



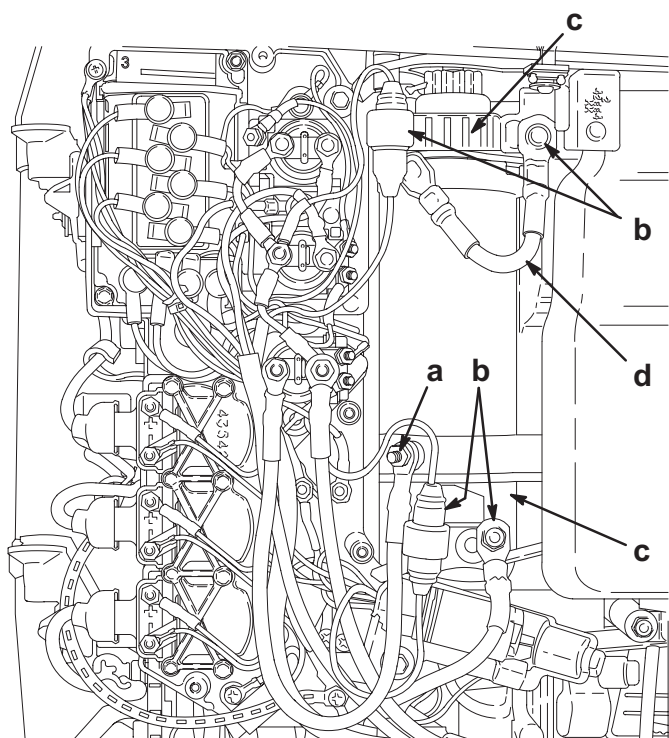
Starter Motor

Removal

CAUTION

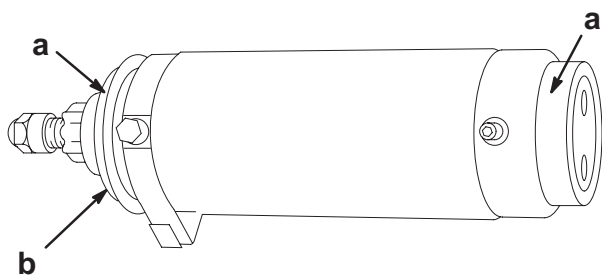
Disconnect battery leads from battery before removing starter.

1. Disconnect battery leads from battery.
2. Disconnect YELLOW cable.
3. Remove 4 bolts and remove starter clamps.
4. Remove starter.
5. Remove BLACK cable.



- a - YELLOW Cable
b - Bolts (4)
c - Starter Clamps
d - BLACK Cable

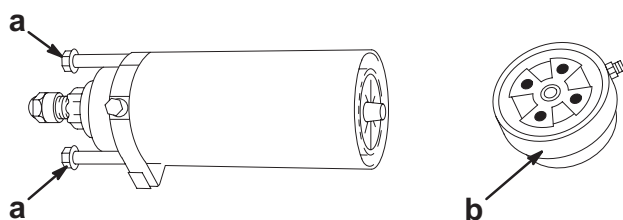
6. Remove 2 rubber collars and 2 rubber bumpers.



- a - Rubber Collar
b - Spacer (If Equipped)

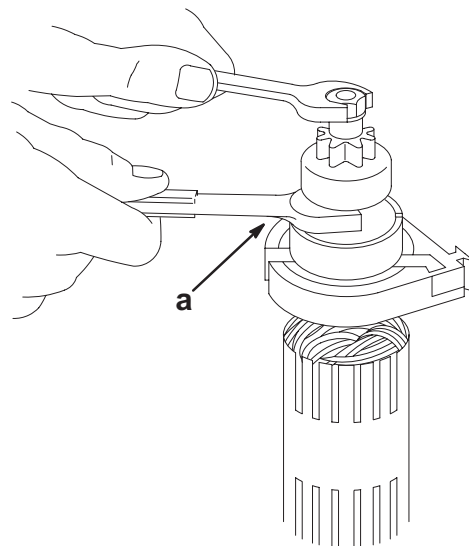
Disassembly

1. Remove 2 thru bolts and commutator end cap, taking care not to lose brush springs.



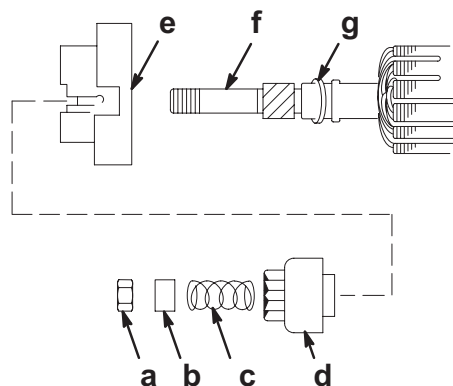
- a - Thru Bolts
b - Commutator End Cap

2. Pull armature from starter frame.
3. Remove locknut.



- a - Hold Armature Shaft With Wrench on Hex Portion of Drive Assembly

4. Remove components from armature.



- a - Locknut
b - Spacer
c - Spring
d - Drive Assembly
e - Drive End Cap
f - Armature Shaft
g - Washer



Starter Cleaning, Inspection and Testing

CLEANING AND INSPECTION

1. Clean all starter motor parts.
2. Check pinion teeth for chips, cracks or excessive wear.
3. Replace the drive clutch spring and/or collar if tension is not adequate or if wear is excessive.
4. Inspect brush holder for damage or for failure to hold brushes against commutator.
5. Replace brushes that are pitted or worn to less than 1/4" (6.4mm) in length.
6. Inspect the armature conductor (commutator bar junction) for a tight connection. A loose connection (excessive heat from prolonged cranking melts solder joints) results in a burned commutator bar.
7. Resurface and undercut a rough commutator as follows:

⚠ CAUTION

Do not turn down the commutator excessively.

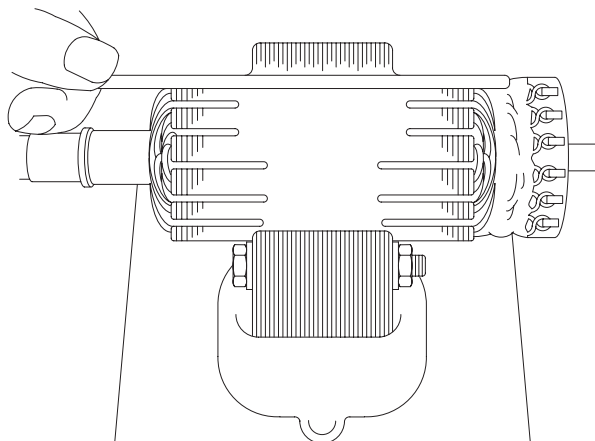
- a. Resurface the commutator and undercut the insulation between the commutator bars 1/32" (0.8mm) to the full width of the insulation and so that the undercut is flat.
 - b. Clean the commutator slots after undercutting.
 - c. Sand the commutator lightly with No. 00 sandpaper to remove burrs, then clean the commutator.
 - d. Recheck the armature on a growler for shorts as specified in the following procedure ("Testing").
8. Open-circuited armatures often can be repaired. The most likely place for an open circuit is at the commutator bars, as a result of long cranking periods. Long cranking periods overheat the starter motor so that solder in the connections melts and is thrown out. The resulting poor connections then cause arcing and burning of the commutator bars.
 9. Repair bars, that are not excessively burned, by resoldering the leads in bars (using rosin flux solder) and turning down the commutator in a lathe to remove burned material, then undercut the mica.
 10. Clean out the copper or brush dust from slots between the commutator bars.

11. Check the armature for ground. See the following procedure ("Testing").

Testing

ARMATURE TEST FOR SHORTS

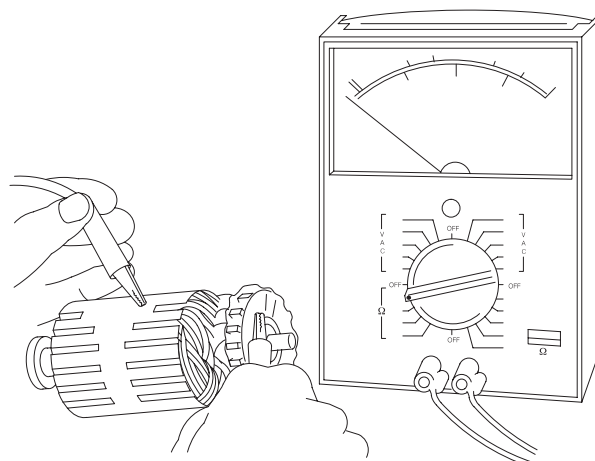
Check armature for short circuits by placing on growler and holding hack saw blade over armature core while armature is rotated. If saw blade vibrates, armature is shorted. Recheck after cleaning between commutator bars. If saw blade still vibrates, replace armature.



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ARMATURE TEST FOR GROUND

1. Set ohmmeter to (R x 1 scale). Place one lead of ohmmeter on armature core or shaft and other lead on commutator.
2. If meter indicates continuity, armature is grounded and must be replaced.

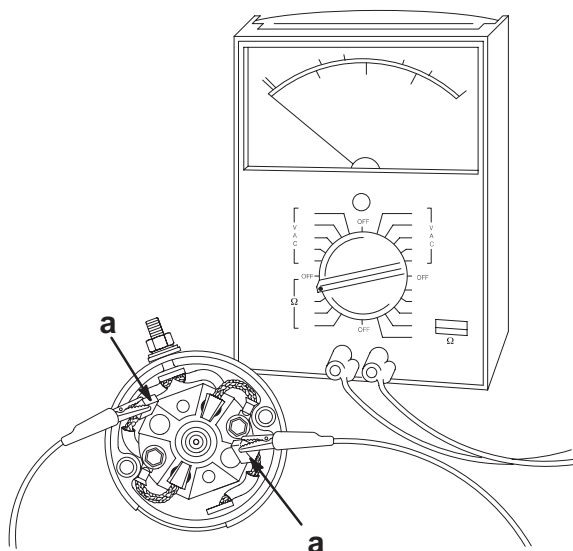


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CHECKING POSITIVE BRUSHES AND TERMINAL

Set ohmmeter to (R x 1 scale). Connect meter leads between POSITIVE brushes. Meter must indicate full continuity or zero resistance. If resistance is indicated, inspect lead to brush and lead to POSITIVE terminal solder connection. If connection cannot be repaired, brushes must be replaced.

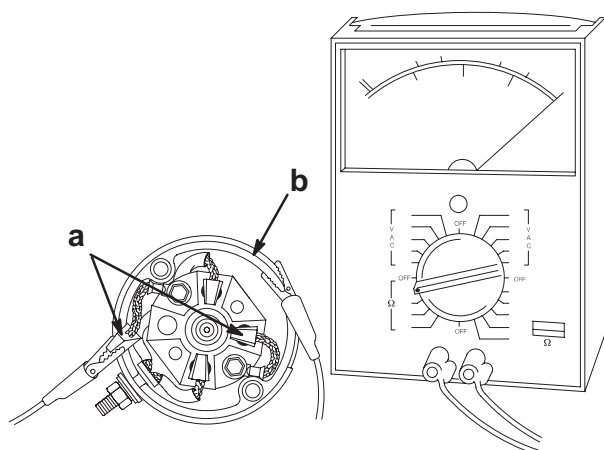


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a - POSITIVE (+) Brushes

TESTING NEGATIVE BRUSHES FOR GROUND

Set ohmmeter to (R x 1 scale). Place one lead of the ohmmeter on the NEGATIVE brush and the other lead on the end cap (bare metal). If the meter indicates NO continuity, replace the NEGATIVE brush. Repeat this procedure on the other NEGATIVE brush.



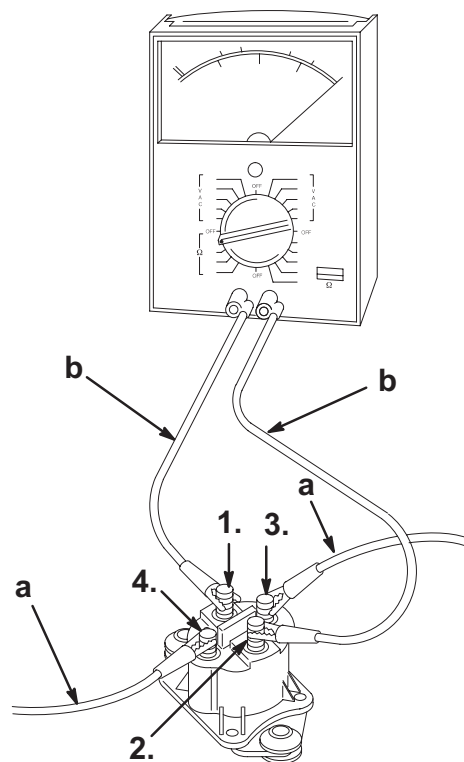
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a - NEGATIVE (-) Brushes

b - End Cap

STARTER SOLENOID TEST

1. Disconnect all wires from solenoid.
2. Use an ohmmeter (R x 1 scale) and connect meter leads between solenoid terminals 1 and 2.
3. Connect a 12-volt power supply between solenoid terminals 3 and 4. Solenoid should click and meter should read 0 ohms (full continuity).
4. If meter does not read 0 ohms (full continuity), replace solenoid.



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a - 12-Volt Supply

b - VOA Leads

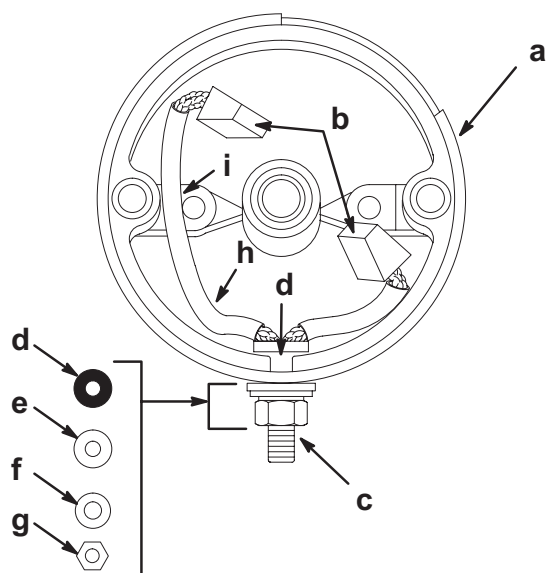


Brush Replacement

STARTER REASSEMBLY

1. If brushes were removed, replace as follows:

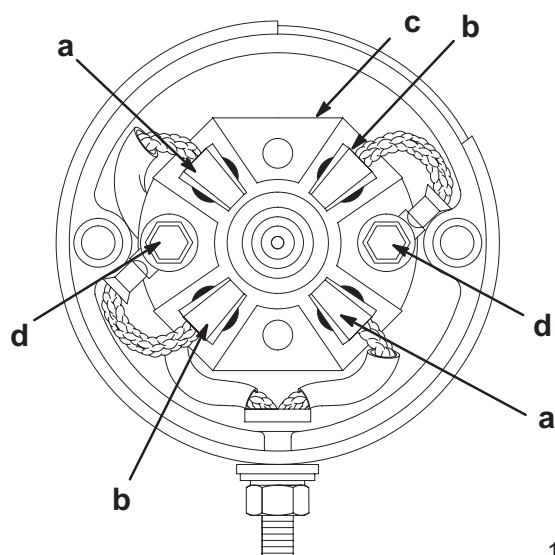
- a. Install **POSITIVE** brushes (along with **POSITIVE** terminal) into commutator end cap.



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- | | |
|------------------------|-------------------------|
| a - End Cap | f - Split Washer |
| b - POSITIVE Brushes | g - Hex Nut |
| c - POSITIVE Terminal | h - Long Brush Lead |
| d - Insulating Bushing | i - Push Lead into Slot |
| e - Washer | |

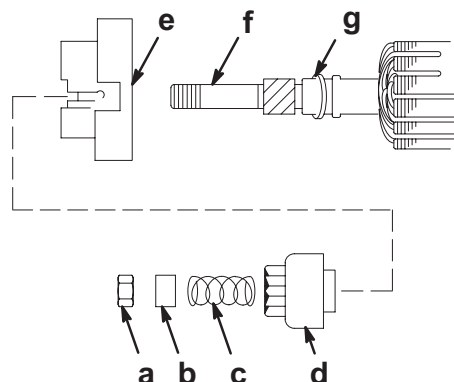
- b. Install **NEGATIVE** brushes (along with brush holder).



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|--|
| a - POSITIVE (+) Brushes |
| b - NEGATIVE (-) Brushes |
| c - Brush Holder |
| d - Bolts (Fasten NEGATIVE Brushes and Holder) |

2. If removed, reinstall parts on armature shaft. Use a new locknut and tighten securely on end of shaft.



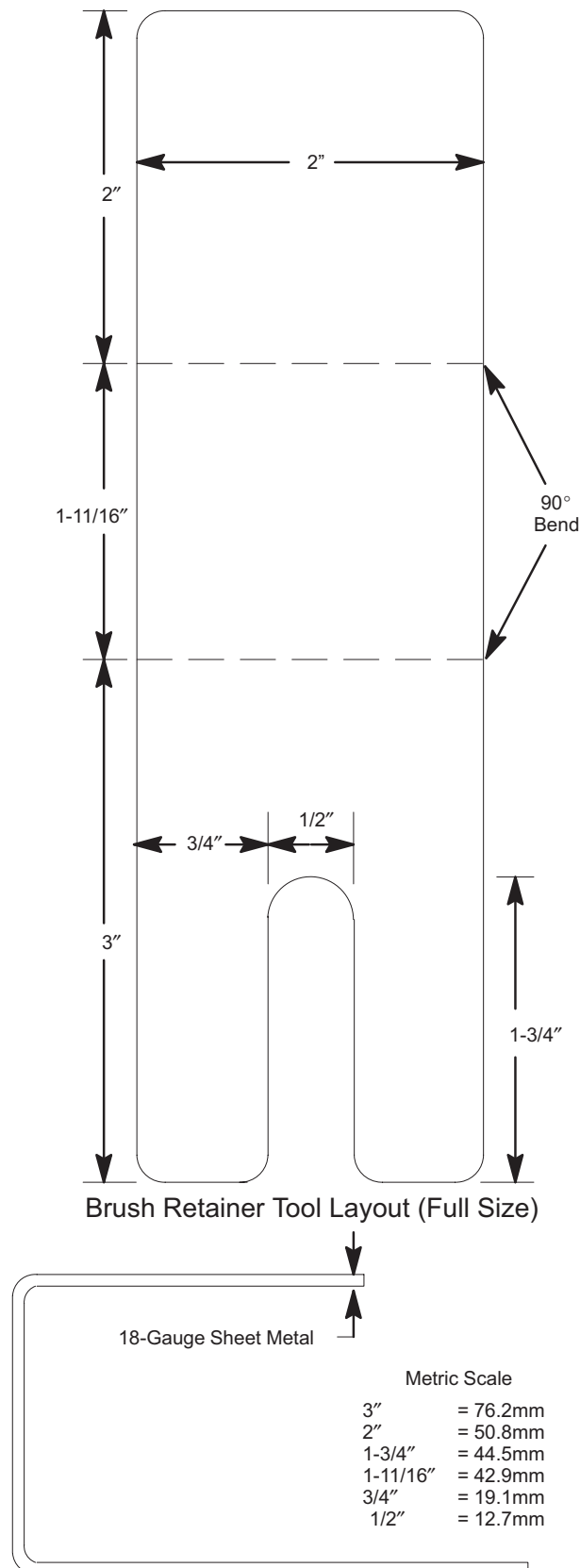
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- | |
|--------------------|
| a - Locknut |
| b - Spacer |
| c - Spring |
| d - Drive Assembly |
| e - Drive End Cap |
| f - Armature Shaft |
| g - Washer |

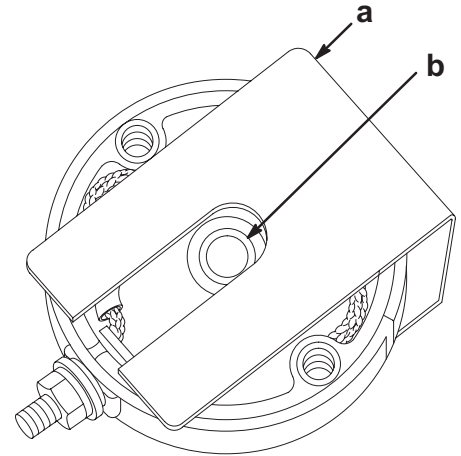
3. Lubricate helix threads on armature shaft with a drop of SAE 10W oil.
4. Lubricate bushing in drive end plate with a drop of SAE 10W oil.



5. Position armature into starter frame.
6. To prevent damage to brushes and springs when installing commutator end cap, it is recommended that a brush retaining tool be made as shown:

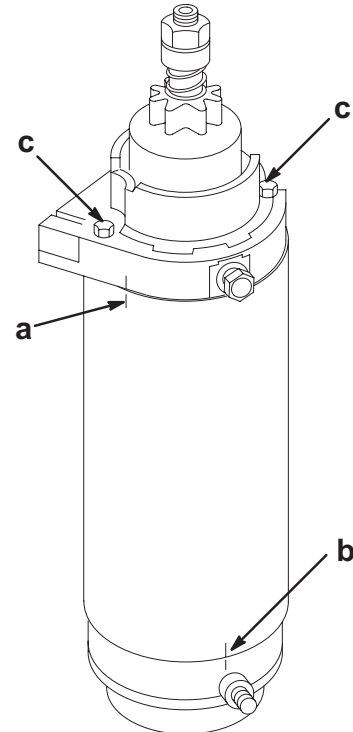


7. Lubricate bushing (located in commutator end cap) with one drop of SAE 10W oil. DO NOT over lubricate.
8. Place springs and brushes into brush holder and hold in place with brush retainer tool.



- a - Brush Retainer Tool
b - Bushing (DO NOT Over Lubricate)

9. Install armature into starter frame and align match marks (a). Install commutator end cap onto starter frame and align match marks (b). Remove brush retainer tool. Install through bolts (c) and torque to 70 lb. in. (7.9 N·m).



- a - Alignment Marks
b - Alignment Marks
c - Bolts [Torque to 70 lb. in. (7.9 N·m)]