

### CHECKING THE ELECTRIC STARTER SYSTEM USING THE SUN VAT-26 TESTER

This bulletin gives instructions for trouble shooting the electric starting system as used on Electra-Glide and Servi-Car Models, using the Sun Vat 26 voltage-ampere tester.

The following chart shows common starting system troubles and the test procedure to use for getting at the cause.

TROUBLE	TEST PROCEDURE (Make tests in order given)
<p>Solenoid operates (clicks in) but starter cranks slowly or not at all.</p> <p>Possible Causes: (Other than mechanical - See Note *)</p> <p>Low Battery Defective Starter Motor Resistance in cranking circuit</p>	<p><u>Test</u></p> <ol style="list-style-type: none"><li>1. Battery Capacity Test.</li><li>2. Starter Motor Draw Test.</li><li>3. Starter Motor Free Running Test.</li><li>4. Starter Cable Circuit Test.</li><li>5. Starter Ground Circuit Test.</li></ol>
<p>Engine does not crank and solenoid does not operate.</p> <p>Possible Causes:</p> <p>Low Battery Defective Starter Motor Resistance in Cranking Circuit Resistance in Control Circuit Defective Solenoid Switch</p>	<p><u>Test</u></p> <ol style="list-style-type: none"><li>1. Battery Capacity Test</li><li>6. Solenoid Test.</li><li>7. Control Circuit Test.</li><li>2. Starter Motor Draw Test.</li><li>3. Starter Motor Free Running Test.</li><li>4. Starter Cable Circuit Test.</li><li>5. Starter Ground Circuit Test.</li></ol>

\* Note: Extremely cold temperatures and/or high oil viscosity, higher than normal compression ratios, tightness of engine or transmission, can cause excessive mechanical resistance. Before attributing slow cranking speed or failure to crank to the electric starting system, check by turning engine over with the kick starter or rear wheel to make sure engine turns freely.

A complete test of the starting system includes test of the battery, solenoid, starter and wiring.

### BATTERY AND STARTER TESTS

#### Test 1. Battery Capacity Test

Since the battery could be the single cause of trouble and since any tests of the starting system depend upon a good battery the first step in any starting system check is to test the battery.

Set VAT-26 tester controls and make connections as follows, see Figure 1.

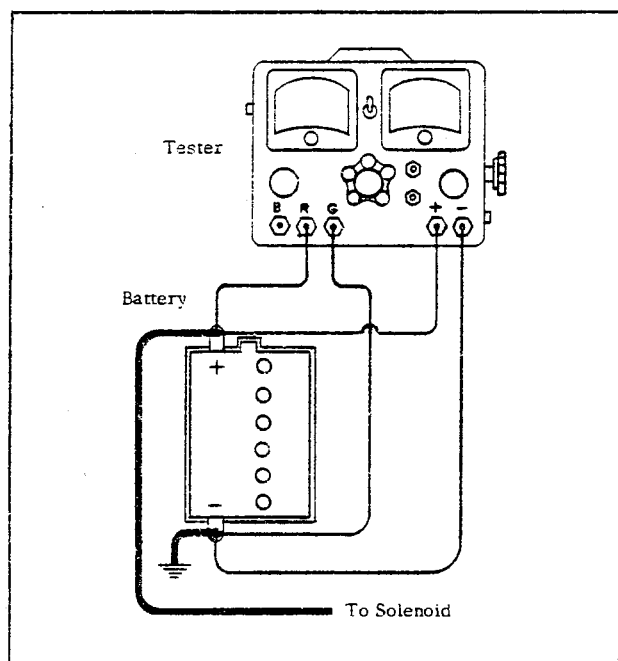


FIGURE 1

1. Turn tester load control knob left to direct position, ammeter selector toggle switch to 300A position, and voltage selector to 16 V. position.
2. Attach an alligator spring clip to spade terminal of Regulator lead "R" of tester and connect clip to battery positive terminal post.

3. Also connect Positive (+) volt-meter lead of tester to battery positive terminal post.
4. Connect Ground lead "G" of tester to battery negative terminal post.
5. Also connect Negative (-) volt-meter lead of tester to battery negative terminal post.
6. Turn load control knob clockwise until ammeter reading on 300A scale is equal to 3 times the Ampere-Hour rating of the battery as shown below.

Battery Part No. 66006-65 Electra-Glide

$32 \times 3 = 96$  Ampere Load

Battery Part No. 66009-64 Servi-Car

$53 \times 3 = 159$  Amperes Load

Caution: Do not exceed 160 amperes load with VAT 26 tester at any time.

7. Maintain load for 15 seconds, note final voltmeter reading, then turn control knob back to direct position.

If final voltmeter reading is 9.6 volts or higher, battery has a good output capacity. Test specific gravity and if necessary, recharge to obtain at least 75% charge (1.250 specific gravity) before placing battery in service.

If voltmeter reading is less than 9.6 volts after 15 second load test, battery output is unsatisfactory and it should be replaced with a good battery before making further tests.

Note: If battery is good and solenoid functions (clicks-in) but engine cranks slowly or not at all, proceed with next Test 2. If solenoid does not operate, skip to Test 6.

Test 2. Starter Motor Draw Test

Note: Battery must be in good condition and at least 75% charged (1.250 specific gravity). All wiring connections between battery and starter solenoid and motor must be clean and tight. Engine should be at room temperature.

1. Connect tester and set controls as in Test 1.
2. Disconnect ignition wires from spark plugs and operate starter to crank engine. Observe voltmeter reading and stop cranking engine.  
Caution: Do not crank engine longer than 15 seconds.
3. Turn load control knob clockwise until voltage reading is the same as it was in above Step 2 with the starter in operation. Now read ammeter on 300A scale, then turn control knob back to direct position.

This is the starting motor amperage draw and is equivalent to actual starter operation.

Normal starting draw should range between:

120 - 160 amperes

Engine cranking speed should be normal (approximately 400 R. P. M. ). There will be a normal variation between these ampere draw values depending upon mechanical resistance due to oil viscosity, newness of the engine, etc.

High Draw

An unusually high ampere draw often accompanied by slow cranking speed is usually an indication of trouble in the starter motor, providing the cranking load is normal. Possible causes include armature rubbing, tight shaft bearings and shorted circuits in motor. Test starter motor by making free running test under following Test 3. e.

Low Draw

An unusually low ampere draw with slow cranking speed is an indication of poor connections between battery, solenoid and motor, poor battery and motor ground, defective solenoid, poor motor brush or commutator condition, loose or high resistance connections in the field or armature circuits.

Test starter motor condition (brushes, commutator, windings, etc.) by making free running Test 3 following.

Test wiring connections, ground, and solenoid as outlined under heading "Cables and Control Circuit Tests."

Test 3. Starter Motor Free Running Test

1. Set tester controls as in preceding Test 1, and connect tester to starter motor as shown in Figure 2.

Turn load control knob clockwise to operate starting motor (without cranking engine) at voltage specified in following table. If a motor spins at a high R. P. M. and current draw is normal, the cranking motor is in good condition.

Caution: Operate motor only long enough to read meters since motor speed will be very high.

If current draw is considerably above or below specifications, motor should be repaired or replaced as outlined in service manual, Section 5L.

Motor	Set Volts	Amps	Minimum Speed
4 Pole Electra-Glide	8	40 to 50	12,000
2 Pole Servi-Car	8	20 to 30	10,000

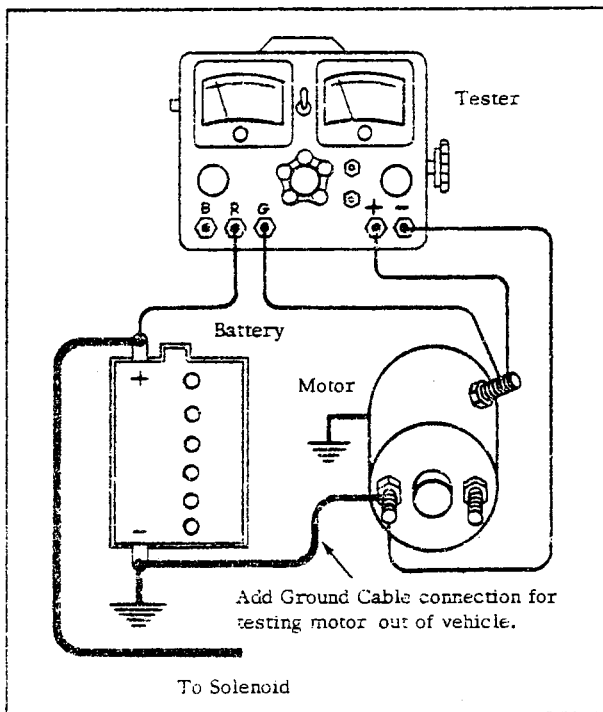


FIGURE 2

Note: Free running motor test can be made with starter motor out of vehicle, as a check on repairs, etc. Remove starter motor and clamp it in a bench vise and use same hookup, except add a ground cable between test battery negative post and starter motor frame. (See Figure 2.), then proceed to make test.

#### CABLES AND CONTROL CIRCUIT TESTS

The following tests are made using a voltmeter to determine if there is excessive resistance in the starting circuit.

##### Test 4. Starter Cable (motor-solenoid-battery) Circuit Test

1. Turn voltmeter selector switch to 16 V. position.
2. Connect test leads as shown in Figures 3 or 4 for model being tested.

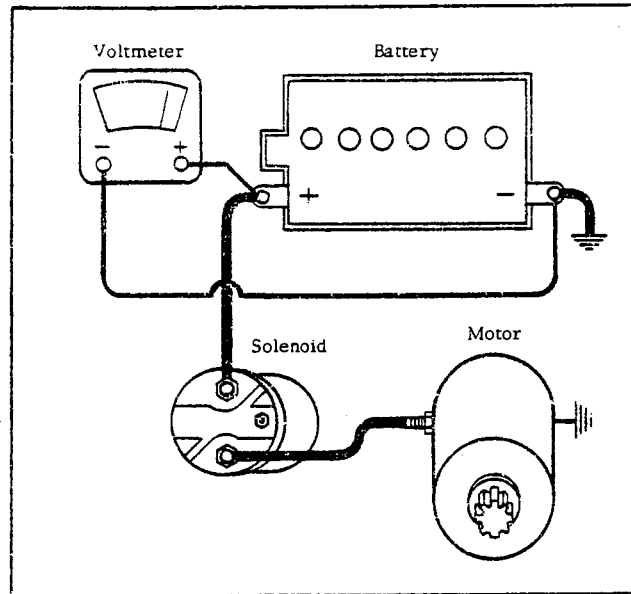


FIGURE 3 (ELECTRA-GLIDE)

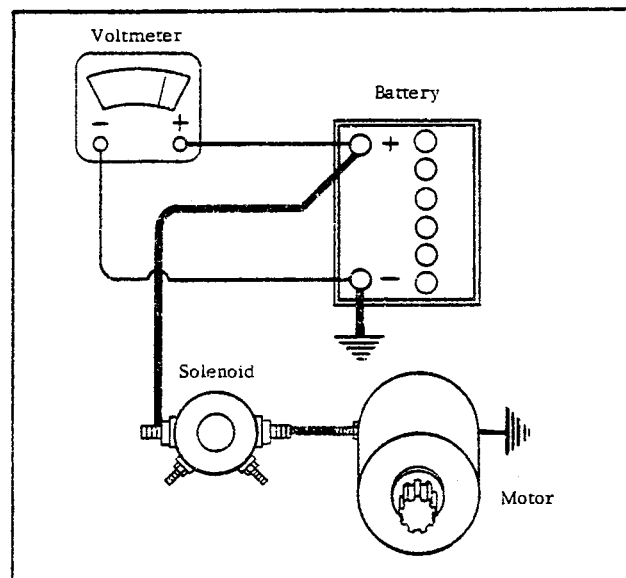


FIGURE 4 (SERVI-CAR)

3. Remove ignition wires from spark plugs, turn on ignition switch and with transmission in neutral, operate the starter by depressing starter button.
4. While cranking, observe voltmeter reading. (Battery voltage).

Caution: Do not operate starter for more than 15 seconds without stopping to allow starter motor to cool.

5. Repeat test with test leads connected as shown in Figures 5 or 6 (starter motor voltage).

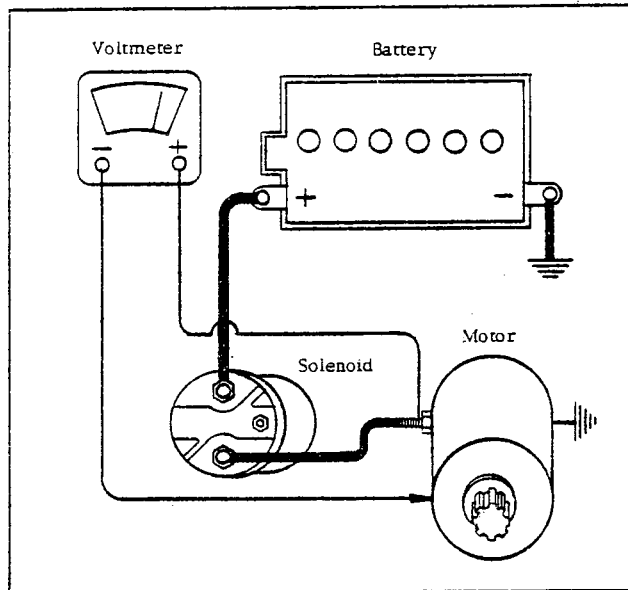


FIGURE 5 (ELECTRA-GLIDE)

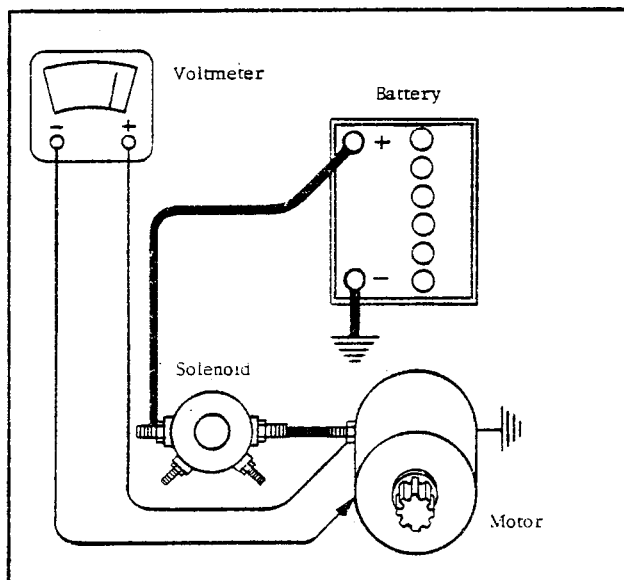


FIGURE 6 (SERVI-CAR)

If difference in voltmeter readings is more than .5 volts, high resistance is indicated in cables, solenoid switch or connections.

Example:

10.0	Volts	(Battery Voltage)
9.3	Volts	(Starter Motor Voltage)
<hr/>		
.7	Volts	(Difference) This voltage drop is excessive and should be corrected.

To find location, turn voltage selector switch to 4V. position and repeat test with voltmeter connected across each cable, connection and switch in turn, for example, across solenoid main contacts as shown in Figures 7 or 8.

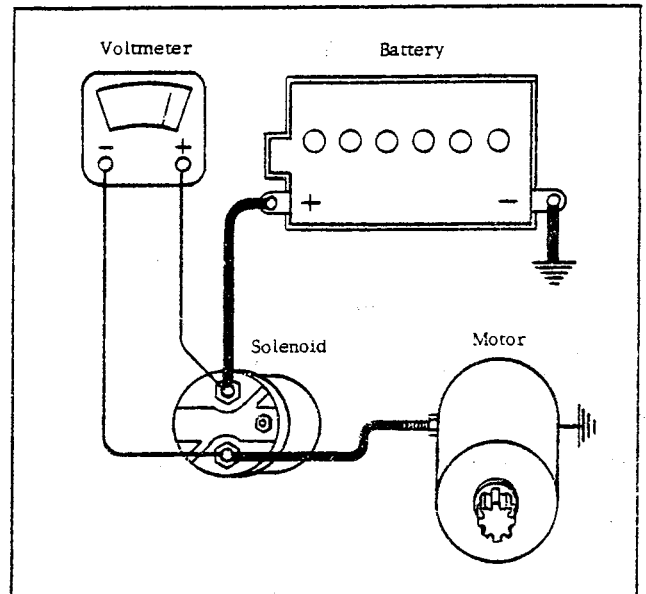


FIGURE 7 (ELECTRA-GLIDE)

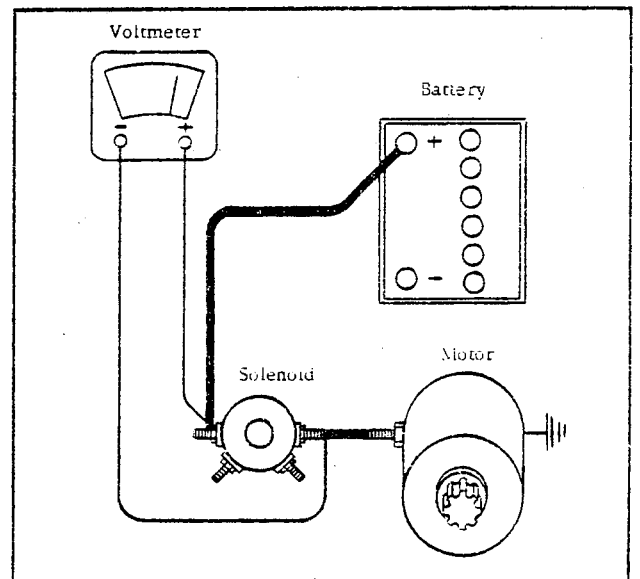


FIGURE 8 (SERVI-CAR)

Maximum voltmeter readings across various parts of the circuit should not exceed:

Each Cable	.2	volts
Each Connection	0	volt
Solenoid Switch	.1	volt

Test 5. Starter Ground Circuit Test

Use same procedure as for starter cables (Test 4) except use hookup as shown in Figures 9 or 10 for model being tested.

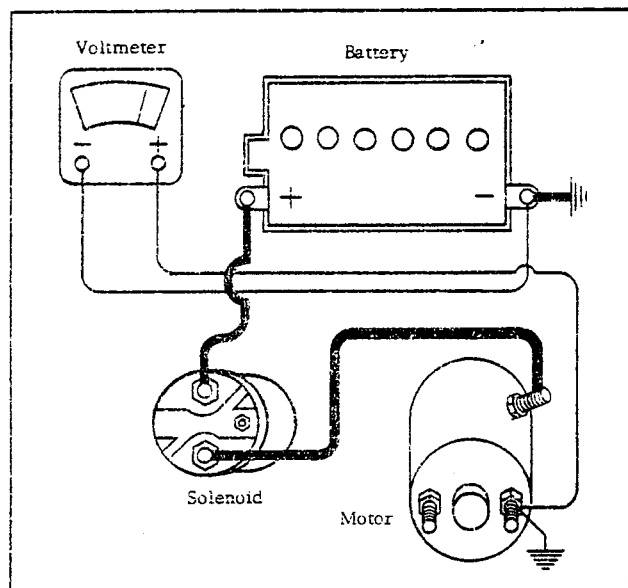


FIGURE 9 (ELECTRA-GLIDE)

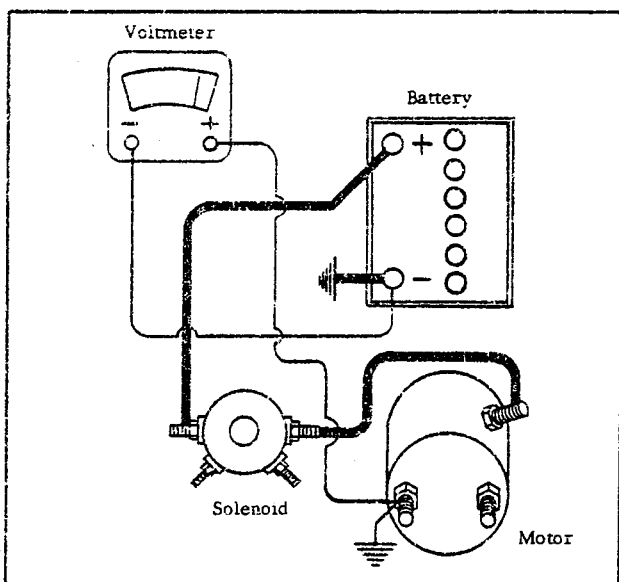


FIGURE 10 (SERVI-CAR)

A voltmeter reading higher than .1 or .2 volt is usually an indication of loose, dirty, or corroded connections, or a bad ground cable.

Test 6. Solenoid Coil Test

If the solenoid does not function, connect voltmeter at solenoid switch as shown in Figures 11 and 12. Use 16 V. position and attempt to operate the starter.

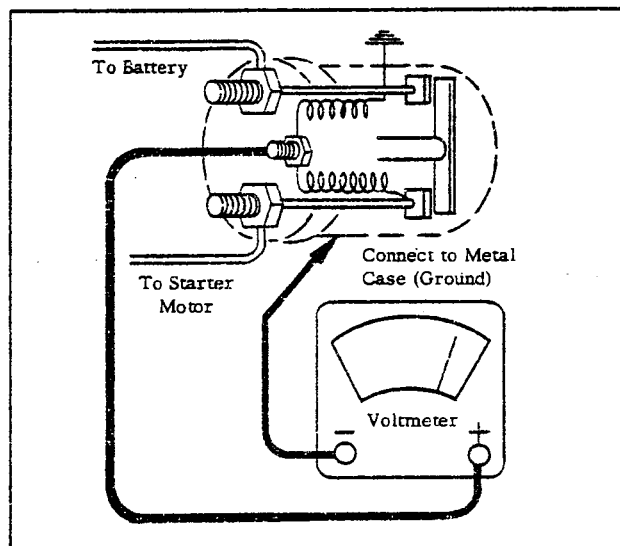


FIGURE 11 (ELECTRA-GLIDE)

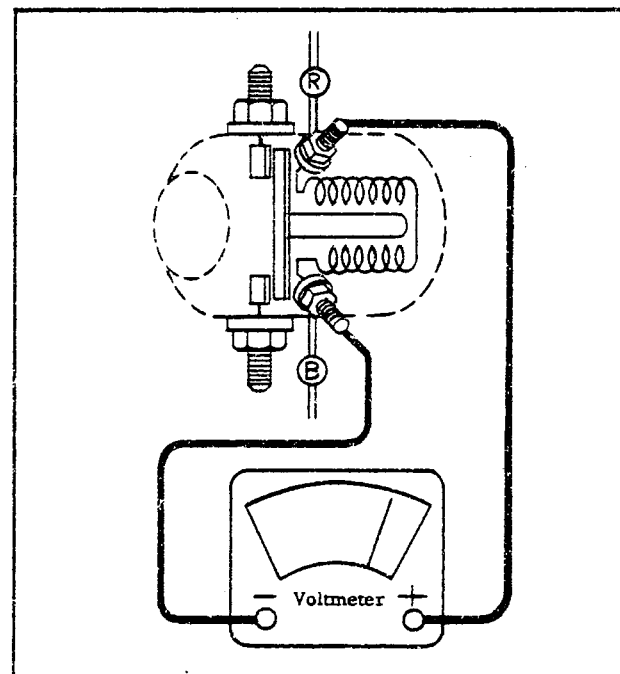


FIGURE 12 (SERVI-CAR)

If the magnetic switch does not feel warm, it should pull in or close whenever the voltage is 6 volts or more. If the unit is cool and will not operate at this or a higher voltage,

the magnetic switch is at fault and should be repaired or replaced.

If there is normal battery voltage, but less than 6 volts at the solenoid with motor cranking, check for excessive resistance in the control circuit. See Test 7.

### Test 7. Solenoid Control Circuit Tests

High resistance in the solenoid control circuit will reduce current flow through the solenoid windings causing it to function weakly or not at all. Weak action will cause the main contacts to burn, reducing current to the starter motor.

Use same procedure as for circuit Tests 4 and 5, except use hookups as shown in Figures 13 or 14 for model being tested. Note that test of Servi-Car control circuit is divided into two steps.

A voltmeter reading higher than 1.0 volt with motor cranking indicates excessive resistance. This could be caused by damaged wires or loose terminal connections at the solenoid, neutral switch, frame terminal board, instrument panel, fork terminal board or starter button. Good clean tight connections are necessary.

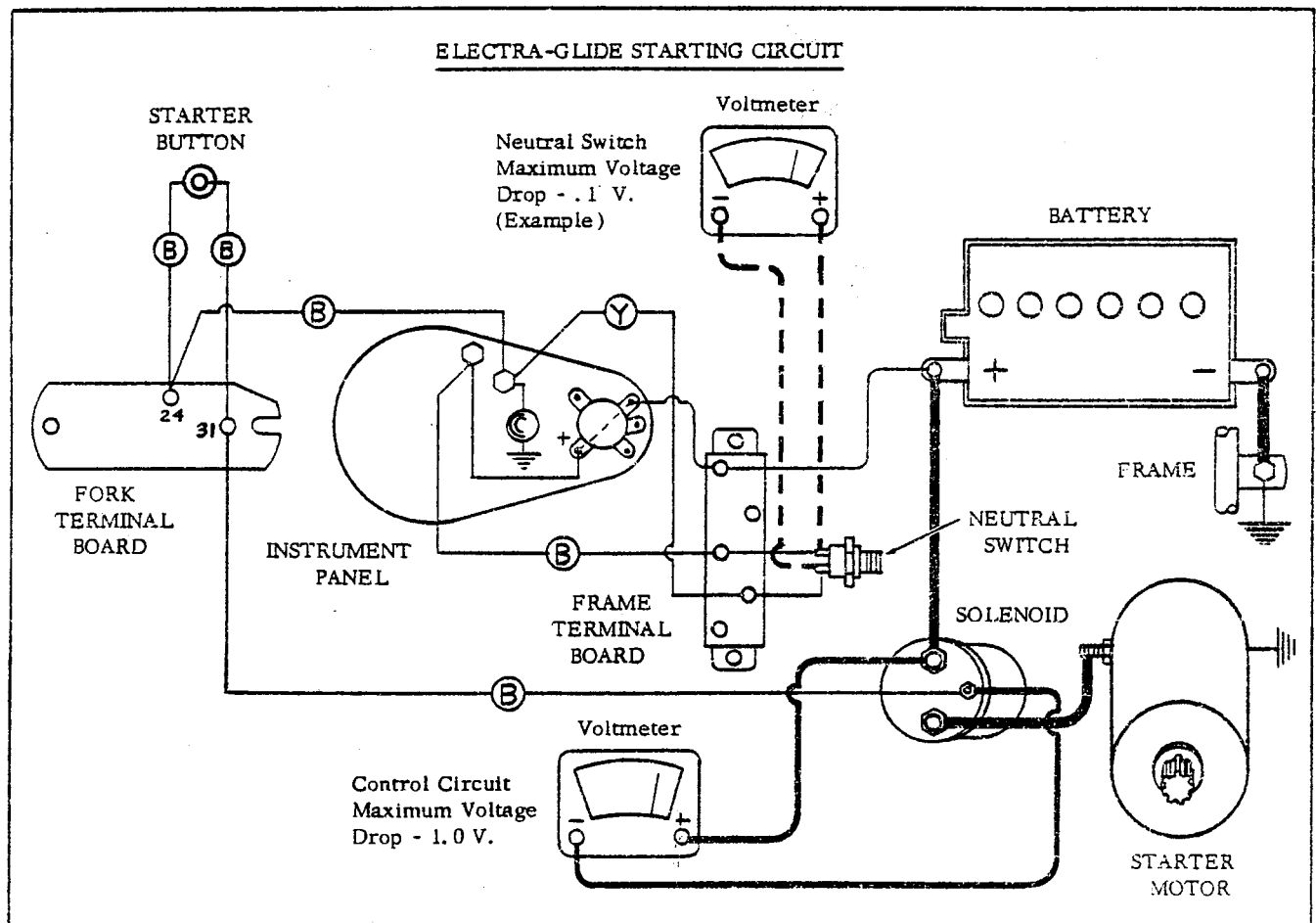


FIGURE 13 (ELECTRA-GLIDE)

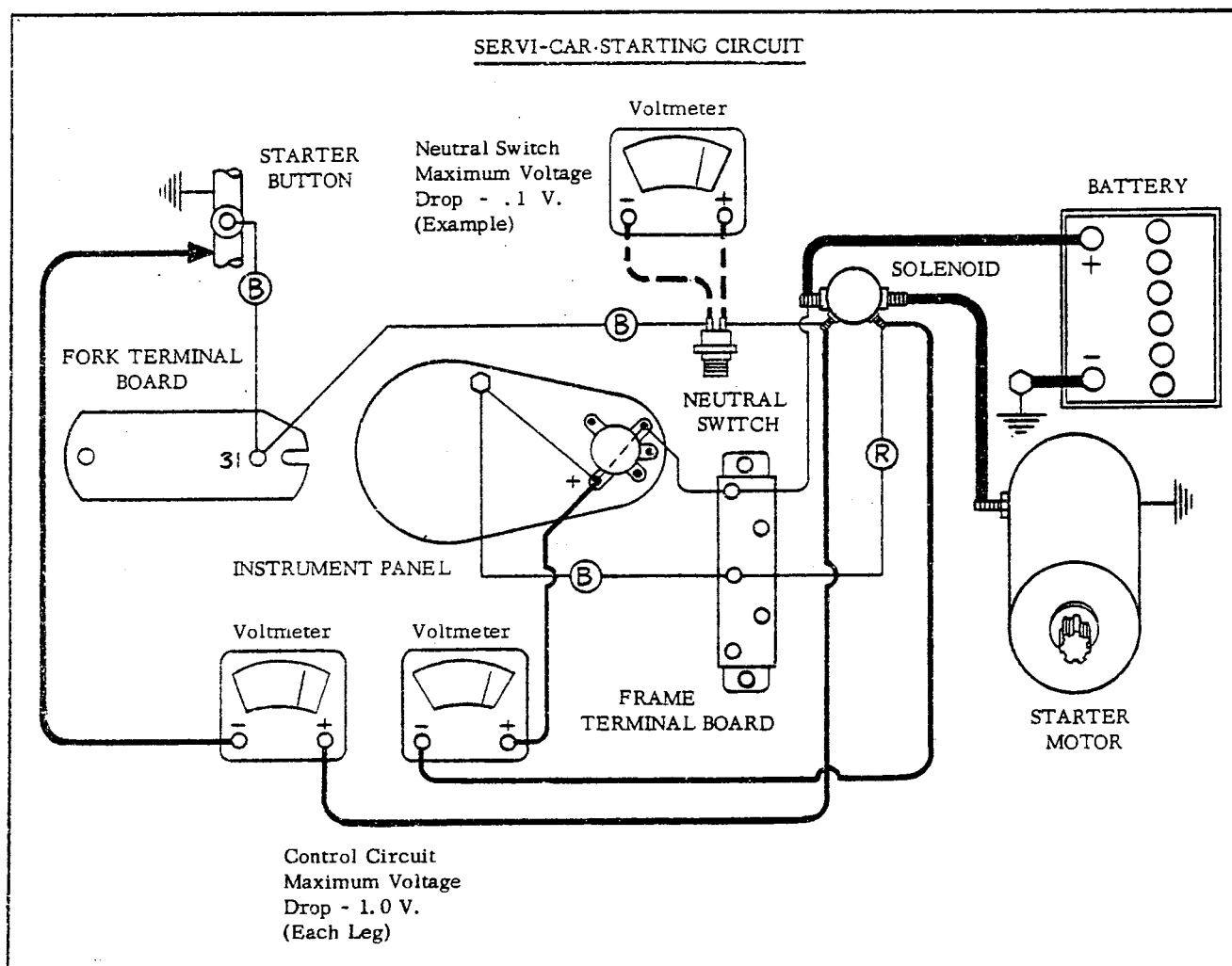


FIGURE 14 (SERVI-CAR)

To find location of trouble repeat test with voltmeter connected across each wire connection and switch in turn. A reading of more than .1 volt across any one wire,

terminal or switch is an indication of trouble. Example tests are also shown in Figures 13 and 14.

HARLEY-DAVIDSON MOTOR CO.