ELECTRO-MOTIVE DIVISION • GENERAL MOTORS CORPORATION
SERVICE DEPARTMENT

MAINTENANCE INSTRUCTION

BATTERY CHARGING RECTIFIER

DESCRIPTION

A battery charging rectifier of the type shown in Fig. 1 is employed in the locomotive battery charging circuit as a blocking rectifier to prevent reverse flow of DC current from the storage battery to the auxiliary generator, alternator field, fuel pump motor, or electric cab heater.

The battery charging rectifier consists of a matched set of silicon diodes mounted on copper or extruded aluminum heat sinks. The heat sinks on current models of the rectifiers are mounted on "Glastic" end boards to provide electrical insulation, yet allow maximum circulation of air.

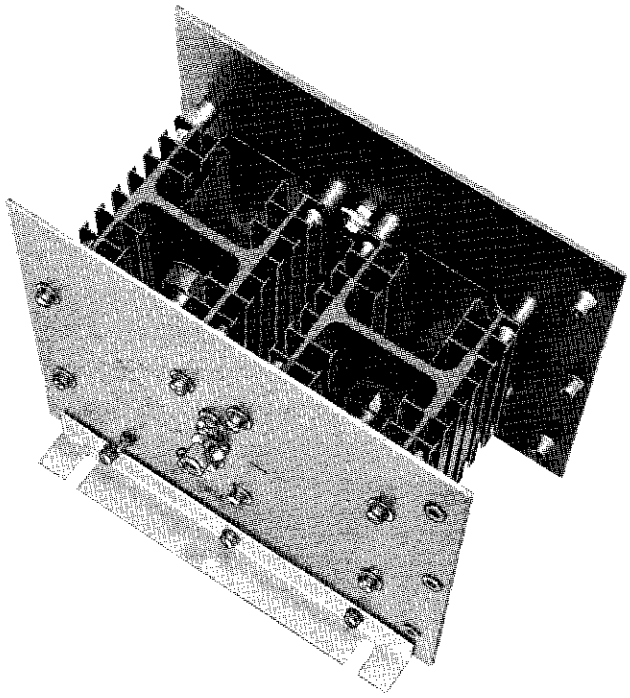

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Fig. 1 — Battery Charging Rectifier

The battery charging rectifiers employ a selenium suppression rectifier, Fig. 2, to protect the silicon diodes from voltage transient spikes in the reverse direction. The selenium rectifier permits, without damage to the rectifier, passage of current in the reverse direction before the potential at the positive (red) side of the battery charging rectifier assembly becomes high enough to cause damaging breakdown current to pass through the silicon diodes.

CAUTION: Although the selenium rectifier protects the silicon 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 it or its protective selenium rectifier to fail. It is

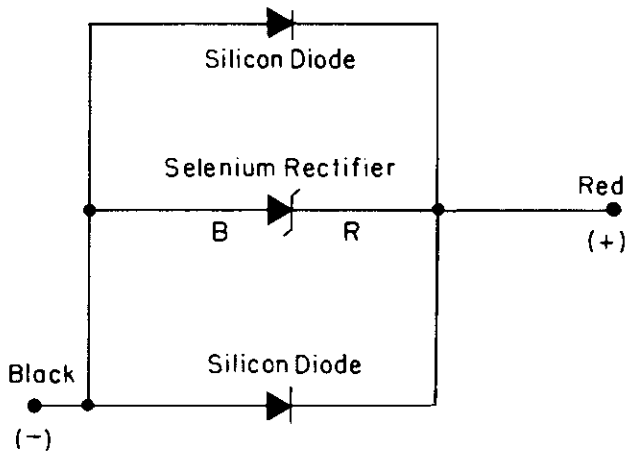

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Fig. 2 — Selenium Suppression Rectifier Circuit

*NOTE: Information contained herein is applicable to equipment being produced as of the date of publication.

therefore recommended that before a high potential test is made on the locomotive, the battery switch should be opened and the red and black terminals of the battery charging rectifier jumpered together. After high potential tests are complete, remove the jumper prior to closing the main battery switch.

MAINTENANCE

Battery charging rectifiers require no routine maintenance other than visual inspection. Rectifier assemblies 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 insure 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 ASSEMBLY

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

SELENIUM SUPPRESSION RECTIFIER

Visually inspect the suppression rectifier for blistered paint and points of metal. These are general symptoms of a shorted selenium rectifier. To determine whether the rectifier is in working order, connect a 6-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 selenium rectifier, the rectifier should first be "formed" by application of at least 2 volts in both the forward and reverse direction for a few minutes before the resistance of the rectifier is checked.

SILICON DIODES

If the battery charging rectifier assembly is faulty, the silicon diodes must be disconnected and tested individually for blocking characteristics. Faulty diodes must be removed and replaced by a matching diode. The diode matching number appears on the circular portion of the diode body. If diodes are not matched, one of the parallel diodes 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

Removal And Replacement Of Diodes Mounted on Flat Copper Heat Sink, Fig. 3

1. Disconnect the diode leads and the black suppression rectifier lead from the terminal plate by removing the 3/8" - 16 × 1-1/8" hex head bolt and locknut.

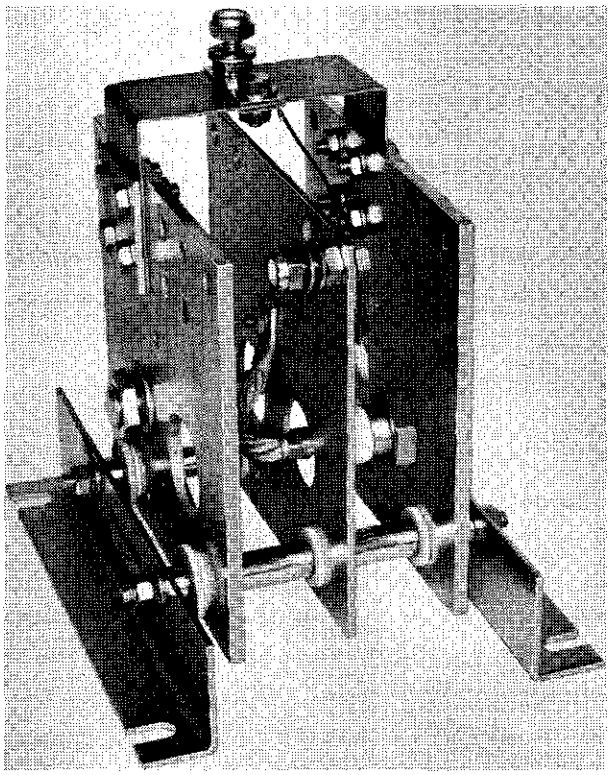

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Fig. 3 — Flat Copper Heat Sink Rectifier

2. Place a 1-1/4" open end wrench over the lead side of the diode as shown in Fig. 4. This is to keep the diode from rotating when its mounting nut is removed.

3. Remove the locknut from the opposite end of the diode by using a 1-1/16" box wrench as shown in Fig. 4.

4. Remove the nut behind the locknut by using a 1-1/8" box wrench while the open end wrench keeps the diode from rotating.

5. Remove all paint and other contaminate from heat sink plate in at least a 1-1/2" diameter circle around the diode mounting hole.

6. Apply a thin film of silicone grease under the hex portion of the diodes. Do not apply grease to the stud portion. See Maintenance Data for part number of silicone grease.

7. Install a matched pair of diodes (see Maintenance Data for part numbers of matched diodes) and torque both diodes evenly to 225 in.-lbs.

8. Assemble flexible diode leads and black lead from suppression rectifier to terminal plate with 3/8" - 16 × 1-1/8" hex head bolt and locknut.

Removal And Replacement Of Diodes Mounted On Fluted Heat Sinks, Fig. 4

Remove and replace defective diodes in accordance with the following procedure:

1. Remove the "Glastic" end board on the negative side of the rectifier assembly by removing the eight screws and the two 7/16" nuts located adjacent to the negative terminal.

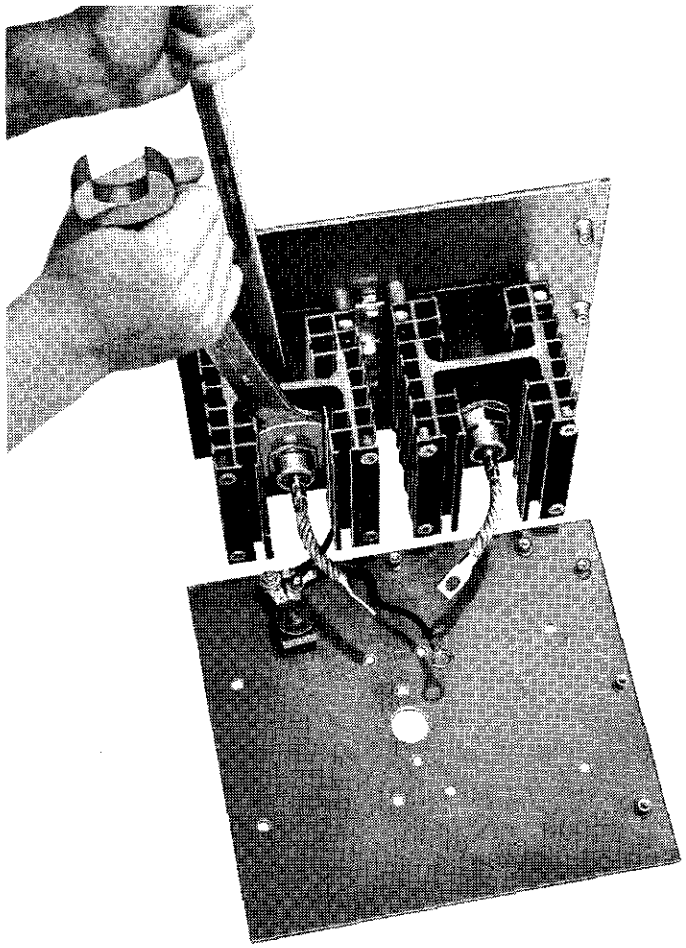

Fig. 4 — Removal Of Diodes From Rectifier Assembly

2. Carefully remove the "Glastic" end board from the heat sink.

3. Disconnect the diode leads from the terminal plate by removing the 7/16" bolt holding the diode leads together.

4. Place a 1-1/4" open end wrench over the lead side of the diode as shown in Fig. 4. This is to keep the diode from rotating when its mounting nut is removed.

5. Remove the "Pal" locknut from the opposite end of the diode by using a 1-1/16" box wrench as shown in Fig. 4.

6. Remove the nut behind the "Pal" locknut by using a 1-1/8" box wrench while the open end wrench keeps the diode from rotating.

NOTE: Care must be taken when removing diodes to prevent damage to the diode heat sink assembly.

When mounting a diode in the fluted heat sink, take care to remove all contaminate from the area of the diode mounting. Silicone grease should be applied sparingly to the hex portion of the diode to improve heat transfer and prevent oxidation of the mating surfaces. Do not apply grease to the stud portion of the diode. See Maintenance Data for part numbers of matched diodes and silicone grease.

The diode reassembly is done in reverse order of the diode removal procedure, taking care to tighten the diodes uniformly onto the heat sink at 190-250 in.-lbs. If the diodes are not tightened uniformly, heat transfer will be unequal; the hotter diode will carry more current than the other(s) and will fail prematurely. The same is true of diodes that are not matched. Always match the numbers appearing on the circular portion of the diodes.

BENCH TESTING OF RECTIFIERS

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. Hence, it is strongly recommended to use test transformers in which the voltage is gradually increased from zero to the full value and back without switching.

RECOMMENDED TEST EQUIPMENT

The following test equipment is recommended in the testing of diodes. The meters should be of 2% accuracy. Each piece of equipment is identified by a reference designation number that is used to identify the equipment in the test circuits, Figs. 5 and 6.

1. V1 - 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.

REVERSE LEAKAGE TEST AT RATED PEAK REVERSE VOLTAGE

1. Connect the diode to be tested in a circuit as shown in Fig. 5.
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. 6. 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.

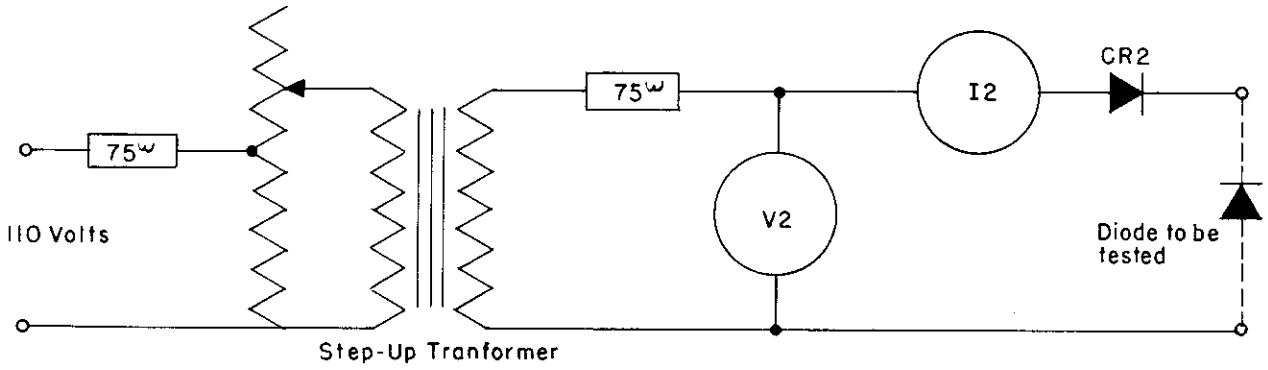

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Fig. 5 — Reverse Leakage Test

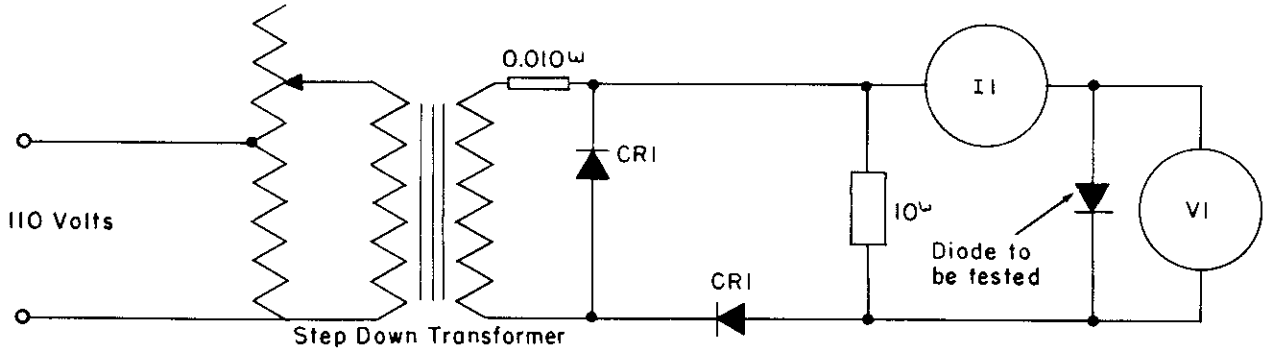

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Fig. 6 — Forward Voltage Drop Test

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SERVICE DEPARTMENT

MAINTENANCE DATA

Electrical Characteristics	8319071	8319696	8321535	8333596	8333841
Max. Peak Inverse Voltage	400 volts	400 volts	400 volts	400 volts	400 volts
Max. Continuous DC Current (Amps.)	150	150	250	250	150
Type Load	Resistive Inductive	Resistive Inductive	Resistive Inductive	Resistive Inductive	Resistive Inductive
Max. Ambient Operating Temperature	80° C.	80° C.	80° C.	80° C.	80° C.
Cooling	Convection	Convection	Convection	Convection	Convection
Selenium Suppression Rectifier	8325166	8325166	8325166	8325166	8333859
RMS Operating Volts	104 max.	104 max.	104 max.	104 max.	120 max.
Clamping Volts (at 3 amp. peak current 25° C.)	320 max.	320 max.	320 max.	320 max.	300 max.

General Information

Circuit: Single Phase Half Wave

Diode Matching Numbers

Matching Number On Diode	EMD Part Number
66-6228	8319901
66-6227	8319902
66-6225	8319903

Type	
1N4050 or 770-H	8333860

Silicone Grease: 8325649

Diode Mounting Torque: 190 in.-lbs Min.
250 in.-lbs Max.