Section 7
STARTERS & CHARGING SYSTEMS

REWIND STARTERS

Various rewind starter assemblies are illustrated below.

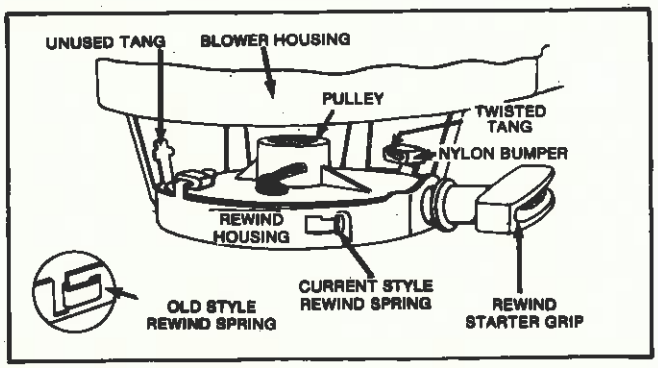

Fig. 1 — Old Style Model Series: 60000, 80000, 92000, 100000 and 110000

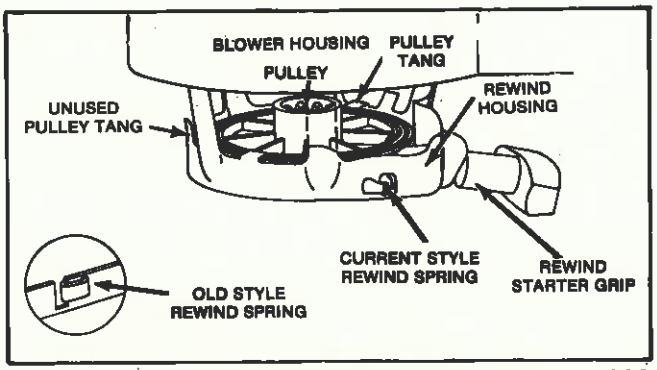

Fig. 2 — Model Series: 60000, 80000, 92000, 100000 and 110000

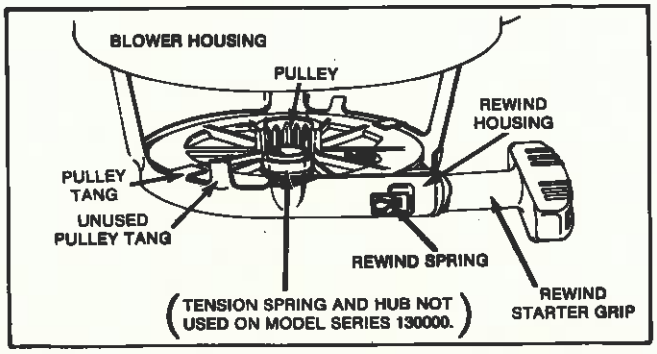

Fig. 3 — Model Series: 130000, 140000, 170000, 190000, 220000 and 250000

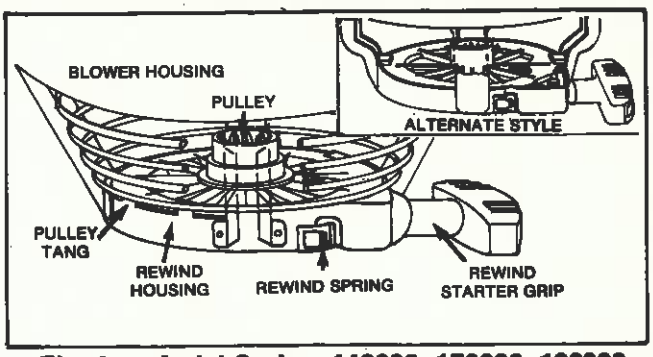

Fig. 4 — Model Series: 140000, 170000, 190000, 250000 and 300000

Repair procedure is similar except as indicated.

7 A

TO REPLACE A SPRING

Remove Spring

Cut knot at starter pulley to remove rope. With rope removed, grasp outer end of rewind spring with pliers, see Fig. 5, and pull out of housing as far as possible. Turn spring 1/4 turn and remove from pulley or bend one of the tangs up and lift out starter pulley to disconnect spring.

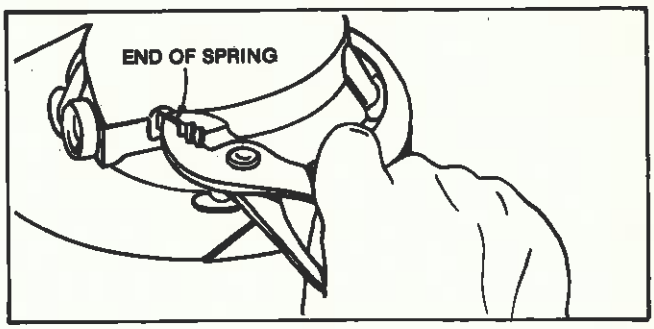

Fig. 5 — Remove Spring

Install Spring

Clean rewind housing, pulley and rewind spring in solvent. Wipe clean with cloth. Straighten spring to allow easier installation and restore tension. Oil spring. Insert either end of spring into blower housing slot and hook into pulley. Fig. 6.

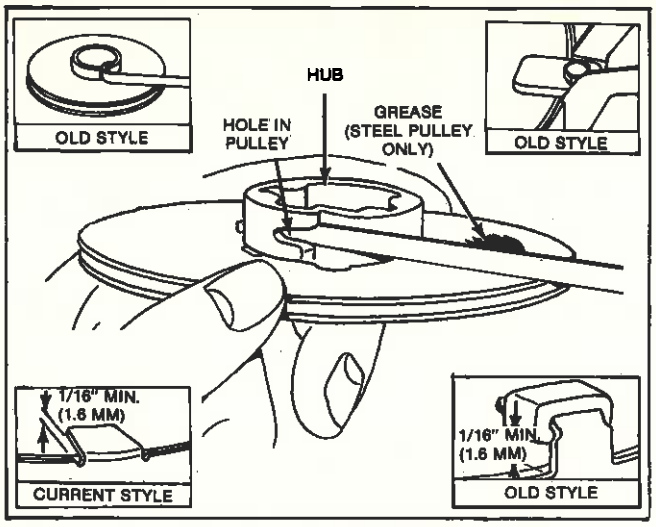

Fig. 6 — Install Spring

Place a dab of grease on pulley. Set pulley into housing and bend tang down. See Fig. 6. Adjust tang gap as shown. Pulley must be depressed fully into rewind housing when measuring tang gap.

NOTE: Do not remove nylon bumper from old style tang when replacing metal pulley with nylon pulley. Replace nylon bumpers if worn.

7 A

Wind Spring

Place a 3/4" square piece of stock into center of pulley hub or make rewind tool similar to one shown in Fig. 7. GRASPING STOCK WITH A WRENCH, WIND PULLEY COUNTERCLOCKWISE UNTIL SPRING IS WOUND TIGHT. Then back off pulley one turn or until hole in pulley for rope knot and eyelet in blower housing are in alignment. See Fig. 11 or 12.

Spring should be securely locked in smaller portion of tapered hole. See Fig. 8.

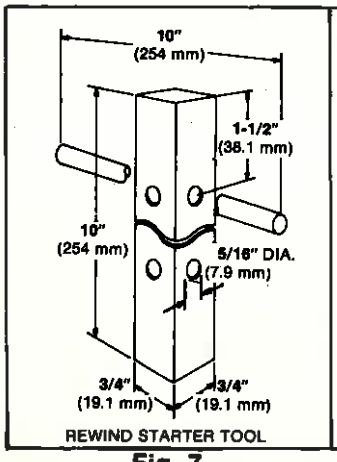

Fig. 7

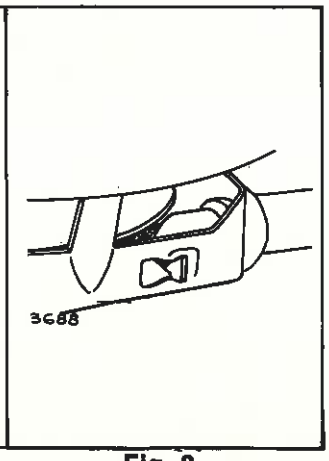

Fig. 8

Install Rope

Inspect rope. Replace if frayed. Insert rope through handle and tie a figure eight knot. Insert pin through knot and pull tightly into handle. Fig. 9. ALWAYS SEAL BOTH ENDS OF KNOT.

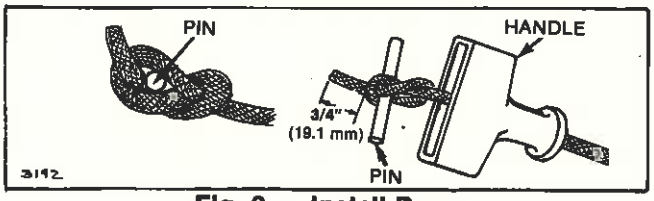

Fig. 9 — Install Rope

If re-using old rope, burn pulley end of rope with a match. Wipe with waste cloth, using caution, while it is still hot, to prevent swelling and unravelling.

NOTE: WHEN INSTALLING A NEW ROPE, CHECK PARTS LIST TO BE SURE CORRECT DIAMETER AND LENGTH ROPE IS USED.

A rope inserter tool may be made by using a piece of music wire or spring wire, and forming it as shown in Fig. 10.

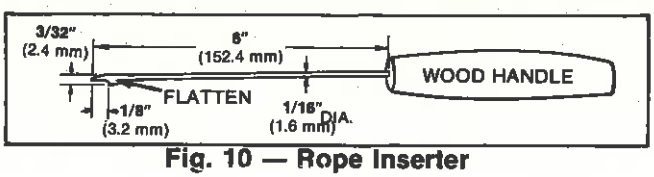

Fig. 10 — Rope Inserter

Thread wire and rope through rope eyelet in housing and out pulley hole. (CAUTION: Rope must pass inside a guide lug on metal pulley.) Fig. 11.

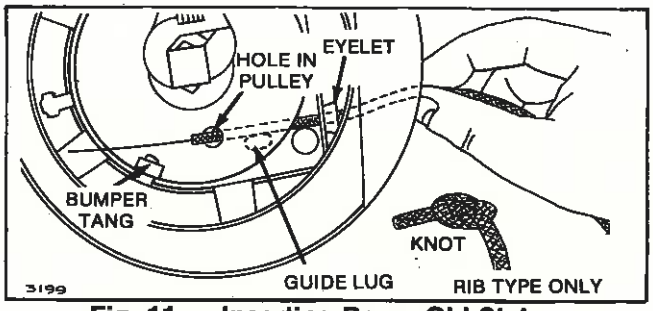

Fig. 11 — Inserting Rope, Old Style

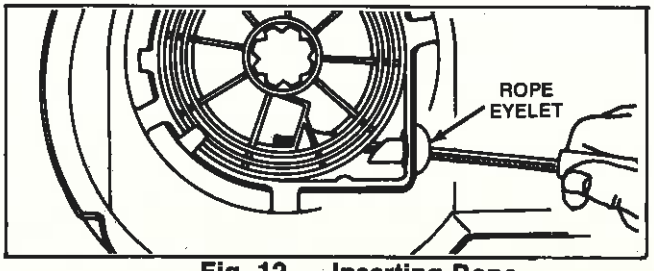

Fig. 12 — Inserting Rope

Old Style with Guide Lug

Tie a knot in rope and pull tight. Fig. 13. Make sure knot in pulley does not contact bumper tangs. Fig. 11.

Current Style without Guide Lug

Tie a knot in rope and pull tight. Manipulate knot so it can be pulled down into knot cavity. Fig. 13.

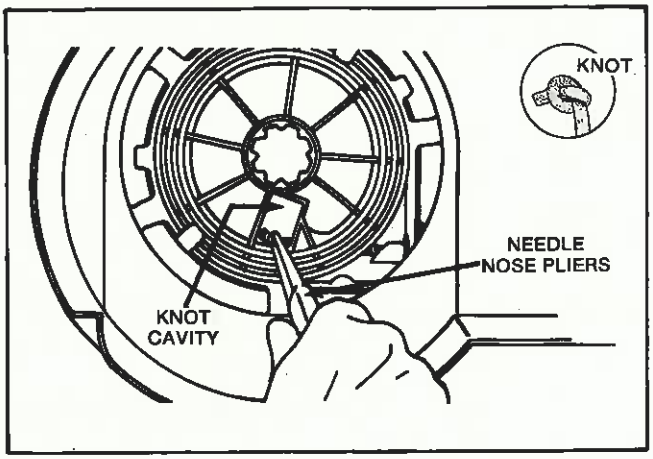

Fig. 13 — Tie Knot

Replace Rewind Assembly

If original starter housing is spot welded to blower housing, drill out spot welds using a 3/16" diameter drill. Drill deep enough to loosen spot welds ONLY. Locate replacement rewind assembly in desired position. Install screws from inside blower housing up through starter housing mounting leg. Fasten securely with nuts as shown in Fig. 14.

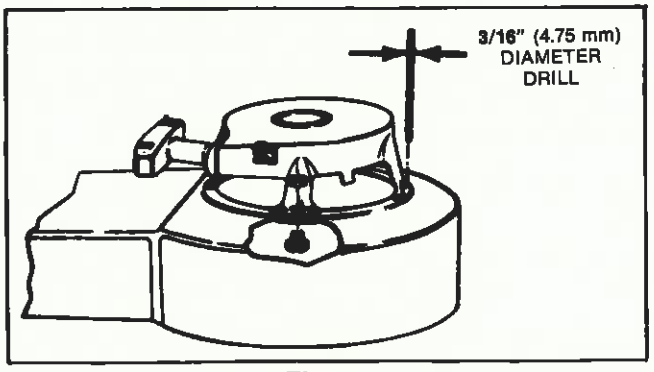

Fig. 14

Starter Clutch (Old Style)

Inspect and clean starter clutch assembly as necessary. Fig. 15 and 16. Do not oil ball cavity area.

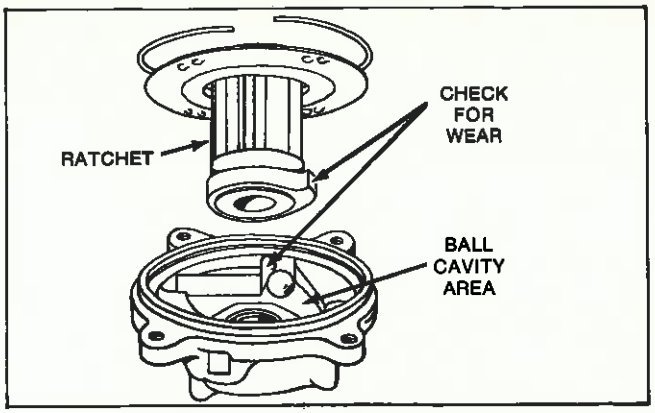

Fig. 15 — Starter Clutch (Old Style)

Starter Clutch (Sealed)

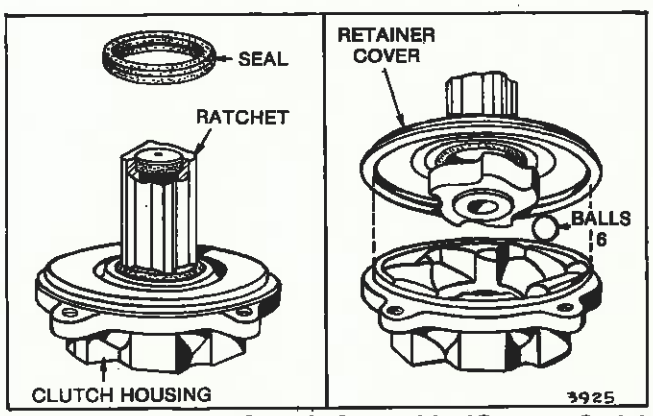

Fig. 16 — Sealed Clutch Assembly (Current Style)

If necessary, the sealed clutch can be disassembled by using a screwdriver or wedge to pry the retainer cover from the housing, as shown in Fig. 17. Place one drop of engine oil on end of crankshaft before replacing clutch assembly on crankshaft. Tighten clutch to torque noted on specification sheet for your model engine. DO NOT run engine without screen screws assembled to clutch.

NOTE: Clean ratchet by wiping with cloth only.

Fig. 17 — Disassembling Sealed Clutch

7 A

STARTERS
Windup Starters

NOTE: The sealed clutch may be installed on older model engines, by modifying the starter pulley and crankshaft. The old pulley can be made to fit the new clutch by cutting off the hub to a dimension of 1/2" as shown in Fig. 18.

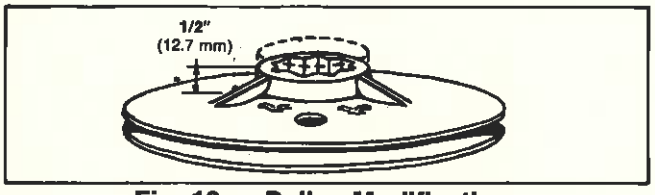

Fig. 18 — Pulley Modification

The crankshaft must be shortened 3/8" and the end chamfered as shown in Fig. 19. A new screen #221661 is required with the new clutch.

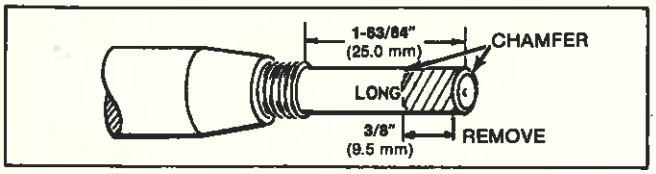

Fig. 19 — Crankshaft Modification

WINDUP STARTER

7A

Windup Starter

Two types of windup starters have been used. The control knob release was used with the unsealed four ball clutch. The control lever release can only be used with a sealed six ball clutch. See Fig. 20 and Fig. 21.

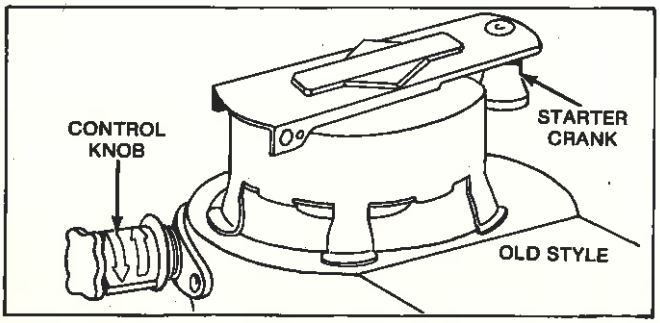

Fig. 20 — Old Style Starter Assembly

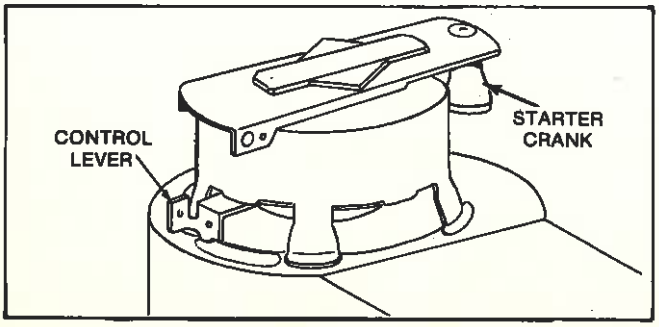

Fig. 21 — Lever Starter Assembly

Before working on equipment, remove spark plug from engine. Make sure starter spring is not wound. This can be determined by attempting to turn starter crank clockwise.

If wound tight, release tension by placing control knob or lever to "Start" position. If starter spring does not release, place control at "Crank" position. To prevent injury, hold crank handle with one hand while removing Phillips head screw and handle assembly from starter housing. This will release spring. Fig. 22.

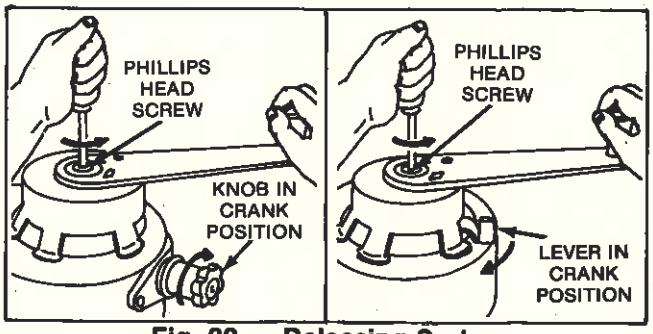

Fig. 22 — Releasing Spring

Broken Spring, Windup Starter

To check starter for a broken spring, while unit is still on engine, place control knob or lever to "Start" position. Turn cranking handle ten turns clockwise. If engine does not turn over, either the spring is broken or the starter clutch balls are not engaged. While turning the cranking handle, watch the starter clutch ratchet; if it does not move the starter spring is probably broken.

Disassemble Windup

Remove blower housing. Remove screw holding cranking handle to housing. Fig. 22. Bend tangs holding starter spring and housing assembly upward and lift retainer plate, spring and housing assembly out of blower housing. Fig. 23.

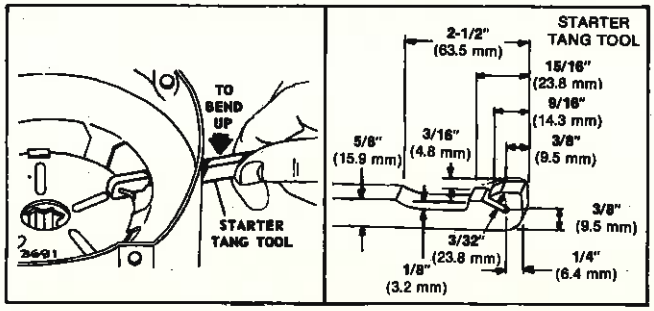

Fig. 23 — Removing Spring Housing

CAUTION: Do not attempt to remove starter spring from its housing.

Inspect Starter Parts

Inspect spring and housing assembly for spring breakage or other damage. Inspect ratchet gear on outside of blower housing for wear or damage.

Do not remove retaining plate from spring and cup assembly.

Check movement of control knob or control lever for ease of operation and damage or wear. (Clean and oil.) Fig. 24.

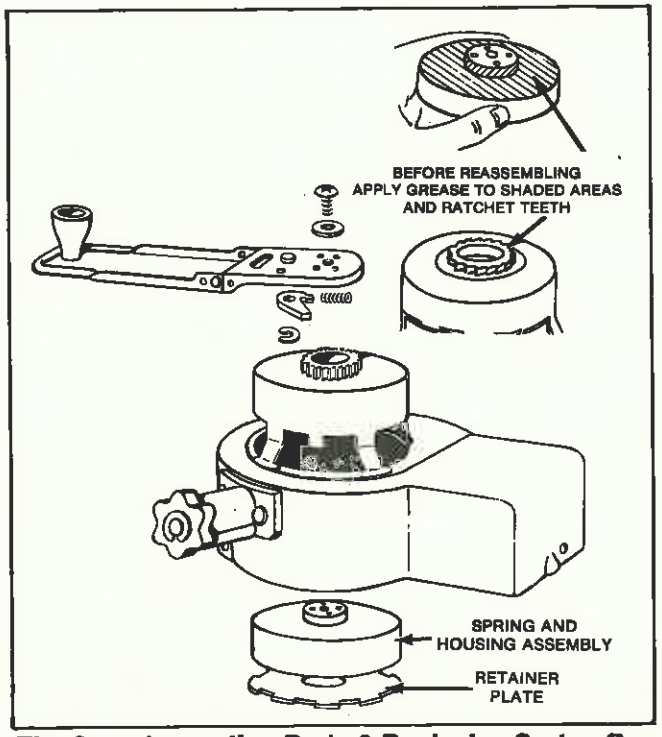

Fig. 24 — Inspecting Parts & Replacing Spring Cup

When re-assembling, be sure to re-install spring washer in housing before placing cup, spring and release assembly into housing. Bend retaining tangs down securely, Fig. 25.

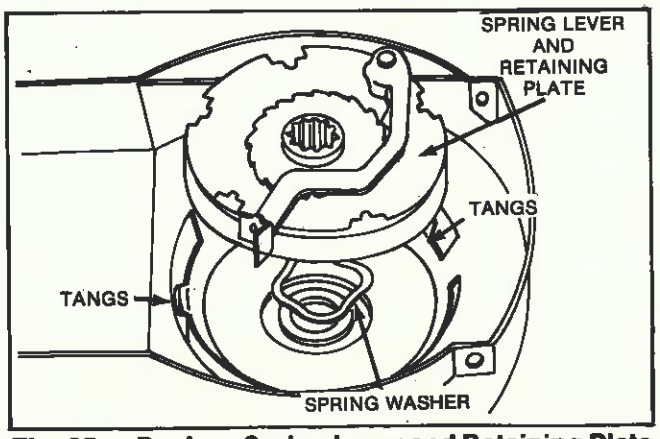

Fig. 25 — Replace Spring Lever and Retaining Plate

VERTICAL PULL STARTER

REMOVING AND INSTALLING A ROPE OR SPRING

Before servicing starter, all tension must be removed from rope.

Use a screwdriver to lift the rope up approximately one foot (304.8 mm). Wind the rope and pulley counterclockwise 2 or 3 turns, as shown in Fig. 26. This will completely release tension from the starter spring.

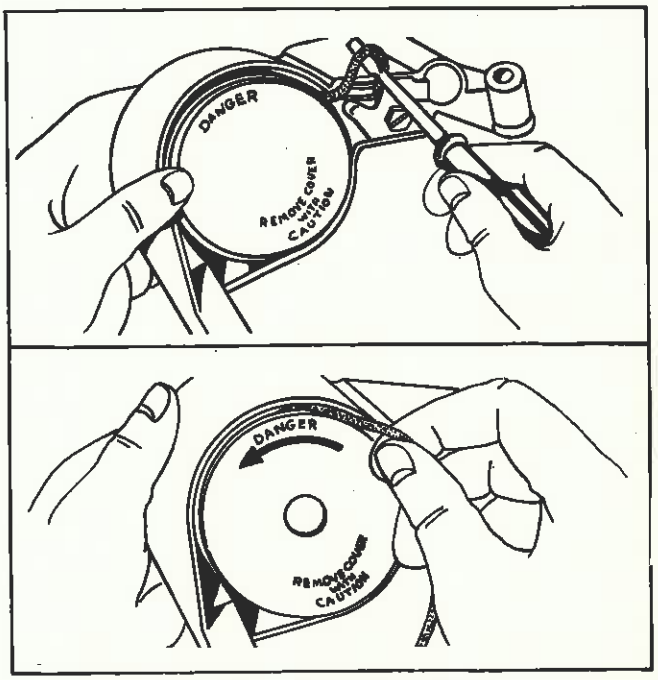

Fig. 26 — Providing Slack

Note the warning on the plastic cover, then use a screwdriver as shown in Fig. 27, to remove the cover.

CAUTION: Do not pull rope with the pulley cover removed, unless the spring is detached from spring anchor.

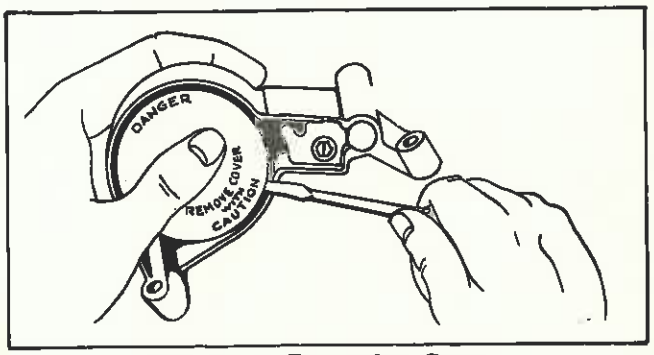

Fig. 27 — Removing Cover

7A

Vertical Pull

Remove anchor bolt and anchor. Fig. 28. Inspect starter spring for kinks or damaged ends. If the starter spring is to be replaced, carefully remove it from the housing at this time.

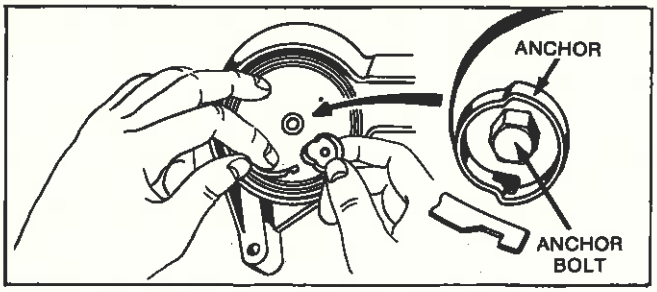

Fig. 28 — Removing Spring Anchor

Remove the rope guide and note the position of the link before removing the assembly from its housing. Fig. 29.

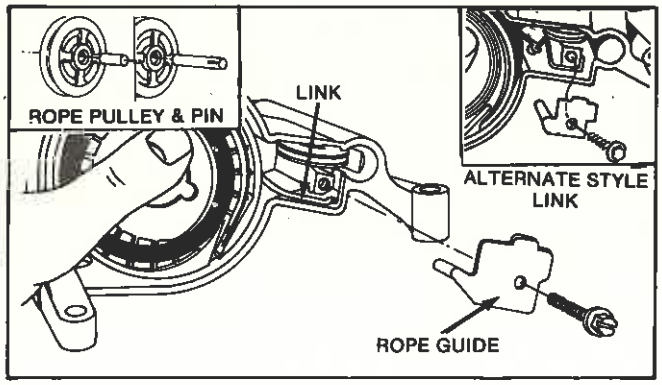

Fig. 29 — Removing Rope Guide

Rope pulley and pin may be replaced if worn or damaged.

Make a rope inserter tool, as shown in Fig. 30. Use the rope inserter tool and/or pliers to remove rope from pulley. Fig. 31 and 32.

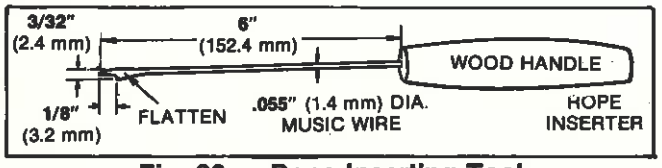

Fig. 30 — Rope Inserting Tool

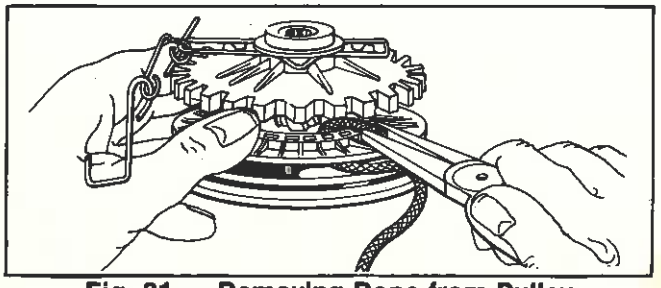

Fig. 31 — Removing Rope from Pulley

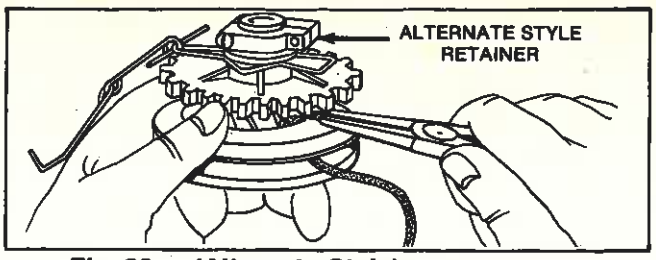

Fig. 32 — (Alternate Style) Removing Rope from Pulley

Remove rope from grip, as shown in Fig. 33.

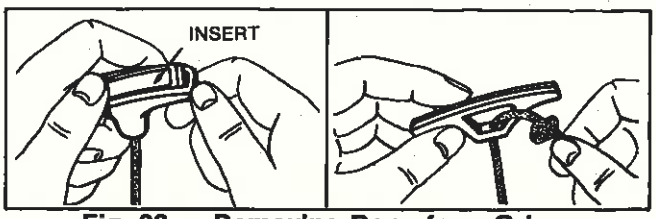

Fig. 33 — Removing Rope from Grip

If pulley or gear is damaged, replace with new assembly.

Clean all dirty or oily parts and check the link for proper friction. The link should move the gear to both extremes of its travel; if not, replace the link assembly. Fig. 34.

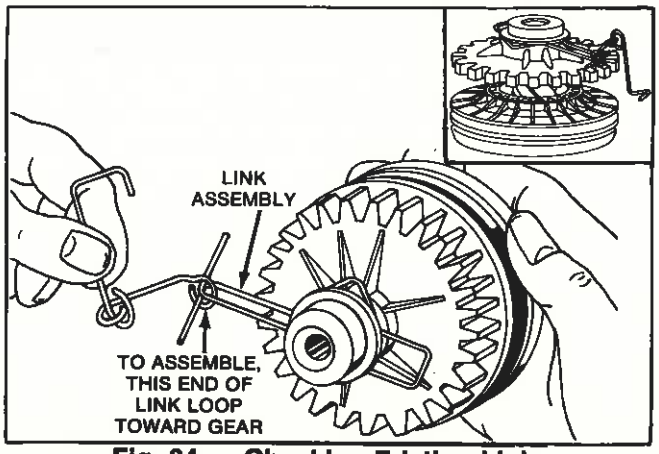

Fig. 34 — Checking Friction Link

NOTE: To repair vertical pull starters with INTERLOCK SYSTEM, follow equipment manufacturers interlock repair procedure.

RE-ASSEMBLY

Install a new spring by hooking end in pulley retainer slot and winding until spring is coiled in the housing. Fig. 35.

NOTE: When installing a new rope, check parts list to be sure correct diameter and length rope is used.

Fig. 35 — Installing Spring

Thread rope through grip and into insert. Tie a small, tight knot. Heat seal the knot to prevent loosening. Pull knot into insert pocket and snap insert into grip. Fig. 36.

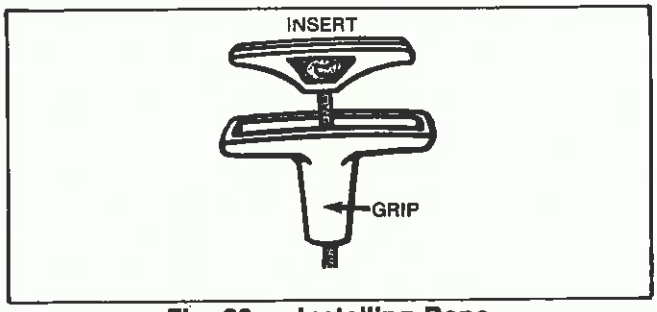

Fig. 36 — Installing Rope

Insert the rope through the housing and into the pulley, using the rope inserter tool. Tie a small knot, heat seal and pull tight into the recess in the rope pulley. Rope must not interfere with gear motion. Fig. 37.

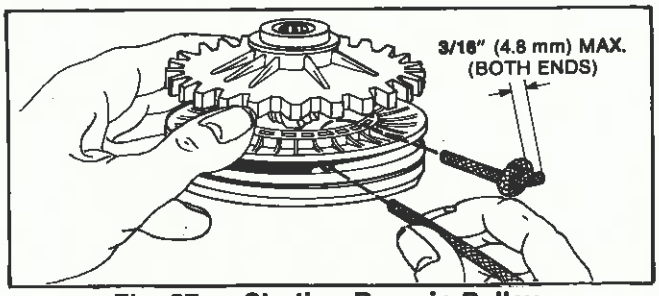

Fig. 37 — Starting Rope in Pulley

Install pulley assembly in the housing, with link in pocket or hole of casting, as shown. Install rope guide. Fig. 38.

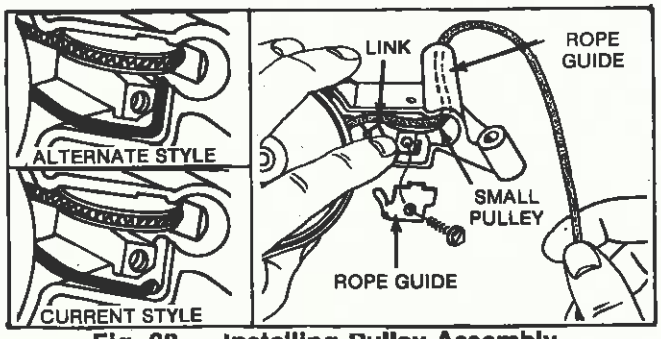

Fig. 38 — Installing Pulley Assembly

Rotate pulley in a counterclockwise direction until the rope is fully retrieved. Fig. 39.

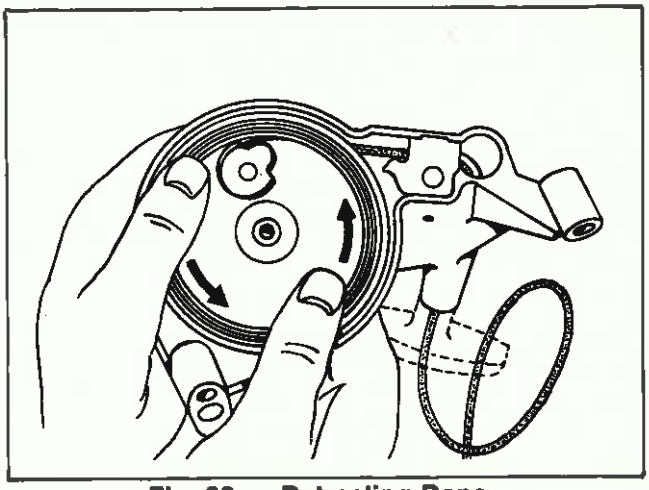
Fig. 39 — Retracting Rope

Hook the free end of spring to spring anchor, and install the screw, torque to 75 to 90 inch pounds (8.5-10.2 Nm). Lubricate spring with a small quantity of engine oil or lubricate. Fig. 40.

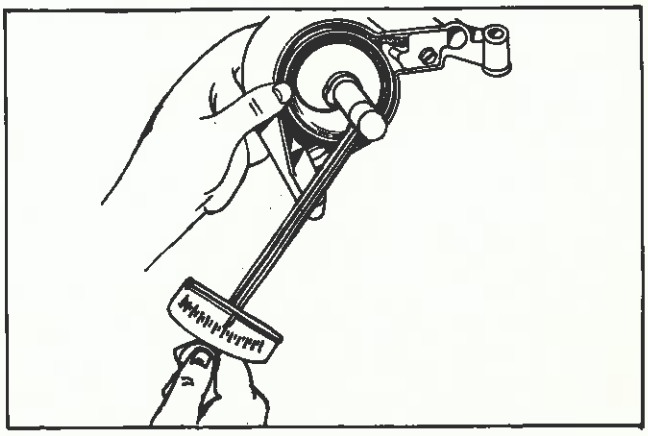
Fig. 40 — Tightening Screw

Snap the cover in place. Wind starter spring by pulling rope out approximately one foot (304.8 mm); wind rope and pulley 2 or 3 turns. clockwise to achieve proper rope tension. Fig. 41.

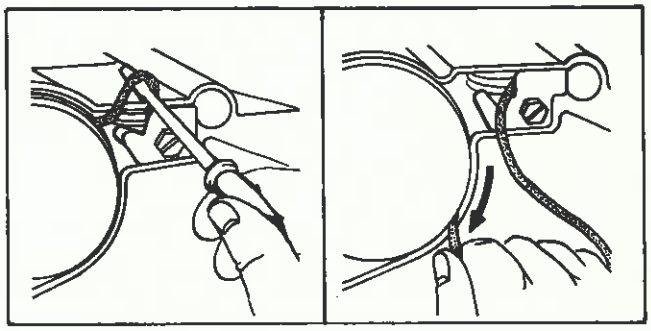
Fig. 41 — Adding Tension to Rope

Equipment to Test Starter Motors

The following equipment is recommended for test and repair of starter motors.

Volt/Ohm/Ampere (VOA) Meter

The suggested VOA meter is available from your Briggs & Stratton source of supply. Order as part No. 19236. The meter may be used to read volts. ohms or amperes when leads are attached to appropriate connector. Fig. 42.

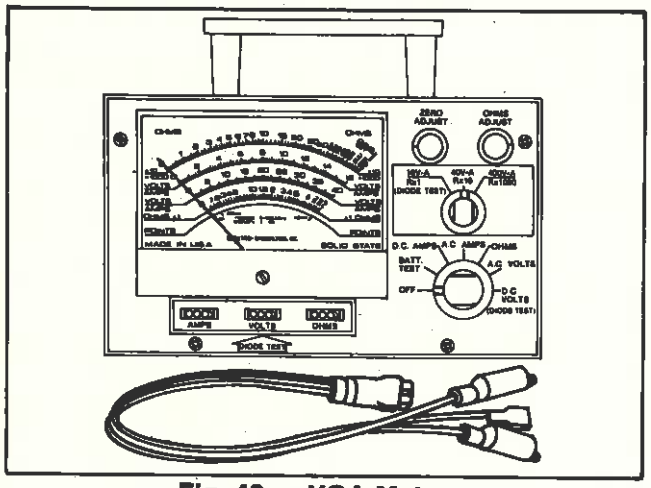

Fig. 42 — VOA Meter

A growler or armature tester is available from an Automobile Diagnostic Service supplier.

A known good 12 volt or 6 volt battery is required for some tests.

A Trysit Sirometer is available from your Briggs & Stratton source of supply. Order as part No. 19200. The Sirometer measures from 800 to 25000 revolutions per minute (RPM). Fig. 43.

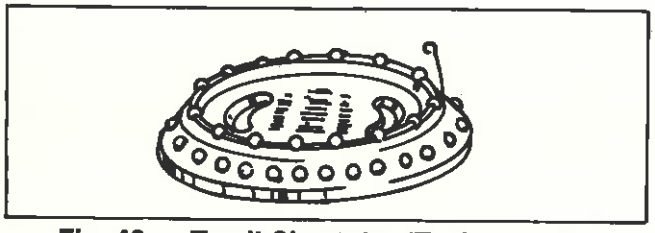

Fig. 43 — Trysit Sirometer (Tachometer)

A starter motor test bracket may be made as shown in Fig. 44.

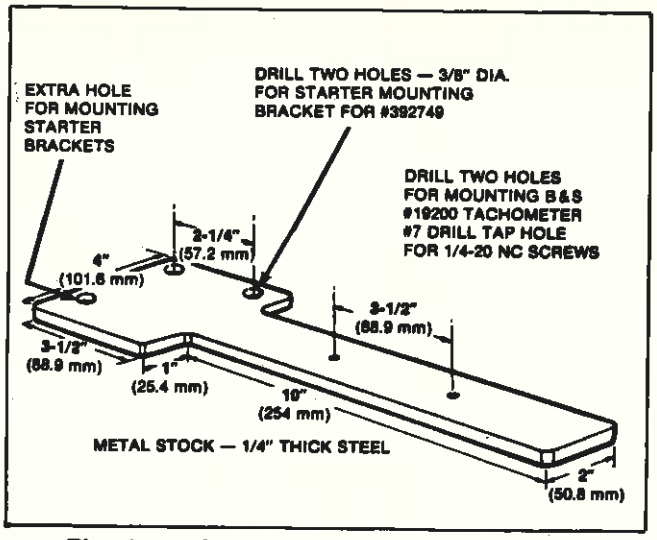

Fig. 44 — Starter Mounting Test Bracket

Brush retainers may be made from scrap pieces of rewind starter spring as shown in Fig. 45. Select the retainer required.

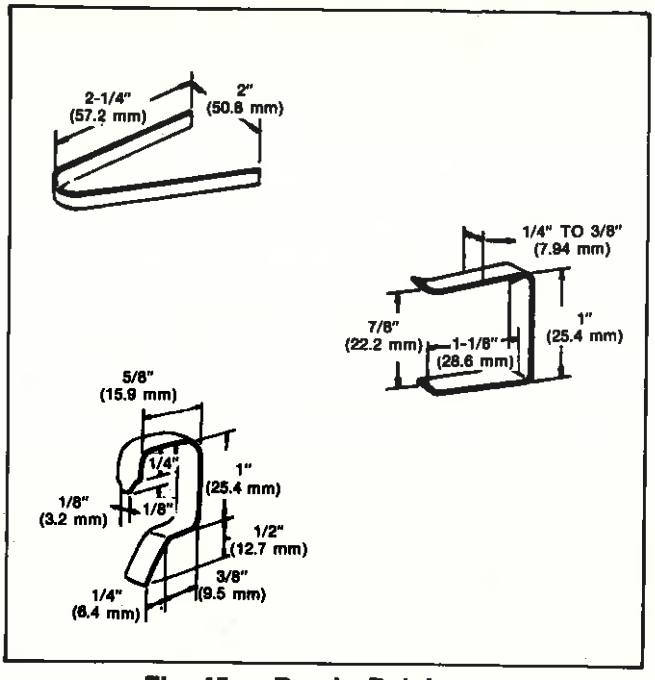

Fig. 45 — Brush Retainers

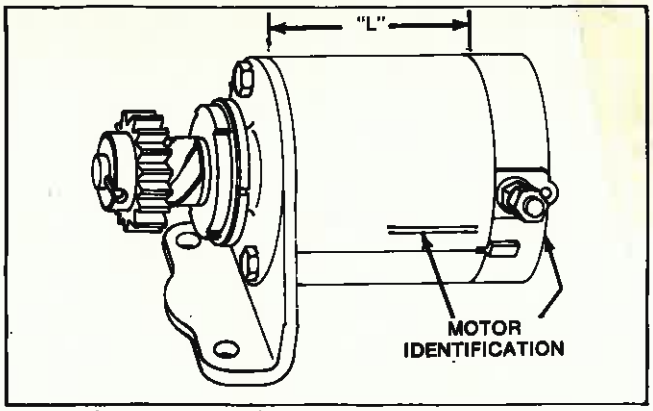

Fig. 46 — Typical 12 VDC Starter Motor

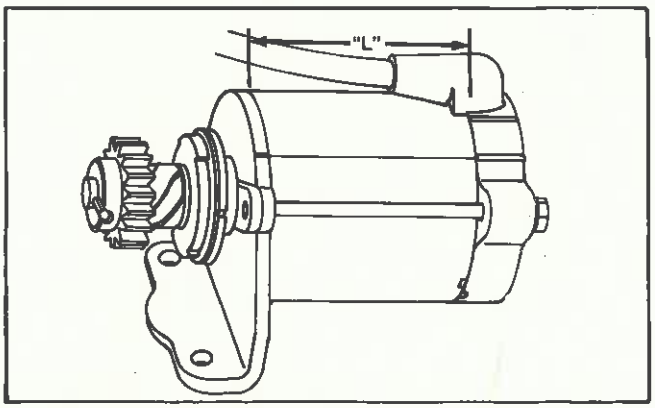

Fig. 47 — Typical 120 VAC Starter Motor

TROUBLESHOOTING 12 VOLT & 120 VOLT STARTING SYSTEMS

The following list is given to aid in diagnosing problems for 12 volt and 120 volt systems.

NOTE: If a starting problem is encountered, the engine itself should be thoroughly checked to eliminate it as the cause of starting difficulty. It is a good practice to check the engine for freedom of rotation by removing the spark plug and turning the crankshaft over by hand, to be sure it rotates freely.

1. Cranks Engine Slowly —

A. Additional load affecting performance (see note).
B. Discharged battery (page 11 and 17).
C. Faulty electrical connection (battery circuit).
D. Discharged battery (see alternators).
E. Dirty or worn starter motor commutator, bearing, weak magnets, etc.
F. Worn brushes or weak brush spring.
G. Wrong oil viscosity for temperature expected.
H. Extension cord longer than 25 feet. (120 volt AC only)

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Manufacturer Name	Motor Identification (Fig. 46 and 47)	Motor Voltage	Page Number
Briggs & Stratton	3-1/16" L	12	23
Briggs & Stratton	3-3/4" L	12	23
Briggs & Stratton	3-1/2" L	120	23
American Bosch	SMH-12-A11	12	30
American Bosch	SME-12-48	12	30
American Bosch	01965-23-MO-30-SM	12	30
American Bosch	SME-110-C3	120	30
American Bosch	SME-110-C6	120	30
American Bosch	SME-110-C8	120	30
American Bosch	06026-28-M030SM	120	30
Mitsubishi	MMO-5ML	12	30
Mitsubishi	MMO-4FL	12	30
Mitsubishi	M001T02271	12	30
Mitsubishi	V282188	120	30
Motor Products	None	12	10

Fig. 48 — Starter Motor Identification

2. Engine Will Not Crank —

A. Faulty safety interlocks.
B. Discharged or defective battery.
C. Faulty electrical connections.
D. Faulty starter motor switch (open circuit).
E. Open circuit in starter motor.
F. Defective rectifier assembly (120 VAC only).
G. Brushes sticking, etc.
H. Faulty solenoid.
I. Power source inoperative (wall outlet - 120 VAC only).

3. Starter Motor Spins; But Does Not Crank Engine —

A. Sticking pinion gear due to dirt.
B. Damaged pinion or ring gear.
C. Battery faulty or damaged.
D. Incorrect rotation due to reversed motor polarity — all motors rotate counterclockwise viewed from pinion gear.

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4. Starter Motor Blows Fuses — (120 Volt Starter Motor Only)

A. Shorted starter motor switch.
B. Shorted rectifier assembly.
C. Shorted 120 volt extension cord to starter motor.
D. Armature shorted.
E. Overloaded circuit.

5. Starter Motor Spins; Will Not Stop

A. Defective starter switch.

NICKEL-CADMIUM STARTING SYSTEM SERIES 92000 and 110900 ENGINES

This Briggs & Stratton starter system consists of a starter motor and a starter switch, a wiring harness and a nickel cadmium rechargeable battery and battery charger. When the ignition key is turned to START, the battery supplies power to the starter motor, cranking the engine similar to the system used in an automobile. Under normal conditions, the battery will provide 40 to 60 starts before recharging is necessary.

NOTE: Some equipment manufacturers use a battery and charger of a different style than illustrated. In such cases, follow the equipment manufacturer's recommendations.

When the battery needs recharging, the charger is plugged into a 120 volt AC household outlet, and then connected to the battery. The battery will be fully charged within a 14 to 16 hour period. It is not recommended the battery be recharged if temperatures are below 40° F (4° C). Continual charging may be harmful to this battery. For best results, charge the battery within temperature limits of 40° F (4° C) to 105° F (40° C) and after each use of equipment. When long periods of storage are encountered, the battery should be charged over night every two months. This type of battery will lose its charge when not in use. This will shorten battery life.

NOTE: The battery is shipped in a discharged state and must be charged 14 to 16 hours prior to its initial use.

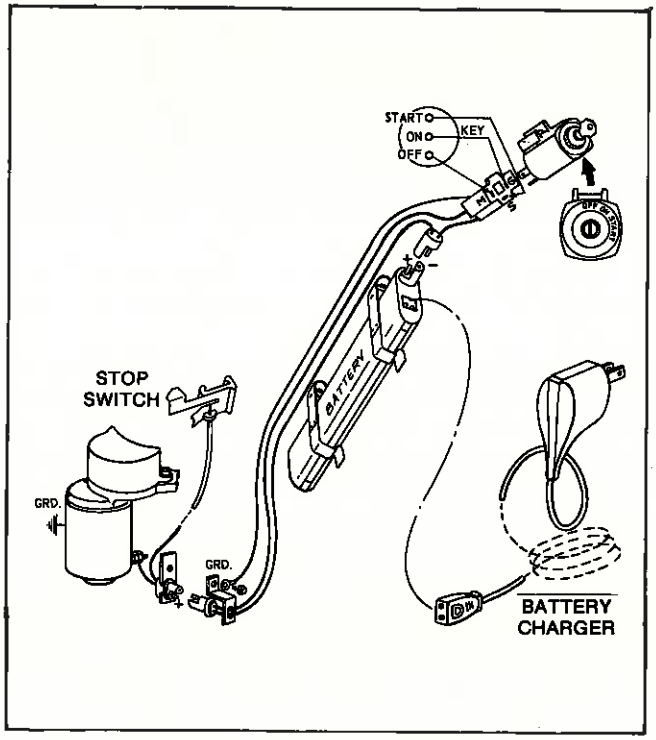

Fig. 49 — Wiring Diagram

NOTE: If a starting problem is encountered, the engine itself should be thoroughly checked to eliminate it as the cause of starting difficulty. It is a good practice to check the engine for freedom of rotation by removing the spark plug and turning the crankshaft over by hand, to be sure it rotates freely.

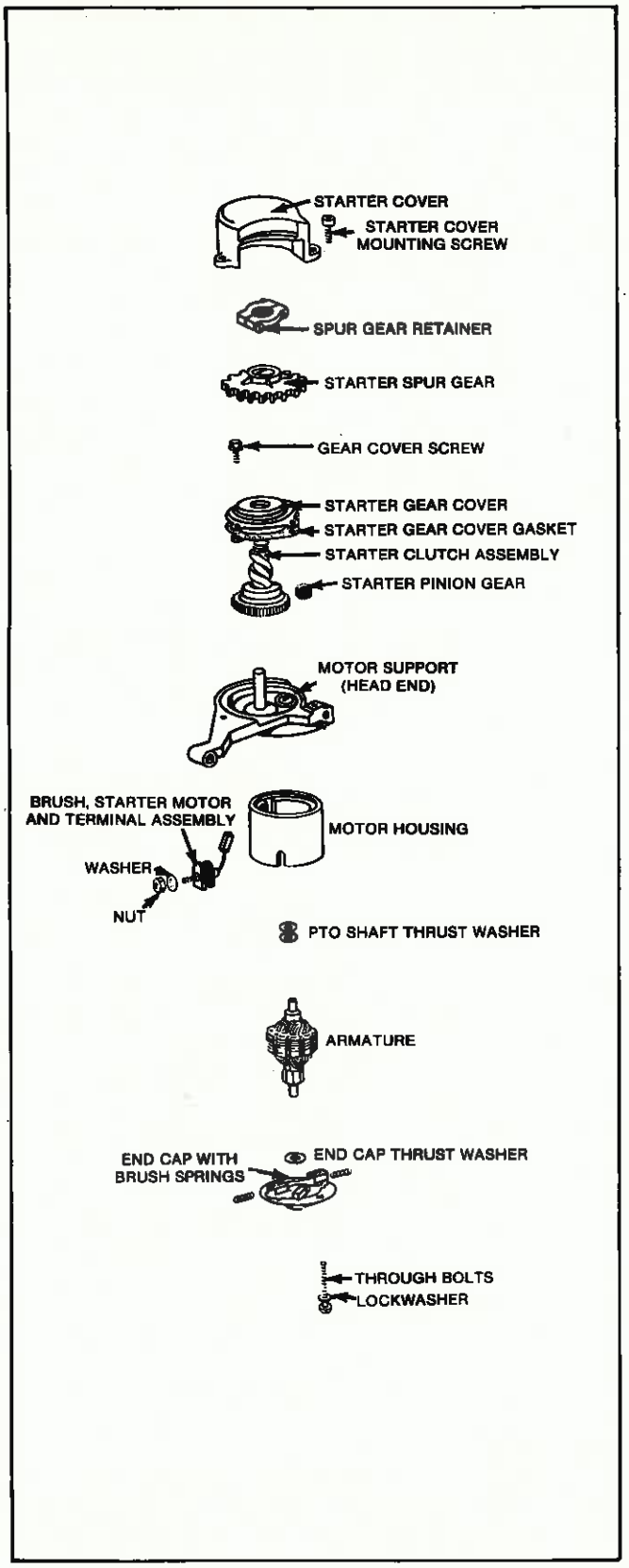

Fig. 50 — Exploded View

The following list is provided to aid in diagnosing problems.

1. **Cranks Engine Slowly —**
   - A. Additional starting load affecting performance. See Note, page 10.
   - B. Battery discharged. See Fig. 51.
   - C. Faulty battery charger. See Fig. 52.
   - D. Poor electrical connection (wiring harness). See Fig. 49.
   - E. Starter motor clutch slipping. See page 13.
   - F. Brushes sticking in brush holders or worn brushes. See Fig. 58.
   - G. Dirty or worn starter motor commutator. See page 14 and 15.
   - H. Weak magnets.
2. **Engine Will Not Crank —**
   - A. Discharged or faulty battery. See page 12.
   - B. Faulty wiring harness (open circuit). See Fig. 49.
   - C. Faulty starter switch (open circuit). See Fig. 53.
   - D. Open circuit in starter motor itself. See page 13.
   - E. Brushes sticking, etc. See Fig. 58.
3. **Starter Motor Spins; But Does Not Crank Engine —**
   - A. Sticking nylon spur gear, due to dirt. See page 13.
   - B. Damaged pinion or starter clutch gear. See page 13.
   - C. Starter motor clutch slipping. See page 13.
   - D. Incorrect rotation due to reversed motor polarity — all motors rotate counterclockwise at the pinion gear.

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TESTING THE NICKEL CADMIUM BATTERY AND CHARGER

The following paragraphs describe an inexpensive battery load tester and a battery charger tester which may be easily constructed.

BATTERY TESTER

Parts Needed

1. Two GE sealed beam headlight bulbs #4001.
2. Briggs & Stratton VOA meter; page 8 or use a 0 to 15 volt DC voltmeter.
3. Two #70 Miller alligator clips, with #62 insulators, or a battery connector plug from a wiring harness.

Solder the two headlights together with wires, and connect the voltmeter as shown in the accompanying illustration. Fig. 51.

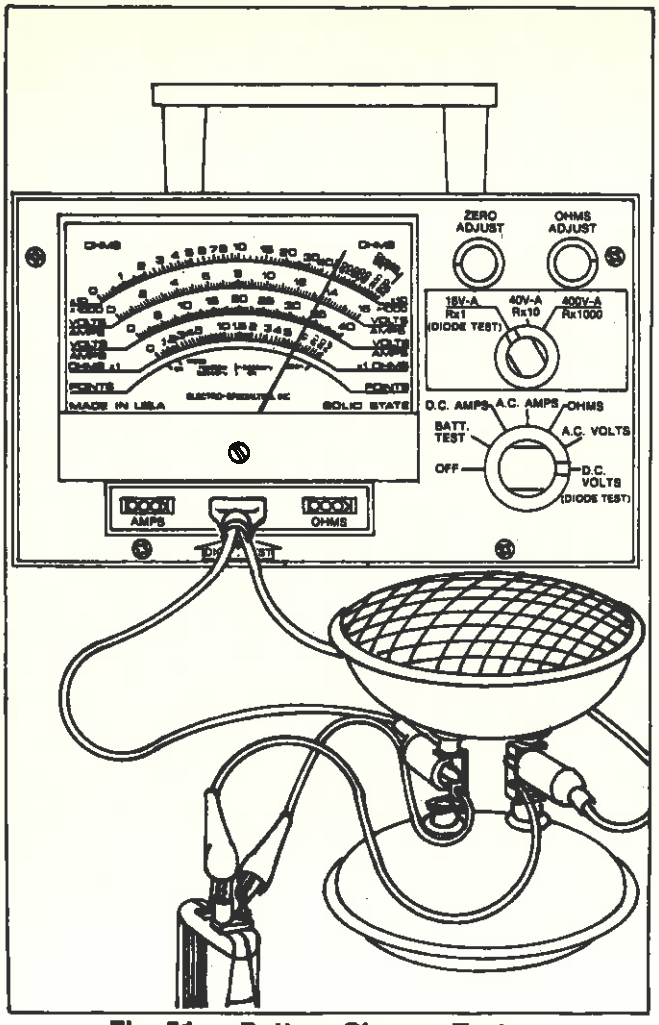


Fig. 51 — Battery Charger Tester

A fully charged battery, when connected to this headlight set up will light the bulbs brightly for at least five minutes. The voltmeter reading should be 13.5 volts minimum after one minute, using the headlight load. A voltmeter reading of 13 volts, or less, within a one minute period indicates a defective cell in the battery. Replace battery.

NOTE: The battery must be in a fully charged condition, prior to the above test. If the battery is not fully charged, it will require charging for a 14 to 16 hour period before proceeding with the above test. This voltmeter test is valid only after a one minute period, when using the lights as a load, because the voltage continues to drop slowly throughout most of the test.

BATTERY CHARGER TESTER

The parts needed to construct a battery charger tester are as follows. (See following for parts ordering information.)

1. One IN4005 diode.
2. Two lamp sockets, such as a Dialco #0931-102, red color and a #0932-102, green color.
3. Two #53 bulbs.
4. One #6-32, 3/4" long screw (m3.5 x 0.6).
5. One #3-48, 3/4" long screw (m2.5 x 0.45).

These components are soldered together as shown in the accompanying illustration, Fig. 52. if desired, these components may be fitted to a plastic case.

The test procedure is as follows:

Plug the charger into a 120 volt AC outlet, known to be good, connect the other end of the charger to the tester.

A charger in good condition will light the green bulb only.

If neither bulb lights, or both bulbs light, the charger would be defective.

NOTE: The component parts for this tester may be purchased at any radio supply parts house.

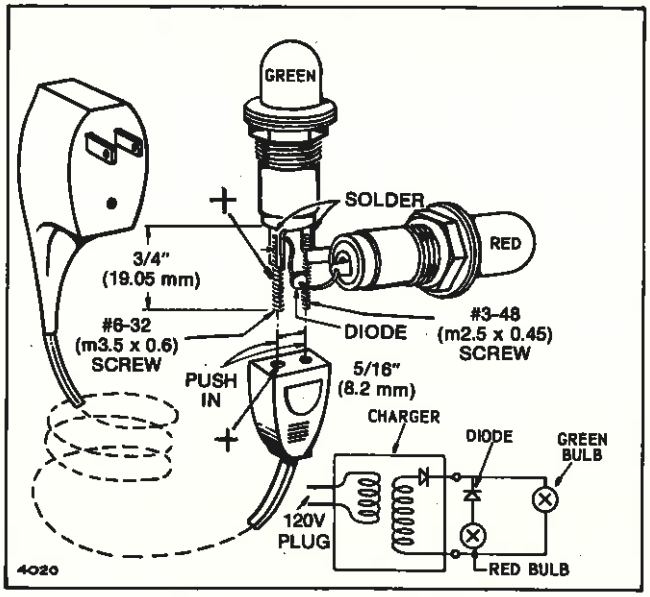
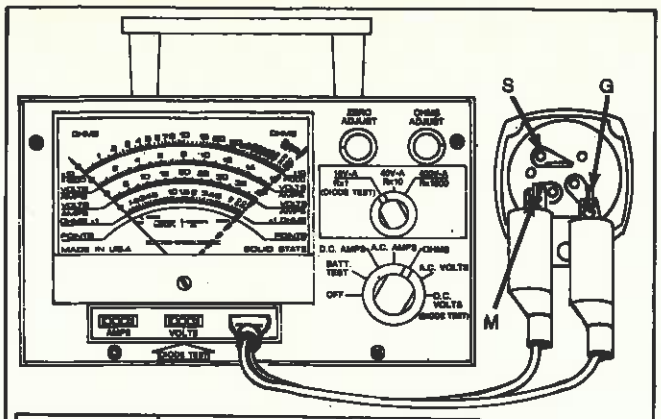


Fig. 52 — Battery Tester

KEY SWITCH TEST

The equipment needed to test the key switch is as follows: Briggs & Stratton meter #19236 or equivalent ohmmeter.

Test key switch as noted in Fig. 53. Replace switch if not as shown under column, "Check Continuity."



KEY POSITION	CHECK CONTINUITY	SCALE READING
OFF	G-M	0
ON	M-S (NONE)	INF.
START	G-S	0

NOTE: Check combinations of G, M & S in each key position.

G = GROUND
M = MAGNETO
S = STARTER

Fig. 53 — Starter Key Switch

CHECKING THE STARTER MOTOR DRIVE AND CLUTCH

When the starter switch is activated, the nylon spur gear should rise, engaging the flywheel ring gear, and crank the engine. This action can be observed by removing the starter cover. If the starter motor drive does not react properly, inspect the helix and the nylon spur gear for freeness of operation. If any sticking occurs, this must be corrected. Proper operation of the starter is dependent on the nylon spur gear freely moving on the helix. See Fig. 54.

NOTE: Do not oil nylon spur gear or clutch helix.

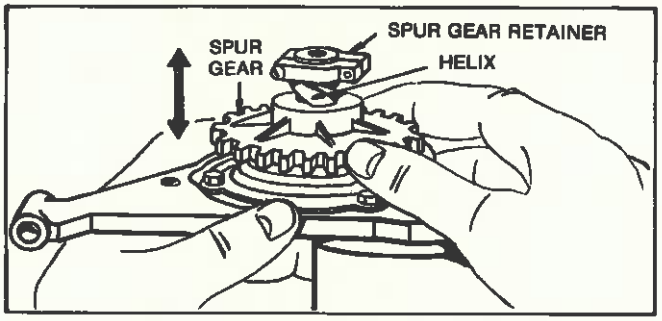


Fig. 54 — Starter Motor Drive

The starter motor clutch is designed to prevent damage from shock loads such as an engine backfire. The clutch should not slip during normal engine cranking. This can be checked by blocking the mower blade and engaging the starter motor. If the clutch assembly slips at this time, it should be replaced.

CAUTION: Remove spark plug high tension wire prior to this test if starter motor is mounted on engine.

CHECKING THE STARTER MOTOR

A performance test of the starter motor may be made in the following manner.

Equipment Needed —

A tachometer capable of reading 1500 RPM.
An ammeter capable of reading 0 to 5 amps.
A fully charged battery.

Connect the starter motor, battery and ammeter, as shown in the illustration. See Fig. 55.

Insert the tachometer in the end of the starter clutch helix and activate the starter motor.

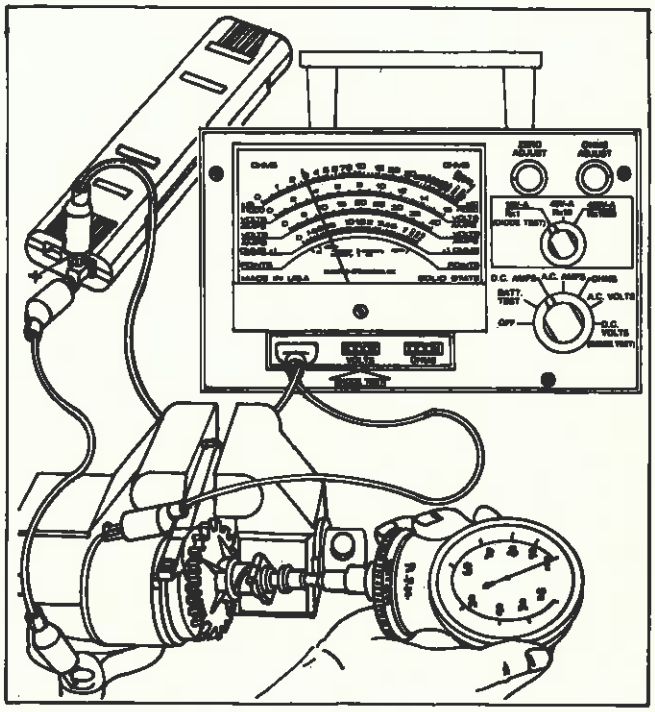


Fig. 55 — Performance Test

A starter motor in good condition will be within the following specifications.

Starter Motor RPM — 1000 minimum
Current — 3½ Amperes maximum

If the starter motor does not perform satisfactorily, the following should be checked, and corrected if necessary.

1. A binding condition between the pinion and clutch gear or mis-alignment of motor bearings.

2. Starter motor brushes sticking in brush holders.
3. A dirty or worn armature commutator.
4. A shorted, open or grounded armature.
   A. Shorted armature (worn insulation, wires touching each other) will be indicated by slow speed and high current.
   B. Open armature (broken wire) may not turn or will have low RPM.
   C. Grounded armature (worn insulation, wire touching armature) will not turn or may turn slowly and will have excessive current (amperes).
5. Weak magnets.

DISASSEMBLY OF STARTER MOTOR

Study Fig. 50 prior to Starter Motor Disassembly.

Remove the starter cover, nylon spur gear retainer and the nylon spur gear. The three screws holding the gear cover and the gear itself may now be removed. Lift the clutch assembly and the pinion gear off their respective shafts.

Remove the starter motor thru bolts. Separate motor end head from motor housing. Fig. 56. Push motor armature out through bottom of starter housing, taking care to slide rubber mounted terminal out of motor housing along with end cap. Fig. 57.

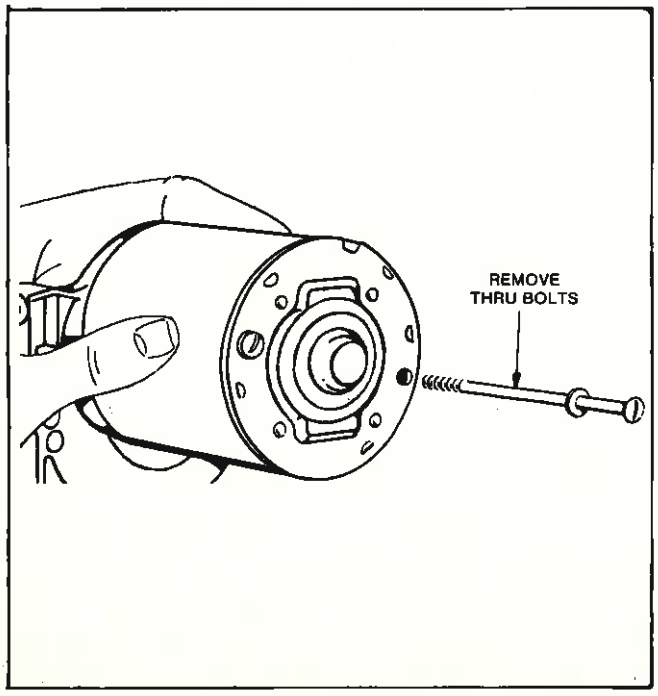


Fig. 56 — Removing Thru Bolts

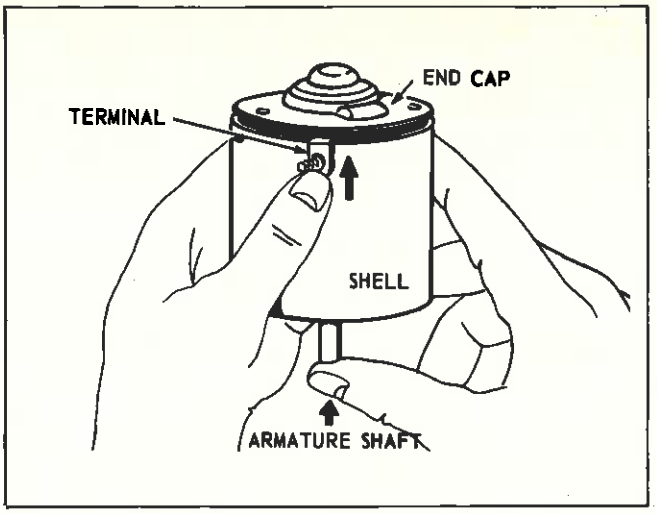


Fig. 57 — Removing Armature

Before removing armature from end cap, check brushes for freedom of movement. If brushes are found to be sticking in their retainers, this must be corrected, or poor starter motor performance will result. Fig. 58. If brushes are worn to a length of 1/4" (6.4 mm) or less, the brushes should be replaced. Check brush springs for proper tension (sufficient force to keep brush in firm contact with commutator).

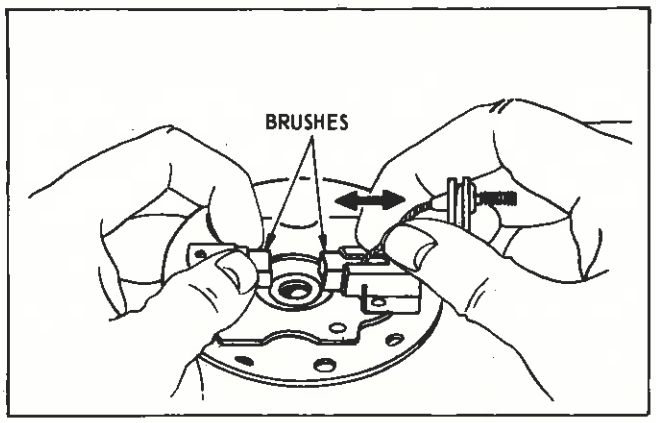


Fig. 58 — Checking Brushes

Clean all dirt accumulations from armature, end cap, motor support, gears, etc. The end cap bearings and armature should not be soaked in a solvent. The armature commutator may be cleaned with a fine sandpaper or commutator paper. Do not use aluminum oxide paper or emery cloth, as emery will embed in the commutator and cause rapid brush wear.

If the armature is suspected to be defective, a new armature should be tried in the motor. If proper testing equipment is available, check the suspected armature to determine if it is defective.

Starter motor armatures have very low resistance. Usually below detection on available multimeters (volts - amperes - ohms). To check for shorted armatures, a piece of equipment known as a "growler" may be used. If this equipment is not available, a known good armature should be used and performance checked.

If the magnets are suspect, a new motor housing should be tried to test motor performance.

ASSEMBLY OF STARTER MOTOR

When all parts have been thoroughly inspected, lightly lubricate bearings with a #20 oil and reassemble in the following manner.

Insert brush springs and brushes in holders as far as possible, and hold them in this position with tool shown in Fig. 59. Place thrust washers on armature shaft, using care to insure brushes clear commutator, slide armature shaft into end cap bearing. See Fig. 59.

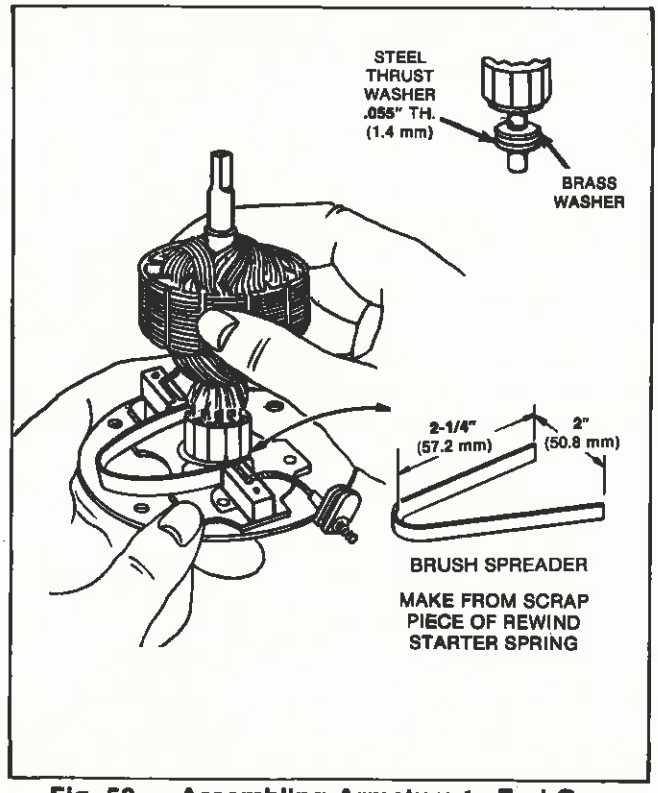


Fig. 59 — Assembling Armature to End Cap

Support armature shaft and slide it slowly into starter housing, as shown in Fig. 60. Insert rubber mounted terminal into starter housing at this time.

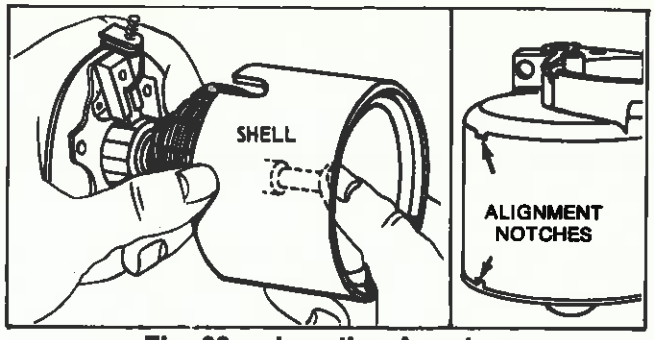


Fig. 60 — Inserting Armature

Place remaining thrust washers on motor PTO shaft, install end head cover and thru bolts. Notches in end cap, housing and end head must be aligned. Fig. 60. Check for end play to be sure armature is free. Slip pinion and starter motor clutch gear on shaft, add a small amount of gear lubricant to gears and install gear cover and gasket. Fig. 61.

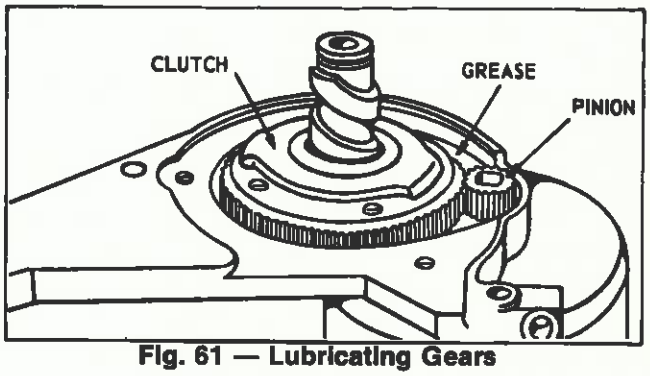


Fig. 61 — Lubricating Gears

Tap end cap edge lightly using a soft hammer as this will align the bearings. See Fig. 62.

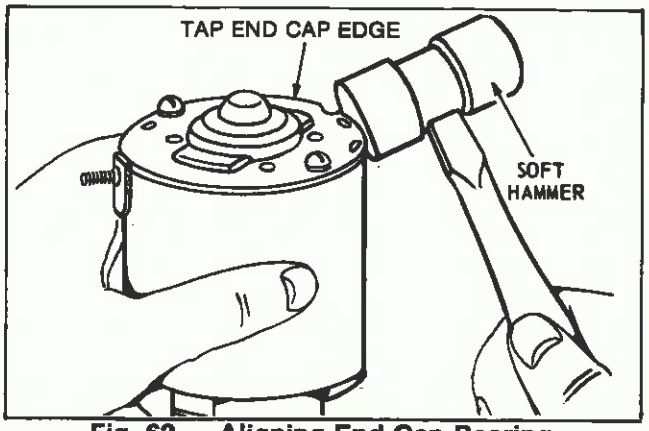
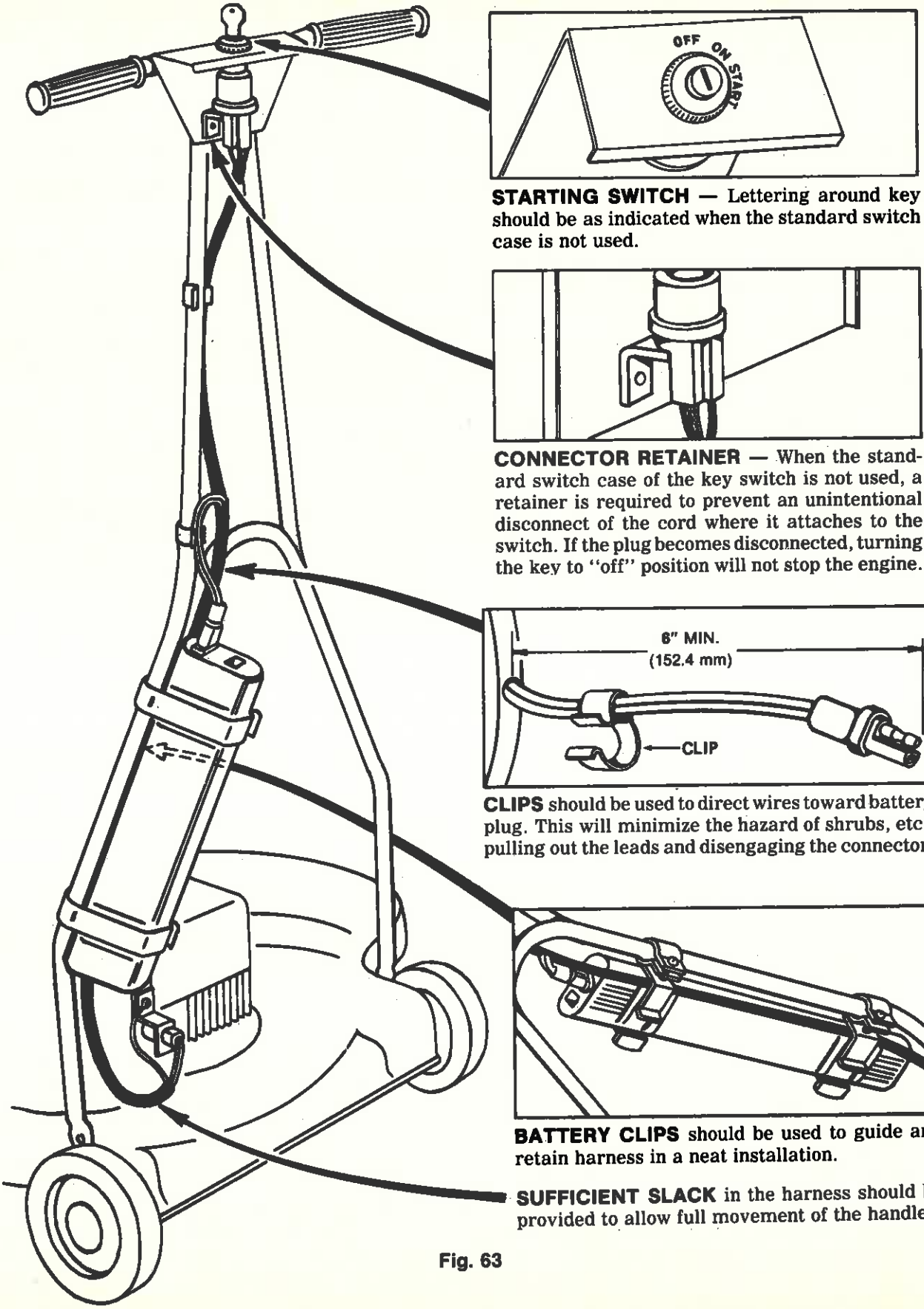


Fig. 62 — Aligning End Cap Bearing

Replace nylon spur gear and retainer assembly, tighten retainer screws securely. NOTE: Do not oil nylon spur gear or clutch helix. Install starter cover. The starter motor assembly is now ready for re-installation to the engine.

ELECTRIC STARTER KEY SWITCH AND WIRING RECOMMENDATIONS

FOR 12 VOLT NICKEL CADMIUM BATTERY STARTING SYSTEM — SERIES 92000 AND 110900 ENGINES



STARTING SWITCH — Lettering around key should be as indicated when the standard switch case is not used.

CONNECTOR RETAINER — When the standard switch case of the key switch is not used, a retainer is required to prevent an unintentional disconnect of the cord where it attaches to the switch. If the plug becomes disconnected, turning the key to "off" position will not stop the engine.

CLIPS should be used to direct wires toward battery plug. This will minimize the hazard of shrubs, etc., pulling out the leads and disengaging the connector.

BATTERY CLIPS should be used to guide and retain harness in a neat installation.

SUFFICIENT SLACK in the harness should be provided to allow full movement of the handle.

Fig. 63

The battery used to operate starter motors on most Briggs & Stratton engines above 4 horsepower, is of the 12 volt, lead acid — wet cell type. This type is available as a wet charge or dry charge battery.

The wet charged maintenance-free battery is filled with electrolyte at the time of manufacture. The level of electrolyte can not be checked.

The dry charge battery is manufactured with fully charged plates. Electrolyte must be added at the time that the battery is placed in service. Before activating a dry charge battery, read and follow the manufacturer's recommended procedure. Fig. 66.

BATTERY GAS IS EXPLOSIVE. DO NOT store, charge or use a battery near an open flame or devices which utilize a pilot light or can create a spark.

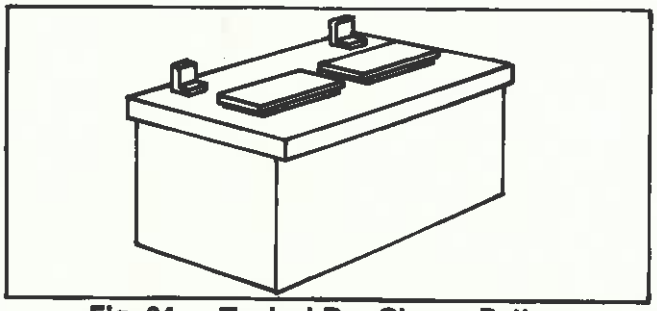


Fig. 64 — Typical Dry Charge Battery

Installation:

1. Before installing battery, connect all equipment to be operated.
2. Place battery in holder with a flat base. Tighten hold downs evenly until snug. DO NOT overtighten.
3. Connect positive terminal to positive post FIRST to prevent sparks from accidental grounding. Tighten connectors securely.
4. Connect negative terminal to negative battery terminal. Tighten connectors securely.

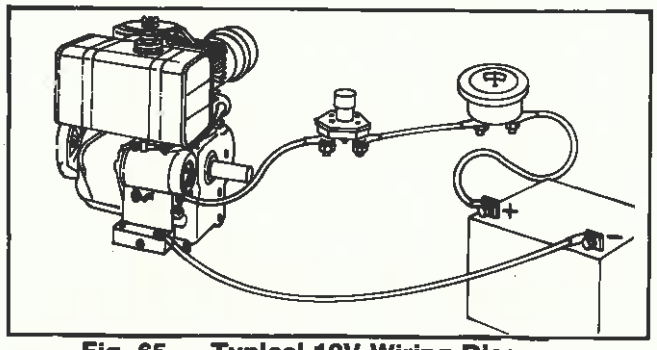


Fig. 65 — Typical 12V Wiring Diagram

Checking Battery

1. Physical check — clean if necessary.
   A. Corrosion
   B. Dirt
   C. Terminal and clamps (secure — good conditions)
2. Bring battery to full charge.

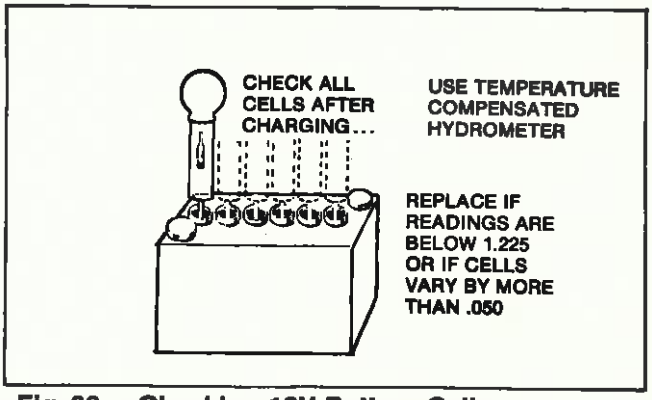


Fig. 66 — Checking 12V Battery Cells (Lead Acid — Wet Cell — Dry Charge)

DANGER: DO NOT EXCEED CHARGE RATE OF 1/10 AMPERE FOR EVERY AMPERE OF BATTERY RATING. Consult battery manufacturer for maximum charge recommendations.

7 B

   A. Use a taper charger (automatically reduces charge rate).
   B. Fill battery cells with distilled water or tap water after charging (for batteries that have been in service).

NOTE: If battery gets "Hot" to the touch or is spitting acid (gassing) excessively, unplug charger periodically.

3. With battery fully charged, check specific gravity readings of each cell with a Battery Hydrometer and record readings (Fig. 66).
   All readings should be above 1.250 (compensating for temperature). If specific gravity readings varied .050 or if ALL cells read less than 1.225, replace battery.
   Attach voltmeter clips to the battery posts, positive lead (+) to positive post of battery, negative lead (-) to negative post of battery.
   With ignition switch "Off" press starter button. If ignition switch and starter switch are the same switch, disconnect spark plug lead from plug and turn switch to "Start."
   Voltmeter should read 9 volts or more while cranking engine. If less than 9 volts, replace battery.

STARTERS
Gear Drive 12V & 120V

GEAR DRIVE STARTER MOTOR USED ON MODEL 130000

This starting system incorporates a permanent magnet motor and back gearing. A gear type engagement method similar to an automobile starter is used. When the starter motor is activated, the helix on the back gear shaft drives a pinion gear into engagement with a ring gear attached to the engine flywheel and cranks the engine.

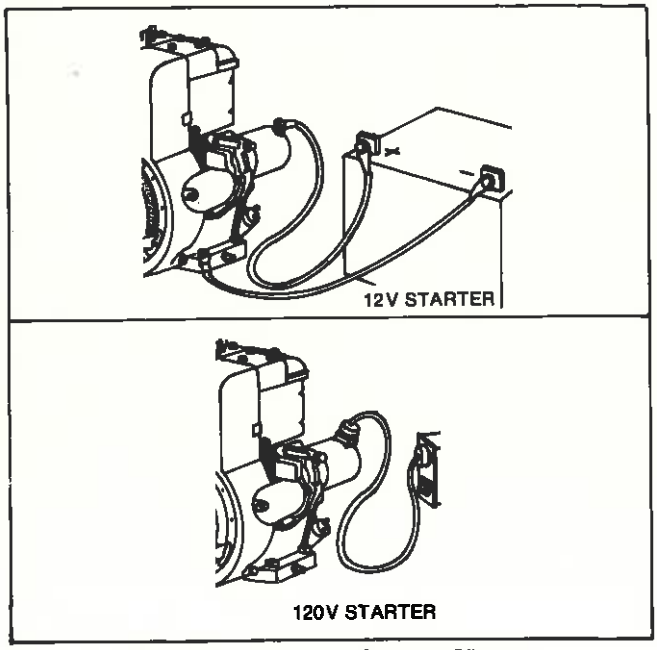


Fig. 67 — Typical Starter Motors

A LIST IS GIVEN TO AID YOU IN DIAGNOSING PROBLEMS FOR 12 VOLT AND 120 VOLT SYSTEMS. SEE PAGE 9.

The service procedures for both the 12 volt and 120 volt starter motors are similar and will be covered together except where noted otherwise.

The 120 volt electric starter is equipped with a three-prong plug for safety. The longer prong in this plug is connected to the starter motor housing. When the starter motor is plugged into the three-wire cord supplied, and the cord is plugged into a properly grounded receptacle, it will protect the user from shock should the starter-motor insulation fail for any reason. If a longer extension cord is used with this starter, it should also have three-prong and three-hole plugs. Fig. 68.

CAUTION: 120 volt starter motor should be Hi-Pot tested before reassembly to engine to determine if a shock hazard exists.

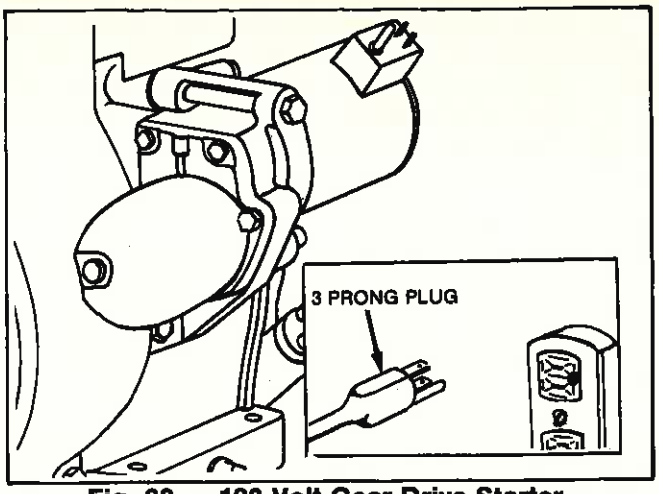


Fig. 68 — 120 Volt Gear Drive Starter

CAUTION: DO NOT run starter motor for more than one minute without cooling 15 minutes.

A 12 ampere hour battery is suggested for warm temperature operation and a 24 ampere hour battery should be used in cold service. See page 17.

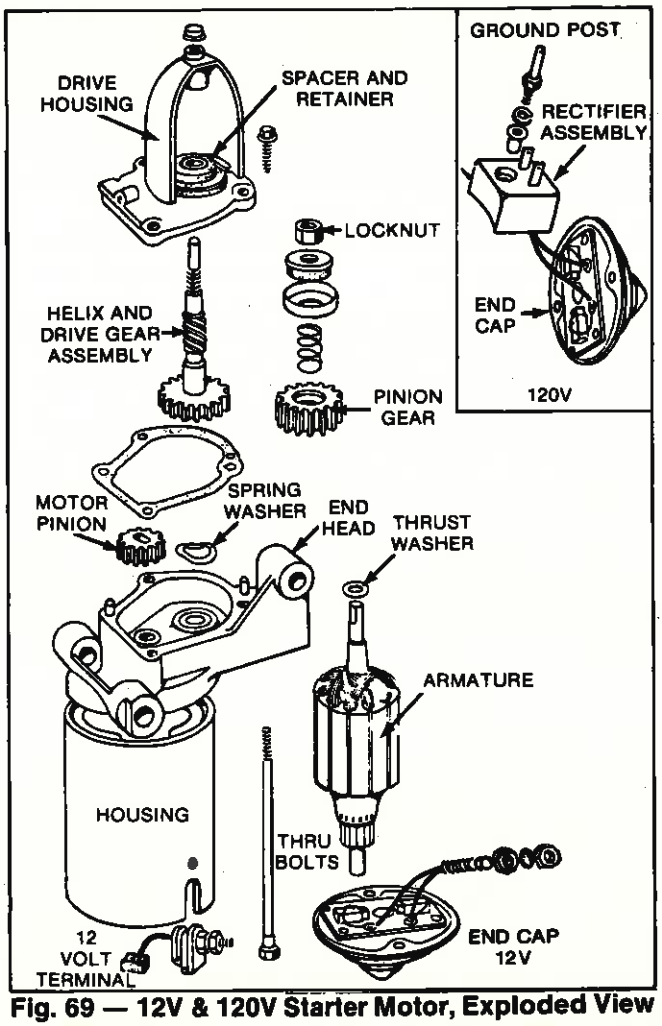


Fig. 69 — 12V & 120V Starter Motor, Exploded View

NOTE: If a starting problem is encountered, the engine itself should be thoroughly checked to eliminate it as the cause of starting difficulty. It is a good practice to check the engine for freedom of rotation by removing the spark plug and turning the crankshaft over by hand, to be sure it rotates freely.

CHECKING STARTER MOTOR DRIVE

When the starter motor is activated, the pinion gear should rise, engaging the flywheel ring gear, and crank the engine. This action can be observed by removing the starter motor. If the starter motor drive does not react properly, inspect the helix and pinion gear for freeness of operation. If any sticking occurs, this must be corrected. Proper operation of the starter is dependent on the pinion gear freely moving on the helix. See Fig. 70.

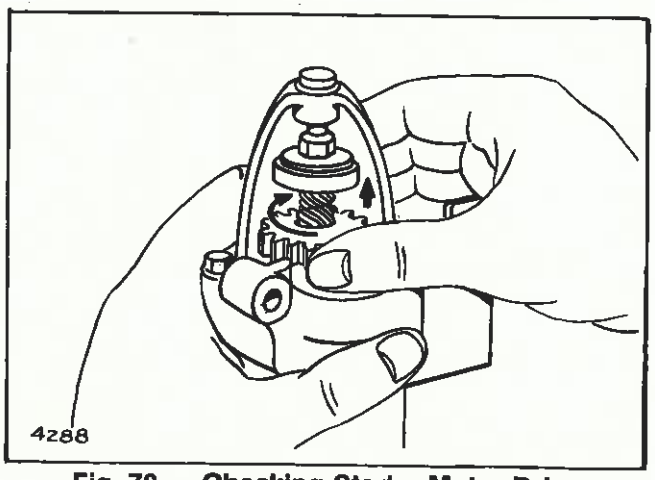


Fig. 70 — Checking Starter Motor Drive

DISASSEMBLY OF STARTER MOTOR DRIVE

Remove drive housing from end head. Fig. 69.

To remove the drive gear assembly for cleaning or replacement, clamp the drive gear in a vise having brass jaws, to prevent damage to the gear teeth. The lock nut may then be removed and the starter drive disassembled for cleaning or replacement.

The pinion gear should be inspected for damaged teeth. If a sticking condition exists between the pinion gear and the helix, the parts may be washed in a solvent such as Stanisol or Varsol. If the sticking condition is not corrected by cleaning, the complete drive assembly must be replaced. Individual parts of the drive assembly are not available.

ASSEMBLING STARTER MOTOR DRIVE

Reversing disassembly procedure for assembling. See Fig. 71. Use care to insure drive spacer and retainer are correctly positioned in drive housing. Note: Do not lubricate drive assembly. A dry silicone spray may be used if necessary.

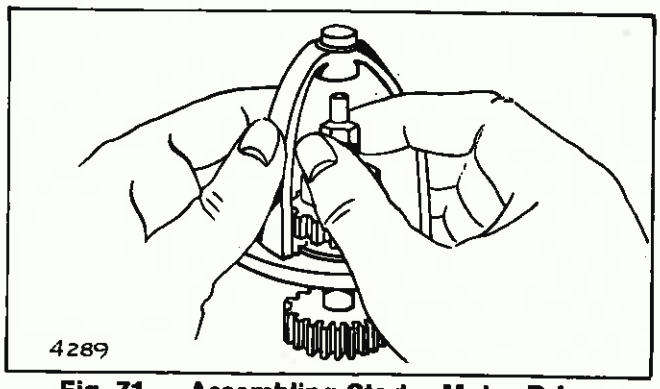


Fig. 71 — Assembling Starter Motor Drive

CHECKING 12 VOLT DC MOTORS

A performance test of the 12 volt starter motor may be made in the following manner.

Equipment Needed —

1. A tachometer capable of reading 10,000 RPM.
2. A 12 volt battery ± 0.3 volts.
3. An ammeter capable of reading 25 amperes.

Connect the starter motor, battery and ammeter as shown on the accompanying illustration. Fig. 72.

NOTE: To test starter motor ON ENGINE, refer to Briggs & Stratton #19236 VOA meter Instruction Manual.

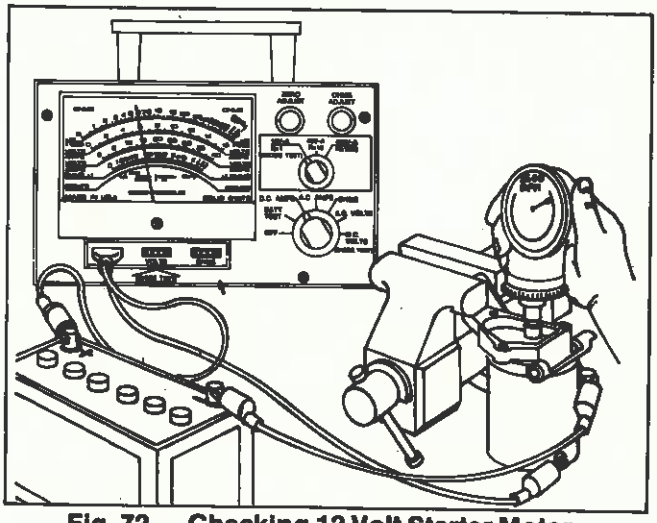


Fig. 72 — Checking 12 Volt Starter Motor Performance

7 B

Insert the tachometer in the end of the starter motor shaft and activate the starter motor. A starter motor in good condition will be within the following specifications.

1. Starter motor RPM — 5,600 minimum.
2. Current — 6 amperes maximum (disregard surge current)

CHECKING THE 120 VOLT AC STARTER MOTOR

A performance test of the 120 volt starter motor may be made in the following manner.

Equipment Needed —

1. A tachometer capable of reading 10,000 RPM.
2. An ammeter capable of reading 0 to 10 amperes AC (RMS).

DANGER: The performance test of this starter requires the use of an ammeter, connected in the 120 volt AC starter motor circuit. Extreme care should be used in making this test to minimize the hazard of electrical shock.

7 B

Clamp the starter motor in a vise as shown. An ammeter may be connected as shown in the accompanying illustration. Fig. 73. Plug the electrical cord into a 120 volt outlet and insert the tachometer in the end of the starter motor shaft.

CAUTION: Starter motor housing contains two powerful ceramic magnets that may crack if motor housing is clamped in a vise or struck with a hammer or a hard object.

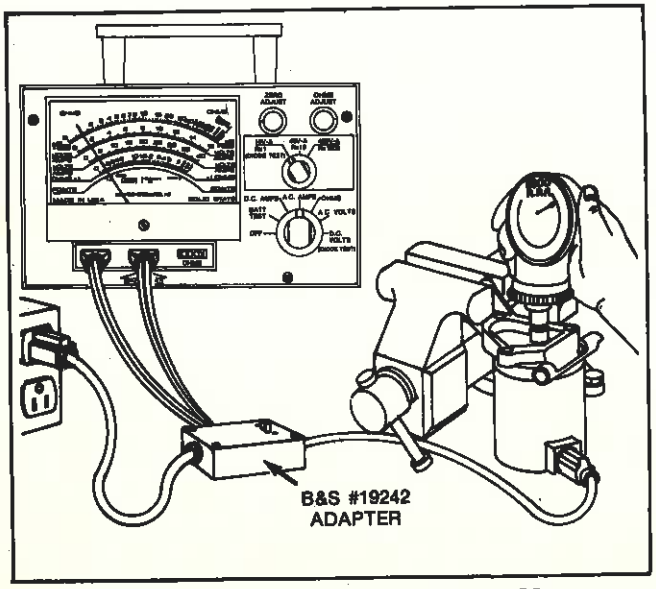


Fig. 73 — Checking 120 Volt Starter Motor Performance

A starter motor in good condition will be within the following specifications.

1. Starter Motor RPM — 8,300 minimum.
2. Current — 1½ amperes maximum AC.

If either the 120 volt AC or 12 volt DC starter motor does not perform satisfactorily, the following should be checked and corrected if necessary.

1. Binding condition between the pinion gear, helix and drive gear assembly.
2. Misalignment or binding between motor bearings.
3. Starter motor brushes sticking in brush holders.
4. Dirty or worn commutator.
5. Shorted, open or grounded armature.
   A. Shorted armature (wire insulation worn and wires touching one another) will be indicated by slow speed and high current.
   B. Open armature (wire broken) will be indicated by low or no RPM.
   C. Grounded armature (wire insulation worn and wire touching armature lamination or shaft) will be indicated by excessive current or no RPM.
6. A defective starter motor switch (in cord).
7. A defective starter motor rectifier assembly.
8. Weakened magnets.

DISASSEMBLY OF STARTER MOTOR

Study Fig. 69 prior to starter motor disassembly.

NOTE: END HEAD, END CAP AND HOUSING MUST BE PLACED IN THE SAME POSITION AS WHEN REMOVED, OR INTERFERENCE MAY RESULT. See Fig. 74.

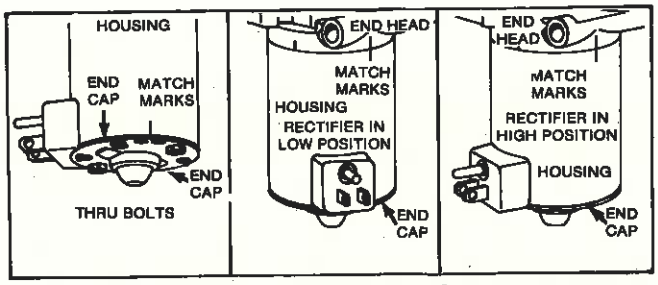


Fig. 74 — Match Marks

Remove thru bolts. Fig. 75. The end cap may then be removed.

(See checking starter motor drive if repair, cleaning or replacement of drive assembly is necessary.)

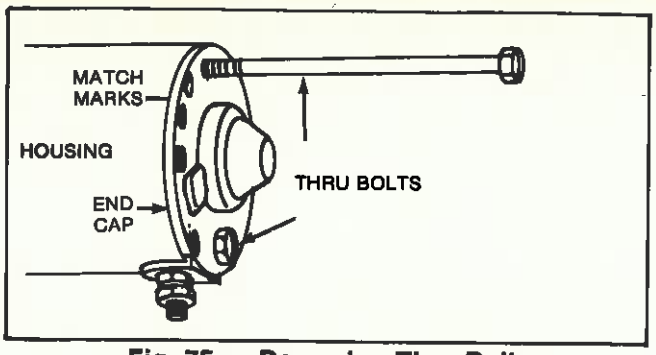


Fig. 75 — Removing Thru Bolts

CAUTION: Do not clamp the motor housing in a vise or strike the motor housing with a hammer. These motors contain two powerful ceramic magnets which can be broken or cracked if the motor housing is deformed or dented.

Remove armature and end cap as shown in Fig. 76. (If 120 volt motor, remove ground post with 1/4" nut driver to free rectifier assembly. Fig. 79.)

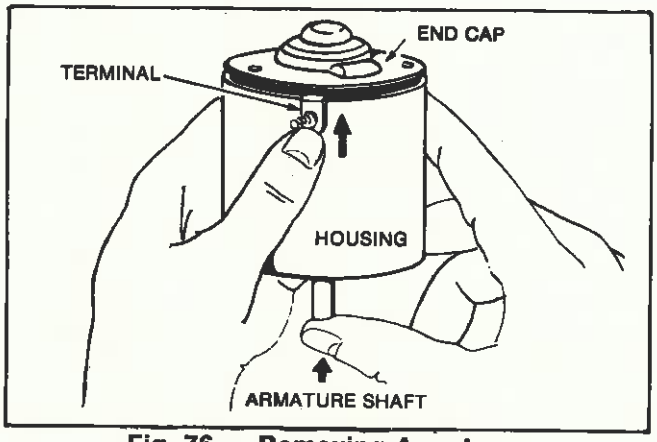


Fig. 76 — Removing Armature

Clean all dirt or corrosion accumulations from the armature, end cap, end head, etc. The bearings, motor housing and armature should not be soaked in a cleaning solution. The armature commutator may be cleaned with a fine sand paper or commutator paper. Do not use emery cloth, as emery will embed in the commutator and cause rapid brush wear. If it is suspected that the armature is defective, a new armature should be tried in the motor. If proper testing equipment is available, check the suspected armature to determine if it is defective.

Starter motor armatures have very low resistance, usually below detection on available multimeters (volt-ampere-ohm). To check for shorted armatures, a piece of equipment known as a "growler" may be used.

The brushes should be checked for poor seating, weak brush springs, dirt, oil or corrosion. See Fig. 77.

If the magnets are suspect, a new motor housing should be tried to test motor performance (Figs. 72 and 73).

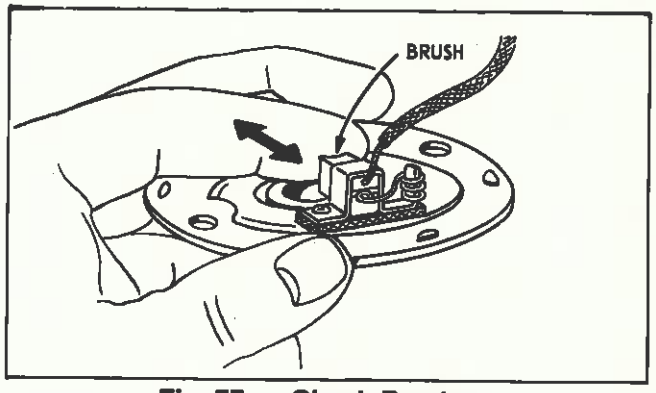


Fig. 77 — Check Brushes

CHECKING THE RECTIFIER ASSEMBLY 120 VAC STARTER MOTOR

Disconnect rectifier from end cap by removing leads from terminals.

Test rectifier with multimeter (VOA meter, page 8) set on resistance (R x 1 ohm) scale. Touch meter leads to red and black rectifier lead, then reverse meter leads and recheck. The meter should indicate a reading in one direction only. Touch meter leads to black rectifier lead shown in Fig. 79 and both AC posts, then reverse meter leads. The meter should show a reading in one direction only. Touch meter leads to red rectifier lead and both AC posts, then reverse meter leads. The meter should show a reading in one direction only.

If a meter reading is indicated in both directions or no reading is indicated in either direction, the rectifier assembly is defective and must be replaced.

ASSEMBLY OF STARTER MOTORS

When all parts have been thoroughly inspected, lightly lubricate the bearings with #20 oil, and reassemble in the following manner.

Insert the brushes in their respective holders. NOTE: A tool such as shown in Fig. 45 and 78 should be used to hold the brushes clear of the armature commutator when assembling the armature to end cap.

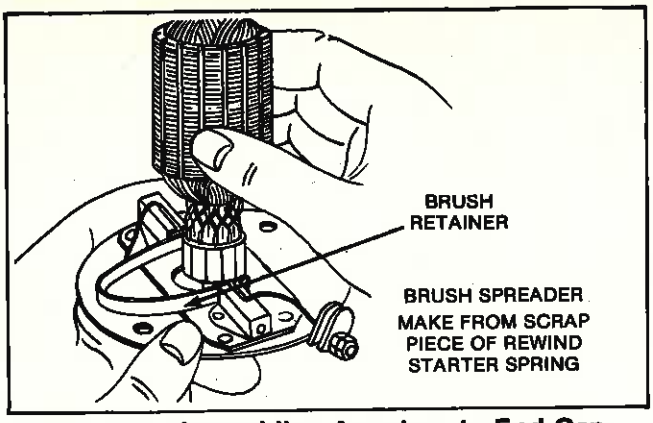


Fig. 78 — Assembling Armature to End Cap

If 120 volt motor, connect rectifier to end cap as shown in Fig. 79 with 1/4" nut driver.

INSTALL LEADS IN EXACT POSITION SHOWN.

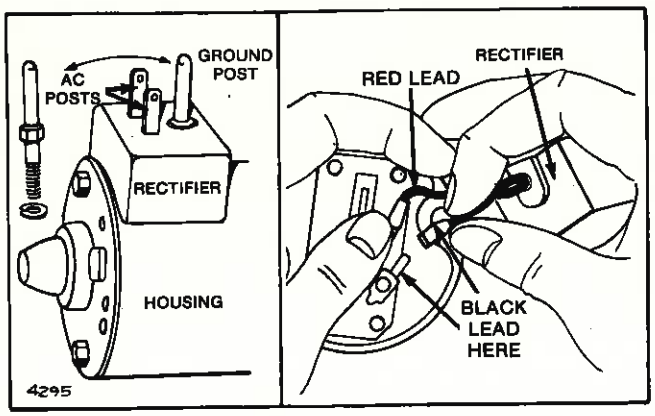


Fig. 79 — Installing Rectifier Assembly

Support armature shaft and slide it slowly into housing, as shown in Fig. 80. Insert rubber mounted terminal into housing at this time.

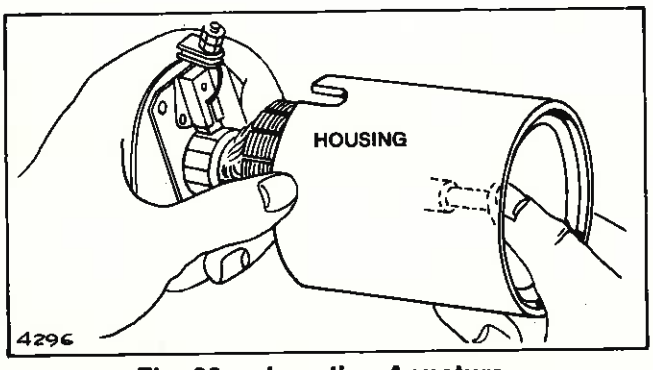


Fig. 80 — Inserting Armature

Place thrust washer on motor PTO shaft. Install end head and thru bolts. Align end cap and end head match marks correctly. Fig. 74. Tighten screws. Tap edge of end cap using a soft hammer to align motor bearings if required. Fig. 81. Check armature shaft for end play. Armature should rotate freely.

NOTE: 120 VOLT MOTORS HAVE TWO POSSIBLE HOUSING POSITIONS. INTERFERENCE MAY RESULT IF CORRECT POSITION IS NOT USED. FIG. 74.

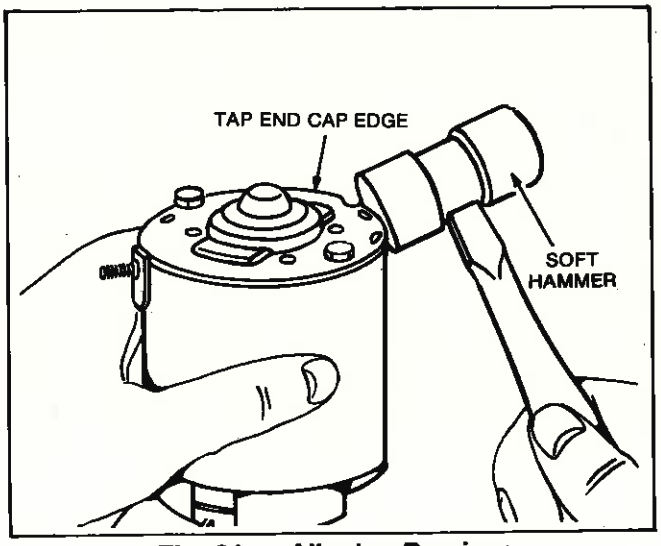


Fig. 81 — Aligning Bearings

Test performance of starter motor. Page 19 or 20. If starter motor tests as specified, continue assembly.

HI-POTENTIAL TEST (HI-POT)

WARNING: A Hi-Potential Test of the 120 Volt AC starter motor must be conducted prior to installation of starter motor to engine.

DANGER: High voltage is used in this test. Exercise extreme care to minimize the hazard of electrical shock.

If test equipment is not available, take starter motor to a local electrical motor repair shop for test. Failure to perform this test may present an electrical hazard. If starter motor tests are positive, continue assembly.

Slip motor pinion gear on armature shaft. Add a small amount of gear lubricant to gear teeth. Position gasket, spring washer and drive housing assembly. Fig. 69. Fasten drive housing to end head securely with three screws. The starter motor assembly is now ready for installation to the engine.

GEAR DRIVE STARTERS

120 VOLT AC; 12 VOLT DC STARTER MOTOR — USED ON MODEL SERIES: 170000, 190000, 220000, 240000, 250000 and 320000.

The 120 volt electric starter is equipped with a three-prong plug for safety. The longer prong in this plug is connected to the starter motor housing. When the starter motor is plugged into the three-wire cord supplied, and the cord is plugged into a properly grounded receptacle, it will protect the user from shock should the starter-motor insulation fail for any reason. If a longer extension cord is used with this starter, it should also have three-prong and three-hole plugs. Fig. 68. DO NOT USE extension cords longer than 25 feet (7.62 m).

These starter motors use a gear type engagement method, similar to an automobile starter. When the starter motor is activated, the helix on the starter motor is activated, the helix on the starter motor shaft drives a pinion gear into engagement with a ring gear attached to the engine flywheel and cranks the engine.

CAUTION: 120 volt starter motor should first be Hi-Pot tested before re-assembly to engine to determine if a shock hazard exists.

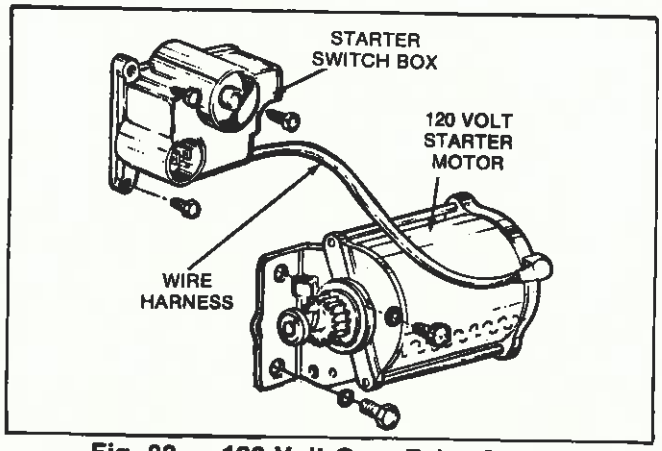


Fig. 82 — 120 Volt Gear Drive Starter

CAUTION: DO NOT run starter motors for more than one minute without cooling 15 minutes.

It is recommended a battery of 32 ampere hour capacity be used with the 12 volt starter. The battery cable size should be #4 or #6.

NOTE: A battery of higher amperage may be required for extremely cold weather starting conditions.

Replacing a Ring Gear

To replace a worn or damaged flywheel ring gear, proceed as follows:

A steel ring gear must be used on the flywheel if the pinion gear on the starter motor is made of steel, An aluminum ring gear must be used on the flywheel if the pinion gear on the starter motor is made of nylon.

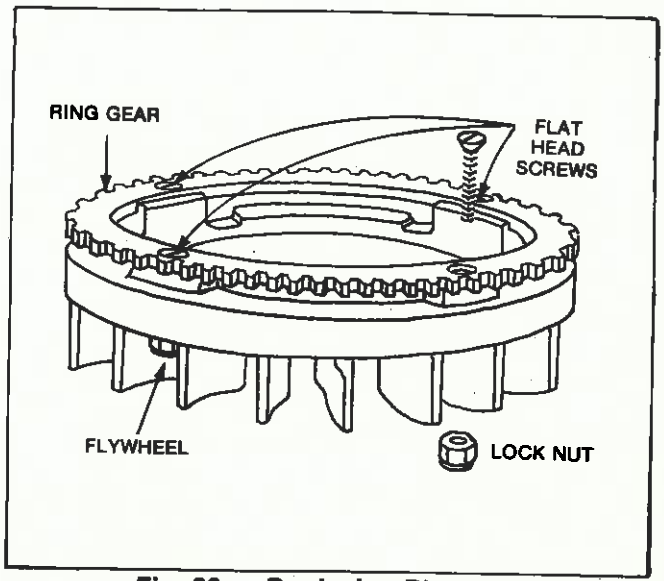


Fig. 83 — Replacing Ring Gear

WARNING: DO NOT strike flywheel with a hard object or metal tool as this may cause flywheel to shatter in operation, causing personal injury or property damage.

STARTERS - Briggs & Stratton Gear Drive 12V & 120V

Mark the center of the rivets holding the ring gear to flywheel, with a center punch. Drill out the rivets using a 3/16" (4.8 mm) drill. Clean holes after drilling. Fig. 83.

Attach new gear to flywheel using four screws and lock nuts provided with gear.

CHECKING STARTER MOTORS

If a starting problem is encountered, check the engine thoroughly to be sure it is not the cause of starting difficulty. It is a good practice to remove the spark plug and rotate the crankshaft by hand, to be sure it rotates freely. Any belt, clutch or other parasitic load will affect cranking performance.

Service procedures for both the 12 volt and 120 volt starter motors are similar and will be covered together, except where noted otherwise.

A list is provided to aid in diagnosing problems for 120 volt DC and 120 volt AC systems. See page 9 and 10.

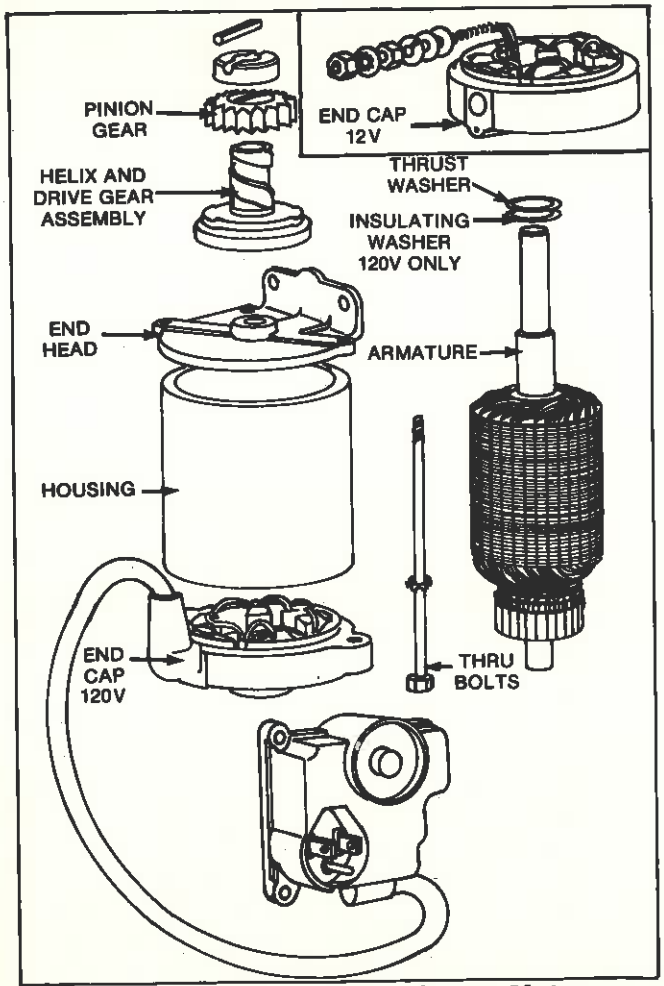


Fig. 84 — 12 Volt & 120 Volt Starter Motor — Exploded View

CHECKING STARTER MOTOR DRIVE

When the starter motor is activated, the pinion gear should rise, engaging the flywheel ring gear and crank the engine. This action can be observed by removing the starter shield. If the starter motor drive does not react properly, inspect the helix and pinion gear for freeness of operation. If any sticking occurs, this must be corrected. Proper operation of the starter is dependent on the pinion freely moving on the helix. See Fig. 85.

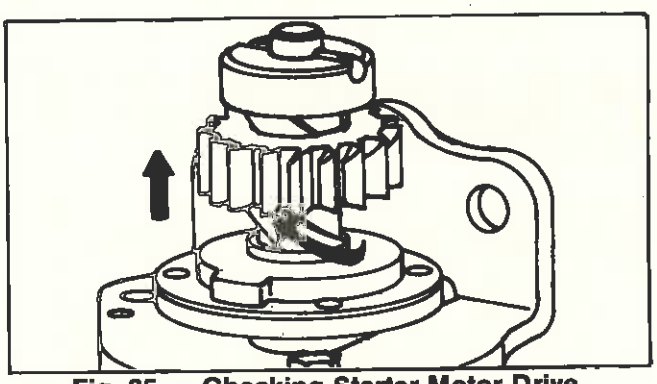


Fig. 85 — Checking Starter Motor Drive

DISASSEMBLING STARTER MOTOR DRIVE

To remove the drive assembly for cleaning or replacement, disconnect and remove starter from engine. Place in "V" block as shown in Fig. 87. Drive the roll pin out with a hammer and 1/8" (3.2 mm) diameter punch to remove the retainer.

NOTE: Some starter drive assemblies utilize a gear return spring. These are protected with a plastic cap over the drive assembly. Carefully snap the plastic cap from the cup using two screwdrivers. See Fig. 86.

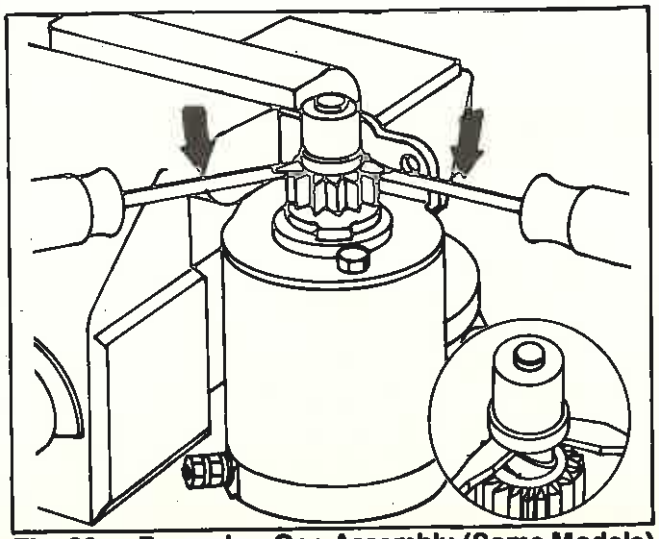


Fig. 86 — Removing Cap Assembly (Some Models)

The pinion gear should be inspected for damaged teeth. If a sticking condition exists between the pinion gear and the helix, this must be corrected. The parts may be washed in a solvent such as Stanasol or Varsol. The gear, retainer, roll pin and clutch assembly are available from your Briggs & Stratton source of supply if required.

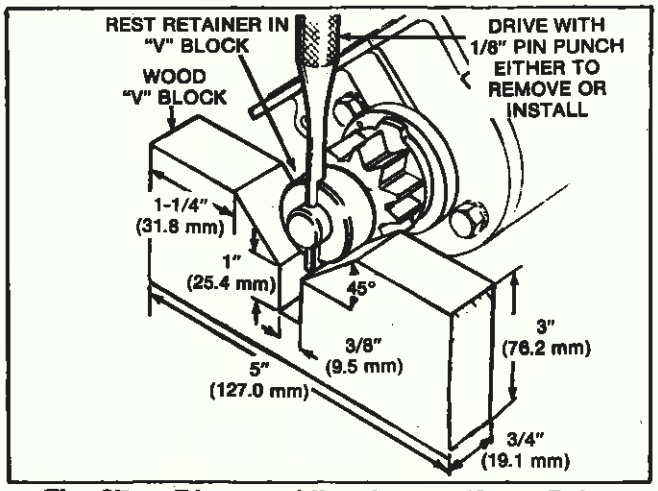


Fig. 87 — Disassembling Starter Motor Drive

ASSEMBLING STARTER MOTOR DRIVE

Reverse disassembly procedure for assembling. Assemble the pinion gear with beveled edge on the gear as shown in Fig. 88. Assemble cup and spring on gear if original assembly was so equipped. Press or drive the roll pin through retainer slot and armature shaft hole with roll pin slot positioned as shown. The roll pin should be centered in shaft within 1/32" (0.8 mm).

NOTE: ASSEMBLE WITH NEW ROLL PIN ONLY.

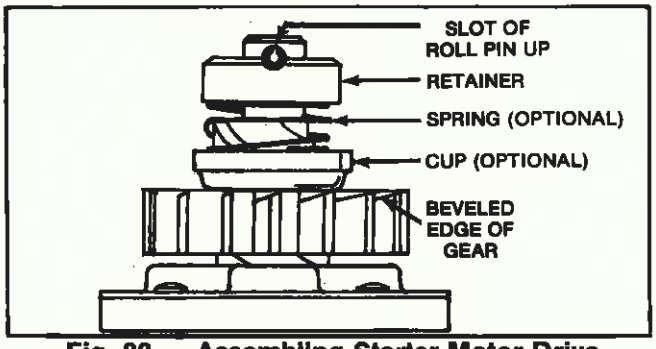


Fig. 88 — Assembling Starter Motor Drive

If the original assembly is equipped with a spring cap assembly, assemble cap as follows:

To install plastic cap, use a socket approximately the same diameter as the plastic cap, for a driver as shown in Figure 89. Press cap in position, cap should lock in position when properly assembled.

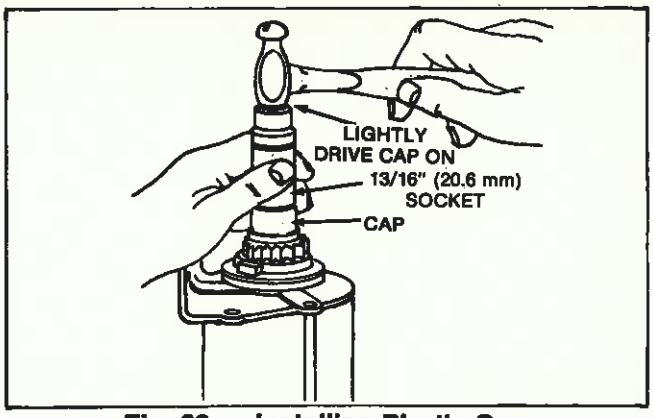


Fig. 89 — Installing Plastic Cap

CHECKING THE STARTER MOTOR PERFORMANCE

A performance test of the 12 volt DC and 120 volt AC starter motors may be made in the following manner.

12 VOLT DC STARTER MOTOR

Equipment Needed — (Page 8)

1. A tachometer capable of reading 10,000 R.P.M.
2. An ammeter capable of reading 0 to 25 amperes.
3. A 12 volt ± 0.3 battery.

Connect the starter motor, battery and ammeter as shown on the accompanying illustration. See Fig. 90. Refer to Fig. 91 for specifications.

NOTE: To test starter motor ON ENGINE, refer to Briggs & Stratton #19236 VOA meter Instruction Manual.

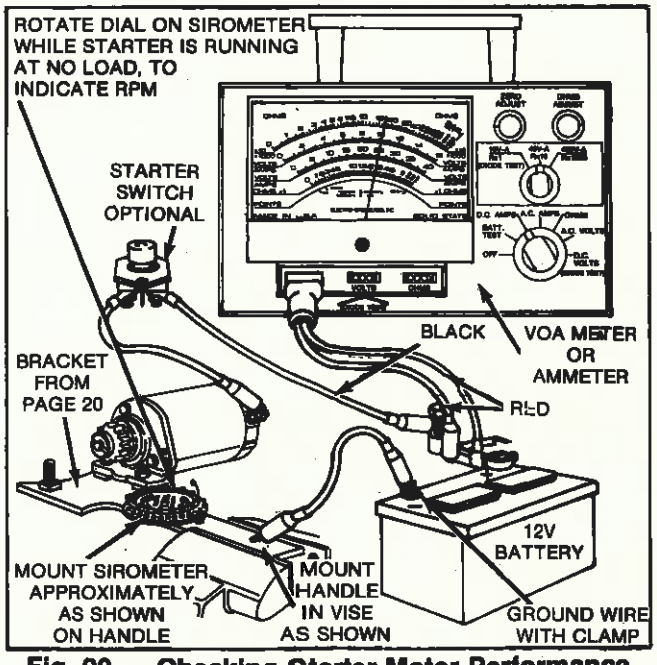


Fig. 90 — Checking Starter Motor Performance

7 B

STARTERS - Briggs & Stratton Gear Drive 12V & 120V

CAUTION: DO NOT clamp motor housing in a vise or strike with a steel hammer. Starter motors contain two powerful magnets which can be broken or cracked if the motor housing is deformed or dented.

Activate the starter motor and note readings of ammeter and tachometer (RPM). Note length of starter motor housing as shown on page 9 and refer to Fig. 91. A starter motor in good condition will be within specifications listed.

Motor Housing Length	Minimum Motor RPM	Maximum Amperes
3-1/16" (77.8 mm)	6500	18
3-3/4" (95.3 mm)	6900	19

Fig. 91 — 12 Volt DC Starter Motor Specifications

120 VOLT AC STARTER MOTOR

Connect the starter motor and ammeter as shown in Fig. 92.

DANGER: It is recommended that the starter motor be Hi-Pot tested after final re-assembly.

7 B

CAUTION: The performance test of this starter requires the use of an ammeter, connected in the 120 volt AC line cord. Extreme care should be used in making this test to minimize the hazard of electrical shock.

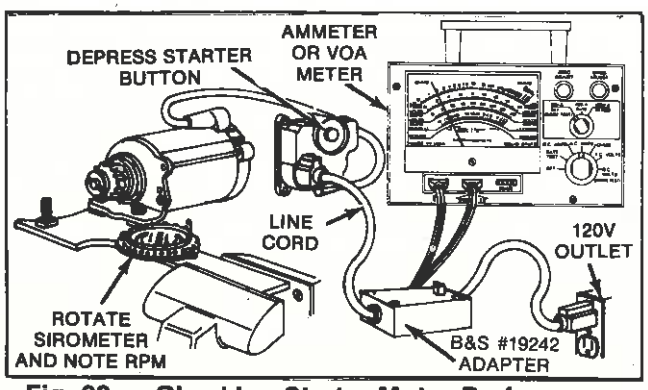


Fig. 92 — Checking Starter Motor Performance

Plug the electrical cord into a 120 volt outlet and press the starter motor button. Note the readings of tachometer or sirometer (RPM) and ammeter. A starter motor in good condition will be within the following specifications. Fig. 93.

Motor Housing Length	Minimum RPM	Maximum Amperes
3-1/2" (88.9 mm)	6500	2.7

Fig. 93 — Starter Motor Specifications

If either the 120 VAC or 12 VDC starter motor does not perform satisfactorily, the following should be checked and corrected if necessary.

1. A binding or seizing condition in the starter motor bearings.
2. Starter motor brushes sticking in brush holders.
3. A dirty or worn armature commutator or brushes.
4. A shorted, open or grounded armature.
   A. Shorted armature (wire insulation worn and wires touching one another). Will be indicated by low or no R.P.M.
   B. Open armature (wire broken) will be indicated by low or no RPM.
   C. Grounded armature (wire insulation worn and wire touching armature lamination or shaft). Will be indicated by excessive current or no RPM.
5. A defective starter motor switch.
6. A defective starter motor rectifier assembly. (120 volt AC only).
7. Weakened magnets.

DISASSEMBLY OF STARTER MOTORS

Study Fig. 84 prior to starter motor disassembly. Remove thru bolts. The drive head end may now be removed. Inspect bushing for wear. If worn, replace drive head end assembly. Fig. 94.

NOTE: MATCH MARKS AND THRU BOLTS MUST BE PLACED IN THE SAME POSITION AS WHEN REMOVED OR INTERFERENCE MAY RESULT.

(See checking starter motor drive if repair, cleaning or replacement of drive assembly is necessary.)

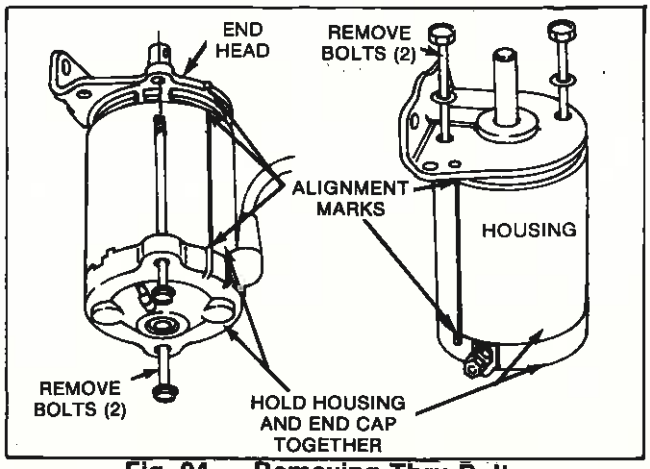


Fig. 94 — Removing Thru Bolts

CAUTION: DO NOT clamp motor housing in a vise or strike with a steel hammer. Starter motors contain two powerful magnets which can be broken or cracked if the motor housing is deformed, dented or dropped.

Hold the armature and commutator end cap against a work surface while sliding housing off the armature. Note: This allows the armature to remain in the end cap for inspection of brush contact to armature. Fig. 95.

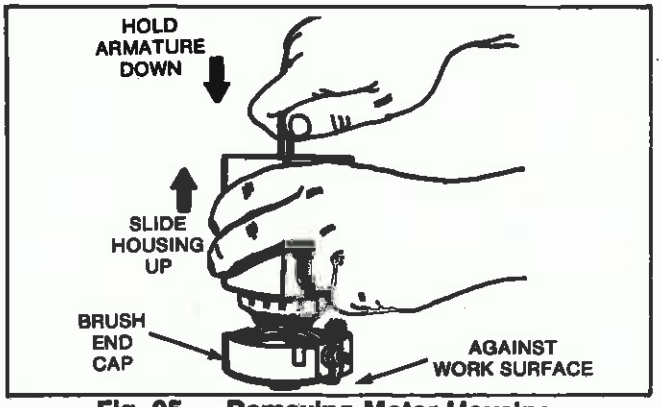


Fig. 95 — Removing Motor Housing

Remove armature from commutator end cap.

Clean all dirt or corrosion accumulations from the armature, end cap, motor support, etc. The bearings, housing and armature should not be soaked in a cleaning solution. The armature commutator may be cleaned with a fine sand paper. Do not use emery cloth, as emery will embed in the commutator and cause rapid brush wear. The commutator may also be machined with the use of a diamond cutting tool to no less than 1.23 (31.24 mm) inches outside diameter. Slots between commutator bars should be cleaned as shown in Fig. 96 after cleaning or machining. If it is suspected that the armature, field coil, magnets or motor housing is defective, a new part should be tried in the motor. If proper testing equipment is available, check the suspected armature or field coil to determine if it is defective (opens or grounds).

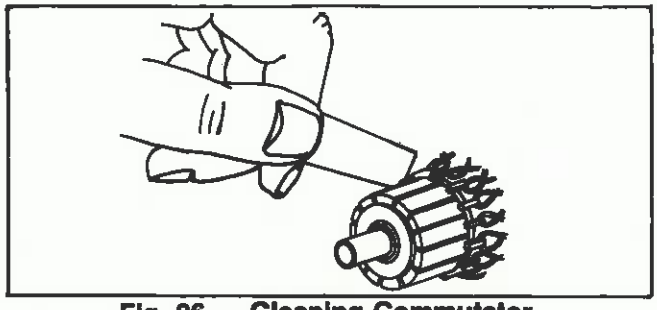


Fig. 96 — Cleaning Commutator

The brushes should be checked for poor seating, weak brush springs, dirt, oil or corrosion. Brush spring pressure should measure from 4.0 to 6.0 ounces. If brushes are worn as shown in Fig. 97, replace. Check to be sure brushes are not sticking in their holders. Use holders to retain brushes and spring during assembly.

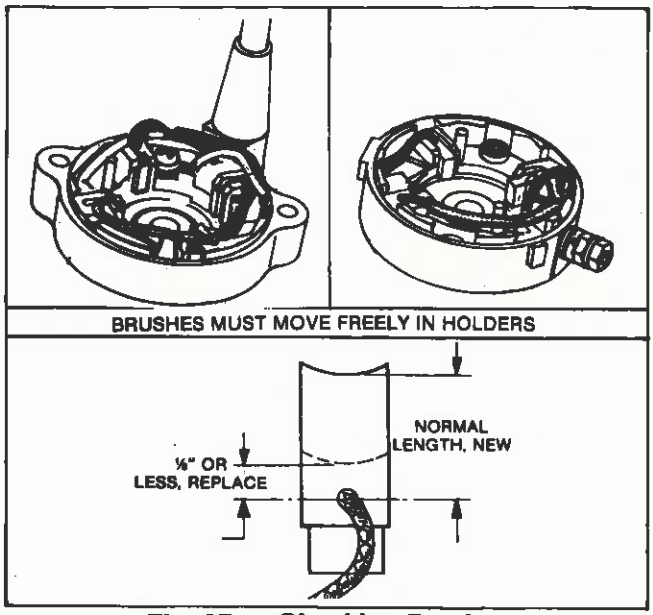


Fig. 97 — Checking Brushes

CHECKING THE BRIGGS & STRATTON RECTIFIER CONTROL ASSEMBLY — 120 VOLT AC STARTER MOTOR

The control assembly consists of a spring loaded switch assembly, cord assembly and rectifier assembly contained in a housing assembly which is provided with an AC three wire ground receptacle. Fig. 98. The test procedure for checking the rectifier control assembly is as follows:

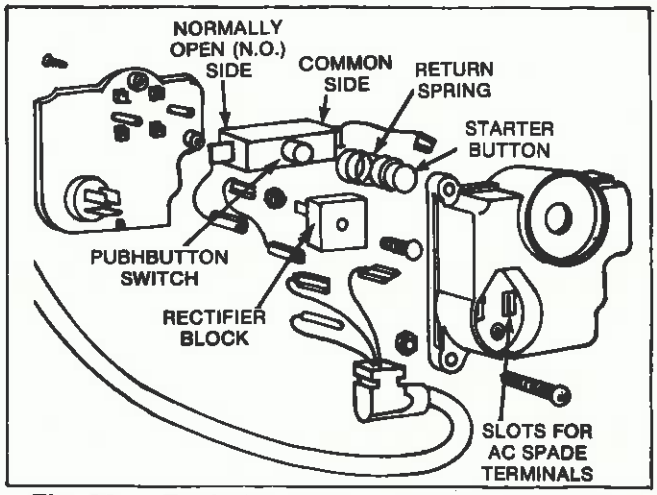


Fig. 98 — Exploded View — Control Assembly

7 B

Equipment Needed —

1. An AC volt meter capable of measuring 120 volts AC.
2. An AC ammeter capable of measuring 25 amperes AC.
3. A VOA meter as shown on page 20 may be used in place of volt meter and ammeter noted above.
4. Remove the spark plug from the engine.

CAUTION: The test of this rectifier assembly requires the use of a 120 volt AC circuit. Extreme care should be used when making this test to minimize the hazard of electrical shock.

Measure the line voltage of the 120 volt AC outlet to be used. Connect the voltmeter and ammeter as shown in Fig. 99 prior to removal from engine.

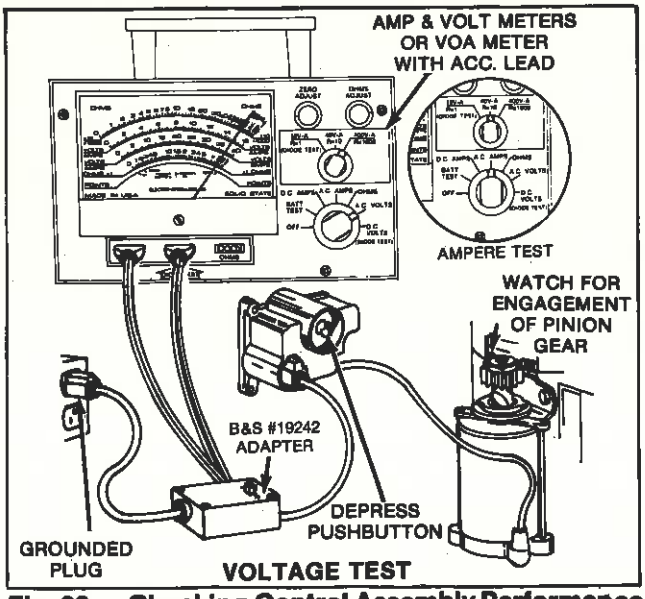


Fig. 99 — Checking Control Assembly Performance

A control assembly in good condition will show 120 volts of line voltage and a maximum of 15 amperes on the ammeter with starter button depressed and starter motor engaged. Fig. 99 inset.

If meters show no readings or a reading of 20 amperes is exceeded, see Troubleshooting, page 9 and 10.

DISASSEMBLING CONTROL ASSEMBLY

DANGER: Disconnect extension cord from outlet before disassembling control assembly.

With control assembly removed from mounting surface, remove three screws holding back plate to housing. Fig. 100. Note position of wires.

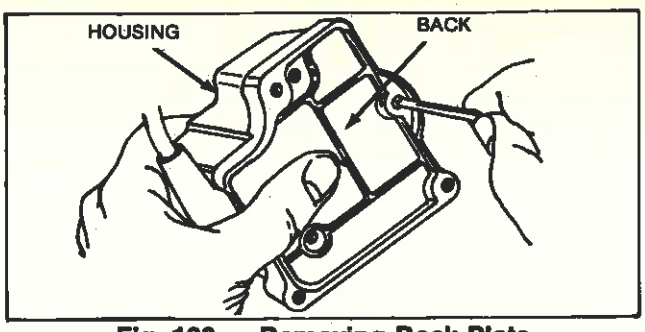


Fig. 100 — Removing Back Plate

Disconnect wires from rectifier. Test rectifier as shown in Fig. 101. With one probe on (+) plus terminal, touch three remaining terminals with other probe. Reverse procedure. Place other probe on (+) terminal and touch three terminals with probe. One test should not indicate any reading.

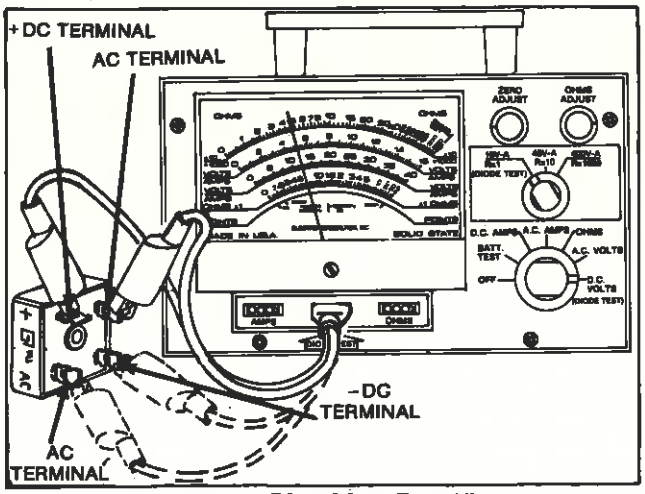


Fig. 101 — Checking Rectifier

To replace rectifier assembly, remove retainer spring washer. Note rectifier position and remove. If rectifier post should break, drill a 3/16" diameter hole in post location. Connect rectifier with plastic screw and nut. Assemble as noted in Fig. 102 and 104.

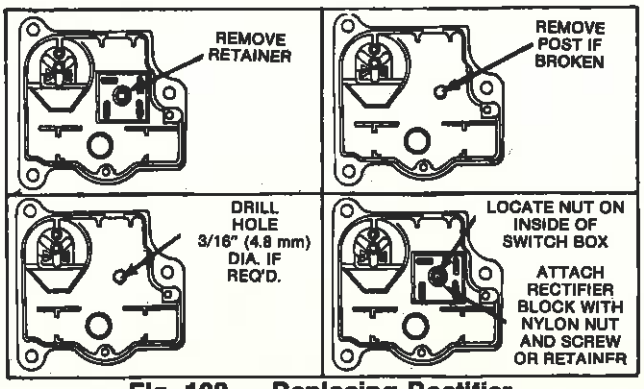


Fig. 102 — Replacing Rectifier

Test switch assembly as noted in Fig. 103.

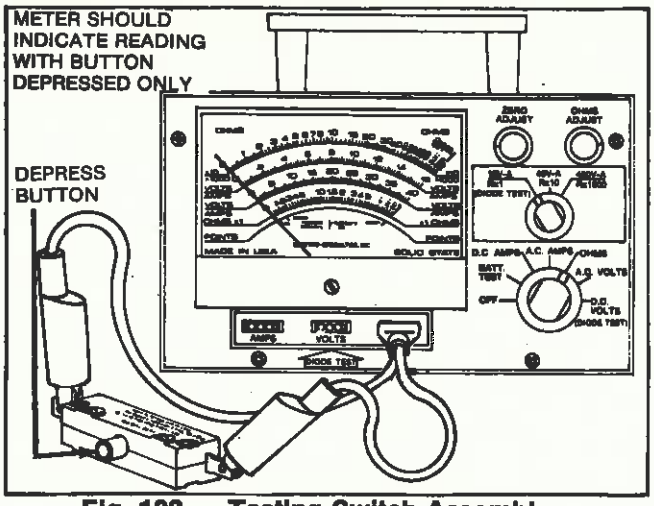


Fig. 103 — Testing Switch Assembly

When re-assembling switch, position starter button and return spring as noted in Fig. 98.

The cord assembly continuity may be tested with the VOA meter noted on page 8.

ASSEMBLY OF 120 VOLT CONTROL ASSEMBLY

Connect wires as shown in Fig. 104.

CAUTION: Incorrect assembly of black and white wires from cord to rectifier will cause motor to run backwards.

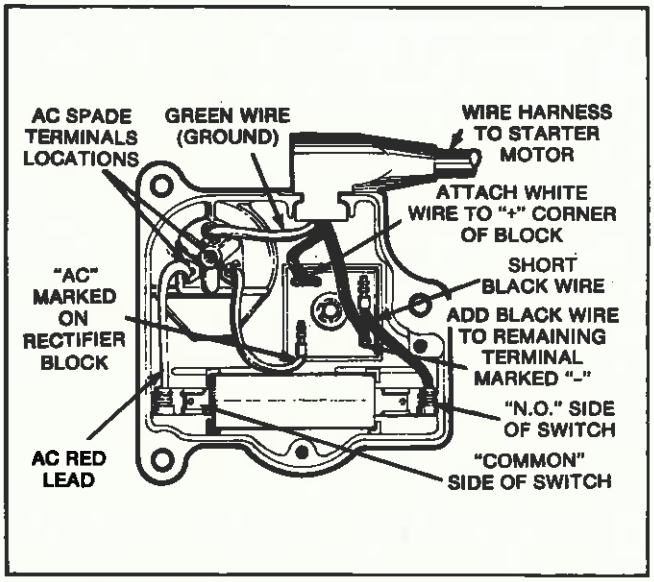


Fig. 104 — Wiring Diagram

Re-assemble backplate to housing. Fig. 100.

ASSEMBLY OF STATOR MOTOR

When all parts have been thoroughly inspected, lightly lubricate the bearings with #20 oil and re-assemble in the following manner. (Assemble wiring in commutator end cap as shown in Fig. 105, 120 volt AC.)

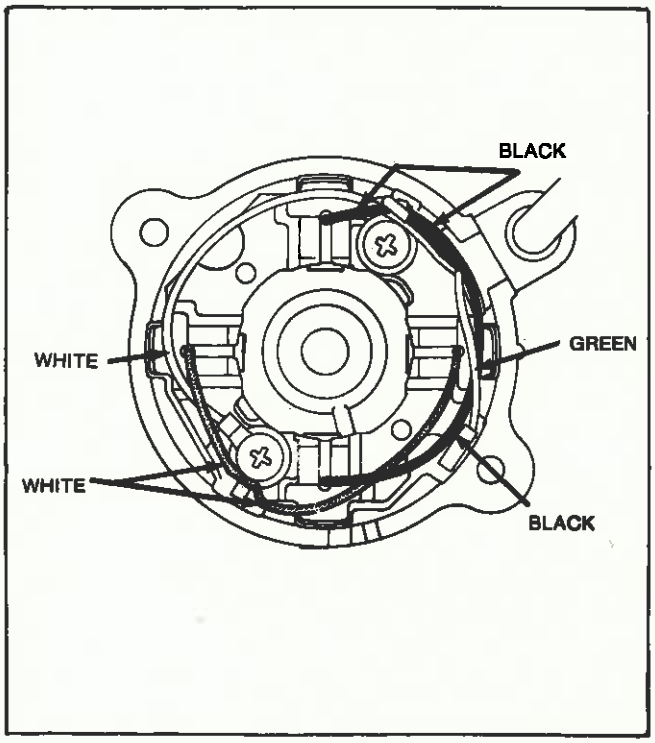


Fig. 105 — Commutator End Cap Wiring 120 Volt AC

Insert brushes and springs in their respective holders.

NOTE: A tool as shown in Fig. 45 and 106 should be used to hold the brushes clear of the armature commutator during assembly.

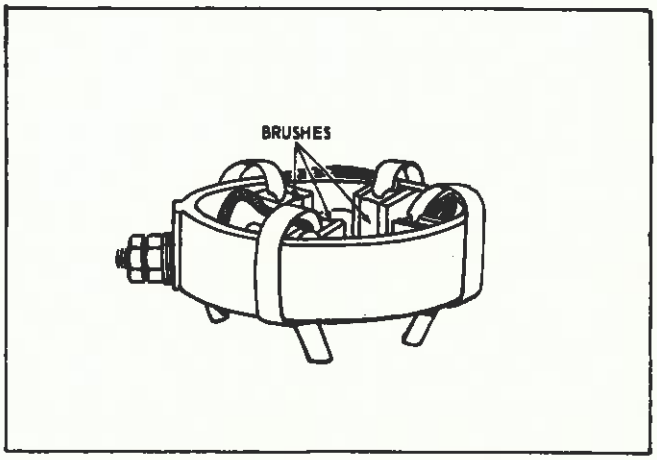


Fig. 106 — Positioning Brushes

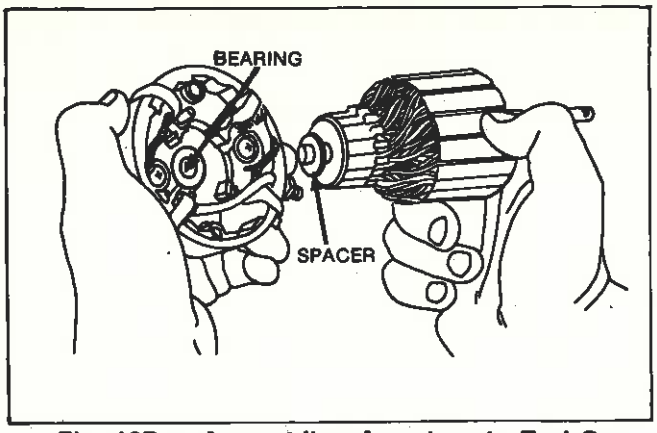


Fig. 107 — Assembling Armature to End Cap

Slide motor housing over armature with the notch toward commutator end cap. Match alignment marks. Fig. 94. Care should be used to prevent damage to magnets in motor housing during assembly. Assemble spacers and drive head end bracket, again aligning match marks. Armature end play is .006 to .038" (.15 to .97 mm) after assembly.

Assemble thru bolts and washers. Torque thru bolts, 45 to 55 inch pounds (5.1 to 6.2 Nm) for 1/4-20 thru bolts and 40 to 45 inch pounds (4.5 to 5.1 Nm) for 10-24 thru bolts.

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HIGH POTENTIAL (HI-POT) TEST — 120 VAC (ONLY)

Before and after repairing the 120 volt AC starter motor, a Hi-Pot test must be made to prevent injury. If the proper test equipment is not available, take the starter motor to a qualified electric motor repair shop for testing.

After assembly of the starter motor drive and Hi-Pot test is passed, the starter motor is now ready for installation to the engine.

GEAR DRIVE STARTERS

120 VOLT AC; 12 VOLT DC STARTER MOTOR — USED ON SERIES 140000, 170000 and 190000

These starter motors use a gear type engagement method, similar to an automobile starter. When the starter motor is activated, the helix on the starter motor shaft drives a pinion gear into engagement with a ring gear attached to the engine flywheel and cranks the engine.

Electrical shock is always a hazard with any electrical equipment. To minimize the hazard of electrical shock, the 120 volt starter motor is provided with a three wire power source connection. To maintain the safety provided against electrical shock, the extension cord used between the starter motor and the power source must be a three wire cord, which connects to a properly grounded receptacle. DO NOT USE power cords longer than 25 feet.

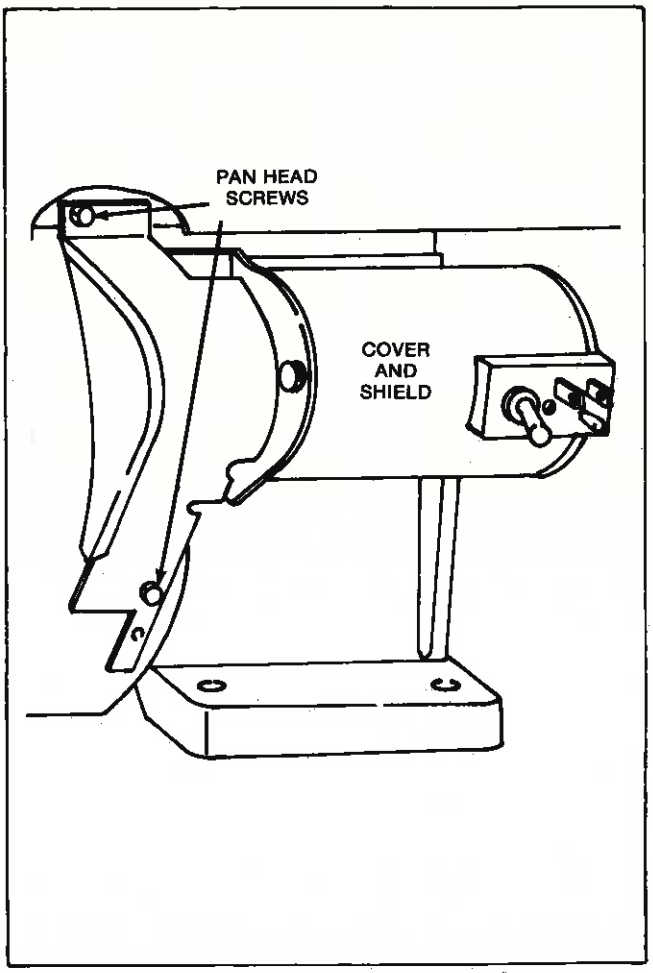

Fig. 108 — 120 Volt Gear Drive Starter Motor

CAUTION: DO NOT run starter motor for more than one minute without cooling 15 minutes.

It is recommended a battery of 32 ampere hour capacity be used with the 12 volt starter. The battery cable size should be #4 or #6. Note: A battery of higher amperage may be required for extremely cold weather starting conditions.

Replacing a Ring Gear

To replace a worn or damaged flywheel ring gear, see page 23, Fig. 82.

Checking Starter Motors

If a starting problem is encountered, check the engine thoroughly to be sure it is not the cause of starting difficulty. It is a good practice to remove the spark plug and rotate the crankshaft by hand, to be sure it rotates freely. Any belt, clutch or other parasitic load will affect cranking performance.

Service procedures for both the 12 volt and 120 volt starter motors are similar and will be covered together, except where noted otherwise.

A list is provided to aid in diagnosing problems for 12 volt DC and 120 volt AC systems. See page 9 and 10.

CHECKING STARTER MOTOR DRIVE

When the starter motor is activated, the pinion gear should rise, engaging the flywheel ring gear and crank the engine. This action can be observed by removing the starter shield. If the starter motor drive does not react properly, inspect the helix and pinion gear for freeness of operation. If any sticking occurs, this must be corrected. Proper operation of the starter is dependent on the pinion freely moving on the helix. See Fig. 109.

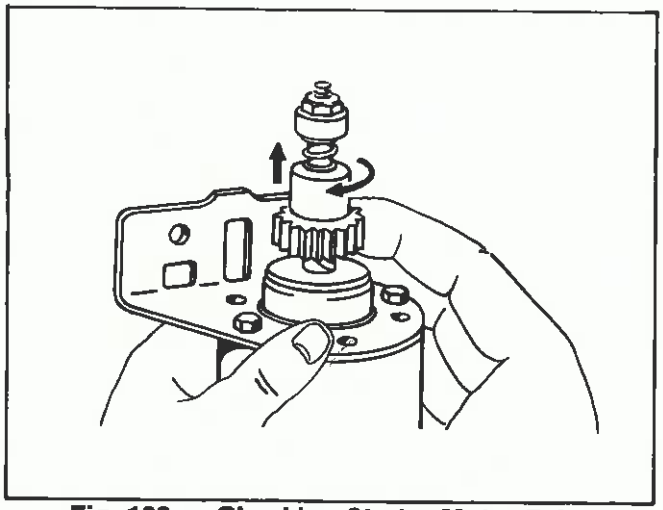

Fig. 109 — Checking Starter Motor Drive

DISASSEMBLING STARTER MOTOR DRIVE

To remove the drive assembly for cleaning or replacement, clamp the pinion gear in a vise having brass jaws, to prevent damage to the gear teeth. The lock nut may then be removed and the starter drive disassembled for cleaning or replacement.

The pinion gear should be inspected for damaged teeth. If a sticking condition exists between the pinion gear and the helix, the parts may be washed in a solvent such as Stanasol or Varsol. If the sticking condition is not corrected by cleaning, the complete drive assembly must be replaced. Individual parts of the drive assembly are not available.

ASSEMBLING STARTER MOTOR DRIVE

Reverse disassembly procedure for assembling. The interior of the shaft screw has a spline machined to the center; when assembling, the spline must face the end of the armature shaft. See Fig. 110. Torque the lock nut to 170 inch pounds (19.2 Nm). This torque has an effect on pinion travel, so proper torque should be maintained. NOTE: Do not lubricate Drive Assembly.

NOTE: For starter motors equipped with nylon pinion gear, page 24 and 25 contains assembly and repair information.

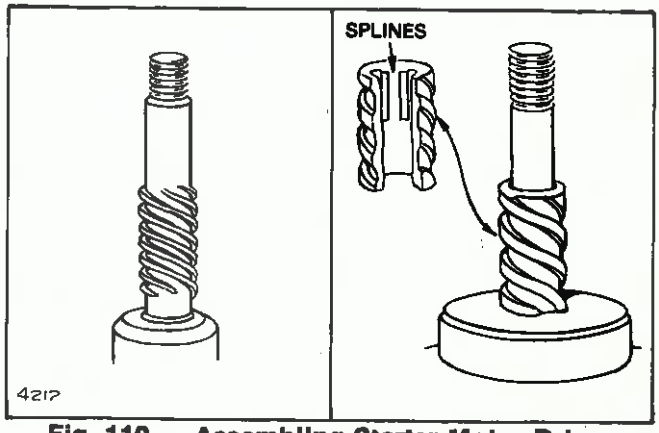

Fig. 110 — Assembling Starter Motor Drive

If sticking occurs during freezing weather, spray a dry silicone spray on helix.

CHECKING STARTER MOTOR PERFORMANCE

120 VOLT AC STARTER MOTORS

A performance test of the 120 volt starter motor may be made in the following manner.

Equipment Needed —

1. A tachometer capable of reading 10,000 RPM.
2. An ammeter capable of reading 0 to 10 amperes.

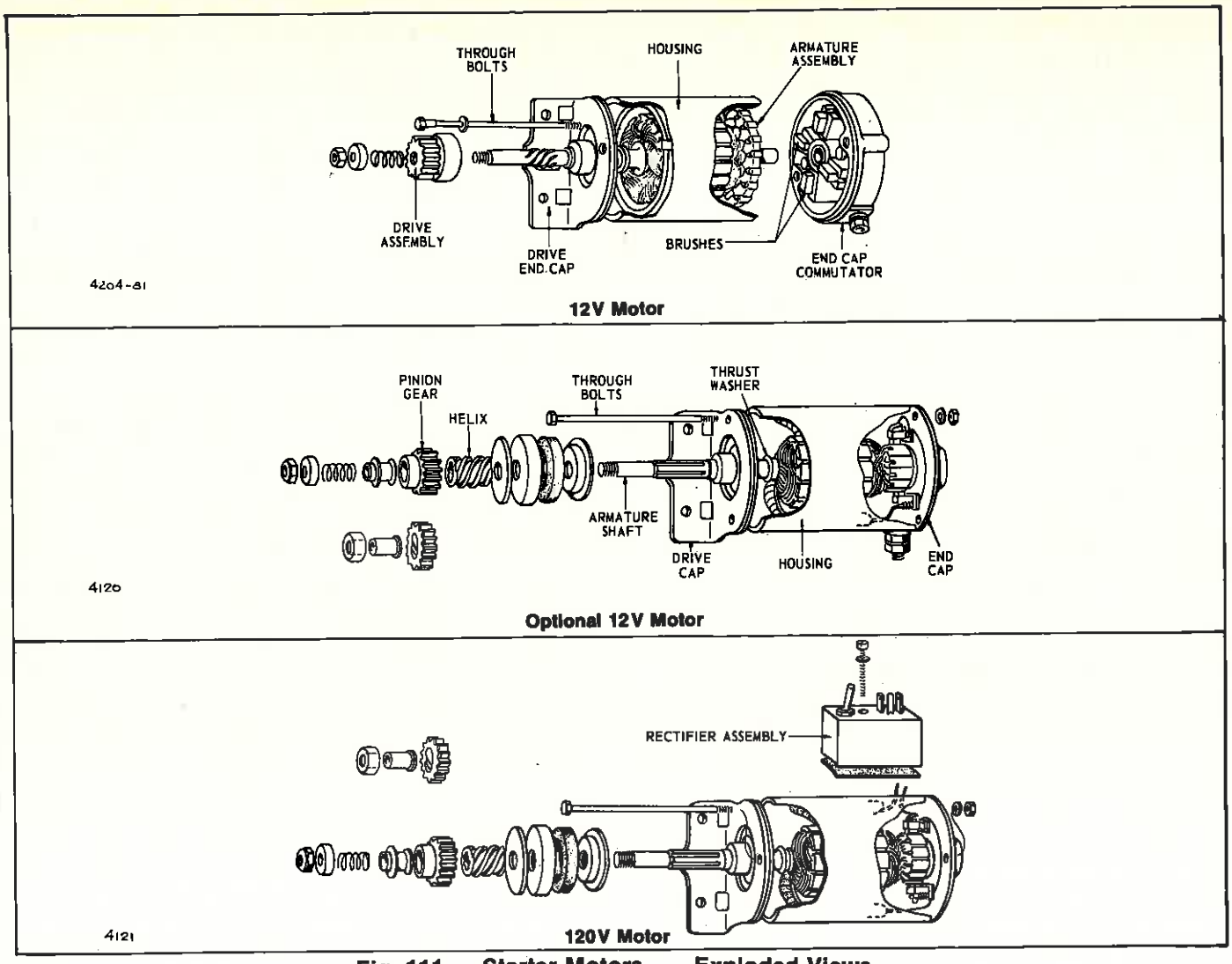

Fig. 111 — Starter Motors . . . Exploded Views

CAUTION: The performance test of this starter requires the use of an ammeter connected in the 120 volt AC starter motor circuit. Extreme care should be used in making this test to minimize the hazard of electrical shock. It is recommended that a Hi-Pot test be conducted after repairing starter motors to prevent injury.

Clamp the starter motor and connect ammeter as shown in the accompanying illustration. Fig. 112. Plug the electrical cord into a 120 volt outlet, insert the tachometer in the end of the starter motor and press the starter motor switch. Disregard surge current.

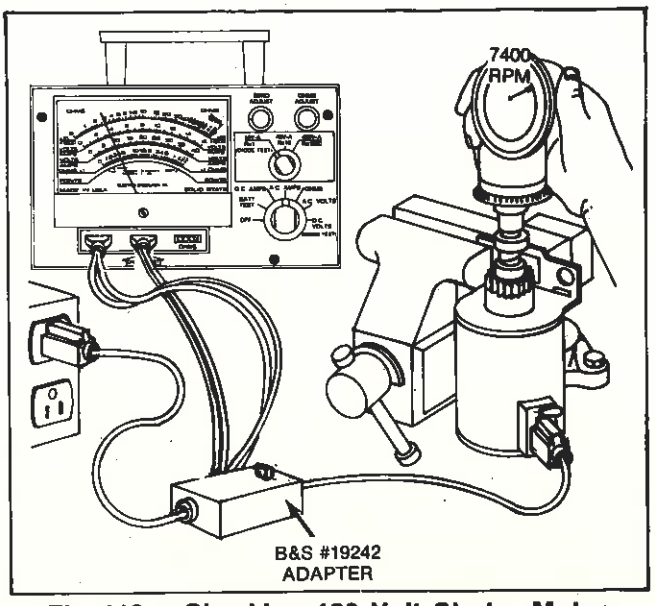

Fig. 112 — Checking 120 Volt Starter Motor Performance

A starter motor in good condition will be within the following specifications. Fig. 113.

If the starter motor does not meet these requirements a list is given to aid in diagnosing problems. See page 9 and 10.

Starter Motor Identification	Voltage Required	Minimum Motor RPM	Maximum Amperes
American Bosch SME-110-C3 SME-110-C6 SME-110-C8	120	7400	3-1/2
American Bosch 06026-28-M030SM	120	7400	3
Mitsubishi V282188	120	7800	3-1/2

Fig. 113 — 120 Volt Starter Motor Performance Chart

12 VOLT DC STARTER MOTORS

A performance test of the 12 volt starter motor may be made in the following manner.

Equipment Needed —

1. A tachometer capable of reading 10,000 R.P.M.
2. A 6 volt battery ± 0.3 volts.
3. An ammeter capable of reading 40 amperes.
4. A 12 volt battery ± 0.3 volts.

Connect the starter motor, battery and ammeter as shown on the accompanying illustration. See Fig. 114.

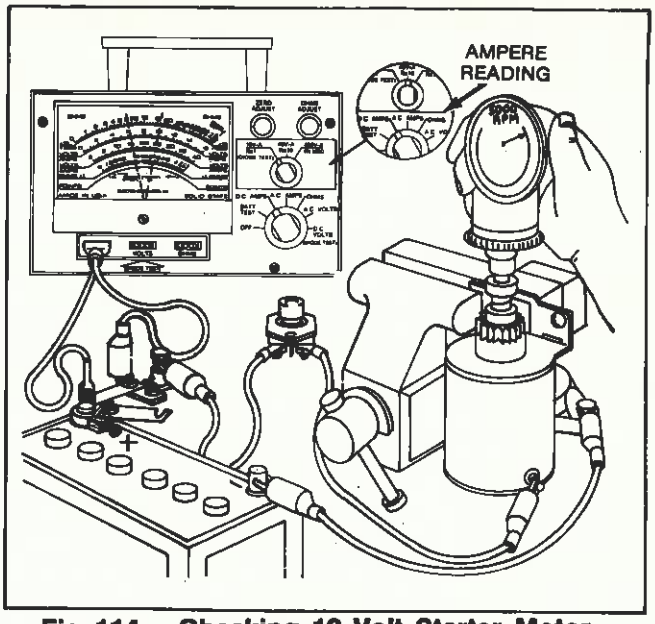

Fig. 114 — Checking 12 Volt Starter Motor Performance

Insert the tachometer in the end of the starter motor and activate the starter motor. A starter motor in good condition will be within the specifications noted in Fig. 115. Disregard surge current.

NOTE: A 6 volt battery is required in some instances for test purposes only. This allows R.P.M. readings to be made on a lower scale. See Fig. 115.

If the starter motor does not perform satisfactorily, a list is given to aid in diagnosing problems. See page 9 and 10.

NOTE: To test starter motor ON ENGINE, refer to Briggs & Stratton #19236 VOA meter Instruction Manual.

Starter Motor Identification	Voltage Required	Minimum Motor RPM	Maximum Amperes	VOA Scale
American Bosch SME-12A8	6V±0.1	5000	25	40 V-A R x 10*
American Bosch SMH-12A-11	12V±0.3	4800	16	16 V-A R x 1
American Bosch 01965-23-MO-30-SM	12V±0.3	5500	16	16 V-A R x 1
Mitsubishi MMO-4FL MMO-5ML MOO1TO2271	6V±0.1	6700	16	16 V-A R x 1

*Note inserts, Fig. 114.

Fig. 115 — 12 Volt Starter Motor Performance Chart

DISASSEMBLY OF STARTER MOTORS

Remove the lockwasher, nuts and thru bolts. See Fig. 116. The armature, drive cap and gear drive can now be removed as an assembly.

NOTE: THRU BOLTS AND NUTS MUST BE PLACED IN THE SAME POSITION AS WHEN REMOVED OR INTERFERENCE MAY RESULT.

(See checking starter motor drive if repair, cleaning or replacement of drive assembly is necessary.)

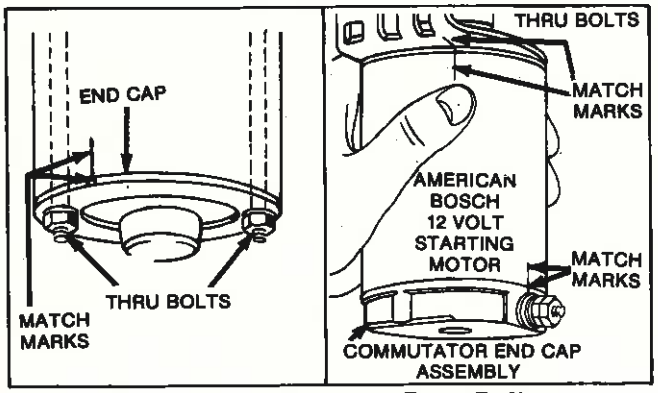

Fig. 116 — Removing Thru Bolts

CAUTION: Do not clamp the motor in a vise or strike the motor with a hammer. Some motors include two powerful ceramic magnets which can be broken or cracked if the motor housing is deformed or dented.

To remove the commutator end cap, lift the brush springs and slide brushes out of the brush holders. The 120 volt AC starter motor rectifier assembly may now be removed by loosening the cover screw and unsoldering the field lead attached to the rectifier assembly. See Fig. 117.

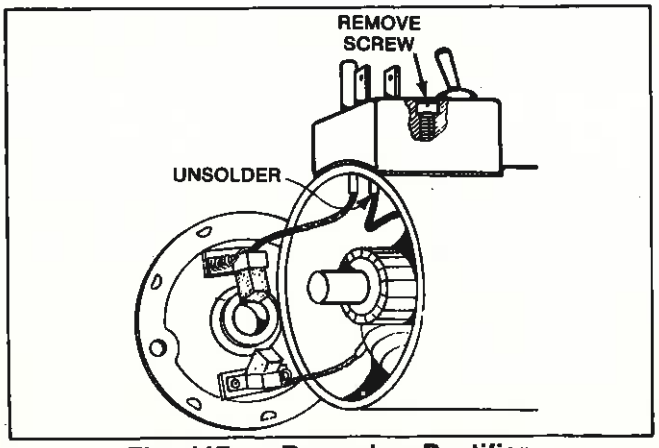

Fig. 117 — Removing Rectifier

Clean all dirt or corrosion accumulations from the armature, commutator end cap, drive end cap, etc. The bearings, housing and armature should not be soaked in a cleaning solution. The armature commutator may be cleaned with a fine sand paper. Do not use emery cloth, as emery will embed in the commutator and cause rapid brush wear. If it is suspected that the armature, field coil or motor housing is defective, new parts should be tried in the motor. If proper testing equipment is available, check the suspected armature or field coil to determine if it is defective. The brushes should be checked for proper seating, weak brush spring, dirt, oil or corrosion. Brush spring pressure should measure from 4 to 6 ounces when pressed to working position. Also check to be sure brushes are not sticking in their respective brush holders. See Fig. 118.

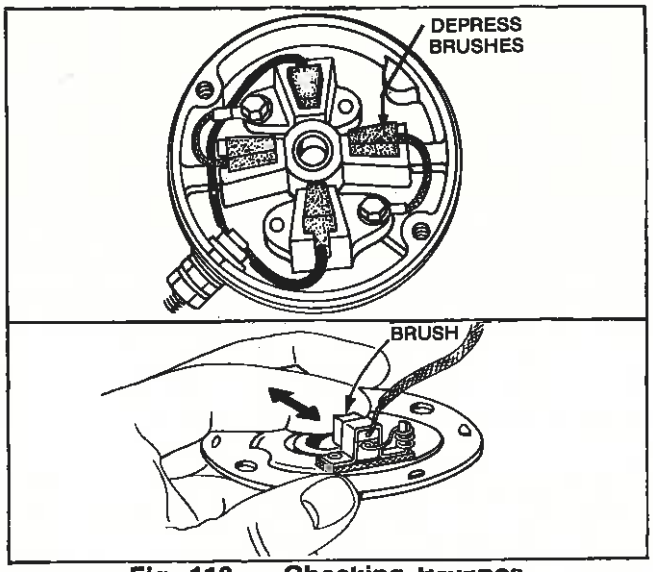

Fig. 118 — Checking Brusnes

CHECKING THE RECTIFIER ASSEMBLY 120 VOLT AC STARTER MOTOR

The rectifier assembly consists of a spring loaded switch, which is in a normally "off" position, an AC three wire ground receptacle and four rectifiers encapsuled in an epoxy case. The test procedure for checking the rectifier is as follows:

Equipment Needed —

1. An AC volt meter capable of measuring 120 volts AC.
2. A DC volt meter capable of reading 100 volts DC.
3. A 10,000 ohm resistor (1 watt).

CAUTION: The test of this rectifier assembly requires the use of a 120 volt AC circuit. Extreme care should be used when making this test to minimize the hazard of electrical shock.

Solder the 10,000 ohm resistor to the DC internal terminals of the rectifier, as shown in the accompanying illustration. Fig. 119.

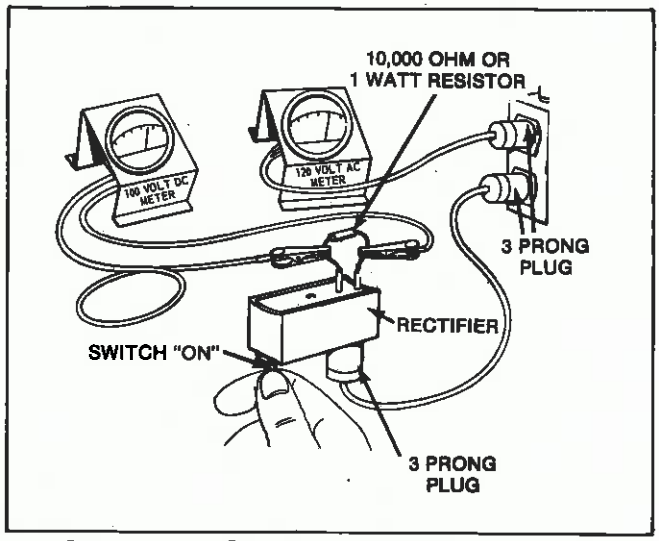

Fig. 119 — Checking Rectifier Assembly

Connect the DC volt meter between the rectifier field terminal and the brush terminal. Fig. 119.

Measure the line voltage of the 120 volt AC outlet to be used. A rectifier assembly in good condition will be within the following specifications:

1. With the switch in the off position, a zero reading should be observed on the DC volt meter.
2. With the switch in the on position, the DC volt meter reading should be 0 to 14 volts lower than the AC line voltage measured previously.

If the drop exceeds 14 volts, the complete rectifier assembly must be replaced, as individual parts for the rectifier assembly are not available.

ASSEMBLY OF STARTER MOTORS

When all parts have been thoroughly inspected, lightly lubricate the bearings with #20 oil and reassemble in the following manner. (Solder the field lead to the rectifier assembly and assemble the rectifier to the housing (120 VAC motor). Fig. 120.

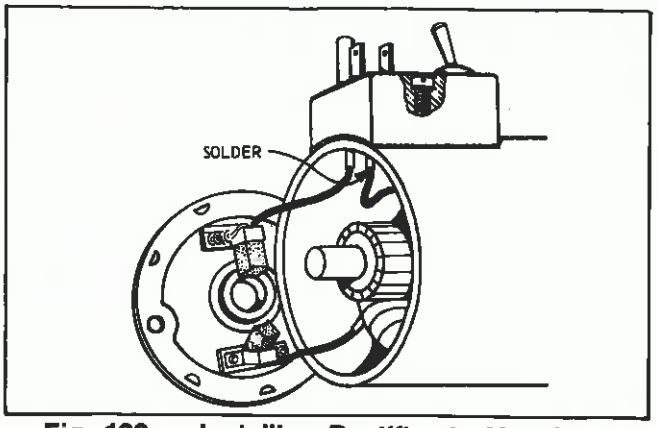

Fig. 120 — Installing Rectifier to Housing

Insert the brushes in their respective holders.

NOTE: A tool such as shown in Fig. 45 should be used to hold the brushes clear of the armature commutator when assembling the commutator end cap to the motor housing.

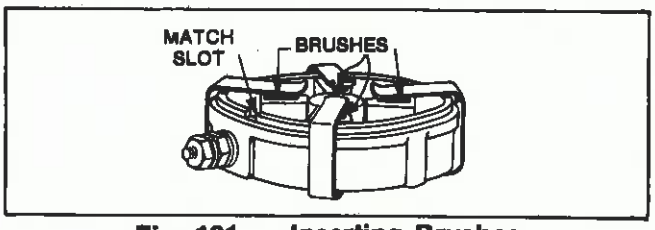

Fig. 121 — Inserting Brushes

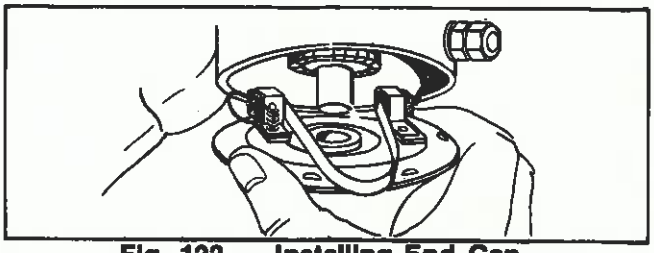

Fig. 122 — Installing End Cap

Slide the armature into the motor housing, being sure to match the drive end cap keyway to the stamped key in motor housing. Assemble end cap, again matching the keyway to key in housing. Care should be used to prevent damage to ceramic magnets where used.

Assemble thru bolts, lockwashers and nuts.

NOTE: THRU BOLTS AND NUTS MUST BE PLACED IN THE SAME POSITION AS WHEN REMOVED OR INTERFERENCE MAY RESULT.

After Hi-Pot test and assembly of the starter motor drive, the starter motor is now ready for installation to the engine.

GEAR DRIVE STARTER MOTOR USED ON MODELS 300400 and 320400

This starter motor uses a gear type engagement method, similar to an automobile starter. When the starter motor is activated, the helix on the starter motor shaft drives a pinion gear into engagement with a ring gear attached to the engine flywheel and cranks the engine.

Recommended battery sizes range from 32 ampere hour for normal service to 50 ampere hour for -20° F service.

CHECKING STARTER MOTOR DRIVE

When the starter motor is activated, the pinion gear should engage the flywheel ring gear and crank the engine. This action can be observed by removing the blower housing. If the starter motor drive does not react properly, inspect the helix and pinion gear for freeness of operation. If any sticking occurs, this must be corrected. Proper operation of the starter is dependent on the pinion freely moving on the helix. See Fig. 123.

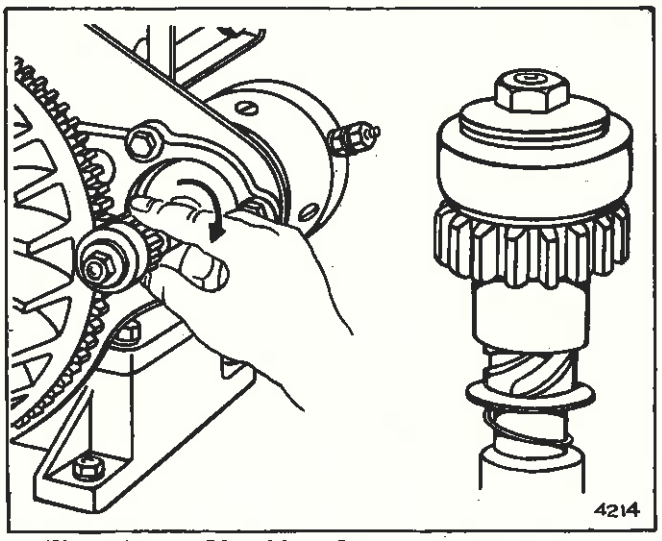

Fig. 123 — Checking Starter Motor Drive

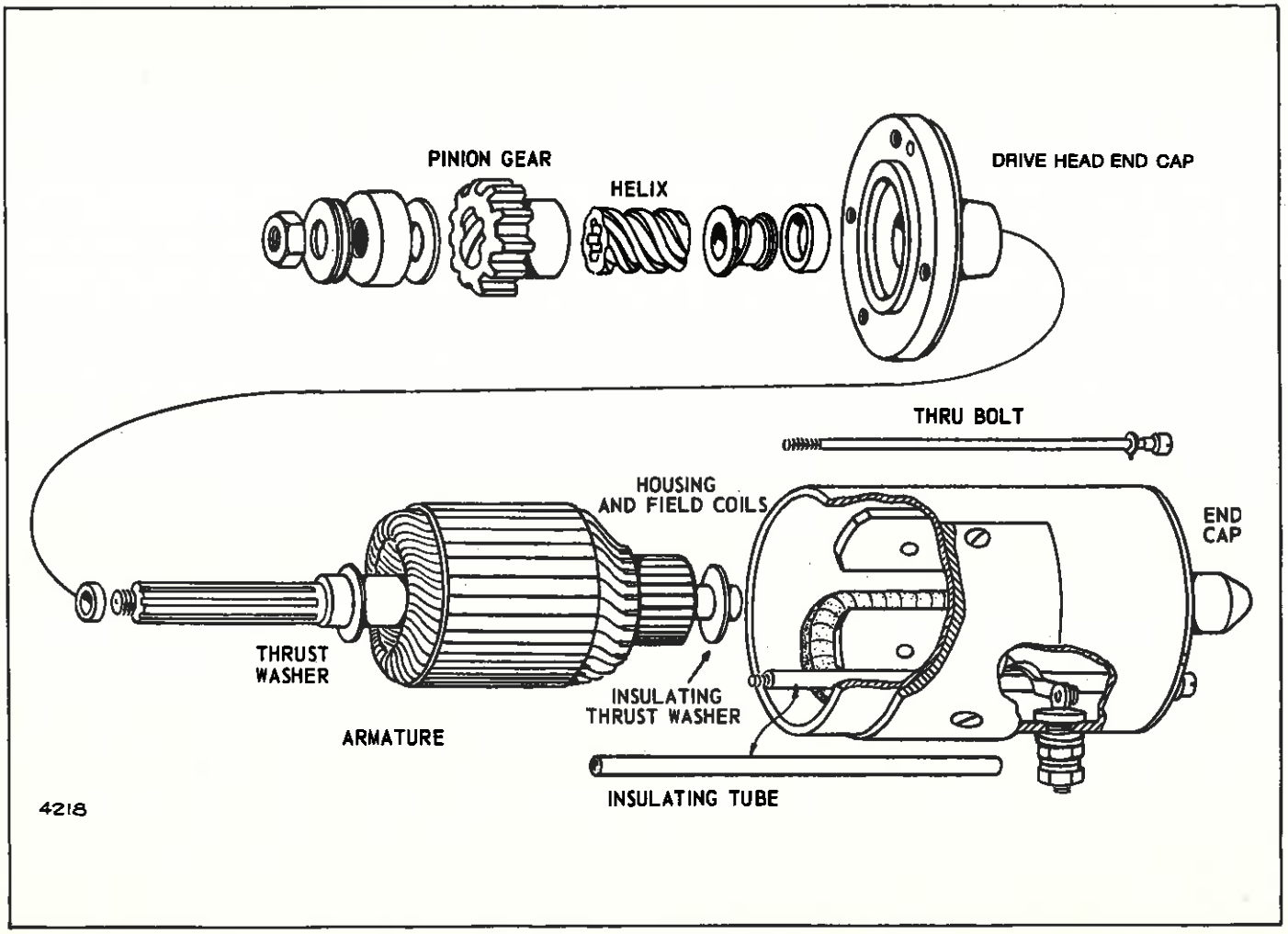

Fig. 124 — Exploded View

CHECKING THE STARTER MOTOR

A performance test of the starter motor may be made in the following manner.

Equipment Needed —

1. A tachometer capable of reading 10,000 RPM.
2. A 12 volt battery ± 0.3 volts.
3. An ammeter capable of reading 100 amperes.

Connect the starter motor, battery and ammeter as shown on the accompanying illustration. See Fig. 125.

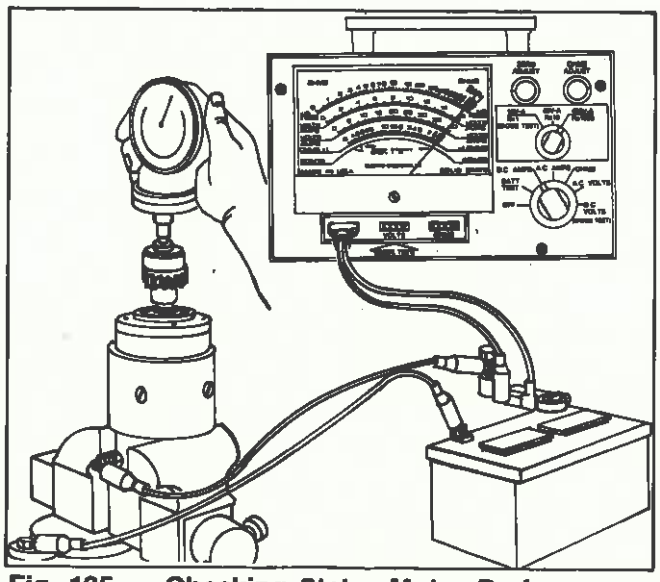

Fig. 125 — Checking Stator Motor Performance

Insert the tachometer in the end of the starter motor and activate the starter motor. A starter motor in good condition will be within the following specifications.

1. Starter motor RPM — 5500 minimum.
2. Current draw (amperes) — 60 maximum (Disregard surge current.)

If the starter motor does not perform satisfactorily, the following should be checked and corrected if necessary.

1. A binding or seizing condition in the starter motor bearings.
2. Starter motor brushes sticking in brush holders.
3. A dirty or worn armature commutator or brushes.
4. A shorted, open or grounded armature or field coil.

DISASSEMBLY OF STARTER MOTOR

(See checking starter motor drive if repair, cleaning or replacement of drive assembly is necessary.)

Remove thru bolts and commutator end cap. The armature, drive cap and gear drive may be removed as an assembly. See Fig. 126.

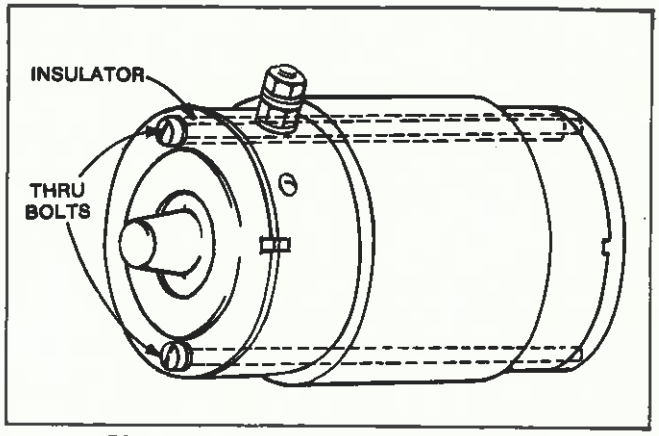

Fig. 126 — Removing Thru Bolts

Clean all dirt accumulations from the armature, end caps, etc. The bearings, housing and armature should not be soaked in a cleaning solution. The armature commutator may be cleaned with a 000 sand paper. Do not use emery cloth, as emery will embed in the commutator and cause rapid wear. If it is suspected that the armature or field coil is defective, a new armature or field coil should be tried in the motor. If proper testing equipment is available, check the suspected armature or field coil to determine if it is defective. The brushes should be checked for poor seating, weak brush springs or dirt and oil. Check to be sure brushes are not sticking in their respective brush holders. See Fig. 127.

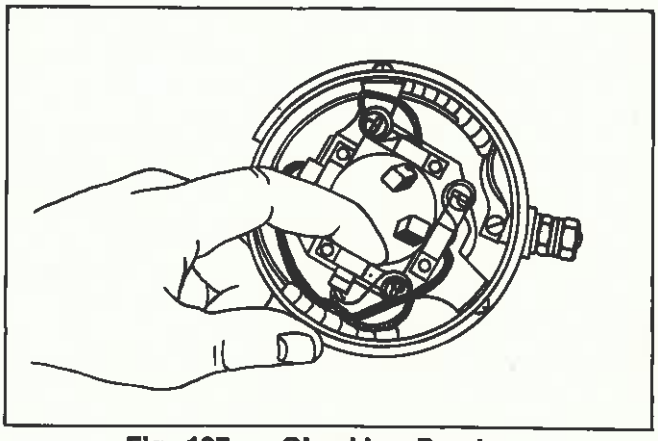

Fig. 127 — Checking Brushes

ASSEMBLY OF STARTER MOTOR

When all parts have been thoroughly inspected, lightly lubricate the bearings with #20 oil and re-assemble in the following manner:

Slide the armature into the housing. Drive cap key must match keyway in housing. Insert brushes and brush spring in their respective brush holders as shown in Fig. 128.

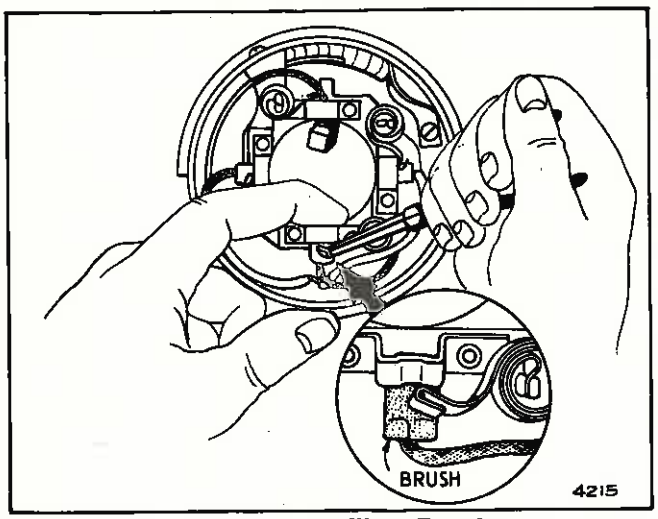

Fig. 128 — Installing Brushes

Install insulator tube on thru bolt close to motor terminal. See Fig. 129. Assemble end cap, matching key to keyway in housing. Tighten thru bolts securely.

NOTE: Insulating thrust washer must be installed on armature shaft or shorting will occur when commutator bars contact end cap. Fig. 129.

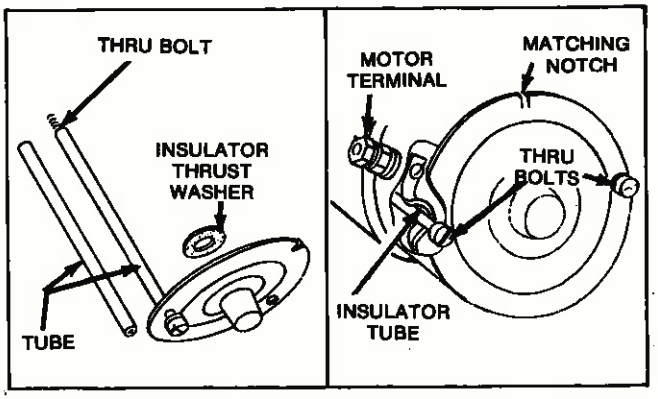

Fig. 129 — Installing Thrust Washer and Insulator Tube

After assembly of the starter motor drive, the starter motor is now ready for installation to the engine.

7 B

12 VOLT ELECTRIC STARTER-GENERATOR UNIT

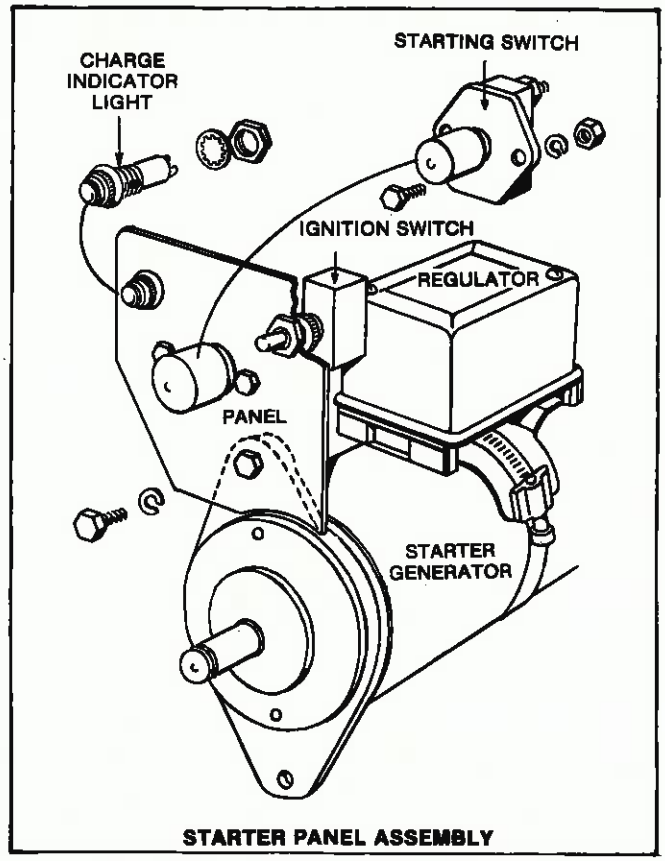

Fig. 130 — Starter Panel Assembly

Removing and Replacing Belts

Remove belt guard. Loosen starter-generator unit mounting bolts and push the unit toward the engine as far as it will go. The belt(s) can then be removed. (Note: Starter-generator units on some models are equipped with two belts. On these units, both belts should be replaced even though only one belt appears to be worn. Use only matched sets of belts.) Do not force belts onto pulleys. There is sufficient adjustment to allow them to be slipped in place. After belt has been installed apply a 30 lb. (13.6 kg) force to the upper pulley and flange.

Tighten mounting bolts securely and replace belt guard. NOTE: Belts are of special high strength design. See Figs. 134 and 135 on page 43. Use only genuine factory replacements obtainable at authorized Briggs & Stratton service station.

Emergency Winter Operation

If run-down batteries are repeatedly experienced due to short or infrequent operation at low temperatures, it is advisable to temporarily increase the generator charge rate.

A simple method of increasing the charge rate is to disconnect the lead to the regulator BAT terminal and reconnect this lead to the regular (L) terminal. This bypasses the current-voltage feature of the regulator automatically increasing the amount of charge to the battery. See Fig. 132.

CAUTION: Operate the regulator with these connected during cold weather when operating periods are short or infrequent. Re-establish the original lead connections as soon as mild weather returns or operating time becomes normal; otherwise the battery will be damaged by over charging.

Battery Size

A 12 volt battery of 50 ampere hour capacity is recommended. CAUTION: Battery must have negative (-) terminal grounded to engine or machine frame.

Maintenance of Battery and Cables (See Fig. 131 for cable size)

Check electrolyte level every 100 hours. Maintain level with distilled or demineralized water. Avoid overfilling. Keep top of battery clean by periodically washing with a brush dipped in ammonia or bicarbonate of soda solution followed by flushing with clean water. Keep battery hold down clamps tight to prevent vibration of battery, but do not overtighten as this may warp case.

Battery cable clamps must be kept tight on terminals to provide a good contact. If corrosion occurs at terminals, disconnect cables and clean clamps and terminals separately. Coat clamps with petroleum jelly and re-install.

Warranty and Service

For warranty and service on all Delco-Remy parts, contact United Motors Service Agencies.

STARTER-GENERATOR WIRING DIAGRAM

The three drawings shown below illustrate the most common method of wiring 12 volt starter-generator units.

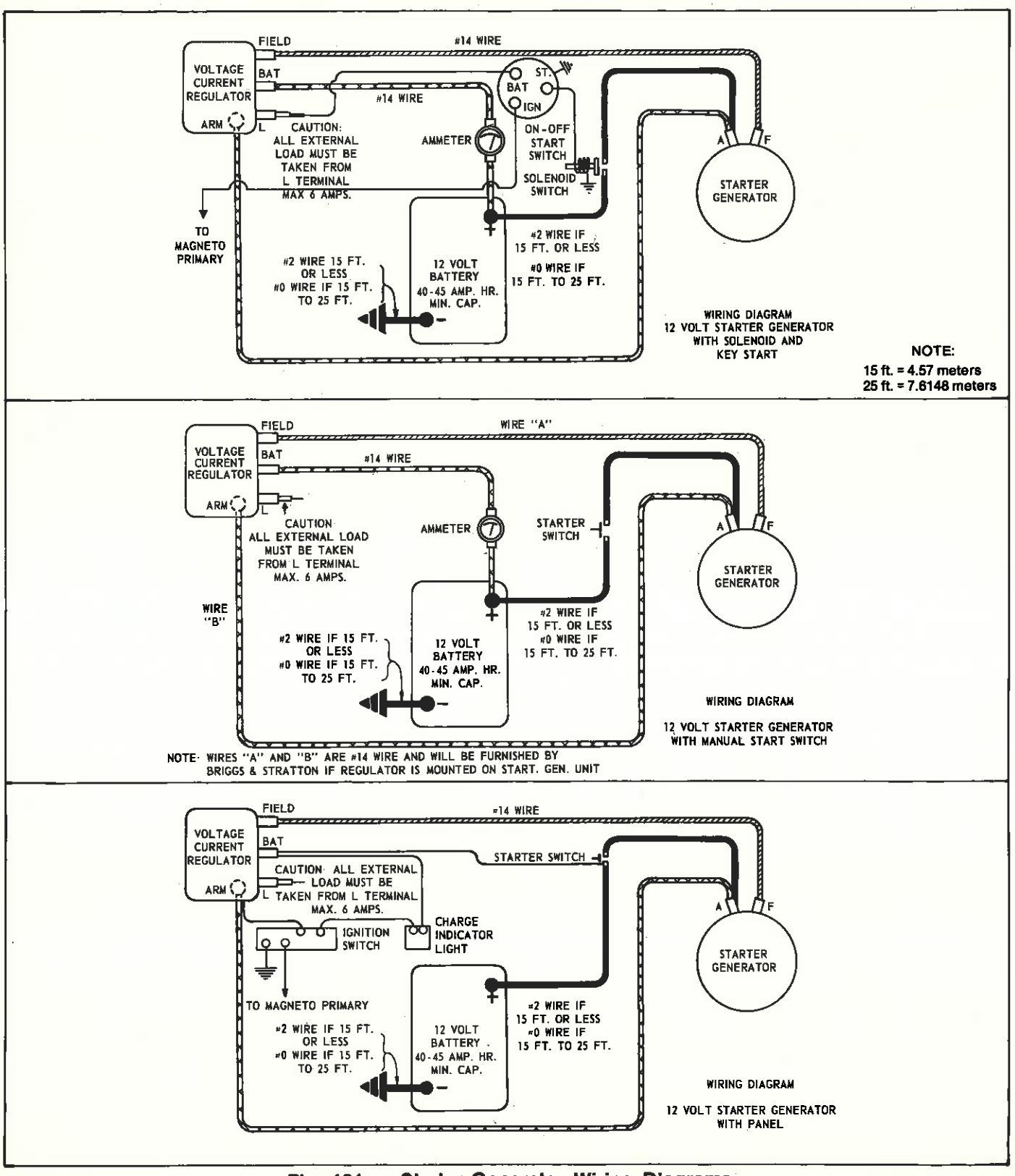

Fig. 131 — Starter Generator Wiring Diagrams

CHECKING 12 VOLT STARTER-GENERATOR SYSTEMS

The following tools and materials should be available.

1. Hydrometer
2. Battery cable and terminal cleaning tool
3. Hand tools for tightening belts and connections
4. Baking soda and water
5. Briggs & Stratton 19236 VOA meter or Eico Model 540 Readi-Tester.
6. 4 to 6 amp taper battery charger

CHECKING BATTERY

Check for clean, corrosion-free and tight connections. Hydrometer reading should be a minimum of 1.225 and each cell should read within less than .050 variation after charging. Battery must meet these conditions before conducting starter-generator tests.

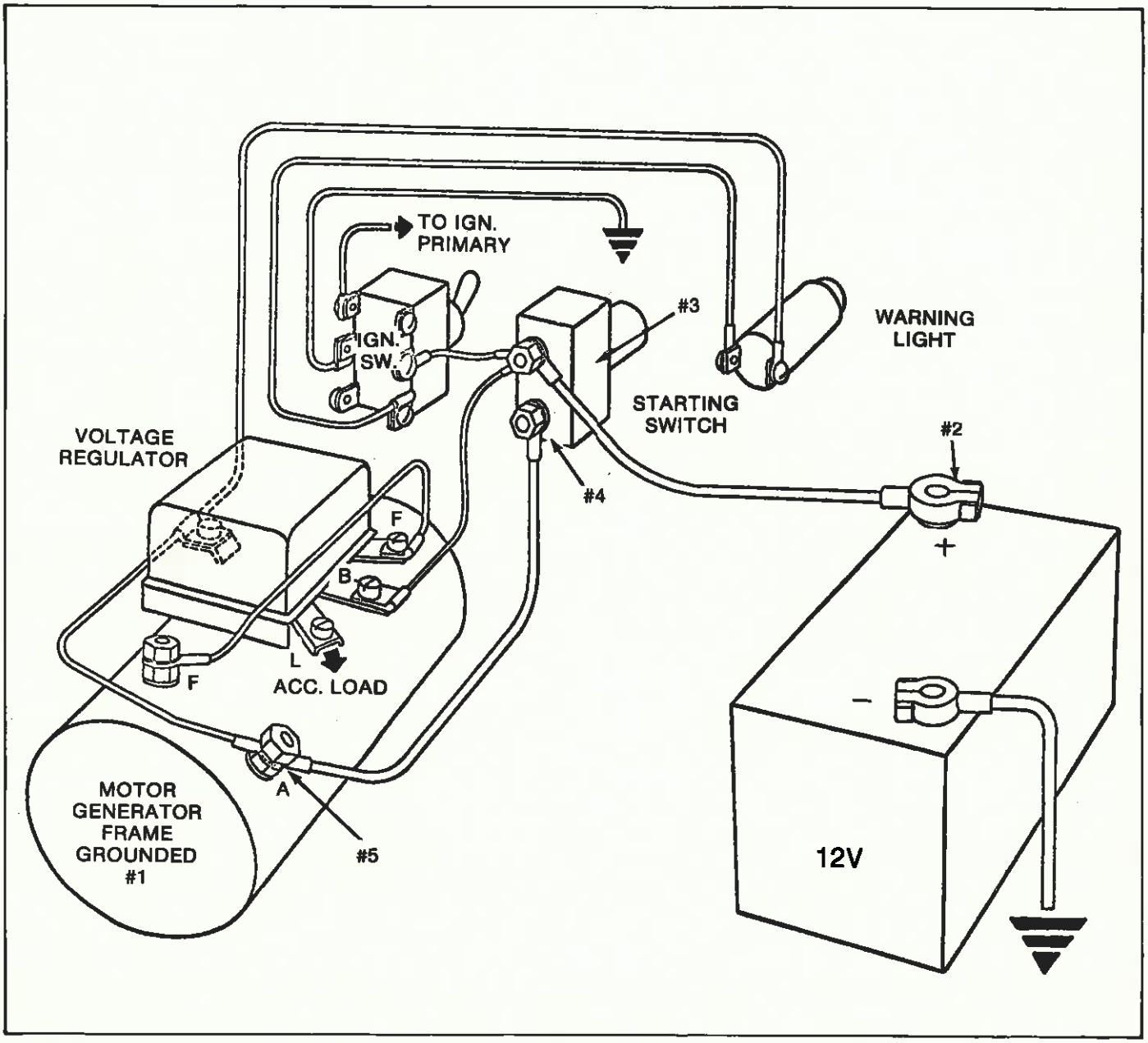

Fig. 132 — Wiring Diagram

STARTERS
Starter Generator 12V

CHECKING STARTER-GENERATOR AND REGULATOR (See Fig. 132)

NOTE: All tests to be made with ignition off and starter switch pressed long enough for meter needle to settle.

1. Checking Ground Resistance (Poor Connection)

Plug black lead in black common meter socket and red lead in VOLTS-OHMS-LEAKAGE socket. Negative test lead to #1 (ground). Positive test lead to #2. Press starter switch. Meter should read 10 volts or more.

2. Checking Lead to Switch

Leave negative test lead at ground #1. Move positive lead to #3. Low or no voltage reading while pressing starter switch indicates defective positive battery cable or connection.

3. Checking Starter Switch

Move the positive test lead to #4. The meter should read "close to battery voltage" when starter switch is pressed. Very low or no voltage indicates a defective starter switch.

4. Checking Lead from Switch to Starter

Move the positive test lead to #5. Press the starter switch. The meter should read "close to battery voltage." If the starter motor does not crank and battery voltage is available, the starter motor is defective. If voltage is not available, cable or connection between test-point #5 and #4 is defective.

5. Generator-Regulator Test

Set test meter at 15 amps, put red lead in AMP socket. Disconnect wire at voltage regulator terminal "B," and connect test instrument in series. The meter will register charge, if any, to the battery when the engine is running. The charge will start approximately 1800 to 2000 engine RPM, and will vary according to the battery state of charge.

If meter reads 10 amps or more, disconnect "F" terminal at regulator. If output remains high, the generator is defective. If output stops, the regulator is defective.

If no charge is shown on meter, short the regulator "F" terminal to ground. Meter should then show a 10 amp or more charge. No charge would indicate a defective generator. A charge would indicate a defective regulator.

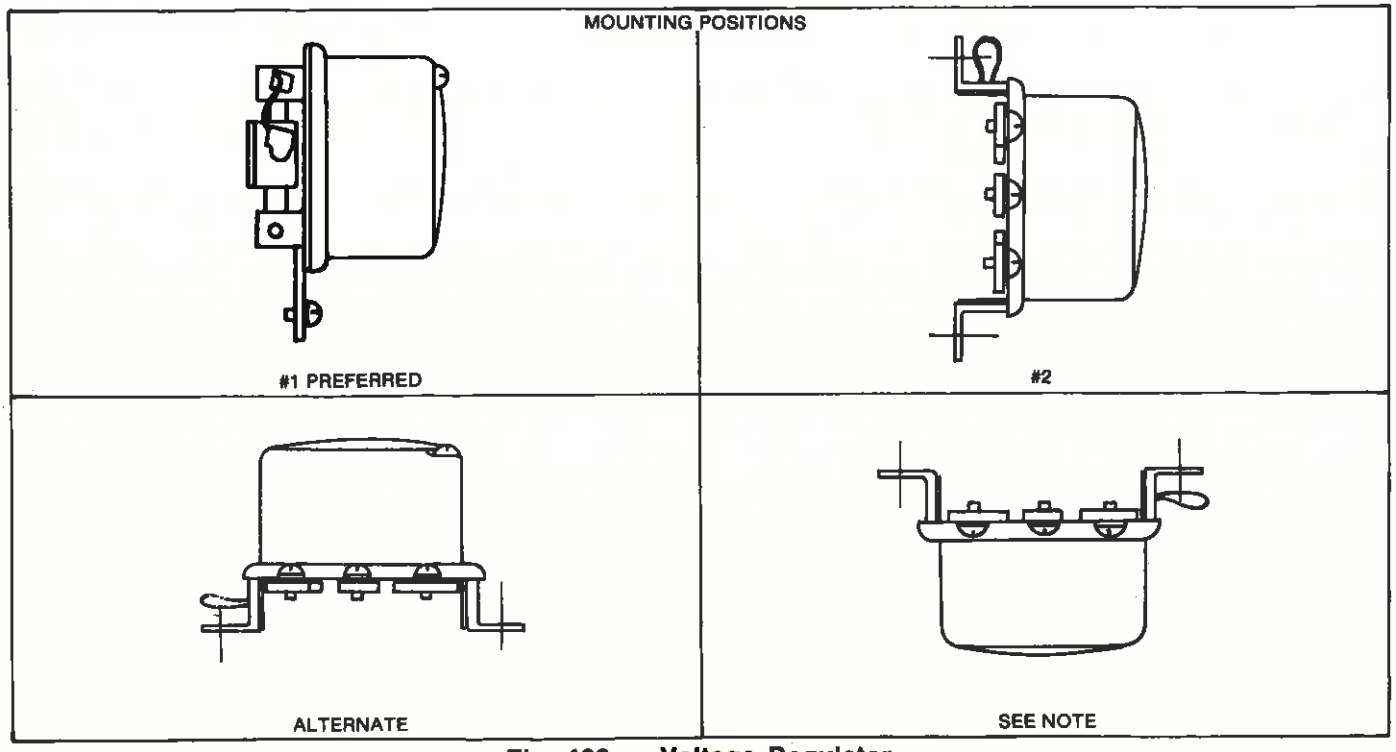

Fig. 133 — Voltage Regulator

Installation of Voltage Regulators

NOTE: Avoid — Regulator will not function in this position.

Regulator should be mounted at a point of minimum vibration.

There must be a good ground connection between regulator mounting feet and equipment frame and between the engine and equipment frame. If this is not possible, a #14 wire must be run from the grounded regulator mounting foot to the engine.

12 Volt Starter-Generator

Belt Adjustment Procedure

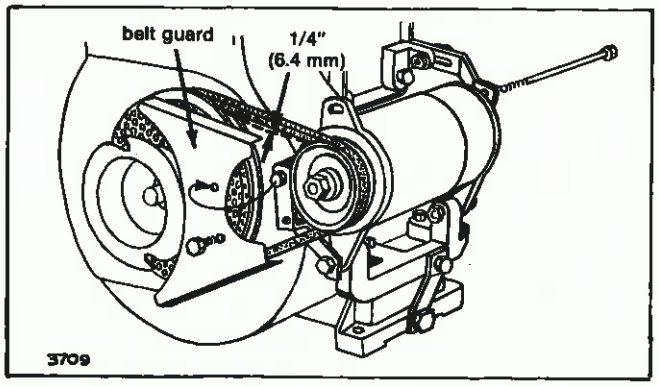

Fig. 134 — 12 Volt Starter-Generator (Low Position)

To adjust, tilt away from blower housing until belts move up and down 1/4" with thumb pressure at a point midway between pulleys. Tighten screws to hold in place and install guard and tighten in place. Fig. 134 and Fig. 135.

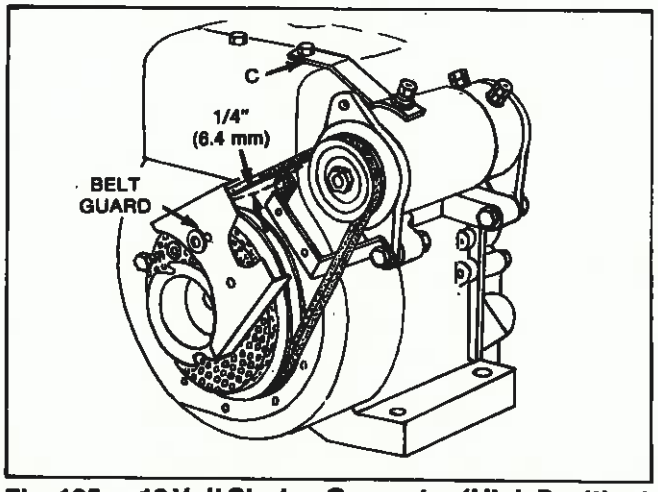

Fig. 135 — 12 Volt Starter-Generator (High Position)

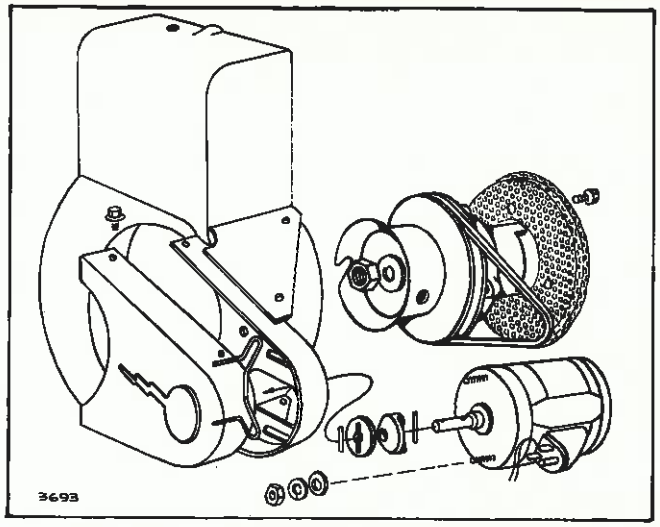

Fig. 136 — Belt Drive 120 Volt Starter

Adjust Belt (120 Volt AC Starter Motor)

Belt adjustment is made by loosening the two nuts shown in Fig. 137, and sliding the motor in the slots. Torque on nuts in 15-20 inch pounds (1.7 to 2.2 Nm).

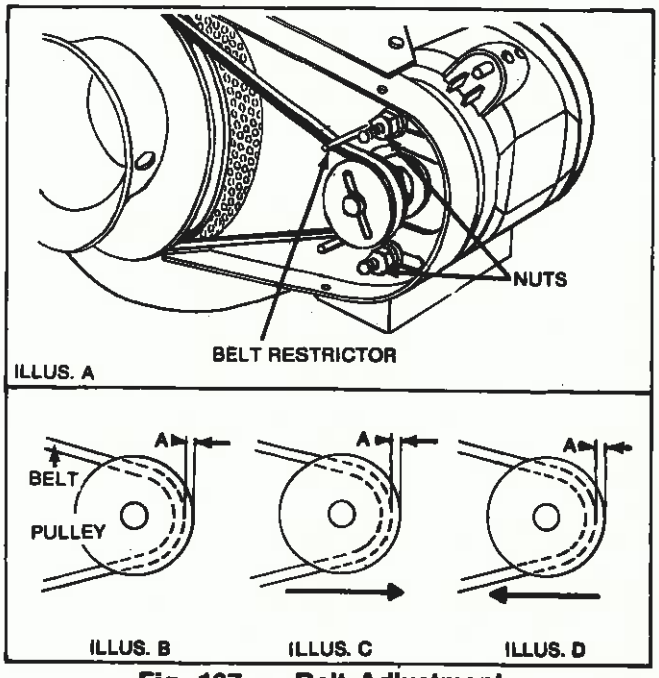

Fig. 137 — Belt Adjustment

Be sure belt is between prongs of the belt restrictor. Crank engine with starter motor and ignition "Off." Observe dimensions as indicated in Fig. 137, Illus. A. If dimension "A" is 3/32" to 1/8" (2.4 to 3.2 mm), belt is in proper adjustment. If dimension "A" is less than 3/32" while cranking, the starter motor must be adjusted away from the engine. If more than 1/8", the motor must be adjusted toward the engine.

Final Check (120 Volt AC Starter Motor)

Starting motor should be tested under maximum load. To do this, turn engine by hand until compression stroke is reached. Plug in starter. Belt should engage and crank engine without slipping. When engine starts, disconnect plug. Belt should not circulate while engine is running. If two prong outlet is the only one available, it should be converted to three prong outlet. See Fig. 138.

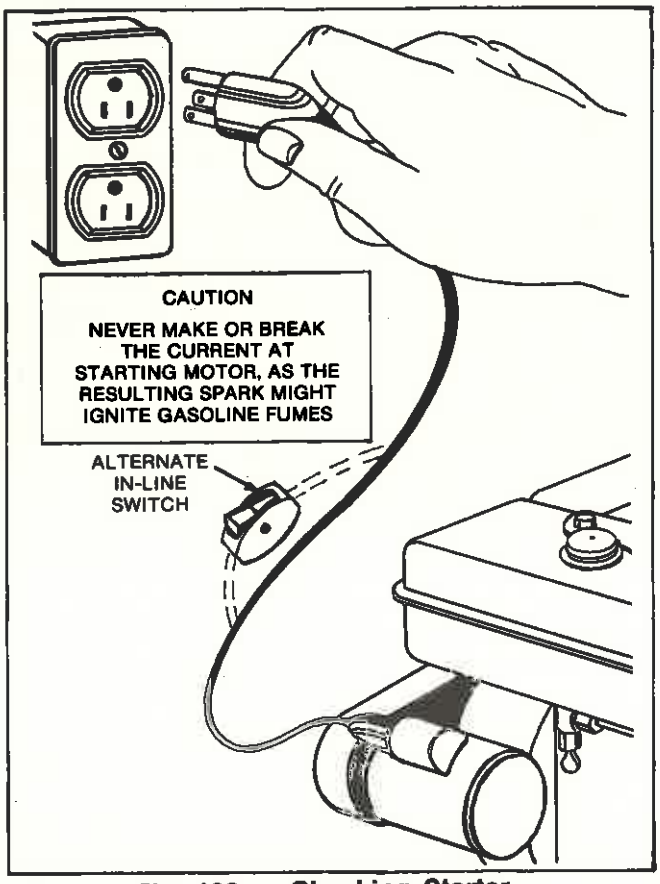

Fig. 138 — Checking Starter

7 B

12 VOLT BELT DRIVE STARTER

Operation

This Briggs & Stratton electric starter automatically engages a belt clutch and cranks engine when a 12 volt battery is connected between the terminal on the starter and engine cylinder. When engine starts, the belt clutch automatically disengages starter motor from engine. Driven equipment should be disengaged from engine prior to engaging electric starter. The starting system is designed to turn over engine only. Fig. 139.

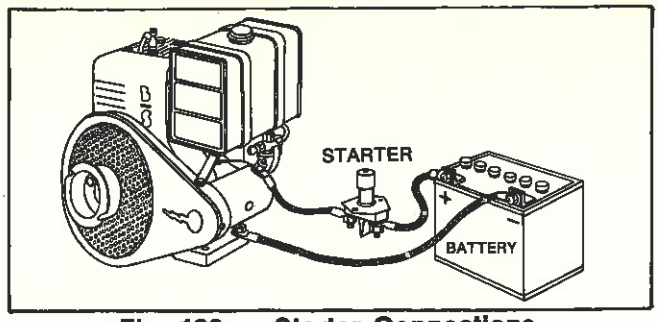

Fig. 139 — Starter Connections

Proper Electric Installation

Negative (-) side of battery must be grounded to engine. This lead must carry starting current and therefore, must be a No. 4 size wire or larger.

Another heavy lead (No. 4 or larger) should be connected from the starter motor terminal through the starter switch and to the positive (+) battery terminal. Fig. 140.

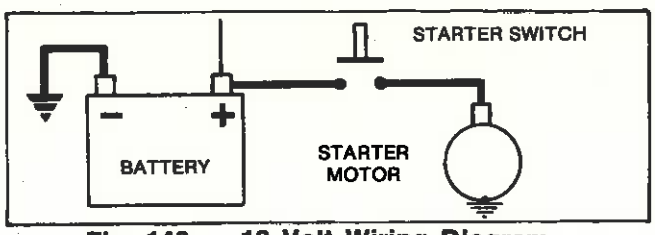

Fig. 140 — 12 Volt Wiring Diagram

Battery Size

A 12 volt battery of 40 to 45 ampere hour capacity is recommended.

Motor Repairs

For warranty and service on starter motors, contact Authorized Representative of Presto-Lite.

Adjust Belt

The two assemblies which had been used are shown below. Fig. 141 and 142. Adjust as follows:

Loosen nut "A" and "B" slightly so the starter motor can just be moved by hand. Move starter motor away from engine as far as possible. Rock engine pulley back and forth and at the same time, slowly slide the starter motor toward engine until the starter motor pulley stops being driven by the vee belt. Move starter motor another 1/16" (1.6 mm) toward the engine. Tighten nuts "A" and "B."

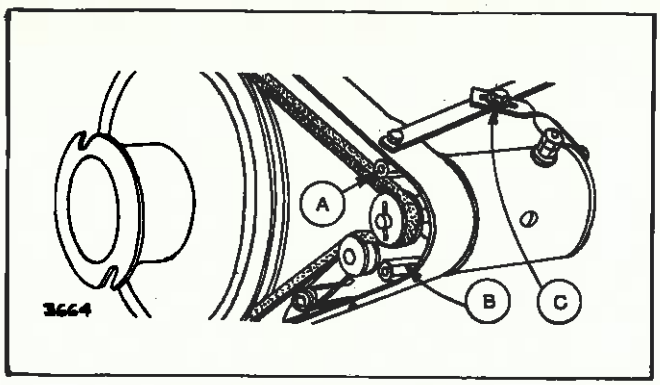

Fig. 141 — Adjust Belt

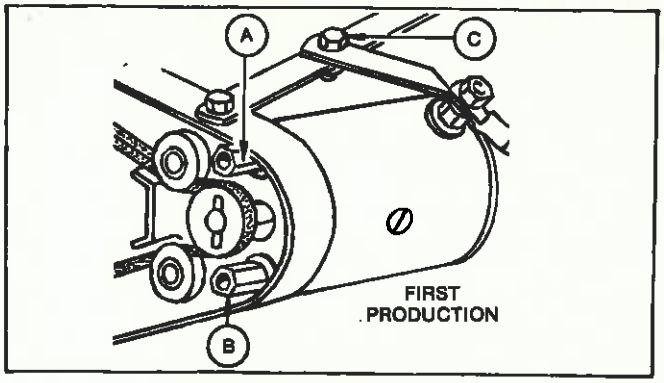

Fig. 142 — Adjust Belt

ALTERNATOR
Identification

Alternators are used on engines noted and may be located on page indicated.

Basic Engine Model Series	1½ Ampere	4 Ampere	7 Ampere	10 Ampere Fuse Type	10 Ampere Regulated	Dual* Circuit	Tri-Circuit
130000	48						
140000		62	58			52, 55	
170000		62	58		66	51, 52, 55	64
190000		62	58		66	51, 52, 55	64
220000					66	51, 52	64
240000					66		64
250000					66	51, 52	64
320000				68	66	51, 52	64

*AC or DC only included with Dual Circuit Alternators.

Fig. 143

ALTERNATOR TROUBLESHOOTING

The following list is provided to aid you in diagnosing problems for alternator systems.

Battery — Not Charging	Alternator defective
	Diode/rectifier defective
	Regulator defective
	Wiring, shorted, broken or corroded
	Stator, damaged
	Battery cables connected to wrong terminals
	Battery defective
	Flywheel magnets, broken or not charged
Battery — Overcharging	Regulator defective (regulated alternator only)
	Battery size too small for alternator
	Vibration/equipment (battery appears to be overcharging when water splashes from battery caps.)
Lights — Not Functioning	Light bulbs, defective
	Wiring, shorted or broken
	Light switch, defective
	Stator defective
	Regulator (regulated alternator), defective
	Battery defective (regulated alternator)

Fig. 144

WARNING: Do not strike flywheel with a hard object or metal tool as this may cause flywheel to shatter in operation, causing personal injury or property damage. Use Briggs & Stratton approved tools only, and if in doubt, contact your Authorized Briggs & Stratton Service Center.

Equipment to Test Alternators

The following list of equipment is recommended for test and repair of alternators.

Volt/Ohm/Ampere (VOA) Meter

The VOA meter is available from your Briggs & Stratton source of supply. Order as part no. 19236. The meter may be used to read volts, ohms or amperes when leads are attached to appropriate connector. Fig. 145.

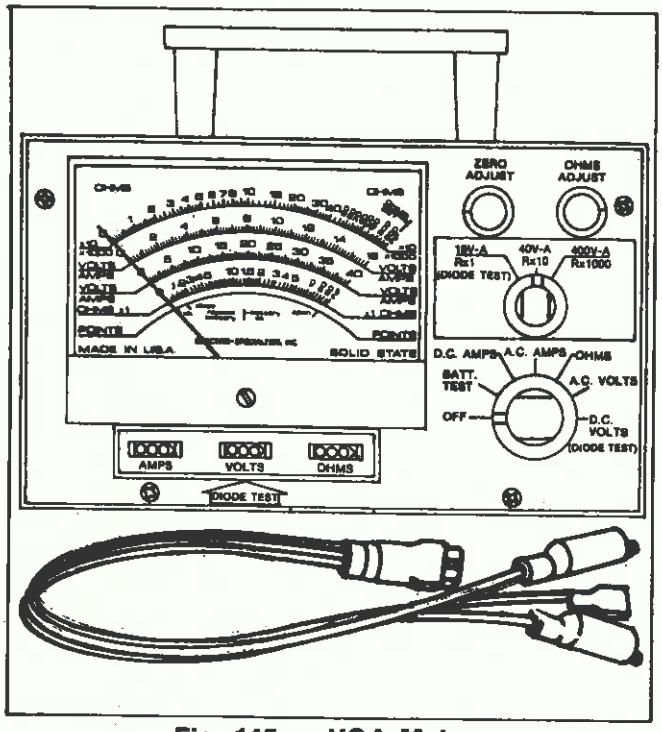

Fig. 145 — VOA Meter

Ammeter

Range 20-0-20; available from automotive parts supplier or use Briggs & Stratton No. 295158. Attach leads and alligator clips as shown in Figure 146.

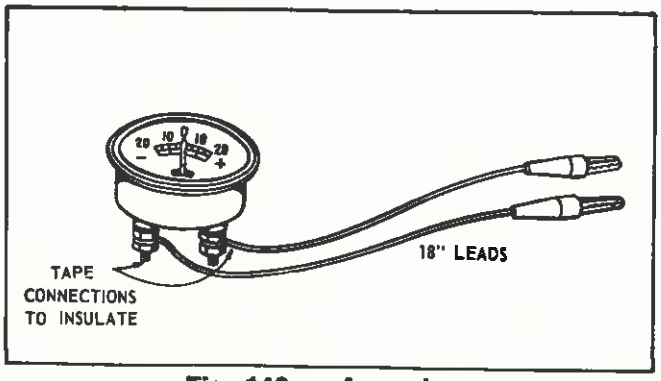

Fig. 146 — Ammeter

Test Lamp

12-volt bulb and bulb holder; available from automotive parts supplier, or use Briggs & Stratton No. 67245 bulb and No. 298586 bulb holder. Attach leads and alligator clips as shown in Figure 147.

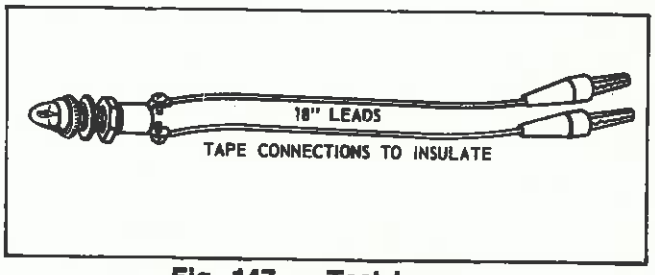

Fig. 147 — Test Lamp

Fuse Cap Test Lead

Part no. 390888 fuse cap. Attach alligator clip as shown in Figure 148.

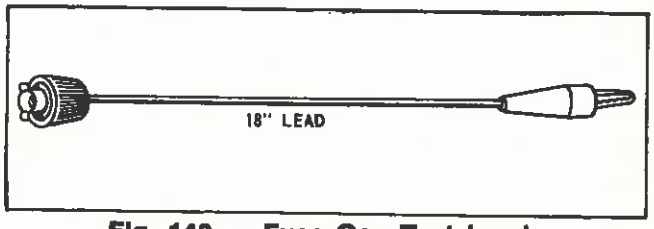

Fig. 148 — Fuse Cap Test Lead

Load Lamp

G.E. No. 4001 sealed beam headlight or equivalent. Available from automotive parts supplier. Attach leads and clips as shown in Figure 149.

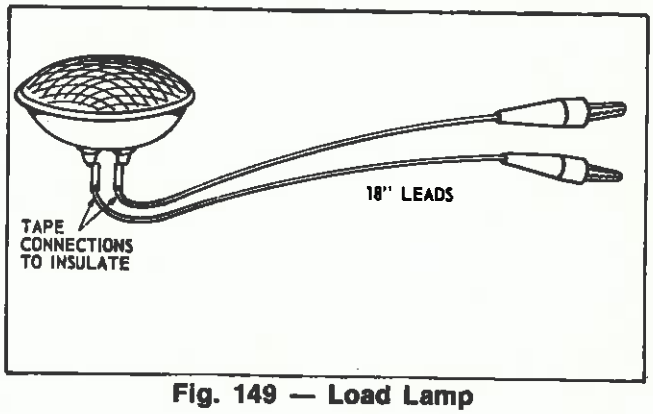

Fig. 149 — Load Lamp

Fuses

AGC or 3AG, 7-1/2 and 15 ampere fuse, available from automotive parts supplier or Briggs & Stratton No. 67125 (7-1/2 amp.) and No. 67345 (15 amp.).

7 C

ALTERNATOR
1½ Amp

1-1/2 AMP ALTERNATOR
Used on Model Series 130000

The integral 1-1/2 ampere alternator, with solid state rectifier, is designed for use with a compact battery. A 12 ampere hour battery is suggested for warm temperature operation and a 24 ampere hour battery should be used in cold service.

The alternator is rated at 3600 RPM. At lower speeds available output is reduced.

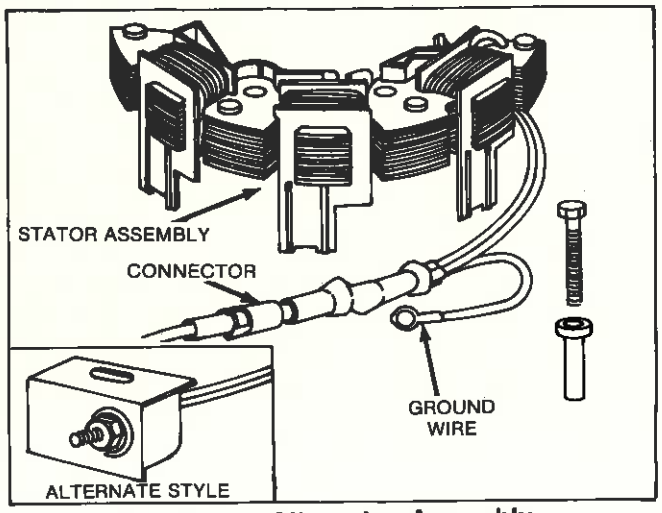

Fig. 150 — Alternator Assembly

WHEN CHECKING ALTERNATOR COMPONENTS, MAKE THE TESTS IN THE FOLLOWING SEQUENCE:

CHECKING 1-1/2 AMP. NON-REGULATED ALTERNATOR

Condition Found (Battery Run Down)

Check battery polarity. Negative (-) side of battery should be grounded to engine or frame; positive (+) side of battery to starter motor and alternator charge lead. Figure 151. If reversed, rectifier will be damaged.

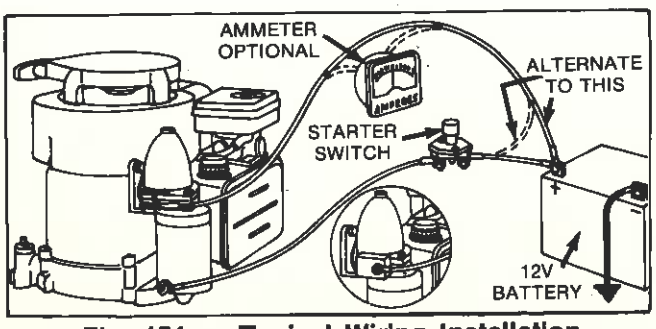

Fig. 151 — Typical Wiring Installation

Testing for Output

Disconnect connector or charging lead from charging terminal. Fig. 152 and 153. Do not allow terminal on charging lead to touch engine or equipment. Clip 12 volt load lamp between charging terminal and ground. Start engine. if lamp lights, alternator is functioning. If lamp does not light, alternator system is defective. The same test may be performed using 19236 Briggs & Stratton VOA meter.

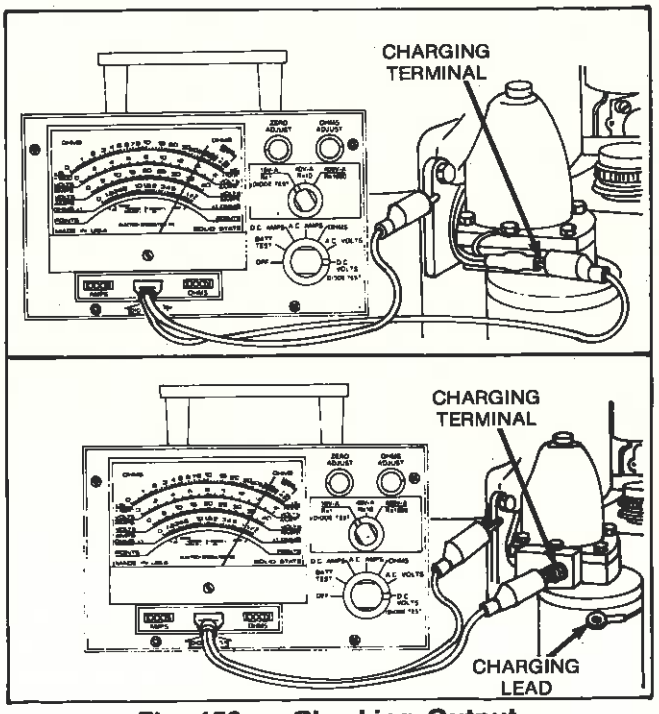

Fig. 152 — Checking Output

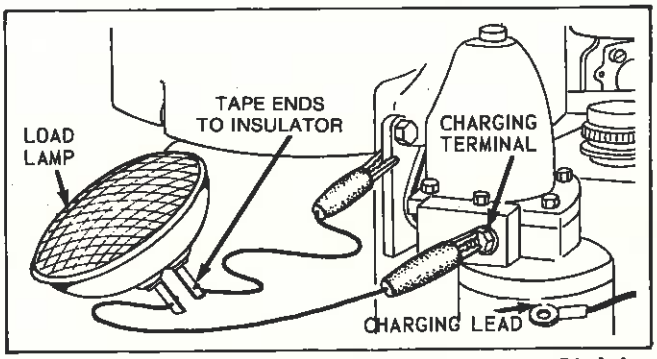

Fig. 153 — Checking Output, (Alternate Style)

Testing Stator

Unplug connector or disconnect charging lead from battery and rectifier assembly on alternate style. Remove screw from ground wire or rectifier assembly from starter motor. Turn rectifier assembly to expose wires attached to soldered terminals on alternate style.

NOTE: Ground wire or rectifier assembly must not touch the engine during this test.

Start engine. With engine running, pierce stator wires with probes from load lamp or touch terminals in rectifier box. Fig. 154 and 155. If load lamp lights, the stator is satisfactory. If load lamp does not light, the flywheel magnet or stator is inoperative. The flywheel should be examined to be sure magnet is charged. If required, replace flywheel or the stator.

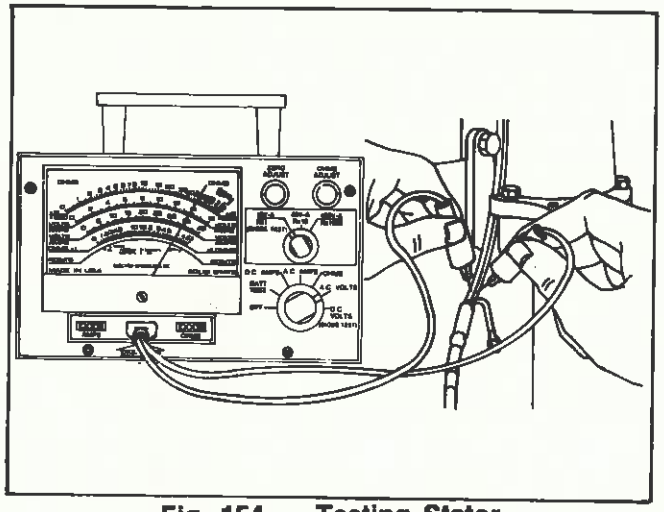

Fig. 154 — Testing Stator

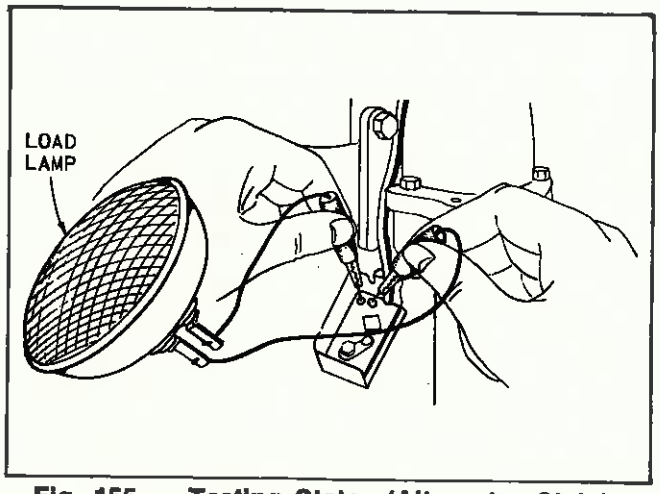

Fig. 155 — Testing Stator (Alternator Style)

Replacing Defective Stator

Remove the blower housing, rotating screen, clutch assembly and flywheel. Note and remember location of stator wires, under one coil spool, then between starter and drive unit housing as shown in Fig. 156. Remove ground wire or rectifier assembly from starter drive housing. Remove the two stator mounting screws and bushings.

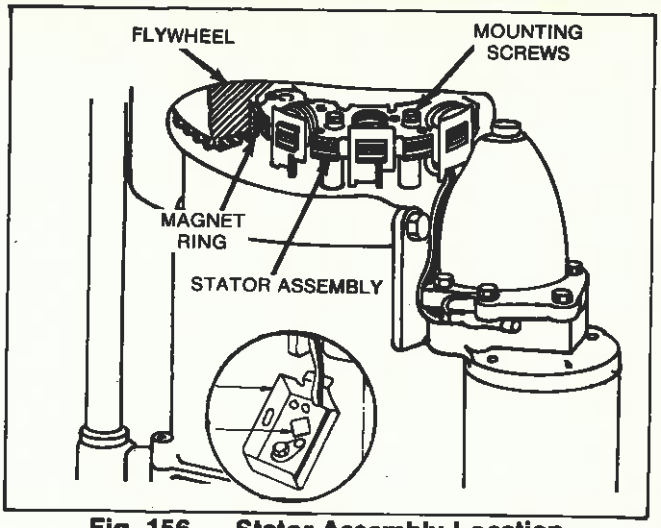

Fig. 156 — Stator Assembly Location

Install new stator assembly with stator mounting screws and bushings. Be sure leads are properly positioned as shown in Figure 157. While tightening mounting screws, push stator toward crankshaft to take up clearance in bushing. Torque mounting screws 18 to 24 inch pounds (1.6 to 2.1 Nm). Before re-assembly, locate stator wires against cylinder in order to clear ring gear and flywheel. Attach ground wire or rectifier assembly to drive housing. Replace flywheel and torque clutch housing as noted on specification chart. Re-assemble rotating screen and blower housing.

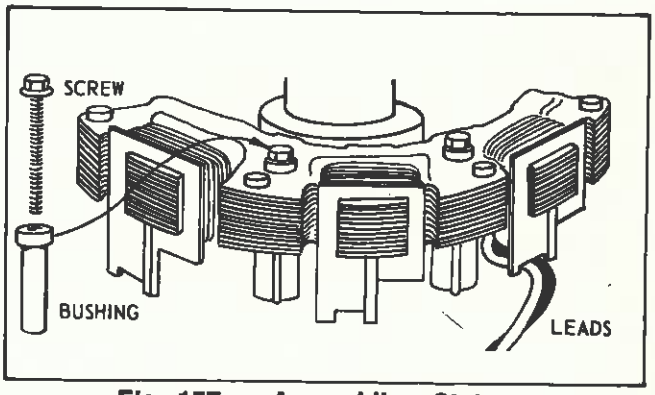

Fig. 157 — Assembling Stator

Testing Rectifier

Do not start engine. Use the #19236 VOA meter to test resistance from charging terminal to ground, as shown in Fig. 158 or 159. Now reverse test leads and recheck. One way there should be a meter reading. The other way there should not be a meter reading. The actual meter readings are not important. If the meter shows a reading both ways, or neither way, the rectifier is defective. Replace rectifier.

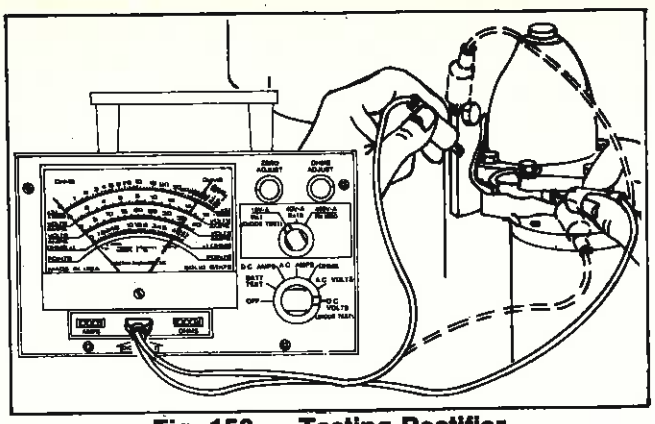

Fig. 158 — Testing Rectifier

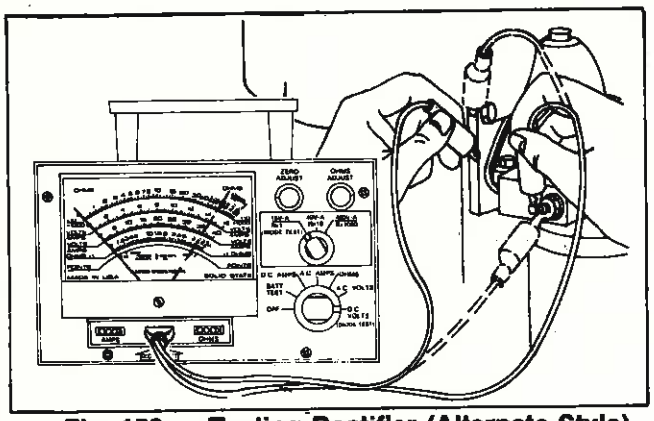

Fig. 159 — Testing Rectifier (Alternate Style)

Replacing Rectifier

Cut stator wires close to rectifier so that stator wires remain as long as possible. Discard old rectifier. Strip insulation back 3/8" from stator wires. Replacement rectifier has two exposed wires which are already stripped of insulation. Twist and solder each stator wire to a rectifier wire. Insulate each connection with electrical friction tape, keeping connected areas as compact as possible. Remove and discard original ground wire from drive housing. Fasten new ground wire to drive housing. Locate wires as shown in Figure 160. Retest rectifier as shown in Figure 158 or 159.

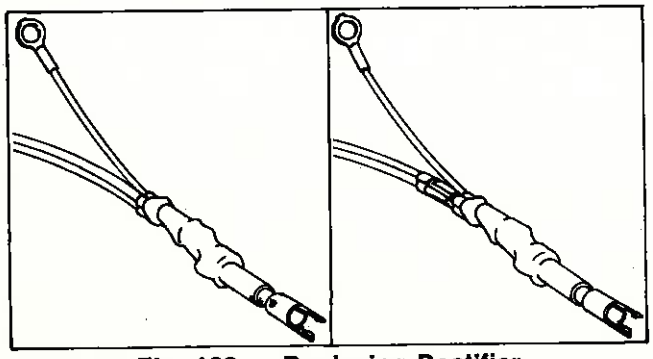

Fig. 160 — Replacing Rectifier

Replacing Defective Rectifier Box

Remove rectifier box from starter motor. Use a screwdriver to pry under the fibre board as shown in Figure 161. Fibre will break, exposing soldered connections between rectifier and stator leads. Cut stator leads close to eyelets so stator leads remain as long as possible. Strip insulation back to expose about 3/8" of wire. Discard defective rectifier box.

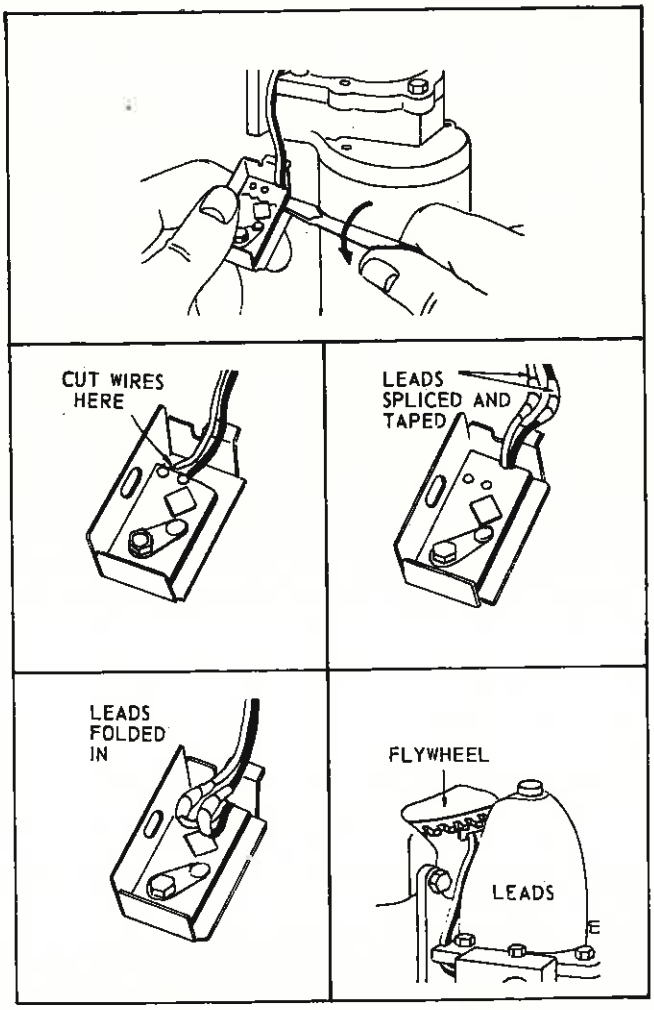

Fig. 161 — Replacing Rectifier

Replacement rectifier box has short leads, the tips of which are already stripped of insulation. Twist and solder each stator lead to a rectifier lead. Insulate each connection with electrical friction tape, keeping splices as compact as possible because of small space available. Form splices into bottom of rectifier box as shown in Figure 161, and re-assemble rectifier box to starter motor. Pull gently on leads to insure a firm connection and locate them as shown in Figure 161, so they cannot rub on flywheel ring gear. Recheck output as shown in Figure 153.

AC Only Alternator

The AC alternator is designed to operate as an integral part of the engine. It provides current for lights normally used on lawn and garden equipment.

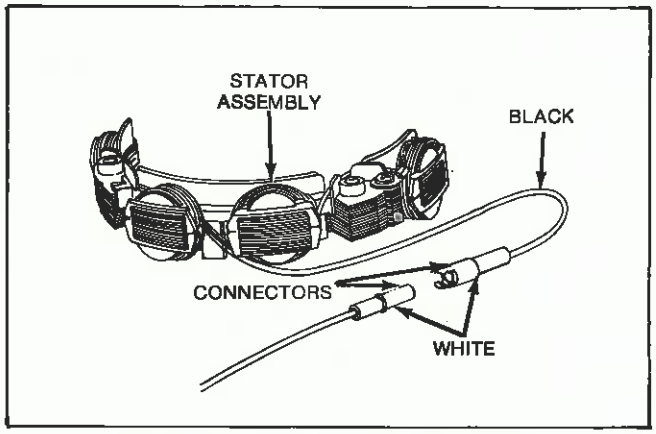

Fig. 162 — AC Circuit Alternator

Current for the lights is available as long as the engine is running. The output depends upon engine speed. Twelve-volt lights with a total rating of 60 to 100 watts may be used. With lights rated at 70 watts, the voltage rises from 8 volts at 2400 RPM to 12 volts at 3600 RPM, so the brightness of the light changes with the engine speed. The 5 amp lighting alternator uses less than .2 of a horsepower at full output.

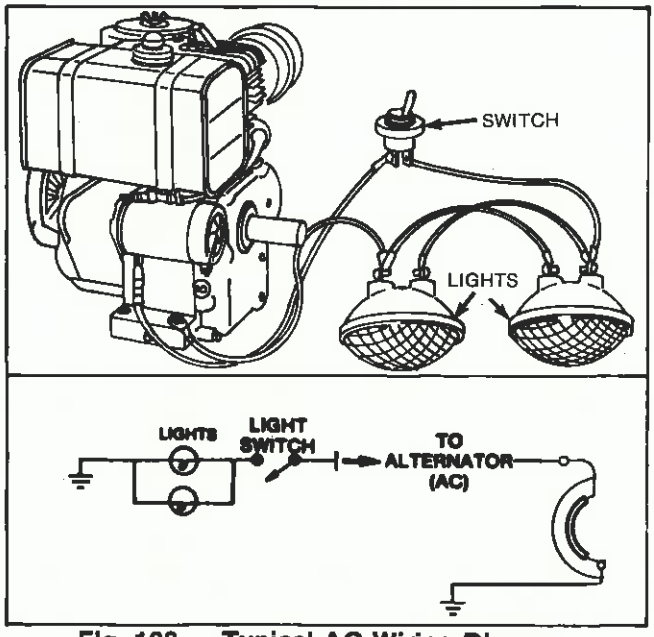

Fig. 163 — Typical AC Wiring Diagram

The test procedure for this alternator is located in the Dual Circuit Alternator Section 7, page 54.

DC Only Alternator

The DC alternator is designed to operate as an integral part of the engine and is separate from the engine starting system. It is intended to provide DC charging current for 12 volt batteries. Recommended battery sizes range from 12 ampere hour for warm temperature service to 24 ampere hour in coldest service for model series 130000. Model series 140000 and up range from 20 ampere hour for warm temperature service to 40 ampere hour in coldest service.

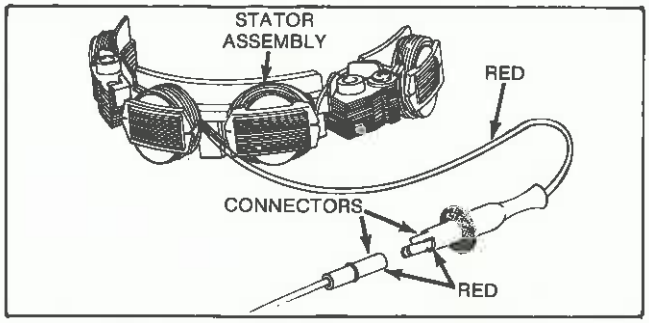

Fig. 164 — DC Circuit Alternator

The current from the battery charging alternator is unregulated and is rated at 3 amperes. The output rises from 2 amperes at 2400 RPM to 3 amperes at 3600 RPM; the alternator uses less than .2 of a horsepower.

WARNING: For electrical safety always remove cable from negative (-) side of the battery before attempting any repairs or maintenance to engine or equipment.

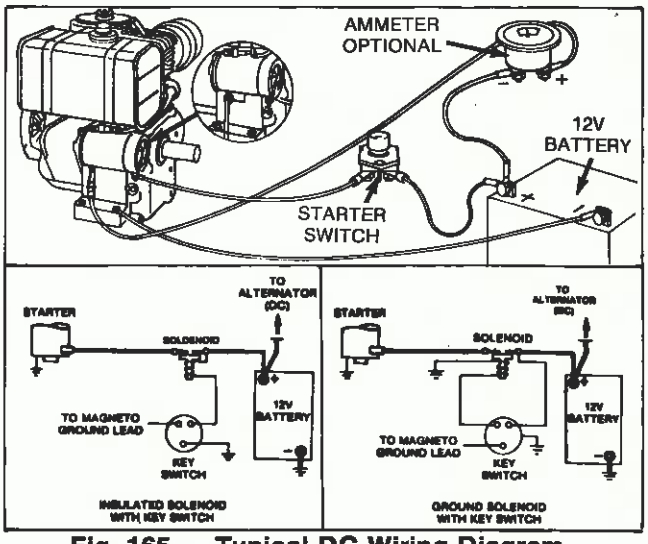

Fig. 165 — Typical DC Wiring Diagram

The test procedure for this alternator is located in the Dual Circuit Alternator Section 7, pages 52 and 53.

ALTERNATOR
Dual Circuit
5 Amp AC - 3 Amp DC - Rectifier Plug Type

The dual circuit alternator is designed to operate as an integral part of the engine and is separate from the engine starting system. Recommended battery sizes range from 20 ampere hour for warm temperature service to 40 ampere hour in coldest service.

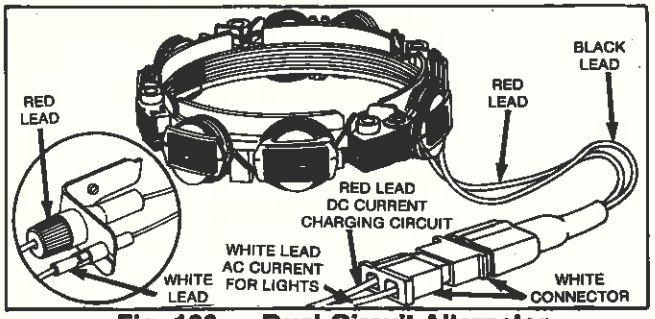

Fig. 166 — Dual Circuit Alternator

The dual circuit alternator is actually two separate alternator systems. A single ring of magnets inside the flywheel supplies the magnetic field for both of them. One alternator system uses a solid state rectifier and provides battery charging current. The other alternator system feeds alternating current directly to the lights. Since the two are electrically independent, use of the lights does not reduce the charge going into the battery.

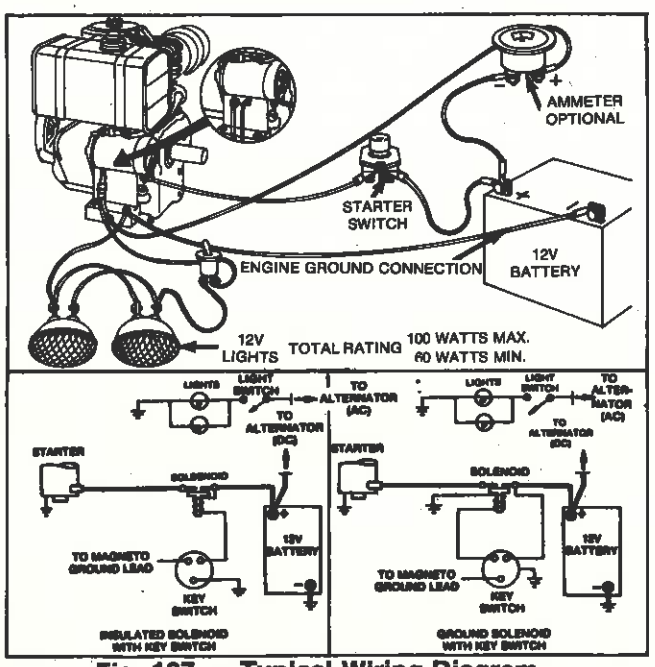

Fig. 167 — Typical Wiring Diagram

The battery is not used for the lights, so lights are available even if the battery is disconnected or removed. The alternator uses less than 0.2 horsepower.

Current for the lights is available as long as the engine is running. The output depends upon engine speed. Twelve-volt lights with a total rating of 60 to 100 watts may be used. With lights rated at 70 watts, the voltage rises from 8 volts at 2400 RPM to 12 volts at 3600 RPM, so the brightness of the light changes with the engine speed.

The current from the battery charging alternator is unregulated and is rated at 3 amperes. The output rises from 2 amperes at 2400 RPM to 3 amperes at 3600 RPM.

There is one external connection. The battery charging current connection is made through one terminal of a two connector plug. Current for lights is available at the second terminal of this plug. The plug is polarized to prevent improper connections. The return circuit for both alternators is through ground to the engine block.

CHECKING BATTERY INSTALLATION

Check if battery polarity is correct. Negative (-) side of battery should be grounded to engine or frame; positive (+) side of battery to alternator output lead. Figure 167.

WHEN CHECKING ALTERNATOR COMPONENTS, MAKE THE TESTS IN THE FOLLOWING SEQUENCE:

TESTING ALTERNATOR CHARGING (DC) OUTPUT

Set #19236 VOA meter to measure amperes. Attach leads in series with positive battery terminal and wire as shown in Fig. 168. Meter should indicate output. The charge range is dependent on the condition of the battery and engine speed. If meter shows no charge or shows a discharge, test diode and stator.

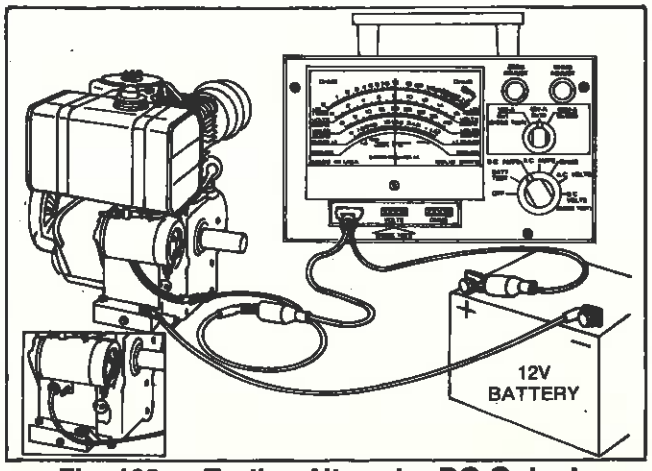

Fig. 168 — Testing Alternator DC Output

TESTING FOR SHORT IN ALTERNATOR SYSTEM

Disconnect charging lead from battery, and connect charge lead test lamp in series between battery and charge lead. (Figure 169) DO NOT START ENGINE. Test lamp should not light. If it does light, stator charging lead is shorted or diode is defective. Disconnect charge lead connector at alternator. If test light does not go out, the lead from the cap to the battery is shorted. If light goes out, diode is defective.

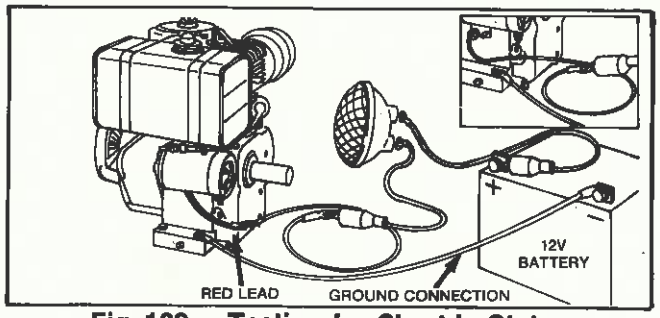

Fig. 169 — Testing for Short in Stator, Diode or Charge Lead

TESTING DIODE

Disconnect connector plug. Set meter on ohm scale. Check diode by attaching one meter lead to red stator lead wire. (A needle may be used to pierce stator lead wire insulation.) Touch the other meter lead to diode join in plastic connector, then reverse meter leads. The meter should show a reading in one direction only. If meter shows a reading in both directions or does not show a reading in either direction, the diode is defective and the connector assembly must be replaced. See Fig. 170.

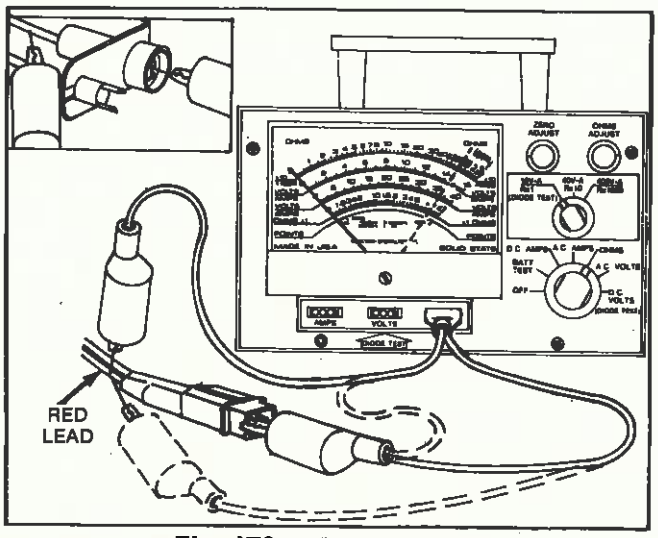

Fig. 170 — Testing Diode

NOTE: Service replacement diodes are pre-assembled to a connector and a short lead wire for ease of installation.

TESTING STATOR CHARGING COILS

Remove blower housing, flywheel etc. and examine red lead wire for cuts, damaged insulation or obvious short on lead. If bare spots are found repair with electrical tape. If short cannot be repaired, replace stator. Stator should also be checked for continuity as follows:

Use VOA meter set on ohm scale. Touch one meter lead to stator laminations, touch the other meter lead to red stator charge lead wire. (Pierce red wire insulation with a needle to insure meter lead contact.) Meter should show continuity. Fig. 171.

Next remove screw which attaches stator ground wires to stator laminations. Be certain ground wire does not touch laminations as shown in Fig. 171 and repeat previous test. Meter should not show continuity. If meter does not show continuity in first test or shows continuity during second test, stator is defective and must be replaced.

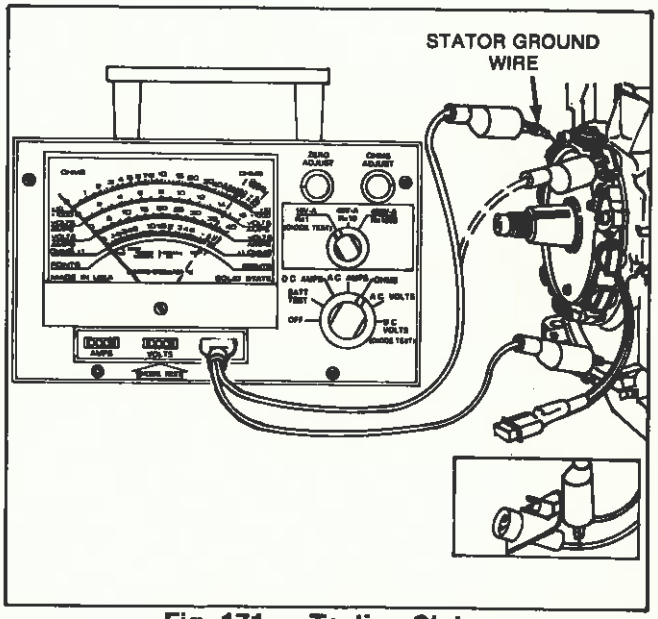

Fig. 171 — Testing Stator

NOTE: Discoloration of stator coils does not mean stator is defective. A shorted diode will pass battery current thru stator coils to ground, which discolors coils due to heat. Replacing diode would normally restore alternator without replacing stator.

7 C

ALTERNATOR
Dual Circuit - Rectifier Plug Type

TESTING ALTERNATOR AC CIRCUIT (Lighting)

Connect load lamp to AC side of connector and ground as shown in Fig. 172. Load lamp should light to full brilliance at medium engine speed. If lamp does not light or is very dim at medium speeds, stop engine and remove blower housing and flywheel. Disconnect stator ground wire as shown in Fig. 171.

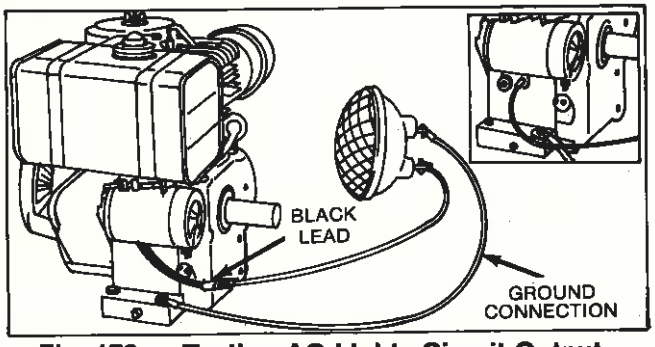

Fig. 172 — Testing AC Lights Circuit Output

With #19236 VOA meter, check for continuity between ground lead wire of AC coil and AC plug of connector as shown in Fig. 173. Meter reading should show continuity.

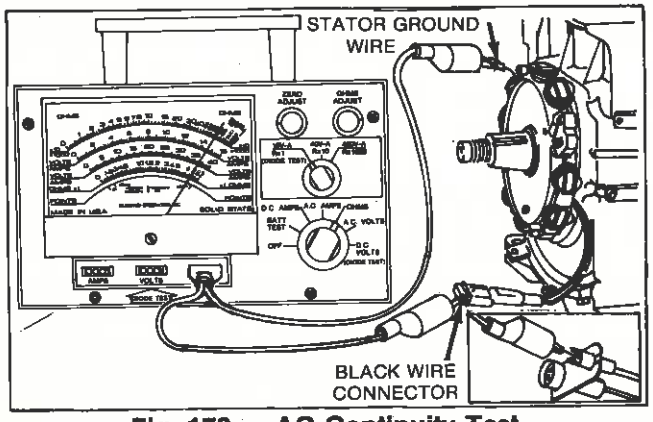

Fig. 173 — AC Continuity Test

Next, be sure ground lead terminal is not touching a grounded surface, and check continuity from terminal to ground. Figure 174. Meter should not show continuity. If meter indicates continuity, coils are grounded and defective. Examine black lead to be sure the insulation is not worn or cut. Repair with tape and shellac if a bad spot is found. If ground still exists, or if AC coils do not show continuity, stator must be replaced.

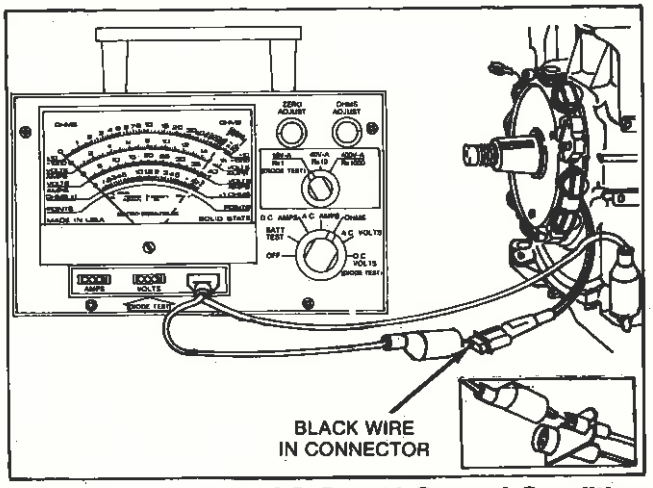

Fig. 174 — Test for AC Output Ground Condition

7 C

Dual Circuit Alternator with Fuse

This efficient gear drive, 12 volt battery powered starter system is compact and powerful. It is available with either a rope or rewind auxiliary starter. Recommended battery sizes range from 20 ampere hour for warm temperature service to 40 ampere hour in coldest service.

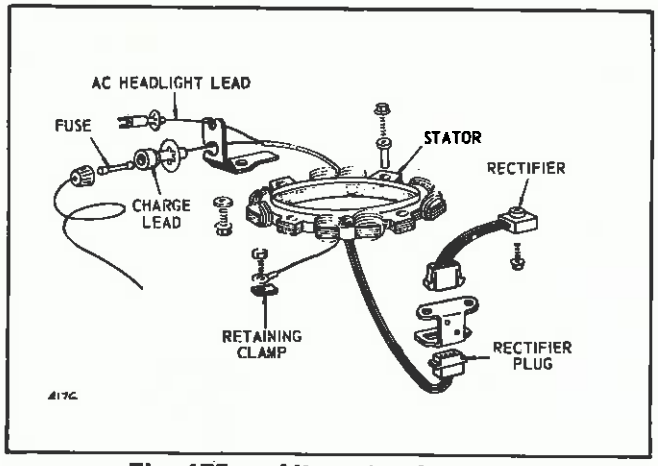

Fig. 175 — Alternator Assembly

DUAL CIRCUIT ALTERNATOR

The dual circuit alternator is actually two separate alternator systems. A single ring of magnets inside the flywheel supplies the magnetic field for both of them. One alternator system uses a solid state rectifier and provides battery charging current. The other alternator system feeds alternating current directly to the lights. Since the two are electrically independent, use of the lights does not reduce the charge going into the battery.

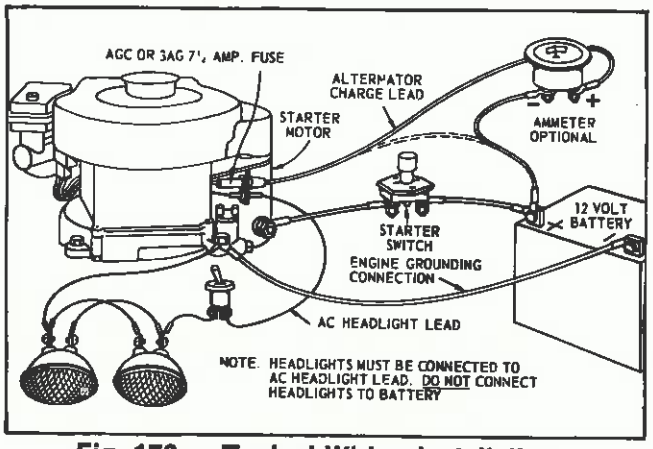

Fig. 176 — Typical Wiring Installation

The battery is not used for the lights, so lights are available even if the battery is disconnected or removed.

Current for the lights is available as long as the engine is running. The output depends upon engine speed. Twelve-volt lights with a total rating of 60 to 100 watts may be used. With lights rated at 70 watts, the voltage rises from 8 volts at 2400 RPM to 12 volts at 3600 RPM, so the brightness of the light changes with the engine speed.

The current from the battery charging alternator is unregulated and is rated at 3 amperes. The output rises from 2 amperes at 2400 RPM to 3 amperes at 3600 RPM.

There are two external connections. The battery charging current connection is made through a 7.5 ampere fuse mounted in a fuse holder beside the starter motor. Current for the lights is available at a plastic connector located below the fuse-holder. The two connections are different so they cannot be accidentally interchanged. The fuse protects the 3 amp charging alternator and rectifier from burnout due to improper (reverse polarity) battery connections. The 5 amp lighting alternator does not require a fuse as a short circuit in its output will not damage it. The return circuit for both alternators is through ground to the engine block. The alternator uses less than 0.2 horsepower.

7 C

CHECKING DUAL CIRCUIT ALTERNATOR

Fuse Blown

Check if battery polarity is correct: Negative (-) side of battery should be grounded to engine or frame; positive (+) side of battery to (fused) alternator output lead. Figure 177. If reversed, correct and put in new fuse.

WHEN CHECKING ALTERNATOR COMPONENTS, MAKE THE TESTS IN THE FOLLOWING SEQUENCE:

BATTERY RUNS DOWN

Testing Alternator Charging Output

Install ammeter in series with charging lead, as in Figure 177. Start engine. Ammeter should indicate charge. The charge rate is dependent upon the condition of the battery.

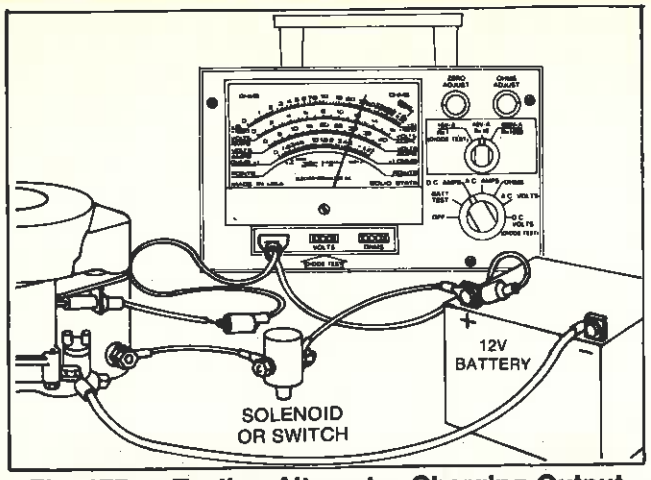

Fig. 177 — Testing Alternator Charging Output

If VOA meter shows no reading, test stator and rectifier.

Testing for Short in Stator or in Rectifier

Disconnect charging lead from battery, and connect small test lamp in series between battery positive terminal and fuse cap, as shown in Figure 178. DO NOT START ENGINE. Test lamp should not light. If it does light, stator's charging lead is grounded or rectifier is defective. Unplug rectifier plug under blower housing. See Figure 179. If test light goes out, rectifier is defective. If test light does not go out, stator charging lead is grounded.

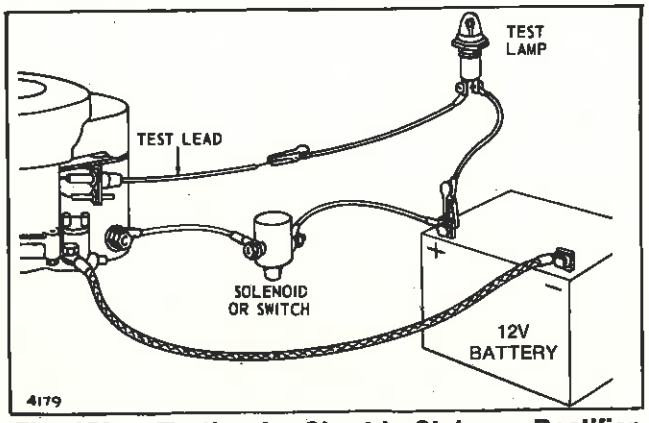

Fig. 178 — Testing for Short in Stator or Rectifier

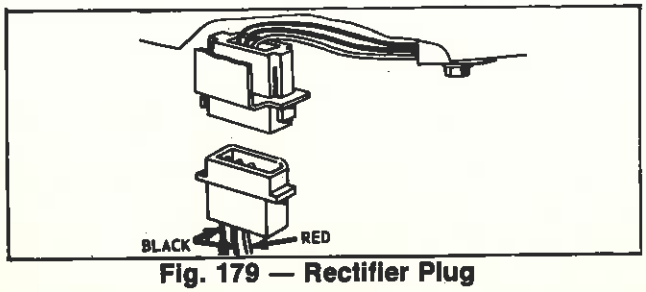

Fig. 179 — Rectifier Plug

Testing Stator Charging Coils

If "short" test indicates stator charging lead is grounded, remove blower housing, flywheel, starter motor and retaining clamp (see figure 175), and examine length of red lead for damaged insulation or obvious shorts on lead. If bare spots are found, repair with electrical tape and shellac. If short cannot be repaired, replace stator. Charging lead should also be checked for continuity as follows: Use multimeter, set on ohm Rx1 scale. Touch one test prod to lead at fuse holder. Touch other test prod to red lead pin in plastic connector: See Figure 180. Unless the meter shows continuity, the charging lead is open and the stator must be replaced.

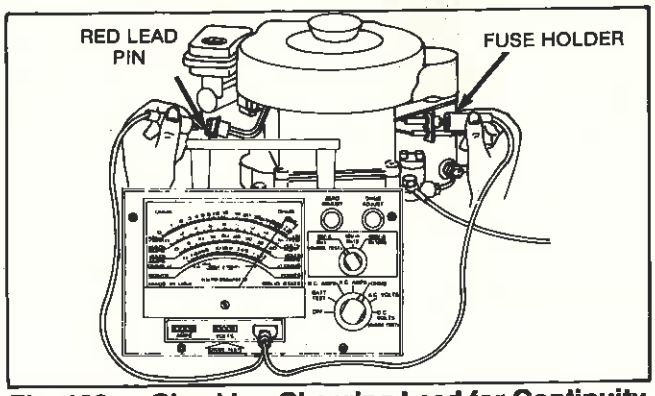

Fig. 180 — Checking Charging Lead for Continuity

The charging coils should be checked for continuity as follows: Using the multimeter, touch one test prod on each of the black lead pins as shown in Figure 181. Unless the meter shows continuity, charging coils are defective and stator must be replaced. Test for grounded charging coils by touching one test prod to a clean "ground" surface on the engine and touching the other test prod on each of the black lead pins as shown in Figure 182. If the meter shows continuity, the charging coils are grounded and stator must be replaced.

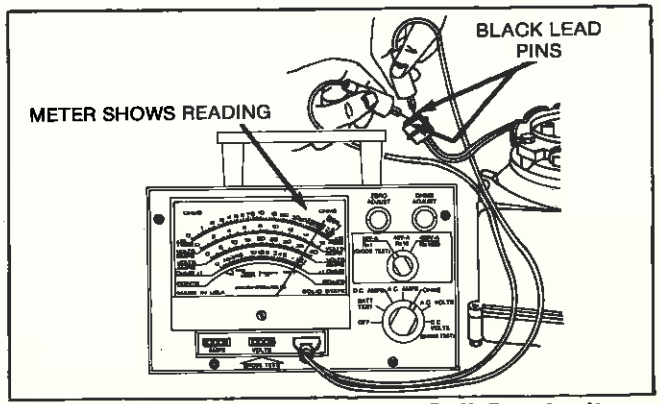

Fig. 181 — Checking Charging Coil Continuity

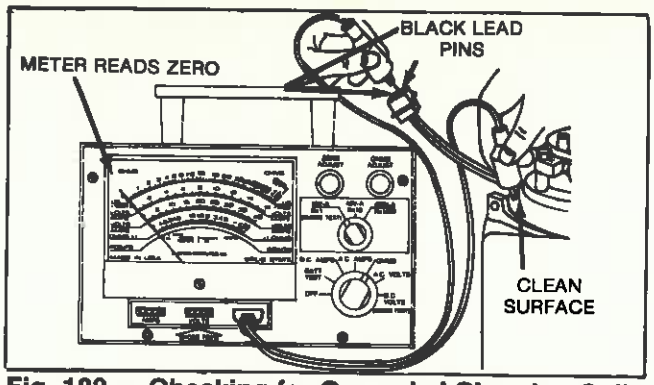

Fig. 182 — Checking for Grounded Charging Coils

Testing Rectifier

Attached to the blower housing baffle is a small black rectifier assembly.

The rectifier is tested with a multimeter as follows: Three leads from the rectifier connect to pins in the detachable plug. See Figure 183. Leave rectifier installed on blower housing. Test rectifier with multimeter (using resistance scale) to check resistance from the red lead pin to blower housing (in an unpainted clean area). See Figure 183.

After checking pin, reverse meter leads and recheck. The meter should show a reading in one direction only. If the rectifier pin shows a meter reading both ways, the rectifier is defective. If the pin shows no reading either way, the rectifier is again defective.

Leaving one probe on blower housing, repeat with each black lead pin. Again meter should show continuity in one direction only, otherwise rectifier is defective. Now try between red lead pin and each black lead pin. Again, when probes are interchanged, meter should show continuity in one direction only.

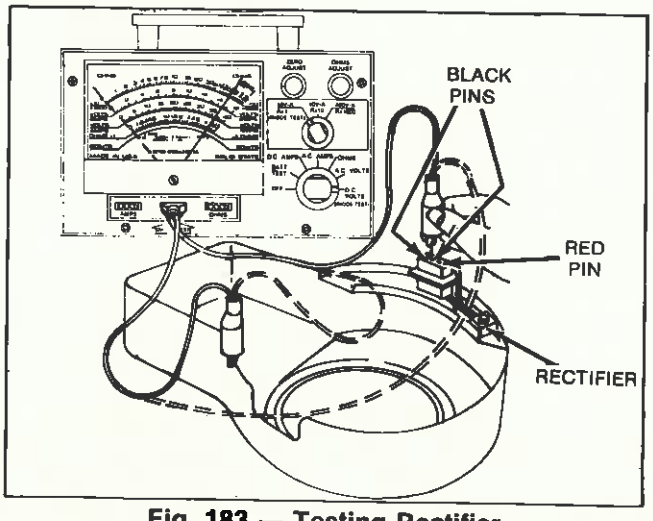

Fig. 183 — Testing Rectifier

Testing Alternator AC Circuit (Lighting)

Connect load lamp to AC output plug and ground as shown in Figure 184. Load lamp should light to full brilliance at medium engine speed. If lamp does not light, or is very dim at medium speeds, remove blower housing and flywheel. Disconnect ground end of AC coil, which is attached to the retaining clamp screw as shown in Figure 185.

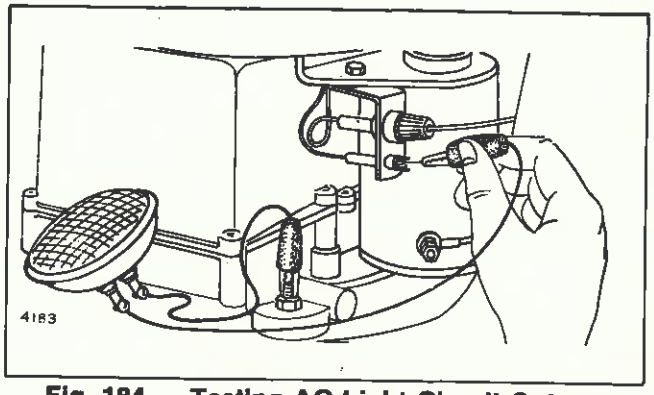

Fig. 184 — Testing AC Light Circuit Output

With multimeter, check continuity between ground lead of AC coil and AC output terminal as shown in Figure 185. Meter should show continuity.

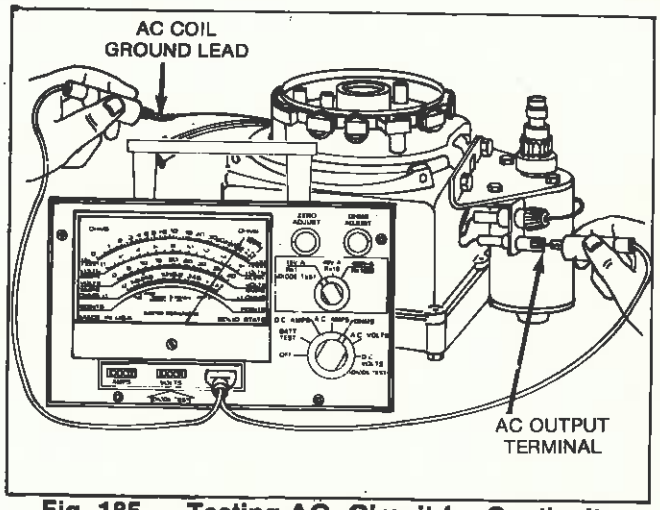

Fig. 185 — Testing AC Circuit for Continuity

Next, be sure ground lead terminal is not touching a grounded surface, and check continuity from terminal to ground.

Meter should not show continuity. If meter indicates continuity, coils are grounded and defective. Examine both (white) leads to be sure the insulation is not worn or cut. Repair with tape and shellac if a bad spot is found. If ground still exists, or if AC coils do not show continuity, stator must be replaced.

7 AMP REGULATED ALTERNATOR
Used on Model Series 140000, 170000 and 190000

The 7 ampere regulated alternator uses both a rectifier and a solid state electronic regulator for rapid charging or extra electrical loads. The regulator protects the battery from overcharge. The alternator requires less than 0.2 horsepower.

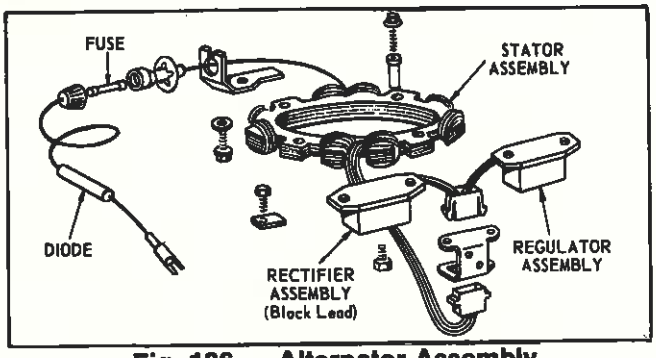

Fig. 186 — Alternator Assembly

Condition Found (Fuse Blown)

Check if battery polarity is correct. Negative (-) side of battery should be grounded to engine or frame; positive (+) side of battery to alternator output lead.

If reversed, correct and put in new fuse.

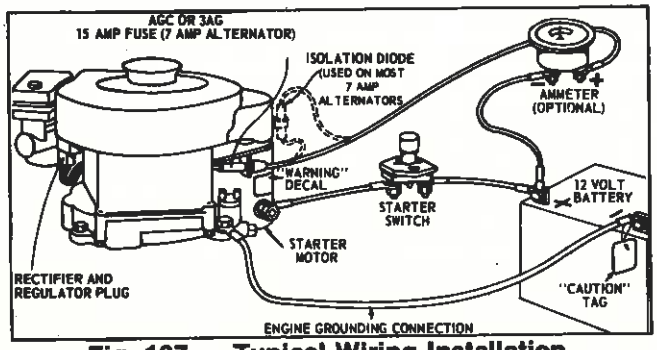

Fig. 187 — Typical Wiring Installation

Condition Found (Battery Run Down)

Certain operating conditions could cause the regulator to malfunction, permitting the battery to discharge even after then engine is stopped. To prevent such a malfunction, and the possible inconvenience of a "dead" battery, an isolation diode assembly (an electronic check-valve) is installed in the alternator output lead, on engines with 7 ampere regulated alternators.

The isolation diode assembly is installed at the time of production, or may be added with kit #390607 described as follows:

Disconnect cable from (-) negative (ground) battery terminal. Unscrew fuse holder cap from fuse holder by pushing in and twisting counter-clockwise. Remove and save fuse. Mount diode assembly in one of the various positions shown in Fig. 188. Use 1/2" long screw, lockwasher and flat washer. If diode assembly is mounted on tank strap, install clamp between lock washer and strap.

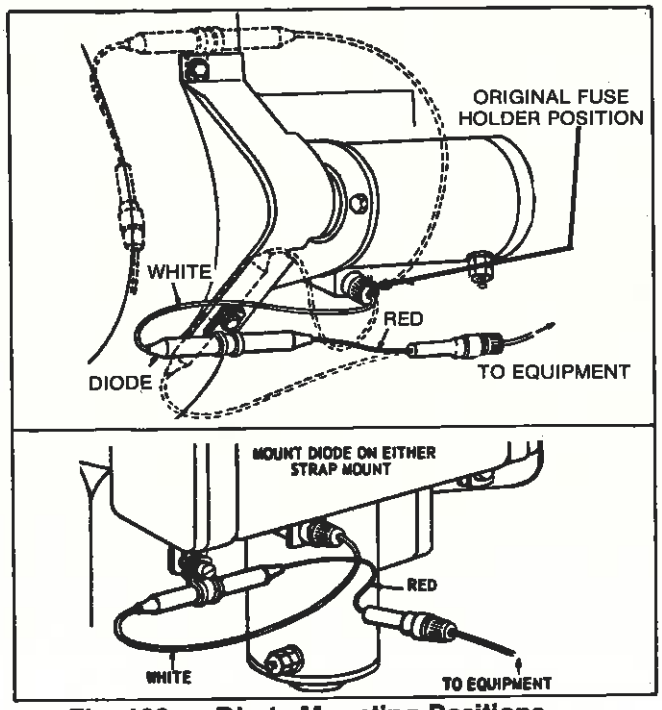

Fig. 188 — Diode Mounting Positions

The body of the isolation diode assembly should not rub against any metal part. Repeated contact with a metal part could wear through the insulation, causing a short.

Insert fuse in fuse holder on engine. Assemble fuse holder cap on white lead of diode assembly to fuse holder on engine. Attach connector on red lead of diode assembly to original fuse cap, which was disconnected above. No fuse is used at this connection. Wrap two turns of wire, provided with diode assembly, between cap and socket. Secure the wires and socket with tape to prevent rubbing or interference with other parts. See Fig. 189.

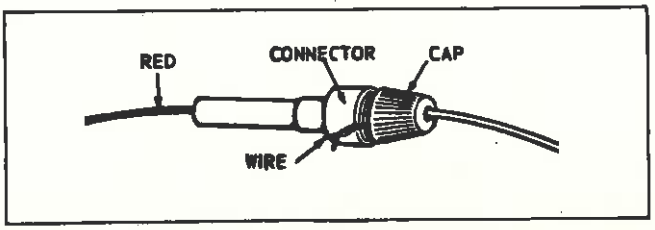

Fig. 189 — Wiring Connector

Reconnect (-) negative (grounded) cable to battery post. If necessary, recharge battery with a battery charger, or by running engine 3 to 5 hours.

NOTE: An isolation diode is not required if the equipment manufacturer routes the alternator output lead through a special ignition switch, which disconnects the alternator when the switch is in the "OFF" position.

WHEN CHECKING ALTERNATOR COMPONENTS, MAKE THE TESTS IN THE FOLLOWING SEQUENCE:

Testing Isolation Diode

Unplug cap from fuseholder and connect small test lamp between tip of white wire and battery negative terminal, as shown in Figure 190. Lamp should not light. If lamp lights, isolation diode is defective. Now disconnect test lamp, and check continuity from the tip of white diode lead to tip of red diode lead with multimeter. The meter should show continuity in one direction and not in the other — reverse leads to check this, as shown in Figure 191. If indication is incorrect, diode is defective and must be replaced.

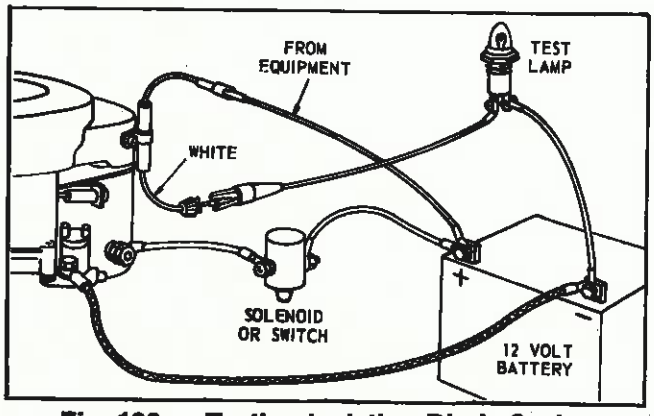

Fig. 190 — Testing Isolation Diode System

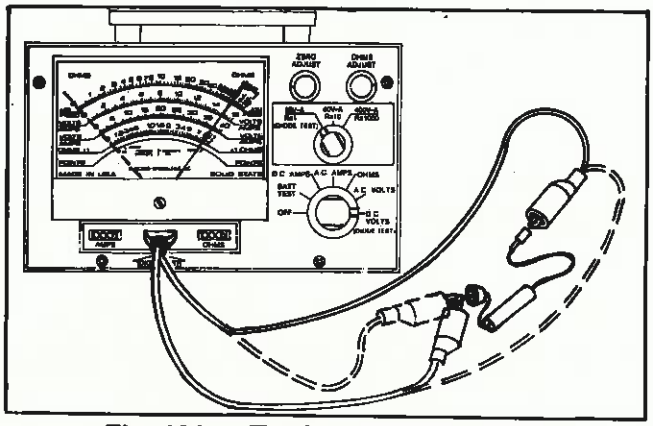

Fig. 191 — Testing Isolation Diode

Testing for Shorts or Ground in Stator, Regulator or Rectifier

Disconnect charging lead from battery, and connect small test lamp in series between battery positive terminal and fuse cap, as shown in Figure 192. (Test lead must not include an isolation diode.) DO NOT START ENGINE. Test lamp should not light. If it does light, stator or regulator or rectifier is defective. Unplug rectifier-regulator plug under blower housing. See Figure 193. If test light goes out, rectifier or regulator is shorted. If test light does not go out, stator is grounded.

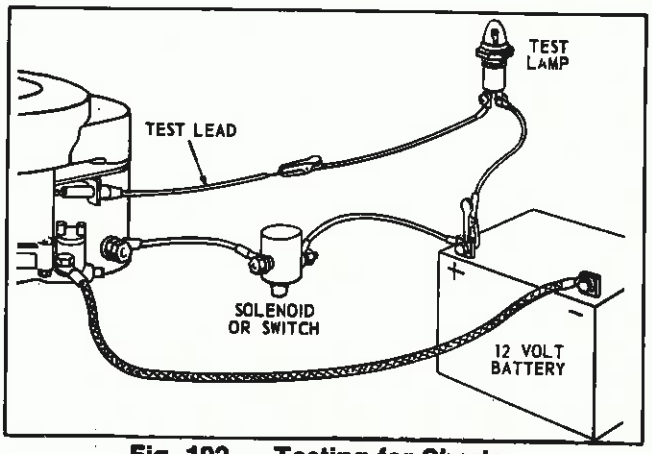

Fig. 192 — Testing for Shorts

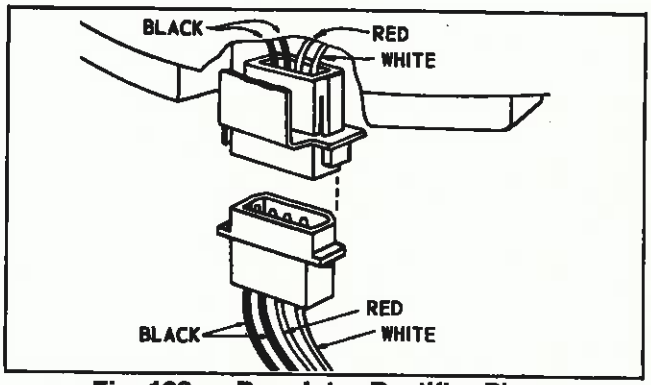

Fig. 193 — Regulator Rectifier Plug

Testing Stator

If test indicates stator is grounded, look for obvious defects on leads. If bare leads are found, repair with friction tape and shellac. If shorted leads are not visible, replace stator. Stator should also be checked for continuity as follows: Use multimeter, set on resistance scale. Touch one test prod to lead at fuse holder. Touch other test prod to each of the four pins in plastic connector. Unless the meter shows continuity at each of the four pins, the stator winding is open and the stator must be replaced. Figure 194.

7 C

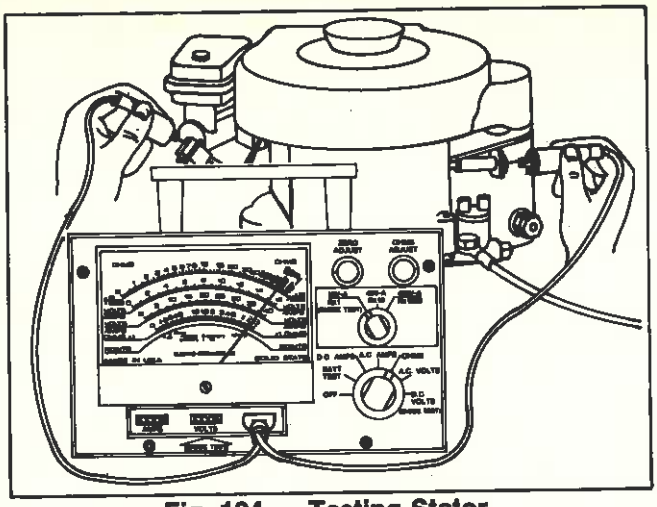

Fig. 194 — Testing Stator

Testing Rectifier

Attached to the blower housing baffle are two small black boxes; one (the rectifier box) has two black leads, and the other (the regulator box) has one red lead and one white lead. These leads connect to four pins in the detachable plug. Leave boxes installed on blower housing. Test rectifier with multimeter (using resistance scale) to check resistance from each black lead pin to blower housing (in an unpainted clean area). See Figure 195. After checking each pin, reverse meter leads and recheck. The meter should show a reading in one direction only. If either of the rectifier pins shows a meter reading both ways, the rectifier is defective. If either of the pins shows no reading either way, the rectifier is again defective. Remove rectifier lead pins from detachable plug and replace rectifier box. Instruction sheet packed with rectifier assembly shows how to remove lead pins from detachable plug.

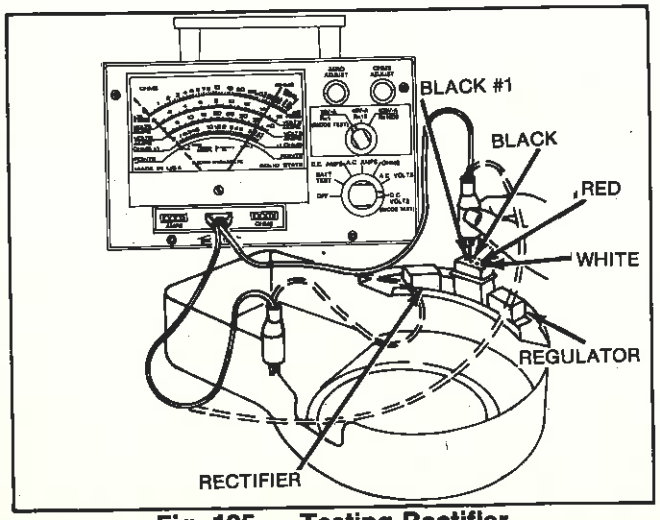

Fig. 195 — Testing Rectifier

Testing Regulator

Test regulator with multimeter (using resistance scale) as described in "Testing Rectifier," except touching red lead pin and white lead pin, as shown in Figure 196. If the red lead pin shows a reading in either direction, the regulator is defective. The white lead pin must show a weak reading in one direction only. If meter indicates otherwise, regulator is defective. Replace regulator by removing rectifier pins from plug and installing rectifier pins in new plug furnished with new regulator. Instruction sheet packed with regulator assembly shows how to replace pins in plug.

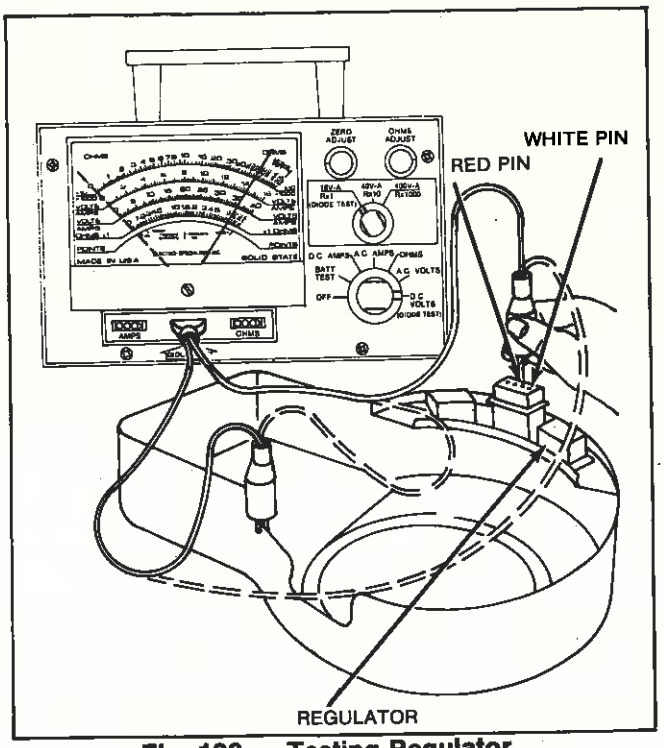

Fig. 196 — Testing Regulator

Testing Alternator Output

Install ammeter in series with charging lead, as in Figure 197. Start engine. Ammeter should indicate charge. If battery is fully charged, ammeter will show little or no needle deflection. If such is the case, connect a 12 volt headlight lamp across battery terminals to apply a load. Ammeter should then show increased charge rate.

If ammeter shows no charge, and if rectifier and regulator have been tested, look for loose connections, broken or frayed wires, etc. If there is no visible fault, replace stator and re-test alternator output.

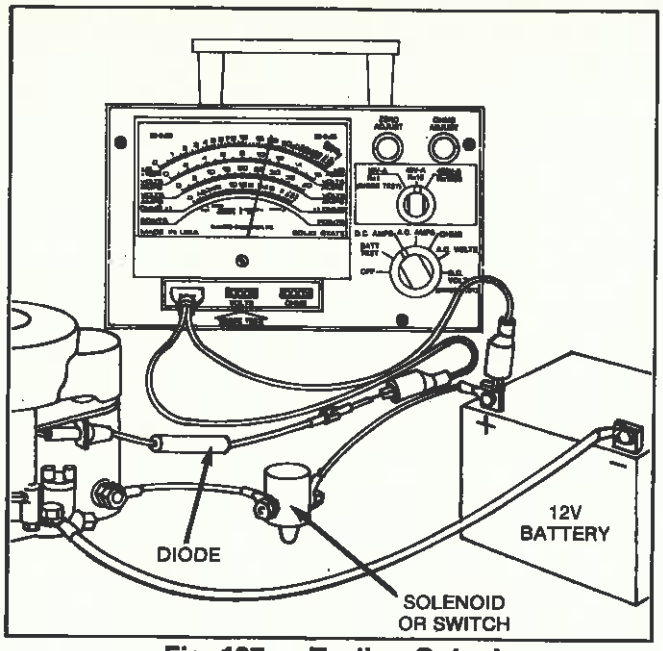

Fig. 197 — Testing Output

ALTERNATOR
4 Amp

4 AMP NON-REGULATED ALTERNATOR

The 4 ampere non-regulated alternator is entirely self-contained. It incorporates a solid state rectifier and a fuse, and uses less than 0.2 horsepower.

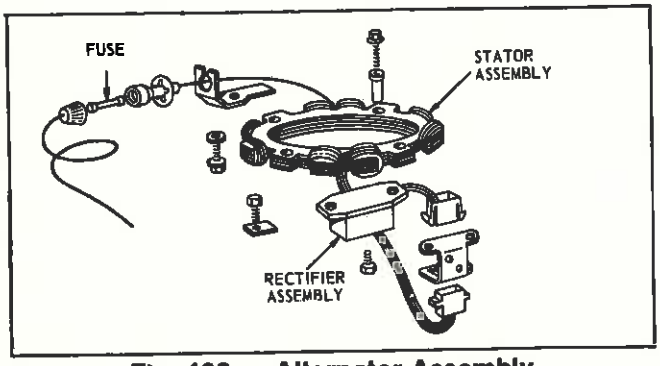

Fig. 198 — Alternator Assembly

CHECKING 4 AMP NON-REGULATED ALTERNATOR

Condition Found (Fuse Blown)

Check if battery polarity is correct: Negative (-) side of battery should be grounded to engine or frame; positive (+) side of battery to alternator output lead. Figure 199. If reversed, correct and put in new fuse.

Condition Found (Battery Run Down)

WHEN CHECKING ALTERNATOR COMPONENTS, MAKE THE TESTS IN THE FOLLOWING SEQUENCE:

Testing for Short in Stator or Rectifier

Disconnect charging lead from battery, and connect small test lamp in series between battery positive terminal and fuse cap, as shown in Figure 200. DO NOT START ENGINE. Test lamp should not light. If it does light, stator or rectifier is defective. Unplug rectifier plug under blower housing. See Figure 201. If test light goes out, rectifier is shorted. If test light does not go out, stator is shorted.

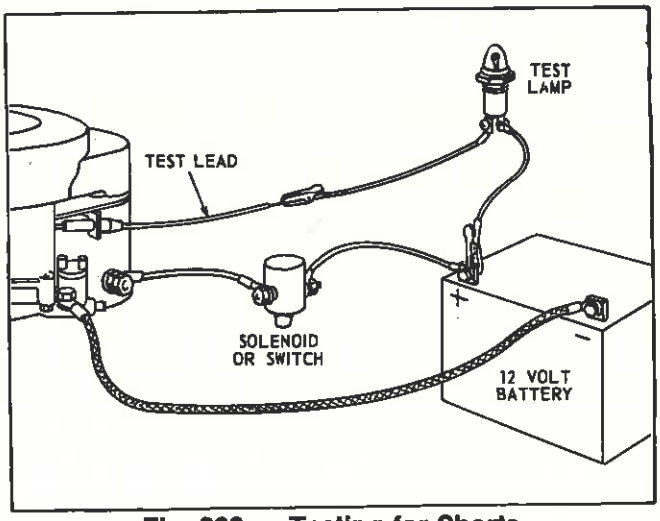

Fig. 200 — Testing for Shorts

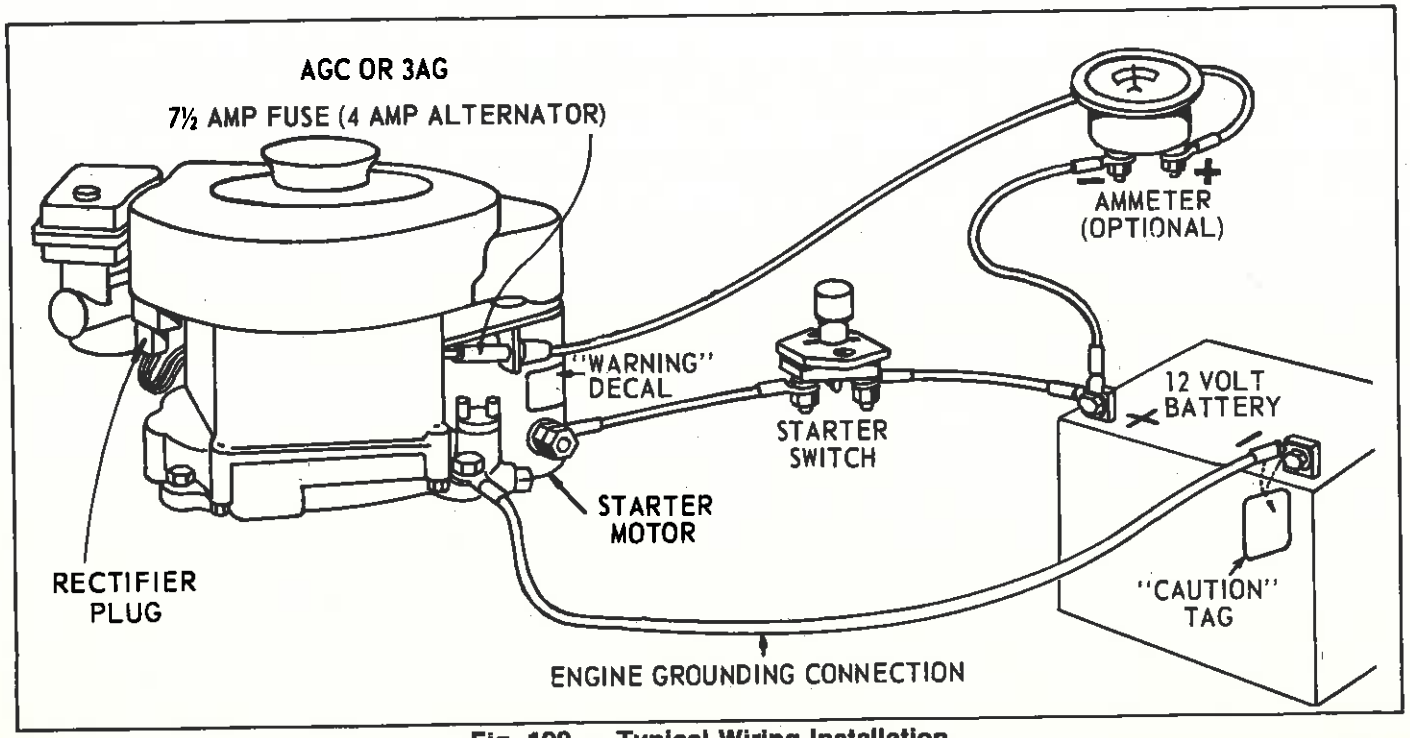

Fig. 199 — Typical Wiring Installation

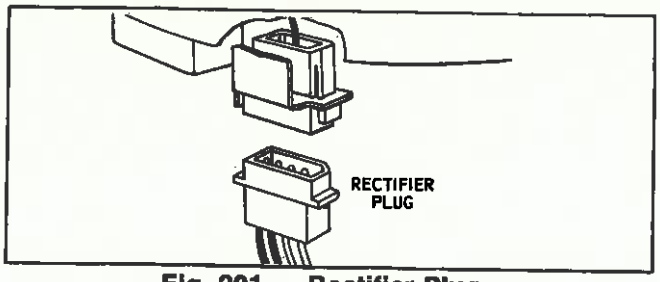

Fig. 201 — Rectifier Plug

Testing Stator

If "short" test indicates stator is shorted, look for obvious shorts on leads. If bare leads are found, repair with friction tape and shellac. If shorted leads are not visible, replace stator. Stator should also be checked for continuity as follows: Use VOA meter, set on resistance scale. Touch one test prod to lead at fuse holder. Touch other test prod to each of the four pins in plastic connector. See Figure 202. Unless the meter shows continuity at each of the four pins, the stator winding is open and the stator must be replaced.

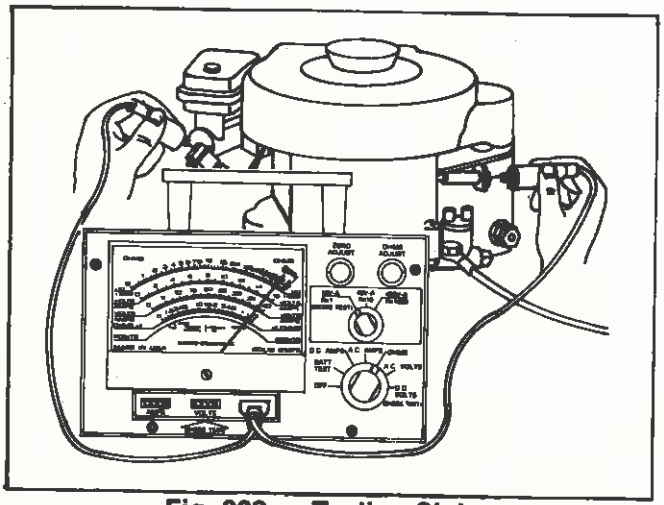

Fig. 202 — Testing Stator

Testing Rectifier

Attached to the blower housing baffle is a small black rectifier box. A lead from the box connects to a single pin in the detachable plug. See Figure 201. Leave box installed on blower housing. Test rectifier with multimeter (using resistance scale) to check resistance from the pin to blower housing (in an unpainted clean area). See Figure 203. After checking pin, reverse meter leads and recheck. The meter should show a reading in one direction only. If the rectifier pin shows a meter reading both ways, the rectifier is defective. If the pin shows no reading either way, the rectifier is again defective.

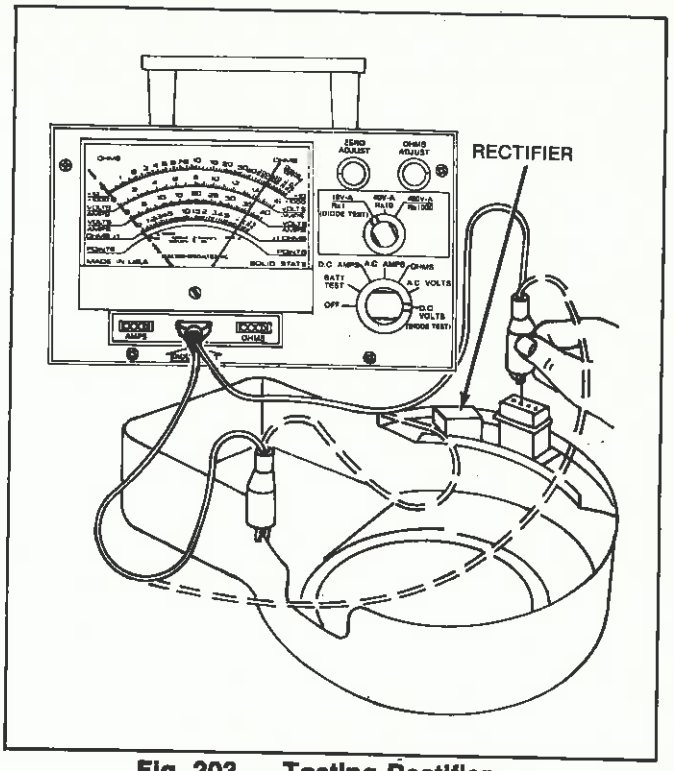

Fig. 203 — Testing Rectifier

Testing Alternator Output

Install ammeter in series with charging lead, as in Figure 204. Start engine. Ammeter should indicate charge.

If ammeter shows no charge, and if rectifier has been tested, look for loose connections, broken or frayed wires, etc. If there is no visible fault, replace stator and re-test alternator output.

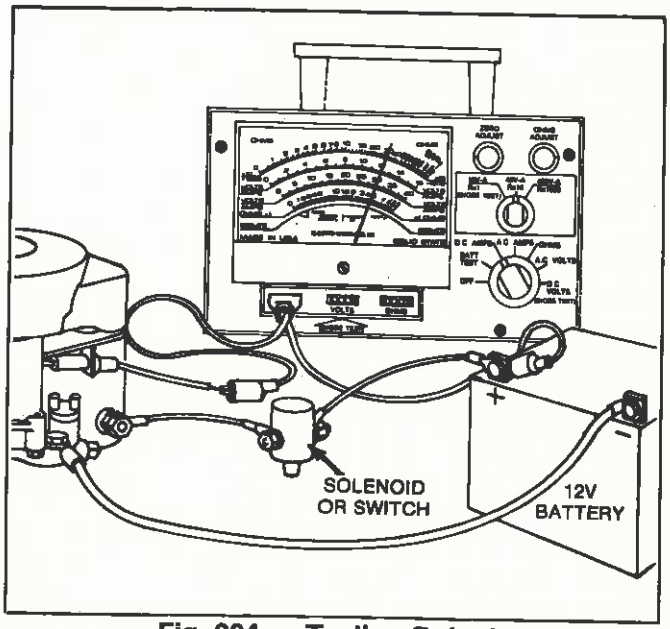

Fig. 204 — Testing Output

ALTERNATOR
Tri-Circuit

THE TRI-CIRCUIT ALTERNATOR

The Tri-Circuit alternator consists of a single ring of magnets inside the flywheel, which supplies the magnetic field for a stator having one output lead which produces AC voltage. The output lead connects to a charge lead that contains one diode which rectifies minus -12 volts DC (5 amps at 3600 RPM) for lights. This same charge lead contains a second diode that rectifies plus +12 volts DC (5 amps at 3600 RPM) for battery charging and external loads. See Fig. 205. The alternator uses less than 0.2 horsepower.

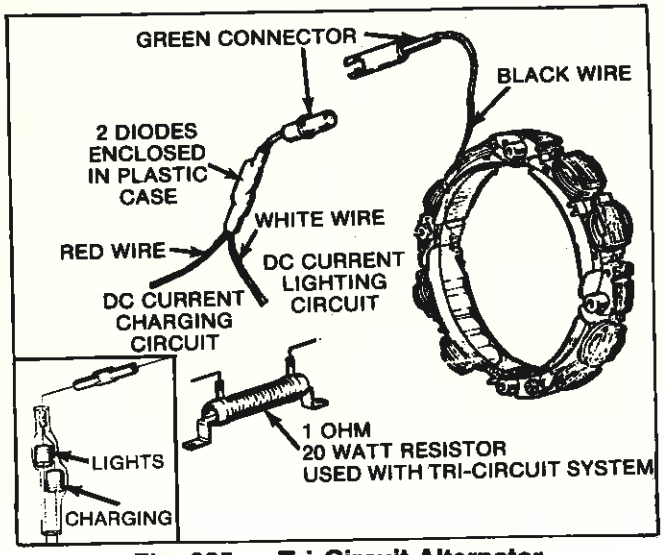

Fig. 205 — Tri-Circuit Alternator

If an accessory such as an electric clutch is used on the equipment, 3.5 amps powers the clutch, and up to 1.5 amps charges the battery, thus not over-charging the battery. A two-pole clutch switch is used on the vehicle when an electric clutch is an accessory. When the clutch is switched on, one circuit is used to engage the clutch, and the other circuit bypasses the resistor, thus allowing full alternator output to be applied to the battery and clutch. Fig. 206 and 207.

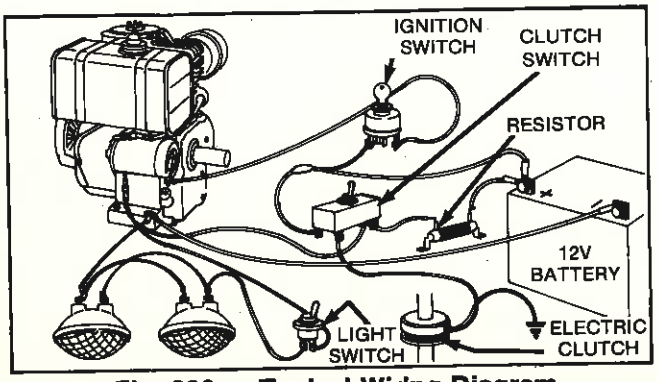

Fig. 206 — Typical Wiring Diagram

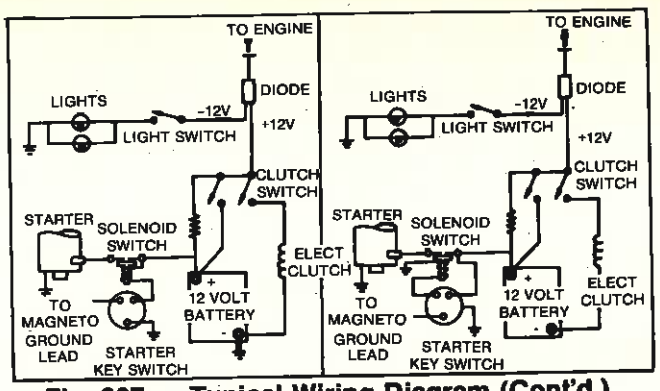

Fig. 207 — Typical Wiring Diagram (Cont'd.)

If the clutch is not engaged, a resistor is placed in series with the alternator charge lead, thereby limiting the charge current to about 3 amps. See Fig. 207. The resistor (20 watts), becomes hot and must be mounted somewhere on the vehicle by the manufacturer.

The battery is not used for the lights, so lights are available even if the battery is disconnected or removed.

Current for the lights is available as long as the engine is running. 12 volt lights with a total rating of 60 to 100 watts may be used. With lights rated at 70 watts, the voltage rises from 8 volts at 2400 RPM to 12 volts at 3600 RPM, so the brightness of the light changes with the engine speed.

TESTING ALTERNATOR STATOR OUTPUT

Connect load lamp to AC (green connector) output plug and ground as shown in Figure 208. Load lamp should light to full brilliance at medium engine speed. If lamp does not light, or is very dim at medium speeds, remove blower housing and flywheel. Disconnect the ground terminal end of AC coil, which is attached to the stator laminations with screw.

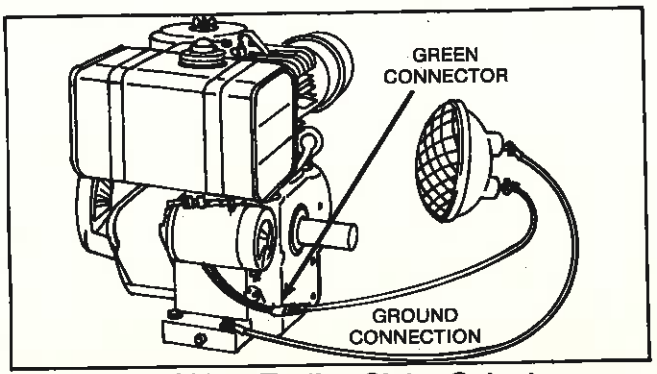

Fig. 208 — Testing Stator Output

TESTING STATOR COILS

With multimeter, check continuity between ground lead to stator coil and output connector lead shown in Figure 209. Meter should show continuity. If meter does not indicate continuity, replace stator.

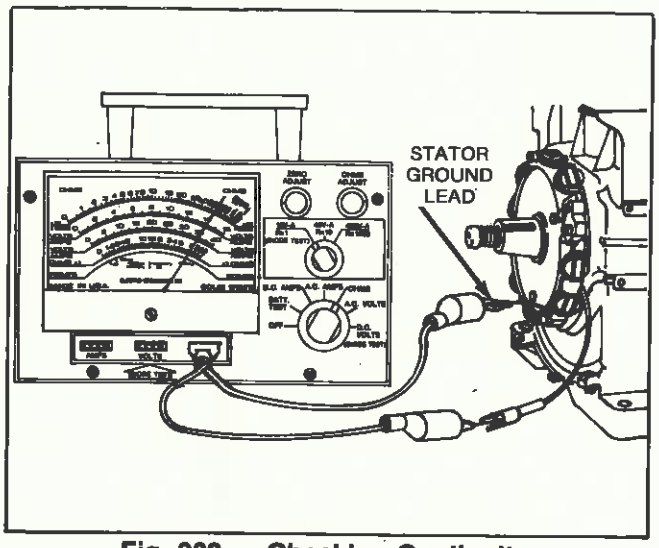

Fig. 209 — Checking Continuity

Next, be sure ground lead terminal is not touching a grounded surface. Check continuity from terminal to ground. See Fig. 210.

Meter should not show continuity. If meter indicates continuity, coils are grounded and defective. Examine lead to be sure the insulation is not worn or cut. Repair with tape and shellac if a bad spot is found. If ground still exists, sator must be replaced.

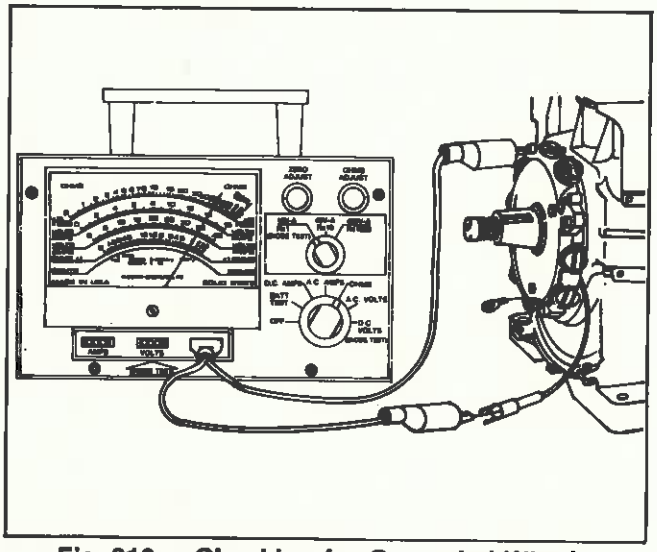

Fig. 210 — Checking for Grounded Wire in Stator Assembly

CHECKING DIODES

Disconnect charge lead from stator output lead. Using a multimeter set on resistance scale, check diodes by attaching one meter lead to connector pin. Touch the other meter lead to the white wire (light circuit diode), then reverse meter leads. Meter should show continuity in one direction only. Repeat this procedure for the red wire (battery charging diode). Meter should show continuity in one direction only. If meter shows continuity in both directions or does not show continuity in either direction, the diode harness must be replaced. See Fig. 211.

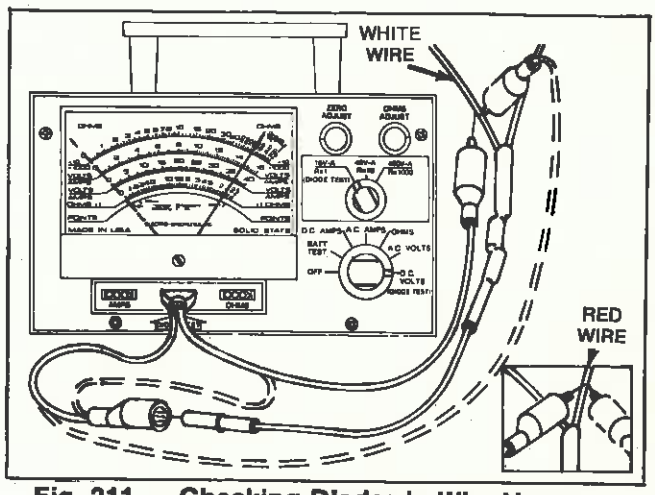

Fig. 211 — Checking Diodes in Wire Harness

The resistor that reduces battery charging current should also be checked when testing alternator. See Fig. 212. An acceptable resistor should have approximately one ohm resistance. Also check to be certain the double pole switch is operating properly. See Fig. 207.

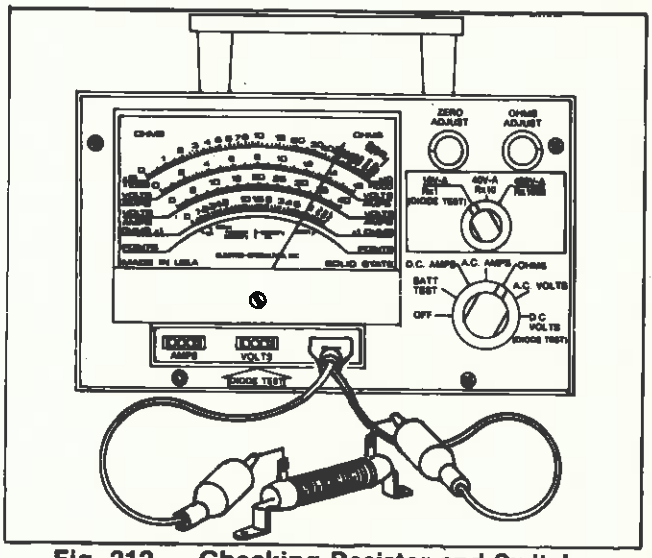

Fig. 212 — Checking Resistor and Switch

ALTERNATOR
10 Amp

10 AMP REGULATED ALTERNATOR

The 10 amp regulated alternator incorporates a system in which the charging rate is regulated to the battery. The stator is located under the flywheel and is similar to the Dual Circuit stator and Tri-Circuit stator.

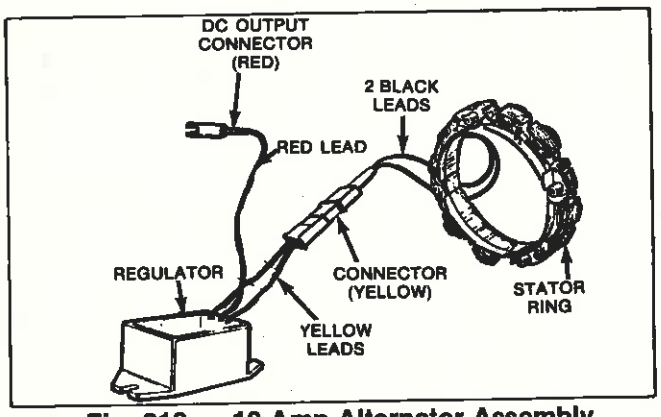

Fig. 213 — 10 Amp Alternator Assembly

There are two leads from the stator, similar to the dual circuit alternator, but of the same color. Fig. 213. The charge rate to the battery is 10 amps and less than 0.2 horsepower is used to operate the system. In the regulator box assembly there are diode rectifiers and S.C.R. (Silicon Controlled Rectifiers) which convert alternating current to direct current for charging the battery, and regulating the voltage.

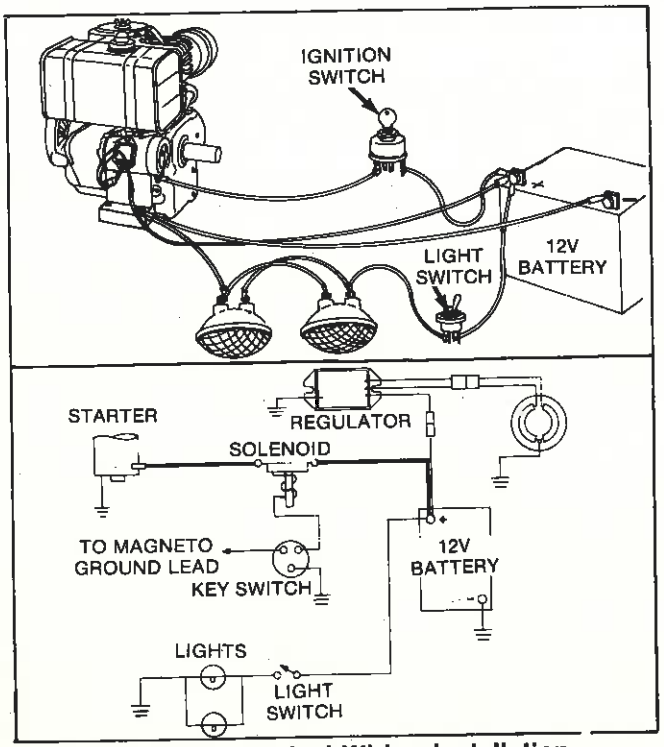

Fig. 214 — Typical Wiring Installation

CHECKING ALTERNATOR OUTPUT

NOTE: There will be no charging output unless a 12 volt battery with a minimum of 5 volts charge is connected to the output side of the regulator. See Fig. 214.

To check the 10 amp system, first make sure the battery is at a minimum of 5 volts. With a VOA meter, check the amperage output of the regulator. Attach the meter in series (see Fig. 215) on the positive side of the charging circuit. Start the engine and run at normal operating RPM. If battery voltage is at its maximum the charging current will be less. An example would be if the battery voltage reads 14 volts, the amperage would probably read less than 3 amps. If the battery voltage reads 10 volts, the charge current will read approximately 10 amps.

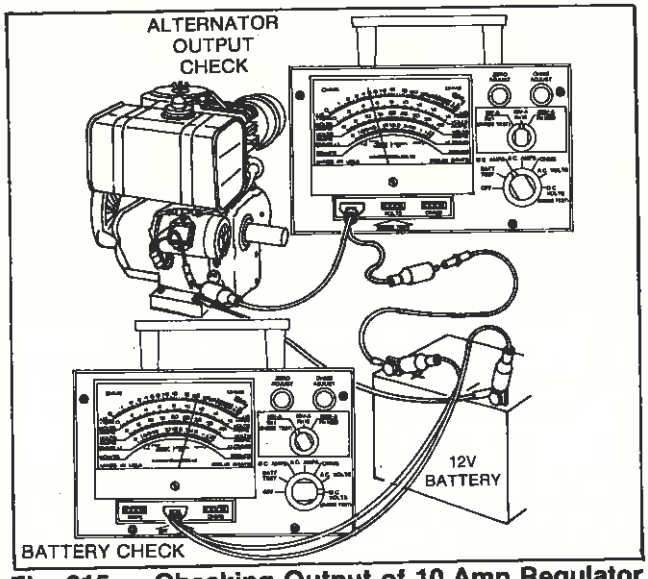

Fig. 215 — Checking Output of 10 Amp Regulator

TESTING STATOR COILS

With a multimeter, check continuity of the stator windings; this can be done by disconnecting the plug connector. See Fig. 216. Use a VOA meter set on the low ohm resistance scale. Touch one terminal with a probe and the other terminal with the remaining probe. Continuity should be present. If no continuity is present, this would indicate an open in the stator windings. Remove flywheel and repair or replace stator.

To check for a grounded stator winding, repeat the above procedure, but attach one probe to ground, Fig. 217. If continuity is present, this would indicate a grounded or "shorted" stator winding.

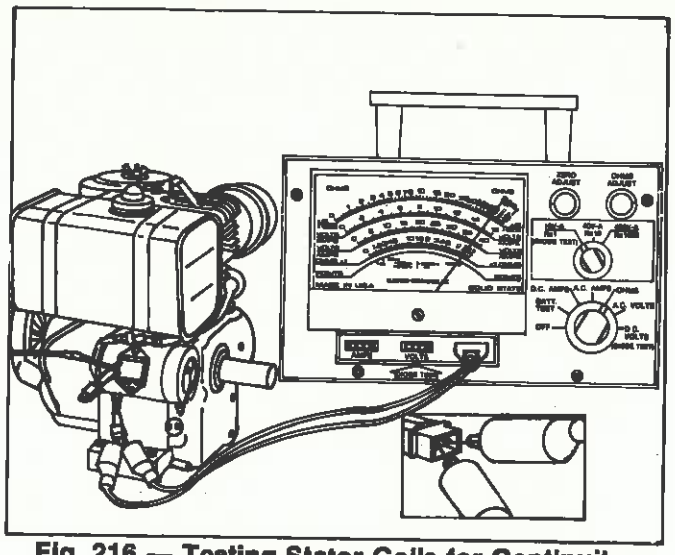

Fig. 216 — Testing Stator Coils for Continuity

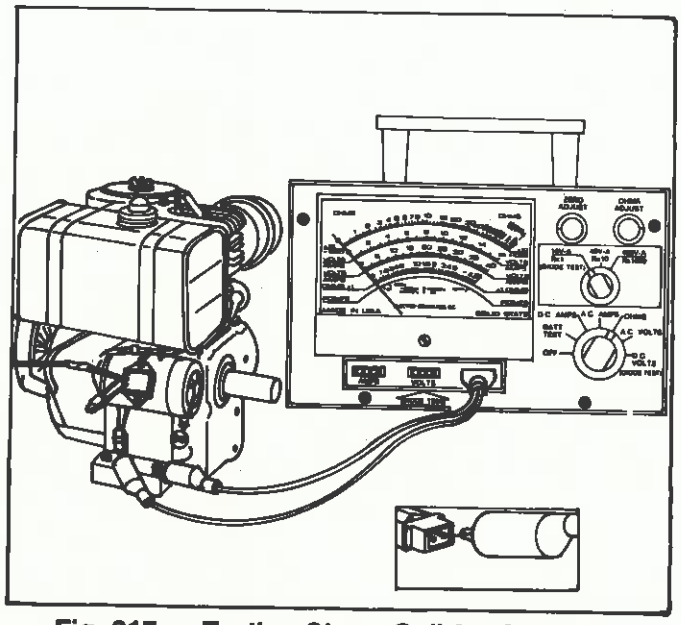

Fig. 217 — Testing Stator Coil for Grounds

CHECK STATOR ASSEMBLY (OUTPUT VOLTAGE)

If there is no current flow on the DC output side of regulator, check to insure the stator is functioning. Disconnect the regulator to stator plug, Fig. 219. Attach the leads from a #19236 VOA meter to the pins in the stator plug. Start and run the engine at normal operating speed (minimum 3200 RPM). The voltmeter should read at least 17 volts (20 volts at 3600 RPM). If meter does not show a reading, check the stator for an open or ground condition, Fig. 217. If voltage is present, first make sure there is continuity in the charging lead (rectifier to battery wire), Fig. 218. If continuity exists, replace the regulator.

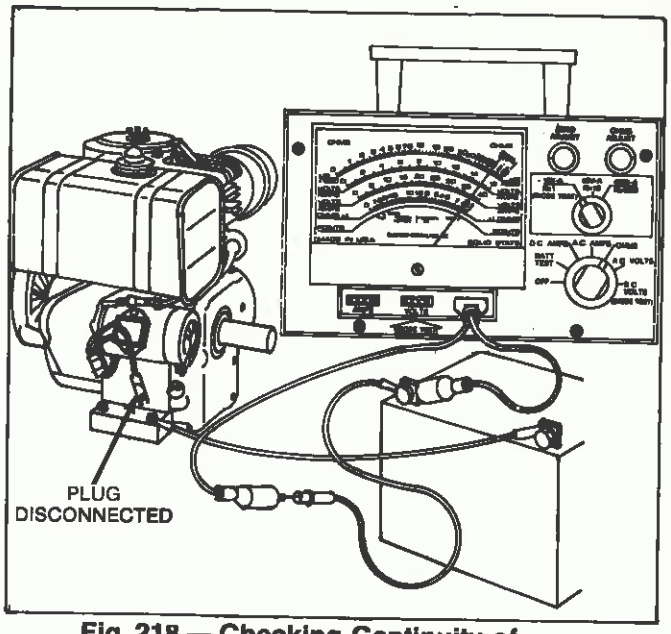

Fig. 218 — Checking Continuity of DC Output Lead to Battery

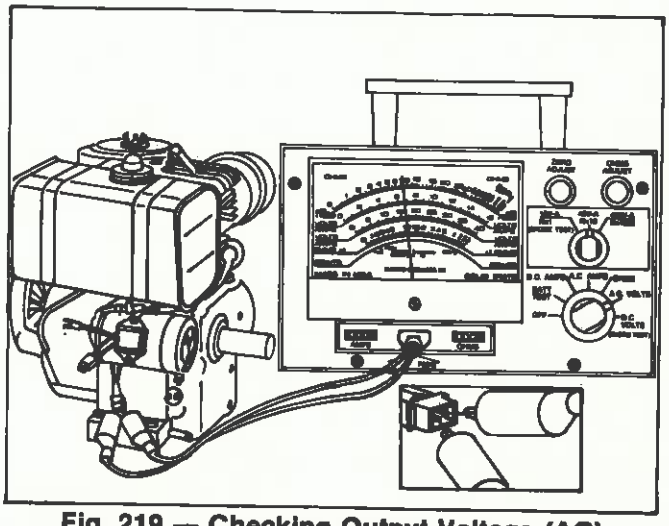

Fig. 219 — Checking Output Voltage (AC)

OVERCHARGING

If battery seems to be in a state of overcharge (boiling out of water), first check to ensure the battery is not vibrating or shaking in the battery holder or case. If battery seems secure, check battery voltage. If voltage is more than 16 volts, it is being overcharged. This could be either the fault of the battery which is due to a high resistance or the regulator which is continually putting current into the battery. If the battery is replaced and the voltage still is above 16 volts, this would indicate the regulator is at fault. Replace the regulator in that case. If upon replacement of the battery the voltage stays below 16 volts, this would indicate the battery was at fault.

ALTERNATOR
10 Amp - Fuse Type

10 AMP REGULATED ALTERNATOR Used on Model Series 320400

This completely self-contained 10 ampere regulated alternator uses both solid state rectifier and electronic regulating elements. It provides rapid charging and handles extra electrical loads without overcharging the battery. Its output rises from 4.2 amperes at 2000 RPM to 10 amperes at 3600 RPM. It uses less than 0.2 horsepower.

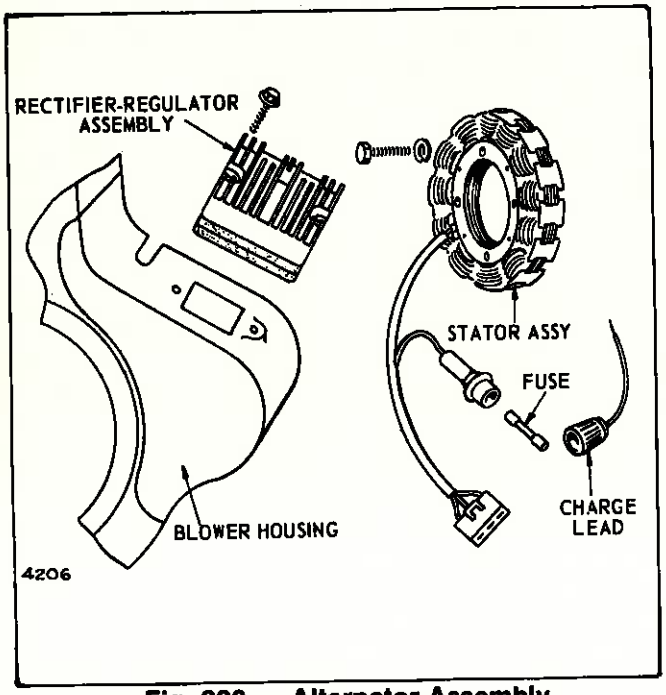

Fig. 220 — Alternator Assembly

7 C

CHECKING 10 AMP REGULATED ALTERNATOR

Condition Found (Fuse Blown)

Check if battery polarity is correct. Negative (-) side of battery should be grounded to engine or frame; positive (+) side of battery to alternator output lead.

If reversed, correct and put in new fuse.

WHEN CHECKING THE ALTERNATOR COMPONENTS, MAKE THE TESTS IN THE FOLLOWING SEQUENCE:

Condition Found (Fuse Blown)

Disconnect charging lead from battery. Connect a DC ammeter between charging lead and battery, as shown in Fig. 221.

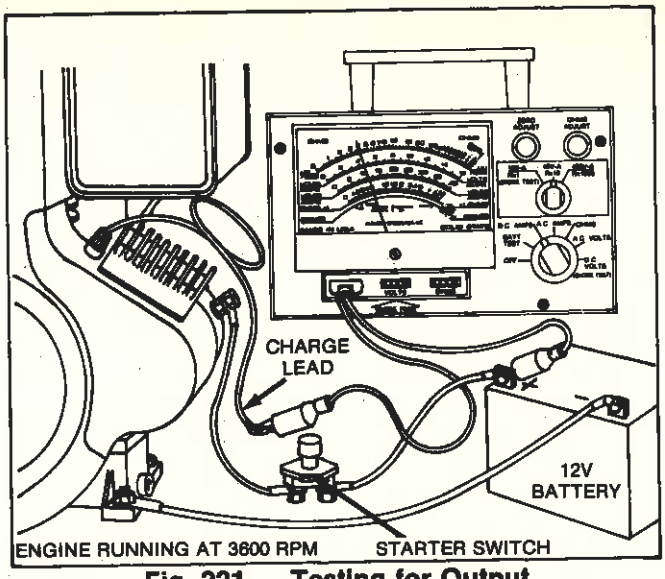

Fig. 221 — Testing for Output

Start engine and run at 3600 RPM. An ammeter reading of 10 amps or above indicates alternator is functioning. Check battery, cables, etc.

If ammeter reading is less than 10 amps, stator or rectifier-regulator is defective.

Testing Stator

Disconnect plug from regulator-rectifier assembly. Start engine and run at 3600 RPM. Connect AC volt meter to AC terminals at stator plug. See Fig. 222. A meter reading above 20 volts indicates stator is good. A volt meter reading less than 20 volts indicates stator is defective. Check for shorted leads or obvious defects. If shorted leads are found, repair with electrical tape. If visible defect is not found, replace stator.

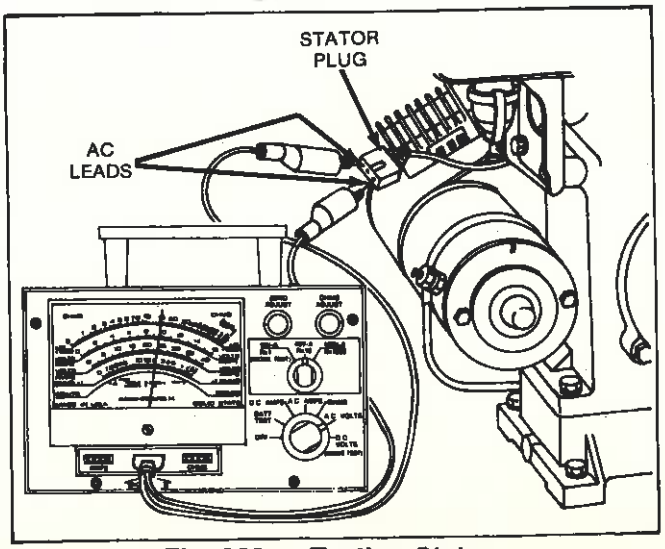

Fig. 222 — Testing Stator

Testing Rectifier-Regulator Assembly

With changing lead connected to battery, check voltage across battery terminals with DC voltmeter. See Fig. 223. If voltmeter reads 13.8 volts or higher, reduce battery voltage by connecting 12 volt load lamp across battery terminals.

When battery voltage is below 13.5 volts, note voltage. Start engine and run at 3600 RPM. Voltmeter reading should rise. If battery is fully charged reading should rise about 13.8 volts. If voltage does not increase and stator has been checked previously, rectifier-regulator assembly is defective and must be replaced.

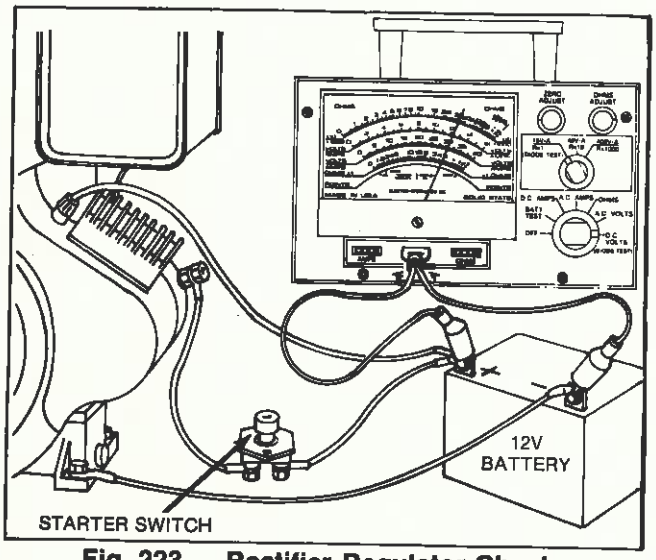

Fig. 223 — Rectifier-Regulator Check

Condition Found (Continuous High Charge Rate)

Start engine and run at 3600 RPM. (Charge lead must be connected to battery.) Measure voltage across battery terminals with DC voltmeter. See Fig. 223. Voltmeter reading should not be above 14.7 volts. If voltage is higher regulator-rectifier assembly is defective and must be replaced.

NOTE: A high charge rate with voltage below 14.7 volts indicates battery condition is poor. Test battery!

7
C