STARTING SYSTEM

CONVENTIONAL STARTING SYSTEM CIRCUIT

Fig. 7-1

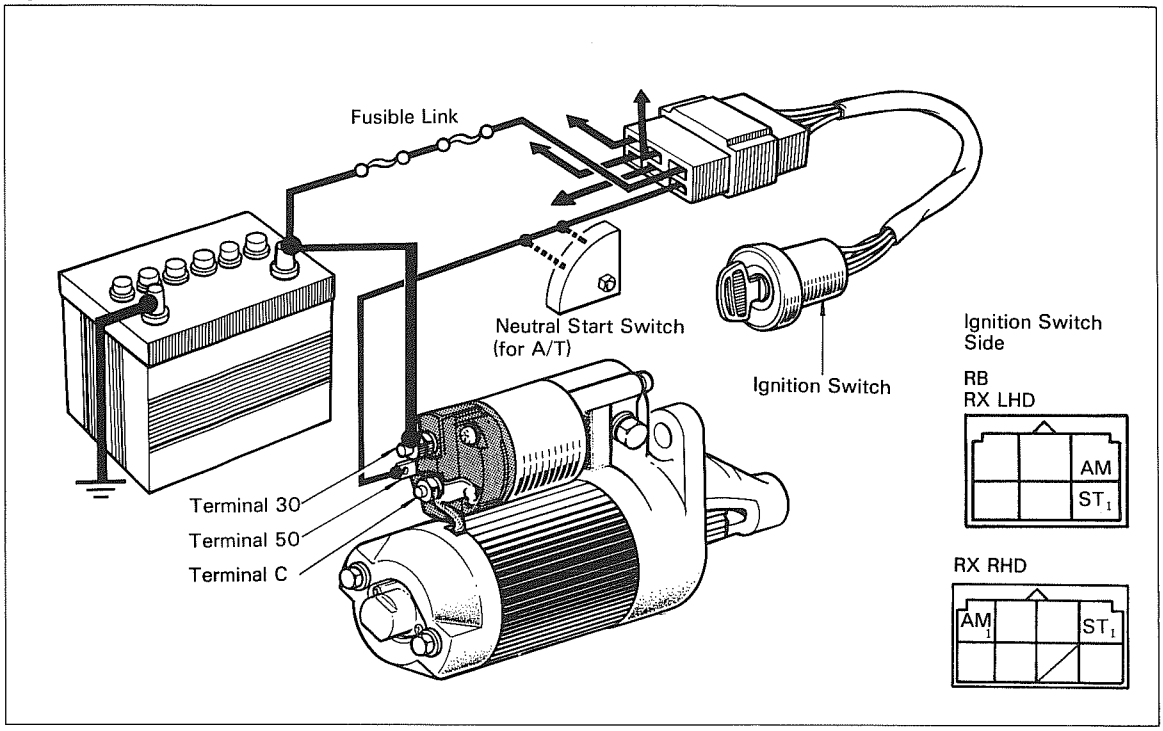


Fig. 7-2

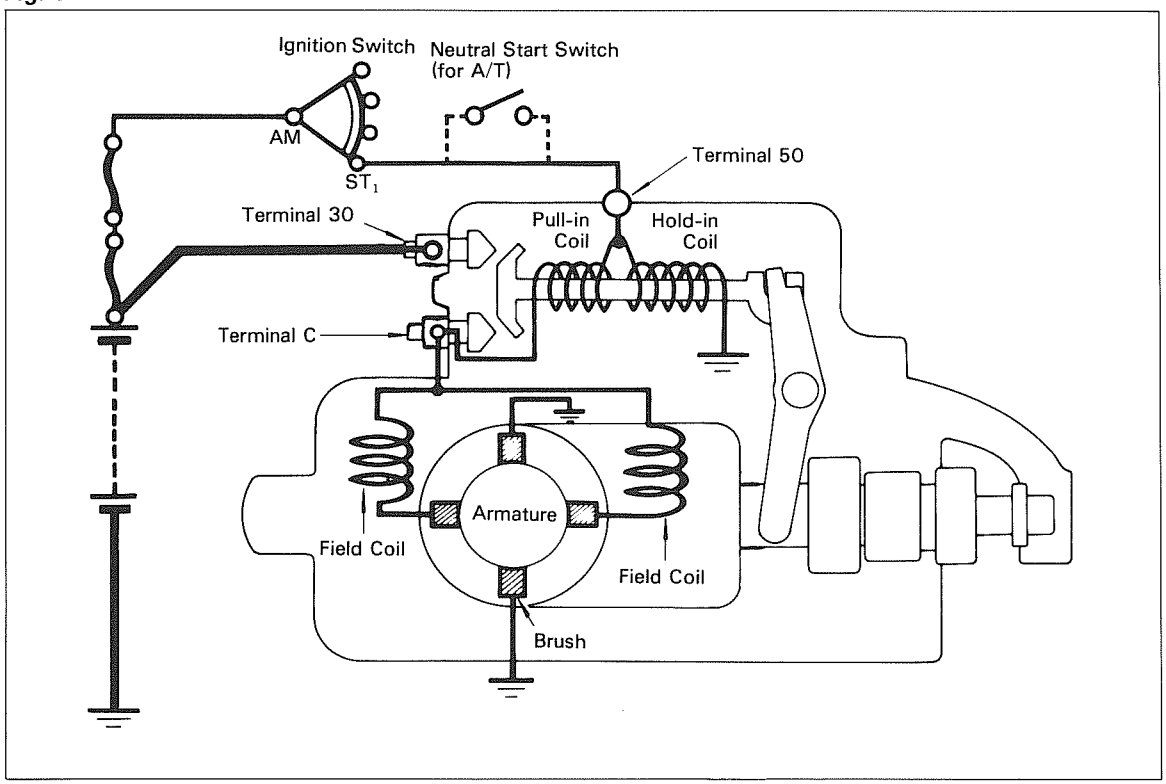
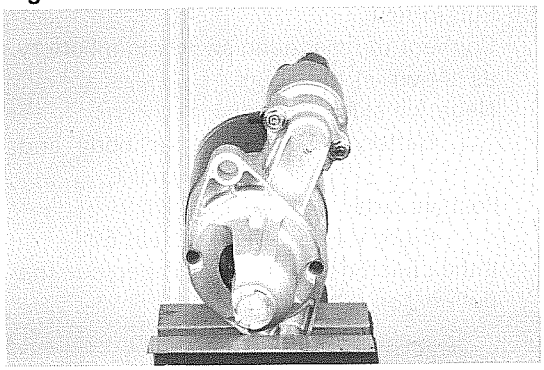


Fig. 7-3

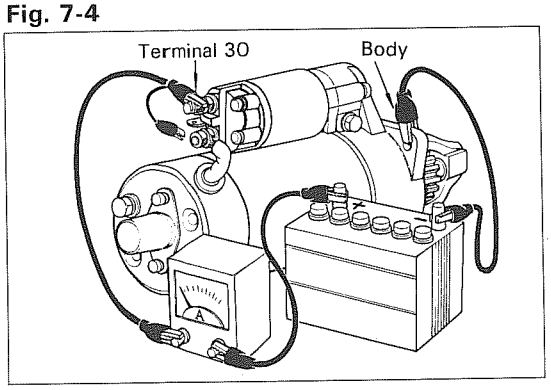


PERFORMANCE TEST

NO-LOAD PERFORMANCE TEST

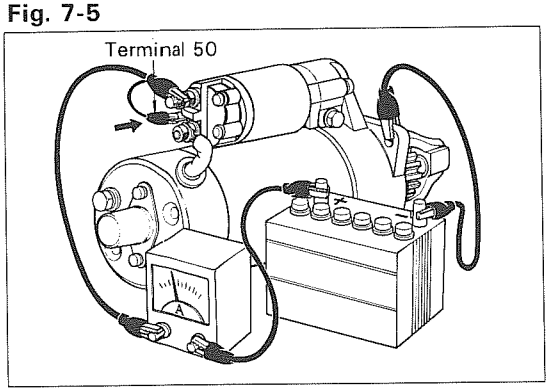
1. Secure the starter in a vise to prevent an accident.

Fig. 7-4



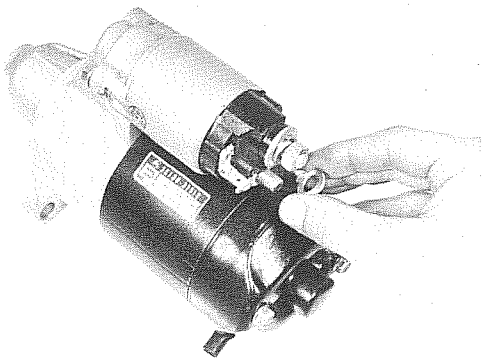
2. Connect the starter to a battery as shown in the figure.
   Positive side
   Battery (+) ——→ Ammeter (+)
   Ammeter (−) ——→ Terminal 30
   Negative side
   Battery (−) ——→ Starter body

Fig. 7-5



3. Connect the 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 50A (at 11V)

Fig. 7-6

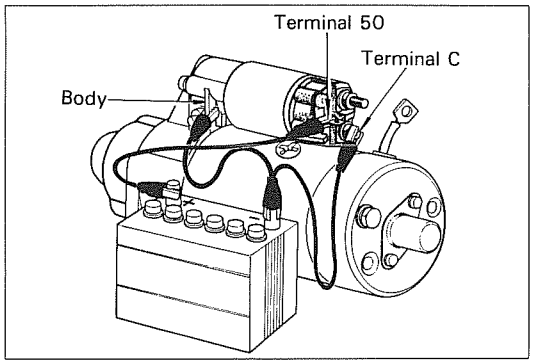


MAGNETIC SWITCH TEST

— Caution —
Each test must be performed within a short time (3 — 5 seconds) to prevent the coil from burning out.

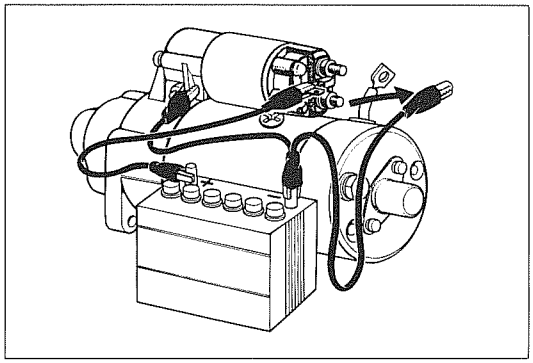
1. Disconnect the terminal C lead wires.

Fig. 7-7



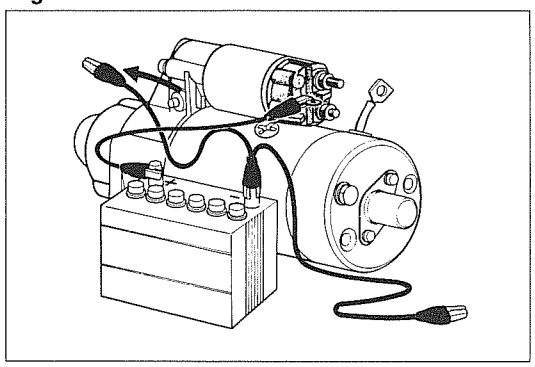
2. Pull-in test
Connect the magnetic switch to a battery as shown in the figure.
Negative side
Battery (−) ——→ Starter body and terminal C
Positive side
Battery (+) ——→ Terminal 50
If the pinion has definitely jumped out, the pull-in coil is satisfactory.

Fig. 7-8



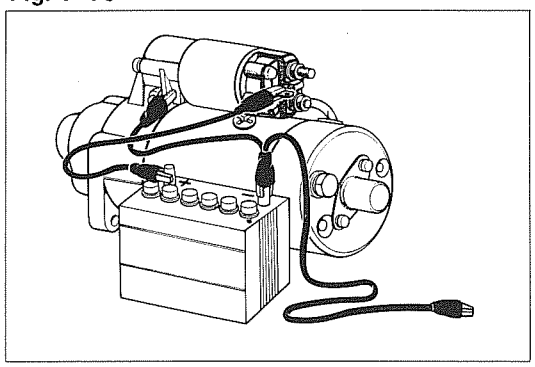
3. Hold-in test
Disconnect terminal C. The pinion should remain projected.

Fig. 7-9



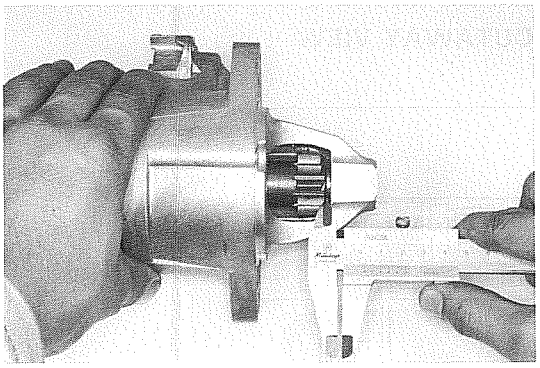
4. Check the plunger return.
When disconnecting the switch body, the pinion should return quickly.

Fig. 7-10



5. Check pinion clearance.
(1) Connect the field coil lead to terminal C.
(2) Connect the magnetic switch to a battery as shown in the figure.
Positive side
Battery (+) ——→ Terminal 50
Battery (−) ——→ Starter body

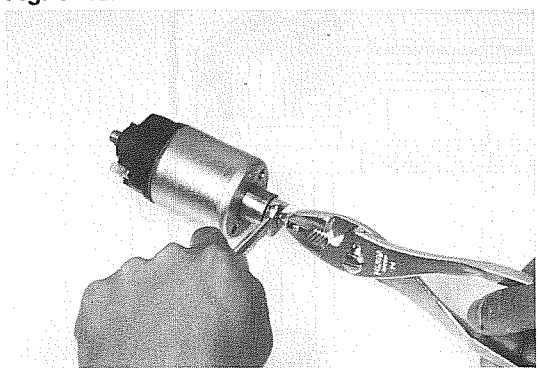
Fig. 7-11



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

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

Fig. 7-12



(4) For 1.0 kw
If necessary, loosen the lock nut and adjust.

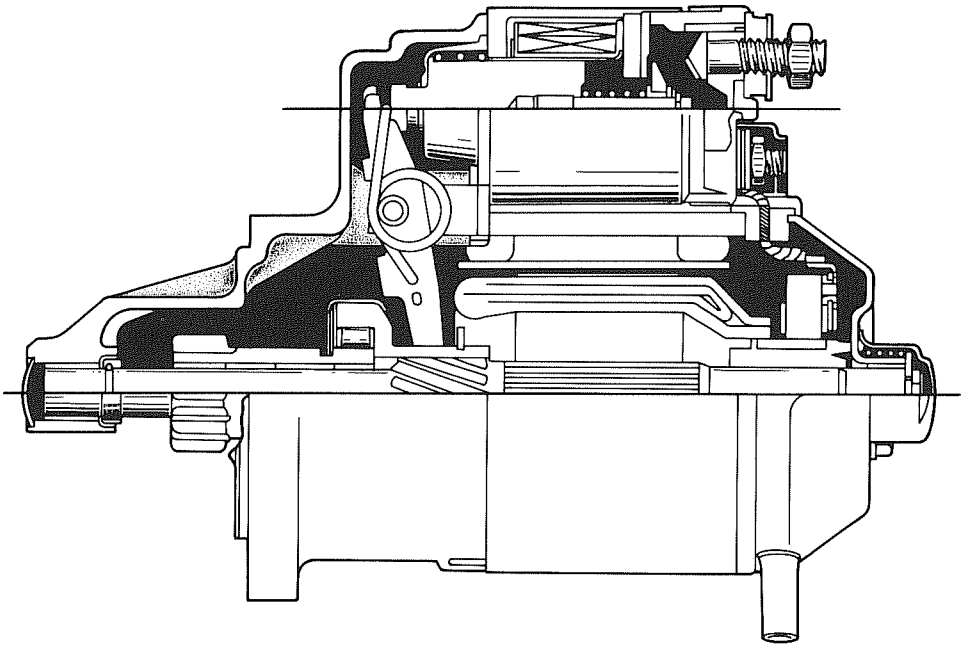
Clearance	Stud
Too large	→ Screw in
Too small	→ Screw out

CONVENTIONAL STARTER

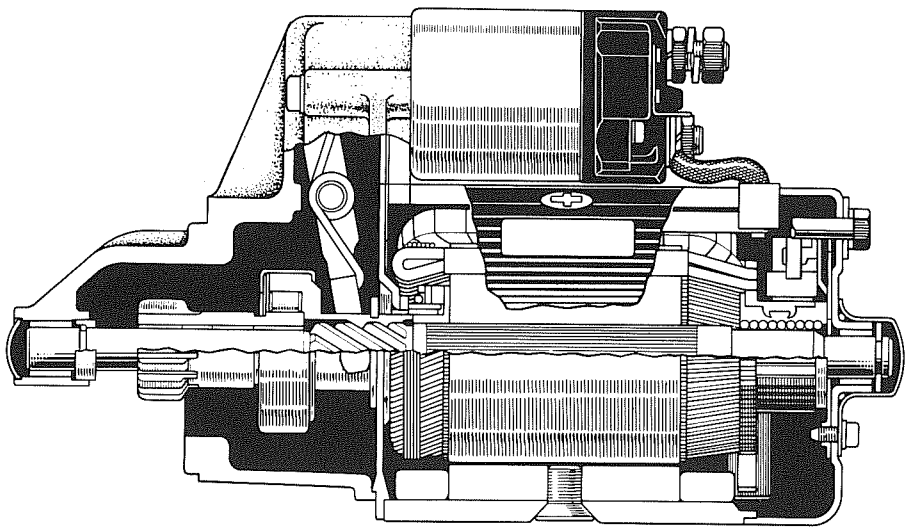
CUTAWAY VIEW

Fig. 7-13

[0.8 kw Type]



[1.0 kw Type]

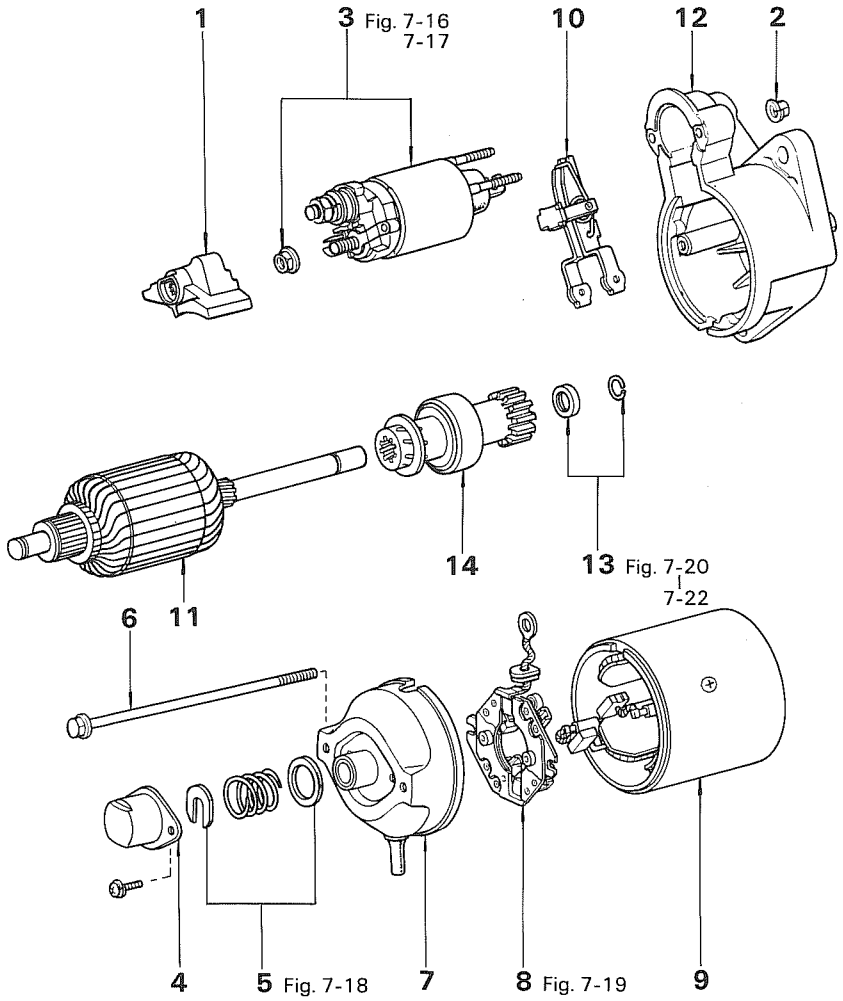


DISASSEMBLY

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

Fig. 7-14

[0.8 kw Type]

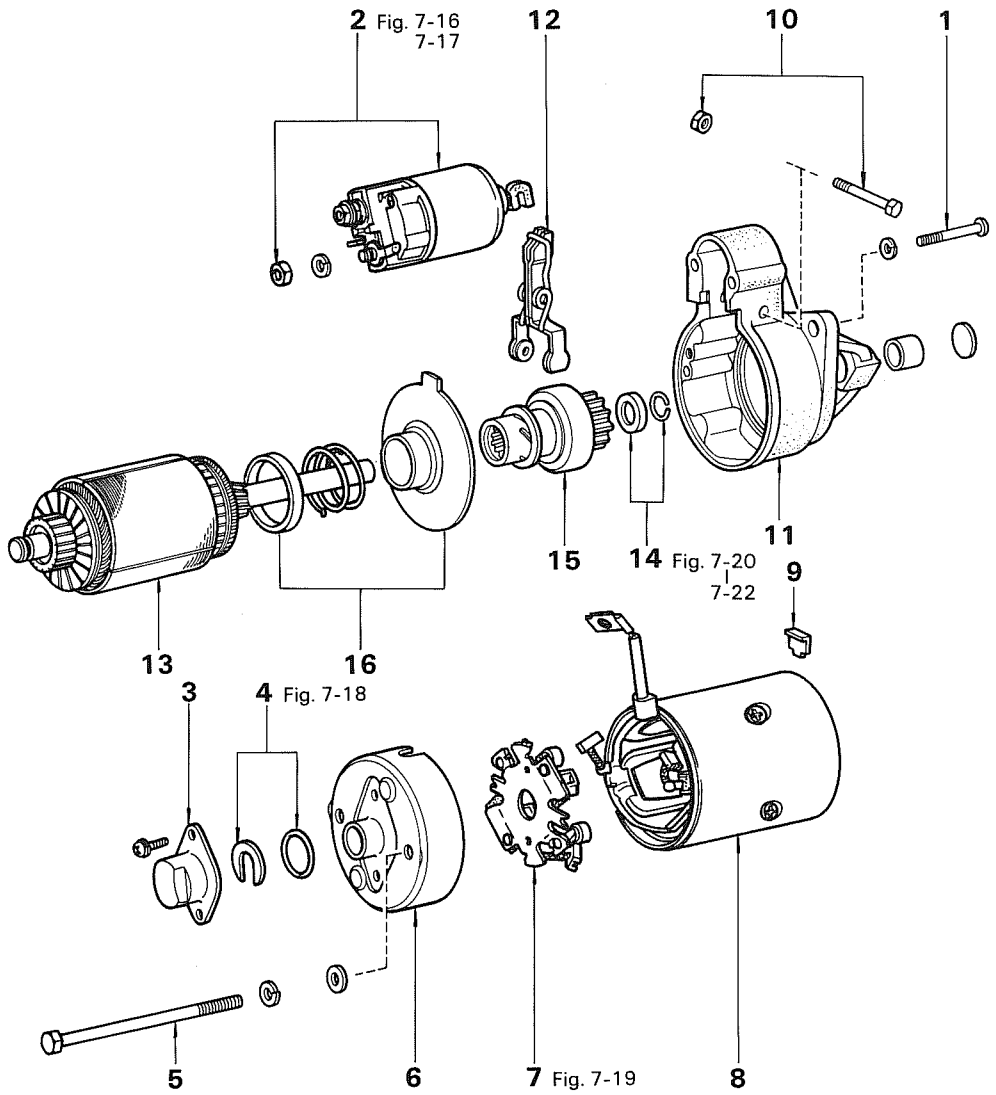


1. Terminal Cover
2. Magnetic Switch Set Nut
3. Magnetic Switch Assembly
4. Bearing Cover
5. Lock Plate, Spring & Rubber
6. Bolt
7. Commutator End Frame
8. Brush Holder
9. Yoke
10. Drive Lever
11. Armature
12. Drive Housing
13. Snap Ring & Stop Collar
14. Clutch with Pinion Gear

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

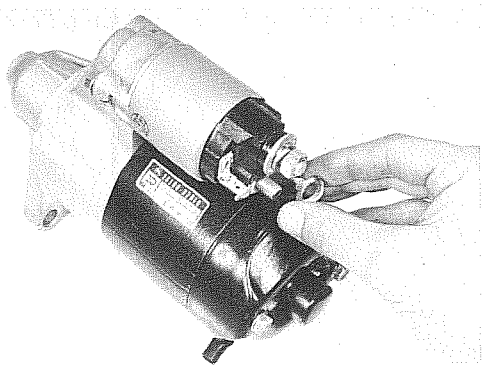
Fig. 7-15

[1.0 kw Type]



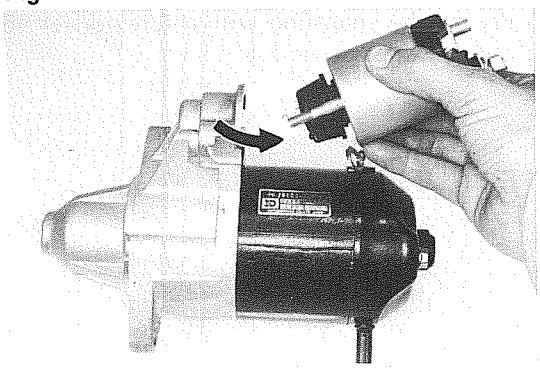
1. Magnetic Switch Set Bolt
2. Magnetic Switch Assembly
3. Bearing Cover
4. Lock Plate, O Ring & Rubber
5. Bolt
6. Commutator End Frame
7. Brush Holder
8. Yoke
9. Seal
10. Bolt
11. Drive Housing
12. Drive Lever
13. Armature
14. Snap Ring & Stop Collar
15. Clutch with Pinion Gear
16. Spring, Spring Holder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

Fig. 7-16



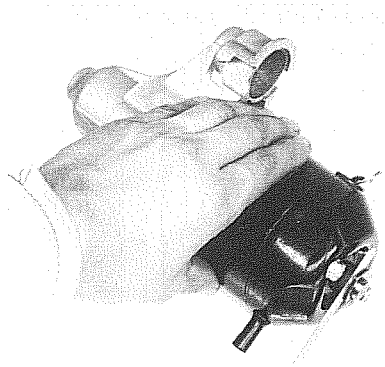
Disconnect the terminal C lead wire from the magnetic switch.

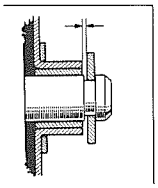
Fig. 7-17



Remove the magnetic switch as shown in the figure.

Fig. 7-18



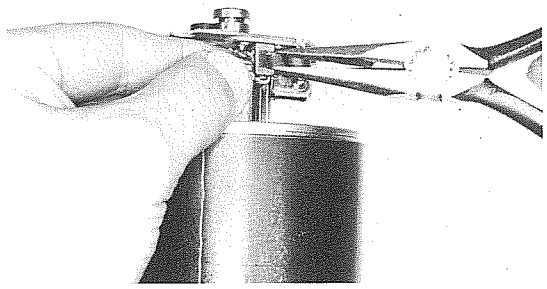


Measure the armature shaft thrust clearance.

Thrust clearance:

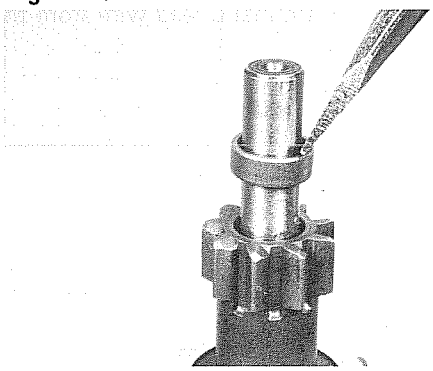
STD	**0.05 – 1.00 mm (0.0020 – 0.0394 in.)**
Limit	**1.00 mm (0.0394 in.)**

Fig. 7-19



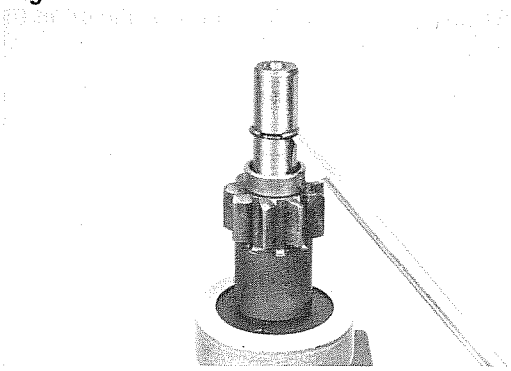
Remove the brushes from the brush holder.

Fig. 7-20



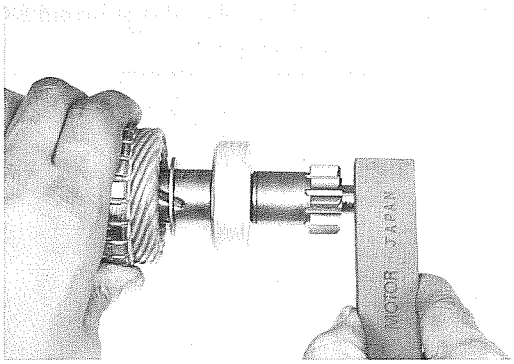
Tap in the stop collar with a screwdriver.

Fig. 7-21



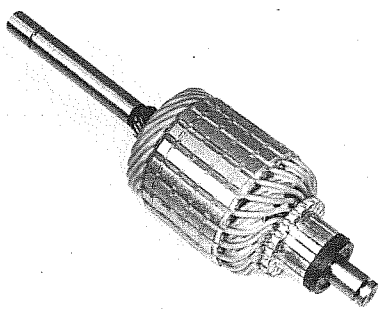
Pry off the snap ring with a screwdriver and remove the stop collar.

Fig. 7-22



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

Fig. 7-23



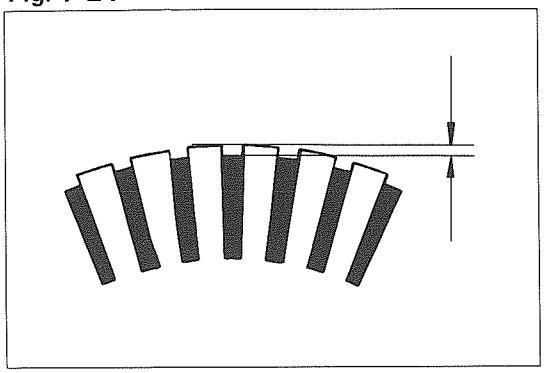
INSPECTION & REPAIR

Commutator

Check for following items and repair or replace, if necessary.

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

Fig. 7-24

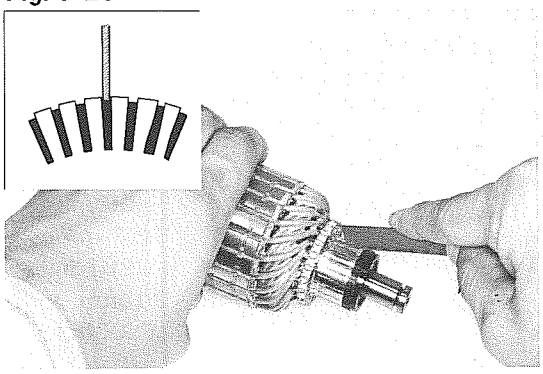


2. Depth of segment mica

Mica depth:

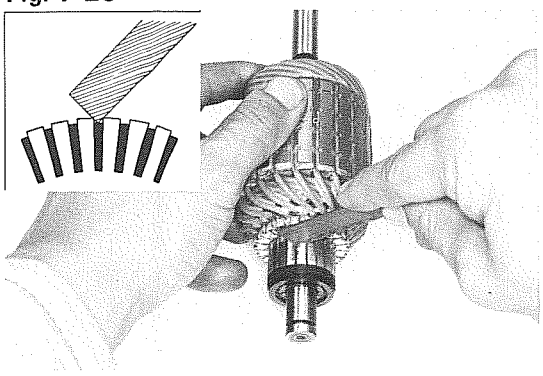
STD	**0.4 – 0.8 mm (0.016 – 0.031 in.)**
Limit	**0.2 mm (0.008 in.)**

Fig. 7-25



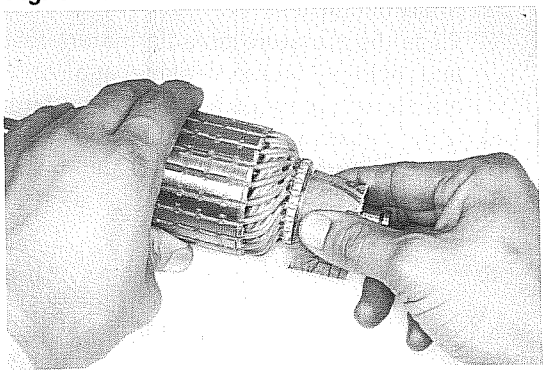
3. Repair the segment mica
   (1) If the mica depth is below the limit, correct with a hacksaw blade.

Fig. 7-26



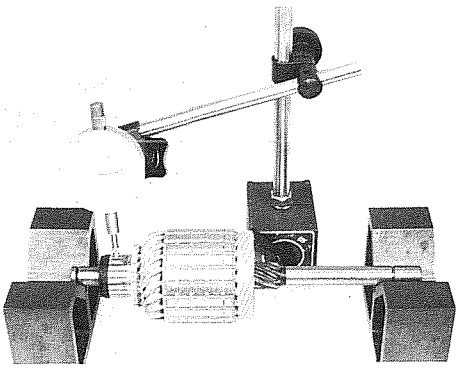
(2) Smooth out the edges with a hacksaw blade.

Fig. 7-27



(3) Use #400 sandpaper to smooth the commutator surface.

Fig. 7-28

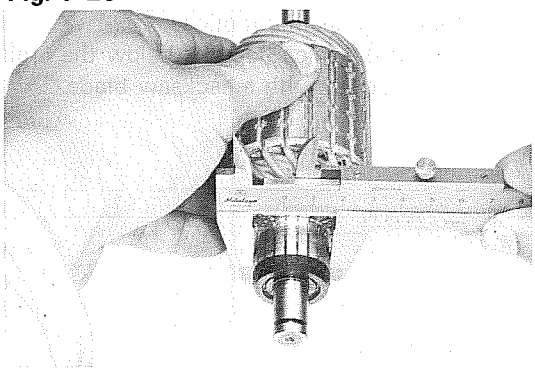


4. Runout
Correct on a lathe if it exceeds the limit.

Runout:

STD	**Less than 0.1 mm (0.004 in.)**
Limit	**0.3 mm (0.012 in.)**

Fig. 7-29

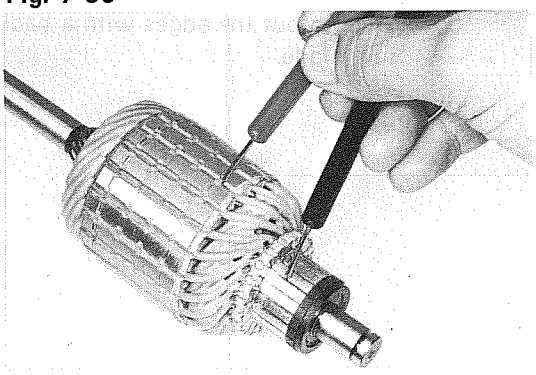


5. Surface wear
Replace the armature if below the limit.

Commutator outer diameter:

0.8 kw	**STD**	**28.0 mm (1.102 in.)**
	Limit	**27 mm (1.06 in.)**
1.0 kw	**STD**	**32.7 mm (1.287 in.)**
	Limit	**31 mm (1.22 in.)**

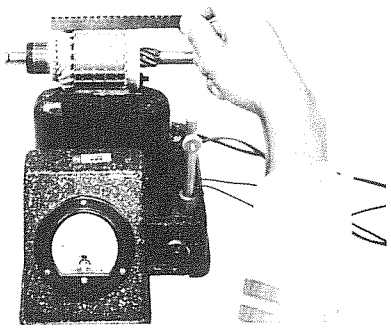
Fig. 7-30



Armature Coil

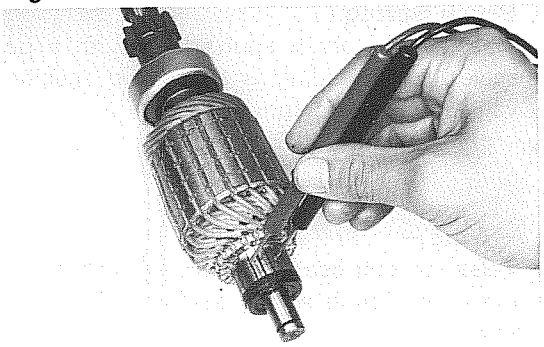
1. Ground test
Check the commutator and armature coil core. If there is continuity, the armature is grounded and must be replaced.

Fig. 7-31



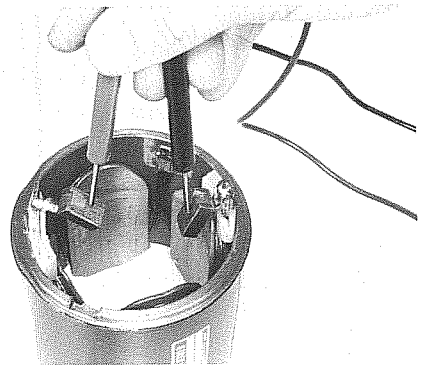
2. Short circuit test
Place the armature on an armature tester and hold a hacksaw blade against the armature core while turning the armature. If the hacksaw blade is attracted or vibrates, the armature is shorted and must be replaced.

Fig. 7-32



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

Fig. 7-33



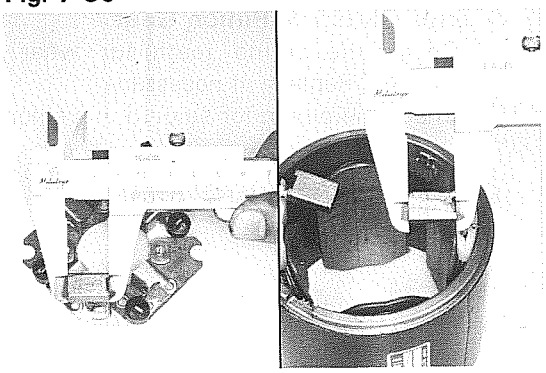
Field Coil

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

Fig. 7-34

2. Ground test
Check for continuity between the field coil end and field frame.
If there is continuity, repair or replace the field coil. (for 1.0 kw)

Fig. 7-35



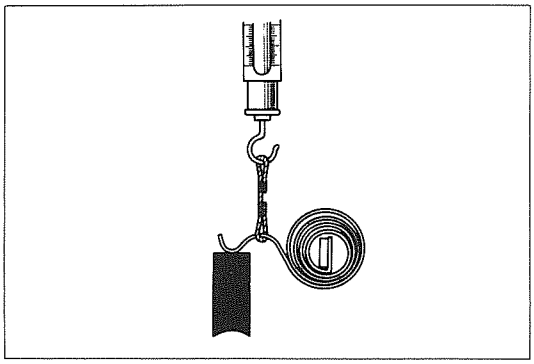
Brush

Measure the brush length and replace if below the limit.

Brush length:

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

Fig. 7-36



Brush Spring

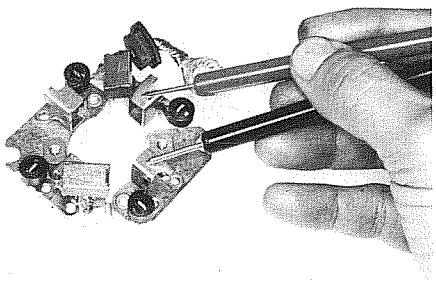
Measure the brush spring load with a pull scale. If the reading is below the specified value, replace the spring.

Tension: 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.

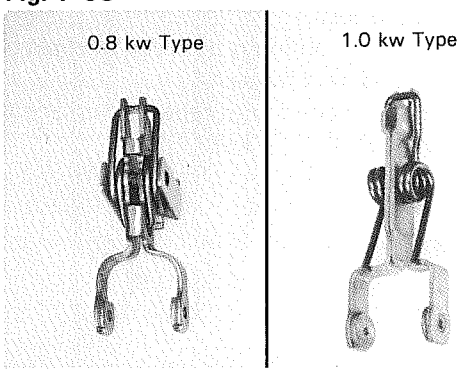
Fig. 7-37



Brush Holder

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

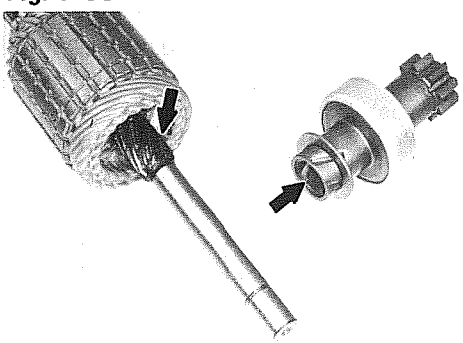
Fig. 7-38



Drive Lever

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

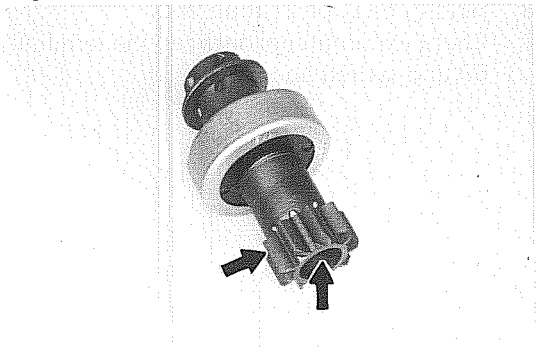
Fig. 7-39



Starter Clutch & Pinion Gear

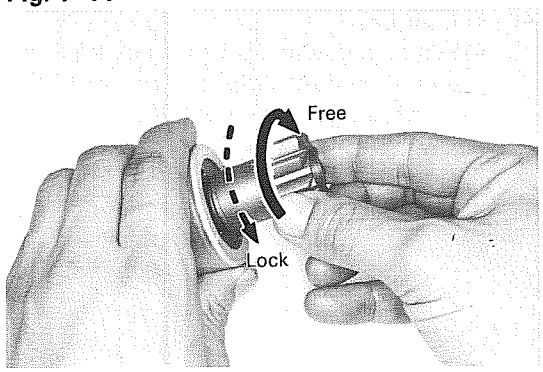
1. Check the spline teeth for wear or damage. Replace, if necessary.
2. Check the pinion for smooth movement.

Fig. 7-40



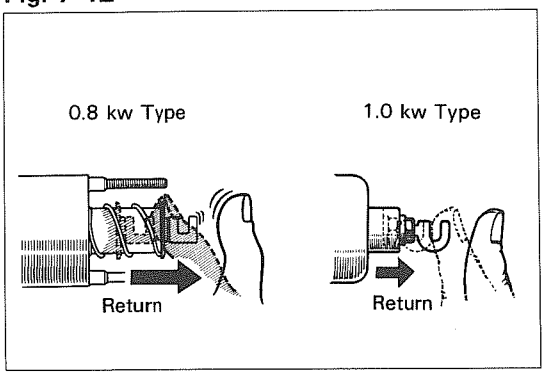
3. Check the pinion gear teeth and the chamfer for wear or damage.

Fig. 7-41



4. Rotate the pinion. It should turn freely in clockwise direction but lock when turned counterclockwise.

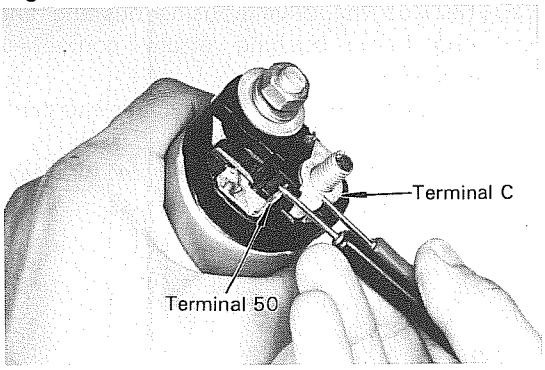
Fig. 7-42



Magnetic Switch

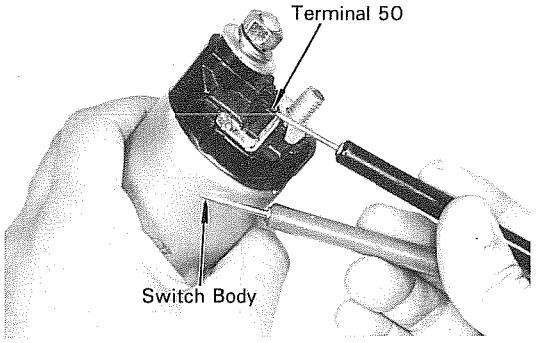
1. Push in the plunger and release it.
   The plunger should return quickly to its original position.

Fig. 7-43



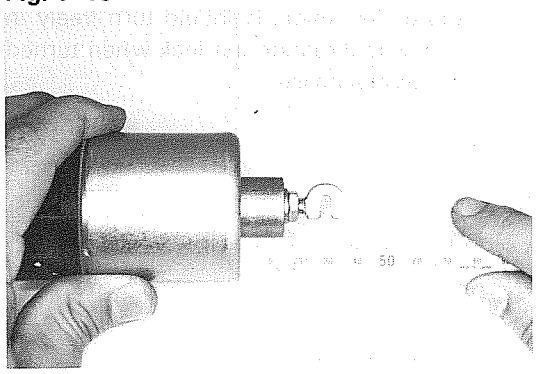
2. Pull-in coil open circuit test
   Check for continuity between the terminal 50 and terminal C.

Fig. 7-44



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

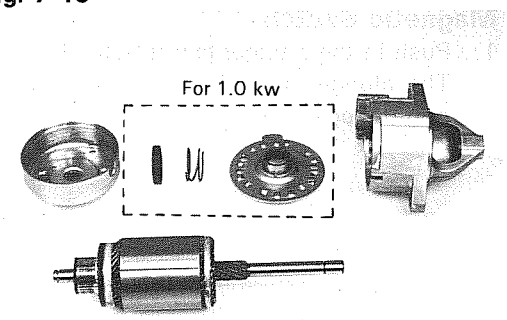
Fig. 7-45



4. For 1.0 kw
Measure and adjust the distance from the switch mounting surface to the stud end.

Moving stud length:
STD 34 mm
(1.34 in.)
(Reference only)

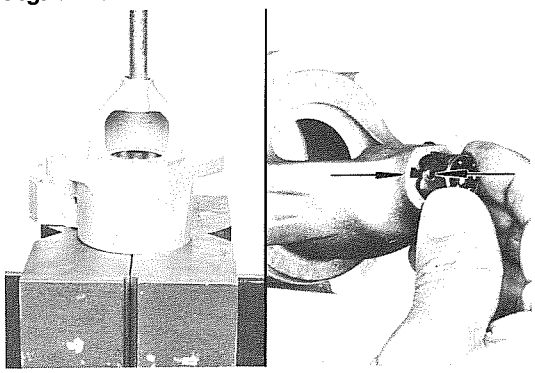
Fig. 7-46



Armature Shaft, Bushing & Center Bearing

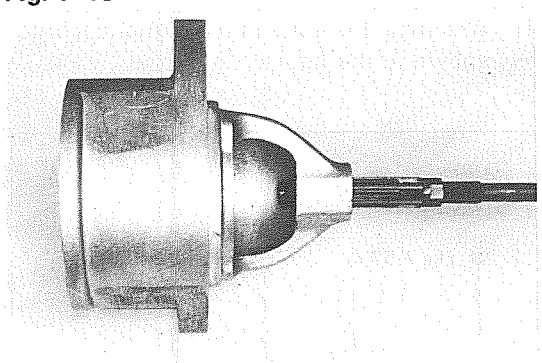
1. Inspect the armature shaft, drive housing bushing and end frame bushing for wear or damage.

Fig. 7-47



2. Replace the drive housing bushing and end frame bushing if any contact is suspected.
   (1) Pry out the bushing cover and press out the bushing.
   (2) Align the bushing hole with the housing groove and press in a new bushing.

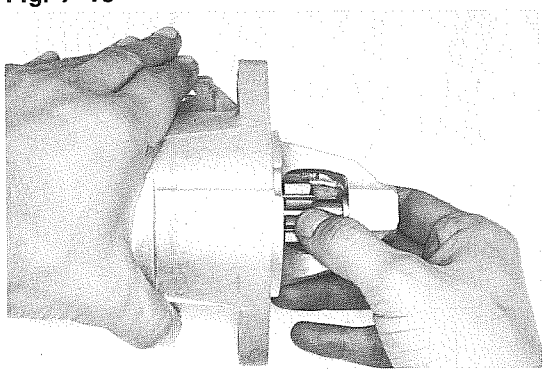
Fig. 7-48



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

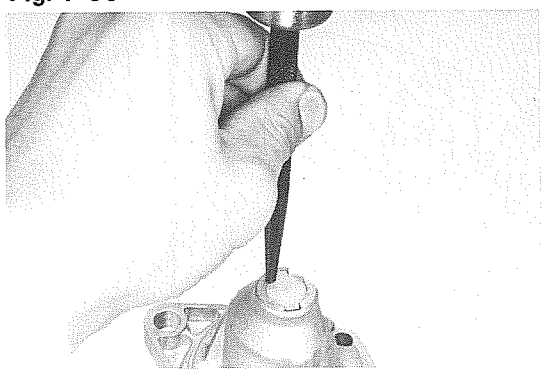
Bushing to shaft clearance:
STD
0.035 – 0.077 mm
(0.0014 – 0.0030 in.)
Limit
0.2 mm
(0.008 in.)

Fig. 7-49



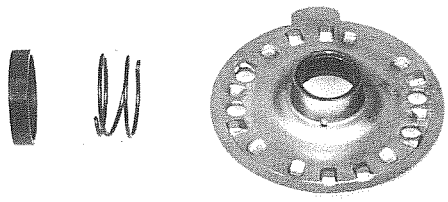
(4) Temporarily assemble the parts.
(5) Make sure that the armature shaft rotates smoothly.

Fig. 7-50



(6) Clean the bore, install a new bushing cover and stake the housing at four positions.

Fig. 7-51



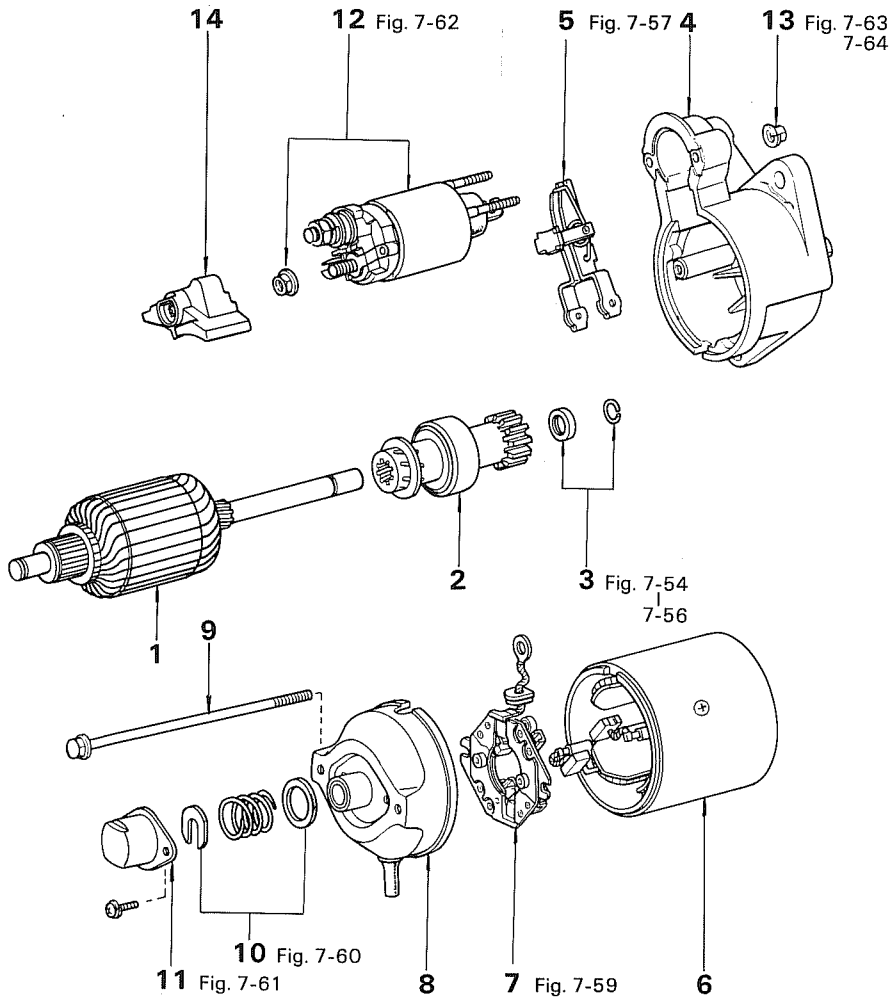
3. 1.0 kw Type
Inspect the spring holder, spring and center bearing for cracks, wear or damage. Replace, if necessary.

ASSEMBLY

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

Fig. 7-52

[0.8 kw Type]

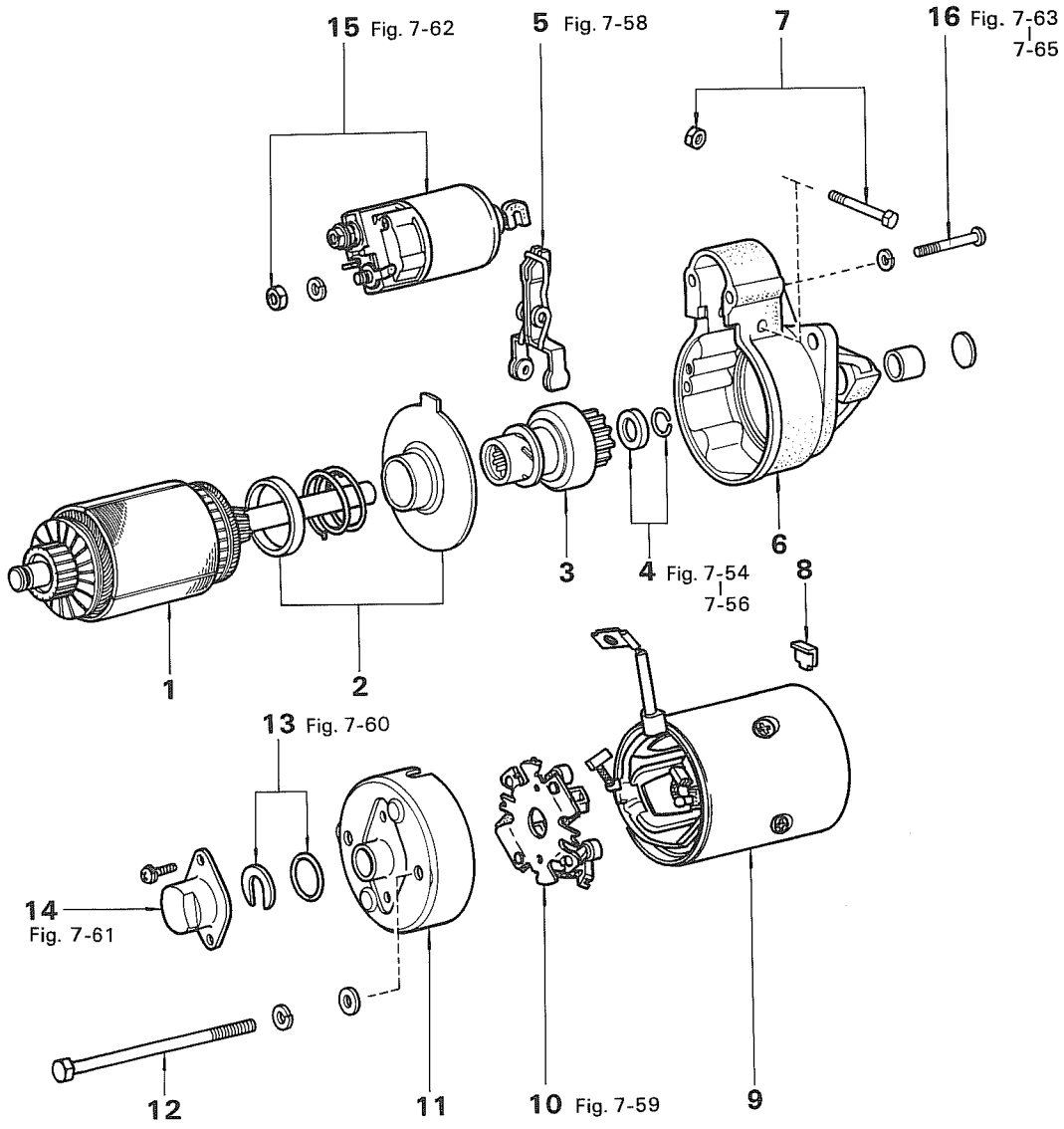


1. Armature
2. Clutch with Pinion Gear
3. Stop Collar & Snap Ring
4. Drive Housing
5. Drive Lever
6. Yoke
7. Brush Holder
8. Commutator End Frame
9. Bolt
10. Lock Plate, Spring & Rubber
11. Bearing Cover
12. Magnetic Switch Assembly
13. Magnetic Switch Set Nut
14. Terminal Cover

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

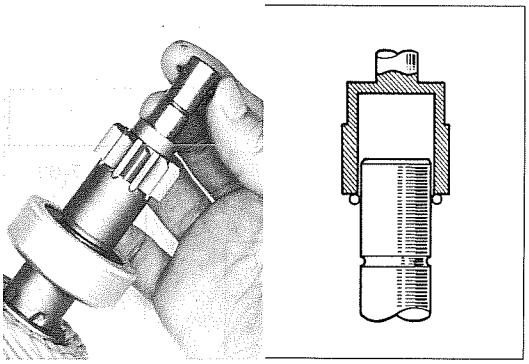
Fig. 7-53

[1.0 kw Type]



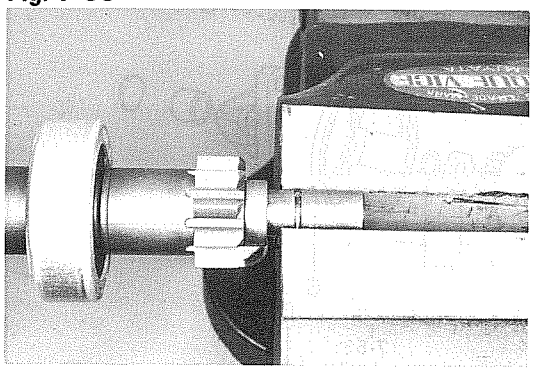
1. Armature
2. Center Bearing, Spring Holder & Spring
3. Clutch with Pinion Gear
4. Stop Collar & Snap Ring
5. Drive Lever
6. Drive Housing
7. Bolt
8. Seal
9. Yoke
10. Brush Holder
11. Commutator End Frame
12. Bolt
13. Rubber, O Ring & Lock Plate
14. Bearing Cover
15. Magnetic Switch Assembly
16. Magnetic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

Fig. 7-54



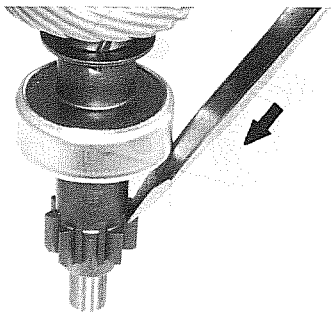
Drive in the snap ring with a 14 mm socket wrench, then fit it into the shaft groove.

Fig. 7-55



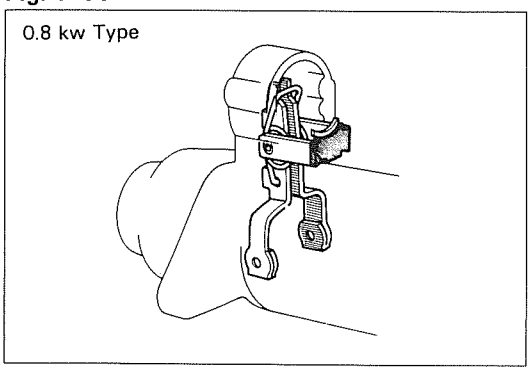
Compress the snap ring with a vise.
Make sure that the snap ring fits correctly.

Fig. 7-56



Tap the pinion to slide the stop collar onto the snap ring.

Fig. 7-57



Install the drive lever.

– Note –

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

Fig. 7-58

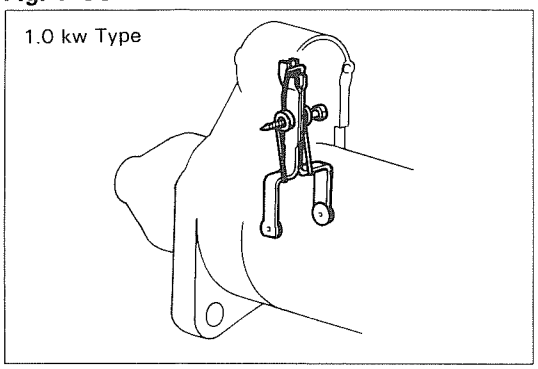
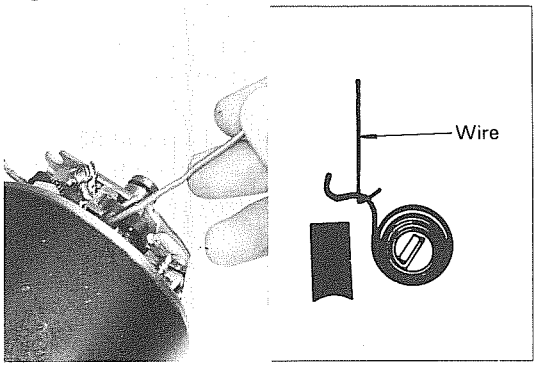
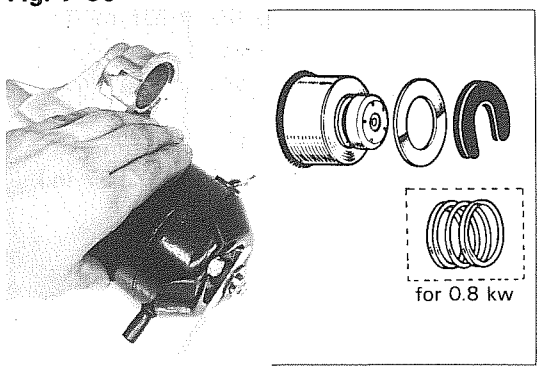


Fig. 7-59



Assemble the brushes with a bent wire, being careful not to damage them.

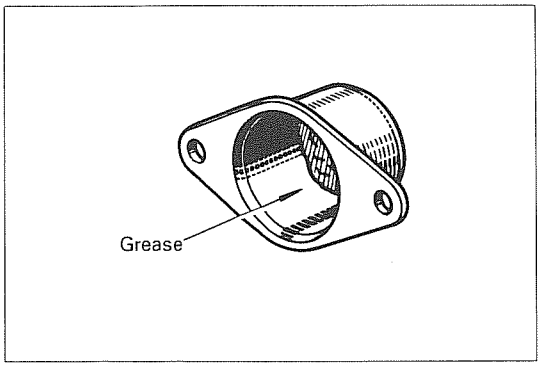
Fig. 7-60



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:
STD 0.05 – 1.00 mm
(0.0020 – 0.0394 in.)
Limit 1.00 mm
(0.0394 in.)
Adjusting shim thickness:
0.5 mm
(0.020 in.)

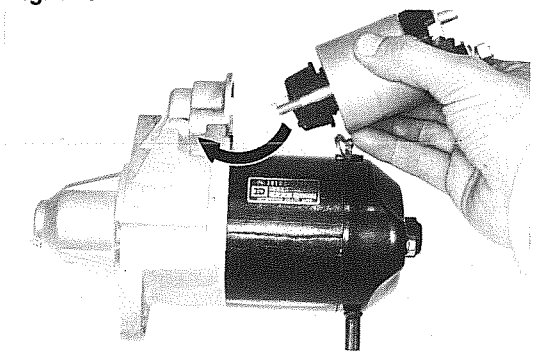
Fig. 7-61



Install the bearing cover.

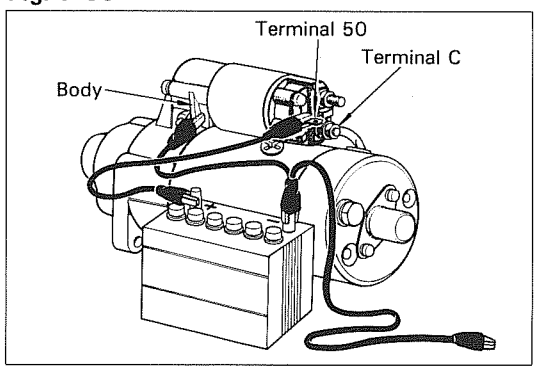
– Note –
Refill the cover about 1/4 full with grease.

Fig. 7-62



Hook the magnetic switch onto the drive lever spring from underneath.

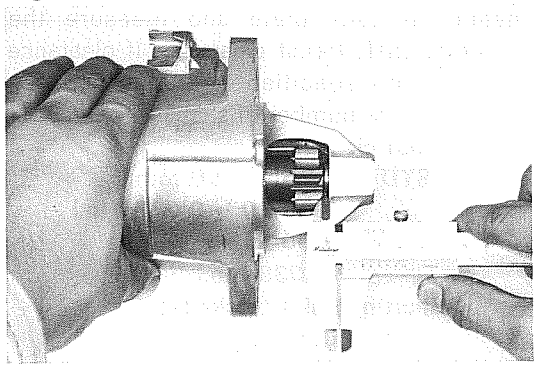
Fig. 7-63



Check the pinion clearance.

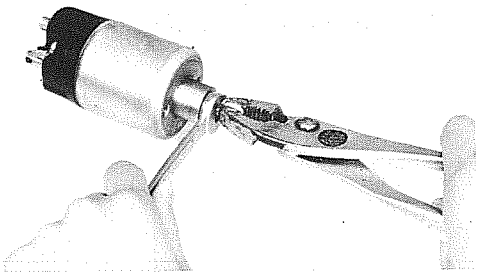
1. Connect the field coil lead to terminal C.
2. Connect the magnetic switch to a battery as shown in the figure.
   Battery (+) ——→ Terminal 50
   Battery (—) ——→ Starter body

Fig. 7-64



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

Fig. 7-65



4. 1.0 kw Type
   If necessary, loosen the lock nut and adjust.

Clearance	Stud
Too large	——→ Screw in
Too small	——→ Screw out

REDUCTION STARTING SYSTEM CIRCUIT

Fig. 7-66

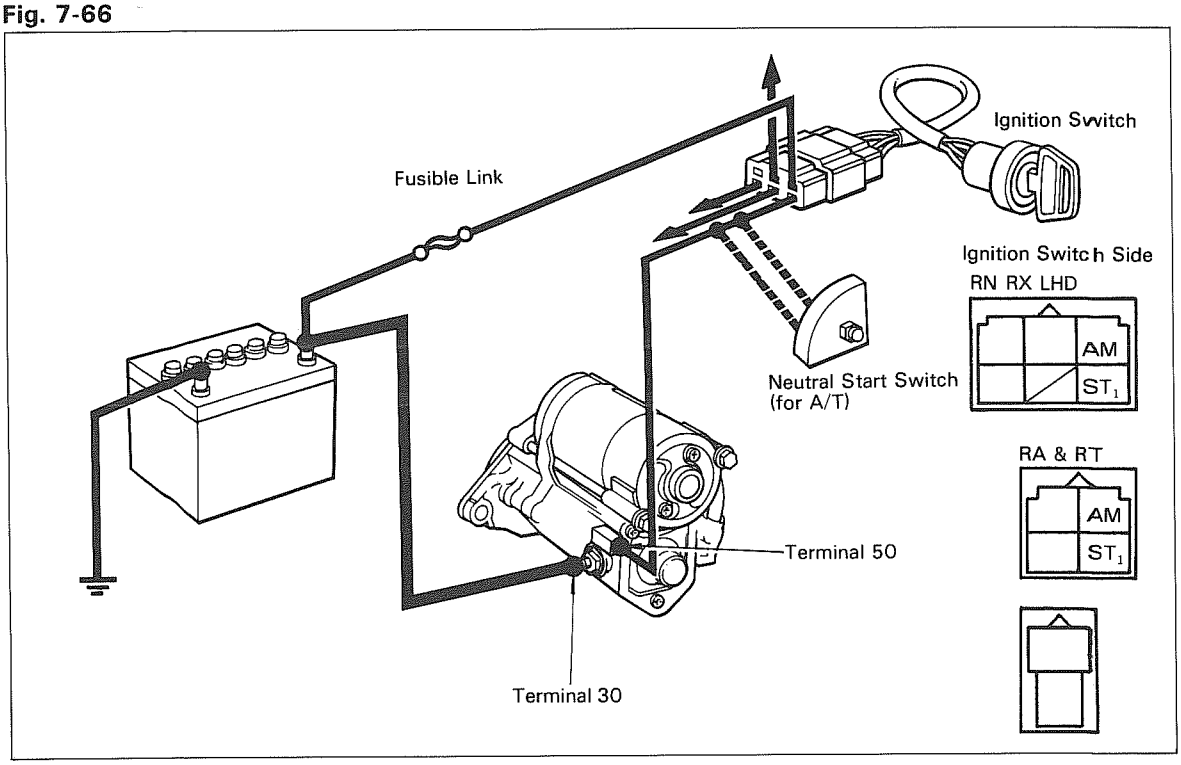


Fig. 7-67

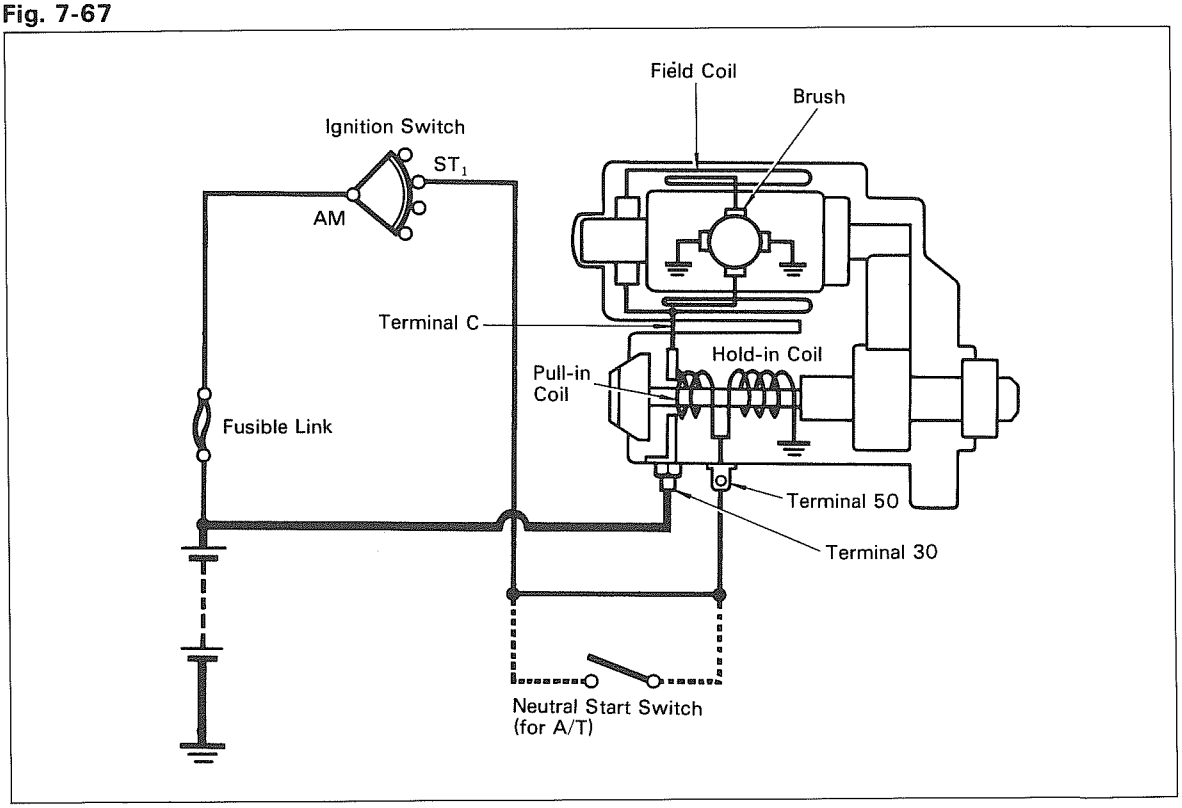
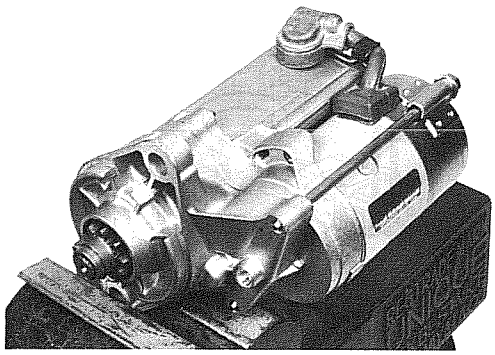


Fig. 7-68

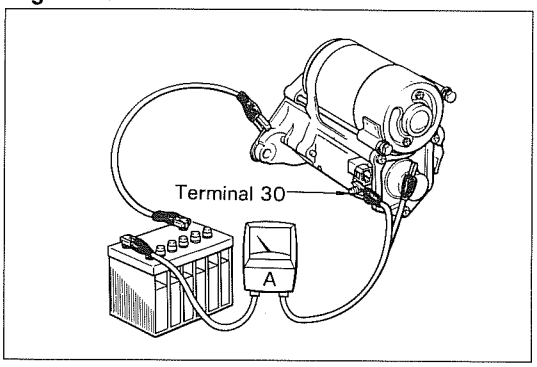


PERFORMANCE TEST

NO-LOAD PERFORMANCE TEST

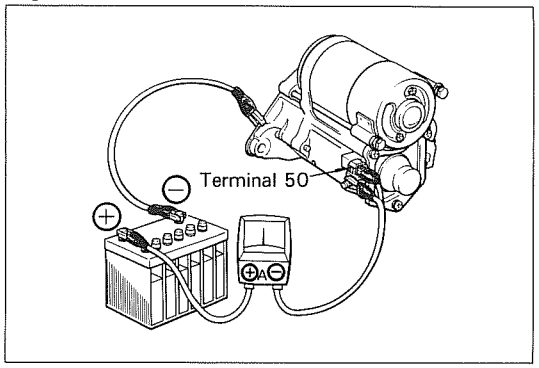
1. Secure the starter in a vise to prevent an accident.

Fig. 7-69



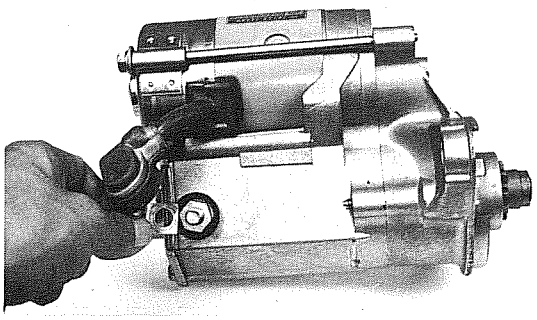
2. Connect the starter to a battery as shown in the figure.
   Positive side:
   Battery (+) ——→ Ammeter (+)
   Ammeter (—) ——→ Terminal 30
   Negative side:
   Battery (—) ——→ Starter housing

Fig. 7-70



3. Connect the 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 90A
   (at 11.5 V)

Fig. 7-71

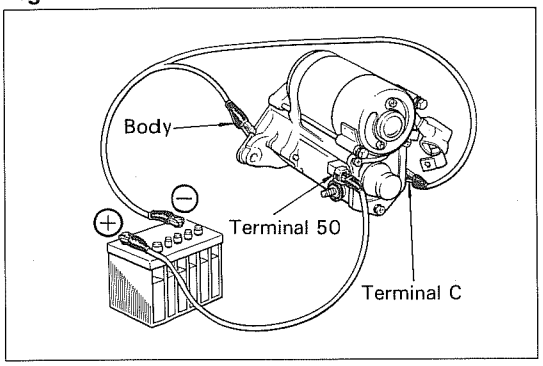


MAGNETIC SWITCH TEST

— Note —
Each test must be performed within a short time (3 — 5 seconds) to prevent the coil from burning out.

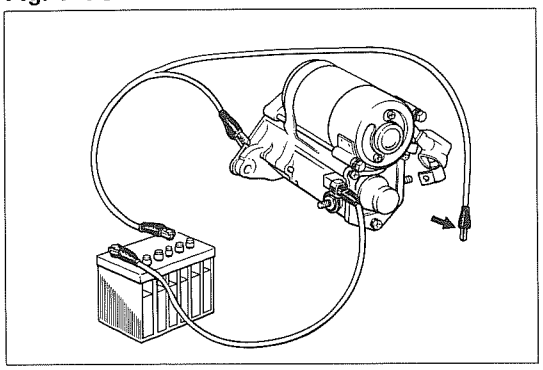
1. Disconnect the terminal C lead wire.

Fig. 7-72



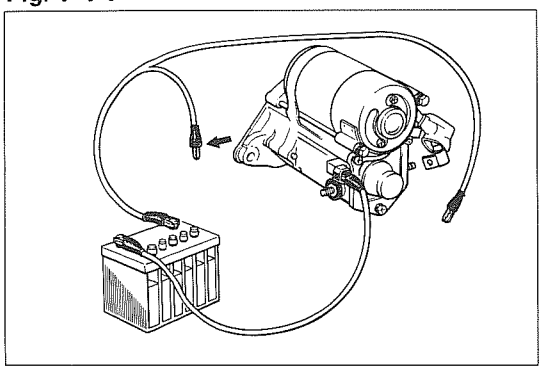
2. Pull-in test
Connect the magnetic switch to a battery as shown in the figure.
Negative side:
Battery (−) ——→ Starter body and terminal C
Positive side:
Battery (+) ——→ Terminal 50
If the pinion has definitely jumped out, the pull-in coil is satisfactory.

Fig. 7-73



3. Hold-in test
Disconnect the terminal C. The pinion should remain projected.

Fig. 7-74



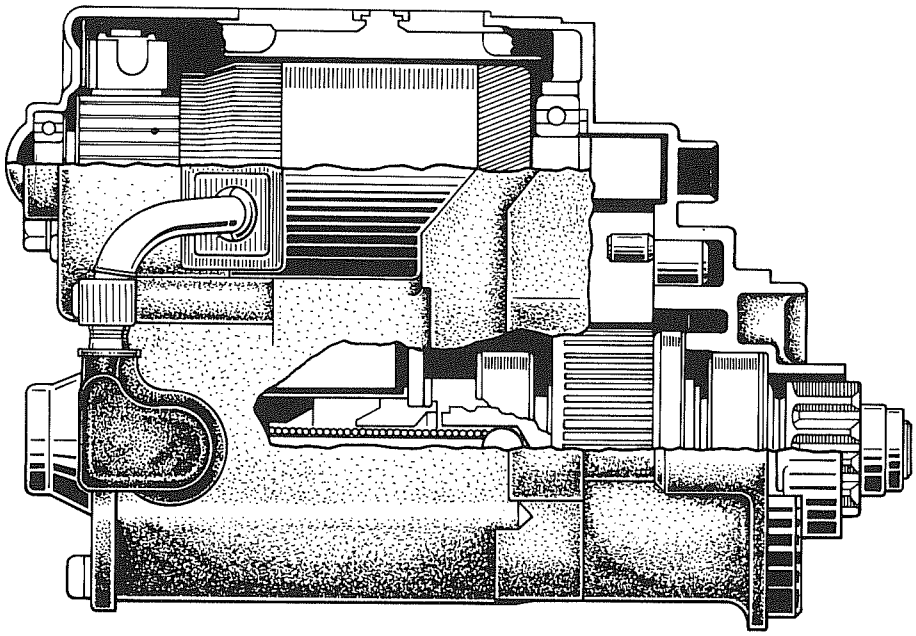
4. Check pinion return.
When disconnecting the cable from the starter housing, the jumped-out pinion should return quickly.

REDUCTION STARTER

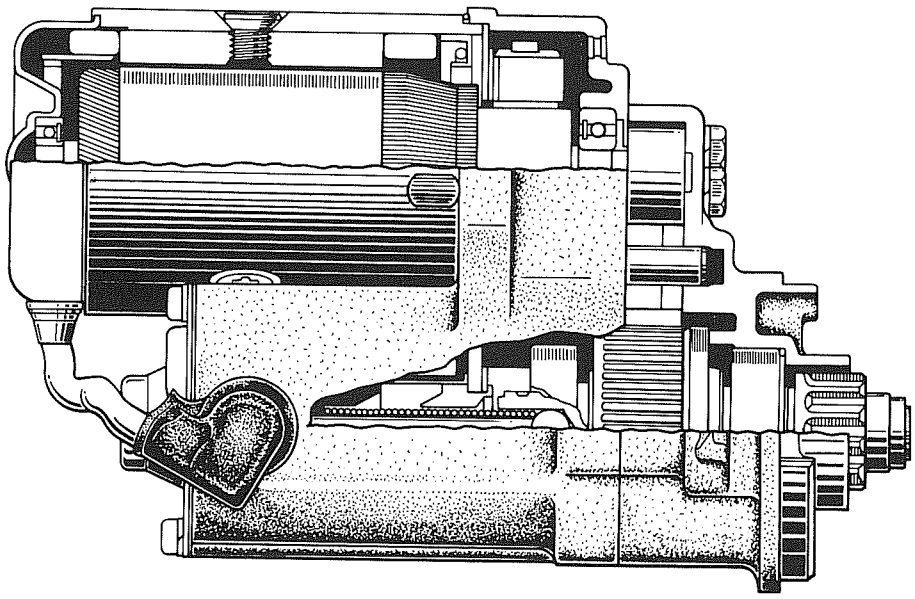
CUTAWAY VIEW

Fig. 7-75

[1.0 kw Type]



[1.4 kw Type]

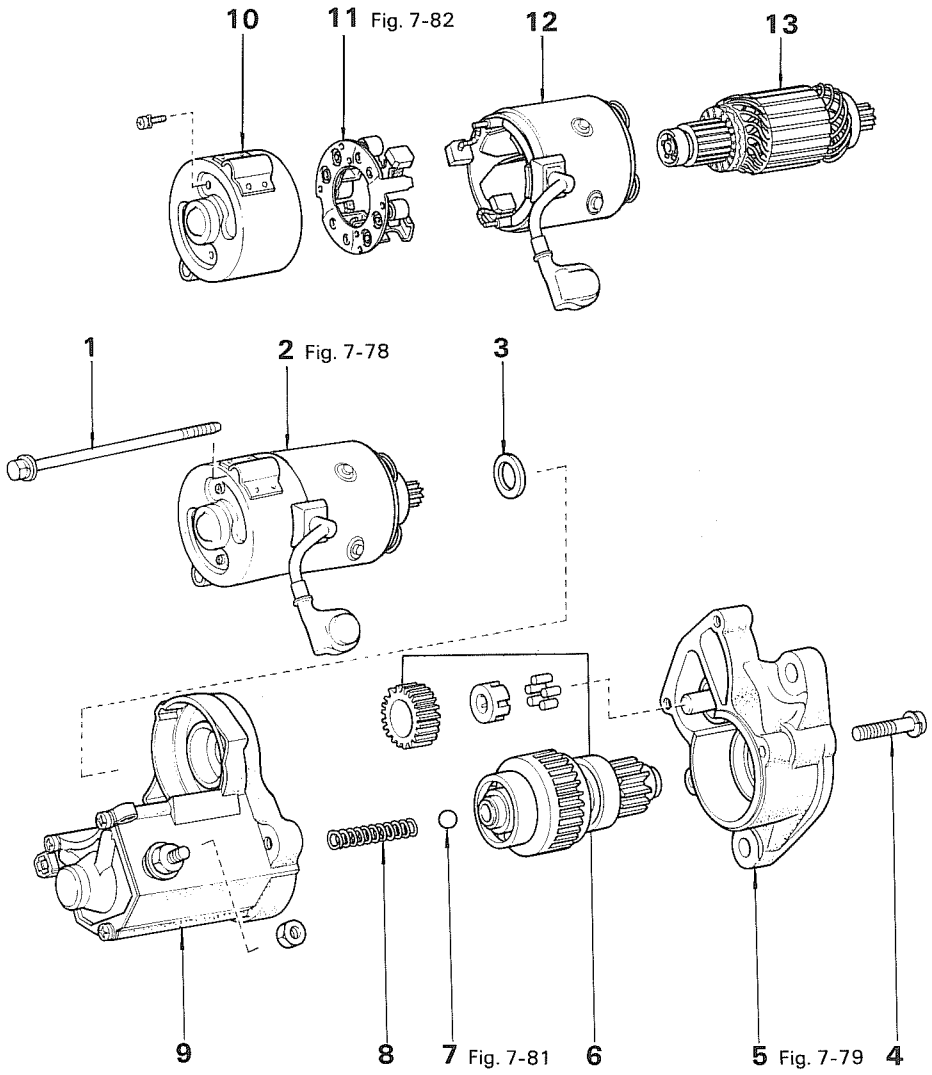


DISASSEMBLY

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

Fig. 7-76

[1.0 kw Type]

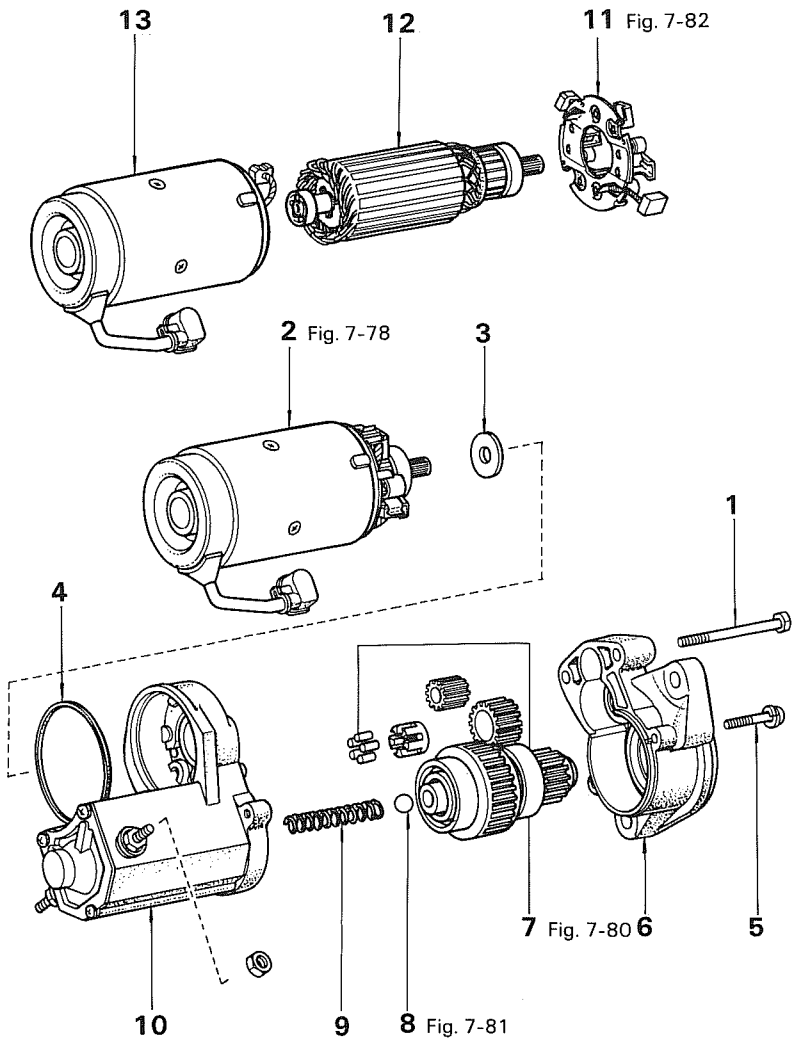


1. Through Bolt
2. Yoke & Armature
3. Felt Washer
4. Bolt
5. Starter Housing
6. Clutch & Idler Gear
7. Steel Ball
8. Return Spring
9. Magnetic Switch
10. End Frame
11. Brush Holder
12. Yoke
13. Armature

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

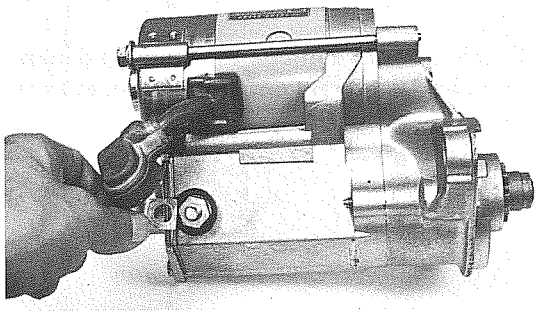
Fig. 7-77

[1.4 kw Type]



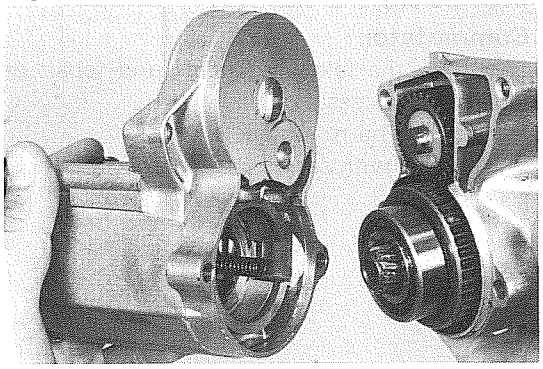
1. Through Bolt
2. Yoke & Armature
3. Felt Washer
4. O Ring
5. Bolt
6. Starter Housing
7. Clutch Idler Gear & Drive Pinion
8. Steel Ball
9. Return Spring
10. Magnetic Switch
11. Brush Holder
12. Armature
13. Yoke

Fig. 7-78



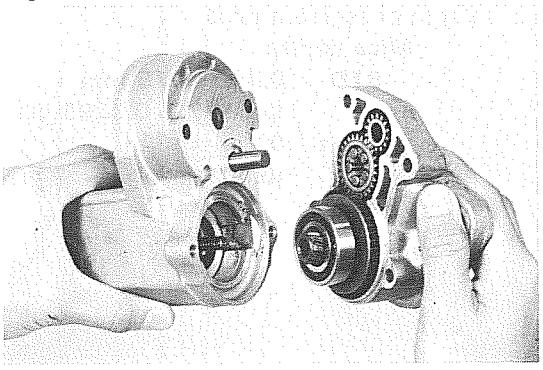
Disconnect the terminal C lead wire from the magnetic switch.

Fig. 7-79



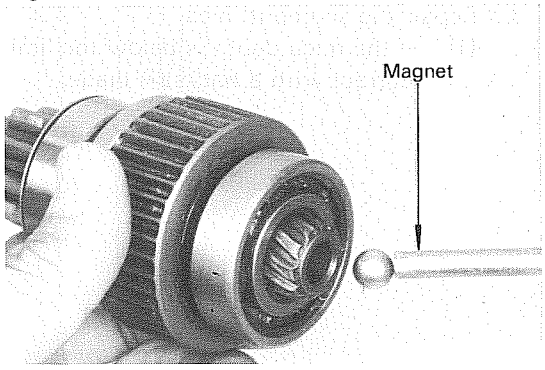
1.0 kw Type
Remove the starter housing together with the idler gear and clutch.

Fig. 7-80



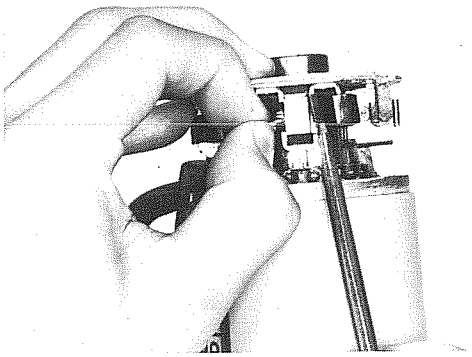
1.4 kw Type
Remove the starter housing together with the drive pinion, idler gear and clutch.

Fig. 7-81



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

Fig. 7-82

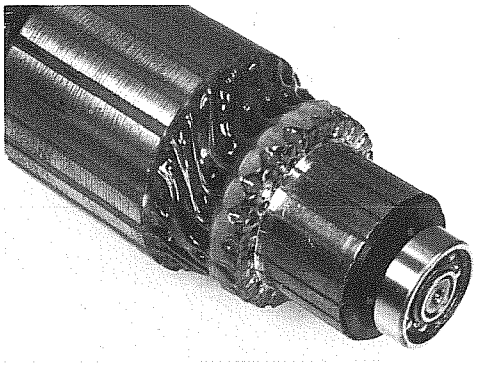


Remove the brushes from the brush holder.

— Note —

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

Fig. 7-83



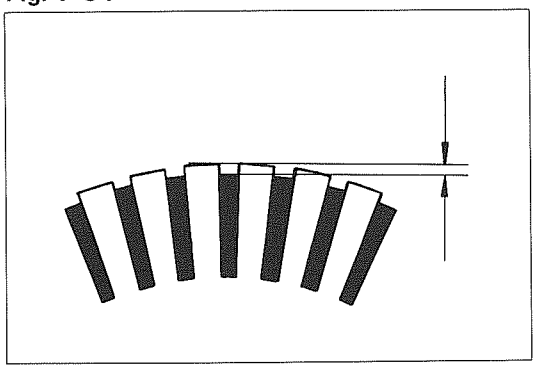
INSPECTION & REPAIR

Commutator

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

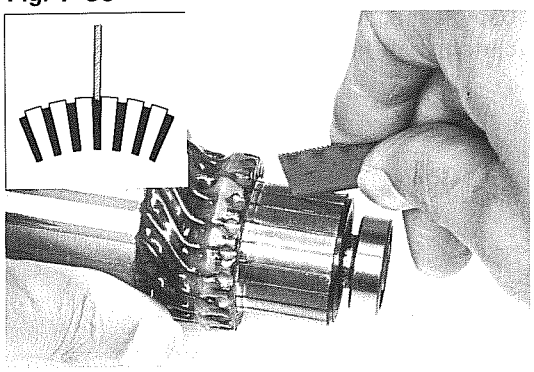
1. Dirty or burnt surface
   Correct with sandpaper if necessary.

Fig. 7-84



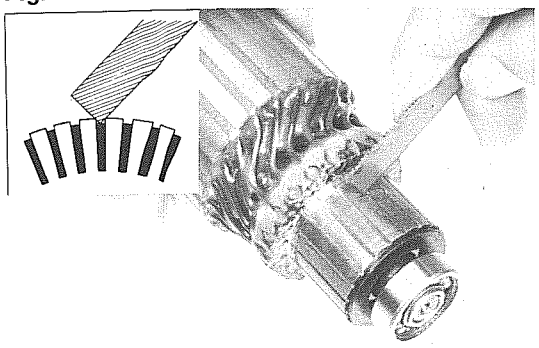
2. Depth of segment mica
   Mica depth:
   STD 0.45 – 0.75 mm (0.0177 – 0.0295 in.)
   Limit 0.2 mm (0.008 in.)

Fig. 7-85



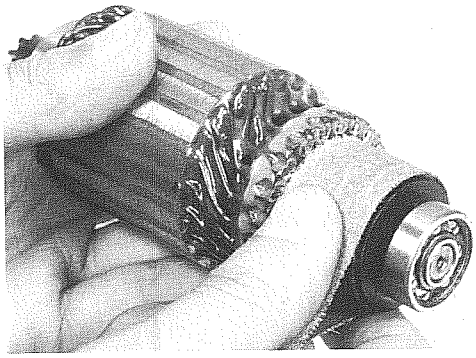
3. Repair the segment mica.
   (1) If the mica depth is below the limit, correct with a hacksaw blade.

Fig. 7-86



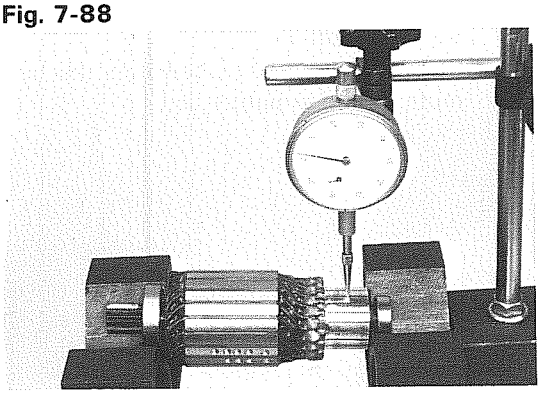
(2) Smooth out the edge with a hack-saw blade.

Fig. 7-87



(3) Use #400 sandpaper to smooth the commutator surface.

Fig. 7-88

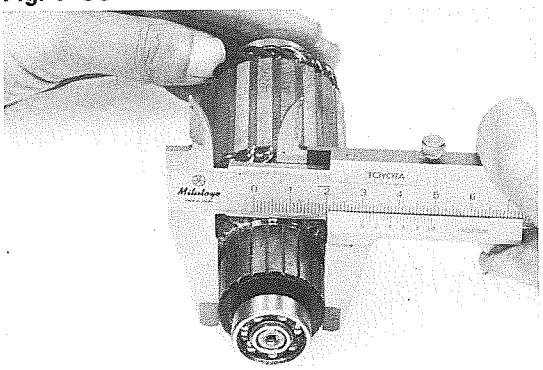


4. Runout
Correct on a lathe if it exceeds the limit.

Runout:

STD	**Less than 0.02 mm (0.0008 in.)**
Limit	**0.2 mm (0.008 in.)**

Fig. 7-89

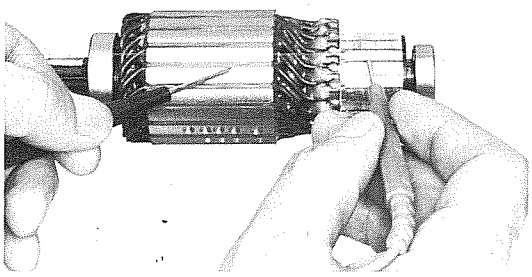


5. Surface wear
Replace the armature if below the limit.

Commutator outer diameter:

STD	**30 mm (1.18 in.)**
Limit	**29 mm (1.14 in.)**

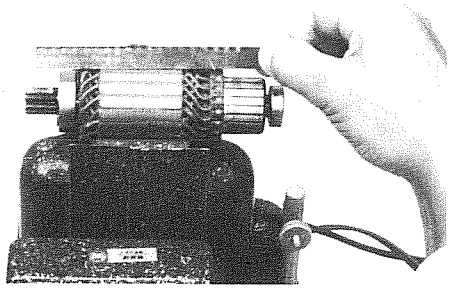
Fig. 7-90



Armature Coil

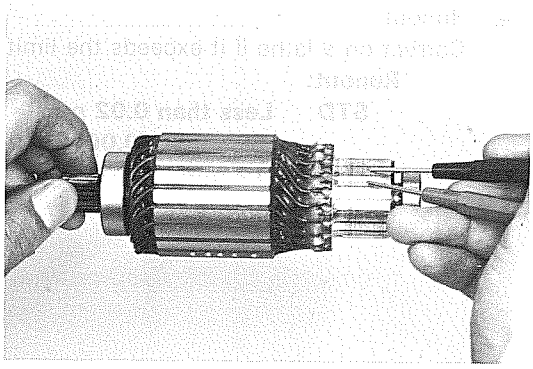
1. Ground test
   Check the commutator and armature coil core.
   If there is continuity, the armature is grounded and must be replaced.

Fig. 7-91



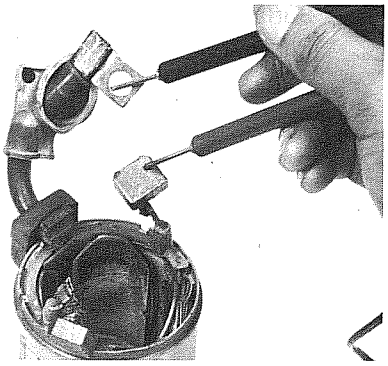
2. Short circuit test
   Place the armature on the armature tester and hold a hacksaw blade against the armature core while turning the armature. If the hacksaw blade is attracted or vibrates, the armature is shorted and must be replaced.

Fig. 7-92



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

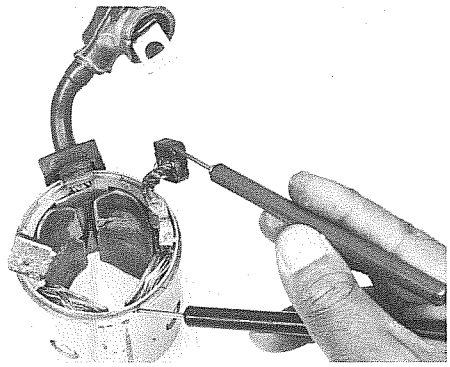
Fig. 7-93



Field Coil

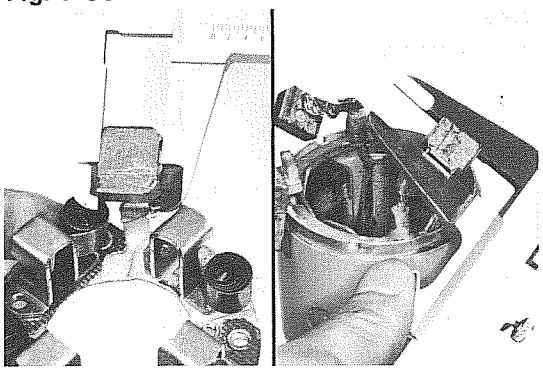
1. Open circuit test
   Check for continuity between the lead wire and soldered connection of the field coil brush. If there is no continuity, there is an open circuit in the field coil and it should be replaced.

Fig. 7-94



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. 7-95

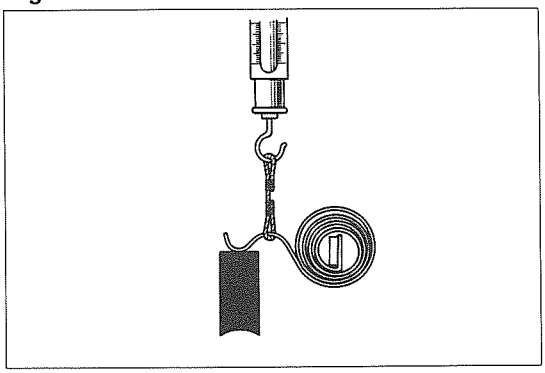


Brush
Measure the brush length and replace if below the limit.

Brush length:

1.0 kw STD	**13.5 mm (0.531 in.)**
Limit	**10 mm (0.39 in.)**
1.4 kw STD	**14.5 mm (0.571 in.)**
Limit	**10 mm (0.39 in.)**

Fig. 7-96

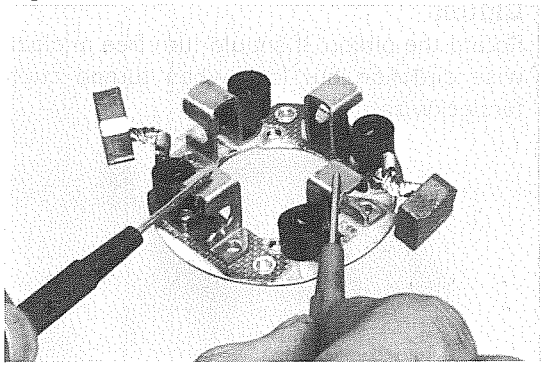


Brush Spring
1. Measure the brush spring load with a pull scale. If the reading is below the specified value, replace the spring.

Tension:

1.0 kw STD	**1,445 – 1,955 g (3.2 – 4.3 lb)**
Limit	**1,200 g (2.6 lb)**
1.4 kw STD	**1,785 – 2,415 g (3.9 – 5.3 lb)**
Limit	**1,200 g (2.6 lb)**

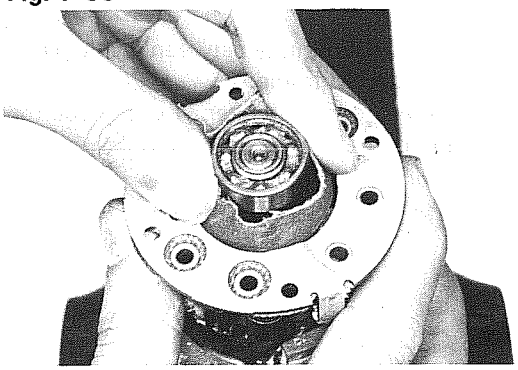
Fig. 7-97



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

Brush Holder
1. Check the insulation between the (–) brush holder and (+) brush holder. Repair or replace, if continuity is indicated.

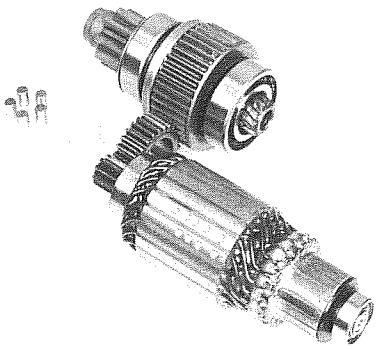
Fig. 7-98



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

– Note –
Secure the armature gear in a vise or such.

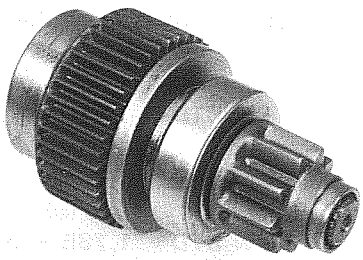
Fig. 7-99



Gear

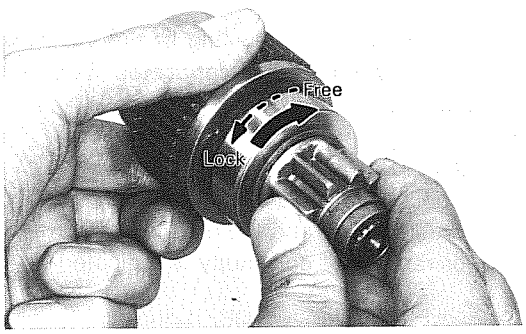
1. Check the gears for wear or damage.

Fig. 7-100



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

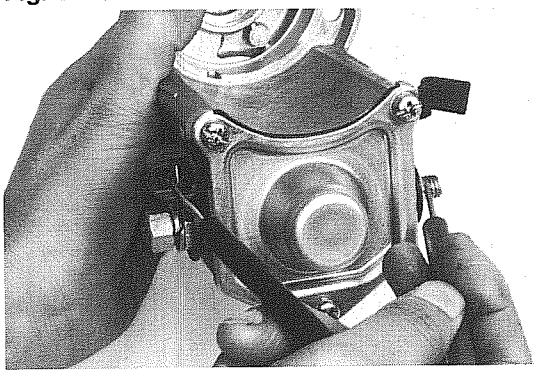
Fig. 7-101



Clutch

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

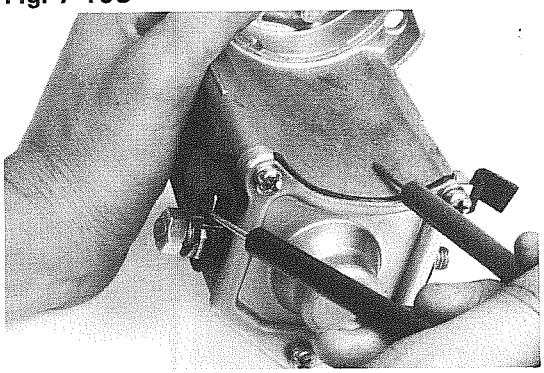
Fig. 7-102



Magnetic Switch

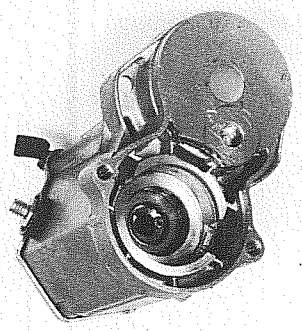
1. Pull-in coil open circuit test
   Check for continuity between the terminal 50 and terminal C.

Fig. 7-103



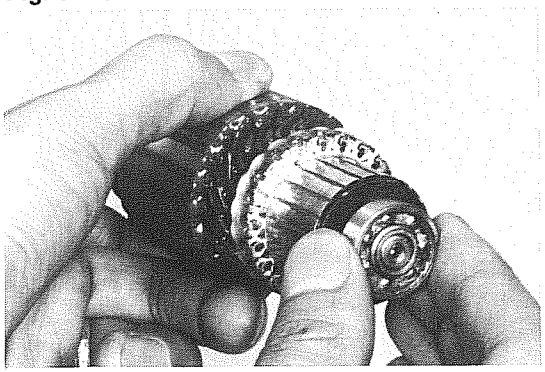
2. Hold-in coil open circuit test
   Check for continuity between terminal 50 and the magnetic switch body.

Fig. 7-104



3. Check for wear or damage.

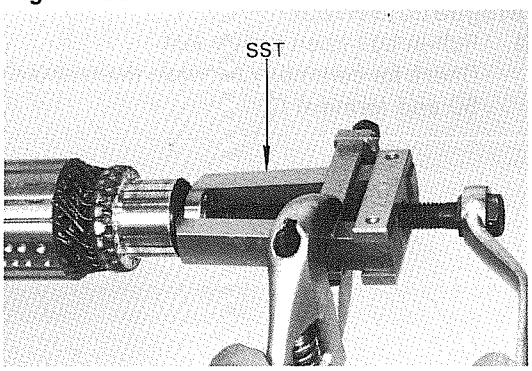
Fig. 7-105



Bearing

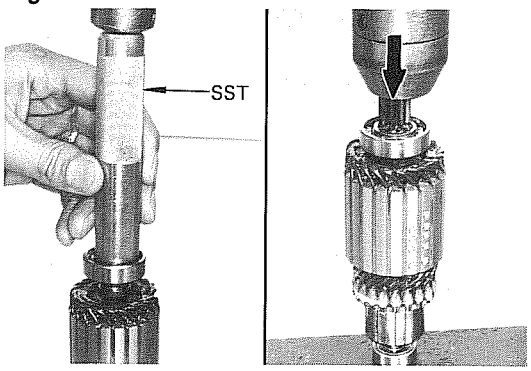
1. Check the bearing for wear or damage.

Fig. 7-106



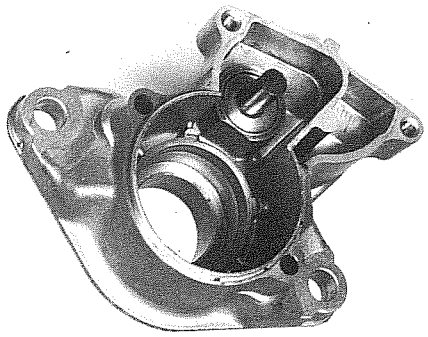
2. Replace armature bearing if defective.
   (1) Remove the bearing with SST
   SST [09286-46011]

Fig. 7-107



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

Fig. 7-108



Starter Housing
Inspect for wear or damage.

ASSEMBLY

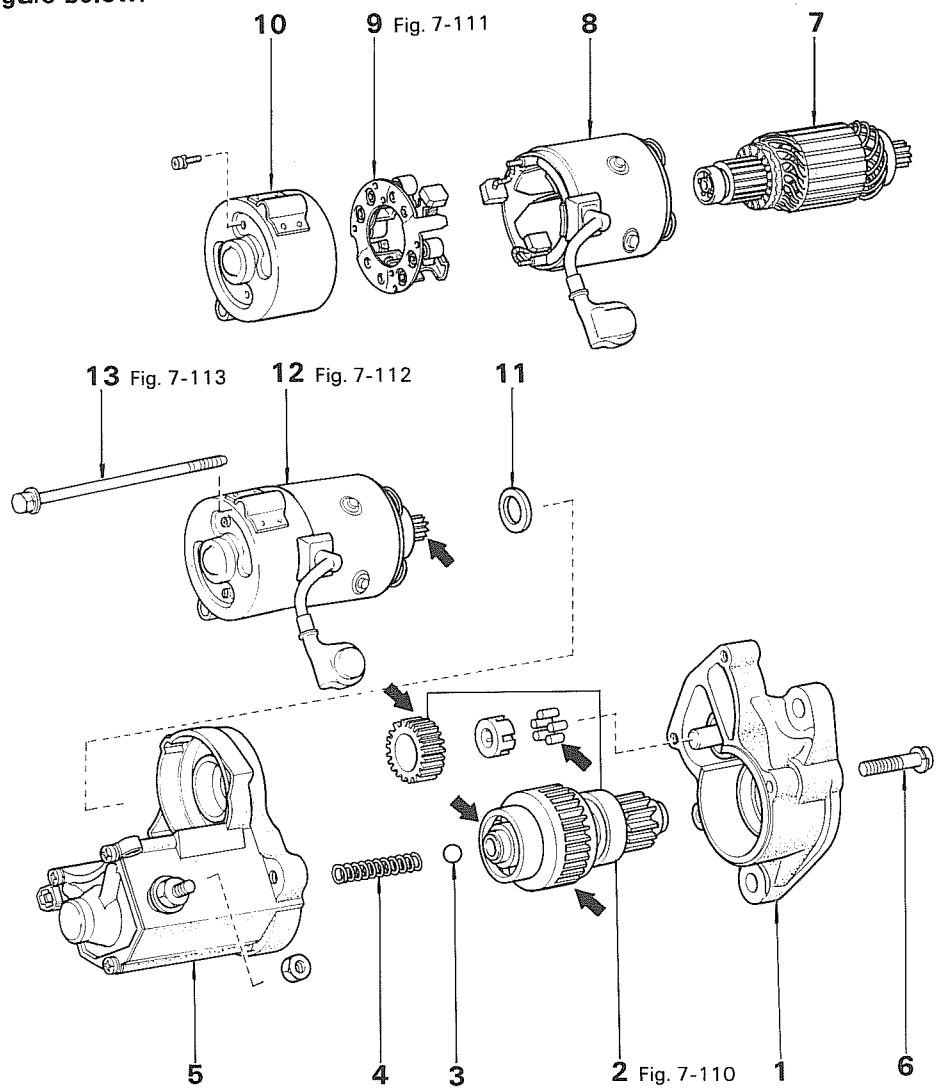
1. Assemble the parts in the numerical order shown in the figure.

Fig. 7-109

[1.0 kw Type]

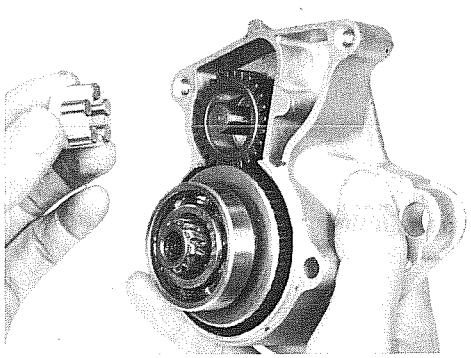
– Note –

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



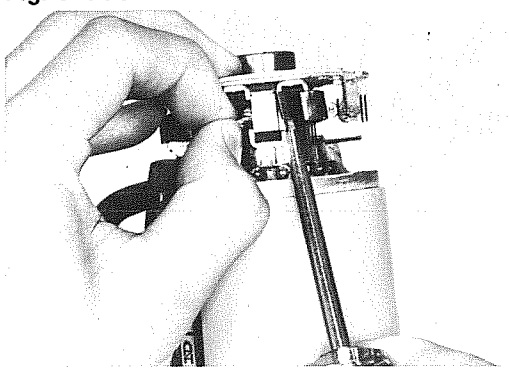
1. Starter Housing
2. Clutch & Idler Gear
3. Steel Ball
4. Return Spring
5. Magnetic Switch
6. Bolt
7. Armature
8. Yoke
9. Brush Holder
10. End Frame
11. Felt Washer
12. Yoke & Armature
13. Through Bolt

Fig. 7-110



Install the clutch and idler gear to the starter housing.

Fig. 7-111

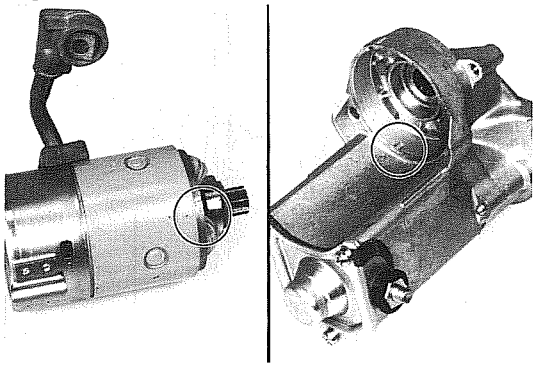


Assemble the brush holder.

– Note –

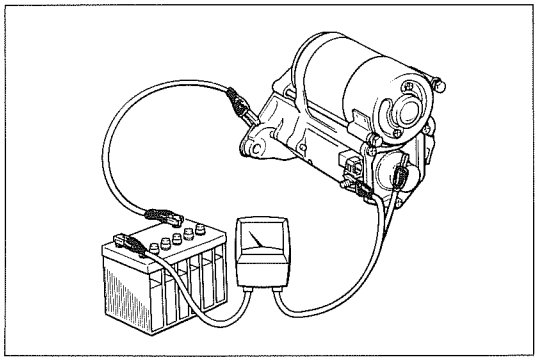
1. **Use care not to damage or get oil on the brushes and commutator.**
2. **Secure the armature gear in a vise or such.**

Fig. 7-112



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

Fig. 7-113



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 corrent, it is satisfactory.

Specified current: Less than 90A (at 11.5 V)

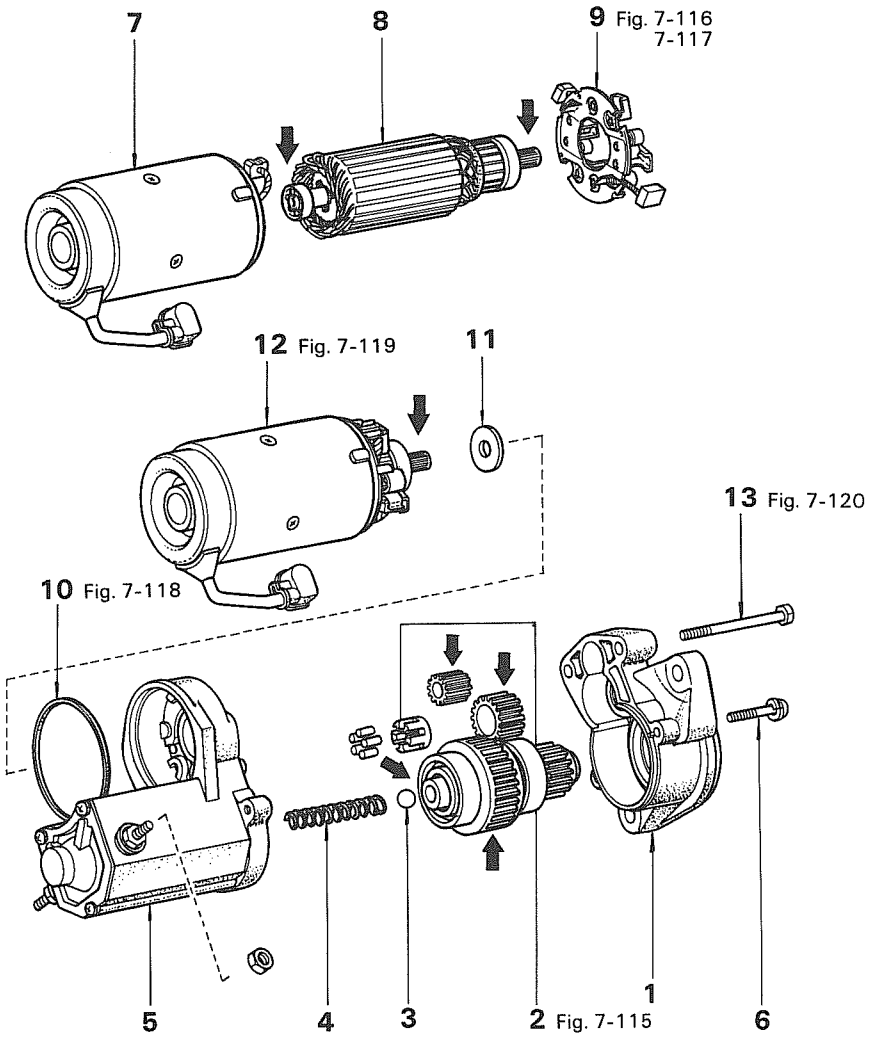
2. Assemble the parts in the numerical order shown in the figure.

Fig. 7-114

[1.4 kw Type]

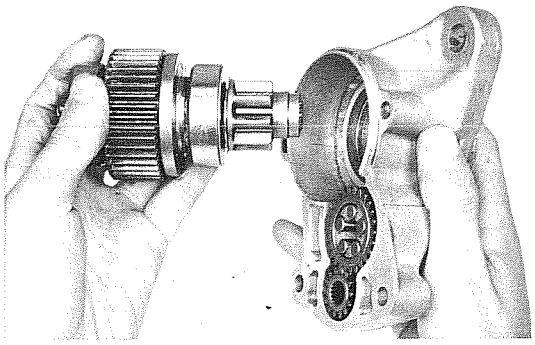
– Note –

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



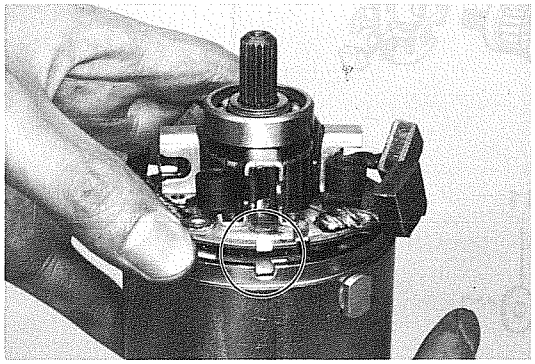
1. Starter Housing
2. Clutch, Idler Gear & Drive Pinion
3. Steel Ball
4. Return Spring
5. Magnetic Switch
6. Bolt
7. Yoke
8. Armature
9. Brush Holder
10. O Ring
11. Felt Washer
12. Yoke & Armature
13. Through Bolt

Fig. 7-115



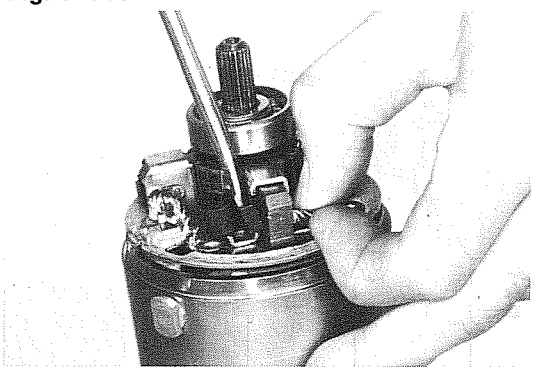
Install the clutch, idler gear and drive pinion to the starter housing.

Fig. 7-116



Align the brush holder tab with the notch in the field frame.

Fig. 7-117

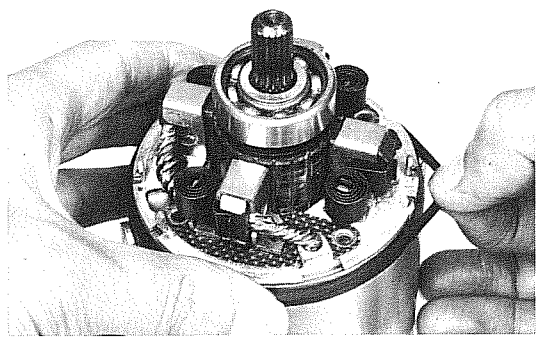


Assemble the brush holder.

– Note –

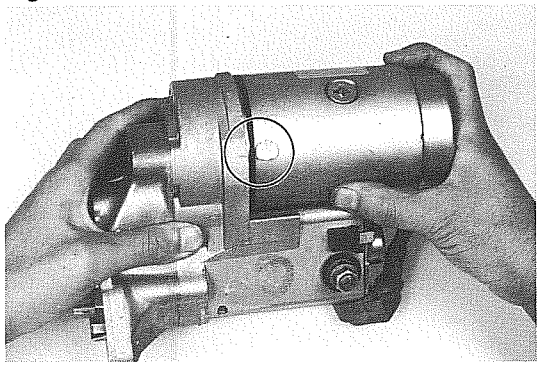
Use care not to damage or get oil on the brushes and commutator.

Fig. 7-118



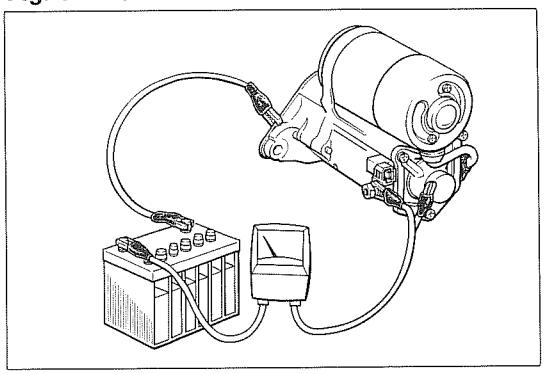
Install the O ring around the yoke.

Fig. 7-119



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

Fig. 7-120



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 90A (at 11.5 V)

MEMO