

ENGINE 4H SERIES

SECTION 6D2
STARTING SYSTEM

Contents

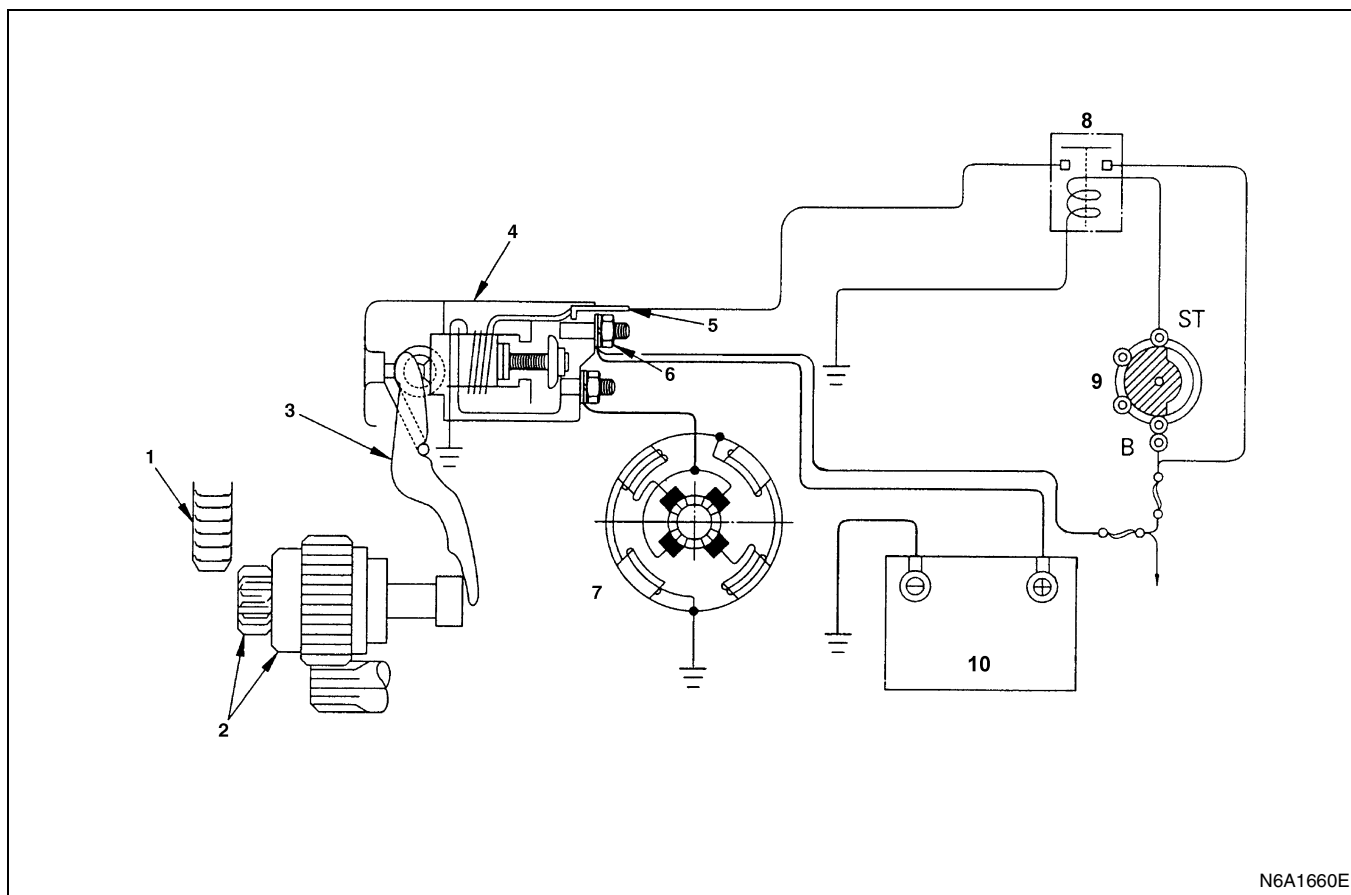
GENERAL DESCRIPTION	6D2-2
Component	6D2-2
ON-VEHICLE SERVICE	6D2-5
Component	6D2-5
Removal	6D2-5
Installation	6D2-6
UNIT REPAIR	6D2-7
Component	6D2-7
Disassembly	6D2-9
Inspection and Repair.....	6D2-11
Reassembly	6D2-15

GENERAL DESCRIPTION

Component

Starting Circuit

The cranking system consists of a battery, starter, starter switch, starter relay, etc. and these main components are connected as shown in figure. For details of the starting circuit.



Legend

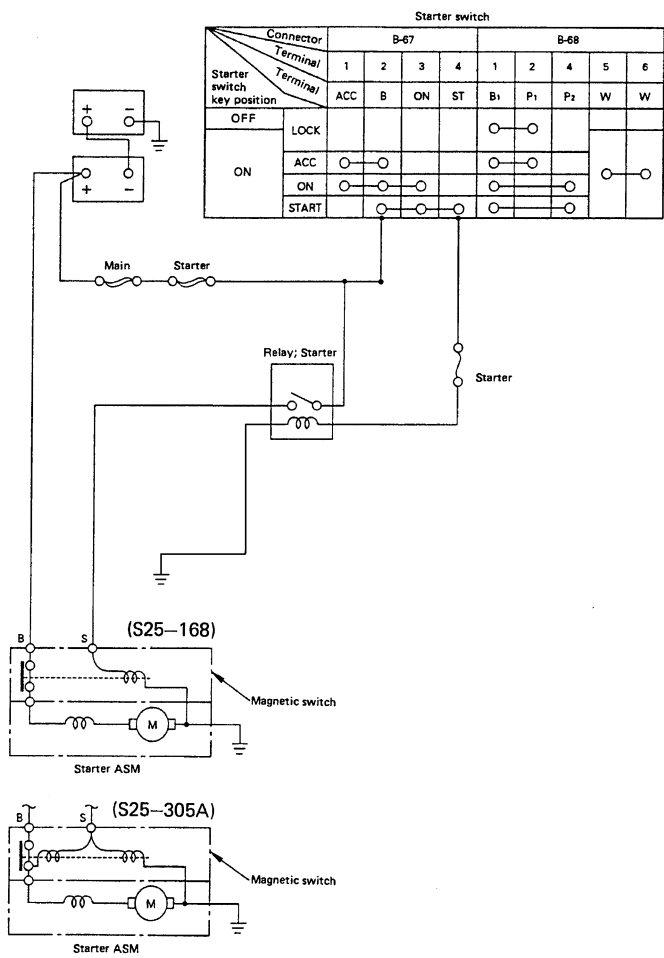
- | | |
|--------------------|-------------------|
| 1. Ring gear | 6. "B" terminal |
| 2. Pinion clutch | 7. Starter |
| 3. Shift lever | 8. Relay; starter |
| 4. Magnetic switch | 9. Starter switch |
| 5. "S" terminal | 10. Battery |

Starter

The starting system employs a magnetic type reduction starter in which the motor shaft is also used as a pinion shaft. When the starter switch is turned on, the contacts of magnetic switch are closed, and the armature rotates. At the same time, the plunger is attracted, and the pinion is pushed forward by the shift lever to mesh with ring gear.

Then, the ring gear runs to start the engine. When the engine starts and the starter switch is turned off, the plunger returns, the pinion is disengaged from ring gear, and the armature stops rotation. When the engine speed is higher than the pinion, the pinion idles, so that the armature is not driven.

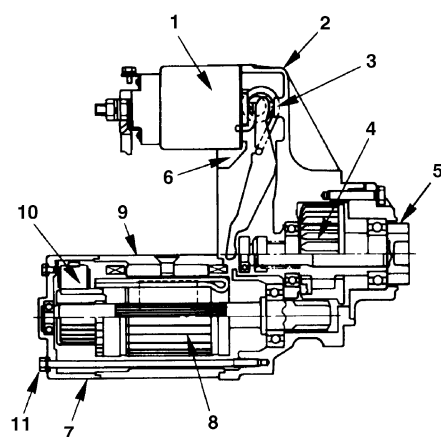
Starting Circuit



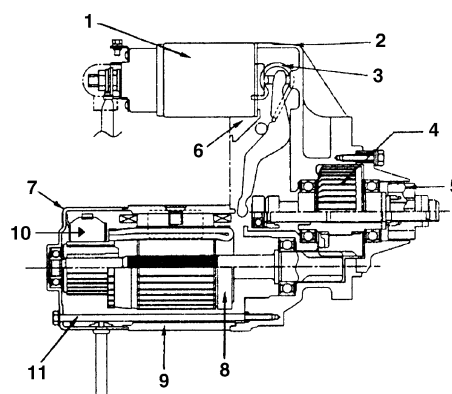
6D2-4 STARTING SYSTEM

Starting Motor

S25—168



S25—305A



N6A0987E

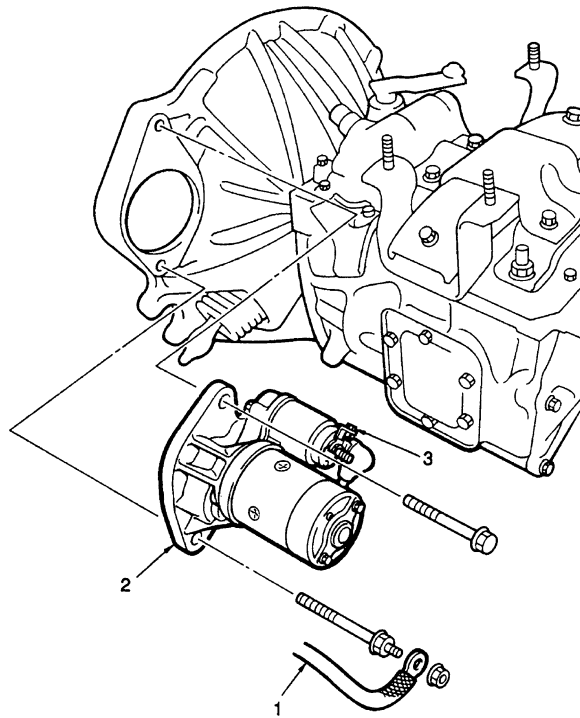
Legend

- | | |
|--------------------|------------------|
| 1. Magnetic switch | 7. Rear cover |
| 2. Gear case | 8. Armature |
| 3. Torsion spring | 9. Yoke |
| 4. Clutch | 10. Brush |
| 5. Pinion | 11. Through bolt |
| 6. Dust cover | |

ON-VEHICLE SERVICE

Component

Starter



N6A0988E

Legend

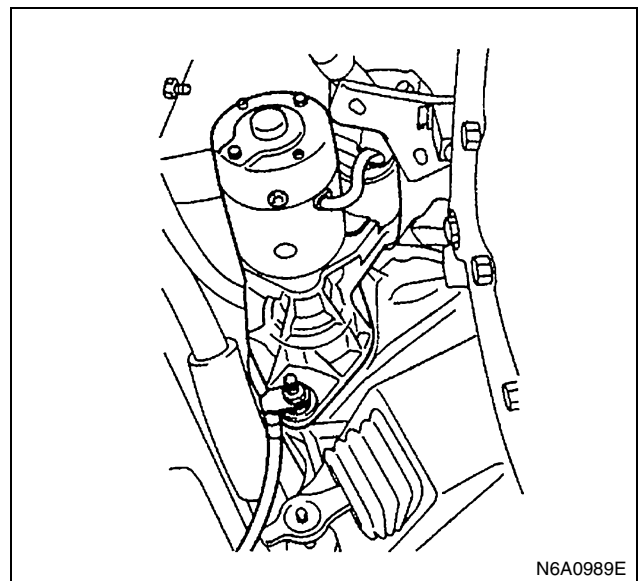
- | | |
|------------------------|-----------------------------|
| 1. Starter earth cable | 3. Starter wiring connector |
| 2. Starter assembly | |

Removal

Preparation

- Disconnect the battery ground cable (both batteries).

1. Starter Earth Cable



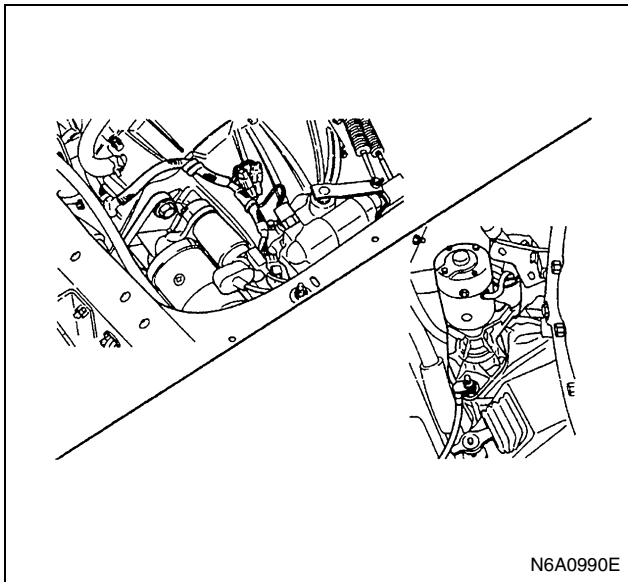
N6A0989E

- Disconnect the starter earth cable at the starter motor.

6D2-6 STARTING SYSTEM

- Disconnect the front frame harness connector somewhere near the control box of the transmission, remove each clip that fastens the harness.

2. Starter Assembly

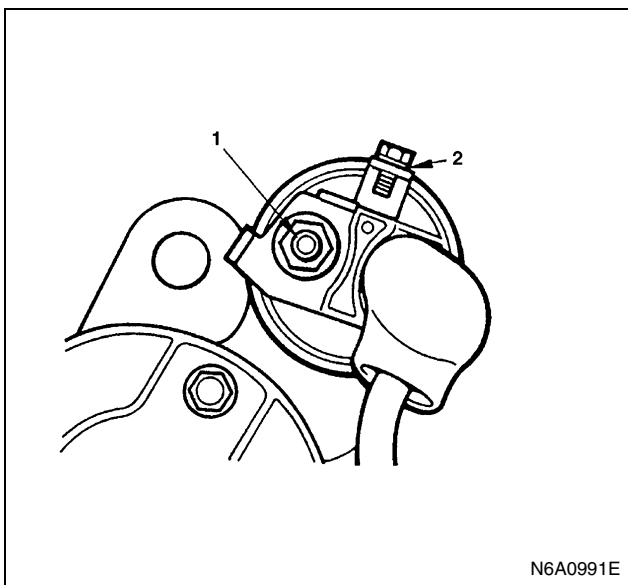


- Remove the starter assembly from flywheel housing.

3. Starter Wiring Connector

Installation

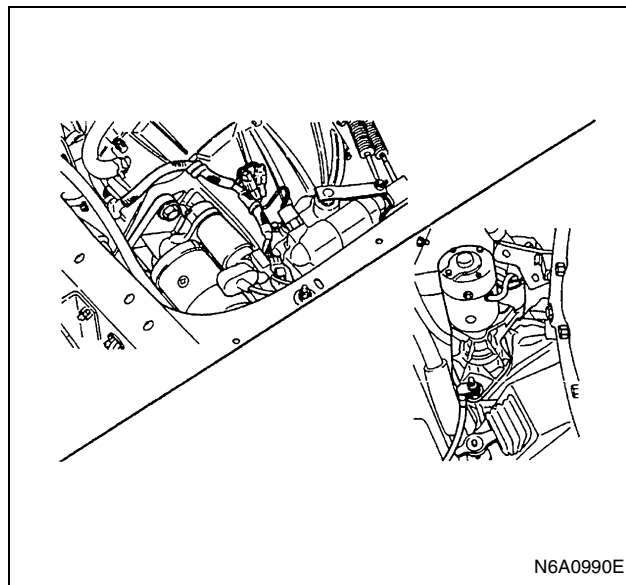
1. Starter Wiring Connector



Legend

1. Terminal B
2. Terminal S

2. Starter Assembly



- Install the starter to the flywheel housing.

Tighten:

Starter bolt to 126 N·m (12.9 kg·m / 93 lb·ft)

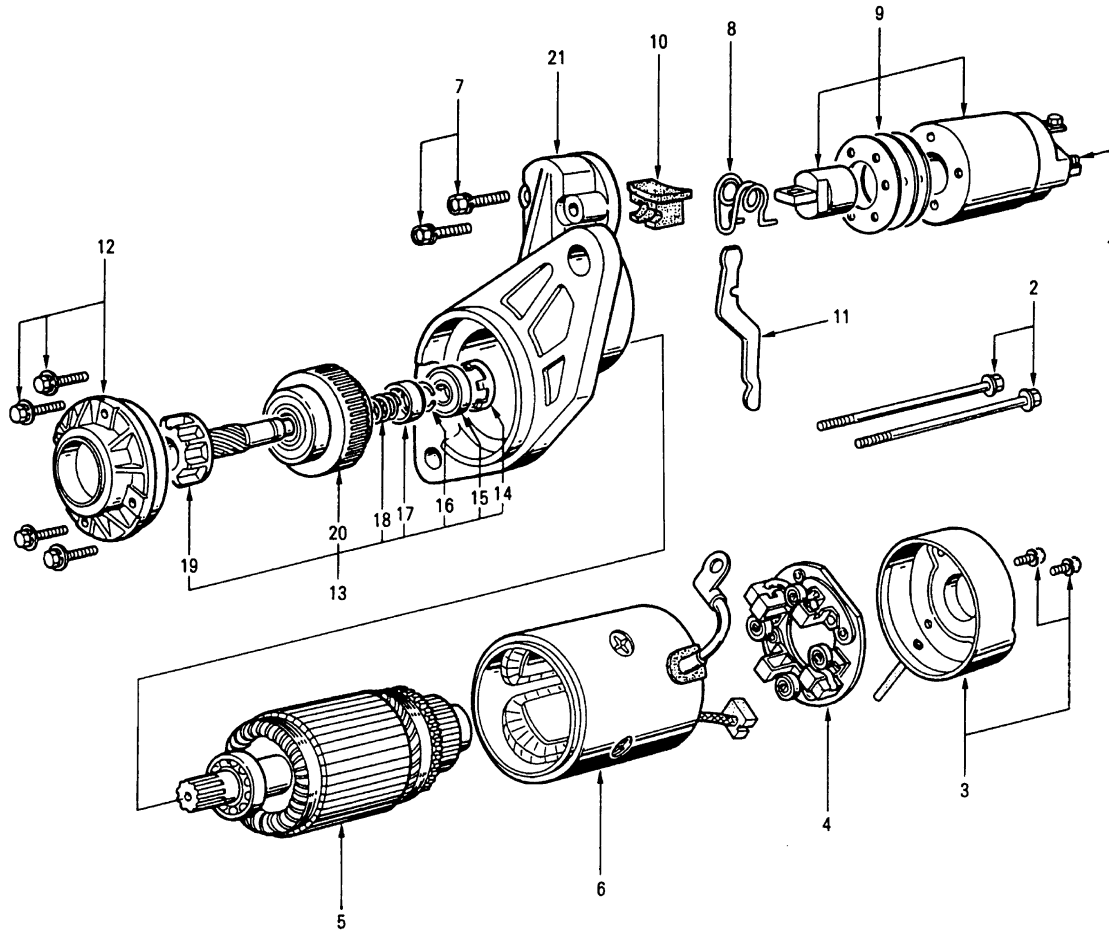
3. Starter Earth Cable

- Connect the earth cable to the starter motor.
- Connect the battery ground cable.

UNIT REPAIR

Component

S25-168



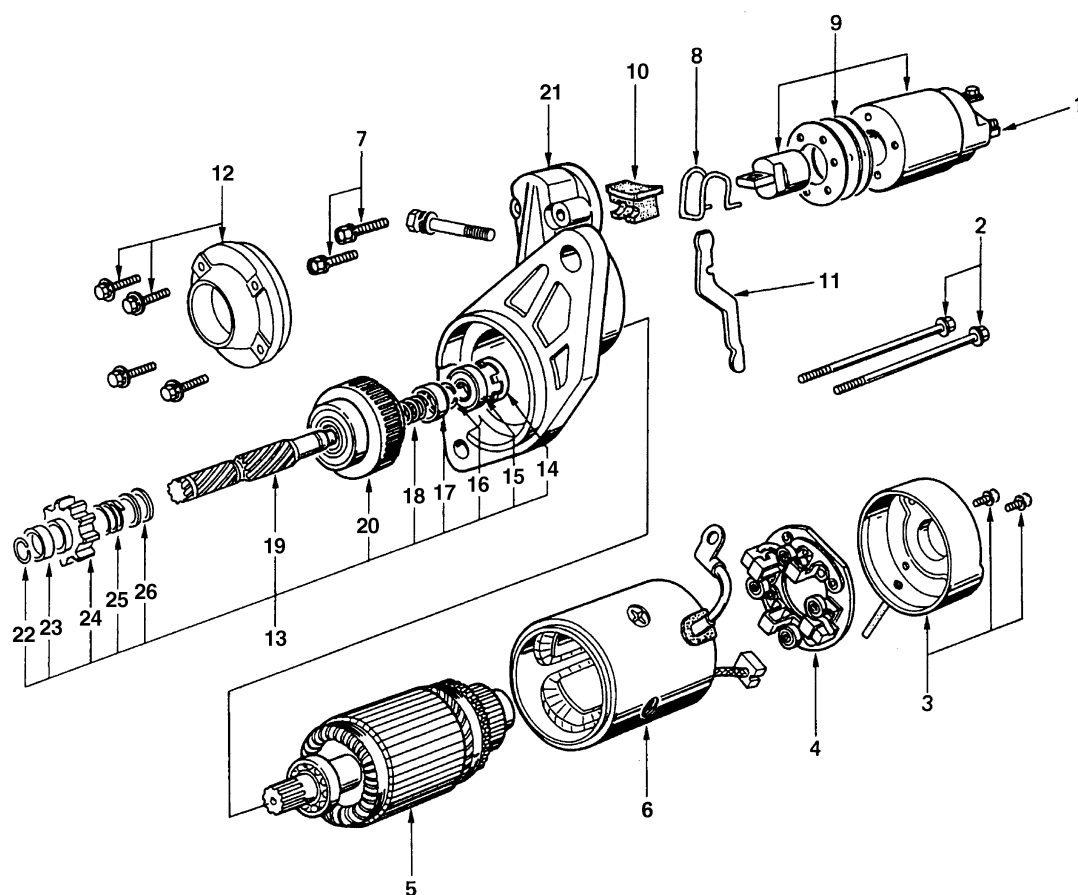
N6A0993E

Legend

- | | |
|-----------------------------|-------------------------|
| 1. Lead wire nut | 12. Bearing retainer |
| 2. Through bolt | 13. Clutch assembly |
| 3. Rear cover | 14. Bearing holder |
| 4. Brush holder | 15. Ball bearing |
| 5. Armature | 16. Pinion stopper clip |
| 6. Yoke | 17. Pinion stopper |
| 7. Bolt | 18. Return spring |
| 8. Torsion spring | 19. Pinion shaft |
| 9. Magnetic switch assembly | 20. Pinion clutch |
| 10. Dust cover | 21. Gear case |
| 11. Shift lever | |

6D2-8 STARTING SYSTEM

S25-305A

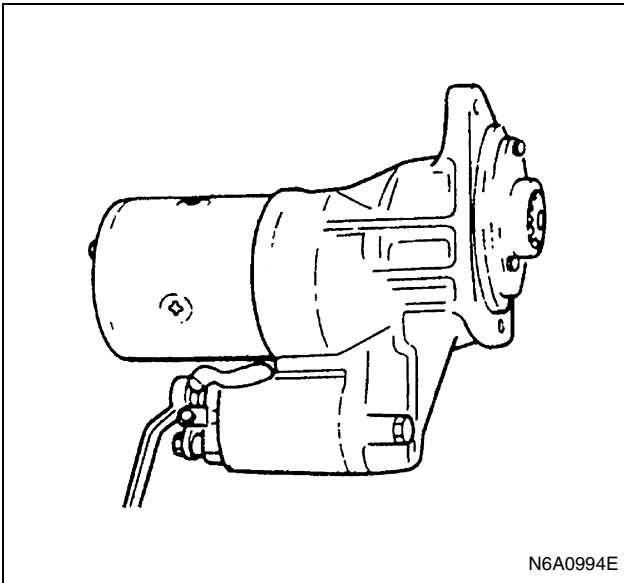


N6A1003E

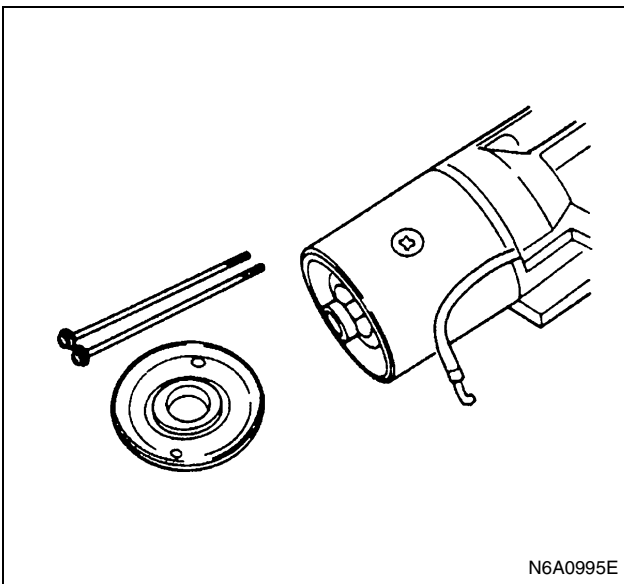
Legend

- | | |
|-----------------------------|-------------------------|
| 1. Lead wire nut | 14. Bearing holder |
| 2. Through bolt | 15. Ball bearing |
| 3. Rear cover | 16. Pinion stopper clip |
| 4. Brush holder | 17. Pinion stopper |
| 5. Armature | 18. Return spring |
| 6. Yoke | 19. Pinion shaft |
| 7. Bolt | 20. Pinion clutch |
| 8. Torsion spring | 21. Gear case |
| 9. Magnetic switch assembly | 22. Clip |
| 10. Dust cover | 23. Pinion stopper |
| 11. Shift lever | 24. Pinion |
| 12. Bearing retainer | 25. Cushion spring |
| 13. Clutch assembly | 26. Washer |

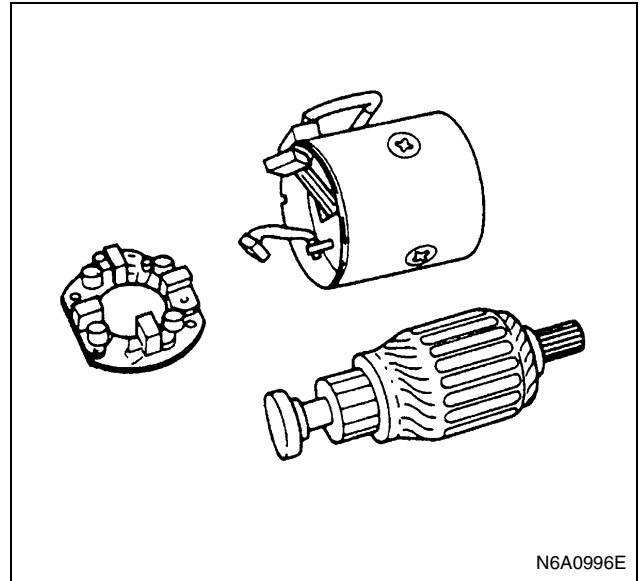
Disassembly



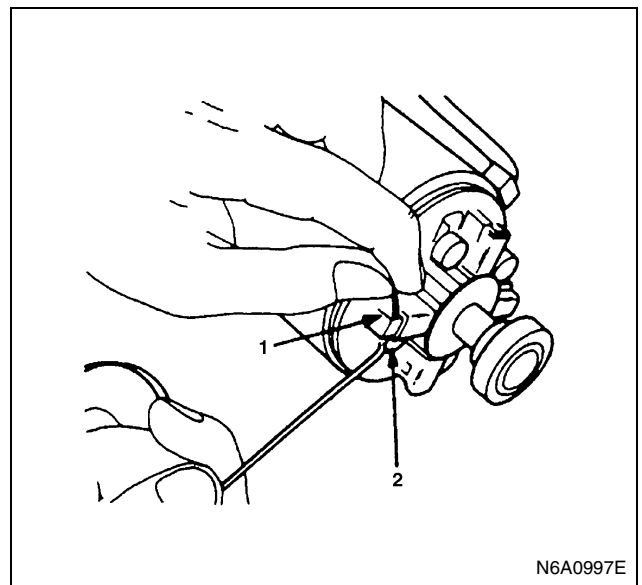
1. Lead Wire Nut
Disconnect the lead wire at the magnetic switch.
2. Through Bolt



3. Rear Cover
Remove the through bolts, then remove the rear cover.
4. Brush Holder



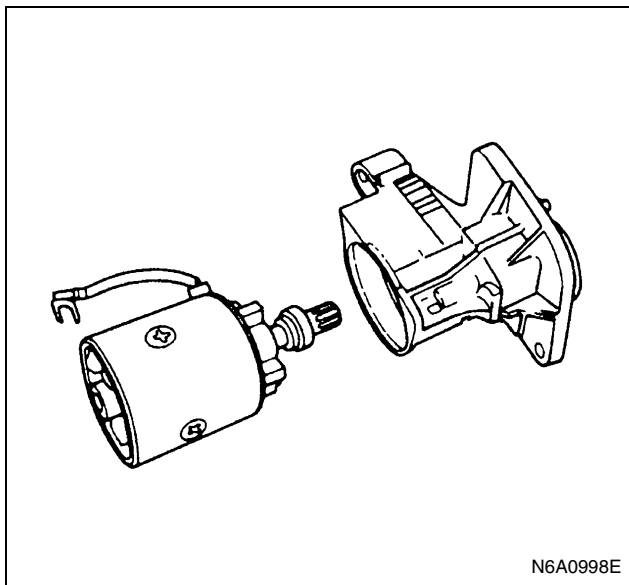
5. Armature
6. Yoke
Remove the brush holder and pull the armature assembly from the yoke.
Remove the four brushes from the brush holders.



Legend

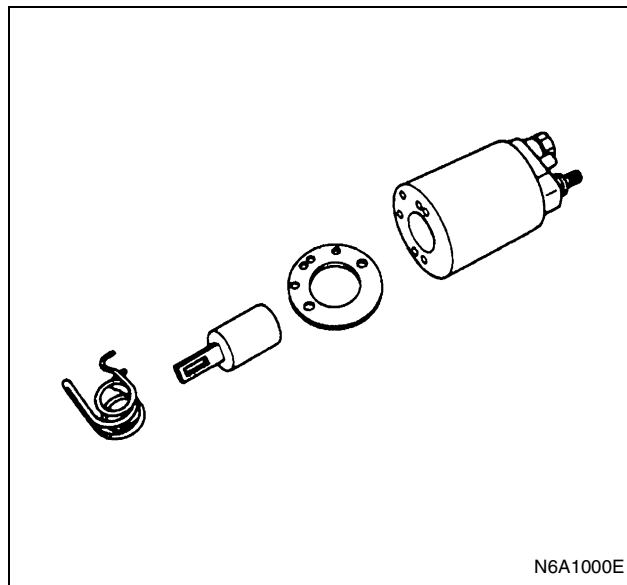
1. Brush
2. Brush spring

Remove the yoke along with the armature and the brush holder from the drive housing.

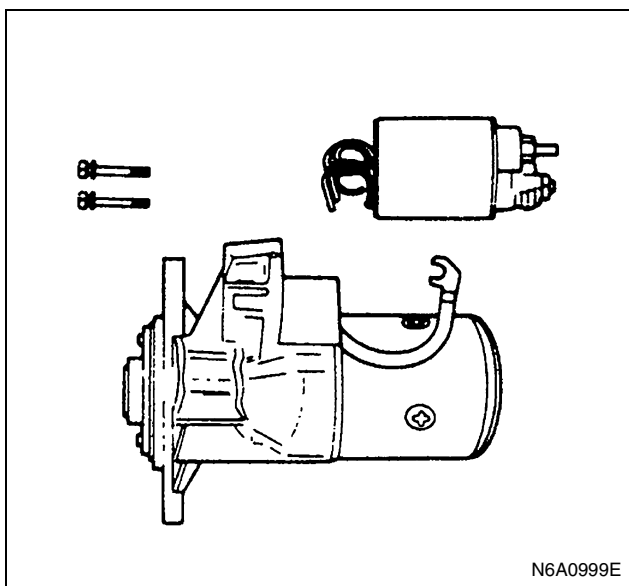


Remove the brushes and commutator carefully so as not to allow them in contact with the adjacent parts.

7. Bolt
8. Torsion Spring
9. Magnetic Switch Assembly

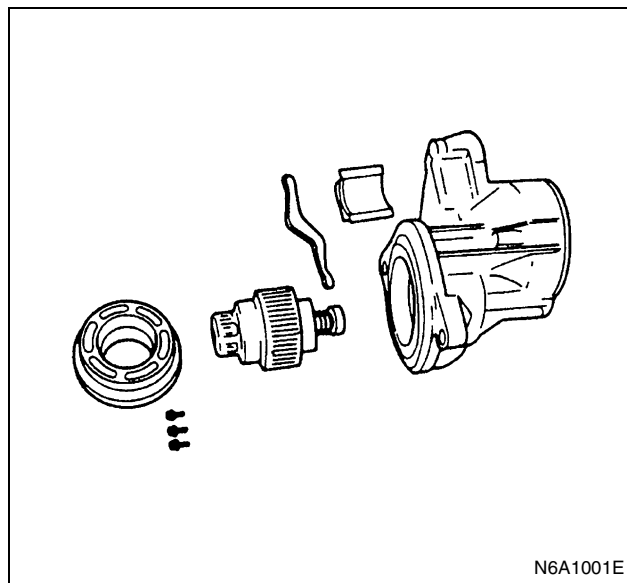


10. Dust Cover
11. Shift Lever
12. Bearing Retainer
13. Clutch Assembly

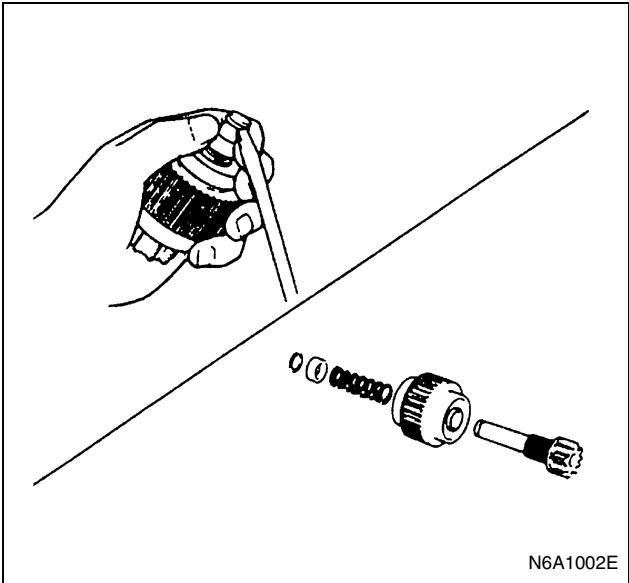


Remove the magnetic switch bolts, then remove the switch from the shift lever.

Remove the torsion spring from the magnetic switch.



- 1) Remove the bearing retainer.
 - 2) Remove the clutch assembly from the gear case.
14. Bearing Holder
 15. Ball Bearing
 16. Pinion Stopper Clip
 17. Pinion Stopper
 18. Return Spring
 19. Pinion Shaft
 20. Pinion Clutch
- Use a screwdriver to remove the stopper clip. Then disassemble the clutch assembly.



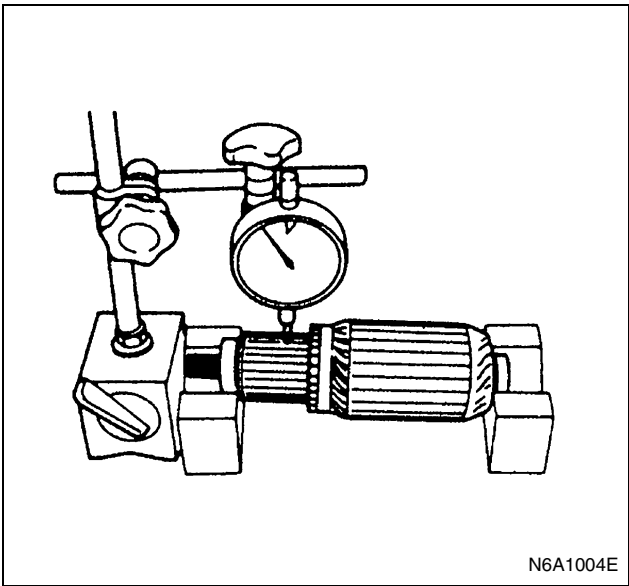
Inspection and Repair

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

Armature

1. Measure the commutator run-out.
Replace the commutator if the measured run-out exceeds the specified limit.

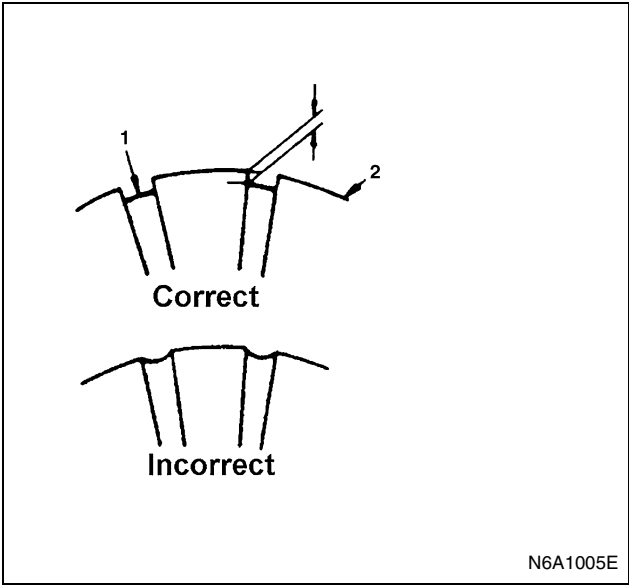
Commutator Run-Out		mm (in)
Standard	Limit	
0.05 (0.002) or less	0.2 (0.008)	



2. Check the commutator mica segments for excessive wear.
3. Measure the mica segment depth.

Mica Segment Depth		mm (in)
Standard	Limit	
0.5 — 0.8 (0.020 — 0.031)	0.2 (0.008)	

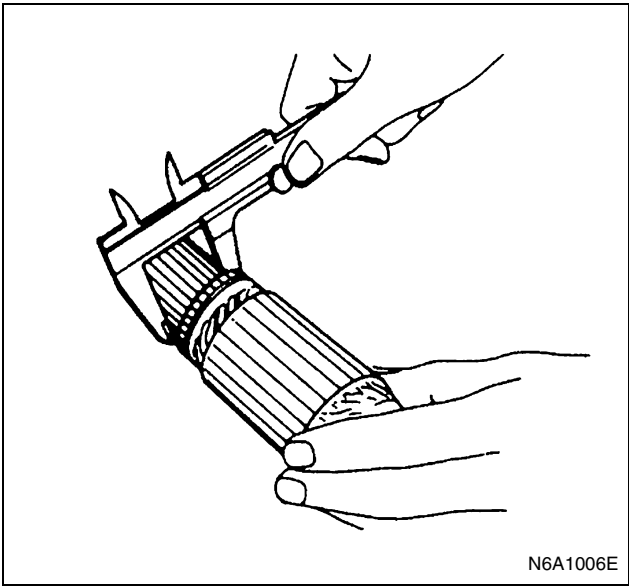
If the mica segment depth is less than the standard but more than the limit, the commutator may be re-ground.
If the mica segment depth is less than the limit, the commutator must be replaced.



Legend

1. Insulator
2. Commutator segments

4. Measure the commutator outside diameter.

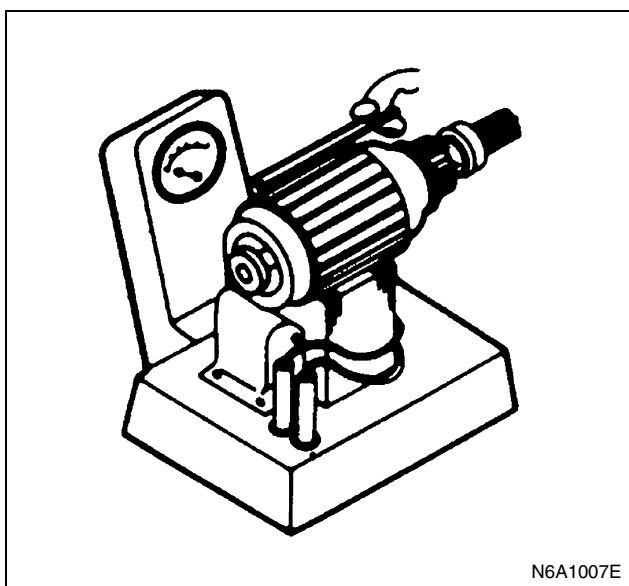


6D2-12 STARTING SYSTEM

Commutator Outside Diameter			mm (in)
Model	Yoke Diameter	Standard	Limit
S25-163C	φ80	36.5 (1.437)	35.5 (1.398)
S25-305C	φ90	38.0 (1.496)	36.6 (1.441)

If the measured outside diameter is less than the specified limit, the commutator must be replaced.

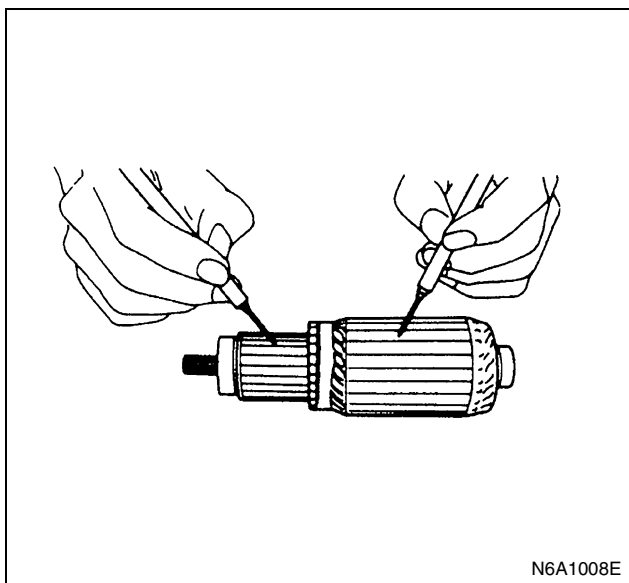
5. Test the armature for short circuiting.



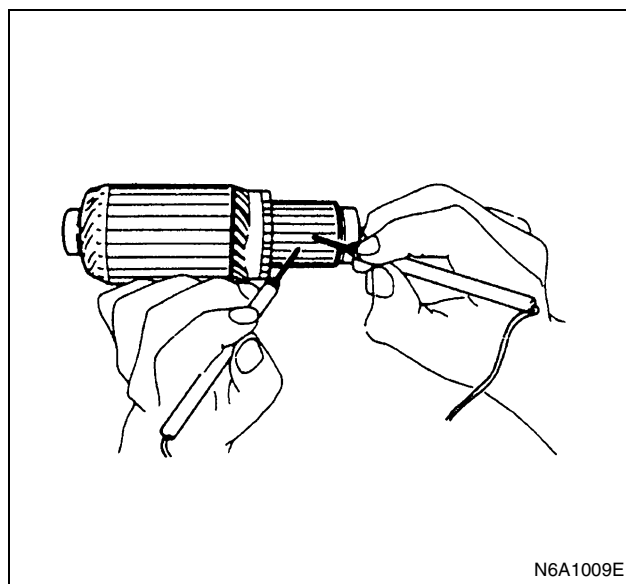
- Place the armature in a growler tester.
- Hold a hacksaw blade against the armature core.
If the armature has a short circuit, the hacksaw blade will vibrate.

Replace the armature if there is a short circuit.

6. Use a circuit tester to check the armature for grounding.



- Hold one probe of the circuit tester against the commutator segment.
- Hold the other circuit tester probe against the armature core.
If the circuit tester indicates continuity, the armature is grounded.
The armature must be replaced.
- Use the circuit tester to check the armature for continuity.



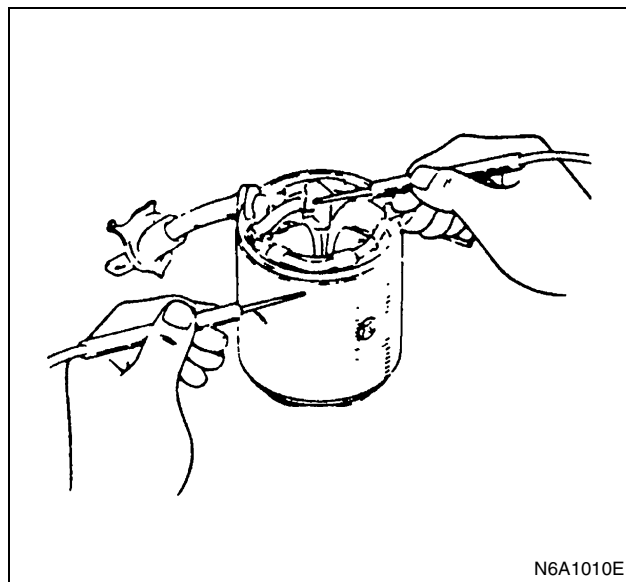
- Hold the circuit tester probes against two armature core segments.
- Repeat Step 1 at different segments of the armature core.

There should be continuity between all segments of the armature core.

If there is not, the armature must be replaced.

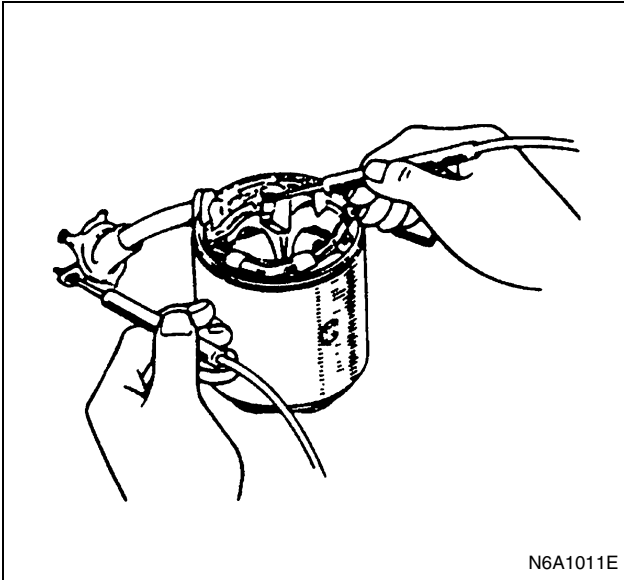
Yoke

- Use a circuit tester to check the field winding ground.



- 1) Hold one circuit tester probe against the field winding end or brush.
 - 2) Hold the other circuit tester probe against the bare surface of the yoke body.
- There should be no continuity.
If there is continuity, the field coil is grounded.
The yoke must be replaced.

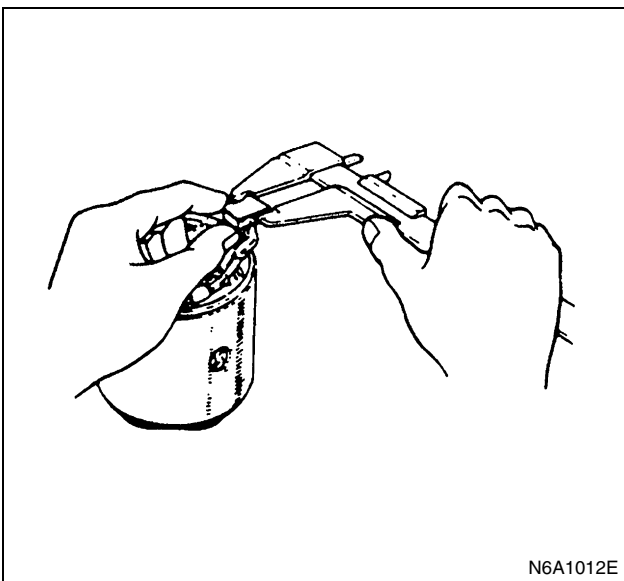
2. Use the circuit tester to check the field winding continuity.



- 1) Hold one circuit tester probe against the "C" terminal lead wire.
 - 2) Hold the other circuit tester probe against the field winding brush.
- There should be continuity.
If there is no continuity, the yoke must be replaced.

Brush and Brush Holder

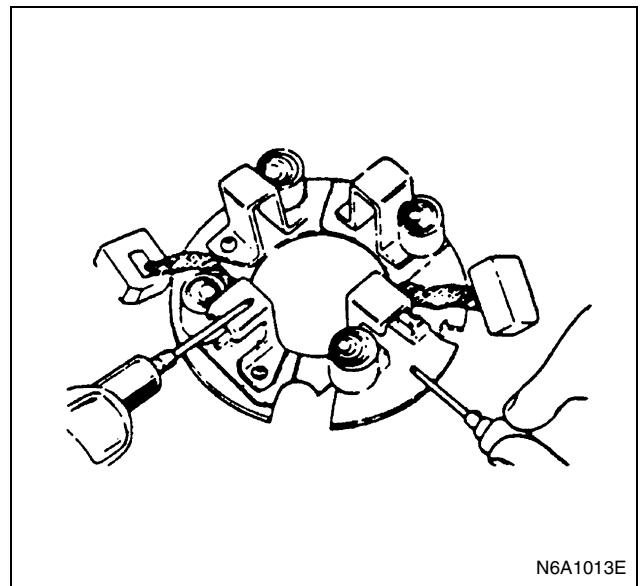
1. Use a vernier caliper to measure the brush length (four brushes).



Replace the brushes as a set if one or more of the brush length is less than the specified limit.

Brush Length			mm (in)
Model	Yoke Diameter	Standard	Limit
S25-168	φ80	15.0 (0.591)	10.5 (0.413)
S25-305	φ90	18.0 (0.709)	11.0 (0.433)

2. Use a circuit tester to check the brush holder insulation.

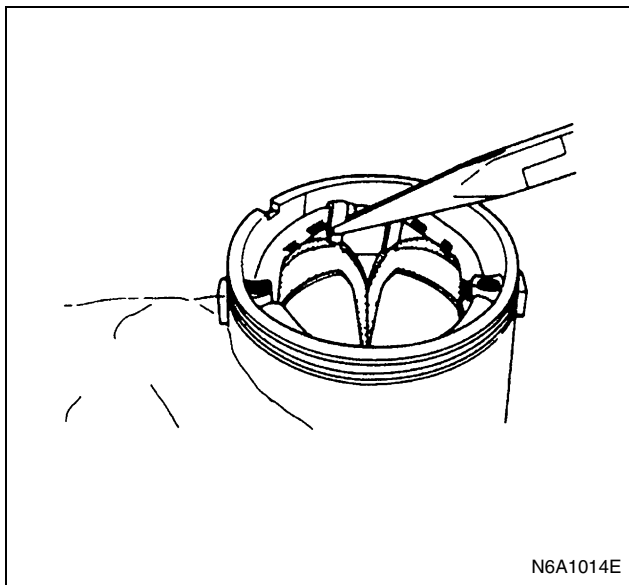


Touch one probe to the holder plate and the other probe to the positive brush holder.

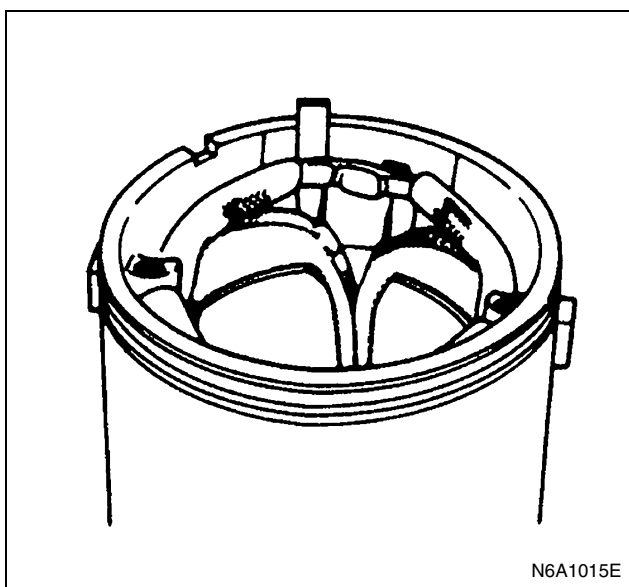
There should be no continuity.

3. Inspect the brushes for excessive wear.
If the negative brushes have excessive wear, the entire brush holder assembly must be replaced.
If the positive brushes have excessive wear, only the brushes must be replaced.

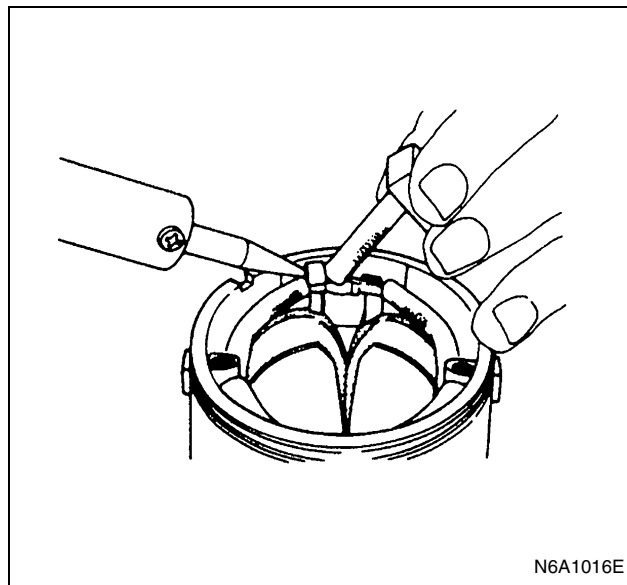
- 1) Use a pair of side cutters to cut the lead wire from the brush.



- 2) File away any foreign material clinging to the edge of the lead wire.
- 3) Remove the brushes from the brush holder.
- 4) Install the new brushes.
- 5) Straighten the bent portion of the clip.



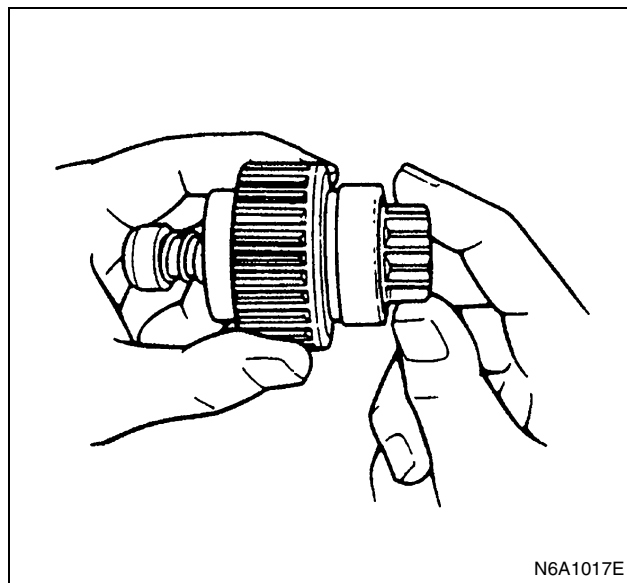
- 6) File away any foreign material clinging to the clip surface.
- 7) Place the lead wire in the clip.
- 8) Bend the clip shut.
- 9) Solder the brush lead.



- 10) Repeat the procedure for each of the brushes.

Overrunning Clutch

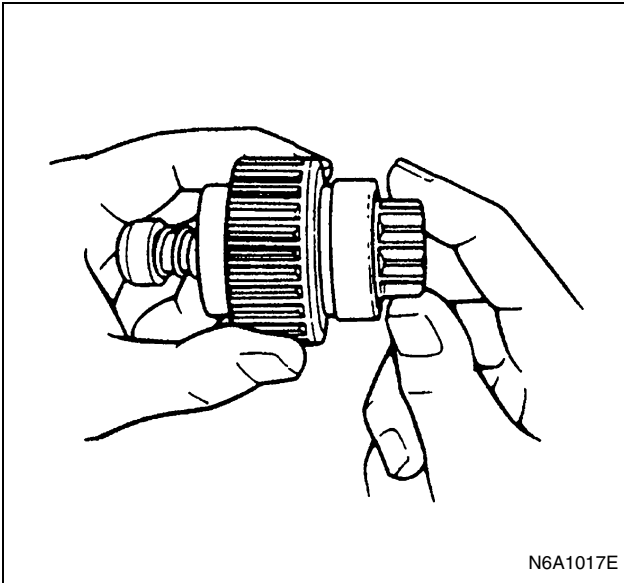
1. Inspect the overrunning clutch gear teeth for excessive wear and damage. Replace the overrunning clutch if necessary.
2. Rotate the pinion clockwise.



- It should turn smoothly.
3. Try to rotate the pinion in the opposite direction. The pinion should lock.

Ball Bearing

Inspect the bearings for excessive wear and damage. Replace the bearings if necessary.



Magnetic Switch

The following tests must be performed with the starter motor fully assembled.

The yoke lead wire must be disconnected from the "C" terminal.

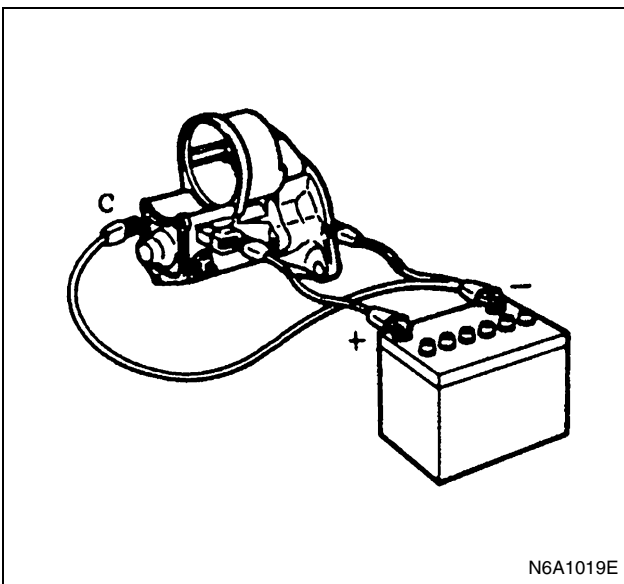
To prevent coil burning, complete each test as quickly as possible (within three to five seconds).

Temporarily connect the magnetic switch between the clutch and the housing and run the following test.

Complete each test within three to five seconds.

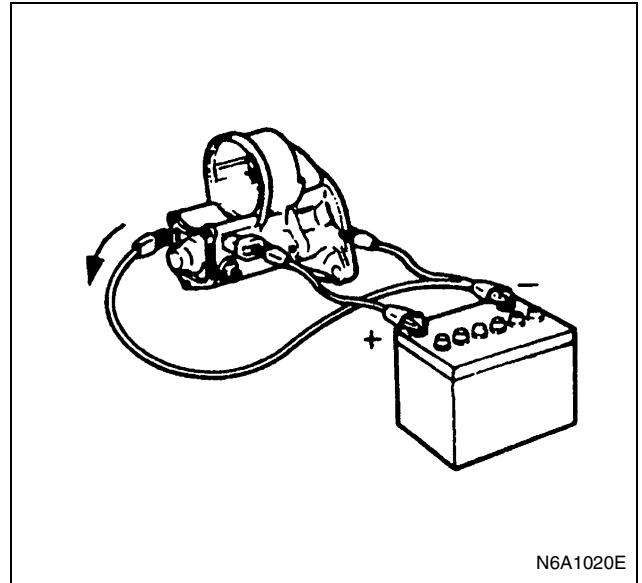
1. Pull-Out Test

Connect the battery negative terminal with the magnetic switch body and the C terminal. When current is applied to the 50 terminal from the battery positive terminal, the pinion should flutter.



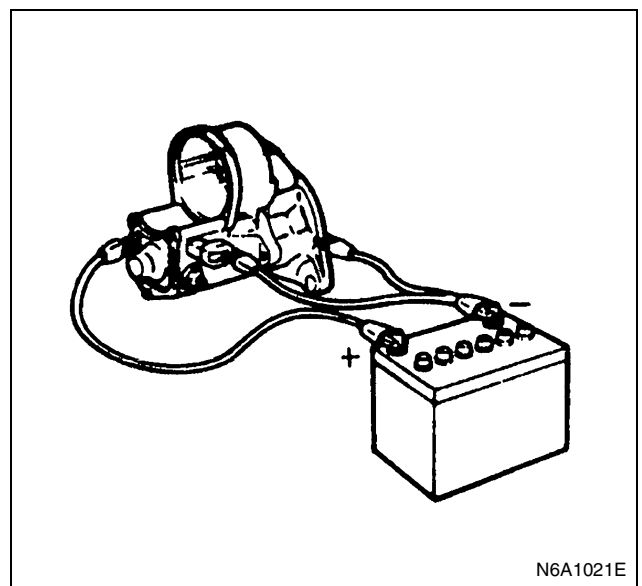
2. Hold-in Maintenance Test

Disconnect the lead at the C terminal. The pinion should continue to flutter.



3. Return Test

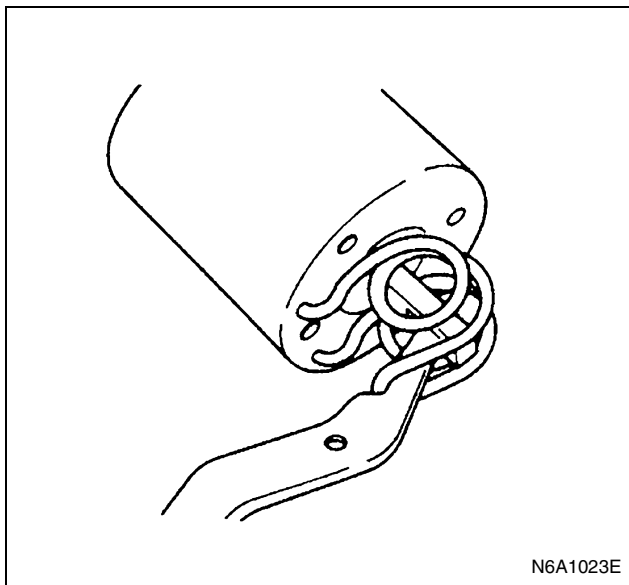
Connect the battery negative leads to the starter body and the 50 terminal.



Connect the battery positive lead at the C terminal. The pinion should return to its home position.

Reassembly

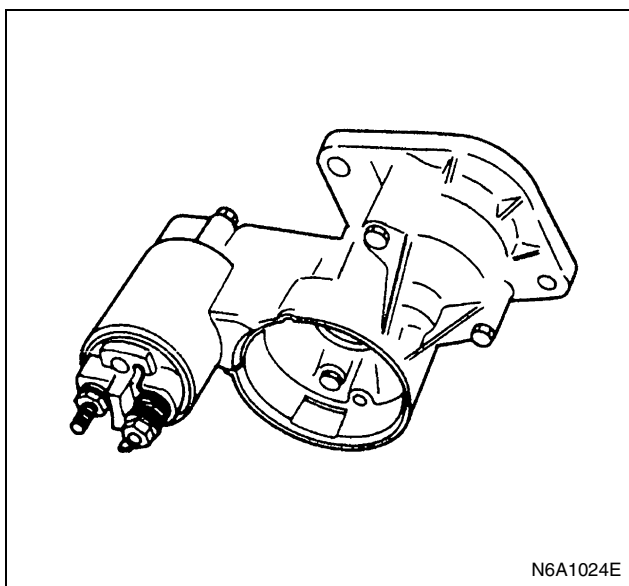
1. Gear Case
2. Magnetic Switch Assembly
3. Torsion Spring
4. Shift Lever
 - 1) Attach the torsion spring to the hole in the magnetic switch as illustrated.



2) Insert the shift lever into the plunger hole of the magnetic switch.

5. Dust Cover
Install the dust cover.

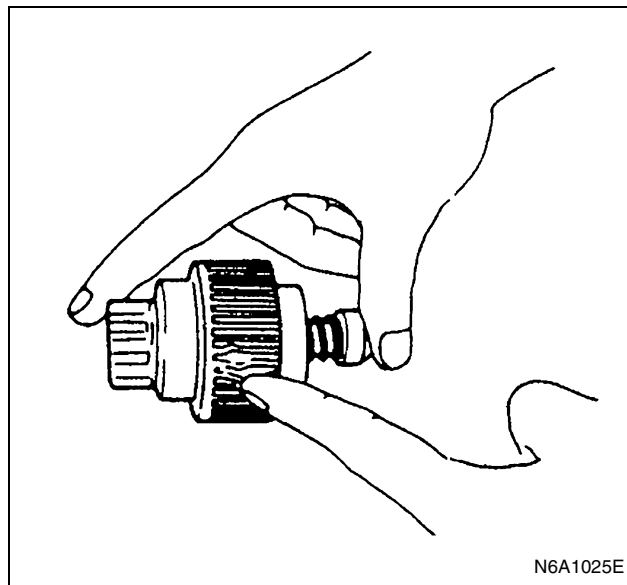
6. Bolt
Install the magnetic switch assembly in the gear case and tighten the bolt to the specified torque.



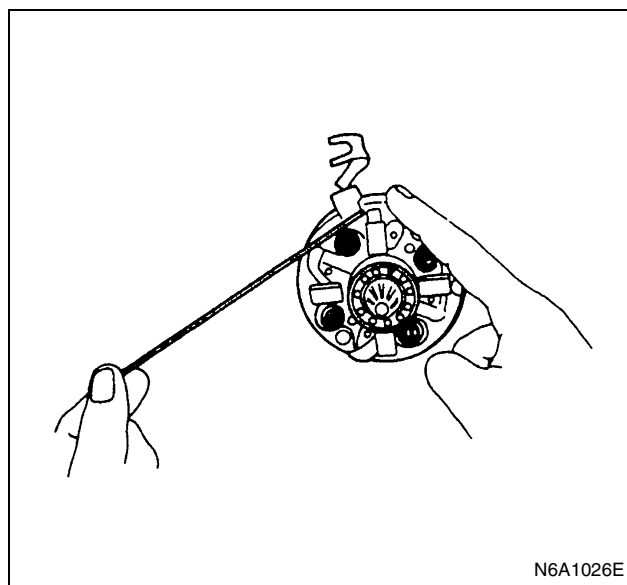
Tighten:

Gear case bolt to 8 N·m (0.8 kg·m / 69 lb-in)

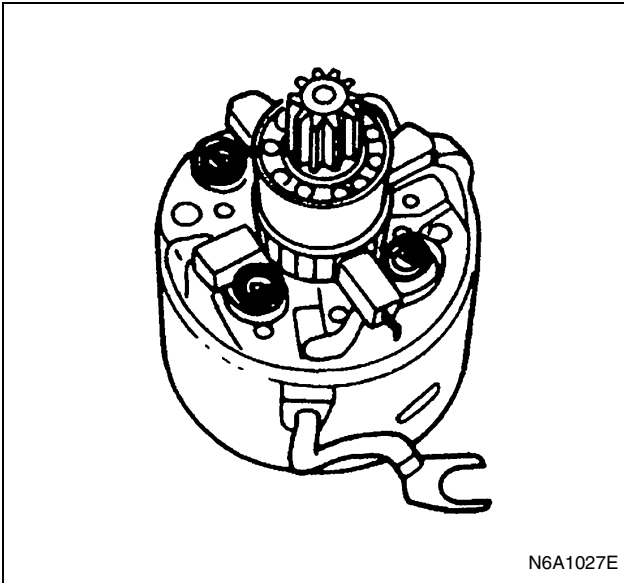
7. Pinion Clutch
8. Pinion Shaft
Apply a coat of grease to the pinion clutch gear and install the pinion assembly to the armature shaft.



9. Return Spring
10. Pinion Stopper
11. Pinion Stopper Clip
12. Ball Bearing
13. Bearing Holder
14. Clutch Assembly
15. Bearing Retainer
16. Armature
17. Yoke
18. Brush Holder



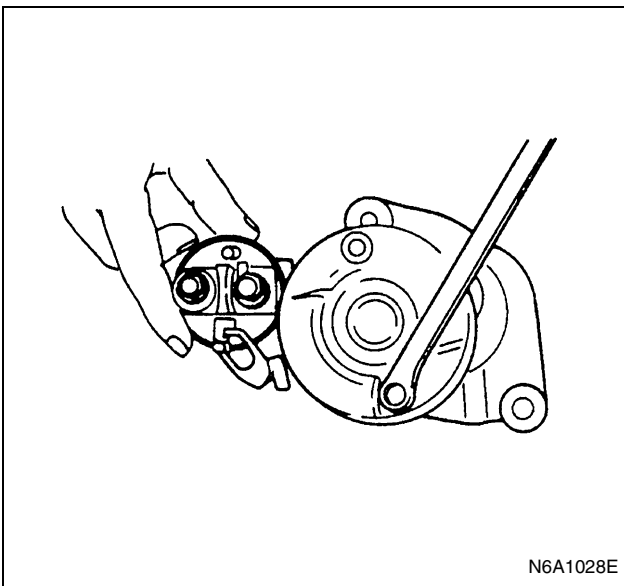
- 1) Twist the holder spring and hold it.
- 2) Install the brush to the brush holder.
- 3) Repeat step 1 and 2 for the remaining holders.
- 4) Install the brush holder assembly to the yoke.



Take care not to damage the commutator face and the brushes.

19. Rear Cover
20. Through Bolt

Install the through bolts in the rear cover and tighten them to the specified torque.

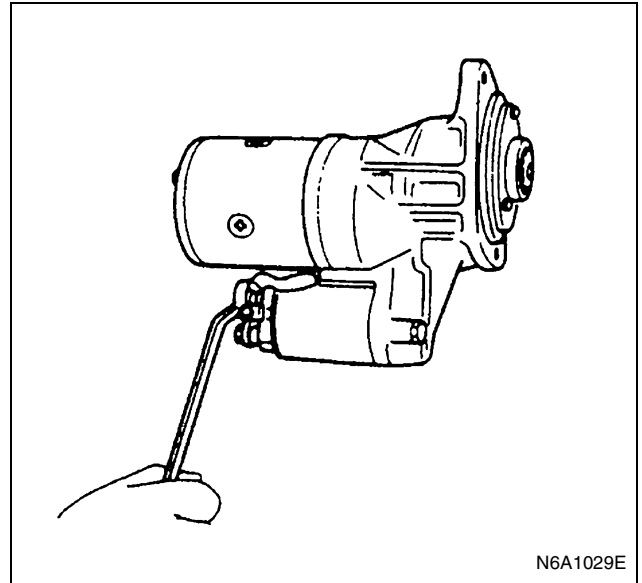


Tighten:

Through bolt to 6 N·m (0.6 kg·m / 52 lb·in)

21. Lead Wire Nut

Connect the lead wire in the magnetic switch and tighten the terminal nut to the specified torque.

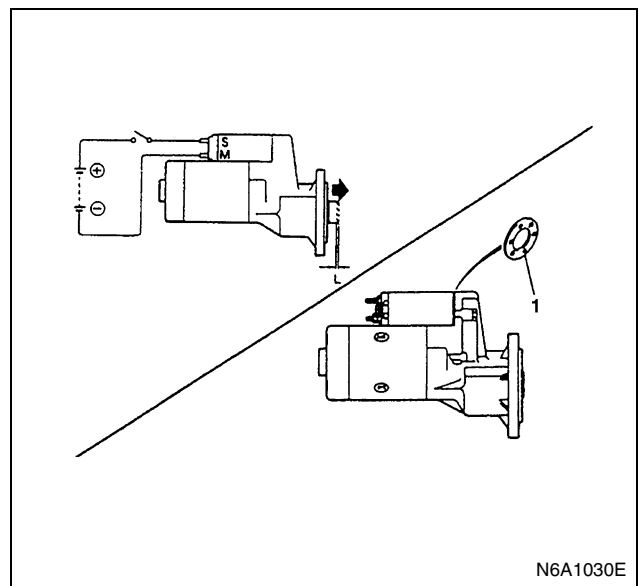


Tighten:

Lead wire terminal nut to 10 N·m (1.0 kg·m / 87 lb·in)

Pinion Jump-out dimension

- Connect the (+) cable of battery to terminal S and the (–) cable to terminal M. Turn the switch on, and measure pinion travel dimension “L” in thrust direction from the jump-out position.



Legend

1. Spacer

In measuring the dimension, pull the pinion out a little in the arrow direction.

mm (in)	
Dimension	Standard
L	0.3 — 0.1 (0.01 — 0.004)

If the measured value is out of standard, adjust the of shims.

