UNITED STATES MARINE CORPS
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FESCR 8107

STUDENT OUTLINE

REPAIR NIEHOFF 200 AMP DUAL-VOLTAGE ALTERNATOR ASSEMBLY

LEARNING OBJECTIVES:

1. Terminal Learning Objective: Provided with faulty alternators, required tools, test equipment, replacement parts, shop supplies, cleaning materials, and references, rebuild the alternators to a serviceable condition, per the references. (8.1.5)

2. Enabling Learning Objectives: Provided with a faulty Niehoff 200 amp dual-voltage alternator, required tools, test equipment, replacement parts, shop supplies, cleaning materials, and TM 2320-34/9, rebuild the alternator to a serviceable condition, per the reference.

OUTLINE:

1. NOMENCLATURE AND DESCRIPTION OF THE MAJOR COMPONENTS OF THE ALTERNATOR ASSEMBLY

a. Rotor Assembly- The rotor assembly consists of a shaft and core assembly and two rotors. The rotor positions can be adjusted to minimize output voltage ripple.

b. Front End Housing- The front housing contains the rectifier assembly consisting of the standard diodes that control the high output portion of the alternator and silicon controlled rectifier for the low-voltage system. The front housing contains the bearing for the front of the rotor shaft. The mounting lugs for the alternators are also on the front housing.

c. Voltage Regulator- The voltage regulator controls the field coil of the alternator and silicon rectifier gates for the low-voltage portion.

d. Shell/Stator/Field Coil- The stator and field coil shell assembly contains the coil and two sets of three-phase stator windings.

e. End Housing: The end housing contains the bearing for the fan end of the rotor. It also provides the rear mounting lugs for installing the alternator.

f. Fan: The fan provides a flow of cool air into the alternator.

2. PRINCIPLES OF OPERATION OF THE NIEHOFF DUAL-VOLTAGE ALTERNATOR

a. Alternator Operation

(1) The alternator is belt driven through a pulley connected to the front of the rotor assembly. The rotor assembly consists of a shaft with two, six-pole rotors and a core shaft mounted on it. The dual-voltage alternator design is basically a standard automotive alternator with a redesigned rectifier output stage and voltage regulator. The rectifier output stage is comprised of a standard rectifier diode set for the high-voltage portion of the dual-voltage system, and a silicon controlled rectifier (SCR) set for the low-voltage portion of the dual-voltage system. The stator windings are shared between the lower and the higher voltage system. Voltages of both the high and low-voltage systems are provided by the stator windings that are connected to both the conventional six-phase rectifier diode and also the silicon controlled rectifier assemblies. Current in the stator windings is controlled by the amount of current passing through the field coil which is limited by the high-voltage system while maintaining the low-voltage system at a constant value, the low-voltage setting. The silicon controlled rectifier assembly is switched to direct the current from one or both stator winding(s) as required by the low-voltage system. The voltage regulator has been designed to control the field coils of the alternator as well as the SCR gates.

(2) In summary, control of the field coil regulates both the voltages of the high-voltage system as well as the total power produced by the alternator. Control of the SCR gates regulates the voltage of the low-voltage portion of the alternator. This action ensures the field coil is on or off as required, so the alternator is producing electrical power at the proper supply voltage for both electrical systems. In case of defective battery(s), the charging system continues its operation without overcharging the non-defective battery(s).

3. DEMONSTRATION AND PRACTICAL APPLICATION ON THE REBUILD OF THE ALTERNATOR

a. Cleaning the Alternator before Disassembly: Cleaning the alternator in the class is not necessary. However, in the field, cleaning would be required before disassembling the alternator. Clean the exterior thoroughly, using clean rags dampened with cleaning solvent and then dry with compressed air at 15 psi. Compressed air for cleaning purposes will not exceed 30 psi. Use only with effective chip guarding and personal protective equipment, such as goggles/shield, gloves, etc. Make sure the electrical cover is installed on the front housing before cleaning.

b. Removal of the Voltage Regulator

(1) Remove the pulley and spacer.

(2) Disconnect the cannon plugs from the regulator.

(3) In order to remove the voltage regulator you must remove the three screws and spacer securing the regulator to the alternator. DO NOT LOSE THE SPACER.

c. Disassembly of the Alternator Assembly

(1) Removal of End Housing Assembly.

(a) Remove the locknut and washer securing the fan to the core and shaft assembly. Remove the fan from the end bell assembly.

(b) Remove the six screws and lockwashers securing the plate cover to the front housing assembly. Remove the plate cover from the front housing. Scribe alignment marks on the front housing, stator, and end housing.

(c) Remove the nine locknuts from the end housing and the studs of the stator shell. Using a puller, slowly remove the end housing from the stator shell.

(2) Removal of Rear Rotor.

(a) Mark the position of the rotor on the core shaft. Remove the six torque-screws from the rear rotor securing the rotor assembly to the core shaft. Using three 10-32X2 inch long machine screws as jacks in the threaded holes on the end plate of the rear rotor, gradually tighten the screws down evenly and remove the rear rotor from the core shaft assembly and remove the machine screws.

(3) Removal of Front Housing.

(a) Prior to removal, tag all the leads for installation. Remove the eight locknuts securing the field leads and phase leads to the front housing assembly. Gently lift off and remove the leads from the diodes on the front housing.

(b) Remove the eight locknuts securing the front housing to the stator shell and remove the studs of the stator shell. Remove the front housing from the stator shell by tapping it lightly with a soft-face mallet.

(c) Remove the shaft-retaining ring from the core shaft assembly. Using a press, remove the core shaft and shaft assembly from the front bearing and front housing.

(d) Remove the front and rear-retaining rings from the housing. Using a press, remove the front bearing from the front housing.

(4) Removal of Front Rotor

(a) Mark the position of the rotor on the core shaft. Remove the six torque-screws from the front rotor securing the rotor assembly to the core shaft. Using three 10-32X2 inch long machine screws as jacks in the threaded holes on the end plate of the front rotor, gradually tighten the screws down evenly and remove the front rotor from the core shaft assembly and remove the machine screws.

(b) Using a press, remove the front bearing from the core shaft assembly.

d. Static Testing of Alternator

(1) Perform Stator Test

(a) Remove the six nuts and phase leads from the diodes in the front housing.

(b) Set the multimeter to the ohms scale.

(c) Connect the multimeter leads between each successive phase lead, P1-P2, P2-P3, AND P3-P1. The multimeter should read less than one ohm. If the multimeter reads infinity (00), the stator is open; replace the alternator.

(d) Set the multimeter to the ohms scale.

(e) Connect the multimeter leads between each phase lead, P1, P2, and P3 and the ground terminal on the outside of the front housing. The multimeter should read infinity (00). If the multimeter reads zero, the stator is open; replace the alternator.

(2) Perform Field Coil Test

(a) Remove the two nuts and the field coil leads (F+, F-) from the diodes in the front housing.

(b) Set the multimeter to the ohms scale.

(c) Connect the multimeter leads to the two field leads and measure the resistance. The multimeter should read less that 3 ohms. If the multimeter reads more that 3 ohms, the field coil is open; replace the alternator.

(d) Set the multimeter to ohms scale.

(e) Connect one multimeter lead to a field lead and the other to the ground on the front housing. The multimeter should read infinity (00). If the multimeter reads less than 100k ohms, the field coil is grounded, replace the alternator.

(3) Perform Positive Diode Test

(a) Set the multimeter to the diode scale.

(b) Connect one multimeter lead to the B+ output stud and the other lead to the six diode terminals S. The multimeter should read either 600 ohms or infinity (00), for all six diode terminals. Reverse the multimeter leads. The readings should be similar for all six, but opposite of the first

six readings. If the readings are not opposite, the diode rectifier assembly is open. Replace the alternator.

(4) Perform Negative Diode Test

(a) Set the multimeter to the diode scale

(b) Connect one multimeter lead to the ground terminal and the other lead to the six diode terminals S. The multimeter should read either 600 ohms or infinity (00), for all six diode terminals. Reverse the multimeter leads. The readings should be similar for all six, but opposite of the first six readings. If the readings are not opposite, the diode rectifier assembly is open. Replace the alternator.

e. Cleaning of Components

(1) Clean all screws, bolts, washers, and retaining rings with cleaning solvent and rags. If deposits are hard to remove, use a cleaning brush, and dry the parts with compressed air.

(2) Clean the following parts with cleaning solvent and rags. Again, use a cleaning brush if deposits are hard to remove. Dry the components with compressed air at 15 psi. Remember to use protective gear.

(a) Pulley

(b) Brackets/cover

(c) Rotors

(d) Shaft and core assembly

(e) Inner bearing ring

(f) Fan assembly

(3) Clean the lower portion of the front housing assembly using cleaning solvent, rags, and a brush as required. At no time will you submerse the front housing assembly into the solvent tank. Dry it with compressed air at 15 psi.

(4) Clean the roller bearings by soaking them in cleaning solvent and brushing until all of the grease is removed. Allow them to air dry.

(5) Components cleaned in the following steps can be damaged by excessive exposure to cleaning solvent. To prevent damage to the electrical wires and parts, use extra care while cleaning.

(a) Using rags lightly dampened with cleaning solvent, clean the sealed bearing.

(b) Clean all silicone off the stator lead brackets of the front housing and coil terminals

(c) Using rags lightly dampened with cleaning solvent, clean the outer surface of the stator coil assembly tube. Use a dry brush to loosen hard to remove deposits. Dry it with compressed air at 15 psi.

(d) Using compressed air at 30 psi maximum, clean the interior of the stator and field coil assembly tube. Use a dry brush to loosen hard to remove deposits.

(e) Using a dry brush and rags lightly dampened with cleaning solvent, clean the voltage regulator. Dry it with compressed air at 15 psi.

(f) Place the components on a clean, dry surface after cleaning. Cover them with clean, dry towels if they will not be installed immediately.

f. Visual/Mechanical Inspection

(1) Inspect all bolt holes, screws, and nuts for worn or damaged threads. Replace defective parts

(2) Inspect the threads on the shaft and core assembly, the outer terminals, and the stator and coil assembly tube for wear and damage. Minor damage may be repaired by using the correct size thread chaser. The shaft and core assembly or front housing assembly must be replaced if either has threads that cannot be repaired. The damaged shaft and core assembly studs should be replaced.

(3) Inspect the thread holes in the front housing, stator assembly and field coil assembly tube for wear and damage. Minor damage can be repaired with the proper size tap.

(4) Inspect all assemblies for cracks. Pay extra attention to areas around the mounting lugs and all threaded holes.

(5) Inspect the front housing assembly bearing for cracks, corrosion, dented shield, or discoloration due to overheating. Check for signs of wear on the outer and inner rings. Support the bearing by placing it between two fingers and spinning it. The bearing should rotate smoothly without catching or roughness. Replace the bearing if any evidence of damage or wear is found.

(6) Inspect the inner bearing ring on the shaft and core assembly for discoloration due to overheating. Check for cracks, corrosion, scratches, and excessive wear. Replace the bearing ring and roller bearing as a set if any damage or wear is evident.

(7) Inspect the end housing roller bearing for discoloration due to overheating. Check the outer ring for scratches, cracks, and corrosion. Check for a broken or damaged roller retainer. Check the rollers for corrosion,

pitting, and scratches. If any damage or excessive wear is evident, replace the roller bearing and the inner bearing ring.

(8) Inspect the bearing bores in the end and front housing for damage and corrosion. Minor damage may be repaired. Replace the end housing or the front housing if there is any damage that cannot be repaired.

(9) Inspect the retaining ring grooves in the front housing assembly for wear. Replace the front housing if wear is excessive.

(10) Inspect the retaining rings for wear. Replace them if either is worn.

(11) Inspect the fan assembly for bent or broken blades. Minor bends may be straightened. The fan assembly must be replaced if the blades cannot be straightened or if it is broken

(12) Inspect the mating surfaces of the front housing, the stator tube and field coil assembly tube, and the end housing for high spots or deformation. High spots may be repaired. Any other damage requires replacement of the damaged assemblies

(13) Inspect the rotors and the core portion of the shaft and core assembly for nicks, scratches, and high spots. High spots and minor scratches may be repaired. Replace any of the three components if they are damaged badly.

(14) Inspect the inner surfaces of the rotors and their mating surfaces on the shaft and core assembly. Clean off any corrosion.

(15) If the inner bearing ring was removed, check the bearing seating area of the shaft and core assembly for corrosion and scratches. Minor damage may be repaired. Replace the shaft and core assembly if it is badly scratched, corroded, or worn.

(16) Inspect the wires and windings in the stator and field coil tube assembly for cracks and damage to the insulation. Check for evidence of arcing and shorting. Replace the assembly if any damage is found.

g. Reassemble the Alternator

(1) Reassemble the Core Shaft Assembly

(a) Using a press, install the rear bearing on the core shaft assembly.

(b) Install the front rotor on the core shaft assembly. Apply silicone compound to the studs of the core shaft assembly.

(c) Install the core assembly on the front rotor with six torque screws and tighten to 45-inch lbs.

(d) Coat the outer race of the front bearing with a thin coat of silicone compound.

(e) Using a press, install the front bearing in the front housing.

(f) Install the front retaining ring and rear retaining ring in the front housing.

(g) Using a press, install the front bearing with the housing on the core shaft assembly.

(h) Install the shaft-retaining ring on the core shaft assembly.

(2) Install Front Housing Assembly

(a) Insert the core and shaft assembly and front housing into the stator shell.

(b) Feed the leads from the stator shell through the front housing.

(c) Apply silicone compound to the studs on the stator shell.

(d) Install the front housing on the stator shell with eight locknuts and tighten the locknuts to 18-inch lbs.

(e) Install the six phase leads and two field coil leads on the diodes on the front housing with eight nuts.

(f) Apply a thin coat of RTV sealant on the leads and diodes on the front housing.

(3) Install Rear Rotor assembly

(a) Install the rear rotor assembly on the core shaft assembly.

(b) Apply silicone compound to the studs on the core and shaft assembly.

(c) Install the core and shaft assembly on the rear rotor with six locknuts and tighten the locknuts to 45-inch lbs.

(4) Install End Housing

(a) Install the end housing on the core shaft assembly and rear bearing. Tap it lightly with a soft-faced mallet if required.

(b) Apply silicone compound to the studs on the stator shell.

(c) Install the end housing on the stator shell with nine locknuts and tighten the locknuts to 18-inch lbs.

(5) Install Cover Plate. Install the cover plate on the front housing with six lockwashers and screws.

(6) Install Fan Assembly

(a) Install the bearing bushing on the core shaft assembly.

(b) Install the fan on the core and shaft assembly with a washer and locknut. Do not tighten the locknut.

(c) Install the core and shaft assemblies in a soft-jawed vice and tighten the locknut to 50-inch lbs.

REFERENCES:

TM 2320-34/9 - Technical Manual Direct Support and General Support Maintenance for 11/4 ton, 4x4, Series Vehicles
Brushless Alternator - C.E. Niehoff Brushless Alternators