

MOTORCRAFT WITH SEPARATE REGULATOR

Ford Motor Co.

DESCRIPTION

Alternator is belt driven from engine. Current is supplied from Alternator-Regulator system, to rotating field of alternator through two brushes to two slip rings. Power is produced in form of alternating current which is rectified to direct current by six diodes. Alternator regulator automatically adjusts alternator field current to maintain alternator output voltage within prescribed limits to correctly charge battery. A fuse link is incorporated into the wiring harness between the starter relay and alternator to prevent damage should the harness become grounded or a booster battery be used with incorrect polarity.

Regulator is electronic (100% solid state) and consists of transistors, diodes and resistors. The electronic regulator is used on all charging systems. Two regulators, similar in appearance but not interchangeable, are used. One, color coded black, is used in systems with alternator warning lamps; another, color coded blue, is used in systems with ammeters. No adjustment is required or possible.

IDENTIFICATION & SPECIFICATIONS

Alternator is color-ink stamped with "Motorcraft" trademark. Color Stamp is code for rated amperage output. Rated amperage is also stamped on end frame (40A, 60A, etc.). Color code is as follows:

Application	Amperage @ 15V.	Rated Output Speed (Engine RPM)
Orange	40	2900
Green	60	2900
Black (Rear Term.)	65	①
Black (Side Term.)	70	②1640
Red	100	②2900

- ① - Not available from manufacturer.
- ② - Rated cold output.

Specifications

Alternator	Specification
Field Current at 12 volts (All)	4.0 Amps.
Slip-Rings (All)	
Minimum Diameter	1.22"
Maximum Runout.....	.0005"
Brush Length Wear Limit (70 Amp.)	5/16"
Brush Length Wear Limit (Except 70 Amp.)	3/16"
Pulley Nut Torque (70 Amp.)	80-100 ft. lbs.
Pulley Nut Torque (Except 70 Amp.)	60-100 ft. lbs.

SERVICE

CAUTION - When testing or servicing alternator or regulator, take following precautions to avoid damage to components:

Battery - Do not reverse battery connections. Negative terminal must be connected to ground. When charging battery, cables must be disconnected from battery before connecting charger. Do not use charger as a booster for starting engine. If booster battery is used to start engine, negative cable of

booster must NOT be connected to negative cable of vehicle battery. Attach instead to engine bolt head or similar clean, grounded contact.

Alternator - Do not ground field circuit between alternator and regulator, or operate alternator on an open circuit with field winding energized. Do not ground output terminal or attempt to polarize alternator as polarization is not required.

Regulator - Turn ignition switch off when working on regulator. Use care to prevent a short circuit between regulator relay and regulator base while working on components.

TESTING

VOLTMETER TEST PROCEDURES

NOTE - When performing charging system test with a voltmeter, turn off all lights and electrical components. Be sure battery specific gravity is at least 1.200.

- 1) Connect negative lead of voltmeter to negative battery post and positive lead to positive battery post. Record battery voltage.
- 2) To run No Load test, attach suitable tachometer and start engine. Operate at 1500 RPM with no electrical load (foot off brake and doors closed). Voltmeter reading should increase 1-2 volts above battery voltage. Reading should be taken when voltmeter needle stops moving (may require a few minutes).

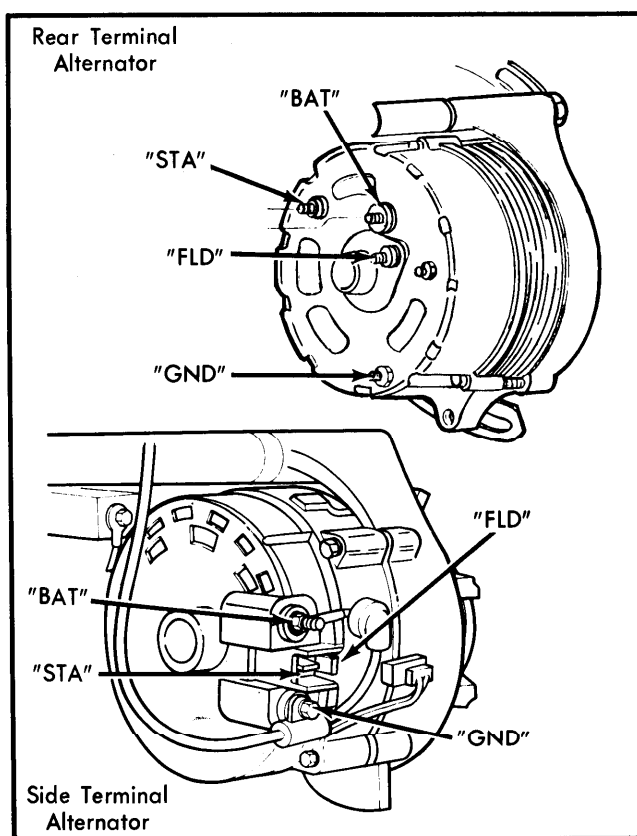


Fig. 1 Terminal Locations for Rear and Side Terminal Alternator

Alternators & Regulators

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3) To run Load test, attach suitable tachometer and start engine. Turn on heater or A/C blower motor to "high" position and turn on headlights to high beam. Increase engine speed to 2000 RPM. Voltmeter should indicate a minimum of 0.5 volt increase over battery voltage. If system conforms to these readings, operation is normal.

TEST RESULTS

1) If voltmeter reading indicates over-voltage (more than two volts above battery voltage), shut off engine and check ground connections between regulator and alternator and/or regulator and engine. Clean and tighten connections, then repeat No Load test.

2) If over-voltage condition still exists, disconnect regulator wiring plug and repeat No Load test. If condition is corrected, replace regulator and repeat No Load test.

3) If over voltage still exists with regulator disconnected, a short is indicated in wiring harness between alternator and regulator. Repair short circuit, then replace voltage regulator and repeat tests with regulator plug connected.

4) If voltmeter reading does not increase at least one volt, check for presence of battery voltage at alternator "BAT" terminal, and at regulator plug "A" terminal. If no voltage is present, an open wire is indicated. Repair wire and repeat tests.

FIELD CIRCUIT & ALTERNATOR TESTS

1) If voltmeter does not indicate more than 0.5 volt above base voltage, disconnect wiring plug from regulator and connect an ohmmeter from "F" terminal to ground. Ohmmeter should indicate more than 3 ohms. If less, repair grounded field circuit and repeat Load test.

NOTE — Ohmmeter reading in step 1) should be between 4 and 250 ohms.

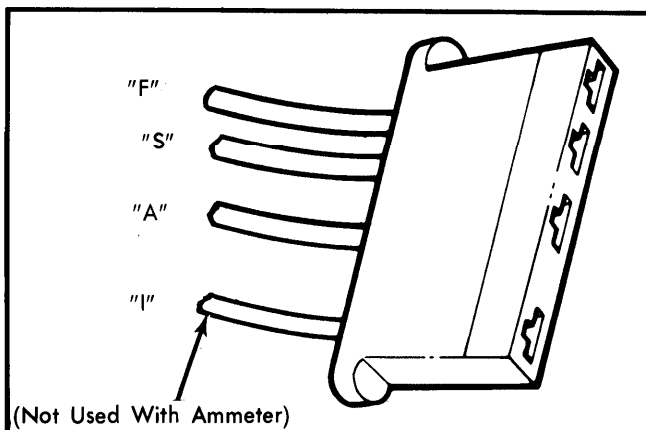


Fig. 2 Regulator Plug Wire Connections

2) If field circuit is satisfactory, disconnect regulator wiring plug at regulator and connect jumper wire between "A" and "F" terminals on regulator wiring plug. Repeat voltmeter Load test. If more than 0.5 volt above battery voltage, regulator or

wiring harness is defective. If problem of under-voltage still exists, remove jumper wire at regulator plug and leave plug disconnected from regulator.

3) Connect jumper wire to "FLD" and "BAT" terminals on alternator. Repeat voltmeter Load test. If results are now satisfactory, repair wiring harness from alternator to regulator. If voltmeter test still indicates under-voltage, move positive lead of voltmeter to "BAT" terminal. If you now have base voltage, repair or replace alternator. If 0 volts, repair "BAT" wire.

REGULATOR CIRCUIT TESTS

"S" Circuit With Ammeter — Connect positive voltmeter lead to regulator wiring plug "S" terminal position. Turn ignition "ON", but do not start engine. Voltmeter should indicate battery voltage. If there is no voltage, the "S" wire lead from ignition switch is open. Connect positive voltmeter lead to positive battery cable terminal. Connect regulator wiring plug to regulator and repeat Load test.

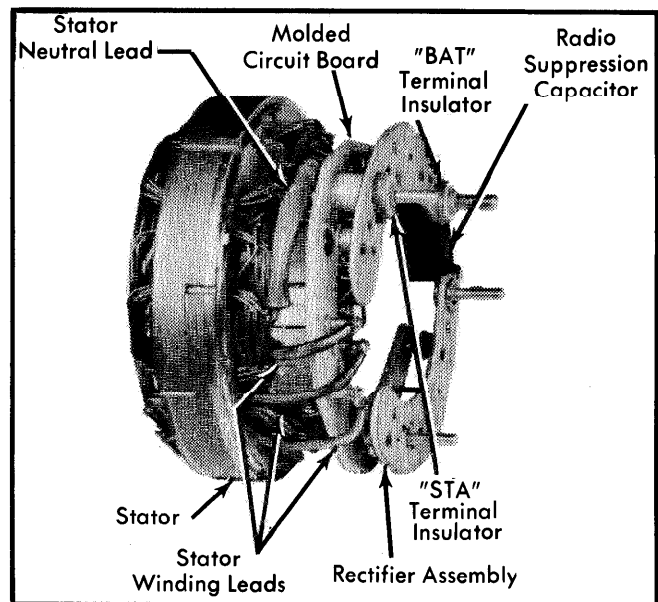


Fig. 3 Stator Components and Lead Connections (Rectifier with Exposed Diode Shown)

"S" & "I" Circuit With Indicator Light — Disconnect regulator wiring plug and install a jumper wire between "A" and "F" terminals. With engine idling, connect positive lead of voltmeter to "S", and then "I" terminals of regulator wiring plug. Voltage of "S" circuit should be about $\frac{1}{2}$ of "I" circuit. If no voltage is present, repair wiring circuit at fault. Reconnect positive voltmeter lead to positive battery cable terminal. If circuit tests are satisfactory, install new regulator. Remove jumper wire from regulator wiring plug, connect plug to regulator and repeat Load test.

DIODE TEST (ON VEHICLE)

Disconnect electric choke (if equipped) and voltage regulator plug. Connect jumper wire between "A" and "F" terminals of voltage regulator wiring plug. Connect voltmeter to battery

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posts, start and run engine at idle speed, then record voltmeter reading. Move positive voltmeter lead to "S" terminal of alternator and note voltmeter reading. If meter reads $\frac{1}{2}$ of battery voltage, diodes are in working order. If meter reads approximately 1.5 volts, alternator has shorted negative diode or grounded stator winding. If meter reads approximately 1.5 volts less than battery voltage, alternator has shorted positive diode. If meter reads approximately 1.0-1.5 volts less than $\frac{1}{2}$ of battery voltage, alternator has an open positive diode. If meter reads about 1.0-1.5 volts more than $\frac{1}{2}$ battery voltage, alternator has an open negative diode. Reconnect electric choke (if equipped) back into circuit after test is completed.

BENCH TESTS

Rectifier Shorted or Grounded and Stator Grounded Test

1) Use a calibrated ohmmeter and set knob at 1. Connect one ohmmeter probe to alternator "BAT" terminal and other probe to "STA" terminal (rear blade terminal). Then reverse terminal probes and repeat test. Ohmmeter should read about 60 ohms in one direction with no needle movement when probes are reversed.

2) A reading in both directions indicates a bad positive diode, a grounded positive diode plate, or a grounded "BAT" terminal.

3) Perform same test using "STA" or "GND" terminals of alternator. Readings in both directions indicate either bad negative diode, grounded stator winding, grounded stator terminal, grounded positive diode plate, or grounded "BAT" terminal. Infinite reading (no needle movement) in all four probe positions in the preceding tests indicates an open "STA" terminal lead connection inside alternator.

Field Open or Short Circuit Test — Set ohmmeter knob at 1 and calibrate meter as directed by manufacturer. Contact alternator "FLD" terminal with one probe and "GRD" terminal with other probe, then spin alternator pulley. Ohmmeter should read between 2.4 and 25.0 ohms, and should fluctuate while pulley is spinning. Infinite reading (no needle movement) indicates open brush lead, worn or stuck brushes, or bad rotor assembly. Meter reading of less 2.4 ohms indicates grounded brush assembly, grounded field terminal, or bad rotor.

Diode Test — Remove rectifier assembly from alternator. Set meter knob at 10 and calibrate instrument. To test one set of diodes, contact one probe to terminal bolt and contact each of three stator lead terminals with other probe. Reverse probes and repeat test. All diodes should show readings of about 60 ohms in one direction, and infinite readings with probes reversed. Repeat test for other set of diodes, moving first probe to other terminal screw. If meter readings are not as specified, replace rectifier assembly.

Stator Coil Open Or Grounded Test — Following tests are to determine if stator coil is operating properly. Disassemble stator from alternator. Set ohmmeter knob at 1000. Contact meter probe to one stator lead and other probe to stator laminated core. Meter should show infinite. If meter needle moves, stator winding is shorted to core and must be replaced. Repeat test for each one of stator leads.

Rotor Open or Short Circuit Test — Disassemble front housing and rotor from rear housing. Set ohmmeter knob at 1 and calibrate meter. Contact each probe to a rotor slip ring. Meter should read 2.4-4.9 ohms. Higher reading indicates damaged slip ring solder connection, or broken wire. Lower reading indicates shorted wire or slip ring. Replace rotor if damaged. Contact one meter probe to slip ring and other probe to rotor shaft. Meter reading should be infinite (no needle deflection), reading other than infinite indicates rotor is shorted to shaft. If shorted replace rotor.

NOTE — Slip ring terminals or solder touching rotor shaft will cause shorted condition.

ADJUSTMENTS

ALTERNATOR REGULATOR

Electronic Type — Electronic regulator is used on all charging systems and is factory calibrated and cannot be adjusted.

OVERHAUL

REAR TERMINAL ALTERNATORS

Disassembly — 1) Mark end housings and stator frame with scribe for reassembly reference. Remove through bolts. Separate front housing and rotor assembly from stator and rear housing. Remove brush springs from rear housing brush holder. Remove all nuts, washers and insulators from terminals on back of rear housing. Note color and location of insulators for later reassembly.

2) Remove stator and rectifier assembly from rear housing. Remove brush holder, brushes, brush terminal insulator and press bearing from rear housing.

3) Clamp front housing in vise using protective jaws. Remove drive pulley nut from rotor shaft using suitable tool (T65P-10300-B). Remove lock washer, drive pulley, fan and fan spacer from rotor shaft. Remove rotor from front housing and release housing from vise.

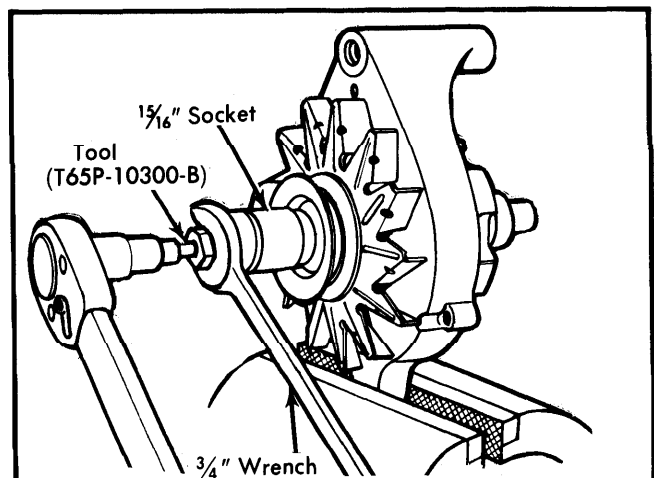


Fig. 4 View Showing Proper Tools for Removing Pulley

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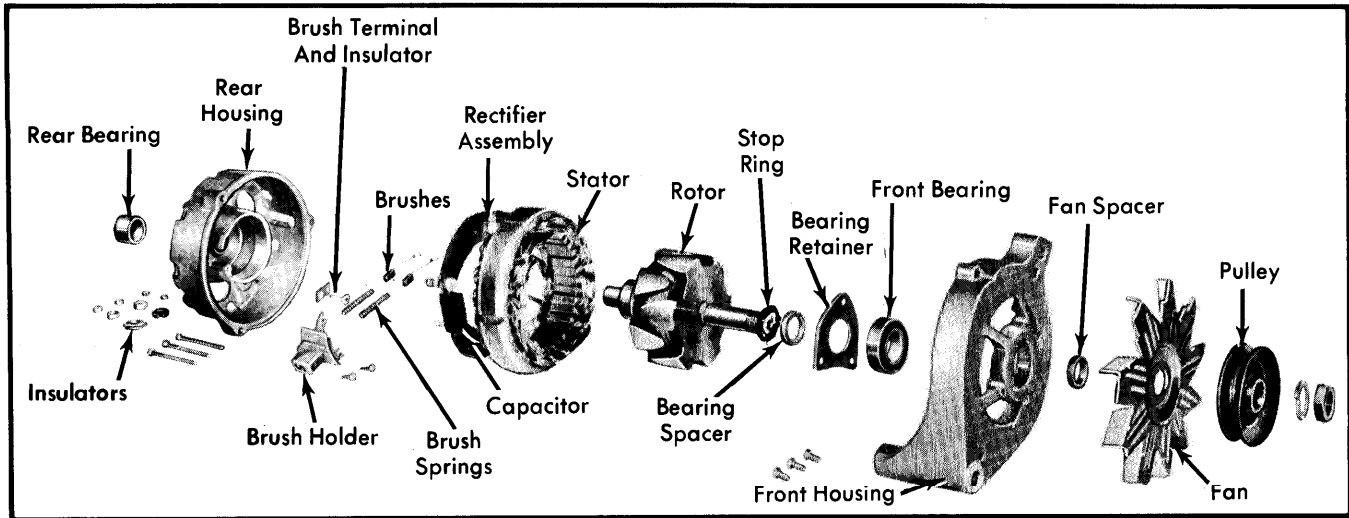


Fig. 5 Exploded View of Rear Terminal Alternator

4) Remove front bearing spacer from rotor shaft. Do not remove stop ring from rotor shaft unless it is damaged. Remove bearing retainer and bearing from front housing. Press bearing out if necessary. Remove radio suppression capacitor and battery terminal insulator from rectifier assembly.

5) Using a 100 watt soldering iron, unsolder stator leads from rectifier assembly. Do not permit rectifiers to overheat. On 65 amp. alternators, use care not to cut stator lead wires. Unsolder stator lead terminals from molded circuit board terminals. Use needle nose pliers to pull stator lead terminals upwards from rectifier assembly. Shake molten solder from terminals while hot.

6) Disconnect stator neutral lead from flat type rectifiers by removing stator terminal screw by pressing it straight out of rectifier. Do not turn terminal screw during removal, as this will destroy retaining serrations. On stacked type rectifiers (with exposed diodes as contrasted with built-in diodes of flat type rectifiers), remove stator terminal screw by turning it $\frac{1}{4}$ turn to unlock it. Ground screw can be removed in similar manner, depending on type of rectifier.

Reassembly – 1) Never use solvent to clean rotor, stator or bearings. Wipe parts off with suitable clean cloth. Install bearing in front housing, pressing on outer race only. Install bearing retainer.

2) If stop ring was removed from rotor shaft, install new ring by sliding it over end of shaft and into groove. Do not open stop ring with snap ring pliers or stop ring will be permanently deformed. Install bearing spacer on rotor shaft with recessed side against stop ring.

3) Install rotor in front housing and clamp housing in vise. Install fan spacer, fan, drive pulley, lock washer and nut on rotor shaft. Remove rotor and housing assembly from vise.

4) Press bearing in rear housing, providing support close to bearing boss. Bearing should be flush with housing. Position brush wiring connector over brush terminal and install in-

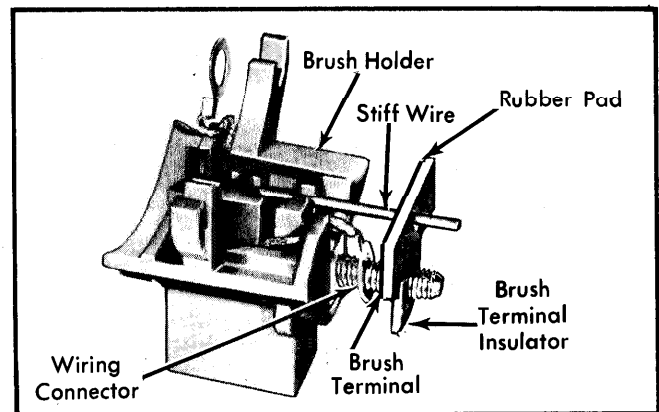


Fig. 6 Brush Holder Assembly with Wire for Retaining Brushes in Place Inserted Through Holes

ulator. Install springs and brushes in holder. Use toothpick or stiff wire to hold brushes against spring tension.

5) Install brush holder in rear housing and install attaching screws. Press holder firmly against housing while tightening. Be sure ground brush wiring connector is positioned under screw before tightening.

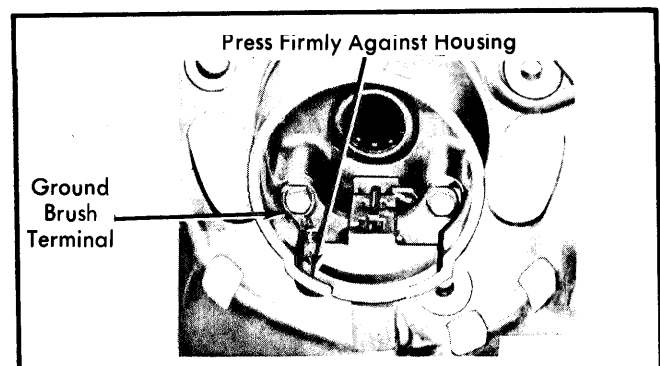


Fig. 7 View Showing Proper Positioning of Brush Leads

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6) Connect stator neutral lead to rectifiers. On flat type rectifiers with built-in diodes, position stator terminal insulator and stator neutral lead on rectifier assembly. Insert terminal screw and press into position. Neutral lead terminal should not move if screw is pressed to proper depth.

7) On stacked type rectifiers with exposed diodes, place stator neutral lead and dished washer on rectifier assembly. Insert terminal screw and rotate it $\frac{1}{4}$ turn to lock it in place.

8) If ground screw was removed, install in same manner as other screws, depending on type of rectifier. Wrap stator winding leads around terminals of rectifier assembly and solder them, using 100 watt soldering iron and rosin core electrical solder.

NOTE — On 65 amp. alternators, push stator terminals onto rectifier assembly pins and position as shown in Fig. 8. Solder in place.

9) Install radio suppression capacitor and battery terminal insulator on rectifier assembly. Install insulator on stator terminal screw. Align terminal screws on rectifier assembly with holes in back of rear housing, and install stator rectifier assembly in rear housing.

NOTE — Be sure terminal insulators are seated in their recesses.

10) Install insulators, washers and nuts on proper terminals. Insulators are color coded — black for "STA" terminal; red for "BAT" terminal and orange for "FLD" terminal.

11) Wipe rear end bearing surfaces on rotor shaft with clean rag. Place rear housing and stator assembly over rotor and align scribe marks made during disassembly. Seat machined portion of stator core into stop in each end housing. Install through bolts.

12) Remove toothpick or stiff wire from brush holder.

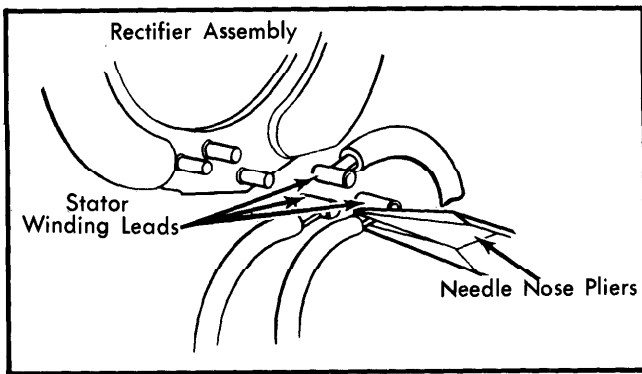


Fig. 8 Installing Stator Leads on Rectifier Pins (65 Amp. Alternator)

SIDE TERMINAL ALTERNATORS

Disassembly — 1) Mark both end housings and stator with a scribe for reassembly reference. Remove through bolts and separate front and rear housings. Do not separate rear housing from stator at this time.

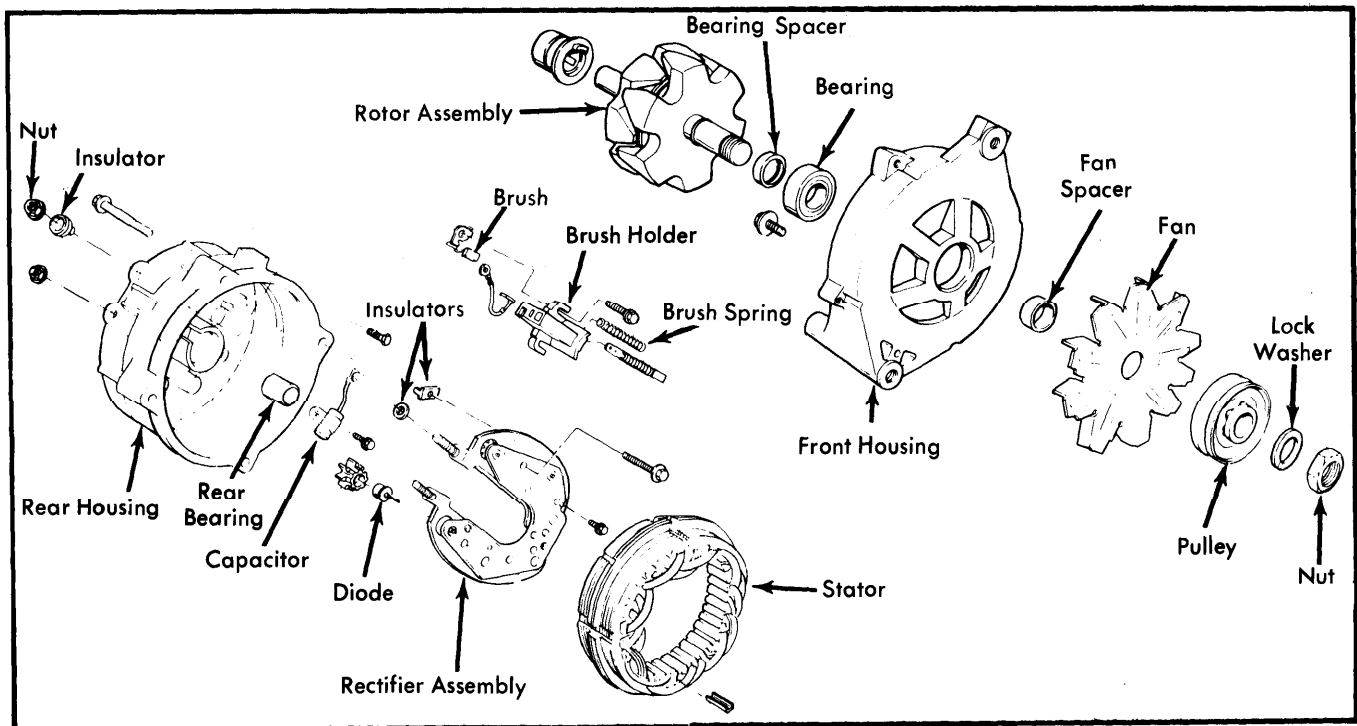


Fig. 9 Exploded View of Side Terminal Alternator

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2) Remove drive pulley nut, lock washer, pulley, fan and fan spacer from rotor shaft. Pull rotor and shaft from front housing. Remove spacer from rotor shaft.

3) Remove 3 screws retaining bearing in front housing. If damaged or dry of lubricant, press bearing from housing. Unsolder and remove 3 stator leads from rectifier, using care not to overheat rectifier. Lift stator from rear housing.

4) Unsolder and remove brush holder lead from rectifier. Remove screw attaching capacitor lead and 4 screws securing rectifier to rear housing. Remove 2 terminal nuts and insulator from outside housing, and remove rectifier from rear housing.

5) Remove brush holder assembly. Remove any sealing compound from rear housing and brush holder. Remove capacitor. Remove rear bearing if necessary, supporting housing close to bearing boss.

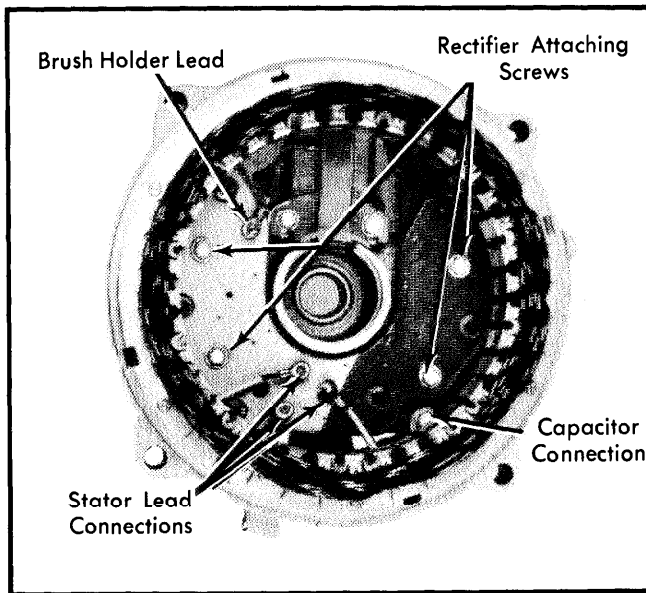


Fig. 10 Side Terminal Alternator Lead Connections

Reassembly — 1) Do not clean rotor, stator or bearings in solvent, but use a clean cloth to wipe these parts. Press new front bearing into housing, if necessary to replace it. Apply pressure on bearing outer race only. Install bearing retaining screws.

2) Place inner spacer on rotor shaft and insert shaft into front housing and bearing. Install fan spacer, fan, pulley, lock washer and nut on rotor shaft. Use suitable tool (T65P-10300-B) to tighten nut.

3) If rear bearing requires replacing, press new bearing in from inside housing until it is flush with boss on outer surface. Place brush terminal on brush holder. Install springs and brushes in holder and secure with stiff wire or toothpick. Install brush holder in rear housing. Push brush holder toward rotor shaft opening and tighten attaching screws.

4) Install capacitor in rear housing. Place 2 rectifier insulators on bosses inside housing. Place insulator on "BAT" (large) terminal and position rectifier in rear housing. Install outside insulator on "BAT" terminal and install nuts on "BAT" and "GND" terminals (fingertight only).

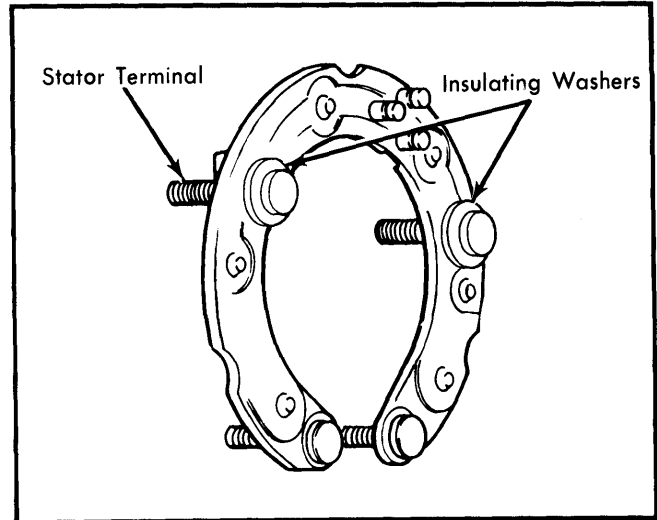


Fig. 11 Flat Type Rectifier Assembly (With Built-in Diodes)

5) Install 4 rectifier attaching screws loosely. Tighten "BAT" and "GND" terminal nuts outside of housing and then 4 rectifier attaching screws. Attach capacitor lead to rectifier.

6) Press brush holder lead on rectifier pin and solder securely. Do not permit rectifier to overheat. Position stator in rear housing and align scribe marks made during disassembly. Press 3 stator leads on rectifier pins and solder securely.

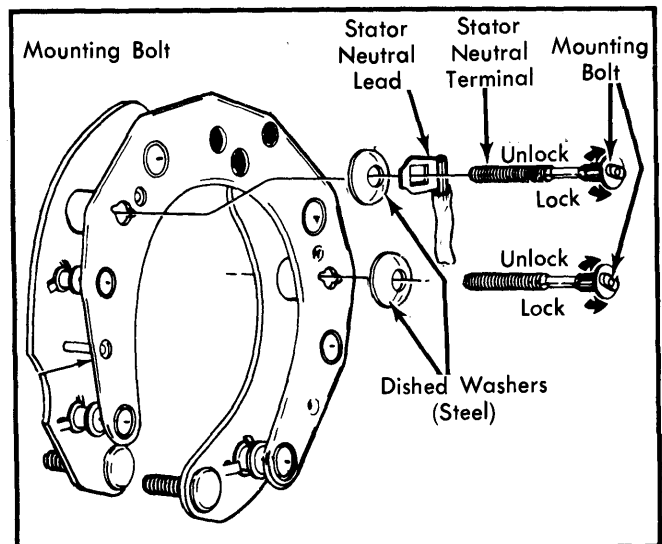


Fig. 12 Stacked Type Rectifier Assembly (With Exposed Diodes)

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7) Install rotor and front housing to stator and rear housing, aligning scribe marks.

NOTE — Tighten 2 opposing bolts and then the 2 remaining bolts.

8) Spin fan and pulley to check for binding. Remove brush retaining wire or toothpick. Place daub of waterproof cement over hole to seal it.

BRUSH REPLACEMENT ONLY

1) Mark both end housings and stator with a scribe mark. Remove 4 housing through bolts and separate front housing and rotor from rear housing and stator. Do not separate rear housing and stator.

2) Unsolder and remove brush holder lead from rectifier. Remove brush holder from rear housing. Remove any sealing compound from housing and brush holder.

NOTE — Brushes and springs are serviced as an assembly only.

3) Install brush holder to rear housing, inserting wire to retract brushes through hole in rear housing. Push brush holder toward rotor shaft opening and tighten attaching screws.

4) Press brush holder lead on rectifier pin and solder. Do not allow rectifier to overheat. Align rotor and front housing to stator and rear housing and install through bolts. Spin fan to check for binding. Remove wire from brush holder. Place daub of waterproof cement over hole to seal it.