

STARTING SYSTEM

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STARTING SYSTEM CIRCUIT

Fig. 9-1

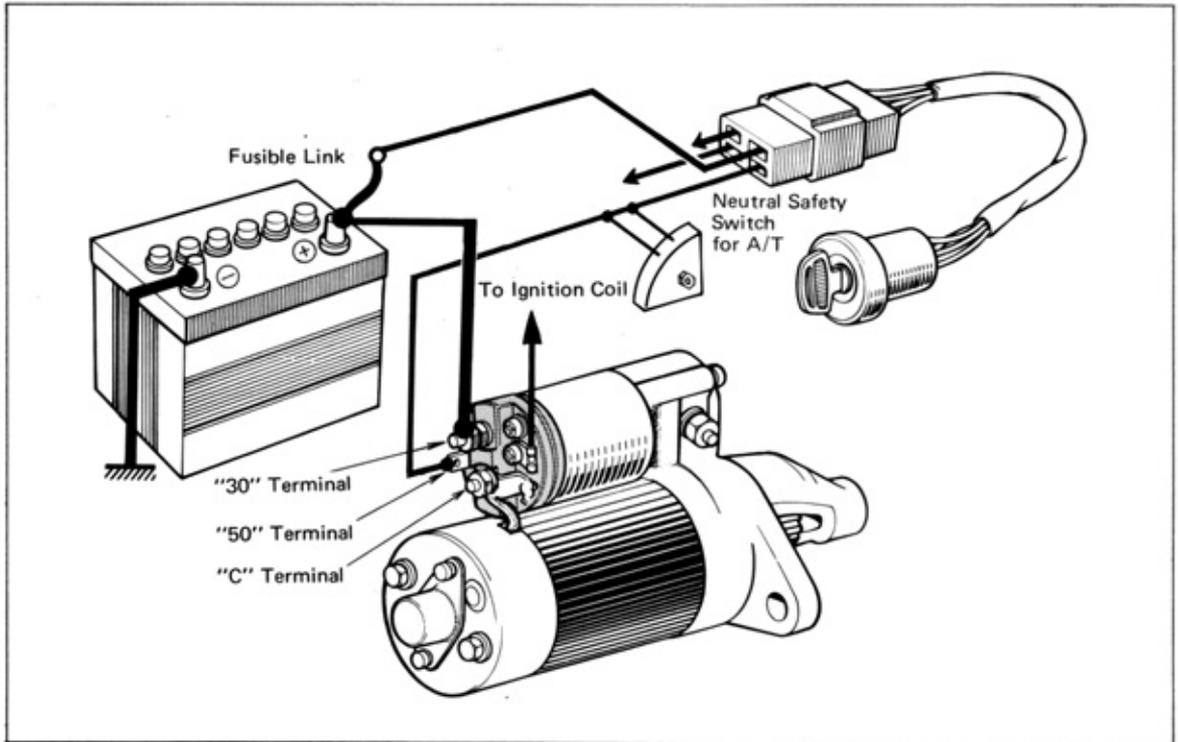
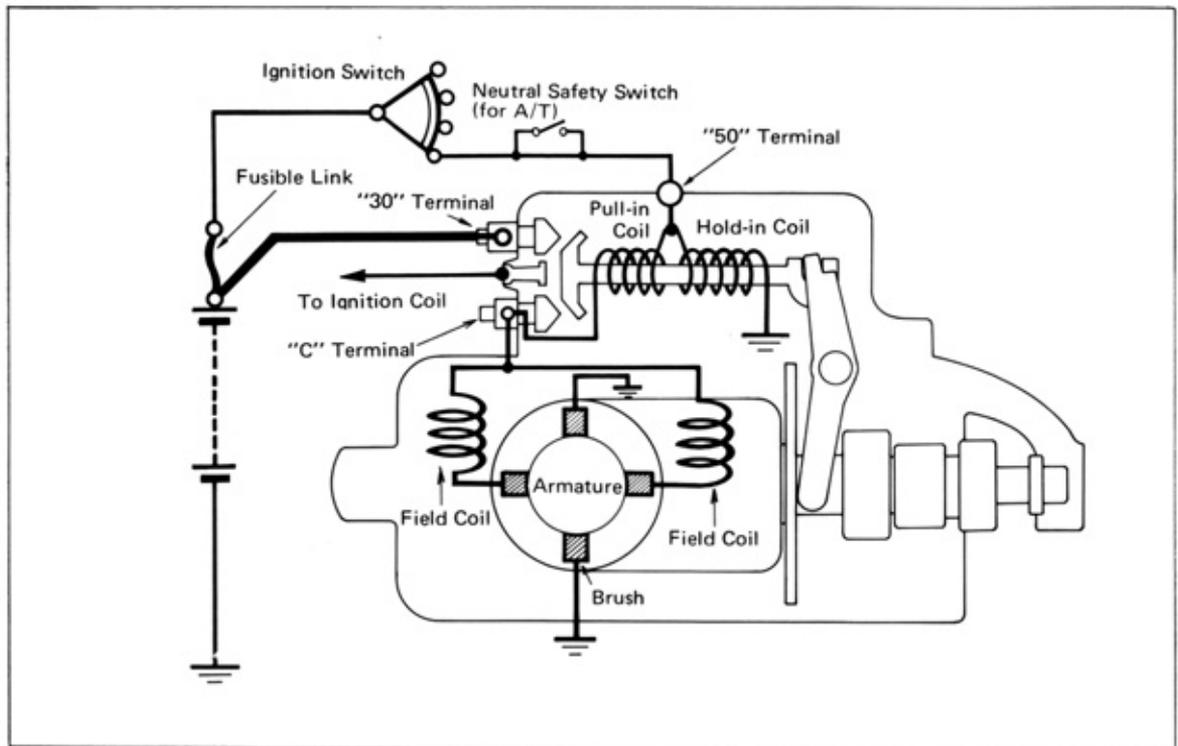


Fig. 9-2



STARTER**DISASSEMBLY**

Disassemble in numerical order.

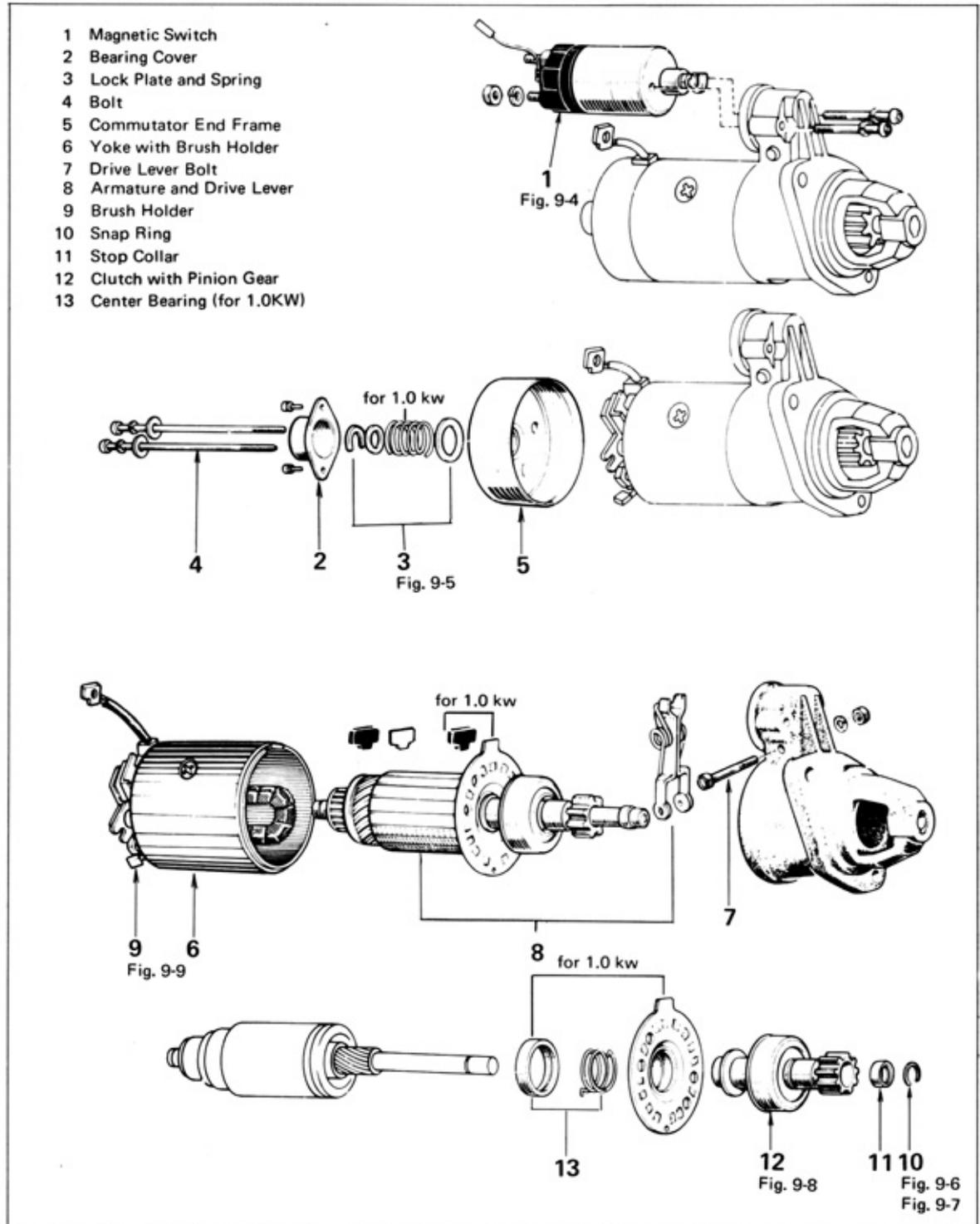
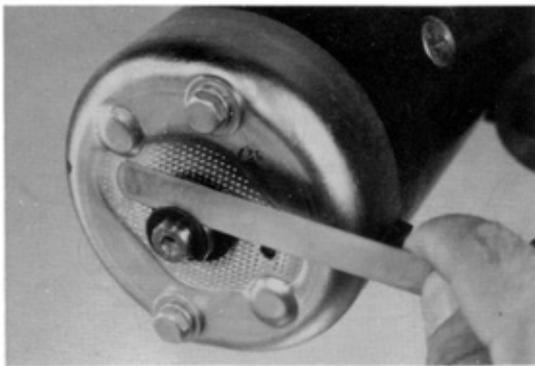
Fig. 9-3

Fig. 9-4



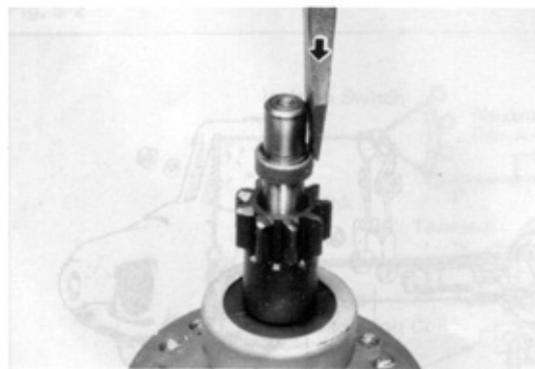
Disconnect lead wire before removing magnetic switch.

Fig. 9-5



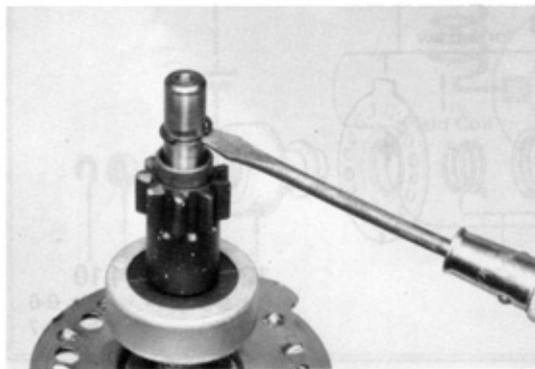
Check the armature shaft thrust clearance.
Thrust clearance limit 0.8 mm (0.032 in)

Fig. 9-6



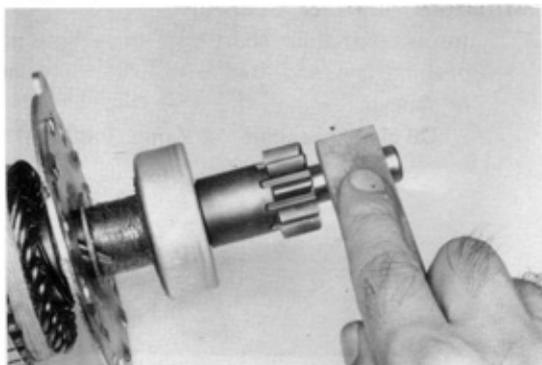
Tap in stop collar, using a screwdriver.

Fig. 9-7



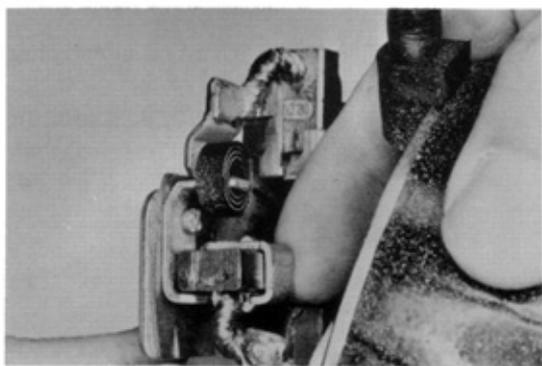
Pry the snap ring, using a screwdriver.

Fig. 9-8



If difficult to pull out the pinion, repair the shaft with an oil stone.

Fig. 9-9



Take off brushes and remove brush holder.

Fig. 9-11

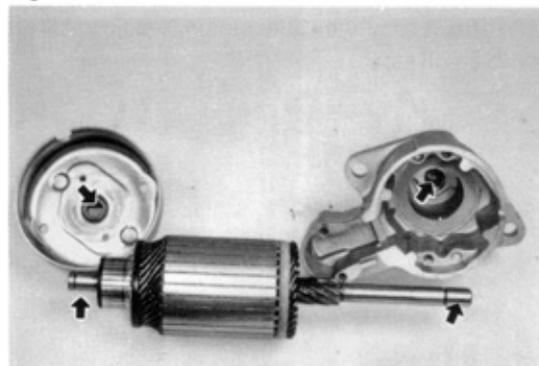


Fig. 9-12



Fig. 9-13

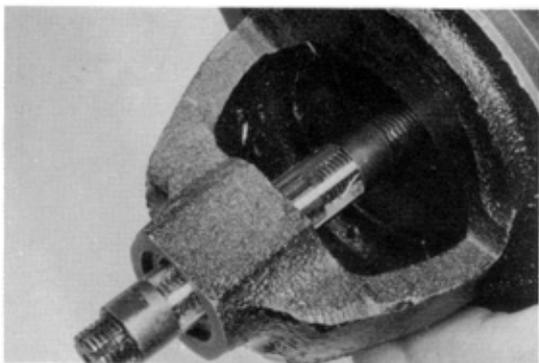
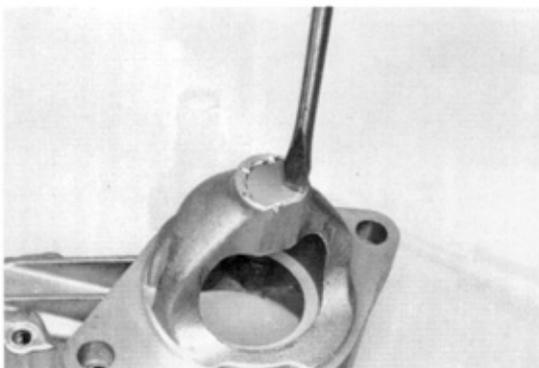


Fig. 9-14



INSPECTION AND REPAIR

Armature Shaft & Bearings



1. Inspect armature shaft end, drive housing bushing and end frame bushing for wear or damage.

Oil clearance limit 0.2 mm (0.008 in)



2. Bushing replacement.

- (1) Pry out the bushing cover and press out the bushing.
- (2) Aligning the bushing hole with the housing groove, Press in new bushing.

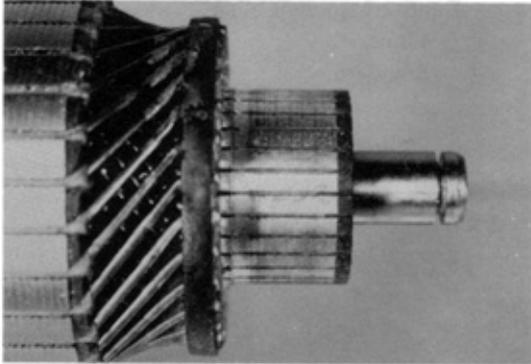
- (3) Ream bushing to obtain the specified clearance.

**Oil clearance 0.10 – 0.14 mm
(0.0039 – 0.0055 in)**



- (4) Clean the bore, and install new bushing cover.

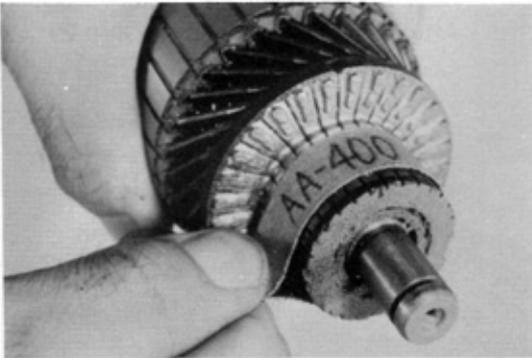
Fig. 9-15

**Commutator**

Inspect for the following items and repair or replace.

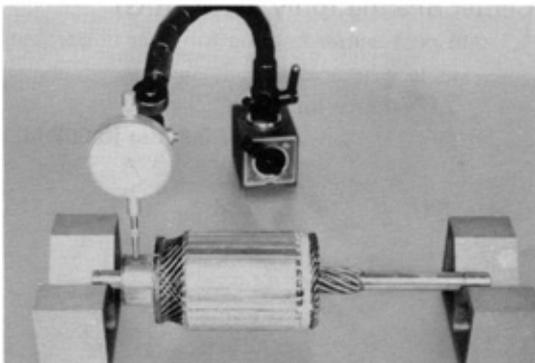
1. Dirty or burnt surface.
Correct by sandpaper or lathe if necessary.

Fig. 9-16



Use # 400 sandpaper.

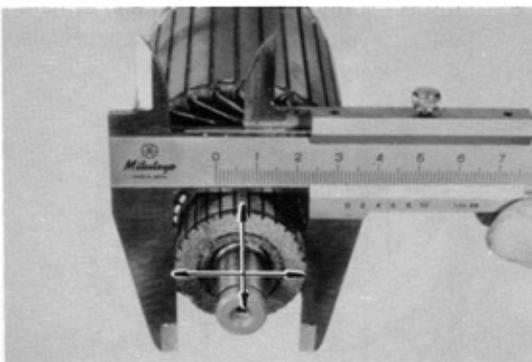
Fig. 9-17



2. Runout: Correct on a lathe if it exceeds the limit.

Runout limit	0.4 mm (0.016 in)
Standard	0.05 mm (0.0020 in)

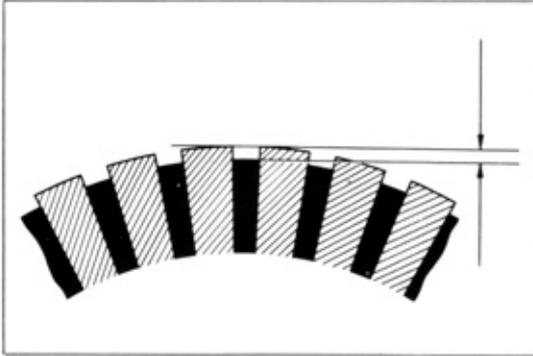
Fig. 9-18



3. Surface wear: If below the limit, replace armature.

Limit	31 mm (1.22 in)
Standard	32.7 mm (1.287 in)

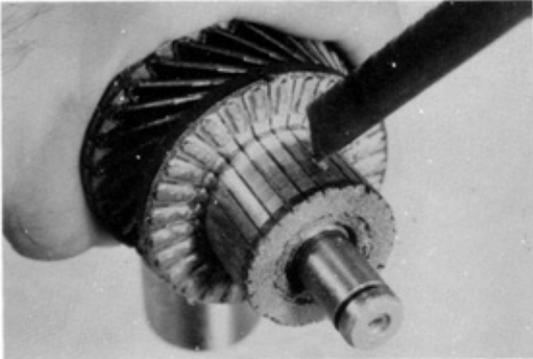
Fig. 9-19



4. Depth of segment mica.

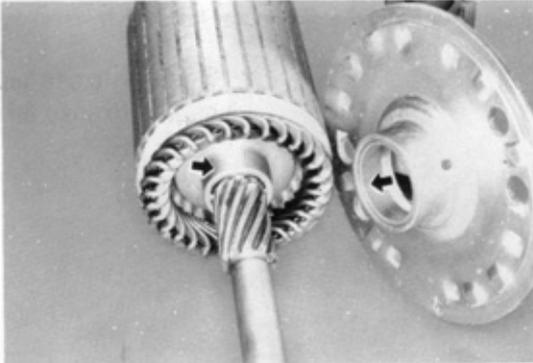
Limit	0.2 mm (0.008 in)
Standard	0.5-0.8 mm (0.020-0.031 in)

Fig. 9-20



Correct with a hacksaw blade.
After correcting, eliminate chips using sandpaper.

Fig. 9-21

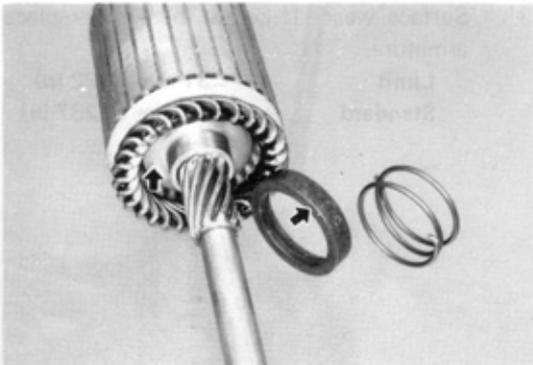


Center Bearing (only for 18R-G)

1. Inspect center bearing for wear or damage. Replace if necessary.

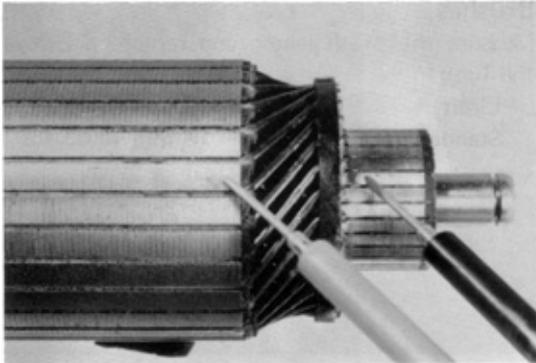
Clearance limit**0.2 mm (0.008 in)**

Fig. 9-22



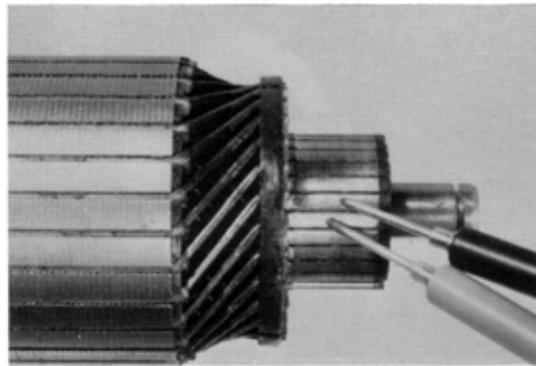
2. Inspect spring holder, spring and armature shaft for cracks, wear or damage. Replace if necessary.

Fig. 9-23

**Armature Coil**

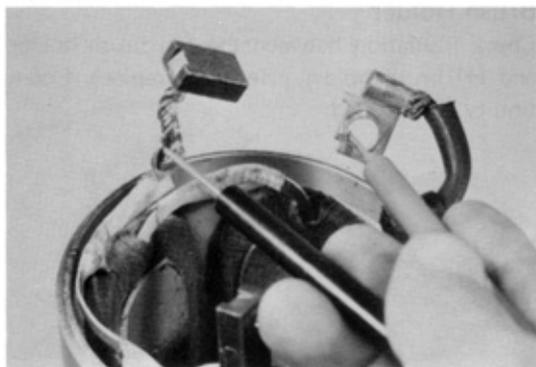
1. Ground test
Check commutator and armature coil core. If there is continuity, the armature is grounded and must be replaced.

Fig. 9-24



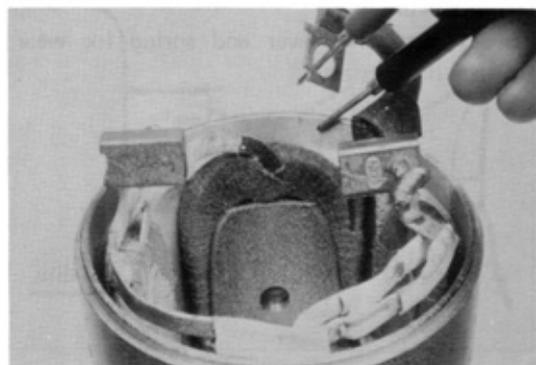
2. Open-circuit test
Check for continuity between the segments. If there is no continuity at any test point, there is an open-circuit and armature must be replaced.

Fig. 9-25

**Field Coil**

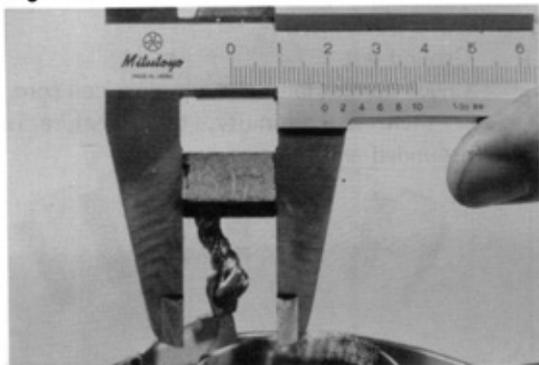
1. Open-circuit test
Check for continuity between the lead wire and field coil brush soldered connection. If there is no continuity, there is an open-circuit in the field coil, and it should be replaced.

Fig. 9-26



2. Ground test
Check for continuity between field coil end and field frame. If there is continuity, repair or replace the field coil.

Fig. 9-27

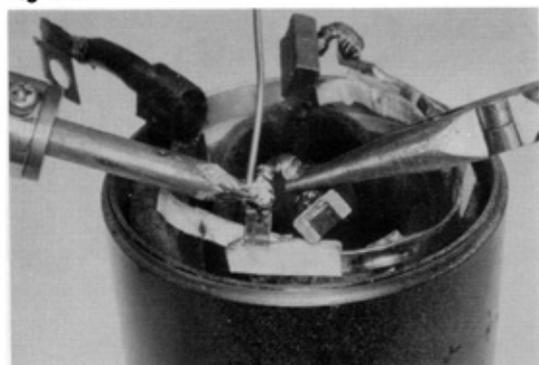
**Brushes**

Measure the brush length and replace if below the limit.

Limit
Standard

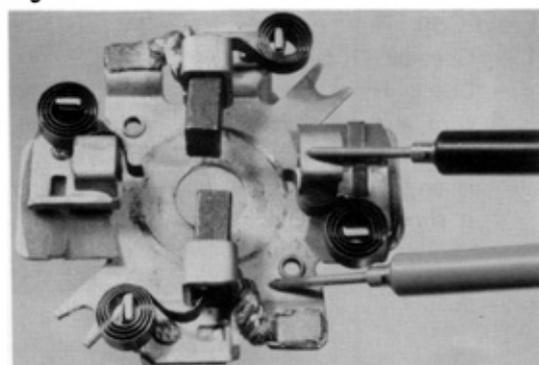
12 mm (0.47 in)
16 mm (0.63 in)

Fig. 9-28

**Brush Replacement**

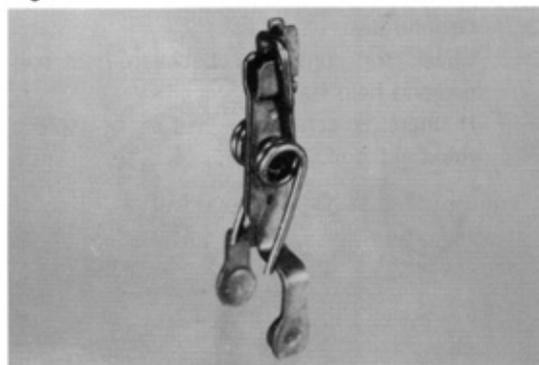
Solder brush lead firmly.

Fig. 9-29

**Brush Holder**

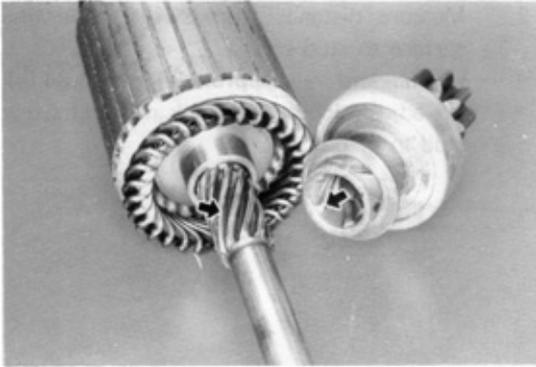
Check insulation between the (-) brush holder and (+) brush holder. Repair or replace if continuity is indicated.

Fig. 9-30

**Drive Lever**

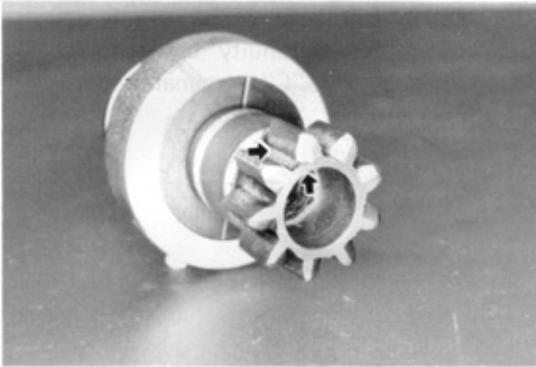
Inspect the drive lever and spring for wear. Replace if necessary.

Fig. 9-31

**Starter Clutch and Pinion Gear**

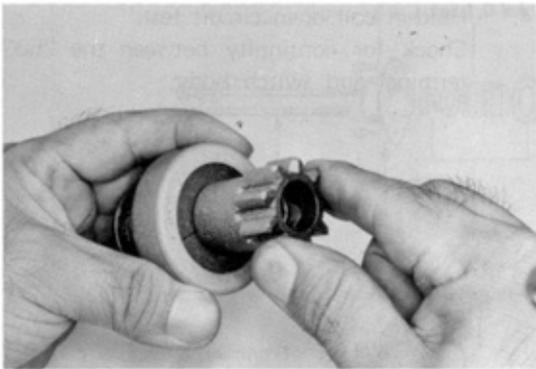
1. Inspect spline teeth for wear and damage. Replace if necessary.
2. Inspect pinion for smooth movement.

Fig. 9-32



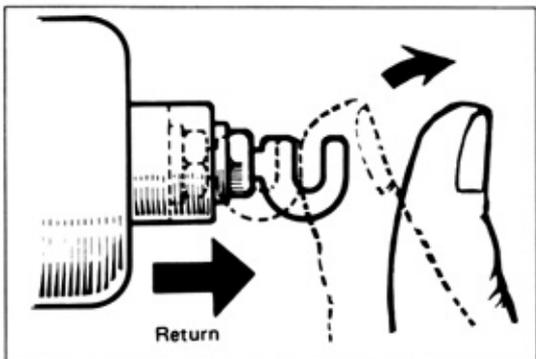
3. Inspect pinion gear teeth and chamfer if worn or damaged.

Fig. 9-33



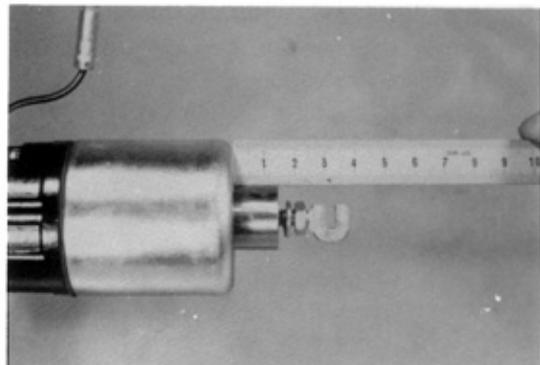
4. Rotate pinion. It should turn free in clockwise direction and lock when turned counterclockwise.

Fig. 9-34

**Magnetic Switch**

1. Push in plunger and release it. The plunger should return quickly to its original position.

Fig. 9-35

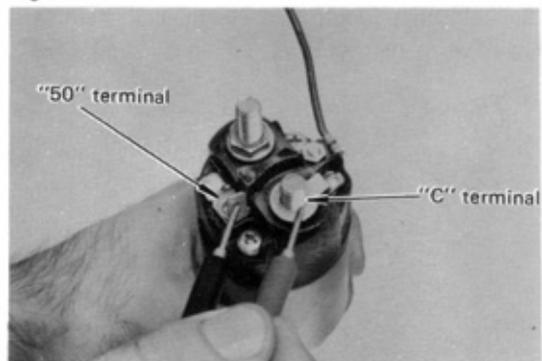


2. Measure distance from switch mounting surface to stud end.

Standard approx. 34 mm (1.34 in)

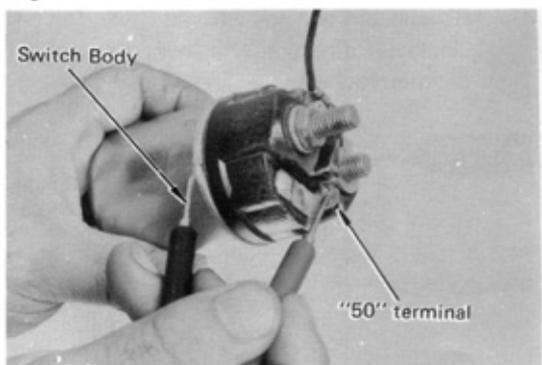
To adjust, loosen the lock nut and screw stud in or out.

Fig. 9-36



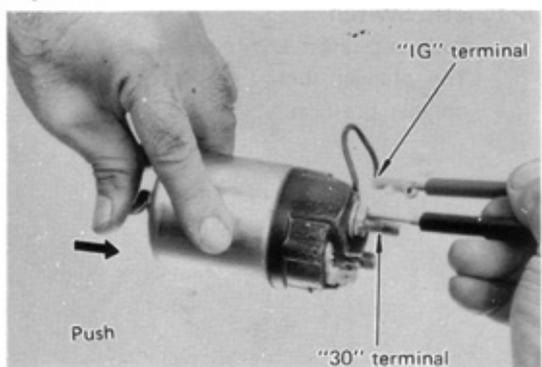
3. Pull-in coil open circuit test.
Check for continuity between the "50" terminal and "C" terminal.

Fig. 9-37



4. Hold-in coil open circuit test.
Check for continuity between the "50" terminal and switch body.

Fig. 9-38



5. I.G. terminal continuity test.
Push in plunger until it stops. Check for continuity between "30" terminal and lead wire.

– Note –

Perform the switch operation test after assembling it to the motor.

ASSEMBLY

Assemble in numerical order.

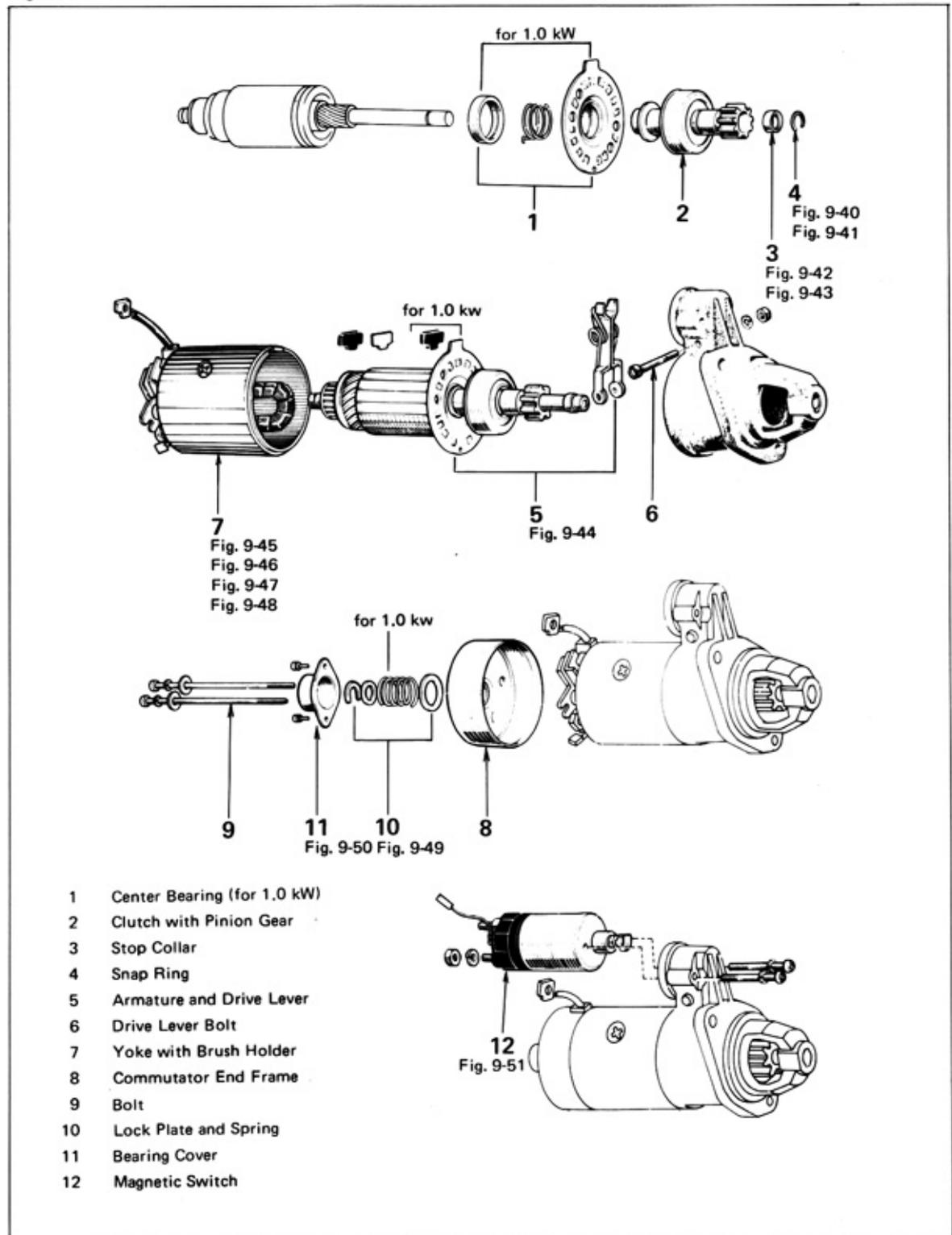
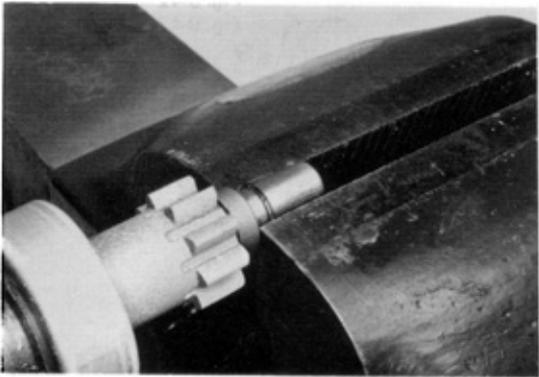
Fig. 9-39

Fig. 9-40



Fit snap ring into shaft groove.

Fig. 9-41



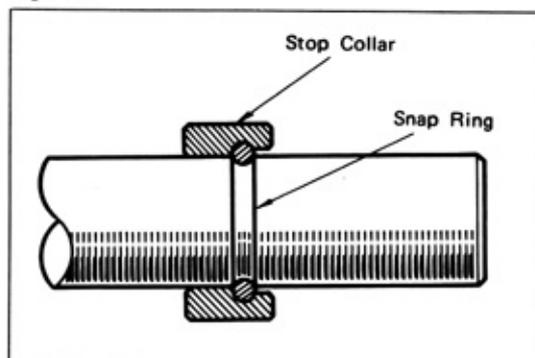
Compress the snap ring with a vise.

Fig. 9-42



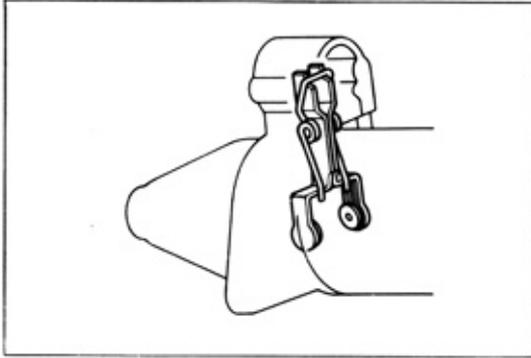
Tap pinion to slide the stop collar onto snap ring.

Fig. 9-43



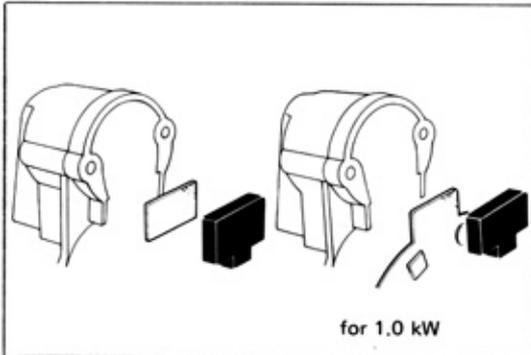
Make sure that the snap ring fits correctly.

Fig. 9-44



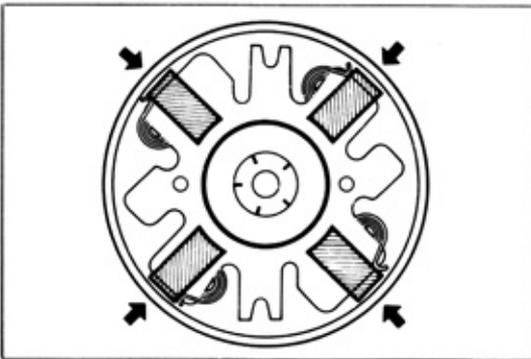
Assemble drive lever in direction as shown.

Fig. 9-45



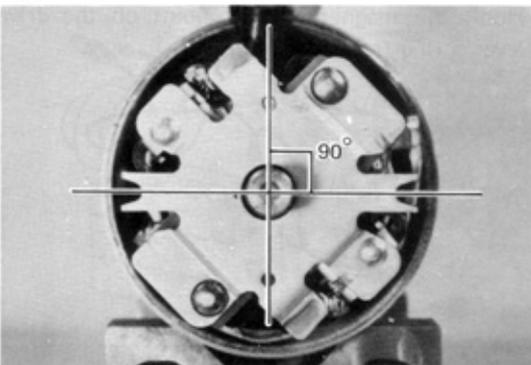
Match notch in yoke with tab on rubber plate and assemble yoke with drive housing.

Fig. 9-46



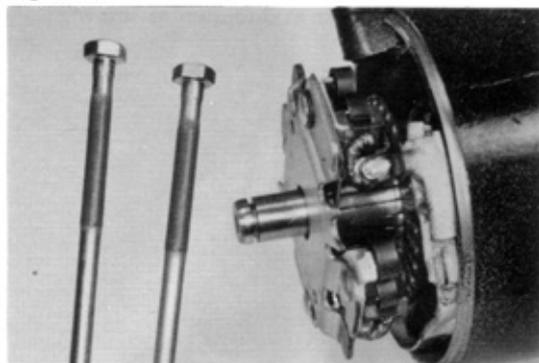
Assemble brushes, being careful not to damage them.

Fig. 9-47



After installation, position the holder as shown.

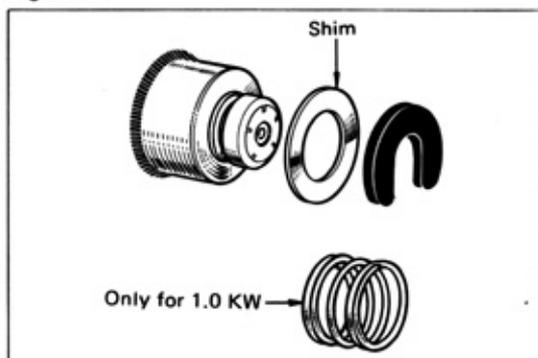
Fig. 9-48



Check that the (+) wires are not grounded.

- Field coil
- Brush (+) leads
- Through bolts

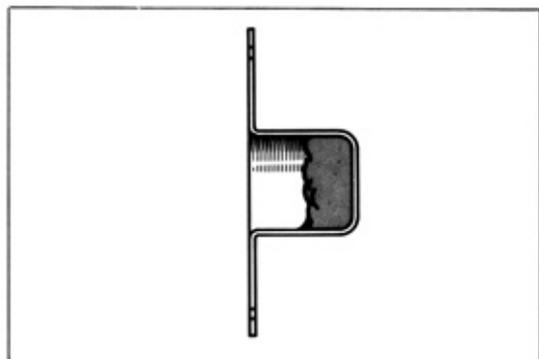
Fig. 9-49



Install the lock plate and measure the armature shaft thrust clearance. If clearance exceeds the specified value, correct by increasing the number of shims.

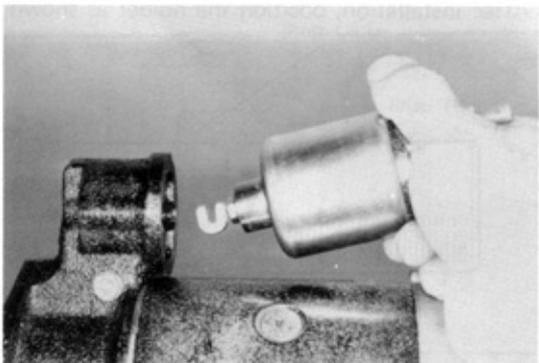
Thrust clearance	0.05-0.35 mm (0.002-0.0138 in)
Adjusting shim thickness	0.5 mm (0.02 in)

Fig. 9-50



Install end frame cap not more than half full of grease.

Fig. 9-51



Hook the magnetic switch joint on the drive lever spring from the lower side.

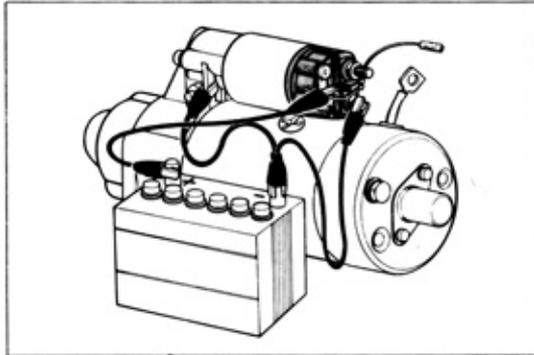
– Precaution –

These tests must be performed in short time (3-5 seconds) to prevent the coil from burning. Disconnect the field coil lead from "C" terminal.

PERFORMANCE TEST

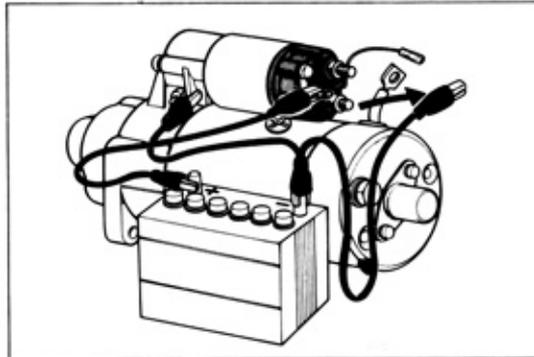
Check the magnetic switch performance and pinion gap as follows:

Fig. 9-52



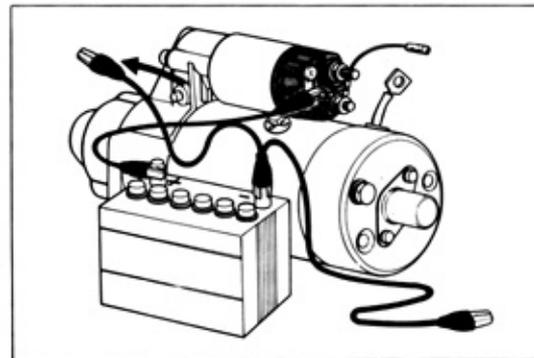
1. Pull-in test
Connect magnetic switch to battery as shown. (negative side to "C" terminal and switch body; positive side to "50" terminal). If the pinion has definitely jumped out, the pull-in coil is satisfactory.

Fig. 9-53



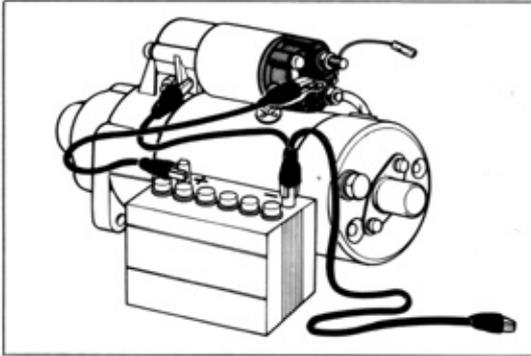
2. Hold-in test
Next disconnect the "C" terminal. The pinion should remain in jumped-out condition.

Fig. 9-54



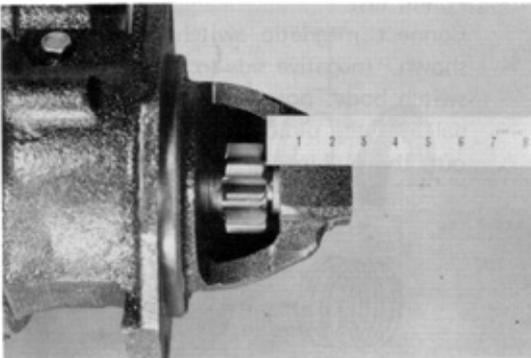
3. Check the plunger return.
When disconnecting the switch body, the pinion should return quickly.

Fig. 9-55



4. Check the pinion clearance.
- (1) Connect the magnetic switch to battery as shown.
Field coil lead to "C" terminal
Battery negative side to body
Battery positive side to 50 terminal

Fig. 9-56



- (2) Move the pinion to armature side to eliminate the slack, and check the clearance between the pinion end and stop collar.

Standard clearance

**1.0-4.0 mm
(0.04-0.16 in)**

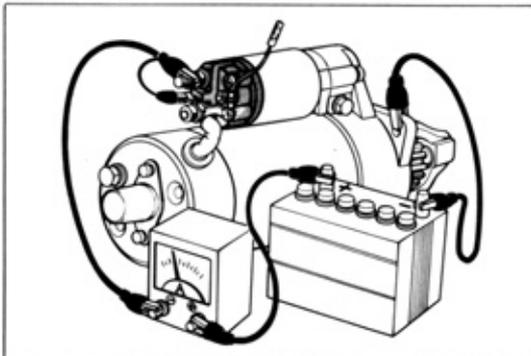
Fig. 9-57



- (3) Adjust if necessary after loosening lock nut.

<u>Clearance</u>		<u>Stud</u>
Too large	→	Screw in
Too small	→	Screw out

Fig. 9-58



5. No-load performance test
- Connect the field coil lead to the "C" terminal, making sure that the lead wire is not grounded.
- Connect starter to battery. If the starter shows smooth and steady rotation with the pinion jumping out and draws less than specified current, it is satisfactory.

Specified current

Less than 50A