APPENDIX C
INSPECTING AND TESTING ELECTRICAL COMPONENTS

C-1. GENERAL.

C-1.1 This appendix contains general testing and inspection information pertaining to selected electrical components. Refer to ELECTRICAL SCHEM- ATICS in APPENDIX D and to TROUBLE SHOOTING AND TESTING in SECTION 4 when attempting to diagnose electrical system problems.

C-2. REPLACEMENT OF STARTER SOLENOID - Models 2160 and 2165.

Models 2130, 2135, 2140, 2145 and 2185 are equipped with a solenoid shift type starter. Refer to the appropriate Engine Service Manual for information regarding the solenoid on these models.

C-2.1 **General.** In many instances the solenoid is replaced unnecessarily when a starting problem is experienced. Simple testing can determine whether replacement is necessary.

C-2.2 **Solenoid Problems.** The following are solenoid problems that require replacement of the solenoid.

1. Solenoid is stuck; the starter remains engaged regardless of the ignition switch key position.
2. The coil wiring (inside solenoid) is bad; the solenoid will not function.
3. Bad leaf contactor (inside solenoid); solenoid clicks but starter motor does not turn.

C-2.3 Other Problems Which Can Appear To Be A Defective Solenoid.

1. Faulty ground
2. Defective safety switch
3. Discharged battery
4. Defective starter motor
5. Blown fuse
6. Defective ignition switch
7. Defective wire harness

C-2.4 **Testing The Starter Solenoid.** Refer to Section 4, Table 4-2, for electrical system testing procedures which will help to determine if the solenoid should be tested.

1. Remove the solenoid from the tractor.
2. Using an ohmmeter, test for continuity across the two large terminals. There should be **no** continuity.
3. Test for continuity between small coil terminal and the mounting plate. There should be continuity.
4. Using jumper leads, ground the mounting plate to the negative terminal of the battery and connect the small coil terminal to the battery's positive terminal. Re-test for continuity across the large terminals of the solenoid. Continuity should now be present.
5. The solenoid is functioning properly if these results are obtained.

C-3. REPLACEMENT OF THE PTO SWITCH AND REVERSE RELAY - All Models.

C-3.1 **General.** Unnecessary replacement of the PTO switch and/or the reverse relay should not be the first action taken to correct an electric PTO problem. Simple continuity tests can be conducted to determine their condition and whether replacement is necessary.

C-3.2 **Testing the PTO switch.** Refer to Figure C-1. Using an ohmmeter, check the terminals for proper continuity.

1. With the switch knob fully **depressed**, continuity should be present only between terminals 1 & 2 and terminals 5 & 7. **No** continuity should be present between terminals 3 & 4 and 6 & 7.

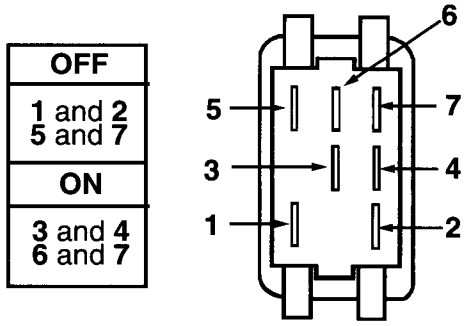

Figure C-1. PTO Switch Terminals.

2. Pull the switch knob to the fully **extended** position. Continuity should now be present between terminals 3 & 4 and terminals 6 & 7. There should be no continuity between terminals 1 & 2 and 5 & 7.

3. If these results are obtained, the switch is operating correctly and the problem is elsewhere in the system.

C-3.3 **Testing the Reverse Relay.** Refer to Figure C-2. The relay consists of two separate circuits: the activation coil circuit and the contact point circuit. Remove the relay and test as follows:

1. Test for continuity across the coil circuit (terminals 1and 2). If there is no continuity, replace the relay. Proceed to step 2 if continuity is present.

2. Using jumper leads, apply battery voltage to one terminal of the relay coil and ground the other terminal (you may hear the contact points close).

3. Test for continuity across the contact point terminals (terminals 3 and 5). No continuity indicates the contact points are not closing and the relay should be replaced. If continuity is present, proceed to step 4.

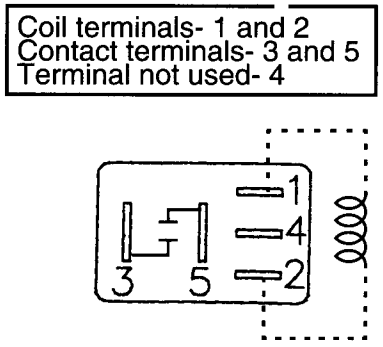

Figure C-2. Reverse Relay Terminals.

4. Remove either jumper lead from its coil terminal (1 or 2). Continuity should be broken across the contact points. If the circuit remains closed, the contact points are sticking and the relay should be replaced. If the circuit is broken, the relay is operating correctly and the problem is elsewhere in the PTO circuit.

C-4. REPLACEMENT OF THE BRAKE PEDAL INTERLOCK SWITCH - All Models.

C-4.1 **General.** The interlock switch consists of two separate switch circuits, one normally open and the other normally closed. Testing the continuity of the circuits can determine if the switch is functioning properly.

C-4.2 **Testing the Interlock Switch.** Refer to figures C-3 and C-4. Using an ohmmeter, check the switch terminals for proper continuity.

1. Touch the tester probes to the switch terminals in Position A as shown in Figure C-3.

   a. With the switch button extended (out) there should be no continuity between the terminals.

   b. Depress the button. The tester should now indicate continuity between the terminals.

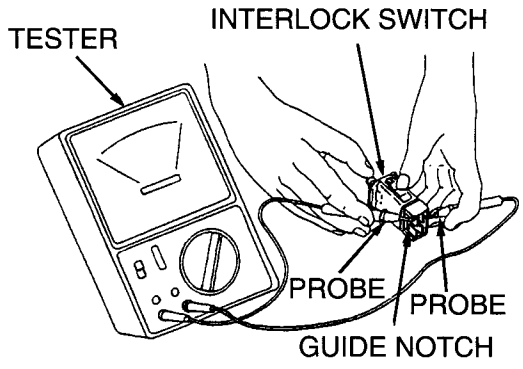

Figure C-3. Interlock Switch Terminals - Position A.

2. Touch the tester probes to the switch terminals in Position B as shown in Figure C-4.

   a. With the switch button extended (out), the tester should indicate continuity between the terminals.

   b. Depress the button. The tester should now indicate no continuity between the terminals.

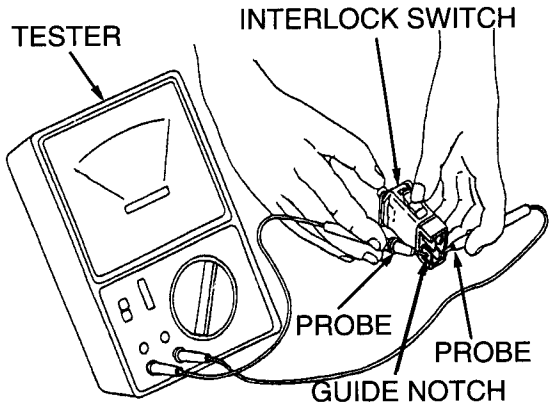

Figure C-4. Interlock Switch Terminals - Position B.

C-5. BATTERY INSPECTION AND TESTS.

C-5.1 A visual inspection cannot be expected to effectively substitute for an instrument check when diagnosing a battery problem or evaluating its condition. An inspection may, however, uncover tell-tale clues which can direct the service technician toward the selection of instrumentation which will most efficiently test a battery under a given set of conditions.

C-5.2 Where there is an indication that there is a need for further service, it is advisable that the technician check the installation date. (Length of service could be a factor — it would certainly be an aid in determining whether trouble is premature or the result of normal degeneration.)

C-5.3 **Common Causes of Battery Failure.**

1. Overcharging. Charging a battery greatly in excess of what is required is harmful in the following ways:

   a. Severely corrodes the positive plate grids, causing mechanical weakening and loss of electrical conduction.

   b. Evaporates the water of the electrolyte into hydrogen and oxygen gas, creating gas bubbles which tend to wash active material from the plates and carry moisture from the cells as a fine mist.

   c. Evaporation of water leaves the acid more consentrated. This concentrated acid is harmfull to cell components.

   d. Causes high internal heat, which accelerates the above mentioned corrosion of the positive plates and damages the separators and negative plates.

   e. Causes liquid expansion, forcing electrolyte from the cells and causing corrosion and damage to external parts.

2. Undercharging. Operating with an insufficient charge can cause sulfating of the plates, which may result in buckling of the plates. Especially if subjected to a prolonged overcharging.

3. Lack of water. The plates cannot take full part in the battery action unless they are completely covered by the electrolyte.

C-5.4 **Visual Inspection.** The following are items which may be checked visually for symptons of trouble in-the-making:

WARNING

Battery cables must be disconnected in proper order to avoid arcing. When disconnecting the cables from the battery, ALWAYS remove the negative cable first, and then remove the positive cable.

WARNING

Battery electrolyte is diluted sulfuric acid. Use extreme care to avoid spilling and to avoid contact with the skin and eyes. Acid can destroy clothing and burn your skin.

1. Battery date coding.

2. The condition of the battery case and its individual cell covers.

3. The top surface of the cover for acid accumulation.

4. The color and odor of the electrolyte in the battery.

5. A gassing condition when the charging circuit is operating.
6. The condition and size of the cables.
7. Corrosive deposits.
8. All surfaces of the battery for any indications of abuse.
9. Missing vent plugs.
10. The level of the battery's electrolyte.

C-5.5 **Condition of the Case and Cover.** Check for cracks or buckling which could result from one of the following:

1. Hold-down attachment too loose, causing vibration damage.
2. Excessive temperatures in the engine compartment, or internally, due to a high charging rate.
3. Freezing of the electrolyte, due to undercharging of the battery (a battery with a 3/4 state of charge is in no danger of freezing).
4. Prolonged overcharging which could cause severe buckling and warping of the battery plates, especially after operating in an undercharged condition over a long period of time.

C-5.6 **Evidence of Acid on the Cover.** If acid deposits are noted on the cover, it is quite possible that leakage, spillover, or gassing due to a high charging rate is a contributing cause. (A voltmeter check will determine whether leakage is taking place.) If these conditions are not serviced, they can result in an increase in the rate of self-discharge.

C-5.7 **Color and Odor of the Electrolyte.** Separately or in combination, discoloration of the normally clear electrolyte and/or the presence of an odor similar to that of rotten eggs suggests one or more of the following:

1. The existence of an excessively high charging rate.
2. The adverse affects of deep cycling.
3. The presence of impurities in the electrolyte solution.
4. An aged battery which is approaching the end of its useful life.

C-5.8 **Electrolyte Level.** Battery capacity is reduced in direct proportion to the amount of active material that is exposed to the air.

WARNING

NEVER use **ACID** to refill the battery.

1. If inspection reveals a low supply, pure water should be added to bring the electrolyte to the proper level. Most batteries will have an electrolyte level indicator near the base of the filler opening. For batteries which do not have a level indicator, add water to restore the level to 1/4 to 1/2 inch above the top of the plates. Never add acid to restore the electrolyte level. This would disrupt the predetermined sulfuric acid to water ratio and cause destruction of the plate separators.
2. The need to add excessive amounts of water suggests the need to check and possibly replace the voltage regulator.

C-5.9 **Signs of Abuse.** Surface indications of abuse to the battery are a clue to the cause of some troubles. Check the battery posts for damage which may be the result of the following:

1. Hammering.
2. Striking tools or wires across the terminals.
3. Stretching short cables on applications where longer lengths are required.
4. Improper removal of the cables.
5. Improper connection of booster or charging equipment.

C-5.10 **Testing the Battery With a Hydrometer.**

1. Raise the hood.
2. Remove the battery cell caps.
3. Make sure the electrolyte level in each cell is high enough to withdraw the proper amount of liquid into the hydrometer barrel
   a. Do not take readings immediately after adding water.

b. In the event the electrolyte level is too low to test with the hydrometer, add water and charge before testing.

c. A correct specific gravity reading can be measured only when the electrolyte temperature is 80°F. If the electrolyte varies from this temperature, compensation must be made in the reading by adding four gravity points (.004) for each 10° above or subtracting .004 for each 10° below 80°F.

4. With the bulb squeezed tightly by thumb pressure, insert the hydrometer pick-up tube into the cell.

5. Slowly release the thumb pressure until the bulb is fully expanded and the float is suspended freely in the barrel.

   a. Always hold the barrel vertically to prevent the float from binding or sticking to the sides

   b. The float assembly should not touch the top or bottom stoppers of the barrel.

   c. Periodically wash the barrel and float assembly with soap and water and inspect the float for leaks.

6. Holding the hydrometer with the liquid at eye level, read the float scale and record the specific gravity reading.

7. Repeat this procedure (steps 4 through 6) for each cell in the battery.

8. When all cells are tested, if the specific gravity between the highest and lowest cell varies 50 points (.050) or more the battery is no longer serviceable.

9. If there is less than a 50 point variation, but the reading of one or more cells is below 1.250, recharge the battery.

10. If unable to bring the specific gravity of any one cell up to 1.250 after charging, the battery is no longer servicable.