Delco Remy

PRODUCT INFORMATION

1G-500

1/98

HEAVY DUTY BRUSHLESS ALTERNATOR SERVICE MANUAL

FEATURES

SPECIFICATIONS:

MAXIMUM SPEED:
Continuous: 10,000 rpm
Intermittent: 12,000 rpm

ROTATION:
Clockwise
Counterclockwise

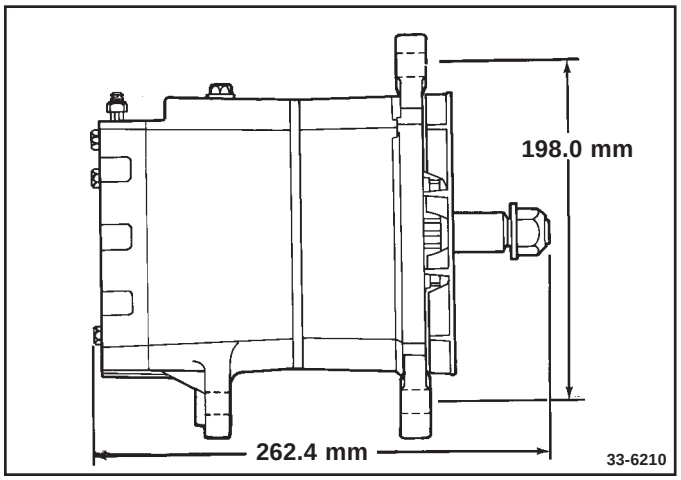
TEMPERATURE LIMITS:
-40°F or -40°C Ambient
+200°F or +93°C Ambient

POLARITY:
Negative Ground Standard
Insulated Models Available

MOUNTING:
SAEJ180 Standard

WEIGHT:
33 SI 24.5 pounds or 11.1kg
34 SI 25.4 pounds or 11.5g

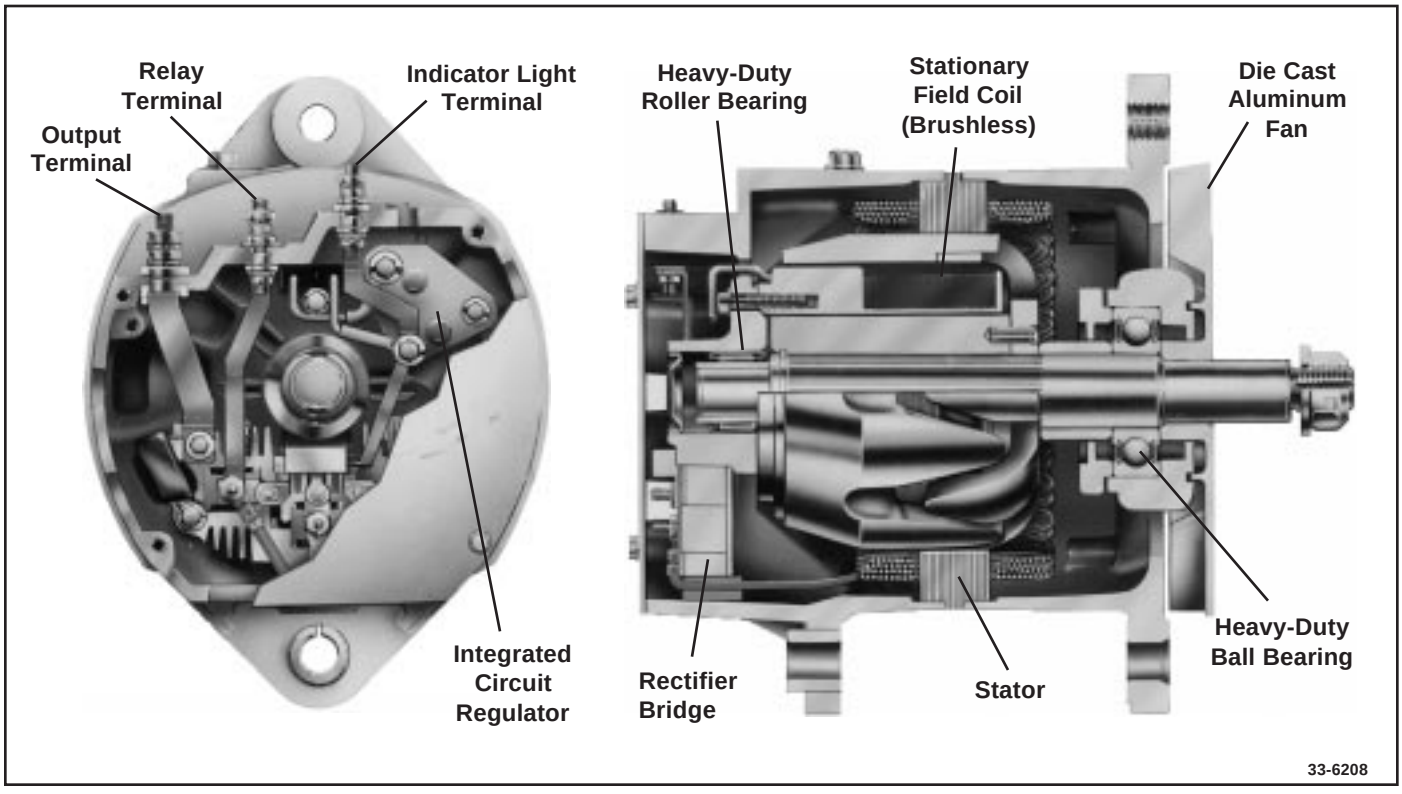
Built-In Voltage Regulator
Solid-State Integrated Circuit
Flat Temperature-Compensated
Low Parasitic Draw
Low Turn-On Speed
Improved RFI Suppression
Load Dump Protection



Brushless Construction
Stationary Field Coil
No Brushes or Slip Rings

Corrosion Protection
Special Environmental Protection Coating

Applications
Line-Haul Diesel Trucks
Large Commercial Diesel Engines
Harsh Environments
Heavy Belt Loads and Vibrations



PRODUCT INFORMATION AND SERVICE MANUAL

33/34 SI HEAVY DUTY BRUSHLESS ALTERNATOR

CONTENTS

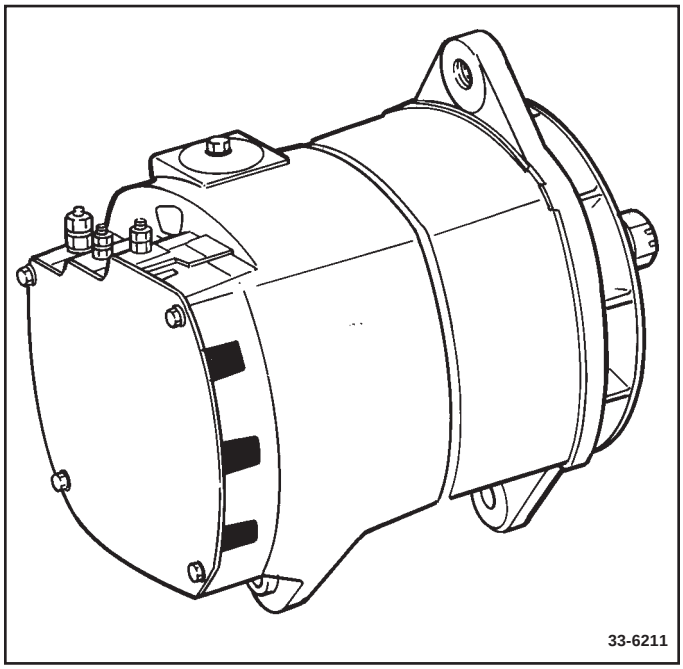


Figure 1. 33 SI Alternator

INTRODUCTION

The 33/34 SI series alternator is a brushless, heavy-duty integral charging system with built-in diode rectifier and voltage regulator, producing DC current for battery electrical systems. The 33/34 SI series is designed for use on large and mid-range diesel and gasoline engines in over the-road service, as well as for off-road, agricultural, and construction equipment.

The 34 SI is identical to the 33 SI except for the stabilizing lug (4th lug) on top of the rectifier end frame and the ground screw is located on the right side of the rectifier end housing. The stabilizing lug provides superior vibration resistance on certain applications.

The 33/34 SI alternator may be operated in either clockwise or counterclockwise directions (external fan may require changing to reverse rotation) at continuous speeds of up to 10,000 alternator rpm. Intermittent speeds of up to 12,000 alternator rpm are also acceptable. The ambient temperature range for proper operation is -34°C to +93°C (-30°F to +200°F).

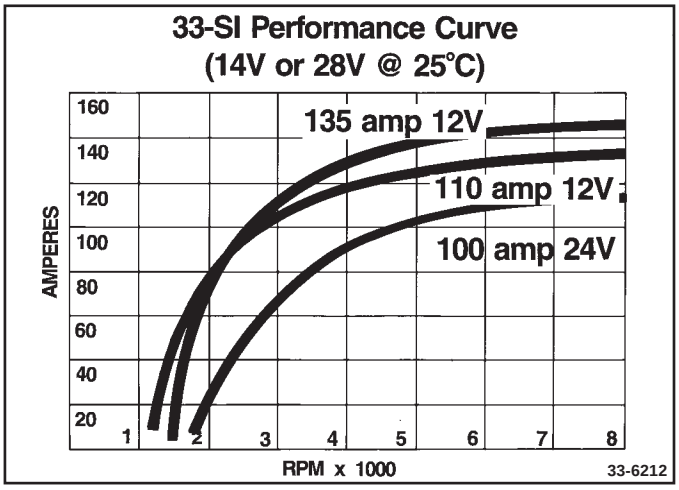


Figure 2. Typical Output vs. Alternator RPM

The solid state, integrated circuit voltage regulator built into the 33/34 SI alternator limits system voltage by switching the ground circuit for the field on and off. When the ground circuit is on, field current passes from a diode trio through the stationary field coil. Nominal regulated voltages of 13.8, 14.0, and 14.2 volts are available for 12 volt systems, and 27.5 volts for 24-volt systems.

For 12-volt systems, output ratings of 110 and 135 amperes are available. For 24-volt systems, an output rating of 100 amperes is available. Refer to Figure 2 for graphs of typical outputs over a range of alternator speeds. For output ratings of specific 33/34 SI models refer to DRA model specifications.

FEATURES

The 33/34 SI alternator is designed for a “one-wire” charging system configuration. “One-wire” refers to the minimum number of lead wire connections necessary at the alternator for operation and requires only that the alternator output terminal be connected to the battery insulated (positive for a negative-ground system) terminal and that a ground path be provided between the alternator housing and the battery ground terminal. (See Figure 3) (Insulated units will have a battery "Pos" and battery "Neg" terminal for "Output" and "Ground" connections.)

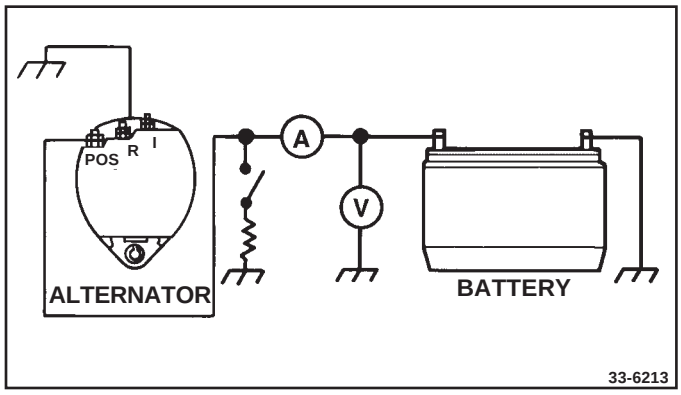


Figure 3. Basic One-Wire System

The “I” terminal may be used in a circuit to power an indicator light and/or to lower the engine speed (RPM) at which the alternator will turn on. Typical system wiring using this type of circuit is shown in Figure 4. This is commonly referred to as a “one-wire system with "I" terminal” or as a “two-wire system.

External connections to the 33/34 SI alternator are made to terminals shown in Figure 5. The standard output terminal is a 1/4"-28 thread. With this type of terminal, the exposed metal parts will have battery voltage when connected to the battery.

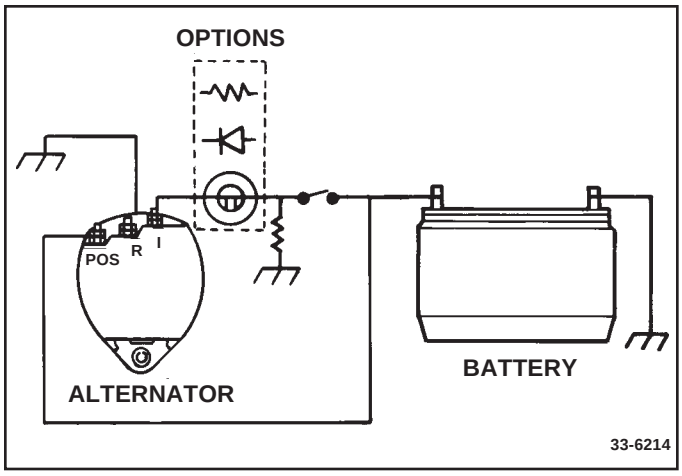


Figure 4. One-Wire System with "I" Terminal

Other connections to the 33/34 SI series include an “R” (relay), “I” (indicator light) terminal, and a ground lead connection to the alternator’s rectifier end housing.

An “R” or relay terminal is located on the rectifier end frame next to the output terminal. This terminal may be used to operate some types of charge indicators, an ADLO system, a tachometer, or similar device by providing voltage pulses at a frequency of 8 pulses for each revolution of the alternator. The current draw of the accessories being powered through this terminal must not exceed 4 amperes and operate at approximately one half of system voltage. The “R” terminal may be 10-24 threaded or the pin type.

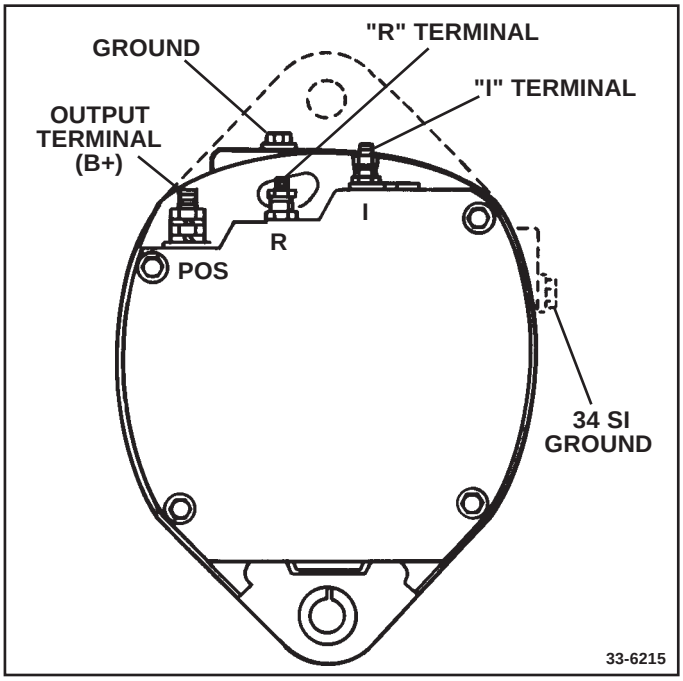


Figure 5. 33/34 SI Electrical Terminals

The "I" terminal is connected internally to the field circuit. An indicator light connected in series with this terminal will glow whenever there is a voltage difference between the "positive" side of the field circuit and the system voltage at other side of the indicator light. During normal alternator operation, the light will be off since the diode trio output voltage equals the system voltage. Current passed through the field winding during engine start-up, results in a lower alternator turn-on speed. A diode or resistor may be used instead of a light bulb if no indicator light is needed. (See Fig. 4) Up to 1 ampere of current may be passed through this circuit to aid in alternator turn-on. An "I" terminal is normally a threaded stud type with a 10-24 thread.

A threaded 1/4" hole (with screw and lockwasher assembly) in the rectifier end housing is provided to connect a ground lead if used; otherwise, the ground path is through the mounting hardware and brackets to the engine. On replacement units, a paper tag is present identifying the "ground screw"; remove and discard the tag. The screw and lockwasher assembly should be installed in the housing regardless of whether a ground lead is connected, to prevent entry of dirt and water.

All electronic parts of the alternator are specially coated for environmental protection against moisture and dirt, and the alternator is "inside cooled" by air drawn through inlets in the rectifier end frame and exiting from the drive end frame behind the fan.

OPERATING PRINCIPLES

An alternator is a voltage-creating machine. The voltage regulator limits the maximum voltage that the alternator will produce at the output terminal by controlling the magnetic field present in the stationary field. The output voltage, induced in the stator and rectified by the diodes, allows current to flow to satisfy the electrical loads placed on the system, up to a maximum current that is characteristic of the alternator design.

Schematics of the alternator circuitry are shown in Figure 6 (standard unit) and Figure 7 (insulated unit). With the alternator rotor turning, a magnetic field around the stationary field coil is conducted by the rotor poles to induce voltages in the stator windings. The faster the rotor turns, the higher the induced voltage will be.

The initial voltages at start-up are generated by residual magnetism in the rotor. On applications with an "I" terminal in use, this magnetism will be boosted by a small amount of current flowing through the field from the indicator light circuit. As speed and output increase, voltage available at the diode trio becomes sufficient to supply field current for normal operation. When the output voltage exceeds the battery voltage, the alternator begins to drive the system voltage. If the wiring system includes an indicator light, the presence of system voltage at the diode trio equalizes the voltage on both sides of the indicator light and the light goes out.

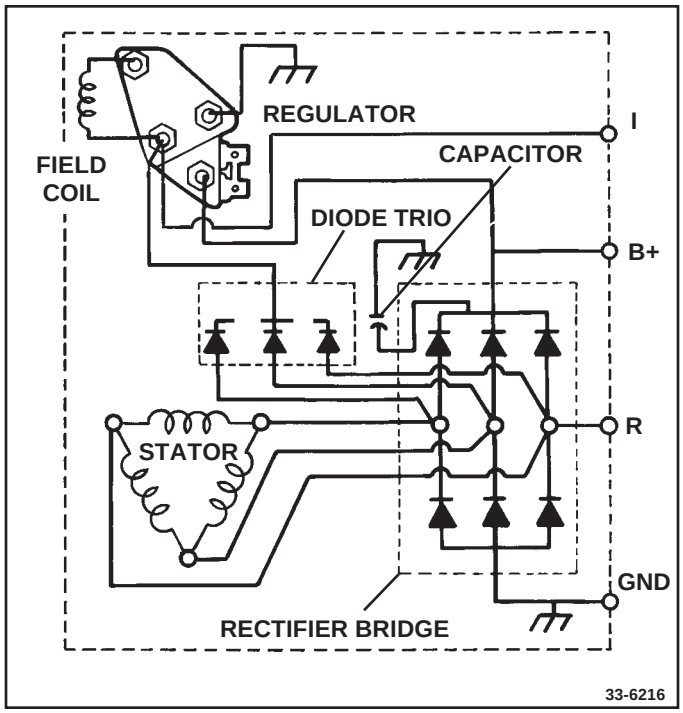


Figure 6. Alternator Schematic

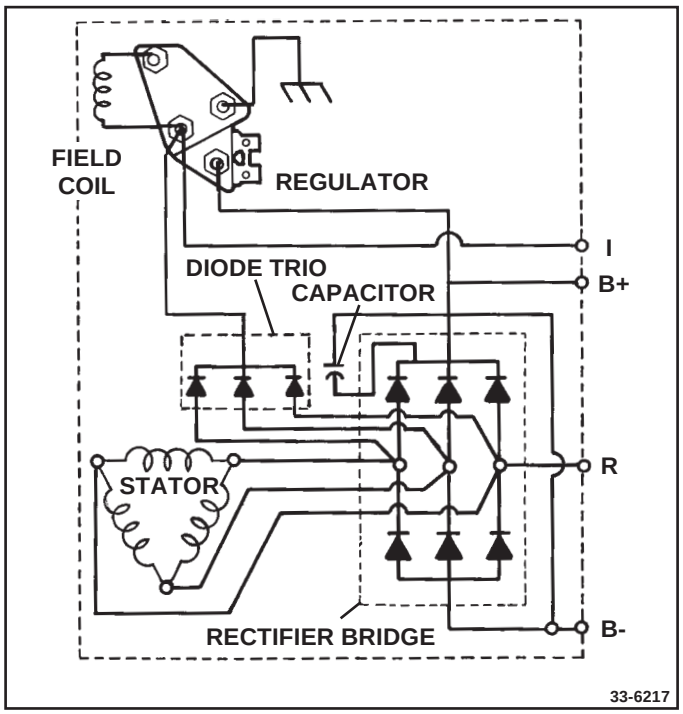


Figure 7. Insulated Model Schematic

While the system voltage is below the voltage regulator setting, the regulator turns on the field current and allows the alternator to produce as much output as possible for the alternator speed (rpm), temperature and system voltage. When the voltage setting is reached, the regulator turns the field current off. When the field current is turned off, the magnetic field in the rotor collapses and the alternator output voltage begins to fall. The falling voltage causes the regulator to turn the field current back on and the magnetic field to rebuild. This switching action of the regulator continues rapidly, keeping the output and system voltage very close to the voltage setting. This will continue unless the electrical demands of the system cause the system voltage to fall below the voltage setting. Should this happen, the regulator will again allow full field current to flow so that the maximum output of the alternator at the given speed, temperature and system voltage is realized.

An internal sense lead installed between the output terminal/diode heat sink and regulator stud, is used for voltage control.

TROUBLESHOOTING

Trouble in the charging system will normally be indicated by one of the following:

- Indicator light “on” with engine running.
- Indicator light “off” with key on, engine not running.
- Undercharged or overcharged battery.
- Short life of light bulbs or other electric equipment caused by abnormally high system voltage.
- System voltmeter readings outside normal range.
- Incorrect or no operation of accessories connected to alternator “R” terminal.

Diagnose system as follows: (See Fig. 8)

A. ALL CHARGING SYSTEMS -

TEST EQUIPMENT NEEDED:

- Belt Tension Gage
- Battery State-of-Charge Indicator

1. Check electrical system wiring and battery terminals for poor connections or other obvious conditions that might result in shorts, opens, grounds, or high resistance. Correct as necessary.

2. Check alternator drive belt for proper tension. Adjust to manufacturer's specifications.

3. Check battery for state-of-charge. If low, recharge according to manufacturer’s specifications and load test to establish serviceability. Further diagnostic tests require a known good, fully-charged battery for accurate results.

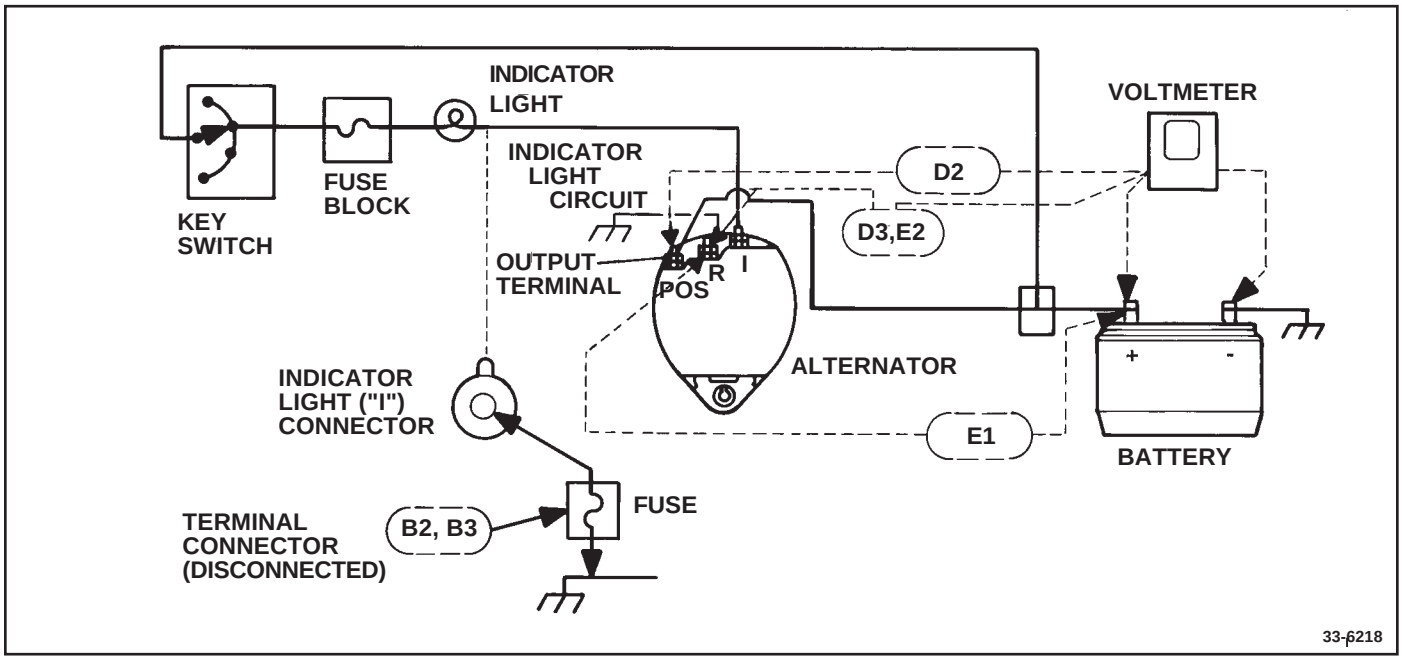


Figure 8. Troubleshooting a 33/34 SI System

B. SYSTEMS WITH INDICATOR LIGHT -

TEST EQUIPMENT NEEDED:

- Jumper Lead with 5-Amp Fuse

1. If indicator light is on with engine running:

   Stop engine. Turn key switch to "run" position. Indicator light should be on. If not, go to Step 3.

   Disconnect indicator light lead at alternator. This will be the "I" terminal connector.

   If indicator light remains on, locate and correct shorted or grounded condition in indicator light circuit between the light and the alternator.

   If indicator light goes out, light is working properly. Proceed to "C." for check of system with indicator light working properly.

2. If indicator light does not come on with the key switch in the "run" position with the engine stopped ("bulb check" mode):

   Leave key in "run" position with engine stopped. Disconnect indicator light lead from alternator. This will be at the "I" terminal. Use fused (5-amp) jumper lead to ground indicator lamp circuit in harness connector to ground screw or other clean metal ground on alternator housing.

- If indicator light comes on with jumper lead in place, repair or replace alternator as described under Unit Repair.

- If indicator light does not come on with jumper lead in place, verify that alternator is properly grounded by touching jumper lead to another ground source. If lamp still does not light, locate and correct open circuit in indicator light circuit. Circuit fuse may be open or light bulb may be burned out. Correct as necessary.

3. If indicator light comes on while engine is running, but is not on with engine stopped and key switch in "run" position:

   Leave key in "run" position with engine stopped. Disconnect indicator light lead from alternator. This will be at the "I" terminal. Use fused (5-amp) jumper lead to ground indicator lamp circuit to alternator housing.

- If indicator light comes on with jumper lead in place, replace internal indicator light lead assembly or regulator as described under Unit Repair.

- If indicator light does not come on with jumper lead in place, locate and correct open circuit in indicator light circuit between battery and light. Circuit fuse may be open. (With engine running, light is being powered by alternator and grounded through other circuits connected in parallel to indicator light circuit.) Correct as necessary.

4. If indicator light is on with key switch in "off" position:

   Disconnect indicator light circuit at alternator.

- If indicator light remains on, locate and correct shorted condition between the light and alternator.

- If indicator light goes out, diode is shorted in rectifier. Locate and replace diode as described under Unit Repair.

C. SYSTEMS WITH VOLTMETER, NO INDICATOR LIGHT, OR WITH LIGHT WORKING PROPERLY -

TEST EQUIPMENT NEEDED:

- Voltmeter

1. If battery is undercharged, indicator light remains on while vehicle is running, or system voltmeter shows operating voltage is below acceptable range:

   With engine stopped and all electrical loads off, use voltmeter to check system voltage across battery terminals. Record voltage.

   Start engine and run at moderate speed. Check system voltage across battery terminals with engine running.

- If voltage reading at battery terminals is different from reading showing at system voltmeter (if equipped), locate and correct cause of incorrect reading.

- If voltage is lower than reading previously recorded with engine stopped, there is no alternator output. Proceed to section on No Output.

- If voltage is higher than previous reading with engine stopped, alternator output is present. Proceed to Rated Output Check.

2. If battery is overcharged (as evidenced by excessive water use or electrolyte spewing from battery vents), or light bulbs or other electrical equipment have shortened life due to suspected high system voltage, or system voltmeter reads above normal range:

   With fully charged battery, engine running at moderate speed and all electrical loads off, use voltmeter to check voltage at battery terminals. (Battery electrolyte temperature must be below 120°F (49°C).)

For a 12-volt system, readings should be stable, around 13.5 - 14.5 volts and in no case go above 15.5 volts. For a 24-volt system, readings should be stable, around 27 - 28 volts and in no case go above 31 volts.

- One-wire system: If voltage is erratic or goes above 15.5 volts (31 volts on 24-volt system), check internal sense circuit and regulator as described under Unit Repair.

D. "R" TERMINAL ACCESSORY PROBLEMS

1. Disconnect lead from “R” terminal.

2. Start engine and run at moderate speed. Check system voltage across battery terminals with engine running. Record voltage.

3. Use voltmeter to check voltage between “R” terminal and alternator ground screw or other clean metal ground.

- If voltage is near half of system voltage, “R” terminal output is O.K. Note that this is a pulsating signal, so some voltmeters may give an unsteady reading.

- If no voltage is present, replace diode trio assembly as described under Unit Repair.

- If the voltage is nearly the same as the alternator output voltage, check the voltage at the other small terminal. If that voltage is near half system voltage, the "R" terminal leads were connected to the "I" terminal. Connect them to the "R" (half voltage) terminal. If both terminals are near alternator output voltage, replace the diode trio assembly, unless internally both terminals are wired to the same place. In that case, rewire the "R" terminal to the rectifier bridge stud as shown in Unit Repair section.

E. NO OUTPUT

TEST EQUIPMENT NEEDED:

- Voltmeter
- Jumper Lead (18 ga. min; no fuse)

Note that 33/34 SI alternators must be connected to a battery for the voltage sensing circuit to allow initial turn on (refer to section on Features). When properly connected and system checks indicate a “no output” condition, use the following steps to determine if the alternator requires repair:

! IMPORTANT

1. For alternators without an “I” terminal in use, battery positive voltage at the output terminal and residual magnetism in rotor are necessary for alternator to turn on. With engine stopped, use voltmeter to verify that battery voltage is present in cable at output terminal. If not, locate and correct cause of voltage loss.

   Residual magnetism in the rotor is sometimes lost during servicing of the alternator. The rotor can normally be remagnetized without removing alternator from application.

   CAUTION: Do not allow jumper lead to be accidentally grounded while connected to battery terminal. If the free end of this lead is accidentally touched to the alternator housing or other grounded areas, the jumper lead may quickly get hot enough to cause a skin burn or to damage the jumper lead. Keep jumper lead carefully insulated from grounding during this procedure.

   To remagnetize rotor, make sure the normal connections are made to the alternator output terminal and to the ground circuit. Disconnect the wiring harness from the “R” terminal. Momentarily connect a jumper lead from battery positive to the alternator “R” (or unused “I”) terminal. (See Fig. 42) This will cause field current to momentarily flow through the field windings in the proper direction and restore magnetism. Reconnect wiring harness to “R” terminal, then recheck alternator for output.

2. For systems with an “I” terminal in use, the indicator light current at this terminal will establish normal magnetism at each engine start-up. Such systems may depend on this current to help ensure a low turn-on speed of the alternator. With engine stopped and key switch in “run” position, use voltmeter to check for voltage present at this terminal. With “I” terminal connected and indicator lamp on, voltage will be less than battery voltage. If necessary, disconnect wiring at “I” terminal to make this check, check for battery voltage in harness wire. If voltage is present, proceed to Step 3. If no voltage is present, check “I” terminal circuit for cause of voltage loss (bulb may be burned out). Correct as necessary.

3. If no conditions have been found that might prevent the alternator from turning on (Step 1 or 2), remove alternator from engine in accordance with engine manufacturer’s instructions and proceed to Unit Repair.

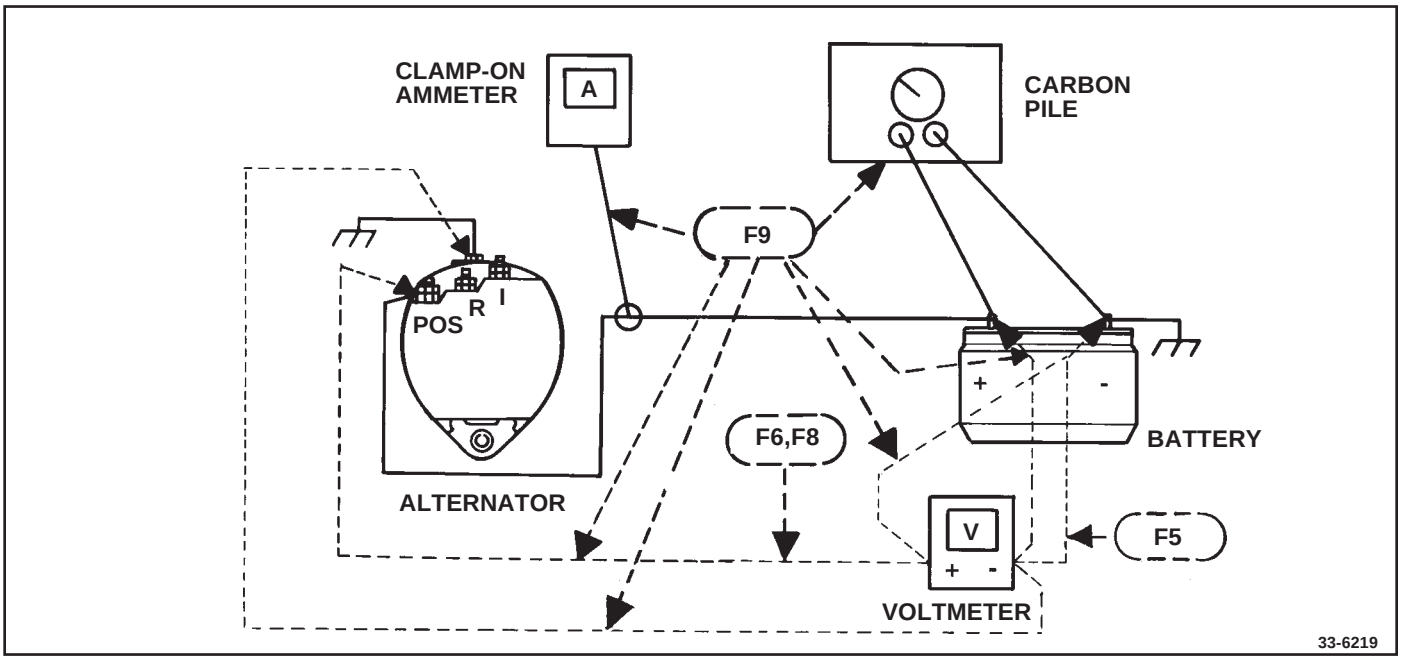


Figure 9. Rated Output Check

F. RATED OUTPUT CHECK

TEST EQUIPMENT NEEDED:

- Voltmeter
- Ammeter (current capability at least 15 amperes higher than alternator rating)
- Variable Carbon Pile Load Test

CAUTION: Failure to disconnect grounded battery cable at battery before removing or attaching battery cable at alternator output terminal may result in an injury. If a tool is shorted to the battery cable connector at the output terminal, the tool can quickly heat enough to cause a skin burn or the tool or cable may be damaged.

1. Refer to Fig. 9 for test equipment hookups as described in following steps. If inductive pickup ("clamp on") type ammeter is used, place current clamp on alternator output lead and skip to Step 4. If series ammeter is used, disconnect grounded battery cable at battery first.

2. Install ammeter in series with alternator output terminal.

3. Reconnect grounded battery cable at battery.

4. **NOTICE:** When a 12-volt carbon pile load test is used to diagnose a 24-volt system attach load test only to 12-volt potential in battery pack. Attaching a 12-volt load test to a 24-volt potential will damage the load test.

   With load turned off, attach carbon pile load test across battery.

5. Attach voltmeter lead to grounded battery terminal, observing proper polarity for system. Leave other voltmeter lead open for checks at various points.

6. Check and record voltage at battery terminal. For multi-battery systems, check voltage of battery set connected as if in battery charging mode.

7. With all system electrical loads off, start engine and run at moderate speed (rpm). Alternator speed should be near 5,000 rpm.

8. Recheck voltage at battery terminal. Voltage should be higher than previous reading, but below 15.5 volts on 12-volt system (31 volts on 24 volt system).

- If reading is lower than previous reading (Step 6), refer to section on No Output.

- If reading is higher than 15.5 volts on 12-volt system (31 volts on 24-volt system), refer to section on High Voltage Output.

9. Turn carbon pile load on and adjust to obtain maximum alternator output on ammeter. Record maximum output.

   With alternator still running at maximum output, check and record voltage drop in ground circuit between alternator housing and grounded battery terminal. Then check voltage drop from output terminal to battery positive. Turn carbon pile load off.

   Maximum ampere output should be within 15 amps of output rating stamped on alternator identification plate, or as listed in Specifications section of this manual. Voltage drop should be 0.25 volts or less for each voltage drop test on 12-volt system (0.5 volts or less on 24-volt system).

- If ground circuit voltage drop is over 0.25 volts on 12-volt system (0.5 volts on 24-volt system), clean and tighten all ground circuit connections. If this does not correct excessive voltage drop, check ground circuit cables for improper sizing or high resistance conditions. Correct as necessary.

- If within 15 amps of rating, alternator is good. Look elsewhere for cause of problem.

- If more than 15 amps below rating, repair or replace alternator.

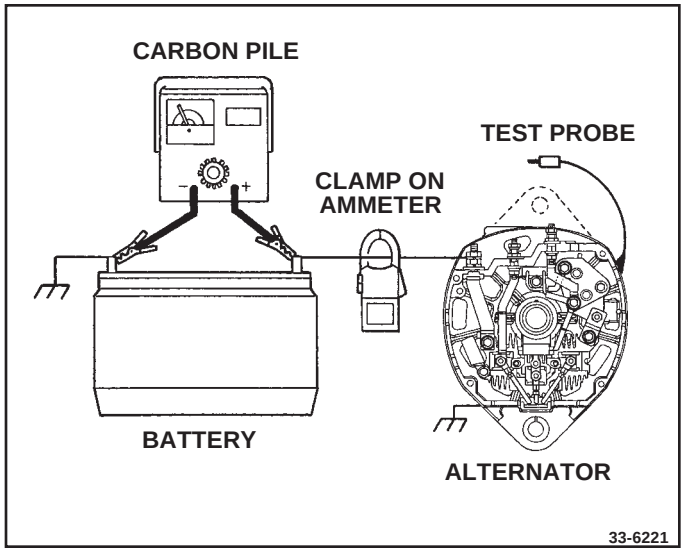


Figure 10. Test Bench Schematic

REGULATOR "QUICK CHECK"

NOTICE: On some alternators on certain engine configurations, a 1.5µf capacitor has been installed to the output terminal and attached with a cover screw. Remove the capacitor (DRA 1985444) before performing "Regulator Quick Check."

A “No Output” condition may be caused by a defective regulator. This can be determined by the following procedure.

CAUTION: Do not allow jumper lead or probe to touch strap or battery while connected to ground. If the free end of this lead is accidentally touched to battery voltage, the jumper lead may quickly get hot enough to cause a skin burn or to damage the jumper lead. Keep jumper lead carefully insulated from battery and alternator voltage surfaces during this procedure.

Install and hook up alternator (Fig. 10) in test bench (at least 5 hp) and remove rectifier cover plate. Attach one end of a test lead to alternator ground and the other to a sharp test probe (Fig. 11). Spin alternator at approximately 2,000 rpm and touch probe to insulated field ground terminal under the insulation at regulator (not on screw head). Be sure probe touches metal terminal through the protective coating!

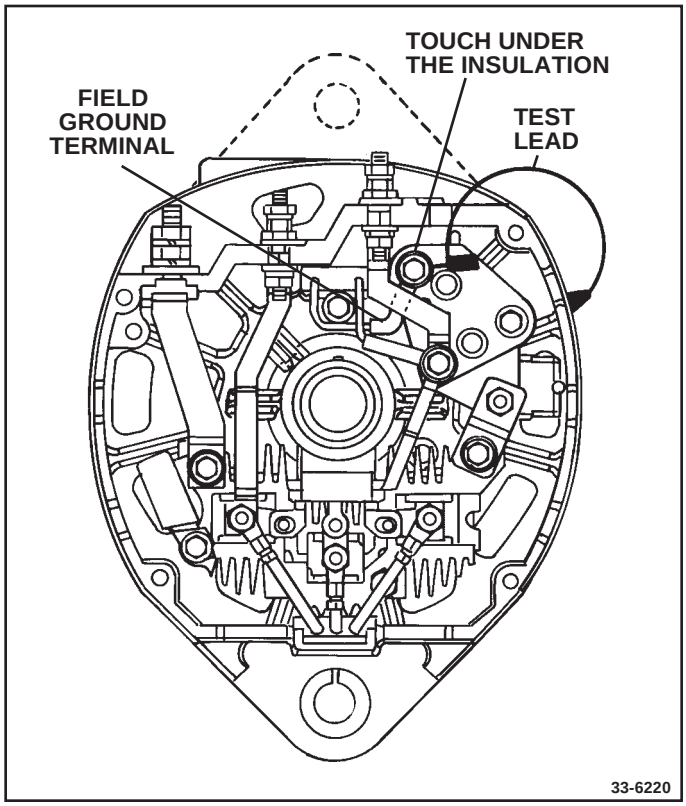


Figure 11. Regulator “Quick Check”

If ammeter shows 20 amps or more and drops to zero when probe is removed, replace the regulator and test field coil for shorts or grounds.

If no output, remove alternator and make bench checks.

ALTERNATOR UNIT REPAIR

CAUTION: Disconnect grounded cable at battery before removing or attaching battery cable at alternator output terminal. Otherwise, a tool shorted to the battery cable at the output terminal can quickly heat enough to cause a skin burn or damage the tool or cable.

NOTICE: Always reinstall fasteners at original location. If necessary to replace fasteners, use only correct part number or equivalent.

- If correct part number is not available, use only equal size and strength. For alternator internal fasteners, refer to Delco Remy Standard Hardware Fasteners section in Service Parts Catalog.
- Fasteners that are NOT to be reused will be noted in procedure.
- Fasteners requiring thread locking compound will be noted in procedure.
- Use specified torque values when shown.

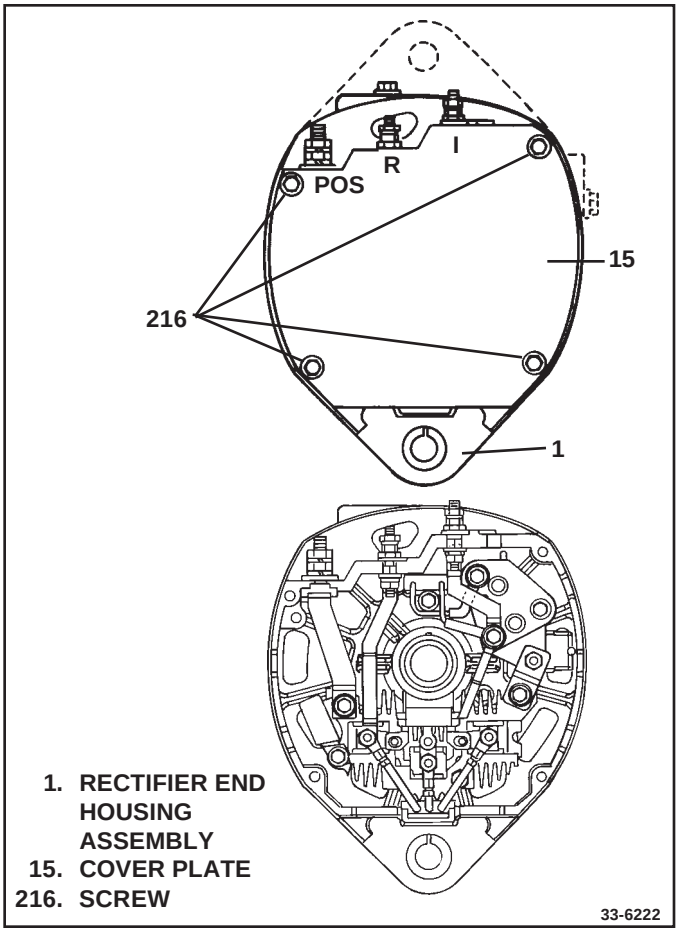


Figure 12. Electronics Compartment

CAUTION: Using or replacing fasteners in any other manner could result in part or system damage.

If diagnosis determines that alternator repair is needed, remove alternator from engine according to manufacturer's instructions.

DISASSEMBLY AND BENCH CHECKS

TEST EQUIPMENT NEEDED:

- Multimeter
- Regulator Tester

ALTERNATOR

NOTICE: On some alternators on certain engine configurations, a 1.5µf capacitor has been installed to the output terminal and attached with a cover screw. Remove the capacitor (DRA 1985444) before performing "Regulatror Quick Check."

1. Remove screws (216) and rectifier end plate (15) to expose electronics compartment. (See Fig. 12)

2. Inspect electronics compartment for contamination, for shorted or grounded wires, and for loose connections. If contamination is present, clean and dry compartment before proceeding. The protective coating on all electronic components is a good insulator and must be scraped off to get a good contact for test equipment probes.

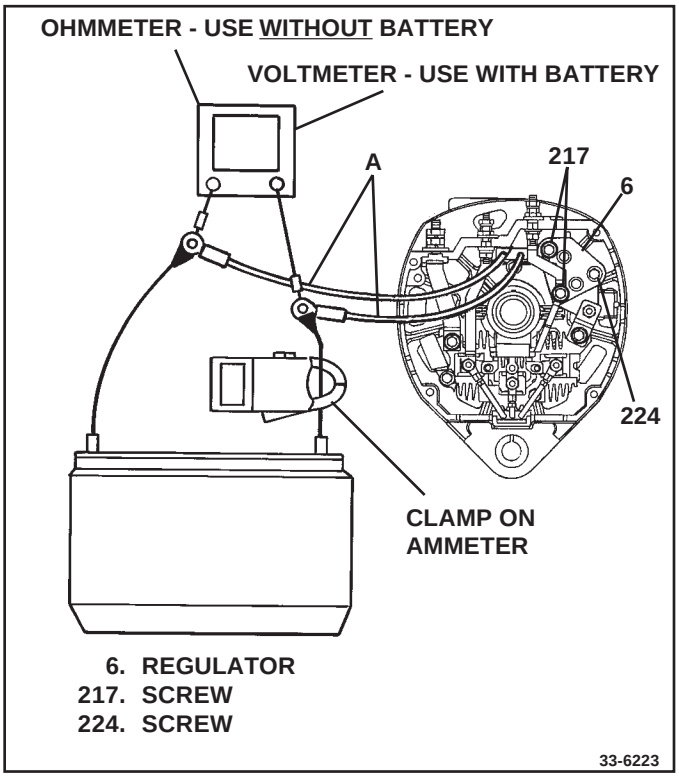


Figure 13 Checking Field Coil Resistance

FIELD COIL

3. Disconnect 2 field leads (A) from regulator (6) (See Fig. 13), by removing 2 insulated regulator attachment screws (217). Use ohmmeter (or voltmeter, ammeter and battery) to check resistance of field coil.

   Compare to Field Check ohms (or volts and amps) in Specifications at the end of this manual or from Service Specification Bulletin. If outside specifications, replace field coil as described later in this manual.

DIODE TRIO

4. To check the diode trio (7), remove it from the electronics compartment by detaching the 3 nuts (218), stator leads (B) and attaching screw (217). **Note that the insulating washer on the screw is assembled over the top of the diode trio connector.** Discard screw if insulation is fractured during removal.

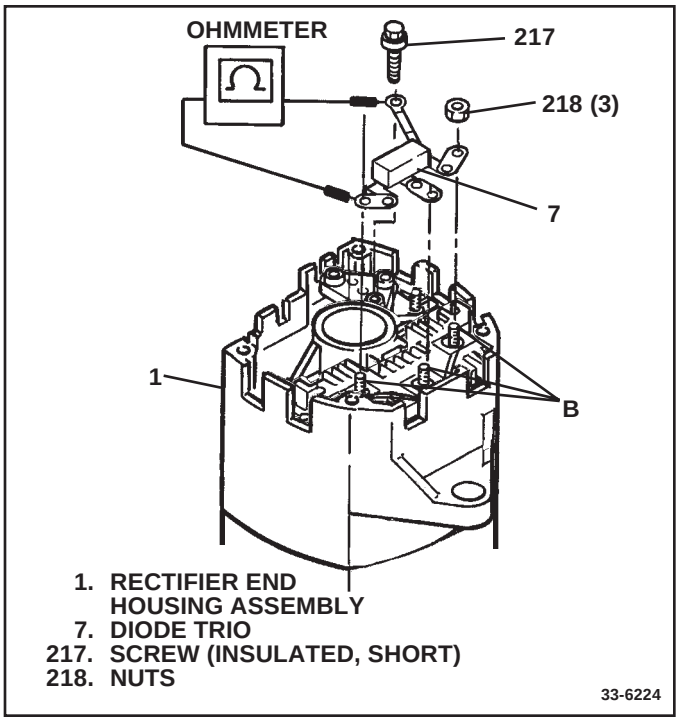


Figure 14. Electrical Check of Diode Trio

Use ohmmeter or diode check function on multimeter to check diode trio (7). (See Fig. 14) Place negative ohmmeter lead on the regulator strap and the positive lead to check continuity to each of the three rectifier bridge straps. All three readings should indicate continuity. Reverse the ohmmeter leads and perform checks again. Reading should all indicate open circuits.

– If all readings are proper, diode trio is good.

– If any reading is wrong, replace diode trio.

CAPACITOR

5. Remove capacitor (12) by removing the remaining two attachment screws (224) and screw (226) sliding out capacitor. (A sharp tool may be used to break varnish seal.)

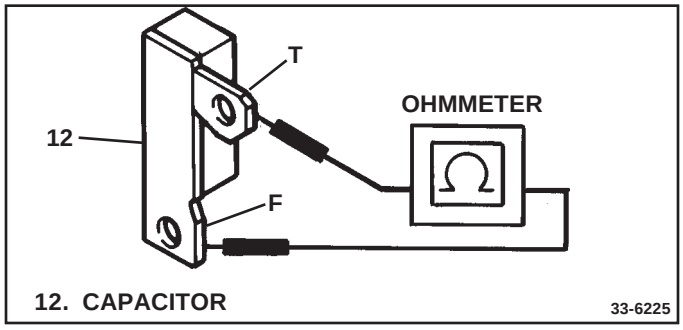


Figure 15. Electrical Check of Capacitor

Using continuity check mode (diode check mode on digital meter), check for a shorted capacitor by touching ohmmeter leads to capacitor lead (F) and grounding tab (T). (See Fig. 15) This check should show an open circuit.

REGULATOR

6. To remove regulator (6) for testing, remove sense lead nut (218), bridge to regulator stud connector (219) and 2 screws (217) if not removed previously and screw (224). Disconnect "I" terminal sense lead strap to allow regulator removal. (See Fig. 16) Note: Discard insulated screw if insulation is fractured during removal.

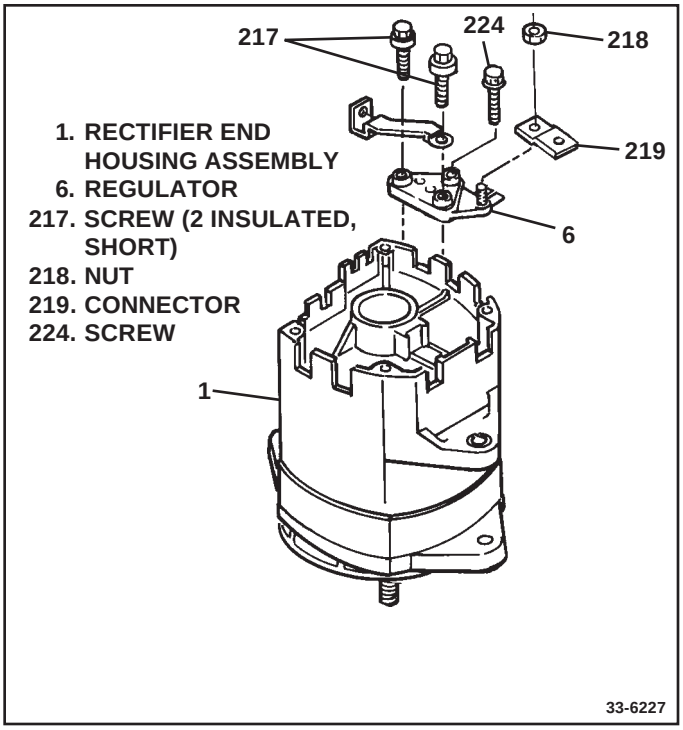


Figure 16. Removing Regulator

Check regulator on approved tester for SI type regulators. If regulator tests "good", return it to service. If it tests "bad", replace it. Install regulator as described later in this section.

RECTIFIER BRIDGE

7. Use the ohmmeter or (for digital meters) the diode check function of the multimeter to check the rectifier bridge (8). Bridge may be checked in place in the RE housing (1).

   All terminals must be disconnected from the threaded phase studs. "R" terminal and output terminal straps (198 &186) may be raised approximately one inch (2.5 cm) above rectifier for removal of diode trio (7) or rectifier bridge (8).

   Check 6 diodes as follows:

   Place negative ohmmeter lead on grounded heat sink. Touch positive ohmmeter lead firmly to metal diode clips that surround each of the 3 threaded studs. All 3 readings should be the same, and indicate open circuits. Switch leads and repeat. All 3 new readings should indicate continuity. (Fig. 17)

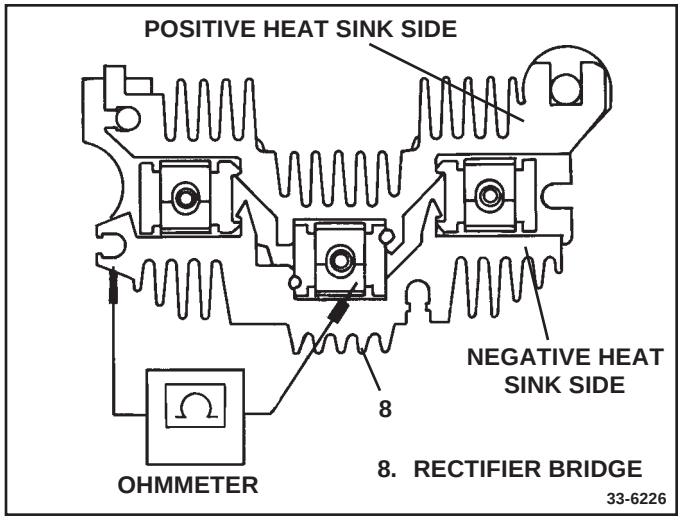


Figure 17. Electrical Check of Rectifier Bridge

Repeat checks using insulated (positive) heat sink in place of grounded heat sink. With negative ohmmeter lead on insulated heat sink, all 3 readings should indicate continuity. Switch leads and repeat. All 3 new readings should indicate open circuits.

– If all readings are correct, the rectifier bridge is good.

– If any reading is wrong, an open or shorted diode is indicated and rectifier bridge should be replaced. To remove bridge, remove nut (218), nut (199) and relay strap (198) from regulator stud (193), two bridge attaching screws (226), and insulated capacitor attaching screw (224). Lift capacitor (12) and rectifier bridge (8) from SRE housing (Fig. 18).

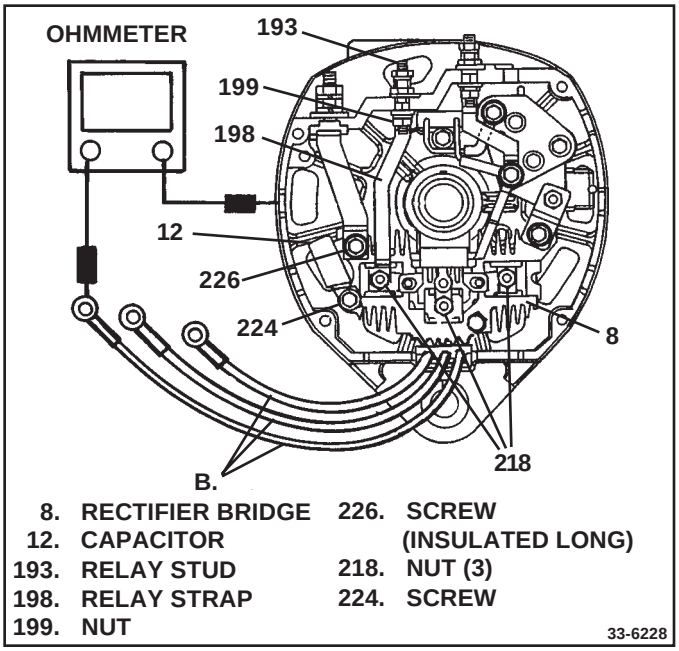


Figure 18. Checking Stator Windings

STATOR

8. Disconnect the 3 stator phase leads (B) from the diode bridge studs by removing 3 nuts (218). Use continuity check function of ohmmeter to check stator windings. (See Fig. 18) Place one meter lead on one of the stator phase lead connectors and check for continuity to each of the other two stator leads. There should be continuity to both. If not, one or more of the stator coils is open; replace the stator as described later in this section.

   To check for grounds, again touch one meter lead to one of the stator phase leads, and touch the other meter lead to clean metal ground on the alternator housing. There should not be continuity. If there is continuity, the stator is grounded and should be replaced as described later in this section.

   It is not possible to detect shorted stator windings with ordinary shop equipment. However, if all other electrical checks are normal and the alternator has exhibited low output, shorted stator windings may be the cause. In such cases, replace the stator as described later in this section.

FINAL DISASSEMBLY

NOTICE: Do not damage exposed stator or field windings. Bumping or scraping these windings may break the insulation and leave a place for a short circuit or ground to develop later, causing the alternator to fail. Protect the windings from damage by careful handling.

9. To replace the field coil (9), stator assembly (11), rotor assembly (10), or drive end (5) or rectifier end bearings (2), the drive end frame assembly must be separated from the rectifier end housing. (Fig. 19) Use 5/16" hex wrench or 5/16" hex drive, in the end of the shaft, to hold while removing shaft nut (211). Remove washer (212), pulley (14), and fan (13).

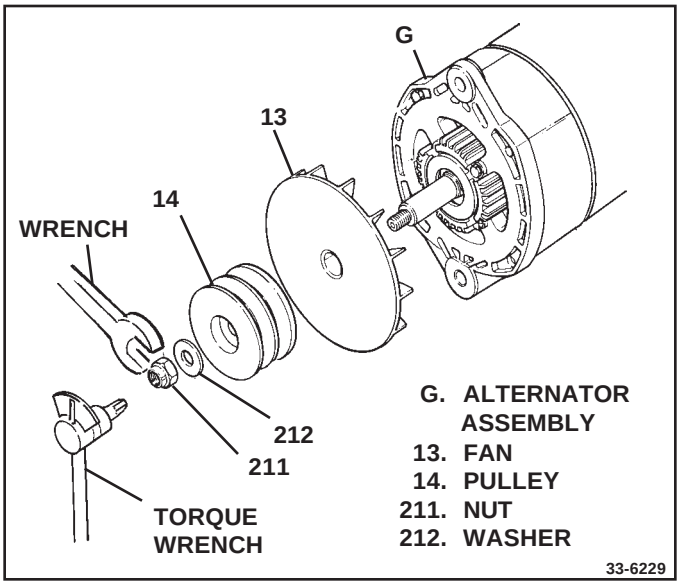


Figure 19. Alternator Disassembly

10. Remove the 4 thru bolts (213). Carefully separate the drive end housing (4) from the stator (11) and rectifier end housing (1), taking care not to damage stator windings. (See Fig. 20)

NOTICE: Rectifier bridge must be removed before removing stator. (See Paragraph 7 and Fig. 18) To remove stator (11) from rectifier end housing (1), be sure all 3 stator leads are disconnected from diode bridge studs in electronics compartment. Pry stator and housing apart carefully. Guide stator leads and grommet (C) through well as stator is pulled from housing. It may be necessary to push on grommet with a blunt instrument to unseat it from the housing. (See Fig. 21)

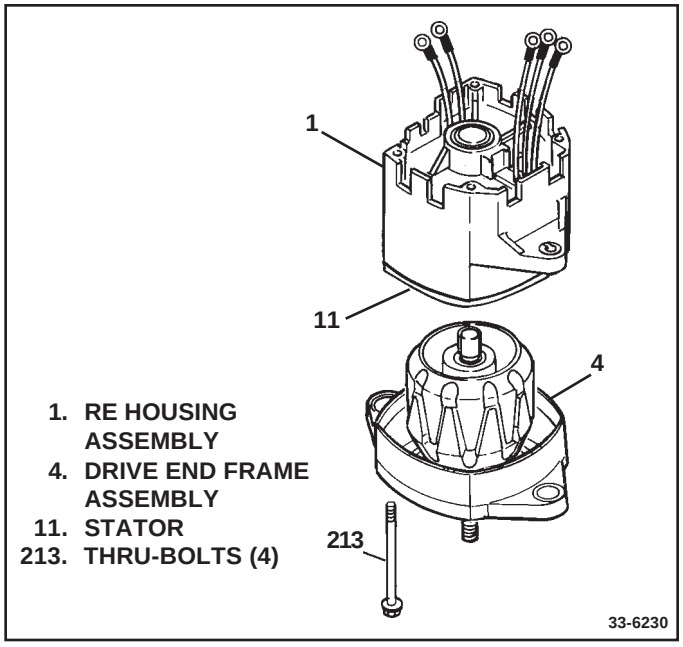


Figure 20. Separating Housings

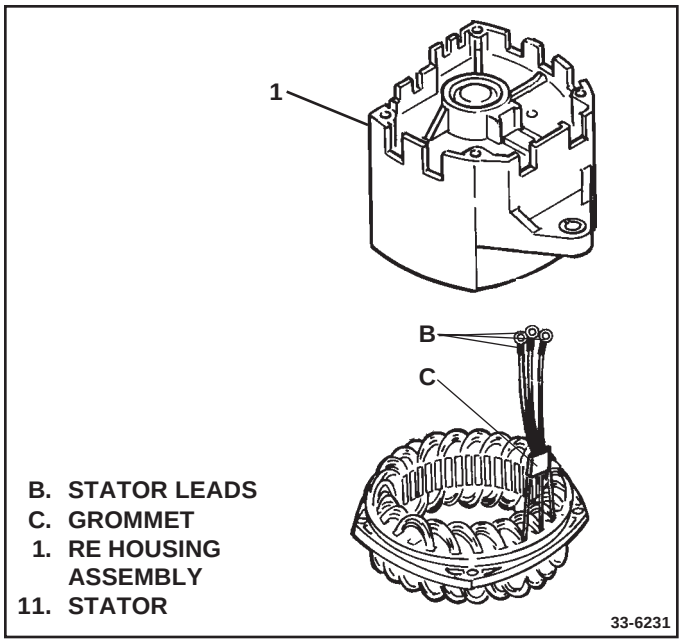


Figure 21. Removing Stator

11. To remove field coil and support (9) from rectifier end housing, (See Fig. 22) remove 4 field coil and support attaching screws (221). Lift coil and support from housing, while guiding field leads through hole.

12. To remove rectifier end bearing (2) from RE housing (1), (See Fig. 23) use small screwdriver at slot to pry plug (222) from housing.

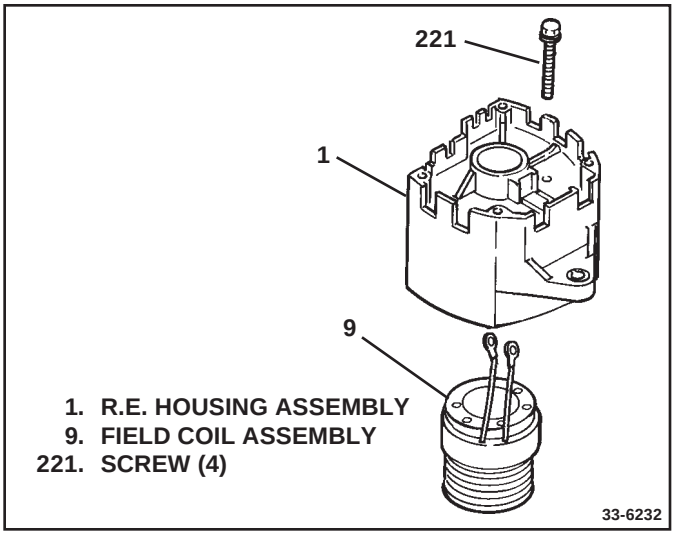


Figure 22. Removing Field Coil

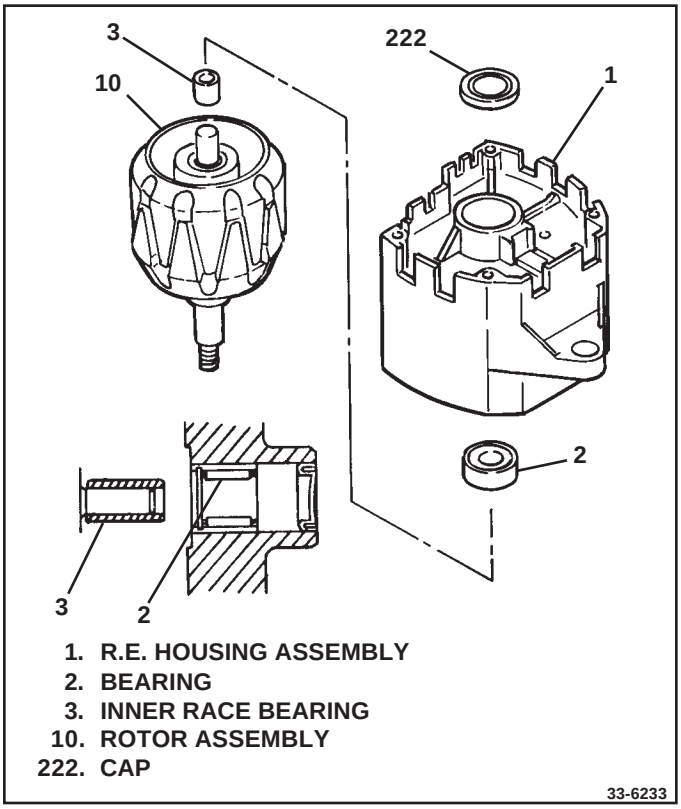


Figure 23. Removing Rectifier End Bearing

NOTICE: Do not drive bearing out with hammer or other tool. Use arbor press to push bearing from housing.

Wipe excess grease from bearing well, then press bearing through to inside of housing.

13. If bearing inner race (3) appears to be worn or rough, remove from rotor shaft with a suitable puller.

14. To replace rotor (10) or drive end bearing (5), (See Fig. 24) remove 4 bearing retainer attachment screws (214) from outside of housing (4). Lift rotor with bearing from housing, then pull bearing off of rotor shaft. If inside collar (215) appears rough or damaged, pull collar from shaft.

    NOTICE: Do not drive mounting hinge bushing from lug on rectifier end housing with a hammer or other tool. Use arbor press or vise to remove and replace bushing.

15. To remove mounting hinge bushing (17) from lug on rectifier end housing (1), Press bushing from housing using arbor press with suitable tool.

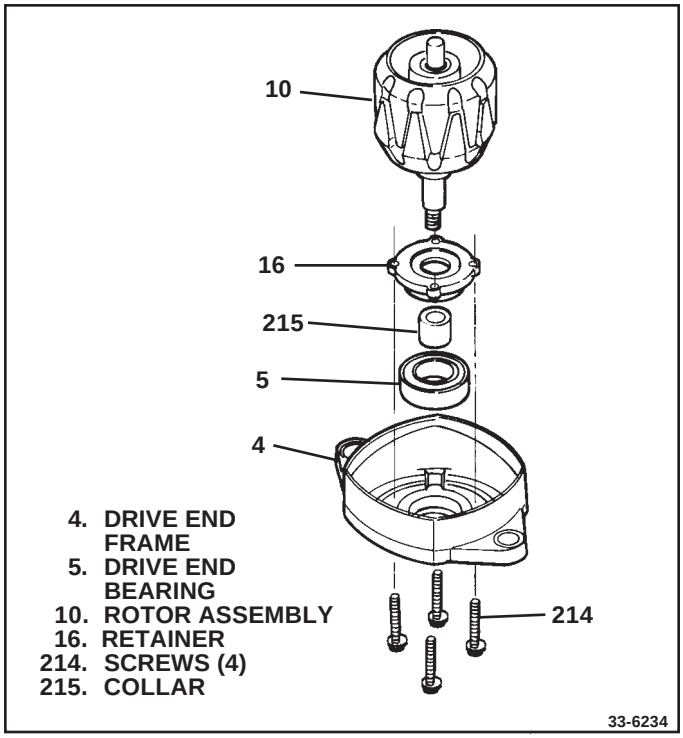


Figure 24. Disassembly of Drive End Components

ALTERNATOR ASSEMBLY

ASSEMBLY OF DE FRAME AND ROTOR

INSTALL OR CONNECT

1. Press inner race for rectifier end bearing (3) onto short end of rotor shaft. Stop when race is 3.7 mm (.15 in.) above end of shaft. (See Fig. 25)

2. Press inside collar (215) onto rotor shaft until collar is against shoulder on rotor (10). Place retainer plate (16) onto collar (flanged side of retainer will face away from rotor, toward bearing). Using open tube that bears only on inner race of bearing, press new DE bearing (5) onto rotor shaft until bearing is against collar.

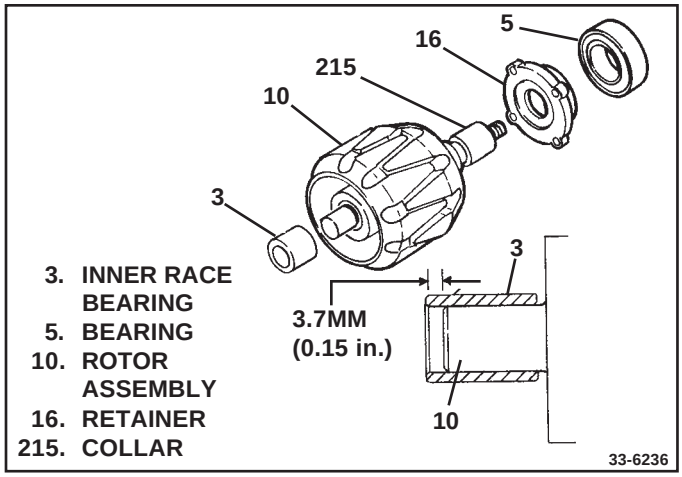


Figure 25. Rotor Assembly

3. Insert bearing (5) (on rotor shaft) into bearing well in drive end frame (4). (See Fig. 26) Bearing will be a snug fit, but should slip in easily when properly aligned. Lubricate outside of bearing very lightly with ball and roller bearing lubricant (1948791) if necessary to facilitate assembly.

4. Hold drive end assembly with long end of rotor shaft down so that bearing retainer plate (16) falls against housing, then align retainer with screw holes. (See Fig. 26) Start each of the four retainer attaching screws (214), then tighten screws gradually in sequence to pull retainer squarely against bearing.

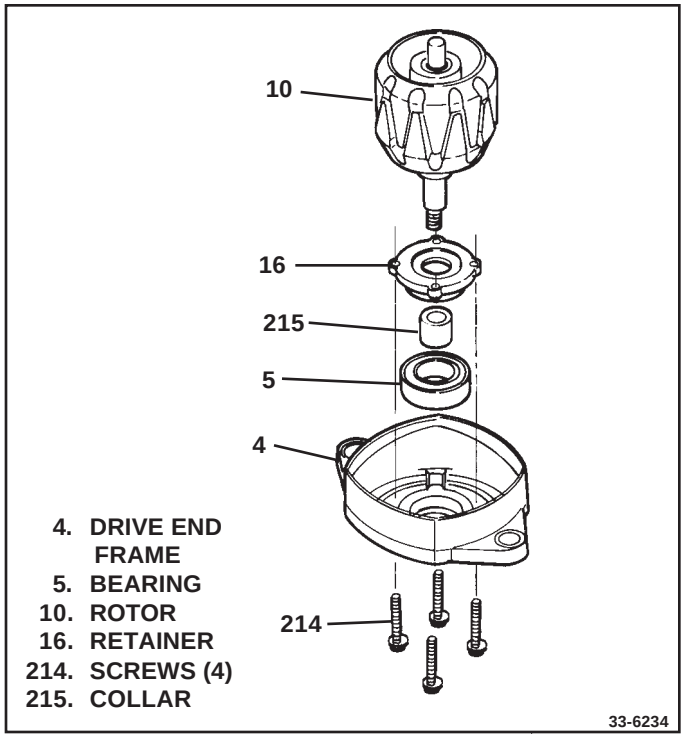


Figure 26. Installing Rotor in Drive End Frame

TIGHTEN

Bearing retainer attaching screws (214) to 5 N.m (45 lb. in.).

IMPORTANT

To allow access for later installation of thru bolts (213), do not assemble fan and pulley to drive end assembly at this time.

ASSEMBLY OF RECTIFIER END HOUSING AND COMPONENTS

INSTALL OR CONNECT

5. Lightly lubricate outside surface of hinge bushing (17). Press hinge bushing into hole in lug on rectifier end housing (1). Install bushing flush with inside of lug to allow maximum distance between two hinge lugs for mounting. Final position of hinge bushing will be adjusted during mounting. (See Fig. 27)

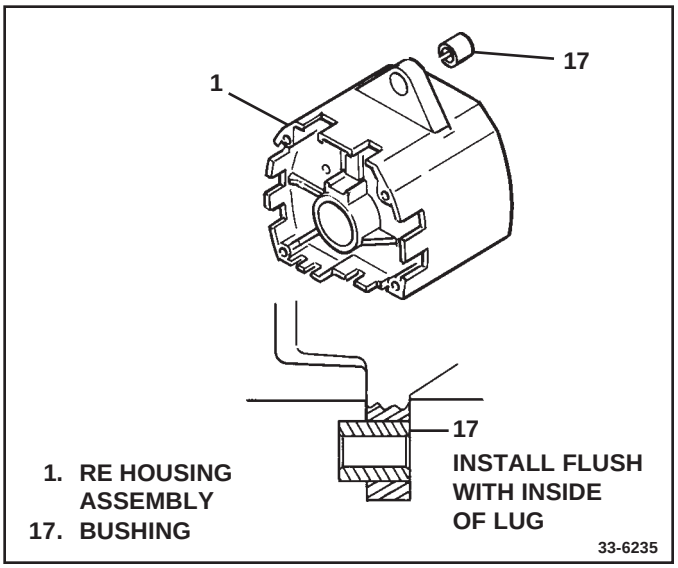


Figure 27. Installing Mounting Hinge Bushing

6. Position new bearing (2) into rectifier end housing (1) with seal toward rotor assembly (10) as assembled. Press bearing outer race into housing center hole until flush with machined face inside housing. (See Fig. 28) Push plug (222) into end of housing until outside edges are flush with edge of RE housing.

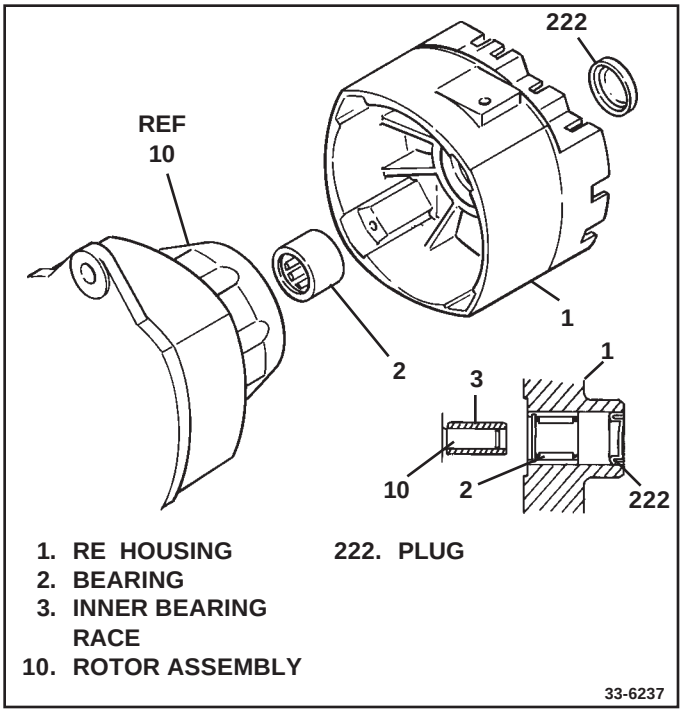


Figure 28. Installing Rectifier End Bearing

7. Add ball and roller bearing lubricant (1948791) until cavity between plug (222) and bearing outer race (2) is about half full, placing grease so that it touches the edge of the bearing outer race in several places around the outside of the bearing. Cover opening with tape to prevent contamination.

8. Turn leads so that they will be properly positioned after installation. (See Fig. 29) Place field coil and support (9) into rectifier end housing (1), guiding leads through hole into electronics compartment and aligning mounting holes in support with screw holes in rectifier housing. Ensure leads do not touch housing. Install 4 field coil and support attachment screws (221). (3 screws used in early production)

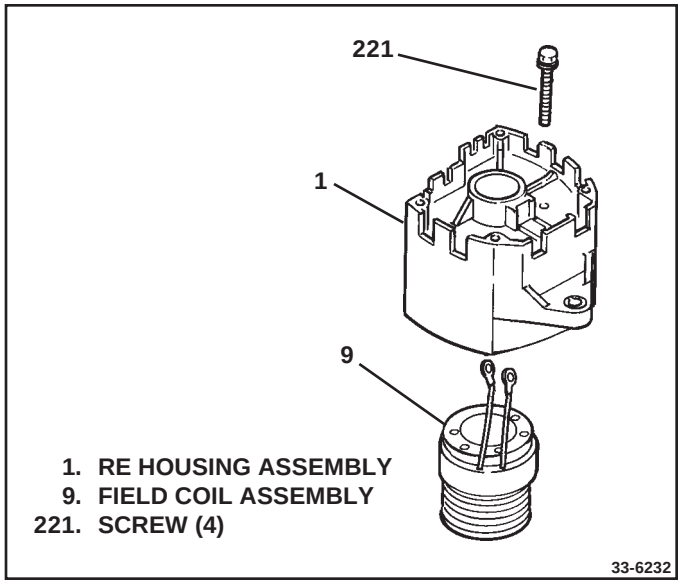


Figure 29. Installing Field Coil

TIGHTEN

Field coil and support attachment screws (217) to 6.2 N.m (55 lb. in.).

INSTALL OR CONNECT

NOTICE: Handle stator with care to avoid bending windings or breaking varnish insulation on windings. If windings are damaged before or during installation, they may become shorted and cause reduced alternator output. Stator must be installed before rectifier.

9. Straighten stator leads (B) to ease installation. Lubricate grommet (C) on stator leads lightly with petroleum jelly. Welded junction connector on some stators must be positioned straight up from windings to prevent grounding to housing or rotor when alternator is assembled. Straighten stator lead wires all the way to the windings and insert through well in housing into electronics compartment. (See Fig. 30)

   Align thru-bolt holes in stator (11) with those in RE housing (1). Push stator into housing far enough to hold it in place, being sure grommet (C) on wires is inserted into well in housing at the same time. Stator lead wires should be stiff enough to push grommet into well as stator is installed (if not, carefully push on grommet with a blunt instrument to seat it in the well). The stator must be fully seated in housing at this time. Note: If necessary, place wood blocks on opposite corners of the stator frame and use arbor press (or tap blocks with hammer) to seat stator frame against rectifier end housing. Do not push against windings!

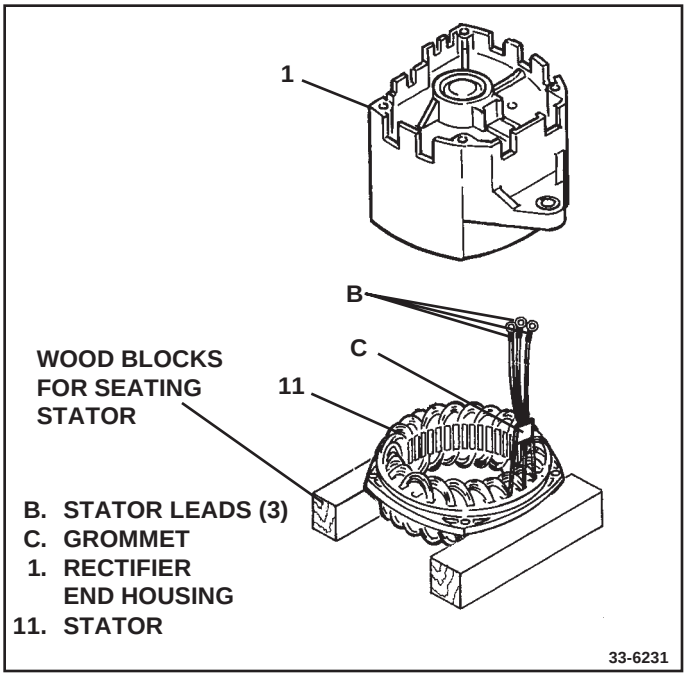


Figure 30. Installing Stator

10. Rectifier bridge (8) to RE housing (1). Install one rectifier bridge attaching screw (224) through grounded heat sink into RE housing. (Fig. 31) Finger tighten.

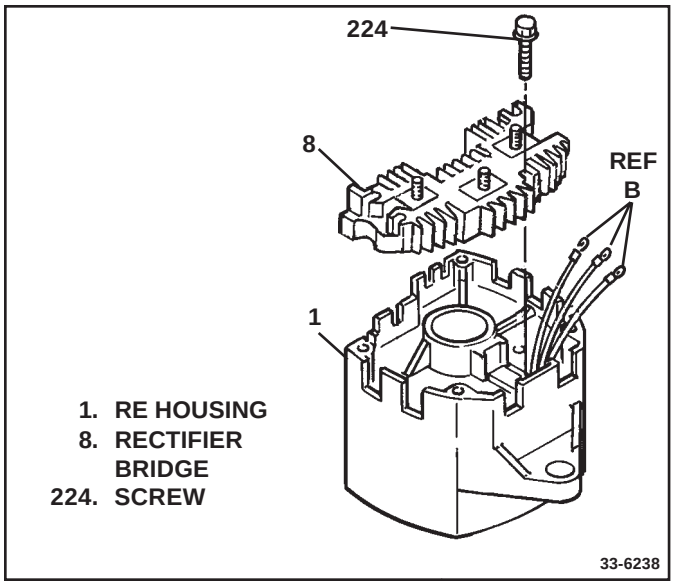


Figure 31. Installing Rectifier Bridge

11. Capacitor (12) to holes in end of rectifier bridge (8) (Fig. 32) Install ground screw (224) through capacitor (12), grounded heat sink, and into RE housing. Finger tighten.

12. Output strap (186) over insulated rectifier and capacitor holes. (If new output terminal assembly, install per instructions in package.)

13. Insulated capacitor attaching screw (226), through output strap (186), capacitor connector (12), and into RE housing. Finger tighten.

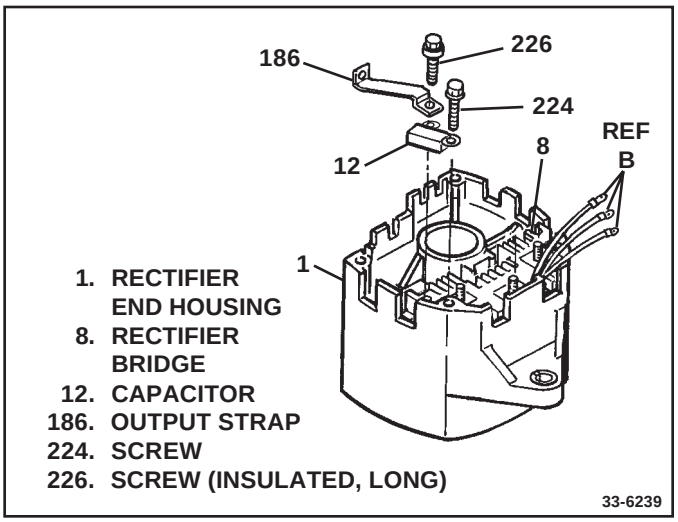


Figure 32. Installing Output Terminal and Capacitor

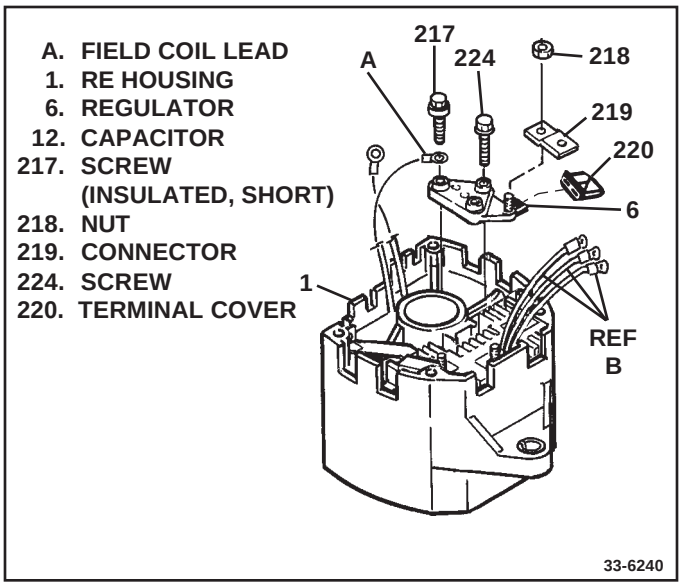


Figure 33. Installing Regulator

INSPECT

Regulator mounting area for presence of grease or dirt (Fig. 33). Good electrical contact is necessary in this area.

NOTICE: Do not immerse or wet regulator with solvent. Internal damage to regulator could result.

CLEAN

Regulator mounting bosses in RE housing, metal base plate and contact rings on regulator by wiping with dry cloth.

INSTALL OR CONNECT

14. Regulator (6) with terminal cover (220) assembled to RE housing (1) with regulator attaching screw (224) (grounding). (See Fig. 33) Finger tighten.

15. One field coil lead terminal (A) over regulator (6) mounting hole closest to terminal. (Ensure leads do not touch edge of frame hole.)

16. Insulated screw (217) through lead terminal (A) and regulator (6) into rectifier end housing (1). Finger tighten.

17. Bridge to regulator stud connector (219) over threaded stud of regulator (6) with nut (218). Finger tighten.

18. Diode trio (7) on to 3 threaded studs on rectifier bridge (8).

19. Insulated screw (217) through indicator strap (208) hole, long leg of diode trio (7) and other field coil lead terminal (A) into regulator (6) unused hole and into R.E. housing. (See Fig. 34) Finger tighten.

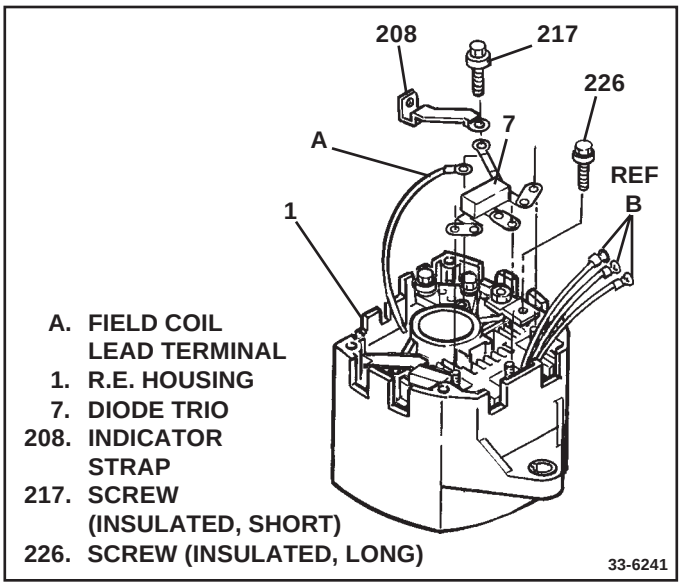


Figure 34. Installing Diode Trio and Sense Connector

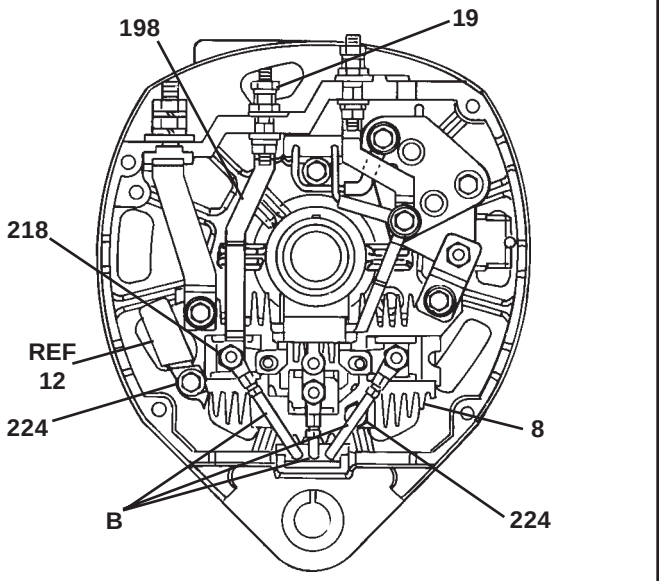
20. Screw (226) through other hole in bridge to regulator stud connector (219) into rectifier bridge (8) and into RE housing. Finger tighten.

TIGHTEN

21. Two rectifier ground screws (224) to 4 N.m (35 lb. in.) (See Fig. 35)

INSTALL OR CONNECT

22. "R" terminal connector strap (198) over rectifier stud closest to capacitor (12). (If installing new "R" terminal follow instruction in package.) (See Fig. 35)



B. STATOR LEADS
8. RECTIFIER BRIDGE
12. CAPACITOR
19. RELAY TERMINAL
198. "R" TERMINAL CONNECTOR STRAP
218. NUTS (3)
224. RECTIFIER GROUND SCREW (2)

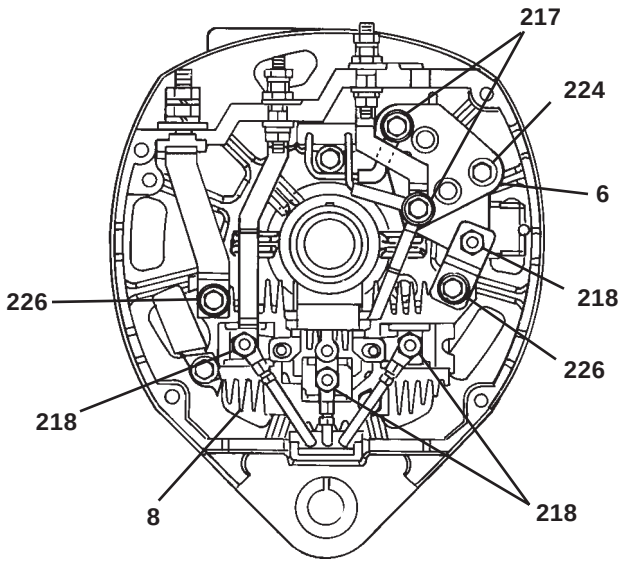
33-6242

Figure 35. Installing "R" Terminal and Stator Leads

23. Three stator leads (B) over matching rectifier bridge (8) studs.

24. Three nuts (218) on rectifier bridge studs. Finger tighten.

25. Secure fasteners shown in the following order (See Fig. 36)



6. REGULATOR
8. RECTIFIER BRIDGE
217. SCREW (INSULATED, SHORT)
218. NUT
224. SCREW
226. SCREW (INSULATED, LONG)

33-6243

Figure 36. Fastener Torques

TIGHTEN

1. One regulator ground (mounting) screw (224) to 2.5 N.m (23 lb. in.)

2. Two insulated regulator screws (217) to 2.0 N.m (20 lb. in.)

3. Two rectifier bridge insulated screws (226) to 2.0 N.m (20 lb. in)

4. Three rectifier bridge nuts (218) to 2.5 N.m (23 lb. in.)

5. Regulator stud nut (218) to 2.0 N.m (20 lb. in.)

FINAL ALTERNATOR ASSEMBLY

CLEAN

26. Inner race of rectifier end bearing (3) on rotor shaft to prevent contamination of grease. (See Fig. 37) Remove tape to expose rectifier end bearing.

27. Align mounting lugs and assemble two halves of alternator (See Fig. 37), inserting rectifier end bearing inner race (on rotor shaft) into bearing in rectifier end housing (1). Seat drive end housing (4) at this time. Using arbor press and appropriate block to apply even pressure on end frames.

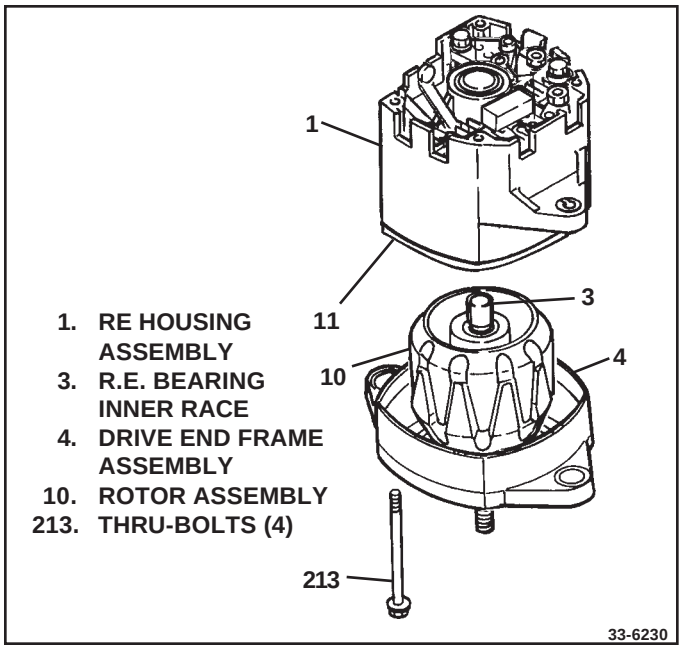


Figure 37. Assembly of Alternator Halves

28. Insert 4 thru-bolts (213) through drive end housing (4) and stator (11) into threaded holes in rectifier end housing (1). Align housings and stator as needed to allow thru-bolts to stand straight in holes and engage threads. When all four thru-bolts are inserted, tighten them in round-robin fashion.

TIGHTEN

Thru bolts (213) to 12.4 N.m (110 lb. in.)

29. After assembly, dip rectifier end frame of alternator about one and one quarter inch (1¼") deep into clear electric grade varnish or otherwise coat area of electronics to protect from corrosion. (See Fig. 38)

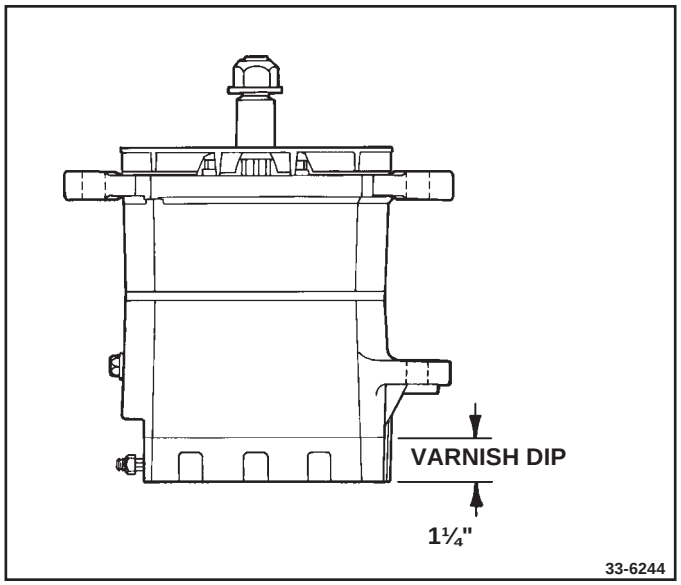


Figure 38. Protective Varnish Dip

INSTALL

NOTICE: Make sure varnish is dry before proceeding.

30. After varish is dry, install rectifier end cover plate (15) with four attachment screws (216). If removed, replace capacitor (DRA 198544) with one screw (216). (See Fig. 39)

TIGHTEN

Attachment screws (216) to 3 N.m (26 lb. in.).

INSTALL

31. Fan (13) onto rotor shaft with vanes toward body of alternator. (See Fig. 40)

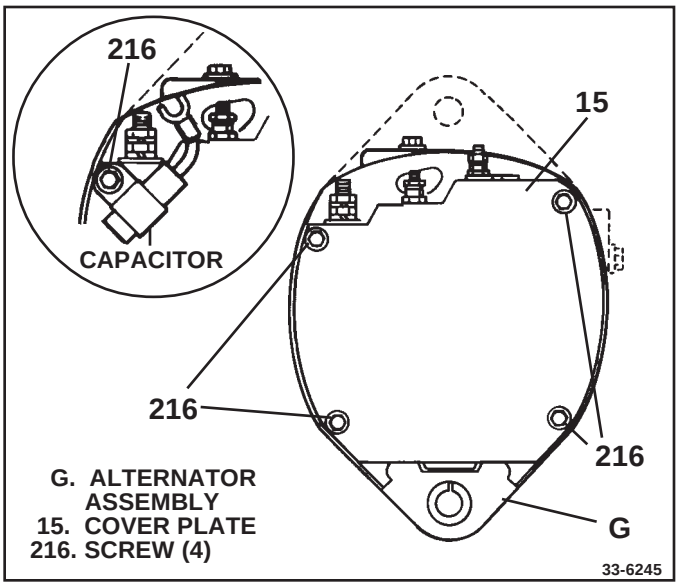


Figure 39. Installing Cover Plate

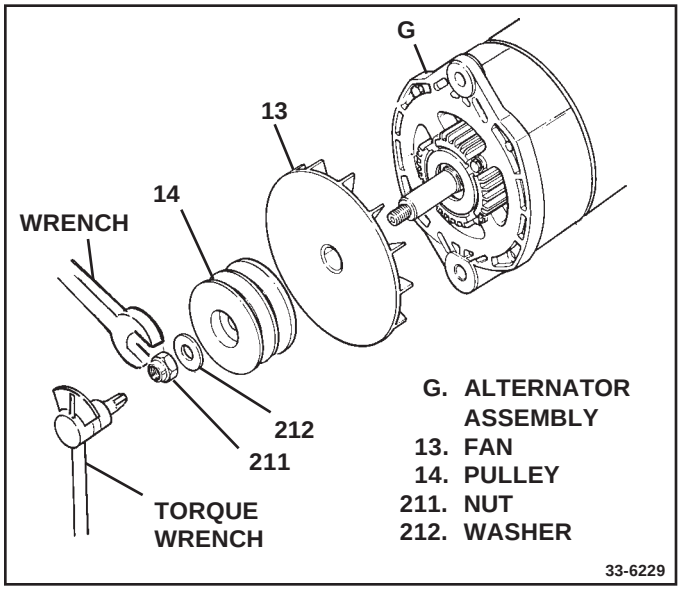


Figure 40. Installing Fan and Pulley

NOTICE: Several pulley styles are available from ACDelco for 7/8" shaft alternators, including a blank that can be custom machined for unique applications.

32. Pulley (14) suitable for engine application.

33. Flat washer (212) and lock nut (211) onto shaft with locknut flat side next to washer.

34. Insert 5/16" hex wrench or driver into end of shaft. Holding the shaft with a hex driver installed on a torque wrench makes an ideal way to check torque while tightening the nut. Tighten pulley nut to 102 N.m (75 lb. ft.).

ALTERNATOR BENCH TEST

TEST EQUIPMENT NEEDED:

- Alternator Test Stand (5000 rpm capability at least 5 HP)
- Battery or Battery Set (fully charged)
- Variable Carbon Pile Load Test
- Ammeter (current capability at least 15 amps higher than alternator rating)
- Voltmeter
- Ohmmeter

The bench test procedure will verify alternator performance prior to installation on the vehicle. This test checks the alternator output in the same manner as the Rated Output Check covered earlier. If bench test equipment is not available, install the alternator on the engine according to manufacturer's instructions and repeat the Rated Output Check to verify alternator operation. If bench test equipment is available, proceed as follows:

1. Mount alternator in test stand according to test stand manufacturer's instructions.

2. **IMPORTANT:** Battery or battery set must be fully charged for test results to be valid.

   NOTICE: When a 12-volt carbon pile load test is used to diagnose a 24-volt system, attach load test only to 12-volt potential in battery set. Attaching a 12-volt load test to a 24-volt potential will damage the carbon pile.

   With carbon pile load turned off and with battery or battery set fully charged, make electrical connections as shown in Fig. 41. Battery voltage and ground polarity must be same as system in which alternator is used. Check and record battery or battery set voltage before proceeding with test.

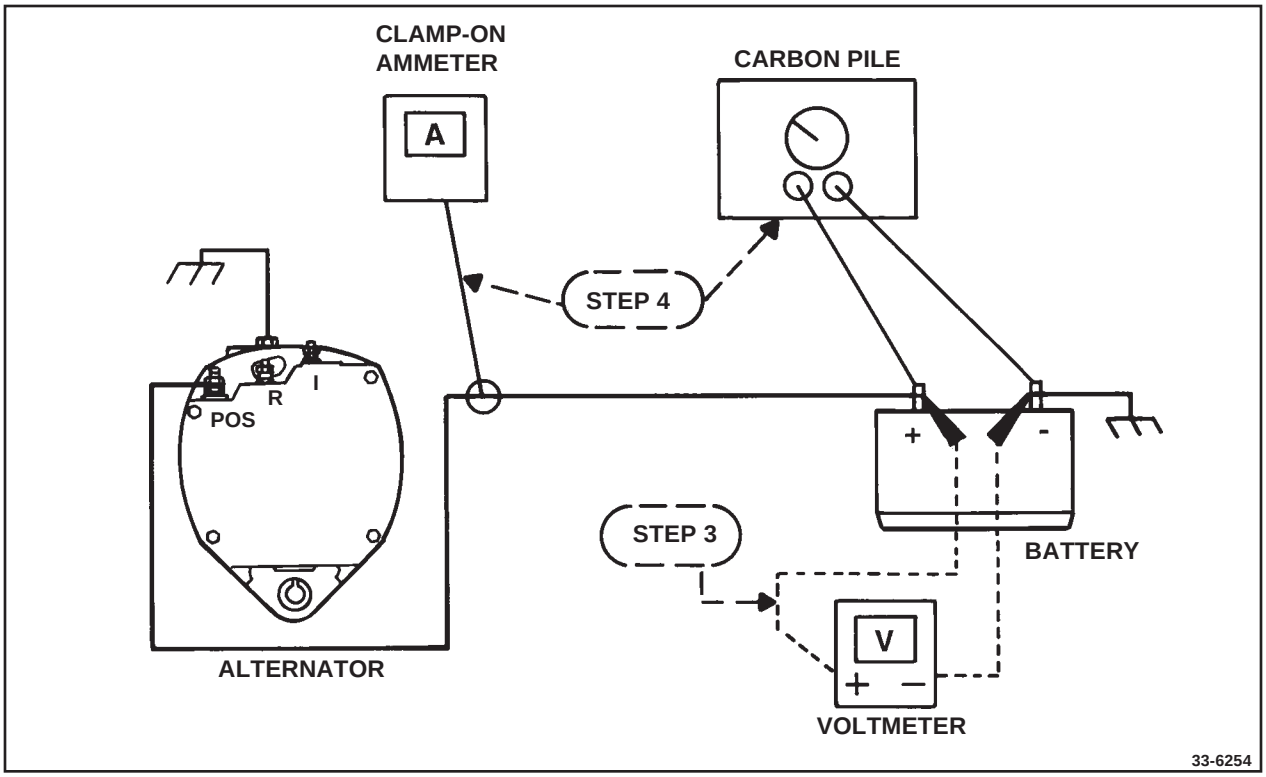


Figure 41. Alternator Bench Test

3. With carbon pile load "off," start test stand and slowly increase alternator speed to highest rpm shown under Cold Output specifications in 33/34 SI Alternator Specifications at the end of this manual. Observe voltmeter.

- If voltage does not increase but remains at or below previous reading (Step 2), there is no alternator output. Turn carbon pile load off and stop test stand. Residual magnetism in rotor may have been lost. Skip to Step 5.

- If voltage increases above 15.5 volts on 12-volt system (or above 31 volts on 24-volt system), voltage is uncontrolled. Turn carbon pile load off and stop test stand. Recheck alternator for proper assembly. If alternator has been assembled properly, replace regulator as described under Unit Repair. Also check field coil for shorts and replace if defective.

- If voltage is proper, proceed to next step.

4. With alternator running at highest rpm shown under Cold Output in Specifications, turn on carbon pile load and adjust to obtain maximum alternator output on ammeter.

- If ammeter reading is within 15 amps of Cold Output in Specifications, alternator is good. Turn off carbon pile load and stop test stand.

- If ammeter reading is more than 15 amps below specification, alternator is not operating properly. Turn off carbon pile load and stop test stand. Return to Unit Repair section in this manual and re-diagnose the alternator.

5. **CAUTION: Do not allow jumper lead to be accidentally grounded while connected to battery insulated terminal. If the free end of this lead is accidentally touched to the alternator housing or other grounded areas, the jumper lead may quickly get hot enough to cause a skin burn or to damage the jumper lead. Keep jumper lead carefully insulated from grounding during this procedure.**

EQUIPMENT NEEDED:

- Jumper Lead (18 ga. min; no fuse)

To restore residual magnetism in alternators with an "R" or "I" terminal, alternator ground terminal must be connected to battery ground terminal. This may be done directly or through the test stand wiring. (See Fig. 42)

Disconnect carbon pile load test from battery if still connected. Disconnect any leads connected to alternator "R" or "I" terminal. Connect jumper lead to battery positive. Without touching other grounded areas (See CAUTION Above), momentarily touch ("flash") free end of jumper lead to alternator "R" or "I" terminal. The momentary current flow into the terminal will restore the proper magnetism in the rotor. Disconnect the jumper lead from the battery, then return to Step 1 and repeat Alternator Bench Test.

ALTERNATOR INSTALLATION

CAUTION: Failure to disconnect grounded battery cable at battery before removing or attaching alternator "BAT" terminal lead may result in an injury. If a tool is shorted to the battery cable connector at the output terminal, the tool can quickly heat enough to cause a skin burn or to damage the tool or cable.

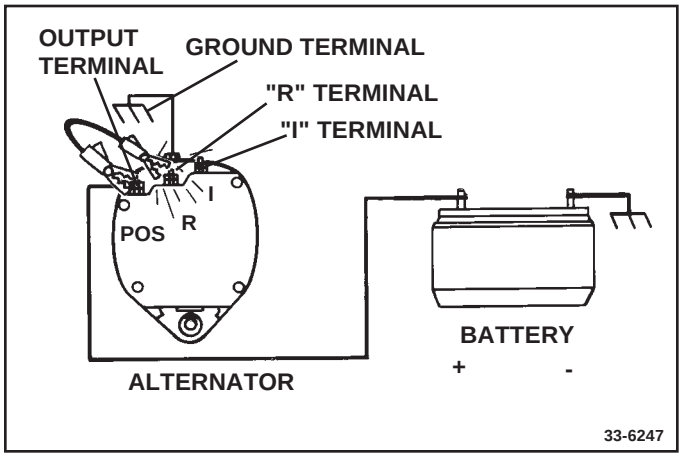


Figure 42. Restoring Residual Magnetism

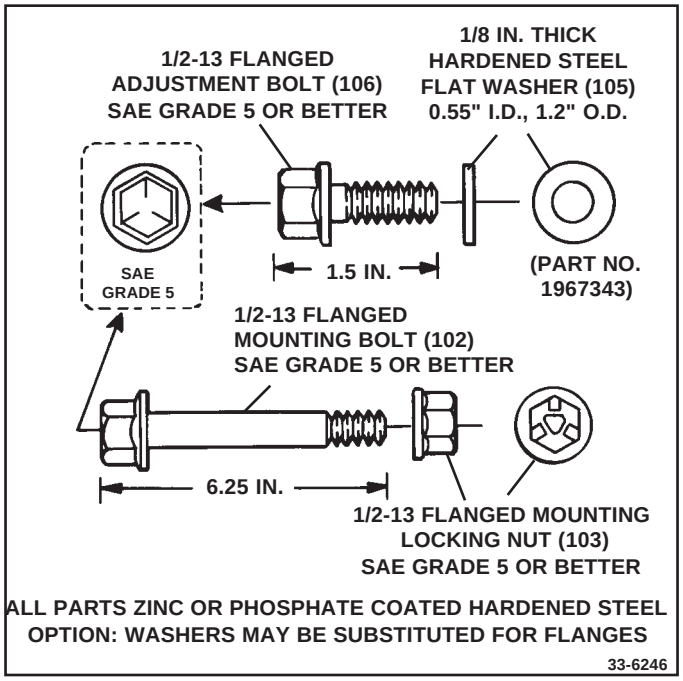


Figure 43. Alternator Mounting Bolts

REMOVE OR DISCONNECT

1. Negative cable at battery.

NOTICE: Always reinstall fasteners at original location. If necessary to replace fasteners, use only correct part number or equivalent. (See Fig. 43)

- If correct part number is not available, use only equal size and strength.
- Fasteners that are NOT to be reused will be noted in procedure.
- Fasteners requiring thread locking compound will be noted in procedure.
- Use specified torque values when shown.

Using or replacing fasteners in any other manner could result in part or system damage.

INSTALLATION PROCEDURE (See Figure 44)

Always follow engine manufacturer's instructions for installing alternator on engine. The following procedure is typical and may not match all steps necessary for a specific application.

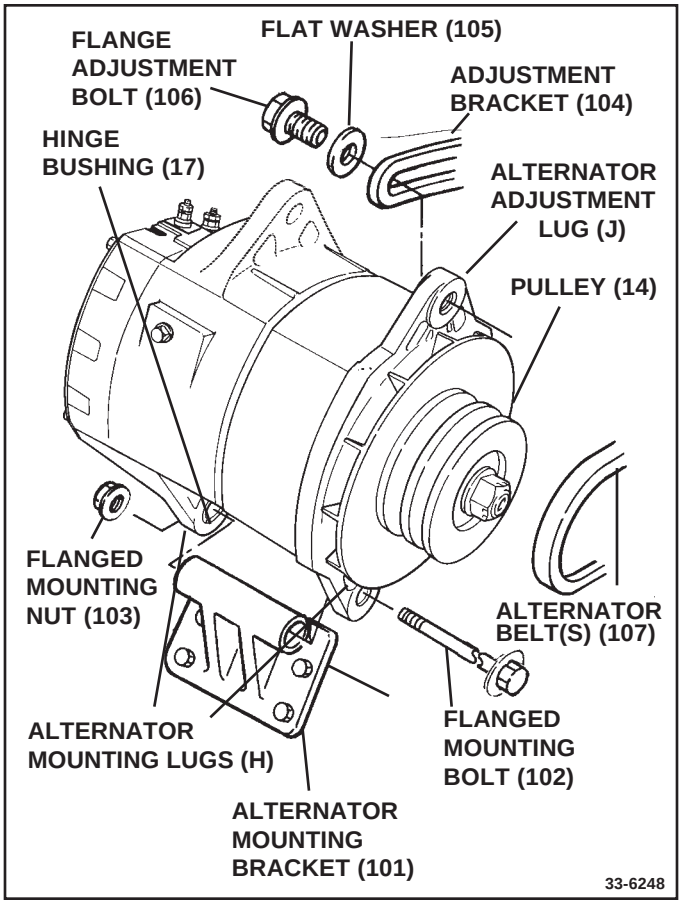


Figure 44. Installing Alternator on Engine

TEST EQUIPMENT NEEDED:

- Belt Tension Gage

NOTICE: Before installing alternator to engine, check mounting bracket (101) and adjustment bracket (104), also stabilizer bracket (111 Fig. 46); if used, to ensure they are not worn or cracked. Make sure they will securely mount alternator to engine with proper hardware.

TIGHTEN

All fasteners holding alternator mounting bracket (101) to engine manufacturers torque specifications.

ADJUST

Rectifier end bushing (17) position in RE housing mounting lug to allow maximum distance between mounting lugs (H).

NOTICE: Belt tensioning and tightening of adjusting bracket and mounting bolts must be completed before stabilizing bracket is installed.

INSTALL OR CONNECT

1. 33 SI or 34 SI mounting lugs (H) to alternator mounting bracket (101).

2. One flanged mounting bolt (102) through the D.E. frame mounting lug (H), the alternator mounting bracket (101), and the R.E. frame mounting lug bushing (17).

3. Flanged mounting nut (103) to flanged mounting bolt (102) finger tight.

   NOTICE: If either bolt or nut are not flanged a 1/8" thick, hardened steel flat washer (105) (See Figure 43) must be substituted for flanged applications.

4. Flanged adjustment bolt (106) through flat washer (105), slot in adjustment bracket (104) and thread into hole in DE frame adjustment lug (J) finger tight.

5. Alternator belt(s) (107) onto pulley (14).

   NOTICE: If engine uses automatic belt tensioning (idler) see engine manufactures installation instruction.

6. Idler if used.

   NOTICE: Do not pry on alternator, rectifier end housing (1) to adjust belt tension. This may damage alternator. Pry against the drive end frame (4) with suitable pry bar (108).

   NOTICE: When alternator is used to attain belt tension see engine manufacturers tension specifications.

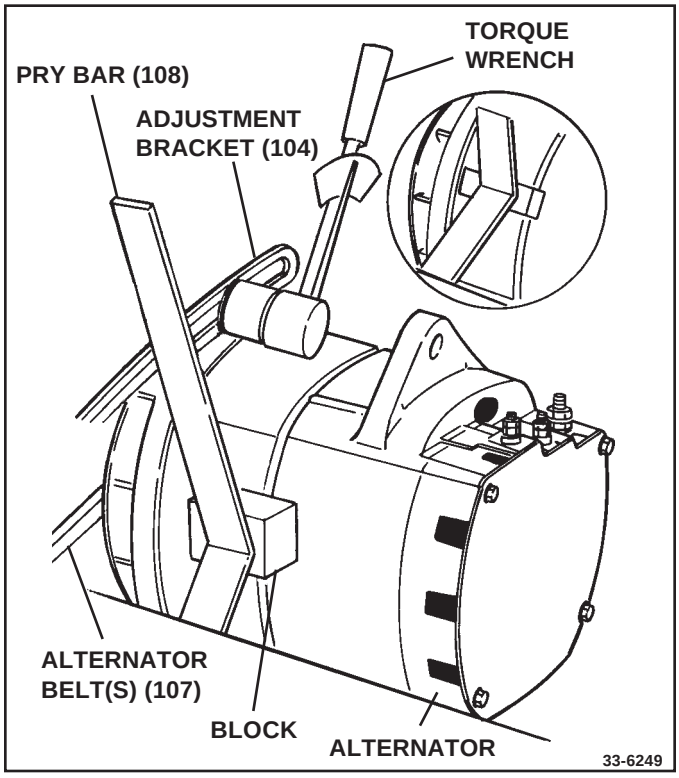


Figure 45. Adjusting Belt Tension

7. Pry bar (108) between engine and drive end frame (4) of alternator. Using pry bar (108) as a lever apply force to pry alternator and increase belt tension.

ADJUST

Belt (107) tension using belt tension gage to specification and hold. (See Fig. 45)

TIGHTEN

Adjustment bracket (104) to engine or vehicle manufacturers specifications. Flange adjustment bolt (106) and flanged mounting bolt (102) and nut (103) to 88 N.m (65 lb. ft.).

MEASURE

Belt (107) tension with belt tension gage to ensure the specification is maintained. If not repeat steps 7.

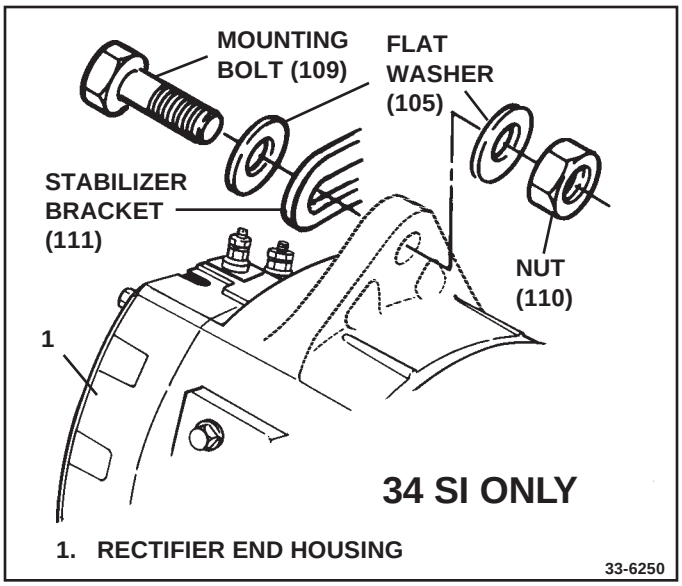


Figure 46. Connecting Stabilizing Bracket

INSTALL OR CONNECT

NOTICE: Belt tensioning and tightening of adjusting bracket and mounting bolts must be completed before stabilizing bracket is installed.

8. Stabilizer mounting bolt (109) through flat washer (105), stabilizer bracket (111), RE housing stabilizer lug (1), flat washer (105) and thread into nut (110) finger tight. (See Fig. 46)

TIGHTEN

Stabilizer bolt (109) and nut (110) to 88 N.m (65 lb. ft.).

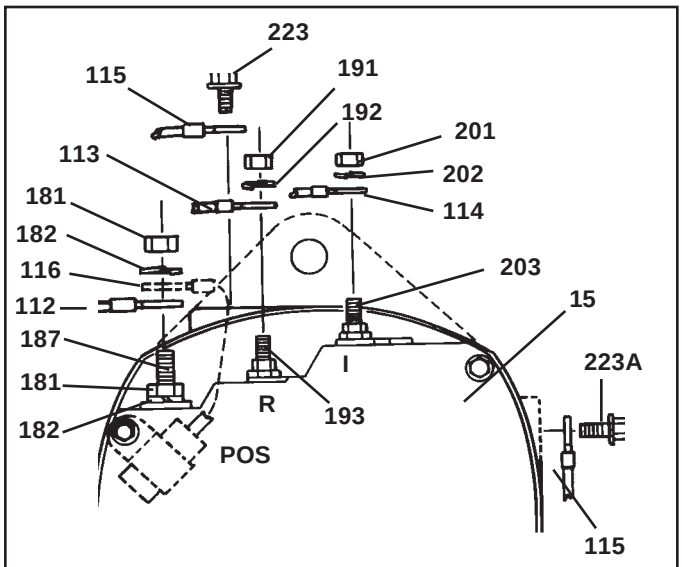
VEHICLE WIRING INSTALLATION
(See Figure 47 & 48)

NOTICE: On certain engine configurations a 1.5µf capacitor (DRA 198544) was retrofited to some alternators.

INSTALL OR CONNECT

1. Battery lead (112), lead capacitor (116) if required, lockwasher (182) and nut (181) onto output stud (187), labeled "POS" on cover plate (15) finger tight. (See Fig. 48)

2. Relay lead (113), lockwasher (192) and nut (191) onto relay stud (193) labeled "R" on cover plate finger tight, if used.



112. BATTERY LEAD
113. RELAY LEAD
114. INDICATOR LIGHT LEAD
115. GROUND LEAD
116. CAPACITOR (A/R)
181. NUT
182. LOCK WASHER
187. OUTPUT STUD
191. NUT
192. LOCK WASHER
193. RELAY STUD
201. NUT
202. LOCK WASHER
203. INDICATOR LIGHT STUD
223. SCREW
223A. SCREW ASSEMBLY 34 SI ONLY

Figure 47. Installing Wiring

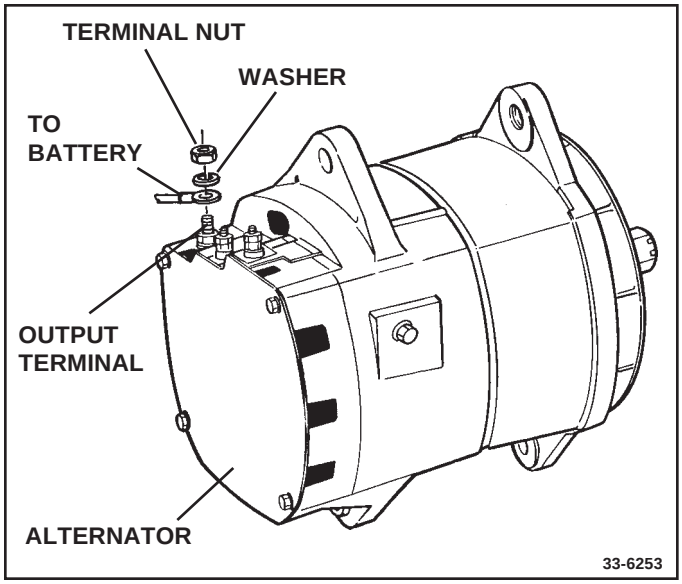


Figure 48. Connecting to Output Terminal

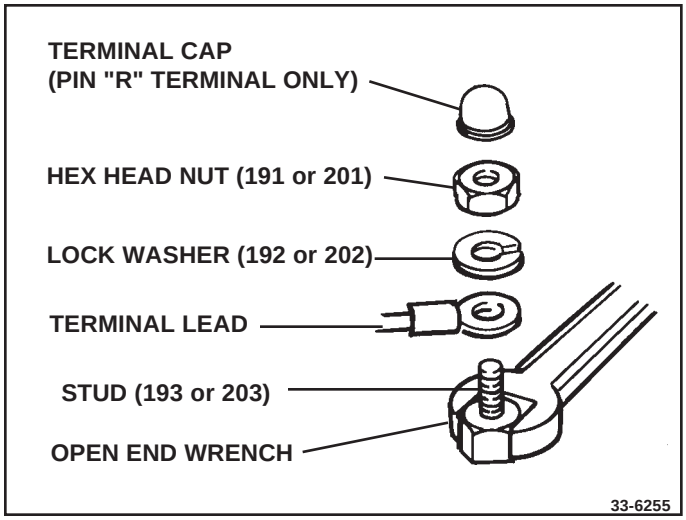


Figure 49. Tighten Threaded "I" or "R" Terminals

3. Indicator light lead (114), lockwasher (202) and nut (201) on to indicator light stud (203), labeled "I" on cover plate finger tight, if used.

4. Ground screw and lockwasher assembly (223) through ground wire lead (115) into threaded hole in rectifier end housing (1) located on top of 33 SI or on side of 34 SI finger tight.

TIGHTEN

1. Ground screw and lockwasher assembly (223) to 6 N.m (55 lb. in.)

   NOTICE: Use suitable open end wrench to hold nut (181) hex heads on "R" and "I" terminal studs (193 and 203). (See Fig. 49.)

2. Hex head nut (181) on "POS" terminal to 7 N.m (65 lb. in.).

3. Hex nuts (191) and (201) or ""R" and "I" terminals to 2 N.m (20 lb. in.), if used.

INSTALL OR CONNECT

4. PIN terminal cap on any terminals not used or any PIN connections.

5. Vehicle battery cable to battery(s).

33/34 SI ALTERNATOR SPECIFICATION

The typical 33/34 SI field coil specs for 12V is 5.5 - 9.0 amps at 12V or 1.4-2.1 ohms at 80°F. The field coil specification for 24V models is 2.9-3.6 amps at 24V or 6.9-8.1 ohms at 80°F. The 32V model field coil specifications are 1.4-1.9 amps at 32V or 17.0-21.4 ohms at 80°F.

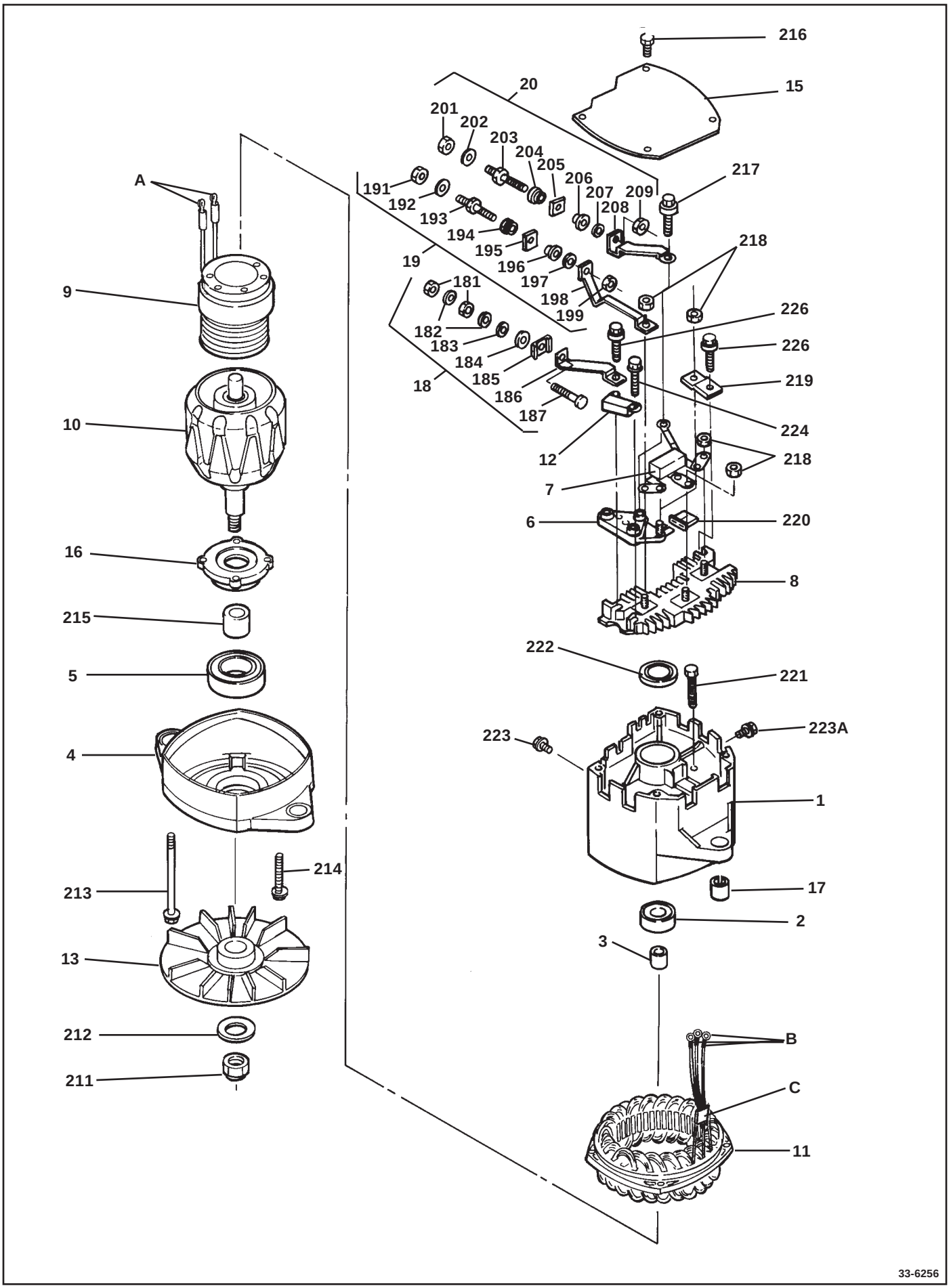
Cold Current output at 80°F is shown in the following table.

Alternator Model	Amperes @ 80° F	
	1800 rpm	5000 rpm
12V/110A 12V/135A	60 52	110 135
24V/100A	0	100
32V/60A	8	60

For further information on rotations and exact specification number on these or other Delco Remy America products: Call 1-800-DRA-0222

Illus. No.	Name	Qty.
1.	Housing, Rectifier End	1
2.	Bearing, Outer Race	1
3.	Bearing, Inner Race	1
4.	Frame, Drive End	1
5.	Bearing, Ball	1
6.	Regulator	1
7.	Diode Trio	1
8.	Bridge, Rectifier	1
9.	Field Coil & Support	1
10.	Rotor Assembly	1
11.	Stator Assembly	1
12.	Capacitor	1
13.	Fan	1
14.	Pulley (Not Shown)	N/A
15.	Plate, Cover	1
16.	Retainer, Bearing	1
17.	Bushing, Rectifier End	1
18.	Package, Output Terminal	1
19.	Package, Relay Terminal	1
20.	Package, Indicator Light Terminal	1
21.	Package, Hardware	1
A.	Field Coil Leads	2
B.	Stator Leads	3
C.	Insulator, Grommet	1

Illus. No.	Name	Qty.
18.	Output Terminal Package	1
181.	• Nut, Hex Head	2
182.	• Washer, Flat	2
183.	• Insulator	1
184.	• Insulator, Housing	1
185.	• Insulator, Connector	1
186.	• Strap, Output	1
187.	• Stud, Output	1
19.	Relay Terminal Package	1
191.	• Nut, Hex Head	1
192.	• Washer, Lock	1
193.	• Stud, Relay	1
194.	• Insulator, Terminal	1
195.	• Washer (Square)	1
196.	• Insulator, Housing	1
197.	• Washer, Flat	1
198.	• Strap, Relay	1
199.	• Nut, Hex Flanged	1
20.	Indicator Light Terminal Package	1
201.	• Nut, Hex Head	1
202.	• Washer, Lock	1
203.	• Stud, Indicator Light	1
204.	• Insulator, Terminal	1
205.	• Washer (Square)	1
206.	• Insulator, Housing	1
207.	• Washer, Flat	1
208.	• Strap, Indicator	1
209.	• Nut, Hex Flanged	1
21.	Hardware Package	1
211.	• Nut, Lock	1
212.	• Washer, Flat	1
213.	• Bolt, Thru	4
214.	• Screw, Retainer	4
215.	• Collar, Shaft	1
216.	• Screw, Cover Plate	4
217.	• Screw, Insulated Hex Head (Regulator, Short)	2
218.	• Nut, Hex Head	4
219.	• Connector, Bridge to Regulator Stud	1
220.	• Cover, Terminal	1
221.	• Screw, Hex Head, Field Coil Attch.	4
222.	• Plug, Rectifier Housing	1
223.	• Screw and Lockwasher Assembly	1
224.	• Screw, Ground	3
225	• Cap, Pin Terminal	1
226.	• Screw, Insulated Hex head (Rectifier, Long)	2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