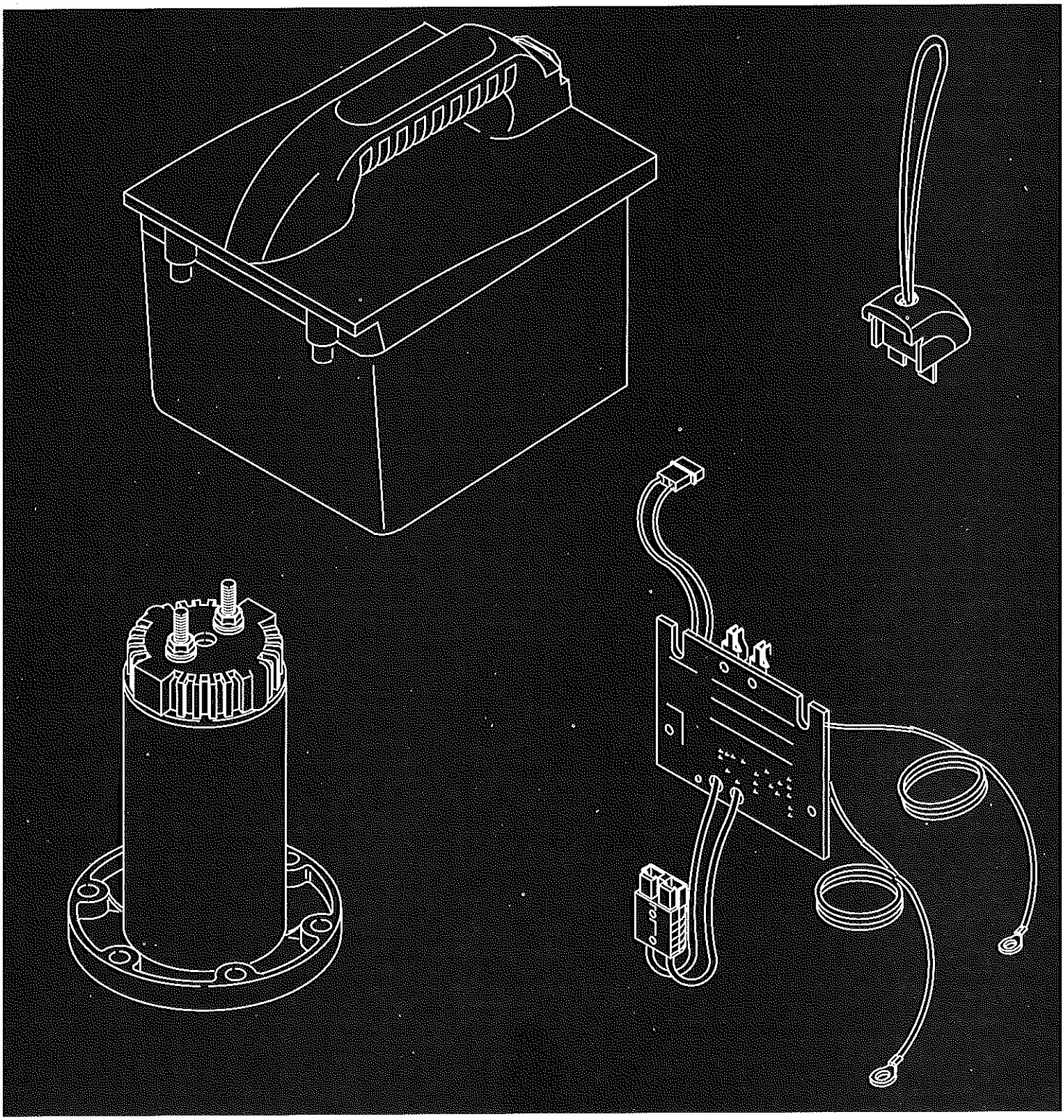
Repair Manual for Briggs & Stratton Power Pack System for BE 2010 Lawn Mower



Briggs & Stratton Corporation Milwaukee, Wisconsin 53201

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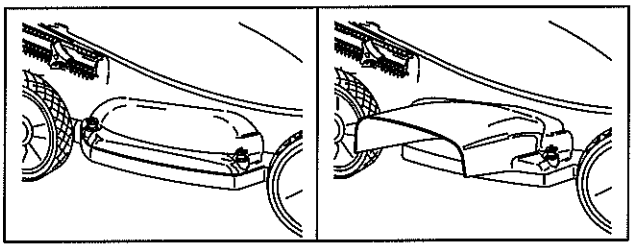
FORM MS-0900-12/95

FOREWORD

Briggs & Stratton is participating in the manufacturing of a battery powered electric lawn mower, Model BE 2010, consisting of a replaceable battery pack, circuit board, motor and solenoid with safety interlocks. A charger and a "Y"-connector for multiple battery charging are included with the lawn mower. The lawn mower is convertible from mulching to side discharge. Specifications are:



Mulching **Side Discharge**

Motor ..... 30 amp permanently lubricated
Battery pack .... 24 volt DC, 9 amp-hr, sealed lead acid
Battery charger ..... 120 volt AC 60 Hz
Typical run time from full charge (1 battery) ... 30/45 mins
Time to charge fully ..... (1 battery pack) 16 hrs
(2 battery packs with "Y"-connector) 24 hrs

In the event service is required, parts, service and warranty information will be provided by two sources: Briggs & Stratton and the participating lawn mower supplier. Briggs & Stratton provides parts (shown below) and servicing and warranty information in this Repair Manual for the Power Pack System. The participating lawn mower supplier will provide parts and servicing and warranty information on all other components of the lawn mower.

Servicing a Briggs & Stratton Power Pack System requires a knowledge of electric motors and the tools to perform tests and make repairs. See Section 1.

Terms INSPECT and CHECK are used as follows:

INSPECT – visually looking for damage, wear, bent or burnt parts, correct assembly, etc.

CHECK – measure by means of meter, scale, micrometer, torque wrench, etc.

TABLE OF CONTENTS

Section 1
GENERAL INFORMATION

BE 2010 Lawn Mower Theory of Operation

The BE 2010 lawn mower is an electric lawn mower powered by a self-contained power pack system consisting of battery pack, circuit board, motor and solenoid as well as safety interlocks.

It is important to remember when troubleshooting the power pack system that there are several safety interlock systems. They include a reed switch (supplied by participating lawn mower supplier), a control handle switch and a key switch. All interlocks must be connected and functional before the mower will operate. They provide safeguards for the servicing technician as well as the operator.

The control handle switch is an operator presence system. A yellow button on the side of the control handle must be depressed before the handle can be engaged. This system ensures that the operator is behind the mower when the mower is running.

The reed switch is a magnetic interlock system. There is no physical (electrical) connection between the chute which contains the magnet and the switch itself. When either the cover or the chute is removed, the switch opens, preventing mower operation.

The key switch is a simple jumper system that connects the battery pack to the circuit board. Without the key in place, the motor will not operate.

The solenoid plays a dual role in this power pack system, providing both a high current connection/switch to the motor and a system of dynamic braking for the motor (blade). When battery voltage energizes the solenoid through two small terminals on the side of the solenoid, two large terminals, also on the side of the solenoid, have continuity. This allows high current to flow through the solenoid and actuate the motor through terminals (studs) on top of the motor bearing cap. When the solenoid is not energized, two large terminals on top of the solenoid have continuity, but the large side terminals do not. When battery power is removed from the circuit, the electric motor generates power by induction, as it coasts down, and shunts this power through the top terminals of the solenoid. This creates a load on the motor which causes it to stop rapidly. This process is known as dynamic braking.

The 24 volt motor contains no serviceable parts and, because it is sealed, requires little maintenance. The motor must receive a minimum of 23.5 volts from the battery pack through a circuit board and the solenoid in order to run.

The circuit board is also sealed and contains no serviceable parts. Push down on the Mini Breaker® (circuit breaker), and the system will reset itself.

The battery pack itself is 24 volt lead acid. A charger, converting a 120 volt 60 Hz signal from a wall socket to 24 volt DC 18W current, charges the battery pack. A "Y"-connector is provided so that two battery packs can be charged simultaneously. Neither the batteries nor the wiring encased in the battery pack are serviceable.

Safety

⚠ ALWAYS KEEP HANDS AND FEET CLEAR OF MOVING AND ROTATING PARTS.

Do not bypass safety devices. Check for proper operation.

Do not attempt to make an equipment adjustment while the motor is running.

Before servicing power pack system, make sure all moving and rotating parts have stopped.

Remove key to prevent accidental starting.

⚠ Remove battery pack, before servicing blade or tipping lawn mower.

Wrap blade or use gloves when servicing a lawn mower blade.

When replacing a blade use only the replacement blade specified for the lawn mower.

⚠ A.N.S.I. Standard Specifications for rotary power lawn mowers specify a maximum blade tip speed of 19,000 feet per minute (5,791 meters per minute), primarily to reduce the danger from thrown objects.

⚠ Neither the batteries nor the connectors in the battery pack are serviceable. Contact with connectors or terminals may cause severe burns.

Do not clean mower by pouring or spraying water on it.

Do not run lawn mower in the rain or wet grass.

Keep motor free of chaff, debris and dirt.

Maintenance

The motor in this power pack system does not require lubrication.

The motor cooling system should be cleaned at least annually. Brush built up grass, chaff or dirt out of the grooves of the end cap and the motor base (inset).

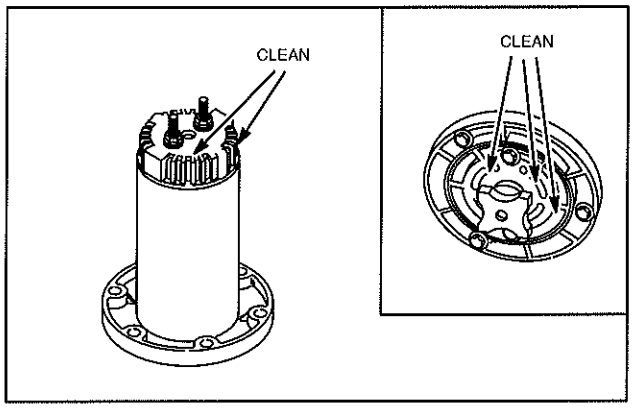


Fig. 1 – Motor

Specifications

Motor ..... 30 amp permanently lubricated
Battery pack 24 volt DC, 9 amp-hr, sealed lead acid
Battery charger ..... 120 volt AC 60 Hz
Typical run time from full charge ..... 30/45 mins
Time to charge fully ..... (1 battery pack) 16 hrs
(2 battery packs with "Y"-connector) 24 hrs
Operating temperature ..... 40° to 120° F
Storage temperature ..... –40° to 104° F

Tools

Box wrenches (3/8", 7/16", 1/2" & 5/8").
Torx driver (T20).
Torque wrench (300 in. lbs. max). Order from your Briggs & Stratton source of supply (Tool #19393).
Digital multimeter. Order from your Briggs & Stratton source of supply (Tool #19357 or #19390).

Digital Multimeter

The Briggs & Stratton digital multimeter, Tool #19357 or Tool #19390, will test the components of this power pack system. Order from your source of supply.

1. For all tests, insert:
   a. RED test lead into V Ω ⊣⊢ receptacle in meter,
   b. BLACK test lead into COM receptacle in meter.
2. For continuity tests:
   a. Meter will emit a continuous tone and display .000 indicating continuity (complete circuit),
   b. Meter will emit no tone and display OL indicating no continuity (incomplete circuit).

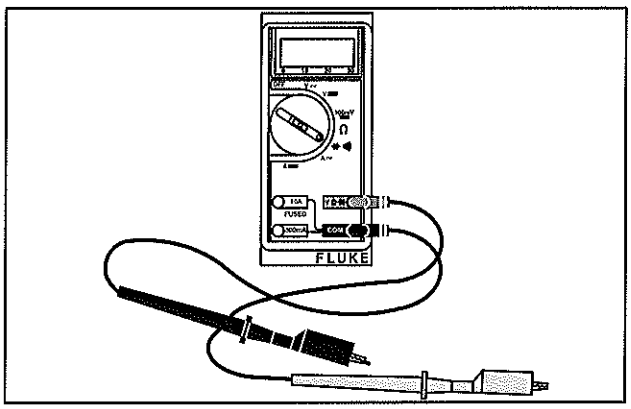
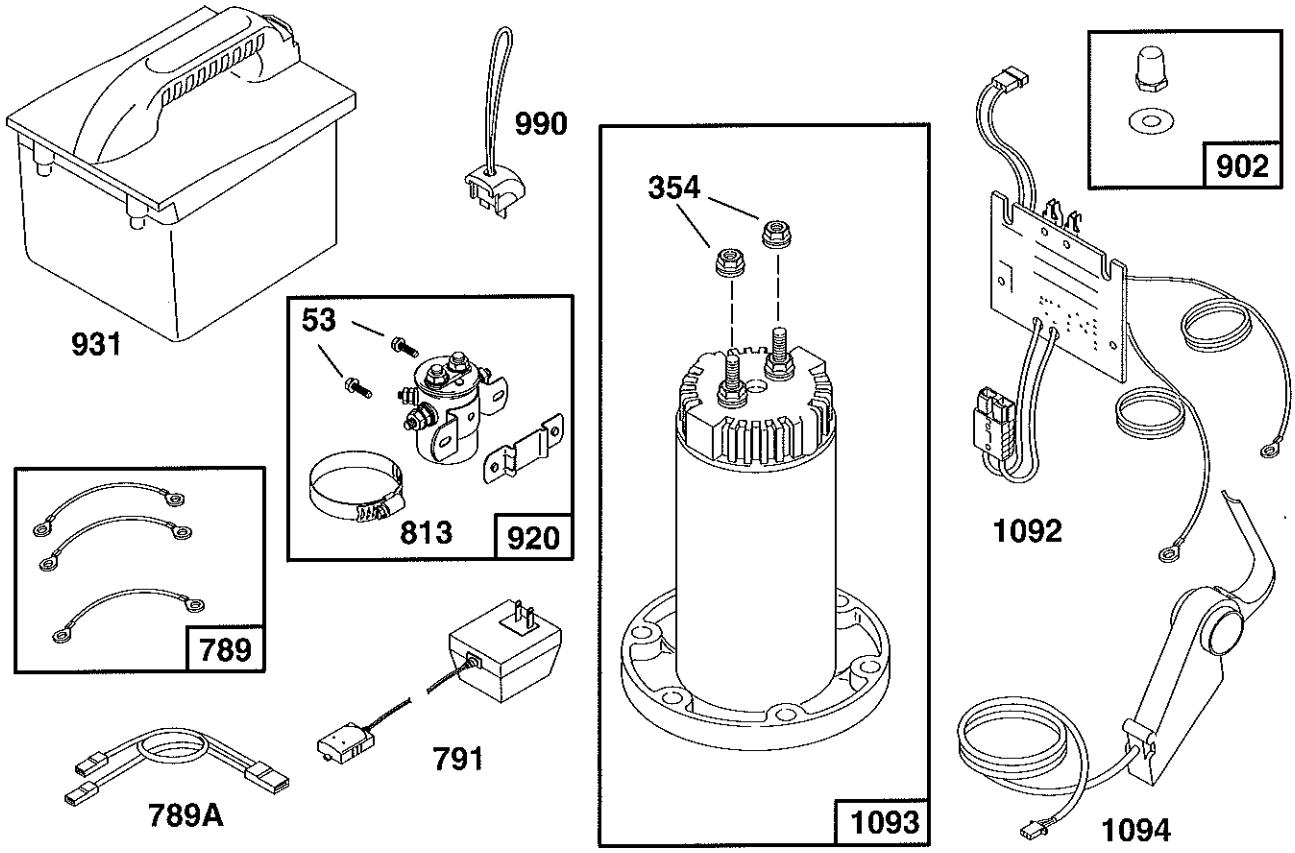


Fig. 2 – Digital Multimeter, Tool #19357 or 19390



REF. NO.	PART DESCRIPTION
53	Screw–Phillips Hex.
354	Nut–Hex.
789	Harness–Wiring
789A	Wire Assembly (Battery Charger)
791	Charger–Battery
813	Clamp
902	Grommet (Circuit Breaker)
920	Solenoid

REF. NO.	PART DESCRIPTION
931	Battery
990	Key Set
	——Note——
	498271 Key Set Used on Type No(s). 0122–01.
1092	Module–Control
1093	Motor
1094	Control–Motor

* Because service information is subject to change, service replacement part numbers are not listed here. Refer to current Illustrated Parts List (MS-1065) for current service replacement part numbers.

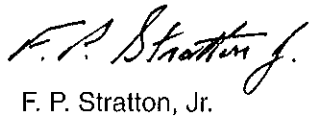
WARRANTY

BRIGGS & STRATTON POWER PACK SYSTEM WARRANTY POLICY
effective January 1, 1995

LIMITED WARRANTY

"Briggs & Stratton Corporation will repair or replace, free of charge, this component part or parts of the lawn mower, as listed below,that are defective in material or workmanship or both. This warranty is effective for the time periods and subject to the conditions provided for in this policy. For warranty service contact your nearest Authorized Service Dealer as listed in the 'Yellow Pages™' under 'Lawn Mowers' or similar category. Transportation charges and parts submitted for repair or replacement under this warranty must be born by purchaser. THERE IS NO OTHER EXPRESS WARRANTY. IMPLIED WARRANTIES, INCLUDING THOSE OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED TO ONE YEAR FROM PURCHASE, OR TO THE EXTENT PERMITTED BY LAW ANY AND ALL IMPLIED WARRANTIES ARE EXCLUDED. LIABILITY FOR CONSEQUENTIAL DAMAGES UNDER ANY AND ALL WARRANTIES ARE EXCLUDED TO THE EXTENT EXCLUSION IS PERMITTED BY LAW. Some states do not allow limitations on how long an implied warranty lasts, and some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation and exclusion may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from state to state."

Briggs & Stratton Corporation



F. P. Stratton, Jr.
Chairman and Chief Executive Officer

WARRANTY PERIOD

POWER PACK SYSTEM (KEY, CONTROL LEVER, CIRCUIT BOARD, MOTOR, SOLENOID, CHARGER AND "Y"-CONNECTOR, IF EQUIPPED)	2 YEARS
BATTERY PACK	1 YEAR

This warranty policy shall apply to "consumer use" means personal residential household use by the original retail consumer.

NO WARRANTY REGISTRATION CARD IS NECESSARY TO OBTAIN WARRANTY ON BRIGGS & STRATTON POWER PACKS. YOU MUST SAVE THE PURCHASE RECEIPT. A PROOF OF PURCHASE DATE WILL BE REQUIRED TO OBTAIN WARRANTY.

Section 2
TROUBLESHOOTING, TEST PROCEDURES AND DISASSEMBLY

TROUBLESHOOTING

Remove key and battery pack before servicing blade or tipping lawn mower.

Remove key and battery pack to test Power Pack System unless a test requires that they be installed.

Clean terminals of dirt, debris and any foreign material that would prevent good electrical connections.

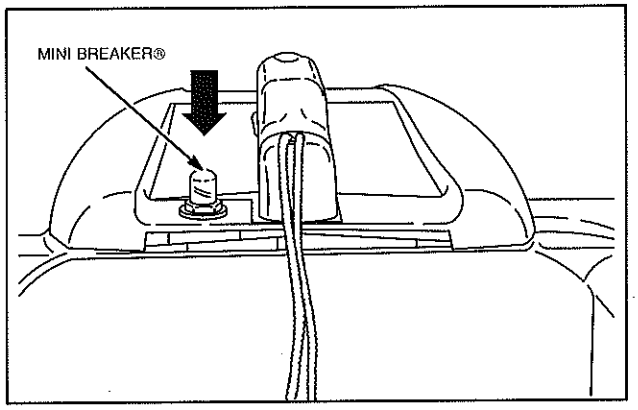


Fig. 1 – Mini Breaker®

1. Motor does not start when control lever is engaged or Mini Breaker® is reset with key in place. Test power pack system and replace any component that fails any test on the following pages:
   c. Charger (and "Y"-connector, if used), page 10,
   d. Battery pack, page 10,
   e. Solenoid, page 11,
   f. Motor, page 11
   g. Reed switch, page 12
   h. Control lever, page 12, and
   i. Circuit board, page 13.

2. Motor stops and cannot be restarted.
   a. Reset Mini Breaker®.
   b. Inspect for bound/seized motor shaft.
   c. Check battery pack.
   d. Inspect and test solenoid.
   e. Inspect and test circuit board.

3. Excessive vibration.
   a. Check motor mounting and motor shaft bolt torques. Torque to specifications.
   b. Inspect for bent motor shaft.
   c. Check blade for balance. Re-balance.

4. Motor does not stop when control lever is released.
   a. Inspect and test control lever, wires and connectors.
   b. Inspect and test solenoid.
   c. Inspect and test circuit board.

5. Poor equipment performance or loses power during operation.
   a. Motor designed to cut moderate grass. Raise mower cutting height.
   b. Check orientation of blade. If upside down, reinstall blade correctly. Sharpen if required.
   c. Check rotation of motor shaft. (When viewed from below, CW is wrong direction.) Switch leads from one motor terminal to the other.

TEST PROCEDURES AND DISASSEMBLY

Charger Test and "Y"-connector

(optional accessory for charging both battery packs at once)

Plug charger into wall outlet.

Rotate meter selector to V ⎓.

1. Attach test leads to terminals in charging socket. Meter should register 28 volts DC, minimum.

- If reading is less than 28 volts DC, replace charger.

Connect "Y"-connector, if equipped, to charging socket.

2. Attach test leads at one connector. Meter should register 28 volts DC, minimum. Repeat procedure with other connector.

- If reading for either connector is less than 28 volts DC, replace "Y"-connector.

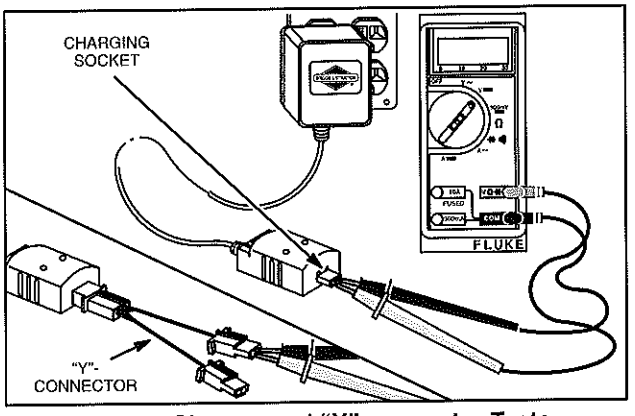


Fig. 2 – Charger and "Y"-connector Tests

Battery Pack Test

Remove battery pack.

Rotate meter selector to V ⎓.

Attach test leads to battery pack power connector. Meter should register a minimum of 26 volts DC.

Note: Do not attach test leads at charging socket. A blocking diode in this circuit prevents a reading.

- If fully charged battery pack registers less than 23.5 volts DC, replace battery pack.

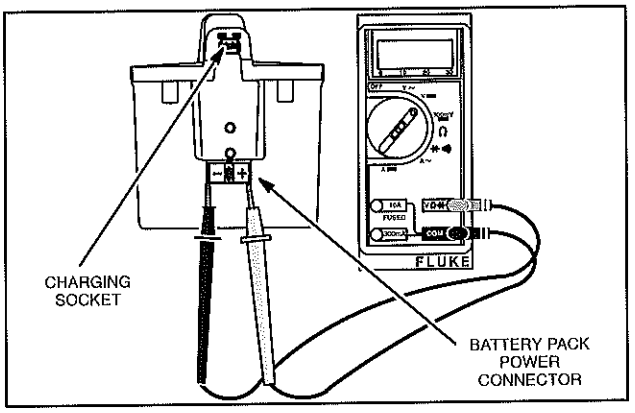


Fig. 3 – Battery Pack Test

Battery Pack Charging

The battery charger is energized from a normal household outlet (120 volts AC 60 Hz). 2 battery packs can be charged simultaneously even though they may be at varying degrees of discharge.

When the battery charger ("Y"-connector) and battery packs(s) are connected, the red light appears indicating charging. When both green and red lights appear and remain on, the battery packs are at least 90% charged.

Note: It is preferable to leave the battery pack(s) on the battery charger continuously between use. (Continuous charging requires only minimal house current.)

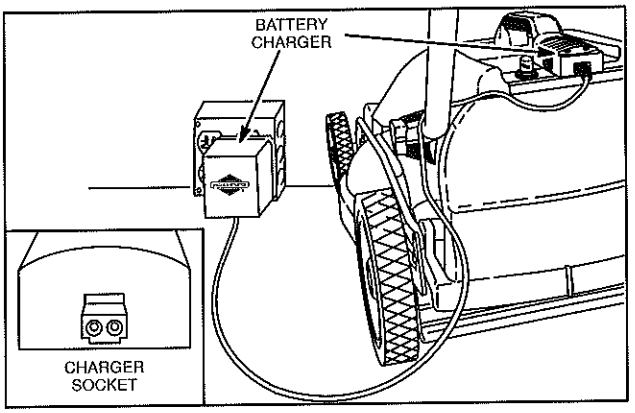


Fig. 4 – Battery Charging

Remove Mower Cover

Remove battery pack from cover.
Remove 2 screws from battery pack cavity in mower cover.
Carefully lift mower cover and set on mower deck.
Remove wires from plastic clip on inside of cover.

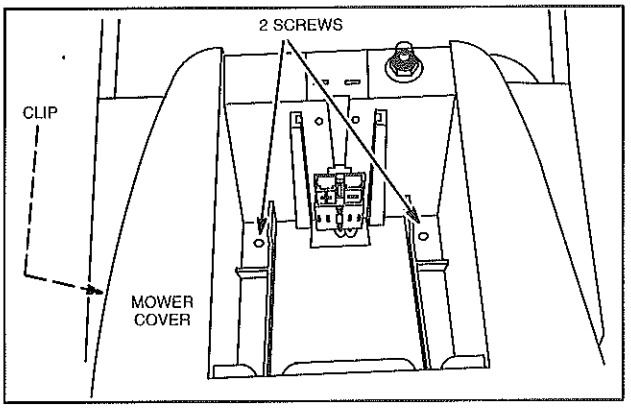


Fig. 5 – Mower Cover

Solenoid Test

Rotate meter selector to ⊣⊢ 🔊.
Disconnect all leads from the motor terminals as shown.

⚠ Install battery pack and key in cover for this test only. Remove battery pack and key from cover immediately after test.

Attach test leads across solenoid terminals as shown.
Engage control lever.
Meter should indicate continuity and the solenoid switch should close with an audible "click."

- If no continuity and audible "click," replace solenoid.

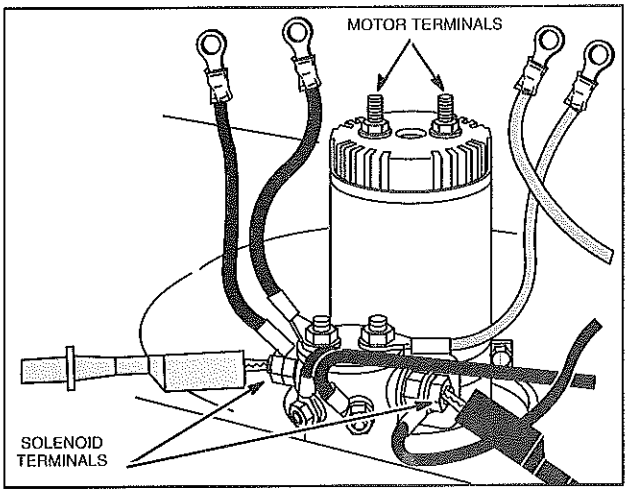


Fig. 6 – Solenoid Test

Remove Solenoid

Disconnect all leads from solenoid terminals.
Remove bolts fastening solenoid to bracket on motor.
Remove solenoid.

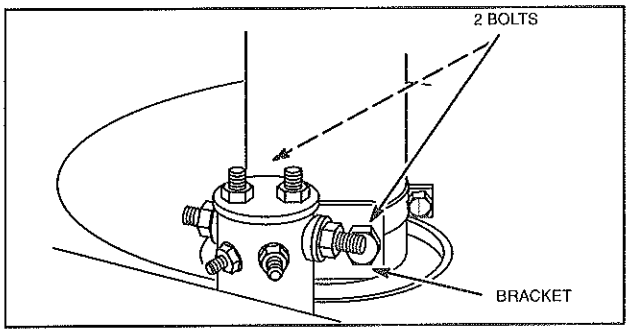


Fig. 7 – Solenoid

Motor Test

Disconnect all leads from motor terminals.
Rotate selector to ⊣⊢ 🔊.
Attach test leads to motor terminals. Meter should indicate continuity.

- If no continuity, replace motor.

Note: Replace motor if severely damaged, e.g., bent shaft, etc.

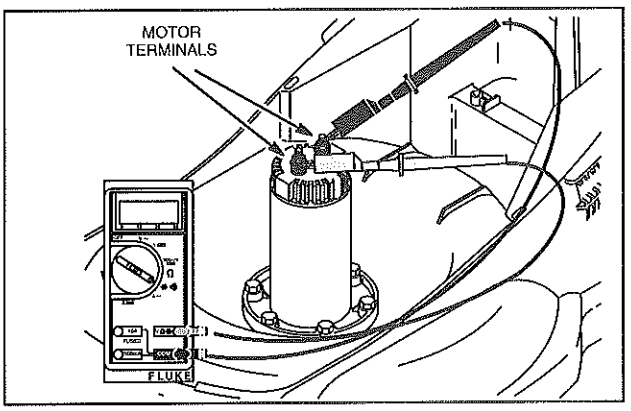


Fig. 8 – Motor Test

Remove Motor

Remove blade mounting bolt.
Remove blade and hub.
Remove 3 motor mounting bolts. (Support motor while removing mounting bolts.)

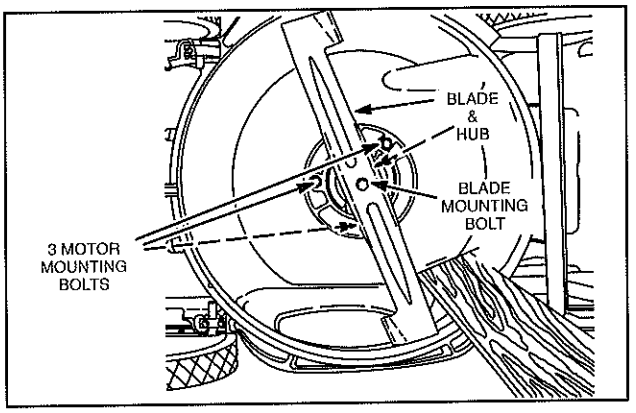


Fig. 9 – Motor

Reed Switch Tests

Note: Magnet must be in place (and charged) in mulching cover/discharge chute.
Unplug reed switch from circuit board.
Rotate meter selector to ⊣⊢ 🔊.
Insert pins into reed switch socket and attach test leads to pins.

1. With mulching cover/discharge chute installed, meter should indicate continuity.
2. With mulching cover/discharge chute removed, meter should indicate no continuity.

- If either test fails, replace reed switch (available from participating lawn mower supplier).

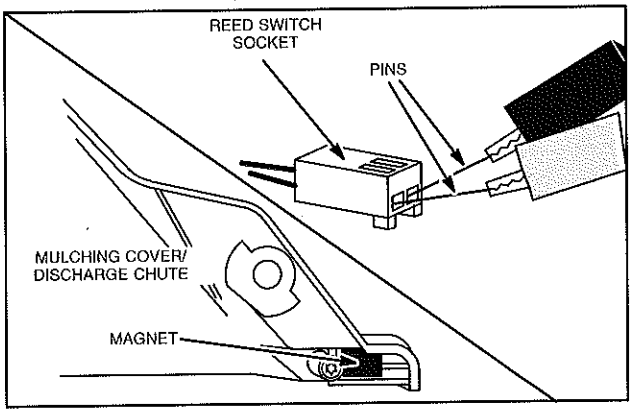


Fig. 10 – Reed Switch Tests

Control Lever Tests

Rotate meter selector to ⊣⊢ 🔊.
Terminals in control lever socket are marked #1, #2 and #3 (inset). Terminal #2 is not used.

1. With control lever disengaged, attach test leads across terminals #1 and #3. Meter should indicate no continuity.
2. With control lever engaged, attach test leads across terminals #1 and #3. Meter should indicate continuity.

- If either test fails, replace control lever.

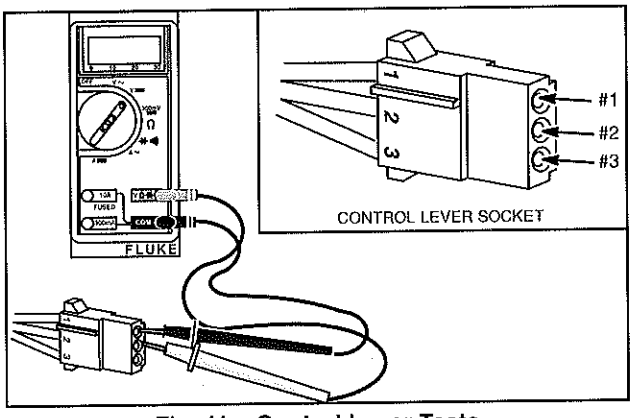


Fig. 11 – Control Lever Tests

Remove Control Lever

Remove 2 control lever mounting screws.
Note: Internal components not serviceable.

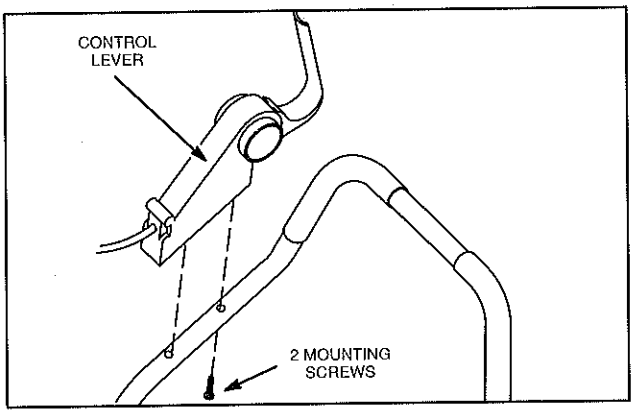


Fig. 12 – Control Lever

Circuit Board Tests

Unplug control lever plug from control lever socket.

Rotate selector to ⊣⊢ 🔊.

Meter should indicate continuity across terminals as illustrated below:

a. of resistor;
b. right key and red motor lead;
c. "+" in battery pack power connector and left key;
d. #3 in control lever plug and right key;
e. #3 in control lever plug and red motor lead;
f. #1 in control lever plug and top of the reed switch plug (inset).

- If no continuity in any one of the above tests, replace circuit board.

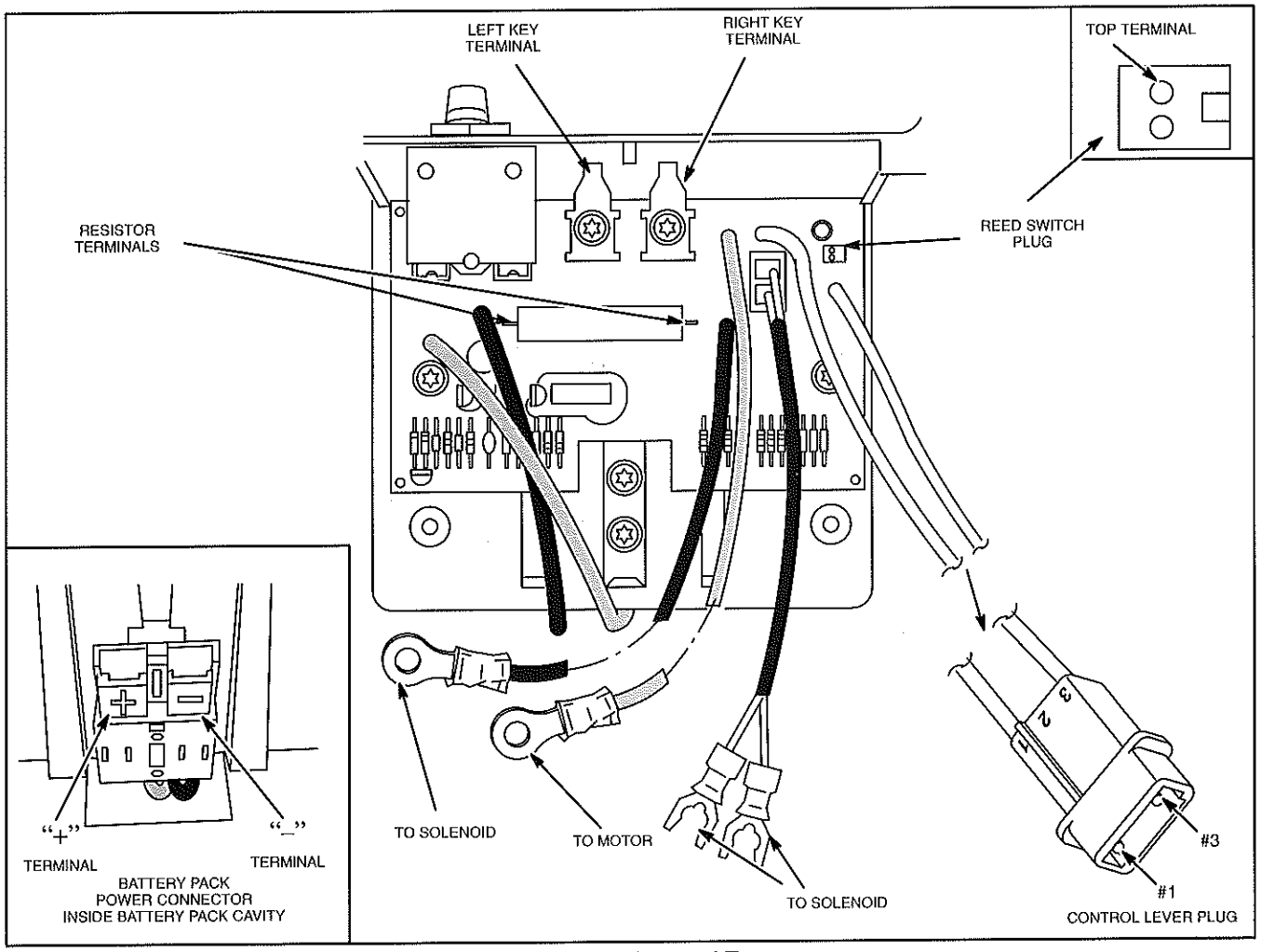


Fig. 13 – Circuit Board Tests

Remove Circuit Board

Remove locknut/plastic cover assembly which secures Mini Breaker® and label around Mini Breaker®.

Remove 4 screws from circuit board.

Remove 2 screws under circuit board securing battery pack power connector.

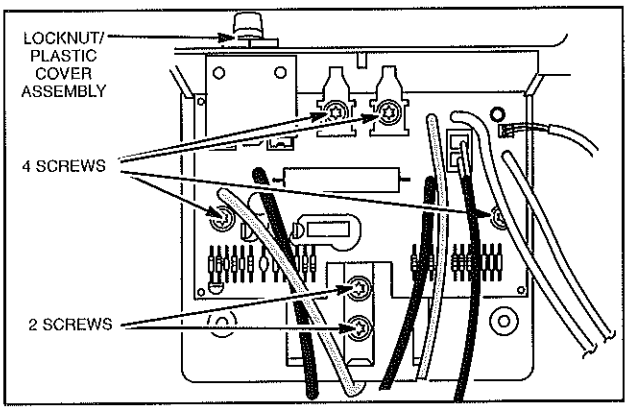


Fig. 14 – Circuit Board

Section 3
ASSEMBLY

Control Lever

Fasten control lever to handle with mounting screws. Torque 2 screws to 15 in. lbs.

Note: Over-torquing mounting screws can damage control lever. Check for correct operation after installation.

Clamp wire from control lever to deck (inset) with screw and retainer. Torque 1 screw to 18 in. lbs.

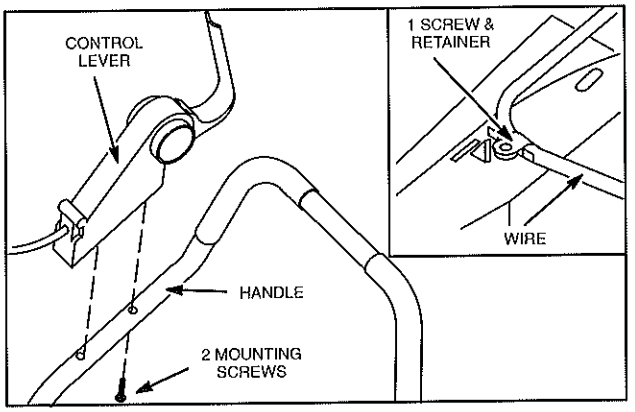


Fig. 1 – Control Lever

Motor

Bolt motor to deck with motor mounting bolts. Torque 3 bolts to 190 in. lbs. (Motor can be installed only one way.)

Slide blade bolt hub on to motor shaft. Align blade, with hub between blade side rails, and bolt to motor shaft. Torque 1 bolt to 225 in. lbs.

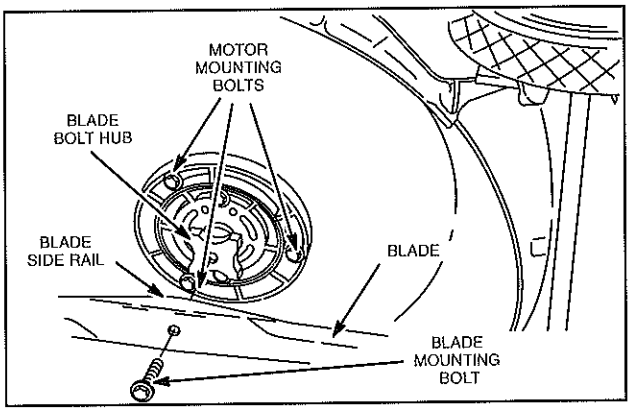


Fig. 2 – Motor

Reed Switch

Position reed switch as shown. (Lawn mower will not run if position is reversed.) Clamp reed switch to deck with screw and retainer. Torque 1 screw to 18 in. lbs.

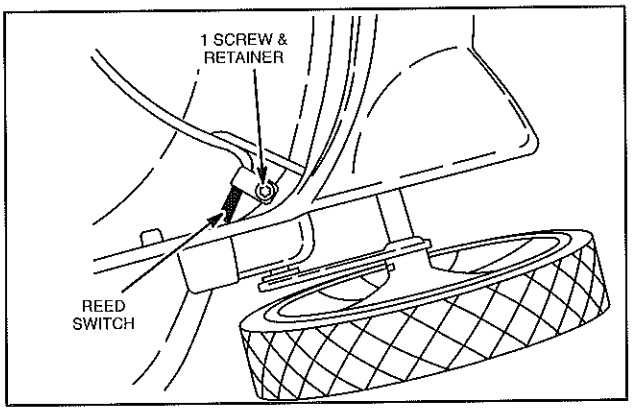


Fig. 3 – Reed Switch

Circuit Board

Locate battery pack power connector in battery pack cavity in cover inset and mount with screws. Torque 2 screws to 20 in. lbs.

Insert Mini Breaker® through hole in cover. Align circuit board to bosses and mount with screws. Torque 4 screws to 10 in. lbs.

Place label over Mini Breaker®. Tighten locknut/plastic cover assembly securely (5 in. lbs.).

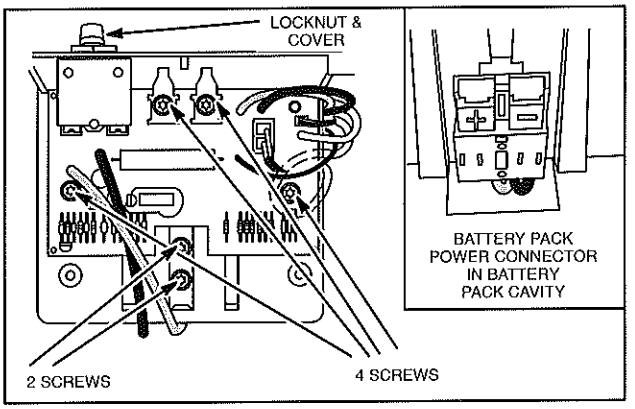


Fig. 4 – Circuit Board

Solenoid

All solenoid terminals require lock washers, but motor terminals do not. DO NOT over-torque fasteners.

Torques: 2 bolts to bracket, 70 in. lbs.
nuts to terminals ❶ and ❷, 45 in. lbs.
nuts to terminals ❸, ❹, ❺ and ❻, 30 in. lbs.
nuts to terminals ❼ and ❽, 8 in. lbs.

Bolt solenoid to bracket strapped to motor.

Connect leads to terminals as illustrated below:

❶ red leads from solenoid ❸ and circuit board,

❷ black leads from solenoid ❹ and ❻,

❺ black lead from circuit board, and

❼ and ❽ 2-conductor black lead from circuit board.

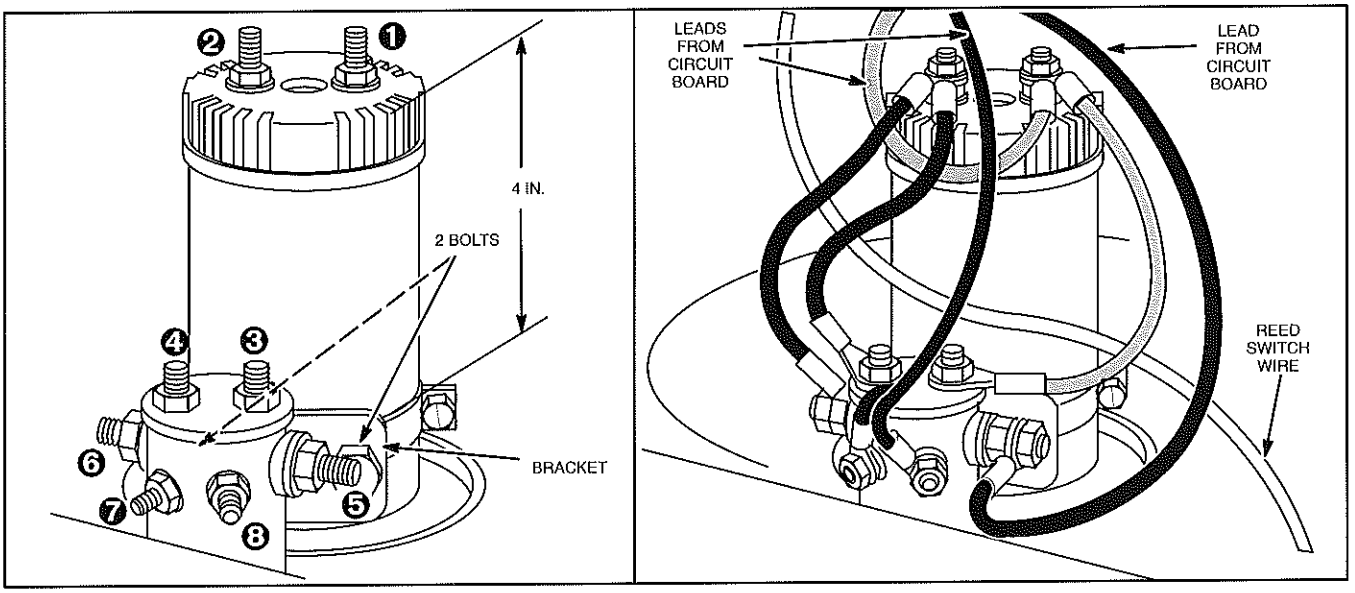


Fig. 5 – Solenoid

Safety Interlocks

Plug reed switch socket into circuit board.

Connect control lever socket and plug.

Push long wires from circuit board to #1 ("+" or red) motor terminal, side solenoid terminals and reed switch into clip on underside of cover.

Finally, reinstall mower cover on deck with screws in battery pack cavity. Torque 2 screws to 15 in. lbs.

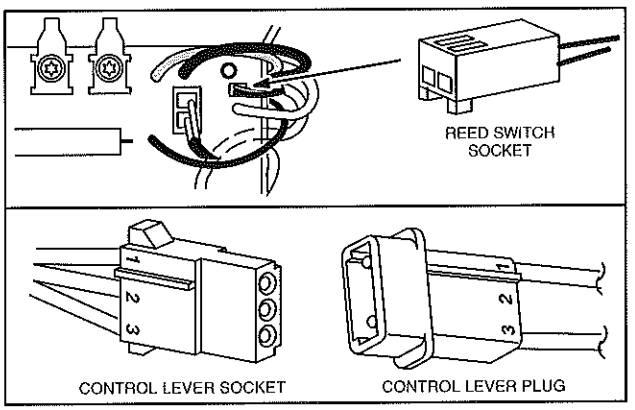


Fig. 6 – Safety Interlocks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