ENGINE ELECTRICAL

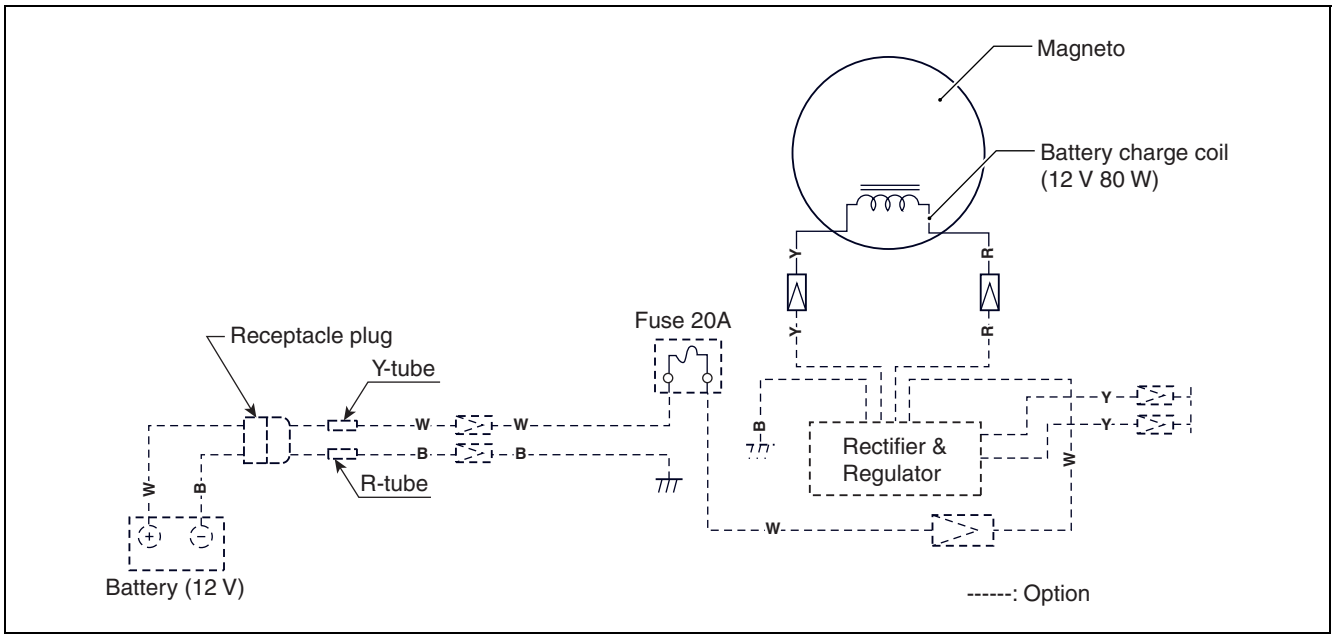
CONTENTS

BATTERY CHARGING SYSTEM

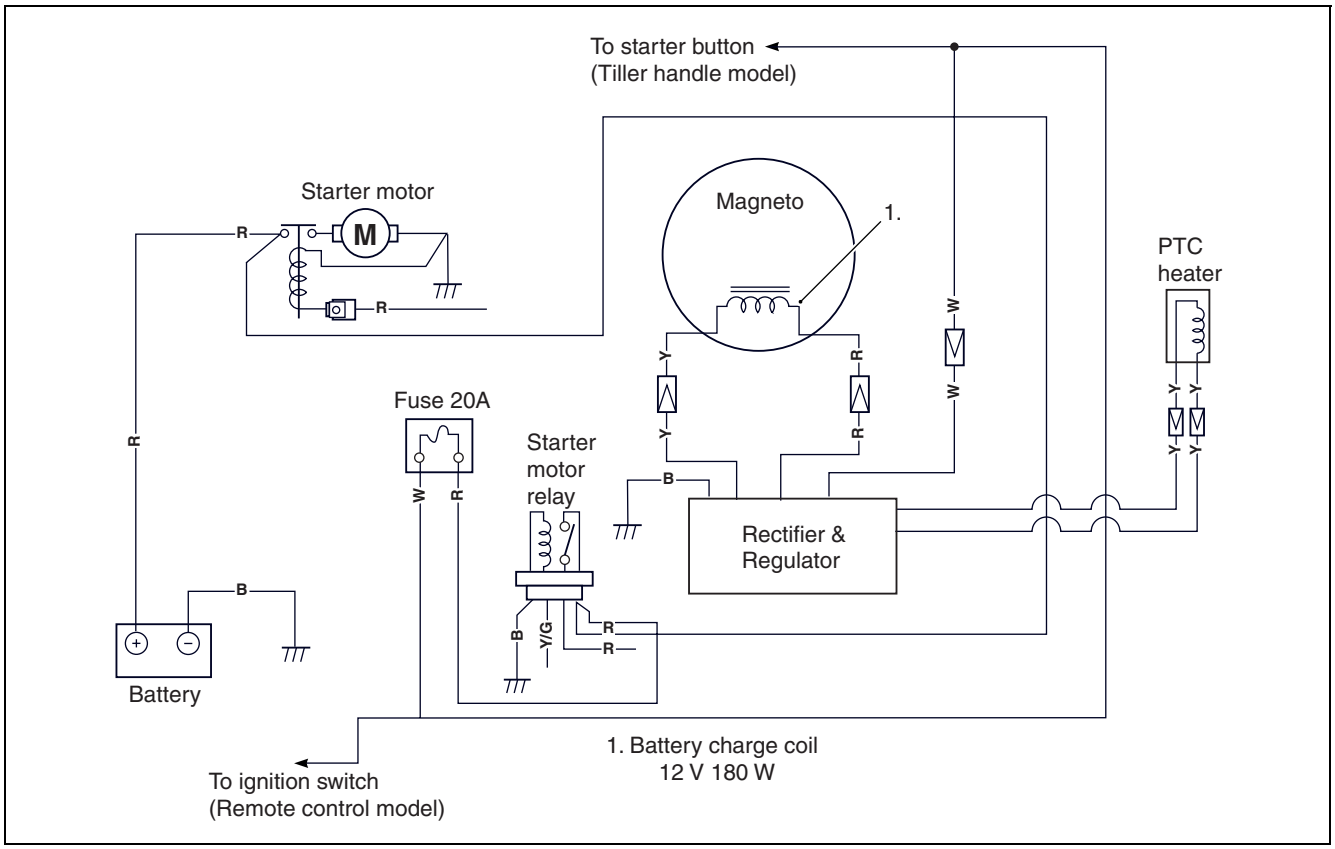
OUTLINE

The battery charging system circuit is illustrated below.
It is composed of the battery charge coil, the rectifier & regulator and the battery.
The AC current generated from the battery charge coil is converted by the rectifier into regulated DC current which is used to charge the battery.

Manual start model



Electric start model



INSPECTION

BATTERY CHARGE COIL OUTPUT

Peak Voltmeter Stevens CD-77
Tester range: POS 50

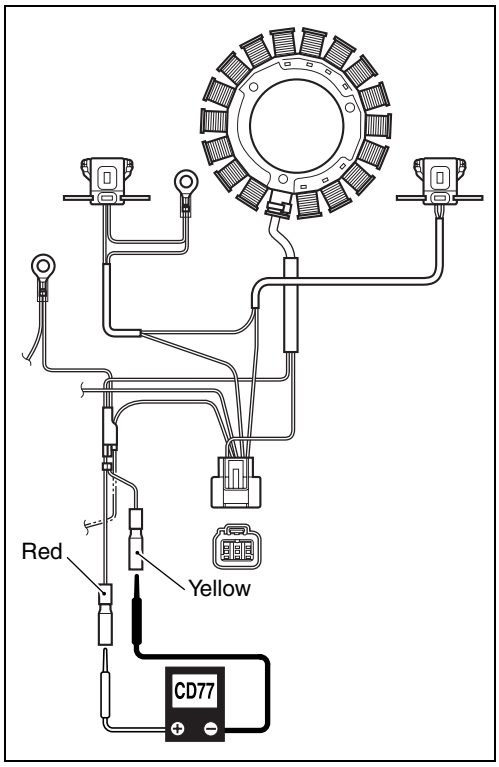
1. Disconnect battery charge coil wires from rectifier.
2. Remove all spark plugs.
3. Connect tester probe to battery charge coil lead wires as shown.

Tester probe connection	
⊕ (Red)	⊖ (Black)
Red	Yellow

4. Crank with the recoil starter or starter motor.

Coil output:
2 V or over (Manual start model)
4.8 V or over (Electric start model)

If measurement is out of specification, replace the battery charge coil.



BATTERY CHARGE COIL RESISTANCE

09930-99320: Digital tester

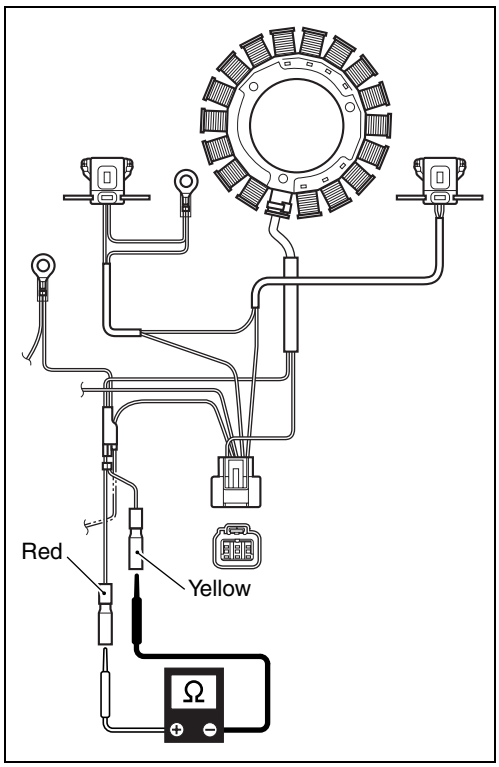
Tester range: Ω (Resistance)

1. Disconnect the battery charge coil wires from the rectifier.
2. Connect tester probe to battery charge coil lead wires as shown.

Tester probe connection	
Probe	Other probe
Red	Yellow

Coil resistance:
0.27 – 0.41 Ω {80 W coil}
0.24 – 0.36 Ω {180 W coil}

If measurement is out of specification, replace the battery charge coil.



RECTIFIER & REGULATOR

09900-25002: Pocket tester

Tester range: ×1 kΩ (Resistance)

1. Disconnect all lead wires of rectifier & regulator.
2. Measure resistance between leads in the combinations shown.

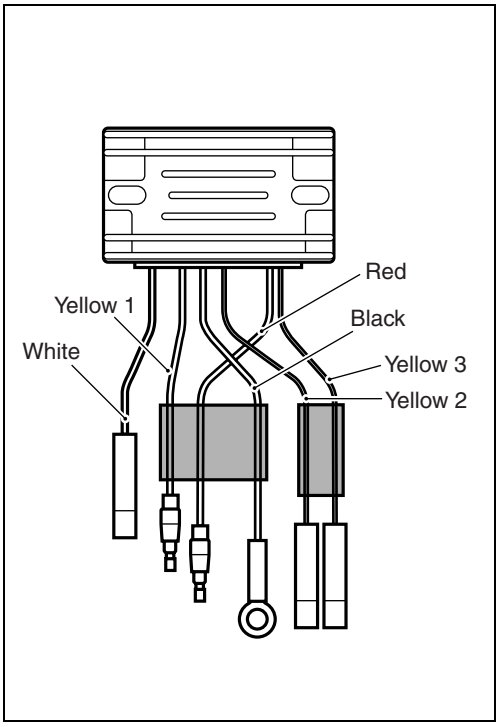
NOTE:
The values given below are for a SUZUKI pocket tester.
As thyristors, diodes, etc. are used inside this rectifier & regulator, the resistance values will differ when an ohmmeter other than SUZUKI pocket tester is used.

Rectifier & regulator resistance:

Unit: Approx. kΩ

		Tester probe ⊕ (Red)					
		Black	**White**	**Yellow 1**	**Red**	**Yellow 2**	**Yellow 3**
Tester probe ⊖ (Black)	**Black**		7 – 11	2 – 4	2 – 4	2 – 3	7 – 11
	White	∞		∞	∞	∞	0
	Yellow 1	160 – 240	2 – 4		400 – 600	400 – 600	2 – 4
	Red	160 – 240	2 – 4	400 – 600		400 – 600	2 – 4
	Yellow 2	∞	∞	∞	∞		∞
	Yellow 3	∞	0	∞	∞	∞	

If measurement exceeds specification, replace rectifier & regulator.



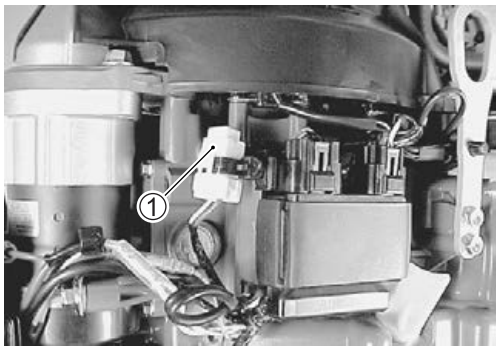
FUSE CASE/FUSE

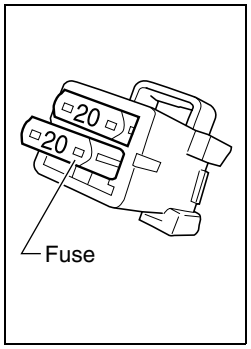
09930-99320: Digital tester

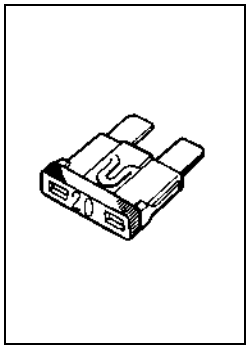
Tester range: (Continuity)

Fuse

1. Remove the fuse from fuse case ①.
2. Inspect the fuse and replace with a new 20-amp fuse if needed.

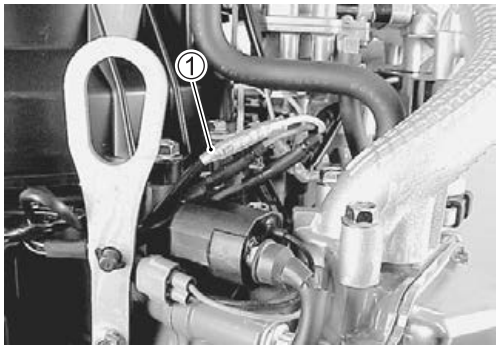




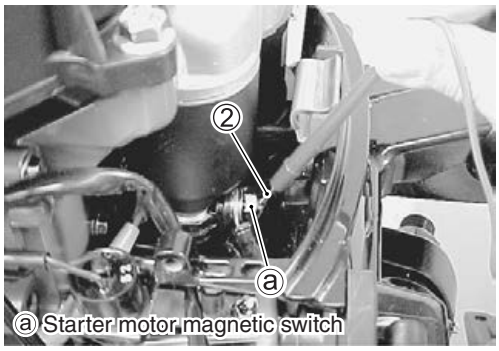


Fuse case

1. Disconnect battery cables from battery.
2. Disconnect white lead wire of rectifier from engine wire harness.
3. Check continuity between White lead wire ① of engine wire harness and Red lead wire ② of starter motor magnetic switch “B” terminal.



If no continuity is indicated, replace engine wire harness and/or fuse.

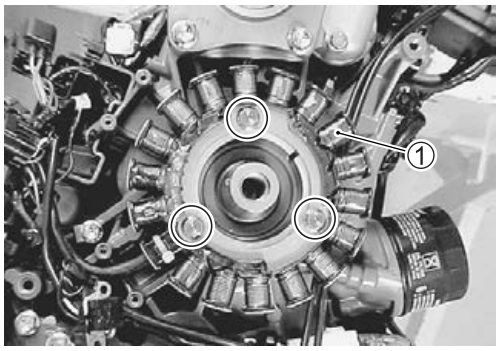


REMOVAL/INSTALLATION

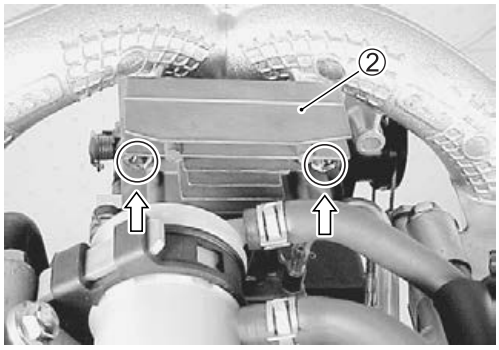
REMOVAL

Before removing electrical parts:
- **Disconnect battery cables from battery.**
- **Disconnect spark plug cap from all spark plugs.**

Battery charge & Power source coil
- Remove flywheel. (See page 3-15)
- Remove screws and CKP sensors.
- Remove the bolts and battery charge coil ①. (See page 3-16 to 3-17)



Rectifier & Regulator
- Remove the screws securing the rectifier & regulator ②.
- Disconnect lead wire connectors.



INSTALLATION

Installation is reverse order of removal with special attention to the following steps.

- **Battery charge & Power source coil**
  - Install CKP sonsors and charge coil. (See page 3-18)
- **Wire routing**
  - Check wire routing. (See page 10-5 to 10-8)

ELECTRIC STARTER SYSTEM

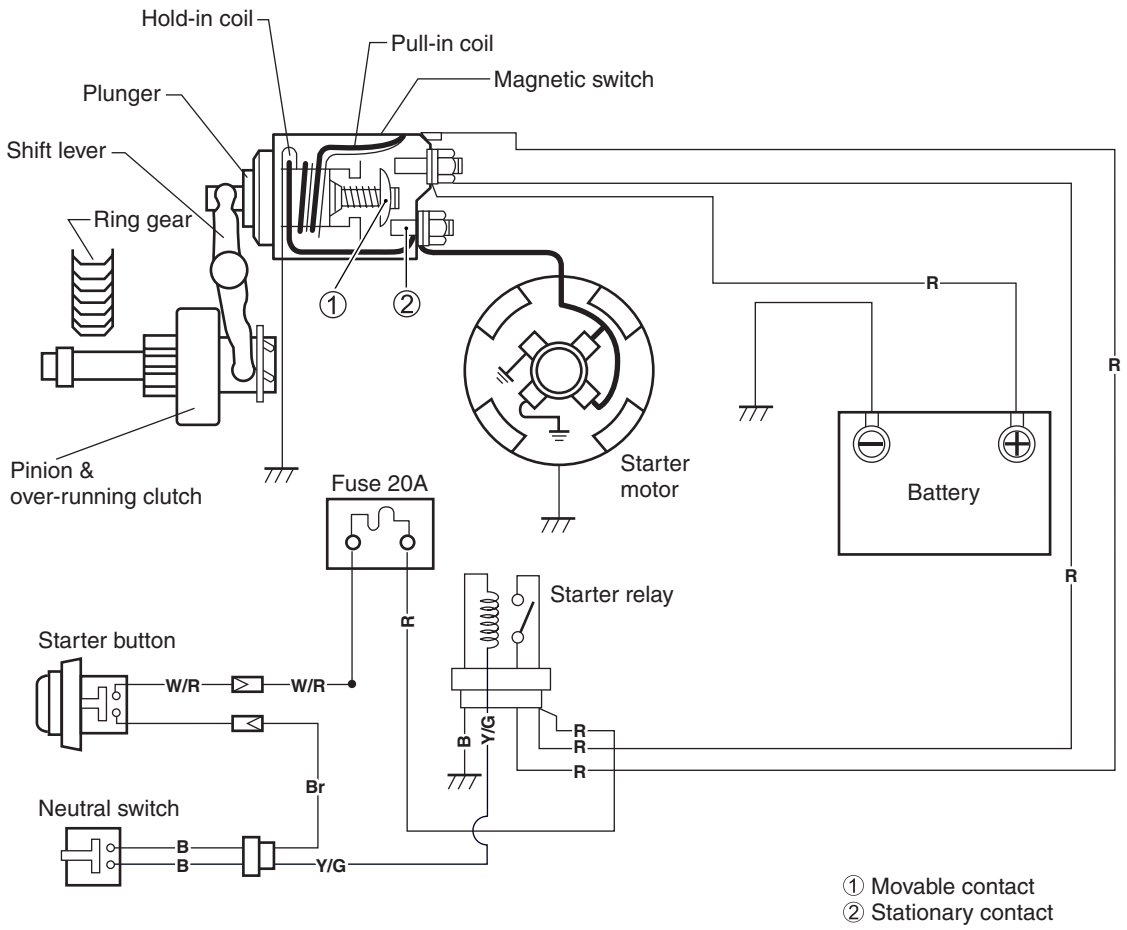
OUTLINE

The starting circuit consists of the battery, starting motor, ignition switch (or starter button), neutral switch and related electrical wiring.
These components are connected electrically as shown in figure below.

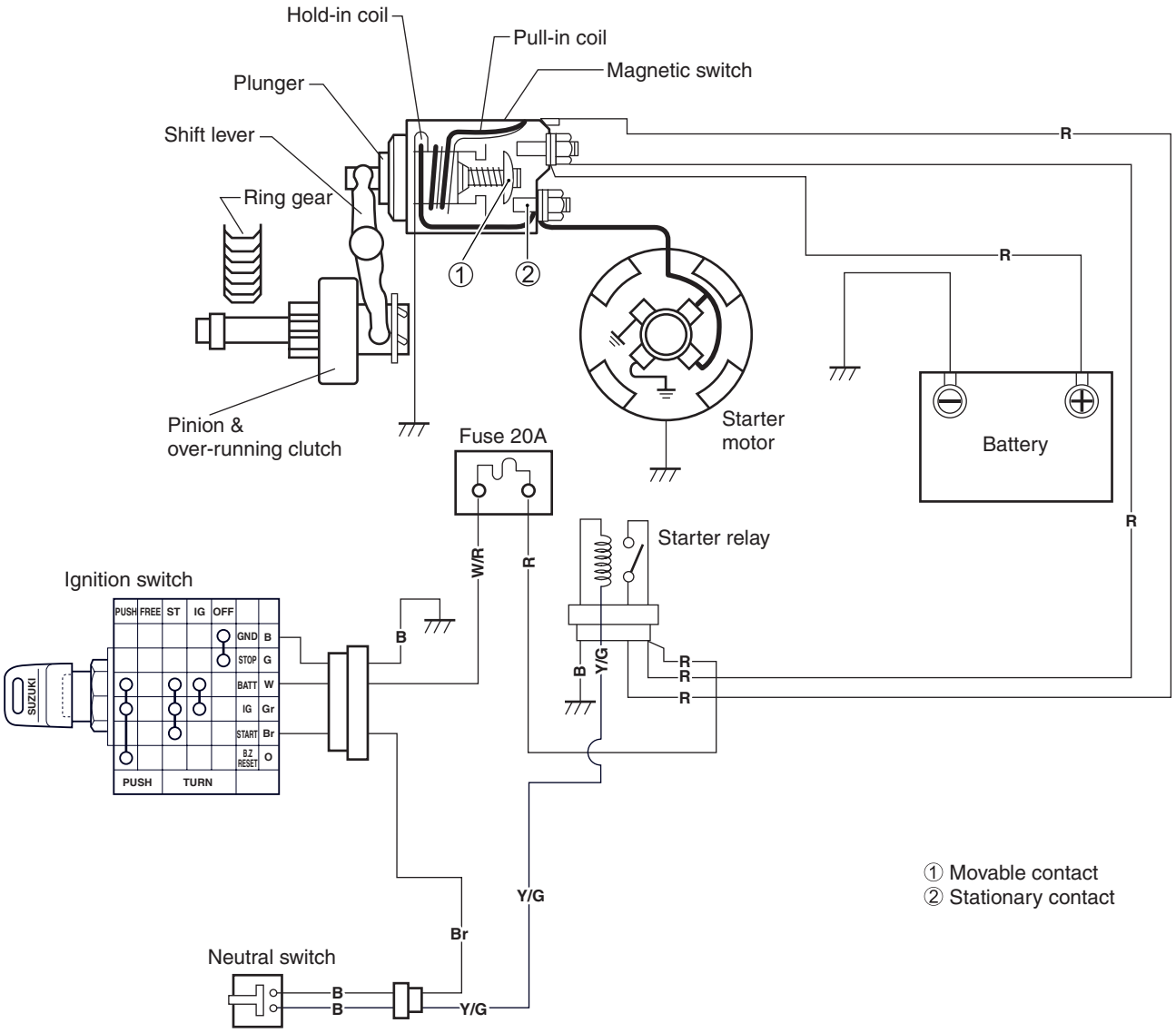
STARTING SYSTEM CIRCUIT

In the circuit shown in figure below, the magnetic switch coils are magnetized when the starter button is closed (Starter button depressed).
The resulting plunger and pinion shift lever movement causes the pinion to engage the engine flywheel gear, the magnetic switch main contacts to close, and engine cranking to take place.
When the engine starts, the pinion over-running clutch protects the armature from excessive speed until the starter button is opened, at which time the torsion spring causes the pinion to disengage.

For Tiller handle model



For Remote control model



TROUBLESHOOTING

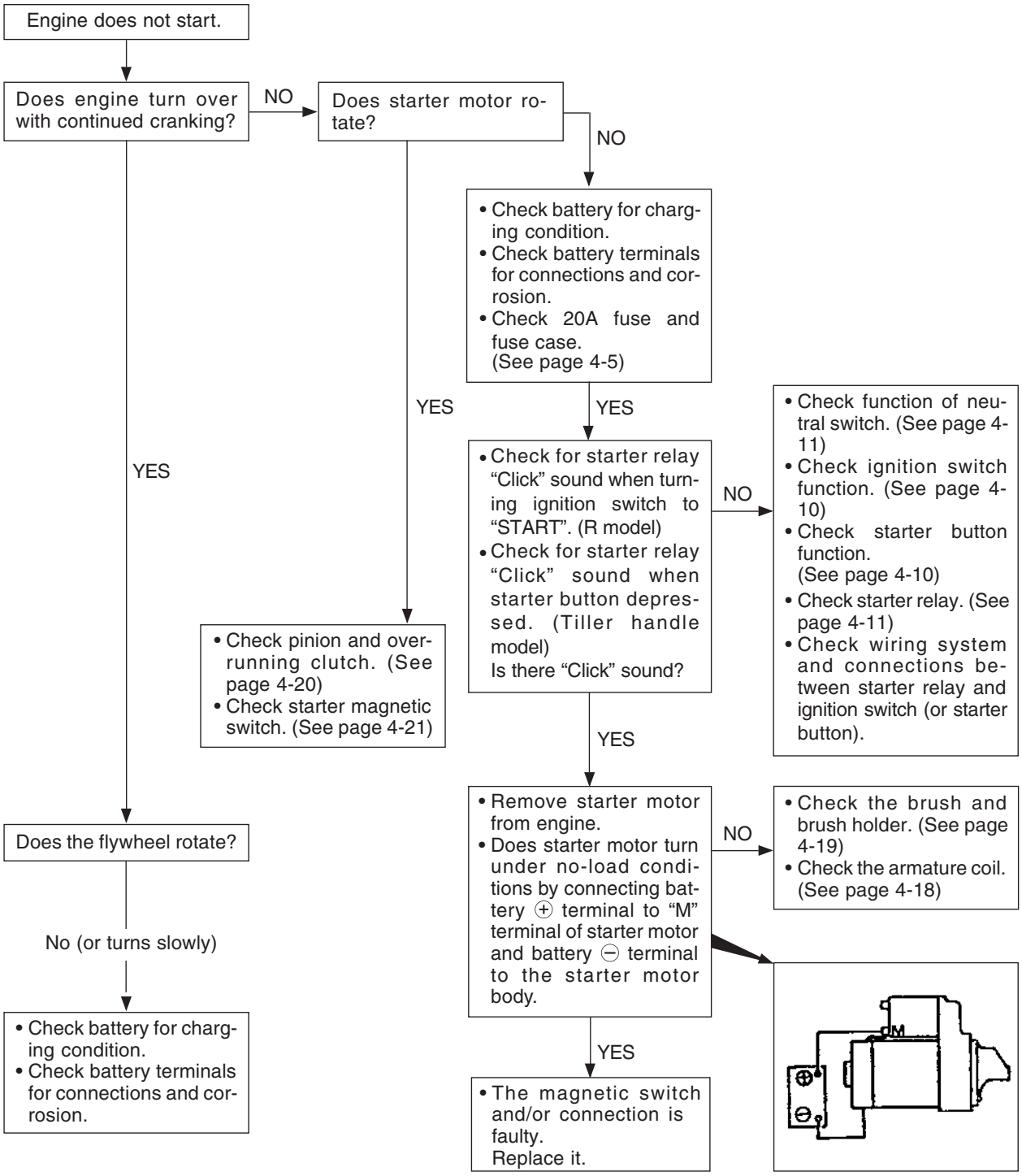
NOTE:

Before troubleshooting the electric starter system, make sure of the following:

- *Battery is fully charged.*
- *All cables/wires are securely connected.*
- *Shift is in "NEUTRAL" position.*

CAUTION

If any abnormality is found, immediately disconnect battery cables from battery.



INSPECTION

IGNITION SWITCH (Remote control model)

09930-99320: Digital tester

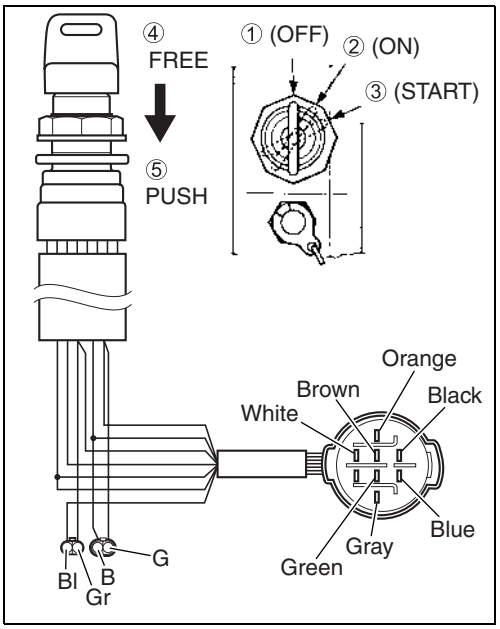
Tester range: (Continuity)

1. Disconnect the ignition switch from remote control wiring harness.
2. Check continuity between wiring leads at the key positions shown in the chart.

Key Position	Switch Lead Wires					
	Black	Green	White	Gray	Brown	Orange
① OFF	○	○				
② ON			○	○		
③ START			○	○	○	
④ FREE						
⑤ PUSH			○	○		○

○——○: Continuity

If out of specification, replace ignition switch.



STARTER BUTTON (Tiller handle model)

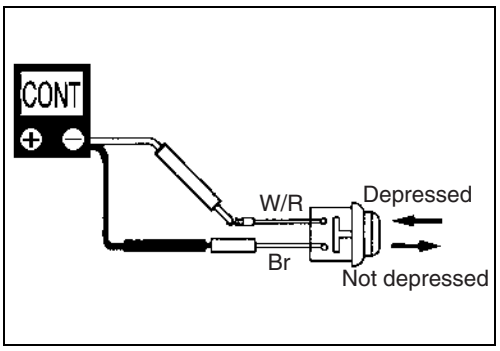
09930-99320: Digital tester

Tester range: (Continuity)

1. Disconnect the starter button lead wire.
2. Check continuity between the wiring leads under the condition shown below.

	Tester probe connection		Tester indicates
	Red ⊕	Black ⊖	
Starter button not depressed	White/Red	Brown	Infinity
Starter button depressed			Continuity

If out of specification, replace the starter button.



NEUTRAL SWITCH

Check for continuity/infinity of the neutral switch.

09930-99320: Digital tester

Tester range: (Continuity)

1. Disconnect neutral switch lead wire connector.
2. Check continuity/infinity between Black and Black lead wires while operating the shift lever or remo-con handle.

Neutral switch function:

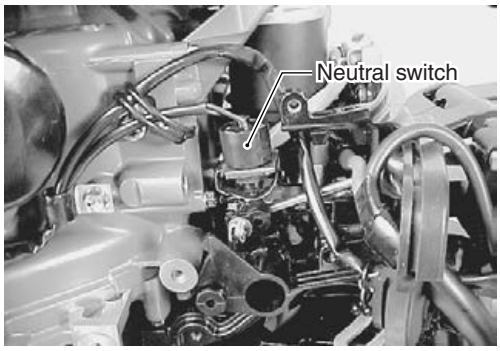
Shift position	Tester indicates
Neutral	Continuity
Forward	Infinity
Reverse	Infinity

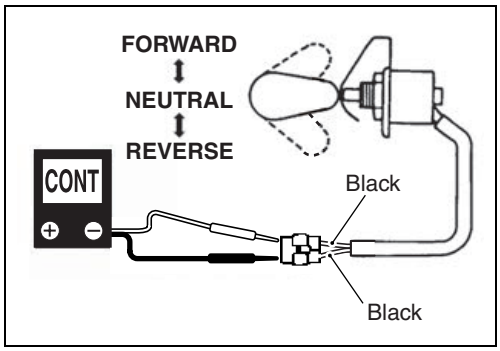
If out of specification:

- 1st Check switch position adjustment, readjust if necessary.
- 2nd Replace neutral switch.

NOTE:

After installing neutral switch, check for proper correct function by operating remo-con handle or shift lever.



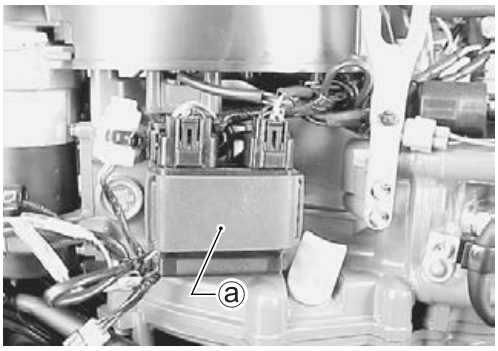


STARTER MOTOR RELAY

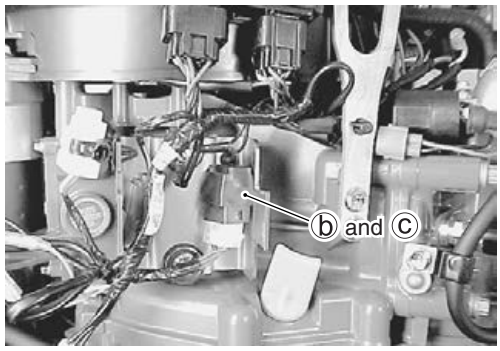
09930-99320: Digital tester

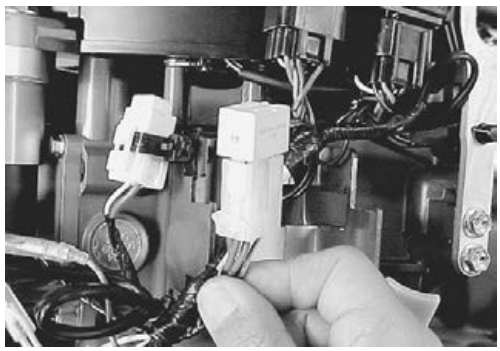
Tester range: (Continuity)

1. Remove CDI unit ⓐ.

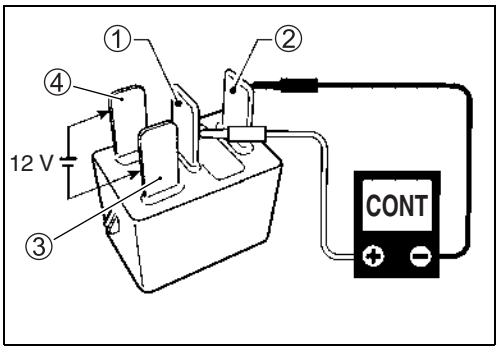


2. Pull out relay ⓑ and relay holder ⓒ from electric parts holder, then remove relay holder ⓒ from starter motor relay. Disconnect starter motor relay from wire connector.





3. Check continuity between terminal ① and ② each time 12 V is applied. Connect positive ⊕ side to terminal ④, and negative ⊖ side to terminal ③.



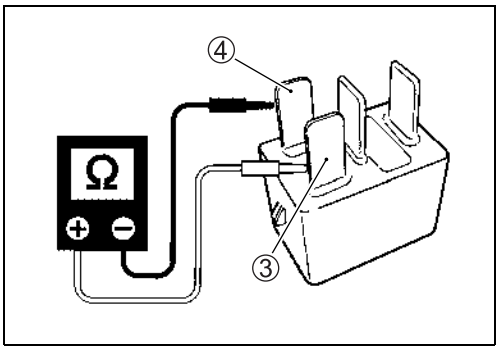
Starter motor relay function:

12 V power	Continuity
Applied	Yes
Not applied	No

CAUTION

Be careful not to touch 12 V power supply wires to each other or with other terminals.

4. Measure resistance between relay terminals ③ and ④.



Tester range: Ω (Resistance)
Starter motor relay solenoid coil resistance:
145 – 190 Ω

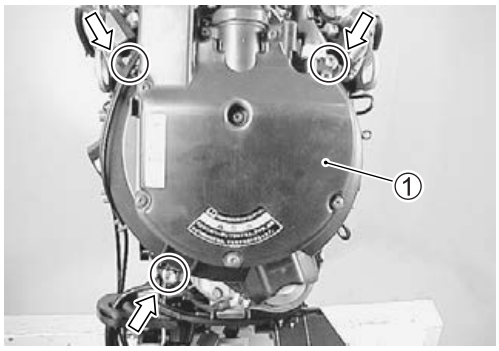
If out of specification, replace starter motor relay.

STARTER MOTOR

REMOVAL

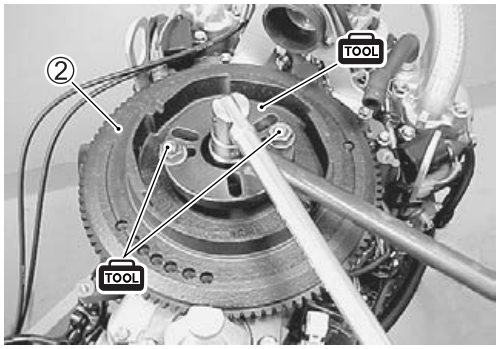
Prior to removing starter motor:
- **Disconnect battery cables from battery.**

1. Remove the side covers. (See page 8-2)
   Remove bolts and flywheel cover ①. (See page 7-2)

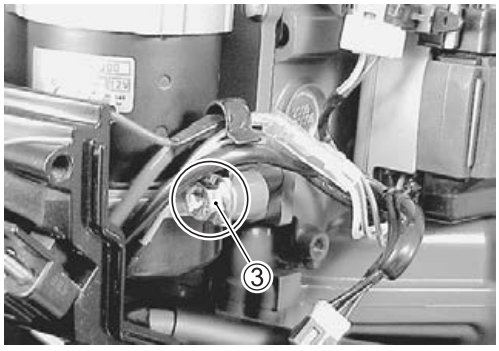


2. Remove the flywheel ②. (See page 3-15)

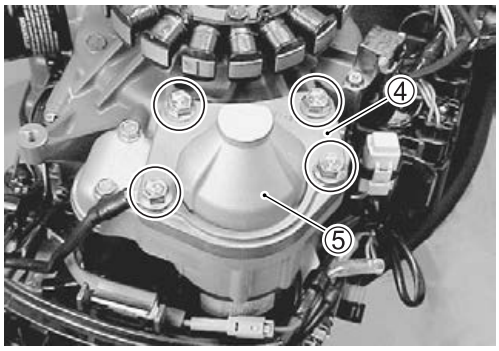
TOOL **09930-48720: Flywheel holder**
09930-49210: Flywheel holder attachment
09930-39411: Flywheel rotor remover
09930-39420: Rotor remover bolt



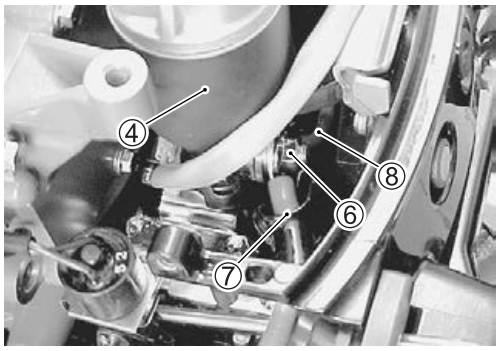
3. Loosen the PORT side bolt ③ securing starter motor band.



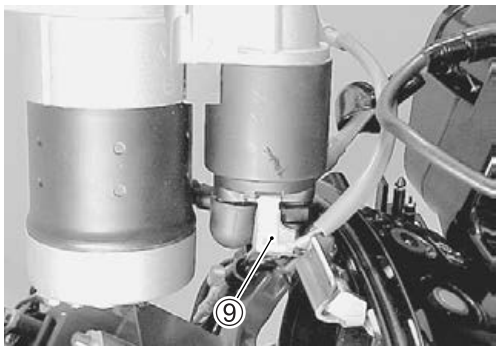
4. Remove the two bolts securing motor bracket ④.
   Remove the two bolts securing starter motor ⑤.
   Lift up and remove the motor bracket ④.



5. Lift up starter motor ④, then remove nut ⑥, positive (+) battery cable ⑦, positive cable ⑧ from the magnetic switch "B" terminal of starter motor.



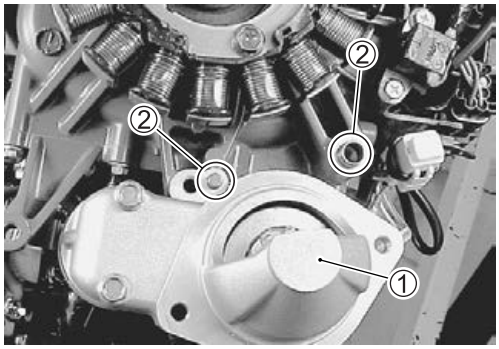
6. Disconnect the red lead wire ⑨ from starter motor magnetic switch “S” terminal.



INSTALLATION

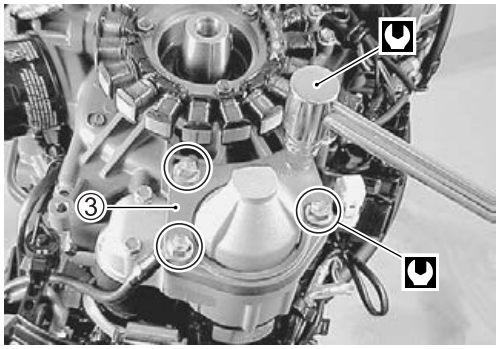
Installation is reverse order of removal with special attention to the following steps.

- Place the starter motor ① in position, then install two dowel pins ② and motor bracket ③.



- Tighten starter motor mounting bolts and motor bracket bolts securely.

Starter motor mounting bolt: 23 N·m (2.3 kg-m, 16.5 lb-ft)
Starter motor bracket bolt: 23 N·m (2.3 kg-m, 16.5 lb-ft)



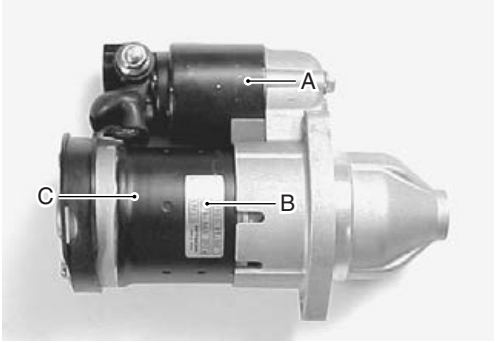
DISASSEMBLY

When overhauling starting motor, it is recommended that component parts be cleaned thoroughly.

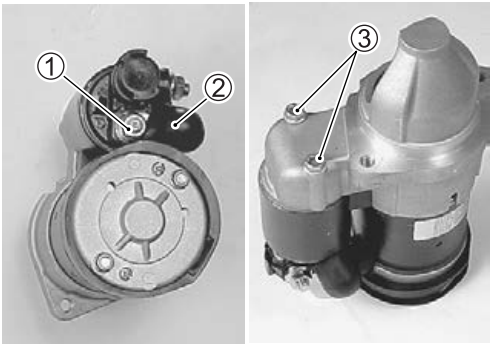
However, the yoke assembly, armature coil, over-running clutch assembly, magnetic switch assembly, and rubber or plastic parts should not be washed in a degreasing tank or with a grease dissolving solvent. These parts should be cleaned with compressed air or wiped with clean cloth.

NOTE:

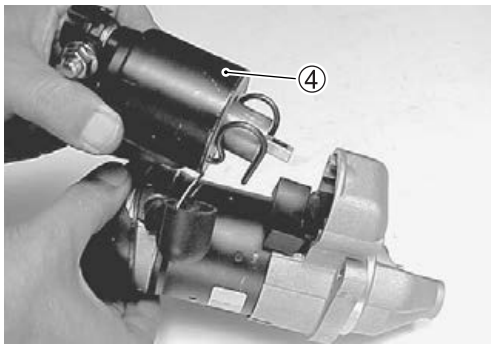
Before disassembling starting motor, be sure to put match marks at three locations (A, B and C) as shown in figure at right to avoid any possible component alignment mistakes.



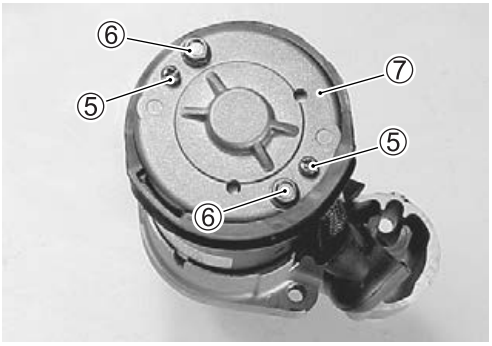
1. Remove nut ① from magnetic switch, then disconnect the connecting wire ②.
2. Remove two bolts ③ securing magnetic switch.



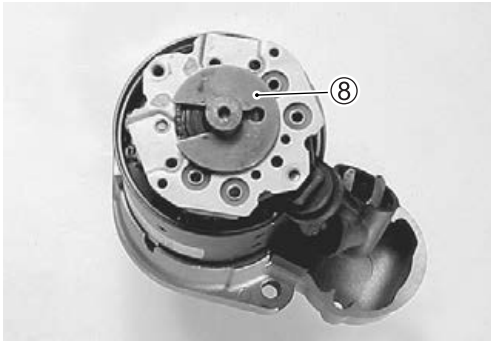
3. Remove the magnetic switch ④.



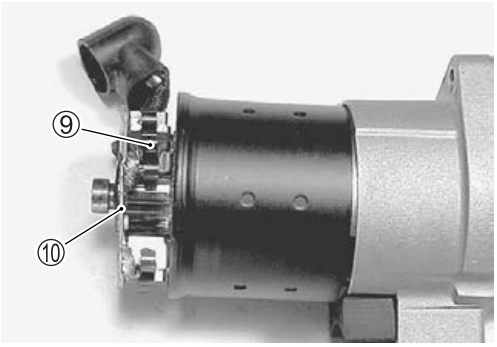
4. Remove screws ⑤, long through bolts ⑥ and rear cover ⑦.



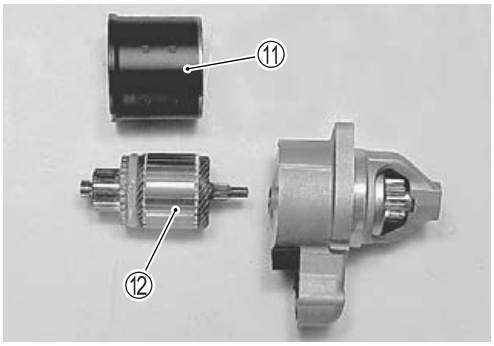
5. Remove thrust washer ⑧ with screwdriver.



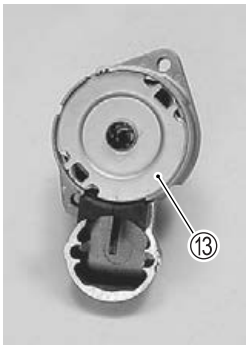
6. Pull the brush spring ⑨ up to separate the brush from the surface of the commutator, then remove the brush holder ⑩.

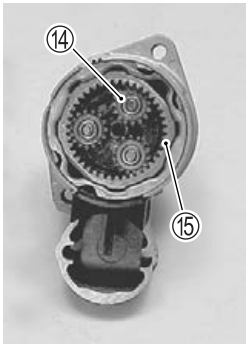


7. Remove the yoke ⑪ and armature ⑫.

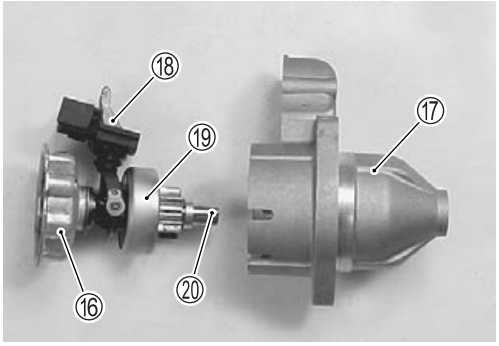


8. Remove the center cover plate ⑬.
9. Remove the planetary gears ⑭ and internal gear ⑮.

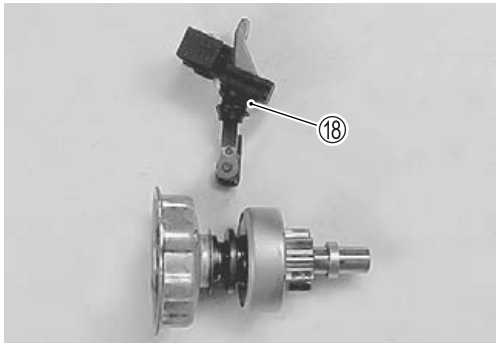




10. Remove the center bracket ⑯ (with shift lever ⑱, pinion ⑲ and pinion shaft ⑳) from front housing ⑰.



11. Remove the shift lever ⑱.

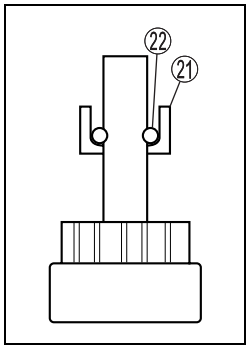


12. Push the pinion stopper ㉑ down, then remove stopper ring ㉒.
    Remove the pinion stopper and pinion ⑲.

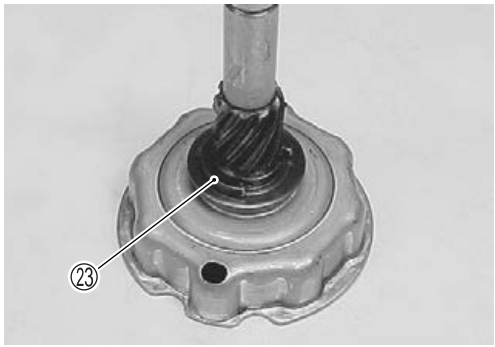
⚠ WARNING

Wear safety glasses when disassembling and assembling stopper ring.

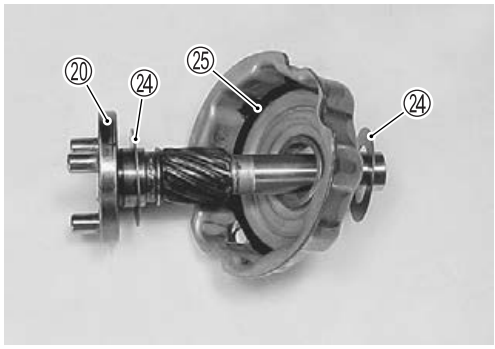
NOTE:
Using a screw-driver, pry off the stopper ring.



13. Remove the E-ring ㉓.

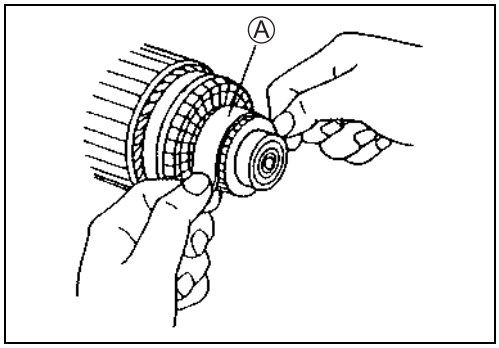


14. Remove the pinion shaft ⑳, washers ㉔ and rubber ring ㉕ from center bracket.



INSPECTION AND SERVICING
Armature and Commutator

- Inspect the commutator surface.
  If surface is gummy or dirty, clean with #500 grit emery paper Ⓐ.

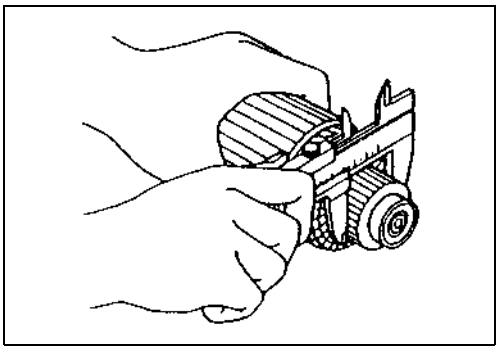


• Measure commutator outside diameter.

09900-20101: Vernier calipers

Commutator outside diameter:
Standard: 29.0 mm (1.14 in)
Service limit: 28.0 mm (1.10 in)

If measurement exceeds service limit, replace armature.

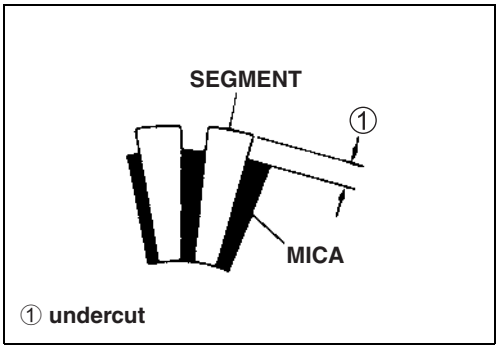


• Check that mica (insulator) between the segments is undercut to specified depth.

Commutator undercut ①:
Standard: 0.5 – 0.8 mm (0.02 – 0.03 in)
Service limit: 0.2 mm (0.01 in)

If measurement exceeds service limit, cut to specified depth.

NOTE:
Remove all particles of mica and metal using compressed air.



① **undercut**

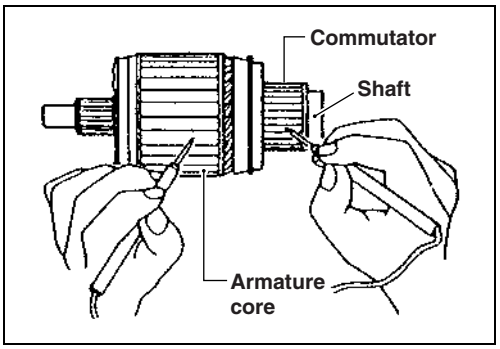
⚠ WARNING

Wear safety glasses when using compressed air.

• Check for continuity between the commutator and the armature core/shaft.
Replace armature if continuity is indicated.

09930-99320: Digital tester

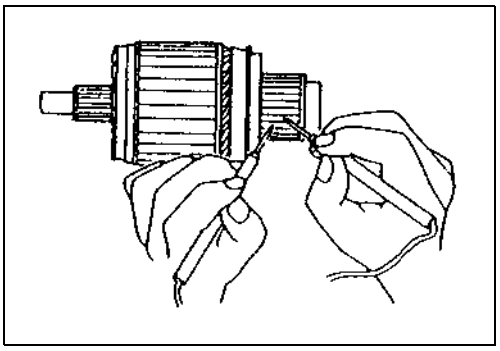
Tester range: (Continuity)



• Check for continuity between adjacent commutator segments.
Replace armature if no continuity is indicated.

09930-99320: Digital tester

Tester range: (Continuity)



BRUSHES

Check the length of each brush.

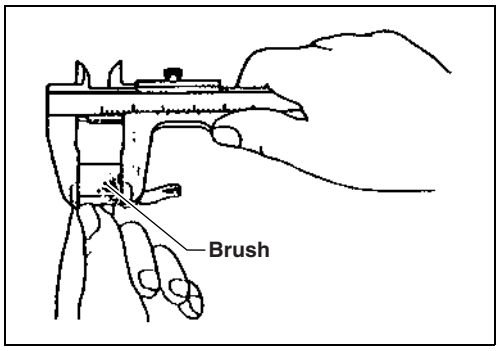
09900-20101: Vernier calipers

Brush length:

Standard: 15.5 mm (0.61 in)

Service limit: 9.5 mm (0.37 in)

If brushes are worn down to the service limit, they must be replaced.



BRUSH HOLDER

- Check brush holder continuity.

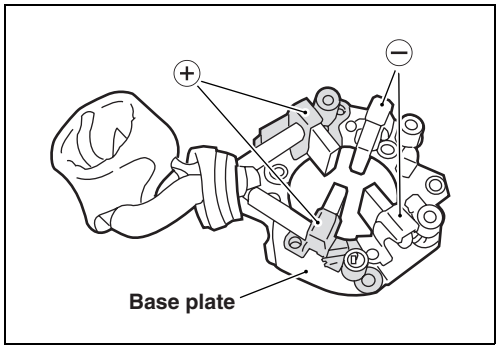
09930-99320: Digital tester

Tester range: (Continuity)

Brush holder continuity:

Tester probe connection	Continuity
Brush holder positive ⊕ to Brush holder negative ⊖	No
Brush holder positive ⊕ to Base plate (ground)	No

Replace brush holder if the tester doesn't show the above.



BRUSH SPRING

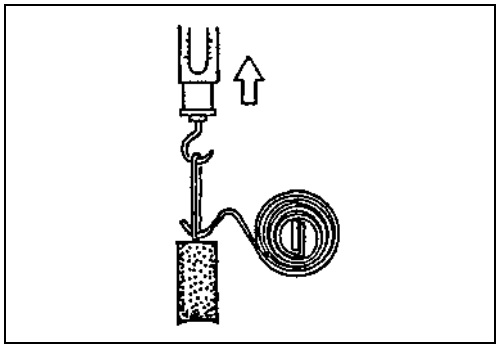
Inspect brush spring for wear, damage or other abnormal conditions.

Check the brush spring tension.

Replace if necessary.

Brush spring tension

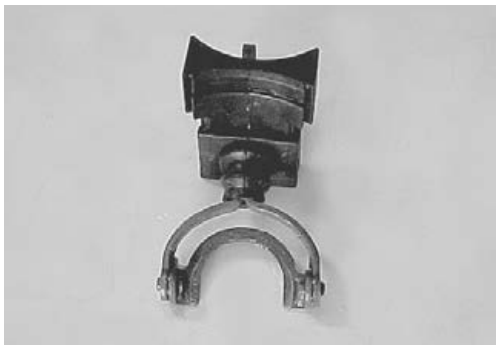
Standard: 15 – 18 N (1.5 – 1.8 kg, 3.3 – 4.0 lb)



SHIFT LEVER

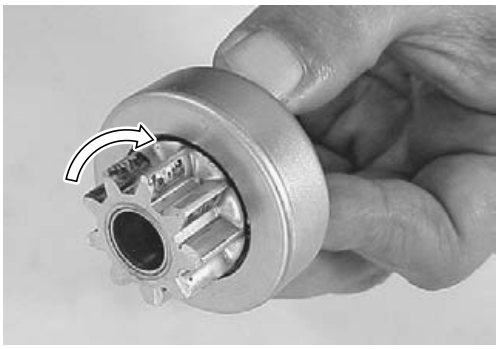
Inspect shift lever for wear.

Replace if necessary.



PINION AND OVER-RUNNING CLUTCH

- Inspect pinion for wear, damage or other abnormal conditions. Check that clutch locks up when turned in direction of drive and rotates smoothly in reverse direction.
  Replace if necessary.



- Inspect spline teeth for wear or other damage.
  Inspect pinion for smooth movement.
  Replace if necessary.

GEAR

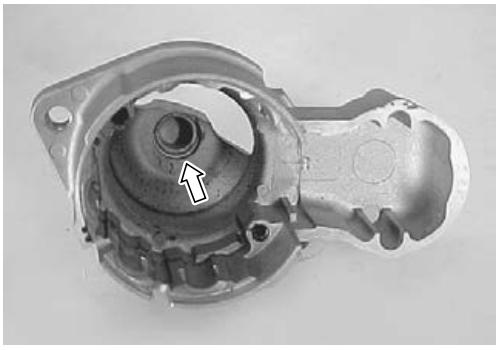
- Inspect planetary gears and internal gear for wear, damage or other abnormal conditions.
  Replace if necessary.

PINION SHAFT/PINION SHAFT BUSH

- Inspect pinion shaft for wear, damage or other abnormal conditions. Replace if necessary.
- Inspect pinion shaft bush for wear or other damage.
  Replace if necessary.

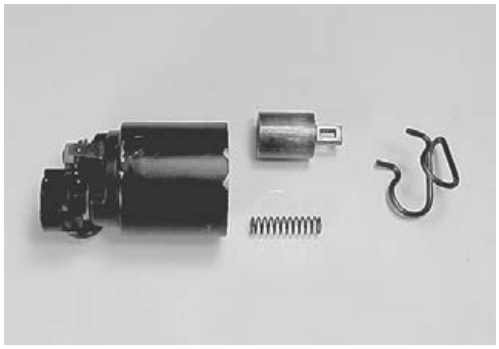
FRONT HOUSING

- Inspect front housing for wear, damage or other abnormal conditions. Replace if necessary.
- Inspect bush for wear or other damage.
  Replace if necessary.

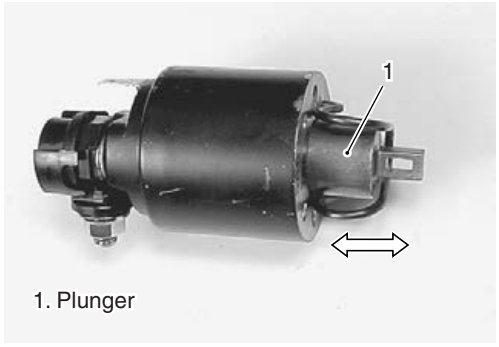


ARMATURE SHAFT BUSH
Inspect bush for wear or other damage.
Replace if necessary.

PLUNGER
Inspect plunger for wear or other damage.
Replace if necessary.



MAGNETIC SWITCH
Push in plunger and release. The plunger should return quickly to its original position.
Replace if necessary.



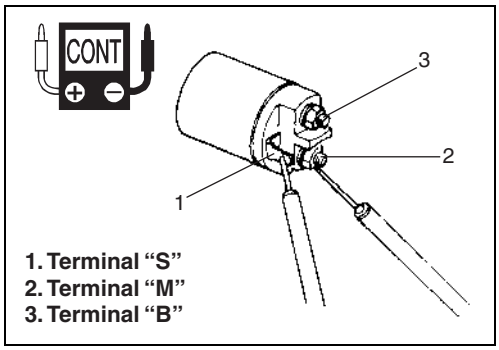
1. Plunger

Pull-in coil Open circuit Test

09930-99320: Digital tester

Tester range: (Continuity)

Check for continuity across magnetic switch “S” terminal and “M” terminal.
If no continuity exists, the coil is open and should be replaced.



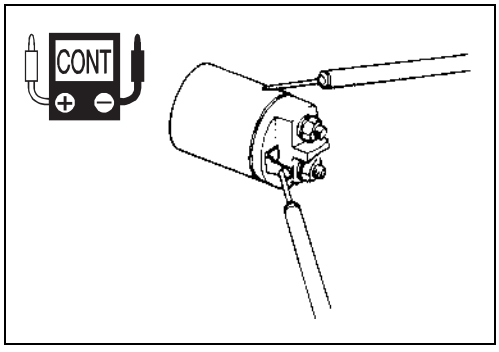
1. Terminal “S”
2. Terminal “M”
3. Terminal “B”

Hold-in coil Open circuit Test

09930-99320: Digital tester

Tester range: (Continuity)

Check for continuity across magnetic switch “S” terminal and coil case.
If no continuity exists, the coil is open and should be replaced.



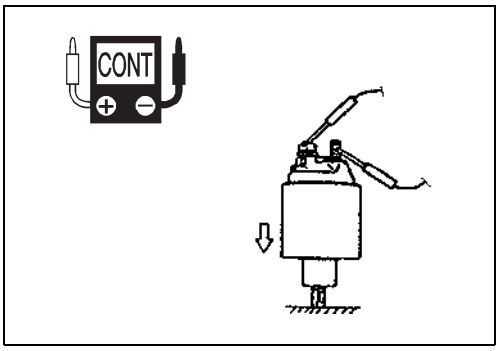
Contact points Test

09930-99320: Digital tester

Tester range: (Continuity)

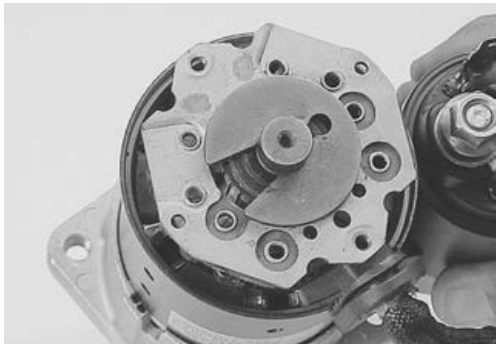
Put the plunger on the under side and then push the magnetic switch down. At this time, check for continuity between terminal “B” and terminal “M”.

Continuity indicates proper condition. If no continuity exists, replace the magnetic switch and/or plunger.



ASSEMBLY

Assembly is reverse order of disassembly with special attention to the following steps.

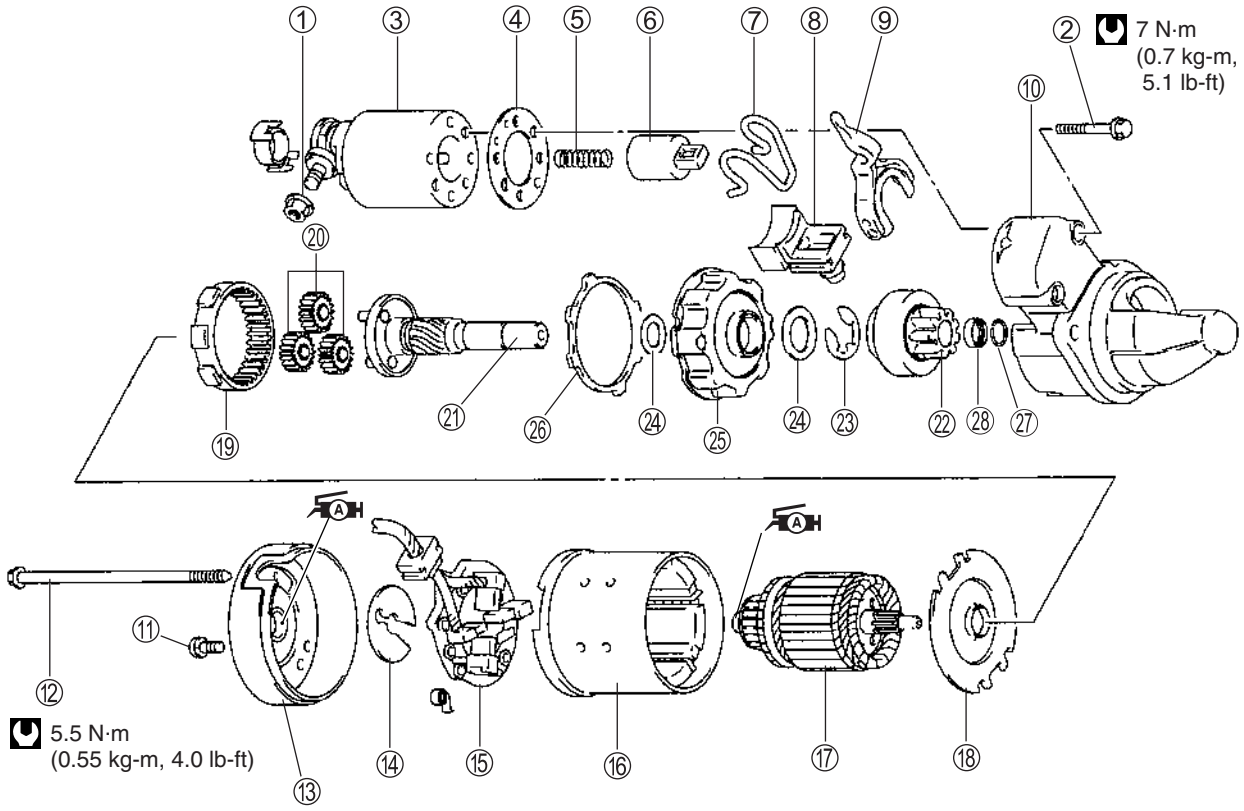


CAUTION

When installing armature, use care to avoid breaking brushes.

When installing pinion shift lever, refer to figure in construction diagram for installation direction.

Construction diagram



① Nut
② Bolt
③ Magnetic switch
④ Gasket
⑤ Spring
⑥ Plunger
⑦ Torsion spring
⑧ Rubber packing
⑨ Shift lever
⑩ Front housing
⑪ Screw
⑫ Through bolt
⑬ Rear cover
⑭ Thrust washer
⑮ Brush holder
⑯ Yoke
⑰ Armature
⑱ Center cover plate
⑲ Internal gear
⑳ Planetary gear
㉑ Pinion shaft
㉒ Pinion
㉓ E-ring
㉔ Washer
㉕ Center bracket
㉖ Rubber ring
㉗ Stopper ring
㉘ Pinion stopper

PERFORMANCE TEST

CAUTION

Each test must be performed within 3 – 5 seconds to avoid coil damage from overheating.

⚠ WARNING

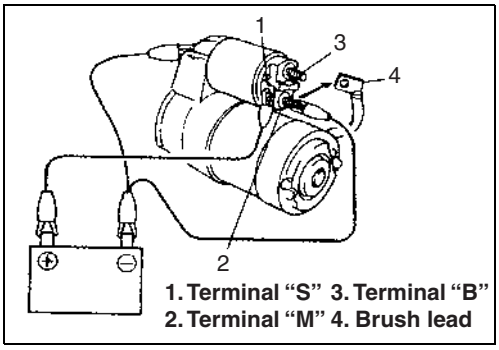
When performing the following test, be sure to connect the battery and the starting motor with a lead wire of the same size as original equipment used there.

PULL-IN/HOLD-IN TEST

Connect battery to magnetic switch as shown in figure.

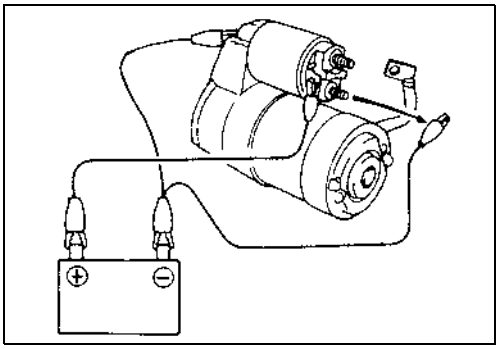
- Check that plunger and pinion (over-running clutch) move outward.
  If plunger and pinion don't move, replace magnetic switch.

NOTE:
Before testing, disconnect brush lead from terminal "M".



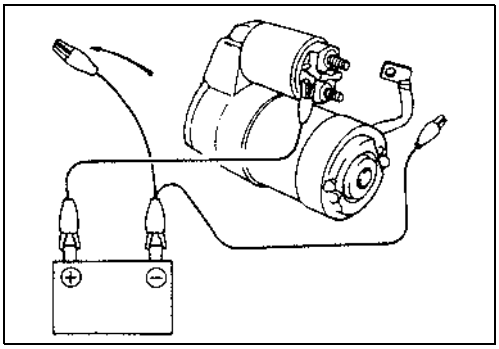
1. Terminal "S" 3. Terminal "B"
2. Terminal "M" 4. Brush lead

- While connected as above with plunger out, disconnect negative lead from terminal "M".
  Check that plunger and pinion remain out.
  If plunger and pinion return inward, replace magnetic switch.



PLUNGER AND PINION RETURN TEST

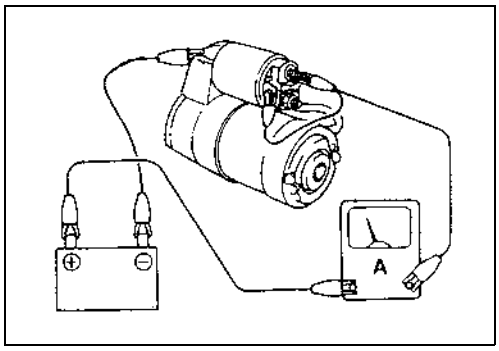
Disconnect negative lead from switch/motor body.
Check that plunger and pinion return inward.
If plunger and pinion don't return inward, replace magnetic switch.



NO-LOAD PERFORMANCE TEST

CAUTION

Before performing following test, secure the starter motor to the test bench.



1. Connect battery and ammeter to starter motor as shown.
2. Check that starter rotates smoothly and steadily with pinion moving out. Check that ammeter indicates specified current.

   No load current: Within 90 A at 11 V