

TRANSMISSION DATA

TRANSMISSION	DATA
Type	5-speed forward - constant mesh
FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT	Part No. 99851-05 (qt)
Capacity (dry)	24 oz.
	710 ml
Capacity (wet)	Approximately 20-24 oz.
	590-710 ml

GEAR	Internal Gear Ratios (Domestic, HDI and Swiss)
First	3.21
Second	2.21
Third	1.57
Fourth	1.23
Fifth	1.00

ENGINE OIL	DATA
Capacity (dry)	4 quarts
	3.8 liters
Capacity (wet)	Approximately 3-1/2 quarts
	3.3 liters

CAUTION

A bent jiffy stand, modified suspension or uneven parking area can cause dipstick to indicate a false low oil condition.

NOTE

Since a sidecar equipped motorcycle is fixed in an upright position, the actual full engine oil level is about 1/2 inch (12.7 mm) above the FULL mark on the dipstick.

SERVICE WEAR LIMITS

SHIFTER FORKS	IN.	MM
Shifter fork to cam groove end play	0.0017-0.0019	0.043-0.048
Shifter fork to gear groove end play	0.0010-0.0110	0.025-0.279

SHIFTER DOG GEARS	MINIMUM CLEARANCE	MAXIMUM CLEARANCE
2nd-5th	0.035 in.	0.139 in.
	0.89 mm	3.53 mm
2nd-3rd	0.035 in.	0.164 in.
	0.89 mm	4.17 mm
1st-4th	0.035 in.	0.152 in.
	0.89 mm	3.86 mm
1st-3rd	0.035 in.	0.157 in.
	0.89 mm	3.99 mm

MAINSHAFT TOLERANCE	IN.	MM
Mainshaft runout	0.000-0.003	0.000-0.08
Mainshaft end play	none	none
1st gear clearance	0.0000-0.0080	0.000-0.203
2nd gear clearance	0.0000-0.0800	0.000-2.032
3rd gear end play	0.0050-0.0420	0.127-1.067
3rd gear clearance	0.0003-0.0019	0.008-0.048
4th gear end play	0.0050-0.0310	0.127-0.787
4th gear clearance	0.0003-0.0019	0.008-0.048

MAIN DRIVE GEAR (5TH)	IN.	MM
Bearing fit in transmission case (loose)	0.0003-0.0017	0.008-0.043
Fit on mainshaft	0.0001-0.0009	0.0025-0.023
End play	none	none
Fit in side door (tight)	0.0014-0.0001	0.036-0.0025

SERVICE WEAR LIMITS (CONT.'D)

COUNTERSHAFT TOLERANCE	IN.	MM
Countershaft runout	0.000-0.003	0.00-0.08
Countershaft end play	none	none
1st gear clearance	0.0003-0.0019	0.008-0.048
1st gear end play	0.0050-0.0039	0.127-0.099
2nd gear clearance	0.0003-0.0019	0.008-0.048
2nd gear end play	0.0050-0.0440	0.127-1.118
3rd gear clearance	0.0000-0.0080	0.000-0.203
4th gear clearance	0.0000-0.0080	0.000-0.203
4th gear end play	0.0050-0.0390	0.127-0.991
5th gear clearance	0.0000-0.0080	0.000-0.203
5th gear end play	0.0050-0.0040	0.127-0.102

TORQUE VALUES

Item		ft/in-lbs	Nm
Shifter linkage rod locknuts		80-120 in-lbs	9.0-13.6 Nm
Detent arm pivot screw to right support block		84-108 in-lbs	9.5-12.2 Nm
Shifter cam support block screws		84-108 in-lbs	9-12 Nm
Transmission top cover socket head screws		84-132 in-lbs	9.5-14.9 Nm
Neutral switch		120-180 in-lbs	13.6-20.3 Nm
Clutch release cover socket head screws		84-132 in-lbs	9.5-14.9 Nm
Clutch cable fitting		36-60 in-lbs	4-7 Nm
Transmission lubricant drain plug		14-21 ft-lbs	19-28 Nm
Transmission filler plug/dipstick		25-75 in-lbs	2.8-8.5 Nm
Transmission side door 5/16 inch screws 1/4 inch screws		13-18 ft-lbs 84-132 in-lbs	17.6-24.4 Nm 9.5-14.9 Nm
Mainshaft/countershaft locknuts		45-55 ft-lbs	61-75 Nm
Transmission mainshaft sprocket nut		60 ft-lbs, then 35° to 45°	81 Nm, then 35° to 45°
Transmission sprocket nut lockplate screws		84-108 in-lbs	9-12 Nm
Oil pan screws		84-132 in-lbs	9.5-14.9 Nm
Transmission-to-engine mounting bolts		15 ft-lbs, then 30-35 ft-lbs	20.3 Nm, then 40.7-47.5 Nm
Oil hose cover		84-108 in-lbs	10-12 Nm
Rear swingarm bracket bolts		34-42 ft-lbs	46-57 Nm
Rear swingarm pivot shaft locknut		40-45 ft-lbs	54-61 Nm
Shifter lever to shifter shaft socket head screw		18-22 ft-lbs	24-30 Nm
Engine oil drain plug		14-21 ft-lbs	19-28 Nm
Oil filler spout allen head socket screws		84-132 in-lbs	9.5-14.9 Nm
Shift arm to transmission shift shaft socket screw	5/16"	18-22 ft-lbs	24-30 Nm
Inner shift arm to shift lever shaft socket screw	1/4"	90-110 in-lbs	10.2-12.4 Nm

GENERAL

See [Figure 7-1](#). The 5-speed transmission consists of two parallel shafts supporting five gears each. The longer, or mainshaft, also supports the clutch and serves as the input shaft. The shorter shaft is called the countershaft.

Each gear on the mainshaft is in constant mesh with a corresponding gear on the countershaft. Each of these five pairs of gears makes up a different speed in the transmission.

The transmission gears are divided into two types, gears that are splined and rotate with the shaft, and freewheeling gears that ride on bearings and spin freely on the shaft. A splined gear always meshes with a freewheeling gear. Also, three of the splined gears are able to slide sideways on the shaft. These sliding gears are used to change transmission speeds. The projections (or dogs) on the sides of the sliding gears, engage dogs on adjacent freewheeling gears, transmitting power through the transmission.

Gear shifting is accomplished by three forks which fit into grooves machined into the hubs of the three sliding gears. The position of the shifter forks is controlled by a drum-shaped shifter cam located on the top of the transmission.

Neutral

Power is introduced to the transmission through the clutch. In neutral, with the clutch engaged, the mainshaft 1st and 2nd gears are rotating, but no power is transferred to the countershaft since countershaft 1st and 2nd are freewheeling gears.

1st Gear

When the transmission is shifted into first gear, countershaft 3rd, which rotates with the countershaft, engages countershaft 1st, which has been spinning freely on the countershaft driven by mainshaft 1st.

Now countershaft 3rd is no longer freewheeling, but locked to the countershaft causing the countershaft and countershaft 5th to turn. Countershaft 5th transmits the power to the main drive gear and the sprocket.

2nd Gear

Second gear is engaged when countershaft 3rd is shifted out of countershaft 1st and engages countershaft 2nd. This locks countershaft 2nd to the countershaft to complete the power flow as shown.

3rd Gear

Two shifter forks are used to make the shift from second to third. One fork moves countershaft 3rd out of countershaft 2nd to its neutral position, while another fork engages mainshaft 2nd with mainshaft 3rd. This locks mainshaft 3rd to the mainshaft to complete the power flow as shown.

4th Gear

The shift into fourth is made when mainshaft 2nd is disengaged from mainshaft 3rd and mainshaft 1st engages mainshaft 4th, locking it to the mainshaft.

5th Gear

The shift from fourth to fifth gear occurs when mainshaft 1st is shifted out of mainshaft 4th, and mainshaft 2nd is shifted directly into the main drive gear. Mainshaft 2nd lock the main drive gear to the mainshaft resulting in a direct one-to-one drive ratio from the clutch to the sprocket.

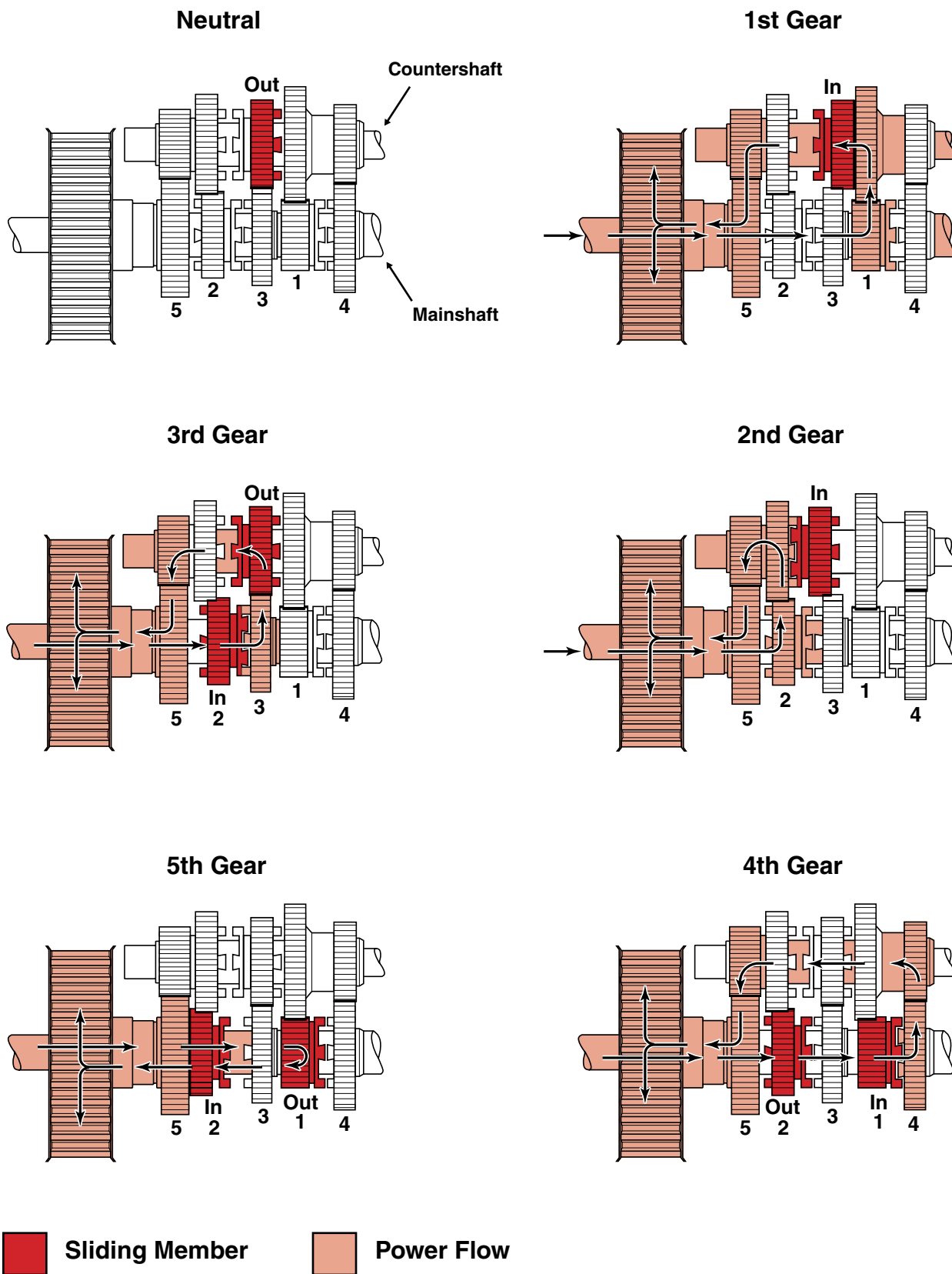


Figure 7-1. Transmission Power Flow Schematic

ADJUSTMENT

If operating problems exist, check the shift linkage for wear, interference or adjustment. If adjustment is necessary, see [SHIFT ROD](#) below. If problems persist, see the checks under Section [1.21 TROUBLESHOOTING, TRANSMISSION](#), along with the repair procedures in this section.

SHIFT ROD

The shift rod is set at the factory and should not need adjustment under normal circumstances. However, if full engagement or full lever travel is not achieved, adjust the rod as follows:

CAUTION

To ensure proper gear engagement and avoid possible damage to transmission, the shift levers should not contact the footboard when shifting. A minimum clearance of 3/8 inch (9.5 mm) between shift levers and footboard must be maintained to accommodate engine movement when running.

1. Remove locknut, lockwasher and flat washer to free front end of shift rod from inner shift arm. See [Figure 7-2](#).

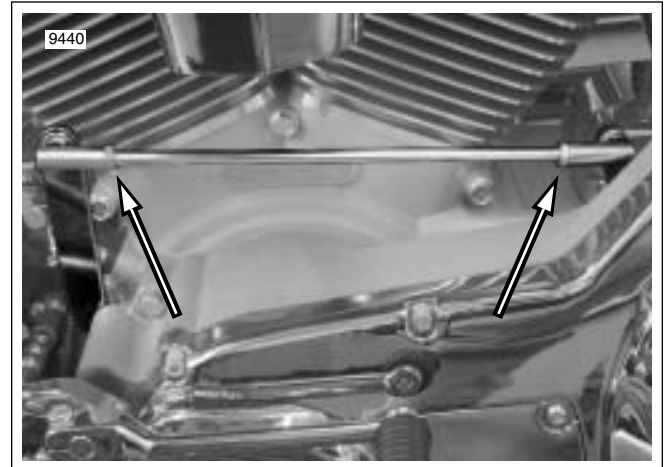


Figure 7-2. Loosen Locknuts and Adjust Rod

2. Loosen locknuts and adjust rod as necessary.
3. Install flat washer, lockwasher and locknut to fasten front end of shift rod to inner shift arm.
4. Tighten locknuts to 80-120 **in-lbs** (9.0-13.6 Nm).

DISASSEMBLY

1. Remove maxi-fuse. See Section 8.3 SYSTEM FUSES, MAXI-FUSE, REMOVAL.
2. Remove the exhaust system in two sections. See Section 2.38 EXHAUST SYSTEM, REMOVAL.
3. Remove the magnetic drain plug at the bottom right side of the oil pan and drain the transmission lubricant into a suitable container. Remove the fill plug/dipstick.
4. Using fingers and flat tip screwdriver, remove two elbow connectors from neutral switch studs. Using 7/8 inch box end wrench, remove neutral switch and O-ring from transmission top cover. Remove preformed vent hose from the top cover fitting, if necessary.
5. Remove the five socket head screws from the transmission top cover. Remove the top cover from the transmission case. Remove and discard the cover gasket.

CAUTION

Pulling shifter cam assembly from dowels allows left support block to rotate freely, which can cause screws and washers to drop into transmission case if left loosely installed.

6. See Figure 7-3. Remove the four hex head screws (with flat washers) to free the right and left shifter cam support blocks. Raise shifter pawl and lift shifter cam assembly from dowels on deck of transmission case.
7. See CLEANING AND INSPECTION, steps 2 and 3, on the next page. If necessary, disassemble shifter cam assembly as follows:

WARNING

Always wear proper eye protection when removing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

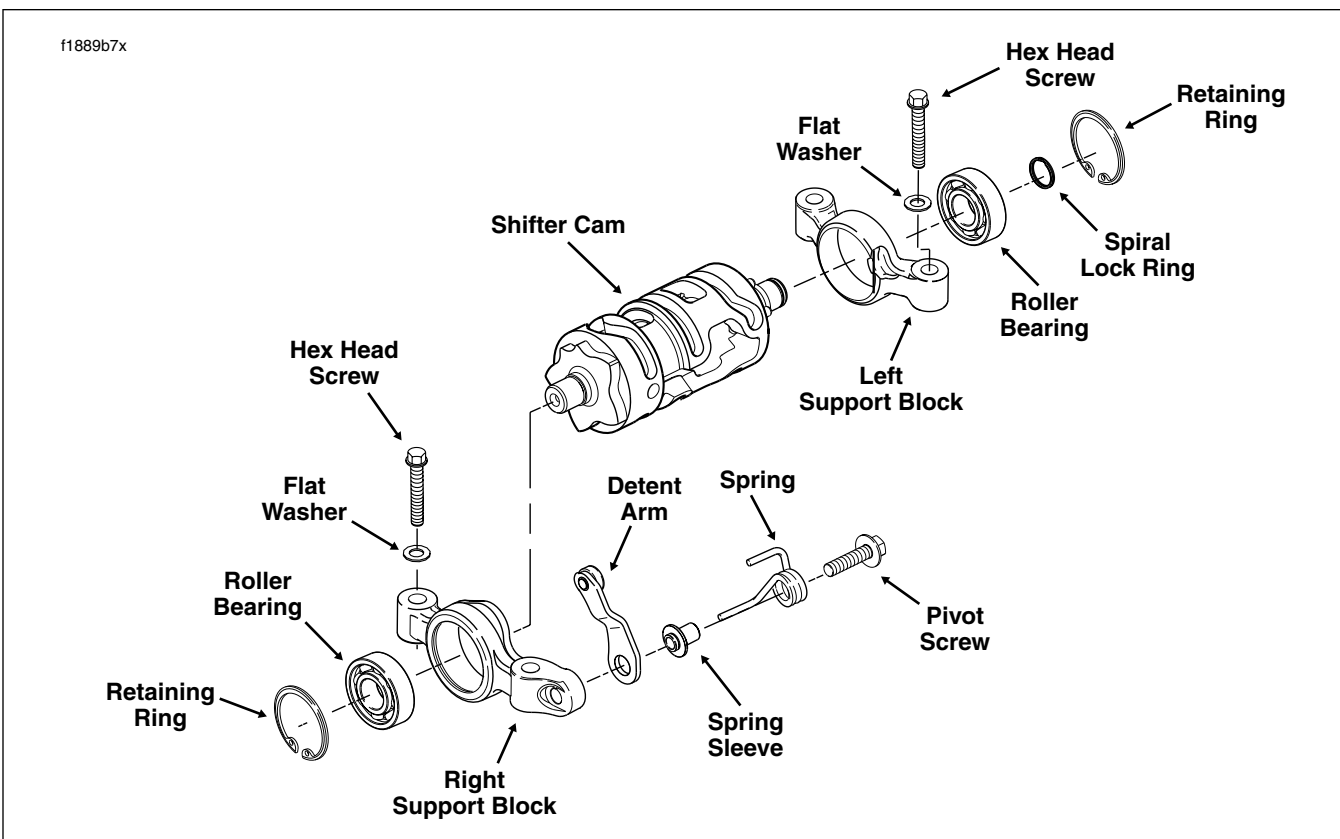


Figure 7-3. Shifter Cam Assembly

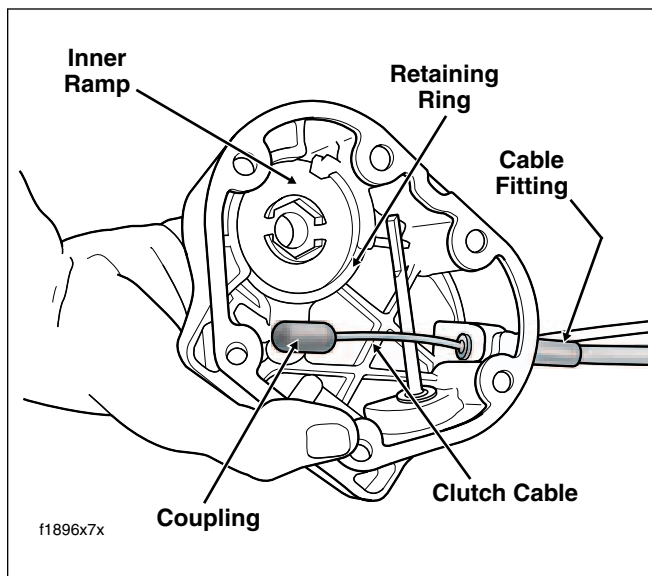


Figure 7-4. Clutch Release Cover Assembly

- a. Retract detent arm and slide right support block off end of shifter cam. Remove pivot screw to release detent arm, spring sleeve and spring. Remove and discard retaining ring. Press against inner race of roller bearing to remove from support block. Discard roller bearing.
 - b. Moving to opposite side, remove spiral lock ring from groove at left end of shifter cam. Using a small knife, push on end of spiral lock ring working tip of blade under edge of ring. Raise end of ring until free of ring groove. Work around circumference of ring to alternately pull spirals from ring groove. Discard ring.
 - c. Slide left support block off end of shifter cam. Remove and discard retaining ring. Press against inner race of roller bearing to remove from support block. Discard roller bearing.
8. Slide rubber boot off clutch cable adjuster. Holding cable adjuster with 1/2 inch wrench, loosen jam nut using 9/16 inch wrench. Back jam nut away from cable adjuster. Move adjuster toward jam nut to introduce a large amount of free play at hand lever.
 9. Remove six socket head screws to free clutch release cover from transmission side door. Remove and discard gasket.
 10. Remove retaining ring and lift inner ramp out of clutch release cover. Turn the inner ramp over so that ball sockets are facing outboard. Remove hook of ramp from button on coupling. Remove coupling from clutch cable end. See [Figure 7-4](#).
 11. Unscrew the cable fitting from the clutch release cover. Remove clutch cable and fitting.

12. Remove the fork shaft from the hole on the right side of the transmission case. See [Figure 7-5](#). Remove the shifter forks from the mainshaft and countershaft gear grooves.
13. To replace the transmission gears or side door bearings, see Section [7.6 MAINSHAFT/COUNTERSHAFT](#). To replace the main drive gear, see Section [7.7 MAIN DRIVE GEAR/BEARING](#).

CLEANING AND INSPECTION

WARNING

Compressed air can pierce the skin and cause injury. Never use your hand to check for leaks or to determine air flow rates. Wear safety glasses to shield your eyes from flying dirt and debris. Failure to comply could result in death or serious injury.

1. Clean all parts with solvent (except left and right support blocks if roller bearings installed). Blow dry with low pressure compressed air.
2. Inspect roller bearings. Verify that bearings rotate freely without sticking.
3. Inspect the shifter cam for cracks or wear. Inspect the ends for grooves or pitting. Install **new** roller bearings whenever the shifter cam is replaced.
4. Check the shifter fork shaft. Replace if bent or damaged.
5. Using a small carpenter's square, verify that the shifter fork shafts are square. If a fork does not rest directly on the square, then it is bent and must be replaced. See [Figure 7-6](#).

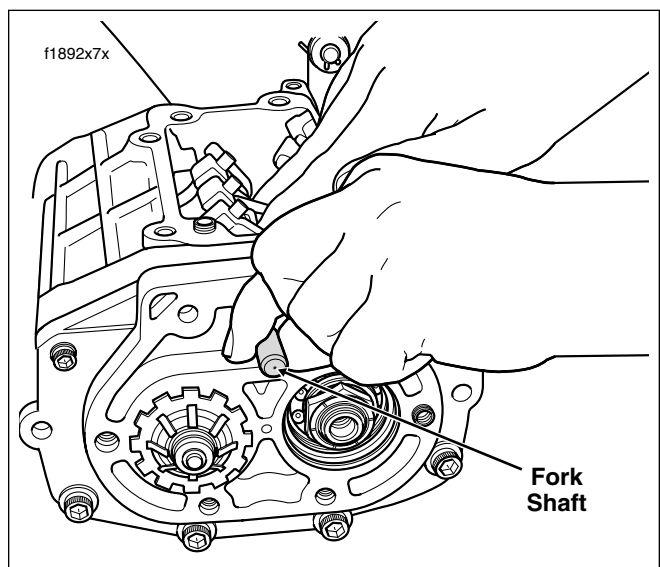


Figure 7-5. Remove Fork Shaft/Shifter Forks (Right Side View)

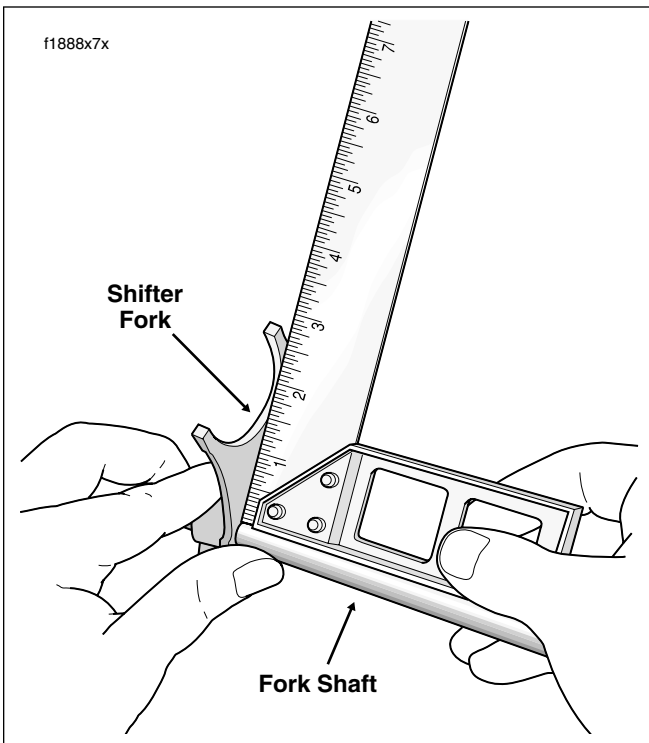


Figure 7-6. Check Shifter Forks for Squareness

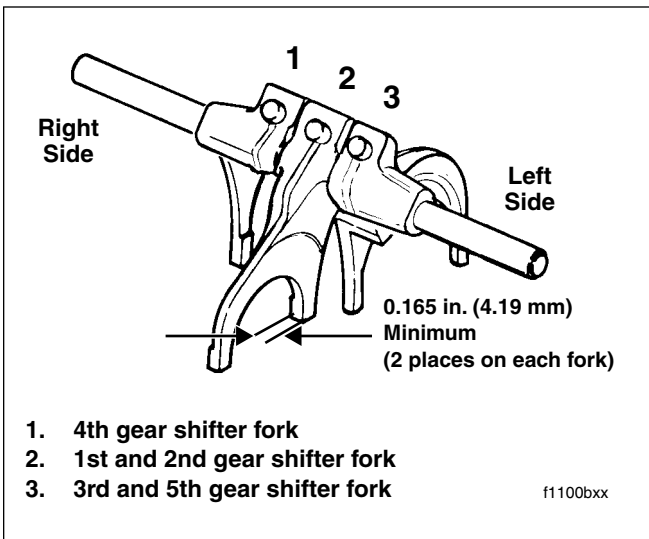


Figure 7-7. Shifter Fork Identification

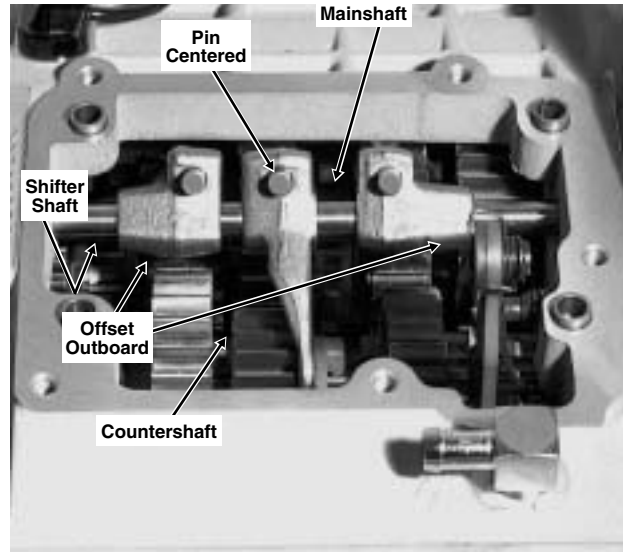
6. Inspect the shifter forks for wear. With a micrometer or dial caliper, measure the width of the forks where they contact the gear fork grooves. Replace any fork that measures less than 0.165 inch (4.19 mm). See [Figure 7-7](#).
7. Inspect the neutral switch. Depress plunger and observe the action. Plunger should spring back without binding. Switch is non-repairable and must be replaced if defective. See [ASSEMBLY](#), step 11.

ASSEMBLY

1. See upper frame of [Figure 7-8](#). Find the shifter fork with the centered pin. Holding the fork so that the pin is positioned at the rear of the transmission case, install the fork in the countershaft gear fork groove. See [Figure 7-9](#).
2. Slide the two outer forks into the mainshaft gear fork grooves so that the pins are positioned on the inside (offset outboard). After installation, the pins of all three forks should be in alignment.

SHIFTER FORKS

7976



SHIFTER CAM ASSEMBLY

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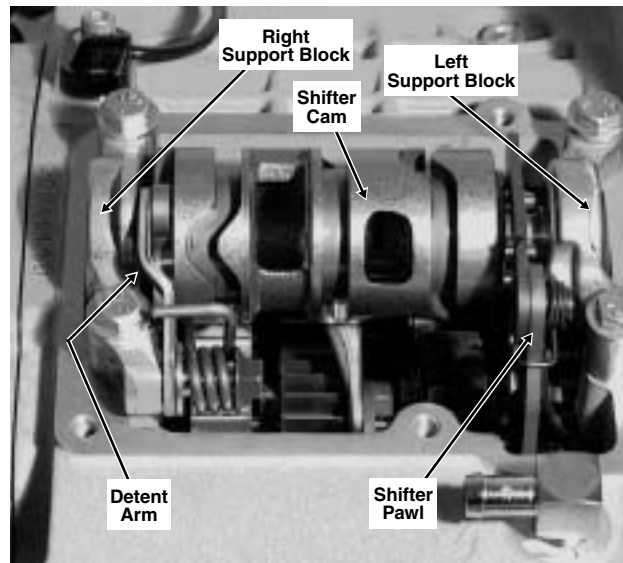


Figure 7-8. Install Shifter Forks/Shifter Cam

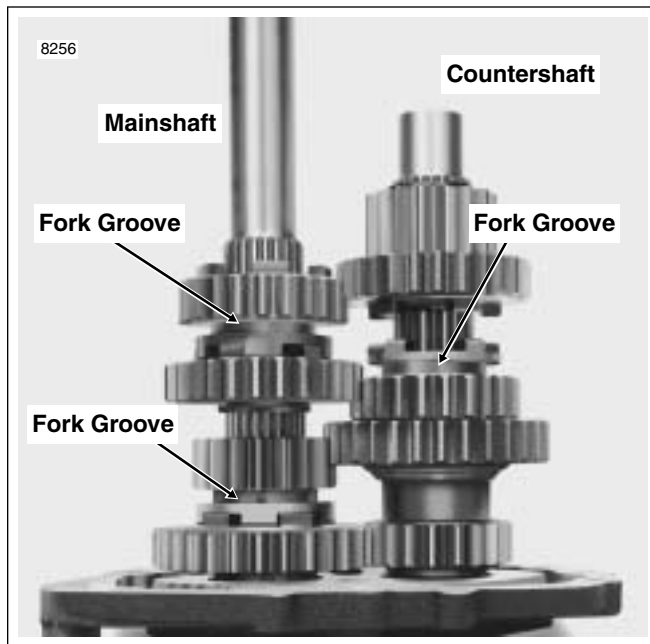


Figure 7-9. Shifter Fork Groove Locations

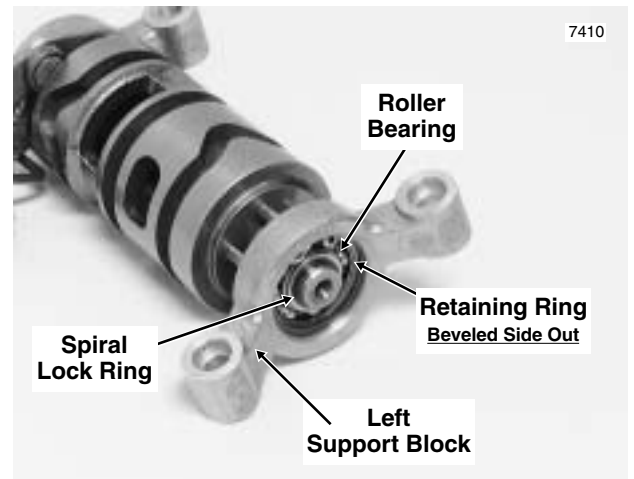
3. Insert the fork shaft into the hole on the right side of the transmission case. Slide the shaft through the shifter forks and into the drilling on the left side of the case. See [Figure 7-5](#).
4. Check the sliding movement of the forks and gears. All parts should move freely without binding.

WARNING

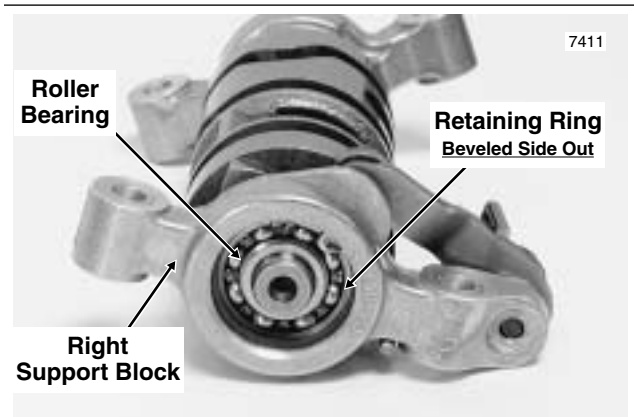
Always wear proper eye protection when installing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

5. If disassembled, assemble shifter cam assembly as follows:
 - a. Place left support block under ram of arbor press. Center **new** roller bearing over bore with the lettered side up. Using a suitable driver, press against outer race until bearing makes firm contact with the counterbore. Install **new** retaining ring with the flat side in against the bearing (beveled side out). See upper frame of [Figure 7-10](#).
 - b. Place left support block onto end of shifter cam. Start bottom end of **new** spiral lock ring into ring groove. Alternately work around circumference of ring feeding each spiral into the ring groove a section at a time. When complete, verify that spiral lock ring is fully seated in the groove.

- c. Place right support block under ram of arbor press. Center **new** roller bearing over bore with the lettered side up. Using a suitable driver, press against outer race until bearing makes firm contact with the counterbore. Install **new** retaining ring with the flat side in against the bearing (beveled side out). See lower frame of [Figure 7-10](#).
- d. Hold spring so that ends are pointing to the right. Insert long end of spring sleeve into right side of spring. Insert pivot screw into left side of spring sleeve. With roller facing screw head, slide detent arm onto short end of spring sleeve positioning arm between spring ends. Start pivot screw into threaded hole in right support block positioning support block between spring ends. Tighten pivot screw to 84-108 **in-lbs** (9.5-12.2 Nm). Retract detent arm and slide right support block onto end of shifter cam. See [Figure 7-11](#).



Left Side



Right Side

Figure 7-10. Shifter Cam Assembly

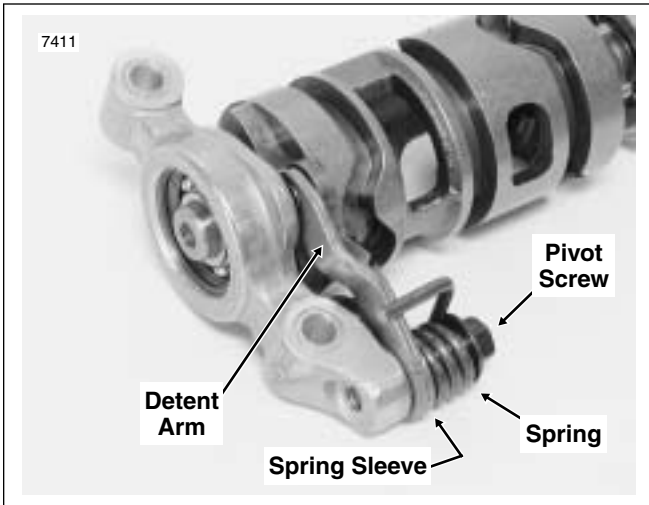


Figure 7-11. Shifter Cam Assembly

6. To ensure proper location, verify that four locating dowels are in place on the deck of the transmission case.
7. Raise the shifter cam pawl and place the shifter cam assembly over the locating dowels. See [Figure 7-12](#). While aligning the holes in the support blocks with the dowels on the deck of the transmission case, slide the shifter forks as necessary so that the fork pins engage the channels in the shifter cam. See lower frame of [Figure 7-8](#).
8. Hand start the hex head screws (with flat washers) to fasten the right and left support blocks to the transmission case. Alternately tighten the four support block screws to 84-108 **in-lbs** (9-12 Nm) in a crosswise pattern.

NOTE

Check the gear engagement and clearance in every gear to make sure assembly and alignment is correct.

9. Obtain a **new** top cover gasket and align the holes with those in the transmission case. Align the holes in the top cover with those in the gasket. Install the five socket head screws and tighten to 84-132 **in-lbs** (9.5-14.9 Nm). The long screw is installed in the center hole on the left side of the top cover.
10. Install preformed vent hose to top cover fitting, if removed.

NOTE

Whenever the transmission top cover is removed, be sure to install neutral switch after top cover installation to ensure proper switch engagement.

11. Install the neutral switch in the transmission top cover as follows:
 - a. Roll the motorcycle back and forth to verify that the transmission is in NEUTRAL.

- b. Lubricate O-ring with clean transmission lubricant.
- c. Using 7/8 inch box end wrench, install neutral switch with O-ring in the transmission top cover. Tighten to 120-180 **in-lbs** (13.6-20.3 Nm).
- d. Install the two elbow connectors on neutral switch studs.

NOTE

The neutral switch is not polarity sensitive, so the elbow connectors can be attached to either stud.

12. See [Figure 7-4](#). Install clutch cable fitting into clutch release cover. Do not tighten at this time.

NOTE

Replace cable fitting O-ring if damaged or deformed.

13. Hold clutch cable coupling with button facing outboard. Place cable end in recess of coupling. With ball sockets facing outboard, place hook of inner ramp on button of coupling. Holding inner ramp and coupling together, turn the assembly over. Place inner ramp (ball socket side down) over balls in outer ramp sockets. Install the retaining ring so that the opening is above and to the right of the outer ramp tang slot in the clutch release cover.
14. Verify that the two locating dowels are in place on the transmission side door. Hang a **new** gasket on the dowels.
15. Holding clutch release cover in position against transmission side door, install six socket head screws. Alternately tighten screws to 84-132 **in-lbs** (9.5-14.9 Nm) in the sequence shown in [Figure 7-13](#).
16. Tighten clutch cable fitting to 36-60 **in-lbs** (4-7 Nm).

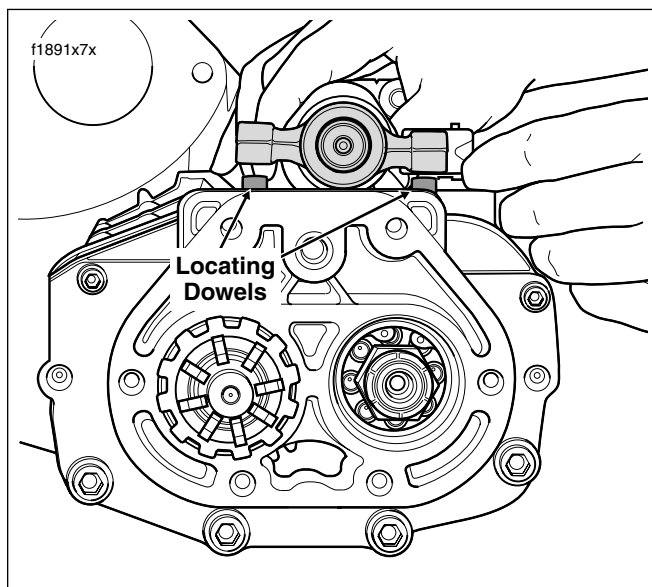


Figure 7-12. Place Support Blocks on Locating Dowels

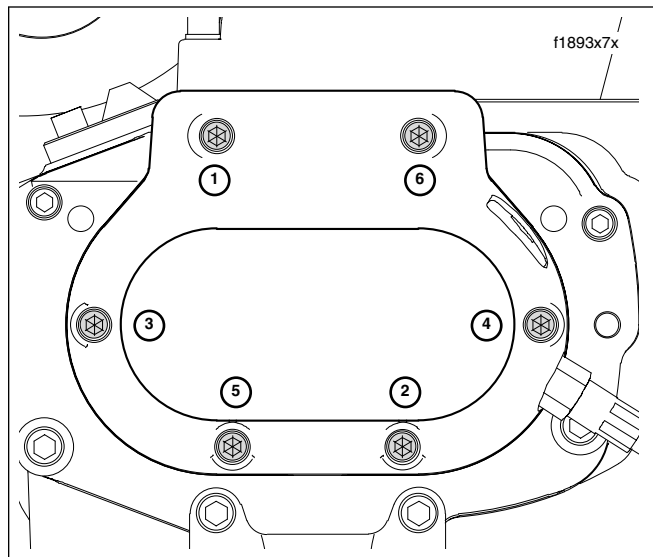


Figure 7-13. Clutch Release Cover Torque Sequence

17. Check the O-ring on the transmission lubricant drain plug for tears, cuts or general deterioration. Replace as necessary.

CAUTION

Do not overtighten filler or drain plugs. Overtightening plugs may cause leaks.

18. Install the transmission lubricant drain plug and tighten to 14-21 ft-lbs (19-28 Nm).

19. Fill the transmission with 20-24 oz. (590-710 ml) of transmission lubricant or until the lubricant level on the dipstick of the filler plug is at the F(ULL) mark with the motorcycle in a level, upright position and the filler plug resting on the threads.

Use only Harley-Davidson FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT, Part No. 99851-05 (quart).

20. Install the transmission filler plug/dipstick in the clutch release cover. Tighten the plug to 25-75 **in-lbs** (2.8-8.5 Nm).
21. Adjust the clutch cable. See Section [6.3 CLUTCH, ADJUSTMENT](#).
22. Install the exhaust system. See Section [2.38 EXHAUST SYSTEM, INSTALLATION](#).
23. Install maxi-fuse. See Section [8.3 SYSTEM FUSES, MAXI-FUSE, INSTALLATION](#).

REMOVAL/DISASSEMBLY

1. Remove maxi-fuse. See Section 8.3 SYSTEM FUSES, MAXI-FUSE, REMOVAL.
2. Remove the exhaust system in two sections. See Section 2.38 EXHAUST SYSTEM, REMOVAL.
3. Remove the magnetic drain plug at the bottom right side of the oil pan and drain the transmission lubricant into a suitable container. Remove the filler plug/dipstick.
4. Remove six socket head screws to free clutch release cover from transmission side door. Depress clutch lever to break the cover seal, and then remove and discard gasket.
5. Slide rubber boot off clutch cable adjuster. Holding cable adjuster with 1/2 inch wrench, loosen jam nut using 9/16 inch wrench. Back jam nut away from cable adjuster. Move adjuster toward jam nut to introduce a large amount of free play at hand lever.

⚠ WARNING

Always wear proper eye protection when removing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

6. Remove retaining ring securing ball and ramp mechanism to clutch release cover.
7. See Figure 7-14. Lift inner ramp out of clutch release cover. Turn the inner ramp over so that ball sockets are facing outboard. Remove hook of ramp from button on coupling. Remove coupling from clutch cable end.
8. Remove balls from outer ramp sockets. Remove outer ramp from clutch release cover.
9. Unscrew the cable fitting from the clutch release cover. Remove clutch cable and fitting.

CLEANING AND INSPECTION

1. Wash the ball and ramp components in cleaning solvent.
2. Inspect the three balls and the ball socket surfaces on both the inner and outer ramps for wear, pitting, surface breakdown and other damage.
3. Check fit of the inner ramp hub in the outer ramp. Replace both parts if excessive wear is noted.
4. Inspect the inner/outer ramp retaining ring for damage or distortion.

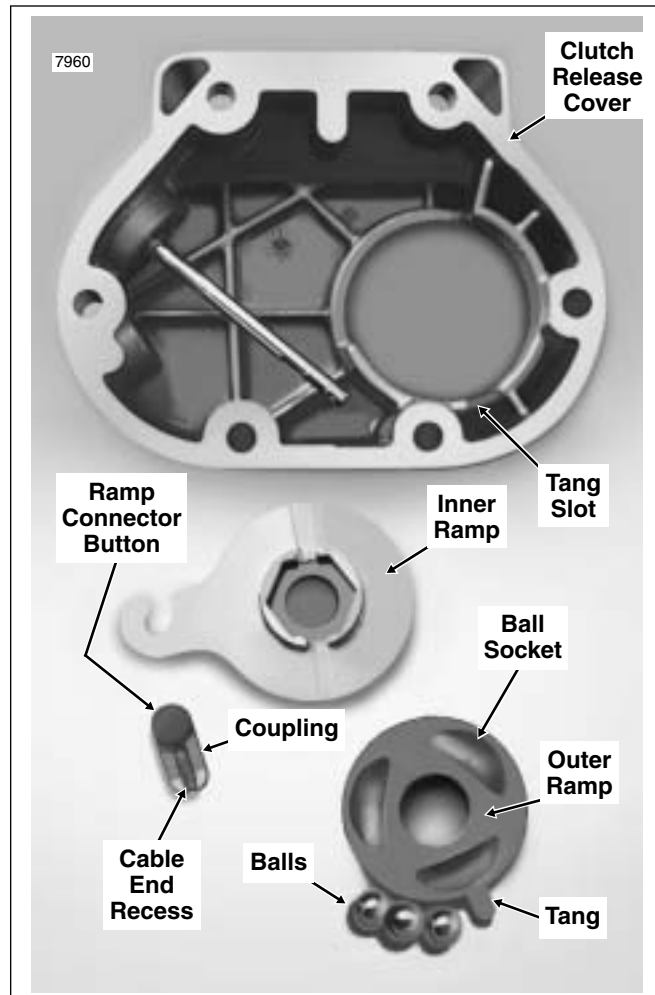


Figure 7-14. Clutch Release Cover Assembly

5. See Figure 7-14. Check the recess in the clutch release cover casting where the inner and outer ramps are retained. There should be no wear/lips worn into the bore that would catch the ramps and cock them, causing improper clutch adjustment.
6. Check clutch cable for damage and frayed or worn ends. Check cable fitting O-ring for cuts, tears or signs of deterioration.

ASSEMBLY/INSTALLATION

1. Install clutch cable fitting into clutch release cover. Do not tighten cable fitting at this time.

NOTE

Replace cable fitting O-ring if damaged or deformed.

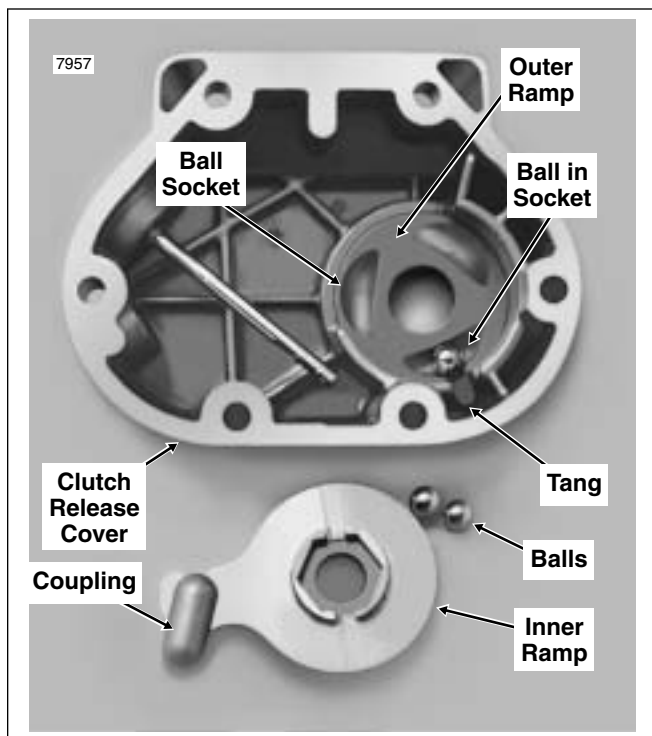


Figure 7-15. Install Outer Ramp and Balls

2. See [Figure 7-15](#). Place outer ramp in clutch release cover recess with tang in cover slot.
3. Apply a multi-purpose grease to the balls and outer ramp sockets. Place a ball in each of three outer ramp sockets.
4. Hold coupling with button facing outboard. Place cable end in recess of coupling. With ball sockets facing outboard, place hook of inner ramp on button of coupling. Holding inner ramp and coupling together, turn the assembly over.
5. Place inner ramp (ball socket side down) over balls in outer ramp sockets.

WARNING

Always wear proper eye protection when installing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

6. Install the retaining ring so that the opening is above and to the right of the outer ramp tang slot in the clutch release cover.
7. Verify that the two locating dowels are in place on the transmission side door. Hang a **new** gasket on the dowels.

8. Holding clutch release cover in position, install six socket head screws. Tighten screws to **84-132 in-lbs** (9.5-14.9 Nm) in the sequence shown in [Figure 7-13](#).
9. Tighten clutch cable fitting to **36-60 in-lbs** (4-7 Nm).
10. Check the O-ring on the transmission lubricant drain plug for tears, cuts or general deterioration. Replace as necessary. Install the transmission lubricant drain plug and tighten to **14-21 ft-lbs** (19-28 Nm).

CAUTION

Do not overtighten filler or drain plugs. Overtightening plugs may cause leaks.

11. Remove the filler plug from the clutch release cover, if installed. See [Figure 7-16](#). Check the O-ring for tears, cuts or general deterioration. Replace as necessary. See [Figure 7-17](#).
 12. Fill the transmission with 20-24 oz. (590-710 ml) of transmission lubricant or until the lubricant level on the dipstick of the filler plug is at the F(ULL) mark with the motorcycle in a level, upright position and the filler plug resting on the threads.
- Use only Harley-Davidson FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT, Part No. 99851-05 (quart).
13. Install the transmission filler plug/dipstick in the clutch release cover. Tighten the plug to **25-75 in-lbs** (2.8-8.5 Nm).
 14. Adjust the clutch cable. See Section [6.3 CLUTCH, ADJUSTMENT](#).

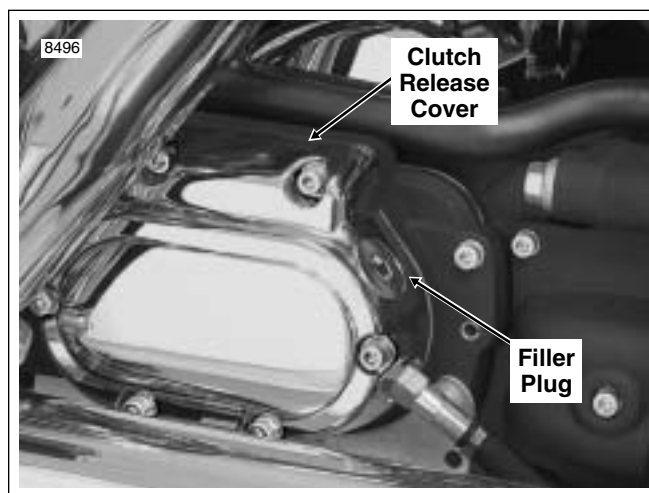


Figure 7-16. Transmission Case (Right Side)

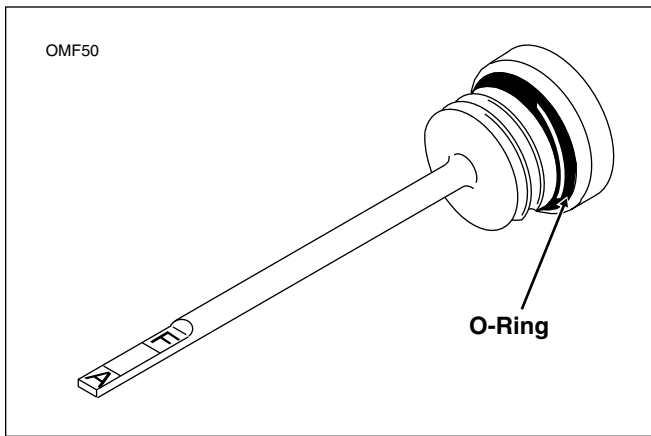


Figure 7-17. Transmission Lubricant Filler Plug/Dipstick

15. Install the exhaust system. See Section [2.38 EXHAUST SYSTEM, INSTALLATION](#).
16. Install maxi-fuse. See Section [8.3 SYSTEM FUSES, MAXI-FUSE, INSTALLATION](#).

NOTE

Check the eight digit number stamped on the transmission case just above the side door. If the third digit is "9," then the transmission was built for Japan only. If the digit is "0," then it was built for all countries except Japan. If servicing a Japanese transmission, follow the steps under [REMOVAL](#) below and then see Appendix [D.1 JAPANESE MAINSHAFT/COUNTERSHAFT](#) for disassembly and assembly instructions.

REMOVAL

1. Remove the exhaust system in two sections. See Section [2.38 EXHAUST SYSTEM, REMOVAL](#).
2. Remove the shifter cam and shifter fork assemblies. See Section [7.4 SHIFTER CAM ASSEMBLY/SHIFTER FORKS, DISASSEMBLY](#).
3. Remove the primary chaincase cover. Remove clutch assembly, primary chain, and compensating sprocket components. Remove the starter jackshaft assembly and primary chaincase. See Section [6.5 PRIMARY CHAINCASE, REMOVAL](#).
4. Remove oil filler spout and starter. See Section [5.4 STARTER, REMOVAL](#), steps 6-12.
5. Remove the bearing inner race from the transmission mainshaft. See Section [6.5 PRIMARY CHAINCASE, MAINSHAFT BEARING INNER RACE, REMOVAL](#).
6. Remove the oil slinger assembly (with two-piece push rod and clutch release bearing components).
7. Lock the transmission. This can be accomplished by manually engaging the shifter dogs of any two gears (mainshaft or countershaft) with the shifter dogs of an adjacent gear and then turning the mainshaft counter-clockwise.
8. Remove the locknut from both the mainshaft and countershaft. Use an air impact wrench for best results. See [Figure 7-18](#). Remove the spacer from each shaft.
9. Remove the six socket head screws (bottom four with flat washers) to free both the side door and transmission exhaust bracket from the transmission case. Pull the side door, mainshaft and countershaft from the transmission case as a single assembly. Remove and discard the door gasket. See [Figure 7-19](#).

NOTE

DO NOT USE A HAMMER TO REMOVE THE SIDE DOOR. If the side door sticks or binds on the locating dowels, gently pry open using the indents at each side of the door. See [Figure 7-19](#).

10. To remove the main drive gear, refer to Section [7.7 MAIN DRIVE GEAR/BEARING, REMOVAL](#).

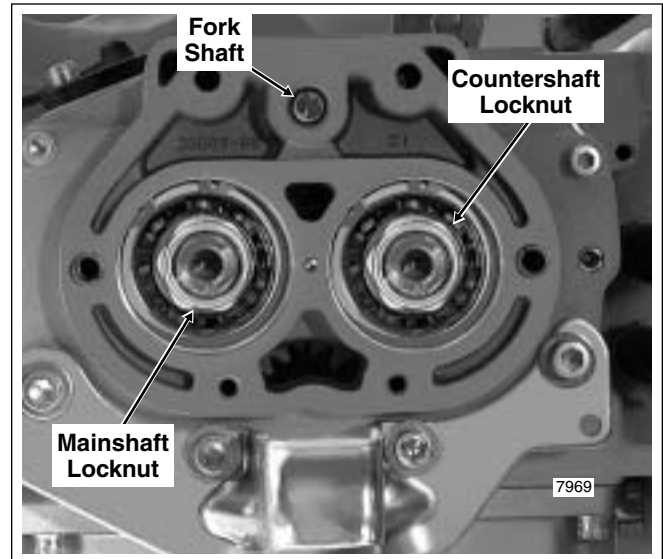


Figure 7-18. Remove Mainshaft/Countershaft Locknuts

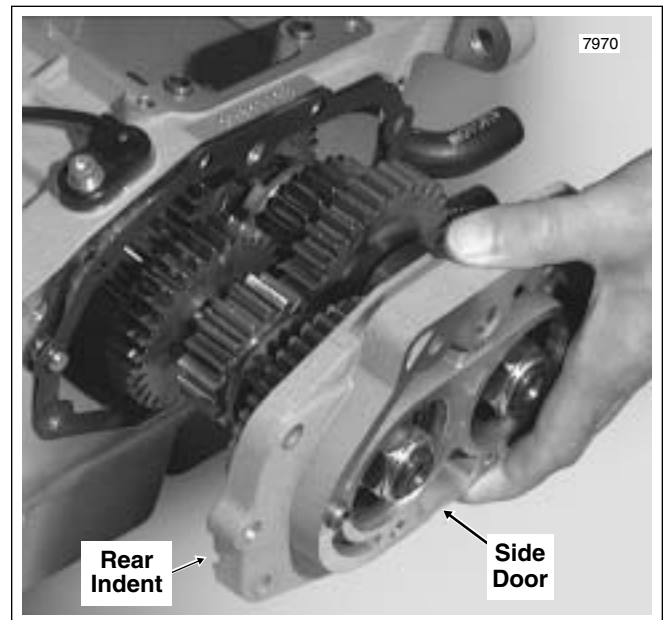


Figure 7-19. Remove Transmission Side Door

DISASSEMBLY

⚠ WARNING

Always wear proper eye protection when removing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

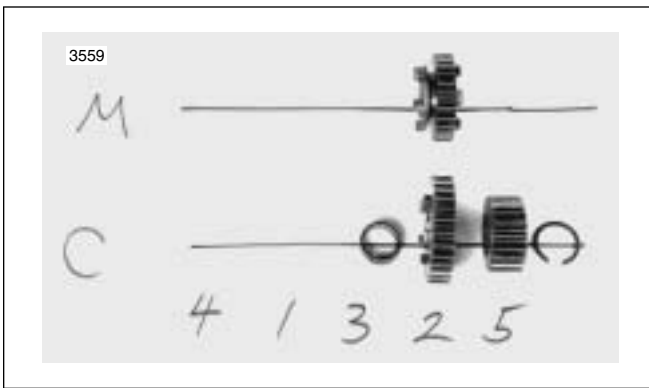


Figure 7-20. Note Gear Location During Disassembly

NOTE

Use the *TRANSMISSION SHAFT RETAINING RING PLIERS*, Part No. J-5586, to remove all mainshaft and countershaft retaining rings. Note each gear and its location as it is removed. See [Figure 7-20](#).

1. Position the assembly on a bench with the side door down, mainshaft on the left hand side.
2. See A in [Figure 7-21](#). Working from the end of the countershaft toward the side door, remove the retaining ring from the countershaft.
3. Remove the countershaft 5th gear.
4. Remove the countershaft 2nd gear and thrust washer.
5. See B in [Figure 7-21](#). Gently pull apart the split cage bearing and remove.
6. Remove the retaining ring and the countershaft 3rd gear.
7. See C in [Figure 7-21](#). Moving to the mainshaft, remove the mainshaft 2nd gear.
8. See D in [Figure 7-21](#). Remove the upper retaining ring and thrust washer.

NOTE

For best results, move the lower retaining ring toward the side door. The mainshaft 3rd gear will move down the shaft for easy access to the upper retaining ring.

9. Remove the mainshaft 3rd gear.
10. Remove the thrust washer and lower retaining ring.
11. See E in [Figure 7-21](#). Gently pull apart the split cage bearing and remove.
12. Leave both the mainshaft and countershaft 1st gears and the mainshaft and countershaft 4th gears on their respective shafts.

CAUTION

Supporting the gears is necessary to provide support for the side door bearing inner races. Failure to support the gears will result in bearing damage.

13. Support the countershaft 1st gear and press out the countershaft.
14. Remove the mainshaft 1st gear.
15. Support the mainshaft 4th gear and press out the mainshaft.
16. Remove the spacer from the mainshaft. Remove the mainshaft 4th gear, thrust washer and retaining ring. Remove the split cage bearing from the mainshaft race.
17. Remove the spacer from the countershaft. Remove the countershaft 4th gear and the countershaft 1st gear. Remove the thrust washer and retaining ring. Gently pull apart the split cage bearing and remove.

CLEANING AND INSPECTION

1. Clean all parts in cleaning solvent and blow dry with compressed air.
2. Check gear teeth for damage. Replace the gears if they are pitted, scored, rounded, cracked or chipped.
3. Inspect the engaging dogs on the gears. Replace the gears if the dogs are rounded, battered or chipped.
4. Inspect the side door bearings. Bearings must rotate freely without drag. Replace the bearings if pitted or grooved. Proceed as follows:
 - a. Remove the retaining rings and press the bearings out of the side door.

CAUTION

To avoid side door damage, use a flat plate for support when pressing in new bearings.

- b. When installing new bearings, always press on the bearing OD marked with the number stamp. The number stamp must face toward the outside surface of the side door. Use a flat plate to support the inboard side of the side door at the bearing bores.

NOTE

Note that one side of the retaining rings are beveled. Always install the ring with the beveled side opposite the bearing. Side doors using the beveled retaining rings are marked with a "drill-point" hole between the bearing bores. See [Figure 7-23](#).

- c. Install **new** retaining rings with the flat side in towards the bearing, the beveled side out.

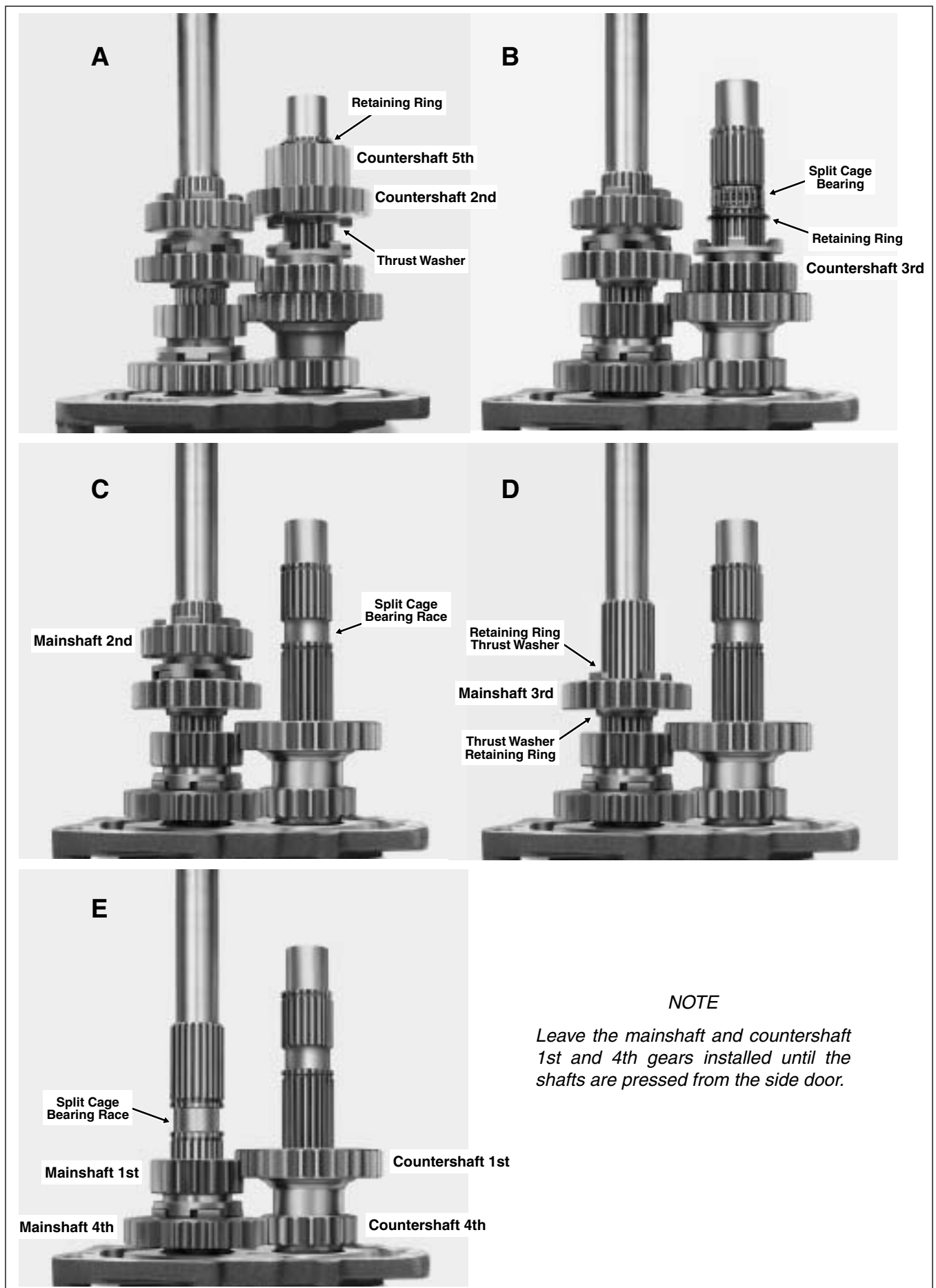


Figure 7-21. Mainshaft/Countershaft Disassembly

ASSEMBLY

⚠ WARNING

Always wear proper eye protection when installing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

⚠ WARNING

Always use new retaining rings when assembling the mainshaft and countershaft. Reusing retaining rings can cause the transmission to become “locked” during vehicle operation, a situation which could result in death or serious injury.

NOTE

Use the TRANSMISSION SHAFT RETAINING RING PLIERS, Part No. J-5586, to install all mainshaft and countershaft retaining rings.

1. Install a **new** retaining ring in the groove closest to the side door end of the mainshaft. Slide the thrust washer onto the side door end of the mainshaft until it contacts the retaining ring. Lightly coat split cage bearing with oil and install in the mainshaft race next to the thrust washer.
2. See [Figure 7-22](#). Install mainshaft 4th gear over the split cage bearing with the shifter dogs up. From the opposite end of the shaft, slide on the mainshaft 1st gear with the shifter fork groove facing the side door end of the shaft.
3. Install a **new** retaining ring in the groove closest to the side door end of the countershaft. Slide the thrust washer onto the side door end of the countershaft until it contacts the retaining ring. Lightly coat split caged bearing with oil and install in the countershaft race next to the thrust washer.
4. See [Figure 7-22](#). Install countershaft 1st gear over the split caged bearing with the taper facing down (flat side up). From the same end of the shaft, slide on the countershaft 4th gear so that the sleeve contacts the taper of the countershaft 1st gear.

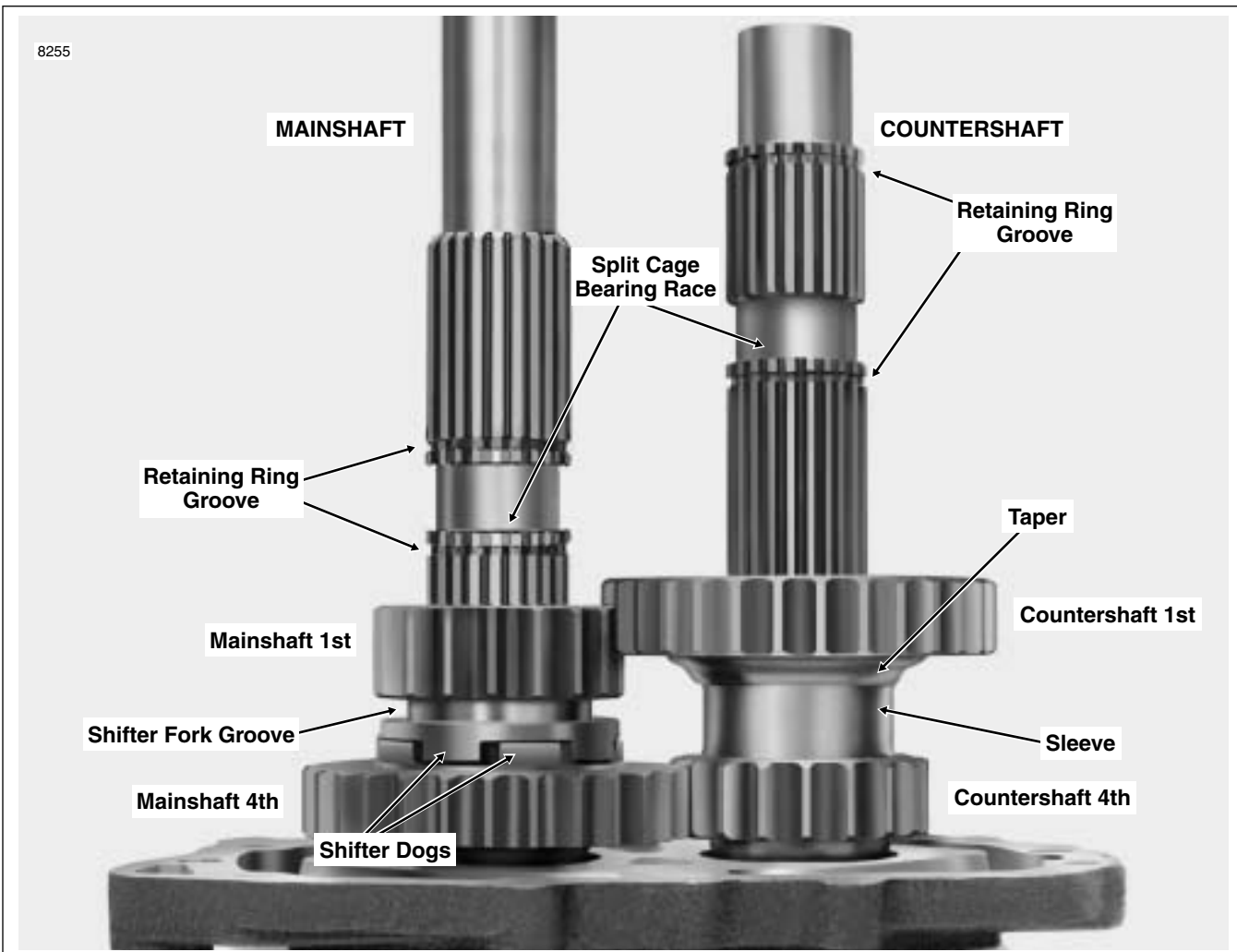


Figure 7-22. Install Mainshaft and Countershaft 1st and 4th Gears

5. See [Figure 7-25](#). Slide the spacers onto the shafts with the tapered side facing the side door end. Note that the mainshaft spacer has a shoulder while the countershaft spacer does not.

CAUTION

Failure to support the inner races while pressing shafts through the side door bearings will result in bearing damage.

6. Place the side door in an arbor press. Support the inner bearing races with a suitable socket. Starting with the mainshaft, press the shafts into the bearings. With the shafts properly pressed into the side door, the spacers will have no end play. Be sure to install the mainshaft to the left of the fork shaft hole (when viewing the side door from the top).
7. Install a spacer and locknut on the threaded end of each shaft and tighten the nuts until finger tight. See [Figure 7-23](#). Final tightening is performed under [INSTALLATION](#), steps 5 and 6.

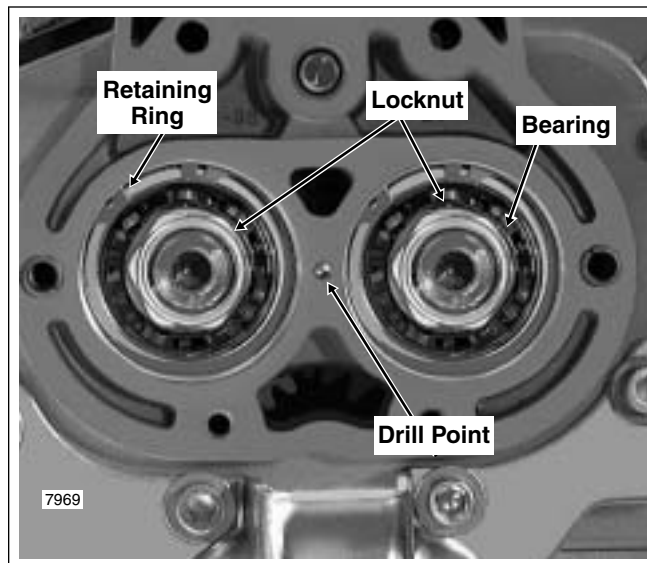


Figure 7-23. Side Door Bearings

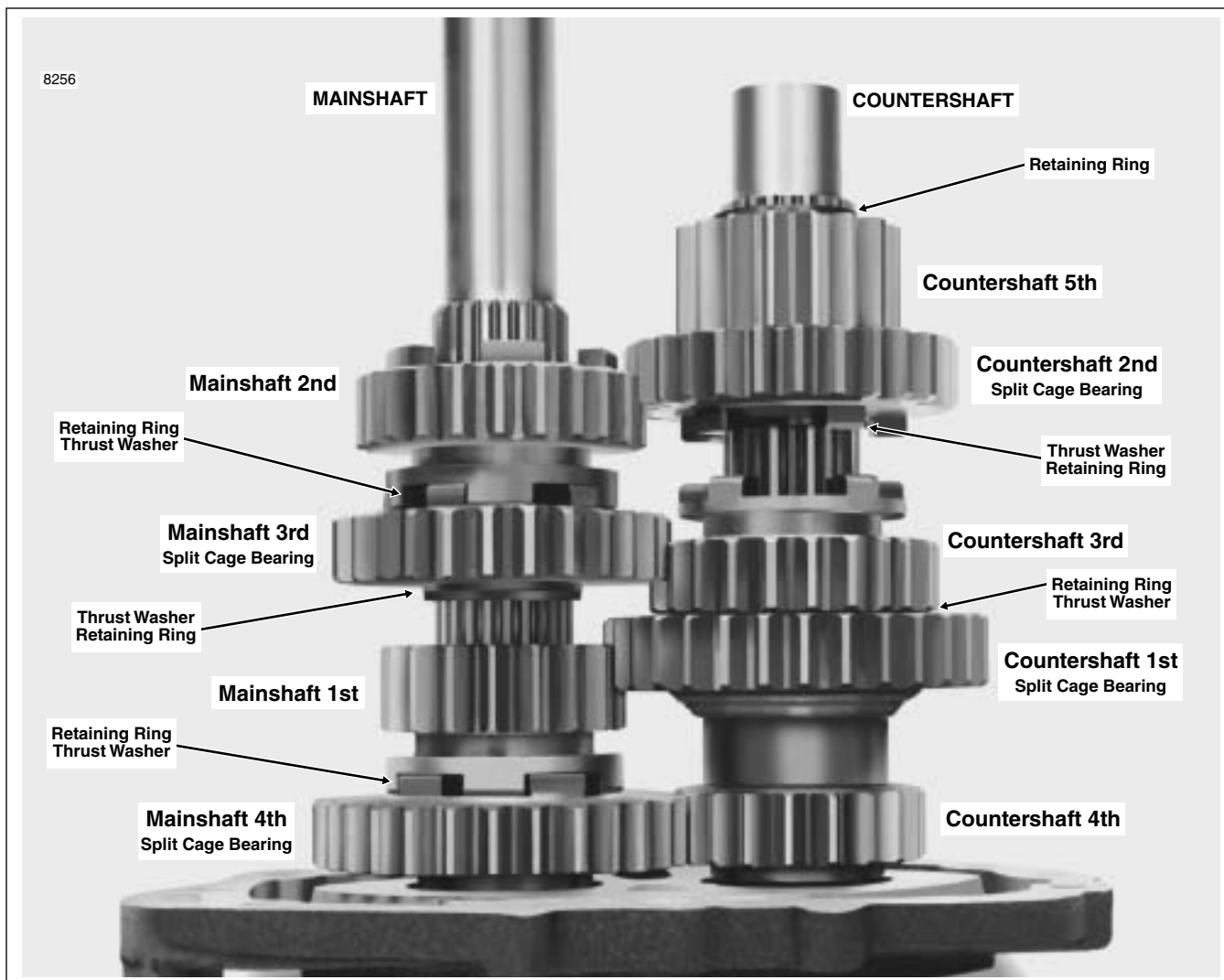


Figure 7-24. Completed Side Door Assembly

f1103axx

1. Side door
2. Gasket
3. Mainshaft spacer
4. Countershaft spacer
5. Mainshaft
6. Countershaft
7. Spacer (2)
8. Locknut (2)
9. Bearings, one-piece split cage (4)
10. Mainshaft 4th gear
11. Thrust washer (5)
12. Retaining ring (6)
13. Mainshaft 1st gear
14. Countershaft 4th gear
15. Retaining ring
16. Countershaft 1st gear
17. Countershaft 3rd gear
18. Mainshaft 3rd gear
19. Countershaft 2nd gear
20. Thrust washer (2)
21. Countershaft 5th gear
22. Mainshaft 2nd gear
23. Push rod
24. Push rod – left side
25. Clutch release bearing

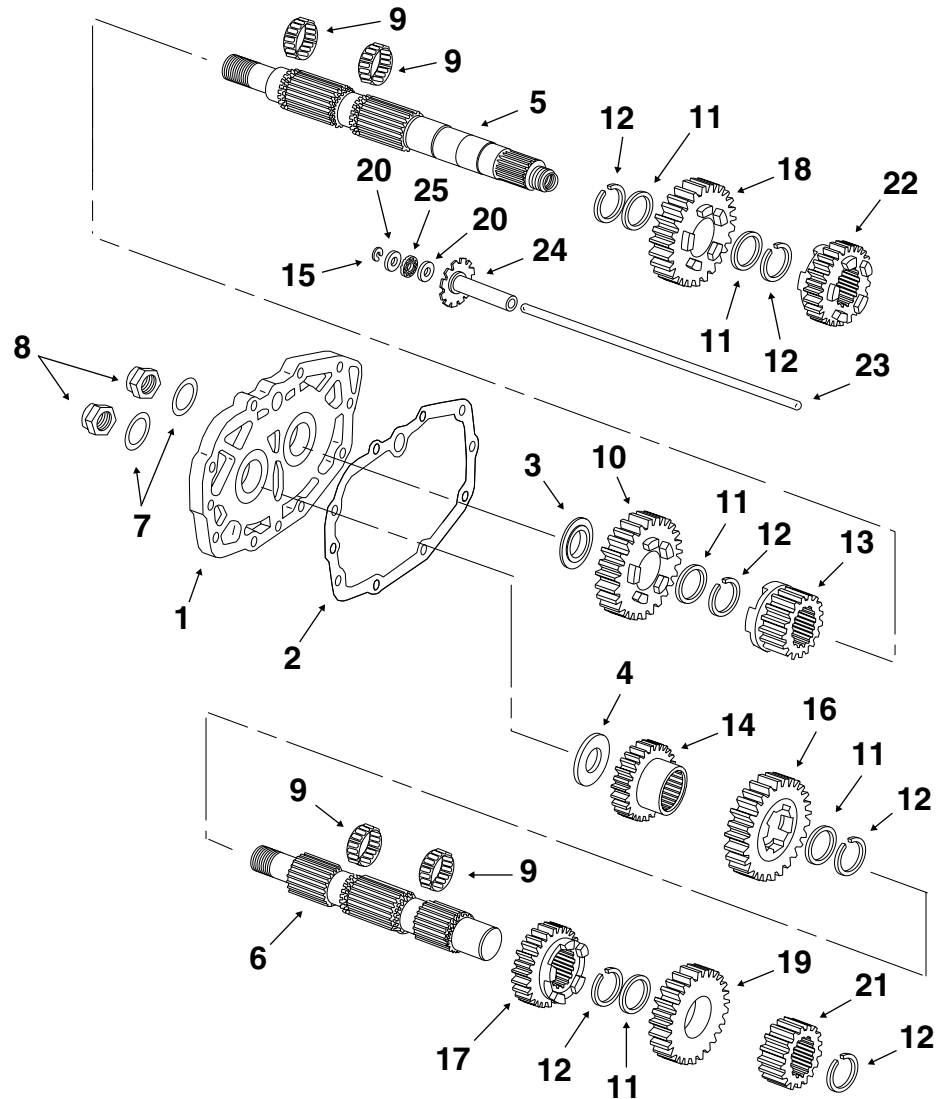


Figure 7-25. Side Door, Mainshaft and Countershaft Assembly (Exploded View)

8. See [Figure 7-24](#). Install countershaft 3rd gear with the shifter fork groove facing opposite the side door.
9. Install a **new** retaining ring in the groove just above the mainshaft 1st gear. Slide a thrust washer down the mainshaft until it contacts the retaining ring. Lightly coat split caged bearing with oil and install in the mainshaft race next to the thrust washer. Place mainshaft 3rd gear over the bearing. Install a second thrust washer and a **new** retaining ring above the gear
10. Install a **new** retaining ring in the groove above the countershaft 3rd gear. Slide a thrust washer down the countershaft until it contacts the retaining ring. Lightly coat split caged bearing with oil and install in the countershaft race next to the thrust washer. Install the countershaft 2nd gear over the bearing with the shifter dogs facing the side door end of the shaft.
11. Slide the countershaft 5th gear down the countershaft until it contacts the countershaft 2nd gear. Install a **new** retaining ring in the groove above the countershaft 5th gear.
12. Install the mainshaft 2nd gear on the shaft with the shifter fork groove towards the side door.

The final assembly appears as shown in [Figure 7-24](#).

NOTE

Install the main drive gear, if removed. See [Section 7.7 MAIN DRIVE GEAR/BEARING, INSTALLATION](#).

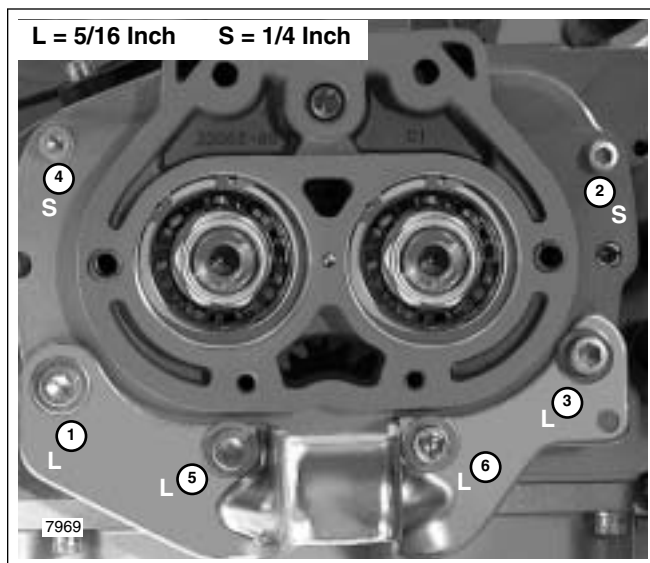


Figure 7-26. Side Door Screw Size and Torque Sequence

INSTALLATION

1. Verify that the two locating dowels are in place on the right side of the transmission case. Hang a **new** gasket on the dowels.
2. Squirt a liberal amount of clean transmission lubricant into the main drive gear to prelube needle bearings. Install the assembled side door in the transmission case. See [Figure 7-19](#).
3. Install the four 5/16 inch screws (with flat washers) to fasten transmission exhaust bracket and bottom of side door to the transmission case. Install the two 1/4 inch screws to fasten the top of the side door to the transmission case. Alternately tighten six screws until snug.
4. Resetting the torque wrench as necessary, tighten the four 5/16 inch screws to 13-18 ft-lbs (17.6-24.4 Nm) and the two 1/4 inch screws to 84-132 **in-lbs** (9.5-14.9 Nm) in the sequence shown in [Figure 7-26](#).
5. Lock the transmission. This can be accomplished by manually engaging the shifter dogs of any two gears (mainshaft or countershaft) with the shifter dogs of an adjacent gear and then turning the mainshaft locknut counterclockwise.

6. With the transmission locked, tighten the mainshaft and countershaft locknuts to 45-55 ft-lbs (61-75 Nm). See [Figure 7-23](#).
7. Install the oil slinger assembly (with two-piece push rod and clutch release bearing components).
8. Install shifter cam and fork assemblies. See Section [7.4 SHIFTER CAM ASSEMBLY/SHIFTER FORKS, ASSEMBLY](#).
9. Install the bearing inner race on the transmission mainshaft. See Section [6.5 PRIMARY CHAINCASE, MAIN-SHAFT BEARING INNER RACE, INSTALLATION](#).
10. Install the starter and oil filler spout. See Section [5.4 STARTER, INSTALLATION](#), steps 1-8.
11. Install the primary chaincase and starter jackshaft assembly. Install the clutch assembly, primary chain, and compensating sprocket components. Install the primary chaincase cover. See Section [6.5 PRIMARY CHAINCASE, INSTALLATION](#).
12. Install the exhaust system. See Section [2.38 EXHAUST SYSTEM, INSTALLATION](#).

NOTES

PRELIMINARY INSTRUCTIONS

NOTE

Leave the transmission case in the frame unless the case itself requires replacement. For illustration purposes, some photographs may show the case removed.

1. Remove the exhaust system in two sections. See Section 2.38 EXHAUST SYSTEM, REMOVAL.
2. Remove the shifter cam and shifter fork assemblies. See Section 7.4 SHIFTER CAM ASSEMBLY/SHIFTER FORKS, DISASSEMBLY.
3. Remove the primary chaincase cover. Remove the clutch assembly, primary chain, and compensating sprocket components. Remove the starter jackshaft assembly and primary chaincase. See Section 6.5 PRIMARY CHAINCASE, REMOVAL.
4. Remove the starter. See Section 5.4 STARTER, REMOVAL, steps 6-11.
5. Moving to rear wheel, remove E-clip and loosen hex nut on right side of axle. Moving to left side, turn adjuster cam in a counterclockwise direction until belt tension is relieved. Remove the belt from the transmission sprocket.
6. Remove the bearing inner race from the transmission mainshaft. See Section 6.5 PRIMARY CHAINCASE, MAINSHAFT BEARING INNER RACE, REMOVAL.

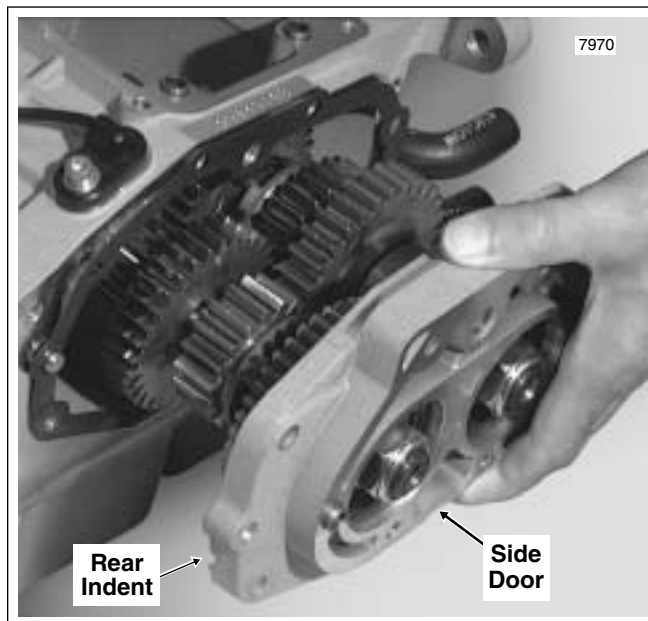


Figure 7-27. Remove Transmission Side Door

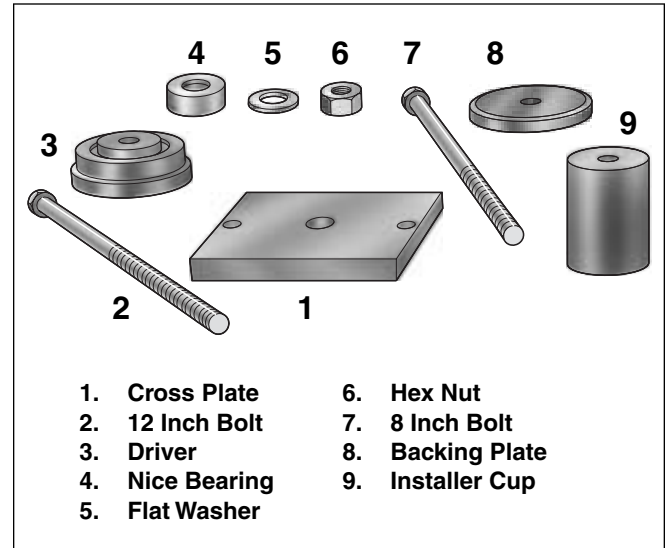


Figure 7-28. Main Drive Gear/Bearing Remover/Installer (Part No. HD-35316B)

7. See Figure 7-27. Remove the six socket head screws (bottom four with flat washers) to free both the side door and transmission exhaust bracket from the transmission case. Pull the side door, mainshaft and countershaft from the transmission case as a single assembly. Remove and discard the door gasket.

NOTE

DO NOT USE A HAMMER TO REMOVE THE SIDE DOOR. If the side door sticks or binds on the locating dowels, gently pry open using the indents at each side of the door. See Figure 7-27. Exercise caution to avoid damaging paint.

8. Remove the two socket screws and lockplate to free the sprocket nut. Remove the sprocket nut. Use an air impact wrench for best results.

NOTE

The transmission sprocket nut has left handed threads. Turn the nut clockwise to remove from the main drive gear.

9. Remove the transmission sprocket.

REMOVAL

1. Obtain the MAIN DRIVE GEAR/BEARING REMOVER/INSTALLER (HD-35316B). See Figure 7-28.
2. Obtain two screws with flat washers not provided with tool. One screw must be 1/4-20 x 1 inch, and the other must be 5/16-18 x 1-1/2 inch.

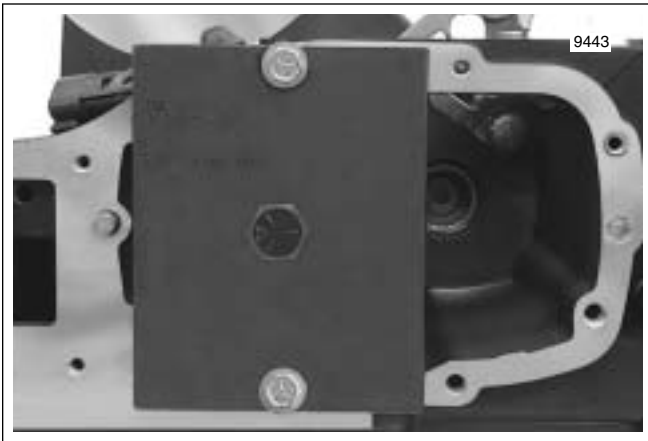


Figure 7-29. Main Drive Gear Removal (Right Side)

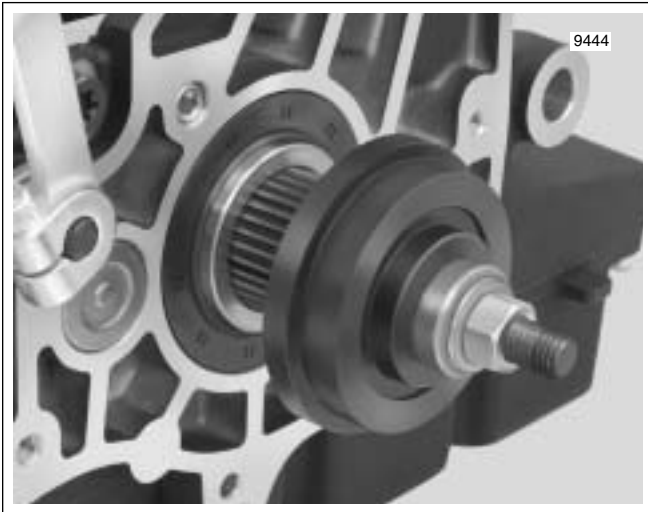


Figure 7-30. Main Drive Gear Removal (Left Side)

3. With the stamp "this side out" facing outboard and the script right side up, fasten cross plate to right side of transmission case using second most rearward set of holes in the side door flange. Install the 1/4-20 x 1 inch screw (with flat washer) in the top flange hole, the 5/16-18 x 1-1/2 inch screw (with flat washer) in the bottom flange hole. Alternately tighten screws until snug.
4. Slide 12 inch bolt through center hole in cross plate until threaded end exits left side of transmission case. See [Figure 7-29](#).
5. On left side of transmission case, slide driver over end of bolt with the side stamped "S" facing the transmission case.
6. Sparingly apply graphite lubricant to threads of bolt to ensure smooth operation and prolong service life.
7. Install Nice bearing, flat washer and hex nut on bolt. See [Figure 7-30](#).

8. Holding head of bolt on right side of transmission case, turn hex nut on left side in a clockwise direction until main drive gear is free.
9. Remove tool. Remove main drive gear from inside transmission case.
10. On left side of transmission case, pull spacer from bore of large oil seal.
11. Remove quad seal from either bevel on spacer or shoulder on main drive gear. Discard quad seal.

NOTE

Always replace the main drive gear bearing when the main drive gear is removed. The bearing will be damaged during the removal procedure.

WARNING

Always wear proper eye protection when removing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

12. Remove retaining ring from groove in bearing bore.
13. From inside transmission case, use a block of wood and rubber mallet to gently tap bearing (and large oil seal) towards the outside. Discard bearing and large oil seal.

CLEANING AND INSPECTION

1. Clean all parts in solvent except the transmission case and needle bearings. Blow dry with compressed air.

CAUTION

Do not clean the transmission case and needle bearings. Normal cleaning methods will wash dirt and other contaminants into the bearing case and behind the needle bearings leading to bearing failure.

2. Inspect the main drive gear for pitting and wear. Replace if necessary.
3. Inspect the needle bearings inside the main drive gear. Replace the needle bearings if the mainshaft race is pitted or grooved.
4. Replace the sprocket if teeth are cracked or worn. See [Section 6.4 SECONDARY DRIVE BELT AND SPROCKETS](#), [TRANSMISSION SPROCKET](#), for more information.

Needle Bearing Replacement

NOTE

If the main drive gear needle bearings and/or small oil seal need to be replaced, proceed as follows.

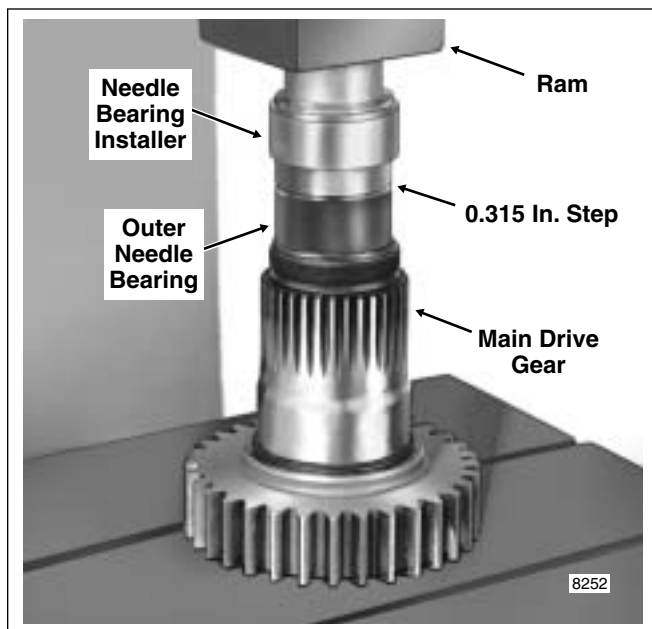


Figure 7-31. Press Clutch Side Needle Bearing into Main Drive Gear

1. Pull small oil seal from splined end of main drive gear. Use a seal remover or rolling head pry bar for best results.
2. Remove needle bearings using a bushing/bearing puller or a suitable straight-thru press tool.
3. Obtain the MAIN DRIVE GEAR NEEDLE BEARING AND SMALL OIL SEAL INSTALLER (HD-37842A).
4. With the splined side up, center main drive gear under ram of arbor press.
5. Start **new** outer (clutch side) needle bearing into splined end.
6. Insert the 0.315 inch step end of tool into needle bearing.
7. Apply pressure until shoulder on tool makes light contact with the gear. See [Figure 7-31](#). Remove tool.
8. Lightly apply Loctite RETAINING COMPOUND No. 609 to OD of **new** small oil seal.
9. With the lip garter spring side down, start oil seal into splined end.
10. Turn the tool over and insert the 0.080 inch step end into oil seal.
11. Apply pressure until shoulder on tool makes light contact with the gear. See [Figure 7-32](#). Remove tool.

NOTE

An alternative method is provided which allows the small oil seal to be pressed into place after installation of the main drive gear. For more information, see [FINAL INSTRUCTIONS](#), step 14.

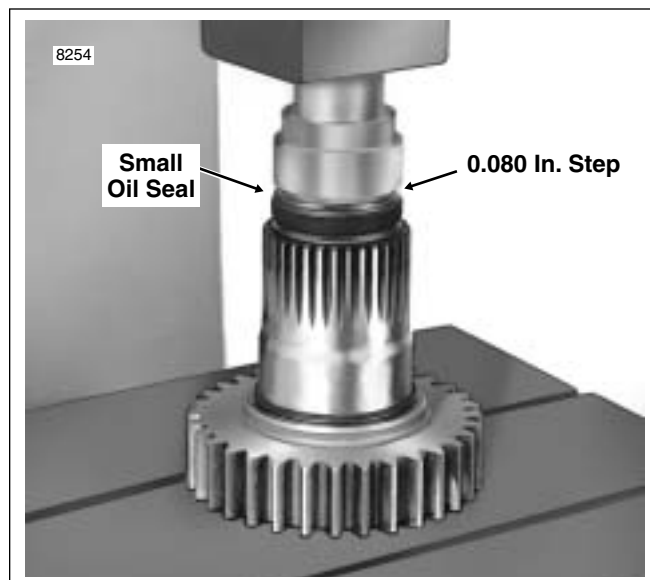


Figure 7-32. Press Small Oil Seal into Main Drive Gear

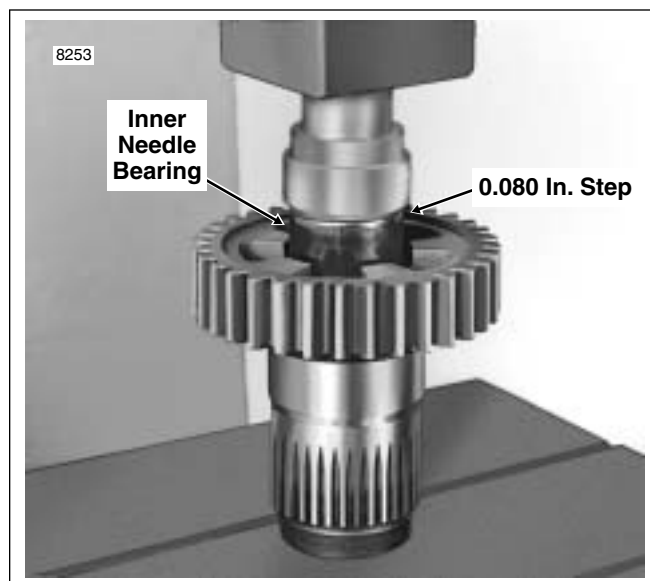


Figure 7-33. Press Transmission Side Needle Bearing into Main Drive Gear

12. Turn the main drive gear over so that the gear side is up.
13. Start **new** inner (transmission side) needle bearing into gear end.
14. Insert the 0.080 inch step end of tool into needle bearing.
15. Apply pressure until shoulder on tool makes light contact with the gear. See [Figure 7-33](#). Remove tool.

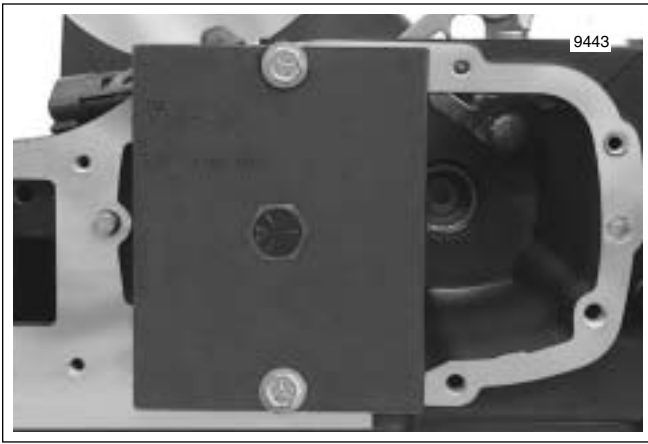


Figure 7-34. Main Drive Gear Bearing Installation (Right Side)



Figure 7-36. Main Drive Gear Installation (Right Side)



Figure 7-35. Main Drive Gear Bearing Installation (Left Side)



Figure 7-37. Main Drive Gear Installation (Left Side)

INSTALLATION

NOTE

A light interference fit should allow the main drive gear bearing to be hand pressed into the transmission case. Move to step 7 if the bearing installs easily by hand. If the bearing is difficult to install, start at step 1 below.

1. If removed, fasten cross plate to right side of transmission case using second most rearward set of holes in the side door flange (with the stamp “this side out” facing outboard and the script right side up). Alternately tighten screws until snug.
2. Slide 12 inch bolt through center hole in cross plate until threaded end exits left side of transmission case. See [Figure 7-34](#).

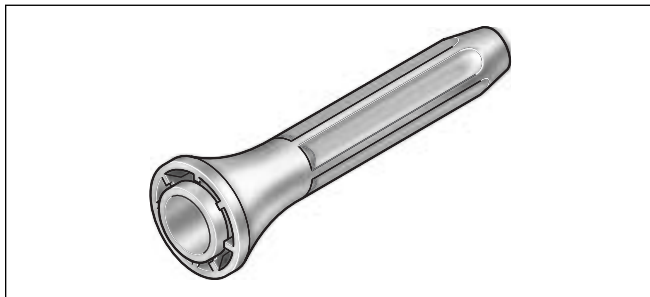
3. On left side of transmission case, slide **new** bearing over end of bolt with the lettered side out.
4. With the side stamped “S” facing the transmission case, slide driver over end of bolt until it contacts bearing.
5. Install Nice bearing, flat washer and hex nut on bolt. See [Figure 7-35](#).
6. Holding head of bolt on right side of transmission case, turn hex nut on left side in a clockwise direction until bearing bottoms in the bore. Remove tool.

⚠ WARNING

Always wear proper eye protection when installing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.



Figure 7-38. Install Retaining Ring With Gap Facing Rear



**Figure 7-39. Main Drive Gear Large Oil Seal Installer
(Part No. HD-41496)**

7. With the beveled side out and the ring gap facing the rear, install **new** retaining ring in groove of bearing bore. Verify that the ring is fully seated in the groove. See [Figure 7-38](#).
8. From inside transmission case, carefully position main drive gear in bearing bore.
9. Install backing plate onto 8 inch bolt. From inside transmission case, slide 8 inch bolt through main drive gear until threaded end exits left side of transmission case. Pull on end of bolt until backing plate is positioned flat against inboard side of main drive gear. See [Figure 7-36](#).
10. On left side of transmission case, slide installer cup over end of bolt with the open side over the main drive gear.
11. Sparingly apply graphite lubricant to threads of bolt.
12. Install Nice bearing, flat washer and hex nut on bolt. See [Figure 7-37](#).
13. Holding head of bolt inside transmission case, turn hex nut on left side in a clockwise direction until shoulder on main drive gear makes contact with bearing. Remove tool.
14. Obtain the MAIN DRIVE GEAR LARGE OIL SEAL INSTALLER (HD-41496). See [Figure 7-39](#). Proceed as follows:

- a. With the lip garter spring side out (toward the transmission case), place a **new** large oil seal on lip of tool.
- b. Lightly apply Loctite RETAINING COMPOUND No. 609 to OD of oil seal.
- c. Slide tool over the main drive gear so that it is positioned squarely over the bearing bore.
- d. Hand press the oil seal into the bore. If necessary, use a rubber mallet to lightly tap the tool.

15. Carefully slide **new** quad seal down main drive gear until it contacts shoulder.
16. Apply a small amount of clean transmission lubricant to OD of spacer. With the bevel on the ID toward the transmission case, slide spacer down main drive gear until it contacts shoulder (quad seal seats in bevel of spacer).

FINAL INSTRUCTIONS

1. Verify that the two locating dowels are in place on the right side of the transmission case. Hang a **new** gasket on the dowels.
2. Squirt a liberal amount of clean transmission lubricant into the main drive gear to prelube needle bearings. Install the assembled side door in the transmission case. See [Figure 7-27](#).
3. Install the four 5/16 inch screws (with flat washers) to fasten transmission exhaust bracket and bottom of side door to the transmission case. Install the two 1/4 inch screws to fasten the top of the side door to the transmission case. Alternately tighten six screws until snug.

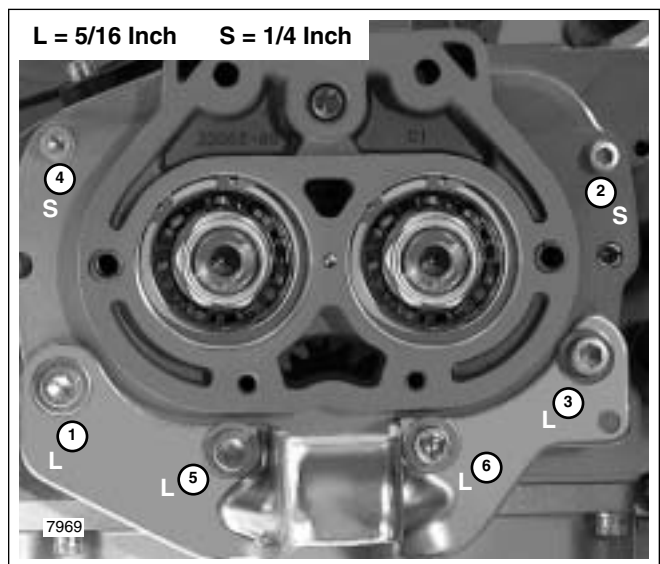


Figure 7-40. Side Door Screw Size and Torque Sequence

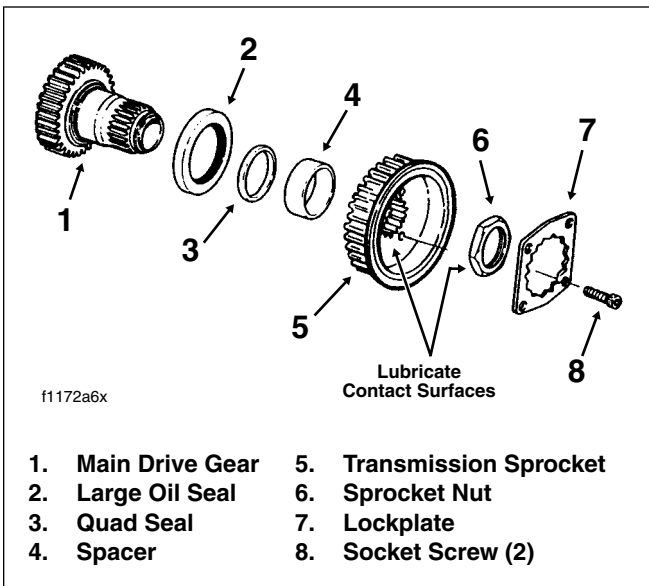


Figure 7-41. Install Transmission Sprocket Components

4. Resetting the torque wrench as necessary, tighten the four 5/16 inch screws to 13-16 ft-lbs (18-22 Nm) and the two 1/4 inch screws to 84-108 **in-lbs** (9-12 Nm) in the sequence shown in [Figure 7-40](#).
5. Install the transmission sprocket. Install the belt on the sprocket as the sprocket is installed on the main drive gear.
6. Install the sprocket nut. The following procedure is based on whether a new or used nut is being used.

CAUTION

Exercise caution to avoid getting oil on the threads of the sprocket nut or the integrity of the lock patch may be compromised.

New sprocket nut: smear a small quantity of clean engine oil on the inside face of the sprocket nut and the outside face of the sprocket. Limit the application to where the surfaces of the two parts contact each other. See [Figure 7-41](#). Install the sprocket nut until finger tight.

NOTE

The transmission sprocket nut has left handed threads. Turn the nut counterclockwise to install on the main drive gear.

Used sprocket nut: apply Loctite High Strength Threadlocker 262 (red) to the threads of the sprocket nut. Also smear a small quantity of Loctite or clean engine oil on the inside face of the sprocket nut and the outside face of the sprocket. Limit the application to where the surfaces of the two parts contact each other. See [Figure 7-41](#). Install the sprocket nut until finger tight.

7. Obtain FINAL DRIVE SPROCKET LOCKING TOOL (HD-41184) to lock transmission sprocket. See [Figure 7-42](#). Proceed as follows:

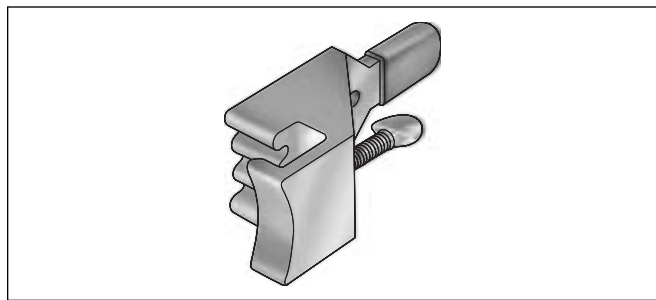


Figure 7-42. Final Drive Sprocket Locking Tool (Part No. HD-41184)

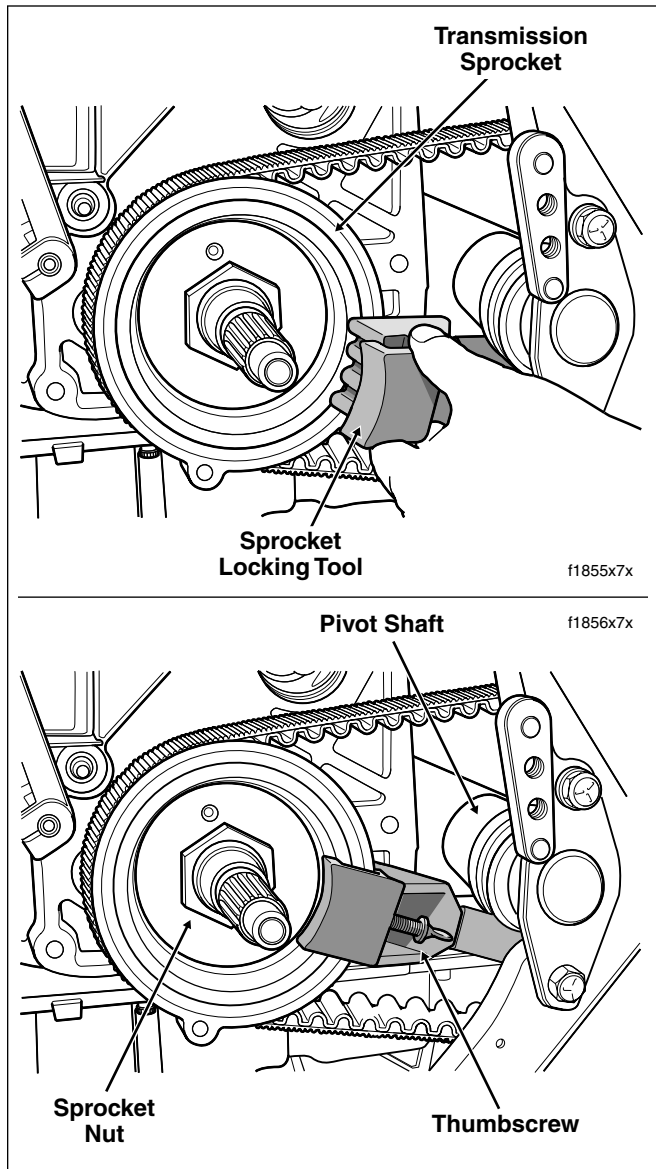
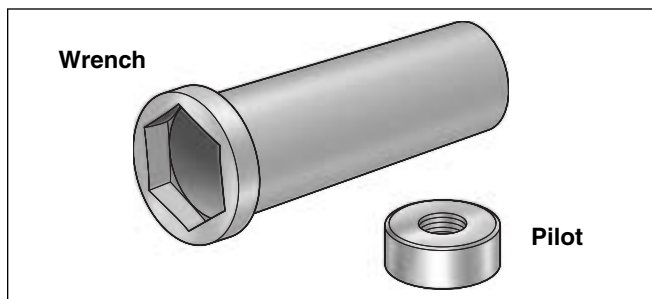
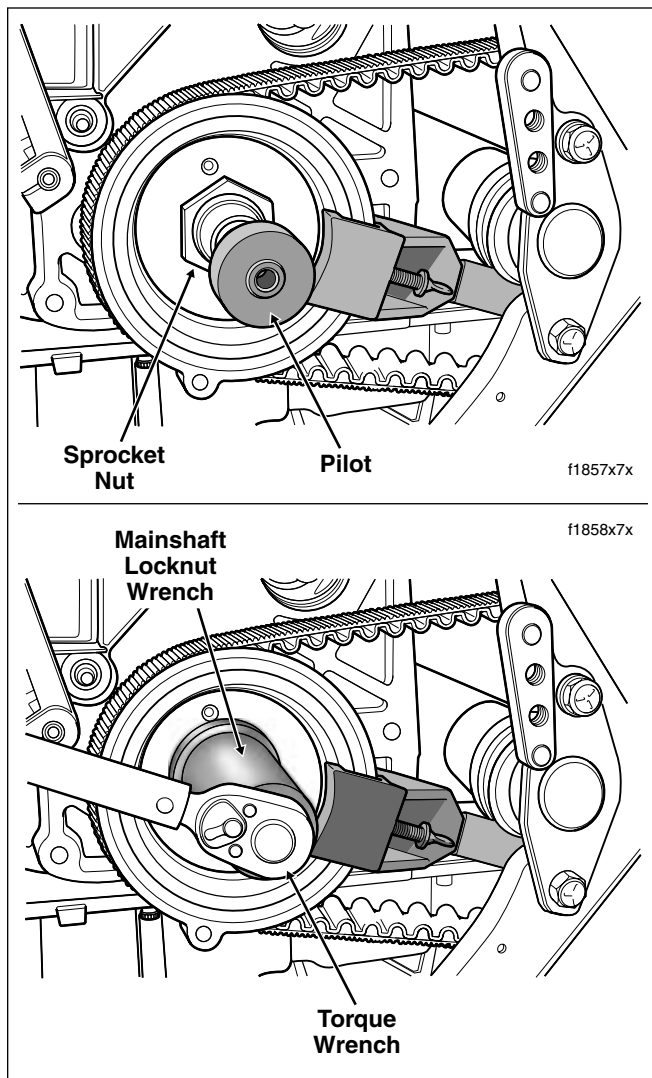


Figure 7-43. Install Final Drive Sprocket Locking Tool

- a. Insert handle of tool below pivot shaft inboard of bottom frame tube and attach to sprocket. See upper frame of [Figure 7-43](#).



**Figure 7-44. Mainshaft Locknut Wrench/Pilot
(Part No. HD-94660-37B)**



**Figure 7-45. Install Mainshaft Locknut Pilot/Wrench
and Torque Sprocket Nut**

- b. Snug thumbscrew to lock position of tool on sprocket. See lower frame of [Figure 7-43](#).
8. Obtain MAINSHAFT LOCKNUT WRENCH/PILOT (HD-94660-37B). See [Figure 7-44](#). Proceed as follows:

- a. Install pilot on threaded end of mainshaft. See upper frame of [Figure 7-45](#).
- b. Slide sleeve of locknut wrench over pilot and onto sprocket nut.
- c. Tighten sprocket nut to 60 ft-lbs (81 Nm). See lower frame of [Figure 7-45](#). As the nut is tightened the handle of the sprocket locking tool rises to contact the pivot shaft, thereby preventing sprocket/mainshaft rotation.

9. Scribe a straight line on the transmission sprocket nut continuing the line over onto the transmission sprocket as shown in [Figure 7-46](#). Tighten the transmission sprocket nut an additional 35° to 40°.
10. Install lockplate over nut so that two diagonally opposite holes align with two tapped holes in sprocket. To find the best fit, lockplate can be rotated to a number of positions and can be placed with either side facing sprocket.
11. If holes in lockplate do not align with those in sprocket, tighten sprocket nut as necessary (up to the 45° maximum) until sprocket and lockplate holes are in alignment. See [Figure 7-46](#).

CAUTION

Maximum allowable tightening of sprocket nut is 45° of counterclockwise rotation after a torque of 60 ft-lbs (81 Nm). Do not loosen sprocket nut to align holes or nut will be under tightened.

12. Insert two socket head screws through lockplate into sprocket holes. Tighten screws to 84-108 **in-lbs** (9.5-12.2 Nm).

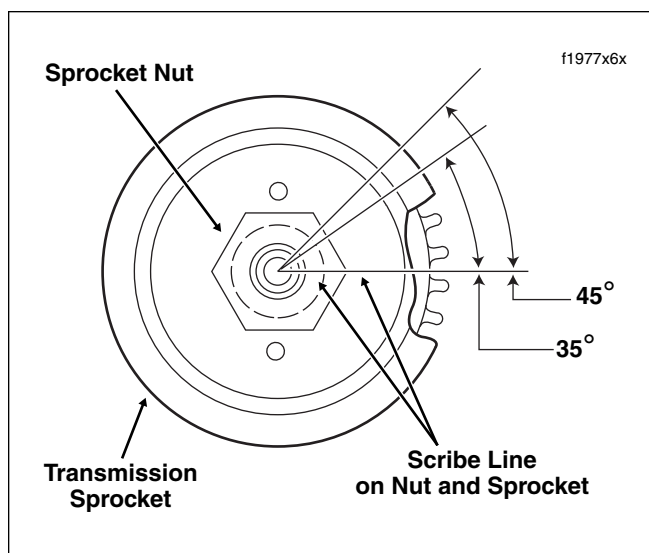


Figure 7-46. Tighten/Secure Sprocket Nut

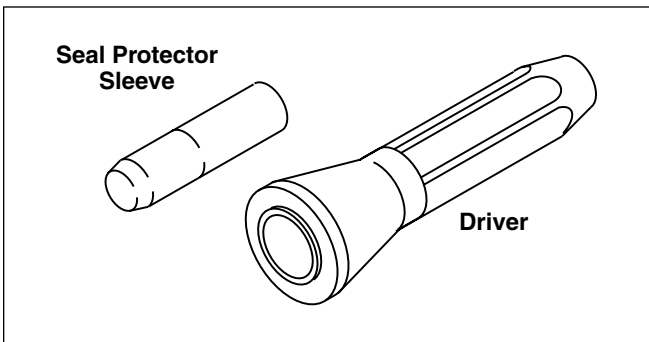


Figure 7-47. Main Drive Gear Small Oil Seal Installer (Part No. HD-41405)

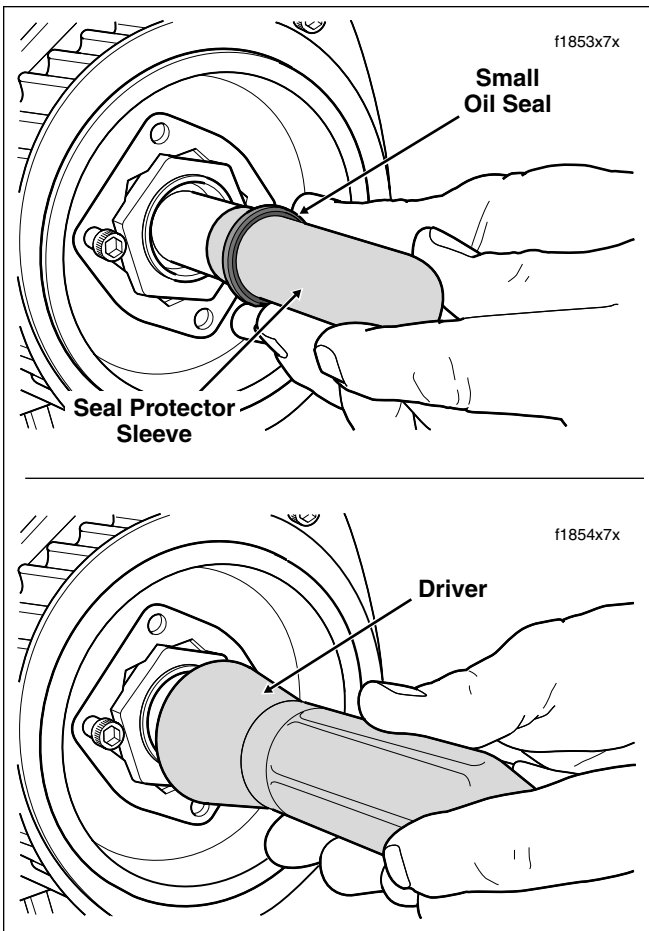


Figure 7-48. Install Small Oil Seal Using Seal Protector Sleeve and Driver

NOTE

The socket head screws have a thread locking compound that allows them to be reused up to three times. The fourth time the screws are removed, replace with **new** screws (H-D Part No. 3594).

13. Complete installation of rear wheel and adjust the belt tension. See Section [2.4 REAR WHEEL, INSTALLATION](#).

14. If the main drive gear small oil seal was not installed with the needle bearings (or if a faulty seal is discovered with the main drive gear installed in the transmission case), an alternative method is provided. Proceed as follows:

NOTE

If a serviceable small oil seal is already installed, proceed to step 15.

- a. Obtain the MAIN DRIVE GEAR SMALL OIL SEAL INSTALLER (HD-41405). See [Figure 7-47](#).
 - b. Verify that the lip garter spring is in place on the lip of the oil seal.
 - c. Place the seal protector sleeve over the end of the mainshaft.
 - d. Lightly lubricate the protector sleeve and ID of oil seal with clean transmission lubricant.
 - e. Squarely seat the oil seal on the seal protector sleeve with the lip garter spring facing the transmission case. See upper frame of [Figure 7-48](#).
 - f. Lightly apply Loctite RETAINING COMPOUND No. 609 to OD of oil seal.
 - g. Using the driver, hand press oil seal into the main drive gear. See lower frame of [Figure 7-48](#). A rubber mallet may be used to lightly tap the driver, if necessary.
15. Install the bearing inner race on the transmission mainshaft. See Section [6.5 PRIMARY CHAINCASE, MAIN-SHAFT BEARING INNER RACE, INSTALLATION](#).
 16. Install shifter cam and fork assemblies. See Section [7.4 SHIFTER CAM ASSEMBLY/SHIFTER FORKS, ASSEMBLY](#).
 17. Install the starter. See Section [5.4 STARTER, INSTALLATION](#), steps 1-8.
 18. Install the primary chaincase and starter jackshaft assembly. Install the clutch assembly, primary chain, and compensating sprocket components. Install the primary chaincase cover. See Section [6.5 PRIMARY CHAINCASE, INSTALLATION](#).
 19. Install the exhaust system. See Section [2.38 EXHAUST SYSTEM, INSTALLATION](#).

Countershaft Needle Bearing Replacement

1. Find a suitable bearing driver 1-1/4 inch (31.75 mm) in diameter.
2. From the outside of the transmission case place the needle bearing open end first next to the bearing bore. Hold the driver squarely against the closed end of the bearing and tap the bearing into place. The bearing is properly positioned when it is driven inward flush with the outside surface of the case or to a maximum depth of 0.030 inch (0.76 mm).
3. Lubricate the bearing with transmission lubricant.

GENERAL

The transmission case and oil pan can be removed as an assembly if the transmission case must be replaced.

If necessary, the oil pan can be removed without removing the transmission case. Once the rear wheel is removed, the oil pan can be slid out from the rear.

REMOVAL

Transmission Case and Oil Pan

1. See [Figure 7-49](#). Remove both the engine oil and transmission lubricant drain plugs from the oil pan. Drain the fluids into suitable containers.
2. Remove the mainshaft and countershaft assemblies. See [Section 7.6 MAINSHAFT/COUNTERSHAFT, REMOVAL](#).

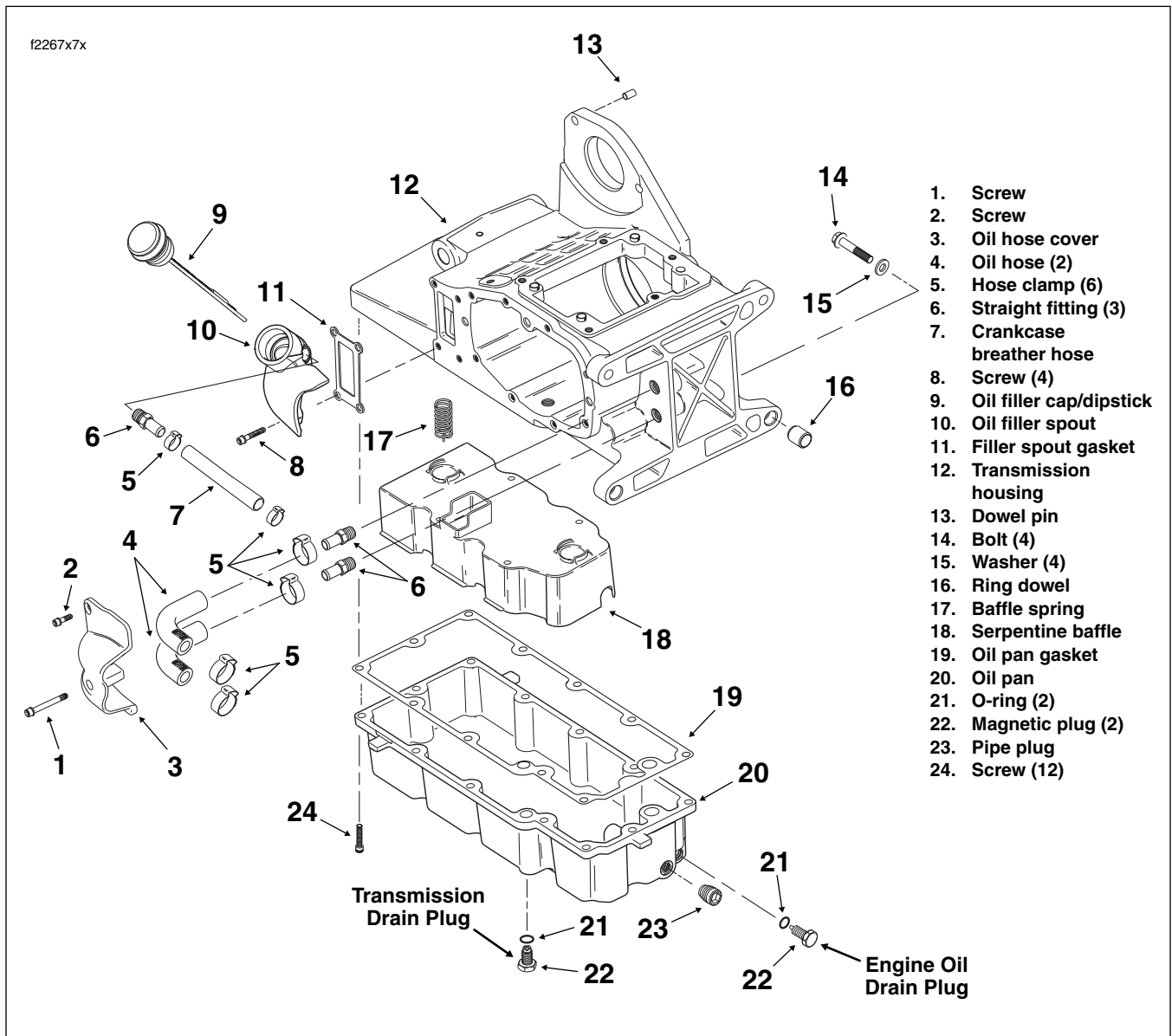


Figure 7-49. Transmission Case and Oil Pan

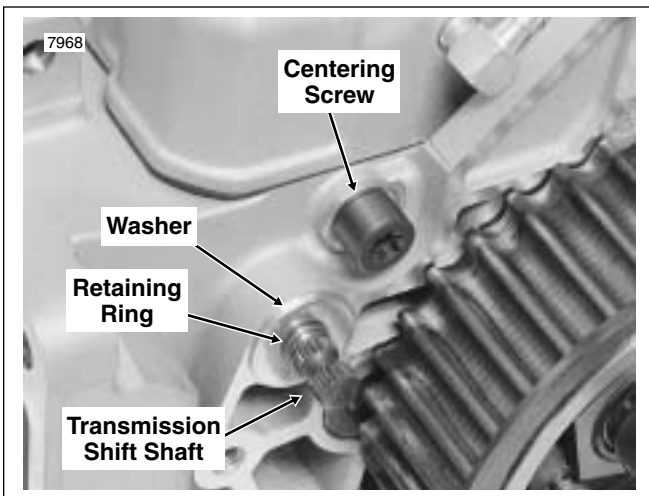


Figure 7-50. Shifter Pawl Centering Screw

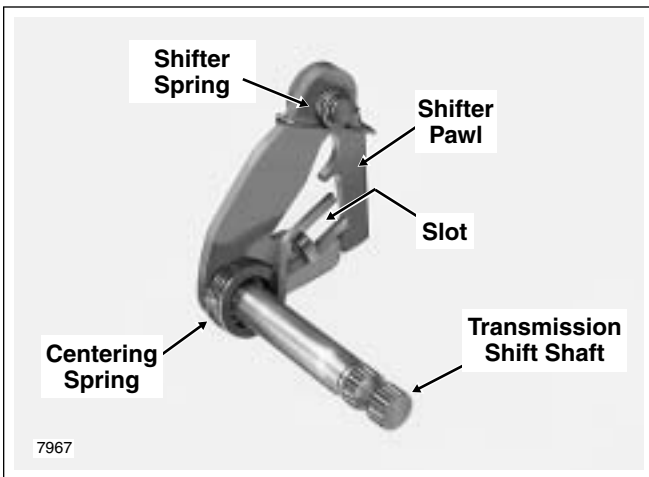


Figure 7-51. Shifter Pawl Assembly

3. Remove rear wheel and rear swingarm. See Section [2.20 REAR SWINGARM, REMOVAL](#).

NOTE

The main drive gear and bearing may be removed with the transmission case in the frame. See Section [7.7 MAIN DRIVE GEAR/BEARING, REMOVAL](#).

4. Remove the socket head screw from the shift arm. Remove the shift arm from the transmission shift shaft. Mark splines on transmission shift shaft and shift arm as they are removed to assist in assembly. See [Figure 7-50](#).
5. Using a T50 TORX drive head, turn the centering screw out until it clears the centering spring slot of the shifter pawl assembly. Remove the retaining ring and flat washer from the transmission shift shaft. See [Figure 7-51](#). Push on end of transmission shift shaft to free shifter pawl assembly from transmission case.
6. Remove two allen head socket screws to release oil hose cover. See [Figure 7-49](#).

7. Using a side cutters, cut and remove clamps on transmission side of oil supply and return hoses. Pull hoses from fittings on transmission housing.
8. Cut and remove clamp on transmission side of crankcase breather hose. Pull hose from fitting on oil filler spout.
9. Remove four bolts (with flat washers) to free front of transmission from rear of crankcase. Loosen and remove bolts in a crosswise pattern. Move transmission rearward until two ring dowels in lower flange are free of crankcase.

NOTE

If the main drive gear was not removed from the transmission case, then it may be removed at this time. See Section [7.7 MAIN DRIVE GEAR/BEARING, REMOVAL](#).

10. Remove the transmission case from the right side of the motorcycle.

NOTE

If removal is difficult, remove the twelve socket head screws to separate the oil pan from the transmission case. For best results, use a long 3/16 inch ball hex socket driver. Holes in the lower frame crossmember allow access to bolts which would not otherwise be accessible.

Oil Pan Only

NOTE

Perform the following procedure if only the oil pan must be removed.

1. See [Figure 7-52](#). Remove both the engine oil and transmission lubricant drain plugs from the oil pan. Drain the fluids into suitable containers.

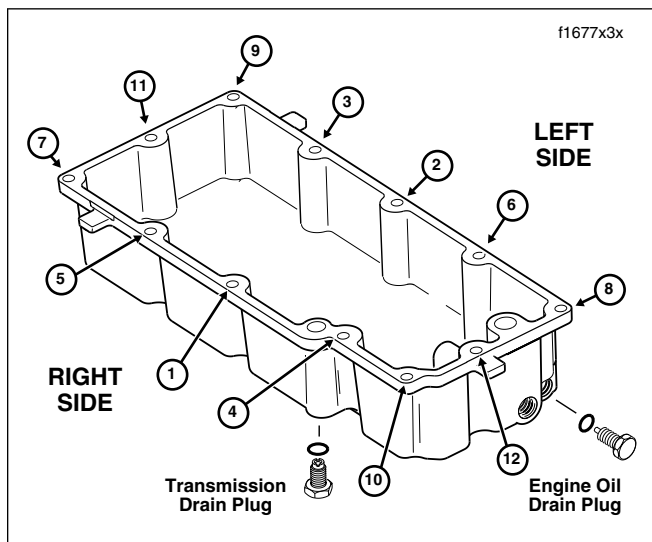


Figure 7-52. Oil Pan Torque Sequence

2. Install lifting strap around frame backbone, and using overhead jack, support motorcycle from the top.
3. Remove rear wheel. See Section [2.4 REAR WHEEL, REMOVAL](#).
4. With a long 3/16 inch ball hex socket driver (Snap-On stock number FABL6 or equal), remove the twelve socket head screws from the bottom of the oil pan.

NOTE

Holes in the frame crossmember allow access to bolts which would not otherwise be accessible.

CAUTION

Remove the engine oil dipstick before attempting to slide the oil pan rearward. Contact with the oil pan will result in damage to the dipstick.

5. Slide oil pan rearward and remove from underside of transmission.

CLEANING AND INSPECTION

1. Clean all parts in solvent except the transmission case and needle bearings. Blow dry with compressed air.

CAUTION

The transmission case and needle bearings must not be cleaned. Normal cleaning methods will wash dirt or other contaminants into the bearing case (behind the needles) and lead to bearing failure.

2. Inspect the shifter pawl and centering spring for wear. Replace assembly if pawl ends are damaged. Replace centering spring if elongated.
3. Inspect the shifter spring. Replace the spring if it fails to hold the pawl on the cam pins.
4. Thoroughly clean the oil pan with solvent, if removed.
5. Inspect the hoses for nicks, cuts or general deterioration. Replace as necessary. Used compressed air to verify that hoses and fittings are unobstructed.

INSTALLATION

Oil Pan Only

NOTE

The following procedure describes installation of the oil pan with the transmission case mounted in the motorcycle frame. Follow the applicable steps to install the oil pan with the transmission case removed from the motorcycle frame.

1. Apply a thin coat of HYLOMAR® gasket sealer to gasket surface of oil pan.

2. Place gasket on oil pan and allow sealer to dry until tacky.
3. It is normal for the baffle springs to hold the oil pan away from transmission housing. Use a long screwdriver to compress the springs as the pan enters the housing. Exercise caution to avoid cocking or distorting the springs.
4. Position oil pan under transmission and install the twelve oil pan screws, but only tighten about two turns after initial thread engagement.

CAUTION

Inspect the oil pan gasket to ensure that gasket is properly positioned. If gasket was moved out of position, remove screws and repeat step 3 to ensure that gasket is properly positioned.

5. Tighten the oil pan screws to 84-132 **in-lbs** (9.5-14.9 Nm) following the numerical sequence shown in [Figure 7-52](#).
6. Install rear wheel. See Section [2.4 REAR WHEEL, INSTALLATION](#).
7. Remove lifting strap to release frame backbone from overhead jack.

Transmission Case and Oil Pan

NOTE

If the main drive gear was assembled prior to mounting of the transmission, place belt on transmission sprocket as transmission is placed in position.

1. From right side of motorcycle, place the transmission case (with oil pan) in the frame. Move transmission forward until two ring dowels in lower flange fully engage holes in crankcase. Support the engine and transmission, so that they do not sag at their mating surfaces.
2. Install the transmission-to-engine mounting bolts as follows:
 - a. Using a crosswise pattern, **hand tighten** four bolts (with flat washers) to secure transmission housing to rear of crankcase.
 - b. Alternately tighten the four bolts to 15 ft-lbs (20.3 Nm) in the same crosswise pattern.

NOTE

For best results, use Open End Crowfoot (Snap-On FC018) on upper left and upper right transmission housing to crankcase bolts.

- c. Repeating the pattern again, final tighten the four bolts to 30-35 ft-lbs (40.7-47.5 Nm).

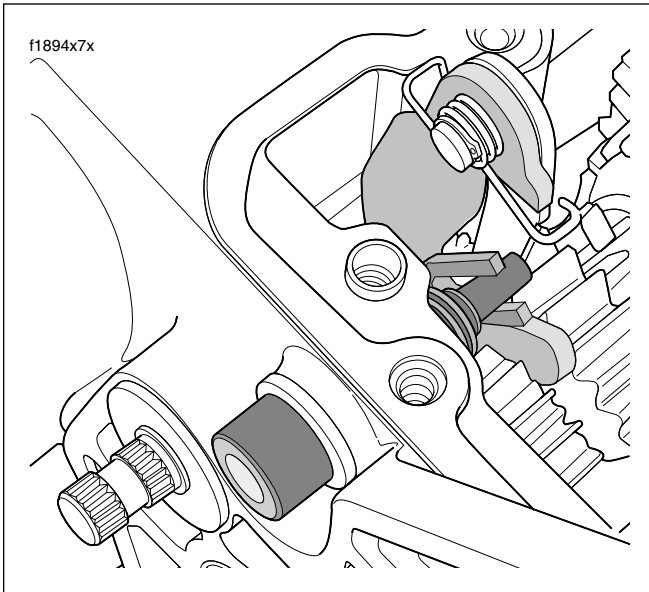


Figure 7-53. Shifter Pawl Assembly

3. Slide **new** clamps onto free ends of oil supply and return hoses. See [Figure 7-49](#). Install hoses onto transmission fittings. Crimp clamps using the Hose Clamp Pliers (HD-41137).
4. Slide **new** clamp onto free end of crankcase breather hose. Install hose onto fitting of oil filler spout. Crimp clamp using HOSE CLAMP PLIERS (HD-97087-65B).
5. Install two allen head socket screws (with captive washers) to secure oil hose cover to transmission and engine housings. Longer screw goes to engine housing. Alternately tighten screws to 84-108 **in-lbs** (10-12 Nm).
6. Slide splined end of shift shaft through sleeved bore until it protrudes from left side of transmission case. Install flat washer and retaining ring on splined end of shift shaft. Hold the shifter pawl assembly inside the transmission case so that the centering spring slot is aligned with the centering screw. Using a T50 TORX drive head, tighten centering screw until snug. See [Figure 7-53](#).
7. Install the shift arm onto the splined end of the transmission shift shaft taking note to align marks placed on splines during disassembly. Install socket head screw and tighten to 18-22 ft-lbs (24-30 Nm). Make sure screw registers in slot of shift arm.
8. Install the mainshaft and countershaft assemblies. See [Section 7.6 MAINSHAFT/COUNTERSHAFT, INSTALLATION](#).
9. Install belt on transmission sprocket.

10. Install the primary chaincase and starter jackshaft assembly. Install clutch assembly, primary chain, and compensating sprocket components. Install the primary chaincase cover. See [Section 6.5 PRIMARY CHAINCASE, INSTALLATION](#).
11. Install rear swingarm and rear wheel. Adjust belt tension. See [Section 2.20 REAR SWINGARM, INSTALLATION](#).
12. Install engine oil drain plug and tighten to 14-21 ft-lbs (19-28 Nm).
13. Add engine oil. See [Section 3.3 GENERAL INFORMATION, CHANGING ENGINE OIL AND FILTER](#), steps 9-12.