

APPENDIX D

ELECTRICAL SCHEMATICS AND CIRCUIT DESCRIPTIONS

D-1. GENERAL.

D-1.1 This appendix contains electrical schematics for all tractors covered in this manual, along with a general description of each working circuit within the schematic.

D-1.2 All switches shown in the electrical schematics are depicted (normally open/normally closed) in their non-engaged position.

D-1.3 The information provided is schematically correct; however, some wire connections may not be located as shown. In many cases the connection is made at the terminal connector (resulting in multiple wires at the connectors).

D-1.4 The following applies to all tractors covered in this manual and will be considered as understood when describing the circuit functions: Battery voltage should always be present at one large terminal of the solenoid via the positive battery cable; and at terminal B of the key switch, through a circuit consisting of a red wire connecting the large solenoid terminal (or positive battery terminal) to the fuse and a black wire connecting the fuse to the B terminal of the key switch. Because the circuit is incomplete, there should be no current flow (amperage) with the key switch in the off position.

D-2. CIRCUIT DESCRIPTION AND SCHEMATICS (All Models).

D-2.1 **General.** The Engine Crank and Engine Run circuits of Models 2160, 2165 and 2185 differ slightly from those of Models 2130, 2135, 2140 and 2145. Therefore, separate schematics and descriptions are included for the Models 2160, 2165 and 2185.

D-2.2 **Function: Engine Cranking - Models 2130, 2135, 2140 and 2145 (Refer to Figure D-1).** Observe the following to start the engine.



WARNING

Operator must be in the seat when starting the engine.

1. The brake pedal must be depressed.
2. The PTO switch must be in the off position.
3. The key switch must be turned to the start position.
 - a. Current flows through the key switch from terminal B to terminal S. From terminal S, current flows through an orange wire to terminal 2 of the PTO switch. With the PTO switch in the off position, current passes through the closed contacts to terminal 1 and on to the interlock switch through the orange wire.
 - b. With the brake pedal depressed, the normally open contacts of the interlock switch are closed. Current passes across the now closed contacts and through the orange wire to the starter solenoid. The solenoid is engaged and the contacts are closed, allowing current to flow from the battery to the starter which cranks the engine over.

D-2.3 **Function: Engine Cranking - Models 2160 and 2165 (Refer to Figure D-2).** Observe the following to start the engine.



WARNING

Operator must be in the seat when starting the engine.

1. The brake pedal must be depressed.
2. The PTO switch must be in the off position.
3. The key switch must be turned to the start position.
 - a. Current flows through the key switch from terminal B to terminal S. From terminal S, current flows through an orange wire to terminal 2 of the PTO switch. With the PTO switch in the off position, current passes through the closed contacts to terminal 1 and on to the interlock switch through the orange wire.

- b. With the brake pedal depressed, the normally open contacts of the interlock switch are closed. Current passes across the now closed contacts and through the orange wire to the starter solenoid. The solenoid is activated, allowing current to flow from the battery to the starter which cranks the engine over.
- c. With the starter solenoid activated, battery current at the starter is also picked up by a red wire connected to the starter cable terminal. Current flows through a diode assembly and a red wire to the carburetor fuel solenoid, activating the fuel solenoid. This allows fuel flow in the carburetor when the key switch is in the start position.

D-2.4 Function: Engine Cranking - Model 2185 (Refer to Figure D-3). Observe the following to start the engine.



WARNING

Operator must be in the seat when starting the engine.

1. The brake pedal must be depressed.
2. The PTO switch must be in the off position.
3. The key switch must be turned to the start position.
 - a. Current flows through the key switch from terminal B to terminal S. From terminal S, current flows through an orange wire to terminal 2 of the PTO switch. With the PTO switch in the off position, current passes through the closed contacts to terminal 1 and on to the interlock switch through the orange wire.
 - b. With the brake pedal depressed, the normally open contacts of the interlock switch are closed. Current passes across the now closed contacts and through the orange wire to the starter solenoid. The solenoid is engaged and the contacts are closed, allowing current to flow from the battery to the starter which cranks the engine over.

- c. Battery current from the orange wire also flows through a wire (normally red) and diode in the engine wire harness to the carburetor fuel solenoid. This circuit supplies power to the fuel solenoid, allowing fuel flow in the carburetor when the key switch is in the start position.

D-2.5 Function: Engine Run and Charging - Models 2130, 2135, 2140 and 2145 (Refer to Figure D-4). Observe the following.

1. The operator must be in the seat or the brake pedal must be depressed.
2. The operator must be in the seat if the PTO switch is in the on position.
3. The key switch must be in the run position.
 - a. Battery current passes from terminal B to terminal R of the key switch. From terminal R, current passes through a red wire to the regulator/rectifier of the engine, activating the regulator. With the engine running, alternating current (AC) is produced by the engine alternator and converted to direct current (DC) by the rectifier. This DC current flows in the reverse direction through this same circuit (red wire) to the positive terminal of the battery and maintains the battery charge.
 - b. With the PTO switch in the off position and the tractor in neutral or forward drive, current flows from the R terminal to the reverse switch through a red wire. Current passes across the closed reverse switch and on to the coil of the reverse relay through a white wire, through the relay coil, and on to terminal 7 of the PTO switch through a brown wire. With the PTO off, the contacts of terminals 7 and 5 are closed and the circuit is completed to ground. This energizes the relay, closing the relay points and providing this circuit with a second source to ground.
 - c. Battery current also flows from the R terminal through a red wire to the hourmeter, activating the hourmeter.
 - d. Battery *voltage* from terminal R is supplied through red wires to the PTO clutch, dash lights, and voltage sensor. No current flow (amperage) is present until conditions are met that will complete each circuit to ground.

D-2.6 Function: Engine Run and Charging - Models 2160 and 2165 (Refer to Figure D-5). Observe the following.

1. The operator must be in the seat or the brake pedal must be depressed.
2. The operator must be in the seat if the PTO switch is in the on position.
3. The key switch must be in the run position.
 - a. Battery current passes from terminal B to terminal R of the key switch. From terminal R, current passes through a red wire to the regulator/rectifier of the engine, activating the regulator. With the engine running, alternating current (AC) is produced by the engine alternator and converted to direct current (DC) by the rectifier. This DC current flows in the reverse direction through this same circuit (red wire) to the positive terminal of the battery and maintains the battery charge. Battery current and/or charge current is also supplied to the carburetor fuel solenoid through a red wire, keeping the solenoid activated.
 - b. With the PTO switch in the off position and the tractor in neutral or forward drive, current flows from the R terminal to the reverse switch through a red wire. Current passes across the closed reverse switch and on to the coil of the reverse relay through a white wire, through the relay coil, and on to terminal 7 of the PTO switch through a brown wire. With the PTO off, the contacts of terminals 7 and 5 are closed and the circuit is completed to ground. This energizes the relay, closing the relay points and providing this circuit with another source to ground.
 - c. Battery current also flows from the R terminal through a red wire to the hourmeter, activating the hourmeter.
 - d. Battery *voltage* from terminal R is supplied through red wires to the PTO clutch, dash lights, and voltage sensor. No current flow (amperage) is present until conditions are met that will complete each circuit to ground.

D-2.7 Function: Engine Run and Charging - Model 2185 (Refer to Figure D-6). Observe the following.

1. The operator must be in the seat or the brake pedal must be depressed.
2. The operator must be in the seat if the PTO switch is in the on position.
3. The key switch must be in the run position.
 - a. Battery current passes from terminal B to terminal R of the key switch. From terminal R, current passes through a red wire to the regulator/rectifier of the engine, activating the regulator. With the engine running, alternating current (AC) is produced by the engine alternator and converted to direct current (DC) by the rectifier. This DC current flows in the reverse direction through this same circuit (red wire) to the positive terminal of the battery and maintains the battery charge. Battery current and/or charge current is also supplied to the carburetor fuel solenoid through a wire (normally red) and diode in the engine wire harness, keeping the solenoid activated.
 - b. With the PTO switch in the off position and the tractor in neutral or forward drive, current flows from the R terminal to the reverse switch through a red wire. Current passes across the closed reverse switch and on to the coil of the reverse relay through a white wire, through the relay coil, and on to terminal 7 of the PTO switch through a brown wire. With the PTO off, the contacts of terminals 7 and 5 are closed and the circuit is completed to ground. This energizes the relay, closing the relay points and providing this circuit with a second source to ground.
 - c. Battery current also flows from the R terminal through a red wire to the hourmeter, activating the hourmeter.
 - d. Battery *voltage* from terminal R is supplied through red wires to the PTO clutch, dash lights, and voltage sensor. No current flow (amperage) is present until conditions are met that will complete each circuit to ground.

D-2.8 Function: Normal and Safety Engine Shutdown - All Models (Refer to Figure D-7).

1. *Normal Engine Shutdown.* A yellow wire runs from the engine wire harness to the M terminal of the key switch. The corresponding wire of the engine harness connects to the grounding terminal of the ignition module(s). When the key switch is turned to the off position, contact is closed between terminals M and G. The ignition module is grounded and engine shutdown occurs.
2. *Safety Engine Shutdown.* A second yellow wire runs to the normally closed seat switch. If the operator is **not** in the seat, the circuit continues through a yellow wire to the normally closed interlock switch and also to terminal 3 of the PTO switch. If the brake pedal is not depressed, the circuit is completed to ground and the engine is shut down. The operator cannot leave the seat without locking down the brake pedal. If the PTO switch is in the on position, contact between terminals 3 and 4 is closed, completing the circuit to ground and shutting down the engine. The operator cannot leave the seat when the PTO switch is on.

D-2.9 Function: PTO Start and Run - All Models (Refer to Figure D-8).



WARNING

The operator must be in the seat when operating the PTO.

1. Battery voltage from terminal R of the key switch is available at the PTO clutch through a red wire, and also at terminal 6 of the PTO switch through the clutch field coil and a blue wire. Because the circuit is incomplete, no current flows and the PTO clutch is not engaged.
2. As noted previously in the **Engine Run** descriptions, when the PTO switch is in the off position and the tractor in neutral or forward drive, current flows from the R terminal of the key switch to the reverse switch through a red wire. Current passes across the closed reverse switch and through a white wire to the coil of the reverse relay, through the relay coil, and on to terminal 7 of the PTO switch through a brown wire. With the PTO off, the contacts of terminals 7 and 5 are closed and the circuit is completed to ground. This closes the relay points and provides this circuit with a second source to ground.
3. When the PTO switch is moved to the on position, continuity between terminals 5 and 7 is broken and terminals 6 and 7 are closed. The opening of terminals 5 and 7 eliminates one source to ground and the relay coil must now ground through the relay points to remain energized. The closing of terminals 6 and 7 provides the blue wire from the PTO clutch a source to ground through a brown wire and the relay points, thus completing the PTO circuit and engaging the PTO clutch.
4. When the reverse drive pedal is depressed, the reverse switch is actuated and the switch contacts are opened. This breaks the circuit energizing the relay coil, causing the relay points to open. The opening of the relay eliminates the source of ground for the PTO clutch circuit and the clutch disengages.
5. When the reverse drive pedal is released, the reverse switch closes and battery *voltage* is again available to the relay coil. However, because the PTO switch is in the on position and the relay points are open, the circuit cannot be completed. The PTO switch must be moved to the off position, closing terminals 5 and 7, to complete the circuit and re-activate the relay.

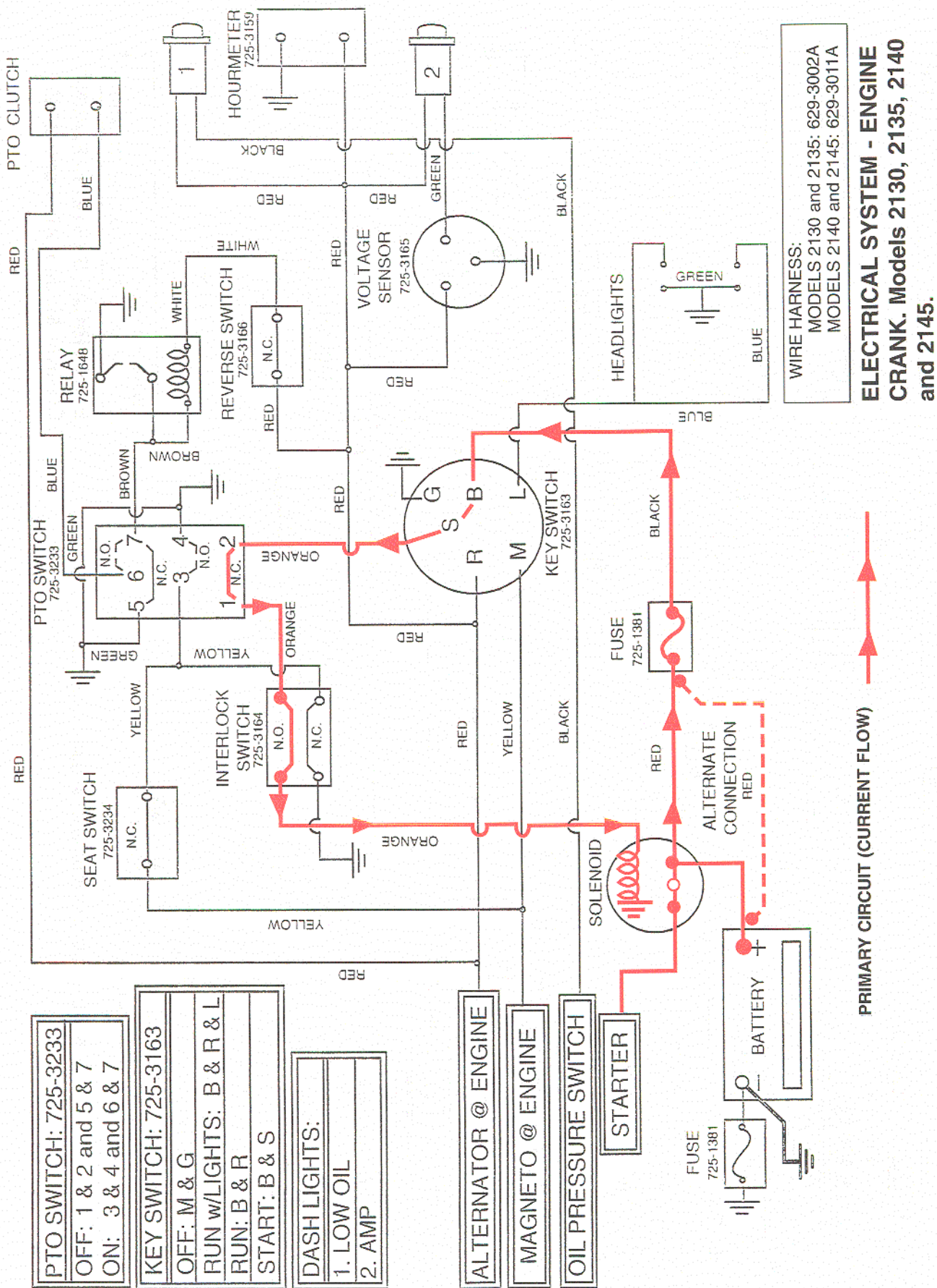
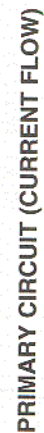


Figure D-1. Engine Crank, Models 2130, 2135, 2140 and 2145



D-6



D-7

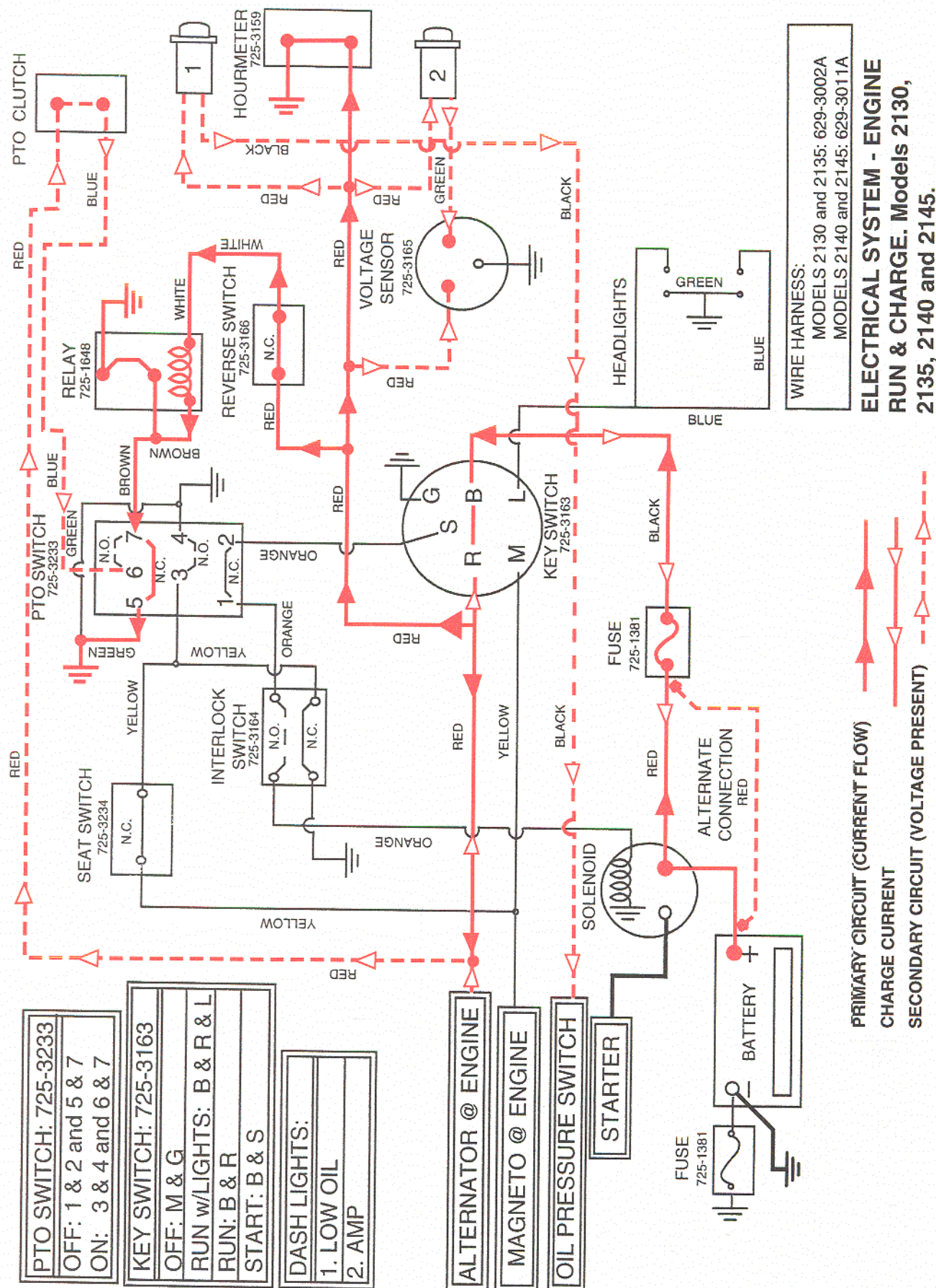


Figure D-4. Engine Run and Charging Circuit, Models 2130, 2135, 2140 and 2145.

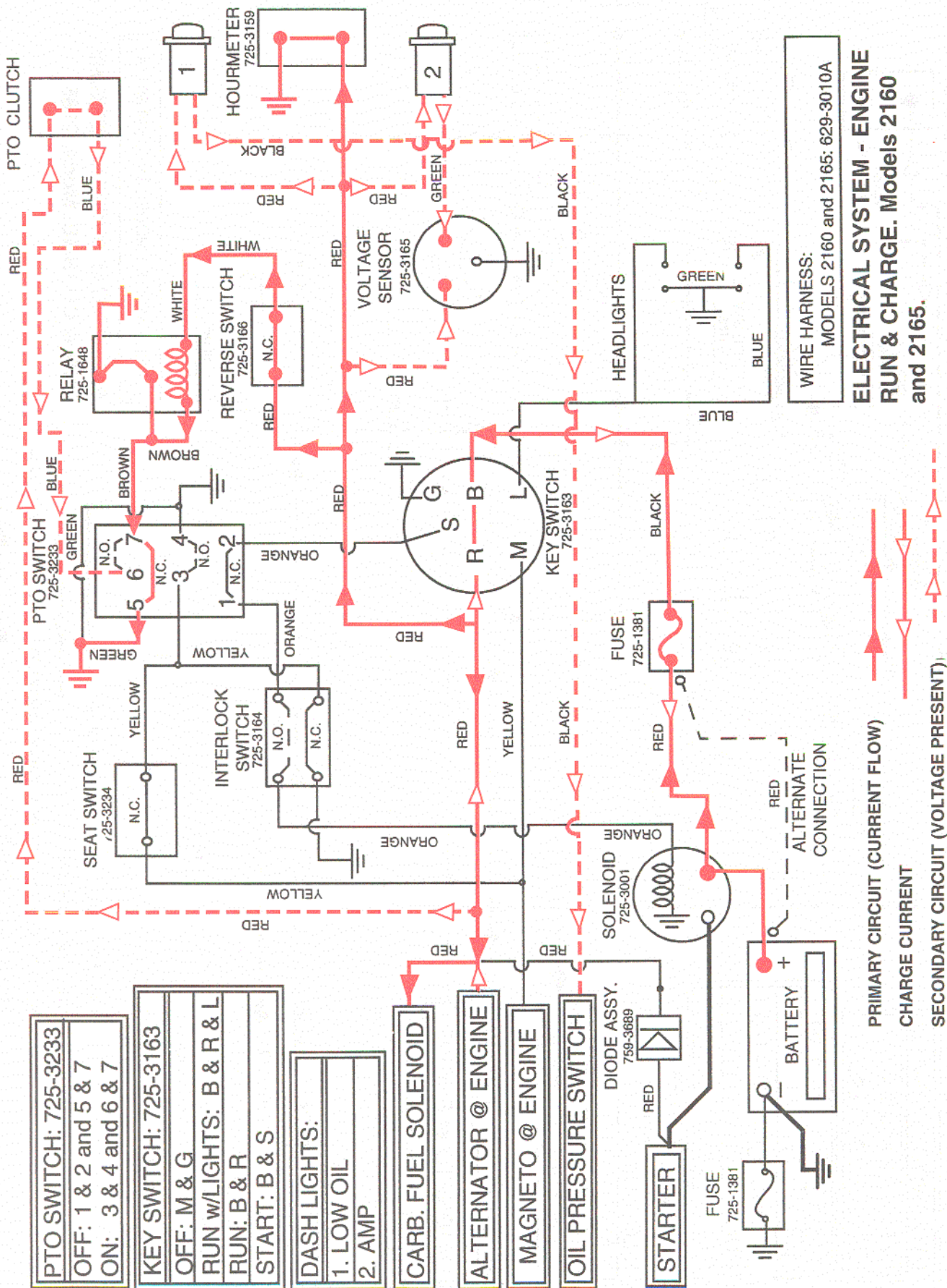


Figure D-5. Engine Run and Charging Circuit, Models 2160 and 2165.

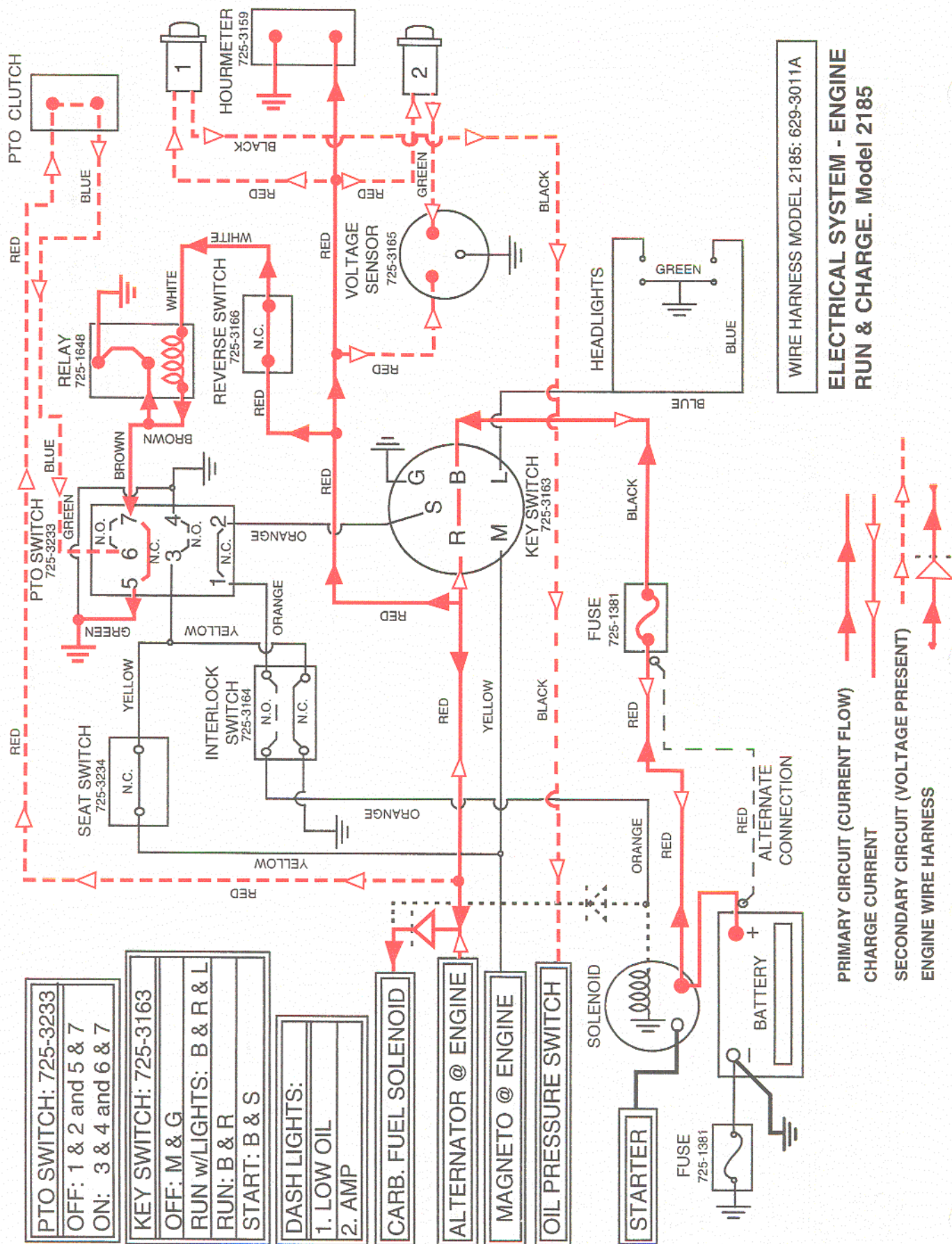


Figure D-6. Engine Run and Charging Circuit, Model 2185.
 D-10

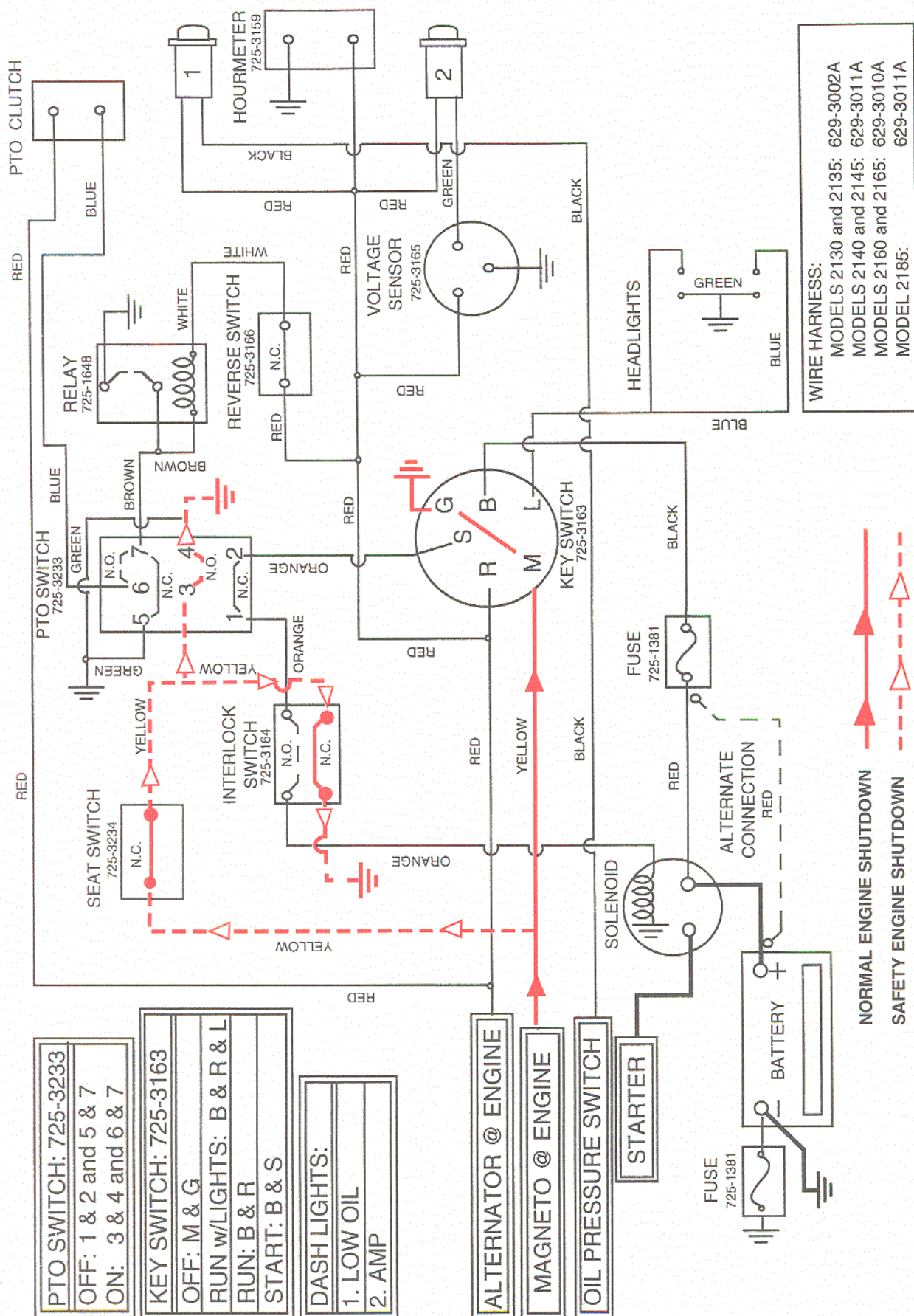


Figure D-7. Normal/Safety Engine Shutdown, ALL MODELS.
 D-11

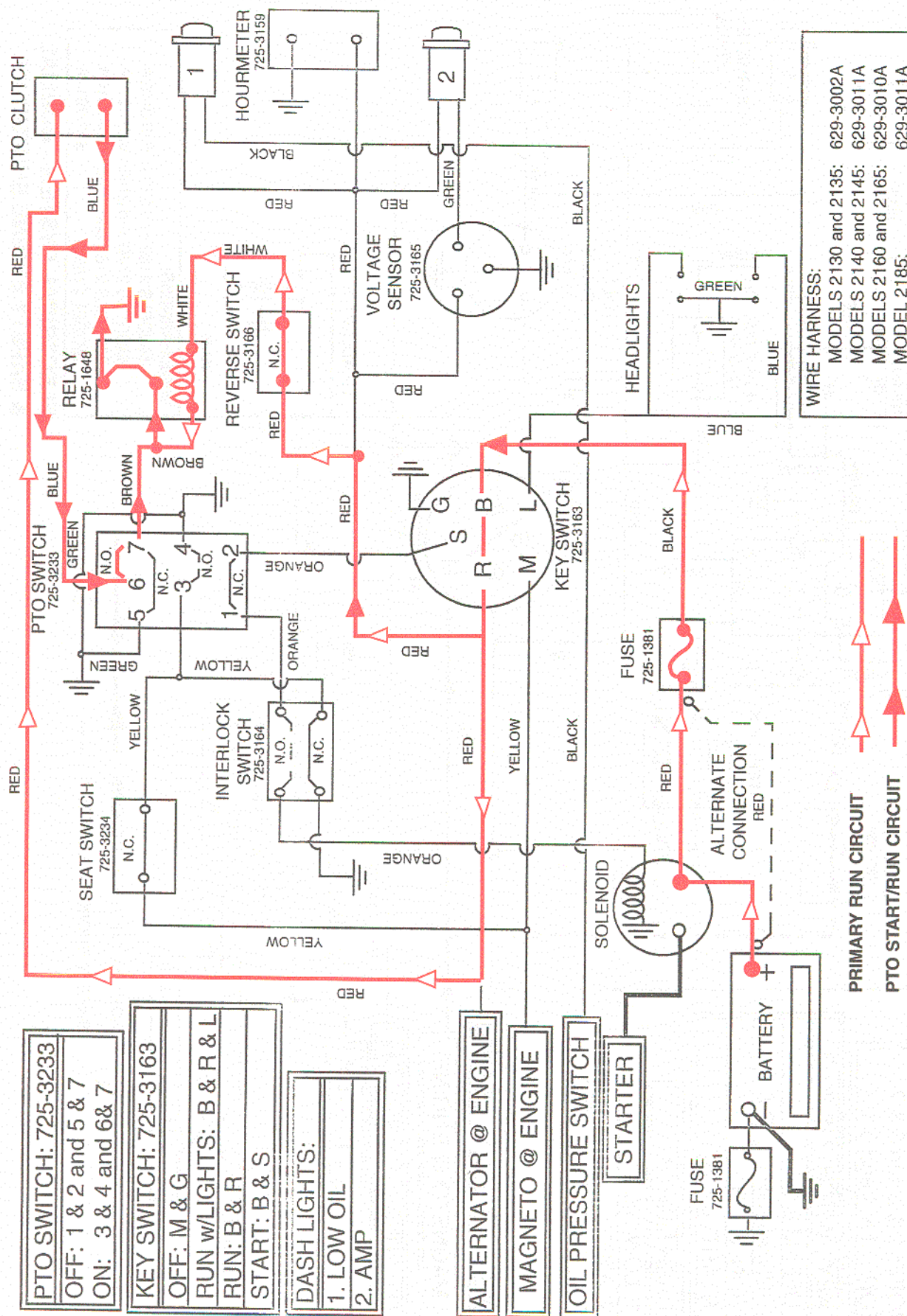


Figure D-8. PTO Start/Run, ALL MODELS.
D-12