

DAIHATSU

L500, L501

ST-2

STARTING SYSTEM

ST

GENERAL DESCRIPTION & COMPONENTS	ST- 2
STARTING SYSTEM CIRCUIT	ST- 4
TROUBLE SHOOTING	ST- 4
DESCRIPTION	ST- 5
SERVICING INSTRUCTIONS OF STARTER	ST- 6
TOOLS REQUIRED FOR STARTER MOTOR REPAIR	ST- 6
IN-VEHICLE INSPECTION	ST- 7
REMOVAL	ST- 7
UNIT CHECK OF STARTER MOTOR	ST- 7
DISASSEMBLY	ST- 9
INSPECTION	ST-15
ASSEMBLY	ST-19
INSTALLATION	ST-24

LST00001-00000

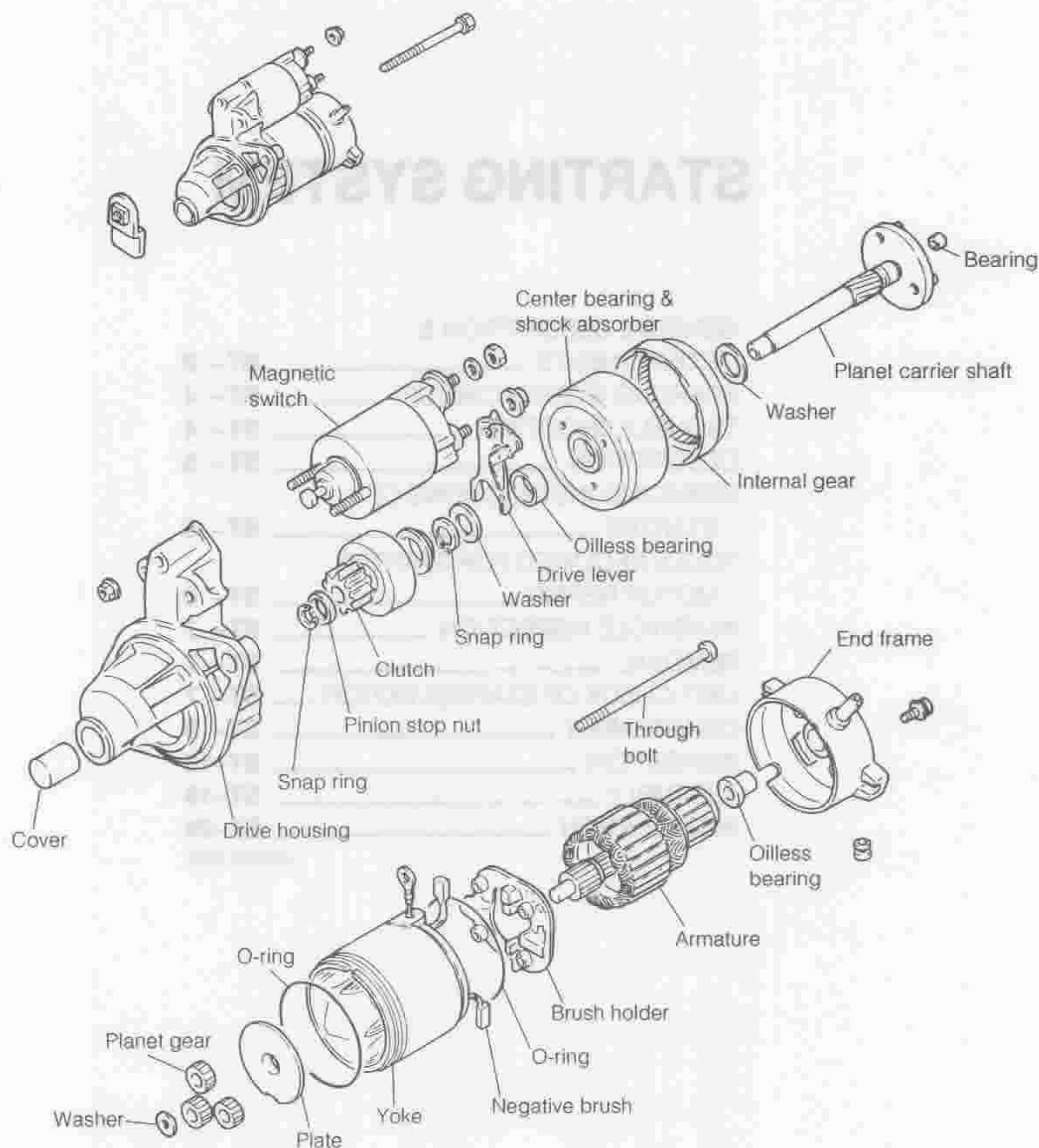
GENERAL DESCRIPTION & COMPONENTS

The starter motor is of a conventional design and can be disassembled. The starter consists of a solenoid switch and a motor. The solenoid has electric contact points which supply electric power to the motor. The solenoid also has a shift fork (drive lever) which moves the motor pinion gear into mesh with the ring gear mounted on the engine flywheel.

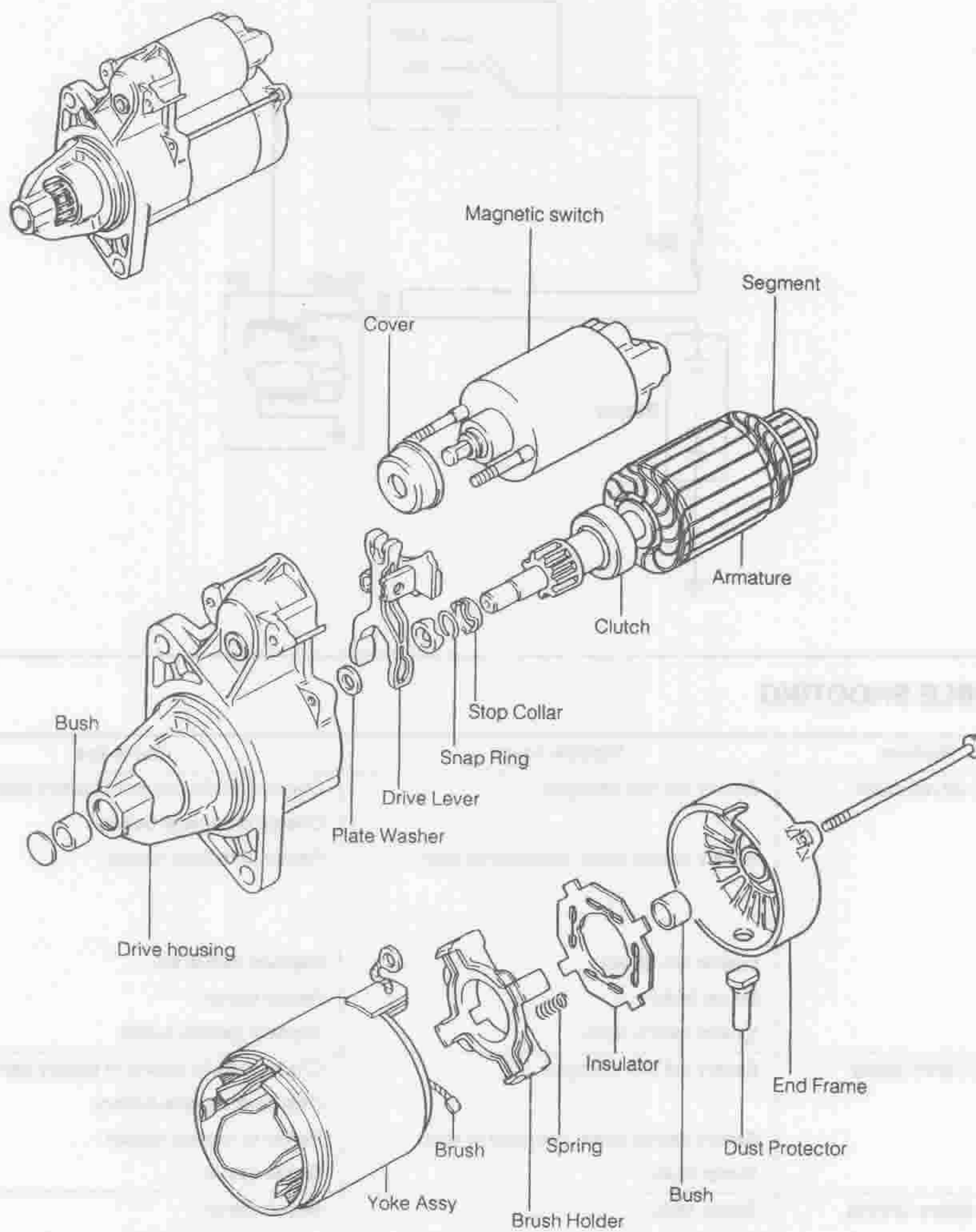
The starter is connected to the battery and ignition switch without passing through the starter relay.

The starter motor is a four-pole, four-brush unit. A roller clutch drive is provided to make the pinion gear mesh with the ring gear. Its another purpose is the protection of the gears.

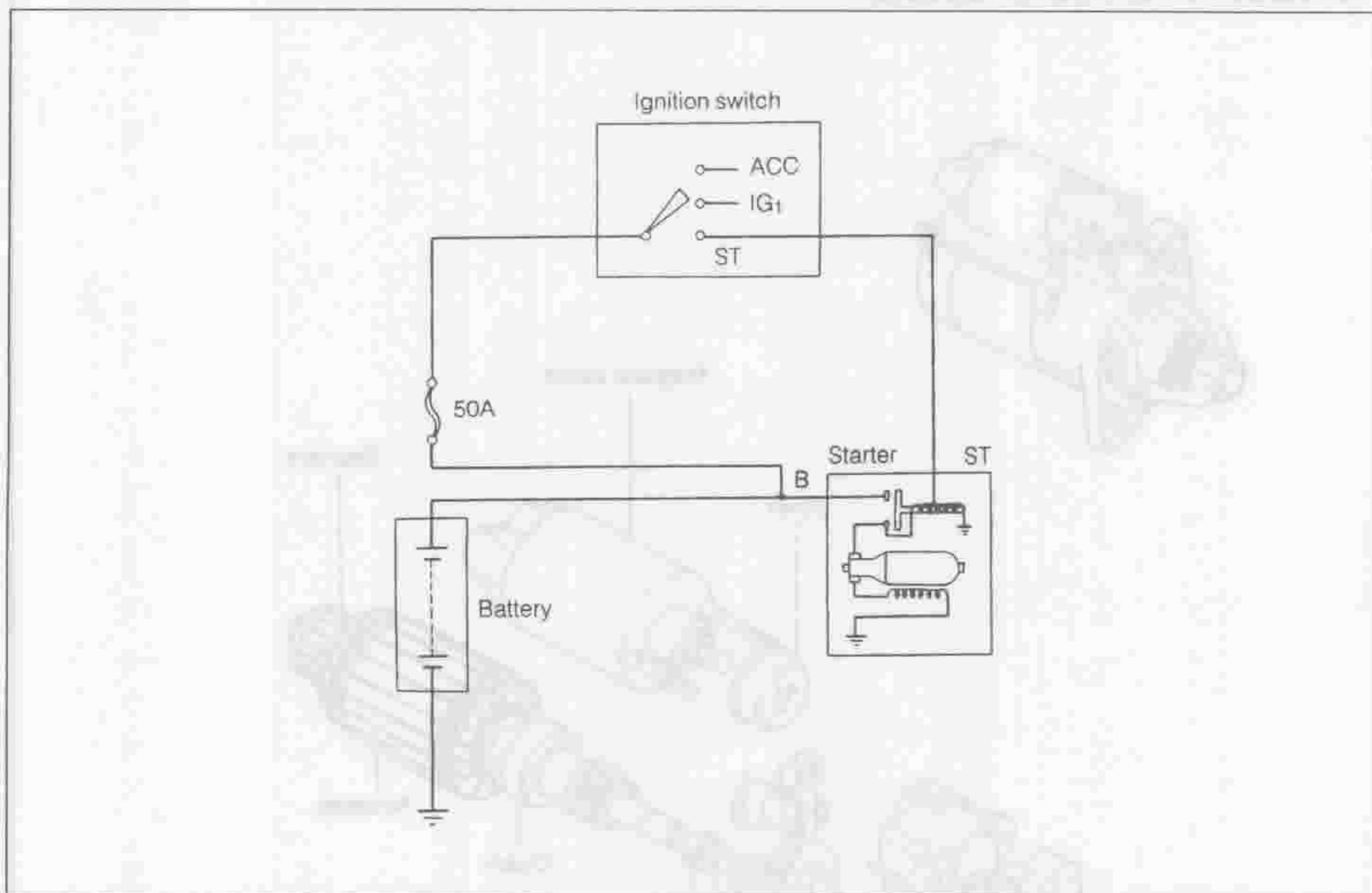
RATING OUTPUT: 1.0 kW



RATING OUTPUT: 0.6 kW, 0.7 kW and 0.8 kW



STARTING SYSTEM CIRCUIT



LST00003-00003

TROUBLE SHOOTING

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

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DESCRIPTION

Principles of operation & starting system circuit

The starter operations can be divided into two stages.

When the ignition switch is set to the start (ST) position, current from the battery flows to the motor through the solenoid. Then, the motor begins to rotate. Simultaneously, the solenoid pushes the shift fork forward, thereby moving the motor pinion gear forward into mesh with the ring gear.

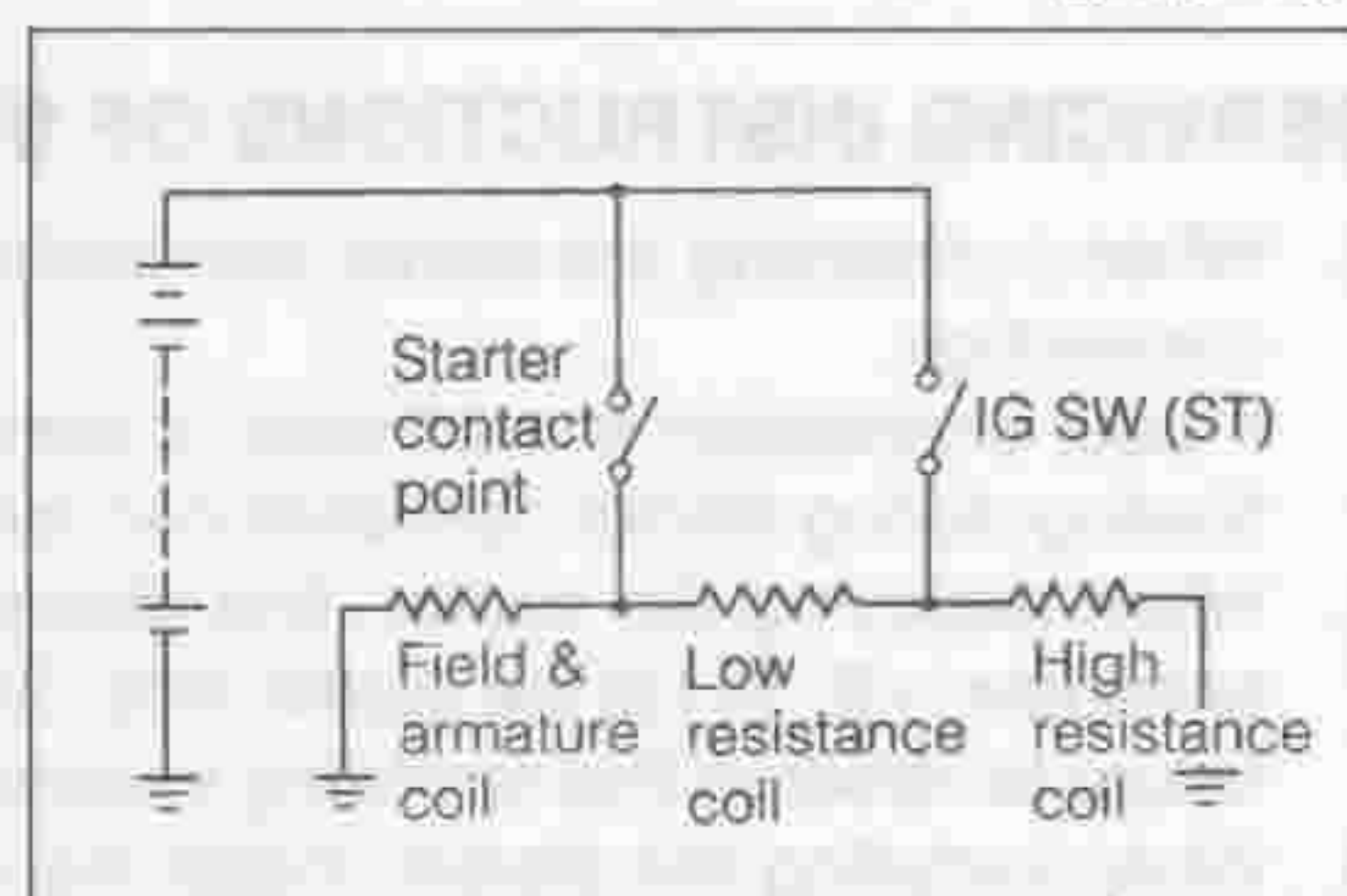
When the pinion gear has shifted into a complete mesh with the ring gear, the solenoid contact points are closed. The current from the battery now directly goes to the motor, thus supplying high power enough for cranking the engine. In this way, the starter motor begins cranking the engine.

The solenoid is composed of two coils. One is a low-resistance coil which moves the shift fork. The other is a high-resistance coil which retains the solenoid at the "start" position.

The low-resistance coil is connected to the battery ground through the motor brush (and armature coil) and field coil. The high-resistance coil is directly grounded to the solenoid case.

LST00005-00000

During the engine cranking, the solenoid is energized at the high-resistance coil alone. Since the low-resistance coil has the same potential at its both ends, no current flows. Consequently, the solenoid is retained at the "start" position by means of the high-resistance coil only. The right figure shows an equivalent circuit of the system.



During the starting period, the low-resistance coil provides the solenoid with a large amount of current to move the shift fork. Afterward, however, it is no longer necessary to use a large amount of current to hold the solenoid. Therefore, the above-described circuit has been employed for the starting system so that no burning takes place.

The plunger of the solenoid has two functions; One is to move the shift fork and the other is to close the electric contact points, which is simultaneous with the first function. For positive contact, the contact points are connected to the plunger through a spring.

When the ignition switch is set to the start (ST) position, current from the battery goes to the low-resistance coil and the field and armature coils. As a result, the motor starts rotating. Simultaneously, the high-resistance coil is also energized. These two coils exert drawing force on the plunger, thus making the plunger overcome the force of a spring (a spring which is provided to return the plunger and differs from the aforesaid spring provided at the contact points). The plunger then moves the shift fork strongly and brings the pinion gear into mesh with the ring gear. Simultaneously, the starter contact points are closed and current is directly drawn from the battery. At this stage, the low-resistance coil has an equal potential at its both ends, as previously described. Hence, no current flows to the motor through the low-resistance coil.

After the engine has started, when the ignition switch is returned to the IG position, current to the solenoid is cut off (NOTE). The spring built in the solenoid returns the plunger, thereby opening the contact points and cutting the current to the motor. At the same time, the shift fork which has been pushing the pinion gear is returned to the original position by means of the aforesaid spring force. Consequently, the pinion gear is disengaged and separated from the ring gear.

This pinion gear's separation from the ring gear can not be performed positively and assuredly by the spring at the shift fork alone. To achieve positive separation, screw-shaped spline is provided between the motor shaft and the pinion gear. After start of the engine, the rotation speed of the ring gear continues to increase, consequently, it becomes possible for the ring gear to drive the pinion gear. At this point, owing to the

screw-shaped spline, the pinion gear is moved in such a direction that it tends to disengage from the ring gear. On the other hand, this screw-shaped spline helps the pinion gear to be pushed and moved into mesh with the ring gear during the starting period.

(NOTE).

In fact, at this moment, the current to the solenoid goes to the starter contact points and passes in series through the low-resistance coil and the high-resistance coil. Consequently, electromagnet function continues and drawing forces are generated. However, the electromagnetic forces generated at the low-resistance and high-resistance coils counteract, for the winding direction of the coil is opposite to each other. As a result, no drawing force is produced.

On the other hand, when the ignition switch is set to the ON (ST/ON) position, a parallel circuit is formed. The electromagnetic forces generated at both coils are in the same direction, resulting in an increased drawing force.

Namely, the direction of the current at the low-resistance coil changes reversely when the ignition switch is switched between the ON and OFF states. (This explanation applies only to the instance when the ignition switch is changed from the ST position to the IG position.)

LST00006-00004

SERVICING INSTRUCTIONS OF STARTER

1. When connecting the starter terminal or battery terminal, perform positive tightening so as to avoid poor connection.
If poor connection should exist, it presents the hazard of serious danger that a large amount of current flowing during starter operation can overheat the poor connection.
2. When removing the starter, first disconnect the negative ; terminal of the battery. Then, disconnect the terminals (+B, ST) at the starter side. Since the battery voltage is always applied to the starter +B terminal, failure to observe this removing sequence may lead to battery short, which is extremely dangerous.
3. When installing the starter, install the starter in the clutch housing positively and be sure to tighten the attaching bolts to the specified torque. Improper installation can cause premature wear of the teeth of the pinion gear or ring gear and also can cause breakage of the clutch housing.

LST00007-00000

TOOLS REQUIRED FOR STARTER MOTOR REPAIR

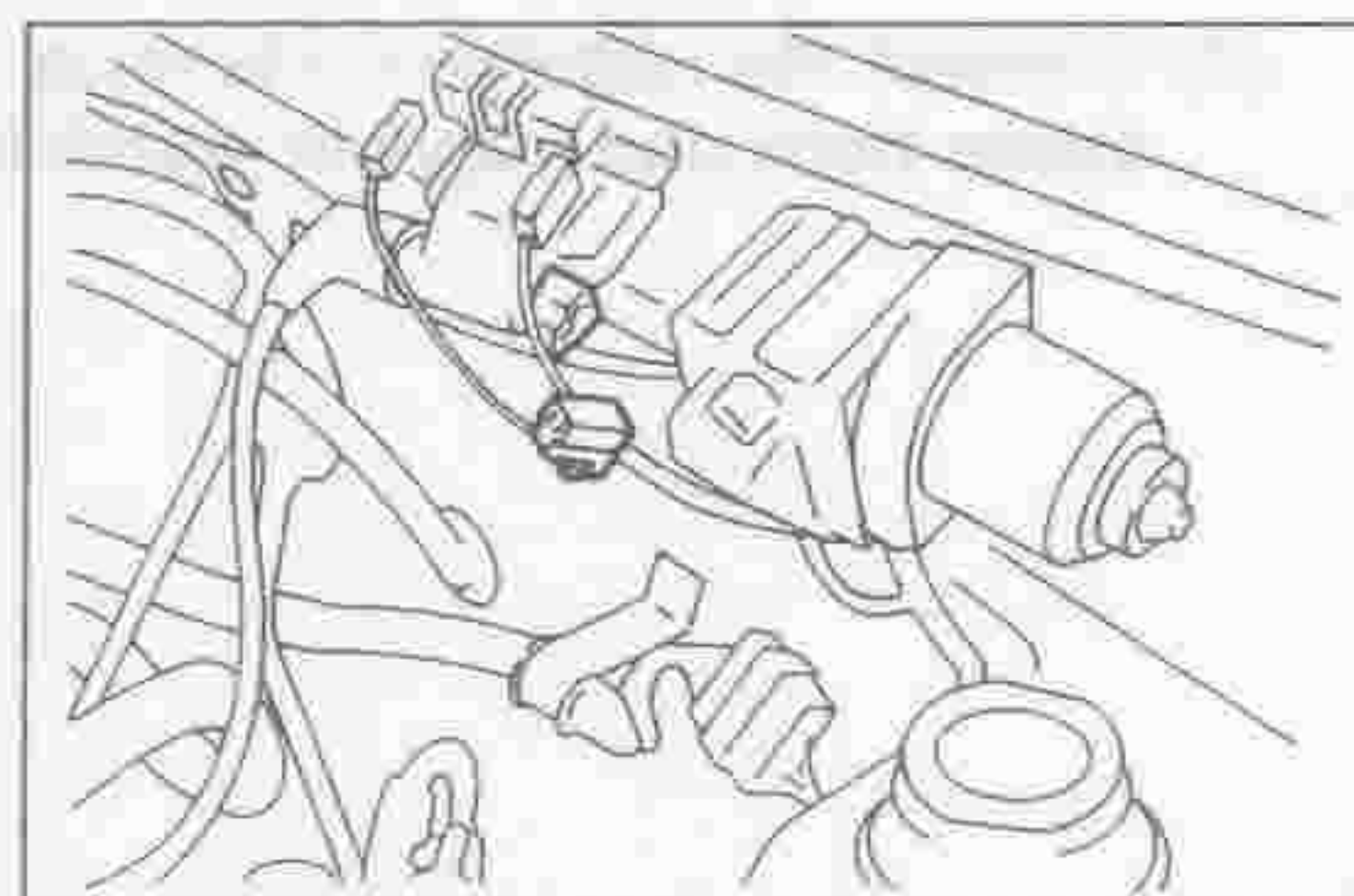
Prepare the following tools, SSTs, lubricants and so forth which are necessary for the starter service.

#	Wrench	10 × 12 mm
#	T-shaped wrench (long stem)	12 mm
#	Pliers	
#	Phillips screwdriver	300 mm
#	Standard screwdriver	300 mm
#	V-block	
#	Dial gauge	
#	Vernier calipers	200 mm
#	Micrometer	25 mm
#	Tester	(For measurement of insulation resistance, 1 MΩ or more)
#	Voltmeter	(12 V)
#	Ammeter	(75 A)
#	Battery cable & lead wire	(1 m long, wire diameter of at least 0.5 mm)
#	Battery	(The onboard battery can be used.)
#	Vice	
#	Press	
#	SST	(09301-87601 with 15 mm outer dia.)
#	Grease	(High-temperature grease)
#	Abrasive paper	(No. 400)
#	Lathe	

LST00008-00000

IN-VEHICLE INSPECTION

1. Place the shift lever to the neutral position. Apply the parking brake lever.
2. Disconnect the ignition coil coupler so that the engine will not start.



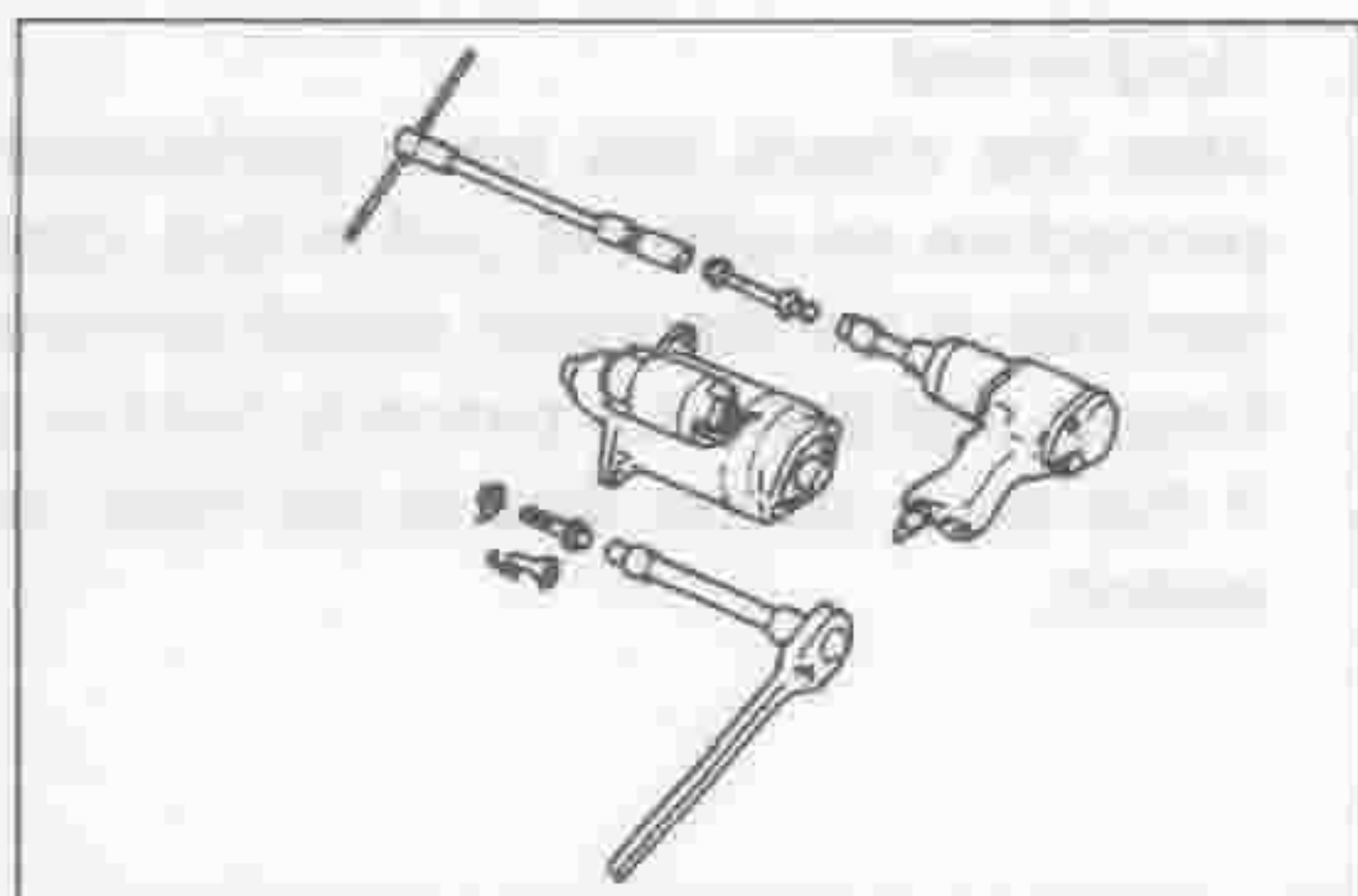
LST00009-00005

3. Set the ignition switch to the ST position. Check to see if the engine cranks.
4. If the engine will not crank, check the battery for damage and discharge. Perform the wire harness continuity test.
5. If the starter motor still will not rotate even after the checks above have been performed, remove the starter motor and perform the unit check.

LST00010-00000

REMOVAL

1. Disconnect the wires for the starter circuit.
2. Remove the starter motor from the clutch housing.

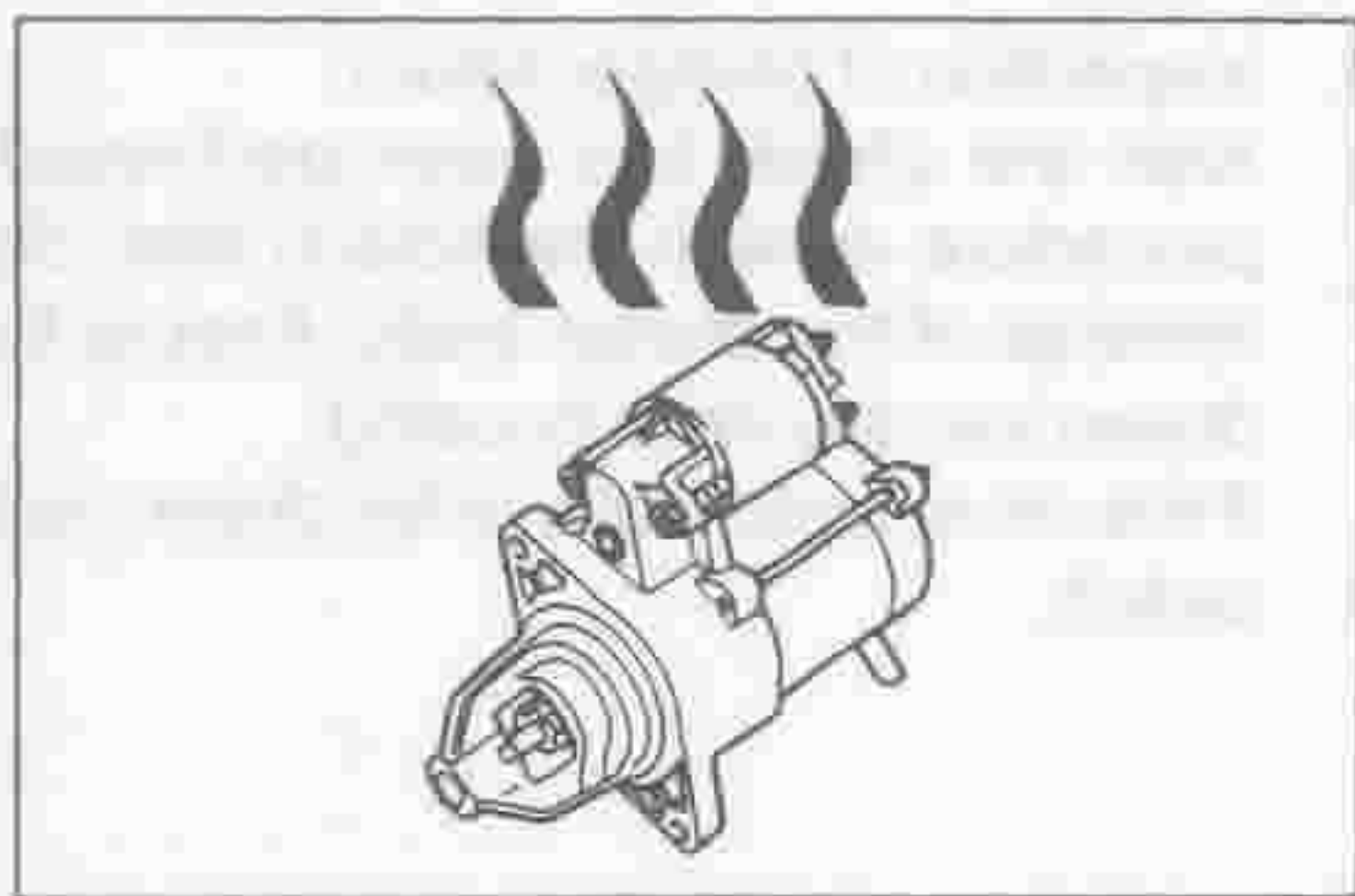


LST00011-00006

UNIT CHECK OF STARTER MOTOR

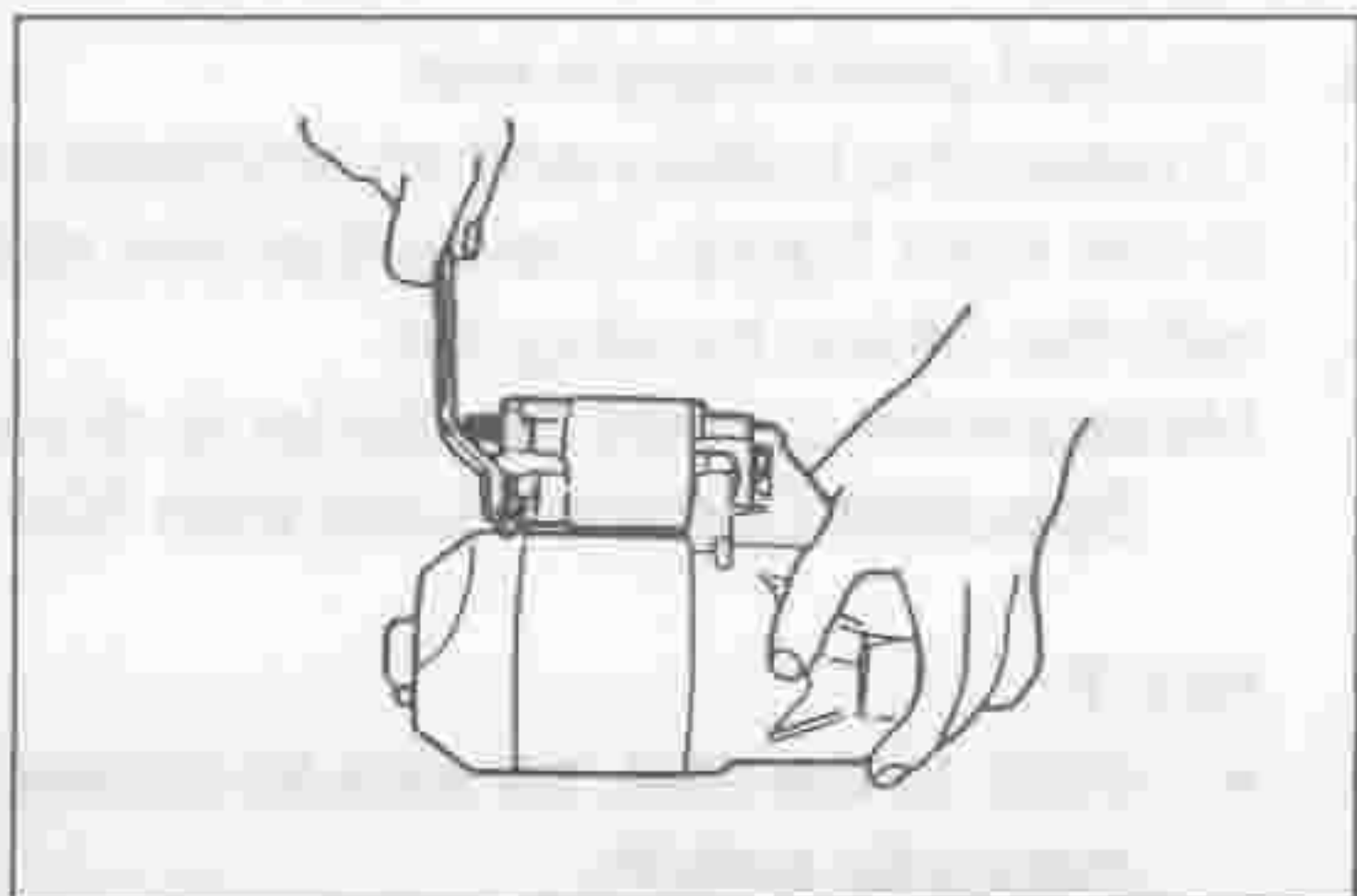
CAUTION:

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



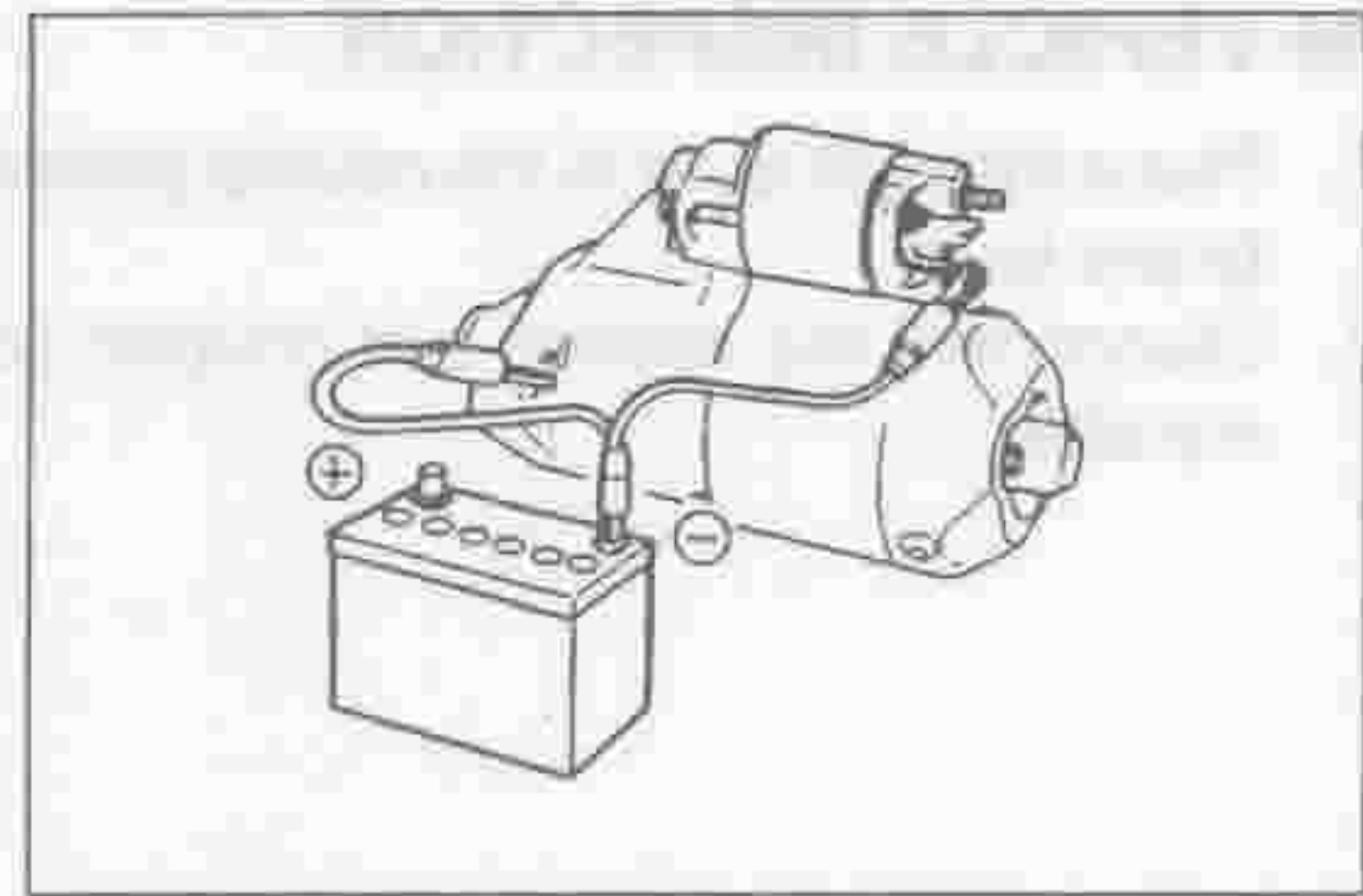
LST00012-00007

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



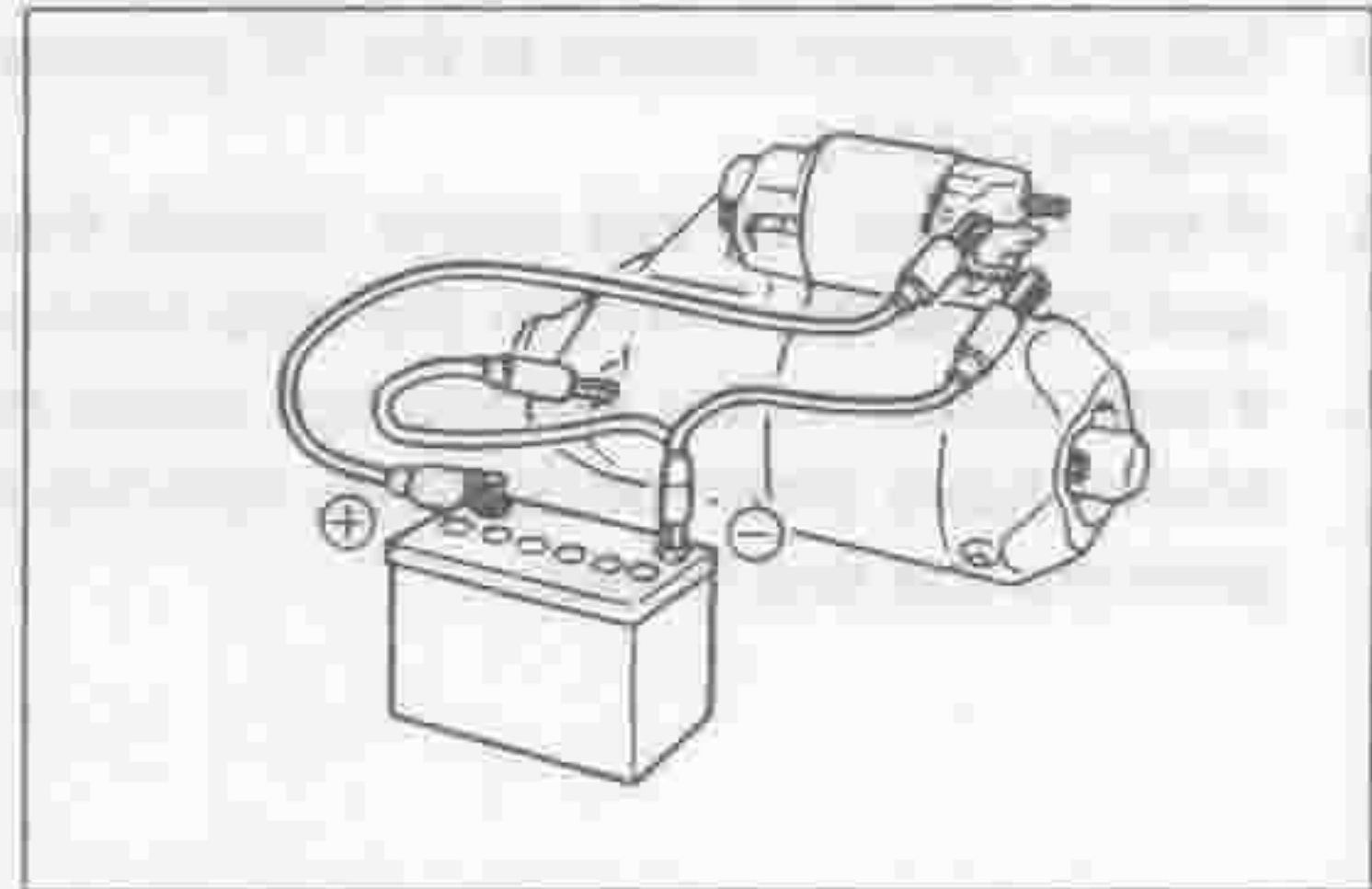
LST00013-00008

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



LST00014-00009

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

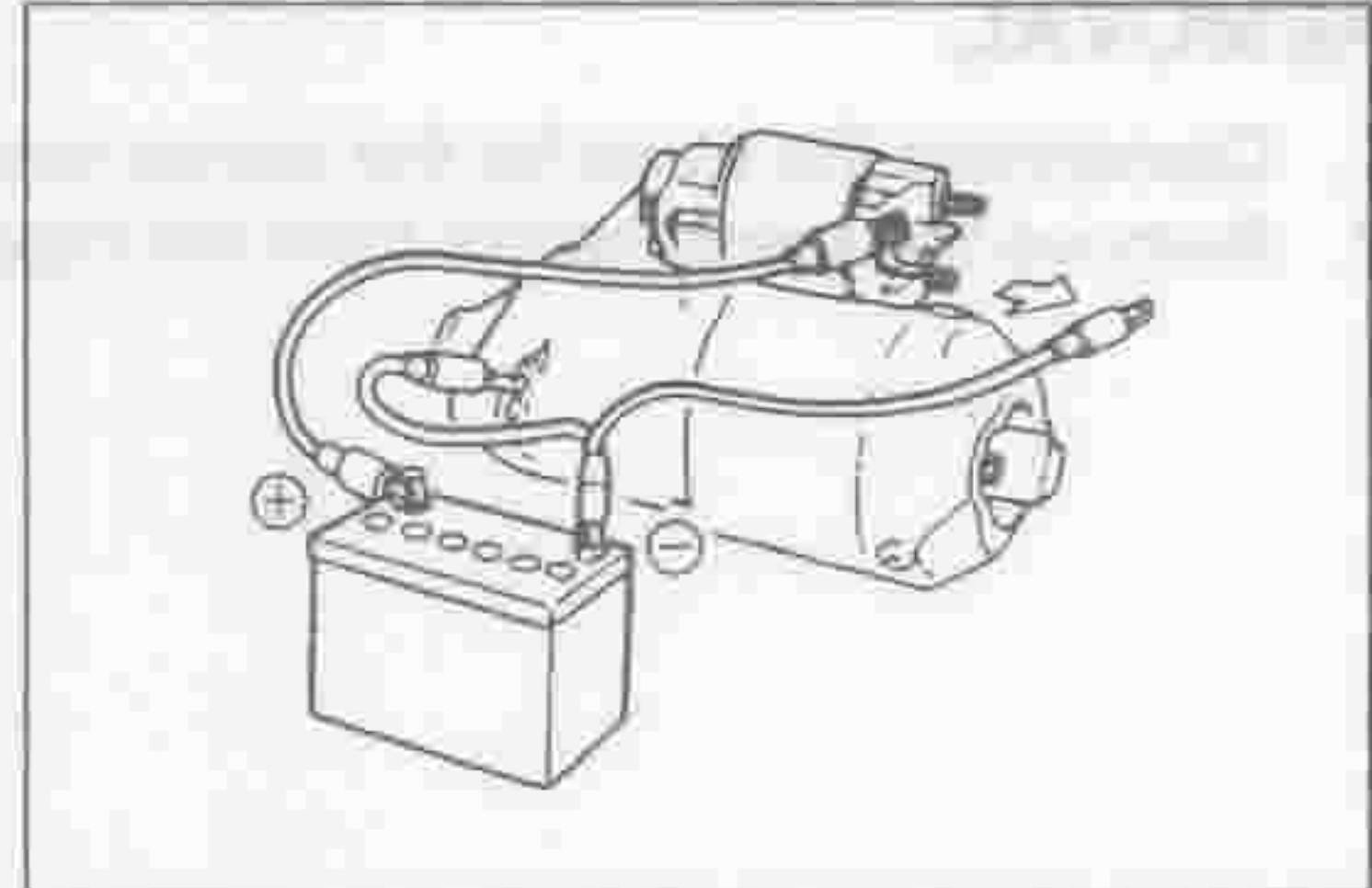


LST00016-00010

2. Hold-in test

After the check has been performed following the same procedure as with the pull-in test, disconnect the negative terminal of the magnetic switch terminal.

Ensure that the drive pinion is held in a pushed-out state. If the drive pinion fails to be held, replace the magnetic switch.

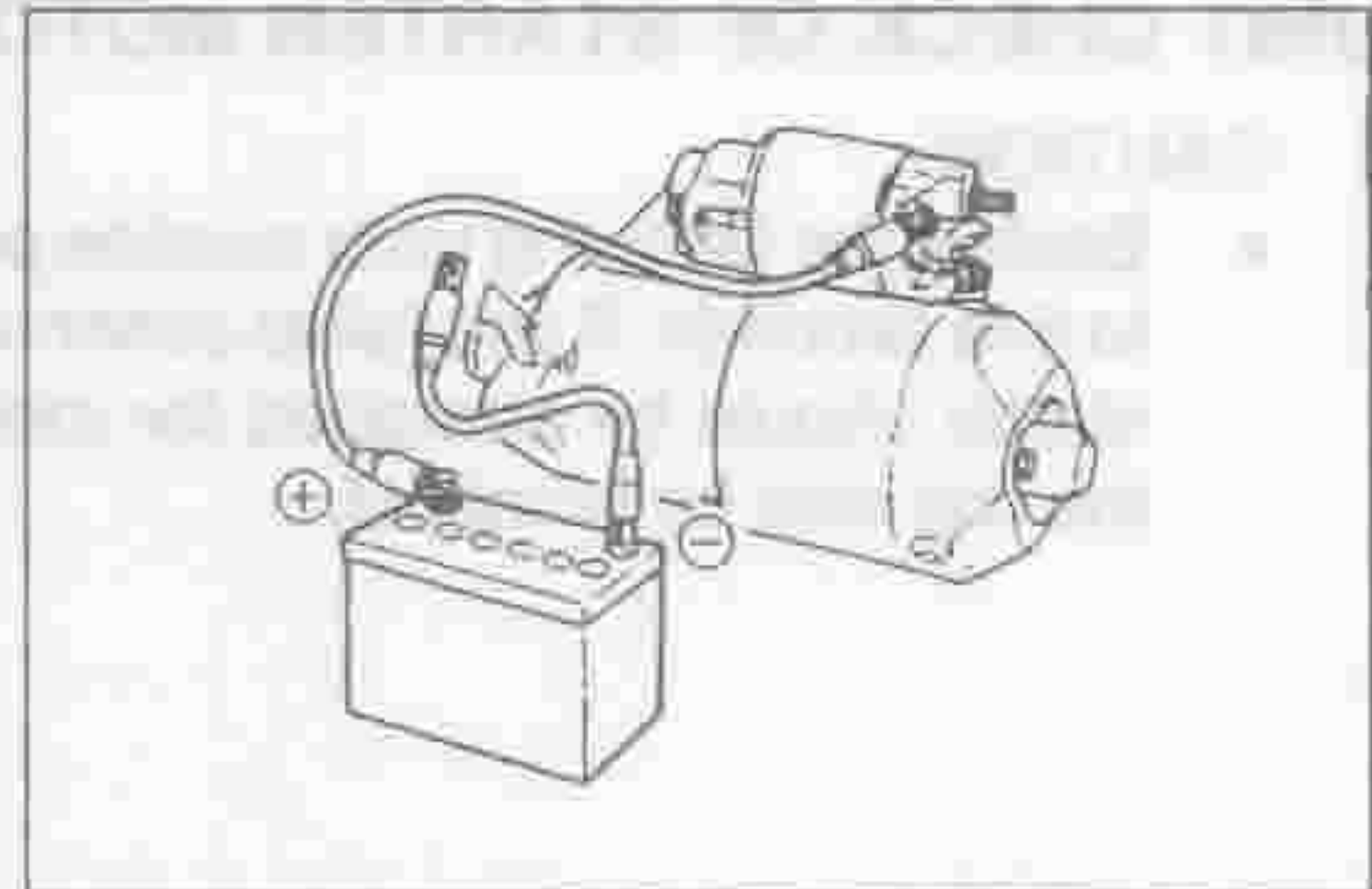


LST00016-00011

3. Inspection of plunger return

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

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



LST00017-00012

4. No-load performance test

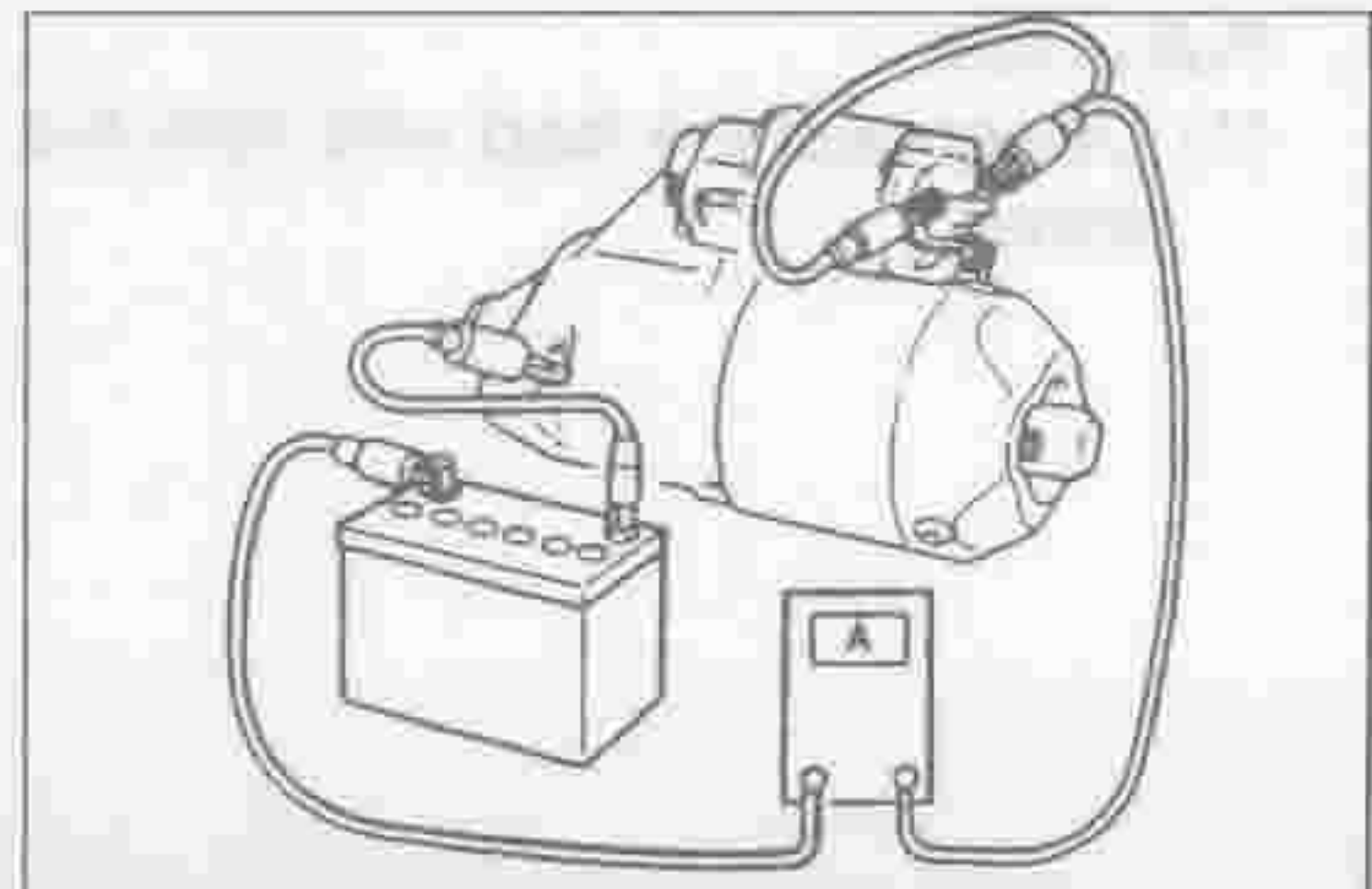
Connect the battery and an ammeter to the starter as shown in the right figure. Ensure that the starter rotates smoothly with the pinion moving out.

Measure the current the starter is drawing.

Specified Current: Less than 50A at 11V

NOTE:

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

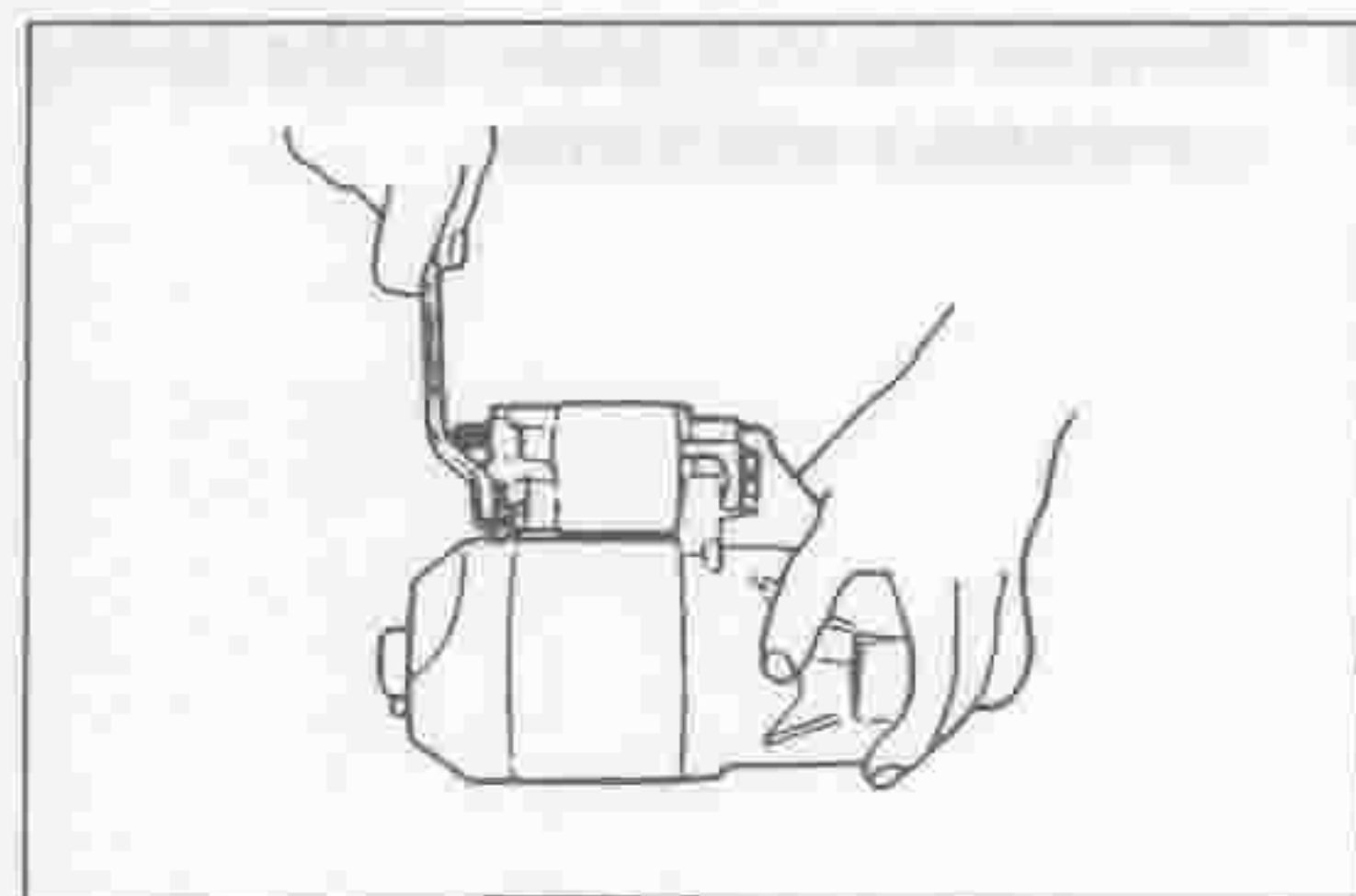


LST00018-00013

DISASSEMBLY

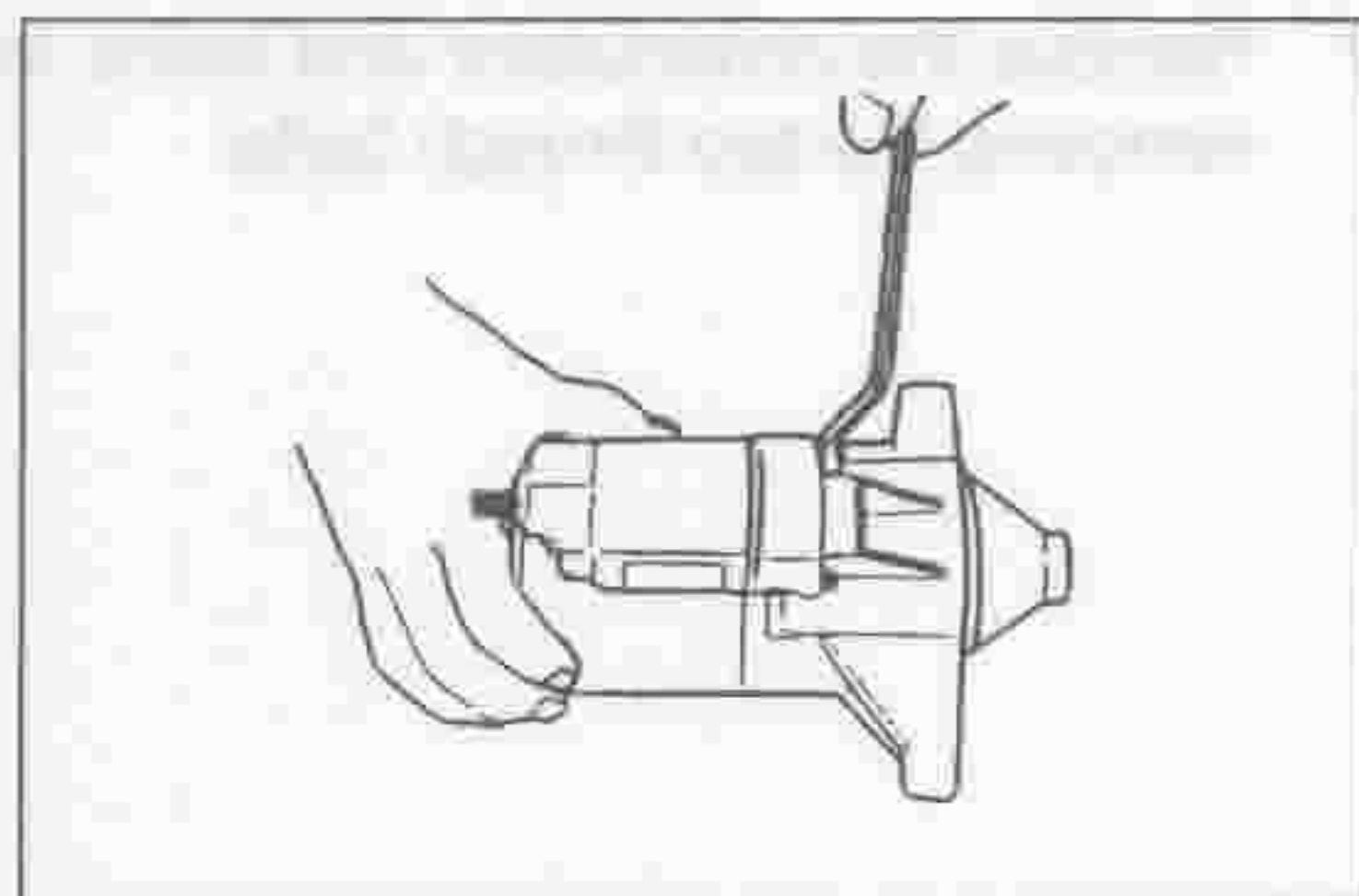
For 1.0 kW moter

1. Disconnect the lead wire from the magnetic switch.



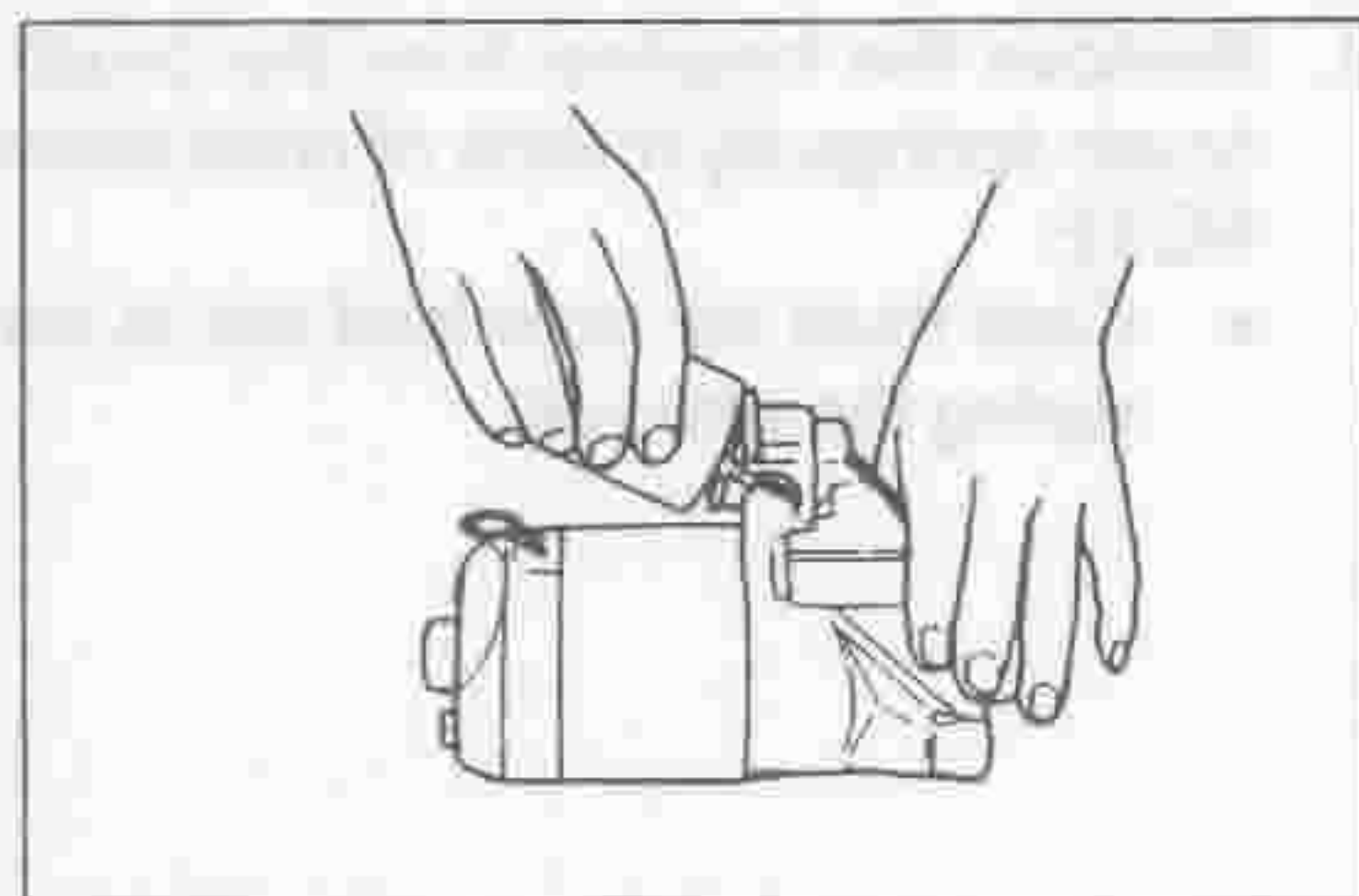
LST00019-00014

2. Remove the attaching nut of the magnetic switch from the drive housing.



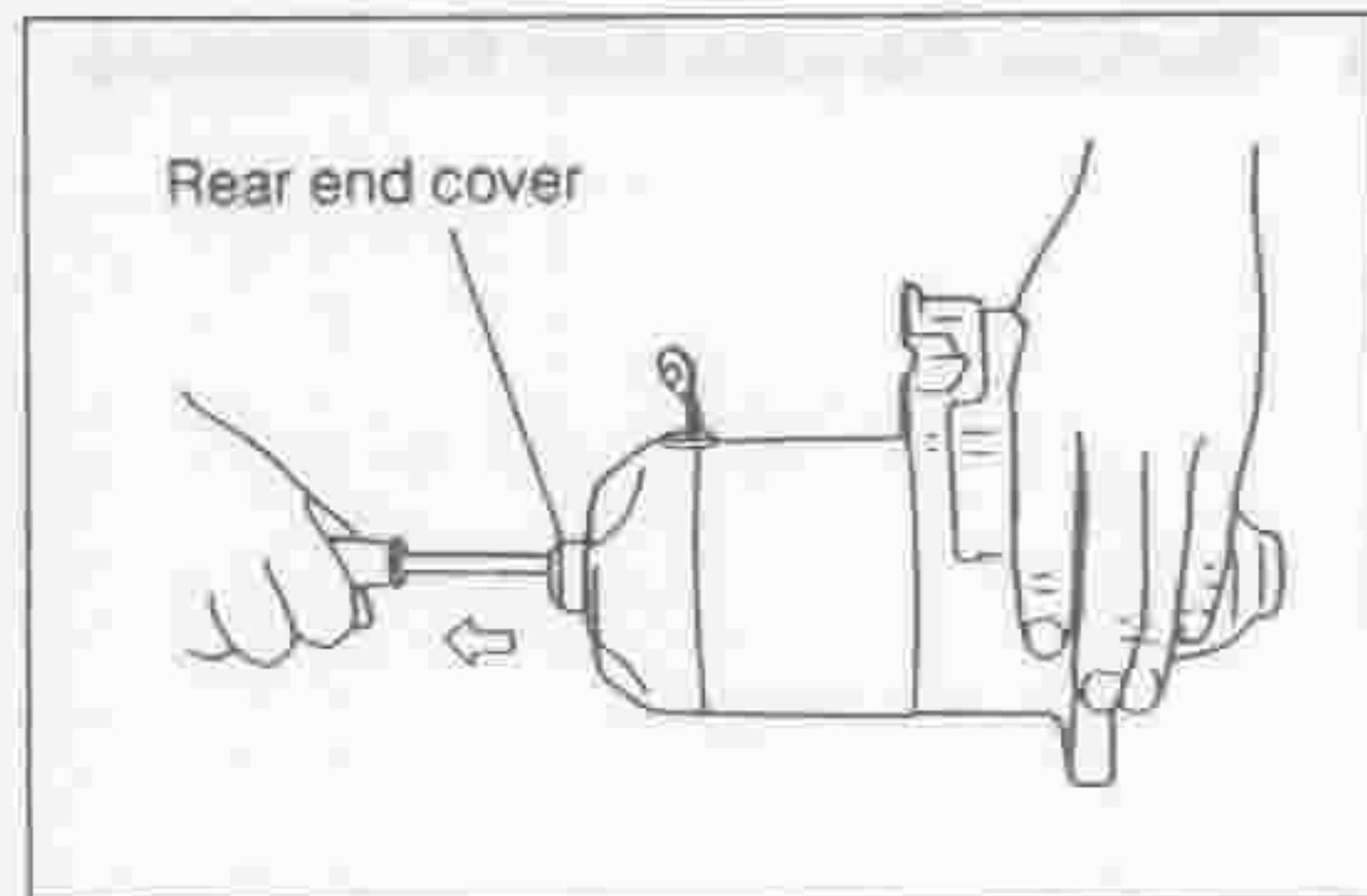
LST00020-00015

3. Remove the magnetic switch from the drive housing.



LST00021-00016

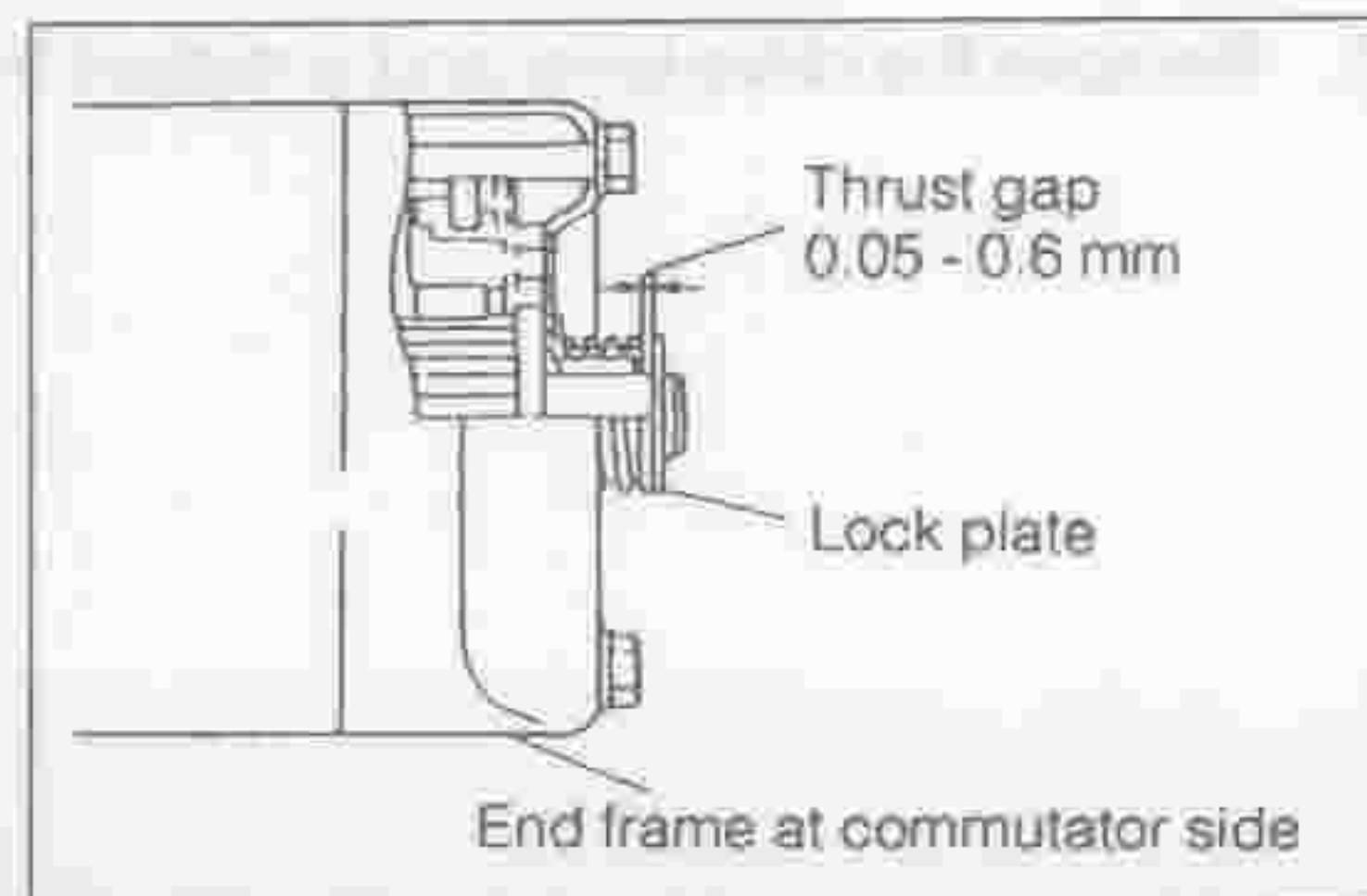
4. Remove the end frame cover by removing the two screws.



LST00022-00017

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

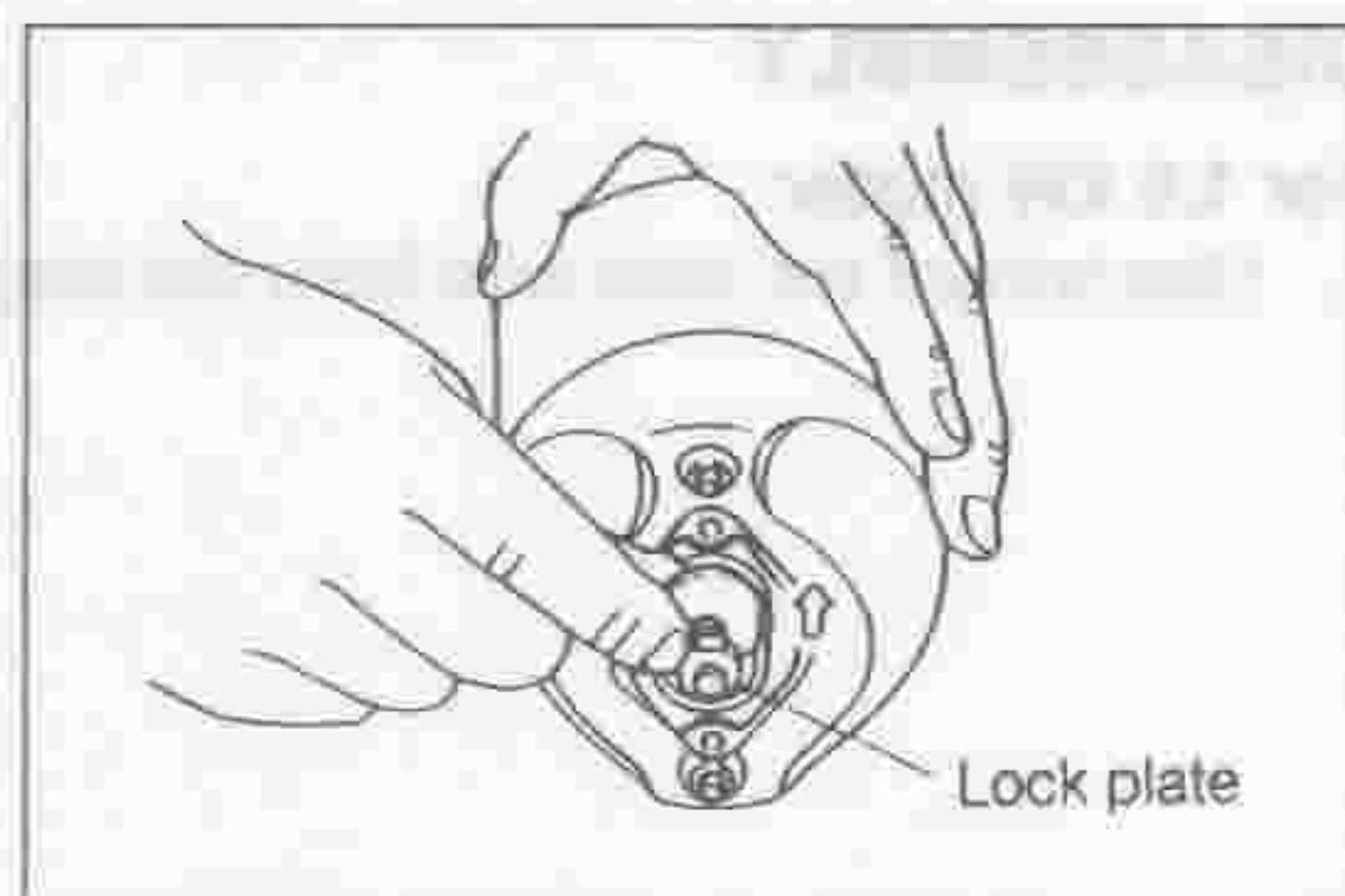
Thrust Clearance: 0.05 - 0.60 mm



LST00023-00018

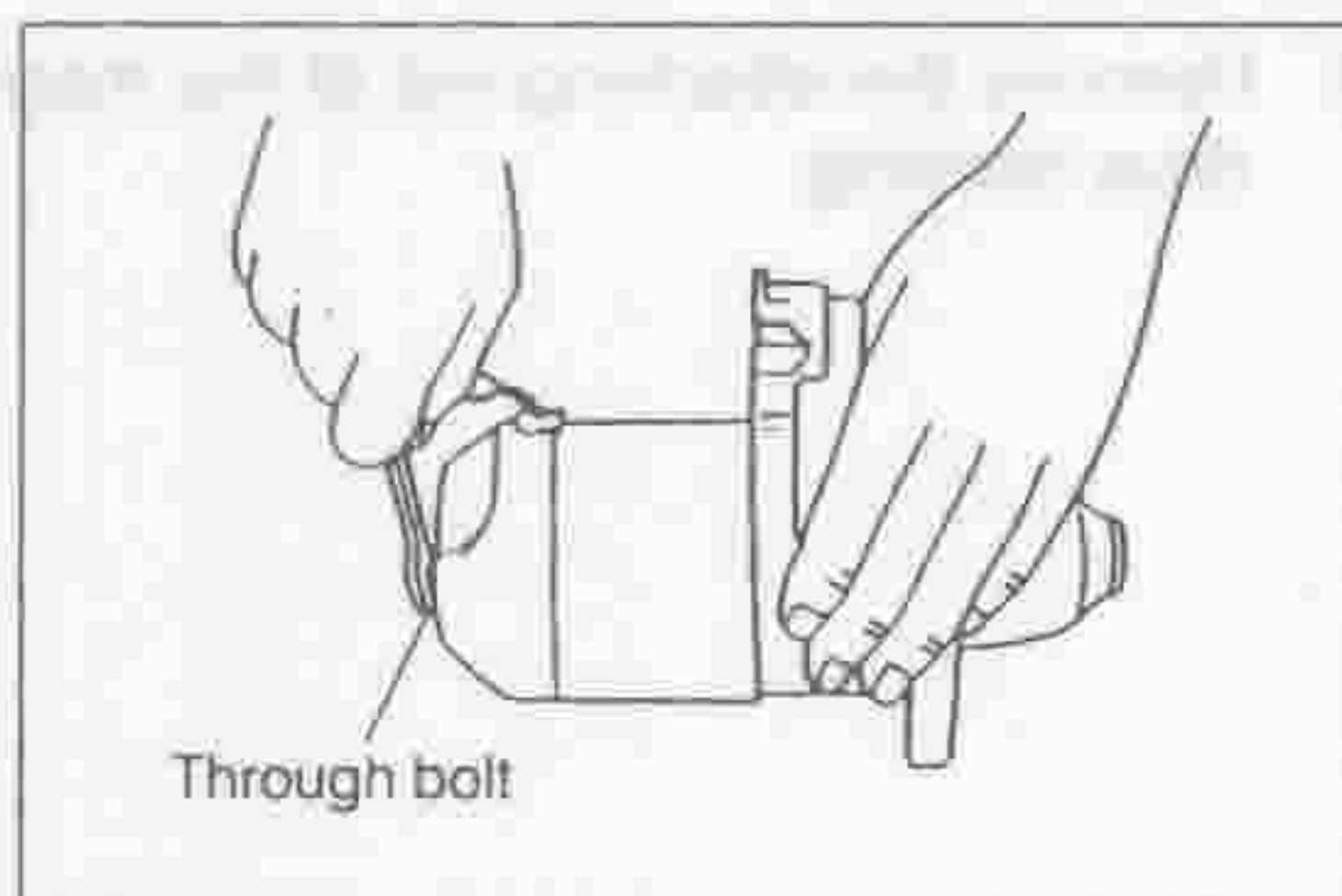
ST-10

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



LST00024-00019

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

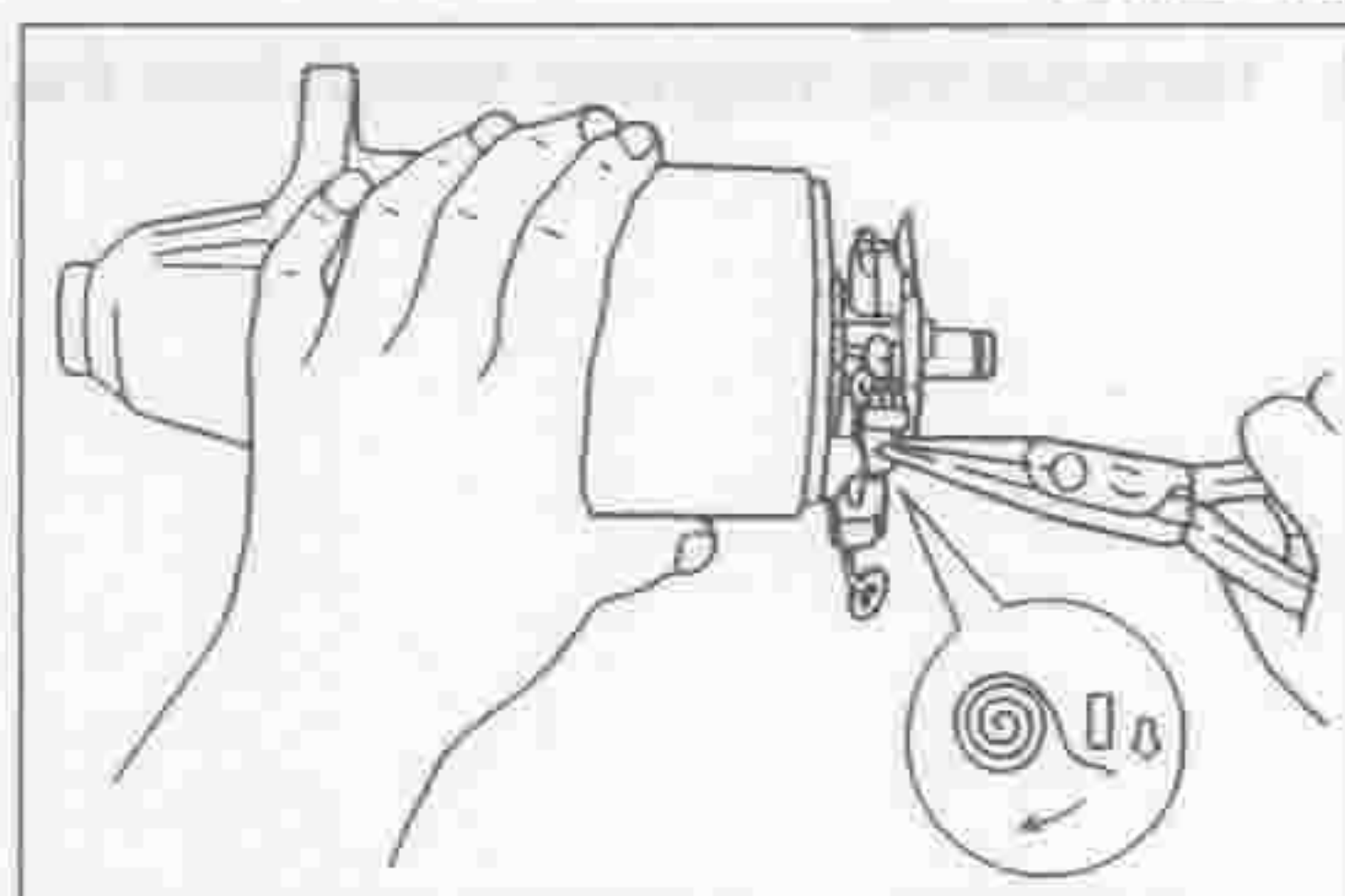


LST00025-00020

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

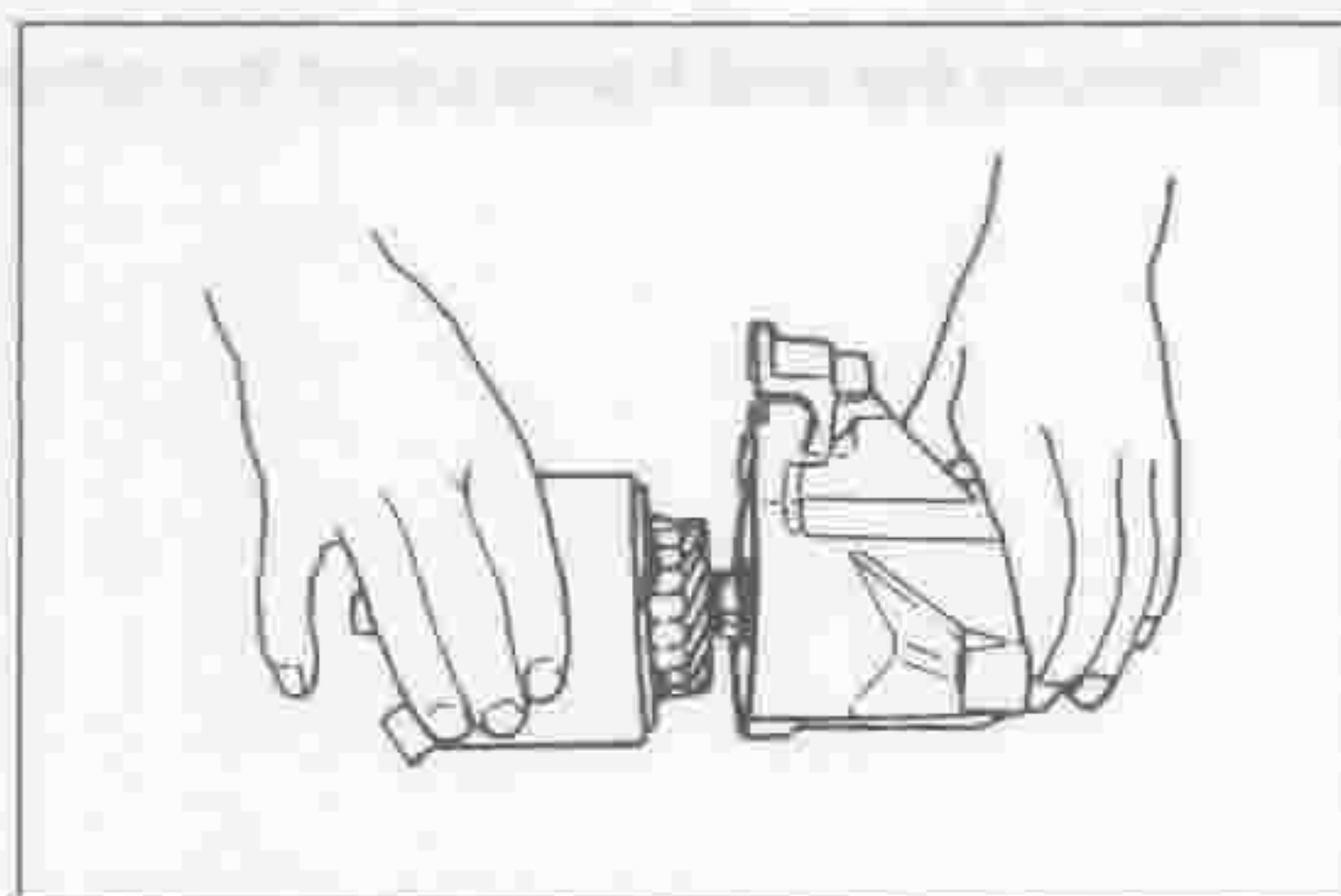
NOTE:

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



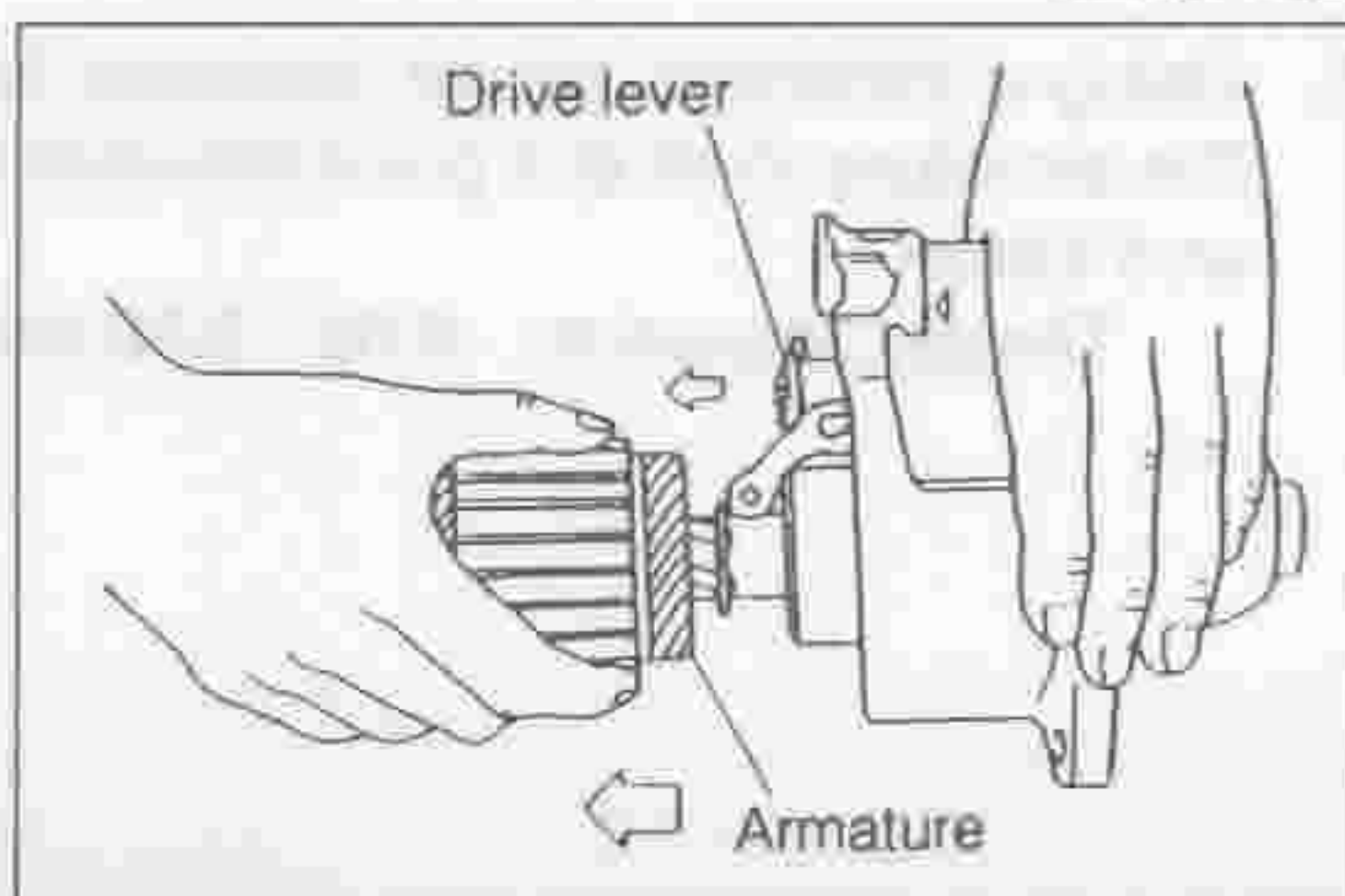
LST00026-00021

9. Remove the yoke from the armature.



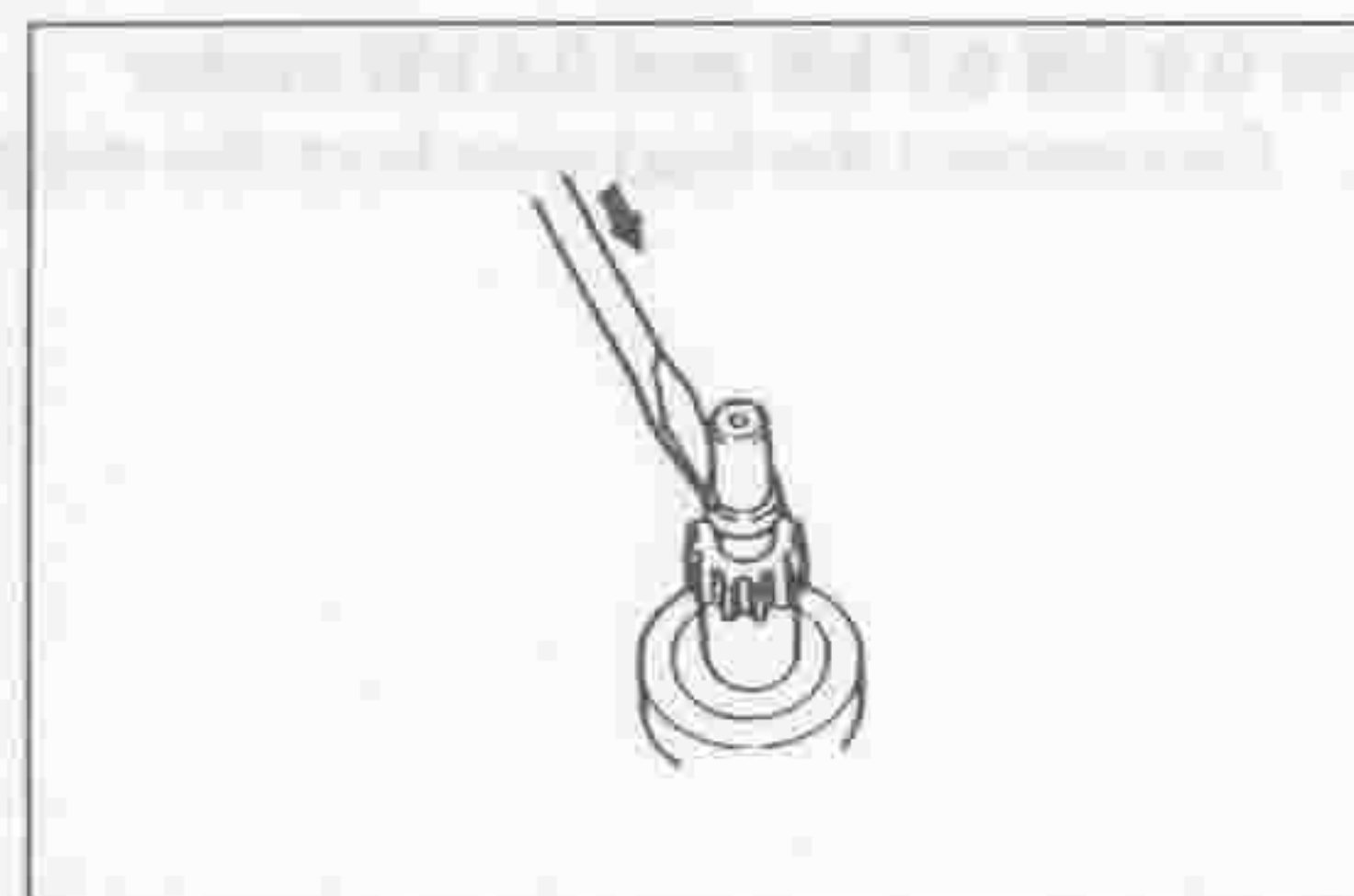
LST00027-00022

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



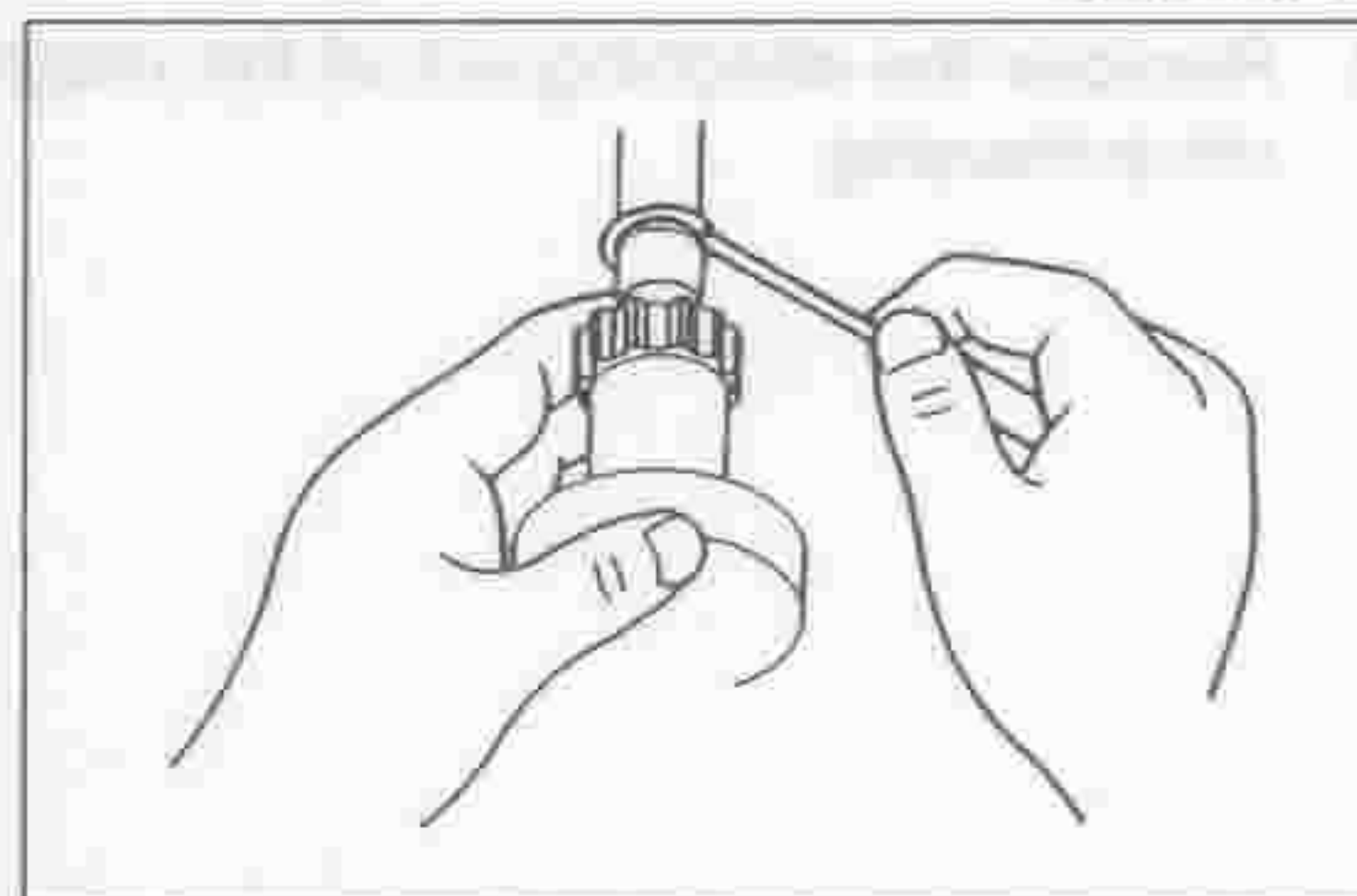
LST00028-00023

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



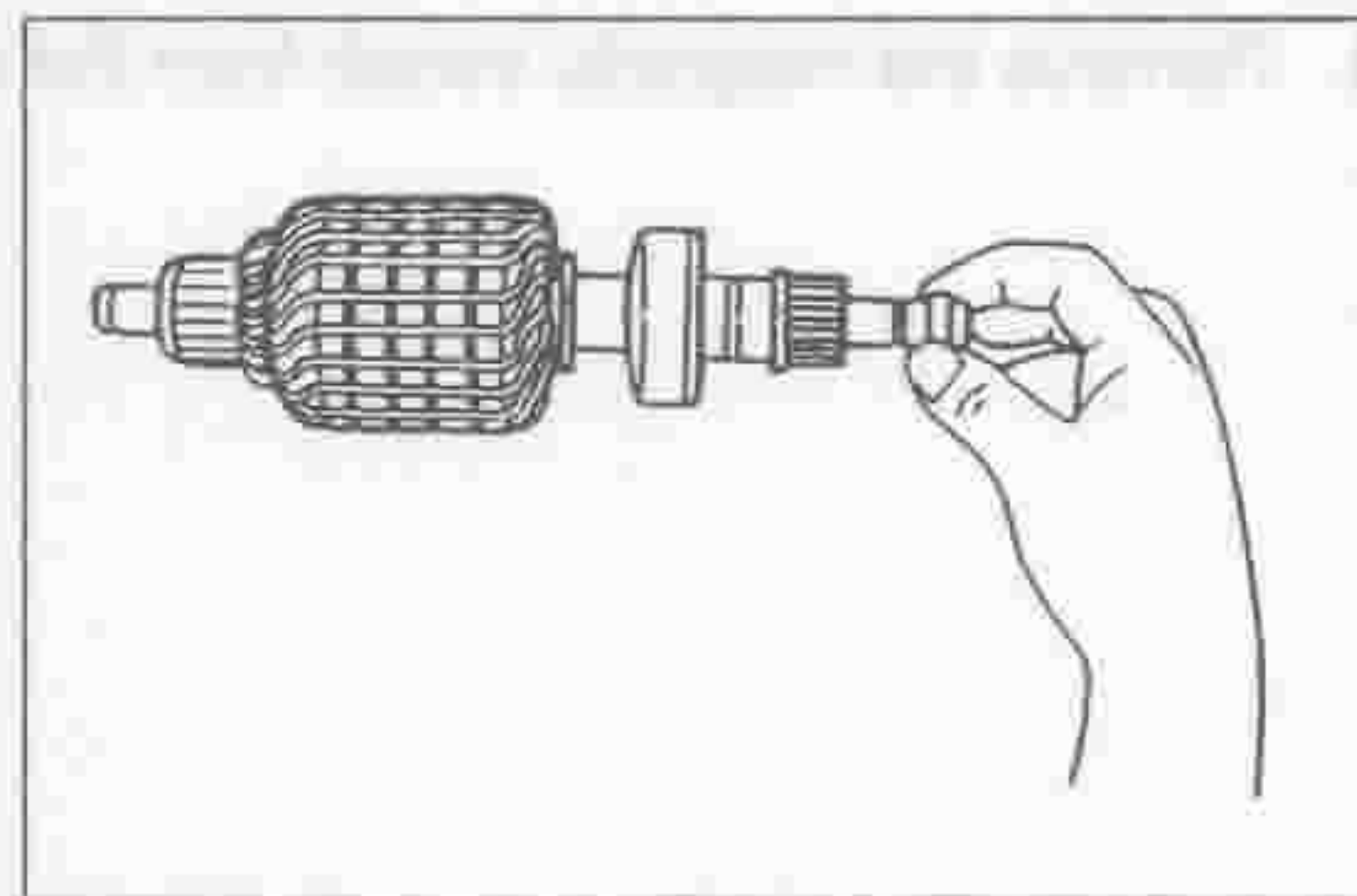
LST00029-00024

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



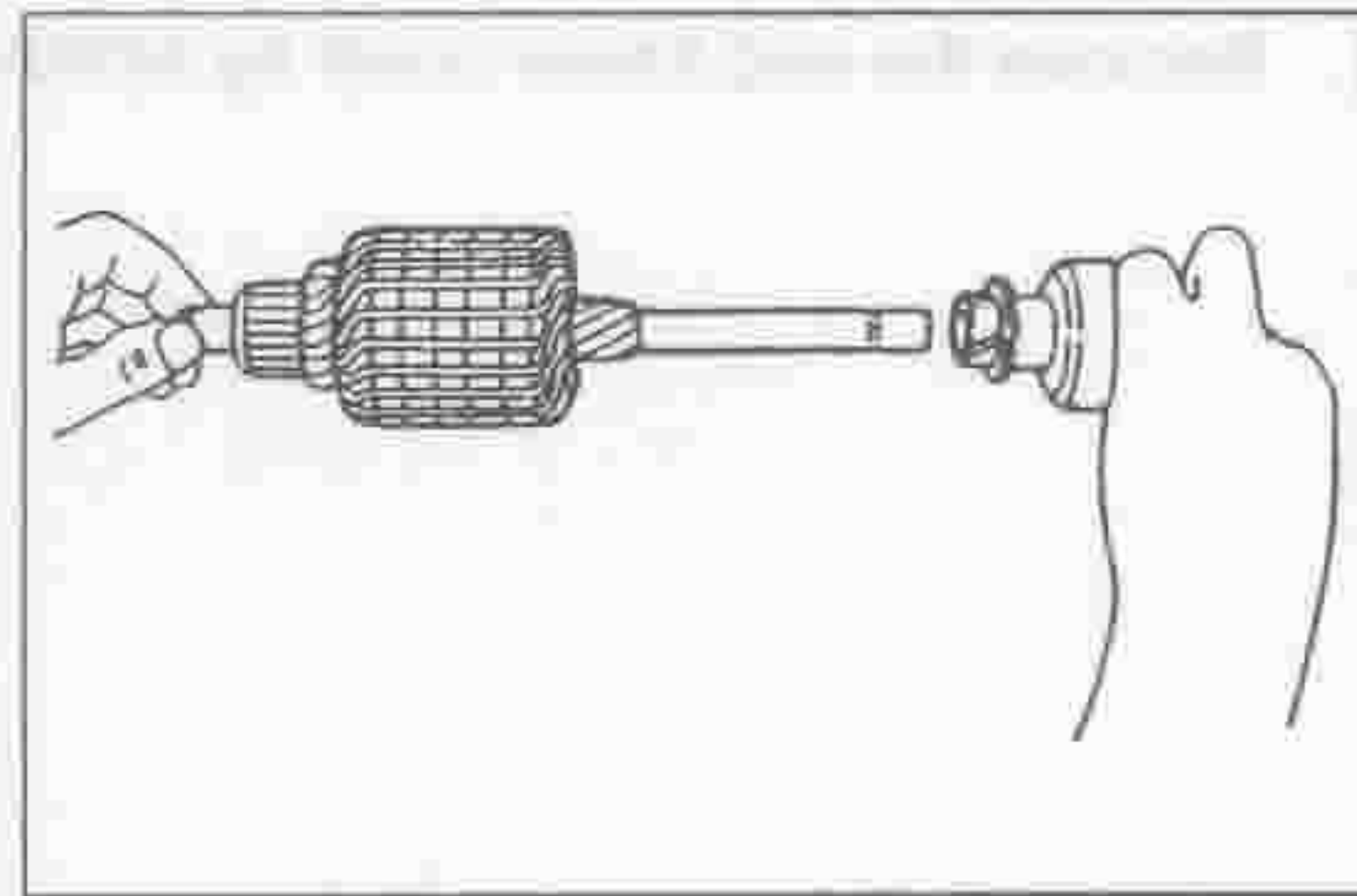
LST00030-00025

13. Remove the collar.



LST00031-00026

14. Remove the clutch.

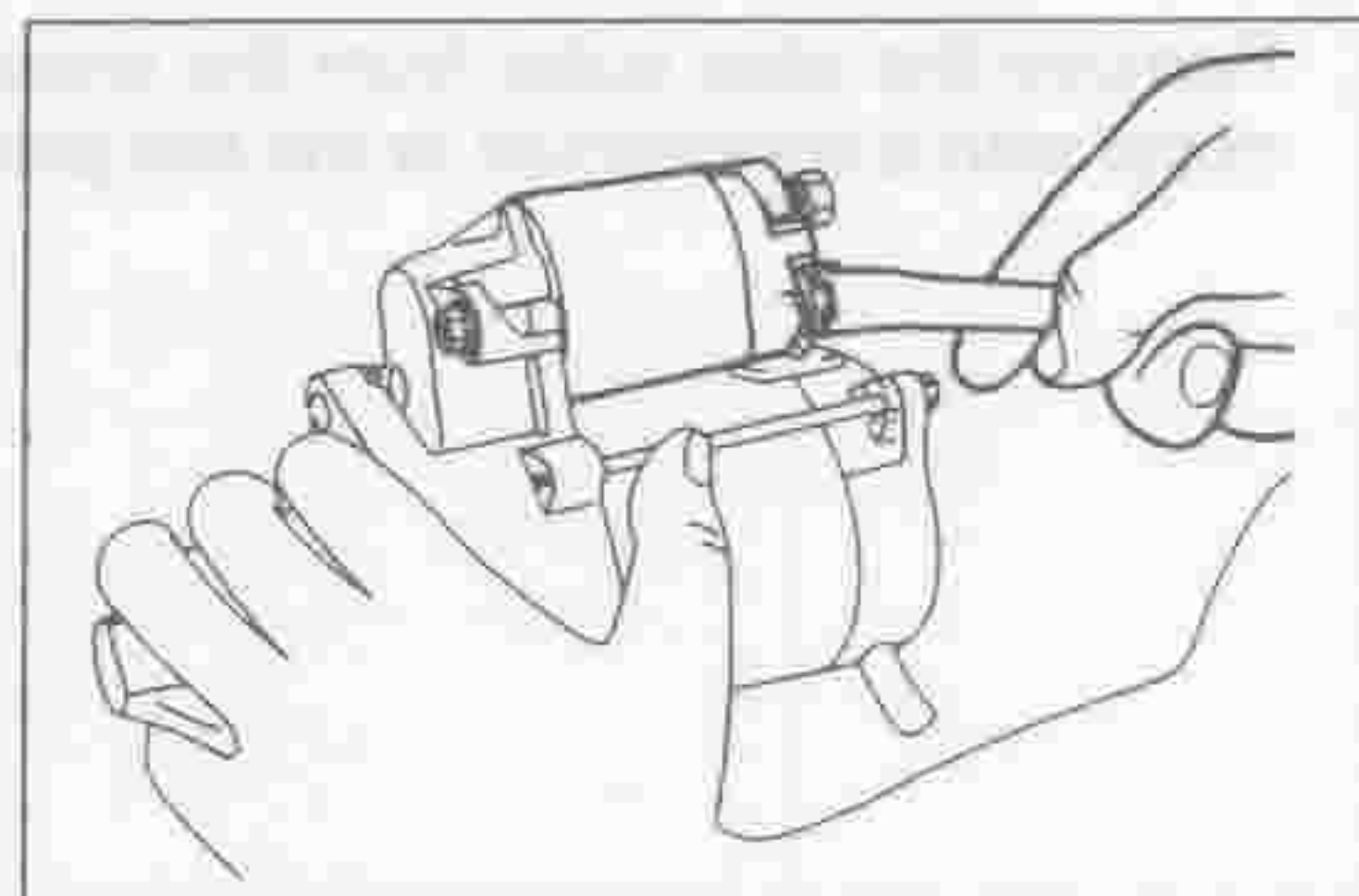


LST00032-00027

ST-12

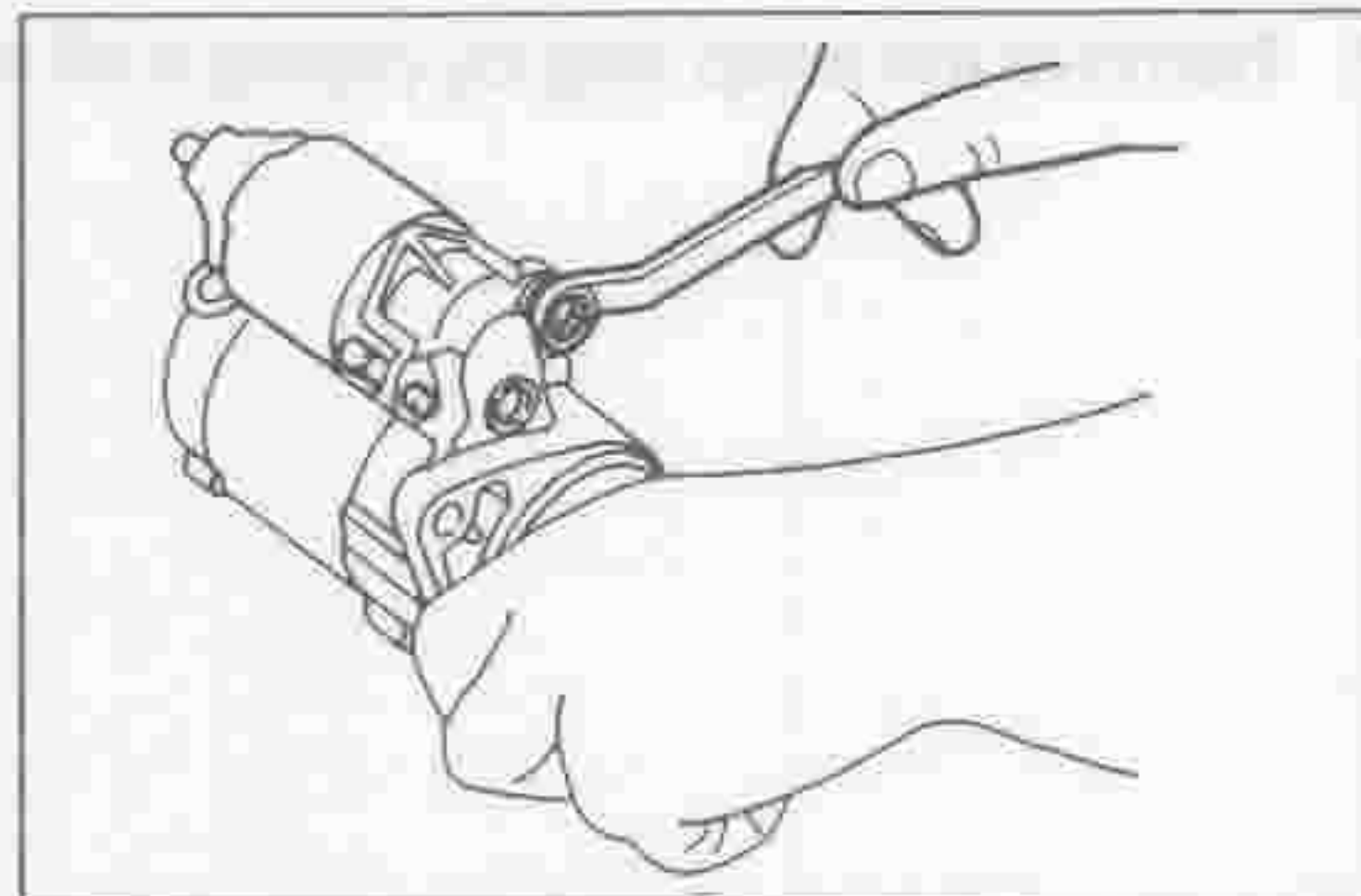
For 0.6 kW 0.7 kW and 0.8 kW motor

1. Disconnect the lead wire from the magnetic switch.



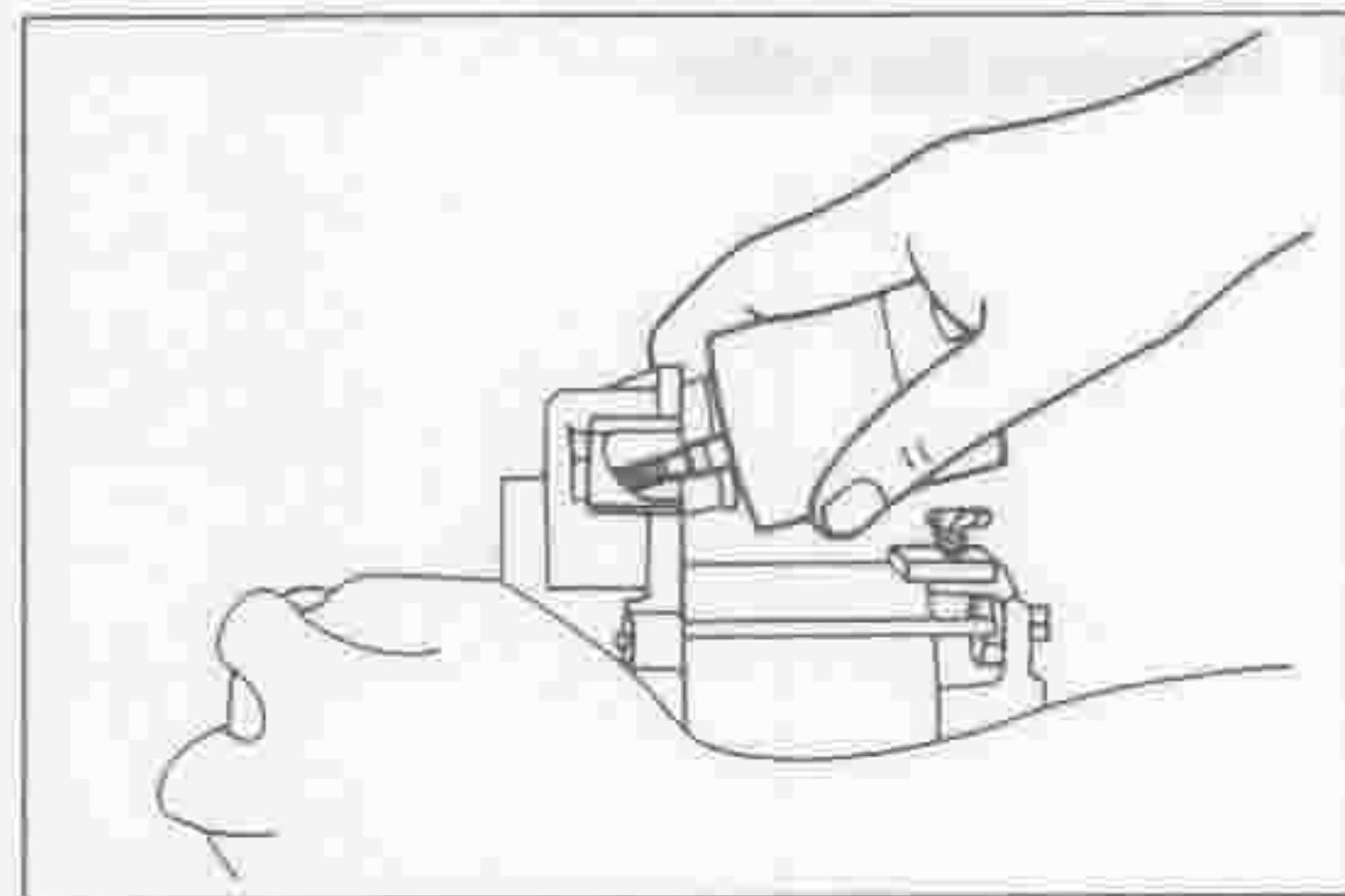
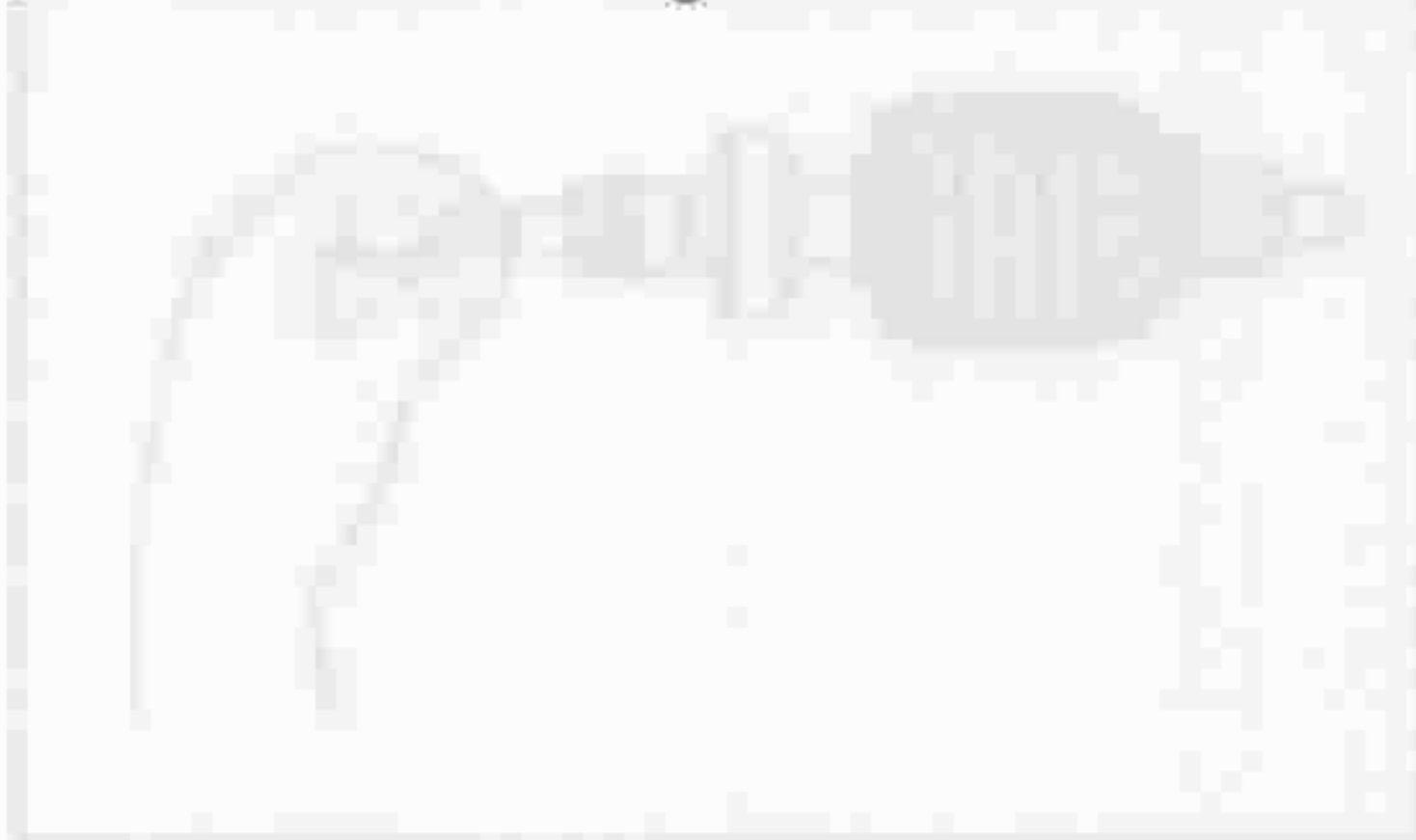
LST00033-00028

2. Remove the attaching nut of the magnetic switch from the drive housing.



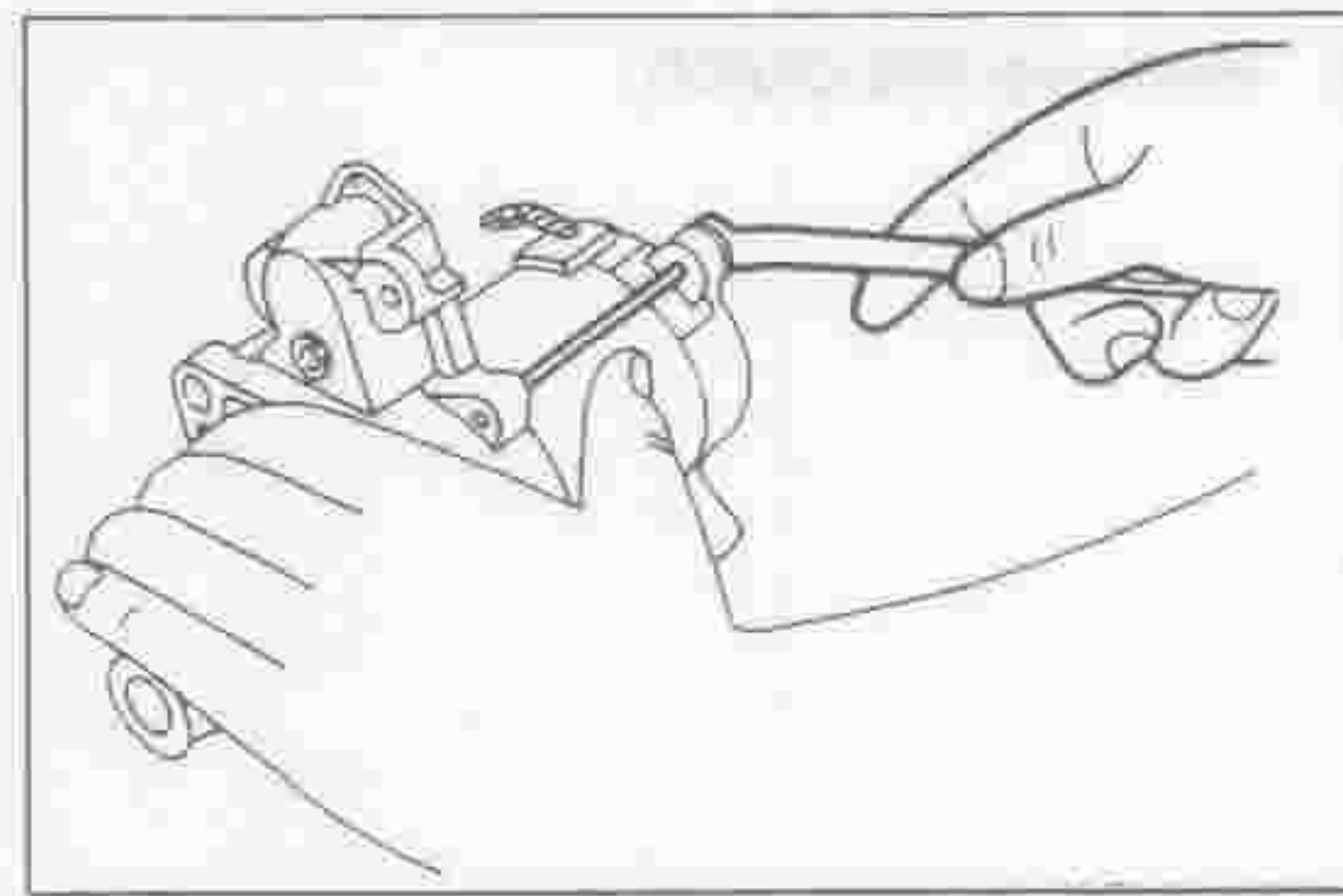
LST00034-00029

3. Remove the magnetic switch from the drive housing.



LST00035-00030

4. Remove the end frame cover by removing the two screws.



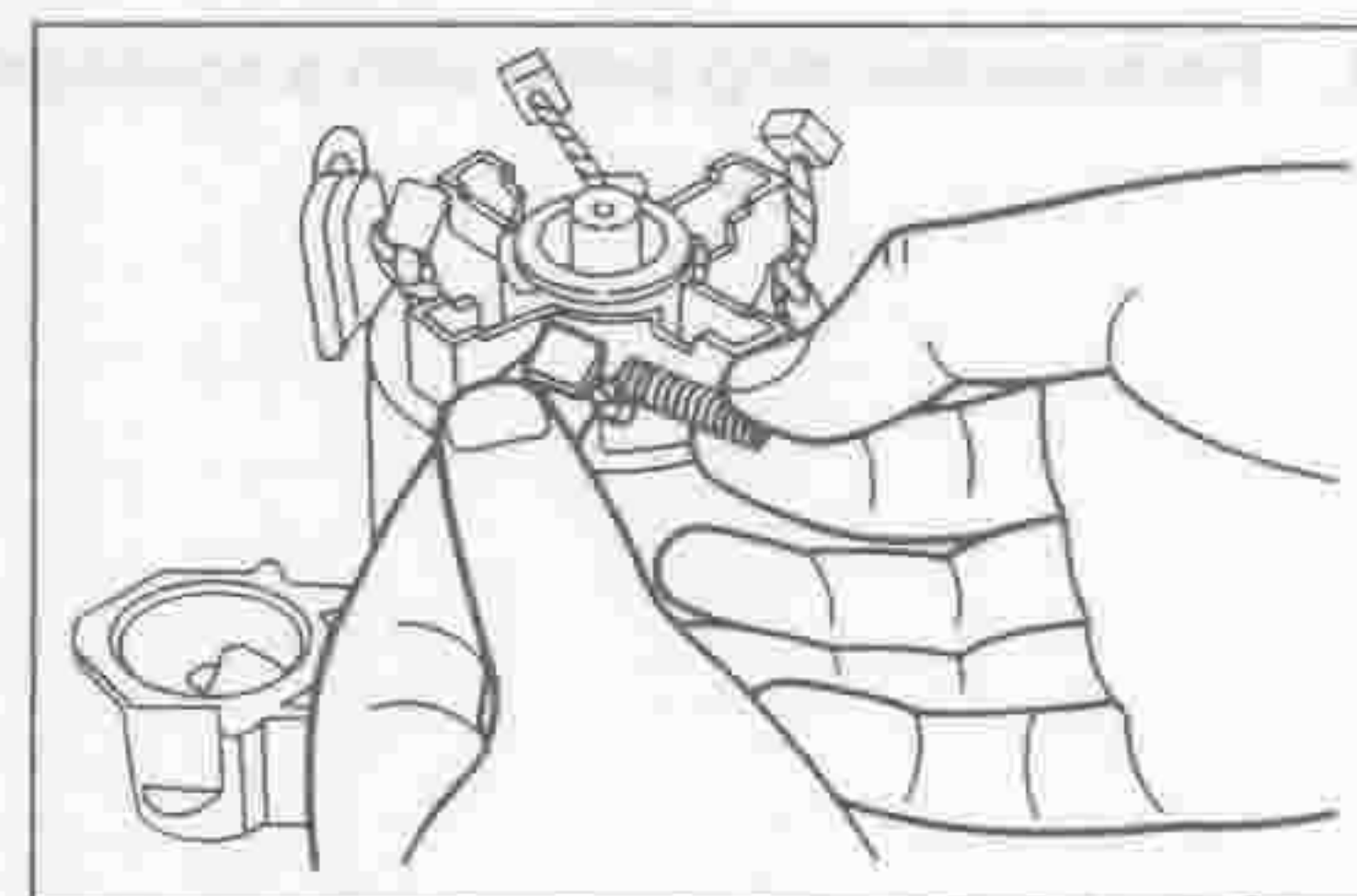
LST00036-00031

5. Remove the insulator from the brush holder.



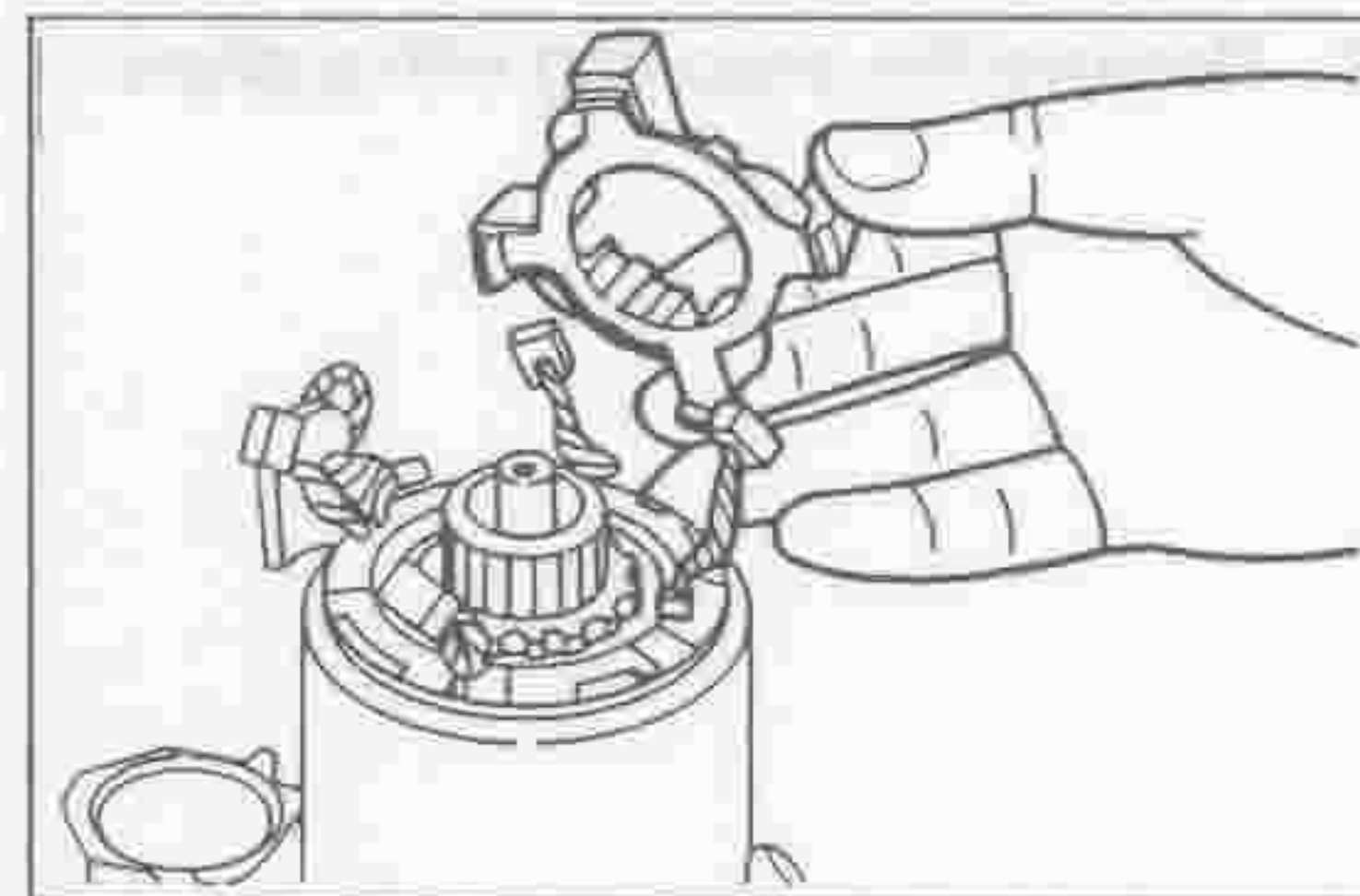
LST00037-00032

6. Remove the brush spring and brush from the brush holder.



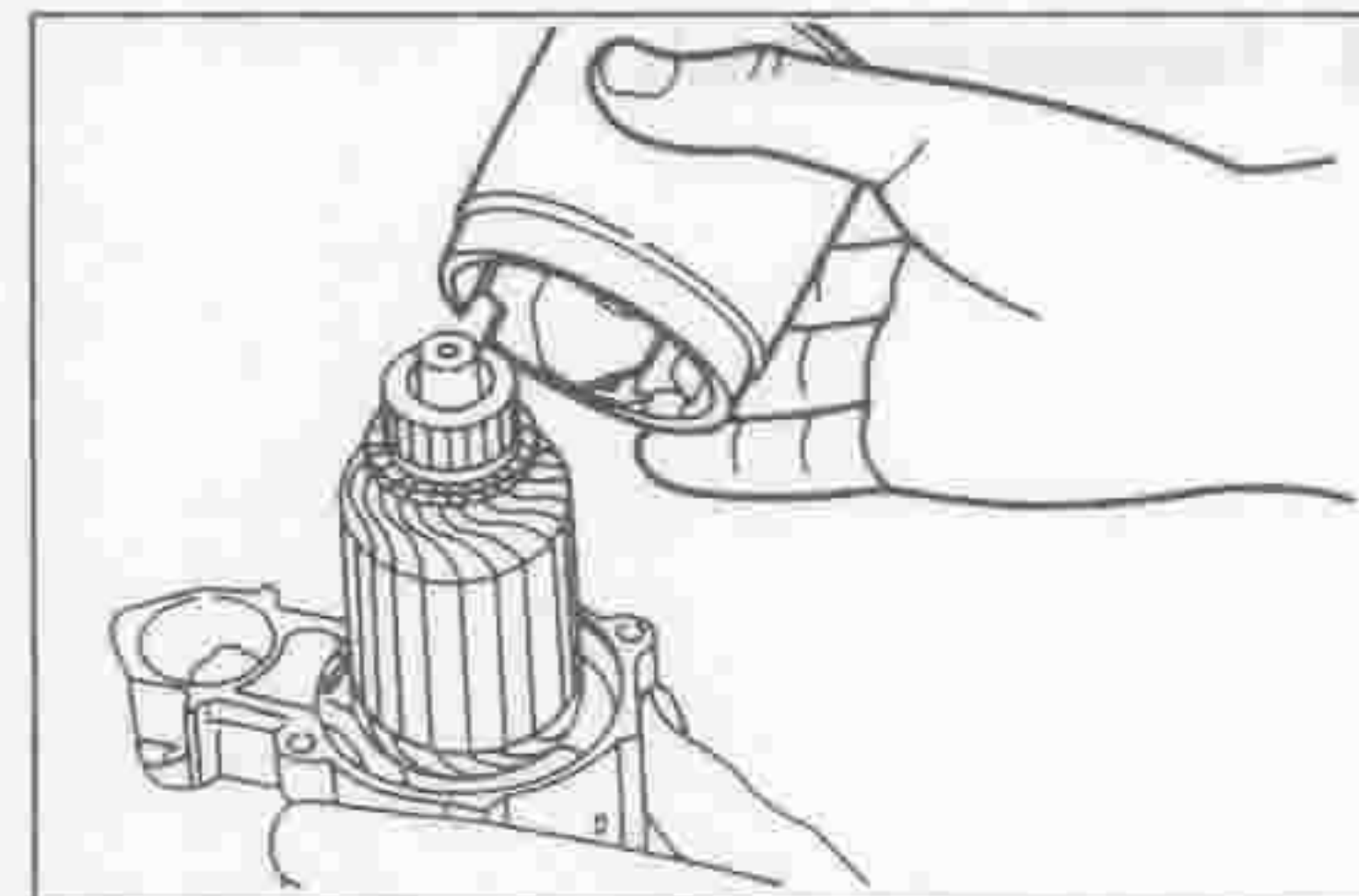
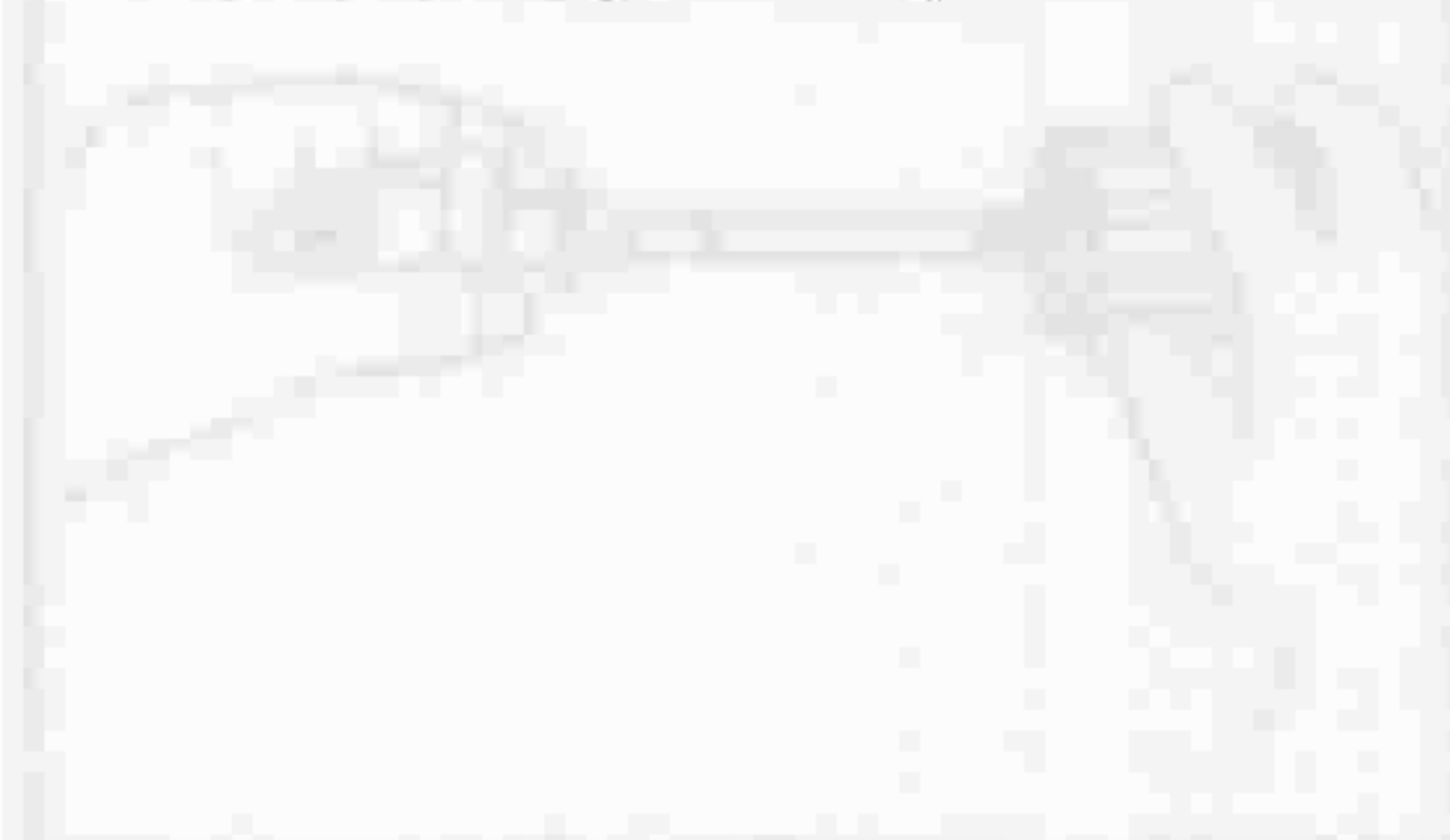
LST00038-00033

7. Remove the brush holder from the yoke assy.



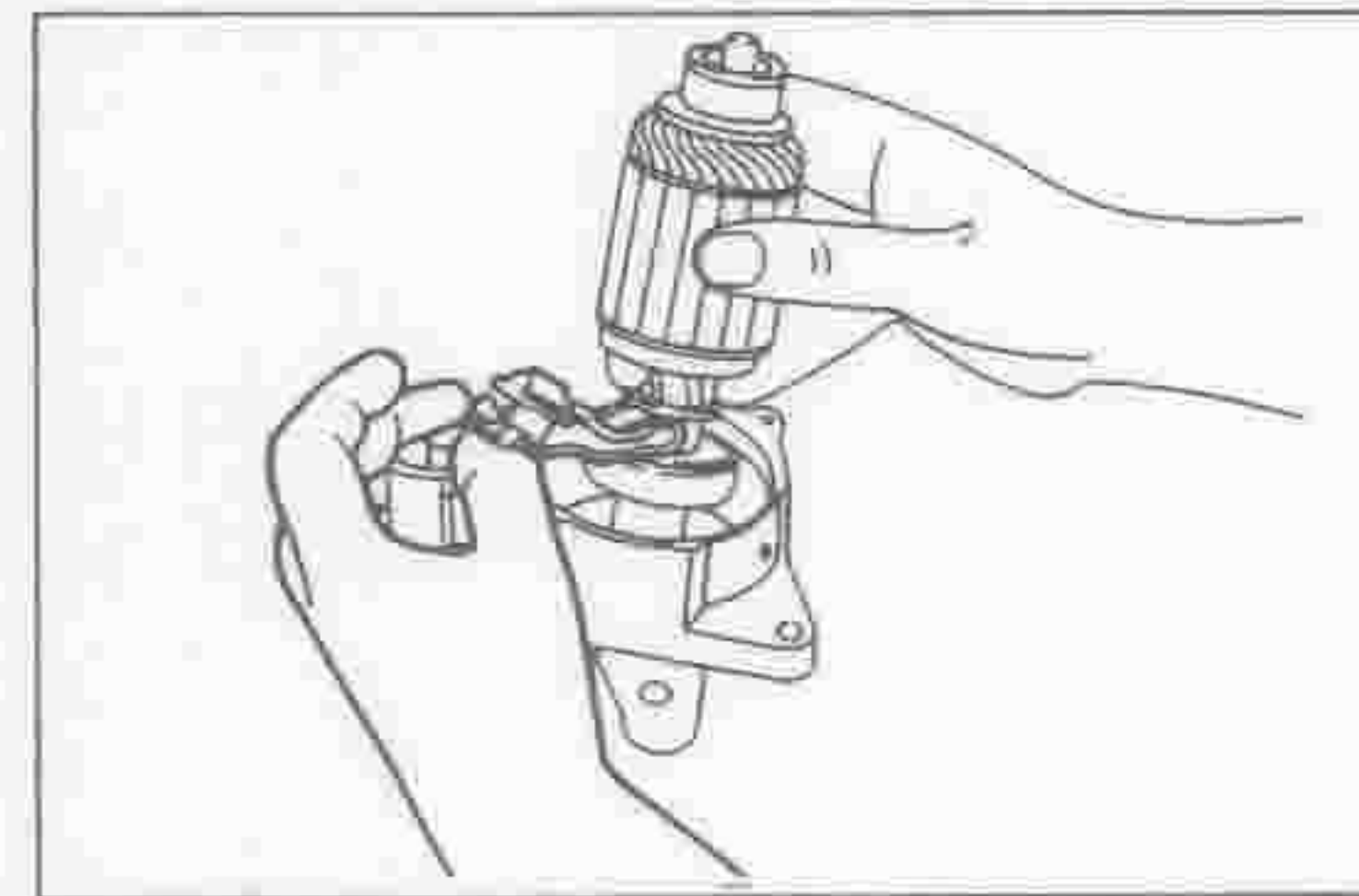
LST00039-00034

8. Remove the yoke assy from the armature.



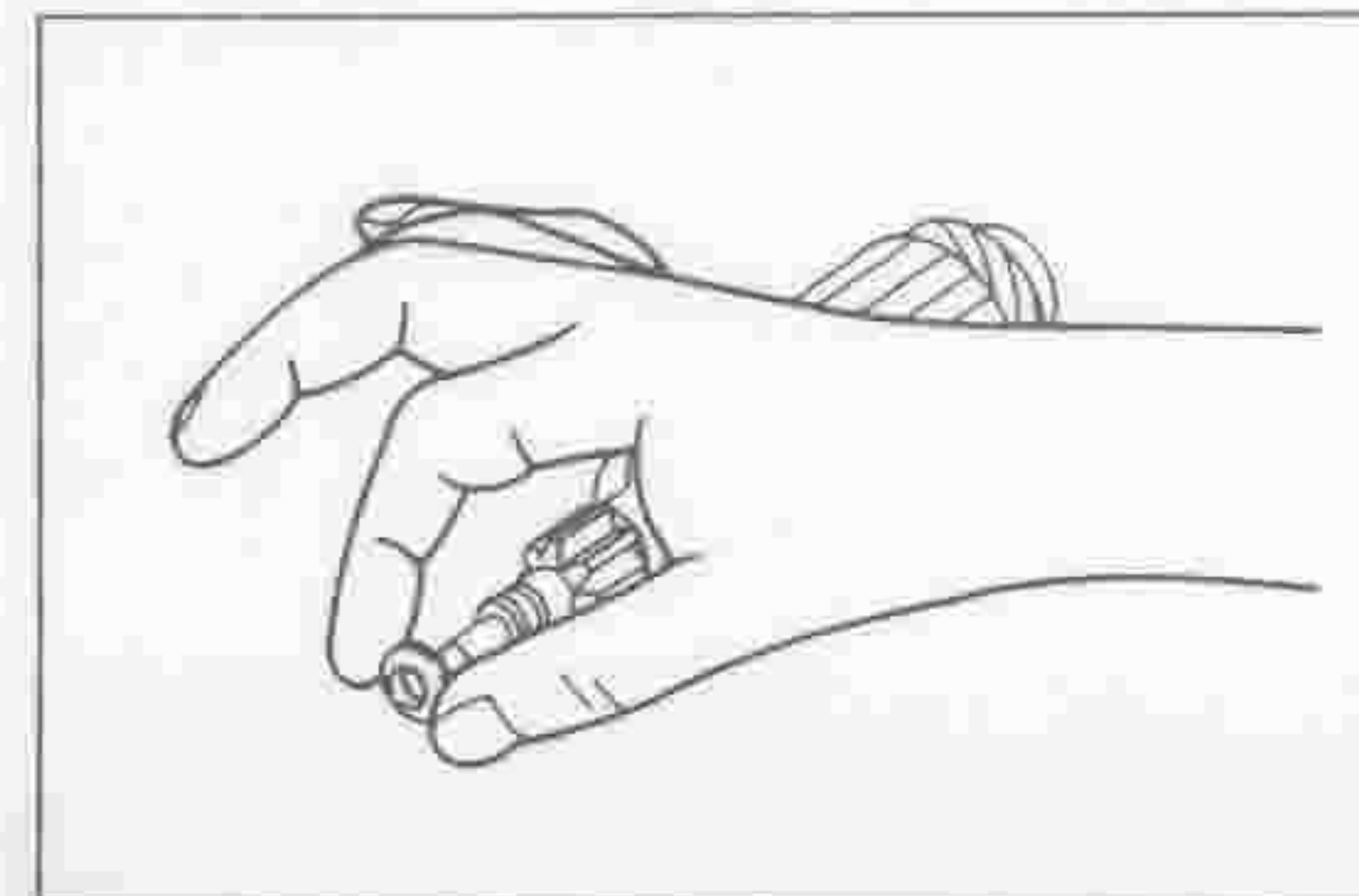
LST00040-00035

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



LST00041-00036

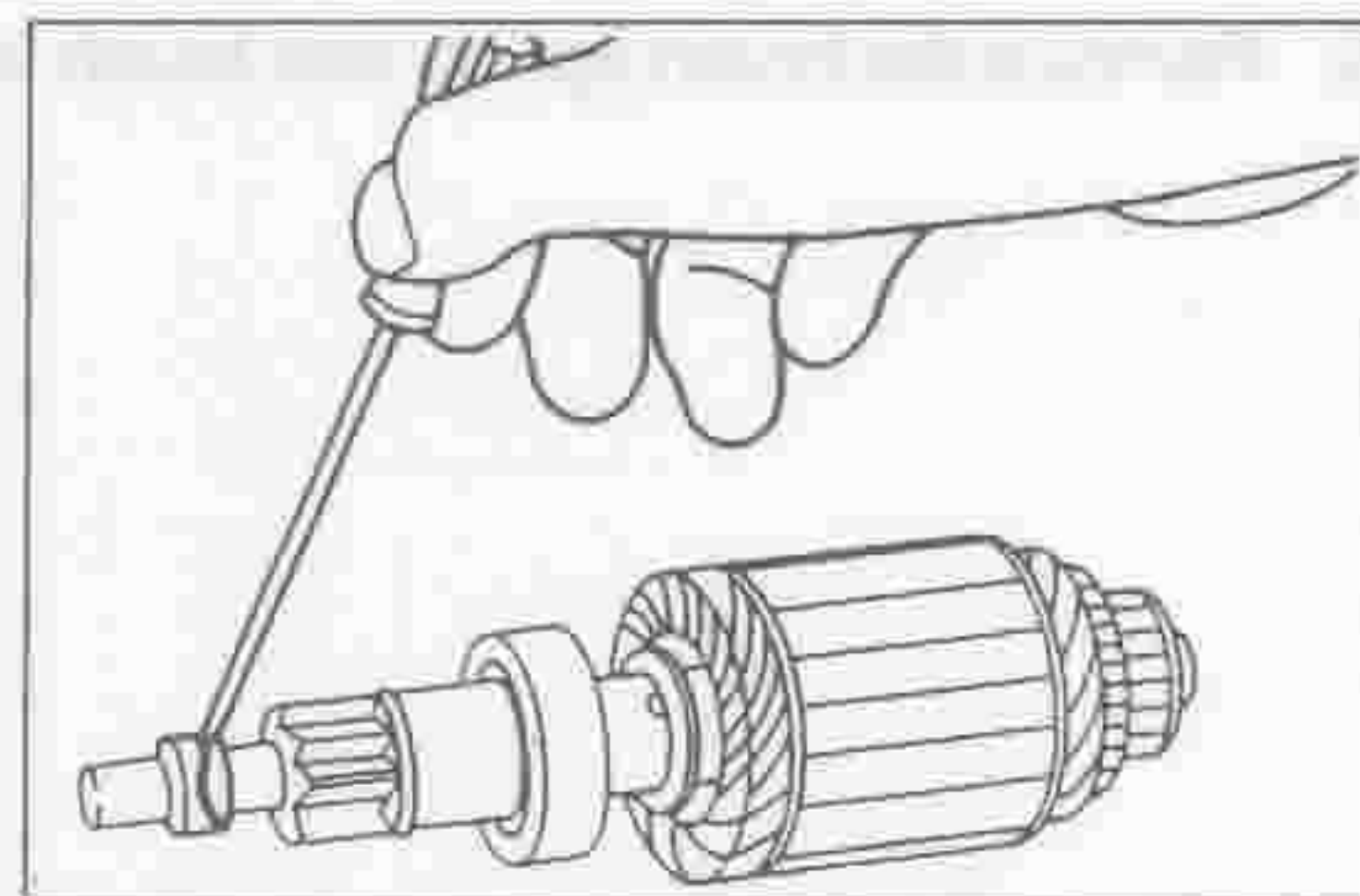
10. Remove the plate washer from the shaft.



LST00042-00037

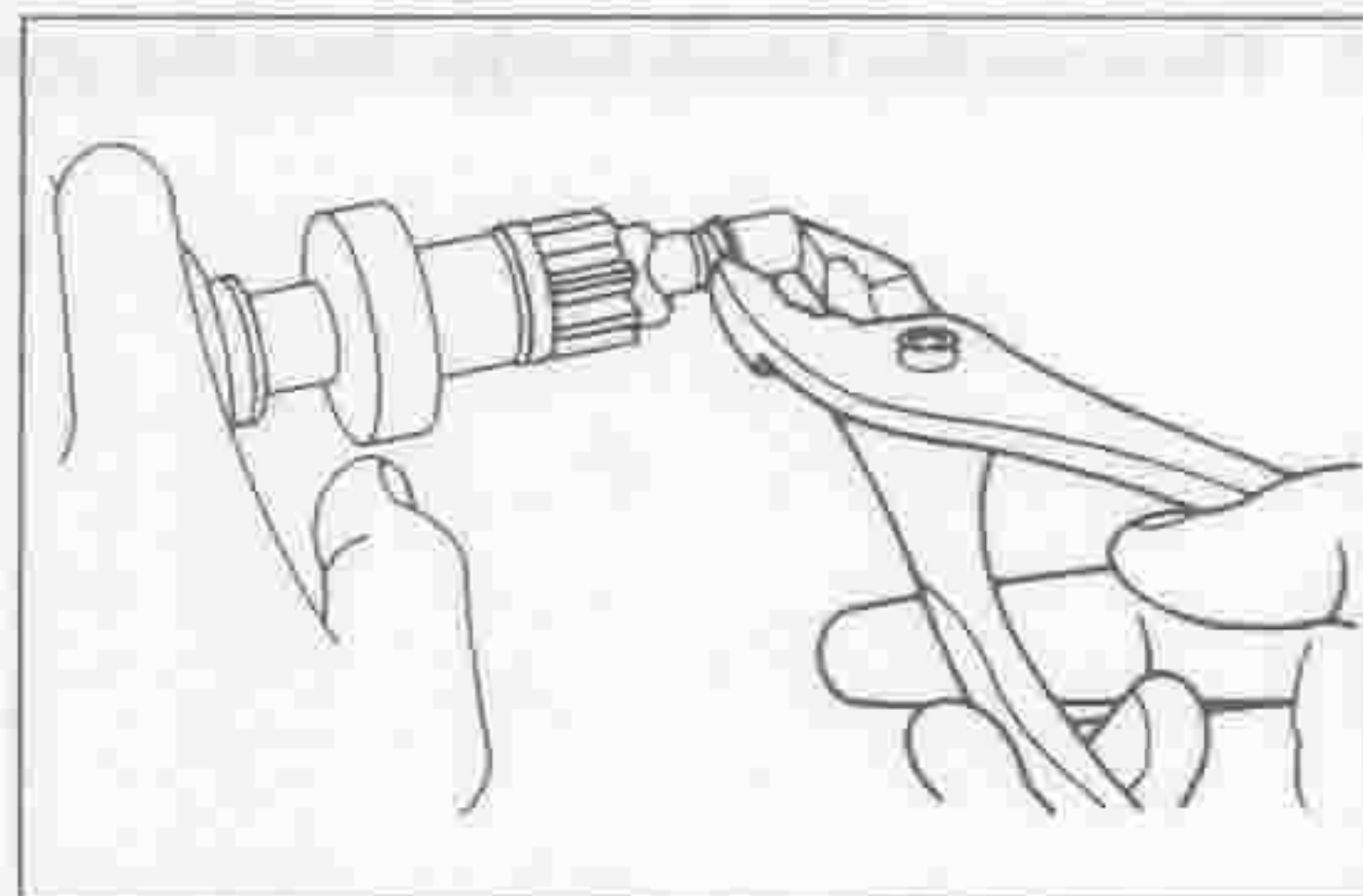
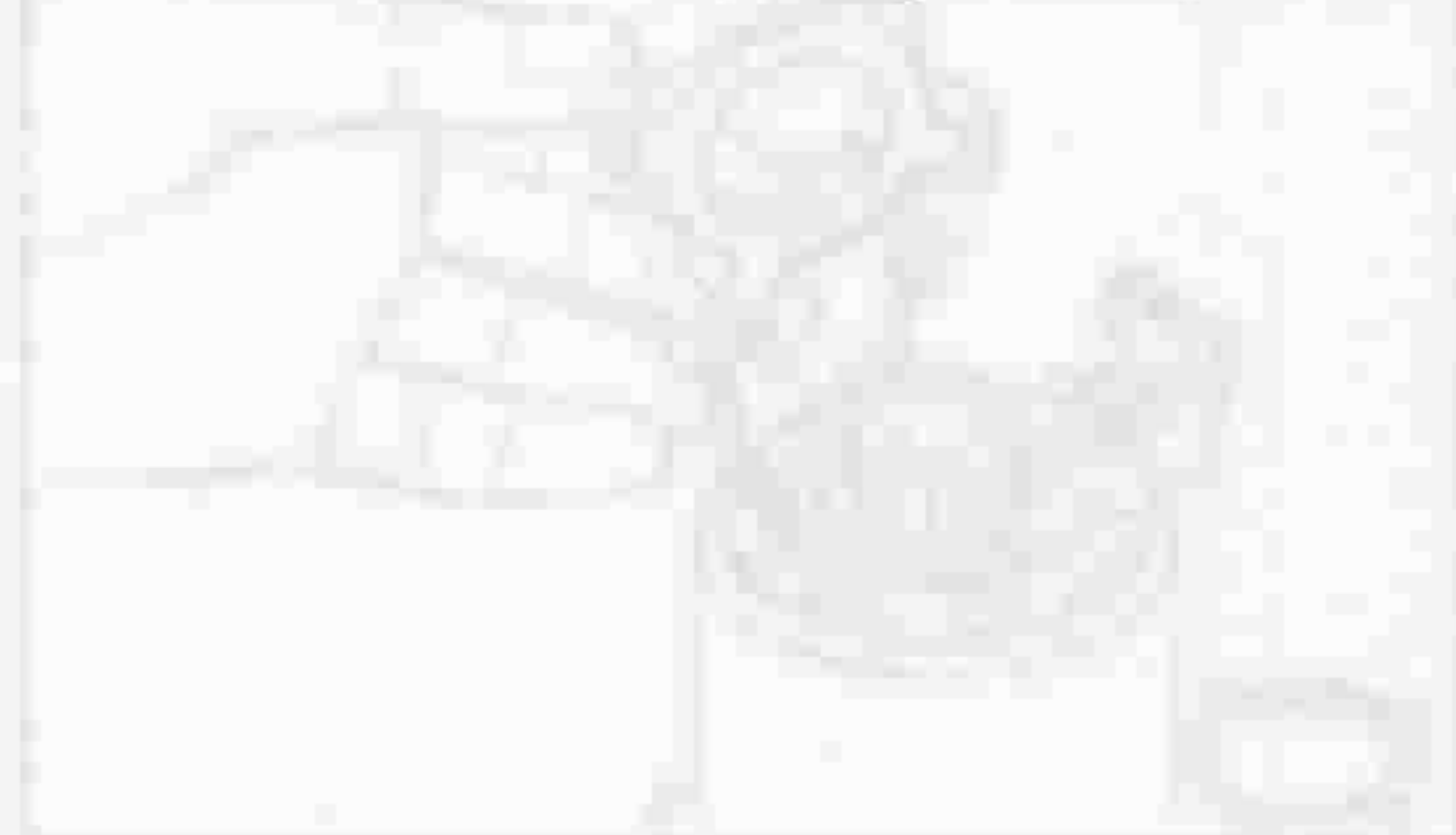
ST-14

11. Remove the stop collar with a screwdriver.



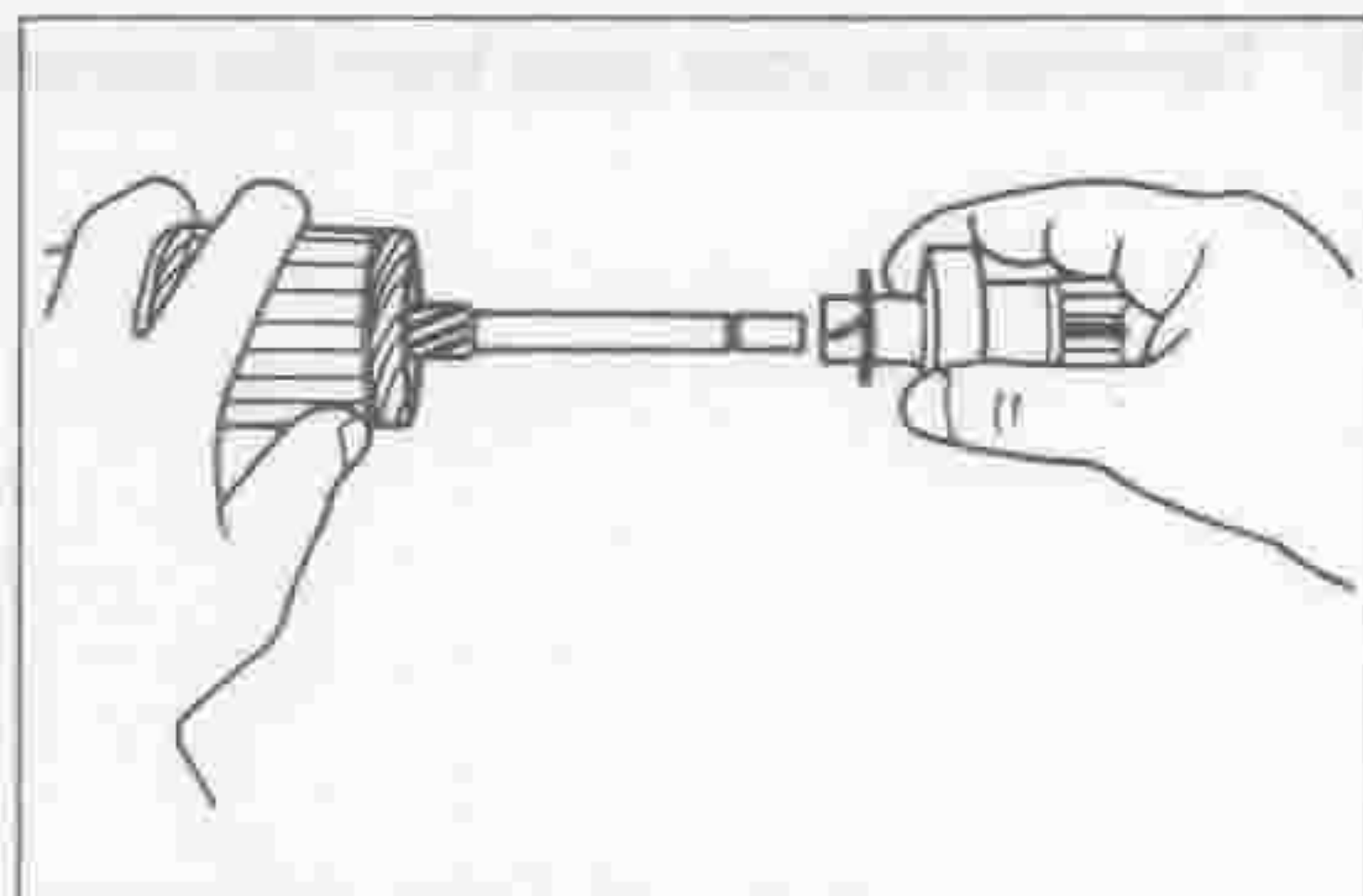
LST00043-00038

12. Remove the snap ring with a pliers.



LST00044-00039

13. Remove the clutch.



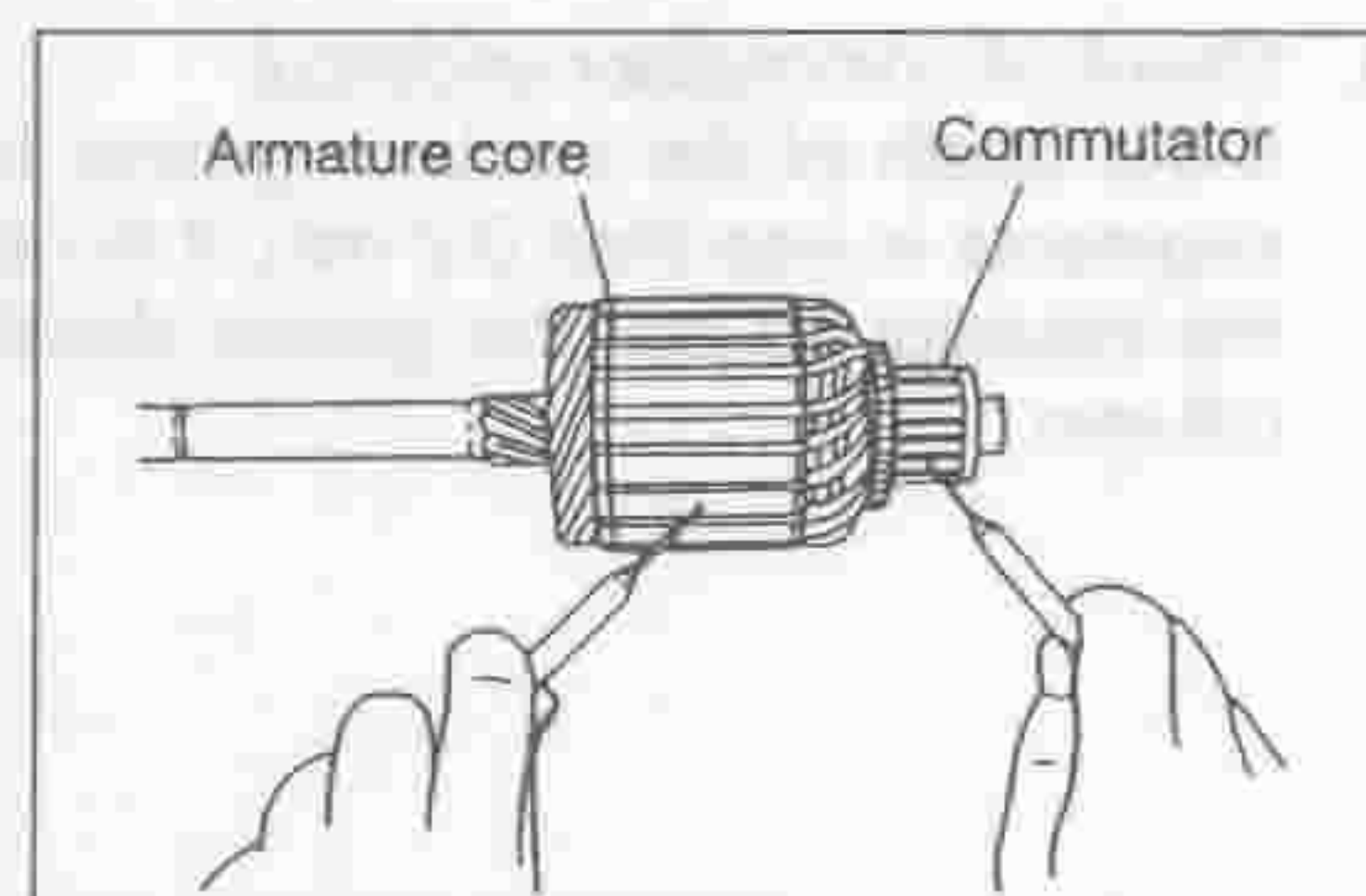
LST00045-00040



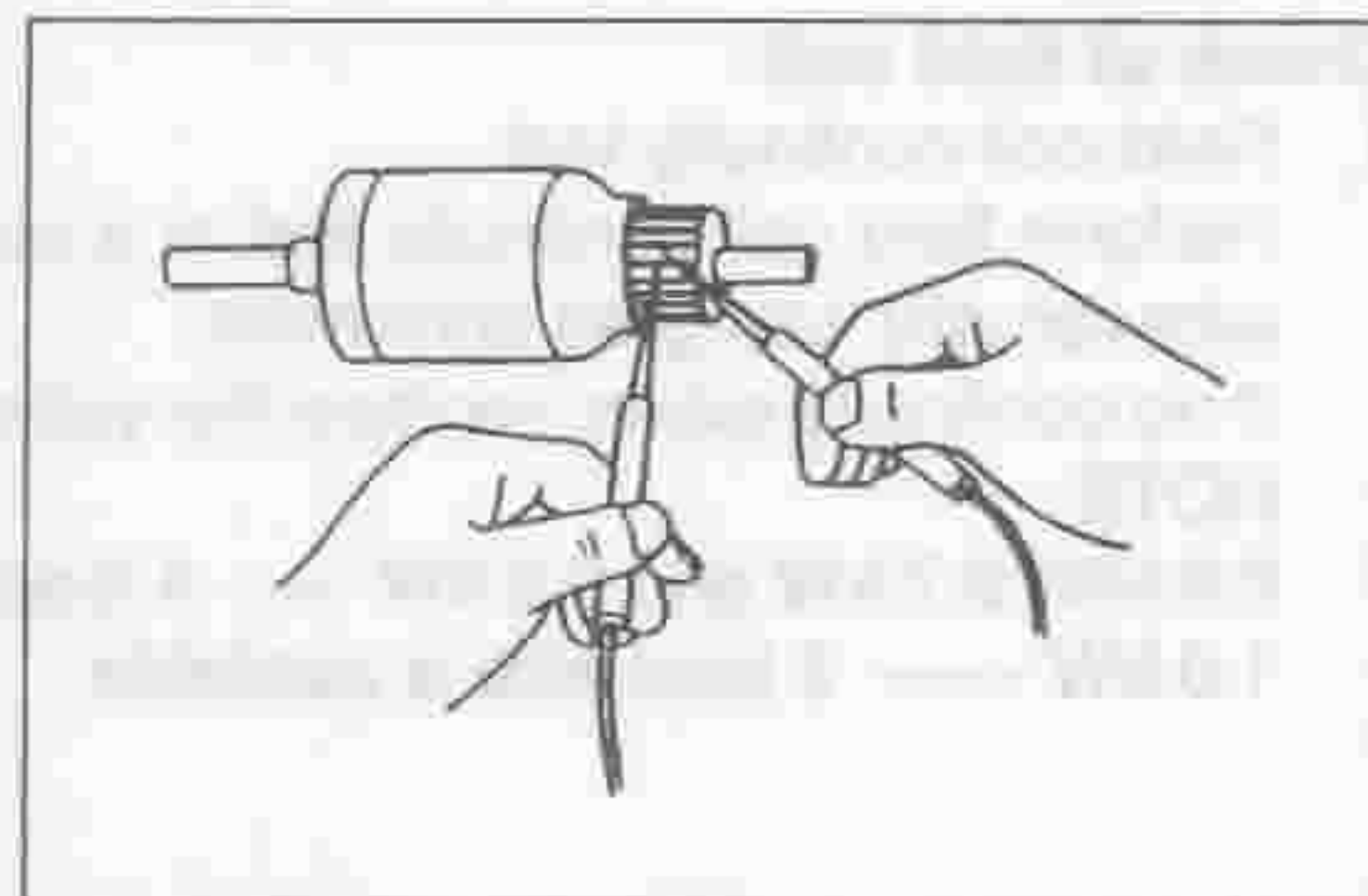
INSPECTION

Check of armature

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



LST00046-00041



LST00047-00042

Check of commutator

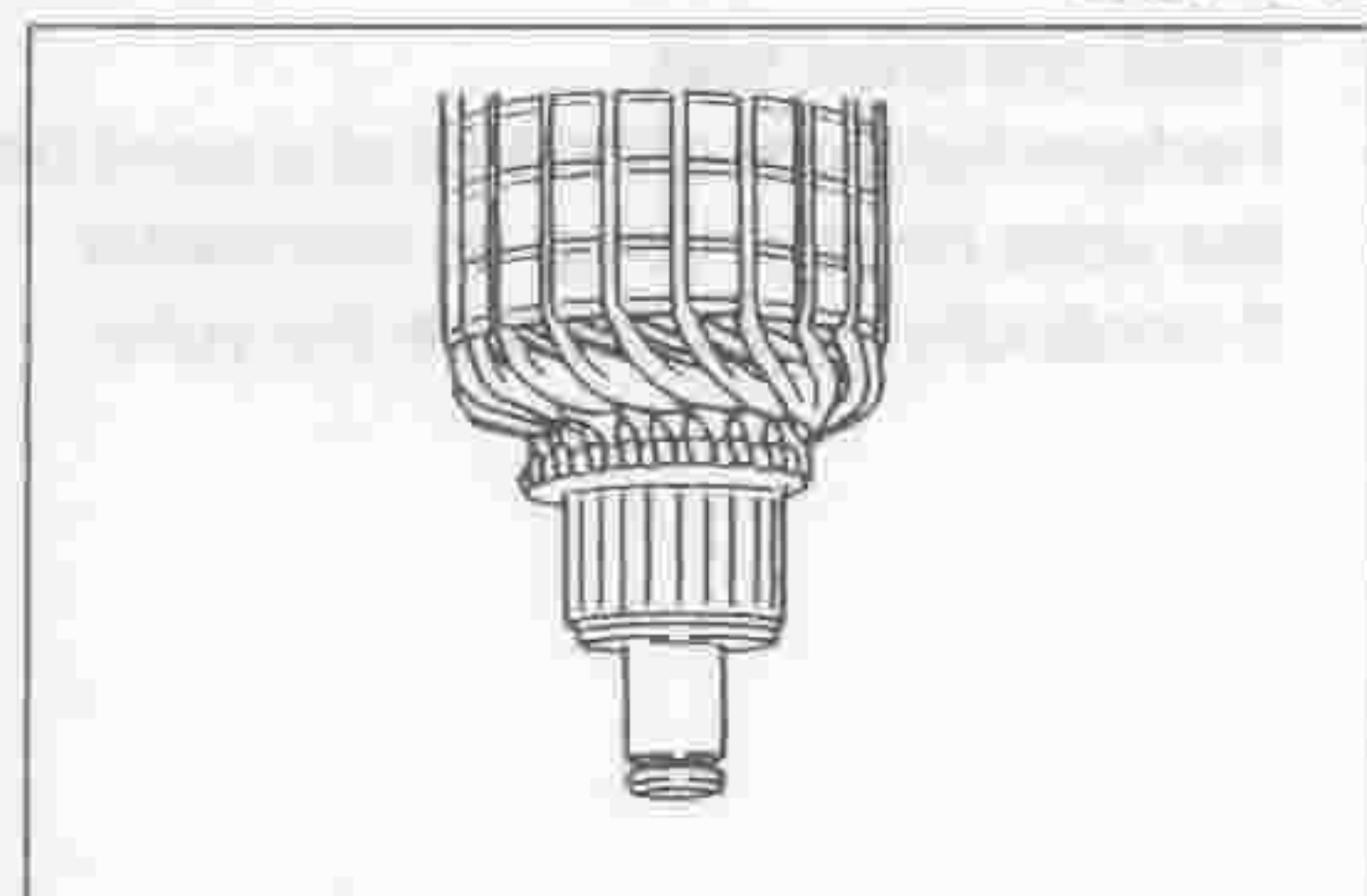
1. Check each contact surface of the commutator segments with the brushes for burning.
If the surfaces are dirty or burnt, correct the commutator surfaces, using abrasive paper (No. 400) or a lathe.
2. Check of commutator for circle runout
Support the armature at its both ends on a Vee block.
Check the commutator for circle runout, using a dial gauge.
Circle Runout Limit: 0.40 mm

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

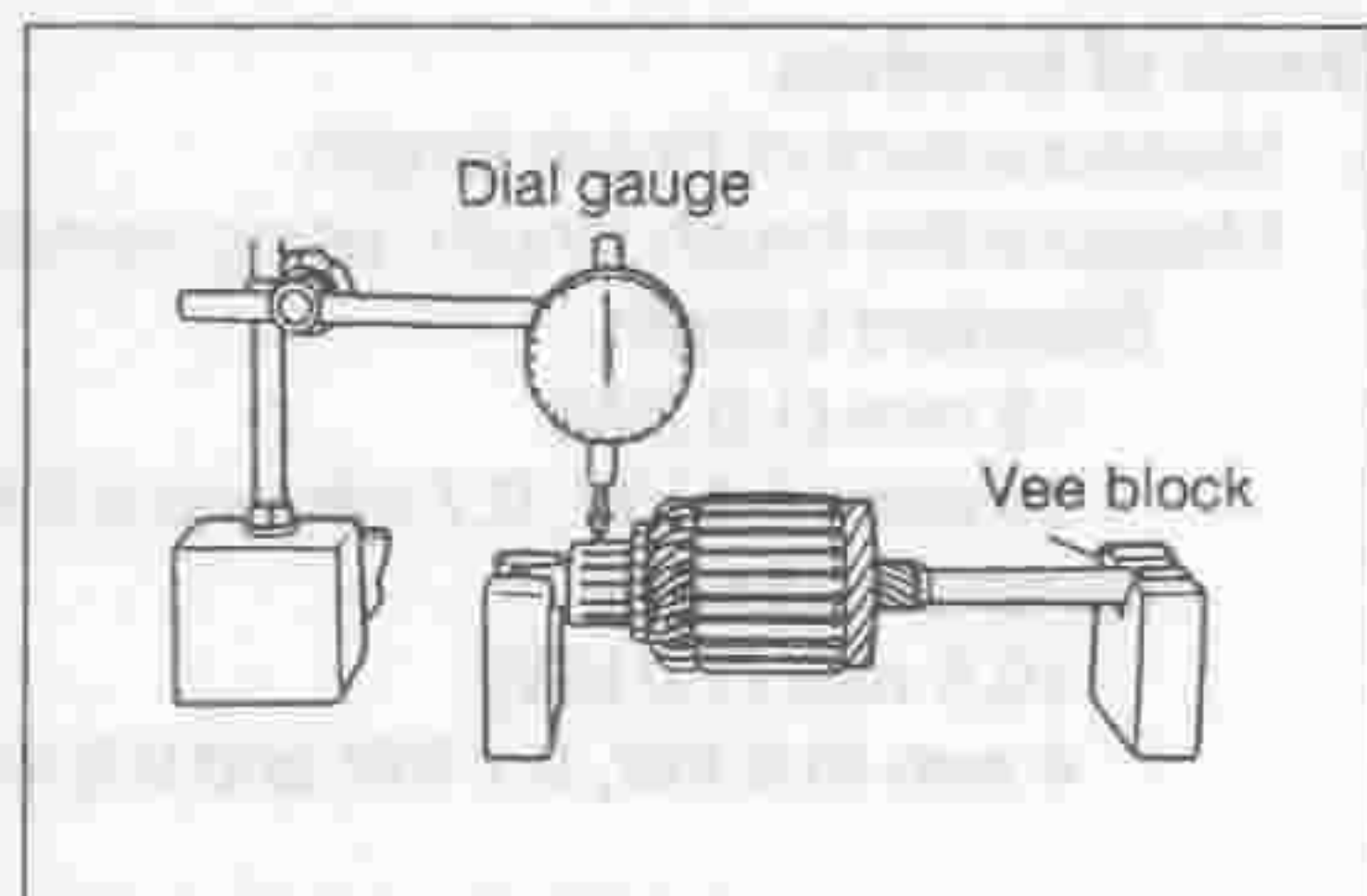
At this point, care must be exercised to ensure that the commutator diameter is not less than the minimum requirement diameter of 27 mm

3. Measurement of commutator diameter
Measure the commutator diameter by means of a micrometer or vernier calipers.
Standard Diameter: 28 mm
Minimum diameter: 27 mm

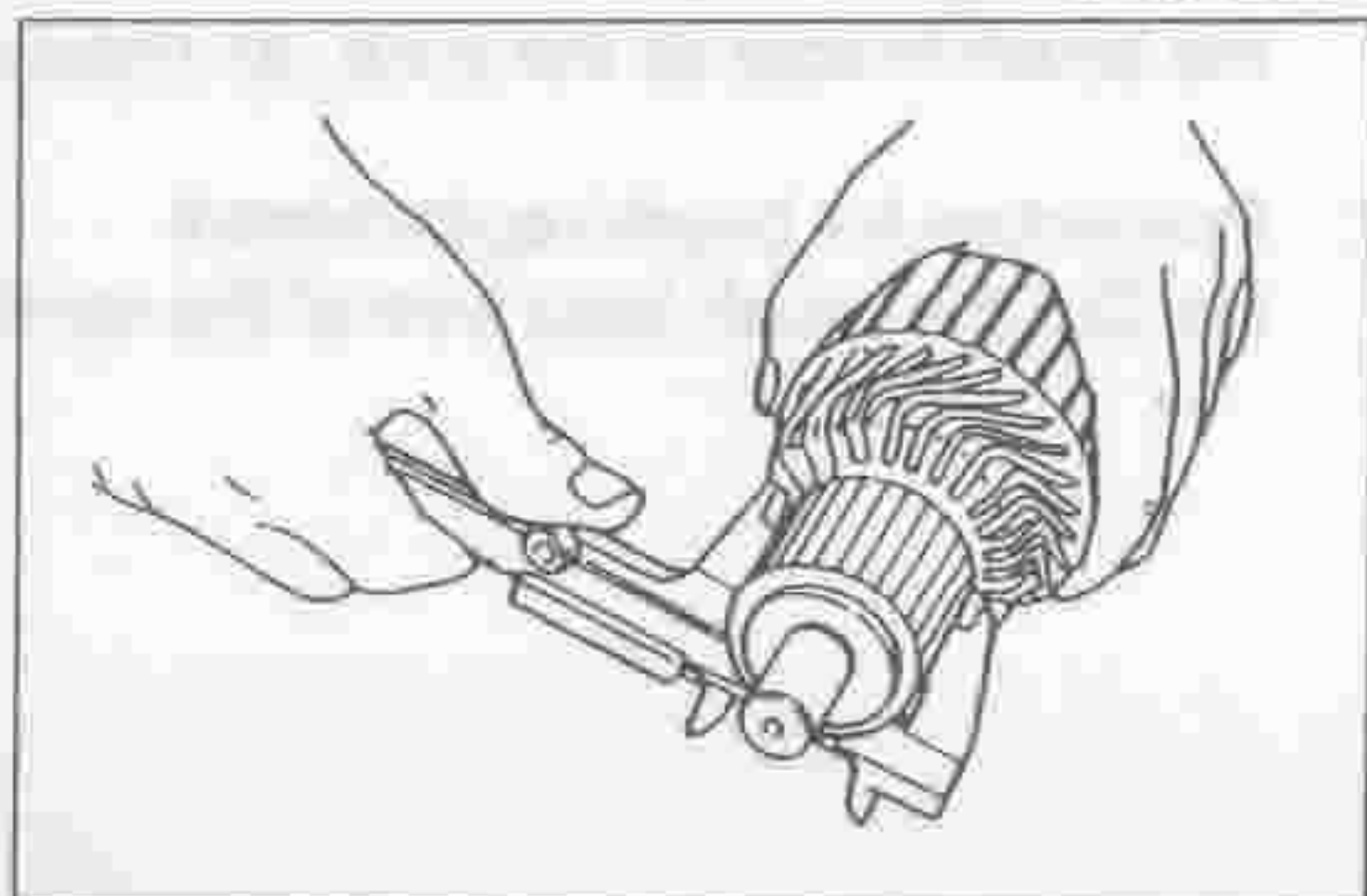
If the commutator diameter is less than the minimum diameter, replace the armature.



LST00048-00043



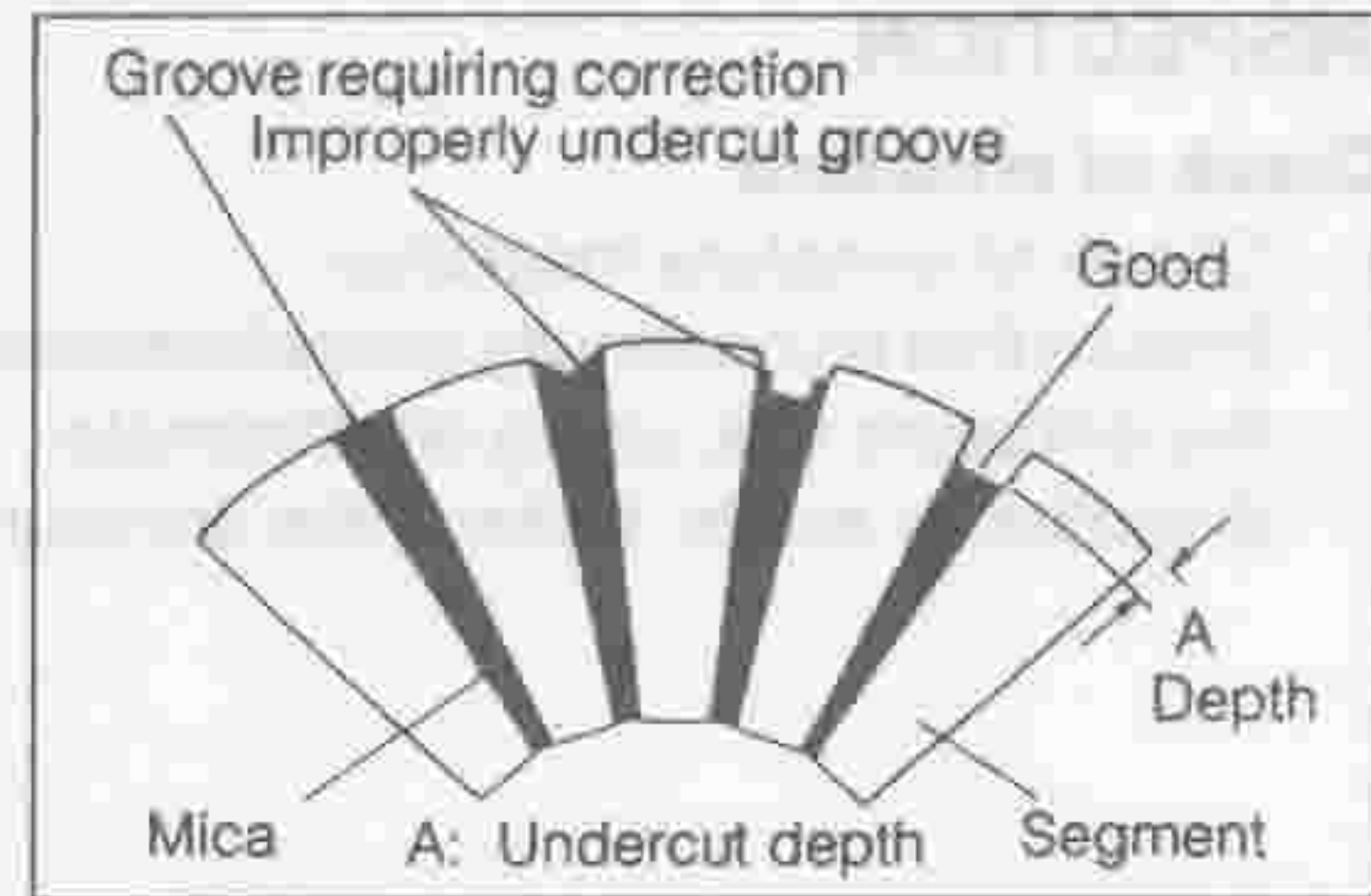
LST00049-00044



LST00050-00045

4. Check of commutator undercut

If the depth of the insulator groove between commutator segments is less than 0.2 mm, it is necessary to undercut the insulator so that the groove depth may become 0.5 - 0.8 mm.



LST00051-00046

Check of field coil

1. Field coil continuity test

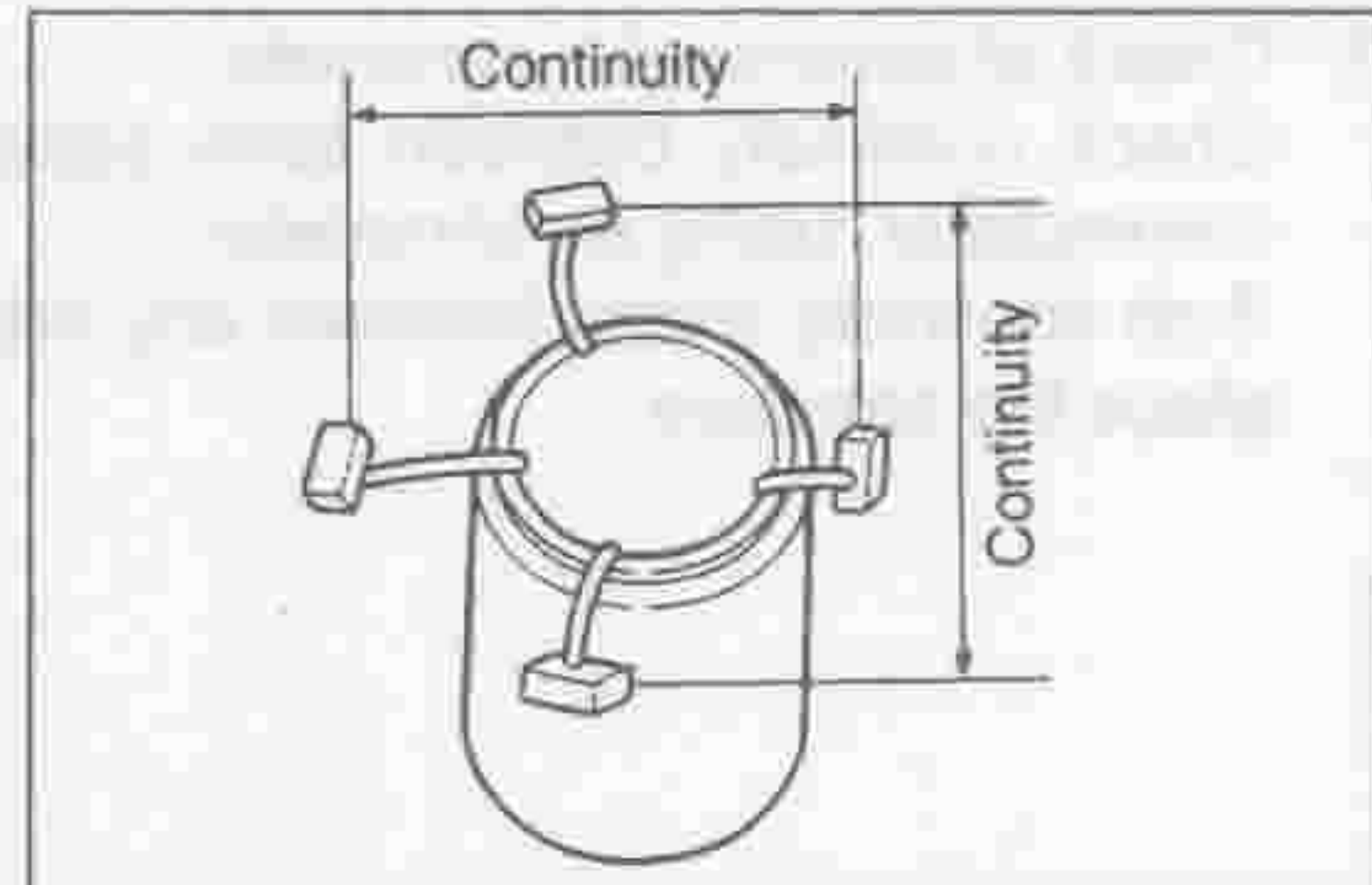
Perform field coil continuity test at a point between the lead wire (brush), using an ohmmeter.

If no continuity exists, replace the yoke.

NOTE:

0.6 kW, 0.7 kW and 0.8 kW — 4 lead wire is available

1.0 kW — 2 lead wire is available

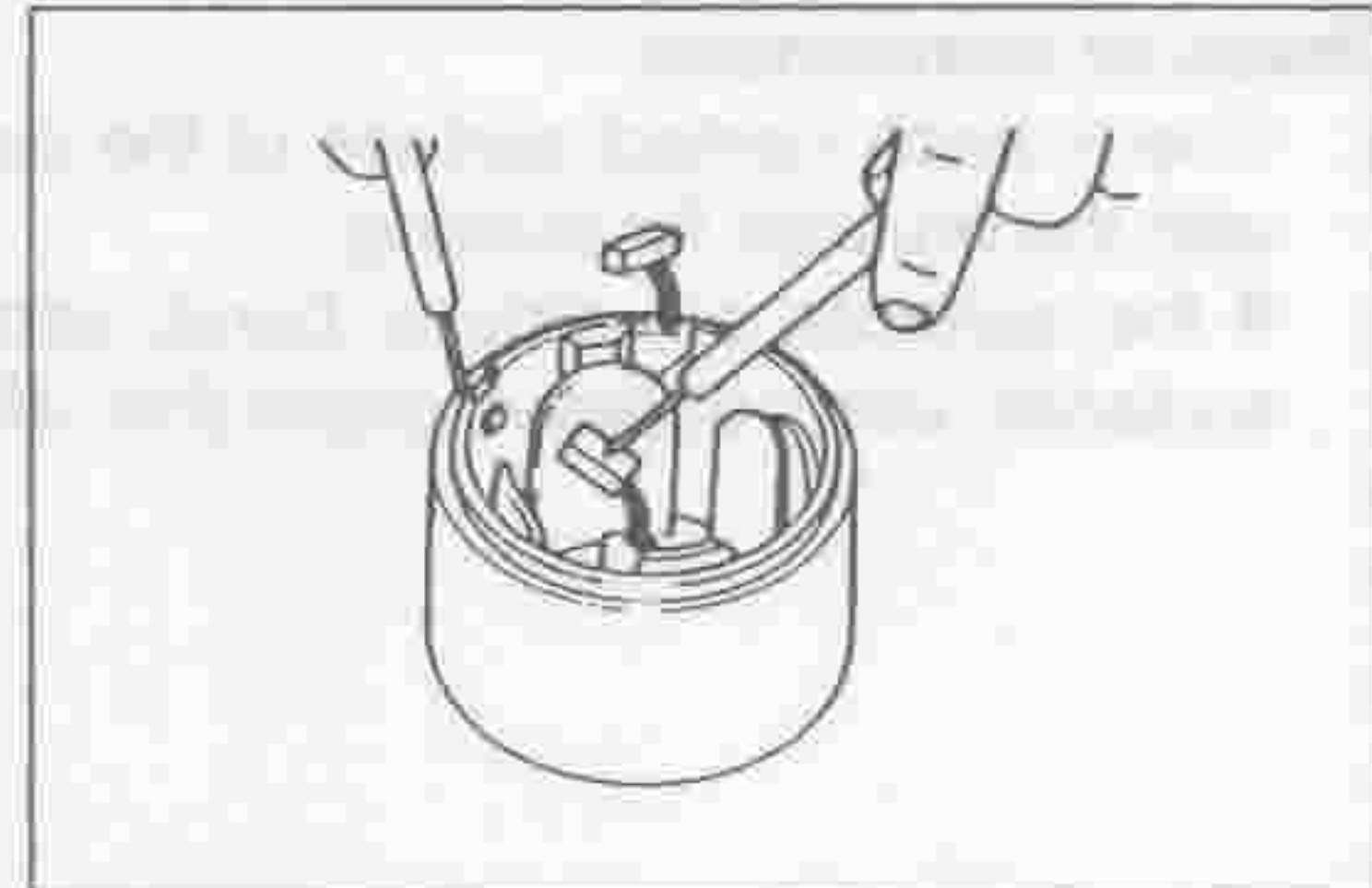


LST00052-00047

2. Field coil short test

Perform field coil short test at a point between the brush and the yoke proper, using an ohmmeter.

If continuity exists, replace the yoke.



LST00053-00048

Check of brushes

1. Measurement of brush length

Measure the brush length, using vernier calipers.

Standard Length:

16 mm (1.0 kW)

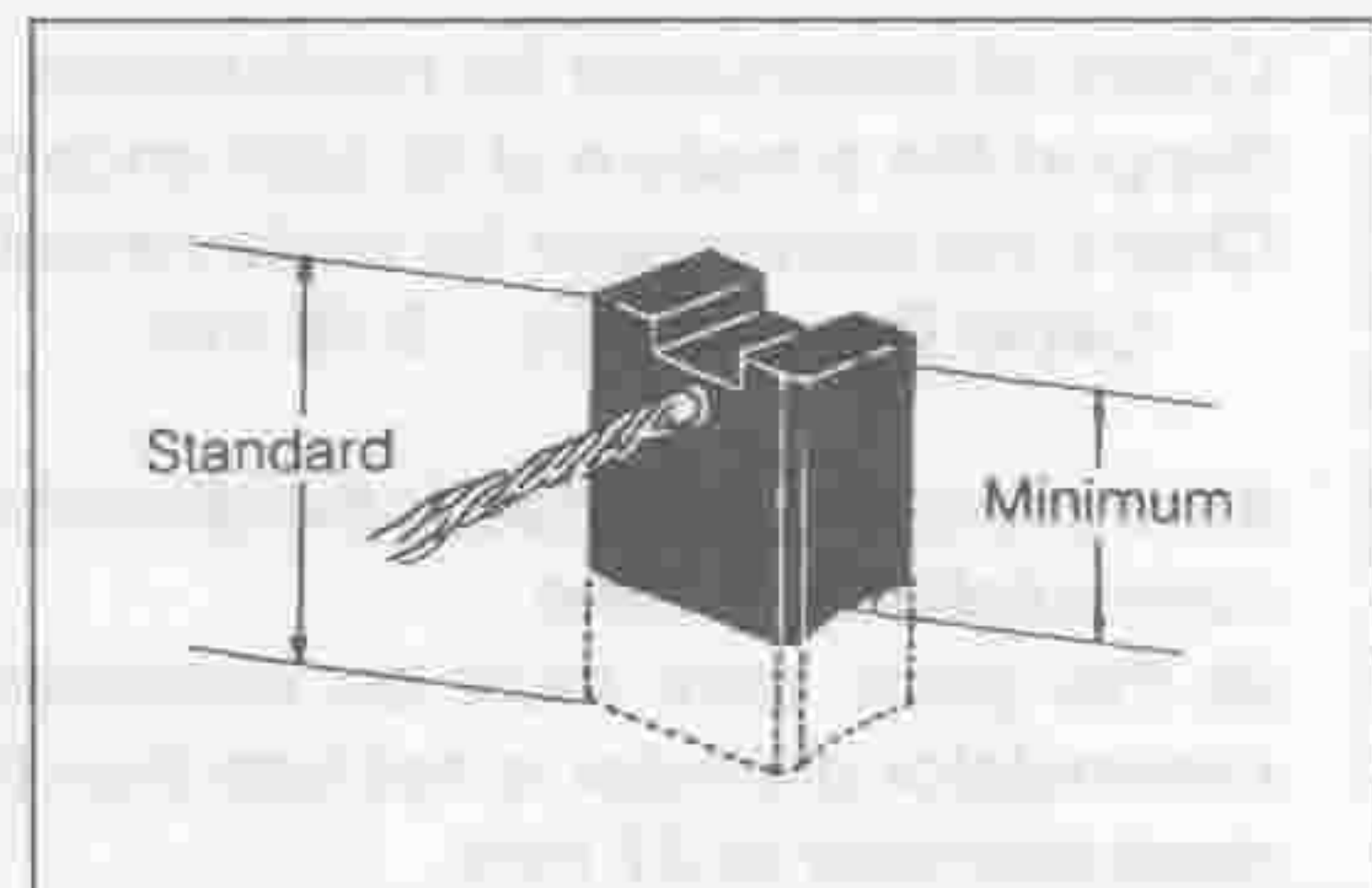
10 mm (0.6 kW, 0.7 kW and 0.8 kW)

Minimum Length:

10.5 mm (1.0 kW)

4 mm (0.6 kW, 0.7 kW and 0.8 kW)

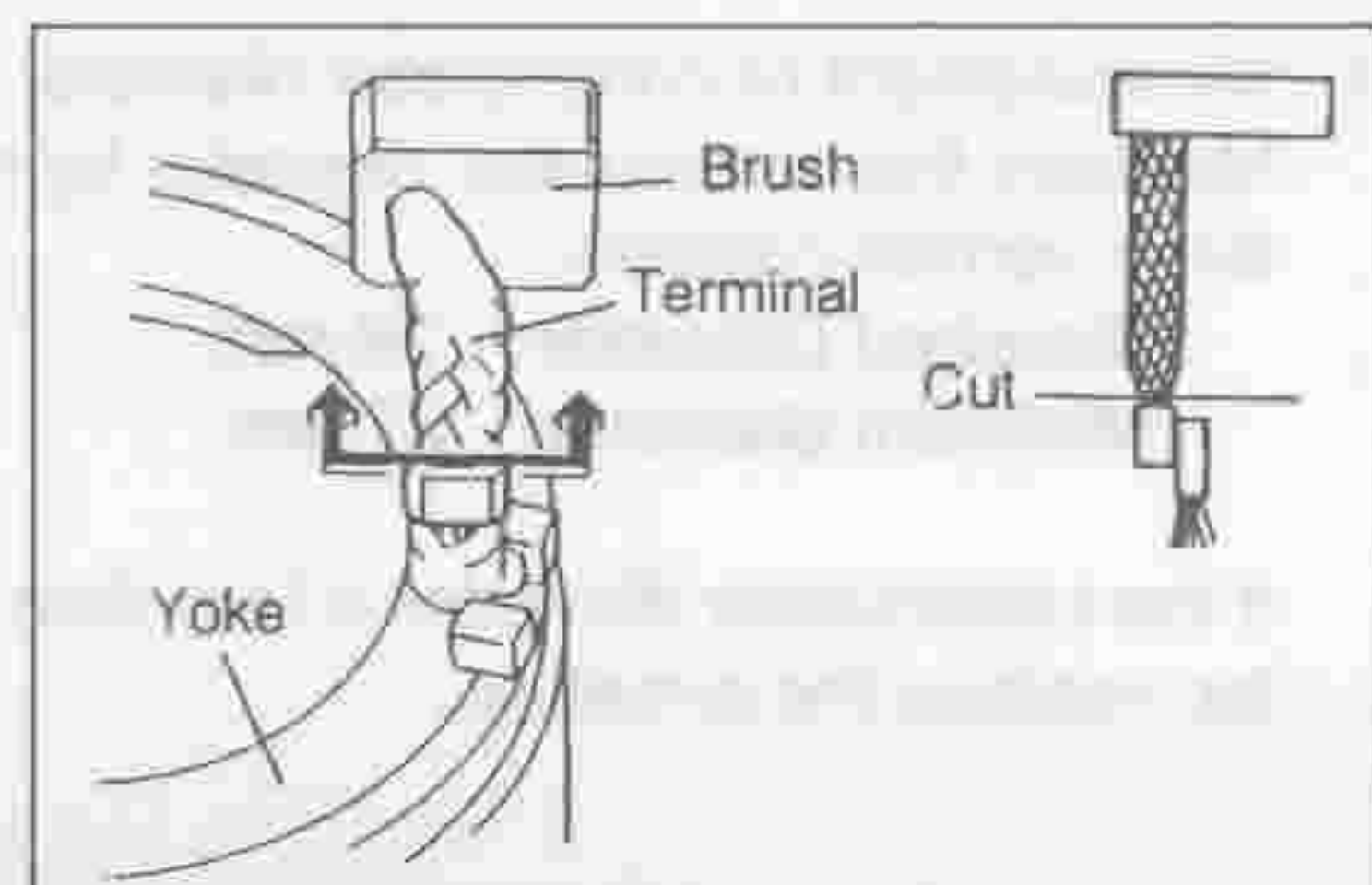
If the length is less than the minimum requirement, replace the brush holder or the yoke, as required.



LST00054-00049

2. Procedure for brush replacement

(1) Cut the brush lead wire at the terminal side.



LST00055-00050

- (2) Remove welding traces with a file or the like to correct the brush terminal to the specified dimensions.

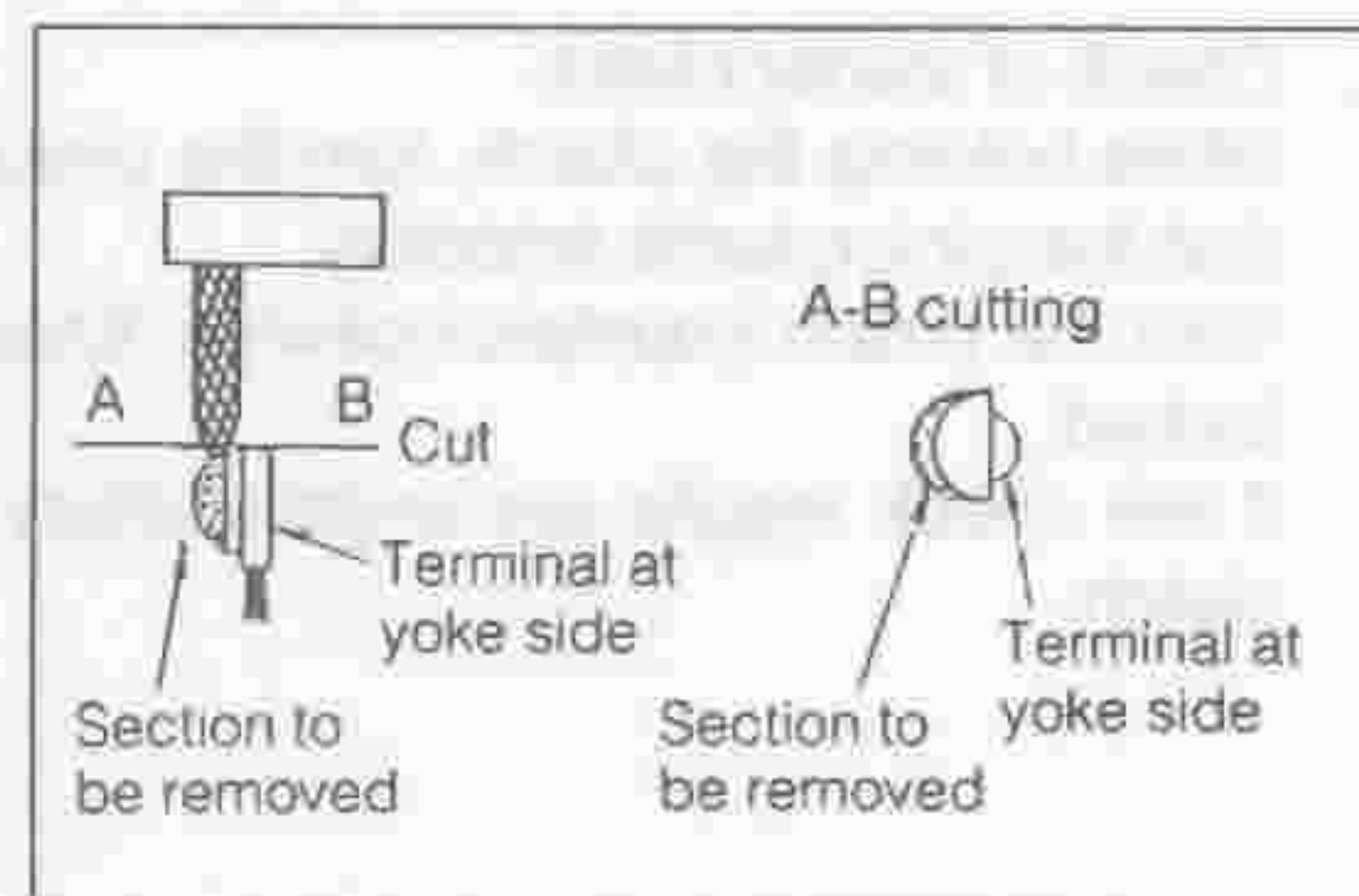
Specified Dimensions:

Thickness: 1.3 - 1.5 mm

Width: 5 mm

NOTE:

- Be sure to remove the  section of the brush terminal as indicated in the right figure. Since the section to be removed is narrow, be very careful not to damage the field coil.

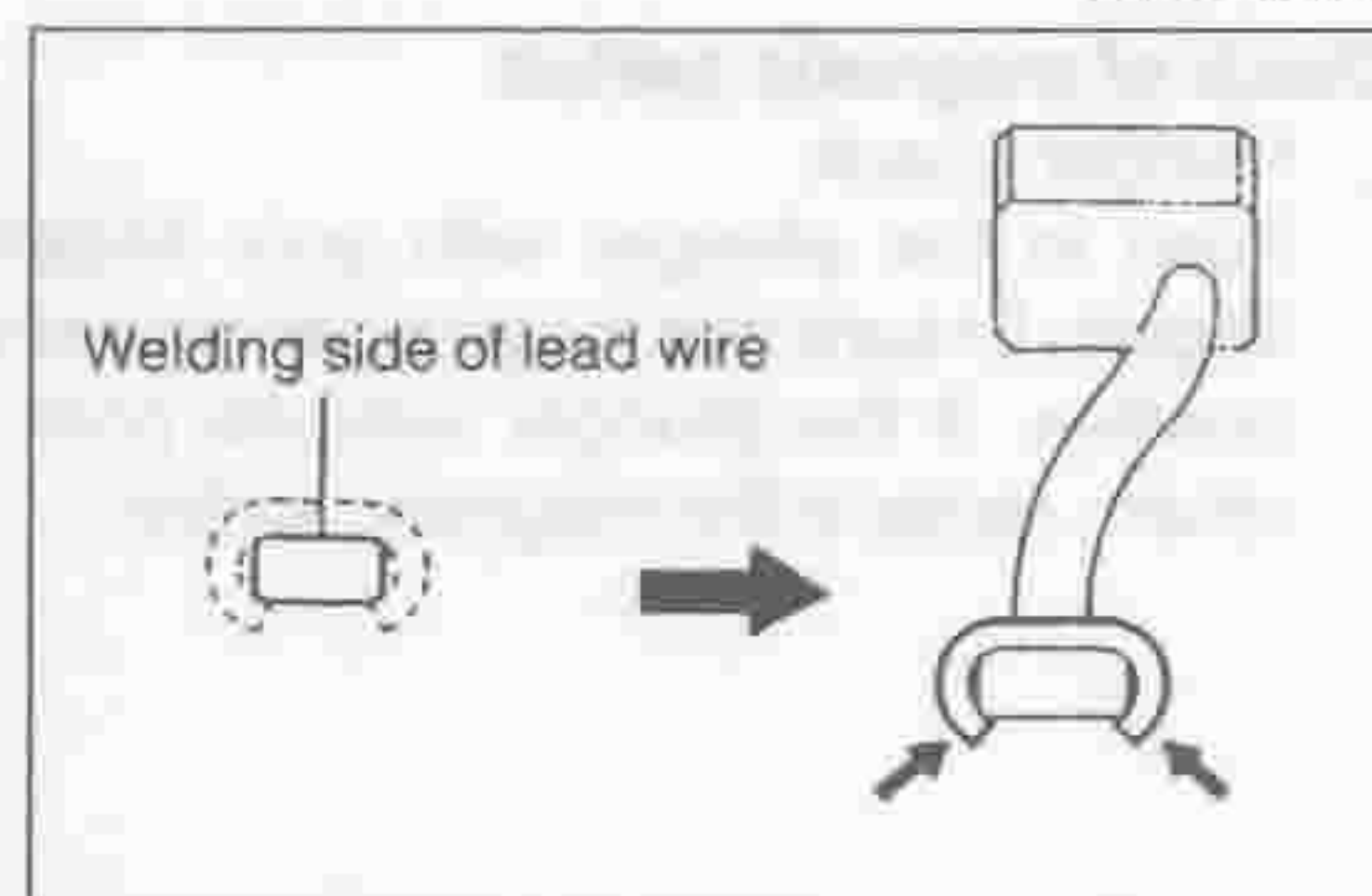


LST00056-00051

- (3) Stack the plate section of a replacement brush onto the welding side of the lead wire. Make pressure connection over the overlaid section by pinching it with pliers.

NOTE:

- Be sure to take out the brush lead wire in the correct direction.

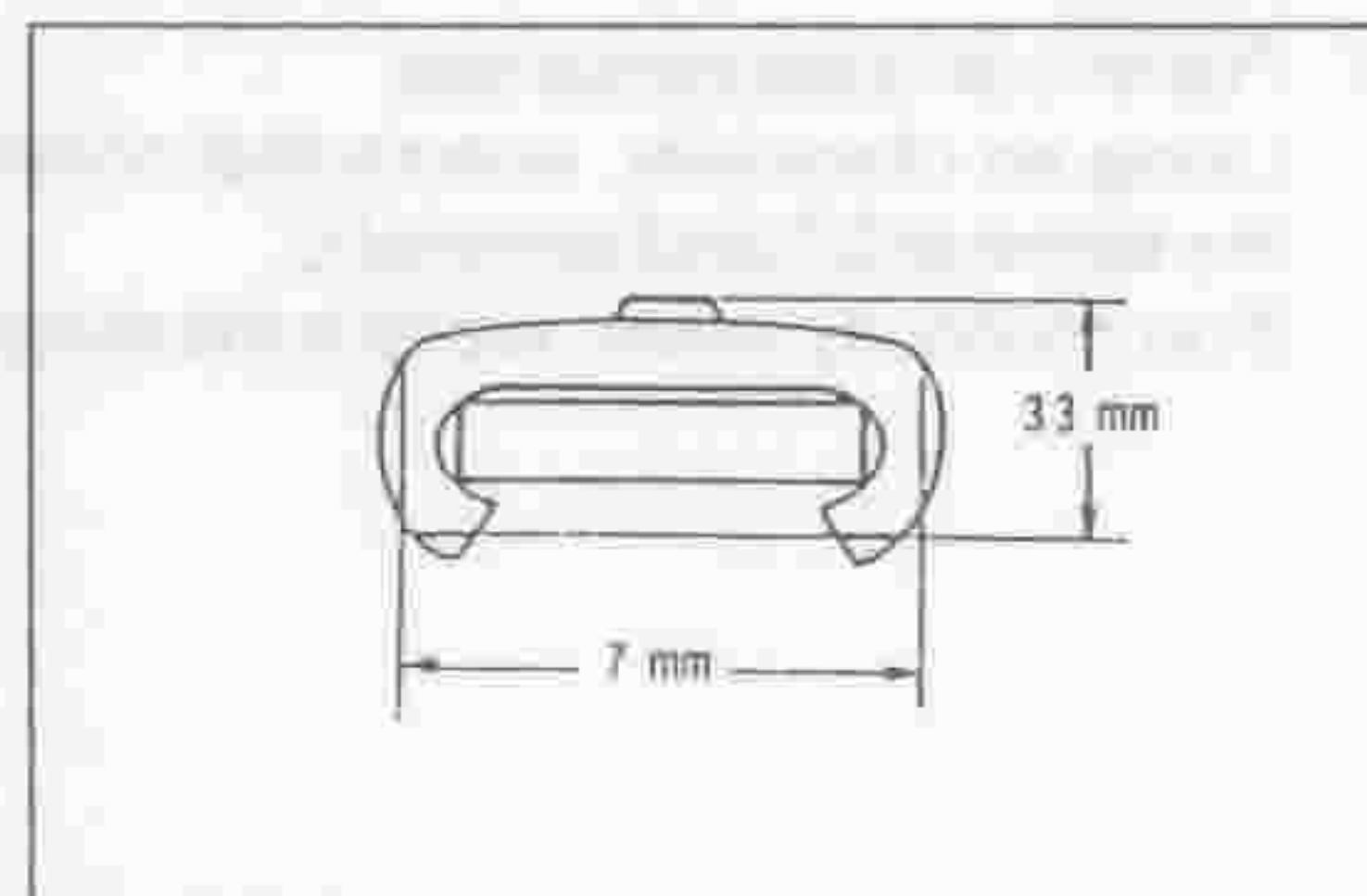


LST00057-00052

- (4) Solder the pressure connection section. Correct the section, using a file or the like, so that the section conforms to the dimensions, as indicated in the right figure.

NOTE:

- When performing the soldering, heat the section to be soldered thoroughly. Be very careful not to allow any solder to flow into the positive side lead wire.
- Be sure to allow solder in a sufficient amount to flow into the inside of the plate.
- Ensure that no solder oozes to the field side.



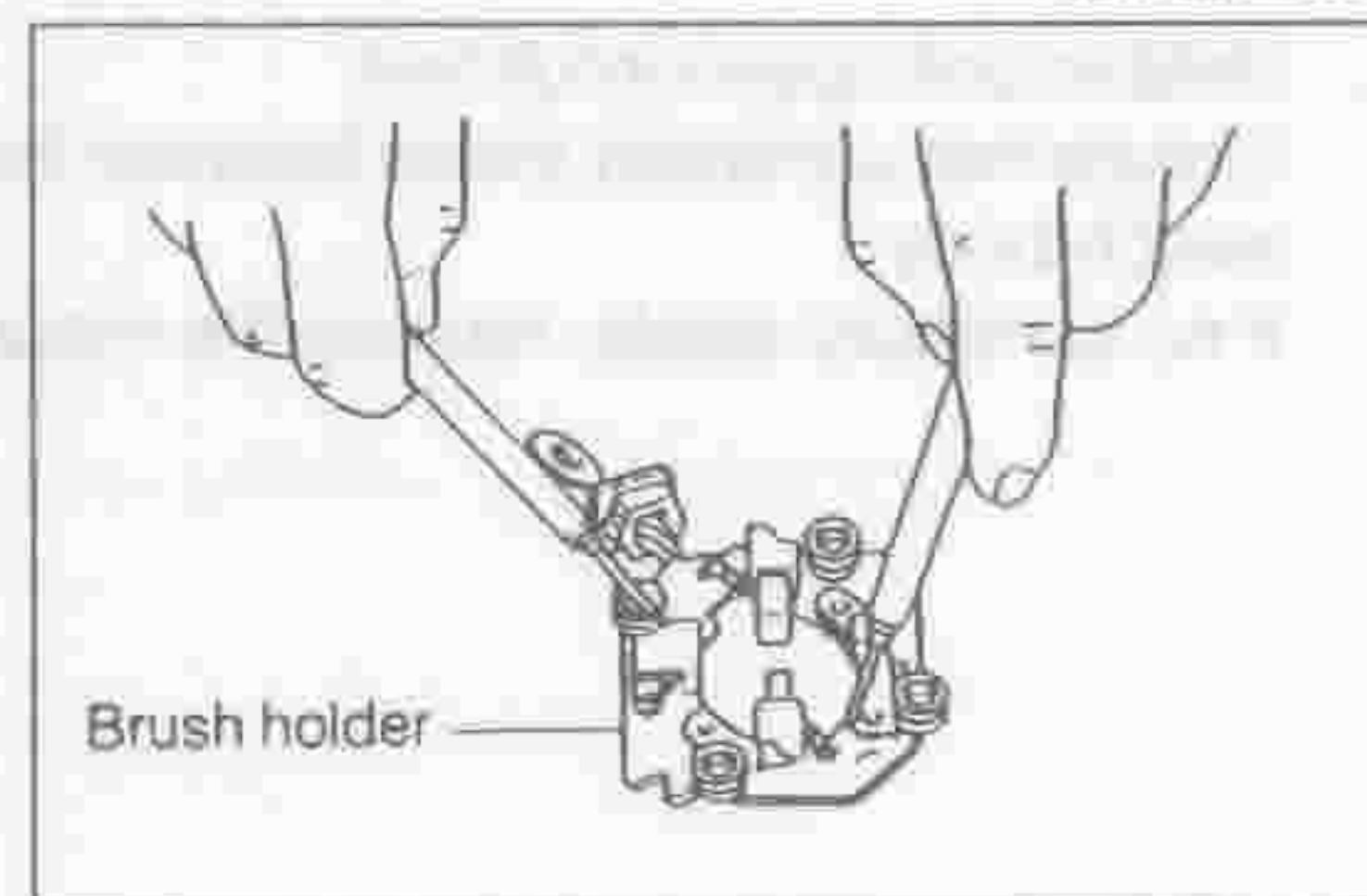
LST00058-00053

Check of brush holder

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

Insulation Resistance: 100 MΩ or more

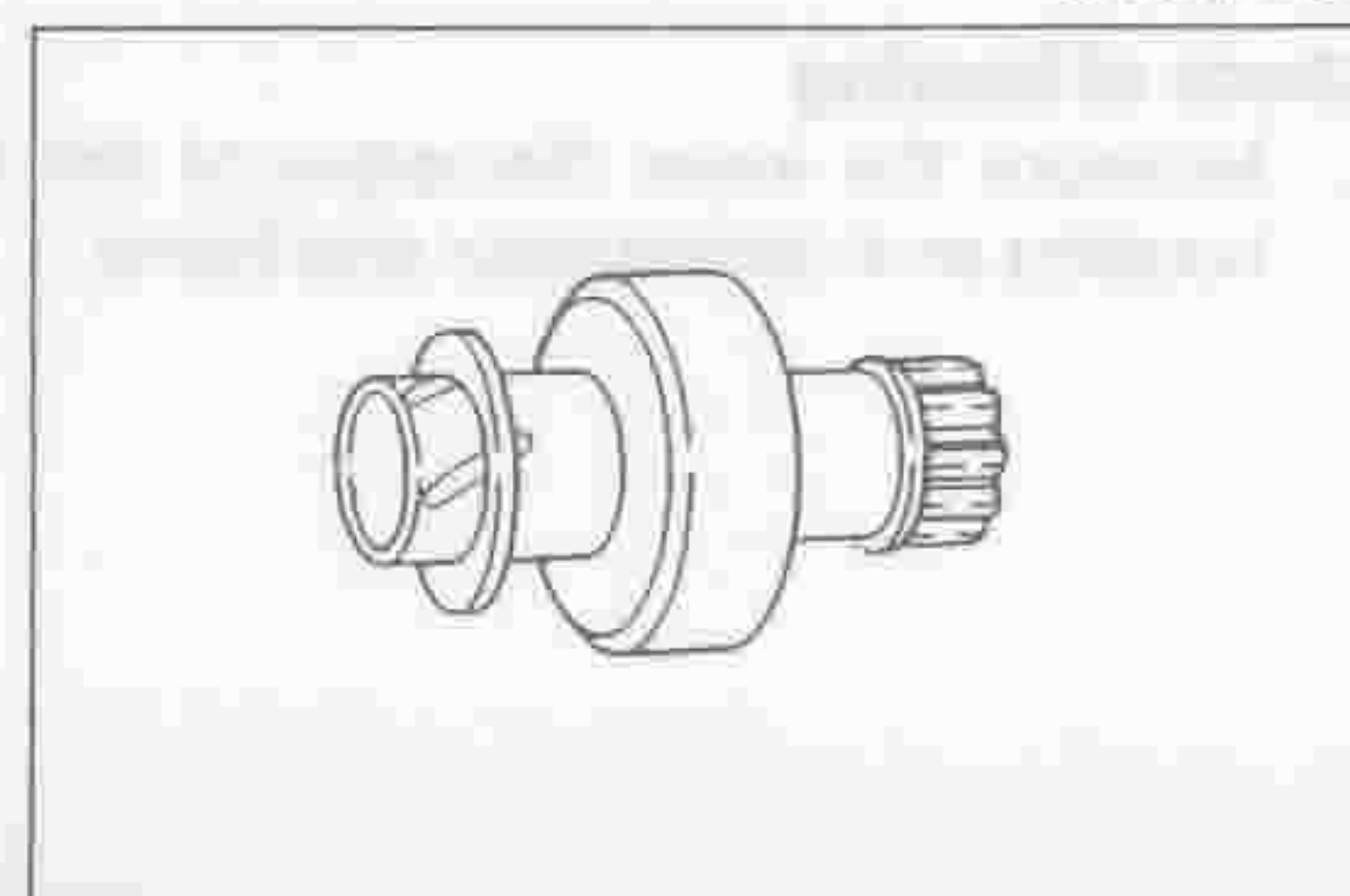
2. Replacement of brush holder.
If the insulation resistance is less than the specification, replace the brush holder.



LST00059-00054

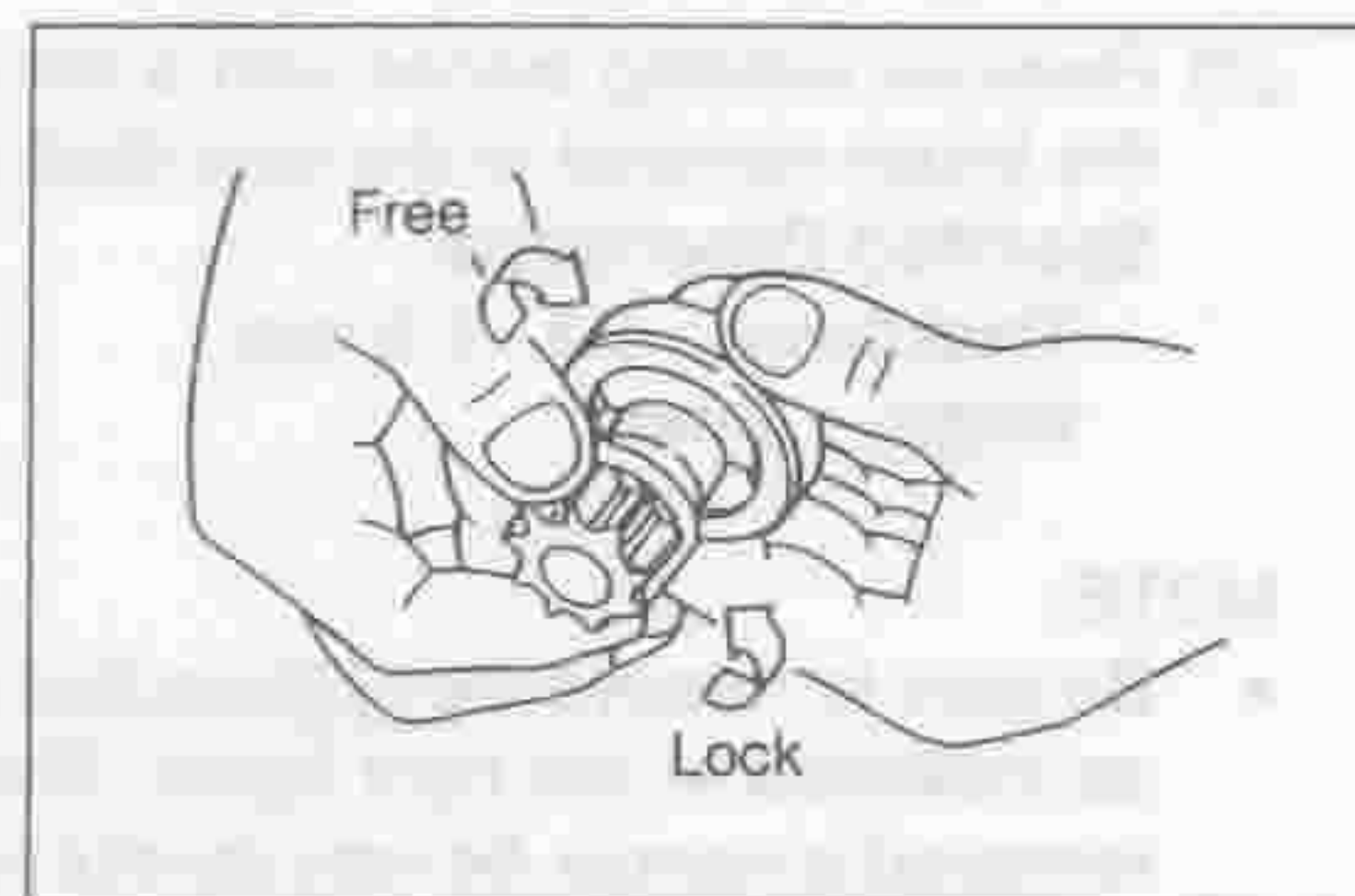
Check of clutch

1. Inspection of pinion gear and spline teeth
Check the teeth of the pinion gear and spline for wear or damage.
If the teeth exhibit any damage, replace the clutch. Also, inspect the flywheel ring gear for wear or damage.



LST00060-00055

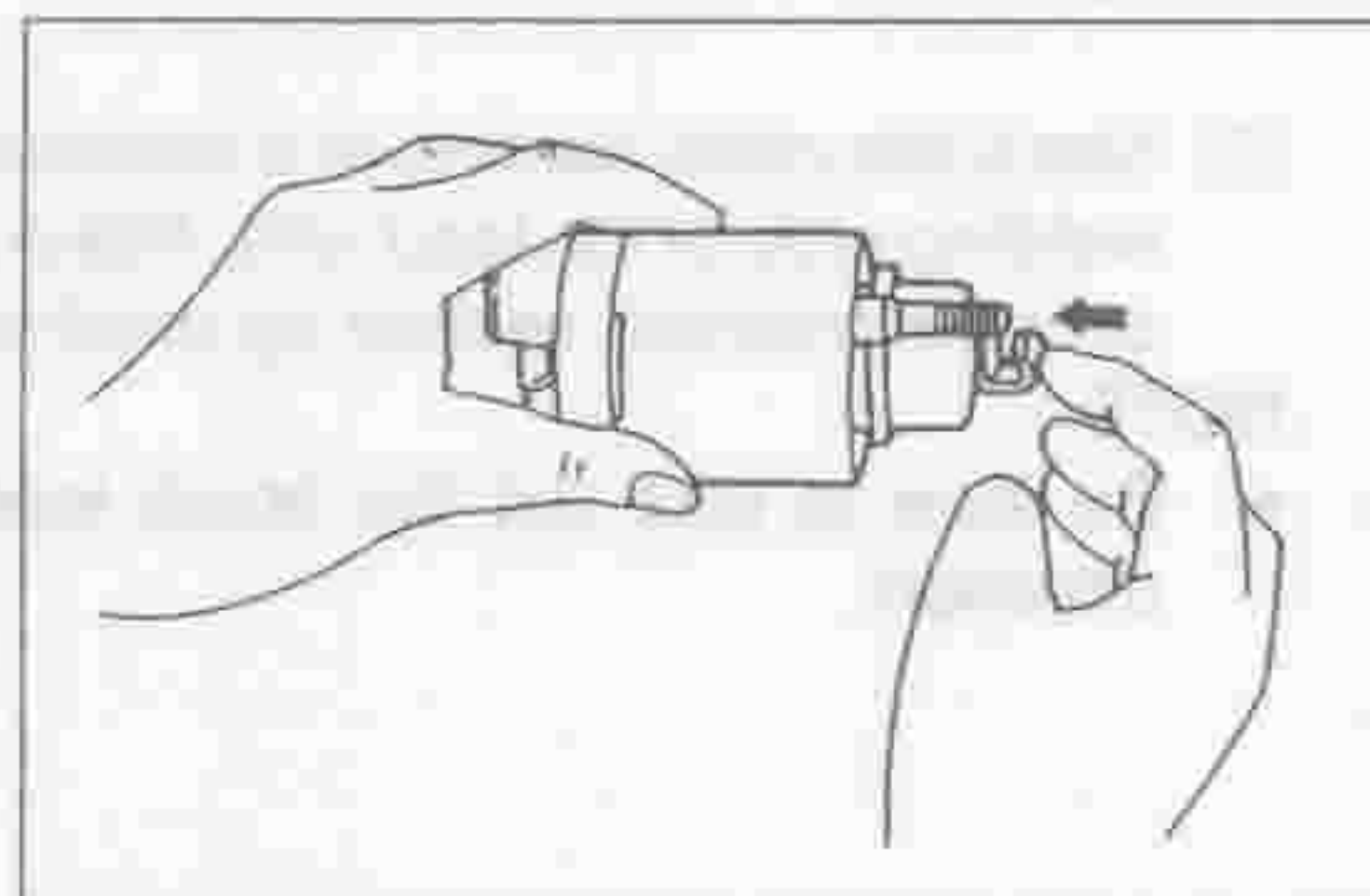
2. Check of starter clutch
While holding the clutch, turn the pinion clockwise. Ensure that the pinion turns smoothly.
Turn the pinion counterclockwise. Ensure that the pinion is locked.
If the check results are unsatisfactory, replace the starter clutch.



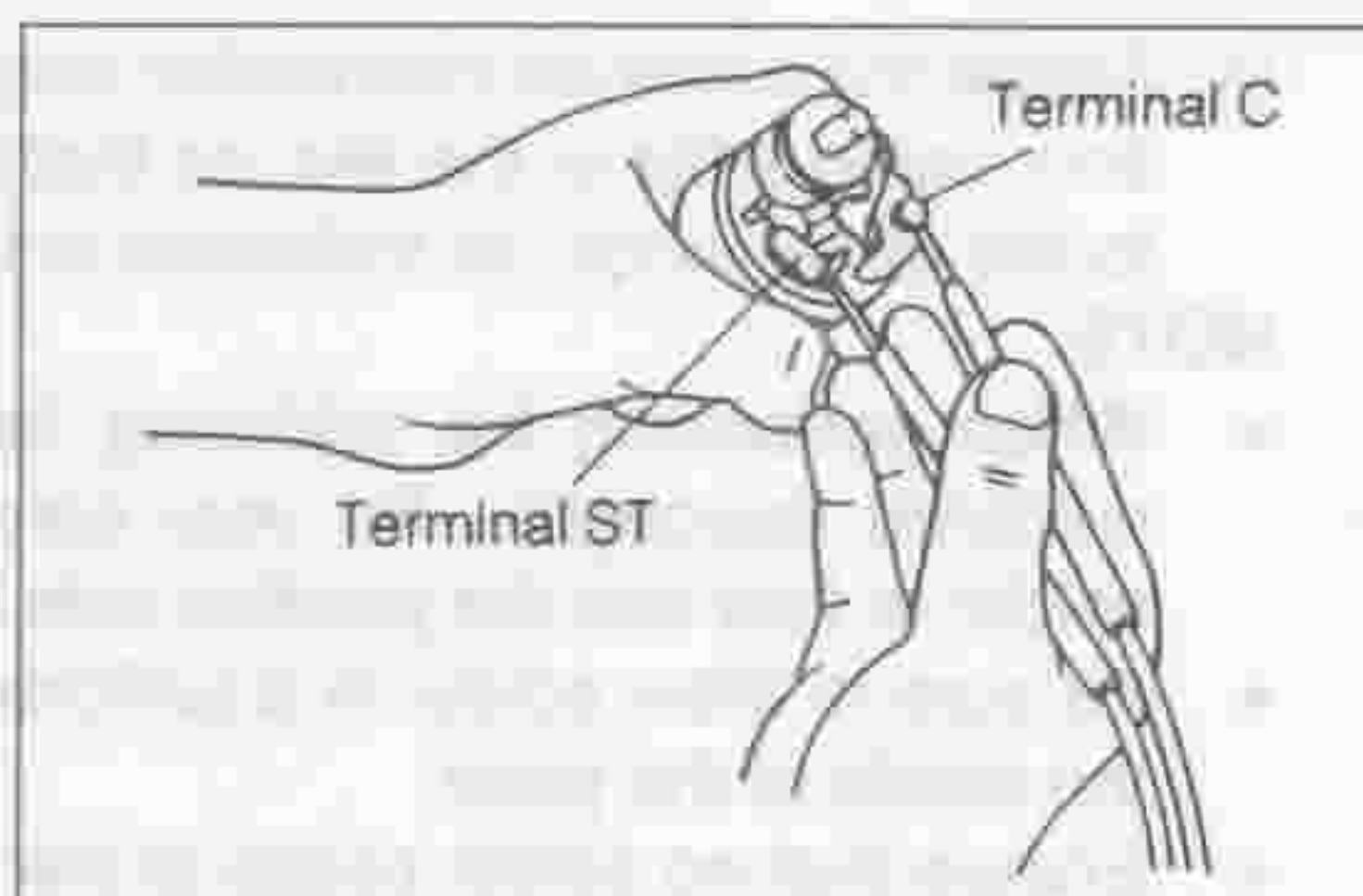
LST00061-00066

Check of magnetic switch

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

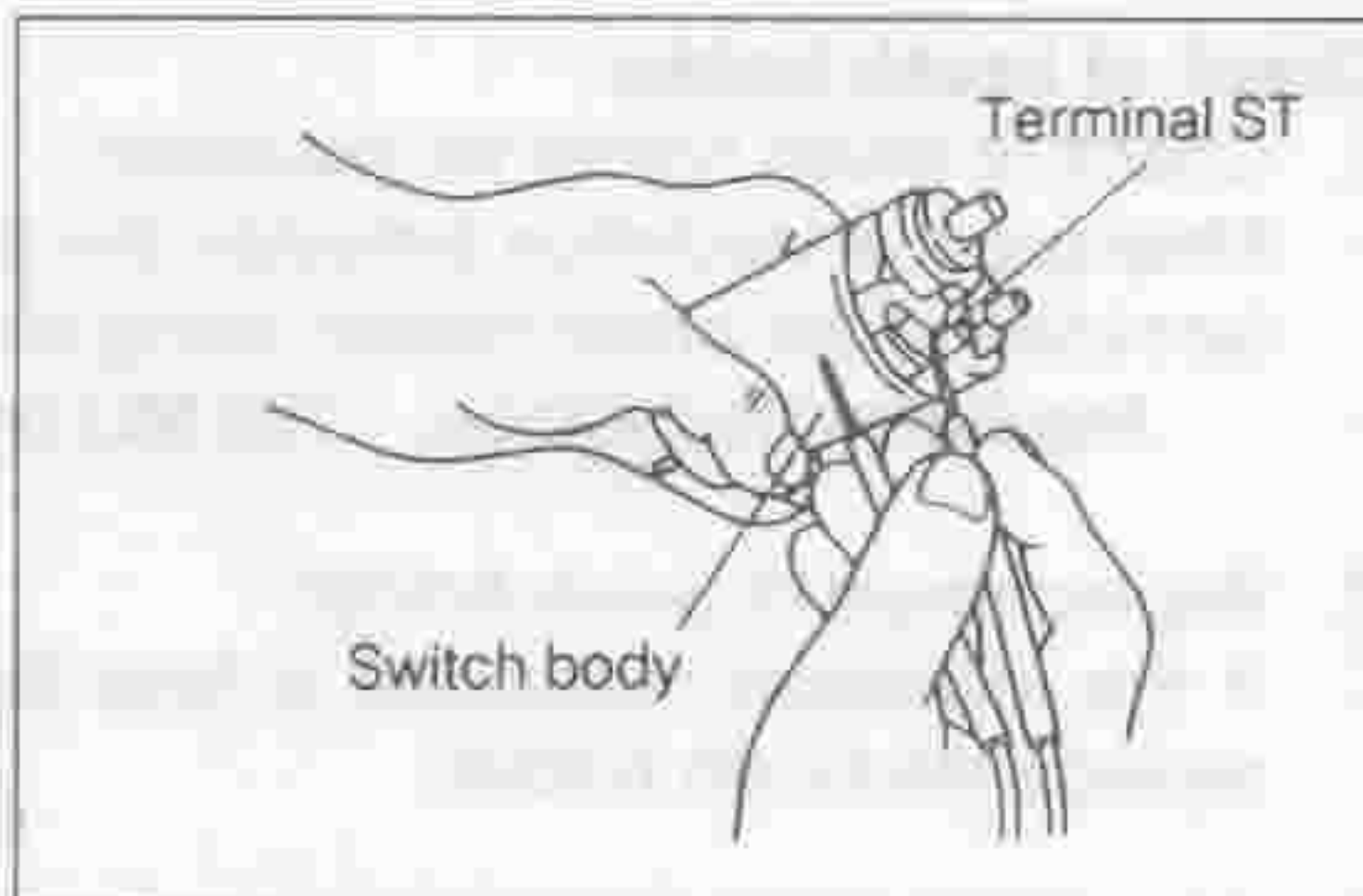


LST00062-00067



LST00063-00068

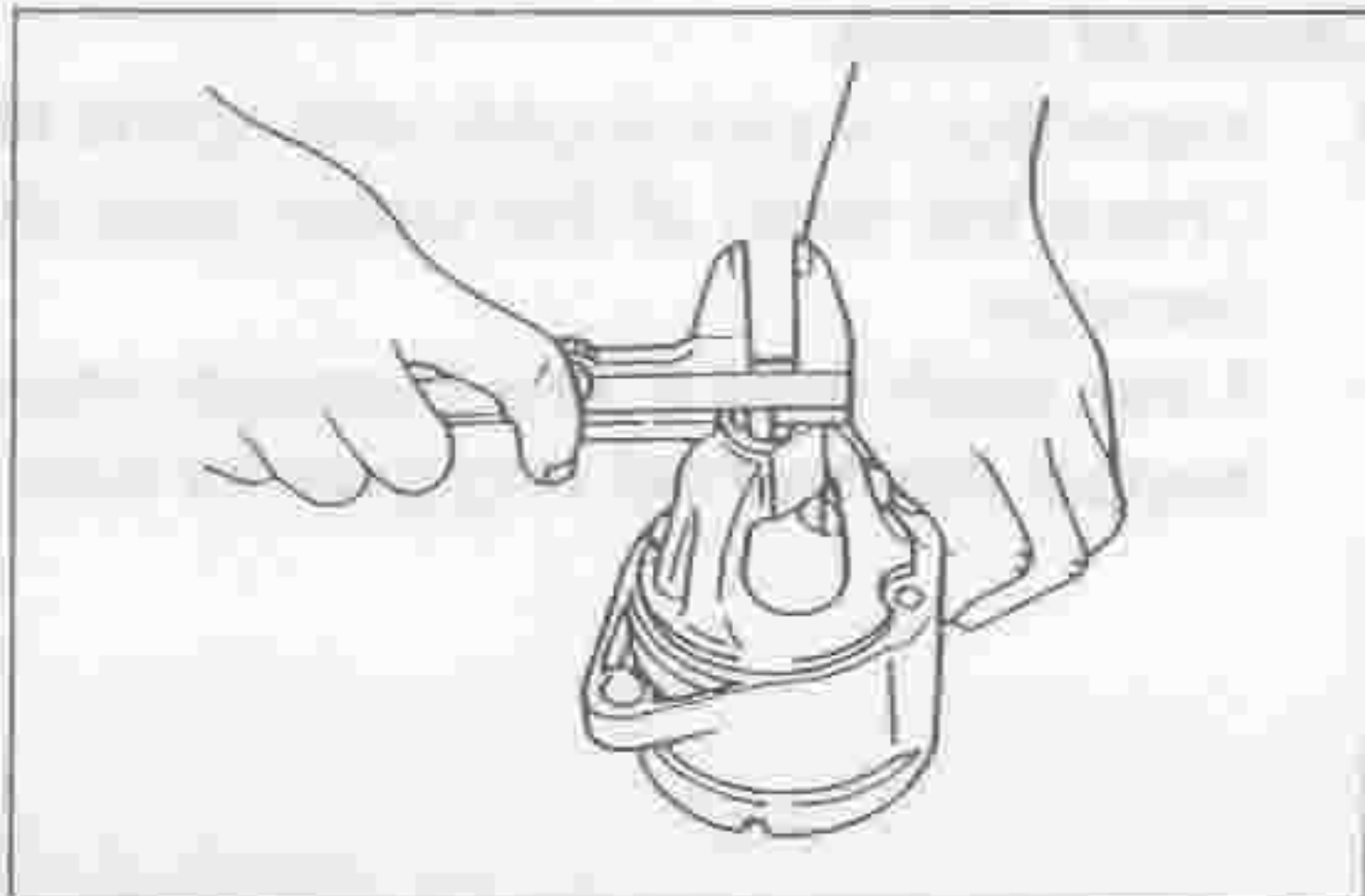
3. Hold-in coil open circuit test
Ensure that continuity exists between the terminal ST and the switch body.
If no continuity exists, replace the magnetic switch.



LST00064-00069

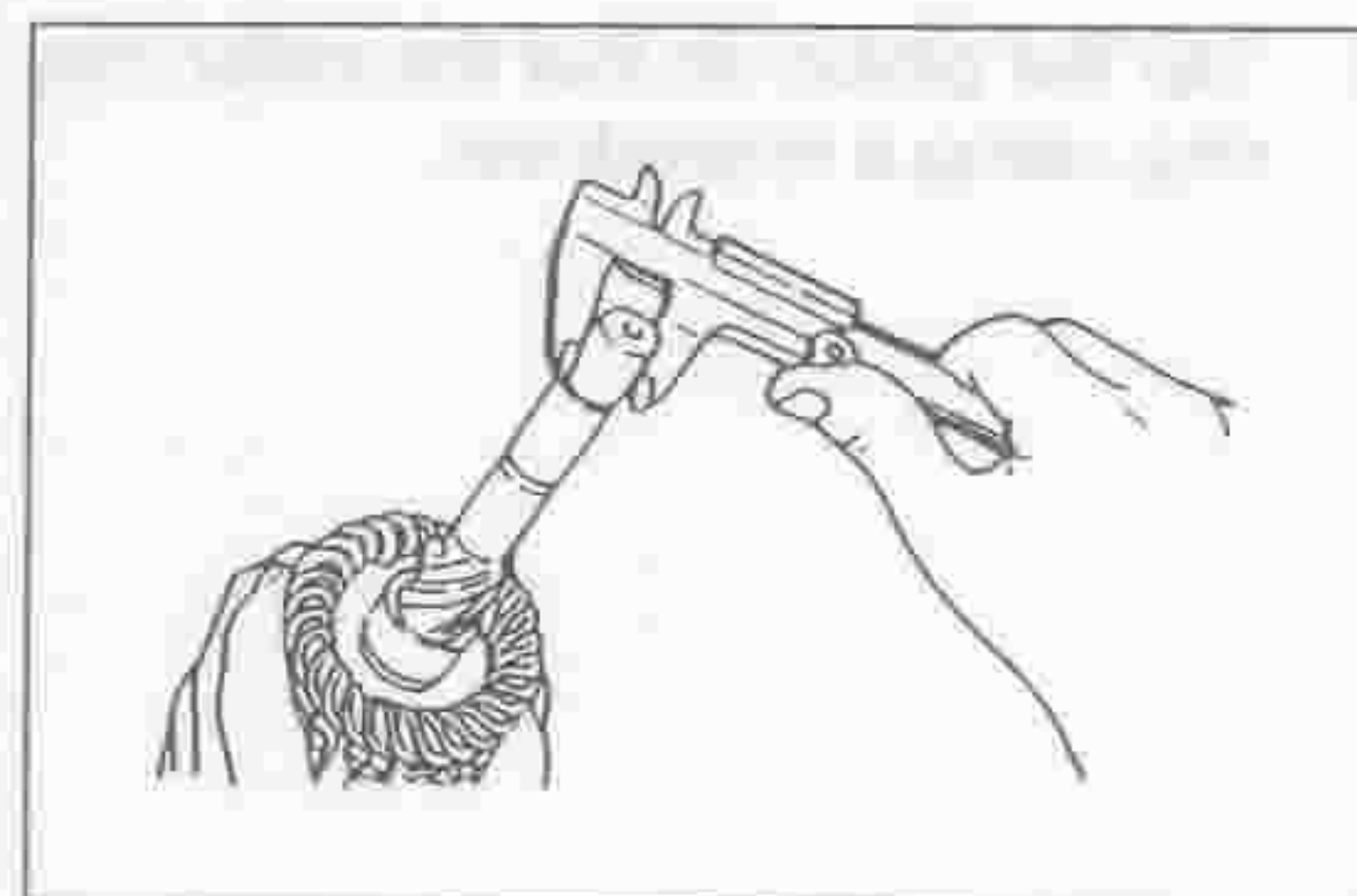
Check of bearing

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



LST00065-00060

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



LST00066-00061

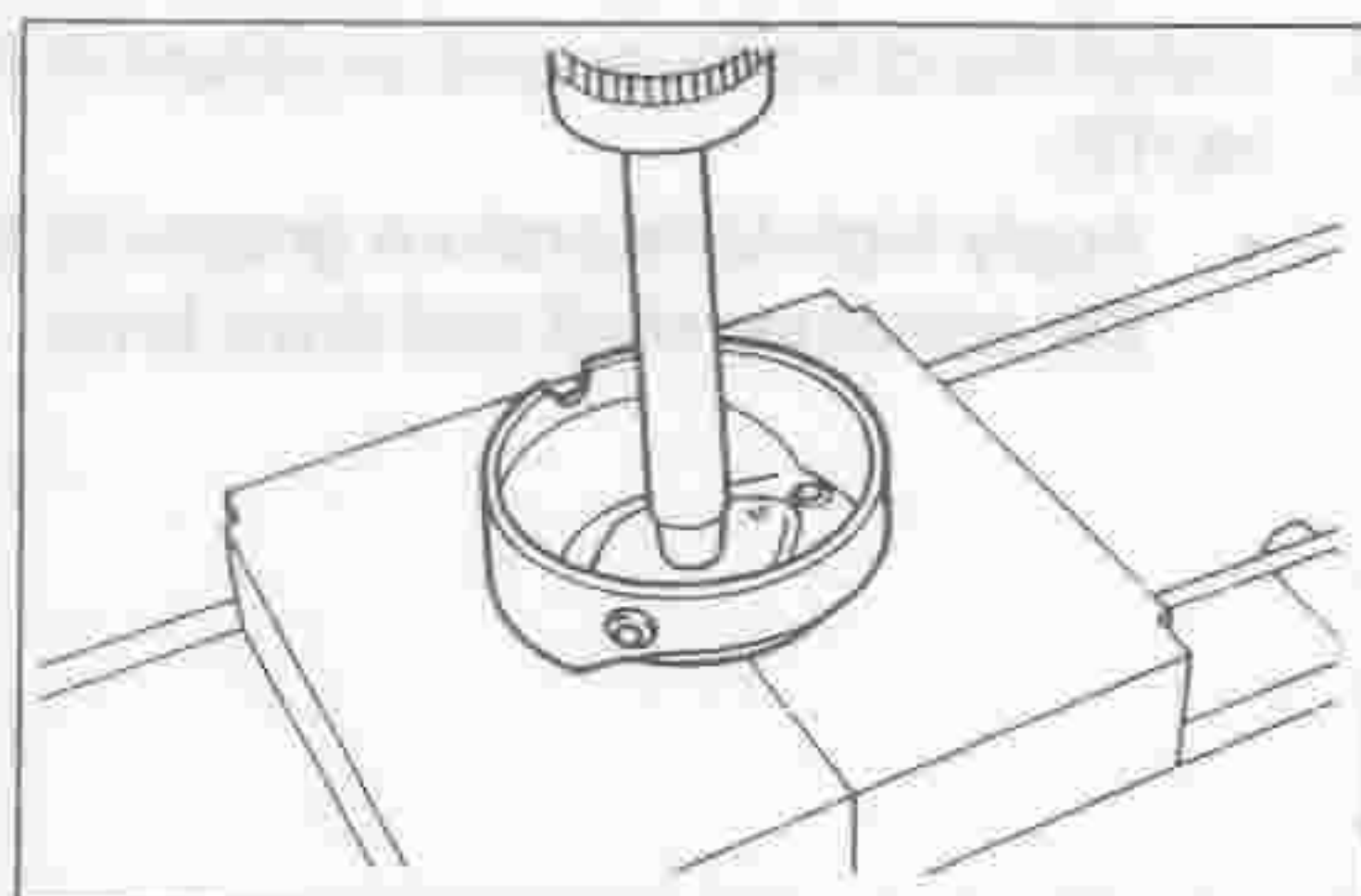
3. Determine the clearance by subtracting the outer diameter of the armature bearing section from the inner diameter of the drive shaft.

Clearance Limit: 0.2 mm

If the clearance exceeds the limit, replace the drive housing bearing (bush).

SST: 09301-87601-000

(Round rod of 15 mm outer dia.)



LST00067-00062

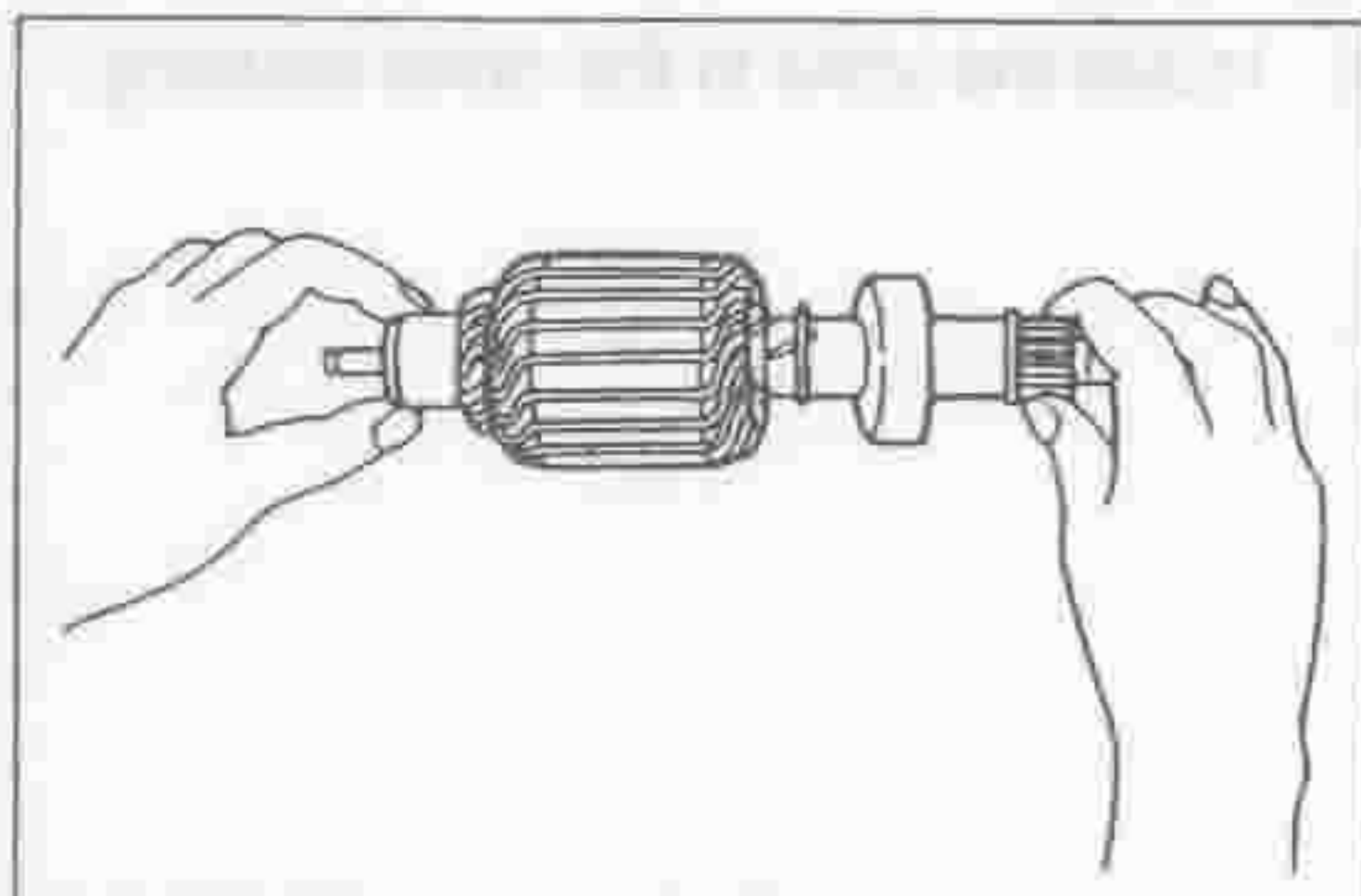
ASSEMBLY

NOTE:

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

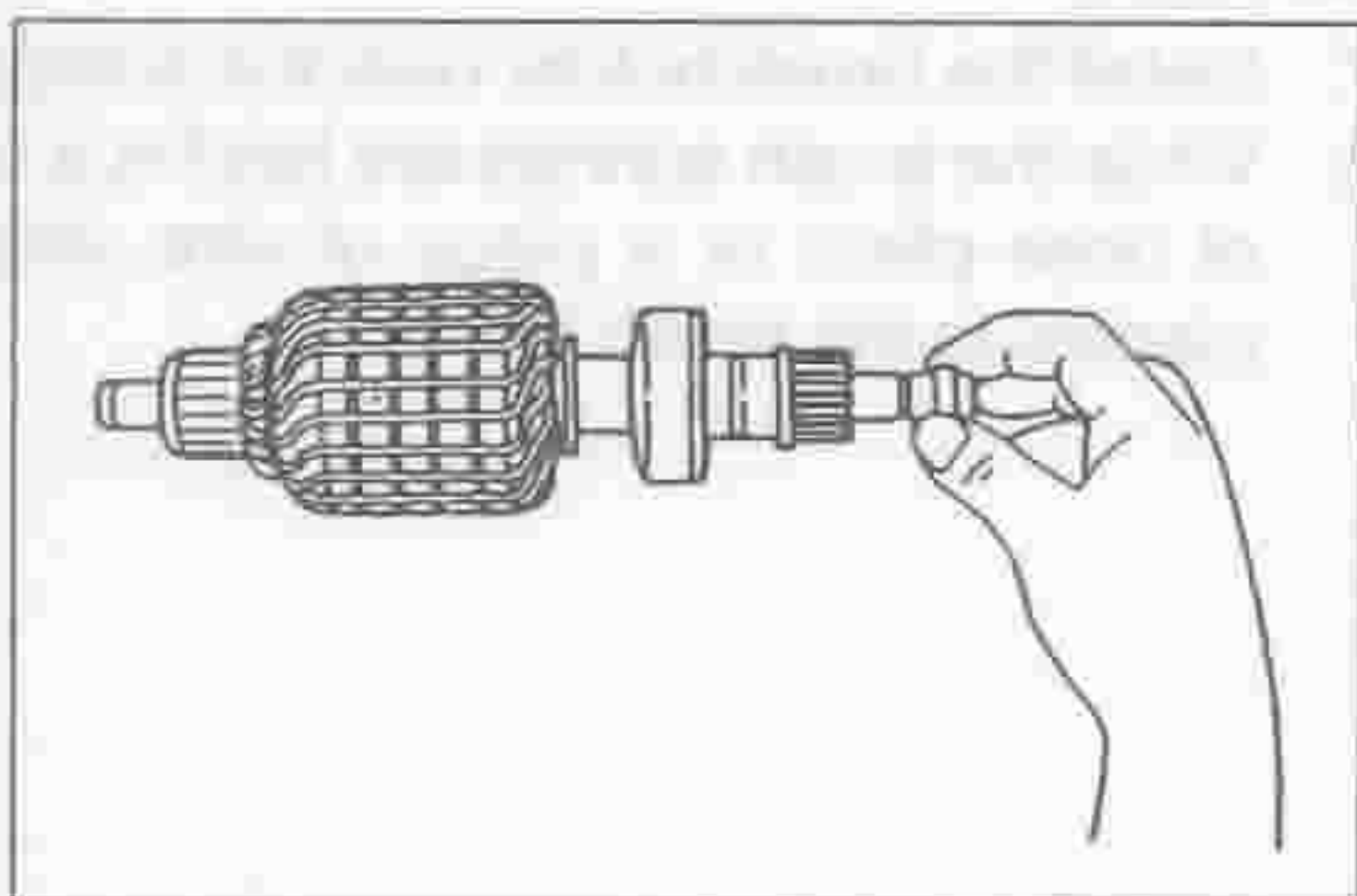
For 1.0 kW motor

1. Install the clutch on the armature shaft.



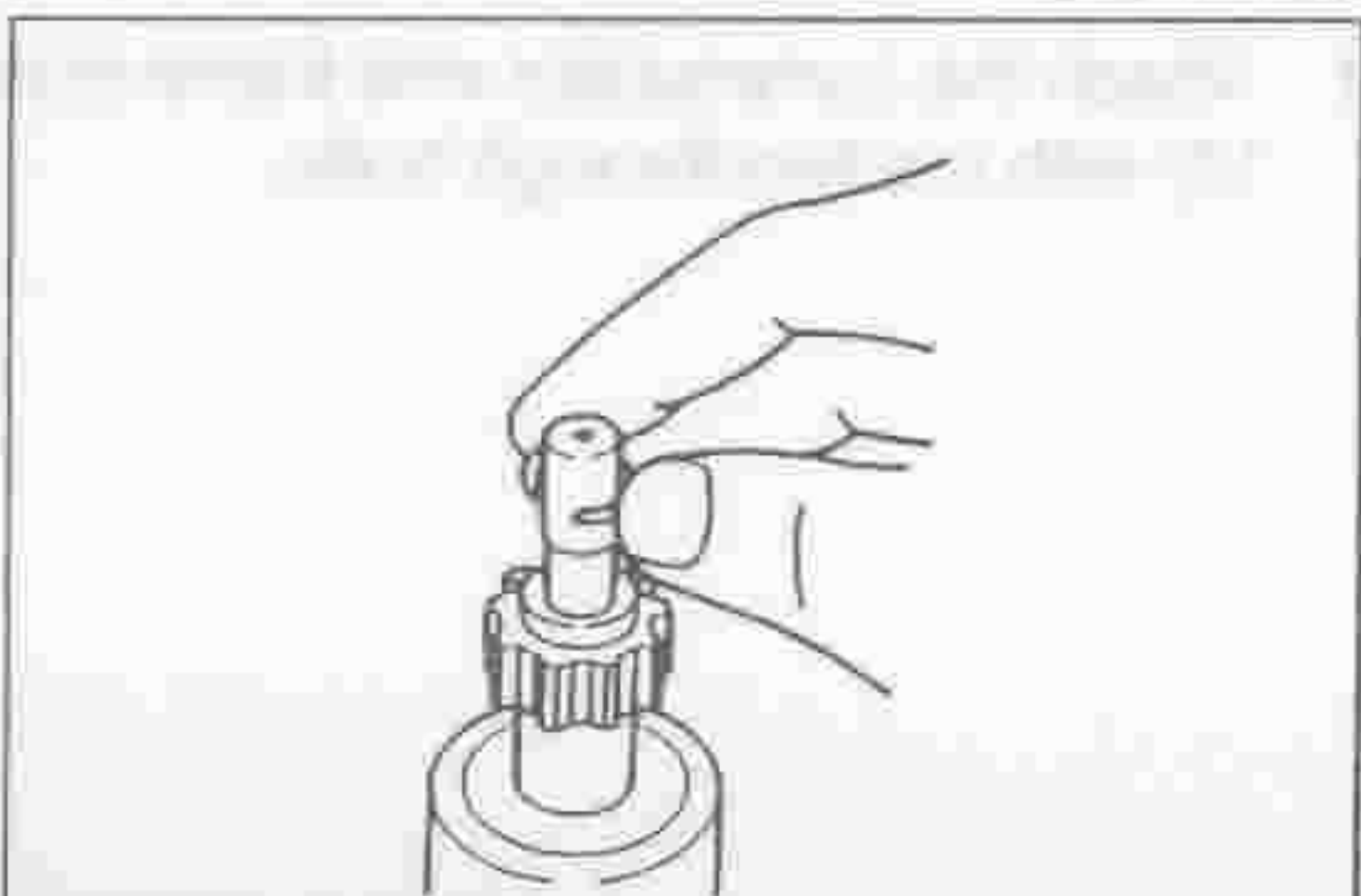
LST00068-00063

2. Install the collar on the armature shaft.



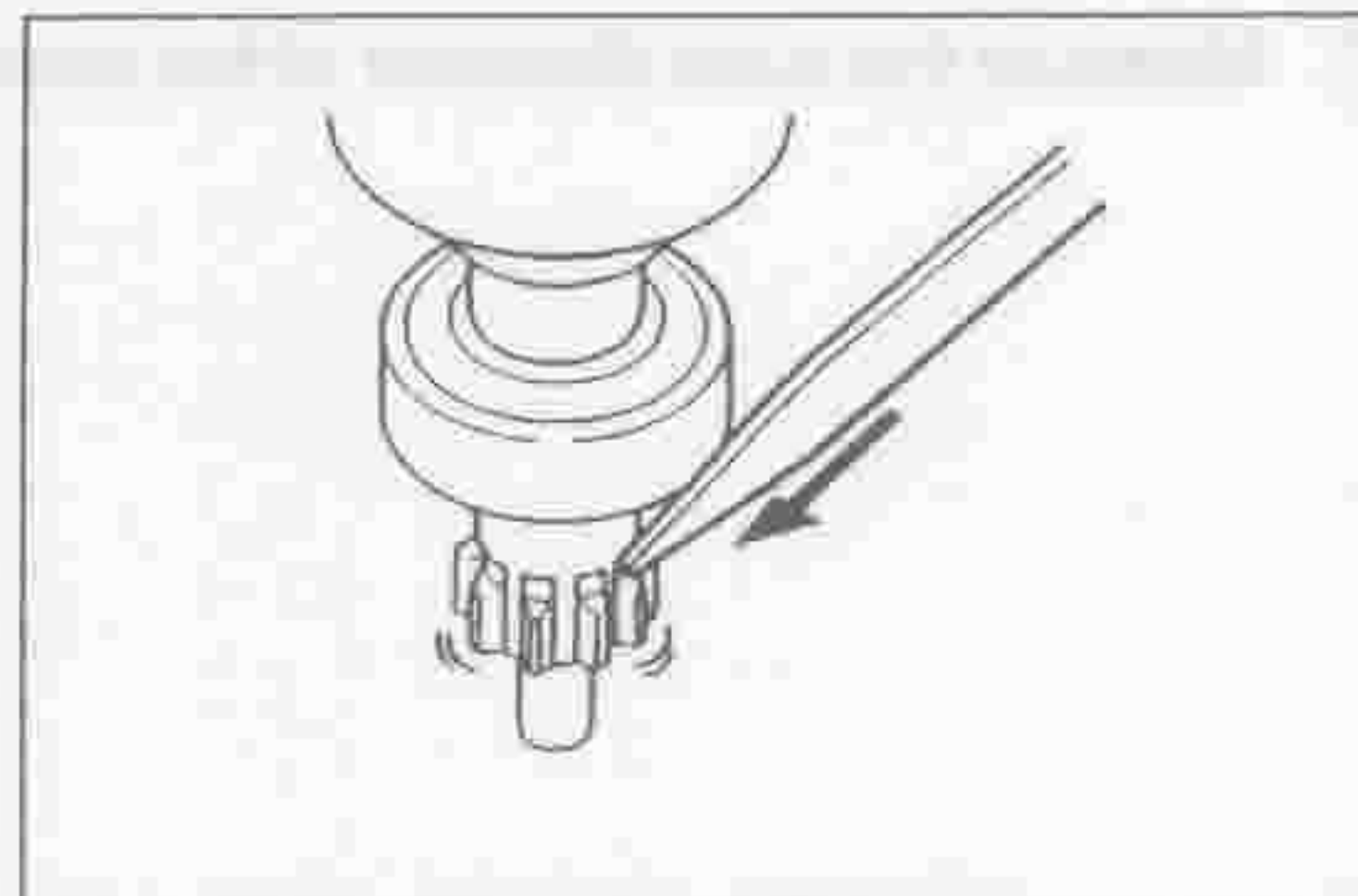
LST00069-00064

3. Fit the snap ring onto the armature shaft.



LST00070-00065

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

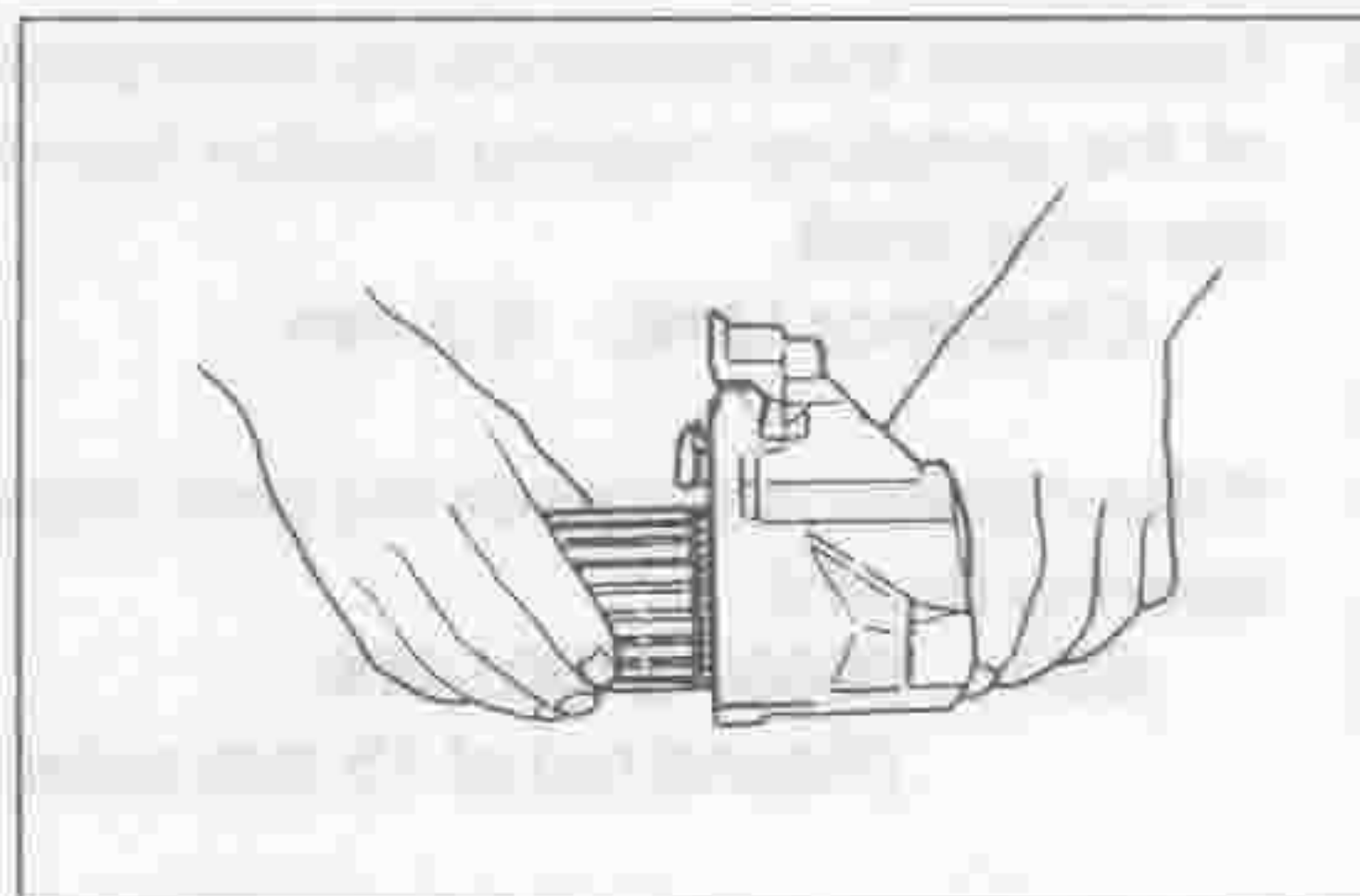


LST00071-00066

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

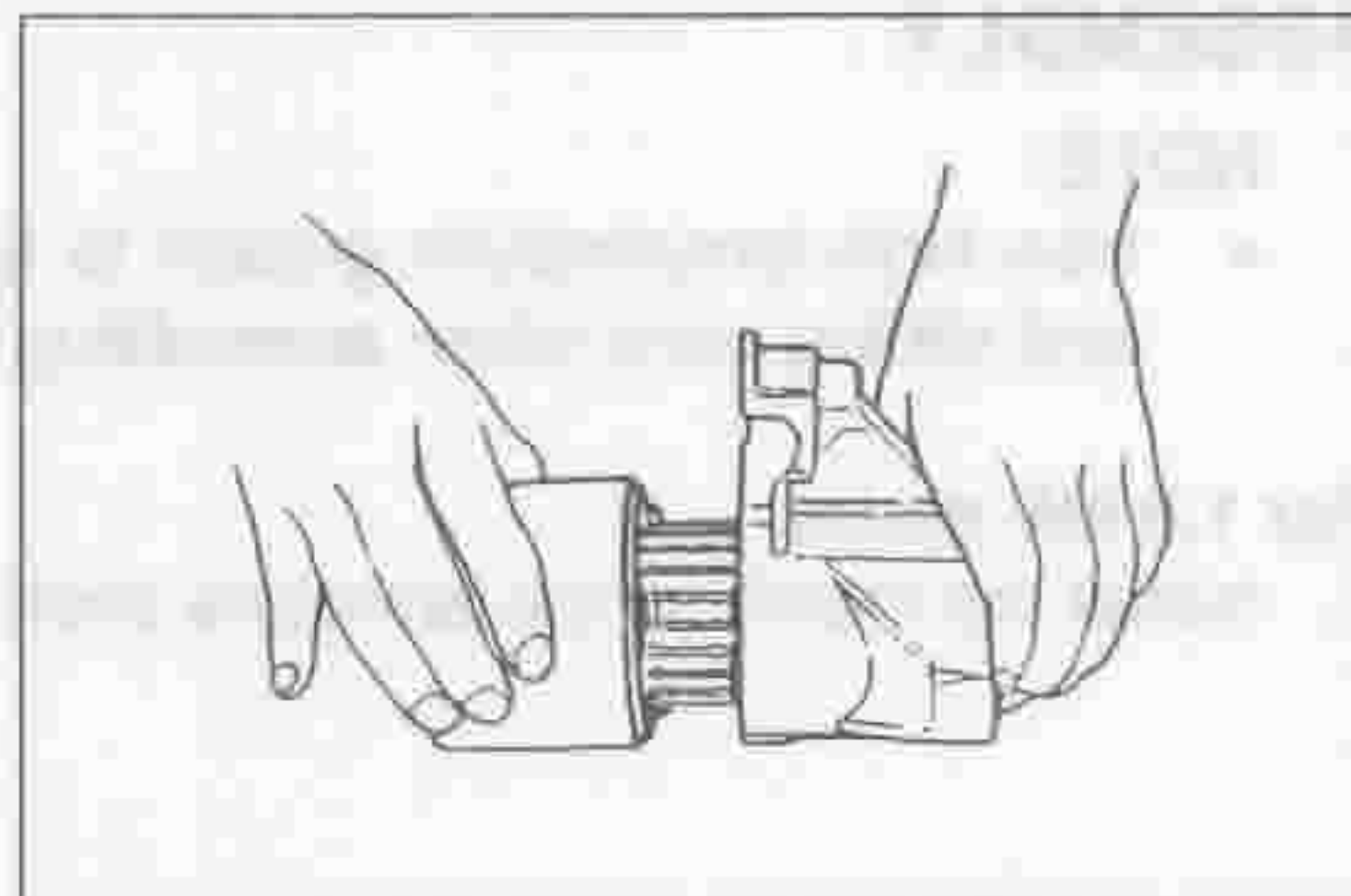
NOTE:

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



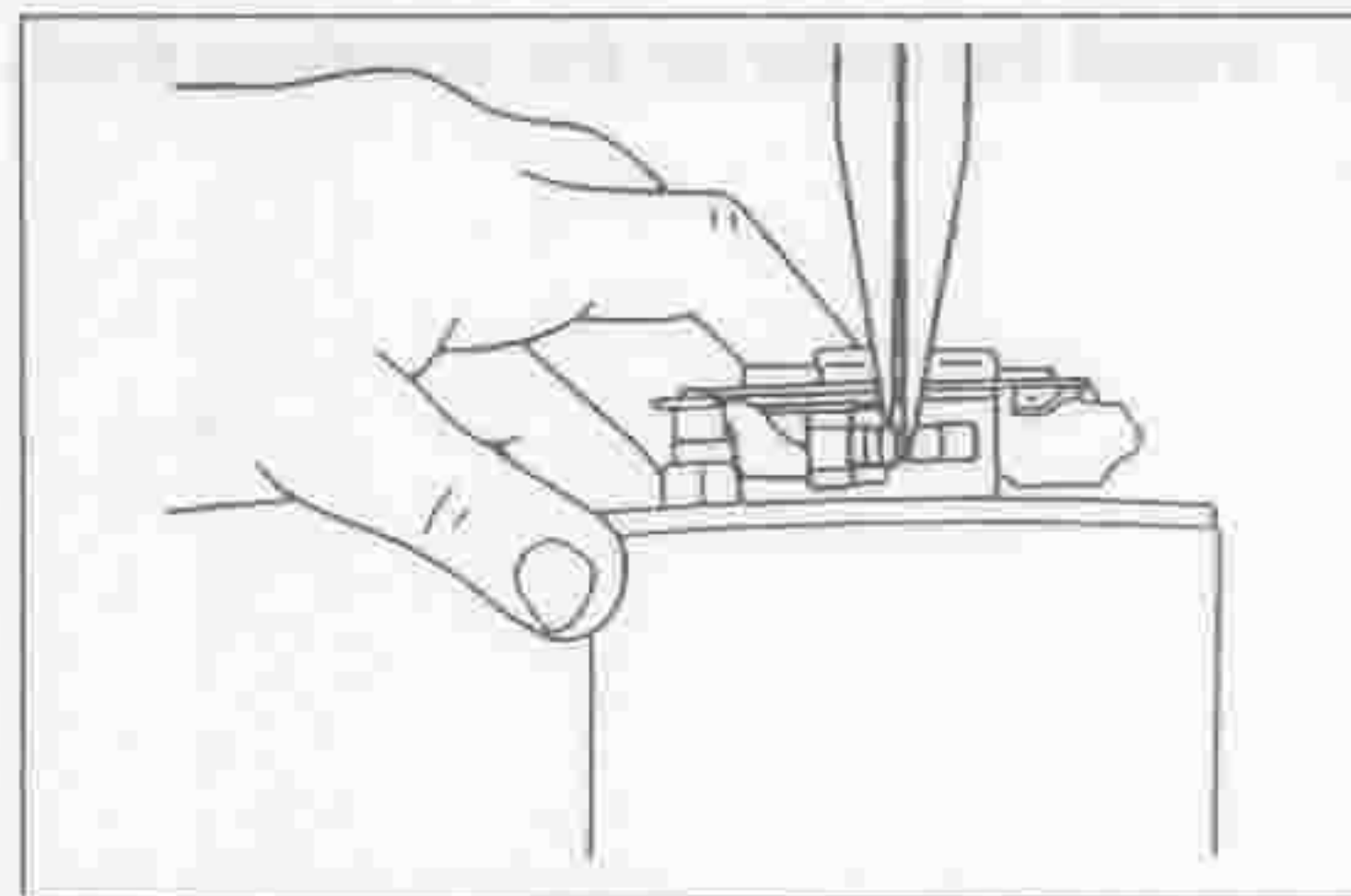
LST00072-00067

6. Install the yoke in the drive housing.



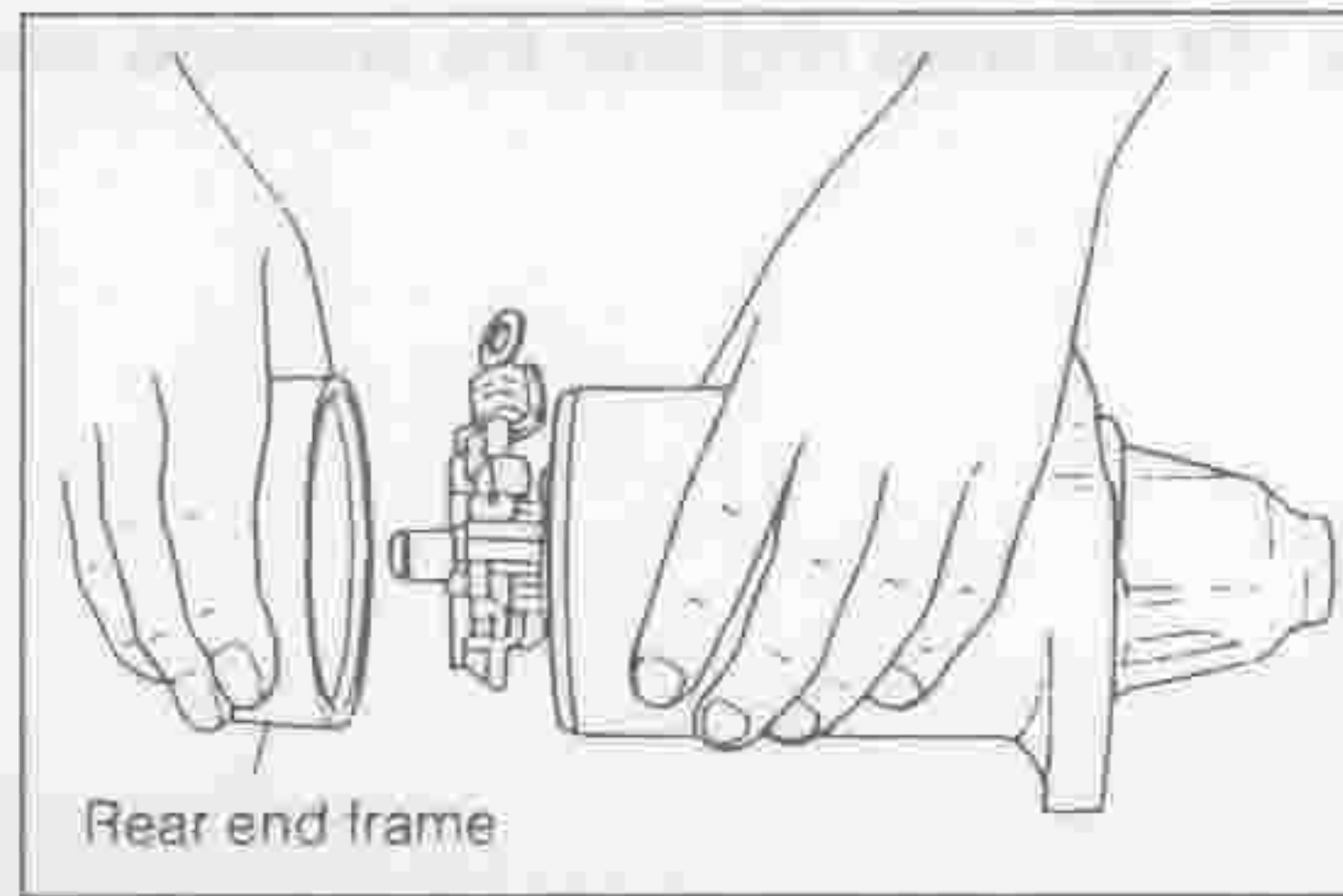
LST00073-00068

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



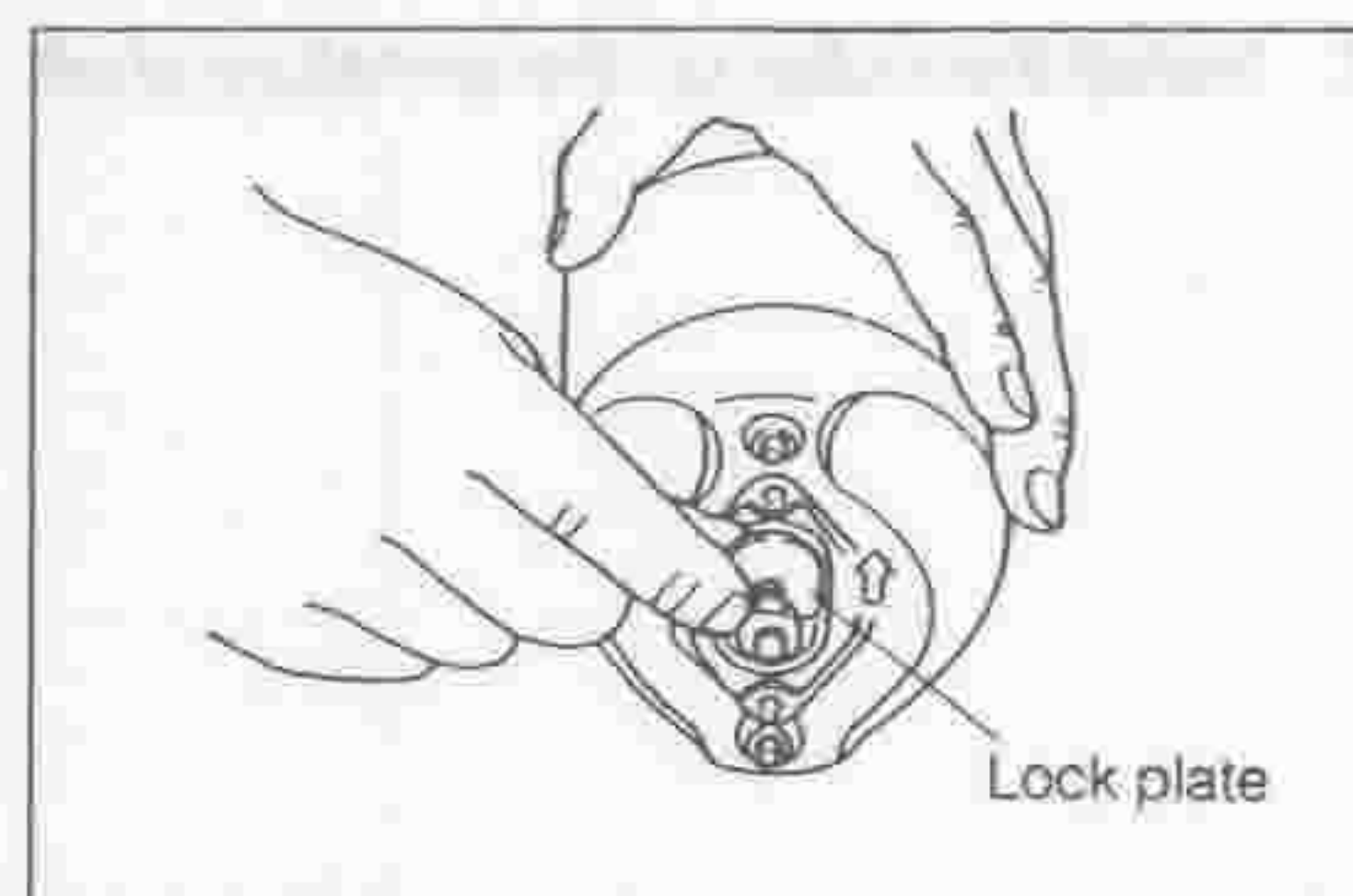
LST00074-00069

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



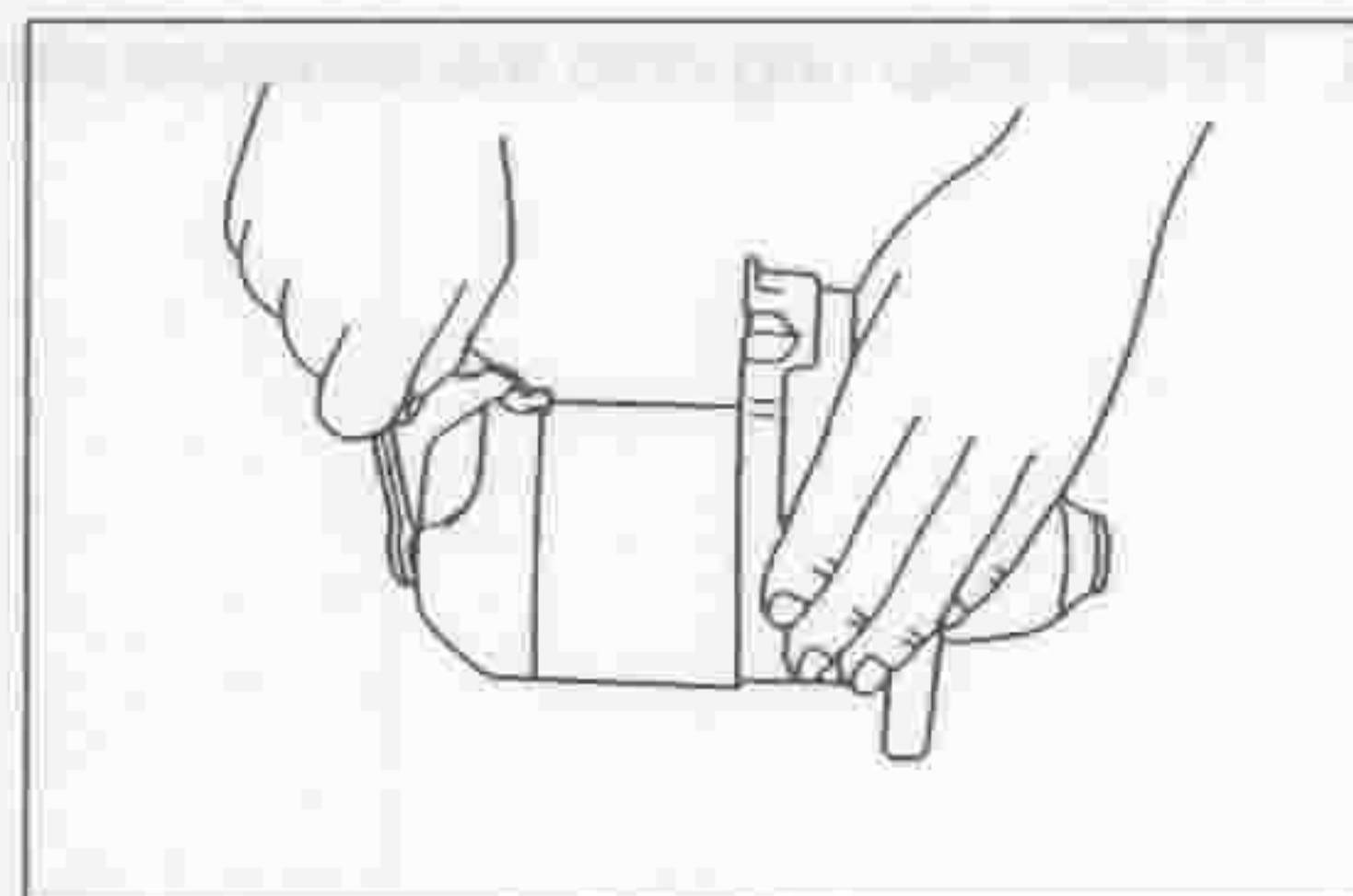
LST00075-00070

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



LST00076-00071

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

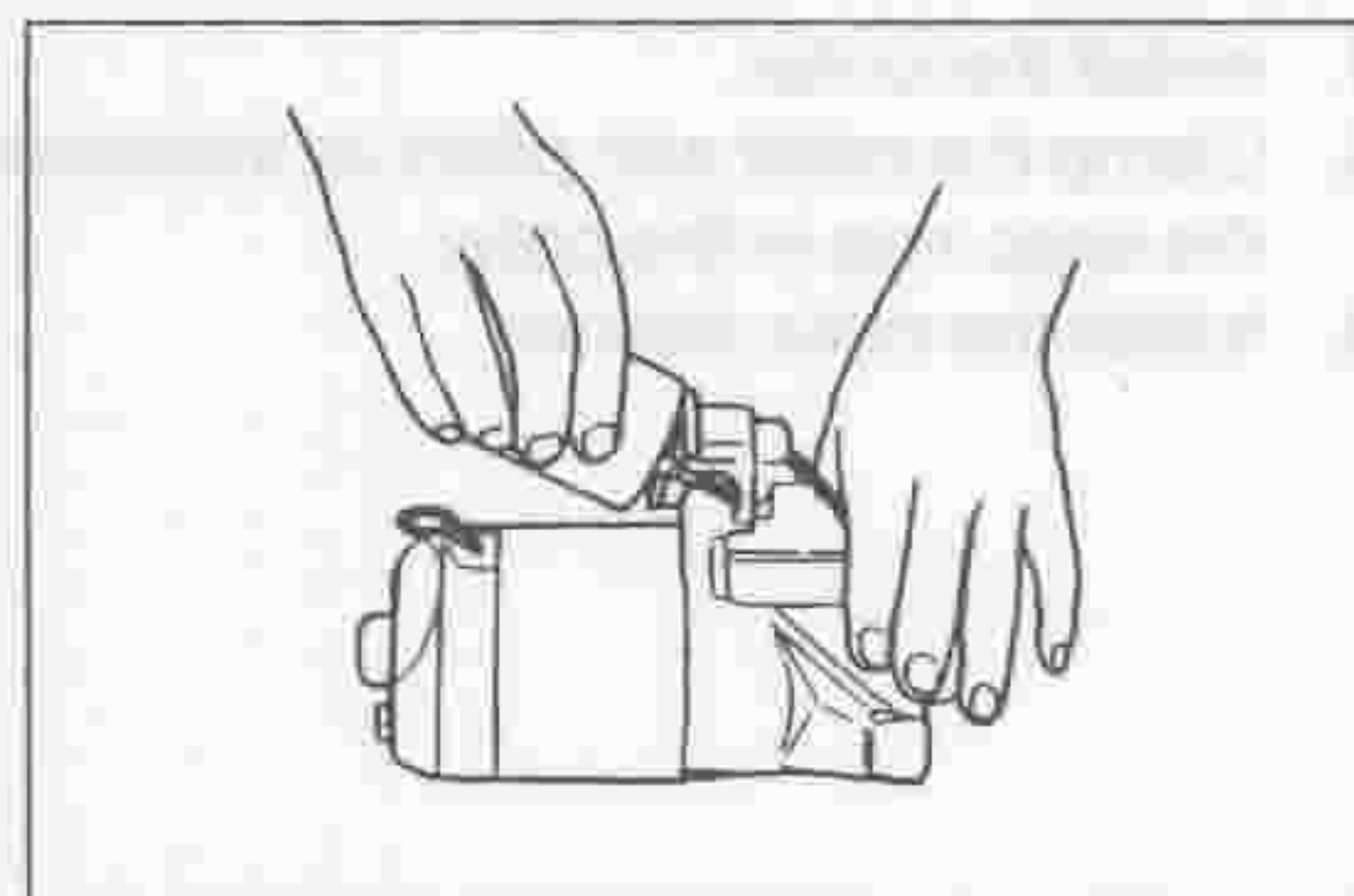
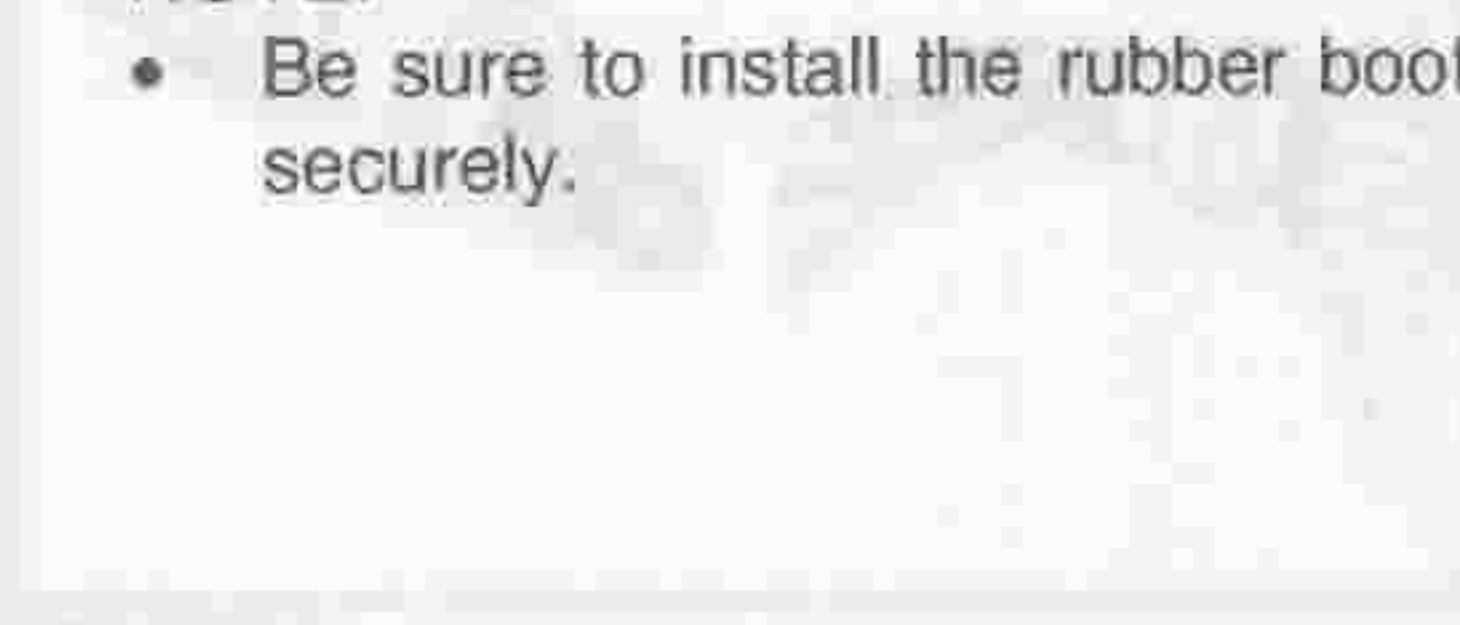


LST00077-00072

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

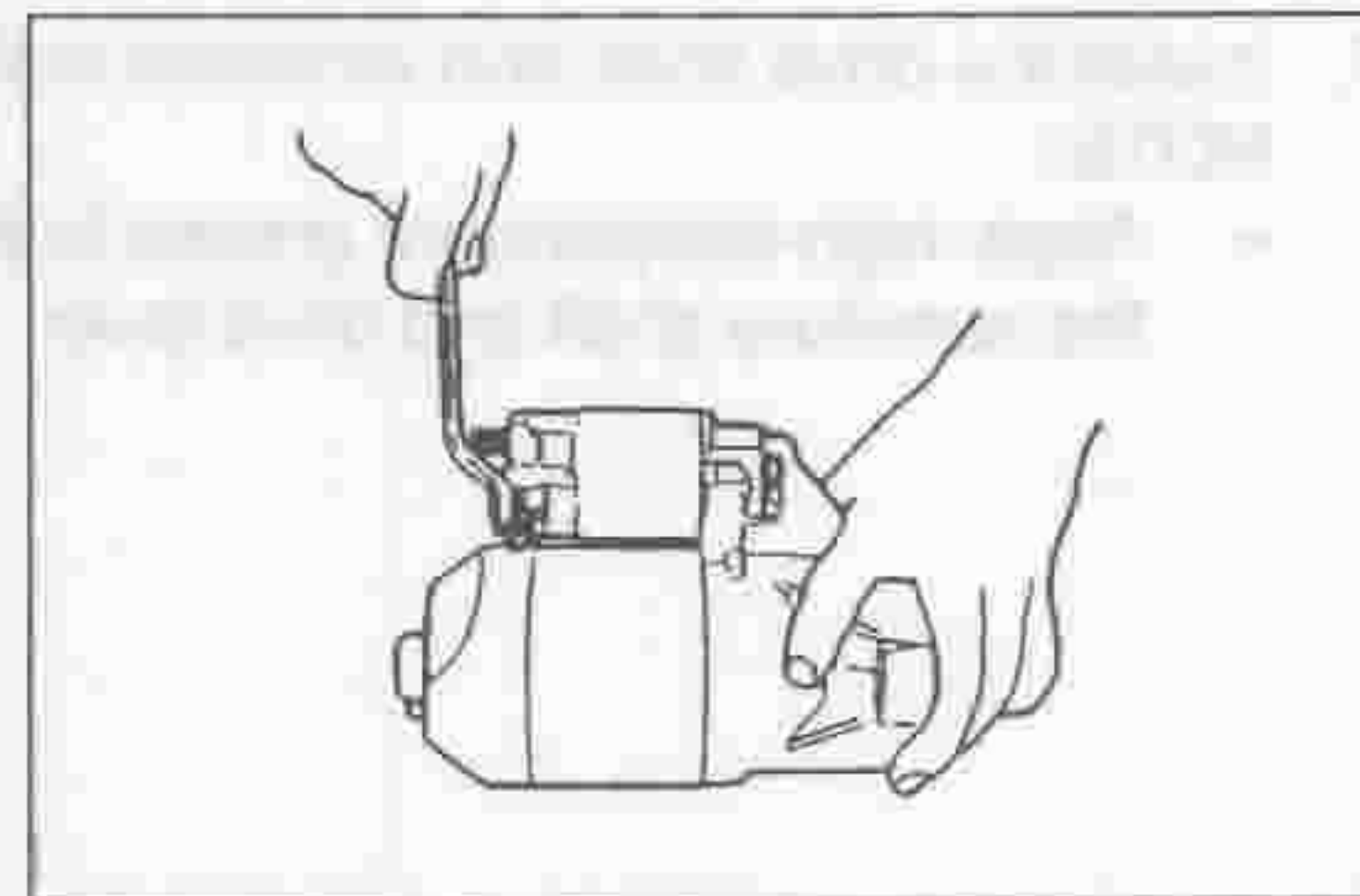
NOTE:

- Be sure to install the rubber boot in the spring section securely.



LST00078-00073

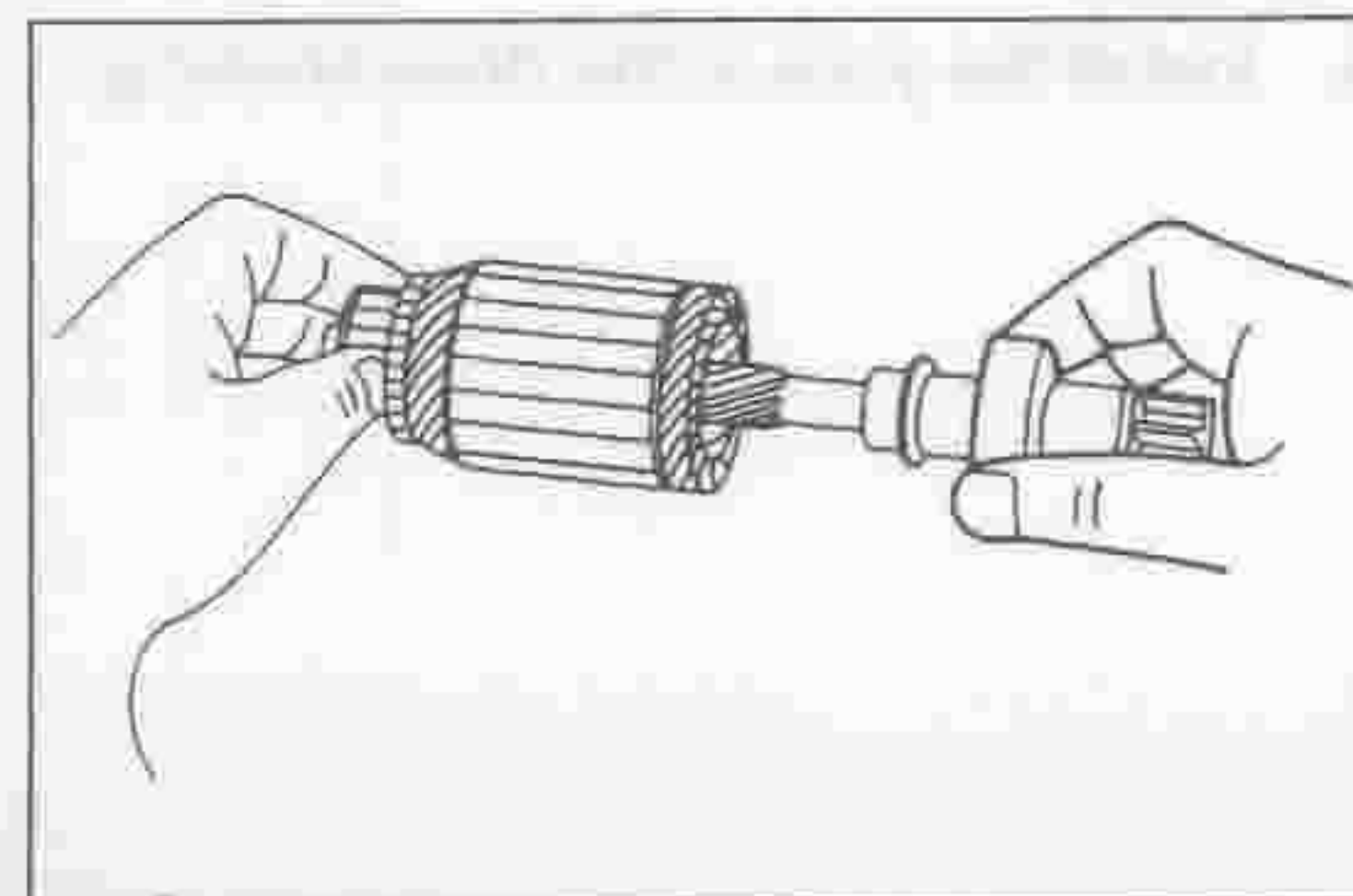
13. Connect the lead wire to the magnetic switch.



LST00079-00074

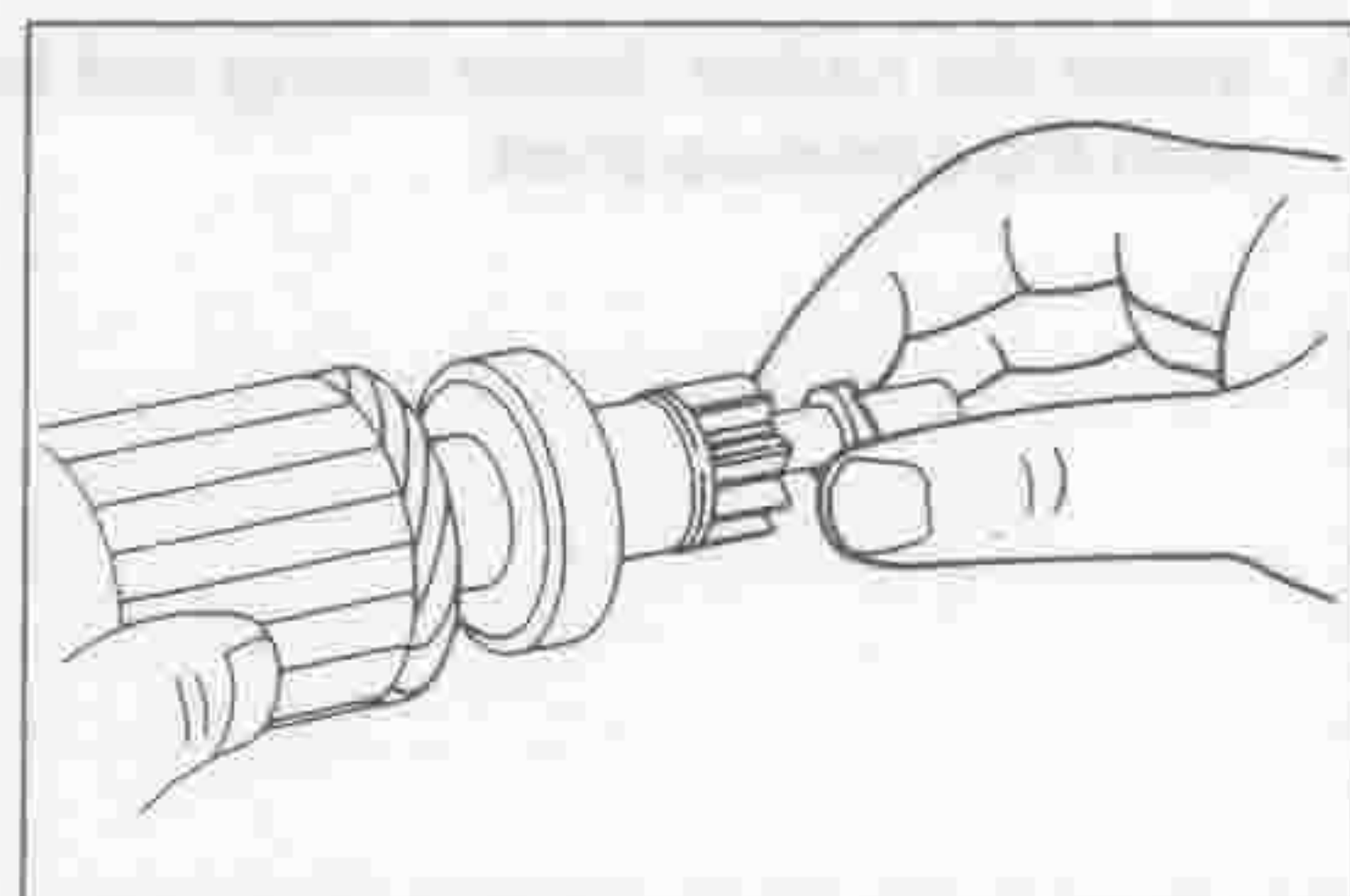
For 0.6 kW, 0.7 kW and 0.8 kW motor

1. Install the clutch on the armature shaft.



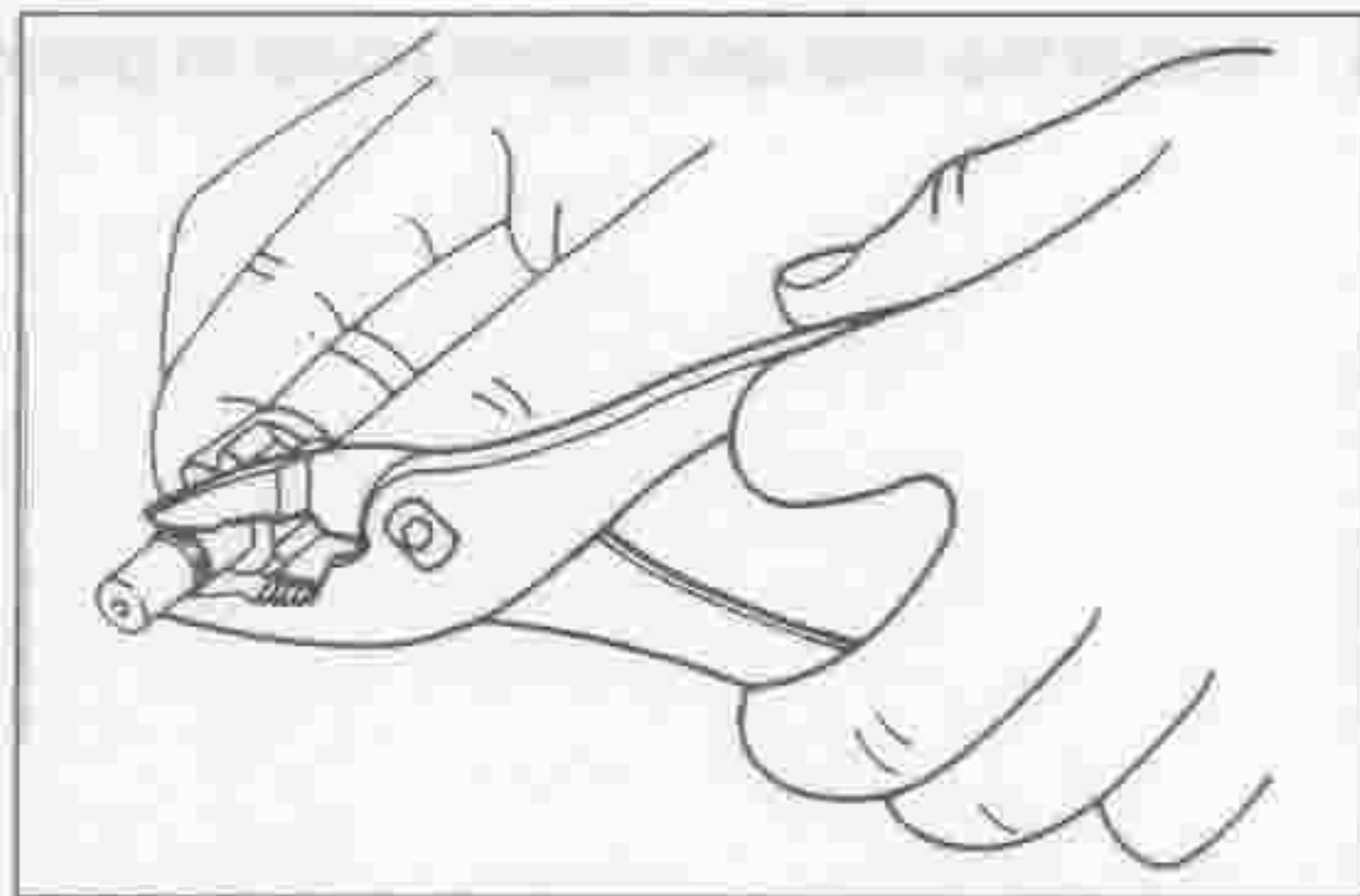
LST00080-00075

2. Install the collar on the armature shaft.



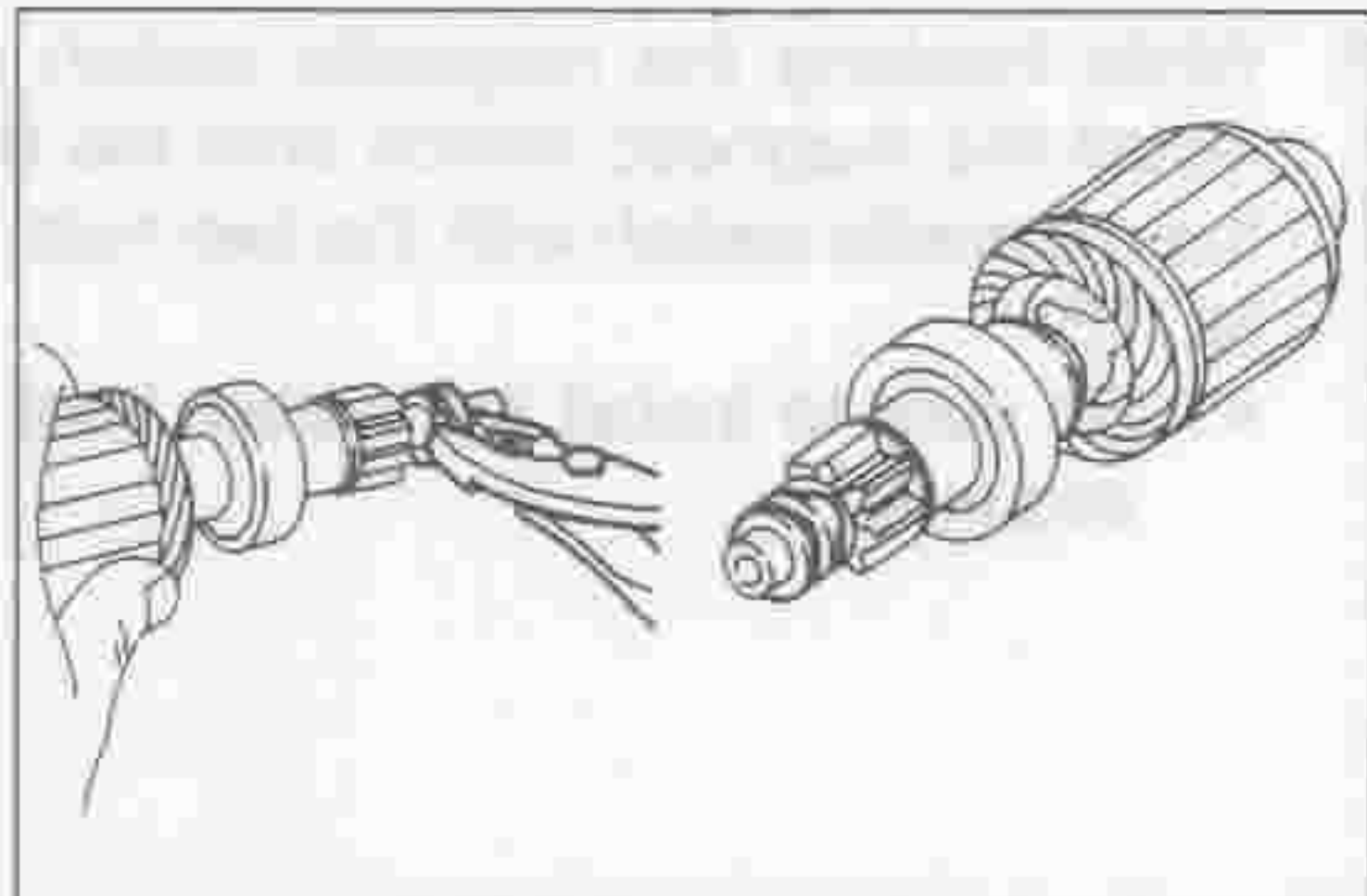
LST00081-00076

3. Fit the snap ring onto the armature shaft.



LST00082-00076

4. Install the collar.
5. Clamp the collar with pliers as indicated in the figure. Secure the snap ring in the collar.
6. Install the plate washer

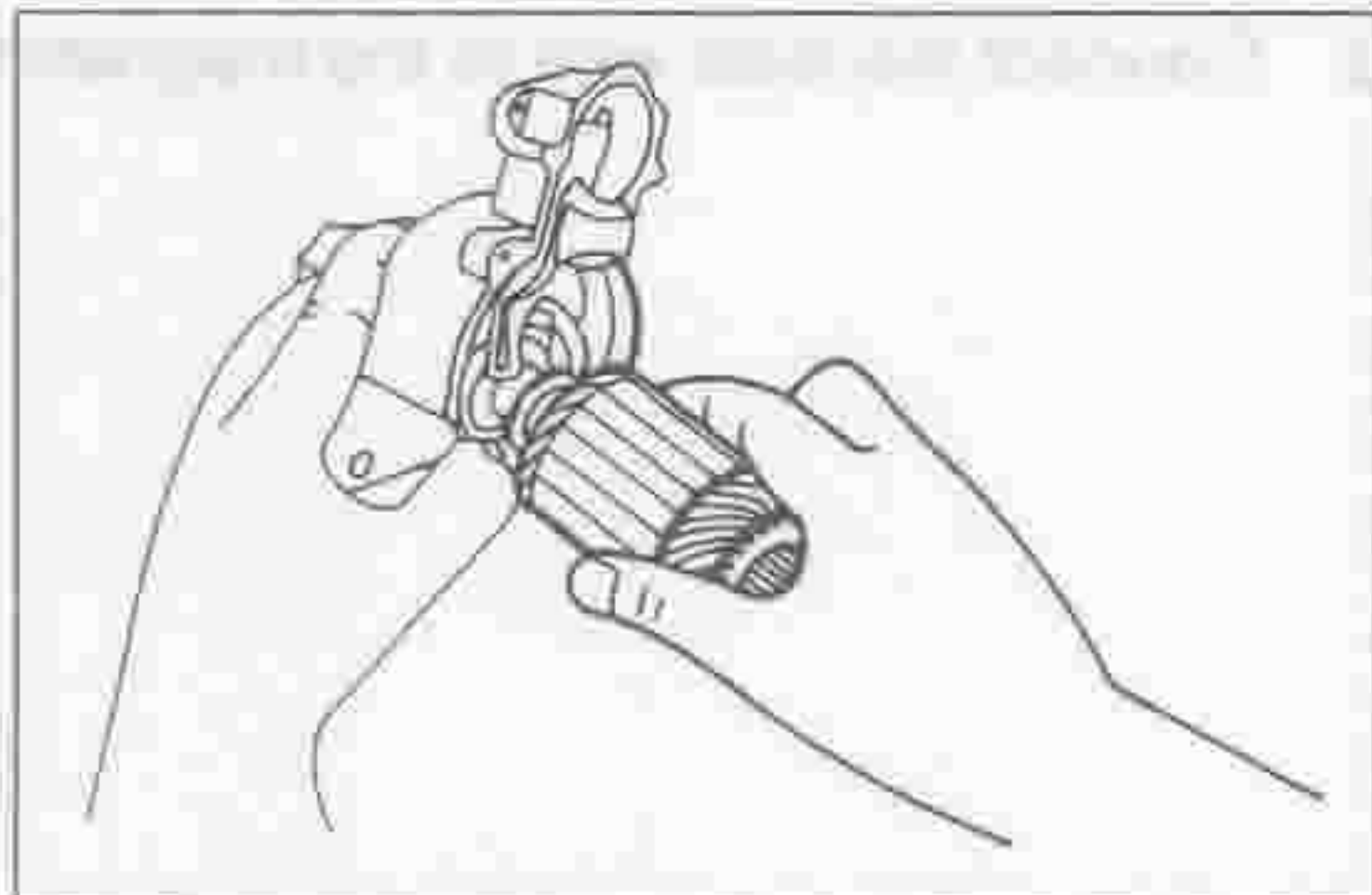


LST00083-00076

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

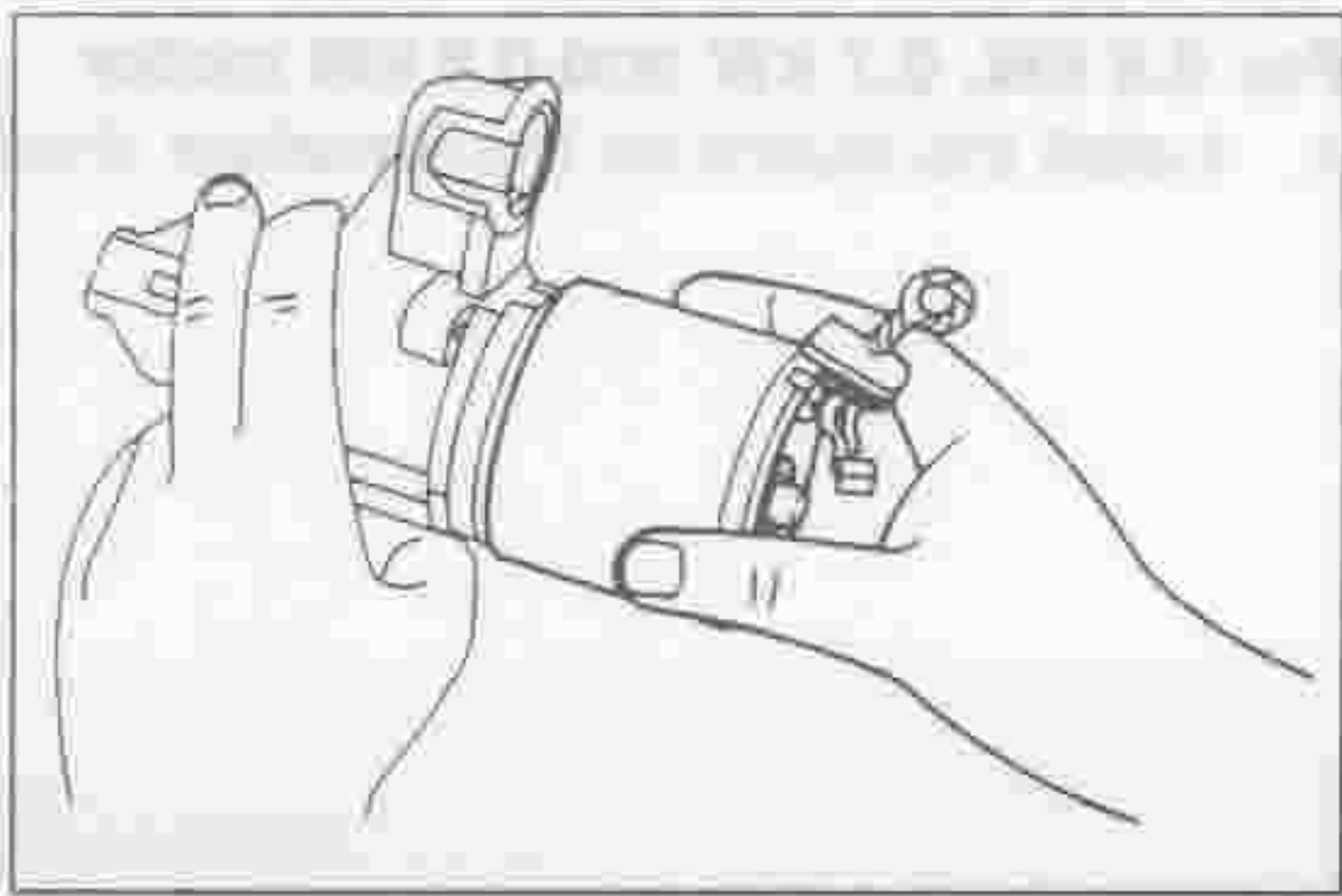
NOTE:

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



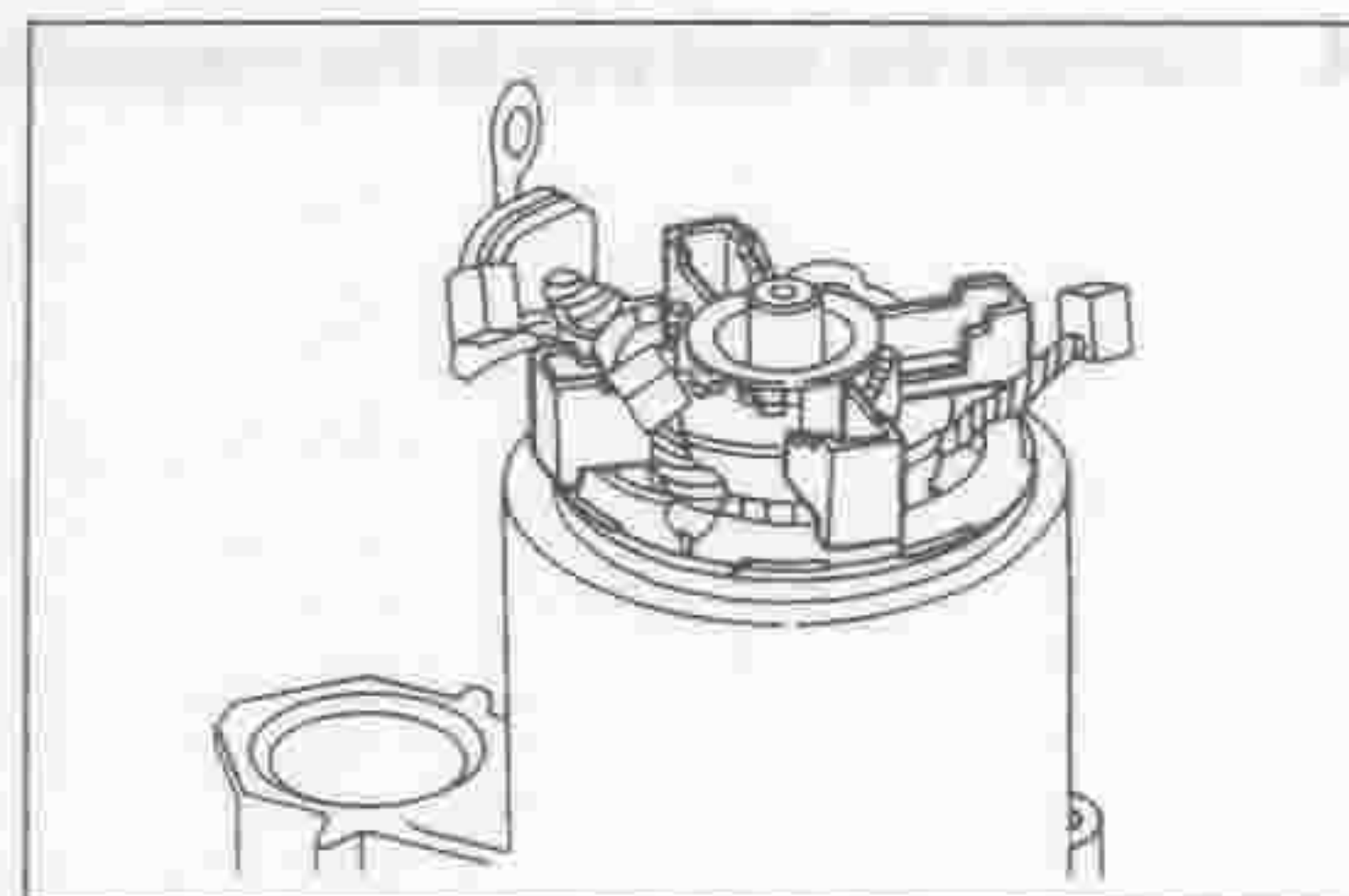
LST00084-00079

8. Install the yoke in the drive housing.



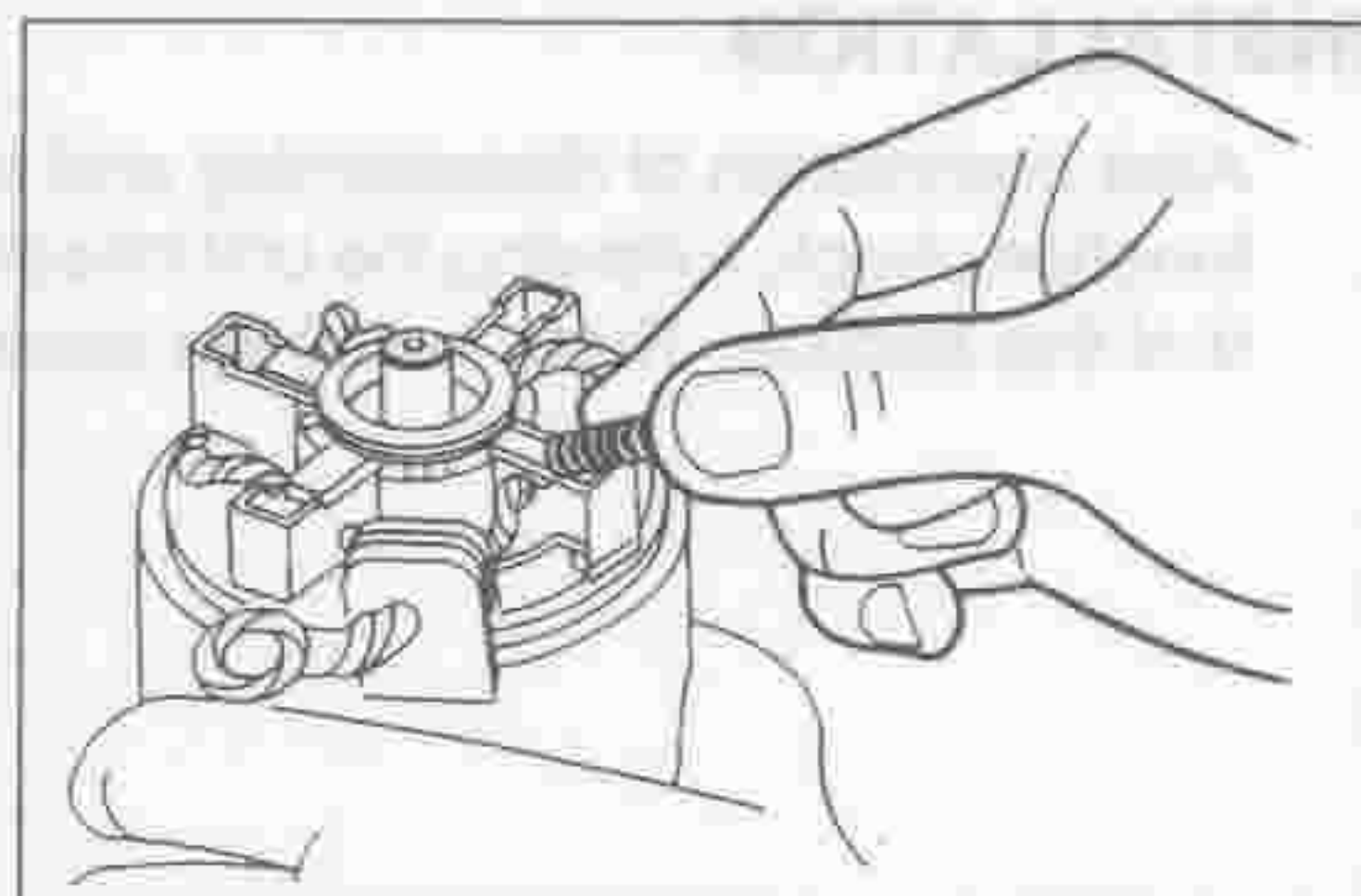
LST00085-00080

9. Install the brush holder over the armature shaft.



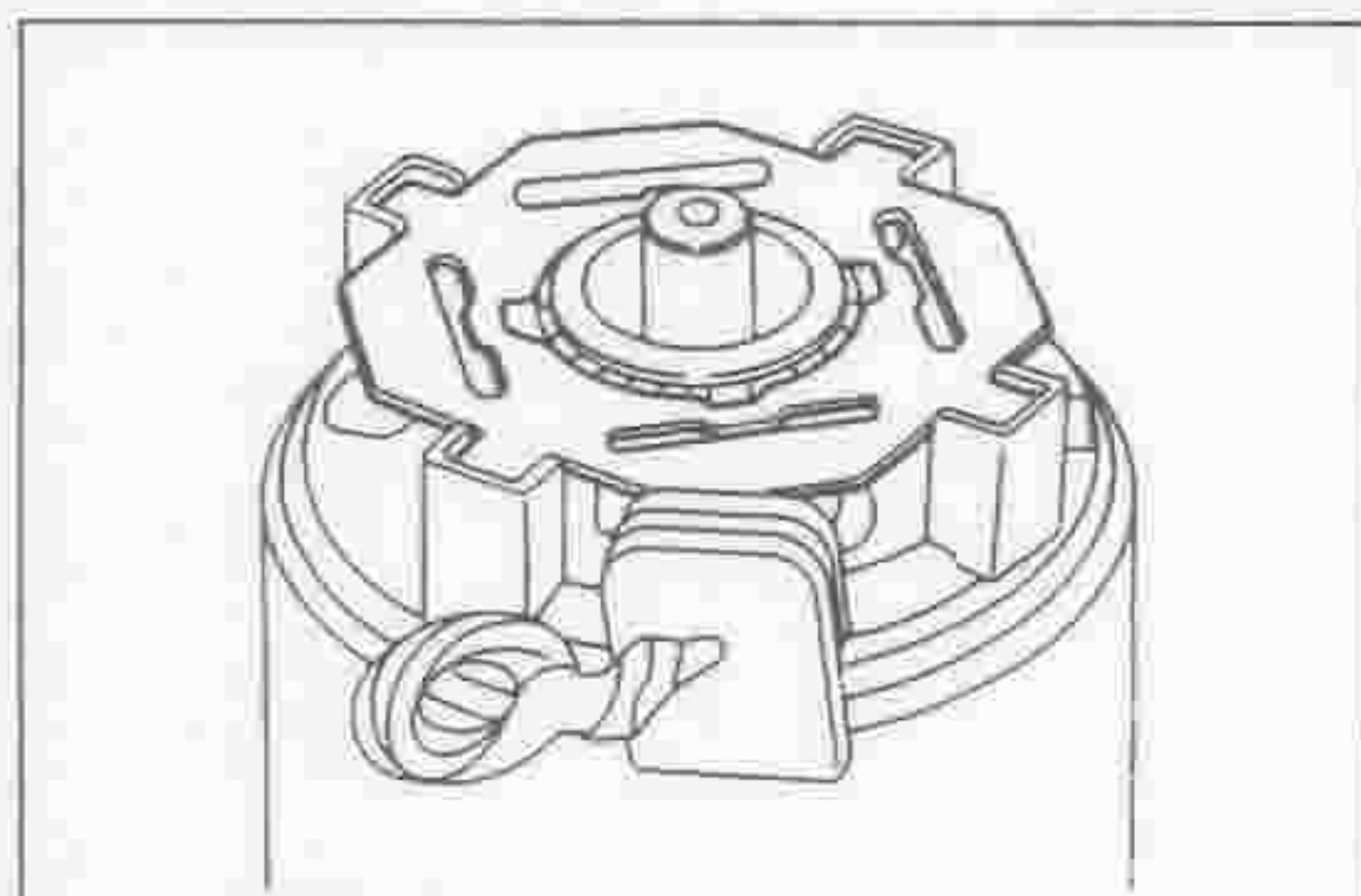
LST00086-00081

10. Install the brush and brush spring in the brush holder.



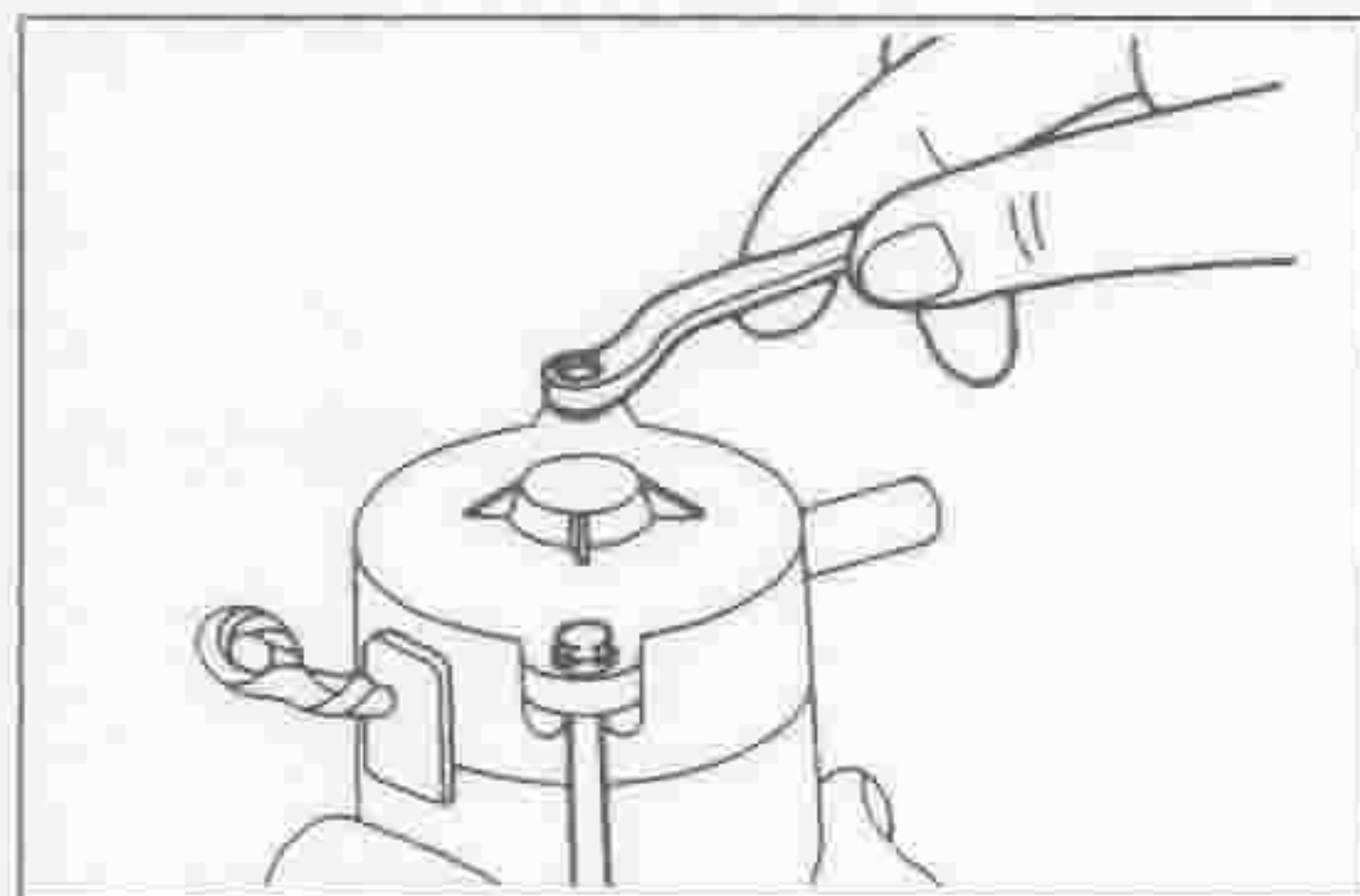
LST00087-00082

11. Install the insulator on the brush holder.



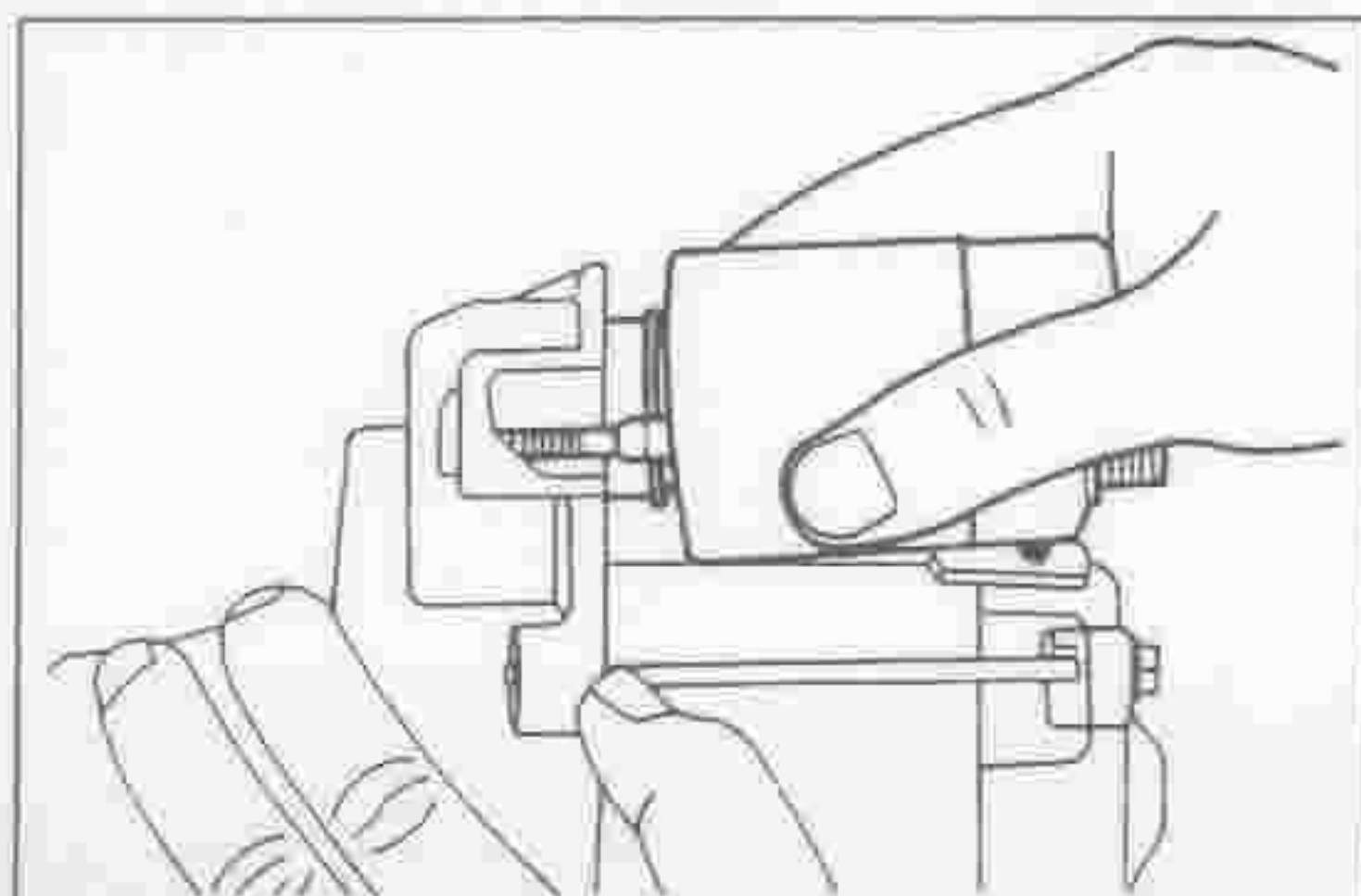
LST00088-00083

12. Attach the end frame to the stator yoke assy.



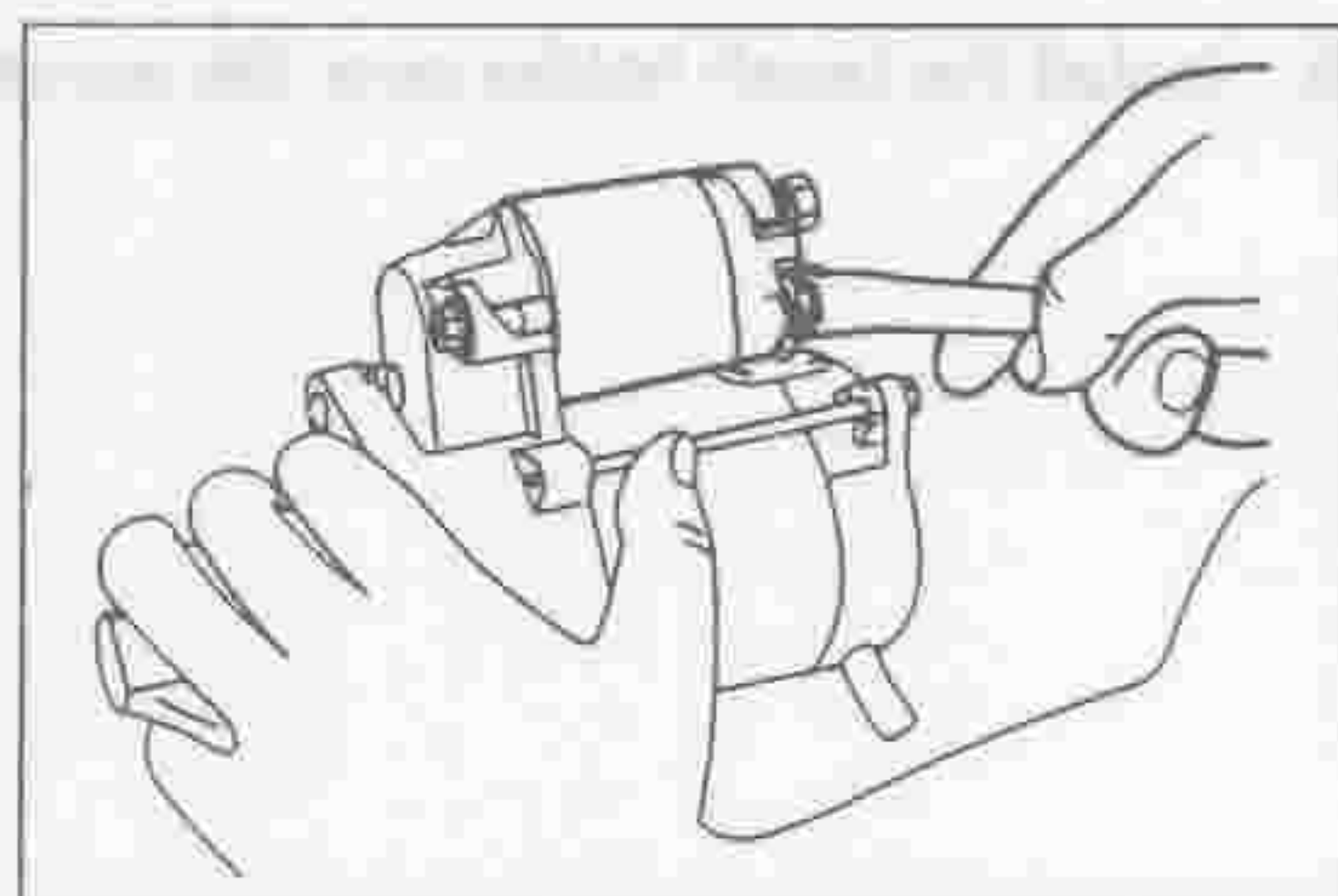
LST00089-00084

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



LST00090-00085

14. Connect the lead wire to the magnetci switch.



LST00091-00086

INSTALLATION

After completion of disassembly and assembly, perform the function check, following the unit check described in the item 9 of this section. Then, install the starter onto the vehicle.

LST00092-00000

