMISSIONS

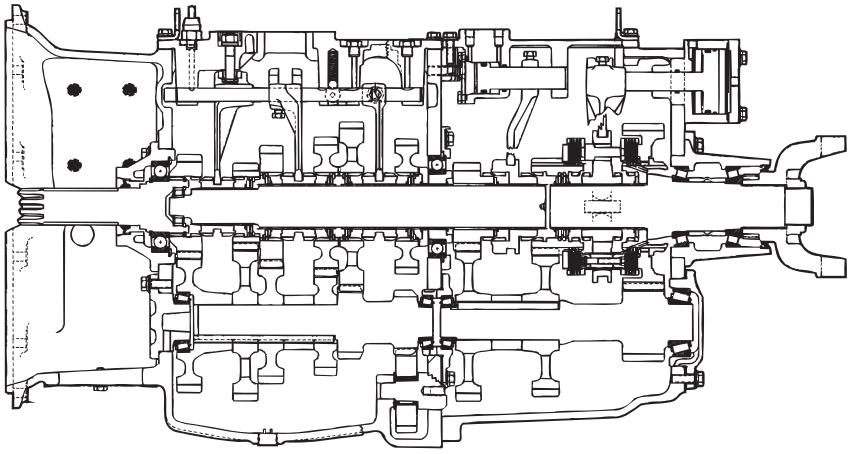
T313–T318(L)(LR)(21)(L21)(LR21)

SERVICE MANUAL



T313–T318(L)(LR)

T313–T318(21)(L21)(LR21)



OCTOBER 2008
(REVISED — SUPERSEDES ISSUE DATED JULY 2003)

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ATTENTION

The information in this manual is not all inclusive and cannot take into account all unique situations. Note that some illustrations are typical and may not reflect the exact arrangement of every component installed on a specific chassis.

The information, specifications, and illustrations in this publication are based on information that was current at the time of publication.

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INTRODUCTION

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SAFETY INFORMATION

Advisory Labels

Cautionary *signal words* (Danger-Warning-Caution) may appear in various locations throughout this manual. Information accented by one of these signal words must be observed to minimize the risk of personal injury to service personnel, or the possibility of improper service methods which may damage the vehicle or cause it to be unsafe. Additional Notes and Service Hints are used to emphasize areas of procedural importance and provide suggestions for ease of repair. The following definitions indicate the use of these advisory labels as they appear throughout the manual:

⚠ DANGER

Danger *indicates an unsafe practice that could result in death or serious personal injury. Serious personal injury is considered to be permanent injury from which full recovery is NOT expected, resulting in a change in life style.*

⚠ WARNING

***Warning* indicates an unsafe practice that could result in personal injury. Personal injury means that the injury is of a temporary nature and that full recovery is expected.**

⚠ CAUTION

***Caution** indicates an unsafe practice that could result in damage to the product.*

NOTE

Note indicates a procedure, practice, or condition that must be followed in order for the vehicle or component to function in the manner intended.

SERVICE HINT

A helpful suggestion that will make it quicker and/or easier to perform a procedure, while possibly reducing service cost.

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Service Procedures and Tool Usage

Anyone using a service procedure or tool not recommended in this manual must first satisfy himself thoroughly that neither his safety nor vehicle safety will be jeopardized by the service method he selects. Individuals deviating in any manner from the instructions provided assume all risks of consequential personal injury or damage to equipment involved.

Also note that particular service procedures may require the use of a special tool(s) designed for a specific purpose. These special tools must be used in the manner described, whenever specified in the instructions.

⚠ DANGER

1. ***Before starting a vehicle, always be seated in the driver's seat, place the transmission in neutral, apply the parking brakes, and push in the clutch pedal. Failure to follow these instructions could produce unexpected vehicle movement, which can result in serious personal injury or death.***
2. ***Before working on a vehicle, place the transmission in neutral, set the parking brakes, and block the wheels. Failure to follow these instructions could produce unexpected vehicle movement, which can result in serious personal injury or death.***

⚠ DANGER

Engine-driven components such as Power Take-Off (PTO) units, fans and fan belts, driveshafts and other related rotating assemblies, can be very dangerous. Do not work on or service engine-driven components unless the engine is shut down. Always keep body parts and loose clothing out of range of these powerful components to prevent serious personal injury. Be aware of PTO engagement or nonengagement status. Always disengage the PTO when not in use.

⚠ DANGER

Do not work under a vehicle that is supported only by a hydraulic jack. The hydraulic jack could fail suddenly and unexpectedly, resulting in severe personal injury or death. Always use jackstands of adequate capacity to support the weight of the vehicle.

⚠ CAUTION

Before towing the vehicle, place the transmission in neutral and lift the rear wheels off the ground, or disconnect the driveline to avoid damage to the transmission during towing.

REMEMBER,
SAFETY . . . IS NO ACCIDENT!

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Mack Trucks, Inc. cannot anticipate every possible occurrence that may involve a potential hazard. Accidents can be avoided by recognizing potentially hazardous situations and taking necessary precautions. Performing service procedures correctly is critical to technician safety and safe, reliable vehicle operation.

The following list of general shop safety practices can help technicians avoid potentially hazardous situations and reduce the risk of personal injury. DO NOT perform any services, maintenance procedures or lubrications until this manual has been read and understood.

- Perform all service work on a flat, level surface. Block wheels to prevent vehicle from rolling.
- DO NOT wear loose-fitting or torn clothing. Remove any jewelry before servicing vehicle.
- ALWAYS wear safety glasses and protective shoes. Avoid injury by being aware of sharp corners and jagged edges.
- Use hoists or jacks to lift or move heavy objects.
- NEVER run engine indoors unless exhaust fumes are adequately vented to the outside.
- Be aware of hot surfaces. Allow engine to cool sufficiently before performing any service or tests in the vicinity of the engine.
- Keep work area clean and orderly. Clean up any spilled oil, grease, fuel, hydraulic fluid, etc.
- Only use tools that are in good condition, and always use accurately calibrated torque wrenches to tighten all fasteners to specified torques. In instances where procedures require the use of special tools which are designed for a specific purpose, use only in the manner described in the instructions.
- Do not store natural gas powered vehicles indoors for an extended period of time (overnight) without first removing the fuel.
- Never smoke around a natural gas powered vehicle.

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EXPLANATION OF NUMERICAL CODE

The organization of MACK service manuals has been upgraded to standardize manual content according to a reference system based on component identification. The reference system helps link the information contained in this publication with related information included in other MACK service-warranty publications, such as associated service bulletins, warranty manuals, and MACK Service Labor Time Standards.

The system is based on a numerical code, the first **digit** of which identifies the general component grouping as listed here:

GROUP **0**00 — GENERAL DATA

GROUP **1**00 — CHASSIS

GROUP **2**00 — ENGINE

GROUP **3**00 — CLUTCH, TRANSMISSION, TRANSFER CASE AND PTO

GROUP **4**00 — STEERING, AXLES, WHEELS AND TIRES, DRIVELINE

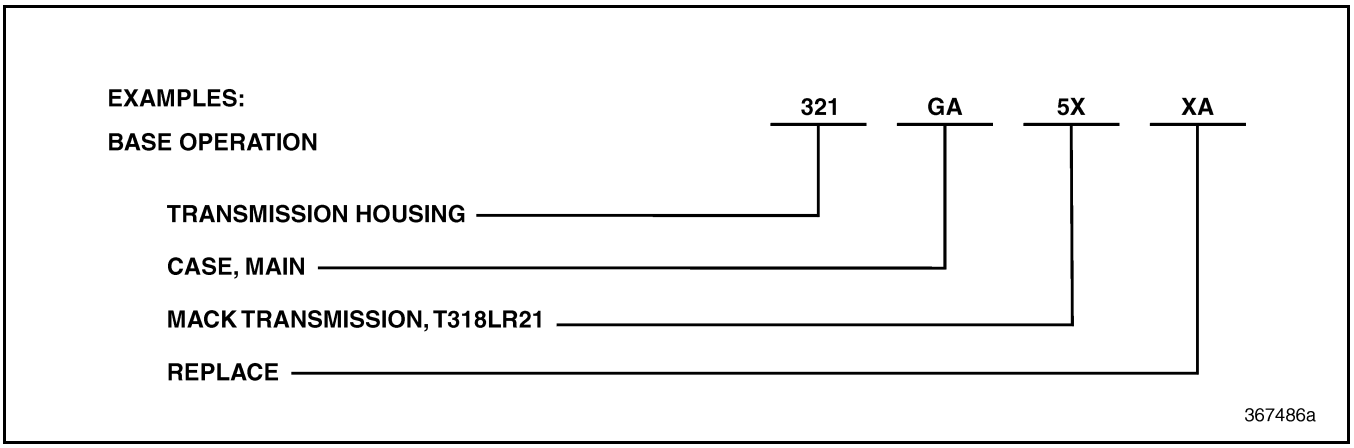
GROUP **5**00 — BRAKES, AUXILIARY SYSTEMS

GROUP **6**00 — CAB, TRUCK BODY

GROUP **7**00 — ELECTRICAL

The second two digits of the three-digit code are used to identify the **system, assembly** or **subassembly**, as appropriate, within each of the groupings. The codes applicable to this publication are shown at the beginning of each procedure, as necessary, to guide you to specific component information.

Additionally, a two-character alpha-code (i.e., [GA] CASE, MAIN) may be shown with each operation. This alpha code, in combination with the three-digit Group number, identifies the specific assembly, sub-assembly or part, and directly relates to the first five positions of the operation code listed in MACK Service Labor Time Standards.



Example of Numerical Code

CONVERSION CHART

Conversion Units			Multiply By:
Length Calculations			
Inches (in)	to	Millimeters (mm)	25.40
Inches (in)	to	Centimeters (cm)	2.540
Feet (ft)	to	Centimeters (cm)	30.48
Feet (ft)	to	Meters (m)	0.3048
Yards (yd)	to	Centimeters (cm)	91.44
Yards (yd)	to	Meters (m)	0.9144
Miles	to	Kilometers (km)	1.609
Millimeters (mm)	to	Inches (in)	0.03937
Centimeters (cm)	to	Inches (in)	0.3937
Centimeters (cm)	to	Feet (ft)	0.0328
Centimeters (cm)	to	Yards (yd)	0.0109
Meters (m)	to	Feet (ft)	3.281
Meters (m)	to	Yards (yd)	1.094
Kilometers (km)	to	Miles	0.6214
Area Calculations			
Square Inches (sq-in)	to	Square Millimeters (sq-mm)	645.2
Square Inches (sq-in)	to	Square Centimeters (sq-cm)	6.452
Square Feet (sq-ft)	to	Square Centimeters (sq-cm)	929.0
Square Feet (sq-ft)	to	Square Meters (sq-m)	0.0929
Square Yards (sq-yd)	to	Square Meters (sq-m)	0.8361
Square Miles (sq-miles)	to	Square Kilometers (sq-km)	2.590
Square Millimeters (sq-mm)	to	Square Inches (sq-in)	0.00155
Square Centimeters (sq-cm)	to	Square Inches (sq-in)	0.155
Square Centimeters (sq-cm)	to	Square Feet (sq-ft)	0.001076
Square Meters (sq-m)	to	Square Feet (sq-ft)	10.76
Square Meters (sq-m)	to	Square Yards (sq-yd)	1.196
Square Kilometers (sq-km)	to	Square Miles (sq-miles)	0.3861
Volume Calculations			
Cubic Inches (cu-in)	to	Cubic Centimeters (cu-cm)	16.387
Cubic Inches (cu-in)	to	Liters (L)	0.01639
Quarts (qt)	to	Liters (L)	0.9464
Gallons (gal)	to	Liters (L)	3.7854
Cubic Yards (cu-yd)	to	Cubic Meters (cu-m)	0.7646
Cubic Centimeters (cu-cm)	to	Cubic Inches (cu-in)	0.06102
Liters (L)	to	Cubic Inches (cu-in)	61.024
Liters (L)	to	Quarts (qt)	1.0567
Liters (L)	to	Gallons (gal)	0.2642
Cubic Meters (cu-m)	to	Cubic Yards (cu-yd)	1.308

Conversion Units			Multiply By:
Weight Calculations			
Ounces (oz)	to	Grams (g)	28.5714
Pounds (lb)	to	Kilograms (kg)	0.4536
Pounds (lb)	to	Short Tons (US tons)	0.0005
Pounds (lb)	to	Metric Tons (t)	0.00045
Short Tons (US tons)	to	Pounds (lb)	2000
Short Tons (US tons)	to	Kilograms (kg)	907.18486
Short Tons (US tons)	to	Metric Tons (t)	0.90718
Grams (g)	to	Ounces (oz)	0.035
Kilograms (kg)	to	Pounds (lb)	2.205
Kilograms (kg)	to	Short Tons (US tons)	0.001102
Kilograms (kg)	to	Metric Tons (t)	0.001
Metric Tons (t)	to	Pounds (lb)	2205
Metric Tons (t)	to	Short Tons (US tons)	1.1023
Metric Tons (t)	to	Kilograms (kg)	1000
Force Calculations			
Ounces Force (ozf)	to	Newtons (N)	0.2780
Pounds Force (lbf)	to	Newtons (N)	4.448
Pounds Force (lbf)	to	Kilograms Force (kgf)	0.456
Kilograms Force (kgf)	to	Pounds Force (lbf)	2.2046
Kilograms Force (kgf)	to	Newtons (N)	9.807
Newtons (N)	to	Kilograms Force (kgf)	0.10196
Newtons (N)	to	Ounces Force (ozf)	3.597
Newtons (N)	to	Pounds Force (lbf)	0.2248
Torque Calculations			
Pound Inches (lb-in)	to	Newton Meters (N•m)	0.11298
Pound Feet (lb-ft)	to	Newton Meters (N•m)	1.3558
Pound Feet (lb-ft)	to	Kilograms Force per Meter (kgfm)	0.13825
Newton Meters (N•m)	to	Pound Inches (lb-in)	8.851
Newton Meters (N•m)	to	Pound Feet (lb-ft)	0.7376
Newton Meters (N•m)	to	Kilograms Force per Meter (kgfm)	0.10197
Kilograms Force per Meter (kgfm)	to	Pound Feet (lb-ft)	7.233
Kilograms Force per Meter (kgfm)	to	Newton Meters (N•m)	9.807
Radiator Specific Heat Dissipation Calculations			
British Thermal Unit per Hour (BTU/hr)	to	Kilowatt per Degree Celsius (kW/°C)	0.000293
Kilowatt per Degree Celsius (kW/°C)	to	British Thermal Unit per Hour (BTU/hr)	3414.43
Temperature Calculations			
Degrees Fahrenheit (°F)	to	Degrees Celsius (°C)	(°F – 32) x 0.556
Degrees Celsius (°C)	to	Degrees Fahrenheit (°F)	(1.8 x °C) + 32

Conversion Units			Multiply By:
Pressure Calculations			
Atmospheres (atm)	to	Bars (bar)	1.01325
Atmospheres (atm)	to	Kilopascals (kPa)	101.325
Bars (bar)	to	Atmospheres (atm)	0.98692
Bars (bar)	to	Kilopascals (kPa)	100
Bar (bar)	to	Pounds per Square Inch (psi)	14.5037
Inches of Mercury (in Hg)	to	Kilopascals (kPa)	3.377
Inches of Water (in H2O)	to	Kilopascals (kPa)	0.2491
Pounds per Square Inch (psi)	to	Kilopascals (kPa)	6.895
Pounds per Square Inch (psi)	to	Bar (bar)	0.06895
Kilopascals (kPa)	to	Atmospheres (atm)	0.00987
Kilopascals (kPa)	to	Inches of Mercury (in Hg)	0.29612
Kilopascals (kPa)	to	Inches of Water (in H2O)	4.01445
Kilopascals (kPa)	to	Pounds per Square Inch (psi)	0.145
Power Calculations			
Horsepower (hp)	to	Kilowatts (kW)	0.74627
Kilowatts (kW)	to	Horsepower (hp)	1.34
Fuel Performance Calculations			
Miles per Gallon (mile/gal)	to	Kilometers per Liter (km/L)	0.4251
Kilometers per Liter (km/L)	to	Miles per Gallon (mile/gal)	2.352
Velocity Calculations			
Miles per Hour (mile/hr)	to	Kilometers per Hour (km/hr)	1.609
Kilometers per Hour (km/hr)	to	Miles per Hour (mile/hr)	0.6214
Volume Flow Calculations			
Cubic Feet per Minute (cu-ft/min)	to	Liters per Minute (L/min)	28.32
Liters per Minute (L/min)	to	Cubic Feet per Minute (cu-ft/min)	0.03531

VISUAL IDENTIFICATION

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TRANSMISSION IDENTIFICATION

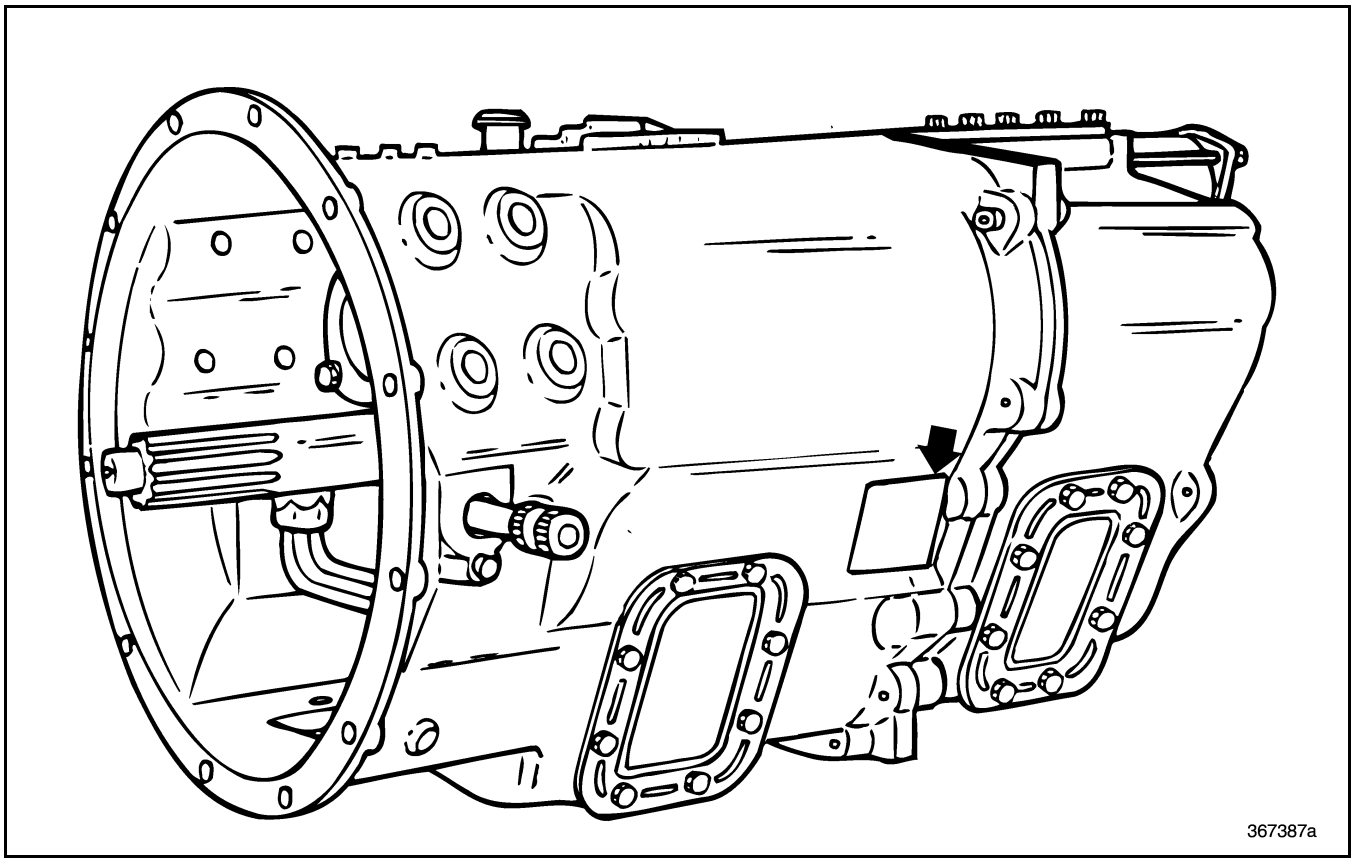


Figure 1 — Location of Identification Stamping on Left Side of Main Case

Unit Identification Stamping Location

The following model code information is stamped on the left side of the transmission, toward the rear of the main case.

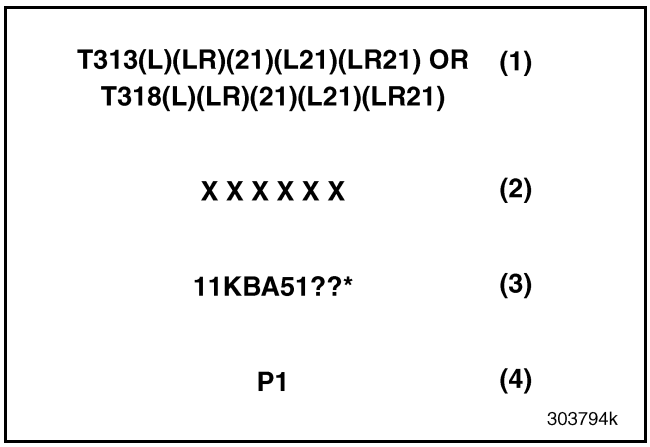


Figure 2 — Unit Identification Stamping

1. Unit Symbol Identification
   T = transmission
   3 = 300 series
   13/18 = useable forward speeds
   L = low forward gear
   R = low reverse gear
   21 = 2100 lb-ft torque capacity
2. Transmission Serial No.
3. Transmission Assembly (Part) No.
   * = digits may vary
4. Specific variant of the base assembly number (variant to item No. 3)

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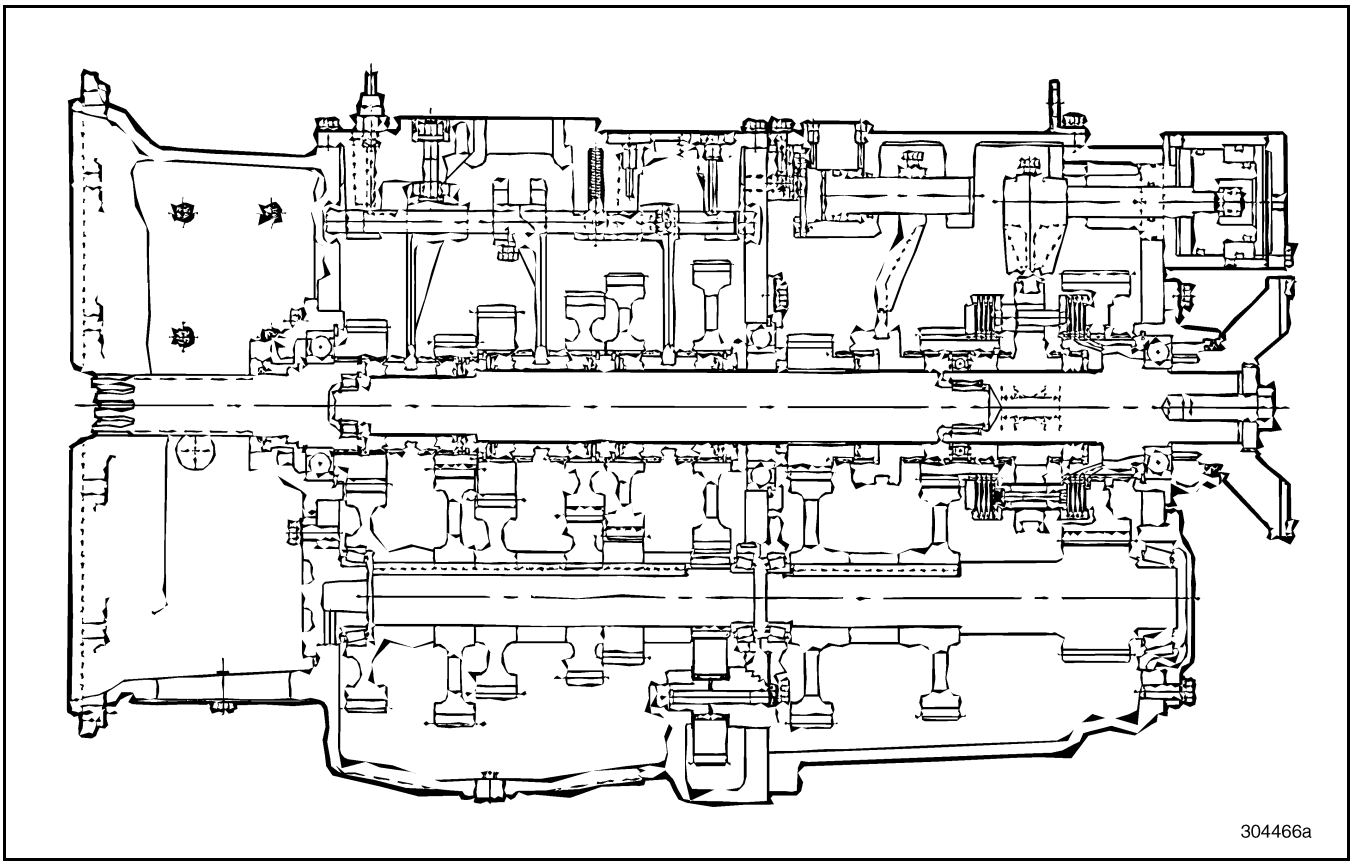


Figure 3 — Cutaway View of T313/T318 Transmission

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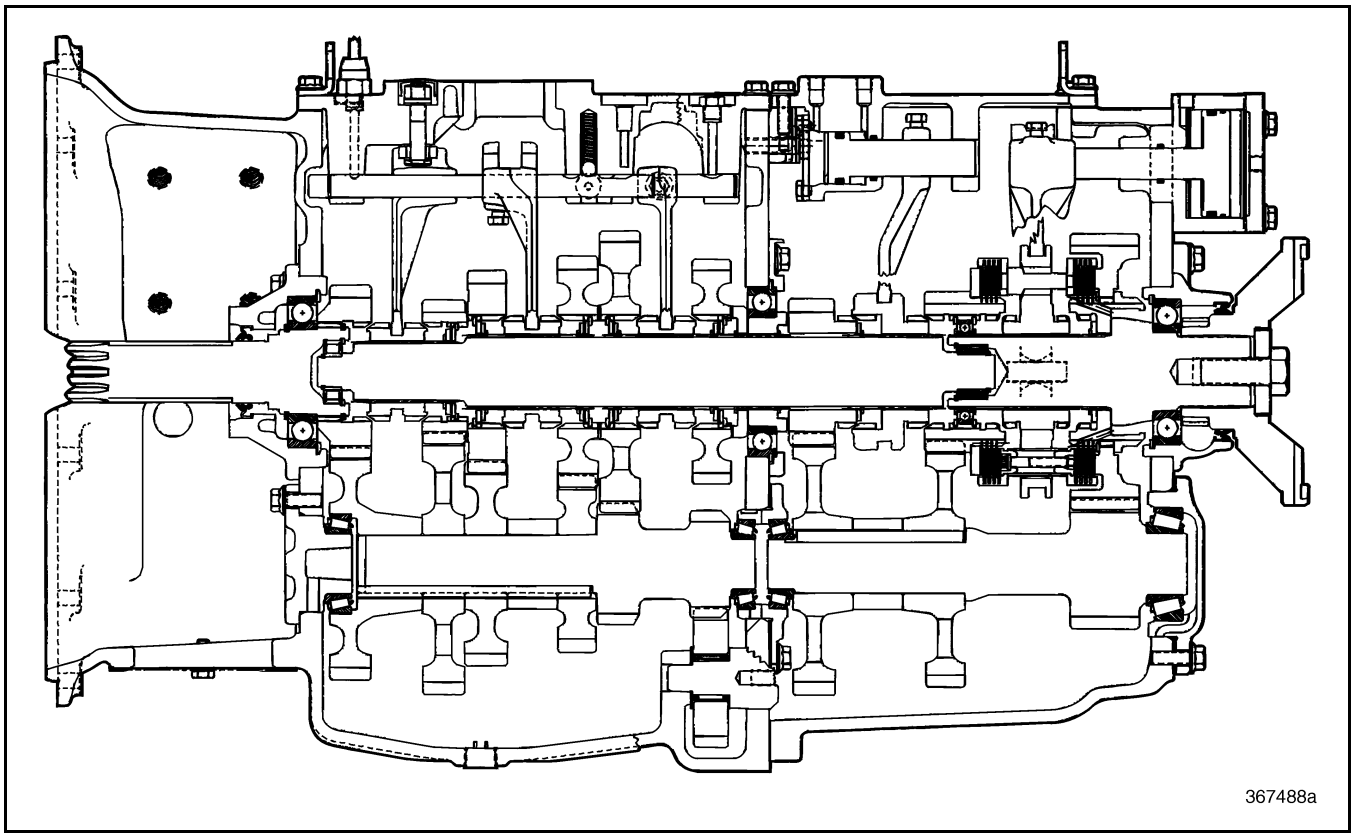


Figure 4 — Cutaway View of T313L/T318L Transmission

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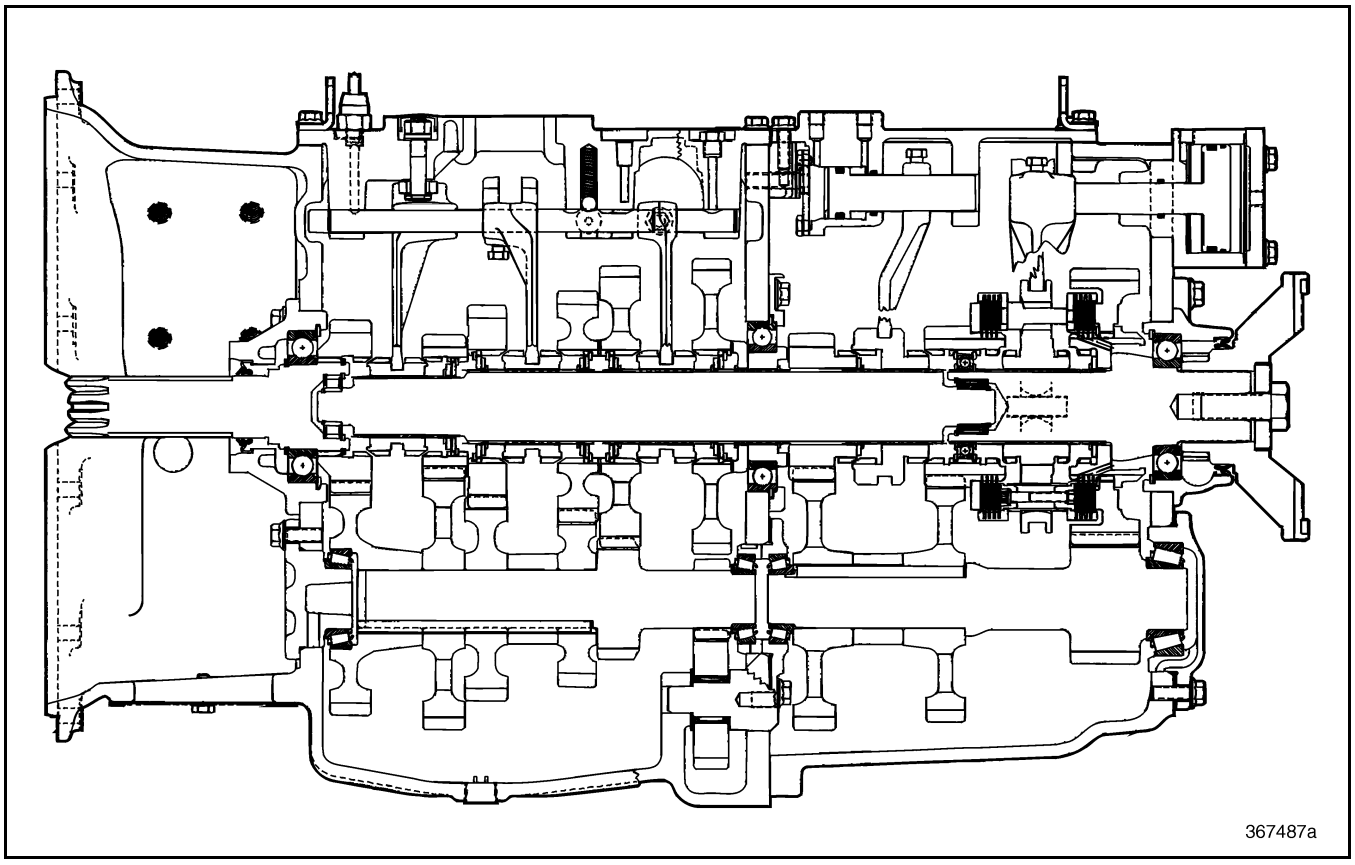


Figure 5 — Cutaway View of T313LR/T318LR Transmission

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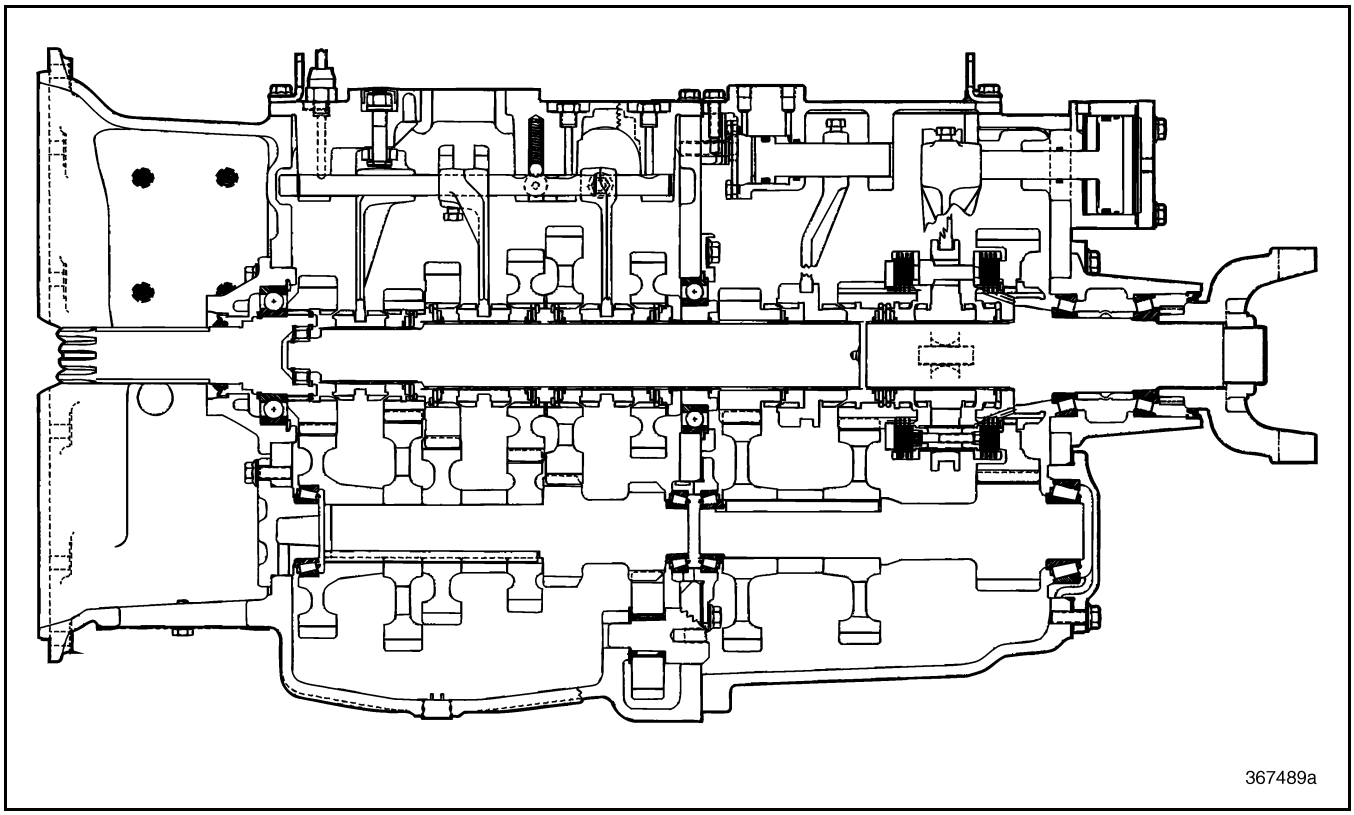


Figure 6 — Cutaway View of T313L21/T318L21 Transmission

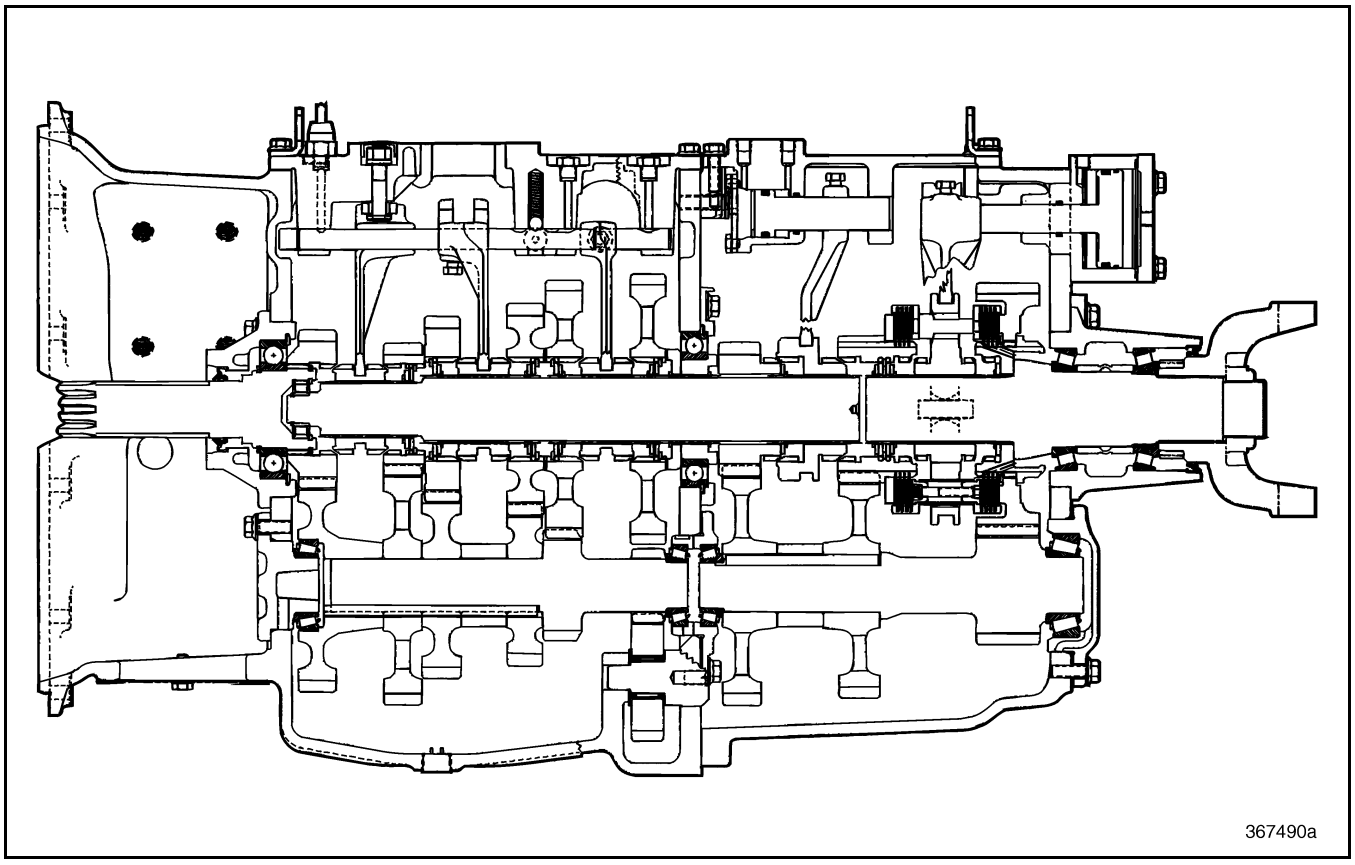


Figure 7 — Cutaway View of T313LR21/T318LR21 Transmission

Transmission model not shown:

- T31321/T31821

NOTES

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DESCRIPTION AND OPERATION

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DESCRIPTION AND OPERATION

T313–T318(L)(LR)(21)(L21)(LR21) Transmissions

DESCRIPTION

The T313/T318 series transmissions are a member of a new family of MACK transmissions designated as MAXITORQUE® ES (T300) series transmissions. These transmissions are the next evolution of the durable triple-countershaft transmission. New features and product enhancements have been engineered into these transmissions to provide a wide range of advantages which include the following:

- New and revised gear ratios for greater overall range and versatility
- Lower “LOs” in forward and reverse for superior site maneuvering
- Improved shift quality through the use of a new sliding clutch with a fine-pitch tooth design versus the coarse-pitch tooth design of previous transmissions
- Enhanced durability
- Weight reduction versus the previous series transmissions

The T313/T318 transmissions are triple-countershaft units. They consist of a compact main box which houses five non-synchronized forward-speed gear sets plus a reverse gear set. The rear case of the T313/T318 transmission is also a triple-countershaft unit. The rear case consists of Lo-range and Hi-range gear sets plus a splitter section.

A single gearshift lever is used to shift through a “progressive-H” shift pattern. In addition, an air-operated valve (with two selectors), mounted on the shift lever, is used to shift both the range gears and splitter gears in the compound. A plate-type synchronizer is used to range shift between the Hi-range and Lo-range gear sets.

T313 series transmission provides two reverse speeds, while the T318 series provides three reverse speeds. The reverse speeds are produced by the gear sets in the main case and by means of the Lo-range, Hi-range and splitter gearing in the compound case.

The T318 series transmission has 18 forward speeds produced by five forward gear sets in the main case (Lo, first, second, third and fourth), along with a splitter gear set and the Lo-range and Hi-range gear sets. With the Lo-range gear set in the compound selected, the five main case gear sets can be split shifted to obtain 10 forward speeds, starting with Lo gear. The main case Lo gear is used only when the compound is in Lo range and is not used in Hi range. To obtain eight additional forward speeds, the Hi-range gear set in the compound is selected and the main case gearshift lever positions of first through fourth are split shifted a second time, for a total of 18 forward speeds.

The T313 series transmission has 13 forward speeds produced by the same five gear sets (Lo, first, second, third and fourth) as the T318 series. The T313 series, however, is not split shifted while the compound is in the Lo-range. This provides five forward, Lo-split, Lo-range speeds. To obtain the remaining eight forward speeds, the compound Hi-range gear set is selected and the main case gearshift lever positions of first through fourth are repeated, only this time, split shifted for a total of 13 forward speeds. Refer to “T313(L)(LR)(21)(L21)(LR21) Shifting Instructions” on page 23 or “T318(L)(LR)(21)(L21)(LR21) Shifting Instructions” on page 24 for complete shifting procedure information.

The main case and the bell housing of both the 13- and the 18-speed transmissions are constructed of a one-piece casting, made from aluminum and heat-treated for strength.

The main case also has six- and eight-bolt openings that allow for the addition of Power Take-Off (PTO) units. PTO operation is off the countershaft fourth (8th) speed gear. The rear case has six- and eight-bolt openings also, to allow for additional PTO units. PTO operation is off the Hi-range/Hi-split gear.

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Provisions for Rear-Mounted Power Take-Off (RMPTO) units are available on these transmissions. The output speed (as a percentage of engine speed) of the RMPTO units, depends on which T300 transmission it is mounted on and is fixed at that percentage, regardless of which transmission gear is selected. The PTO speed to engine RPM percentage for the T313 and T318 series transmissions are all at 70 percent.

The bearings are housed in cast-iron bearing retainers (covers). Tapered roller bearings are used at each end of all transmission countershafts.

All gears are of the spur-type design and are in constant mesh with mating gears. All shifting is done by forks and sliding clutches. The shift rails and forks are integral with the shift cover for the main case.

The six countershafts, three in the main case and three in the rear case, are equally spaced around the mainshafts. This design distributes the load equally among the countershafts, thus keeping normal deflection and gear tooth loading to a minimum.

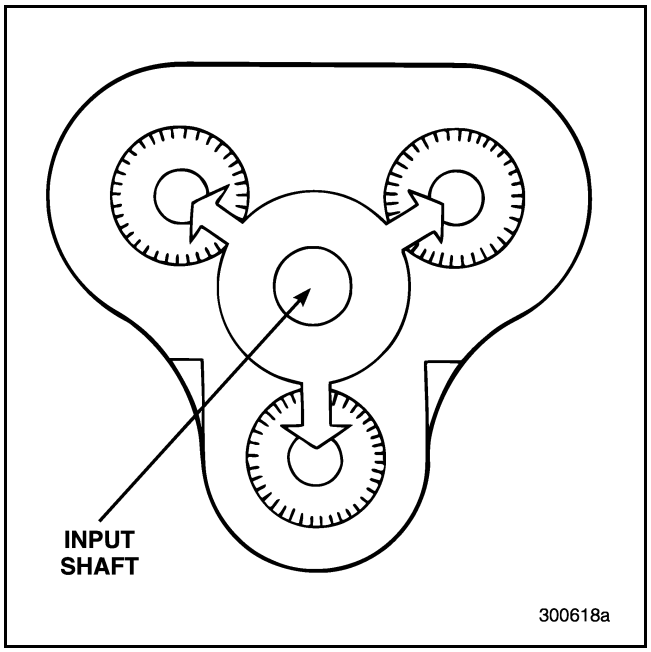


Figure 8 — Equal Torque Distribution

Lubrication

SPLASH LUBRICATION

All parts inside the transmission are lubricated by a splash-and-gravity system. To minimize churning, only the lower countershaft dips into the lubrication oil. As the gears on that countershaft spin, a constant spray of oil is directed to all internal parts of the transmission. The oil cools as it circulates over the aluminum case. Troughs and passages, cast into the inside of the case, capture and direct oil to the bearings.

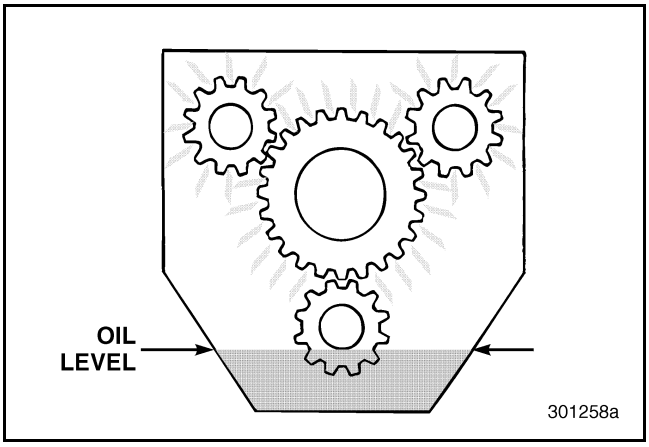


Figure 9 — Splash Lubrication

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TRANSMISSION CASE OIL COOLER LINE PLUGS

An integral oil cooler pump system has been developed for MACK T300 series transmissions. The oil cooler is **optional** for engine ratings under 400 hp and chassis ratings under 80,000 GVW. The oil cooler system is **required** when the engine rating is equal to or exceeds 400 hp, or the chassis rating is greater than 80,000 GVW.

On T313/T318 series transmissions that are not built with oil cooler pump systems, the tube line openings are plugged or capped. The main suction tube area contains a metal plug and the outlet fitting area receives a plastic cap.

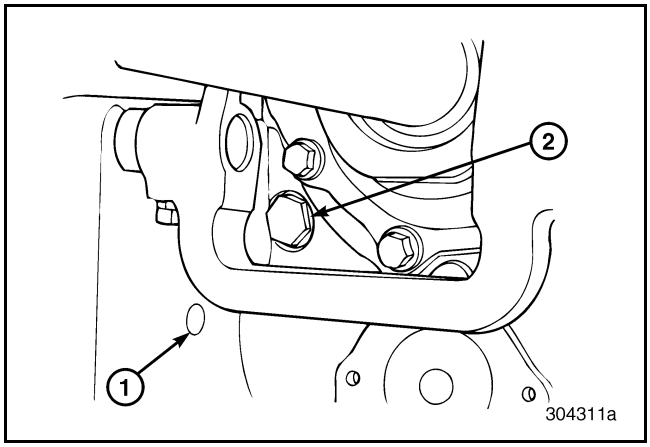


Figure 10 — Transmission Case Oil Cooler Line Plugs

1. Outlet Plastic Cap	2. Suction Tube Plug

MAGNETIC OIL FILTER

A magnetic oil filter assembly is built into the right side of the main case. It consists of a magnetic plug which removes ferrous metallic particles from the passing oil. After passing the magnetic plug, the oil is channelled upward to an outlet, where it returns (by gravity) down into the transmission case sump. The magnetic plug is removable from the outside of the transmission, without the necessity of draining the oil since this plug is above the oil level. The drain plug at the bottom of the case is also magnetic.

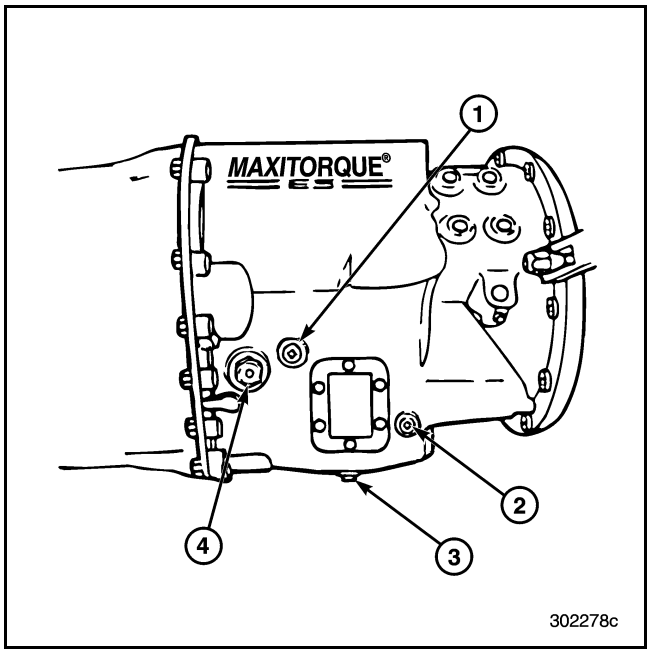


Figure 11 — Plug Locations

1. Magnetic Filter Plug 2. Oil Temperature Sensor	3. Oil Drain Plug 4. Oil Fill and Level Plug

T313 Series Gear Ratios and Shift Pattern

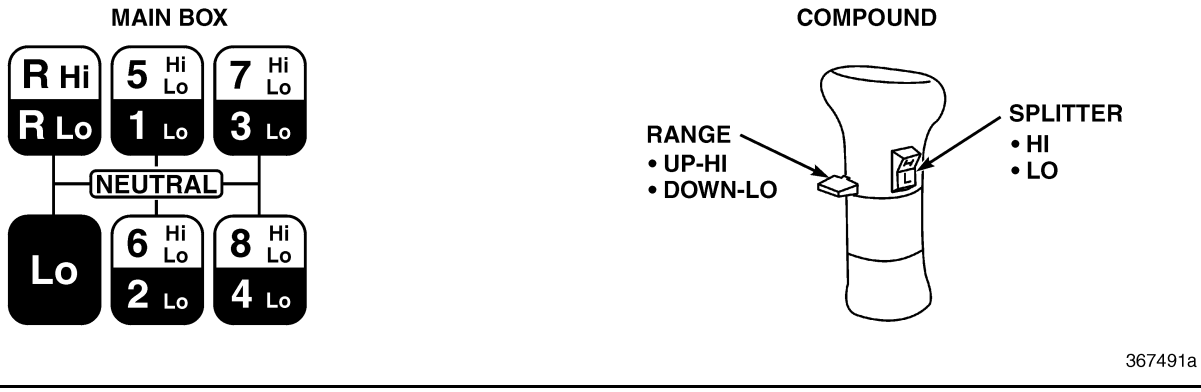


Figure 12 — T313(L)(LR)(21)(L21)(LR21) Shift Pattern

T313(L)(LR)(21)(L21)(LR21) SHIFT PATTERN

Gear Position (Main Box)	Splitter	Range	T313(21)Ratios	T313(L)(L21) Ratios	T313(LR)(LR21) Ratios
Lo	Lo	Lo	13.44	16.42	16.42
1	Lo	Lo	8.78	8.78	8.78
2	Lo	Lo	6.28	6.28	6.28
3	Lo	Lo	4.52	4.52	4.52
4	Lo	Lo	3.22	3.22	3.22
Range Shift					
5	Lo	Hi	2.29	2.29	2.29
5	Hi	Hi	1.94	1.94	1.94
6	Lo	Hi	1.64	1.64	1.64
6	Hi	Hi	1.39	1.39	1.39
7	Lo	Hi	1.18	1.18	1.18
7	Hi	Hi	1.00	1.00	1.00
8	Lo	Hi	0.84	0.84	0.84
8	Hi	Hi	0.71	0.71	0.71
Reverse					
R	Lo	Lo	15.91	15.91	28.98
R	Lo	Hi	4.15	4.15	N/A
R	Hi	Hi	3.52	3.52	6.41

T318 Series Gear Ratios and Shift Pattern

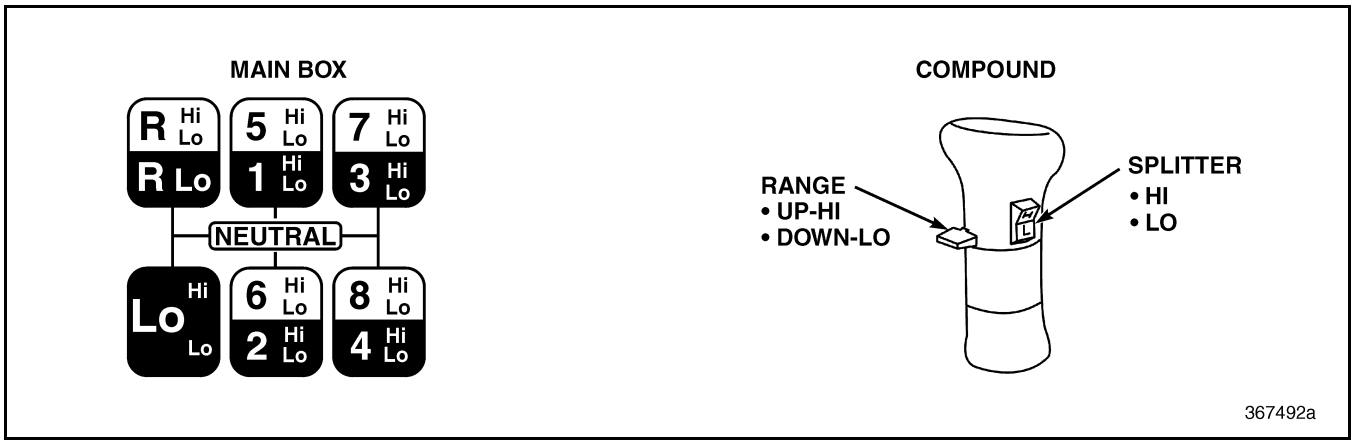


Figure 13 — T318(L)(LR)(21)(L21)(LR21) Shift Pattern

T318(L)(LR)(21)(L21)(LR21) SHIFT PATTERN

Gear Position (Main Box)	Splitter	Range	T318(21) Ratios	T318(L)(L21) Ratios	T318(LR)(LR21) Ratios
Lo	Lo	Lo	13.44	16.42	16.42
Lo	Hi	Lo	11.40	13.93	13.93
1	Lo	Lo	8.78	8.78	8.78
1	Hi	Lo	7.45	7.45	7.45
2	Lo	Lo	6.28	6.28	6.28
2	Hi	Lo	5.33	5.33	5.33
3	Lo	Lo	4.52	4.52	4.52
3	Hi	Lo	3.83	3.83	3.83
4	Lo	Lo	3.22	3.22	3.22
4	Hi	Lo	2.73	2.73	2.73
Range Shift					
5	Lo	Hi	2.29	2.29	2.29
5	Hi	Hi	1.94	1.94	1.94
6	Lo	Hi	1.64	1.64	1.64
6	Hi	Hi	1.39	1.39	1.39
7	Lo	Hi	1.18	1.18	1.18
7	Hi	Hi	1.00	1.00	1.00
8	Lo	Hi	0.84	0.84	0.84
8	Hi	Hi	0.71	0.71	0.71
Reverse					
R	Lo	Lo	15.91	15.91	28.98
R	Hi	Lo	13.49	13.49	24.58
R	Lo	Hi	4.15	4.15	N/A
R	Hi	Hi	3.52	3.52	6.41

T313(L)(LR)(21)(L21)(LR21) Shifting Instructions

NOTE

The shifting instructions in this Service Manual may have been upgraded and superseded due to Mack's continuous program of testing and evaluating to provide the best possible product.

Be sure to check the latest shifting instructions found in the on-line Operator's Handbooks located on the Mack website at www.macktrucks.com.

The T313 series transmission is a range and split shifted unit which has 12 forward gears with an extra Lo gear in the Lo range. It features an air-operated Lo range, Hi range and splitter section in the rear compound, controlled by a range selector and splitter selector on the shift lever. The Lo range provides five low ratios (includes Lo gear). In Hi range there are eight additional forward gears that can be obtained. Reverse gear can be used in Lo and Hi ranges for a total of two reverse speeds:

- Lo Range — Lo Split
- Hi Range — Hi Split

NOTE

When making a split shift (from one gear to the next gear), the splitter selector must not be actuated, either up or down, until the main case is in neutral. When making a split shift (in the same gear), especially under heavy load, the splitter will not shift until driveline torque is relieved by depressing the clutch pedal or backing off the throttle. An audible shift is heard (engine speed drops approximately 200 rpm).

When making a range shift, it is important to preselect the shift. This means that the range selector must be moved to the next position (up or down) before the gearshift lever is moved. Preselect the range shift and then move the shift lever through neutral to the desired gear position. As the lever passes through neutral, the range shift is automatically completed.

UPSHIFTING (NORMAL HIGHWAY)

To begin, position the shift lever in neutral and move the range selector to the Hi position (a mechanical interlock prevents splitter selector movement to the Lo position). Next, select Lo split using the splitter selector. Then select Lo range using the range selector.

Refer to the shift pattern and move the shift lever to the Lo speed gear (Lo range, Lo split) position. Apply the accelerator, engage the clutch and accelerate to governed speed. Shift up through first, second, third and fourth speed gears, double-clutching between the gears.

Continue shifting while in fourth gear (Lo range, Lo split) by preselecting Hi range with the range selector and then moving the shift lever through neutral to the fifth gear position. As the lever moves through neutral, the range shift to Hi will be completed. The transmission is now in fifth gear (Hi range, Lo split). To continue, use a combination of splitter selector and shift lever to shift to fifth (Hi range, Hi split), sixth (Hi range, Lo split), sixth (Hi range, Hi split) and so on, until eighth (Hi range, Hi split) is achieved, double-clutching between the gears.

To upshift from Lo-split to Hi-split (in the same gear), accelerate the engine to governed speed, move the splitter switch to Hi (preselect), then depress the clutch and back off the accelerator pedal. Reapply the accelerator and engage the clutch when the audible shift is heard, or when the engine speed falls by approximately 200 rpm. Depressing the clutch may not be necessary to break the driveline torque, but this will vary with road conditions.

To upshift from a Hi-split gear to the next higher gear's Lo-split (in Hi-range), accelerate the engine to governed speed, break the driveline torque by depressing the clutch or backing off the accelerator pedal, then move the splitter switch to Lo and, at the same time, move shift lever through neutral to the next higher gear. Note that the splitter switch must not be actuated down to the Lo position until the main box is in neutral.

DOWNSHIFTING (NORMAL HIGHWAY)

Shift from eighth (Hi range, Hi split) to eighth (Hi range, Lo split), then to seventh (Hi range, Hi split) to seventh (Hi range, Lo split) and so on, double-clutching between each gear until fifth (Hi range, Lo split) is reached.

While in fifth (Hi range, Lo split), preselect Lo range with the range selector and move the shift lever through neutral (range shift automatically occurs) to fourth (Lo range, Lo split). Then, continue using only the shift lever to shift down to third, second, first and so on.

To downshift from Hi split to Lo split (in same gear position), as engine speed falls, move the splitter switch to Lo split, release the accelerator and reapply it (audible shift should be heard). To downshift from Lo split in one gear to the next gear Hi split, move the shift lever into neutral, select Hi split, and move the shift lever to the next lower gear.

⚠ CAUTION

- *Be careful not to overspeed the engine during downshifting. Damage to powertrain components may result.*
- *To avoid transmission damage, do NOT change range while moving in reverse gear.*
- *Make sure air pressure is at least 100 psi and unit is warmed before making range shifts.*
- *Always start in Lo range per shift marker plate instructions. Never start higher than second (Lo range, Lo split) gear, including when dynamometer testing.*
- *With truck stationary, do not shift into Hi range and then move the truck. Damage to the synchronizer can result.*

T318(L)(LR)(21)(L21)(LR21) Shifting Instructions

NOTE

The shifting instructions in this Service Manual may have been upgraded and superseded due to Mack's continuous program of testing and evaluating to provide the best possible product.

Be sure to check the latest shifting instructions found in the on-line Operator's Handbooks located on the Mack website at www.macktrucks.com.

The T318 series transmission is a range- and split-shifted unit that has 16 forward gears with two extra Lo gears in the Lo range (Lo split and Hi split). It features an air-operated Lo range, Hi range and splitter section in the rear compound, controlled by a range selector and splitter selector on the shift lever. The Lo range provides 10 low ratios (includes Lo gear — Lo split and Hi split). In Hi range there are eight additional forward gears that can be obtained. Reverse gear can be used in Lo and Hi ranges for a total of three reverse speeds:

- Lo Range — Lo Split
- Hi Range — Lo Split
- Hi Range — Hi Split

NOTE

When making a split shift (from one gear to the next gear), the splitter selector must not be actuated, either up or down, until the main case is in neutral. When making a split shift (in the same gear), especially under heavy load, the splitter will not shift until driveline torque is relieved by depressing the clutch pedal or backing off the throttle. An audible shift should be heard (engine speed drops approximately 200 rpm).

When making a range shift, it is important to preselect the shift. This means that the range selector must be moved to the next position (up or down) before the gearshift lever is moved. Preselect the range shift and then move the shift lever through neutral to the desired gear position. As the lever passes through neutral, the range shift is automatically completed.

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UPSHIFTING (NORMAL HIGHWAY)

To begin, position the shift lever in neutral and select Lo split using the splitter selector. Then select Lo range using the range selector.

Move the shift lever to the Lo-speed gear (Lo range, Lo split) position. Apply the accelerator, engage the clutch and accelerate to governed speed. Select Hi with the splitter selector and release the accelerator. Wait for the split shift to complete and then reapply the accelerator. Shift up through first (Lo range, Lo split), first (Lo range, Hi split), second (Lo range, Lo split), second (Lo range, Hi split) and so on, until fourth (Lo range, Hi split) is reached. Double-clutch between the gears.

Continue shifting while in fourth gear (Lo range, Hi split), move the range selector to Hi (preselect), select Lo on the splitter selector (preselect) and then move the gear shift to fifth (Hi range, Lo split). As the gear shift lever passes through neutral, the range shift to Hi and the split shift to Lo is completed. To continue, use a combination of splitter selector and shift lever to shift to fifth (Hi range, Hi split), sixth (Hi range, Lo split), sixth (Hi range, Hi split) and so on, until eighth (Hi range, Hi split) is achieved.

To upshift from Lo split to Hi split (in the same gear), accelerate the engine to governed speed, move the splitter switch to Hi (preselect), then depress the clutch and back off the accelerator pedal. Reapply the accelerator and engage the clutch when the audible shift is heard, or when the engine speed falls by approximately 200 rpm. Depressing the clutch may not be necessary to break the driveline torque, but this will vary with road conditions.

To upshift from a Hi-split gear to the next higher gear's Lo split (in Hi-range), accelerate the engine to governed speed, break the driveline torque by depressing the clutch or backing off the accelerator pedal, then move the splitter switch to Lo and, at the same time, move shift lever through neutral to the next higher gear. Note that the splitter switch must not be actuated down to the Lo position until the main box is in neutral.

DOWNSHIFTING (NORMAL HIGHWAY)

Shift from eighth (Hi range, Hi split) to eighth (Hi range, Lo split), then to seventh (Hi range, Hi split) to seventh (Hi range, Lo split) and so on, double-clutching between each gear until fifth (Hi range, Lo split) is reached.

While in fifth (Hi range, Lo split), move the range selector to Lo (preselect), select Hi on the splitter selector (preselect) and then move the gear shift to fourth (Lo range, Hi split). As the gear shift lever passes through neutral, the range shift to Lo and the split shift to Hi is completed. Then, continue using the shift lever and splitter selector as described to shift down to Lo (Lo range, Lo split).

To downshift from Hi split to Lo split (in same gear position), as engine speed falls, preselect Lo split, release the accelerator and reapply it (audible shift should be heard). To downshift from Lo split in one gear to the next gear Hi split, move the shift lever into neutral, select Hi split, and move the shift lever to the next lower gear.

⚠ CAUTION

- *Be careful not to overspeed the engine during downshifting. Damage to powertrain components may result.*
- *To avoid transmission damage, do NOT change range while moving in reverse gear.*
- *Make sure air pressure is at least 100 psi and unit is warmed before making range shifts.*
- *Always start in Lo range per shift marker plate instructions. Never start higher than second (Lo range, Lo split) gear, including when dynamometer testing.*
- *With truck stationary, do not shift into Hi range and then move the truck. Damage to the synchronizer can result.*

Guidelines for PTO Use

SIDE-MOUNTED PTO APPLICATION INFORMATION

For ease of PTO operation, and transmission and PTO reliability and durability, the recommended choice for PTO location is on either opening of the main case. Hydraulic pumps, product pumps, blowers and some mechanical winches, operate best when the PTO is located on the main case.

Properly engineered, direct-mount SAE-type splined pump drives, which eliminate PTO shafts and joints, should be bracket-mounted as close as possible to the rear engine supports. This reduces static and dynamic loads on components and support members.

Rear compound PTO openings are available for applications that require multi-speed capabilities, such as some mechanical winches, or units that require unique speeds or have multiple PTO requirements. To prevent transmission damage when using the rear compound PTO locations, use the following operating procedure.

PREFERRED OPERATING PROCEDURES FOR REAR COMPOUND-MOUNTED PTO APPLICATIONS

ENGAGING PTO

1. Select Lo split and Lo range, using the splitter and range selectors on the shift lever. (The transmission MUST be in Lo range and Lo split at all times during PTO operation.)
2. Depress the clutch pedal to disengage the clutch.
3. Set the parking brakes.
4. Move the shift lever to the neutral position.
5. Move the dash-mounted compound neutral control valve to the On position. This moves the rear compound synchronizer clutch to a neutral position.
6. Engage the PTO.
7. Move the shift lever to the desired main case gear ratio.
8. Release the clutch pedal to engage the clutch.
9. Operate the PTO-driven load.

DISENGAGING PTO

1. Depress the clutch pedal to disengage the clutch.
2. Move the shift lever to the neutral position.
3. Disengage the PTO.
4. Move the dash-mounted compound neutral control valve to the Off position. This moves the rear compound synchronizer clutch to the Lo range.
5. Move the shift lever to the desired main case gear ratio.
6. Release the parking brakes.
7. Release the clutch pedal to engage the clutch for vehicle operation, if desired.

Preferred Method for Engaging T313/T318 Series High Range Gear for Output Shaft Driven Power Take-Off Operation

METHOD NO. 1

After positioning the vehicle for power take-off operation, and with vehicle wheels off the ground:

1. Shift the transmission to neutral.
2. Engage power take-off drive.
3. Move range selector to Hi range.
4. Disengage engine clutch and select reverse.
5. Feather the clutch until the transmission range clutch engagement is heard.
6. Disengage engine clutch.
7. Select “thirteenth” gear for T313 series or “eighteenth” gear for T318 series.
8. Engage clutch when power take-off operation is desired.

METHOD NO. 2

After positioning the vehicle for power take-off operation, and with vehicle wheels on the ground:

1. Shift the transmission to neutral.
2. Move range selector to Hi range.
3. Disengage engine clutch and select reverse.
4. Feather the clutch until the transmission range clutch engagement is heard.
5. Disengage engine clutch.

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6. Engage power take-off drive.
7. Select “thirteenth” gear for T313 series or “eighteenth” gear for T318 series.
8. Engage clutch when power take-off operation is desired.

T313 Power Flow Diagrams

The following illustrations show power flow through the T313, T313L T313LR, T31321 T313L21 or T313LR21 transmission in each gear range (T313L shown).

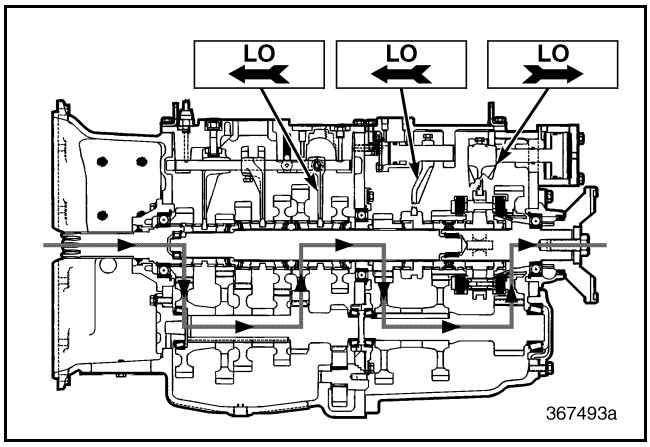


Figure 14 — Lo Speed (Lo Split, Lo Range)

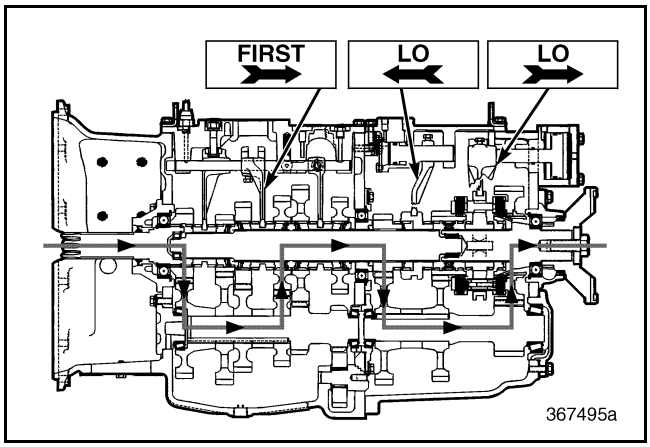


Figure 15 — First Speed (Lo Split, Lo Range)

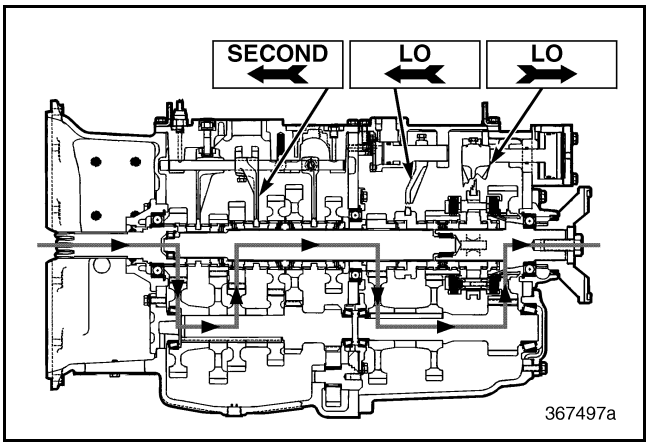


Figure 16 — Second Speed (Lo Split, Lo Range)

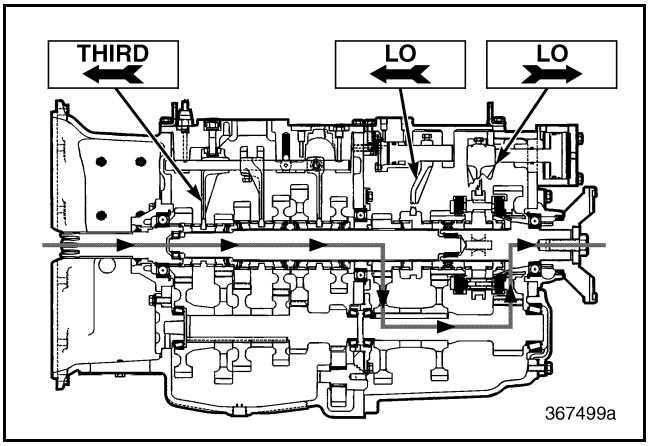


Figure 17 — Third Speed (Lo Split, Lo Range)

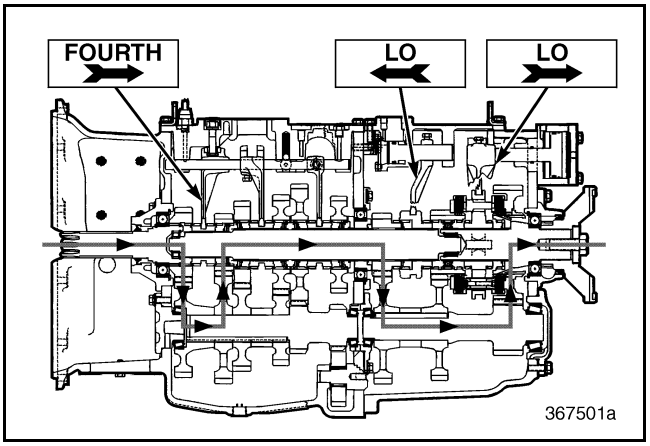


Figure 18 — Fourth Speed (Lo Split, Lo Range)

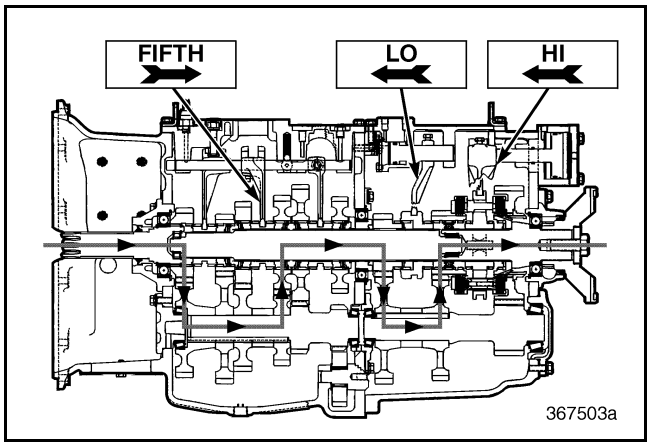


Figure 19 — Fifth Speed (Lo Split, Hi Range)

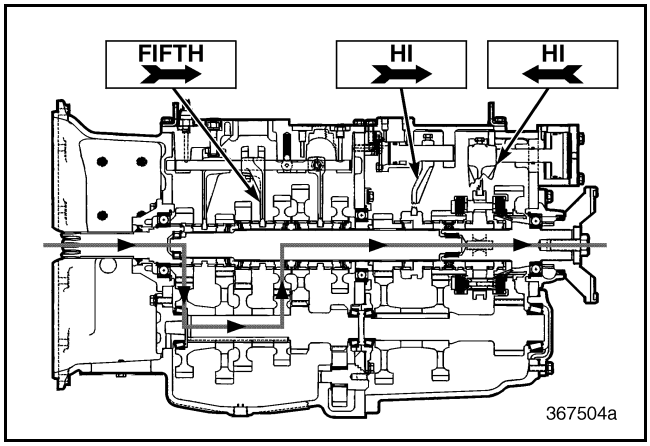


Figure 20 — Fifth Speed (Hi Split, HI Range)

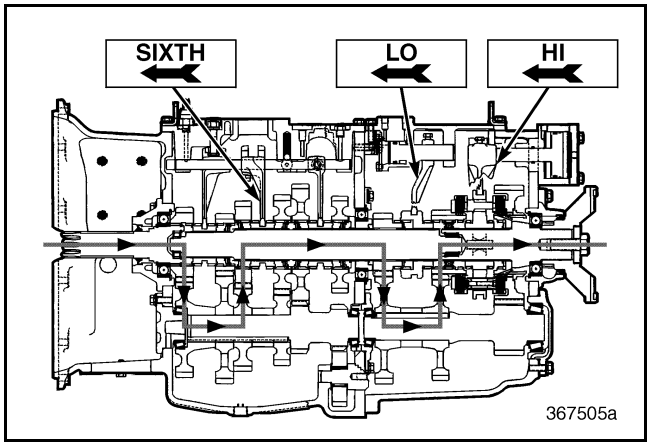


Figure 21 — Sixth Speed (Lo Split, Hi Range)

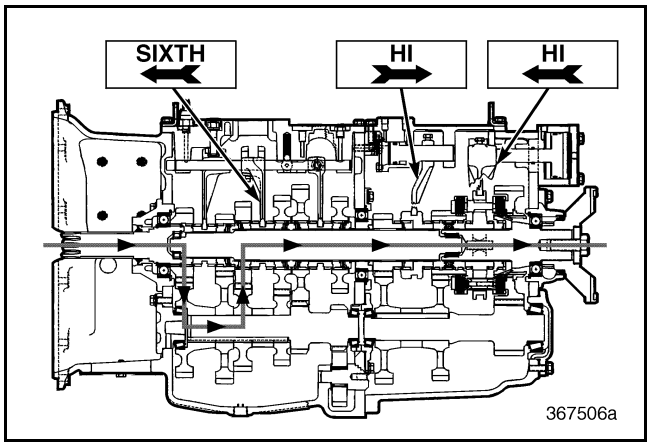


Figure 22 — Sixth Speed (Hi Split, Hi Range)

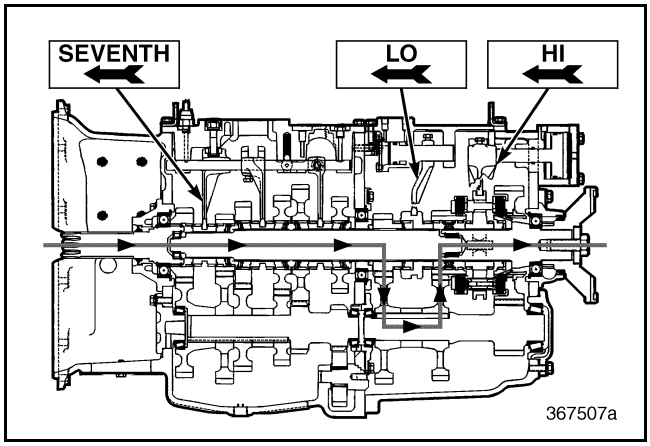


Figure 23 — Seventh Speed (Lo Split, Hi Range)

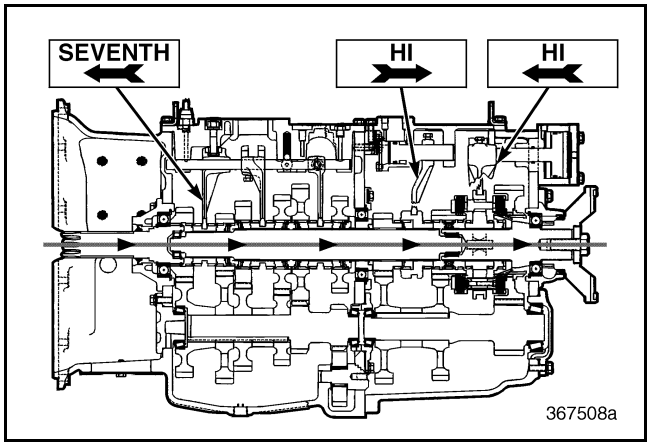


Figure 24 — Seventh Speed (Hi Split, Hi Range)

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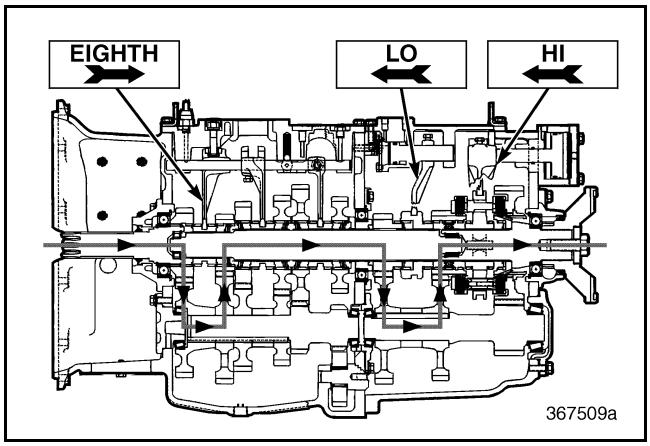


Figure 25 — Eighth Speed (Lo Split, Hi Range)

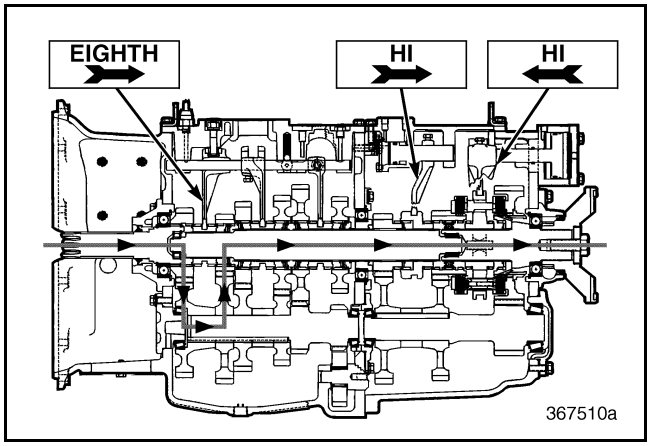


Figure 26 — Eighth Speed (Hi Split, Hi Range)

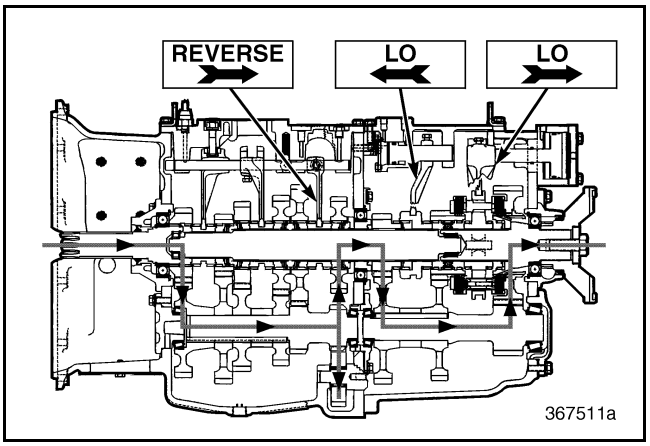


Figure 27 — Reverse Speed (Lo Split, Lo Range)

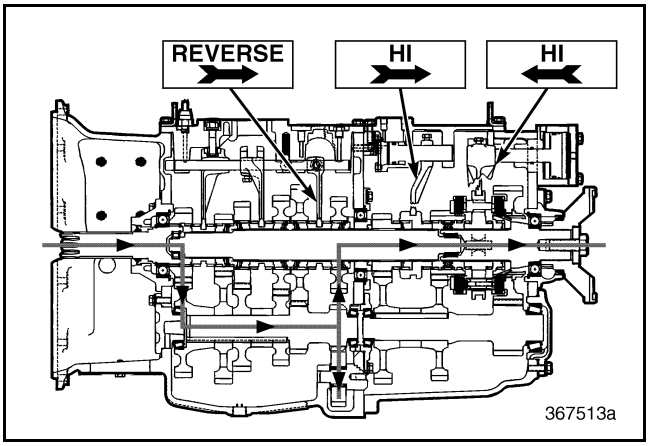


Figure 28 — Reverse Speed (Hi Split, Hi Range)

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T318 Power Flow Diagrams

The following illustrations show power flow through the T318, T318L, T318LR, T31821, T318L21 or T318LR21 transmission in each gear range (T318L shown).

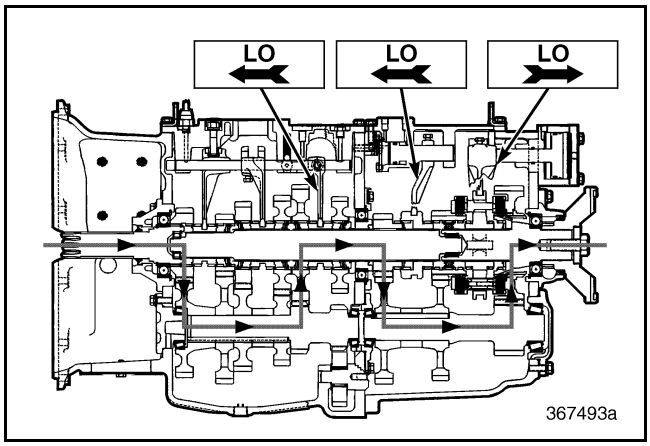


Figure 29 — Lo Speed (Lo Split, Lo Range)

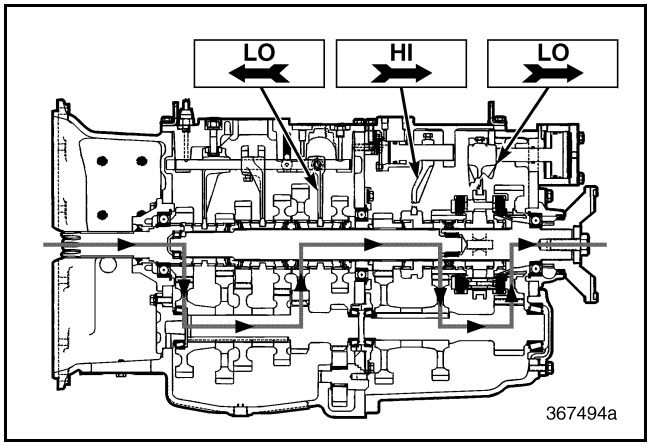


Figure 30 — Lo Speed (Hi Split, Lo Range)

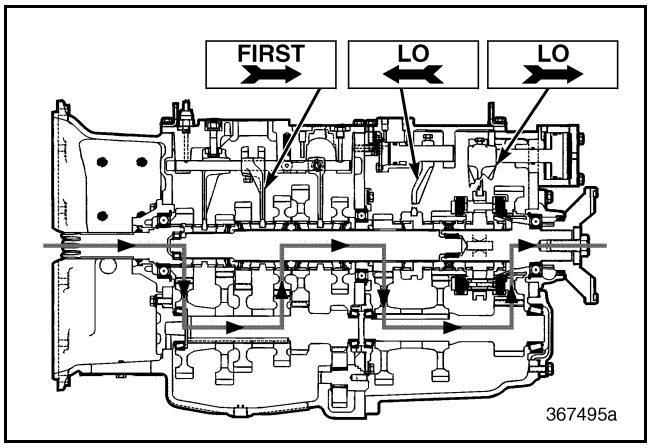


Figure 31 — First Speed (Lo Split, Lo Range)

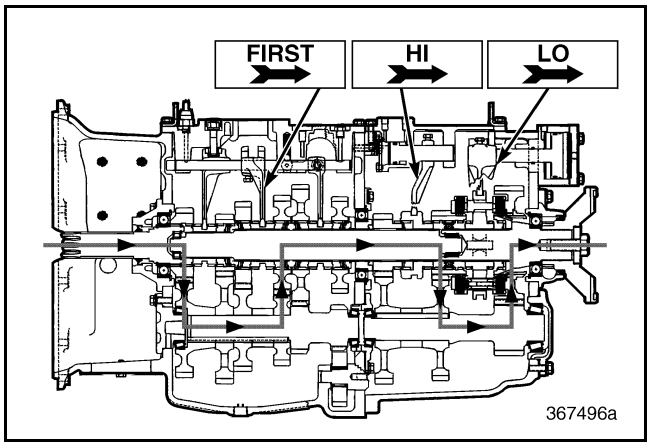


Figure 32 — First Speed (Hi Split, Lo Range)

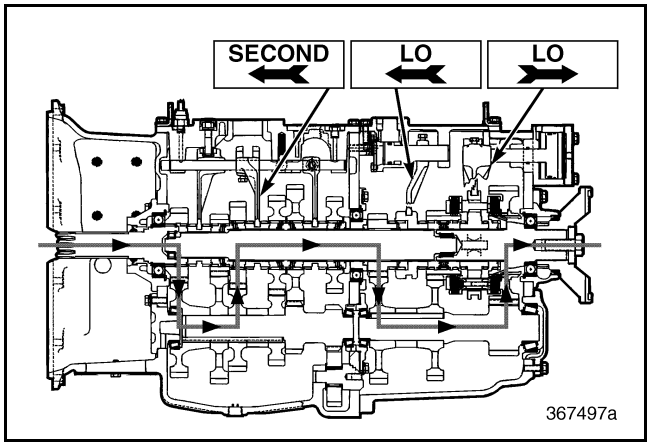


Figure 33 — Second Speed (Lo Split, Lo Range)

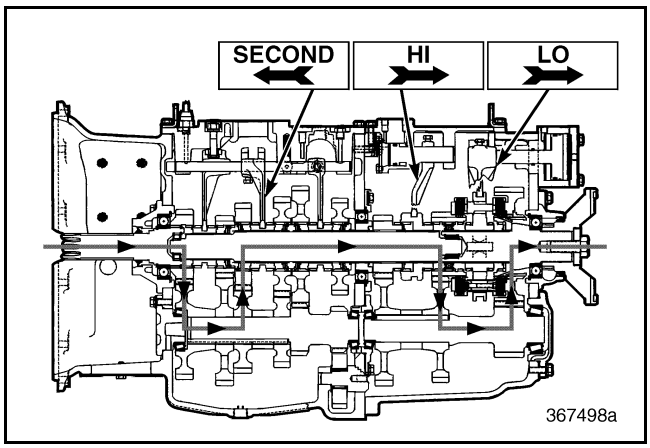


Figure 34 — Second Speed (Hi Split, Lo Range)

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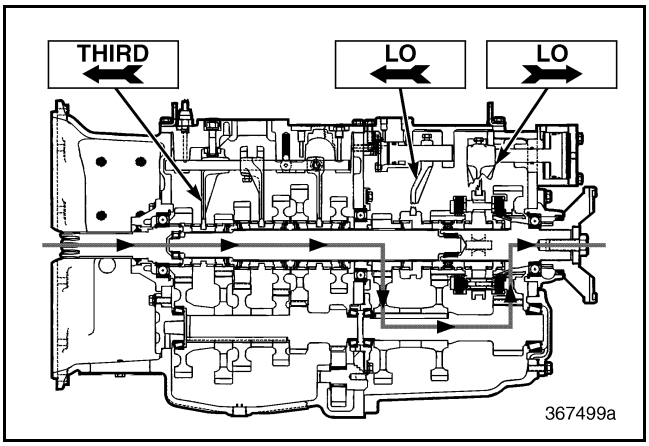


Figure 35 — Third Speed (Lo Split, Lo Range)

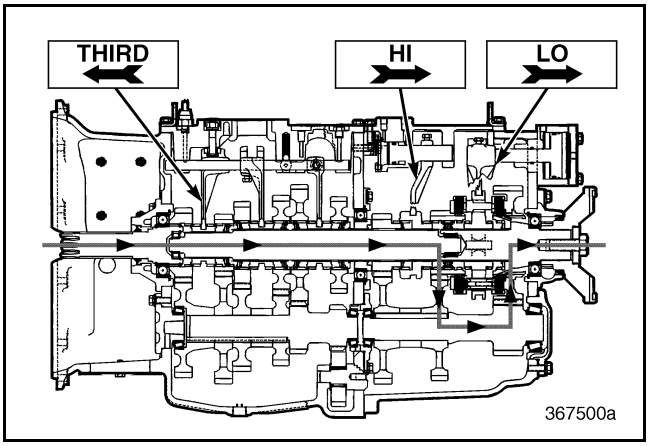


Figure 36 — Third Speed (Hi Split, Lo Range)

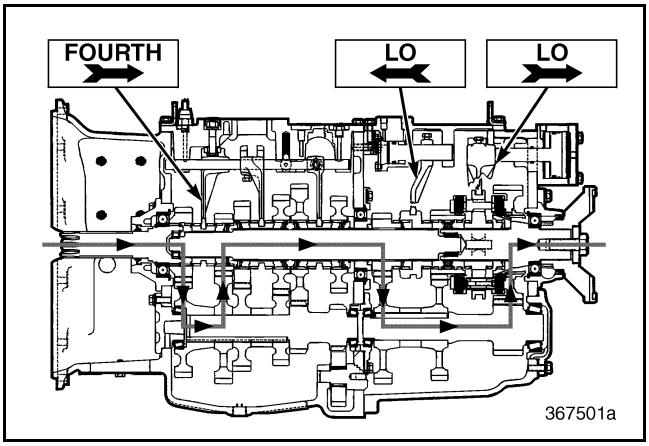


Figure 37 — Fourth Speed (Lo Split, Lo Range)

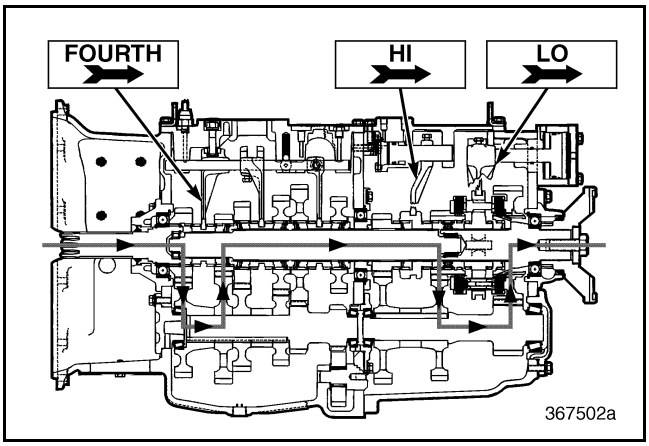


Figure 38 — Fourth Speed (Hi Split, Lo Range)

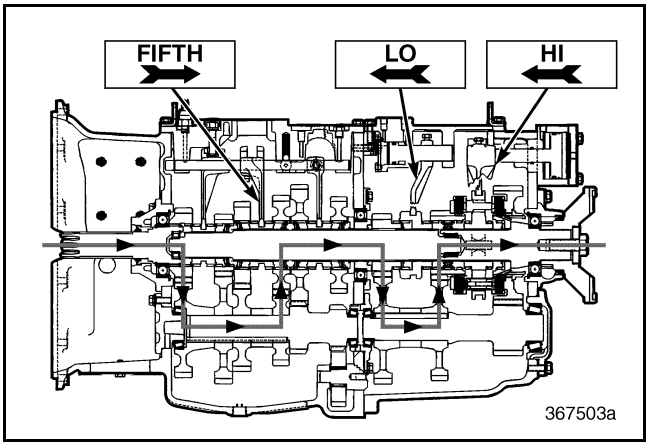


Figure 39 — Fifth Speed (Lo Split, Hi Range)

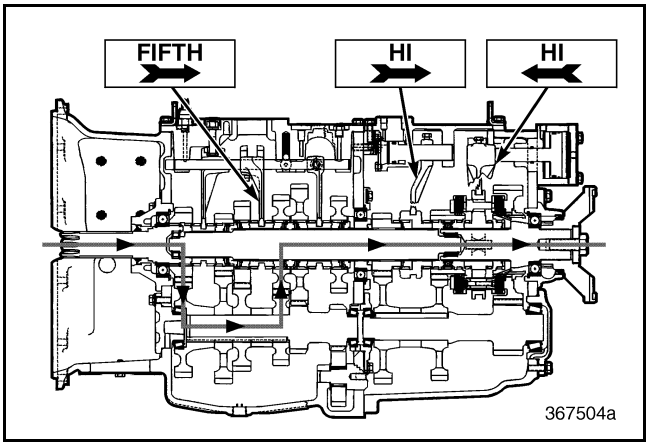


Figure 40 — Fifth Speed (Hi Split, Hi Range)

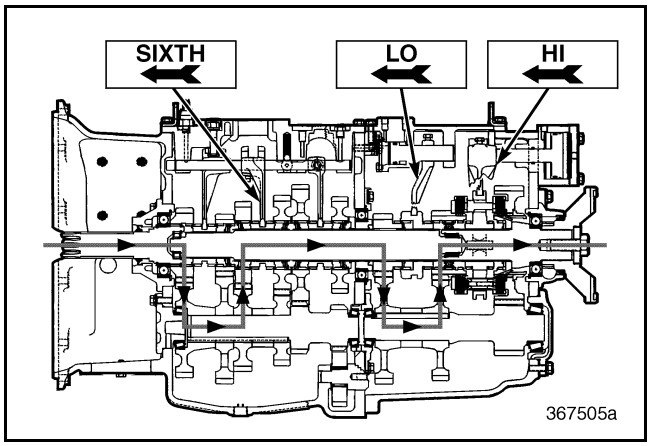


Figure 41 — Sixth Speed (Lo Split, Hi Range)

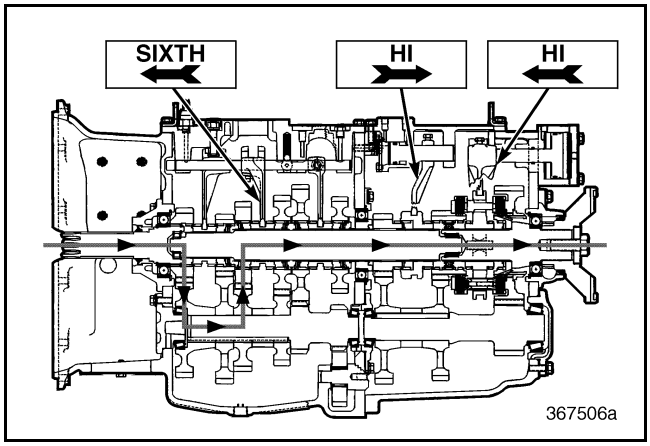


Figure 42 — Sixth Speed (Hi Split, Hi Range)

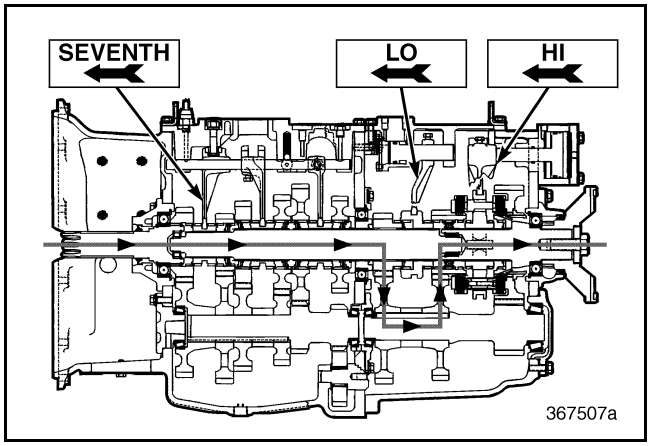


Figure 43 — Seventh Speed (Lo Split, Hi Range)

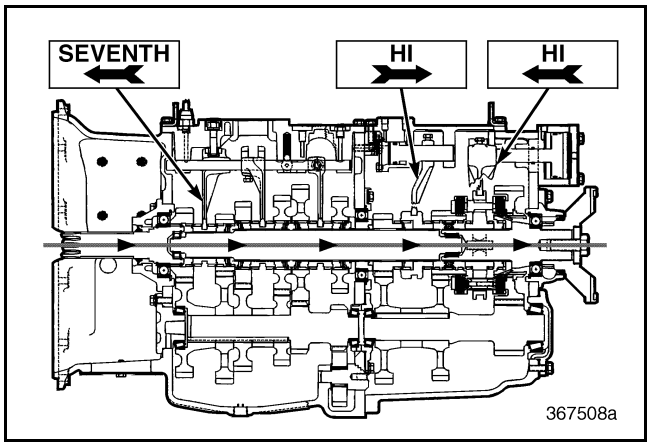


Figure 44 — Seventh Speed (Hi Split, Hi Range)

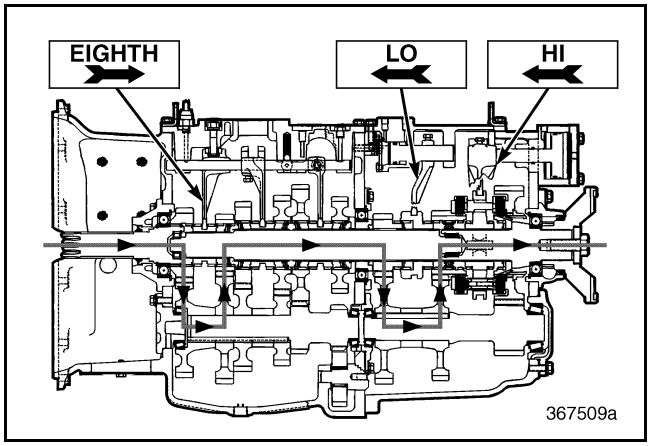


Figure 45 — Eighth Speed (Lo Split, Hi Range)

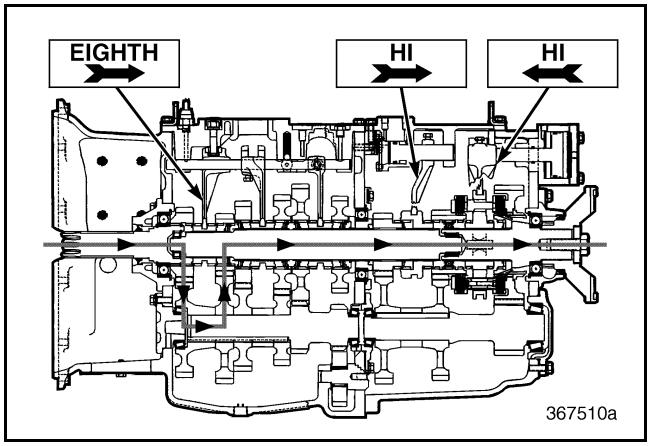


Figure 46 — Eighth Speed (Hi Split, Hi Range)

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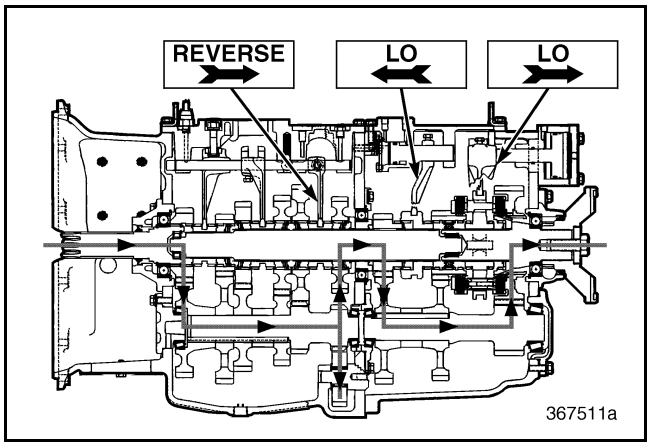


Figure 47 — Reverse Speed (Lo Split, Lo Range)

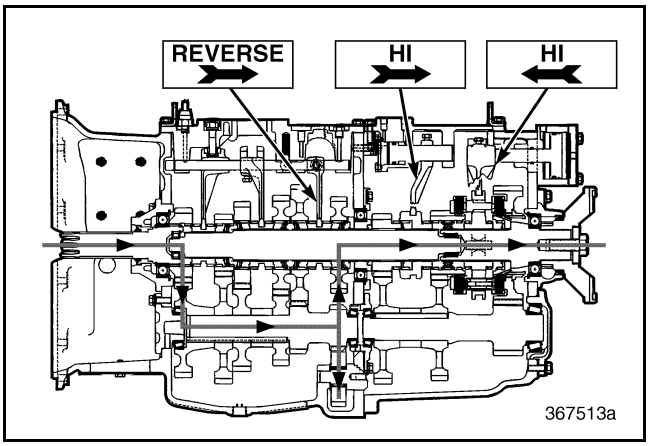


Figure 49 — Reverse Speed (Hi Split, Hi Range)

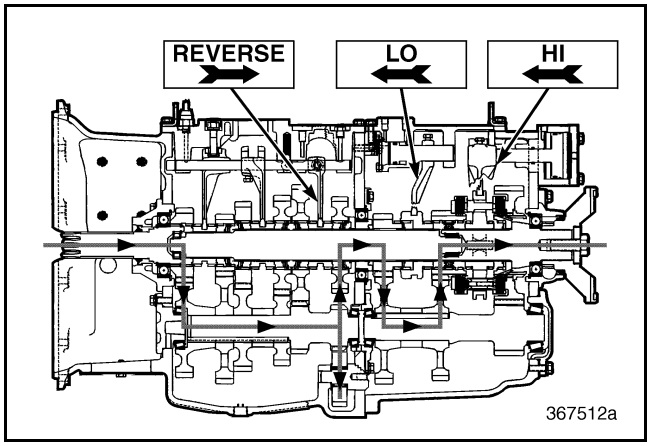


Figure 48 — Reverse Speed (Lo Split, Hi Range)

NOTES

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COMPONENT LOCATOR

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TRANSMISSION MAJOR COMPONENT LOCATIONS

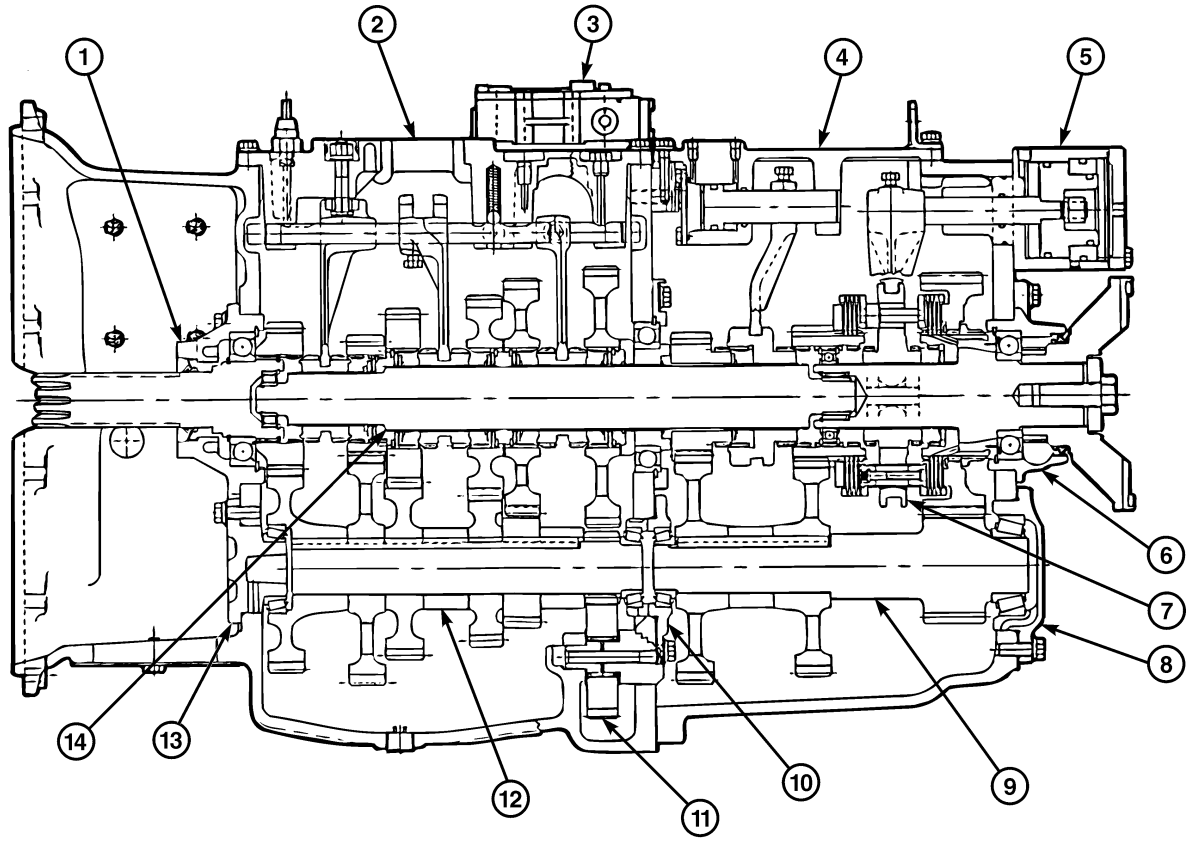


Figure 50 — Major Component Locations for T313/T318 Transmission

1. Main Drive Pinion Assembly	6. Rear Mainshaft Bearing Cover	11. Reverse Idler Gear
2. Main Case Shift Cover Assembly	7. Rear Mainshaft and Synchronizer Assembly	12. Front Countershaft Assembly
3. Range Shift Valve	8. Rear Countershaft Bearing Cover	13. Front Countershaft Front Bearing Cover
4. Rear Case Shift Cover (Splitter) Assembly	9. Rear Countershaft Assembly	14. Front Mainshaft Assembly
5. Range Shift Cylinder Assembly	10. Front Countershaft Rear Bearing Cover	

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COMPONENT LOCATOR

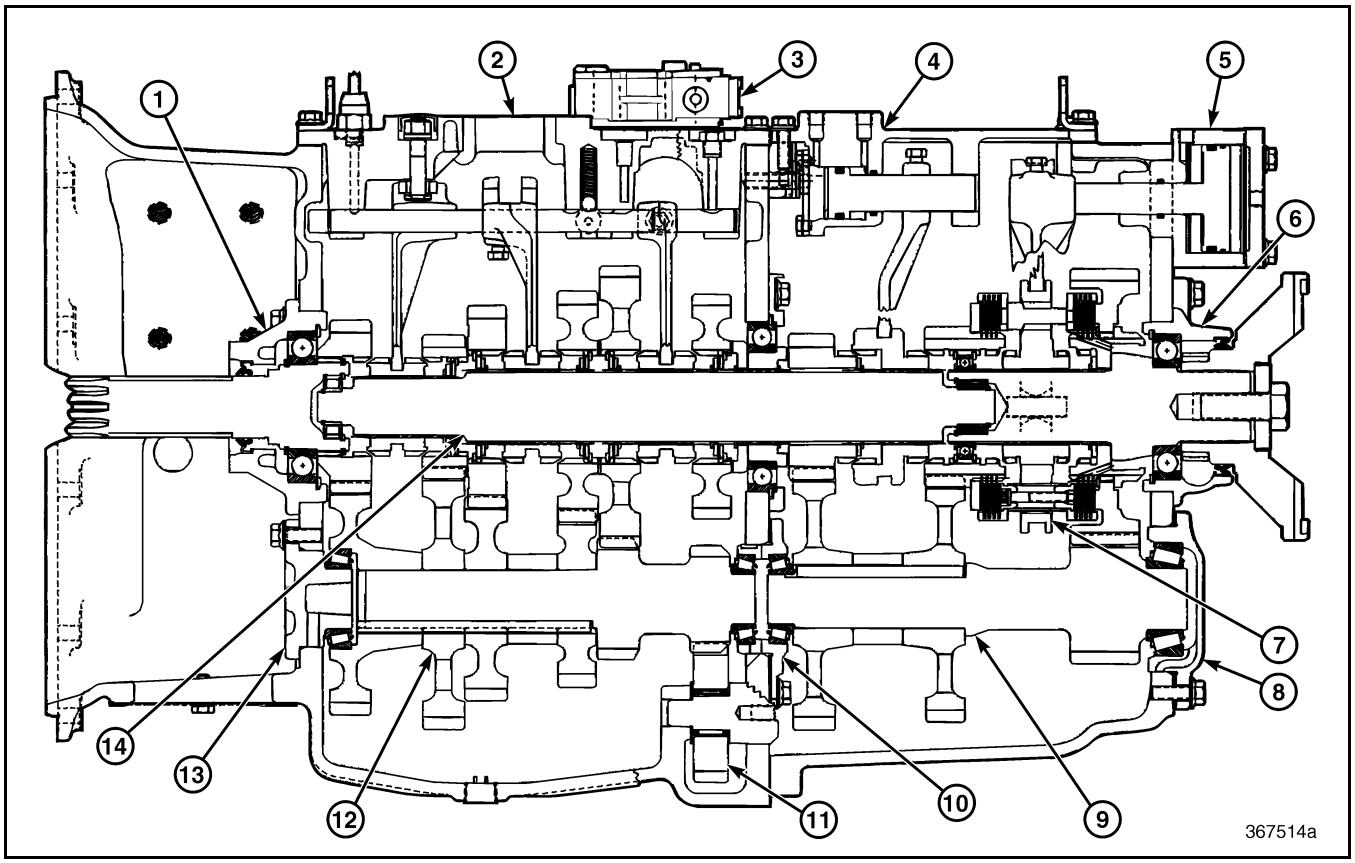


Figure 51 — Major Component Locations for T313L/T318L Transmission

1. Main Drive Pinion Assembly	6. Rear Mainshaft Bearing Cover	11. Reverse Idler Gear
2. Main Case Shift Cover Assembly	7. Synchronizer Assembly	12. Front Countershaft Assembly
3. Range Shift Valve	8. Rear Countershaft Bearing Cover	13. Front Countershaft Front Bearing Cover
4. Rear Case Shift Cover (Splitter) Assembly	9. Rear Countershaft Assembly	14. Front Mainshaft Assembly
5. Range Shift Cylinder	10. Front Countershaft Rear Bearing Cover	

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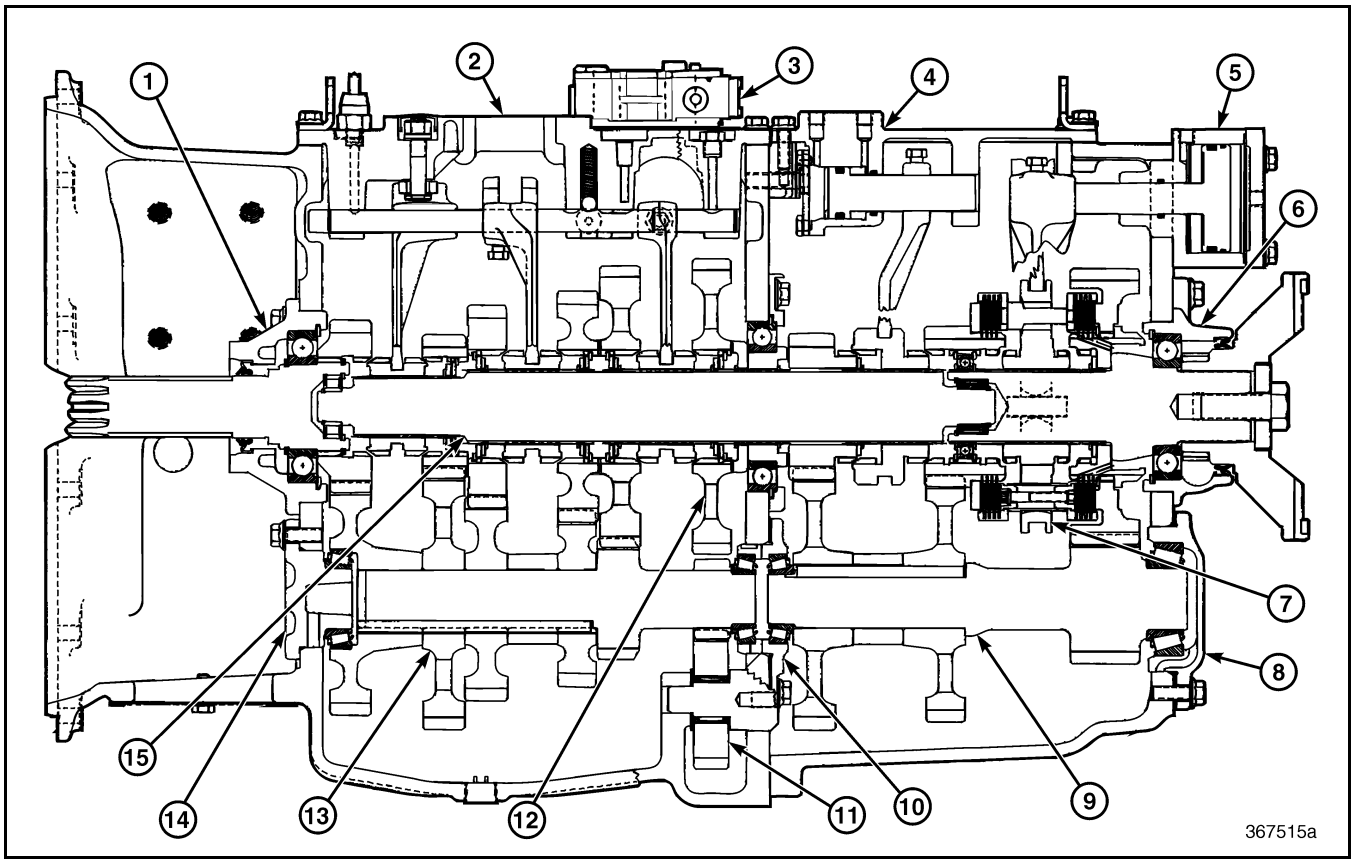


Figure 52 — Major Component Locations for T313LR/T318LR Transmission

1. Main Drive Pinion Assembly	6. Rear Mainshaft Bearing Cover	11. Reverse Idler Gear
2. Main Case Shift Cover Assembly	7. Synchronizer Assembly	12. Low Reverse Gear
3. Range Shift Valve	8. Rear Countershaft Bearing Cover	13. Front Countershaft Assembly
4. Rear Case Shift Cover (Splitter) Assembly	9. Rear Countershaft Assembly	14. Front Countershaft Front Bearing Cover
5. Range Shift Cylinder	10. Front Countershaft Rear Bearing Cover	15. Front Mainshaft Assembly

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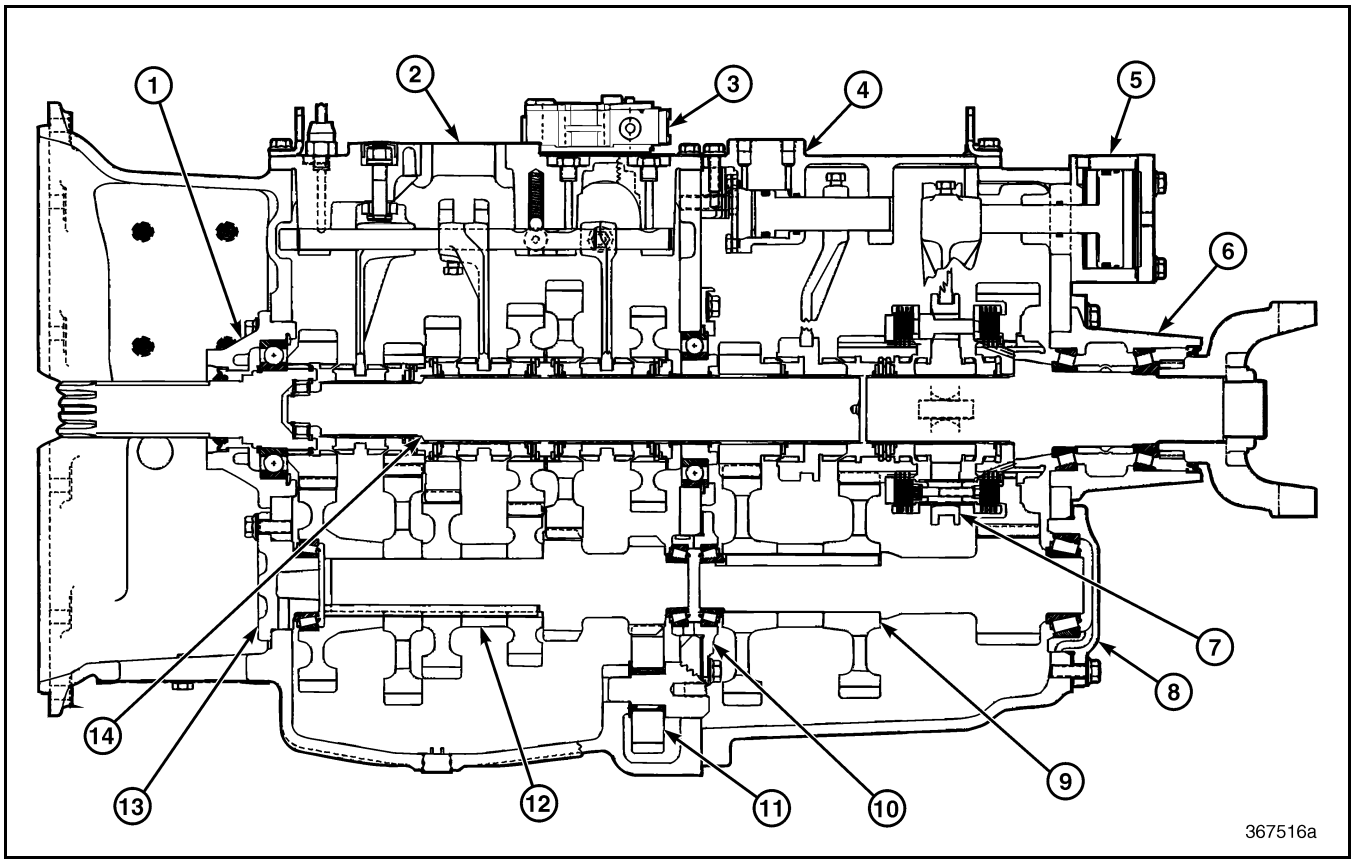


Figure 53 — Major Component Locations for T313L21/T318L21 Transmission

1. Main Drive Pinion Assembly 2. Main Case Shift Cover Assembly 3. Range Shift Valve 4. Rear Case Shift Cover (Splitter) Assembly 5. Range Shift Cylinder	6. Rear Output Housing (Extended Output Shaft) 7. Synchronizer Assembly 8. Rear Countershaft Bearing Cover 9. Rear Countershaft Assembly 10. Front Countershaft Rear Bearing Cover	11. Reverse Idler Gear 12. Front Countershaft Assembly 13. Front Countershaft Front Bearing Cover 14. Front Mainshaft Assembly

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COMPONENT LOCATOR

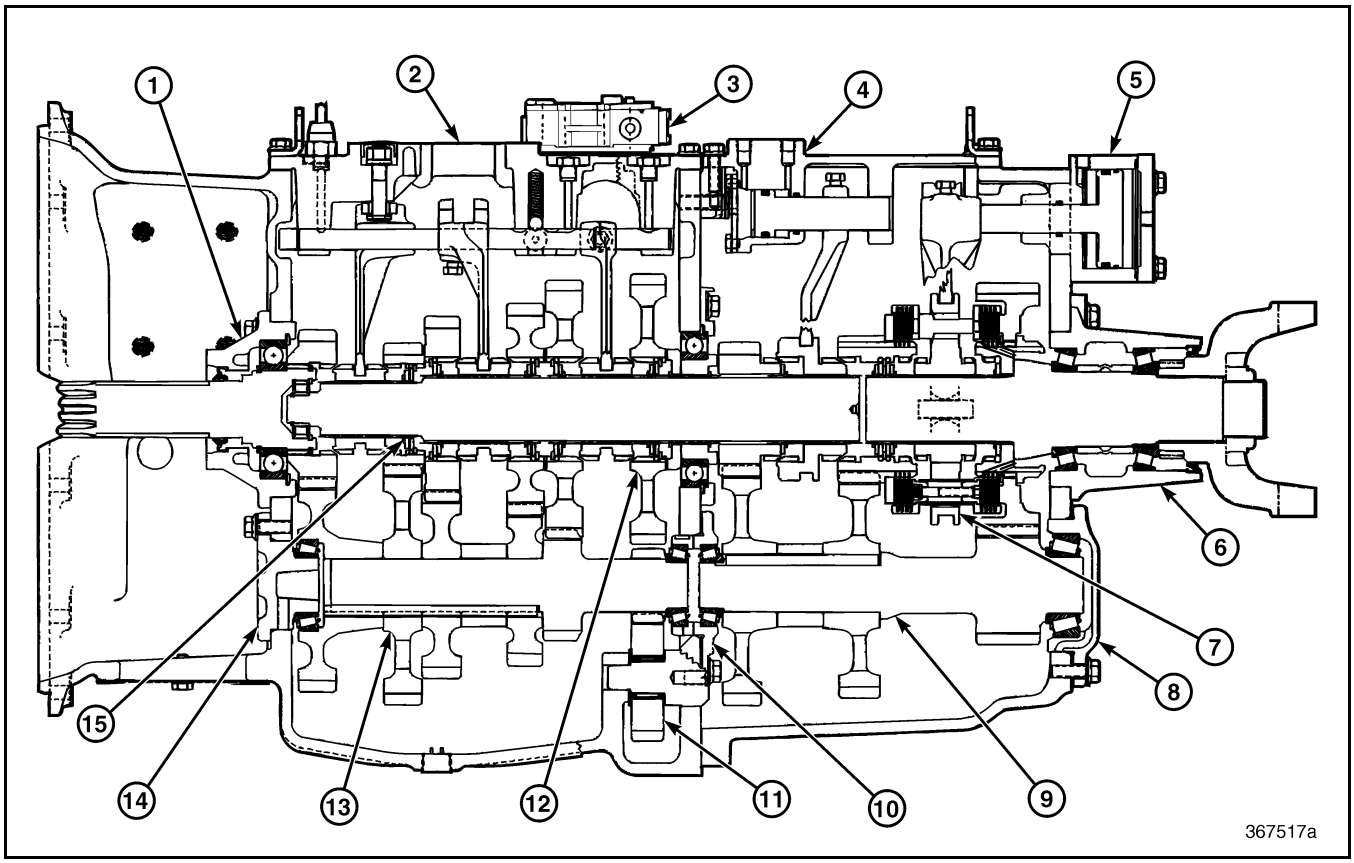


Figure 54 — Major Component Locations for T313LR21/T318LR21 Transmission

1. Main Drive Pinion Assembly 2. Main Case Shift Cover Assembly 3. Range Shift Valve 4. Rear Case Shift Cover (Splitter) Assembly 5. Range Shift Cylinder	6. Rear Output Housing (Extended Output Shaft) 7. Synchronizer Assembly 8. Rear Countershaft Bearing Cover 9. Rear Countershaft Assembly 10. Front Countershaft Rear Bearing Cover	11. Reverse Idler Gear 12. Low Reverse Gear 13. Front Countershaft Assembly 14. Front Countershaft Front Bearing Cover 15. Front Mainshaft Assembly

Transmission Model Not Shown:

- T31321/T31821 Transmission

TROUBLESHOOTING

TROUBLESHOOTING CHARTS

NOISY TRANSMISSION

Probable Cause	Remedy
a. Low oil level	a. Fill to correct level.
b. Wrong oil used	b. Drain and refill with correct oil.
c. Mismatched carrier ratios	c. Install correct matched gearing.
d. Resonating (ringing) driveshaft	d. Install suitable dampening material, then high-speed balance the driveshaft.
e. Side-mounted PTO mounted too loose or too tight	e. Reinstall PTO correctly.
f. Loose bell housing to flywheel housing capscrews	f. Install new capscrews using Loctite®.
g. Incorrect clutch-driven discs used	g. Install correct clutch-driven discs.
h. Gears worn, chipped, rough, cracked	h. Replace gears.
i. Bearings worn, cracked, corroded, galled, etc.	i. Replace bearings.
j. Improperly adjusted fifth/sixth eccentric pin (SB-323-004)	j. Adjust properly.
k. Driveline angles (air bags deflated)	k. Correct driveline angles (allow air bags to fill).

HARD SHIFTING

Probable Cause	Remedy
a. Incorrect driving practices	a. Train driver in correct driving practices.
b. Low oil level	b. Fill to correct level.
c. Improperly adjusted clutch, clutch linkage, clutch brake or shift linkage	c. Adjust properly.
d. Wrong oil used	d. Drain and refill with correct oil.
e. Remote shift linkage not lubricated	e. Clean and lubricate.
f. Shift lever binding or interference	f. Relieve binding or interference.
g. Poppet balls binding in their holes	g. Clean holes and balls.
h. Loose setscrews in shifters or shift forks	h. Tighten to correct torque.
i. Worn spigot bearing	i. Replace bearing.
j. Clutch brake tangs broken	j. Replace clutch brake.
k. Clutch discs worn into main drive pinion shaft splines	k. Replace clutch discs and main drive pinion.
l. Mainshaft snap ring or thrust washer failure	l. Replace snap rings or thrust washers.
m. PTO engaged	m. Disengage PTO.
n. Improperly adjusted third/fourth eccentric pin (SB-323-004)	n. Adjust properly.

GEAR DISENGAGEMENT (JUMPING OUT OF GEAR)

Probable Cause	Remedy
a. Excessive weight and/or length of gear shift lever and/or knob	a. Replace with standard lever and/or knob.
b. Shift lever interference	b. Remove interference.
c. Improperly adjusted remote control linkage	c. Adjust properly.
d. Worn or loose mounting insulators	d. Replace insulators.
e. Loose, broken or missing capscrews between clutch housing and flywheel housing	e. Replace capscrews, check threads in case.
f. Weak or broken shifter rail poppet springs	f. Replace springs.
g. Bent or worn shifter forks	g. Replace forks.
h. Broken snap rings	h. Replace snap rings.
i. Shift rail bent or poppet notches worn	i. Replace shift rail.
j. Worn taper or chipped teeth on sliding clutch teeth	j. Replace sliding clutch and mating gear if its clutch teeth are damaged.
k. Worn or damaged spigot bearing	k. Replace bearing.
l. Engine flywheel housing misalignment	l. Realign properly.
m. Chassis resonant ride	m. Correct resonance.

OIL LEAKS

Probable Cause	Remedy
a. Oil level too high	a. Drain to correct level.
b. Drain plug, fill plug or magnetic filter plug loose	b. Tighten plugs.
c. Loose or missing capscrews	c. Tighten or replace.
d. Improper lubricant used	d. Drain and refill with correct oil.
e. Clogged air breather	e. Clean or replace.
f. Gaskets or O-rings broken, shifted or squeezed out of position	f. Replace gaskets or O-rings.
g. Worn oil seals	g. Replace seals.
h. O-rings in air shift cylinder or cover leaking air pressure into transmission	h. Replace O-rings.

BEARING FAILURE

Probable Cause	Remedy
a. Dirt in system	a. Clean system, replace bearings as needed, flush and refill with clean lubricant.
b. Wrong grade of oil, or contaminated oil	b. Clean system, replace bearings as needed, flush and refill with clean lubricant.
c. Excessive vibrations	c. Eliminate vibrations, replace bearings.
d. Binding or seized propeller shaft slip yoke	d. Clean and replace as needed.
e. Improper bearing clamping	e. Replace bearings and re-clamp using correct procedures.
f. Improper bearing installation (preloads, etc.)	f. Replace using correct procedures.

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AIR SHIFT MALFUNCTIONS

Probable Cause	Remedy
a. Low system air pressure	a. Wait for pressure to build back up to normal.
b. Restricted or clogged air filter in range shift valve	b. Replace air filter.
c. Restricted air line (bent, squeezed, twisted, etc.)	c. Re-route and/or replace air lines.
d. Air lines too small	d. Replace with correct size air lines.
e. Defective O-rings in air shift cylinder	e. Replace O-rings.
f. Scored air shift cylinders or pistons	f. Repair or replace cylinders or pistons.
g. Defective range shift valve and/or air shift selector valve (on shift lever)	g. Repair or replace as needed.
h. Defective synchronizer	h. Repair or replace as needed.
i. Range synchronizer friction discs worn or burned	i. Replace synchronizer discs as needed.
j. Intermixed synchronizer parts	j. Install matched parts.

MAINTENANCE

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TRANSMISSION MAINTENANCE

Checking Oil Level

NOTE

Perform oil level check when the oil is at operating temperature. The vehicle must be in a level position, both front-to-rear and side-to-side.

- Check the transmission oil level at the intervals specified in the Maintenance and Lubrication Manual (TS494).
- To check the oil level in the transmission, first remove the filler plug (2) from the right side of the main case (Figure 55).

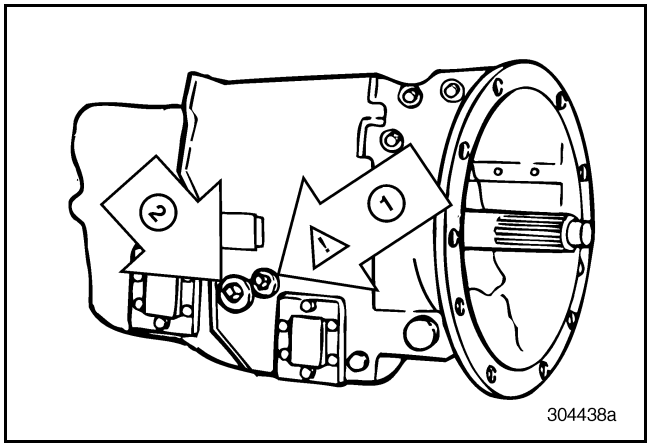


Figure 55 — Oil Filler and Check Plug

1. Magnetic Filter Plug (Not for Level Check)	2. Oil Filler and Check Plug

- The oil must be level with the bottom of the filler plug hole as determined by feel or by visual inspection.

⚠ WARNING

Be careful not to burn your finger in hot gear oil when checking the oil level in the transmission.

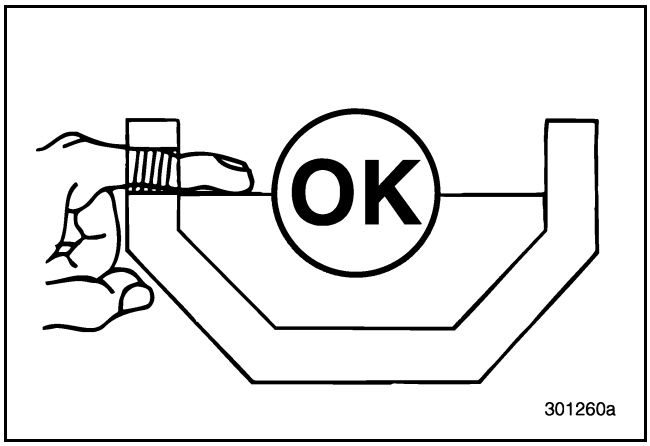


Figure 56 — Correct Oil Level

- If oil can only be felt by reaching the finger down into the unit, the oil level is too low.

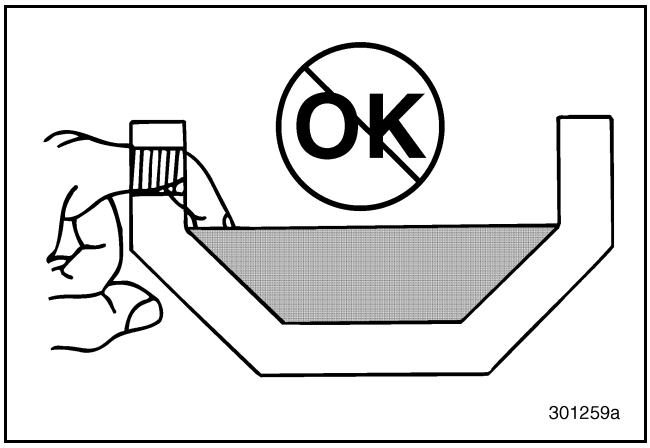


Figure 57 — Incorrect Oil Level

- If needed, add specified make-up oil until the oil is level with the bottom of the filler plug hole. Do NOT overfill. Use oil of the proper specification (refer to “Transmission Specifications and Capacities” on page 237).
- Reinstall and tighten the oil filler plug (Figure 55) as follows:
  1. Check that the O-ring on the plug is not cut or damaged.
  2. Install the plug and tighten to 41–48 N•m (30–35 lb-ft) of torque.

⚠ CAUTION

DO NOT exceed 48 N•m (35 lb-ft) as plug can seize, resulting in damage to the transmission case when attempting to remove the plug.

Changing Oil

⚠ CAUTION

Preserve the environment! Drained gear oil is classified as a hazardous toxic material which must be recovered, handled, stored and disposed of according to applicable State or Federal guidelines.

CHANGE INTERVAL

- Change the oil at intervals specified in the Maintenance and Lubrication Manual (TS494).

DRAINING OIL

- Before draining oil from the transmission, the oil should be at normal operating temperature.
- Remove the magnetic drain plug (Figure 58) from the bottom of the transmission main case and drain the hot oil into an industry-approved recovery container.
- Clean and replace the magnetic drain plug, then torque plug to 34–41 N•m (25–30 lb-ft).

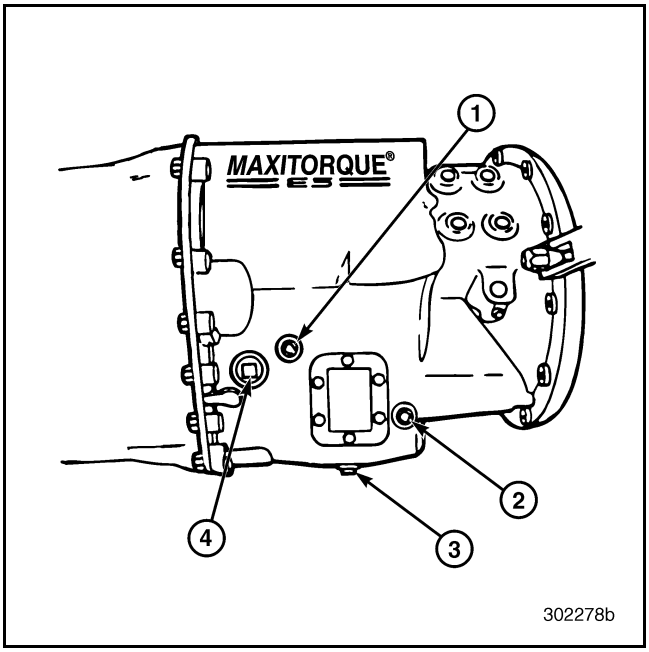


Figure 58 — Plug Locations

1. Magnetic Filter Plug 2. Oil Temperature Sensor	3. Oil Drain Plug 4. Oil Fill and Level Plug

OIL FILL

- Remove the oil filler plug (2) (Figure 59), then fill the transmission using specified oil until the oil is level with the bottom of the filler plug hole (also see Figure 56). Do NOT overfill.

NOTE

MACK-approved lubricants can be found on the internet at www.macktrucks.com, then click on the PARTS AND SERVICE category.

- Reinstall and tighten the oil filler plug as follows:
  1. Check that the O-ring on the plug is not cut or damaged.
  2. Install the plug and tighten to 41–48 N•m (30–35 lb-ft) of torque.

⚠ CAUTION

DO NOT exceed 48 N•m (35 lb-ft) as plug can seize, resulting in damage to the transmission case when attempting to remove the plug.

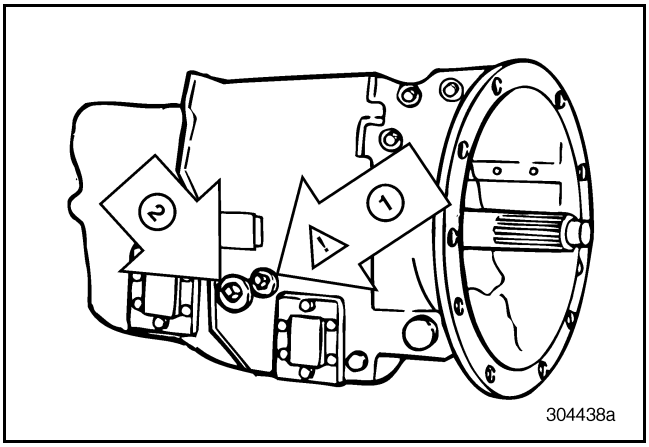


Figure 59 — Oil Filler and Check Plug

1. Not for Oil Fill	2. Oil Filler and Check Plug

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⚠ CAUTION

Be sure to add oil to the transmission through the filler hole, NOT the magnetic filter plug hole. Damage to the transmission and seals may occur due to overfilling. The magnetic oil filter hole is higher on the transmission case than the filler hole.

Magnetic Oil Filter Plug

Remove the magnetic oil filter plug and clean the magnet in the plug every time the oil is changed. Reinstall the magnetic plug. Tighten the plug to 27–31 N•m (20–23 lb-ft) torque.

Air Breather(s)

The T313–T318(L)(LR)(21)(L21)(LR21) transmissions have one air breather, located on the main case shift cover. The air breather should be removed and cleaned with a suitable solvent every time the oil is changed. Also check to be sure that airflow through the breather is unobstructed. Reinstall breather into the main case shift cover and tighten until snug.

The optional three-position (compound neutralizing) range shift cylinder contains a breather vent screen which should be cleaned any time the main case shift cover is cleaned. The following figure shows the breather vent removed (1) and installed (2). Check the breather vent for free airflow. Clean or replace as necessary.

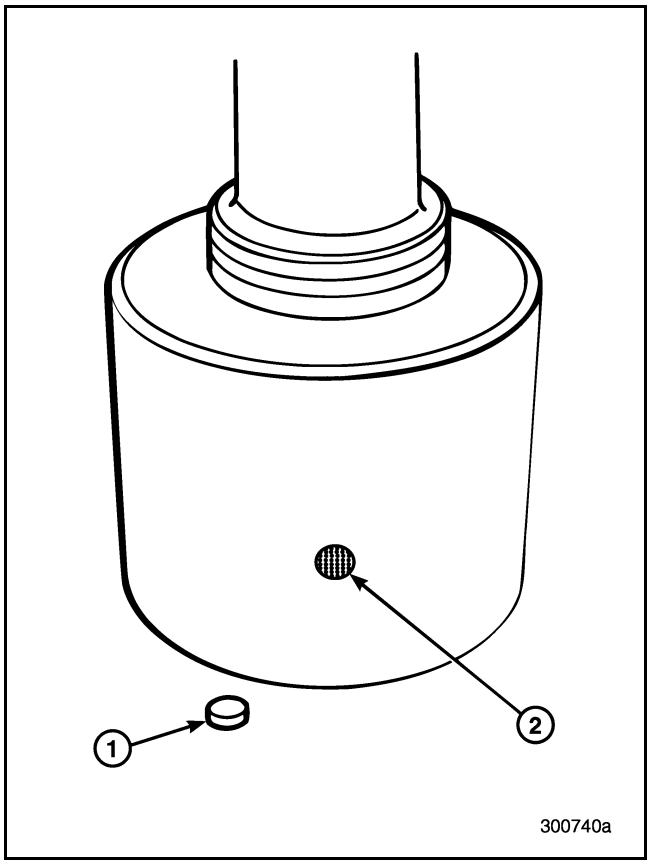


Figure 60 — Shift Cylinder Breather Vent Shown Removed (1) and Installed (2)

REPAIR INSTRUCTIONS

TRANSMISSION DISASSEMBLY PROCEDURES [320]

NOTE

Unless a complete overhaul is necessary, remove only those parts required to gain access to faulty parts. Do not disturb parts with a heavy press fit (interference fit) unless replacement is necessary. When replacement is necessary, use proper press setups and pullers so that usable parts are not damaged.

NOTE

External inspection of the unit before cleaning and disassembly often reveals information about existing operating conditions. This may help when diagnosing problems.

SERVICE HINT

During disassembly, remember the sequence in which components and individual parts are removed from the transmission. It is good practice to keep related parts together in groups when removed. Small parts such as shims and spacers can be wired to the larger pieces they go with. Groups of parts can be kept together in boxes.

SERVICE HINT

Keep parts such as shim packs, bearing cones, bearing retainers (covers), bearing cups and gears with the original countershaft from which they are removed. Mark each countershaft and bearing cover before removal. Mark the upper left front and rear countershafts and bearing covers (viewed from rear) as number 1. Mark the upper right front and rear countershafts and bearing covers (viewed from rear) as number 2. Mark the lower front and rear countershafts and bearing covers as number 3.

1. Clean the transmission externally and mount it in an overhaul stand. Drain the lubricant and plug any air line openings to prevent dirt from entering.

NOTE

Lift and move the transmission with a hoist, using the two lifting brackets provided.

2. Remove the clutch release bearing assembly, shafts, yoke and clutch brake (if equipped).
3. Disconnect the air lines attached to the range shift cylinder, rear case shift cover (splitter) and range shift valve. Air lines are installed using a push/pull-type fitting and are best removed using tool kit 9032-1800trk which can be obtained through the MACK Parts System. Disconnect the air lines using the following procedure:
   a. Select the appropriate size release tool from kit 9032-1800trk.
   b. Insert the tool over the air line and release the lines from the fittings by pushing in toward the fitting and at the same time, pulling on the hose.

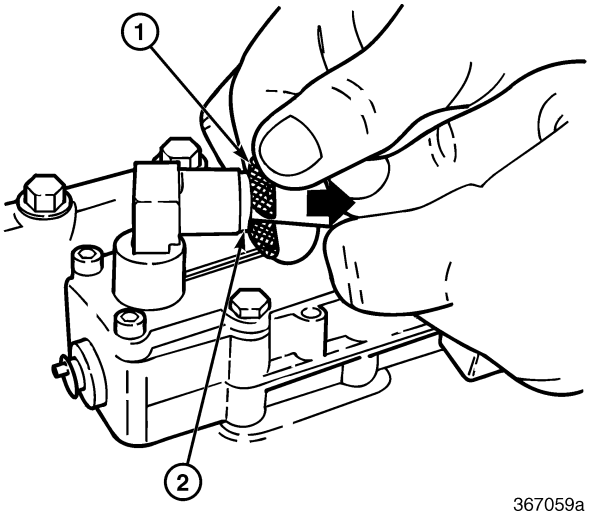


Figure 61 — Removing Air Lines

1. Air Line Removal Tool 9032-1800trk	2. Air Hose Fitting Release Ferrule

4. Label the air lines for proper reassembly.

5. Remove the range shift valve 5/32-inch Allen screws (outer) and capscrews (inner), using the appropriate tools.

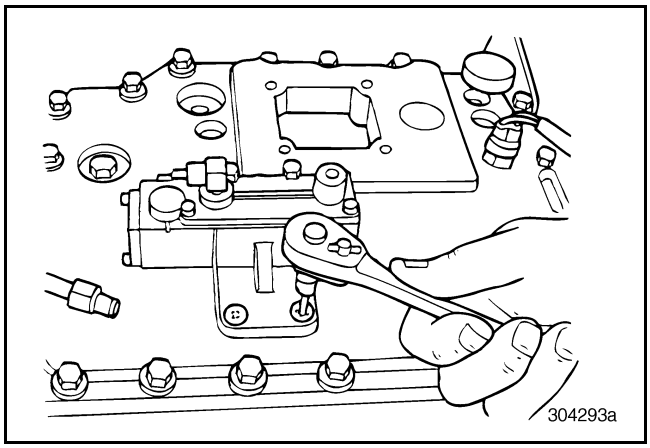


Figure 62 — Removing Range Shift Valve Screws (Air Lines Removed for Clarity)

6. Remove the range shift interlock sleeve, spring, pin and O-ring from the main case shift cover.

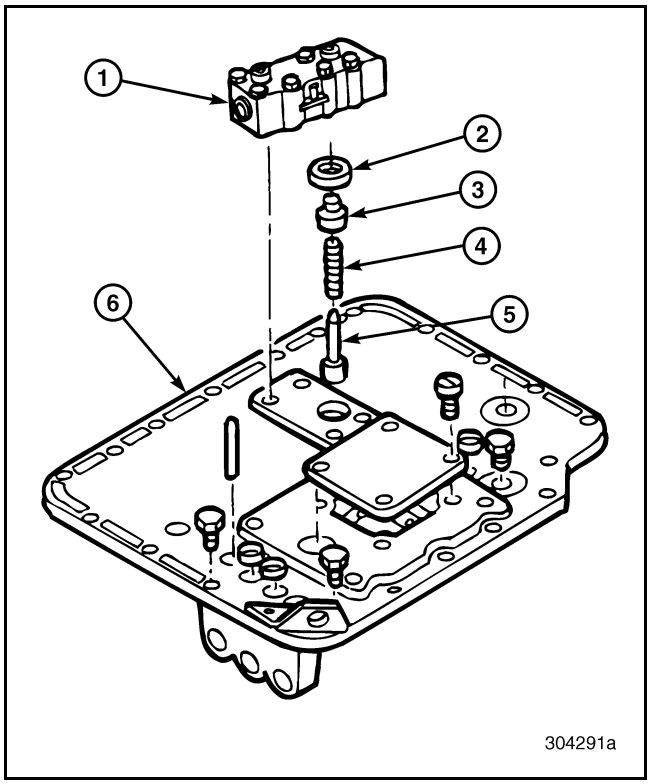


Figure 63 — Removing Range Shift Valve

1. Range Shift Valve (Reference)	4. Interlock Spring
2. O-Ring	5. Interlock Pin
3. Interlock Sleeve	6. Main Case Shift Cover

7. Remove the range shift valve, dual-double check valve, pressure switch and associated brackets from the transmission.
8. Leave all air lines and valves connected. Then remove the valves and air lines as an assembly.

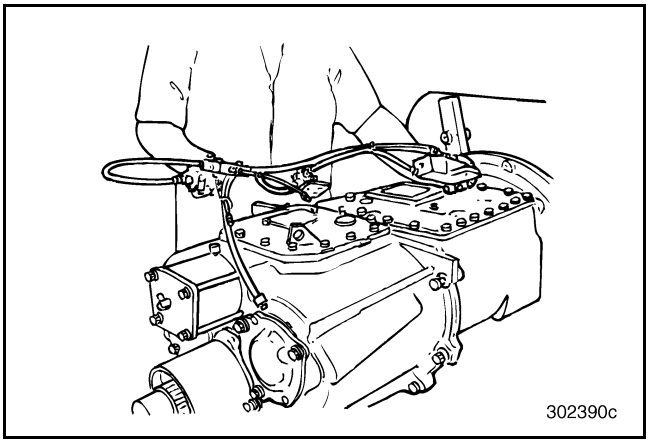


Figure 64 — Removing Air Lines and Valves

9. With the transmission in neutral, remove the main case shift cover capscrews.

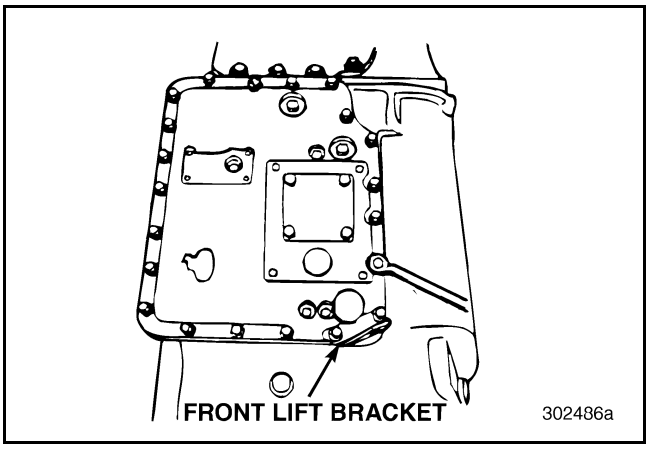


Figure 65 — Removing Main Case Shift Cover Capscrews

10. Remove the main case shift cover assembly and cover gasket.

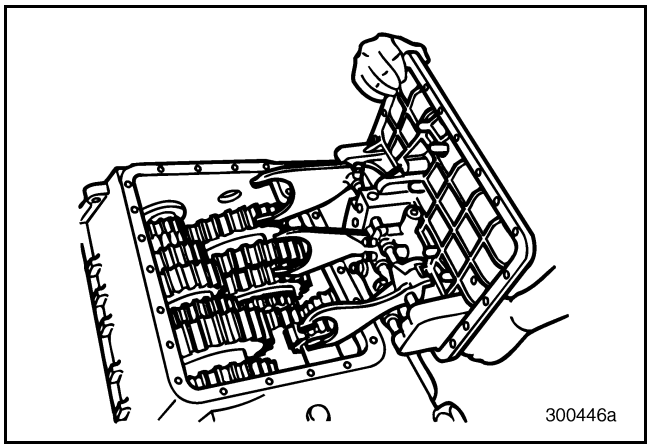


Figure 66 — Removing Main Case Shift Cover

11. Remove the rear case shift cover capscrews.

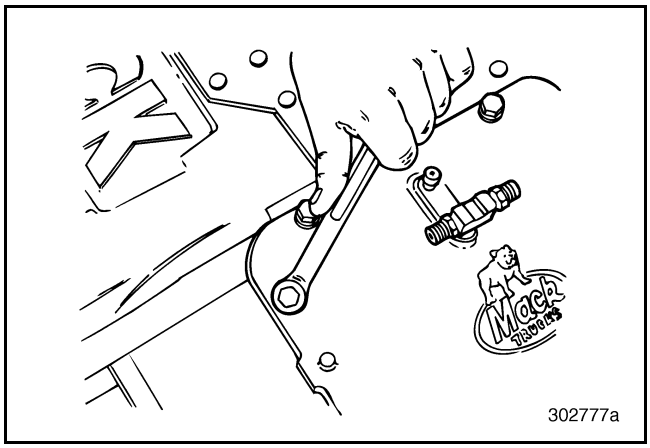


Figure 67 — Removing Rear Case Shift Cover Capscrews

12. Remove the rear case shift cover and gasket.

SERVICE HINT

To remove the drive yoke nut (extended output shaft) or yoke (or flange), clamp plate bolt and clamp plate (conventional output shaft), place at least two gears in both the main case and the rear case into engagement. This is done to lock the transmission gearing and prevent it from rotating while removing the yoke bolt or nut.

13. Reach through the rear case top opening and verify that both the splitter sliding clutch and the synchronizer assembly sliding clutch are engaged.

14. Reach into the main case top opening and move at least two sliding clutches into engagement. This locks two different gears to the mainshaft and prevents the gears and shaft of the transmission from rotating.

15. Remove the drive yoke nut from the extended output shaft.

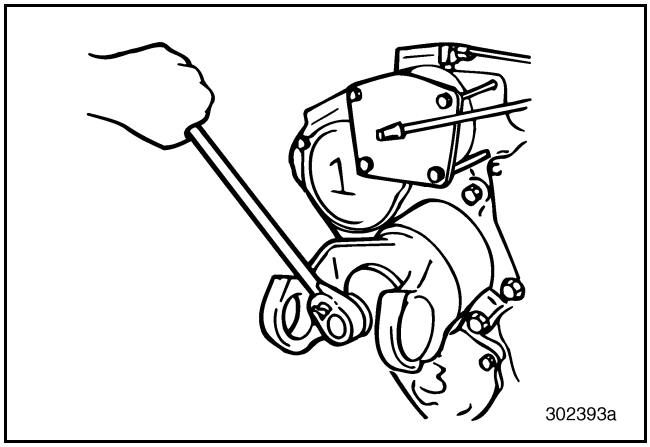


Figure 68 — Removing Drive Yoke Nut (T313L21/T318L21 Shown)

16. Remove the drive yoke or drive flange capscrew and clamp plate from the conventional output shaft.

NOTE

Effective June 2007, drive yoke clamp plate capscrews were changed to a Scotch-Grip™ torque retention method. DO NOT reuse these fasteners, as they are one-time use only.

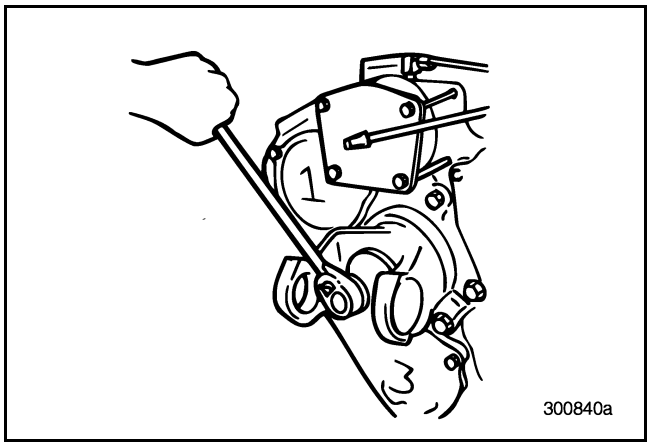


Figure 69 — Removing Clamp Plate and Capscrew (T313L/T318L Shown)

17. Remove the drive yoke or drive flange, using a suitable puller such as J 07804-A or equivalent.

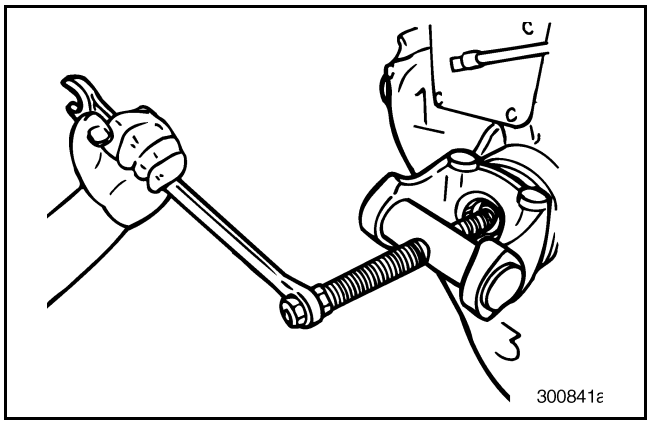


Figure 70 — Removing Drive Yoke (T313L/T318L Shown)

18. Shift the transmission gears into neutral. Verify that the transmission is in neutral.
19. Reach inside the rear case opening and remove the range shift fork setscrew.

NOTE

Effective June 2007, shift fork setscrews were changed to a Scotch-Grip™ torque retention method. DO NOT reuse these fasteners, as they are one-time use only.

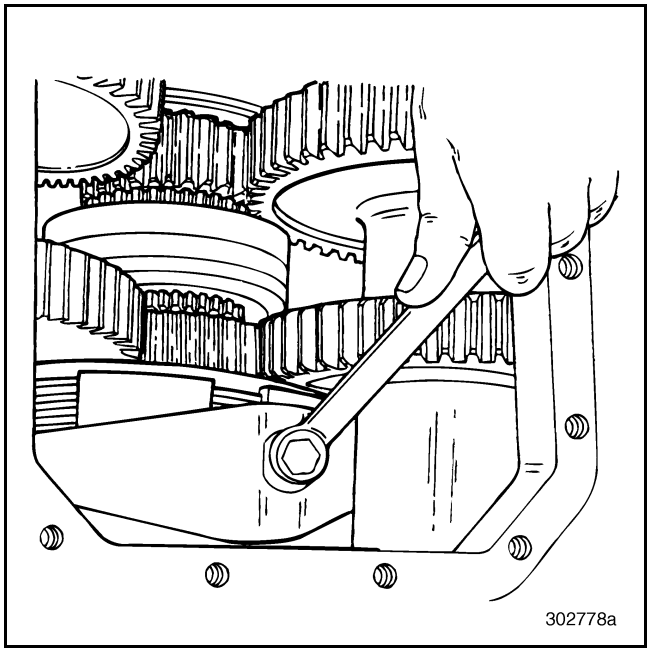


Figure 71 — Removing Range Shift Fork Setscrew

20. Remove the range shift cylinder capscrews.

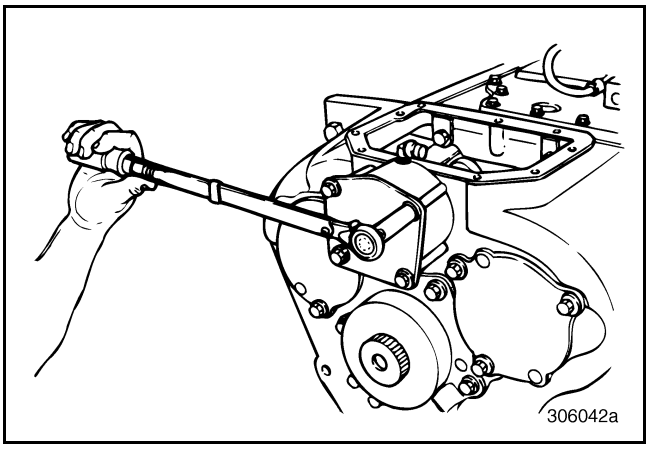


Figure 72 — Removing Range Shift Cylinder Capscrews

21. Remove the range shift cylinder cover and O-ring, and set aside.

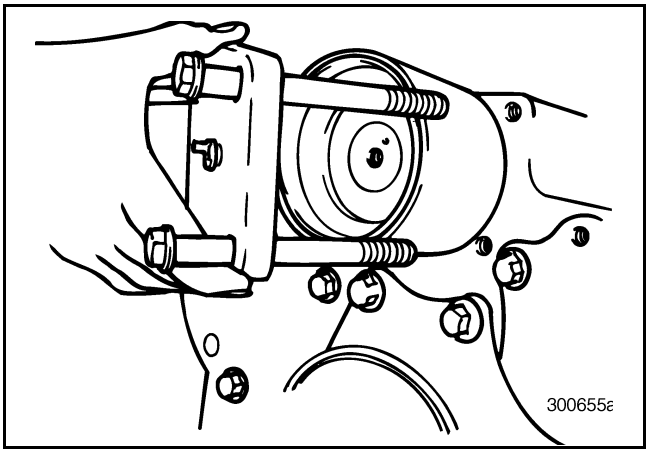


Figure 73 — Removing Range Shift Cylinder Cover

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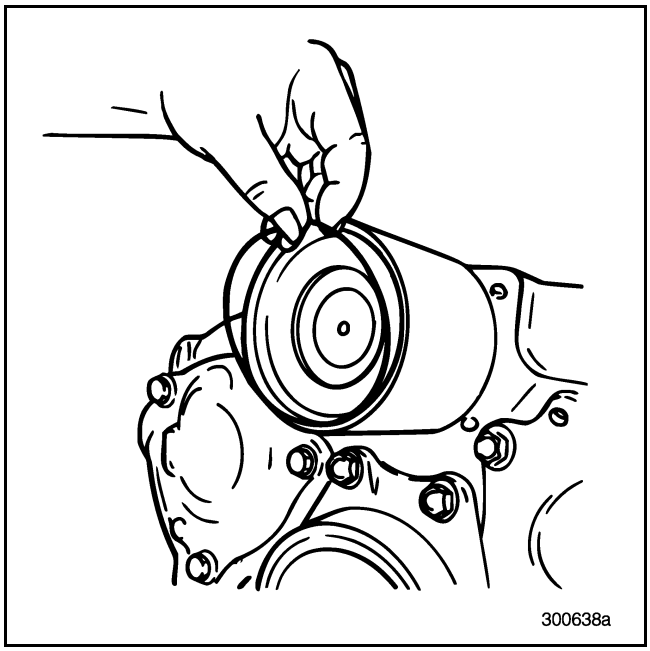


Figure 74 — Removing Range Shift Cylinder O-Ring

22. While holding the shift fork, slide the shift cylinder from the rear of the transmission.

NOTE

To help remove the shift cylinder, use a plastic mallet to lightly tap on the piston to loosen the shift rail from the fork.

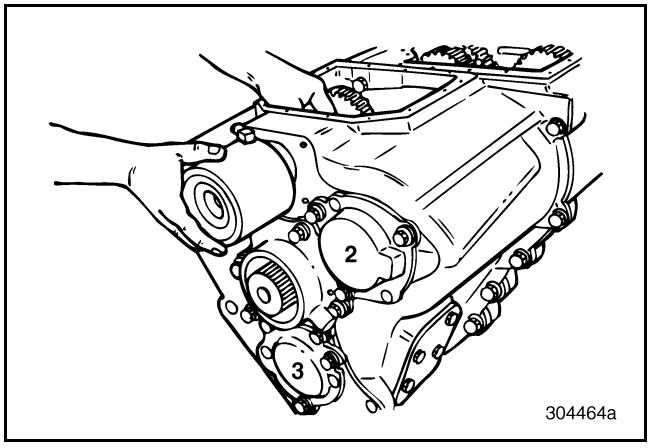


Figure 75 — Removing Range Shift Cylinder

23. For transmission models with the two-position range shift cylinder (non-neutralizing), also remove the gasket as shown in Figure 76.

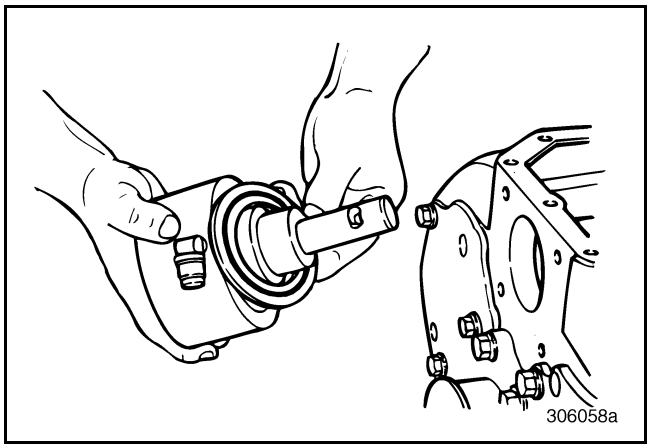


Figure 76 — Two-Position Shift Cylinder Gasket

24. Remove the range shift fork from the rear case. Note the offset of the range shift fork. Straight side of the fork faces the front; angled side of fork faces the rear.

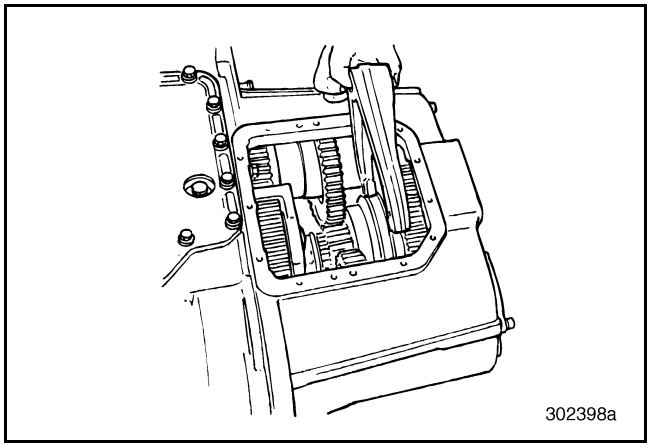


Figure 77 — Shift Fork Offset

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25. Position the transmission vertically, rear end up.
26. Remove the rear output housing oil seal on the extended output housing transmission: T313–T318(21)(L21)(LR21).

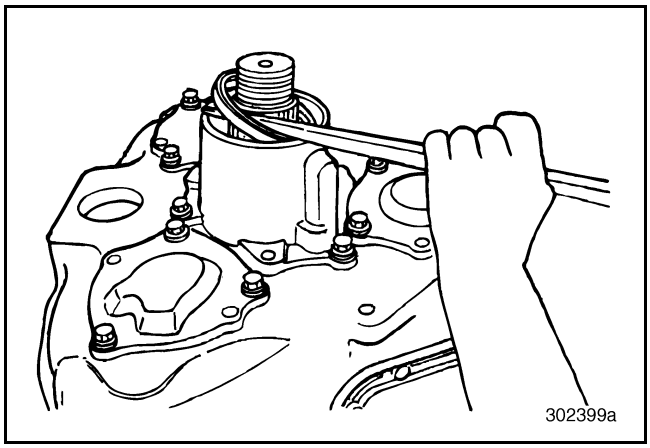


Figure 78 — Removing Output Housing Oil Seal for T313L21/T318L21 Series

27. On the extended output housing transmissions: T313–T318(21)(L21)(LR21), remove the rear output housing capscrews. Remove the jackscrew plugs from the housing.

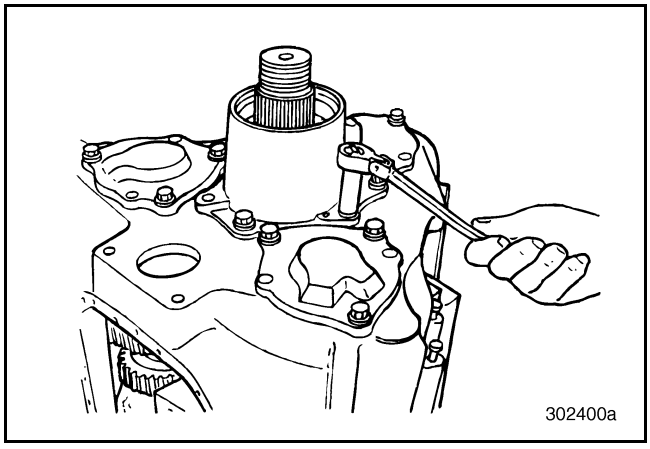


Figure 79 — Removing Extended Output Housing Capscrews (T313L21/T318L21 Shown)

28. Using jackscrews, separate the output housing from the rear case on extended output housing transmissions.

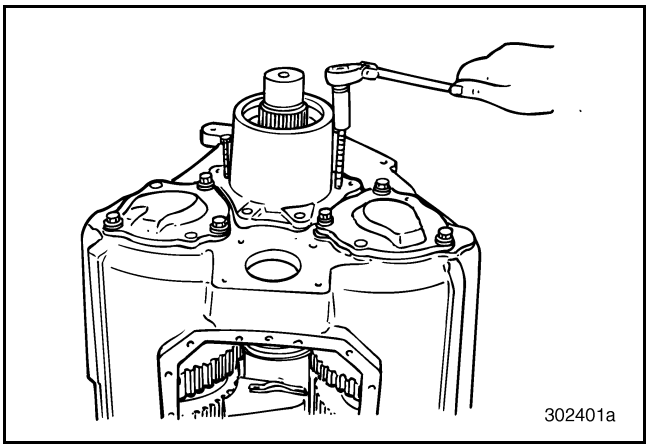


Figure 80 — Separating Output Housing from Case (T313L21/T318L21 Shown)

29. Remove the output housing along with the outer bearing cone and bearing preload collapsible spacer.

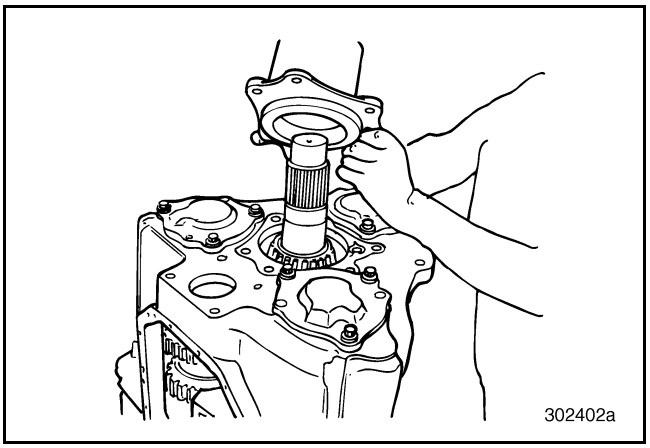


Figure 81 — Removing Output Housing, Bearing Cone and Spacer (T313L21/T318L21 Shown)

30. On the conventional output shaft model transmissions: T313–T318(L)(LR), remove the capscrews from the rear mainshaft bearing cover.

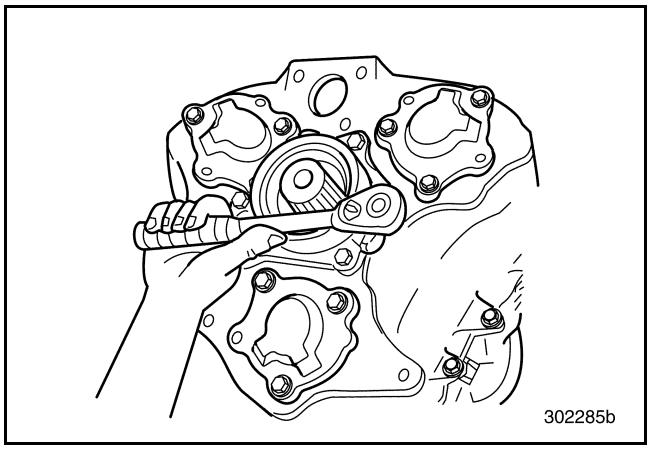


Figure 82 — Removing Rear Mainshaft Bearing Cover Capscrews

31. For the conventional output shaft model transmissions: T313–T318(L)(LR), remove the rear mainshaft bearing cover. Jackscrew holes are provided to assist in removal.

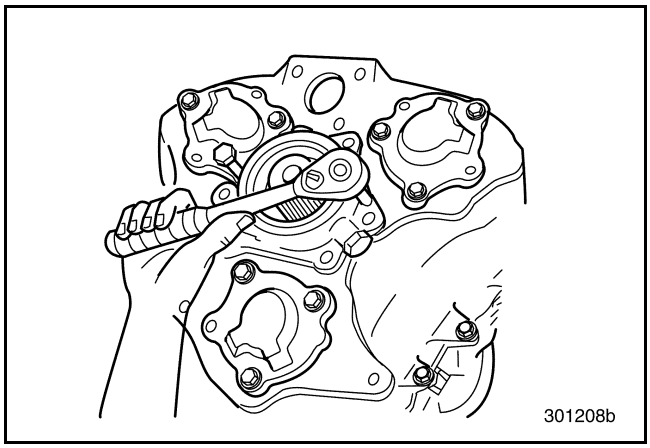


Figure 83 — Removing Rear Mainshaft Bearing Cover Using Jackscrews

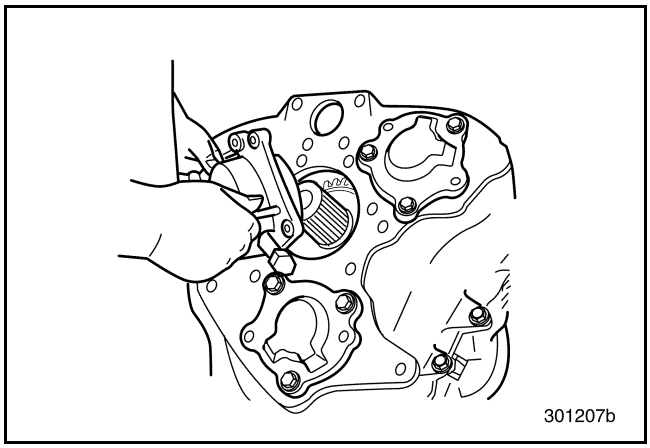


Figure 84 — Rear Mainshaft Bearing Cover Removed

32. Remove the output housing gasket from either the housing or the case as needed.

33. Number the front countershaft front bearing covers and the rear countershaft bearing covers, using a grease pencil. Write number 1 on the upper right front cover (viewed from front), number 2 on the upper left front cover (viewed from front) and number 3 on the lower front cover. Write number 1 on the upper left rear cover (viewed from rear), number 2 on the upper right rear cover (viewed from rear) and number 3 on the lower rear cover.

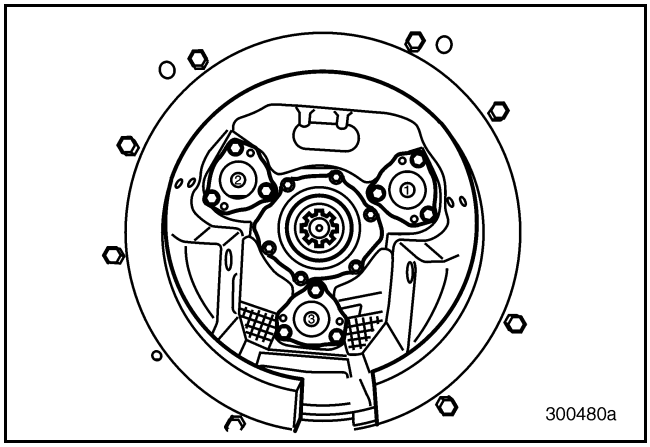


Figure 85 — Mark Front Countershaft Front Bearing Covers for Placement

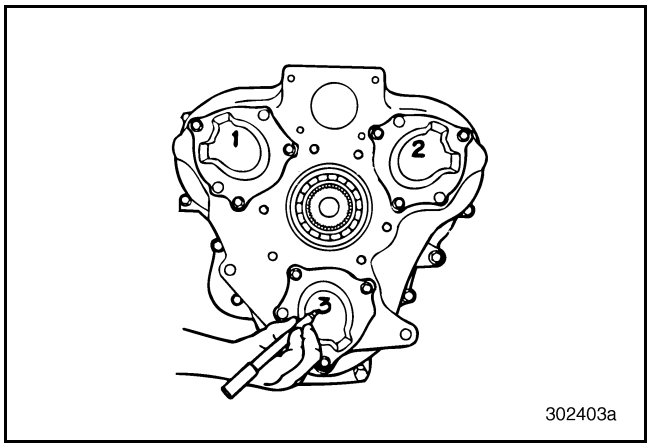


Figure 86 — Mark Rear Countershaft Bearing Covers for Placement

34. Remove all of the rear countershaft bearing cover capscrews.

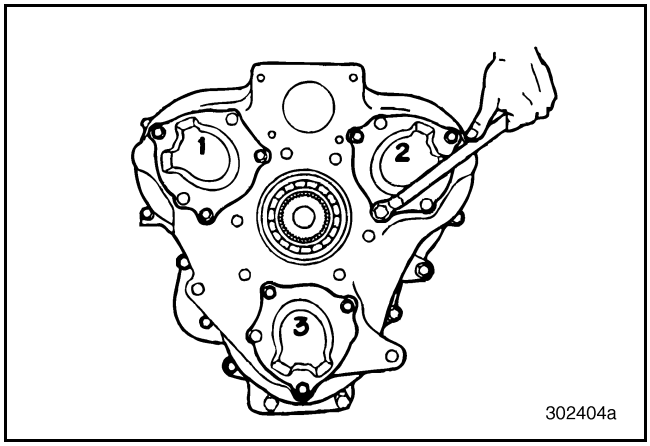


Figure 87 — Removing Rear Countershaft Bearing Cover Capscrews

35. Remove the jackscrew plugs from the covers.

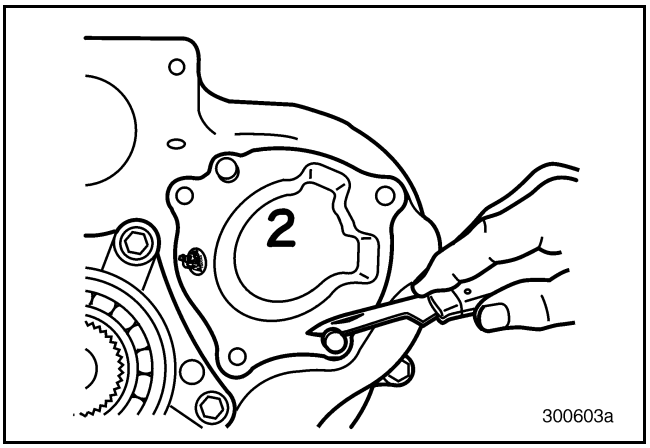


Figure 88 — Removing Jackscrew Plugs

NOTE

Pry the plugs loose using a thin knife-edge or similar tool. Do not cut through plugs during removal. Save for reuse or replace if necessary.

36. Remove the rear countershaft bearing covers, shims and O-rings. Jackscrew holes are provided to assist removal.

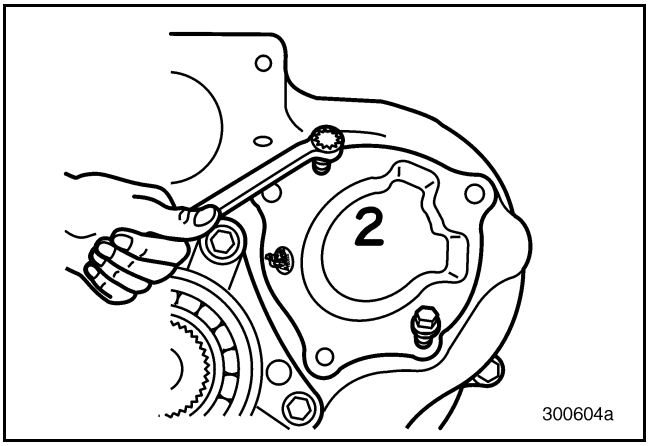


Figure 89 — Removing Bearing Cover

37. Mark the rear countershafts so they can be installed in the same position during reassembly.

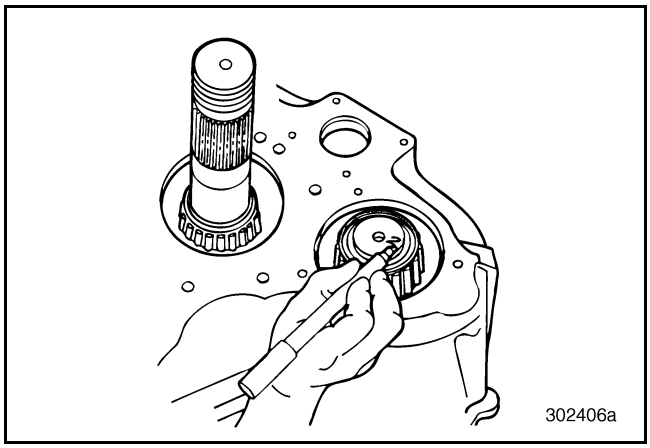


Figure 90 — Marking Rear Countershafts (T313L21/T318L21 Shown)

38. Place the transmission in a vertical position (rear case upward), and remove the two capscrews located inside the rear case.

⚠ WARNING

When separating the rear case from the front case, make sure the transmission is in the vertical position. The rear countershafts are not supported when the case is removed. They can fall out and cause damage or personal injury.

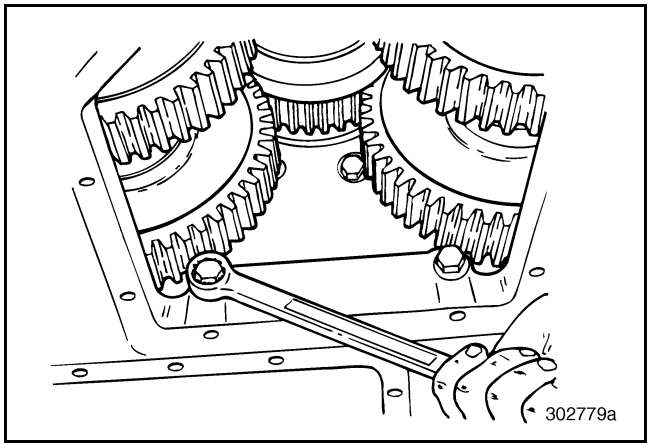


Figure 91 — Removing Outer Rear Case-to-Main Case Capscrews

39. Remove all of the remaining capscrews and dowel bolts that hold the rear case to the main case.

NOTE

Tap dowel bolts out of the rear case using a brass hammer or a combination of a brass hammer and a steel hammer as long as contact is made with the brass hammer only.

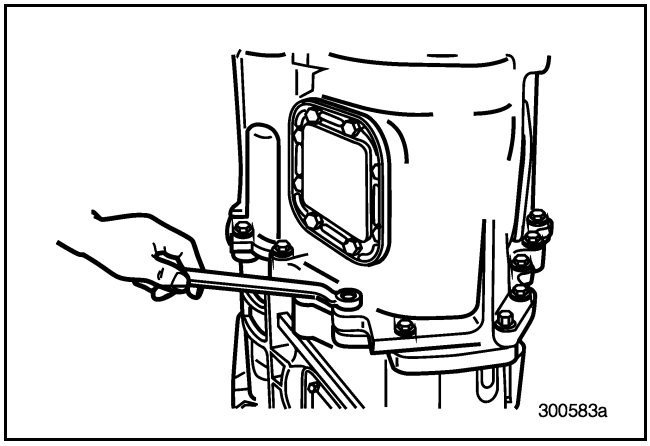


Figure 92 — Removing Inner Rear Case-to-Main Case Capscrews

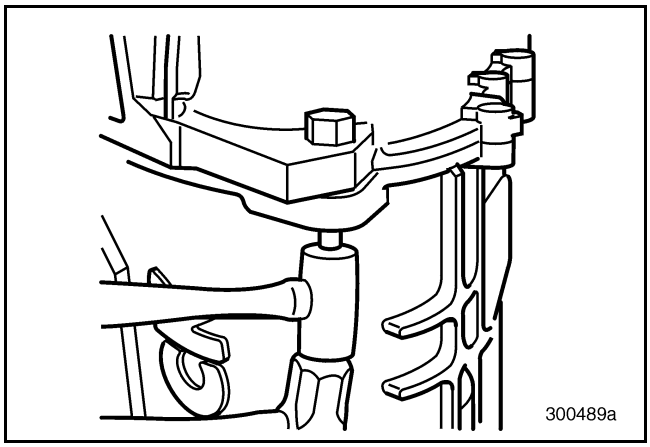


Figure 93 — Removing Dowel Bolts

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⚠ WARNING

Be sure unit is vertical, so that the countershafts will not fall out when the case is removed.

40. Using a hoist and chain, remove the rear case from the main case. Only the rear case should be lifted, not the output assembly. If necessary, tap on the end of the output shaft to loosen it from the case. Lift only the case, not the compound gear set or mainshaft and synchronizer assembly.

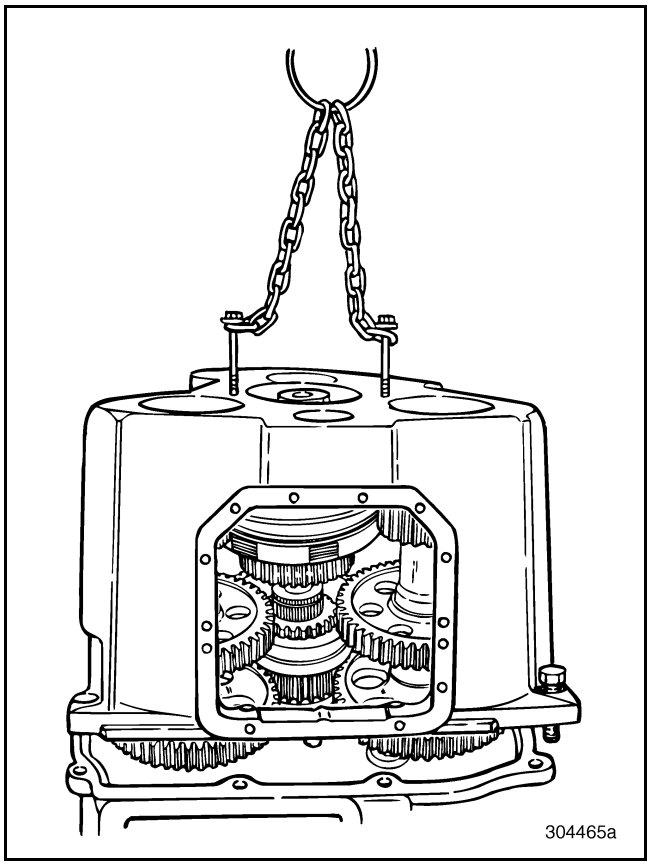


Figure 94 — Removing Rear Case (T313L/T318L Shown)

41. For the extended output shaft transmissions: T313–T318(21)(L21)(LR21), using a hoist and suitable output yoke retaining nut with welded strap, lift and remove the synchronizer and output shaft assembly.

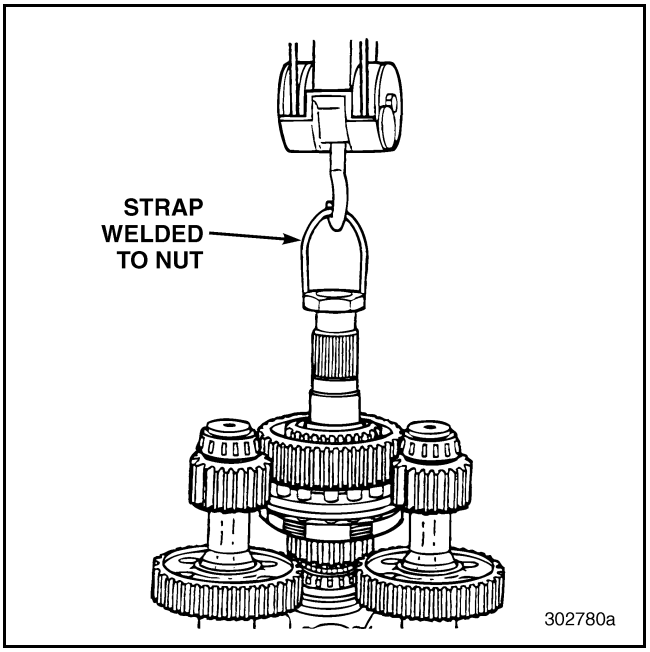


Figure 95 — Removing Mainshaft and Synchronizer Assembly (T313L21/T318L21 Shown)

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42. On the conventional output shafted transmissions: T313–T318(L)(LR), use a hoist and a threaded eye-bolt to lift and remove the mainshaft and synchronizer assembly from the rear case.

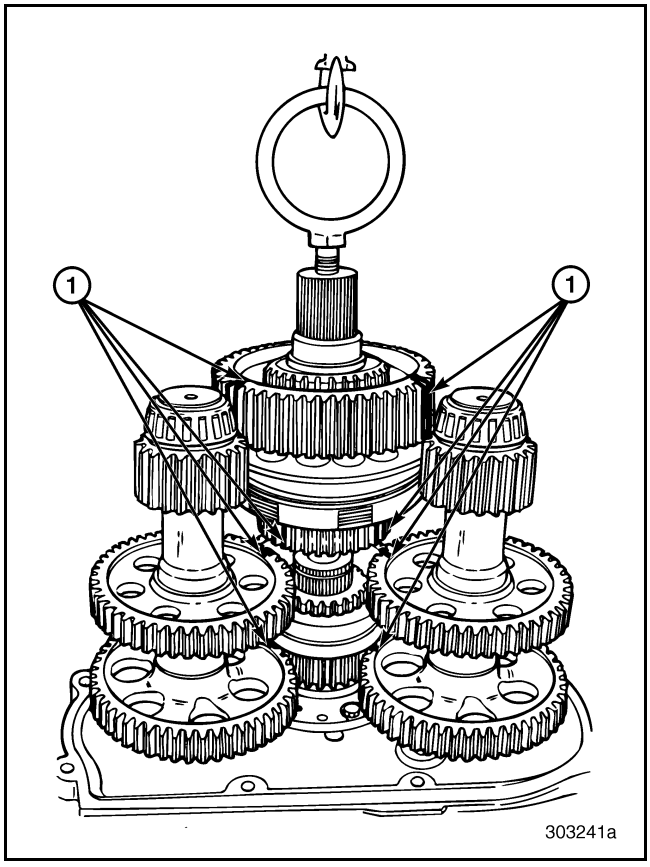


Figure 96 — Removing Mainshaft and Synchronizer Assembly (T313L/T318L Shown)

1. Timing Marks

43. Remove the three compound countershafts from the rear of the transmission.

44. If not already done, mark the rear countershafts so that they can be installed in the same location during installation.

NOTE

Remember to mark the countershafts so they can be installed in the same position during reassembly. Also, notice the gear timing marks. Countershaft gear timing should be marked in alignment with the countershaft keyway.

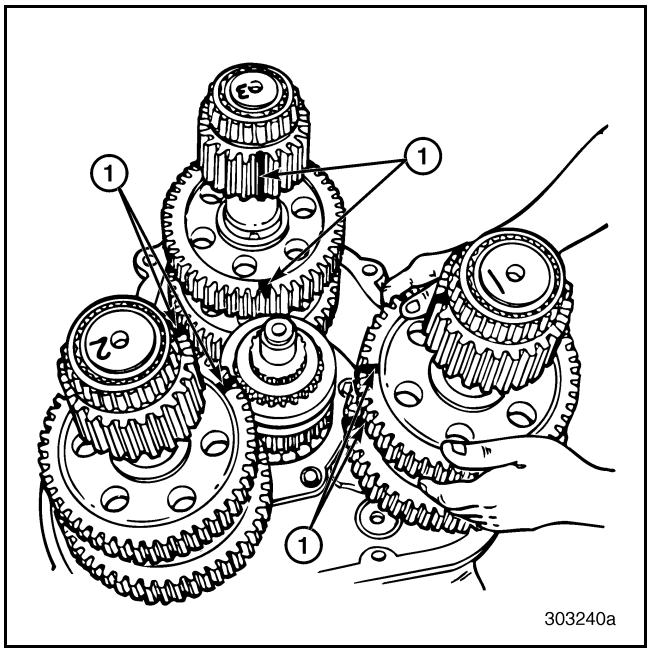


Figure 97 — Removing Compound Countershafts (T313L/T318L Shown)

1. Timing Marks

45. Remove the splitter sliding clutch from the rear of the front mainshaft.

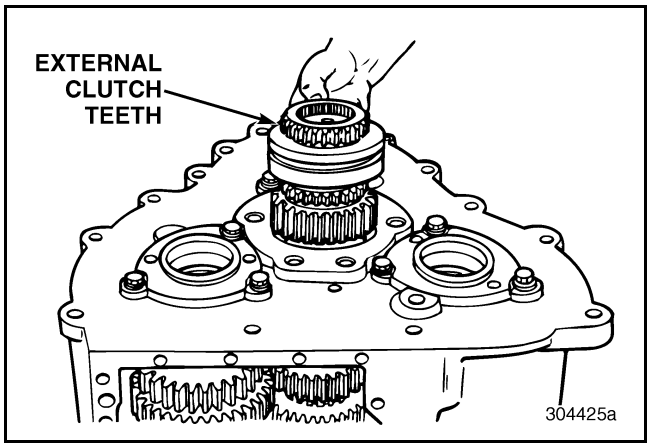


Figure 98 — Removing Splitter Sliding Clutch

46. Remove the compound Lo-split gear snap ring using snap ring plier set J 34629 or suitable, internal-toothed thrust washer and Lo-split gear from the mainshaft.

SERVICE HINT

To help in removing the compound Lo-split gear snap ring, use a pry bar to lift the front mainshaft slightly during removal. This allows more clearance and frees the snap ring from the snap ring groove.

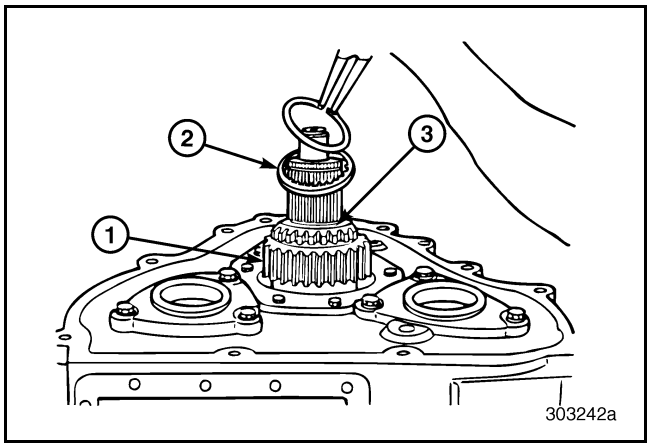


Figure 99 — Removing Snap Ring, Thrust Washer and Lo-Split Gear (T313L/T318L Shown)

1. Lo-Split Gear 2. Internal-Toothed Thrust Washer	3. Snap Ring Groove

NOTE

If not already done, mark the front countershaft rear bearing covers so they can be installed in the same position during reassembly.

47. Remove the No. 2 (upper right) front countershaft rear bearing cover capscrews.

48. Using jackscrews, remove the No. 2 (upper right) front countershaft rear bearing cover.

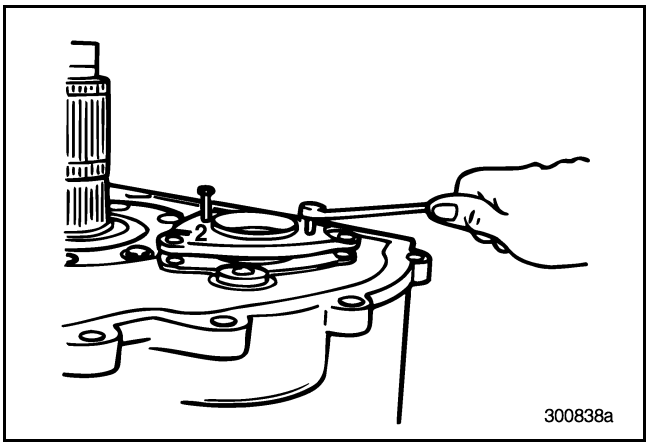


Figure 100 — Removing No. 2 Front Countershaft Rear Bearing Cover (T313L/T318L Shown)

49. Remove the capscrews from the front of the mainshaft rear bearing cover. Then remove the cover.

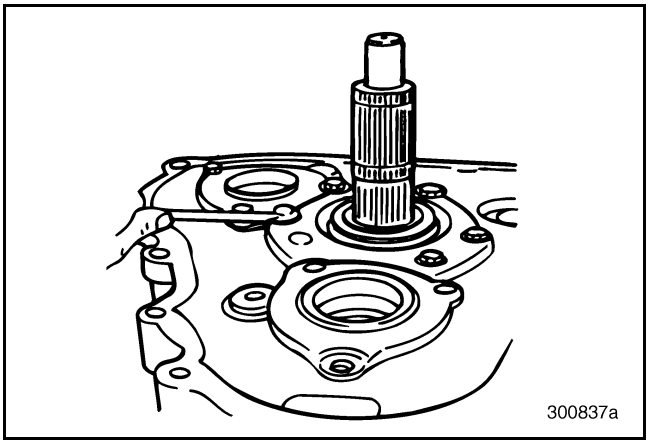


Figure 101 — Removing Mainshaft Rear Bearing Cover Capscrews (T313L/T318L Shown)

50. Remove the front mainshaft snap ring next to the rear bearing.

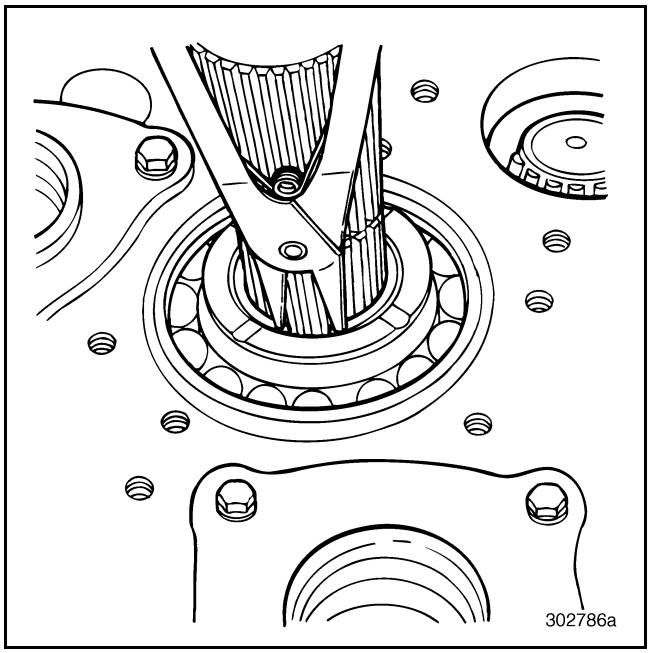


Figure 102 — Removing Rear Bearing Snap Ring

51. Remove the front mainshaft rear bearing from the case.

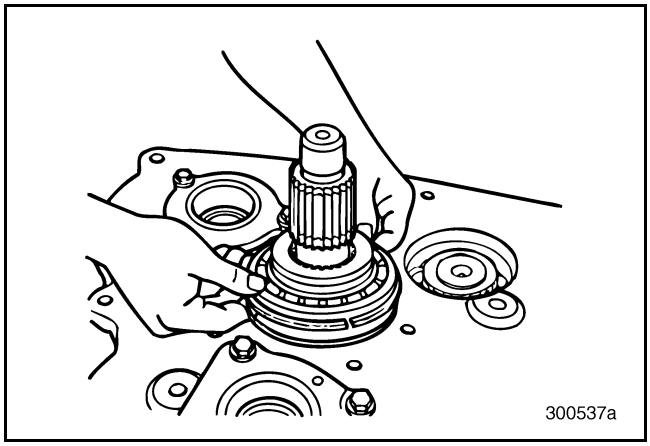


Figure 103 — Removing Front Mainshaft Rear Bearing (T313L/T318L Shown)

52. Press the sleeve out of the mainshaft rear bearing.

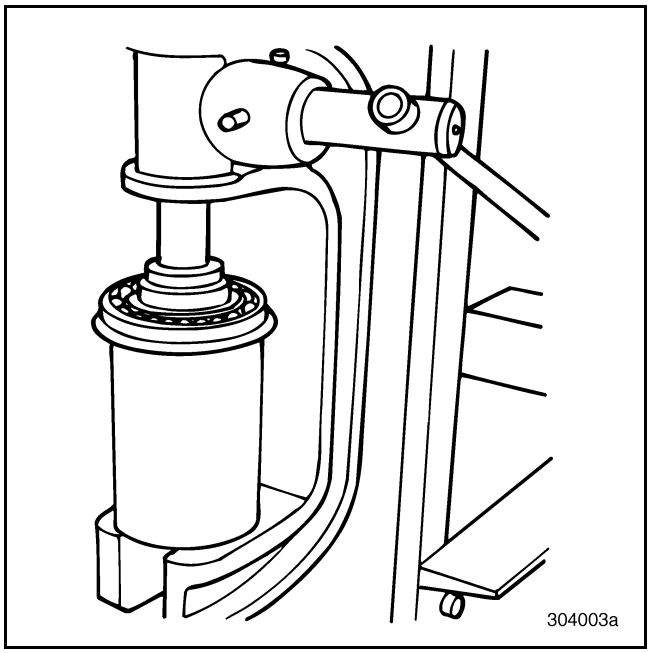


Figure 104 — Pressing Sleeve Out of Bearing

53. Remove the front mainshaft rear bearing spacer and spacer snap ring from the mainshaft.

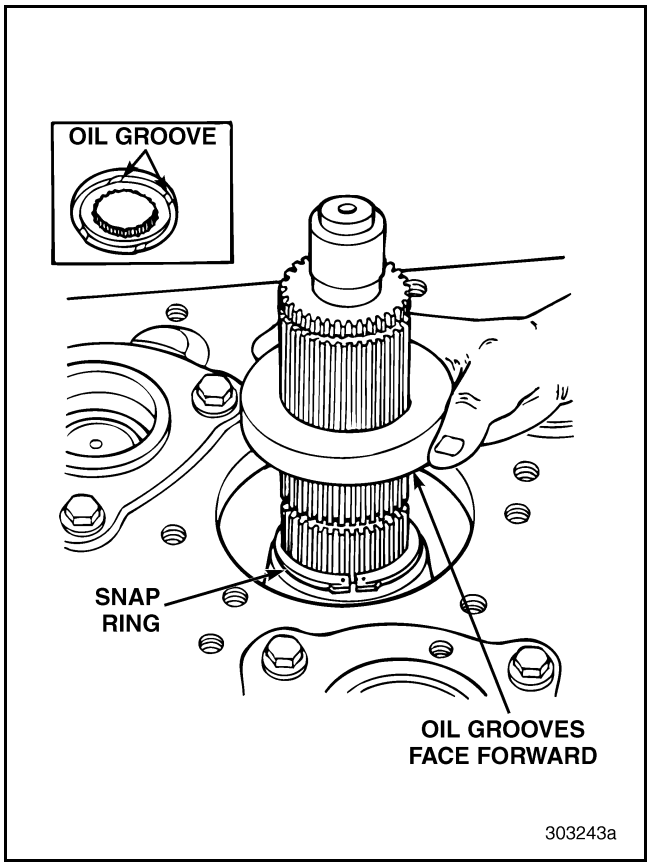


Figure 105 — Removing Front Mainshaft Spacer and Snap Ring (T313L/T318L Shown)

54. Remove the snap ring from inside the reverse speed gear, using suitable snap ring pliers.

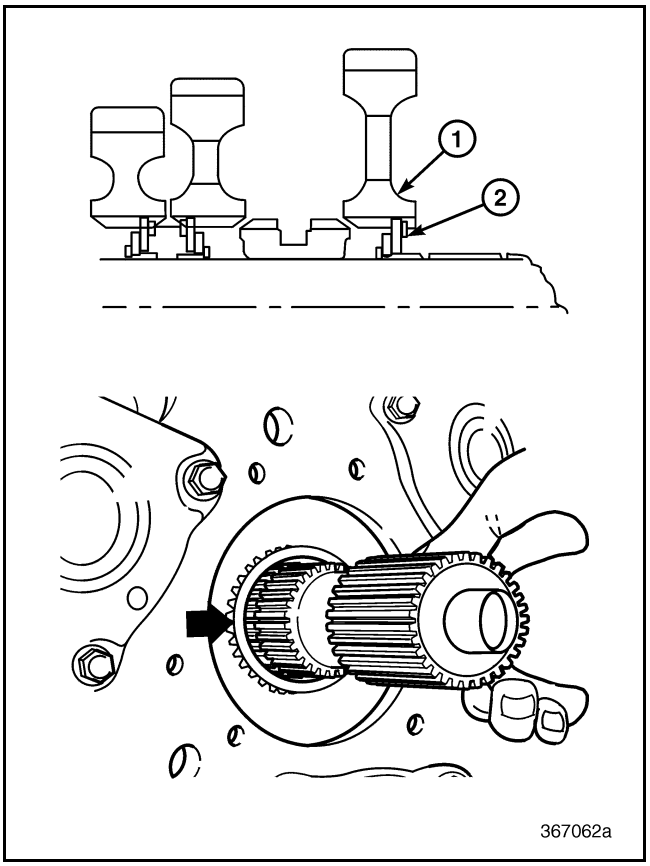


Figure 106 — Removing Snap Ring from Inside Reverse Speed Gear (T313L/T318L Shown)

1. Reverse Gear	2. Reverse Gear Snap Ring

55. Remove the external-toothed and internal-toothed thrust washers from inside the reverse speed gear. Then remove the reverse gear mainshaft snap ring, using suitable snap ring pliers.

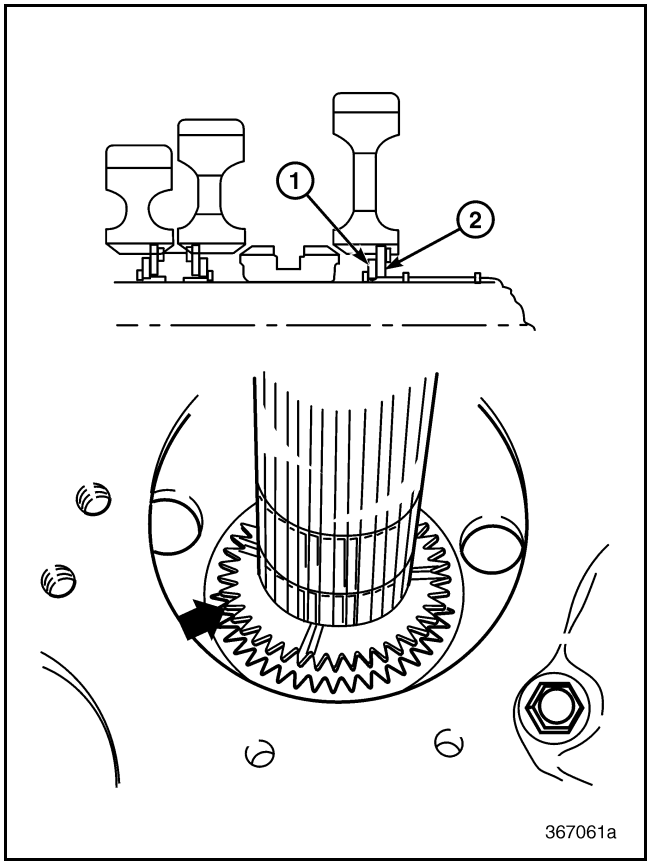


Figure 107 — Removing External- and Internal-Toothed Thrust Washers

1. Internal-Toothed Thrust Washer	2. External-Toothed Thrust Washer

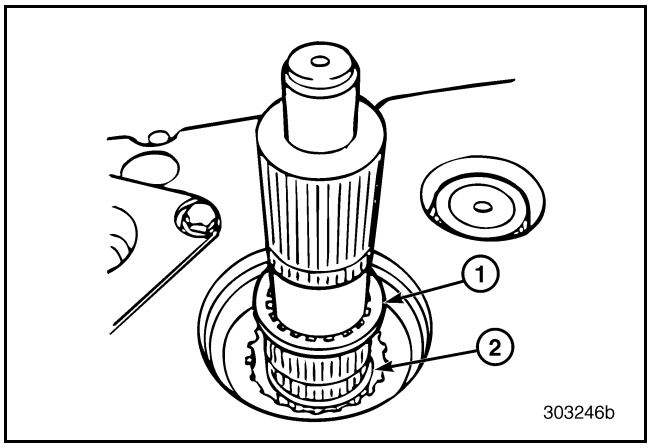


Figure 108 — Removing Internal-Toothed Thrust Washer and Snap Ring (T313L/T318L Shown)

1. Internal-Toothed Thrust Washer	2. Reverse Gear Snap Ring

56. Position the transmission case horizontally. Remove the main drive pinion bearing cover capscrews.

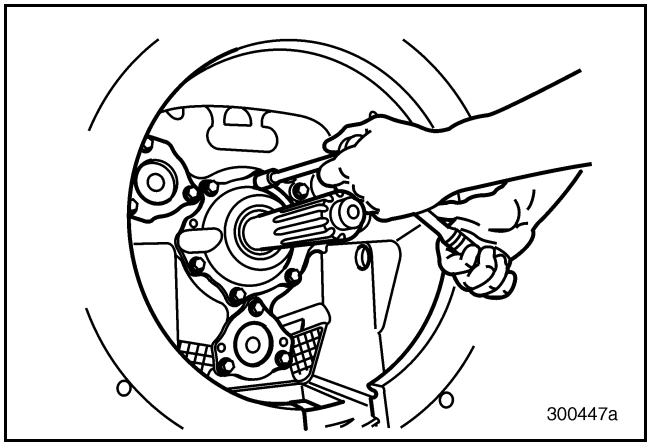


Figure 109 — Removing Pinion Bearing Cover Capscrews

57. Remove the main drive pinion assembly. Jackscrew holes are provided to assist in removal.
58. Remove main drive pinion assembly from the case.

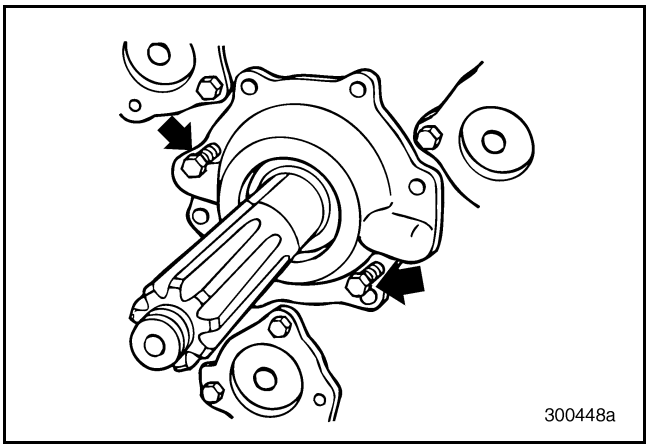


Figure 110 — Use Jackscrews to Remove Main Drive Pinion Assembly

NOTE

On transmissions built with oil cooler circulation pumps, the oil pump discharge line must be removed before the main drive pinion assembly can be removed.

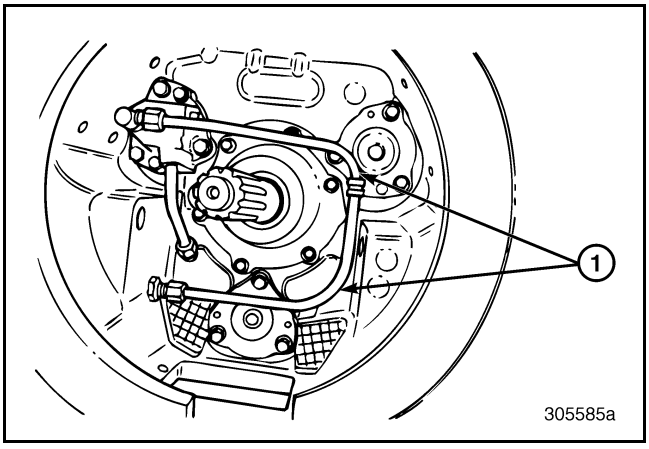


Figure 111 — Oil Pump Discharge Line (if Equipped)

1. Oil Pump Discharge Line

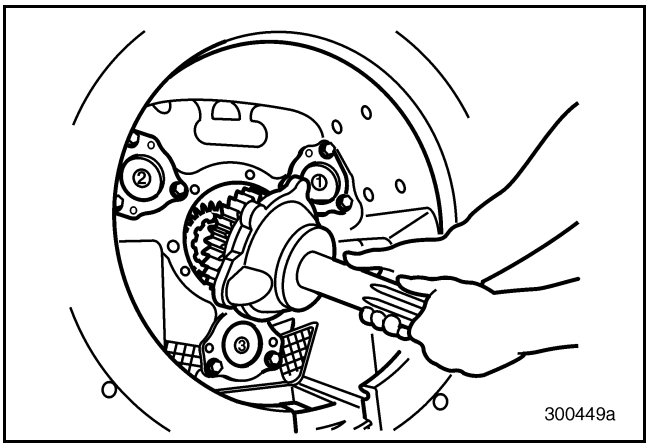


Figure 112 — Removing Main Drive Pinion Assembly

59. Remove the third/fourth (7th/8th) sliding clutch.

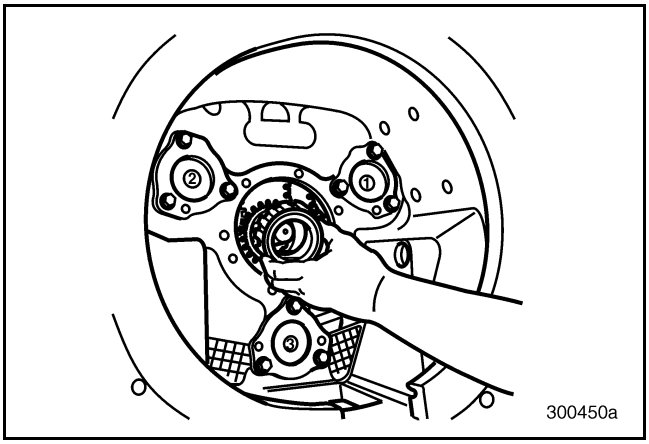


Figure 113 — Removing Sliding Clutch

60. Using a soft mallet, drive the mainshaft forward in the case to free the mainshaft gears from the countershafts.
61. Remove the No. 2 (upper right) countershaft from the case by lifting the front end off the front bearing cone and then sliding the countershaft through the opening.

SERVICE HINT

Removal is easier if the transmission is in the vertical position.

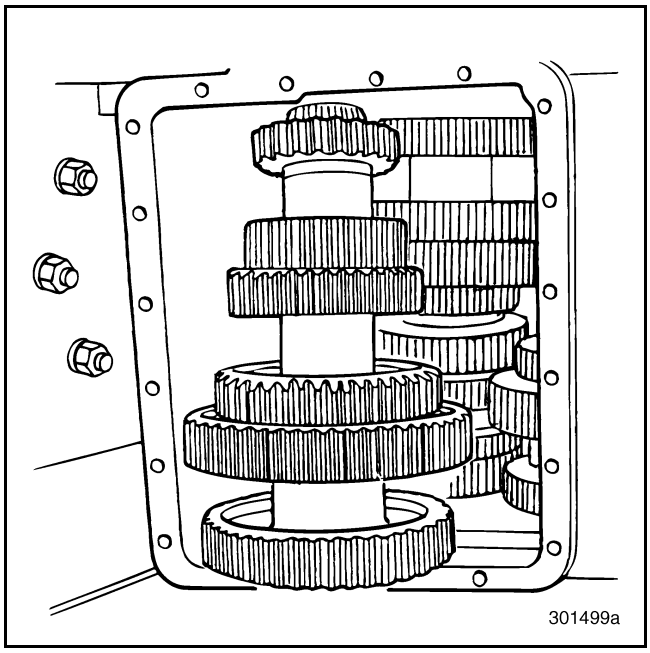


Figure 114 — Removing No. 2 Countershaft from Transmission Case

62. Remove the No. 2 (upper left) front countershaft front bearing cover capscrews.

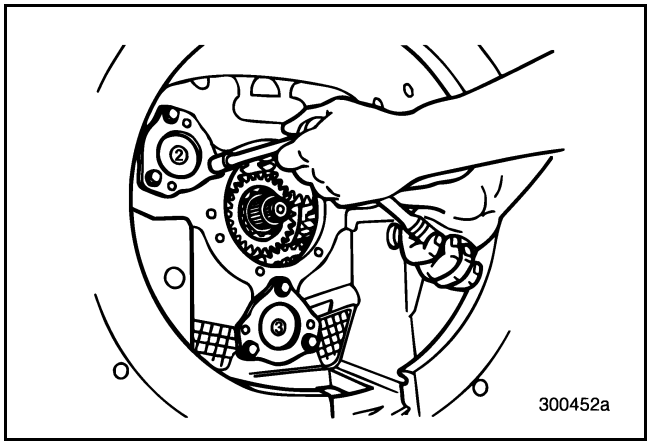


Figure 115 — Removing No. 2 Front Countershaft Front Bearing Cover Capscrews

63. Using jackscrews, remove the No. 2 (upper left) front countershaft front bearing cover.

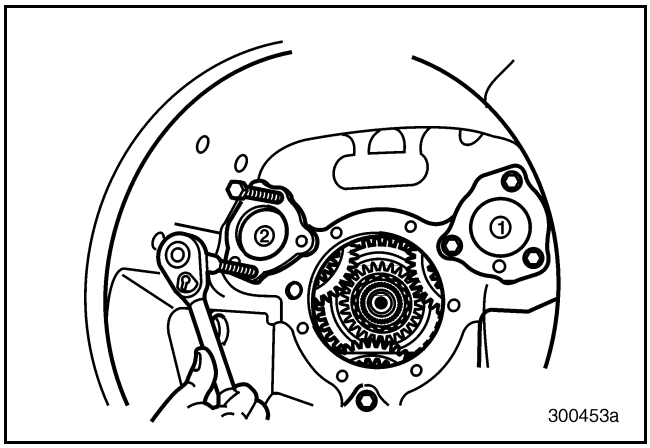


Figure 116 — Removing No. 2 Front Countershaft Front Bearing Cover

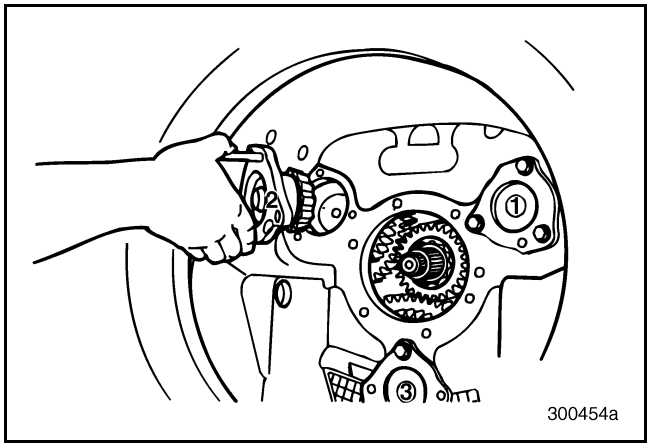


Figure 117 — No. 2 Front Countershaft Front Bearing Cover Removed

64. Using tool J 34630 or a slide hammer, remove the upper right reverse idler shaft (next to No. 2 countershaft location). To prevent damage to the reverse idler gear, catch the gear as it separates from the shaft.

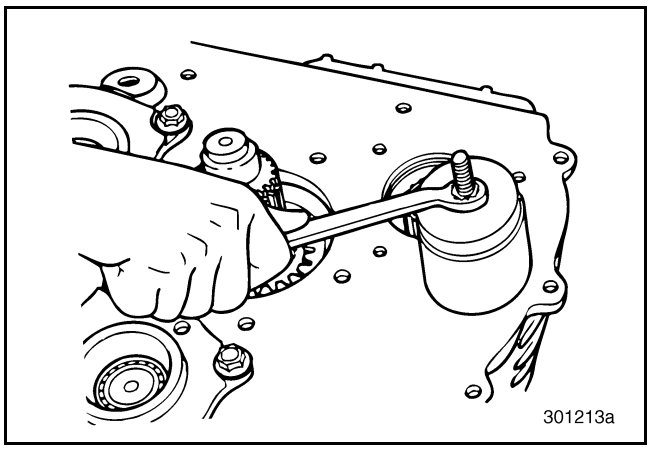


Figure 118 — Using Tool J 34630 to Remove Reverse Idler Shaft

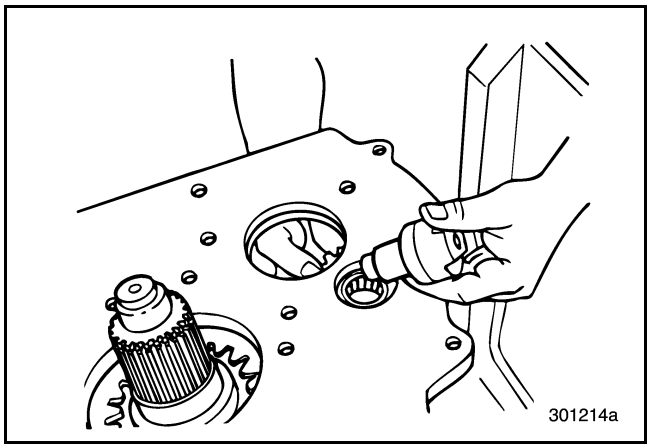


Figure 119 — Removing Reverse Idler Gear and Shaft

65. Remove the No. 1 (upper left) front countershaft rear bearing cover capscrews.

66. Remove the No. 1 (upper left) front countershaft rear bearing cover, using jackscrews. Remove shims with cover.

67. Using tool J 34630 or slide hammer, remove the upper left reverse idler shaft (next to No. 1 countershaft). To prevent damage to the reverse idler gear, catch the gear as it separates from the shaft.

68. From the top of the case, slide the mainshaft reverse gear and Lo/reverse sliding clutch forward toward the front of the transmission.

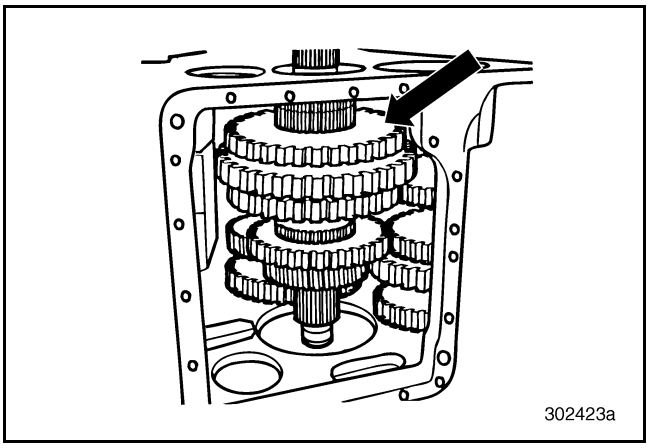


Figure 120 — Sliding Reverse Gear and Lo/Reverse Clutch Forward

69. Using a pry bar, move the rear end of the No. 1 (upper left) countershaft away from the mainshaft as far as possible without damaging the bearing. Block the countershaft in this position, using wadding made from rags.

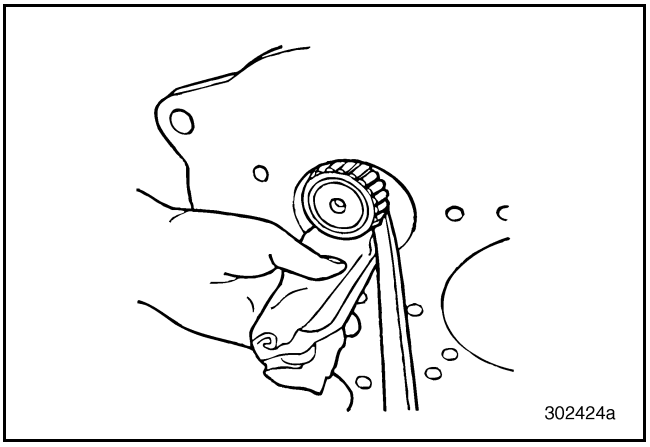


Figure 121 — Moving and Blocking No. 1 (Upper Left) Countershaft Away from Mainshaft

70. Tip the front end of the mainshaft outward and remove it from the case.

⚠ CAUTION

Be careful when handling the mainshaft assembly, the reverse gear is free on the shaft and can fall off during handling.

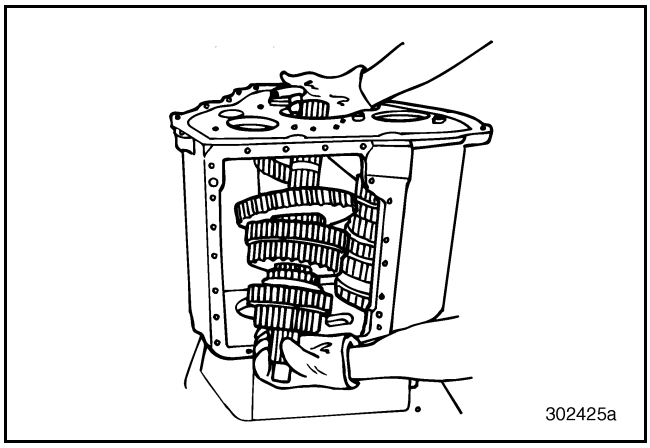


Figure 122 — Removing the Mainshaft

71. Remove the No. 3 (lower) front countershaft rear bearing cover capscrews.
72. Remove the No. 3 (lower) front countershaft rear bearing cover, using jackscrews. Remove shims with cover.
73. Using tool J 34630 or a slide hammer, remove the lower reverse idler shaft (next to No. 3 countershaft). To prevent damage to the reverse idler gear, catch the gear as it separates from the shaft.
74. Remove the No. 1 (upper left) front countershaft by pulling and tilting the front end of the shaft upward.

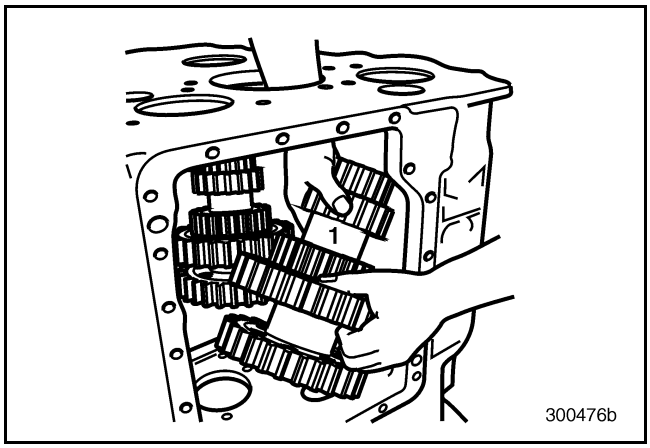


Figure 123 — Removing No. 1 Upper Left Countershaft

75. Remove the No. 3 (lower) countershaft by pulling and tilting the front end of the shaft upward.

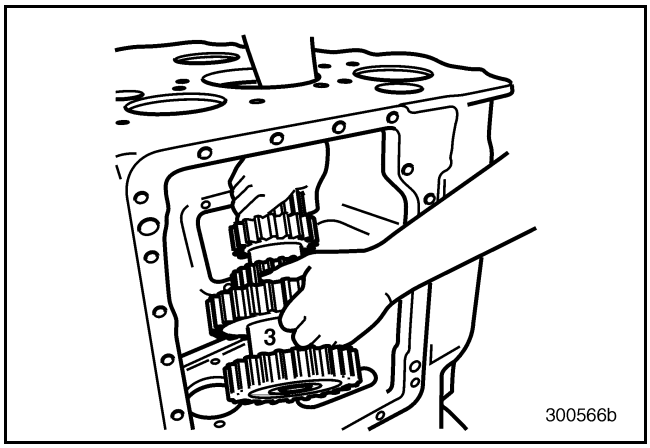


Figure 124 — Removing No. 3 Lower Countershaft

76. Remove the remaining No. 1 (upper right, viewed from front) and No. 3 (lower) front countershaft front bearing cover capscrews and bearing covers. Use jackscrews to remove the covers.

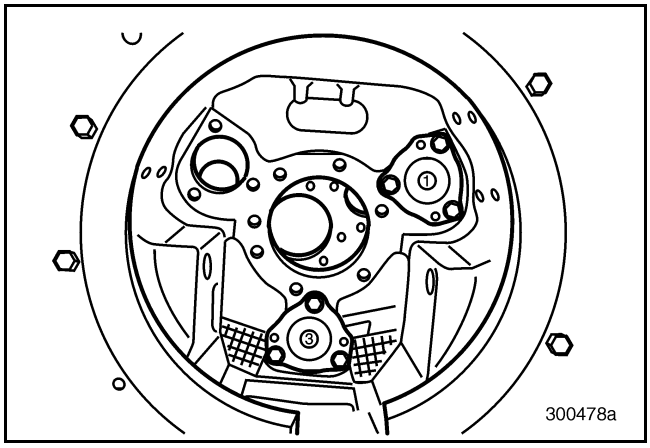


Figure 125 — Remaining No. 1 and No. 3 Front Countershaft Bearing Covers

TRANSMISSION COMPONENT DISASSEMBLY
[320]

NOTE

Unless a complete overhaul is necessary, remove only the parts that are required to repair the assembly. Do not disturb parts that have a heavy press fit (interference fit) unless replacement of the part is necessary. When replacement is necessary, use proper pullers and press setups to prevent damage to usable parts.

Main Case Shift Cover Disassembly

[323]

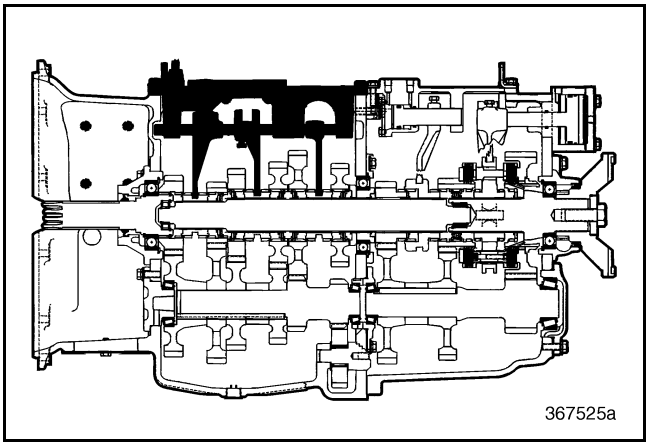


Figure 126 — Main Case Shift Cover Component Locator (T313L/T318L Shown)

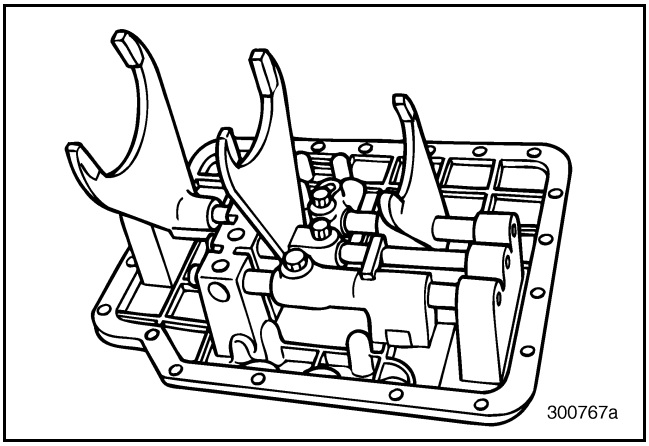


Figure 127 — Shift Cover Assembly

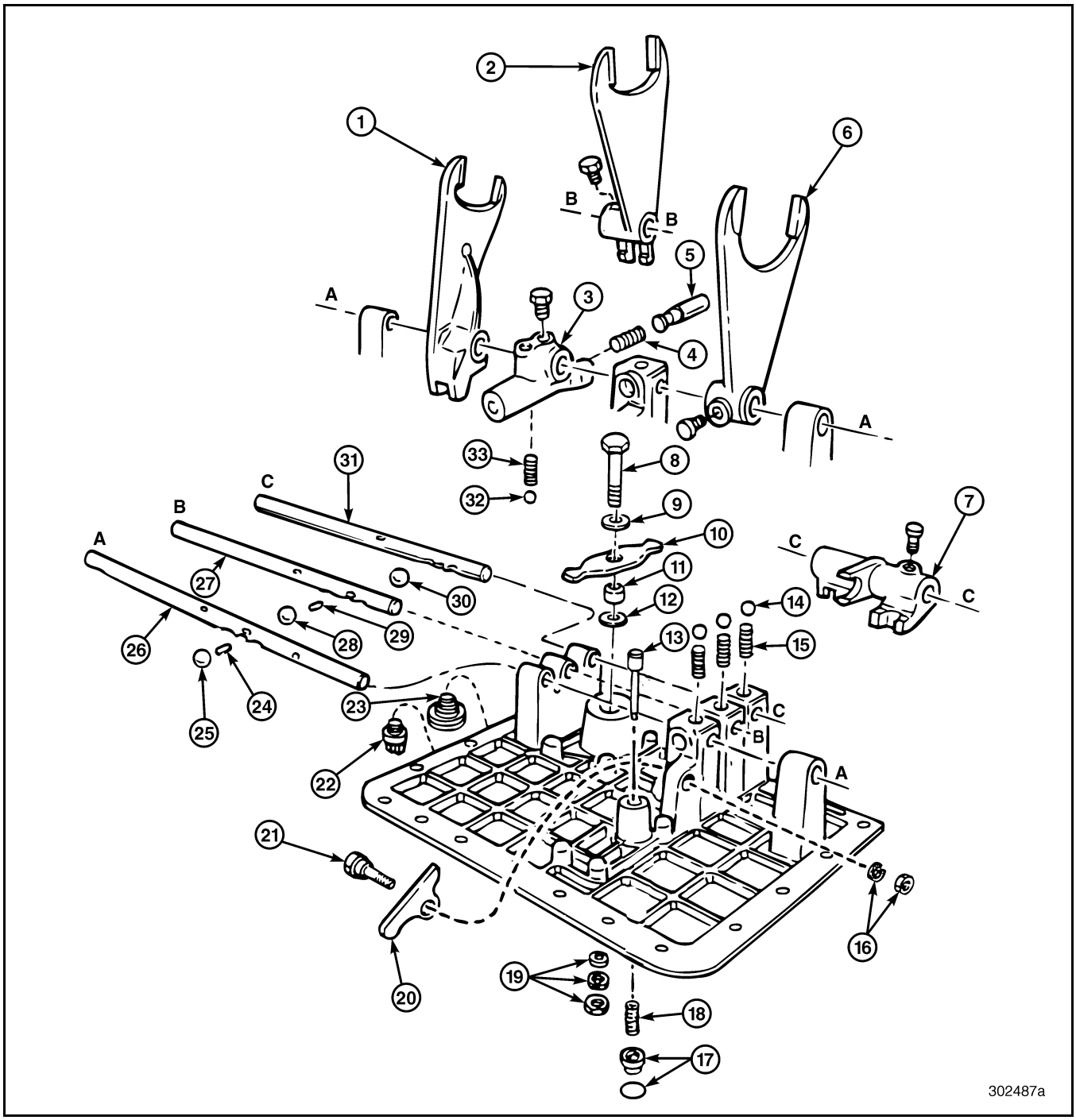


Figure 128 — Exploded View of Main Case Shift Cover

1. Third/Fourth Shift Fork	12. Washer	23. Breather
2. First/Second Shift Fork	13. Interlock Pin	24. Interlock Pin
3. Lo/Reverse Shifter	14. Poppet Ball	25. Interlock Ball
4. Shifter Body Spring (Interlock)	15. Poppet Ball Spring	26. Lo/Reverse Shift Rail
5. Shifter Body Plunger (Interlock)	16. Interlock Rocker Hardware	27. First/Second Shift Rail
6. Lo/Reverse Shift Fork	17. Interlock Sleeve and O-Ring	28. Interlock Ball
7. Third/Fourth Shifter	18. Interlock Spring	29. Interlock Pin
8. Third/Fourth Rocker Pin	19. Third/Fourth Rocker Pin Hardware	30. Interlock Ball
9. Washer	20. Interlock Rocker	31. Third/Fourth Shift Rail
10. Third/Fourth Rocker Arm	21. Interlock Rocker Bolt	32. Lo/Reverse Shifter Ball
11. Bushing	22. Pipe Plug	33. Lo/Reverse Shifter Spring

1. Remove the nut and washers from the interlock rocker bolt.

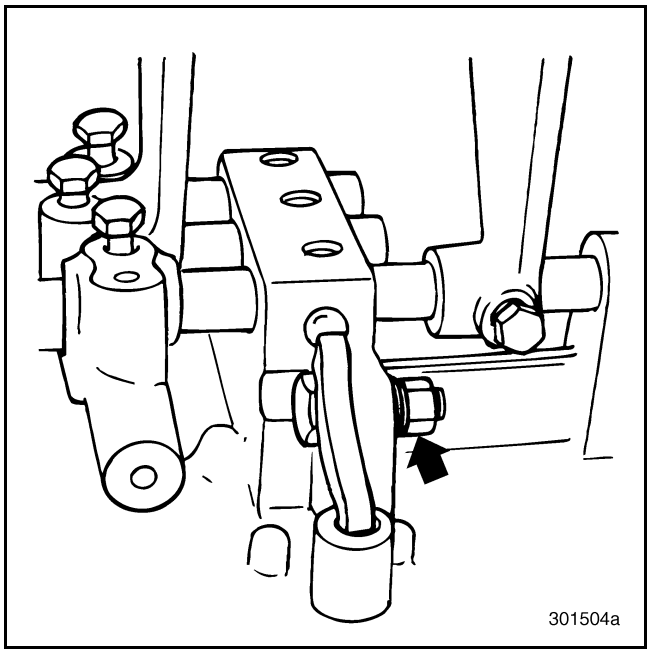


Figure 129 — Remove Nut and Washers

2. Remove the interlock rocker and bolt from the cover.

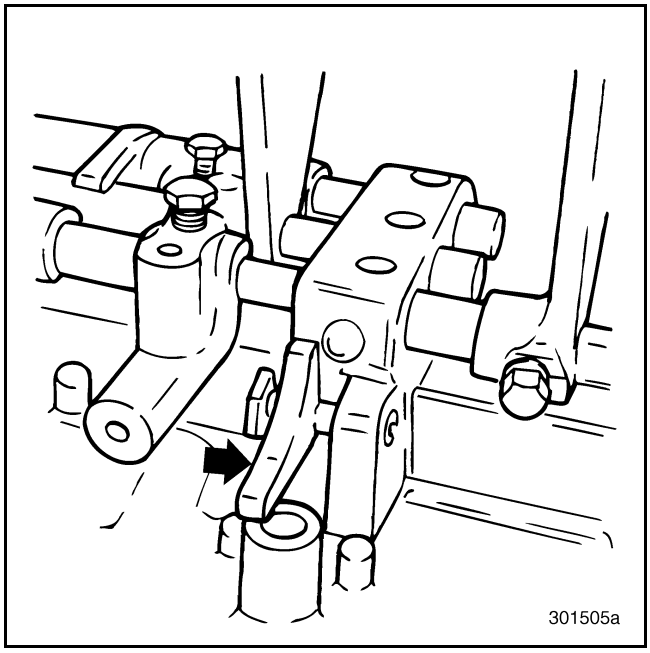


Figure 130 — Remove Interlock Rocker and Bolt

3. Remove the interlock ball from the cover.

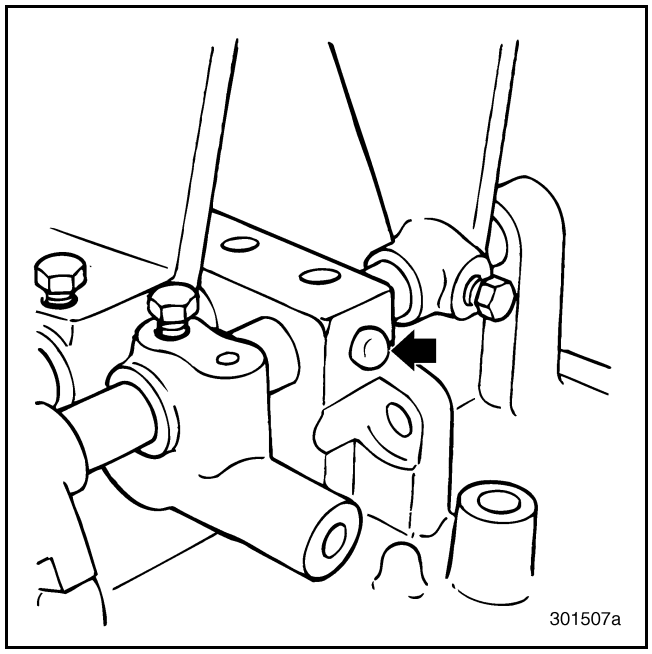


Figure 131 — Remove Interlock Ball from Cover

4. Remove the setscrew from the Lo/reverse shift fork.

NOTE

Effective June 2007, shift fork setscrews were changed to a Scotch-Grip™ torque retention method. DO NOT reuse these fasteners, as they are one-time use only.

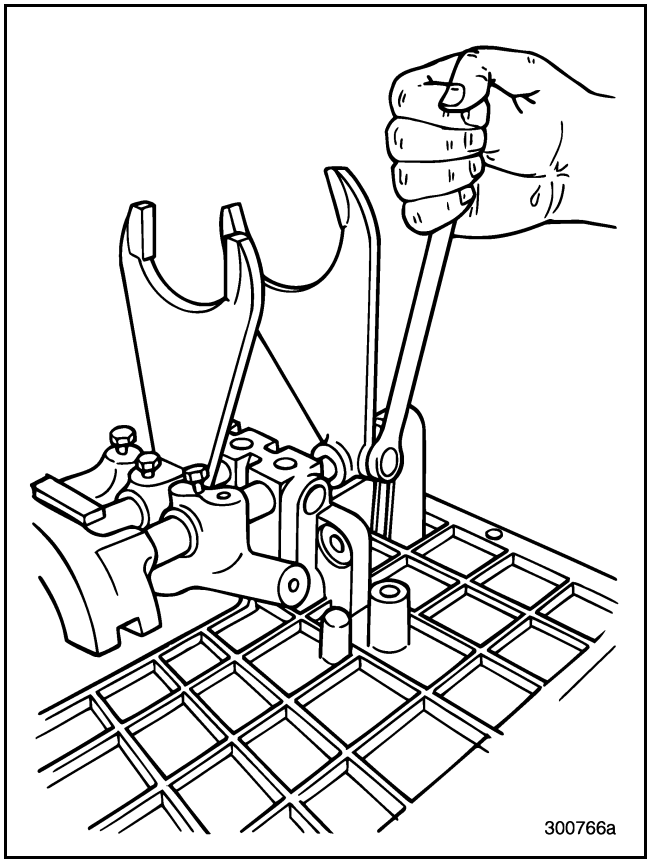


Figure 132 — Removing Setscrew from Lo/Reverse Shift Fork

5. Remove the setscrew from the Lo/reverse shifter.

NOTE

Effective June 2007, shift fork setscrews were changed to a Scotch-Grip™ torque retention method. DO NOT reuse these fasteners, as they are one-time use only.

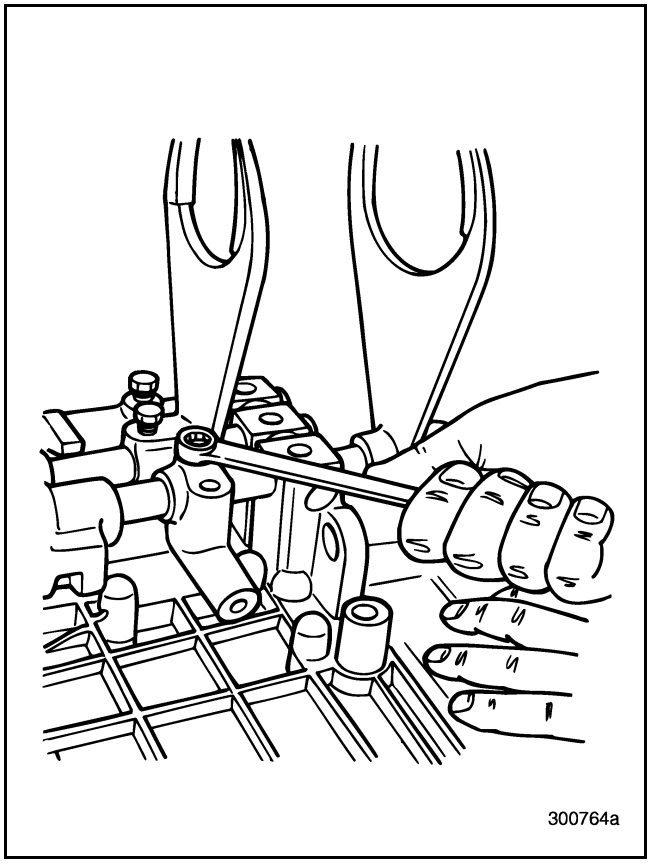


Figure 133 — Removing Setscrew from Lo/Reverse Shifter

6. Slide the Lo/reverse shift rail to the left and remove the interlock pin.

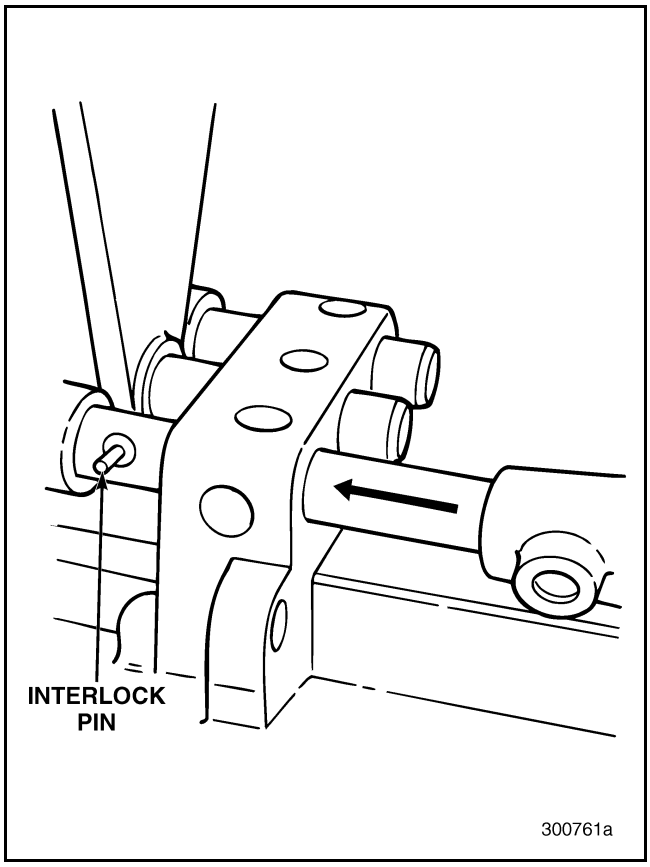


Figure 134 — Sliding Lo/Reverse Shift Rail

7. Remove the Lo/reverse shift fork from the cover.

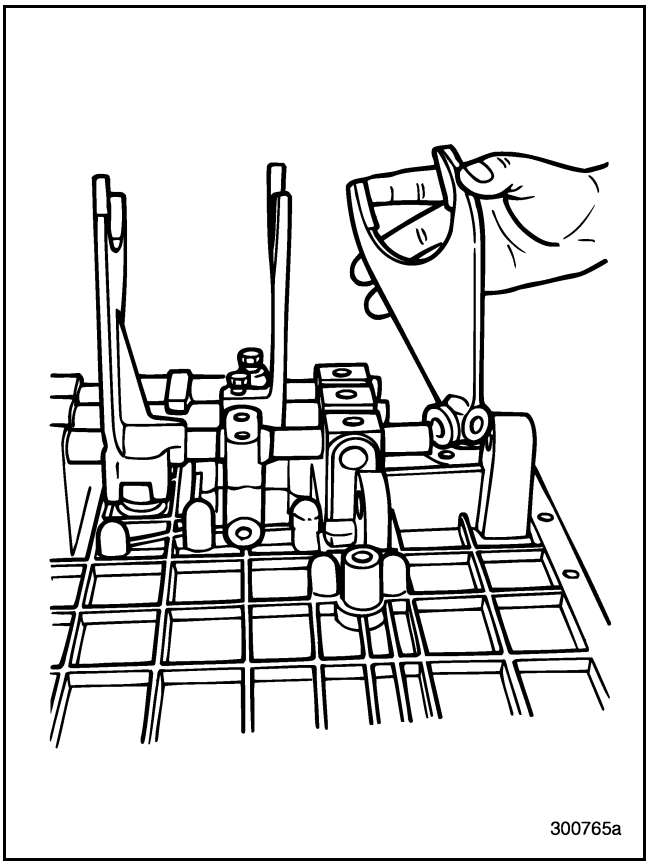


Figure 135 — Removing Lo/Reverse Shift Fork

8. Push the Lo/reverse shift rail forward, using a metal bar or large screwdriver. Hold a shop towel over the top opening. The shop towel prevents the spring and ball under the rail from popping out and becoming lost.

⚠ WARNING

Poppet balls are spring loaded and may cause injury when released.

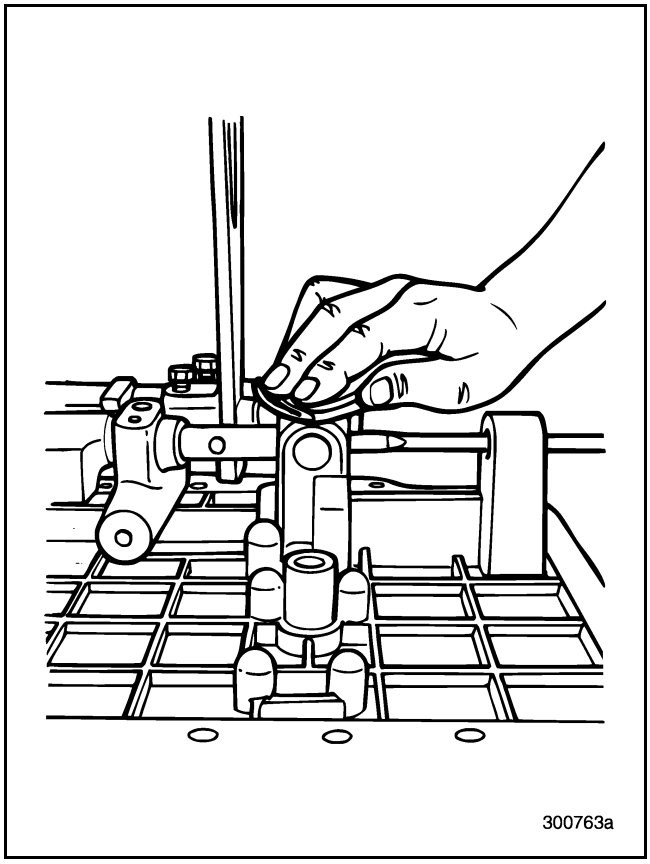


Figure 136 — Pushing Lo/Reverse Shift Rail Forward

9. Remove the poppet ball and spring from the Lo/reverse shift rail vertical pocket in line with the rail.

SERVICE HINT

A magnet is helpful in removing the poppet ball and spring.

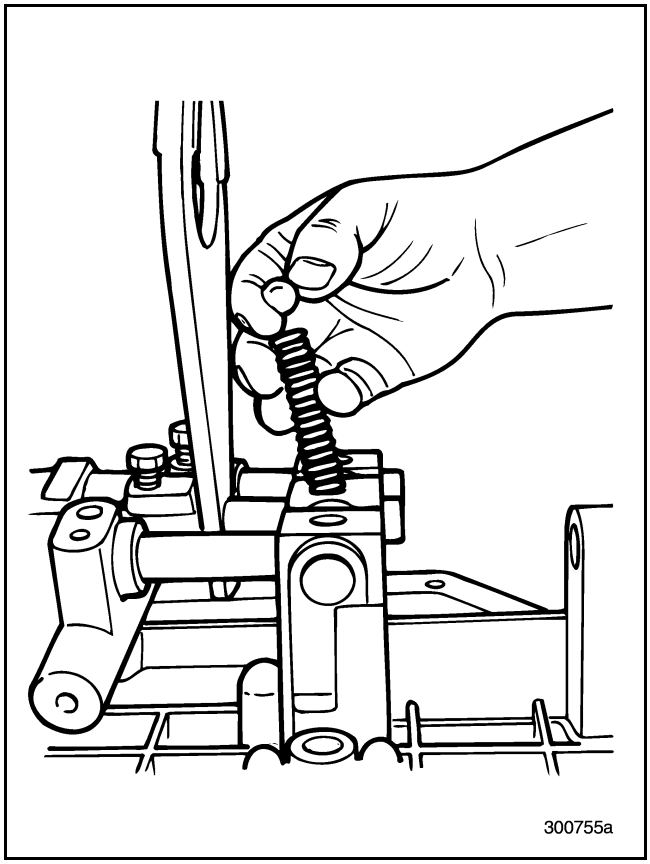


Figure 137 — Removing Poppet Ball and Spring

10. Remove the interlock ball from the horizontal pocket between the Lo/reverse shift rail and the first/second shift rail.

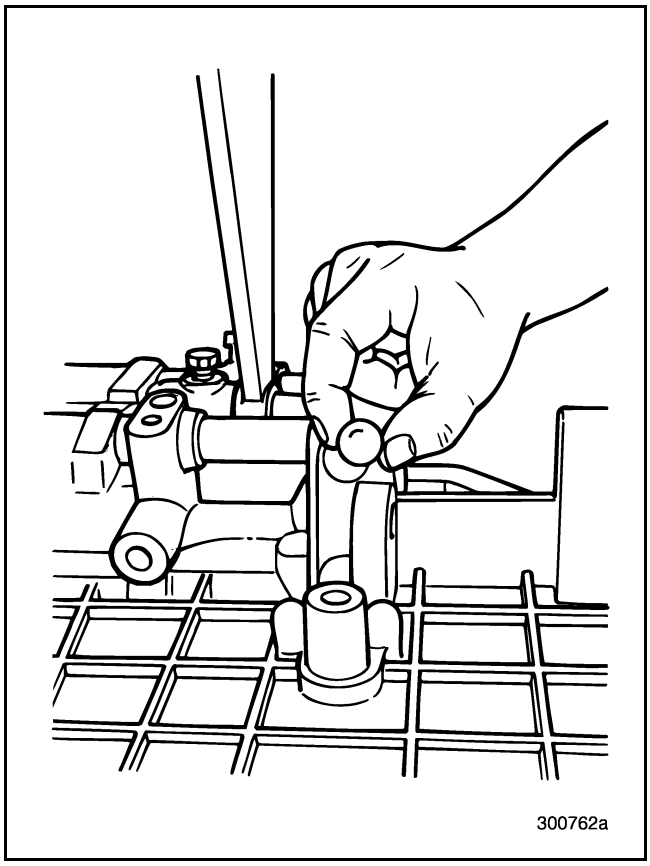


Figure 138 — Removing Interlock Ball

11. Continue sliding the Lo/reverse shift rail forward to remove the Lo/reverse shifter.

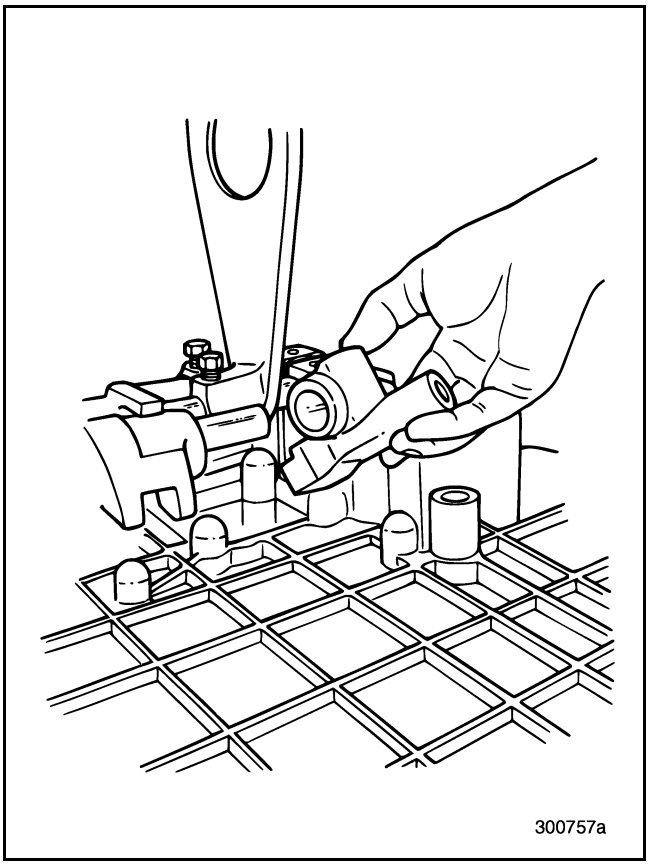


Figure 139 — Removing Lo/Reverse Shifter

12. Slide the Lo/reverse shift rail from the shift cover and at the same time, remove the third/fourth shift fork.

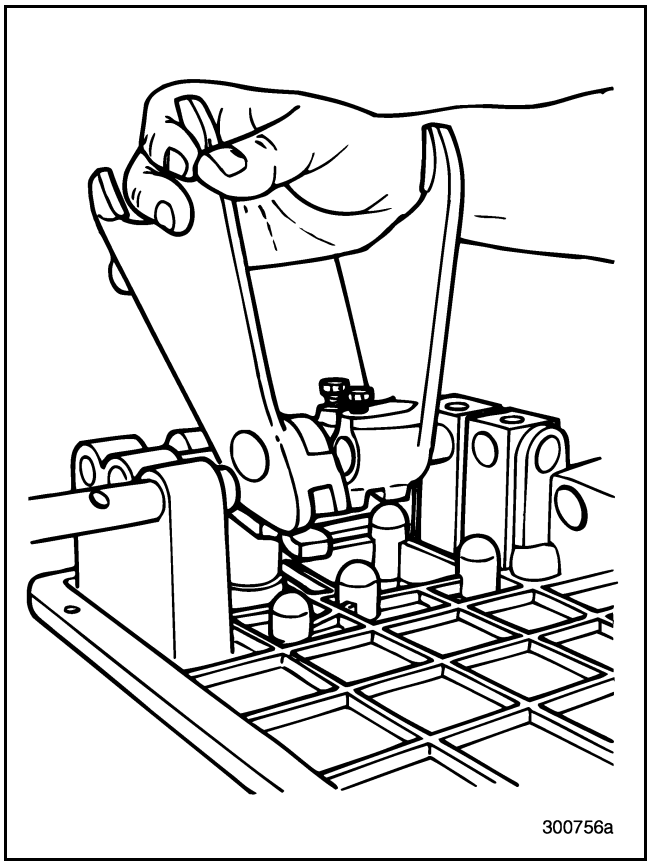


Figure 140 — Removing Third/Fourth Shift Fork

13. Remove the setscrew from the first/second shift fork.

NOTE

Effective June 2007, shift fork setscrews were changed to a Scotch-Grip™ torque retention method. DO NOT reuse these fasteners, as they are one-time use only.

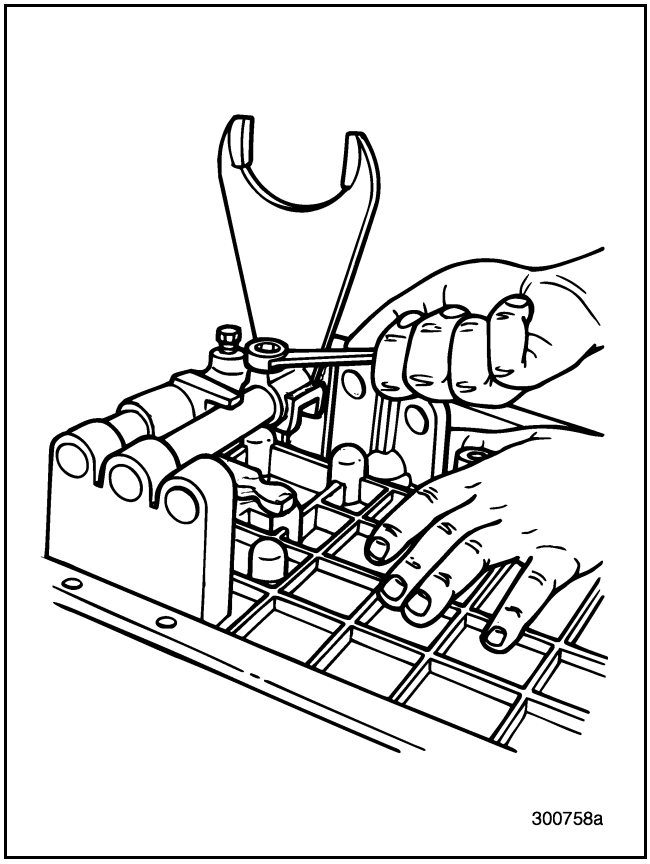


Figure 141 — Removing Setscrew from First/Second Shift Fork

14. Push the first/second shift rail forward using a metal bar or large screwdriver. Hold a shop towel over the top opening. The shop towel prevents the spring and ball under the rail from popping out and becoming lost.

⚠ WARNING

Poppet balls are spring loaded and can cause injury when they are released.

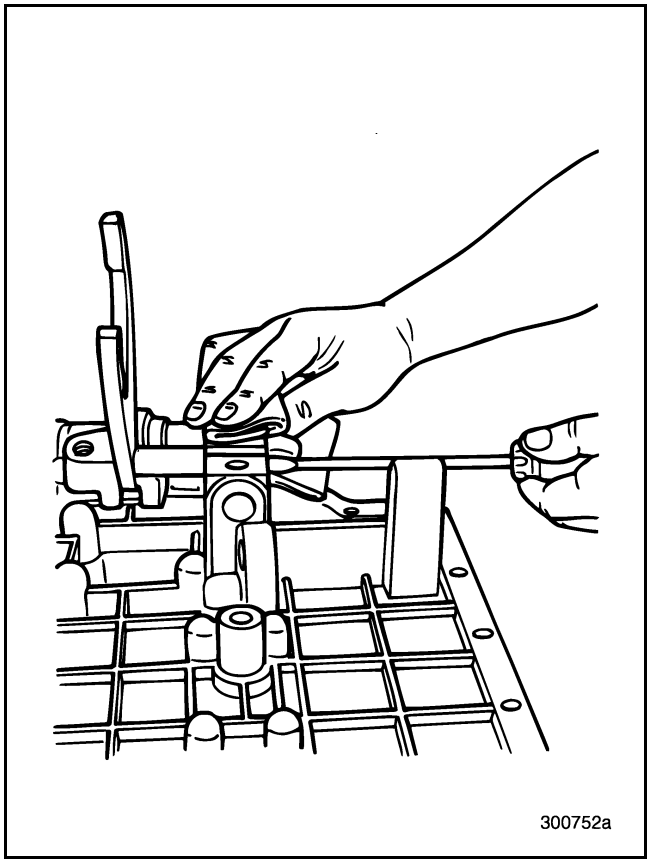


Figure 142 — Pushing First/Second Shift Rail Forward

15. Remove the poppet ball and spring from the first/second shift rail vertical pocket in line with the rail.

SERVICE HINT

A magnet is helpful in removing the poppet ball and spring.

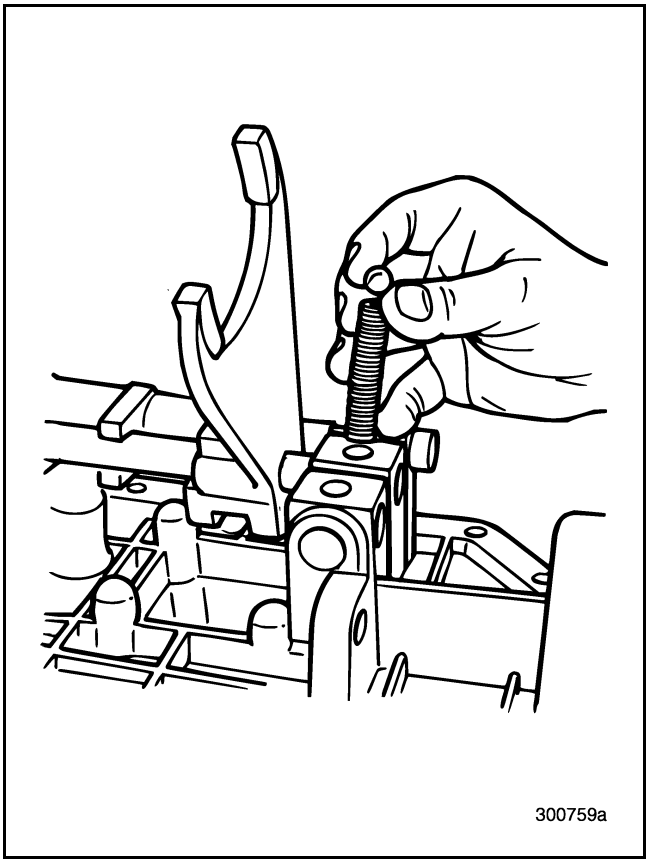


Figure 143 — Removing Poppet Ball and Spring

16. Remove the interlock ball from the horizontal pocket between the first/second shift rail and the third/fourth shift rail.

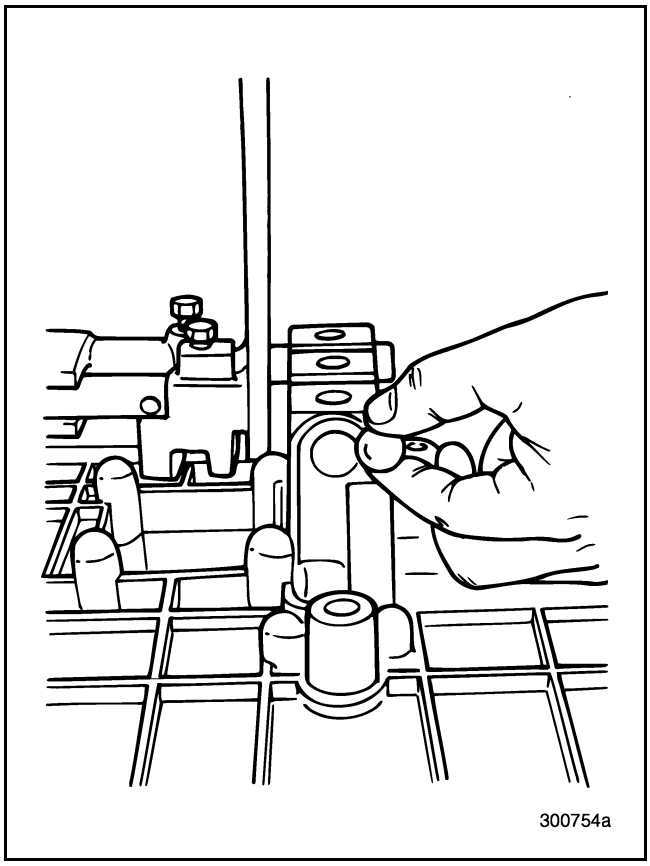


Figure 144 — Removing Interlock Ball

17. Remove the interlock pin from the first/second shift rail.

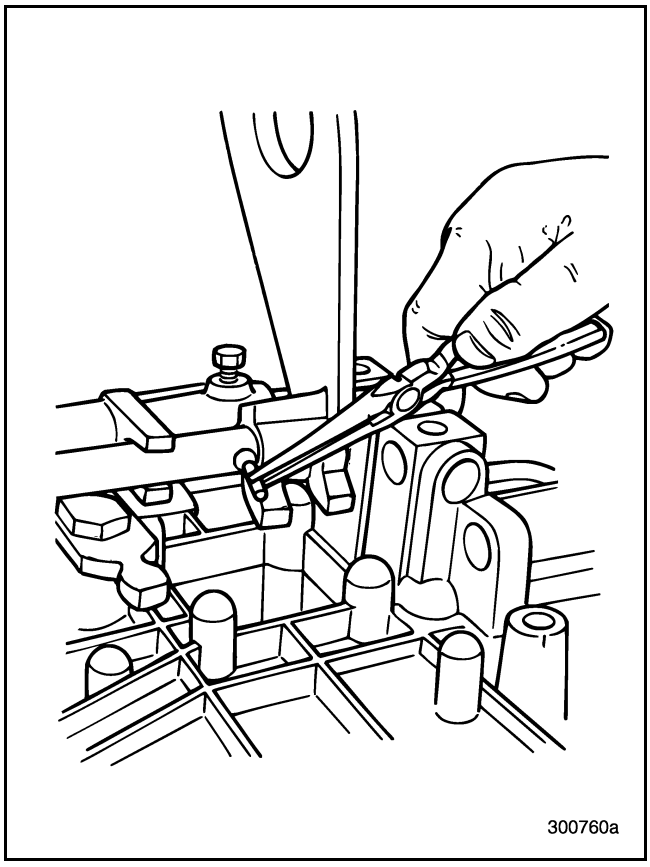


Figure 145 — Removing Interlock Pin

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18. Slide the first/second shift rail further forward and remove the first/second shift fork.

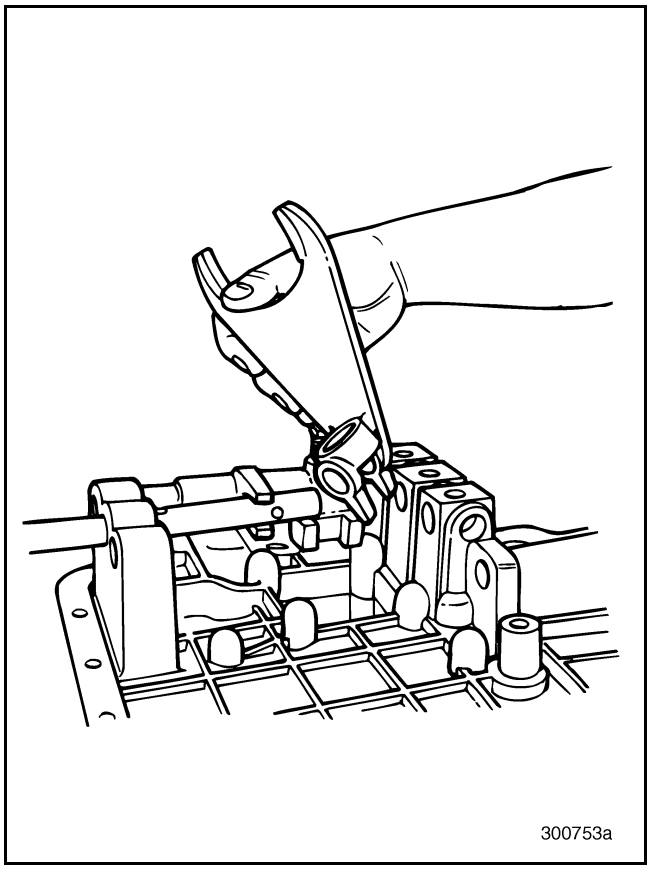


Figure 146 — Removing First/Second Shift Fork

19. Continue sliding the first/second shift rail until it clears the cover.

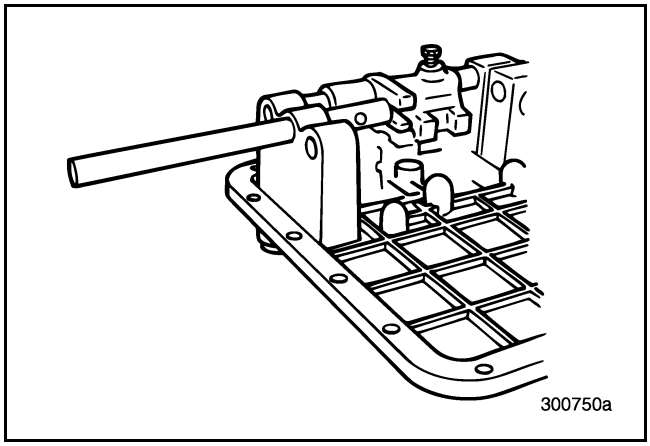


Figure 147 — Removing First/Second Shift Rail

20. Remove the setscrew from the third/fourth shifter.

NOTE

Effective June 2007, shift fork setscrews were changed to a Scotch-Grip™ torque retention method. DO NOT reuse these fasteners, as they are one-time use only.

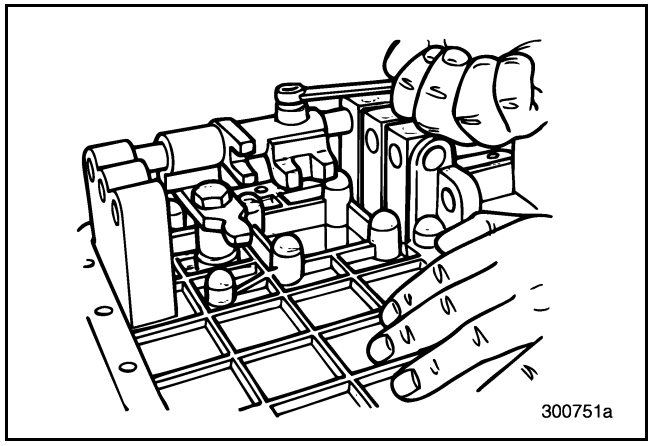


Figure 148 — Removing Setscrew from Third/Fourth Shifter

21. Push the third/fourth shift rail forward, using a metal bar or large screwdriver. Hold a shop towel over the top opening. The shop towel prevents the spring and ball under the rail from popping out and becoming lost.

⚠ WARNING

Poppet balls are spring loaded and can cause injury when they are released.

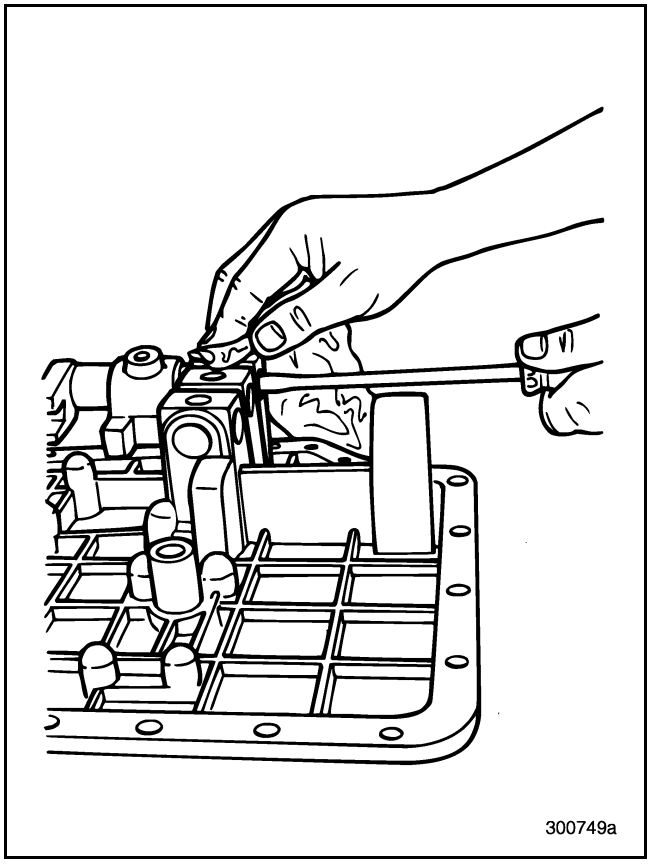


Figure 149 — Pushing Third/Fourth Shift Rail Forward

22. Continue sliding the third/fourth shift rail forward out of the shift cover. At the same time, remove the third/fourth shifter.

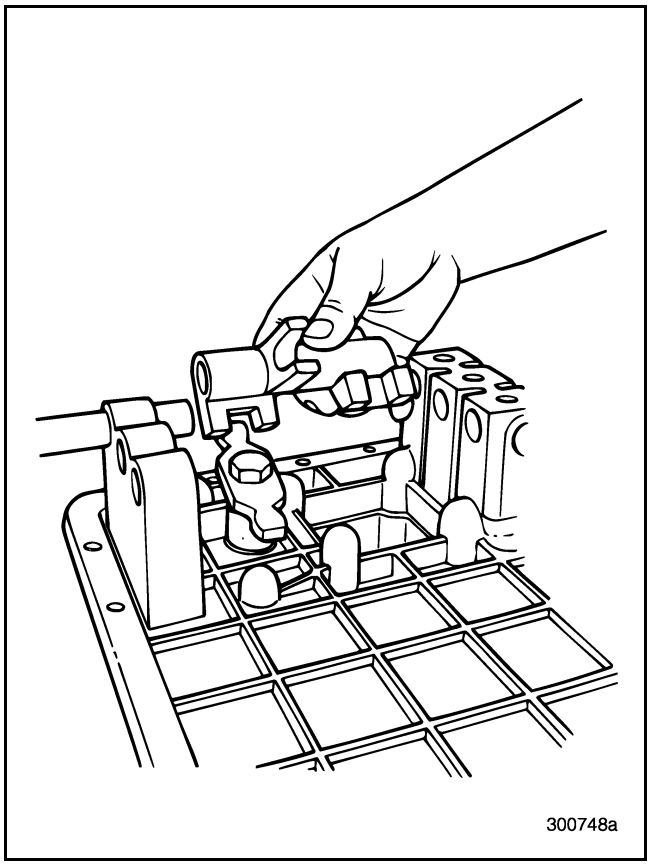


Figure 150 — Removing Third/Fourth Shifter

23. Remove the poppet ball and spring from under the third/fourth shift rail.

SERVICE HINT

A magnet is helpful in removing the poppet ball and spring.

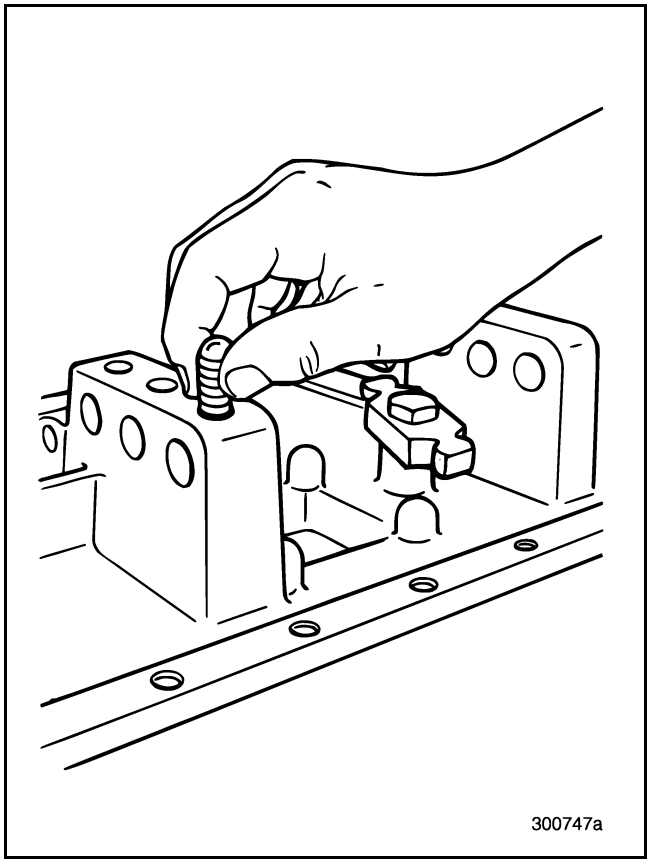


Figure 151 — Removing Poppet Ball and Spring

24. Remove the poppet ball and spring and interlock plunger and spring from the Lo/reverse shifter.

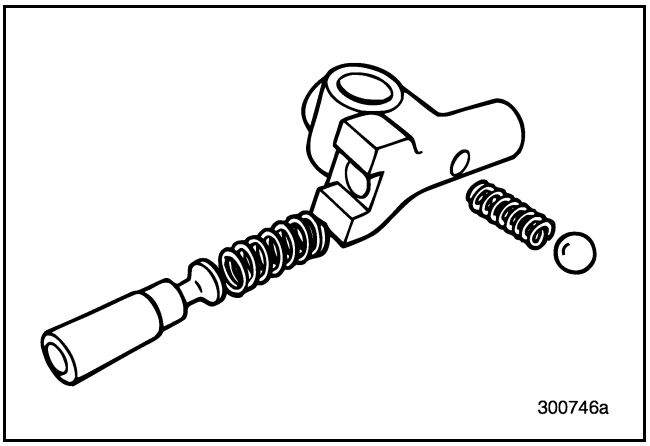


Figure 152 — Lo/Reverse Shifter Disassembled

25. Remove the reverse light switch from the shift cover.

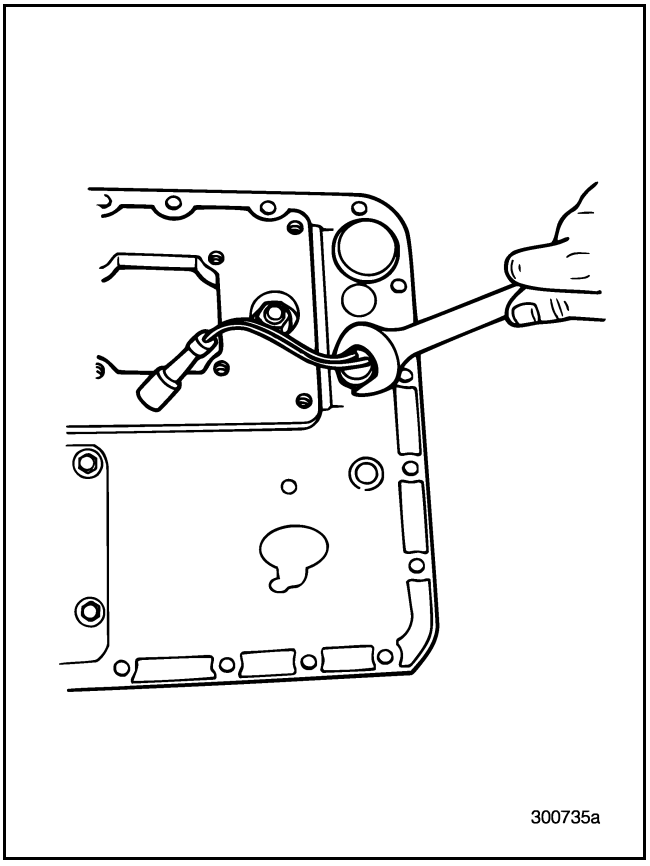


Figure 153 — Removing Reverse Light Switch

26. Remove the reverse light switch rod.

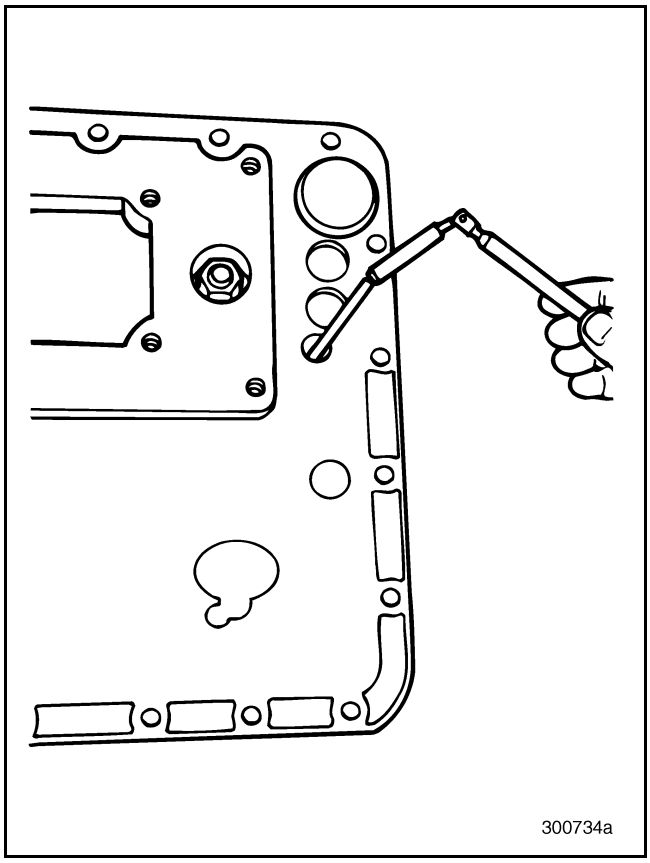


Figure 154 — Removing Reverse Light Switch Rod

27. Remove the nut and washers from the third/fourth rocker pin.

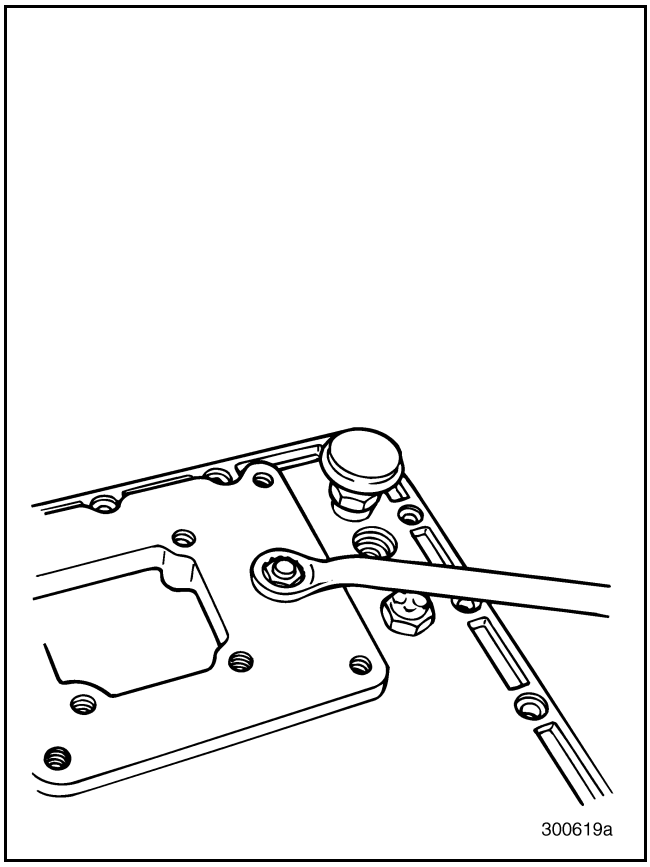


Figure 155 — Loosening Third/Fourth Rocker Pin Nut

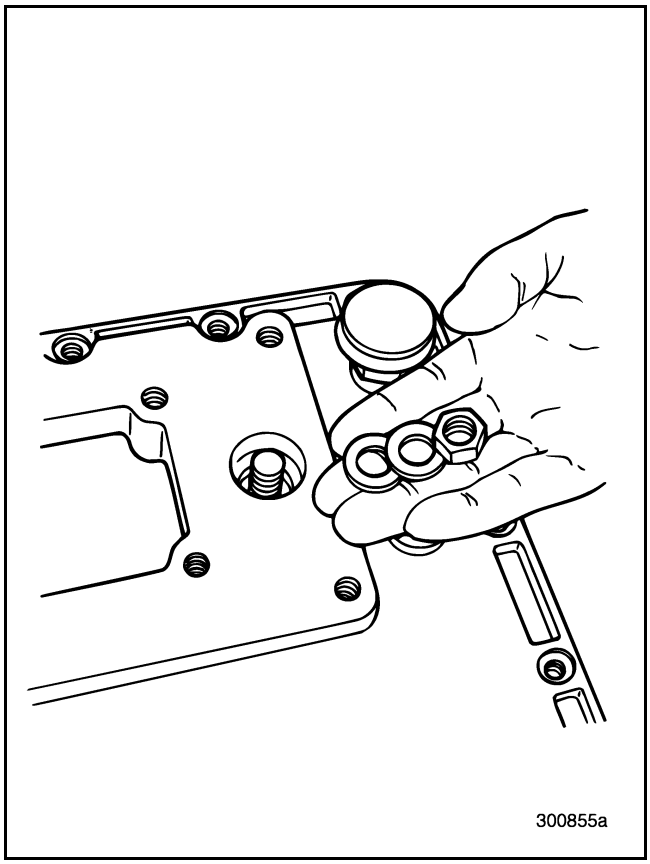


Figure 156 — Recovering the Lock Washer, Flat Washer and Nut

28. Remove the third/fourth rocker pin and rocker arm.

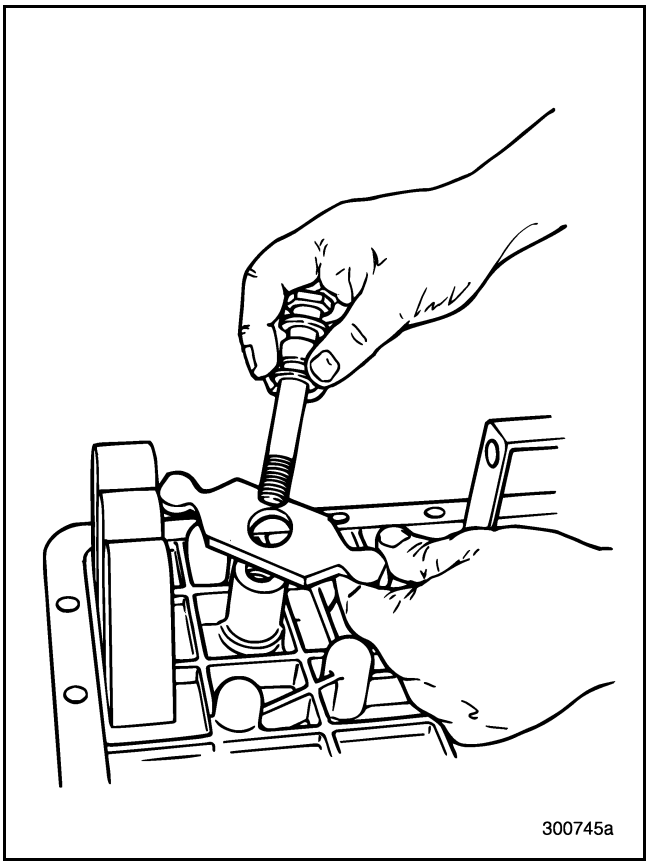


Figure 157 — Removing Third/Fourth Rocker Pin and Rocker Arm

29. Remove the shift cover breather vent.

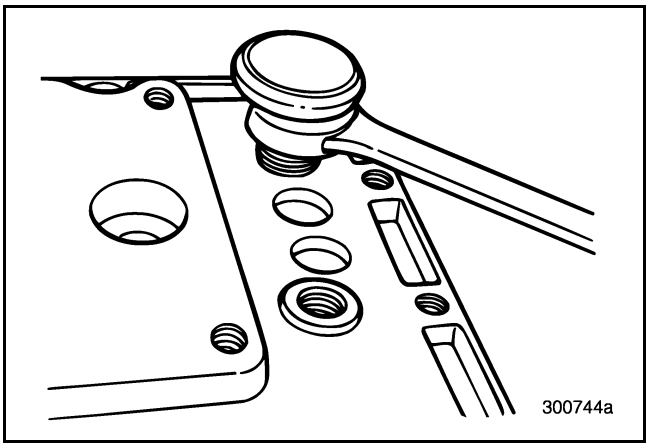


Figure 158 — Removing Breather Vent

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Rear Case Shift Cover Disassembly [324]

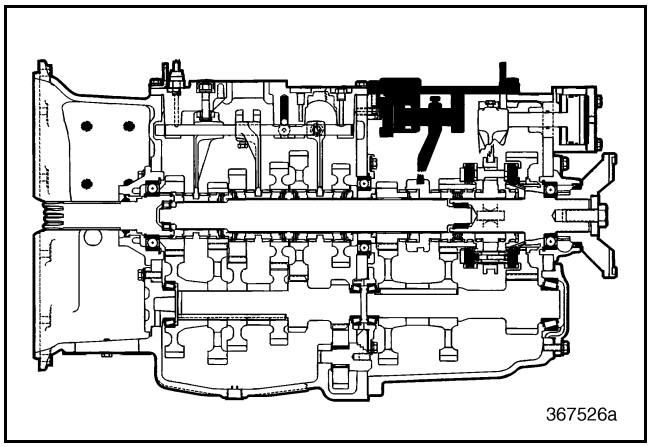


Figure 159 — Rear Case Shift Cover Component Locator (T313L/T318L Shown)

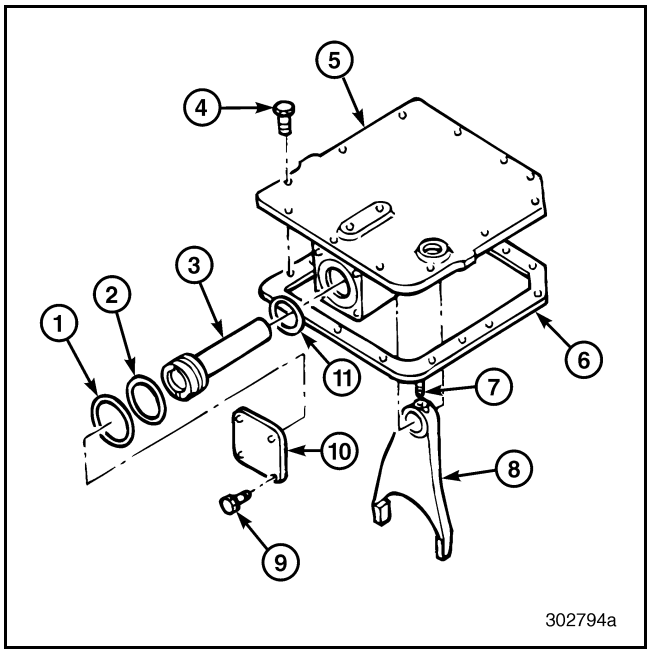


Figure 160 — Exploded View of Rear Case Shift Cover

1. Cover O-Ring	7. Shift Fork Setscrew
2. Piston O-Ring	8. Splitter Shift Fork
3. Splitter Shift Piston	9. Capscrew (4)
4. Capscrew (10)	10. Piston Cover
5. Rear Case Shift Cover	11. Shaft O-Ring
6. Gasket	

1. Remove the setscrew that secures the shift fork to the shift piston.

NOTE

Effective June 2007, shift fork setscrews were changed to a Scotch-Grip™ torque retention method. DO NOT reuse these fasteners, as they are one-time use only.

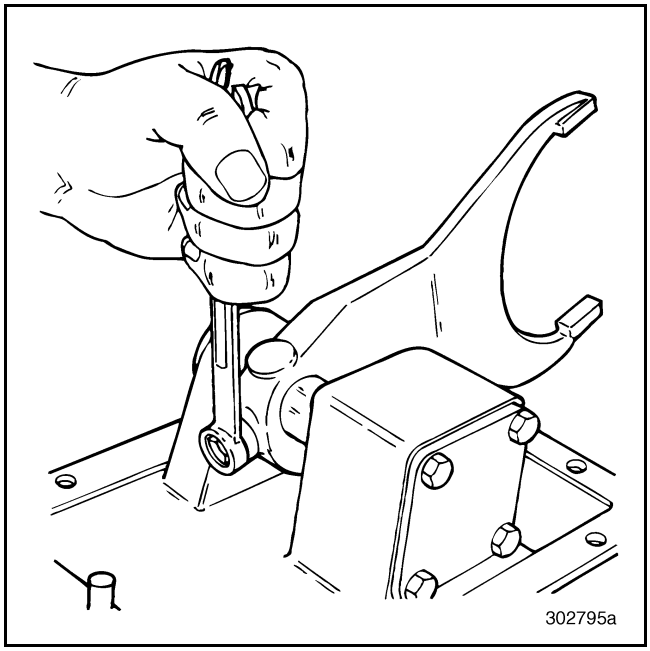


Figure 161 — Removing Setscrew

2. Remove the piston cover capscrews and shift piston cover.

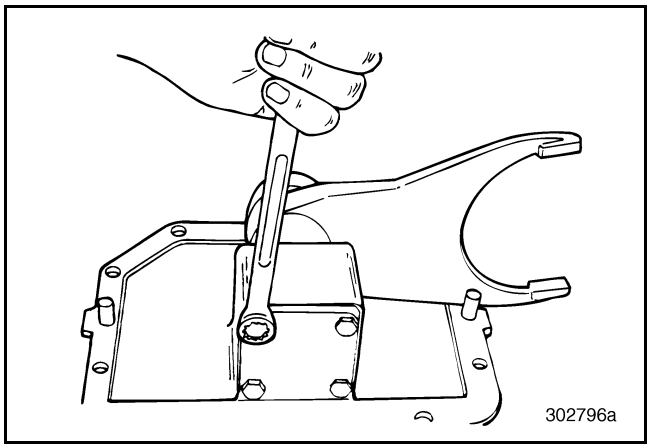


Figure 162 — Removing Cover Capscrews

3. Slide the shift piston out of the housing and at the same time, remove the shift fork. Note the orientation of the shift fork; the offset faces forward.

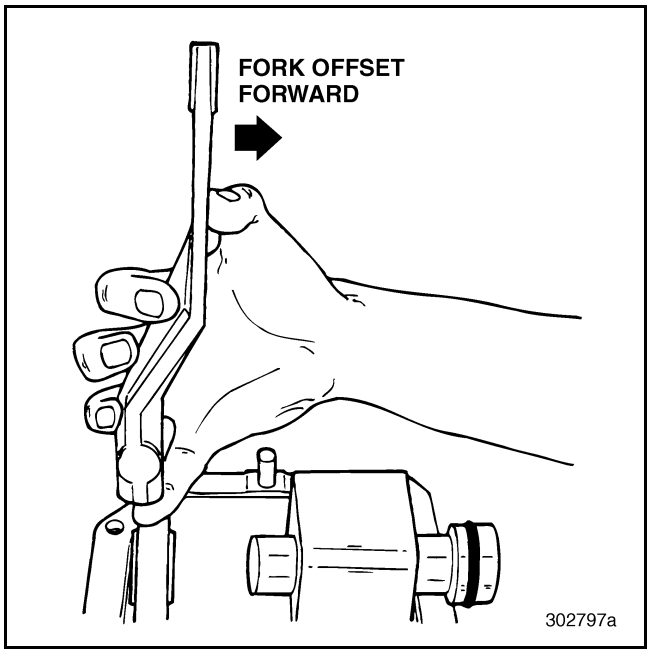


Figure 163 — Removing Piston and Shift Fork

4. Remove the piston cover O-ring from the housing of the shift cover.

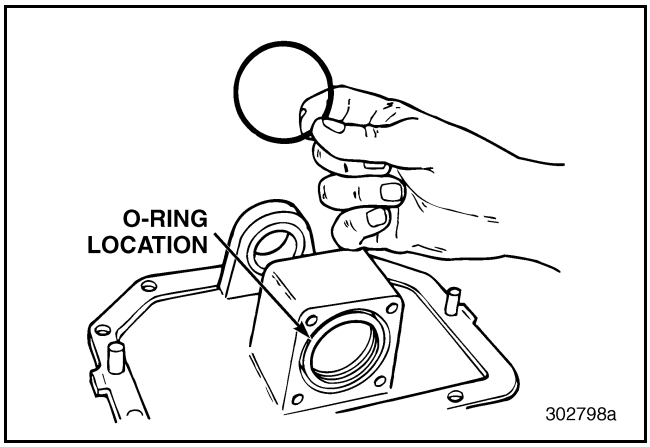


Figure 164 — Removing Piston Cover O-Ring

5. Remove the O-ring (that seals the shaft of the piston) from the rear of the shift piston housing.

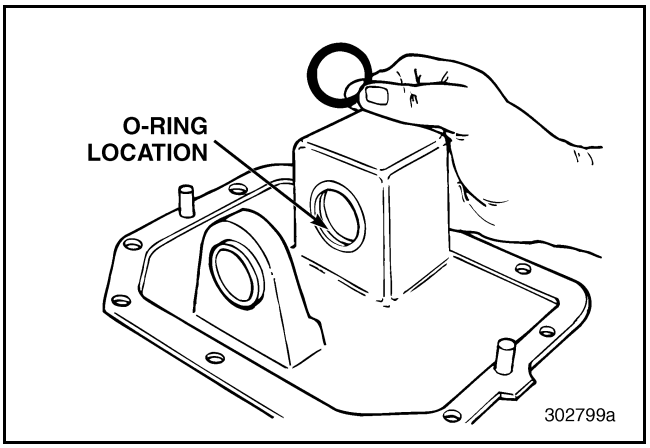


Figure 165 — Removing O-Ring from Rear of Housing

6. Remove the O-ring located on the shift piston.

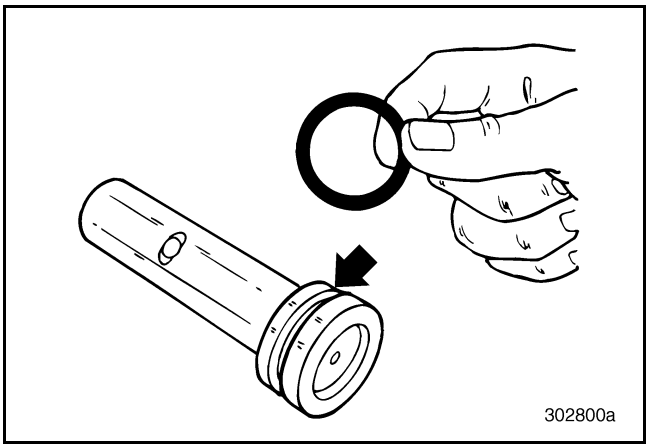


Figure 166 — Removing Piston O-Ring

Three-Position Range Shift Cylinder Disassembly (Compound Neutralizing)

[324]

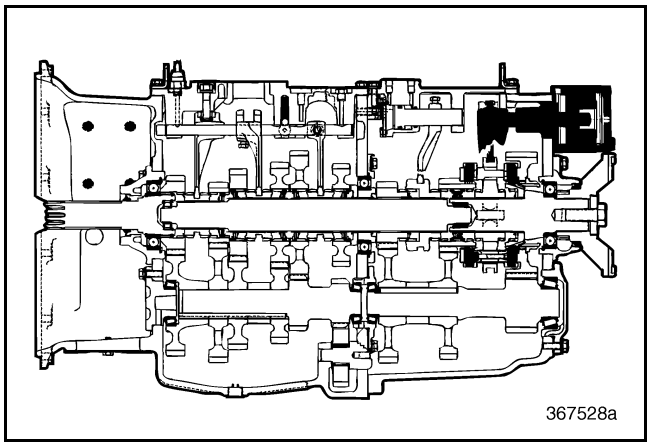


Figure 167 — Range Shift Cylinder Component Locator (T313L/T318L Shown)

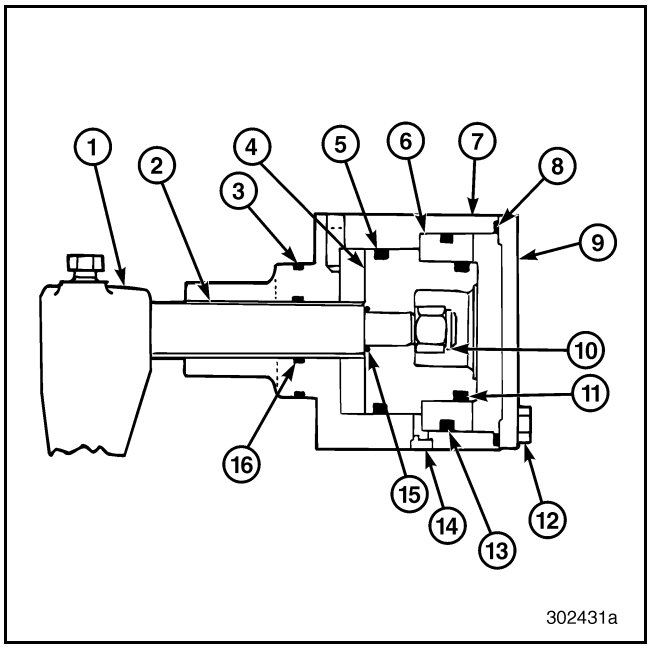


Figure 168 — Cutaway View of Range Shift Cylinder

1. Shift Fork	9. Shift Cylinder Cover
2. Rail	10. Piston/Rail Nut
3. O-Ring	11. O-Ring
4. Shift Piston	12. Cover Capscrew
5. O-Ring	13. O-Ring
6. Piston Sleeve	14. Breather Vent
7. Shift Cylinder	15. O-Ring
8. O-Ring	16. O-Ring

1. With the range shift cylinder in hand, tap the end of the piston shift rail on a firm surface to remove the piston assembly.

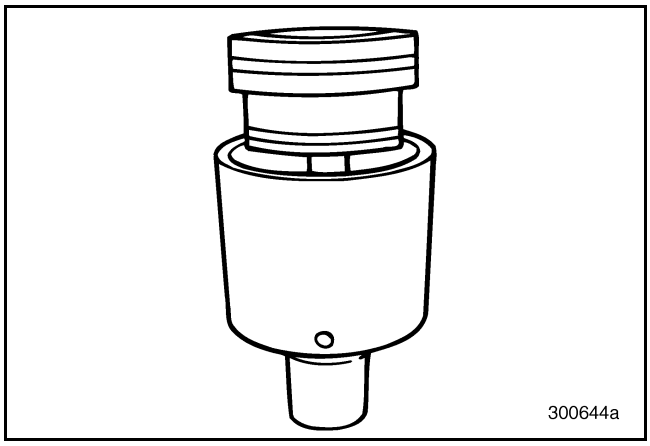


Figure 169 — Piston Assembly Partially Removed

2. Remove the sleeve from the shift piston.

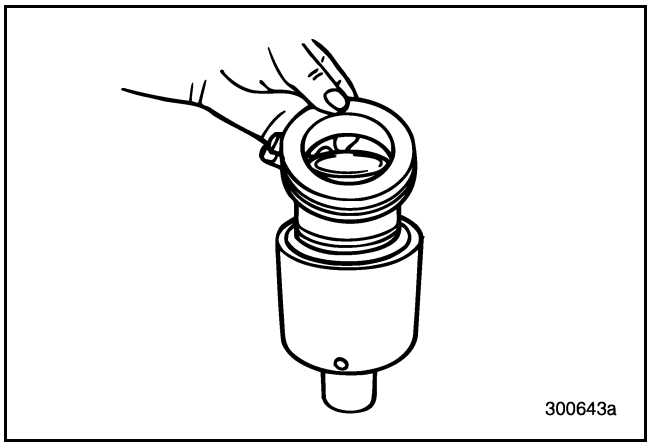


Figure 170 — Removing Sleeve from Piston

3. Remove the shift piston and rail assembly from the range shift cylinder.
4. Remove the O-ring from the outside front end of the shift cylinder. Also remove the shift rail O-ring located inside the cylinder, using a pick or suitable tool.

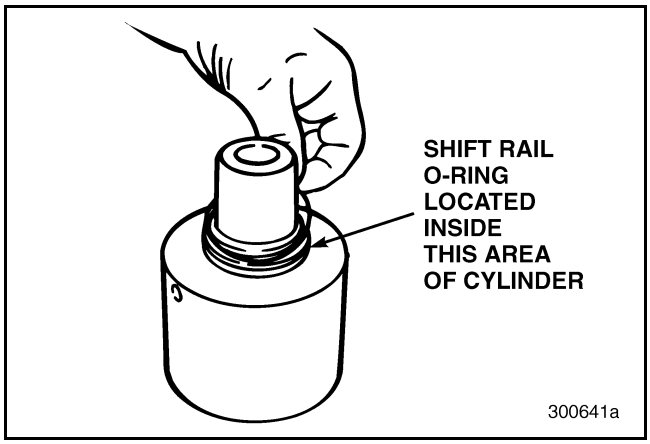


Figure 171 — Removing Shift Cylinder Outside O-Ring

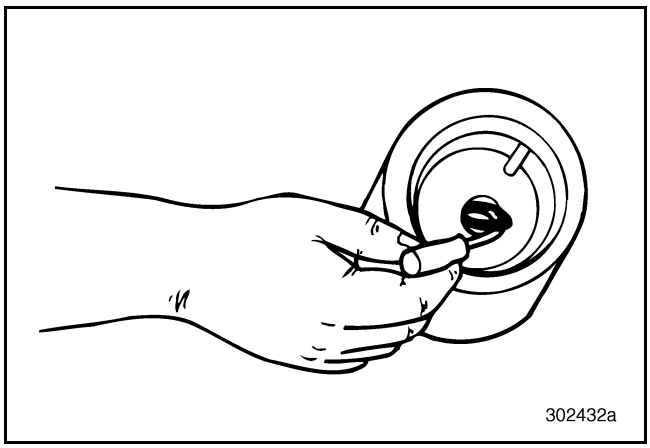


Figure 172 — Removing Shift Cylinder Inside O-Ring

5. Remove the O-ring from the rear of the shift piston.

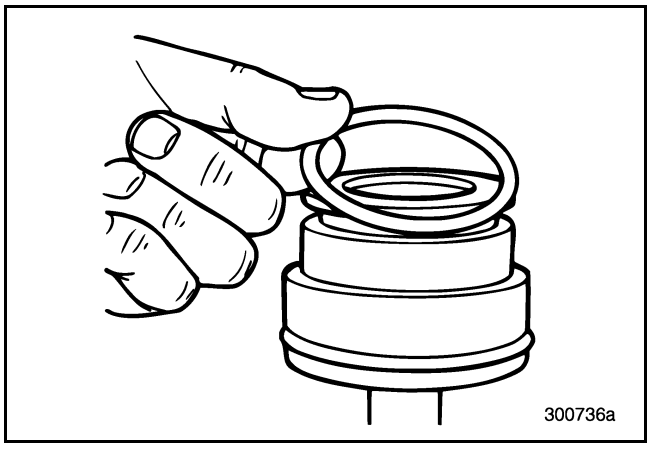


Figure 173 — Removing O-Ring from Rear of Piston

6. Remove the front O-ring at the shift rail end of the piston.

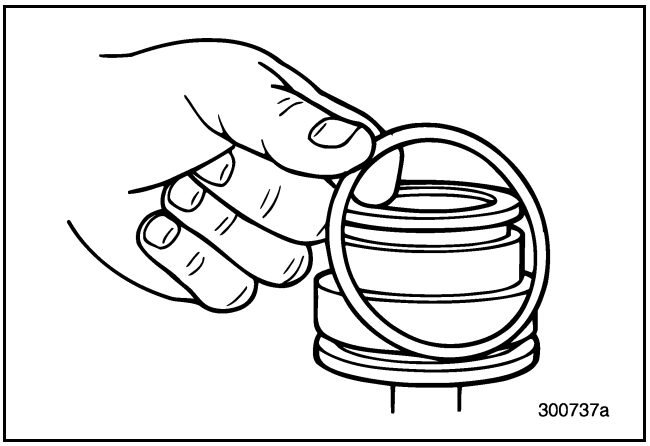


Figure 174 — Removing O-Ring from Front of Piston

7. Remove the nut securing the shift piston to the shift rail. Then separate rail and piston.

⚠ CAUTION

Do not clamp the shift piston or shift rail in a vise. This can cause damage to the piston or rail, preventing proper shifting.

SERVICE HINT

To prevent damage to the shift rail or piston when removing the nut, temporarily install the shift fork and tighten the setscrew. This provides leverage for loosening the nut.

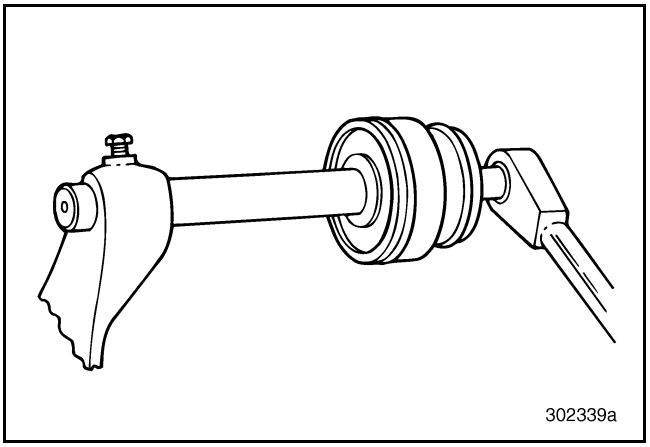


Figure 175 — Removing Shift Piston Retaining Nut

8. Remove the O-ring located on the shift rail.

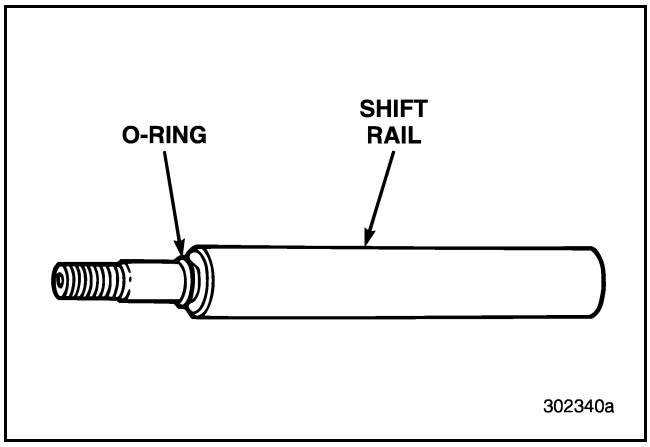


Figure 176 — Removing Shift Rail O-Ring

9. Remove the O-ring from the piston sleeve.

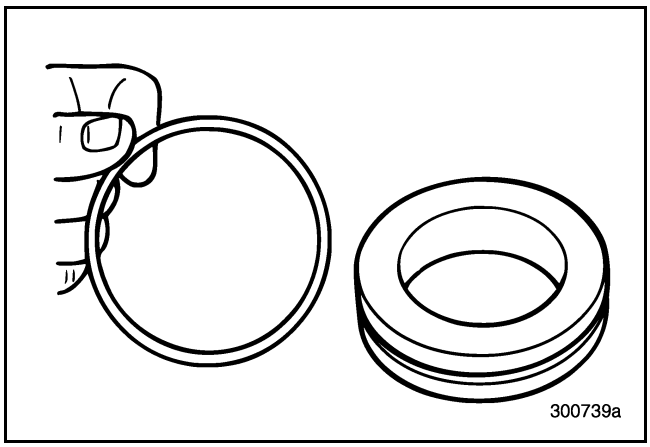


Figure 177 — Removing O-Ring from Sleeve

10. The following figure shows the breather vent removed (1) and installed (2). Check the breather vent for free airflow. Clean or replace, if necessary.

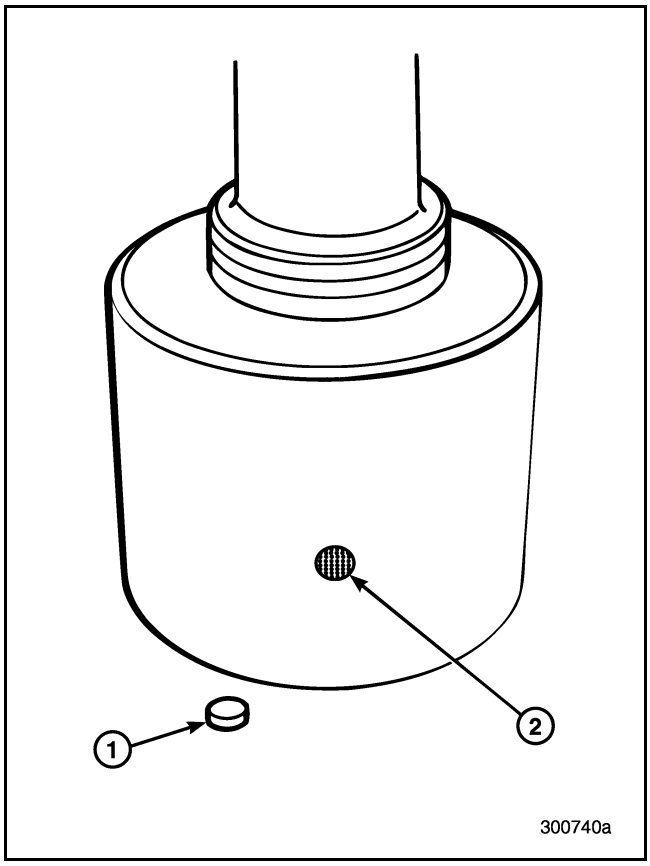


Figure 178 — Shift Cylinder Breather Vent Shown Removed (1) and Installed (2)

Two-Position Range Shift Cylinder Disassembly (Compound Non-Neutralizing)

[324]

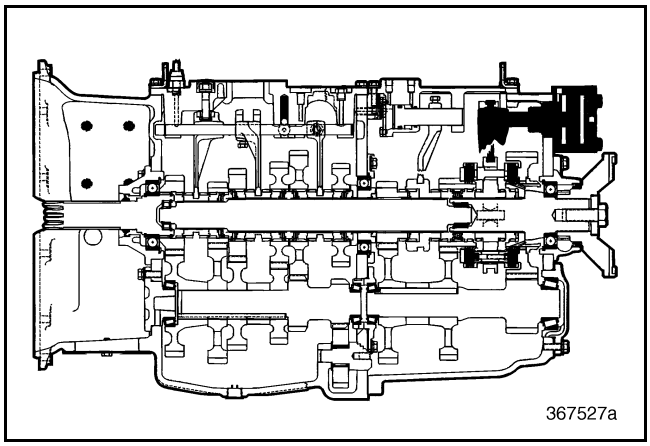


Figure 179 — Range Shift Cylinder Component Locator (T313L/T318L Shown)

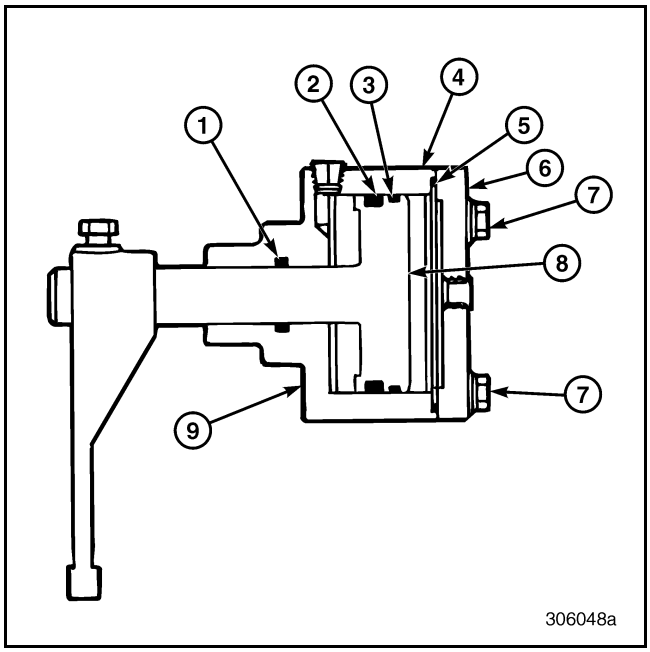


Figure 180 — Range Shift Cylinder Cutaway View

1. Shift Rail Seal	6. Cylinder Housing Cover
2. Piston Seal	7. Bolt
3. Shift Cylinder Wiper Ring	8. Piston/Shift Rail Assembly
4. Shift Cylinder Housing	9. Gasket
5. Housing-to-Cover O-Ring	

1. With the range shift cylinder in hand, tap the end of the piston shift rail on a firm surface to begin removal of the piston/shift rail assembly.

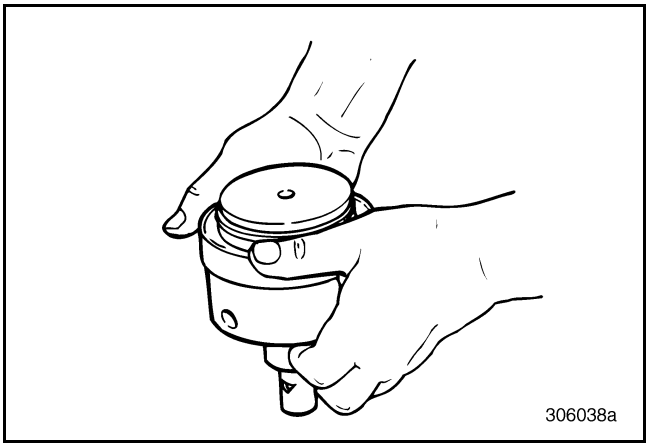


Figure 181 — Piston Assembly Partially Removed

2. Continue moving the piston/shift rail out of the cylinder housing to completely separate the piston/shift rail from the housing.
3. Using a small screwdriver, remove the Teflon® seal and O-ring from the shift rail bore inside the cylinder housing.

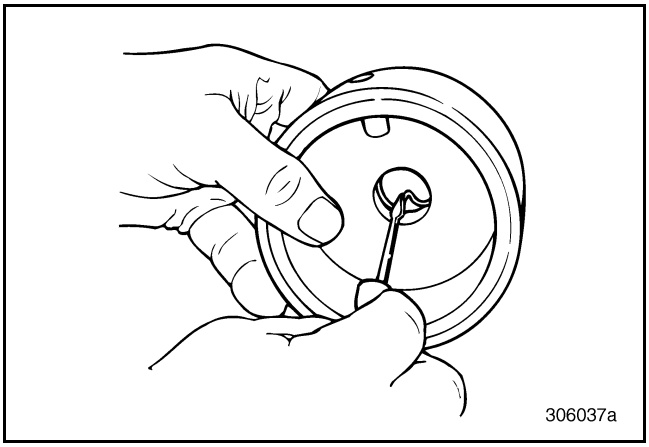


Figure 182 — Removing Teflon® Seal and O-Ring Expander

4. Remove the wiper ring from the piston groove.

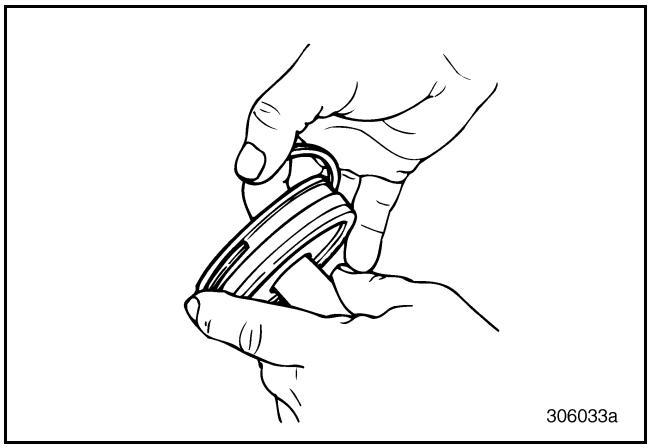


Figure 183 — Removing Wiper Ring from Piston Groove

5. Using a small screwdriver, remove the Teflon® seal and O-ring expander from the second piston groove.

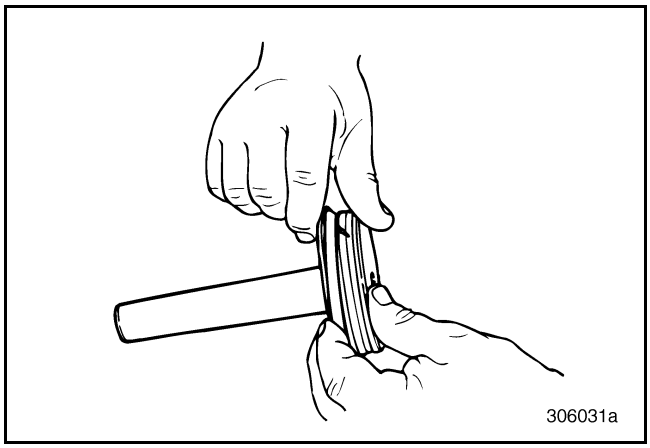


Figure 184 — Removing Teflon® Seal and O-Ring from Piston Grooves

Range Shift Valve

[324]

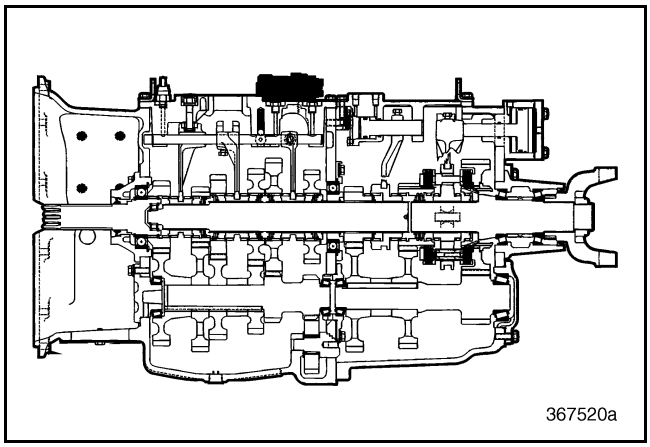


Figure 185 — Range Shift Valve Component Locator (T313L21/T318L21 Shown)

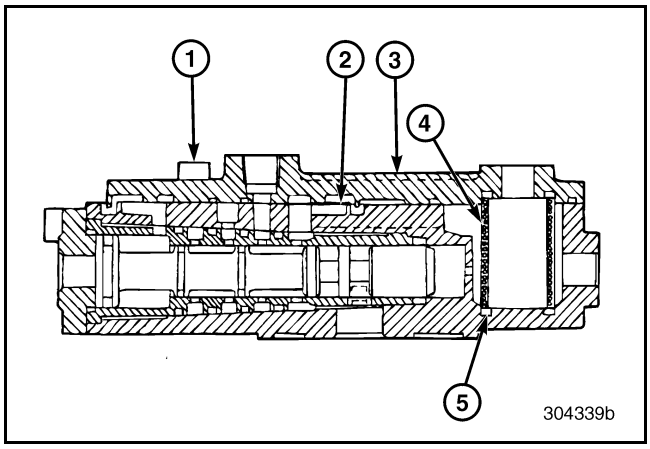


Figure 186 — Cutaway View of Range Shift Valve Assembly

1. 4 mm Screw 2. Top Cover Seal 3. Top Cover	4. Sintered Bronze Filter 5. Silicone Rubber O-Ring

1. Remove the four (4 mm) interlock valve top cover screws.

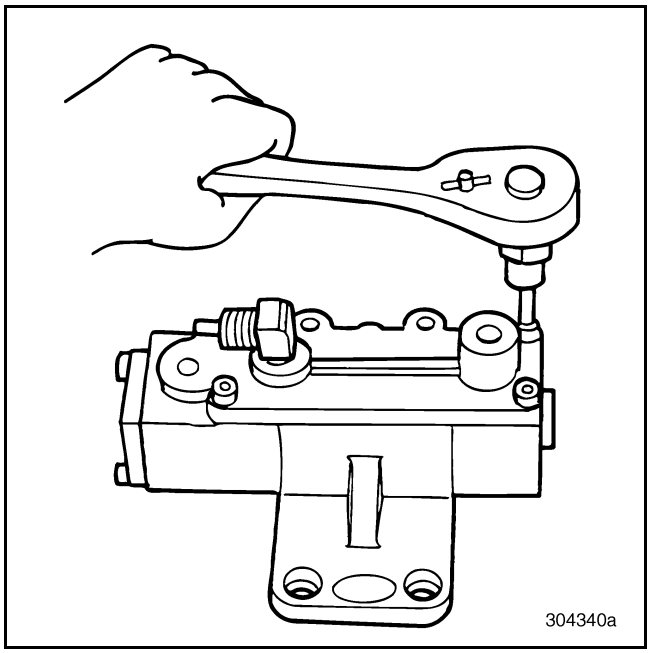


Figure 187 — Valve Top Cover Screws

2. Separate cover from valve housing and remove sintered bronze filter and silicone rubber O-ring.

NOTE

The sintered bronze filter is the only part that is serviceable on the range shift valve. Replace the range shift valve as an assembly if any internal component has failed or if the valve has become contaminated.

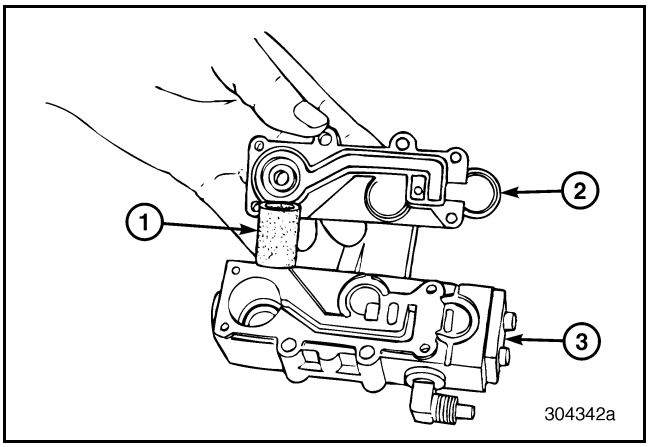


Figure 188 — Removing Sintered Bronze Filter

1. Sintered Bronze Filter 2. Cover	3. Valve Housing

3. Inspect top cover gasket and replace as necessary.

Main Drive Pinion Disassembly [322]

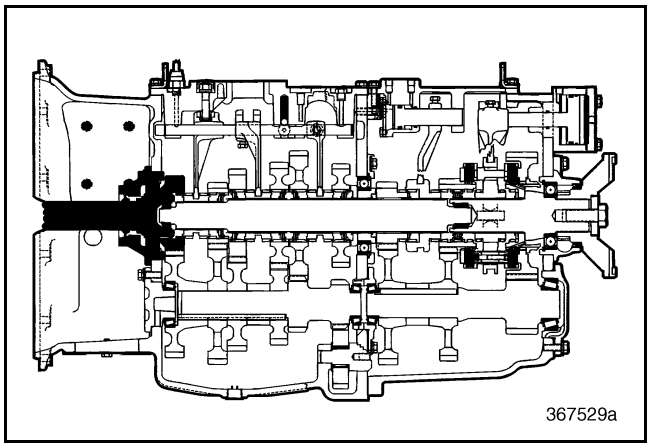


Figure 189 — Main Drive Pinion Component Locator (T313L/T318L Shown)

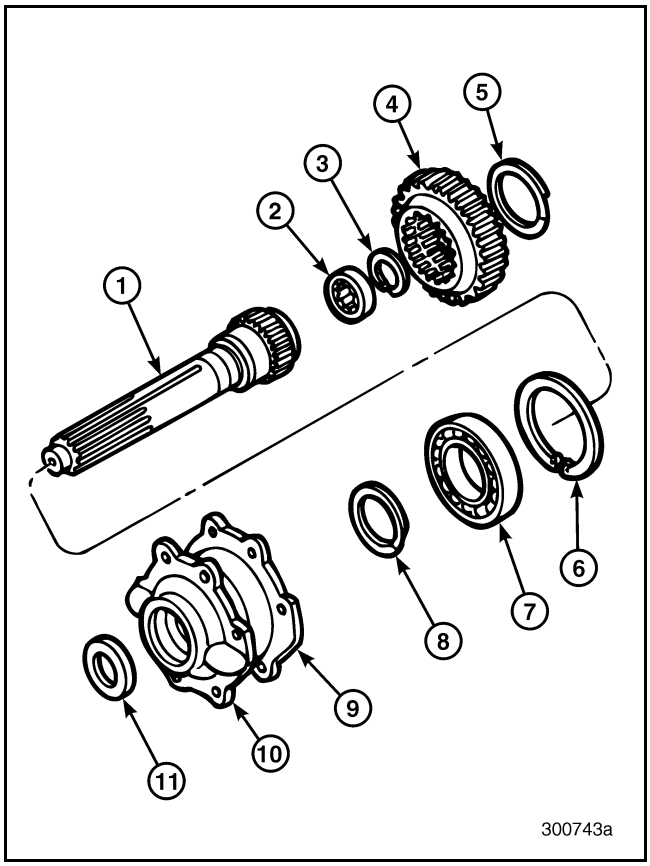


Figure 190 — Exploded View of Main Drive Pinion

1. Main Drive Pinion Shaft	7. Bearing
2. Spigot Bearing	8. Spiral Snap Ring
3. Snap Ring	9. Gasket
4. Main Drive Pinion Gear	10. Pinion Bearing Cover
5. Spiral Snap Ring	11. Oil Seal
6. Snap Ring	

1. Remove the gasket from the main drive pinion bearing cover.

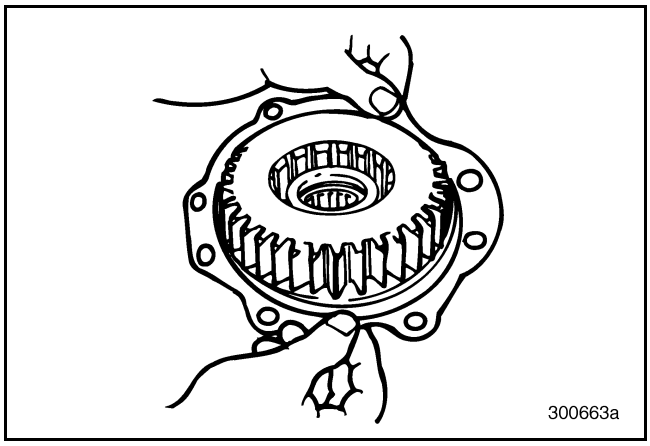


Figure 191 — Removing Gasket from Main Drive Pinion Bearing Cover

2. Remove the spiral snap ring from the end of the main drive pinion shaft, inside the main drive pinion gear. Using a flat-blade screwdriver, roll the snap ring out of the groove and over the shoulder of the main drive pinion.

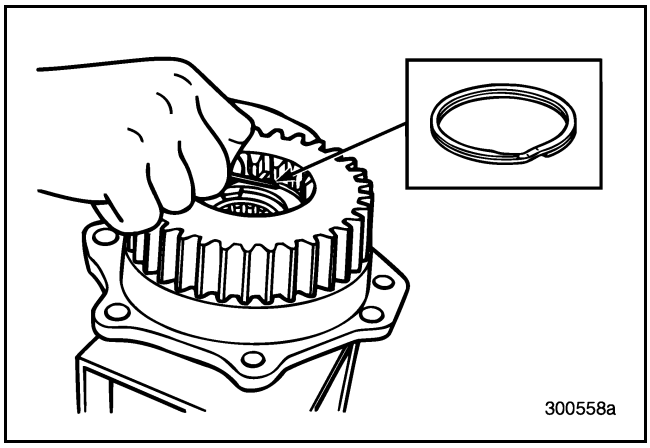


Figure 192 — Removing Snap Ring from Main Drive Pinion

NOTE

The action of removing the snap ring may destroy the snap ring. Make sure a replacement snap ring is available.

3. Remove the main drive pinion gear by lifting it straight up.

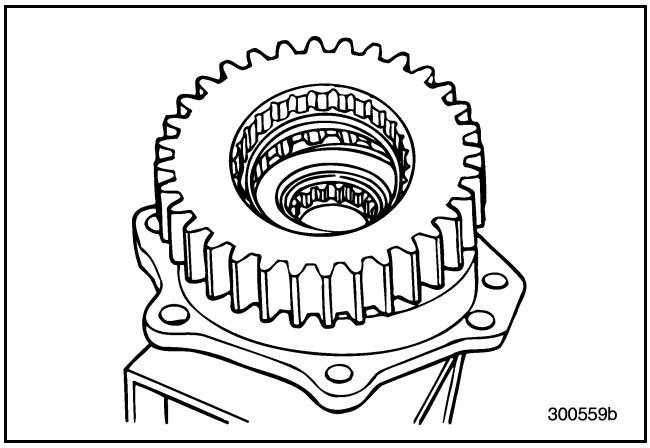


Figure 193 — Removing Main Drive Pinion Gear

4. Remove the spigot bearing snap ring from the main drive pinion, using suitable snap ring pliers.

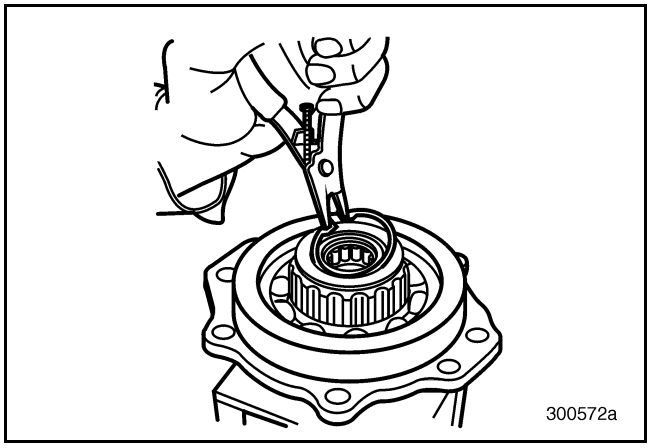


Figure 194 — Removing Spigot Bearing Snap Ring

5. Remove the spigot bearing from inside the end of the main drive pinion shaft.

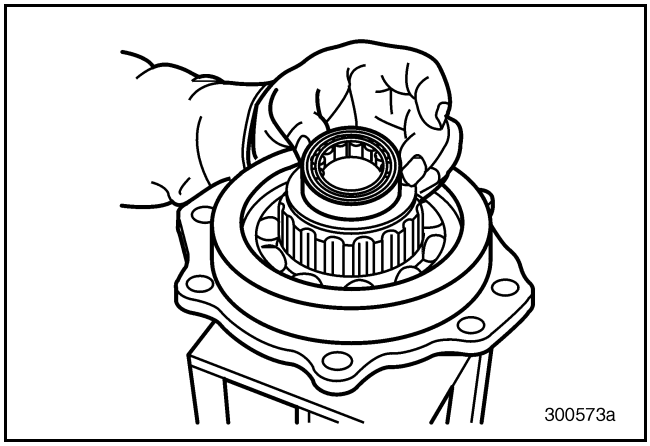


Figure 195 — Spigot Bearing Removed from Main Drive Pinion Shaft

6. Remove the main drive pinion cover bearing snap ring, using suitable snap ring pliers.

⚠ WARNING

The large snap ring is very difficult to compress and remove, and may fly off the snap ring pliers, causing injury.

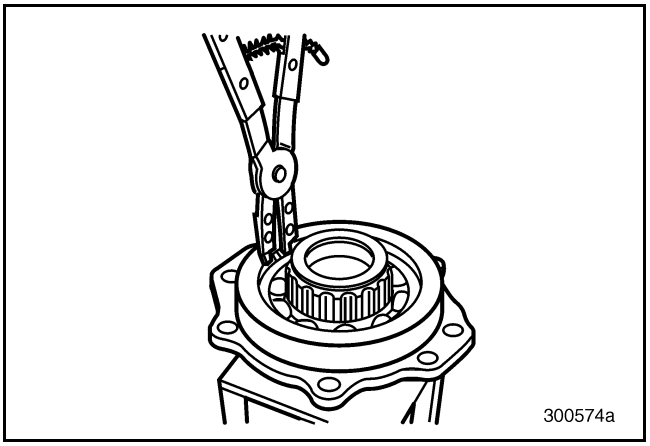


Figure 196 — Removing Main Drive Pinion Cover Bearing Snap Ring

7. Separate the main drive pinion shaft and bearing assembly from the main drive pinion bearing cover.

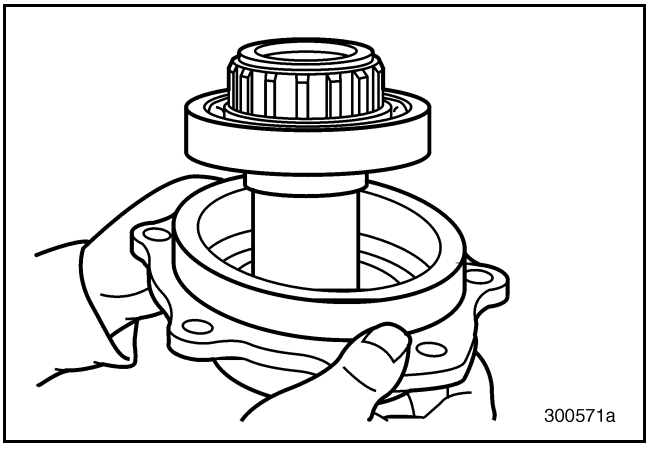


Figure 197 — Removing Main Drive Pinion Shaft and Bearing from Cover

8. Remove the spiral snap ring securing the bearing to the main drive pinion shaft. Using a small flat-blade screwdriver, roll the spiral snap ring out of the groove until released.

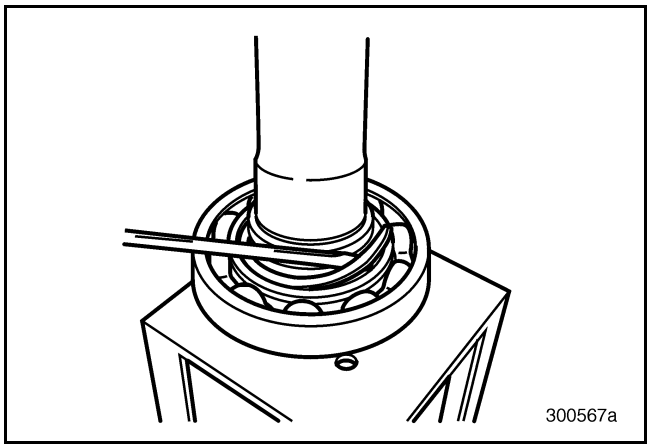


Figure 198 — Removing Spiral Snap Ring from Main Drive Pinion

NOTE

The action of removing the spiral snap ring may destroy the snap ring. Make sure a replacement snap ring is available.

9. Place the main drive pinion shaft and bearing into a suitable press and remove the bearing.

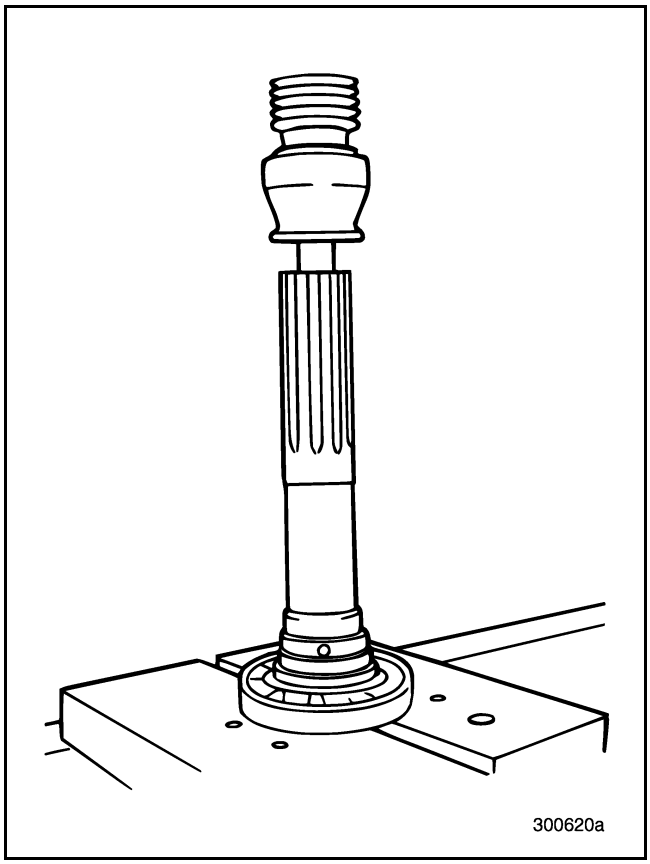


Figure 199 — Pressing Bearing Off Main Drive Pinion Shaft

10. Remove the oil seal from the main drive pinion bearing cover, using a hammer and a blunt punch.

NOTE

Removing the oil seal destroys the seal. Make sure a replacement oil seal is available.

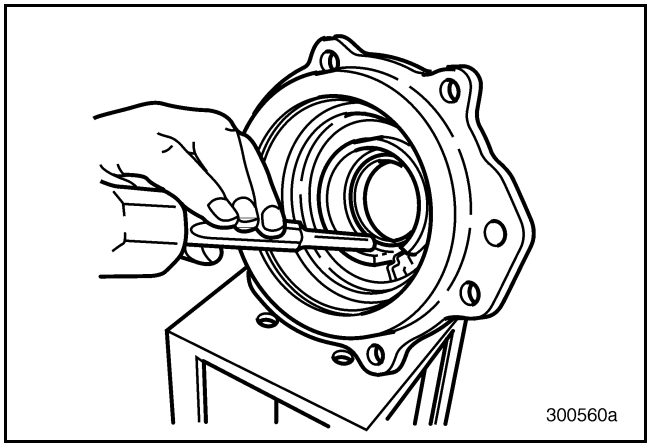


Figure 200 — Removing Bearing Cover Oil Seal

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Front Mainshaft Disassembly

[322]

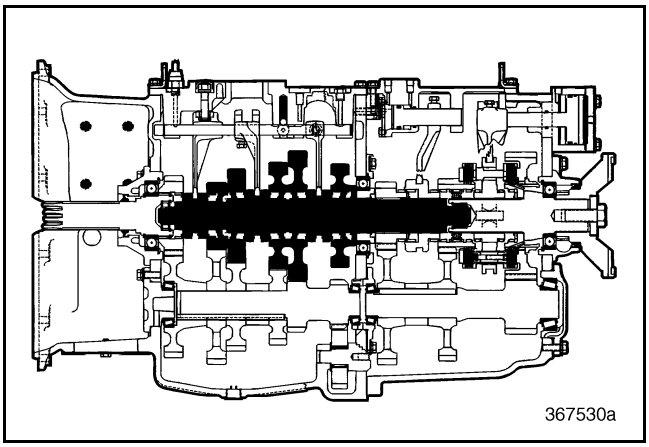


Figure 201 — Front Mainshaft Component Locator (T313L/T318L Shown)

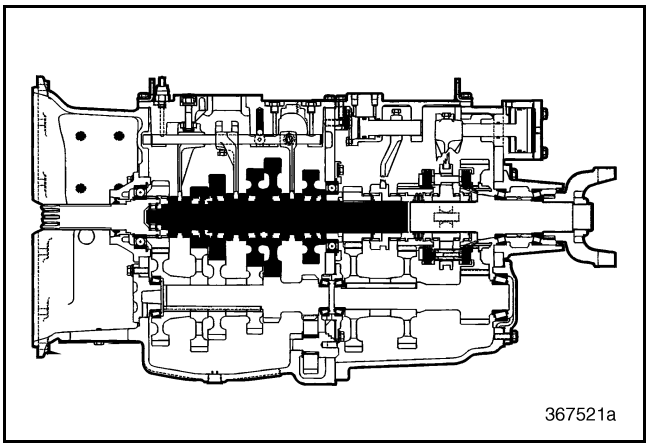


Figure 202 — Front Mainshaft Component Locator (T313L21/T318L21 Shown)

The splines on the mainshaft are usually not aligned for the whole length of the shaft. The recommended procedure is to remove the fourth and second speed gears, gear thrust washers and snap rings, and first/second sliding clutch from the front of the shaft (parts shown to the left of the arrows). Remove the remaining reverse, Lo- and first speed gears, plus sliding clutch and components from the rear of the shaft (parts shown to the right of the arrows).

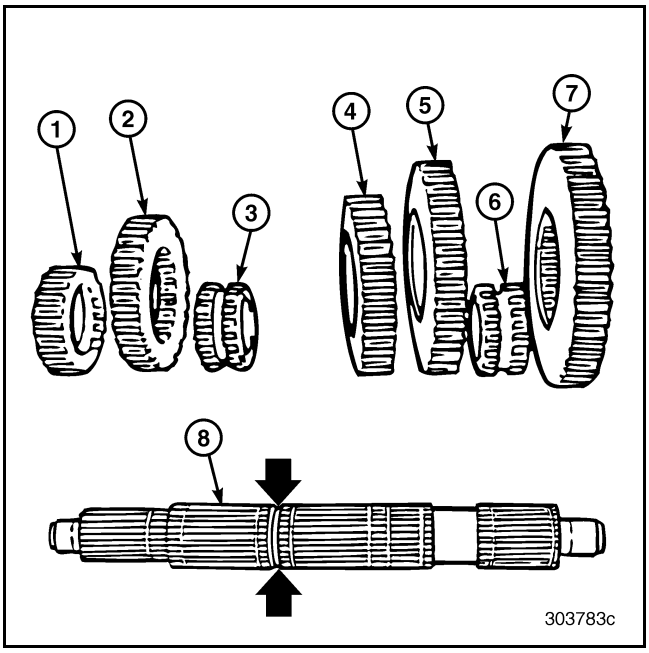


Figure 203 — View of Mainshaft and Gears (T313L/T318L Shown)

1. Fourth (Eighth) Speed Gear	4. First (Fifth) Speed Gear
2. Second (Sixth) Speed Gear	5. Lo-Speed Gear
3. First/Second Sliding Clutch	6. Lo/Reverse Sliding Clutch
	7. Reverse Speed Gear
	8. Front Mainshaft

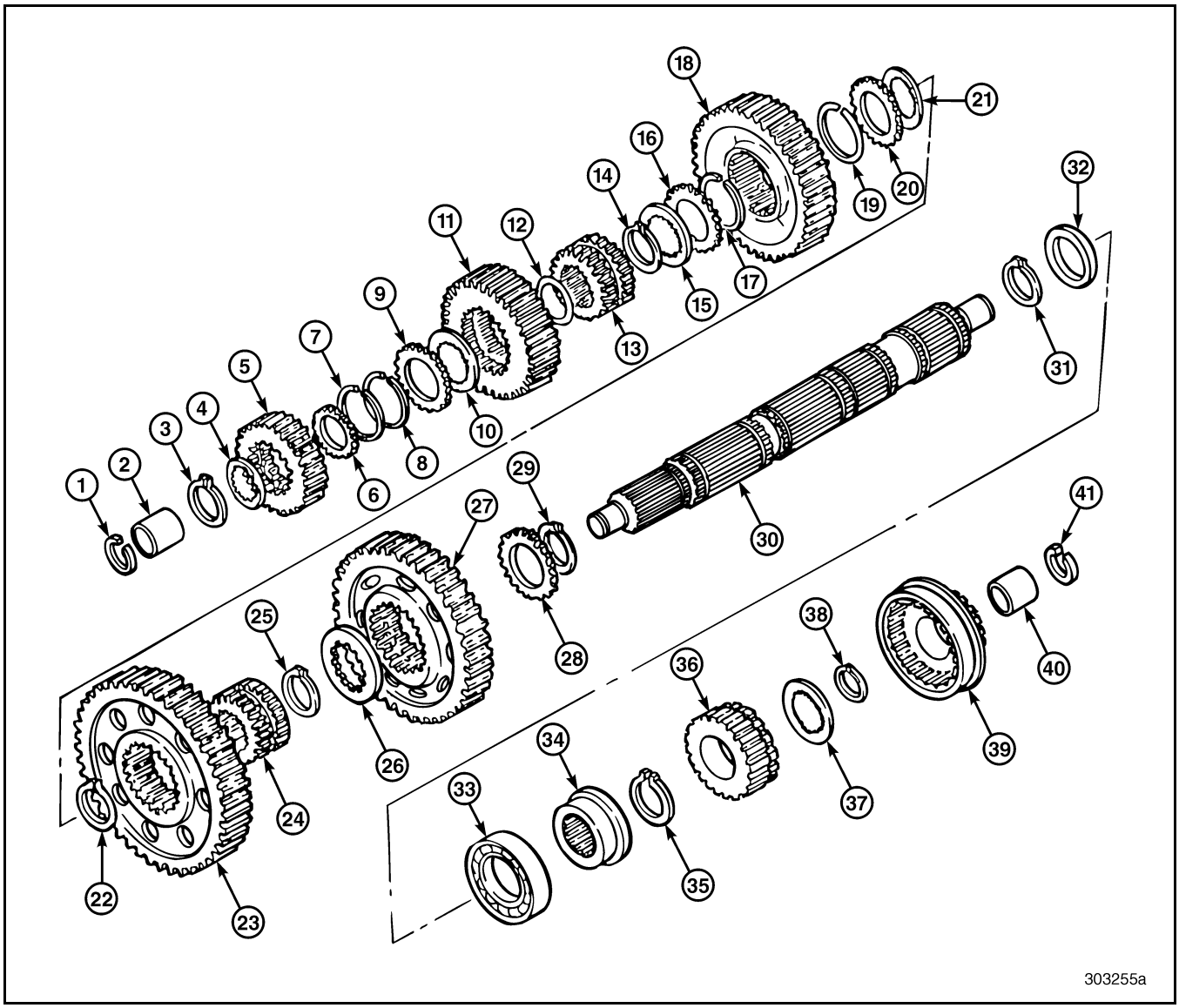


Figure 204 — Exploded View of Front Mainshaft (T313L/T318L Shown)

1. Spigot Bearing Inner Race Snap Ring	15. Internal-Toothed Thrust Washer	29. Gear Snap Ring
2. Spigot Bearing Inner Race	16. External-Toothed Thrust Washer	30. Front Mainshaft (T313L/T318L Shown)
3. Mainshaft Snap Ring	17. Gear Snap Ring	31. Mainshaft Snap Ring
4. Internal-Toothed Thrust Washer	18. First (Fifth) Speed Gear	32. Spacer
5. Fourth (Eighth) Speed Gear	19. Gear Snap Ring	33. Mainshaft Rear Bearing
6. External-Toothed Thrust Washer	20. External-Toothed Thrust Washer	34. Mainshaft Rear Bearing Sleeve
7. Gear Snap Ring	21. Internal-Toothed Thrust Washer	35. Mainshaft Snap Ring
8. Gear Snap Ring	22. Mainshaft Snap Ring	36. Lo-Split Gear
9. External-Toothed Thrust Washer	23. Lo-Speed Gear	37. Internal-Toothed Thrust Washer
10. Internal-Toothed Thrust Washer	24. Sliding Clutch	38. Mainshaft Snap Ring
11. Second (Sixth) Speed Gear	25. Mainshaft Snap Ring	39. Sliding Clutch
12. Mainshaft Snap Ring	26. Internal-Toothed Thrust Washer	40. Spigot Bearing Inner Race: T313–T318(L)(LR) Only
13. Sliding Clutch	27. Reverse Speed Gear	41. Spigot Bearing Inner Race Snap Ring: T313–T318(L)(LR) Only
14. Mainshaft Snap Ring	28. External-Toothed Thrust Washer	

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1. If not already done, remove the external-toothed and internal-toothed thrust washers. Then remove the snap ring retaining the reverse gear to the mainshaft, using suitable snap ring pliers (fifth snap ring groove from the rear of the shaft).

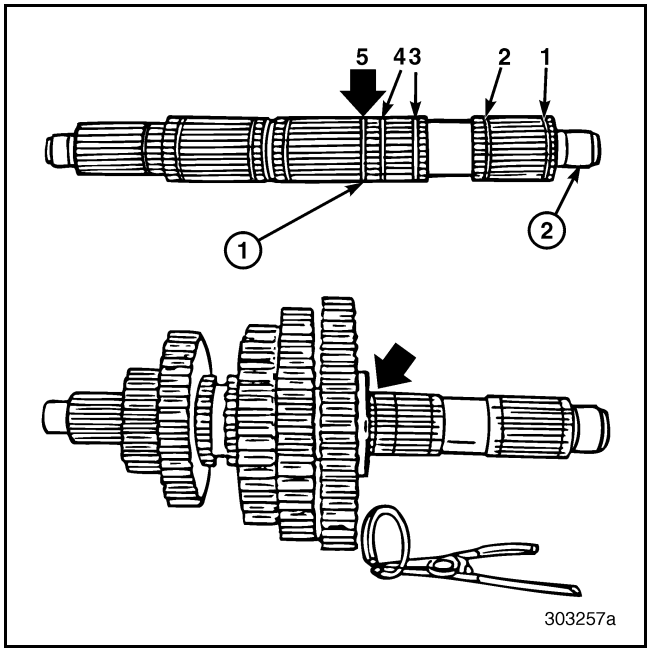


Figure 205 — Removing Reverse Gear Snap Ring (T313L/T318L Shown)

1. Fifth Snap Ring Groove	2. Rear of Mainshaft

2. Working at the rear, slide the reverse gear off the mainshaft.

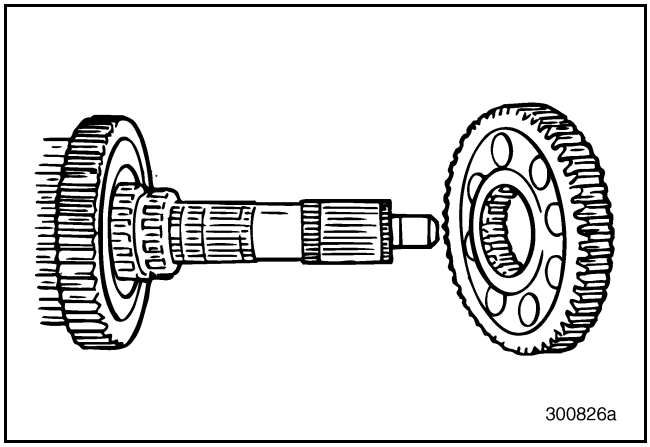


Figure 206 — Removing Reverse Gear from Mainshaft (T313L/T318L Shown)

3. Remove the Lo/reverse sliding clutch from the mainshaft.

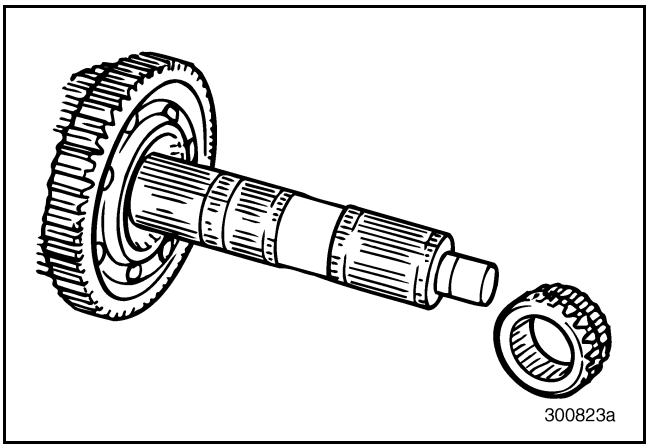


Figure 207 — Removing Lo/Reverse Sliding Clutch from Mainshaft (T313L/T318L Shown)

4. Remove the snap ring retaining the Lo-speed gear to the mainshaft, using suitable snap ring pliers (sixth snap ring groove from the rear of the mainshaft).

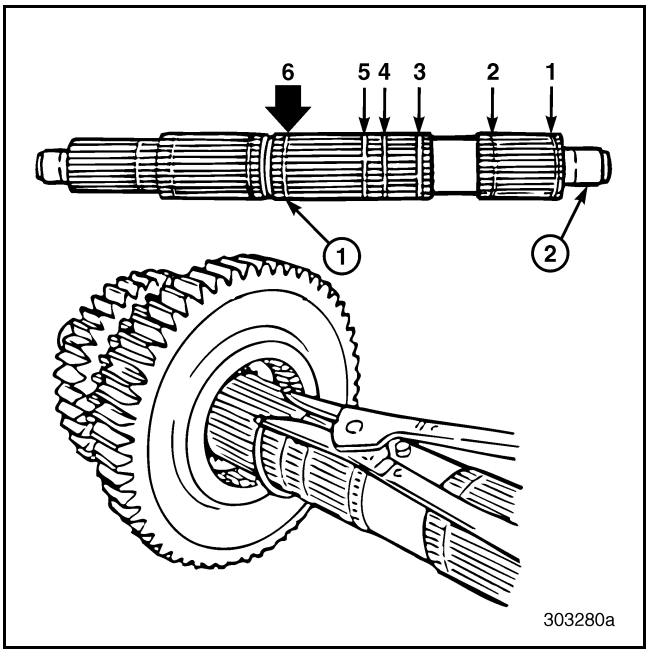


Figure 208 — Removing Lo-Speed Gear Snap Ring (T313L/T318L Shown)

1. Sixth Snap Ring Groove	2. Rear of Mainshaft

5. Remove the internal- and external-toothed thrust washers from inside the Lo-speed gear.

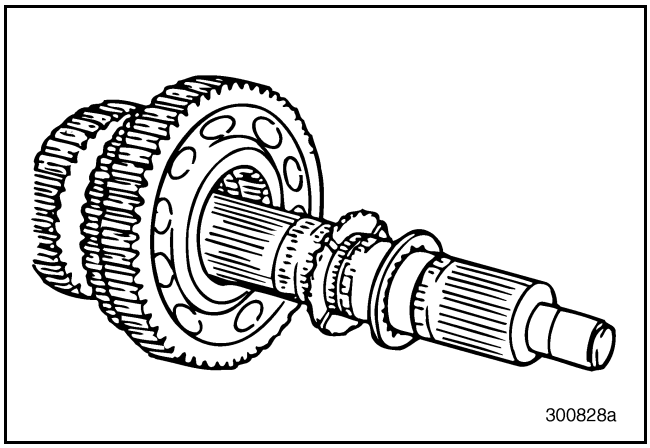


Figure 209 — Removing Internal-Toothed and External-Toothed Thrust Washers (T313L/T318L Shown)

6. Slide Lo-speed gear from mainshaft.

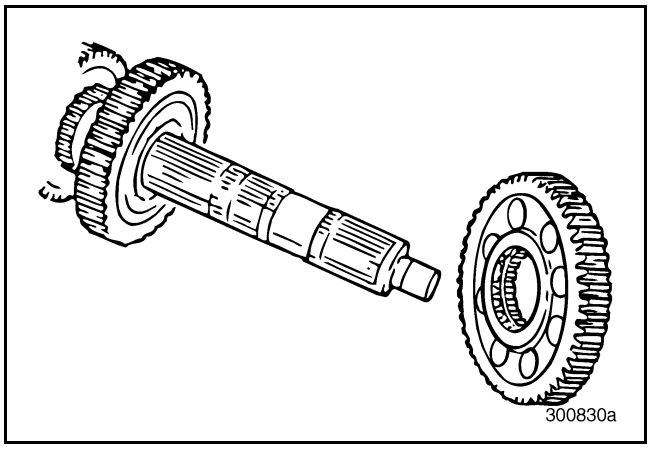


Figure 210 — Removing Lo-Speed Gear (T313L/T318L Shown)

7. Using suitable snap ring pliers, remove the snap ring from the outside groove, inside the Lo-speed gear.

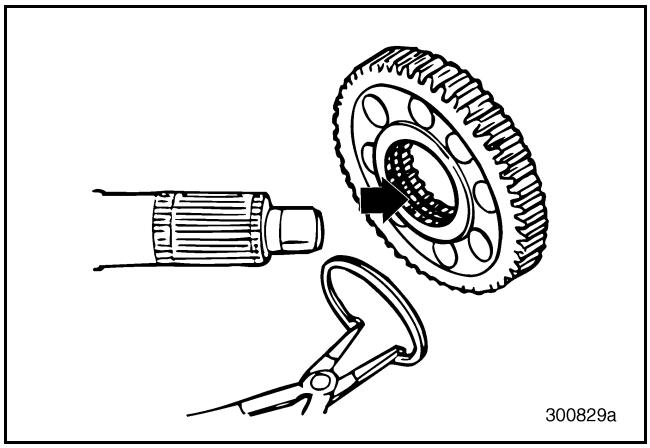


Figure 211 — Removing Snap Ring from Inside Lo Gear (T313L/T318L Shown)

8. Remove the first (fifth) speed gear from the mainshaft. Slide the gear straight off the rear end of the shaft.

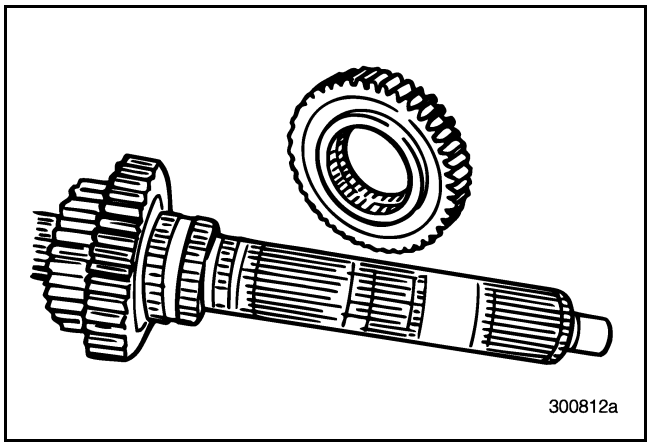


Figure 212 — Removing First Speed Gear from Mainshaft (T313L/T318L Shown)

9. Remove the first (fifth) speed gear snap ring, using suitable snap ring pliers.

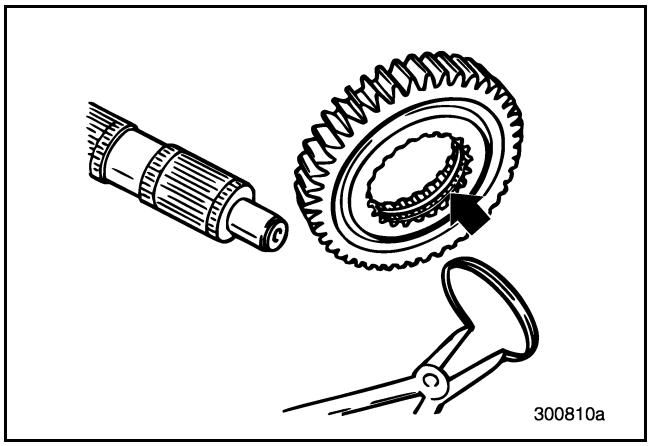


Figure 213 — Removing First Speed Gear Snap Ring (T313L/T318L Shown)

10. Remove the first (fifth) speed gear internal- and external-toothed thrust washers. Then remove the first (fifth) speed gear mainshaft snap ring, using suitable snap ring pliers (seventh snap ring groove from the rear of the mainshaft).

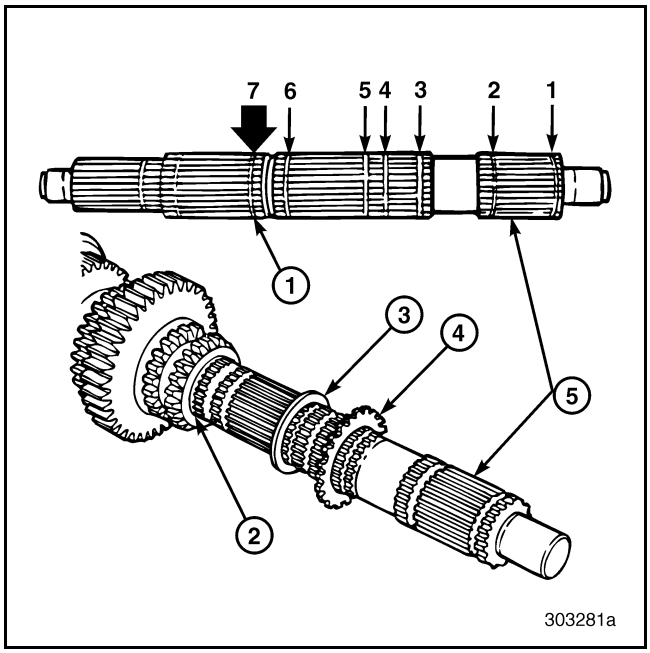


Figure 214 — Removing Internal- and External-Toothed Thrust Washers and Snap Ring (T313L/T318L Shown)

1. Seventh Snap Ring Groove	4. External-Toothed Thrust Washer
2. Snap Ring	5. Rear of Mainshaft
3. Internal-Toothed Thrust Washer	

11. Working at the opposite end of the mainshaft and using suitable snap ring pliers, remove the snap ring that retains the fourth (eighth) speed gear to the mainshaft (first snap ring groove from the front of the mainshaft).

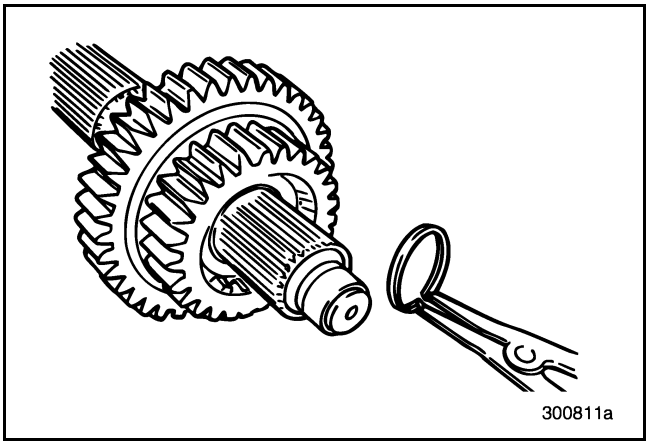


Figure 215 — Removing Fourth Speed Gear Snap Ring

12. Remove the internal- and external-toothed thrust washers at the fourth (eighth) speed gear and remove them from the mainshaft.

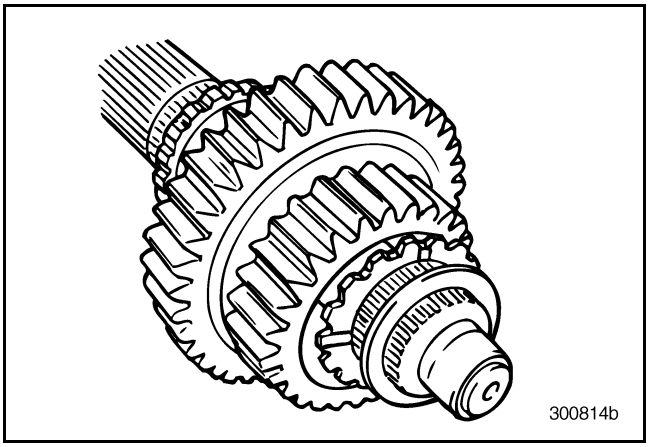


Figure 216 — Removing Internal- and External-Toothed Thrust Washers at Fourth Speed Gear

13. Remove the fourth (eighth) speed gear from the mainshaft.

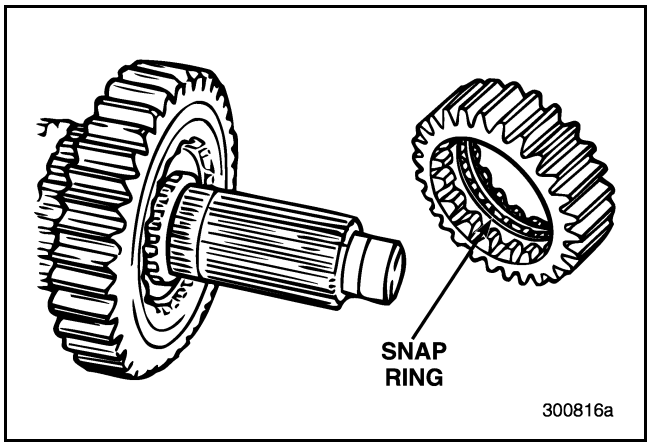


Figure 217 — Removing Fourth Speed Gear

14. Remove the snap ring from inside the fourth (eighth) speed gear.

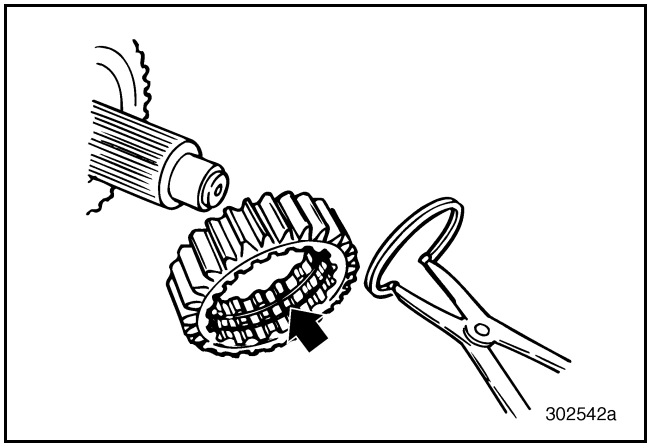


Figure 218 — Removing Snap Ring Inside Fourth Speed Gear

15. Slide the second (sixth) speed gear from the mainshaft.

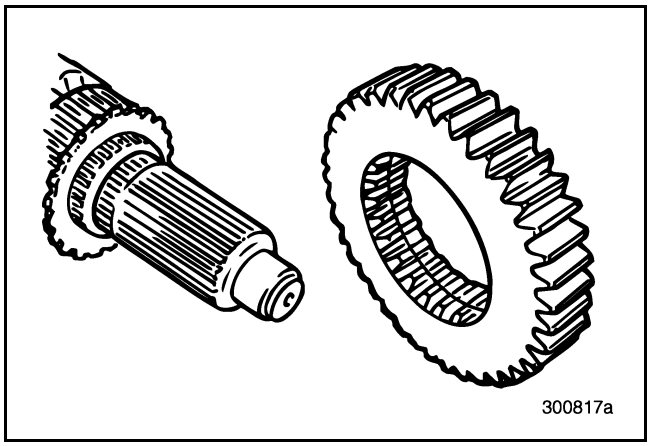


Figure 219 — Removing Second Speed Gear

16. Remove the snap ring from inside the second (sixth) speed gear, using suitable snap ring pliers.

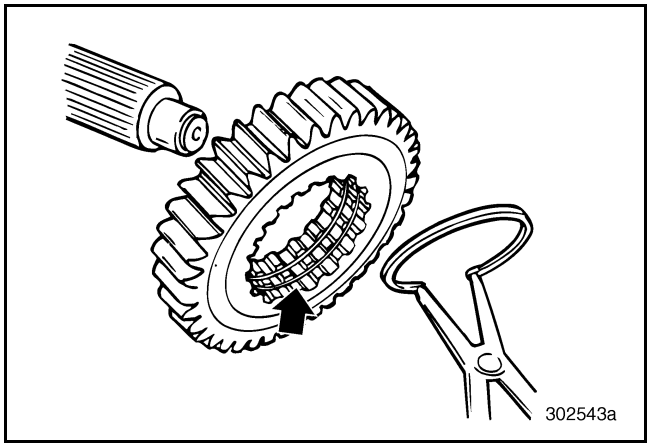


Figure 220 — Removing Second Speed Gear Snap Ring

17. Remove the second (sixth) speed gear external- and internal-toothed thrust washers.

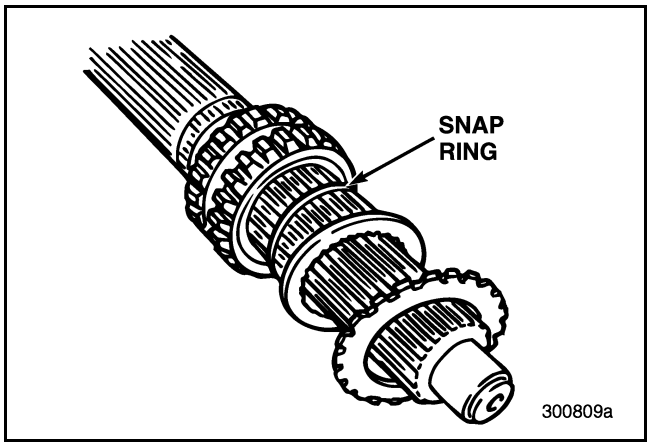


Figure 221 — Removing Second Speed Gear External- and Internal-Toothed Thrust Washers

18. Remove the second (sixth) speed gear mainshaft snap ring, using suitable snap ring pliers (second snap ring groove from the front of the mainshaft).

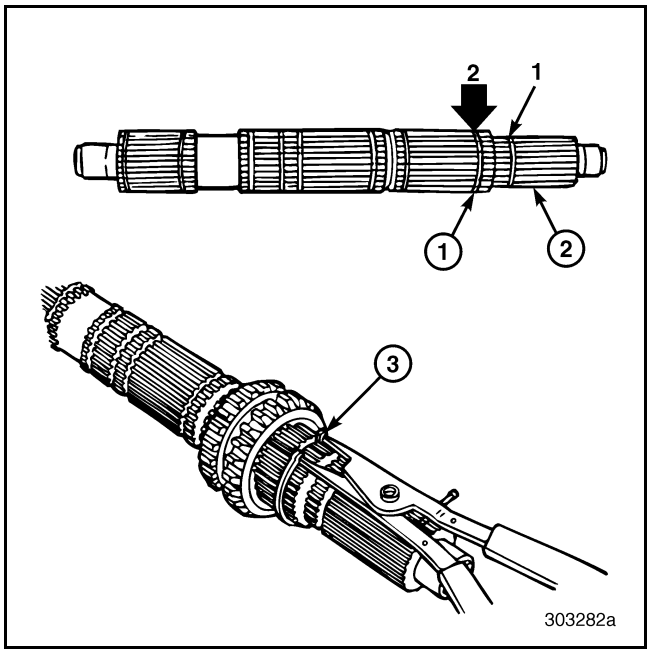


Figure 222 — Removing Second Speed Snap Ring (T313L/T318L Shown)

1. Second Snap Ring Groove	2. Front of Mainshaft 3. Snap Ring Groove

19. Remove the first/second sliding clutch from the mainshaft. Slide straight off splines.

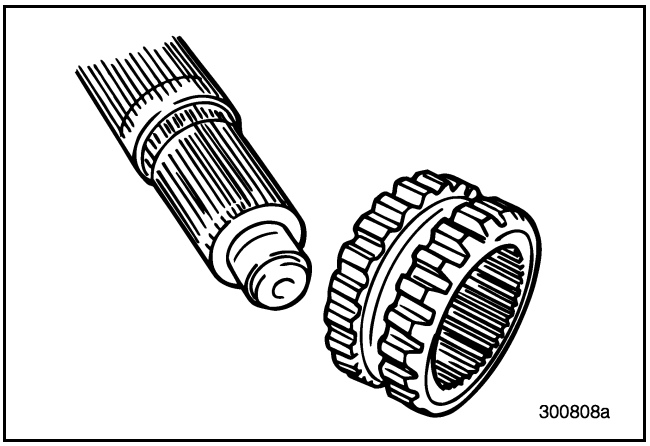


Figure 223 — Removing First/Second Sliding Clutch

20. Remove the snap ring that retains the spigot bearing inner race at the front of the mainshaft, using suitable snap ring pliers.

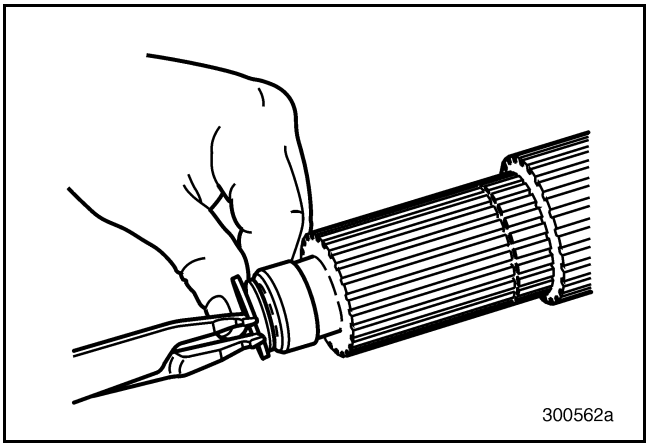


Figure 224 — Removing Front Spigot Bearing Inner Race Snap Ring

21. Remove the front spigot bearing inner race, using a suitable puller such as J 39477-1, or equivalent.

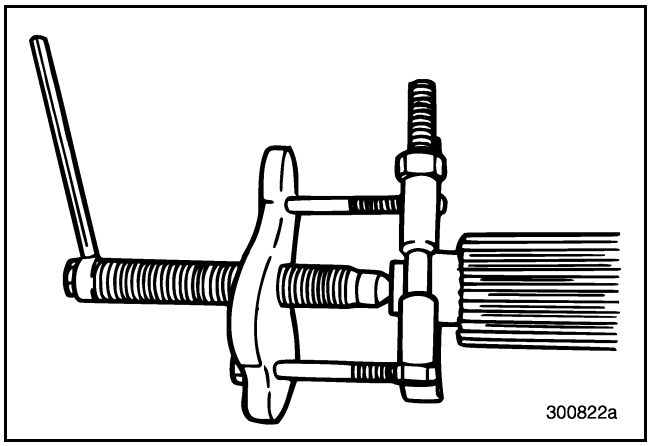


Figure 225 — Removing Front Spigot Bearing Inner Race

22. For the conventional output shaft transmissions: T313–T318(L)(LR), remove the snap ring that retains the spigot bearing inner race at the rear of the mainshaft, using suitable snap ring pliers.

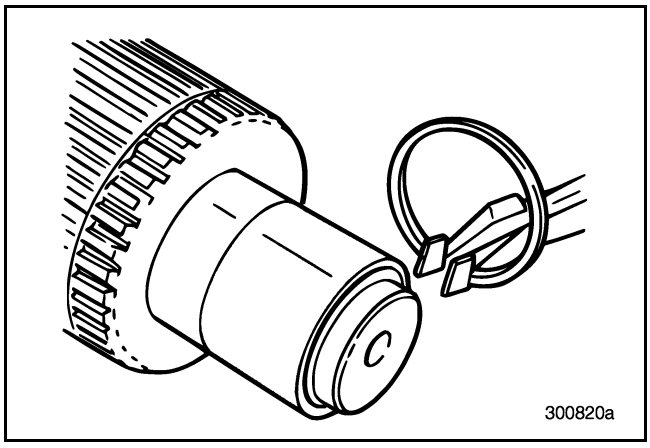


Figure 226 — Removing Rear Spigot Bearing Inner Race Snap Ring (T313L/T318L Shown)

23. On the conventional output shaft transmissions: T313–T318(L)(LR), remove the rear spigot bearing inner race, using a suitable puller such as J 39477-1, or equivalent.

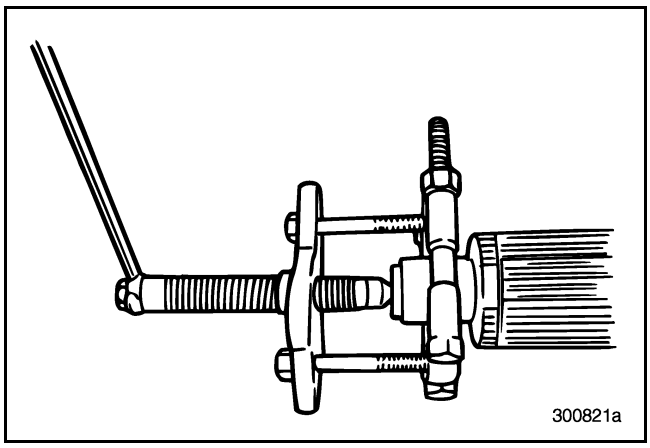


Figure 227 — Removing Rear Spigot Bearing Inner Race (T313L/T318L Shown)

Rear Mainshaft (Output Shaft) and Synchronizer Disassembly

[322]

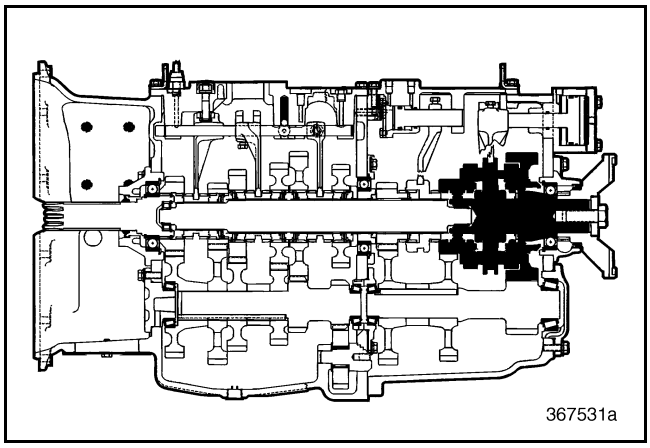


Figure 228 — Rear Mainshaft and Synchronizer Component Locator (T313L/T318L Shown)

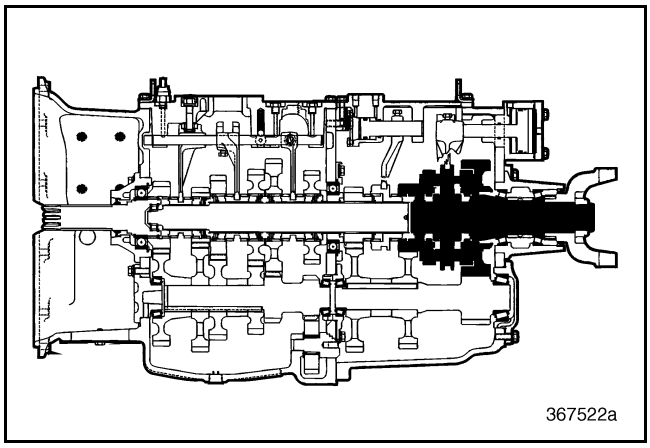


Figure 229 — Rear Mainshaft (Output Shaft) and Synchronizer Component Locator (T313L21/T318L21 Shown)

1. Place the rear mainshaft and synchronizer assembly in a soft-jawed vise to secure for disassembly purposes. Rest the Lo-range gear on top of vise jaws and tighten on shaft.

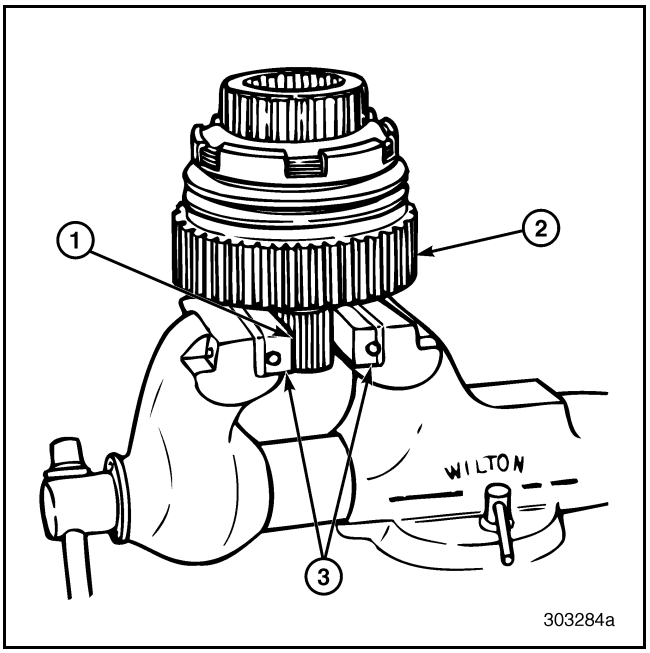


Figure 230 — Position Assembly in Soft Jaw Vise (T313L/T318L Shown)

1. Rear Mainshaft 2. Lo-Range Gear	3. Soft Jaw Inserts

2. For the conventional output shaft transmissions: T313–T318(L)(LR), remove the smaller shaft snap ring from the front end of the rear mainshaft.

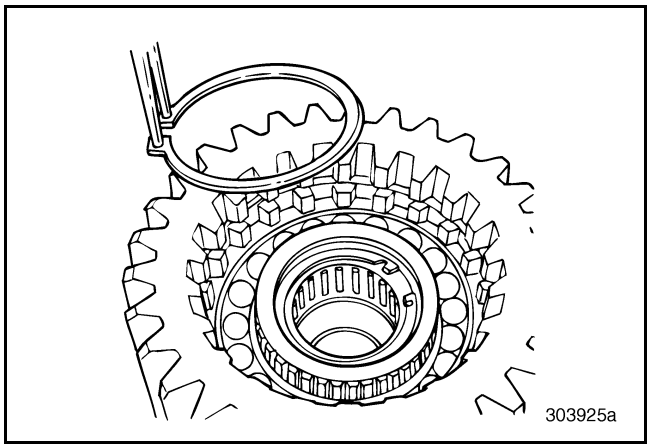


Figure 231 — Removing Smaller Mainshaft Snap Ring (T313L/T318L Shown)

3. On the conventional output shaft transmissions: T313–T318(L)(LR), remove the larger gear snap ring from inside the Hi-range/Hi-split gear.

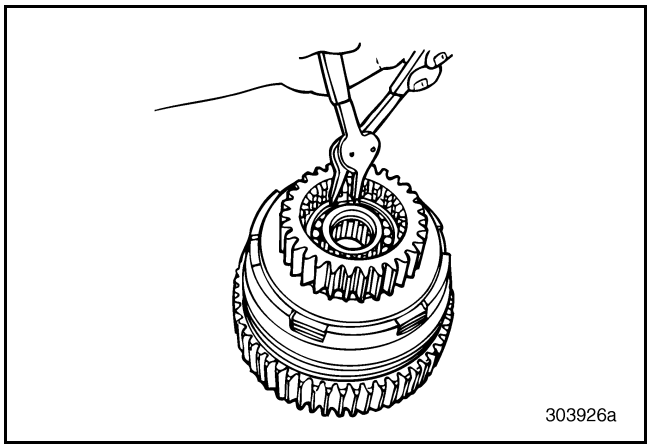


Figure 232 — Removing Larger Snap Ring in Gear (T313L/T318L Shown)

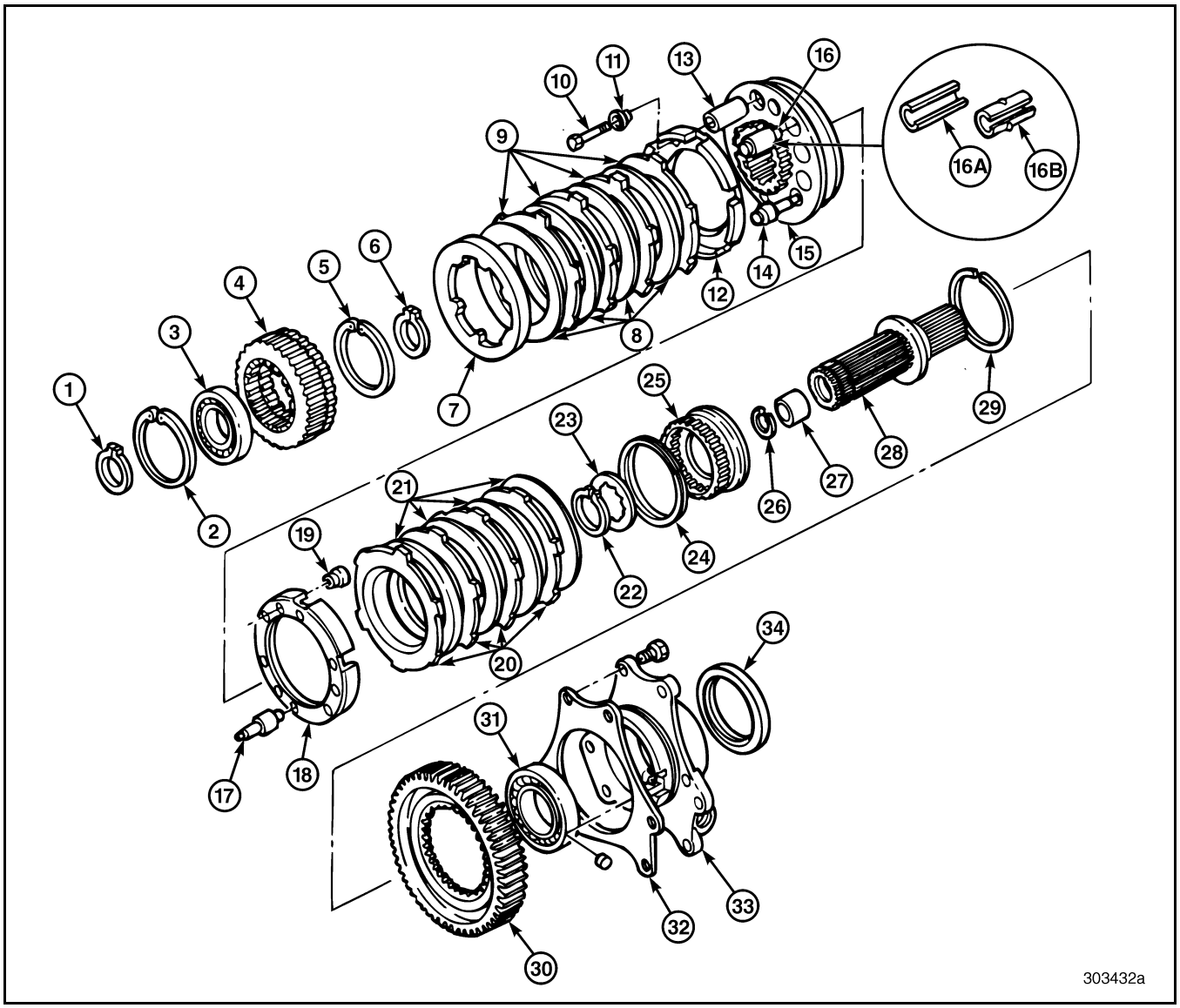


Figure 233 — Exploded View of: T313–T318(L)(LR) Rear Mainshaft and Synchronizer Assembly

1. Snap Ring	13. Support Tube	23. Internal-Toothed Thrust Washer
2. Snap Ring	14. Synchronizer Pin	24. Lo-Range Gear Snap Ring
3. Hi-Range/Hi-Split Gear Bearing	15. Sliding Clutch	25. Lo-Range Gear Hub
4. Hi-Range/Hi-Split Gear	16. Preload Spring Assembly	26. Spigot Bearing Snap Ring
5. Snap Ring	A. Inner Spring	27. Rear Mainshaft Spigot Bearing
6. Snap Ring	B. Outer Spring	28. Rear Mainshaft
7. Spacer (Front Synchronizer Pack)	17. Synchronizer Pin	29. Rear Bearing Snap Ring
8. Friction Disc (4)	18. Clutch Housing	30. Lo-Range Gear
9. Reaction Disc (4)	19. Threaded Insert (3)	31. Mainshaft Rear Bearing
10. 12-Point Capscrew (3)	20. Reaction Disc (4)	32. Rear Bearing Cover Gasket
11. Nonthreaded Insert (3)	21. Friction Disc (4)	33. Rear Bearing Cover
12. Clutch Housing	22. Snap Ring	34. Rear Bearing Cover Seal

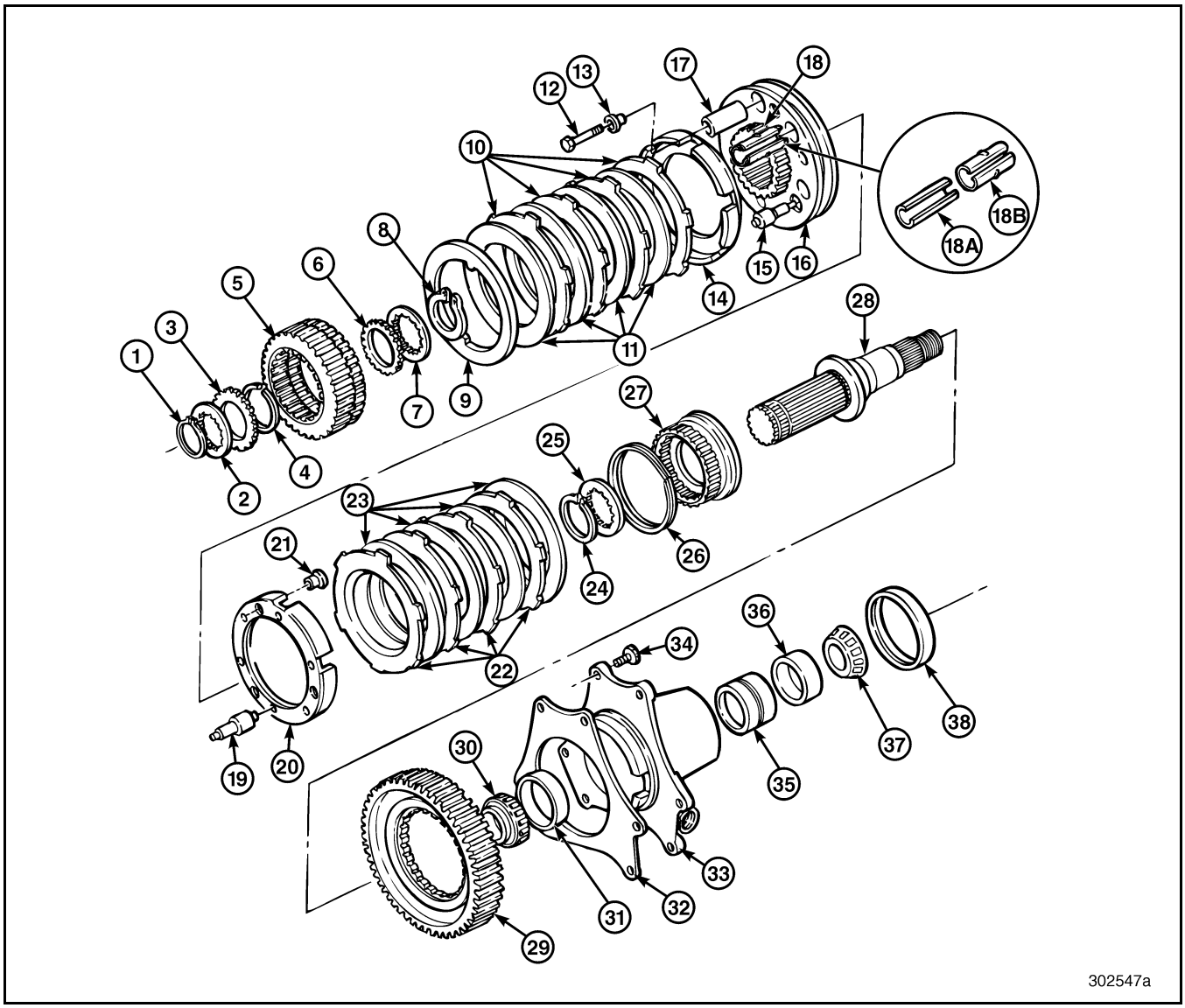


Figure 234 — Exploded View of: T313–T318(21)(L21)(LR21) Rear Mainshaft (Output Shaft) and Synchronizer Assembly

1. Output Shaft Snap Ring	15. Synchronizer Pin	27. Lo-Range Gear Hub
2. Internal-Toothed Thrust Washer	16. Sliding Clutch	28. Output Shaft
3. External-Toothed Thrust Washer	17. Support Tube	29. Lo-Range Gear
4. Hi-Range/Hi-Split Gear Snap Ring	18. Preload Spring Assembly	30. Bearing Cone
5. Hi-Range/Hi-Split Gear	A. Inner Spring	31. Bearing Cup
6. External-Toothed Thrust Washer	B. Outer Spring	32. Gasket
7. Internal-Toothed Thrust Washer	19. Synchronizer Pin	33. Output Housing
8. Output Shaft Snap Ring	20. Clutch Housing	34. Output Housing Capscrew
9. Spacer (Front Synchronizer Pack)	21. Threaded Insert (3)	35. Collapsible Spacer
10. Reaction Disc (4)	22. Reaction Disc (4)	36. Bearing Cup
11. Friction Disc (4)	23. Friction Disc (4)	37. Bearing Cone
12. 12-Point Capscrew (3)	24. Snap Ring	38. Output Housing Oil Seal
13. Nonthreaded Insert (3)	25. Internal-Toothed Thrust Washer	
14. Clutch Housing	26. Lo-Range Gear Snap Ring	

4. On the conventional output shaft transmissions: T313–T318(L)(LR), remove the Hi-range/Hi-split gear and ball bearing from the synchronizer assembly. Place two long-handled pry bars between the synchronizer thrust plate (spacer) and Hi-range/Hi-split gear. Apply steady pressure on gear to overcome the slight interference fit between shaft and ball bearing inner race.

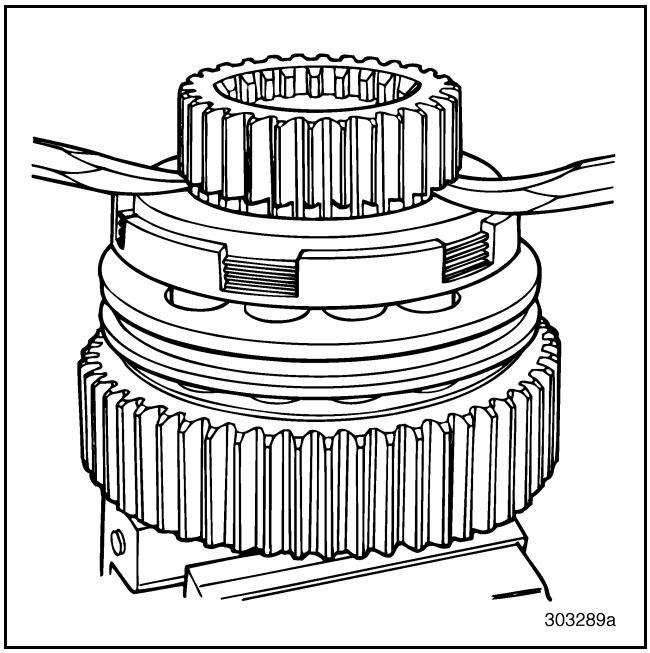


Figure 235 — Removing Hi-Range/Hi-Split Gear and Ball Bearing (T313L/T318L Shown)

5. For the conventional output shaft transmissions: T313–T318(L)(LR), remove the ball bearing from the Hi-range/Hi-split gear, using a suitable driver and hammer. Place gear on suitable support to allow bearing to be driven out of front of gear.

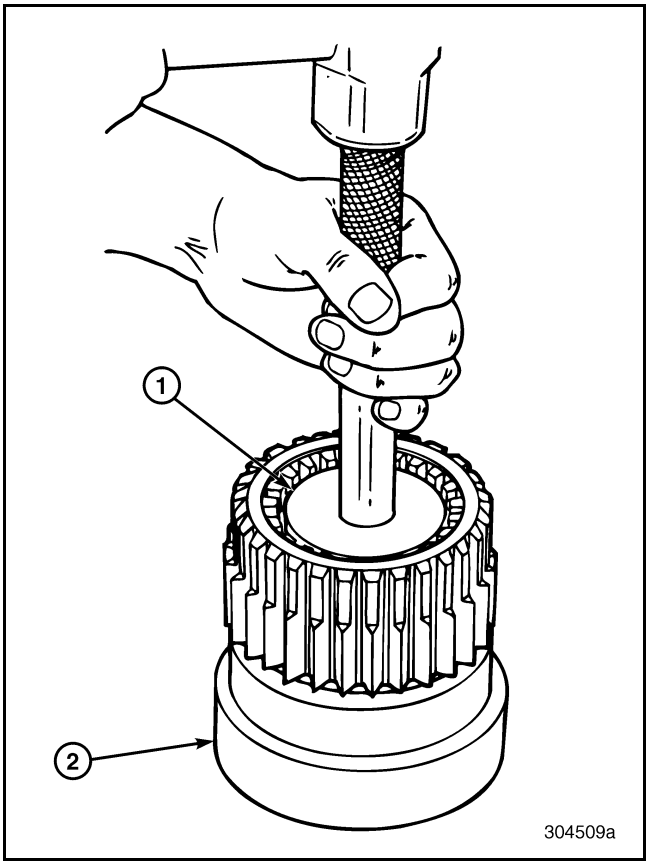


Figure 236 — Removing Ball Bearing from Gear (T313L/T318L Shown)

1. Bearing Driver	2. Gear Support

6. On the conventional output shaft transmissions: T313–T318(L)(LR), remove the remaining rear snap ring from inside the Hi-range/Hi-split gear.

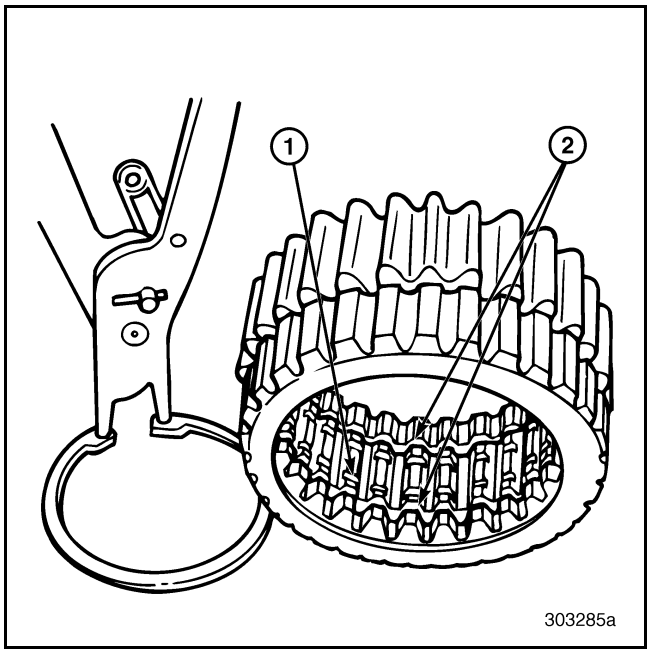


Figure 237 — Removing Remaining Gear Snap Ring (T313L/T318L Shown)

1. Rear Snap Ring Groove	2. Gear Machining Relief Grooves

7. For the conventional output shaft transmissions: T313–T318(L)(LR), remove the remaining snap ring from the front end of the rear mainshaft.

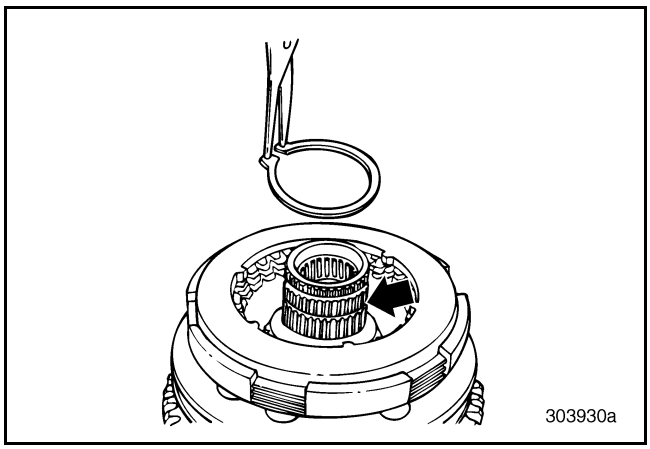


Figure 238 — Removing Shaft Snap Ring (T313L/T318L Shown)

8. For the extended output shaft transmissions: T313–T318(21)(L21)(LR21), remove the snap ring from the front end of the output shaft, using suitable snap ring pliers.

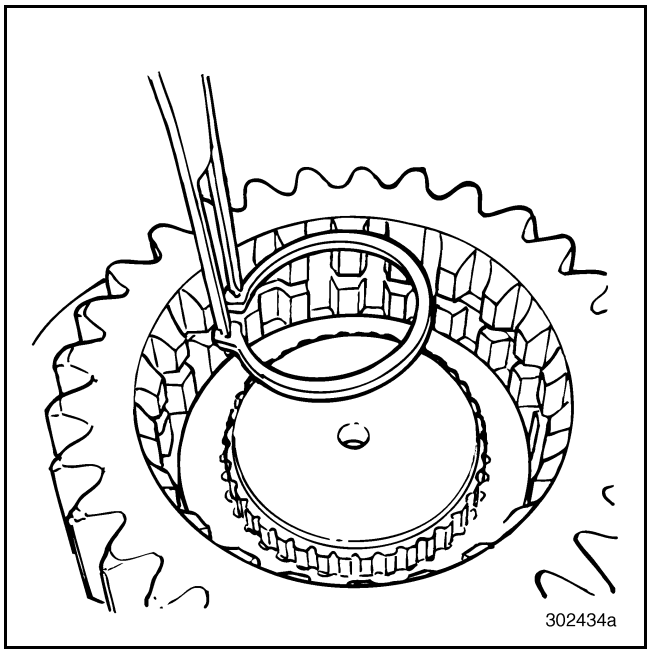


Figure 239 — Removing Snap Ring from Front of Shaft (T313L21/T318L21 Shown)

9. On the extended output shaft transmissions: T313–T318(21)(L21)(LR21), remove the internal-toothed and external-toothed thrust washers from the front end of the output shaft. Note that the oil grooves of the external-toothed thrust washer face the front of the shaft toward the internal-toothed thrust washer.

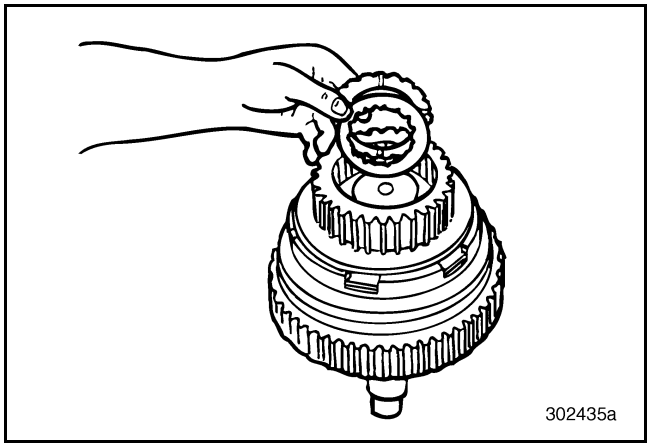


Figure 240 — Removing Thrust Washers (T313L21/T318L21 Shown)

10. On the extended output shaft transmissions: T313–T318(21)(L21)(LR21), remove the Hi-range/Hi-split gear.

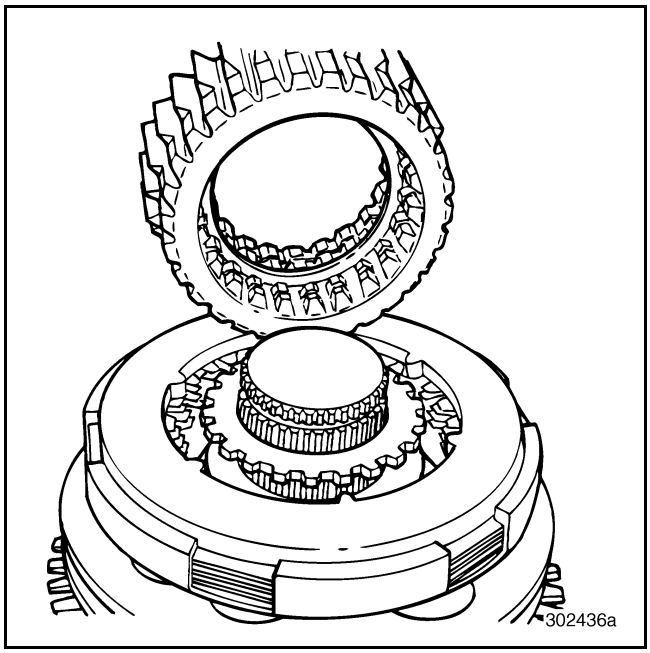


Figure 241 — Removing Hi-Range/Hi-Split Gear (T313L21/T318L21 Shown)

11. For the extended output shaft transmissions: T313–T318(21)(L21)(LR21), remove the snap ring from inside the Hi-range/Hi-split gear, using suitable snap ring pliers.

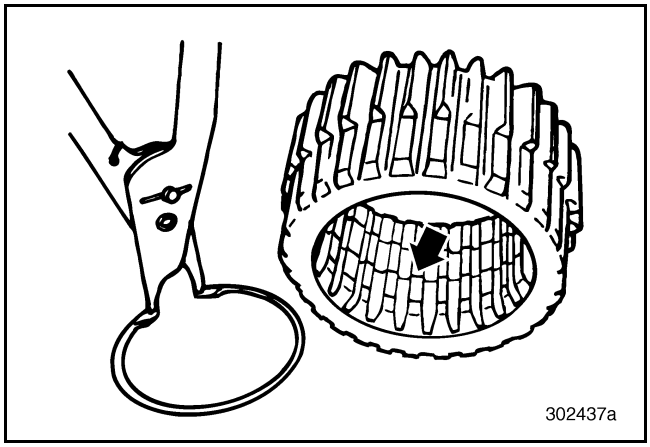


Figure 242 — Removing Snap Ring from Gear (T313L21/T318L21 Shown)

12. On the extended output shaft transmissions: T313–T318(21)(L21)(LR21), remove the Hi-range/Hi-split gear and ball bearing from the synchronizer assembly. Place two long-handled pry bars between the synchronizer thrust plate (spacer) and Hi-range/Hi-split gear. Apply steady pressure on gear to overcome the slight interference fit between shaft and ball bearing inner race.

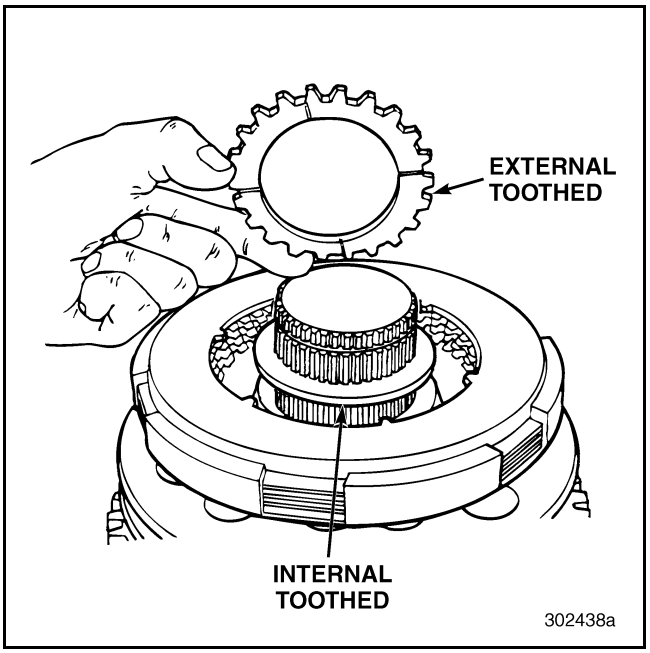


Figure 243 — Removing External-Toothed Thrust Washer (T313L21/T318L21 Shown)

13. For the extended output shaft transmissions: T313–T318(21)(L21)(LR21), remove the internal-toothed thrust washer and snap ring from the front of the synchronizer assembly.

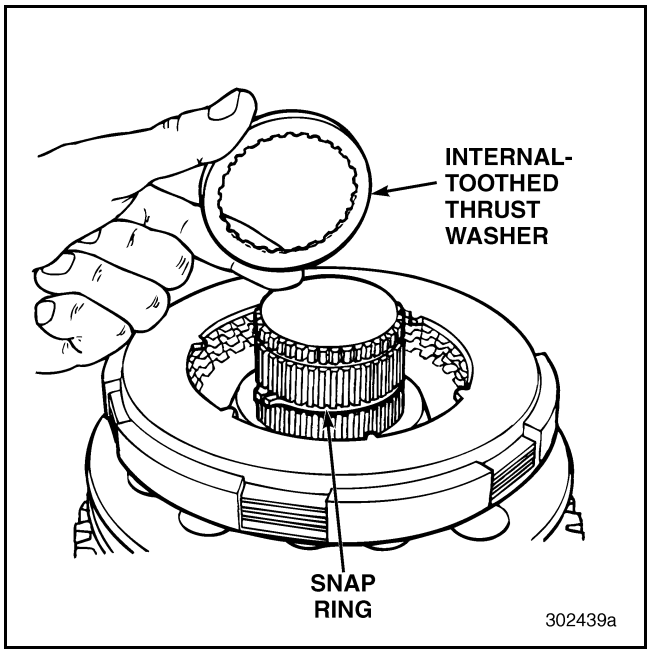


Figure 244 — Removing Internal-Toothed Thrust Washer and Snap Ring (T313L21/T318L21 Shown)

14. Remove the spacer from the front synchronizer disc pack.

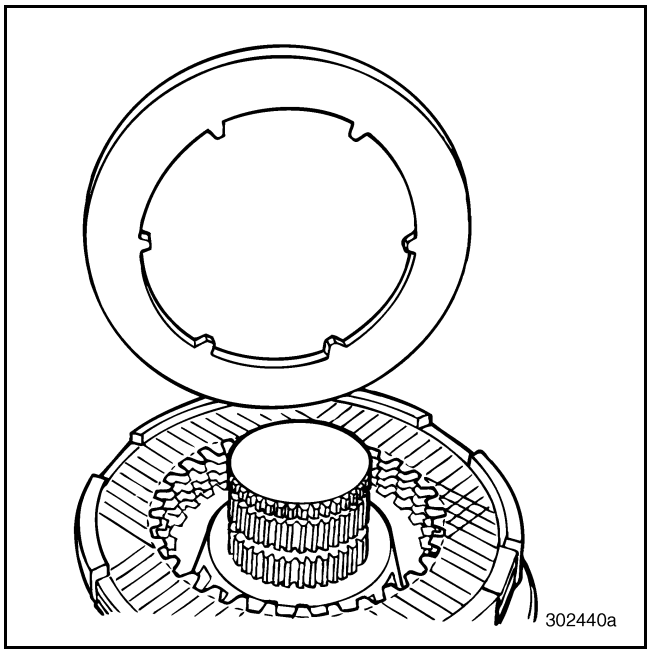


Figure 245 — Removing Spacer from Disc Pack (T313L21/T318L21 Shown)

15. Remove the first internal-toothed friction disc from the front synchronizer disc pack.

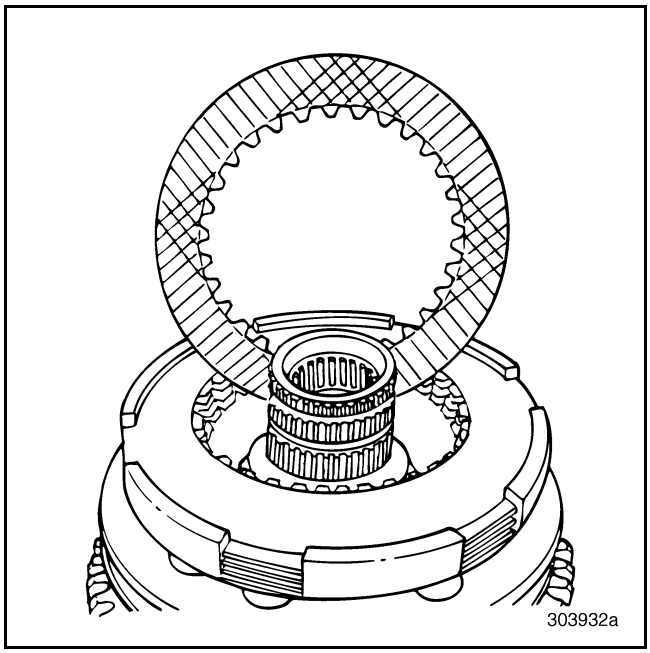


Figure 246 — Removing Friction Disc (T313L/T318L Shown)

16. Remove the first external-toothed reaction disc from the front synchronizer disc pack.

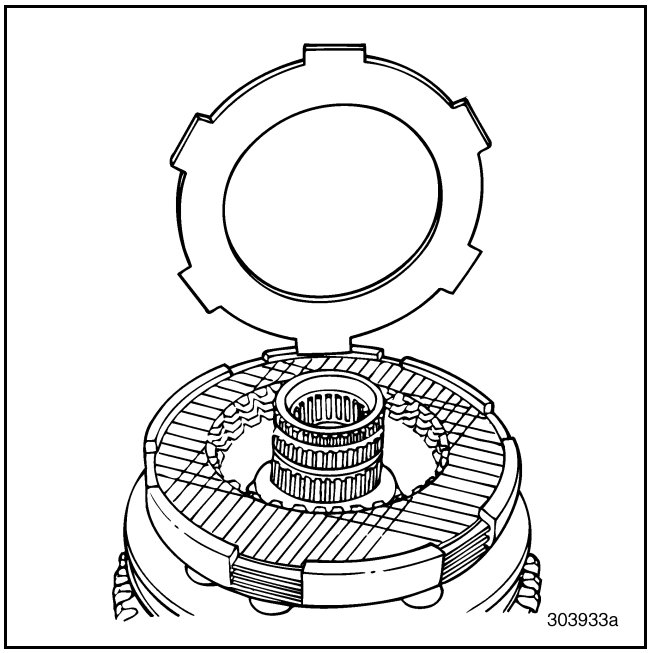


Figure 247 — Removing Reaction Disc (T313L/T318L Shown)

17. Continue removing the friction and reaction discs until all are removed.
18. Remove the synchronizer assembly from the rear mainshaft.

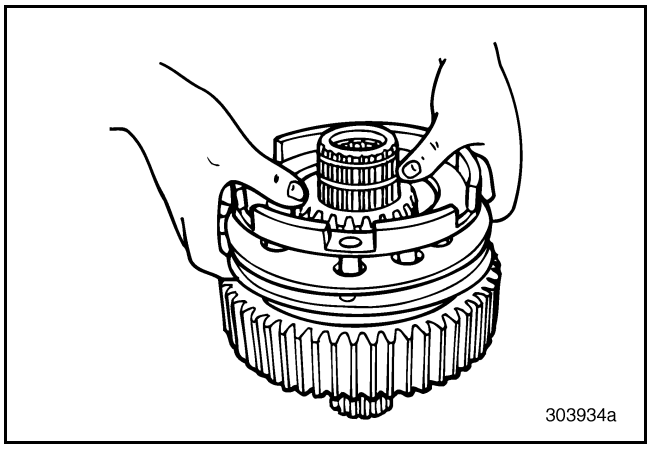


Figure 248 — Removing Synchronizer Assembly (T313L/T318L Shown)

19. Set the synchronizer assembly aside for later disassembly.

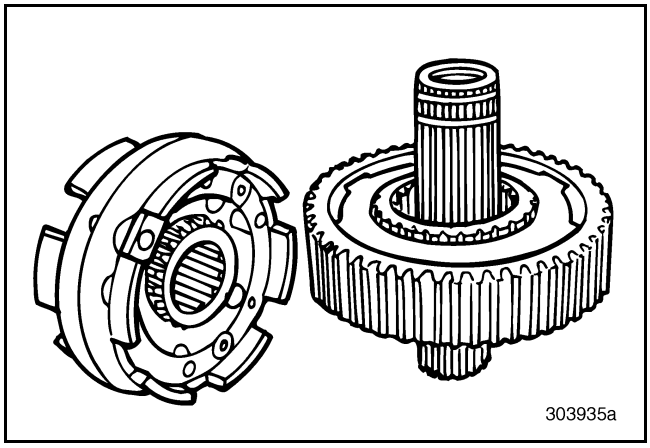


Figure 249 — Synchronizer Assembly Removed (T313L/T318L Shown)

20. Remove the first external-toothed reaction disc from the rear synchronizer disc pack.

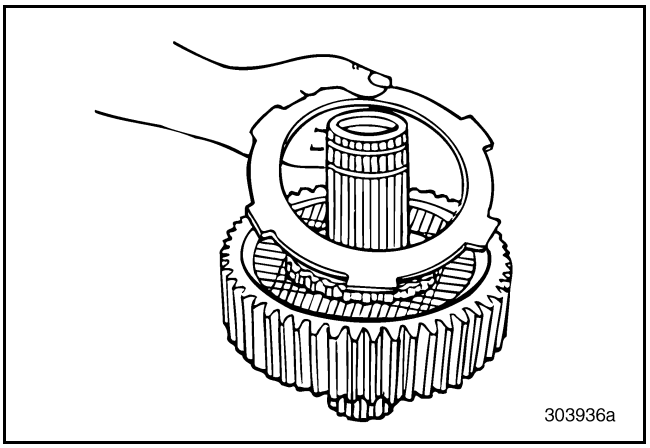


Figure 250 — Removing Reaction Disc (T313L/T318L Shown)

21. Remove the first internal-toothed friction disc from the rear synchronizer disc pack.

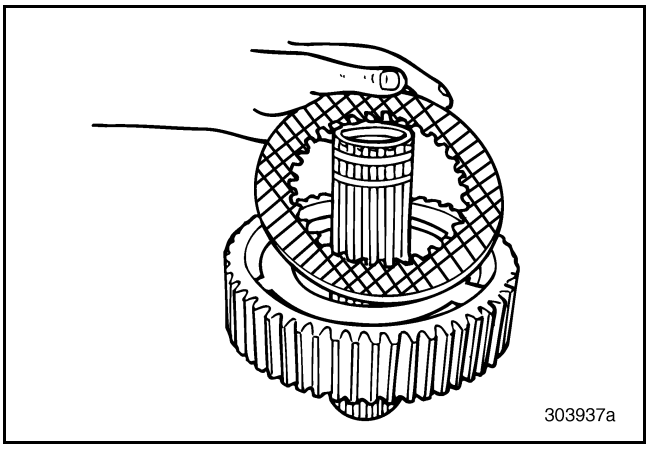


Figure 251 — Removing Friction Disc (T313L/T318L Shown)

22. Continue removing the friction and reaction discs until all are removed.
23. Remove the shaft snap ring from inside the Lo-range gear hub.

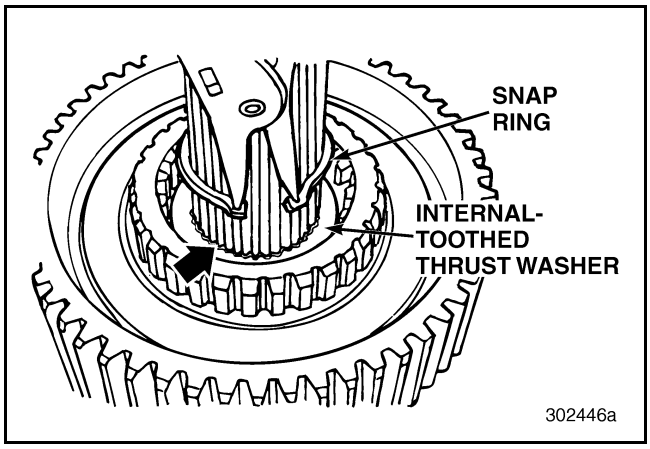


Figure 252 — Removing Shaft Snap Ring

24. Remove the internal-toothed thrust washer from inside the Lo-range gear hub.

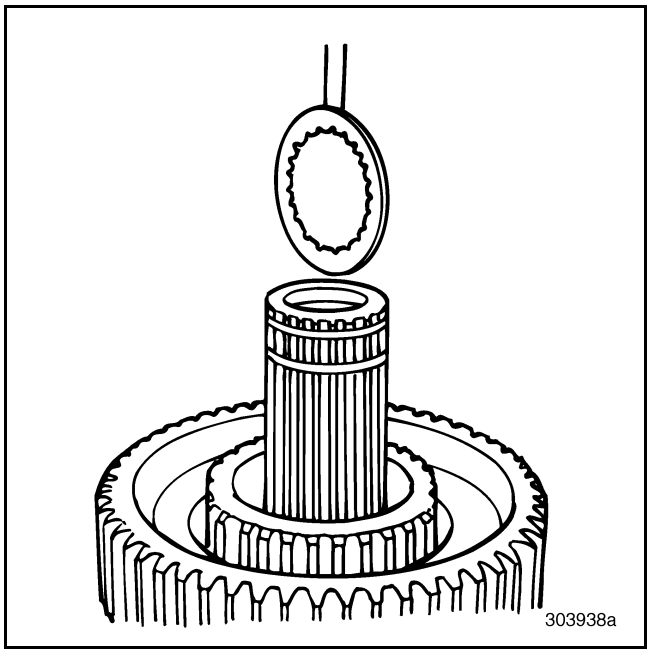


Figure 253 — Removing Hub Thrust Washer (T313L/T318L Shown)

25. Remove the larger snap ring that secures the Lo-range gear to the gear hub.

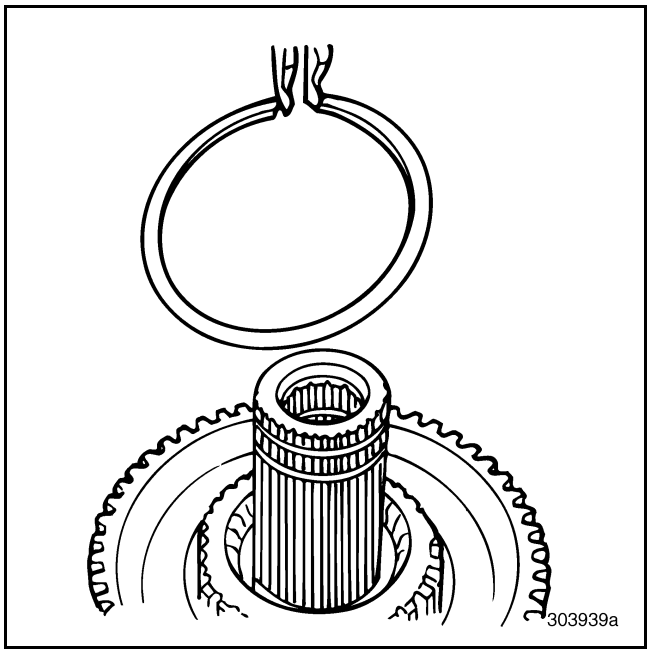


Figure 254 — Removing Gear-to-Hub Snap Ring (T313L/T318L Shown)

26. Remove the Lo-range gear from the hub. Notice that the ground surface on the gear faces the front of the transmission.

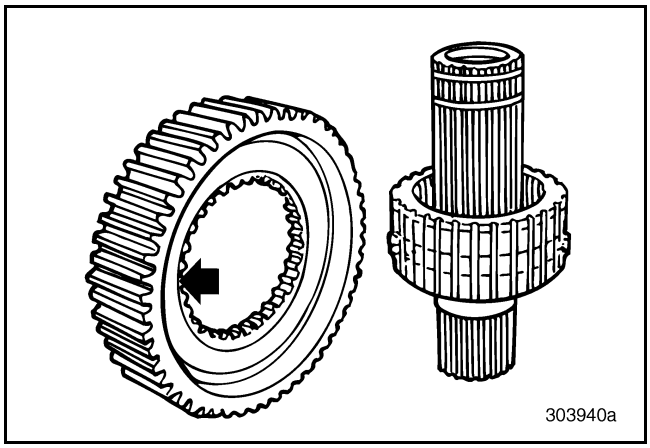


Figure 255 — Removing Lo-Range Gear from Hub (T313L/T318L Shown)

27. Remove the Lo-range gear hub from the rear mainshaft.

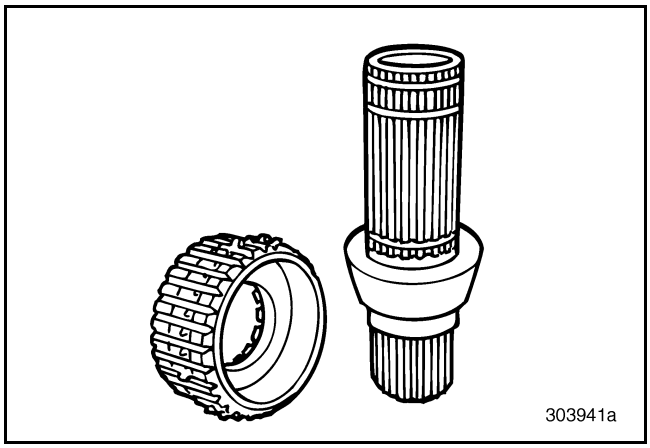


Figure 256 — Removing Lo-Range Gear Hub from Rear Mainshaft (T313L/T318L Shown)

28. On the extended output shaft transmissions: T313–T318(21)(L21)(LR21), position the output shaft in a suitable press. Separate the tapered roller bearing cone from the shaft, using bearing separator J 8176 or equivalent.

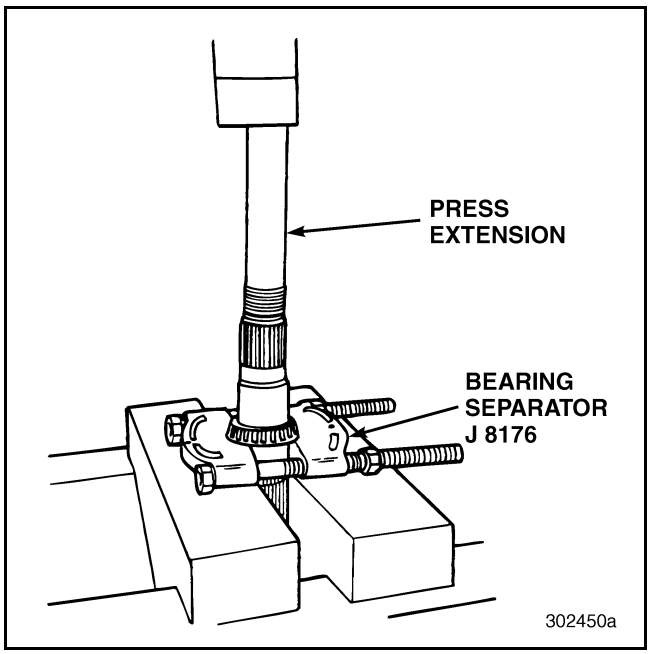


Figure 257 — Separating Bearing Cone from Output Shaft (T313L21/T318L21 Shown)

29. For the conventional output shaft transmissions: T313–T318(L)(LR), remove the spigot bearing snap ring from inside the front end of the rear mainshaft.

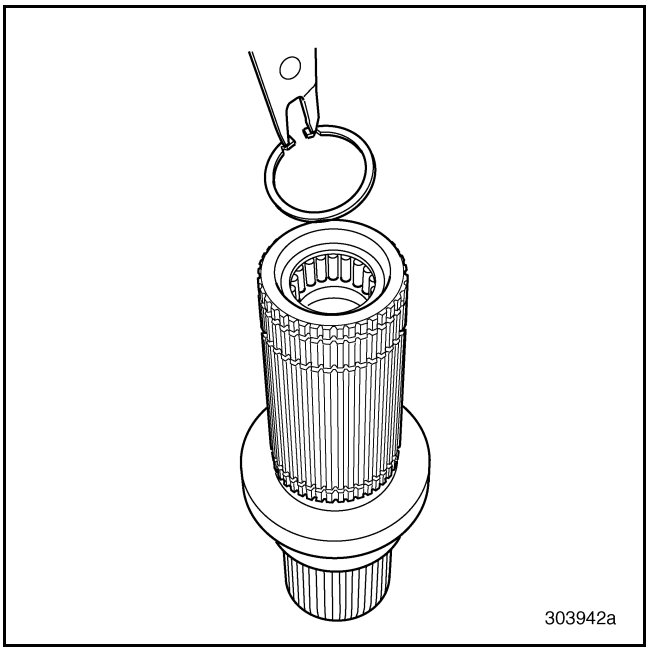


Figure 258 — Removing Spigot Bearing Snap Ring (T313L/T318L Shown)

30. On the conventional output shaft transmissions: T313–T318(L)(LR), using a suitable bearing puller, remove the spigot bearing from the front end of the rear mainshaft.

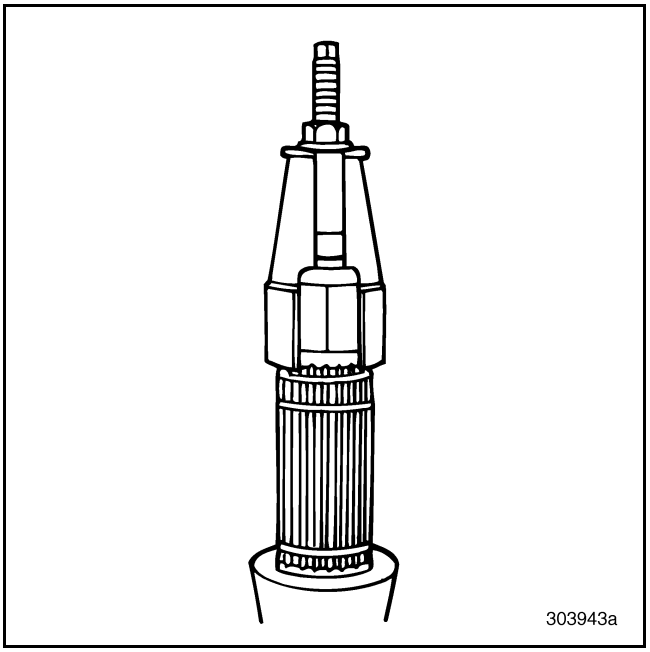


Figure 259 — Removing Spigot Bearing from Rear Mainshaft (T313L/T318L Shown)

SYNCHRONIZER DISASSEMBLY

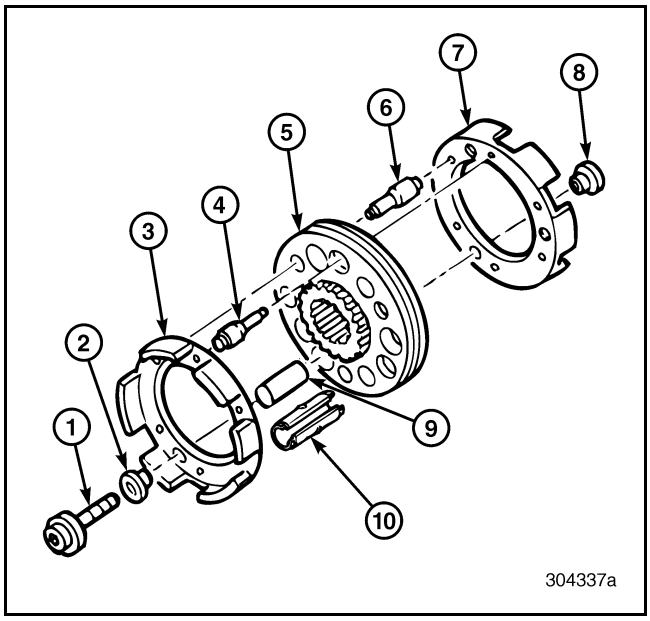


Figure 260 — Exploded View of Synchronizer

1. 12-Point Screw	7. Clutch Housing
2. Nonthreaded Insert	8. Threaded Insert
3. Clutch Housing	9. Support Tube
4. Synchronizer Pin	10. Preload Spring Assembly
5. Sliding Clutch	
6. Synchronizer Pin	

1. Remove the 12-point screws and threaded and nonthreaded inserts from the synchronizer assembly.

NOTE

Effective November 28, 2007, a revised fastener was implemented into production at this synchronizer location. These fasteners are one-time use only and must be replaced anytime the synchronizer assembly is disassembled.

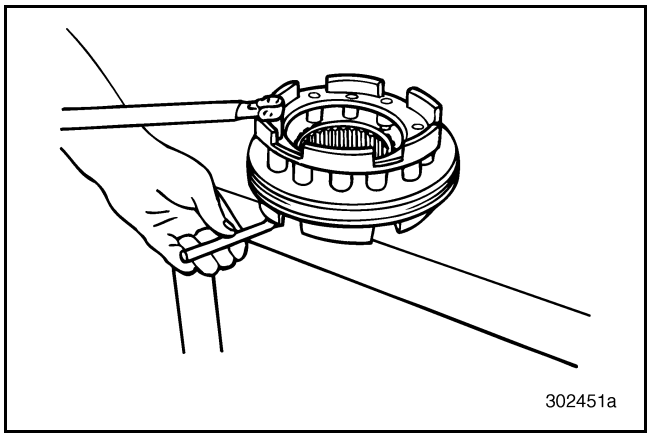


Figure 261 — Removing 12-Point Screws

2. Remove the clutch housing from the assembly.
3. Remove the three support tubes and preload springs from the synchronizer assembly.

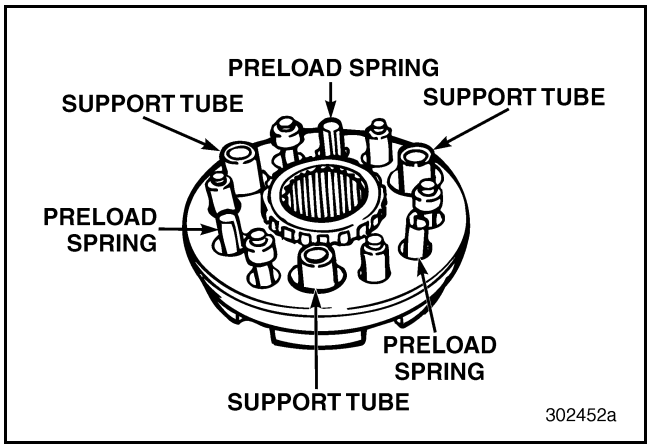


Figure 262 — Remove Synchronizer Support Tubes and Preload Springs

4. Remove the sliding clutch from the remaining clutch housing.

NOTE

As you remove the synchronizer sliding clutch and pins, notice that the pins and the sliding clutch are marked with the letter “R”, which stands for “Rear.” All the R marks on either end of the pins are placed on the same side of the sliding clutch marked with the letter R. During reassembly, make sure to coordinate all R marks on both the pins and sliding clutch of the synchronizer assembly. All R marks must face the rear of the transmission when installed.

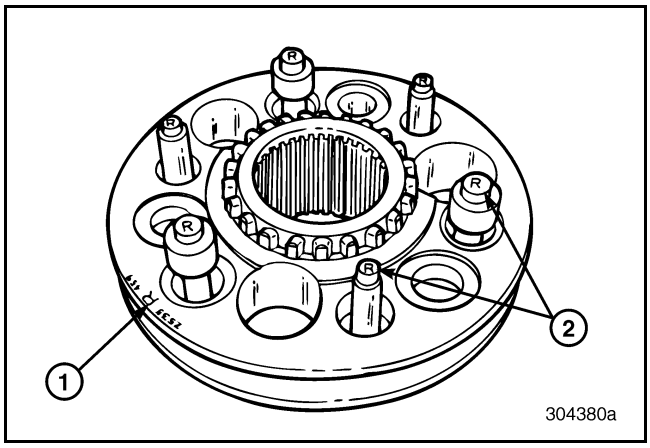


Figure 263 — Letter "R" on Sliding Clutch and Synchronizer Pins

1. "R" on Sliding Clutch, Faces Rearward	2. "R" on Synchronizer Pins, Faces Rearward

5. Remove the synchronizer pins from the remaining clutch housing.

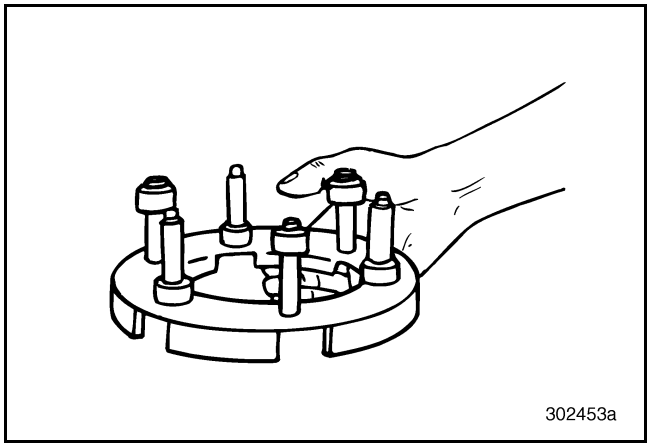


Figure 264 — Removing Synchronizer Pins

6. Thoroughly clean the synchronizer assembly and inspect for damage.

Rear Mainshaft Bearing Cover Disassembly: T313–T318(L)(LR) [321]

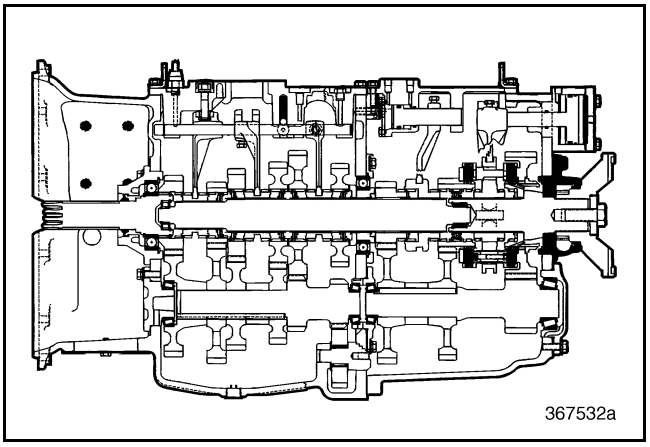


Figure 265 — Rear Mainshaft Bearing Cover Component Locator (T313L/T318L Shown)

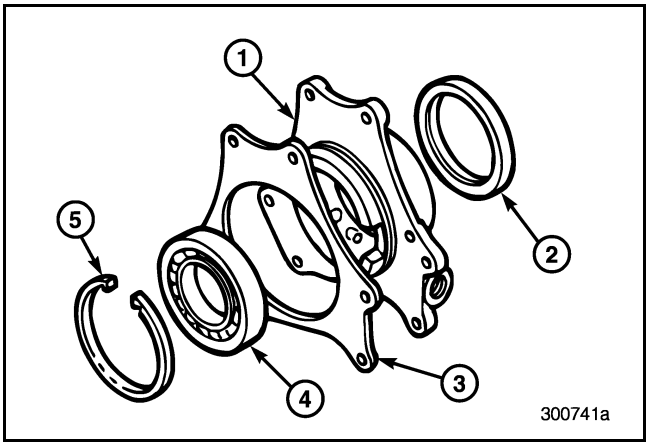


Figure 266 — Exploded View of Rear Mainshaft Bearing Cover

1. Bearing Cover 2. Oil Seal 3. Gasket	4. Bearing 5. Snap Ring

1. Remove the gasket from the bearing cover. Discard the cover gasket.
2. Remove the snap ring securing the bearing in the rear mainshaft bearing cover, using suitable snap ring pliers.

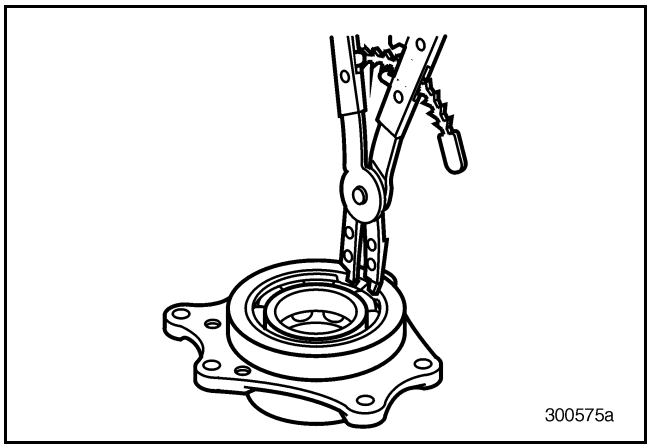


Figure 267 — Removing Snap Ring from Rear Mainshaft Bearing Cover

3. Remove the bearing from the rear mainshaft bearing cover, using a suitable puller.

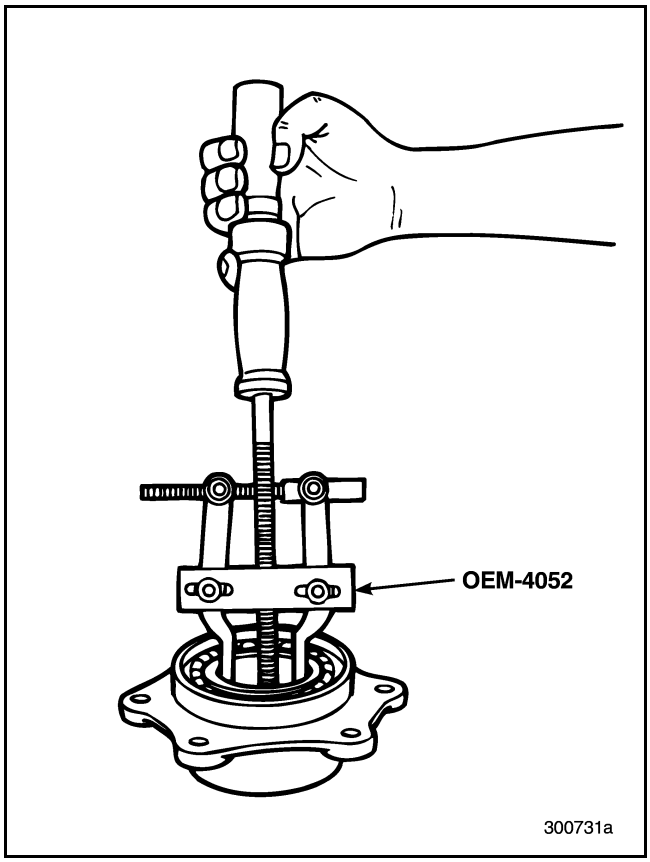


Figure 268 — Removing Bearing from Bearing Cover

4. Remove the oil seal from the rear mainshaft bearing cover, using a hammer and blunt punch. Drive the seal out from the opposite side. Discard the cover oil seal.

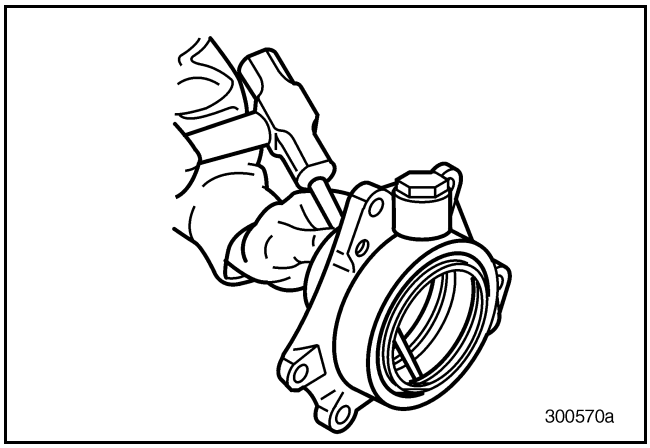


Figure 269 — Using Hammer and Blunt Punch to Remove Oil Seal

NOTE

This action destroys the oil seal. Make sure a replacement oil seal is readily available.

5. Thoroughly clean the rear mainshaft bearing and bearing cover, and inspect for damage.

Rear Output Housing Disassembly: T313–T318(21)(L21)(LR21)

[321]

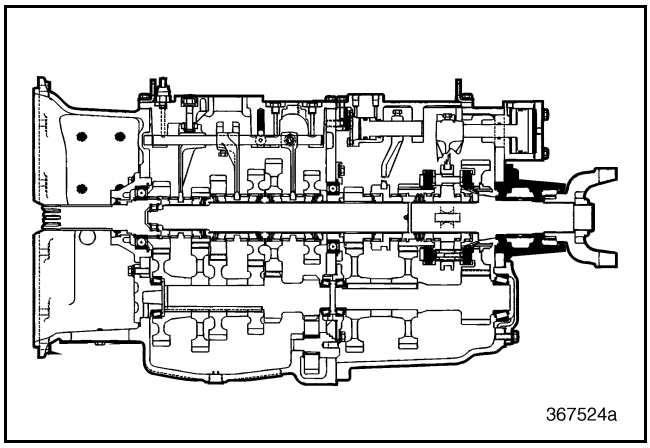


Figure 270 — Rear Output Housing Component Locator (T313L21/T318L21 Shown)

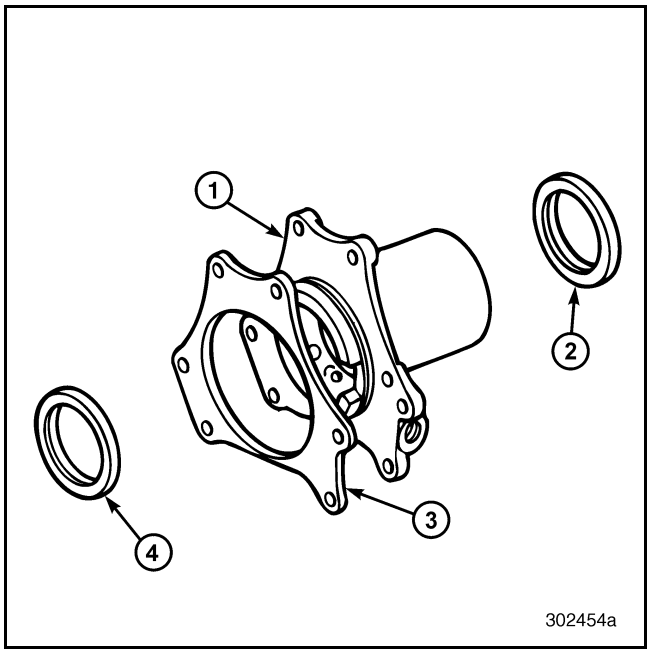


Figure 271 — Exploded View of Rear Output Housing

1. Rear Output Housing	3. Gasket
2. Outer Bearing Cup	4. Inner Bearing Cup

1. Remove the gasket from the bearing cover.
2. Using a blunt punch and hammer, remove the outer bearing cup from the output housing.

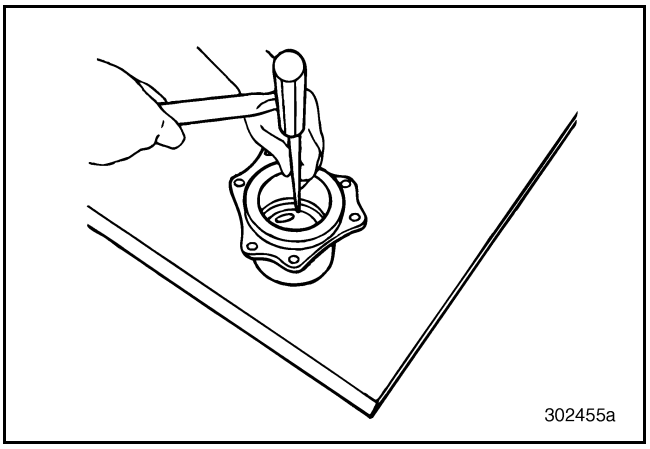


Figure 272 — Removing Bearing Cup from Housing

3. In the same manner, remove the inner bearing from the output housing.
4. Thoroughly clean the rear output housing, and inspect for damage.

Front Countershaft Front Bearing Cover Disassembly

[321]

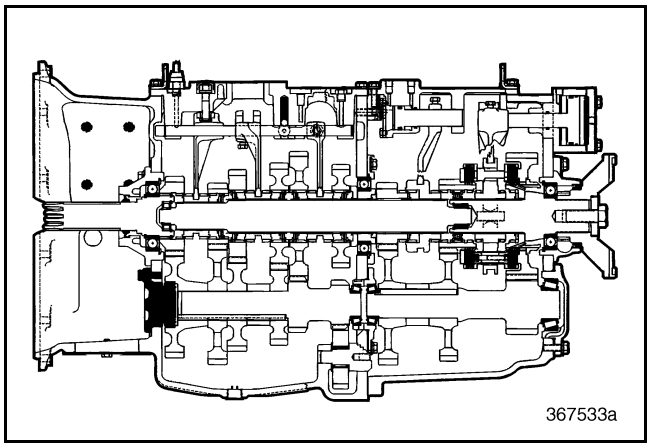


Figure 273 — Front Countershaft Front Bearing Cover Component Locator (T313L/T318L Shown)

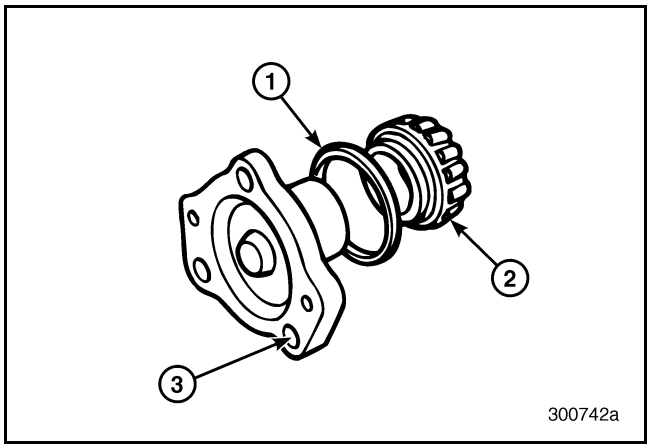


Figure 274 — Exploded View of Front Countershaft Front Bearing Cover

1. O-Ring 2. Bearing Cone	3. Front Bearing Cover

The following procedure applies to all three front countershaft front bearing covers.

1. Remove the O-ring from the shoulder of the front countershaft front bearing cover.

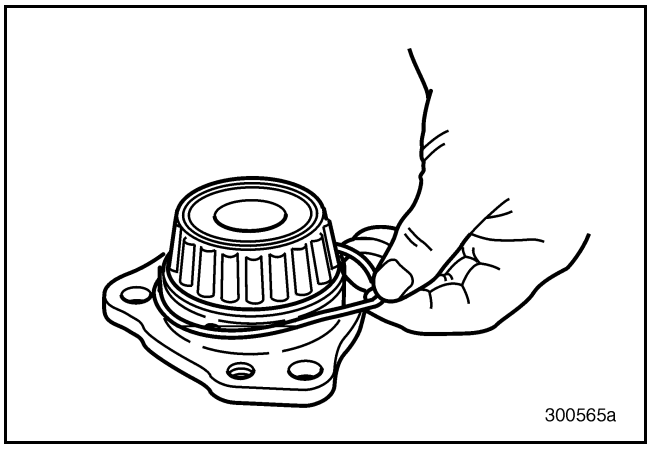


Figure 275 — Removing O-Ring from Shoulder of Front Countershaft Front Bearing Cover

2. Remove the bearing cone from the front countershaft front bearing cover, using a suitable puller such as J 39477 with bearing separator J 8176 or equivalent.

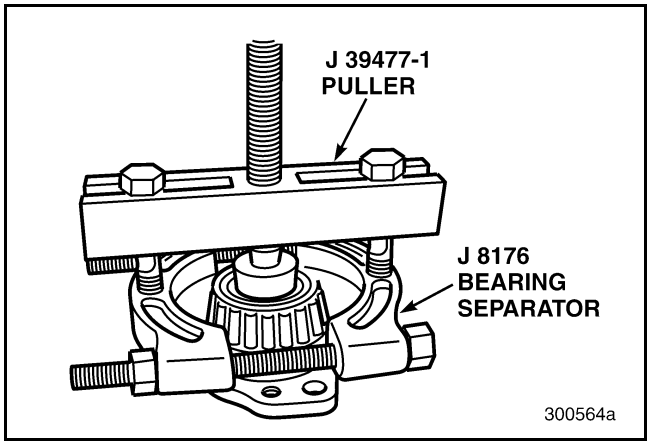


Figure 276 — Removing Bearing Cone from Front Countershaft Front Bearing Cover

3. Thoroughly clean the bearing cover and inspect for damage.

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Front Countershaft Disassembly [322]

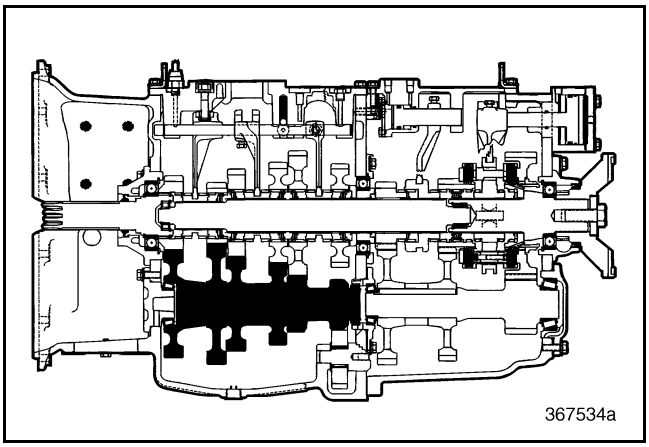


Figure 277 — Front Countershaft Component Locator (T313L/T318L Shown)

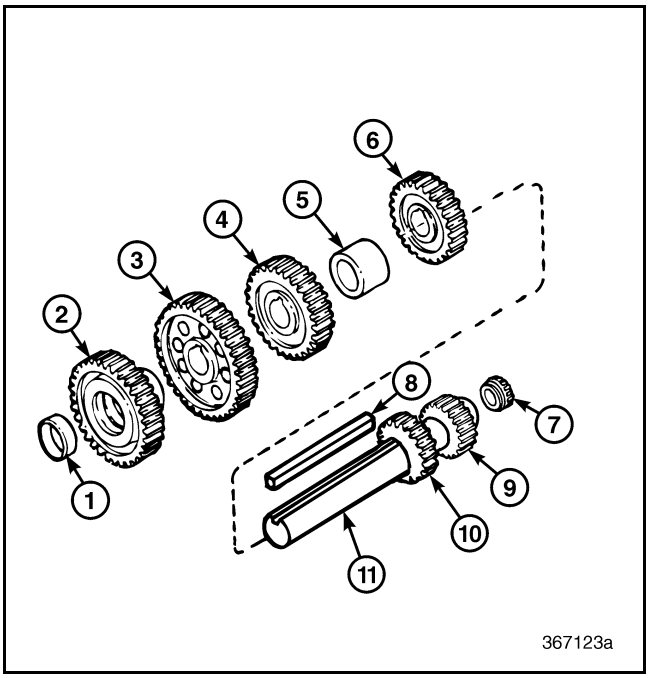


Figure 278 — Exploded View of Front Countershaft

1. Bearing Cup 2. Main Drive Gear 3. Fourth Speed Gear 4. Second Speed Gear 5. Front Spacer 6. First Speed Gear 7. Bearing Cone 8. Key	9. Lo-Speed Gear (Integral with Countershaft) 10. Reverse Gear (Integral with Countershaft) 11. Front Countershaft (Contains Two Integral Gears)

⚠ DANGER

Do not attempt to press-remove the Lo speed or reverse gears from the shaft. These gears are integral with the shaft and could fragment explosively when pressing action is attempted.

The following procedure applies to all three front countershafts.

1. Place the front countershaft on the press table with the front of the shaft up and suspend the main drive gear, fourth (eighth) and second (sixth) gears using a suitable puller or bearing separator such as J 8176 or equivalent. Press the third (seventh), fourth (eighth) and second (sixth) gears from the countershaft as a group.

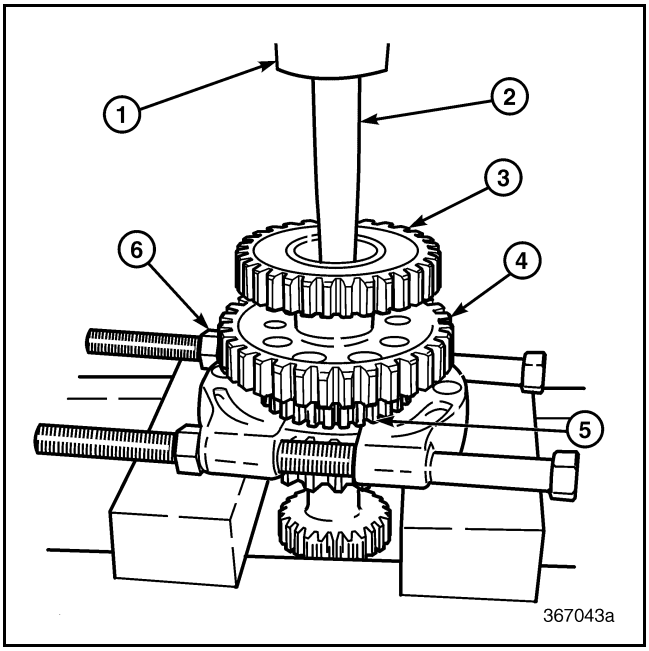


Figure 279 — Pressing Gears off Shaft

1. Press Ram 2. Press Extension 3. Main Drive Gear 4. Fourth (Eighth) Gear	5. Second (Sixth) Gear 6. Bearing Separator J 8176 or Equivalent

2. Remove the first (fifth) and second (sixth) gear spacer by hand.

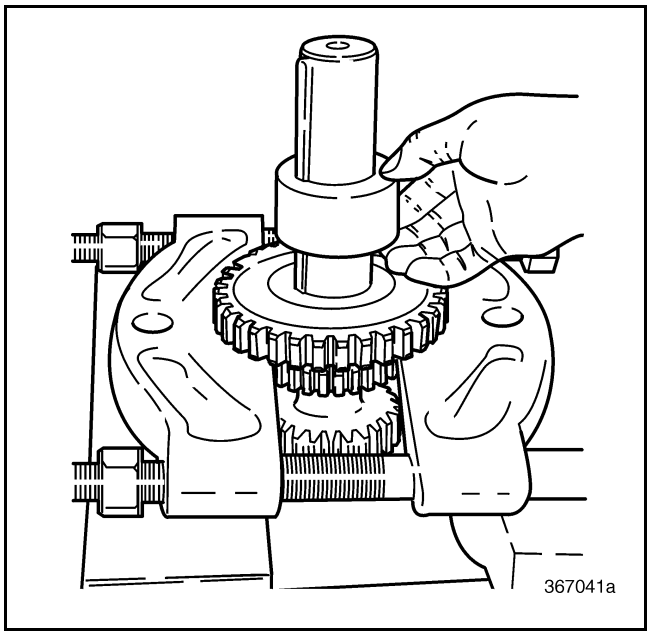


Figure 280 — Removing First/Second Gear Spacer

3. Reposition the countershaft on the press table to suspend the first (fifth) gear, using a suitable puller or bearing separator such as J 8176 or equivalent. Apply press pressure to the countershaft and remove gear from shaft.

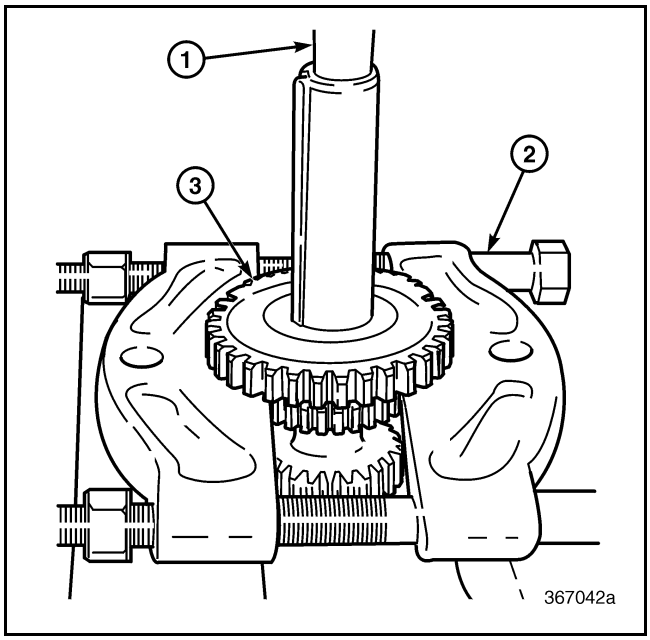


Figure 281 — Pressing First (Fifth) Gear off Shaft

1. Press Arbor 2. Bearing Separator J 8176 or Equivalent	3. First (Fifth) Gear

4. Pull the rear bearing cone off the rear end of the countershaft, using a suitable knife puller and bearing separator arrangement such as puller J 4558-01 and bearing separator J 22912-01 or equivalent.

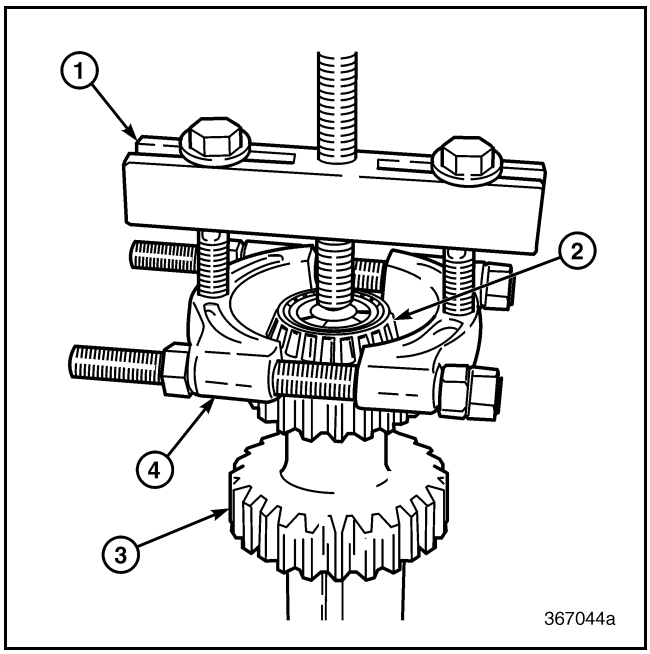


Figure 282 — Removing Rear Bearing Cone

1. Bar Type Puller J 4558-01 2. Countershaft Tapered Roller Bearing	3. Front Countershaft 4. Bearing Separator J 22912-01 or Equivalent

5. Remove the key from the keyway of the front countershaft.

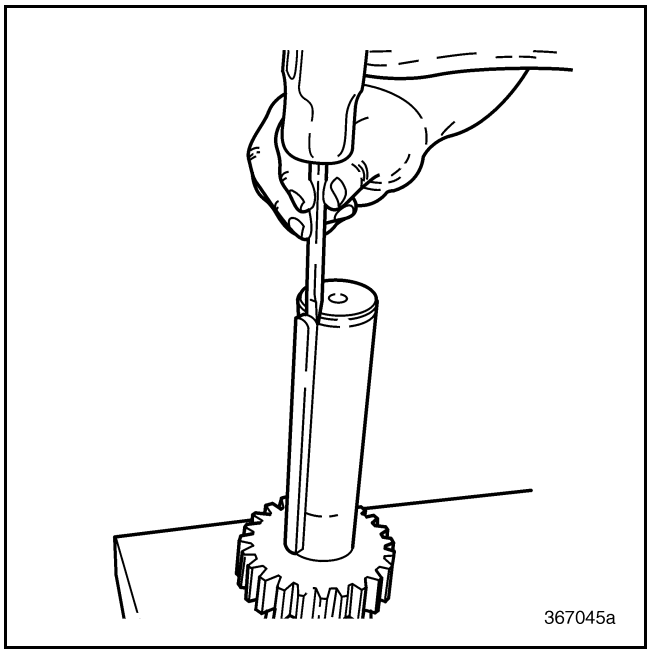


Figure 283 — Removing Key

6. Remove the bearing cup from the front countershaft main drive gear, using a suitable puller.

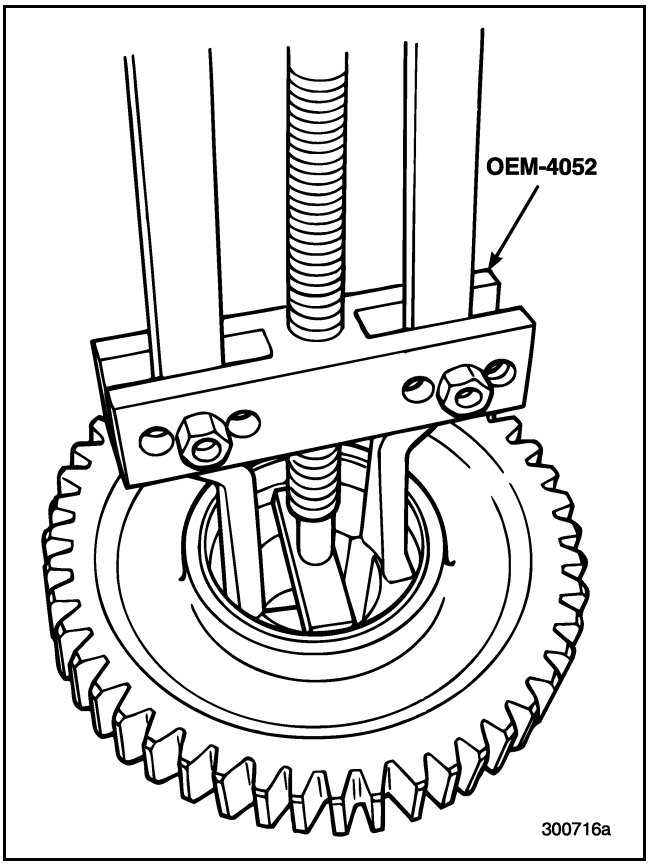


Figure 284 — Removing Bearing Cup from Main Drive Gear

7. Inspect the countershaft integral Lo and reverse gears. Any damage or defects to these gears require replacement of the entire countershaft as the gears cannot be removed from the shaft.

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Front Countershaft Rear Bearing Cover Disassembly

[321]

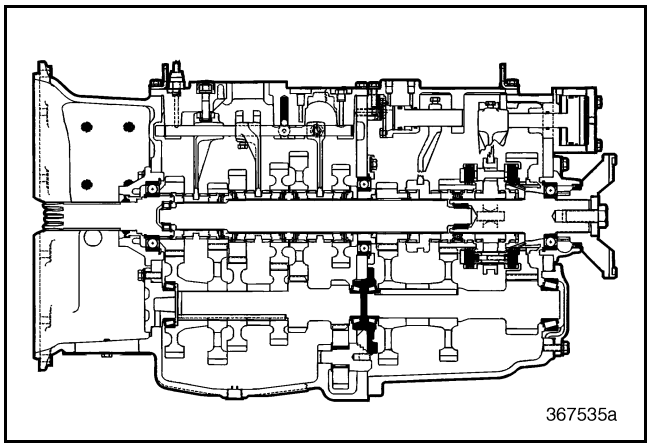


Figure 285 — Front Countershaft Rear Bearing Cover Component Locator (T313L/T318L Shown)

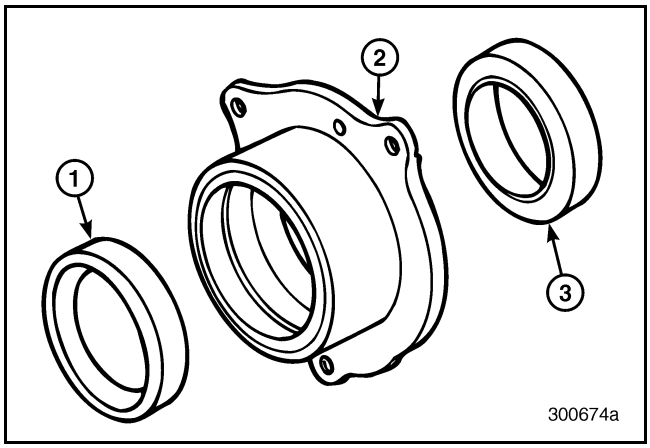


Figure 286 — Exploded View of Front Countershaft Rear Bearing Cover

1. Front Bearing Cup 2. Bearing Cover	3. Rear Bearing Cup

The following procedure applies to all three front countershaft rear bearing covers.

1. Remove the front and rear bearing cups from the front countershaft rear bearing cover.

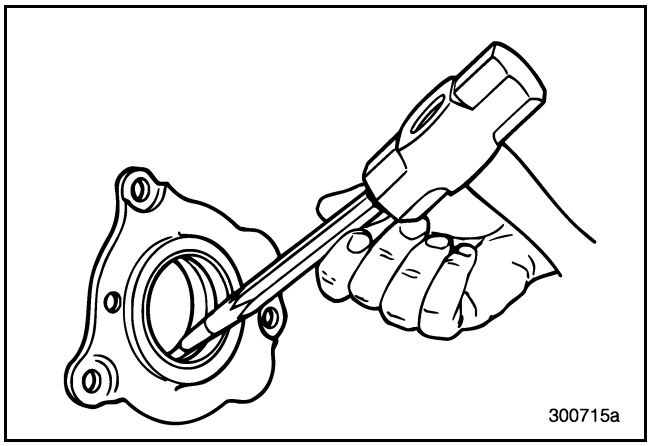


Figure 287 — Removing Front Bearing Cup

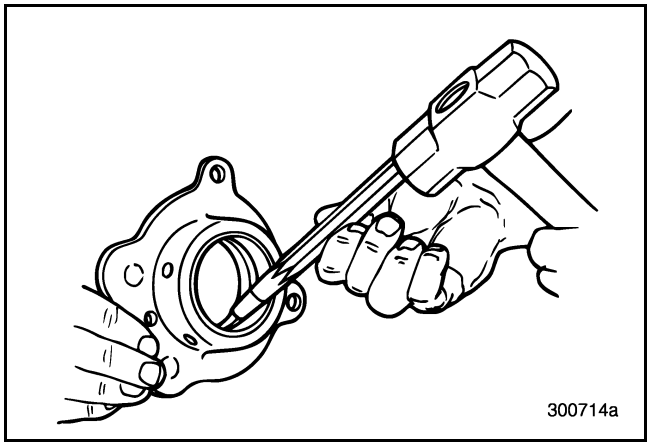


Figure 288 — Removing Rear Bearing Cup

2. Thoroughly clean the bearing cover and inspect for damage.

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Rear Countershaft Disassembly

[322]

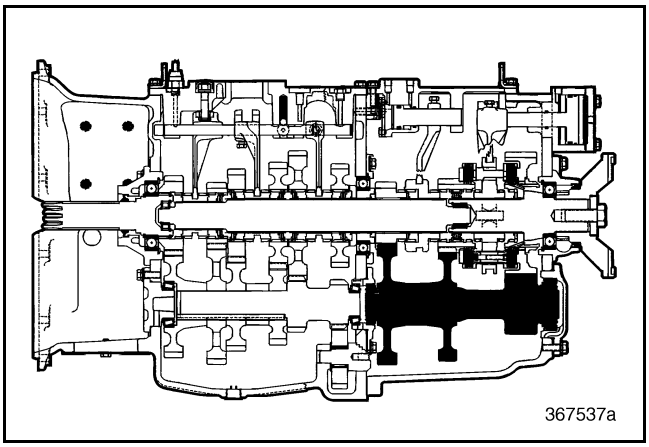


Figure 289 — Rear Countershaft Locator (T313L/T318L Shown)

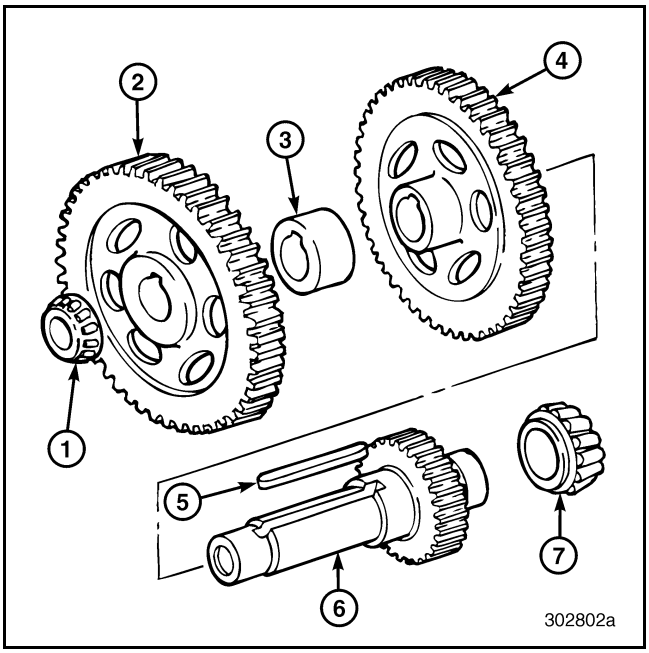


Figure 290 — Exploded View of Rear Countershaft

1. Front Bearing Cone 2. Lo-Split Gear 3. Spacer 4. Hi-Range/Hi-Split Gear 5. Key	6. Rear Countershaft (Lo-Range Gear Part of Shaft) 7. Rear Bearing Cone

The following procedure applies to all three rear countershafts.

⚠ DANGER

Do not attempt to press the Lo-range gear off these rear countershafts. The gear is integral with the shaft and can explode if pressed.

1. Press the rear bearing cone off the rear countershaft, using a bearing separator such as J 8176 or equivalent.

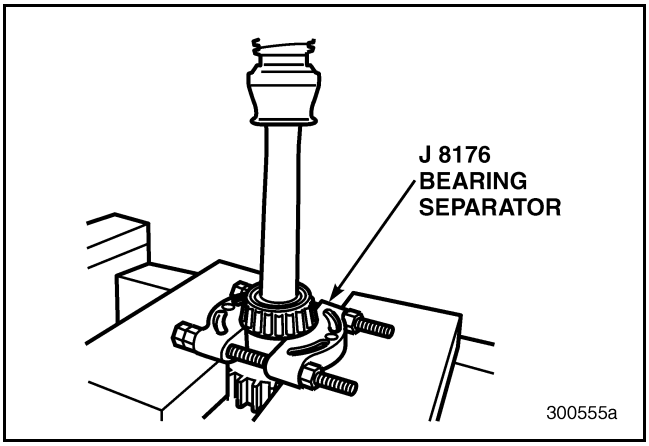


Figure 291 — Pressing off Rear Bearing Cone

2. Press the rear countershaft Lo-split gear and the front bearing cone off the countershaft.

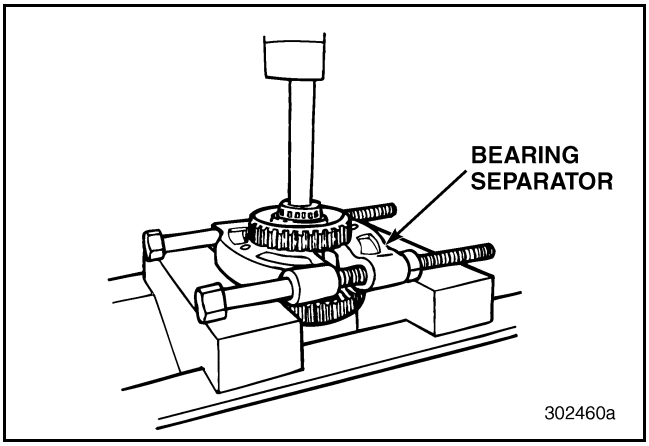


Figure 292 — Pressing off Lo-Split Gear and Bearing Cone

3. Remove the spacer located between the Lo-split gear and the Hi-range/Hi-split gear.
4. Press the Hi-range/Hi-split gear from the countershaft. Note that the hub of the gear faces forward.

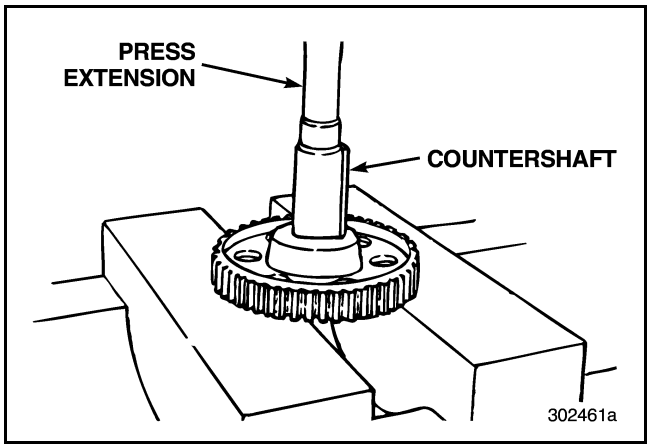


Figure 293 — Pressing off Hi-Range/Hi-Split Gear

5. Remove the key from the keyway of the rear countershaft.

Rear Countershaft Bearing Cover Disassembly

[321]

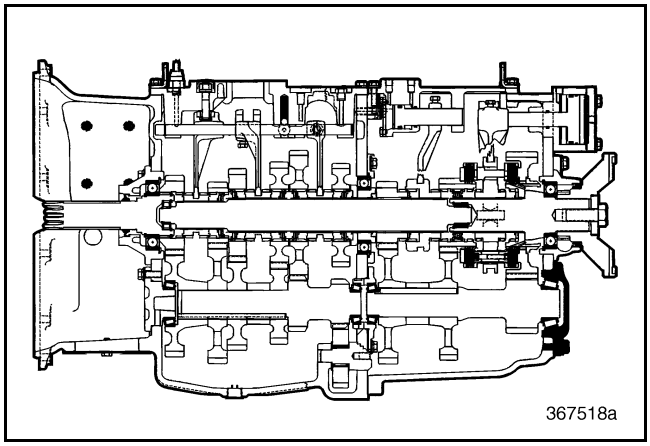


Figure 294 — Rear Countershaft Bearing Cover Component Locator (T313L/T318L Shown)

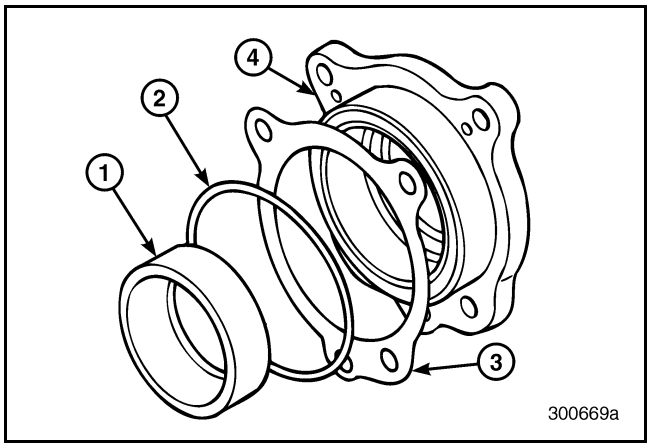


Figure 295 — Exploded View of Rear Countershaft Bearing Cover

1. Bearing Cup 2. O-Ring	3. Shim(s) 4. Bearing Cover

The following procedure applies to all three rear countershaft bearing covers.

1. Remove the shim(s) and O-ring from the shoulder of the countershaft rear bearing cover. Tag the shim(s) and record the markings for use during assembly.

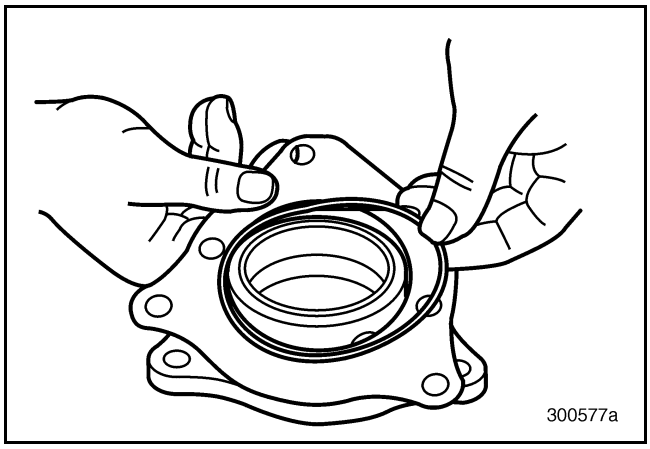


Figure 296 — Removing Cover Shims and O-Ring

2. Remove the bearing cup from the bearing cover, using puller J 21834-4A or suitable puller.

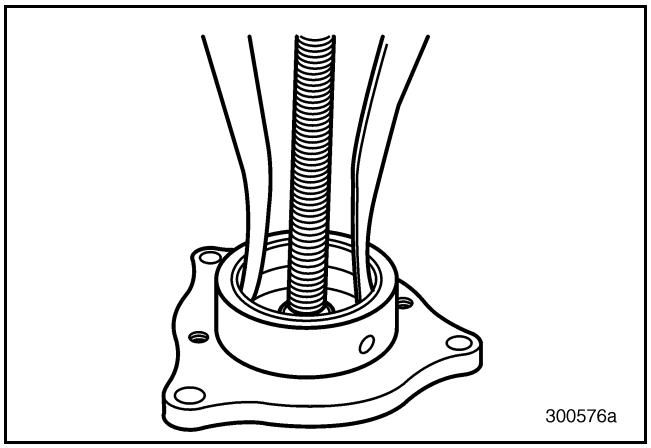


Figure 297 — Removing Bearing Cup from Cover

3. Thoroughly clean the bearing cover and inspect for damage.

Reverse Idler Gear Disassembly [322]

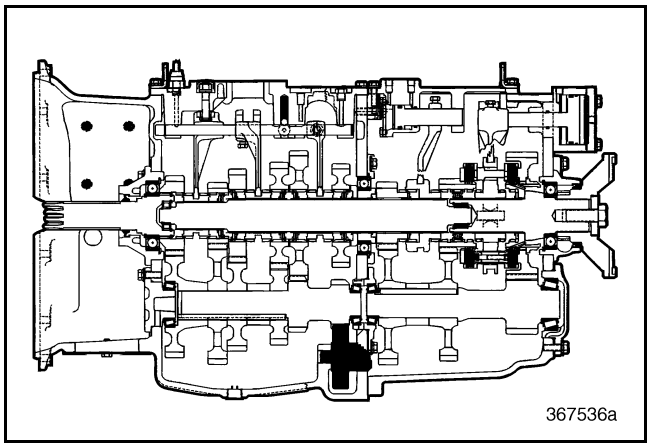


Figure 298 — Reverse Idler Gear Component Locator (T313L/T318L Shown)

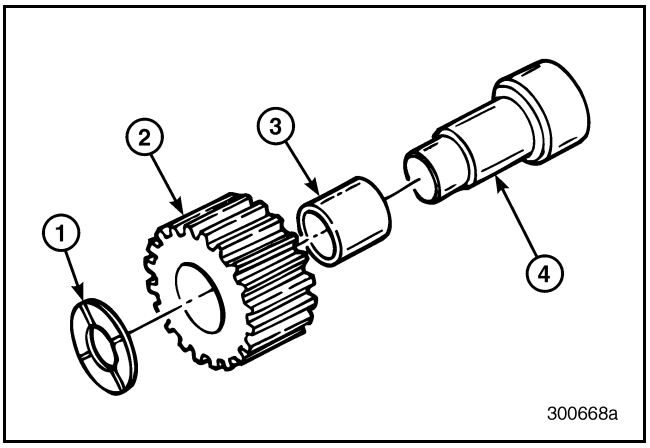


Figure 299 — Exploded View of Reverse Idler Gear Assembly

1. Thrust Washer	3. Bearing
2. Reverse Idler Gear	4. Reverse Idler Shaft

The following procedure applies to all three reverse idler gears.

1. Press the bearing out of the reverse idler gear, using a suitable driver.

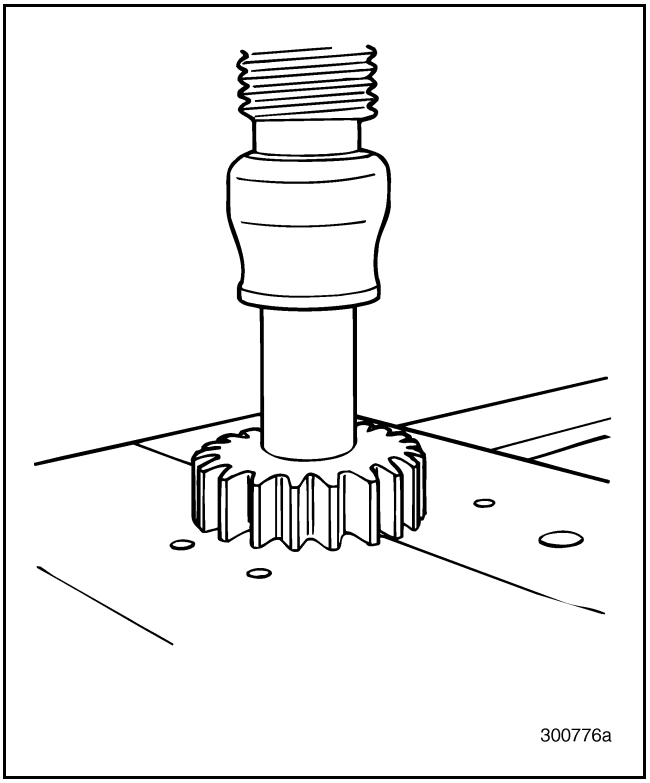


Figure 300 — Pressing out Reverse Idler Gear Bearing

2. Thoroughly clean the reverse idler gear and inspect for damage.

INSPECTION OF PARTS

Inspection and Cleaning

Thoroughly clean the cases, covers and all other parts of the transmission. Remove all grease, oil and foreign matter, using a suitable safety solvent. Dry the parts with moisture-free compressed air.

Bearings

[322]

Soak bearings in fresh clean solvent to loosen all hardened grease and foreign matter, until the bearings are clean. Blow them dry with filtered, moisture-free compressed air.

⚠ CAUTION

Do not spin the bearings with compressed air. Doing so can damage the bearings.

Inspect each bearing for flaking, cracks, fractures, cavities, indentations, measurable wear, brinelling, fretting, corrosion, nicking, cage wear or deformation and other damage. If any of these conditions are present, the bearing should be replaced.

Apply a light coat of fresh, clean, specified gear oil to the bearings. (Refer to Recommended SAE Grade Gear Oil in “Transmission Specifications and Capacities” on page 237.) Turn the races and bearings slowly by hand to be sure they move freely and are smooth. If there is resistance to movement, or if the bearing cones or cups feel rough, replace the bearings.

⚠ CAUTION

If a bearing cone or cup needs replacement, a complete new assembly, including cup and mating cone, is required.

*Do not remove a **new** bearing from its packing before time of installation. Never clean protective grease from new bearings.*

Do not handle bearings with dirty hands. Rags must be clean and lint free.

Clean the bearings that are satisfactory for installation. Wrap the bearings in clean, lint-free cloth and store for assembly.

Gears

[322]

Replace all gears having teeth that show signs of abrasive wear, scratching (except normal manufacturing tool marks), ridging, scoring, surface fatigue, pitting, spalling, corrosive wear, digging in or cracking. Gears should always be inspected using magnaflux (or similar method) for cracks that would not otherwise be detected.

Shifter Forks, Sliding Clutches and Shift Rails

[323]

Replace forks and/or sliding clutches when the side clearance (A) between the fork (2) and sliding clutch (1) groove exceeds the specified limit (refer to “TRANSMISSION SPECIFICATIONS” on page 224).

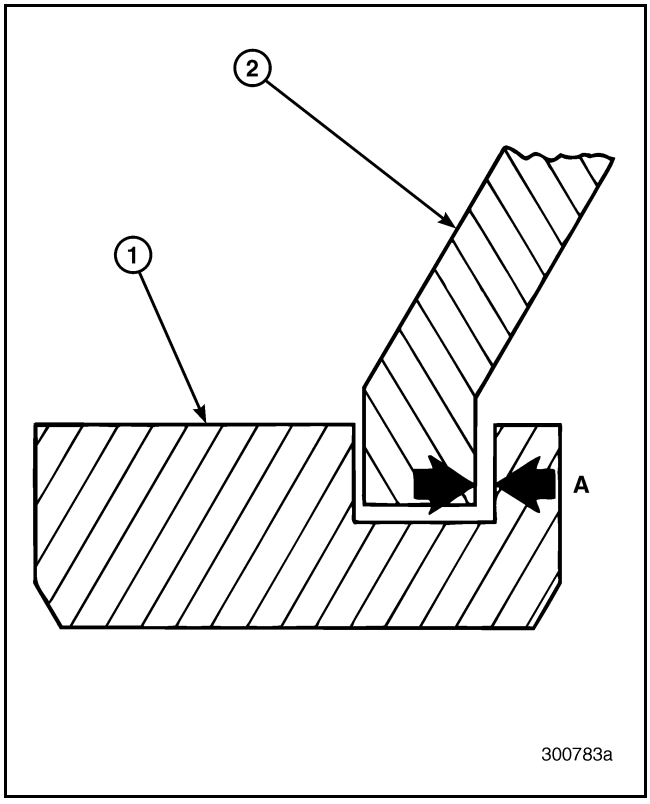


Figure 301 — Fork and Clutch Detail

Replace shift rails if they are cracked in either the poppet or setscrew holes. If the clearance between the shift rail and housing (cover) bore exceeds 0.254 mm (0.010 inch) maximum, determine which part is worn before replacing. Shaft wear can be checked by measuring the shaft at an unworn location. Then measure the shaft at the worn area and compare measurements. When measuring a shift rail, the reading should be an average of diameter measurements taken at four locations. Compare one side of the shaft to the other, AB–CD as shown in Figure 302.

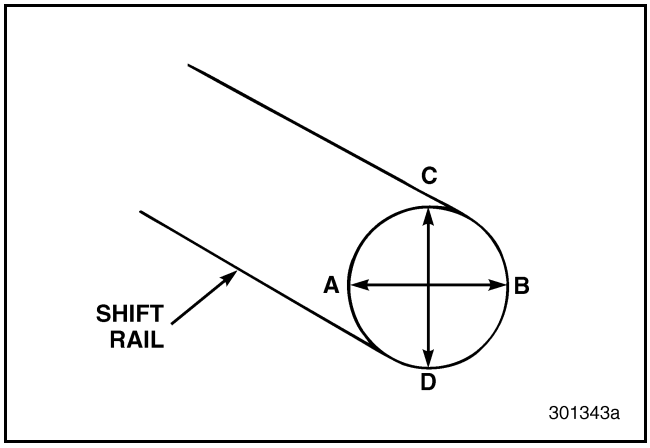


Figure 302 — Measuring Shift Rail

Oil Seals

[321]

When an overhaul is required, replace all oil seals. Be careful to ensure that the sealing surface of any seal is not damaged, turned back or cut. A nick on a shaft sealing surface can cut the seal. Remove sharp edges that can damage the seal (chamfer edges if possible). Press seals into housings, using smooth, even pressure to prevent cocking the seal.

⚠ CAUTION

Be careful when using any abrasive polishing methods, such as emery or crocus cloth, on a sealing surface. It is possible to leave microgrooves on the sealing surface. This can cause oil to leak past the sealing lip(s) of the oil seal. With this condition, a new seal will not stop the oil leak.

Be careful when installing a shaft through a **new** seal (or seal over shaft). Lubricate the shaft before inserting it through the seal. Splines, keyways and holes in a shaft can damage seals unless care is taken. Lubricate the seal to prevent damage during the initial start-up period, before normal lubrication begins. Keep anti-seize and sealing compounds away from oil seals.

If an oil seal does not have a preapplied sealant on its outer diameter, apply an appropriate sealer around the outside diameter to prevent leaks.

Lip-type oil seals are precision elements that require close attention and care during installation.

NOTE

The quality of the installation method and tools used has a direct influence on the life of the seal. Do not use a block of wood or discarded bearing as a substitute for the proper seal driver.

However, with some seal applications, a seal driver may not be available. In these situations, light tapping in a circular motion using a light, broad-faced hammer is acceptable.

For the seal to function properly, install it squarely with respect to the shaft center line. The seal should be kept square within 0.254 mm (0.010 inch) Total Indicated Runout (TIR). Squareness of the seal to the shaft is controlled by using the proper seal installation tools, as shown in Figure 303 and Figure 304.

Press seals into housings using smooth, even pressure to prevent cocking or distorting the seal. Gently press the seal into place. Correct installation depth is achieved as the driver tool bottoms against the positioning tool, as shown.

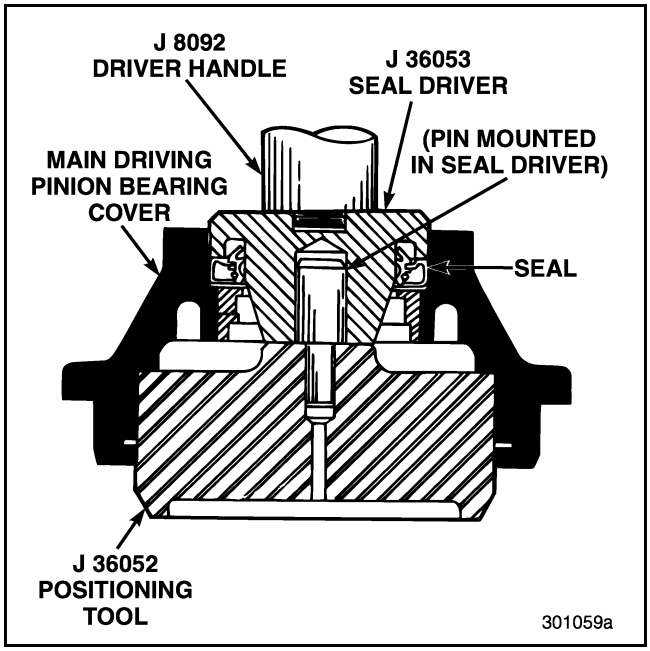


Figure 303 — Main Drive Pinion Oil Seal Tools

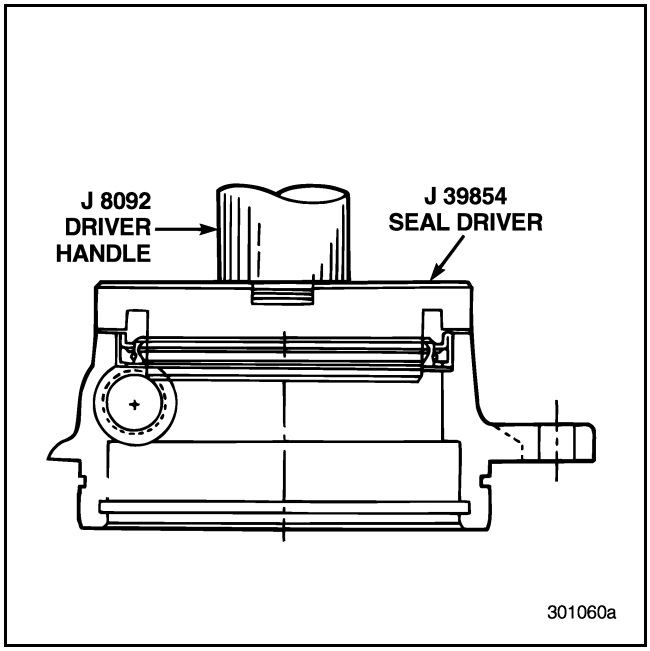


Figure 304 — Rear Mainshaft Bearing Cover Oil Seal Tools

General Inspection

Any cracked transmission case should be replaced. Check all components for wear or damage. Replace all parts as required. Replace all gaskets, O-rings and any part that shows mutilation or damage. Repair all stripped threads, using a thread repair insert that is compatible with patch-lock type capscrews.

General Reassembly Instructions

Refer to “TRANSMISSION SPECIFICATIONS” on page 224 for torque specifications and for fits and limits.

All working metal parts, especially the bearings, should be coated with fresh, clean, specified gear oil while the transmission is being reassembled. This ensures immediate lubrication and helps prevent parts seizure during start-up. (Refer to Recommended SAE Grade Gear Oil in “Transmission Specifications and Capacities” on page 237.)

When installing bearings, use proper bearing drivers. When pressing a bearing onto a shaft, apply force to the inner race of the bearing. When pressing a bearing into a housing (bearing cover), apply force only to the outer race. Do not apply force that is transmitted through the bearing rollers, balls or cage. Damage and premature bearing failure can result. Always apply even pressure to the bearing to prevent it from cocking or distorting during installation.

As moving parts are installed, check the parts frequently to see that they are moving freely.

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TRANSMISSION COMPONENT REASSEMBLY [320]

Reverse Idler Gear Reassembly [322]

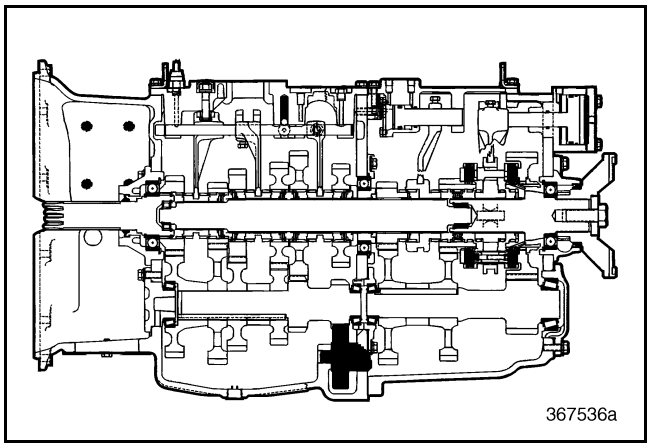


Figure 305 — Reverse Idler Gear Component Locator (T313L/T318L Shown)

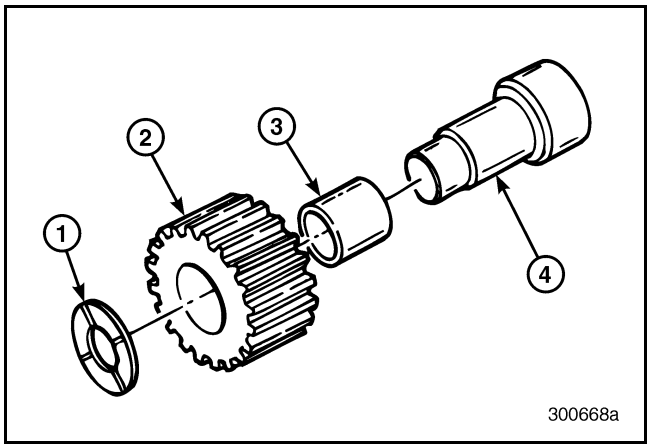


Figure 306 — Exploded View of Reverse Idler Gear Assembly

1. Thrust Washer	3. Bearing
2. Reverse Idler Gear	4. Reverse Idler Shaft

The following procedure applies to all three reverse idler gears

1. Install a **new** bearing into the reverse idler gear. Press until flush with gear surface. The bearing must not protrude on either side of the gear surface.

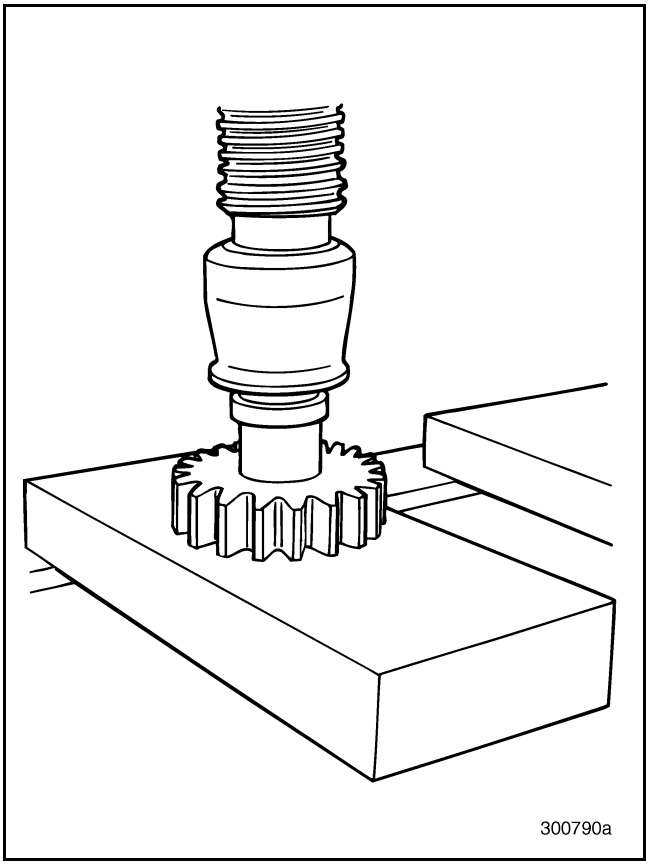


Figure 307 — Pressing Bearing into Gear

NOTE

Drawn cup needle bearings (reverse idler gear bearings) have a specific direction that they must be installed. The radius end of the bearing is to be installed first. The flat end (the end with identification markings) faces against the angled shoulder of the pressing tool.

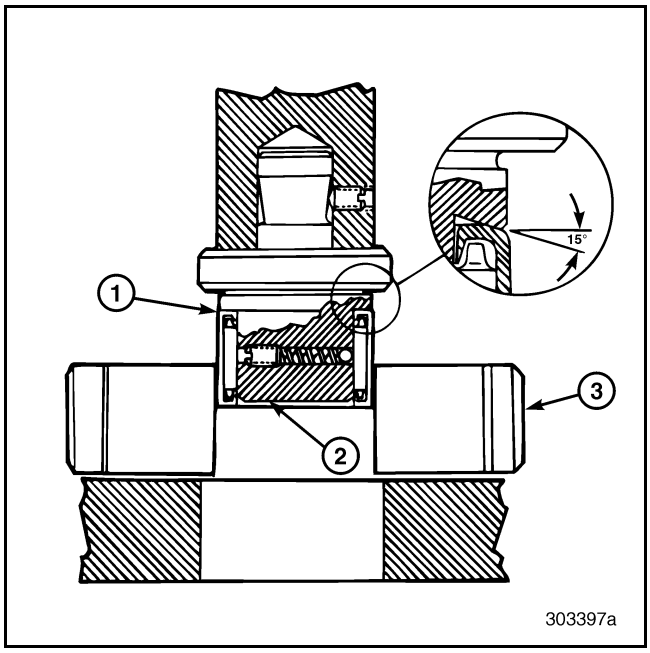


Figure 308 — Installation of Drawn Cup Bearings

1. Stamped End of Bearing 2. Press Tool Leader or Pilot	3. Reverse Idler Gear

Rear Countershaft Bearing Cover Reassembly

[321]

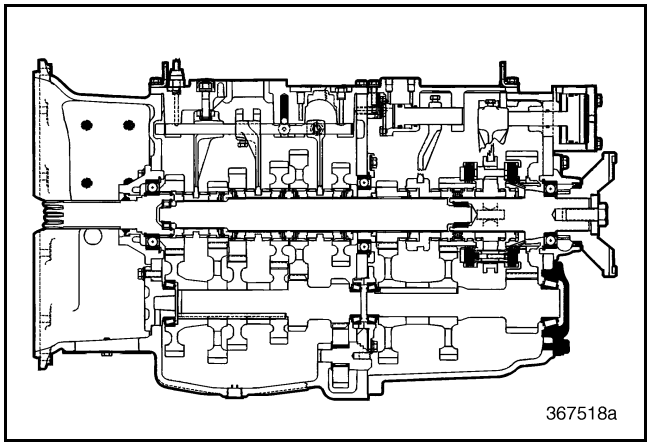


Figure 309 — Rear Countershaft Bearing Cover Component Locator (T313L/T318L Shown)

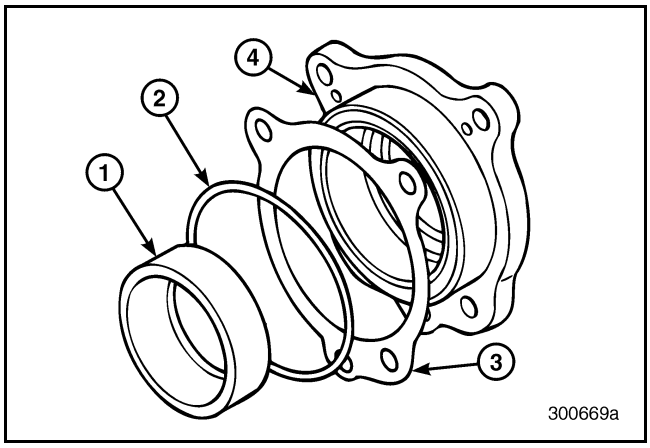


Figure 310 — Exploded View of Rear Countershaft Bearing Cover

1. Bearing Cup 2. O-Ring	3. Shim(s) 4. Bearing Cover

The following procedure applies to all three rear countershaft bearing covers.

1. Press a **new** bearing cup into the cover, using a suitable driver.

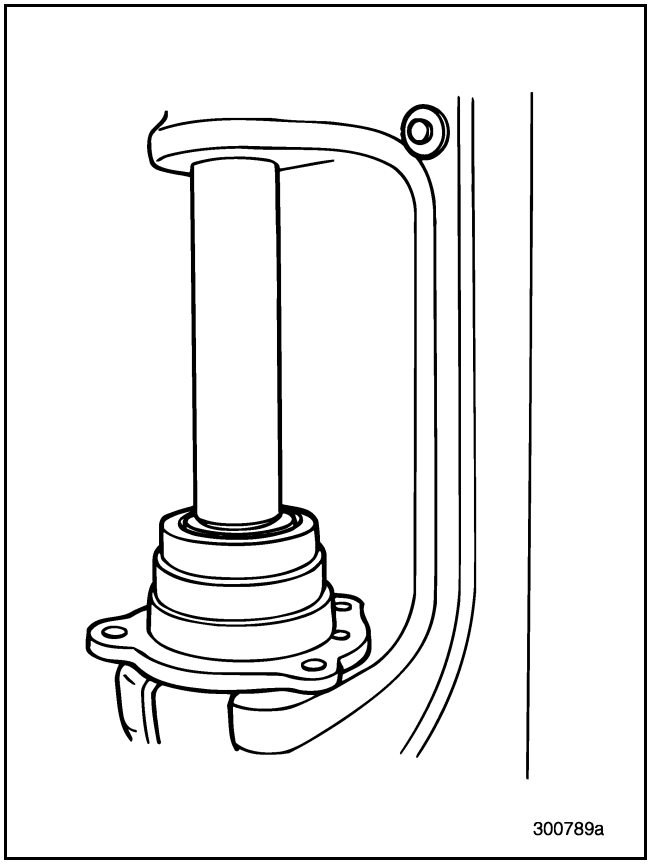


Figure 311 — Pressing Bearing Cup into Cover

2. Keep the original shims and a **new** O-ring with each cover for reassembly. Bearing preload adjustments must be made before installing shim pack and O-ring.

Rear Countershaft Reassembly [322]

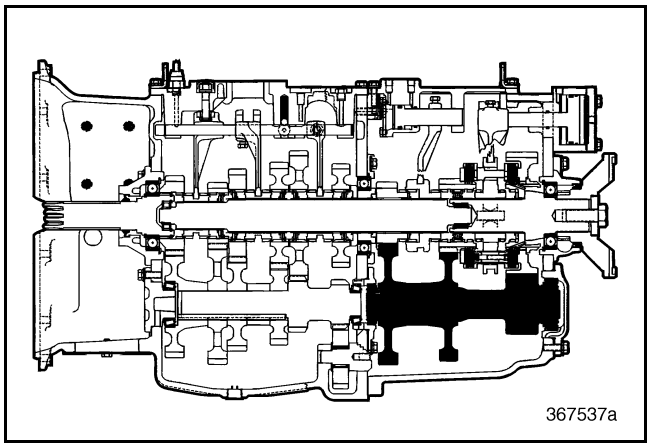


Figure 312 — Rear Countershaft Component Locator (T313L/T318L Shown)

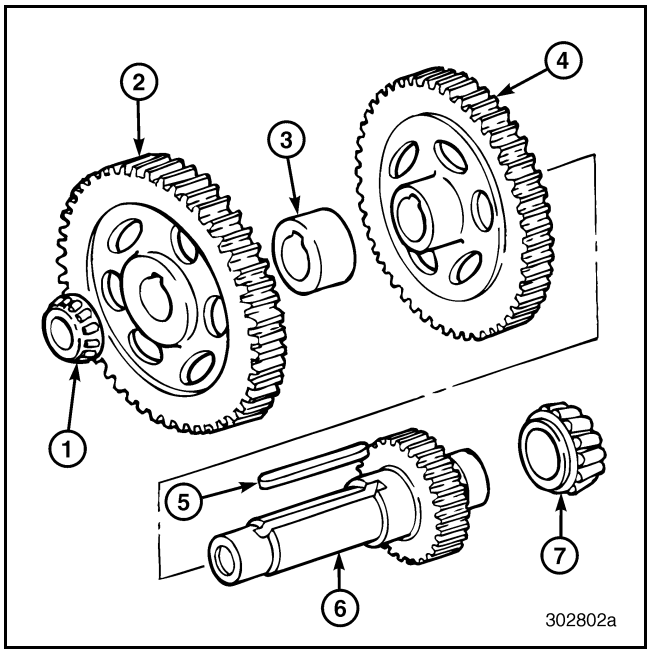


Figure 313 — Exploded View of Rear Countershaft

1. Front Bearing Cone 2. Lo-Split Gear 3. Spacer 4. Hi-Range/Hi-Split Gear 5. Key	6. Rear Countershaft (Lo-Range Gear Part of Shaft) 7. Rear Bearing Cone

The following procedure applies to all three rear countershaft assemblies.

NOTE

Remember to apply the recommended oil to all shaft and gear surfaces before pressing parts.

⚠ DANGER

Do not attempt to press the Lo-range gear off these rear countershafts. The gear is integral with the shaft and can explode if pressed.

1. Install the key into the keyway of the rear countershaft, using a soft-faced mallet.

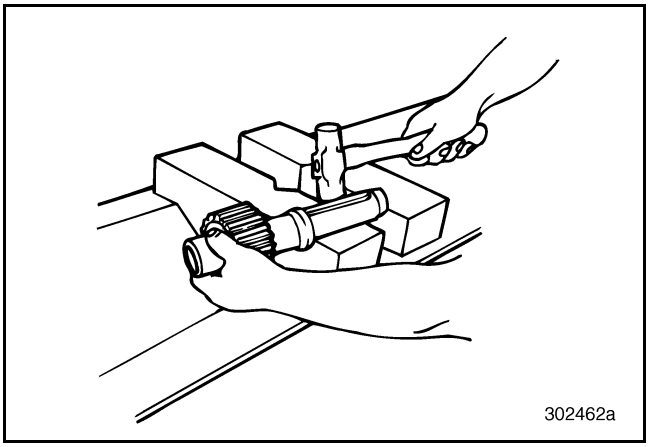


Figure 314 — Installing Key

2. Press the rear countershaft Hi-range/Hi-split gear onto the rear countershaft. Place the gear onto the shaft, with the protruding hub facing the front of the shaft.

NOTE

During all pressing operations involving a key and keyway, watch the key to make sure that no material is shaved off as each gear is being pressed on. This material can collect between the gears and prevent proper seating.

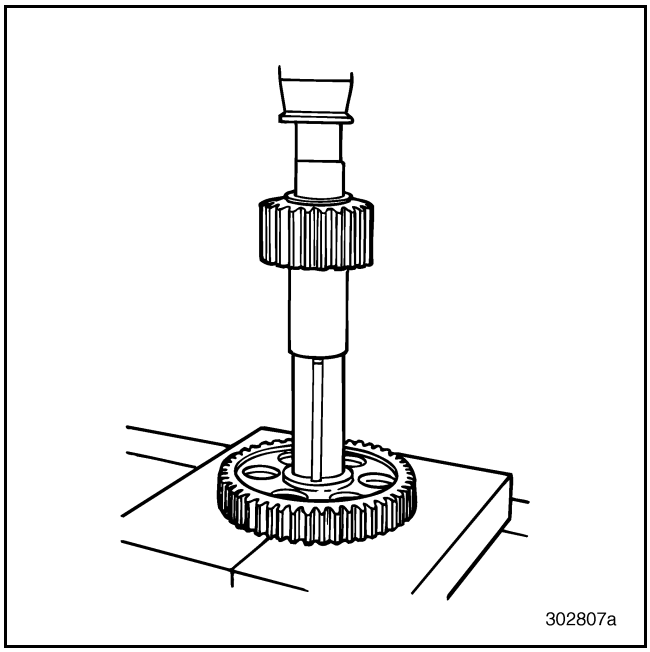


Figure 315 — Pressing on Hi-Range/Hi-Split Gear

3. Install the spacer onto the shaft.

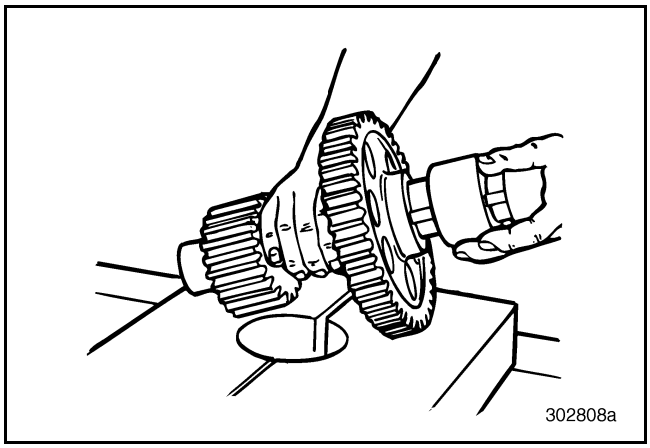


Figure 316 — Installing Spacer

4. Press the rear countershaft Lo-split gear onto the shaft. Position the gear so that the protruding hub faces the rear of the shaft.

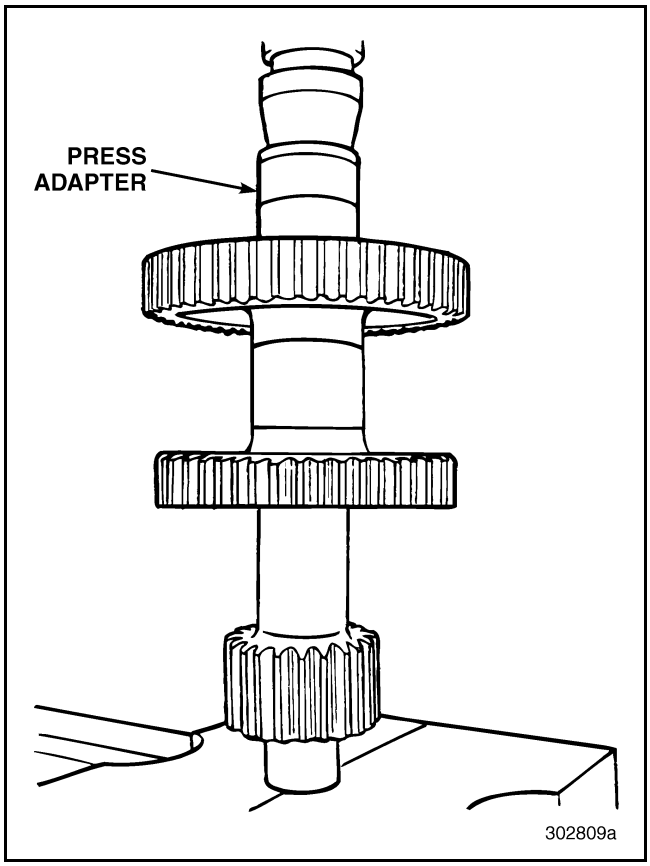


Figure 317 — Pressing on Lo-Split Gear

5. Press a **new** front bearing cone onto the rear countershaft, using a suitable driver. Apply force to only the inner race of the bearing cone.

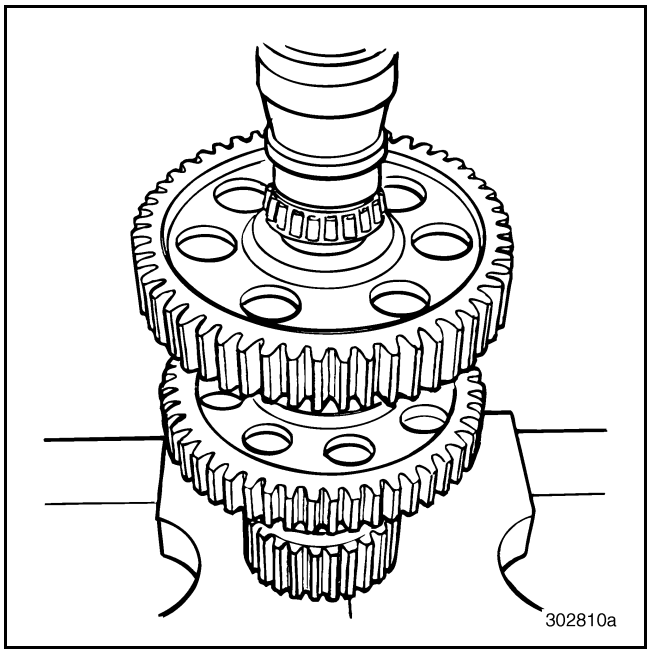


Figure 318 — Pressing on Front Bearing Cone

6. Press a **new** rear bearing cone onto the rear countershaft, using a suitable driver. Apply force to only the inner race of the bearing cone.

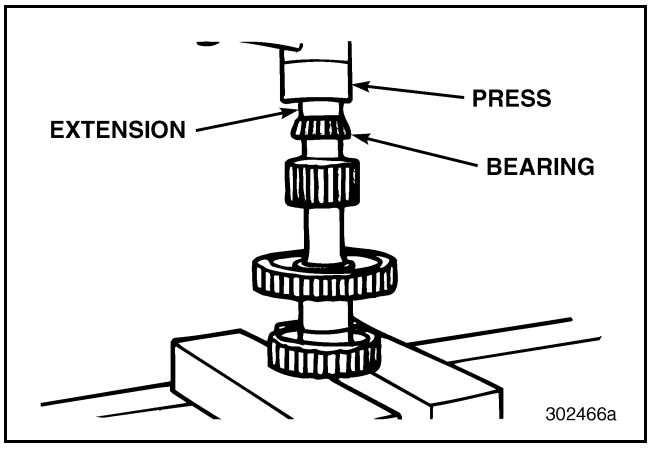


Figure 319 — Pressing on Rear Bearing Cone

Front Countershaft Rear Bearing Cover Reassembly

[321]

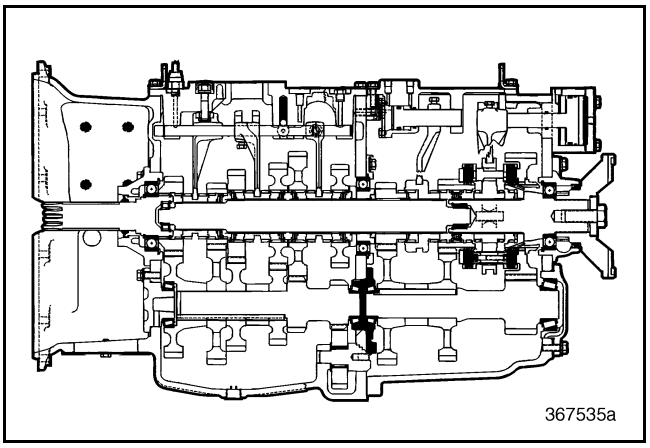


Figure 320 — Front Countershaft Rear Bearing Cover Component Locator (T313L/T318L Shown)

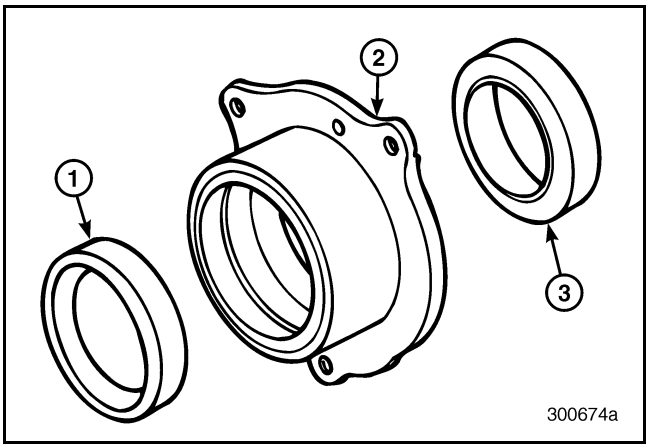


Figure 321 — Exploded View of Front Countershaft Rear Bearing Cover

1. Front Bearing Cup 2. Bearing Cover	3. Rear Bearing Cup

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The following procedure applies to all three front countershaft rear bearing covers.

1. Press **new** front and rear bearing cups into the front countershaft rear bearing cover, using a suitable driver.
2. Set the front countershaft rear bearing cover aside for later installation.

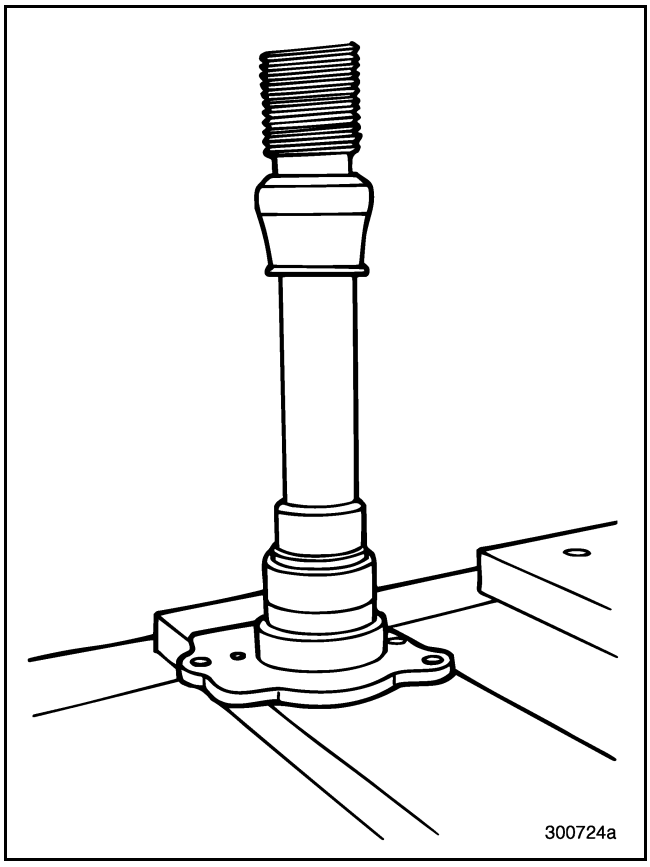


Figure 322 — Pressing Front Bearing Cup into Cover

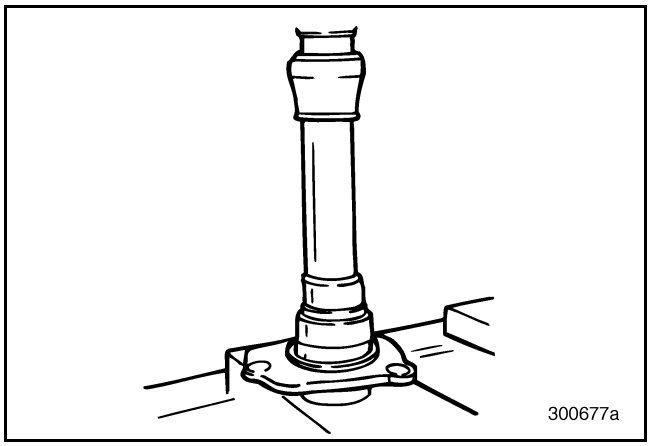


Figure 323 — Pressing Rear Bearing Cup into Cover

Front Countershaft Reassembly [322]

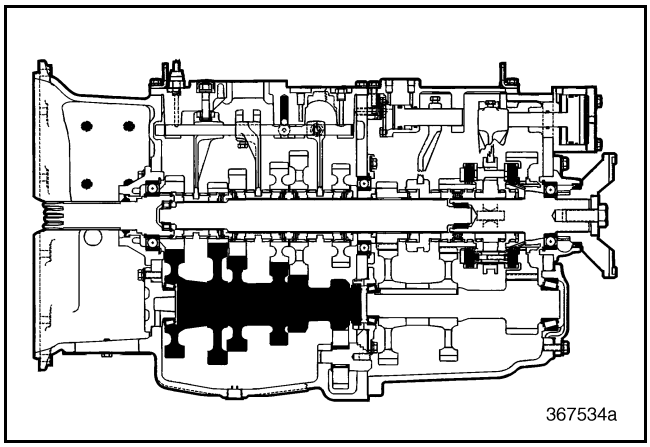


Figure 324 — Front Countershaft Component Locator (T313L/T318L Shown)

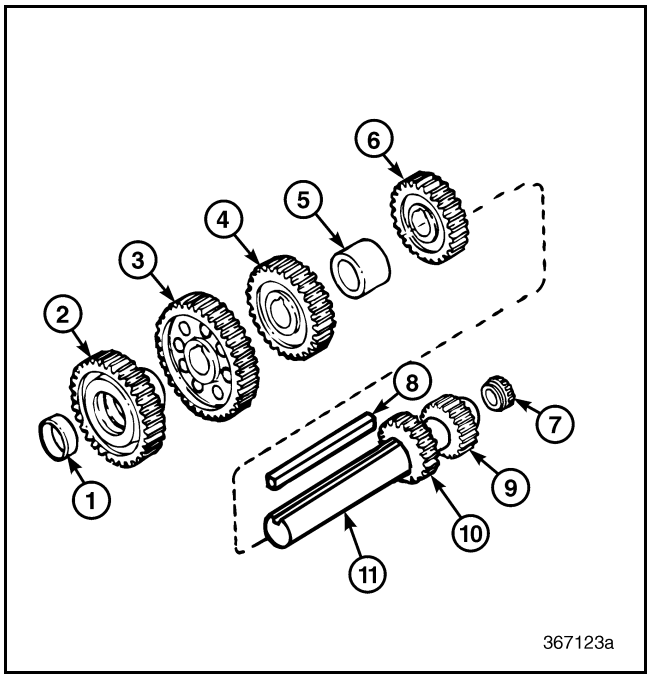


Figure 325 — Exploded View of Front Countershaft

1. Bearing Cup 2. Main Drive Gear 3. Fourth Speed Gear 4. Second Speed Gear 5. Front Spacer 6. First Speed Gear 7. Bearing Cone 8. Key	9. Lo-Speed Gear (Integral with Countershaft) 10. Reverse Gear (Integral with Countershaft) 11. Front Countershaft (Contains Two Integral Gears)

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The following procedure applies to all three front countershafts.

NOTE

Remember to apply the recommended oil to all shaft and gear surfaces before pressing parts together.

⚠ DANGER

Do not attempt to press-remove the Lo speed or reverse gears from the countershaft. These gears are integral with the shaft and could fragment explosively when pressing action is attempted.

1. Press a **new** bearing cup into the front countershaft main drive gear, using a suitable driver.

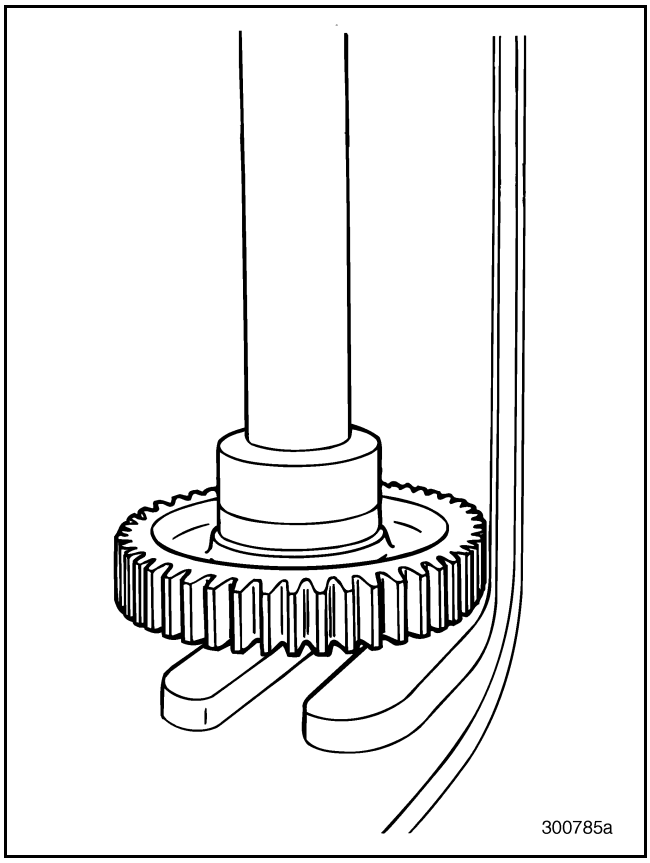


Figure 326 — Pressing Bearing Cup into Main Drive Gear

2. Install the key into the keyway of the front countershaft, using a soft-faced mallet.

NOTE

The key must be even with the front end of the shaft.

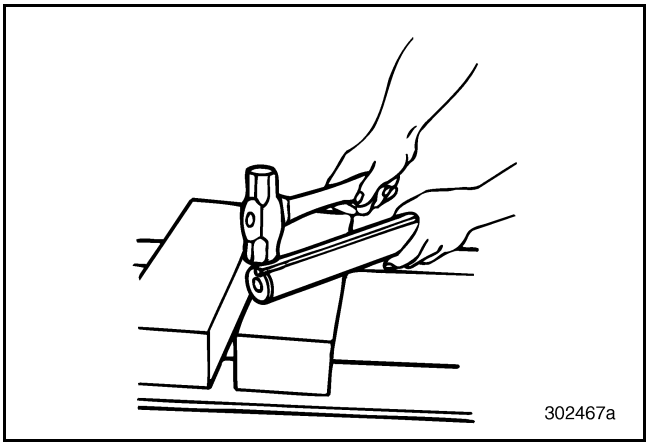


Figure 327 — Installing Key

3. Position the first (fifth) speed gear onto the countershaft and align gear slot with the previously installed key. Press the first (fifth) speed gear on the countershaft using a suitable press arrangement.

NOTE

During all pressing operations involving a key and keyway, watch the key to make sure that no material is shaved off as each gear is being pressed on. This material can collect between the gears and prevent proper seating.

⚠ CAUTION

When pressing the gears onto the countershaft, the press plates must support the hub of the gear. Do not press gears onto the countershaft with only the outer edges of the gear supported by the press plate.

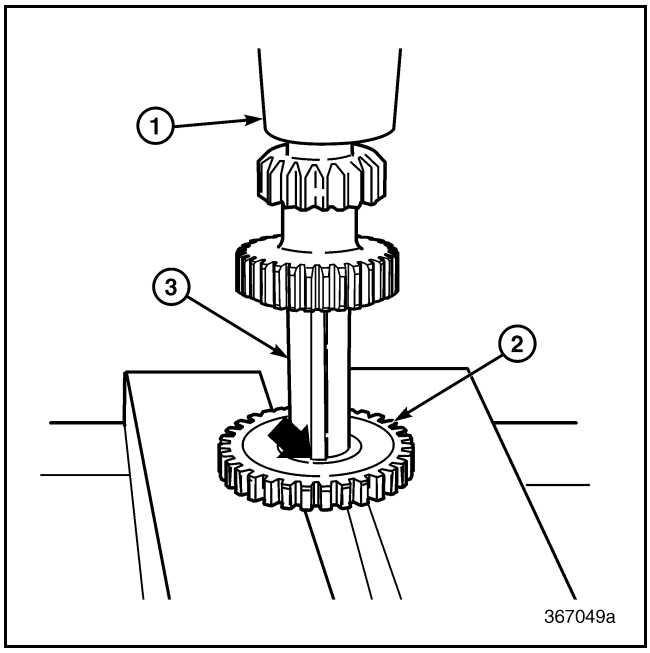


Figure 328 — Installing First (Fifth) Gear on Countershaft

1. Press Ram 2. First (Fifth) Gear	3. Front Countershaft

4. Align keyway slot in first (fifth) and second (sixth) gear spacer and install onto the front countershaft.

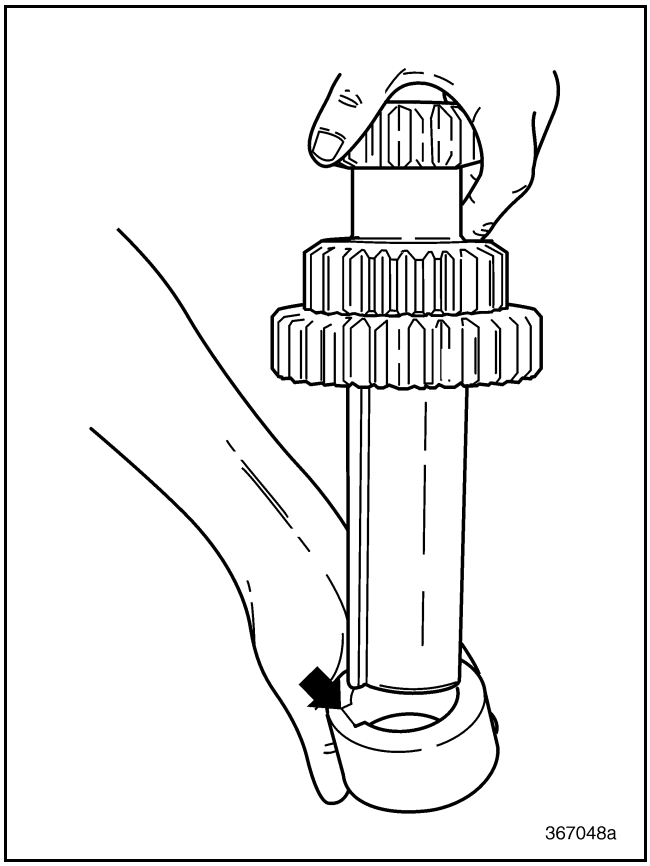


Figure 329 — Installing First and Second Gear Spacer

5. While supporting first (fifth) and second (sixth) gear spacer, align shaft key with slot in second (sixth) gear.

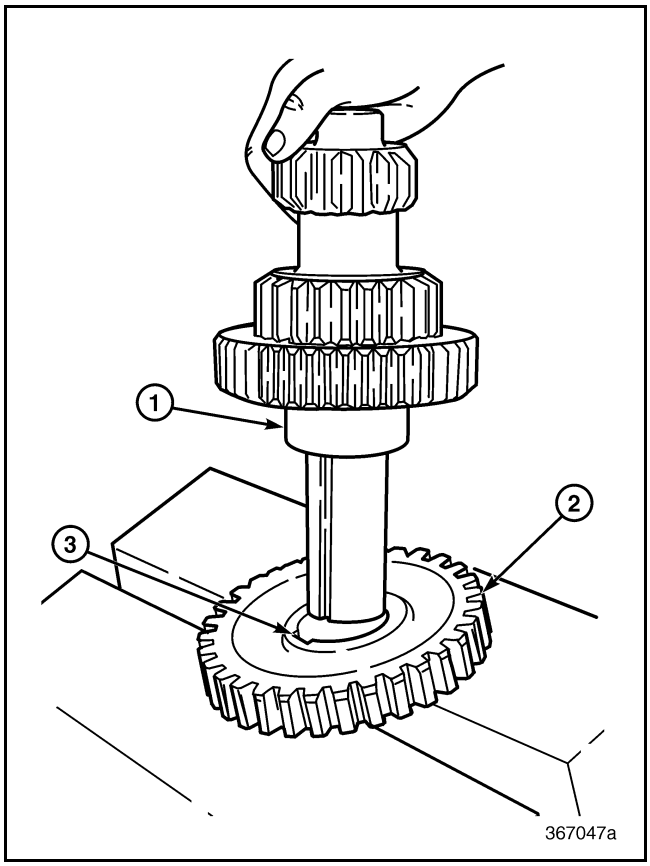


Figure 330 — Aligning Keyway with Second (Sixth) Gear

1. Countershaft Gear Spacer	2. Second (Sixth) Speed Gear 3. Gear Keyway Slot

6. While supporting gear spacer, press the second (sixth) speed gear onto the front of the shaft using a suitable press setup. Continue pressing until the gear and spacer seat against the first (fifth) gear.

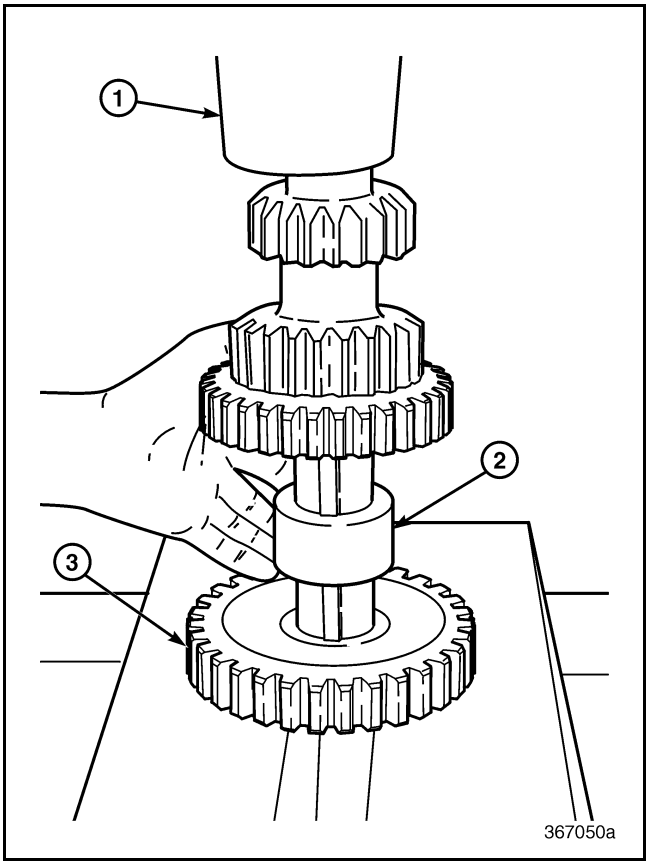


Figure 331 — Pressing Second Speed Gear onto Shaft

1. Press Ram 2. First (Fifth) and Second (Sixth) Gear Spacer	3. Second (Sixth) Speed Gear

7. Using a suitable press arrangement, align fourth (eighth) gear slot with countershaft key and press gear onto shaft until gear hub is approximately 6.4 to 12.7 mm (1/4 to 1/2 inch) from contacting the hub of the second (sixth) speed gear.

⚠ CAUTION

The fourth/eighth speed gear must only be partially installed by itself (as shown) to avoid cracking in the circle of low-inertia holes.

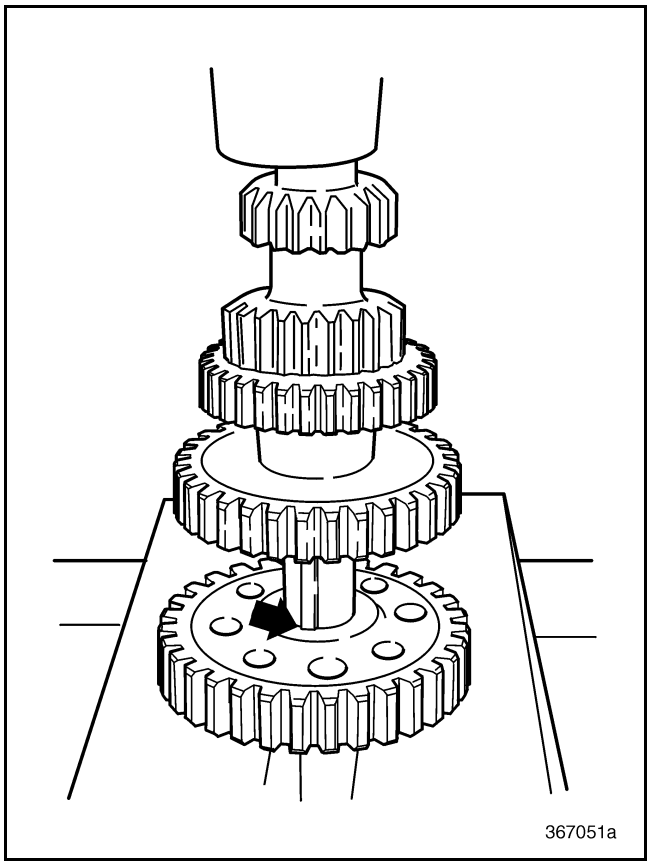


Figure 332 — Installing Fourth (Eighth) Speed Gear

8. Align the hub of the main drive gear with the key of the countershaft and allow the protruding hub of the gear to face the rear of the shaft.
9. Press the main drive gear onto the shaft until seated against the fourth (eighth) speed gear. Continue pressing on the main drive gear to install both the fourth (eighth) and the main drive gears on at the same time. This action places all of the press pressure on the hub of the main drive gear and none on the web of the fourth (eighth) speed gear. Check that the main drive gear is flush with the end of the countershaft after installation.

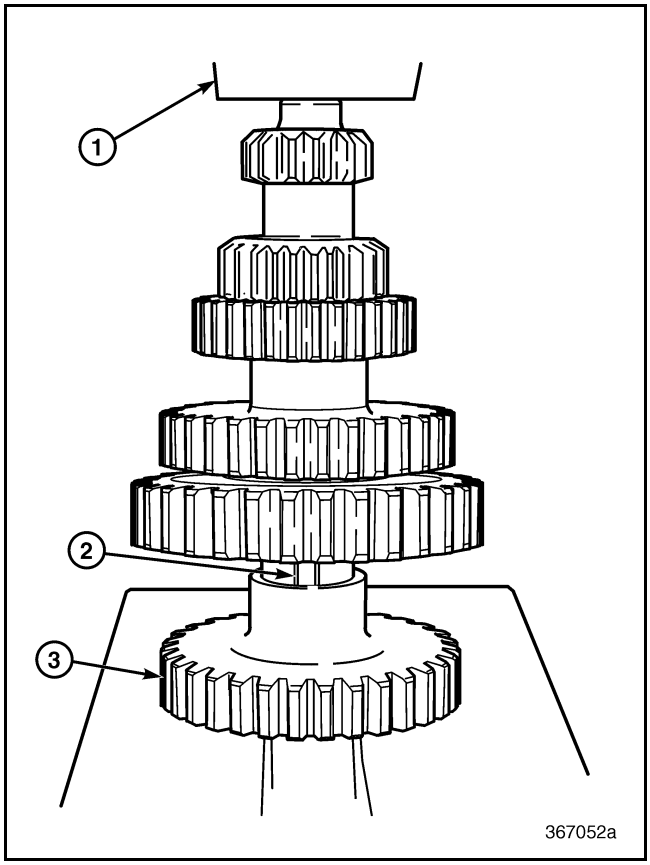


Figure 333 — Pressing Main Drive Gear onto Shaft

1. Press Ram 2. Countershaft Key	3. Main Drive (Third/Seventh) Speed Gear

10. At this time, install a **new** bearing cone onto the rear of the No. 2 countershaft only. Using a suitable driver, apply force only to the inner race of the bearing cone. Install the bearing until seated against the surface of the reverse speed gear (part of shaft). Delay installation of the No.1 and No. 3 countershaft rear bearing cones until after countershaft installation into the case.

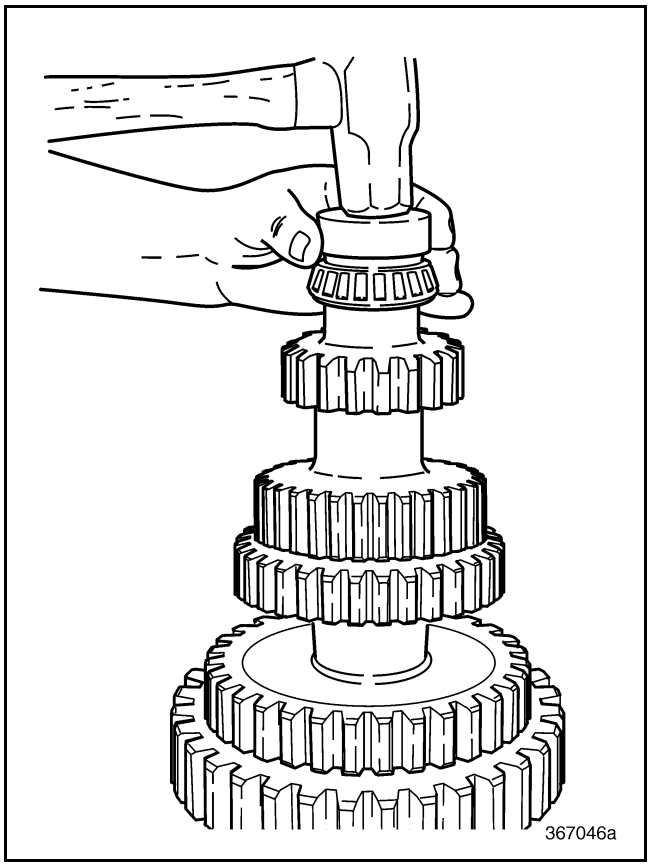


Figure 334 — Installing Rear Bearing Cone onto Shaft

Front Countershaft Front Bearing Cover Reassembly

[321]

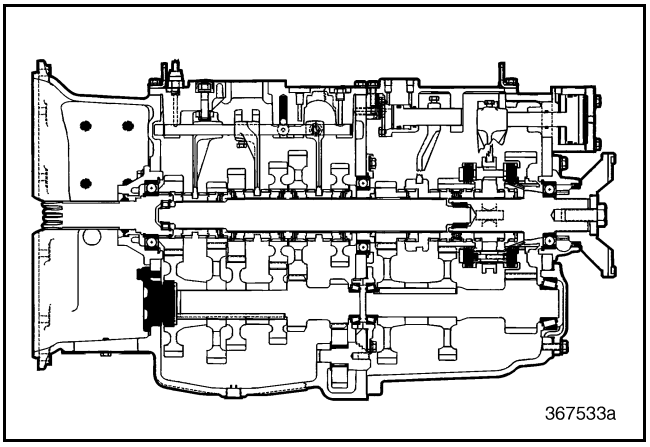


Figure 335 — Front Countershaft Front Bearing Cover Component Locator (T313L/T318L Shown)

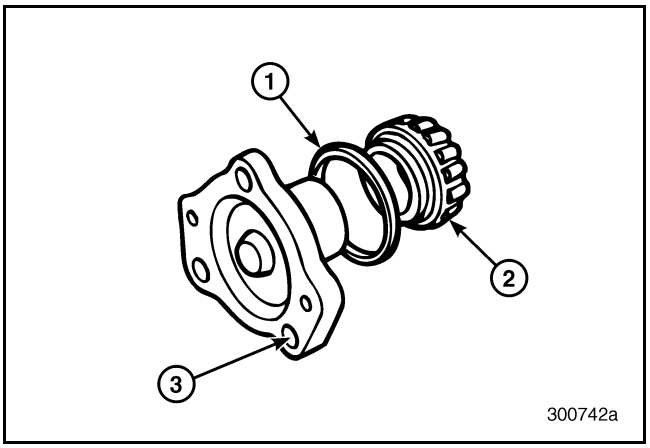


Figure 336 — Exploded View of Front Countershaft Front Bearing Cover

1. O-Ring 2. Bearing Cone	3. Front Bearing Cover

The following procedure applies to all three front countershaft front bearing covers.

1. Press a **new** bearing cone onto the front countershaft front bearing cover, using a suitable driver. Apply force to the inner race of the bearing only.

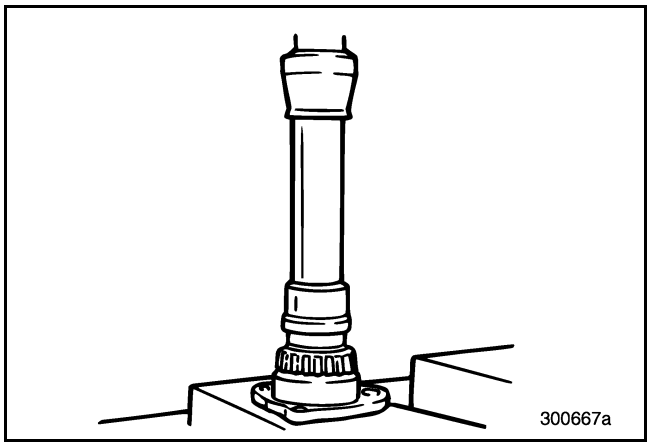


Figure 337 — Pressing Bearing Cone onto Cover

2. Install a **new** O-ring onto the shoulder of the front bearing cover.

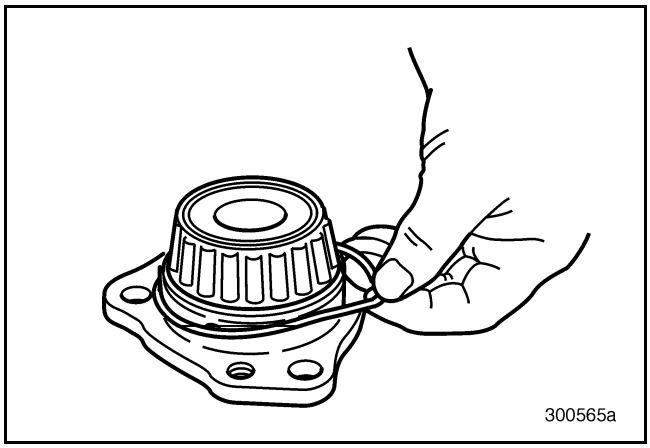


Figure 338 — Installing O-Ring onto Front Cover

3. Set the assembly aside for later installation.

Rear Mainshaft Bearing Cover Reassembly: T313–T318(L)(LR)

[321]

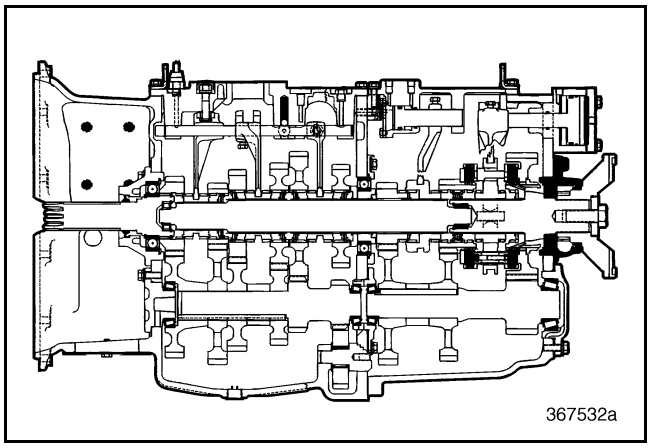


Figure 339 — Rear Mainshaft Bearing Cover Component Locator (T313L/T318L Shown)

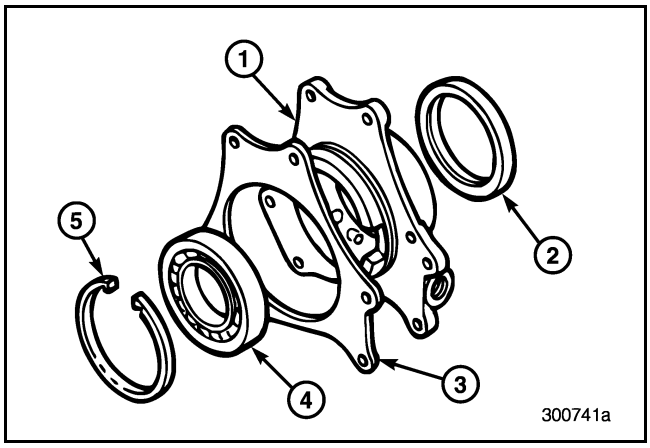


Figure 340 — Exploded View of Rear Mainshaft Bearing Cover

1. Bearing Cover 2. Oil Seal 3. Gasket	4. Bearing 5. Snap Ring

1. Press a **new** oil seal into the rear mainshaft bearing cover, using J 39854 seal driver, or equivalent. Refer to “INSPECTION OF PARTS” on page 126 for installation instructions and seal precautions.

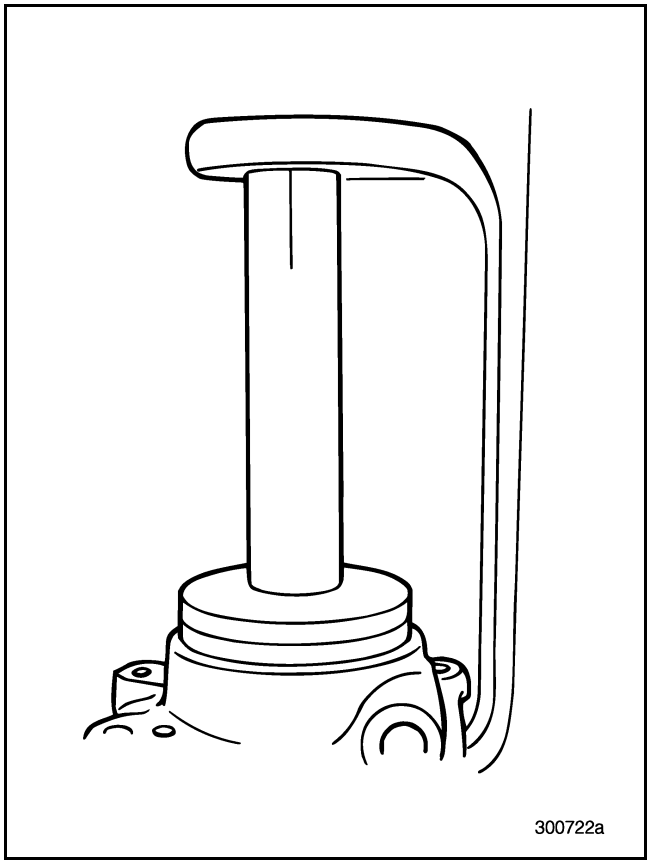


Figure 341 — Pressing Oil Seal into Rear Mainshaft Bearing Cover

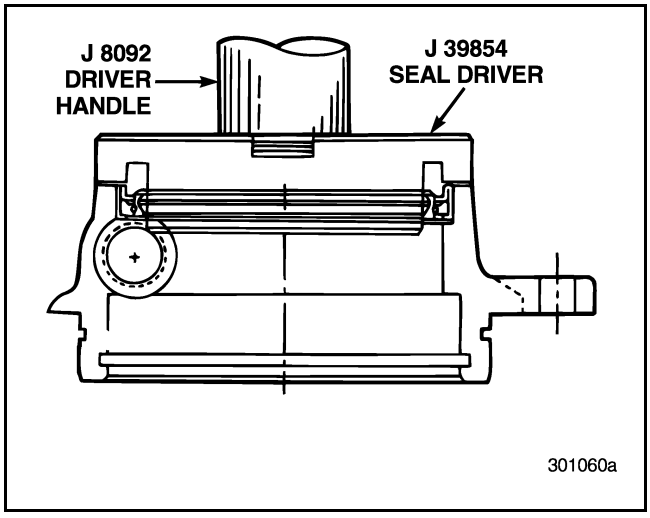


Figure 342 — Oil Seal Driver

2. Press a **new** bearing into the cover, using a suitable driver. Apply force to only the outer race of the bearing.

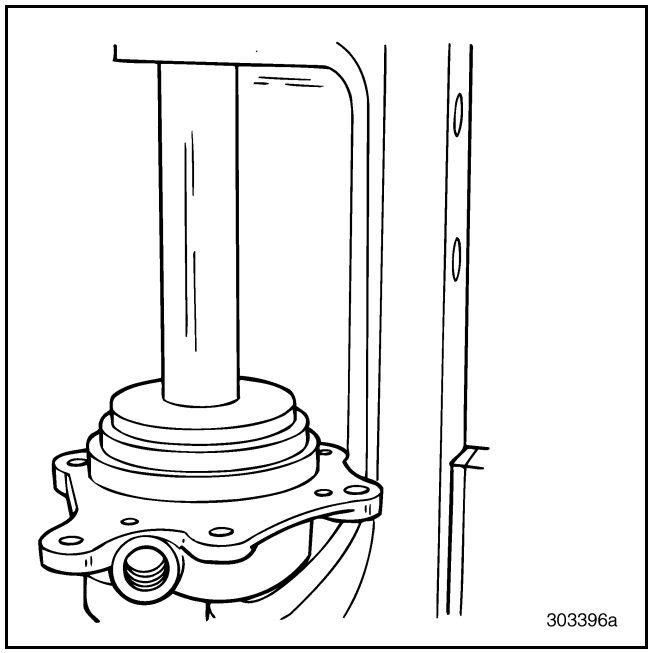


Figure 343 — Pressing Bearing into Cover

3. Install the snap ring to secure the bearing in the rear mainshaft bearing cover, using suitable snap ring pliers.

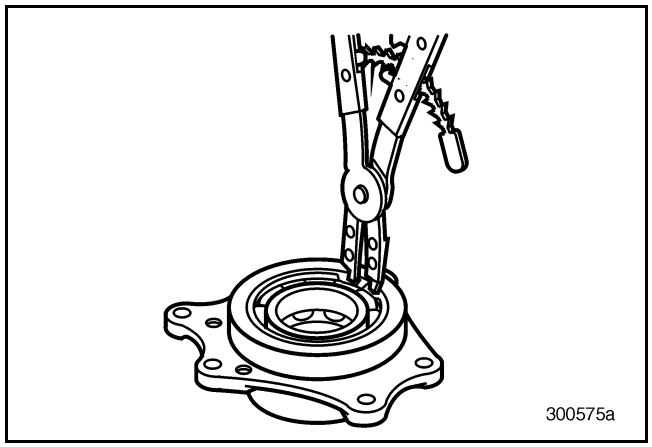


Figure 344 — Installing Snap Ring

4. Install a **new** rear mainshaft bearing cover gasket. Make sure the oil passageways in the gasket line up with the oil passageways in the cover.

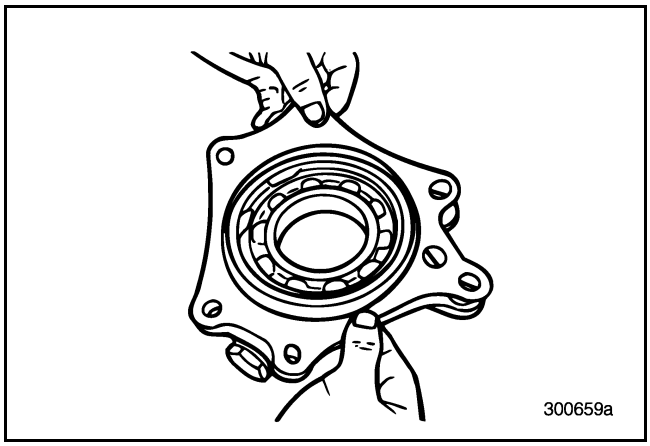


Figure 345 — Installing Gasket onto Cover

Rear Output Housing Reassembly: T313–T318(21)(L21)(LR21)

[322]

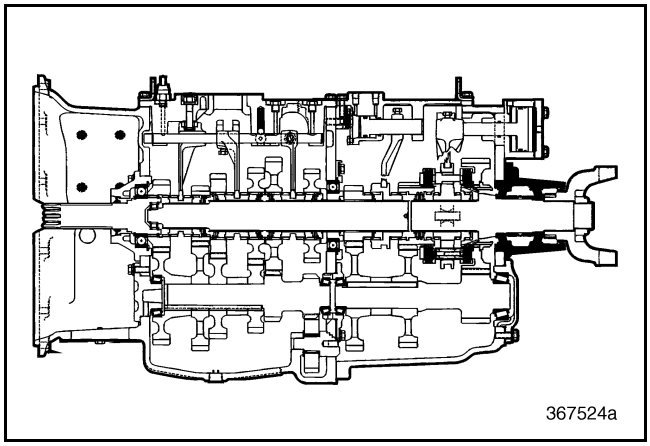


Figure 346 — Rear Output Housing Component Locator (T313L21/T318L21 Shown)

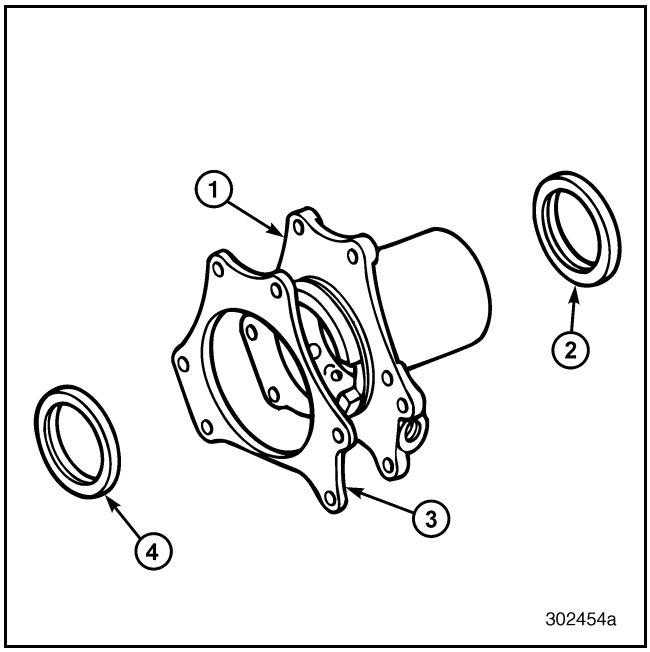


Figure 347 — Exploded View of Rear Output Housing

1. Rear Output Housing 2. Outer Bearing Cup	3. Gasket 4. Inner Bearing Cup

1. Drive a **new** inner bearing cup into the output housing, using a suitable driver.

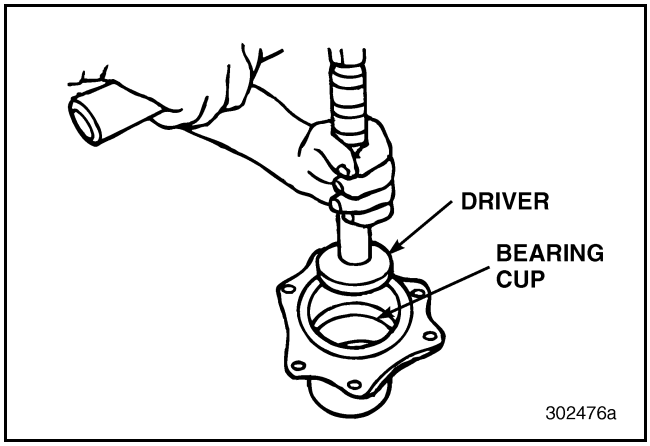


Figure 348 — Driving Bearing Cup into Output Housing

2. In a similar manner, install a **new** outer bearing cup into the housing.

3. Obtain the output shaft. Using a suitable driver, press a **new** inner bearing cone onto the shaft until seated against the shoulder of the shaft. Apply force to the inner race only.

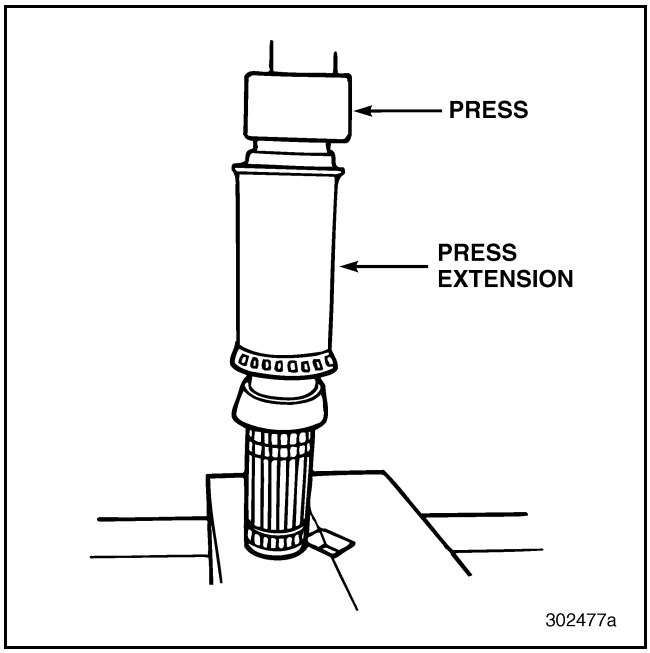


Figure 349 — Pressing Bearing onto Output Shaft

4. Position the output housing over the output shaft until the inner bearing cup is seated on the inner bearing cone.

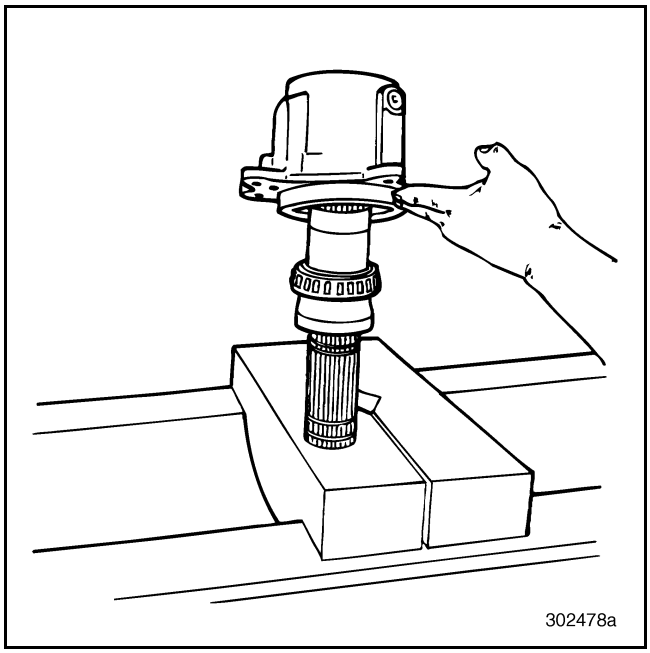


Figure 350 — Positioning Output Housing Over Shaft

5. Install a **new** collapsible spacer onto the output shaft.

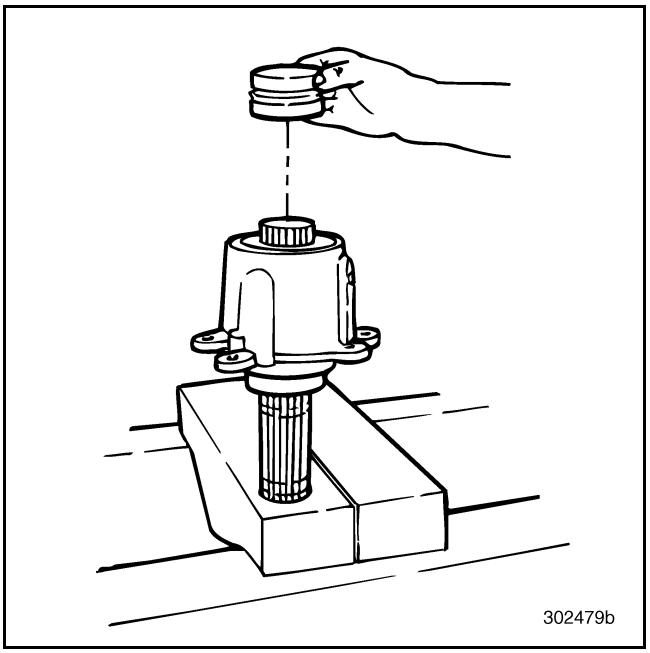


Figure 351 — Installing Spacer

6. Position the outer bearing cone over the output shaft as far as it will go without pressing.

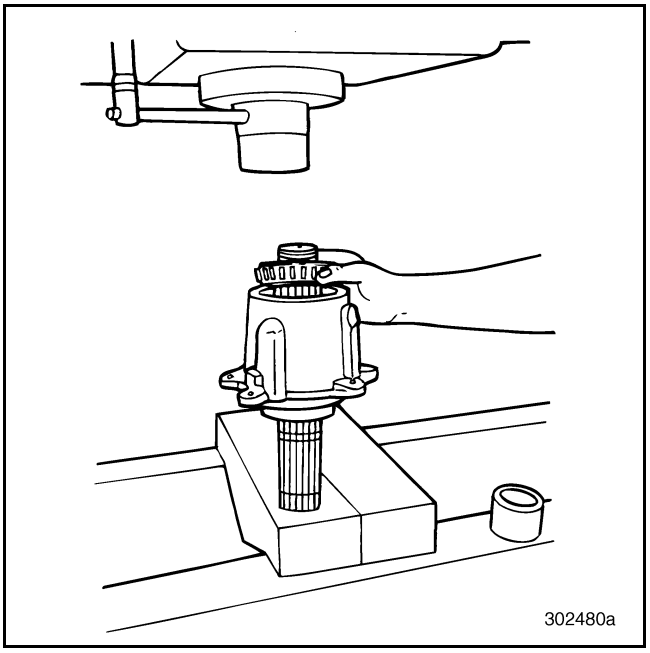


Figure 352 — Positioning Bearing Cone

7. Lubricate all bearing cups and cones with the recommended gear oil, in preparation for the following bearing preload adjustment procedure.
8. Position the output housing assembly in a hydraulic press.

Setting Rear Output Housing Bearing Preload With Collapsible Spacer

NOTE

The following procedure may require more than one attempt to achieve the required bearing preload. Make sure to have extra **new** collapsible spacers on hand.

9. For the collapsible-type spacer, wrap several turns of cord around the pilot area of the output housing and attach a spring tension scale, such as J 8129 or equivalent, to the cord. Refer to Figure 353.
10. Begin pressing the bearing cone over the shaft while moving the housing up and down. Watch press gauge pressure during this procedure. Stop pressing immediately when all end play is removed. Gauge pressure will begin to climb when this occurs.
11. While maintaining crush load, use the spring tension scale and test for the amount of bearing preload resistance required to rotate the housing. Maintain a steady pull on the housing while reading the scale.

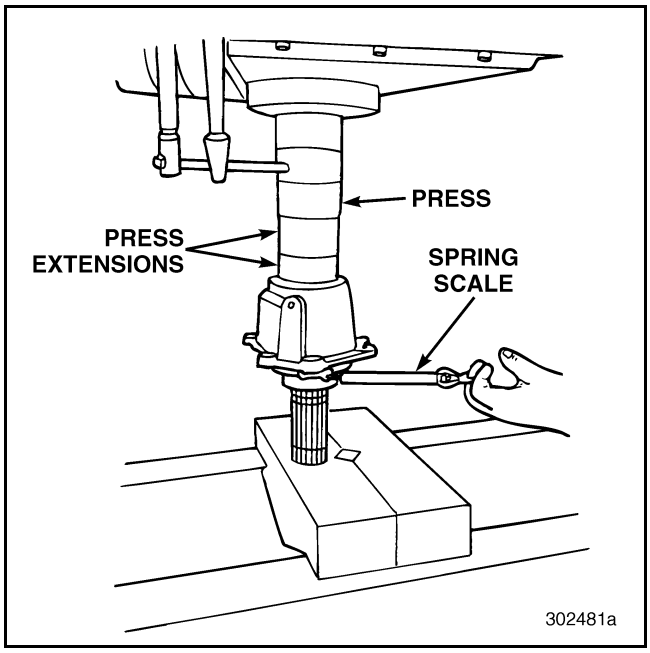


Figure 353 — Setup for Bearing Preload Adjustment Using Collapsible Spacer

12. Increase crush load slowly until rolling torque of 1.5–5 pounds of resistance is achieved, then stop! If rolling torque exceeds 5 pounds of resistance, the collapsible spacer has been crushed too far and must be removed. Replace with a **new** spacer and repeat the procedure until desired rolling torque is achieved.
13. Set output shaft aside with the associated synchronizer assembly components for later reassembly.
14. Place the output housing, spacer and outer bearing on a clean work surface for later transmission reassembly.

Rear Mainshaft (Output Shaft) and Synchronizer Reassembly

[322]

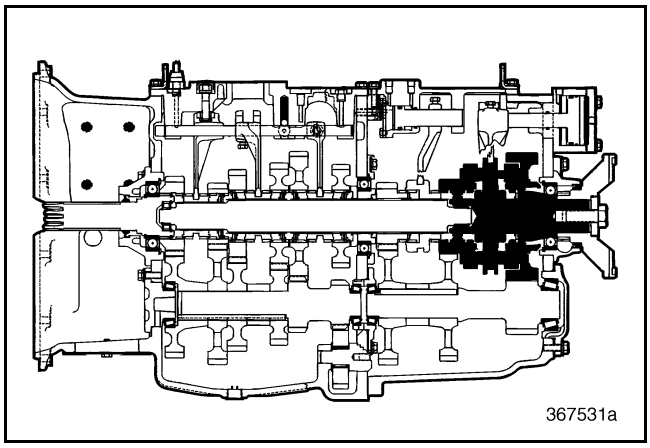


Figure 354 — Rear Mainshaft and Synchronizer Component Locator (T313L/T318L Shown)

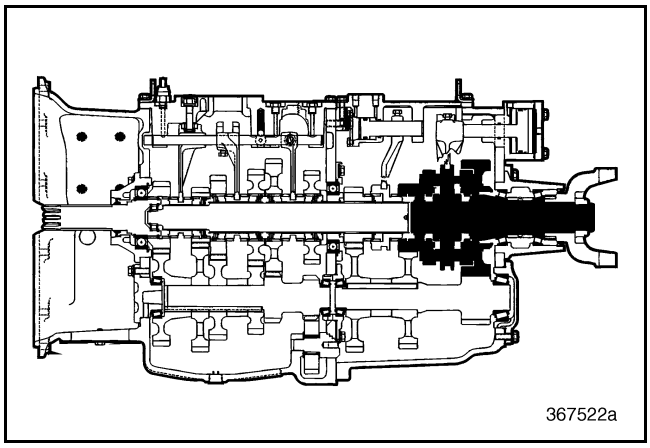


Figure 355 — Rear Mainshaft (Output Shaft) and Synchronizer Component Locator (T313L21/T318L21 Shown)

SYNCHRONIZER REASSEMBLY

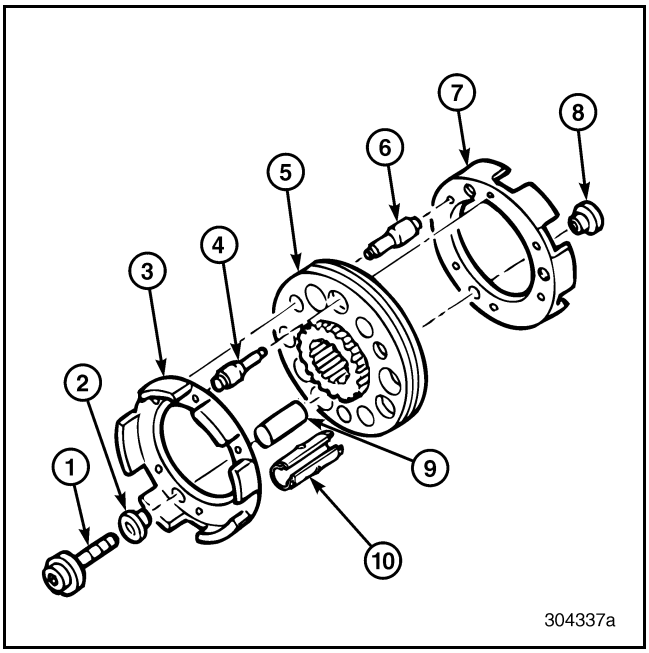


Figure 356 — Exploded View of Synchronizer

1. 12-Point Screw	7. Clutch Housing
2. Nonthreaded Insert	8. Threaded Insert
3. Clutch Housing	9. Support Tube
4. Synchronizer Pin	10. Preload Spring Assembly
5. Sliding Clutch	
6. Synchronizer Pin	

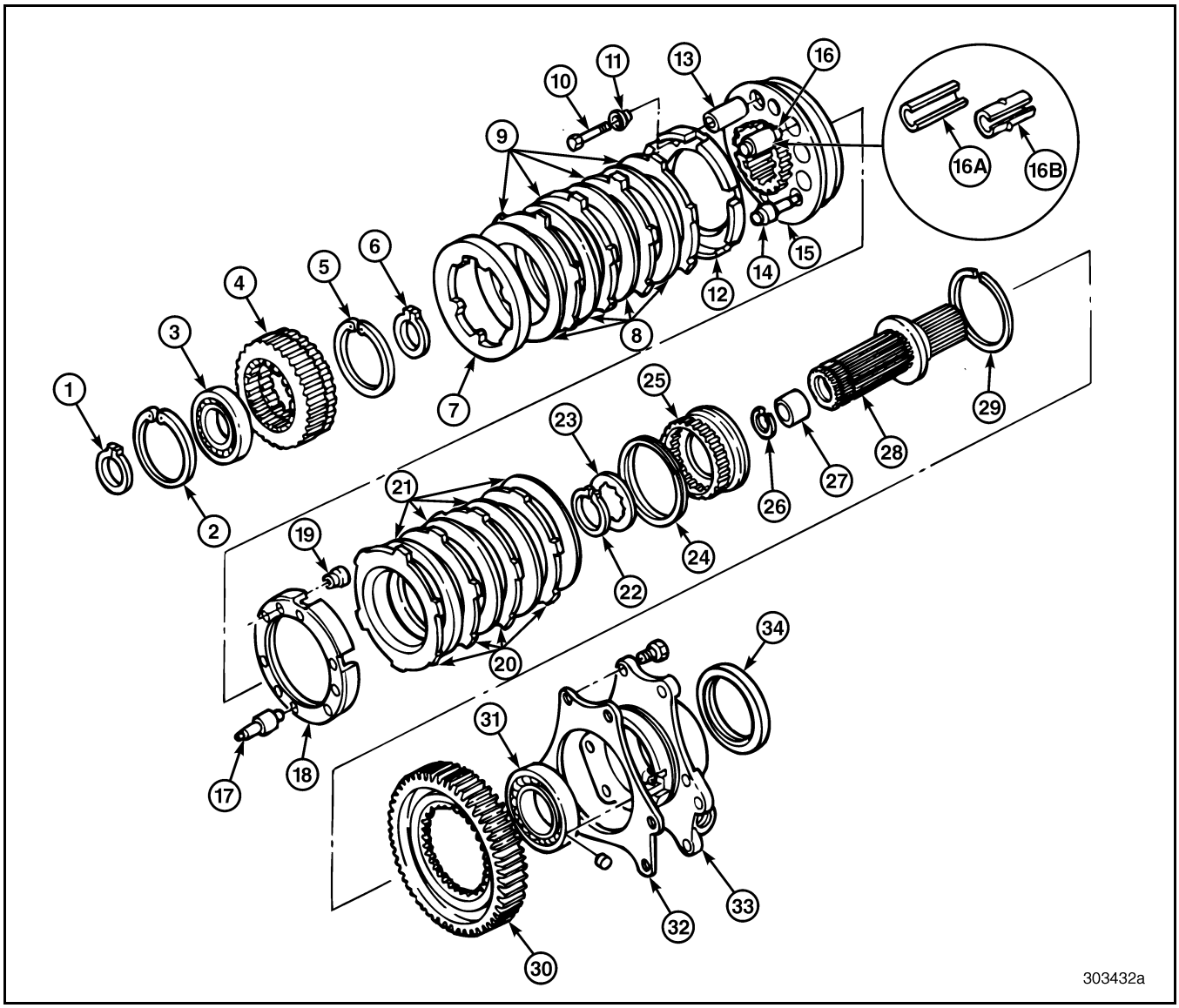


Figure 357 — Exploded View of: T313–T318(L)(LR) Rear Mainshaft and Synchronizer Assembly

1. Snap Ring	13. Support Tube	23. Internal-Toothed Thrust Washer
2. Snap Ring	14. Synchronizer Pin	24. Lo-Range Gear Snap Ring
3. Hi-Range/Hi-Split Gear Bearing	15. Sliding Clutch	25. Lo-Range Gear Hub
4. Hi-Range/Hi-Split Gear	16. Preload Spring Assembly	26. Spigot Bearing Snap Ring
5. Snap Ring	A. Inner Spring	27. Rear Mainshaft Spigot Bearing
6. Snap Ring	B. Outer Spring	28. Rear Mainshaft
7. Spacer (Front Synchronizer Pack)	17. Synchronizer Pin	29. Rear Bearing Snap Ring
8. Friction Disc (4)	18. Clutch Housing	30. Lo-Range Gear
9. Reaction Disc (4)	19. Threaded Insert (3)	31. Mainshaft Rear Bearing
10. 12-Point Capscrew (3)	20. Reaction Disc (4)	32. Rear Bearing Cover Gasket
11. Nonthreaded Insert (3)	21. Friction Disc (4)	33. Rear Bearing Cover
12. Clutch Housing	22. Snap Ring	34. Rear Bearing Cover Seal

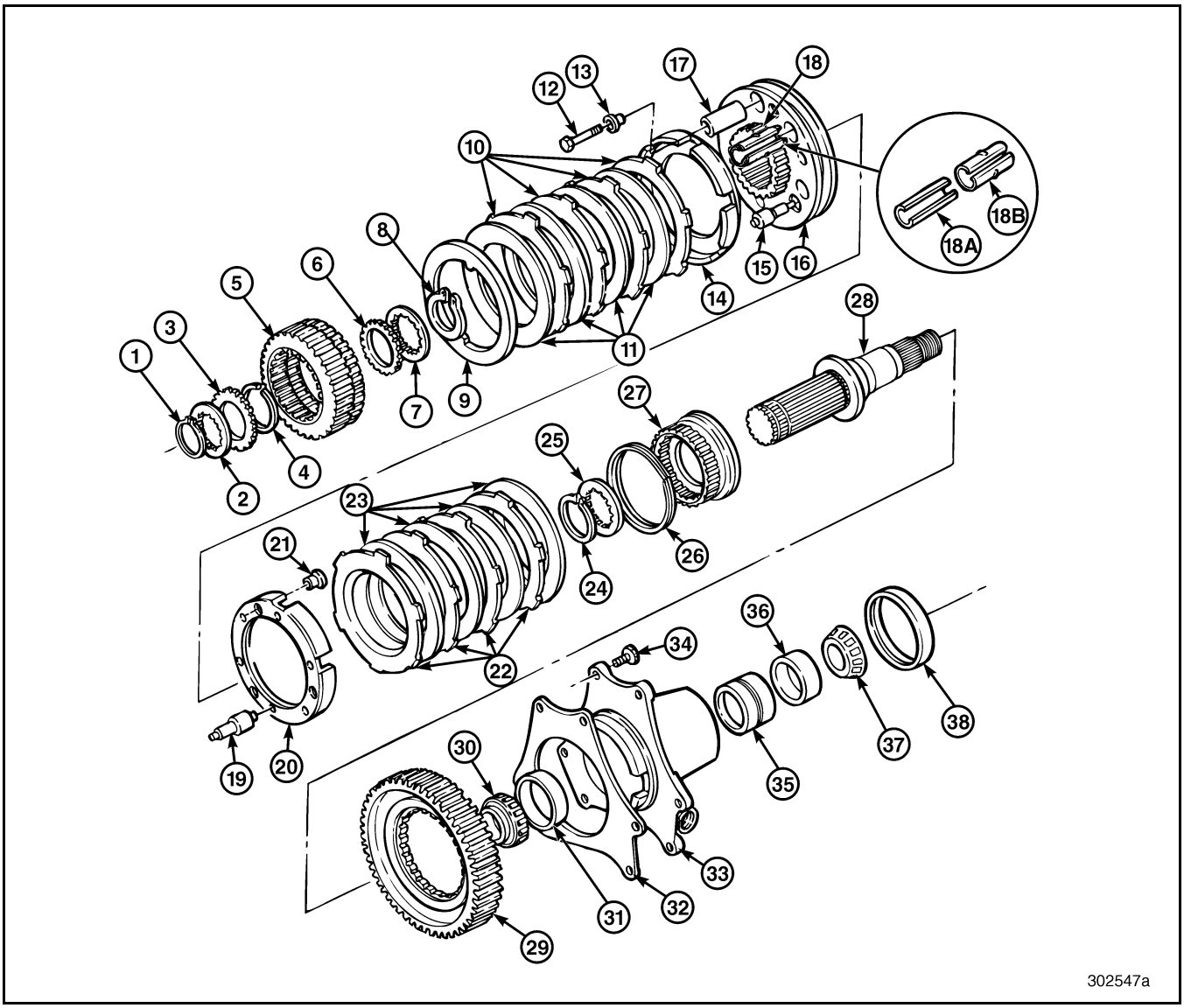


Figure 358 — Exploded View of: T313–T318(21)(L21)(LR21) Rear Mainshaft (Output Shaft) and Synchronizer Assembly

1. Output Shaft Snap Ring	14. Clutch Housing	27. Lo-Range Gear Hub
2. Internal-Toothed Thrust Washer	15. Synchronizer Pin	28. Output Shaft
3. External-Toothed Thrust Washer	16. Sliding Clutch	29. Lo-Range Gear
4. Hi-Range/Hi-Split Gear Snap Ring	17. Support Tube	30. Bearing Cone
5. Hi-Range/Hi-Split Gear	18. Preload Spring	31. Bearing Cup
6. External-Toothed Thrust Washer	19. Synchronizer Pin	32. Gasket
7. Internal-Toothed Thrust Washer	20. Clutch Housing	33. Output Housing
8. Output Shaft Snap Ring	21. Threaded Insert (3)	34. Output Housing Capscrew
9. Spacer (Front Synchronizer Pack)	22. Reaction Disc (4)	35. Collapsible Spacer
10. Reaction Disc (4)	23. Friction Disc (4)	36. Bearing Cup
11. Friction Disc (4)	24. Output Shaft Snap Ring	37. Bearing Cone
12. Twelve-Point Capscrew (3)	25. Internal-Toothed Thrust Washer	38. Output Housing Oil Seal
13. Nonthreaded Insert (3)	26. Lo-Range Gear Snap Ring	

1. Install the synchronizer pins into one of the two identical synchronizer clutch housings. Install the pins with the marked letter “R” facing up. Alternate pin heads as shown in the following figure.

NOTE

As you install the pins, notice that the pins and the sliding clutch are marked with the letter “R,” which stands for “Rear.” All the R marks on either end of the pins are placed on the same side of the sliding clutch marked with the letter R. During reassembly, make sure to coordinate all R marks on both the pins and sliding clutch of the synchronizer assembly. All R marks must face the rear of the transmission when installed.

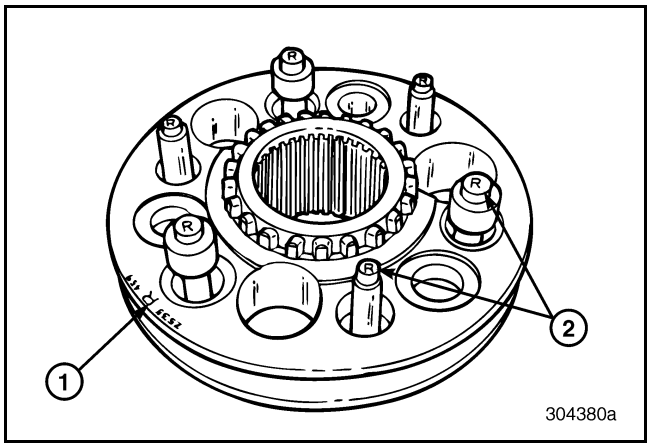


Figure 359 — Synchronizer Pins and Sliding Clutch Temporarily Assembled to Show “R” Marks

1. “R” on Sliding Clutch, Faces Rearward	2. “R” on Synchronizer Pins, Faces Rearward

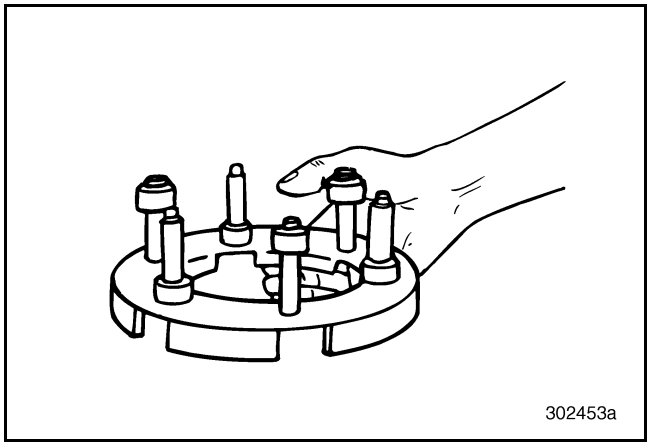


Figure 360 — Installing Synchronizer Pins

2. The three synchronizer preload springs are made up of two pieces. Make sure that the preload springs are assembled with smooth-sided inner portion of the spring, inside the notched (detent) outer portion of the spring.

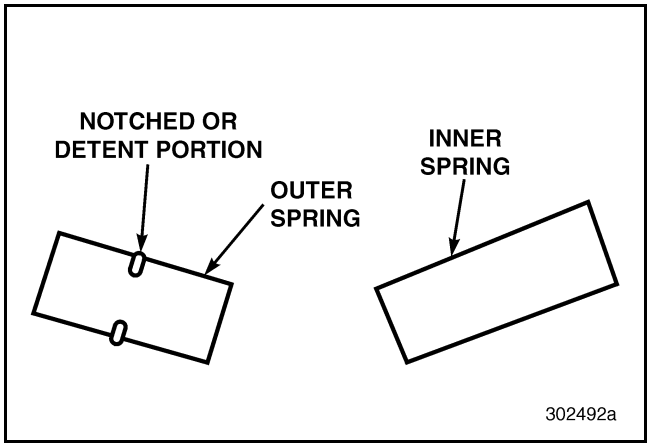


Figure 361 — Assembling Preload Springs

3. Position the synchronizer sliding clutch on the bench with the marked letter “R” facing up. Install the three preload springs into the sliding clutch holes provided. The smaller holes are ramped and found halfway between the three largest holes.

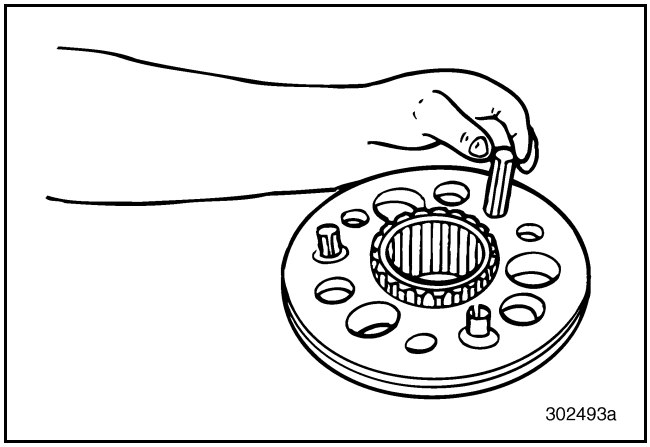


Figure 362 — Installing Preload Springs into Sliding Clutch

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4. Install the sliding clutch (with preload springs) over the synchronizer clutch housing and pins. Make sure the marked letter “R” on the clutch is facing in the same direction as the R marked on the pins.

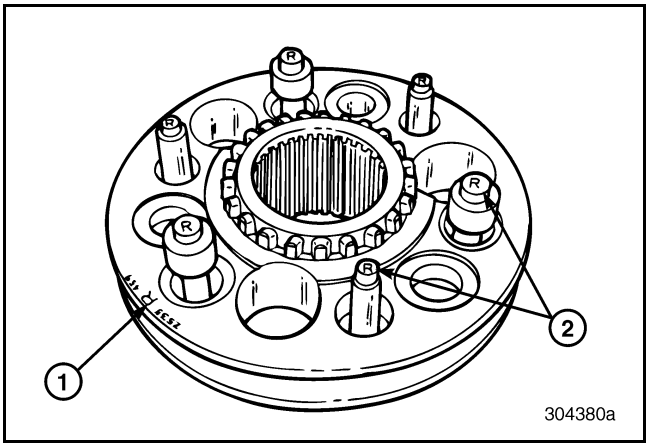


Figure 363 — Synchronizer Pins and Sliding Clutch Showing “R” Marks (Preload Springs Removed for Clarity)

1. “R” on Sliding Clutch, Faces Rearward	2. “R” on Synchronizer Pins, Faces Rearward

NOTE

With this sliding clutch design, it is very important to make sure that the clutch is facing in the correct direction when installed. This is due to the differing number of clutch teeth on the Lo-range and Hi-range sides of the range clutch. The Lo-range side contains 21 clutching teeth and the Hi-range side contains 22 clutching teeth. Incorrectly installing the sliding clutch prevents proper shifting.

5. Install the three support tubes into the synchronizer assembly.

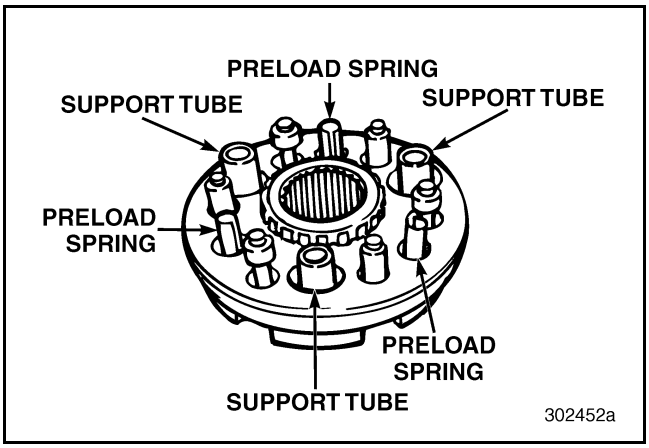


Figure 364 — Install Support Tubes into Assembly

6. Install the remaining synchronizer housing over the pins, tubes and springs. Align the housing with the pin heads.
7. Install the three 12-point screws, plus threaded and nonthreaded inserts into the largest holes of the synchronizer assembly.

NOTE

Effective November 28, 2007, a revised fastener was implemented into production at this synchronizer location. These fasteners are one-time use only and must be replaced anytime the synchronizer assembly is disassembled.

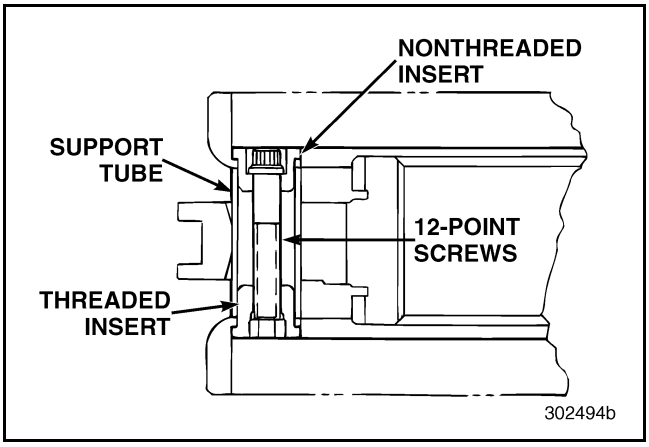


Figure 365 — Installing 12-Point Screws and Inserts

8. Tighten the three 12-point screws to specification, using a suitable hex wrench to hold the threaded inserts.

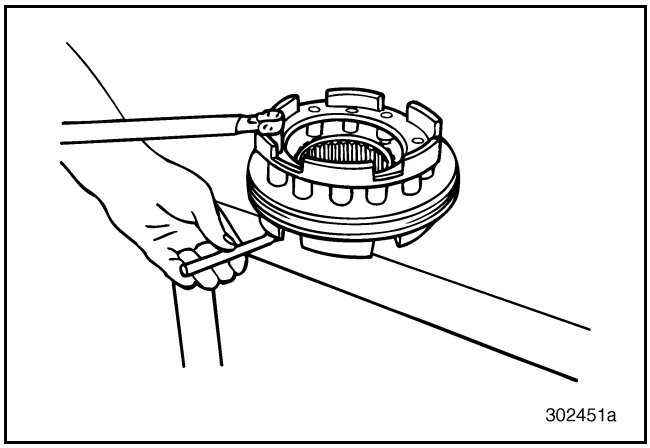


Figure 366 — Tightening 12-Point Screws

9. For the extended output shaft transmissions: T313–T318(21)(L21)(LR21), if not previously done, press a **new** inner bearing cone onto the output shaft. Seat the bearing against the shoulder of the shaft, using a suitable driver. Apply force to the inner race only.

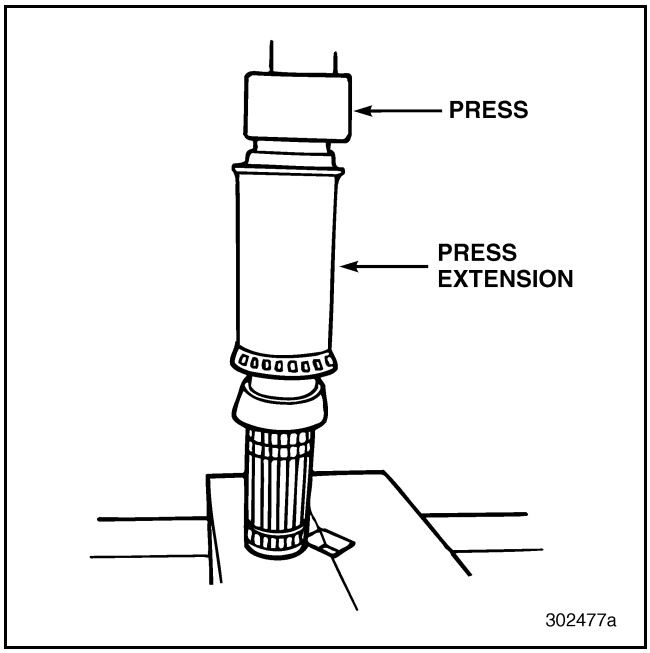


Figure 367 — Pressing Bearing onto Output Shaft (T313L21/T318L21 Shown)

10. On the conventional output shaft transmissions: T313–T318(L)(LR), press a **new** spigot bearing into the front of the rear mainshaft.

NOTE

Drawn cup needle bearings (spigot bearings) have a specific direction in which they must be installed. The radius end of the bearing must be installed first. The flat end (the end with identification markings) faces against the angled shoulder of the pressing tool.

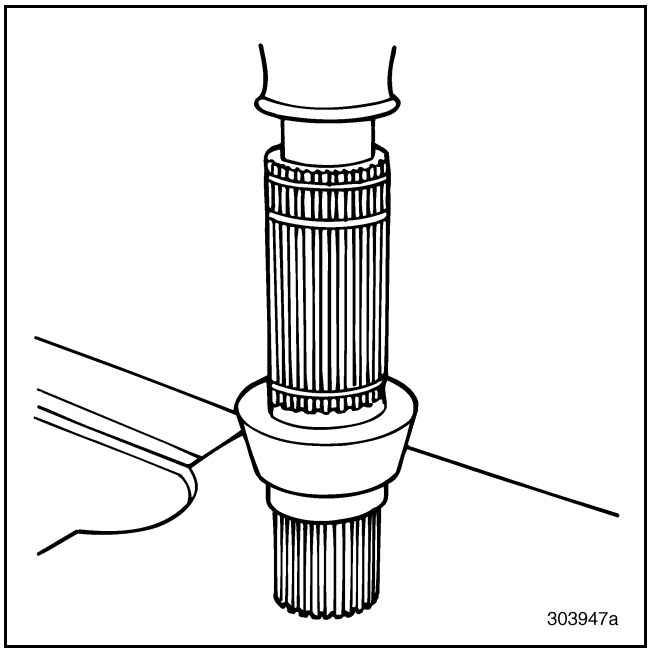


Figure 368 — Installing Spigot Bearing (T313L/T318L Shown)

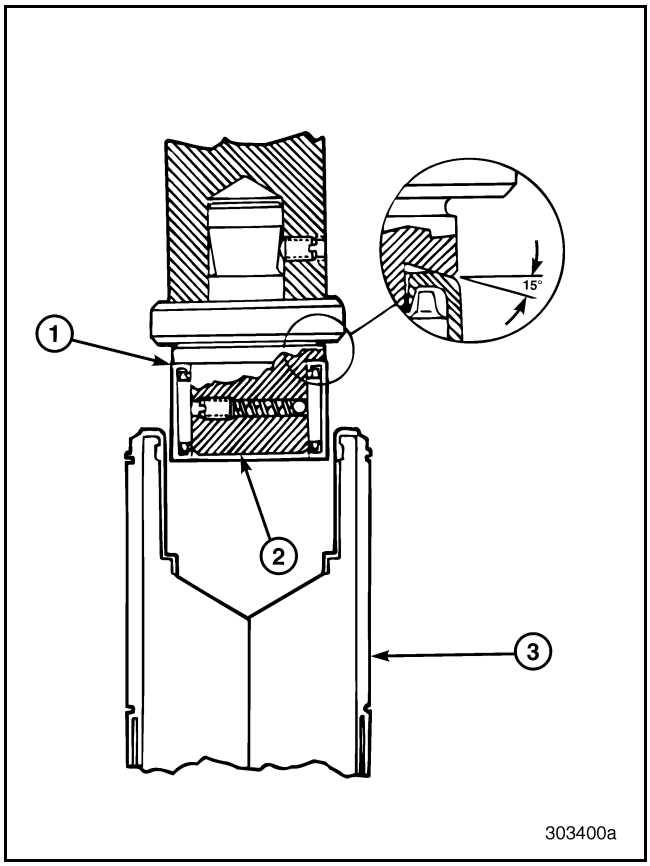


Figure 369 — Installation of Drawn Cup Bearings (T313L/T318L Shown)

1. Stamped End of Bearing 2. Press Tool Leader or Pilot	3. Rear Mainshaft

11. On the conventional output shaft transmissions: T313–T318(L)(LR), install the snap ring into the front end of the rear mainshaft to retain the spigot bearing.

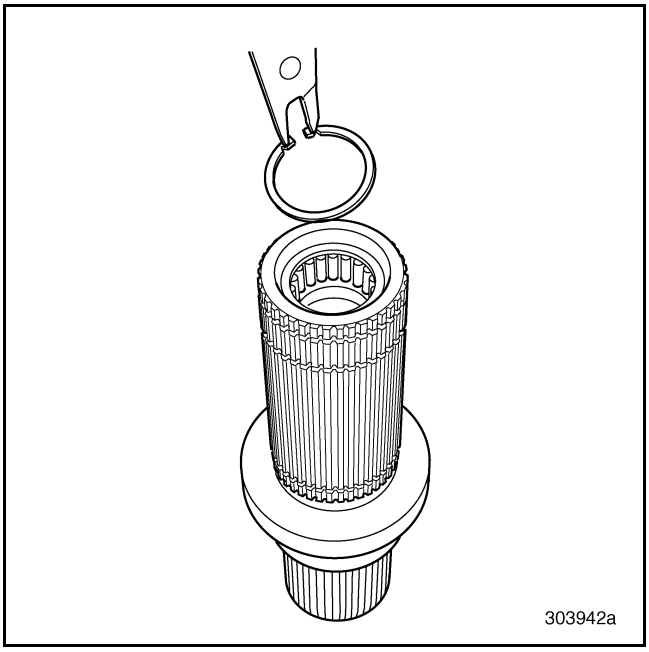


Figure 370 — Installing Spigot Bearing Snap Ring (T313L/T318L Shown)

12. Install the Lo-range gear hub onto the rear mainshaft.

NOTE

Make sure that the oil holes in the Lo-range gear hub are open and free to channel oil to the synchronizer discs.

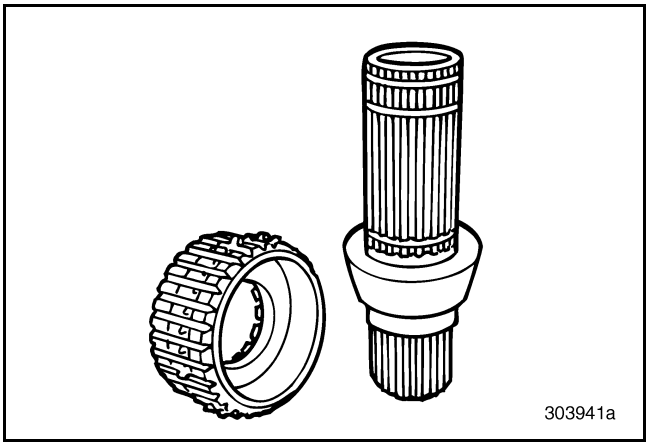


Figure 371 — Installing Lo-Range Gear Hub (T313L/T318L Shown)

13. Install the Lo-range gear over the hub. Notice that the ground surface on the gear faces the front of the transmission.

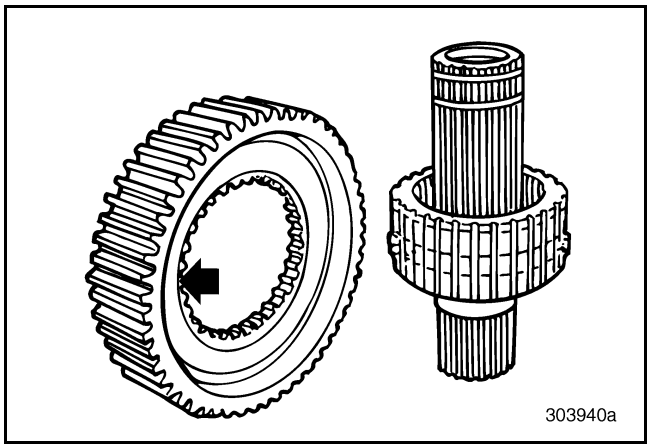


Figure 372 — Installing Lo-Range Gear

14. Install the larger snap ring that secures the Lo-range gear to the gear hub.

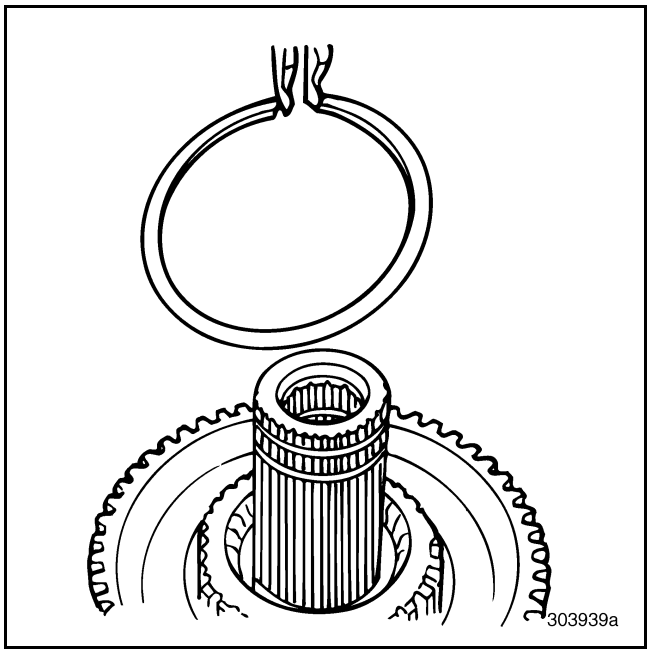


Figure 373 — Installing Lo-Range Gear-to-Hub Snap Ring (T313L/T318L Shown)

15. Install the internal-toothed thrust washer into the Lo-range gear hub.

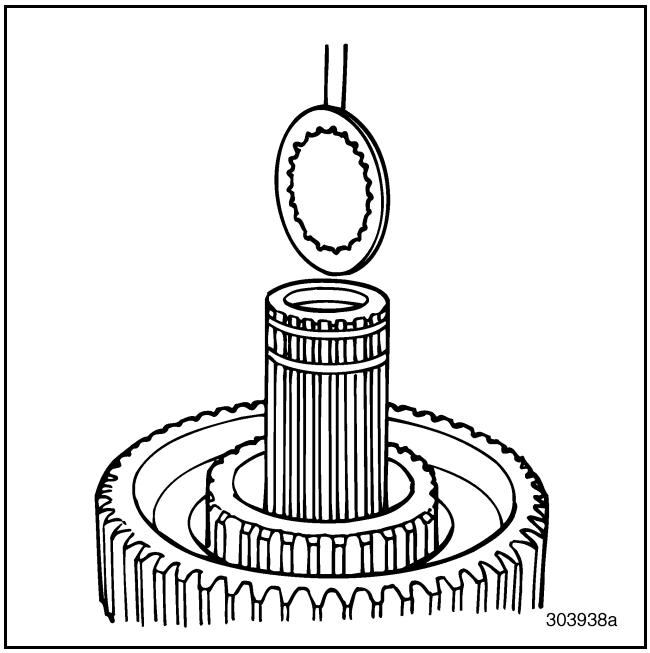


Figure 374 — Installing Internal-Toothed Thrust Washer (T313L/T318L Shown)

16. Install the Lo-range gear hub shaft snap ring into the groove of the rear mainshaft just above the previously installed internal-toothed thrust washer.

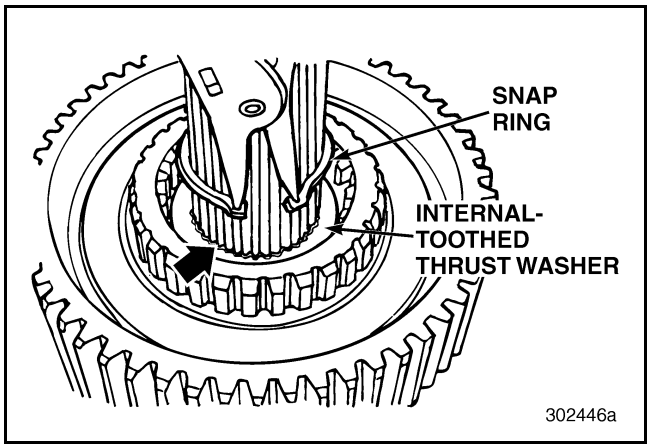


Figure 375 — Installing Lo-Range Gear Hub Shaft Snap Ring

17. Lubricate all synchronizer friction and reaction discs, using the recommended lubricant.

NOTE

Before and during installation, make sure to lubricate all synchronizer assembly friction and reaction discs and associated parts (gear and gear hub) using the recommended lubricant. This prevents premature wear to individual parts of the assembly during initial transmission start-up.

18. Install the first internal-toothed friction disc into the Lo-range gear, and then install the first external-toothed reaction disc onto the friction disc just installed.

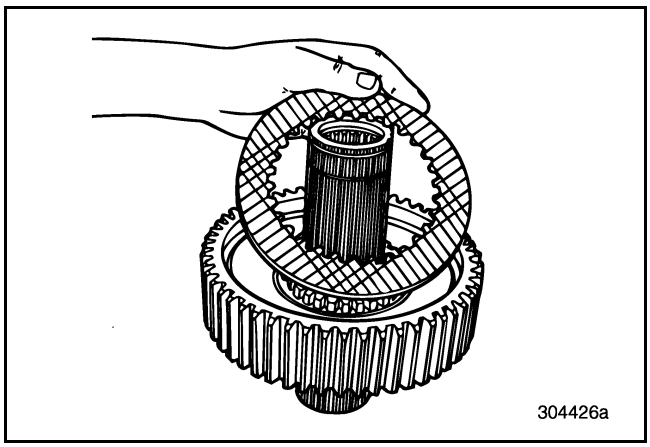


Figure 376 — Installing Friction Disc (T313L/T318L Shown)

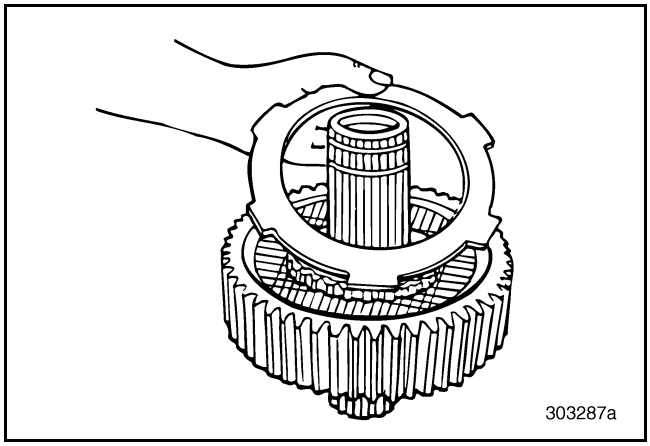


Figure 377 — Installing Reaction Disc (T313L/T318L Shown)

19. Continue alternately installing the remaining friction and steel reaction discs until four of each have been installed. Make sure to lubricate each friction and reaction disc with specified gear oil during installation. The last disc installed should be an external-toothed steel reaction disc.
20. Align the tangs (external teeth) of the steel reaction discs and then install the synchronizer assembly over the rear mainshaft (output shaft). Engage the slots of the synchronizer clutch housing with the tangs of all four reaction discs.

NOTE

Make sure that the synchronizer assembly is installed with the “R” markings on the clutch and pins, facing the rear of the mainshaft against the discs just installed.

SERVICE HINT

Rotating the synchronizer assembly back and forth during installation helps the assembly to align with the external teeth of the steel reaction discs.

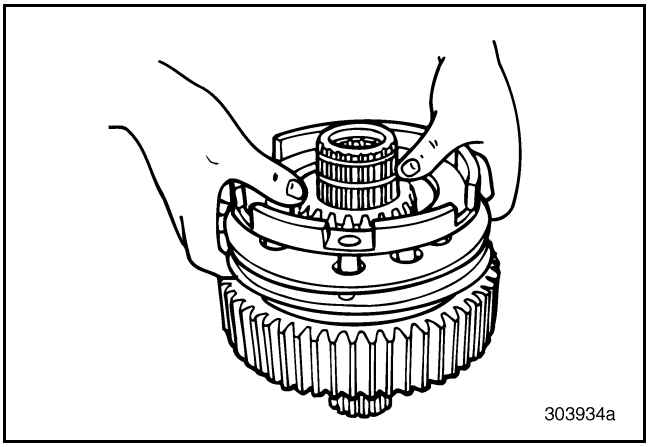


Figure 378 — Installing Synchronizer Assembly (T313L/T318L Shown)

21. Install an external-toothed steel reaction disc onto the front synchronizer disc housing, aligning the external teeth. Lubricate the disc with the specified gear oil during installation.

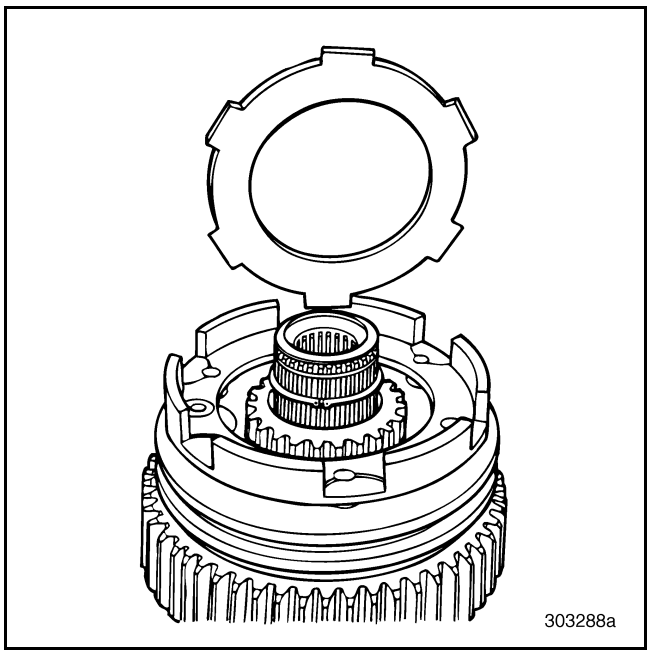


Figure 379 — Installing Reaction Disc (T313L/T318L Shown)

22. Install an internal-toothed friction disc onto the steel reaction disc just installed. Make sure to lubricate both sides of the disc with the specified gear oil during installation.

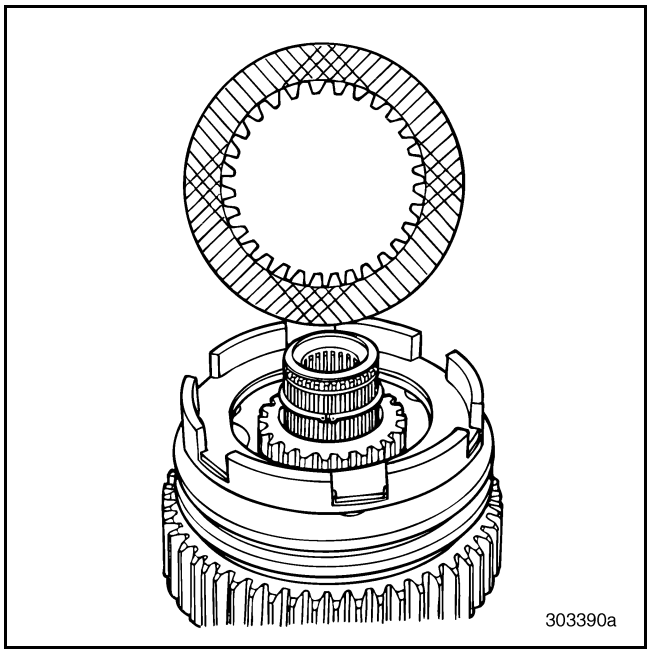


Figure 380 — Installing Friction Disc (T313L/T318L Shown)

23. Continue alternately installing the remaining friction and steel reaction discs until four of each have been installed. Make sure to lubricate each friction and reaction disc with the specified gear oil during installation. The last disc installed should be an internal-toothed friction disc.
24. Install the synchronizer disc pack spacer onto the synchronizer friction disc just installed. Lubricate the spacer with the specified gear oil during installation

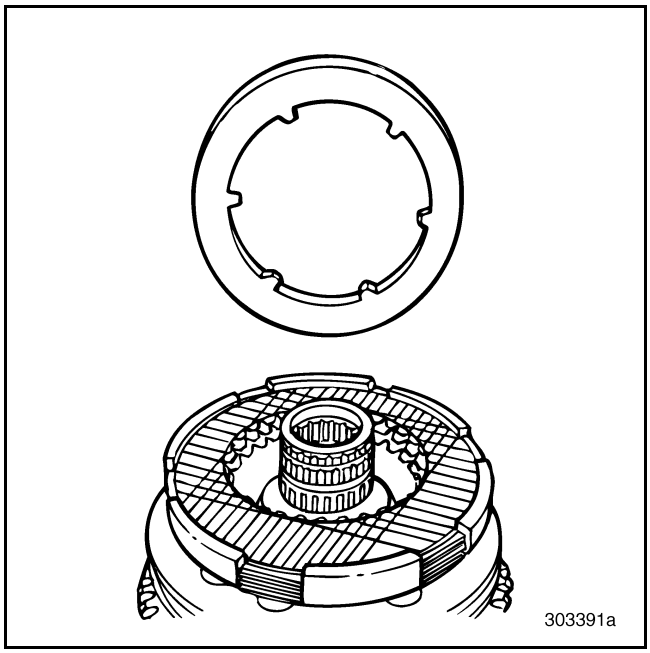


Figure 381 — Installing Spacer (T313L/T318L Shown)

25. On the conventional output shaft transmissions: T313–T318(L)(LR), install the shaft snap ring into the second groove from the front end of the rear mainshaft.

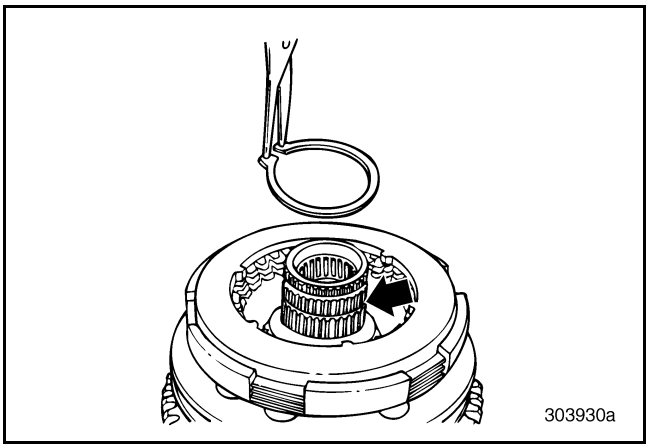


Figure 382 — Installing Shaft Snap Ring (T313L/T318L Shown)

26. For the conventional output shaft transmissions: T313–T318(L)(LR), install the larger gear snap ring into the second from rear groove of the Hi-range/Hi-split gear.

NOTE

There are four grooves on the inside of the Hi-range/Hi-split gear. The two outer grooves are relief grooves and are not to be used to retain snap rings. To properly retain the current design ball bearing, use only the two inner snap ring grooves.

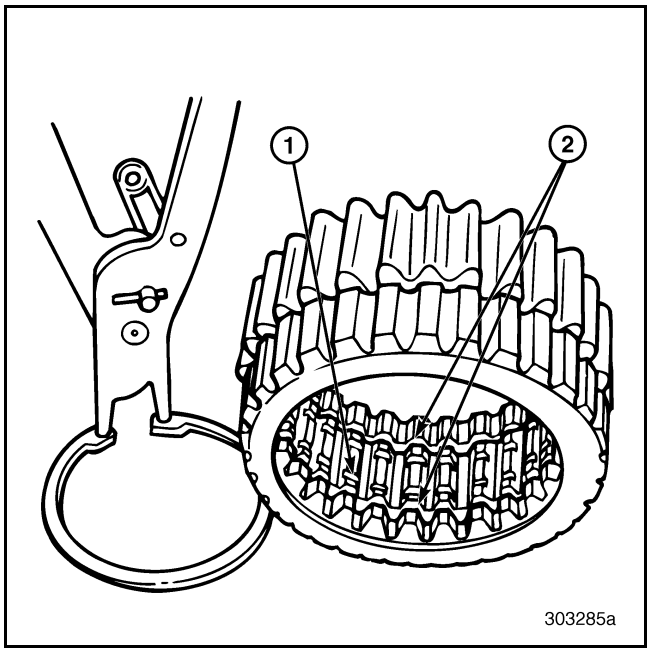


Figure 383 — Installing Gear Snap Ring (T313L/T318L Shown)

1. Rear Snap Ring Groove	2. Gear Machining Relief Grooves

27. For the conventional output shaft transmission: T313–T318(L)(LR), align the internal teeth of the friction discs and spacer. Then, install the Hi-range/Hi-split gear into the synchronizer assembly (smaller diameter of gear slips into disc splines).

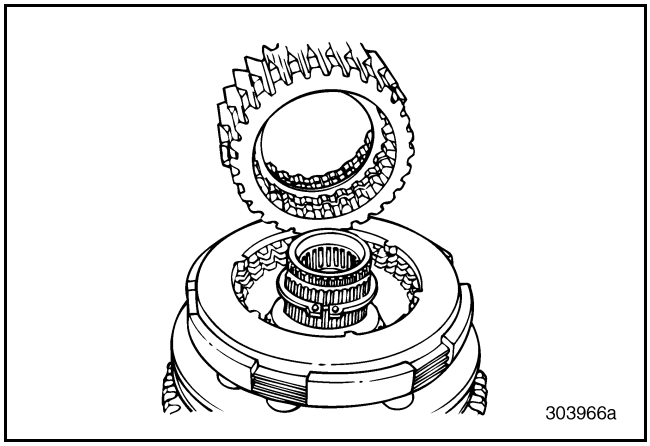


Figure 384 — Installing Hi-Range/Hi-Split Gear into Synchronizer (T313L/T318L Shown)

28. On the conventional output shaft transmissions: T313–T318(L)(LR), insert a **new** ball bearing into the Hi-range/Hi-split gear, over the front of the shaft.

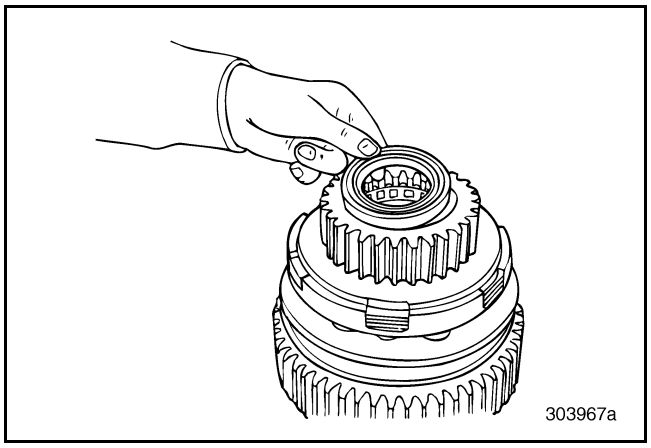


Figure 385 — Inserting Ball Bearing (T313L/T318L Shown)

29. For the conventional output shaft transmissions: T313–T318(L)(LR), using a suitable driver and hammer, seat the ball bearing into the gear against the gear and shaft snap rings previously installed.

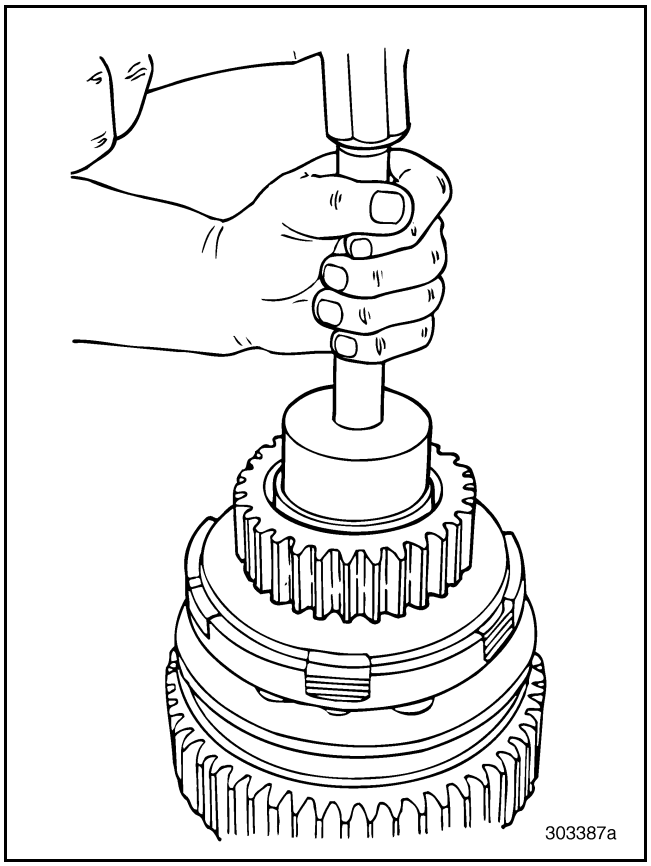


Figure 386 — Installing Ball Bearing (T313L/T318L Shown)

30. For the conventional output shaft transmissions: T313–T318(L)(LR), install the shaft snap ring into the front groove of the rear mainshaft, against the inner race of the ball bearing.

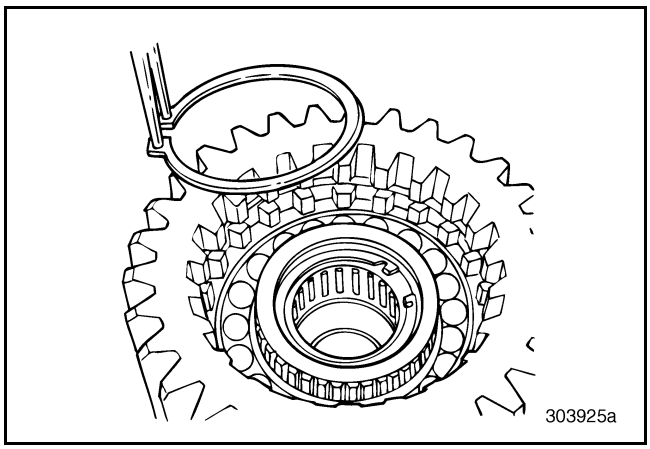


Figure 387 — Installing Shaft Snap Ring (T313L/T318L Shown)

31. On the conventional output shaft transmissions: T313–T318(L)(LR), install the remaining gear snap ring into the second (forward) groove from the front of the gear.

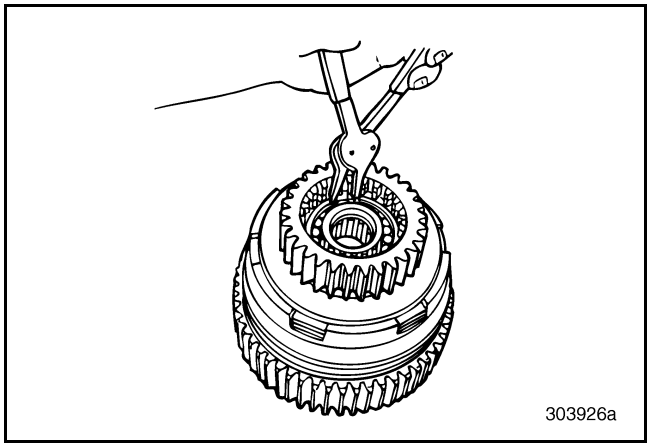


Figure 388 — Installing Gear Snap Ring (T313L/T318L Shown)

32. On the extended output shaft transmissions: T313–T318(21)(L21)(LR21), install the snap ring onto the output shaft. Then, install the internal-toothed thrust washer over the output shaft and against the snap ring.

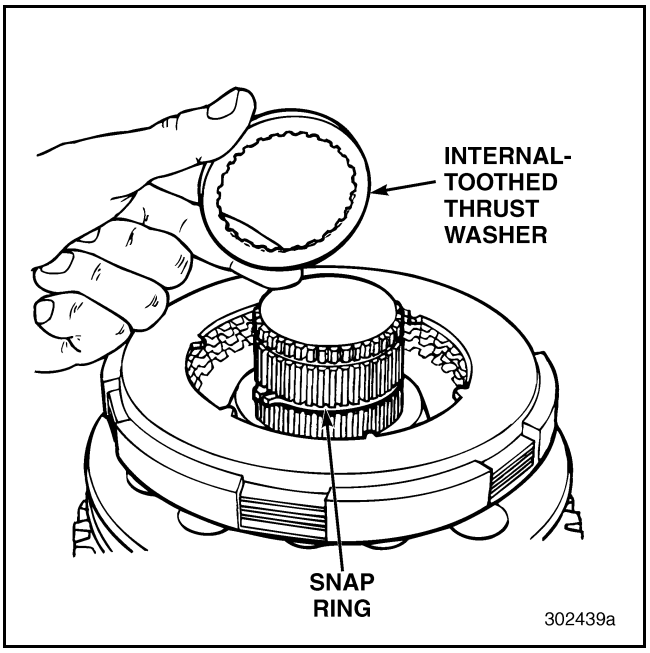


Figure 389 — Installing Internal-Toothed Thrust Washer (T313L21/T318L21 Shown)

33. For the extended output shaft transmissions: T313–T318(21)(L21)(LR21), install the external-toothed thrust washer onto the front of the output shaft. Note that the oil grooves of the external-toothed thrust washer face rearward toward the internal-toothed thrust washer.

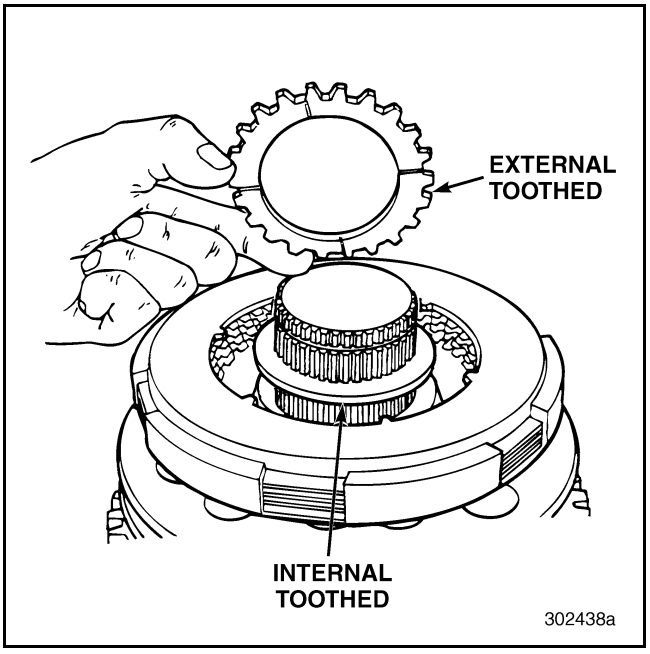


Figure 390 — Installing External-Toothed Thrust Washer (T313L21/T318L21 Shown)

34. For the extended output shaft transmissions: T313–T318(21)(L21)(LR21), install the snap ring inside the Hi-range/Hi-split gear, using suitable snap ring pliers.

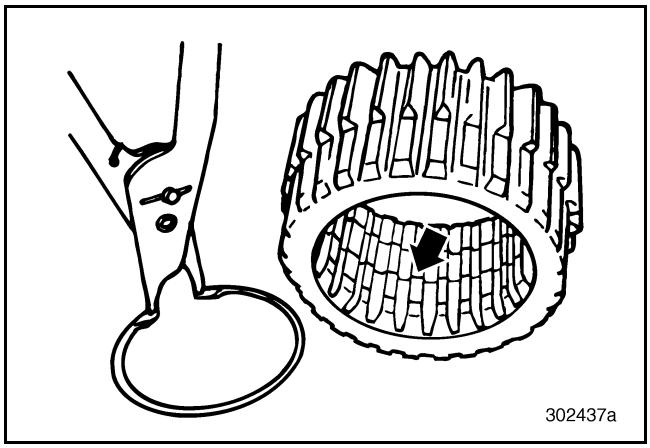


Figure 391 — Installing Snap Ring into Gear (T313L21/T318L21 Shown)

35. On the extended output shaft transmissions: T313–T318(21)(L21)(LR21), install the Hi-range/Hi-split gear over the end of the output shaft.

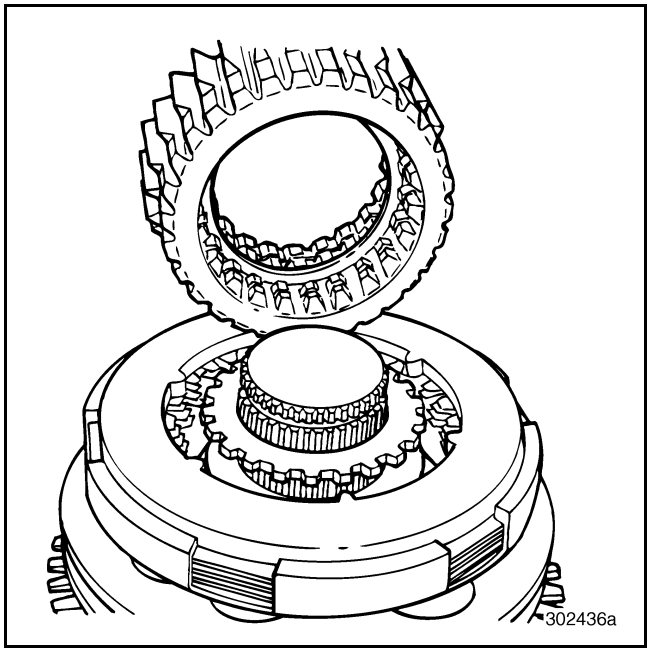


Figure 392 — Installing Hi-Range/Hi-Split Gear (T313L21/T318L21 Shown)

36. On the extended output shaft transmissions: T313–T318(21)(L21)(LR21), install the external-toothed and internal-toothed thrust washers over the front end of the output shaft. Note that the oil grooves of the external-toothed thrust washer face the front of the shaft toward the internal-toothed thrust washer.

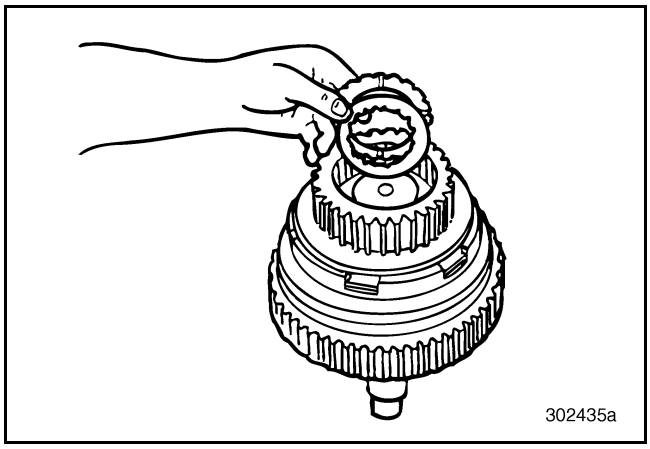


Figure 393 — Installing Thrust Washers (T313L21/T318L21 Shown)

37. For the extended output shaft transmissions: T313–T318(21)(L21)(LR21), install the remaining snap ring onto the front end of the output shaft, using suitable snap ring pliers.

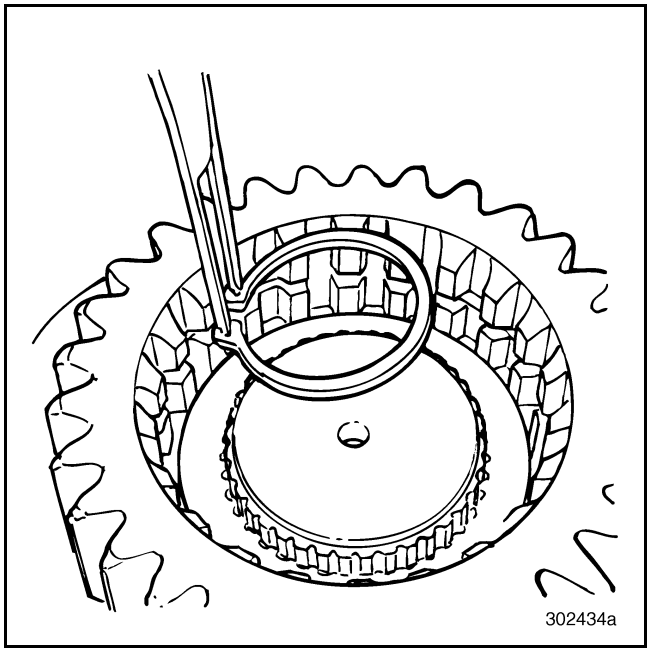


Figure 394 — Installing Snap Ring onto Front of Shaft (T313L21/T318L21 Shown)

38. Paint three sets of corresponding timing marks on the teeth of both the Hi-range/Hi-split gear and the Lo-range gear.
    - Paint two teeth on either side of every 10th space on the Hi-range/Hi-split gear.
    - Paint two teeth on either side of every 18th space on the Lo-range gear.

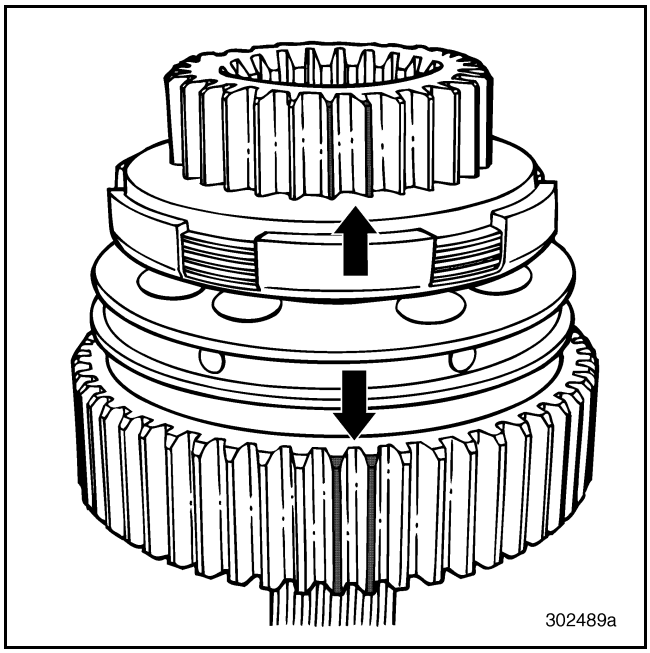


Figure 395 — Painting Timing Marks on Gears

Front Mainshaft Reassembly [322]

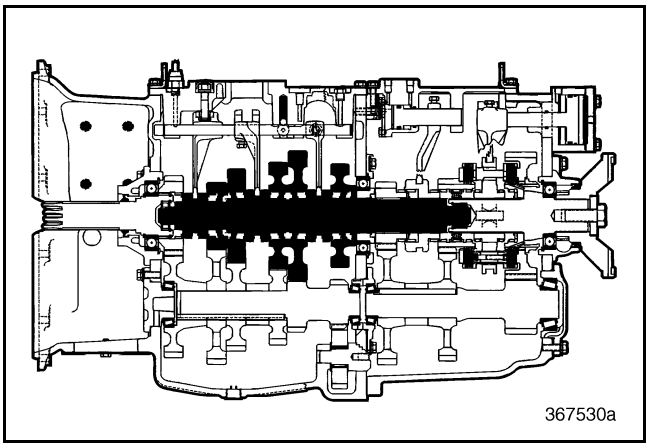


Figure 396 — Front Mainshaft Component Locator (T313L/T318L Shown)

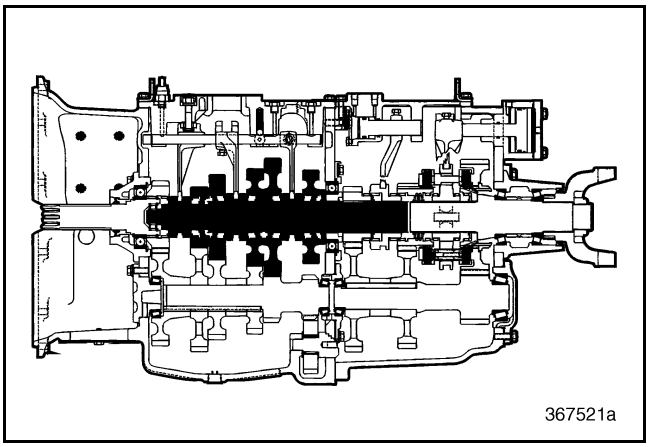


Figure 397 — Front Mainshaft Component Locator (T313L21/T318L21 Shown)

The splines on the front mainshaft are usually not aligned for the entire length of the shaft. The recommended procedure is to install the first/second sliding clutch, second (sixth) and fourth (eighth) speed gears, gear thrust washers and snap rings onto the front of the shaft. Install the remaining reverse gear, Lo/reverse sliding clutch, Lo-speed gear, first (fifth) speed gear, thrust washers and snap rings onto the rear of the shaft.

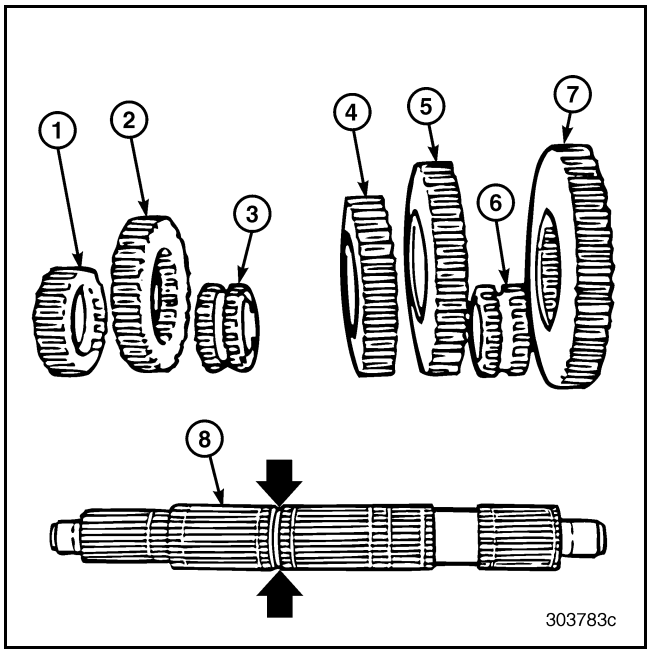


Figure 398 — View of Mainshaft and Gears (T313L/T318L Shown)

1. Fourth (Eighth) Speed Gear	4. First (Fifth) Speed Gear
2. Second (Sixth) Speed Gear	5. Lo-Speed Gear
3. First/Second Sliding Clutch	6. Lo/Reverse Sliding Clutch
	7. Reverse Speed Gear
	8. Front Mainshaft

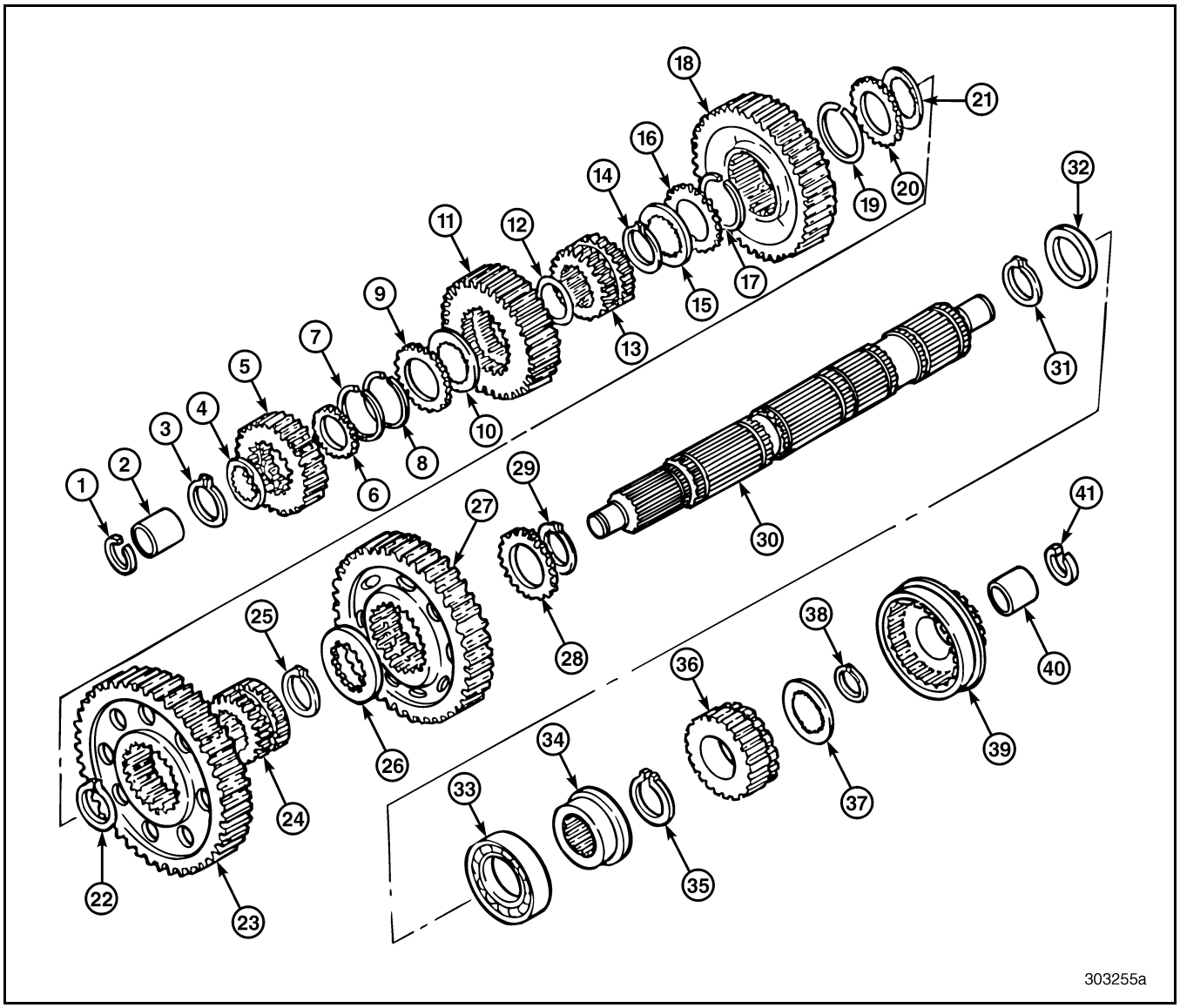


Figure 399 — Exploded View of Front Mainshaft (T313L/T318L Shown)

1. Spigot Bearing Inner Race Snap Ring	15. Internal-Toothed Thrust Washer	29. Mainshaft Snap Ring
2. Spigot Bearing Inner Race	16. External-Toothed Thrust Washer	30. Front Mainshaft (T313L/T318L Shown)
3. Mainshaft Snap Ring	17. Gear Snap Ring	31. Mainshaft Snap Ring
4. Internal-Toothed Thrust Washer	18. First (Fifth) Speed Gear	32. Spacer
5. Fourth (Eighth) Speed Gear	19. Gear Snap Ring	33. Mainshaft Rear Bearing
6. External-Toothed Thrust Washer	20. External-Toothed Thrust Washer	34. Mainshaft Rear Bearing Sleeve
7. Gear Snap Ring	21. Internal-Toothed Thrust Washer	35. Mainshaft Snap Ring
8. Gear Snap Ring	22. Mainshaft Snap Ring	36. Lo-Split Gear
9. External-Toothed Thrust Washer	23. Lo-Speed Gear	37. Internal-Toothed Thrust Washer
10. Internal-Toothed Thrust Washer	24. Sliding Clutch	38. Mainshaft Snap Ring
11. Second (Sixth) Speed Gear	25. Mainshaft Snap Ring	39. Sliding Clutch
12. Mainshaft Snap Ring	26. Internal-Toothed Thrust Washer	40. Spigot Bearing Inner Race: T313–T318(L)(LR) Only
13. Sliding Clutch	27. Reverse Speed Gear	41. Spigot Bearing Inner Race Snap Ring: T313–T318(L)(LR) Only
14. Mainshaft Snap Ring	28. External-Toothed Thrust Washer	

1. Install a **new** spigot bearing inner race onto the front of the mainshaft, using a suitable driver and hammer.

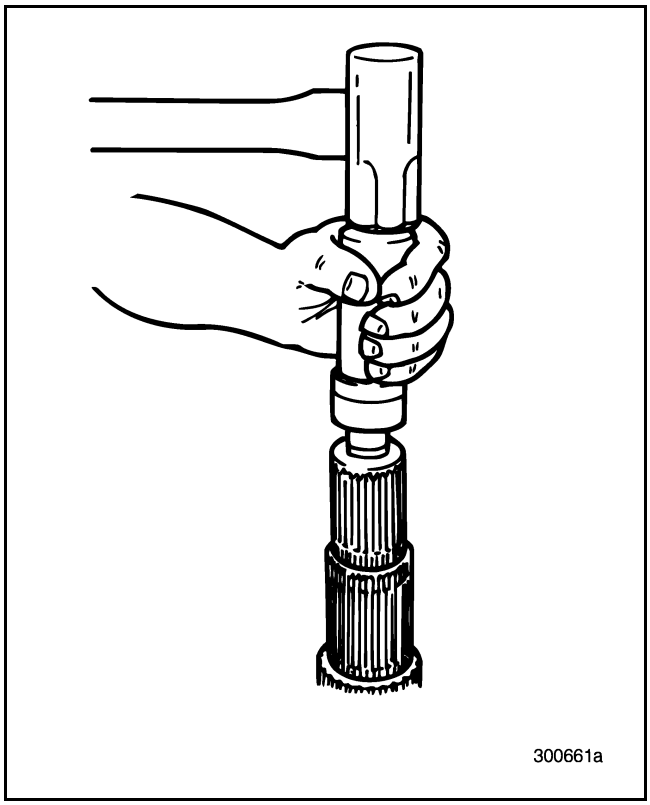


Figure 400 — Installing Spigot Bearing Inner Race

2. Install the inner race snap ring, using suitable snap ring pliers.

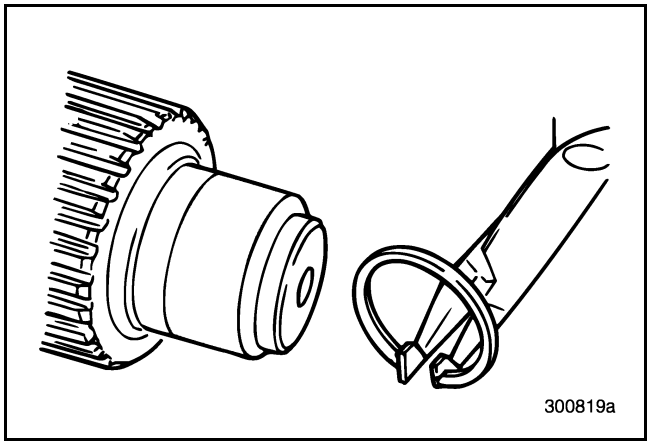


Figure 401 — Installing Inner Race Snap Ring

3. For the conventional output shaft transmissions: T313–T318(L)(LR), install a **new** spigot bearing inner race onto the rear of the front mainshaft. Use a suitable driver and press, if necessary. Install the retaining snap ring.

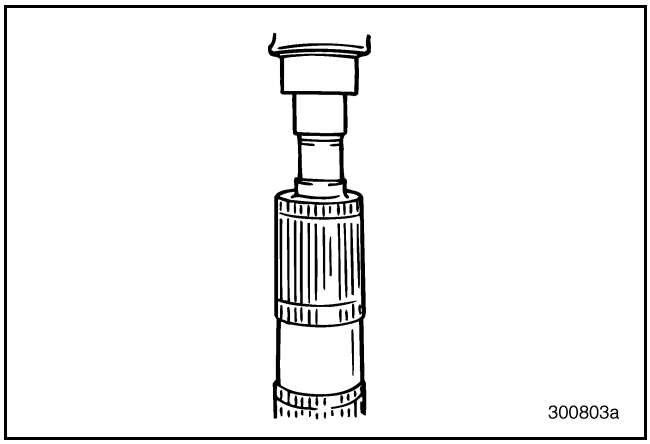


Figure 402 — Installing Spigot Bearing Inner Race (T313L/T318L Shown)

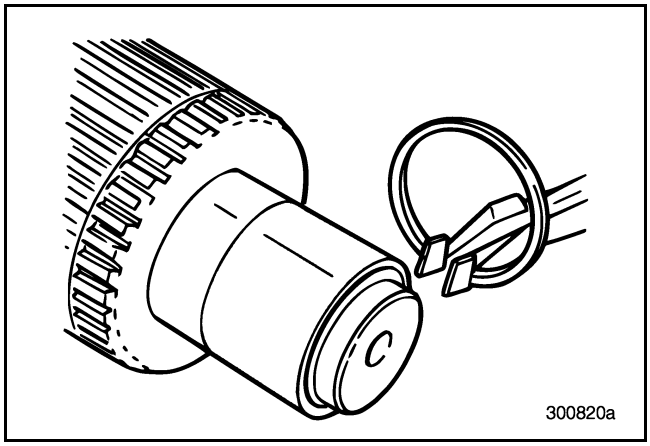


Figure 403 — Installing Inner Race Snap Ring (T313L/T318L Shown)

4. Working at the front of the mainshaft, install the first (fifth) speed gear mainshaft snap ring into the third snap ring groove of the shaft.

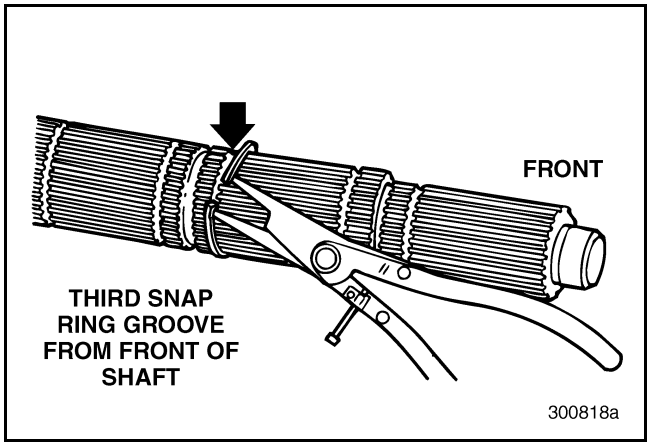


Figure 404 — Installing First Speed Gear Snap Ring

5. Install the first/second sliding clutch onto the mainshaft.

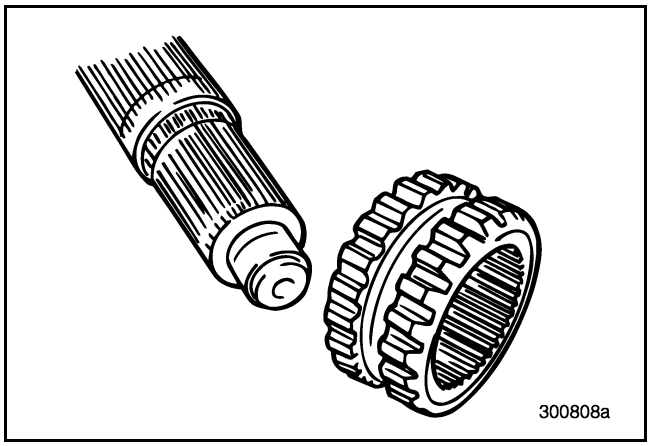


Figure 405 — Installing First/Second Sliding Clutch onto Mainshaft

6. Install the second (sixth) speed gear mainshaft snap ring into the second snap ring groove from the front of the shaft.

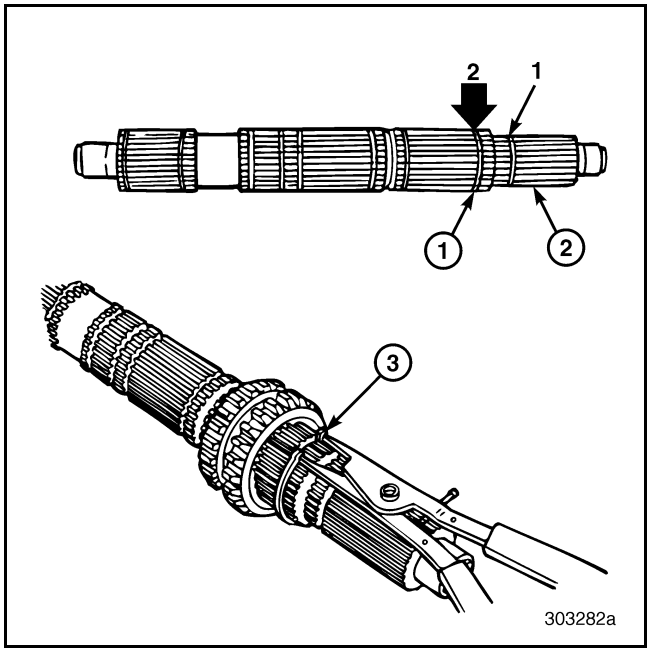


Figure 406 — Installing Second Speed Gear Mainshaft Snap Ring (T313L/T318L Shown)

1. Second Snap Ring Groove	2. Front of Mainshaft 3. Snap Ring Groove

7. Install the second (sixth) speed gear internal-toothed and external-toothed thrust washers onto the mainshaft against the previously installed snap ring.

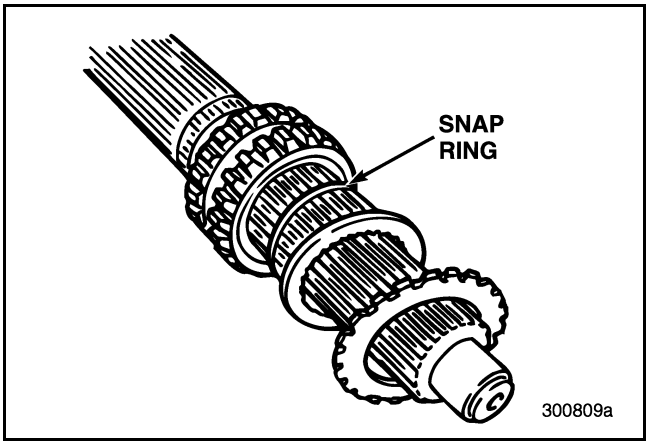


Figure 407 — Installing Internal-Toothed and External-Toothed Thrust Washers

8. Install the snap ring into the snap ring groove of the second (sixth) speed gear, using suitable snap ring pliers.

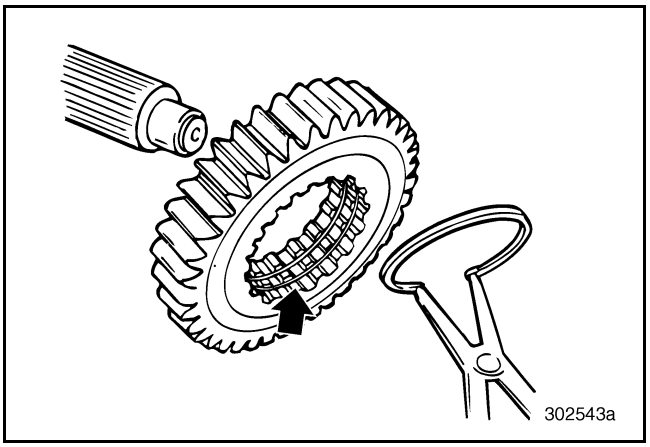


Figure 408 — Installing Snap Ring into Second Speed Gear

9. Install the second (sixth) speed gear onto the mainshaft, with the clutch teeth facing rearward and the snap ring facing forward.

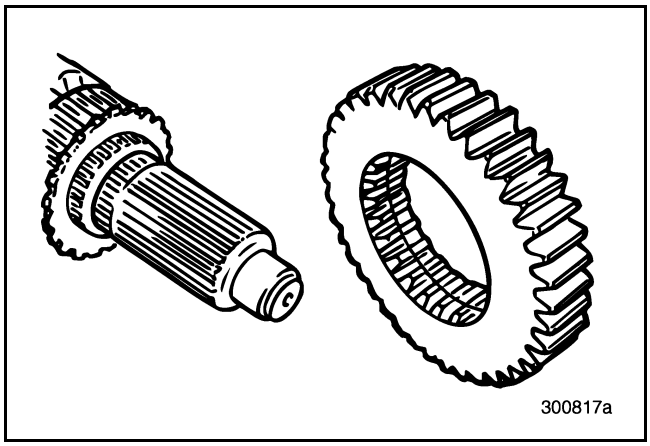


Figure 409 — Installing Second Speed Gear onto Mainshaft

10. Install the snap ring into the snap ring groove of the fourth (eighth) speed gear, farthest away from the clutch teeth, using suitable snap ring pliers.

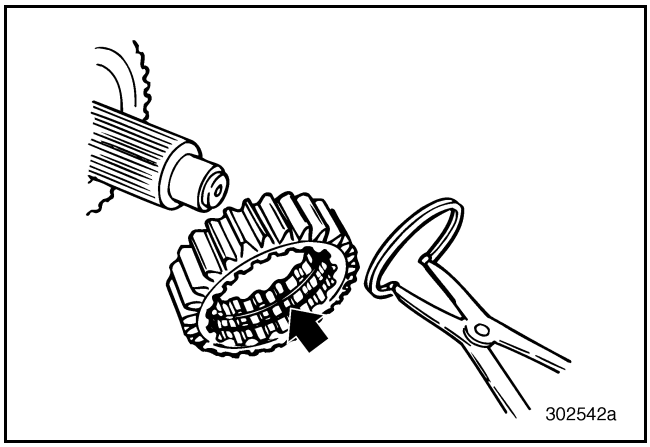


Figure 410 — Installing Snap Ring into Fourth Speed Gear

11. Install the fourth (eighth) speed gear onto the mainshaft with the clutch teeth facing forward and the snap ring facing rearward.

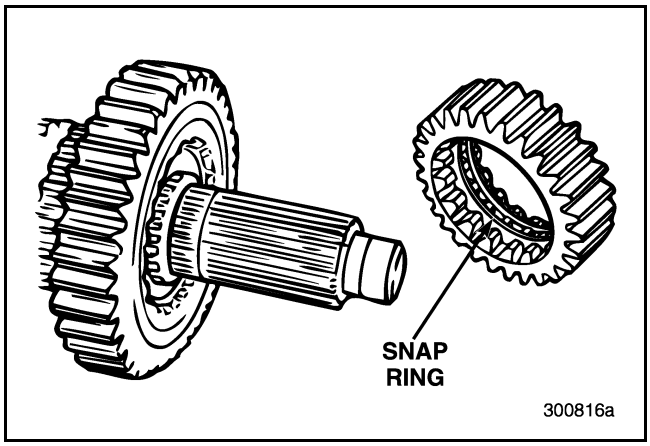


Figure 411 — Installing Fourth Speed Gear

12. Install the fourth (eighth) speed gear external-toothed and internal-toothed thrust washers. Place the oil groove side of the external-toothed thrust washer facing forward (toward the internal-toothed thrust washer).

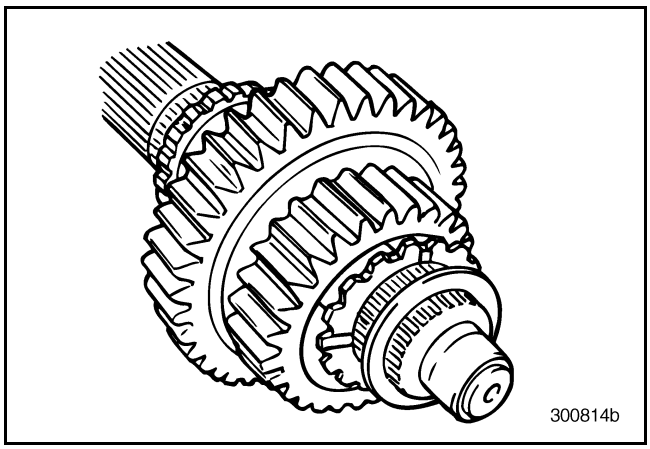


Figure 412 — Installing Internal- and External-Toothed Thrust Washers

13. Install the fourth (eighth) speed gear snap ring onto the mainshaft, inside the fourth speed gear.

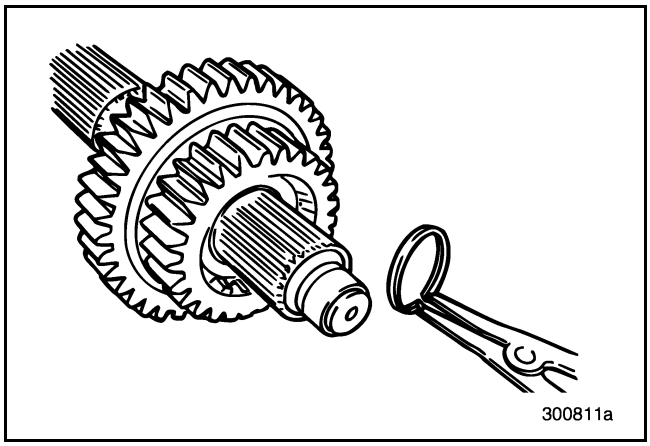


Figure 413 — Installing Fourth Speed Gear Snap Ring

14. Working at the rear of the mainshaft, install the first (fifth) speed gear internal-toothed and external-toothed thrust washers. Slide them forward against the previously installed snap ring. The oil grooves of the external-toothed thrust washer face forward toward the internal-toothed thrust washer.

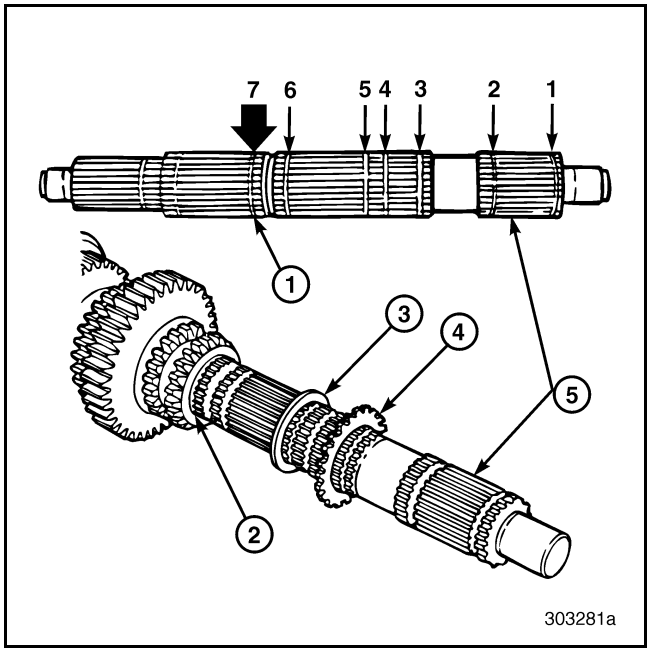


Figure 414 — Installing Internal- and External-Toothed Thrust Washers (T313L/T318L Shown)

1. Seventh Snap Ring Groove	4. External-Toothed Thrust Washer
2. Snap Ring	5. Rear of Mainshaft
3. Internal-Toothed Thrust Washer	

15. Install the snap ring into the snap ring groove of the first (fifth) speed gear, farthest from the clutch teeth.

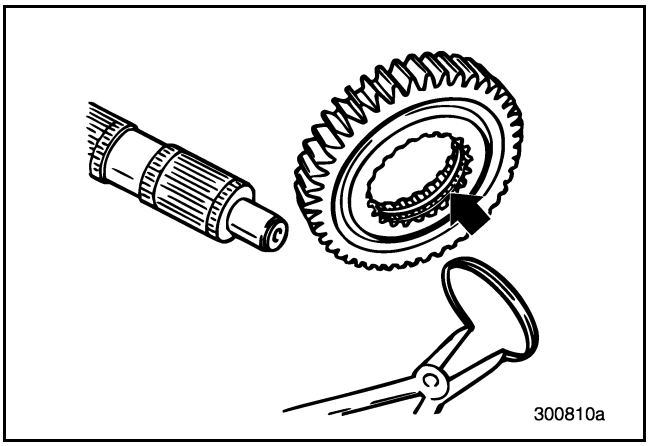


Figure 415 — Installing Snap Ring into First Speed Gear (T313L/T318L Shown)

16. Install the first (fifth) speed gear onto the mainshaft with the clutch teeth facing the front of the shaft.

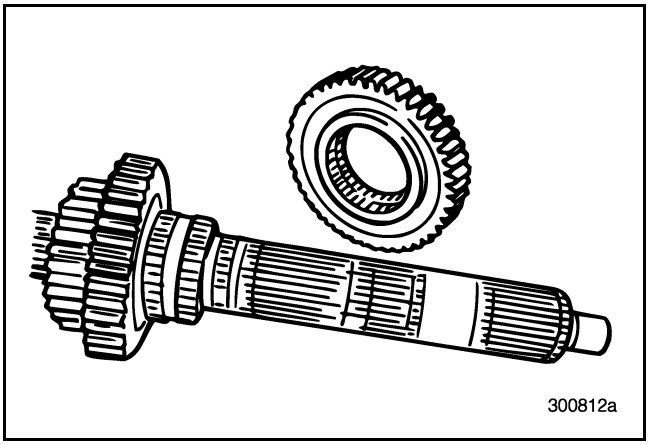


Figure 416 — Installing First Speed Gear onto Mainshaft (T313L/T318L Shown)

17. Install the snap ring into the groove of the Lo-speed gear, farthest away from the clutch teeth.

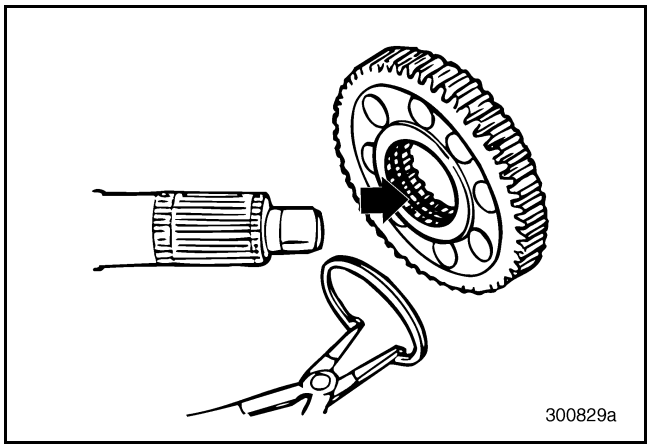


Figure 417 — Installing Snap Ring into Lo-Speed Gear (T313L/T318L Shown)

18. Install the Lo-speed gear onto the mainshaft with clutch teeth facing rearward.

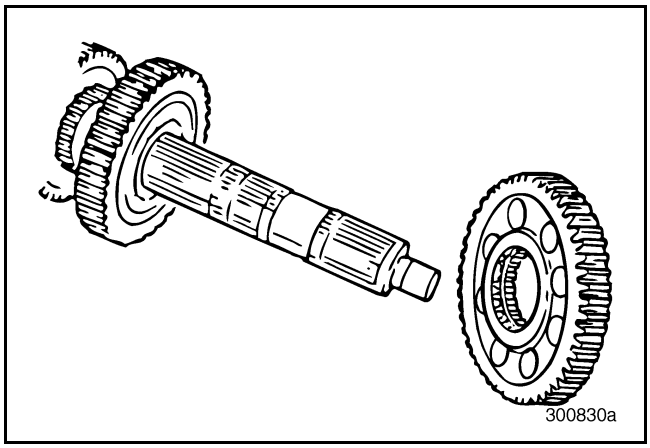


Figure 418 — Installing Lo-Speed Gear (T313L/T318L Shown)

19. Install the Lo-speed gear external-toothed and internal-toothed thrust washers onto the mainshaft. Make sure the oil groove side of the external-toothed thrust washer faces rearward.

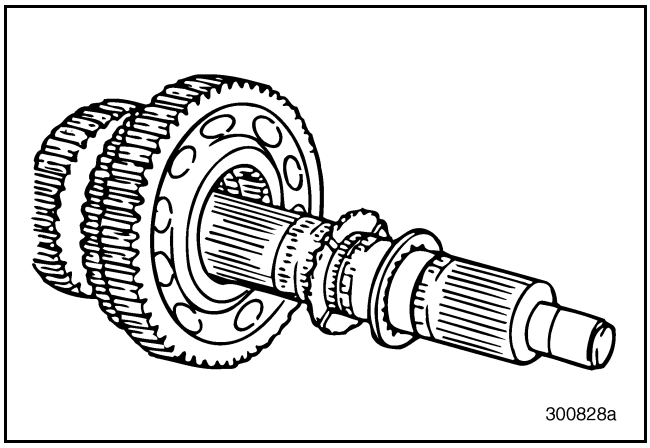


Figure 419 — Installing Internal- and External-Toothed Thrust Washers (T313L/T318L Shown)

20. Install the snap ring for the Lo-speed gear onto the mainshaft.

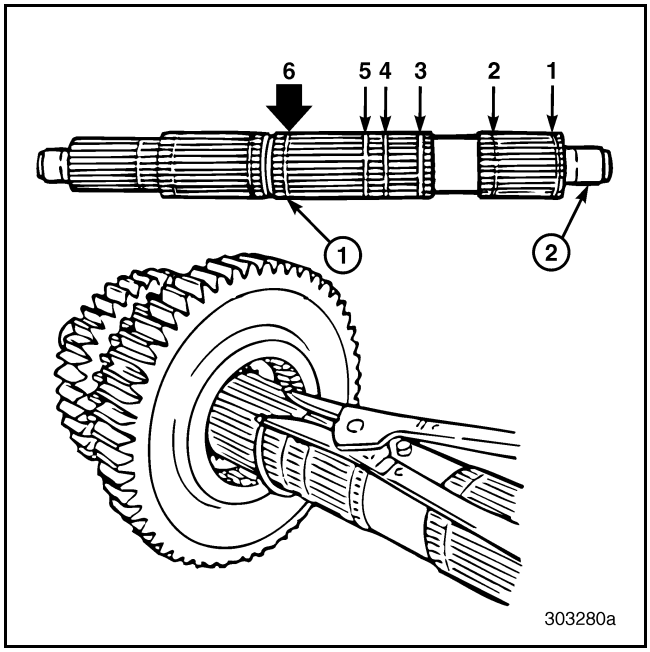


Figure 420 — Installing Internal- and External-Toothed Thrust Washers (T313L/T318L Shown)

1. Sixth Snap Ring Groove	2. Rear of Mainshaft

21. Install the Lo/reverse sliding clutch onto the mainshaft.

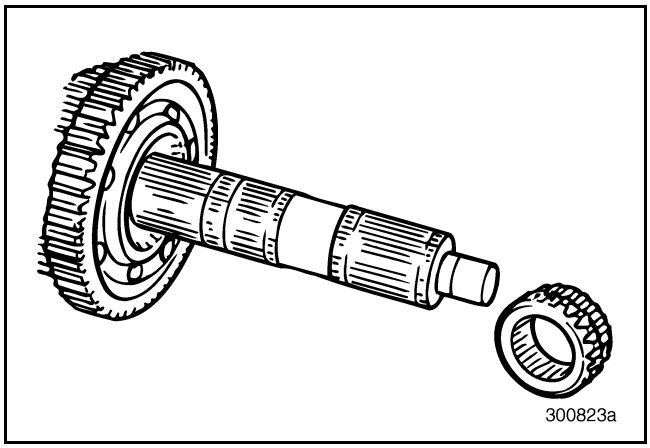


Figure 421 — Installing Lo/Reverse Sliding Clutch onto Mainshaft (T313L/T318L Shown)

22. Install the reverse speed gear onto the mainshaft with clutch teeth facing the sliding clutch.

NOTE

The reverse speed gear thrust washers and remaining snap ring will be installed after the mainshaft has been installed into the case, during transmission reassembly.

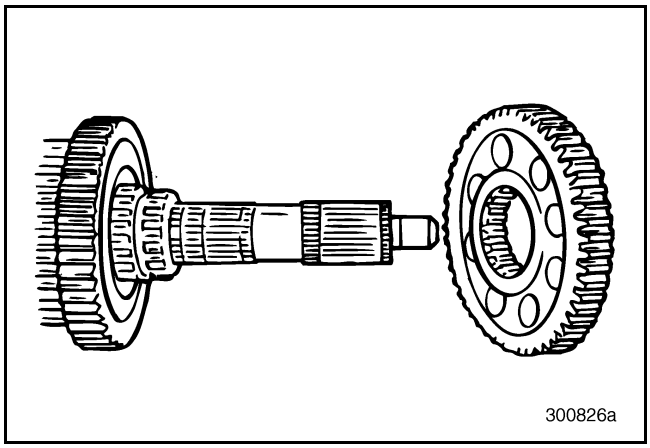


Figure 422 — Installing Reverse Speed Gear onto Mainshaft (T313L/T318L Shown)

23. Install the snap ring retaining the reverse gear to the mainshaft, using suitable snap ring pliers. Install snap ring into the fifth snap ring groove from the rear of the shaft.

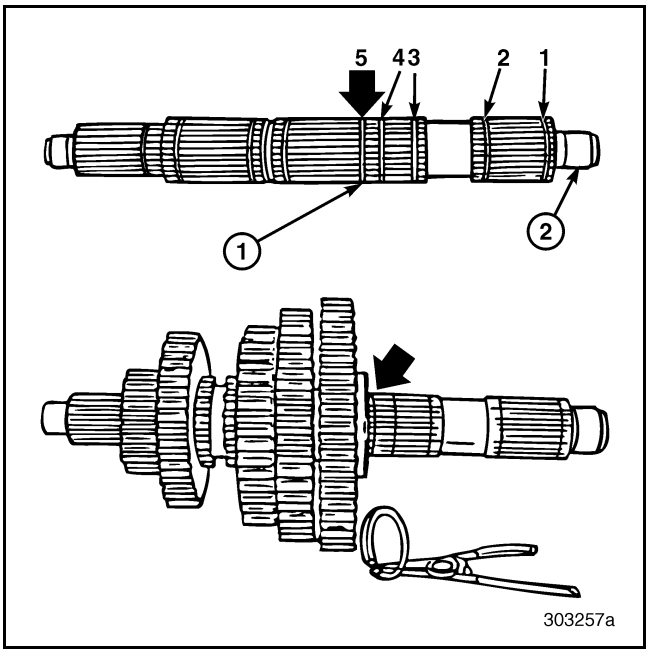


Figure 423 — Installing Reverse Speed Gear Snap Ring onto Mainshaft (T313L/T318L Shown)

1. Fifth Snap Ring Groove	2. Rear of Mainshaft

24. To make it easier to install the mainshaft into the main case:
    - Slide the Lo/reverse sliding clutch forward until it engages the Lo-speed gear.
    - Slide the reverse speed gear over the Lo/reverse sliding clutch until fully engaged.

NOTE

The following parts will be reinstalled during transmission reassembly:

- Internal-toothed thrust washer (26)
- External-toothed thrust washer (28)
- Reverse speed gear snap ring (29)

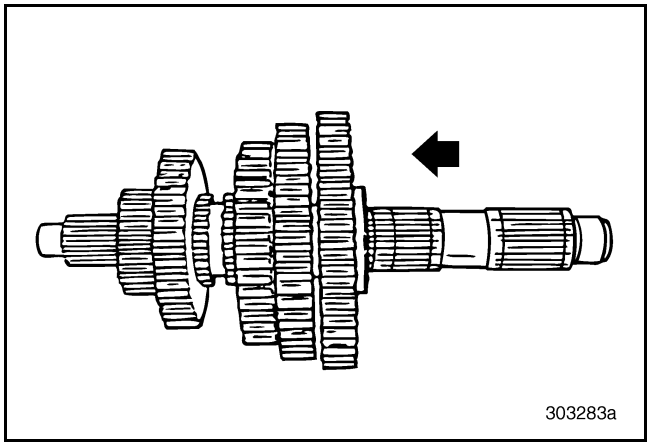


Figure 424 — Moving Sliding Clutch and Reverse Speed Gear Forward (T313L/T318L Shown)

Main Drive Pinion Reassembly

[322]

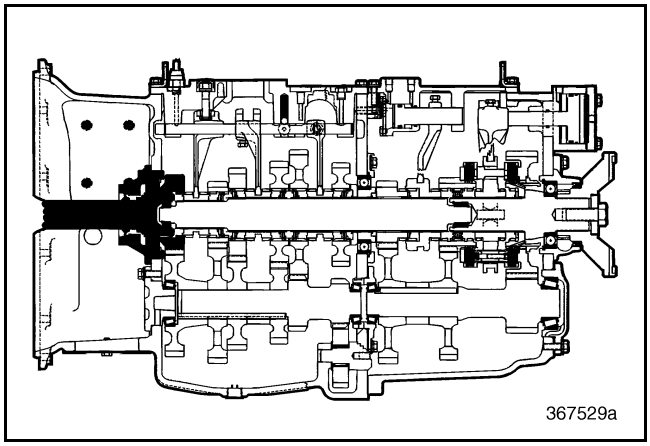


Figure 425 — Main Drive Pinion Component Locator (T313L/T318L Shown)

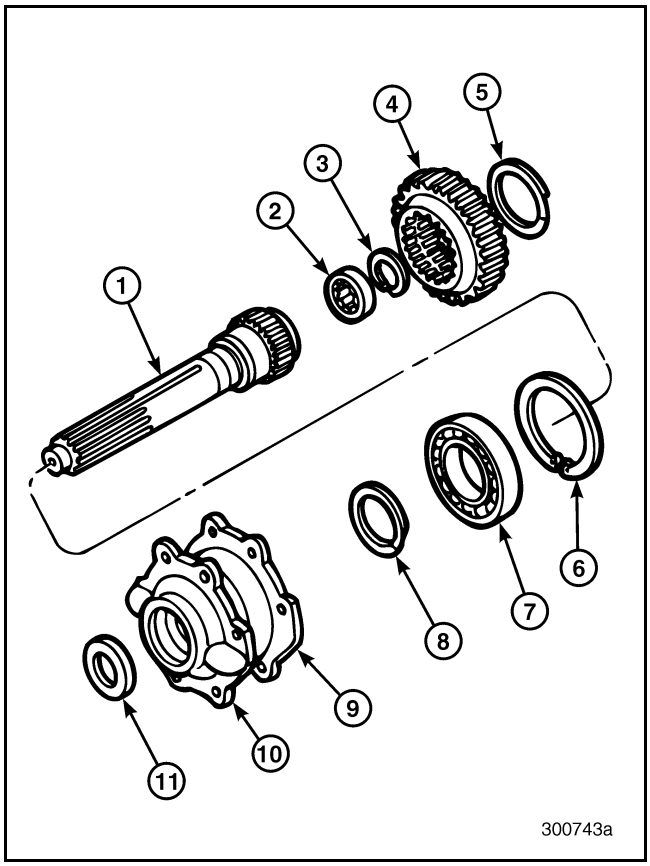


Figure 426 — Exploded View of Main Drive Pinion

1. Main Drive Pinion Shaft	7. Bearing
2. Spigot Bearing	8. Spiral Snap Ring
3. Snap Ring	9. Gasket
4. Main Drive Pinion Gear	10. Pinion Bearing Cover
5. Spiral Snap Ring	11. Oil Seal
6. Snap Ring	

1. Press a **new** ball bearing onto the main drive pinion shaft. Support the inner race of the bearing while pressing.

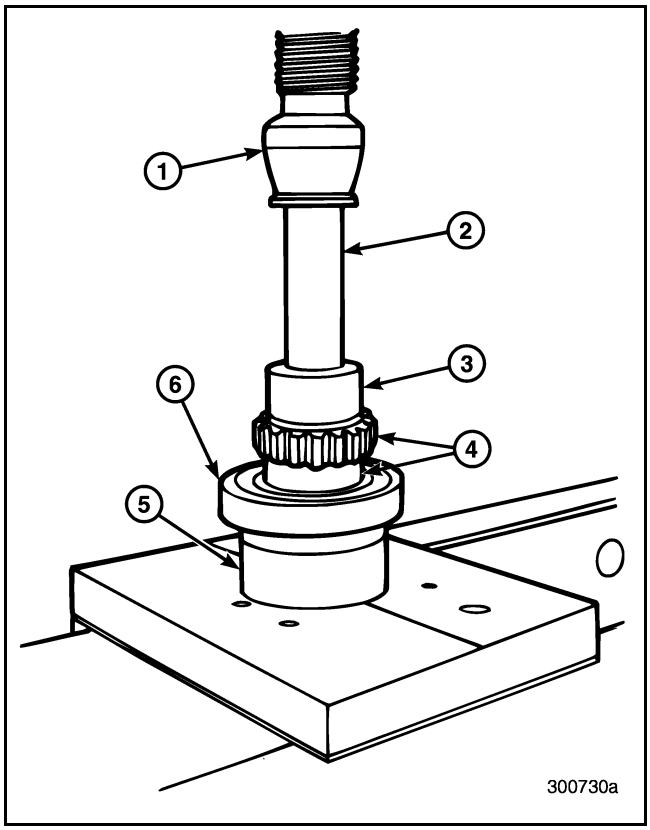


Figure 427 — Installing Main Drive Pinion Bearing

1. Press	4. Main Drive Pinion Shaft
2. Spacer Tube	5. Sleeve
3. Driver	6. Bearing

2. To retain the ball bearing, install the spiral snap ring. To do this, use a circular motion while pressing the snap ring tightly into the groove on the shaft.

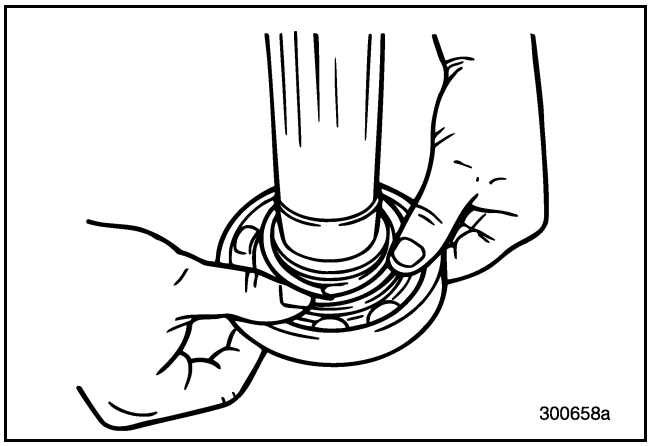


Figure 428 — Installing Spiral Snap Ring

3. Position a **new** oil seal in the main drive pinion bearing cover.

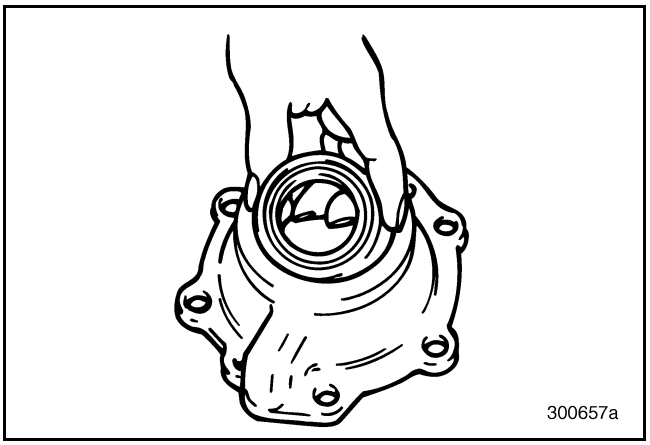


Figure 429 — Positioning Bearing Cover Oil Seal

4. Install the oil seal into the front of the main drive pinion bearing cover. Refer to “Oil Seals” on page 127 for installation instructions and seal precautions.

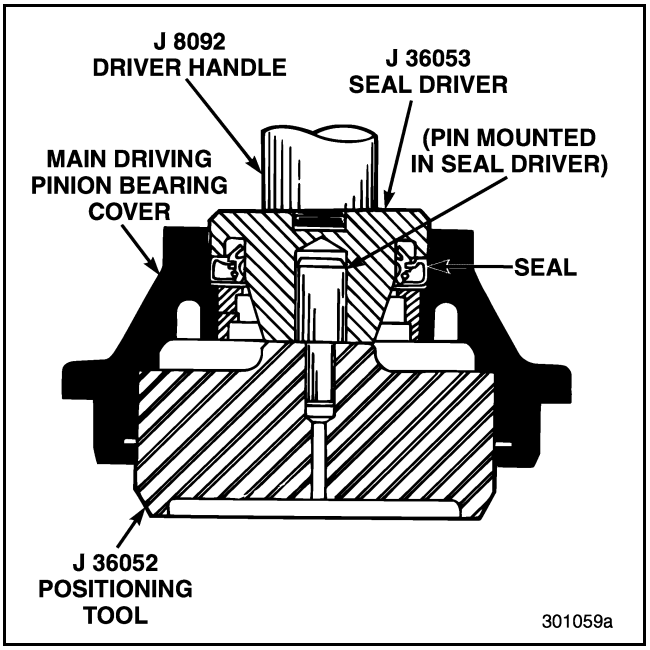


Figure 430 — Installing Bearing Cover Oil Seal

5. Press the main drive pinion shaft and bearing assembly into the main drive pinion bearing cover.

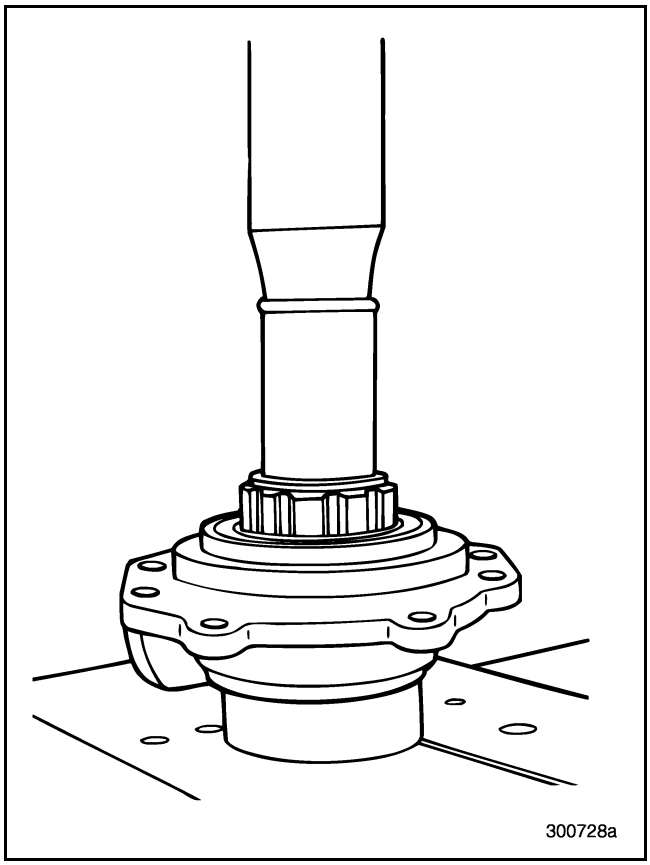


Figure 431 — Installing Main Drive Pinion Assembly into Drive Pinion Bearing Cover

6. Install the main drive pinion bearing snap ring, using suitable snap ring pliers.

⚠ WARNING

The large snap ring is very difficult to compress and may fly off the snap ring pliers, causing injury.

NOTE

One side of the large snap ring is bevelled and faces out. The flat side of the snap ring goes against the bearing.

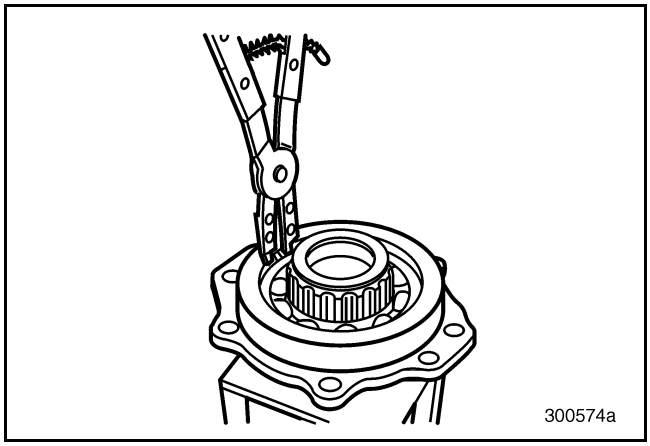


Figure 432 — Installing Snap Ring into Main Drive Pinion Bearing Cover

7. Install a **new** spigot bearing into the end of the main drive pinion shaft by hand. Then, install the retaining snap ring.

NOTE

Drawn cup needle bearings (spigot bearings) have a specific direction in which they must be installed. The radius end of the bearing must be installed first. The flat end of the bearing faces out.

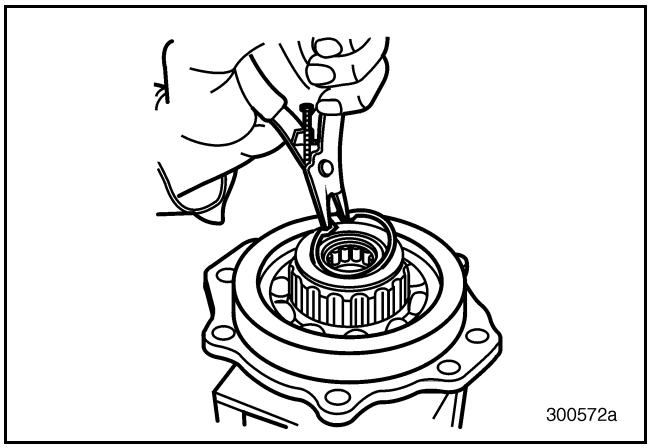


Figure 433 — Installing Spigot Bearing and Snap Ring

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8. Install the main drive pinion gear onto the pinion shaft. Install the spiral snap ring, using a circular motion while pressing the snap ring tightly into the groove on the shaft.

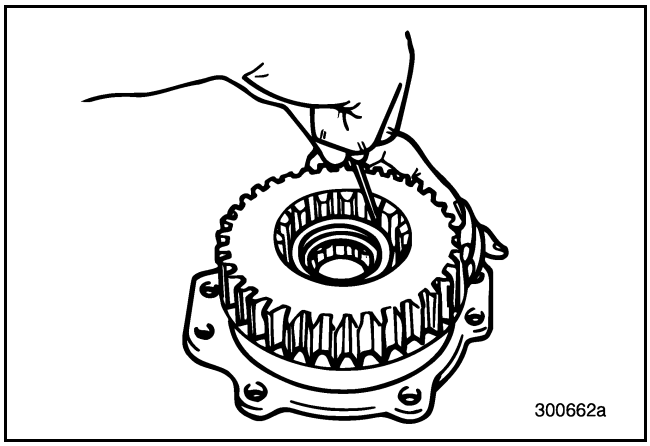


Figure 434 — Installing Main Drive Pinion Gear and Spiral Snap Ring

9. Install a **new** bearing cover gasket, using sealant between the gasket and cover. Make sure the oil passage hole and capscrew holes in the gasket align with the cover holes.

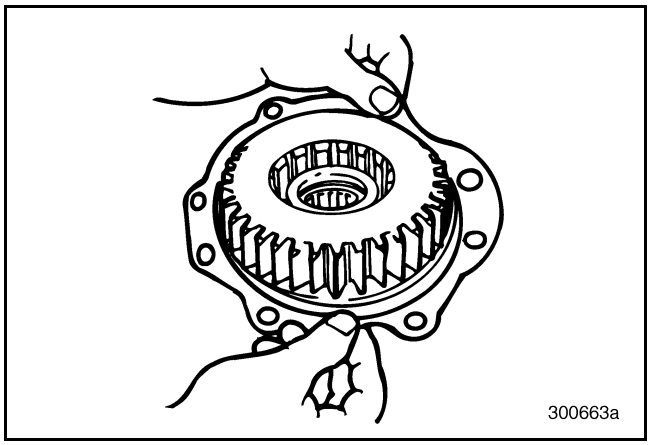


Figure 435 — Installing Main Drive Pinion Bearing Cover Gasket

Range Shift Valve

[324]

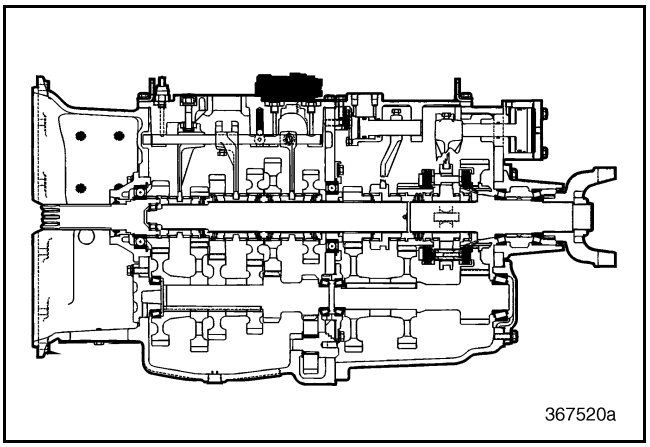


Figure 436 — Range Shift Valve Component Locator (T313L21/T318L21 Shown)

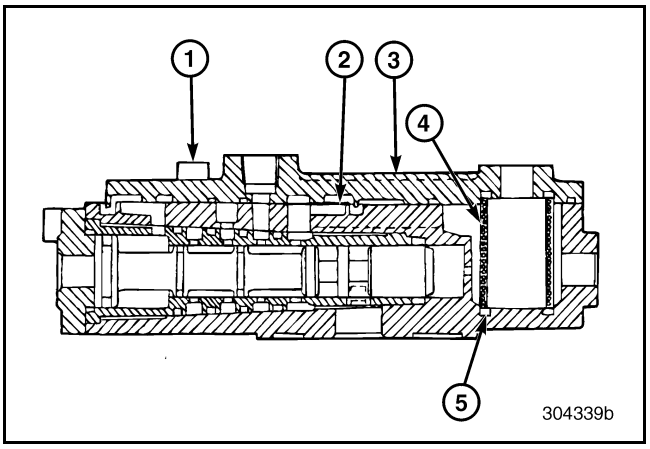


Figure 437 — Cutaway View of Range Shift Valve Assembly

1. 4 mm Screw 2. Top Cover Seal 3. Top Cover	4. Sintered Bronze Filter 5. Silicone Rubber O-Ring

1. Install a **new** filter O-ring and bronze filter into the filter bore of the housing. Set the filter on top of the O-ring.

NOTE

Lightly lubricate the O-ring before installation. Overlubricating the O-ring may cause filter restriction. Make sure to properly seat the O-ring.

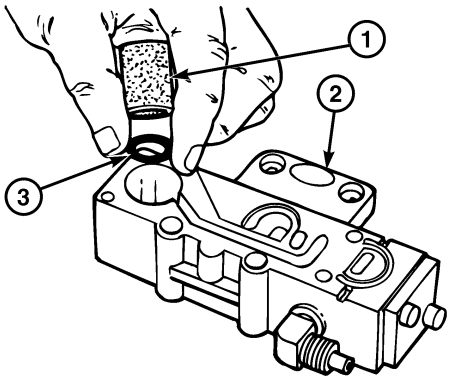


Figure 438 — Installing O-Ring and Filter

1. Sintered Bronze Filter 2. Valve Housing	3. Filter O-Ring

2. Position a **new** top cover seal (if required) into the groove of the top cover. Lightly lubricate the seal before installation, and make sure all portions of the seal are properly seated in the grooves.

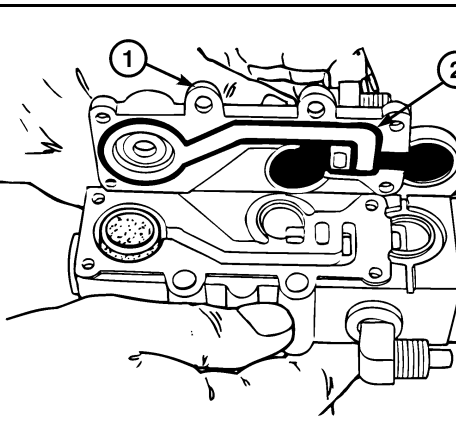


Figure 439 — Installing Top Cover Seal

1. Housing Top Cover 2. Top Cover Seal	3. Valve Housing

3. Install the top cover over the range shift valve body. Install cover screws and tighten the screws to the specified torque.

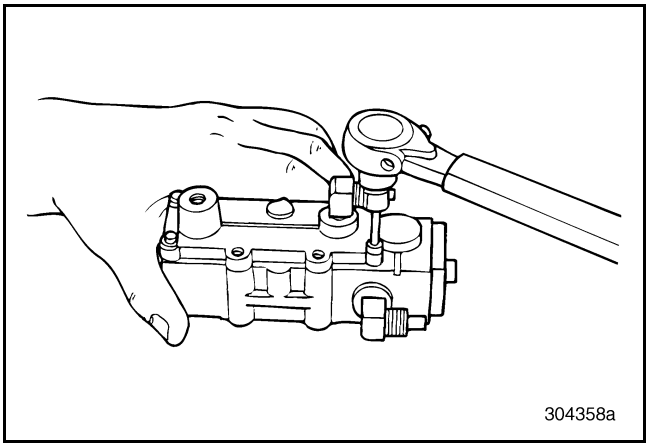


Figure 440 — Installing Top Cover

4. Set the assembly aside for later installation onto the main case shift cover.

Two-Position Range Shift Cylinder Reassembly (Compound Non-Neutralizing)

[324]

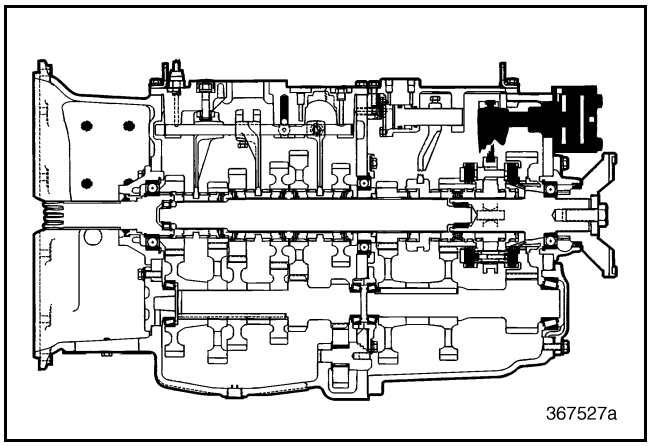


Figure 441 — Range Shift Cylinder Locator (T313L/T318L Shown)

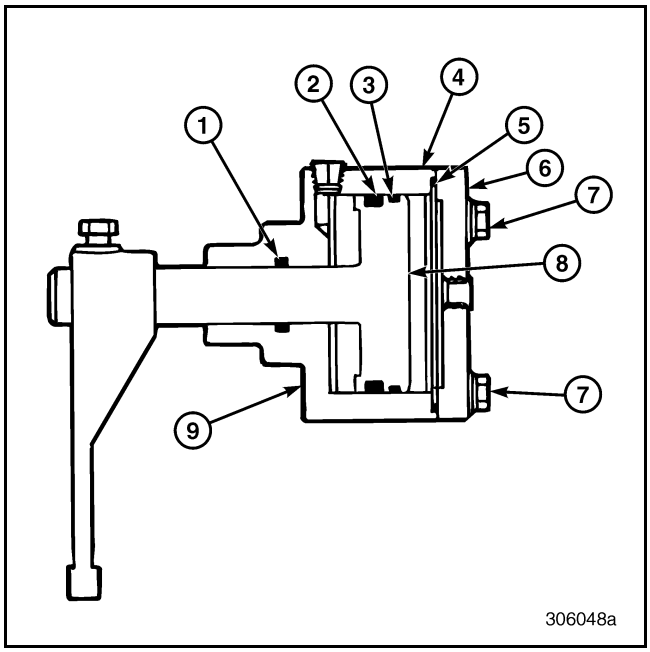


Figure 442 — Cutaway View of Range Shift Cylinder

1. Shift Rail Seal	6. Cylinder Housing Cover
2. Piston Seal	7. Bolt
3. Shift Cylinder Wiper Ring	8. Piston/Shift Rail Assembly
4. Shift Cylinder Housing	9. Gasket
5. Housing-to-Cover O-Ring	

1. Install a **new** O-ring into the groove in the shift rail bore.
2. Form the Teflon® seal into a kidney shape as shown in Figure 443.

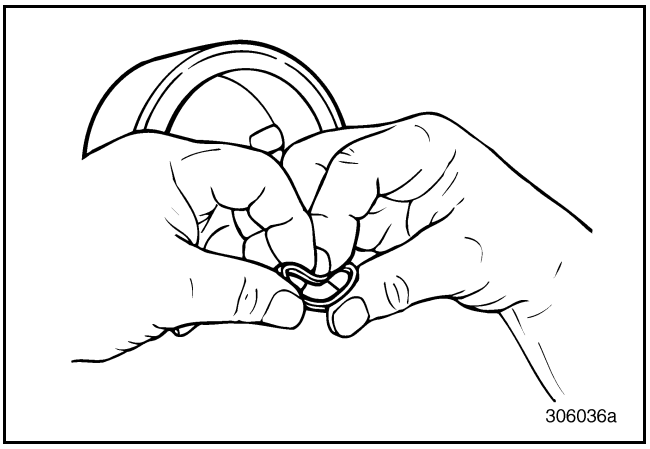


Figure 443 — Forming Teflon® Seal

3. With the nose of the range shift cylinder Teflon® seal inserter (tool No. J 47357) retracted, place the seal in the nose the tool and then push the fold outward to make it sit as flat as possible in the nose.

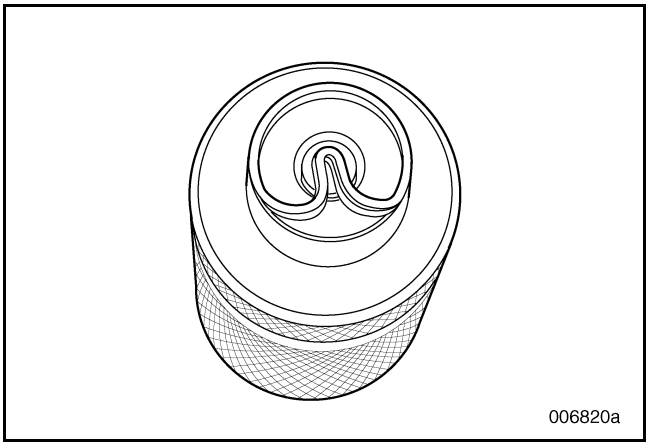


Figure 444 — Inserting Teflon® Seal in Nose of Insertion Tool (Tool No. J 47357)

4. Position the nose of the seal inserter in the cylinder housing shift rail bore.

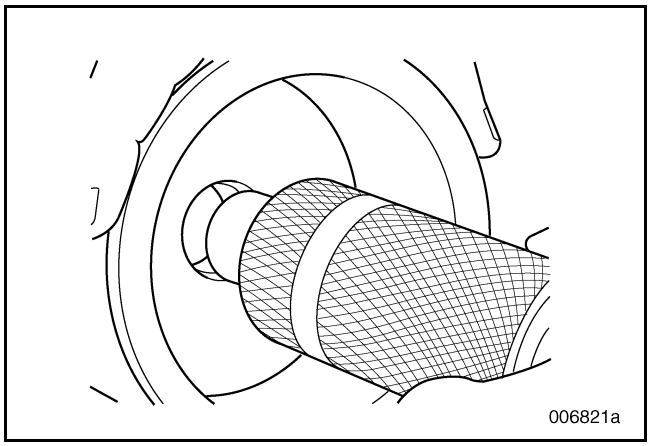


Figure 445 — Positioning Tool in Shift Rail Bore

5. Press the plunger down to fully extend the nose. This positions the seal inside the shift rail bore over the O-ring.

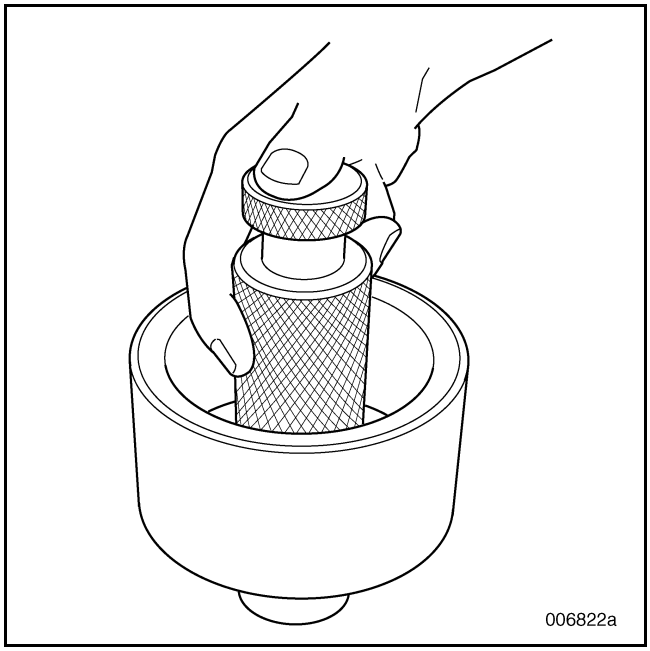


Figure 446 — Installing Teflon® Seal

6. Remove the tool and then push on the seal with your finger to make sure it is seated against the O-ring. Also, push on the “V” fold of the seal to make sure it is seated, and to remove some of the fold.

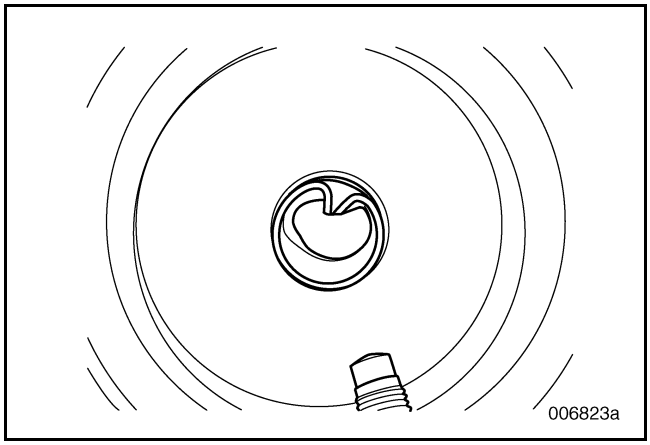


Figure 447 — Seal Properly Installed in Shift Rail Bore

7. Align the relief of the range shift cylinder Teflon® seal installer/sizer (tool No. J 47358) with the “V” fold of the seal, and then gently insert the tool into the bore. DO NOT twist the tool as it is being installed.

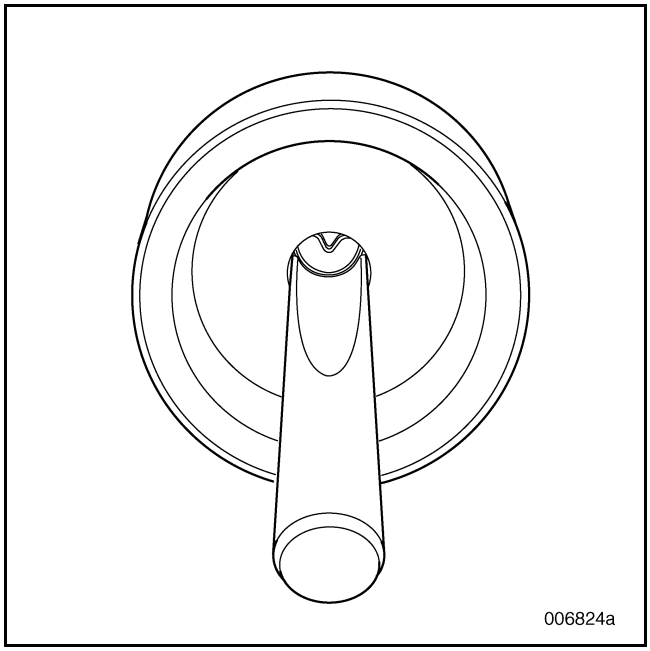


Figure 448 — Inserting Teflon® Seal Installer/Sizer (Tool No. J 47358)

SERVICE HINT

Using a piece of crocus cloth to polish and remove any sharp edges from the installer/sizer tool will ensure that the seal will not be damaged as it is being installed.

8. Continue gently pushing the tool into the bore until the flat end of the tool is flush with the inside bottom of the cylinder.

NOTE

Examine the seal as the tool is being pushed into place. If the seal moves out of position on the O-ring, or if the fold or a portion of the fold becomes kinked, immediately remove the tool and reseat the seal against the O-ring before reattempting to use the tool to seat the seal.

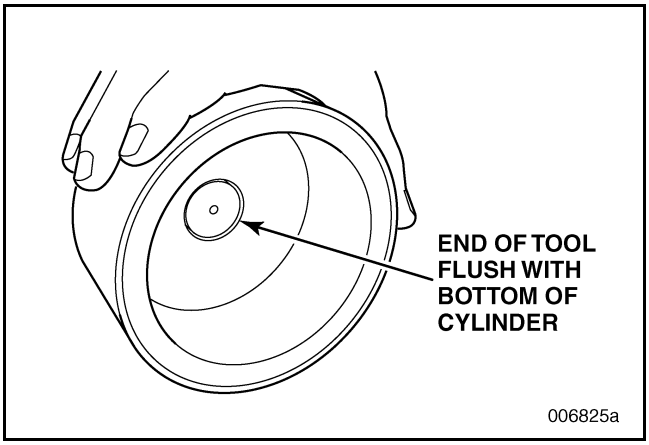


Figure 449 — Installer/Sizer Tool Fully Inserted and End Flush with Bottom of Cylinder

9. After the tool has been fully inserted, leave the tool in place while the remaining cylinder rebuild procedures are performed. This allows the Teflon® seal to form to the circumference of the shift rail bore.

10. On the shift piston, install a **new** O-ring into the lower (wide) piston groove.

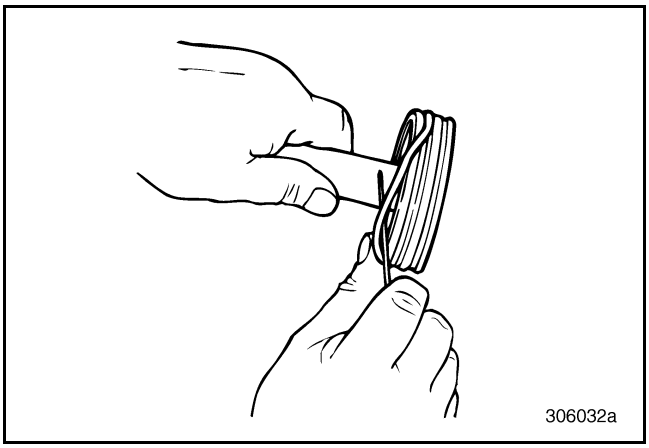


Figure 450 — Installing O-Ring in Second/Lower Groove on Piston

11. Carefully install the Teflon® seal over the O-ring. Work the seal over the O-ring by hand as much as possible. Once the seal is in position, slide a small screwdriver under the section of the seal that is not in position, and pry the seal into position.

NOTE

Be sure the screwdriver does not have any sharp edges on the blade or nicks on the shank. DO NOT over-stretch the Teflon® seal, and make sure that the seal lips seat over each side of the O-ring.

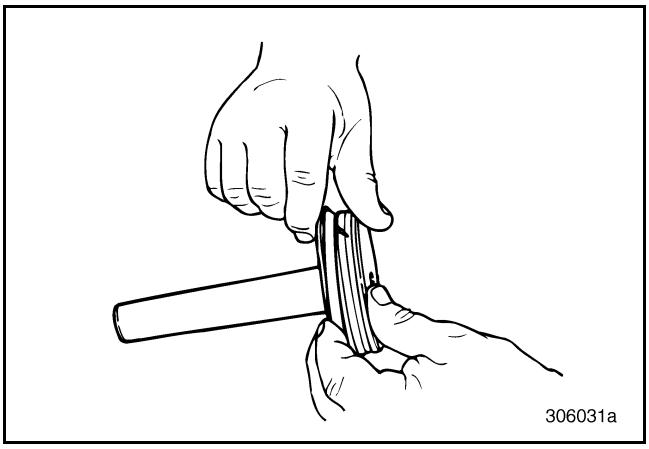


Figure 451 — Installing Teflon® Seal

⚠ CAUTION

Do not over-stretch the Teflon® seal. Be sure that the seal lips seat over each side of the O-ring.

12. Install the wiper ring into the upper (thin) piston groove.

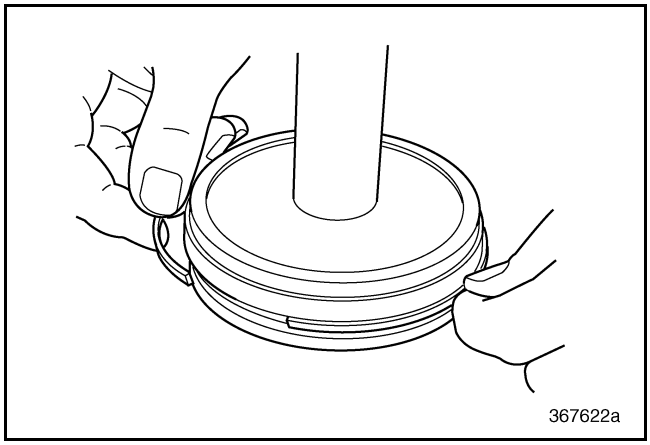


Figure 452 — Installing Wiper Ring in Upper (Thin) Piston Groove

13. Place the range shift piston seal sizer/piston installer (tool No. J 47359) flange-side (pilot end) down on a clean flat surface.

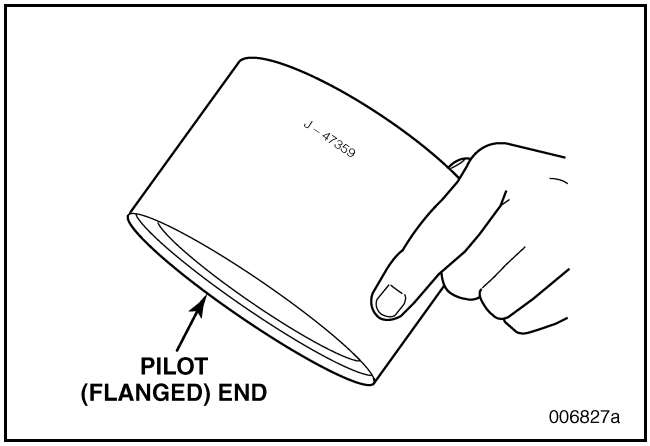


Figure 453 — Piston Assembled in Seal Sizer/Piston Installer (Tool No. J 47359)

14. Slide the piston into the tool until it bottoms on the flat surface.

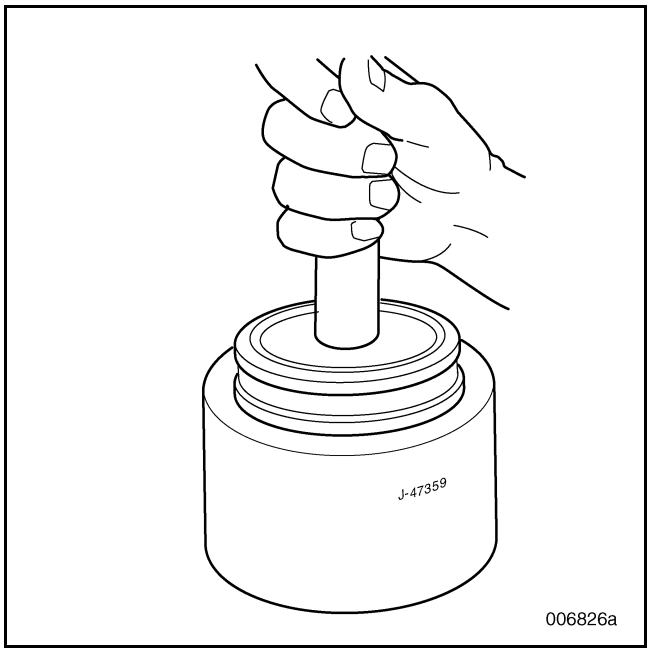


Figure 454 — Inserting Range Shift Piston into Seal Sizer/Piston Installer (Tool No. J 47359)

NOTE

It is recommended that the piston assembly be allowed to remain in the seal sizer/piston installer tool for approximately 15 minutes before proceeding with the final assembly. This will properly size the O-ring and seal to the piston, and make final installation easier.

15. Using a piece of crocus cloth, polish the end of the shift rail and around the setscrew hole to remove any sharp edges or burrs. This will prevent damaging the seal as the piston assembly is installed into the cylinder. Be sure to clean any debris from the shift rail after polishing with the crocus cloth.

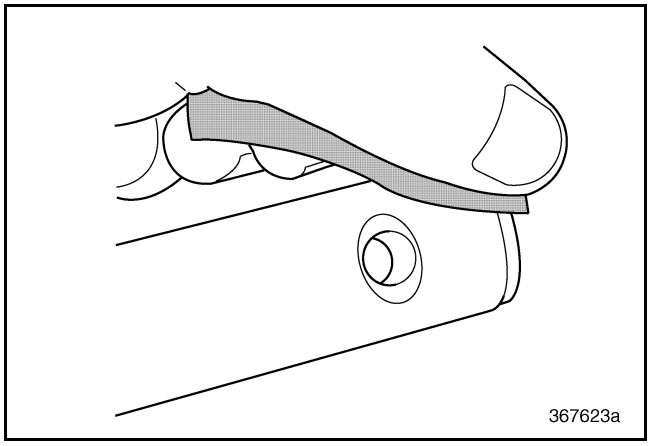


Figure 455 — Polishing Shift Rail and Setscrew Hole with Crocus Cloth

16. Remove the piston assembly from the seal sizer/piston installer tool.

17. Carefully clamp the range shift cylinder assembly in a vise. DO NOT remove the range shift cylinder Teflon® seal installer/sizer from the cylinder assembly. The tool will be pushed from the shift rail bore as the piston assembly is being installed. Place the range shift piston seal sizer/piston installer with the flanged-side (pilot end) on the cylinder housing.

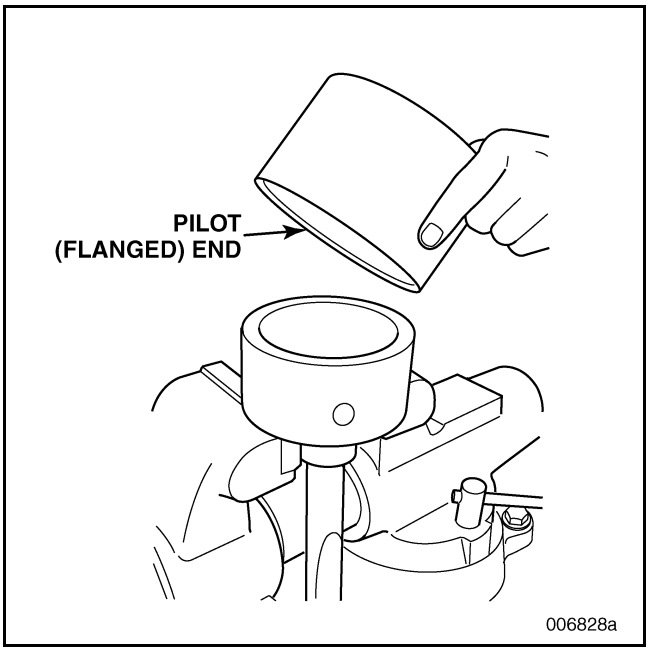


Figure 456 — Placing Seal Sizer/Piston Installer (Tool No. J 47359) on Cylinder Housing

18. Align the shift fork locking bolt hole in the shift rail with the air line fitting port in the cylinder housing.

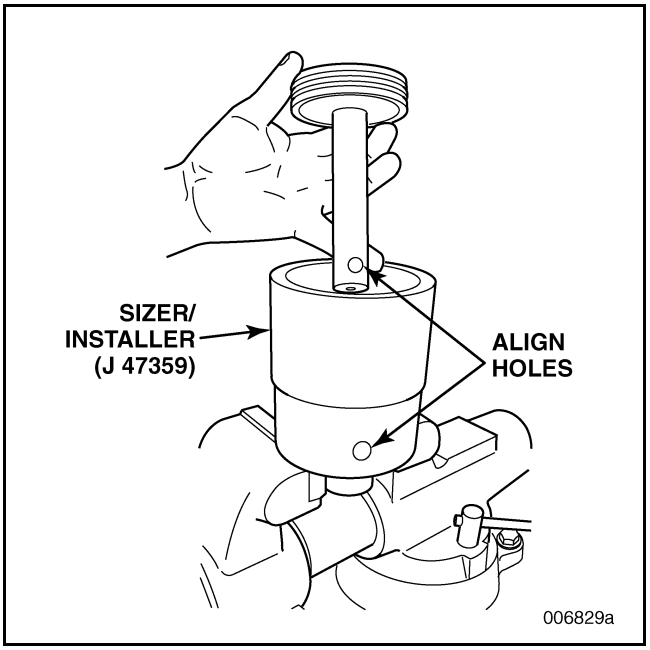


Figure 457 — Aligning Shift Fork Locking Bolt Hole with Air Fitting Port in Cylinder Housing

19. Carefully push the piston assembly through the installation tool until it seats inside the cylinder housing bore. Be sure to catch the range shift Teflon® seal installer/sizer as it is being pushed from the shift rail bore.

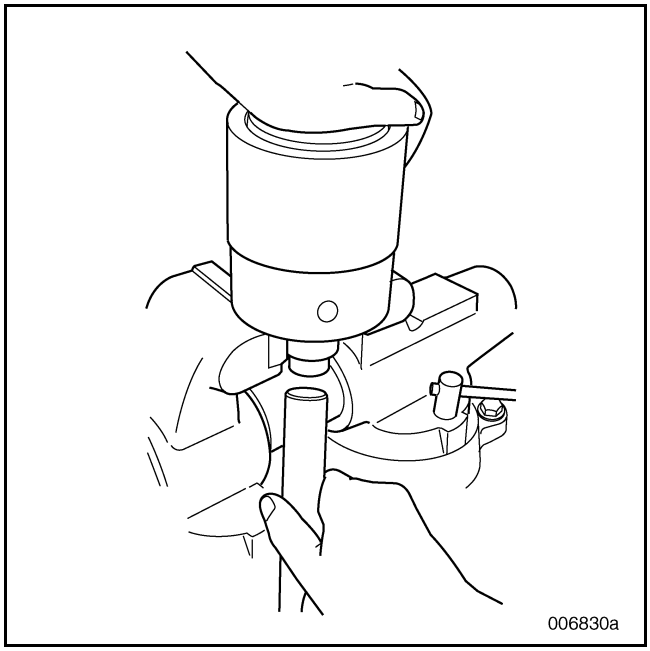


Figure 458 — Installing Piston into Range Shift Cylinder Housing

Three-Position Range Shift Cylinder Reassembly (Compound Neutralizing)

[324]

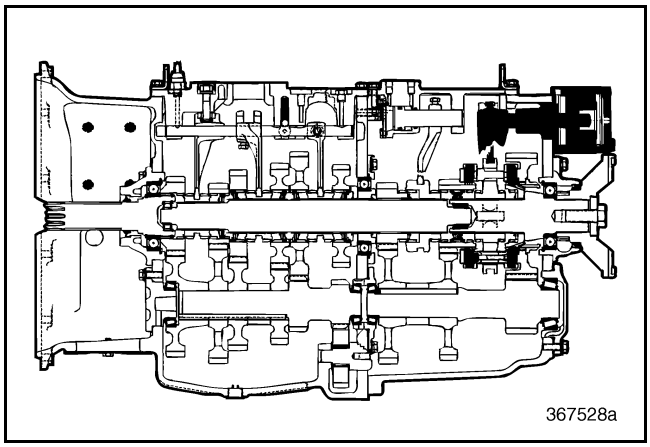


Figure 459 — Range Shift Cylinder Locator (T313L/T318L Shown)

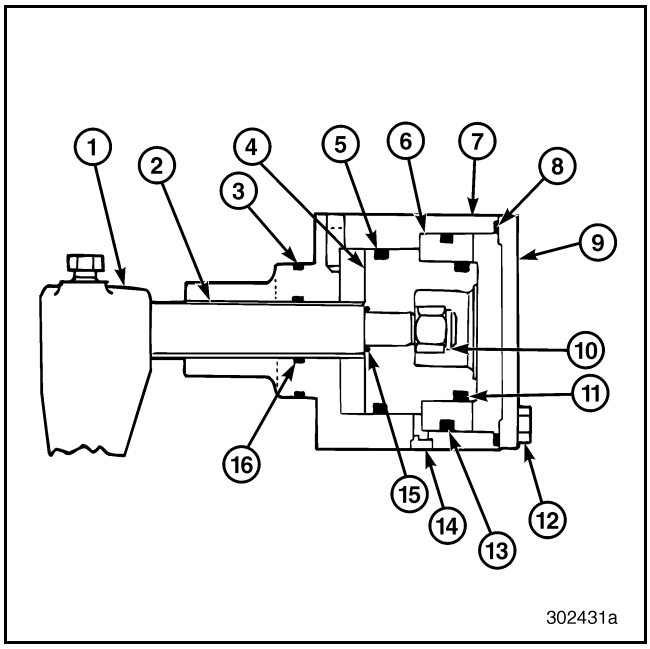


Figure 460 — Cutaway View of Range Shift Cylinder

1. Shift Fork	9. Shift Cylinder Cover
2. Rail	10. Piston/Rail Nut
3. O-Ring	11. O-Ring
4. Shift Piston	12. Cover Capscrew
5. O-Ring	13. O-Ring
6. Piston Sleeve	14. Breather Vent
7. Shift Cylinder	15. O-Ring
8. O-Ring	16. O-Ring

NOTE

The nut securing the piston to the rail is tightened to a torque of 102–142 N•m (75–105 lb-ft).

1. The following figure shows the breather vent removed (1) and installed (2). Check the breather vent for free airflow. Clean or replace, if necessary.

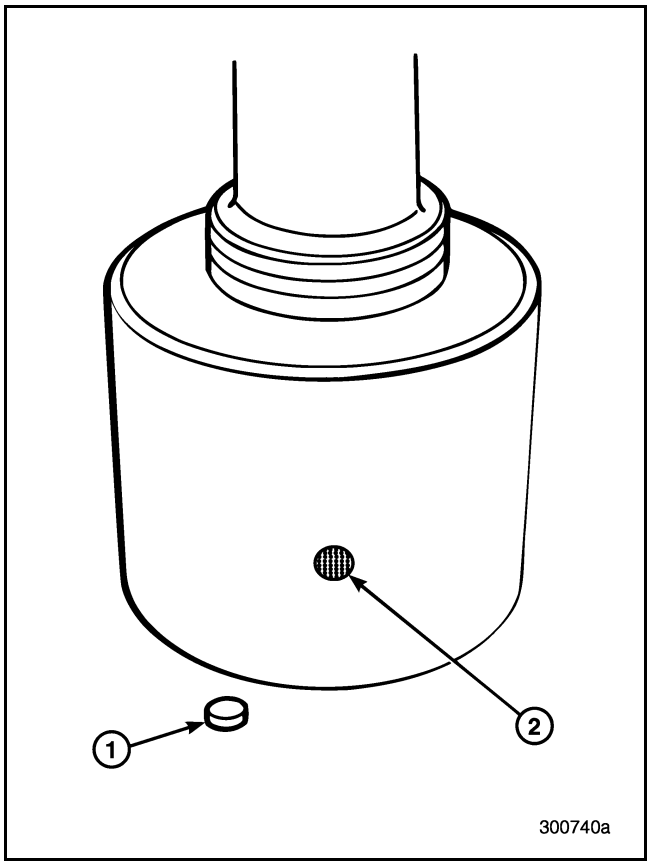


Figure 461 — Shift Cylinder Breather Vent

NOTE

Before installation, lightly lubricate all O-rings for the range shift cylinder piston, sleeve and rail with a multipurpose grease that meets MACK specification MG-C.

2. Install a **new** O-ring onto the piston sleeve.

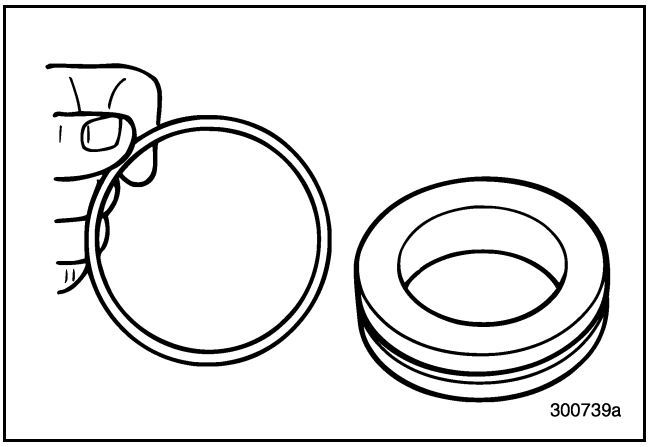


Figure 462 — Installing Piston Sleeve O-Ring

3. Install a **new** small O-ring located on the shift rail.

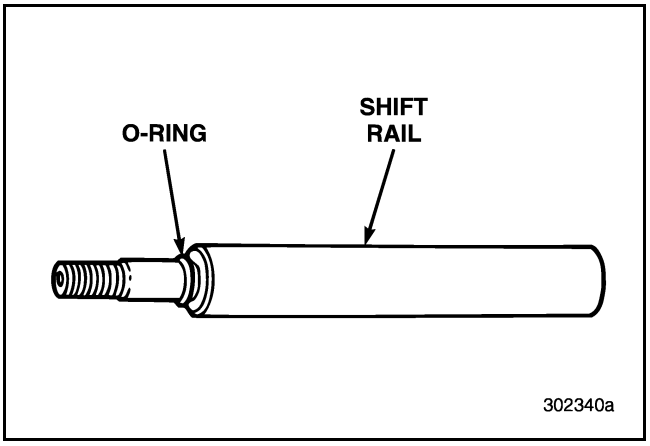


Figure 463 — Installing Shift Rail O-Ring

4. Insert the rail into the piston and install and tighten the shift rail nut to 102–142 N•m (75–105 lb-ft) torque.

⚠ CAUTION

Do not clamp the shift piston or shift rail in a vise. This can cause damage to the piston or rail, preventing proper shifting.

SERVICE HINT

To prevent damage to the shift rail or piston when removing the nut, temporarily install the shift fork and tighten the setscrew. This provides leverage for tightening the nut. Remove the shift fork for later installation.

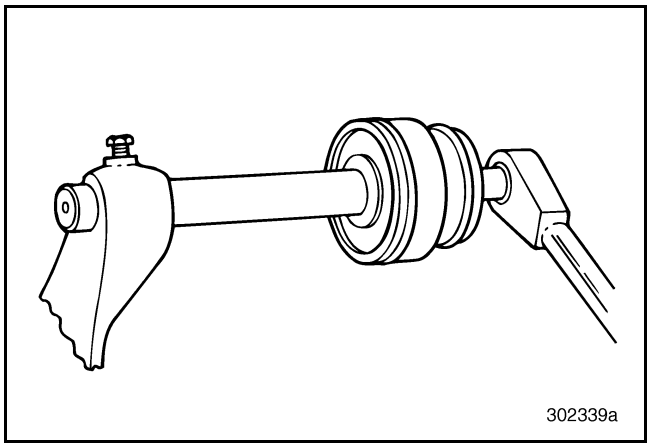


Figure 464 — Tightening Shift Piston Retaining Nut

5. Install a **new** front O-ring at the shift rail end of the piston.

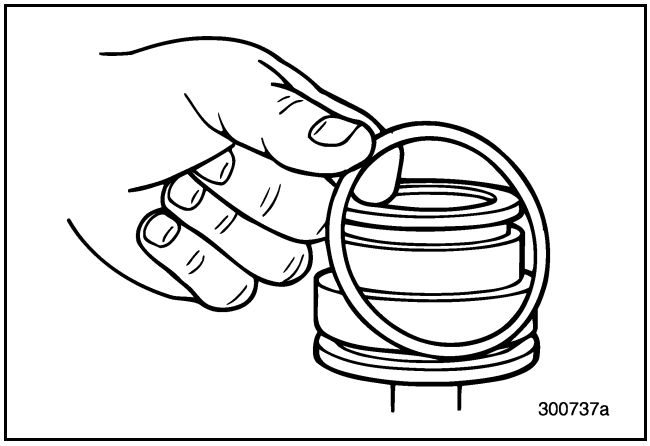


Figure 465 — Installing Shift Piston Front O-Ring

6. Install a **new** O-ring onto the rear of the shift piston.

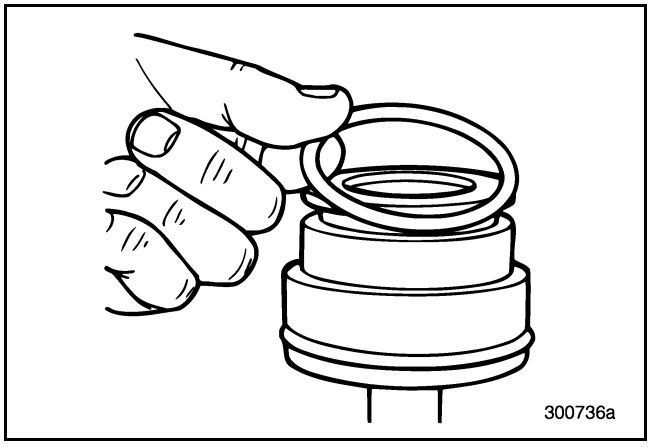


Figure 466 — Installing Shift Piston Rear O-Ring

7. Install a **new** outside O-ring onto the front of the shift cylinder (shift cylinder-to-case O-ring). Also install the shift rail O-ring located inside the cylinder.

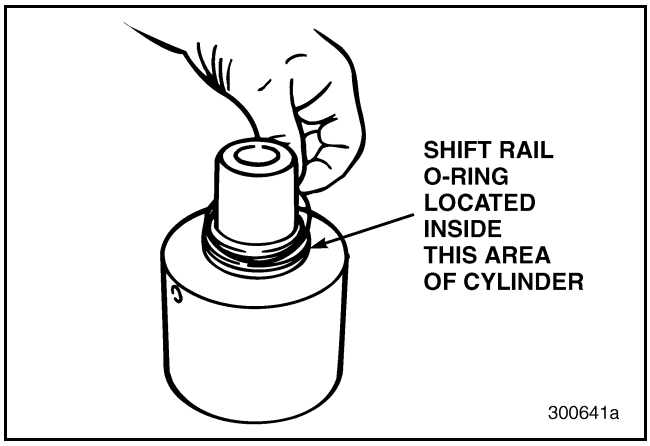


Figure 467 — Installing Shift Cylinder Outside O-Ring

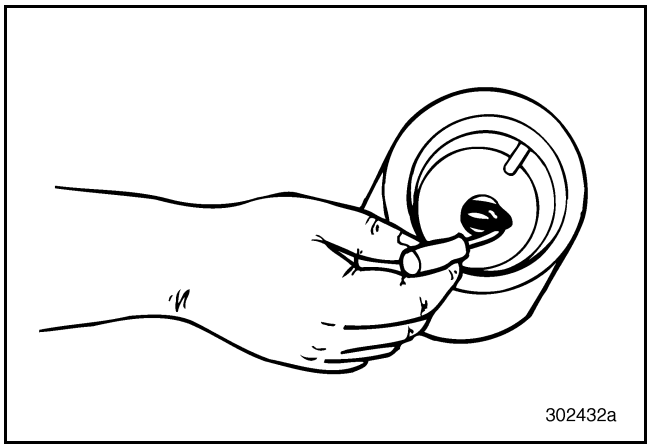


Figure 468 — Installing Shift Cylinder Inside O-Ring

8. Install the shift piston and rail assembly into the range shift cylinder.

9. Install the sleeve onto the rear end of the shift piston. To ease installation, lubricate the inside diameter of the sleeve with MG-C specification grease. Do not overlubricate. Too much grease can clog the breather vent.

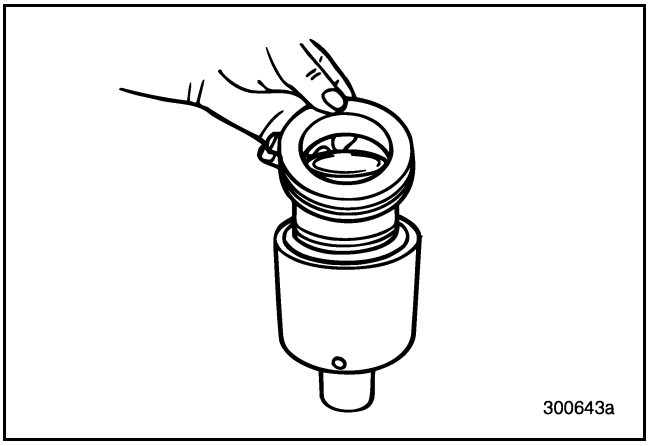


Figure 469 — Installing Sleeve onto Shift Piston

10. Push the piston assembly into the cylinder.

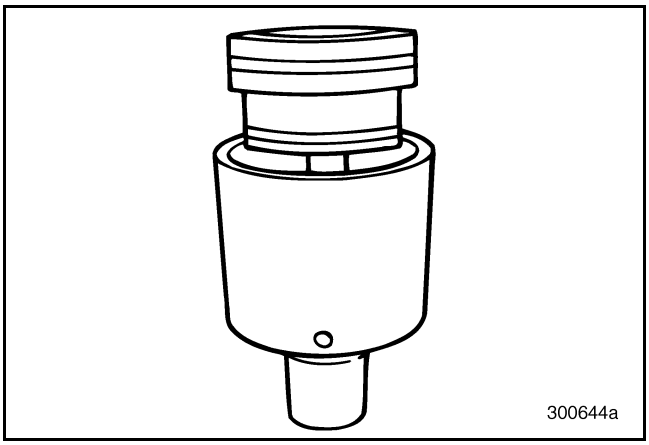


Figure 470 — Pushing Piston Assembly into Cylinder

11. Set aside the range shift cylinder assembly, the shift cylinder cover, capscrews and **new** cover O-ring, for later installation into the rear compound case.

Rear Case Shift Cover Reassembly [324]

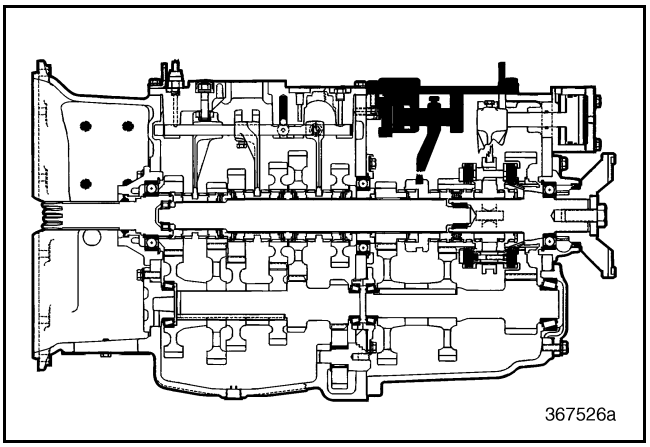


Figure 471 — Rear Case Shift Cover Locator (T313L/T318L Shown)

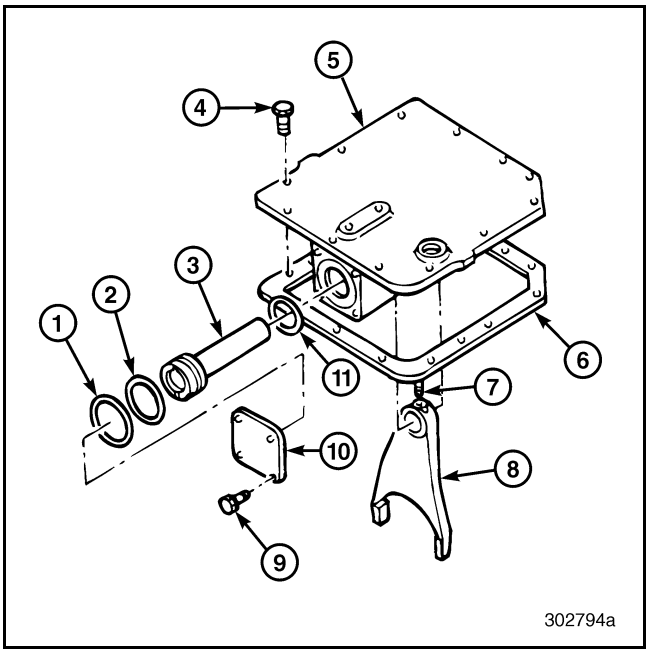


Figure 472 — Exploded View of Rear Case Shift Cover

1. Cover O-Ring	7. Shift Fork Setscrew
2. Piston O-Ring	8. Splitter Shift Fork
3. Splitter Shift Piston	9. Capscrew (4)
4. Capscrew (10)	10. Piston Cover
5. Rear Case Shift Cover	11. Shaft O-Ring
6. Gasket	

NOTE

Lubricate the shift cover O-rings with a multipurpose grease meeting MACK specification MG-C, during installation.

1. Install a **new** O-ring onto the shift piston.

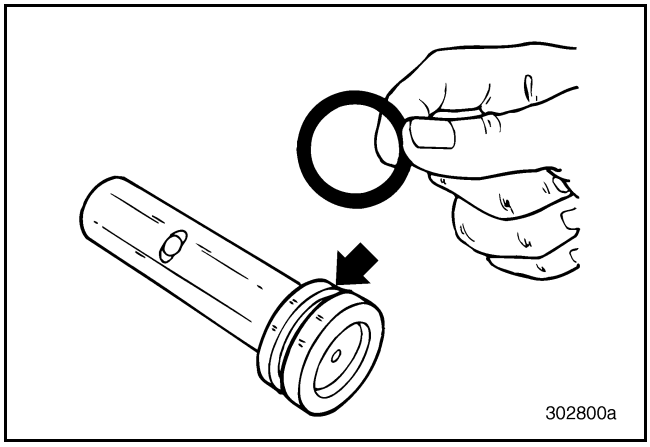


Figure 473 — Installing Shift Piston O-Ring

2. Install a **new** O-ring into the rear of the shift piston housing. This seals the shaft of the piston.

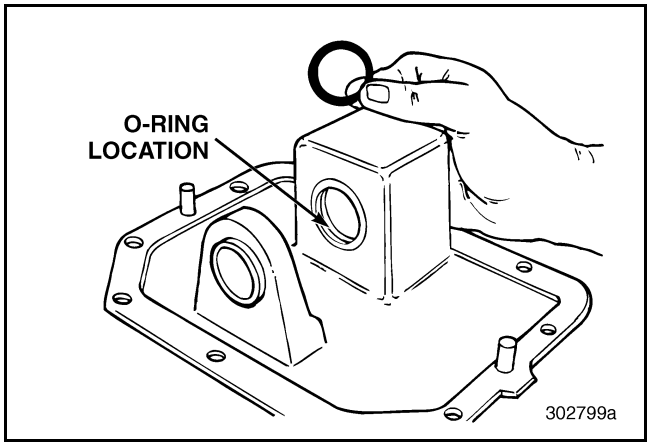


Figure 474 — Installing O-Ring into Rear of Housing

3. Install a **new** piston cover O-ring onto the front of the housing.

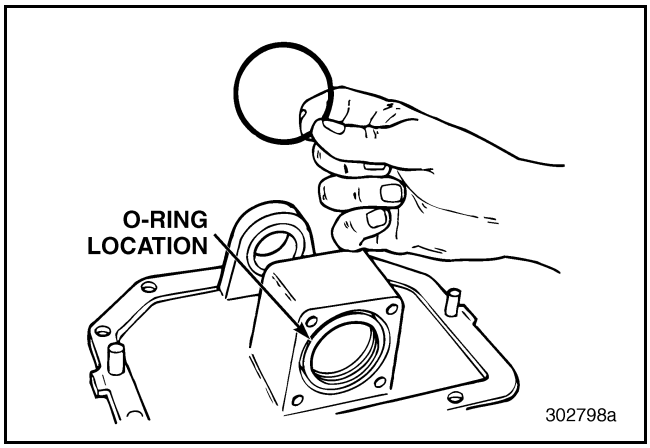


Figure 475 — Installing O-Ring onto Front of Housing

4. Install the piston into the housing and at the same time, install the shift fork. Note the orientation of the shift fork; the offset faces forward.

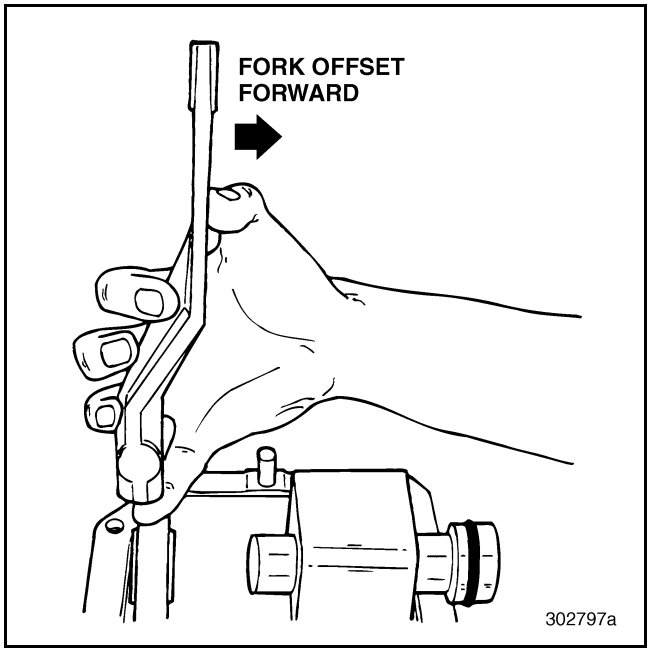


Figure 476 — Installing Piston and Shift Fork

5. Align the shift fork setscrew with the setscrew hole in the shaft of the piston. Tighten the setscrew to the specified torque.

NOTE

Effective June 2007, shift fork setscrews were changed to a Scotch-Grip™ torque retention method. DO NOT reuse these fasteners, as they are one-time use only.

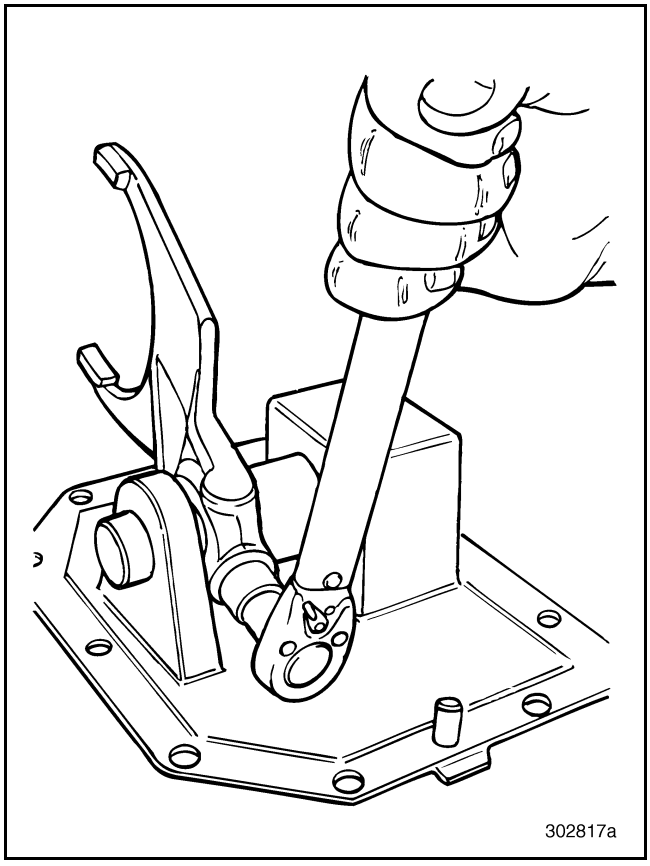


Figure 477 — Tightening Shift Fork Setscrew

6. Install the piston cover and capscrews. Tighten the capscrews to the specified torque.

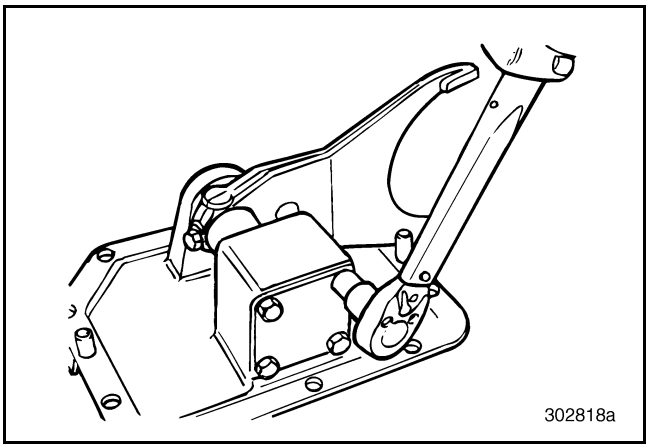


Figure 478 — Installing Piston Cover and Capscrews

Main Case Shift Cover Reassembly [323]

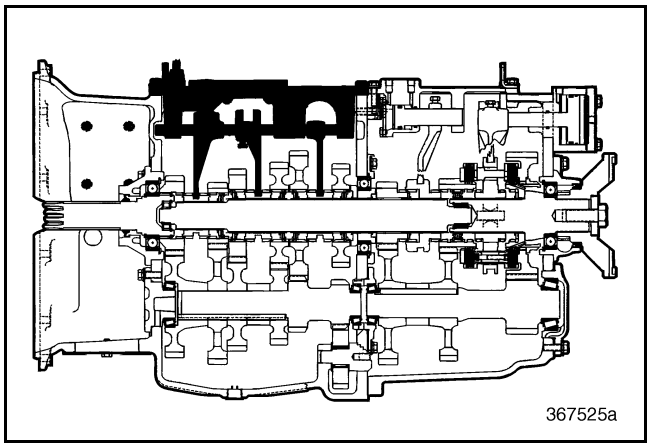


Figure 479 — Main Case Shift Cover Locator (T313L/T318L Shown)

1. Install the shift cover breather vent into the cover.

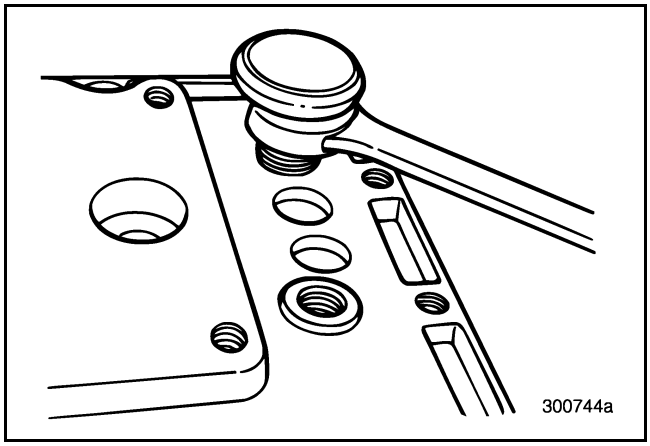


Figure 480 — Installing Breather Vent

2. Install the third/fourth rocker pin and rocker arm. Be sure to position the washer, bushing and washer on the rocker pin as illustrated. The bottom washer is positioned between the rocker arm and main case shift cover.

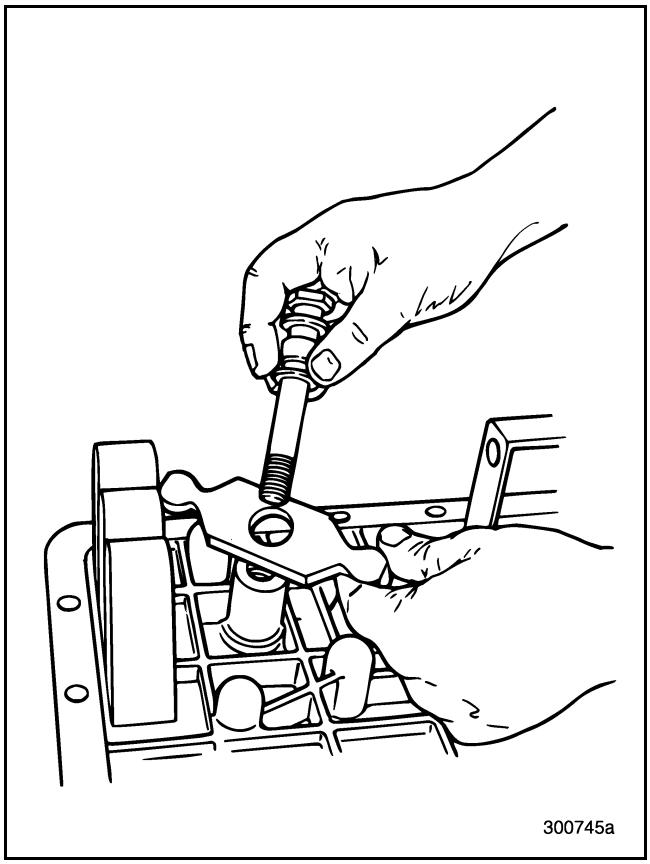


Figure 481 — Installing Third/Fourth Rocker Pin and Rocker Arm

SERVICE HINT

Occasionally, due to assembly tolerances, particularly in units which have been operated, the current production rocker pivot pin will not center the fourth/fifth clutch sufficiently to prevent clutch tooth contact when the fourth/fifth shift rail is in neutral. For transmissions with a history of clutch tooth contact, the noncurrent eccentric pivot pin, which is available for service, should be installed and adjusted per instructions found in Figure 577.

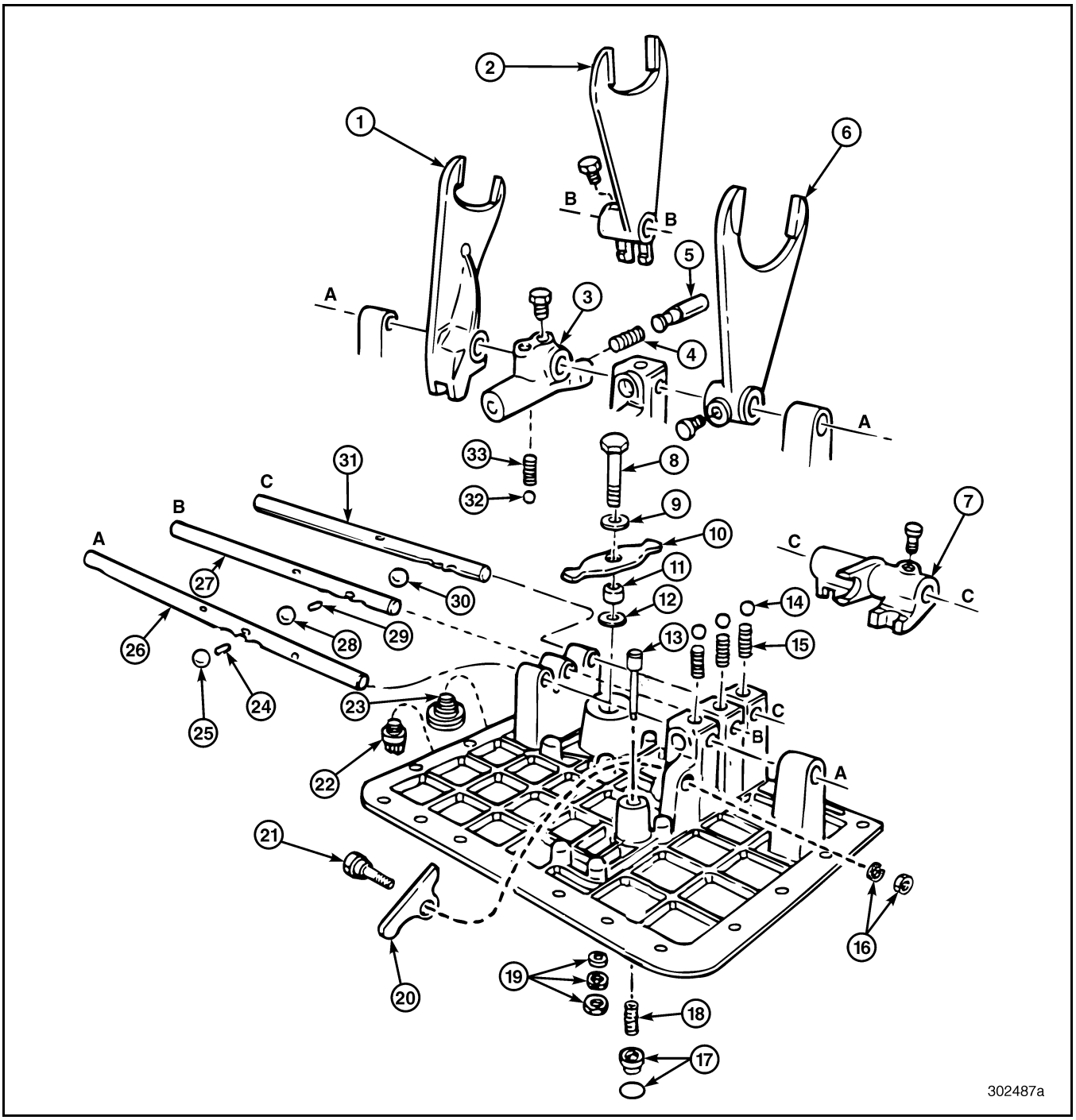


Figure 482 — Exploded View of Main Case Shift Cover

1. Third/Fourth Shift Fork	12. Washer	23. Breather
2. First/Second Shift Fork	13. Interlock Pin	24. Interlock Pin
3. Lo/Reverse Shifter	14. Poppet Ball	25. Interlock Ball
4. Shifter Body Spring (Interlock)	15. Poppet Ball Spring	26. Lo/Reverse Shift Rail
5. Shifter Body Plunger (Interlock)	16. Interlock Rocker Hardware	27. First/Second Shift Rail
6. Lo/Reverse Shift Fork	17. Interlock Sleeve and O-Ring	28. Interlock Ball
7. Third/Fourth Shifter	18. Interlock Spring	29. Interlock Pin
8. Third/Fourth Rocker Pin	19. Third/Fourth Rocker Pin Hardware	30. Interlock Ball
9. Washer	20. Interlock Rocker	31. Third/Fourth Shift Rail
10. Third/Fourth Rocker Arm	21. Interlock Rocker Bolt	32. Lo/Reverse Shifter Ball
11. Bushing	22. Pipe Plug	33. Lo/Reverse Shifter Spring

3. Install the third/fourth pin lock washer, flat washer and nut. Tighten nut to the specified torque.

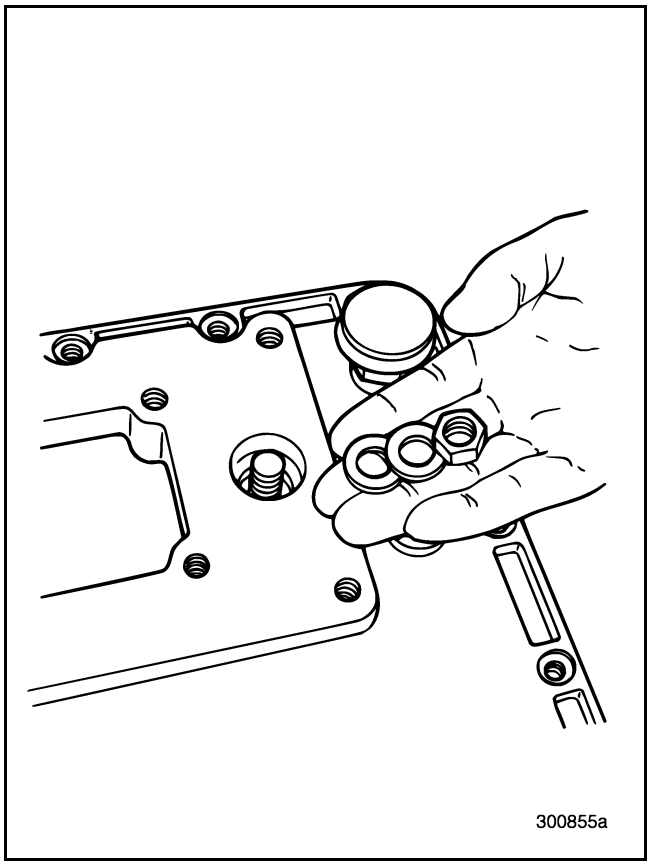


Figure 483 — Installing Washers and Nut

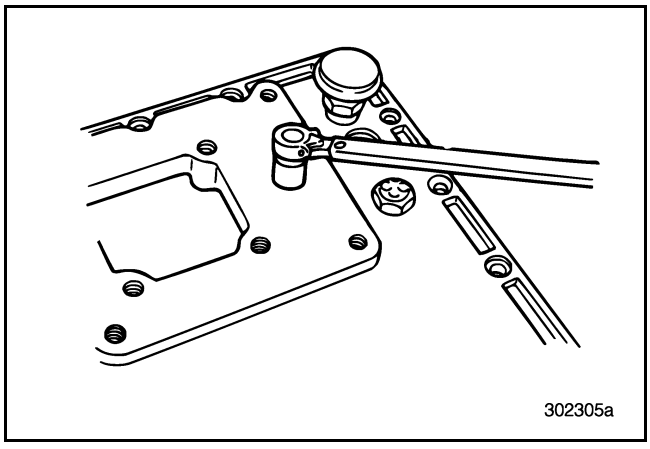


Figure 484 — Tightening Nut

4. Install the reverse light switch rod into the shift cover.

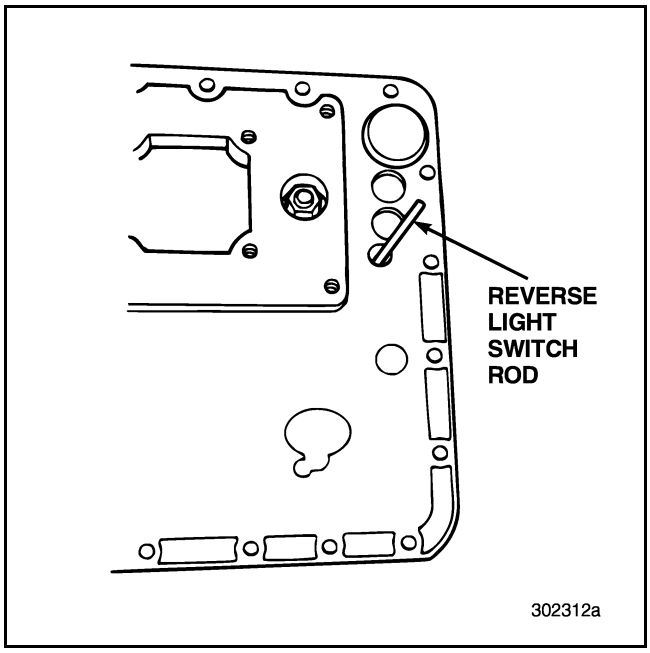


Figure 485 — Installing Reverse Light Switch Rod

5. Install the reverse light switch into the shift cover.

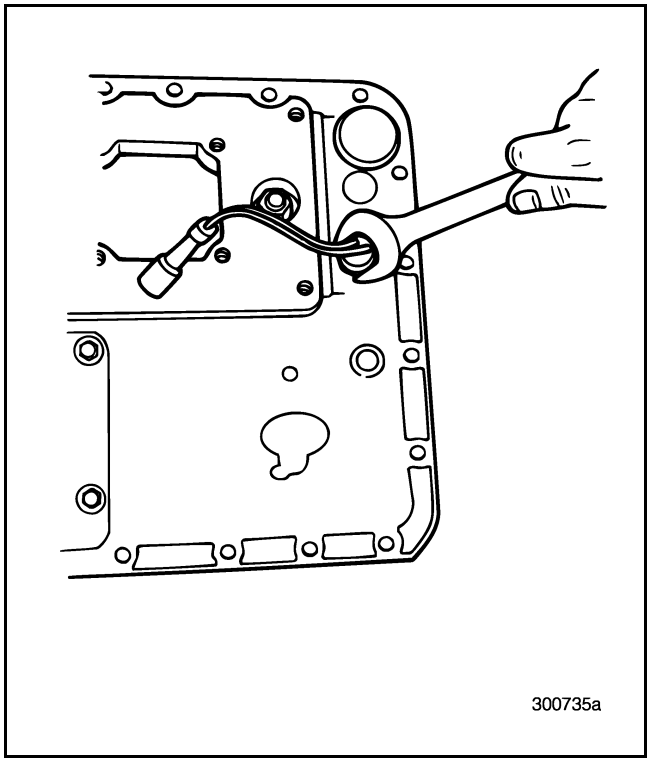


Figure 486 — Installing Reverse Light Switch

6. Install the poppet ball and spring for the third/fourth shift rail.

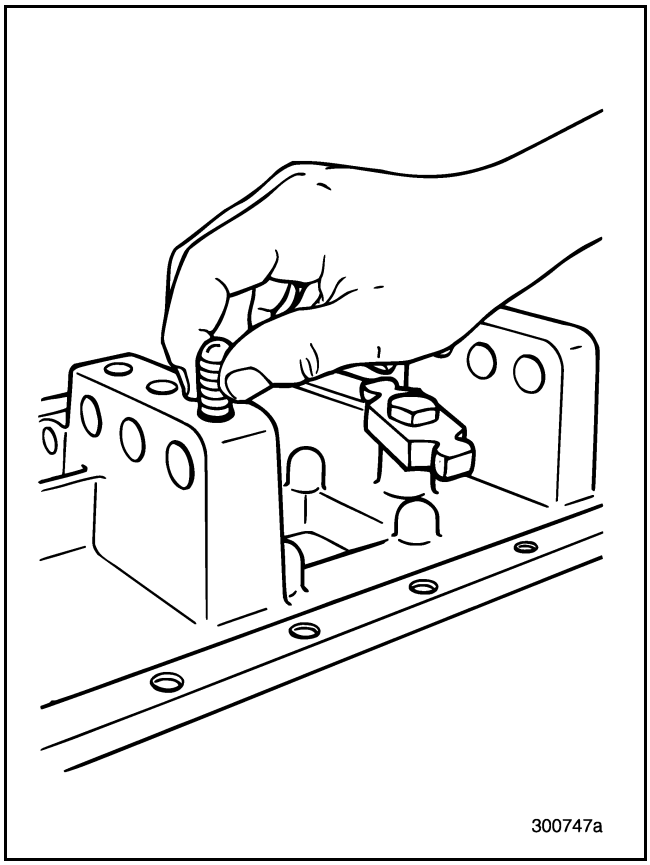


Figure 487 — Installing Poppet Ball and Spring

7. Slide the third/fourth shift rail into the cover. At the same time, install the third/fourth shifter onto the shift rail.

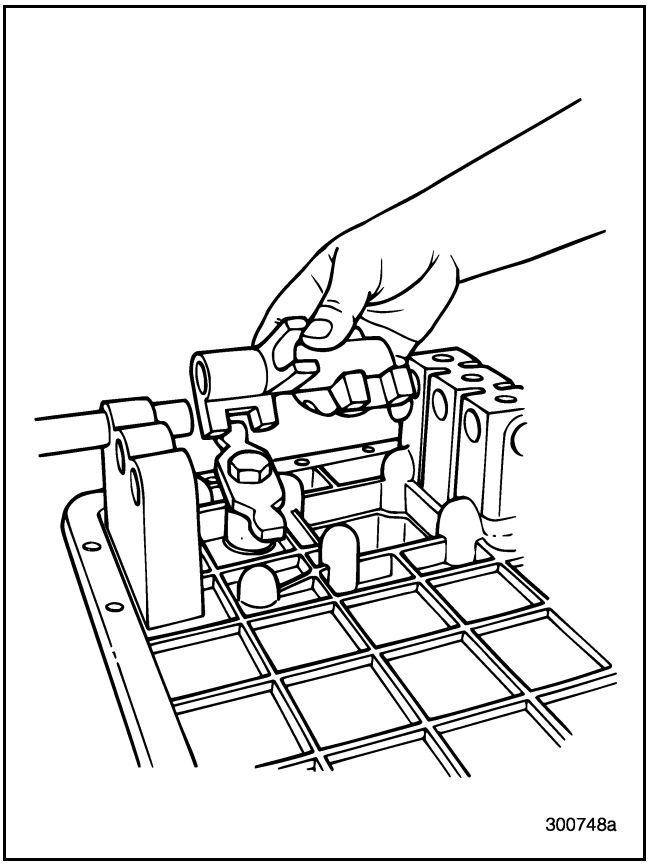


Figure 488 — Installing Shift Rail and Shifter

8. Press the poppet ball down while sliding the third/fourth shift rail over the ball. A hollow tube works well to press down the ball.

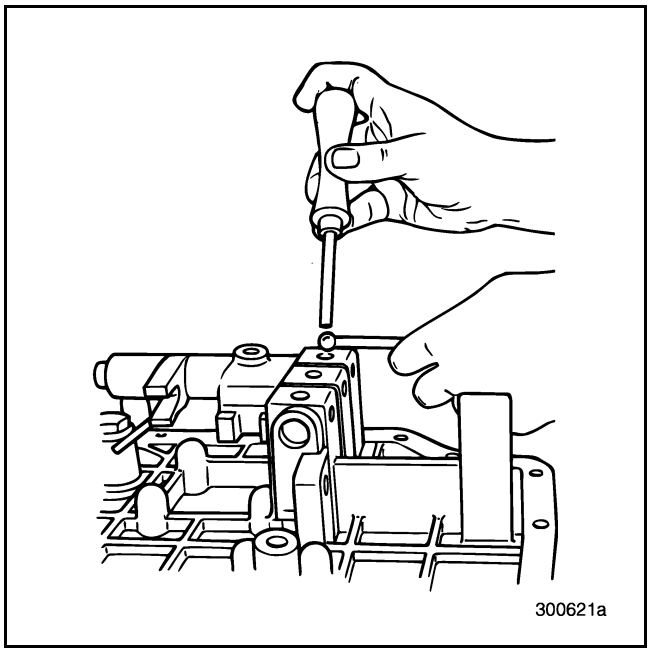


Figure 489 — Pushing Poppet Ball Down

9. Align the setscrew in the third/fourth shifter with the notch in the shift rail. Tighten the setscrew to the specified torque.

NOTE

Effective June 2007, shift fork setscrews were changed to a Scotch-Grip™ torque retention method. DO NOT reuse these fasteners, as they are one-time use only.

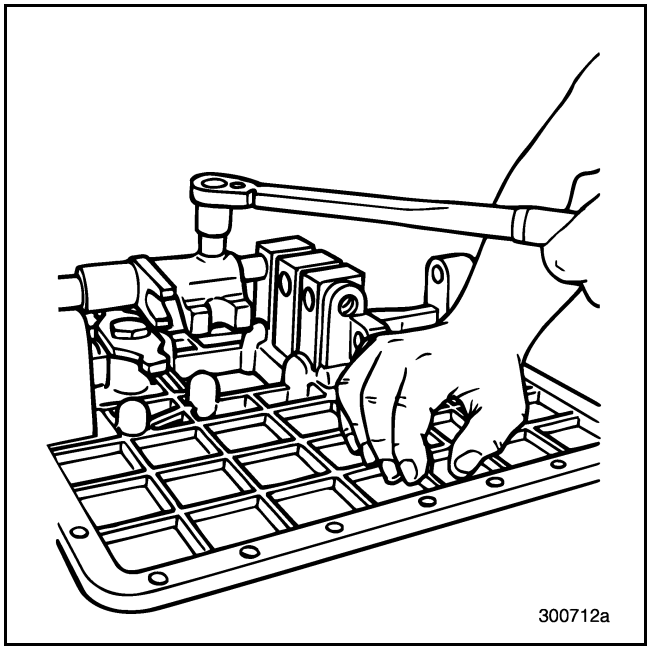


Figure 490 — Tightening Setscrew

10. Slide the first/second shift rail into the shift cover. At the same time, install the first/second shift fork onto the shift rail.

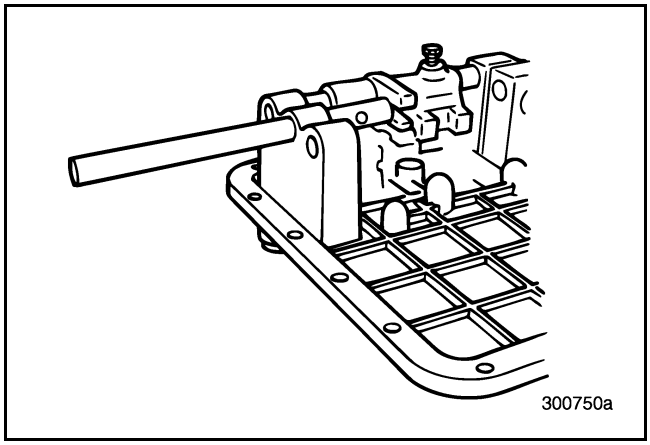


Figure 491 — Installing First/Second Shift Rail

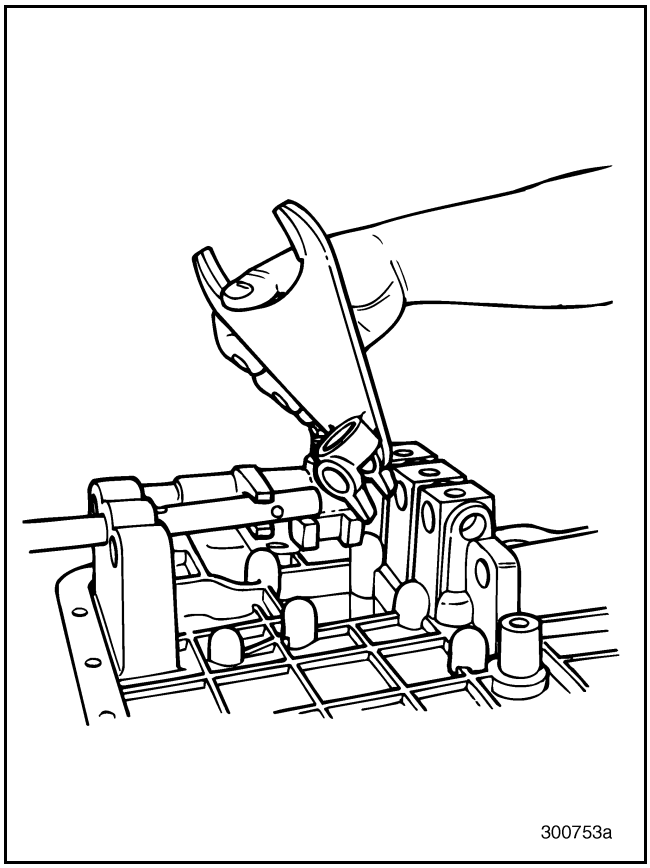


Figure 492 — Installing First/Second Shift Fork

11. Install the interlock pin into the first/second shift rail.

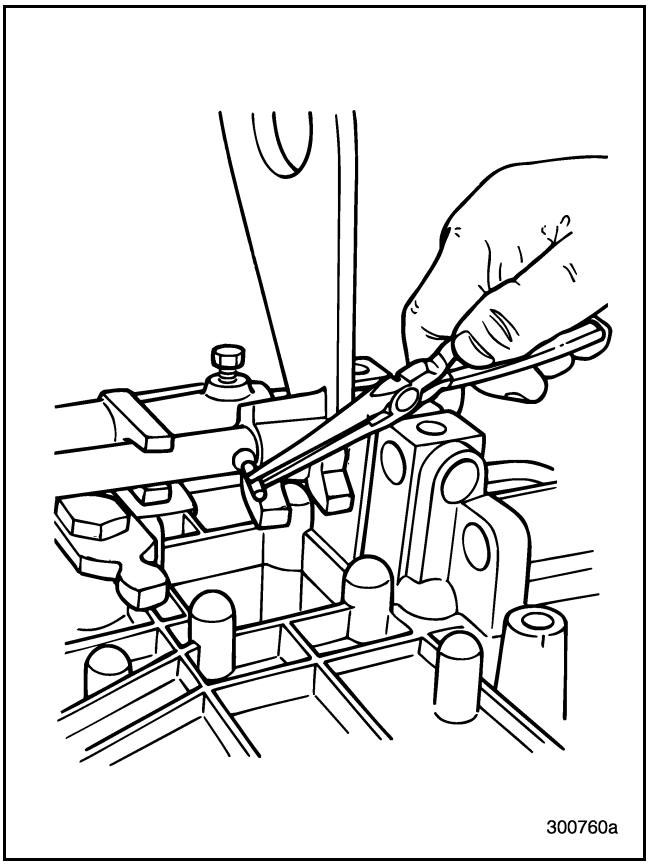


Figure 493 — Installing Pin into First/Second Shift Rail

12. Install the interlock ball between the first/second shift rail and the third/fourth shift rail.

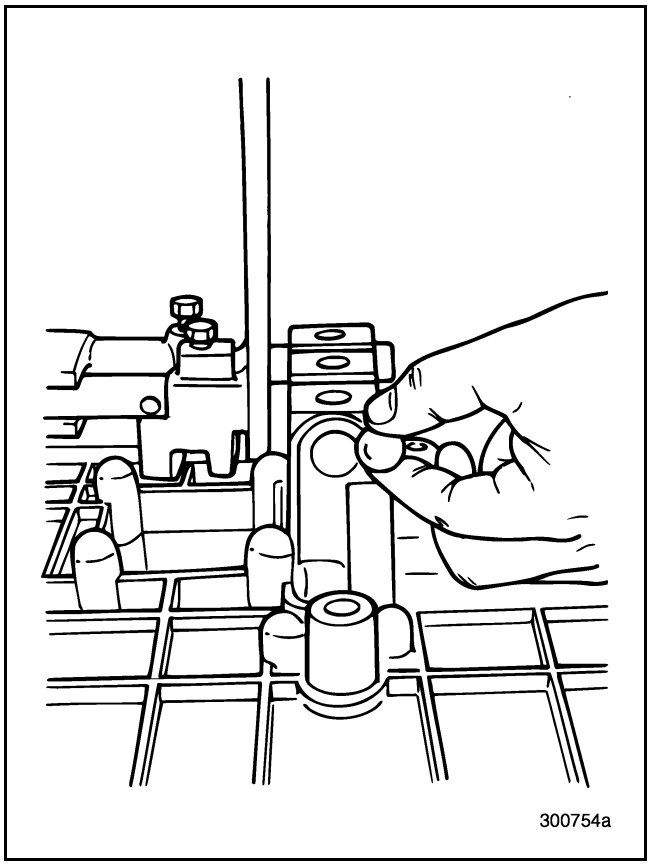


Figure 494 — Installing Interlock Ball Between Rails

13. Install the poppet ball and spring for the first/second shift rail.

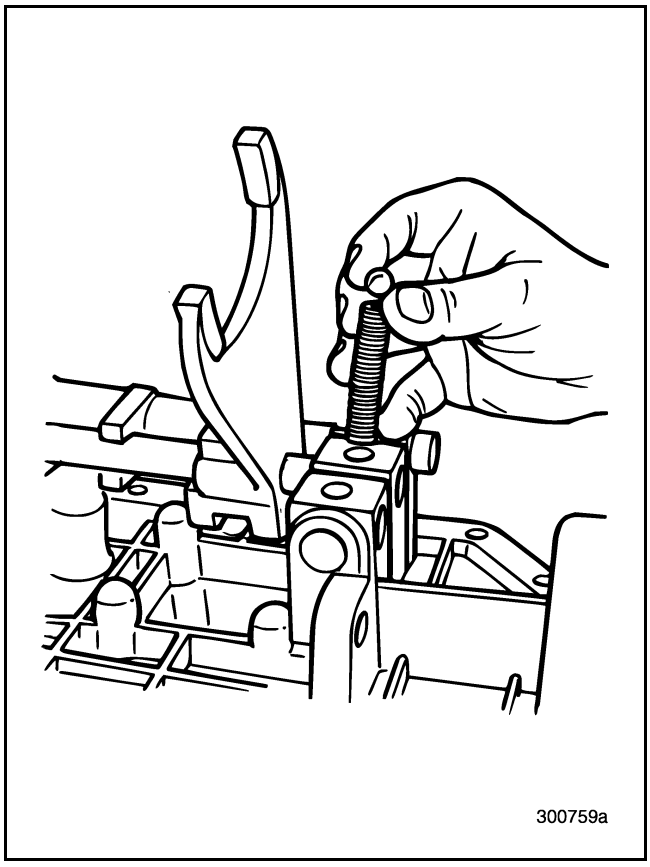


Figure 495 — Installing Poppet Ball and Spring

14. Press the poppet ball down while sliding the first/second shift rail over the ball. A hollow tube works well to press down the ball.

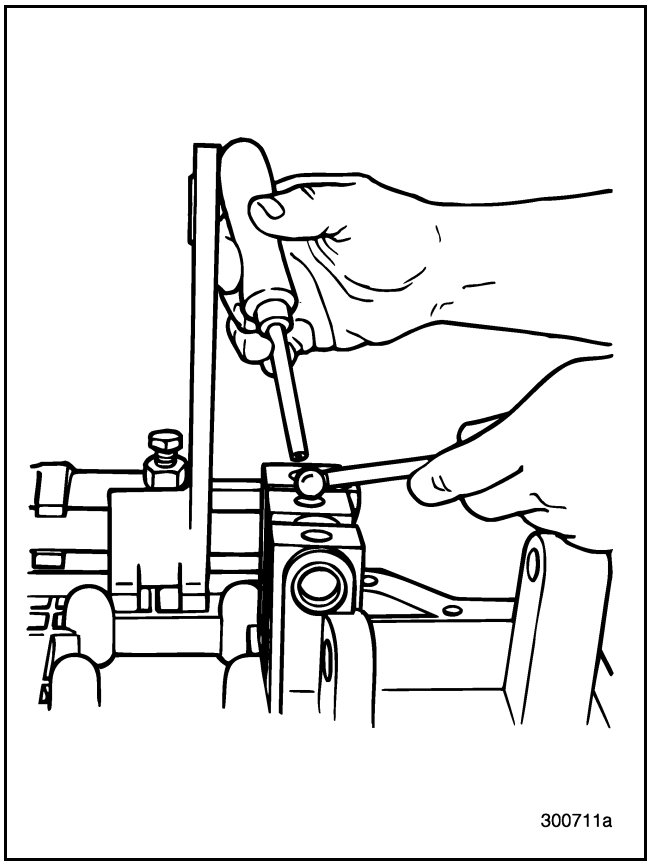


Figure 496 — Pressing Poppet Ball Down

15. Align the setscrew in the first/second shift fork with the notch in the shift rail. Tighten the setscrew to the torque.

NOTE

Effective June 2007, shift fork setscrews were changed to a Scotch-Grip™ torque retention method. DO NOT reuse these fasteners, as they are one-time use only.

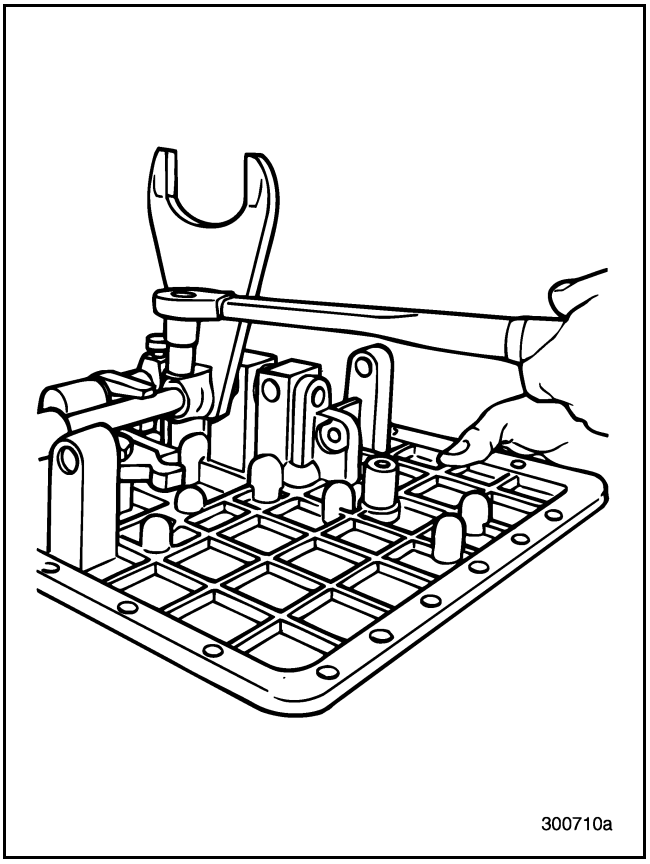


Figure 497 — Tightening Setscrew

16. Slide the Lo/reverse shift rail into the shift cover. At the same time, install the third/fourth shift fork onto the shift rail.

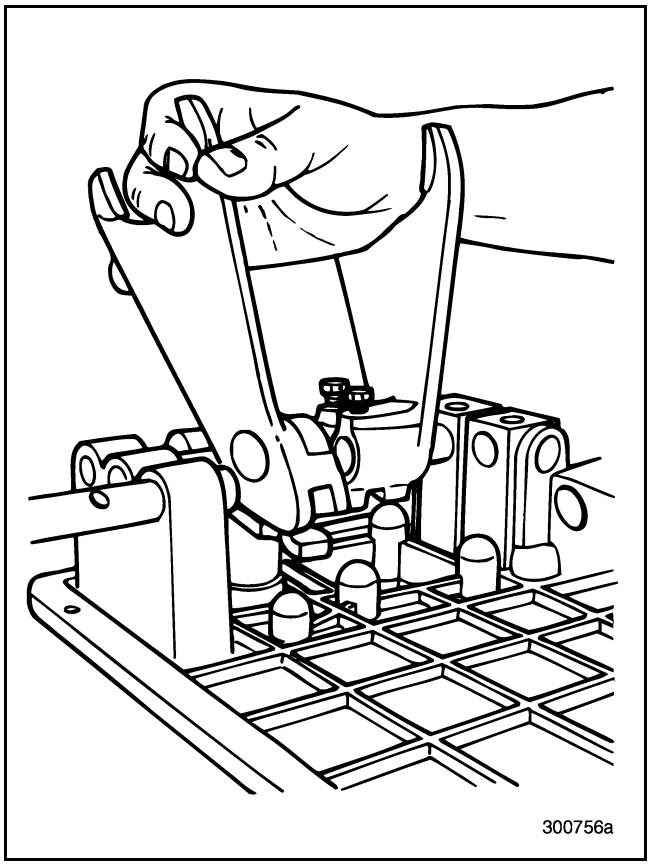


Figure 498 — Installing Third/Fourth Shift Fork

17. Install the poppet ball and spring into the Lo/reverse shifter, followed by the spring and plunger. Depress the poppet ball and spring into the shifter to allow the spring and plunger to pass. The poppet ball rests in the radius of the plunger.

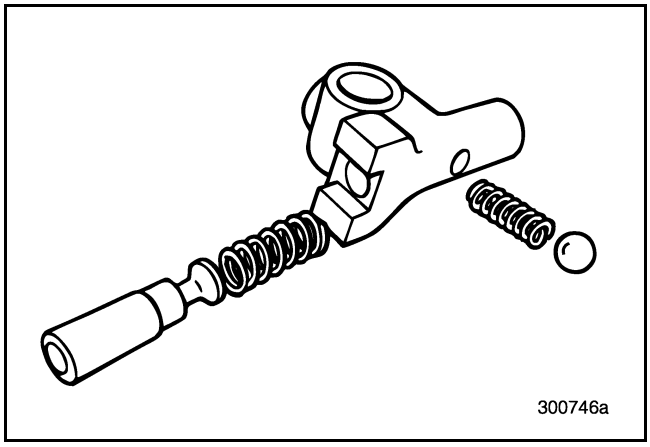


Figure 499 — Assembling Lo/Reverse Shifter

18. Install the Lo/reverse shifter onto the shift rail, behind the third/fourth shift fork.

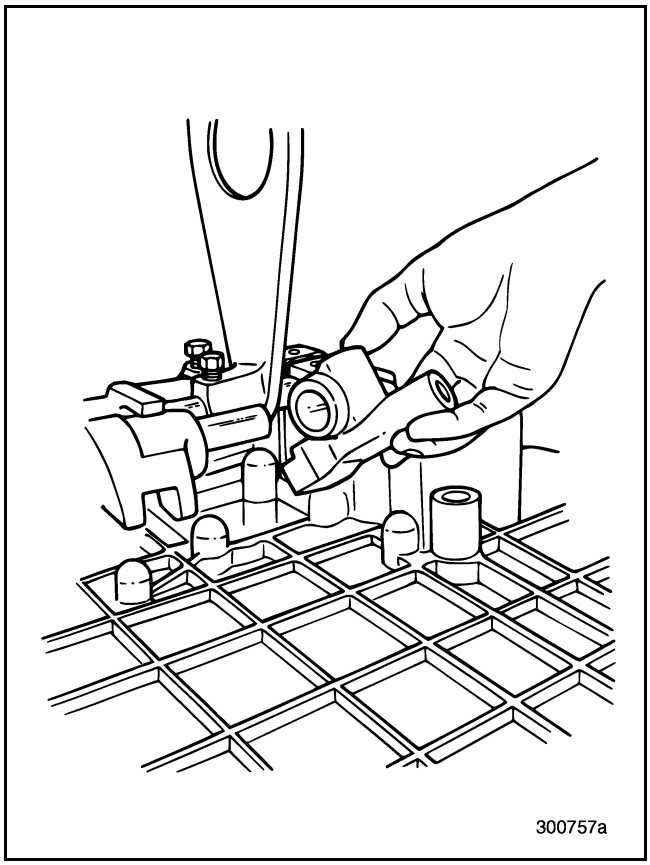


Figure 500 — Installing Lo/Reverse Shifter

19. Install the interlock ball between the Lo/reverse shift rail and the first/second shift rail.

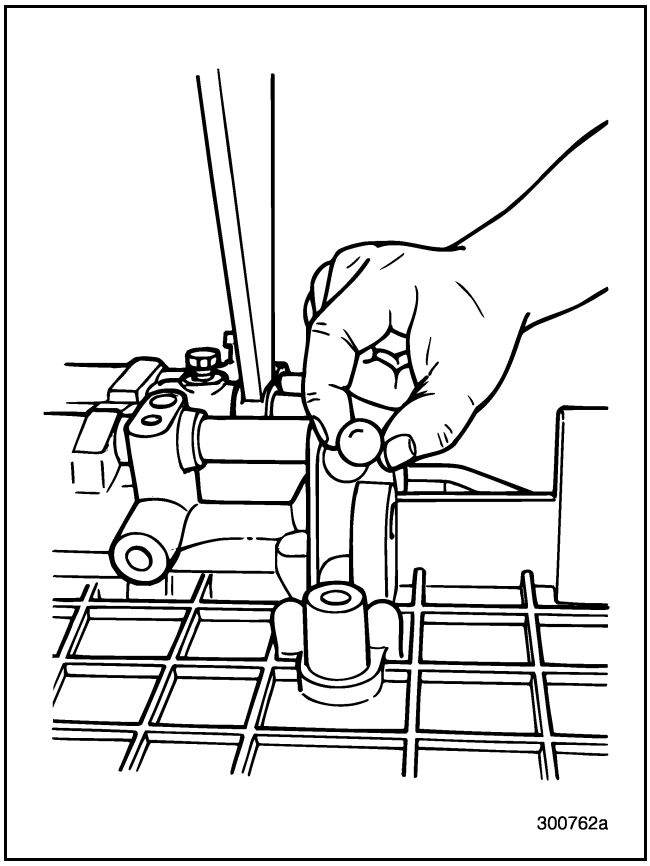


Figure 501 — Installing Interlock Ball

20. Install the poppet ball and spring for the Lo/reverse shift rail.

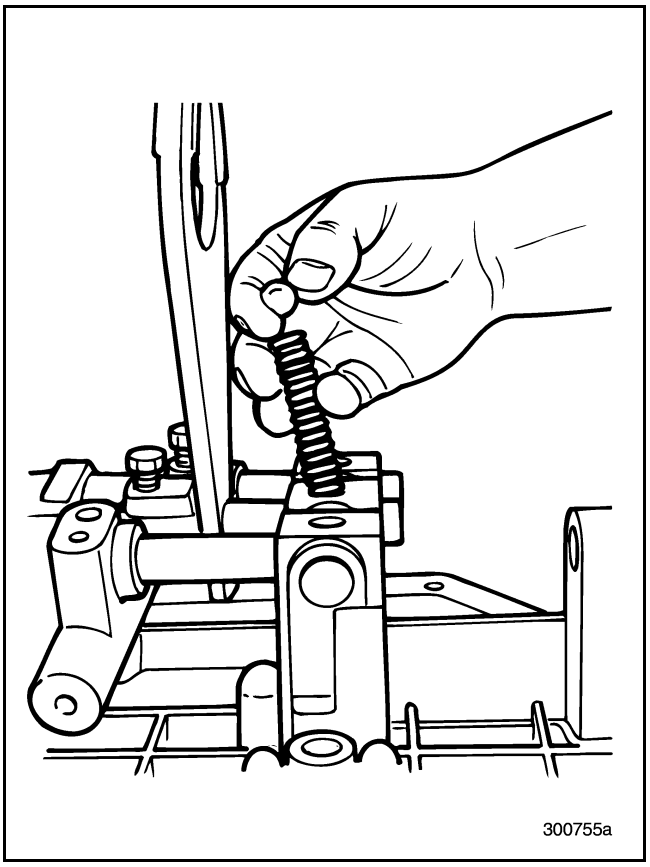


Figure 502 — Installing Poppet Ball and Spring

21. Press the poppet ball down while sliding the Lo/reverse shift rail over the ball. A hollow tube works well to press down the ball.

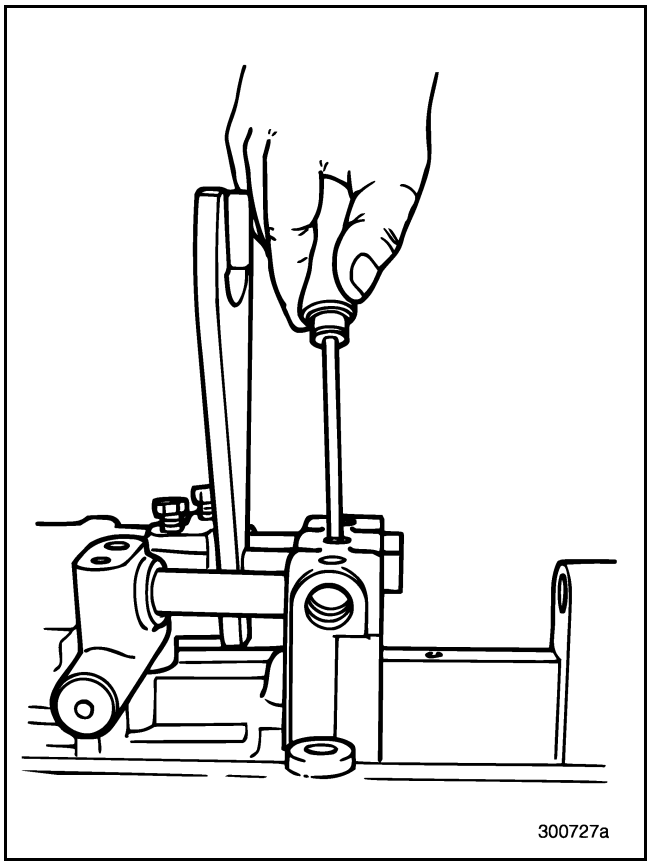


Figure 503 — Pushing Poppet Ball Down

22. Install the Lo/reverse shift fork onto the Lo/reverse shift rail.

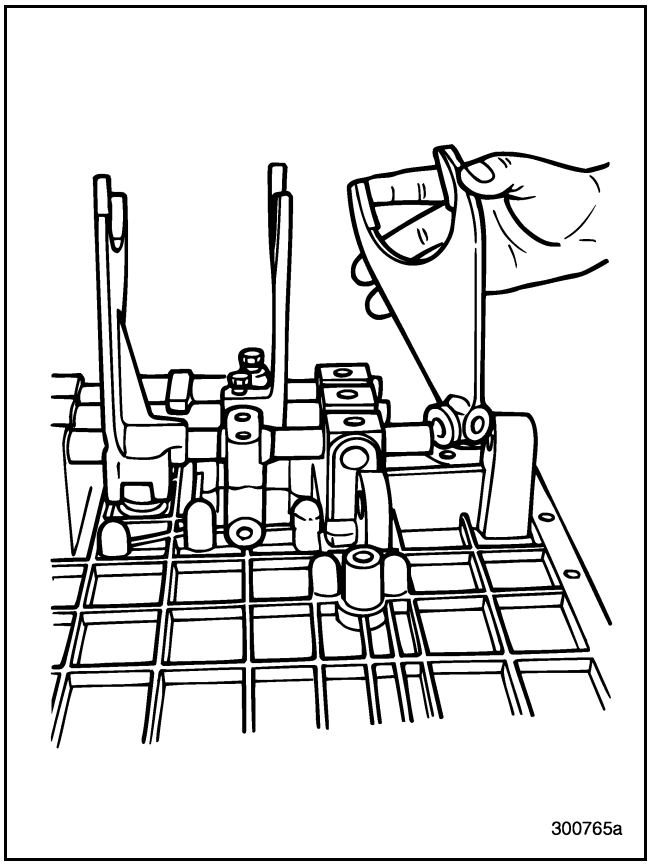


Figure 504 — Installing Lo/Reverse Shift Fork

23. Continue sliding the Lo/reverse shift rail as shown and then, install the interlock pin into the rail.

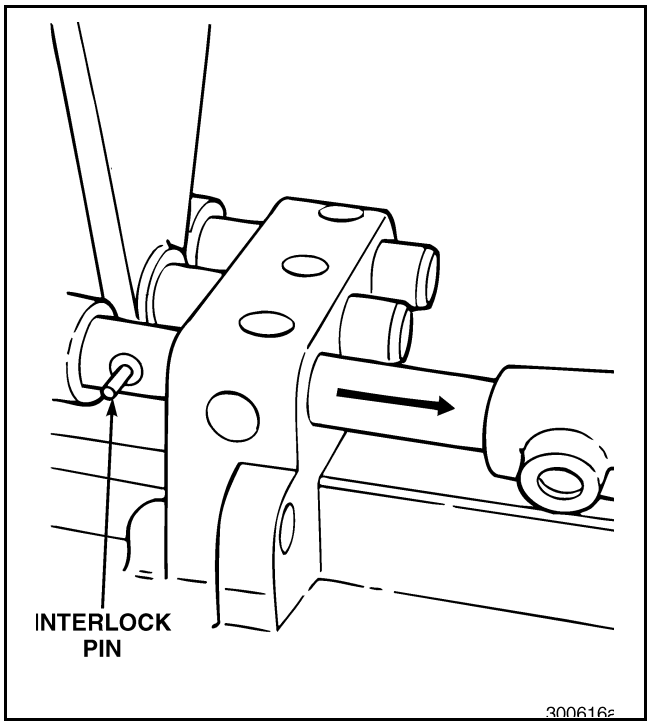


Figure 505 — Sliding Lo/Reverse Shift Rail

24. Finish sliding the shift rail through the fork and into position.

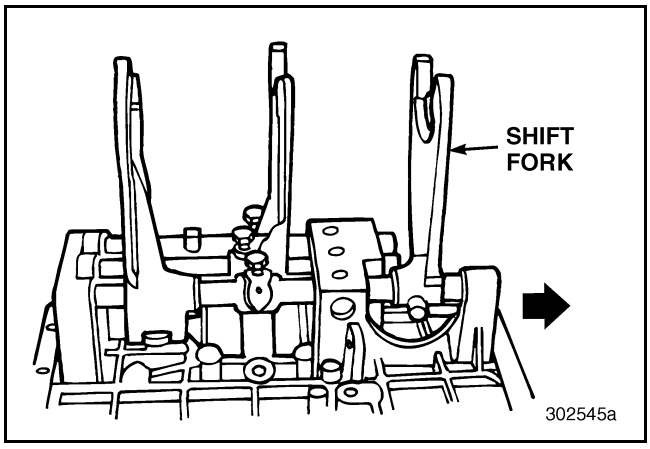


Figure 506 — Shift Rail in Position

25. Align the setscrew in the Lo/reverse shifter with the notch in the shift rail. Tighten the setscrew to the specified torque.

NOTE

Effective June 2007, shift fork setscrews were changed to a Scotch-Grip™ torque retention method. DO NOT reuse these fasteners, as they are one-time use only.

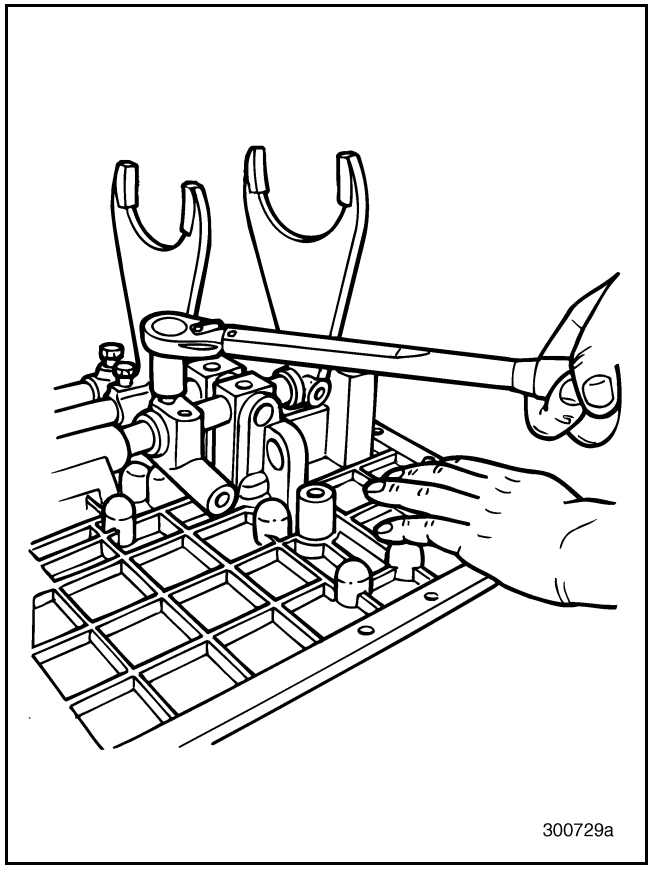


Figure 507 — Tightening Setscrew

26. Align the setscrew in the Lo/reverse shift fork with the notch in the shift rail. Tighten the setscrew to the specified torque.

NOTE

Effective June 2007, shift fork setscrews were changed to a Scotch-Grip™ torque retention method. DO NOT reuse these fasteners, as they are one-time use only.

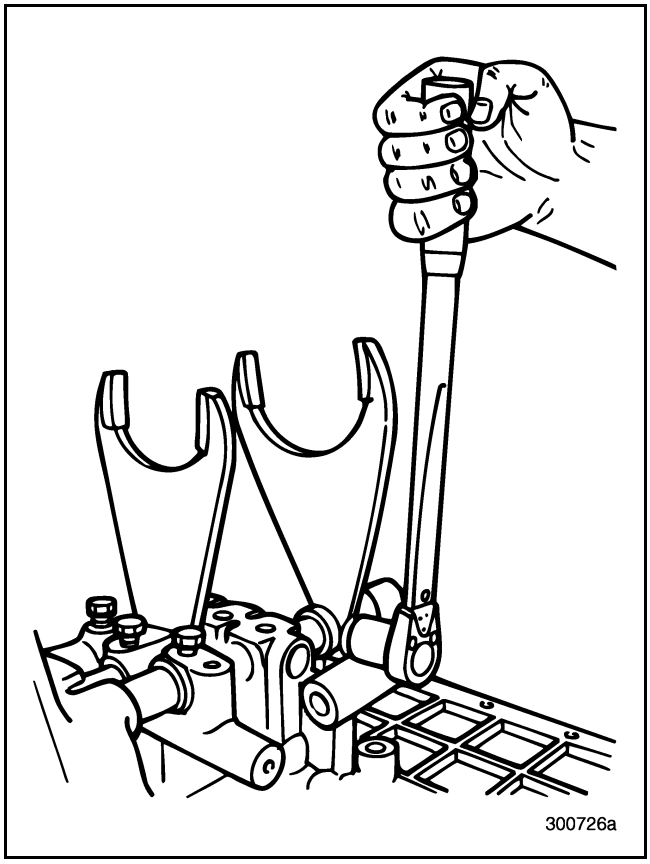


Figure 508 — Tightening Setscrew

27. Install the interlock ball into the opening next to the interlock rocker location of the cover.

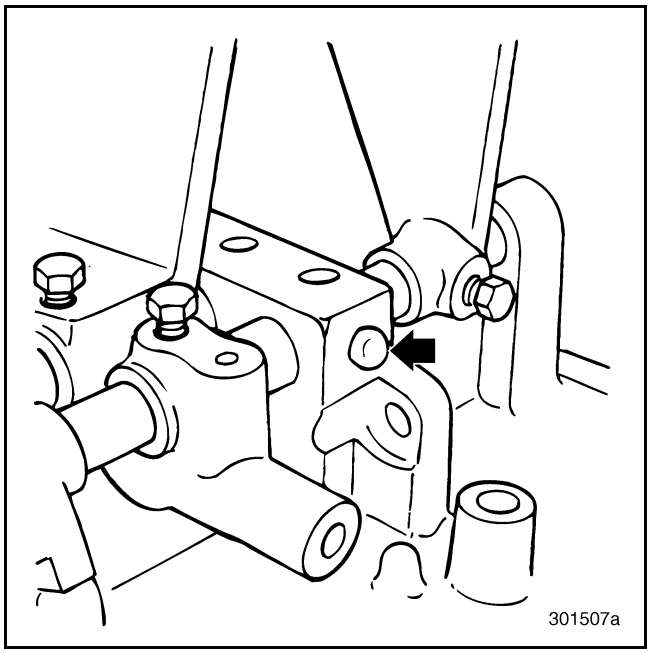


Figure 509 — Installing Interlock Ball into Cover

28. Install the interlock rocker and bolt into the cover.

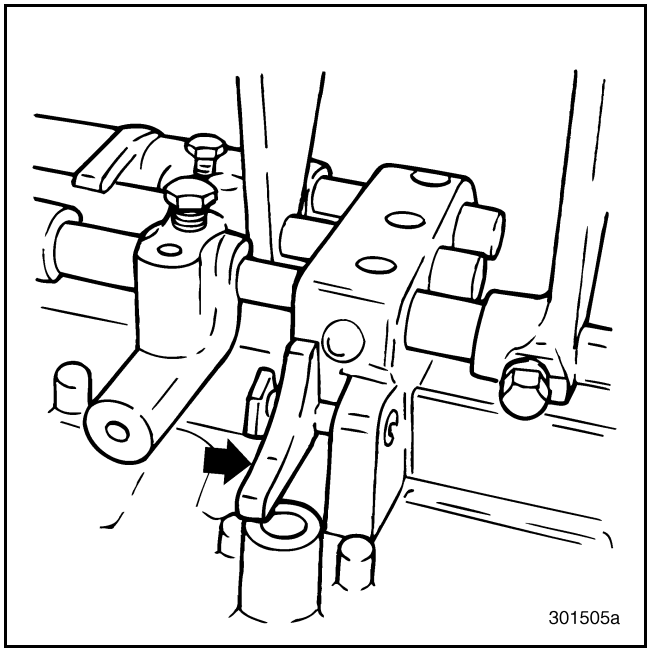


Figure 510 — Installing Interlock Rocker and Bolt

29. Install the nut and washers onto the interlock rocker bolt, and tighten to the specified torque.

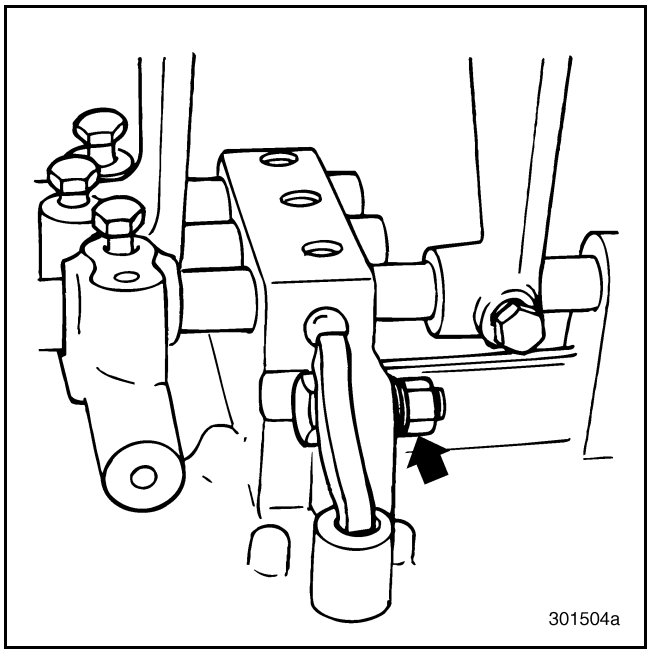


Figure 511 — Installing Nut and Washers

TRANSMISSION REASSEMBLY PROCEDURES [320]

SERVICE HINT

Locate the stamped letter “O” on the front of each front countershaft fourth (eighth) speed gear that aligns with the keyway. Paint the **front** of the corresponding gear tooth with white paint for greater visibility when timing the countershafts later. Do this for each of the three front countershafts.

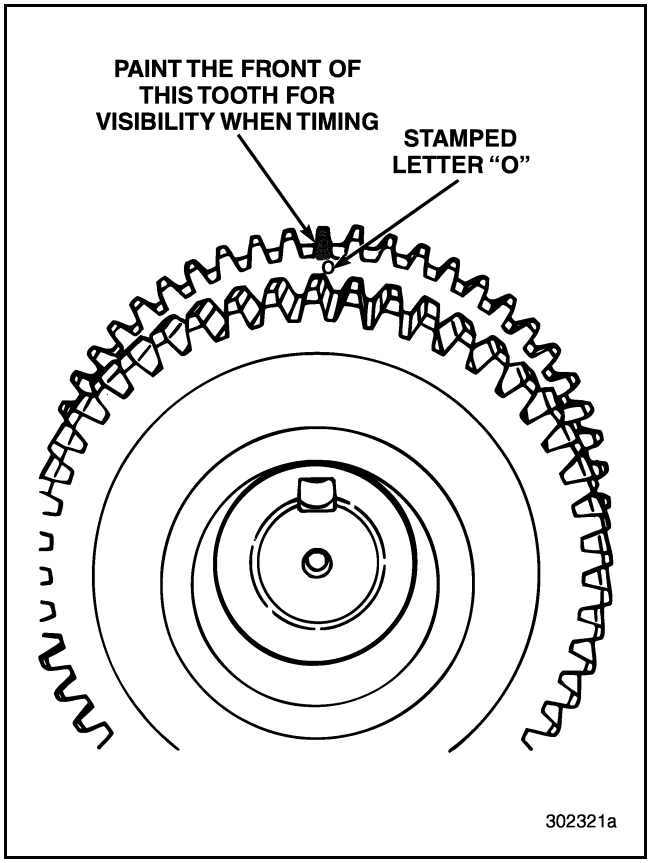


Figure 512 — Gear Tooth Marked for Timing

SERVICE HINT

Locate the three gear tooth spaces on the mainshaft fourth (eighth) speed gear, stamped with the letter “O”. Paint the front of each tooth **space** with white paint for greater visibility when timing the countershafts later. If there are no stamped letters, count the number of gear teeth (result should be divisible by three). Place a white paint mark on any tooth space. Then count around one-third of the total spaces and place the second white mark. Finally, count around one-third of the total spaces again and place the third white mark. The three marks should now be evenly spaced around the gear.

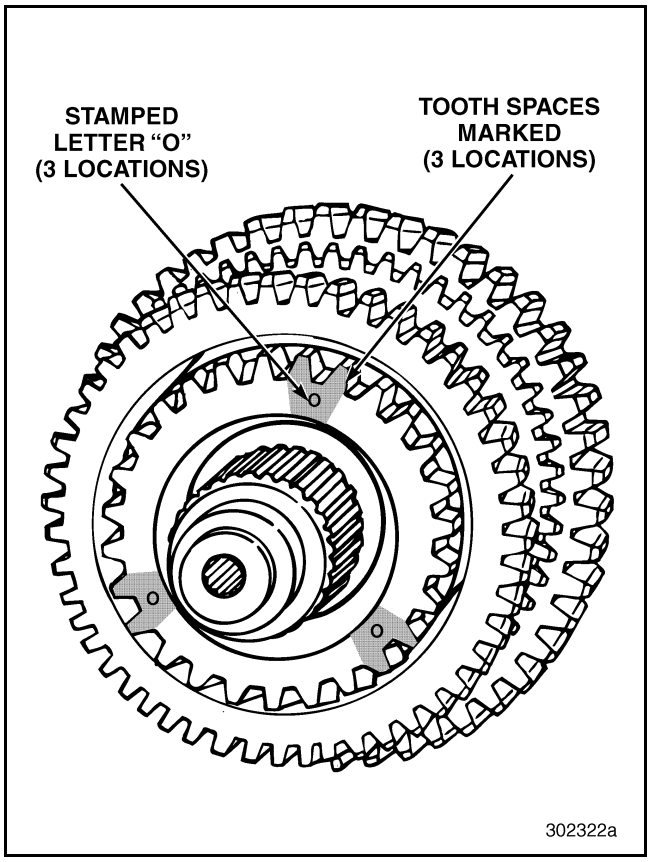


Figure 513 — Gear Tooth Spaces Marked for Timing

1. Install the No. 1 (upper right, when viewed from front) and No. 3 (lower) front countershaft front bearing covers and capscrews. Make sure **new** O-rings are in place. Tighten the capscrews to the specified torque.

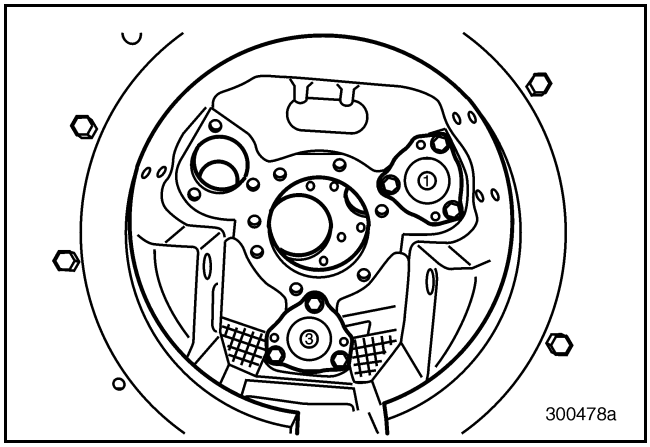


Figure 514 — No. 1 and No. 3 Front Countershaft Front Bearing Covers Installed

2. With the main case in a vertical position, front end down, install the No. 3 (lower) front countershaft into the main transmission case.

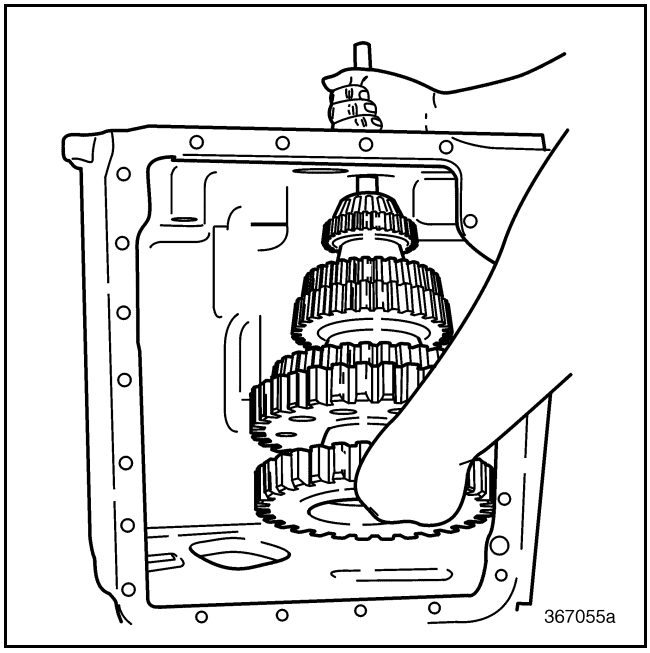


Figure 515 — Installing Lower No. 3 Countershaft into Main Case

3. Position the countershaft to center it over the front bearing.

4. Temporarily position a shim pack over one of the front countershaft rear bearing cover openings. Mark the overhang of the shim pack at the reverse idler shaft opening of the case. This helps position the reverse idler shaft and prevents bearing cover interference with the shaft. Mark all idler shaft openings.

NOTE

The bearing cover fits into the flat on the idler shaft to retain the shaft and prevent it from rotating.

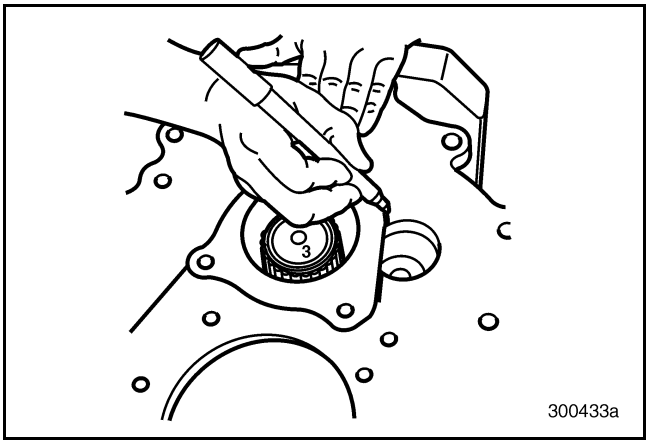


Figure 516 — Marking Idler Shaft Opening

5. Install the No. 3 (lower) reverse idler shaft into the opening provided next to the installed countershaft. As the reverse idler shaft is inserted into the case, install (in order) the reverse idler gear and thrust washer onto the shaft, from inside the case.

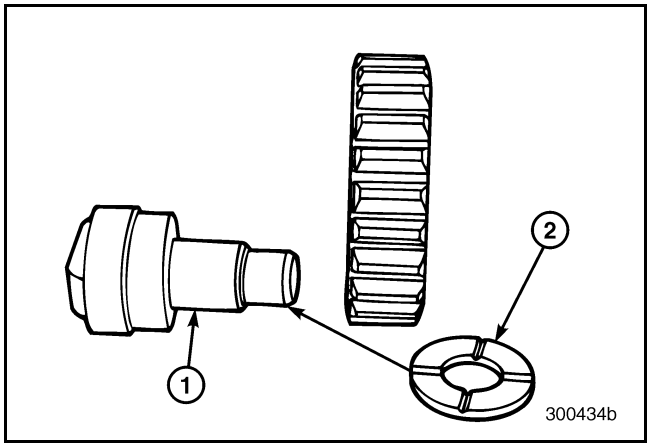


Figure 517 — Order of Reverse Idler Shaft and Components

1. Reverse Idler Shaft	2. Thrust Washer

6. Align the flat on the end of the reverse idler shaft (next to No. 3 countershaft) with the mark made along the edge of the shim pack.

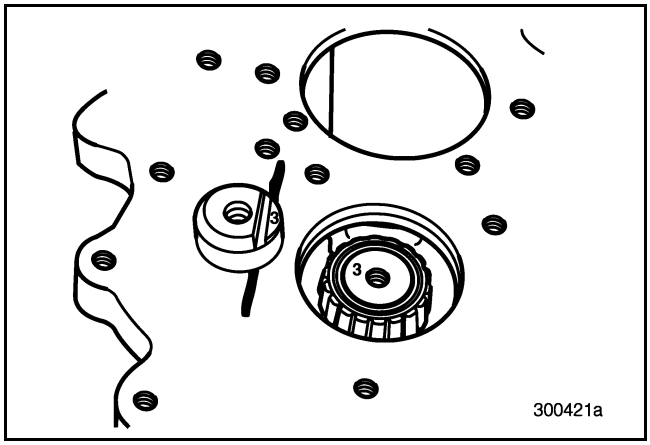


Figure 518 — Aligning Reverse Idler Shaft with Marks

7. Maintaining mark alignment, use a brass hammer to tap the reverse idler shaft for the No. 3 (lower) countershaft into the case. To ease installation of the mainshaft, do not drive the reverse idler shaft all the way into the case at this time. Leave approximately 1/2 inch of the idler shaft protruding above the case as shown in Figure 520. Be sure to maintain mark alignment.

⚠ CAUTION

Make sure that the thrust washer is aligned correctly with the idler shaft while tapping the idler shaft into place. If not aligned, damage to the thrust washer may result.

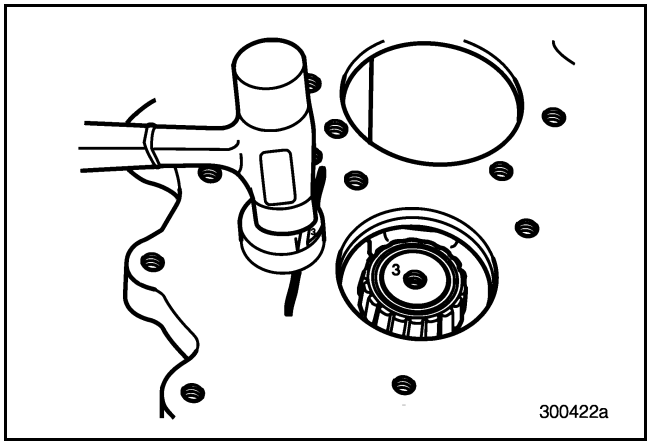


Figure 519 — Tapping Reverse Idler Shaft into Place

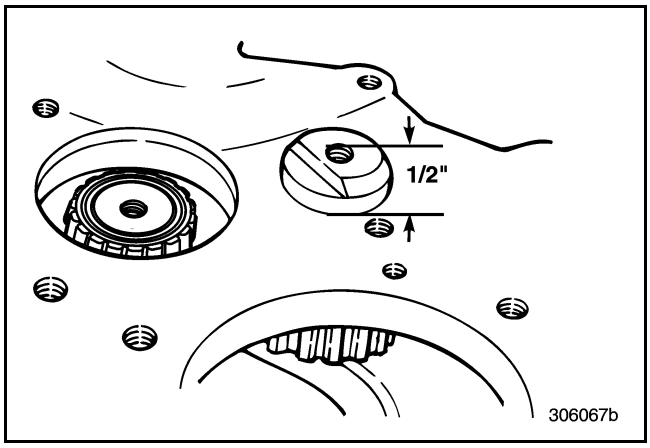


Figure 520 — Reverse Idler Shaft Protrusion

NOTE

Leaving the reverse idler shaft protruding from the transmission case allows the countershaft to be moved rearward to provide sufficient clearance for installation of the mainshaft.

8. Tip the No. 1 (upper left, when viewed from the rear) front countershaft into position as described earlier for the No. 3 (lower) countershaft.
9. Install the reverse idler gear and thrust washer into the opening next to the No. 1 (upper left) front countershaft. Roll the idler gear and thrust washer into position.
10. Install the reverse idler shaft. Align the flat on the end of the shaft with the mark previously made along the edge of the shim pack.
11. While maintaining mark alignment, use a brass hammer to tap the reverse idler shaft into the case. To ease installation of the mainshaft, do not drive the reverse idler shaft all the way into the case at this time. Leave approximately 1/2 inch of the shaft protruding above the case as shown in Figure 520.

⚠ CAUTION

Make sure that the thrust washer is aligned correctly with the idler shaft while tapping the idler shaft into place. If not aligned, damage to the thrust washer may result.

12. After installing the No. 1 and No. 3 reverse idler gears and idler shafts, install the front countershaft rear bearings onto the No. 1 and No. 3 countershafts.
13. To hold the No. 1 and No. 3 countershafts in place, temporarily install the front countershaft rear bearing covers. Position 1/2-inch thick spacers (nuts) between the bearing covers and the transmission case to allow for the temporary protrusion of the reverse idler shafts.

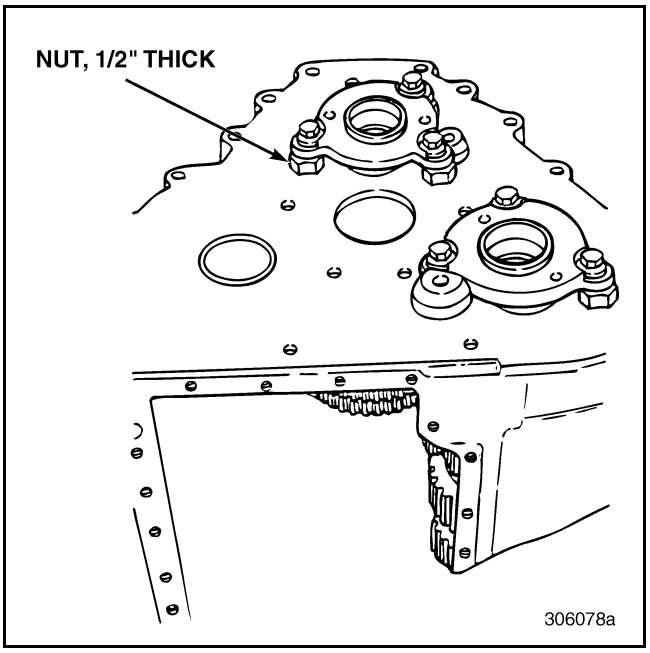


Figure 521 — Bearing Covers Temporarily Installed with Spacers

14. With the No. 1 and No. 3 front countershafts temporarily in place, move both countershafts as far rearward as possible, against the rear bearing covers. This provides clearance for mainshaft installation and Lo-speed gear and reverse speed gear positioning. Also, position the reverse idler gears as far rearward as possible.
15. Install the mainshaft into the case by lifting the mainshaft into position and in gear contact with the No. 1 and No. 3 countershafts.

NOTE

Before the mainshaft is installed, slide the Lo/reverse sliding clutch forward until it fully engages the Lo-speed gear. Slide the reverse speed gear forward until it fully engages the sliding clutch.

⚠ WARNING

Reverse gear is not secured to the shaft and can fall off if not careful.

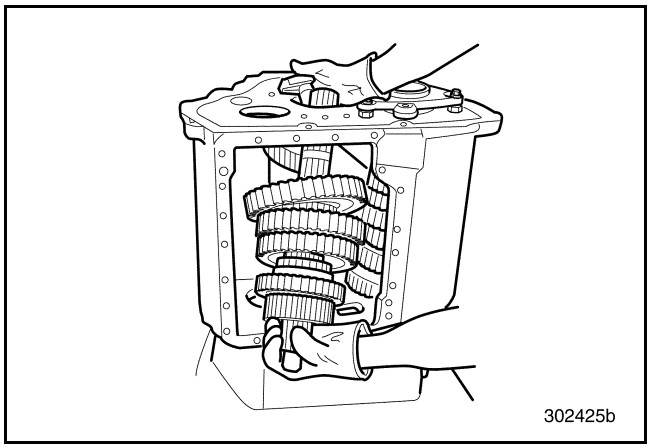


Figure 522 — Installing Mainshaft into Case

16. Place the transmission in a horizontal position.
17. Move the reverse gear and Lo/reverse sliding clutch to normal positions.
18. Position the mainshaft, No. 3 (lower) countershaft and No. 1 (upper right, when viewed from the front) countershaft so that the timing marks on the gears are aligned. Roll the shafts into place and make sure gear timing is correct.

SERVICE HINT

Timing the shafts is easier if the transmission is in a horizontal position, rotated 15 degrees counterclockwise, as viewed from the rear of the transmission case.

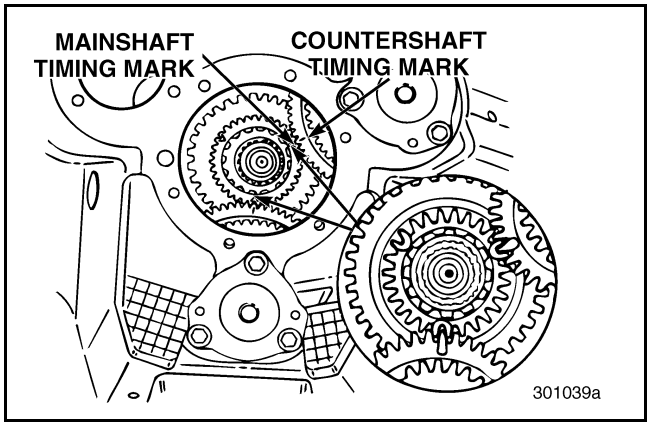


Figure 523 — Timing Gears with Mainshaft in Place

19. Remove the temporarily installed No. 1 and No. 3 front countershaft rear bearing cover capscrews, covers and spacers.
20. Using a brass hammer, tap the No. 1 and No. 3 reverse idler shafts until fully seated in the case.

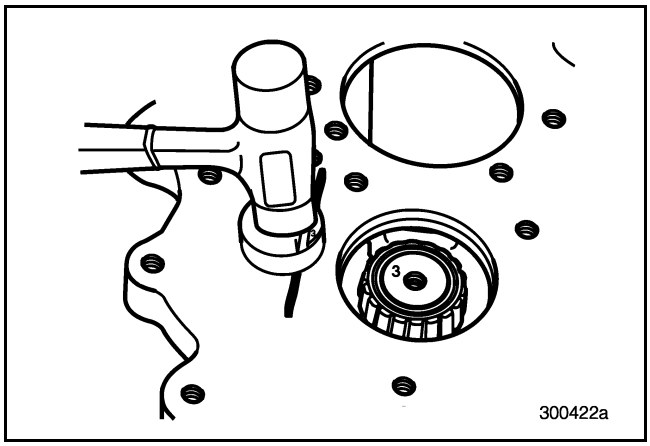


Figure 524 — Tapping Reverse Idler Shaft into Place

21. Temporarily reinstall the No. 1 and No. 3 front countershaft rear bearing covers (without 1/2-inch thick spacers) to secure the countershafts. Jiggle the countershafts while tapping the covers in place. Install the capscrews, but do not tighten to specification at this time. Front countershaft bearing preload must be adjusted after main case assembly.

NOTE

Do not use the bearing cover capscrews to pull any bearing cover into place. Damage to the bearings or bearing cover may result. Make sure all components are properly in place before tightening the capscrews.

22. Install the remaining No. 2 reverse idler shaft, gear and thrust washer (next to No. 2 countershaft, not yet installed) as described in the steps for the lower (No. 3) reverse idler shaft and gear. Move the reverse speed gear on the mainshaft as far away as possible. When installing the reverse idler shaft and gear, make sure that the thrust washer is held in place.

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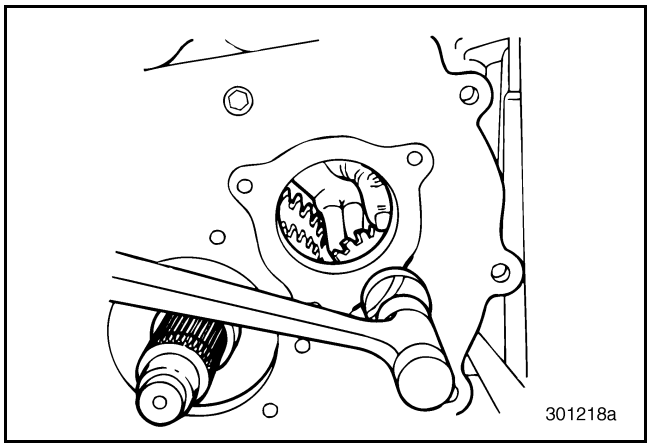


Figure 525 — Installing No. 2 Reverse Idler Shaft and Gear

⚠ CAUTION

Make sure that the thrust washer is aligned correctly with the idler shaft while tapping the idler shaft into place. If not aligned, damage to the thrust washer may result.

23. Shift the Lo/reverse sliding clutch and reverse gear rearward, to allow the gear teeth on the reverse speed gear to engage all three reverse idler gears. Temporarily install a folded rag between the Lo and reverse speed gears to hold them in place.

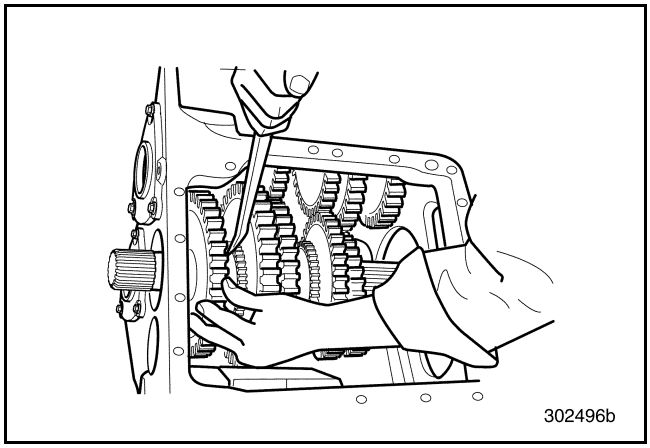


Figure 526 — Sliding Lo/Reverse Sliding Clutch and Reverse Speed Gear to Engage Gear Teeth (T313L21/T318L21 Shown)

SETTING FRONT COUNTERSHAFT BEARING PRELOAD

24. Install enough shims under the No. 3 (lower) and No. 1 (upper left, when viewed from the rear) front countershaft rear bearing cover to produce measurable countershaft end play. Then install the cover and tighten the capscrews to the specified torque. Measure end play of the countershaft, using a dial indicator.

NOTE

Use a pry bar to move the countershaft up and down while measuring end play on the dial indicator.

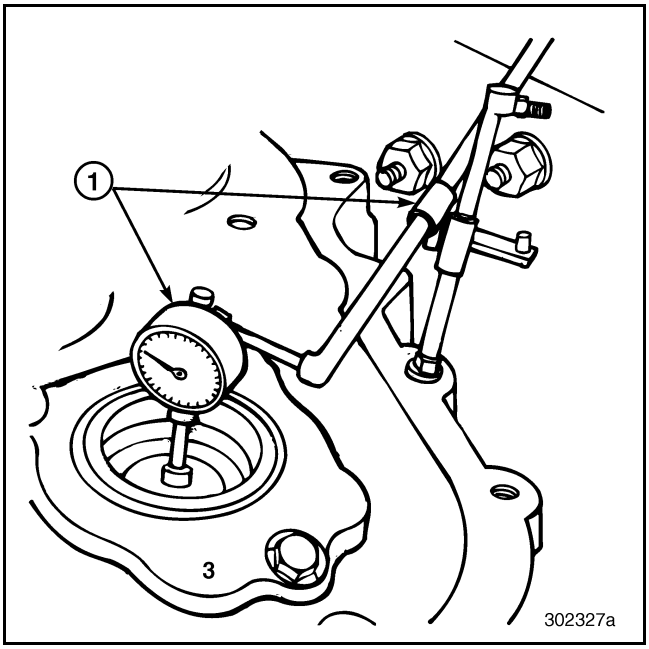


Figure 527 — Measuring Countershaft End Play

1. Dial Indicator Set J 05959-A

25. For the No. 3 (lower) and No. 1 (upper left) countershaft, measured end play determines the thickness of shims that must be removed from the shim pack to obtain zero end play. Then remove additional shim thickness to obtain the required 0.003 to 0.007 inch preload.

    Example:

    a. Begin the procedure, using enough shims under the cover to produce measurable end play.

    b. Measure countershaft end play. For this example, end play is 0.100 inch.

    c. Remove 0.100-inch shims from the shim pack to obtain zero end play.

    d. Remove (subtract) additional 0.003 to 0.007 inch shims from the pack to obtain the specified preload.

    e. Total shim thickness removed from the shim pack to obtain 0.003 to 0.007 inch preload must be 0.103 to 0.107 inch.

NOTE

Preload is “negative end play” or “crush.” It cannot be measured directly. Determining shim thickness must be done carefully, as described, to obtain the correct preload on the bearings.

26. After determining the correct shim thickness, install the shim pack onto the No. 3 and No. 1 front countershaft rear covers.

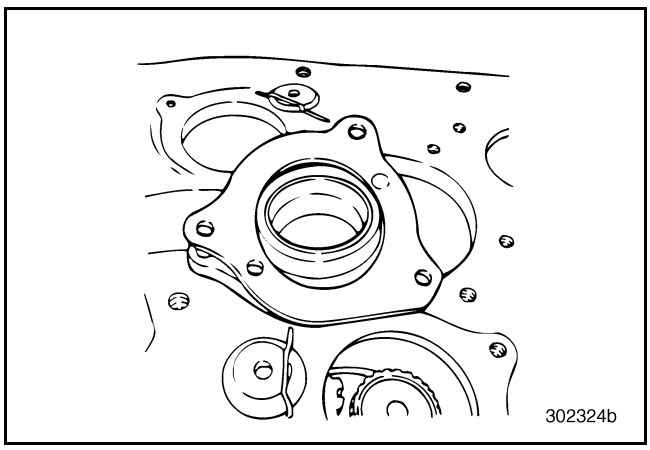


Figure 528 — Installing Shim Pack

27. Install the No. 3 (lower) and No. 1 (upper left) front countershaft rear bearing covers by aligning and lightly tapping the covers in place. Install the capscrews and tighten to the specified torque.

NOTE

Do not use the bearing cover capscrews to pull any bearing cover into place. Damage to the bearings or bearing cover may result. Make sure all components are properly in place before tightening the capscrews.

28. Working through the opening at the rear of the case, install the reverse speed gear mainshaft snap ring onto the shaft, if not already done. Install into fifth groove from rear of shaft.

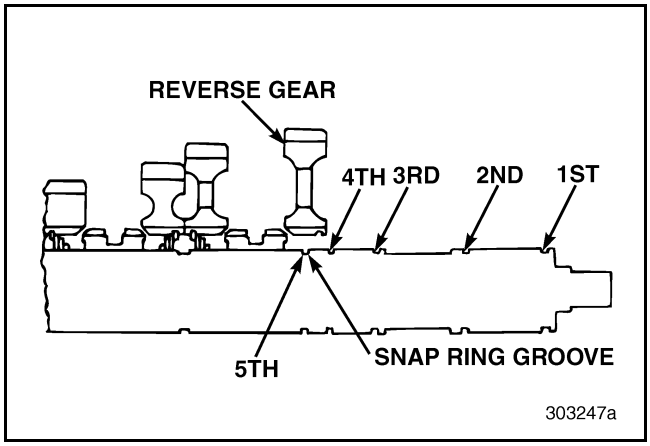


Figure 529 — Installing Reverse Gear Mainshaft Snap Ring (T313L/T318L Shown)

29. Install the internal-toothed and external-toothed thrust washers onto the mainshaft. The oil grooves on the external-toothed thrust washer face forward (toward the internal-toothed thrust washer).

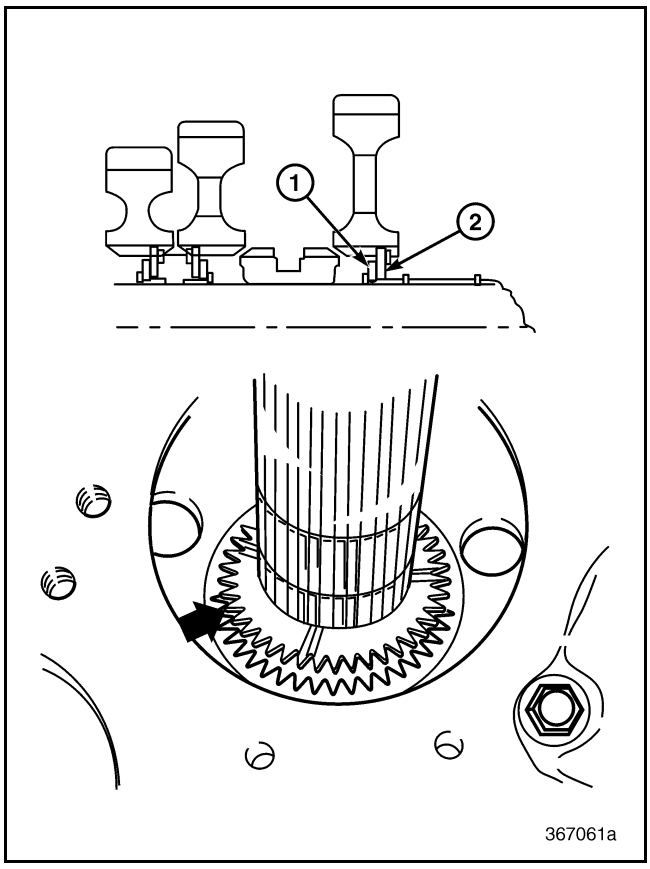


Figure 530 — Installing Internal-Toothed Thrust Washer

1. Internal-Toothed Thrust Washer	2. External-Toothed Thrust Washer

30. Install the snap ring on the inside of the reverse gear, using suitable snap ring pliers. Remove the rag temporarily installed between the Lo and reverse speed gears, if not already done.

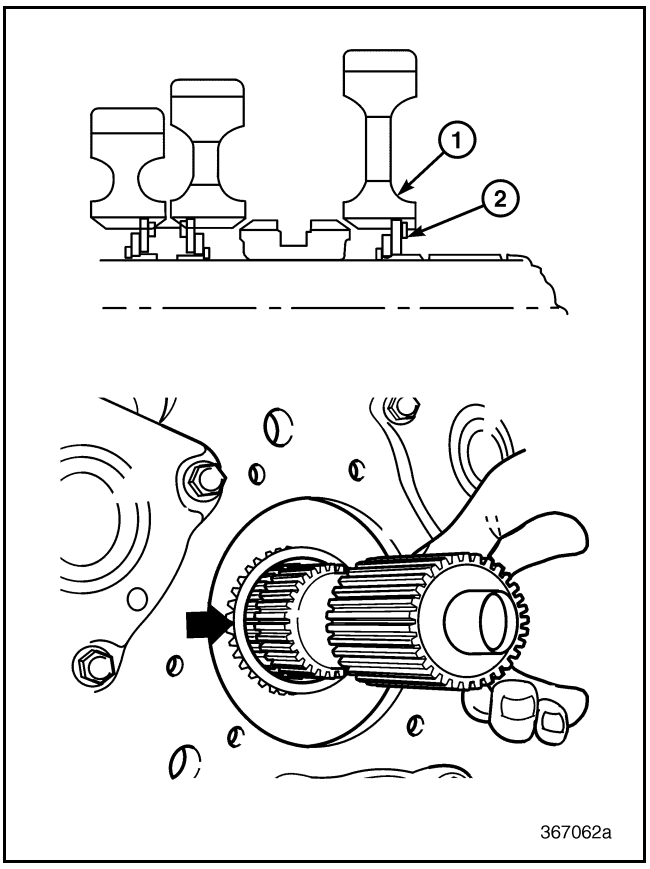


Figure 531 — Installing Reverse Gear Snap Ring (T313L/T318L Shown)

1. Reverse Gear	2. Reverse Gear Snap Ring

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31. Install the mainshaft snap ring (located just behind the reverse speed gear and before the spacer) onto the mainshaft, using suitable snap ring pliers. Install into fourth groove from rear of shaft.

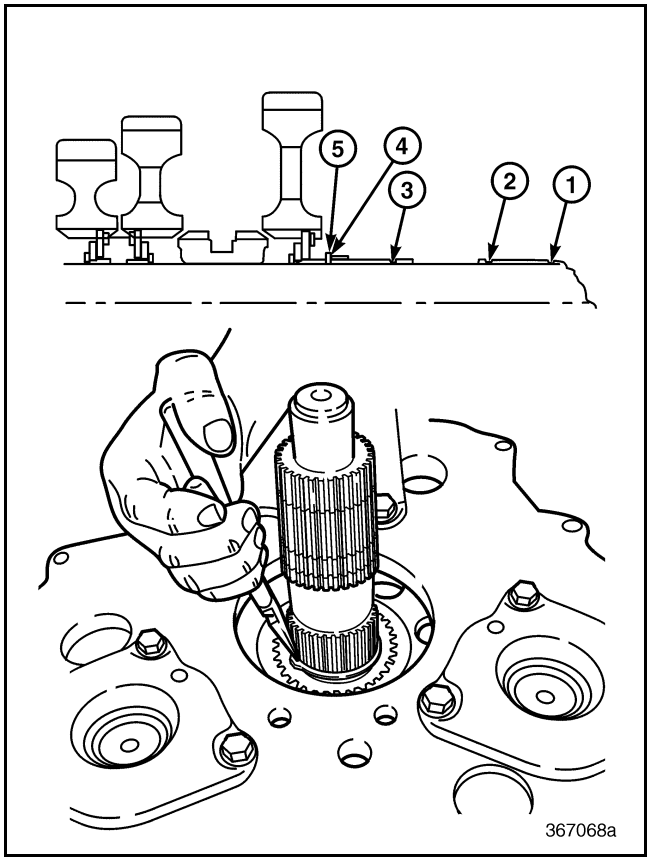


Figure 532 — Installing Spacer Snap Ring onto Mainshaft (T313L/T318L Shown)

1. Mainshaft First Snap Ring Groove 2. Mainshaft Second Snap Ring Groove 3. Mainshaft Third Snap Ring Groove	4. Mainshaft Fourth Snap Ring Groove 5. Bearing Thrust Washer Spacer Snap Ring

32. Install the remaining No. 2 (upper right when viewed from the rear) countershaft.

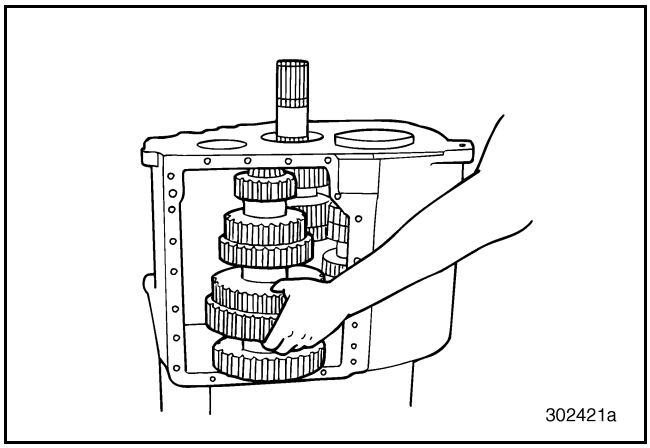


Figure 533 — Installing No. 2 Countershaft (T313L21/T318L21 Shown)

33. Place the transmission in a horizontal position. Align the timing marks on the No. 2 countershaft with the mainshaft. All three countershafts and mainshaft timing marks should be aligned at this point.

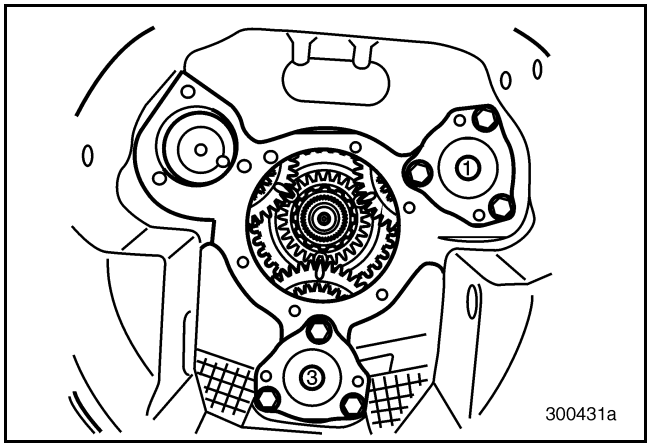


Figure 534 — Gear Timing Marks Aligned

34. Install the No. 2 (upper left, as viewed from the front) countershaft front bearing cover. While holding the shaft with one hand, insert the front bearing cover ensuring a **new** O-ring is in place. Carefully wiggle or tap cover in place using a soft hammer. Tighten the cover capscrews to the specified torque.

NOTE

Do not attempt to pull any bearing cover in place, using the bearing cover capscrews. Damage to the bearings or bearing cover may result. Make sure all components are properly in place before tightening the capscrews.

35. Install the front mainshaft rear bearing thrust spacer onto the mainshaft, against the last snap ring. Make sure that the oil grooves face forward.

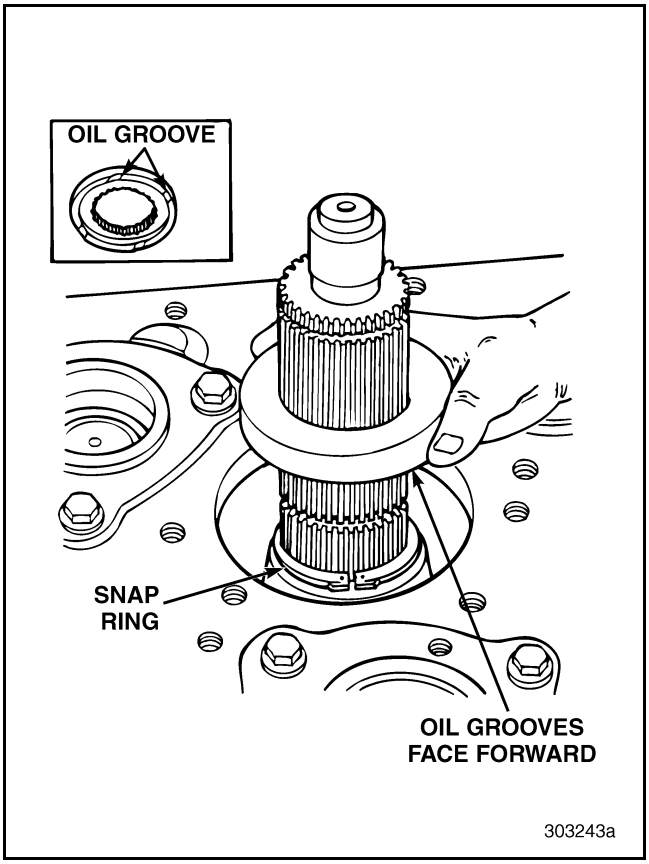


Figure 535 — Installing Bearing Spacer (T313LR/T318LR Shown)

36. Press the sleeve into the mainshaft rear bearing, being careful to support the bearing on its inner race to prevent damage.

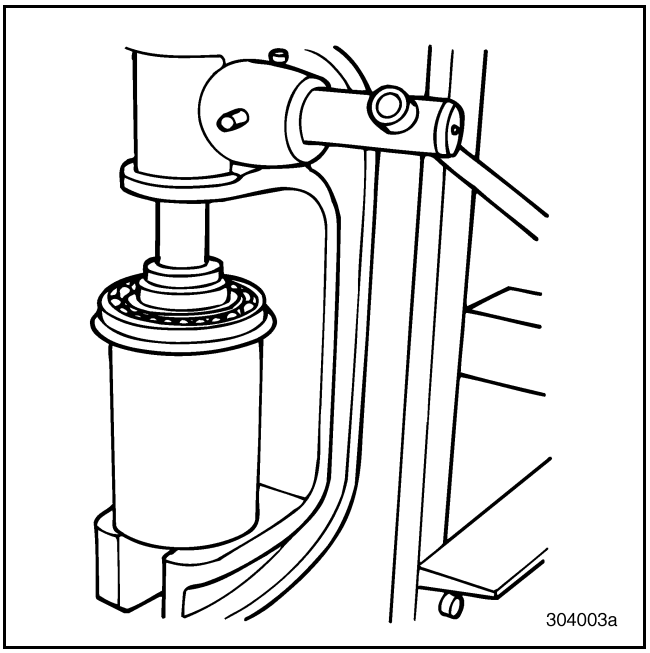


Figure 536 — Installing Front Mainshaft Rear Bearing

37. Install the front mainshaft rear bearing.

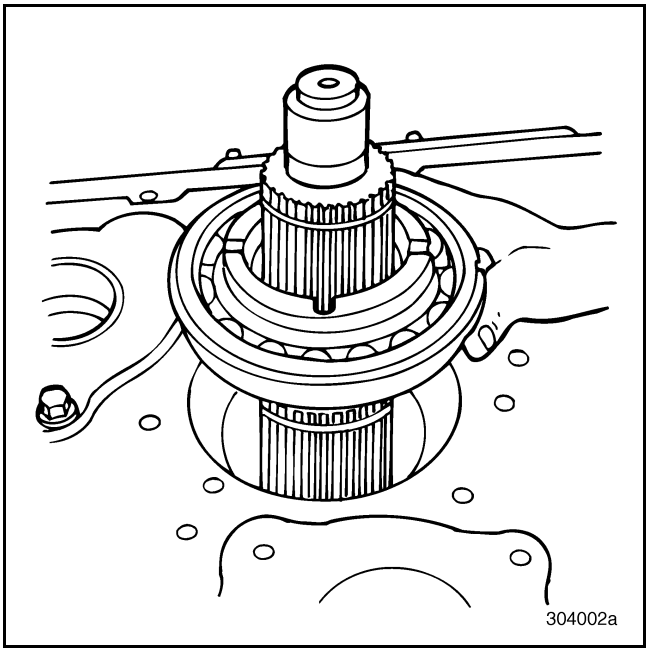


Figure 537 — Installing Front Mainshaft Rear Bearing (T313LR/T318LR Shown)

38. Install the front mainshaft rear bearing mainshaft snap ring.

SERVICE HINT

To install the snap ring that retains the rear bearing, it may be necessary to raise the mainshaft using a pry bar.

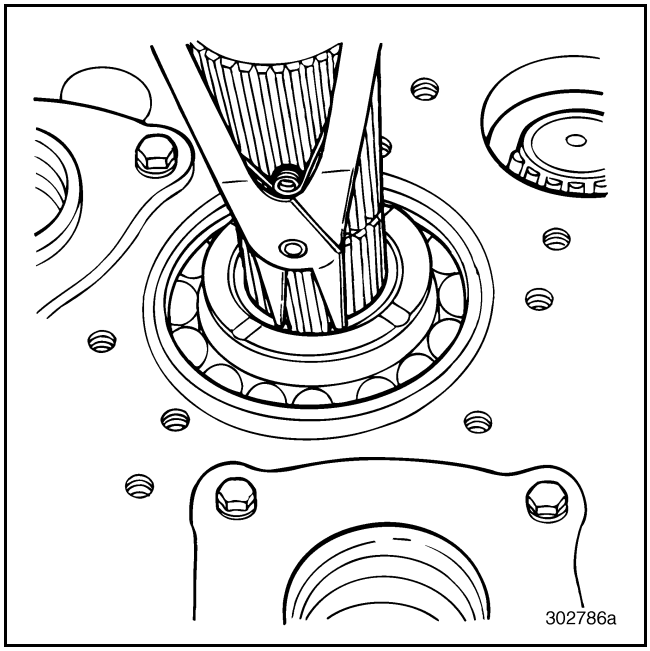


Figure 538 — Installing Snap Ring

39. Install the No. 2 (upper right) countershaft rear bearing cover. Determine shim pack thickness for proper bearing preload adjustment, as described earlier for the No. 3 lower countershaft. Tighten the rear cover capscrews to the specified torque.

40. Install the front mainshaft rear bearing cover and capscrews. Tighten the capscrews to the specified torque.

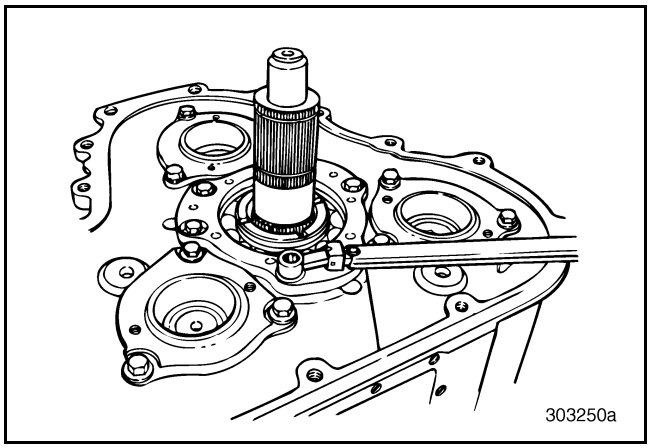


Figure 539 — Installing Front Mainshaft Rear Bearing Cover (T313L/T318L Shown)

41. Working at the front of the mainshaft, install the third/fourth sliding clutch.

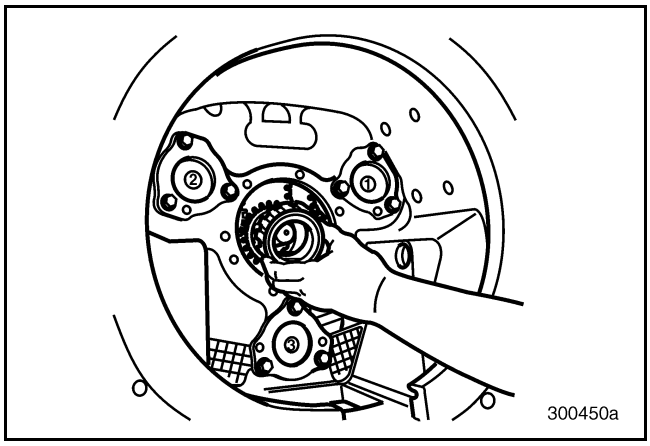


Figure 540 — Installing Sliding Clutch

42. Install a **new** main drive pinion cover gasket. Make sure the rubber sealing material on the gasket is facing the bearing cover.

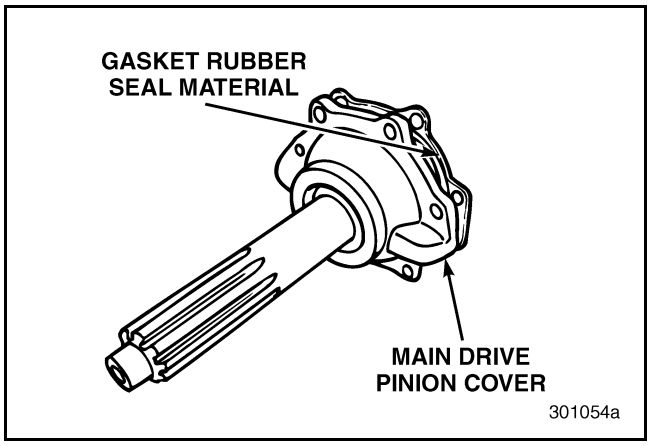


Figure 541 — Installing Cover Gasket with Sealing Material Facing Cover

43. Align the main drive pinion bearing cover gasket. Make sure the hole in the cover aligns with the oil passageway in the bearing cover.

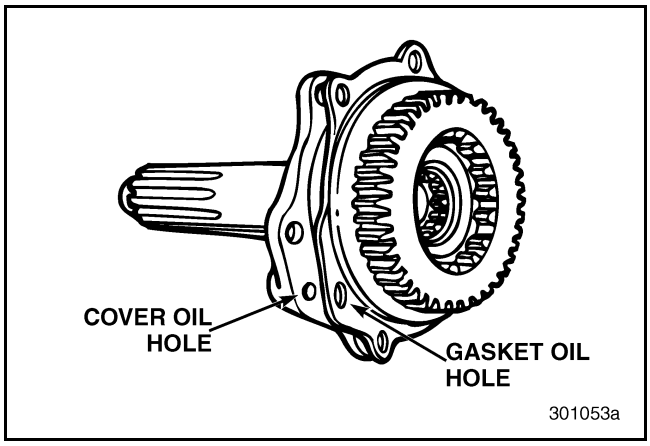


Figure 542 — Aligning Cover and Gasket Oil Holes

44. Before installing the main drive pinion assembly, make sure to align the oil passage hole in the cover with the oil passage hole in the case.

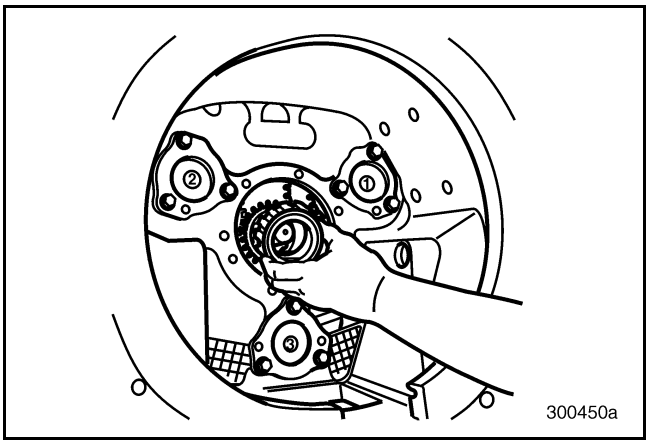


Figure 543 — Aligning Pinion Cover Oil Hole with Hole in Case

⚠ CAUTION

Make sure the oil passages in the gasket, cover and case are aligned.

45. Install the main drive pinion assembly and tighten the bearing cover capscrews to the specified torque.

NOTE

Main drive pinions for these transmissions are designed with the equivalent of three degrees 1.753–1.803 mm (0.069–0.071 inch) of backlash between the shaft splines and the mating splines of the main drive pinion gear. This amount of backlash was designed to eliminate a rattling noise that can occur when the engine is idling with the clutch engaged.

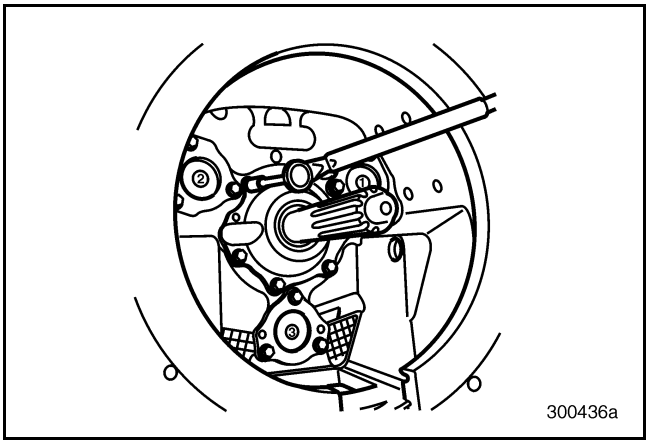


Figure 544 — Tightening Main Drive Pinion Bearing Cover Capscrews

NOTE

Reinstall the oil pump discharge line (if equipped) that was removed at disassembly. Tighten the upper and lower portions of the discharge tube to 49–53 N•m (36–39 lb-ft) using a crowfoot adapter and torque wrench.

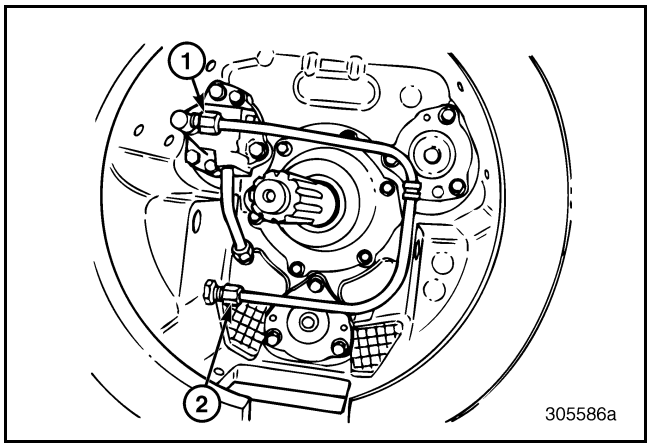


Figure 545 — Tighten Upper and Lower Discharge Tube Fittings

1. Upper Discharge Tube Fitting	2. Lower Discharge Tube Fitting

46. Locate the stamped letter “O” on the rear face of the rear compound Lo-split gear at three tooth spaces 120 degrees apart. If there are no stamped letters, count the number of teeth (result should be divisible by three). Paint three white marks, each 120 degrees apart, located on the rear face of the gear, on the tooth spaces.

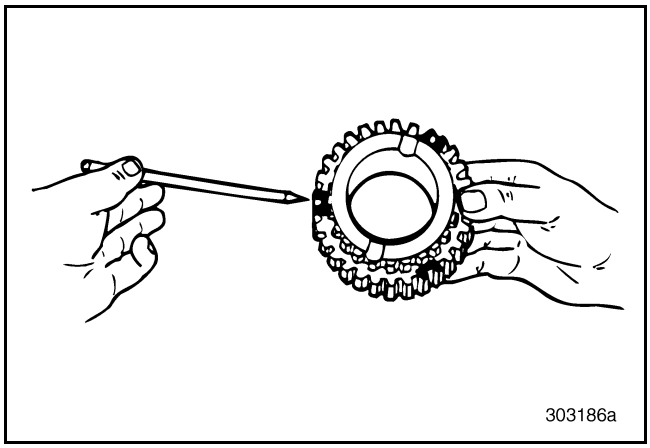


Figure 546 — Mark Lo-Split Gear

47. Install the compound Lo-split gear onto the front mainshaft. The clutch teeth of the gear face rearward.
48. Rotate transmission mainshaft to align the three timing marks on the rear compound Lo-split gear with the approximate center lines of the three front countershafts.

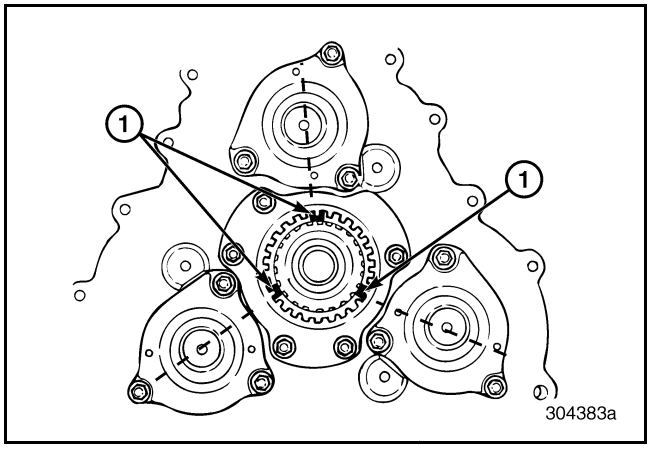


Figure 547 — Installing and Aligning Lo-Split Gear

1. Gear Timing Marks

49. Install the compound Lo-split gear internal-toothed thrust washer and retaining snap ring onto the front mainshaft in the location shown.

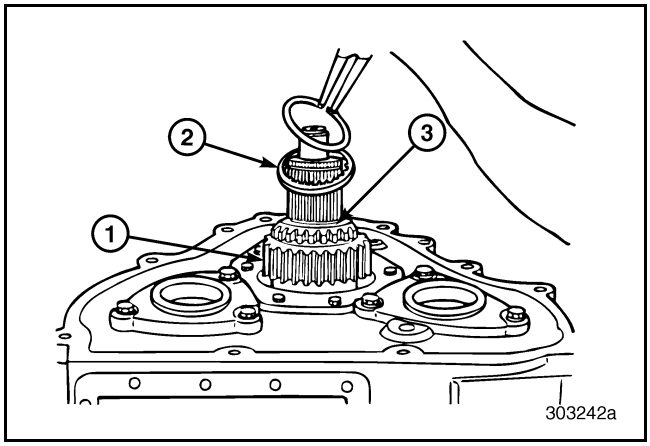


Figure 548 — Thrust Washer and Snap Ring Location (T313L/T318L Shown)

1. Lo-Split Gear 2. Internal-Toothed Thrust Washer	3. Snap Ring Groove

50. Install the sliding clutch onto the mainshaft. The external teeth on the sliding clutch face rearward.

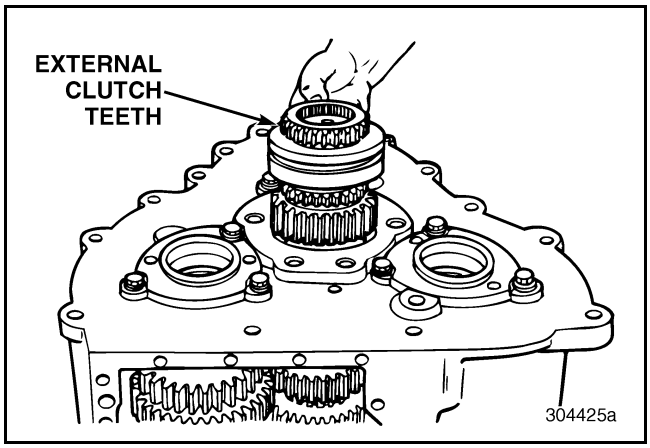


Figure 549 — Installing the Sliding Clutch

51. Locate the stamped letter “O” on the rear face of each rear countershaft Lo-split gear. If there is no stamped letter, mark the gear tooth on each countershaft that is directly in line with the keyway of the countershaft. Paint a corresponding timing mark on the Hi-range/Hi-split gear tooth, directly in line with the tooth marked on the Lo-split gear. Paint a corresponding timing mark on the Lo-range gear also.

SERVICE HINT

If the “O” stamping is not visible, locate the gear tooth on the countershaft that aligns with the keyway. Mark the closest tooth that aligns with the keyway. Then mark the remaining gears.

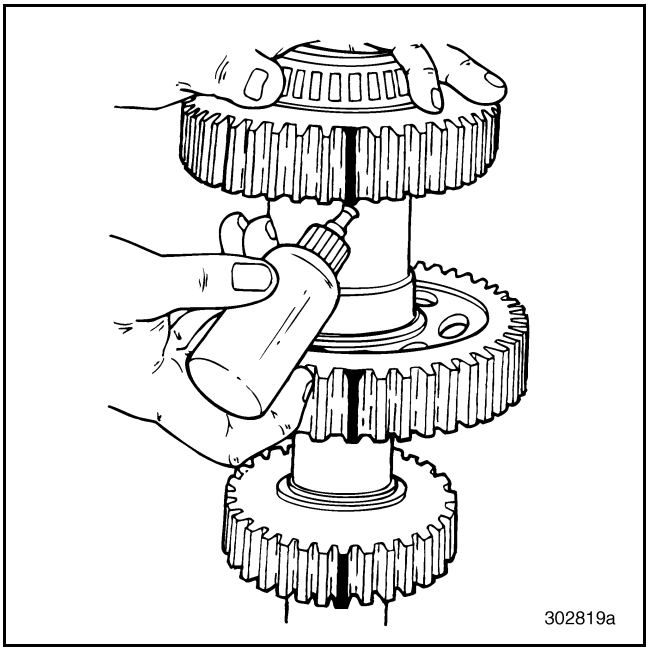


Figure 550 — Marking Rear Countershaft Gears

52. Position each of the three rear countershafts so that the single timing mark on each countershaft Lo-split gear enters the mating set of timing marks on the rear compound mainshaft Lo-split gear. Install each countershaft on the cup of its mating front countershaft rear bearing cover.

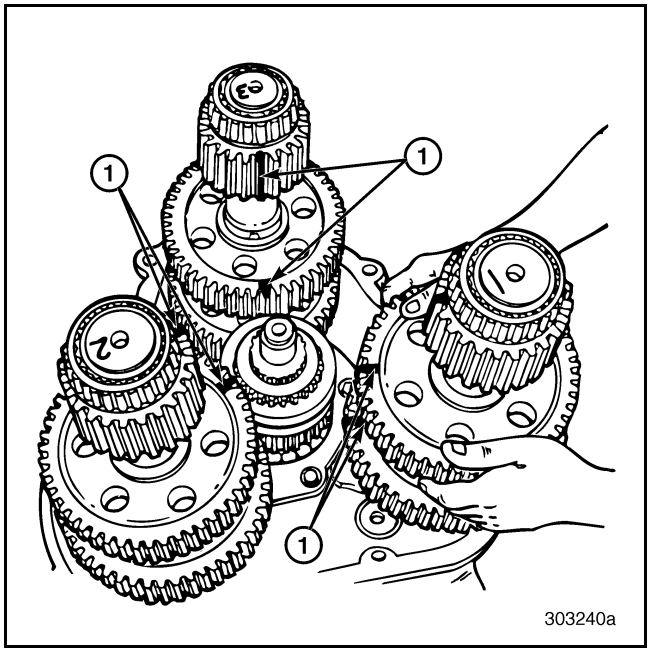


Figure 551 — Installing and Aligning Timing Marks (T313L/T318L Shown)

1. Align timing marks.

53. Obtain the rear mainshaft and synchronizer assembly. Paint three equally spaced sets of double timing marks on the gear teeth surrounding every 10th space between two teeth for the Hi-range/Hi-split gear. Paint three equally spaced sets of double timing marks on the gear teeth surrounding every 18th space between two teeth for the Lo-range gear.
54. On the conventional output shaft transmissions: T313–T318(L)(LR), use a hoist and a threaded eye-bolt to lift and install the rear mainshaft and synchronizer assembly between the rear countershafts. Make sure to retain timing mark alignment.

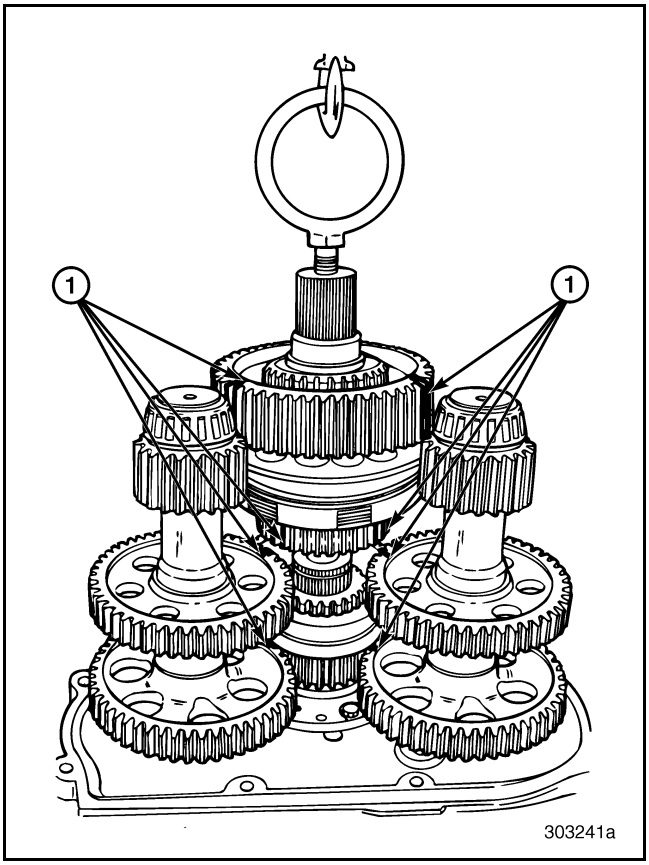


Figure 552 — Installing Rear Mainshaft and Synchronizer Assembly (T313LR/T318LR Shown)

1. Align timing marks as assembly is lowered.

55. For the extended output shaft transmissions: T313–T318(21)(L21)(LR21), suspend the output shaft and synchronizer assembly, using a hoist and suitable output yoke retaining nut with welded strap. Lift and install the synchronizer and output shaft assembly between the rear countershafts. Make sure to retain timing mark alignment.

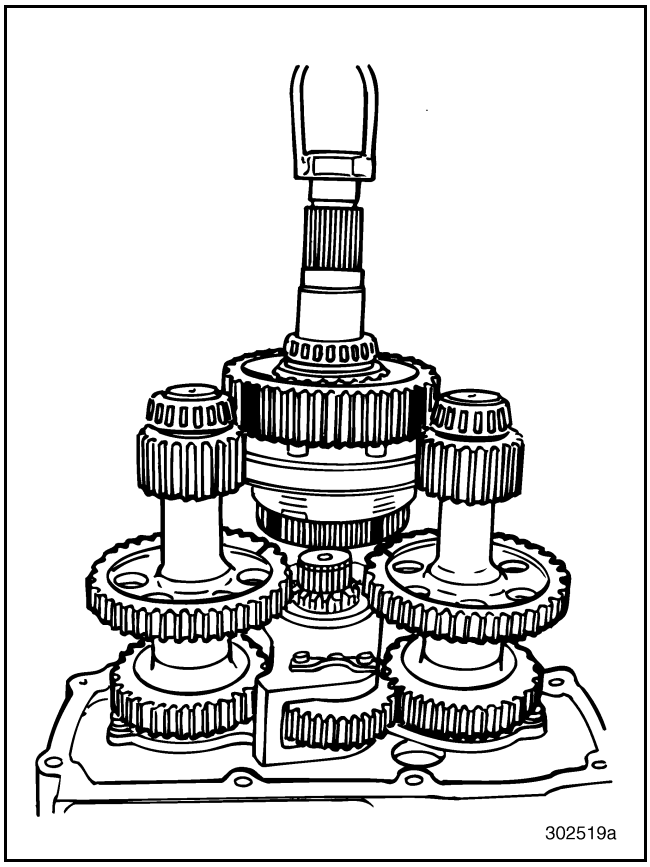


Figure 553 — Installing Output Shaft and Synchronizer Assembly (T313LR21/T318LR21 Shown)

NOTE

Make sure the single timing mark on each countershaft Hi-range/Hi-split gear and Lo-range gear aligns with the double timing marks painted on the corresponding rear mainshaft gears.

56. Remove the threaded eye bolt or nut with welded strap from the end of the rear mainshaft.
57. Install a **new** case-to-case gasket on the gasket surface of the main case.
58. Using a hoist and chain, carefully lower the rear case over the compound gear set and onto the main case and gasket.

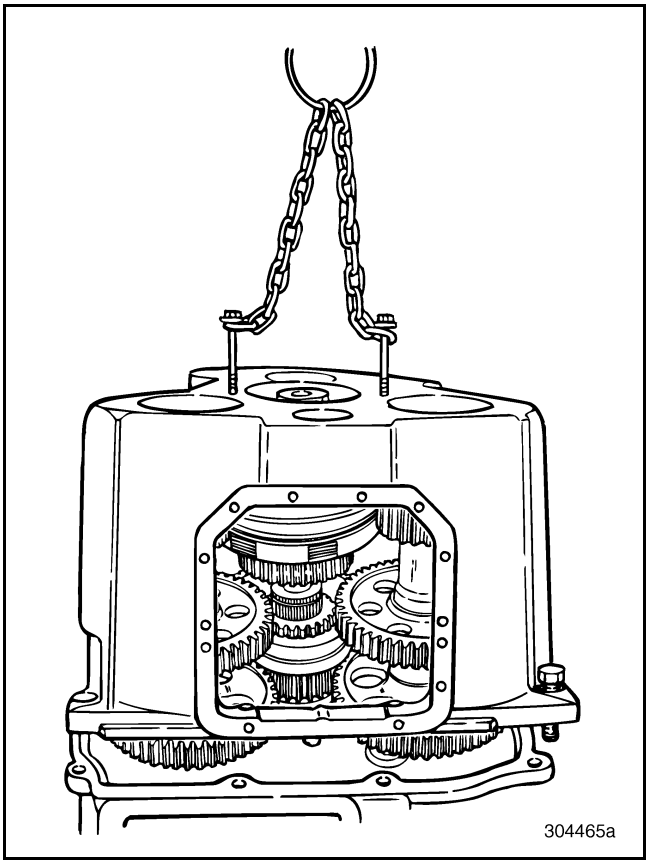


Figure 554 — Installing Rear Case

59. Install the rear case dowel bolts and nuts and tighten them to the specified torque.
60. Install the inner and outer (case-to-case) capscrews to secure the rear case to the main case. There are two inner capscrews located just inside the rear compound cover opening. Tighten the inner and outer case-to-case capscrews to the specified torque.

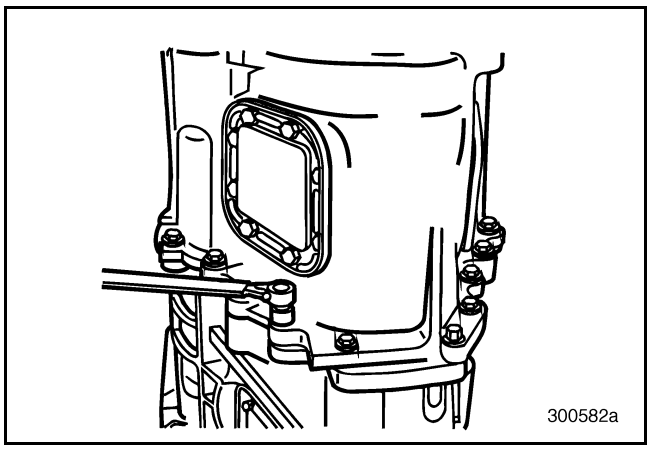


Figure 555 — Tightening Outer Case-to-Case Capscrews

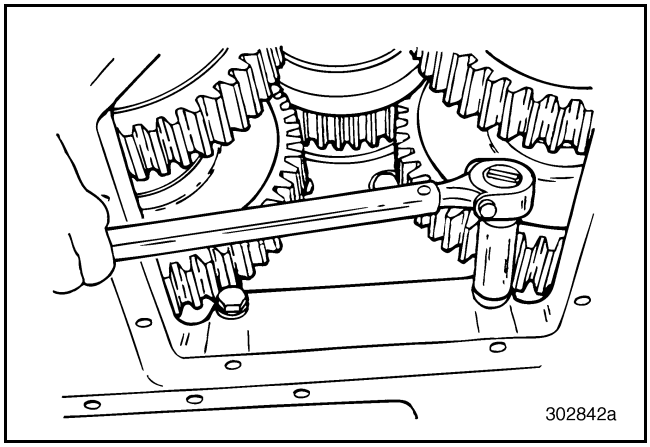


Figure 556 — Tightening Inner Case-to-Case Capscrews

SETTING REAR COUNTERSHAFT BEARING PRELOAD

61. Install the compound countershaft bearing covers. Determine the shim pack thickness for each rear countershaft bearing preload adjustment, using the procedure described in the example that follows.
62. Working at the rear of the countershafts, temporarily install the rear countershaft bearing covers, leaving the capscrews loose. Do not install shim packs or O-rings at this time. Measure the space between the bearing cover and transmission case, using two feeler gauge sets. Take at least two measurements and average the results.

NOTE

A more accurate measurement can be obtained if the transmission is in a vertical position and each bearing cover is hand-held firmly against the countershaft rear bearings.

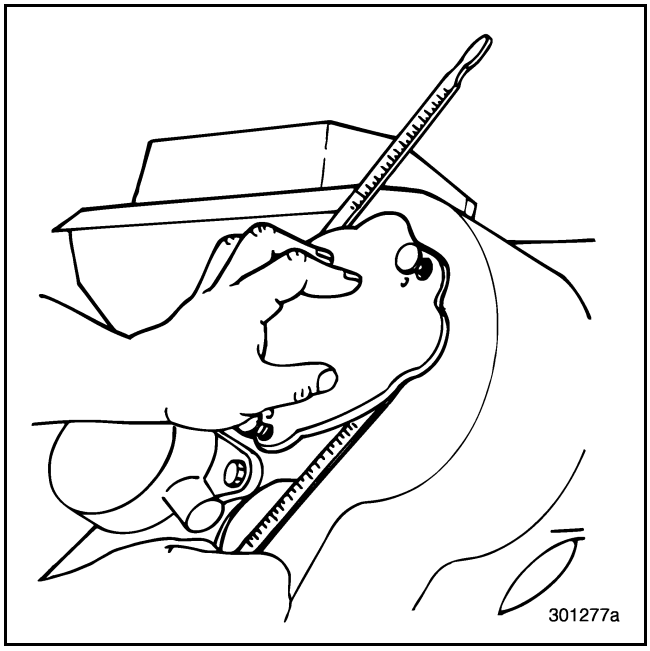


Figure 557 — Measuring with Tapered Feeler Gauges

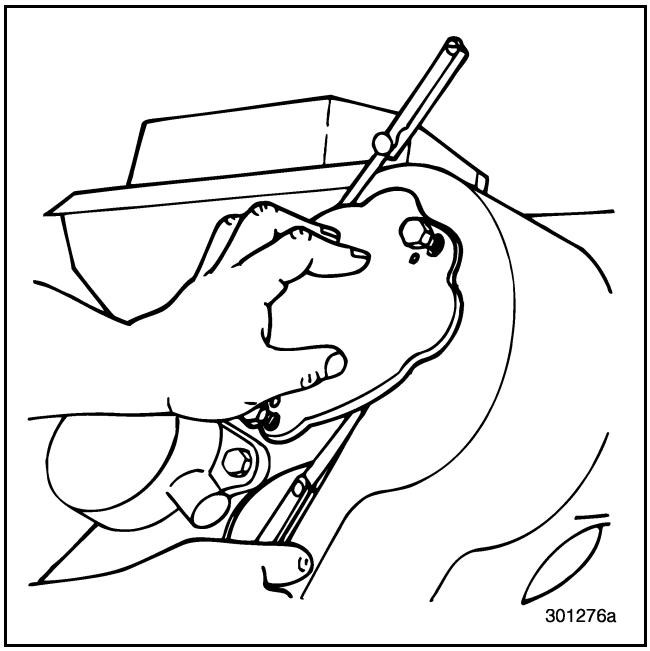


Figure 558 — Measuring with Standard Feeler Gauges

63. For each countershaft, remove the bearing cover and add enough shims to bring the space under the bearing cover to zero. Then remove enough shim thickness to obtain the required 0.002 to 0.006 inch preload.

    Example:

    a. Begin the procedure using no shims or O-rings under the cover.

    b. Measure the space under the cover. For this example, the space is 0.100 inch.

    c. A 0.100-inch shim pack is needed to fill the measured space.

    d. Remove (subtract) 0.002 to 0.006 inch shims from the pack to obtain the specified preload.

    e. To obtain the required 0.002 to 0.006 inch preload, final shim pack thickness must be 0.094 to 0.098 inch for this example.

NOTE

Preload is “negative end play” or “crush.” It cannot be measured directly. Determining shim thickness must be done carefully, as described, to obtain the correct preload on the bearings.

64. When all shim packs have been determined, install the rear compound countershaft bearing covers, shim packs, O-rings and cover capscrews. Then tighten the capscrews to the specified torque. Use **new** O-rings when installing the covers.

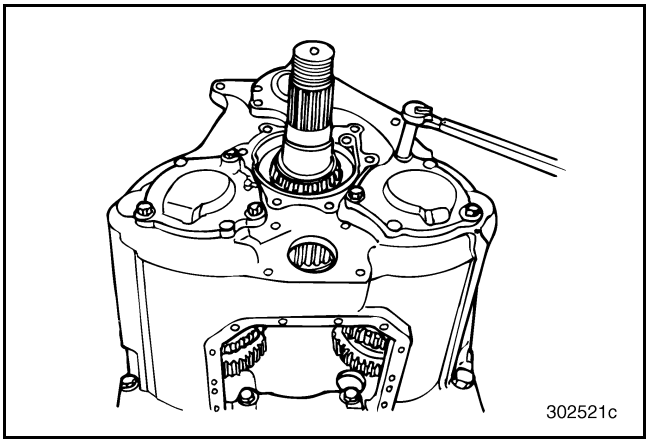


Figure 559 — Tightening Rear Countershaft Bearing Cover Capscrews (T313L21/T318L21 Shown)

65. For the conventional output shaft transmissions: T313–T318(L)(LR), install a **new** gasket onto the rear mainshaft bearing cover. Note the location of the lubrication hole.

66. On the conventional output shaft transmissions: T313–T318(L)(LR), install the rear mainshaft bearing cover assembly to the rear case and secure with capscrews. Tighten the capscrews to the specified torque.

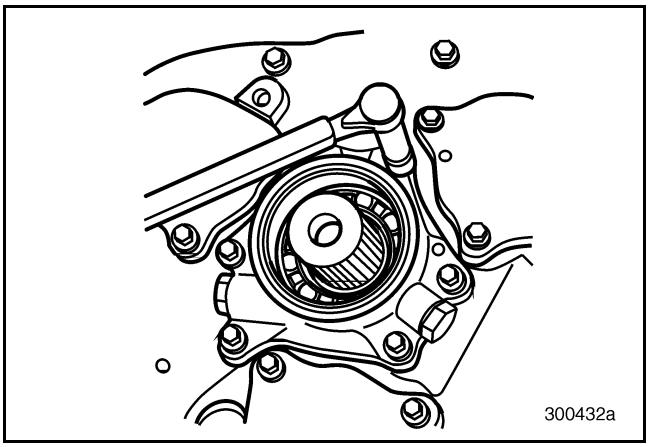


Figure 560 — Installing Rear Mainshaft Bearing Cover Assembly and Tightening Capscrews (T313LR/T318LR Shown)

67. For the extended output shaft transmissions: T313–T318(21)(L21)(LR21), install a **new** gasket onto the output housing and then install the housing onto the rear case. Note the location of the lubrication hole.

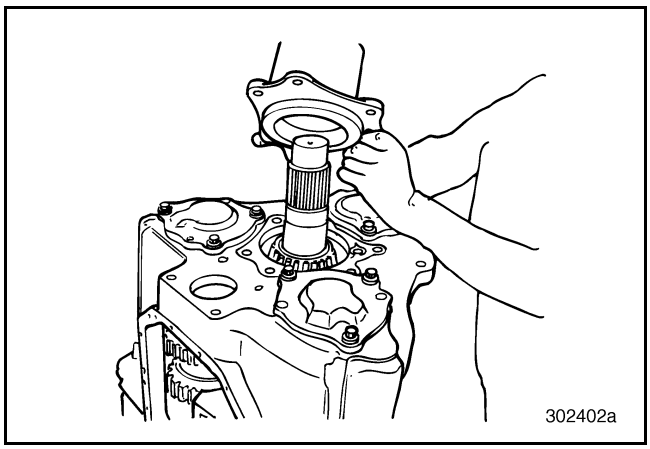


Figure 561 — Installing Output Housing (T313L21/T318L21 Shown)

68. Install and tighten the output housing capscrews to the recommended torque specification.

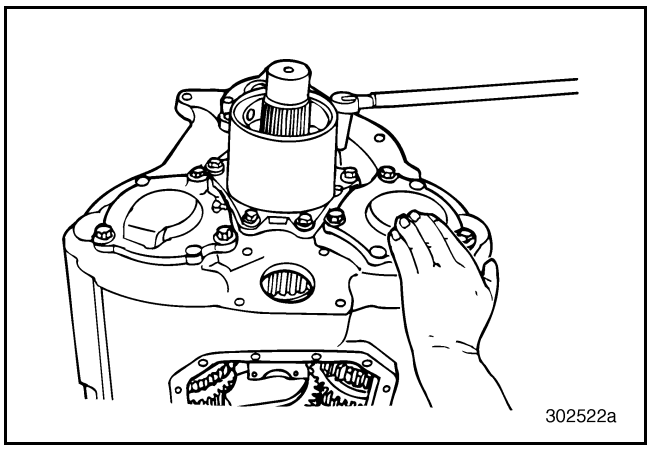


Figure 562 — Tightening Output Housing Capscrews (T313L21/T318L21 Shown)

69. On the extended output shaft transmissions: T313–T318(21)(L21)(LR21), install the collapsible-type spacer (the correct length of the spacer was previously determined in “Rear Output Housing Reassembly: T313–T318(21)(L21)(LR21)” on page 142). Also install the outer bearing cone into the output housing over the output shaft.

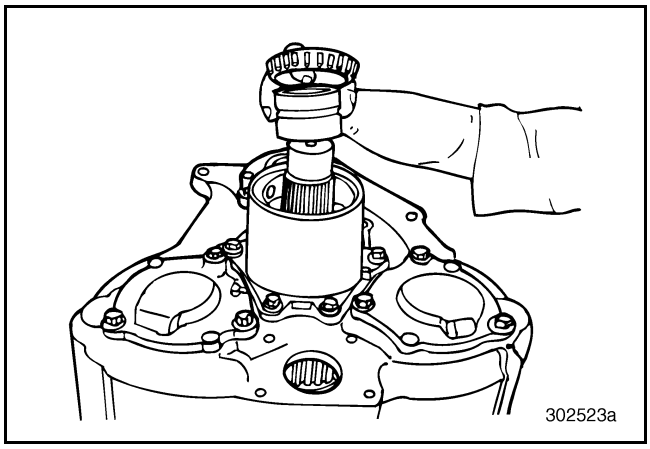


Figure 563 — Installing Spacer and Outer Bearing Cone (T313L21/T318L21 Shown)

70. Seat the outer bearing cone and spacer, using a blunt punch and hammer. Working in a circular motion, tap lightly around the inner race of the bearing cone only.

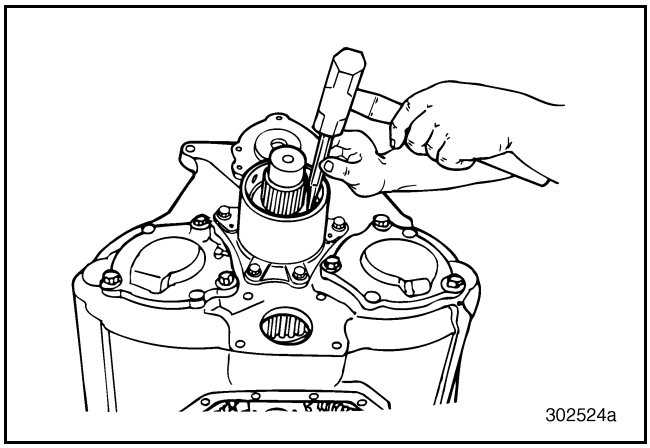


Figure 564 — Seating the Bearing Cone and Spacer (T313L21/T318L21 Shown)

71. For the extended output housing transmissions: T313–T318(21)(L21)(LR21), install a **new** output housing oil seal. Lightly tap the seal into place using a broad, flat-faced hammer until the seal is seated in the housing bore. Refer to “Oil Seals” on page 127 for seal installation and precautions.

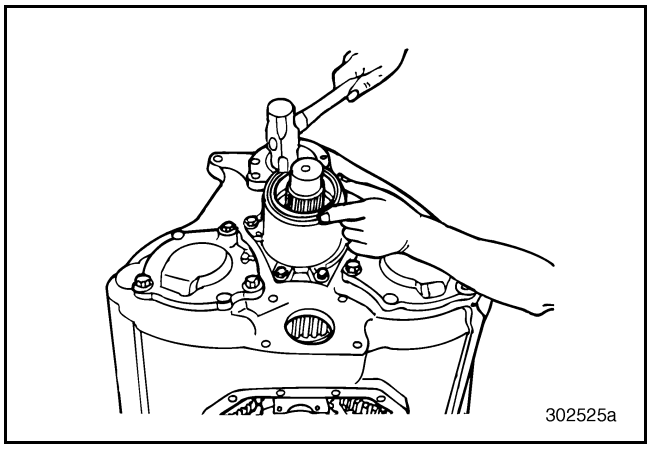


Figure 565 — Installing Output Housing Oil Seal (T313L21/T318L21 Shown)

72. Install the drive yoke (flange) and retaining nut on the extended output shaft transmissions: T313–T318(21)(L21)(LR21).

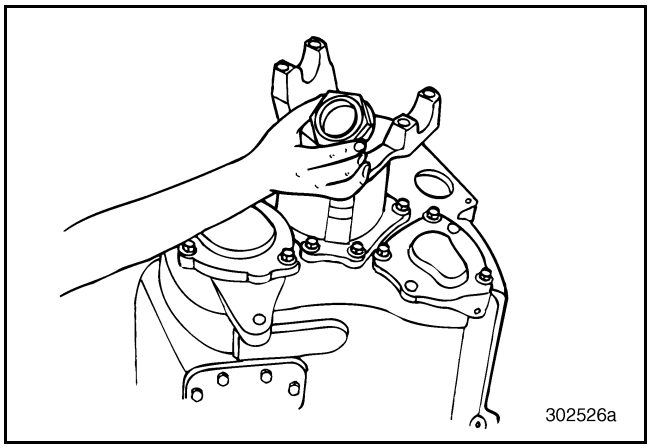


Figure 566 — Installing Drive Yoke and Nut (T313L21/T318L21 Shown)

73. For the conventional output shaft transmissions: T313–T318(L)(LR), install the drive yoke, clamp plate and retaining capscrew onto the rear mainshaft.

SERVICE HINT

To tighten the drive yoke retaining nut on the extended output shaft transmission or the drive yoke clamp plate capscrew for the conventional output shaft transmission, place at least two gears in both the main case and the rear case into engagement. This is done to lock the gearing and prevent it from rotating while tightening the yoke retaining nut or clamp plate capscrew.

74. Reach into the rear case top opening and verify that the splitter sliding clutch and synchronizer assembly sliding clutch are both engaged at the same time with the Hi-range/Hi-split gear.

75. Reach into the main case top opening and move at least two sliding clutches into engagement. This locks up the gearing to prevent it from turning while tightening the drive yoke retaining nut or clamp plate capscrew.

76. Tighten the applicable drive yoke retaining nut or clamp plate capscrew to the specified torque. When finished, make sure all gear sliding clutches and the compound sliding clutches are returned to the normal neutral positions.

NOTE

Effective June 2007, drive yoke clamp plate capscrews were changed to a Scotch-Grip™ torque retention method. DO NOT reuse these fasteners, as they are one-time use only.

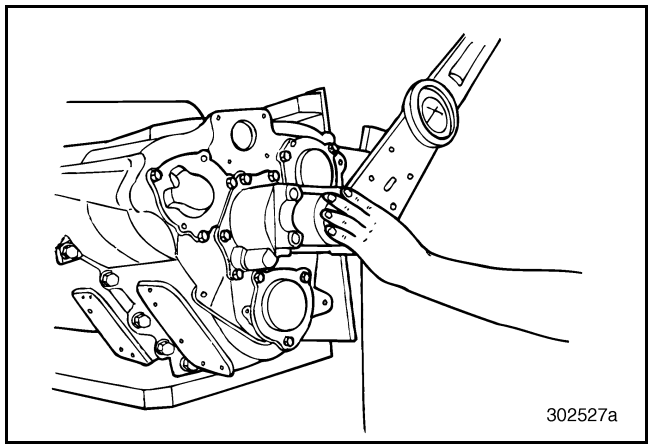


Figure 567 — Torquing Drive Yoke Nut (T313L21/T318L21 Shown)

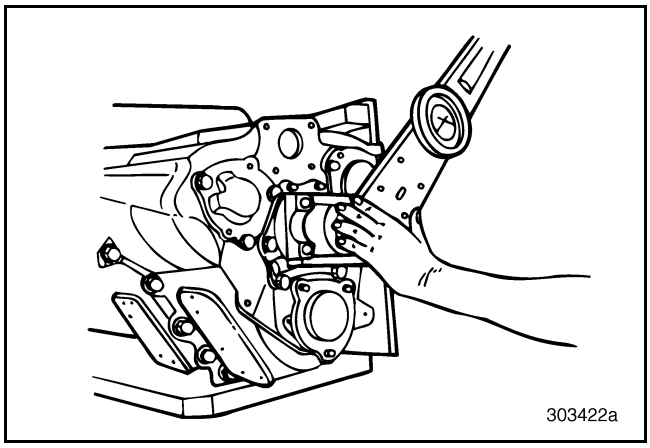


Figure 568 — Tightening Clamp Plate Capscrew (T313LR/T318LR Shown)

77. Make sure the synchronizer sliding clutch is in the neutral position. Install the range shift fork into the case and engage the fork onto the sliding clutch. The straight side of the fork (1) faces the front and the angled side of the fork (2) faces the rear.

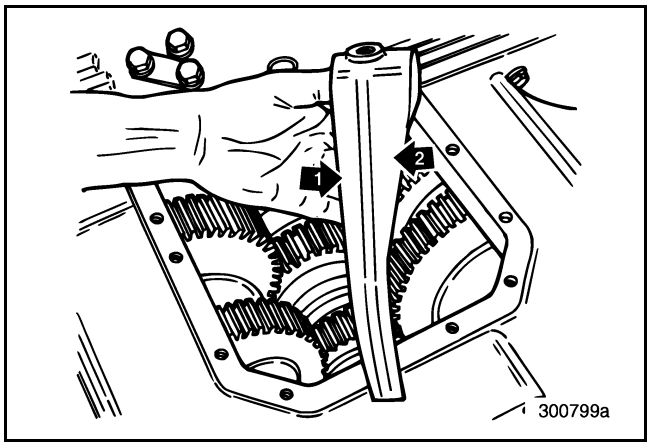


Figure 569 — Installing Range Shift Fork

78. Install the range shift cylinder into the rear case. Line up the shift fork with the shift rail as the cylinder is installed. Install the cylinder so that the breather vent is facing down and the air port is facing up.

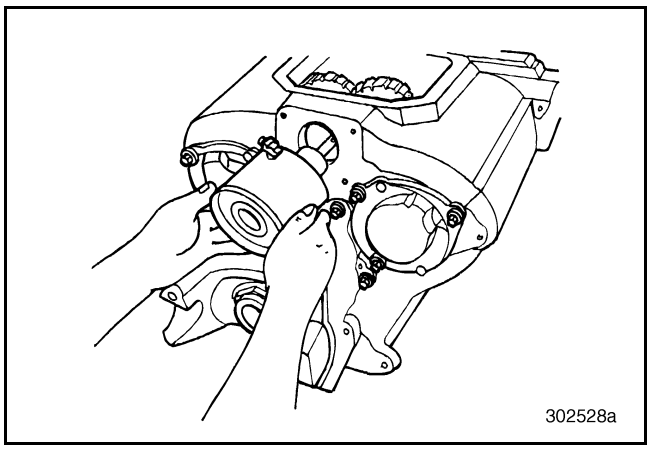


Figure 570 — Installing Range Shift Cylinder

NOTE

The two-position (compound non-neutralizing) range shift cylinder also requires the installation of a gasket before the cylinder can be installed. This gasket must be installed with the red silicone bead of the gasket facing the transmission case as shown in Figure 571.

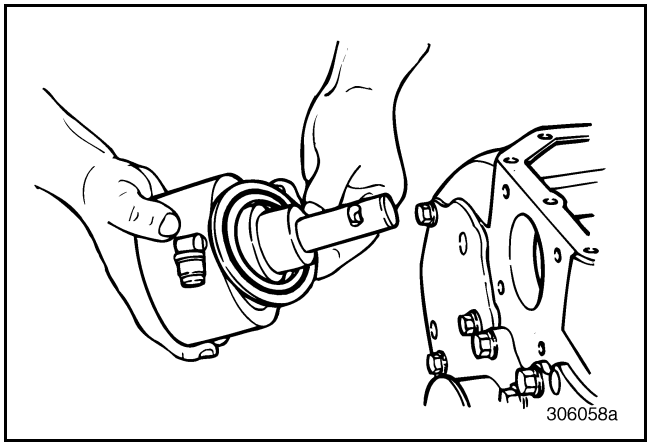


Figure 571 — Installing Shift Cylinder Gasket

79. Install the range shift cylinder cover, capscrews and **new** O-ring. Be sure O-ring is properly in position as cover is installed.

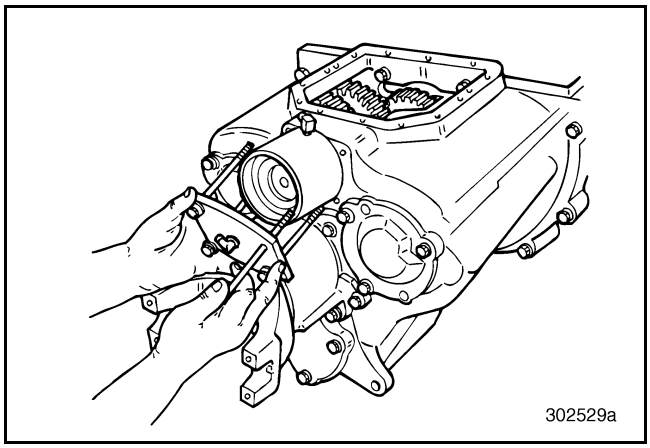


Figure 572 — Installing Range Shift Cylinder, Capscrews, Cover and O-Ring

80. Tighten the range shift cylinder cover capscrews to the specified torque.

⚠ CAUTION

Do not overtighten the four long capscrews that hold the range shift cylinder and cover to the rear case. Overtightening can cause the rear cover to bend.

81. Align the setscrew in the shift fork with the setscrew hole in the shift rail. Tighten the setscrew to the specified torque.

NOTE

Effective June 2007, shift fork setscrews were changed to a Scotch-Grip™ torque retention method. DO NOT reuse these fasteners, as they are one-time use only.

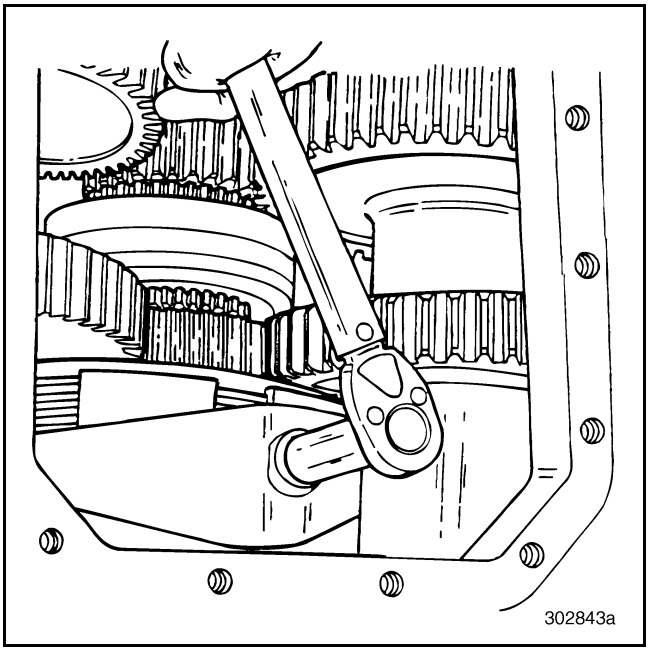


Figure 573 — Tightening Shift Fork Setscrew

82. Clean the gasket or sealant surface of the rear case shift cover.
83. Make sure that the sliding clutch next to the rear compound Lo-split gear is placed in the neutral position.
84. Install a **new** rear case shift cover gasket. Use a small amount of adhesive or grease to hold it in place. Apply sealant to the shift cover sealing surface of the case.

85. Install the rear case shift cover, lift bracket and cover capscrews. Make sure to align the shift fork with the sliding clutch. Tighten the capscrews to the specified torque.

NOTE

The lift bracket capscrews are slightly longer than the remainder of the shift cover capscrews. Make sure the longer capscrews are used to secure the lift bracket. The lift bracket is placed at the right rear corner of the shift cover.

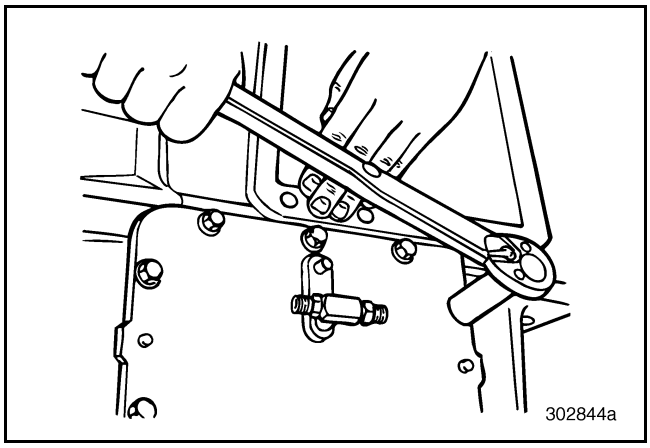


Figure 574 — Tightening Rear Case Shift Cover Capscrews

86. Clean the gasket or sealant surface of the main case shift cover.
87. Install a **new** main case shift cover gasket. Use a small amount of adhesive or grease to hold it in place.
88. Make sure the shift forks on the cover and the sliding clutches on the mainshaft are in the neutral position for proper alignment.
89. Align the shift forks with the sliding clutches and install the main case shift cover.

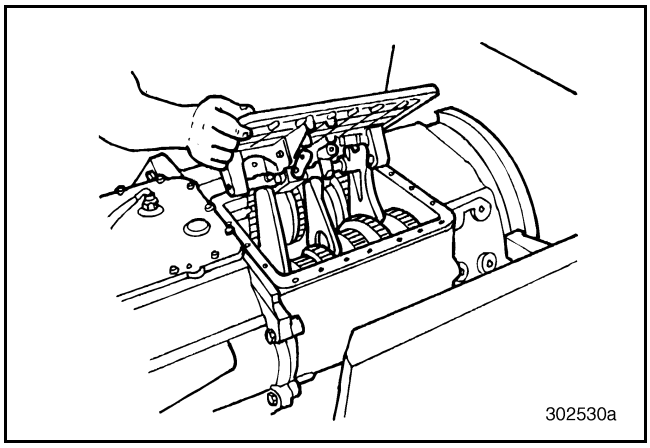


Figure 575 — Installing Main Case Shift Cover Assembly

90. Install the main case shift cover and lift bracket capscrews and tighten to the specified torque. Install the lifting bracket and longer capscrews at the left front corner of the main case shift cover as shown.

NOTE

The lift bracket capscrews are slightly longer than the remainder of the shift cover capscrews. Make sure the longer capscrews are used to secure the lift bracket.

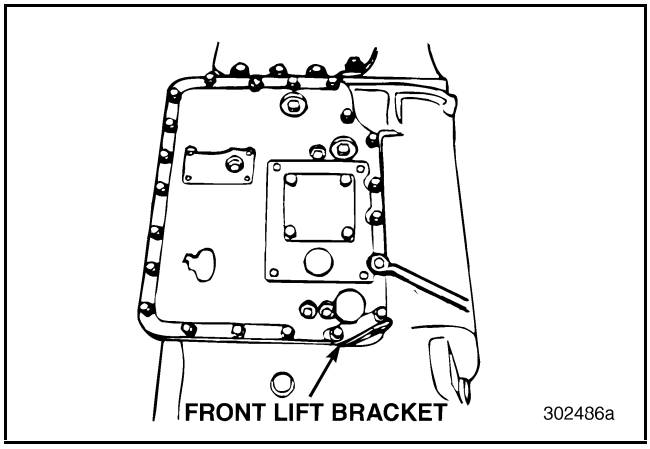


Figure 576 — Tightening Main Case Shift Cover Capscrews

SERVICE HINT

On the very rare occasion of clutch tooth contact, the noncurrent eccentric pivot pin, which is available for service should be installed. Adjustment of the eccentric pivot is as follows:

a. Loosen the locknut on the eccentric pin. While rotating the transmission input shaft by hand, adjust the eccentric pin until gear clash occurs. Note the position of the eccentric pin.

b. Turn the eccentric pin in the other direction until gear clash occurs again and note the position of the eccentric pin.

c. Return the eccentric pin to a point midway between the two positions.

d. Tighten the locknut to 54–68 N•m (40–50 lb-ft).

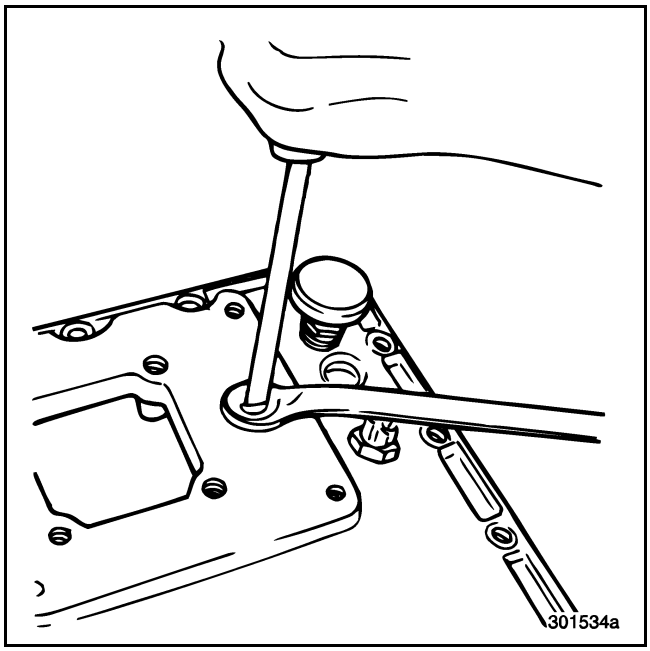


Figure 577 — Adjusting Eccentric Pin

91. Install the interlock O-ring, pin, spring and sleeve into the main case shift cover.

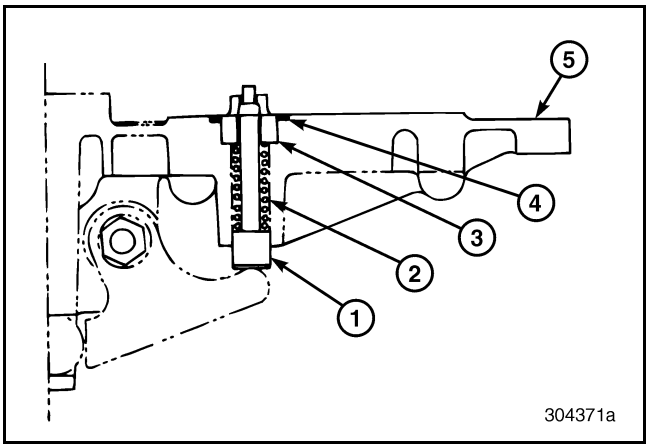


Figure 578 — Range Shift Interlock

1. Interlock Pin 2. Interlock Spring 3. Interlock Sleeve	4. O-Ring 5. Main Case Shift Cover (For Reference)

92. Position the range shift valve over the tip of the interlock pin. Install the two (outer) Allen-head 5/32-inch screws and torque to specification.

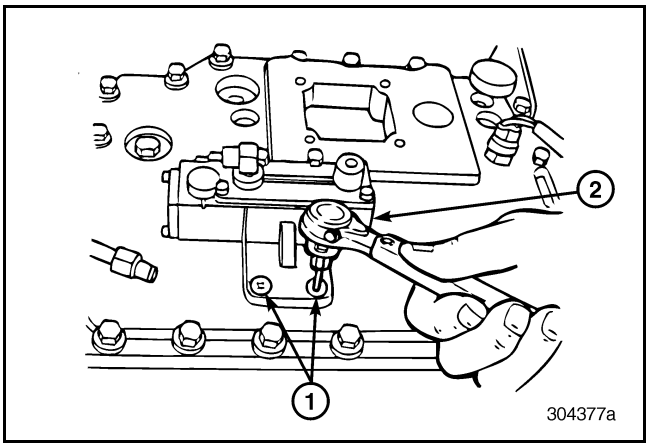


Figure 579 — Tightening Range Shift Interlock Valve Screws

1. Allen-Head Screws (5/32 inch)	2. Range Shift Valve

93. Install the two (inner) hex-head screws and torque to specification.

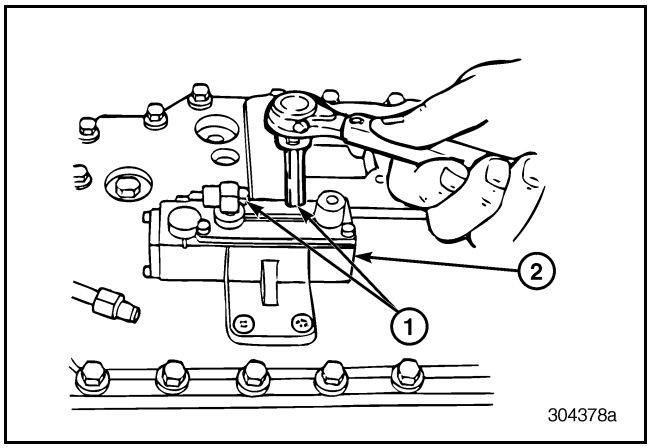


Figure 580 — Tightening Remaining Range Shift Valve Screws

1. Hex-Head Screws	2. Range Shift Valve

94. Reconnect the air lines attached to all transmission valves, range shift cylinder and the rear case shift cover. Install air line by holding approximately 152 mm (6 inches) away from air fitting. Insert hose straight into fitting until seated. Slightly tug on hose to ensure it is seated.

NOTE

Refer to the air piping diagrams in “T313–T318(L)(LR)(21)(L21)(LR21) Air Control without Compound Neutralizing for PTO Operation” on page 240 or “T313–T318(L)(LR)(21)(L21)(LR21) Air Control with Compound Neutralizing for PTO Operation” on page 242.

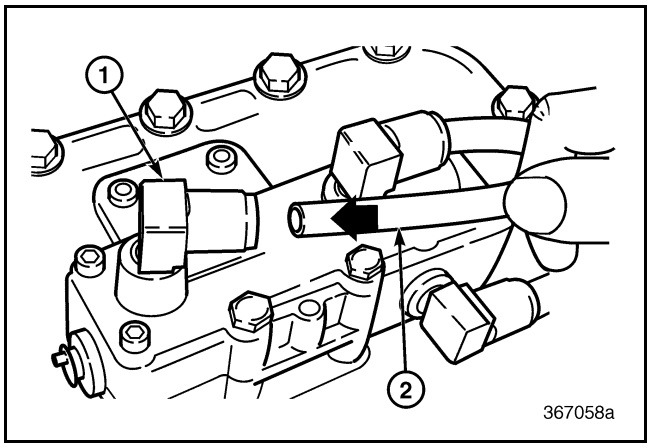


Figure 581 — Installing Air Line

1. Air Line Fitting	2. Air Hose

95. Install the transmission drain plug and magnetic filter plug and torque to specification.

96. Install the clutch release bearing assembly, shafts, yoke and clutch brake (if equipped).

97. Reinstall the transmission into the chassis of the vehicle.

98. Following installation of the transmission into the chassis, remove the oil filler plug. Fill the unit to the proper oil level, using the recommended lubricant. Add lubricant until even with the bottom of the fill hole. Refer to “Transmission Specifications and Capacities” on page 237 in the SPECIFICATIONS section.

99. Allow time for distribution of the lubricant. Then check the level again.

100. Install and tighten the filler plug to specification of 41–48 N•m (30–35 lb-ft).

⚠ CAUTION

DO NOT exceed 48 N•m (35 lb-ft) as the plug can seize, resulting in damage to the transmission case when attempting to remove the plug.

RANGE SHIFT VALVE CHECK

101. Reconnect all remaining air lines and gear shift linkage/gearshift lever.

102. Check range shift valve operation to make sure that the compound range shift does not occur without being in neutral.

SPECIFICATIONS

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TRANSMISSION SPECIFICATIONS

Torque Specifications, T313–T318(L)(LR)

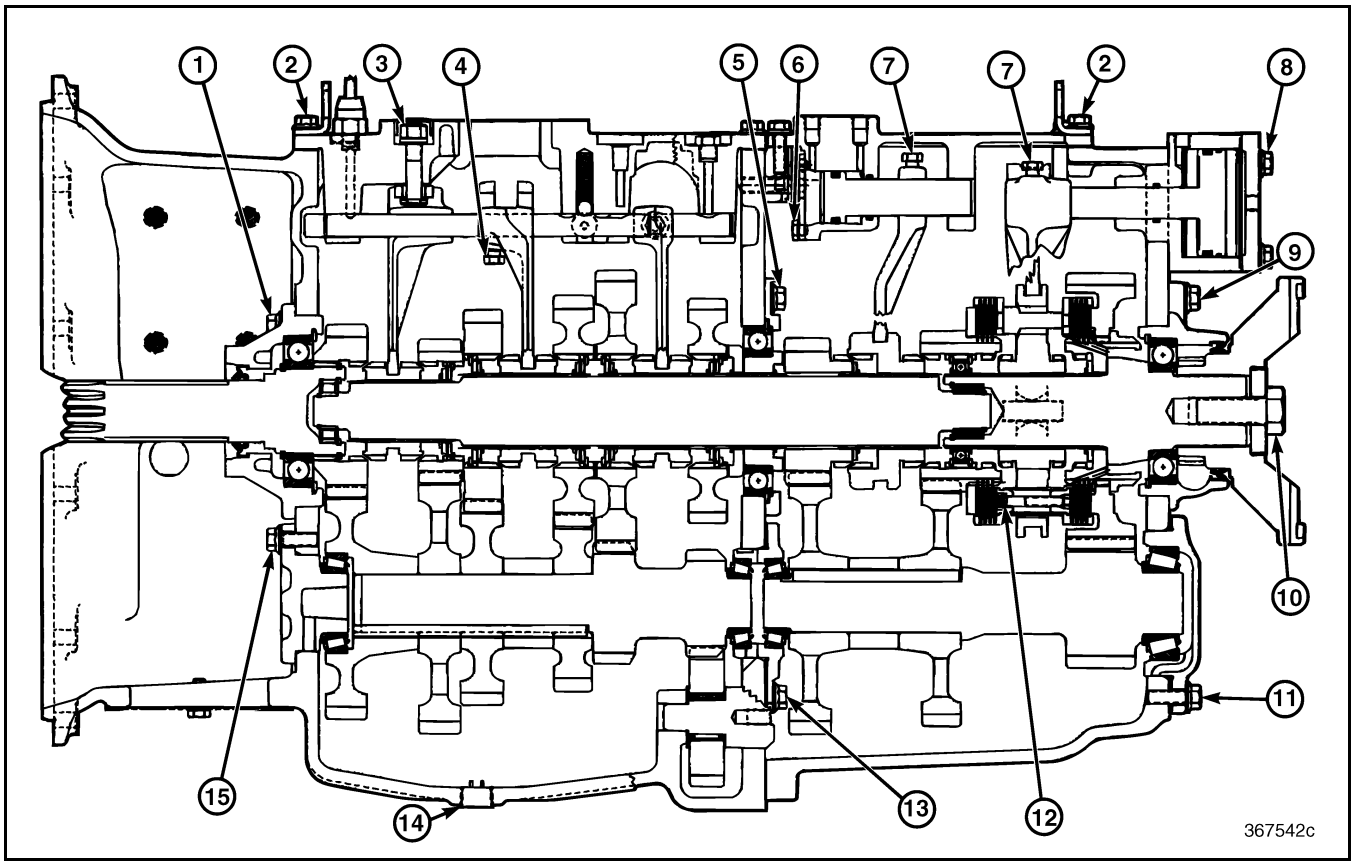


Figure 582 — Torque Specifications (T313L/T318L Shown)

SPECIFICATIONS

Item and Location	Torque — N•m (Lb-Ft)
1. Main Drive Pinion Bearing Cover Capscrews*	49–73 (36–54)
2. Shift Cover Capscrews (Main Case/Rear Case)*	33–49 (24–36)
3. Third/Fourth Pivot Pin Locknut	54–68 (40–50)
4. Shifter and Shift Fork Setscrews**	47–68 (35–50)
5. Front Mainshaft Rear Bearing Cover Capscrews	54–68 (40–50)
6. Splitter Shift Piston Cover Capscrews	23–28 (17–21)
7. Splitter and Range Shift Fork Setscrews**	35–50 (47–68)
8. Rear Mainshaft Bearing Cover Capscrews*	54–68 (40–50)
9. Range Shift Cylinder Cover Capscrews	37–45 (27–33)
10. Drive Flange (or Yoke) Clamp Plate Capscrew**	670–814 (494–600)
11. Rear Countershaft Bearing Cover Capscrews*	54–68 (40–50)
12. Synchronizer Special 12-Point Screws (Quantity 3)**	33–38 (24–28)
13. Front Countershaft Rear Bearing Cover Capscrews	49–73 (36–54)
14. Drain Plug	34–41 (25–30)
15. Front Countershaft Front Bearing Cover Capscrews*	49–73 (36–54)
— Main Case-to-Rear Case Capscrews	84–106 (62–78)
— Main Case-to-Rear Case Dowel Bolts	75–88 (55–65)
— Oil Filler Plug	41–48 (30–35)
— Magnetic Oil Filter Plug	27–31 (20–23)
— Range Shift Piston-to-Rail Retaining Nut (Compound Neutralizing Only)	102–142 (75–105)
— Range Shift Interlock Rocker Nut	27–34 (20–25)
— Range Shift Valve Mounting Screws (Two Hex, Two Allen)	9–11 (84–96 lb-in)
— Range Shift Valve Top Cover Screws	3.4–4.5 (30–40 lb-in)
— Double Check Valve Mounting Screws (Air Piping for Compound Neutralizing)	9–11 (84–96 lb-in)

* Indicates that fastener has epoxy-coated threads. Fastener can be reused a maximum of five times.

** Indicates that fastener utilizes Scotch-Grip™ as torque retention. Do not reuse these fasteners, one-time use only.

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Torque Specifications, T313–T318(21)(L21)(LR21)

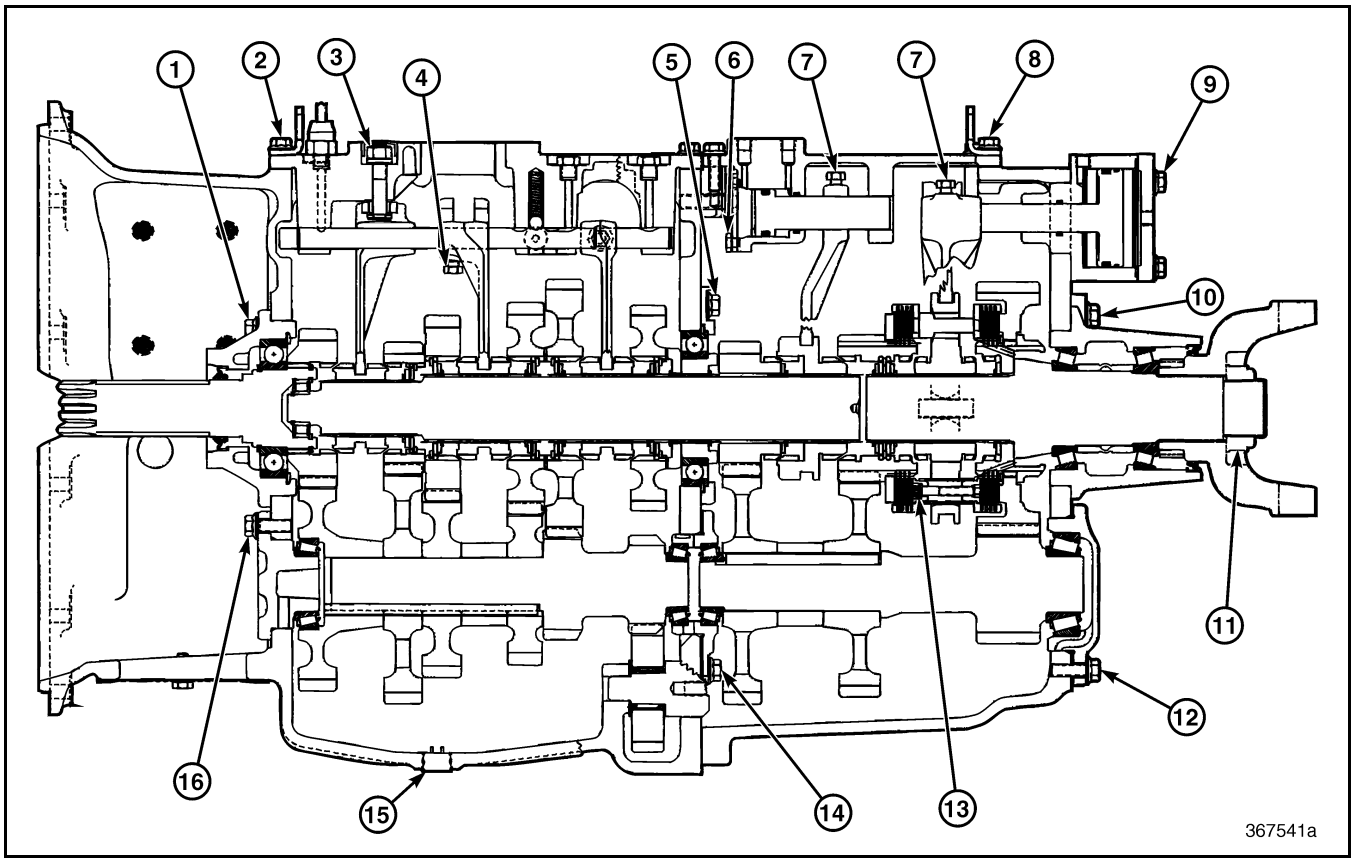


Figure 583 — Torque Specifications (T313L21/T318L21 Shown)

SPECIFICATIONS

Item and Location	Torque — N•m (Lb-Ft)
1. Main Drive Pinion Bearing Cover Capscrews*	49–73 (36–54)
2. Main Case Shift Cover Capscrews*	33–49 (24–36)
3. Third/Fourth Pivot Pin Locknut	54–68 (40–50)
4. Shifter and Shift Fork Setscrews**	47–68 (35–50)
5. Front Mainshaft Rear Bearing Cover Screws	54–68 (40–50)
6. Splitter Shift Piston Cover Capscrews	23–28 (17–21)
7. Splitter and Range Shift Fork Setscrews**	47–68 (35–50)
8. Rear Case Shift Cover Capscrews*	24–36 (33–49)
9. Range Shift Cylinder Cover Capscrews*	27–33 (37–45)
10. Mainshaft Output Housing Capscrews*	54–68 (40–50)
11. Drive Yoke Nut***	600–670 (450–500)
12. Rear Countershaft Bearing Cover Capscrews*	54–68 (40–50)
13. Synchronizer Special 12-Point Screws (Quantity 3)**	33–38 (24–28)
14. Main Case Countershaft Rear Bearing Cover Capscrews*	49–73 (36–54)
15. Drain Plug	34–41 (25–30)
16. Front Countershaft Front Bearing Cover Capscrews*	49–73 (36–54)
— Main Case-to-Rear Case Capscrews	84–106 (62–78)
— Main Case-to-Rear Case Dowel Bolts	75–88 (55–65)
— Oil Filler Plug	41–48 (30 –35)
— Magnetic Oil Filter Plug	27–31 (20–23)
— Range Shift Piston-to-Rail Retaining Nut (Compound Neutralizing Only)	102–142 (75–105)
— Range Shift Interlock Rocker Nut	27–34 (20–25)
— Range Shift Valve Mounting Screws (Two Hex, Two Allen)	9–11 (84–96 lb-in)
— Range Shift Valve Top Cover Screws	3.4–4.5 (30–40 lb-in)
— Double Check Valve Mounting Screws (Air Piping for Compound Neutralizing)	9–11 (84–96 lb-in)

* Indicates that fastener has epoxy-coated threads. Fastener can be reused a maximum of five times.

** Indicates that fastener utilizes Scotch-Grip™ as torque retention. Do not reuse these fasteners, one-time use only.

*** Indicates drive yoke nut has self-locking feature. Nut can be reused three times.

Gear Identification, T313–T318(21)

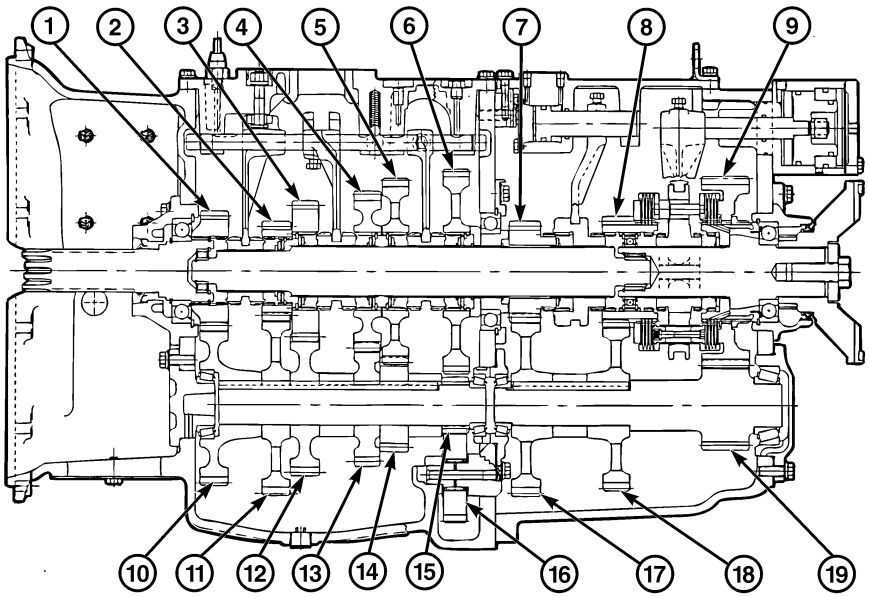


Figure 584 — Gear Identification (T313/T318 Shown)

SPECIFICATIONS

T313/T318			T31321/T31821		
Mainshaft Gear (Main Box)	**Number of Teeth**	**Outside Diameter**	**Mainshaft Gear (Main Box)**	**Number of Teeth**	**Outside Diameter**
1. Main Drive Pinion (3rd/7th)	33	5.633	1. Main Drive Pinion (3rd/7th)	33	5.633
2. 4th/8th Speed Gear	27	4.692	2. 4th/8th Speed Gear	27	4.692
3. 2nd/6th Speed Gear	39	6.603	3. 2nd/6th Speed Gear	39	6.603
4. 1st/5th Speed Gear	45	7.539	4. 1st/5th Speed Gear	45	7.539
5. Lo-Speed Gear	48	8.712	5. Lo-Speed Gear	48	8.712
6. Reverse Speed Gear	42	7.305	6. Reverse Speed Gear	42	7.305
Mainshaft Gear (Compound)			**Mainshaft Gear (Compound)**		
7. Lo-Split Gear	27	4.754	7. Lo-Split Gear	27	4.754
8. Hi-Range/Hi-Split Gear	30	5.204	8. Hi-Range/Hi-Split Gear	30	5.204
9. Lo-Range Gear	54	8.996	9. Lo-Range Gear	54	8.996
Countershaft Gear (Main Box)			**Countershaft Gear (Main Box)**		
10. Main Drive Gear	47	7.583	10. Main Drive Gear	47	7.583
11. 4th/8th Speed (PTO) Gear	54	8.514	11. 4th/8th Speed (PTO) Gear	54	8.514
12. 2nd/6th Speed Gear	40	6.641	12. 2nd/6th Speed Gear	40	6.641
13. 1st/5th Speed Gear	33	5.757	13. 1st/5th Speed Gear	33	5.757
14. Lo-Speed Gear	23	4.375	14. Lo-Speed Gear	23	4.375
15. Reverse Speed (Part of Shaft)	17	3.495	15. Reverse Speed Gear	17	3.495
16. Reverse Idler Gear	24	4.520	16. Reverse Idler Gear	24	4.520
Countershaft Gear (Compound)			**Countershaft Gear (Compound)**		
17. Lo-Split Gear	52	8.519	17. Lo-Split Gear	52	8.519
18. Hi-Range/Hi-Split Gear	49	8.001	18. Hi-Range/Hi-Split Gear	49	8.001
19. Lo-Range Gear (Part of Shaft)	23	4.205	19. Lo-Range Gear (Part of Shaft)	23	4.205

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Gear Identification, T313–T318(L)(LR)

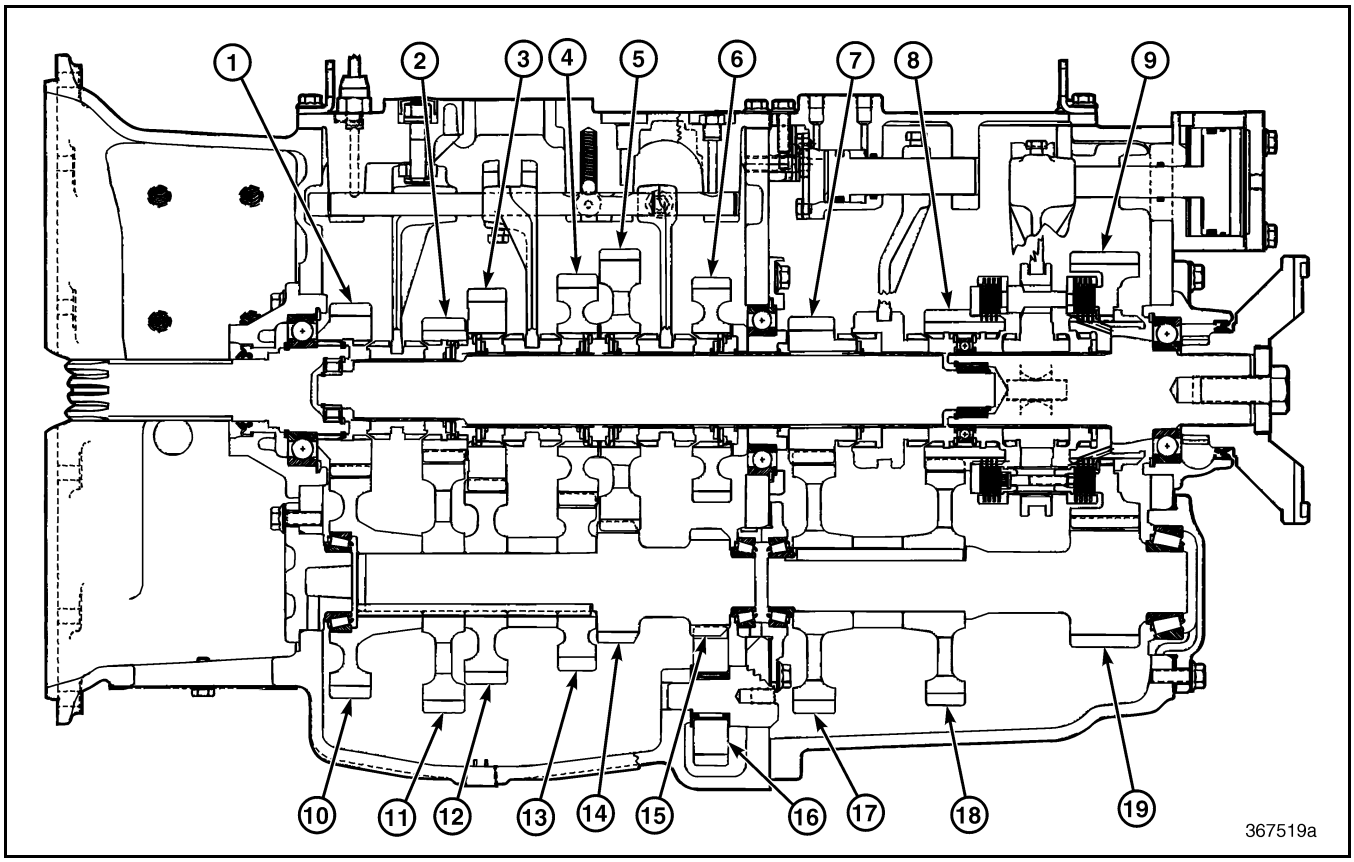


Figure 585 — Gear Identification (T313L/T318L Shown)

SPECIFICATIONS

T313–T318(L)			T313–T318(LR)		
Mainshaft Gear (Main Box)	**Number of Teeth**	**Outside Diameter**	**Mainshaft Gear (Main Box)**	**Number of Teeth**	**Outside Diameter**
1. Main Drive Pinion (3rd/7th)	33	5.633	1. Main Drive Pinion (3rd/7th)	33	5.633
2. 4th/8th Speed Gear	27	4.692	2. 4th/8th Speed Gear	27	4.692
3. 2nd/6th Speed Gear	39	6.603	3. 2nd/6th Speed Gear	39	6.603
4. 1st/5th Speed Gear	45	7.539	4. 1st/5th Speed Gear	45	7.539
5. Lo-Speed Gear	51	9.158	5. Lo-Speed Gear	51	9.156
6. Reverse Speed Gear	42	7.305	6. Reverse Speed Gear	54	9.601
Mainshaft Gear (Compound)			**Mainshaft Gear (Compound)**		
7. Lo-Split Gear	27	4.754	7. Lo-Split Gear	27	4.754
8. Hi-Range/Hi-Split Gear	30	5.204	8. Hi-Range/Hi-Split Gear	30	5.204
9. Lo-Range Gear	54	8.996	9. Lo-Range Gear	54	8.996
Countershaft Gear (Main Box)			**Countershaft Gear (Main Box)**		
10. Main Drive Gear	47	7.583	10. Main Drive Gear	47	7.583
11. 4th/8th Speed (PTO) Gear	54	8.514	11. 4th/8th Speed (PTO) Gear	54	8.514
12. 2nd/6th Speed Gear	40	6.641	12. 2nd/6th Speed Gear	40	6.641
13. 1st/5th Speed Gear	33	5.757	13. 1st/5th Speed Gear	33	5.757
14. Lo-Speed Gear	20	3.954	14. Lo-Speed Gear	20	3.952
15. Reverse Speed (Part of Shaft)	17	3.495	15. Reverse Speed Gear	12	2.625
16. Reverse Idler Gear	24	4.520	16. Reverse Idler Gear	24	4.502
Countershaft Gear (Compound)			**Countershaft Gear (Compound)**		
17. Lo-Split Gear	52	8.519	17. Lo-Split Gear	52	8.519
18. Hi-Range/Hi-Split Gear	49	8.001	18. Hi-Range/Hi-Split Gear	49	8.001
19. Lo-Range Gear (Part of Shaft)	23	4.205	19. Lo-Range Gear (Part of Shaft)	23	4.205

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Gear Identification, T313–T318(L21)(LR21)

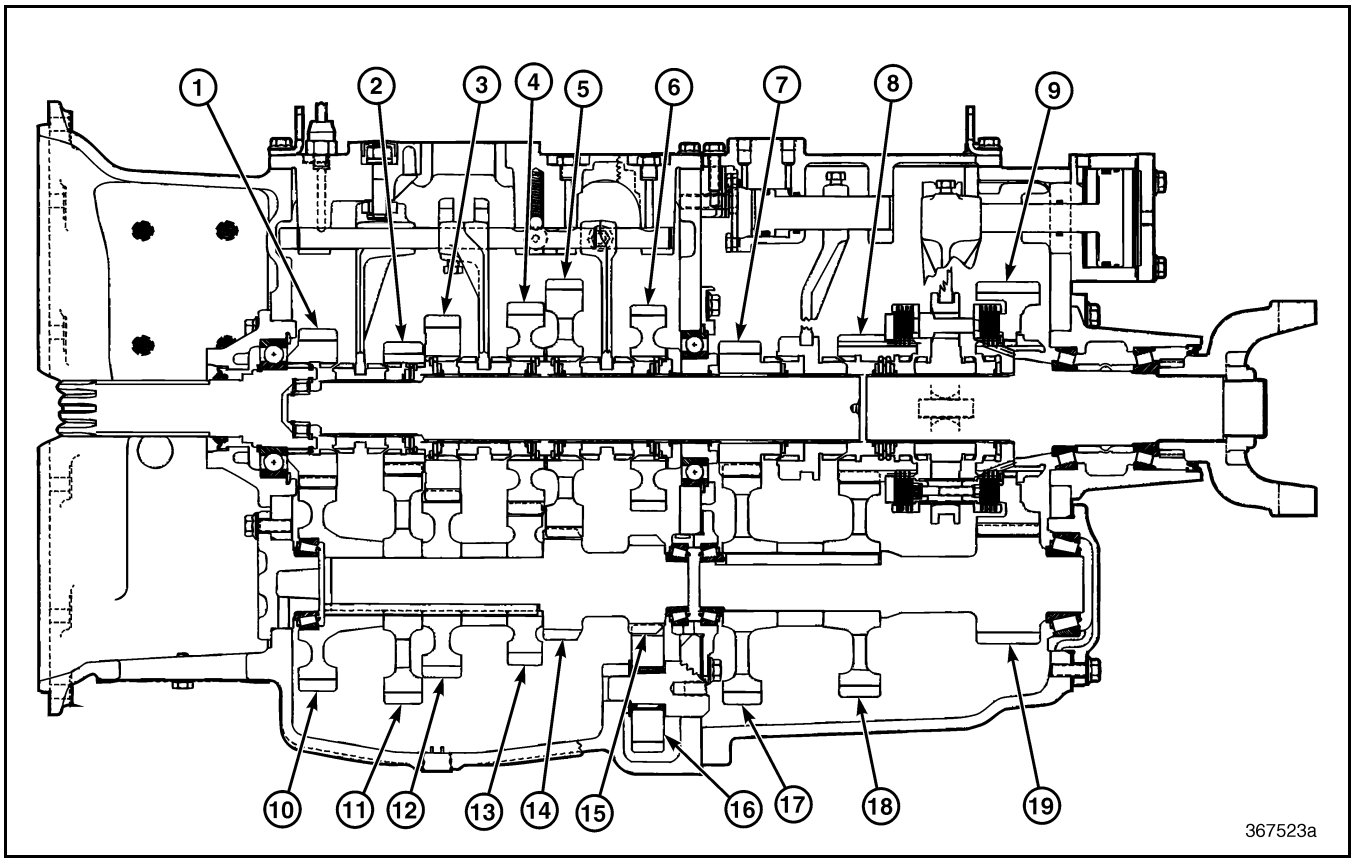


Figure 586 — Gear Identification (T313L21/T318L21 Shown)

SPECIFICATIONS

T313L21/T318L21			T313LR21/T318LR21		
Mainshaft Gear (Main Box)	**Number of Teeth**	**Outside Diameter**	**Mainshaft Gear (Main Box)**	**Number of Teeth**	**Outside Diameter**
1. Main Drive Pinion (3rd/7th)	33	5.633	1. Main Drive Pinion (3rd/7th)	33	5.633
2. 4th/8th Speed Gear	27	4.692	2. 4th/8th Speed Gear	27	4.692
3. 2nd/6th Speed Gear	39	6.603	3. 2nd/6th Speed Gear	39	6.603
4. 1st/5th Speed Gear	45	7.539	4. 1st/5th Speed Gear	45	7.539
5. Lo-Speed Gear	51	9.158	5. Lo-Speed Gear	51	9.156
6. Reverse Speed Gear	42	7.305	6. Reverse Speed Gear	54	9.601
Mainshaft Gear (Compound)			**Mainshaft Gear (Compound)**		
7. Lo-Split Gear	27	4.754	7. Lo-Split Gear	27	4.754
8. Hi-Range/Hi-Split Gear	30	5.204	8. Hi-Range/Hi-Split Gear	30	5.204
9. Lo-Range Gear	54	8.996	9. Lo-Range Gear	54	8.996
Countershaft Gear (Main Box)			**Countershaft Gear (Main Box)**		
10. Main Drive Gear	47	7.583	10. Main Drive Gear	47	7.583
11. 4th/8th Speed (PTO) Gear	54	8.514	11. 4th/8th Speed (PTO) Gear	54	8.514
12. 2nd/6th Speed Gear	40	6.641	12. 2nd/6th Speed Gear	40	6.641
13. 1st/5th Speed Gear	33	5.757	13. 1st/5th Speed Gear	33	5.757
14. Lo-Speed Gear	20	3.954	14. Lo-Speed Gear	20	3.952
15. Reverse Speed (Part of Shaft)	17	3.495	15. Reverse Speed Gear	12	2.625
16. Reverse Idler Gear	24	4.520	16. Reverse Idler Gear	24	4.520
Countershaft Gear (Compound)			**Countershaft Gear (Compound)**		
17. Lo-Split Gear	52	8.519	17. Lo-Split Gear	52	8.519
18. Hi-Range/Hi-Split Gear	49	8.001	18. Hi-Range/Hi-Split Gear	49	8.001
19. Lo-Range Gear (Part of Shaft)	23	4.205	19. Lo-Range Gear (Part of Shaft)	23	4.205

Fits and Limits

ALL FORKS AND SLIDING CLUTCHES

	Minimum New	Maximum New	Maximum Wear
1. Clearance between fork pad and clutch groove	0.005 inch	0.020 inch	0.050 inch*
2. Clearance between synchronizer shift fork pads and sliding clutch	0.073 inch	0.087 inch	0.135 inch
*If unit has experienced disengagement, clearance must not exceed 0.030-inch maximum.			

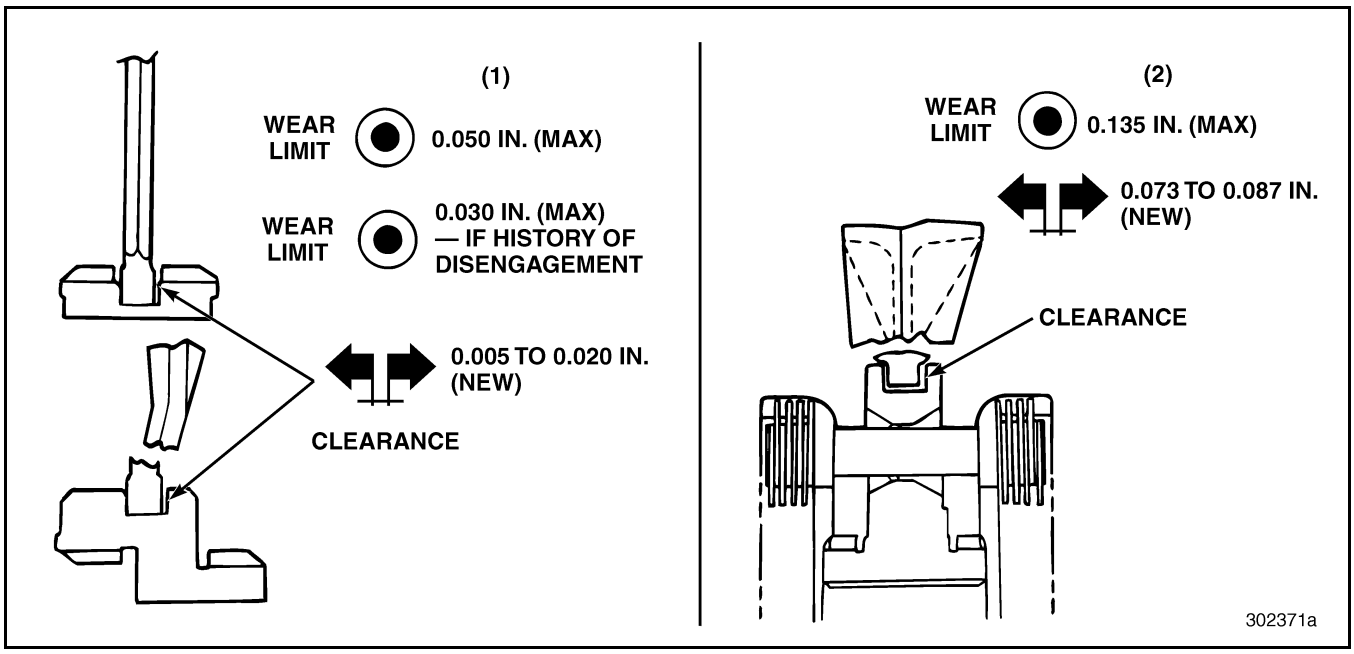


Figure 587 — Sliding Clutch Clearances

SPRING SPECIFICATIONS

SPRING SPECIFICATIONS

Springs	Free Length	Load	Length Under Load
Lo/Reverse Shifter Ball Spring	1.562 inches	41.8 ± 5 lbs.	0.875 inch
Lo/Reverse Shifter Plunger Spring	1.500 inches	22.0 ± 2 lbs.	0.625 inch
Shift Rail Poppet Ball Springs (3)	2.250 inches	25 ± 2.5 lbs.	1.539 inches
Range Shift Interlock Pin Spring	1.310 inches	18.7 lbs. 31.2 lbs.	1.120 inches 1.000 inch

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General Tolerances, T313–T318(L)(LR)

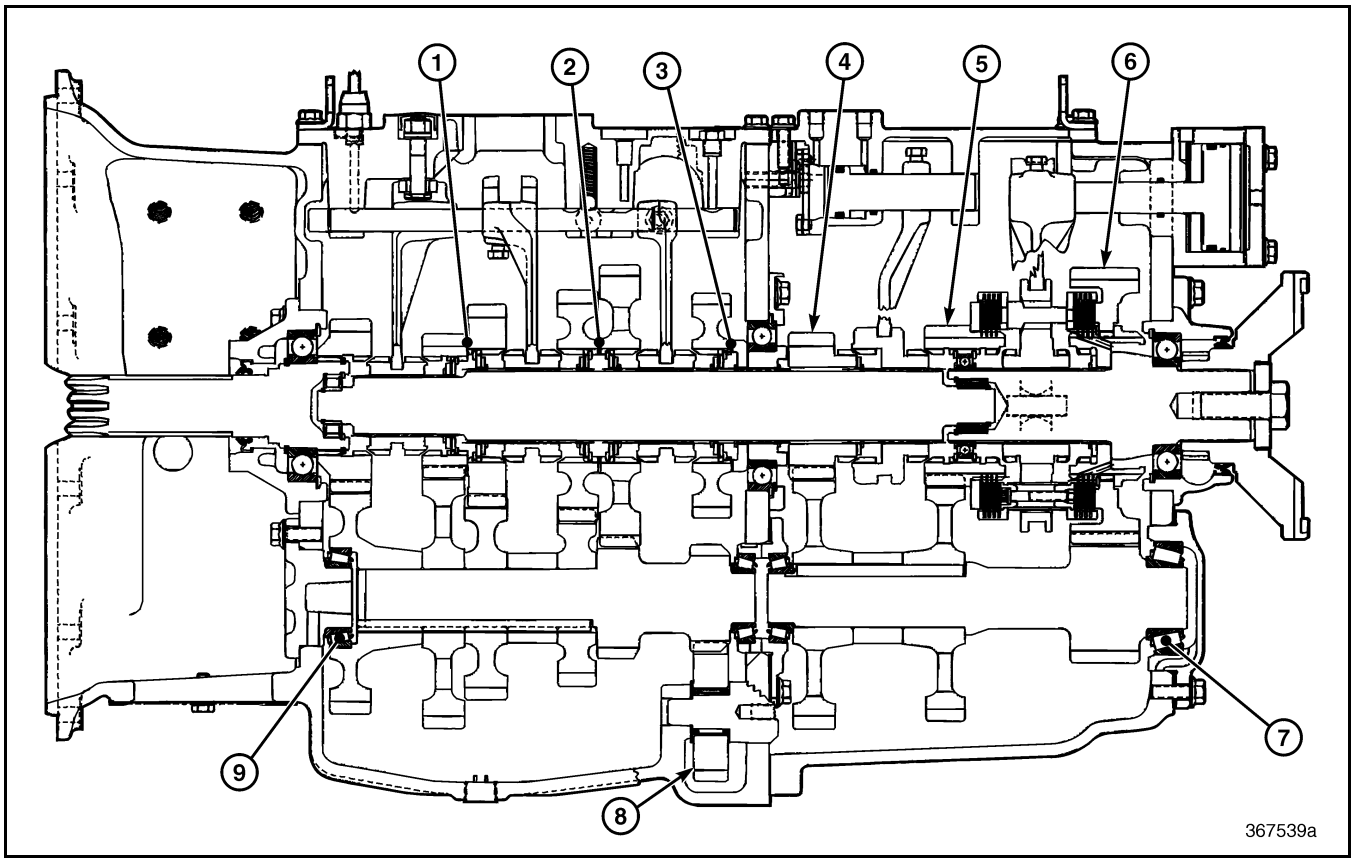


Figure 588 — Gear End Play and Bearing Preload (T313L/T318L Shown)

Component	Specification
1. Mainshaft 4th/8th-to-2nd/6th Speed Gear (Floating Gear) End Play	0.024–0.081 inch
2. Mainshaft Lo-to-1st/5th Speed Gear (Floating Gear) End Play	0.020–0.080 inch
3. Mainshaft Reverse Gear-to-Gear Spacer (Floating Gear) End Play	0.003–0.050 inch (Shaft Seated)
4. Mainshaft Compound Lo-Split Gear End Play	0.005–0.041 inch
5. Rear Mainshaft Hi-Range/Hi-Split Gear End Play	0.006–0.040 inch
6. Rear Mainshaft Lo-Range Gear End Play	0.002–0.026 inch
7. Rear Countershaft Bearing Preload	0.002–0.006 inch
8. Reverse Idler Gear End Play	0.010–0.090 inch (Shaft Flush with Case Wall)
9. Front Countershaft Bearing Preload	0.003–0.007 inch
— Shift Rails-to-Mating Bore Clearance	0.010-inch maximum

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General Tolerances, T313–T318(21)(L21)(LR21)

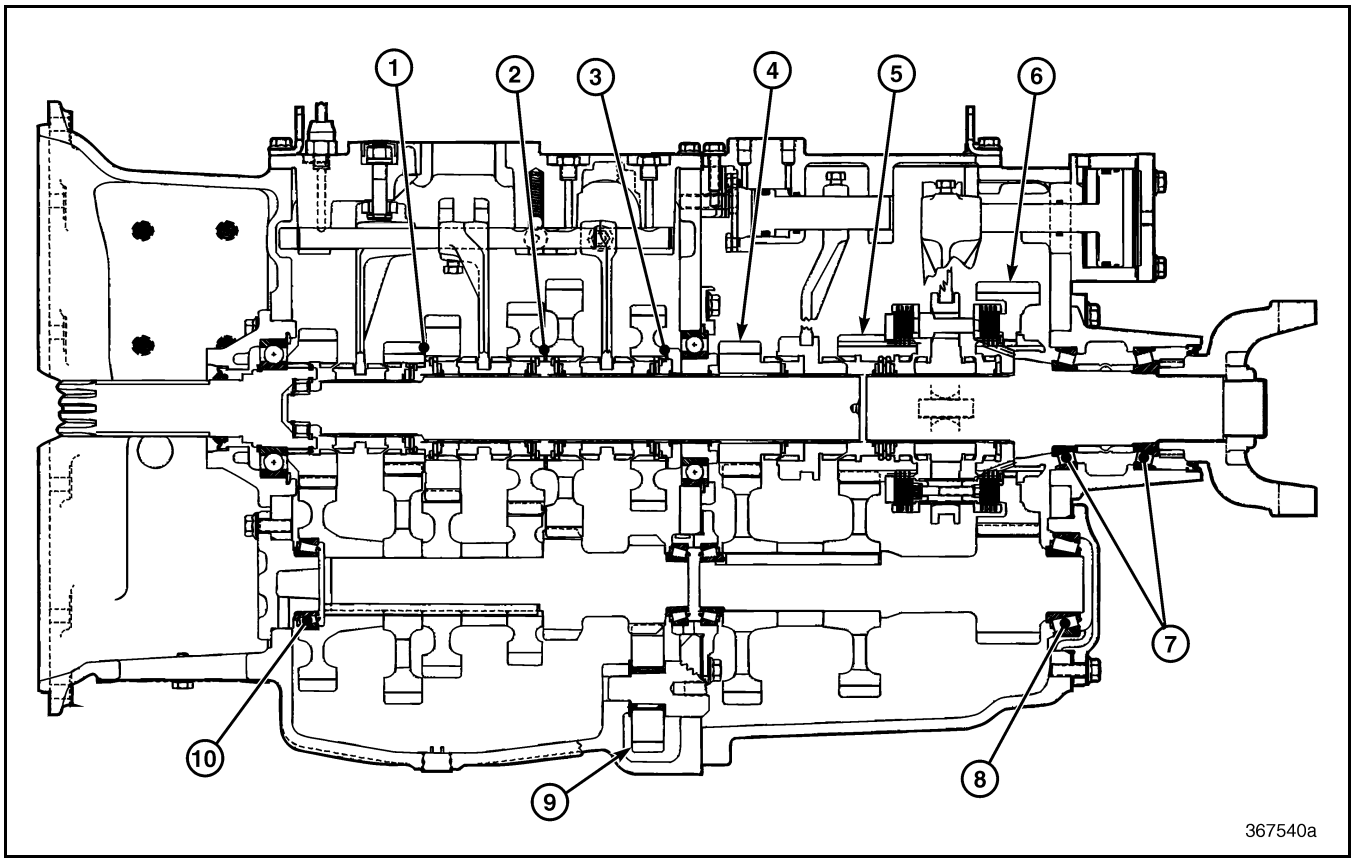


Figure 589 — Gear End Play and Bearing Preload (T313L21/T318L21 Shown)

Component	Specification
1. Mainshaft 4th/8th-to-2nd/6th Speed Gear (Floating Gear) End Play	0.024–0.081 inch
2. Mainshaft Lo-to-1st/5th Speed Gear (Floating Gear) End Play	0.020–0.080 inch
3. Mainshaft Reverse Gear-to-Gear Spacer (Floating Gear) End Play	0.003–0.050 inch (Shaft Seated)
4. Mainshaft Compound Lo-Split Gear End Play	0.005–0.041 inch
5. Rear Mainshaft Hi-Range/Hi-Split Gear End Play	0.006–0.040 inch
6. Rear Mainshaft Lo-Range Gear End Play	0.002–0.026 inch
7. Mainshaft Output Housing Bearing Preload — Collapsible Spacer	1.5–5.0 lbs. pull
8. Rear Countershaft Bearing Preload	0.002–0.006 inch
9. Reverse Idler Gear End Play	0.010–0.090 inch (Shaft Flush with Case Wall)
10. Front Countershaft Bearing Preload	0.003–0.007 inch
— Shift Rails-to-Mating Bore Clearance	0.010-inch maximum

Transmission Specifications and Capacities

T313–T318(L)(LR) AND T313–T318(21)(L21)(LR21)

Make		Mack Trucks, Inc.
Type		Overdrive, Triple Countershaft, Range and Splitter Shift
Range Shift Synchronizer		Plate Type, Four Friction/Four Reaction Discs Each for Hi Range and Lo Range
Controls		Selective, One Lever Manual with Air-Shifted Compound
Speeds — T313(L)(LR)(21)(L21)(LR21)		13 Forward, 2 Reverse
Speeds — T318(L)(LR)(21)(L21)(LR21)		18 Forward, 3 Reverse
Bell Housing		SAE No. 1, Integral with Main Case
Cases		Cast Aluminum, Heat Treated
Gears		Spur Type
Shaft Splines		Fine Pitch Rolled Involute
Lubrication		Splash Lubrication
Oil Filter		Integral, Magnetic
Drain Plug		Magnetic
PTO Openings:	Left Side	Std. SAE 8-Hole (Main Case and Rear Case)
	Right Side	Std. SAE 6-Hole (Main Case and Rear Case)
Oil Capacity		Approx. 30 pints (depends on angle of installation in chassis)

Recommended SAE Grade Gear Oil for All Temperature Operations, MACK GO-J and GO-J Plus* or TO-A PLUS* Specification:

- 90, 140, 80W-90, 80W-140, 85W-140 for Mineral Base
- SAE 50, 75W-90, 75W-140, 80W-140 for Synthetic Base

*GO-J Plus or TO-A PLUS is required for MACK geared component extended service drain intervals.

Visit Mack Trucks, Inc. internet website at www.macktrucks.com for MACK-approved oil suppliers.

NOTES

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SCHEMATIC & ROUTING DIAGRAMS

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AIR PIPING DIAGRAMS
[543]

T313–T318(L)(LR)(21)(L21)(LR21) Air Control without Compound Neutralizing for PTO Operation

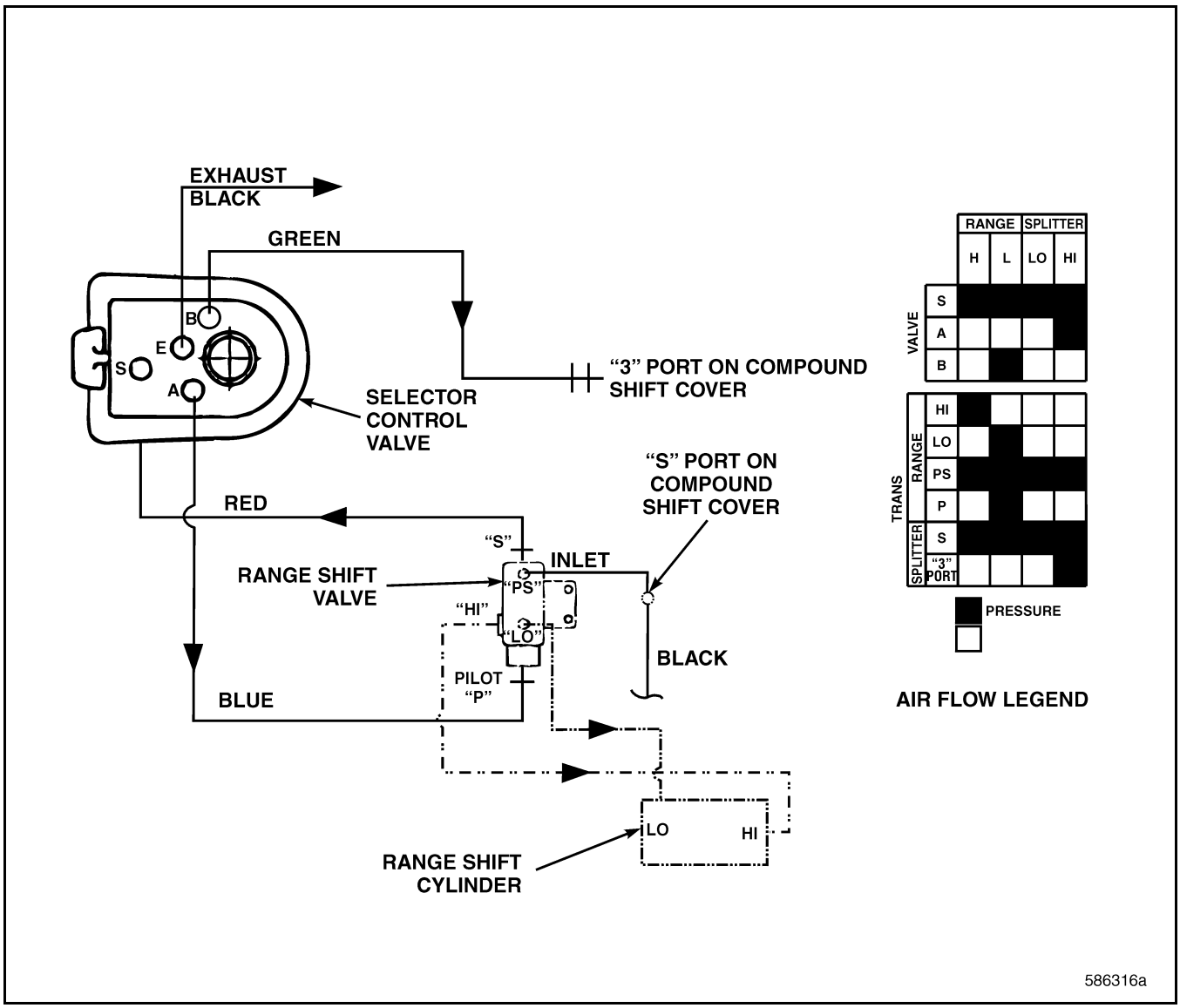


Figure 590 — Air Control Schematic

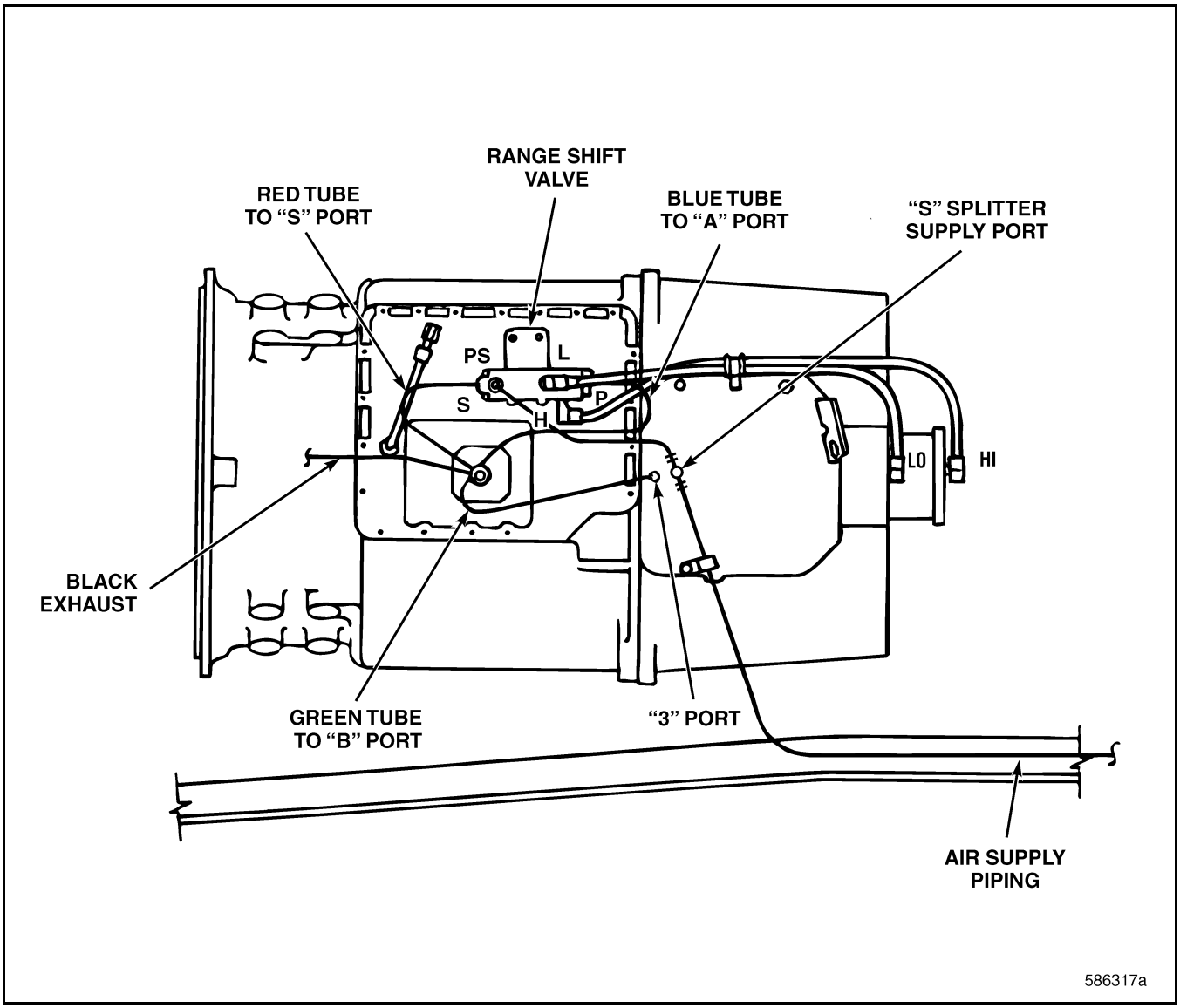


Figure 591 — Air Piping Diagram

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T313–T318(L)(LR)(21)(L21)(LR21) Air Control with Compound Neutralizing for PTO Operation

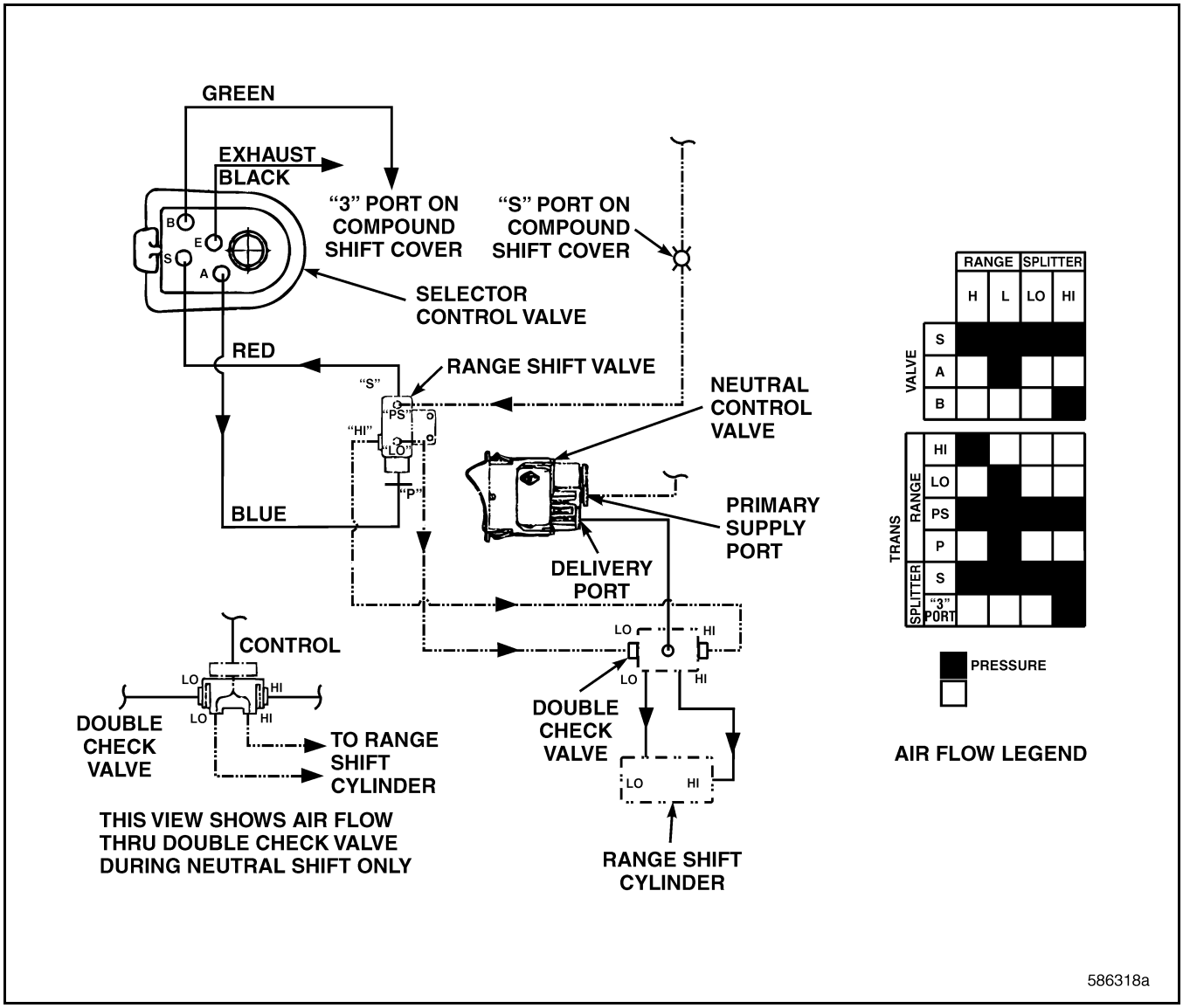


Figure 592 — Air Control Schematic

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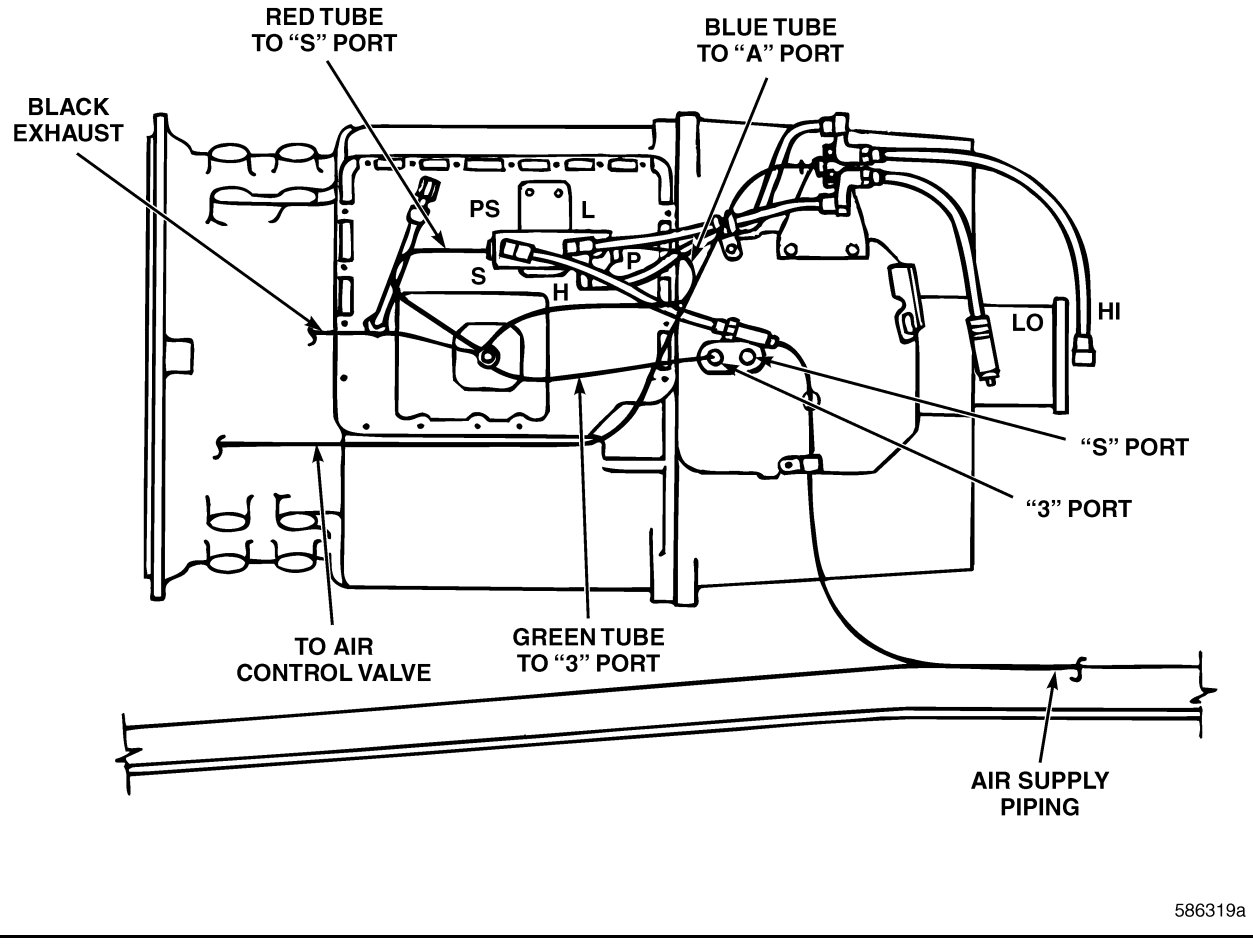


Figure 593 — Air Piping Diagram

NOTES

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SPECIAL TOOLS & EQUIPMENT

SPECIAL TOOLS

TOOLS

J 2619-01	Slide Hammer
J 4558-01	Bearing Puller
J 5959-01	Dial Indicator Set
J 7379	100–600 lb-ft Torque Wrench
J 8092	Driver Handle
J 8176	Bearing Separator
J 21834-01	Bearing Puller
J 22912-01	Bearing Separator
J 24407	30–250 lb-ft Torque Wrench
J 28506	Carrier Adapter
J 29048	Tapered Feeler Gauge
J 29369-1	Bearing Puller
J 29369-2	Bearing Puller
J 34629	Snap Ring Pliers Set
J 34630	Reverse Idler Shaft Removal Tool
J 36052	Positioning Tool
J 36053	Seal Driver
J 39477	Bar Type Puller
J 39854	Seal Driver
J 47357	Seal Inserter
J 47358	Seal Installer/Sizer
J 47359	Seal Sizer/Piston Installer
OEM4052	Internal Puller
J 07804-A	Yoke and Flange Remover
9032-1800trk	Air Line Quick Disconnect Fitting Tool Kit **Available through MACK Parts System**

Above tools are available from Kent-Moore (except as noted):

KENT-MOORE

O.E. TOOL AND EQUIPMENT GROUP

SPX CORPORATION

28635 MOUND ROAD

WARREN, MICHIGAN 48092-3499

TEL: 1-800-328-6657

FAX: 1-800-578-7375

DISASSEMBLED VIEWS

TRANSMISSION DISASSEMBLED VIEWS [320]

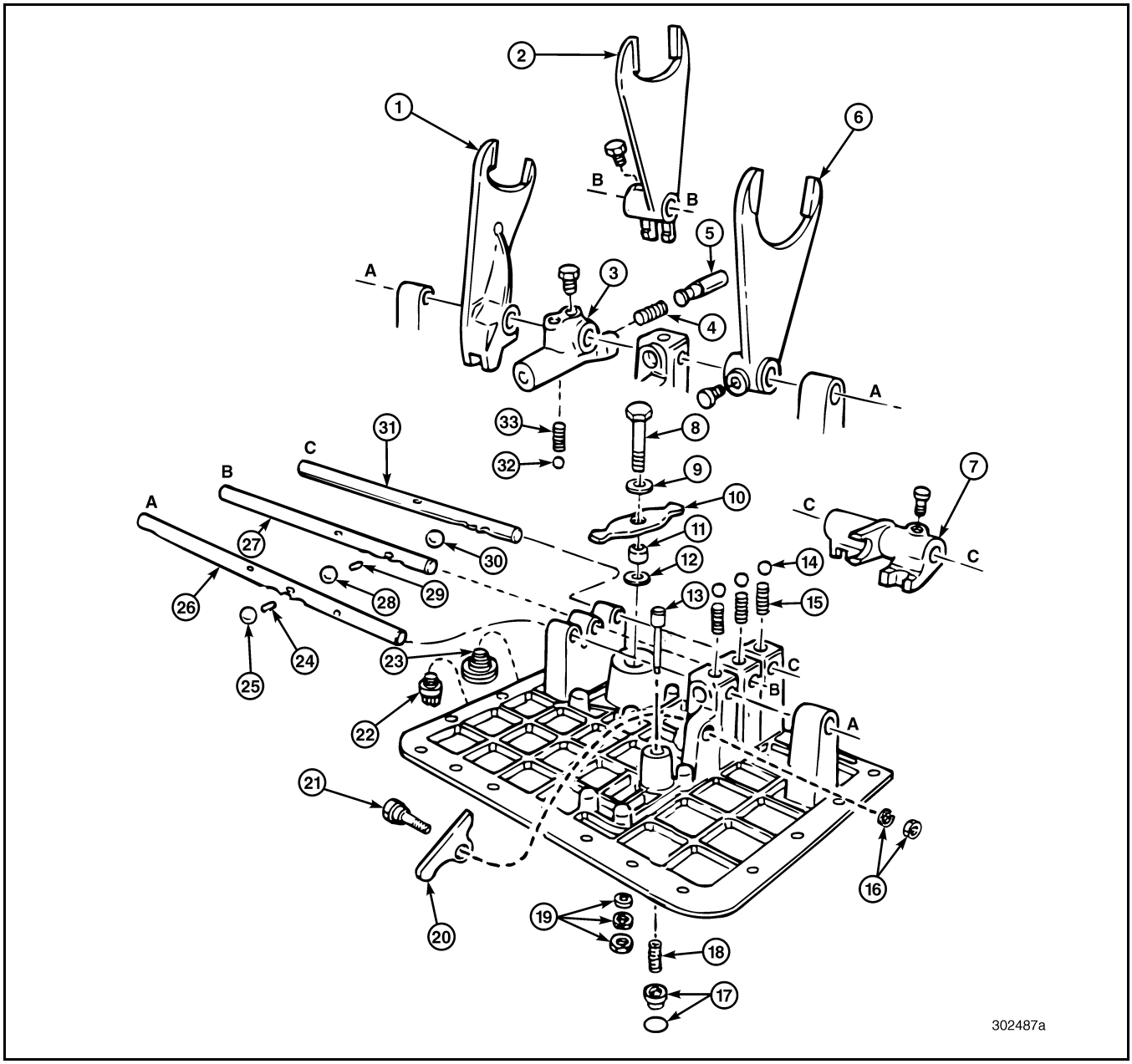


Figure 594 — Exploded View of Main Case Shift Cover

1. 3rd/4th Shift Fork	12. Washer	23. Breather
2. 1st/2nd Shift Fork	13. Interlock Pin	24. Interlock Pin
3. Lo/Reverse Shifter	14. Poppet Ball	25. Interlock Ball
4. Shifter Body Spring (Interlock)	15. Poppet Ball Spring	26. Lo/Reverse Shift Rail
5. Shifter Body Plunger (Interlock)	16. Interlock Rocker Hardware	27. 1st/2nd Shift Rail
6. Lo/Reverse Shift Fork	17. Interlock Sleeve and O-Ring	28. Interlock Ball
7. 3rd/4th Shifter	18. Interlock Spring	29. Interlock Pin
8. 3rd/4th Rocker Pin	19. 3rd/4th Rocker Pin Hardware	30. Interlock Ball
9. Washer	20. Interlock Rocker	31. 3rd/4th Shift Rail
10. 3rd/4th Rocker Arm	21. Interlock Rocker Bolt	32. Lo/Reverse Shifter Spring
11. Bushing	22. Pipe Plug	33. Lo/Reverse Shifter Spring

DISASSEMBLED VIEWS

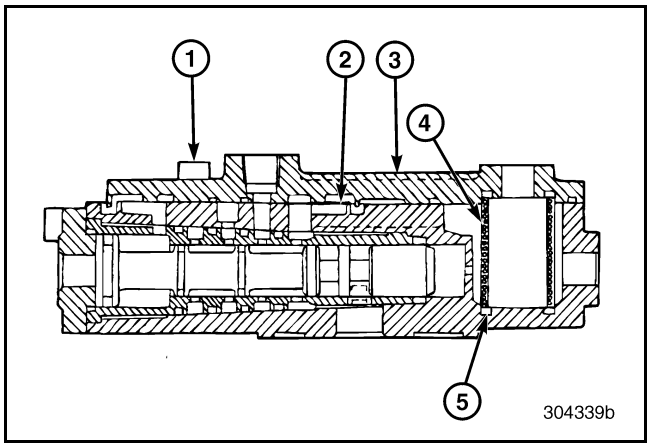


Figure 595 — Cutaway View of Range Shift Interlock Valve Assembly

1. 4 mm Screw	4. Sintered Bronze
2. Top Cover Seal	5. Silicone Rubber O-Ring
3. Top Cover	

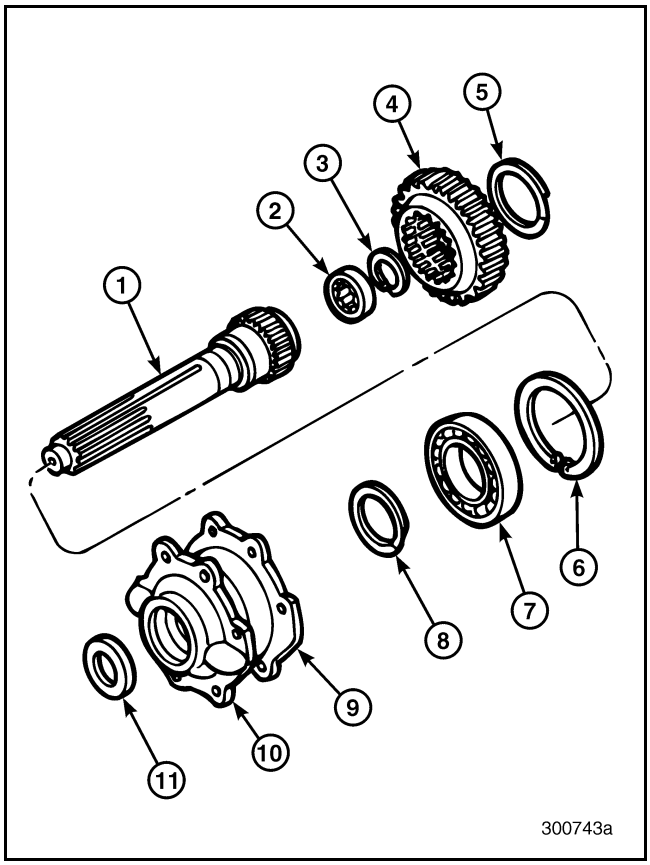


Figure 596 — Exploded View of Main Drive Pinion

1. Main Drive Pinion Shaft	7. Bearing
2. Spigot Bearing	8. Spiral Snap Ring
3. Snap Ring	9. Gasket
4. Main Drive Pinion Gear	10. Pinion Bearing Cover
5. Spiral Snap Ring	11. Oil Seal
6. Snap Ring	

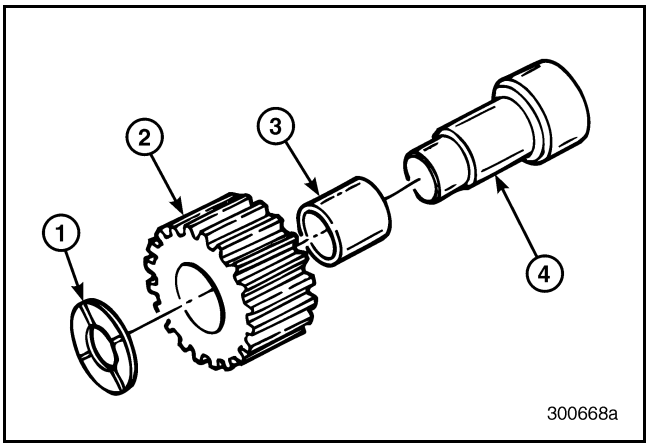


Figure 597 — Exploded View of Reverse Idler Gear Assembly

1. Thrust Washer	3. Bearing
2. Reverse Idler Gear	4. Reverse Idler Shaft

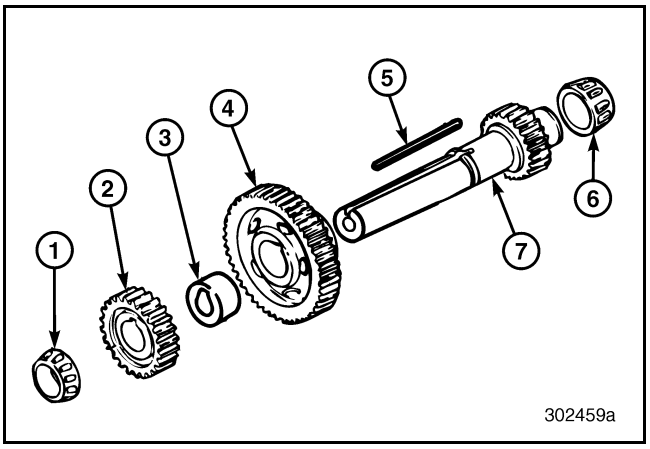


Figure 598 — Exploded View of Rear Countershaft

1. Front Bearing Cone	5. Key
2. Reverse Speed Gear	6. Rear Bearing Cone
3. Spacer	7. Rear Countershaft
4. Main Drive Gear	

DISASSEMBLED VIEWS

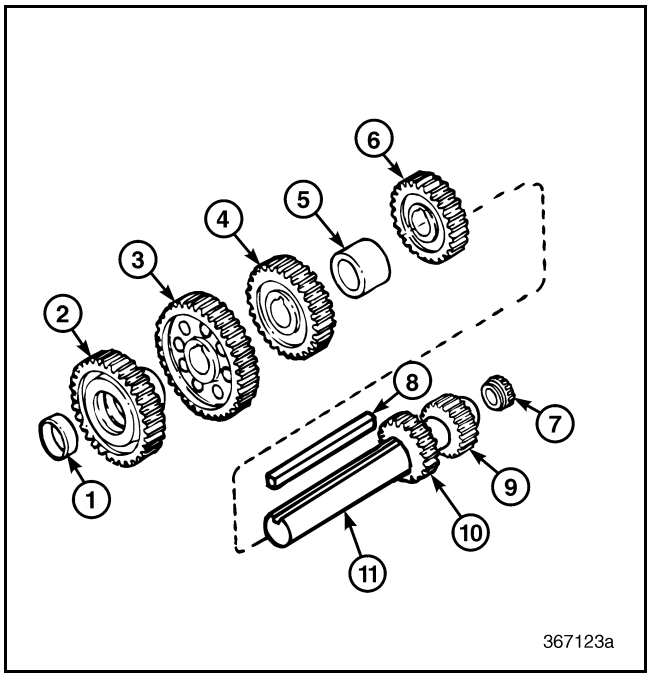


Figure 599 — Exploded View of Front Countershaft

1. Bearing Cup 2. Main Drive Gear 3. Fourth Speed Gear 4. Second Speed Gear 5. Spacer 6. First Gear 7. Bearing Cone 8. Key	9. Reverse Gear (Integral with Countershaft) 10. Lo-Speed Gear (Integral with Countershaft) 11. Front Countershaft (Contains Two Integral Gears)

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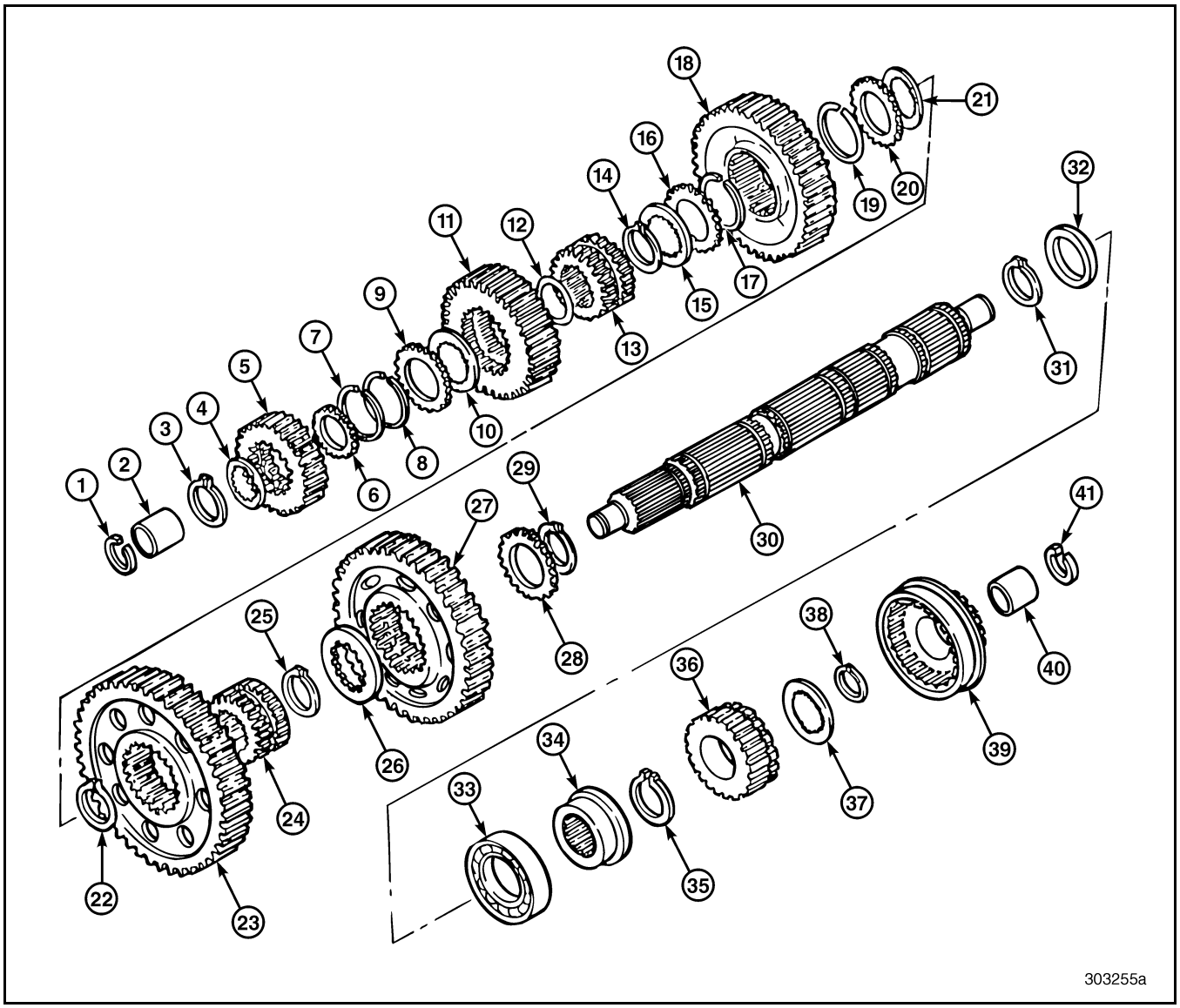


Figure 600 — Exploded View of Front Mainshaft, T313–T318(L)(LR)

1. Spigot Bearing Inner Race Snap Ring	15. Internal-Toothed Thrust Washer	29. Mainshaft Snap Ring
2. Spigot Bearing Inner Race	16. External-Toothed Thrust Washer	30. Front Mainshaft
3. Mainshaft Snap Ring	17. Gear Snap Ring	31. Mainshaft Snap Ring
4. Internal-Toothed Thrust Washer	18. First (Fifth) Speed Gear	32. Spacer
5. Fourth (Eighth) Speed Gear	19. Gear Snap Ring	33. Mainshaft Rear Bearing
6. External-Toothed Thrust Washer	20. External-Toothed Thrust Washer	34. Mainshaft Rear Bearing Sleeve
7. Gear Snap Ring	21. Internal-Toothed Thrust Washer	35. Mainshaft Snap Ring
8. Gear Snap Ring	22. Mainshaft Snap Ring	36. Reverse Gear
9. External-Toothed Thrust Washer	23. Lo-Speed Gear	37. Internal-Toothed Thrust Washer
10. Internal-Toothed Thrust Washer	24. Sliding Clutch	38. Mainshaft Snap Ring
11. Second (Sixth) Speed Gear	25. Mainshaft Snap Ring	39. Sliding Clutch
12. Mainshaft Snap Ring	26. Internal-Toothed Thrust Washer	40. Spigot Bearing Inner Race
13. Sliding Clutch	27. Reverse Gear	41. Spigot Bearing Inner Race Snap Ring
14. Mainshaft Snap Ring	28. External-Toothed Thrust Washer	

DISASSEMBLED VIEWS

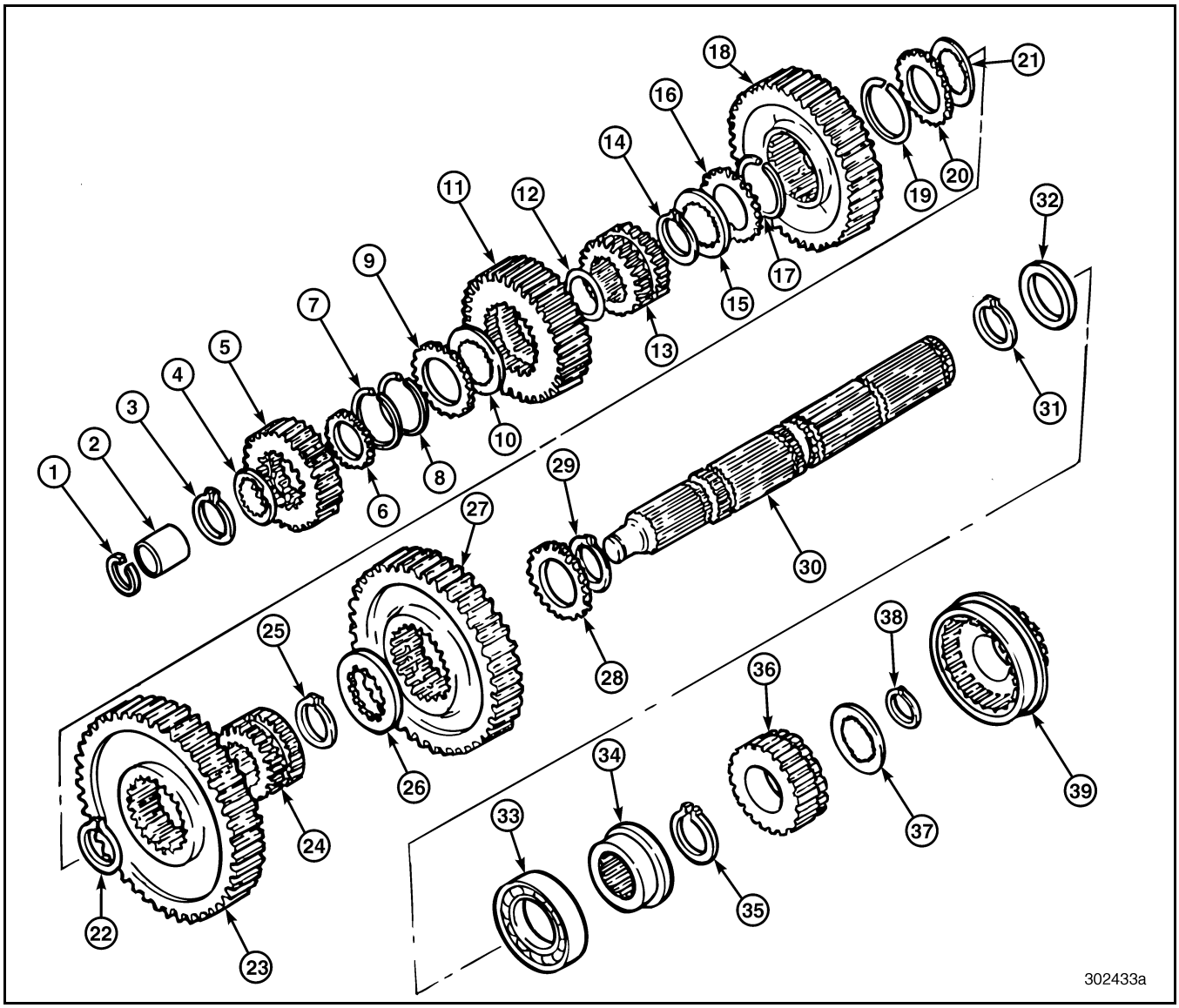


Figure 601 — Exploded View of Front Mainshaft, T313–T318(21)(L21)(LR21)

1. Spigot Bearing Inner Race Snap Ring	14. Mainshaft Snap Ring	27. Reverse Gear
2. Spigot Bearing Inner Race	15. Internal-Toothed Thrust Washer	28. External-Toothed Thrust Washer
3. Mainshaft Snap Ring	16. External-Toothed Thrust Washer	29. Gear Snap Ring
4. Internal-Toothed Thrust Washer	17. Gear Snap Ring	30. Front Mainshaft
5. Fourth (Eighth) Speed Gear	18. First (Fifth) Speed Gear	31. Mainshaft Snap Ring
6. External-Toothed Thrust Washer	19. Gear Snap Ring	32. Spacer
7. Gear Snap Ring	20. External-Toothed Thrust Washer	33. Mainshaft Rear Bearing
8. Gear Snap Ring	21. Internal-Toothed Thrust Washer	34. Mainshaft Rear Bearing Sleeve
9. External-Toothed Thrust Washer	22. Mainshaft Snap Ring	35. Mainshaft Snap Ring
10. Internal-Toothed Thrust Washer	23. Lo-Speed Gear	36. Reverse Gear
11. Second (Sixth) Speed Gear	24. Sliding Clutch	37. Internal-Toothed Thrust Washer
12. Mainshaft Snap Ring	25. Mainshaft Snap Ring	38. Mainshaft Snap Ring
13. Sliding Clutch	26. Internal-Toothed Thrust Washer	39. Sliding Clutch

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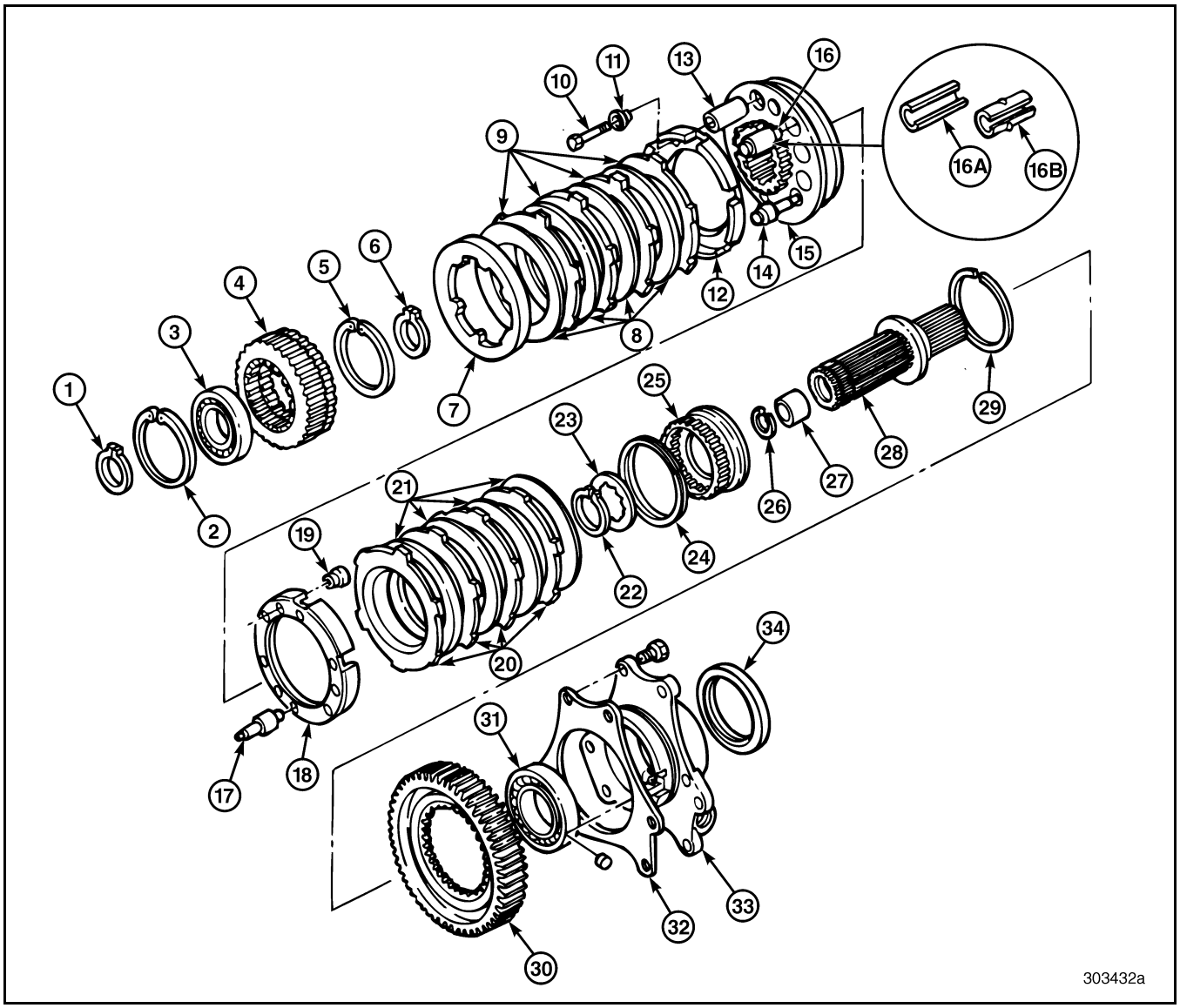


Figure 602 — Exploded View of Rear Mainshaft and Synchronizer Assembly, T313–T318(L)(LR)

1. Snap Ring	14. Synchronizer Pin	24. Lo-Range Gear Snap Ring
2. Snap Ring	15. Sliding Clutch	25. Lo-Range Gear Hub
3. Main Drive Gear Bearing	16. Preload Spring Assembly	26. Spigot Bearing Snap Ring
4. Main Drive Gear	A. Inner Spring	27. Rear Mainshaft Spigot Bearing
5. Snap Ring	B. Outer Spring	28. Rear Mainshaft
6. Snap Ring	17. Synchronizer Pin	29. Rear Bearing Snap Ring
7. Spacer (Front Synchronizer Pack)	18. Clutch Housing	30. Lo-Range Gear
8. Friction Disc (4)	19. Threaded Insert (3)	31. Mainshaft Rear Bearing
9. Reaction Disc (4)	20. Reaction Disc (4)	32. Rear Bearing Cover Gasket
10. 12-Point Capscrews (3)	21. Friction Disc (4)	33. Rear Bearing Cover
11. Nonthreaded Insert (3)	22. Snap Ring	34. Rear Bearing Cover Seal
12. Clutch Housing	23. Internal-Toothed Thrust Washer	
13. Support Tube		

DISASSEMBLED VIEWS

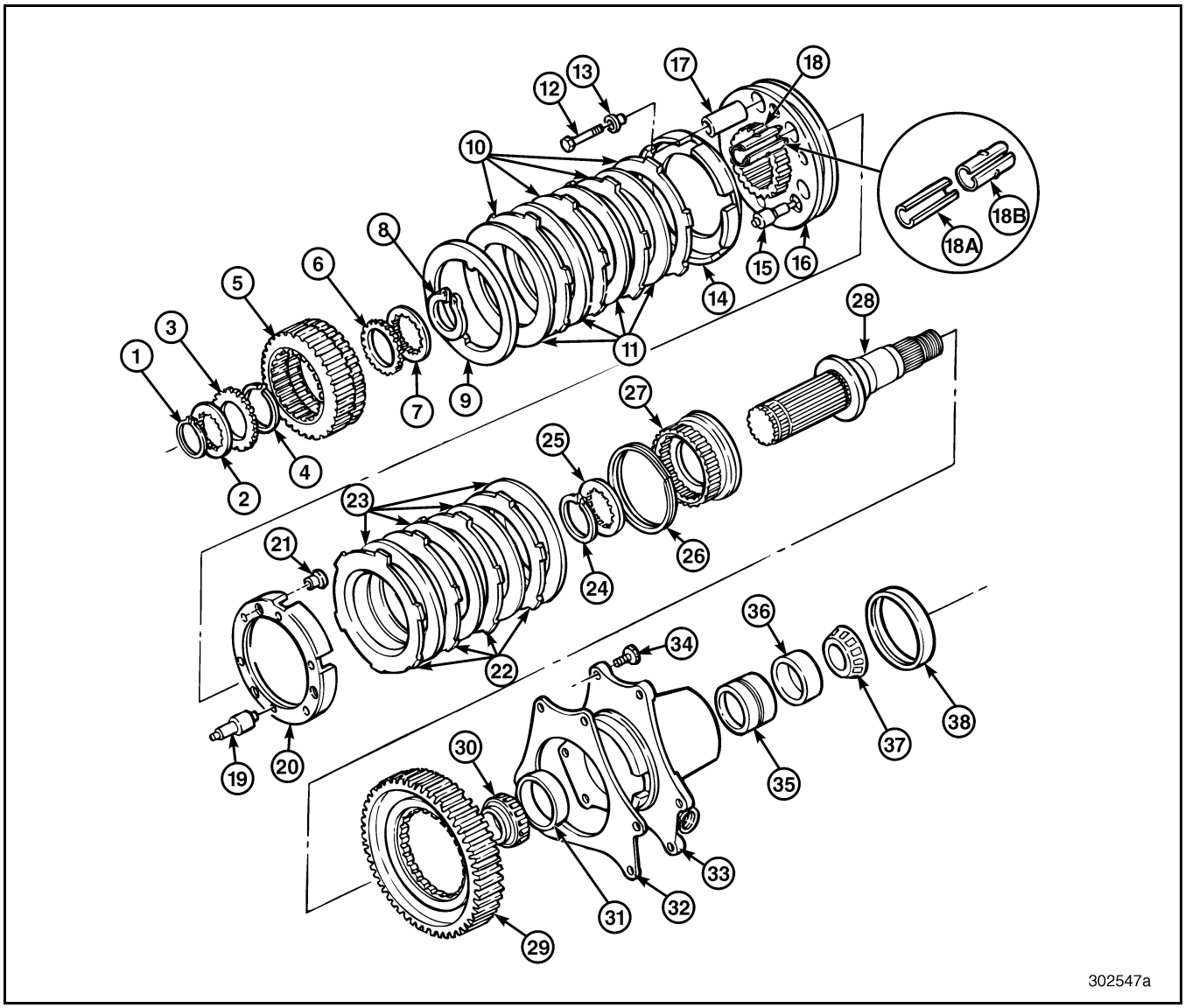


Figure 603 — Exploded View of Rear Output Shaft and Synchronizer Assembly, T313–T318(21)(L21)(LR21)

1. Output Shaft Snap Ring	15. Synchronizer Pin	27. Lo-Range Gear Hub
2. Internal-Toothed Thrust Washer	16. Sliding Clutch	28. Output Shaft
3. External-Toothed Thrust Washer	17. Support Tube	29. Lo-Range Gear
4. Main Drive Gear Snap Ring	18. Preload Spring	30. Bearing Cone
5. Main Drive Gear	A. Inner Spring	31. Bearing Cup
6. External-Toothed Thrust Washer	B. Outer Spring	32. Gasket
7. Internal-Toothed Thrust Washer	19. Synchronizer Pin	33. Output Housing
8. Output Shaft Snap Ring	20. Clutch Housing	34. Output Housing Capscrew
9. Spacer (Front Synchronizer Pack)	21. Threaded Insert	35. Collapsible Spacer
10. Reaction Disc	22. Reaction Disc	36. Bearing Cup
11. Friction Disc	23. Friction Disc	37. Bearing Cone
12. Twelve-Point Capscrew	24. Output Shaft Snap Ring	38. Output Housing Oil Seal
13. Nonthreaded Insert	25. Internal-Toothed Thrust Washer	
14. Clutch Housing	26. Lo-Range Gear Snap Ring	

DISASSEMBLED VIEWS

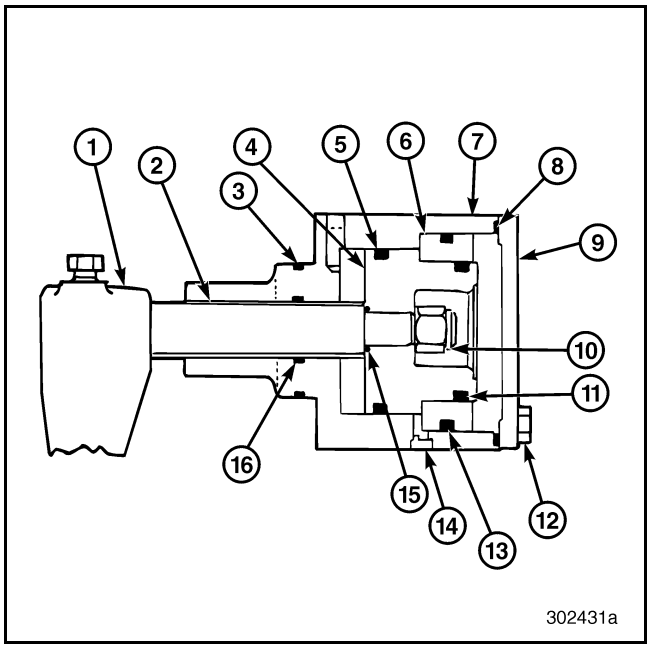


Figure 604 — Cutaway View of Three-Position Range Shift Cylinder

1. Shift Fork	9. Shift Cylinder Cover
2. Rail	10. Piston/Rail Nut
3. O-Ring	11. O-Ring
4. Shift Piston	12. Cover Capscrew
5. O-Ring	13. O-Ring
6. Piston Sleeve	14. Breather Vent
7. Shift Cylinder	15. O-Ring
8. O-Ring	16. O-Ring

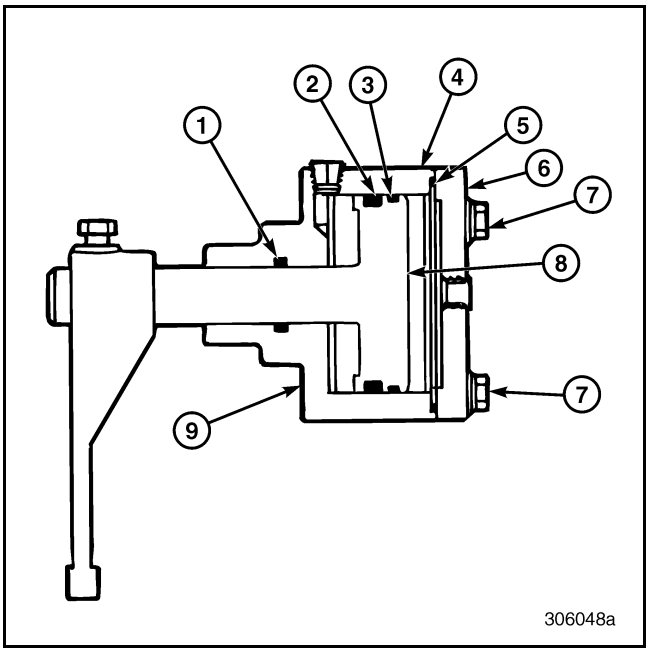


Figure 605 — Cutaway View of Two-Position Range Shift Cylinder

1. Shift Rail Seal	6. Cylinder Housing Cover
2. Piston Seal	7. Bolt
3. Shift Cylinder Wiper Ring	8. Piston/Shift Rail Assembly
4. Shift Cylinder Housing	9. Gasket
5. Housing-to-Cover O-Ring	

DISASSEMBLED VIEWS

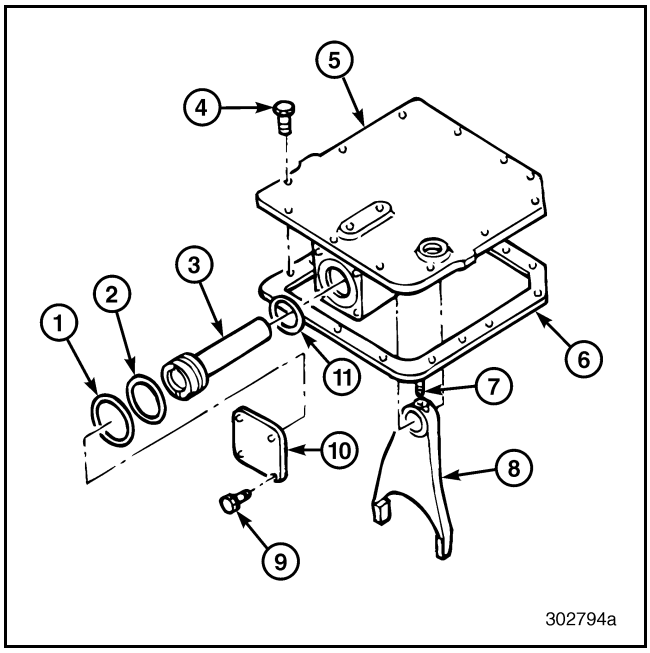


Figure 606 — Exploded View of Rear Case Shift Cover

1. Cover O-Ring	7. Shift Fork Setscrew
2. Piston O-Ring	8. Splitter Shift Fork
3. Splitter Shift Piston	9. Capscrew (4)
4. Capscrew (10)	10. Piston Cover
5. Rear Case Shift Cover	11. Shaft O-Ring
6. Gasket	

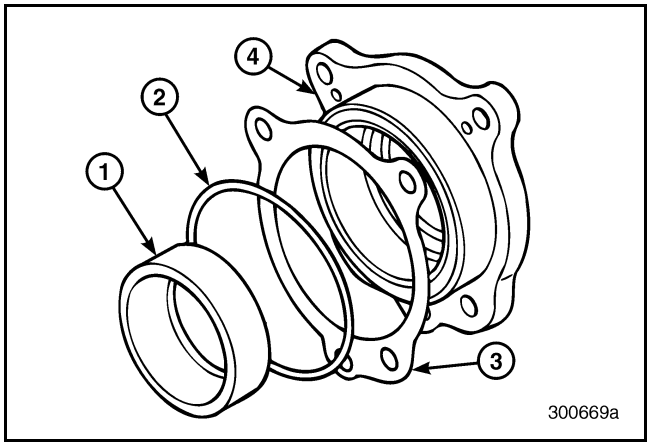


Figure 607 — Exploded View of Rear Countershaft Bearing Cover

1. Bearing Cup	3. Shim(s)
2. O-Ring	4. Bearing Cover

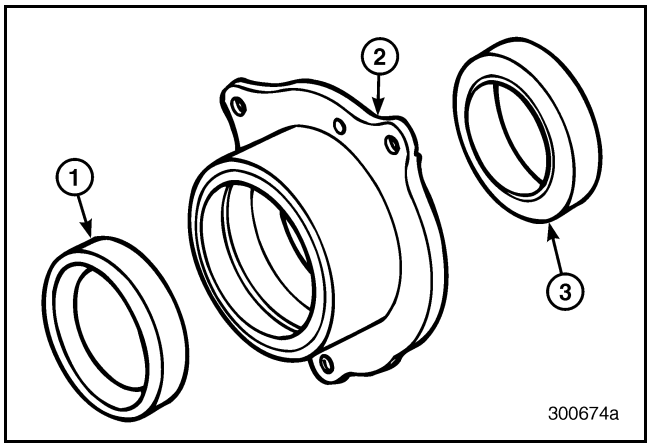


Figure 608 — Exploded View of Front Countershaft Rear Bearing Cover

1. Front Bearing Cup	3. Rear Bearing Cup
2. Bearing Cover	

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SERVICE MANUAL

PRINTED IN U.S.A.
10-123

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