

# **DAIHATSU**

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# **F300**

[HD-ENGINE]

## **STARTING SYSTEM**

<b>TROUBLE SHOOTING .....</b>	<b>ST- 2</b>
<b>STARTING SYSTEM CIRCUIT .....</b>	<b>ST- 2</b>
<b>STARTER .....</b>	<b>ST- 3</b>

WN88E-ST001

**ST**

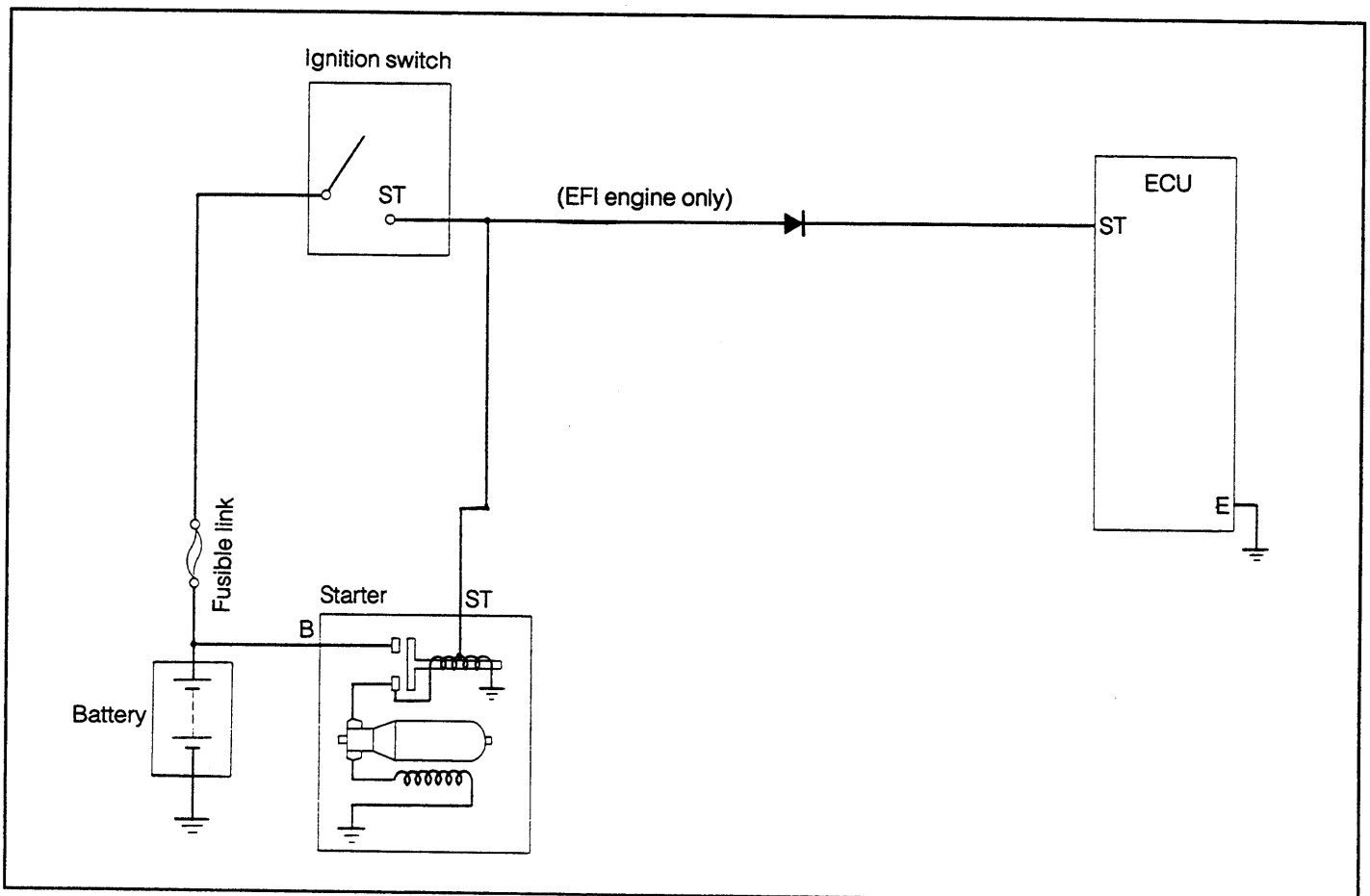
# STARTING SYSTEM

## TROUBLE SHOOTING

Problem	Possible cause	Remedies	Page
Engine will not crank	Battery not fully charged	Check specific gravity of battery electrolyte. Charge or replace battery.	CH-4
	Battery cables loose, corroded or worn	Repair or replace cables.	CH-4
	Shift position switch faulty	Adjust or replace shift position switch.	
	Fusible link blown	Replace fusible link.	
	Starter faulty	Repair starter.	ST-3
Engine cranks slowly	Ignition switch faulty	Replace ignition switch.	
	Flywheel teeth broken	Replace flywheel.	
Starter keeps running	Starter faulty	Repair starter.	ST-3
	Ignition switch faulty	Replace ignition switch.	
Starter spins – engine will not crank	Short in wiring	Repair wiring.	
	Pinion gear teeth broken or faulty starter	Repair starter	ST-3

WN88E-ST002

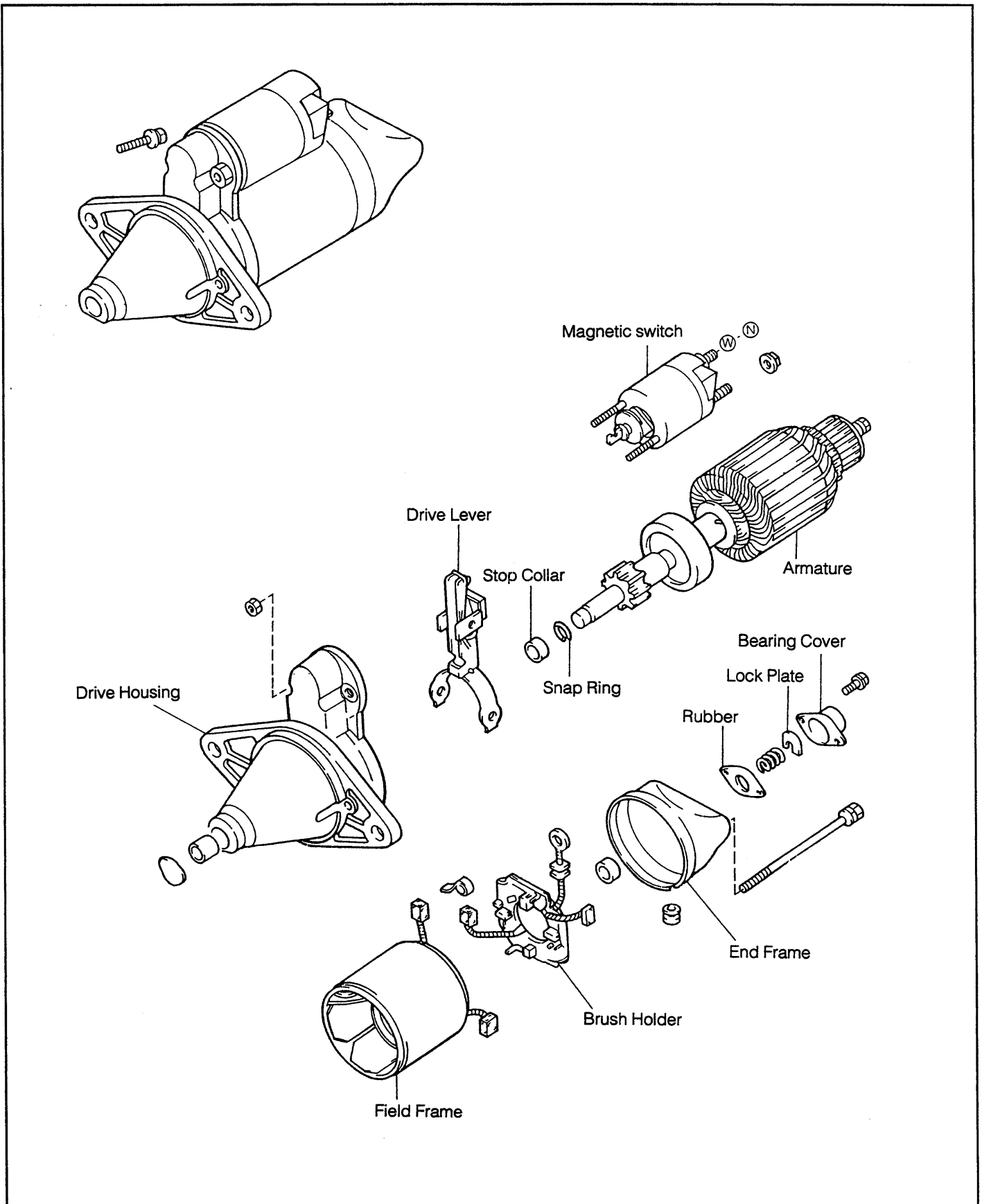
## STARTING SYSTEM CIRCUIT



WN88E-ST003

# STARTER COMPONENTS

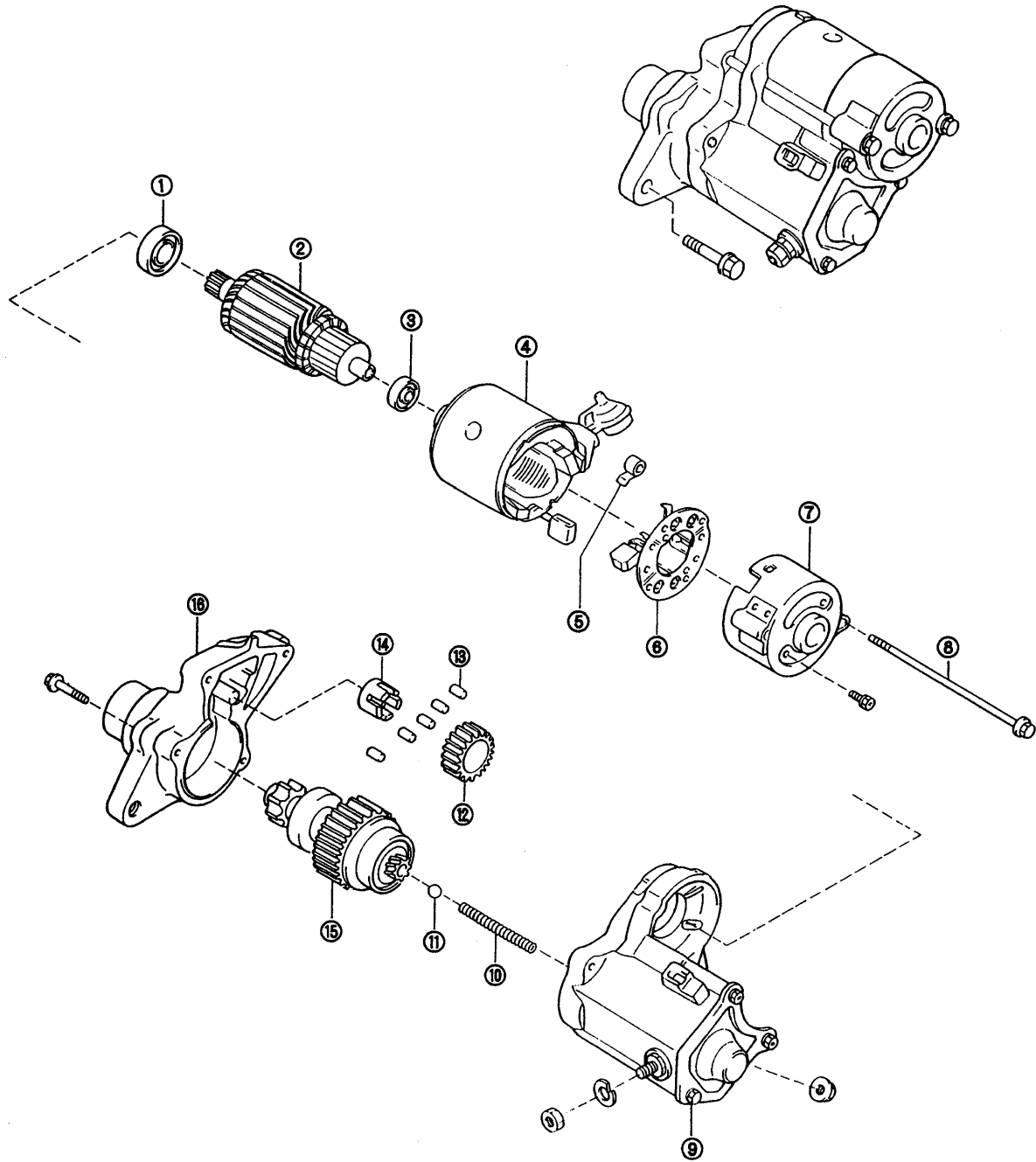
0.9 kW Conventional Starter Motor



WN88E-ST004

# STARTING SYSTEM

## 1.0 kW Reduction Type Starter Motor

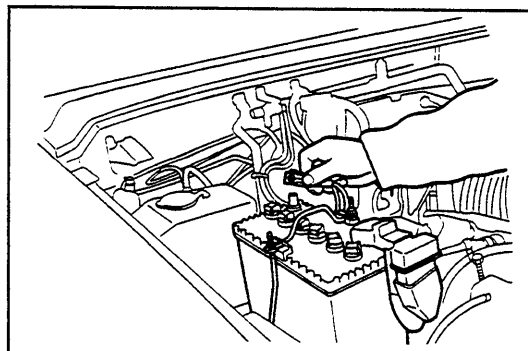


- ① Bearing
- ② Armature
- ③ Bearing
- ④ Field frame
- ⑤ Spring
- ⑥ Brush holder
- ⑦ End cover
- ⑧ Through bolt

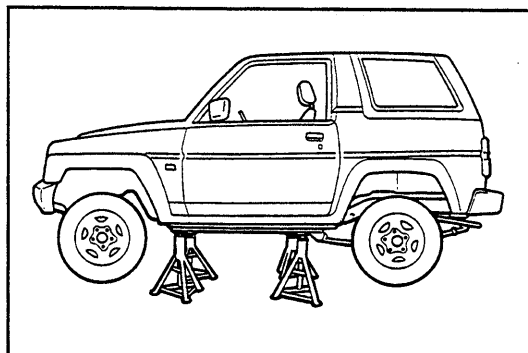
- ⑨ Magnet switch assembly
- ⑩ Spring
- ⑪ Ball
- ⑫ Idle gear
- ⑬ Bearing housing
- ⑭ Bearing housing
- ⑮ Clutch assembly
- ⑯ Starter housing

## REMOVAL OF STARTER MOTOR

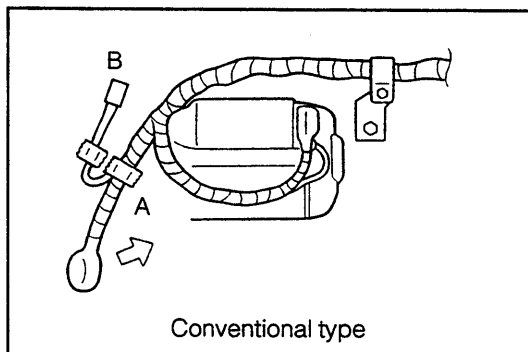
1. Disconnect the ground cable terminal from the negative (-) terminal of the battery.



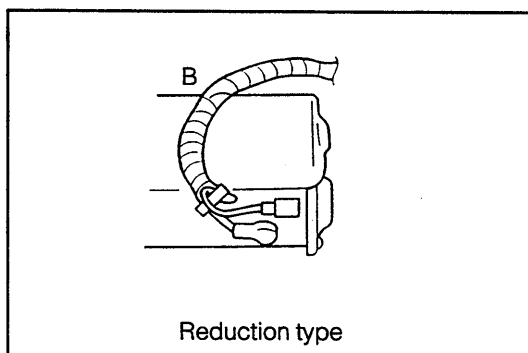
2. Jack up the vehicle and support it with safety stands. (See page GI-9.)



3. Disconnection of two wires from starter  
(1) Disconnect the starter terminal ST of the alternator wire from the starter.



- (2) Disconnect the starter terminal B of the alternator wire from the starter.



4. Detach the wire harness from the clamp by removing the wire harness clamp bolt.

WR88-ST010

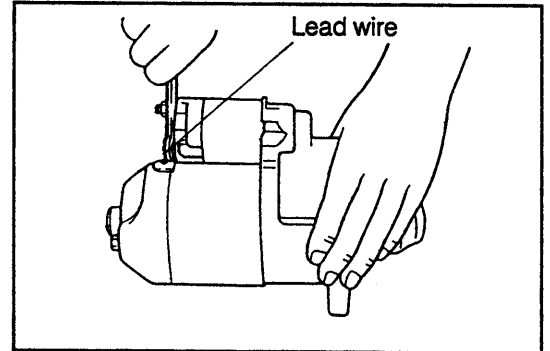
## STARTING SYSTEM

5. Removal of starter motor attaching bolts
  - (1) Remove the upper attaching bolt.
  - (2) Remove the lower attaching bolt from the underside of the vehicle.
6. Remove the starter motor.

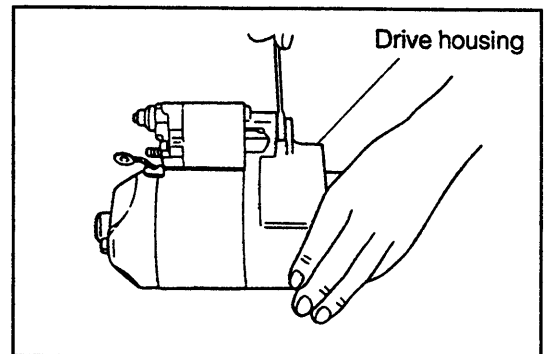
WN88E-ST007

### DISASSEMBLY OF CONVENTIONAL STARTER MOTOR

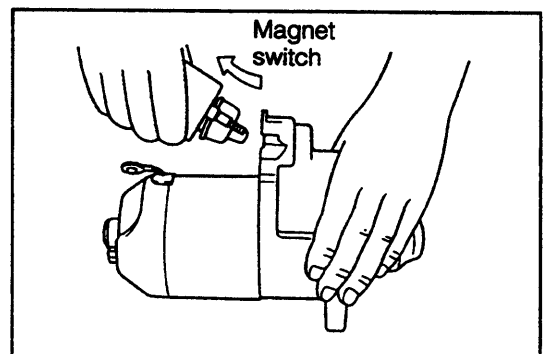
1. Disconnect the lead wire from the magnetic switch.
2. Remove the attaching nut of the magnetic switch from the drive housing.
3. Remove the magnetic switch from the drive housing.
4. Remove the end frame cover by removing the two screws.



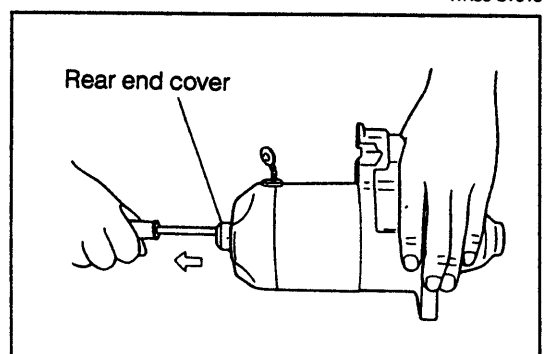
WR88-ST014



WR88-ST015



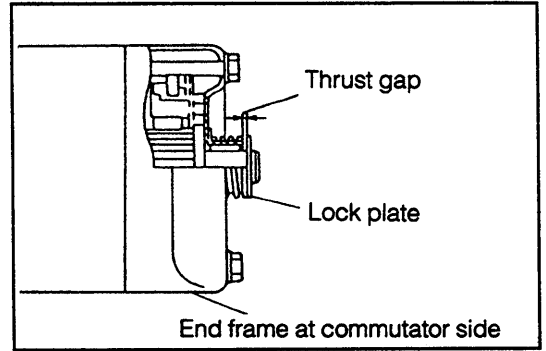
WR88-ST016



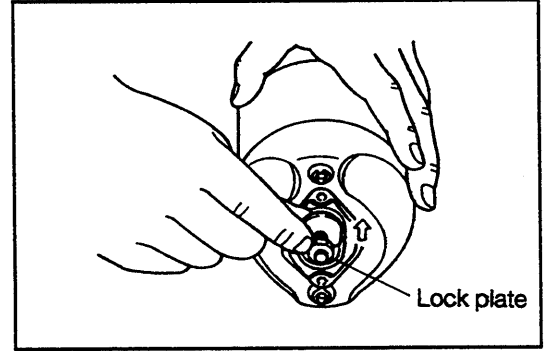
WR88-ST017

- Using a thickness gauge, measure the thrust clearance of the armature shaft at a point between the lock plate and the end frame.

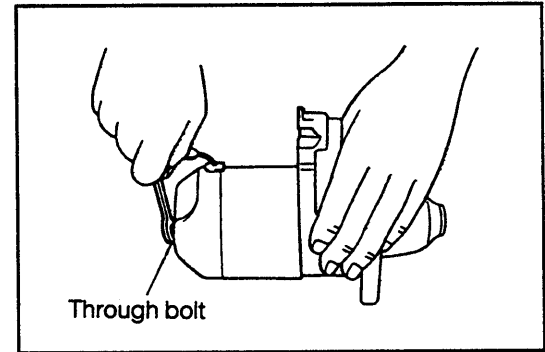
Thrust Clearance: 0.05 - 0.60 mm (0.002 - 0.024 inch)



- Remove the lock plate, brake spring and rubber from the commutator end frame.



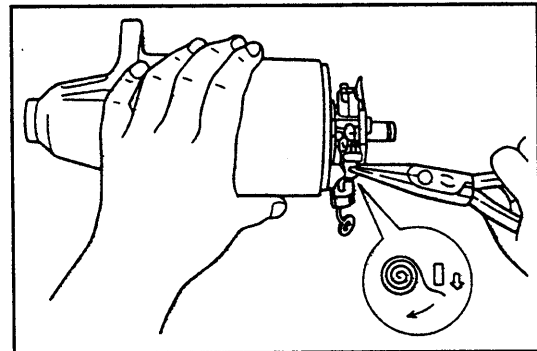
- Remove the commutator end frame from the field frame by removing the two through bolts.



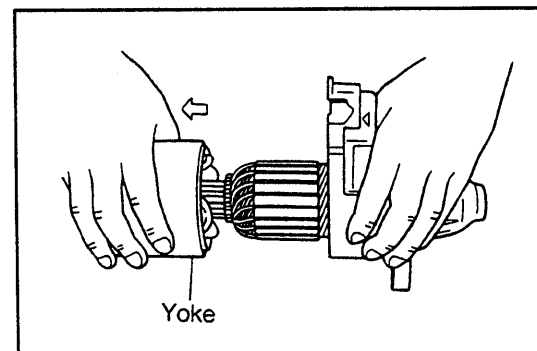
- Remove the brushes from the brush holder by lifting the brush springs by means of nose pliers or the like.

**NOTE:**

Care must be exercised not to scratch the commutator during the removal.

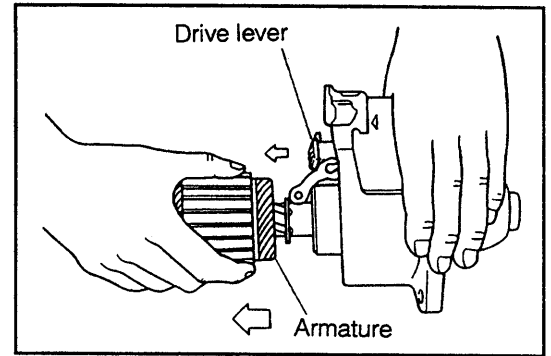


- Remove the yoke from the armature.



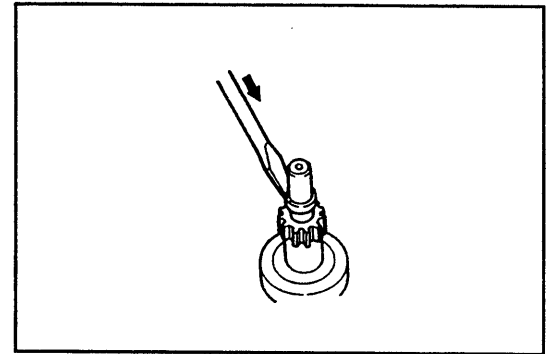
# STARTING SYSTEM

10. Remove the drive lever and armature from the drive housing.



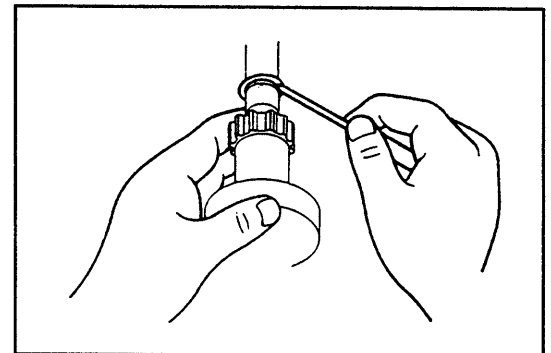
WR88-ST023

11. Remove the stop collar from the snap ring by tapping the collar with a screwdriver or the like placed on it.



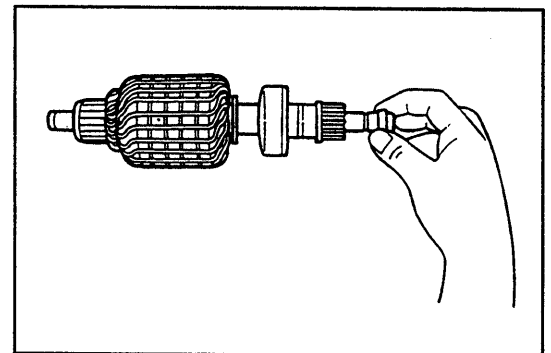
WR88-ST024

12. Remove the snap ring by prying it off with a screwdriver.



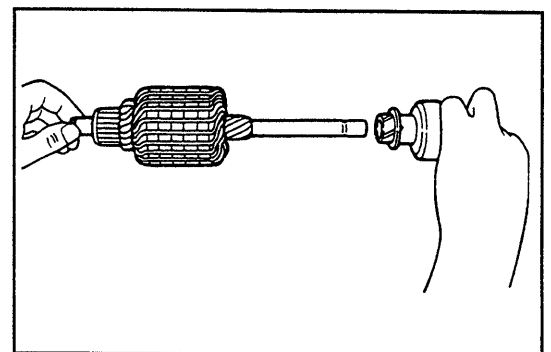
WR88-ST025

13. Remove the collar.



WR88-ST026

14. Remove the clutch.



WR88-ST027

## INSPECTION OF CONVENTIONAL STARTER

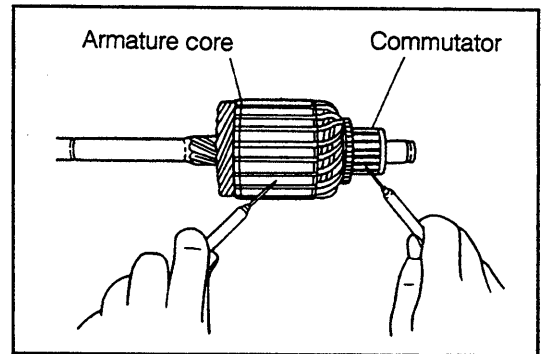
### Armature Coil

1. Check of armature insulation  
Ensure that no continuity exists between the commutator and the armature coil, using an ohmmeter.  
If continuity exists, replace the armature.
2. Check of commutator continuity  
Check continuity between each adjacent segment of the commutator, using an ohmmeter.  
If no continuity exists between any adjacent segments, replace the armature.

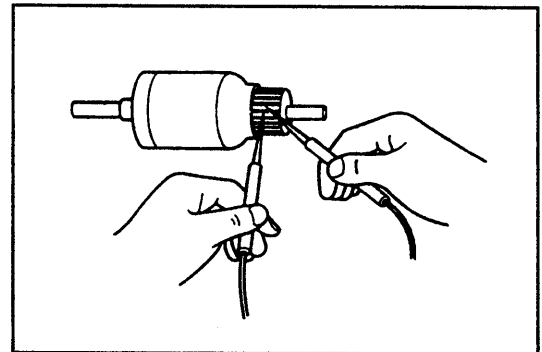
### Commutator

1. Check each contact surface of the commutator segments with the brushes for burning.  
If the surfaces are dirty or burnt, correct the commutator surfaces, using abrasive paper (No. 400) or a lathe.
2. Check of commutator for circle runout  
Support the armature at its both ends on a Vee block.  
Check the commutator for circle runout, using a dial gauge.  
**Circle Runout Limit: 0.40 mm (0.016 inch)**  
  
If the circle runout exceeds the allowable limit, turn down the commutator on a lathe.  
At this point, care must be exercised to ensure that the commutator diameter is not less than the minimum requirement diameter of 27 mm (1.063 inch).
3. Measurement of commutator diameter  
Measure the commutator diameter by means of a micrometer or vernier caliper.  
**Standard Diameter: 28 mm (1.102 inch)**  
**Minimum diameter: 27 mm (1.063 inch)**

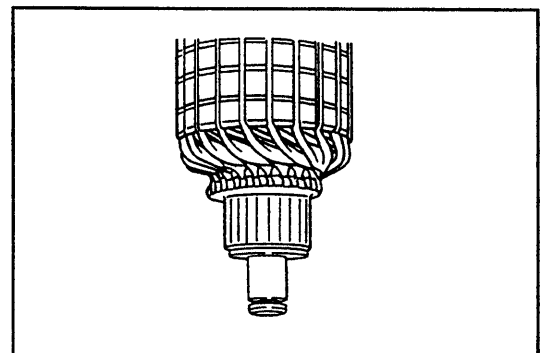
If the commutator diameter is less than the minimum diameter, replace the armature.



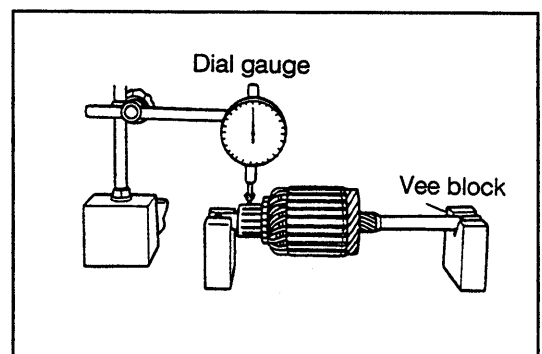
WR88-ST028



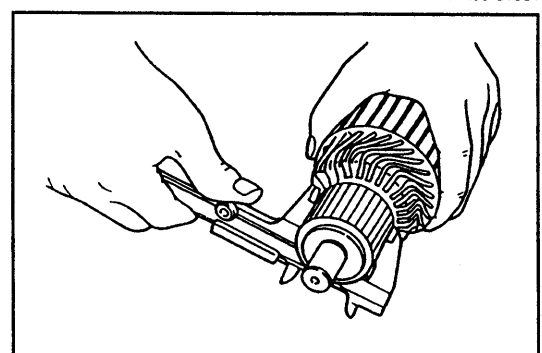
WR88-ST029



WR88-ST030



WR88-ST031

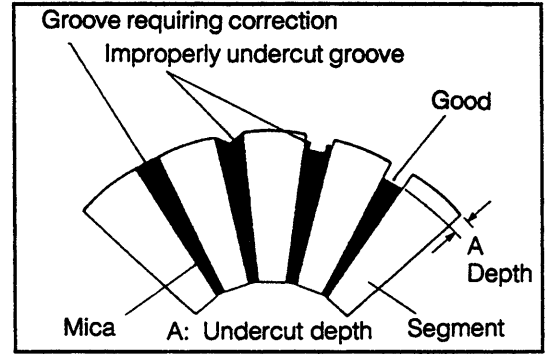


WR88-ST032

# STARTING SYSTEM

## 4. Check of commutator undercut

If the depth of the insulator groove between commutator segments is less than 0.2 mm (0.0079 inch). It is necessary to undercut the insulator so that the groove depth may become 0.5 - 0.8 mm (0.020 - 0.031 inch).

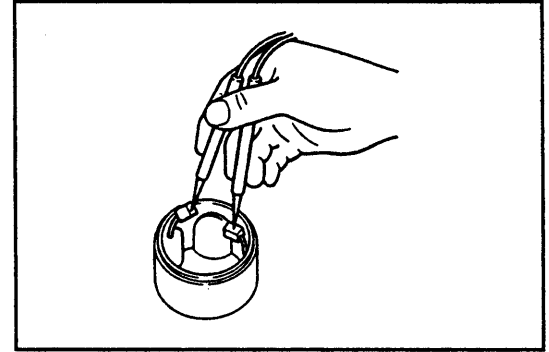


WR88-ST033

## Yoke

### 1. Field coil continuity test

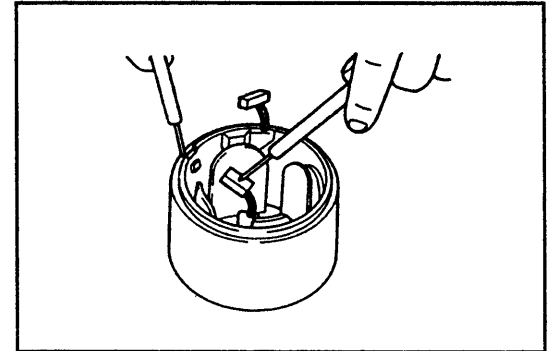
Perform field coil continuity test at a point between the lead wire and the brush, using an ohmmeter. If no continuity exists, replace the yoke



WR88-ST034

### 2. Field coil short test

Perform field coil short test at a point between the brush and the yoke proper, using an ohmmeter. If no continuity exists, replace the yoke.



WR88-ST035

## Brushes

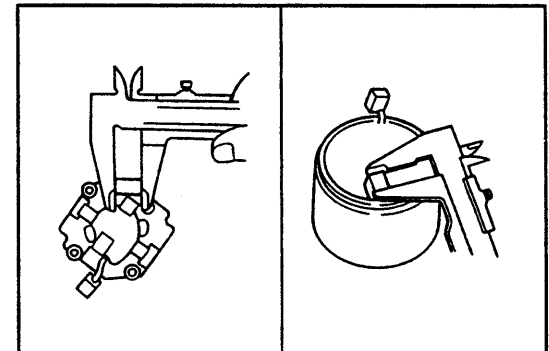
### Measurement of brush length

Measure the brush length, using vernier calipers.

**Standard Length:** 16 mm (0.63 inch)

**Minimum length:** 10.5 mm (0.41 inch)

If the length is less than the minimum requirement, replace the brush holder or the yoke, as required.



WR88-ST036

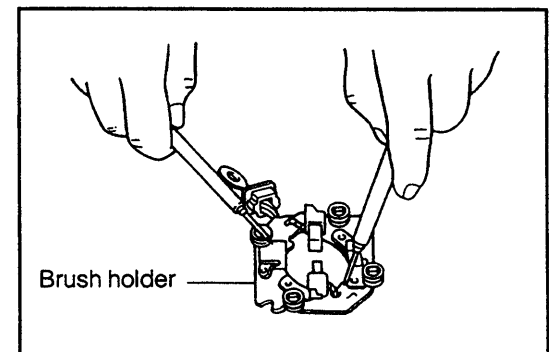
## Brush Holder

### Check of brush holder for insulation

Measure the insulation between the positive and negative terminals of the brush holder, using an ohmmeter.

**Insulation Resistance:** 100 MΩ or more

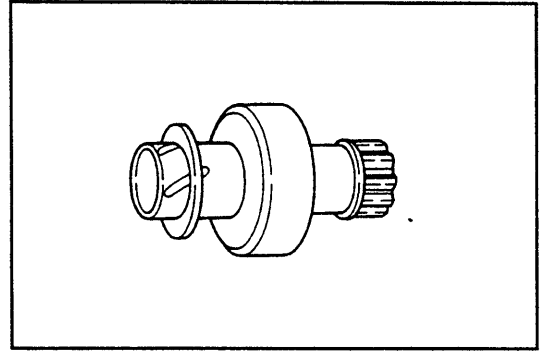
If the insulation resistance is less than the specification, replace the brush holder.



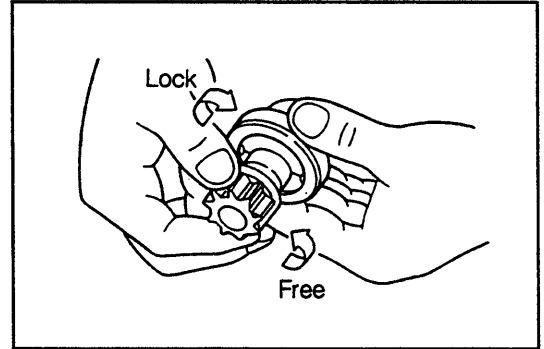
WR88-ST-037

## Clutch

1. Inspection of pinion gear and spline teeth  
Check the teeth of the pinion gear and spline for wear or damage.  
If the teeth exhibit any damage, replace the clutch. Also, inspect the flywheel ring gear for wear or damage.
2. Check of starter clutch  
While holding the clutch, turn the pinion clockwise. Ensure that the pinion turns smoothly.  
Turn the pinion counterclockwise. Ensure that the pinion is locked.  
If the check results are unsatisfactory, replace the starter clutch.



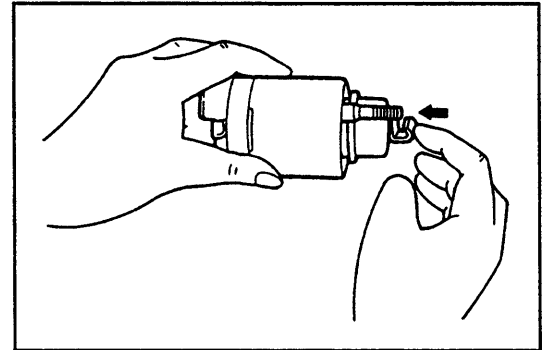
WR88-ST038



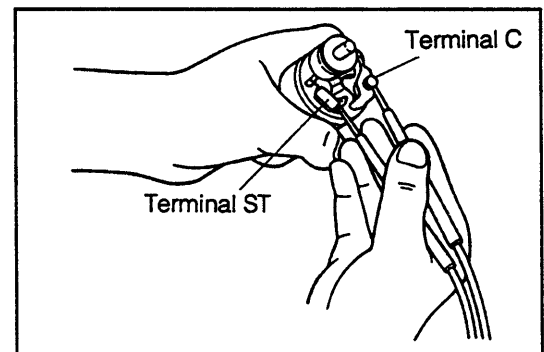
WR88-ST039

## Magnetic Switch

1. Plunger check  
Push in the plunger with your fingers and release your fingers. Ensure that the plunger returns quickly to the original position. If the plunger exhibits poor returning or fails to return, replace the magnetic switch.
2. Pull-in coil open circuit test  
Using an ohmmeter, ensure that continuity exists between the terminal ST and terminal C.  
If no continuity exists, replace the magnetic switch.

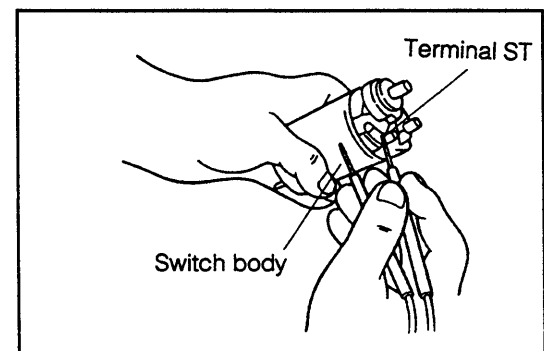


WR88-ST040



WR88-ST041

3. Hold-in coil open circuit test  
Ensure that continuity exists between the terminal ST and the switch body.  
If no continuity exists, replace the magnetic switch.

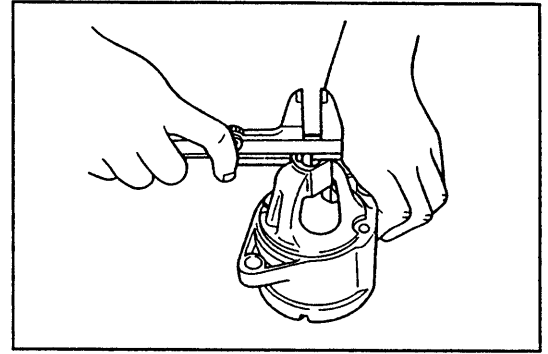


WR88-ST042

# STARTING SYSTEM

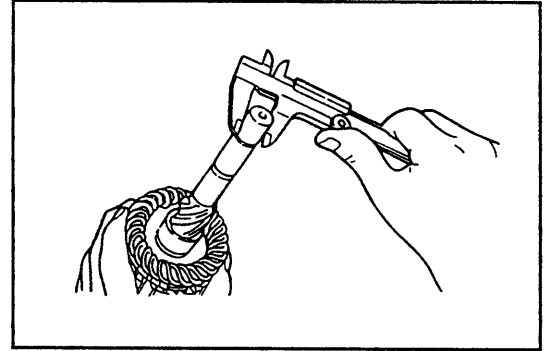
## Check of Bush-To-Shaft Clearance

1. Measure the inner diameters of the bushes of the drive housing and commutator end frame.



WR88-ST043

2. Measure the outer diameter of the armature bearing section.



WR88-ST044

3. Determine the clearance by subtracting the outer diameter of the armature bearing section from the inner diameter of the drive shaft.

**Clearance Limit: 0.2 mm (0.0079 inch)**

If the clearance exceeds the limit, replace the drive housing bearing.

WR88-ST045

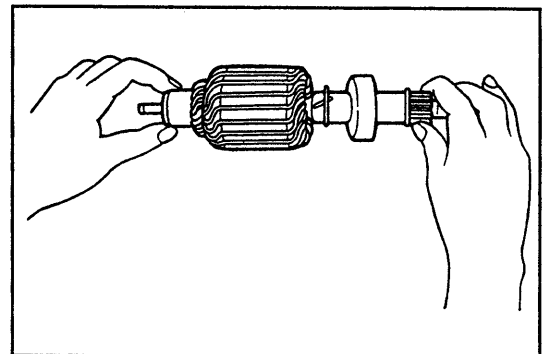
## ASSEMBLY OF CONVENTIONAL STARTER

(See page ST-3.)

### NOTE:

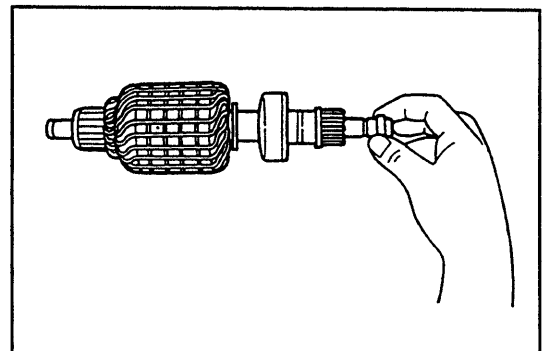
Use high-temperature grease to lubricate the bearings and sliding parts when assembling the starter.

1. Install the clutch on the armature shaft.



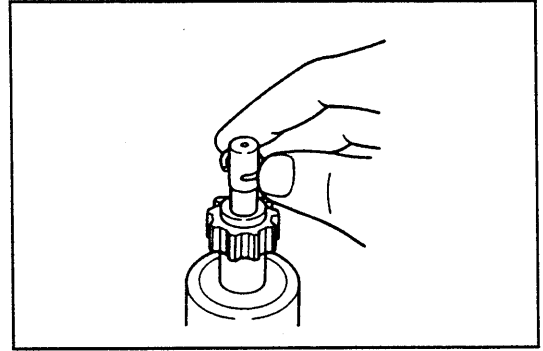
WR88-ST046

2. Install the collar on the armature shaft.



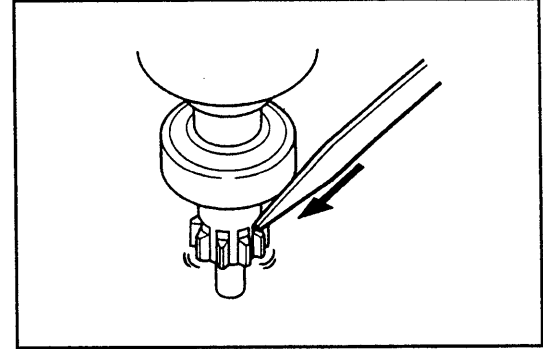
WR88-ST047

3. Fit the snap ring onto the armature shaft.



WR88-ST048

4. Tap the pinion so that the collar may come onto the snap ring, using a screwdriver.

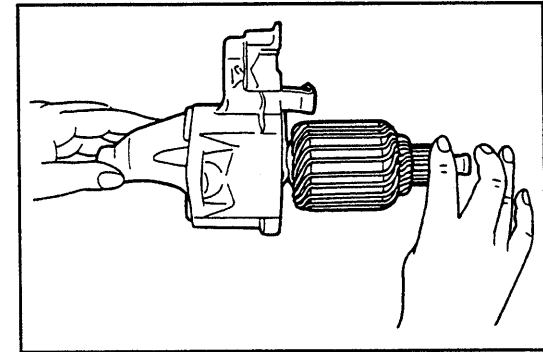


WR88-ST049

5. Install the drive lever and armature in the drive housing.

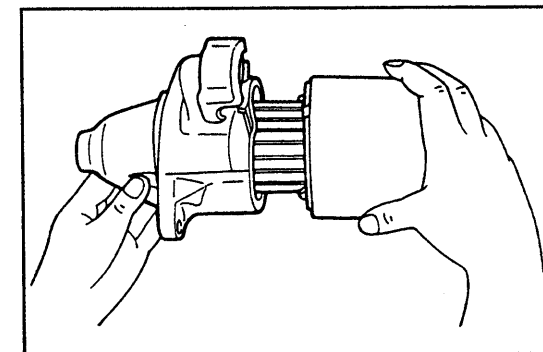
**NOTE:**

Apply high-temperature grease to the sliding sections of the armature shaft and drive lever.



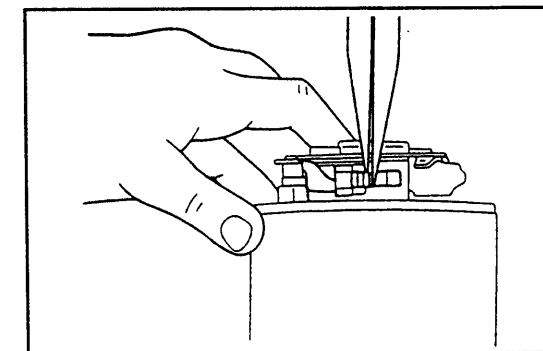
WR88-ST050

6. Install the yoke in the drive housing.



WR88-ST051

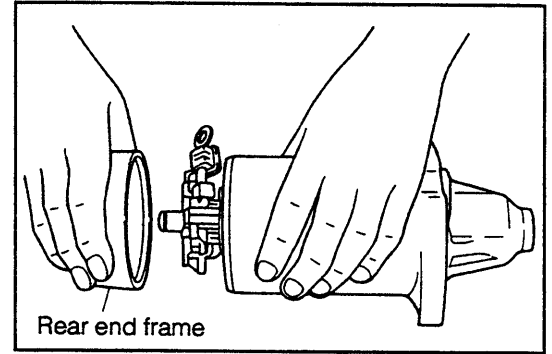
7. Install the brush holder over the armature shaft.
8. While the brush springs are held in a raised state by means of nose pliers or a piece of wire, install the brushes (four pieces) in the brush holder.



WR88-ST052

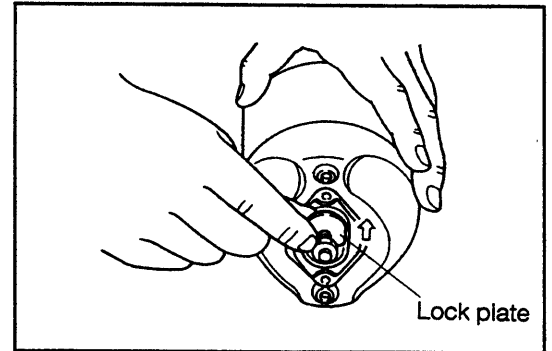
## STARTING SYSTEM

9. Attach the commutator end frame to the stator yoke assembly with the two through bolts.



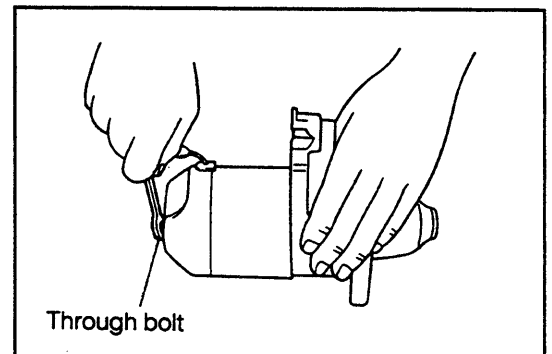
WR88-ST053

10. Install the rubber, brake spring and lock plate in this order onto the armature shaft.



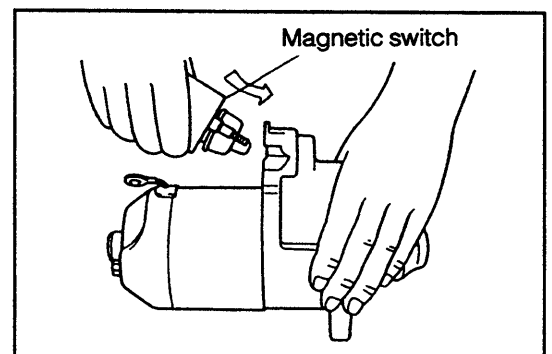
WR88-ST054

11. Install the rear end frame cover in place with the two screws.



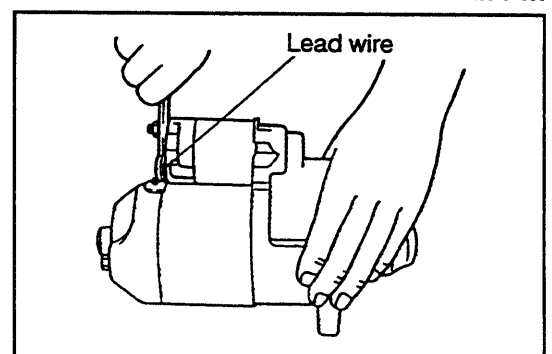
WR88-ST055

12. While hooking the magnetic switch over the drive lever, install the magnetic switch onto the drive housing. Secure the magnetic switch with the two nuts.



WR88-ST056

13. Connect the lead wire to the magnetic switch.



WR88-ST057

## PERFORMANCE TEST OF CONVENTIONAL STARTER MOTOR

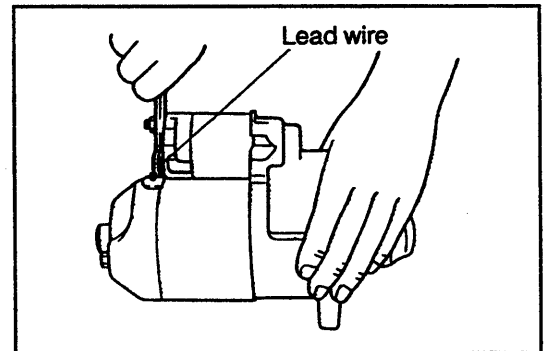
### CAUTION:

Each of the following tests must be performed within three to five seconds. If you fail to observe this caution and the starter is energized for more than this duration, the coil may be burnt out.

WR88-ST058

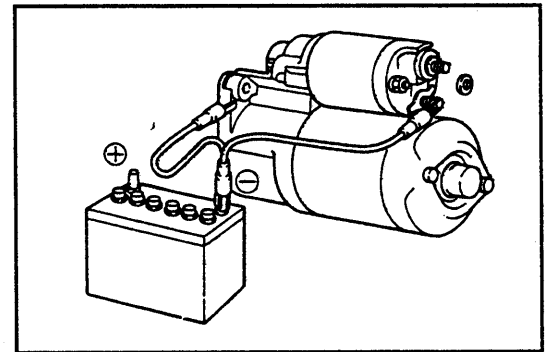
### 1. Pull-in Test

- (1) Disconnect the lead wire from the magnetic switch terminal.



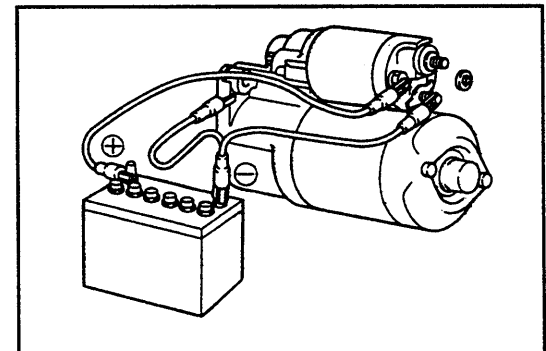
WR88-ST059

- (2) Connect the negative (-) terminal of the battery to the starter body and magnetic switch terminal.



WR88-ST060

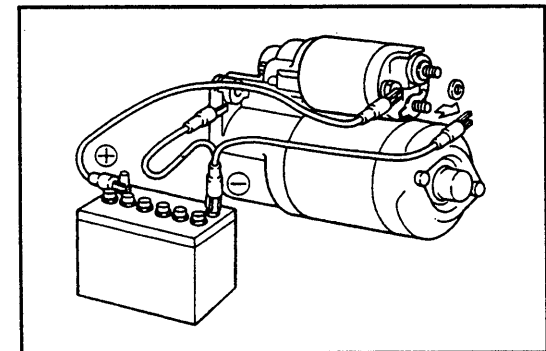
- (3) Connect the positive (+) terminal to the terminal ST. Ensure that the pinion is pushed outward. If the drive pinion fails to move out, replace the magnetic switch.



WR88-ST061

### 2. Hold-in Test

After the check has been performed following the same procedure as with the pull-in test, disconnect the negative terminal of the magnetic switch terminal. Ensure that the drive pinion is held in a pushed-out state. If the drive pinion fails to be held, replace the magnetic switch.



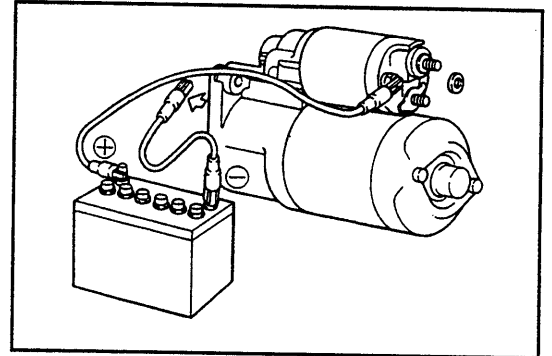
WR88-ST062

# STARTING SYSTEM

## 3. Inspection of Plunger Return

After the check has been performed following the same procedure as with the hold-in test, disconnect the ground terminal of the starter body. Ensure that the drive pinion is drawn into the drive housing.

If the drive pinion fails to be drawn, replace the magnetic switch.



WR88-ST063

## 4. No-load Performance Test

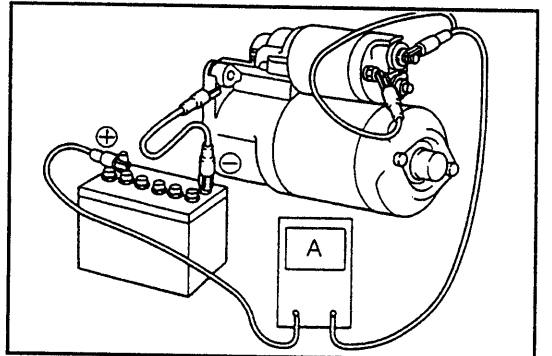
Connect the battery and an ammeter to the starter as shown in the right figure. Ensure that the starter rotates smoothly with the pinion moving out.

Measure the current the starter is drawing.

Specified Current: Less Than 50A at 11V

### NOTE:

Prior the test, be sure to connect the lead wire to the magnetic switch.

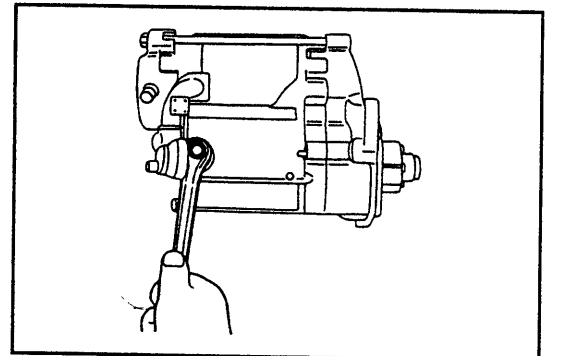


WR88-ST064

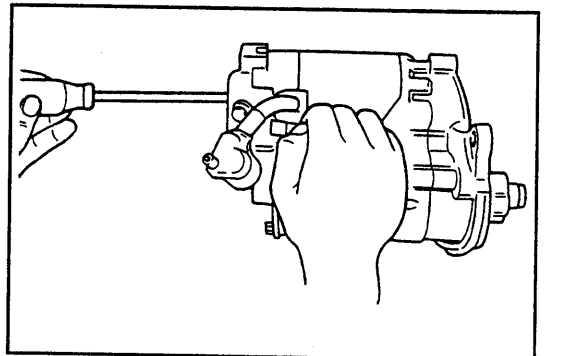
## DISASSEMBLY OF REDUCTION TYPE STARTER MOTOR

(See page ST-4.)

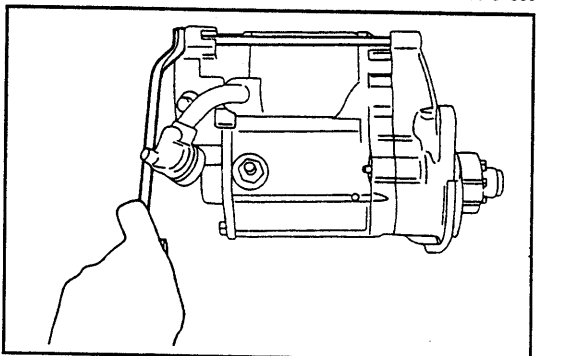
1. Disconnect the lead wire from the magnetic switch.
2. Remove the brush holder retaining screws from the commutator end frame.
3. Remove the two through bolts from the commutator end frame.



WN88E-ST008

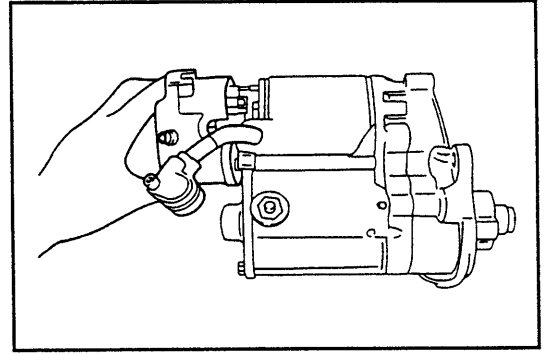


WR88-ST066

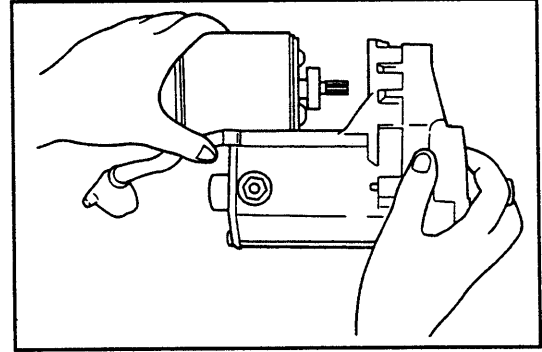


WR88-ST067

4. Remove the commutator end frame and "O" ring.



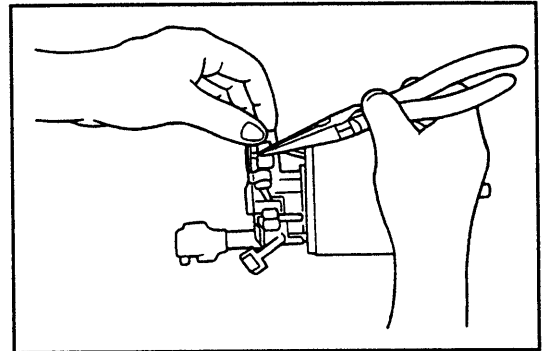
5. Remove the yoke together with the armature from the drive housing.
6. Remove the "O" ring.



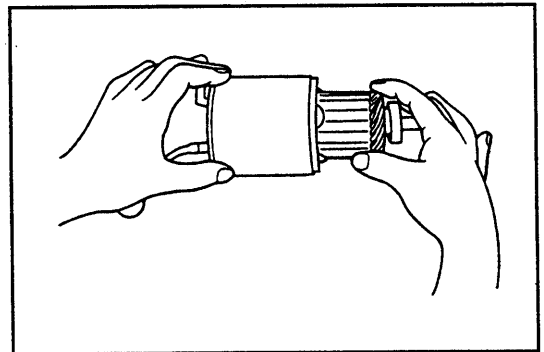
7. Remove the brushes from the brush holder by means of nose pliers or the like.

**NOTE:**

Care must be exercised not to damage the brushes during the removal.

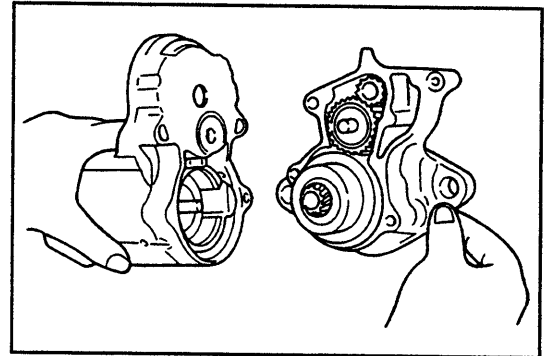
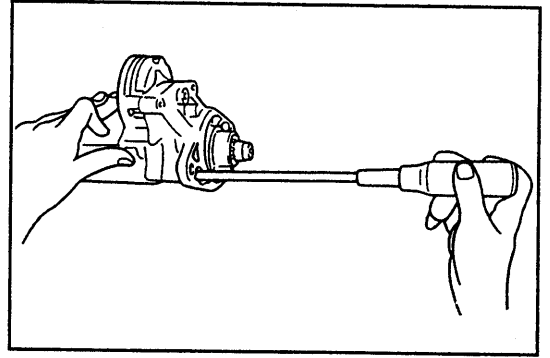


8. Remove the armature from the yoke, being very careful not to damage the brushes.



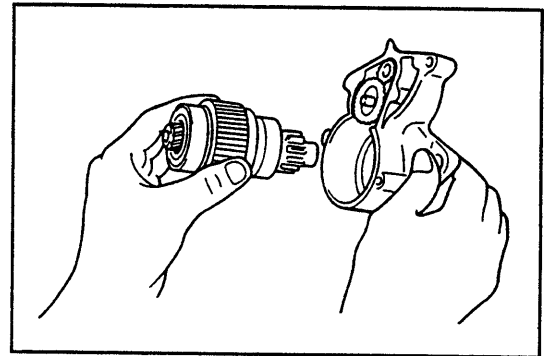
## STARTING SYSTEM

9. Remove the starter switch assembly from the drive housing by removing the two screws.



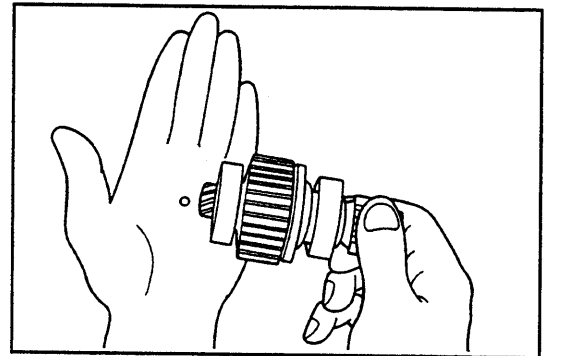
WR88-ST072

10. Remove the clutch assembly from the drive housing.



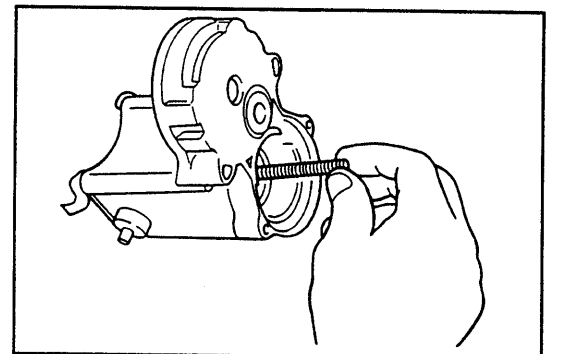
WR88-ST073

11. Remove the steel ball from the clutch assembly.



WR88-ST074

12. Remove the return spring from the starter switch assembly.

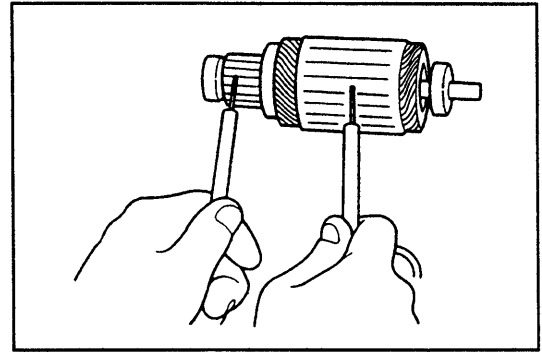


WR88-ST075

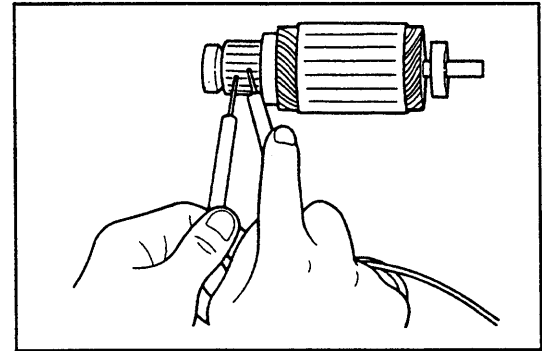
**INSPECTION OF REDUCTION TYPE STARTER MOTOR**

**Armature Coil**

1. Check of armature insulation  
 Ensure that no continuity exists between the commutator and the armature coil, using an ohmmeter.  
 If continuity exists, replace the armature.
  
2. Check of commutator continuity  
 Check continuity between each adjacent segment of the commutator, using an ohmmeter.  
 If no continuity exists between any adjacent segments, replace the armature.



WR88-ST076



WR88-ST077

**Commutator**

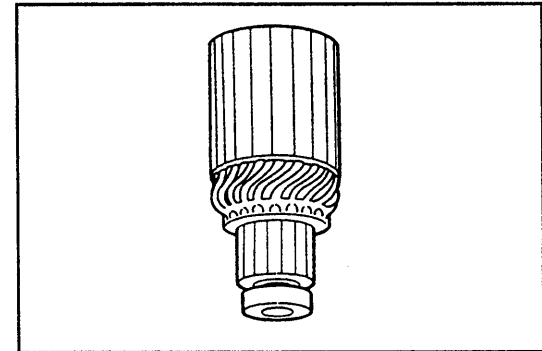
1. Check each contact surface of the commutator segments with the brushes for burning.  
 If the surfaces are dirty or burnt, correct the commutator surfaces, using abrasive paper (No. 400) or a lathe.
  
2. Check of commutator for circle runout  
 Support the armature at its both ends on a Vee block.  
 Check the commutator for circle runout, using a dial gauge.  
**Circle Runout Limit: 0.05 mm (0.0020 inch)**

If the circle runout exceeds the allowable limit, turn down the commutator on a lathe.

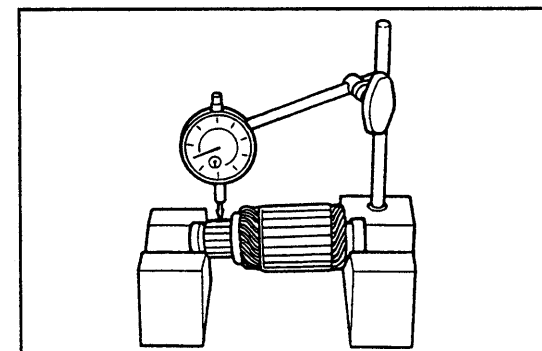
At this point, care must be exercised to ensure that the commutator diameter is not less than the minimum requirement diameter of 29.0 mm (1.142 inch).

3. Measurement of commutator diameter  
 Measure the commutator diameter by means of a micrometer or vernier caliper.  
**Standard Diameter: 30.0 mm (1.181 inch)**  
**Minimum Diameter: 29.0 mm (1.142 inch)**

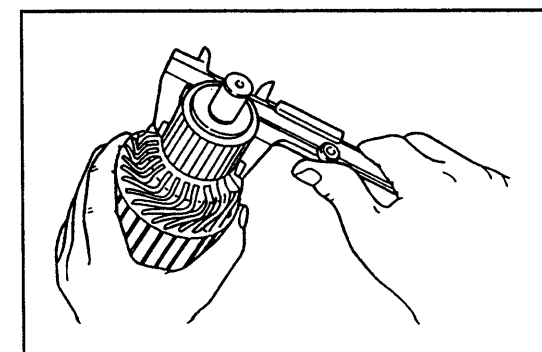
If the commutator diameter is less than the minimum diameter, replace the armature.



WR88-ST078



WR88-ST079

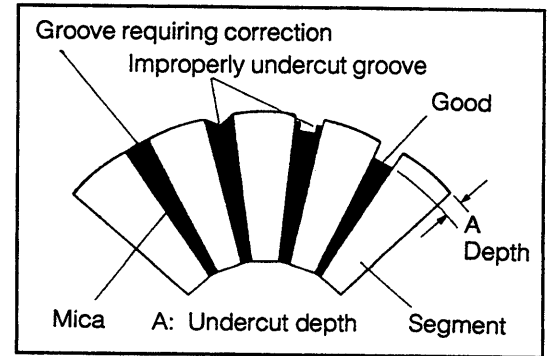


WR88-ST080

# STARTING SYSTEM

## 4. Check of commutator undercut

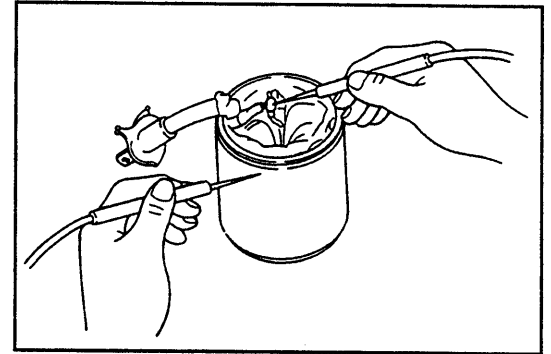
If the depth of the insulator groove between commutator segments is less than 0.2 mm (0.0079 inch), it is necessary to undercut the insulator so that the groove depth may become 0.6 mm (0.024 inch).



## Yoke

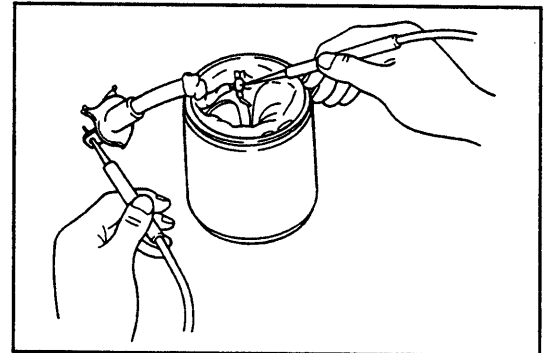
### 1. Field coil continuity test

Perform field coil continuity test at a point between the lead wire and the brush, using an ohmmeter. If no continuity exists, replace the yoke.



### 2. Field coil short test

Perform field coil short test at a point between the brush and the yoke proper, using an ohmmeter. If no continuity exists, replace the yoke.



## Brushes

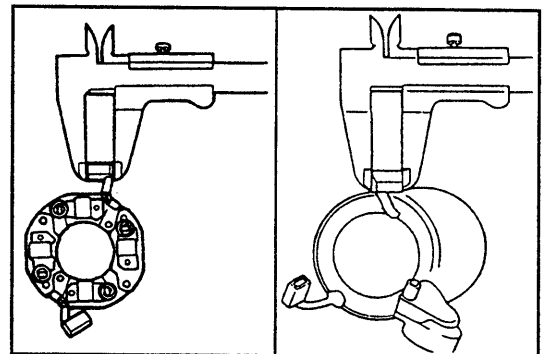
Measurement of brush length

Measure the brush length, using vernier calipers.

**Standard Length:** 13.0 mm (0.51 inch)

**Minimum Length:** 8.5 mm (0.33 inch)

If the length is less than the minimum requirement, replace the brush holder or the yoke, as required.



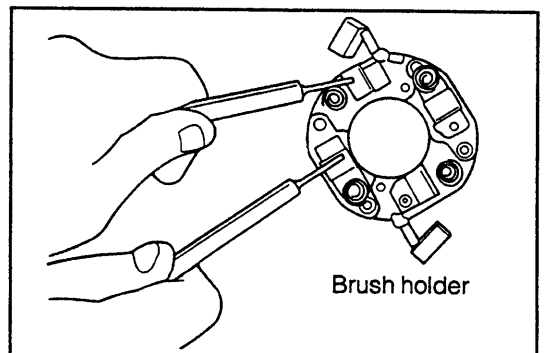
## Brush Holder

Check of brush holder for insulation

Measure the insulation between the positive and negative terminals of the brush holder, using an ohmmeter.

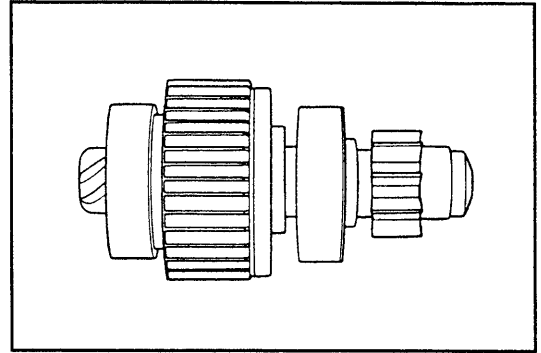
**Insulation Resistance:** 100 MΩ or more

If the insulation resistance is less than the specification, replace the brush holder.

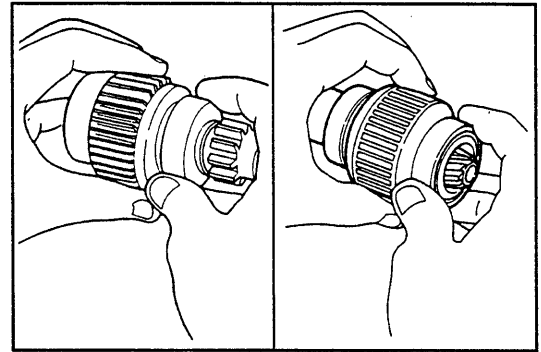


## Clutch

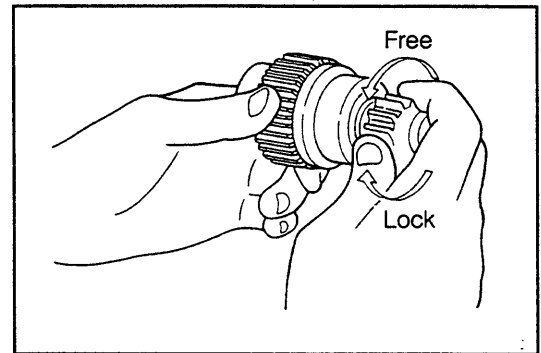
1. Inspection of pinion gear and spline teeth  
Check the teeth of the pinion gear and spline for wear or damage.  
If the teeth exhibit any damage, replace the clutch. Also, inspect the flywheel ring gear for wear or damage.
2. Bearing check  
Lightly turn the bearing hand. Ensure that the bearing turns smoothly.
3. Check of starter clutch  
While holding the clutch, turn the pinion clockwise. Ensure that the pinion turns smoothly.  
Turn the pinion counterclockwise. Ensure that the pinion is locked.  
If the check results are unsatisfactory, replace the starter clutch.



WR88-ST086



WR88-ST087



WR88-ST088

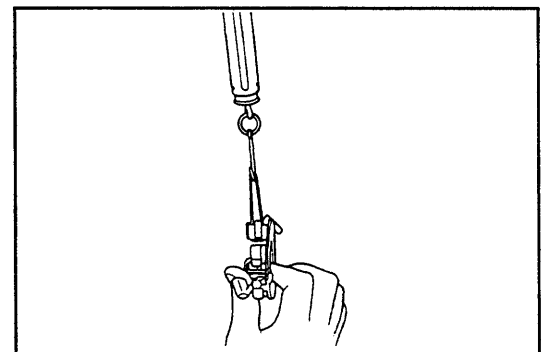
## Brush Spring

Measure the brush spring tension, using spring scale.

**Tension with Spring Installed:**

1.785 - 2.415 kg (3.94 - 5.32 lb)

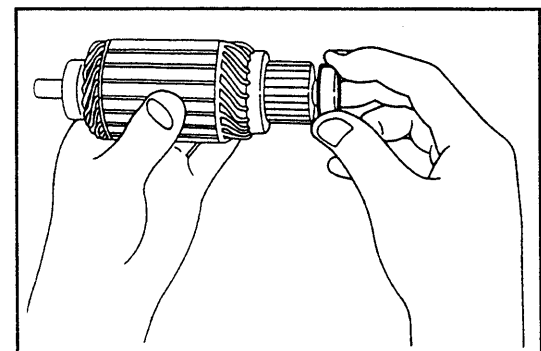
If the spring tension is less than the specification, replace the spring.



WR88-ST089

## Bearing

1. Inspection of bearings  
Turn the bearing while applying a force to it by your hand.  
Ensure that the bearing turns smoothly. If the bearing fails to turn smoothly, replace the bearing.

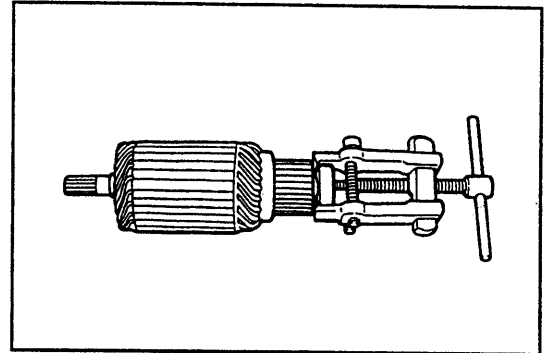


WR88-ST090

# STARTING SYSTEM

## 2. Bearing replacement (Only when bearing is faulty)

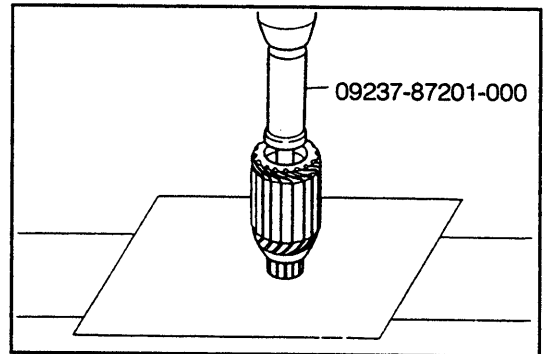
(1) Remove the bearing, using a armature bearing puller.



WR88-ST091

(2) Press the bearing into the armature shaft, using a press in conjunction with the SST.

SST: 09237-87201-000



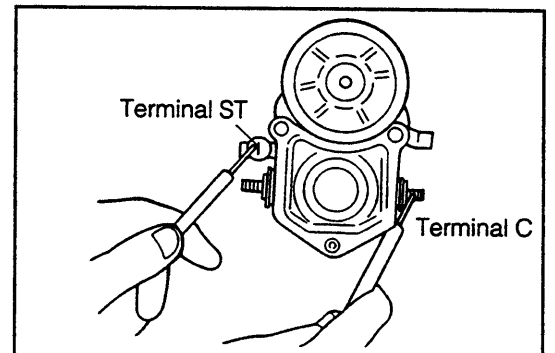
WR88-ST092

## Magnetic Switch

### 1. Pull-in coil test

Using an ohmmeter, ensure that continuity exists between the terminal ST of the starter and the terminal C.

If no continuity exists, replace the magnetic switch.

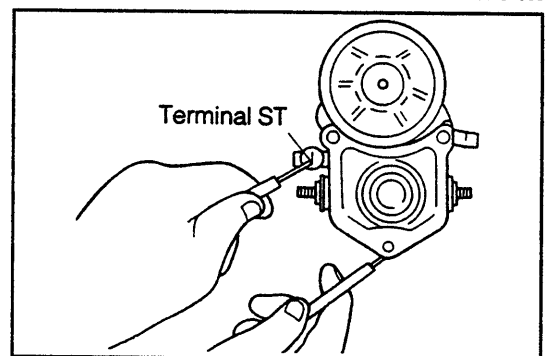


WR88-ST093

### 2. Hold-in coil test

Ensure that continuity exists between the terminal ST of the magnetic switch and the switch body.

If no continuity exists, replace the magnetic switch.

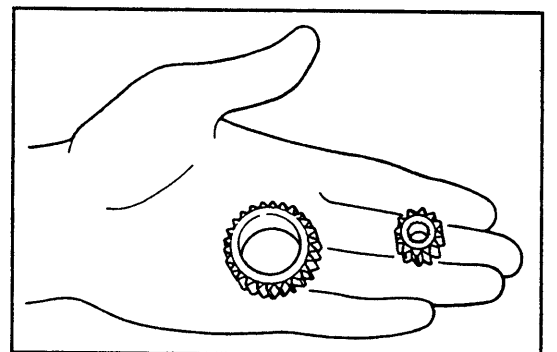


WR88-ST094

## Gears

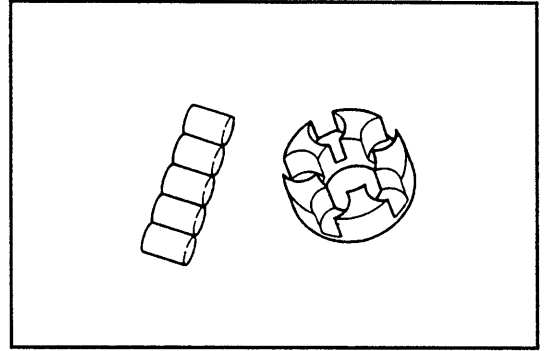
1. Check the starter drive pinion and starter idle gear for damage or wear.

Replace the gear which exhibits damage or wear.



WR88-ST095

2. Check the starter idle gear clutch and clutch retainer for damage or wear.  
Replace the clutch or retainer, as required.



WR88-ST096

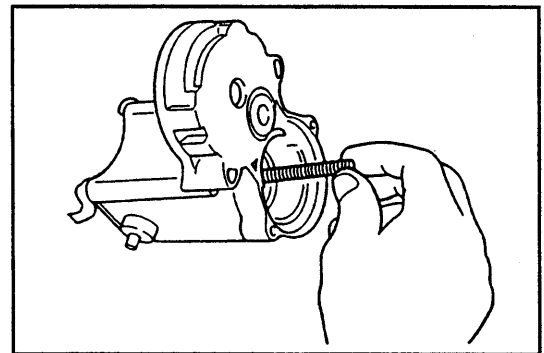
## ASSEMBLY OF REDUCTION TYPE STARTER MOTOR

(See page ST-4.)

### NOTE:

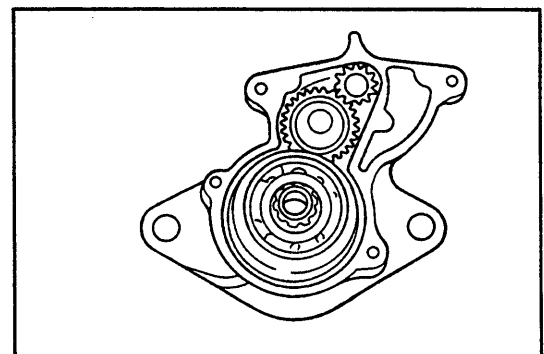
Use high-temperature grease to lubricate the bearings and gears when assembling the starter.

1. Install the return spring in the starter switch assembly.



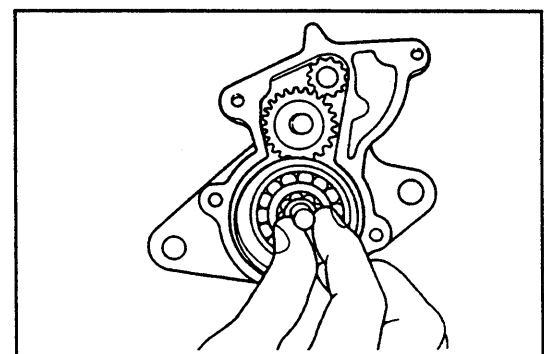
WR88-ST097

2. Fit the steel ball in the starter clutch assembly.



WR88-ST098

3. Assemble the starter clutch housing, idle gear clutch retainer, idle gear clutch roller and starter drive pinion in the starter drive housing.

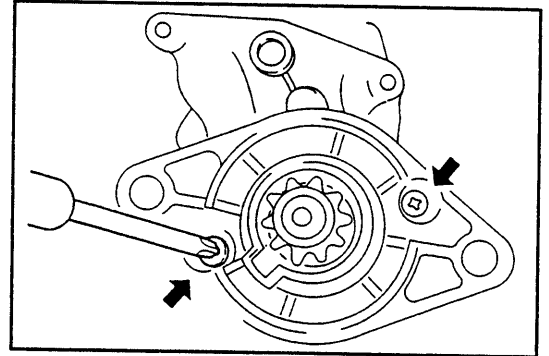


WR88-ST099

WR88-ST100

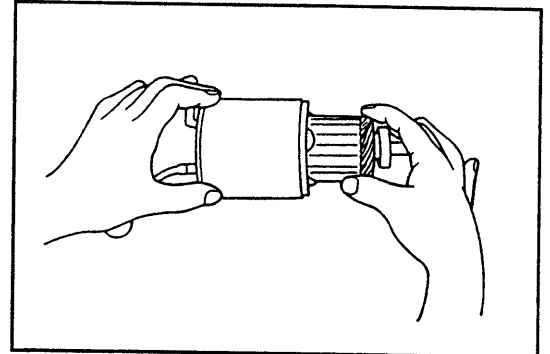
## STARTING SYSTEM

4. Install the starter magnetic switch assembly in the starter drive housing. Secure the switch assembly with the two screws.



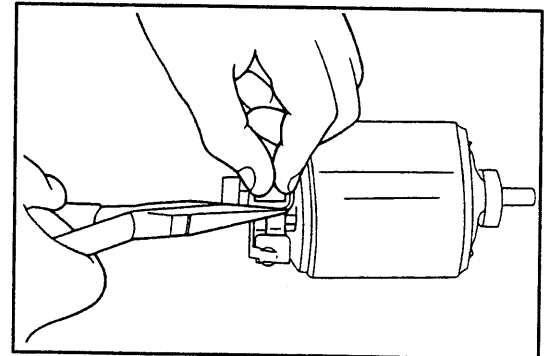
WR88-ST101

5. Insert the armature into the yoke.



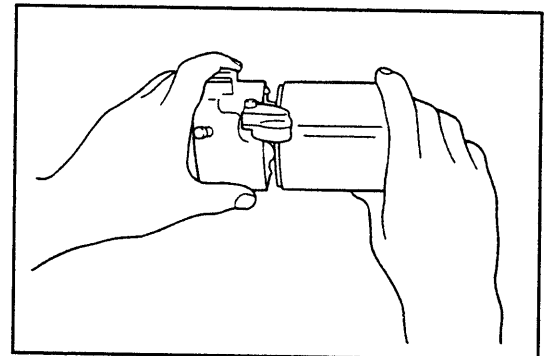
WR88-ST102

6. While the brush holder is held in a raised state by means of a screwdriver or nose pliers, insert the brushes.



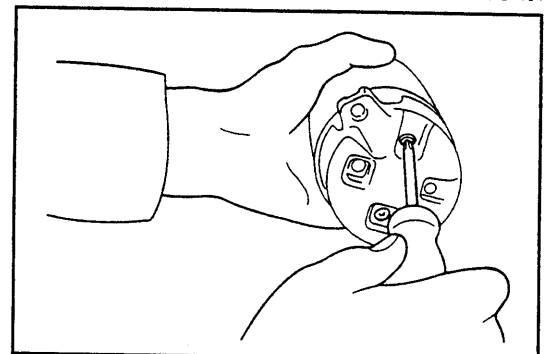
WR88-ST103

7. Attach the commutator end frame to the yoke with a new "O" ring interposed.



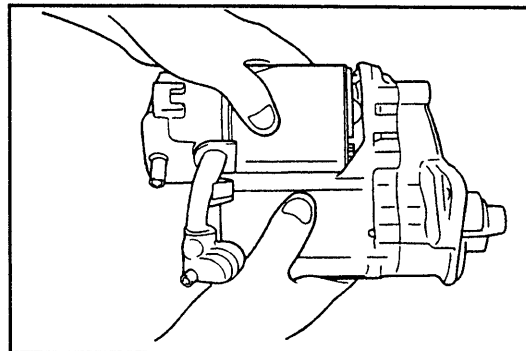
WR88-ST104

8. Install the brush holder on the end frame, using the two screws.



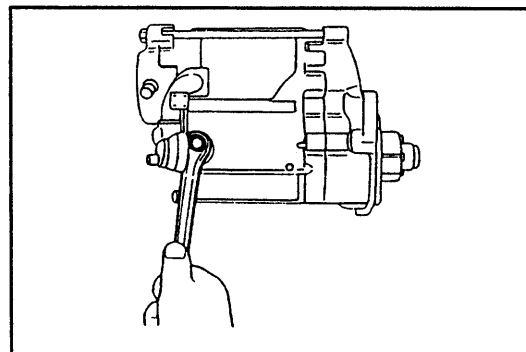
WR88-ST105

9. Install the yoke on the drive housing with a new "O" ring interposed. Make sure that the cut-out marks are aligned with each other. Secure the yoke with the two through bolts.



WR88-ST106

10. Connect the lead wire to the magnetic switch terminal.



WR88-ST107

## PERFORMANCE TEST OF REDUCTION TYPE STARTER MOTOR

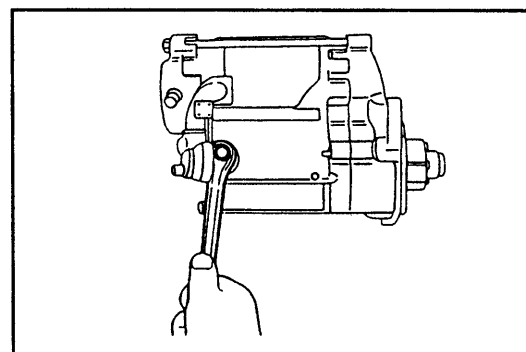
### CAUTION:

Each of the following tests must be performed within three to five seconds. If you fail to observe this caution and the starter is energized for more than this duration, the coil may be burnt out.

WR88-ST108

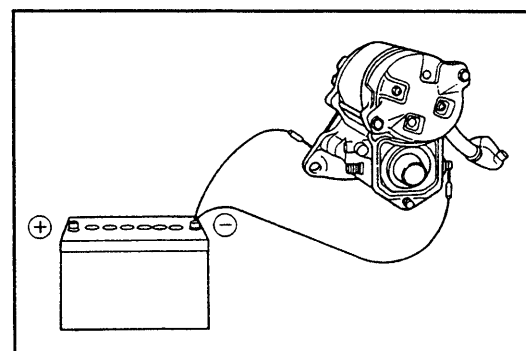
### 1. Pull-in Test

- (1) Disconnect the lead wire from the magnetic switch terminal.



WR88-ST109

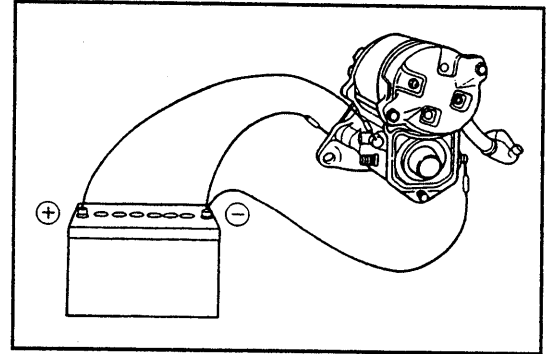
- (2) Connect the negative (-) terminal of the battery to the starter body and magnetic switch terminal.



WR88-ST110

# STARTING SYSTEM

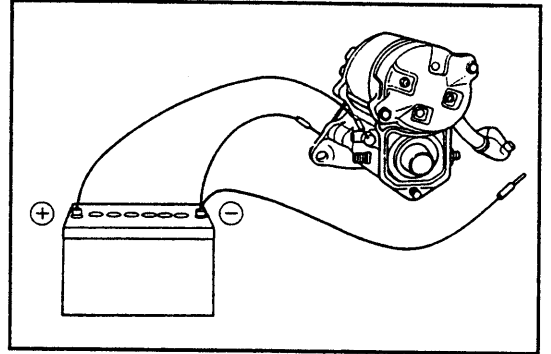
- (3) Connect the positive (+) terminal to the terminal ST.  
Ensure that the pinion is pushed outward.  
If the drive pinion fails to move out, replace the magnetic switch.



WR88-ST111

## 2. Hold-in Test

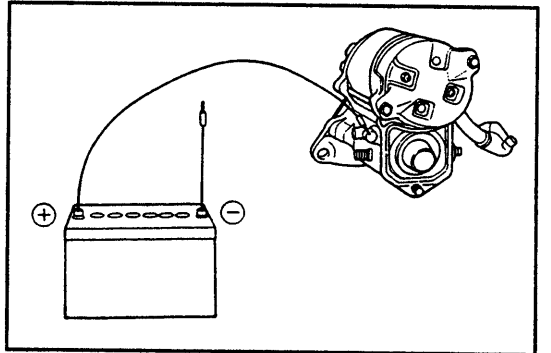
After the check has been performed following the same procedure as with the pull-in test, disconnect the negative terminal of the magnetic switch terminal. Ensure that the drive pinion is held in a pushed-out state. If the drive pinion fails to be held, replace the magnetic switch.



WR88-ST112

## 3. Inspection of Plunger Return

After the check has been performed following the same procedure as with the hold-in test, disconnect the ground terminal of the starter body. Ensure that the drive pinion is drawn into the drive housing. If the drive pinion fails to be drawn into the drive housing, replace the clutch assembly and return spring.



WR88-ST113

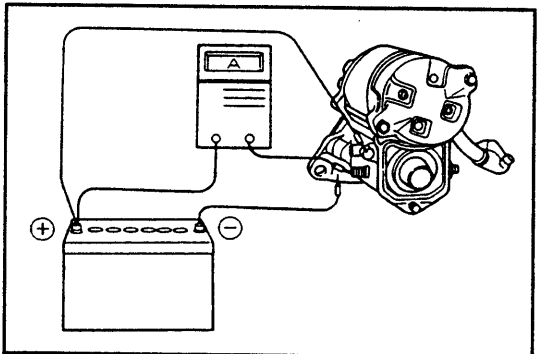
## 4. No-load Performance Test

Connect the battery and an ammeter to the starter as shown in the right figure. Ensure that the starter rotates smoothly with the pinion moving out.

Measure the current the starter is drawing:  
Specified Current: Less Than 90A at 11.5V

### NOTE:

Prior to test, be sure to connect the lead wire to the magnetic switch.



WR88-ST114

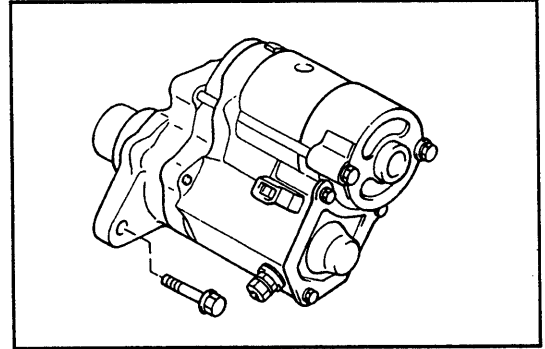
## INSTALLATION OF REDUCTION TYPE STARTER MOTOR

1. Install the starter motor to the bell housing.

WR88-ST115

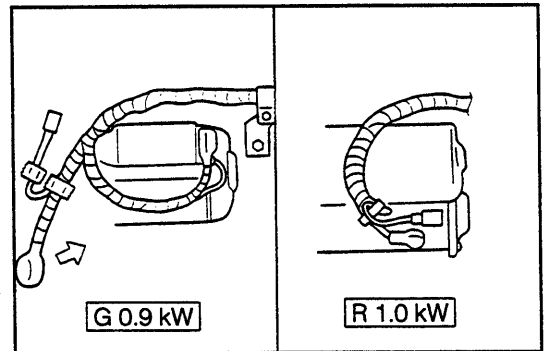
2. Tighten the attaching bolts of the starter motor to the specified torque.

**Tightening Torque: 5.0 - 7.0 kg-m (36.2 - 50.6 ft-lb)**



WR88-ST116

3. Jack up the vehicle and remove the safety stands.
4. Attach the wire harness to the clamp. Tighten the clamp bolt.
5. Connect the starter terminal B of the alternator wire to the starter.



WN88E-ST009

6. Connect the starter terminal ST of the alternator wire to the starter.
7. Connect the ground cable terminal to the negative (-) terminal of the battery.

WR88-ST120