

VACUUM FUEL TANK

A. DESCRIPTION

Because fuel pump on motor pumps fuel from tank to carburetor, following initial priming and starting of motor, only one flexible fuel line is necessary between tank and motor.

B. PRIMING

1. Priming on first vacuum tanks was done by pulling up on plunger on handle assembly.
2. Priming on new vacuum tanks (6 gal. and 3¼ gal.) (22.7 and 12.3 liters) is done by squeezing primer bulb on fuel line. (Figure 6)

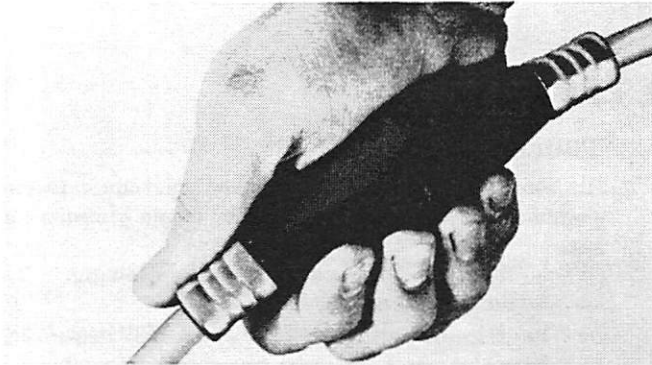


Figure 6. Priming Vacuum Fuel System

3. Carburetor is filled with fuel by slowly actuating primer bulb on fuel line. (Figure 6) When fully primed, pressure will be felt on bulb.

C. REPAIR OF VACUUM TANK

1. Remove filler cap assembly and check wear of parts for possible replacement.
2. Remove 4 fastening screws and washers which secure fuel tank cover.
3. Remove fuel tank cover assembly and disassemble component parts to check for possible wear, filter on end of pickup tube in particular.
4. Replace any worn part.
5. Check fuel line and component parts for wear and replace a worn part.
6. Primer bulb.

NOTE: Two different fuel lines are used; one with 7/16" (11.2mm) outside diameter, the other with 1/2" (12.7mm). The 7/16" fuel line has a A-25423A1 check valve assembly in engine end of line and a A-25425A1 body and stem assembly in fuel tank end. (Figure 7) The 1/2" fuel line has a A-23-30184 sleeve in engine end of line and A-30183A1 body and stem assembly in fuel tank end. (Figure 8)

- a. Remove damaged or inoperative primer bulb by cutting fuel line as close as possible to bulb.
- b. Inspect check valve assembly and body and stem assembly for free operation. (Figure 8) If corroded,

stuck, damaged or otherwise inoperative, replace with new check valve assembly and body and stem assembly.

- c. Apply light coat of adhesive (C-92-27813) to outside of check valve assembly stem only. Care must be exercised not to get adhesive in stem hole or on valve face.
- d. Insert stem into fuel line (fuel tank end). (Figure 8)
- e. Apply light coat of adhesive around outside of fuel line over check valve assembly.
- f. Push fuel line end in about one inch or until check valve end can be felt flush on inside end of primer bulb.
- g. Place circle clamp (A-54-27764) in position over small end of primer bulb and, with a pair of end cutter pliers, clinch sides (recesses) of clamp. Compress until recesses of circle clamp shoulders touch.
- h. Repeat procedure for body and stem assembly on opposite end of primer bulb.

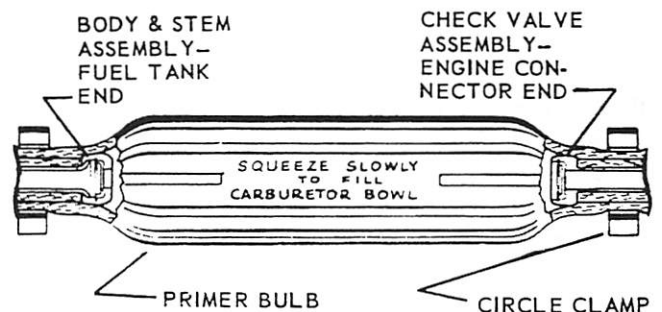


Figure 7. Primer Bulb Repair (Old Style)

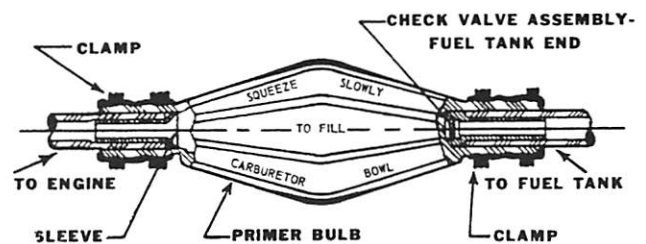


Figure 8. Primer Bulb Repair (New Style)

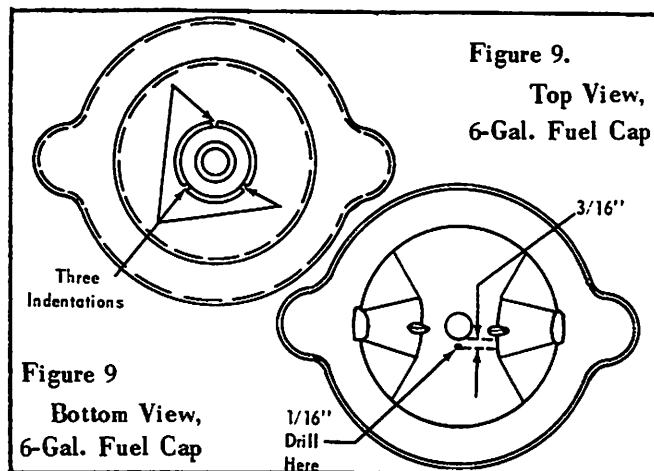
7. Finding fuel tank leaks

- a. Remove filler cap and fuel tank cover assembly.
 - b. If point of leak is known, circle hole with pencil, drain tank thoroughly and flush with hot water or carbon tetrachloride.
 - c. If point of leak is not known, drain tank thoroughly and flush with hot water or carbon tetrachloride. Submerge tank in water and observe bubbles rising from hole in tank.
8. Repair leak in sheet metal tank
 - a. Use equipment listed in Para. H-1, if available.
 - b. Weld according to procedure in Para. H-2, preceding.

D. FUEL TANK CAP MODIFICATION - LOSS OF RPM

If there is a noticeable decrease in RPM after operation for several minutes at high speed, it may be caused by one of the following:

1. Inadequate air vent hole in fuel tank cap with identification of one indentation around vent screw hole. (Caps with 3 indentations [Figure 9] have adequate hole.) To remedy, drill $1/16''$ (1.6mm) hole as follows: Turn fuel cap upside down and drill $1/16''$ diameter hole thru inner plate (in bayonet fitting) only. Locate hole $3/16''$ (4.8mm) from edge of vent screw opening.
2. Wrong fuel tank (refer to correct tank in parts list).
3. Fuel line too small (refer to correct line in parts list).
4. Filter on end of pick-up tube clogged or wrong type (refer to correct pick-up tube in parts list).



OTHER FUEL TANKS

A. AUXILIARY FUEL TANKS

NOTE: New style fuel gauge can be installed on auxiliary tank by removing old gauge with sharp instrument inserted between flange of fuel gauge and tank. Then pry up and set new gauge in place and press in with fingers.

B. CUSTOM-MADE FUEL TANKS

When using vacuum system with these tanks, an air vent is only requirement. A special pickup tube can be made but should have a large pre-filter attached to prevent excessive dirt in carburetor top filter.

C. "FOREIGN" FUEL TANKS

1. If other than Kiekhaefer Mercury fuel tank is used, engine may run lean, lose RPM or cause piston scoring.
2. Check "foreign" fuel tanks for the following:
 - a. Adequate air vent in fuel cap.
 - b. Fuel line large enough ($5/16''$ -to- $3/8''$) (8-to-9.5mm)
 - c. Filter on end of pickup too small or clogged, or fuel pickup tube too small.

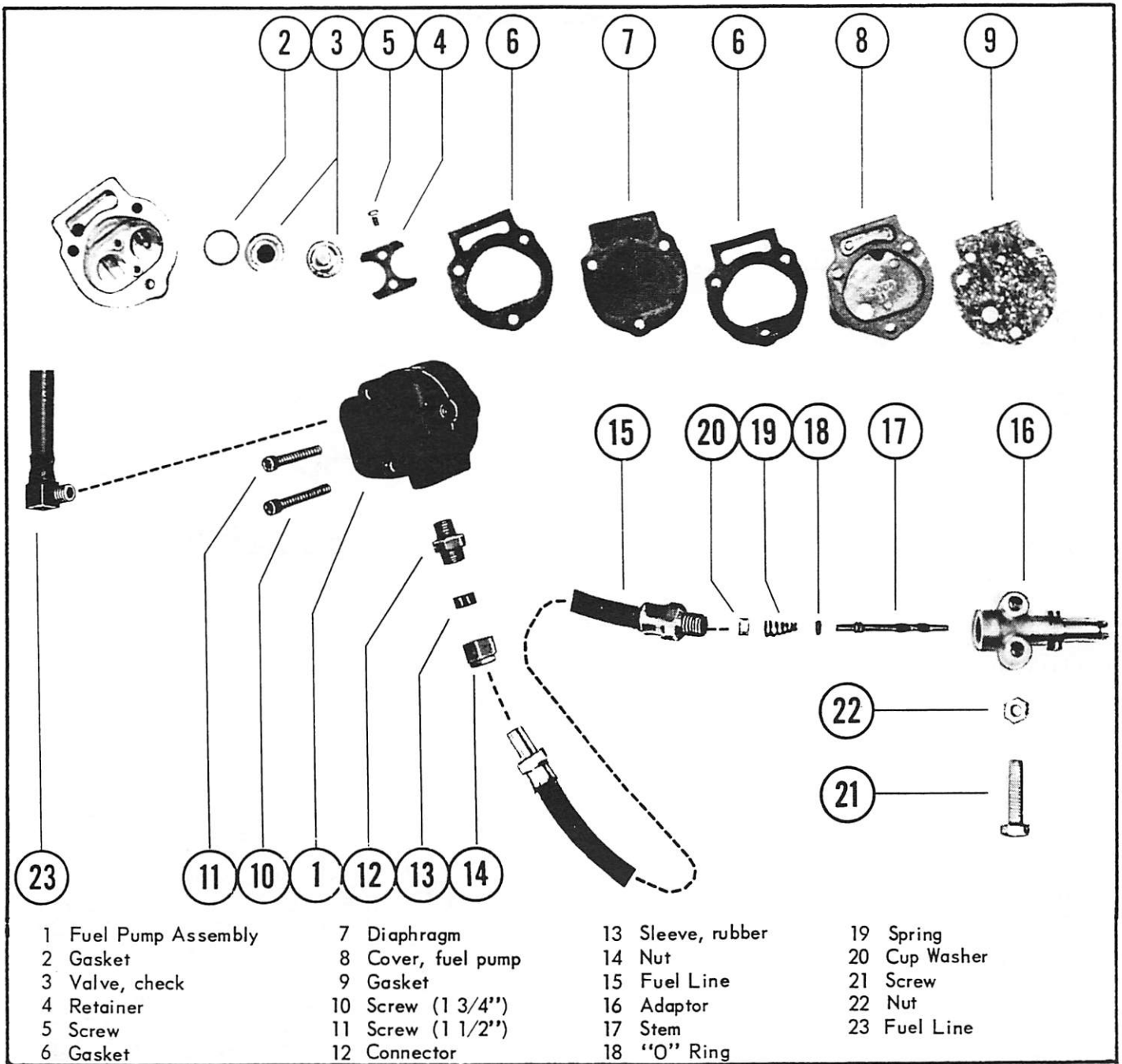


Figure 10. Vacuum Fuel Pump Exploded View

FUEL PUMPS

A. DESCRIPTION

1. Before attempting to service fuel pump, determine whether pump really is defective.
2. Be sure to have necessary replacement parts required for job. *Without replacement parts, only cleaning can be done.*
3. The following are parts which are usually replaced:
 - a. Diaphragm
 - b. Gaskets
 - c. Fuel lines

B. SERVICING

1. Wash all parts thoroughly and use compressed air to clean all parts completely.
2. Inspect each part carefully for wear or damage.
3. Replace pulsator diaphragm with new, if old diaphragms show least sign of deterioration.
4. Be sure that valve seats provide flat contact area for valve disc.
5. Tighten elbows and check valve connections firmly when replacing.
6. Do not use Permatex on valve retainer gasket.
7. Check valves after reassembling fuel pump cover by blowing thru outlet hole. Air should be drawn thru valve but should close immediately when attempting to blow thru it.
8. Check inlet valve by reverse procedure. If leakage is encountered, check for free operation and accurate setting of valves.
9. Worn or slightly warped valve will cause leakage. Replace with new valves for more accurate setting.
10. When installing fuel line fittings, we recommend aviation Permatex for sealing. Apply sparingly to avoid clogging of fuel lines.

CAUTION: Do not use Liquid Neoprene on fuel line fittings. Neoprene is recommended only for exposed electrical connections. Permatex is available thru all local hardware stores.

C. VACUUM FUEL SYSTEM PUMP (Figure 10)

Found on all engines with vacuum fuel system.

1. Disassembly
 - a. Remove 2 fuel lines from fuel pump.
 - b. Remove 3 screws which hold fuel pump assembly to crankcase.
 - c. Remove gaskets, diaphragm, check valve, retainer and screw from under fuel pump cover.
2. Reassembly
 - a. First, inspect all parts, making certain that all are usable, clean and ready for reassembly. (Figure 10)
 - b. Place new check valve gaskets in seats and set check valve discs in position. Inlet check valve seat is identified by its protruding tip in casting. Flat side of check valve seats over this tip. Outlet check valve is set in opposite (flat end up) so tension is against valves. (Figure 11)
 - c. Position retainer on check valves in housing and secure with 2 screws.
 - d. Place new gasket on pump body followed by neoprene diaphragm, another gasket, fuel pump cover and cover to crankcase gasket. Be sure that gasket holes align with cover holes.

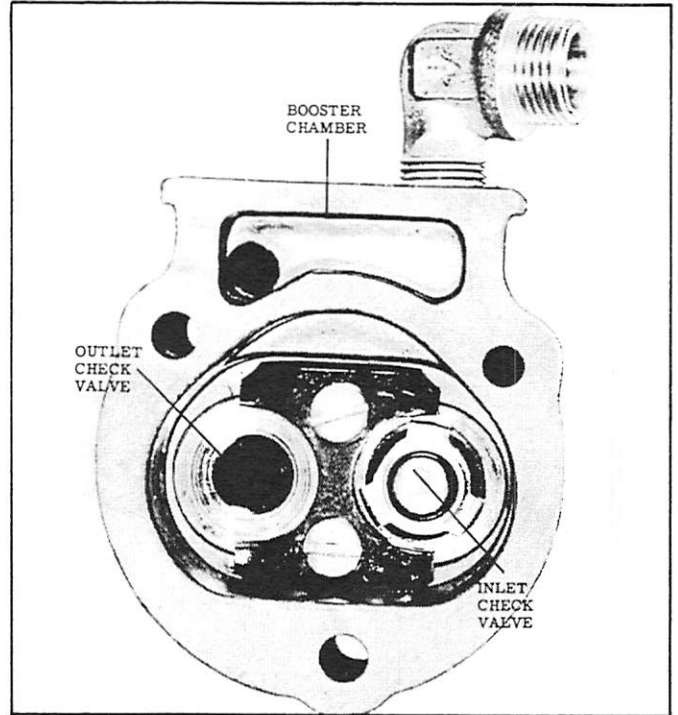


Figure 11. Check Valve Location

e. Secure to crankcase with 3 screws.

NOTE: Inlet line from adaptor assembly attaches to fuel inlet hole marked "IN".

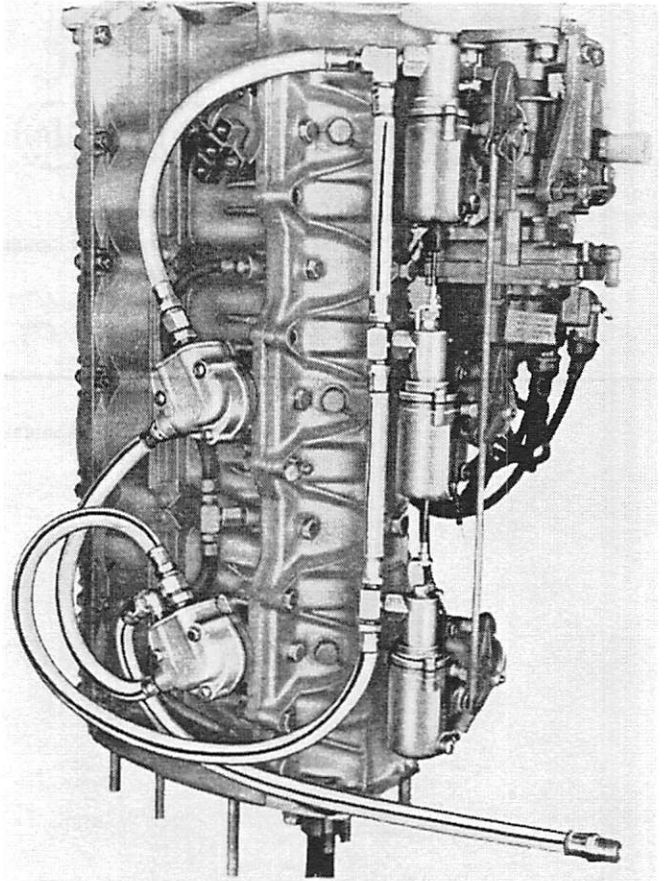


Figure 12. Fuel Pumps in Parallel

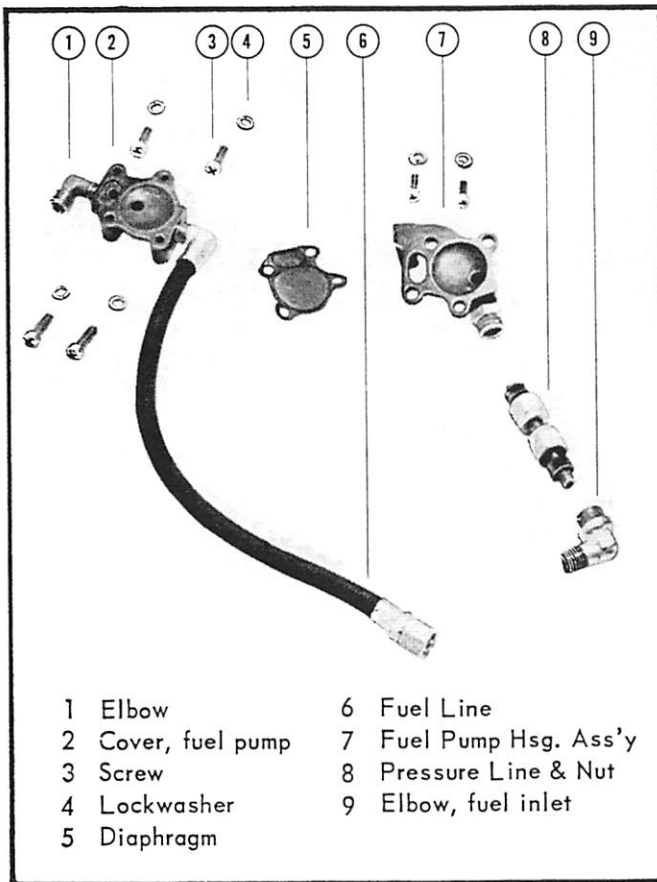


Figure 13. Mark 6 Fuel Pump

D. MARK 6 FUEL PUMP

1. Description

- Crankcase pulsating pressure is transferred to fuel pump diaphragm via line from fuel transfer cover on cylinder block which in turn draws fuel from fuel tank. (Figure 13)
- Prime engine first by actuating priming bulb on fuel line.

2. Disassembly

- Remove 2 screws which hold housing in bottom cowl bracket.
- Remove pressure line from intake cover.
- Remove nut which holds carburetor line to fuel pump.
- Remove 4 screws which hold fuel pump together.
- Lift off diaphragm and discard.
- Test check valves in fuel pump housing assembly.
- Remove check valves by pressing out with $9/32''$ (7.2mm) drift from intake side, thru to outside. *Replace check valves with new valves, if removed.*

3. Reassembly

- Inspect and clean parts as outlined in "B. Servicing", preceding.
- Press new check valves into fuel pump housing from inlet side of housing. (Figure 14)
- Press first check valve in until top of valve housing is $1-1/32''$ (26.2mm) from face of inlet side.
- Press 2nd check valve in $31/64''$ (12.4mm) from face of inlet side.
- Test pump, following instructions in "B. Servicing", preceding.

- Place new diaphragm in position between fuel pump housing and fuel pump cover and secure with 4 screws.
- Install fuel inlet line to bottom hole of fuel pump, elbow to top outlet.
- Install fuel pump assembly on powerhead.

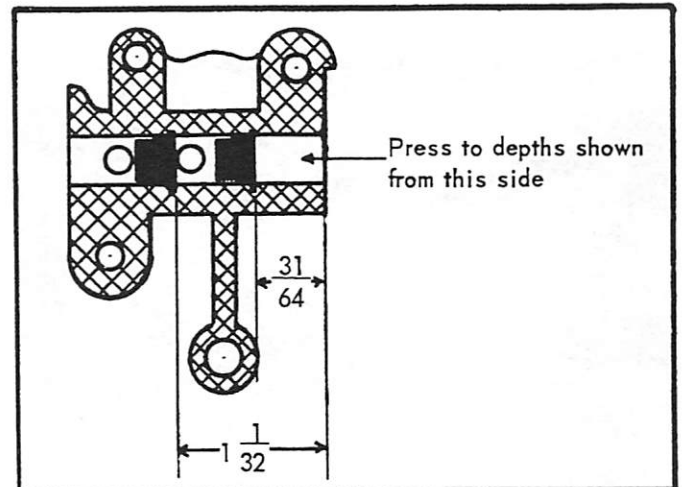


Figure 14. Pressing in Check Valves

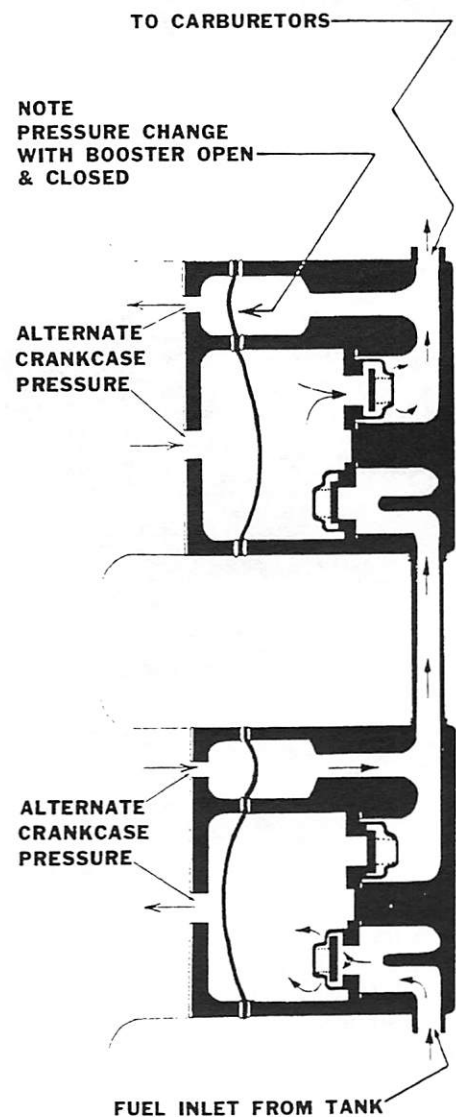


Figure 15. Fuel Pump Operation

E. MERC 60 FUEL PUMP CONVERSION

Installing Late Style Fuel Pump (Figure 16)

1. Install filter cover and check unit adaptor on new fuel pump assembly.
2. Install gasket and new spacer assembly on cylinder block. Tighten screws securely.

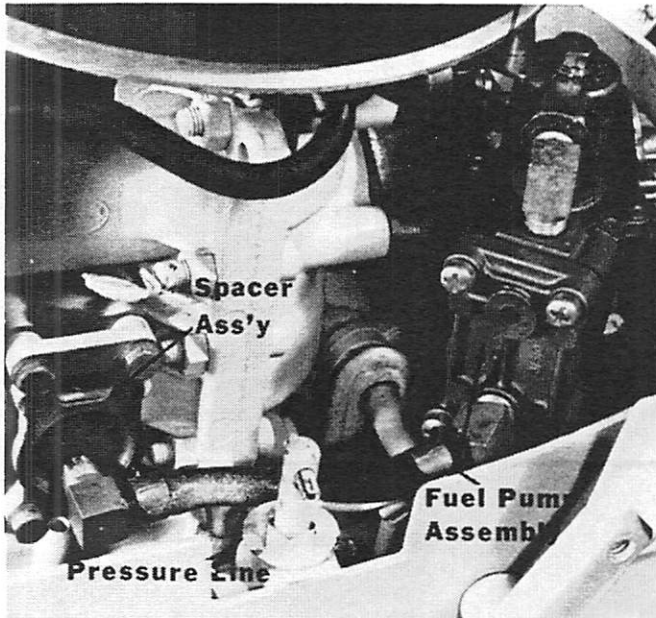


Figure 16. Late Style Fuel Pump Installed

3. Install pressure line on fuel pump assembly and secure with hose clamp.
4. Install opposite end of pressure line on spacer elbow and secure with hose clamp.

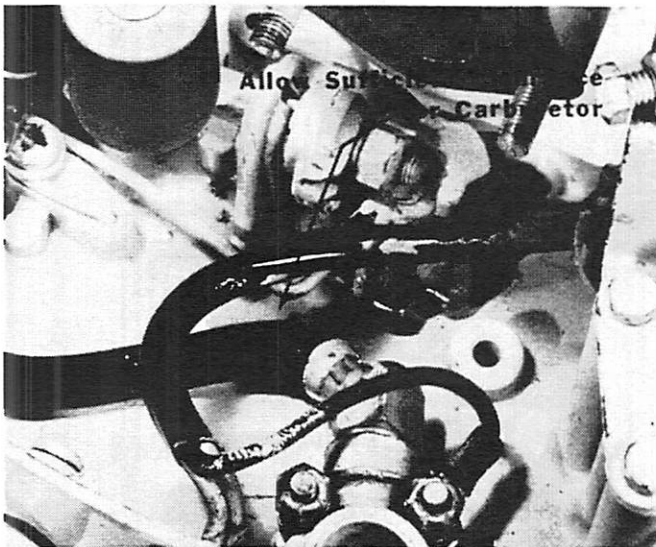


Figure 17. Stop Switch Ground Lead Attached

5. Install check unit adaptor in bottom cowl and secure with 2 screws. Be sure that stop switch ground lead is attached. (Figure 17)
6. Install carburetor.
7. Install filter cover and fuel pump assembly on carburetor.
8. When installation is completed (Figure 18), check for clearance during shifting and for easy installation of fuel tank line connector.

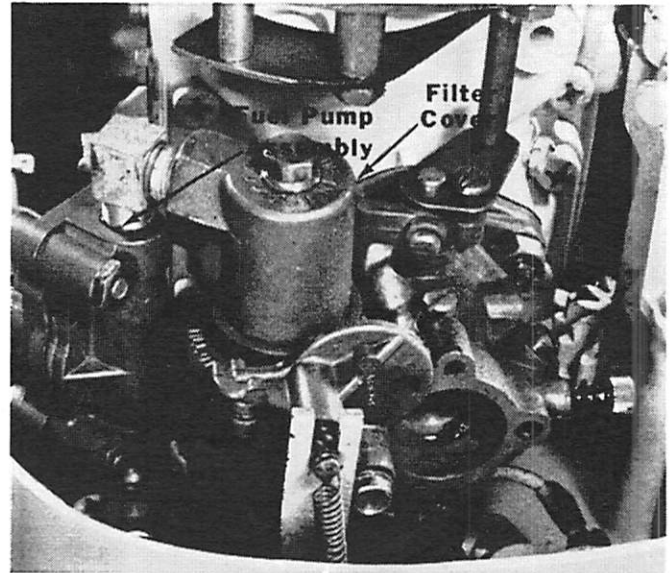


Figure 18. Installation Completed

F. FUEL LINE CHECK UNIT ADAPTOR, MERC 110-60

A new check unit adaptor can be mounted with spring loading to provide flexibility as on latest model motors.

1. Drill out the 2 adaptor to bottom cowl threaded screw holes with $7/32''$ diameter drill. (Tilt motor up and to right side for access to screw holes.)
2. Counter bore 2 holes from underside of cowl to depth shown in Figure 19. Use $11/32''$ diameter drill. This is not necessary if bolt heads clear swivel bracket.
3. Place new check unit adaptor (A-32454) in position and insert 2 Phillips head screws (C-10-24233), $1\frac{1}{2}''$ (38mm) long.
4. Place coil spring (A-24-28357) on screws and thread on elastic stop nuts (C-11-20110).
5. Elastic stop nuts are to be tightened only far enough to preload coil springs. (Expose approximately 3 threads above nut.)

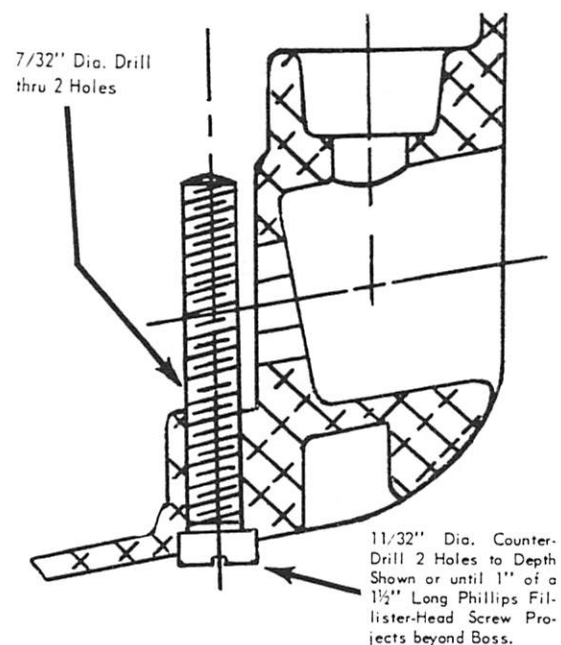
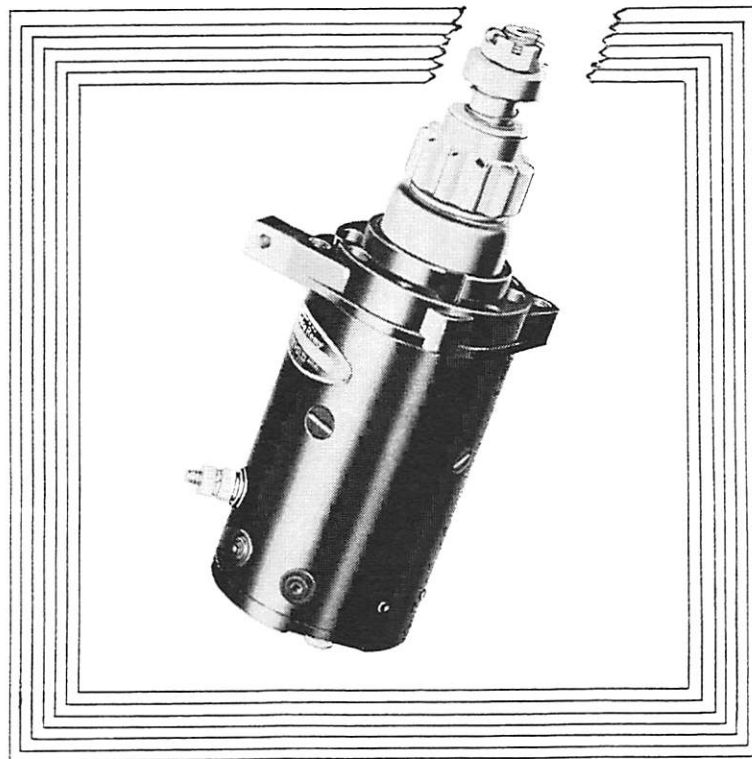


Figure 19. Bottom Cowl
(Side View Cross-Section)

section

VII

starters



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Description

A. TYPES OF STARTERS

1. Manual
 - a. Magna-Pull
 - b. Automatic Rewind
2. Electric
 - a. With generator
 - b. Less generator

B. MANUAL STARTING, PRINCIPLE OF OPERATION

1. Principle of starting both Magna-Pull and Automatic Rewind starters is generally the same.

2. When pulling on starter handle, starter pawls of starter make a positive action with flywheel adaptor, thereby impelling magneto to make a spark at spark plug and causing combustion in cylinder, thus starting motor.
3. After motor has started, pawls disengage automatically.
4. Starter mechanism remains idle after motor has started; thus, there is little wear on any of the parts and very little attention is required.

NOTE: For principle of electric starting, refer to Page 6 of this section.

Magna-Pull Starters

A. DISASSEMBLY

The following procedure is used in disassembly of Magna-Pull starters on Mark 20, Mark 20H, Mark 15, Mark 7, Mark 6, Mark 5, all models with a "K" prefix and all "K" models. (Figure 1)

1. Remove screws on top cover which holds starter to cover.
2. Remove starter cable bushing insert from rubber handle by prying out with screwdriver.
3. Slip rubber handle back on cable and cut cable as close to bushing as possible, releasing cable so that spring unwinds.
NOTE: If starter is to be removed from a tank and no work performed on the starter, hold cable after cutting off knot. Lift starter from tank and tie knot in cable in screw hole of cover so it will not unwind.
4. Remove screws and washers which hold friction plate to starter housing.
5. Remove friction plate, starter pawls and anti-rattle springs from sheave.
6. Remove flat head screw from sheave shaft in top of starter housing with Allen wrench.
7. Remove sheave assembly, being careful that sheave does not drop out so that spring unwinds with force. (Figure 2) **CAUTION:** Be sure to place other hand under sheave, as it is removed, to prevent spring from coming out of recess.
8. Remove starter spring by placing cloth in hand and grasping spring firmly.
9. Pull spring out and allow to unwind slowly in hand.

NOTE: End of starter sheave shaft is peened over shaft collar. It will be necessary to grind off end of shaft even with collar. Drive the shaft out of collar with drift to remove pawl retainer washers, starter pawl retainer washers, starter pawl retainer, pawl retainer spacer, sheave shaft

shim and starter sheave shaft wave washer.

10. Remove 4 Phillips head screws from sheave to release anchor cable. (*Note: On Mark 6, Mark 5, KF5 and KF3 models, only 2 screws in sheave hold cables. Be sure not to lose 2 thread guards.*)
11. Remove cable from sheave by unwinding and twisting end near anchor ½-turn.
12. Use Needle Bearing Drift (91-24739) to remove bearing or bushing in sheave.
13. Starter now is completely disassembled and parts are available for inspection. Replace any worn or broken part before reassembly.

B. REASSEMBLY

1. Replace bearing or bushing in starter sheave with Needle Bearing Drift (91-24739), pressing into sheave.
2. Lubricate bearing with MULTIPURPOSE Lubricant (92-30239).
3. Replace starter cable in starter sheave by attaching anchor end of cable in slot.
4. Slide in sideways and twist ½-turn after anchor is in hole in sheave in lock.
5. Wind cable on sheave in clockwise rotation.
6. After completing one full revolution, insert 4 Phillips screws to secure cable. (*Note: Two screws have thread guards on small sheave models Mark 6, Mark 5, KF5, KF3 and KE3.*)
7. Complete winding cable on sheave, leaving sufficient length to insert later through cover opening.
8. Place starter sheave shaft wave washer on sheave shaft and insert sheave shaft in sheave, replacing sheave shaft shim, washer, pawl retainer, washer and collar in this order on shaft.
9. Peen end of shaft over shaft collar with ball peen hammer. *Do not peen too tightly, as a moderate amount of tension is required.*

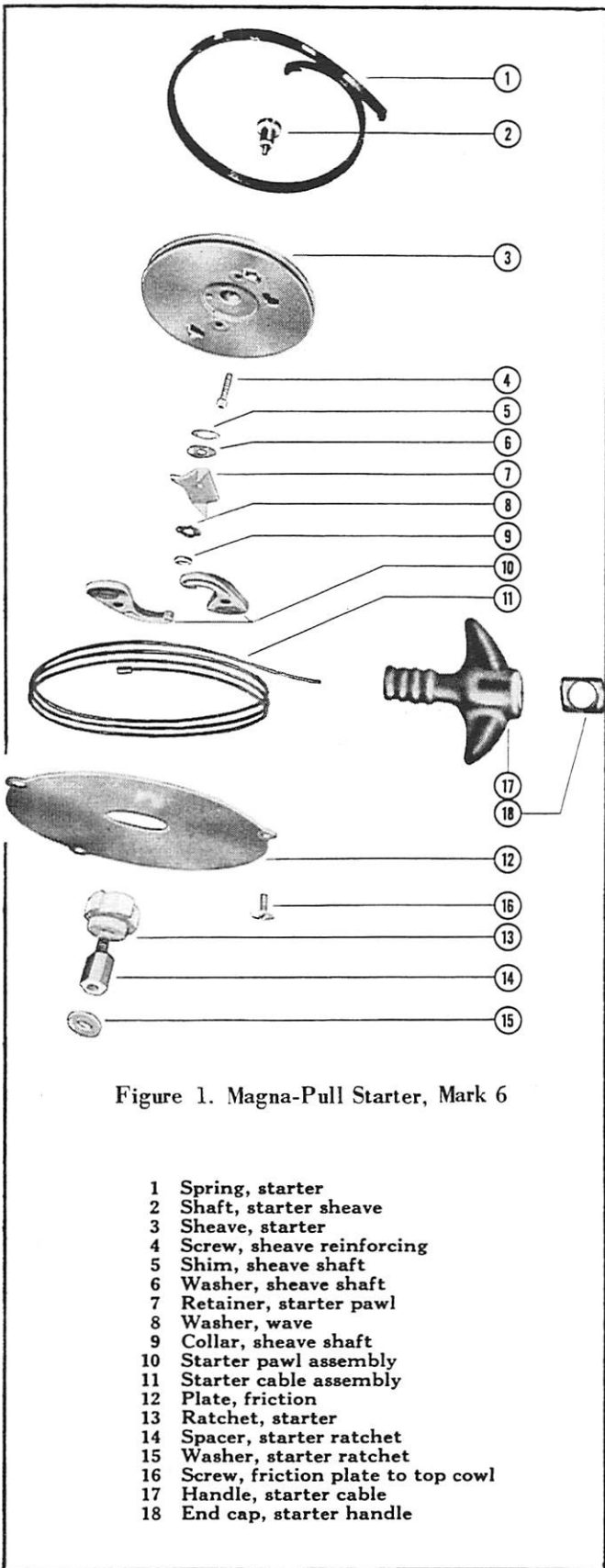


Figure 1. Magna-Pull Starter, Mark 6

- 1 Spring, starter
- 2 Shaft, starter sheave
- 3 Sheave, starter
- 4 Screw, sheave reinforcing
- 5 Shim, sheave shaft
- 6 Washer, sheave shaft
- 7 Retainer, starter pawl
- 8 Washer, wave
- 9 Collar, sheave shaft
- 10 Starter pawl assembly
- 11 Starter cable assembly
- 12 Plate, friction
- 13 Ratchet, starter
- 14 Spacer, starter ratchet
- 15 Washer, starter ratchet
- 16 Screw, friction plate to top cowl
- 17 Handle, starter cable
- 18 End cap, starter handle

- 10. Check tension by twisting pawl retainer with fingers, holding sheave shaft rigid.
- 11. If starter and shift handle (Mark 5) was disassembled for servicing, see "NOTE" on Page 3 to reassemble.

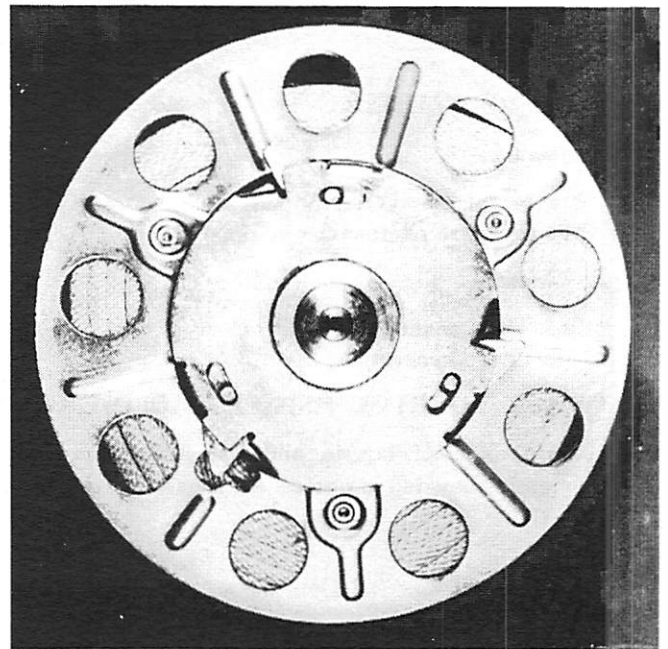


Figure 2. Starter Pawls and Sheave

- 12. Lubricate spring lightly with MULTIPURPOSE Lubricant (92-30239) and engage inner loop of spring on sheave anchor pin.
- 13. Insert sheave with shaft head into hub recess of housing and rotate sheave until slot in hub engages pin in hub recess.
- 14. Install Allen set screw into top of housing to hold assembly.

NOTE: Without unwinding starter cable from starter sheave, make 3 full revolutions of starter sheave to obtain correct tension for rewind. Place rope in starter cover hole and tie loose temporary knot in starter cable about a foot from end of protruding cable to prevent spring from unwinding.

- 15. Insert starter cable in starter handle and through end plug.
- 16. Tie a "figure 8" knot in cable. (Figure 3)
- 17. Cut excess cable off 1/2 inch from end of knot and press knot into recess of plug.
- 18. Pull cable and plug into handle.
- 19. Lubricate pawl posts on sheave hub and inner face of friction plate with MULTIPURPOSE Lubricant (92-30239) and install pawls.

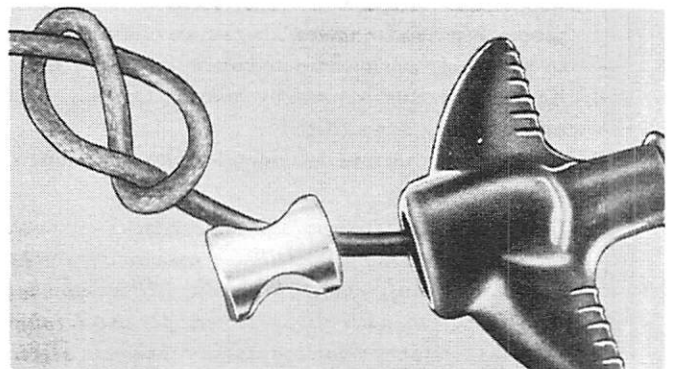


Figure 3. "Figure 8" Knot in Cable (Magna-Pull)
Revised Jan. 1961

20. Replace friction plate and secure with screws and lockwashers.

C. NOTES

1. Starter & Shift Handle (Mark 5) Reassembly

- a. Set adjusting neutral lever screw in back part of lever.
- b. Place finger release in front part of lever catch and fasten with 2 small counter-sunk-head screws.
- c. Reassemble push button release in handle by inserting first the finger release spring, the finger release which is pinned with a roll pin through handle. Follow with spring for release button and insert push button from front of handle through spring and lock with retaining ring.

- d. Set adjusting lever neutral yoke into notch end of lever, place lever spring under lever into handle and pin lever with roll pin through handle.

- e. Attach lever handle assembly to starter cover with 4 screws through bottom of cover.

2. Sheave Shaft Service

- a. An objectionable rattling noise has been noted in this type starter on some motors. This is caused by excessive looseness of starter pawl retainer.
- b. To eliminate this, simply peen end of starter sheave shaft to tighten pawl retainer. Do not peen too tightly, rendering it inoperative. Strong finger pressure should be able to move it.

Automatic Rewind Starters

A. DISASSEMBLY (Figure 4)

Use following procedure in disassembly of automatic rewind starters, all 6-and-4-cylinder engines and all recent 2-cylinder models (those not mentioned under Magna-Pull starters on Page 1).

1. After starter assembly has been removed from motor proper, entire unit can be disassembled further if in need of repair.
2. Pull starter handle out from housing cover and, with screwdriver, pry end cap out of rubber handle.
3. Cut cable as close to end cap as possible and release cable so that spring unwinds.
4. Remove auxiliary cover by removing auxiliary cover screw.
5. Bend lock tabs down from nut and remove nut which holds internal parts to inside top of cover with aid of sheave shaft. Component parts are removable.
6. Place screwdriver in sheave shaft slot to hold while removing nut (left hand thread).
7. Remove retainer plate, shaft, starter pawls, wave washers, bushing, spring guide, retainer spring, sheave shaft spacer, wave washer and wave washer retainer.
CAUTION: Be careful when removing these parts that rewind spring does not fly out of sheave and cause injury. Place cloth in hand and grasp spring firmly. Pull out, allowing spring to uncoil slowly in hand.
8. Remove cable from sheave by unwinding & twisting end near anchor $\frac{1}{2}$ -turn.

B. REASSEMBLY (Figure 4)

1. Replace starter cable in starter sheave by attaching anchor end of cable in slot. Slide in sideways and twist $\frac{1}{2}$ -turn after anchor is in hole in sheave to lock.
2. Wind cable on sheave in clockwise (right hand) direction, working from bottom of sheave and leaving enough free end to insert later through

cover opening. (Note: Wind cable on new sheave as shown in Figure 5.)

3. Place sheave in vise and engage outer loop of spring into slot of spring recess in sheave. Wind counterclockwise (to left) until spring is in place.
4. Place spring guide bushing on hub of sheave, chamfered end toward sheave.

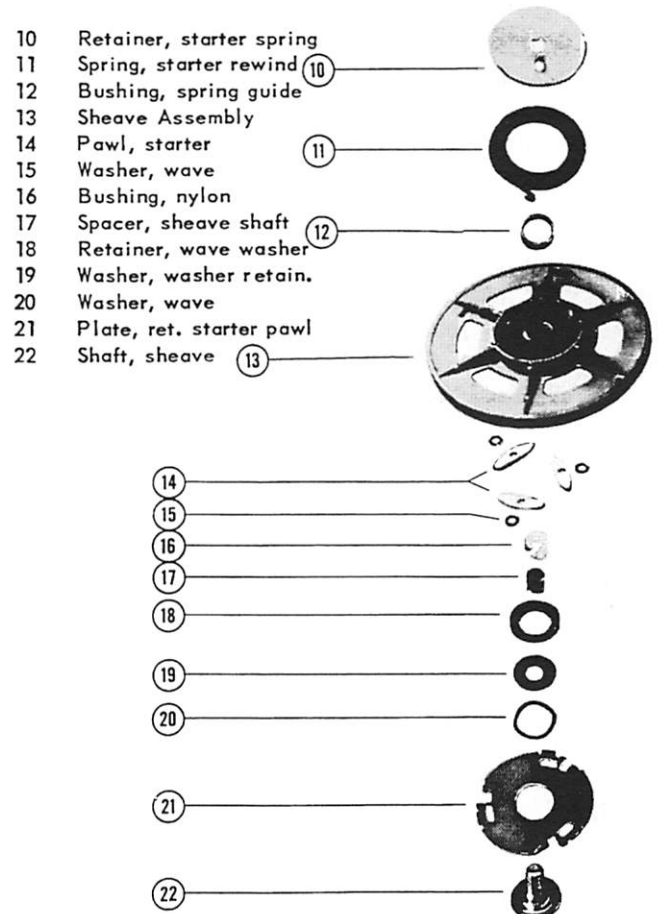


Figure 4. Automatic Rewind Starter

5. Set spring retainer on top of spring, engaging inner loop in anchor pin of spring retainer plate.
6. Lubricate spring and spring guide bushing with MULTIPURPOSE Lubricant (92-30239).
7. Assemble starter pawl to sheave with identification mark side away from sheave and end on which mark appears toward rim of sheaves.
8. Mount the 3 starter pawl wave washers on anchor pins on bottom of sheave and follow with starter pawls on top of pins. Lubricate all parts with MULTIPURPOSE Lubricant as they are being installed.

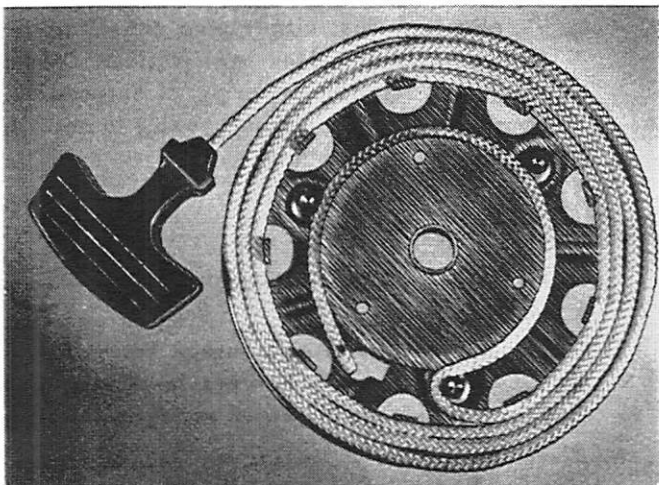


Figure 5. Top Cut-A-Way View of Sheave With Correct Rope Positioning

NOTE: Be careful when replacing these pawls that they are all set the same way. Radii of pawls are to follow radius of pawl retainer plate (flat angle end to inside) which follows to hold pawls in place.

9. Set sheave shaft spacer in place in sheave hub.
10. Set wave washer retainer on with cup end up. Set washer equalizer ring into cup and set wave washer and pawl retainer plate in position. Refer to Figure 4, items 19-20-21-22. *Be sure pawls extend through slots in sides and insert sheave shaft so keyway guides through spring retainer notch.*
11. Insert sheave shaft through pawl retainer plate assembly and sheave.
12. Insert free end of starter cable into cable outlet in starter cover and tie loose, temporary knot about one foot from end of cable to hold.
13. Place sheave assembly, with sheave shaft up, into cover for tightening.
14. Place lock washer for sheave shaft with notch set in keyway and screw nut (left hand thread) on sheave shaft.
15. Untie temporary knot and insert through starter cable handle and end cap.
16. Tie "figure 8" knot in cable, cut off excess $\frac{1}{2}$ " from end of knot and press knot into recess of end cap, or install cable into new starter handle as shown in Figure 6.
17. Pull cable and end cap into starter handle to complete assembly.

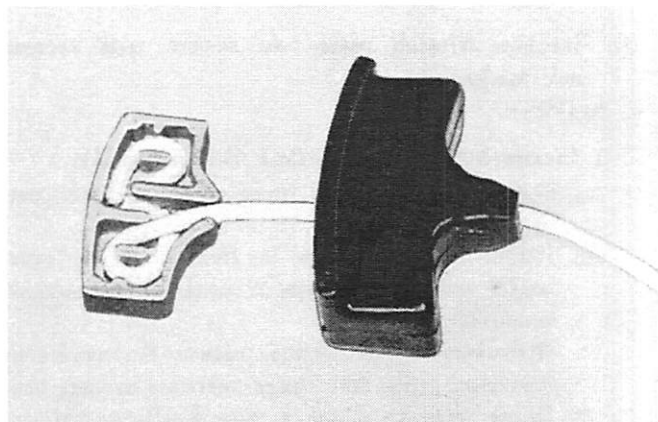


Figure 6. Installing Cable in New Starter Handle

18. Turn sheave shaft counterclockwise with screwdriver until handle is against guide bushing, then turn in additional $1\frac{1}{4}$ turns counterclockwise to wind spring to correct returning tension. (Figure 7)
19. With a $\frac{3}{4}$ " open end wrench, turn down on sheave shaft nut until tight, while keeping screwdriver in slot in shaft to prevent spring from unwinding.
20. Bend one tab of washer down into hole of cover and one tab up to flat side of nut.
21. Replace auxiliary cover and secure with small screw.
22. Pull starter cord several times to see that pawls actuate correctly and that there is sufficient tension on starter spring.

NOTE: Cord should be pulled out to full length to be sure that it does not stick when pulled out.

23. Replace entire starter housing assembly on top of unit and tighten.
24. Check that starter pawls engage auxiliary starter plate for proper operation.
25. Replace top cowl on engine and place small washers, large washers and elastic stop nuts on studs. Small washers fit against bushings. Tighten to secure top cowl.

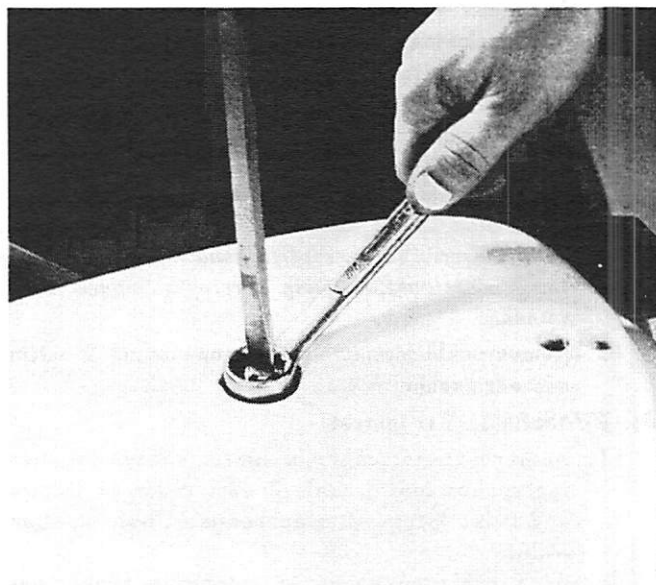


Figure 7. Preloading Starter Spring

MERCELECTRIC STARTING - - Positive Ground Type

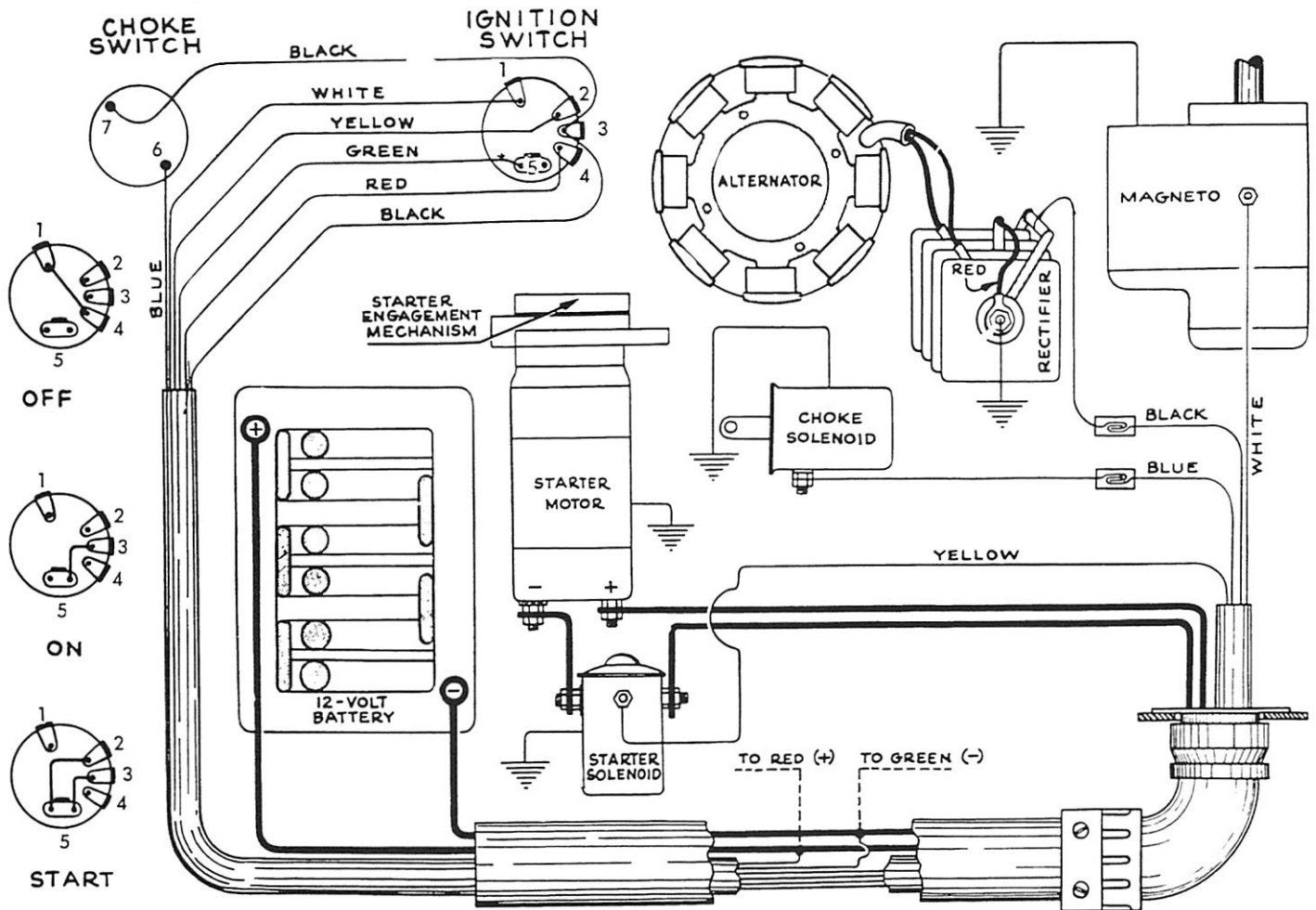


FIGURE 4. Mark 55E and Mark 50E Wiring Diagram (Positive Ground)

- | | |
|---|--|
| 1. Terminal, ignition switch, white wire | 4. Terminal, ignition switch, red wire |
| 2. Terminal, ignition switch, yellow wire | 5. Terminal, ignition switch, green wire |
| 3. Terminal, ignition switch, black jumper wire | 6. Terminal, choke switch, blue wire |
| 7. Terminal, choke switch, black jumper wire | |

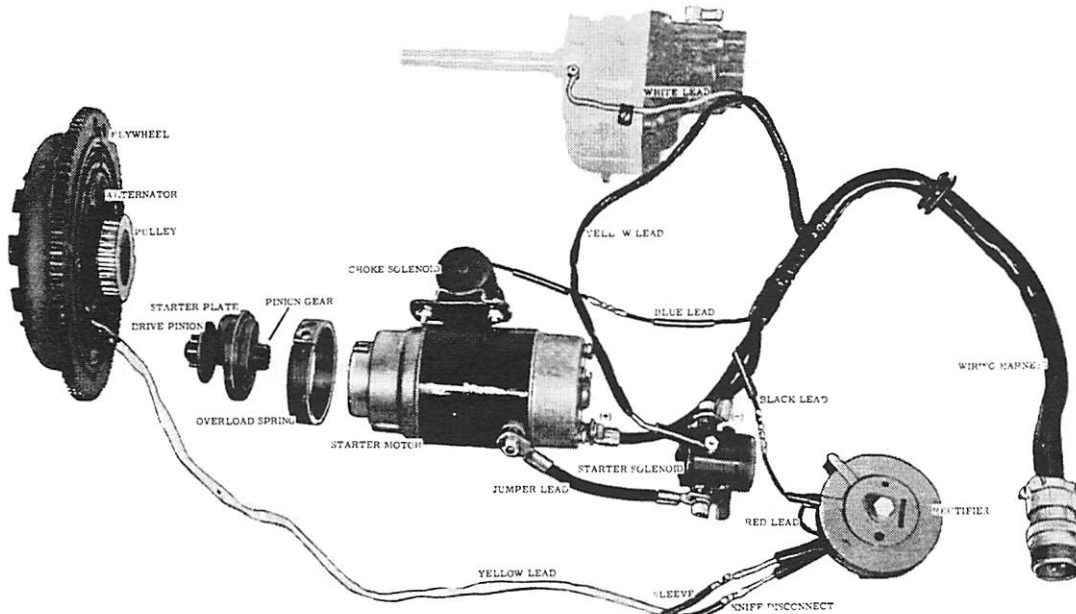


FIGURE 5. Electric Starter Assembly (Positive Ground), Mark 50E and Early Mark 55E

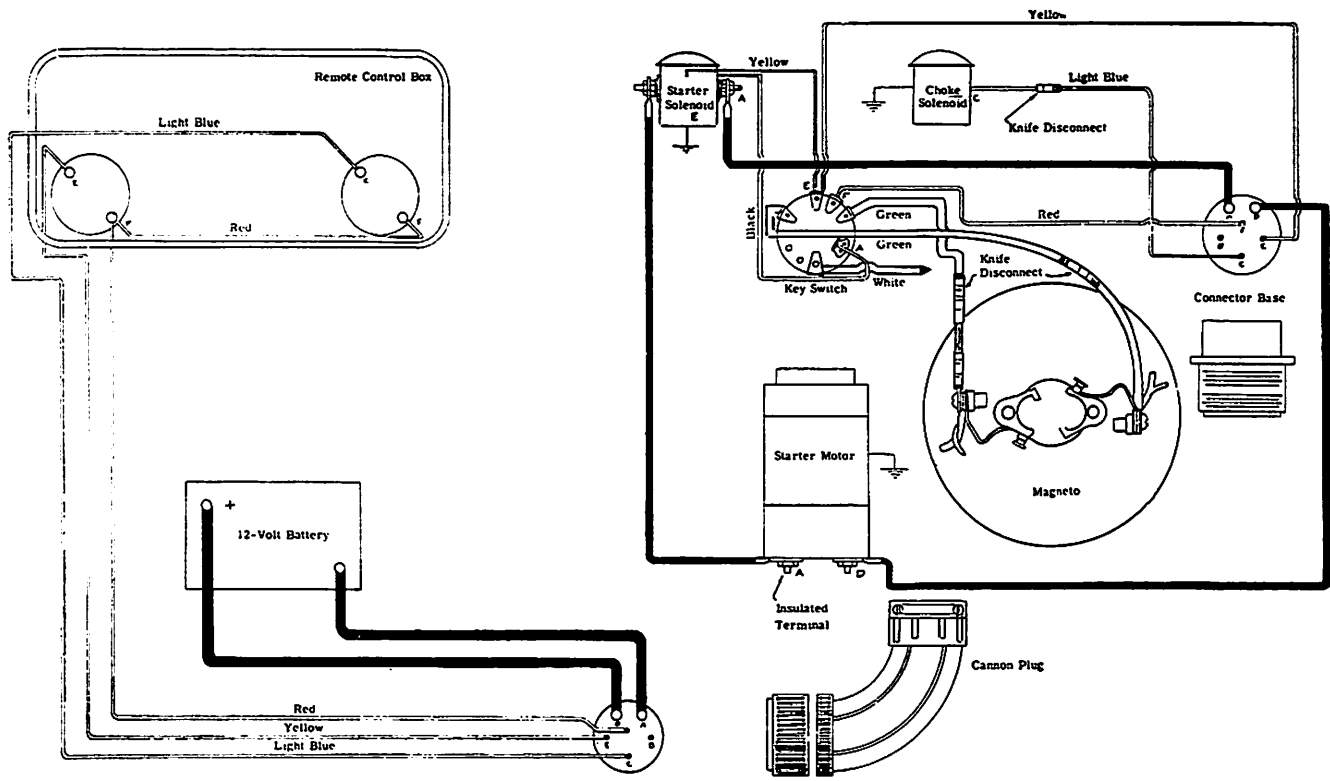


FIGURE 6. Mark 25E Wiring Diagram (Positive Ground)

- A: Negative (-) battery cable, battery thru starter solenoid
- B: Terminal, open
- C: Choke solenoid lead, blue
- D: Positive (+) battery cable, battery to starter motor
- E: Starter solenoid lead, yellow
- F: Ignition switch lead, red
- Ground: Green lead to breaker assembly

ELECTRIC STARTING

A. Description

The smooth operating MercElectric starter is optional on late model Mercury outboards of higher horsepower. Motors equipped with MercElectric starting are distinguished by the letter "E" following the model number; e.g. Merc 400E, Mark 58AEL, Mark 75E, Mark 25E.

The electric starter system is a 12 volt type especially designed for outboard use. It is as simple and dependable as the starting system on your automobile. There are no adjustments to make.

B. Circuits

The MercElectric system on 4 and 6 cylinder motors consists of 4 circuits; on 2 cylinder motors, 3 circuits. (Figures 4 and 6) The generator circuit is not present on 2 cylinder models. The four circuits follow:

Generator Circuit (4 and 6 Cylinder Only): Within the flywheel are permanent magnets and a wound stator. The alternating current generated in the stator windings passes to the rectifier. This, in turn, produces direct current (DC) from the alternating current (AC). Negative side of rectifier is grounded; positive side goes to

internal harness plug. Through the plug, the current passes on to the ignition switch in the control box and from there to the battery on the negative side. The positive side of the battery is connected through connector to ground of the engine.

Starter Circuit: The starter circuit consists of a 12 volt motor and starter engaging mechanism. A starter solenoid prevents the full starting current from passing through the ignition switch.

Choke Circuit: To operate choke, key must be in the ON (middle) or STARTING (right) position. While using electric choke, manual choke must be in down position; however, manual choke can be operated at all times if necessary.

Magneto Circuit: The engine is stopped by grounding the magneto, not by choking the engine. This is accomplished by turning key to OFF (left) position.

C. Starting and Stopping

For starting and stopping procedure with electric starter, refer to charts in Section I, General Information.

BATTERY AND ELECTRIC ACCESSORIES

A. Maintenance

A strong battery must be maintained. (Figure 7A) If battery shows less than 9½ volts when under starting load, it should be recharged. Check with DC voltmeter. A reading under 9½ volts (measured at the battery terminals under starting load) indicates insufficient voltage and subsequent shortage of power with result that motor will not turn fast enough to start.

Note: When installing a new battery, make it a habit to wire brush the tapered terminals and clamp terminals, then clean and grease them. This will protect against high resistance connections which make it difficult to keep the battery fully charged and may contribute to low available voltage in entire electrical starting system (and ignition system on 6-cylinder models).

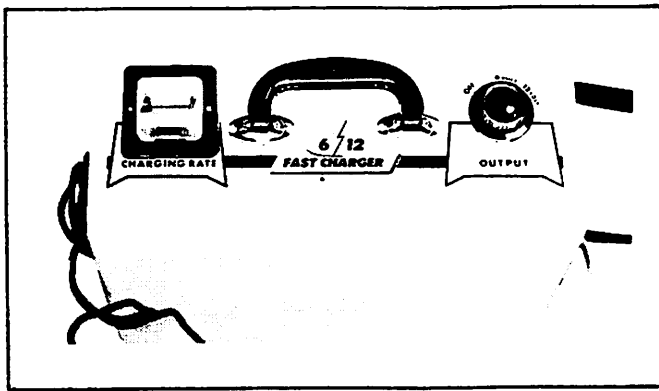


Figure 7. 6-and-12-Volt Battery Charger

A 12-volt full marine type Quicksilver battery of a minimum 70-ampere-hour capacity is recommended for all MercElectrics.

Note: Check can also be made with Hydrometer. (Figure 7A) If reading below 1.230 (specific gravity), recharge or replace present battery. Battery and battery readings in this manual refer to "Quicksilver" 12-volt battery.

WARNING

Lead acid batteries have an inherent, self-discharge characteristic which necessitates recharging when not in use every 30-45 days. Failure to do so will result in plate sulfation which will permanently damage the battery. The company cannot be responsible for battery damage either in winter storage or in dealer stock if the above information is not strictly complied with.

When adding distilled water to the battery, be extremely careful not to fill more than 3/16" above the perforated baffles appearing inside the battery. Battery solution or electrolyte expands from heat caused by charging. Overfilling the battery will cause the electrolyte to overflow if filled beyond 3/16" above the baffles.

If the specific gravity drops below 1.230, check the battery for reason and recharge battery. Battery

recharge rate should not be over 4 amperes. When gravity reaches recommended gravity reading (see chart below), discontinue charging. (Figure 7A)

B. Ampere Capacity

New storage batteries, which are not initially fully charged, supply insufficient amperage and voltage capacity to the starting (cranking) motor and results in few engine starts before battery will no longer turn starter motor fast enough to start engine. If you do not have a battery charger in your service shop, have the local automotive garage check and recharge (at slow charge) all batteries in your stock before delivery to a customer so that optimum battery performance may be obtained.

If a dry-charge battery is put into outboard service, the battery should not be filled with an electrolyte until it is sold. After the battery has been filled, wait 15 minutes and check the specific gravity of each cell with a hydrometer. If the specific gravity drops below 1.230 in any cell, the battery should be brought up to full charge before being put into service. Bring battery to full charge with a slow charge for 2-to-3 hours at a 5-6 ampere rate.

C. Table of Gravity Readings

The specific gravity of the electrolyte in a charged battery, which contains approximately 39 percent sulphuric acid, is 1.290, while the specific gravity of a discharged battery, which contains approximately 14 percent acid, is 1.100. Specific gravity readings between these two extremes indicate various states of battery charge. Refer to the following tabulation which translates specific gravity into general terms of battery state of charge. The table is based on the battery's ability to crank the engine at 80° F. It is assumed that no electrolyte has been lost from the battery and that the adjustment at full charge is correct.

Capacity Reading*	Battery Condition
1.260 Sp. Gr.	100% Charged
1.230 Sp. Gr.	75% Charged
1.200 Sp. Gr.	50% Charged
1.170 Sp. Gr.	25% Charged
1.140 Sp. Gr.	Very Little Useful Capacity
1.110 Sp. Gr.	Discharged

* Based on a temperature of 80° F. for 35190 battery.

To obtain accurate measurements of the battery's state of charge, it is necessary to consider temperature as well as the specific gravity. The specific gravity of electrolyte varies not only with the amount of sulphuric acid in the solution but also with the temperature of the solution. As electrolyte is cooled, it contracts, becoming more dense and gaining specific gravity. When electrolyte is heated, it expands, becoming less dense and losing in specific gravity.

WINTER STORAGE OF BATTERIES

Battery companies are not responsible for battery damage either in winter storage or in dealer stock if the following instructions are not complied with:

Remove battery from its installation as soon as possible and remove all grease, sulfate and dirt from top surface. This can best be done by turning a hose on the top of the battery. Be sure, however, that vent caps are tight beforehand, and blow off all excess water thoroughly with compressed air. Check water level, making sure that plates are covered.

When adding distilled water to the battery, be extremely careful not to fill more than 3/16" above the perforated baffles appearing inside the battery. Battery solution or electrolyte expands from heat caused by charging. Overfilling the battery will cause the electrolyte to overflow if filled beyond 3/16" above the baffles.

Grease the terminal bolts well with cup grease or DC4 Compound and store battery in a COOL-DRY place. Remove battery from storage every 30-45 days, check water level, and put on charge for 5 or 6 hours at 6 amperes. **DO NOT FAST CHARGE.**

If the specific gravity drops below 1.230, check the battery for reason and recharge battery. When gravity reaches 1.260, discontinue charging. To check the specific gravity, use a hydrometer which can be purchased locally. (See illustration.)

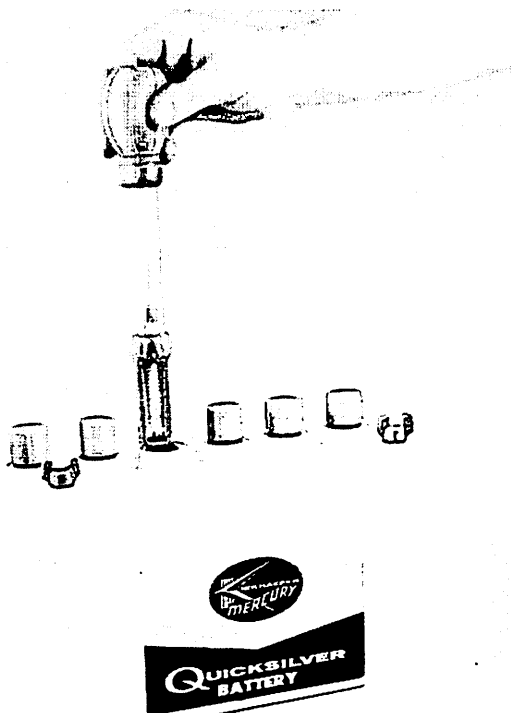


Figure 7A. Testing with Hydrometer

Repeat the preceding charging procedure every 30-45 days as long as battery is in storage. Adhering to this procedure is the best possible method of maintaining the battery during inactive periods and will insure a good serviceable battery in spring. When ready to place the battery back in service, remove excess grease from ter-

minals (a small amount is desirable on the terminals at all times), recharge again as necessary, and reinstall in your equipment.

When charging 2 or more batteries, connect them in series, positive terminal of one to negative terminal of next.

WARNING! Hydrogen and oxygen gases are produced during normal battery operation or charging. Sparks or flame can cause this mixture to ignite and explode if they are brought near the vent openings. Sulphuric acid in the battery can cause serious burns if spilled on the skin or in the eyes. Flush or wash away immediately with clear water.

Batteries in Parallel

To increase the amperage hour capacity of a battery, connect two or more batteries together. The positive terminal of one battery is connected to the like terminal of second battery. Negative terminal is connected to negative terminal of second battery. Two 35 ampere hour capacity batteries in parallel are equal to 70 ampere hours.

Example: $35 + 35 = 70$ Ampere Hours

$70 + 70 = 140$ Ampere Hours

Any electrical accessories, such as horns, running lights, etc, should be installed with electrical connections attached directly to clamps on battery terminals.

NOTE TO CONVERT ELECTRICAL ACCESSORIES:

The following electrical accessories, if manufactured for a 6-volt system, may be converted to a 12-volt system:

Radio: Usually considerable internal modification.

Refer most radios to radio expert only.

Stove: Change 6-volt elements to 12-volt elements on some; on others, change impossible.

Running Lights: Change to 12-volt bulbs or connect 2 identical bulbs in series.

Search Light: Change to 12-volt bulb or 12-volt sealed element.

Fuel Pump: Change to 12-volt fuel pump or consult manufacturer of pump on possible use of 6-volt pump on 12-volt system.

Bilge Pump: See fuel pump (above).

Horns: See fuel pump (above).

Rugged, attractive MercElectric Battery Boxes have been designed for Quicksilver Aircraft Type Batteries. The new battery boxes which can be mounted on the transom of most boats, 1) hold the battery snugly, 2) prevent damage to battery and boat, 3) protect battery cables, and 4) facilitate easy installation and removal of battery from box.

Caution! Operating 4-cylinder Merc-Electrics without battery: If it should be necessary to run without a battery connected to the engine, disconnect alternator leads (yellow) from the rectifier at the "knife" disconnects

provided for this purpose. Then tape the 2 alternator leads and 2 short rectifier leads individually and secure on engine to prevent breakage or short circuiting.

NOTE: Battery terminal lugs and terminals on Quick-silver batteries incorporate a feature to prevent the possibility of errors in crossed leads. The positive terminal post has a 3/8"-16 stud, while the negative has a 5/16"-18 stud. Remote control electrical harness has 3/8" hole in positive lead, 5/16" hole in negative lead.

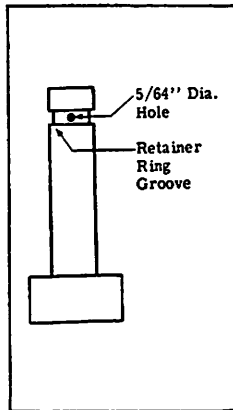
DISASSEMBLY OF STARTER MOTOR

All Mark 50E, Mark 55E below Serial No. 899950, Mark 30E below 950251 and Mark 25E below 956420

1. Remove positive (+) battery lead from starter motor lower end cap.
2. Remove jumper lead between starter motor and starter solenoid.
3. Bend down lock tab of washer and remove 5/16" hex head cap screw on starting mechanism drive pinion assembly.

NOTE: On Mark 55E and Mark 25E, remove snap ring lock with Snap Ring Pliers (91-24283). Set expander lock in order not to over-stress ring during removal. Later models used washer and cotter pin in place of snap ring.

IMPORTANT: Servicing Fastening Retaining Ring - Occasionally a retaining ring (53-24810) has become disengaged from the pinion gear and shaft and from the output gear and shaft in the starter motor and starter mechanism. In cases where this occurs, or when performing repair work on some other part of the starter motor, the shaft should be removed and drilled with a 5/64" diameter drill. Locate the hole in the center of the retainer ring groove, as shown on right, and insert cotter pin (18-20180). Replacement shaft and gears are drilled for cotter pin fastening.



4. Lift drive pinion gear off pinion gear shaft.
5. Remove 3 cap screws and lockwashers which hold starter mechanism plate to top of starter motor.
NOTE: Hold starter motor when removing last of the 3 screws, as motor is loose once screws are removed. Pinion gear and shaft, also loose, may drop out of starter mechanism.
6. Remove upper end cap.
 - a. Remove 2 nuts and washers from upper to lower end cap studs at bottom of starter motor.
 - b. Tap lightly under end cap assembly with mallet to loosen from body and field, then pull off. Note that 6" studs are threaded into upper end cap and that insulator sleeves pull off bottom of studs and remain loose in lower end cap.
 - c. Pull armature out of body and field with fingers or tip unit upside down and armature will fall out. Do not lose thrust washer on commutator end of armature shaft.

E. Twin Installation, 4-Cylinder MercElectrics

When operating two 4-cylinder MercElectrics on the same boat with one battery, it is imperative that only ONE engine's GENERATING UNIT be used to recharge the battery. With both alternators recharging the battery simultaneously, battery life will decrease or result in complete failure. One alternator, therefore, should be disconnected (as described in "CAUTION", above) when twin installation is made on a boat.

- d. Remove reduction gear from reduction gear output shaft by bending down tab washer and removing hex head cap screw.

NOTE: On Mark 55E and Mark 25E engines, remove snap ring lock with Snap Ring Pliers (91-24283). Set expander lock in order not to over-stress ring during removal. Later models had flat washer and cotter pin. (Refer to "Fastening Retaining Ring" in Paragraph 1, preceding.)

- e. Remove reduction gear, thrust washer and reduction gear output shaft. Thrust washers are located on each side of upper end cap assembly.
 - f. Press needle bearing from end cap assembly with body of Tachometer Bearing Tool (91-24101). (*Note: Oilite bearing from armature shaft is not replaceable, as it requires reaming after installation. Wear is negligible.*)
7. Remove lower end cap.
 - a. Remove lower end cap assembly from body and field by tapping lightly against end cap to loosen.
 - b. Remove field lead wire from lower end cap by removing screw, nut, flat washer, insulator washer and insulator bushing which secures wire to brush lead wire and cap.
 8. Remove carbon brush and holder.
 - a. Detach brushes from holders by removing screws, lockwashers and washers which hold brushes to brush holders.
 - b. Remove screw which holds second brush lead wire to positive (+) terminal.
 - c. Remove carbon brushes, holders and springs from brush holder post by pulling up on entire brush holder assembly.
 - d. Detach brush holder post and spring holder post by turning cap upside down and, with a 1/8" drift punch and hammer, drive out the 4 posts.
 - e. Use 1/4" drift to remove 4 insulator bushings. Tap lightly, being careful not to damage bushings.
 - f. Remove brush ground post in lower end cap by removing nut, lockwasher and flat washer. Tap post from bottom to remove.
 - g. Oilite bearing is not replaceable, as it requires reaming after installation. Normal wear is negligible. If worn, replace end cap assembly.

DISASSEMBLY OF MERCELECTRIC COMPONENTS

All Mark 50E, Mark 25E and Mark 30E Engines and Mark 55E below Serial No. 1090100

1. Remove starter mechanism.
 - a. Remove starter mechanism from crankcase flange. Do not lose locating dowel on models equipped with dowel.
 - b. Remove overload spring from starter plate by bending back lock tabs on washer and removing 2 cap screws and double tab washer.
 - c. Pull out pinion gear and shaft. Do not lose 2 thrust washers, one located on each side of starter arm.
 - d. Remove starter arm assembly by driving starter arm roll pin out of starter plate. Pin holds starter arm pin in plate.
 - e. Press out starter arm pin with arbor press.
 - f. Remove starter arm spring.
2. Remove electrical harness, 4-cylinder MercElectrics (Figure 5).
 - a. Remove nylon harness clip by detaching 5/16" cap screw, nut and washer from clip.
 - b. Remove 10-32 screw from bottom cowl so that nylon clip which holds small white lead (magneto shorting wire) and clip which holds fuel inlet hose can be removed.
 - c. Remove self-tapping screw and hex head nut which hold white lead to magneto body and primary ground terminal of magneto.
 - d. Remove ground strap which is connected to rear mounting screw and to bottom screw of No. 3 transfer port.
 - e. Remove negative (-) battery lead to starter solenoid.
 - f. Remove single yellow lead to starter solenoid from harness.
 - g. Remove black lead to rectifier via knife disconnect after sliding back rubber insulator sleeve.
 - h. Remove positive (+) battery lead to starter motor.
 - i. Remove blue lead to choke solenoid via knife disconnect.
 - j. Remove 4 screws which secure wiring harness connector into cowling. (*Note: Rubber grommet on Mark 50E will pull out of 1-1/8" hole with harness.*) If nylon clamp is used in a 1-3/16" hole, clamp may be removed by squeezing with pliers. Be careful that harness leads do not catch on rectifier bracket, thus causing damage to lead wires while harness is being withdrawn.
3. Remove starter solenoid (Figure 5).
 - a. Negative (-) battery lead was removed when harness was removed.
 - b. Remove jumper lead.
 - c. Remove 2 cap screws which hold starter solenoid to bottom cowl.
4. Remove rectifier (Figure 5).
 - a. Remove 2 yellow alternator leads from yellow leads on rectifier at knife disconnects under insulator sleeves.
 - b. Remove black lead from wiring harness, if not already detached.
 - c. Detach rectifier from rectifier bracket by removing 1/2" hex head nut, lockwasher and steel clamp which hold choke and rectifier leads from wiring harness.
 - d. Rectifier mounting bracket is held to fuel connector and bottom cowl by 7/16" hex head cap screws.
5. Remove choke solenoid (Figure 5).
 - a. Remove blue lead from harness, if not removed previously.
 - b. Remove cap screws which hold choke solenoid to starter motor, magneto adaptor or to top cowl.
 - c. Remove connecting link rod from choke lever adaptor by removing link rod clevis clip.
 - d. Choke plunger is ejected from solenoid when solenoid is removed and can be taken off link rod by removing second clevis clip.
6. Remove alternator (Figure 5).
 - a. Remove elastic stop nut and washer, which hold alternator flywheel to crankshaft, with Universal Flywheel Holder (91-24937A1). Alternator is an integral part of the flywheel.
 - b. Remove magneto driven pulley flange by removing 5/16" cap screw, flat washer and lock washer.
 - c. Remove timing belt from driven pulley.
 - d. Remove alternator flywheel with Flywheel Puller (91-24695A1).
 - e. Remove flywheel, being careful not to damage timing belt.
7. Alternator Stator.
 - a. Remove 4 screws and lockwashers which hold alternator generator to upper end cap assembly and lift off alternator stator.
 - b. Remove self-tapping screw and clip which hold alternator leads to top of cylinder block (if leads are so fastened).

noid mounting screw from left rear top cowl bolt.

NOTE: On first Mark 50E models, leads were 20" long and were clamped to rear screw of pressure housing with nylon clip and to right side of bottom cowl with 2 "S" clips to take up slack in leads.

NOTE: On Mark 25E, remove starter solenoid from bracket on top cylinder block. Note that solenoid is upside down. Remove ground strap for starter sole-

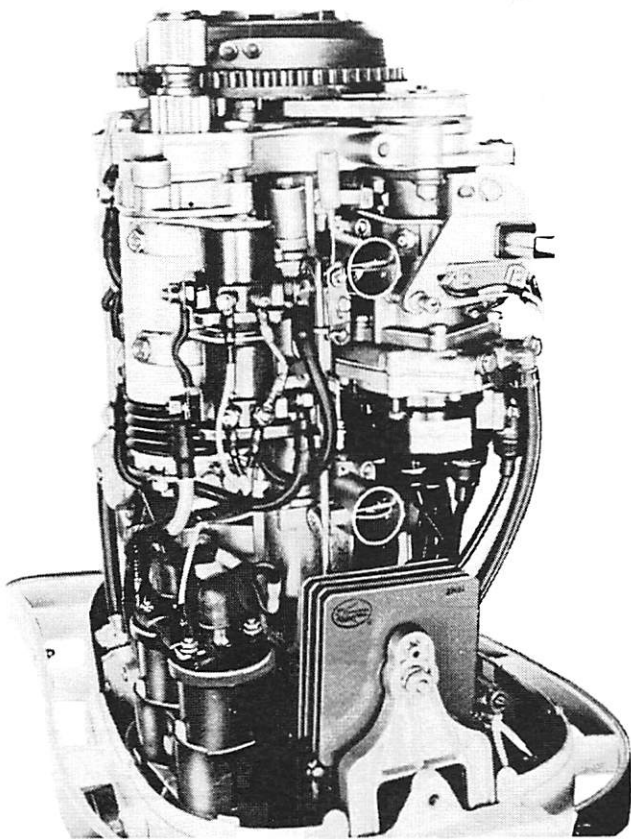


Figure 9A. Merc 700 Direct Reversing Powerhead

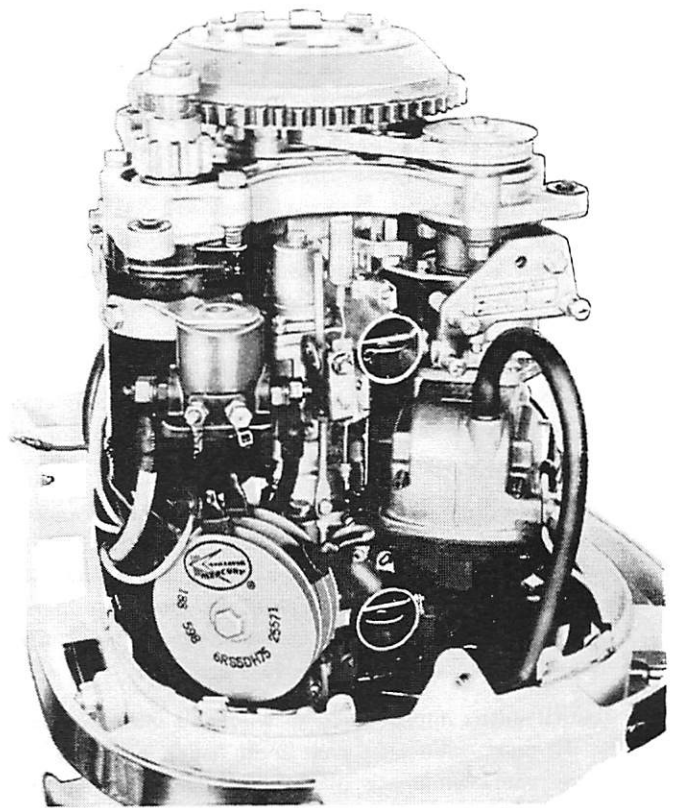


Figure 9B. Merc 400E Powerhead

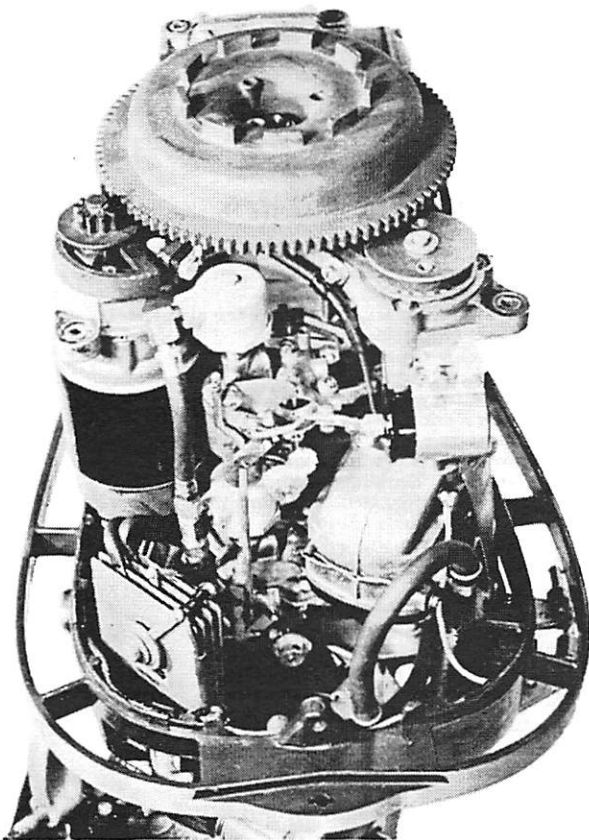


Figure 9C. Mark 50E Powerhead

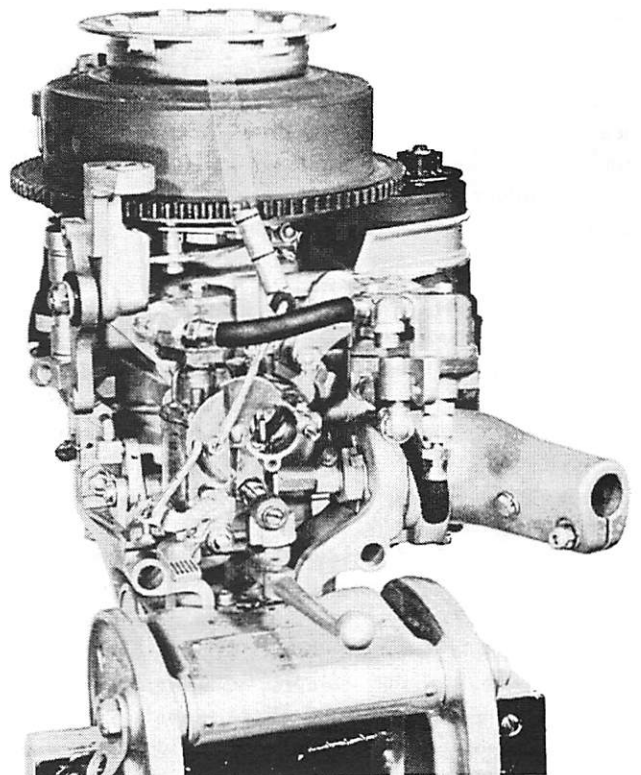


Figure 9D. Mark 25E Powerhead

REASSEMBLY OF STARTER MOTOR

All Mark 50E, Mark 55E Below Serial No. 899950, Mark 30E Below 950251 and Mark 25E Below 956420

Upper End Cap: Press needle bearing into upper end cap with Tachometer Bearing Tool (91-24101) body. Bearing is pressed even on both sides of end cap. Always press against number side of bearing. Lubricate needle bearing with Skelly Multipurpose Grease No. 2 or equivalent. Place thrust washer on reduction gear output shaft. Insert shaft into needle bearing from outside of cap. Place thrust washer and reduction gear on output shaft with small detent hole in gear facing up. Insert screw and tighten. Bend tab.

Note: On Mark 25E and 55E, replace snap ring lock with Snap Ring Pliers (91-24283). Snap ring pliers should be set so not to over-stress ring during installation. Be sure lock ring is seated in groove properly. On later models a cotter pin and washer are used. (See "Fastening Retaining Ring" in F, Page 9.)

Install entire upper end cap assembly onto field and body. Be sure reduction gear teeth mesh with teeth of armature gear. Studs are placed through holes in field and body. Tap cap lightly to seat.

Body and Field: The field winding is an integral part of the body. Inspect carefully for burned out winding, shorting or poor insulation. If insulated covering is burned or removed, or unit is shorted, it can be rewound at an electric motor repair shop, or it must be replaced.

Lower End Cap: Replace 4 insulator bushings and insulator bushing and brush ground post by pressing in from inside of lower end cap.

(Note: Larger insulator bushing is for brush lead and field winding lead attachment. Secure with flat washer, lockwasher and nut.) Press 2 brush holder posts and 2 spring holder posts into 4 insulator bushings. Two spring holder post holes are located in line with tips from oilite bearing recess. Spring holder posts have groove cut around center.

Brush Holders and Brushes: Replace carbon brush on brush holder with screw, lockwasher and flat washer. Place brush and brush holder with brush holder spring on brush holder posts. The brush holder spring fingers are retained in grooves behind carbon brush mounting lip. Opposite end catches in groove on spring holder post, causing brush holder assembly to tension against armature commutator.

Repeat above for second brush holder assembly.

Lead wire from one brush is secured to ground post with 8-32x3/8" screw. Lead wire from second brush and lead from field windings (see Body and Field, above, before proceeding) are secured to lower end cap with screw into insulator bushing. Place insulator washer on screw from outside of cap, following with flat washer, lockwasher and nut and tighten. Cover this connection on outside with Glyptal (General Electric Red Enamel No. 1201) for insulation. Glyptal may be obtained at any local electrical supply house.

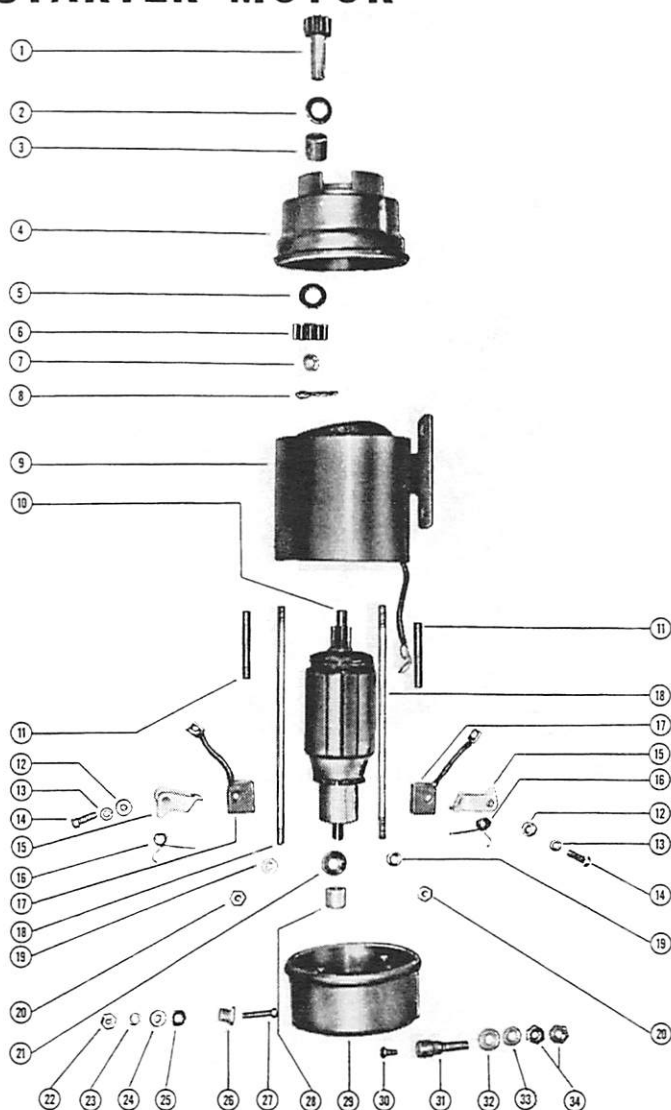


Figure 10. Electric Starter Motor

- 1 Ring, retaining—reduction gear to output shaft
- 2 Washer, reduction gear
- 3 Gear and shaft, output
- 4 Washer, thrust, output gear and shaft
- 5 Gear, reduction
- 6 Bearing, needle
- 7 End cap, upper
- 8 Bushing, oilite armature
- 9 Body and field
- 10 Armature
- 11 Sleeve, stud insulating
- 12 Washer, brush fastening screw
- 13 Lockwasher, brush fastening screw
- 14 Screw, brush to holder
- 15 Holder, brush
- 16 Spring, brush holder
- 17 Brush
- 18 Stud, end cap to body and field
- 19 Washer, starter stud
- 20 Nut, starter stud
- 21 Washer, thrust—armature
- 22 Nut, starter terminal
- 23 Lockwasher, starter terminal
- 24 Washer, starter terminal
- 25 Washer, insulating—starter terminal
- 26 Bushing, insulating
- 27 Screw, terminal
- 28 Bushing, oilite armature
- 29 End cap, lower
- 30 Screw, ground post
- 31 Post, ground
- 32 Washer, ground post
- 33 Lockwasher, ground post
- 34 Nut, ground post

Armature: Not much of the armature can be repaired. If commutator is worn, due to brush wear, it can be machined evenly and reinstalled with new brushes. This can be accomplished by any dealer having a lathe or regular armature reconditioning tool which can be purchased from a local automotive or tool supply store. The aforementioned armature reconditioning tool turns down the commutator and undercuts the mica. Undercut of mica should be approximately 1/32". After thorough inspection has been completed and armature is found to check out OK, or has been reworked, it can be reinstalled. Armature can be checked out on an armature growler. Any automotive garage can test armatures, or armature can be checked on Magneto Analyzer (91-25213). Check for

REASSEMBLY OF MERCELECTRIC COMPONENTS

(All Mark 50E and Mark 30E engines and Mark 55E below Serial No. 1090100.

A. Wiring Harness, 4 Cylinder Motors Only (Figure 11)

Install wiring harness through hole in front of cowl. Before positioning rubber grommet or nylon clamp holding harness in hole, run leads of wiring harness, except white lead to magneto, through leg of rectifier bracket. Position rubber grommet of harness in 1-1/8" hole of cowl. (NOTE: If nylon clamp is used in place of grommet, position it in 1-3/16" hole.) Install large nylon wiring harness clip on harness at inside end of rubber grommet near end of heavy plastic sleeve. Place 10-32 screw, nut and washer on nylon clip. Tighten screw, as clip does not connect to any part. Pull harness out from cowl until nylon clip touches rubber grommet, thus preventing harness from being pulled out of bottom cowl. Tape end of plastic sleeve with 3 turns of friction tape to prevent worn nylon clips from pulling off, allowing harness to pull out.

Note: On Mark 55E, electric harness assembly is attached to right side of bottom cowl with 4 small screws and nuts. Install 4 screws which secure connector into cowling.

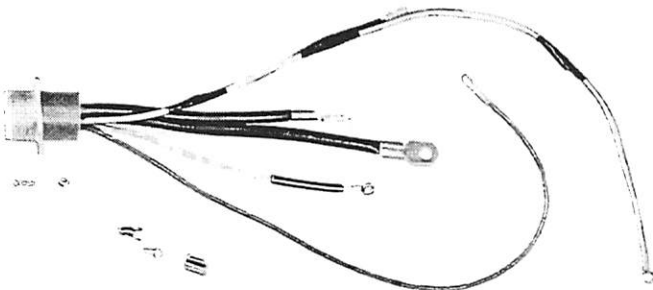


Figure 11. Electrical Wiring Harness, Mark 55E

Place nylon clip on white ground wire leading to magneto and place nylon cable clip on fuel line leading to fuel filter. Hold the 2 clips together with 10-32x1/2" screw and insert screw through small hole in bottom front cowl, fastening with nut and washer. Attach shorting wire (white lead) to magneto primary ground terminal with 5/16" nut. Fasten magneto shorting wire

continuity between commutator and windings. If continuity exists, winding is grounded and armature must be replaced. Place armature in body and field with commutator toward lower end cap and thrust washer on commutator end of armature. Spread brush and holders so that armature commutator will slide into position. Be sure thrust washer does not fall off. A minute spot of grease can be placed on thrust washer to prevent dropping off. Place insulator sleeves on studs. Align lower end cap stud holes with studs of upper end cap. Insert studs through holes in lower end cap and complete reassembly of starter motor by placing washer and nut on stud ends and tightening.

to magneto body with nylon clip and self tapping screw. (Note: Be sure white lead has enough play for magneto movement.)

Note: On Mark 25E, the internal wiring harness is secured to left cowl by 1) key switch bezel, 2) 4 screws securing connector to cowl, and 3) nylon clamp around lead wires fastened with metal screws. Blue (choke) lead is secured to cowl and attaches to choke with knife disconnects covered by sleeve. White lead is a ground. Eyelet is secured to cowl. Green leads to magneto breaker points are shorting wires to stop engine.

B. Starter Solenoid, 4 and 2 Cylinder Motors (Figure 12)

Attach yellow lead from wiring harness to small terminal of starter solenoid. Waterproof connection with Glyptal.

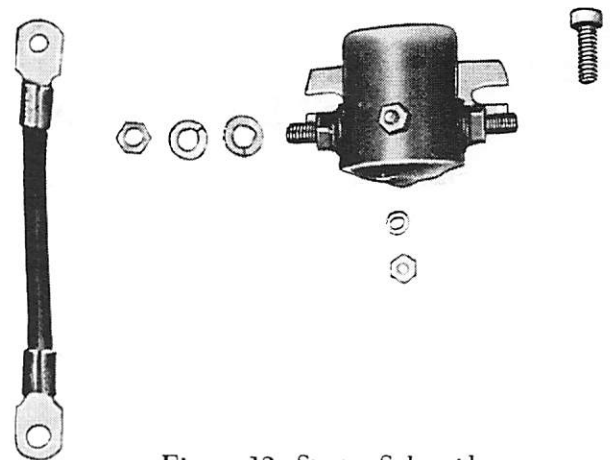


Figure 12. Starter Solenoid

Secure negative (-) battery lead to starter solenoid with nut and lockwasher. NOTE: This terminal is not marked. Positive (+) has plus (+) marked on terminal. Place negative (-) jumper lead on terminal at far end of starter solenoid with nut and lockwasher. Waterproof connections with Glyptal. Mount starter solenoid with 2 cap screws, washers, lockwashers and 2 nuts through 2 holes drilled in cowl. Attach electric grounding strap to rear mounting screw with opposite end of strap to bottom screw of No. 3 transfer port.

Note: On Mark 25E, mount starter solenoid onto bracket on top of cylinder block. Note that solenoid is upside down. Ground strap for starter solenoid attaches from solenoid mounting screw to left rear top cowl bolt.

C. Starter Mechanism, 4 and 2 Cylinder Motors (Figure 13)

Inspect parts for wear. If bushings in starter arm assembly are worn, replace assembly. Place spring in position around starter arm. Tips of spring recess in starter arm and starter plate. After correctly aligning spring, press starter arm pin into place with arbor press.

(Note: Starter arm long end is positioned "up" in order to push against overload spring. Groove of starter arm pin should line up with hole in side of starter plate for roll pin. Press in with arbor press.)

Drive roll pin into position. Place thrust washer on pinion gear and shaft. Insert pinion gear and shaft through starter arm. Lubricate with oil. Place thrust washer on shaft on top of starter plate. Place drive pinion gear assembly on splined shaft on pinion gear and shaft. Set tab washer on gear and insert screw several threads to hold shaft while reworking and installing starter motor. Unit is now ready for installation. Overload spring, screw and tab washer can be installed after starter mechanism has been secured to starter motor.

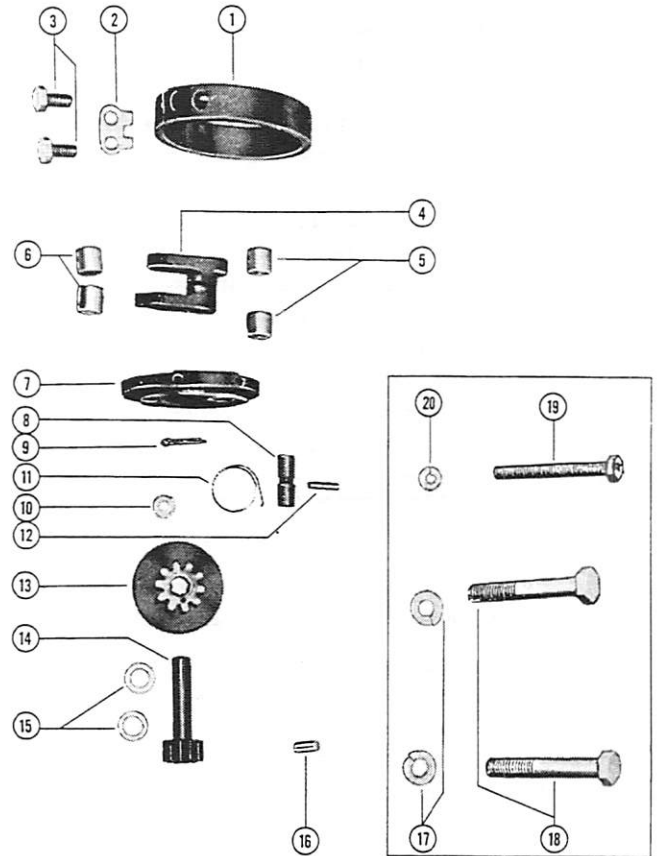


Figure 13. Starter Mechanism

- | | |
|--------------------------------------|--------------------------|
| 1 Spring, overload | 11 Spring, starter arm |
| 2 Tab washer | 12 Pin, roll |
| 3 Screw | 13 Drive pinion assembly |
| 4 Arm, starter | 14 Pinion gear and shaft |
| 5 Bushing | 15 Washer, thrust |
| 6 Bushing | 16 Pin, dowel |
| 7 Plate, starter | 17 Washer, splitlock |
| 8 Pin, starter arm | 18 Screw, hex head |
| 9 Screw (or cotter pin or snap ring) | 19 Screw, hex head |
| 10 Tab washer | 20 Lockwasher |

INSTALLATION OF STARTER & COMPONENTS

A. Installing Starter Motor and Starter Mechanism, 4 and 2 Cylinder motors

Install dowel pin in hole at top of crankcase in starter motor mounting flange. Install starter mechanism assembly, engaging dowel pin into hole in starter plate. (Caution: Plate must seat flat on machined surface of crankcase.) Insert starter motor assembly through bottom of crankcase mounting flange. Remove screw, tabwasher and pinion gear (set on loose). With choke mounting bracket to the front (on Mark 50E only), hold starter motor assembly in place and secure starter motor and starter mechanism plate with the 3 cap screws and 3 lockwashers. Draw down cap screws securely. Place overload spring over starter mechanism plate, spreading with screwdriver if necessary. Position 2 holes in spring with 2 holes in starter mechanism plate. Insert 2 cap screws in double tab washer and thread into holes in starter mechanism plate. Bend tabs to secure. Insert drive pinion gear assembly and secure with tab washer and screw. Bent end of tab engages small hole in gear. Set tab.

Note: On Mark 25E and 55E, replace snap ring lock using Snap Ring Pliers (91-24283). Snap ring pliers should be set so not to over-stress ring during installation. Be sure lock ring is seated in groove properly. Later models have cotter pin and washer. (See "Fastening Retaining Ring" in F, Page 9.)

Connect positive (+) battery lead from wiring harness to bottom terminal (positive) of starter motor (Caution: Be careful that terminal does not touch crankcase, causing a short.) Connect negative (-) jumper lead from starter solenoid to starter motor negative terminal with lockwasher and nut. Coat with Glyptal.

B. Rectifier, 4 Cylinder Motors Only (Figure 14)

Rectifier converts alternating current (AC) supplied by alternator flywheel and alternator stator to direct current (DC) in order to recharge battery.

Important-Rectifier, Loss of Direct Current Output: Failure of rectifier to discharge a direct current (DC) indicates that it, or the alternator, is faulty. Rectifiers are usually rendered useless when battery leads of electrical control harness are connected to wrong battery terminals.

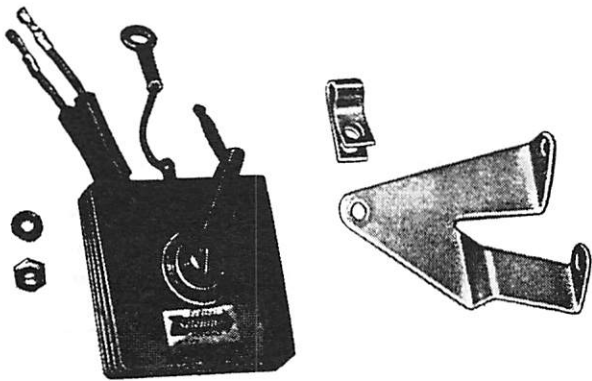


Figure 14. Rectifier

Connect black lead from rectifier to black lead from wiring harness with knife disconnects. Cover with insulator sleeve. Install rectifier to rectifier bracket, placing red ground lead on bolt between rectifier and rectifier bracket. Position rectifier so that red lead is up. Install rectifier to bracket. Place steel clamp around blue and black leads below knife disconnects. Place steel clamp on rectifier bolt and secure with lockwasher, washer and nut

NOTE: Round-shaped and square-shaped rectifiers are interchangeable.

C. Choke Solenoid, 4 and 2 Cylinder Motors (Figure 15)

Connect blue leads from choke solenoid and wiring harness with knife disconnects. Cover with insulator sleeves.

Note: On Mark 50E only, place nylon clip around yellow alternator leads and attach in lower choke solenoid mounting hole on starter motor with cap screw, large flat washer, lockwasher and nut. Set large washer in place on screw before installing. Do not tighten. Install

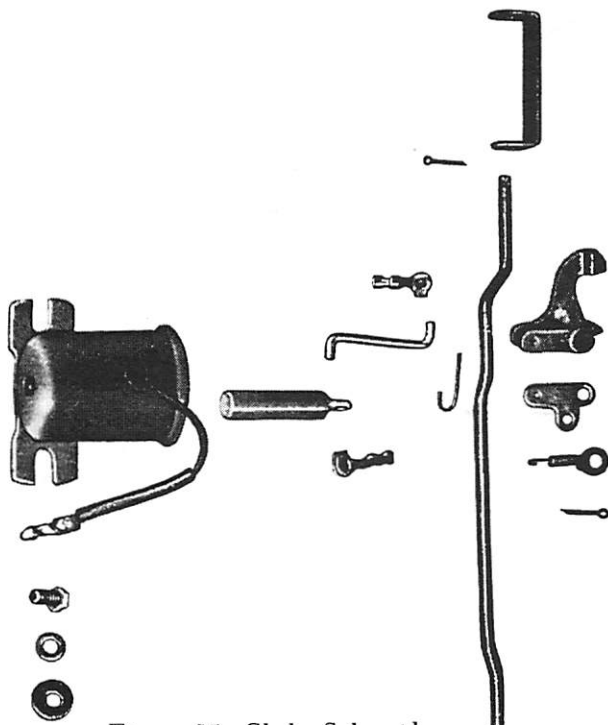


Figure 15. Choke Solenoid

choke solenoid to bracket on starter motor. Remove paint from face of starter mounting bracket to insure good ground. Choke solenoid bracket slides into lower screw, holding nylon clip and yellow alternator leads. Install upper screw, washer, lockwasher and nut and secure both screws.

Note: On Mark 55E only, install 2 cap screws to secure choke solenoid bracket to magneto adaptor housing. The opening faces toward carburetor. On Mark 25E only, install 3 screws to secure choke solenoid bracket to starter housing.

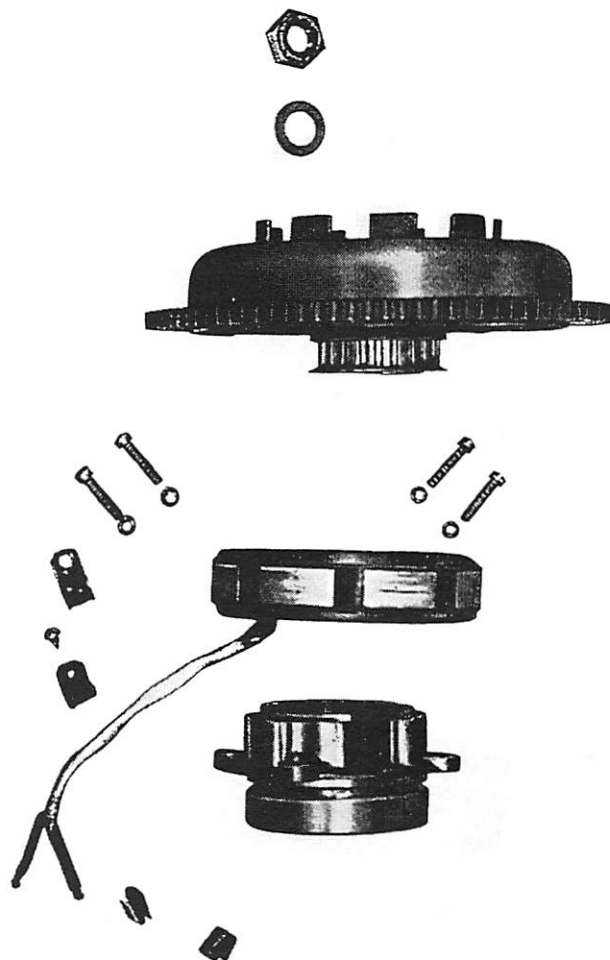


Figure 16. Alternator Stator

Install choke solenoid plunger into solenoid and connect to choke lever adaptor with connecting link rod and 2 link rod clevis clips. (*Important: Free movement of plunger is necessary. Tilt solenoid slightly in order to achieve free movement.*)

D. Alternator Stator, 4 Cylinder Motors (Figure 16)

Lay timing belt in 2 slots in upper end cap assembly. (*Note: It cannot be placed into position after alternator stator is installed.*) Install alternator stator with 4 screws and lockwashers. Lead wires are down, toward right rear side of motor. Place nylon clip on yellow alternator lead and fasten with self tapping screw and washer to hole at top of cylinder block. Connect yellow alternator lead ends to 2 yellow leads on rectifier and cover with insulator sleeves.

Note: For alternators with 20" leads only (first Mark 50E motors), place nylon clip on yellow alternator leads and fasten to rear screw of pressure valve cover. Install 2 "S" clips to right side of bottom cowl lip to take up slack. Place leads in these "S" clips. "S" clips are used only on alternators with 20" leads.

E. Alternator (Flywheel), 4 Cylinder Motors (Figure 16)

Install new drive pulley on flywheel, if removed, by pressing on with arbor press. Be sure locating dowel is installed. Position timing belt on flywheel pulley as flywheel is being placed on crankshaft. (See Figure 50, Section IV.) Pull opposite end of belt in order to maintain tension and to prevent belt from falling off. Place

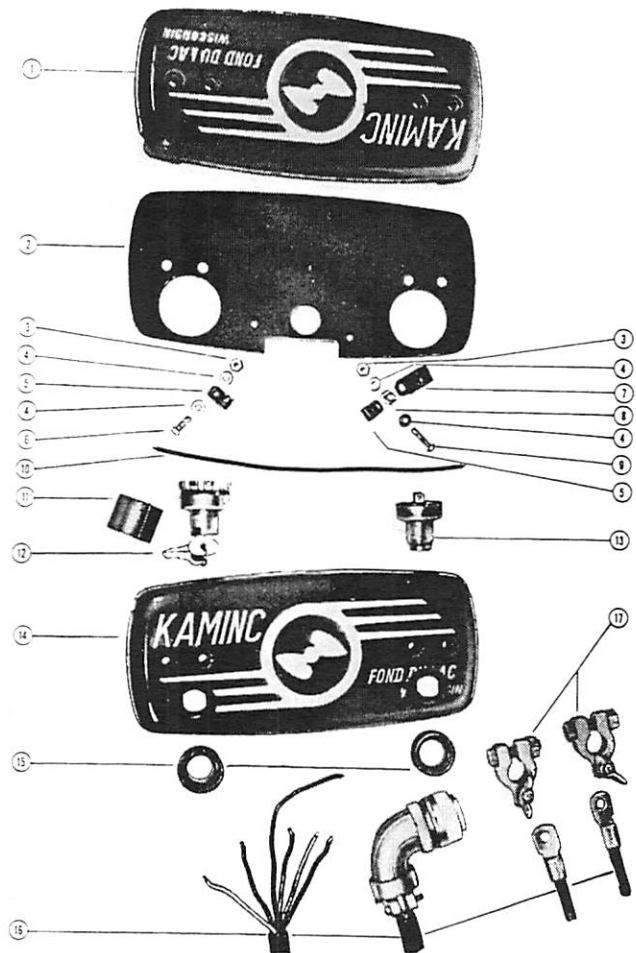


Figure 17. Electric Remote Control Assembly

Electric Remote Control Assembly

- 1 Housing, rear half
- 2 Plate, housing divider
- 3 Nut, cable clip screw
- 4 Washer, cable clip screw
- 5 Clip, choke wire to plate
- 6 Screw, cable clip
- 7 Clip, harness to plate
- 8 "D" washer, clip screw
- 9 Screw, cable clip
- 10 Wire, choke to starter switch
- 11 Cap, choke/starter buttons
- 12 Starter switch
- 13 Choke switch
- 14 Housing, front half
- 15 Bezel, starter button
- 16 Wiring harness
- 17 Terminals, battery

large, flat flywheel washer over crankshaft at top of flywheel and install elastic stop nut on crankshaft. Tighten to 65 ft. pounds with Torque Wrench (91-25667). (See Torque Specification Chart, Miscellaneous Section VIII.)

F. Remote Control, 4 and 2 Cylinder Motors (Figure 17)

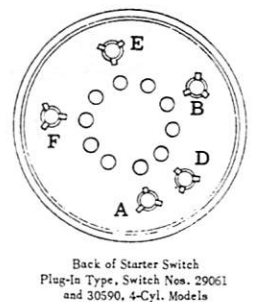
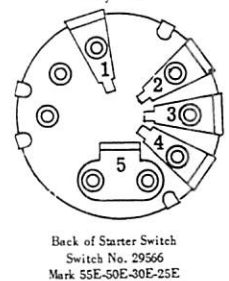
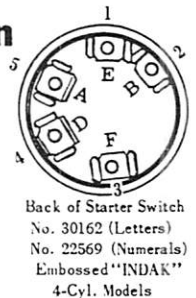
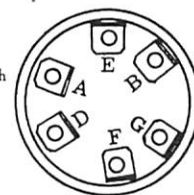
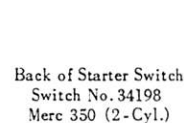
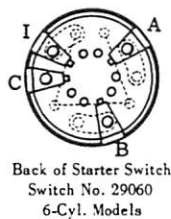
After parts have been thoroughly inspected, wiring and switches tested according to Trouble Chart, following, remote control is now ready for reassembly.

Lead wires from control wiring harness are to be soldered to starting switch.

Note: On Mark 55E and 50E, green lead is soldered to wider terminal on back side of switch. Place this wider terminal at bottom and solder. Installing counter-clockwise, lead wires are green - red - black (solder 2 black lead wires together here; one leads to choke control switch) - yellow - white.

Wiring harness can be checked for broken or shorted wires by using Continuity Tester (91-22966) or Magneto Analyzer (91-25213). Place one lead of meter on plug end and opposite lead of meter on starting switch end of lead. Check to see that current flows through wire. If not, wire is shorted or broken. Check each individual lead the same way. (Refer to wiring diagrams, Figures 4 and 5, for correct leads and terminals and see Back of Starter Switch Diagram, Figure 18, and chart following.)

MercElectric Ignition & Starter Switches



Position	Connects Terminals	Models
Off	E & D 1 & 4 1-4-6 No Contact E-D-G	All 4-Cyl. 1958 & Newer Mark 55E-50E-30E Mark 25E All 6-Cyl. Models Merc 350 (2-Cyl.)
Run	A & F 3 & 5 B-A-I A-F	All 4-Cyl. 1958 & Newer Mark 55E-50E-30E-25E All 6-Cyl. Models Merc 350 (2-Cyl.)
Choke	B-A-I-C	Merc 800-700-600 Dir. Rev.
Start	A-F-B 2-3-5 2 & 5 B-A-I-C* B-A-I A-F-B	All 4-Cyl. 1958 & Newer Mark 55E-50E-30E Mark 25E All 6-Cyl. but 800-700-600 D.R. Merc 800-700-600 Dir. Rev. Merc 350 (2-Cyl.)

* Merc 800-700-600 Full Gear Shift in Neutral

Figure 18. Back of Starter Switches

RECTIFIER CHECK

A. REASONS FOR RECTIFIER FAILURE

1. Reversed battery wires.
2. Stopping engine with ignition switch at RPM's above idle.
3. Open circuit, such as broken wire, loose connection, bad switch or loose harness connector at engine.

B. HOW TO CHECK FOR OPEN CIRCUIT

1. Connect remote control to engine.
2. Disconnect BATTERY terminals from battery.
3. Use Merc-O-Tronic Tester (91-25213) set to scale No. 3, (Figure 1)
4. Connect 2 small test leads together and adjust meter for "ZERO".
5. Connect one test lead to Red (center) wire of rectifier.
6. Connect other test lead to "RED" BATTERY cable.
7. Turn ignition switch of remote control to "ON" position. Meter should move to right to "ZERO". IF WIRING IS GOOD, METER HAND ALWAYS WILL REMAIN AT RIGHT HAND "ZERO", WHILE IGNITION SWITCH IS IN "ON" POSITION, WHEN BELOW TESTS ARE BEING MADE. IF IT DOES NOT, FAULT MUST BE FOUND AND CORRECTED OR NEW RECTIFIER ALSO WILL BE BURNED OUT.
8. Turn ignition switch "ON" and "OFF" several times and make sure that pointer moves to "ZERO" each time that switch is turned "ON". If it does not, high resistance will be present and must be found or a new rectifier also will fail.
9. With ignition switch "ON", move external wiring harness back and forth, up and down, to check for breaks in wiring. Meter should remain at "ZERO" if harness is good.
10. Move red wire on rectifier back and forth, up and down. Meter should remain at "ZERO" if lead is not broken.
11. Remove test lead from "Red" BATTERY cable and connect to "Black" BATTERY cable.
12. Remove other test lead from "Red" (center) wire of rectifier and connect center ground stud of rectifier.
13. Move internal harness back-and-forth, up-and-down to

check for breaks in wiring. Meter should remain at "Zero" if harness is good.

14. Move external harness back-and-forth, up-and-down to check for breaks in wiring. Meter should remain at "Zero" if harness is good.
15. Disconnect meter from engine and harness, reconnect battery terminals and engine is ready for use.

C. RECTIFIER TEST PROCEDURE

Two types of rectifiers are used, the plate type and the diode type. The following methods may be used to test them.

TESTING PLATE TYPE

(By Measuring Direct Current Resistance on Magneto Analyzer) (Figure 1)

1. Set selector switch on Position No. 3 (Continuity).
2. Clip small red and black test leads together and turn meter adjustment knob for Scale No. 3. until meter pointer hand lines up on net position on Scale No. 3, right side.
3. Connect small red and black test leads from analyzer to:
 - a. Black wire and red wire on positive ground type rectifiers or
 - b. Red wire and ground bolt on negative type rectifier.
4. Note reading of figures on lower band, Scale No. 3.
5. Reverse test leads on rectifier and note readings again.
6. Ratio of two readings should be 10:1 or greater.
7. Remove analyzer test leads and connect to the two alternator leads or lead terminals on rectifier. Note reading of figures on lower band, Scale No. 3.
8. Reverse test leads on rectifier and note readings again.
9. The ratio of the two readings should be no more than 2:1.
10. This is only a preliminary test to determine condition of rectifier. If questionable, as a final test, rectifier should be installed on engine and checked with ammeter while engine is running.

TESTING DIODE RECTIFIER

1. Turn Magneto Analyzer selector switch to position No. 3 (Coil Continuity) and connect small red and black test leads together.
2. Turn meter adjustment knob for Scale No. 3 until meter pointer lines up on right side (set position).
3. Testing positive diodes
 - a. Connect small red test lead to either alternator terminal and connect black lead to positive terminal of rectifier. (Figure 2) Meter pointer should move to right of Scale No. 3.
 - b. Reverse test leads on rectifier. Meter pointers should remain stationary at left side of Scale No. 3.
 - c. Repeat Steps "a" & "b" on the opposite alternator terminal.
This will determine condition of positive diodes.
4. Testing negative diodes
 - a. Connect small red test lead to either alternator terminal and connect black test lead to rectifier

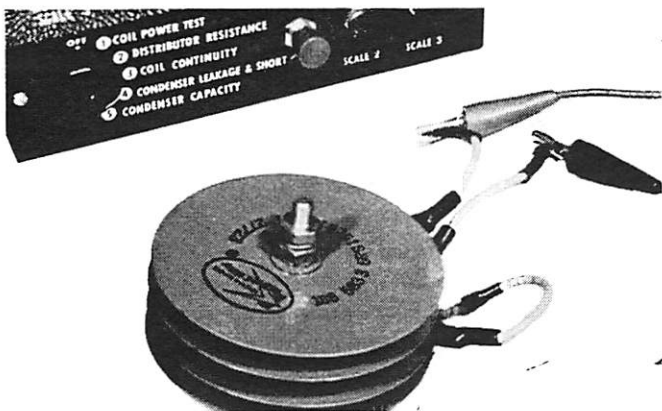


Figure 1. Testing Rectifier

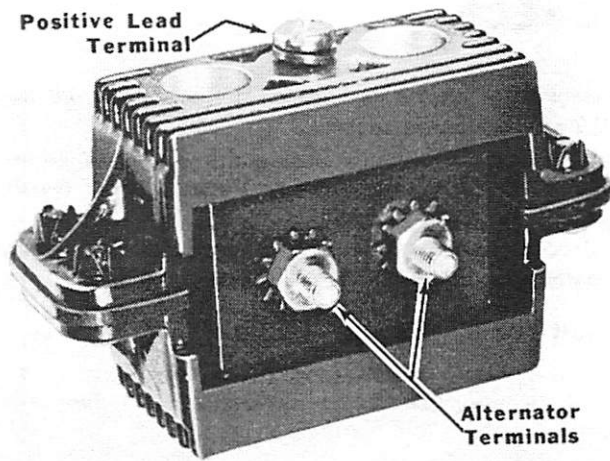


Figure 2. Testing Positive Diodes

ground stud. (Figure 3) Meter pointer should remain stationary at left side of Scale No. 3.

- b. Reverse test leads on rectifier. Meter pointer should move to right side of Scale No. 3.
- c. Repeat Steps "a" & "b" on opposite alternator terminal. This will determine condition of negative diodes.

NOTE: If any of the diodes do not check good, rectifier is defective and must be replaced.

Caution: Do not attempt to check polarity of battery leads by "sparking" lead terminals against battery terminals. This action may result in a burned-out rectifier.

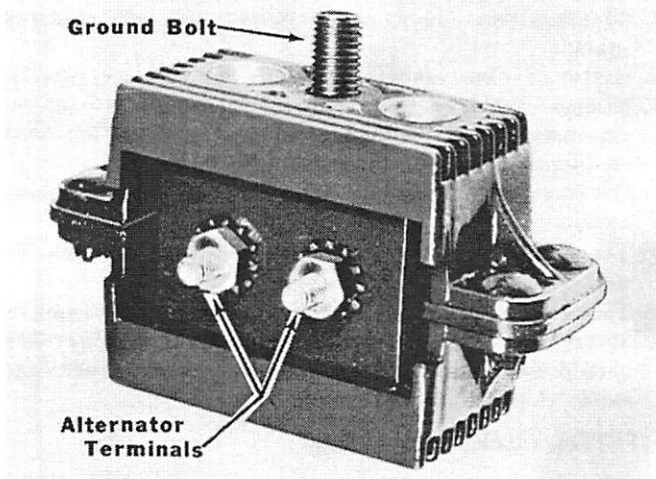


Figure 3. Testing Negative Diodes

FINDING CAUSE OF TROUBLE: Burned-out rectifiers are greatly discolored and/or have a "baked" appearance. Unless condition which caused failure is corrected, new rectifier will provide no better service than old rectifier. See Section VII for analysis of rectifier failure.

Rectifiers usually are rendered useless (burned-out) when battery leads of the electrical control harness are connected to the wrong terminals on the battery, or if battery leads are disconnected from battery terminals during operation of motor. Burned-out rectifiers are greatly discolored and/or have a "baked" appearance.

The Kiekhaefer Corporation will not honor warranty on any rectifiers which are burned out, as described above.

D. REPLACEMENT RECTIFIER AND ASSEMBLY (A-25571A1) NEGATIVE (-) GROUND

The A-22507A1, A-22692A1 and A-25448 positive (+) ground type rectifiers are no longer available and are no longer available and are replaced by a negative (-) ground type rectifier assembly (A-25571A1).

NOTE: Rectifier assembly A-25571A1 has been superseded by rectifier replacement assembly A-32970A1. See paragraph E below.

Replacement of a positive ground rectifier with a negative ground rectifier requires that the battery leads on the A-22631 series remote controls be reversed.

Each A-25571A1 rectifier will have a yellow tag containing the preceding information. This tag should not be removed from the rectifier when installed. A small piece of green tape will accompany the new rectifier to be placed on the negative ground battery lead.

The 2 yellow leads, side-by-side on the rectifier, are for alternator leads attachment. The black lead attaches to the black lead of the internal harness (on motors formerly with positive ground). The ground wire, formerly attached to the thru bolt, is no longer used, as grounding is now accomplished through the center bolt (internally).

CAUTION! Failure to connect leads properly will result in a burned-out rectifier.

E. RECTIFIER REPLACEMENT ASSEMBLY (A-32970A1)

When replacing early style (large) rectifier (A-25571, A-25571A1 and A-25571A2) with late style (small) rectifier use the accompanying lead wires as follows:

1. Attach red extension lead to rectifier output (red) terminal. Secure with 10-32x $\frac{1}{4}$ " screw and nut. Paint terminal and screw with Liquid Neoprene (C-92-25711).
2. Slide rubber sleeve over red extension lead and position over rectifier terminal.
3. Connect red extension lead (knife disconnect end) to internal harness red lead terminal. Position rubber sleeve over knife disconnect.
4. Attach yellow extension leads to rectifier input (yellow) terminals. Secure with 10-32x $\frac{1}{4}$ " screws and nuts. Paint terminal and screw with Liquid Neoprene (C-92-25711).
5. Slide rubber sleeves over yellow extension leads and position over rectifier terminals.
6. Connect yellow extension leads (knife disconnect ends) to yellow alternator leads. Position rubber sleeves over knife disconnects.

NOTE: Some models have spade disconnects on yellow alternator leads. Remove spade connectors, install knife disconnects, crimp securely and solder with resin core solder and connect leads as outlined immediately preceding.

ALTERNATOR

TESTING ALTERNATOR

1. Alternator may be tested without removing flywheel.
2. Disconnect 2 yellow alternator leads from rectifier.
3. Turn selector switch of Magneto Analyzer to Position No. 2.
4. DO NOT clip small red and black leads together.
5. Turn No. 2 Scale meter adjustment knob to adjust meter needle with red line on right side of Scale No. 2.
6. Connect small red and black test leads to terminals of yellow alternator leads.

7. Read figures on Scale No. 2. Refer to specification chart, below, for model being tested. If alternator does not meet specifications, it should be replaced.

ALTERNATOR SPECIFICATIONS

Model	Ohms
All 6-Cyl. except Late Merc 1000-850	.4 to .6
Late Merc 1000-850	.35 to .45
All 4-Cyl. except Merc 650	.25 to .35
Merc 650	.35 to .45

IGNITION REPLACEMENT KEY & COIL

IGNITION KEY REPLACEMENT

Ignition key serial numbers for MercElectric motors should be recorded by the user. In event key is lost, a new one may be ordered directly from the Kiekhaefer Corporation, but only if key number is provided. In event correct serial number of key is not provided, it will be necessary to purchase a new key and switchlock assembly. (NOTE: Only the key not the switch) has the number stamped on it.)

IGNITION COIL REPLACEMENT, 6-CYL. MODELS

1. Do not install a 26433 Delco ignition coil on Merc models which use 32193 Autolite coils, because ignition wiring system differs in that it uses ignition coil ballasts rather than resistors. Coils are not connected as on earlier 6-cylinder models.
2. Six-cylinder models, which use 32193 (Autolite) coils, employ starter solenoid 32082 or 28062 which are not interchangeable with "switch" type starter solenoids used on some other 6-cylinder models.

BATTERY METER INSTALLATION

FOUR (4) CYLINDER MODELS

1. Disconnect red rectifier lead at knife disconnect and discard present rubber sleeve. Place new rubber sleeve over either lead and hook one furnished knife connector to each lead.
2. Connect one wire from battery meter "IGN" terminal to ring terminal furnished and connect all 3 together with nut and screw provided. Slide rubber sleeve over this connection to provide insulation.
3. Connect second wire from battery meter "GROUND" terminal to a clean metal ground.

SIX (6) CYLINDER MODELS

1. Connect one wire from battery meter "IGN" terminal

to bottom terminal of terminal block on right side of engine (located on upper fuel pump mounting pad).

2. Connect second wire from battery meter "GROUND" terminal to suitable engine ground (mounting screw for terminal block).

Battery meter will indicate system voltage only when ignition key is in "RUN" or "START" position. Instrument reaction is slow, requiring approximately one minute warmup period.

3. On earlier models without terminal block, follow "Four Cylinder Model" procedure, which substitutes ring terminals for knife disconnects provided.

STARTER ARM REPAIR

(From Service Bulletin 2, Section VII)

Super oilite bushings, Part Nos. 23-22602 and 23-22530, are available for replacing worn starter arm bushings.

Bushing 23-22602 (1/4" long) is pressed into open end of arm. Bushing 23-22530 (5/16" long) is pressed in opposite end.

The bushings must be pressed flush with outside surfaces and then line reamed. A sharp reamer is necessary to clean the hole without plugging the lubricating pores. Use a 3/8" diameter expansion hand reamer and adjust with micrometer. Line ream to .375" - .376" diameter after installing bushings.

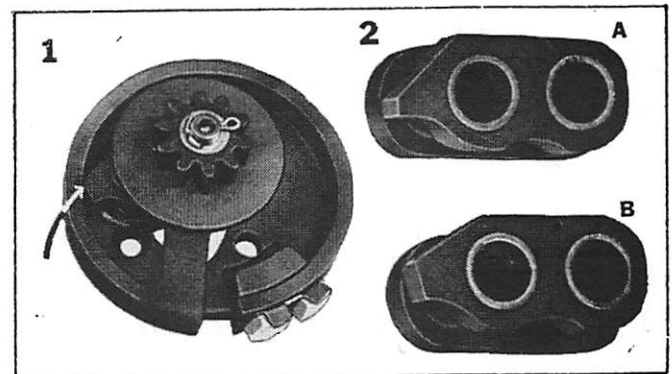


Figure 4. 1) Greasing Point on Overload Spring and 2) 22422A1 Starter Arm, "A", and 23881A1 Starter Arm, "B"

STARTER SOLENOID

Identification: Two types of starter solenoids are used on Mercury Outboard Motors, 1) standard type and 2) switch type. Although they have the same general external appearance, internal construction is different and they are not interchangeable. The following wiring diagrams (Figures 5-6) will illustrate internal construction of each.

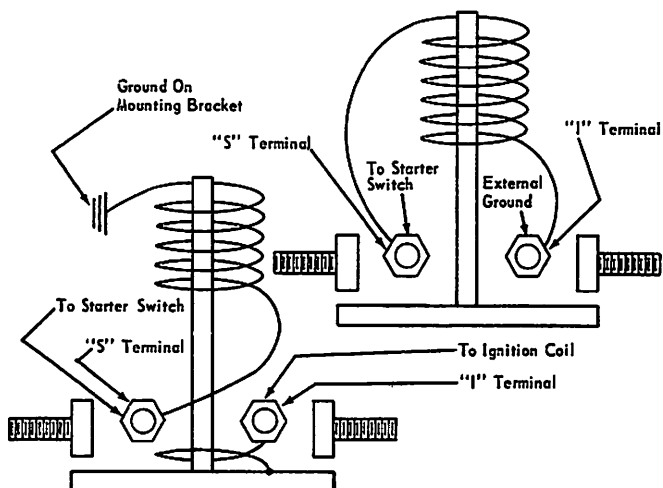


Figure 5 (Top, Rt.). Standard Type Starter Solenoid

Figure 6 (Bottom). Switch Type Starter Solenoid

If, for any reason, solenoid cannot be identified, the following methods may be used for easy identification:

A. Using Magneto Analyzer

1. Turn Magneto Analyzer selector switch to position No. 2 (Distributor Resistance).
2. DO NOT clip small red and black lead together.
3. Turn No. 2 scale meter adjustment knob to adjust meter needle with red line on right side of scale No. 2.
4. Connect small red test lead to "S" terminal and black test lead to "I" terminal.
5. An ohm reading of 3.5 to 5.5 (Scale 2) indicates a standard type solenoid. If meter pointer hand remains stationary, this will indicate that it is a switch type solenoid.

B. Using 12-volt Battery

1. Connect jumper leads to 12-volt battery.
2. Connect positive jumper lead to small "S" terminal.
3. Touch negative jumper lead to "I" terminal. If solenoid engages (a clicking sound), this indicates a Standard Type Solenoid.
4. If solenoid did not engage, touch negative jumper lead to mounting bracket. If solenoid then engages (a clicking sound), this indicates a Switch Type Solenoid.
5. After solenoid has been identified, use the following test procedure to test solenoid.

TESTING STANDARD TYPE SOLENOID

1. Turn selector switch of Magneto Analyzer to Position No. 2 (Distributor Resistance) and clip small red and black lead together.
2. Turn meter adjustment knob for Scale No. 2 until

meter pointer lines up with set position on left side of "OK" block on Scale No. 2.

3. Unclip small red and black leads.
4. Connect small red test lead to one large terminal of solenoid and connect small black test lead to other large terminal as shown in Figure 7.
5. Using 12-volt battery and jumper leads, connect positive lead to small "S" terminal of solenoid.
6. Connect negative battery lead to "I" terminal of solenoid.
7. Meter pointer hand must move into the "OK" block, or solenoid is defective and must be replaced.

CAUTION: Do not connect battery leads to large terminals of solenoid, or meter will be damaged.

TESTING SWITCH TYPE SOLENOID

1. Turn selector switch of Magneto Analyzer to Position No. 2 (Distributor Resistance) and clip small red and black lead together.
2. Turn meter adjustment knob for scale No. 2 until meter pointer lines up with "set" position on left side of "OK" block on Scale No. 2.
3. Unclip small red and black leads.
4. Connect small red test lead to one large terminal of solenoid and connect small black test lead to other large terminal, as shown in Figure 7.

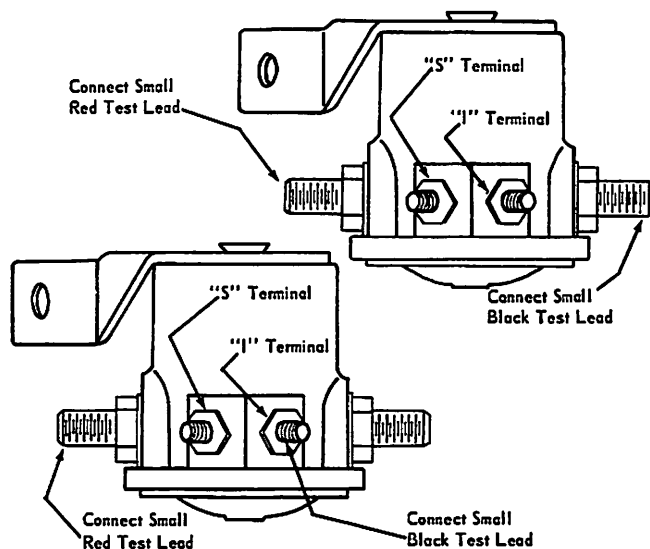


Figure 7 (Top, Rt.). Terminals on Standard Solenoid

Figure 8 (Bottom). "I" Terminal on Switch Solenoid

5. Using 12-volt battery and jumper leads, connect positive lead to small "S" terminal of solenoid.
6. Connect negative battery lead to mounting bracket of solenoid.
7. Meter pointer must move into "OK" block or solenoid is defective and must be replaced.
8. Remove one test lead from large terminal and connect to small "I" terminal of solenoid, as shown in Figure 8.
9. Again, meter pointer must move into "OK" block, or solenoid is defective and must be replaced.

CAUTION: Do not connect battery leads to large terminals of solenoids, or meter will be damaged.

MERCELECTRIC TESTING & TROUBLE CHART

Trouble	Cause	Remedy
Starter does not operate.	Run down battery	(1) Check battery with hydrometer. If reading is below 1.150, recharge or replace battery. Use Battery Charger 91-28997.
	Poor contact at terminals	(2) Remove terminals, scrape clean and tighten bolts securely. Coat with sealer to protect against further corrosion.
	Wiring or key switch	Check for resistance between: a) Positive (+) terminal of battery and large input terminal of starter solenoid; b) Large wire at top of starter motor and negative (-) terminal of battery; and c) Small terminal of starter solenoid and positive battery terminal (key switch must be in "Start" position). Repair all defective parts.
	Starter solenoid	Disconnect wire from starter solenoid to starter motor. With key switch in "Start" position, check resistance between 2 large terminals of starter solenoid. Replace a defective solenoid.
	Starter motor	(3) With a fully charged battery, connect a negative (-) jumper wire to upper terminal on side of starter motor and a positive jumper to large lower terminal of starter motor. If motor still does not operate, dismount for overhaul or replacement.
Starter turns over too slowly.	Low battery	Complete (1) preceding.
	Poor contact at battery terminal	Complete (2) preceding.
	Poor contact at starter solenoid or starter motor	(4) Check all terminals for looseness and tighten all nuts securely. Disconnect positive (+) battery terminal. Rotate pinion gear in disengage position. Pinion gear and motor should run freely by hand. If motor does not turn over easily, clean starter and replace all defective parts.
	Starter mechanism	Complete (3) preceding.
Starter spins freely but does not engage engine.	Low battery	Complete (1) preceding.
	Poor contact at battery terminals	Complete (2) preceding.
	Poor contact at starter solenoid or starter motor	Complete (4) preceding.
	Dirty or corroded drive pinion	Clean thoroughly and grease the spline underneath pinion with MULTI-PURPOSE Lubricant (92-30239).
Starter does not engage properly.	Pinion or flywheel gear	Inspect mating gears for excessive wear. Replace all defective parts.
	Small anti-drift spring	If drive pinion interferes with flywheel gear after engine has started, inspect small anti-drift spring located under pinion gear. Replace all defective parts. (NOTE: If drive pinion tends to stay engaged in flywheel gear when starter motor is in idle position, start motor at ¼ throttle to allow starter pinion gear to release flywheel ring gear instantly.)
	Starter arm sticks against overload spring	Grease overload spring at point where starter arm contacts overload spring. (Refer to Figure 1 on Page 16.)
Starter keeps spinning after key is turned to "On" position.	Key not fully returned	Check that key has returned to normal "On" position from "Start" position. Replace switch if key constantly stays in "Start" position.
	Starter solenoid	Inspect starter solenoid to see if contacts have become stuck in closed position. If starter does not stop running with small yellow lead disconnected from starter solenoid, starter solenoid should be replaced.
	Wiring or key switch	Inspect all wires for defects. Open remote control box and inspect wiring at switches. Repair or replace all defective parts.
Choke does not open or close sufficiently	Choke linkage	Check for interference between moving parts of choke linkage. Adjust any pins or clips which may interfere. Replace all defective parts.
	Choke solenoid improperly located.	Loosen base bolts on choke solenoid and readjust for improved action.

MERCELECTRIC TESTING, TROUBLE CHART - CONT.

Trouble	Cause	Remedy
Choke does not operate.	Low battery Poor contact at battery terminals Wiring or key switch Choke solenoid	Complete (1) preceding. Complete (2) preceding. With key switch turned to "On" position, check for continuity between positive (+) terminal of battery and choke knife disconnect, located under rubber sleeve about 6 inches down blue wire lead from choke solenoid. Repair or replace all defective parts. With a fully-charged battery, connect a positive (+) jumper to disconnected lead of choke solenoid and a negative (-) jumper to base of solenoid. Replace a defective solenoid. Unit should operate with Analyzer (91-25213), using switch on resistance between lead and ground.
Alternator is not charging battery.	Battery will not retain charge Wiring between rectifier and battery or key switch Wiring between rectifier and alternator	Complete (1) preceding. With key in "On" position, check for resistance between: a) Positive (+) terminal of battery and the spade terminal located at the "red" terminal of the rectifier; and b) Negative (-) terminal of battery and mounting bolt at rear of rectifier. Inspect all soldered joints. Repair or replace all defective parts. Rectifier: With an ohmmeter, measure the DC resistance between: a) Red wire on rectifier and mounting (ground) bolt. Reverse the 2 leads from ohmmeter and measure resistance again. Ratio of the 2 readings should be 10-to-1 or greater; and b) Two yellow leads on rectifier. Reverse the 2 leads from ohmmeter and measure resistance again. Ratio of 2 readings should be no more than 2-to-1. Replace a defective unit. Alternator: With the 2 spade terminals open, check for continuity between 2 yellow leads from alternator. Also, check that there is NO continuity between alternator wire and ground (base of stator or engine block). Repair or replace all defective parts.
Rectifier is overheating.	Battery terminals improperly connected Rectifier is damaged	Check that negative marking on harness matches that of battery. If battery is connected improperly, severe burning of rectifier will occur. Inspect rectifier for damaged protective coating of plates. Replace a defective unit.
Wires are overheating.	Battery terminals improperly connected Short circuit in wiring system Short circuit in choke solenoid ... Short circuit in starter solenoid ...	Check that negative marking on harness matches that of battery. If battery is connected improperly, red wire to rectifier will overheat. Inspect all connections and wires for looseness or defects. Open remote control box and inspect wiring at switches. Repair or replace all defective parts. Check for high resistance. If blue choke wire heats rapidly when using choke, choke solenoid may have internal short. Replace if defective. If yellow starter solenoid lead overheats, there may be internal short (resistance) in starter solenoid. Replace a defective solenoid.
Circuit tester	Circuits on MercElectric models ..	To check performance of various components of MercElectric system, use Magneto Analyzer (91-25213), scale No. 2.
Battery voltage	Battery voltage	Battery voltage is checked with Ampere-Volt Tester (91-27883) only when battery is under starting load. Battery must be recharged if it registers under 9½ volts. If battery is below specified Hydrometer readings (1.150), it will not turn engine fast enough to start.

MERCELECTRIC STARTER SYSTEM - COMPONENTS

(Refer to Wiring Diagrams, following in Section.)

A. CIRCUITS

1. Generator Circuit (On All 6-Cyl. Models and 4-Cyl. MercElectric "E" Models Only)

Within the flywheel are permanent magnets and a wound stator. The alternating current generated in the stator windings passes to the rectifier which, in turn, produces direct current from the alternating current. Negative side of rectifier is grounded; positive side goes to internal harness. Through the plug, current passes on to the ignition switch in the control box, and from there to the battery on the positive side. Negative side of battery is connected through connector to ground of engine.

2. Starter Circuit (MercElectric "E" and "S" Models)

Consists of a 12-volt starter motor and starter engaging mechanism. Starter solenoid (two on 6-cylinder direct reversing models) prevent full starting current from passing through the ignition switch.

3. Choke Circuit (MercElectric "E" and "S" Models)

To operate choke, ignition key must be in the ON

(middle) or moved past STARTING (right) position. While using electric choke, manual choke must be in down position; however, manual choke can be operated at all times if necessary. (Note: Early Merc 800 direct reversing model does not have a manual choke.)

4. Ignition Circuit (MercElectric "E" and "S" Models)

The engine is stopped by grounding the magneto (2 and 4-cylinder engines) or distributor (6-cylinder engines), not by choking the engine. This is accomplished by turning key to OFF (left) position. (Note: This turns off ignition on 6-cylinder models; engine is stopped by moving throttle lever to FORWARD STOP or REVERSE STOP position. DO NOT turn ignition off on 6-cylinder engines before stopping engine with throttle lever!)

B. STARTING AND STOPPING

For starting and stopping procedure with electric starter, refer to Section I, General Information.

REMOVAL AND INSTALLATION OF COMPONENTS

(Refer to Figure on Page 22.)

A. ELECTRICAL HARNESS - Removal (Figure 1)

Remove 4 small screws and nuts which secure connector into bottom cowl, remove the following leads to harness, then lift connector and harness out of bottom cowl:

1. White lead to primary ground terminal.
2. Black positive (+) jumper lead to starter solenoid.
3. Black negative (-) ground lead to starter motor.
4. Yellow lead to starter solenoid.
5. Blue lead to choke solenoid.
6. Red lead to rectifier.

Electrical Harness - Installation

Install connector thru hole in side of bottom cowl with 4 small screws, then attach the 6 leads to harness listed in Paragraph "A" above.

B. RECTIFIER - Removal

Rectifier can be detached by removing the following:

1. Two yellow leads to alternator.
2. Red lead to electrical harness.
3. The ½" hex head nut and lockwasher from rectifier bracket.

Rectifier - Installation

Install rectifier on rectifier mounting bracket with ½" hex head nut and lockwasher, then attach the 3 leads removed in Paragraph "B" above.

IMPORTANT: Failure of rectifier to discharge a direct current (DC) indicates that it, or the alternator, is faulty. Rectifiers usually are rendered useless ("baked" or discolored appearance) when battery leads of electrical harness are connected to wrong battery terminals. Function of rectifier is to convert alternating current (AC), supplied by alternator flywheel and alternator stator, to direct current (DC) for recharge of battery.

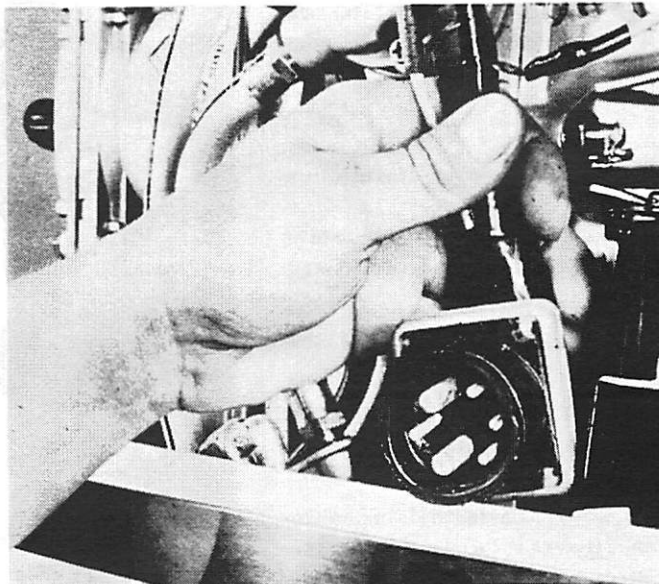


Figure 1. Removing Harness Connector

C. CHOKE SOLENOID - Removal

Choke solenoid can be removed by disconnecting blue lead to harness at knife disconnect and removing screws which hold solenoid to top cowl or to magneto adaptor choke solenoid bracket.

Choke Solenoid - Installation

Secure solenoid to inside top cowl or magneto adaptor bracket with screws and connect blue lead between solenoid and wiring harness with knife disconnect.

IMPORTANT: Free movement of plunger is necessary. Plunger should be as close to "bottoming" as possible in full choke position. Tilt solenoid slightly, on models with solenoid secured to magneto adaptor, to achieve free movement.

D. ALTERNATOR STATOR - Removal

Alternator stator, which is attached to upper end cap, can be removed by removing the following:

1. Flange from top of driven pulley; then slide timing belt off driven pulley. (*Note: Do not damage timing belt by forcing with screwdriver.*)
2. Flywheel elastic stop nut and washer from crankshaft, while holding flywheel with Universal Flywheel Holder (C-91-24937A1).
3. Flywheel with Flywheel Puller (C-91-24695A2). (Figure 1) While lifting flywheel off crankshaft, slide timing belt off flywheel pulley.
4. Two yellow leads between alternator and rectifier at knife disconnects.
5. Alternator stator via 4 screws which hold it to upper end cap.

Alternator Stator - Installation

Install alternator stator by replacing the following:

1. Alternator stator on top of upper end cap and fasten with 4 screws.
2. Two yellow leads between alternator and rectifier via knife disconnects.
3. Timing belt in position on flywheel pulley first, then driven pulley, while placing flywheel on crankshaft. (Figure 2)

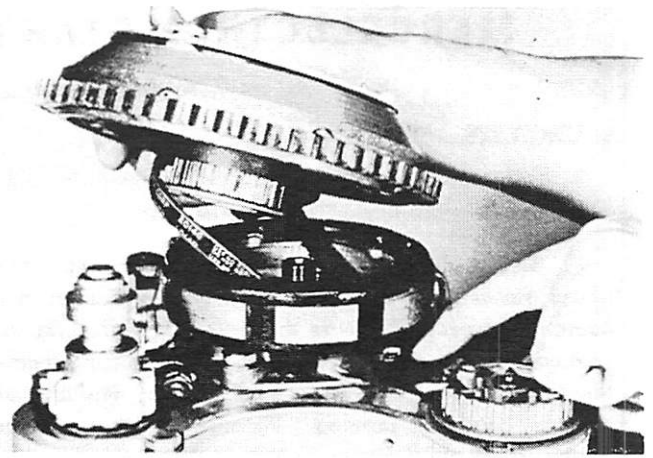


Figure 2. Replacing Timing Belt

4. Flywheel nut on crankshaft and torque to recommended torque (see Master Torque Specifications on Page 2B, Section VIII).

5. Flange on top of driven pulley.

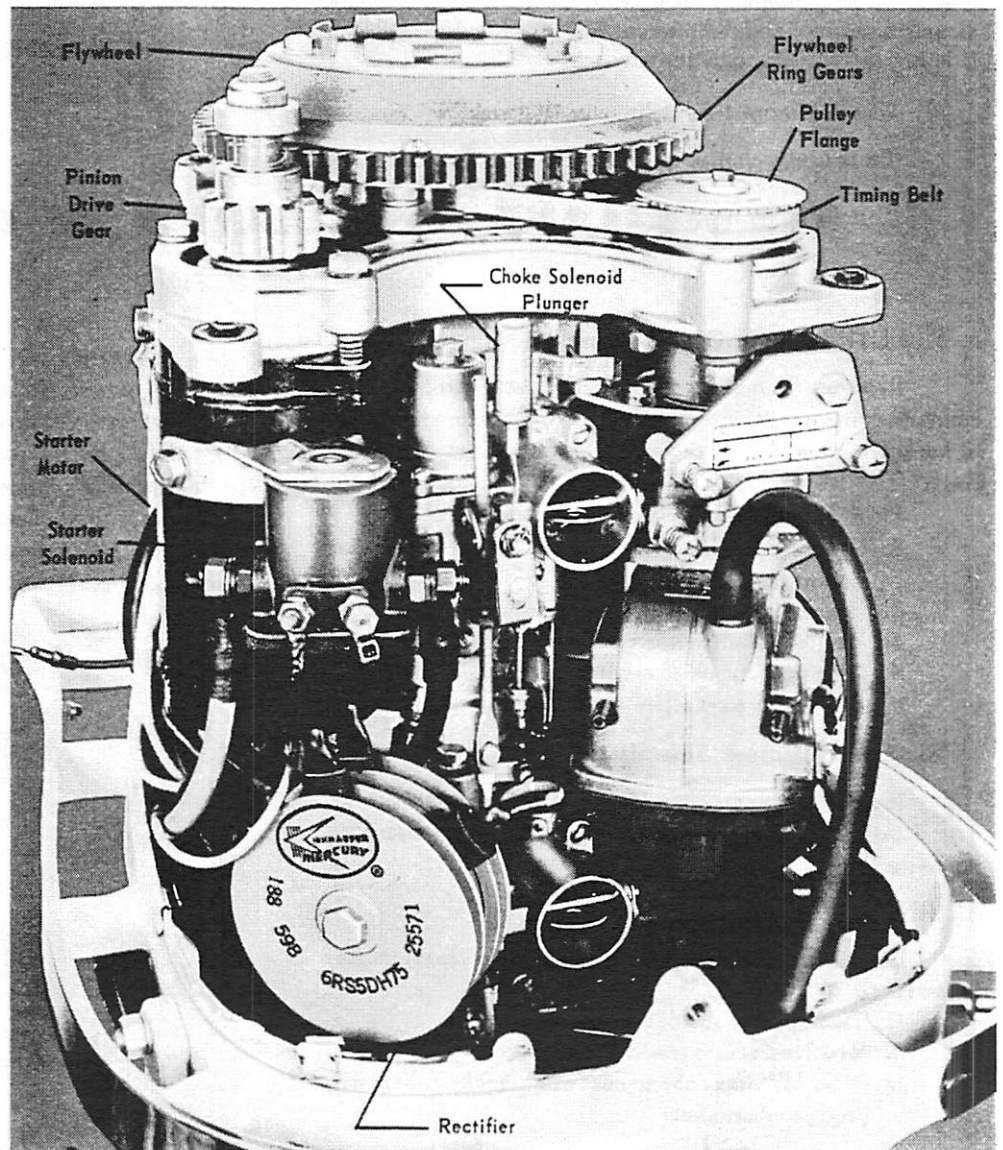
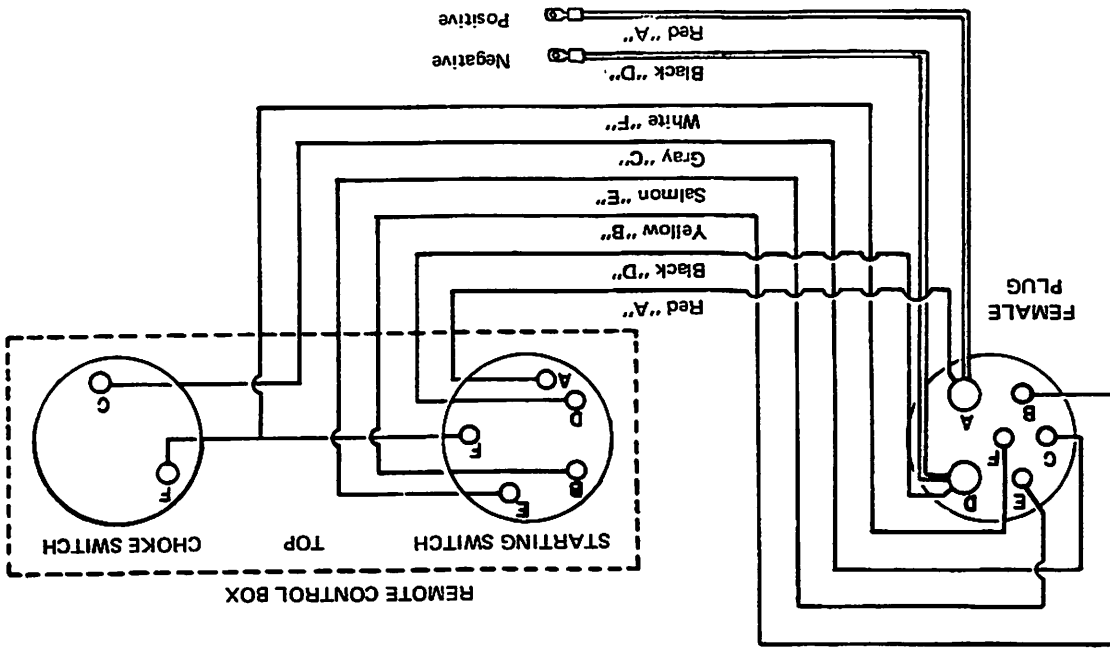


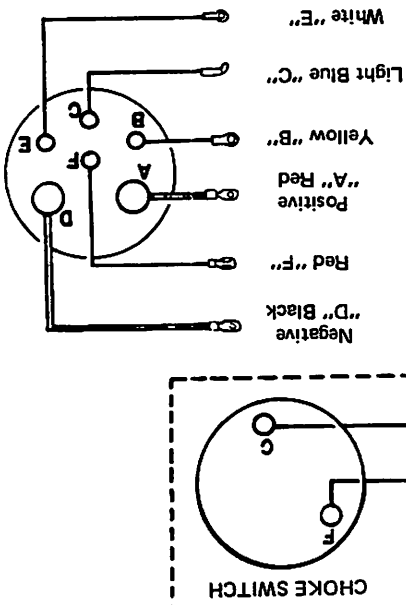
Figure 3. MercElectric Starting Components, 4-Cyl.



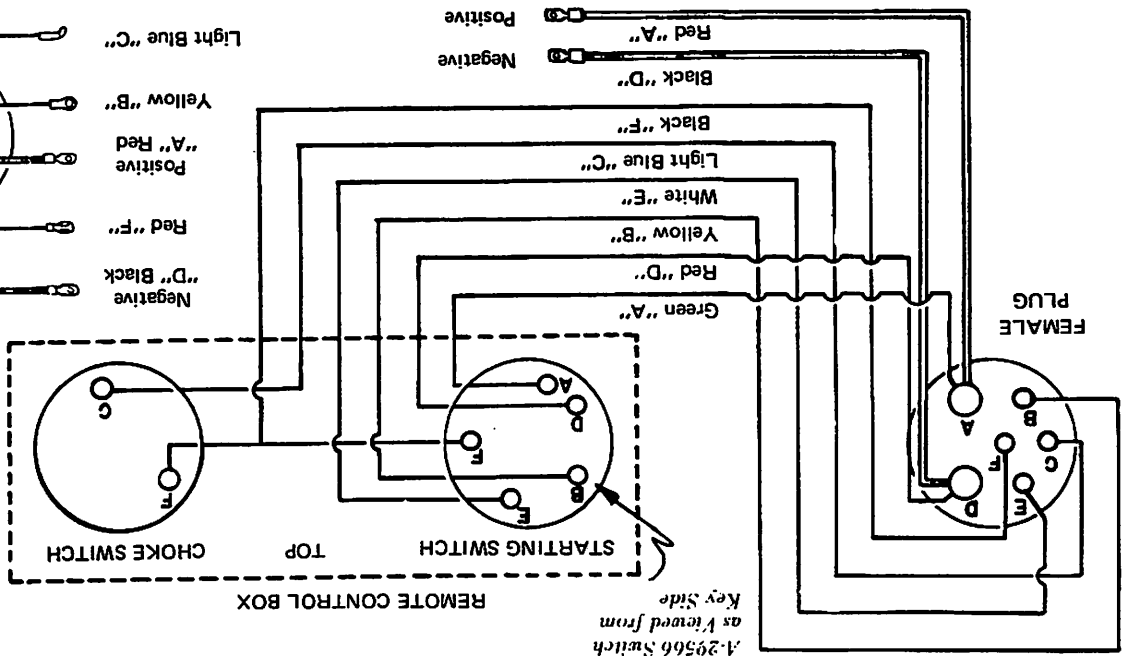
EXTERNAL HARNESS A-39125

External wiring harness A-29645 is superseded by external wiring harness A-39125 (below). When replacing harness A-29645 with an A-39125 harness, use the wiring code shown on drawing.

INTERNAL HARNESS



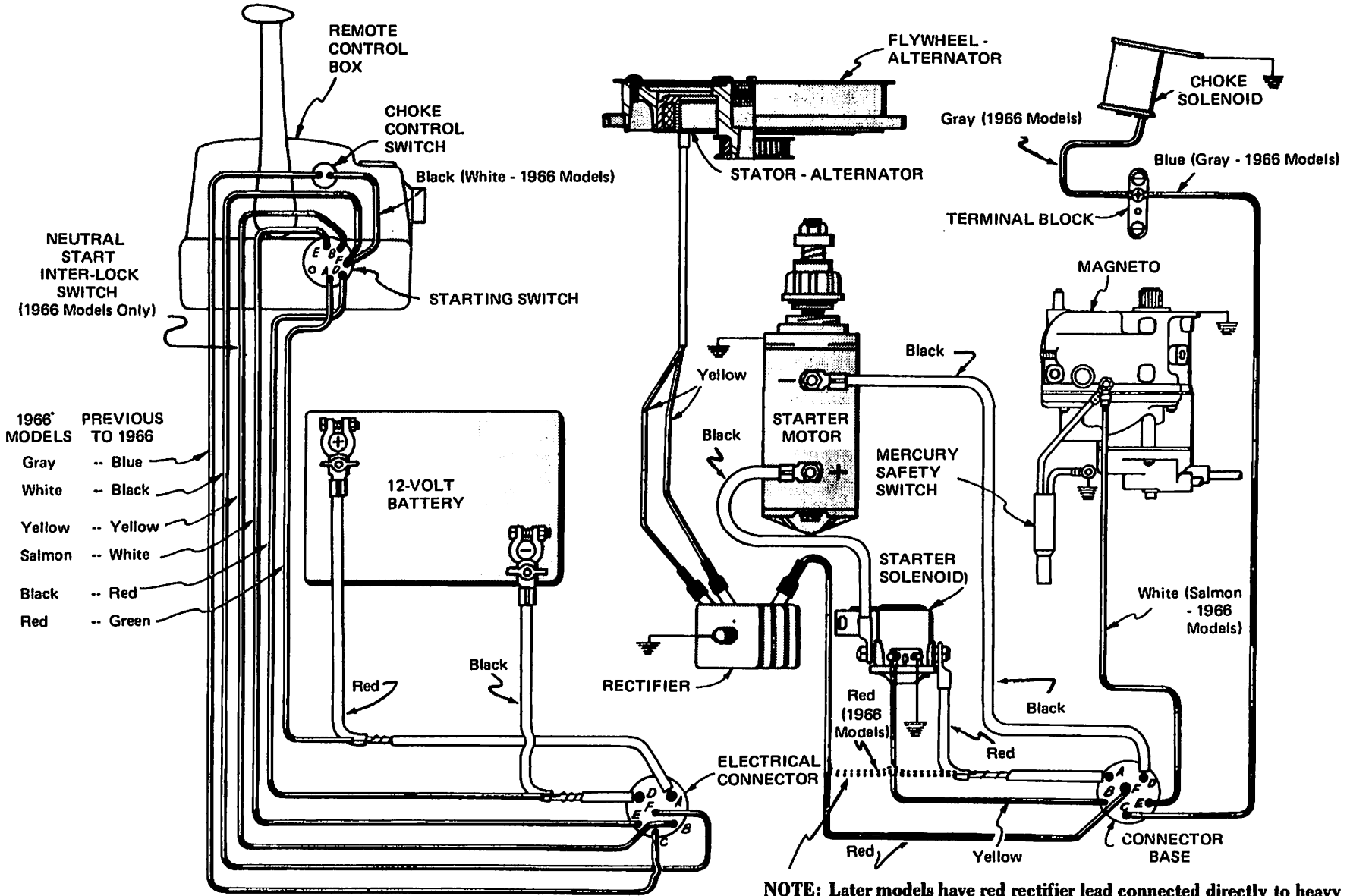
EXTERNAL HARNESS A-29645



A-29566 Switch as Viewed from Key Side

HARNESSES - 4-CYL. 2-LEVER ELECTRIC CONTROL

ELECTRIC STARTER WIRING DIAGRAM 4-CYL. SINGLE LEVER REMOTE CONTROL



1966* MODELS	PREVIOUS TO 1966
Gray	-- Blue
White	-- Black
Yellow	-- Yellow
Salmon	-- White
Black	-- Red
Red	-- Green

NOTE: Later models have red rectifier lead connected directly to heavy red cable. This will permit ignition switch to be turned to "OFF" position at any engine RPM without damage to rectifier.

Starter Mechanism and Starter Motor

American Bosch Disassembly and Reassembly

(Refer to Exploded View, Figure 5.)

A. Starter Mechanism and Starter Motor – Removal

Removal of starter motor and mechanism from the engine can be accomplished by unscrewing the 2 mounting bolts from the mounting flange. Lift flange off, being careful not to allow starter motor and mechanism to drop since starter is loose once bolts are removed. If flange is tight pry off, as it has a locating dowel for alignment to crankcase.

B. Starter Mechanism – Disassembly

Remove cotter pin from armature shaft end, with a wrench, unscrew castellated nut so that the entire starter mechanism can be pulled off in the following sequence: Spacing mechanism collar, anti-drift spring, pinion washer, anti-drift spring sleeve, pinion, screw shaft, neoprene washer, thrust washer, re-entry spring, drive spring support, drive spring, thrust washer and ring spring retainer.

C. Starter Motor – Disassembly

Unscrew and remove the 2 thru-bolts, lockwashers and flat washers at bottom of starter motor. This loosens the drive end mounting bracket. Remove lock spring at "drive end" of armature and slide off the motor end cap and bearing. The entire armature can now be removed by grasping the splined shaft end and pulling out. Be careful not to lose the shim at either end of armature. The commutator end plate assembly can be removed by pulling off. Neoprene end plate cover and insulation strip can be pulled off. Inspection of brushes and commutator end can be made at any time by removing the sealing ring, provided that the edges of the sealing ring are waterproofed with a neoprene sealing compound when replaced.

Lower End Cap

Carbon Brush and Holder: The entire commutator plate, including bearing, 2 brushes and 4 brush springs can be removed by pulling the 2 brush springs from their posts which secure the 2 brushes to the field coil lead wires. Unscrew the brush lead terminal from the end plate mounts by pulling springs off the retainers and pulling brush out. Other parts in the cap are permanent installations. Any damage to these parts will require replacement of entire cap. The carbon brushes attached to the fields can be removed by unsoldering brush lead wire from field contacts. This completes disassembly of the American-Bosch type starter motor.

D. Starter Motor – Reassembly

Brush Holders and Brushes: Solder new carbon brush leads to field leads if old ones were removed for any reason. Be sure to place insulating sleeve on carbon brush lead and clamp on with wire clamp before sol-

dering. Apply a thin film of SAE No. 10 oil on inside surface of bearing prior to assembly of drive end plate to housing. Replace carbon brushes when they are worn - - always in a complete set. Place new carbon brushes into brush holders adjacent to the end cap mounting posts and secure terminals to flange with taper head screws. Place all brush springs on posts with small groove of spring to bottom of post with spring arm to inside of end cap. After spring is on, pull arm of spring in front of brush holder. (See Figure 3)

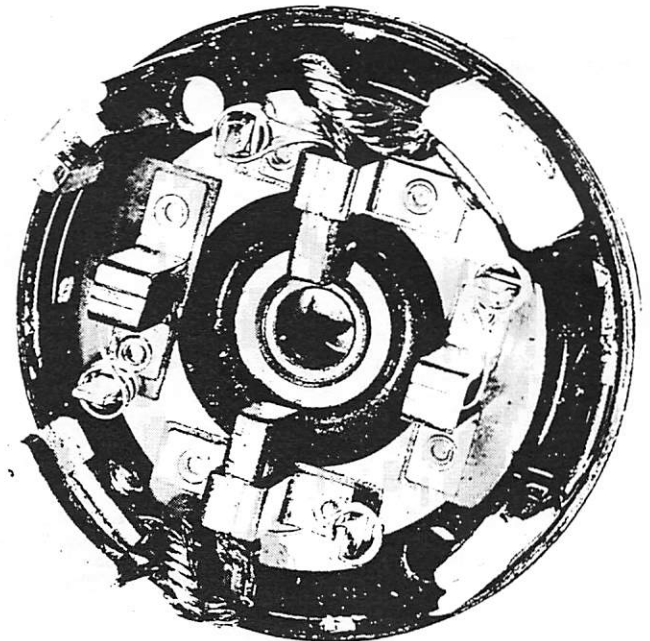


Figure 3. Commutator End Plate Assembly with Springs and Brushes in Place

Body and Field: The field winding is an integral part of the body. Inspect carefully for burned-out winding, shorting or poor insulation. If insulated covering is burned or removed, or unit is shorted, it must be replaced.

Armature: Not much of the armature can be repaired. If commutator is worn, due to brush wear, it can be machined evenly and reinstalled with new brushes. This can be accomplished by any dealer having a lathe or regular armature reconditioning tool which can be purchased from a local automotive or tool supply store. The aforementioned armature reconditioning tool turns down the commutator and undercuts the mica. Undercut of mica should be approximately 1/32". After thorough inspection has been completed and armature is found to check out OK, or has been reworked, it can be reinstalled. Armature can be checked out on an armature growler. Any automotive garage can test armatures, or armature can be checked on Magneto Analyzer (91-25213). Check for continuity exists, winding is grounded and armature must be replaced.

Place carbon brushes into brush holders by pulling brush holder springs back with needle nose pliers and inserting brushes. Reset spring into small groove of carbon brush. (See Figure 4.)

Insert 2 thru-bolts, lockwashers and washers in end cap; set shims on shaft; place drive end plate shoulder down onto armature shaft; and place 2 thru-bolts and lock plate on shaft with locking ring. Check armature end play. Shim as required to obtain 0.010"-0.020" end play. Place adaptor flange on drive end over plate and secure in position by threading the 2 bolts into flange and torque to 60-65 in. lbs. Place insulating band around field housing and commutator end cap. Attach ends with a piece of Scotch Tape. Paint around band with Liquid Neoprene and install neoprene insulator cover, position evenly and seal with Liquid Neoprene.



Figure 4. Installing Carbon Brush

E. Starter Mechanism – Reassembly

In sequence, replace ring spring retainer with recessed end down, large flat thrust washer, drive spring, drive spring support closed end down, entry spring, large thrust washer, neoprene washer, shaft anti-drift spring screw (threaded-end up), drive pinion, pinion washer, anti-drift spring sleeve and spacing collar (recessed end down). Secure with castellated fastening nut to a torque of 200 in. lb. minimum. Nut must be spaced so cotter pin can be inserted through hole in armature shaft.

Drive mechanism operation: The drive mechanism is part of the complete starter motor. It is located at the top of the starter motor. The starter motor drive pinion gear automatically engages the flywheel ring gear, due to sudden inertia when the starter turns over, and automatically disengages when the engine starts. The teeth on the drive pinion gear are chamfered so as to engage more readily with the flywheel ring gear teeth.

Set armature into field housing assembly, commutator end toward end of housing having brushes secured to

field. Place commutator end cap onto armature shaft and align slot in one of the 4 end cap posts with small notch in housing frame. Place carbon brushes into brush holders, being sure brush leads are not touching on metal surfaces.

F. Installing Starter Motor and Starter Mechanism on Engine

Insert starter motor in crankcase adaptor with terminals to rear.

Place upper motor mounting bracket in position. Note that dowel pin hole location for 2-cylinder and 4-cylinder models. Thread two 5/16" bolts to starter motor adaptor flange and torque to 75 in. lbs. Connect negative (-) battery lead from wiring harness to upper terminal, negative (-), of starter motor. Coat with Liquid Neoprene.

G. Starter Solenoid – Installation

Secure positive (+) battery lead to starter solenoid with nut and lockwasher. The solenoid mounts inverted (top down). Attach leads accordingly. Positive has plus (+) marked on terminal. Place positive (+) jumper lead on terminal at near end of starter solenoid with nut and lockwasher attaching opposite end to lower terminal of starter motor. Waterproof connections with Liquid Neoprene. Mount starter solenoid to starter motor with 2 screws and washers through 2 holes drilled in starter motor.

Attaching leads to the solenoid first simplifies installation of solenoid and leads.

Attach yellow lead from wiring harness to small terminal of starter solenoid. Waterproof connection with Liquid Neoprene (92-25711) and secure lead wires to "S" clips on cowl (no "S" clips on yellow lead).

H. Starter Motor Performance Testing - Merc 800 Full Gear Shift

1. Operation

- Use a fully charged 12-volt battery and connect it to starting motor input terminals thru a switch.
- Use test leads of No. 10 stranded cable or larger, but leads should not exceed 6 ft. in length.

CAUTION: These motors should not be operated continuously for more than 15 seconds when testing.

2. Performance Test (No Load)

- Applied Voltage: 12 volts, read at input terminal.
- Minimum RPM: 6,000 RPM
- Maximum Current Draw: 50-55 amperes

3. Performance Test (Under Load)

Starter Load: 180-240 amperes while cranking, 12 volt

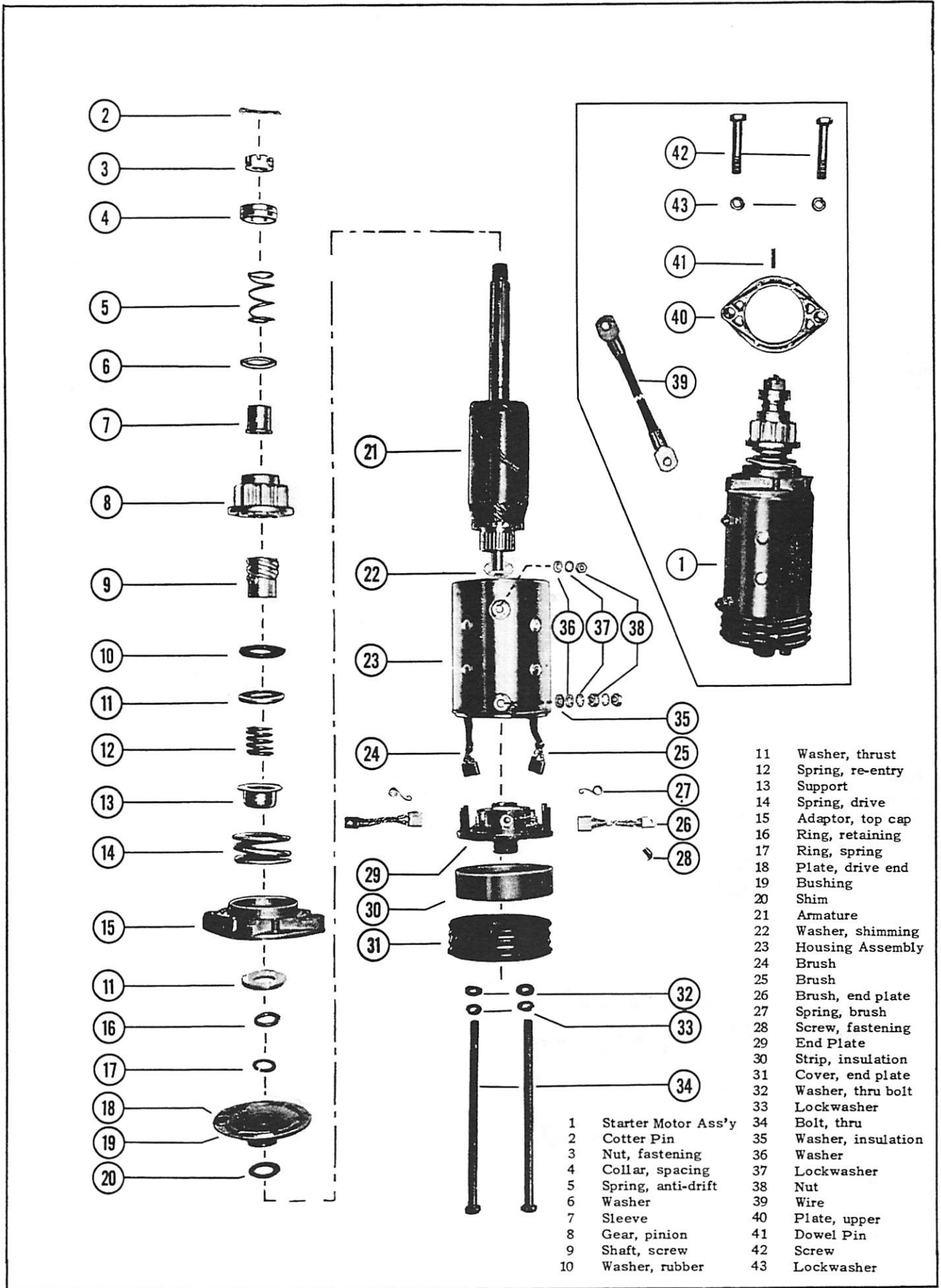


Figure 5. Starter Motor, American Bosch, Negative Ground

Starter Mechanism and Starter Motor Delco-Remy Disassembly and Reassembly

NOTE: The Delco-Remy Starter Motor (Figure 6) replaces the American Bosch Starter Motor (Figure 5) on later MercElectric models and is completely interchangeable as a unit.

A. Removal of Starter Motor and Mechanism from Power-head
Page 23

B. Starter Mechanism, Delco-Remy – Disassembly

Remove the cotter pin from the armature shaft end with a wrench and unscrew castulated nut so entire starter mechanism can be pulled off in the following sequence: Pinion stop, anti-drift spring, pinion washer, anti-drift spring sleeve, pinion gear, screw shaft, thrust washer, cushion cup, cushion, cushion spacer and thrust washer. (See Figure 7.)

C. Starter Motor, Delco-Remy – Disassembly

Unscrew and remove the 2 thru bolts and lockwashers at bottom end of starter motor to loosen drive end mounting bracket. Remove drive end mounting bracket by pulling off armature shaft. The entire armature can now be removed by grasping the splined shaft end and pulling out. Be careful not to lose shims at either end of armature shaft. The lower end cap can be removed by pulling off.

1. Disassembly of frame and field.

If the frame and field assembly is found to be defective, it may be disassembled, if necessary, to locate

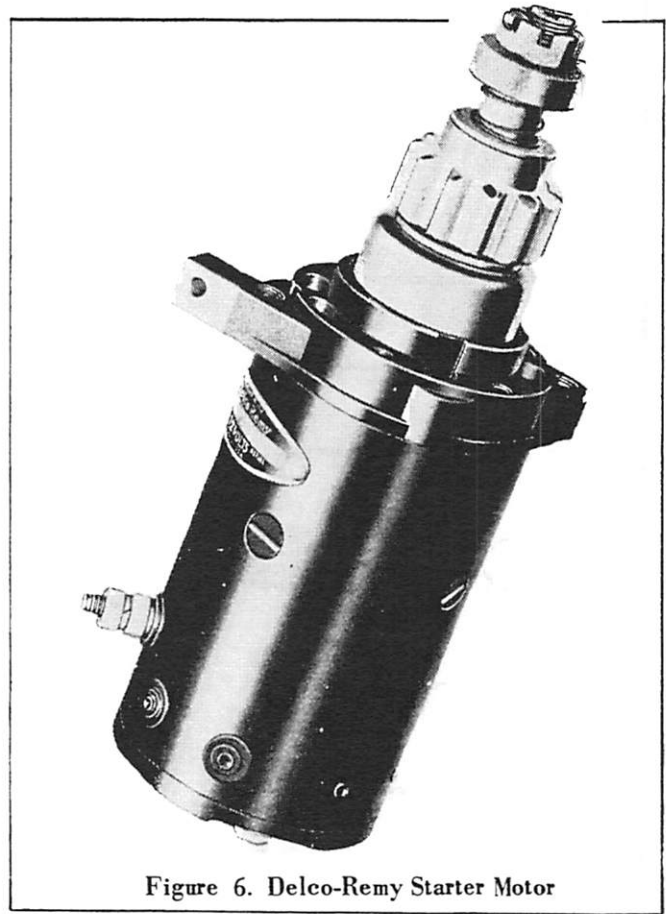


Figure 6. Delco-Remy Starter Motor

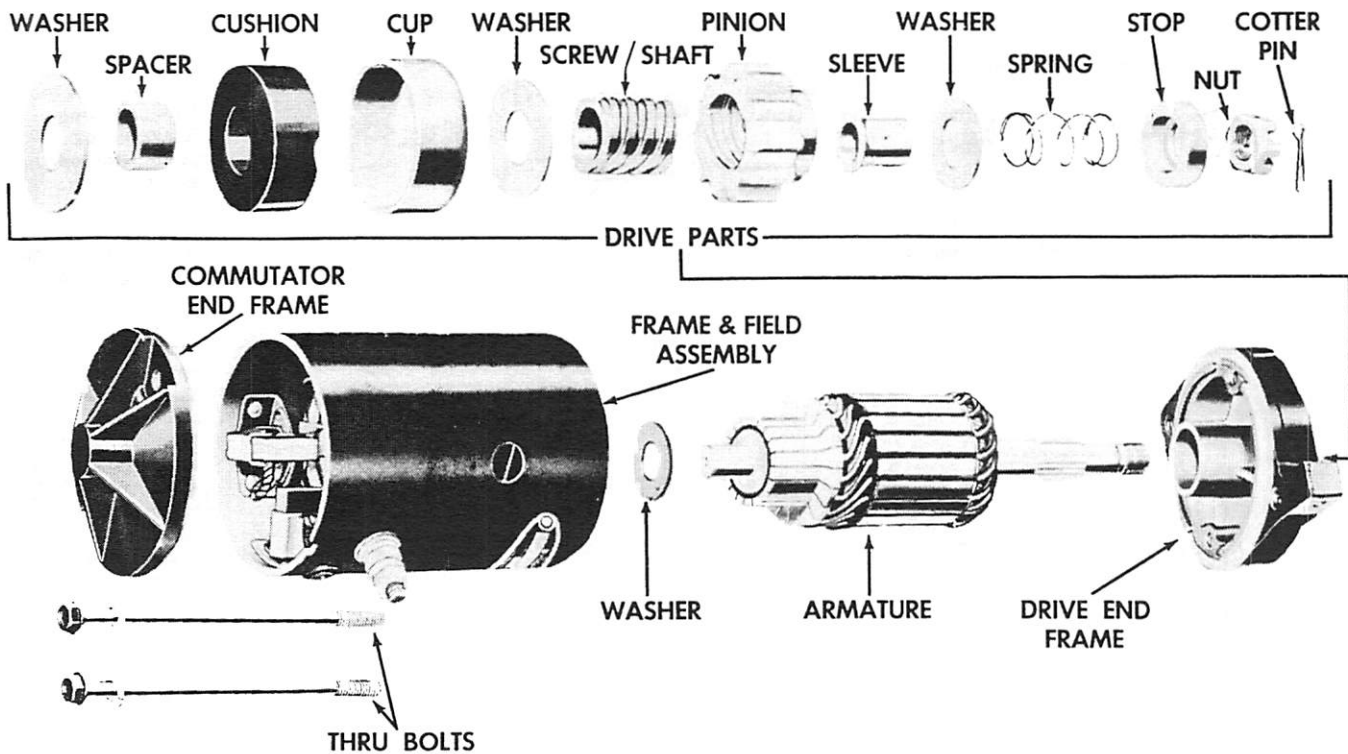


Figure 7. Exploded View of Starter Motor and Mechanism, Delco-Remy

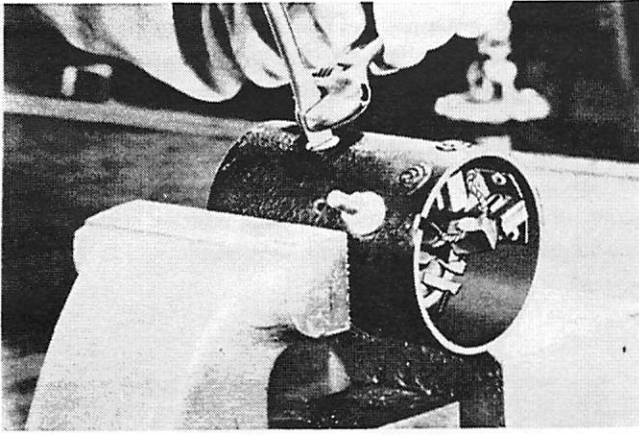


Figure 8. Removing Pole Shoes with Screwdriver and Adjustable Wrench



Figure 9. Brush Replacement Kit

the trouble. The first step is to remove the pole shoe screws. This may be accomplished by placing the frame in a vise (being careful not to clamp it tightly enough to distort the frame). The pole shoe screws may then be removed with a large screwdriver, using an adjustable wrench to turn the screwdriver. (See Figure 8) Next remove the terminal nut and insulating washers, and the field coil set is free to be removed. Disassembly is now complete, except for the brush holders. It is unnecessary to remove the brush holders from the frame except when defective or when replacing the ground brushes. Removal is accomplished by cutting off the rivets with a chisel or by drilling them out. Replacement brush holders are available complete with screws, washers and nuts for attaching to the frame. (See Figure 9) Brush springs are also available for replacement. To remove brush spring from holder, first compress one side of the spring with a small screwdriver until the spring flips out of its seat. Then turn the spring clockwise until it comes out of the holder.

2. Removal of brushes.

If it becomes necessary to replace the brushes in the starter motor, the frame and field must be disassembled as described in the preceding section. Replacement brush sets are available and contain the 2 insulated brushes with flexible leads attached and 2 ground brush holders with brushes and leads attached along with the necessary screws, washers and nuts for attaching to the frame. (See Figure 10.)

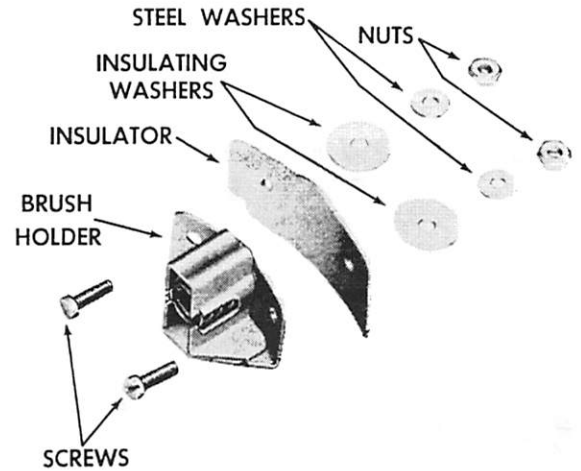


Figure 10. Brush Holder Replacement Kit

D. Starter Motor, Delco-Remy – Reassembly

1. Replacement of brushes.

To replace the insulated brushes, first cut off the old brush leads at the points where they are attached to the field coils. The ends of the coils must then be prepared for soldering on the new brush lead assemblies. It is recommended that the leads be soldered to the back sides of the coils so that excessive solder will not rub the armature. The ends of the coils should be thoroughly cleaned by filing or grinding off the old brush lead connections. Varnish should be removed only as far back as is necessary to make the solder connections. Using rosin flux, the leads may then be soldered to the field coils, making certain that they are in the right position to reach the brush holders. (See Figure 10) Do not overheat leads, as the solder will run on the lead and it will no longer be flexible.

To replace the ground brush assemblies, first remove the old brush holders as described in the preceding section, then attach the new assemblies to the frame with screws, washers and nuts included in the package. After tightening the nuts, the screws should be peened with a hammer so that the nuts cannot vibrate loose during operation of the engine.

When the field coil and brush assembly is reassembled in the frame, the frame and field assembly should be rechecked to make sure that none of the soldered connections is touching the frame, thus grounding the fields.

2. Body and field armature.

The armature should be checked for opens, short circuits or grounds as explained in the following paragraphs. If the armature commutator is worn, dirty, out-of-round or has high mica, the armature should be put in a lathe so the commutator can be turned down or use an armature reconditioning tool. (See Figure 12.) The mica should then be undercut $1/32''$ deep, and the slots cleaned out to remove any trace of dirt or copper dust. (See Figure 13.) As a final step in this procedure, the commutator should be sanded lightly with No. 00 sandpaper to remove any burrs left as a result of the undercutting procedure.

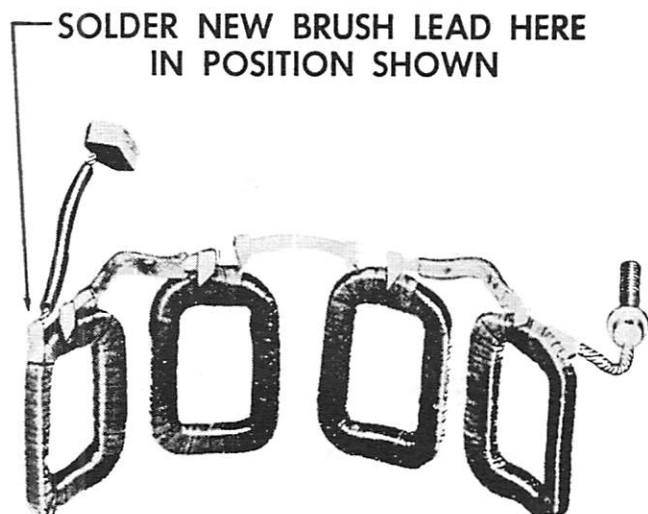


Figure 11. Field Coil and Brush Assembly, Showing Proper Position of Brush lead

Open circuited armatures often can be saved where the open circuit is obvious and repairable. The most likely place for an open circuit to occur is at the commutator bars as a result of excessively long cranking periods. Long cranking periods overheat the starter motor so that the solder in the connections melts and is thrown out. The consequent poor connections then cause arcing and burning of the commutator bars as the starter motor is used. If the bars are not too badly burned, repair can often be affected by resoldering the leads in the bars (using the rosin flux) and turning down the commutator in a lathe to remove the burned material. The mica should then be undercut. (Figure 13)

Short circuits in the armature are located by use of a growler. (See Figure 14.) When the armature is revolved in the growler with a steel strip such as a hack-saw blade held above it, the blade will vibrate above the area of the armature core in which the short circuit is located. Copper or brush dust in the slots between the commutator bars sometimes produces shorts between the bars which can be eliminated by cleaning out the slots.

Grounds in the armature can be detected by the use of the Magneto Analyzer (91-25213), No. 3 continuity test. If the needle moves across the meter when one test point is placed on the commutator with the other point on the core or shaft, the armature is grounded. Grounds often occur as a result of insulation failure which is often brought about by overheating of the starter motor produced by excessively long cranking periods.

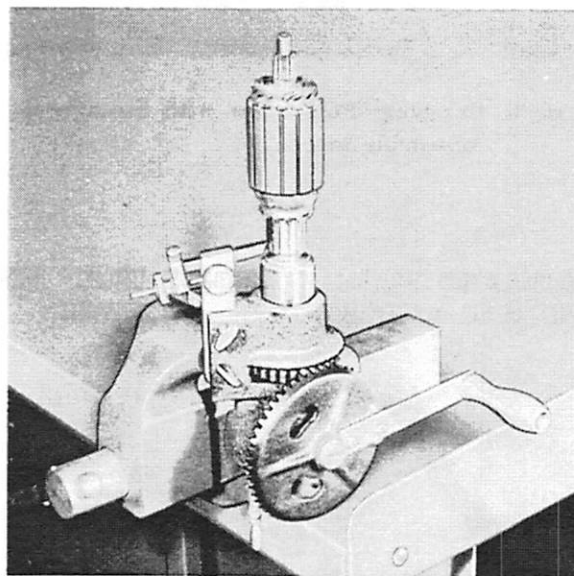


Figure 12. Turning-Down Commutator

Set armature into field and frame assembly, commutator end toward end of frame having brushes secured to frame. Place lower end cap assembly unto armature shaft after having lubricated end cap bearing and thrust washer on armature shaft lightly with multi-purpose lubricant. Align notch in cap with small notch in frame. The bronze bearings of the starting motor are graphite and oil impregnated and ordinarily require no added lubrication. They should be lubricated when the motor is disassembled for some reason, at which time a few drops of light engine oil or multi-purpose lubricant may be added before reassembly. Care should be taken that no oil reaches the commutator.

Insert 2 thru-bolts and lockwashers in end cap, place drive end cover shoulder down on frame over armature shaft, aligning with dowel pin, and secure the 2 thru-bolts to end cover. Torque to 60-65 in. lbs. Note that bushing is not replaceable in upper or lower end caps.

After reassembly has been completed, paint around all screws, seams and terminals with Liquid Neoprene (92-25711) to seal starter motor against water leaks and moisture.

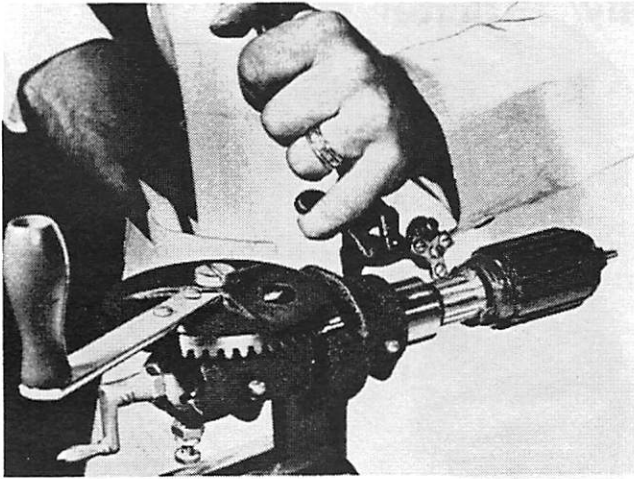


Figure 13. Undercutting Mica

E. Starter Mechanism – Reassembly

In sequence (follow Figure 7), replace thrust washer, cushion spacer, cushion, cushion cup (open end over cushion), cup thrust washer, screw shaft (splined end up; lubricate underside with multi-purpose grease) pinion gear (screw end down), anti-drift spring sleeve (shoulder down), anti-drift spring washer, anti-drift spring and pinion gear stop (recessed end down) and secure with castellated fastening nut to torque of 200 in. lbs. Space so cotter pin can be passed through nut and hole in shaft.

Drive Mechanism Operation: The Bendix drive mechanism should be lubricated with a few drops of light engine oil or DC4 Compound (92-24108) periodically. This can be done easily without removing the motor from its mounting. Grease or heavy oil should never be used, as this will retard the action of the drive mechanism.

F. Installing Starter Motor & Mechanism to Motor

Place starter motor in correct position and secure by threading two 5/16" cap screws through the mounting bracket and tighten to 75 in. lbs. Connect negative (-) battery lead marked negative (-) to upper terminal (ground) of starter motor and positive (+) jumper lead to lower terminal of starter motor. Waterproof all electrical connections with Liquid Neoprene (92-25711).

Performance Test – On Engine

Clockwise rotation

	<u>Amperes</u>	<u>Volts</u>
Starter No Load	45-50	12
Starter Load	160 Cranking	12

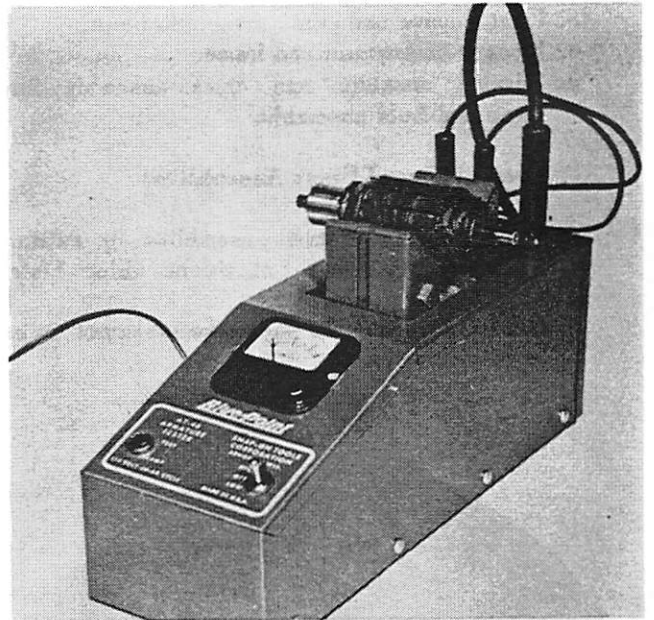


Figure 14. Testing with Growler

New 6-Cyl. Delco-Remy Starter Motor

A. DESCRIPTION

1. Models: For 6-cyl. full gear shift models.
2. These starter motors have field coils and field coil frames (A-31190) specially sealed with an exceptionally hard coating of a clear plastic which has extreme di-electric characteristics.

B. INSTALLATION OF CARBON BRUSHES

1. Disassembly

- a. Partial disassembly of cranking motor is necessary to replace brushes.
- b. First, loosen and pull out the thru bolts.
- c. Remove commutator end frame.
- d. Remove armature and drive assembly from frame and field assembly.

2. Removal of Ground Brush Assemblies

- a. Remove ground brush assemblies by cutting, drilling or grinding out rivets which fasten holders to field frame.
- b. If drill is used, care should be taken not to enlarge hole in frame.

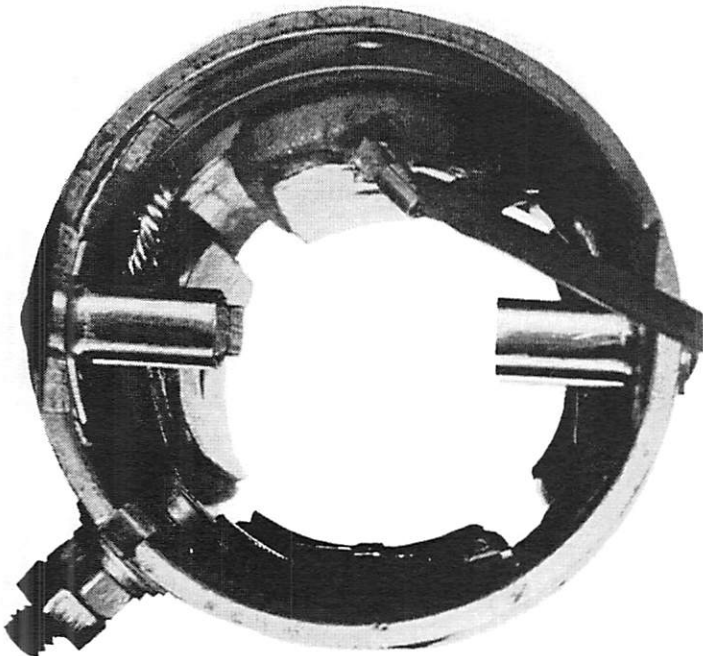


Figure 1. Opening Clip

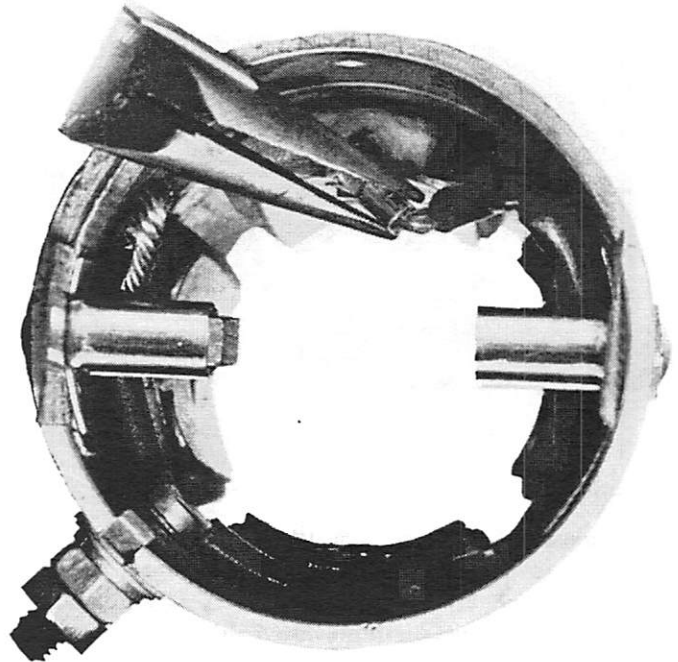


Figure 2. Crimping Clip

3. Removal of Insulated Brushes

- a. Bend clip inward to facilitate brush lead removal.
- b. Open clip which supports insulated brush leads with pair of sidecutters or similar tool. (Figure 1)
- c. Break weld which holds brush lead to clip.
- d. Note which brush has longer lead and replace with same length brush lead provided in package.
- e. Discard all old parts.

4. New Brush Installation

- a. Install new insulated brushes by placing proper brush lead into open clips on field coils.
- b. Tin approx. 1/4" of both field coil assembly clip and brush lead with large (heavy duty) soldering iron before placing into field.
- c. Place brush lead into clip and crimp clip with lead inside it to form good mechanical connection. (Figure 2)
- d. Solder connection with large solder iron to heat quickly so that field coil and brush lead are not overheated. Use only rosin core solder.

CAUTION: Do not allow solder to run up lead, since this will make lead rigid.

Refer to Delco-Remy Starter Motor Disassembly & Reassembly on Pages 26 to 29 for Other Repair Procedures.

DELCO-REMY INERTIA TYPE DRIVE

A. DESCRIPTION

The Delco-Remy inertia type drive assembly is mounted on the armature shaft which has external spiral splines which match the internal splines in the drive assembly.

B. DISASSEMBLY

1. To disassemble Delco-Remy drive from armature, slide a standard half-inch pipe coupling or other metal cylinder onto shaft so end of coupling or cylinder butts against edge of pinion stop collar.
2. Tap end of coupling to drive the stop collar towards armature and off snap ring.
3. Remove snap ring from groove in shaft.
4. Remove drive and spring in order shown in Figure 1.

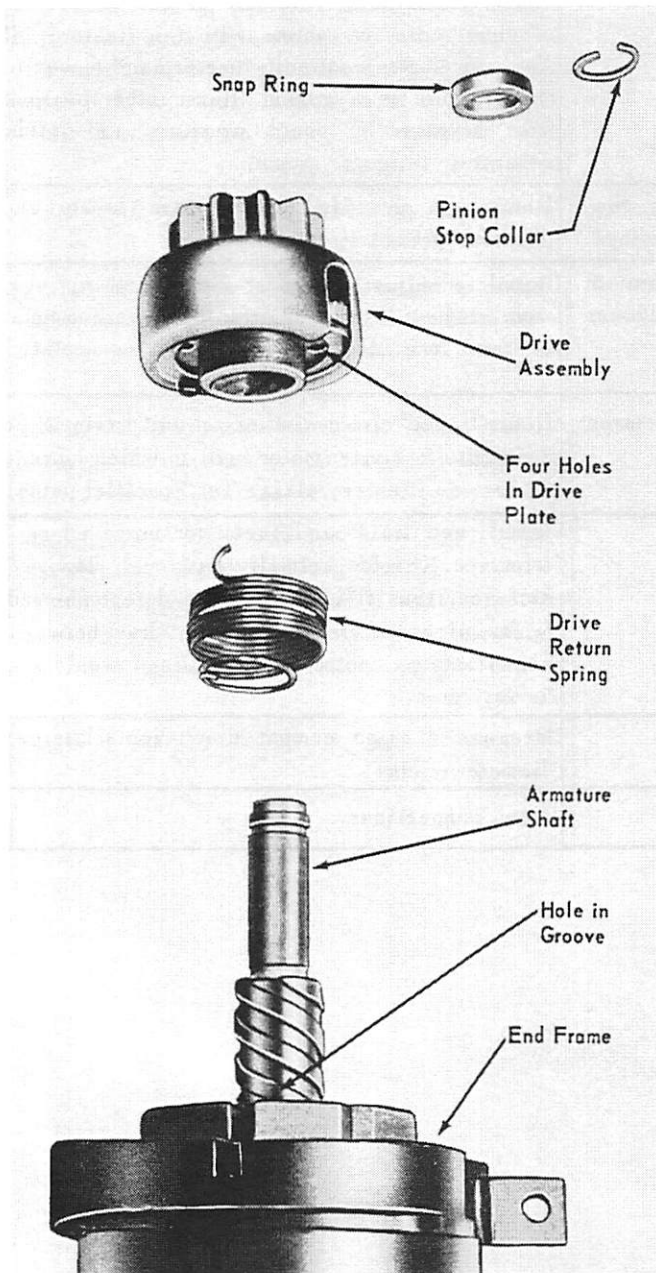


Figure 1. Delco-Remy Inertia Type Drive Assembly

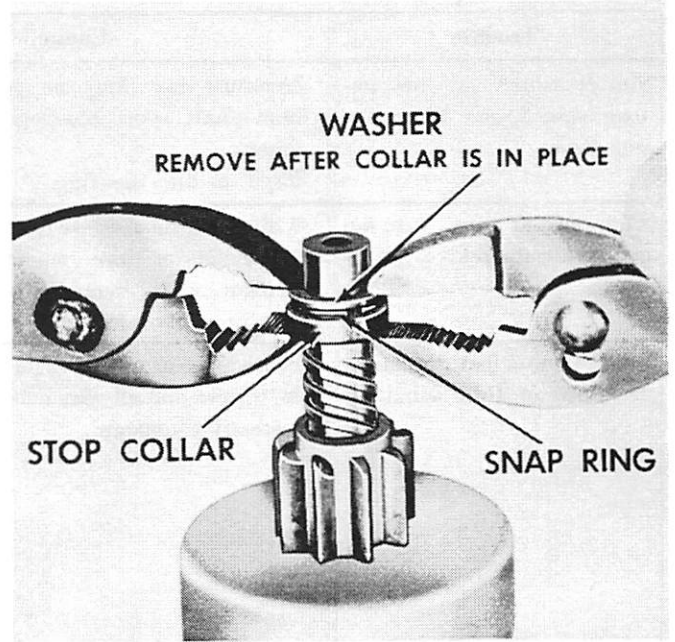


Figure 2. Installing Pinion Stop on Motor with Delco-Remy Inertia Type Drive

5. Remove drive end frame from armature and disassembly is complete.
6. Frame and field assembly may be disassembled for servicing, if required.

C. REASSEMBLY (Figure 1)

1. Lubricate splined portion of armature shaft with SAE 30 or 10W30 oil.
2. Place drive return spring on armature shaft with small diameter of spring towards end frame.
3. Install first turn of small end of spring in groove of shaft next to end frame. Hook tip of end of spring in hole at bottom of groove. *Do not distort spring.*
4. With spring in free position, hold spring out of way while drive is assembled on shaft in full disengaged position.
5. Wind up free end of spring 3/4 turn and hook it into nearest of four holes in drive plate. *Be sure that spring is securely hooked into drive plate.*
6. Slide pinion stop collar onto shaft with cupped surface facing away from drive.
7. Install snap ring in groove at end of shaft. Squeeze snap ring (with pliers) so that it fits well into groove.
8. Position pinion stop collar next to snap ring and assemble a washer (standard automotive cranking motor thrust washer if available) next to other side of snap ring. (Figure 2) *Use 2 pairs of pliers at the same time (one pair on either side of shaft) to grip stop collar and washer.* Stop collar will rotate freely when properly assembled.
9. Rotate drive against pinion stop and relieve any turns which may be overlapping other turns. When spring is properly assembled, drive should return snappily from engaged position.

STARTER MOTOR TESTING and TROUBLE CHART

Trouble	Cause	Remedy
Starter motor has low no-load speed and high current draw.	Armature may drag on pole shoes from bent shaft, worn bearings or loose pole shoes. Tight or dirty bearings.	Remove armature and test on growler for short. Replace shaft or bearings and/or tighten pole shoes. Loosen or clean bearings.
High-current draw with no armature rotation.	A direct ground at switch, at terminal or at brushes or field connections. Frozen shaft bearings which prevent armature from rotating.	Replace defective parts. Loosen, clean or replace bearings.
Starter motor has grounded armature or field winding.	Field and/or armature is burned or lead is thrown out of commutator because of excessive leakage.	Raise grounded brushes from commutator & insulate them with cardboard. Use Magneto Analyzer (Selector #3) & test points to check between insulated terminal of starter motor & starter motor frame. (Remove ground connection of shunt coils on motors with this feature.) If Analyzer shows continuity (meter hand moves to right), there is a ground. Raise other brushes from armature & check armature and fields separately to locate ground.
Starter motor has grounded armature or field winding.	Current passes thru armature first, then goes to ground thru field windings.	Disconnect grounded leads, then locate any abnormal grounds in starter motor.
Starter motor fails to operate & draws no current and/or high resistance condition.	Open circuit in fields or armature, at connections or brushes or between brushes & commutator.	Repair or adjust broken or weak brush springs, worn brushes, high insulation between commutator bars, or a dirty, gummy or oily commutator.
High resistance in starter motor.	Low no-load speed and a low-current draw and low developed torque	Close "open" field winding on unit having 2 or 3 circuits in starter motor (unit in which current divides as it enters, taking 2 or 3 parallel paths)
High free speed and high current draw.	Shorted fields in starter motor.	Install new fields and check for improved performance. (Fields normally have very low resistance, thus it is difficult to detect shorted fields, since difference in current draw between normal starter motor field windings would not be very great.)
Excessive voltage drop.	Cables not adequate size.	Because of high current draw, install larger diameter cables.
High circuit resistance.	Dirty connections.	Clean connections.

MARK 25E STARTER ... NEGATIVE GROUND

Disassembly and Reassembly

A. Electrical Harness - Disassembly

Remove cowl as far as possible. (See Miscellaneous Section VIII, Page 14, Article F, Mark 25E Cowl.)

Remove negative (-) battery lead of wiring harness from upper terminal of starter motor and positive (+) battery lead from starter solenoid, left side. (See figure below.)

Remove positive jumper lead from lower terminal of starter motor and terminal of starter solenoid, right side. Remove single yellow lead from starter solenoid. Disconnect the 2 shorting leads (green) to the magneto and the choke lead (blue) via knife disconnects after pulling back on the neoprene insulating sleeves. Cowl now can be removed from engine.

Remove harness from cowl. Unscrew bezel holding starter switch to front cowl. Remove 2 large nylon harness clips and screws from harness; also screws holding ground wire (white) and choke lead (blue) to cowl. Wiring harness connector is attached to cowl with 4 small screws and nuts. Remove these screws and harness can be completely removed.

Remove starter solenoid from bracket on top of cylinder block. Note that starter solenoid is mounted in an inverted position. Remove ground strap from starter solenoid mounting screw and from left rear top cowl bolt.

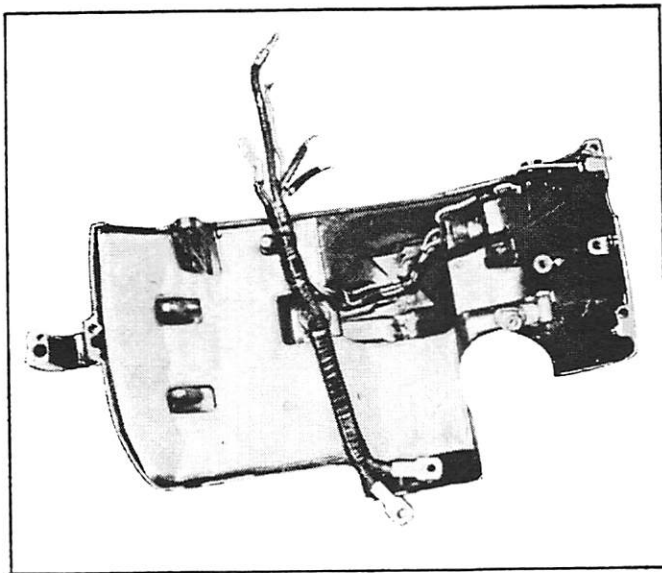


Figure 18. Mark 25E Cowl, Left Side

Electrical Harness - Reassembly

Install wiring harness through hole in side cowl. Two large terminals in connector are located toward the bottom of the cowl in order that lead wires are correctly

located and that harness will attach correctly. Secure electrical harness to cowl with 4 small screws and nuts.

Place starter switch through opening in front of cowl and secure in place with bezel.

Attach shorting wire (white lead) terminal to cowl above switch and choke lead (blue) to inside front of cowl with self-tapping screws and nylon clips.

Fasten large harness to cowl with 2 nylon clips and 2 self-tapping screws.

Cowl now is ready for installation.

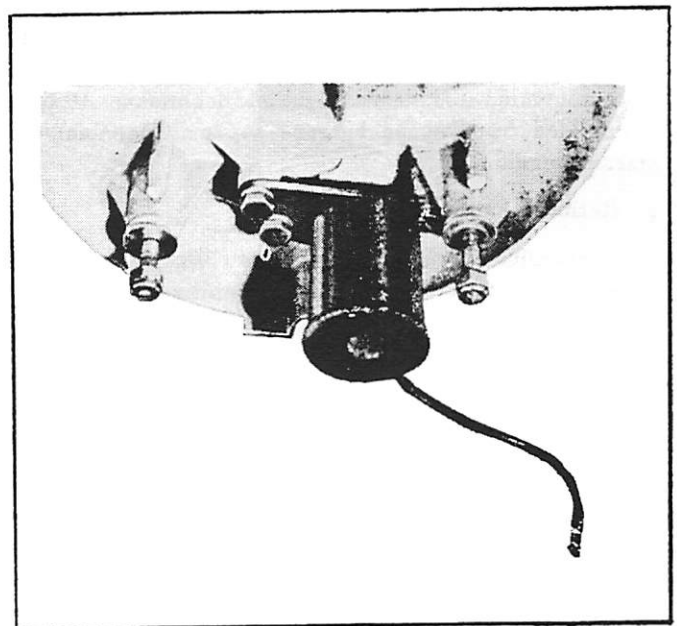


Figure 19. Starter Cover and Choke

B. Choke Solenoid - Disassembly

Choke solenoid is secured to starter cover by 3 screws. (See Figure 19.)

Choke Solenoid - Reassembly

Mount choke solenoid to starter cover with 3 screws.

Connect blue lead from choke solenoid and wiring harness with knife disconnects. Cover with neoprene insulating sleeves.

C. Starter Mechanism and Starter Motor - Bosch Removal Page 23

Starter Mechanism and Starter Motor - Delco-Remy
Removal
Page 26

Starter Mechanism - Bosch - Disassembly Page 23

Starter Mechanism - Delco-Remy - Disassembly
Page 26

Starter Motor - Bosch - Disassembly Page 23

Starter Motor - Delco-Remy - Disassembly
Page 26-27

Starter Motor - Bosch - Reassembly Page 23-24

Starter Motor - Delco-Remy - Reassembly Page 27-28

Starter Mechanism - Bosch - Reassembly Page 24

Starter Mechanism - Delco-Remy - Reassembly
Page 29

Starter Motor and Mechanism to Motor Bosch -
Installation Page 24

Starter Motor and Mechanism to Motor Delco-Remy -
Installation Page 29

D. Starter Solenoid - Installation

Secure positive (+) battery lead to starter solenoid (left side) with nut and washer. The solenoid mounts inverted (top down). Attach positive jumper lead to opposite solenoid terminal with nut and lockwasher. Attach yellow lead from wiring harness to small terminal of starter solenoid.

E. Remote Controls - Conversion

Conversion: Positive Ground to Negative Ground (new style); Negative Ground to Positive Ground (old style).

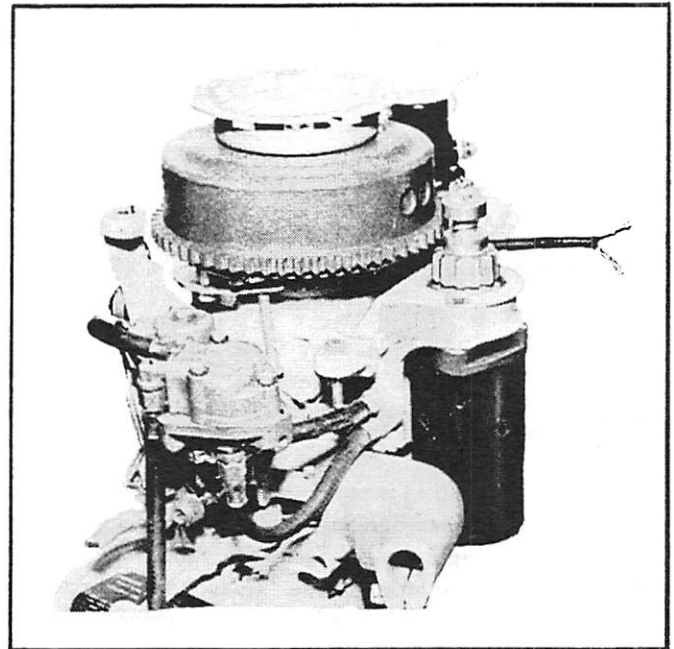
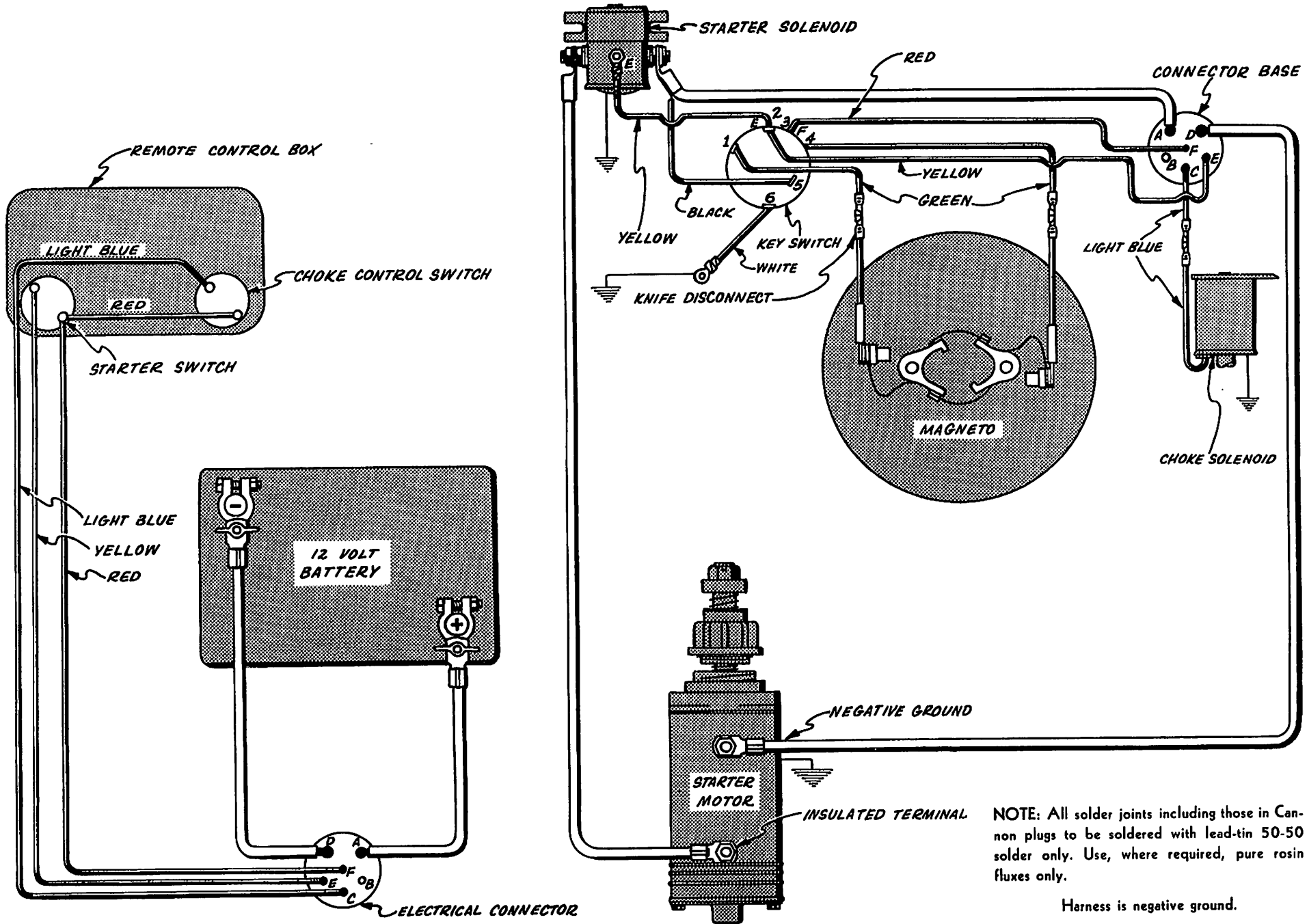


Figure 20. Mark 25E Powerhead, Negative Ground

F. MercElectric Testing - Trouble Chart Page 31-32

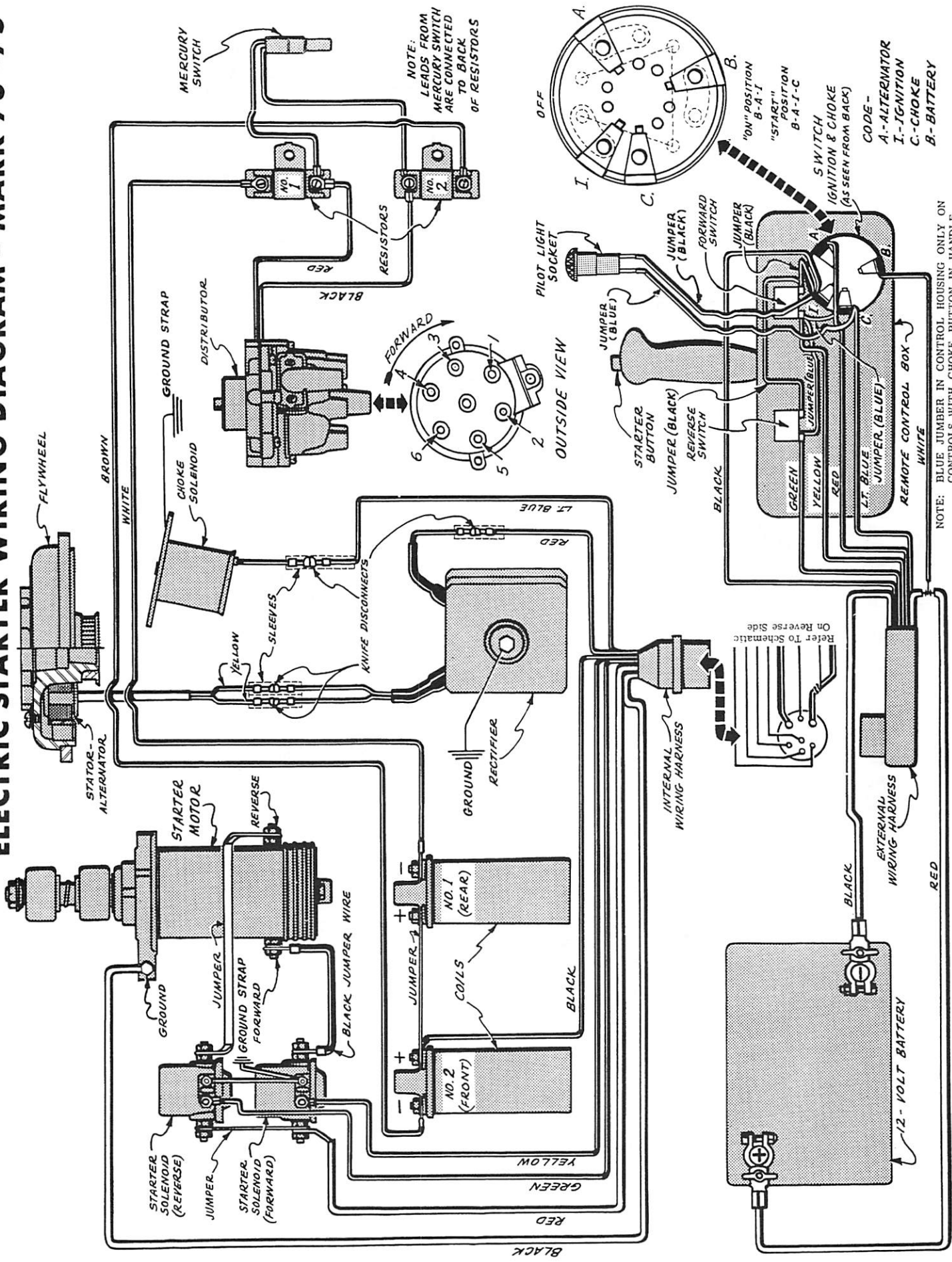
ELECTRIC STARTER WIRING DIAGRAM - MARK 25E



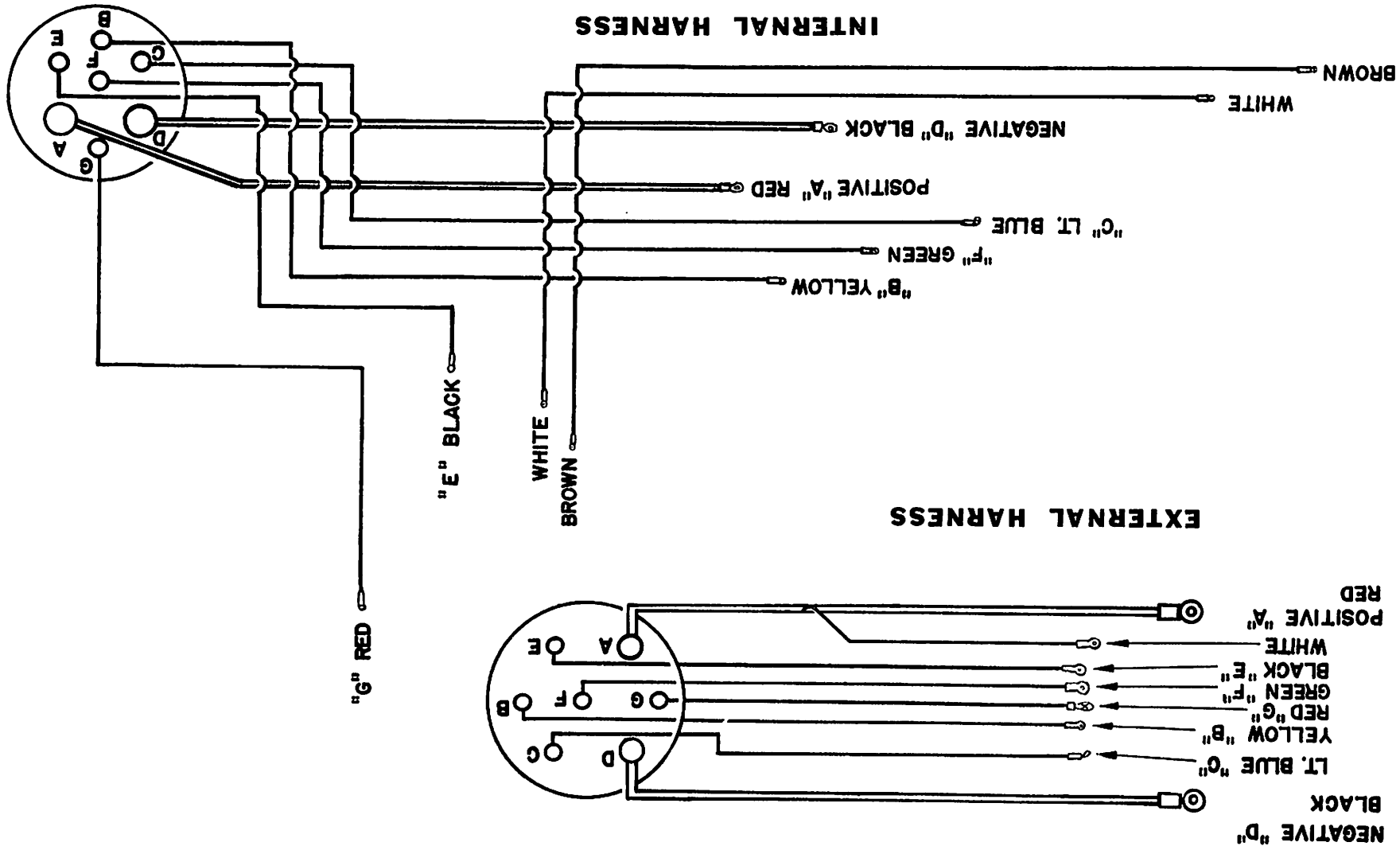
NOTE: All solder joints including those in Cannon plugs to be soldered with lead-tin 50-50 solder only. Use, where required, pure rosin fluxes only.

Harness is negative ground.

ELECTRIC STARTER WIRING DIAGRAM - MARK 78 -75



HARNESSES - MARK 78-75



REVERSING TYPE 4 & 8 BRUSH MERCELECTRIC

STARTER MOTOR - DISASSEMBLY

A. Removing Starter Motor & Mechanism from Engine

Remove starter motor and mechanism from engine by unscrewing the 2 mounting bolts from the mounting flange and the 2 crankcase-to-cylinder block bolts and nuts holding the starter motor support bracket. Be careful not to allow starter motor and mechanism to drop, since unit is loose once the bolts are removed.

B. Starter Mechanism Disassembly

Remove cotter pin from armature shaft end. With a wrench, unscrew castellated nut so that the entire starter mechanism can be pulled off by following sequence 2 through 16 in exploded view on Page 36.

C. Starter Motor Disassembly

Unscrew and remove the 2 thru-bolts, lockwasher and flat washers at bottom of starter motor. This loosens the drive end mounting bracket and support bracket. Slide off the motor end cap and bearing. The entire armature now can be removed by grasping the splined

shaft end and pulling out. Be careful not to lose the shim at either end of armature. The commutator end plate assembly, as well as the neoprene end plate cover and insulation strip, can be removed by pulling off. Inspection of brushes and commutator end can be made at any time by removing the sealing ring, provided that the edges of the sealing ring are waterproofed with a neoprene sealing compound when replaced.

D. Lower End Cap (2 or 4 Brush Type)

Carbon Brush & Holder: Entire commutator plate, including bearing, 2 (or 4) brushes and 4 (8) springs, can be removed by pulling the 2 (4) brush springs from their posts which secure the 2 (4) brushes to the field coil lead wires. Unscrew the brush lead terminal from the end plate mounts by pulling springs off the retainers and pulling brush out. Other parts in the cap are permanent installations. Any damage to these parts will require replacement of entire cap. The carbon brushes attached to the fields can be removed by unsoldering brush lead wire from field contacts. This completes disassembly of the American Bosch type starter motor.

REASSEMBLY

A. Starter Motor Reassembly

Brush Holders & Brushes: Solder new carbon brush leads to field leads if old ones were removed for any reason. When replacing brushes, solder must be prevented from flowing up the brush shunt. When soldering, grip the shunt tightly near the end being soldered with a pair of round-nosed pliers. The shunt must remain flexible to allow the brush to move freely in the brush holder. Make sure that the brush shunts are positioned so that they do not restrict brush movement, and so that they will not hang up on brush holders as brush wears. The live brush shunts must clear ground potential. Brush shunts also must clear commutator riser bars. Be sure to place insulating sleeve on carbon brush lead and clamp on with wire clamp before soldering. Apply a thin film of SAE No. 10 oil on inside surface of bearing prior to assembly of drive end plate to housing. Replace carbon brushes when they are worn — always in a complete set. Place new carbon brushes into brush holders adjacent to the end cap mounting posts and secure terminals to flange with taper head screws. Place all brush springs on posts with small groove of spring to bottom of post with spring arm to inside of end cap. After spring is on, pull arm of spring in front of brush holder. (See Figure 21.)

Body and Field: The field winding is an integral part of the body. Inspect carefully for burned-out winding, shorting or poor insulation. If insulated covering is burned or removed or unit is shorted, it must be replaced.

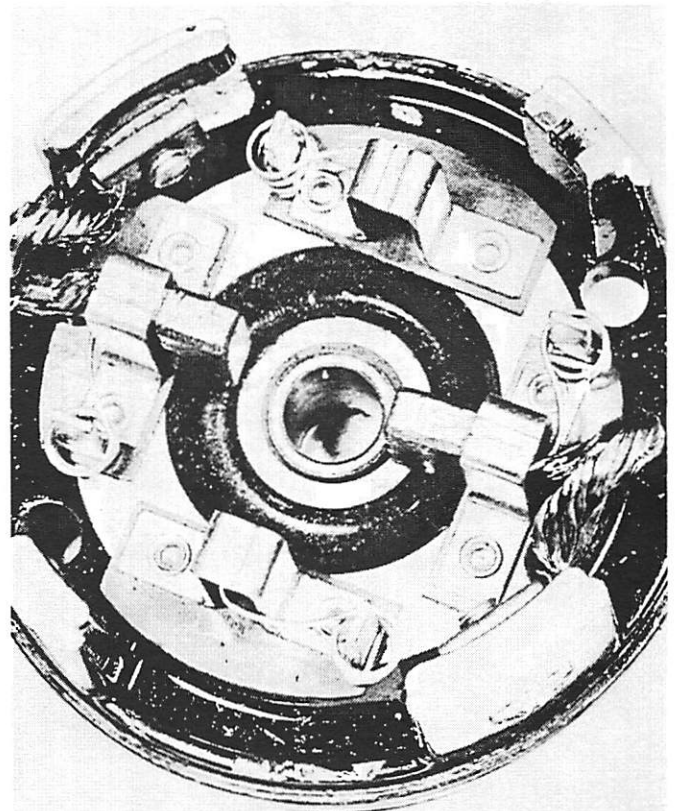


Figure 21. Commutator End Plate Assembly with Springs and Brushes in Place

Cleaning: Field coils, armature & brushes may be wiped with a clean, dry cloth or cleaned with compressed air. Do not immerse bearing-equipped parts in cleaning fluid. These parts should be cleaned with a brush dipped in Varsol, or any other comparable mineral spirits, while exercising caution that none of the cleaning fluid comes in contact with bearings. Thoroughly dry all parts which have come in contact with cleaning fluid.

Armature: Not much of the armature can be repaired. If commutator is worn, due to brush wear, it can be machined evenly and reinstalled with new brushes. This can be accomplished by any dealer having a lathe or regular armature reconditioning tool (See Figure 14 and 15, Page 31 and 32). (*Note: The reconditioning*

tool can be purchased from a local automotive or tool supply store.) The aforementioned armature reconditioning tool turns down the commutator and undercuts the mica.

Undercut of mica should be approximately $1/32''$. After thorough inspection has been completed and armature is found to check out OK, or has been reworked, it can be reinstalled. Armature can be checked out on an armature growler. (See Figure 16, Page 32.) Any automotive garage can test armatures, or armature can be checked on Magneto Analyzer (91-25213). Check for continuity between commutator and armature shaft. If continuity exists, winding is grounded and armature must be replaced. Set armature into field housing assembly, commutator end toward end of housing having brushes secured to field. Place commutator end cap onto armature shaft and align slot in one of the 4 end cap posts with small notch in housing frame. Place carbon brushes into brush holders, being sure brush leads are not touching on metal surfaces.

Place carbon brushes into brush holders by pulling brush holder springs back with needle-nose pliers and inserting brushes. Reset spring into small groove of carbon brush. (See Figure 22.)

Apply a light film of SAE #10 oil to bearing portions of armature shaft before reassembling motor and to splines of armature shaft before reassembling drive assembly. Insert field coil windings insulation strip into the housing at the drive end over drive end thru bolt insulation strip. Assemble tab of insulation strip under commutator end thru bolt insulation strip. The notched end of the insulation strip at commutator end of housing is to clear the terminal. Insert, etc. Insert the 2 pieces of thru-bolt insulation strip into commutator end, flush to $.062''$ inside housing over tab of insulation strip (field coil windings) and glue the 2 pieces of insulation strip (thru bolt, commutator end) into place. Exercise care when inserting thru-bolts, as they must be placed between frame and insulator paper or into insulator tube, whichever is provided at each end of fields in frame. Insert 2 thru-bolts, lockwasher and washers through starter motor support bracket (be sure bracket is correctly located) and commutator end plate. Set shims on shaft. Place drive end plate shoulder down onto armature shaft over 2 thru-bolts. Check armature end play. Shim as required to obtain $0.005''$ to $0.015''$ armature end play. Place adaptor flange on drive end over plate and secure in position by threading the 2 bolts into flange and tighten. Torque thru-bolts to 60-65 in. lbs. Place insulating band around field housing and commutator end cap, attaching ends with a piece of Scotch Tape. Install neoprene insulator cover, position evenly with ridges facing outward and seal with Liquid Neoprene (92-25711) to provide watertight seal.

B. Starter Mechanism Reassembly

Installation of the starter mechanism parts can be made by using the exploded view on Page 36 and noting the following positioning:

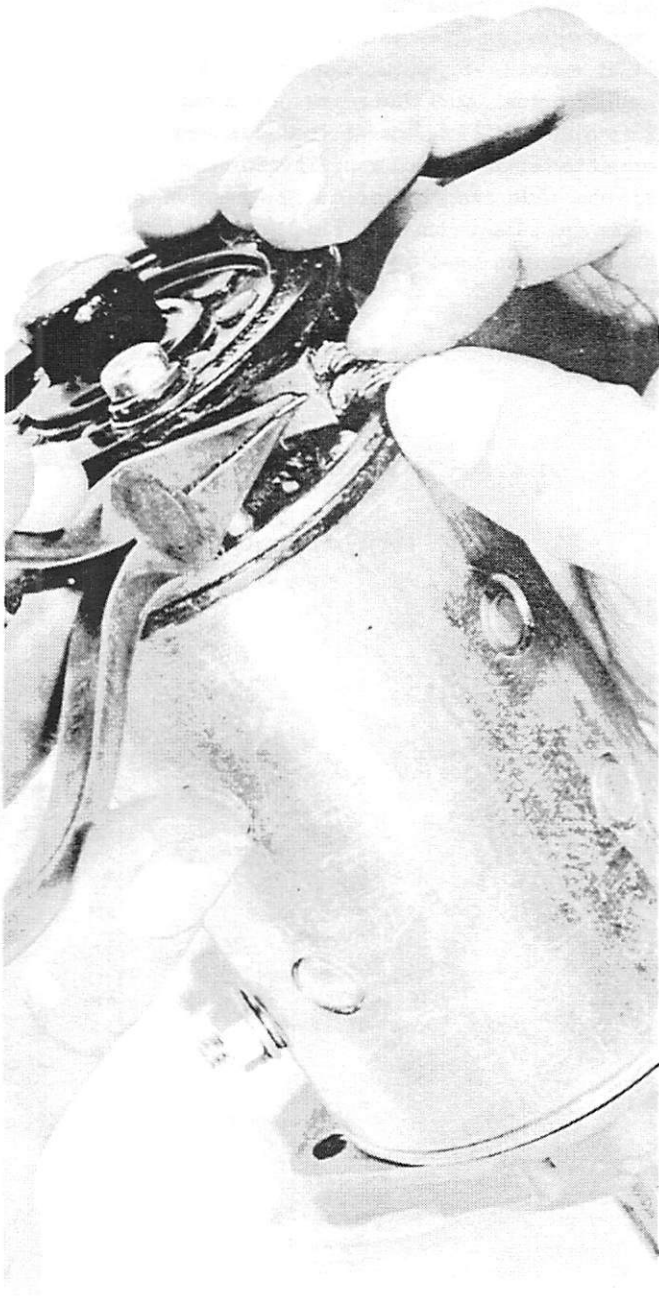


Figure 22. Installing Carbon Brush

In sequence, replace: Washer, thrust - cushion cup, 16; spacer, cushion, 15; cushion, rubber - recoil, 14; cup, cushion (open end over rubber cushion), 13; washer, thrust - cushion cup, 12; assemble the screw shaft to the pinion so that the splined end of the screw shaft enters the inside diameter of the pinion opposite the counterbore and assemble the screw shaft and pinion as a unit to the armature shaft with the inside diameter counterbore of the pinion facing the motor, 7; gear, pinion - forward drive (chamfered teeth up), 8 (later units have these parts as one assembly); sleeve, anti-drift spring (shoulder down), 9; washer, anti-drift spring (recess up), 10; spring, anti-drift, 11; washer, anti-drift spring (recess down), 10; sleeve, anti-drift spring (shoulder up), 9 (later units have these parts as one assembly); gear, pinion - reverse drive (chamfer teeth down), 8; assemble the screw shaft to the pinion so that the splined end of the screw shaft enters the inside diameter of the pinion opposite the counterbore and assemble the screw shaft and pinion as a unit to the armature shaft with the inside diameter counterbore of the pinion facing the castellated nut, 7; sleeve, 6; wave washers (2), 5; flat washer, 4; castellated nut; tighten nut to 200 in. lbs. minimum torque and, if necessary, continue tightening nut until cotter pin can be assembled to hole in shaft and slot in nut (do not back nut off).

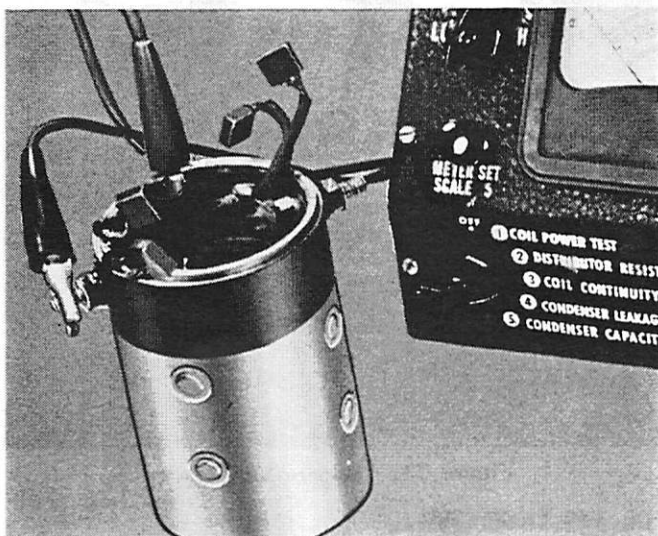


Figure 22A. Checking Starter Motor for Grounded Field Winding

Testing: Use fully charged 12-volt battery for testing and apply power to starting motor input terminal through a switch. Test leads of No. 10 stranded cable or larger must not exceed 6 ft. in length. Check operation of drive assembly by applying rated voltage momentarily. The starting motor should not be run continuously for more than 15 seconds when testing. Before taking each test reading, the motor should be cooled to room temperature (approx. 75° F.), and the reading should be taken as quickly as possible.

NOTE: Refer to Page 43 "Starter Motor Testing and Trouble Chart".

Starter Motor Characteristics — 6-Cylinder Engines

Starter	Volts	Ampere Draw
No load*	12	50-55
Load	12	180-240 while cranking

* Momentary operation only. Caution: Do not allow to run too long!

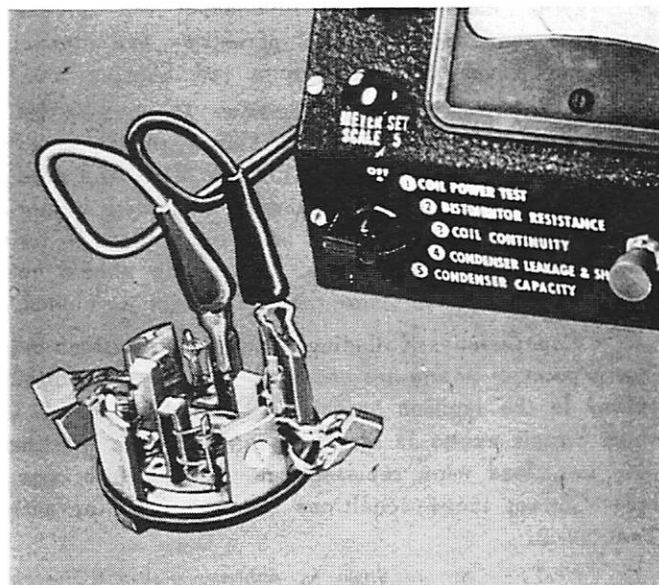


Figure 22B. Checking Starter Motor for Grounded Brushes or Brush Holders

Drive mechanism operation: The drive mechanism is part of the complete starter motor. It is located at the top of the starter motor. The starter motor drive pinion gear automatically engages the flywheel ring gear, due to sudden inertia when the starter turns over, and automatically disengages when the engine starts. The teeth on the drive pinion gear are chamfered so as to engage more readily with the flywheel ring gear teeth.

C. Installing Starter Motor Mechanism on Engine

Place spacer washers as required on top of starter motor to obtain equal clearance between collars of forward and reverse starter pinion gears. (*Note: Insert starter motor assembly into crankcase adaptor flange with terminals to rear.*) Thread two 5/16" bolts into starter motor mounting flange holes. Insert the 2 crankcase-to-cylinder block bolts through the starter motor support bracket holes and thread on nuts. Torque top mounting bolts first and then support bracket bolts. See Page 2B, Section VIII for correct torque specifications.

D. Starter Motor Operation

Warning: Do not operate starter motor continuously for more than 30 seconds without pausing to allow motor to cool off for 2 minutes! Starter motor is not designed for continuous operation, and serious damage may result.

NOTE: Warranty will not apply on starter motor if starter motor and/or armature or field coil assembly is burned or lead thrown out of commutator because of excess cranking.

CHECKING AMPERAGE OUTPUT - - MERCELECTRICS

I. TESTING NET DC AMPERAGE OUTPUT ON ALL 6-CYLINDER ENGINES

(Use 91-27883 Ampere-Volt Tester.)

A. Test No. 1

With engine stopped, disconnect red harness lead from positive (+) terminal of battery and connect negative (-) ammeter terminal to red harness lead. Connect positive (+) side of ammeter to positive (+) terminal of battery. (Figure 23) Turn ignition key to "ON" position (DO NOT START ENGINE) and read ammeter. The proper amperage draw with both points closed should be $5\frac{1}{2}$ -to- $6\frac{1}{2}$ amperes ($6\frac{1}{2}$ -to- $7\frac{1}{2}$ for Mark 75). If reading is less, the engine should be turned over by hand to insure that both points are closed.

Conclusions: If reading is lower, indications are that a point or points are not closing or an open circuit exists in the ignition system. If reading is higher, a short circuit exists in ignition system (a part shorting out; i.e., lead wire, resistor screw grounded to case, etc). Correct these conditions before proceeding with Test No. 2.

NOTE: Current draw is approx. 4-to-5 amperes during operation; (Mark 75 current draw is approx. 4 amperes during operation).

B. Test No. 2

Disconnect ammeter from electrical circuit and reconnect red harness lead to positive battery terminal. Start engine and run at 1500 RPM or less. (**WARNING ABOUT CONNECTION:** Without disconnecting red harness lead from battery, connect the positive clip from ammeter to the positive battery terminal and negative clip to spade lug on red harness lead.) Remove wing nut and carefully remove spade lug from battery post, being sure that neither of the 2 clips breaks contact with the parts to which they are attached. If accidental loss of contact occurs, rectifier failure may result which might be prevented by immediately reconnecting spade lug of harness to battery terminal.

CAUTION: Should engine stop, do not attempt to start engine with ammeter connected, as ammeter will become damaged instantly. Always reconnect red harness lead to battery post before starting.

With a partially discharged battery, the ammeter should change from discharge to charge at between 800-to-1000 RPM (1100-to-1500 for the Mark 75). With a fully-charged battery, this RPM may be somewhat higher. Increase engine RPM to 5200 to 5500, at which time the reading should be approximately 10-to-12 amperes (5-to-6 amperes for the Mark 75) with partially discharged battery. With a fully-charged battery, a somewhat lower reading will be obtained because of self-regulating characteristics of the generating systems.

Before disconnecting ammeter, reconnect red harness lead to positive terminal of battery and replace wing nut.

II. CHECKING GROSS DC AMPERE OUTPUT OF RECTIFIERS, ALL MERCELECTRICS WITH GENERATORS

(Use 91-27883 Ampere-Volt Tester.)

Connect an ammeter (Figure 23) between red output lead from the rectifier and the electrical internal harness red lead. Disconnect this lead by removing the self-tapping screw from the rectifier bracket and pull the neoprene sleeve back from the knife disconnects. Open the disconnects and connect ammeter, attaching lead from rectifier to one terminal of ammeter and lead from internal harness to second terminal. Start engine and check amperage output. Maximum output with a low battery at full throttle is 14 amperes (Mark 75, $9\frac{1}{2}$ amperes).

The same test procedure can be used on 4-cylinder MercElectrics. Maximum output at full throttle on these models is 7 amperes with a low battery.

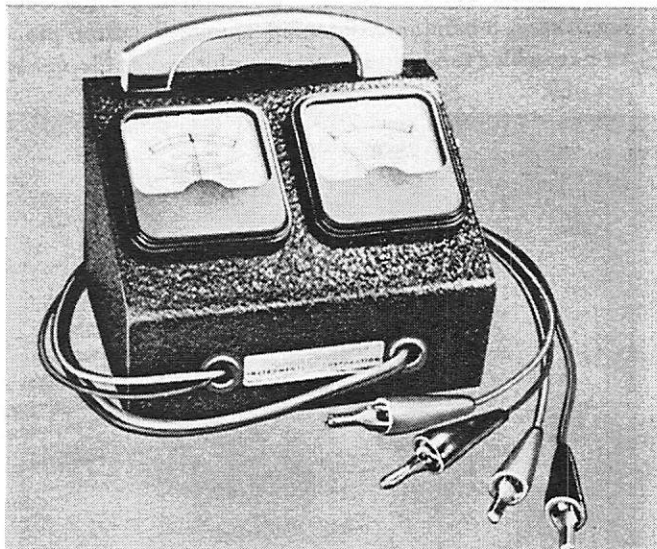


Figure 23. Ampere-Volt Tester

III. VOLTAGE CHECK

(Use Voltmeter Side of Tester.)

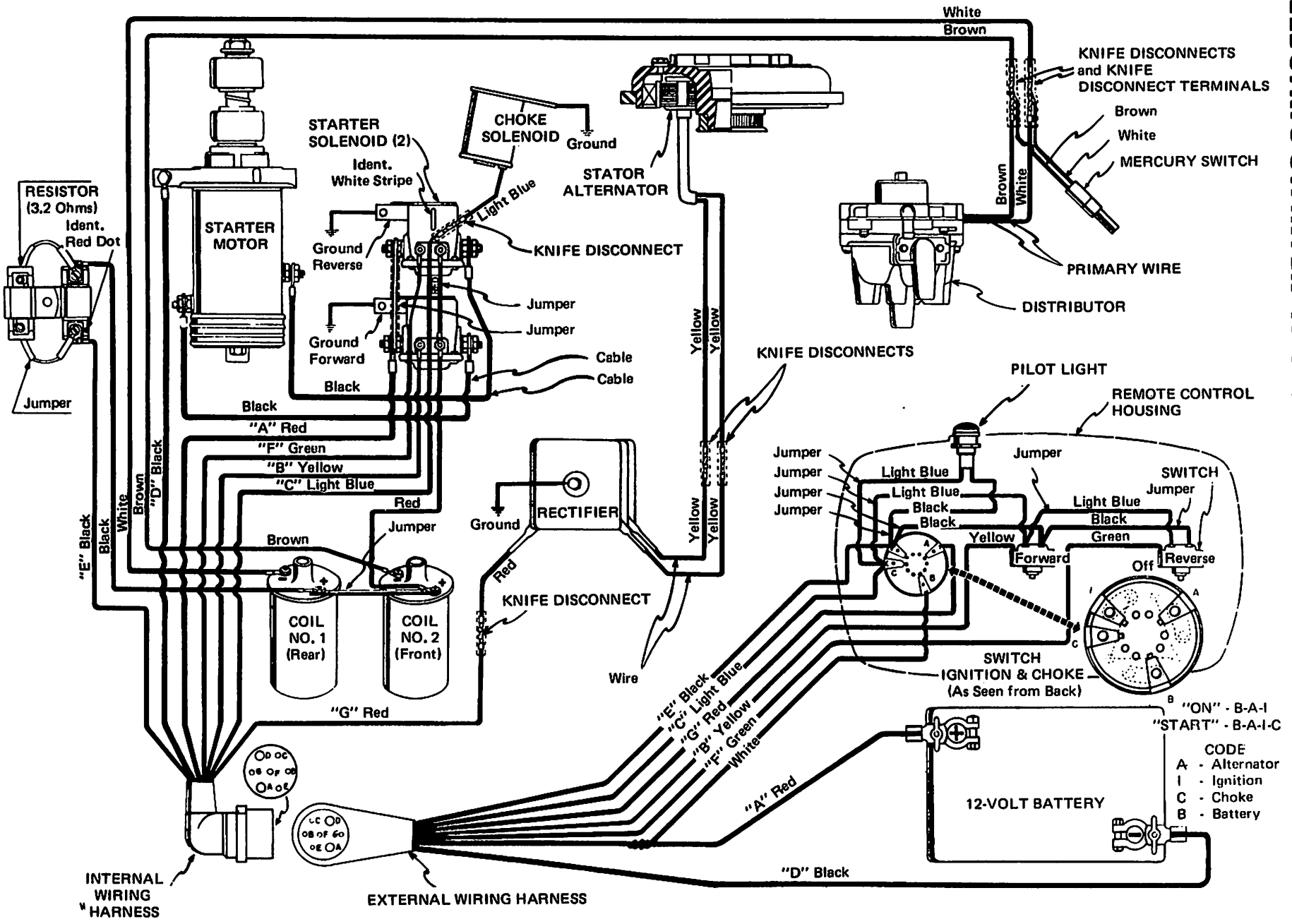
A. Battery Voltage While Cranking Engine

To check battery voltage while cranking engine with electric starting motor, place red (+) lead of tester on positive (+) battery terminal and black (-) lead of tester on negative (-) battery terminal. If the voltage drops below $9\frac{1}{2}$ volts while cranking, the battery is weak and should be recharged or replaced.

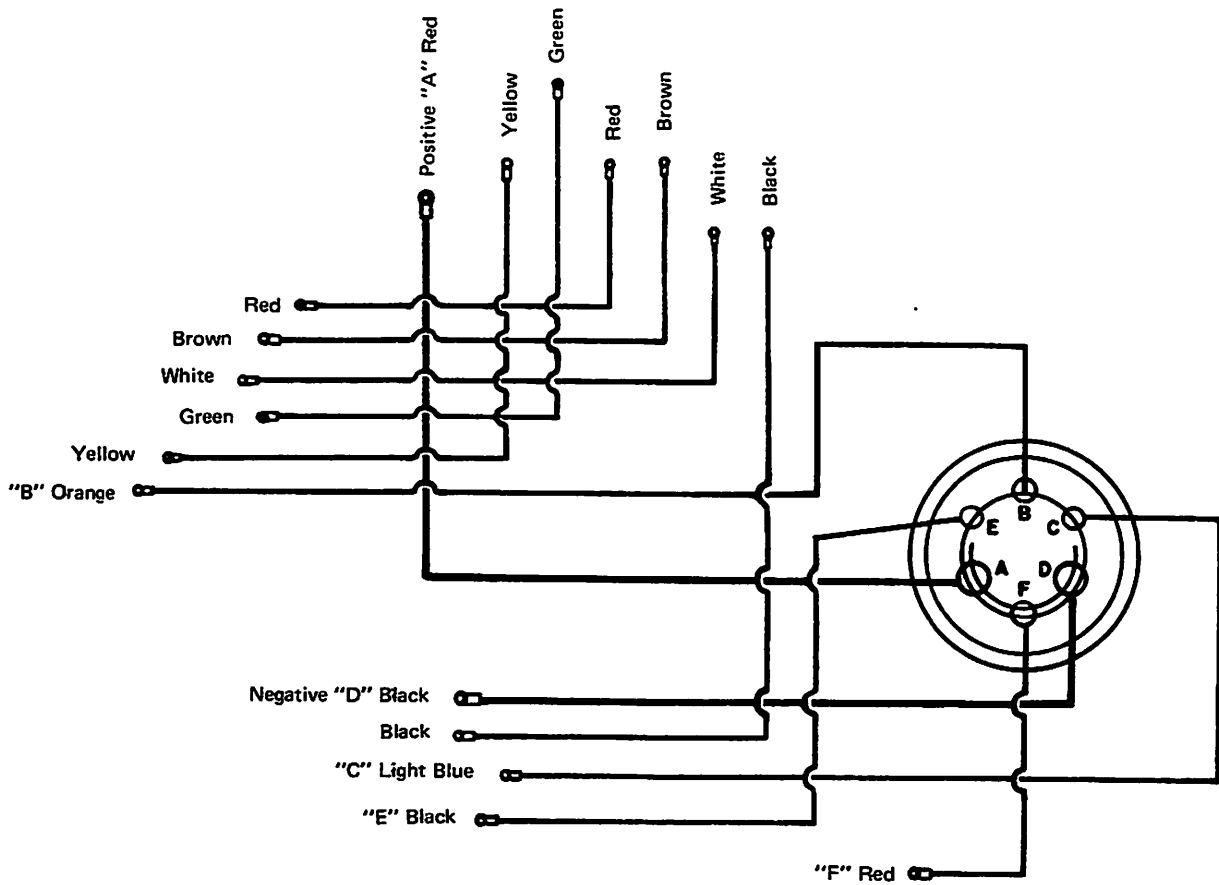
B. Condition of Battery

A quick voltage check to determine condition of the battery can be completed by attaching the leads as stated in "A" above. Meter will indicate voltage. If below 12 volts, it indicates a weak battery. A closer check then can be made with a hydrometer to obtain specific gravity readings.

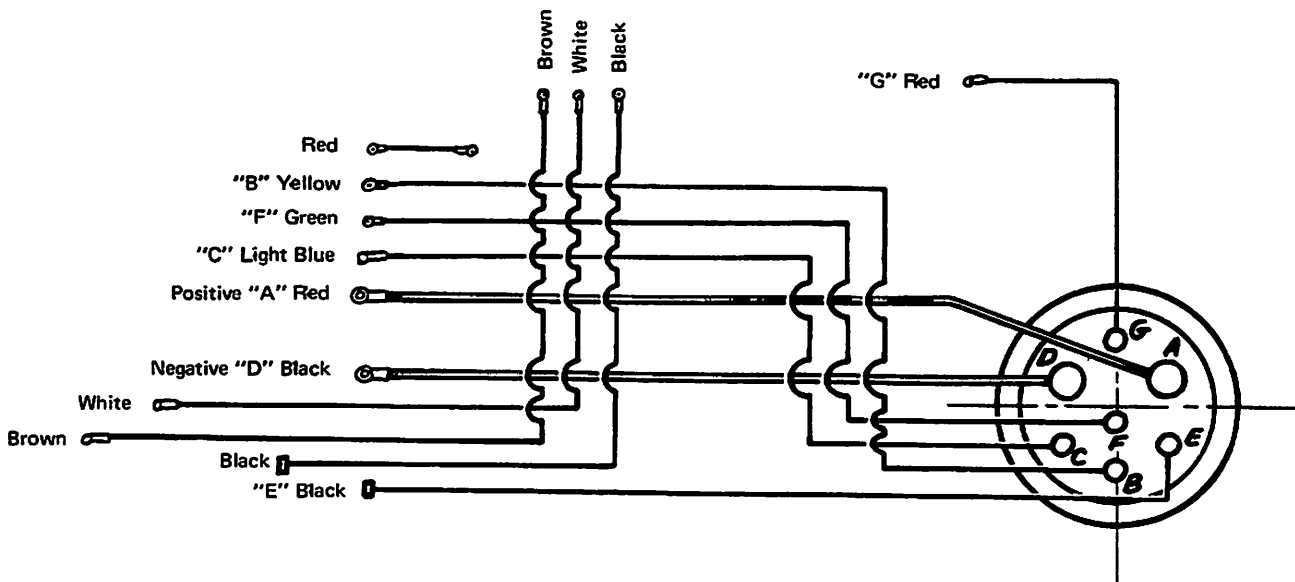
ELECTRIC STARTER WIRING DIAGRAM - MARK 78A-75A



INTERNAL HARNESS - MERC 800-700-600 (DIRECT REVERSING)

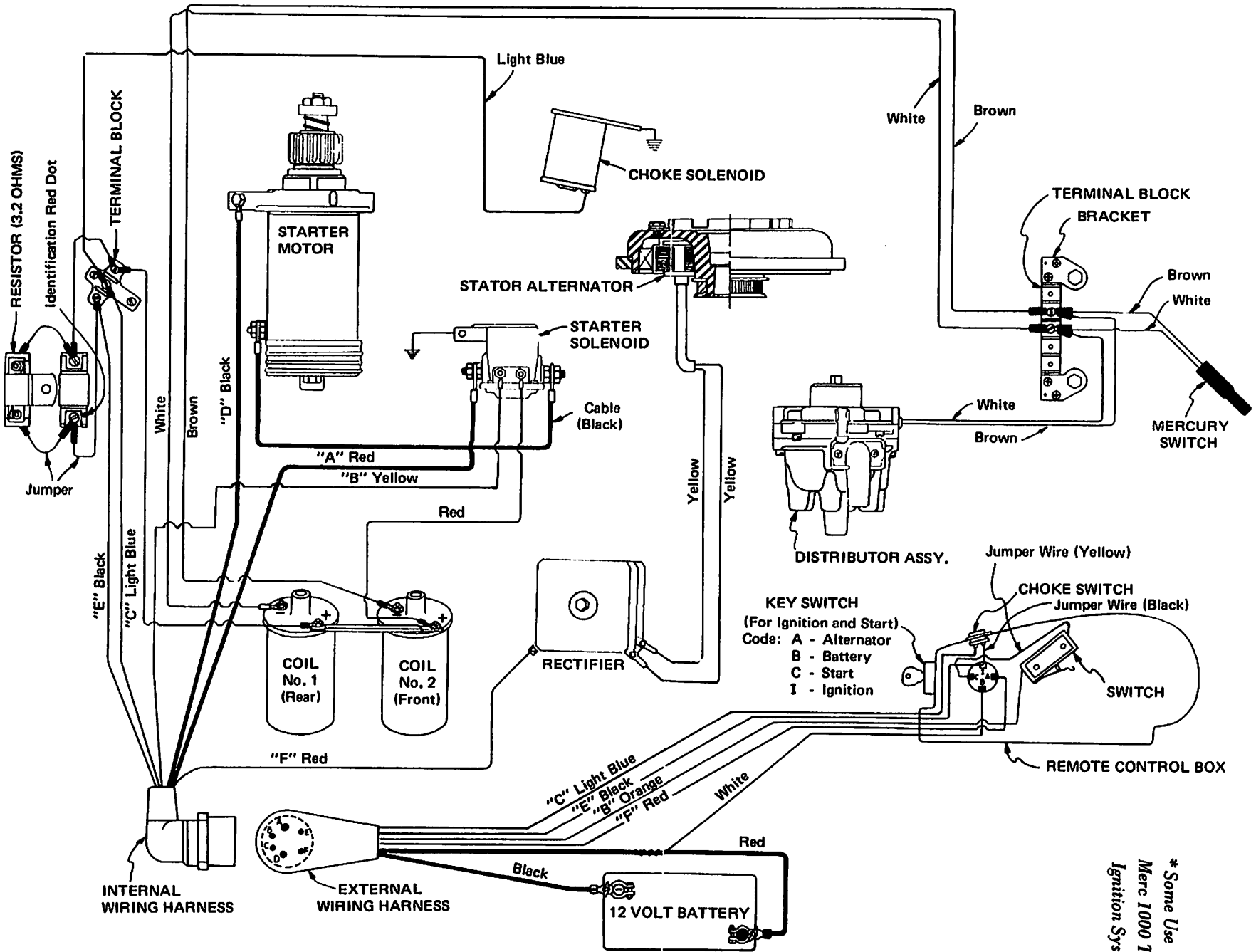


INTERNAL HARNESS - MARK 78A-75A



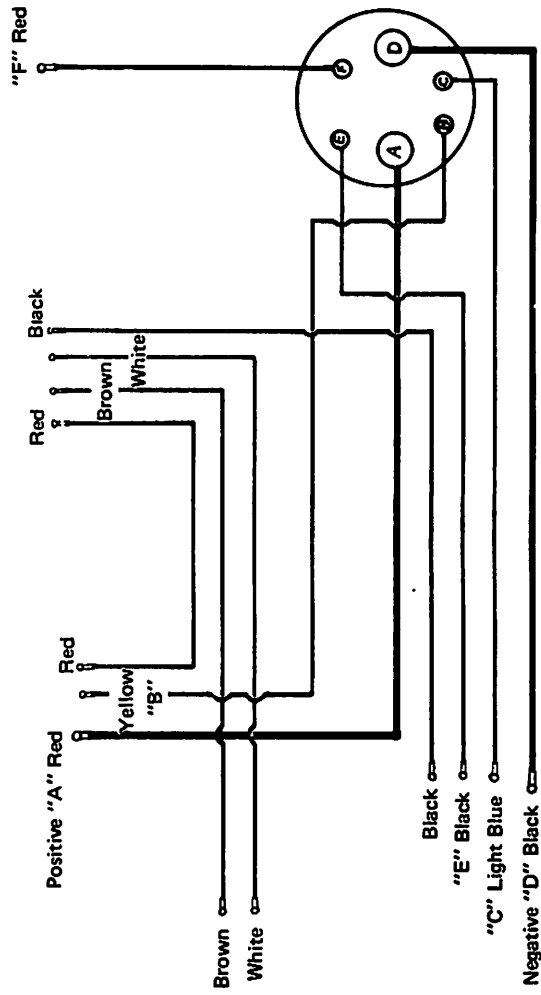
ELECTRIC STARTER WIRING DIAGRAM

MERC 850*-800-700* FULL GEAR SHIFT

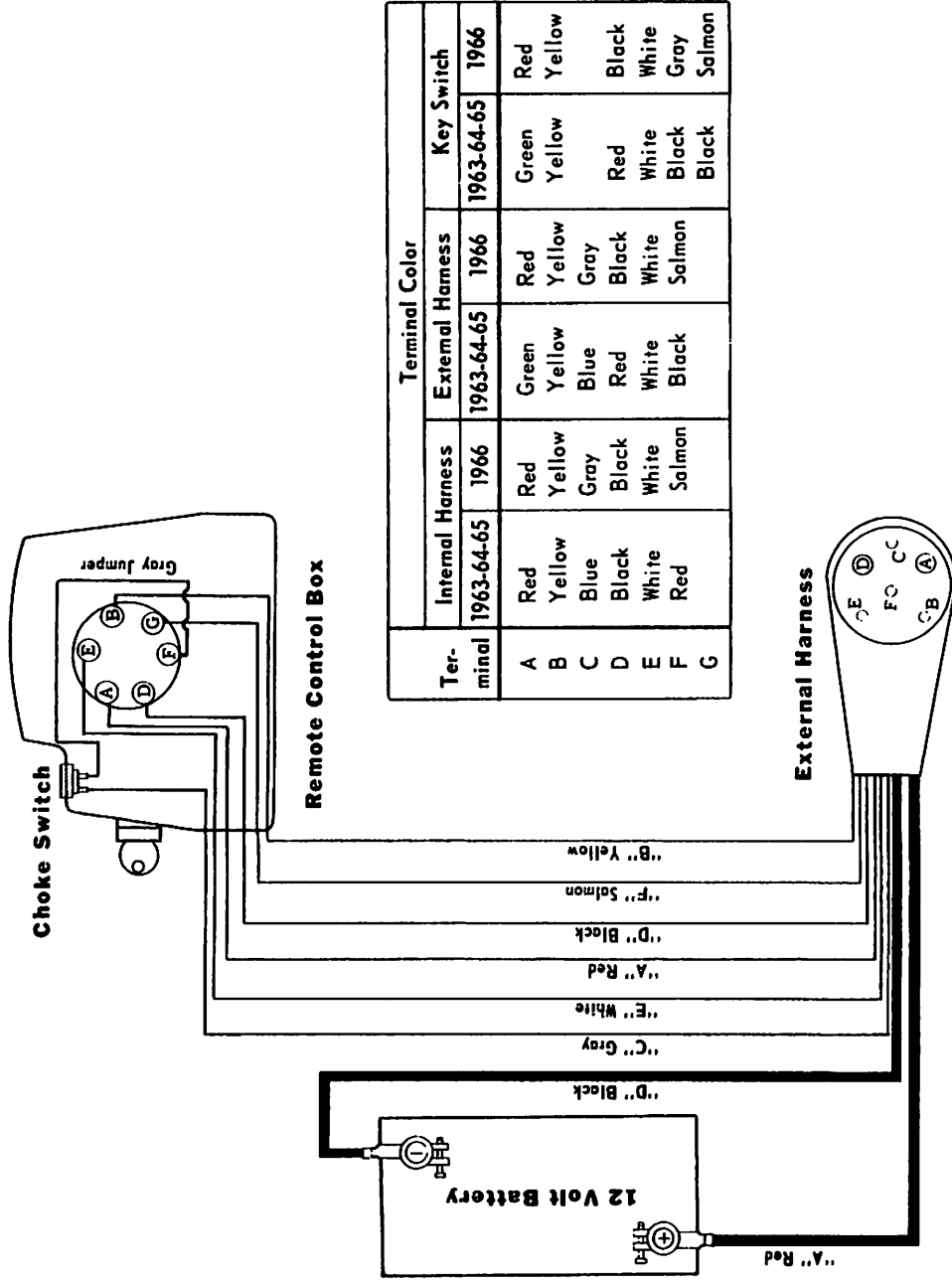


INTERNAL HARNESS - MERC 850-800-700

FULL GEAR SHIFT

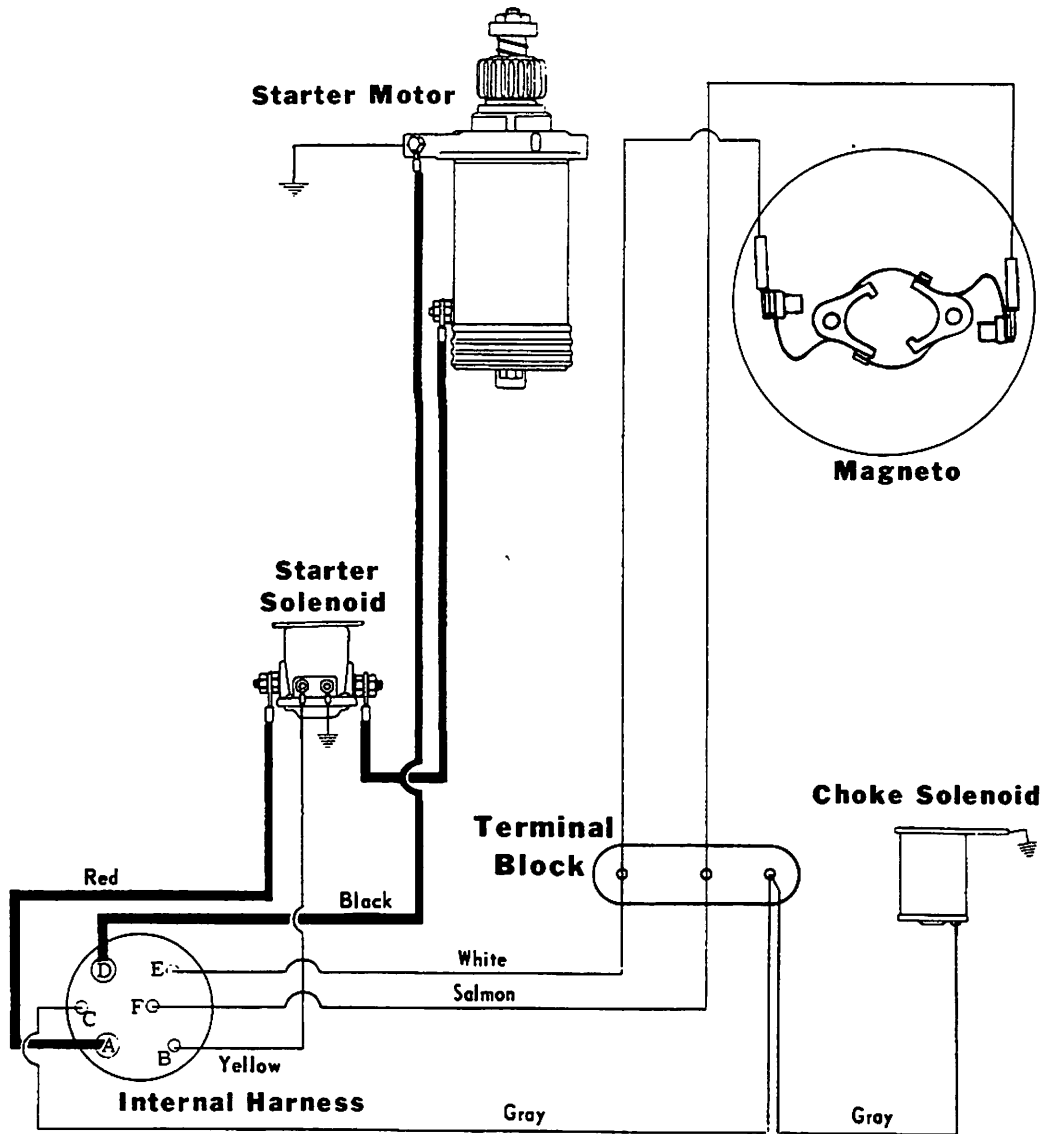


MERC 350 (2-CYL.) MERCELECTRIC HARNESS



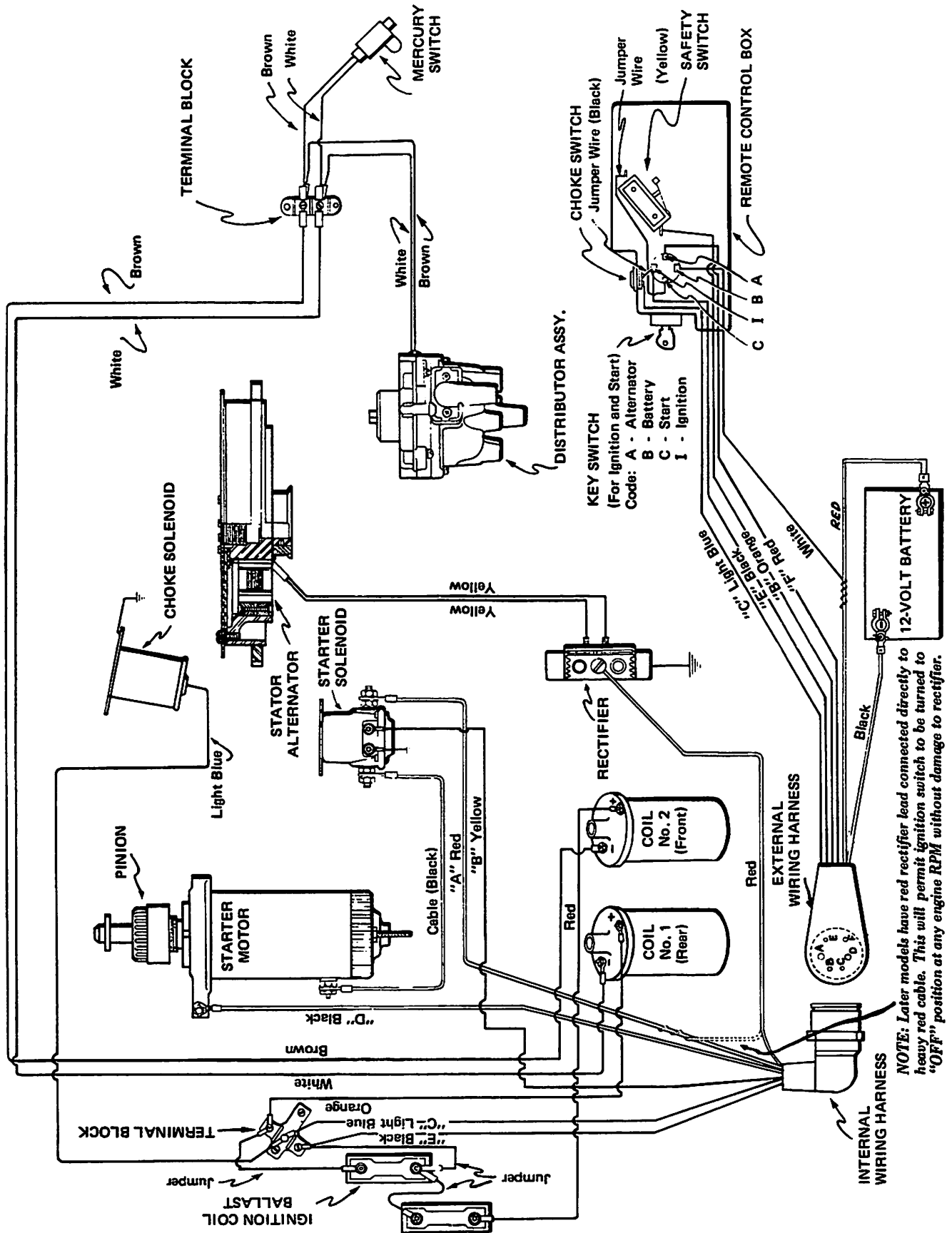
Terminal	Terminal Color					
	Internal Harness		External Harness		Key Switch	
	1963-64-65	1966	1963-64-65	1966	1963-64-65	1966
A	Red	Red	Green	Red	Green	Red
B	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
C	Blue	Gray	Blue	Gray	Gray	Yellow
D	Black	Black	Red	Black	Red	Black
E	White	White	White	White	White	White
F	Red	Salmon	Salmon	Salmon	Black	Black
G					Black	Salmon

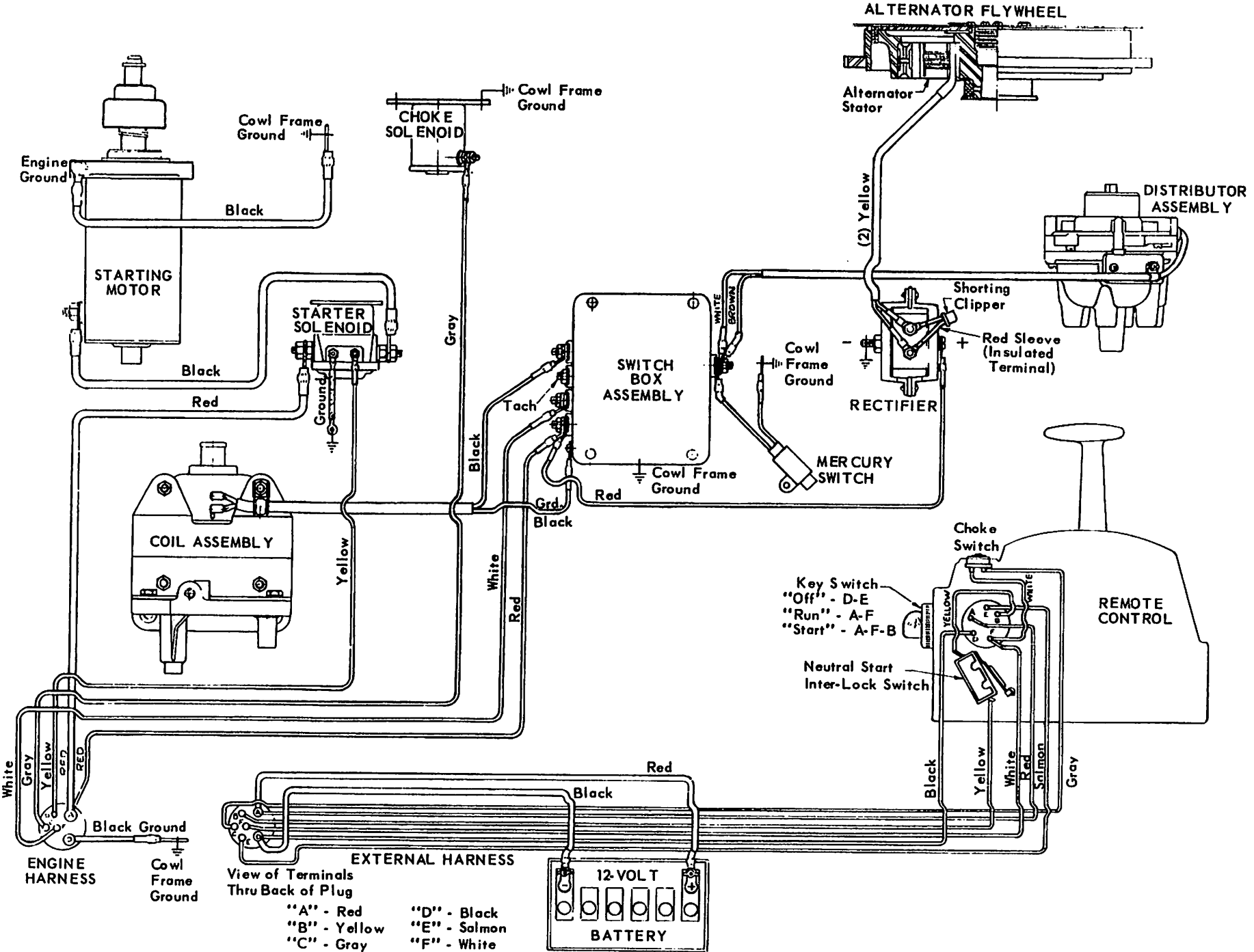
MERC 350 (2-CYL.) MERCELECTRIC WIRING DIAGRAM



ELECTRIC STARTER WIRING DIAGRAM

MERC 1000-900-850-700 FULL GEAR SHIFT

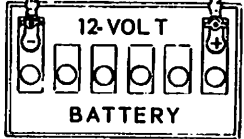




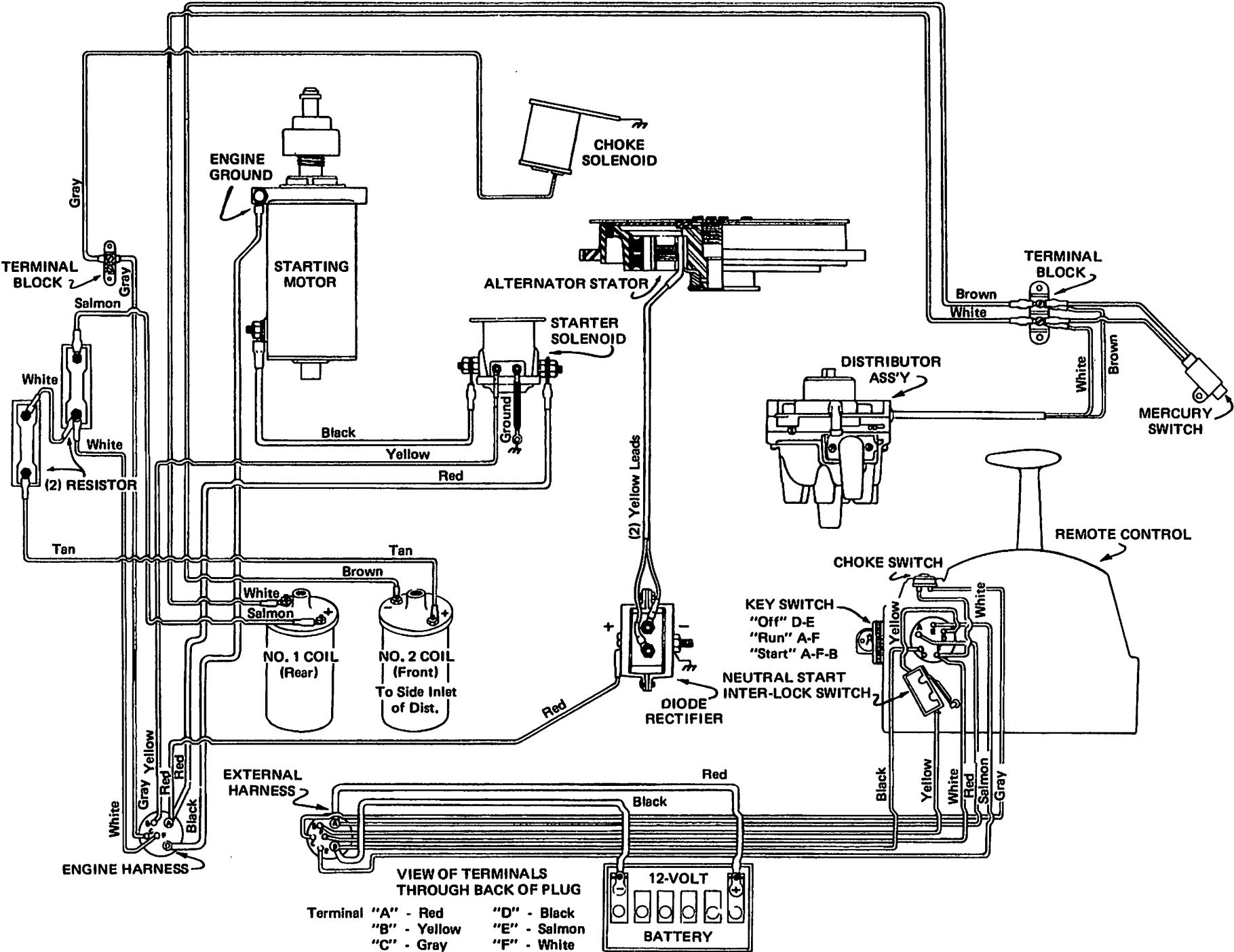
MERC 1100SS-950SS WIRING DIAGRAM

EXTERNAL HARNESS
View of Terminals
Thru Back of Plug

"A" - Red	"D" - Black
"B" - Yellow	"E" - Salmon
"C" - Gray	"F" - White

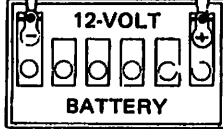


MERC 100-950 WIRING DIAGRAM



VIEW OF TERMINALS THROUGH BACK OF PLUG

Terminal "A" - Red	"D" - Black
"B" - Yellow	"E" - Salmon
"C" - Gray	"F" - White



KIEKHAEFER STARTER MOTOR FOR 6-CYL. MODELS, STARTING WITH 1965

Disassembly

STARTER MECHANISM - DISASSEMBLY OF INERTIA TYPE DRIVE

Refer to disassembly of Delco-Remy inertia type drive, Section VII, Page 31, Paragraph B.

STARTER MOTOR - DISASSEMBLY AND REPAIR

1. Remove 2 thru bolts, lockwashers and flat washers from bottom of starter.
2. Pull armature and upper end cap from body and field.
3. Remove lower end cap and release brushes from brush holder. Do not lose thrust washers from end cap or armature shaft.
4. Brushes should be replaced if worn to one-half of original length or chipped or worn.
5. Two brushes and terminal can be removed by pushing terminal block toward bottom of field housing.
6. Field brushes are removed by loosening solder connections with a soldering gun.
7. Field winding is an integral part of body, as they are spot welded together, and must be replaced complete if found defective.
8. Set Magneto Analyzer on Scale No. 3 and check between field and body. Needle on analyzer should move completely to the right of Scale No. 3, as field and body are connected.
9. Check armature on a growler, or by placing Magneto Analyzer on Scale No. 3, and check for shorts between commutator bars and core. Any movement of analyzer needle to the right indicates a short. Clean carbon dust from armature, as this may be cause for short.
10. Armature commutator bars can be resurfaced with a reconditioning tool, if worn excessively, or cleaned with No. 00 sandpaper.

Reassembly

REASSEMBLY OF STARTER MOTOR

1. Clean connections on field windings and resolder on new brushes with resin flux solder. Do not apply excessive solder on brush lead, as lead must remain flexible.
2. Place shims and upper end cap on armature shaft. Install armature into body and field and line up detents.
3. Install thrust washers on lower end of armature shaft.
4. Install brushes into brush holder and depress brushes and brush springs while sliding over commutator bars. Check for proper alignment of brush and brush holder, as they will only fit onto field body one way. (Fig 1)
5. Align lower end cap with brush holder and install. Two marks on cap line up with terminal block. (Figure 2) Install 2 thru bolts and tighten.

REASSEMBLY OF INERTIA TYPE DRIVE

Refer to reassembly of Delco-Remy inertia type drive, Section VII, Page 31, Paragraph C.

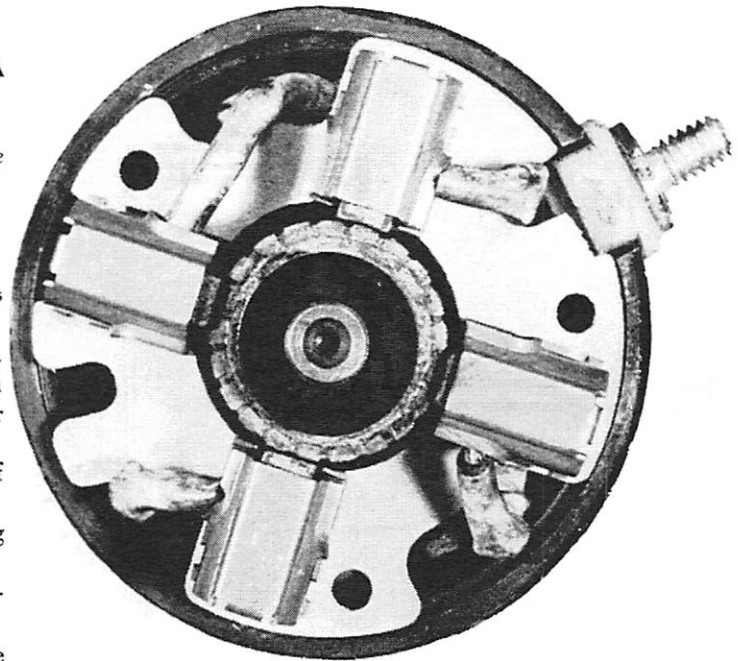


Figure 1. Brush and Brush Holder Aligned

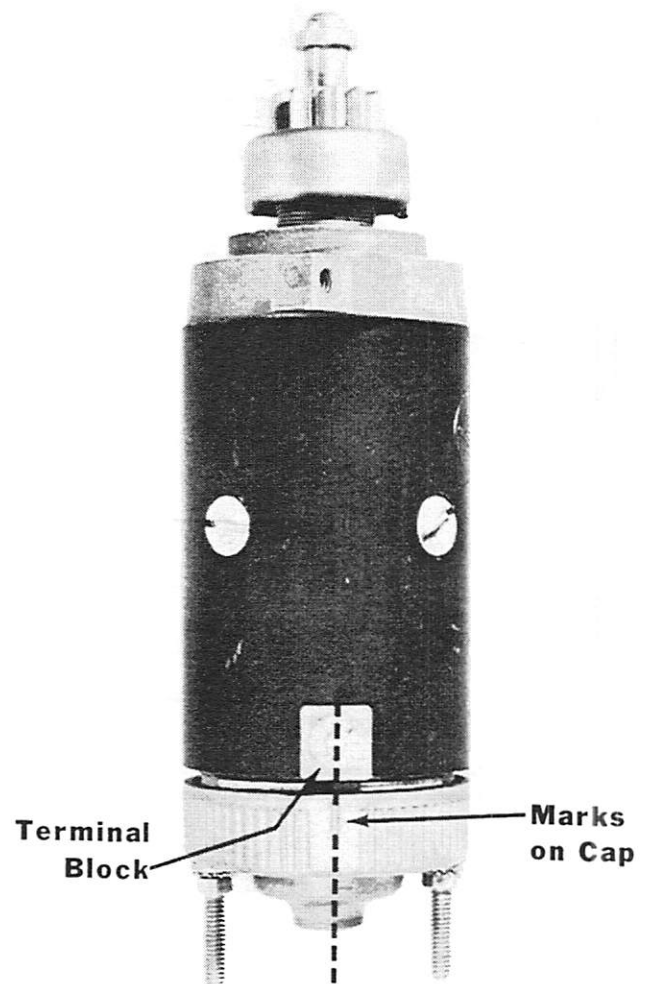


Figure 2. Aligning End Cap with Brush Holder

AMERICAN BOSCH STARTER MOTOR FOR 4-CYL. MODELS, STARTING WITH 1965

Disassembly

STARTER MECHANISM - DISASSEMBLY OF INERTIA TYPE DRIVE

Refer to disassembly of Delco-Remy inertia type drive, Section VII, Page 31, Paragraph B.

STARTER MOTOR - DISASSEMBLY

1. Remove 2 thru bolts and lock washers at bottom of starter.
2. Pull armature and upper end cap from body and field.
3. Remove lower end cap and release field brush by pulling brush spring back with pliers. Do not lose thrust washer from end cap.
4. Brushes
 - a. Replace brushes, if worn 1/2 of original length or if chipped or broken.
 - b. Ground brush may be replaced by removing screw in lower end cap.
 - c. Field brush
 - (1) Unwrap tape and slide sleeve from soldered connection.
 - (2) Loosen soldered connection with soldering iron.
 - (3) Resolder new brush lead to coil connections with rosin flux only. (Figure 1)

NOTE: Do not use excessive solder on lead of brush, as lead must remain flexible.

 - (4) Install sleeve and retape soldered connection.
- d. Brush spring tension: 29-36 oz.

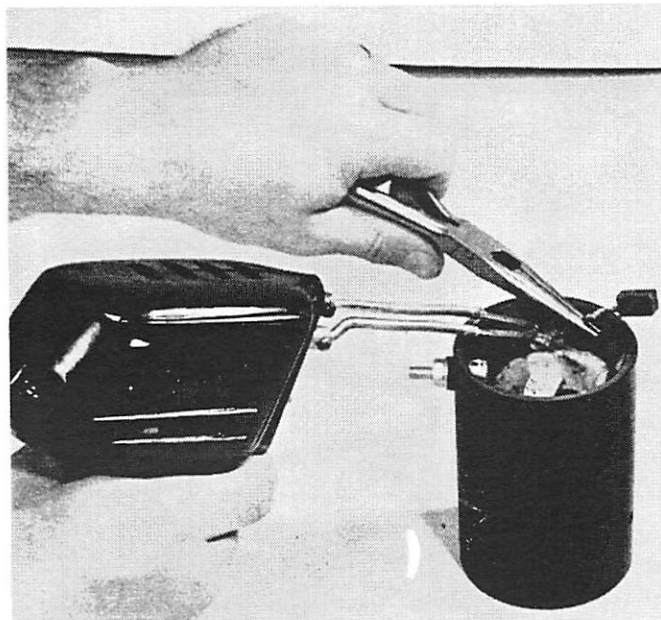


Figure 1. Soldering New Brush Lead

5. Body and field assembly
 - a. Field winding is an integral part of the body and must be replaced complete.
 - b. Check for shorted field by setting Magneto Analyzer (C-91-25213) on Scale No. 3 and checking between



Figure 2. Check for Shorted Field

- field terminal and body. (Figure 2) Any movement of needle to right indicates the field is shorted.
- c. Field coil resistance: .025 ohms
6. Armature
 - a. Commutator can be resurfaced with a reconditioning tool, if excessively worn, and mica undercut to 1/32" (.794mm).
 - b. If commutator bars are not worn excessively, they can be cleaned with No. 00 sandpaper.
 - c. Check armature on a growler or place Magneto Analyzer on Scale No. 3 and check for shorts between commutator bars and core.
 - (1) Any movement to right indicates a short.
 - (2) Clean off carbon dust, as this may be cause for short.

Reassembly

REASSEMBLY OF STARTER MOTOR

1. Place shims and upper end cap on armature shaft. Armature shaft must be shimmed to allow an end play of .005 - .015 (.013 - .038mm).
2. Install armature into body and field and line up detent of upper end cap and body with marking on body and end cap.
3. Install thrust washer over lower end of armature shaft.
4. Pull brush springs back, slide brushes over commutator bars and line up marks on end cap.
5. Install 2 thru bolts and washers and torque to 60 - 65 in. lbs. (10.65 - 11.54 kg/cm).

REASSEMBLY OF INERTIA TYPE DRIVE

Refer to reassembly of Delco-Remy inertia type drive, Section VII, Page 31, Paragraph C.