

## STARTER

Item	Specification
Free (no load) speed	3000 rpm (min.) @ 11.5 V
Free (no load) current	90 amp (max.) @ 11.5V
Stall torque	8.0 ft-lbs (10.8 Nm) @ 2.4 V

## SERVICE WEAR LIMITS

Item	IN.	MM
Brush length minimum	0.433	11
Commutator diameter minimum	1.141	29

## TORQUE VALUES

Item	ft/in-lbs	Nm
Thru-bolts	39-65 <b>in-lbs</b>	4.4-7.3 Nm
End cover mounting bracket	50-60 <b>in-lbs</b>	5.6-6.8 Nm
End cover center screw	90-110 <b>in-lbs</b>	10.2-12.4 Nm
Battery cable terminal bolts	60-96 <b>in-lbs</b>	6.8-10.9 Nm
Starter front and rear mounting screws	14-18 ft-lbs	19-24 Nm
Oil filler spout allen head socket screws	84-132 <b>in-lbs</b>	9.5-14.9 Nm
Starter jackshaft bolt	60-80 <b>in-lbs</b>	6.8-9.0 Nm
Solenoid terminal nut	70-90 <b>in-lbs</b>	7.9-10.2 Nm

## GENERAL

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The starter is made up of an armature, field winding assembly, solenoid, drive assembly, idler gear, and drive housing.

The starter motor torque is increased through gear reduction. The gear reduction consists of the drive pinion on the armature, an idler gear, and a clutch gear in the drive housing. The idler gear is supported by rollers and the clutch gear is part of the overrunning clutch/drive assembly.

The overrunning clutch is the part which engages and drives the clutch ring gear. It also prevents the starter from overrunning. The field windings are connected in series with the armature through brushes and commutator segments.

The starter relay is a non-repairable part and must be replaced if it malfunctions.

### Operation (Figure 5-1)

When the starter switch is pushed, the starter relay is activated and battery current flows into the pull-in winding and the hold-in winding, to ground.

The magnetic forces of the pull-in and hold-in windings in the solenoid, pull the plunger and cause it to shift to the left, so that the pinion gear is engaged with the clutch ring gear. At the same time, the main solenoid contacts are closed and battery current flows directly through the field windings to the armature and to ground. Simultaneously, the pull-in winding is opened.

The current continues flowing through the hold-in winding, keeping the main solenoid contacts closed. At this point the starter begins to crank the engine.

After the engine has started, the pinion gear turns freely on the pinion shaft through the action of the overrunning clutch which prevents the armature overrunning by the rotation of the clutch ring gear.

When the starter switch is released, the current of the hold-in winding is fed through the main solenoid contacts and the direction of the current in the pull-in winding is reversed. The solenoid plunger is returned to its original position by the return spring, disengaging the pinion gear from the clutch ring gear.

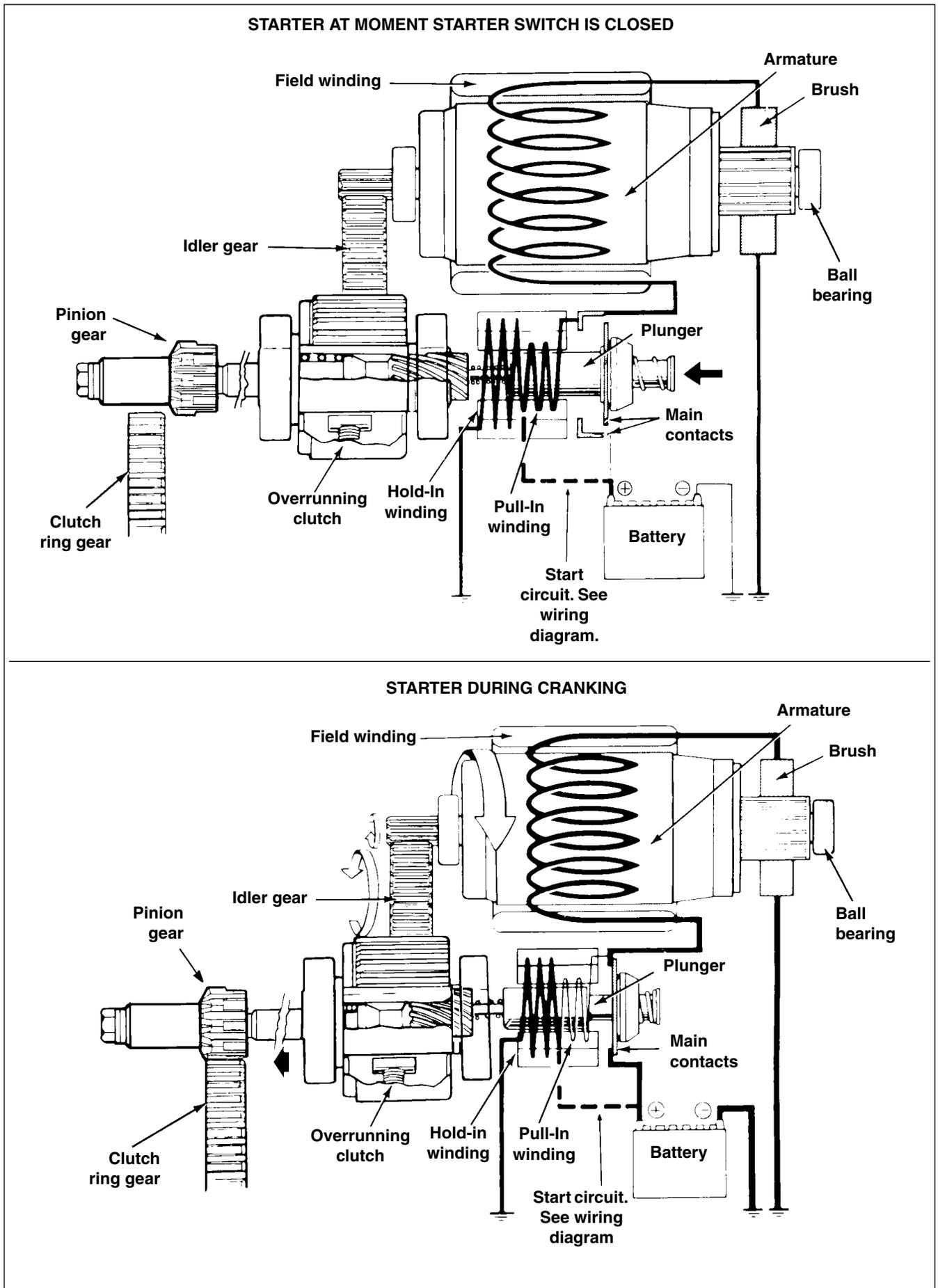


Figure 5-1. Starter Operation

## REMOVAL

## FLHR/C/S

1. Remove left side saddlebag. See Section 2.26 [SADDLEBAG, REMOVAL](#).
2. Gently pull side cover from frame downtubes (no tools required).
3. Depress latches on maxi-fuse holder and then slide cover rearward to disengage tongue from groove in fuse block cover.
4. Pull fuse block from tabs on mounting panel. Tabs on panel fit into slots on each side of fuse block cover.

## NOTE

The fuse block cover also serves as the spare fuse holder. One spare 10 amp and 15 amp fuse are provided.

5. Remove the fuse block cover. Raise lipped side slightly to disengage slots from tabs on fuse block.
6. Pull relay from slots in fuse block. See upper frame of [Figure 5-2](#).

## FLHX, FLHT/C/U, FLTR

1. Remove seat. See Section 2.25 [SEAT, REMOVAL](#).
2. Locate the starter relay installed in cavity of frame cross-member at rear of battery box. See lower frame of [Figure 5-2](#).
3. Place a finger on the rubber molding to hold it in position, and using a needle nose pliers, carefully pull on tab to release starter relay.

## NOTE

Since the position of the relays may be reversed, check the wire tag or color for positive identification. Starter relay can always be positively identified by heavy gauge GREEN wire.

4. Remove harness connector from bottom of relay.

## INSTALLATION

## FLHR/C/S

1. Install **new** relay in fuse block.
2. Slide cover over fuse block until slots fully engage tabs on block.
3. Slide fuse block into position on mounting panel. Tabs on panel fit into slots on each side of fuse block cover.

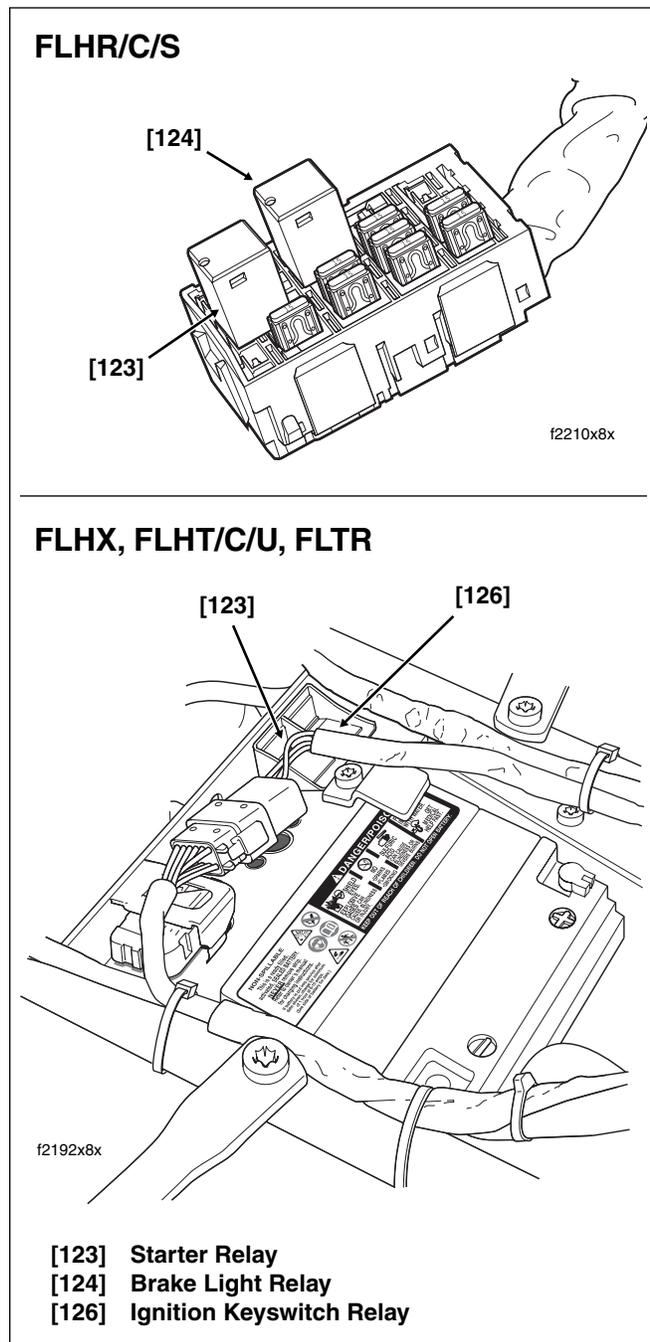


Figure 5-2. Locate Starter Relay

4. Slide maxi-fuse cover forward to engage tongue in groove of fuse block cover and then insert maxi-fuse holder into cover until latches engage.
5. Align barbed studs in side cover with grommets in frame downtubes and push firmly into place (no tools required).

6. Install left side saddlebag. See Section [2.26 SADDLE-BAG, INSTALLATION](#).

## **FLHX, FLHT/C/U, FLTR**

1. Install harness connector at bottom of **new** relay.
2. Place a finger on the molding to hold it in position and push on relay until seated in cavity of frame cross-member.
3. Install seat. See Section [2.25 SEAT, INSTALLATION](#).

## REMOVAL

1. Remove seat. See Section 2.25 SEAT, REMOVAL.

**WARNING**

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

2. Unthread bolt and remove battery negative cable (black) from battery negative (-) terminal.
3. Remove the primary chaincase cover. See Section 6.5 PRIMARY CHAINCASE, REMOVAL, steps 3-8.
4. Bend tab on lockplate away from head of jackshaft bolt.
5. Holding pinion gear to prevent rotation, remove the jackshaft bolt with lockplate and thrust washer.
6. From right side of motorcycle, remove starter front mounting screw with lockwasher. Remove rear mounting screw with lockwasher (and battery negative cable ring terminal). Remove Keps nut from stud of bracket tab and remove exhaust support bracket.
7. Pull back rubber boot and remove flange nut from starter post. Remove main power and battery positive cable ring terminals from starter post. See Figure 5-3.
8. Depress external latch and pull solenoid connector from top of starter housing.
9. Locate oil filler plug/dipstick on right side of motorcycle at top of transmission case. To remove the oil filler plug, pull steadily while moving plug back and forth.
10. Remove the starter from the right side of the motorcycle, carefully sliding it through the space between the exhaust pipe and side cover.

## NOTE

If necessary, remove allen screw and decorative chrome cover to facilitate starter removal.

11. Remove the coupling from the starter motor output shaft, if necessary.
12. Before disassembly, perform tests on the assembled starter. See DISASSEMBLY, TESTING AND REPAIR in this section.

## INSTALLATION

1. Inspect the retaining ring within the output shaft coupling for damage or distortion. Replace as necessary. With the counterbore on the outboard side, install the coupling on the starter motor output shaft, if removed.

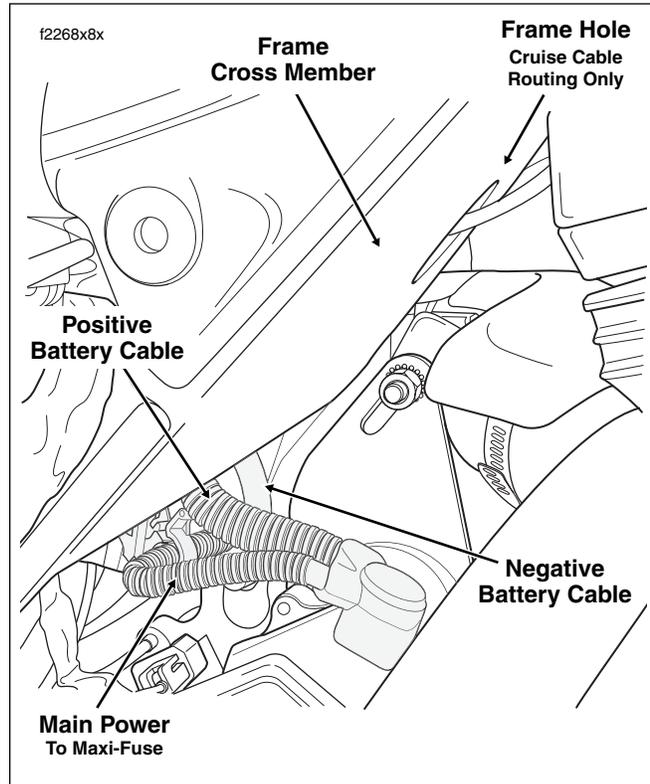


Figure 5-3. Battery Cable Routing (Right Side View)

2. From right side of motorcycle, tilt starter and work into its installed position. Starter output shaft coupling must remain on shaft and mate to starter jackshaft. See Section 5.6 STARTER JACKSHAFT, if necessary.
3. Install oil filler plug/dipstick at top of transmission case on right side of motorcycle.
4. Install slot of exhaust support bracket onto stud of bracket tab aligning other holes with those in starter flange. Start Keps nut on stud.
5. Engaging hole in exhaust support bracket, install starter front mounting screw with lockwasher. Install rear mounting screw with lockwasher (and battery negative cable ring terminal) in the same manner.
6. Alternately tighten starter front and rear mounting screws to 14-18 ft-lbs (19-24 Nm). Tighten Keps nut on stud of bracket tab.
7. Install battery positive and main power cable ring terminals onto starter post. Install flange nut and tighten to 70-90 in-lbs (7.9-10.2 Nm). Pull down rubber boot over terminal connections on starter post. See Figure 5-3.
8. Snap solenoid connector to terminal at top of starter housing.

## NOTE

If removed, install allen screw to fasten decorative chrome cover to starter.

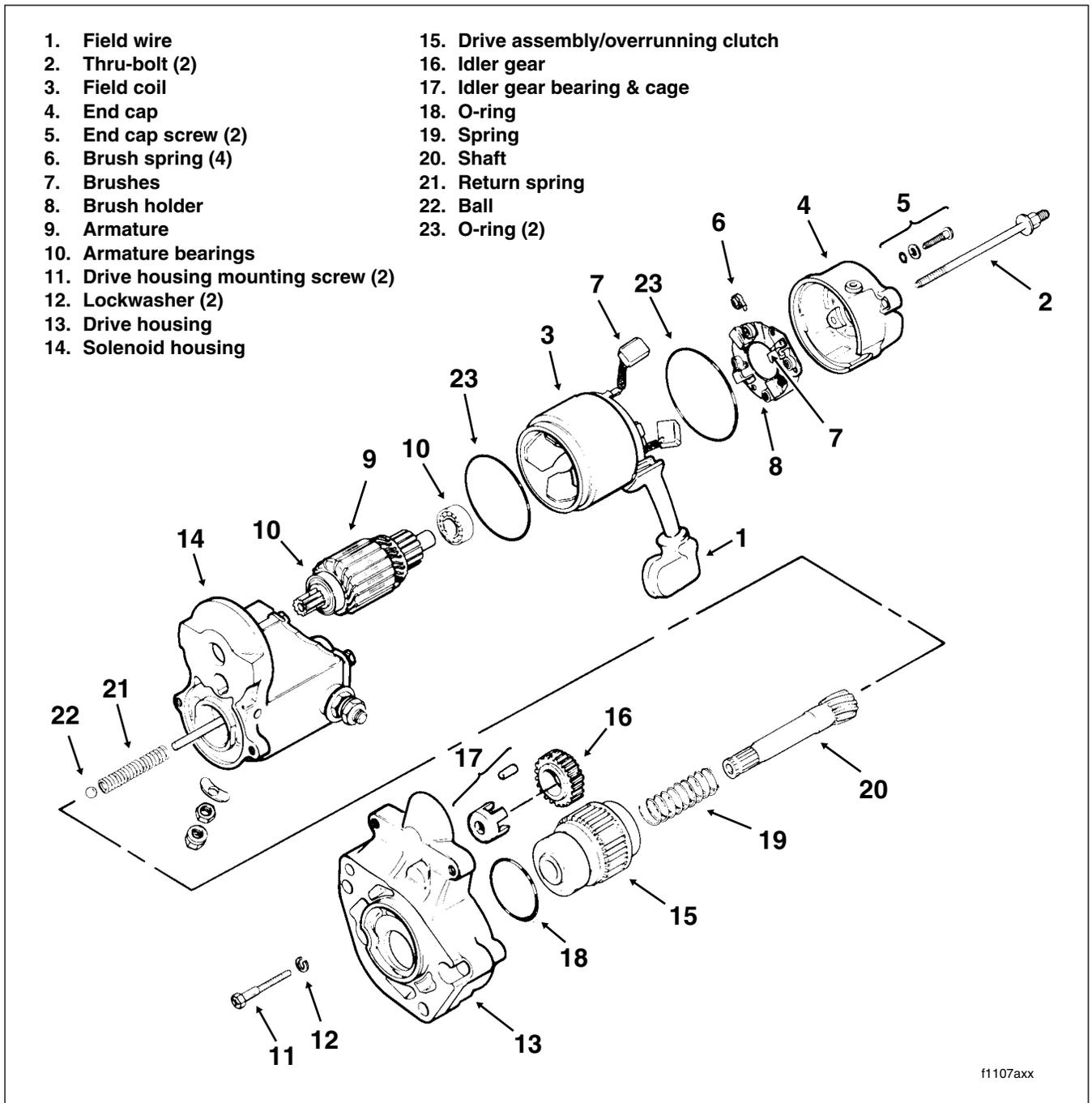


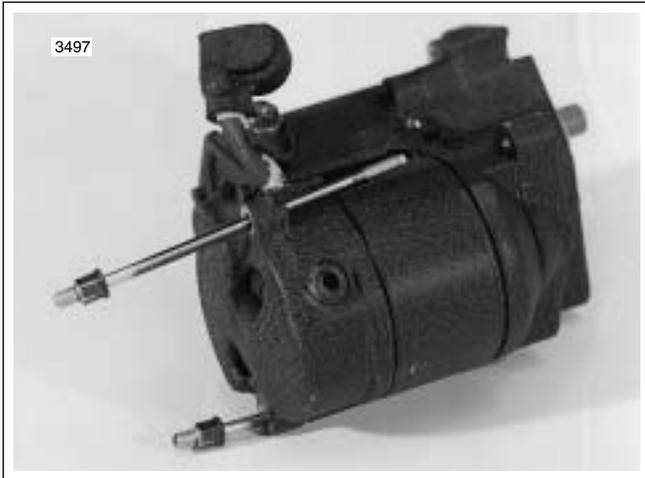
Figure 5-4. Starter

9. Slide lockplate and **new** thrust washer onto jackshaft bolt, if removed. Insert bolt into jackshaft bore.
10. Insert key on lockplate through slot in thrust washer and into keyway on jackshaft. Thread the jackshaft bolt into the starter shaft making sure that the lockplate key remains in the keyway.
11. Holding pinion gear to prevent rotation, tighten jackshaft bolt to 60-80 **in-lbs** (6.8-9.0 Nm). Bend tab on lockplate against flat of bolt head to secure.
12. Install the primary chaincase cover. See Section [6.5 PRIMARY CHAINCASE, INSTALLATION](#), steps 20-31.
13. Insert bolt through battery negative cable (black) into threaded hole of battery negative (-) terminal. Tighten bolt to 60-96 **in-lbs** (6.8-10.9 Nm).
14. Install seat. See Section [2.25 SEAT, INSTALLATION](#).

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## DISASSEMBLY, TESTING AND REPAIR

1. See Figures 5-4 and 5-5. Disconnect field wire (1).



**Figure 5-5. Remove Thru-Bolts**

2. See Figures 5-4 and 5-6. Remove thru-bolts (2). Remove field coil (3) and end cap (4).



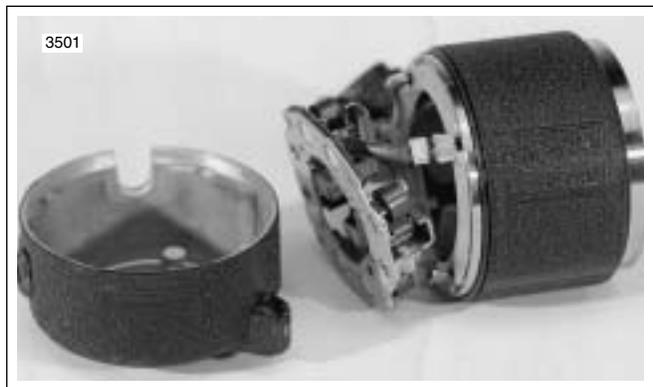
**Figure 5-6. Remove Field Coil and Cap**



3. See Figures 5-7 and 5-8. Remove the end cap screws and cap.



**Figure 5-7. Remove End Cap Screws and O-Rings**



**Figure 5-8. Remove End Cap**

4. See Figures 5-4 and 5-9. Disengage brush springs (6) and pull field coil brushes (7) out of brush holders (8).



**Figure 5-9. Remove Brush Holder**

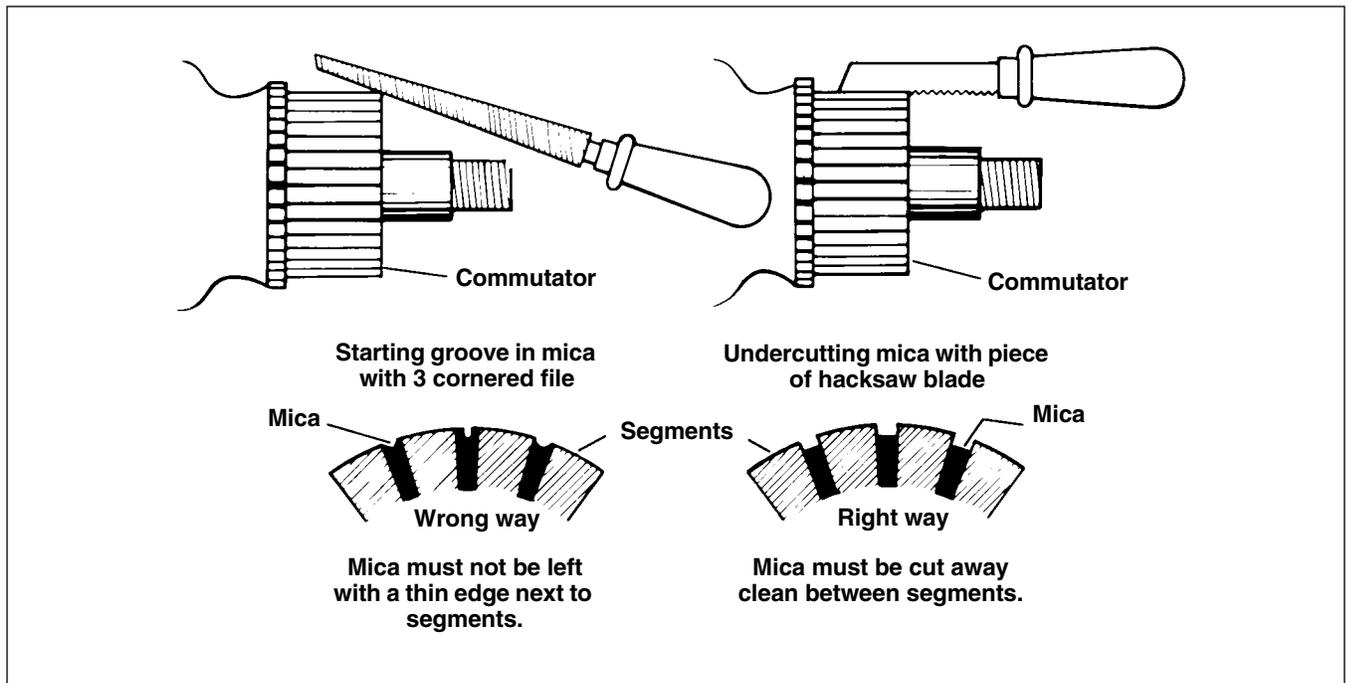


Figure 5-10. Undercutting the Mica Separators

5. Check the brush length. Brushes less than 0.433 inch (11 mm) long should be replaced.

*NOTE*

- *Replace brushes in sets of four only.*
  - *Field coil and brush holder brushes are attached to field coil and brush holder. To replace brushes, replace field coil and brush holder.*
6. See [Figure 5-4](#). Remove armature (9).
  7. Place armature in lathe or truing stand and check runout of commutator. Commutators with more than 0.015 in. (0.38 mm) of runout should be replaced or machined on a lathe. Commutators should be replaced when diameter is less than 1.141 in. (29.98 mm).
  8. Check depth of mica on commutator. If undercut is less than 0.008 in. (0.20 mm), use an undercutting machine to undercut the mica to 1/32 in. (0.79 mm) deep. The slots should then be cleaned to remove any dirt or copper dust.
  9. See [Figure 5-10](#). If an undercutting machine is not available, undercutting can be done satisfactorily using a thin hacksaw blade. After undercutting, lightly sand the armature with crocus cloth to remove any burrs.

**CAUTION**

**Do not use sandpaper or emery cloth on commutator. The abrasive grit may remain on commutator segments and could cause excessive brush wear.**

10. See [Figure 5-11](#). Check for SHORTED ARMATURE with a growler. Place armature on growler. Hold a thin steel strip (hacksaw blade) against armature core and slowly turn armature. A shorted armature will cause the steel strip to vibrate and be attracted to the core. Shorted armatures should be replaced.

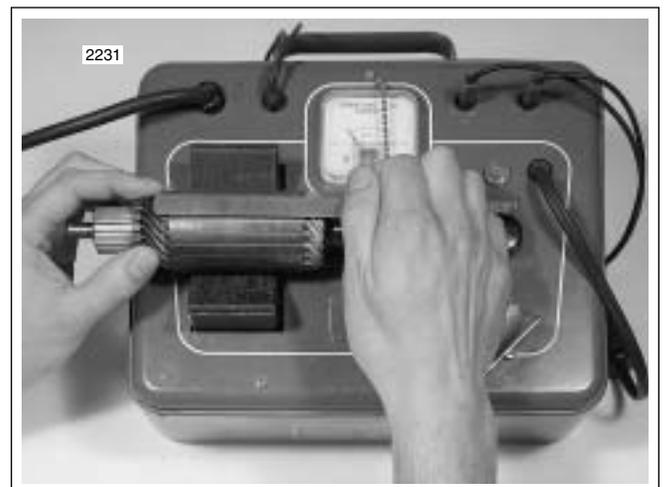
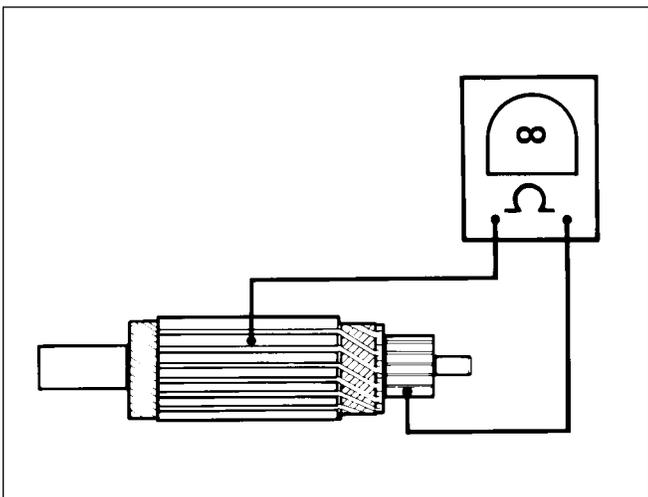


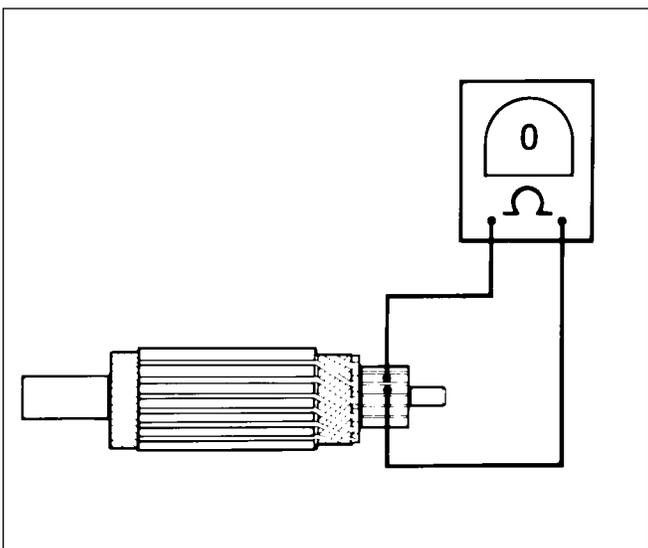
Figure 5-11. Shorted Armature Test Using Growler

11. See [Figure 5-12](#). Check for a GROUND<sup>ED</sup> ARMATURE with an ohmmeter or continuity tester. Touch one probe to any commutator segment, and the other probe to the armature core. There should be no continuity (infinite ohms). If there is any continuity the armature is grounded and should be replaced.



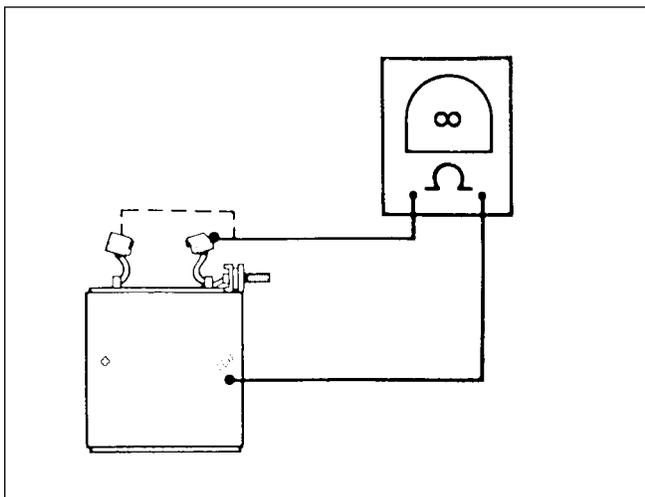
**Figure 5-12. Grounded Armature Test**

12. See [Figure 5-13](#). Check for OPEN ARMATURE with an ohmmeter or continuity tester. Check for continuity between all commutator segments. There should be continuity (0 ohms) at all test points. No continuity at any test point indicates armature is open and should be replaced.



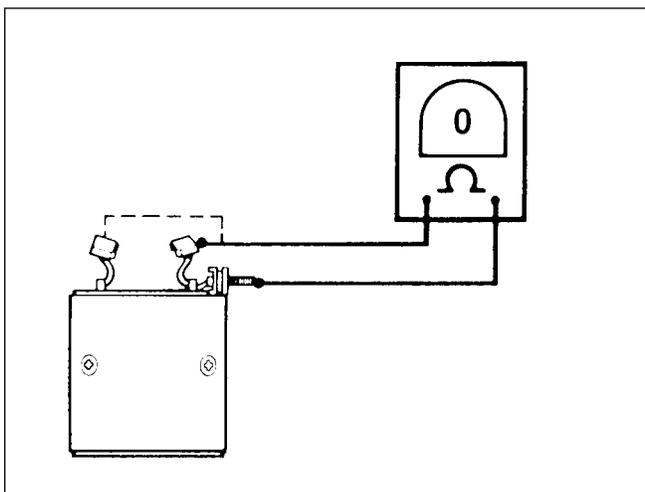
**Figure 5-13. Armature Open Test**

13. See [Figure 5-14](#). Check for GROUND<sup>ED</sup> FIELD WINDING with an ohmmeter or continuity tester. Touch one probe to the frame, and the other probe to each of the brushes attached to the field winding. There should be no continuity (infinite ohms). If there is any continuity at either brush, the field winding(s) are grounded and the field frame should be replaced.



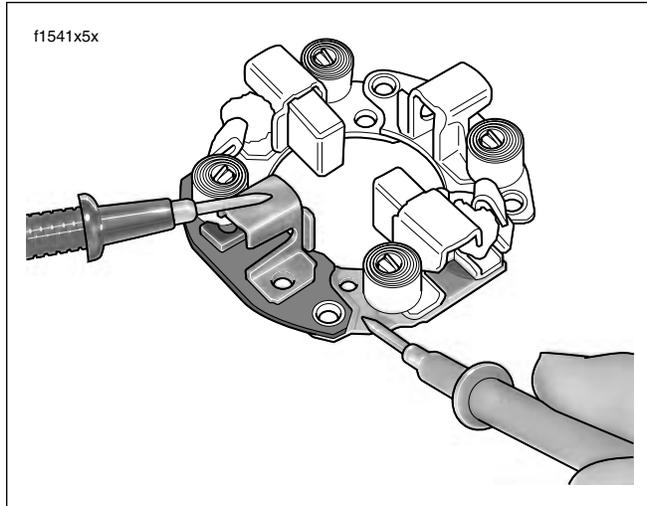
**Figure 5-14. Grounded Field Test**

14. See [Figure 5-15](#). Check for OPEN FIELD WINDING with an ohmmeter or continuity tester. Touch one probe to the field wire, and the other probe to each of the brushes attached to the field coils. There should be continuity. If there is no continuity at either brush, the field winding(s) are open and the field frame should be replaced.



**Figure 5-15. Open Field Test**

15. See [Figure 5-16](#). Test BRUSH HOLDER INSULATION with an ohmmeter or continuity tester. Touch one probe to holder plate and the other probe to each of the positive (insulated) brush holders. There should be no continuity (infinite ohms). If there is continuity at either brush holder, the brush holder assembly should be replaced. Touch one probe to the non-insulated brush holders and the other probe to the holder plate. If you measure any resistance, the brush holder must be replaced.

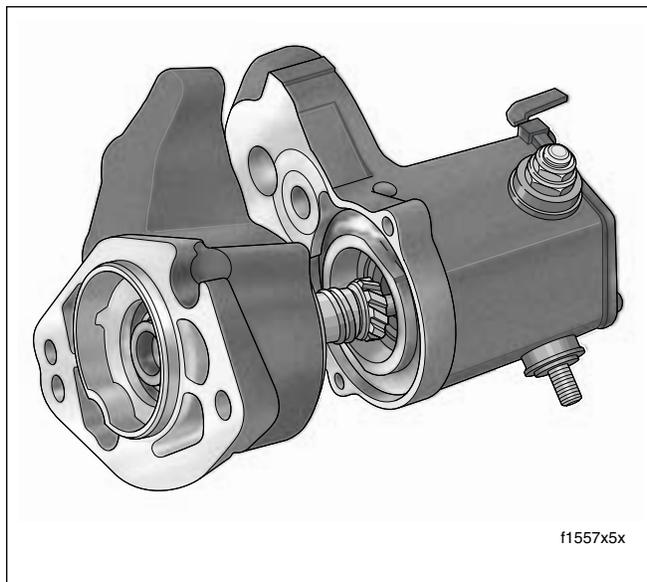


**Figure 5-16. Brush Holder Insulation Test**

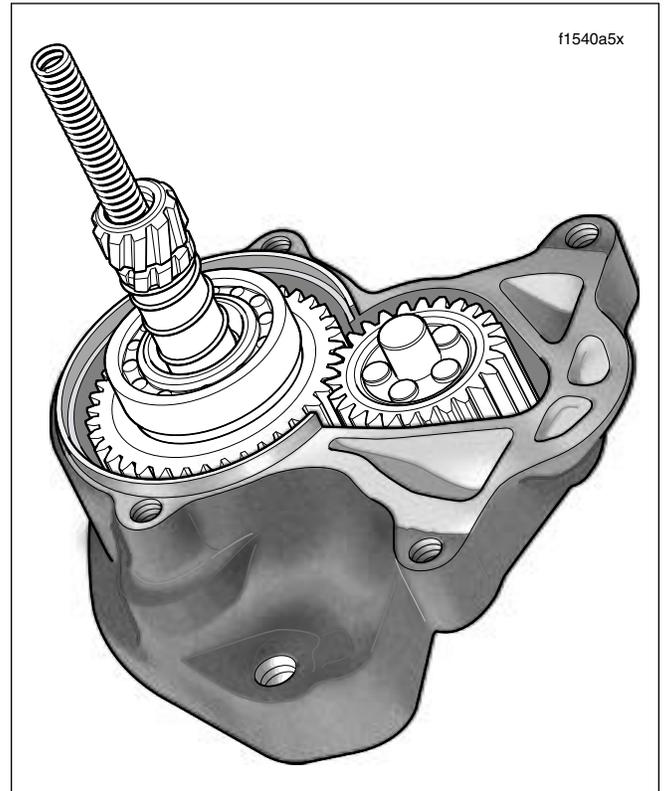
16. Check armature bearings (10) and replace if necessary. See [Figure 5-4](#).

**NOTE**

*Spring (21) and ball (22) are loose in shaft gear end. See [Figure 5-4](#).*



**Figure 5-17. Remove Drive Housing**



**Figure 5-18. Drive Housing Assembly**



**Figure 5-19. Clutch Assembly**

17. See [Figures 5-4](#), [5-17](#) and [5-18](#). Remove the two drive housing mounting screws (11) and washers (12). Remove drive housing (13) from solenoid housing (14).
18. See [Figures 5-4](#) and [5-19](#). Remove drive (15), idler gear (16) and idler gear bearing (17) from drive housing (13). O-ring (18) is in groove in drive housing.
19. Remove spring (19) and shaft (20).

## ASSEMBLY

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1. See [Figure 5-4](#). Replace O-rings (18, 23).

### CAUTION

**Do not use solvents to clean drive assembly/over-running clutch (15). It is lubricated and sealed. If you use a solvent to clean it, the lubricant will be washed out and the clutch will fail.**

2. Clean, inspect and lubricate drive assembly components. Lubricate parts with high temperature grease such as LUBRIPLATE 110.
3. When installing drive assembly components, open end of idler bearing cage (17) faces toward solenoid.
4. When installing drive housing (13) to solenoid housing (14) use new O-ring (18). Be sure to install return spring (21) and ball (22).
5. Lubricate armature bearings (10) with high temperature grease such as LUBRIPLATE 110. Install armature (9) and field coil (3) to solenoid housing (14).
6. Replace brush springs (6), if necessary. Install brushes (7) and brush holder (8).
7. Install end cap (4) with screws (5).
8. Install thru-bolts (2).
9. Connect field wire (1) to solenoid terminal. Tighten solenoid terminal nut to 70-90 **in-lbs** (7.9-10.2 Nm).

## GENERAL

The starter solenoid is a switch designed to open and close the starting circuit electromagnetically. The switch consists of contacts and a winding around a hollow cylinder containing a movable plunger. When the winding is energized by the battery, the magnetism produced pulls the plunger into the coil. The plunger moves against two main switch contacts, closing the circuit.

## DISASSEMBLY

1. See [Figure 5-20](#). Remove screws and washers. Clip comes off with screw.

2. Remove cover and gasket. Discard gasket.
3. Plunger can now be removed from solenoid housing.

## ASSEMBLY

1. Replace wire connection hardware as necessary.
2. Apply a light coat of Lubriplate® 110 to plunger shaft. Install plunger in solenoid housing.
3. Install **new** gasket. Place cover in position and install screws, washers and clip.

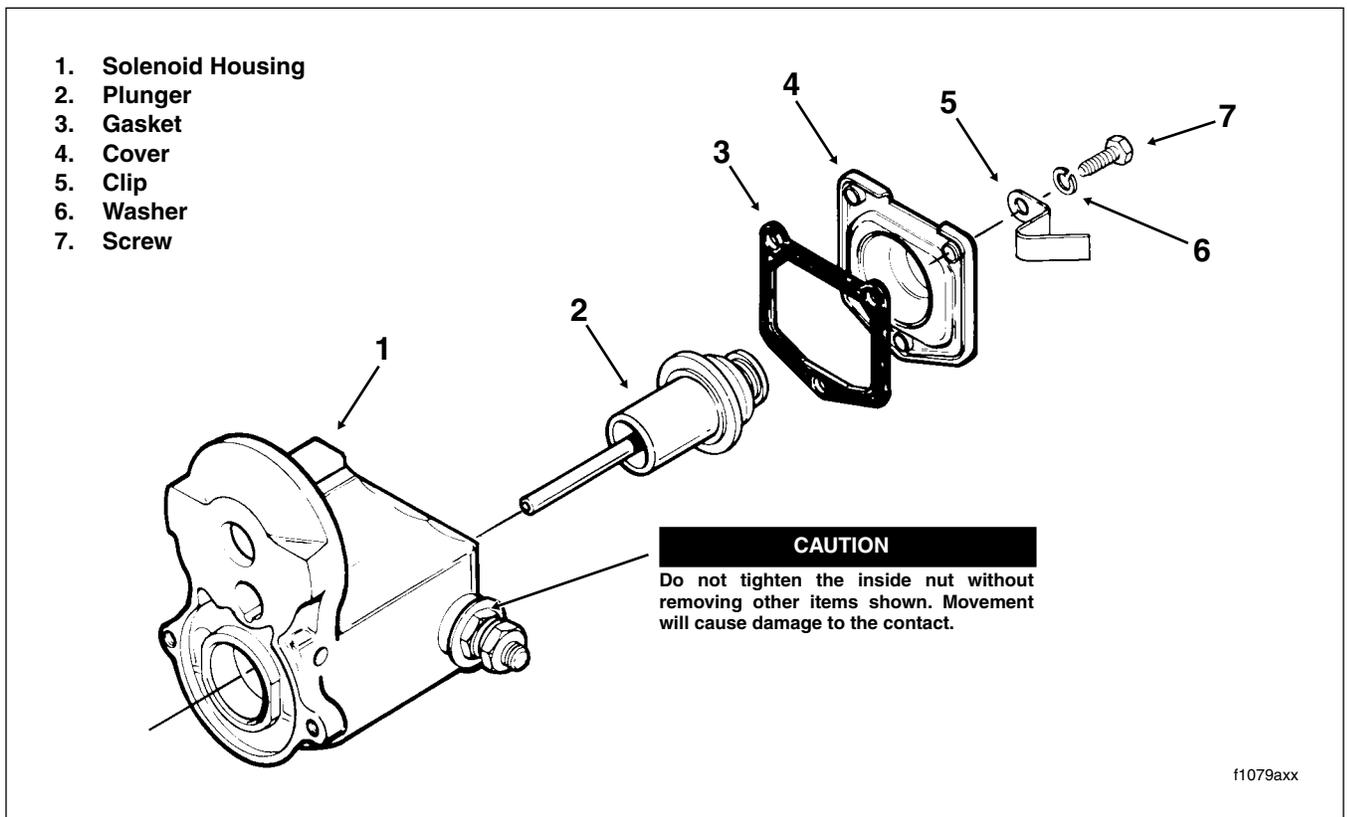


Figure 5-20. Starter Solenoid

## REMOVAL/DISASSEMBLY

1. Remove seat. See Section 2.25 SEAT, REMOVAL.

**⚠ WARNING**

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

2. Unthread bolt and remove battery negative cable (black) from battery negative (-) terminal.
3. See Figure 5-21. Remove the primary chaincase cover. Remove the clutch assembly, primary chain and compensating sprocket components as a single assembly. See Section 6.5 PRIMARY CHAINCASE, REMOVAL, steps 3-15.

## NOTE

If only the jackshaft bolt, thrust washer, lockplate, pinion gear and/or spring require servicing, then the primary chain and clutch assembly may be left in place.

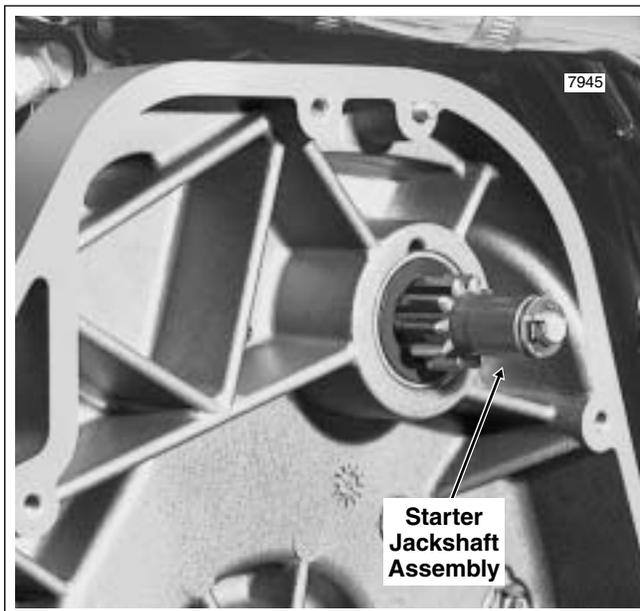


Figure 5-21. Primary Chaincase

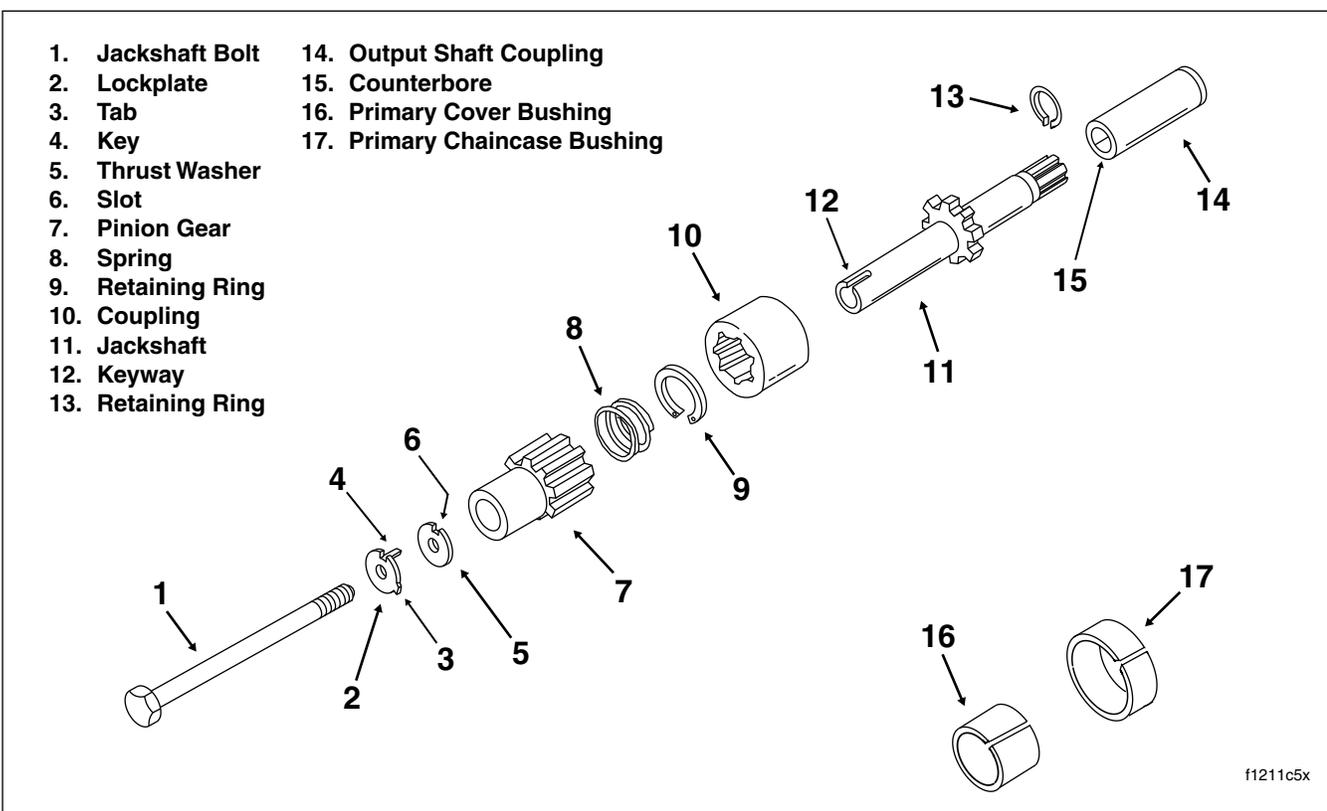


Figure 5-22. Starter Jackshaft Assembly

4. Bend tab on lockplate away from head of jackshaft bolt. See [Figure 5-22](#).
5. Holding pinion gear to prevent rotation, remove the jackshaft bolt with lockplate and thrust washer.
6. Carefully pull jackshaft assembly from the primary chaincase bore.
7. Remove the pinion gear from the jackshaft.
8. Remove the coupling from the jackshaft. Remove the spring from the coupling.

### CAUTION

**Do not force the output shaft coupling through the oil seal in the primary chaincase or the resulting damage will require seal replacement.**

9. From right side of motorcycle, remove starter front mounting screw with lockwasher. Remove rear mounting screw with lockwasher (and battery negative cable ring terminal). Remove Keps nut from stud of bracket tab and remove exhaust support bracket.
10. Pull back rubber boot and remove flange nut from starter post. Remove main power and battery positive cable ring terminals from starter post.
11. Depress external latch and pull solenoid connector from top of starter housing.
12. Locate oil filler plug/dipstick at top of transmission case. To remove the oil filler plug, pull steadily while moving plug back and forth.
13. Remove the starter from the right side of the motorcycle, carefully sliding it through the space between the exhaust pipe and side cover.

### NOTE

*If necessary, remove allen screw and decorative chrome cover to facilitate starter removal.*

14. Remove the coupling from the starter motor output shaft.

## ASSEMBLY/INSTALLATION

### NOTE

*To replace the jackshaft bushings and/or seals in the primary chaincase or primary chaincase cover, see [Section 6.5 PRIMARY CHAINCASE, DISASSEMBLY](#).*

1. Inspect the retaining ring within the output shaft coupling for damage or distortion. Replace as necessary. With the counterbore on the outboard side, install the coupling on the starter motor output shaft, if removed.
2. From right side of motorcycle, tilt starter and work into its installed position. Starter output shaft coupling must remain on shaft and mate to starter jackshaft.

3. Install oil filler plug/dipstick at top of transmission case.
4. Install slot of exhaust support bracket onto stud of bracket tab aligning other holes with those in starter flange. Start Keps nut on stud.
5. Engaging hole in exhaust support bracket, install starter front mounting screw with lockwasher. Install rear mounting screw with lockwasher (and battery negative cable ring terminal) in the same manner.
6. Alternately tighten starter front and rear mounting screws to 14-18 ft-lbs (19-24 Nm). Tighten Keps nut on stud of bracket tab.

7. Install battery positive and main power cable ring terminals onto starter post. Install flange nut and tighten to 70-90 **in-lbs** (7.9-10.2 Nm). Pull down rubber boot over terminal connections on starter post.
8. Snap solenoid connector to terminal at top of starter housing.

### NOTE

*If removed, install allen screw to fasten decorative chrome cover to starter.*

9. Inspect the retaining ring within the coupling for damage or distortion. Replace as necessary.
10. Insert narrow end of jackshaft into shallow side of coupling until gear face contacts installed retaining ring. (Look at position of retaining ring within coupling to determine shallow side.)
11. Slide spring over narrow end of jackshaft until it contacts retaining ring.
12. Slide pinion gear over narrow end of jackshaft until it contacts spring.
13. Slide lockplate and **new** thrust washer onto jackshaft bolt, if removed. Insert bolt into jackshaft bore.
14. Gently insert jackshaft assembly into primary chaincase so that splined end of shaft engages coupling on starter output shaft.
15. Insert key on lockplate through slot in thrust washer and into keyway on jackshaft. Thread the jackshaft bolt into the starter shaft making sure that the lockplate key remains in the keyway.
16. Holding pinion gear to prevent rotation, tighten jackshaft bolt to 60-80 **in-lbs** (6.8-9.0 Nm). Bend tab on lockplate against flat of bolt head to secure.
17. Install the clutch, primary chain, and compensating sprocket components. Install the primary chaincase cover. See [Section 6.5 PRIMARY CHAINCASE, INSTALLATION](#), steps 9-31.
18. Insert bolt through battery negative cable (black) into threaded hole of battery negative (-) terminal. Tighten bolt to 60-96 **in-lbs** (6.8-10.9 Nm).
19. Install seat. See [Section 2.25 SEAT, INSTALLATION](#).

# NOTES

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