STARTING SYSTEM

CONVENTIONAL TYPE STARTING SYSTEM CIRCUIT

Fig. 7-1

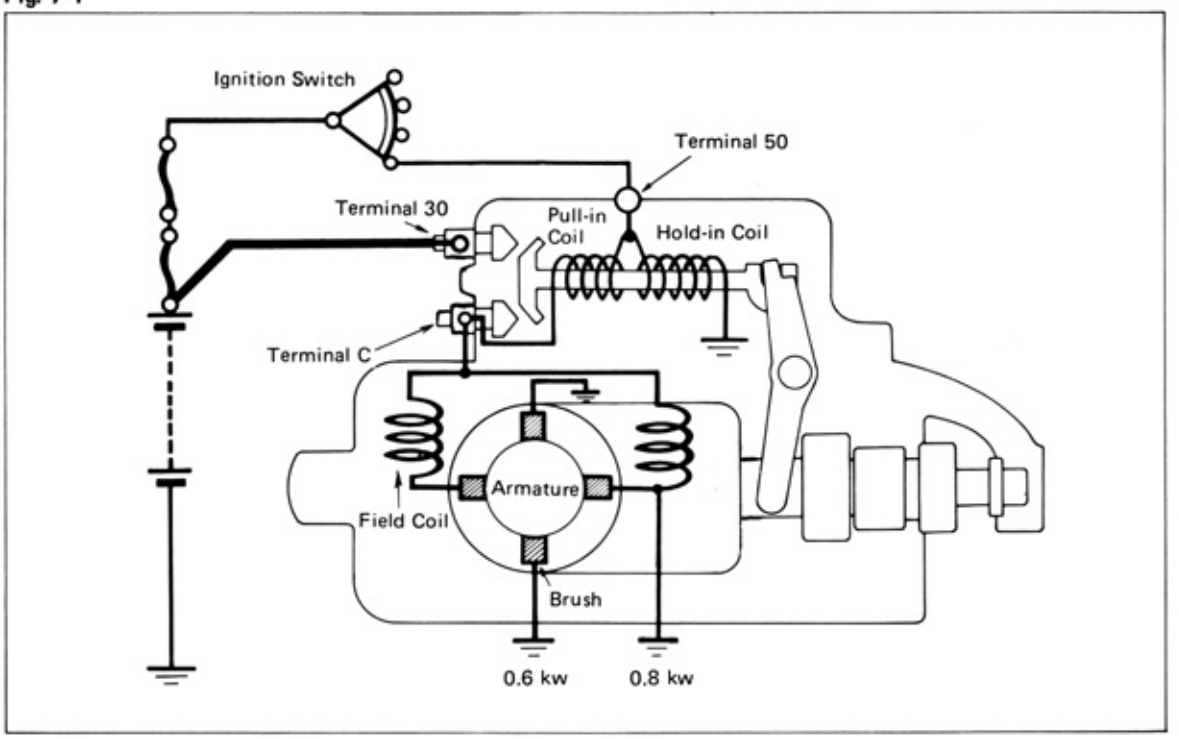
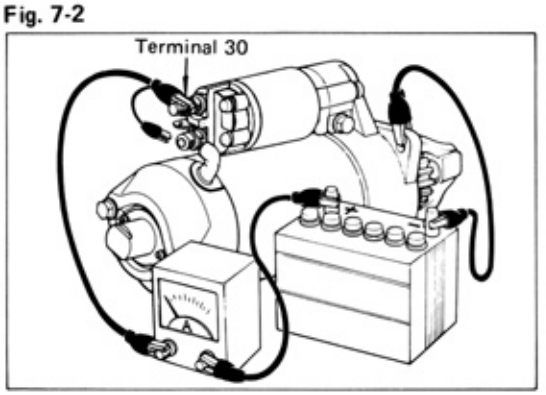


Fig. 7-2



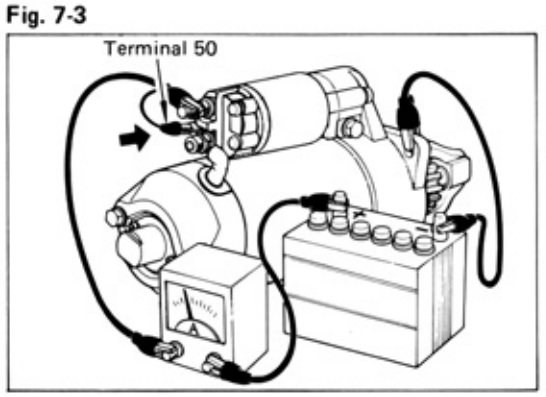
PERFORMANCE TEST

NO-LOAD PERFORMANCE TEST

Secure the starter in a vise to prevent an accident.

1. Connect the starter to a battery as is shown in the figure.
   Positive side
   Battery ⊕ ⟶ Ammeter ⊕
   Ammeter ⊖ ⟶ Terminal 30
   Negative side
   Battery ⊖ ⟶ Starter body

Fig. 7-3



2. Connect terminal 50.
   If the starter shows smooth and steady rotation with the pinion jumping out and drawing less than specified current, it is satisfactory.

   Specified current:

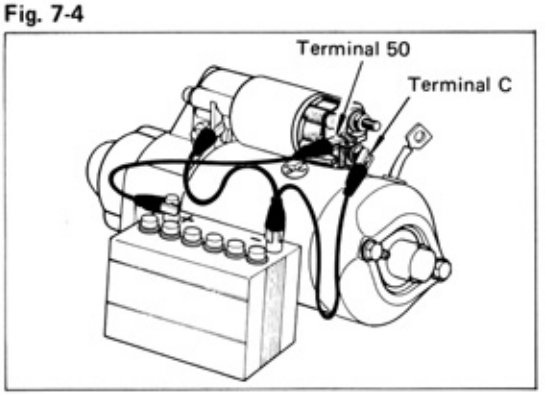
   0.6 kw Less than 55 A at 11V
   0.8 kw Less than 50 A at 11V

TEST MAGNETIC SWITCH

– Caution –

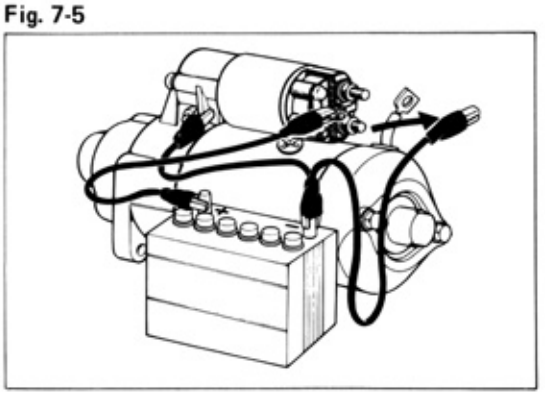
1. **Each test must be performed within 3 – 5 seconds to prevent the coil from burning out.**
2. **Disconnect the C terminal.**

Fig. 7-4



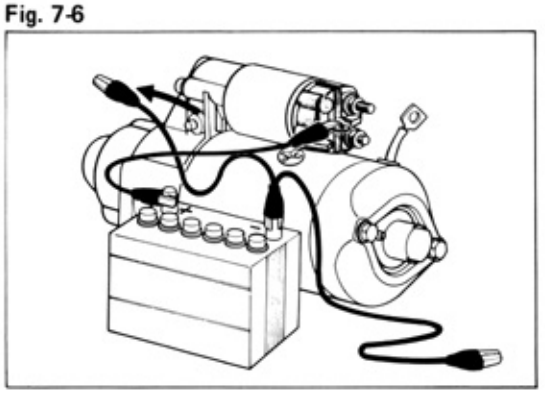
1. Pull-in test
   Connect the magnetic switch to a battery as is shown in the figure.
   Negative side
   Battery ⊖ ⟶ Starter body and terminal C
   Positive side
   Battery ⊕ ⟶ Terminal 50
   If the pinion has protruded, the pull-in coil is satisfactory.

Fig. 7-5



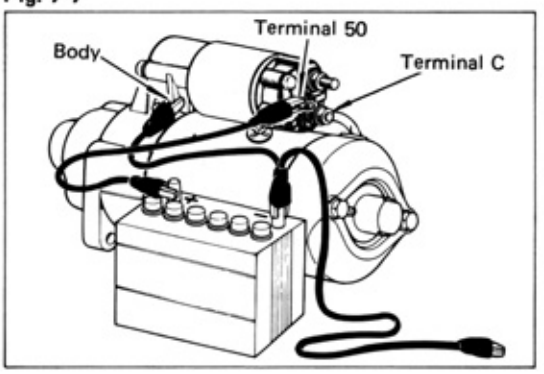
2. Hold-in test
   Disconnect terminal C. The pinion should remain protruded.

Fig. 7-6



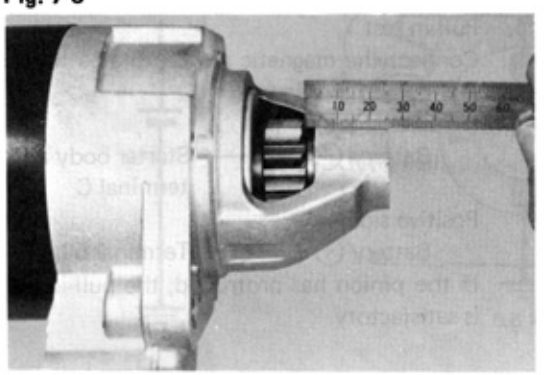
3. Check the plunger return.
   When disconnecting the switch body, the pinion should return quickly.

Fig. 7-7



4. Check pinion clearance.
   (1) Connect the field coil lead to terminal C.
   (2) Connect the magnetic switch to a battery as is shown in the figure.
   Positive side
   Battery ⊕ ⟶ Terminal 50
   Battery ⊖ ⟶ Starter body

Fig. 7-8



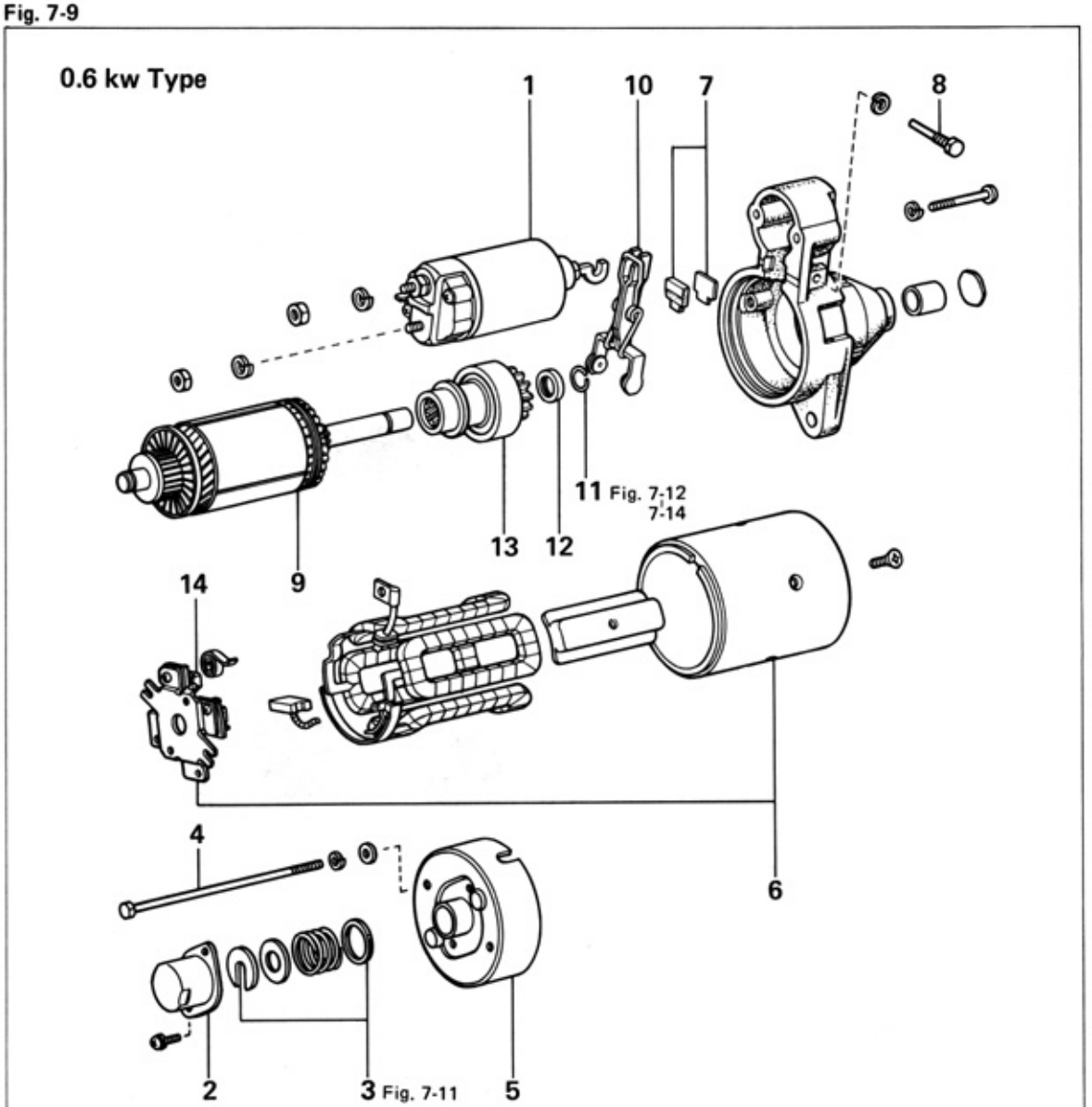
   (3) Move the pinion to the armature side to eliminate slack, and check the clearance between the pinion end and the stop collar.
   Clearance:
   STD 0.1 – 4.0 mm (0.004 – 0.157 in.)

CONVENTIONAL TYPE STARTER

DISASSEMBLY

Disassemble the parts in the numerical order shown in the figure.

Fig. 7-9

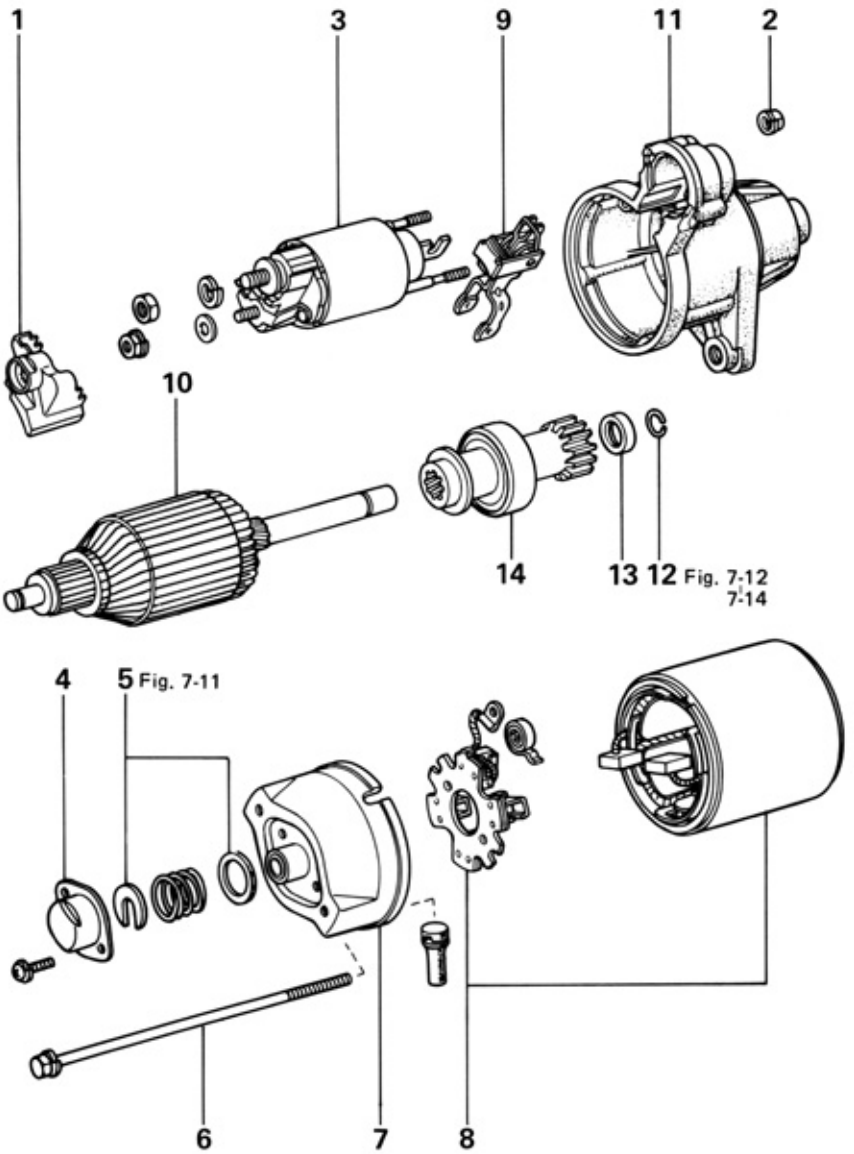


1. Magnetic Switch
2. Bearing Cover
3. Lock Plate, Spring & Rubber
4. Bolt
5. Commutator End Frame
6. Yoke with Brush Holder
7. Plate & Rubber
8. Drive Lever Bolt
9. Armature
10. Drive Lever
11. Snap Ring
12. Stop Collar
13. Clutch with Pinion Gear
14. Brush Holder

Disassemble the parts in the numerical order shown in the figure.

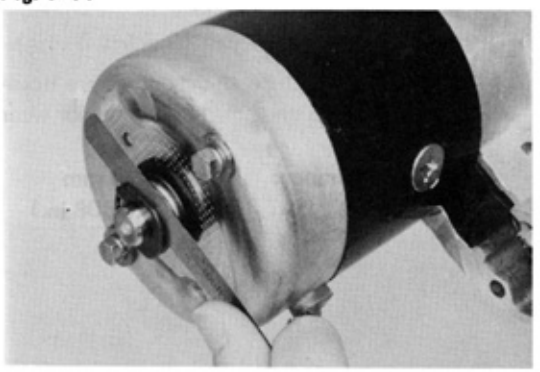
Fig. 7-10

0.8 kw Type



1. Terminal Cover
2. Magnetic Switch Set Nut
3. Magnetic Switch Assembly
4. Bearing Cover
5. Lock Plate, Spring & Rubber
6. Bolt
7. Commutator End Frame
8. Yoke with Brush Holder
9. Drive Lever
10. Armature
11. Drive Housing
12. Snap Ring
13. Stop Collar
14. Clutch with Pinion Gear

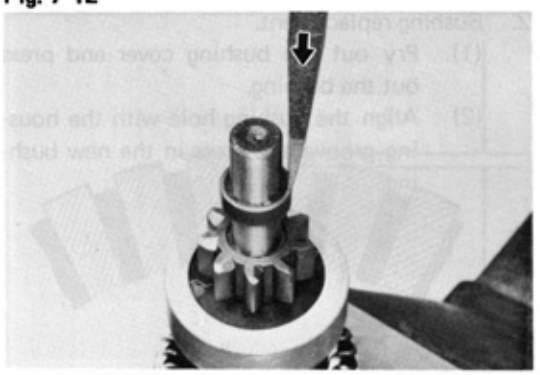
Fig. 7-11



Check the armature shaft thrust clearance.

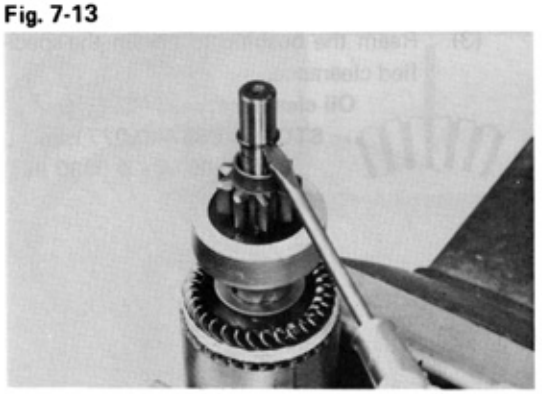
Thrust clearance limit: 1.0 mm (0.039 in.)

Fig. 7-12



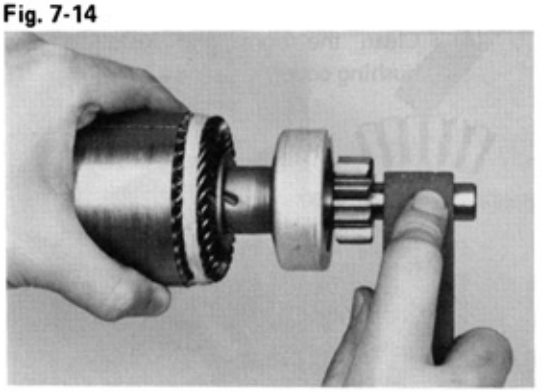
Tap in the stop collar with a screwdriver.

Fig. 7-13



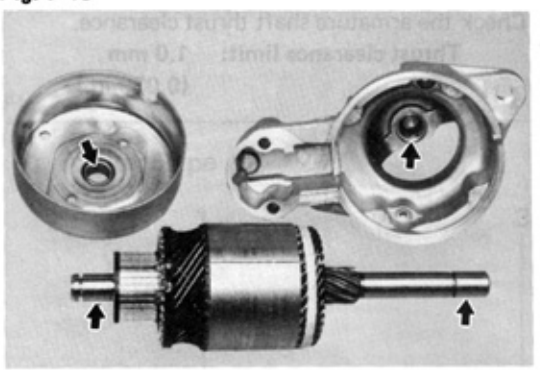
Pry off the snap ring with a screwdriver.

Fig. 7-14



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

Fig. 7-15



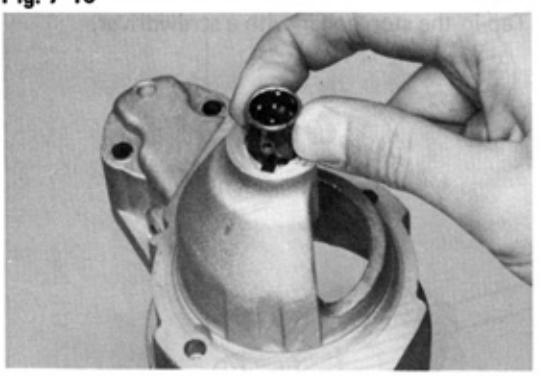
INSPECTION & REPAIR

Armature Shaft & Bearing (0.6 kw Type)

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

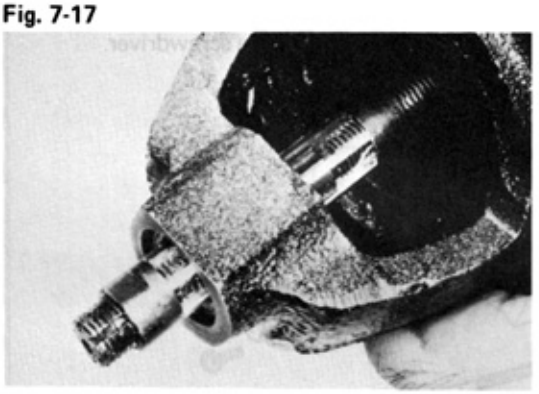
Oil clearance: Limit 0.2 mm (0.008 in.)

Fig. 7-16



2. Bushing replacement.
   (1) Pry out the bushing cover and press out the bushing.
   (2) Align the bushing hole with the housing groove and press in the new bushing.

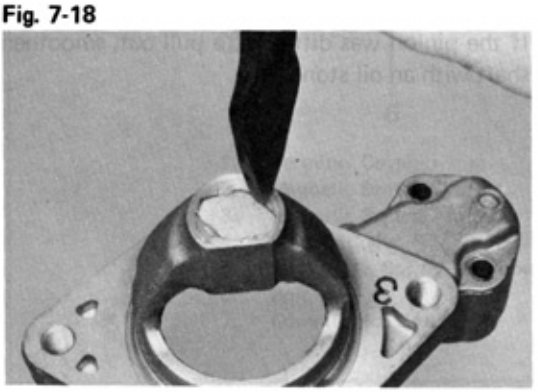
Fig. 7-17



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

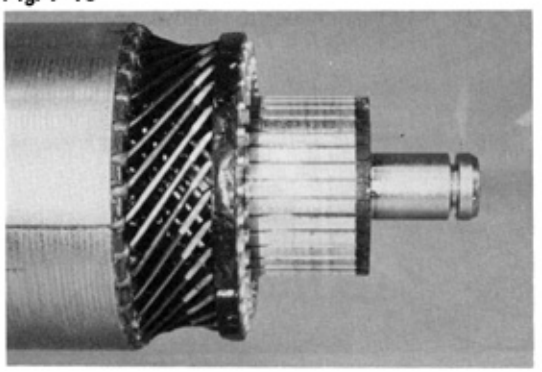
Oil clearance:
STD 0.035 – 0.077 mm (0.0014 – 0.0030 in.)

Fig. 7-18



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

Fig. 7-19

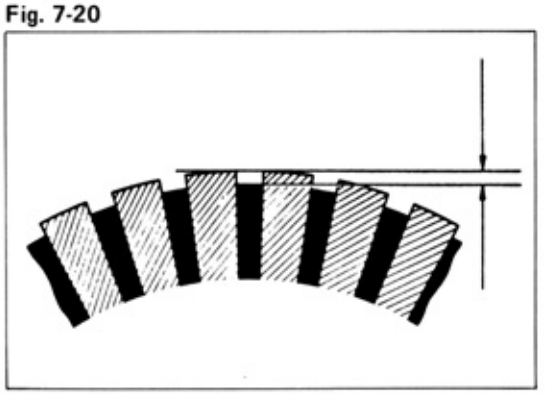


Commutator

Check for the following and repair or replace.

1. Dirty or burnt surface.
   Correct with sandpaper or a lathe if necessary.

Fig. 7-20

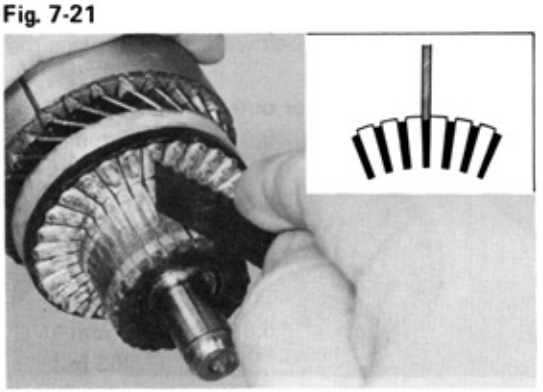


2. Depth of segment mica.

Mica depth:

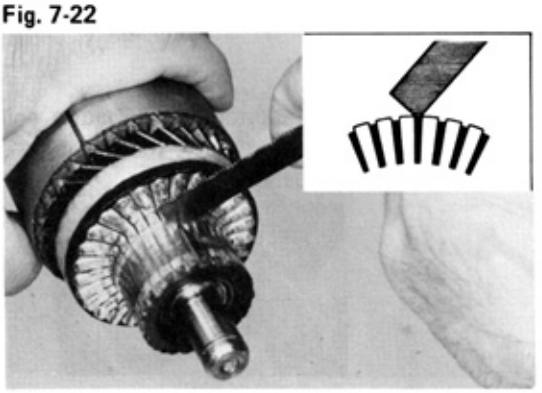
STD	**0.4 – 0.8 mm (0.016 – 0.031 in.)**
Limit	**0.2 mm (0.008 in.)**

Fig. 7-21



3. If the mica depth is below the limit, correct with a hacksaw blade.

Fig. 7-22

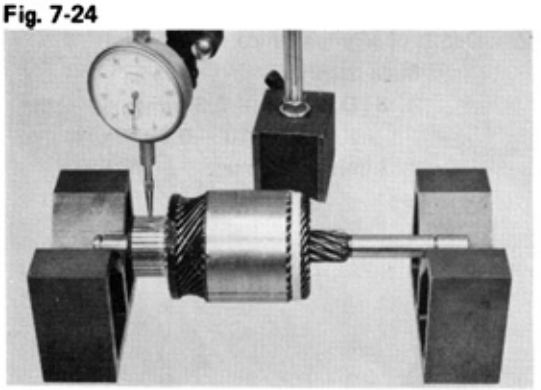


4. Smooth out the edge with a hacksaw blade.

Fig. 7-23

5. Use #400 sandpaper to remove any chips.

Fig. 7-24

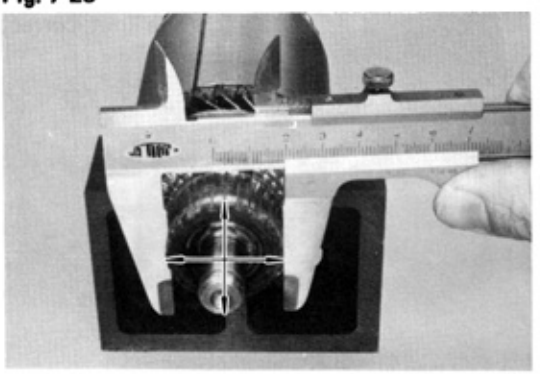


6. Runout: Correct on a lathe if it exceeds the limit.

Runout:

Limit	**0.3 mm (0.012 in.)**

Fig. 7-25

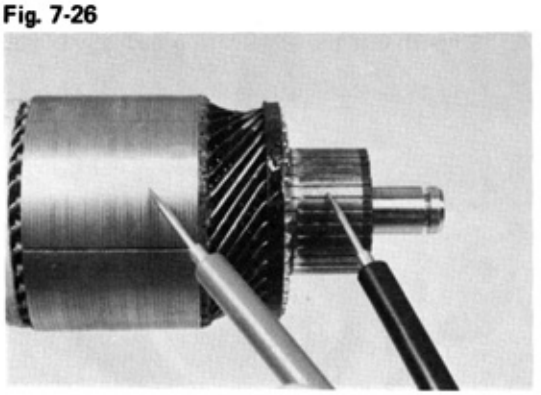


7. Surface wear: If below the limit, replace the armature.

Commutator outer diameter:

STD	**0.6 kw**	**32.7 mm (1.287 in.)**
	0.8 kw	**28.0 mm (1.102 in.)**
Limit	**0.6 kw**	**31.0 mm (1.220 in.)**
	0.8 kw	**27.0 mm (1.063 in.)**

Fig. 7-26

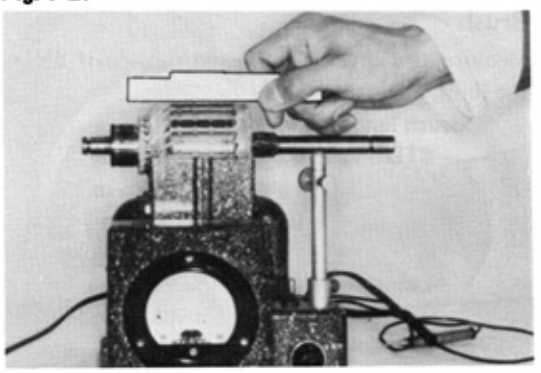


Armature Coil

1. Ground test

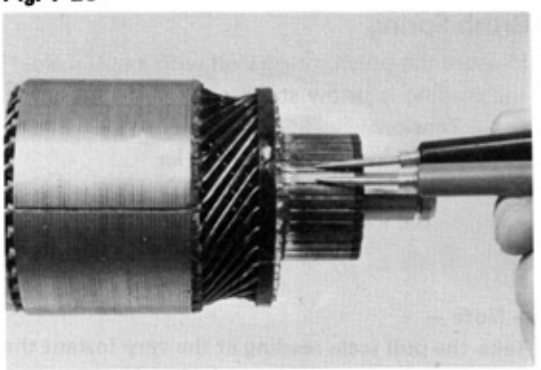
Check the commutator and armature coil core. If there is continuity, the armature is grounded and must be replaced.

Fig. 7-27



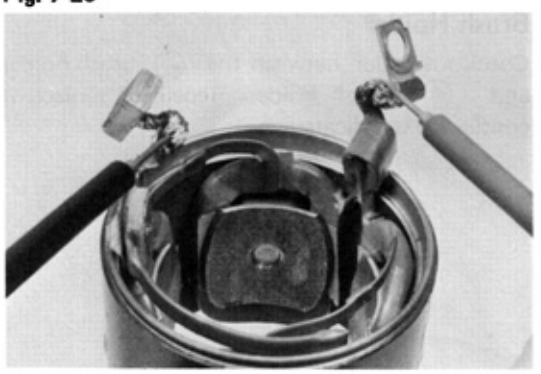
2. Short circuit test
Place the armature on an armature tester and hold a hacksaw blade against the armature core while turning the armature. If the hacksaw blade is attracted or vibrates, there is a short circuit in the armature and it must be replaced.

Fig. 7-28



3. Solder condition
Check for continuity between the commutator and armature coil.

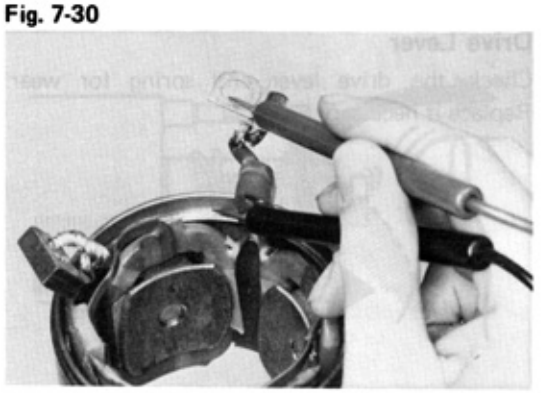
Fig. 7-29



Field Coil

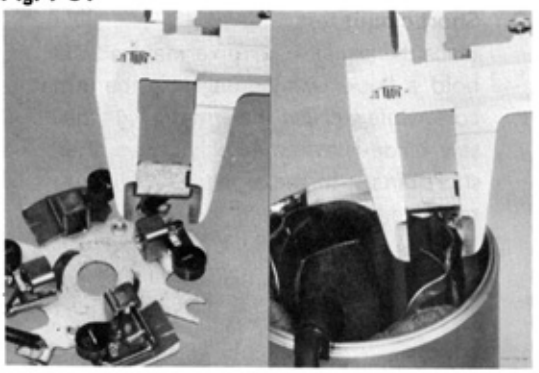
1. Open circuit test
Check the field coil for continuity between the lead wire. If there is no continuity, there is an open circuit in the field coil, and it should be replaced.

Fig. 7-30



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

Fig. 7-31



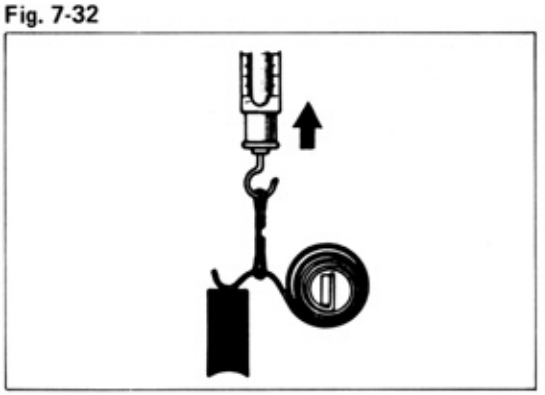
Brush

Measure the brush length and replace if below the limit.

Brush length:

STD	**0.6 kw**	**19 mm (0.75 in.)**
	0.8 kw	**16 mm (0.63 in.)**
Limit		**10 mm (0.39 in.)**

Fig. 7-32



Brush Spring

Measure the brush spring load with a pull scale. If the reading is below standard, replace the spring.

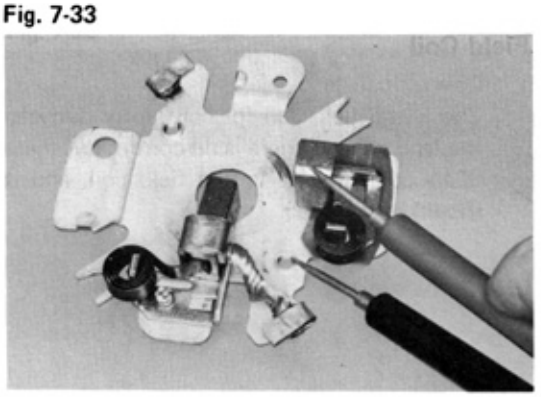
Tension:

0.6 kw	**1.05 – 1.35 kg (2.3 – 2.9 lb)**
0.8 kw	**1.02 – 1.38 kg (2.2 – 3.0 lb)**

– Note –

Take the pull scale reading at the very instant the brush spring separates from the brush.

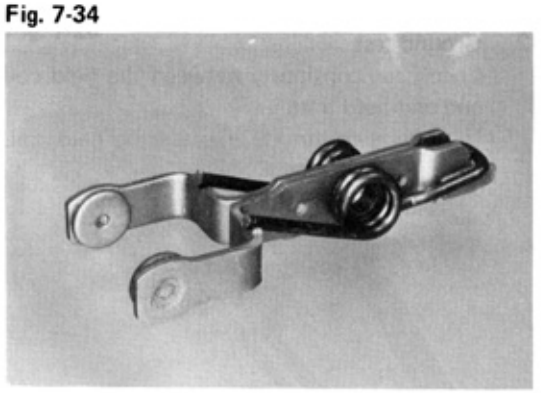
Fig. 7-33



Brush Holder

Check insulation between the ⊖ brush holder and ⊕ brush holder. Repair or replace if continuity is indicated.

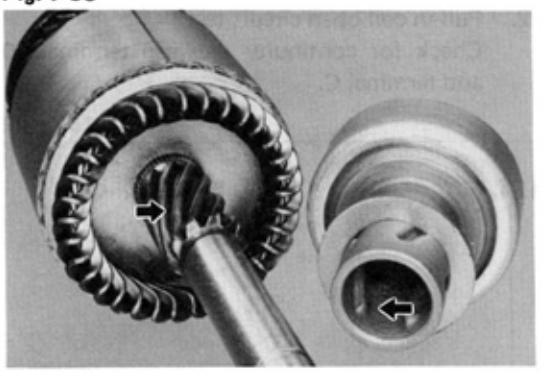
Fig. 7-34



Drive Lever

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

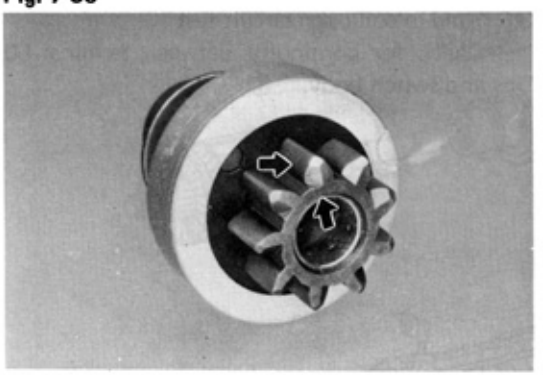
Fig. 7-35



Starter Clutch & Pinion Gear

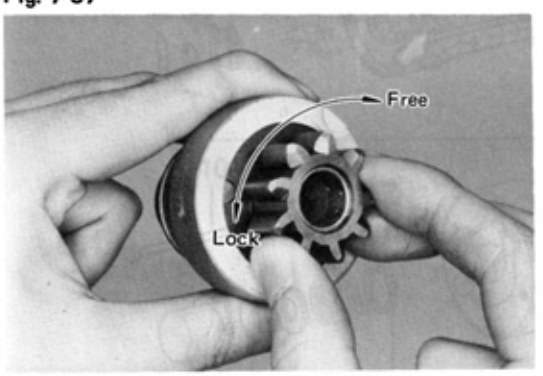
1. Check the spline teeth for wear or damage. Replace if necessary.
2. Check the pinion for smooth movement.

Fig. 7-36



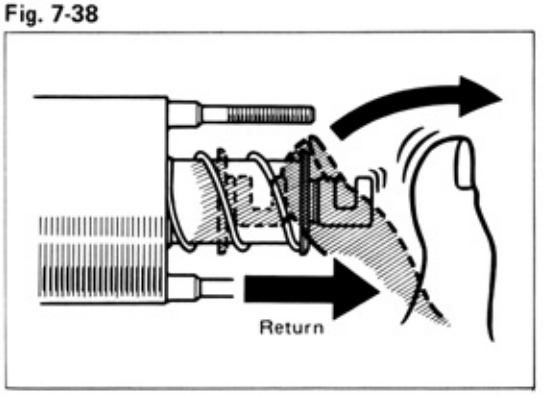
3. Check the pinion gear teeth and chamfer for wear or damage.

Fig. 7-37



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

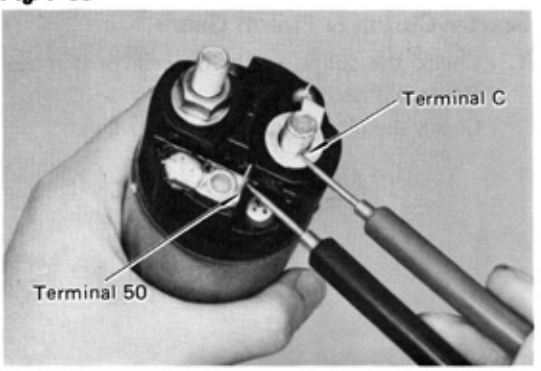
Fig. 7-38



Magnetic Switch

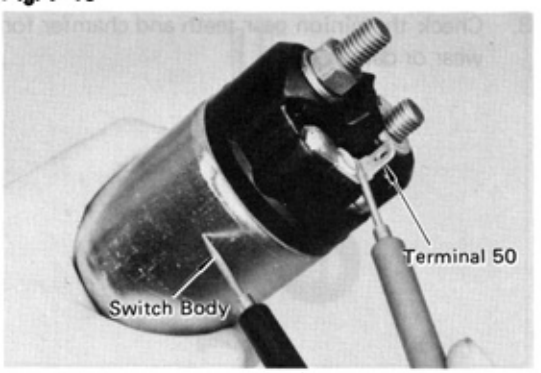
1. Push in the plunger and release it.
   The plunger should return quickly to its original position.

Fig. 7-39



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

Fig. 7-40

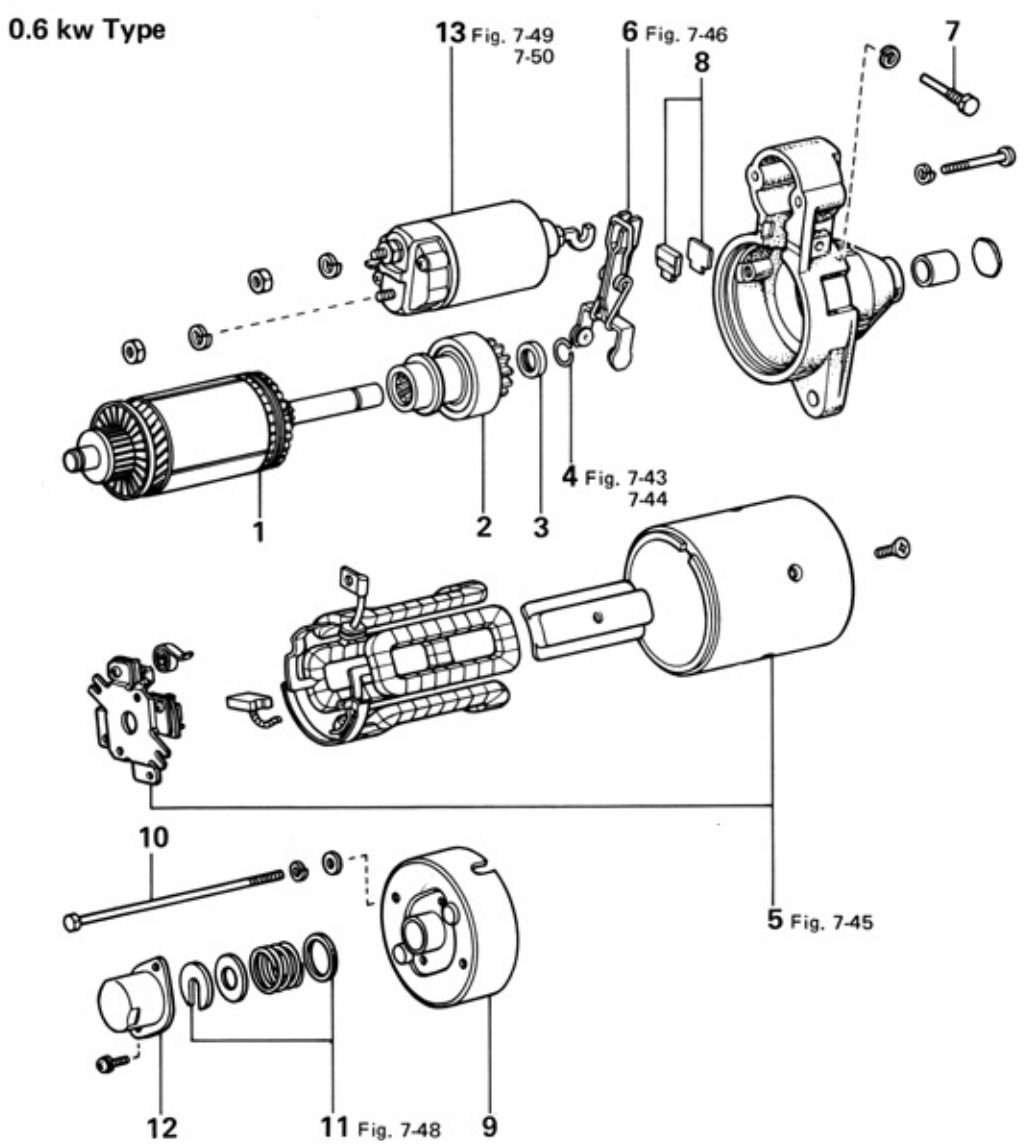


3. Hold-in coil open circuit test
Check for continuity between terminal 50 and switch body.

ASSEMBLY

Assemble the parts in the numerical order shown in the figure.

Fig. 7-41

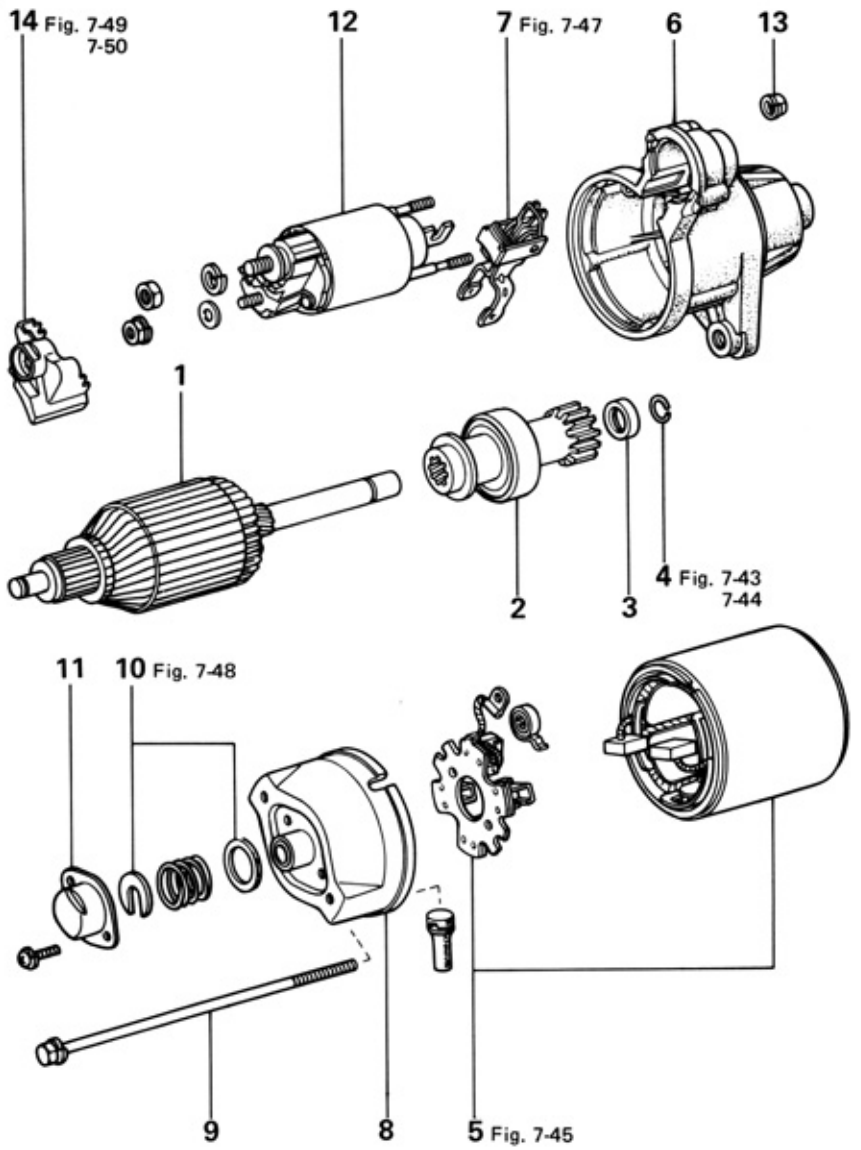


1. Armature
2. Clutch with Pinion Gear
3. Stop Collar
4. Snap Ring
5. Yoke with Brush Holder
6. Drive Lever
7. Drive Lever Bolt
8. Plate & Rubber
9. Commutator End Frame
10. Bolt
11. Lock Plate, Spring & Rubber
12. Bearing Cover
13. Magnetic Switch

Assemble the parts in the numerical order shown in the figure.

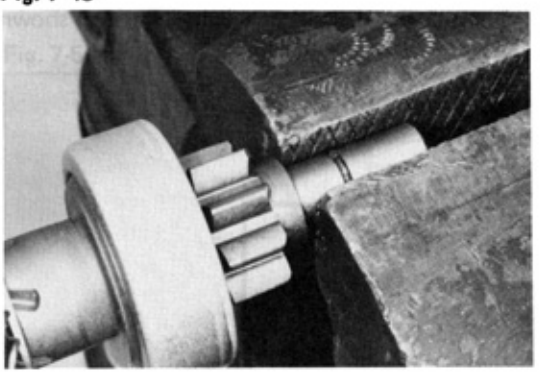
Fig. 7-42

0.8 kw Type



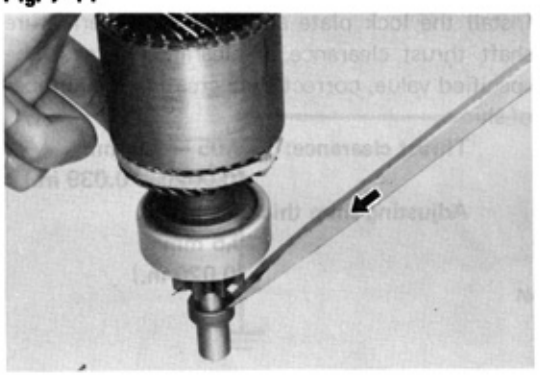
1. Armature
2. Clutch with Pinion Gear
3. Stop Collar
4. Snap Ring
5. Yoke with Brush Holder
6. Drive Housing
7. Drive Lever
8. Commutator End Frame
9. Bolt
10. Lock Plate, Spring & Rubber
11. Bearing Cover
12. Magnetic Switch Assembly
13. Magnetic Switch Set Nut
14. Terminal Cover

Fig. 7-43



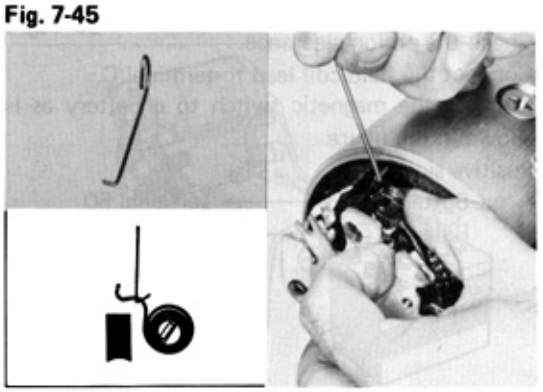
Compress the snap ring with a vise and confirm that it fits properly.

Fig. 7-44



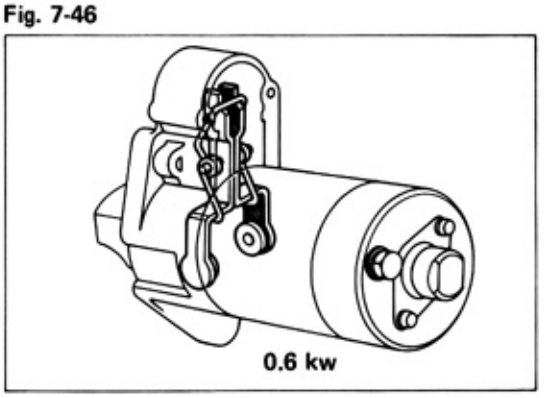
Tap the stop collar onto the snap ring.

Fig. 7-45



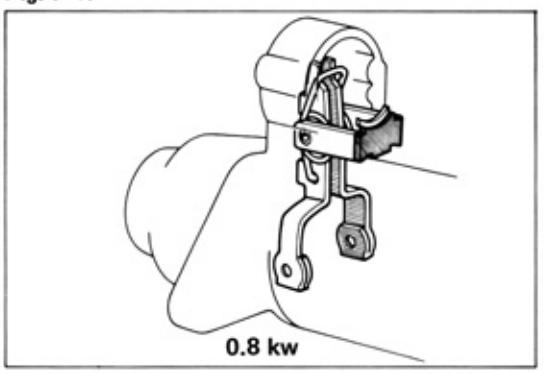
Assemble the brushes, being careful not to damage them.

Fig. 7-46



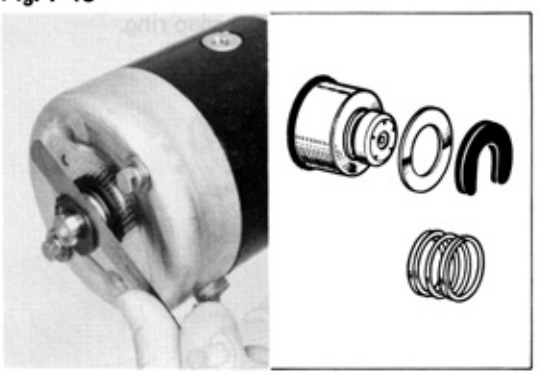
Assemble the drive lever in the direction shown in the figure.

Fig. 7-47



Assemble the drive lever in the direction shown in the figure.

Fig. 7-48

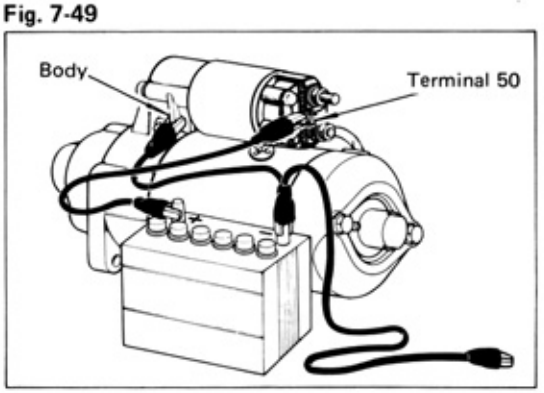


Install the lock plate and measure the armature shaft thrust clearance. If clearance exceeds the specified value, correct by increasing the number of shims.

Thrust clearance: **0.05 – 1.0 mm (0.0020 – 0.039 in.)**

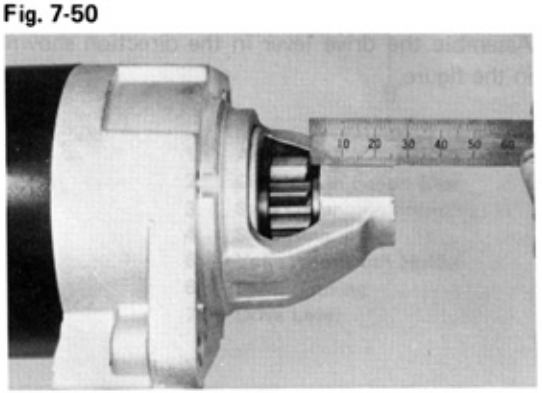
Adjusting shim thickness: **0.5 mm (0.020 in.)**

Fig. 7-49



Check the pinion clearance.
Connect the field coil lead to terminal C.
Connect the magnetic switch to a battery as is shown in the figure.
Positive side
Battery ⊕ ⟶ Terminal 50
Battery ⊖ ⟶ Starter body

Fig. 7-50



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

Clearance:
STD **0.1 – 4.0 mm (0.004 – 0.157 in.)**

REDUCTION TYPE STARTING SYSTEM CIRCUIT

Fig. 7-51

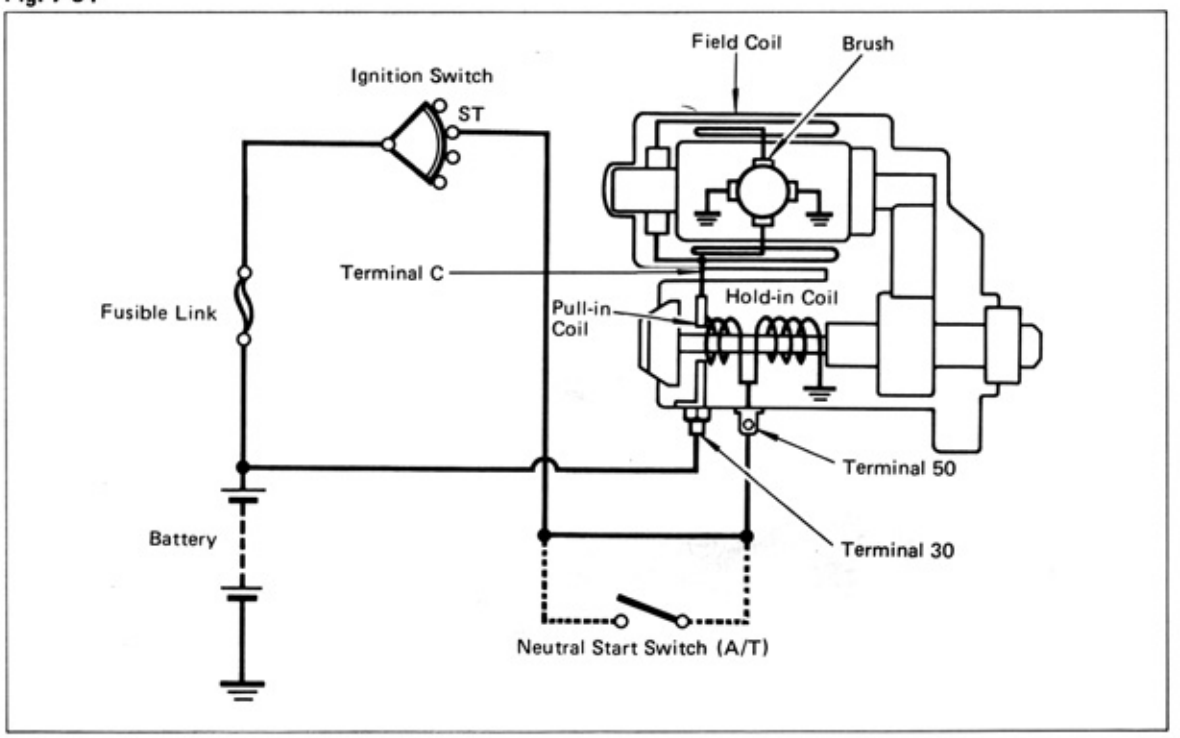
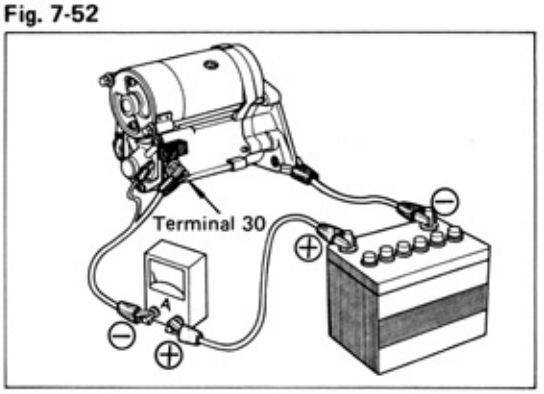


Fig. 7-52

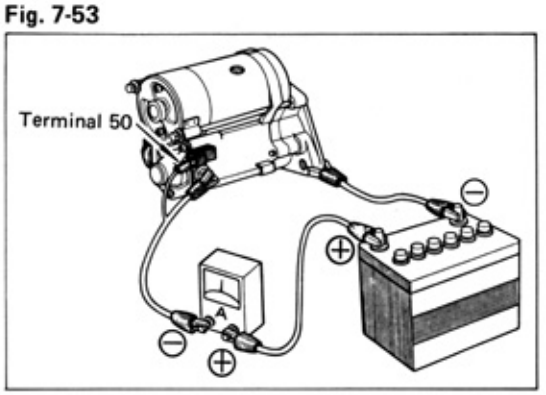


PERFORMANCE TEST

NO-LOAD PERFORMANCE TEST

1. Secure the starter in a vise to prevent an accident.
2. Connect the starter to a battery as is shown in the figure.
   Positive side
   Battery ⊕ ⟶ Ammeter ⊕
   Ammeter ⊖ ⟶ Terminal 30
   Negative side
   Battery ⊖ ⟶ Starter housing

Fig. 7-53



3. Connect the positive wire to terminal 50. If the starter shows smooth and steady rotation with the pinion jumping out and drawing less than specified current, it is satisfactory.

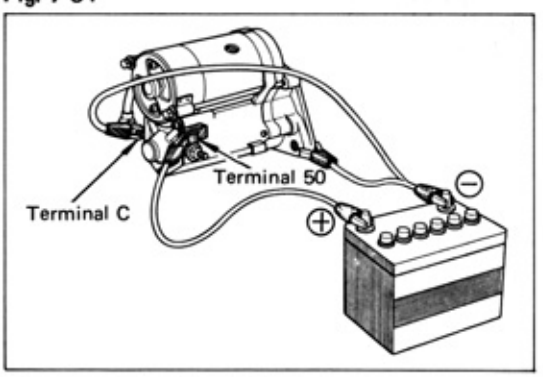
   Specified current: Less than 90 A at 11.5V

MAGNETIC SWITCH TEST

— Caution —

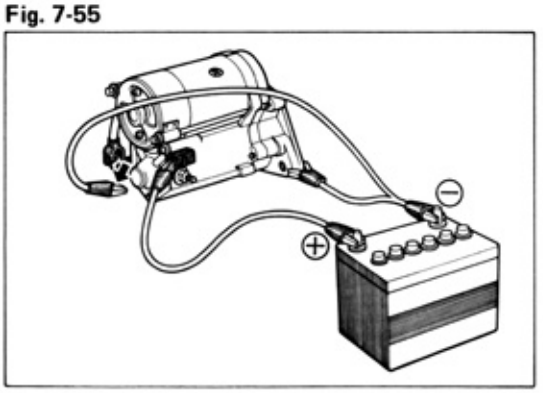
1. **Each test must be performed within 3 — 5 seconds to prevent the coil from burning out.**
2. **Disconnect terminal C.**

Fig. 7-54



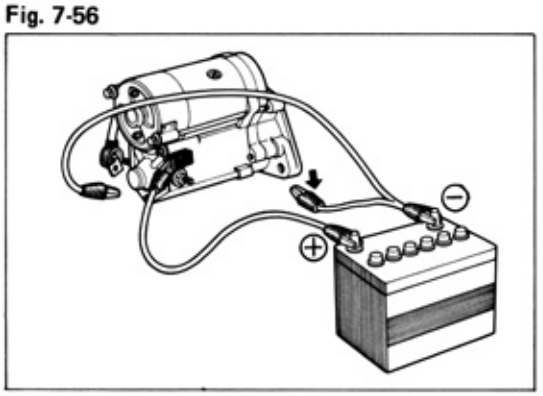
1. Pull-in coil test
   Connect the magnetic switch to a battery as is shown in the figure. The pinion should jump out.
   Negative side
   Battery ⊖ ——→ Starter housing and C terminal
   Positive side
   Battery ⊕ ——→ Terminal 50

Fig. 7-55



2. Hold-in coil test
   With the same connections as in the pull-in coil test, disconnect terminal C.
   At this time, the pinion should remain protruded.

Fig. 7-56



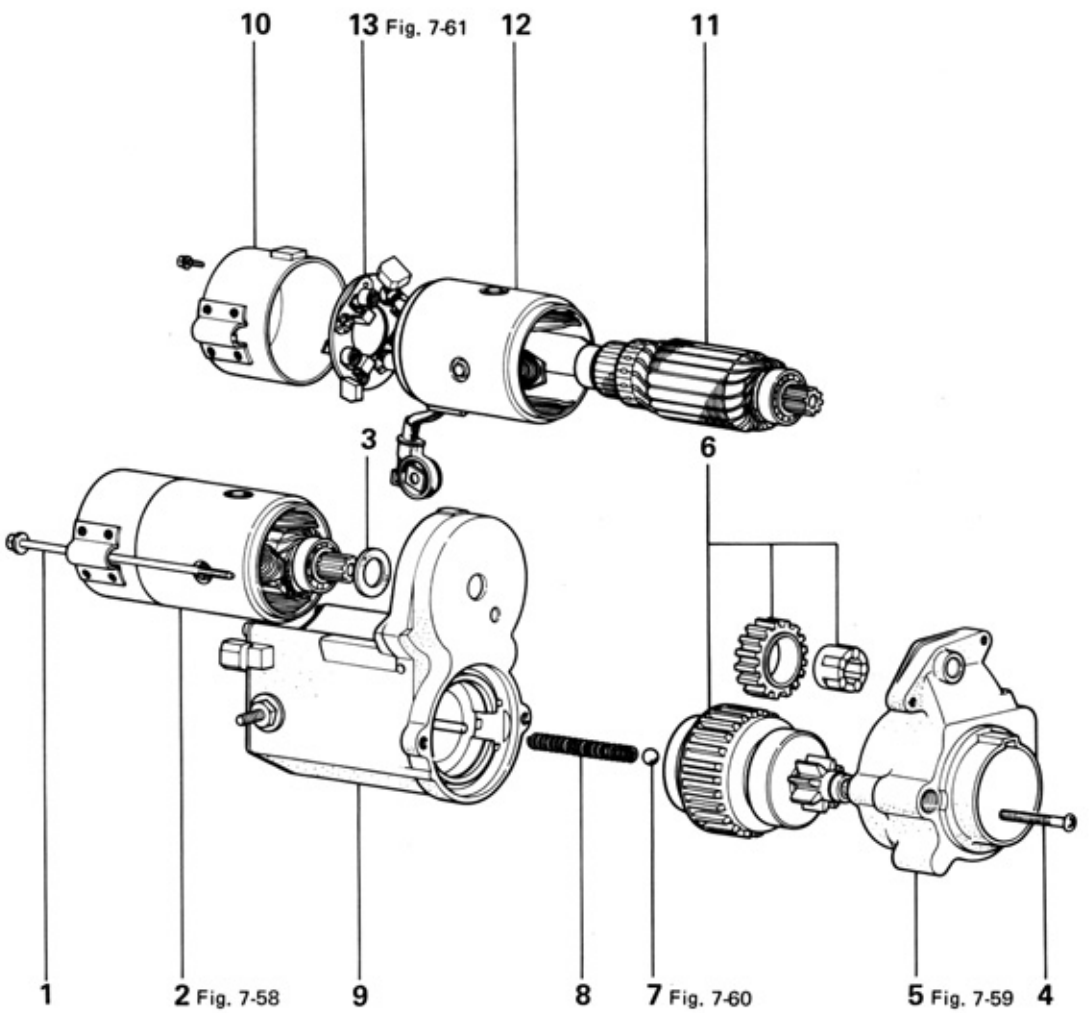
3. Check the pinion return.
   When disconnecting the cable from the starter housing, the protruding pinion should return quickly.

REDUCTION TYPE STARTER

DISASSEMBLY

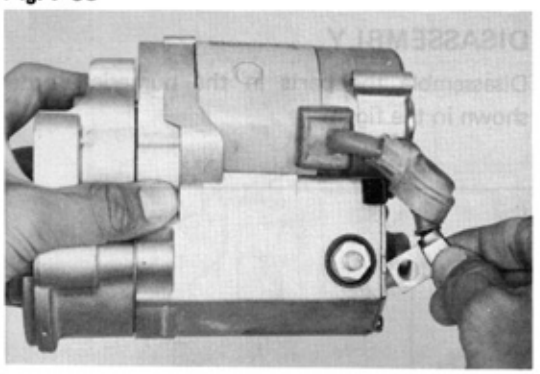
Disassemble the parts in the numerical order shown in the figure.

Fig. 7-57



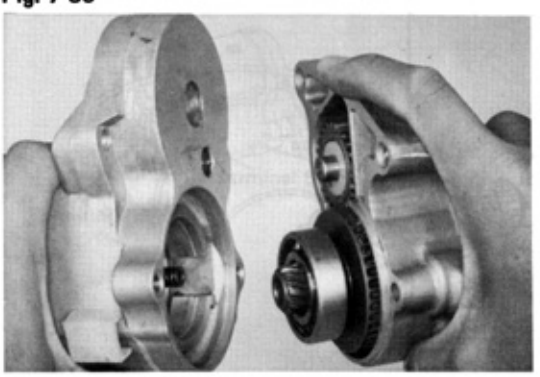
1. Through Bolt
2. Field Frame
3. Felt Seal
4. Bolt
5. Starter Housing
6. Clutch & Idler Gear
7. Steel Ball
8. Plunger Return Spring
9. Magnetic Switch
10. End Cover
11. Armature
12. Field Frame
13. Brush Holder

Fig. 7-58



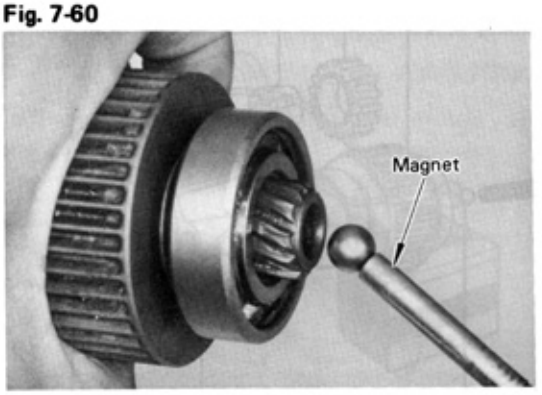
Disconnect the lead wires from the magnetic switch.

Fig. 7-59



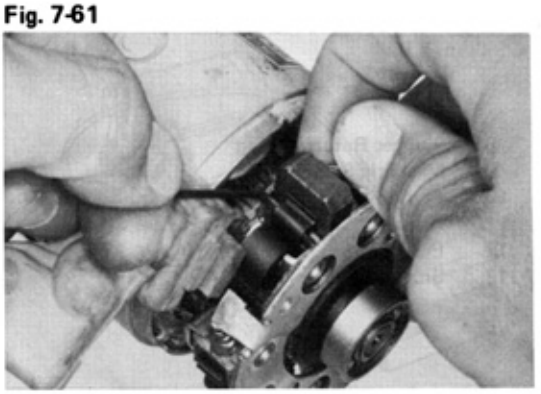
Remove the starter housing together with the idler gear and clutch.

Fig. 7-60



Using a magnet, remove the steel ball from the clutch shaft hole.

Fig. 7-61

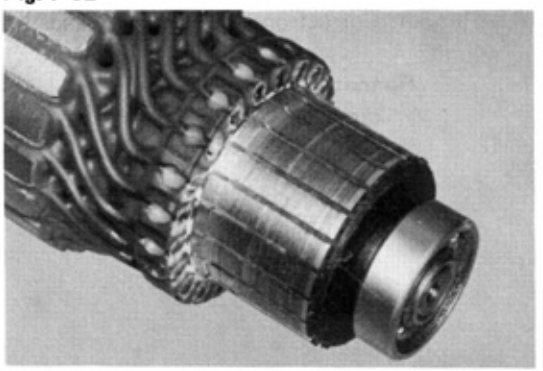


Lift up the brush spring and pull out the brush from the brush holder.

– Caution –

Use care not to damage the brush and commutator. Also avoid getting oil or grease on them.

Fig. 7-62



INSPECTION & REPAIR

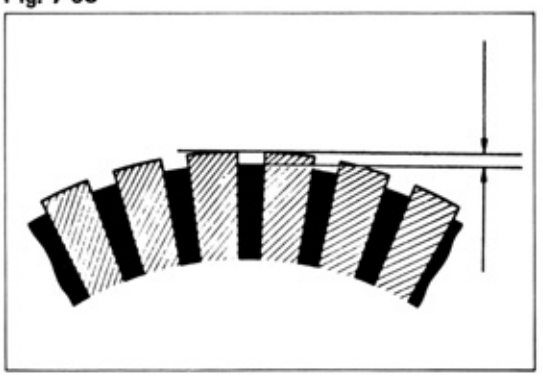
Wipe off dirt and grease from the disassembled parts.

Commutator

Check for the following items, and repair or replace as necessary.

1. Dirty or burnt surface
   Correct with sandpaper or a lathe if necessary.

Fig. 7-63

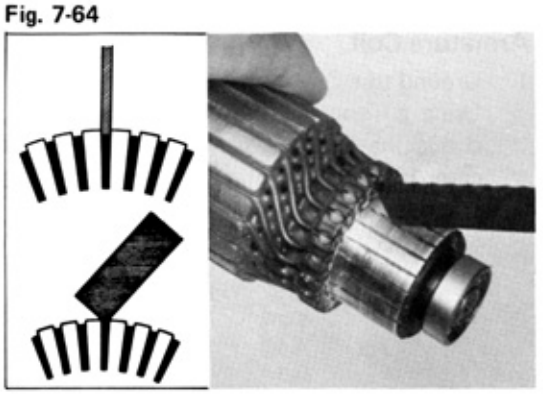


2. Depth of segment mica.

Mica depth:

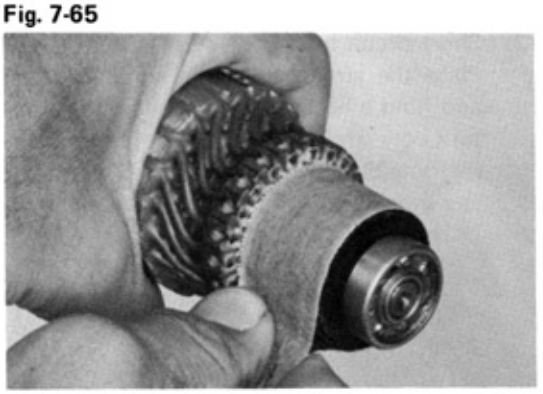
STD	**0.45 – 0.75 mm (0.0177 – 0.0295 in.)**
Limit	**0.2 mm (0.008 in.)**

Fig. 7-64



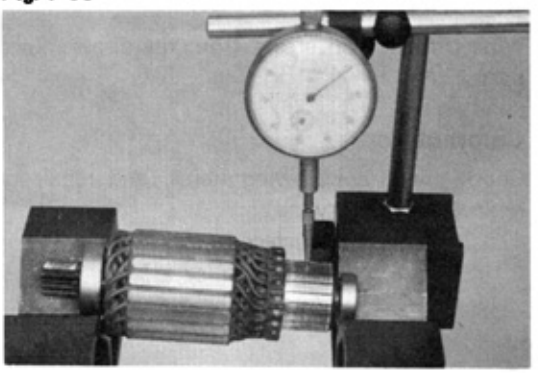
3. If the mica depth is below the limit, correct with a hacksaw blade.
4. Smooth out the edge with a backsaw blade.

Fig. 7-65



5. Use #400 sandpaper to remove chips.

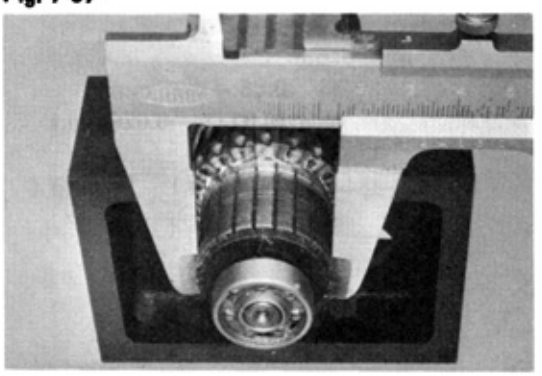
Fig. 7-66



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

Runout:
Limit 0.2 mm (0.008 in.)

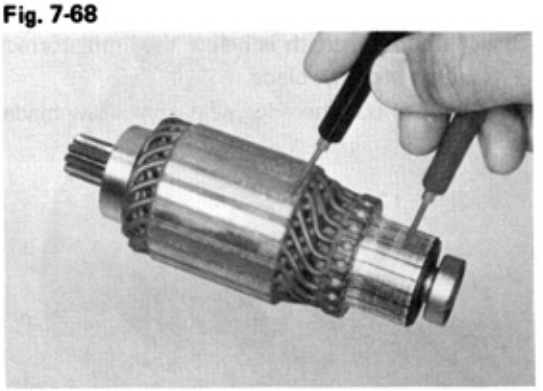
Fig. 7-67



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

Diameter:
STD 30 mm (1.18 in.)
Limit 29 mm (1.14 in.)

Fig. 7-68



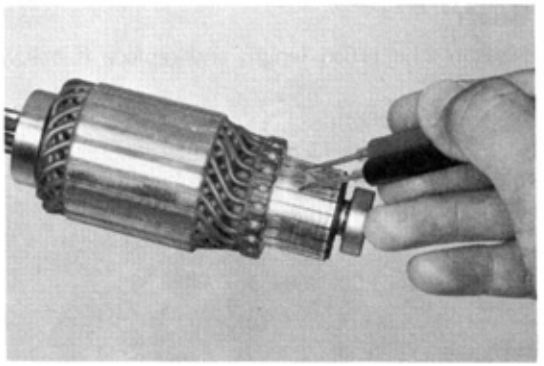
Armature Coil

1. Ground test
Using an armature tester or circuit tester, check the commutator and armature coil core. If there is continuity, the armature is grounded and must be replaced.

Fig. 7-69

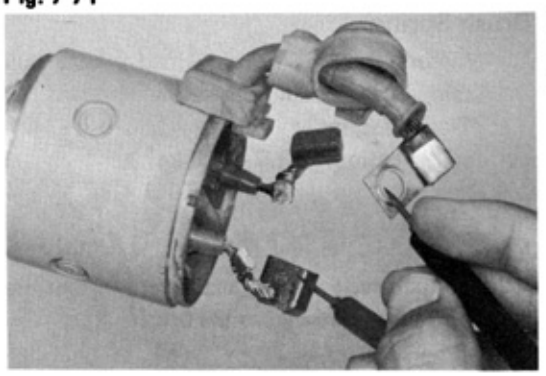
2. Short circuit test
Place the armature on the armature tester and hold a hacksaw blade against the armature core while turning the armature. If the hacksaw blade is attracted or vibrates, there is a short circuit in the armature and it must be replaced.

Fig. 7-70



3. Open circuit test
Using the armature tester or a circuit tester, 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.

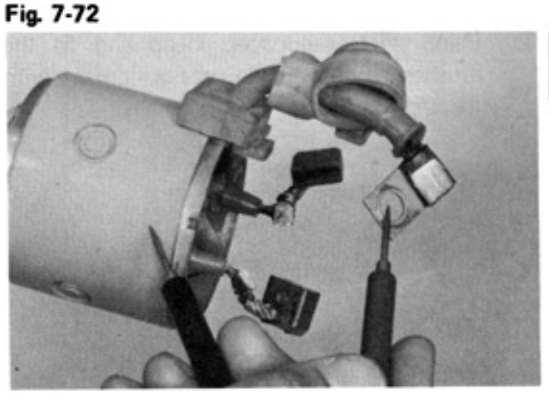
Fig. 7-71



Field Coil

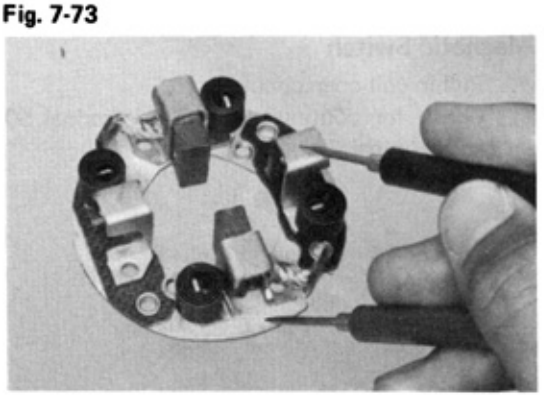
1. Open circuit test
Check for continuity between the lead wire and field coil brush lead. If there is no continuity, there is an open circuit in the field coil, and it must be replaced.

Fig. 7-72



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

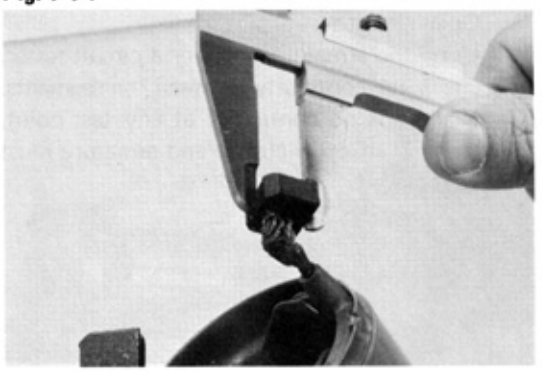
Fig. 7-73



Brush Holder

Check insulation between the ⊕ and ⊖ brush holders. Repair or replace if continuity is indicated.

Fig. 7-74



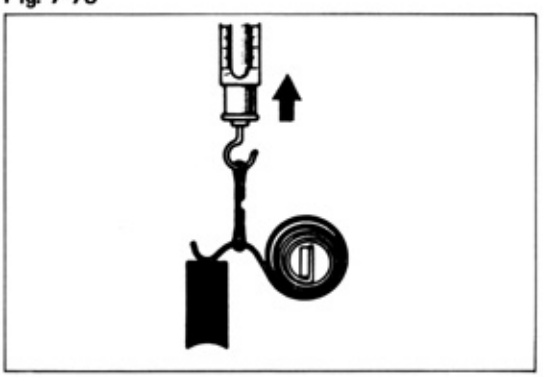
Brush

Measure the brush length and replace if below the limit.

Brush length:

STD	**13.5 mm (0.531 in.)**
Limit	**10 mm (0.39 in.)**

Fig. 7-75



Brush Spring

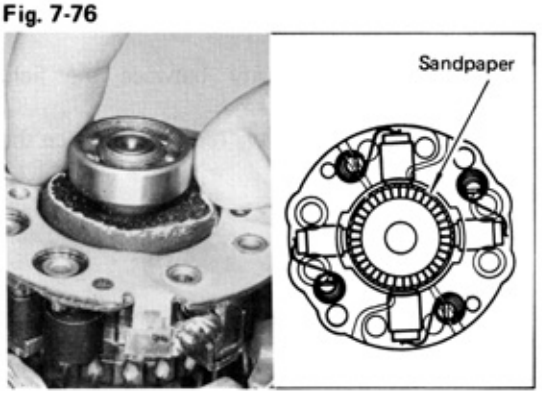
1. Measure the brush spring load with a pull scale. If the reading is below standard, replace the spring.

   Tension: 1.5 – 2.0 kg (3.3 – 4.4 lb)

– Note –

Take the pull scale reading at the very instant the brush spring separates from the brush.

Fig. 7-76



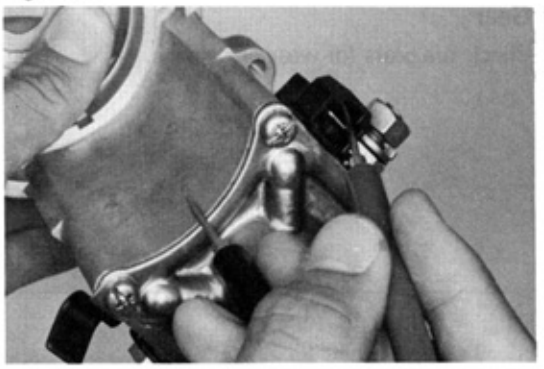
2. Using #400 sandpaper, clean and fit the brushes so they make proper contact with the commutator.

Fig. 7-77

Magnetic Switch

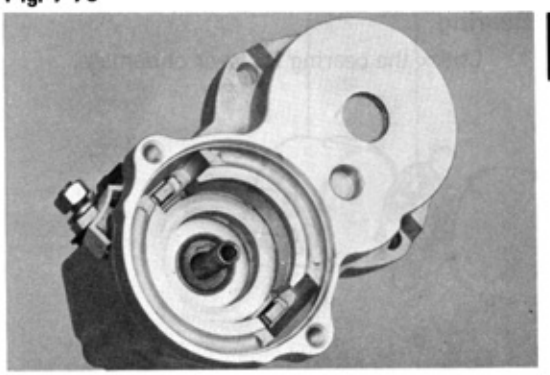
1. Pull-in coil open circuit test
   Check for continuity between terminal 50 and terminal C.

Fig. 7-78



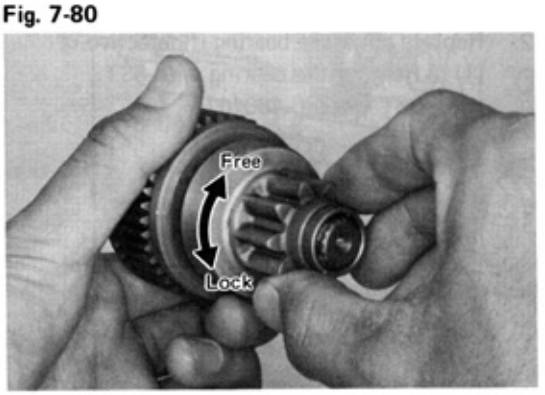
2. Hold-in coil open circuit test
Check for continuity between terminal 50 and the magnetic switch body.

Fig. 7-79



3. Check for wear or damage.

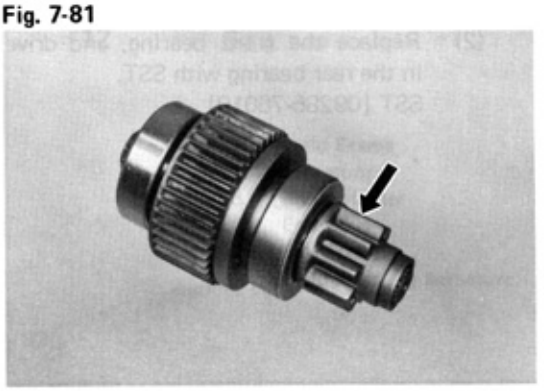
Fig. 7-80



Clutch

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

Fig. 7-81



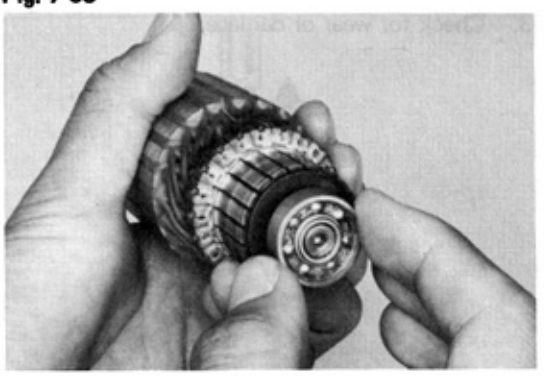
2. Check the gear teeth for wear of damage. Also inspect the flywheel ring gear for same.

Fig. 7-82

Gear

Check the gears for wear or damage.

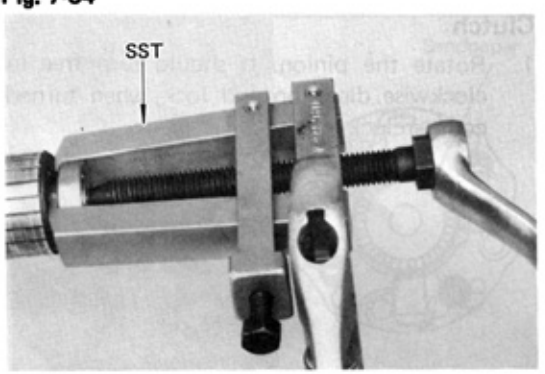
Fig. 7-83



Bearing

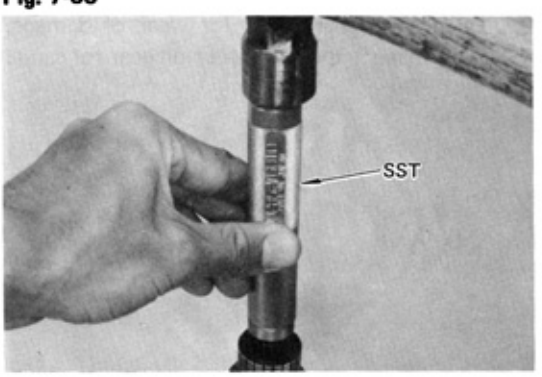
1. Check the bearing for wear or damage.

Fig. 7-84



2. Replace armature bearing if defective.
   (1) Remove the bearing with SST.
   SST [09286-46011]

Fig. 7-85



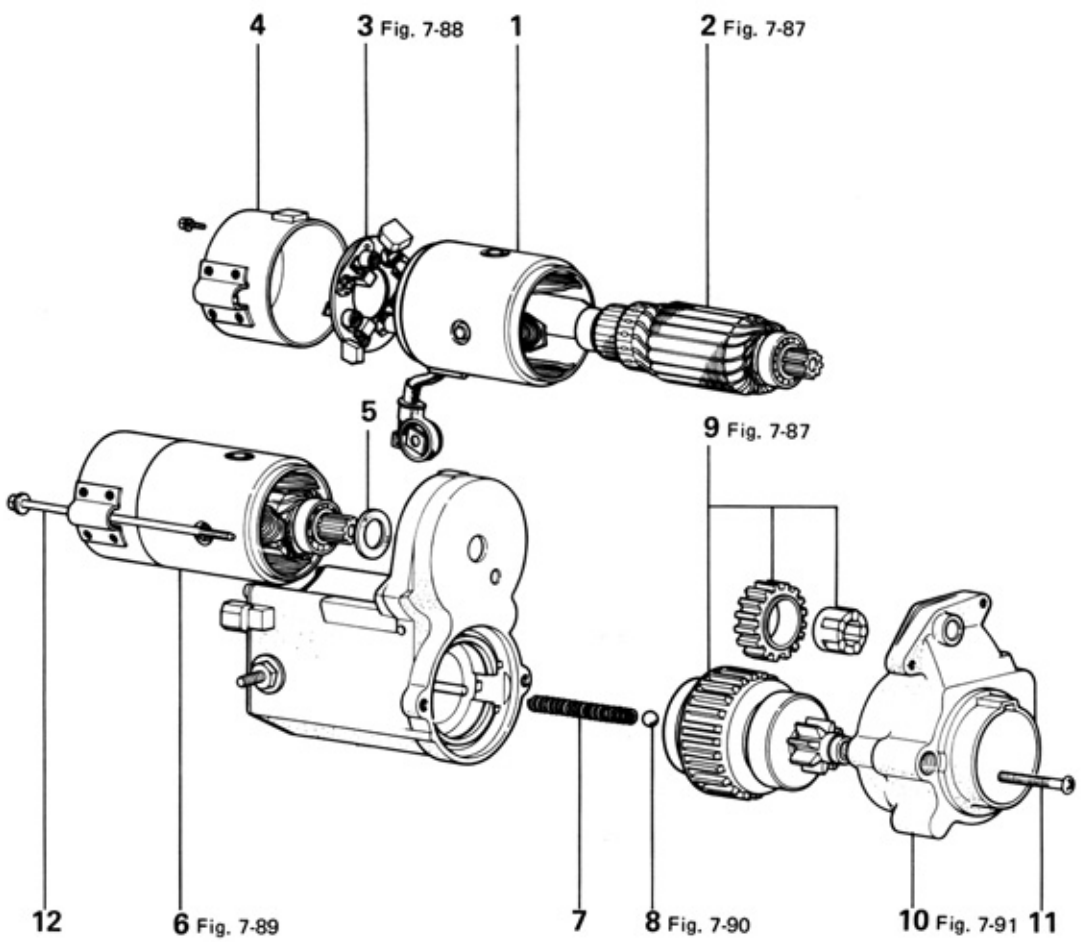
(2) Replace the front bearing, and drive in the rear bearing with SST.
SST [09285-76010]

ASSEMBLY

— Note —
When assembling, lubricate the bearings and gears with high temperature grease.

Assemble the parts in the numerical order shown in the figure.

Fig. 7-86



1. Field Frame
2. Armature
3. Brush Holder
4. End Cover
5. Felt Seal
6. Field Frame & Armature
7. Plunger Return Spring
8. Steel Ball
9. Clutch & Idler Gear
10. Starter Housing
11. Bolt
12. Through Bolt

Use high temperature grease to lubricate bearings and gears in the places shown in the figure below.

Fig. 7-87

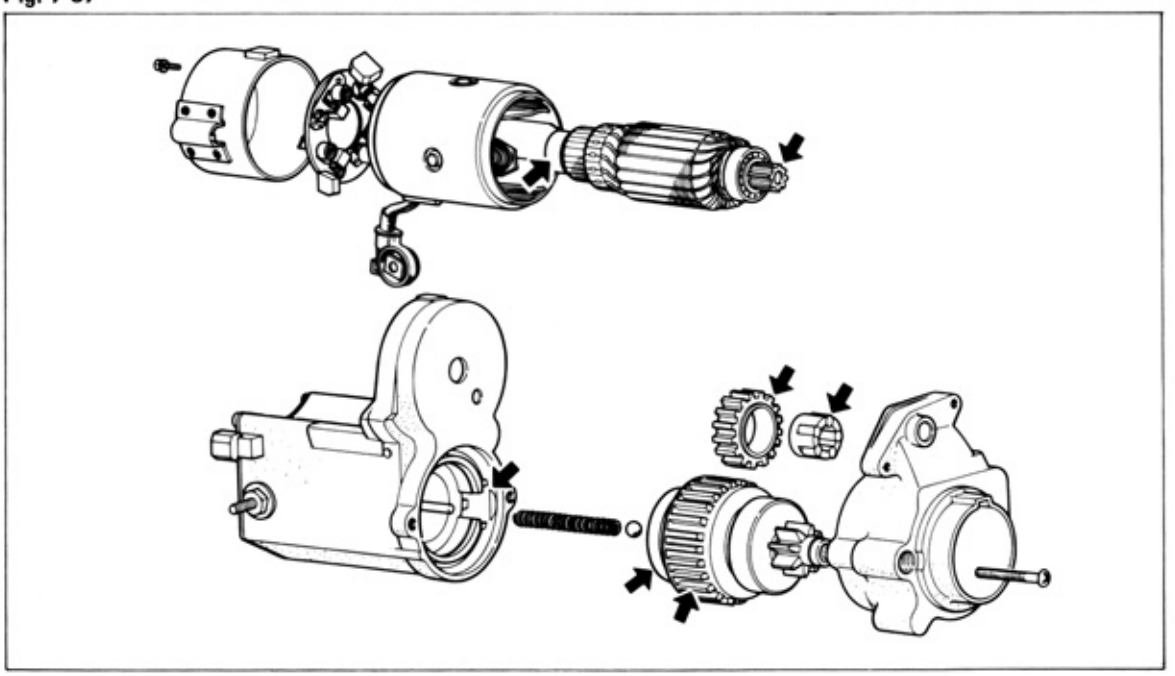
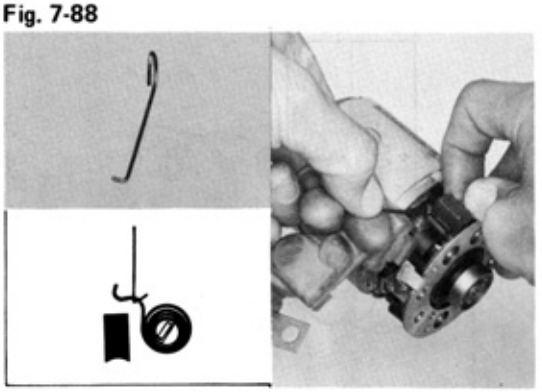


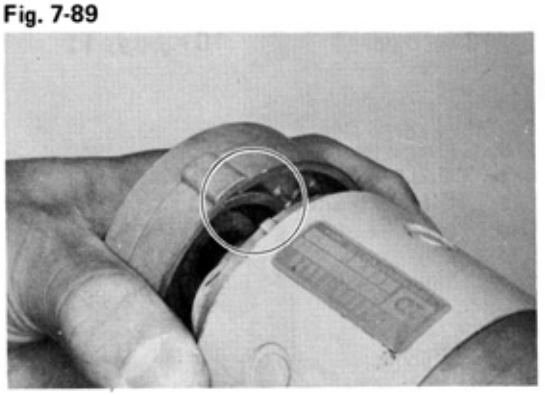
Fig. 7-88



Fir four brushes into the brush holder, using care not to damage them.

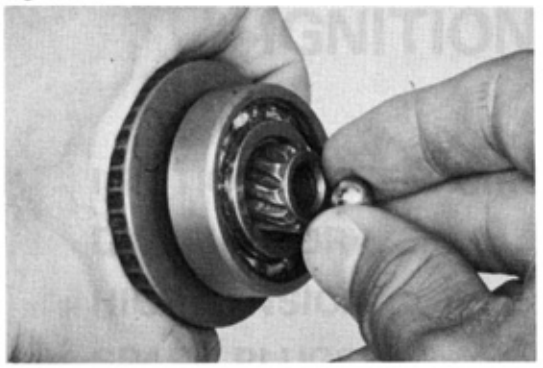
– Note –
Check to see that the ⊕ lead wires are not grounded.

Fig. 7-89



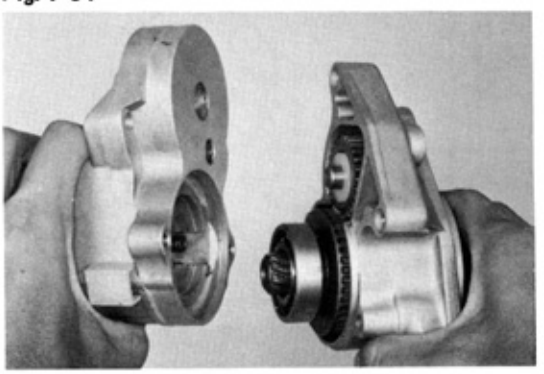
Match the protrusion of the yoke core with the starter housing notch.

Fig. 7-90



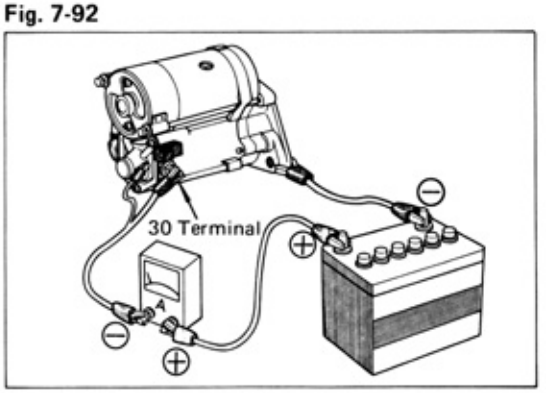
Apply grease and insert the ball into the clutch shaft hole.

Fig. 7-91



Install the idler gear roller bearing in the direction shown in the figure.

Fig. 7-92



PERFORMANCE TEST (NO-LOAD)

Connect the starter to a battery. If the starter shows smooth and steady rotation with the pinion jumping out and drawing less than specified current,it is satisfactory.

Specified current:

Less than 90 A at 11.5V

MEMO