TOP FRONT ENGINE MOUNT

1. Bolt
2. Lockwasher
3. Washer
4. Frame downtube
5. Nut plate
6. Engine
7. Bolt
8. Nut
9. Top front engine mount
10. Stud
8. Inspect the wiring harness for signs of damage that may have occurred when removing the engine. Repair or replace damaged wires as required.

**Installation**

1. Make sure the frame is supported properly before installing the engine. The jack and piece of plywood will not be required until after the engine is resting in the frame.
2. Be sure all clamps or ties are in place before engine installation. See Figure 27 and Figure 28.
3. Lay out the engine mount plates and fasteners in the order shown in Figure 22 and Figure 26.
4. If the frame protectors were removed, reinstall them.
5. Position all of the wiring connectors and hoses so that they are out of the way when installing the engine.
6. Place the engine in the frame from the right side.
7. Slide the jack with the piece of plywood underneath the engine. Use the jack to align the rear engine-to-frame mounting holes. Insert the lower engine dowel pins into the rear frame engine mount bracket as shown in Figure 29.
8. Apply an antiseize lubricant to all of the engine mounting bolts prior to installation.
9. To install the rear engine mount assembly (Figure 26), perform the following:
   a. Install a flat washer on the two upper engine mount bolts and install the bolts through the frame and engine. Install the locknut and washer on the right bolt. Install the hex nut and washer on the left bolt. Do not install the battery ground cable at this time.
   b. Install a lockwasher and flat washer on the two lower engine mount bolts and install the bolts through the frame and thread into the engine hand-tight.
10. Install the left and right lower front engine mount plates, bolts, washers and nuts as shown in Figure 22. Tighten the bolts hand-tight.
11. Tighten the rear engine mounting bolts and nuts (Figure 26) to 25-30 ft.-lb. (34-41 N•m).
12. Tighten the lower front engine bolts (A, Figure 30) to 25-30 ft.-lb. (34-41 N•m). Tighten the lower front frame bolts (B, Figure 30) to 25-30 ft.-lb. (34-41 N•m).
13. Install the top center engine mount assembly (Figure 31) as follows:
   a. Install the top center engine mount bolts and washers through the engine mount.
   b. Place the shim (if used) onto the top center engine mount bolts.

**NOTE**

*Three different shim thicknesses are available: 0.030 in. (0.076 mm), 0.060 in. (1.52 mm) and 0.090 in. (2.27 mm). When installing an engine that did not have any major components replaced (engine cases, cylinder heads, top center engine mount or frame), the original thickness shim can be installed. If one of*
1. Nut
2. Lockwasher
3. Frame downtube
4. 1-pin connector (charging wire to main circuit breaker)
5. 2-pin connector (voltage regulator to alternator stator)
6. Lockwasher
7. Bolt
8. Voltage regulator
21

OIL HOSE ROUTING (1994-2003 MODELS)

Filler cap and dipstick
Oil tank
Transmission
Gear case cover
To “A”

Vent
Return
Feed

Starter
Oil filter
Oil pump

22

LOWER ENGINE MOUNT

1. Bolt
2. Washer
3. Flange nut
4. Bolt
5. Right mounting plate
6. Left mounting plate
7. Washer
8. Bolt
9. Clip
these major components was replaced, a different thickness shim may be required.

c. Install the top center engine mount onto the engine. Insert the two engine mount bolts through the frame so that the shim does not fall off.
d. Place the nut plate into position (Figure 31) and thread the engine mount bolts into the nut plate hand tight.
e. Install the VOES.
f. Tighten the engine bolts to 25-30 ft.-lb. (34-41 N•m).
g. Tighten the frame bolts to 30-35 ft.-lb. (41-47 N•m).

14. Install the top front engine mount bracket (Figure 32) as follows:
   a. Install the front upper mounting bracket and fasteners. Tighten all of the bolts hand-tight only.
   b. Tighten the engine bolts to 25-30 ft.-lb. (34-41 N•m).
   c. Tighten the frame bolts to 30-35 ft.-lb. (41-47 N•m).

   CAUTION
   Be sure the oil hoses are properly connected in Step 15. Refer to the Oil Tank and Oil Lines in Chapter Four.

15. On 883C and 1200C models, install the footrest assemblies as described in Chapter Seventeen.
16. Slide a new hose clamp onto the oil feed, return and vent hoses and connect the hoses to the oil tank.
17. Connect the battery ground wire to the crankcase bolt (Figure 23).
18. Connect the battery positive cable and the starter relay wire to the starter (Chapter Twelve).
19. Reconnect the regulator/rectifier electrical connector at the alternator stator connector. See Figure 17 (1986-1993 models) or Figure 18 (1994-2003 models).
20. Reconnect the ignition timer plate wires at the wiring harness connectors (Figure 16, typical).
21. Reconnect the neutral switch electrical connector at the neutral switch (Figure 15).
22. Connect the oil pressure switch electrical connector at the oil pressure switch (Figure 14).
23. Reconnect the clutch cable at the handlebar. Adjust the clutch as described in Chapter Three.
24. Install the intake manifold as described in Chapter Ten or Chapter Eleven.
25. Install the carburetor and reconnect the throttle and choke cables to the carburetor as described in Chapter Ten or Chapter Eleven. Adjust both cables as described in Chapter Three.
26. Install the choke knob bracket (Figure 4).
27. Install the rear chain or drive belt (Figure 13) onto the front sprocket.
28. Install the rear sprocket cover as follows:
   a. Install the rear sprocket cover (A, Figure 11) together with the rear brake pedal and linkage assembly.
   b. Install the rear sprocket cover mounting bolts and washers; tighten the bolts securely.
   c. Reconnect the brake linkage to the master cylinder (Figure 12).
   d. Install the rear master cylinder bolts (B, Figure 11) and washers and secure the master cylinder to the sprocket cover.
   e. Secure the brake line with the clip and screw (C, Figure 11).
29. Adjust the rear brake pedal as described in Chapter Three.
30. On all models except 1998-2003 1200S models, connect the VOES vacuum hose to the fitting on the carburetor (Figure 2) and connect the VOES electrical connector to the ignition module.
31. Reinstall the ignition coil bracket and the throttle cable clip (where equipped).
32. Install the ignition coil as described in Chapter Twelve.
33. Install the horn as described in Chapter Twelve.
34. Reconnect the spark plug wires.
35. Install the air filter backplate (Chapter Ten or Chapter Eleven).
36. Install the exhaust system as described in Chapter Ten or Chapter Eleven.
TOP CENTER ENGINE MOUNT

2. Washer (1986-1991 models)
4. VOES (all models except 1998-2003 1200S models)
7. Nut plate
8. Frame
9. Shim
10. Washer
11. Bolt
12. Locknut
13A. Bolt (1986-1991 models)
13B. Bolt (1992-2003 models)
15. VOES ground wire (1986-1993 models)
17. Bolt
37. Install the fuel tank as described in Chapter Ten or Chapter Eleven. Secure the fuel hose with new hose clamps, if necessary.

38. Clean the battery and check the electrolyte level as described in Chapter Twelve. The battery should be in good condition and fully charged prior to installing it in the frame.

39. Install the battery tray and battery (Chapter Twelve).

40. Install a new oil filter and refill the engine oil (Chapter Three).

41. Refill the transmission oil (Chapter Three).

42. Reconnect the positive battery cable, then the negative cable (Chapter Twelve).

CAUTION
Check the battery breather tube routing to prevent battery mist from damaging exposed parts. Refer to Battery in Chapter Twelve.

43. Adjust the drive chain or belt (Chapter Three).

44. Install the seat and seat bolt. Tighten the bolt securely.

45. Before starting the engine, perform the following:
   a. Recheck the engine tank oil level (Chapter Three).
b. Check the oil tank hoses for leaks.
c. Recheck the transmission oil level. (Chapter Three).
d. Check that the throttle moves smoothly and snaps back when released.
e. Check the fuel tank for an adequate supply of gasoline. If the motorcycle has been sitting for an extended period, drain the tank and fill with fresh gasoline.
f. Turn off the fuel valve and check for leaks. Turn the fuel valve on.
g. Wipe off the exhaust pipes with a clean rag to remove as much oil and grease residue as possible to prevent the pipes from smoking when they become hot.

46. Start the engine and allow it to idle with the transmission in neutral. Note the following:
a. Listen carefully for rattles or other abnormal sounds. These may indicate loose brackets or fasteners.
b. When the engine reaches normal operating temperature, shut it off.
c. Check the engine oil level (Chapter Three).
d. Check the transmission oil level (Chapter Three).

CAUTION
Failure to follow proper break-in procedures will reduce engine longevity and performance.

47. If new parts were installed, the engine should be broken in as described in this chapter.
48. Before riding the motorcycle, perform the Routine Safety Checks in Chapter Three.

VALVE TAPPETS AND GUIDES
(1986-1990 MODELS)

Refer to Figure 33. During engine operation, the tappets are pumped full of engine oil, thus taking up all play in the valve train. When the engine is not running, the tappets may leak down after a period of time if some of the oil drains out. When the engine is started, the tappets click momentarily until they completely refill with oil. The tappets are working properly if they stop clicking after the engine runs for a few minutes. If the clicking persists, there may be a problem.

Removal

Mark all parts so that they can be returned to their original positions.
1. Remove all dirt from the tappet area.
2. Remove the pushrods and covers as described in Chapter Four.

NOTE
It is not necessary to remove the cylinder and cylinder head as shown in Figure 34 to remove the valve tappets.
3. Remove the tappet guide bolts (Figure 34).

4. Rotate front tappet guides clockwise or rear tappet guides counterclockwise and remove the guides).

**NOTE**
If the tappet is tight in the guide, tap it lightly with a rubber-faced hammer and remove it.

5. Remove the tappet (Figure 35) from the guide. Store the tappets in a container of oil so they can be installed in their original position. Cover the storage container so debris cannot contaminate the oil.

6. Discard the crankcase O-ring (Figure 36).

### Cleaning and Inspection

**CAUTION**
Tappets must be stored and handled carefully to prevent contamination from debris. When storing tappets, leave them in the container of engine oil they were placed in during removal. When measuring or inspecting tappets, place them on a clean, lint-free cloth.

**NOTE**
The tappet is available only as a unit assembly.

1. Remove the O-ring (A, Figure 37) and spacer(B) from the tappet guide (C).

2. Except for the roller/tappet assembly, clean all parts in solvent and allow to dry thoroughly.

3. Check the tappet rollers (A, Figure 38) for pitting, scoring, galling or excessive wear. If the rollers are worn excessively, check the mating cam lobes for the same wear conditions. The cam lobes can be observed through the tappet guide hole in the crankcase. Replace the cam, if necessary, as described in this section.

4. Inspect the tappet socket (Figure 39, typical) for pitting, scoring, galling or excessive wear.

5. Determine valve tappet guide clearance as follows:
Classic Cycles Technical Resources

a. Measure and record the tappet guide inner diameter (Figure 40).

b. Measure and record the valve tappet outside diameter (B, Figure 38).

c. Subtract the measurement made in substep b from the measurement made in substep a. The difference is the tappet-to-guide clearance. See specifications in Table 1 for correct clearance. Replace any guide or tappet not within tolerances.

6. Check the roller end clearance by grasping the tappet assembly in one hand and attempting to move the roller back and forth. Table 1 lists wear specifications. If the end clearance is excessive, replace the tappet assembly.

Installation

1. Soak the tappet assembly in clean engine oil before installation.

2. Install new O-rings onto the tappet guide.

3. Insert the spacer (B, Figure 37) and O-ring (A) into the tappet guide (C). Make sure the O-ring seats completely in the tappet guide.

4. Install a new crankcase O-ring (Figure 36).

5. Insert the tappet into the guide (Figure 35).

   CAUTION

   If the tappet is not installed correctly, the roller and cam may be damaged when the assembly is installed in Step 6.

6. Perform the following:

   a. Align the tappet guide with the crankcase holes.

   b. Hold the tappet so that it is all the way up in the guide.

   c. Install the tappet guide and tappet.

   d. Install the tappet bolts (Figure 34) and tighten to 96-168 in.-lb. (11-19 N*m)

7. Install the pushrods and covers as described in Chapter Four.
VALVE TAPPETS
(1991-2003 MODELS)

Refer to Figure 41 and Figure 42 for an exploded view of the valve tappet, pushrod and cover assembly. During engine operation, the tappets are pumped full of engine oil taking up the play in the valve train. When the engine is not running, the tappets may leak down after a period of time if some of the oil drains out. When the engine is started, the tappets click momentarily until they completely refill with oil. The tappets are working properly if they stop clicking after the engine runs for a few minutes. If the clicking persists, there may be a problem in the tappet(s).

Removal

Refer to Figure 41 and Figure 42.

1. Remove the pushrods and covers as described in Chapter Four.

2A. On 1991-1999 models, perform the following:
   a. Remove the lifter plate bolt and washer and remove the plate (Figure 43).
   b. Remove the tappet pin and O-ring (Figure 44).

2B. On 2000-2003 models, remove the anti-rotation bolts (Figure 42).

3. Remove the tappet (Figure 45) from the crankcase bore.

   Store the tappets in a container of oil so they can be installed in their original tappet bores. Cover the tappet storage container so dirt and debris cannot contaminate the oil.

4. Repeat for each tappet.

5. Discard all O-rings.

Cleaning and Inspection

CAUTION

Tappets must be stored and handled carefully to prevent contamination from dirt or debris. When storing tappets, leave them in the container of engine oil they were placed in during removal. When measuring or inspecting tappets, place them on a clean, lint-free cloth.

NOTE

The tappet is available only as a unit assembly.

1. Clean the pushrod covers in solvent and dry with compressed air. Do not clean the tappets in solvent or with any other type of cleaner. Leave the tappets in the container of oil except when inspecting and installing them.

2. Check the tappet rollers (Figure 46) for pitting, scoring, galling or excessive wear. If the rollers are worn excessively, check the lobes on the cam gears for the same wear conditions. The gear lobes can be observed through the tappet guide hole in the crankcase. Replace the cam, if necessary, as described in Gearcase Cover and Timing Gears in this chapter.
3. Inspect the tappet socket (Figure 47) for pitting, scoring, galling or excessive wear.

4. Determine the valve guide inner diameter as follows:
   a. Measure and record the valve tappet bore inner diameter.
   b. Measure and record the valve tappet outer diameter (Figure 48).
   c. Subtract the measurement recorded in Substep a. from the measurement recorded in Substep b. The difference is the tappet-to-guide clearance. Refer to Table 1 for specifications. Correct out of specification tappet-to-guide clearances by replacing tappets or the crankcase.

5. Measure tappet roller end clearance. If end clearance is worn to the service limit specification in Table 1, replace the tappet.

6. Measure tappet roller fit on pin. If clearance meets or exceeds the service limit in Table 1, replace the tappet.

**Installation**

1. Rotate the engine counterclockwise so that the cam lobes for the tappets being installed are positioned with their base lobes facing up.

2. Soak each tappet in clean engine oil prior to installation. Make sure the roller needles (Figure 46) are well lubricated. This step will ensure smooth tappet operation and lubrication during initial engine start-up.

3. Install the tappet (Figure 45) into its original crankcase tappet bore; refer to your identification notes made during removal. Align the tappet so that the flats on the tappet face the front and rear of the engine; see Figure 49.

4A. On 1991-1999 models, perform the following:
   a. Insert the pins (Figure 44) through the crankcase holes.
   b. Place a new O-ring over the end of the pin as shown in Figure 50.
   c. Install the plate (Figure 43), washer and screw. Tighten the tappet plate screw to 80-110 in.-lb. (9-12 N-m).

4B. On 2000-2003 models, secure the tappets in place with the anti-rotation bolts (Figure 42). Tighten the bolts to 55-65 in.-lb. (6-7 N-m).

5. Install the pushrods and pushrod covers as described in Chapter Four.

**GEARCASE COVER AND TIMING GEARS**

The gearcase assembly consists of the following components (Figure 51):

1. Four cam gears.
1. Crankcase half
2A. Oil pump drive gear (1986-1987 models)
2B. Oil pump drive gear (1988-1990 models)
3A. Pinion gear (1986-1987 models)
3B. Pinion gear (1988-1990 models)
4. Lockwasher
5. Nut
6. Bushing
7. Needle bearing
8. Cam gear guide plate
9. Front cylinder exhaust cam gear
10. Bushing
11. Front cylinder intake cam gear
12. Rear cylinder intake cam gear
13. Bushing
14. Rear cylinder exhaust cam gear
15. Gearcase cover
16. Breather baffle
17. Breather tube
18. Diaphragm valve
19. Seal
CAM GEARS (1991-2003 MODELS)

1. Right crankcase half
2. Cam gear bushing
3. Rear exhaust cam gear
4. Rear exhaust cam gear bushing
5. Rear intake cam gear
6. Rear intake cam gear bushing
7. Front intake cam gear
8. Front intake cam gear bushing
9. Front exhaust cam gear
10. Front exhaust cam gear bushing
11. Oil pump drive gear
12. Pinion gear
13. Nut
14. Pinion gear bushing
15. Gearcase cover
16. Seal
17. Gasket
2. Four cam gear bushings installed in the right crankcase half.
3. Four cam gear bushings installed in the gearcase cover.
4. Pinion gear.
5. Oil pump drive gear.
6. Oil seal installed in gearcase cover.

**Removal**

Refer to Figure 51 or Figure 52.

1. Remove the exhaust system as described in Chapter Ten or Chapter Eleven.
2. Remove the right footpeg assembly as described in Chapter Seventeen.
3. Remove the pushrods and valve tappets as described in this chapter.
4. Before removing the gearcase cover, check the cam gear end play as follows:
   a. Rotate the engine counterclockwise so that the cam being checked has its lobe facing up.
   b. Pry the cam gear toward the gearcase cover with a wide-blade screwdriver.
   c. Measure the gap between the cam gear shaft thrust face and the bushing in the crankcase with a feeler gauge (Figure 53). This gap is cam gear end play. Write down the end play measurement.
   d. Repeat for each cam gear.
   e. If the end clearance is incorrect (Table 1), replace the bushing and/or cam gear as described in this section.
5. Remove the ignition system sensor plate and rotor as described in Chapter Twelve.
6. Place an empty oil pan underneath the crankcase cover.
7. Disconnect and plug the vent oil line (Figure 54) from the crankcase cover.

**NOTE**
The gearcase cover is retained by different length screws. Create a drawing on cardboard in the shape of the gearcase, then punch each screw through the cardboard at its location.

8. Remove the gearcase cover mounting screws.
9. Remove the gearcase cover (Figure 55) from the engine. If the cover is stuck in place, tap the cover lightly with a soft-faced hammer to free it from the gasket or sealer.
10. Remove and discard the gasket.
11. If necessary, remove the dowels (Figure 56).

**NOTE**
After removing a cam gear, label and then place it in a container so that it can be reinstalled in its original position.

12. Remove and identify each cam gear:
a. Rear exhaust cam gear (A, \textbf{Figure 57}).
b. Rear intake cam gear (B, \textbf{Figure 57}).
c. Front intake cam gear (C, \textbf{Figure 57}).
d. Front exhaust cam gear (D, \textbf{Figure 57}).

13. On 1986-1990 models, remove the cam gear guide plates (8, \textbf{Figure 51}).

\textbf{NOTE}
\textit{Loctite 272 was originally applied to the pinion gear nut.}

14. If available, install a pinion gear locking tool (part No. part No. 2234) (A, \textbf{Figure 58}).
15. On 1986-1987 models, pry the lockwasher tab away from the pinion gear nut.
16. Loosen, then remove the pinion gear nut (B, \textbf{Figure 58}). On 1986-1987 models, remove the lockwasher.
17. Slide the pinion gear (C, \textbf{Figure 58}) and oil pump drive gear (\textbf{Figure 59}) off the pinion shaft. On 1998-2003 models, do not lose the Woodruff key in the pinion shaft.

\textbf{Inspection}

1. Clean the gearcase compartment, cover and components with solvent. Blow out all oil passages with compressed air. Make sure all traces of gasket compound are removed from the gasket mating surfaces.
2. Check the pinion gear and cam gear bushings (\textbf{Figure 60} in the gearcase cover for grooving, pitting or other wear). If the bushings are worn, replace them.
3. Inspect the cam gears (\textbf{Figure 61}) for cracks, deep scoring or excessive wear. The gears will show signs of pattern polish but there should be no other damage.

\textbf{NOTE}
\textit{Cam gears are available only as complete sets.}

4. On 1986-1990 models, inspect the cam gear plates (\textbf{Figure 62}) for damage or excessive wear. Replace if necessary.
5. On 1986-1990 models, refer to \textbf{Figure 51} and inspect the breather valve as follows:
   a. Detach the breather assembly from the crankcase cover.
   b. Clean the components in solvent.
   c. Blow out the bleed passage in the crankcase cover with compressed air.
   d. Replace the breather valve if damaged or deteriorated.
   e. Replace the baffle and tube if cracked or damaged.
   f. Insert the diaphragm valve into the breather tube.
   g. Install the breather tube assembly into the cover.
   h. Push the breather baffle into the tube assembly until the baffle fingers engage the breather tube ring.
Cam Gear Identification

The cam gear group consists of the following:
1. Rear exhaust cam gear (A, Figure 57).
2. Rear intake cam gear (B, Figure 57).
3. Front intake cam gear (C, Figure 57).
4. Front exhaust cam gear (D, Figure 57).
5. Pinion gear (C, Figure 58).

The cam lobes are stamped with a number (1, 2, 3 or 4) and a letter (“D” or “W”), see Figure 63. The number identifies the location in the engine:
1. 1–rear exhaust cam gear.
2. 2–rear intake cam gear.
3. 3–front intake cam gear.
4. 4–front exhaust cam gear.

The letter identifies engine application as follows:

Measuring Cam Gear and Pinion Gear Bushing Wear

**NOTE**

On 1986-1990 models a needle bearing supports the inner end of each cam gear in the crankcase. Measure the cam gear shaft diameter to determine shaft wear. Replace the bearing if damaged.

On 1991-2003 models the cam gears and outer end of the pinion gear are supported by bushings in the gearcase cover and crankcase. Excessive cam gear and pinion gear bushing clearance can cause excessive cam gear backlash.
1. Measure the cam/pinion gear outer diameter. Write down the outer diameter measurement.
2. Measure the corresponding bushing inner diameter. Write down the inner diameter measurement.
3. Subtract the measurement made in Step 2 from the measurement made in Step 1. The difference is the cam gear shaft bushing clearance. See Table 1 for the cam and pinion gear clearances. If clearance is excessive, replace the bushing as described in this section.

Bushing Removal

Gearcase cover (Figure 60) and crankcase (Figure 64) bushing replacement requires a number of special tools, including reamers for reaming the new bushings. Incorrect bushing installation will cause increased gear noise and premature wear. Refer all bushing service to a dealership.
Gearcase Cover Oil Seal Replacement

1. Inspect the oil seal (Figure 65) for excessive wear, hardness, cracks or other damage.
2. Remove the oil seal using a seal puller or similar tool.
3. Pack the lip of the new oil seal with a waterproof bearing grease prior to installation.
4. Press in the oil seal (Figure 65) so that the manufacturer’s name and size code faces out.

Installation

1. Apply engine oil to the pinion shaft, oil pump drive gear and pinion shaft gear.
2. Clean the pinion shaft threads and the pinion shaft nut of all threadlock residue.

NOTE
On 1986 and 1987 models, the oil pump drive gear, pinion gear and shaft are splined. On 1988-2003 models, a Woodruff key (Figure 66) in the shaft secures the oil pump drive gear and pinion gear.

3. On 1988-2003 models, install the oil pump drive gear Woodruff key (Figure 66), if removed.
4. Slide the oil pump drive gear (Figure 59) onto the pinion shaft.
5A. On 1986-1987 models, install the pinion gear on the pinion shaft while aligning the timing marks on the gear and shaft.
5B. On 1988-2003 models, align the pinion gear timing mark (A, Figure 67) with the center of the pinion shaft keyway (B) and install the gear.
6. If available, install a pinion gear locking tool (part No. 2234) (A, Figure 58).
7A. On 1986-1987 models, install the pinion shaft lockwasher and nut. Tighten the nut to 35-45 ft. lb. (47-61 N•m). Bend the lockwasher tabs to secure the nut.
7B. On 1988-2003 models, apply threadlock (Loctite 272 or equivalent) to the pinion shaft nut (B, Figure 58) prior to installation. Install the nut and tighten to 35-45 ft. lb. (47-61 N•m).
8. On 1986-1990 models, install both cam gear plates in their gearcase recesses. Position the cam gear plates so the beveled side of the holes faces toward the cams.
9. Identify the cam gears as described in this section.
10. Apply engine oil to the bearings, if so equipped, bushings, gears and gear shafts prior to installation.
11. Align the cam gear timing marks as shown in Figure 68, install the cam gears in the following order:
   a. Rear exhaust cam gear (A, Figure 69).
   b. Front intake cam gear (B, Figure 69).
   c. Rear intake cam gear (Figure 70).
   d. Front exhaust cam gear (Figure 71).
   e. Double check that all of the cam gear timing marks are properly aligned (Figure 68).
12. Install the dowel pins (Figure 56), if removed.
13. Install a new gearcase cover gasket.
14. Install the gearcase cover (Figure 55).
15. Install the gearcase cover screws into their correct mounting positions. Tighten the screws fingertight at first, then tighten in a crisscross pattern to 80-110 in.-lb. (9-12 N•m).
16. Check the cam gear end play for each cam gear as described in Removal in this section.
17. Install the valve tappets as described in this chapter.
18. Install the footpeg assembly as described in Chapter Seventeen.
19. Install the exhaust system as described in Chapter Ten or Chapter Eleven.

**OIL PUMP**

**(1986-1990 MODELS)**

The oil pump is mounted underneath the front of the engine and can be removed with the engine installed in the frame and without removing the gearcase cover.

The oil pump consists of two sections: a feed pump, which supplies oil under pressure to the engine components.
and a scavenger pump, which returns oil to the oil tank from the engine.

**Removal/Installation**

The gearcase cover is shown removed in this procedure for clarity.

1. Place a drip pan underneath the engine.
2. Drain the engine oil tank (Chapter Three).
3. Disconnect the oil lines from the pump (Figure 72). Plug the lines to prevent leaks and contamination.
4. Unscrew the bolts (Figure 73) that attach the pump to the bottom of the crankcase and remove the pump.
5. Install by reversing these steps, noting the following:
   a. Clean the crankcase oil pump machined surface (Figure 74) of all gasket residue.
   b. Install a new oil pump gasket.
   c. Install the bolts (Figure 73) and tighten them to 90-110 in.-lb. (10-12 N•m).
6. After installing the oil pump, refill the engine oil and prime the pump as described in *Periodic Lubrication* in Chapter Three.

**Disassembly**

Refer to Figure 75.

1. Remove the oil pump bolts.
2. Remove the cover (Figure 76) from the pump body and remove the O-ring (Figure 77) from the groove in the cover.
3. Remove the outer (Figure 78) and inner (Figure 79) feed gerotor set from the shaft. Pull the pin (Figure 80) out of the shaft.
4. Remove the outer plate (Figure 81), spring washer (Figure 82) and the inner plate (Figure 83).
5. Remove the outer scavenger gerotor (Figure 84).
6. Remove the circlip (Figure 85) from the gear shaft.
7. Remove the scavenger inner gerotor (Figure 86).
8. Remove the pin (Figure 87) from the shaft and remove the gearshaft (Figure 88) from the pump body.

**Cleaning/Inspection**

Refer to Figure 75. Replace components not within specification as noted in Table 1.

1. Clean all of the parts with solvent and blow dry with compressed air. Blow out all of the ports and passages to ensure no sludge or solvent remains.
2. Replace deformed or damaged O-rings.
3. If the outer plate seal (Figure 89) is worn or damaged, carefully pry it out of the outer plate. Tap a new seal in place.
4. Inspect the spring washer (Figure 90) for damage and replace it if any of the fingers are broken.
5. Check the gerotor sets (Figure 91) for scoring and damage. Assemble the inner and outer rotors of each set. See Figure 92 and Figure 93. Measure the assembled clearance with a flat feeler gauge as shown in Figure 94.
6. Measure the thickness of the inner and outer feed gerotors (Figure 95). If both pieces are not the same thickness, replace them as a set.
7. Assemble the feed gerotor assembly into the cover (Figure 96). Perform the following:
OIL PUMP
(1986-1990)

1. Gearshaft
2. Pin
3. Pin
4. Bushing
5. Gasket
6. Body
7. Roll pin
8. Fitting
9A. Fitting (1986-1987 models)
9B. Fitting (1988-1990 models)
10. Oil line (1/4 in.)
11. Scavenger gerotor (outer)
12. Scavenger gerotor (inner)
13. Circlip
14. Inner plate
15. Spring washer
16. Outer plate seal
17. Outer plate
18. Feed gerotor (inner)
19. Feed gerotor (outer)
20. Bushing
21. O-ring
22. Cover
23. Flat washer
24. Lockwasher
25. Bolt
26. Elbow fitting
27. Fitting
28. Oil line (1/8 in.)
a. Place a straightedge over the gerotors as shown in Figure 97. Both gerotors must be the same height. If not, replace the cover.
b. Insert a flat feeler gauge between the straightedge and the flange of the cover (Figure 98). If the distance is not within specification, replace the cover.

8. Inspect the bushing in the body (Figure 99) and in the cover (Figure 100) for scoring, wear and damage. If worn, replace the bushings as described in this section.
9. Inspect the gearshaft pinion gear teeth. Replace the shaft if any of the teeth are damaged or if they are severely worn.
10. If the bushing(s) and gearshaft condition is okay as checked in Step 8 and Step 9, check the shaft-to-bushing clearance in the body and cover. If the clearance is not within specification, replace the bushings as described in this section.
11. Inspect the gerotor machined surfaces in the body and cover for scoring or cracks. Replace the oil pump if these parts are damaged.

Oil Pump Bushing Replacement

Replacement of the bushings in the body (Figure 99) and cover (Figure 100) require a press. When installing new bushings, observe the following:
1. The body bushing (Figure 99) should be pressed in 0.100 in. (2.54 mm) below the surface.
2. The cover bushing (Figure 100) should be pressed in 0.120 in. (3.05 mm) below the surface.

### Assembly

1. Lightly lubricate all parts with fresh engine oil.
2. Install the gearshaft through the body (Figure 88).
3. Install the gearshaft pin (Figure 87) in the hole closest to the drive gear.
4. Install the scavenger inner gerotor (Figure 86).
5. Install the gearshaft circlip (Figure 85).
6. Install the scavenger outer gerotor (Figure 84).
7. Align the notch in the inner plate with the roll pin installed in the body and install the inner plate. See Figure 83.
8. Install the spring washer (Figure 82) so that its fingers face the inner plate.
9. Align the notch in the outer plate (Figure 81) with the roll pin in the body and install the outer plate. The outer plate seal lip (Figure 89) should face into the pump body. Figure 81 shows the outer plate correctly installed.
10. Install the push pin (Figure 80) into the gearshaft.
11. Install the feed gerotor inner (Figure 79) and outer (Figure 78) gears. Make sure the notch in the inner gerotor meshes with the gear shaft pin.

12. Install a new O-ring into the cover groove (Figure 77).

13. Assemble the cover (Figure 76) onto the body.

14. Install the oil pump screws and install the oil pump as described in this chapter.

**OIL PUMP (1991-2003 MODELS)**

The oil pump (Figure 101) is mounted underneath the front of the engine and can be removed with the engine installed in the frame and without removing the gearcase cover.

The oil pump consists of two sections: a feed pump, which supplies oil under pressure to the engine components, and a scavenger pump, which returns oil to the oil tank from the engine.

**Removal**

*NOTE*

Label all gears and Woodruff keys during removal so that they can be installed in their original positions.

1. Drain the oil tank (Chapter Three).
2. Wipe off each oil line and fitting at the oil pump.
3. Label each oil line (Figure 101) prior to disconnecting it.
4. Disconnect the oil lines from the oil pump. Plug the open end of each line to prevent leaks and contamination.
5. Loosen the oil pump mounting bolts (Figure 102). Remove the bolts and oil pump from the engine (Figure 103).
6. Remove and discard the oil pump gasket.
7. Cover the oil pump opening to keep dirt and debris from entering the engine.
8. Store the oil pump in a plastic bag until disassembly or installation.

**Disassembly**

Refer to Figure 104.

1. Remove the oil pump housing screws (A, Figure 105), lockwashers and flat washers.
2. Remove the oil pump cover (B, Figure 105).
3. Remove and discard the O-ring (Figure 106).
4. Slide off the feed rotor assembly (Figure 107).
5. Remove the separator plate (Figure 108).
6. Slide off the scavange rotor assembly (Figure 109).
7. Remove and discard the retaining ring (Figure 110).
8. Remove the thrust washer (Figure 111).
9. Remove the oil pump gearshaft (Figure 112).

**Inspection**

1. Clean all the parts in solvent and blow dry. Blow out all oil passages with compressed air. Place cleaned parts on a clean, lint-free cloth during inspection and reassembly.

2. Inspect the cover and body (Figure 113) for scratches, scoring or severe wear. Both rotor inside surfaces will show
some scoring but it should not be excessive. If these areas are heavily scored, replace the oil pump assembly.

3. Inspect the gear shaft assembly (Figure 114) for wear. The gear will show signs of pattern polish but there should be no other apparent wear or damage.

4. Check the fit of the gear shaft where it passes through the oil pump body (Figure 112). The shaft should turn smoothly with no binding or excessive play.

5. Inspect the separator plate (Figure 115) for warp, cracks or other damage.

6. Check both rotor sets (Figure 116) for scoring, cracks or excessive wear.

7. Measure the thickness of each feed rotor (Figure 117). Both rotors must be the same thickness. If they are not the same thickness, replace the feed rotors as a set.

8. Assemble the feed rotors and measure the clearance between the gear teeth as shown in Figure 118. If the gear clearance is worn to the service limit in Table 1, replace the feed rotors as a set.

9. Assemble the scavenge rotors and measure the clearance between the gear teeth as shown in Figure 119. If the gear clearance is worn to the service limit in Table 1, replace the scavenge rotors as a set.

### Reassembly

Refer to Figure 104.

**NOTE**

*All parts must be clean prior to assembly. If necessary, reclean as described in Inspection in this section.*

1. Coat all moving parts with clean engine oil prior to assembly.

2. Install the gear shaft (Figure 112) through the bottom of the oil pump body.

3. Install the thrust washer (Figure 111) onto the gearshaft.

4. Install a new retaining ring (Figure 110) into the gearshaft groove. Make sure the ring seats in the groove completely. Turn the gearshaft by hand; the shaft should turn smoothly with no binding or excessive play.

5. Install the inner and then the outer scavenge rotors. See Figure 109.

6. Install the separator plate (Figure 120) into the oil pump body; align the separator plate slots with the tabs inside the pump body.

7. Install the feed rotors (Figure 107) over the gearshaft.

8. Install a new O-ring (Figure 106) into the oil pump cover groove.

9. Install the pump cover (B, Figure 105) onto the pump body. Install oil pump screws, lockwashers and flat washers (A, Figure 105). Tighten the screws to 70-80 in.-lb. (7-9 N•m).

10. Turn the gear shaft by hand; the pump should turn smoothly.
2. Install a new oil pump gasket. Then install the oil pump onto the crankcase. Tighten the oil pump mounting screws (Figure 102) to 125-150 in.-lb. (14-17 N•m).

NOTE
When installing the original equipment (OE) hose clamps, refer to Chapter Four. A screw-type hose clamp may be substituted in place of the OE hose clamp.

3. Unplug, then reconnect the oil hoses (Figure 101) at the oil pump. Secure each hose with new hose clamps.

NOTE
If the oil hose fittings were removed from the oil pump, apply pipe sealant to the fitting threads prior to installation.

4. Refill the oil tank (Chapter Three).

OIL FILTER MOUNT
(1986-1990 MODELS)

The oil filter mount is located on the right crankcase half. The oil filter mount houses the oil filter, check ball or valve and spring, and oil pressure switch. Refer to Figure 121.

Removal/Installation

1. Drain the engine oil (Chapter Three).
2. If it is necessary to disassemble the oil filter mount, remove the oil filter.
3. Disconnect the electrical connector from the oil pressure regulator switch (Chapter Twelve).
4. Disconnect the two pressure hoses (Figure 122) from the oil pump.
5. Remove the filter mount-to-gearcase bolts and pull the filter mount away from the gearcase.
6. Remove the quad seal (2, Figure 121).
7. Installation is the reverse of the preceding steps while noting the following.
   a. Install a new quad seal.
   b. Refill the engine oil and install the oil filter as described in Chapter Three.
   c. Prime the oil pump as described in Engine Oil and Filter Change (Chapter Three).

Disassembly/Reassembly

1. Disconnect the two pressure hoses from the filter mount (Figure 122).
2A. On 1986-early 1987 models, remove the oil filter adapter as follows:
   a. Unscrew the filter adapter.
   b. Push the check valve out of the filter adapter with a 5/16 in. (7.94 mm) diameter rod.
c. Discard the check valve O-ring.

2B. On late 1987-1990 models, remove the oil filter adapter as follows:
   a. Unscrew the filter adapter.
   b. Remove the check ball and spring.
   3. Remove the oil pressure switch (Chapter Twelve).
   4. Unscrew the plug, and then remove the oil pressure regulator plunger, spring and washer.
5. Clean all metal parts in solvent. Allow to dry thoroughly.
   6. Inspect the check valve by moving the spring-loaded cup inside the valve. The cup must move freely and return to its closed (seated) position. Replace the valve if necessary.
   7. Replace the pressure regulator plunger and spring if damaged.
   8. Assemble by reversing Steps 1-4. Note the following.
      a. Install new O-rings.

WARNING
If the check valve is installed backwards, the oiling system will not operate properly and engine seizure will result.

NOTE
The check valve is installed correctly if the brass portion of the valve is visible.

b. Install the check valve so that the arrow on the valve faces toward the oil filter adapter (direction of oil flow).

c. Use pipe sealant on all fittings and plugs.

d. On late 1987-1990 models, install the oil filter adapter so that the end with the smaller diameter faces the check ball.

e. Apply threadlock (Loctite 242 or equivalent) to the oil filter adapter before installation. Tighten the adapter securely.

f. Tighten the plug to 15-20 ft.-lb. (20-27 N•m).

g. Tighten the oil pressure switch to 60-70 in.-lb. (7-8 N•m).

9. Install the oil filter and refill with oil (Chapter Three).
10. Start the engine and check for oil leaks.

OIL FILTER MOUNT
(1991-2003 MODELS)

The oil filter mount is part of the right crankcase half. The oil filter mount houses the oil filter, check ball and spring, and oil pressure switch. See Figure 123.

Disassembly

Refer to Figure 123.

1. Drain the oil and remove the oil filter (Chapter Three).
2. Remove the oil filter adapter (A, Figure 124, typical) from the oil filter mount.
3. Remove the check ball and spring (Figure 125, typical).
4. Disconnect the electrical connector from the oil pressure switch (Chapter Twelve).
5. Remove the oil pressure switch (B, Figure 124).
Inspection

1. Remove thread sealant residue from all threaded parts.
2. Clean the check ball, spring and oil filter adapter in solvent and dry thoroughly.

Reassembly

1. Apply pipe sealant to the oil pressure switch threads prior to installation. Install the switch and tighten to 60-70 in.-lb. (7-8 N•m).
2. Install the oil filter adapter as follows:
   a. The ends on the oil filter adapter are symmetrical; either end may be installed into the oil filter mount.
   b. Apply threadlock (Loctite 243 or equivalent) onto the oil filter adapter threads that will be installed into the oil filter mount. Do not install thread sealant on the oil filter end.
   c. Install the spring, and then the check ball into the hole in the center of the oil filter mount (Figure 125). Then push the oil filter adapter (threadlock end) against the check ball and thread it into the oil filter mount. Tighten the oil filter adapter to 96-144 in.-lb. (11-16 N•m).
3. Reconnect the electrical wire onto the oil pressure switch (Chapter Twelve).
4. Install the oil filter and refill with oil (Chapter Three).
5. Start the engine and check for oil leaks.

CRANKCASE AND CRANKSHAFT

**NOTE**

In Harley-Davidson terminology, the crankshaft is called the flywheel. The crankshaft’s left shaft is referred to as the sprocket shaft; the right shaft is referred to as the pinion shaft.

The crankcase must be disassembled to service the crankshaft, connecting rod bearings, pinion shaft bearing and sprocket shaft bearing. Some specialized service procedures, such as bearing and crankshaft service, should be referred to a dealership.

A press and special tools are required to perform the following service procedures. Refer to Figures 126-128 when servicing the crankcase and crankshaft.

Crankshaft End Play

Measuring crankshaft end play provides an indication of sprocket shaft bearing wear. Crankshaft end play is controlled by a shim placed on the crankshaft sprocket shaft (8, Figure 128). Measure crankshaft end play prior to disassembling the crankcases.

When measuring end play, the crankshaft must be moved in and out. To do this, a tool must be fabricated prior to
CRANKCASE FASTENERS
(1986-1990 MODELS)

1. Crankcase
2. Right, rear crankcase
3. Washer
4. Lockwasher
5. Bolt
6. Nut
7. Washer
8. Bolt
9. Bolt
10. Lockwasher
11. Bolt
12. Bolt
13. Rear engine mount
14. Bolt
15. Bolt
16. Nut
17. Lockwasher
18. Washer
19. Bolt
20. Washer
21. Right, front lower engine mount
22. Nut
23. Left, front lower engine mount
24. Bolt
checking end play. The tool can be made by welding two handles onto a spare sprocket shaft nut.

1. Remove the engine from the frame as described in this chapter.
2. Remove the gearcase cover as described in this chapter.
3. Remove the primary chain and sprocket as described in Chapter Six or Chapter Seven.
4. Secure the crankcase to a workstand or workbench.
5. Attach a dial indicator so that the plunger touches against the end of the crankshaft as shown in Figure 129.

   NOTE
   The sprocket shaft bearings (left side) must be preloaded when measuring crankshaft end play.

6. Install the engine sprocket onto the sprocket shaft. Then thread the sprocket nut tool (with handles) onto the sprocket shaft and tighten to the specification listed in Table 3.
7. Pull the sprocket shaft (Figure 129) in and out and note the crankshaft end play reading on the dial indicator. If the total indicator reading is not within the crankshaft end play...
specification listed in Table 1, the inner shim (8, Figure 128) must be replaced. Select the correct size shim from Table 2.

8. Remove the dial indicator, sprocket shaft nut tool and engine sprocket.

Crankcase Disassembly

A press will be required to remove the crankshaft.

1. Remove the engine from the frame as described in this chapter.

CAUTION

After removing the cylinders, slip hoses (Figure 130) over the cylinder studs to avoid damaging them during the following service procedures. In addition, do not lift the crankcase assembly by grabbing the cylinder studs. Bent or damaged cylinder studs may cause oil leaks.
2. Disassemble and remove the gearcase as described in this chapter.
3. Check the crankshaft end play as described in this chapter.
4. Loosen, then remove the crankcase bolts and washer (Figure 126 and Figure 127).
5. Lay the crankcase on wood blocks so that the right side (Figure 131) faces up.
6. Tap the crankcase with a plastic mallet and remove the right crankcase half.
7. Remove the dowel pins.

**WARNING**
A press is required to remove the crankshaft.
To prevent eye damage from parts flying out while under pressure, wear safety glasses.

**CAUTION**
Do not attempt to remove the crankshaft by driving it out with a hammer. The force may knock the flywheels out of alignment and damage the sprocket shaft threads.

8. Press the crankshaft out of the left crankcase half as follows:
   a. Support the left crankcase half in a press with parallel bars or wood blocks as shown in Figure 132. Check that there is adequate room for the crankshaft and connecting rods as the crankshaft is being pressed out.
   b. Center the press ram with the sprocket shaft, and then press the crankshaft from the case half. Support the bottom of the crankshaft to prevent it from falling to the floor.

**Inspection**
1. Measure the connecting rod side play with a feeler gauge as shown in Figure 133. If the side play is not within the specifications in Table 1, refer service to a dealership.
2. Inspect the piston pin bushings (Figure 134) for wear or damage. Replace the bushings as described in Chapter Four.
3. Inspect the connecting rods (Figure 135) for damage.
4. Inspect the sprocket shaft (A, Figure 136) and pinion shaft (B) for severe wear or damage. If damaged, refer replacement to a dealership.

NOTE
If still in place, do not lose the shim (8, Figure 128) when performing Step 5.

5. Inspect the sprocket shaft bearing (Figure 137) for severe wear or damage. If damaged, replace the bearing and races as described in the Sprocket Shaft Main Bearing Assembly Replacement section.

6. Inspect the pinion shaft needle bearing (Figure 138) for severe wear or damage. If the bearing is worn or damaged, refer replacement to a dealership.

7. Support the crankshaft on a truing stand or in a lathe and check runout at the shaft with a dial indicator and compare it to the runout limit in Table 1. If not within specification, refer service to a dealership.

8. Remove the left crankcase oil seal as follows:
   a. On 1991-2003 models, remove the spacer (Figure 139).
   b. Pry the oil seal out of the crankcase with a wide-blade screwdriver (Figure 140). Pad the screwdriver to avoid damaging the case.

9. Remove the left sprocket bearing (Figure 141). If damaged, replace the bearing and races as described in the Sprocket Shaft Main Bearing Assembly Replacement section.
10. Inspect the bearing races in the left crankcase half (Figure 141). If damaged, replace the bearings and races as described in the Sprocket Shaft Main Bearing Assembly Replacement section.

Sprocket Shaft Main Bearing Assembly Replacement

Replace the sprocket shaft main bearing assembly as a complete set even if only one bearing or race is damaged.

Tools

2. Sprocket shaft bearing race tool (part No. 94547-80B).
3. Race and bearing installation tool handle (part No. 33416-80).
4. Retaining ring removal and installation tool (part No. 1710).
5. Sprocket bearing race installation tool (part No. 2246).

Inner and outer bearing race replacement

CAUTION

When replacing the bearing races in the following steps, do not remove the retaining ring installed between the inner and outer bearing races unless a removal tool is available. This ring is under heavy tension and will damage the crankcase bearing bore as it passes through it.

1. Place the crankcase on the workbench with the inboard surface facing up.
2. If still in place, remove the crankshaft spacer, if used, and oil seal from the bearing bore.
3. Install half of the bearing race remover tool into the crankcase and push it against the inner bearing race (A, Figure 142).
4. Install the other half of the bearing race remover tool into the crankcase and push it against the inner bearing race (B, Figure 142).
5. Hold the bearing race remover tools in place.
6. Insert the tool handle into the center of both race remover tools. Press it in until the ring (Figure 143) is locked into both bearing race remover tools (Figure 144).
7. Support the left crankcase half on the press bed with wooden blocks and with the tool handle facing up.
8. Center the press ram directly over the tool handle and slowly press the inner bearing race out of the crankcase.
9. Remove the crankcase and tools from the press bed.
10. Place the crankcase on the workbench with the outboard surface facing up.
11. Install half of the bearing race remover tool (A, Figure 145) into the crankcase and push it against the outer bearing race.
12. Install the other half of the bearing race remover tool (B, Figure 145) into the crankcase and push it against the outer bearing race.

13. Hold the bearing race remover tools in place.

14. Insert the tool handle into the race remover tools. Press it in until the ring (Figure 146) is locked into both bearing race remover tools (Figure 147).

15. Support the left crankcase half on the press bed with wooden blocks and with the tool handle facing up.

16. Center the press ram directly over the tool handle and press the outer bearing race out of the crankcase.

17. Remove the crankcase and tools from the press bed.

18. Clean the crankcase half in solvent and dry it with compressed air.

19. Check the retaining ring (A, Figure 148) for looseness or damage. If the retaining ring is loose or damaged, perform the following:
   a. Place the crankcase on a workbench with the outboard side facing up.
   b. With the gap of the retaining ring at the 12 o’clock position, install the tool clamps onto each side of the retaining ring at the 10 o’clock and 2 o’clock positions.
   c. Securely tighten the 9/16 in. Allen screws securing the clamps to the retaining ring.
   d. Use snap ring pliers to compress the retaining ring and withdraw it from the crankcase groove.
   e. Remove the clamps from the old retaining ring and install them onto the new retaining ring.
   f. Squeeze the pliers (Figure 149) and insert the retaining ring into the crankcase groove.
   g. Make sure the retaining ring gap is centered on the crankcase oil hole (B, Figure 148).

**NOTE**
*Install both races with their larger diameter sides facing out. Install the bearing races with the same tool used to remove the old ones.*

20. Apply clean engine oil, or press lube, to the bearing receptacles in the crankcase and to the outer surface of the inner bearing races.
21. Place the installer base on the press bed with the large end facing up.
22. Install the inboard outer race (Figure 151) onto the crankcase receptacle.
23. Position the crankcase with the inboard surface facing up.
24. Install the crankcase onto the installer base so the crankcase retaining ring rests on top of the installer base.
25. Apply clean engine oil, or press lube, to the shaft of the pressing plug (Figure 152) and install the pressing plug into the installer base. Push it down onto the bearing outer race (Figure 153).
26. Center the press ram directly over the pressing plug and press the outer bearing race into the outboard surface of the crankcase until it touches the retaining ring (Figure 154).
27. Remove the crankcase and special tools from the press.
28. Turn the crankcase over and repeat Steps 20-27 for the outboard outer bearing race.

_Crankshaft inner sprocket shaft bearing replacement_

A sprocket shaft bearing cone installer (part No. HD-37047A for 1986-1997 models or HD-42759 for 1998-2003 models) is required to install the sprocket shaft bearing.
1. Support the crankshaft with the bearing side facing up.
2. Install the bearing splitter under the bearing (Figure 155) and tighten it securely.
3. Attach a bearing puller to the splitter (Figure 156).
4. Tighten the center screw and withdraw the bearing from the crankshaft shoulder.
5. Remove the bearing remover, splitter and bearing from the crankshaft.
6. Clean the sprocket shaft with contact cleaner. Check the sprocket shaft for cracks or other damage. If damaged, refer service to a dealership.
7. Slide the new bearing onto the sprocket shaft.
8A. On 1986-1990 models, install the new bearing as follows:
   a. Place the appropriate sleeve of the sprocket shaft bearing cone installer onto the sprocket shaft so the rounded end of the sleeve contacts the bearing inner race.
   b. Apply clean graphite lubricant to the threads of the tool nut driver (1, Figure 157).
   c. Thread the nut driver onto the sprocket shaft it contacts the sleeve (Figure 158).
   d. Turn the nut driver to force the bearing onto the sprocket shaft until it bottoms.
   e. Remove the tools.
8B. On 1991-2003 models, refer to Figure 159 and install the new bearing as follows:
a. Apply clean graphite lubricant to the threads of the pilot shaft, the flat washer and the bearing.
b. Thread the pilot shaft (A, Figure 159) onto the crankshaft until it contacts the crankshaft shoulder.
c. Slide the sleeve (B, Figure 159) over the pilot shaft until it contacts the bearing inner race.
d. Install the bearing (C, Figure 159) and washer (D) over the pilot shaft and onto the top of the sleeve.
e. Thread the handle (E, Figure 159) onto the pilot shaft (A).
f. Tighten the handle clockwise until the bearing bottoms on the crankshaft shoulder.
g. Unscrew and remove all parts of the bearing installer tool.

Crankshaft Installation/ Crankcase Assembly

The sprocket shaft bearing installation tool (part No. HD-37047A for 1986-1997 models or HD-42579 for 1998-2003 models) is required to install the sprocket shaft bearing and oil seal.

Refer to Figure 128.
1. Be sure the crankshaft pinion shaft and inner sprocket shaft main bearings are installed as described in this section.
2. Lubricate all parts with new engine oil prior to installation.
3. Position the crankshaft in a vise with soft jaws so that the sprocket shaft (Figure 160) faces up.
4. Place the left crankcase half over the crankshaft (Figure 161).
5. Install the end play shim (8, Figure 128) onto the sprocket shaft.
6. Install the left sprocket shaft bearing (13, Figure 128) onto the sprocket shaft.
7A. On 1986-1997 models, pull the crankshaft into position as follows:
a. Slide the 0.75 in. (19 mm) spacer (2, Figure 157) over the sprocket shaft so that its flat side faces down.
b. Thread the nut driver (1, Figure 157) onto the sprocket shaft threads. Tighten the driver until it bottoms out.
c. Remove the nut driver and spacer from the sprocket shaft.
d. Install the following spacers onto the sprocket shaft so that their flat sides face down: 1.2 in. (30.5 mm), 1.6 in. (40.6 mm) and 2.06 in. (52.3 mm).
e. Install the nut driver (1, Figure 157) onto the sprocket shaft. Then tighten the nut driver until the left and right bearings (7 and 13, Figure 128) and end play shim (8) are drawn together. See Figure 161.
f. Remove the nut driver and the spacer assembly.
7B. On 1998-2003 models, pull the crankshaft into position as follows:
a. Thread the pilot (1, Figure 162) onto the sprocket shaft until the pilot bottoms.
b. Apply a small amount of graphite lubricant to the threads of the pilot shaft.
c. Slide the sleeve (2, Figure 162) onto the pilot until the sleeve contacts the inner bearing race.
d. Install the Nice bearing (3, Figure 162), washer (4) and handle (5).
e. Turn the handle clockwise until the left and right bearings (7 and 13, Figure 128) and end play shim (8) are drawn together.
f. Remove the tool assembly.

8A. To install the left crankcase oil seal on 1986-1990 models:
   a. Pack the oil seal lip with waterproof grease prior to installation.
   b. Install the oil seal over the sprocket shaft so the closed side faces out. Rest the seal against the crankcase.
   c. Using a seal driver (8, Figure 157), press in the oil seal until the driver bottoms or the seal outer surface is flush with the crankcase surface.

8B. To install the left crankcase oil seal on 1991-2003 models three tools are available: (part No. 2324 for 1995-2003 models, HD-37047A with HD-42774 for 1991-1997 models, and HD-42579 with HD-42774 for 1998-2003 models. The first two tools are drivers (Figure 157) while the last tool uses the shaft threads to force the seal into place (Figure 162).
   a. Pack the oil seal lip with a waterproof grease prior to installation.
   b. Install the spacer into the seal.
   c. Install the oil seal around the sprocket shaft so that the open side faces out. Rest the seal against the crankcase.
   d. Place the installation tool over the sprocket shaft so that the smaller outer diameter of the driver fits between the seal wall and the garter spring.
   e. Force the seal and spacer into the crankcase bore until the spacer contacts the bearing. Remove the installation tool.

   **CAUTION**
   *Do not remove the spacer after installing it. Removal damages the oil seal, which will require seal replacement.*

9. Support the left crankcase assembly on wood blocks as shown in Figure 163.
10. Install the crankcase dowel pins (Figure 164).
11. Coat the crankcase mating surfaces with sealant (Dow Corning Silastic, 3-M #800 sealant or equivalent).
12. Align the crankcase halves and install the right crankcase half (Figure 165).
13. Install the crankcase bolts and washers (Figure 166 and Figure 167).
14. Tighten the 1/4 in. bolts to 70-110 in.-lb. (8-12 N•m).
15. Tighten the 5/16 in. bolts to 16-18 ft.-lb. (21-24 N•m).
16. If the pinion shaft bearing (4, Figure 128) was removed, install it as follows:

   a. Lubricate the pinion shaft bearing with new engine oil.
   b. Slide the bearing onto the pinion shaft and into the outer bearing race in the right crankcase.
   c. Install a new retaining ring (3, Figure 128) in the groove in the pinion shaft bearing inner race (5, Figure 128).
17. Install the engine in the frame as described in this chapter.
18. Install all of the engine sub-assemblies as described in this chapter.
19. If new engine components were installed, perform the engine break-in as described in this chapter.
CRANKCASE FASTENERS
(1986-1990 MODELS)

1. Crankcase
2. Right, rear crankcase
3. Washer
4. Lockwasher
5. Bolt
6. Nut
7. Washer
8. Bolt
9. Bolt
10. Lockwasher
11. Bolt
12. Bolt
13. Rear engine mount
14. Bolt
15. Bolt
16. Nut
17. Lockwasher
18. Washer
19. Bolt
20. Washer
21. Right, front lower engine mount
22. Nut
23. Left, front lower engine mount
24. Bolt
Improper stud replacement can cause oil leaks. If all of the tools required to install the studs are not available, have a dealership install the studs.

**NOTE**

*Later 1987-2003 models are equipped with cylinder studs that have a shoulder. Be sure to install the stud so the shoulder is properly positioned.*

**1986-1994 models**

1. If the engine is assembled, stuff some clean shop rags into the crankcase opening to prevent debris from falling into the engine.
2. Remove the damaged stud using a stud remover (Chapter One).
3. Clean the crankcase threads and the new stud with solvent or contact cleaner. Blow dry.
4. Measuring from the top of the stud, paint a mark that is 4.850 in. (123.2 mm) down the stud (Figure 169).
5. Drop a small steel ball (part No. 8860) into a cylinder head bolt and thread the bolt onto the top of the new stud.
6. Hand-thread the new stud into the crankcase, then install it with an air driver until the paint mark on the stud aligns with the crankcase base gasket surface.
7. Remove the cylinder head bolt and steel ball from the cylinder stud.
8. Measure the stud installed height (Figure 170). The stud installed height should be 4.770-4.870 in. (121.2-123.7 mm).
9. Place a protective hose over the stud.
10. Repeat Steps 2-9 for each stud.

1995-2003 models

1. If the engine is assembled, stuff some clean shop rags into the crankcase opening to prevent debris from falling into the engine.
2. Remove the damaged stud with a stud remover (Chapter One).
3. Clean the crankcase threads and the new stud with solvent or contact cleaner. Blow dry.

NOTE
The cylinder studs have a shoulder on the lower end (Figure 171).

4. Drop a small steel ball (part No. 8860) into a cylinder head bolt and thread the bolt onto the top of the new stud.
5. Hand-thread the new stud into the crankcase, then install it with an air driver until the shoulder on the stud contacts the crankcase base gasket surface.
6. Tighten the stud to 120 in.-lb. (14 N•m).
7. Remove the cylinder head bolt and steel ball from the cylinder stud.
8. Place a protective hose around the stud.
9. Repeat Steps 2-8 for each stud.

ENGINE BREAK-IN

If the engine is new, or following cylinder service such as boring, honing and installing new rings, or major lower end work, engine break-in is required.
1. For the first 50 mi. (80 km), maintain engine speed below 2500 rpm in any gear. However, do not lug the engine. Do not exceed 50 mph during this period.
2. From 50-500 mi. (80-804 km), vary the engine speed. Avoid prolonged steady running at one engine speed. During this period, increase engine speed to 3000 rpm. Do not exceed 55 mph.
3. After the first 500 mi. (804 km), the engine break-in is complete.
<table>
<thead>
<tr>
<th></th>
<th>New</th>
<th>Service limit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in. (mm)</td>
<td>in. (mm)</td>
</tr>
<tr>
<td><strong>Tappets</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guide clearance</td>
<td>0.0008-0.0023</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>(0.020-0.058)</td>
<td>(0.076)</td>
</tr>
<tr>
<td>Roller fit</td>
<td>0.0006-0.0013</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>(0.015-0.033)</td>
<td></td>
</tr>
<tr>
<td>Roller end clearance</td>
<td>0.008-0.022</td>
<td>0.026</td>
</tr>
<tr>
<td></td>
<td>(0.203-0.559)</td>
<td>(0.66)</td>
</tr>
<tr>
<td><strong>Oil Pump</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1986-1990 models</td>
<td>Feed and scavenge outer to inner rotor clearance</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.076)</td>
</tr>
<tr>
<td></td>
<td>Shaft-to-bushing clearance</td>
<td>0.0025</td>
</tr>
<tr>
<td></td>
<td>(0.0635)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feed gear height above cover</td>
<td>0.001-0.011</td>
</tr>
<tr>
<td>1991-2003 models</td>
<td>Shaft-to-pump clearance</td>
<td>0.0025</td>
</tr>
<tr>
<td></td>
<td>(0.064)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feed/scavenge inner/outer rotor clearance</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.102)</td>
</tr>
<tr>
<td><strong>Gearcase</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cam gear shaft bushing clearance</td>
<td>0.0007-0.0022</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>(0.018-0.056)</td>
<td>(0.076)</td>
</tr>
<tr>
<td>Cam gear shaft end play (minimum)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1986-1990 models</td>
<td>Rear intake cam gear</td>
<td>0.001-0.035</td>
</tr>
<tr>
<td></td>
<td>(0.025-0.127)</td>
<td>(0.127)</td>
</tr>
<tr>
<td></td>
<td>All other cam gears</td>
<td>0.0005-0.0215</td>
</tr>
<tr>
<td></td>
<td>(0.0127-0.5461)</td>
<td>(0.635)</td>
</tr>
<tr>
<td>1991-2003 models</td>
<td>Rear intake cam gear</td>
<td>0.006-0.024</td>
</tr>
<tr>
<td></td>
<td>(0.15-0.61)</td>
<td>(1.016)</td>
</tr>
<tr>
<td></td>
<td>All other cam gears</td>
<td>0.005-0.024</td>
</tr>
<tr>
<td></td>
<td>(0.13-0.61)</td>
<td>(0.635)</td>
</tr>
<tr>
<td>Cam gear needle bearing journal diameter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1986-1990 models</td>
<td></td>
<td>0.6865-0.6860</td>
</tr>
<tr>
<td></td>
<td>(17.437-17.424)</td>
<td>(17.419)</td>
</tr>
<tr>
<td><strong>Connecting rods</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Side play @ crankshaft</td>
<td>0.005-0.025</td>
<td>0.030</td>
</tr>
<tr>
<td></td>
<td>(0.13-0.64)</td>
<td>(0.762)</td>
</tr>
<tr>
<td>Piston pin fit (clearance)</td>
<td>0.00125-0.00175</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>(0.0318-0.0445)</td>
<td>(0.051)</td>
</tr>
<tr>
<td>Fit on crankpin</td>
<td>Early 1986 models</td>
<td>0.0003-0.0015</td>
</tr>
<tr>
<td></td>
<td>(0.0076-0.0381)</td>
<td>(0.051)</td>
</tr>
<tr>
<td></td>
<td>Late 1986-2003 models</td>
<td>0.0004-0.0017</td>
</tr>
<tr>
<td></td>
<td>(0.010-0.043)</td>
<td>(0.0686)</td>
</tr>
<tr>
<td><strong>Crankshaft</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Runout @ flywheel rim</td>
<td>0.000-0.010</td>
<td>0.010</td>
</tr>
<tr>
<td></td>
<td>(0.00-0.25)</td>
<td>(0.25)</td>
</tr>
<tr>
<td>Runout @ shaft</td>
<td>0.000-0.002</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>(0.00-0.051)</td>
<td>(0.051)</td>
</tr>
<tr>
<td>End play</td>
<td>0.001-0.005</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td>(0.025-0.127)</td>
<td>(0.127)</td>
</tr>
<tr>
<td>Sprocket shaft bearing</td>
<td>Outer race fit in crankcase (interference)</td>
<td>0.0004-0.0024</td>
</tr>
<tr>
<td></td>
<td>(0.010-0.061)</td>
<td></td>
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<tr>
<td>Bearing inner race fit on crankshaft (interference)</td>
<td>0.0002-0.0015</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>(0.005-0.038)</td>
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(continued)
Table 1 ENGINE SERVICE SPECIFICATIONS (continued)

<table>
<thead>
<tr>
<th>Pinion shaft bearing (1987-2003 models)</th>
<th>New in. (mm)</th>
<th>Service limit in. (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer race diameter in crankcase</td>
<td>1.5646-1.5652</td>
<td>1.5672</td>
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<tr>
<td></td>
<td>(39.741-39.756)</td>
<td>(39.807)</td>
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<tr>
<td>Fit in cover bushing</td>
<td>0.0023-0.0043</td>
<td>0.0050</td>
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<tr>
<td></td>
<td>(0.058-0.109)</td>
<td>(0.127)</td>
</tr>
<tr>
<td>Bearing running clearance</td>
<td>0.00012-0.00088</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>(0.0030-0.0224)</td>
<td></td>
</tr>
<tr>
<td>Pinion shaft journal diameter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1986 models</td>
<td>1.2485-1.2490</td>
<td>1.2483</td>
</tr>
<tr>
<td></td>
<td>(31.712-31.725)</td>
<td>(31.707)</td>
</tr>
<tr>
<td>1987-2003 models</td>
<td>1.2496-1.2500</td>
<td>1.2494</td>
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<tr>
<td></td>
<td>(31.740-31.750)</td>
<td>(31.735)</td>
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</table>

Table 2 FLYWHEEL END PLAY SHIM THICKNESS

<table>
<thead>
<tr>
<th>Harley-Davidson part number</th>
<th>in.</th>
<th>mm</th>
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<tbody>
<tr>
<td>9155</td>
<td>0.0975-0.0985</td>
<td>2.477-2.502</td>
</tr>
<tr>
<td>9142</td>
<td>0.0995-0.1005</td>
<td>2.527-2.553</td>
</tr>
<tr>
<td>9143</td>
<td>0.1015-0.1025</td>
<td>2.578-2.604</td>
</tr>
<tr>
<td>9144</td>
<td>0.1035-0.1045</td>
<td>2.629-2.654</td>
</tr>
<tr>
<td>9145</td>
<td>0.1055-0.1065</td>
<td>2.680-2.705</td>
</tr>
<tr>
<td>9146</td>
<td>0.1075-0.1085</td>
<td>2.731-2.756</td>
</tr>
<tr>
<td>9147</td>
<td>0.1095-0.1105</td>
<td>2.781-2.807</td>
</tr>
<tr>
<td>9148</td>
<td>0.1115-0.1125</td>
<td>2.832-2.856</td>
</tr>
<tr>
<td>9149</td>
<td>0.1135-0.1145</td>
<td>2.883-2.908</td>
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</table>

Table 3 ENGINE TORQUE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Crankcase bolts</th>
<th>ft.-lb.</th>
<th>in.-lb.</th>
<th>N•m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4 in.</td>
<td>–</td>
<td>70-110</td>
<td>8-12</td>
</tr>
<tr>
<td>5/16 in.</td>
<td>16-18</td>
<td>–</td>
<td>21-24</td>
</tr>
<tr>
<td>Cylinder head mounting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bracket fasteners</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine mount-to-engine</td>
<td>25-30</td>
<td>–</td>
<td>34-41</td>
</tr>
<tr>
<td>Engine mount-to-frame</td>
<td>30-35</td>
<td>–</td>
<td>41-47</td>
</tr>
<tr>
<td>Engine center mount-to-engine</td>
<td>28-35</td>
<td>–</td>
<td>38-47</td>
</tr>
<tr>
<td>Cylinder stud (1995-2003 models)</td>
<td>–</td>
<td>120</td>
<td>14</td>
</tr>
<tr>
<td>Engine mount brackets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower front</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine bolts</td>
<td>25-30</td>
<td>–</td>
<td>34-41</td>
</tr>
<tr>
<td>Frame bolts</td>
<td>25-30</td>
<td>–</td>
<td>34-41</td>
</tr>
<tr>
<td>Rear mount</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frame to crankcase bolts</td>
<td>25-30</td>
<td>–</td>
<td>34-41</td>
</tr>
<tr>
<td>Upper front</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine bolts</td>
<td>25-30</td>
<td>–</td>
<td>34-41</td>
</tr>
<tr>
<td>Frame bolts</td>
<td>30-35</td>
<td>–</td>
<td>41-47</td>
</tr>
<tr>
<td>Top center</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine bolts</td>
<td>25-30</td>
<td>–</td>
<td>34-41</td>
</tr>
<tr>
<td>Frame bolts</td>
<td>30-35</td>
<td>–</td>
<td>41-47</td>
</tr>
<tr>
<td>Engine sprocket</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gearcase cover screws</td>
<td>–</td>
<td>80-110</td>
<td>9-12</td>
</tr>
<tr>
<td>Oil filter adapter</td>
<td>–</td>
<td>96-144</td>
<td>11-16</td>
</tr>
<tr>
<td>Oil pressure switch¹</td>
<td>–</td>
<td>60-70</td>
<td>7-8</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Component Description</th>
<th>ft.-lb.</th>
<th>in.-lb.</th>
<th>N·m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil pump assembly and mounting screws (1991-2003 models)</td>
<td>–</td>
<td>125-150</td>
<td>14-17</td>
</tr>
<tr>
<td>Oil pump cover screws</td>
<td>–</td>
<td>70-80</td>
<td>7-9</td>
</tr>
<tr>
<td>Oil pressure regulator plug</td>
<td>15-20</td>
<td>–</td>
<td>20-27</td>
</tr>
<tr>
<td>Oil pump mounting screws (1986-1990 models)</td>
<td>–</td>
<td>90-110</td>
<td>10-12</td>
</tr>
<tr>
<td>Pinion shaft nut</td>
<td>35-45</td>
<td>–</td>
<td>47-61</td>
</tr>
<tr>
<td>Tappet plate screws (1991-1999 models)</td>
<td>–</td>
<td>80-110</td>
<td>9-12</td>
</tr>
</tbody>
</table>

1. Apply pipe sealant to the threads.
2. On 1988-2003 models, apply threadlock (Loctite 272 or equivalent).
CHAPTER SIX

PRIMARY DRIVE AND CLUTCH
(1986-1990 MODELS)

This chapter covers the primary drive cover, primary drive, clutch assembly and clutch cable. Table 1 and Table 2 are at the end of the chapter.

PRIMARY DRIVE COVER

Refer to Figure 1.

Removal

1. Disconnect the negative battery cable (Chapter Twelve).
2. Drain the transmission oil (Chapter Three).
3. Remove the gearshift pedal and the left footpeg (Chapter Seventeen).
4. Loosen the locknut and unscrew the adjuster (A, Figure 2) to loosen the primary drive chain.
5. Remove the clutch inspection cover (B, Figure 2).
6. Remove the adjusting screw spring and lockplate (Figure 3).
7. Turn the clutch adjusting screw clockwise (Figure 4) until the nut can be removed, then remove the nut (Figure 5).

   NOTE

Different length screws secure the primary drive cover. Note the location and length of the screws.

8. Remove the primary drive cover (C, Figure 2) and gasket.
9. If necessary, remove the dowel pins.
10. If necessary, service the following components as described in this chapter:
    a. Clutch mechanism adjuster
    b. Primary chain adjuster
    c. Shift shaft oil seal

Installation

1. Clean the primary drive cover and engine crankcase gasket surfaces in solvent and dry thoroughly.
2. If removed, install the clutch assembly and connect the clutch cable as described in this chapter.
3. Install the dowel pins, if removed.
4. Using a new gasket, install the primary drive cover onto the crankcase. Install the mounting screws and tighten to 80-110 in.-lb. (9-12 N•m).
5. Thread the nut (Figure 5) onto the clutch adjusting screw until the screw slot is accessible with a screwdriver. Then align and install the hex portion on the nut into the outer ramp recess. Turn the clutch adjusting screw (Figure 4) counterclockwise until the nut cannot be removed.
6. Adjust the clutch as described in Chapter Three. The spring and lockplate shown in Figure 3 will be installed during the clutch adjustment procedure.
7. Adjust the primary chain (Chapter Three).
8. Refill the transmission oil (Chapter Three).
9. Install the shift lever and tighten the pinch bolt to 90-110 in.-lb. (10-12 N\(\cdot\)m).
10. Install the left footpeg. Tighten the mounting bolts to 24-36 ft.-lb. (33-49 N\(\cdot\)m).

CLUTCH RELEASE MECHANISM

Refer to Figure 1.

Removal
1. Remove the primary drive cover as described in this chapter.
2. Pry the lockplate tabs away from the mounting screws and remove the lockplate (A, Figure 6) and screws.
3. Remove the clutch release mechanism from the cover and disconnect the cable (B, Figure 6) from the ramp and coupling (C, Figure 6).

Inspection
1. Wash the clutch release mechanism in solvent and dry thoroughly.
2. Check the balls and ramp sockets (Figure 7) for pitting, severe wear or other damage.
3. Check the adjusting screw (Figure 8) for thread or bearing damage.
4. Replace the lockplate if the tabs are weak or broken.
5. Replace worn or damaged parts as required.

Installation

NOTE
The early 1986 coupling and outer ramp are not the same as later couplings or outer ramps. See Figure 9. A later coupling and
outer ramp may be used in early engines, but both parts must be installed, not mixed with an early coupling or outer ramp.

1. Install the cable coupling onto the end of the clutch cable. Place the coupling in the ramp.
2. Apply grease to the ball and ramp surfaces (Figure 7) and insert the balls into the ramp sockets.
3. Assemble the inner and outer ramps and install on the primary drive cover (C, Figure 6). Install the lockplate and the ramp mounting screws. Tighten the screws securely. Bend the lockplate tabs over the screws to lock them in place.
4. Install the primary drive cover as described in this chapter.
5. Adjust the clutch as described in Chapter Three.

** PRIMARY CHAIN ADJUSTER **

**Removal/Installation**

Refer to Figure 10.

1. Remove the primary drive cover as described in this chapter.
2. Pull the chain pad (Figure 11), spring and washer from the stud.
3. Replace the chain pad if worn severely or cracked. Also check the carrier (3, Figure 10) and spring (2). Replace if necessary.
4. Install by reversing the preceding steps.
5. Adjust the clutch (Chapter Three).
6. Adjust the primary chain (Chapter Three).
7. Refill the primary case and transmission with oil (Chapter Three).

** PRIMARY DRIVE/CLUTCH **

Refer to Figure 12.

**Special Tools**

Complete disassembly of the clutch requires the use of a clutch spring compression tool (part No. 34761-84). If the compression tool is not available, remove the clutch intact from the motorcycle and take it to a dealership for disassembly and service. Do not attempt to disassemble the clutch without the special tool.

**Clutch/Primary Chain/Engine Sprocket Removal (Clutch is Not Disassembled)**

This procedure describes removal of the clutch, primary chain and engine sprocket, which allows later clutch disassembly as described in this section. If clutch disassembly with the clutch mounted on the motorcycle is desired, refer to Clutch Disassembly on Motorcycle in this section in this chapter.
1. Disconnect the negative battery cable (Chapter Twelve).
2. Remove the primary drive cover as described in this chapter.
3. Remove the clutch adjusting screw snap ring ([Figure 13]) and remove the guide and adjusting screw assembly ([Figure 14]).
4. Install a clutch holder (JIMS tool No. 2234 or equivalent) to prevent engine sprocket rotation, then remove the engine sprocket nut (A, [Figure 15]).
5. Remove the clutch snap ring (B, [Figure 15]) and spacer behind the snap ring. Remove the clutch assembly, primary chain and engine sprocket as an assembly.

Refer to [Figure 12].
CAUTION
Do not attempt to disassemble the clutch assembly after removing it from the motorcycle. The clutch must be disassembled while mounted on the engine.

6. Installation is the reverse of removal while noting the following:
   a. Apply threadlock (Loctite 242 or equivalent) to the sprocket shaft threads.
   b. Tighten the engine sprocket nut to 150-165 ft.-lb. (203-223 N•m).
   c. Adjust the primary chain (Chapter Three).

Clutch Disassembly on Motorcycle

This procedure describes disassembly of the clutch and clutch plate removal while it is mounted on the motorcycle. Engine sprocket and primary chain removal is not required. Read this procedure completely before starting disassembly.

1. Disconnect the negative battery cable (Chapter Twelve).
2. Remove the primary drive cover as described in this chapter.

   WARNING
   Do not attempt to disassemble the clutch assembly without the use of a clutch spring compression tool (part No. 34761-84). The diaphragm spring (Figure 12) is held under considerable pressure and will fly out if pressure is not first removed.

3. Install the spring compression tool onto the clutch assembly (Figure 16). Secure the compression tool per the manufacturer’s instructions.
4. Turn the adjusting screw counterclockwise until the compression tool releases the pressure on the snap ring (Figure 16). Remove the snap ring. Remove the nut and compression tool.
5. Refer to Figure 12. Disassemble the clutch housing by removing the following parts in order:
   a. Adjusting screw assembly (Figure 14).
   b. Outer clutch spring seats (Figure 17).
   c. Diaphragm spring (Figure 18).
d. Inner clutch spring seat (Figure 19).
e. Pressure plate (Figure 20).

6. Remove four friction plates (Figure 21) and three steel plates (Figure 22).
7. Remove the spring plate (Figure 23).
8. Remove the remaining friction and steel plates in the order shown in Figure 12.

**NOTE**
Further removal steps are not required unless it is necessary to separate the clutch hub and shell assembly. Remove these parts as described in this section.

**Clutch Inspection**

Refer to Figure 12.
1. Clean all parts, except friction and steel plates and bearings, in a non-oil based solvent and thoroughly dry with compressed air. Place all cleaned parts on lint-free paper towels.
2. Inspect the steel plates (A, Figure 24) for warp as shown in Figure 25. Also measure the thickness of each plate. Replace all clutch plates; if any one plate is warped excessively or is too thin. Refer to Table 1.
3. Inspect the friction plates (B, Figure 24) for wear or surface damage. Measure the thickness of each plate (Figure 26) and compare to specifications in Table 1. If a plate’s thickness is within specifications but the oil grooves are worn flush with the plate, replace the plates. Also check the friction plates for
warp (Figure 27) and compare to the service limit in Table 1. Replace all friction plates if any one plate is too thin or warped excessively.

4. Inspect the spring plate (C, Figure 24) for cracks or damage. Check for loose or damaged rivets. Replace the spring plate if necessary.

5. Check the diaphragm spring for cracks or damage. Check also for bent or damaged tabs. Replace the diaphragm spring if necessary.

6. A ball bearing is pressed into the clutch shell and the clutch hub is pressed into the bearing. Hold the clutch hub and rotate the clutch shell by hand. The shell should turn smoothly with no sign of roughness or tightness. If the clutch shell binds or turns roughly, the bearing is damaged and must be replaced. Refer to Step 10.

7. The steel plate inner teeth mesh with the clutch hub splines. Check the splines for cracks or galling. They must be smooth for chatter-free clutch operation. If the clutch hub splines are damaged, the clutch hub must be replaced; refer to Step 10.

8. The friction plates (B, Figure 24) have tabs that slide in the clutch shell grooves. Inspect the shell grooves for cracks or wear grooves. The grooves must be smooth for chatter-free clutch operation. If the clutch shell grooves are damaged or worn severely, replace the clutch shell; refer to Step 10.

9. Check the primary chain sprocket and the starter ring gear on the clutch shell for cracks, deep scoring, excessive wear or heat discoloration. If either the sprocket or ring gear is severely worn or damaged, replace the clutch shell; refer to Step 10. If the sprocket is worn, also check the primary chain and the engine sprocket as described in this chapter.

10. If the clutch hub, shell or bearing require replacement, refer to Clutch Hub and Shell Disassembly/Reassembly in this section.

Primary Chain

Replace the primary chain if severely worn or damaged. Do not attempt to repair the chain. If the primary chain is worn or damaged, check the engine sprocket and clutch shell sprocket for wear or damage. Replace parts as required.

Adjust the primary chain as described in Chapter Three.

Clutch Hub and Shell Disassembly/Reassembly

1. Remove the clutch plates from the clutch hub and shell assembly, if they have not been previously removed. Refer to Clutch Disassembly on Motorcycle in this section.

2. Remove the snap ring from the clutch hub groove (Figure 28).

    **CAUTION**
    If it is necessary to press or drive the clutch hub out of the shell bearing, the bearing will be damaged and must be replaced.
3. Remove the clutch hub from the clutch shell bearing.
4. Locate the snap ring securing the bearing in the clutch shell. Remove the snap ring from the clutch shell groove.
5. Support the clutch shell in a press and press the bearing out of the shell. The bearing must be removed through the front side of the shell. The clutch shell is manufactured with a shoulder on the rear (primary chain) side. Discard the bearing.
6. Discard worn or damaged parts. Clean reusable and new parts, except bearings and snap rings, in a non-oil based solvent and dry thoroughly.
7. Place the clutch shell into the press. Then align the bearing with the clutch shell and press the bearing into the shell until the bearing bottoms against the lower shoulder. When pressing the bearing into the clutch shell, press only on the outer bearing race. Installing the bearing by pressing on its inner race will damage the bearing. Refer to Service Methods in Chapter One.
8. Install a new snap ring into the clutch shell groove. Make sure the snap ring seats in the groove completely.
9. Install the clutch hub into the clutch shell bearing. If pressing is required to install the clutch hub into the clutch shell, be sure to support the bearing inner race.
10. Install a new clutch hub snap ring (Figure 28). Make sure the snap ring seats in the clutch hub groove completely.
11. After completing assembly, hold the clutch hub and rotate the clutch shell by hand. The shell should turn smoothly with no roughness or binding. If the clutch shell binds or turns roughly, the bearing may have been damaged during reassembly. Correct before installation.

**Clutch Assembly**

If the clutch assembly was not disassembled, refer to Clutch Installation in this section.

Before installing the clutch plates, count the number of each plate. The set should include seven friction plates, five drive plates and one spring plate.

Refer to Figure 29.

1. Soak all of the clutch plates in clean transmission oil for approximately 5 minutes before installing them.
2. Align the tabs on a friction plate with the clutch shell grooves and install the plate. Then align the inner teeth on
a drive plate with the clutch hub grooves and install the plate. Repeat until all of the clutch plates have been installed. Install the spring plate between the third and fourth friction plates. The last plate installed must be a friction plate.

**NOTE**  
During clutch removal, if the spring compressing tool was not removed from the diaphragm spring and pressure plate, proceed to Step 4. If the spring compressing tool was removed and the diaphragm spring was separated from the pressure plate, continue with Step 3.

3. Assemble the pressure plate and diaphragm spring as follows:
   a. Install the adjusting screw assembly (release plate, snap ring, bearing and adjusting screw) into the pressure plate. Install the release plate by aligning its tabs with the slots in the pressure plate. Secure the release plate by installing the retaining ring into the pressure plate groove. Make sure the retaining ring seats in the groove completely.
   b. The diaphragm spring is concave. Install the diaphragm spring onto the pressure plate so the concave side faces the pressure plate—the convex side must face out.
   c. Install the spring seat with its flat, larger outer diameter side facing toward the diaphragm spring.

**WARNING**  
A clutch spring compression tool (part No. 34761-84), is required to install the diaphragm spring (9, Figure 29). Severe personal injury from the diaphragm spring flying out could occur if the special tool is not used.

4. To install the diaphragm spring snap ring, use a clutch spring compression tool to perform the following:
   a. Install the clutch spring compression tool onto the clutch assembly (Figure 30). Secure the spring compression tool per the manufacturer’s instructions.
   b. Position the spring compression tool against the diaphragm spring and thread the tool handle onto the end of the forcing screw. Do not apply pressure against the diaphragm spring at this time.
   c. Turn the compression tool nut clockwise to compress the diaphragm spring.
   d. Install the spring seat and snap ring into the groove in the clutch hub prongs.
   e. After making sure the snap ring is seated completely in the clutch hub groove, slowly turn the compressing tool handle counterclockwise while checking that the clutch spring seat lip seats against the snap ring. After all tension has been removed from the compressing tool, remove it from the release plate.

5. Remove the release plate retaining ring. Then remove the adjusting screw assembly.
Clutch Installation

1. Assemble the clutch assembly as described in this section.
2. The engine sprocket, primary chain and clutch are installed as an assembly. Assemble the engine sprocket, clutch and primary chain as shown in Figure 31.

**CAUTION**
The alternator rotor is mounted on the clutch shell (Figure 32). Inspect the inside of the rotor for small bolts, washers or other metal debris picked up by the magnets. These metal pieces damage the alternator stator assembly.

3. Lift the primary drive assembly as a unit and slide the engine sprocket and clutch into the primary chaincase (Figure 33).
4. Install the spacer and the clutch circlip (A, Figure 33) and spacer behind the circlip.
5. Use a sprocket locking tool to prevent engine sprocket rotation.

**CAUTION**
The engine sprocket is tightened to a high torque specification. Be sure to hold the sprocket securely when tightening the nut.

6. Apply of threadlock (Loctite 242 or equivalent) to the engine sprocket nut threads and then install the engine sprocket nut (B, Figure 33). Tighten the sprocket nut to 150-165 ft.-lb. (203-223 N•m).
7. Remove the sprocket locking tool.
8. Install the adjusting screw assembly (Figure 34) by aligning the two tabs on the release plate perimeter with the two recesses in the pressure plate.
9. Install a new snap ring (Figure 35).
10. Install the primary drive cover as described in this chapter.
11. Adjust the primary chain (Chapter Three).
12. Refill the primary chain housing with the correct type and quantity oil (Chapter Three).
13. Reconnect the negative battery cable (Chapter Twelve).

CLUTCH CABLE

Replacement

Refer to Figure 1 and Figures 36-38.
1A. On 1986-1987 models, loosen the clutch cable jam nut (A, Figure 36) and turn the adjuster (B) to provide maximum cable slack.
1B. On 1988-1990 models, slide the rubber boot off the clutch in-line cable adjuster. Loosen the adjuster jam nut (A, Figure 37) and turn the adjuster (B) to provide maximum cable slack.
2. Remove the primary drive cover as described in this chapter.
3. Pry the lockplate tabs away from the mounting screws and remove the lockplate (A, Figure 38) and screws.
4. Remove the clutch release mechanism (B, Figure 38) from the cover and disconnect the cable (C) from the ramp and coupling. Hold the ramps together to prevent the balls from falling out.
5. Turn the lower clutch cable fitting and unscrew it from the primary drive cover.
6. At the clutch lever, remove the pivot pin circlip and remove the pivot pin.
7. Disengage the clutch lever from the handlebar bracket.
8. Disengage the cable end from the fitting in the clutch lever.
9. Note the routing of the clutch cable and the position of all cable clamps, then remove the clutch cable.
10. If necessary, remove the screw and anti-rattle spring from the bottom of the clutch lever.
11. Inspect the bushing(s) in the control lever bracket. Replace if damaged or worn.
12. Inspect the pivot pin and replace if damaged or worn.
13. Inspect the cable retaining pin. Replace it if damaged or worn.
14. Install the clutch cable by reversing the removal steps while noting the following:

<table>
<thead>
<tr>
<th>Table 1 CLUTCH SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New</strong></td>
</tr>
<tr>
<td><strong>in. (mm)</strong></td>
</tr>
<tr>
<td>Friction plate thickness</td>
</tr>
<tr>
<td>Steel plate thickness</td>
</tr>
<tr>
<td>Warp</td>
</tr>
</tbody>
</table>

- a. On 1988-1990 models, install a new O-ring on the end of the lower cable housing fitting (Figure 39).
- b. Install the lower cable housing fitting and tighten to 36-60 in.-lb. (4-7 N•m).
- c. Connect the cable coupling to the outer ramp. Install the clutch release mechanism and lockplate. Tighten the screws securely and bend the lockplate tabs over the screws to lock them.
- d. Adjust the clutch (Chapter Three).
Table 2 CLUTCH TORQUE SPECIFICATIONS

<table>
<thead>
<tr>
<th></th>
<th>ft.-lb.</th>
<th>in.-lb.</th>
<th>N·m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable housing fitting</td>
<td>–</td>
<td>36-60</td>
<td>4-7</td>
</tr>
<tr>
<td>Engine sprocket nut*</td>
<td>150-165</td>
<td>–</td>
<td>203-223</td>
</tr>
<tr>
<td>Left footpeg</td>
<td>24-36</td>
<td>–</td>
<td>33-49</td>
</tr>
<tr>
<td>Primary drive chain cover mounting screws</td>
<td>–</td>
<td>80-110</td>
<td>9-12</td>
</tr>
<tr>
<td>Shift lever pinch bolt</td>
<td>–</td>
<td>90-110</td>
<td>10-12</td>
</tr>
</tbody>
</table>

*Apply threadlock (Loctite 242 or equivalent).
This chapter covers the primary drive cover, primary drive, clutch assembly and clutch cable.

Table 1 and Table 2 are at the end of the chapter.

PRIMARY DRIVE COVER
(1991-1993 MODELS)

Refer to Figure 1.

Removal

1. Disconnect the negative battery cable (Chapter Twelve).
2. Remove the transmission oil drain plug (Figure 2) and drain the transmission (Chapter Three).
3. Loosen the locknut (A, Figure 3) and turn the primary chain adjuster screw (B) to loosen the chain.
4. Remove the clutch inspection cover (Figure 4).
5. Remove the spring and lockplate (Figure 5).
6. Turn the clutch adjusting screw clockwise (Figure 6) until the nut can be removed, then remove the nut (Figure 7).
7. Remove the shift lever and left footpeg assembly (Figure 8) as described in Chapter Seventeen.
8. Remove the primary drive cover (Figure 9) and gasket. The primary drive cover is retained by different length screws (Figure 10). Create a drawing on cardboard in the shape of the cover, then punch each screw through the cardboard at its location.
9. Remove the dowel pins (Figure 11), if necessary.
10. If necessary, remove the clutch mechanism as described in this chapter.
11. If necessary, service the following components as described in this chapter:
   a. Clutch release mechanism.
   b. Primary chain adjuster.
   c. Shift shaft oil seal.

Installation

1. Clean the primary drive cover and engine crankcase gasket surfaces and dry thoroughly.
2. Clean the magnetic drain plug and reinstall it into the primary drive cover. Tighten the drain plug to 14-21 ft-lb (19-28 N•m).
3. Assemble the clutch release mechanism and connect the clutch cable as described in this chapter.
4. Install the dowel pins (Figure 11), if removed.
5. Using a new gasket, install the primary chain cover onto the crankcase. Install the cover mounting screws into their correct locations, as noted during removal, and tighten them in a crisscross pattern to 80-110 in-lb (9-12 N•m).
1. Screw
2. O-ring
3. Clutch inspection cover
4. O-ring
5. Spring
6. Lockplate
7. Nut
8. Primary drive cover
9. Cable coupling
10. Outer ramp
11. Balls (3)
12. Inner ramp
13. Lockplate
14. Bolt
15. Clutch adjusting screw assembly
16. Clutch cable
6. Thread the nut (Figure 7) onto the clutch adjusting screw until the screw slot is accessible with a screwdriver. Then align and install the hex portion of the nut into the outer ramp recess. Turn the clutch adjusting screw (Figure 6) until the nut cannot be removed.

7. Adjust the clutch (Chapter Three). The spring and lockplate shown in Figure 5 will be installed during the clutch adjustment procedure.

8. Adjust the primary chain (Chapter Three).

9. Refill the transmission oil (Chapter Three).

10. Install the shift lever (Figure 8) and tighten the pinch bolt to 80-110 in.-lb. (9-12 N•m).
Removal

1. Disconnect the negative battery cable (Chapter Twelve).
2. Remove the left side footrest assembly (Chapter Seventeen).
3. Drain the transmission oil (Chapter Three).
4. Loosen the locknut (A, Figure 3) and turn the primary chain adjuster screw (B) to loosen the chain.
5. Slide the rubber boot off the clutch in-line cable adjuster.
6. Loosen the adjuster jam nut (A, Figure 13) and turn the adjuster (B) to provide maximum cable slack.
7. Remove the clutch inspection cover.
8. Remove the quad ring (A, Figure 14).
9. Remove the spring and lockplate (B, Figure 14).
10. Turn the clutch adjusting screw (A, Figure 15) clockwise and release the ramp (B) and coupling (C). Turn the clutch adjusting screw clockwise to move the ramp assembly forward. Then unscrew the nut (D, Figure 15) from the end of the adjusting screw and remove it.
11. Pivot the hook on the ramp to the rear of the cable end coupling. Then disconnect and remove the clutch cable from the slot in the coupling. Remove the coupling and ramp assembly.
12A. On 883C and 1200C models, remove the bolt and washer securing the rod assembly to the shift lever, then remove the shift lever.
12B. On models except 883C and 1200C models, remove the clamp bolt and washer securing the shift lever to the shift shaft, then remove the shift lever.
13. Unscrew the clutch cable housing fitting (Figure 16) from the primary drive cover.
14. Remove the primary drive cover mounting bolts, then remove the cover and gasket.
15. Remove the dowel pins, if necessary.
16. If necessary, remove the clutch mechanism as described in this chapter.
17. If necessary, service the following components as described in this chapter:
   a. Clutch release mechanism.
   b. Primary chain adjuster.
   c. Shift shaft oil seal.

**Installation**

1. Clean the primary drive cover and engine crankcase gasket surfaces and dry thoroughly.
2. Using a new gasket, install the primary chain cover onto the crankcase. Refer to Figure 17 and install the cover mounting screws and tighten in a crisscross pattern to 80-110 in.-lb. (9-12 N•m).
3. Inspect the O-ring on the end of the cable housing fitting (Figure 18). Replace if damaged.
4. Install the cable housing fitting and tighten to 36-60 in.-lb. (4-7 N•m).
5A. On 1994-1996 models, install the coupling onto the cable end with the rounded side facing out and the ramp connector button facing in.
5B. On 1997-2003 models, install the coupling onto the cable end with the rounded side facing in and the ramp connector button facing out. With the retaining side of the ramp facing in; install the ramp hook around the coupling button.
6. Thread the nut onto the clutch adjusting screw until the slot in the end of the screw is accessible with a screwdriver. Then align and install the hex portion on the nut into the
outer ramp recess. Turn the clutch adjusting screw counterclockwise until resistance is felt, then back off 1/4 turn.
7. Adjust the clutch (Chapter Three). The spring and lockplate (B, Figure 14) will be installed during the clutch adjustment procedure.
8. Adjust the primary chain (Chapter Three).
9. Refill the transmission oil (Chapter Three).
10A. On 883C and 1200C models, install the shift lever and reconnect the rod assembly to the shift lever. Tighten the rod bolt to 15 in.-lb. (11 N•m).
10B. On all models except 883C and 1200C models, install the shift lever and tighten the clamp bolt to 80-110 in.-lb. (9-12 N•m).
11. Install the left side footrest (Chapter Seventeen).
12. Reconnect the negative battery cable (Chapter Twelve).

CLUTCH RELEASE MECHANISM
(1991-1993)

Refer to Figure 1.

Removal
1. Remove the primary drive cover as described in this chapter.
2. Pry the lockplate tabs (A, Figure 19) away from the mounting screws and remove the lockplate and screws.
3. Remove the clutch release mechanism from the cover and disconnect the cable (B, Figure 19) from the ramp and coupling. Remove the clutch mechanism.

Inspection
1. Wash the clutch release mechanism in solvent and dry thoroughly.
2. Inspect the balls and ramp sockets (Figure 20) for pitting, severe wear or other damage.
3. Inspect the adjusting screw (Figure 21) for thread or bearing damage.
4. Replace the lockplate if the tabs are weak or broken.
5. Replace severely worn or damaged parts as required.

Installation
1. Install the cable coupling onto the end of the clutch cable. Place the coupling in the ramp.
2. Apply grease to the ball and ramp surfaces (Figure 20) and insert the balls into the ramp sockets.
3. Assemble the inner and outer ramps (C, Figure 19) and install on the primary drive cover. Install the lockplate and the ramp mounting screws. Tighten screws securely. Bend the lockplate tabs over the screws to lock them in place.
4. Install the primary drive cover as described in this chapter.
5. Adjust the clutch (Chapter Three).

CLUTCH RELEASE MECHANISM
(1994-2003 MODELS)

Refer to Figure 12.

Removal
1. Slide the rubber boot off the clutch in-line cable adjuster.
2. Loosen the adjuster jam nut (A, Figure 13) and turn the adjuster (B) to provide maximum cable slack.
3. Remove the clutch spring cover.
4. Remove the quad ring (A, Figure 14).
5. Remove the spring and lockplate (B, Figure 14).
6. Turn the clutch adjusting screw (A, Figure 15) clockwise and release the ramp (B) and coupling (C). Turn the clutch adjusting screw clockwise to move the ramp assembly forward. Then unscrew the nut (D, Figure 15) from the end of the adjusting screw and remove it.
7. Pivot the hook on the ramp to the rear of the cable end coupling. Disconnect and remove the clutch cable from the slot in the coupling. Remove the coupling and ramp assembly.
8. Remove the snap ring (Figure 22) securing the inner and outer ramp halves. Separate the halves and remove the ramps and balls.

Inspection

1. Wash the clutch release mechanism in solvent and dry thoroughly.
2. Check the balls and ramp sockets (Figure 23) for pitting, severe wear or other damage.
3. Check the adjusting screw (Figure 24) for thread or bearing damage.
4. Replace the lockplate if the tabs are weak or broken.
5. Replace severely worn or damaged parts as required.

Installation

Refer to Figure 12.
1. Apply grease to the ball and ramp surfaces (Figure 23) and insert the balls into the outer ramp sockets.
2. Install the inner ramp on the outer ramp hook so the punch mark (A, Figure 25) on the inner ramp aligns with the hook of the outer ramp (B).
3A. On 1994-1996 models, install the coupling onto the cable end with the rounded side facing out and the ramp connector button facing in.
3B. On 1997-2003 models, install the coupling onto the cable end with the rounded side facing in and the ramp connector button facing out. With the retaining side of the ramp facing in, install the ramp hook around the coupling button. Then rotate the assembly counterclockwise until the tang on the inner ramp fits into the primary drive cover slot.
4. Thread the nut onto the clutch adjusting screw until the slot in the end of the screw is accessible with a screwdriver. Then align and install the hex portion on the nut into the outer ramp recess (Figure 26). Turn the clutch adjusting screw counterclockwise until resistance is felt, then back off 1/4 turn.
5. Adjust the clutch as described in Chapter Three. The spring and lockplate shown in B, Figure 14 will be installed during the clutch adjustment procedure.
PRIMARY CHAIN ADJUSTER

Refer to Figure 27.
The primary chain adjuster assembly is mounted inside the primary drive cover.

Removal

1. Remove the primary drive cover as described in this chapter.
2. Remove the adjuster screw locknut (A, Figure 28).
3. Turn the adjuster screw (B, Figure 28) to remove it from the threaded boss in the primary drive cover.
4. Slide the adjuster shoe (C, Figure 28) off the shoe plate.
5. Remove the upper locknut and shoe plate.

Inspection

1. Clean all parts in solvent and dry thoroughly.
2. Replace the adjuster shoe (C, Figure 28) if severely worn or damaged.
3. Replace the shoe plate if bent or otherwise damaged.
4. Replace the locknut(s) and adjuster screw if thread damage is apparent.

Installation

1. Install the shoe plate over the top of the adjuster screw.
2. Place the spacer over the top of the adjuster screw and rest it on top of the shoe plate.
3. Thread the upper primary chain adjuster locknut onto the top of the adjuster screw. Tighten the upper locknut to 120-144 in.-lb. (14-16 N•m).
4. Slide the open side of the adjuster shoe over the shoe plate until the upper locknut is positioned against the closed side of the shoe.
5. Place the adjuster assembly into the primary drive cover so that the closed side of the adjuster shoe (C, Figure 28) faces toward the primary drive cover.
6. Thread the adjuster screw (B, Figure 28) into the boss at the bottom of the primary drive cover.
7. Thread the lower locknut (A, Figure 28) onto the adjuster screw.
8. Install the primary drive cover as described in this chapter.
9. Adjust the primary chain (Chapter Three).

PRIMARY DRIVE/CLUTCH

Refer to Figure 29.

Tools

Complete disassembly of the clutch requires the use of a clutch spring compression tool (Figure 30 [part No. HD-38515A, 38515-90/91 or equivalent]). If the compres-
1. Spring
2. Locking plate
3. Nut
4. Coupling
5. Coupling
6. Outer ramp
7. Balls (3)
8. Inner ramp
9. Lockplate
10. Bolt
11. Snap ring
12. Snap ring
13. Diaphragm spring
14. Spring seat
15. Retaining ring

16. Release plate
17. Retaining ring
18. Bearing
19. Adjusting screw
20. Pressure plate
21. Friction plate
22. Steel plates
23. Spring plate
24. Nut
25. Washer
26. Clutch hub
27. Retaining ring
28. Bearing
29. Clutch shell/ring gear
30. Retaining ring
sion tool is not available, remove the clutch intact from the motorcycle and take it to a dealership for disassembly or service. Do not attempt to disassemble the clutch without the tool.

**Clutch/Primary Chain/Engine Sprocket Removal (Clutch is Not Disassembled)**

This procedure describes removal of the clutch, primary chain and engine sprocket, which allows later clutch disassembly as described in *Clutch Hub and Shell Disassembly/Reassembly* in this section. If clutch disassembly with the clutch mounted on the motorcycle is desired, refer to *Clutch Disassembly on Motorcycle* in this section.

1. Shift the transmission into 5th gear.
2. Disconnect the negative battery cable (Chapter Twelve).
3. Remove the primary drive cover as described in this chapter.
4. Install the sprocket locking link (part No. HD-38362 or equivalent) between the engine sprocket and clutch shell as shown in Figure 31.
5. Remove the engine sprocket nut (A, Figure 32).
6. Loosen the engine sprocket by pulling it (do not remove it). If the engine sprocket is tight, break it loose with a puller and two bolts installed on the sprocket face (B, Figure 32).
7. Remove the snap ring (Figure 33) holding the release plate/adjusting screw in position.
8. Remove the release plate/adjusting screw assembly (Figure 34).
9. The clutch nut (Figure 35) has left-hand threads. Turn the clutch nut clockwise to loosen it. Then remove the clutch nut and washer (Figure 36).
10. Remove the locking link (Figure 31).
11. Remove the engine sprocket, primary chain and clutch as an assembly (Figure 37).
Clutch Disassembly on Motorcycle

This procedure describes disassembly of the clutch while it is mounted on the motorcycle. Engine sprocket and primary chain removal is not required. Read this procedure completely before starting disassembly.

1. Disconnect the negative battery cable (Chapter Twelve).
2. Remove the primary drive cover as described in this chapter.

**WARNING**

Do not attempt to disassemble the clutch without using a clutch spring compression tool. ([Figure 30](part No. HD-38515A, part No. 38515-90/91 or equivalent)). The diaphragm spring snap ring (12, [Figure 29](Figure 29)) is held under considerable pressure and will fly out if pressure is not first removed.

3. To remove the diaphragm spring snap ring, perform the following:
   a. Thread the clutch spring compression tool forcing screw onto the clutch adjusting screw as shown in [Figure 38](Figure 38).
   b. Position the spring compression tool ([Figure 39](Figure 39)) against the diaphragm spring and thread the tool handle onto the end of the forcing screw.

**CAUTION**

Turn the clutch compression tool handle only the amount required to compress the diaphragm spring and remove the snap ring. Excessive compression of the diaphragm spring may damage the clutch pressure plate.

c. Hold the compression tool forcing screw with a wrench ([Figure 40](Figure 40)) and turn the tool handle clockwise to compress the diaphragm spring.
d. Remove the snap ring ([Figure 41](Figure 41)) and spring seat ([Figure 42](Figure 42)) from the groove in the clutch hub.
e. Remove the diaphragm spring, pressure plate, clutch adjusting screw and spring compressing tool as an assembly; see [Figure 43](Figure 43).
NOTE
Do not loosen the spring compressing tool to remove the diaphragm spring or pressure plate unless these parts require close inspection or replacement. Loosening and removing the clutch compression tool requires repositioning of the diaphragm spring during reassembly. This step will not be required as long as the compression tool is not removed from these parts.

4. Remove the friction and steel clutch plates (Figure 44) and the spring plate, from the clutch assembly in the order shown in Figure 29. Note the spring plate installed between the fourth and fifth friction plates (Figure 45).

NOTE
Further removal steps are not required unless it is necessary to separate the clutch hub and shell assembly. Remove these parts as described in Clutch Hub and Shell Disassembly/Reassembly in this section.

Clutch Inspection

1. Clean all parts, except friction plates and bearings, in a non-oil based solvent and thoroughly dry with compressed air. Place all cleaned parts on lint free paper towels.
2. Check each steel plate (A, Figure 46) for visual damage such as cracks or wear grooves. Then place each plate on a surface plate, such as piece of glass, and check for warp
with a feeler gauge. Replace the steel plates as a set if any one plate is warped more than 0.006 in. (0.15 mm).

3. Inspect the friction plates (B, Figure 46) for worn or grooved lining surfaces. Replace the friction plates as a set if any one plate is damaged. If the friction plates do not show visual wear or damage, wipe each plate thoroughly with a lint-free cloth to remove as much oil from the plates as possible. Measure each plate individually and compare to the measurements in Table 1. Stack each of the eight friction plates on top of each other and measure the thickness of the assembly. Replace the friction plates as an assembly if the combined thickness of the eight plates is less than 0.661 in. (16.79 mm).

4. Measure each steel plate and compare the thickness to the specification in Table 1. Replace if not within specification.

5. Check the spring plate (C, Figure 46) for cracks or damage. Check for loose or damaged rivets. Replace the spring plate if necessary.

6. Check the clutch diaphragm spring for cracks or damage. Check also for bent or damaged tabs. Replace the diaphragm spring if necessary.

7. A ball bearing is pressed into the clutch shell and the clutch hub is pressed into the bearing. Hold the clutch hub and rotate the clutch shell by hand. The shell should turn with no sign of roughness or tightness. If the clutch shell binds or turns roughly, the bearing is damaged and must be replaced. Refer to Step 10.

8. The steel clutch plate inner teeth mesh with the clutch hub splines. Check the splines for cracks or galling. They must be smooth for chatter-free clutch operation. If the clutch hub splines are damaged, the clutch hub must be replaced; refer to Step 10.

9. The friction plates (B, Figure 46) have tabs that slide in the clutch shell grooves. Inspect the shell grooves for cracks or wear grooves. The grooves must be smooth for chatter-free clutch operation. If the clutch shell grooves are damaged or worn severely, replace the clutch shell; refer to Step 10.

10. Check the primary chain sprocket and the starter ring gear on the clutch shell for cracks, deep scoring, excessive wear or heat discoloration. If either the sprocket or ring gear is severely worn or damaged, replace the clutch shell; refer to Step 11. If the sprocket is worn, also check the primary chain and the engine sprocket as described in this chapter.

11. If the clutch hub, shell or bearing require replacement, refer to Clutch Hub and Shell Disassembly/Reassembly in this section.

**Primary Chain**

Replace the primary chain if severely worn or damaged. Do not attempt to repair the chain. If the primary chain is worn or damaged, check the engine sprocket and clutch shell sprocket for wear or damage. Replace parts as required.
Clutch Hub and Shell
Disassembly/Reassembly

The clutch hub and shell should not be separated unless replacement of the hub, shell or bearing is required. Disassembly of the hub and shell will damage the ball bearing; bearing replacement will be required during reassembly.

A press is required for this procedure.

1. Remove the clutch plates from the clutch hub and shell assembly, if they have not been previously removed. Refer to Clutch Disassembly on Motorcycle in this section.

2. Remove the snap ring from the clutch hub groove (Figure 47).

3. Support the clutch hub and shell in a press (Figure 48) and press the clutch hub out of the bearing. See Figure 49. Remove the clutch shell from the press.

4. Locate the snap ring (Figure 50) securing the bearing in the clutch shell and remove it.

5. The bearing must be removed through the front side of the shell. The clutch shell is manufactured with a shoulder on the rear (primary chain) side. Support the clutch shell in the press and press the bearing out of the shell. Discard the bearing.

6. Discard worn or damaged parts. Clean reusable and new parts, except bearings and snap rings, in non-oil based solvent and dry thoroughly.

7. Place the clutch shell into the press. Align the bearing with the clutch shell and press the bearing into the shell until the bearing bottoms out against lower shoulder. When pressing the bearing into the clutch shell, press only on the outer bearing race. Refer to Service Procedures in Chapter One for additional information.

8. Install a new bearing snap ring into the clutch shell groove (Figure 50). Make sure the snap ring seats in the groove completely.

9. Press the clutch hub into the clutch shell as follows:

   CAUTION
   Failure to support the inner bearing race properly will cause bearing and clutch shell damage. Refer to Figure 51 to make sure the inner bearing race is supported properly.

   a. Place the clutch shell in a press. Support the inner bearing race with a sleeve as shown in Figure 51.

   b. Align the clutch hub with the bearing and press the clutch hub into the bearing until the clutch hub shoulder seats against the bearing.

   c. Install a new clutch hub snap ring (Figure 47). Make sure the snap ring seats in the clutch hub groove completely.

10. After completing assembly, hold the clutch hub and rotate the clutch shell by hand. The shell should turn smoothly with no roughness or binding. If the clutch shell binds or turns roughly, the bearing may have been damaged during reassembly. Correct before installing.

Clutch Assembly

After assembly, the clutch will be installed back onto the motorcycle. If the clutch assembly was not disassembled, refer to Clutch Installation in this section. Refer to Figure 29.

NOTE
Before installing the clutch plates, count the number of each plate. The set should include eight friction plates, six steel plates and one spring plate.
1. Soak all of the clutch plates in clean transmission oil for approximately 5 minutes before installing them.

2. Align the tabs on a friction plate with the clutch shell grooves and install the plate. Then align the inner teeth on a steel plate with the clutch hub grooves and install the plate. Repeat until all of the clutch plates have been installed. Install the spring plate (Figure 45) between the fourth and fifth friction plates. The last plate installed must be a friction plate.

   **NOTE**
   During clutch removal, if the spring compressing tool was not removed from the diaphragm spring and pressure plate, proceed to Step 4. If the spring compressing tool was removed and the clutch diaphragm spring was separated from the pressure plate, continue with Step 3.

3. Assemble the pressure plate and clutch diaphragm spring as follows:
   a. Install the adjusting screw assembly (release plate, snap ring, bearing and adjusting screw) into the pressure plate. Install the release plate by aligning its tabs with the slots in the pressure plate. Secure the release plate by installing the retaining ring into the pressure plate groove. Make sure the retaining ring seats in the groove completely.
   b. The diaphragm spring is concave. Install the diaphragm spring onto the pressure plate so the concave side faces the pressure plate—the convex side must face out.
   c. Install the spring seat with its flat, larger outer diameter side facing toward the diaphragm spring.

   **WARNING**
   Because of the force required to compress the diaphragm spring when installing the snap ring, a clutch spring compression (part No.HD-38515A, 38515-90/91 or equivalent) must be used. Severe personal injury from the diaphragm spring flying out could occur if the special tool is not used.

4. To install the diaphragm spring snap ring, use a clutch spring compression tool to perform the following:
   a. Thread the spring compression tool forcing screw onto the clutch adjusting screw.
   b. Position the spring compression tool against the diaphragm spring and thread the tool handle onto the end of the forcing screw. Do not apply pressure against the diaphragm spring at this time.
   c. Align the square holes in the pressure plate and diaphragm spring with the prongs on the face of the clutch hub. Then place the spring seat, snap ring, diaphragm spring, pressure plate, adjusting screw assembly and compressing tool onto the clutch hub (Figure 43).

   **CAUTION**
   Turn the compression tool handle only the amount required to compress the diaphragm spring and install the snap ring. Excessive compression of the diaphragm spring may damage the clutch pressure plate.

   d. Hold the compression tool forcing screw with a wrench and turn the tool handle clockwise to compress the diaphragm spring.
   e. Install the spring seat and snap ring into the groove in the clutch hub.
   f. After making sure the snap ring is seated completely in the clutch hub groove, turn the compressing tool handle counterclockwise while checking that the clutch spring seat lip seats inside the snap ring. After all tension has been removed from the compressing tool, remove it from the release plate.
5. Remove the release plate retaining ring. Then remove the adjusting screw assembly (release plate, retaining ring, bearing and adjusting screw).

**Clutch Installation**

**CAUTION**
The rotor is mounted on the engine sprocket. Carefully inspect the inside of the rotor for small bolts, washers or other metal debris that may have been picked up by the magnets. This debris can cause severe damage to the alternator stator assembly.

1. Assemble the clutch assembly as described in this section.
2. The engine sprocket, primary chain and clutch are installed as an assembly. Assemble the engine sprocket, clutch and primary chain as shown in Figure 52.
3. Lift the primary drive assembly as a unit and slide the engine sprocket and clutch into the primary chaincase. See Figure 53.
4. Install a sprocket locking link (Figure 54) (part No. HD-38362 or equivalent) between the engine sprocket and clutch shell.

**CAUTION**
The engine sprocket is tightened to a high torque specification. Be sure to hold the sprocket securely when tightening the nut.

5. Apply 2-3 drops of Loctite 262 (red) to the engine sprocket nut threads and install the nut (Figure 55) onto the sprocket shaft. Tighten the engine sprocket nut to the torque specified in Table 2.
6. Install the clutch nut Belleville washer onto the mainshaft so that the word OUT on the washer faces away from the engine (Figure 56).
7. Apply threadlock (Loctite 262 or equivalent) to the clutch nut threads and install the nut onto the mainshaft by turning the nut counterclockwise. Tighten the clutch nut (Figure 57) to 70-80 ft.-lb. (96-108 N•m).
8. Remove the sprocket locking link (Figure 54).
9. Install the adjusting screw assembly (Figure 58) by aligning the two tabs on the release plate perimeter with the two recesses in the pressure plate.
10. Install a new retaining ring (Figure 59).
11. Install the primary drive cover as described in this chapter.
12. Adjust the primary chain (Chapter Three).
13. Refill the primary chain housing (Chapter Three).
14. Reconnect the negative battery cable (Chapter Twelve).

**CLUTCH CABLE**

**Replacement**

*1991-1993 models*

Refer to Figure 60.
CLUTCH RELEASE MECHANISM
(1991-1993 MODELS)

1. Screw
2. O-ring
3. Clutch spring cover
4. O-ring
5. Spring
6. Lockplate
7. Nut
8. Primary drive cover
9. Cable coupling
10. Outer ramp
11. Ball (3)
12. Inner ramp
13. Lockplate
14. Bolt
15. Clutch adjusting screw assembly
16. Clutch cable
1. Remove the primary drive cover as described in this chapter.
2. Pry the lockplate tabs (A, Figure 61) away from the mounting screws and remove the lockplate and screws.
3. Remove the clutch release mechanism from the cover and disconnect the cable (B, Figure 61) from the ramp and coupling. Remove the release clutch mechanism (C, Figure 61).
4. Turn the clutch cable (Figure 62) counterclockwise and remove it from the primary drive cover.
5. Remove the O-ring (Figure 63) from the lower cable end fitting.
6. At the clutch lever, remove the pivot pin circlip and remove the pivot pin (2, Figure 64).
7. Slide the clutch lever out of the bracket (3, Figure 64).
8. Remove the screw and anti-rattle spring from the bottom of the clutch lever (6, Figure 64).
9. Note the cable routing before removing it. The new cable must be routed along the same path. Slide the clutch cable through the guide clip (Figure 65) and remove the clutch cable.
10. Slide the O-ring over the lower cable end fitting (Figure 63) and insert the cable into the primary drive cover. Turn the cable (Figure 62) clockwise and tighten it securely.
11. Connect the lower end of the clutch cable to the cable coupling. Connect the cable coupling to the outer ramp (Figure 60).
12. Install the clutch release mechanism and lockplate onto the primary drive cover with the mounting screws. Tighten the screws securely. Bend the lockplate tabs over the screw heads to lock them.
13. Install the primary drive cover as described in this chapter.
14. Route the clutch cable as shown in Figure 66.
16. Install the anti-rattle spring and screw onto the clutch lever (12, Figure 64).
17. Connect the clutch cable to the clutch lever and secure it with the clutch cable pin (5, Figure 64).
18. Install the clutch lever into the bracket (3, Figure 64).
19. Wipe the pivot pin shoulder with a small amount of anti-seize compound. Install the pivot pin through the clutch bracket and lever and secure it with the snap ring (4, Figure 64).
20. Adjust the clutch (Chapter Three).

1994-2003 models

Refer to Figure 67.

CAUTION
When removing the clutch spring cover (2, Figure 67), do not remove or damage the quad ring (11) in the primary drive cover.

1. Remove the clutch spring cover.
2. Remove the spring and lockplate.
3. Turn the clutch adjusting screw clockwise and release the ramp and coupling mechanism.
4. Turn the clutch adjusting screw clockwise to move the ramp assembly forward. Then unscrew the nut from the end of the adjusting screw and remove it.
5. Pivot the hook on the ramp to the rear of the cable end coupling. Then disconnect and remove the clutch cable from the coupling slot.
6. Turn the clutch cable (Figure 62) counterclockwise and remove it from the primary drive cover.
7. Remove the O-ring (Figure 63) from the lower cable end fitting.
8. At the clutch lever, remove the pivot pin snap ring (4, Figure 64) and remove the pivot pin (2).
9. Slide the clutch lever out of its bracket (3, Figure 64).
10. Remove the clutch cable and disconnect the clutch cable from the lever (12, Figure 64).
11. On 1994-1996 models, remove the screw (7, Figure 64) and anti-rattle spring (5) from the bottom of the clutch lever.
12. Note the cable routing before removing it. The new cable must be routed along the same path. Slide the clutch cable through the guide clip (Figure 65) and remove the clutch cable.
13. Slide the O-ring over the lower cable end fitting (Figure 63) and insert the cable into the primary drive cover. Turn the cable (Figure 62) clockwise and tighten it securely.
14A. On 1994-1996 models, fit the coupling over the clutch cable with the rounded side facing out and the ramp connector button facing in.

14B. On 1997-2003 models, fit the coupling over the clutch cable with the rounded side facing in and the ramp connector button facing out. With the retaining side of the ramp facing in, install the ramp hook around the coupling button. Then rotate the assembly counterclockwise until the tang on the inner ramp fits into the primary drive cover slot.

15. Thread the nut onto the clutch adjusting screw until the slot in the end of the screw is accessible with a screwdriver. Then align and install the hex portion on the nut into the outer ramp recess. Turn the clutch adjusting screw counterclockwise until resistance is felt, then backoff 1/4 turn.

16. Adjust the clutch as described in Chapter Three. The spring and lockplate shown in Figure 67 will be installed during the clutch adjustment procedure.

17. Route the clutch cable as shown in Figure 66.

18. Install the anti-rattle spring (6, Figure 64) and screw (7) onto the clutch lever (12).

19. Connect the clutch cable to the clutch lever and secure it with the clutch cable pin (5, Figure 64).

20. Install the clutch lever into the bracket.

21. Apply a small amount of anti-seize compound to the pivot pin shoulder. Then install the pivot pin through the clutch bracket and lever and secure it with the snap ring (4, Figure 64).

22. Adjust the clutch (Chapter Three).

### Table 1 CLUTCH SPECIFICATIONS

<table>
<thead>
<tr>
<th>Friction plates</th>
<th>New in. (mm)</th>
<th>Service limit in. (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual plates</td>
<td>0.0835-0.0897</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>(2.121-2.278)</td>
<td>–</td>
</tr>
<tr>
<td>Friction plate pack*</td>
<td>–</td>
<td>0.6610</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(16.79)</td>
</tr>
<tr>
<td>Steel plate thickness</td>
<td>0.0609-0.0649</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>(1.547-1.648)</td>
<td>–</td>
</tr>
<tr>
<td>Warp (all plates)</td>
<td>–</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.15)</td>
</tr>
</tbody>
</table>

*Refer to text for measurement procedure.

### Table 2 CLUTCH TORQUE SPECIFICATIONS

<table>
<thead>
<tr>
<th></th>
<th>ft.-lb.</th>
<th>in.-lb.</th>
<th>N.m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chain tensioner stud nut</td>
<td>20-25</td>
<td>–</td>
<td>27-34</td>
</tr>
<tr>
<td>Clutch cable housing fitting</td>
<td>–</td>
<td>36-60</td>
<td>4-7</td>
</tr>
<tr>
<td>Clutch lever clamp bolts</td>
<td>–</td>
<td>60-80</td>
<td>7-9</td>
</tr>
<tr>
<td>Clutch nut*</td>
<td>70-80</td>
<td>–</td>
<td>95-108</td>
</tr>
<tr>
<td>Clutch release mechanism screws</td>
<td>22-40</td>
<td>–</td>
<td>2.5-4.5</td>
</tr>
<tr>
<td>Engine sprocket nut*</td>
<td>150-165</td>
<td>–</td>
<td>203-224</td>
</tr>
<tr>
<td>Inspection cover screws</td>
<td>–</td>
<td>40-60</td>
<td>5-7</td>
</tr>
<tr>
<td>Primary chain adjuster locknuts Upper</td>
<td>–</td>
<td>120-144</td>
<td>14-16</td>
</tr>
<tr>
<td>Lower</td>
<td>20-25</td>
<td>–</td>
<td>27-34</td>
</tr>
<tr>
<td>Primary drive cover mounting screws</td>
<td>–</td>
<td>80-110</td>
<td>9-12</td>
</tr>
<tr>
<td>Shift lever pinch bolt</td>
<td>–</td>
<td>80-110</td>
<td>9-12</td>
</tr>
<tr>
<td>Shift rod bolt</td>
<td>15</td>
<td>–</td>
<td>11</td>
</tr>
<tr>
<td>Transmission drain plug</td>
<td>14-21</td>
<td>–</td>
<td>19-28</td>
</tr>
</tbody>
</table>

*Apply threadlock (Loctite 262 or equivalent).
CHAPTER EIGHT

FOUR-SPEED TRANSMISSION
(1986-1990 MODELS)

This chapter covers the four-speed transmission, internal gearshift assemblies and shift mechanism. Tables 1-8 are at the end of this chapter.

When the clutch is engaged, the mainshaft is driven by the clutch hub, which is driven by the primary chain sprocket/clutch outer housing. Power flows from the mainshaft through the selected gear combination to the countershaft, which drives the main drive gear and transmission sprocket.

To gain access to the transmission and internal shift mechanism, it is not necessary to remove the engine or disassemble the crankcase. The transmission components are contained behind an access door on the left crankcase half.

TRANSMISSION

Transmission Removal

1. Drain the transmission/primary drive oil (Chapter Three).
2. Remove the clutch and primary chain (Chapter Six).
3. Remove the drive sprocket (Chapter Thirteen).
4. Remove the stator (Chapter Twelve).
5. Remove the thrust washer (Figure 1).
6. Remove the transmission access cover bolts. See Figure 2.
7. Remove the access cover (Figure 2) with the transmission and shift mechanism assembly attached. See Figure 3.
8. Remove the shift lever (Figure 4).

Transmission Installation

1. Install the shift shaft into the crankcase so that the shift lever arm is centered as shown in Figure 5.

   NOTE
   Mark the shift shaft at the 12 o’clock position as shown in Figure 6. Marking the shaft provides a reference mark to determine if the shift lever arm position changes when installing the transmission.

2. Install the transmission access cover (Figure 3). Then rotate the countershaft to check the shift shaft is engaged with the shifter pawl. To do so, lightly rotate the shift shaft. A noticeable resistance to movement indicates proper engagement.
3. Install the access cover bolts (Figure 2). The short bolt must be installed in the upper right hole. Tighten all access cover bolts to 14-19 ft.-lb. (19-26 N•m).

   CAUTION
   Do not use the old stator Torx screws. New Torx screws have a pellet formed locking compound on their threads. When new Torx screws are installed, the pellet breaks and...
releases the locking compound on the bolt threads. The locking compound on the old bolts cannot be reused; if installed, the old bolts may loosen during engine operation.

4. Install the alternator stator as described in Chapter Twelve.
5. Install the clutch (Chapter Six).
6. Install the drive sprocket (Chapter Thirteen).
7. Install the rear chain. Adjust it as described in Chapter Three.
8. Refill the transmission/primary oil (Chapter Three).

Transmission Disassembly

Refer to Figure 7.
1. Pull the mainshaft assembly (Figure 8) from the clutch gear.
2. Remove the following from the countershaft:
   a. First gear washer (Figure 9).
   b. First gear (Figure 10).
   c. Third gear washer (Figure 11).
3. Remove the shift fork shaft (Figure 12).
4. Remove the shift fork (Figure 13) from the countershaft third gear.
5. Remove the finger rollers (Figure 14) from the shift fork.
6. Remove countershaft third gear (Figure 15).
7. Remove mainshaft second gear (Figure 16).
1. Needle bearing
2. Inner race
3. Thrust washer
4. First mainshaft gear
5. Mainshaft
6. Third mainshaft gear
7. Washer
8. Circlip
9. Second mainshaft gear
10. Circlip
11. Thrust washer
12. Bearing
13. Clutch gear
14. Needle bearing
15. Bearing
16. Circlip
17. Access cover
18. Countershaft bearing closed end
19. Washer
20. First countershaft gear
21. Bearing
22. Washer
23. Third countershaft gear
24. Countershaft
25. Thrust washer
26. Second countershaft gear
27. Spacer
28. Fourth countershaft gear
29. Countershaft bearing open end
FOUR SPEED TRANSMISSION (1986-1990 MODELS)
8. Remove the shift fork (Figure 17). Then remove the finger rollers (Figure 14) from the shift fork.
9. Pull the countershaft (Figure 18) from the access cover.
10. Remove the following from the countershaft:
    a. Fourth gear (Figure 19).
    b. Spacer (Figure 20).
    c. Second gear (Figure 21).
    d. Thrust washer (Figure 22).
11. Remove the following from the mainshaft:
    a. Circlip (8, Figure 7).
    b. Washer (7, Figure 7).
    c. Third gear (6, Figure 7).
    d. Thrust washer (3, Figure 7).

*NOTE*
To remove the mainshaft first gear (4, Figure 7), the bearing inner race (2) must be pressed off the shaft. Complete disassembly is only required for part replacement.

12. Support the first gear in a press. Then press against the mainshaft and remove the bearing inner race and first gear. First gear will be loose once the bearing inner race is free of the mainshaft.
13. Refer to Figure 23. Remove the clutch gear from the access cover as follows:
    a. Remove the snap ring (Figure 24).
b. Tap the clutch gear shaft and bearing (Figure 25) out of the access cover. See Figure 26.

Transmission Inspection

1. Examine gears (A, Figure 27) for worn or chipped teeth, pitting, scoring or other damage. If the gears appear okay, make the following checks:

   a. Install the splined gears on their respective shafts and check for binding or excessive play (Table 1).

   b. Install stationary gears on their respective shafts and place them at their point of operation. Spin these gears and check for binding or rocking. Rocking is caused by excessive inside diameter bushing wear (B, Figure 27).

   c. Replace gears as necessary.

NOTE
Early 1986 883 models use different transmission gears than later 1986 883 models. All 1100 models use the later type transmission gear sets. Only later type gears can be used in 1100 transmissions. The only way to determine which gear set is installed in a 1986 883 model is to measure the gears outside diameter as shown in Figure 28 and compare the measurements to Table 2.
NOTE
When replacing a worn gear(s) it is advisable to also replace the mating gear(s) to prevent accelerated wear to the new gear(s).

NOTE
When replacing gears, note that all 1987 models are equipped with close ratio gears. To install close ratio gears in a 1986 model, refer to Close Ratio Gear Installation in this section.

2. Examine the dog clutches (Figure 29) for chips and rounded edges or wear.
3. Check the shafts (Figure 30) for worn splines and worn or damaged circlip grooves.

CAUTION
The needle bearings installed in the transmission gears, access cover and crankcase housing are press-fit. Replacement of these bearings requires a press or special bearing replacement tools. Driving in the bearings will damage them. If the proper tools are not available, refer replacement to a dealership.

4. Inspect the needle bearings for wear, needle damage or roughness. Replace the bearings if necessary.
5. Replace worn or damaged thrust washers.

CAUTION
Excessive transmission shaft runout will cause vibration and excessive gear wear.

6. Mount the mainshaft or countershaft in a suitable centering device. Rotate each shaft and measure bend with a dial indicator. Replace either shaft if it is bent more than 0.003 in. (0.08 mm).
7. Check the shift fork shaft for cracks, deep scoring or wear. Check the shaft for bending by rolling it on a piece of glass or other flat surface. If the forks do not roll smoothly, the shaft is bent.
8. Check the shift forks (Figure 31) for cracks, deep scoring or excessive wear.
9. Shift fork length varies. If replacing a shift fork, be sure to replace it with one of the same length (Figure 32).

Close Ratio Gear Installation

An internal gear ratio change was made starting on 1987 models. All 1987-1990 models are installed with close ratio gears. Refer to Table 3 for a complete listing of gear ratios. Owners of 1986 models who wish to install close ratio gears should note the following:
1. The close ratio gear set is composed of three new gears: mainshaft first gear, countershaft fourth gear and the clutch gear. See Figure 33.
2. Close ratio gears are identified with grooves machined into the face of the gears. Figure 34 identifies the new gears and their markings. Note that the clutch gear will have its groove cut into the dog faces.
3. Refer to Figure 33 and note the following installation conditions:
   a. The new mainshaft first gear can be used with any 17-tooth countershaft first gear.
   b. A new clutch gear and countershaft fourth gear must be installed as a pair.
   c. Service and installation procedures remain the same as for 1986 models.

Access Cover Inspection/Bearing Replacement

CAUTION

The needle bearings installed in the transmission gears, access cover and crankcase housing are press-fit. Replacement of these bearings requires a press or special bearing replacement tools. Driving in the bearings will damage them. If the proper tools are not available, refer replacement to a dealership.

1. Check the clutch gear ball bearing (Figure 35).
2. Check the needle bearing (Figure 36) for wear or roughness.
3. Check the clutch gear ball bearing surface in the access cover for wear or damage. Replace the access cover if necessary.

**Transmission Assembly**

Refer to **Figure 37**.

**NOTE**
Remove the circlip (16, **Figure 37**) before replacing the bearing (15).

**CAUTION**
Always install new circlips when reassembling the transmission and gear shifter assemblies.

1. Install the shift mechanism onto the access cover as described in this chapter.
2. Install the mainshaft thrust washer so that the grooves on the washer face toward the transmission.
3. Slide the clutch gear and bearing assembly through the access cover until the bearing bottoms on the cover shoulder.
4. Install a new snap ring (Figure 23) so that the flat side faces the bearing.

5. Assemble the following components on the countershaft in the following order:
   a. Second gear thrust washer (Figure 22).
   b. Second gear (Figure 21).
   c. Spacer (Figure 20).

6. Install the countershaft 4th gear so that the recess portion (Figure 38) faces toward the spacer. See Figure 39.

7. Make sure the countershaft second gear turns freely on countershaft.

8. Install the countershaft assembly (Figure 40) into the access cover so that the countershaft fourth gear engages with the mainshaft clutch gear.

9. Install a finger roller (Figure 41) on each shift fork stud.

10. Install the mainshaft second gear with its shift fork (Figure 42). Position the shift fork so that the finger roller stud faces toward the transmission access cover. Make sure the shift fork finger engages the gear slot.

11. Install the countershaft third gear (A, Figure 43) and corresponding shift fork (B). Engage the shift fork finger roller into the gear slot (Figure 44).
12. Install the shift fork shaft (Figure 45) so it passes through both shift forks and bottoms into the access cover. Make sure the shift forks engage the shifter cam after installing the shift fork shaft.

13. Install the variable washer (Figure 46) onto the countershaft.

14. Install the countershaft first gear (Figure 47) and the washer (Figure 48).

 NOTE
If the inner race and first gear were not pressed off the mainshaft, proceed to Step 16.

15. Refer to Figure 37. If the inner race (2, Figure 37) and first gear (4) were pressed off of the mainshaft, perform the following:
   a. Slide first gear (4, Figure 37) on the mainshaft so that its oil retention groove faces toward the bearing inner race (2).
   b. Align the inner race over the mainshaft so that the letter side faces up. Press against this side only.
   c. Press the inner race (2, Figure 37) onto the mainshaft until it touches first gear.
   d. When the inner race is properly installed, the mainshaft first gear will have no end play. Check by attempting to twist the gear upward.
   e. Install the mainshaft thrust washer (3, Figure 37) over the inner race and against first gear.

16. Slide third gear (6, Figure 37) and its washer (7) onto the mainshaft. Install a new circlip (8, Figure 37) in the groove next to the washer (7).

17. Install the mainshaft assembly through second gear and into the clutch gear assembly. See Figure 49.

18. Perform the Transmission Gear Spacing Check as described in this section.

Transmission Gear Spacing Check

Measure transmission gear spacing using a feeler gauge and the transmission gear spacing tool (part No. HD-35820 [Figure 50]). Figure 51 identifies the check points.

1. Slide the countershaft washer (19, Figure 37) and first gear (20) off the countershaft.
2. Place the access cover in a vise or support it on wood blocks so that the transmission shafts face up.

3. Align the transmission gear spacing tool holes with the mainshaft, countershaft and shift fork shaft holes and install the tool. Press down on the tool so that it is positioned as shown in Figure 52.

4. Shift the transmission into neutral.

5. Measure the minimum clearance between the mainshaft second gear and the clutch gear dogs using a 0.040 in. feeler gauge. The feeler gauge should move freely between the gears without moving them.

6. Insert a 0.080 in. feeler gauge between mainshaft third gear and the dogs on mainshaft second gear (Figure 51). The maximum limit is correct if the feeler gauge does not fit or if there is a slight drag when the feeler gauge is inserted and withdrawn.

7. Lift the mainshaft second gear shift fork and raise second gear. Make sure that the shift fork is flush against second gear. Then insert a 0.080 in. feeler gauge between mainshaft second gear and the clutch gear dogs (Figure 51). The maximum limit is correct if the feeler gauge does not fit or if there is a slight drag when the feeler gauge is inserted and withdrawn.

8. Repeat Step 7 and measure the clearance with a 0.040 in. feeler gauge. If the 0.040 feeler gauge is too tight, the minimum clearance is incorrect.

9. If any gear space checked in Steps 5-8 is incorrect, replace the mainshaft second gear shift fork. Shift forks are available in three sizes standard plus 0.020 in., standard, and standard minus 0.020 in. Figure 53 identifies shift fork markings.

10. Shift the transmission into neutral.

11. Measure the minimum clearance between countershaft second gear and the third gear dogs (Figure 51) with a 0.040 in. feeler gauge. The feeler gauge should move freely between the gears without moving them.
12. Lift the countershaft third gear shift fork and raise third gear. Make sure that the shift fork is flush against second gear. Then insert a 0.080 in. feeler gauge between countershaft third gear and countershaft second gear (Figure 51). The maximum limit is correct if the feeler gauge does not fit or if there is a slight rag when the feeler gauge is inserted and withdrawn.

13. If any gear space checked in Step 11 and Step 12 is incorrect, replace the countershaft third gear shift fork. Shift forks are available in three sizes: standard plus 0.020 in., standard, and standard minus 0.020 in. Figure 53 identifies shift fork markings.

14. Remove the transmission gear spacing tool (Figure 52) and turn it over. Align the tool holes with the mainshaft and shift fork shaft and install it (Figure 54).

15. Shift the transmission into neutral.

16. Measure from the top of countershaft third gear to the countershaft spline shoulder (Figure 55). Compare the measurement taken in Step 16 with the measurements in Table 4. Then measure the countershaft washer (19, Figure 37) originally installed in your transmission and cross-reference it with the washer part numbers in Table 5. If the correct washer is used, the countershaft gear spacing is correct. If the washer is different, select the washer(s) from the list in Table 4 that corresponds to the measurement taken in Step 16.

**NOTE**

If the variable thrust washer is changed, check and reshim the countershaft end play as required. See Mainshaft and Countershaft End Play Check and Adjustment in this section.

### Mainshaft and Countershaft End Play Check and Adjustment

1. Temporarily install the assembled transmission assembly as described in the Transmission Installation in this section. It is not necessary to install the shift shaft.

2. Install the access cover bolts (Figure 56) and tighten to 14-19 ft.-lb. (19-26 N•m).

3. Install a dial indicator so that its tip rests against the end of the mainshaft on the clutch side of the engine. Move the mainshaft back and forth by hand and measure end play. Record the measurement.

4. Cross-reference the end play measurement taken in Step 3 with the list in Table 6 and install the correct mainshaft thrust washer (3, Figure 37).

5. Install a dial indicator so that the tip rests against the end of the countershaft on the clutch side of the engine. Then bend a piece of strong wire or welding rod and wedge it into the hole in end of countershaft (clutch side). Push and pull countershaft and measure end play with a dial indicator. Record the measurement.

6. Cross-reference the end play measurement taken in Step 5 with the list in Table 7 and install the correct variable fitness washer(s) (19, Figure 37).

7. Remove the transmission as described in this chapter and install the correct thrust washer(s) if necessary.

### SHIFTER MECHANISM

#### Disassembly/Assembly

Refer to Figure 57.
SHIFTER MECHANISM

1. Lever
2. Shift lever
3. Oil seal
4. Bushing
5. Thrust washer
6. Screw
7. Shift lever
8. Bushing
9. Spring
10. Cam follower
11. Finger rollers
12. Shift forks
13. Shift fork shaft
14. Pins
15. Lockplate
16. Cam support pin
17. Cam capscrew
18. Pawl carrier springs
19. Carrier spring retainer plugs
20. Upper pawl lifter arm
21. Circ clip
22. Thrust washer
23. Pawl carrier support
24. Lower pawl lifter arm
25. Pawl spacer
26. Pawl
27. E-clip
28. Pawl carrier
29. Pawl
30. Pawl
31. Spacer
32. Retaining ring
33. Neutral switch pin
34. Shifter cam
35. Pawl springs
36. Access cover
NOTE
Take careful note of location and orientation of each component as it is removed.

1. Remove the transmission and shift forks from the access cover as described in this chapter.

NOTE
It is not necessary to remove the clutch gear from the access cover when removing the shift mechanism.

2. Remove the cam capscrew (18, Figure 57) and lockplate (16) from the front of the access cover. Then remove the cam follower (11, Figure 57) and springs (10).

3. Lift the pawl carrier support (24, Figure 57) away from the access cover.

4. Remove the circlip (Figure 58) and thrust washer (Figure 59) from the outside of the pawl carrier support.

5. Lift the pawl carrier support (A, Figure 60) off of the shifter cam (B, Figure 60).

6. Remove the pawl carrier springs (Figure 61).

7. Remove the retainer plugs from the end of the pawl carrier springs (20, Figure 57).

8. Disassemble the pawl carrier as follows:
   a. Lift the pawl carrier (Figure 62) off of the shifter cam.
   b. Remove the E-clip (Figure 63) and remove the pawl spacer (Figure 64).
c. Disconnect the pawl spring (Figure 65) and remove the pawl (Figure 66).

d. Repeat for the opposite pawl.

9. Inspect the shift mechanism as described in this section.
10. Assembly is the reverse of disassembly, noting the following.

a. Install pawls on the pawl carrier, using spacers so that the spring hook holes align. Note that one spacer will be underneath the pawl and the other spacer will be on outside of the pawl. See 26 and 31, Figure 57. Retract one pawl at a time, then install the shifter cam into pawl carrier.

b. Install the assembly into the pawl carrier support so that the ear of the pawl is between the ends of the pawl carrier springs.

c. Install a new E-clip and washer.

d. Make sure that the pawls engage the cam ratchet.

**Inspection**

1. Clean all parts in solvent, then blow dry.
2. Examine the shifter cam for worn or grooved cam slots (A, Figure 67). Excessive wear will result in difficult shifting.
3. Check the shifter cam gear (B, Figure 67) for wear or damage.
4. Examine the pawl carrier yoke (Figure 68) where it engages the lever arm shaft. A severely worn yoke will cause the transmission to jump out of gear.
5. Replace the pawl spring(s) if it is longer than 1.75 in. (44.4 mm) between hooks.
6. Examine the shifter pawls (Figure 69) for grooves, cracks, wear or breaks. Replace if necessary.
7. Examine the pawl carrier springs (Figure 70) for fatigue or breaks. Replace them if they are shorter than 2.6562 in. (67.467 mm). See Figure 71.
8. Check the pawl carrier support (Figure 72) for breaks or minute surface cracks.
9. Check cam follower (11, Figure 57) for wear, especially on its thrust surfaces.
10. Check the shift lever for bending or wear.
11. Loosely assemble the shifter cam, pawl carrier and the pawl carrier support. After assembly, check bearing action for play.
12. Replace worn or damaged parts.