

# OPERATION AND SERVICE MANUAL

## SECTION TITLE: ELECTRICAL

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### CIRCUITS AND CONTROLS

The electrical system is a negative grounded 12 volt system and contains a starter/generator, voltage regulator, starter solenoid, forward-neutral-reverse switch, ignitor, pulser coil, accelerator limit switch, "Neutral" limit switch, key switch, and ignition coil. The limit switches are devices to ensure that the electrical contacts are in a fully engaged position before becoming energized.

#### STARTER (Fig. L-1)

When starting the engine, the field coils are in series with the armature and the starter/generator operates as a motor. This circuit is controlled by a key switch, a fuse, an accelerator switch, a solenoid switch and a forward-neutral-reverse switch. With the key switch in the "ON" position and with either "forward or reverse" selected, battery current is available to the accelerator micro switch (5) which remains open until the accelerator pedal is depressed. When the pedal is depressed, the plunger on the switch (5) is released, the contacts close and the ignition circuit is energized. Battery current then energizes the starter solenoid which closes the contacts. Battery current then flows through the forward-neutral-reverse switch (12) and through the neutral limit switch (16) to the starter. The starter now functions as a motor to start the engine.

The engine can be stopped either by releasing the accelerator pedal to the full up position or by turning the key switch to the "OFF" position. When the accelerator pedal is released, the plunger on the accelerator limit switch (5) is depressed, the contacts open, and the ignition circuit is de-energized.

#### GENERATOR (Fig. L-1)

When the engine is running, current is generated. This current is used for charging the battery and for the ignition system. Generated output is controlled by the voltage regulator at 14.5 V to 15.5 V, without regard

to engine R.P.M. However, the charging current will vary depending on the condition of the battery. If the battery is fully charged, current is controlled at 3 to 5 amps.

### WIRING

**WARNING: BEFORE MAKING ANY TEST OF WIRING COMPONENTS, DISCONNECT THE BATTERY CABLES FROM THE BATTERY POSTS (SEE PROCEDURE IN SECTION B).**

Electrical tests of the wiring for continuity may be made with a "multi-tester" meter, available through E-Z-GO Service Parts or the nearest E-Z-GO distributor. Set the meter selector knob to the ohms scale and check continuity between each circuit component as indicated. Example: If the cutout switch is open or if there is a hidden break in the wiring, the meter will read infinity.

### TROUBLE-SHOOTING

#### I. Starter Fails To Operate - (Battery OK)

- A. Turn on the key switch.
- B. Place forward-neutral-reverse indicator in the forward position.
- C. Listen for an audible "click" of the solenoid switch while depressing the accelerator pedal.

1. If an audible "click" of the solenoid switch is heard:

Refer to the Testing Starting Circuit Procedure and check items 8 through 9.

2. If no audible "click" of the solenoid switch is heard:

Refer to the Testing Starting Circuit Procedure and check items 2 through 7 and 9.

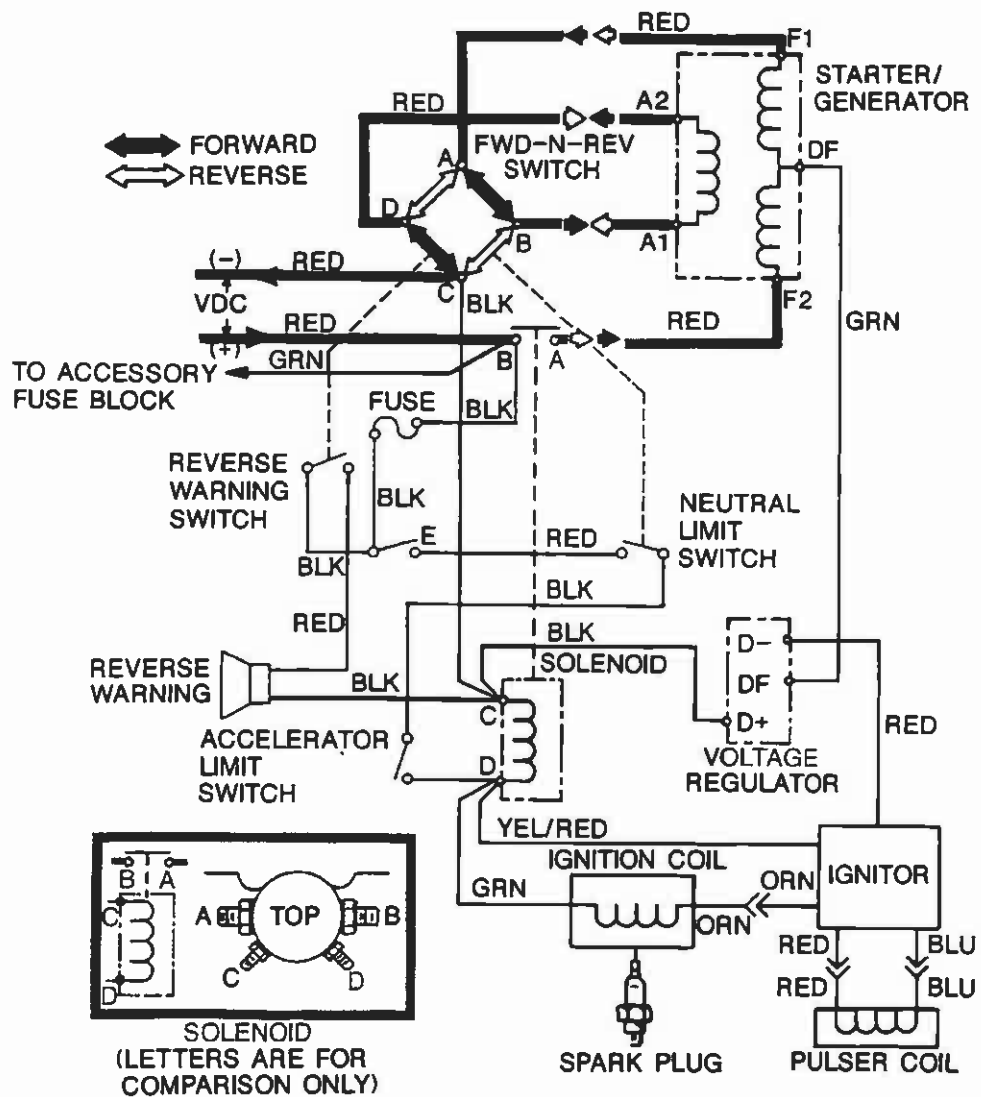
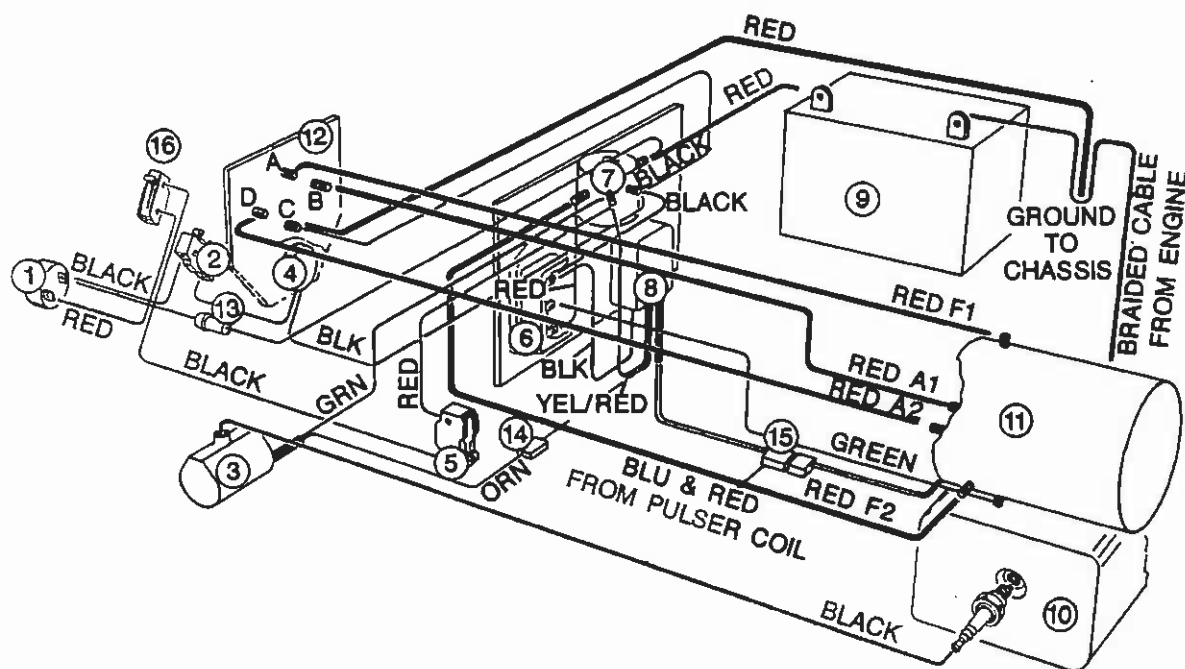


FIG. L-1a ELECTRICAL SYSTEM WIRING DIAGRAM



- |                            |                         |
|----------------------------|-------------------------|
| ① IGNITION SWITCH          | ⑫ FWD-N-REV SWITCH      |
| ② REVERSE WARNING SWITCH   | ⑬ IN-LINE FUSE          |
| ③ IGNITION COIL            | ⑭ CONNECTOR             |
| ④ REVERSE WARNING DEVICE   | ⑮ PULSOR COIL CONNECTOR |
| ⑤ ACCELERATOR LIMIT SWITCH | ⑯ NEUTRAL LIMIT SWITCH  |
| ⑥ VOLTAGE REGULATOR        |                         |
| ⑦ SOLENOID                 |                         |
| ⑧ IGNITOR UNIT             |                         |
| ⑨ 12 VOLT BATTERY          |                         |
| ⑩ STARTER/GENERATOR        |                         |
| ⑪ ENGINE                   |                         |

FIG. L-1b ELECTRICAL SYSTEM (PHYSICAL LOCATIONS)

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### II. Starter Weak or Hesitates - (Battery OK)

#### A. Starter system functions correctly.

1. Refer to the Testing Starting Circuit Procedure.
2. Check items 8 through 11.
3. Inspect the commutator (on armature) for cleanliness.

#### B. Charging system functions correctly.

1. Refer to the Testing Charging Circuit Procedure.
2. Check items I and II.

### TESTING IGNITION CIRCUIT

#### Tools Required

- V.O.M. Quantity 1

If the engine **will not** run but the starter will turn the engine.

1. Check for loose wires at the terminals and connections.
2. Check for an electrical discharge through the spark plug ignition wire as follows: Using a spark plug that is known to be good, place on a metal surface (muffler, cylinder, etc.), connect the spark plug wire and turn over the engine with the starter. Look for a blue electrical arc at the spark plug electrodes.
3. Replace the plug if necessary. Gap the spark plug .028" to .030".
4. If there is either a weak arc or no arc in Step 2, try a new spark plug, then check the spark plug ignition wire for loose terminals. Check the ignition wire by substituting it on another engine or using one that is known to be good.
5. Check the ignitor coil by temporarily attaching another one that is known to be good.

**NOTE:** It is not necessary to place in mounting bracket; just attach the wires. If the engine then operates, replace the old coil.

6. Check the ignitor by temporarily attaching another one that is known to be good.

**NOTE:** It is not necessary to mount the ignitor; just attach the wires.

If the engine then operates, replace the old ignitor.

7. Check the engine timing per the Timing Procedure.

### TESTING STARTING CIRCUIT

**WARNING: DISCONNECT BATTERY FOR STEPS 1 THROUGH 8 (SEE PROCEDURE IN SECTION B).**

If the engine will not turn over in either forward or reverse, check the following:

1. Check the battery for a voltage reading which should be between 12.4 and 14.0 volts. Inspect for loose or dirty battery post connections.
2. Check for a blown fuse and replace if necessary with a Buss AGC 25 amp fuse.
3. Check for loose wires at all terminal connections.
4. Check the complete electrical system for correct circuitry (See Fig. L-1).
5. Inspect for worn insulation and bare wires touching the frame. Bare wires will cause a short circuit.
6. Check for continuity through the key switch. Set volt-ohm meter on XI scale, place positive (+) probe on the terminal with the blue wire attached and negative (-) probe to the terminal with the black wire. The reading on the meter should be "0" ohms with the switch key in the "ON" position. If the meter does not register, replace the switch.

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7. Check continuity through the 'neutral' limit switch. Place a probe on terminal "E" of the ignition switch and the solenoid terminal with the red, green, and yellow/red wires attached. Place the forward-neutral-reverse switch in forward. If the ohmmeter shows "0" ohms the switch is good. If the meter does not register, check the wires from the key switch to the limit switch. If wires and connections are good the forward-neutral-reverse switch should be removed to check the engagement of the micro switch's actuating lever with the cam. If all checks are good, replace the neutral limit switch.
8. Check for continuity through the accelerator limit switch. Place a probe on terminal "E" (See Fig. L-1) of key switch and the other probe on the positive (+) terminal of the coil and depress the accelerator pedal. If the ohm meter shows "0" ohms, the switch is good. If the meter does not register, check the wires from the ignition switch to the accelerator limit switch, accelerator limit switch to the solenoid and from the solenoid to the coil. If wires and connections are good, install a jumper wire across the neutral limit switch that is activated by the forward-neutral-reverse switch arm. Repeat Step 7. If the meter does not register, replace the accelerator limit switch, if the meter registers, replace the neutral limit switch attached to the forward-neutral-reverse switch.
9. Check the electrical contacts in the forward-neutral-reverse switch for continuity. Set the volt-ohm meter on XI scale.
  - a. With the forward-neutral-reverse indicator in the forward position, place positive (+) probe on terminal "A" and the negative (-) probe on terminal "B"; the meter reading should be "0".
  - b. Place positive (+) probe on terminal "D" and the negative (-) on terminal "C"; the meter reading should be "0".
  - c. With forward-neutral-reverse indicator in the reverse position, place positive (+) probe on terminal "A" and the negative (-) probe on terminal "D"; the meter reading should be "0".
  - d. Place positive (+) probe on terminal "C" and the negative (-) probe on terminal "B"; the meter reading should be "0".
  - e. If 0 reading is not obtained in a-d, replace forward-neutral-reverse switch.
10. Check the starting solenoid operation. Turn the key switch to the "ON" position and the forward-neutral-reverse switch to the neutral position. Connect the battery.
  - a. Place the voltmeter positive (+) probe on terminal "A" of the solenoid (See Fig. L-1). Place the negative (-) probe on terminal "B". The voltmeter should indicate approximately 12 V.
  - b. Depress and hold the brake while depressing the accelerator pedal. The voltmeter will return to "0" voltage if the solenoid contacts are closed.
  - c. If "0" voltage is not indicated while the accelerator pedal is depressed, replace the solenoid.

### TESTING CHARGING CIRCUIT

1. If the battery charge is insufficient, check the following:
  - a. Check the battery voltage and inspect for loose or corroded terminal posts.
  - b. Check all terminals for proper and tight connections.
  - c. Check the charging voltage by the following method.
    1. Raise the vehicle (See procedures in Section B) such that both rear wheels are free to spin.
    2. Set the voltmeter on 50 V.D.C. Place the negative (-) probe on negative (-) post on battery and the positive (+) probe on positive post on the battery. Observe the battery voltage.

3. Start the engine and accelerate to governed speed.
4. Observe the meter for a reading between 14.5 V to 15.5 V.
5. If the voltage is above 15.5 volts, replace the regulator.
6. If no increase over battery voltage is observed, there is a malfunction in the charging circuit. If a low voltage is observed, check the following:
  - a. Check the voltage regulator for malfunction.
  - b. Start the engine and accelerate to governed speed.
  - c. A reading of 14.5 V to 15.5 V should be observed.
  - d. With the engine off, check between the ground strap and D-, D+, and DF terminals; the reading should be "0" ohms.

**NOTE:** Do not remove the cover from the voltage regulator. This unit is set and sealed by the manufacturer and is not adjustable. If a charging problem is traced to the regulator, it must be replaced with a new unit.

### **STARTER/GENERATOR (Fig. L-3)**

#### **Tools Required**

- 3/4" Wrench	Quantity 1
- 9/16" Wrench	Quantity 1
- 1/2" Wrench	Quantity 1
- Ratchet	Quantity 1
- 10 mm Wrench	Quantity 1
- 8 mm Wrench	Quantity 1

#### **Starter/Generator Removal (Fig. L-2)**

To remove the starter/generator for repair, proceed as follows: Disconnect battery cables (see procedure in Section B) from battery. Disconnect wires. Loosen the adjustment bolts and mounting bolts and remove the belt. Remove the adjusting bolts and mounting bolts and remove the starter/generator unit from the vehicle.

### **STARTER/GENERATOR DISASSEMBLY (Fig. L-3)**

To disassemble the starter/generator, proceed as follows. Remove the brush covers (1) by prying out with a screwdriver. Pull up on the brush springs and move to the side of brushes, slide the brushes out approximately 1/4" (Fig. L-4). Remove the through bolts (2) and the rear cover (3). Remove the frame and the field coils (4).

Remove the 5 mm screws from the brush holder and 6 mm nuts from A1, A2 terminals. Remove the brush holder. Hold the pulley and remove the pulley nut (5). After the pulley is removed, remove the screws (6) and remove the front cover. Remove the woodruff key (7) and spacer (8). Install a bearing adapter at the rear side of the bearing as shown in Fig. L-6. Using an automotive type 2 jaw puller, apply pressure to the armature shaft and pull the bearing off.

### **STARTER/GENERATOR INSPECTION AND REPAIR**

#### **Inspection**

Visually inspect the following:

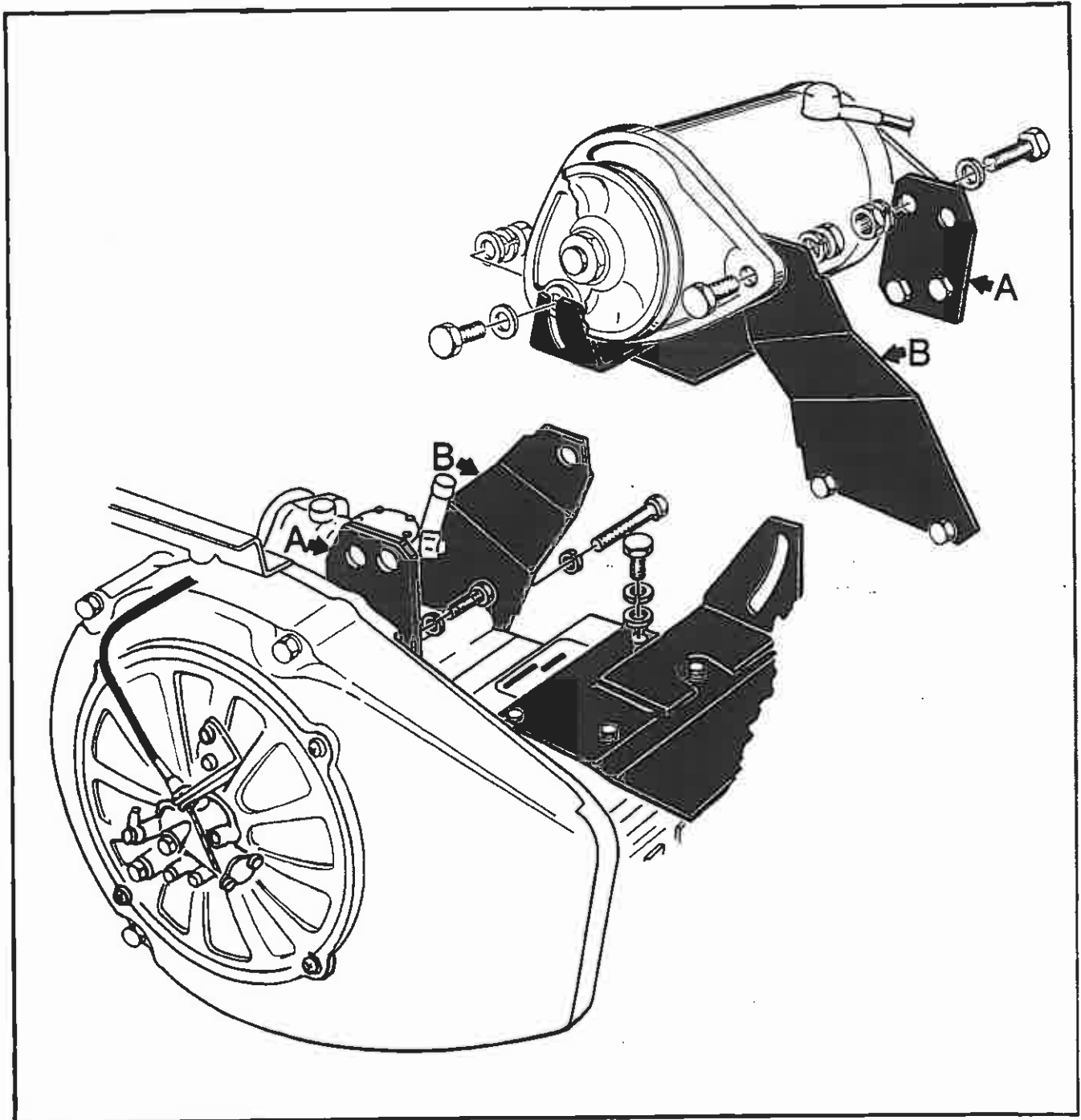
1. Inspect the outside face of the commutator for wear or damage.
2. Inspect the brush assembly for wear and damage to the brush holder insulators. Check the brushes for length and signs of carbonization.
3. Inspect the armature for distortion, broken wires, or carbonization.
4. Inspect the field coil insulators and lead wire.
5. Check the bearings for free rotation and lack of end play.

#### **Repair**

1. Commutator - Clean with a soft, clean cloth moistened with alcohol. If the commutator surface is rough, polish it with no. 500-600 emery cloth.
2. Replace any damaged or cracked brush holders or brushes worn to less than 11/16" in length.

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3. Test the insulation between the core and the commutator segments and between the commutator segments and shaft with a circuit tester. If continuity is indicated, the insulation is defective and the armature must be replaced.
4. Using a circuit tester, check the field coils for continuity between "F1" and "F2" and "DF" and "F1". If an open circuit exists, replace the field coils. Check for continuity between all four terminals and the frame (outer shell). If continuity is indicated, the field coils are grounding against the frame and the field coils must be replaced.



**FIG. L-2 STARTER/GENERATOR MOUNTING**