ElecTroDyne®
BRUSHLESS ALTERNATORS

TROUBLESHOOTING AND REPAIR

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ELECTRODYNE

Presents

ALTERNATOR TROUBLESHOOTING AND REPAIR

This materiel covers single-ended, self-excited, air-cooled, belt-driven alternators which are manufactured by Electrodyne.

We intend to suggest simple but reliable procedures necessary to accomplish commercially acceptable trouble-shooting and repair.

This presentation will not include in-chassis trouble shooting and repair procedures of the entire vehicle charging system which includes batteries, starter, switches, interconnecting wiring and other components in addition to the alternator. This subject is in our opinion best left to the chassis manufacturer or others.

However, The Maintenance Council has prepared an excellent wall chart which covers in-chassis trouble shooting procedures for a 12 volt charging-12 volt cranking system.

The wall chart entitled "TMC DIAGNOSTIC PROCEDURE AVI-6" is available from The Maintenance Council, 1616 P Street, N.W., Washington, D.C. 20035.

One of the first recommendations contained in the wall chart is to LOAD TEST the batteries and REPLACE any batteries failing this test. We therefore assume all the ensuing test and repair procedures are carried out with FULLY CHARGED batteries in sound electrical condition and that voltage losses in the interconnecting cables of the charging system are at an acceptable minimum.

We will begin at the point on The Maintenance Council chart where check out procedures lead to the alternator. This point will be at the end of Section 4A or 4B on the chart where it states "check alternator and belts AFTER you have CORRECTED WIRING if problem still persists".

IN CHASSIS ALTERNATOR CHECK

Before proceeding with any work on the alternator, the belt drive between the engine and the alternator should be inspected.

The belt ratio should be adequate to permit the alternator to do it's job. Many installations are inadequate to meet electrical load requirements over the full range of engine operating speeds.

Check belts for proper alignment. Pulley spacers may be used to accommodate minor adjustments in alignment. Check belt tightness. Loose belts cause slippage of the belt on the pulley resulting in high rate of belt wear, lower than required alternator rotative speeds, and poor alternator performance. Belts which are over tensioned result in premature belt wear and accelerated alternator bearing failure.

Use grade 8 (hardened) mounting bolts. Non-hardened bolts cause excessive wear in the holes of the mounting ears because the bolts stretch under tension and become loose. Loose bolts cause broken housings, belt misalignment and slippage, and poor alternator performance.

Electrical inspection of the alternator begins in chassis. With the batteries connected into the circuit but with the truck engine off measure and record the voltage across the alternator output terminals. This voltage is battery voltage.

Next, analyze alternator operation without electrical load. Start engine and adjust throttle to a medium engine RPM. Be certain that all electrical load devices on the vehicle are turned "OFF". Again measure the voltage across the alternator output terminals. The voltage should increase to some voltage greater than the previously recorded battery voltage but no higher than 15.5 volts. More than likely the voltage will read about 14 volts. If the voltage falls between previously recorded battery voltage and 15.5 volts but requires adjusting it will be necessary to adjust the voltage regulator.

To increase the voltage gently insert a narrow bladed screw driver into the hole in the alternator cover labeled "Volt Adjustment". The screw driver blade will engage into a slotted head adjusting screw. By gently and slowly rotating this adjustment screw it can readily be determined which direction of rotation is required to increase voltage. Clockwise rotation will normally increase voltage. Rotation of the adjustment screw changes the resistance of a very cleverly constructed but delicate variable resistor which is an integral part of the voltage regulator. Exerting too much pressure, rotating beyond the "stops", or crudely digging an oversized screw driver blade into the body of the voltage regulator will damage the voltage regulator beyond repair.

If the forgoing procedure will not increase the voltage to the desired 14 volts it will be necessary to battery excite the voltage regulator. This can be done by applying full battery voltage to the AC connections of the regulator thereby causing the regulator to "turn on" and begin switching battery current into the field coil circuit. Current switching on-off in the field coil circuit will create a moving magnetic field thereby permitting the alternator to generate electrical output. Connect a jumper wire between alternator positive terminal and the "RPM" terminal stud. If the voltage regulator fails to respond to battery excitement (voltage cannot be adjusted upward) the voltage regulator has thus been proven faulty and should be replaced.

If on the other hand the voltage across the alternator terminals increases to approximately 18 volts and adjustment of the voltage regulator will not reduce the voltage it can also be concluded without further testing that voltage regulator should be replaced.
Next determine if the alternator can operate satisfactorily under substantial electrical load. Connect electrical load to the alternator simply by turning on the headlights and some additional electrical loads. Measure the voltage across the output terminals of the alternator. The voltage should drop no more than .5 volts approximately below no load voltage. If voltage drops to battery voltage problems can be anticipated in the output circuit of the alternator which then should be removed from the chassis for further diagnosis and repair.

An important additional in chassis check should be made on the alternator with the engine off. Turn off all connected electrical loads. With the batteries connected measure the voltage from the positive output terminal of the alternator to the collector of the voltage regulator. Any voltage so measured may indicate a leak in the positive rectifier great enough to "turn on" the field coil current even though the engine is not running. The faulty rectifier or diode should be replaced. Since maximum field coil current in a 12 volt system is approximately 5 amperes this condition may cause substantial battery drain and resultant low battery voltages even though the vehicle is not in use. Low battery voltage causes starting problems and is one cause for unscheduled starter maintenance.

The results of the in chassis tests should be recorded. They can serve as an guide to the mechanic who will rebuild the alternator.

BENCH REPAIR PROCEDURES

Visually inspect the alternator for loose terminal connections, broken or cracked components, excessive dirt and/or corrosion, unusual wear marks and worn mounting holes. Careful visual inspections may lead to suggestions as to how to prevent recurrence of the problem.

The openings in the cover have been strategically located to properly direct the flow of cooling air. For this reason the cover should not be broken. Replace old style metal covers with the impact resistant plastic covers which also insulate the electrical connections.

Remove the cover from the terminal end of the alternator. The bridge rectifier, the voltage regulator, and the start-charge unit if used, will be exposed. Remove the stator leads from the positive rectifier terminal studs. Remove the positive field coil and voltage regulator lead from the positive rectifier.

Test the positive rectifier for leaking or shorted diodes by using a volt-ohmeter or a battery powered test light. Connect the positive lead of the meter or test light to the positive out put terminal of the alternator. Touch the negative lead to each of the diode tabs of the positive rectifier. The meter should indicate a very high resistance or if using the test light the test light bulb should not glow.

Reverse the meter leads. The ohmmeter should indicate a very low resistance or the test light bulb should glow.

Remove the AC (white) leads and the negative voltage regulator (black) lead from the negative rectifier. Disconnect the negative field coil lead from the blue wire or stud of the voltage regulator.

With all leads removed the entire bridge rectifier assembly may be easily lifted from the housing.

To test the negative rectifier connect the negative lead of the ohmmeter or test light to the negative output terminal. Touch the positive lead of the meter or test light to each of the diode tabs of the negative rectifier. The ohmmeter should indicate a very high resistance or the test light bulb should not glow.

Reverse the test leads and the ohmmeter should indicate a very low resistance or the test light bulb should glow.

Visually inspect both the positive and negative rectifiers for good mechanical joints. Be certain the hardware is intact.

Failure of any of the aforementioned tests may indicate a faulty diode or rectifier assembly.

Both positive and negative heat sinks may be pressed out of the bottom support if necessary. They must fit very snugly in order to resist vibration forces.

Connect an ohmmeter across the field coil leads. The resistance should be within specifications. No deflection on the meter indicates an open field coil which should be replaced.

Connect an ohmmeter between one field coil lead and the alternator housing. The slightest indication of a deflection on the meter will reveal a short between field coil and housing. In this case the field coil should be replaced.

Because of the very low resistance of the stator windings it is impractical to attempt to use an ohmmeter to check for shorts between stator windings. However the stator windings can be checked for continuity between phases and shorts to ground with a battery powered test light or volt-ohmeter.

There are three stator leads. Arbitrarily label the leads 1, 2 and 3. Connect the test light between stator leads 1 and 2, 1 and 3, and 2 and 3. In each instance the test light bulb should glow. Failure of the test light bulb to glow indicates a broken or open stator lead. Inspect the ring tongue terminal connection since it may be possible to repair a broken connection at this point by resoldering the connection with a high melting point solder. A broken stator lead at any other location requires replacement of the stator.

Next connect the test light between each stator lead and the housing. In each instance the test light bulb should not glow. A glowing bulb is an indication of a short circuit of the stator phase to housing in which case the stator should be replaced.

Neither of these two tests will reveal an internal short between the phases. This type of fault can only be determined by measuring the inductance of each phase of the stator. The stator must be removed from the housing in order to accurately measure inductance of the phases. Measurement of stator phase inductance will be described elsewhere.

Remove the voltage regulator by disconnecting the negative (black wire) and the three AC leads (white wires) from the negative rectifier, the positive (red wire) from the positive rectifier, and the collector lead (blue wire or stud connection) from the other field coil lead. Remove the regulator mounting screws and lift the regulator from the housing.

A thorough test of the voltage regulator requires in our opinion an operating alternator in A-1 condition connected to a fully charged battery, a variable load bank with suitable meters, an accurate digital voltmeter, an accurate strobe light, and an oscilloscope. A test stand with a power source and belt drive arrangement is necessary to drive the test alternator.

The voltage regulator is connected to the alternator in the following manner:

Three white AC leads to three studs on negative rectifier.
Positive red lead to positive heat sink.
Negative black lead to negative heat sink.
Collector blue lead or stud to field coil.

The test equipment is connected to the alternator or voltage regulator as follows:

Battery and load bank connected in parallel to output terminals of alternator.
One oscilloscope lead connected to collector of voltage regulator and the other to the positive terminal post.
Digital voltmeter capable of reading within .1 volts connected across alternator output terminals.

The voltage regulator test is conducted by rotating the alternator at or near its rated RPM. Assume 3500 RPM if rated RPM is unknown. Apply a 10 ampere load to the alternator by means of the variable load bank. Adjust the voltage regulator so that the appropriate voltage is measured on the volt meter. We suggest 14.00 volts for a 12 volt charging system. The oscilloscope will not display an informative pattern under these conditions.

Next apply the full rated load of the alternator by means of the variable load bank. The voltage should drop no more than approximately .5 volts from its no load setting and the pattern on the oscilloscope should display a sharp switching pattern. There should be no evidence of high frequency oscillation or voltage spikes in the scope pattern. If the voltage regulator cannot be adjusted to a predetermined no load setting, if it will not maintain voltage under load, or if excessive high frequency oscillations are present on the scope the regulator should be discarded.

Underneath the cover is a grease cap which encloses the thrust bearing assembly. Underneath the grease cap but located on the shaft is a snap ring retainer which must be removed so that the rotor shaft assembly may be pressed from the bearing using a suitable press and mandrel. Gently remove the rotor shaft assembly from the pulley end of the alternator .

The axial thrust bearing located at the rectifier end of the housing is retained in place by means of a second larger snap ring. This snap ring must be removed to permit bearing removal which may be accomplished by inserting a proper mandrel through the center opening in the pulley end of the alternator. By reversing the mandrel the roller bearing and shaft seal may also be removed from the housing in a similar manner. Bearings and seals should not be reused after they have been carefully examined to determine if they have been abused.

The rotor and shaft assembly should be carefully cleaned. Examine for any signs of loose laminations, loose permanent magnets if used, cracks or breaks or other signs of abnormal wear. The shaft should be examined for excessive wear especially where the shaft seal is in contact with the shaft and where the shaft is in contact with the roller bearing. The rotor and shaft are permanently fitted together and then balanced as a unit. For this reason these parts are not sold separately as replacement parts.

Removal of the rotor and shaft assembly gives access to the stator and field coil assembly. Remove the stator assembly by first removing the three capscrews which lock the assembly into position. The stator may then be removed by first straightening the stator leads so they will pass readily through their access hole from the rectifier area. Some stators may be readily removed by grasping the stator and sliding it out of the housing. Some stators stubbornly resist removal. In these cases it may be necessary to jar the housing against a block of wood in order to loosen the stator by inertia forces. It may be necessary to use pullers or arbor presses which can be adapted to meet your needs.

Behind the stator is the field coil which can now be removed. In some models of alternators a steel spacer ring is located between the stator and the field coil. Spacer rings are used in one of two thicknesses to accommodate variations in stator design. Field coils can be removed by jarring the housing against a wooden block in order to utilize inertia forces. Where the field coil stubbornly resists removal it may be necessary to employ unusual methods which may result in destruction of the coil. In these cases consideration should be given to not removing the field coil if it proves through testing to be electrically sound.

Remove old lubricant, dirt, and contaminants from the housing. Clean thoroughly. Inspect all holes in mounting ears. The split bushing in the bottom rear mounting lug should fit tightly and require considerable force to move. Elongation of the hole in the front bottom mounting ear should not exceed .675 inches at its widest point. The threaded hole in the bracket adjustment mounting ear should accept and permit adequate torquing of a 1/2 - 13 hardened threaded fastener. Inspect bearing bores for evidence of creeping bearing races. Replace the housing if inspection so indicates.

Repaint the exterior of the housing with a rust inhibiting paint taking care to prevent paint from coating any machined surfaces. The bearing bores at both ends of the housing should be plugged at this time to prevent the entrance of dirt or other contaminants into the grease reservoir.

Inspect the field coil assembly for any marks of abuse, heat discoloration, chafing, abrading, or corrosion. If necessary repair or enhance the insulating varnish coating of the field coil assembly with a suitable spray-on coating of insulating paint.

Install the field coil assembly into the housing by threading the field coil leads through the appropriate holes in the rectifier end of the housing. Threading the leads through the appropriate holes is important to ensure that sufficient length of lead wire is available to permit proper electrical connections later in the reassembling process. With the alternator mounting lugs positioned at 9 o'clock when working with the "BIG RED" models the positive field coil lead should pass through the hole located at 7 o'clock and the negative field coil lead should pass through the hole located at 5 o'clock. When working with the "LITTLE RED" models both field coil leads should pass through the hole located at 8 o'clock.

If the spacer ring is to be used install it adjacent to the field coil assembly.

Test the inductance of each stator phase. Inductance measurements must be made with stator removed from the alternator housing and placed on an insulated or non conducting surface. The nearby work area should be free of iron or steel objects to insure an inductance measurement free of distortion. The inductance of each phase should be in accordance with specifications.. Not all stators are designed with the same inductance in each phase. Therefore do not make any assumptions regarding stator inductance without comparing inductance values for each stator with published data.

The stator should be examined to insure solid electrical connections between the ring tongue terminals and the stator lead wires. Resolder with high temperature solder if necessary. Insulating sleeving should be repaired or replaced as required. Loose stator turns may be cemented into place by using electrical epoxies which will cure at ambient temperatures. A brush application of liquid insulating varnish can be made on most bare spots. The varnish will cure at alternator operating temperatures. The outer circumference of the stator should be cleaned.

Before installing the stator inspect again for continuity between phases and shorts between phases and the iron lamination stack. A battery powered test light between each pair of stator leads should glow. The test light when placed between each lead and the lamination stack should not glow.

Straighten the stator leads and arrange at right angles to the horizontal plane of the stator. Locate the leads at about "11 o'clock". Thread these leads along the side of the field coil and through the appropriate stator lead hole.

The three holes in the stator laminations, the spacer ring, and the field coil support must be aligned so that the stator retaining cap screws may be installed and securely torqued. Use Locktite on the threads of these retaining bolts. Using a "high-pot" tester between the field coil leads and housing and between each of the stator leads and housing will quickly locate potential trouble areas.. The "high-Pot" tester simply places a high DC voltage potential across the insulation. Any weak spot in the insulation will immediately break-down thereby creating an obvious electrical short. Disassembly and close inspection will identify the location of the electrical short thereby giving you an opportunity to correct your work with a minimum of disassembly.

Install the voltage regulator prior to installing the bridge rectifier assembly.

Turn the housing so the rectifier end of the housing is uppermost and the alternator mounting lugs are at 6 o'clock. In the lower left quadrant or the lower half of the alternator locate two predrilled holes used for mounting the voltage regulator. Place the voltage regulator over these two holes, install the mounting screws and hardware and fasten securely. Two types of voltage regulators may be encountered in this operation. A triangular shaped regulator is used on our "BIG RED" models. A flat rectangular "flat pack" is used on our "LITTLE RED" models. The internal circuits are the same in both styles. However, the blue lead of the flat pack style is replaced by the threaded stud on the side of the triangular style. Include an empty insulated ring-tongue terminal on the threaded stud with the open end of the insulation pointing toward the cover whenever installing the triangular style voltage regulator. This will facilitate full-fielding procedures. A metal tab which serves the same purpose is molded into the flat pack.

Install the field coil assembly into the housing by threading the field coil leads through the appropriate holes in the rectifier end of the housing. Threading the leads through the appropriate holes is important to ensure that sufficient length of lead wire is available to permit proper electrical connections later in the reassembling process. With the alternator mounting lugs positioned at 9 o'clock when working with the "BIG RED" models the positive field coil lead should pass through the hole located at 7 o'clock and the negative field coil lead should pass through the hole located at 5 o'clock. When working with the "LITTLE RED" models both field coil leads should pass through the hole located at 8 o'clock.

If the spacer ring is to be used install it adjacent to the field coil assembly.

Test the inductance of each stator phase. Inductance measurements must be made with stator removed from the alternator housing and placed on an insulated or non conducting surface. The nearby work area should be free of iron or steel objects to insure an inductance measurement free of distortion. The inductance of each phase should be in accordance with specifications.. Not all stators are designed with the same inductance in each phase. Therefore do not make any assumptions regarding stator inductance without comparing inductance values for each stator with published data.

The stator should be examined to insure solid electrical connections between the ring tongue terminals and the stator lead wires. Resolder with high temperature solder if necessary. Insulating sleeving should be repaired or replaced as required. Loose stator turns may be cemented into place by using electrical epoxies which will cure at ambient temperatures. A brush application of liquid insulating varnish can be made on most bare spots. The varnish will cure at alternator operating temperatures. The outer circumference of the stator should be cleaned.

Before installing the stator inspect again for continuity between phases and shorts between phases and the iron lamination stack. A battery powered test light between each pair of stator leads should glow. The test light when placed between each lead and the lamination stack should not glow.

Straighten the stator leads and arrange at right angles to the horizontal plane of the stator. Locate the leads at about "11 o'clock". Thread these leads along the side of the field coil and through the appropriate stator lead hole.

The three holes in the stator laminations, the spacer ring, and the field coil support must be aligned so that the stator retaining cap screws may be installed and securely torqued. Use Locktite on the threads of these retaining bolts. Using a "high-pot" tester between the field coil leads and housing and between each of the stator leads and housing will quickly locate potential trouble areas.. The "high-Pot" tester simply places a high DC voltage potential across the insulation. Any weak spot in the insulation will immediately break-down thereby creating an obvious electrical short. Disassembly and close inspection will identify the location of the electrical short thereby giving you an opportunity to correct your work with a minimum of disassembly.

Install the voltage regulator prior to installing the bridge rectifier assembly.

Turn the housing so the rectifier end of the housing is uppermost and the alternator mounting lugs are at 6 o'clock. In the left quadrant or the lower half of the alternator locate two predrilled holes used for mounting the voltage regulator. Place the voltage regulator over these two holes, install the mounting screws and hardware and fasten securely. Two types of voltage regulators may be encountered in this operation. A triangular shaped regulator is used on our "BIG RED" models. A flat rectangular "flat pack" is used on our "LITTLE RED" models. The internal circuits are the same in both styles. However, the stud lead of the flat pack style is replaced by the threaded stud on the side of the triangular style. Include an empty insulated ring-tongue terminal on the threaded stud with the open end of the insulation facing toward the cover whenever installing the triangular style voltage regulator. This will facilitate full-fielding procedures. A metal tab which serves the same purpose is molded into the flat p

Intertwine the positive lead of the voltage regulator (red wire) with the positive lead of the field coil. Run these entwined leads directly across the housing to and around the cast support of the bridge rectifier. Secure all lead wire runs with strands of RTV silicone adhesive which will drape over the wires and adhere to the iron housing. By so securing these leads they will not vibrate and shake loose under operating conditions.

Connect the negative field coil lead (it should be the shortest lead) to the blue wire or the threaded stud (which ever the case may be) of the mounted voltage regulator.

We have previously described the correct method of inspecting both the positive and negative rectifiers for shorted or leaking diodes, for mechanical reliability of the connections, and the integrity of the attachment of the terminal stud to the heat sink body.

The bottom support which is molded Vaalox should be inspected for signs of excessive heat, integrity of electrical hardware, fractures or other signs of abuse. Replace if necessary. The positive and negative rectifiers are firmly pressed into the bottom support while at the same insuring proper alignment of the diode tabs or jumper wires with the electrical hardware which is molded into the bottom support materiel.

Rectifier subassemblies are manufactured in two styles. One contains flat tabs each of which are soldered directly onto a pair of diodes. The flat tabs must be carefully aligned over the connecting posts of the rectifier support and then positioned directly against the surface of the bottom support.

A second style of rectifier subassembly is equipped with individually replaceable diodes to which are fastened short lead wires. When working with this style place a 1/4 inch brass spacer over the connecting posts of the bottom support before placing the diode lead wires on these same posts. The spacer is required for convenience in assembly as well as to insure the integrity of the connection. Place a lock washer and nut directly over the lead wire and securely fasten.

After completing the assembly of the positive and negative rectifiers into the bottom support repeat the procedure to check diodes for shorts or excessive leakage before proceeding further. By so doing the need for unnecessary disassembly later on is eliminated.

Bend the stator leads approximately 90 degrees and connect these stator leads to the three diode terminal posts on the positive rectifier. When working with individually replaceable diodes simply place the shortest stator lead on the nearest post and continue in that manner. Place a new lockwasher and nut over each stator lead and securely fasten.

When working with rectifiers which utilize soldered diode tabs place a flat washer directly over the flat diode tab nearest the stator leads. Place a 1/4 inch brass spacer over the middle tab and a 1/2 inch spacer over the tab farthest from the stator leads. Place the shortest stator lead over the nearest post and continue in this manner. Over each stator terminal place a new lock washer and nut and fasten securely. The foregoing procedure staggers the height of the connections and thereby permits a neat wiring arrangement with minimum opportunities for shorts.

Join the entwined positive field coil lead and positive voltage regulator lead to the drilled hole on the side of the positive heat sink.

Intertwine the three white leads of the voltage regulator with a medium tight twist. Connect to each of the three negative rectifier posts by placing a flat washer, new lock washer, and nut in that order. Fasten securely.

Join the negative voltage regulator lead to the drilled hole on the side of the negative heat sink.

Connect the negative field coil lead to the blue wire or stud of the voltage regulator.

Install a rubber grommet into the hole through which the stator leads pass, and bind the stator leads securely with wire wraps.

To complete the mechanical assembly, mount the alternator, stator upper most, over a vertical mandrel which will slip into the center bore of the alternator.

Roller bearings furnished by Electrodyne are prelubricated. Exceptional care should be taken at this point to prevent the least bit of foreign materiel or contaminant from entering the bearing. With printed legend on the outer bearing race uppermost place the bearing onto the opening of the bearing bore. Using an arbor press and a roller bearing installation mandrel to insure alignment press the roller bearing firmly into the housing. With the bearing pressed into place the printed legend on the outer race of the bearing should be visible. Next press the shaft seal into position directly above the roller bearing with the flat side of the shaft seal uppermost.

Thoroughly clean the rotor-shaft assembly with compressed air and place rotor down in the arbor press. Insert the shaft end first through the shaft seal and roller bearing until the rotor-shaft assembly is in position. Great care should be taken during this procedure to prevent any section of the shaft from entering the seal or roller bearing in a rough or heavy handed manner. Rough handling at this point can result in serious failures later on. The life of the bearings to a great degree governs the life of a properly installed and applied alternator.

Insert at least 2 ounces of Electrodyne lubricant into the lubricating reservoir. Again using a properly sized bearing installation mandrel for the ball thrust bearing, insert the ball bearing into the bearing bore and over the shaft. Press the bearing firmly into position. The printed legend on the bearing races should be visible with the bearing in position.

Next install the large snap ring retainer into the groove located in the bearing bore; the flat side of the snap ring toward the bearing and the beveled side of the snap ring away from the bearing. The purpose of this large snap ring retainer is to prevent the outer race of the ball thrust bearing from moving axially in relation to the housing. Press the shaft into the bearing race. At this time a smaller snap ring retainer is also installed over the shaft to prevent the shaft from moving axially in relation to the bearing race.

The shaft and bearing assembly are sealed by installing a lubricated "O" ring in the groove which is machined on the outer surface of the bearing housing. The grease cap is then installed over the "O" ring and locked into position by crimping the bottom edge.

FINAL TEST

The alternator is now ready for final testing.

A thorough test of an alternator requires fully charged batteries of the proper voltage, a variable load bank with capacity at least equal to the capacity of the charging system, an oscilloscope, a strobe light accurate to within 5 RPM, a digital reading voltmeter accurate to .01 volts, accurate ammeters, a test stand with power source and belt drive arrangements.

For those shops which are not equipped with an individually powered test stand and variable load bank it seems logical to install the alternator into a chassis and repeat the IN CHASSIS ALTERNATOR CHECK procedures which we outlined at the beginning of this discussion.

However, we strongly urge you to make use of an individually powered test stand and a variable load bank. By so doing a much more complete and accurate test of the alternator can be made under much more favorable working conditions.

A suitable test stand should have the capability of rotating the alternators at full rated speeds and loads over the entire speed range of the alternator. This capability is most easily accomplished with a variable speed drive. However, you will find a variable speed electric motor quite expensive both to purchase and install.

A practical alternative is to equip a constant speed electric motor with a variety of drive pulley diameters which will permit you to rotate the alternator at those rotative speeds which are critical to your particular application.

Mount and securely fasten the alternator into the test stand mounting bracket. Align and properly tension the belts if a belt drive system is used.

Connect the alternator output terminals in parallel with a variable load bank and battery whose voltage is equal to the system voltage.

A separate ammeter can be installed in the field coil circuit to measure field coil current not only when the alternator is rotating but also when it is not rotating. At Electrodyne we use a modified rectifier cover which is equipped with extra terminals so that:

1. The negative field coil lead is connected to one terminal.
2. The collector of voltage regulator (blue lead or stud) connected to other terminal.
3. The ammeter must be connected across the terminals of the modified cover to complete the field coil circuit. Connect positive lead of ammeter to field coil terminal and negative lead of ammeter to collector terminal.

The oscilloscope should be connected as follows:

1. Channel No. 1 to the blue wire or stud of the voltage regulator.

2. Channel No. 2 to the positive output terminal of the alternator.

3. The grounding tabs on the leads of both channels to the negative output terminal of the alternator.

The alternator to be tested should first be rotated to approximately 3500 RPM measured at the alternator shaft. A 10 ampere load should be applied by means of the load bank. Under these conditions the voltage regulator should be adjusted so the voltage measured across the alternator terminals is set to the desired voltage. i.e., 14.00 volts for a nominal 12 volt charging system. We suggest a digital reading volt meter for this purpose.

Adjust alternator speed to the RPM at which the alternator delivers its full rated amperage. Specifications on this rated RPM are readily available from the alternator manufacturer. The Electrodyne Model E80S for example delivers its full rated 80 amperes at 2400 RPM measured at the alternator shaft.

Apply the full rated load to the alternator. Voltage across the output terminals should drop no more than .5 volts approximately when full load is applied.

The oscilloscope channel connected to the voltage regulator should exhibit a definite switching pattern, with sharp lines, without irregular spikes in the pattern, and without evidence of uncontrolled high frequency oscillation. If high frequency oscillations or unusual voltage spikes either positive or negative appear the voltage regulator may be suspect.

If the switching pattern is replaced by a solid horizontal line this is an indication the voltage under load at the alternator terminals is lower than it should be.

This condition may be caused by:

1. Faulty or incorrect test procedures
2 Faulty or incorrect repair procedures
3. Incorrectly adjusted voltage regulator
4. Faulty components

Under these conditions the alternator cannot furnish sufficient voltage to meet the load demand. The battery is called upon to make up the short fall. Hence the voltage of the battery and therefore the alternator output is lowered to such a degree that the voltage regulator is unable to function in the switching mode. This fact can be verified by comparing the reading of the digital voltmeter with the alternator manufacturer's specifications for full load operating voltage. If all meters are accurate and properly connected and the solid horizontal line persists this condition indicates the alternator is being loaded beyond its capabilities. Recheck all test conditions to be certain they are within the design parameters of the alternator.

Observe the field coil ammeter. Note that the field coil current varies directly with the load current. Less field coil current is required at low loads than at higher loads.

Observe the oscilloscope pattern generated by the positive output terminal. This pattern represents AC RIPPLE which gives indications of the condition of the diodes, stator phases, and electrical connections. A comparison of the pattern with a known acceptable pattern will contribute toward identifying irregularly acting diodes, poor connections, and other similar defects.

If the alternator test results appear to be normal continue operation at full rated load and speed for a 15 minute period. During this 15 minute period the output voltage should not vary more than .1 volts above or below the initially observed full load voltage measured simultaneously with a switching pattern on the scope.

Slowly remove all the load except 10 amperes and adjust the alternator speed again to 3500 RPM. Measure the voltage across the alternator terminals and readjust the voltage if necessary to the desired no load voltage setting.

Disconnect all loads and stop the alternator rotation. Observe the field coil ammeter which should indicate a zero reading. A reading in the field coil ammeter with no alternator rotation is an indication that a positive diode is leaking sufficiently to "turn on" the voltage regulator. A "turned on" voltage regulator will drain the battery even though the vehicle is not in operation.

If the field coil ammeter reads zero with no alternator rotation disconnect all test equipment leads and remove the specially wired test cover.

Connect the negative field coil lead to the blue wire or stud of the voltage regulator. Secure the leads to the housing with RTV adhesive.

Place the permanent cover over the terminal posts and secure with standard hardware.

The alternator should now be as good as new.

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TYPICAL TEST EQUIPMENT

MULTI TESTER	TRIPLETT MODEL 630
DIGITAL VOLT METER	SIMPSON MODEL 460
INDUCTANCE TESTER	HEWLETT PACKARD INDUCTANCE TESTER (LCR METER) (RANGE 3 - 1000)
STROBE LIGHT	DIGISTROBE
HI-POT TESTER	SLAUGHTER (RANGE 500 - 2500)
AMMETER (FIELD COIL)	GENERAL ELECTRIC (RANGE 0 - 10)
TEST STAND	SUN ELECTRIC/SNAP-ON TOOLS
VARIABLE LOAD BANKS	MADE TO ORDER

TYPICAL VOLTAGE REGULATOR RANGE

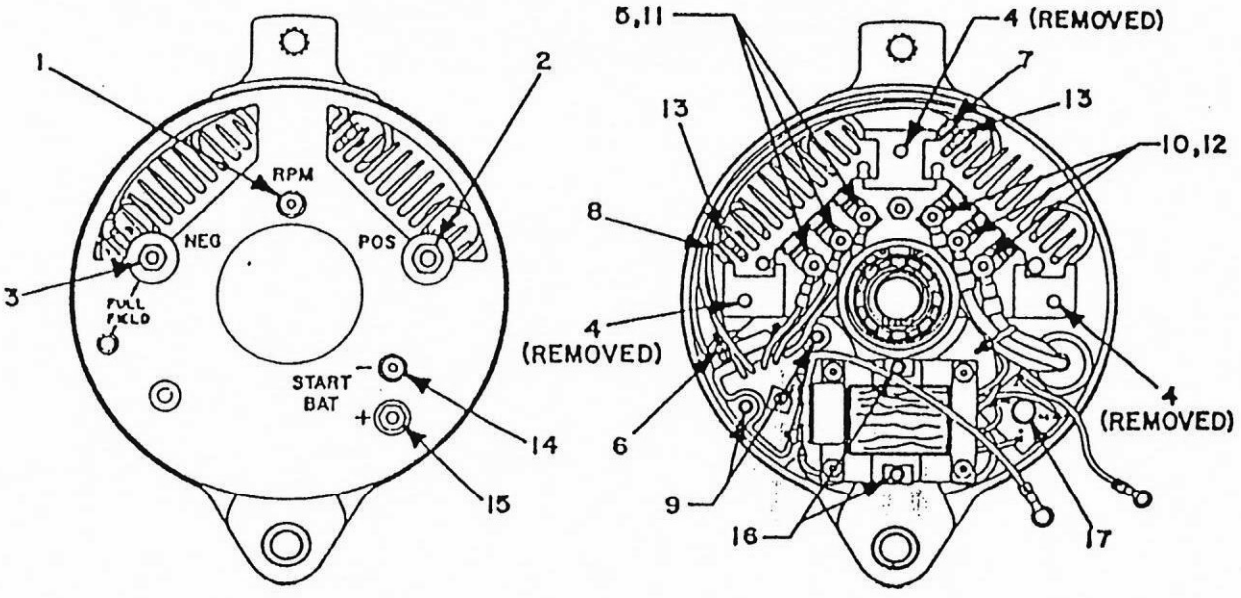
12 VOLT SYSTEM	13 - 15.5 VOLTS
24 VOLT SYSTEM	26 - 29 VOLTS
32 VOLT SYSTEM	35 - 38 VOLTS
48 VOLT SYSTEM	52 - 57 VOLTS

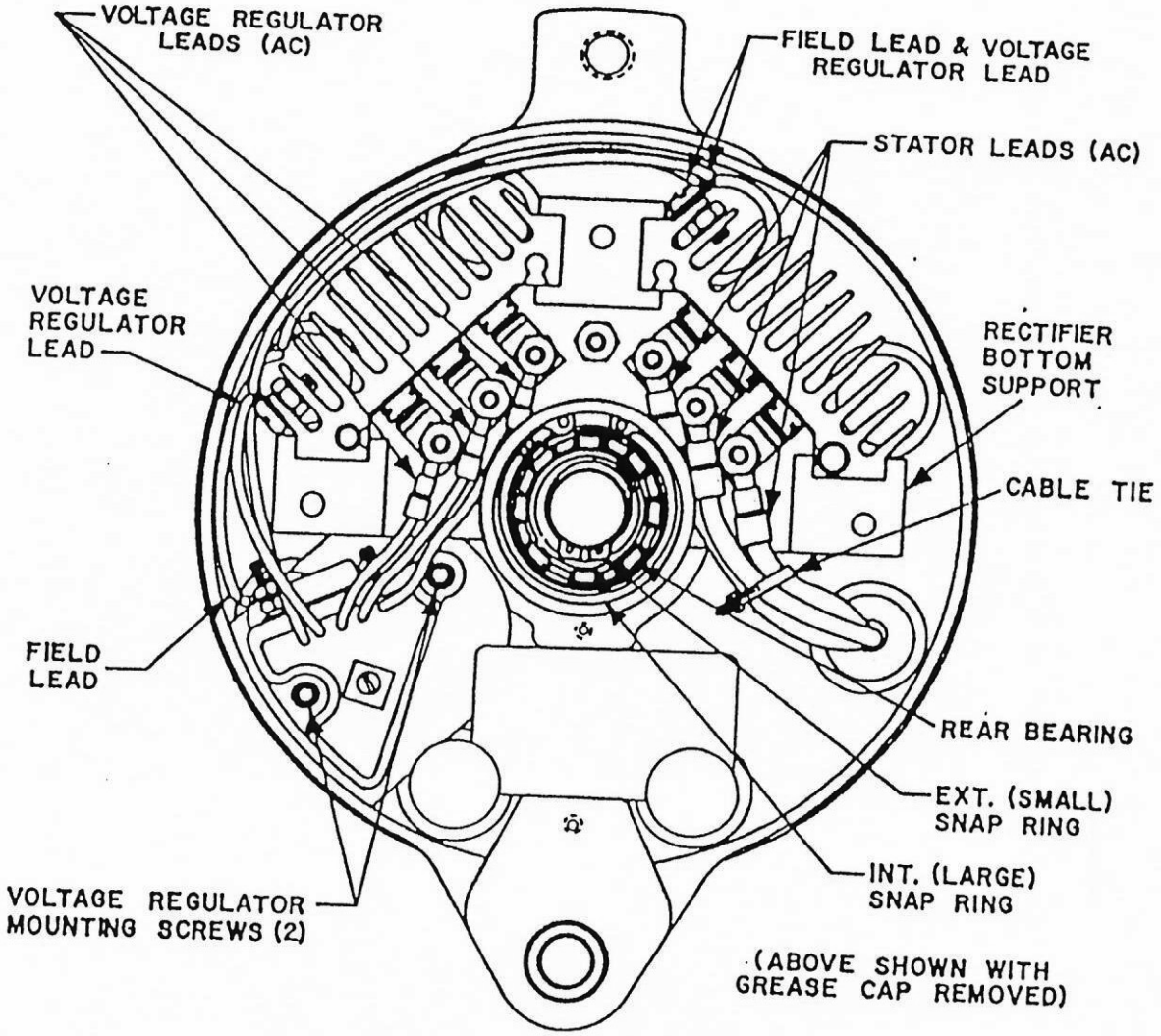
TYPICAL FIELD COIL RESISTNACE

12 VOLT SYSTEM	2.2 OHMS
24 VOLT SYSTEM	11.5 OHMS
32 VOLT SYSTEM	13.1 OHMS
24 VOLT HI-AMP SYSTEM	6.2 OHMS

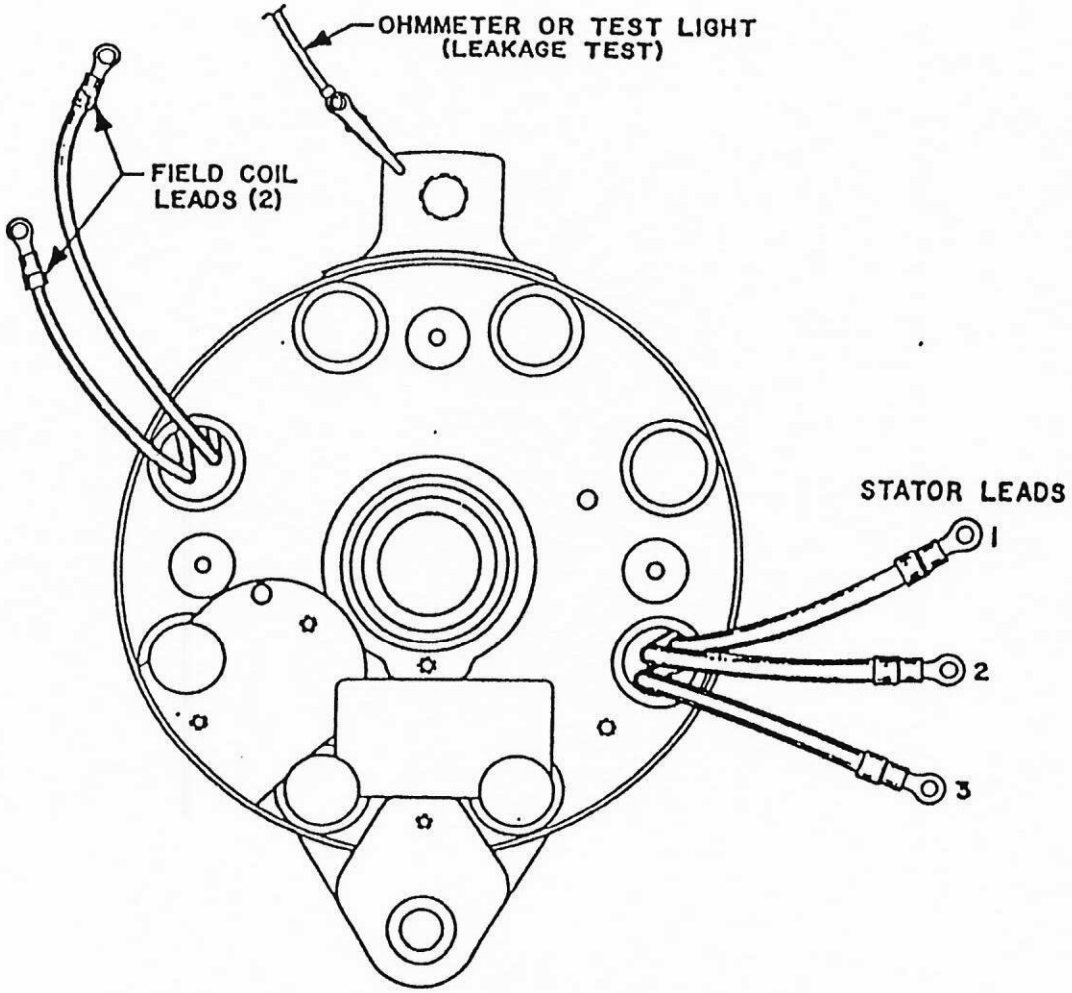
FASTENER TORQUE REQUIREMENTS

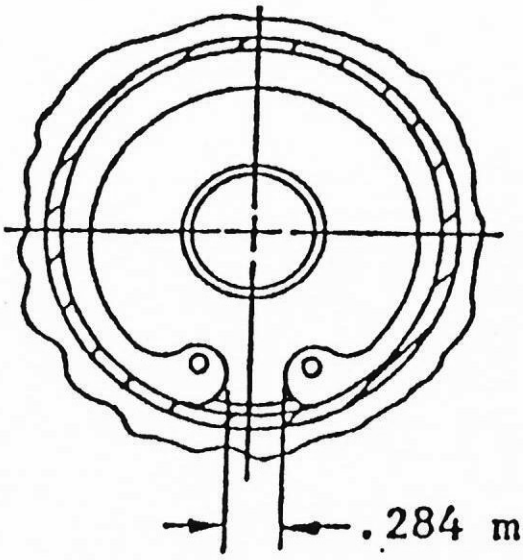
Item	Description	Quantity	Thread Size	Torque Spec.
1	Nuts	2	#10-32	25 in. lb.
2	Nuts	2	5/16"-18	50 in. lb.
3	Nuts	2	1/4"-20	50 in. lb.
4	Screws, Pan Hd.	3	#10-32x1-3/4"	25 in. lb.
5	Nuts	3	#10-32	25 in. lb.
6	Nut	1	#6-32	10 in. lb.
7	Screw, Pan Hd.	1	#10-32x1/2"	25 in. lb.
8	Screw, Pan Hd.	1	#10-32x1/2"	25 in. lb.
9	Sock, Hd. Cap Screw	2	#8-32x5/8"	25 in. lb.
10	Nuts	3	#10-32	25 in. lb.
11	Nuts	3	#10-32	25 in. lb.
12	Nuts	3	#10-32	25 in. lb.
Not Shown	Sock, Hd. Cap Screw (Stator Mounting)	3	1/4"-20x2-1/2"	150 in. lb.
13	Nuts	2	#10-32	24 in. lb.
	(SC UNITS ONLY)			
14	Nuts	2	#10-32	15 in. lb.
15	Nuts	2	1/4"-20	15 in. lb.
16	Sock, Hd. Cap Screw	2	#8-32x1-1/4"	50 in. lb.
17	Screw-Self Locking	1	#10-32x7/8"	50 in. lb.



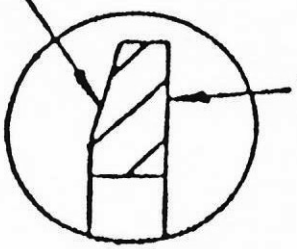

VOLTAGE REGULATOR LEADS (AC)
FIELD LEAD & VOLTAGE REGULATOR LEAD
STATOR LEADS (AC)
VOLTAGE REGULATOR LEAD
RECTIFIER BOTTOM SUPPORT
CABLE TIE
FIELD LEAD
REAR BEARING
EXT. (SMALL) SNAP RING
INT. (LARGE) SNAP RING
VOLTAGE REGULATOR MOUNTING SCREWS (2)
(ABOVE SHOWN WITH GREASE CAP REMOVED)

TEST SET-UP FOR SHORTS





Snap ring has chamfer on one side



COMPONENT TEST AND INSPECTION

NOTE: Prior to any electrical testing of the rectifier assemblies, disconnect the Stator leads and the Voltage Regulator AC Leads. This will prevent erroneous interpretation of the test results.

POSITIVE RECTIFIER TESTING

Connect the positive lead of an ohmmeter or a battery powered test light to the positive output terminal. Touch the negative test lead to each of the three positive rectifier studs. The ohmmeter should indicate a high resistance or the test light should not light.

Reverse the test leads and the ohmmeter should indicate a low resistance or the test light should light.

Visually inspect for good mechanical joints and that hardware is intact.

NEGATIVE RECTIFIER TESTING

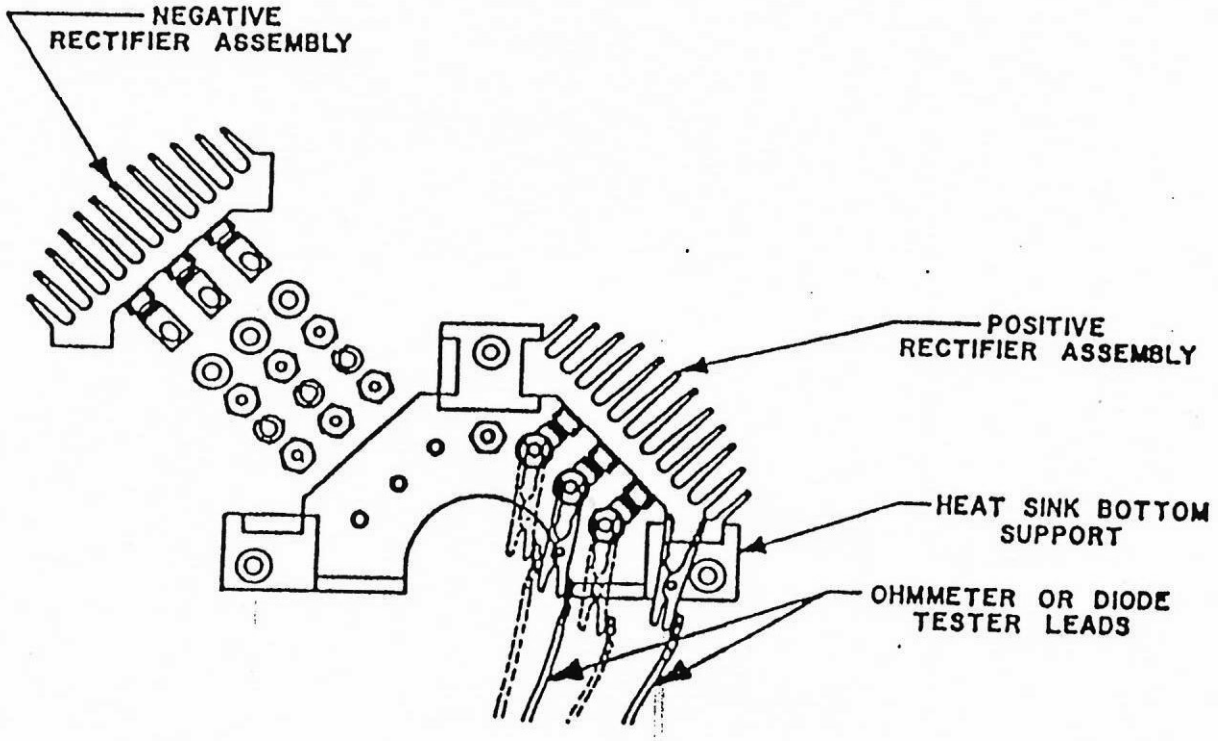
Connect the negative lead of the ohmmeter or test light to the negative output terminal. Touch the positive test lead to each of the three negative rectifier studs. The ohmmeter should indicate a high resistance or the test light should not light.

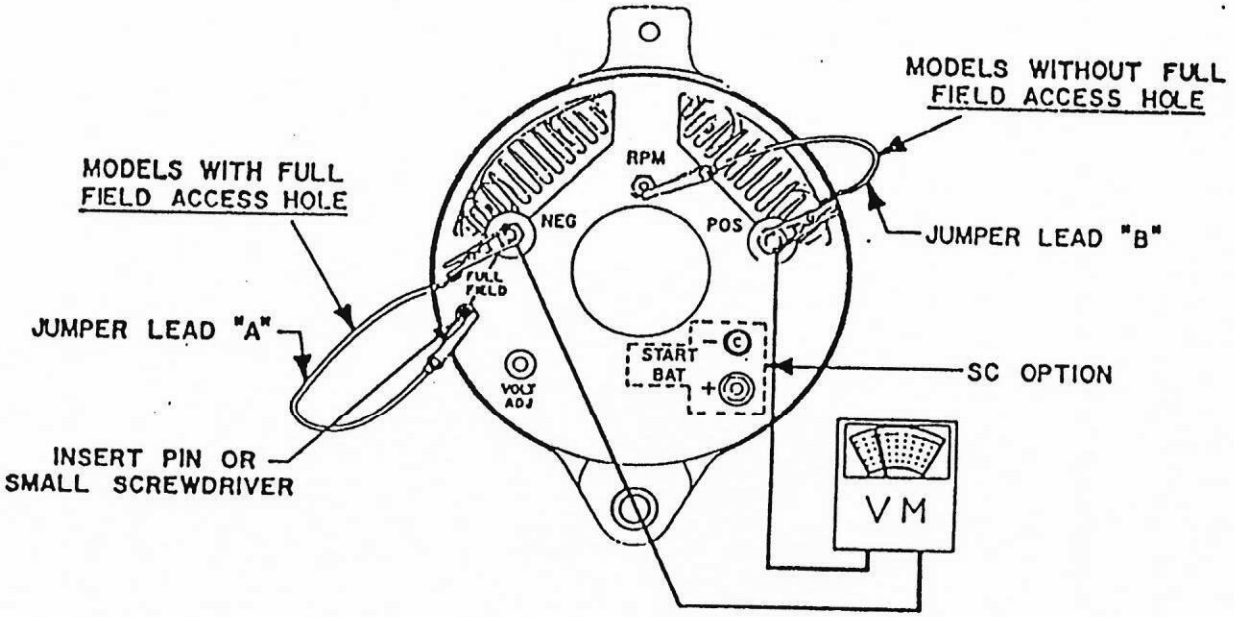
Reverse the test leads and the ohmmeter should indicate a low resistance or the test light should light.

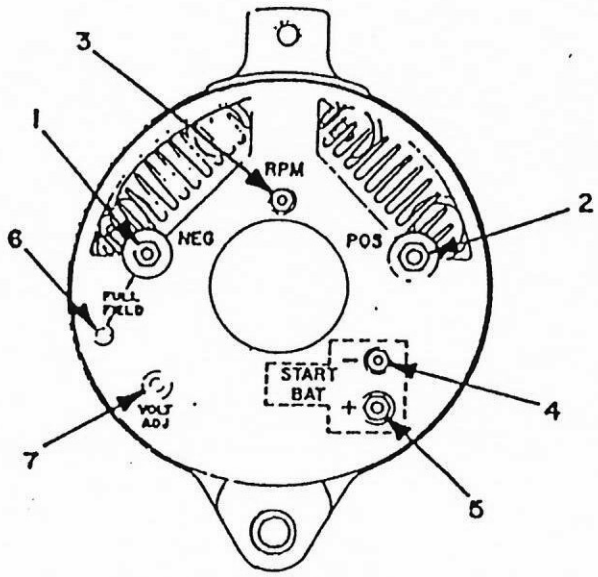
Visually inspect for good mechanical joints and that hardware is intact.

Failure of either of the above tests indicates a faulty diode and the applicable rectifier assembly must be replaced.

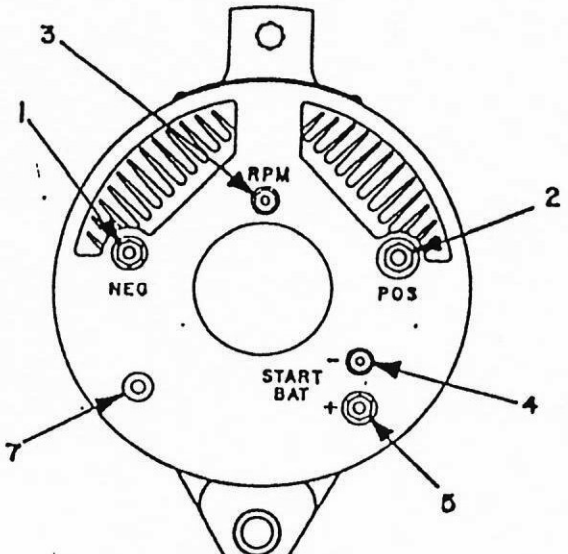
NOTE: Some manufacturers of multimeters reverse ohms polarity – If this is the case, test results of F and G above will be reversed.







USE JUMPER "A"



USE JUMPER "B"

Terminal Number	Description
1	Alternator Negative (-)
2	Alternator Positive (+)
3	RPM (AC Signal for tachometer, etc.)
4	SC Negative (-)

Terminal Number	Description
5	SC Positive (+)
6	Full Field access hole
7	Voltage Regulator Adjustment access hole

Typical Construction and Parts Identification

6.5" Diam. Frame - Belt Drive Models

The following models utilize the typical construction and parts identification indicated on the reverse side of this sheet:

E80S

E90S

E100S

E70S-24

E60S-32

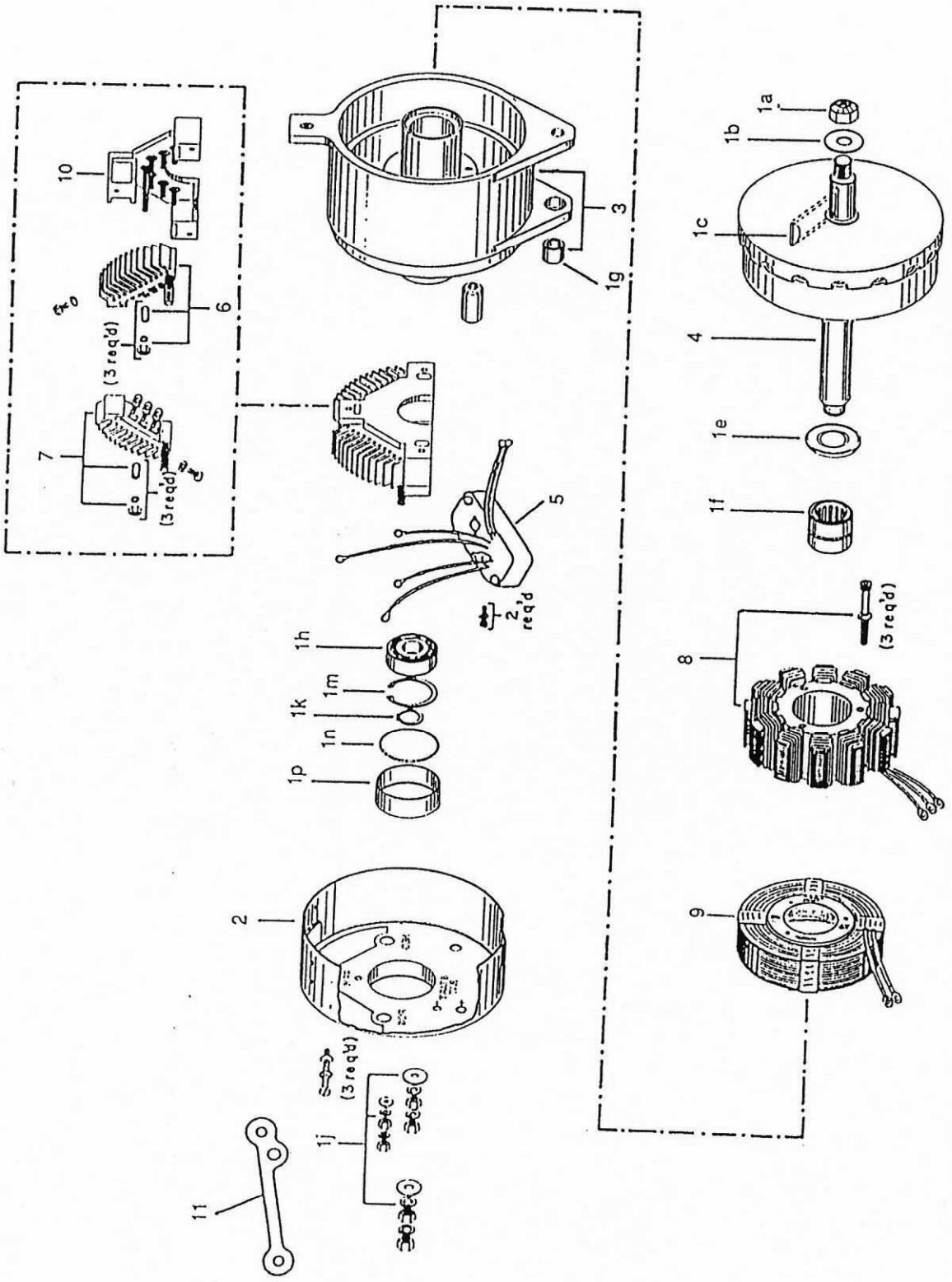
*E85DD

*E65DD

Use the exploded view on Sheet 1520.10 Page 2a to select the description number which identifies the required part. Refer to Sheet 1520.10 Page 2b to select the correct repair kit number which corresponds to the description number and the alternator model of your choice. Use the kit number selected and the alternator model number when ordering replacement parts.

* Direct Drive Models utilize direct drive components which are not illustrated on the reverse side of this sheet. However, these components are listed and easily identified on sheet 1520.10 page 2b.

Electrodyne Div. of GAUSS Corp.
One Gibson Road, P. O. Box 660, Scarborough, ME USA 04074
Tele: 207 883-4121 800 341-0242 Fax 207 883-4427



Typical Construction 6.5" Diam. Frame - Belt Drive Models
All Parts Illustrated Are Not Necessarily Used.

Description	E80S	E90S	E100S	E70S-24	E60S-32	E85DD	E65DD
*1 (a-p) Mech Serv Kit	E4000	E4000	E4000	E4000	E4000	E4000	E4000
2 Cover	E6001	E6001	E6001	E6001	E6001	E6001	E6001
3 Housing & Spilt Bushing	E6002	E6002	E6002	E6002	E6002	E6016	E6016
4 Rotor & Shaft Assembly	E6003	E6003	E6003	E6003	E6003	E6003	E6003
5 Voltage Regulator	E6004	E6004	E6004	E6005	E6013	E6004	E6005
6 Rect. Positive	E6006	E6006	E6006	E6006	E6006	E6006	E6006
7 Rect. Negative	E6007	E6007	E6007	E6007	E6007	E6007	E6007
8 Stator	E6008	E6008	E6008	E6009	E6014	E6008	E6014
9 Field Coil	E6010	E6010	E6010	E6011	E6015	E6010	E6011
10 Rect. Bottom Support	E6012	E6012	E6012	E6012	E6012	E6012	E6012
11 Grounding Strap	E6024	E6024	E6024				
Drive Coupling (not illustrated)						E6017	E6017
Adaptor (not illustrated)						E6018	E6018
Mounting Ears (not illustrated)						E6019	E6019
Seal (not illustrated)						E6020	E6020
Gasket (not illustrated)						E6021	E6021

*1 (a-p) Mech Serv Kit E4000 Contains the following items which may be ordered individually:

1a Locknut - Kit E4511
1b Washer - Kit E4512
1c Woodruff Key - Kit E4513
1e Seal - Kit E4501
1f Roller Bearing - Kit E4500
1g Split Bushing - Kit E4502
1h Ball Bearing - Kit E4504
1j Terminal Hardware - Kit E4503
1k Snap Ring, Internal - Kit E4505
1m Snap Ring, External - Kit E4506
1n "O" Ring - Kit E4508
1p Grease Cap - Kit E4507

Service Parts 6.5" Diam. Frame - Belt Drive Models
All Parts Illustrated Are Not Necessarily Used.

Sheet 1520.10 Page 2b
Effective: April 2, 1990
Supersedes: Jan. 31, 1986
Subject to change without notice.

Sheet 1520.10 Page 1
Effective: April 2, 1990
Supersedes: Jan 31, 1986
Subject to change without notice.

Typical Construction and Parts Identification

7.3" Diam. Frame - Belt Drive Models

The following models utilize the typical construction and parts identification indicated on the reverse side of this sheet:

E80

E80LC

E105

E105SC

E125

E125SC

E145

E145LC

E160

E80-24

E100-24

E125-24

E75-32

E100-32

E104-32

Use the exploded view on Sheet 1520.10 Page 1a to select the description number which identifies the required part. Refer to Sheet 1520.10 Page 1b to select the correct repair kit number which corresponds to the description number and the alternator model of your choice. Use the kit number selected and the alternator model number when ordering replacement parts.

Electrodyne Div. of GAUSS Corp.
One Gibson Road, P. O. Box 660, Scarborough, ME USA 04074
Tele: 207 883-4121 800 341-0242 Fax 207 883-4427

Sheet 1520.10 Page 1
Effective: April 2, 1990
Supersedes: Jan 31, 1986
Subject to change without notice.

Typical Construction and Parts Identification

7.3" Diam. Frame - Belt Drive Models

The following models utilize the typical construction and parts identification indicated on the reverse side of this sheet:

E80

E80LC

E105

E105SC

E125

E125SC

E145

E145LC

E160

E80-24

E100-24

E125-24

E75-32

E100-32

E104-32

Use the exploded view on Sheet 1520.10 Page 1a to select the description number which identifies the required part. Refer to Sheet 1520.10 Page 1b to select the correct repair kit number which corresponds to the description number and the alternator model of your choice. Use the kit number selected and the alternator model number when ordering replacement parts.

Electrodyne Div. of GAUSS Corp.
One Gibson Road, P. O. Box 660, Scarborough, ME USA 04074
Tele: 207 883-4121 800 341-0242 Fax 207 883-4427

Description	E80	E80LC	E105	E105SC	E125	E125SC	E145	E145LC	E160	E80-24	E100-24	E125-24	E75-32	E100-32	E104-32	E100-48
*1 (a-p) Mech Serv Kit	E4000	E4000	E4000	E4000	E4000	E4000	E4000	E4000	E4000	E4000	E4000	E4000	E4000	E4000	E4000	E4000
2 Cover	E4001	E4001	E4001	E4001	E4001	E4001	E4001	E4001	E4001	E4001	E4001	E4001	E4001	E4001	E4001	E4001
3 Housing & Spilt Bushing	E4002	E4002	E4002	E4002	E4002	E4002	E4002	E4002	E4002	E4002	E4002	E4002	E4002	E4002	E4002	E4002
4 Rotor & Shaft Assembly	E4003	E4003	E4003	E4003	E4004	E4004	E4004	E4039	E4039	E4003	E4004	E4039	E4003	E4004	E4039	E4039
5 Voltage Regulator	E4006	E4006	E4006	E4006	E4006	E4006	E4006	E4006	E4006	E4007	E4007	E4007	E4008	E4008	E4008	E4098
6 Stator	E4025	E4010	E4025	E4025	E4013	E4013	E4013	E4013	E4013	E4010	E4027	E4027	E4011	E4027	E4027	E4027
7 Rect. Positive	E4015	E4015	E4015	E4015						E4015			E4015			E4054
8 Rect. Negative	E4016	E4016	E4016	E4016						E4016			E4016			
9 Rect Positive					E4054	E4054	E4054	E4054	E4054		E4054	E4054		E4054	E4054	E4054
10 Rect. Negative					E4055	E4055	E4055	E4055	E4055		E4055	E4055		E4055	E4055	E4055
11 Rect. Bottom Support	E4018	E4018	E4018	E4018	E4018	E4018	E4018	E4018	E4018	E4018	E4018	E4018	E4018	E4018	E4018	E4018
12 Field Coil	E4019	E4019	E4019	E4019	E4019	E4019	E4019	E4019	E4019	E4020	E4056	E4056	E4021	E4021	E4021	E4021
13 Start Charger Serv. Kit				E4022		E4022										
14 Diode, Pos. (3 required)					E4035	E4035	E4035	E4035	E4035		E4035	E4035		E4035	E4035	E4035
15 Diode, Neg. (3 required)					E4036	E4036	E4036	E4036	E4036		E4036	E4036		E4036	E4036	E4036
16 Stator Spacer	E4514	E4514	E4514	E4514	E4515	E4515	E4515	E4515	E4515	E4514	E4515	E4515	E4514	E4515	E4515	E4515

*1 (a-p) Mech Serv Kit E4000 Contains the following items which may be ordered individually:

1a Locknut - Kit E4511
1b Washer - Kit E4512
1c Woodruff Key - Kit E4513
1e Seal - Kit E4501
1f Roller Bearing - Kit E4500
1g Split Bushing - Kit E4502
1h Ball Bearing - Kit E4504
1j Terminal Hardware - Kit E4503
1k Snap Ring, Internal - Kit E4505
1m Snap Ring, External - Kit E4506
1n "O" Ring - Kit E4508
1p Grease Cap - Kit E4507

Service Parts 7.3" Diam. Frame - Belt Drive Models
All Parts Illustrated Are Not Necessarily Used.

Sheet 1520.10 Page 1b
Effective: April 2, 1990
Supersedes: Jan. 31, 1986
Subject to change without notice.

Service Parts 7.3" Diameter Frame-
Belt Drive Model
All Parts Illustrated Are Not Necessarily Used.

Description	24 Volt CSA Alternator 102499-HZ24
1 * (a-p) Mechanical Service Kit	HZ4000
2 Cover	HZ4001
3 Housing & Split Bushing	HZ4002
4 Rotor & Shaft Assembly	HZ4004
5 Voltage Regulator	HZ4007
6 Stator	HZ4010
9 Positive Rectifier	HZ4054
10 Negative Rectifier	HZ4055
11 Rectifier Bottom Support	HZ4018
12 Field Coil	HZ4020
14 Positive Diodes (3 Required)	HZ4035
15 Negative Diodes (3 Required)	HZ4036
16 Stator Spacer	HZ4514

*1 (a-p) Mechanical service kits HZ4000 Contains The following Items Which May Be Sold Individually.

1a Locknut-Kit HZ4511
1b Washer- Kit HZ4512
1c Woodruff Key-Kit HZ4513
1e Seal- Kit HZ4501
1f Roller Bearing-Kit HZ4500
1g Split Bushing-Kit HZ4502
1h Ball Bearing-Kit HZ4504
1k Snap Ring, Internal-Kit HZ4505
1m Snap Ring, External-Kit HZ450
1n "o"Ring- Kit HZ4508
1p Grease Cap-Kit HZ4507