

SAFETY INTERLOCK SYSTEMS

3-1. GENERAL.

- 3-1.1 There are two basic electric wiring systems used: one for battery start models and one for recoil start models. All safety systems used are based on the same principle.
- 3-1.2 Most riders and tractors produced in 1982 were equipped with a reverse safety switch. This safety system required the cutting deck to be disengaged before the unit can be shifted into reverse gear. These systems will be used on all current production units.
- 3-1.3 The lift and disengagement lever is used to raise and lower the cutting deck which determines the cutting height. Pulling it all the way back and locking it disengages the blades. The lift and disengagement lever **MUST** be in the disengaged position when starting the engine, when shifting into reverse or if the operator leaves the seat.
- 3-1.4 All lawn and garden tractors produced after July, 1987 were requested by ANSI (American National Standards Institute) to have an operator present as an added safety feature. If the operator leaves the seat with the blades or PTO engaged, the engine will shut off. This seat switch is a safety device, designed for your protection. See Figure 3-1.



WARNING

NEVER attempt to bypass this operation.

- 3-1.5 In mid 1986, safety switches were added to most lawn and garden tractors, internally mounted in the seat.
- 3-1.6 On 1988 production, the location and type of safety switch was changed on most front engine lawn tractors. It was mounted on the seat bracket under the seat and it will shut off the engine with the deck engaged, with less than 40 lbs. of weight on the safety seat.
- 3-1.7 The 1990 riders and tractors have incorporated a new seat safety switch. The operator must engage the parking brake before leaving seat or unit will stall out. This new switch will also be present on riders and tractors with electric PTO's.

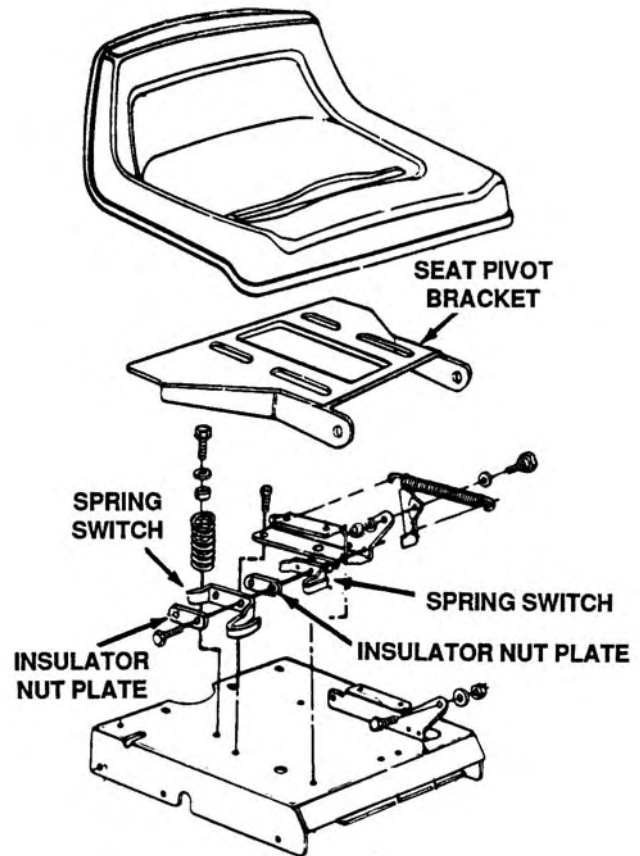


Figure 3-1.

- 3-1.8 For further information regarding this section, refer to the Technical Service Video "Safety Interlock Systems."



WARNING

At no time should the safety interlock system be bypassed for consumer's operation or convenience.



NOTE

The safety interlock system for 1991 has some changes that may or may not retrofit prior production units.

3-2 600 Series Rider Only.

1. The PTO safety switch mounting bracket was changed for added support to 14 gauge steel. This will retrofit 1990 production units. See Figure 3-2.

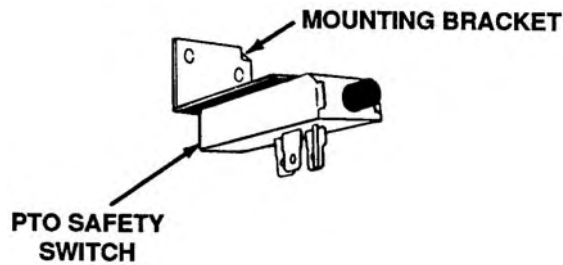


Figure 3-2. Mounting Bracket.

2. The standard battery used in the 600 series is 725-0514 (125 cold cranking amps). This battery can now be replaced by part number 725-1430 (275 cold cranking amps) by removing the battery spring retainer to allow clearance for the larger battery. This will not retrofit prior production units. See Figure 3-3.

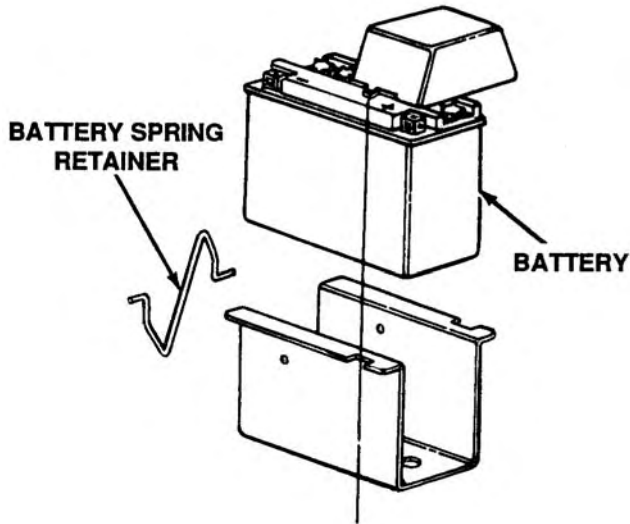


Figure 3-3. Battery With Spring Retainer.

3. Attach the steering wheel and indicator light panel as follows:
 - a. Place the indicator wires through the steering bellows and place the bellows over the steering shaft.
 - b. Place the five wires through the slotted hole located towards the center of the steering wheel hub. With the front wheels positioned straight forward, place the steering wheel over the steering shaft. Secure with the cupped washer and lock nut provided in the screwpack. See Figure 3-4.

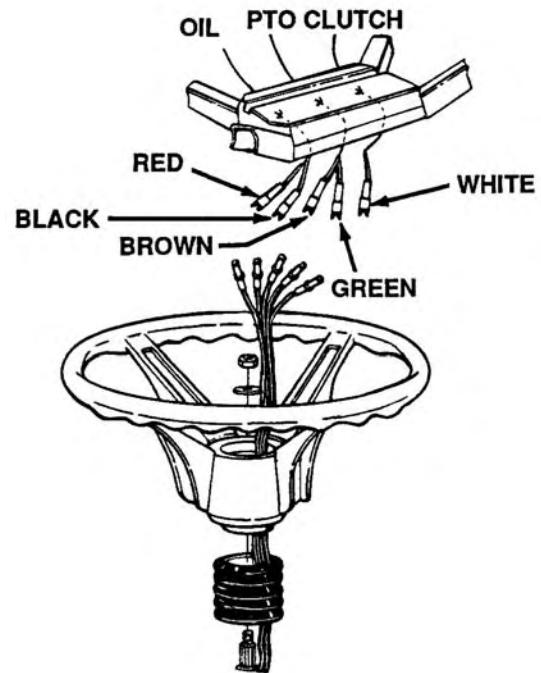


Figure 3-4. Steering Wheel.

NOTE

The indicator wires should be positioned at the bottom of the steering wheel (6 o'clock position).

4. Place the indicator wires through the cable tie located on the bottom side of the steering wheel insert. Connect the wires to the corresponding wires in the steering wheel insert. Tighten the cable tie on the insert to securely hold the wires in position.
5. Snap the steering wheel insert over the four spokes making sure the indicator lights are positioned towards the bottom.
6. Tighten the special cable tie in such a manner so the cable tie can slide up and down the wire harness which goes through the dash panel. (Slide the cable tie up until it rests against the hole on the inside of the dash panel.)
7. Turn the steering wheel fully in both directions. Pull the wires down from the dash and slide the cable tie down an additional 1/4 inch and tighten the cable tie securely. While doing this procedure the cable tie will automatically position itself on the harness to prevent damage to the wires during normal operation.



CAUTION

Do not cut off excess cable tie. The excess end will help keep the harness from being drawn up into the steering wheel and causing serious damage to the wires.

3-2.1 All Riders and Tractors.

1. The clutch safety switch has a retainer bracket for added support. This will retrofit 1990 production units. See Figure 3-5.

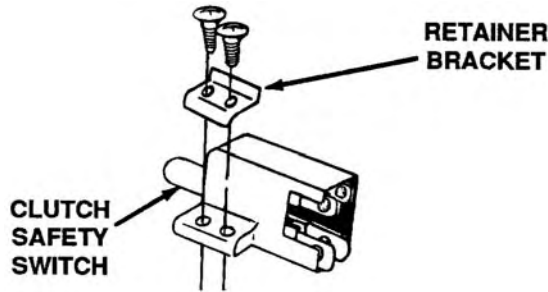


Figure 3-5. Retainer Bracket.



NOTE

If the clutch safety switch (part number 725-3169A) is ordered, it will NOT come with the retainer bracket or screws. To retrofit to a pre 1991 production unit, it is necessary to order the retaining bracket (part number 179162) and two screws (part number 710-0351).

2. The seat safety switch insulator nut plates have been redesigned to reduce the chances of a direct short. This will retrofit 1990 production units. See Figure 3-6.

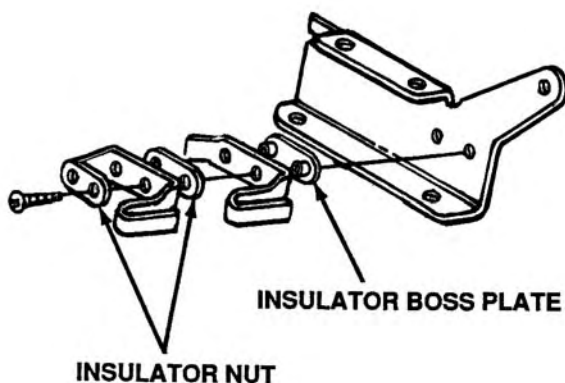


Figure 3-6. Safety Switch Insulator Nut Plates.



NOTE

This boss plate goes all the way through the two spring switches and will reduce the

chances of a short. This also will retrofit prior production unit

- 3-2.2 600, 700 and 800 Series Only. The circuit breaker is being replaced by a standard automotive type fuse. Nonregulated electrical systems will use a 7-1/2 amp fuse. On regulated electrical systems, a 20 amp fuse will be used. This will not retrofit prior production units. See Figure 3-7.

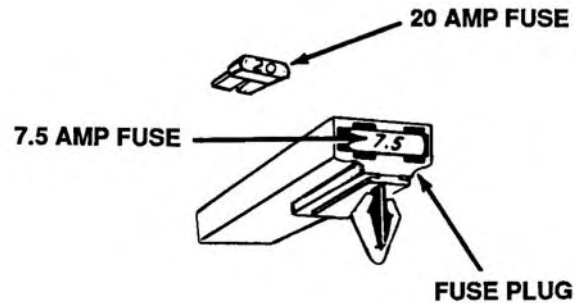


Figure 3-7. Fuse Holder.



NOTE

Although this will not retrofit our prior production units, there are, however, two separate fuses: the 7.5 amp fuse for a standard dual circuit alternating system and the 20 amp fuse for a regulated system.

3-3. ELECTRIC START SYSTEM.

- 3-3.1 Before the engine will crank, the key must be turned on and both of the safety switches must be activated. One is activated when the clutch is depressed and one is activated when the blade is disengaged. When this happens the circuit will be complete between the battery and the coil primary of the solenoid. This will close the solenoid which will allow the starter motor to crank the engine. The safety switches are wired in series on the electric start models. See Figure 3-8.

- 3-3.2 Testing the Interlock System on the Electric Start System.

1. Starting instructions:
 - a. Disengaged the blade or PTO.
 - b. Depress the clutch pedal.
 - c. Set the throttle (and choke if separate).

- d. Turn the ignition key to the START position.

NOTE

If the engine does not crank, use the following procedure to check out the system. If the engine cranks but does not start, the problem is not with the interlock system. Engaging of the blade and the depressing of the clutch depresses the black plunger a minimum of 1/8 inch.

3. Check the fuse or circuit breaker between the positive terminal of the battery and the ignition switch. If the fuse or circuit breaker is blown the engine will not crank.
4. Check the following terminal to see that the wires are in place.
 - a. The positive terminal of the battery. A large and a small wire should be fastened securely to this terminal. On some units both wires are cast into one clamp.
 - b. The negative terminal on the battery and the ground to the frame.
 - c. The ignition switch terminal.
 - d. The clutch safety switch.
 - e. The blade safety switch.
 - f. The solenoid terminals. A small wire is fastened to the coil primary and the two larger wires are fastened to each side.
5. Check the condition of your battery. Even if the battery is dead you should be able to hear the solenoid click. This would verify that the starting system is operating at least to the solenoid. The specific gravity of the battery should be 1.265.
6. A continuity tester can be used to check the continuity between each component of the interlock system. Follow the instructions packed with the continuity tester which can be purchased at electrical shops.

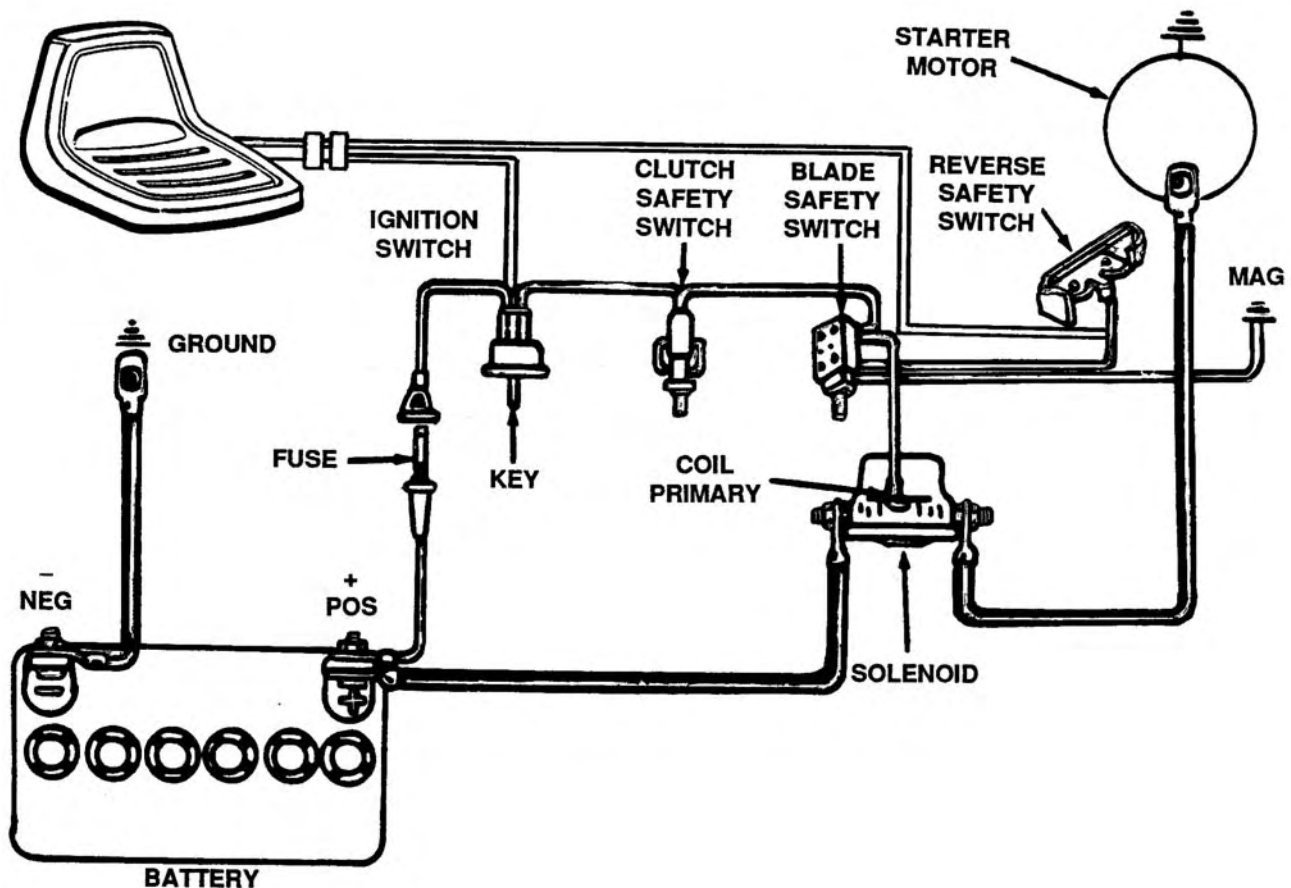


Figure 3-8. Typical Electric Start System.



WARNING

To test the interlock system further, you will be bypassing the safety switches. Make sure that the clutch is disengaged and the blade engagement lever is in the disengaged position. If the clutch cannot be locked in the disengaged position, place the gear shift lever in the neutral (N) position. When using a jumper wire in the following tests the engine may crank over.



NOTE

Disconnect the spark plug lead and ground it against the engine block.

7. Use a jumper wire between the following points:
 - a. The positive terminal on the battery to the terminal on the solenoid (coil primary). If the engine cranks, then test within this circuit to find the exact area of the problem. See steps b and c below.
 - b. The positive terminal of the battery and the S terminal on the ignition switch. If the engine cranks, the problem is between the battery and the ignition switch.
 - c. The S terminal on the ignition switch to the coil primary terminal on the solenoid. If the engine cranks, the problem is between the ignition switch and the solenoid.
 - d. Jump between the two large terminals on the solenoid.



NOTE

Only use a wire as heavy as the wire from the solenoid to the starter with an alligator clip. If you have current up to the coil primary terminal of the solenoid and the starter will not crank, however, you can crank the starter using the jumper wire, the problem is with the solenoid. Check the base of the solenoid to see that it has a good ground to the frame of the unit. If it still fails to operate, replace it.

- 3-3.3 Testing the Safety Reverse Switch on the Electric Start Systems. If the engine can be started, but stalls when the blade is engaged, use the following procedure to determine if the problem is in the reverse safety switch:



NOTE

Transmission lever must not be touching the reverse spring switch and the key must be in the ON position.

1. Disconnect the yellow wire going to the magneto on the engine.
2. Disconnect the wire attached to the spring switch.
3. Attach one lead of a continuity tester to the spring switch and the other lead to ground. If there is continuity, the fiber washers could be damaged and should be replaced.

- 3-3.4 Testing the Solenoid on Electric Start Riders and Tractors.



NOTE

Through examination of returned warranty parts, we have found instances of solenoids being replaced unnecessarily on electric start riders.

1. The following are real solenoid problems and require replacement of the solenoid:
 - a. Solenoid is stuck—Unit will start with ignition key in OFF position.
 - b. Coil wire (inside solenoid) is bad—Solenoid will not function.
 - c. Bad washer (inside solenoid)—Solenoid clicks but starter motor does not turn.
2. Other problems which can appear to be a defective solenoid:
 - a. Faulty ground.
 - b. Defective safety switch.
 - c. Discharged battery.
 - d. Defective starter motor.
 - e. Blown circuit breaker.
 - f. Defective ignition switch.
 - g. Defective wire harness.

1. Coil Check:

- a. Disconnect the spark plug wire from the spark plug.
- b. Disconnect the coil wire from the solenoid.
- c. Using a DVOM (in the OHMS setting) attach the red lead to the coil connection and the black lead to system ground.
- d. The resistance reading should be about 5 ohms.

*Meter readings greater than 10 ohms or less than 3 ohms indicates solenoid failure.

- e. Remove meter leads and reconnect coil wire.

2. Contact Check:

- a. Disconnect the spark plug wire from the spark plug.
- b. Disconnect the wire AT THE STARTER which runs to the solenoid.
- c. Using a DVOM (in the OHMS setting), attached the red lead to a contact bolt and the black lead to the other contact bolt. The meter should read "OPEN" circuit, or infinity.

*A "closed" circuit indicates solenoid failure.

- d. Energize the solenoid using the start switch. WARNING: DO NOT HOLD "ON" FOR MORE THAN 5 SECONDS AT A TIME.

- e. The meter should read "CLOSED" circuit, or less than 10 ohms. Continued on page 3-15.

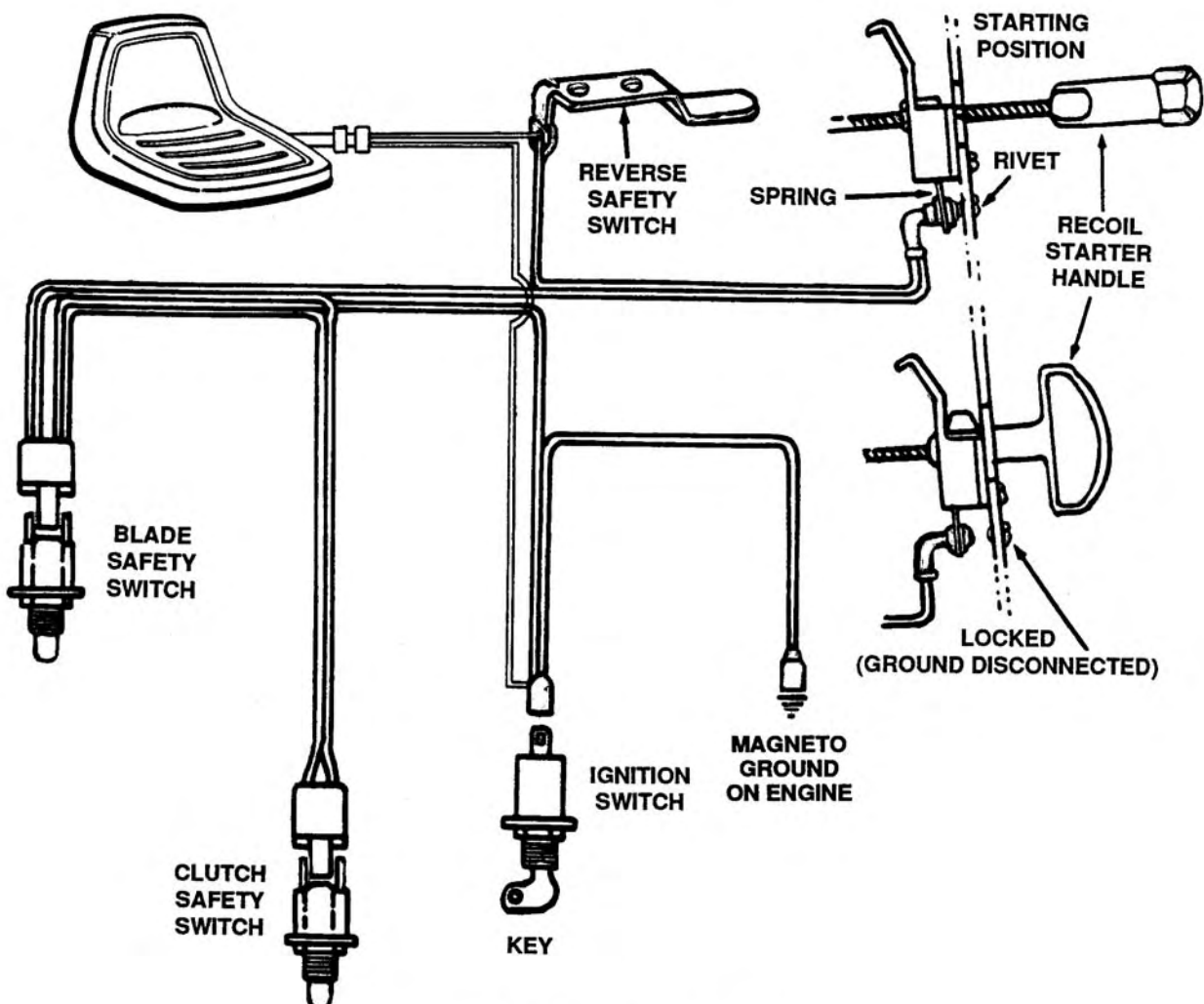
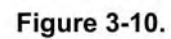


Figure 3-9. Typical Recoil Start System



With the engine running, current exists in the safety circuit. By grounding the reverse switch or the seat switch or a short in the yellow wires, the engine will shut down.

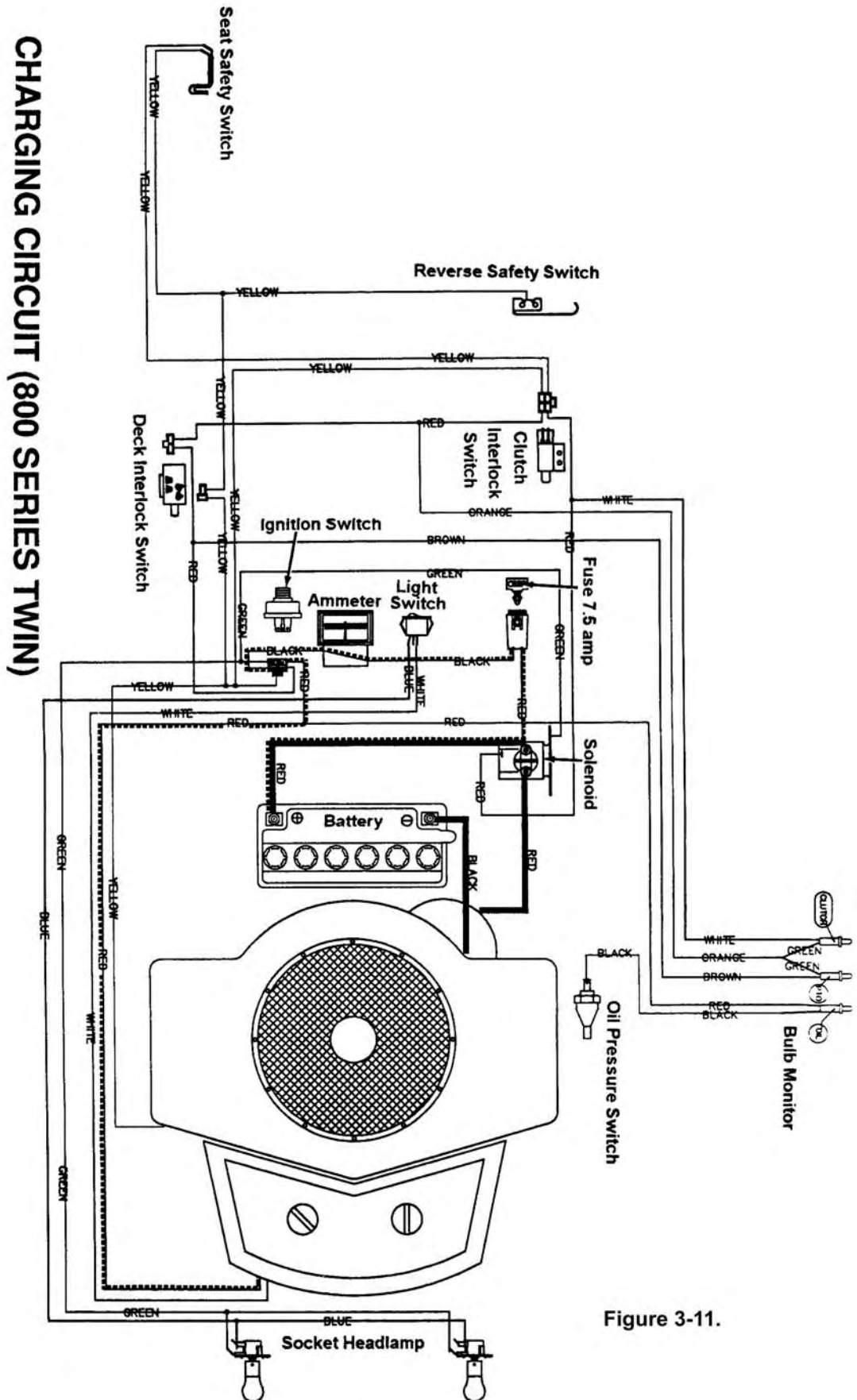


Figure 3-11.

This schematic illustrates the charging system. With the engine running, current flows from the engine alternator, through the ignition switch and fuse, to the positive terminal.

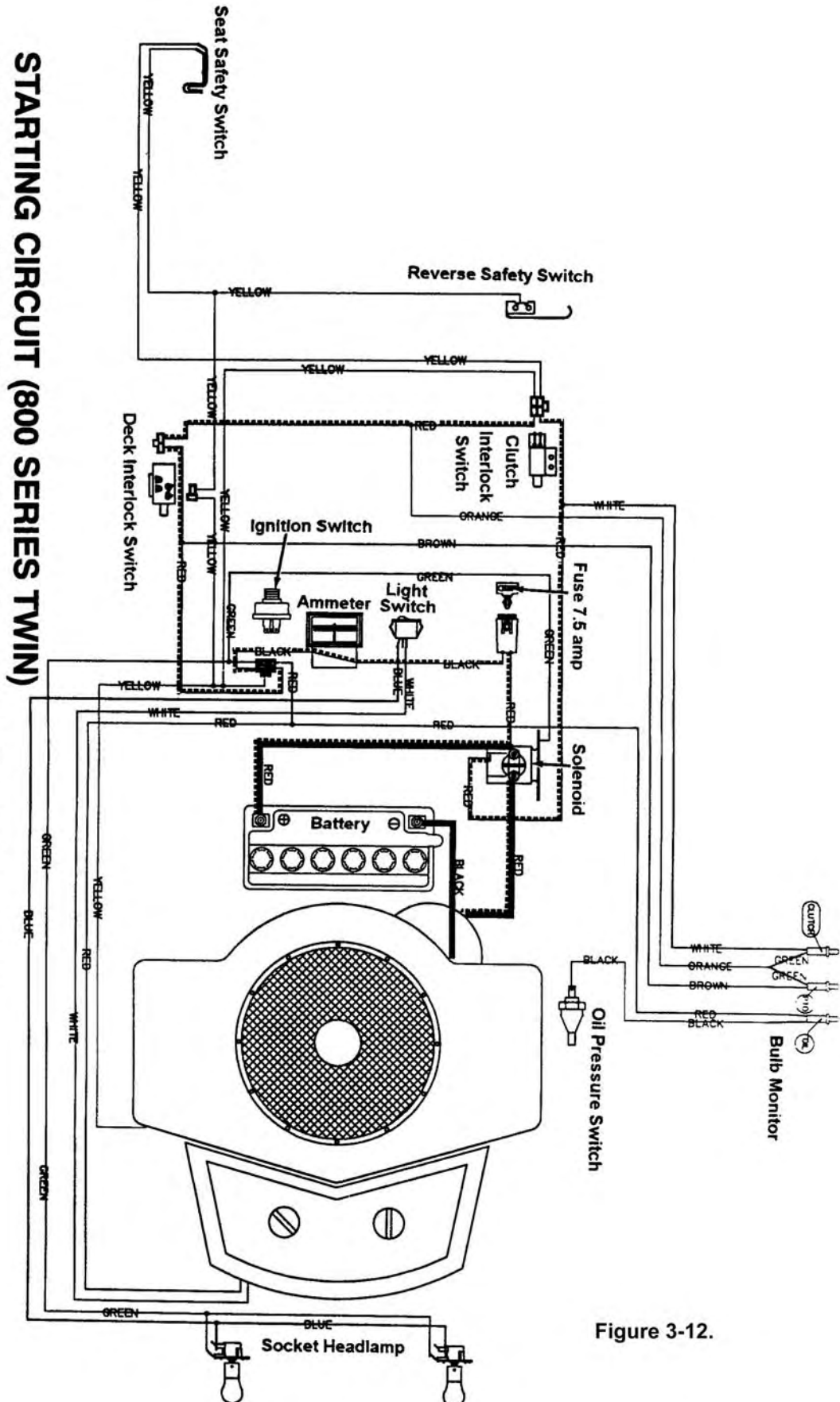


Figure 3-12.

STARTING CIRCUIT (800 SERIES TWIN)

In the starting circuit, the deck lift lever must be in the disengaged position and the clutch/brake pedal depressed to activate the system. With the ignition switch in the start position, current flows in two directions from the positive terminal on the battery almost simultaneously. In the first one, current flows through the fuse, ignition switch, PTO switch and clutch switch to activate the solenoid, thus allowing current to flow in the second line from the battery through the solenoid to the starter.

SAFETY CIRCUIT (PTO ENGAGED SWITCH UP) 800 SERIES (ELECT. PTO & MONITOR)

With PTO switch in up position, relays block out the safety switches and engages the PTO.

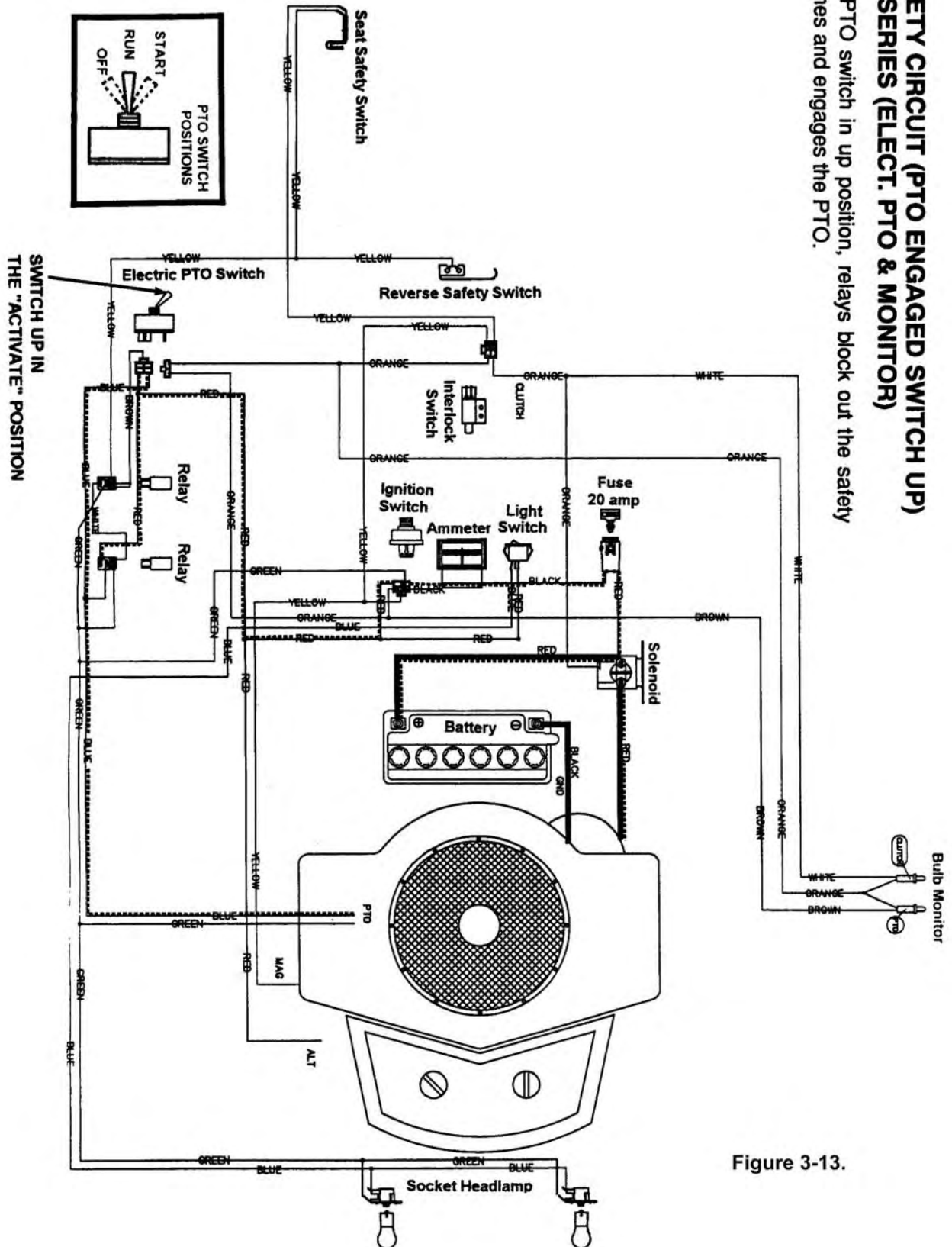


Figure 3-13.

CHARGING CIRCUIT 800 SERIES (ELECT. PTO & MONITOR)

This schematic illustrates the charging system. With the engine running, current flows from the engine alternator, through the ignition switch and fuse, to the positive terminal.

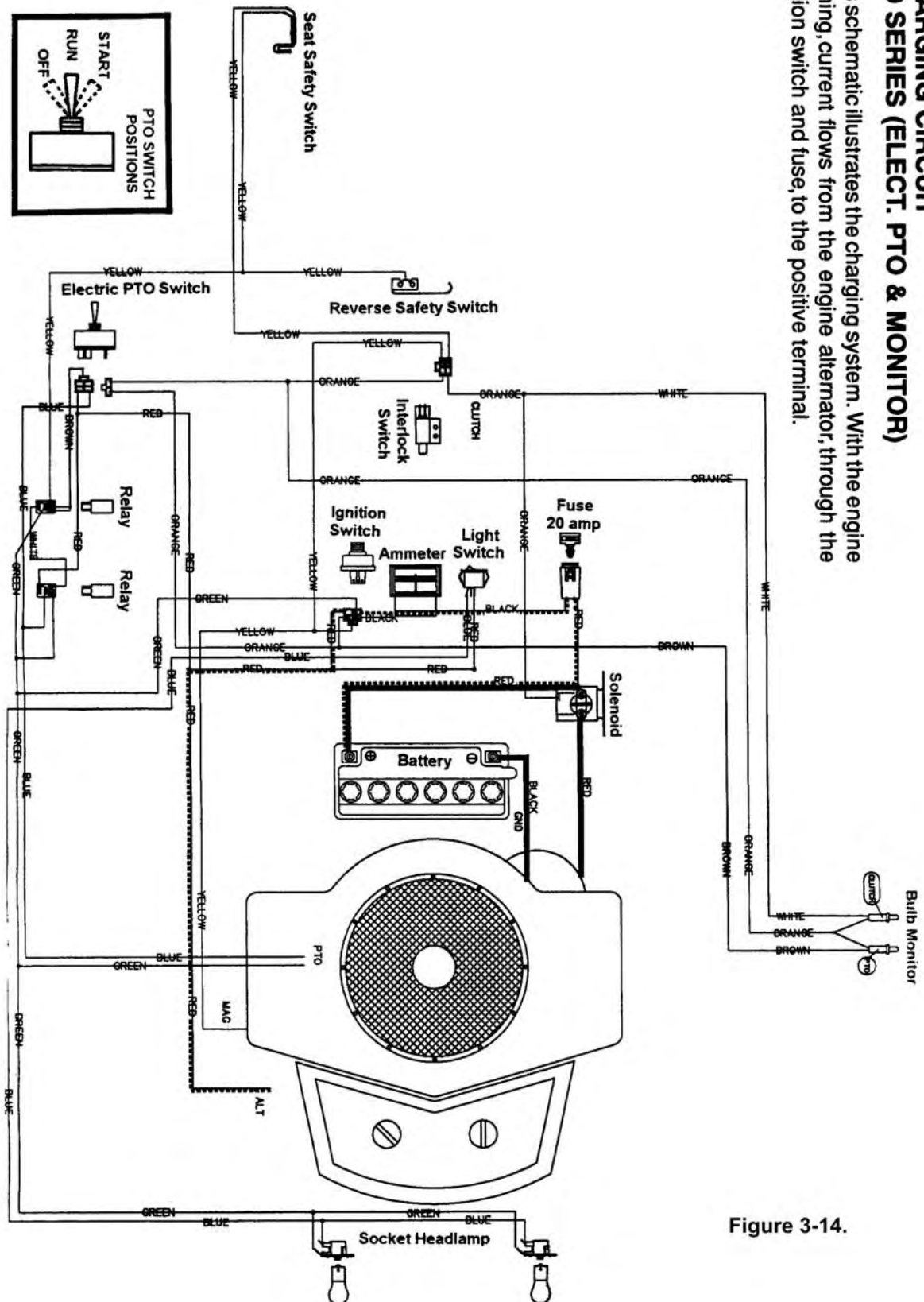


Figure 3-14.

STARTING CIRCUIT 800 SERIES (ELECT. PTO & MONITOR)

In the starting circuit, the deck lift lever must be in the disengaged position and the clutch/brake pedal depressed to activate the system. With the ignition switch in the start position, current flows in two directions from the positive terminal on the battery almost simultaneously. In the first one, current flows through the fuse, ignition switch, PTO switch and clutch switch, to activate the solenoid, thus allowing current to flow in the second line from the battery through the solenoid to the starter.

Also, voltage must exist in the wire from the ignition switch to the after fire solenoid or unit will crank but not run. The fuel supply is shut off.

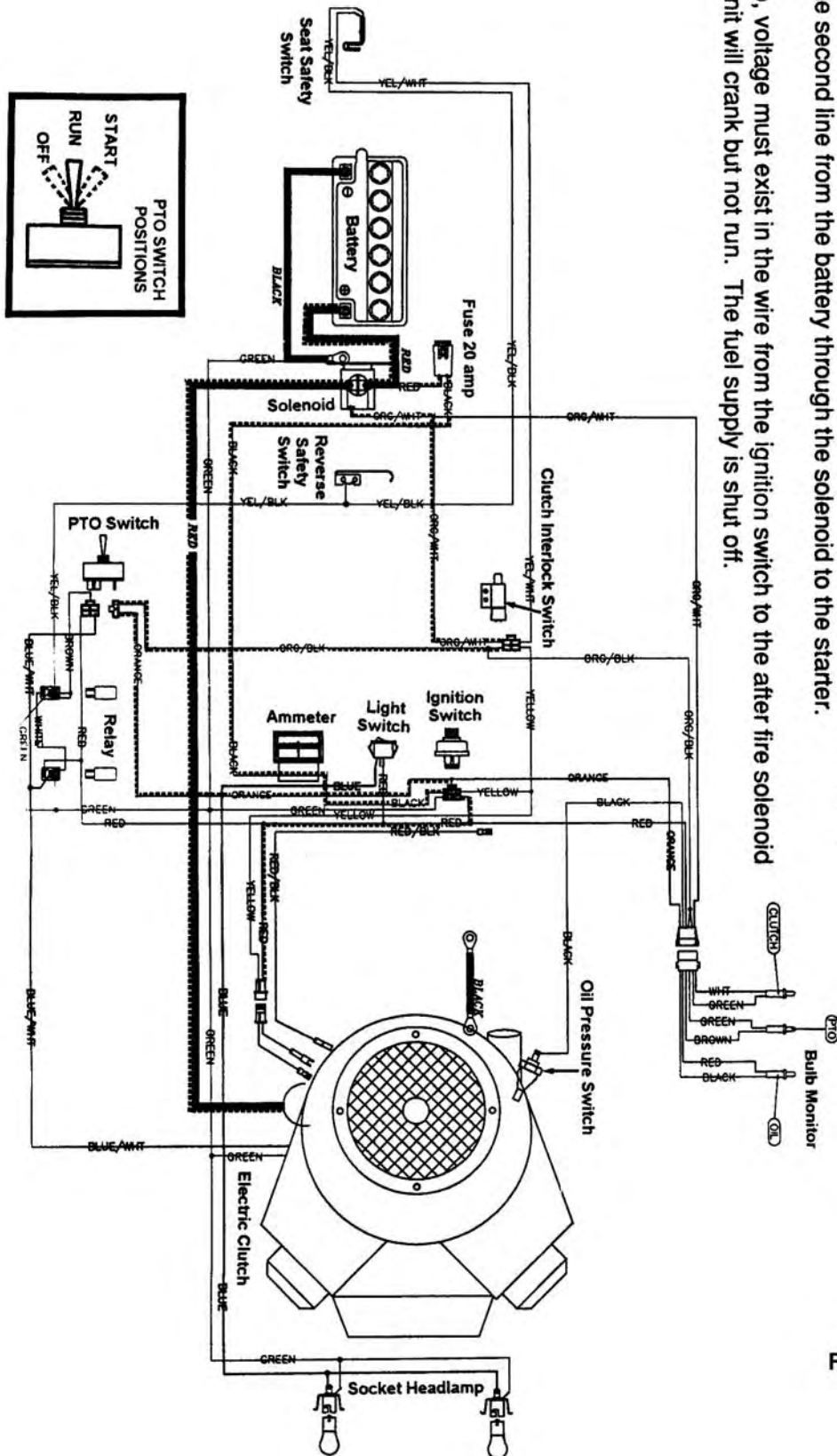


Figure 3-15.

STARTING CIRCUIT 800 SERIES (ELECT. PTO & MONITOR)

In the starting circuit, the deck lift lever must be in the disengaged position and the clutch/brake pedal depressed to activate the system. With the ignition switch in the start position, current flows in two directions from the positive terminal on the battery almost simultaneously. In the first one, current flows through the fuse, ignition switch, PTO switch and clutch switch to activate the solenoid, thus allowing current to flow in the second line from the battery through the solenoid to the starter.

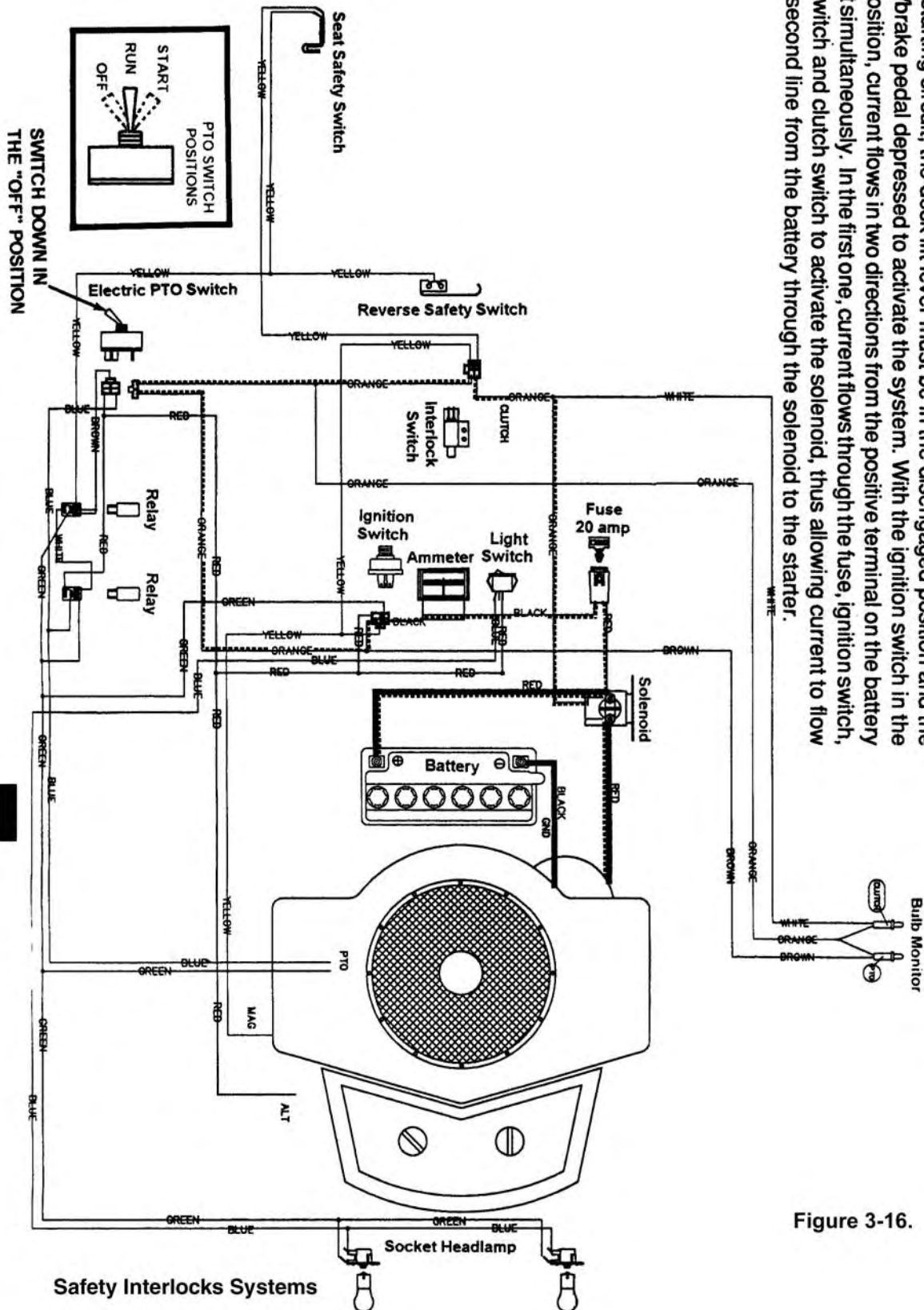


Figure 3-16.

PTO ENGAGED "RUN" POSITION 800 SERIES (ELECT. PTO & MONITOR)

With the PTO switch in the "RUN" position, current flows from the battery through the fuse, ammeter, ignition switch, through the PTO switch and relays, thus engaging the PTO.

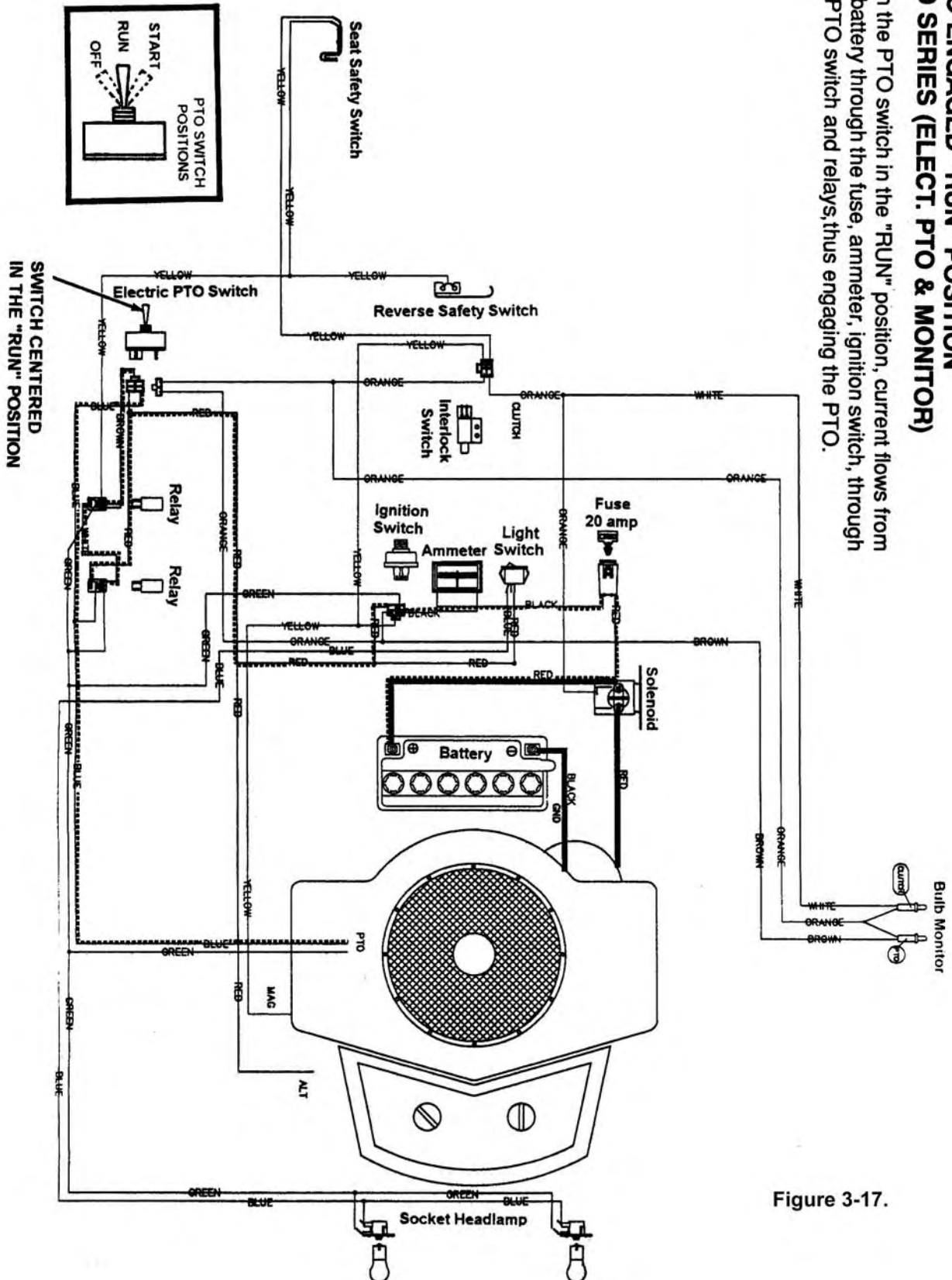


Figure 3-17.

*An "OPEN" circuit indicates solenoid failure.

- f. Remove meter leads and reconnect the starter wire.

3.5 TROUBLESHOOTING SAFETY INTERLOCK SYSTEMS.

Problem: The engine will not crank.

1. Check the battery cables to be certain that they are connected properly. The black cable should be connected to the negative terminal on the battery. The red cable should be connected to the positive terminal on the battery. Connections must be tightened securely. See Figure 3-18.



Figure 3-18.

2. Check the battery with a voltage tester. The battery should read approximately 12 volts. Turn the key switch to the start position. If the voltage drops more than 2 volts, refer to the battery video for testing procedures. See Figure 3-19.

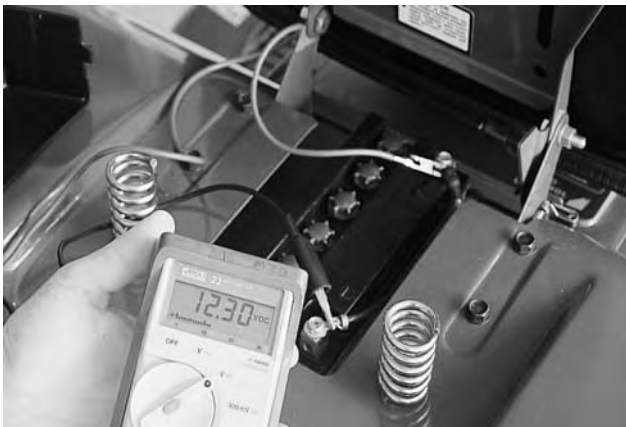


Figure 3-19.

3. Remove the shift panel to gain access to the solenoid and fuse.
 - a. Check for a tripped circuit breaker or blown fuse. Circuit breakers seldom open or fuses blow without a reason. The problem must be corrected. See Figure 3-20.



Figure 3-20.

- b. If your unit has a fuse, pull the fuse to determine if it has blown. If it has, you will have to find the fault.
 - c. To test a circuit breaker, connect a volt meter or a 12 volt test light between the negative battery terminal and each side of the circuit breaker terminals. If voltage is present at both terminals the breaker is good. If not, replace the breaker.
 - d. Check for a short in the wiring. A dead short may be in the cranking or charging circuit where the insulation may have rubbed through and exposed a bare wire. Replace the wire or repair with electrical tape if the wire strands have not been damaged.
 - e. Look for a wire pinched between body panels, burned by the exhaust pipe or muffler or rubbed against a moving part.
4. If your unit has a dual circuit alternator and the fuse is blowing or the breaker is tripping, check for proper wiring. If you have a regulated system disregard this section.

Disconnect the red and white lead connector which goes to the alternator. If the unit cranks, the wires are reversed and a dead short resulted. Reverse the wires to correct the problem. See Figure 3-21.



Figure 3-21.



The connector is notched to fit together one way only. The red wires should align with each other.

For more information on charging systems, see the video "Batteries and Charging Systems."

5. Check to be certain the small orange wire is connected to the small terminal on the solenoid. On some units, this wire may be red instead of orange.

Using a test light or meter, check for voltage at this wire with the key in the start position. If voltage is present, the key switch and safety circuits are O.K. but the solenoid must be checked further or replaced. See Figure 3-22.



Figure 3-22.

6. Clamp the test light to the base of the solenoid. Touch other probe to the positive terminal of the solenoid. It should show voltage. See Figure 3-23.

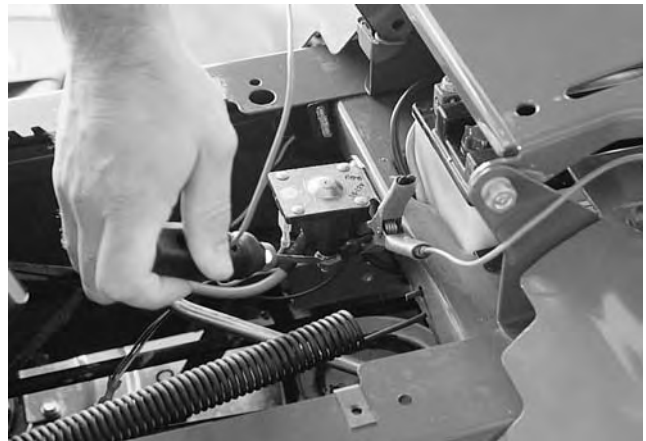


Figure 3-23.

7. Touch probe to terminal on solenoid that goes to starter. Turn ignition key to the start position. If no voltage is present, replace the solenoid. See Figure 3-24.

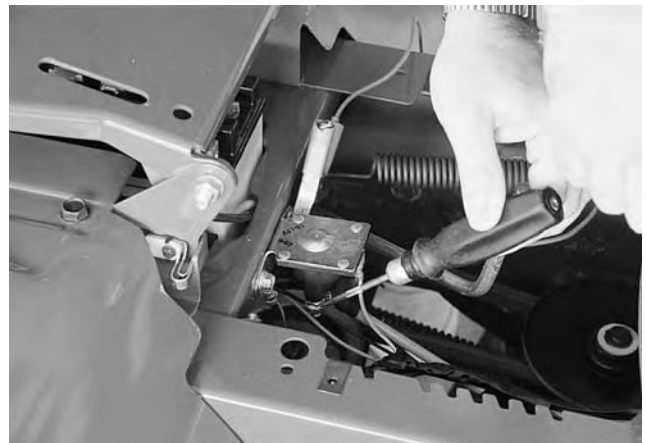


Figure 3-24.

Check to be certain the unit is grounded properly.

The black, or negative, cable coming from the battery must be properly secured to the frame or engine, depending on the model tractor.

8. To check for proper electrical ground, connect one side of your meter or test light to the positive terminal of the battery. See Figure 3-25.



Figure 3-25.

Touch the other lead to the mounting bracket of the solenoid. If voltage is present, the solenoid is properly grounded. See Figure 3-26.



Figure 3-26.

If your unit has a small green wire to the base of the solenoid, make certain that it is securely connected.

9. The engine may have a ground wire located at the base of the engine, attached to the frame. It must be firmly attached to both the engine and the tractor frame. See Figure 3-27.



Figure 3-27.

10. To test for ground, connect one test lead to the positive terminal of the battery and the other lead to the engine block. If voltage is present the engine is grounded properly. If not, check that the ground wires are clean and properly connected. See Figure 3-28.



Figure 3-28.

11. Check for voltage at the starter motor by connecting one lead of your tester to the engine ground. Touch the other lead to the starter motor terminal. Turn the key to the start position. If voltage is present and the engine does not crank, all circuits are working properly and the problem is in the engine. Contact your authorized engine service dealer. See Figure 3-29.

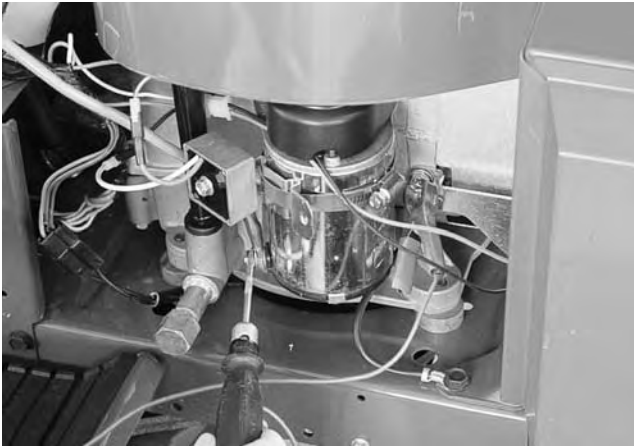


Figure 3-29.

12. If voltage was not present at the orange wire on the solenoid while cranking the engine, you will need to check the ignition switch and safety interlock switches to see if they are being activated properly. There are three switches which must be activated in order to crank the unit: the ignition switch, the clutch/brake pedal switch, and the deck lift lever switch or PTO switch if your unit has an electric PTO.

Make certain the switch activators are depressing the plungers on the switches. Also, check for proper wire connection at the switch terminals.

➡ NOTE

There is a seat safety switch and a reverse safety switch on this unit; however, they are not involved in the cranking circuit.

13. Check the ignition switch to be certain the wire harness connector is completely secured to the ignition switch terminals. Wires on the harness plug at the ignition switch should be installed as illustrated. See Figure 3-30.

If the unit still fails to start you will need to test the ignition switch further.

14. For clarity we have removed the ignition switch.

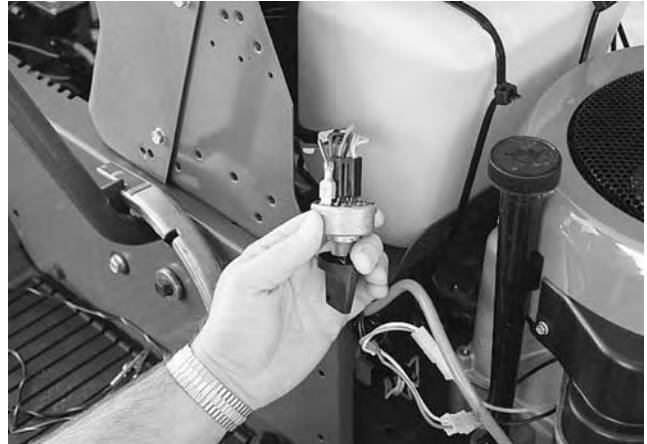


Figure 3-30.

15. Using a test light or meter, connect one lead to ground. Connect the other lead to the black terminal on the ignition switch. Voltage should always be present. See Figure 3-31.



Figure 3-31.

16. Move the tester from the black lead to the orange lead. Turn the ignition key to the start position. If voltage is present, the ignition switch is good. If no voltage is present, replace the ignition switch. See Figure 3-32.

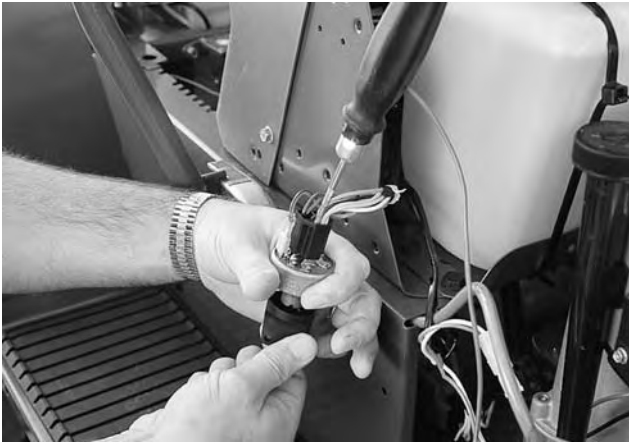


Figure 3-32.

If the unit still fails to crank, continue testing.

17. For units without an electric PTO, raise the deck lift lever fully and make sure the plunger on the safety switch is fully depressed. Attempt to start the unit. If it does not crank, remove the PTO switch. Using a jumper wire, connect between the two orange terminals. If the unit now cranks, replace the deck lift lever safety switch. See Figure 3-33.



Figure 3-33.

18. If you have an electric PTO, remove the connector from the PTO switch. Jump between the two orange terminals. If the unit now cranks, replace the PTO switch. See Figure 3-34.

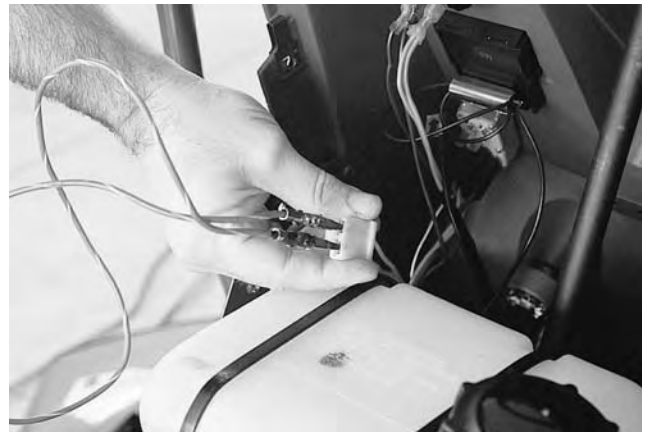


Figure 3-34.

19. If the unit does not crank, make sure the clutch/brake pedal switch is fully depressed. Remove the switch and jump a wire between the two orange terminals. See Figure 3-35.

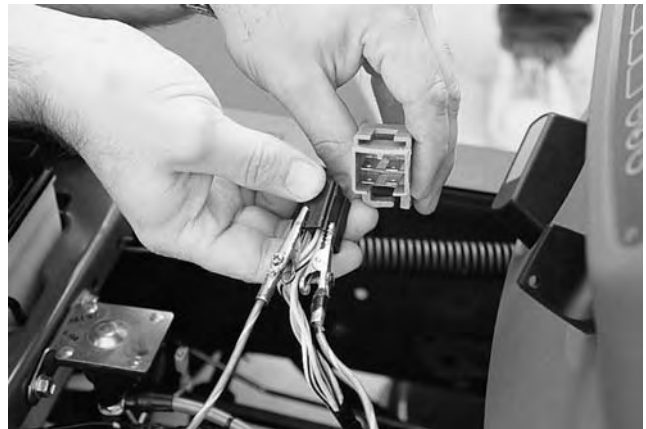


Figure 3-35.

20. If the unit cranks, replace the clutch brake pedal safety switch.

Problem: The engine cranks but will not start.

1. Check the fuel tank for gas.
2. Check to be certain the spark plug wire is firmly connected to the spark plug terminal.
3. Check the throttle and/or choke for proper starting position.
4. Disconnect the yellow ground wire on the engine. If the engine starts, the problem is with the safety switches or wiring harness.

5. If the engine fails to start, and you do not have an afterfire solenoid, the problem is in the engine and must be repaired by an authorized engine service dealer.
6. If you do have an engine with an afterfire solenoid attach your tester to the red wire and ground. Voltage should be present in the start and run positions. If voltage is not present, replace the ignition switch. See Figure 3-36.



Figure 3-36.

7. Disconnect the wires or harness connector from the clutch/brake safety switch. See Figure 3-37.



Figure 3-37.

With another wire, jump across the two red or orange wires in the harness connector and start the unit. If unit starts, the switch is defective and must be replaced. See Figure 3-37.

8. Disconnect the yellow wires on the deck lift lever safety switch or PTO safety switch if your unit has an electric PTO. Jump across the red or orange wires. If engine starts, the switch is defective and must be replaced. See Figure 3-38.



Figure 3-38.

9. Check the ignition switch by removing the yellow wire from the switch harness and try to start the unit. If the unit starts, replace the ignition switch. Reinstall the yellow wire to the connector to stop the engine. See Figure 3-39.



Figure 3-39.

Problem: The engine stalls when engaging clutch/brake pedal.

Check both the reverse safety switch and seat safety switch for grounding out conditions.

➡ NOTE

Wires must not come into contact with the unit when checking these connections.

1. Disconnect the yellow wire on the reverse safety switch. With the engine running, place the shift lever in neutral and release the clutch/brake pedal. See Figure 3-40.



Figure 3-40.

If the engine continues to run, the screws on the reverse safety switch are grounding out against the reverse safety switch bracket.

Correct by removing the screws that hold the reverse safety switch to the bracket. Inspect the insulator plate for cracks or distortion, which can occur if the screws are improperly installed. Replace if defective.

2. If the engine stalls when testing the reverse safety switch, check the seat safety switch by disconnecting both yellow wires on the switch. See Figure 3-41.

With the engine running and the shift lever in neutral, release the clutch/brake pedal. If the engine continues to run, the problem is with the insulator plate on the seat safety switch. Inspect in the same manner as the reverse safety switch. Replace if defective.



Figure 3-41.

Problem: Your unit has an electric PTO and the blades do not engage when activating the PTO switch.

1. Check for voltage at the PTO connector with the PTO switch in the on position.

If there is voltage, adjust the PTO clutch or replace it as needed.

2. If there is no voltage, check for voltage at the red wire at the PTO switch. If no voltage, check for voltage at the ignition switch. See Figure 3-42.



Figure 3-42.

3. If there is voltage at the red wire at the PTO, switch the PTO to the start position and check for voltage at the blue and brown wire. If there is no voltage at either, replace the PTO switch. See Figure 3-43.



Figure 3-43.

Problem: The engine stalls when engaging blade or the blades do not engage when going into the run position on units with PTO's.

Check both the reverse safety switch and seat safety switch for grounding out conditions.

➡ NOTE

Wires must not come into contact with the unit when checking these connections

1. Disconnect the yellow wire on the reverse safety switch. With the engine running, engage the cutting deck. See Figure 3-44.



Figure 3-44.

If the blades engage without stalling the engine, the screws on the reverse safety switch are grounding out against the support bracket or panel.

Correct by removing the screws that hold the reverse safety switch to the bracket or panel. Inspect the insulator plate for cracks or distortion, which can occur if the screws are improperly installed. Replace if defective.

If the engine stalls, reconnect yellow wires and proceed to the next step.

2. Check the seat safety switch by disconnecting both yellow wires or the harness from the switch. See Figure 3-45.



Figure 3-45.

With the engine running, engage the cutting deck. If the engine continues to run with the blades engaged, the problem is with the insulator plate on the seat safety switch. Inspect in the same manner as the reverse safety switch. Replace if defective.

Problem: PTO starts but disengages when the switch is moved to the run position.

1. Check the wiring at the PTO switch. See Figure 3-46.



Figure 3-46.

If correct, check voltage at PTO when blade stops turning. If voltage is present and blades are not turning, check the clutch air gap and adjust, retest, and replace the clutch if the test fails. See Figure 3-47.



Figure 3-47.

2. If voltage is not present, disconnect the wires from the seat safety switch and the reverse safety switch.

Operate the PTO. If it remains running, check the safety switches for shorts or broken insulator plates.

3. If the PTO doesn't operate, test the relays as follows:

➡ NOTE

Relay one has yellow, white, and brown wires. Relay two has red, white, and blue wires.

- a. Test for voltage on relay one at the white wire with the PTO switch in the start posi-

tion. If there is no voltage, replace relay one. See Figure 3-48.



Figure 3-48.

- b. If voltage is present in relay one, check for voltage on the red wire of relay two. See Figure 3-49.



Figure 3-49.

- c. If voltage is present, replace relay two.
4. If no voltage is present at relay two, check for voltage at the red wire on the ignition switch. If there is no voltage, replace the ignition switch. See Figure 3-50.



Figure 3-50.

EVALUATING ELECTRIC CLUTCHES

This section will cover how to evaluate electric clutches. You will need a multi meter to perform these tests.

1. To measure the clutch coil resistance, turn off the engine and the PTO switch.
 - a. Disconnect the clutch wire connection.
 - b. Set the meter to check ohms.
 - c. Connect the meter lead wires to the wires in the clutch connector.

3



Figure 3-51.

- (1) If the meter reads below 2.40 ohms or above 3.40 ohms, the clutch has failed and needs to be replaced.
- (2) If the meter reads between 2.40 and 3.40 ohms, proceed to measuring clutch current draw. See Figure 3-51.
2. Set the meter to check amps using the 10 amp scale.
 - a. Connect one meter lead wire to one wire in the clutch connector and the other lead wire to the corresponding wire in the mating connector.
 - b. Connect a short wire to the second wire in both connectors.



Figure 3-52.

- c. Turn the PTO switch on.
3. If the meter reads below 3.5 amps, the problem would be in the electrical system leading to the clutch such as the battery, a relay, or a switch.
4. If the meter reads 3.5 amps or above, proceed to checking the air gap. See Figure 3-52.
 - a. Turn off the PTO.
 - b. Locate the three windows or notches where the air gap is checked.
 - c. Check the gap at three locations using a feeler gauge.
 - d. The factory air gap setting is .010 to .025 inch. See Figure 3-53.



Figure 3-53.

- e. If the gap is incorrect, use a .017 feeler gauge and adjust the gap by tightening or loosening the three nuts on the clutch. See Figure 3-54.

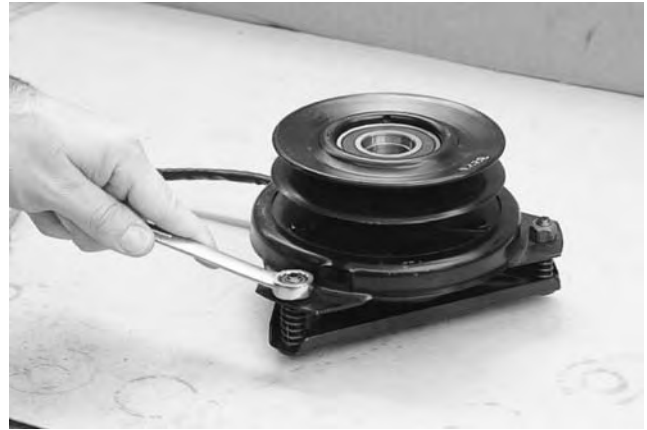


Figure 3-54.

5. The electric clutch initially needs to be bur-nished before it is used by the owner.

It is not done at the factory and is the responsi-bility of the dealer or the customer.

- a. To properly burnish the clutch, run the engine at 50 percent throttle.
- b. Engage and disengage the clutch 5 times, ten seconds on and ten seconds off.
- c. Increase to 75 percent throttle.
- d. Engage and disengage the clutch 5 more times, ten seconds on and ten seconds off.
6. If you have a unit with an electric clutch that operates sporadically, check all wiring around the steering column going to the dash for fray-ing and shorts.
 - a. Check the relays for proper connections. Newer models have in line relays to mini-mize vibration and reduce failure.
 - b. You can remove the relays from the chas-sis of older models and tape them directly to the wiring harness.
 - c. Check the PTO switch for proper connec-tions. The red and blue wires might be reversed. The blue wire should be on top with the red wire directly below it. The brown wire should be on the opposite side.

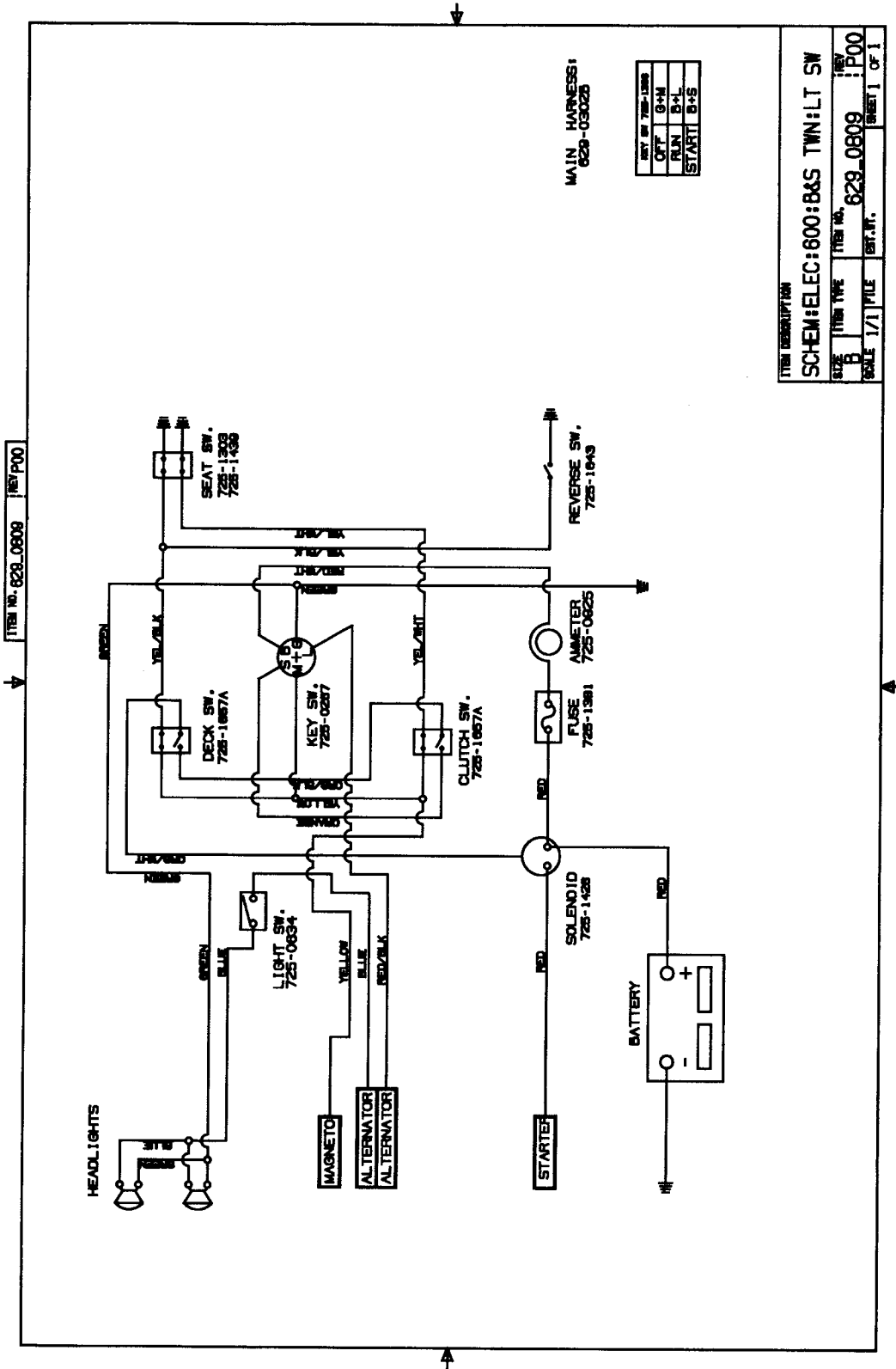


Figure 3-56.

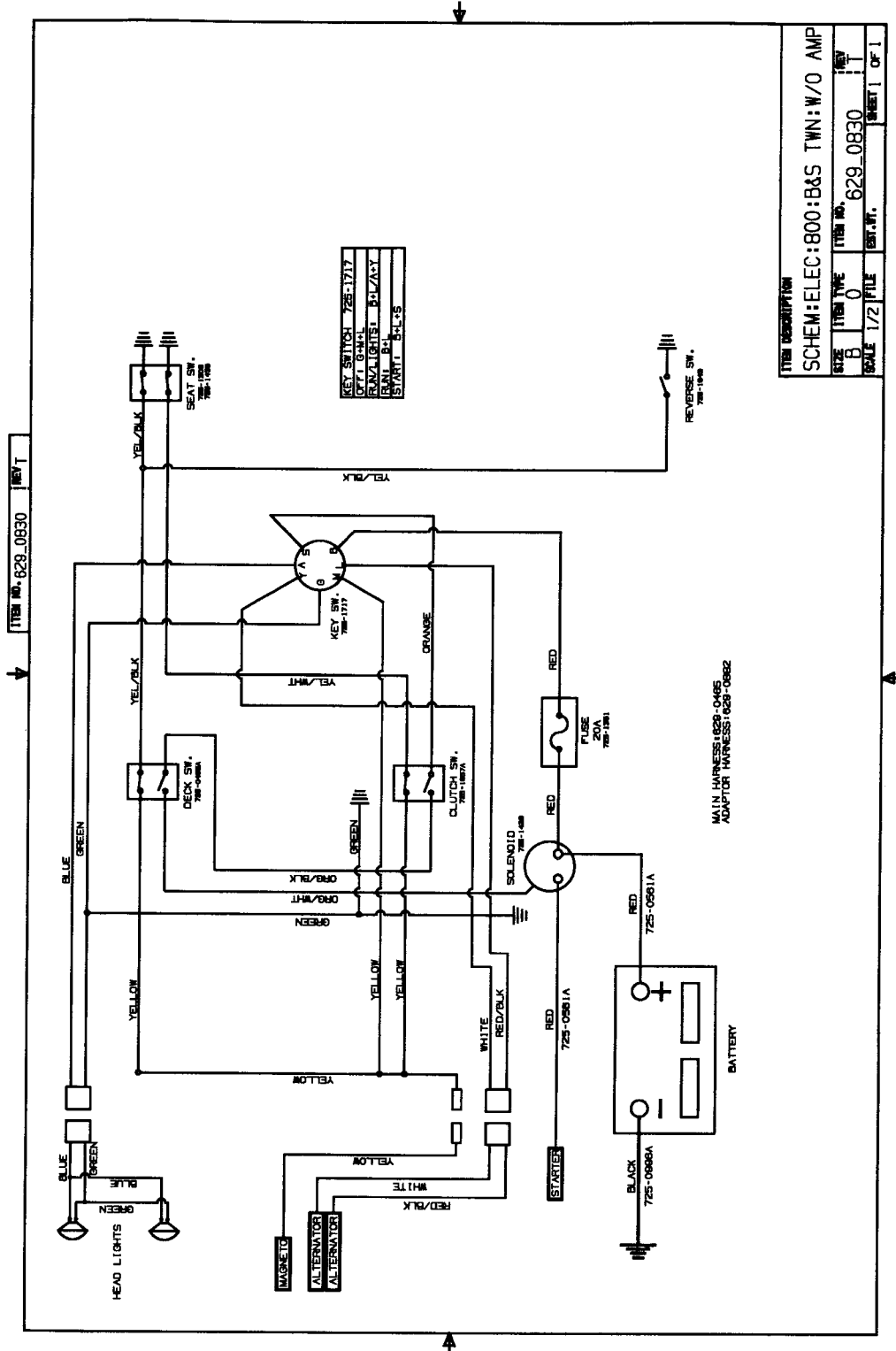


Figure 3-58.

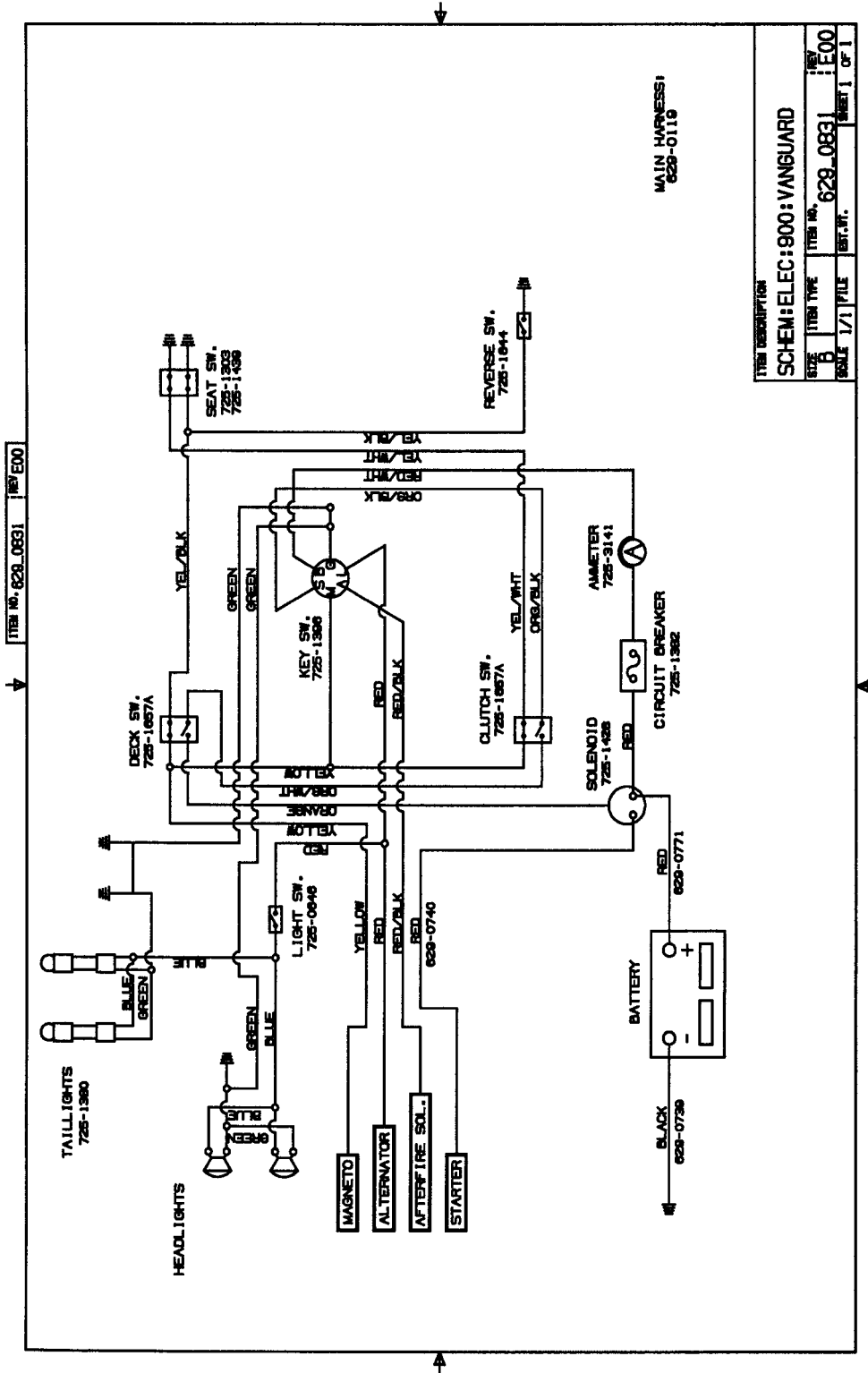


Figure 3-59.

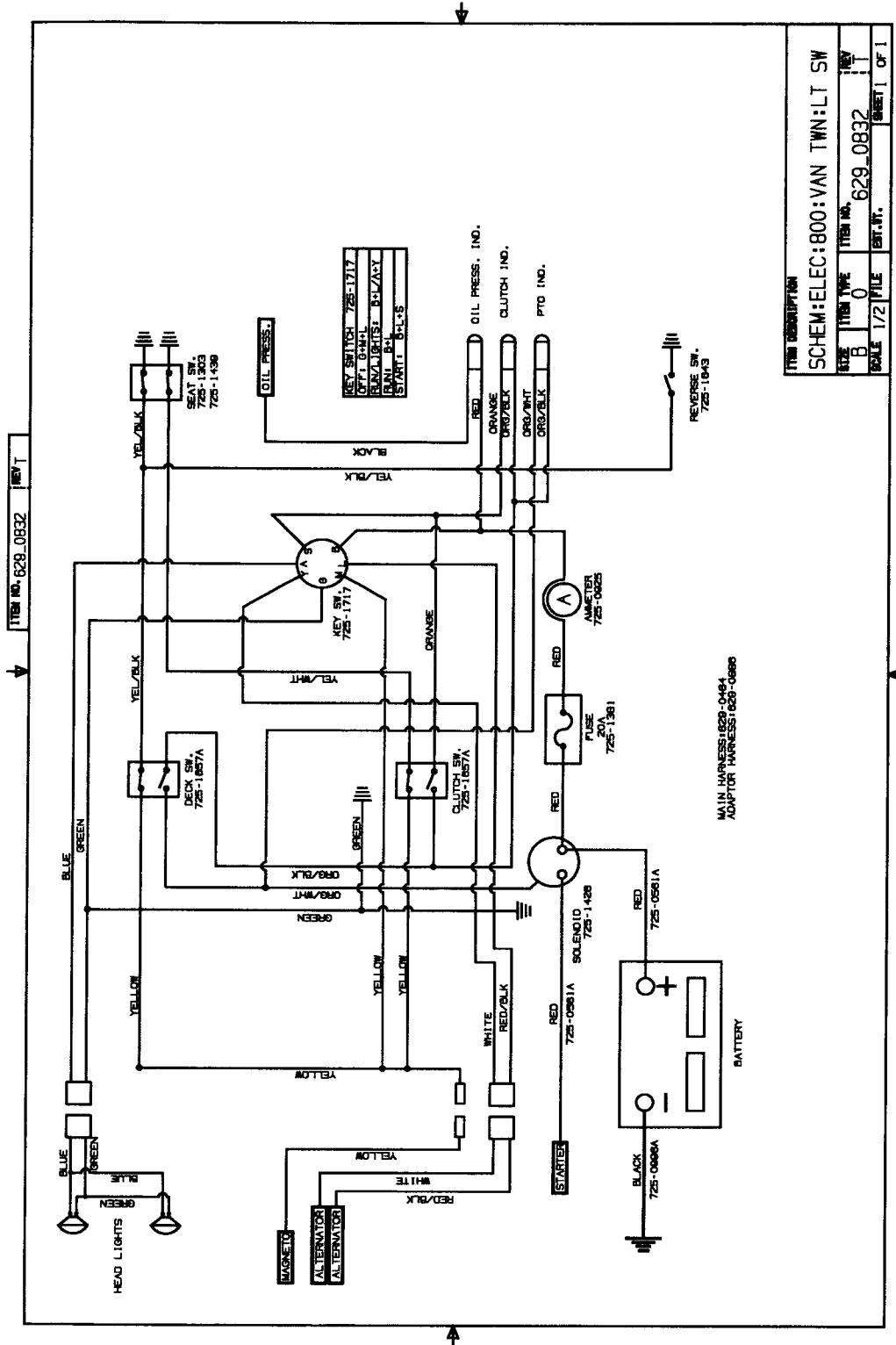
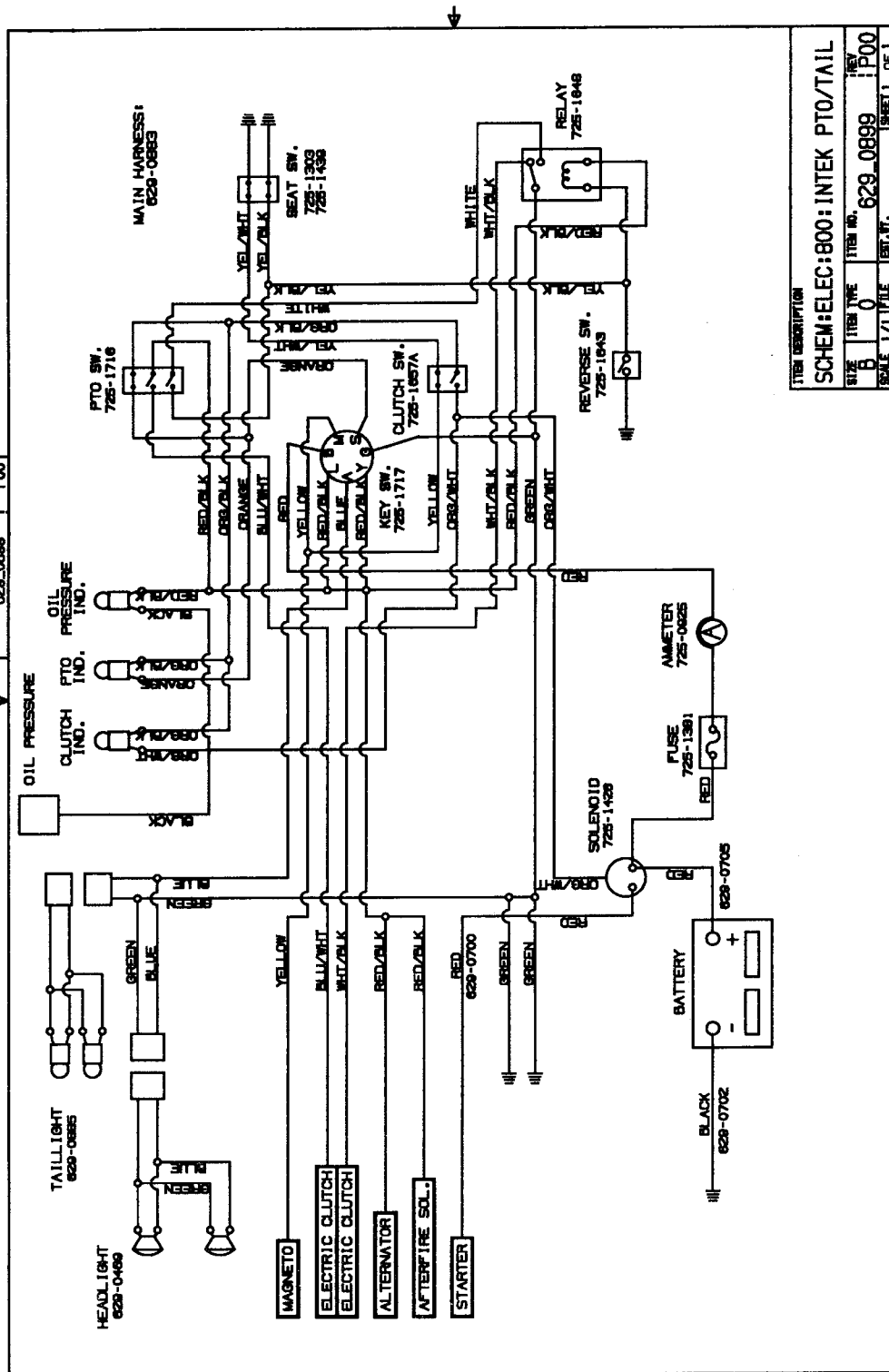


Figure 3-60.



3-32

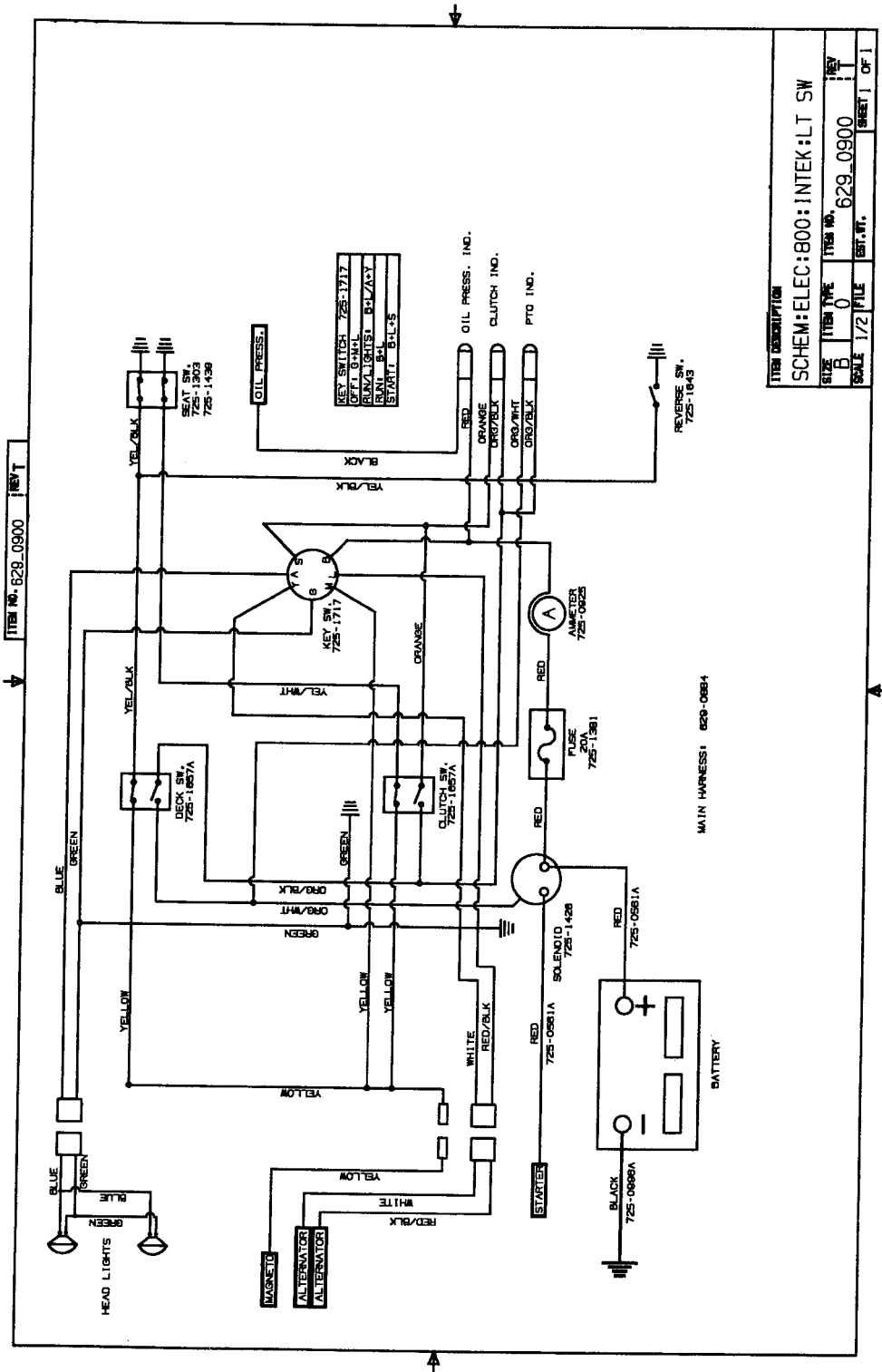


Figure 3-63.

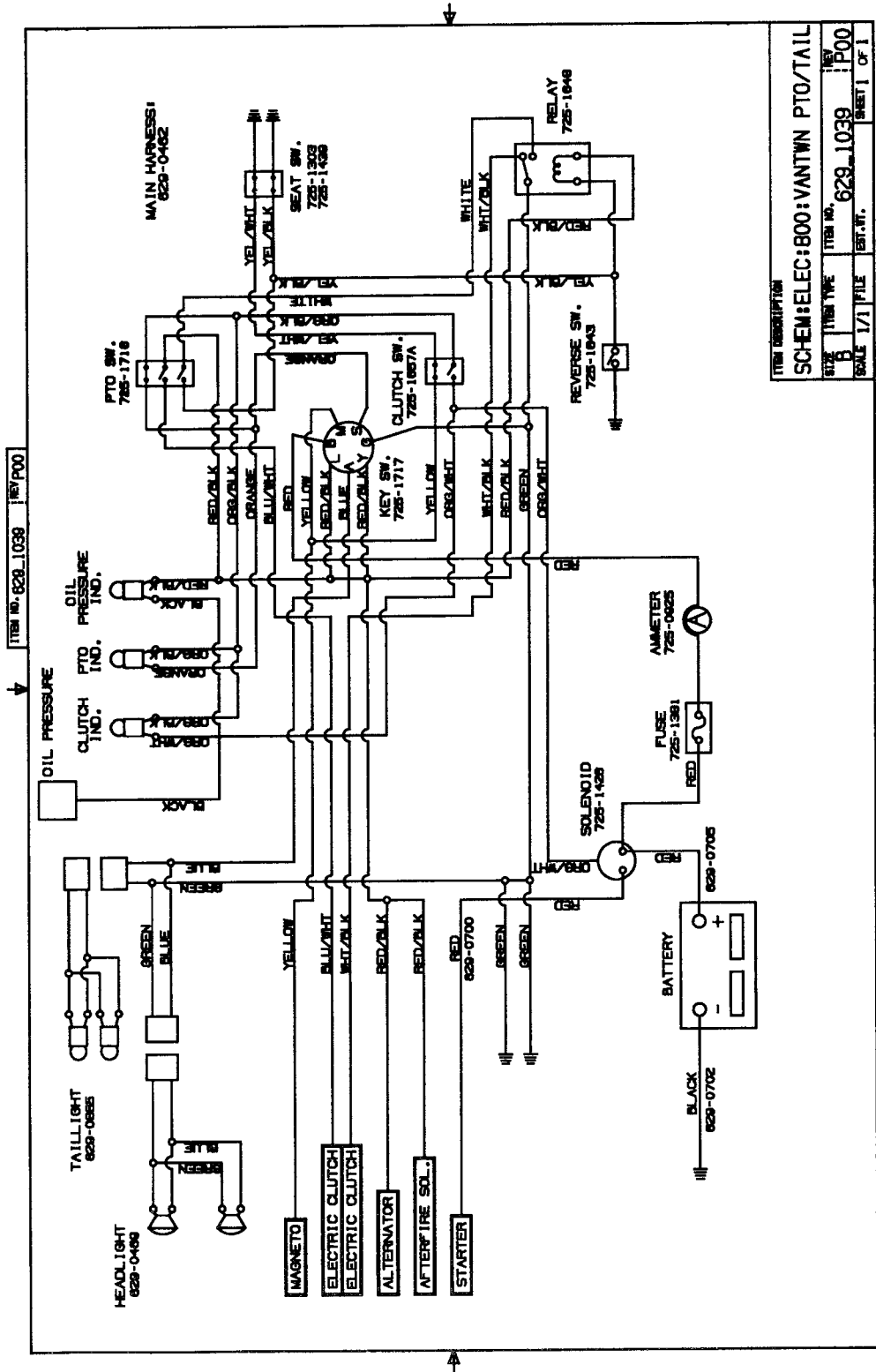


Figure 3-64.

ITEM NO. 829_0981 REV P00

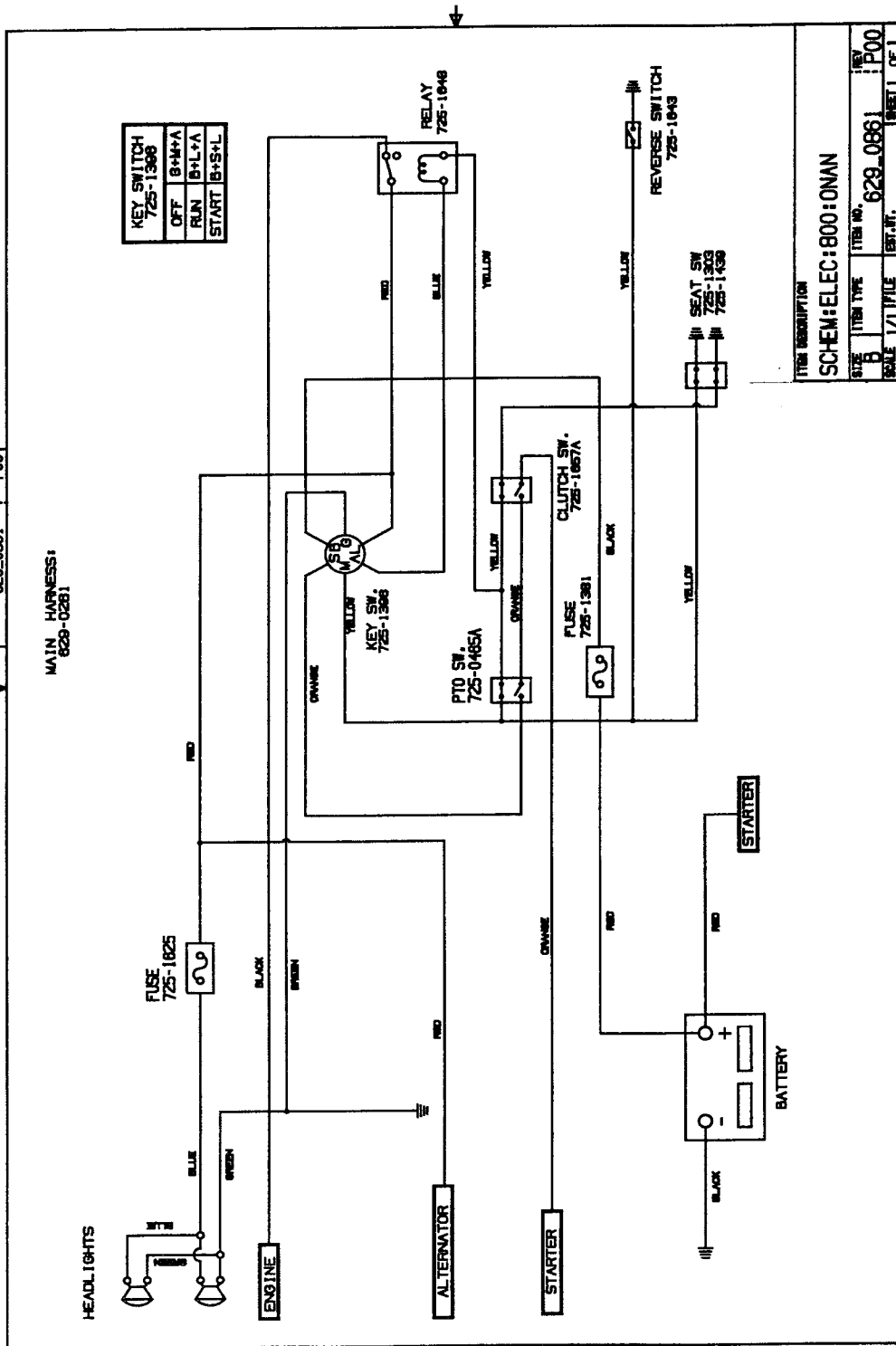


Figure 3-66.

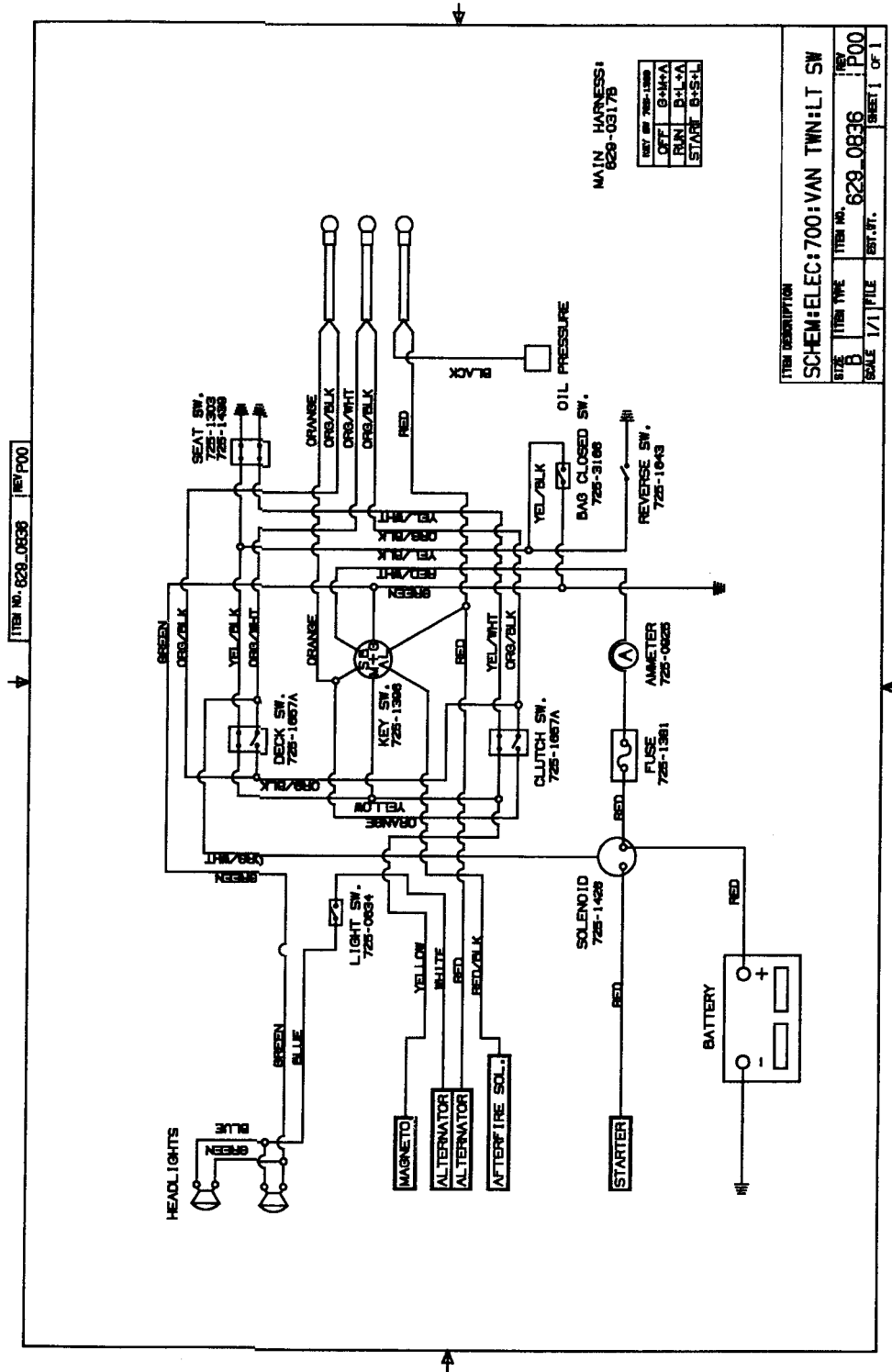


Figure 3-67.

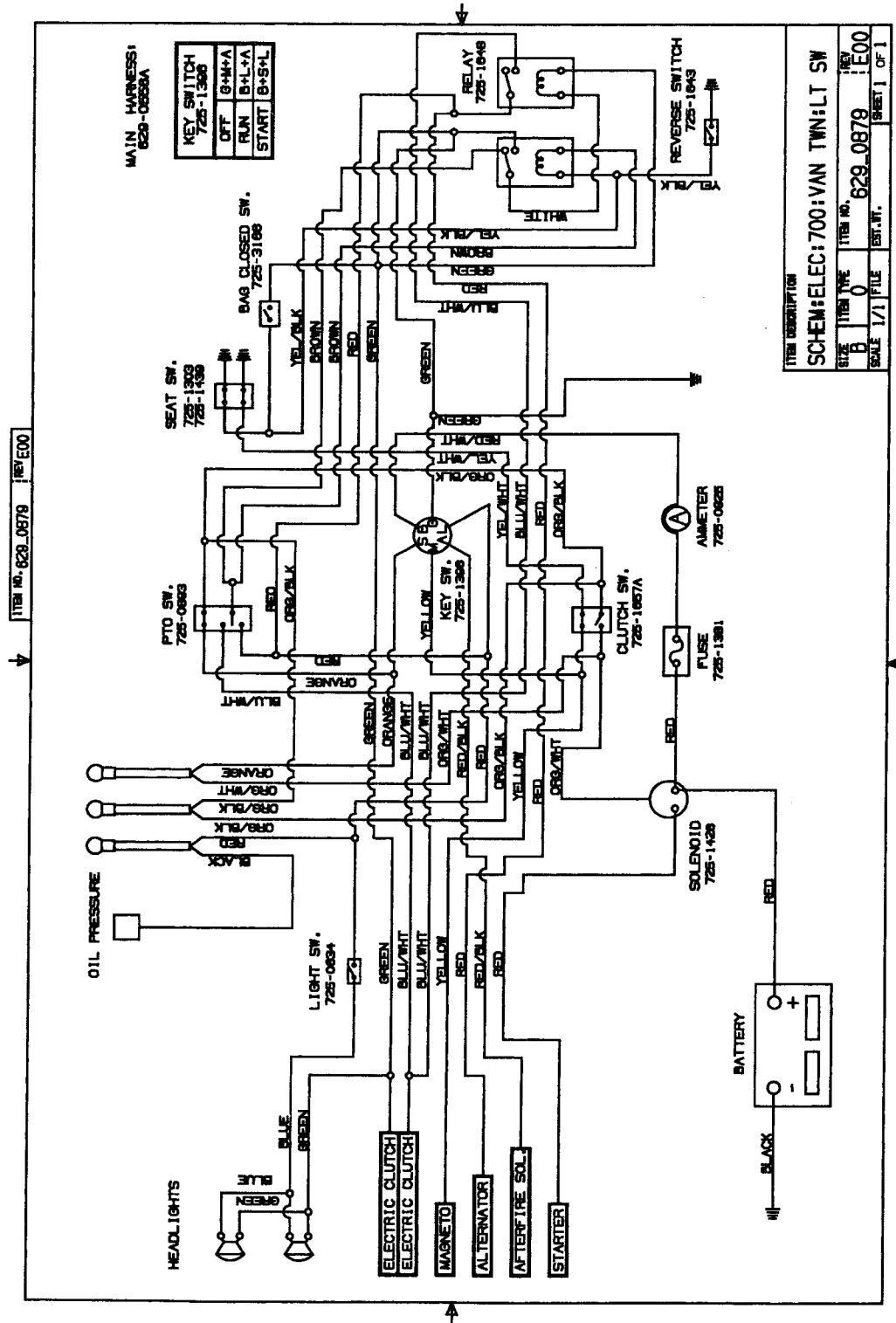


Figure 3-68.

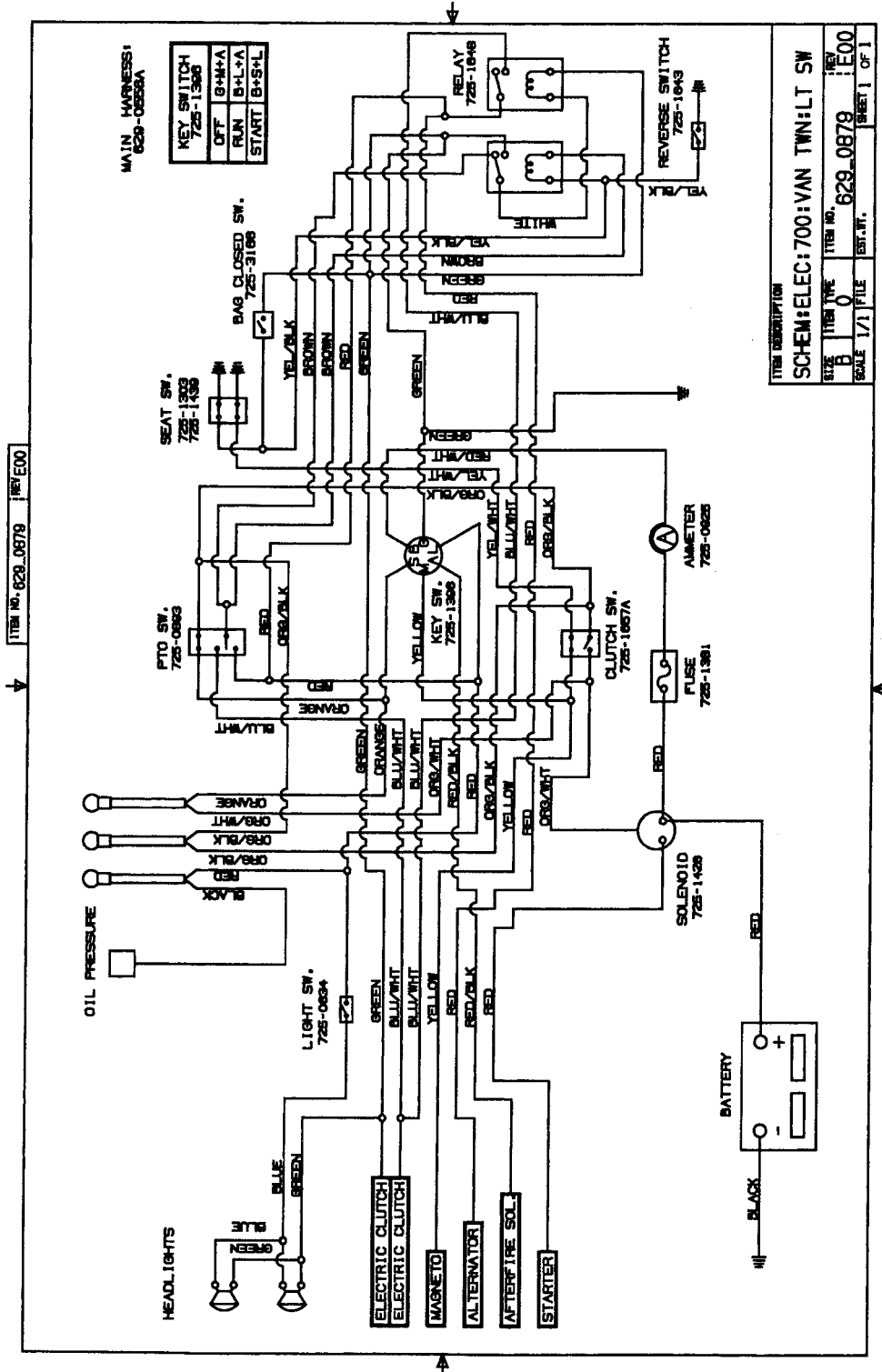


Figure 3-69.



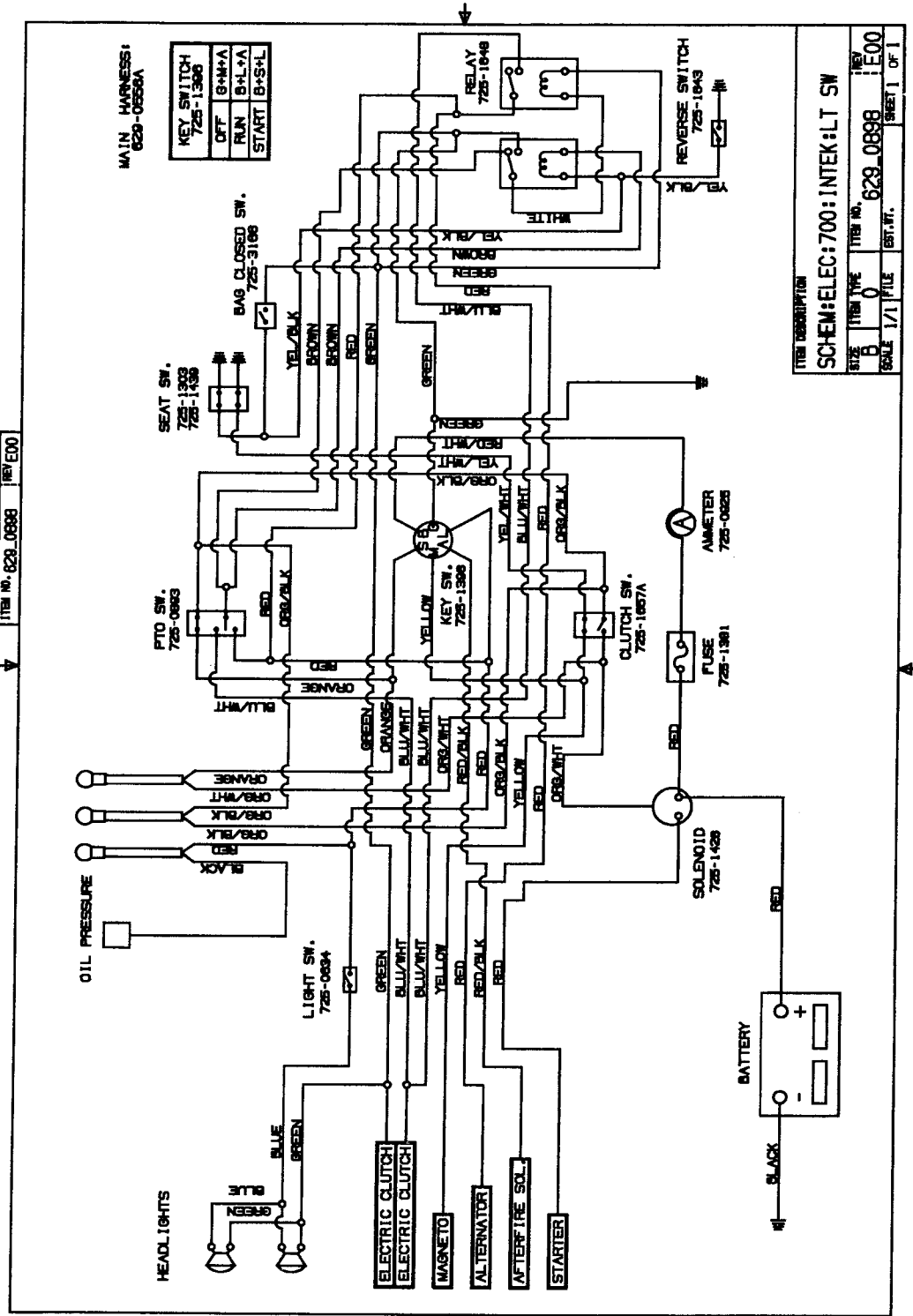


Figure 3-72.

3-4. PROCESS OF ELIMINATION.

- 3-4.1. The process of elimination is a rapid means of establishing the cause of circuit or component failure. The main requisite is to plan a sequence of tests and follow it. Haphazard circuit testing, with no plan in mind, can be the ultimate of frustration. The general plan in process of elimination is to being where the trouble presents itself and then in a step by step manner, locate the cause of trouble. Electrical current will not leave its source (battery, generator, etc.) unless it has a return path back to the source. This is one of the most important things to remember in troubleshooting. One of the major sources of circuit failure is unwanted resistance. This is resistance to the flow of electrons caused by loose connections, corroded connections and wire and faulty components. A lack of circuit resistance is also a major source of trouble. This is commonly known as a short and is caused by faulty components or wiring returning the flow of electrons back to the power source without going through the designed circuit resistance. The result of this reduction in circuit resistance is an increased flow of electrons causing heat, usually causing the destruction of wire, blowing of fuses, discharge of batteries or generator burnout.

3-5 . RESISTANCE.

- 3-5.1 Resistance is any restriction to the flow of electrons in an electrical circuit. All electrical circuits contain resistance. All electrical circuits function with a designed resistance. Increasing or decreasing the resistance from the designed resistance will render the electrical circuit inoperative. A loss of resistance will cause the circuit to overheat due to an increase of current flow. An increase of resistance will decrease the current flow and the circuit will cease to function.

3-6. MAGNETO IGNITION.

- 3-6.1 The magneto ignition also consists of a primary and secondary coil, ignition points and condenser. The magneto ignition is primarily used on small engines, both two and four cycle. It usually operated off flywheel magnets and in its simplest form can be a very economical ignition system.

3-7. GROUNDING.

- 3-7.1 Grounding is the practice of using a metal chassis, engine block or body as a means of providing a return path for electric current back to its source. This practice is economical and serves to simplify the wiring requirements. The importance of good grounding practice cannot be over emphasized. Virtually all of the direct current circuits in a vehicle are grounded as a means of return path to the power source. A faulty ground connection that may be a common ground point for two different electrical circuits can cause some interesting service problems. A tail lamp circuit with a faulty ground may allow the tail lamp to operate in a satisfactory manner. However, if the brake light circuit shares the same ground connection and the brakes are applied, the resistance of the faulty ground will not allow the added current from the brake light to pass and both tail and brake light may go out. Almost everyone who has ever towed a trailer with lights has been subject to the interesting problems posed by a faulty ground connection to the trailer. The popular use of plastic on dash components requires that a ground wire be connected from electrical devices on the dash to a ground point. If this connection becomes faulty, all dash connected circuits will fail to operate in the prescribed manner. For example: turn on the lights and the gas gauge will cease operation; turn on the directional lights and the radio will go on and off.

3-8 USE OF TEST INSTRUMENTS IN CIRCUIT REPAIR.

- 3-8.1 The repair of electrical circuits can be simplified by keeping in mind the behavior of electrical circuits as previously discussed, the operation of test instruments and a few simple facts. Unless a return path is provided, electrical current will never leave the source. The resistance to or failure of current to flow will be caused by:
1. Low power or no power at electrical source (dead battery, faulty generator or magneto, etc.).
 2. High circuit resistance caused by bad connections or faulty components. A burned out lamp will provide high resistance and no current will flow.

*Information courtesy of Briggs and Stratton Corporation.

3-9. EVALUATING ELECTRIC CLUTCHES.

3-9.1 Measure clutch coil resistance as follows:

1. Turn engine and PTO switch off.
2. Disconnect clutch wire connection.
3. Select meter to check ohms.
4. Connect meter lead wires to the wires in the clutch connector. See Figure 3-73.

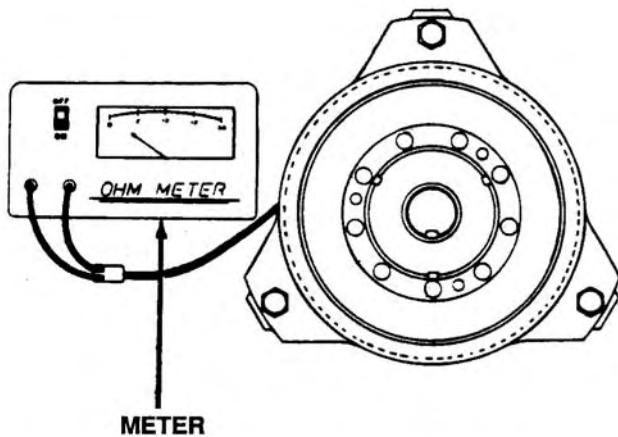


Figure 3-73. Measuring Clutch Coil Resistance

5. If meter reads below 2.40 ohms or above 3.40 ohms then the clutch has failed and needs to be replaced.
6. If meter reads between 2.40 and 3.40 ohms proceed to paragraph 3-9.2.

3-9.2 Measure clutch current draw as follows:

1. Turn engine off.
2. Disconnect clutch wire connection.
3. Select meter to check amps (10 amp scale).
4. Connect one meter lead wire to one wire in clutch connector and the other meter lead wire to the corresponding wire in the mating connector. See Figure 3-74.

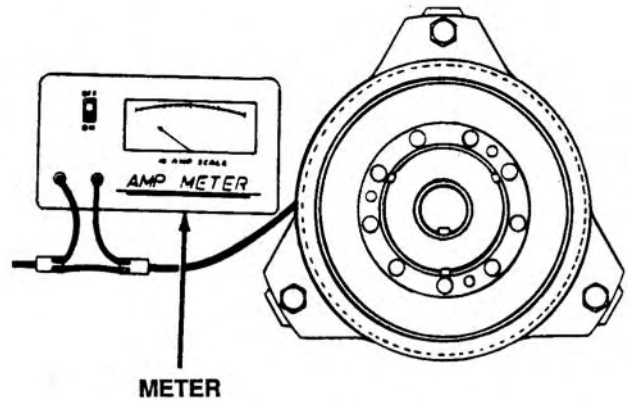


Figure 3-74. Measuring Clutch Current Draw

5. Connect a short wire to the second wire in both connectors.
6. Turn PTO switch on.
7. If meter reads below 3.5 amps, the problem would be in the electrical system leading to the clutch (battery, relay, switch, etc.). If meter reads 3.5 amps or above, proceed to paragraph 3-9.3.

3-9.3 Check air gap setting as follows:

1. Turn engine and PTO switch off.
2. Locate the three windows or notches where the air gap is checked. See Figure 3-75.

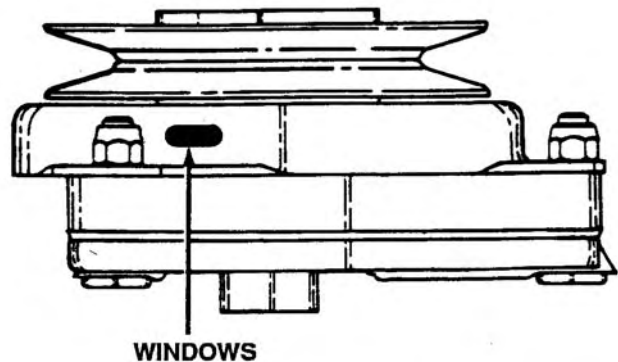


Figure 3-75. Checking Air Gap Setting

3. With feeler gauge check gap at all three locations (minimum of two).
4. Factory air gap setting is .010 to .025 inch.
5. If gap does not fall between .010 and .025 inch then reset using a .017 inch feeler gauge.

6. Changing the air gap is achieved by tightening and/or loosening the three nuts.



NOTE

The electric clutch, part number 717-0983, is used on the 600 and 700 units. The electric clutch, part number 717-0949, is used on the 800 series.

3-10. BURNISHING PROCEDURE FOR ELECTRIC CLUTCH/BRAKE.



NOTE

Burnishing is not done at the factory. It is the responsibility of the customer. It is to be performed after the tractor is completely assembled.

3-10.1 Burnish clutch/brake as follows:

1. Run engine at 50 percent throttle.
2. Engage and disengage the clutch 5 times (10 seconds on/10 seconds off).

3. Increase to 75 percent throttle.
4. Engage and disengage the clutch 5 times (10 seconds on/10 seconds off).
5. If you have a unit with an electric clutch that operates sporadically:
 - a. Check all wiring around the steering column going to the dash. 1991 production models have a one piece steering shaft to minimize fraying of wires going to the dash.
 - b. Check the relays for proper connections. Newer models have in line relays used to minimize failure due to vibration. If the relays are mounted to the chassis you can remove them and tape them directly to the wiring harness.
 - c. Check the PTO switch for proper connections. The red and blue wires might be reversed. The red wire should be on top and the blue wire directly below it. The brown wire would be on the opposite side.

