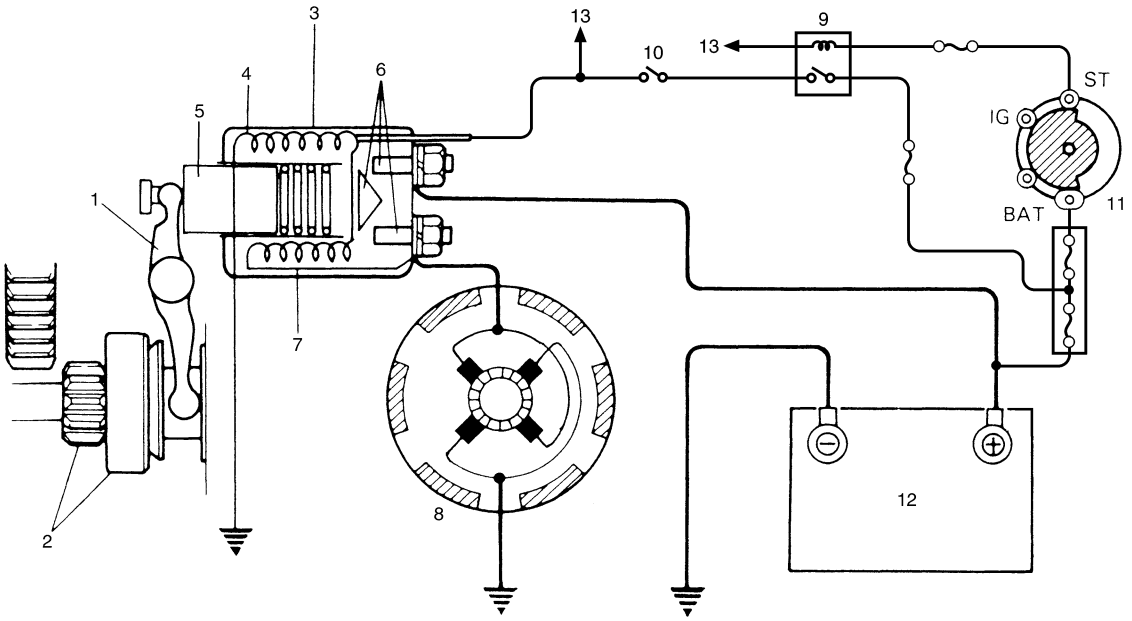
Starting System

Schematic and Routing Diagram

Cranking System Circuit Diagram

S6RW0C1902001



I4RS0A190001-01

1. Pinion drive lever	6. Magnetic switch contacts	11. Ignition & Starter switch
2. Pinion & Over-running clutch	7. Pull-in coil	12. Battery
3. Magnetic switch	8. Starting motor	13. To ECM
4. Hold-in coil	9. Starting motor control relay	
5. Plunger	10. A/T: Transmission range sensor (shift switch)	

Diagnostic Information and Procedures

Cranking System Symptom Diagnosis

S6RW0C1904001

Possible symptoms due to starting system trouble would be as follows:

- Starting motor does not run (or runs slowly)
- Starting motor runs but fails to crank engine
- Abnormal noise is heard

Proper diagnosis must be made to determine exactly where the cause of each trouble lies in battery, wiring harness, (including starting motor switch), starting motor or engine.
Do not remove motor just because starting motor does not run. Check following items and narrow down scope of possible causes.

1) Condition of trouble
2) Tightness of battery terminals (including ground cable connection on engine side) and starting motor terminals
3) Discharge of battery
4) Mounting of starting motor

Condition	Possible cause	Correction / Reference Item
Motor not running (No operating sound of magnetic switch)	Transmission range sensor is not in P or N, or not adjusted (A/T model)	*Shift in P or N, or adjust sensor.*
	Battery run down	*Recharge battery.*
	Battery voltage too low due to battery deterioration	*Replace battery.*
	Poor contact in battery terminal connection	*Retighten or replace.*
	Loose grounding cable connection	*Retighten.*
	Fuse set loose or blown off	*Tighten or replace.*
	Poor contacting action of ignition switch and magnetic switch	*Replace.*
	Lead wire coupler loose in place	*Retighten.*
	Open-circuit between ignition switch and magnetic switch	*Repair.*
	Open-circuit in pull-in coil	*Replace magnetic switch.*
	Brushes are seating poorly or worn down	*Repair or replace.*
	Poor sliding of plunger and/or pinion	*Repair.*
	Faulty starting motor control relay	*"Engine and Emission Control System Relay Inspection in Section 1C".*
	Faulty ECM and its circuit	*"Inspection of ECM and Its Circuits in Section 1A".*
Motor not running (Operating sound of magnetic switch heard)	Battery run down	*Recharge battery.*
	Battery voltage too low due to battery deterioration	*Replace battery.*
	Loose battery cable connections	*Retighten.*
	Burnt main contact point, or poor contacting action of magnetic switch	*Replace magnetic switch.*
	Brushes are seating poorly or worn down	*Repair or replace.*
	Weakened brush spring	*Replace.*
	Burnt commutator	*Replace armature.*
	Layer short-circuit of armature	*Replace.*
	Crankshaft rotation obstructed	*Repair.*
Starting motor running but too slow (small torque) (If battery and wiring are satisfactory, inspect starting motor)	Insufficient contact of magnetic switch main contacts	*Replace magnetic switch.*
	Layer short-circuit of armature	*Replace.*
	Disconnected, burnt or worn commutator	*Replace armature.*
	Worn brushes	*Replace brush.*
	Weakened brush springs	*Replace spring.*
	Burnt or abnormally worn end bush	*Replace bush.*
Starting motor running, but not cranking engine	Worn pinion tip	*Replace over-running clutch.*
	Poor sliding of over-running clutch	*Repair.*
	Over-running clutch slipping	*Replace over-running clutch.*
	Worn teeth of ring gear	*Replace flywheel or drive plate.*
Noise	Abnormally worn bush	*Replace bush.*
	Worn pinion or worn teeth of ring gear	*Replace pinion or flywheel or drive plate.*
	Poor sliding of pinion (failure in return movement)	*Repair or replace.*
	Worn internal or planetary gear teeth	*Replace.*
	Lack of oil in each part	*Lubricate.*
Starting motor does not stop running	Fused contact points of magnetic switch	*Replace magnetic switch.*
	Short-circuit between turns of magnetic switch coil (layer short-circuit)	*Replace magnetic switch.*
	Failure of returning action in ignition switch	*Replace.*

Cranking System Test

S6RW0C1904002

⚠ CAUTION

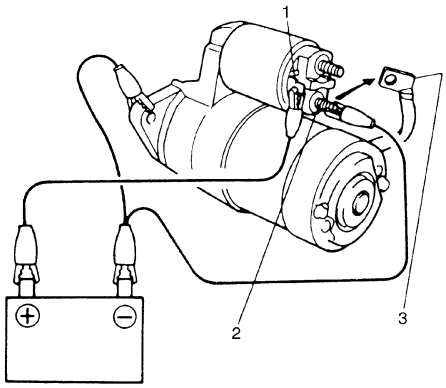
Each test must be performed within 3 – 5 seconds to avoid coil from burning.

Pull-in Test

Connect battery to the magnetic switch as shown.
Check that plunger and pinion move outward.
If plunger and pinion don't move, replace the magnetic switch.

NOTE

Before testing, disconnect lead wire from terminal M (2).



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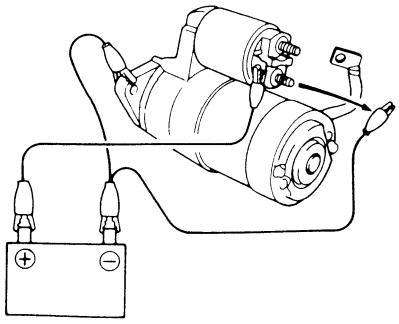
1.	Terminal "S"
3.	Lead wire (switch to motor)

Hold-in Test

While connected as the figure with plunger out, disconnect negative lead from terminal "M".
Check that plunger and pinion remain out.
If plunger and pinion return inward, replace the magnetic switch.



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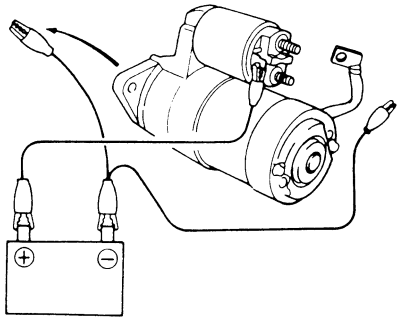
Plunger and Pinion Return Test

Disconnect negative lead from starting motor body.
Check that plunger and pinion return inward.
If plunger and pinion don't return, replace the magnetic switch.



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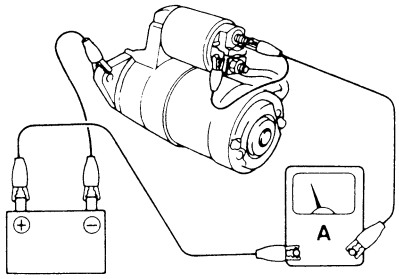
No-load Performance Test

Connect battery and ammeter to starter as shown.
Check that starter rotates smoothly and steadily with pinion moving out. Check that ammeter indicates specified current.

Specified current (No-load performance test)
90 A MAX. at 11 V



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Repair Instructions

Starting Motor Unit Components

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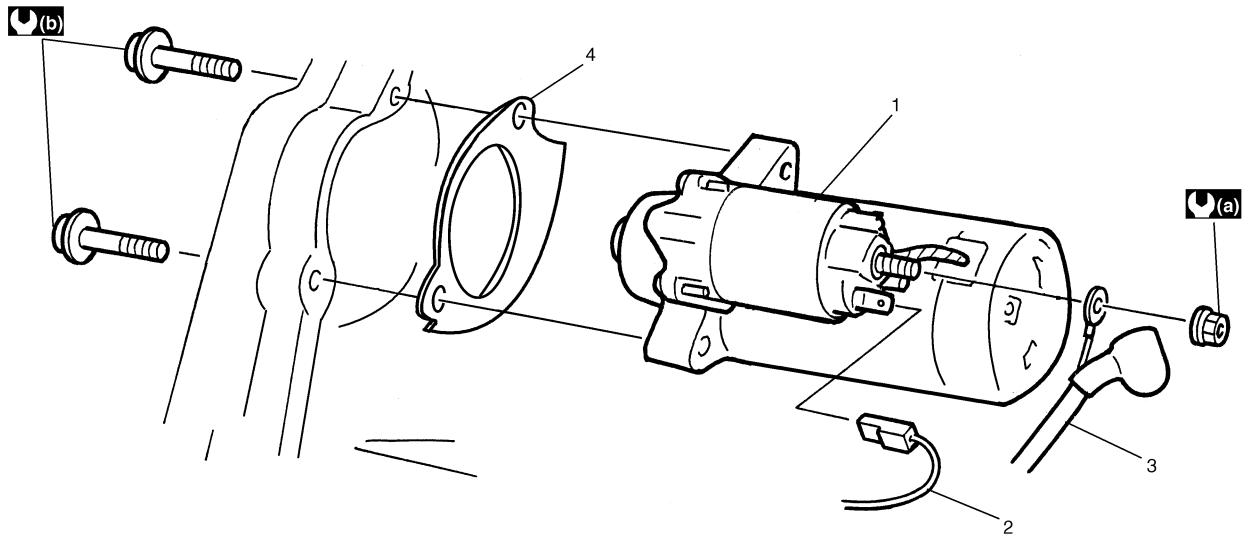

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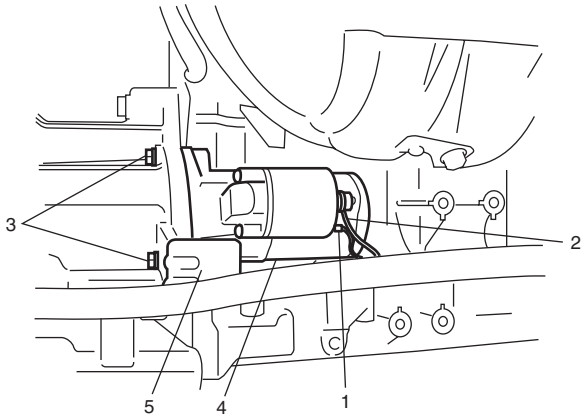
1. Starting motor	4. Plate
2. Magnetic switch lead wire	(a) : 11 N·m (1.1 kgf-m, 8.0 lb-ft)
3. Battery cable	(b) : 25 N·m (2.5 kgf-m, 18.5 lb-ft)

Starting Motor Dismounting and Remounting

S6RW0C1906002

Dismounting

1) Remove battery and battery tray with ECM.
2) Remove magnetic switch lead wire (1) and battery cable (2).
3) Remove starting motor mount bolt (3) and then starting motor (4) and bracket (5).



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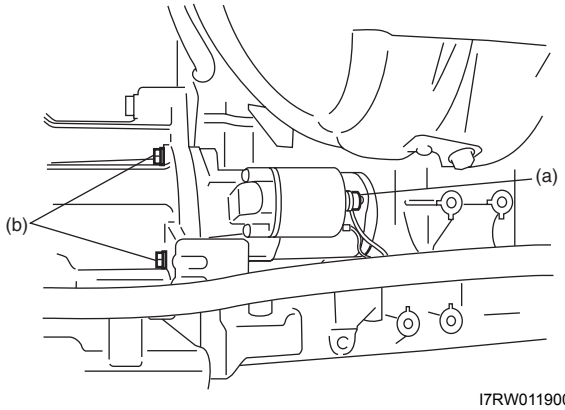
Remounting

Reverse dismounting procedure for remounting noting the following.

- Tighten each bolts and nuts to specified torque.

Tightening torque
Battery cable nut (a): 11 N·m (1.1 kgf-m, 8.0 lb-ft)
Starting motor mount bolt (b): 25 N·m (2.5 kgf-m, 18.5 lb-ft)



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Starting Motor Components

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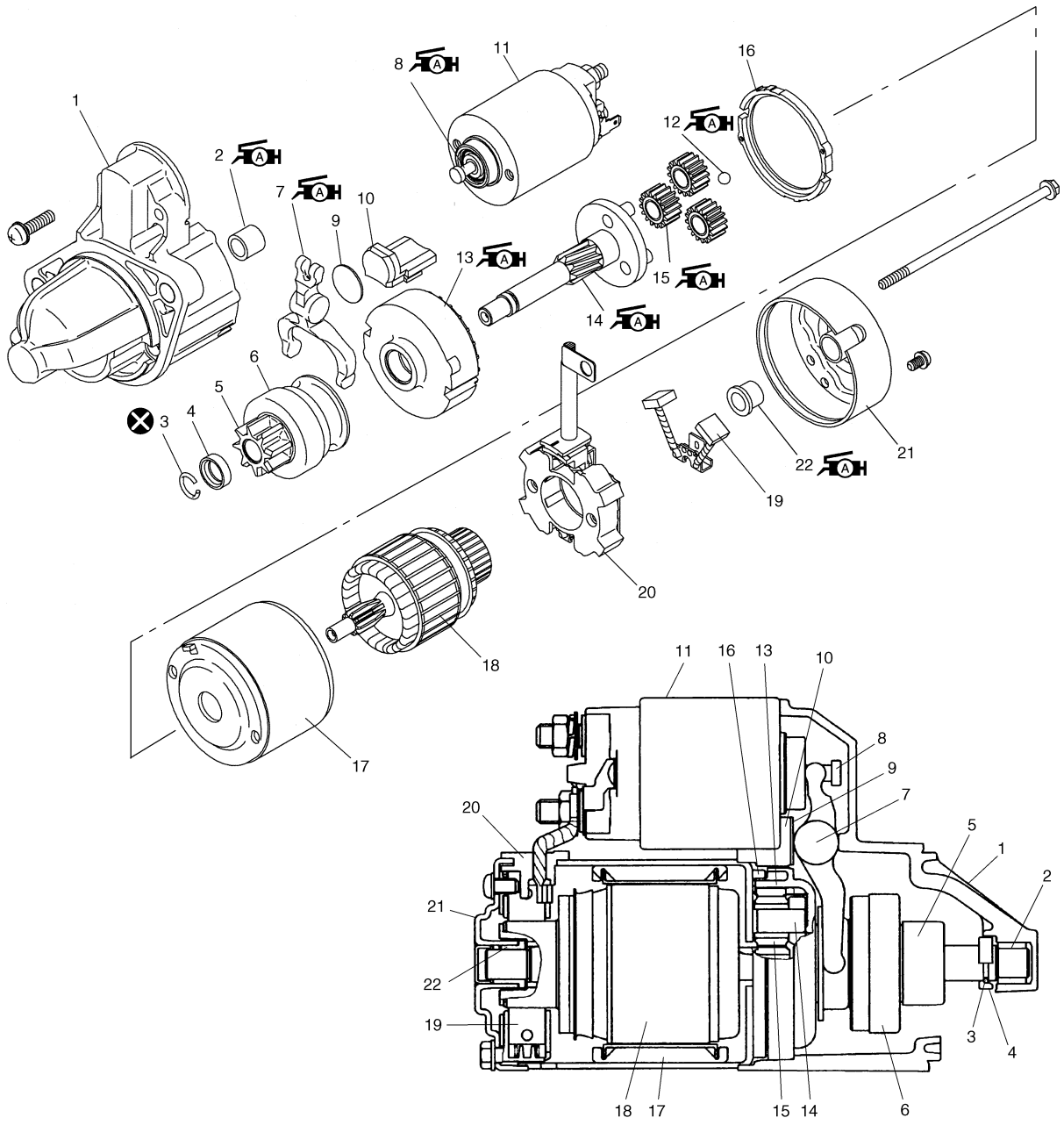

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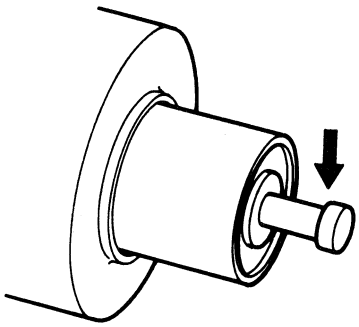
1. Front housing	7. Lever	13. Internal gear	19. Brush
2. Bush	8. Plunger	14. Planetary carrier shaft	20. Brush holder
3. Snap ring	9. Plate	15. Planetary gear	21. Rear bracket
4. Pinion stop ring	10. Seal rubber	16. Packing	A : Apply grease 99000-25011 to sliding surface of each part.
5. Pinion gear	11. Magnetic switch	17. Yoke	22. Rear bush
6. Over-running clutch	12. Ball	18. Armature	: Do not reuse.

Starting Motor Inspection

S6RW0C1906004

Plunger

Inspect plunger for wear. Replace if necessary.



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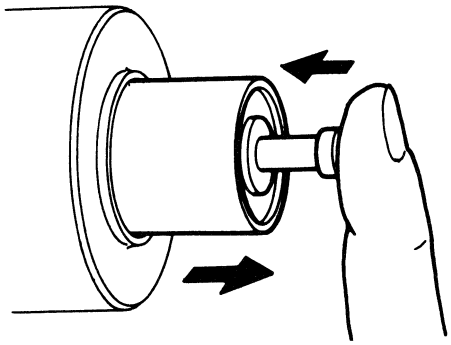
Magnetic Switch

Push in plunger and release it. The plunger should return quickly to its original position. Replace if necessary.



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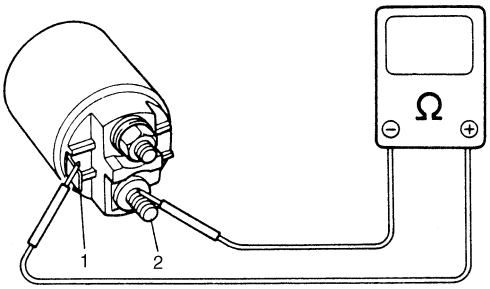
Pull-in coil open circuit test

Check for continuity across magnetic switch “S” terminal (1) and “M” terminal (2). If no continuity, coil is open and should be replaced.



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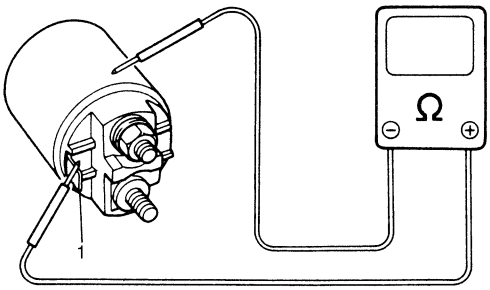
Hold-in coil open circuit test

Check for continuity across magnetic switch “S” terminal (1) and coil case. If no continuity, coil is open and should be replaced.



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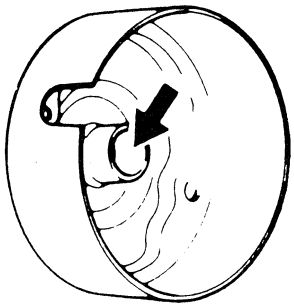
Rear Bracket Bush

Inspect bush for wear or damage. Replace if necessary.



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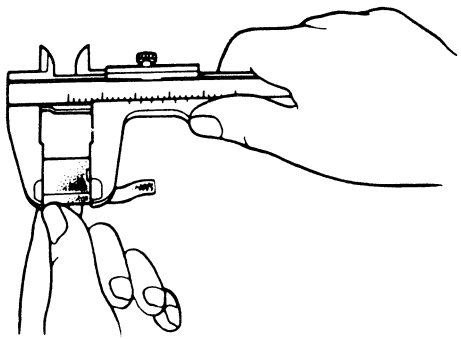
Brush

- Check brushes for wear.
  Measure length of brushes and if below the limit, replace the brush.

  Brush length
  Standard: 12.3 mm (0.48 in.)
  Limit: 7.0 mm (0.28 in.)

- Install brushes to each brush holder and check for smooth movement.



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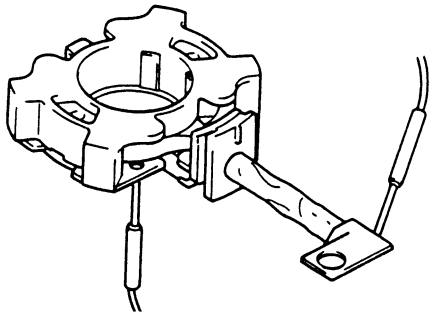
Spring

Inspect brush springs for wear, damage or other abnormal conditions. Replace if necessary.

Brush spring tension
Standard: 2.2 kg (4.85 lb)
Limit: 0.6 kg (1.32 lb)

Brush Holder

- Check movement of brush in brush holder. If brush movement within brush holder is sluggish, check brush holder for distortion and sliding faces for contamination.
  Clean or correct as necessary.
- Check for continuity across insulated brush holder (positive side) and grounded brush holder (negative side).
  If continuity exists, brush holder is grounded due to defective insulation and should be replaced.



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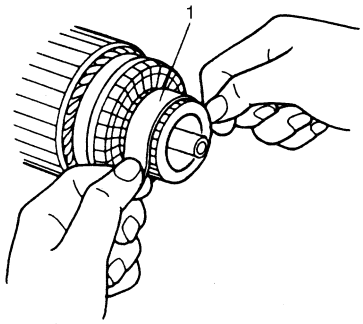
Armature

- Inspect commutator for dirt or burn. Correct with sandpaper or lathe, if necessary.



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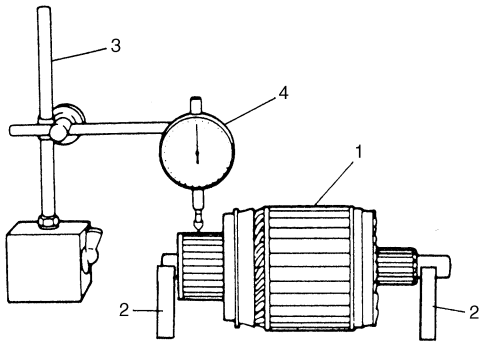
1. Sandpaper of #300 – 400

- Check commutator for uneven wear with armature (1) supported on V-blocks (2). If deflection of dial gauge (4) pointer exceeds limit, repair or replace.

NOTE

The following specification presupposes that the armature is free from bend. Bent armature must be replaced.

Commutator out of round
Standard: 0.05 mm (0.002 in.) or less
Limit: 0.4 mm (0.015 in.)



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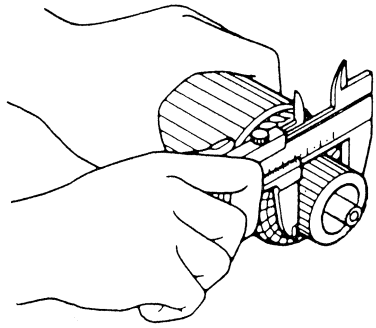
3. Magnetic stand

- Inspect the commutator for wear. If diameter is below limit, replace the armature.

Commutator outside diameter
Standard: 29.4 mm (1.16 in.)
Limit: 28.8 mm (1.13 in.)



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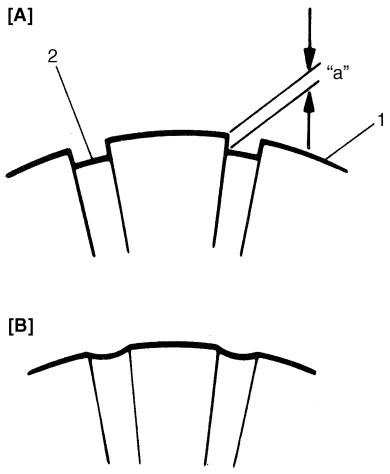
- Inspect the commutator (1) for insulator (2) depth. Correct or replace if below limit.

Commutator insulator depth “a”
Standard: 0.4 – 0.6 mm (0.015 – 0.024 in.)
Limit: 0.2 mm (0.008 in.)



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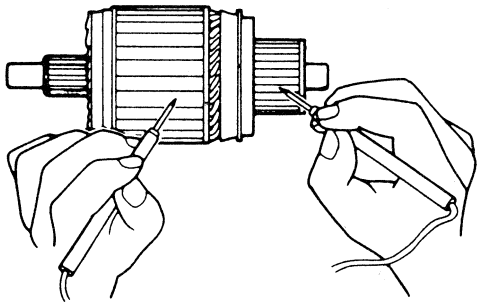
[A]: Correct
[B]: Incorrect

- Check the commutator and armature core. If there is continuity, the armature is grounded and must be replaced.



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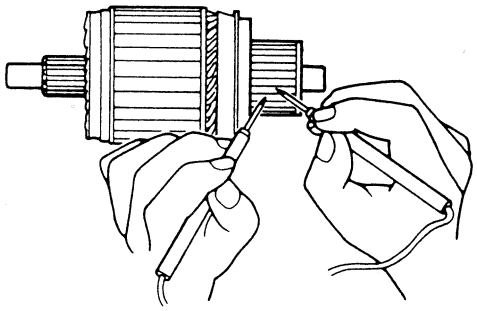
- Check for continuity between segments. If there is no continuity at any test point, there is an open circuit and the armature must be replaced.



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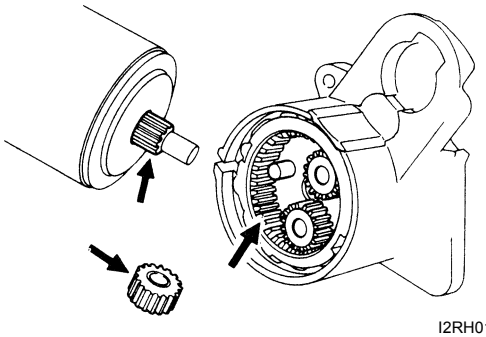
Gears

Inspect the internal gear and the planetary gears for wear, damage or other abnormal conditions. Replace if necessary.



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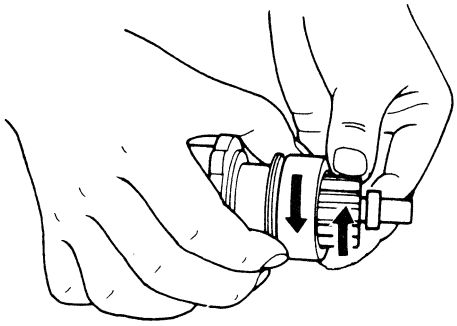
Pinion and Over-running Clutch

- Inspect the pinion for wear, damage or other abnormal conditions.
  Check that clutch locks up when turned in direction of drive and rotates smoothly in reverse direction.
  Replace if necessary.



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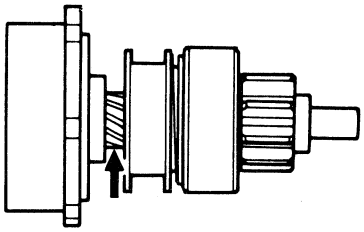
- Inspect the spline teeth for wear or damage. Replace if necessary.
  Inspect the pinion for smooth movement.



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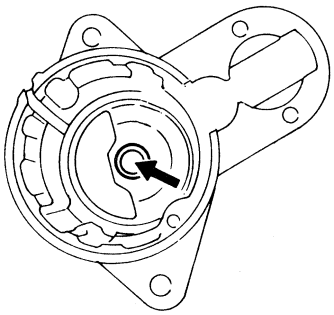
Front Housing Bush

Inspect the bush for wear or damage. Replace if necessary.



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Specifications

Cranking System Specifications

S6RW0C1907001

Voltage			12 volts
Output			1.4 kW
Rating			30 seconds
Direction of rotation			Clockwise as viewed from pinion side
Brush length			Standard: 12.3 mm (0.48 in.) Limit: 7.0 mm (0.28 in.)
Number of pinion teeth			8
Performance		Condition	Guarantee
Around at 20 °C (68 °F)	No load characteristic	11.0 V	90 A maximum 2,000 rpm minimum
	Load characteristic	7.5 V 300 A	11 N·m (1.1 kgf-m, 8.0 lb-ft) minimum 840 rpm minimum
	Locked characteristic	3.0 V	860 A maximum 20 N·m (2.0 kgf-m, 14.5 lb-ft) minimum
	Magnetic switch operating voltage		8 volts maximum

Tightening Torque Specifications

S6RW0C1907002

Fastening part	Tightening torque			Note
	N·m	kgf-m	lb-ft	
Battery cable nut	11	1.1	8.0	☞
Starting motor mount bolt	25	2.5	18.5	☞

NOTE

The specified tightening torque is also described in the following.
“Starting Motor Unit Components”

Reference:
For the tightening torque of fastener not specified in this section, refer to “Fasteners Information in Section 0A”.

Special Tools and Equipment

Recommended Service Material

S6RW0C1908001

NOTE

Required service material is also described in the following.
“Starting Motor Components”