M.I. 9109
*Rev. B

ELECTRO-MOTIVE DIVISION • GENERAL MOTORS CORPORATION
SERVICE DEPARTMENT

MAINTENANCE INSTRUCTION

BATTERY CHARGING RECTIFIER

DESCRIPTION

The battery charging rectifier is used in the locomotive battery charging circuit to permit battery charging current to flow from the auxiliary generator to the battery, but prevents current flow from the battery to the auxiliary generator, alternator field, fuel pump motor, and electrical cab heater.

The battery charging rectifier assembly consists of a matched set of silicon diodes and a selenium suppression rectifier mounted on heat sinks. The assembly is mounted in the electrical cabinet where the circulation of air across the heat sinks helps to keep the assembly at a safe operating temperature.

The suppression rectifier protects the diodes from reverse transient voltage spikes by permitting passage of current in the reverse direction before the potential becomes high enough to cause damaging breakdown current to pass through the silicon diodes.

CAUTION: Although the suppression rectifier protects the diodes from voltage spikes, a ground fault during locomotive high potential tests can set up a condition whereby the high potential is imposed across the battery charging rectifier, causing the diodes or the protective suppression rectifier to fail. It is therefore recommended that before a high potential test is made on the locomotive, the battery switch be opened, and the positive and negative terminals of the battery charging rectifier be jumpered together. After high potential tests are completed, remove the jumper prior to closing the main battery switch.

MAINTENANCE

Battery charging rectifiers require no routine maintenance other than visual inspection. They should not be disassembled for inspection, and the nuts that fasten the diodes to the heat sinks should not be disturbed. These nuts must be uniformly tightened to the proper torque value to ensure proper heat transfer.

INSPECTION AND TESTS

If the auxiliary generator and the alternator field fuses are blown upon engine shutdown, or if an extremely high rate of battery discharge is indicated by the battery charging ammeter at engine shutdown, failure of the battery charging rectifier should be suspected. The entire battery charging circuit and the battery charging rectifier should be inspected for defects.

BATTERY CHARGING RECTIFIER

With a lantern battery and test lamp, or with an ohmmeter, test for blocking. A good rectifier will conduct only in the forward (black to red) direction.

SUPPRESSION RECTIFIER

Visually inspect for blistered paint and points of metal. These are general symptoms of a shorted suppression rectifier. To determine whether the rectifier is in working order, connect a six volt lantern battery in series with the rectifier and a test lamp. The lamp should light when the battery is connected in the forward direction and remain off when the polarity is reversed.

If an ohmmeter is used to check the suppression rectifier, the rectifier should first be "formed" by application of at least two volts in both the forward and reverse direction for a few minutes before the resistance is checked.

DIODES

If the battery charging rectifier is faulty, the diodes must be disconnected and tested individually for blocking characteristics. Faulty diodes must be removed and replaced by a

*This bulletin is revised and supersedes previous issues of this number.

matching diode. The diode matching number appears on the circular portion of the diode body. If diodes are not matched, one of the parallel doides will carry greater current than the other(s) and will fail rapidly.

If for some reason mismatching of diodes is suspected and the matching number is not legible, the diodes can be checked on the locomotive by passing high current through the diodes (as when charging low batteries). After approximately 15 minutes one of the diodes will feel much hotter than the other(s). Matched diodes will not differ in temperature by more than 25° F.

REMOVAL AND REPLACEMENT OF DIODES FOR RECTIFIER ASSEMBLY 8333841, Fig. 1

1. Disconnect the diode lead from the terminal plate by removing nut from the retaining bolt, Fig. 1.

2. Insert special diode socket wrench, Fig. 2, through the access holes, Fig. 1, and seat it firmly on the hex portion of the diode.

3. Use a box end wrench to hold diode mounting nut while removing diode.

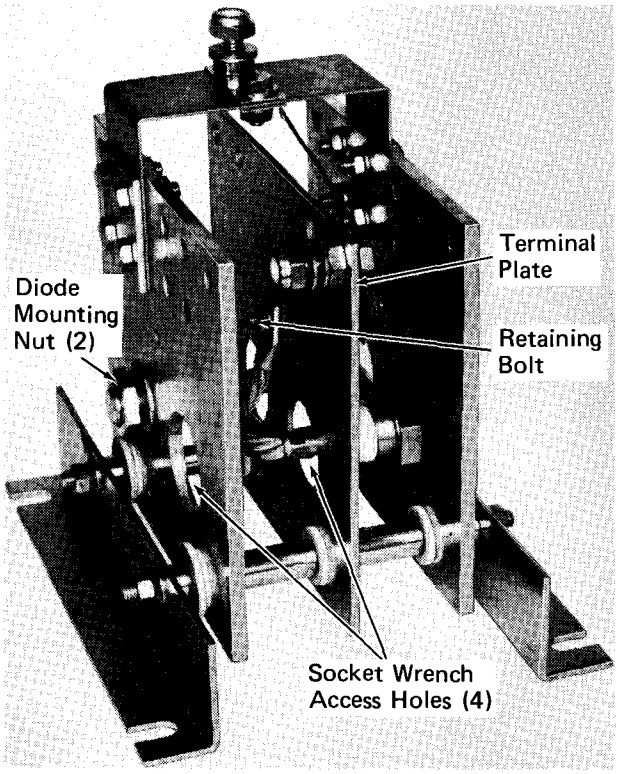

Fig. 1 – Battery Charging Rectifier Assembly 8333841

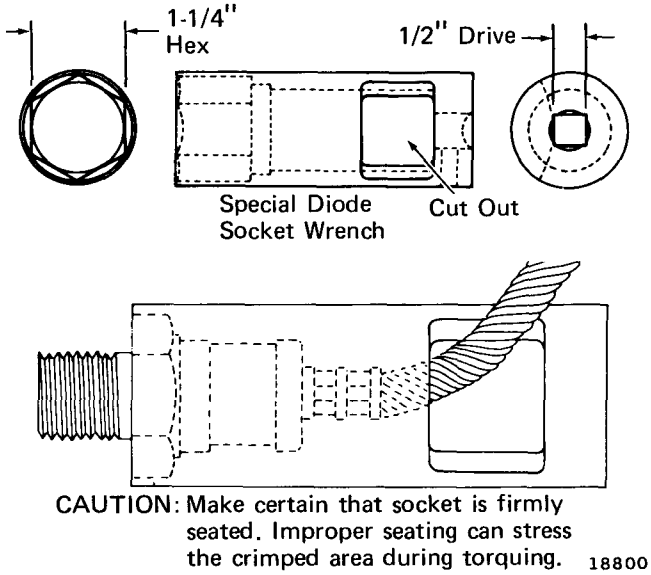

Fig. 2 – Special Diode Socket Wrench 8361524

4. Remove diode from heat sink.

5. Remove all contaminants from heat sink in at least a 1-1/2" diameter circle around the diode mounting hole.

6. Select matching diode(s). Refer to Maintenance Data for type and part number.

7. Apply a thin coat of joint compound under hex portion of the diode, Fig. 3.

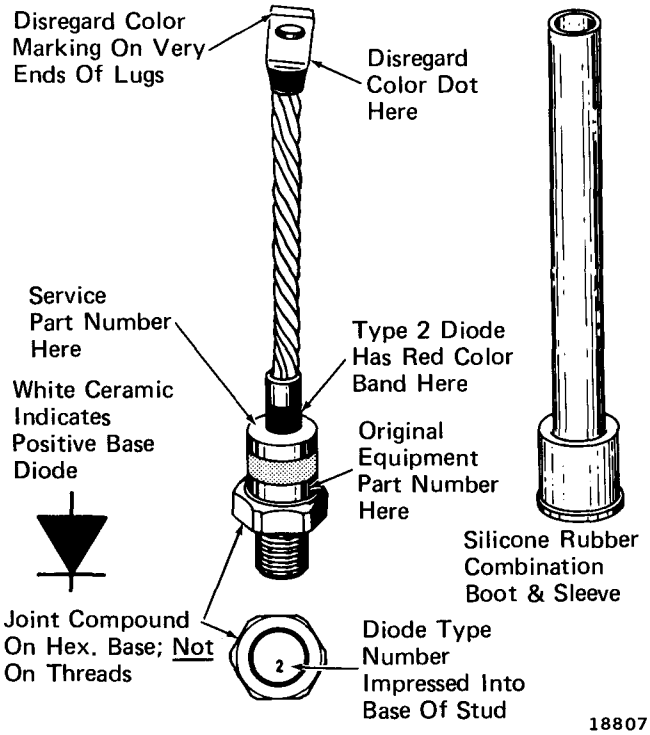

Fig. 3 – Positive Base TYPE 2 Silicon Diode With Identification Markings

CAUTION: Do not apply joint compound to stud portion of the diode. The specified torque value is for dry threads.

8. Install diode and seat socket wrench firmly on the hex portion of the diode, and apply torque to hex portion of the diode as specified in Maintenance Data.

9. Connect diode lead to terminal plate.

REMOVAL AND REPLACEMENT OF DIODES FOR RECTIFIER ASSEMBLIES 8319071 AND 8319696, Fig. 4

The major difference between these rectifiers is the position of the mounting brackets.

1. Remove "Glastic" side panel from negative side of rectifier as follows: Refer to Fig. 4.

a. Remove two 7/16" nuts.

b. Remove eight retaining screws.

c. Remove nut from suppression rectifier mounting stud.

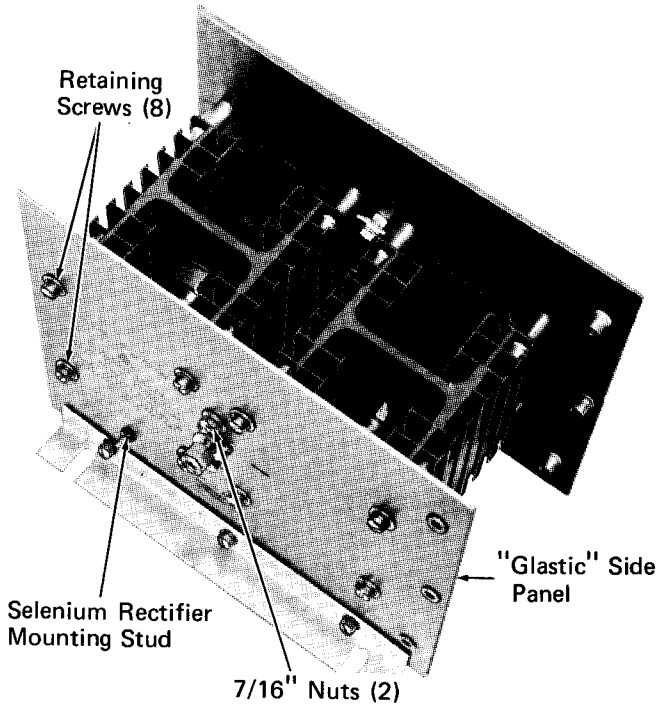

Fig. 4 – Battery Charging Rectifier Assembly 8319071

d. Carefully separate "Glastic" side panel from heat sink.

2. Remove diode leads from negative bus bar.

3. Insert special diode socket wrench, Fig. 2, and seat it firmly on the hex portion of the diode.

4. Use a box end wrench to hold diode mounting nut while removing diode.

CAUTION: Be careful not to damage heat sinks.

5. Remove diode from heat sink.

6. Remove contaminants from heat sink in at least a 1-1/2" diameter circle around the diode mounting hole.

7. Select matching diode(s). Refer to Maintenance Data for type and part number.

8. Apply a thin coat of joint compound under hex portion of the diode, Fig. 3.

CAUTION: Do not apply joint compound to stud portion of the diode. The specified torque value is for dry threads.

9. Install diode and seat socket wrench firmly on the hex portion of the diode, and apply torque to hex portion of the diode as specified in Maintenance Data.

10. Reassemble in reverse order of disassembly. Be sure that negative lead of suppression rectifier is connected to the negative bus bar.

REMOVAL AND REPLACEMENT OF DIODES FOR RECTIFIER ASSEMBLIES 8321535 AND 8333596

The major difference between these rectifiers is the position of the mounting brackets. Procedures for removal and replacement of diodes for these rectifiers are essentially the same procedures for removal and replacement of diodes for rectifiers 8319071 and 8319696. The major difference being that rectifiers 8321535 and 8333596 contain 4 rather than 2 diodes, and the side panels are attached to the heat sinks with 16 rather than 8 retaining screws.

REMOVAL AND REPLACEMENT OF DIODES FOR RECTIFIER ASSEMBLIES 8416094 AND 8416095, Fig. 5

The major difference between these rectifiers is the position of the mounting brackets.

1. Disconnect diode leads from negative bus by removing the 5/16"-18 retaining nuts, lockwashers, and flat washers.

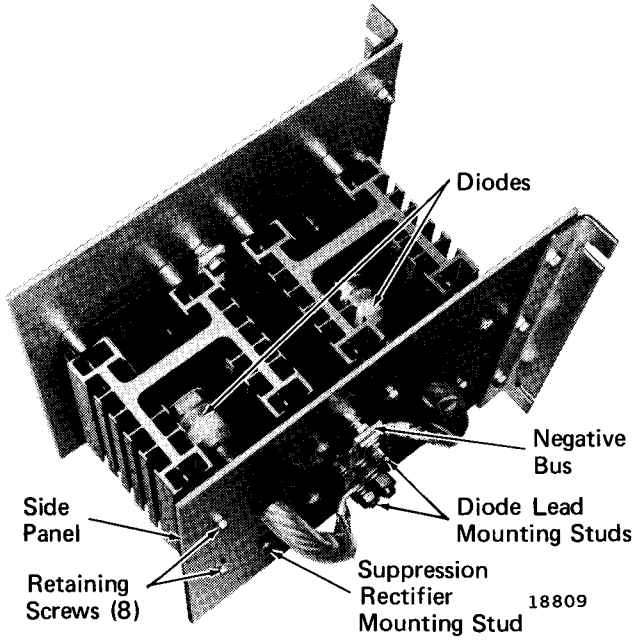

Fig. 5 - Battery Charging Rectifier Assembly 8416095

2. Disconnect lead from red terminal of suppression rectifier.

3. Remove side panel from negative side of rectifier by removing eight No. 10-16 retaining screws.

4. Insert special diode socket wrench, Fig. 2, and seat it firmly on the hex portion of the diode.

5. Use a box end wrench to hold diode mounting nut while removing diode.

CAUTION: Be careful not to damage heat sinks.

6. Remove diode from heat sink.

7. Remove all contaminants from heat sink in at least a 1-1/2" diameter circle around the diode mounting hole.

8. Select matching diode(s). Refer to Maintenance Data for type and part number.

9. Apply a thin coat of joint compound under hex portion of diode, Fig. 3.

CAUTION: Do not apply joint compound to stud portion of the diode. The specified torque value is for dry threads.

10. Install diode and seat socket wrench firmly on the hex portion of the diode, and apply torque to hex portion of the diode as specified in Maintenance Data.

11. Reassemble in reverse order of disassembly. Be sure to reconnect lead to red terminal of suppression rectifier.

REMOVAL AND REPLACEMENT OF DIODES FOR RECTIFIER ASSEMBLIES 8416096 AND 8416192, Fig. 5

The major difference between these rectifiers is the position of the mounting brackets. Procedures for removal and replacement of diodes for these rectifiers are essentially the same as procedures for removal and replacement of diodes for rectifiers 8416094 and 8416095. The major difference being that rectifiers 8416096 and 8416192 contain 4 rather than 2 diodes, and the side panels are attached to the heat sinks with 16 rather than 8 mounting screws.

BENCH TESTING

HIGH-POTENTIAL TEST

Jumper red and black terminals of rectifier assembly during test. Hi-pot the assembly for one minute at 600 volts RMS between terminals and mounting bracket.

BENCH TESTING OF DIODES

Bench testing of diodes must be performed with extreme care. In any test circuit it is of utmost importance to make sure that no transient voltages are introduced by switching on or switching off. The use of test transformers in which the voltage is gradually increased from zero to the full value and back without switching is strongly recommended.

RECOMMENDED TEST EQUIPMENT

The following equipment is recommended for testing diodes. The meters should be of 2% accuracy. Each piece of equipment is identified

by a reference designation number in the test circuits, Figs. 6 and 7 as follows:

1. VI – Average reading DC voltmeter, moving coil type, 0-1 volt.

2. V2 – RMS reading voltmeter, iron vane type, 0-750 volts.

3. I1 – Average reading DC ammeter, moving coil type, range to suit diode.

4. I2 – Average reading DC milliammeter, moving coil type.

5. CR1 – Equivalent to test diode of 500 PRV and 40 MA leakage.

6. CR2 – 1000 PRV and 0.025 MA leakage, or 2000 PRV and 0.025 leakage.

ELECTRICAL REQUIREMENTS FOR EMD RECTIFIER ASSEMBLIES 8416094 AND 8416095

1. Forward voltage drop across assembly must not exceed 1.50 volts DC at 80° C. with 160 amperes forward current.

2. Individual diode current shall not exceed 88 amperes with 160 amperes total current into the rectifier assembly at 25° C.

3. With suppression rectifier disconnected and 400 volts reverse voltage applied, the maximum leakage current of the assembly shall not exceed 24 milliamperes.

ELECTRICAL REQUIREMENTS FOR EMD RECTIFIER ASSEMBLIES 8416096 AND 8416192

1. Forward voltage drop across rectifier assembly must not exceed 1.50 volts DC at 80° C., with 250 amperes forward current.

2. Individual diode current shall not exceed 68.75 amperes with 250 amperes total current into the rectifier assembly at 25° C.

3. With supression rectifier disconnected and 400 volts reverse voltage applied, the maximum leakage current of the assembly shall not exceed 48 milliamperes.

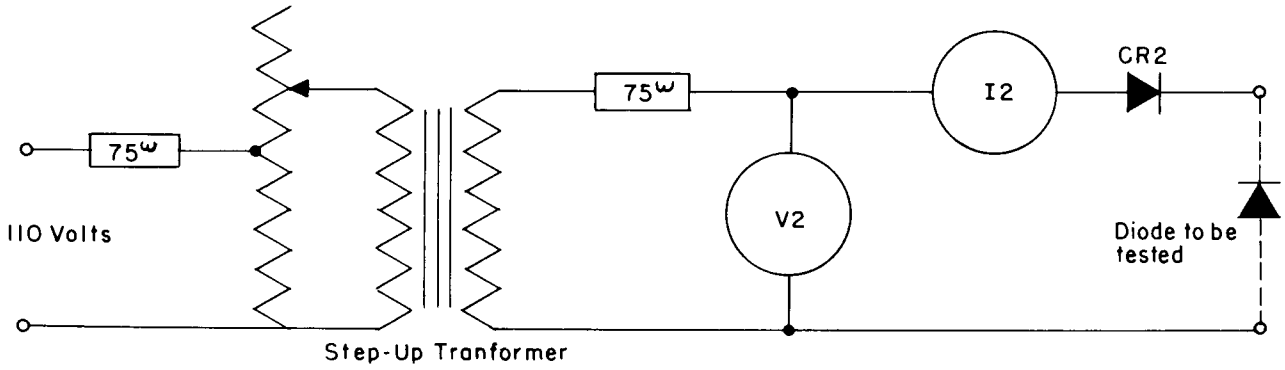

Fig. 6 – Reverse Leakage Test

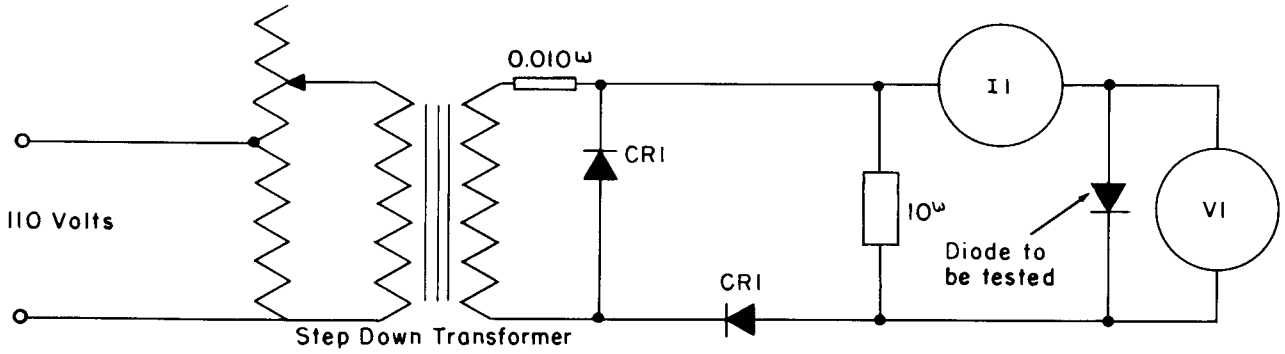

Fig. 7 – Forward Voltage Drop Test

REVERSE LEAKAGE TEST AT RATED PEAK REVERSE VOLTAGE

1. Connect the diode to be tested in a circuit as shown in Fig. 6.

2. The test should be made at room temperature with a maximum base temperature of 150° C.

3. Apply 280 volts RMS. The voltage may be regulated by observing the voltmeter (V2) reading.

CAUTION: While under test, the circuit must not be interrupted or the diode being tested may be damaged by induced transients. The circuit voltage should be regulated from zero to the specified voltage and returned to zero before any part of the circuit is disconnected.

4. If the diode conducts more than the maximum allowable reverse current of 10 milliamperes, the diode is defective and should be discarded.

FORWARD VOLTAGE DROP TEST

1. Connect the diode to be tested in a circuit as shown in Fig. 7. The forward voltage drop metering leads must be attached separately and directly to the diode under test.

2. Adjust the input voltage until the current through the diode is 70 amperes.

CAUTION: This test must be limited to 10 seconds duration if the diode is removed from the heat sink.

3. The forward voltage drop is measured as a full cycle average, read on a DC voltmeter in a half sine wave constant circuit at room temperature. The maximum voltage drop shall be 0.52 volts DC. If the voltage drop exceeds that value, the diode is defective.

SERVICE DATA

Electrical Characteristics	8319071 8319696	8321535 8333596	8333841	8416094 8416095	8416096 8416192
Max. Peak Inverse Voltage	400 volts	400 volts	400 volts	400 volts	400 volts
Max. Continuous DC Amperes	150 amps.	250 amps.	150 amps.	150 amps	250 amps.
Type Load	Resistive Inductive	Resistive Inductive	Resistive Inductive	Resistive Inductive	Resistive Inductive
Max. Ambient Operating Temp.	80° C.	80° C.	80° C.	80° C.	80° C.
Cooling	Convection	Convection	Convection	Convection	Convection
Suppression Rectifier	8325166	8325166	8333859	8413523	8413523
RMS Operating Voltage	104 max.	104 max.	120 max.	108 max.	108 max.
Clamping Volts (at 3 amp. peak current 25° C.)	320 max.	320 max.	300 max.	325 max.	325 max.

SERVICE DATA (CONT'D)

GENERAL INFORMATION

8319071 and 8319696 are identical except for mounting brackets.

8321535 and 8333596 are identical except for mounting brackets.

8416094 and 8416095 are identical except for mounting brackets.

8416096 and 8416192 are identical except for mounting brackets.

NOTE: All diodes in a rectifier assembly must be matched according to type or part number. Diodes are interchangeable between rectifier assemblies as long as all diodes in a specific assembly are the same type or part number. The manufacturer's type or part number, with corresponding EMD part number, is given below.

Manufacturer's Part or Type Number	EMD Part Number
66-6228	8319901
66-6227	8319902
66-6225	8319903
770-H	8333860
Type 2	8413522

Diode mounting torque (applied to diode hex portion, not to retaining nut) should be 35 ft-lbs when nut and spring washer assembly 8378103 is used.

Joint Compound 8346481

Torque Wrench 0-50 ft-lbs, 1/2" drive 8375396
Special Diode Socket Wrench 8361524

Litho in U.S.A.