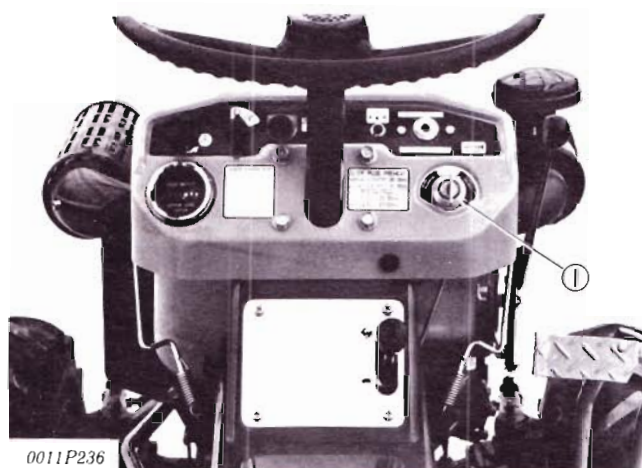


Group 3

Key Switch



1. Key Switch

Fig. N-25

Power is supplied to the circuits from the battery when the engine stops and from the dynamo when the engine rotates, depending on the position of key switch.

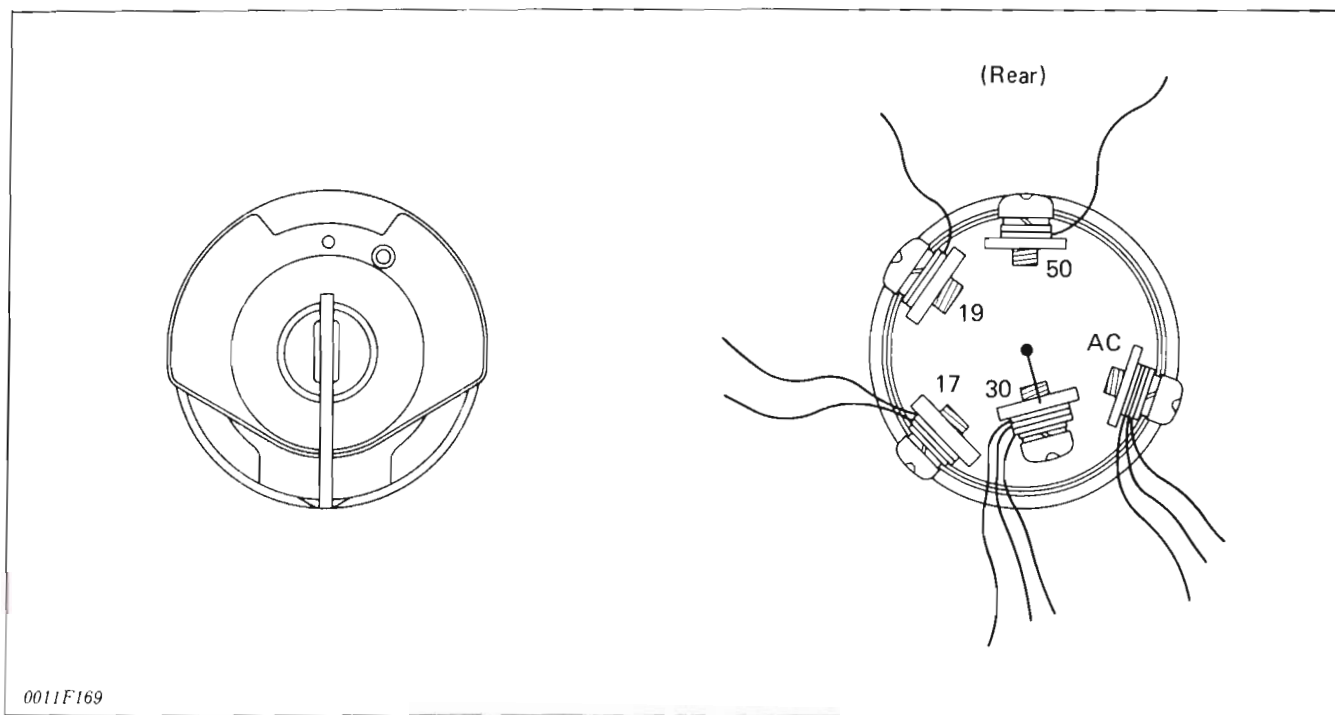


Fig. N-26 Key Position: OFF

The glow plug and glow plug indicator are on while the key is held at the left side and the battery current flows from terminal No. "30" to terminal No. "19". Simultaneously, the current flows from terminal No. "30" to the "AC" terminal to light

the engine oil pressure lamp and activate the hourmeter. After preheating is completed and the key is released, the key will return to OFF by the action of a spring.

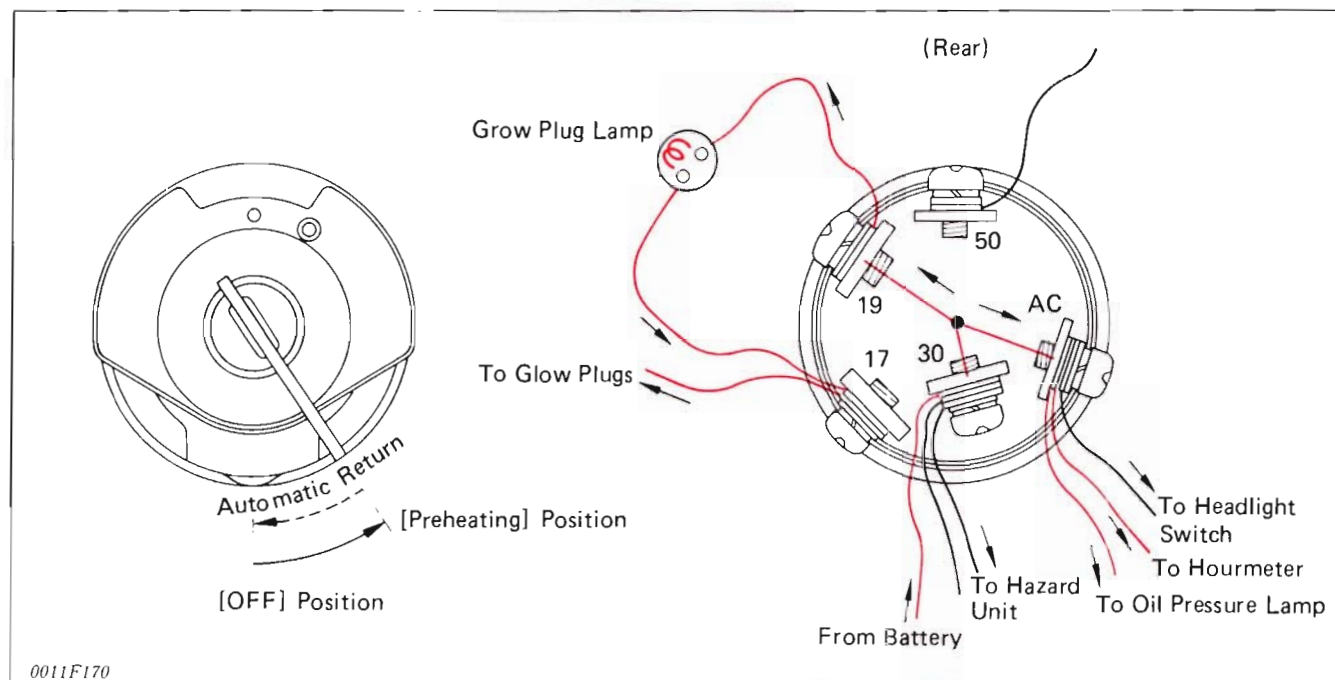


Fig. N-27 Key Position: Preheating

To operate the starter, turn the key to the right through the ON position "⊙". Then, battery current flows from terminal No. "30" to terminal No. "50", for activating the starter. Simultaneously, the battery current flows from terminal No. "30" to terminal No. "17" to heat the glow plug,

and from terminal No. "30" to the "AC" terminal to activate the hourmeter and light the oil pressure lamp.

After the engine is started, release the key and the key will return to the ON position "⊙" by the action of a spring.

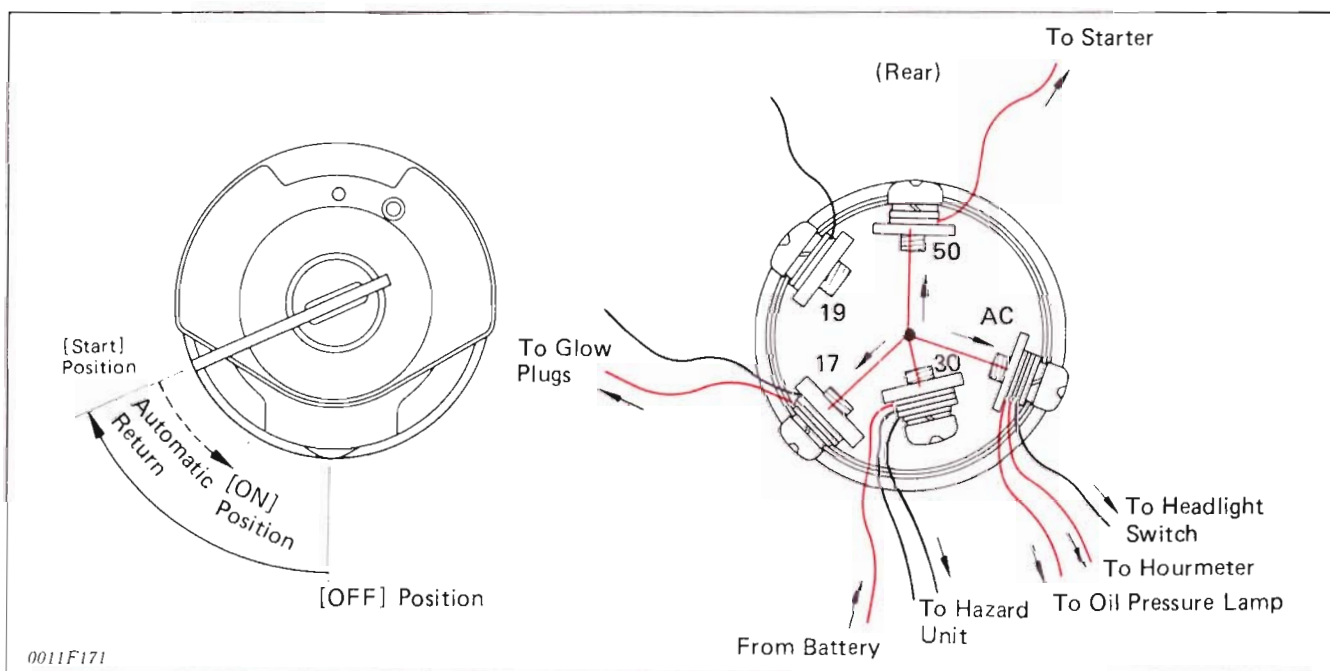


Fig. N-28 Key Position: START

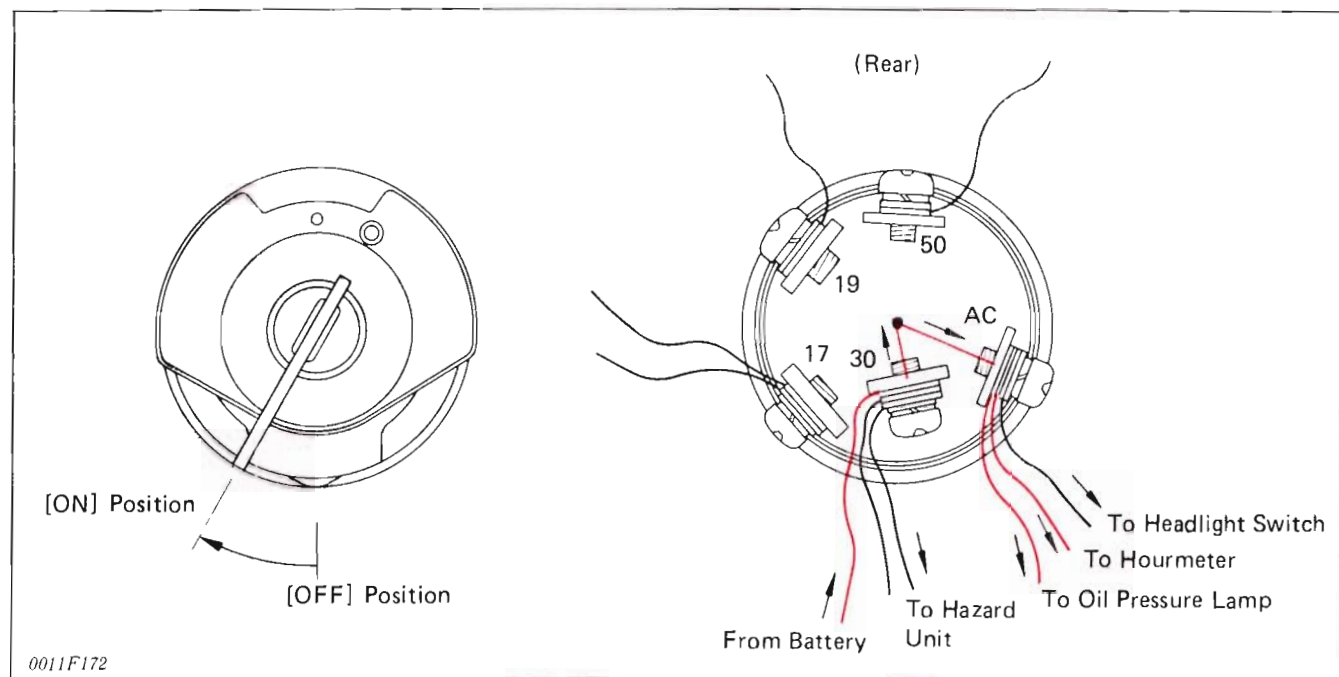


Fig. N-29 Key Position: ON

Rated current of each terminal

No. "17" and No. "19": 30A
No. "50": 12A
"AC": 10A

Group 4

Starter

The magnet-switch type starter is composed of two main sections.

The first section converts battery current into mechanical rotation to turn the engine crankshaft. It is composed of the field coil, armature, brush,

commutator, pinion, overrunning clutch, etc.

The second section allows the pinion and flywheel to engage together and current to flow through the motor section. It is composed of the pull-in coil, holding coil, plunger, drive lever, contact plate, etc.

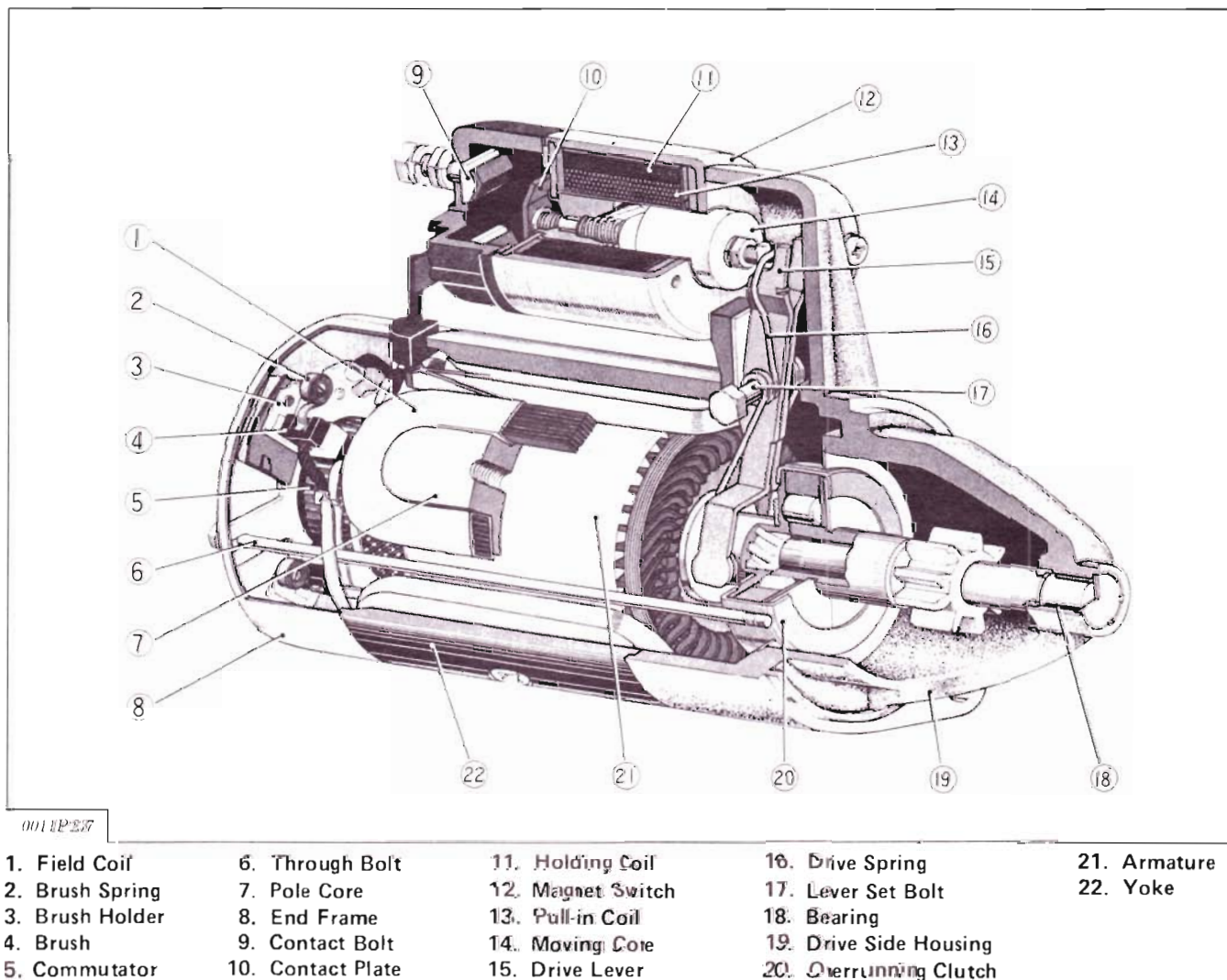
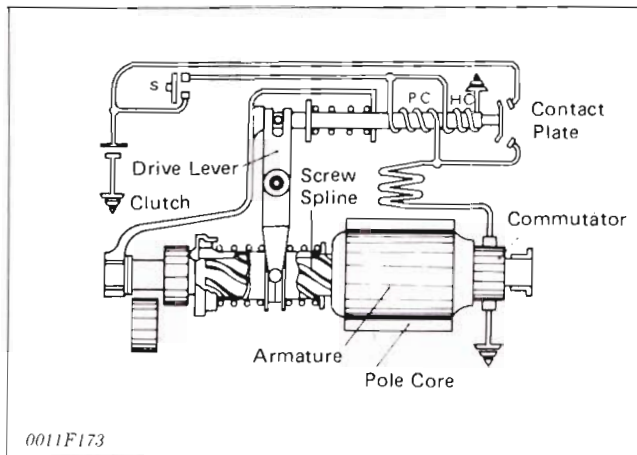


Fig. N-30 Construction



PC: Pull-in Coil HC: Holding Coil S: Switch

Fig. N-31 Starter Circuit

When Key Switch Is On:

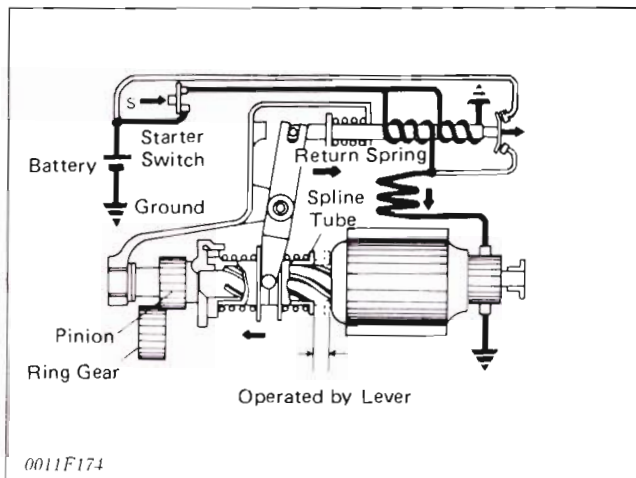


Fig. N-32 When Key Switch Is On:

When the key switch is turned on, a current flows from the battery through the pull-in coil in the magnet switch section to the holding coil, energizing the plunger to pull it in.

At this time, the pinion moves by the drive lever to engage with the ring gear.

When Contact Plate Is Closed:

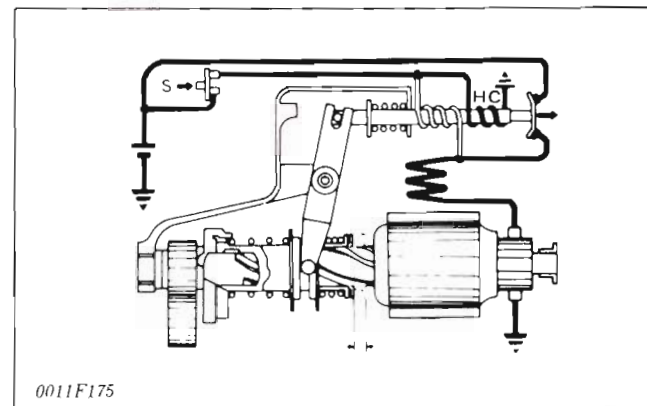


Fig. N-33 When Contact Plate Is Closed.

When the contact plate is closed, a large current flows through the motor section to generate a large mechanical power which turns the engine crankshaft.

At this time, the pinion is moved forward by the screw spline for more contact.

Since the pull-in coil ends are short-circuited by the contact plate, the plunger is held only by the force of the holding coil.

When Key Switch Is Released:

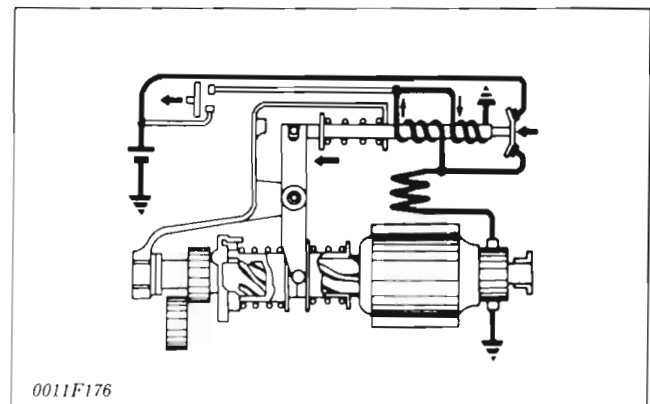
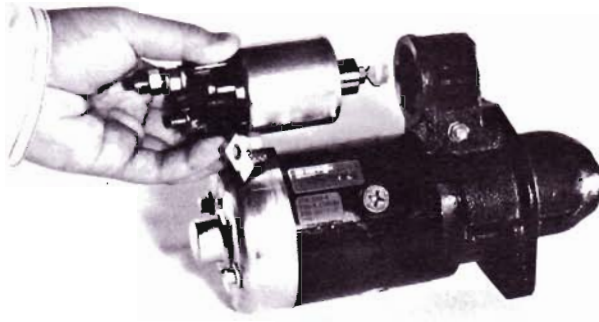


Fig. N-34 When Key Switch Is Released:

When the key switch is released, a current flows instantaneously through the pull-in coil in the opposite direction as shown in Fig. N-34. Therefore, the forces of the holding coil and pull-in coil are balanced. As a result, the plunger is returned by the return spring. Simultaneously, the pinion is disengaged from the ring gear, the contact plate is disconnected, and the starter is promptly stopped by the armature brake.

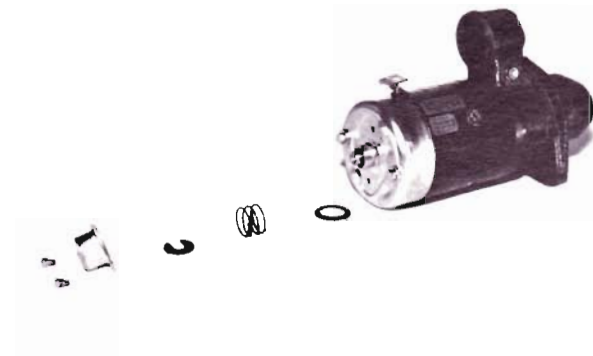
Disassembling Starter



C022P062

Fig. N-35 Removing Magnet Switch

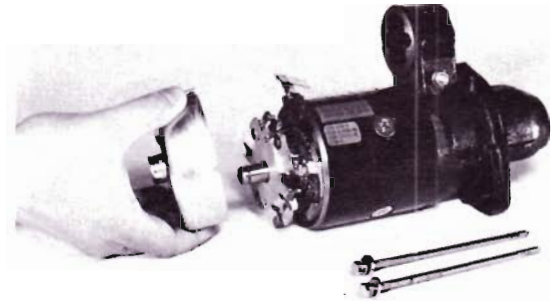
- (1) Remove the connecting lead.
- (2) Remove the set screws.
- (3) Detach the magnet switch by lifting it up while taking care that it does not contact the drive lever.



C022P063

Fig. N-36 Removing Armature Brake

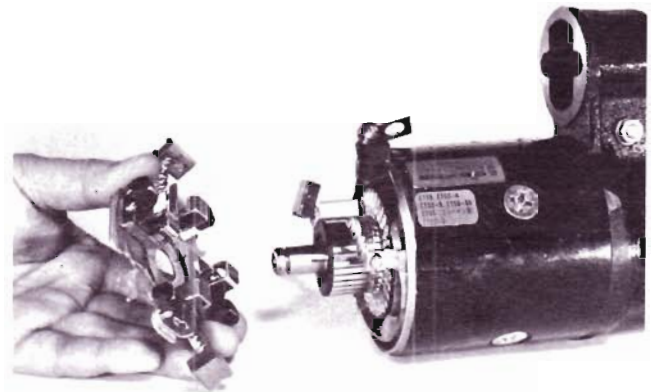
- (4) Remove the end frame cap.
- (5) Remove the washers.
- (6) Remove the brake spring.
- (7) Remove the gasket.



C022P065

Fig. N-37 Removing End Frame

- (8) Remove the through bolts.
- (9) Remove the end frame.



C022P066

Fig. N-38 Removing Brush Holder

- (10) Draw out the brush from the holder while holding the spring up.
- (11) Take off the brush holder.

NOTE:

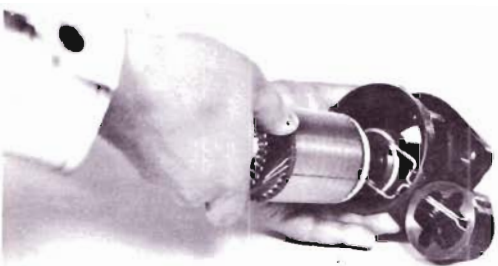
- Be sure not to mistake the direction and position of the spring.
- Do not contact the body with the positive brush's lead.



C022P067

Fig. N-39 Removing Yoke

(12) Draw out the yoke from the drive end frame.



C022P068

Fig. N-40 Removing Armature

(13) Remove the set bolt from the drive lever.
(14) Draw out the armature from the drive end frame.



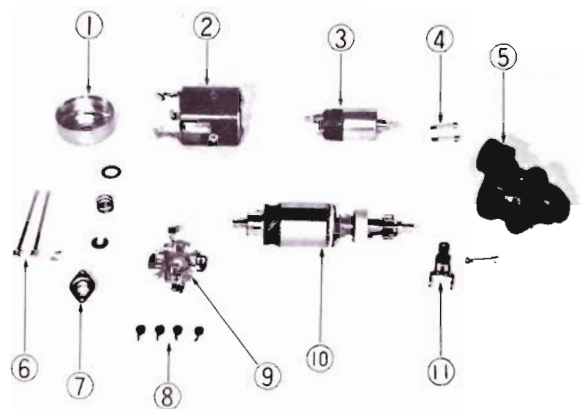
C022P069

Fig. N-41 Detaching Drive Lever

(15) Detatch the drive lever.

CAUTION:

- Be sure not to mistake the installation direction of the drive lever.



0011P238

- | | |
|--------------------|------------------|
| 1. End Frame | 7. End Frame Cap |
| 2. Yoke | 8. Brush Spring |
| 3. Magnet Switch | 9. Brush Holder |
| 4. Screw | 10. Armature |
| 5. Drive End Frame | 11. Drive Lever |
| 6. Through Bolt | |

Fig. N-42 Disassembling Starter

Servicing**Checking procedure**

Checking Battery → Checking Wiring → Checking Safety Switch

Starter no-load test → Checking Motor
→ Checking Magnet Switch

Checking Safety Switch

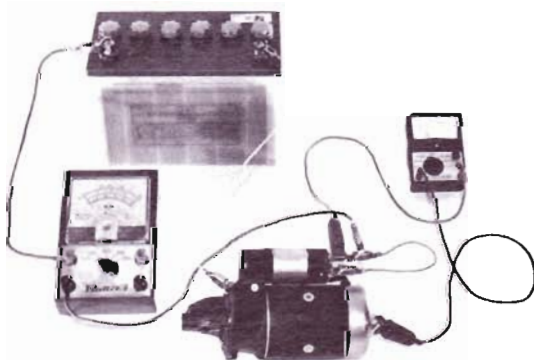
Fig. N-43 Checking Safety Switch

- (1) Remove the safety switch lead.
- (2) Connect the circuit tester to the safety switch side lead.

TEST EQUIPMENT : Circuit Tester

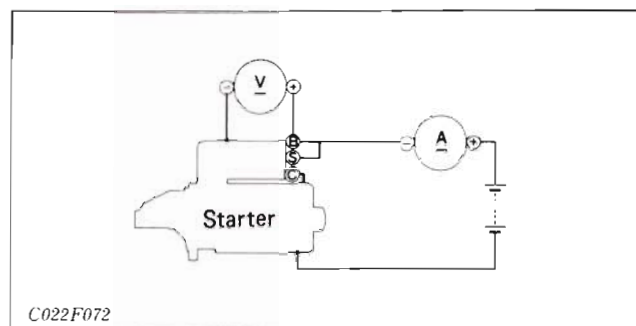
- (3) Measure the resistance while depressing the clutch pedal.
- (4) If the safety switch is defective, replace it.

- Reference value: 0Ω

No-load Testing

C022P042

Fig. N-44 No-load Testing



C022F072

Fig. N-45 Wiring for No-load Testing

- (1) Connect the ammeter's positive probe to the battery's positive terminal and the negative probe to the starter's "B" terminal.
- (2) Connect the battery's negative terminal to the starter body.
- (3) Connect the voltmeter's positive probe to the starter's "B" terminal and the negative probe to the starter body.
- (4) Set a tachometer.
- (5) Connect the starter's "B" terminal to the magnet switch's "S" terminal.
- (6) Check to see that magnet switch actuation results in the specified speed, current and voltage.

- Reference value:

Speed: 5000rpm or more

Current: 50A or more

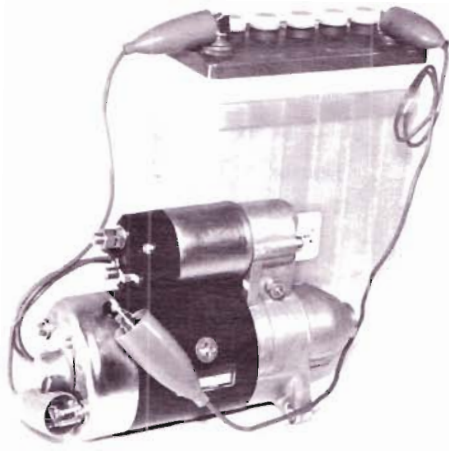
Voltage: 11V

TEST EQUIPMENT: Tachometer,
Circuit Tester

NOTE:

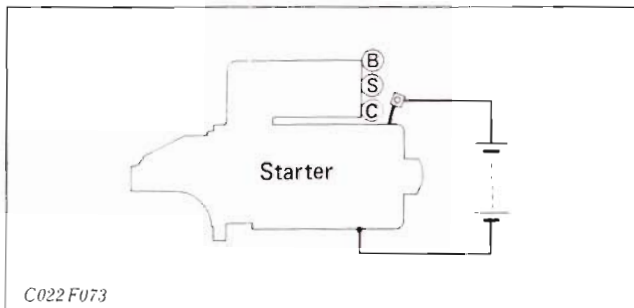
- Use a fully charged battery.
- Use an ammeter and lead of more than 200A capacity because large current flows when the starter runs.

Testing Motor



0011P239

Fig. N-46 Testing Motor

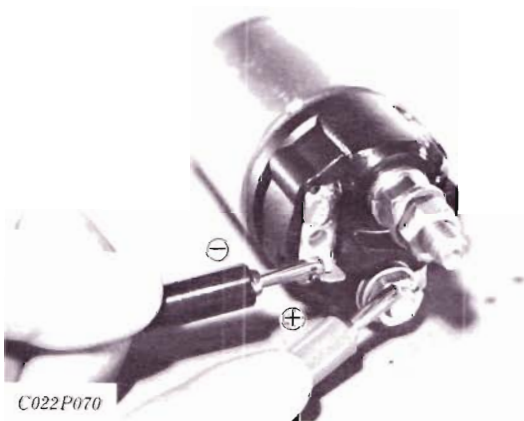


C022F073

Fig. N-47 Wiring for Testing Motor

- (1) Remove the connecting lead from the starter's "C" terminal and connect it directly to the battery's positive terminal. Then connect the battery's negative terminal to the starter body.
- (2) If the starter runs normally, the magnet switch is defective; if not, the motor is defective.

Checking Pull-in Coil (Attraction Test)

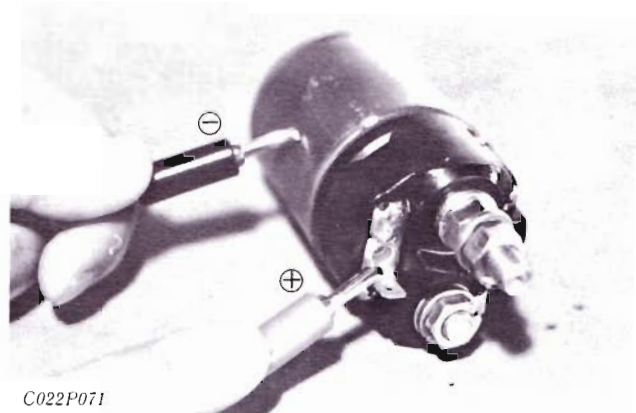


C022P070

Fig. N-48 Checking Pull-in Coil

- (1) Apply 1/2 the rated voltage across "S" terminal and "C" terminal.
- (2) If the plunger is attracted strongly, the pull-in coil is normal; if not, it is defective.

Checking Holding Coil

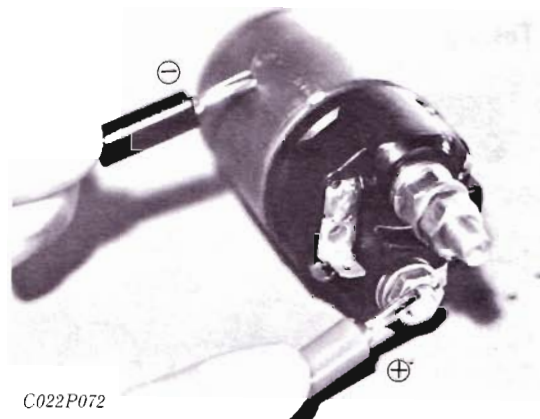


C022P071

Fig. N-49 Checking Holding Coil

- (1) Apply 1/2 the rated voltage across "S" terminal and the body, push the plunger in by hand, and release your hand.
- (2) If the plunger is maintained in the attracted position, the holding coil is good; if not, it is defective.

Checking Return of Magnet Switch Plunger



C022P072

Fig. N-50 Checking Return of Magnet Switch Plunger

- (1) Apply the rated voltage across "C" terminal and body, push the plunger in by hand, and release your hand.
- (2) If the plunger returns immediately, it is good; if not, it is defective.

Checking Pinion Gap

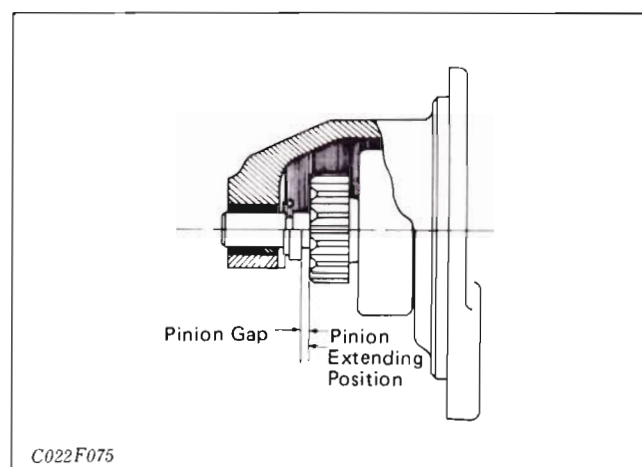


Fig. N-51 Checking Pinion Gap

- (1) Disconnect the connecting lead from "C" terminal.
 - (2) Energize the magnet switch and measure the gap between the pinion tip and the stop collar.
 - (3) To adjust the gap, change the length of the magnet switch joint to the specified one.
- Reference value:
0.1 to 0.4mm (0.0039 to 0.0157 in.)

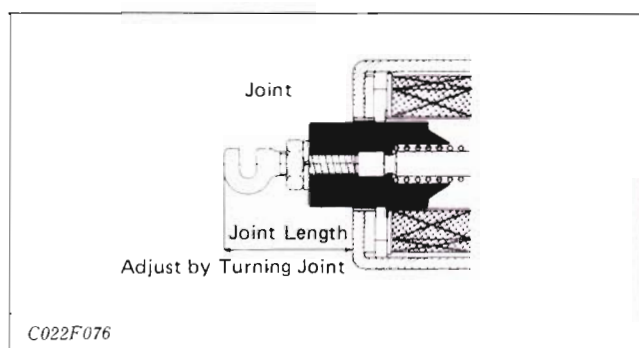


Fig. N-54 Adjusting Pinion Gap

Checking Clearance Between Shaft and Bushing

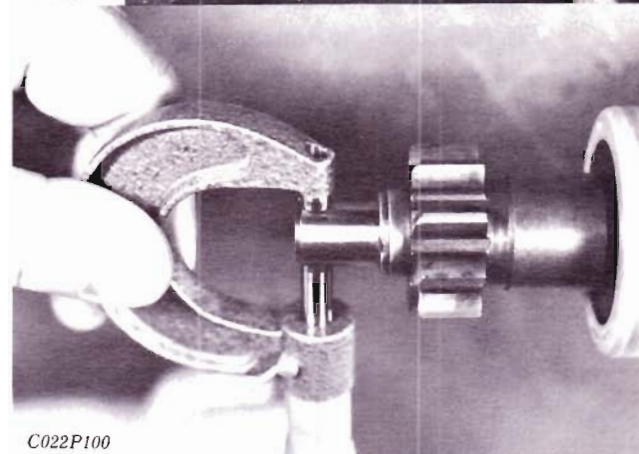
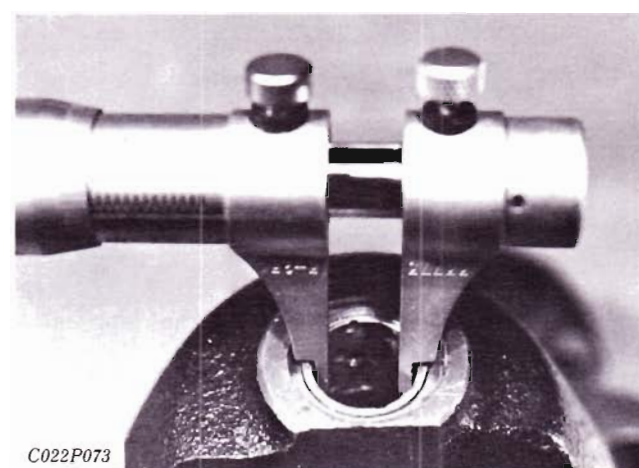


Fig. N-53 Checking Clearance between Shaft and Bushing

- (1) Measure the inside diameters of the bearing bushings on the side of the drive and commutator.
- (2) Measure the drive-side and commutator-side shaft diameters and calculate the clearance.
- (3) If the clearance exceeds the allowable limit, use an undersize bushing.

- Reference value:

	Drive side	Commutator side
Shaft dia.	12.50mm 0.4921 in.	12.50mm 0.4921 in.
Bearing bushing inside dia.	12.54mm 0.4937 in.	12.56mm 0.4945 in.

- Allowable limit:
Clearance 0.2mm (0.0079 in.)

Checking Armature Alignment

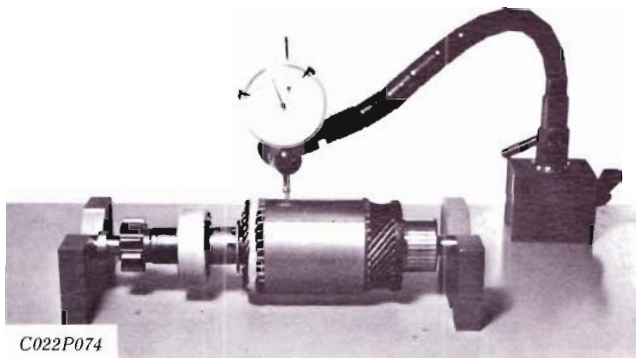


Fig. N-54 Checking Armature Alignment

- (1) Measure the amount of flexure; if the measurement exceeds the allowable limit, replace. Carefully check to see if the core is scratched.
- Allowable limit:
0.1mm (0.0039 in.)

Checking Armature Coil Short-circuit



Fig. N-55 Checking Armature Coil Short-circuit

- (1) Rotate the armature while touching it with a steel block.
- (2) If the steel block starts to vibrate or to be attracted somewhere on the armature, this suggests that the coil contains a layer short at that point.
- (3) If it is defective, replace.

TEST EQUIPMENT: Armature Tester

Checking Armature Coil Breakage

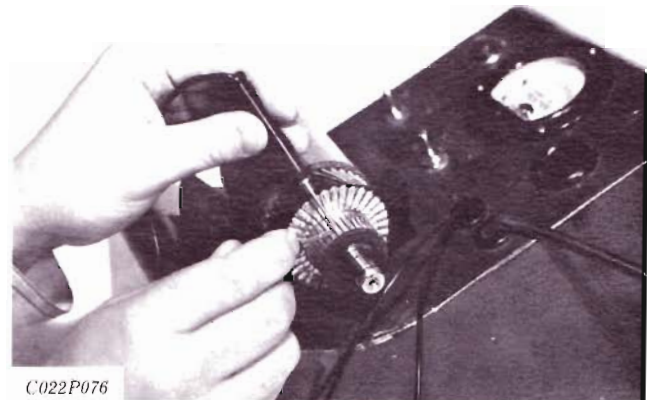


Fig. N-56 Checking Armature Coil Breakage

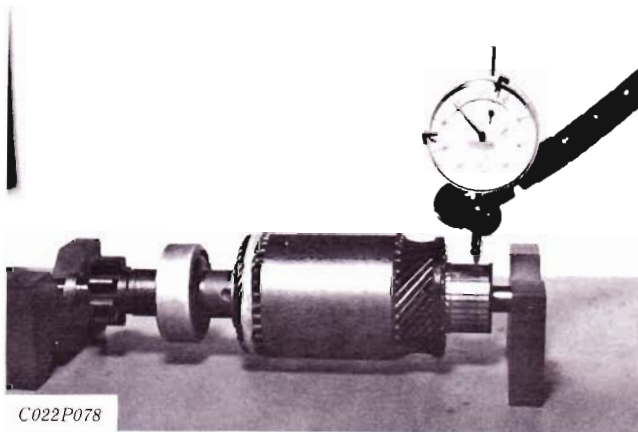
- (1) Check conduction across each pair of segments adjacent to the commutator.
- (2) If it is conducting, the armature coil is good; if not, it is defective.
- (3) If not conducting, replace.

Checking Armature Coil Grounding

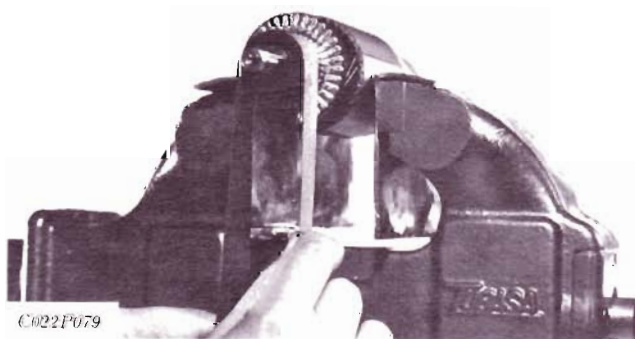


Fig. N-57 Checking Armature Coil Grounding

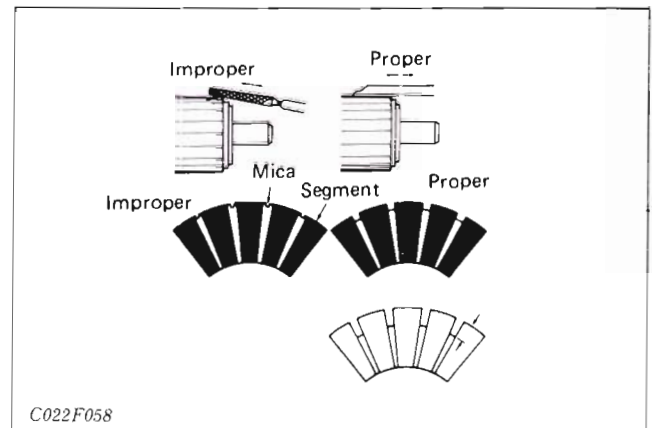
- (1) Check conduction across the commutator and core shaft. If it is not conducting, the coil is good; if it is conducting, the coil is defective.
- (2) If conducting, replace.

Checking Uneven Wear of Commutator*Fig. N-58 Checking Uneven Wear of Commutator*

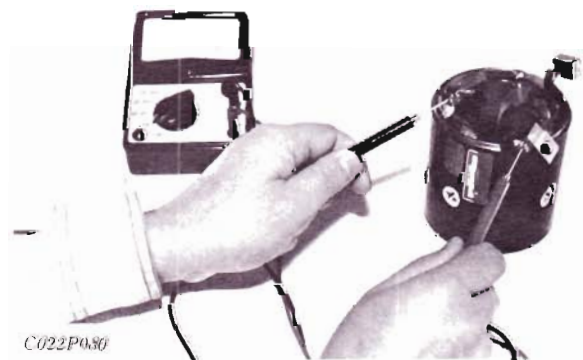
- (1) Check to see if the deflection exceeds 0.2mm (0.0079 in.).
 - (2) Check to see if the brush contact surface is worn unevenly.
 - (3) Correct it with a lathe to less than 0.05mm (0.0020 in.).
 - (4) If the correction reduces the commutator diameter by more than 3mm (0.118 in.) above the reference outside diameter, replace the commutator.
- Reference value:
Less than 0.2mm (0.0079 in.)

Checking Staining or Burning of Commutator*Fig. N-59 Correcting Commutator*

- (1) Check to see if the commutator surface is stained or burnt.
- (2) If it is locally burnt, correct with fine sandpaper.

Checking Mica (undercut)*Fig. N-60 Correcting Mica*

- (1) Check to see if the mica has sunk below the allowable limit.
 - (2) If it is below the allowable limit, correct with a saw blade to reference value. Since the correction produces burrs on the corner of the segment, chamfering should be executed.
- Reference value:
0.5 to 0.8mm (0.0197 to 0.0315 in.)
 - Allowable limit:
0.4mm (0.0157 in.)

Checking Field Coil Breakage*Fig. N-61 Checking Field Coil Breakage*

- (1) To check conduction, place the tester probes onto the lead and brush. If it is conducting, the coil is good; if it is not, the coil is defective.
- (2) If not conducting, replace.