

RECTIFIERS
KS-19210 L11 AND L12
—24 VOLTS, 400 AMPERES
OPERATING METHODS

1. GENERAL

1.01 These rectifiers provide regulated dc power for floating and charging storage batteries primarily in the 300-type power plants. These rectifiers are rated at negative (–) 24 volts, 400 amperes direct current; however, they will provide a maximum of 30.8 volts at full load for a 14-cell plant or 33.4 volts if the rectifier is operating in the manual mode to charge emergency cells. The input requirement is 3-phase, 3-wire, 60-Hz ± 2 percent ac. Taps are provided on the input transformer to match the *nominal* ac line voltage. The KS-19210 L11 rectifier operates within the absolute limits of 190 and 250 volts ac and the KS-19210 L12 rectifier operates within the absolute limits of 400 and 500 volts ac. Either rectifier will operate with a permissible change from the nominal input voltage of –10 percent to +5 percent.

WARNING: *Voltages inside the rectifier cabinet may exceed 250 volts for L11 or 500 volts for L12. Avoid all contact with terminals. Do not allow a test pick to touch two metal parts at the same time, as destructive or dangerous short circuits may occur.*

1.02 This section is reissued to make the following changes.

- (a) To revise the output filter capacitor charging procedure.
- (b) To add information on the high voltage monitor circuit and rectifier failure alarm circuit.
- (c) To reference a trouble-locating Bell System Practice.

This reissue does affect the Equipment Test List.

1.03 This issue of the section is based on drawing SD-81627-02, Issue 4. For a detailed description of the operation, see the corresponding circuit description. If this section is to be used with equipment or apparatus that is associated with an earlier or later issue of the schematic drawing, reference should be made to the SDs and CDs to determine the extent of the changes and the manner in which the section may be affected.

1.04 For more detailed information on operation and maintenance of individual equipment or apparatus, refer to the appropriate Bell System Practice.

1.05 With the rotary S1 switch (dc output selector) set in BAT, GR1, or GR1 and GR2 positions; the rectifier may be connected to charge 11, 12, or 13 cells for an 11-cell plant or 12, 13, or 14 cells for a 12-cell plant.

1.06 Routine checks should be made during a period when they will cause the least service reaction.

2. LIST OF TOOLS AND TEST APPARATUS

CODE OR SPEC. NO. TOOLS	DESCRIPTION
—	3-Inch C Screwdriver
—	Blocking and Insulating Tools (Use tools and apply as covered in Section 069-020-801.)
—	Resistor (10-ohm, 50-watt)
—	Fuse (6-ampere, 125-volt dc)
—	Switch (15-ampere, 125-volt dc)

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TOOLS

— ◆Resistor (1800-ohm, 2-watt)◆

TEST APPARATUS

* KS-8039 DC Volt-Milliammeter

* KS-14510 Volt-Ohm-Milliammeter

**Note:* ◆A digital type meter is a suitable substitute.◆

3. OPERATION

3.01 Preparing to Start: When preparing to put the rectifier in service, check the following (refer to Fig. 1).

- (a) The controls listed (see note) are positioned as follows:

OFF-NOR (S4) Switch to OFF

S1 Switch (DC Output Selector) to OFF

AUTO-MAN (S2) Key to AUTO

NOR-TST (S5) Key to TST

◆CC TST (ON-OFF) (S3)◆ Switch to OFF

CC TST (R36) Potentiometer to fully counterclockwise (ccw)

MAN ADJ (R17) Potentiometer to fully ccw

CONT (CB1) Circuit Breaker to OFF

Associated AC Switch and Fuse Unit in bus duct or power service cabinet to OFF

Caution: *The S3 ON-OFF switch should never be operated to the ON position except when necessary to make tests.*

Note: Do not disturb the setting of any other controls at this time.

- (b) The T1 input transformer taps have been selected to match the ac input voltage.
- (c) All associated fuses are installed in their respective fuse holders.



◆*Later model KS-19210 L11 and L12 rectifiers are not equipped with the VM1 OUTPUT voltmeter. When not equipped with the VM1 voltmeter, test jacks J11 and J12 are provided on the meter panel to measure the rectifier output voltage. Refer to Fig. 1.*◆

3.02 Charging Output Filter Capacitors: This procedure charges the output filter capacitors, preventing arcing when closing the S1 dc output selector switch to the BAT or EC position from the OFF position.

- (1) Verify that the rectifier has been removed from service in accordance with appropriate power plant Bell System Practice, and the rectifier controls are positioned as listed in 3.01.
- (2) ◆Remove the CAP ALM (F6), 1 1/3-ampere fuse, and then the CAP (F4), 30-ampere fuse. See Fig. 2.

Note: This isolates the output filter capacitor bank to permit operation of the S1 dc output selector switch.

- (3) Operate the S1 dc output selector switch to the BAT position.

Caution: *The output filter capacitors are not charged and must be charged prior to installing the CAP (F4) fuse in its fuse holder. The filter capacitors are charged by connecting a jumper across the F4 fuse holder as given in (4).*◆

Note: The jumper used in this procedure is a series connection of a resistor (10-ohm, 50-watt), a fuse (6-ampere, 125-volt), and an **on-off** switch (15-ampere, 125-volt). Suitable clip leads are utilized to connect the jumper in the rectifier circuit.

- (4) **Caution:** *To prevent shorting the jumper with other parts of the rectifier, always make the battery (–) (BAT or EC) connection last.*

Connect the jumper (jumper switch in **off** position) from the ◆common, negative (–) connection of capacitors C5-C15 to terminal 2 of the L8 inductor.◆

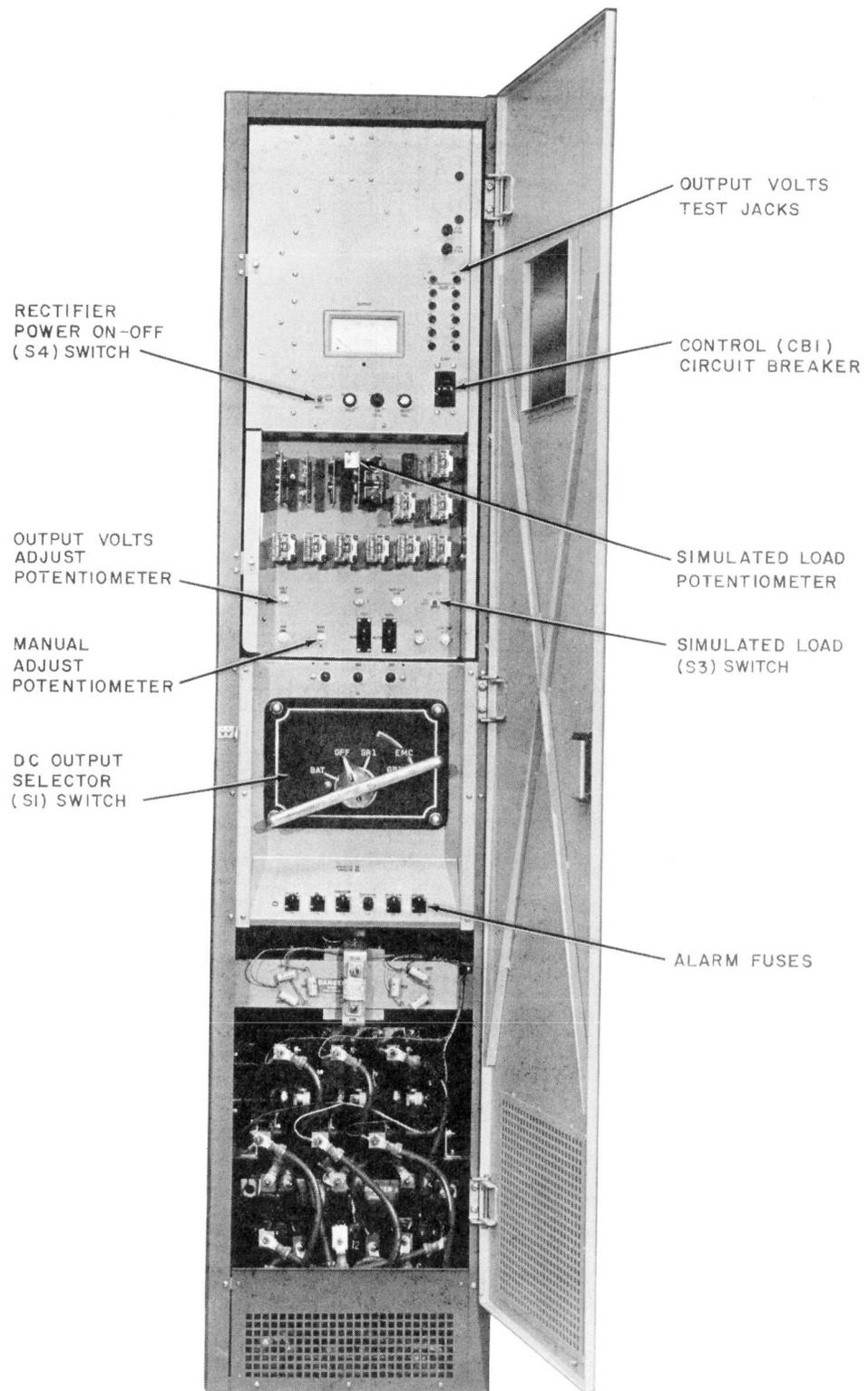


Fig. 1—KS-19210 L11 Rectifier—Late Model Without Output Voltmeter and Control Ammeter—Front View—Door Open

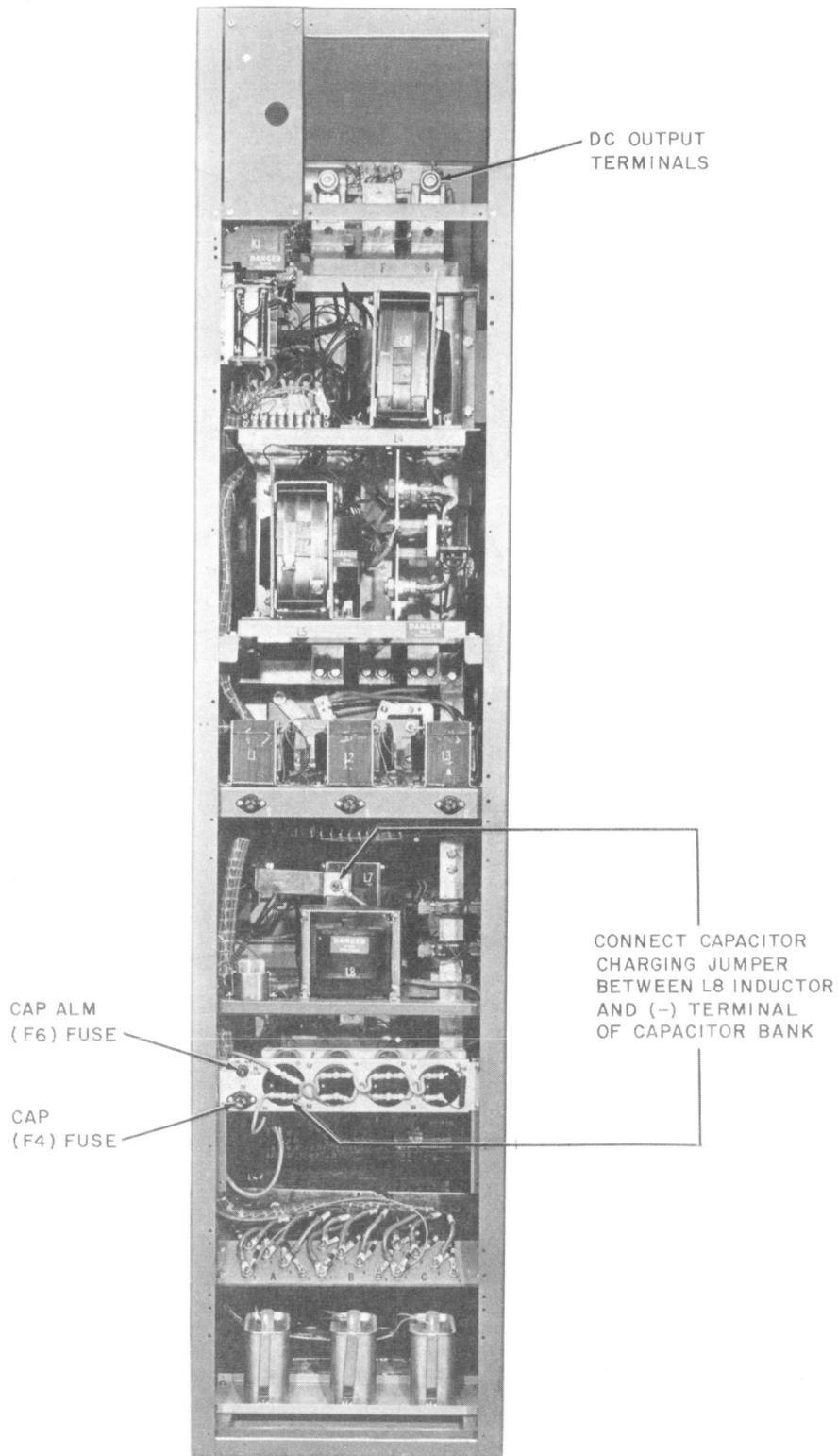


Fig. 2—KS-19210 L11 Rectifier—Rear View—Door Removed

- (5) Operate the jumper switch to the *on* position.
- (6) ♦ Wait approximately 1 minute and then install the CAP (F4) 30-ampere fuse in its fuse holder.♦
- (7) Operate the jumper switch to the *off* (open) position.
- (8) **Caution:** *To prevent shorting with other parts of the rectifier, disconnect both ends of the jumper at the same time.*

Disconnect the capacitor charging jumper from the rectifier.

- (9) ♦ Install the CAP ALM (F6) fuse in its fuse holder.♦

3.03 Starting: To start the rectifier, proceed as follows:

(a) **Automatic Operation:**

- (1) Verify that the rectifier controls are positioned as listed in 3.01.
- (2) Operate the associated AC switch and fuse unit in the bus duct of power service cabinet to the ON position.
- (3) Connect the KS-8039 volt-milliammeter ♦(or digital meter), set on the 30 VOLTS DC scale, across the terminals of the VM1 OUTPUT voltmeter (or the J11 and J12 test jacks).♦
- (4) Operate the CONT (CB1) circuit breaker to the ON position.
- (5) Operate the OFF-NOR (S4) switch to NOR position.

Requirement: ♦The rectifier should start.♦

Note: The nominal float voltage for the battery in a standard plant is usually 2.17 volts per cell. For additional information on the required float voltage, refer to Section 157-601-301.

- (6) Adjust as necessary, the VOLT ADJ (R26) potentiometer until the test meter indicates the float voltage ♦(typical 23.87 volts dc for

11 cells or 26.04 volts dc for 12 cells)♦ as specified in the appropriate power plant Bell System Practice.

Note: The rectifier output voltage, set when the rectifier is in the test mode, may increase as much as 1 volt when the rectifier is connected to the battery (BAT or EC position of S1 switch). If the voltage increase (due to the plant sense control circuit) is enough to cause high voltage shutdown of the rectifier during starting, the VOLT ADJ (R26) potentiometer should be adjusted slightly ccw just before starting. After the rectifier is started, the output voltage should be readjusted upward to the float value as specified in the appropriate power plant Bell System Practice.♦

- (7) Operate the OFF-NOR (S4) switch to the OFF position.
- (8) Operate the CONT (CB1) circuit breaker to the OFF position.
- (9) Charge the output filter capacitors and operate the S1 dc output selector switch to BAT or EC position in accordance with 3.02.
- (10) Operate the associated AC switch and fuse unit in the bus duct or power service cabinet to the ON position.
- (11) Operate the CONT (CB1) circuit breaker to the ON position.
- (12) Verify that the AUTO-MAN (S2) key is in the AUTO position.
- (13) Operate the NOR-TST (S5) key to the NOR position.
- (14) In accordance with the appropriate power plant Bell System Practice, operate the OFF-NOR (S4) switch to the NOR position.
- (15) Observe the associated power plant output voltmeter for the desired float voltage as specified in the power plant Bell System Practice.

Note: The associated power plant output voltmeter indicates the actual voltage that is available to the battery. The plant voltmeter

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and the rectifier VM1 OUTPUT voltmeter (or test meter connected at the J11 and J12 test jacks) may not indicate the same voltage, due to loop voltage drop of the charge leads.

(16) If the rectifier is not supplying the required output to the battery, follow the procedure in the associated power plant Bell System Practice and adjust the VOLT ADJ (R26) potentiometer until the rectifier is supplying the required output to the battery.

(17) Disconnect the test meter from the rectifier.

(b) **Manual Operation:** With the rectifier adjusted and operating as covered in (a), the rectifier is placed in manual operation as follows.

Caution: *An operator must be on duty continuously when the rectifier is operating in the manual mode. Manual operation is intended for trouble-locating procedures or to maintain the rectifier in service if trouble exists in the control circuit. During manual operation, the MAN ADJ (R17) potentiometer must be operated cw or ccw to maintain the required output voltage. The MAN ADJ (R17) potentiometer should be rotated fully ccw before operating the AUTO-MAN (S2) key from one position to another.*

- (1) Place the rectifier in manual operation in accordance with the procedure in the appropriate power plant Bell System Practice.
- (2) Operate the NOR-TST (S5) key to the TST position.
- (3) Operate the AUTO-MAN (S2) key to the MAN position.
- (4) Rotate the MAN ADJ (R17) potentiometer cw until the plant float voltage requirement is met.

3.04 Removing From Service: Remove the rectifier from service in accordance with the appropriate power plant Bell System Practice.

- (1) Operate the OFF-NOR (S4) switch to the OFF position.

Requirement: The rectifier should shut down.

- (2) If the rectifier is to remain out of service, operate the CONT (CB1) circuit breaker to the OFF position and operate the S1 dc output selector switch to the OFF position.

Caution: *If the rectifier is to remain out of service for an extended period of time, connect the electrolytic capacitors of the output filter to a source of direct current of suitable voltage and polarity in accordance with Section 032-110-701.*

3.05 Restoring To Service: Restore the rectifier to service in accordance with the appropriate power plant Bell System Practices.

4. ROUTINE CHECKS

4.01 The following routine checks should be made in accordance with the Equipment Test List, or after the rectifier has been out of service for an extended period of time and is to be returned to service, or if maintenance is performed which may affect the settings of the rectifier controls.

Note: In the following checks, the rectifier should start when the OFF-NOR (S4) switch is operated to the NOR position. When the S4 switch is operated to OFF, the rectifier should shut down.

4.02 Ventilating Passages: Keep the ventilating passages of the rectifier unobstructed to ensure adequate cooling during operation. The interior of the rectifier should be cleaned periodically while the rectifier is shut down. Remove dust from all accessible components inside the rectifier cabinet with a long handle, blade-type brush. Using a suitable vacuum cleaner, vacuum the floor area inside the rectifier cabinet to remove all dust and dirt. The period between cleaning should be determined by local conditions.

4.03 Contactor and Relays: As often as local experience demands, the contactor and relays should be inspected for adjustment and condition of contacts, making sure they are in accordance with the circuit requirement table and the appropriate Bell System Practice.

4.04 Output Selector Switch (S1): Clean, test, and adjust the S1 dc output selector switch in accordance with Section 169-704-701.

4.04.1 Output Voltage Adjustment

- (1) Remove the rectifier from service in accordance with the appropriate power plant Bell System Practice.
- (2) Operate the OFF-NOR (S4) switch to the OFF position.
- (3) Operate the S1 dc output selector switch to the OFF position.

Note: The AUTO-MAN (S2) key should be in the AUTO position and the MAN ADJ (R17) potentiometer should be fully ccw.

- (4) Connect the KS-8039 volt-milliammeter (or digital meter), set on 30 VOLTS DC scale, across the terminals of the VM1 OUTPUT voltmeter (or the J11 and J12 test jacks).
- (5) Operate the NOR-TST (S5) key to the TST position.
- (6) Operate the OFF-NOR (S4) switch to the NOR position.
- (7) Adjust as required the VOLT ADJ (R26) potentiometer until the test meter indicates the required float voltage. This voltage is equal to 2.17 volts per cell (23.87 volts dc for 11 cells or 26.04 volts dc for 12 cells) or the value specified in the appropriate power plant Bell System Practice.
- (8) If the rectifier is equipped with the VM1 OUTPUT voltmeter, adjust the zero adjust on the VM1 voltmeter as required until its indication agrees with the indication on the test meter.
- (9) Operate the simulated current CC TST (ON-OFF) (S3) switch to ON and if necessary hold operated.
- (10) Rotate the simulated current CC TST (R36) potentiometer cw until the AM1 ammeter indicates 400 amperes.

Requirement: The test meter should still indicate the voltage value set in (7). [A minor readjustment of the VOLT ADJ (R26) potentiometer is permissible.]

- (11) Release the CC TST S3 ON-OFF switch and rotate the CC TST (R36) potentiometer fully ccw.
- (12) Operate the OFF-NOR (S4) switch to the OFF position.
- (13) Disconnect the test meter from the rectifier.
- (14) To start the rectifier, perform 3.03(9) through (17).⚡

4.05 Maximum Current Limit Check

- (1) Remove the rectifier from service in accordance with the appropriate power plant Bell System Practice.
- (2) Operate the OFF-NOR (S4) switch to the OFF position.
- (3) Operate the S1 dc output selector switch to the OFF position.

Note: ⚡The AUTO-MAN (S2) key should be in the AUTO position and the MAN ADJ (R17) potentiometer should be fully ccw. The VOLT ADJ (R26) potentiometer should be set for float voltage.

- (4) Connect the KS-8039 volt-milliammeter (or digital meter), set on 30 VOLTS DC scale, across the terminals of the VM1 OUTPUT voltmeter (or the J11 and J12 test jacks).⚡
- (5) Operate the NOR-TST (S5) key to the TST position.
- (6) Block the K9 relay nonoperated.
- (7) Operate the OFF-NOR (S4) switch to the NOR position.

Requirement: ⚡The test meter should indicate float voltage (typical 23.87 volts dc for 11 cells or 26.04 volts dc for 12 cells).⚡

- (8) Operate the simulated current \blacktriangleright CC TST (ON-OFF) (S3) \blacktriangleleft switch to ON and if necessary hold operated.
- (9) Rotate the simulated current CC TST (R36) potentiometer cw until the voltage indicated on the \blacktriangleright test meter dips 0.25 volt maximum from float value. \blacktriangleleft

Requirement: The AM1 ammeter indicates 420 ± 10 amperes. \blacktriangleright The control current AM2 ammeter (if equipped) deflects negatively. \blacktriangleleft

Note: If the requirement is met in (9), proceed to (14). If the requirement is not met, continue with (10).

- (10) Rotate the MAX CUR LIM (R39) potentiometer slightly cw.
- (11) Adjust the CC TST (R36) potentiometer until the AM1 ammeter indicates 420 amperes.
- (12) Rotate the MAX CUR LIM (R39) potentiometer slowly ccw until the voltage indicated on the test meter \blacktriangleright dips 0.25 volt maximum from float value. \blacktriangleleft
- Requirement:** The AM1 ammeter indicates 420 ± 10 amperes \blacktriangleright and the AM2 ammeter (if equipped) deflects negatively. \blacktriangleleft
- (13) Rotate the CC TST (R36) potentiometer fully ccw \blacktriangleright and then repeat (9) to check the setting.

Note: If necessary, perform (10) through (12) until the output voltage dips at the 420 ampere level. \blacktriangleleft

- (14) Release the CC TST (S3) switch and rotate the CC TST (R36) potentiometer fully ccw.
- (15) Operate the OFF-NOR (S4) switch to the OFF position.
- (16) Remove the blocking tool from the K9 relay.
- (17) Disconnect the test meter from the rectifier.
- (18) To start the rectifier, perform 3.03.

4.06 *Partial Current Limit Check*

Note: A partial load current limit setting is used when a motor generator is the first charging unit in the plant. Refer to the associated power plant Bell System Practice for the actual partial load setting. This check is not required for G2 unit in a 302A plant nor for G1 unit in a 301C plant.

- (1) Remove the rectifier from service in accordance with the appropriate power plant Bell System Practice.
- (2) Operate the OFF-NOR (S4) switch to the OFF position.
- (3) Operate the S1 dc output selector switch to the OFF position.
- (4) Operate the NOR-TST (S5) key to the TST position.
- (5) Block the K9 relay operated.
- (6) Connect the KS-8039 volt-milliammeter \blacktriangleright (or digital meter), set on 30 VOLTS DC scale, across the terminals of the VMI OUTPUT voltmeter (or the J11 and J12 test jacks). \blacktriangleleft
- (7) Operate the OFF-NOR (S4) switch to the NOR position.
- (8) Operate the simulated current \blacktriangleright CC TST (ON-OFF) (S3) \blacktriangleleft switch to ON and if necessary hold operated.
- (9) Rotate the simulated current CC TST (R36) potentiometer cw until the voltage indicated on the test meter begins to drop.
- Requirement:** The AM1 ammeter indicates the value specified in the appropriate power plant Bell System Practices for the partial load setting. In the absence of a plant requirement, the setting should be 200 ± 10 amperes.
- Note:** If the requirement is met in (9), proceed to (13). If the requirement is not met, continue with (10).
- (10) Rotate the LO CUR LIM (R41) potentiometer slightly cw.

- (11) Adjust the CC TST (R36) potentiometer until the AM1 ammeter indicates the value specified in (9).
- (12) Rotate the LO CUR LIM (R41) potentiometer ccw until the voltage indicated on the test meter begins to drop.

Requirement: The AM1 ammeter should indicate the value as specified in (9).

- (13) Release the \blacktriangleright CC TST (S3) \blacktriangleleft switch and rotate the CC TST (R36) potentiometer fully ccw.
- (14) Operate the OFF-NOR (S4) switch to the OFF position.
- (15) Remove the blocking tool from the K9 relay.
- (16) Disconnect the test meter from the rectifier.
- (17) To start the rectifier, perform 3.03.

4.07 *Minimum Load Signal Check*

- (1) Remove the rectifier from service in accordance with the appropriate power plant Bell System Practice.
 - (2) Operate the OFF-NOR (S4) switch to the OFF position.
 - (3) Operate the S1 dc output selector switch to the OFF position.
- Note:** \blacktriangleright The AUTO-MAN (S2) key should be in the AUTO position and the MAN ADJ (R17) potentiometer should be fully ccw. \blacktriangleleft
- (4) Operate the NOR-TST (S5) key to the TST position.
 - (5) Operate the OFF-NOR (S4) switch to the NOR position.
 - (6) Operate the simulated current \blacktriangleright CC TST (ON-OFF) (S3) \blacktriangleleft switch to ON and if necessary hold operated.
 - (7) Rotate the simulated current CC TST (R36) potentiometer cw until the K13 relay releases and then slowly ccw until K13 relay operates.

Requirement: The AM1 ammeter indicates 40 ± 5 amperes.

Note: If the requirement is met in (7), proceed to (11). If the requirement is not met, continue with (8).

- (8) Adjust the CC TST (R36) potentiometer until the AM1 ammeter indicates 40 amperes.
- (9) If the K13 relay is operated, rotate the MIN LD SIG (R56) potentiometer cw until the K13 relay releases and then ccw until the relay operates. If the K13 relay is released, rotate the MIN LD SIG (R56) potentiometer ccw until the K13 relay operates.
- (10) Rotate the CC TST (R36) potentiometer fully ccw and repeat (7) to check the setting.
- (11) Release the \blacktriangleright CC TST (S3) \blacktriangleleft switch and rotate the CC TST (R36) potentiometer fully ccw.
- (12) Operate the OFF-NOR (S4) switch to the OFF position.
- (13) To start the rectifier, perform 3.03.

4.08 *Fuse Failure Alarm Check*

- (1) Remove the rectifier from service in accordance with the appropriate power plant Bell System Practice.
- (2) Operate the OFF-NOR (S4) switch to the OFF position.
- (3) Operate the S1 dc output selector switch to the OFF position.
- (4) Operate the NOR-TST (S5) key to the TST position.

CHG ALM (F7) Fuse

- (5) Remove the 70-type fuse from the CHG ALM (F7) fuse holder.
- (6) Install a blown 70-type fuse in the F7 fuse holder.

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- (7) Operate the OFF-NOR (S4) switch to the NOR position.

Requirement: The rectifier starts and then shuts down. The OVERLOAD (DS6) lamp lights. Ground appears on the CMD lead to the plant or when equipped with "ZN" option, the plant RFA signal is given.

Note: The CMD signal to the plant is replaced in later model KS-19210 L11 and L12 rectifiers with "ZN" option. The "ZN" option provides an RFA (rectifier failure alarm) signal to the plant through the release of the K22 (RFA) relay in the rectifier alarm circuit. The RFA signal is either an ungrounded loop closure between the RFA and RFA RTN leads, or ground on the RFA lead as required by the plant alarm circuit.

- (8) Operate the OFF-NOR (S4) switch to the OFF position.

Requirement: The OVERLOAD (DS6) lamp extinguishes and the CMD (RFA) signal is removed.

- (9) Remove the blown 70-type fuse from the F7 fuse holder and install the original 70-type fuse.

◆ CAP ALM (F6) Fuse

- (10) Remove the 70-type fuse from the CAP ALM (F6) fuse holder.
- (11) Install a blown 70-type fuse in the F6 fuse holder.
- (12) Operate the OFF-NOR (S4) switch to the NOR position.

Requirement: The rectifier starts and then shuts down. The RECT FAIL (DS5) lamp lights. The CMD (RFA) signal is given.

- (13) Operate the OFF-NOR (S4) switch to the OFF position.

Requirement: The RECT FAIL (DS5) lamp extinguishes and the CMD (RFA) signal is removed.

- (14) Remove the blown 70-type fuse from the F6 fuse holder and install the original 70-type fuse.

CONTACTOR ALM (F10) FUSE and CONTROL (F12) FUSE

- (15) Repeat (10) through (14) for each fuse.

◆ RELAY (F11) FUSE

- (16) Remove the 70-type fuse from the RELAY (F11) fuse holder.

Requirement: The CMD (RFA) signal is given.

- (17) Operate the OFF-NOR (S4) switch to the NOR position.

Requirement: The rectifier does not start. The RECT FAIL (DS5) lamp does not light.

- (18) Operate the OFF-NOR (S4) switch to the OFF position.

- (19) Install the original 70-type fuse in the F11 fuse holder.

Requirement: The CMD (RFA) signal is removed.

F1, F2, and F3 Fuses

- (20) Operate the OFF-NOR (S4) switch to the NOR position.
- (21) Momentarily depress DS1, DS2, and DS3 pushbuttons.

Requirement: Each lamp lights as it is depressed, indicating that the input power factor correction capacitor fuse (F1, F2, or F3) is not blown.

- (22) Operate OFF-NOR (S4) switch to OFF position.

- (23) To start the rectifier, perform 3.03.

4.09 Shutdown Feature—Plant TR Lead

- (1) Remove rectifier from service in accordance with the appropriate power plant Bell System Practice.
- (2) Operate the OFF-NOR (S4) switch to the OFF position.
- (3) Operate the S1 dc output selector switch to the OFF position.
- (4) Operate the NOR-TST (S5) key to the TST position.
- (5) Operate the OFF-NOR (S4) switch to the NOR position.
- (6) Carefully place a temporary frame ground, using a suitable cord, to the TR lead picked up at terminal 7 of TS1 terminal strip.

Requirement: The K15 relay operates and the rectifier shuts down.

- (7) Remove the temporary frame ground from terminal 7 of TS1. The rectifier will start.
- (8) Operate the OFF-NOR (S4) switch to the OFF position.
- (9) To start the rectifier, perform 3.03.

4.10 **Shutdown and Lockout Feature—High Voltage**

Note: Rectifiers with serial numbers 124 and higher are equipped with a high voltage monitor circuit per "ZL" option. The high voltage monitor circuit limits the output of the rectifier if battery voltage exceeds 27.2 volts dc for 12 cells or 25.0 volts dc for 11 cells. If the high voltage condition persists for more than one second, the high voltage monitor will shut down and lock out the rectifier when the rectifier is supplying 40 amperes or more load current.

- (a) **Equipped with High Voltage Monitor:**
When equipped with the high voltage monitor (ZL option), proceed as follows.

- (1) Remove the rectifier from service in accordance with the appropriate power plant Bell System Practice.

- (2) Operate the OFF-NOR (S4) switch to the OFF position.
- (3) Operate the S1 dc output selector switch to the OFF position.
- (4) Operate the NOR-TST (S5) key to the TST position.

Note: With the NOR TST (S5) key in the TST position, the high voltage monitor senses the voltage of the output terminals of the rectifier.

- (5) Connect the KS-8039 volt-milliammeter (or digital meter), set on 30 VOLTS DC scale, across the terminals of the VMI OUTPUT voltmeter (or the J11 and J12 test jacks).
- (6) Connect an 1800-ohm, 2-watt resistor across the J1 and J8 test jacks.

Note: The addition of the 1800-ohm resistor permits adjustment of the rectifier output voltage for test purposes to 28.0 volts dc for 12 cells or 26.0 volts dc for 11 cells.

- (7) Rotate the VOLT ADJ (R26) potentiometer fully ccw.
- (8) Operate the OFF-NOR (S5) switch to the NOR position.
- (9) Operate the simulated current CC TST (ON-OFF) (S3) switch to ON and if necessary hold operated.
- (10) Rotate the simulated current CC TST (R36) potentiometer cw until the AM1 ammeter indicates 100 amperes.

Requirement: The K13 relay is released.

- (11) Observe the test meter and slowly adjust the VOLT ADJ (R26) potentiometer cw until the rectifier shuts down (output drops to zero).

Requirement: At shutdown, the test meter indicates an output voltage of 25.0 \pm 0.1 volts dc for 11 cells or 27.1 \pm 0.1 volts dc for 12 cells. Approximately one second after the rectifier shuts down, the rectifier locks out.

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The RECT FAIL (DS5) lamp lights and the CMD (RFA) signal is given to indicate lockout.

Note: If the requirement is met in (11), proceed to (24). If the rectifier shuts down at less than or greater than 25.0 ± 0.1 dc for 11 cells or 27.2 ± 0.1 volts dc for 12 cells, continue with (12).

- (12) Release the CC TST (S3) switch.
- (13) Rotate the VOLT ADJ (R26) potentiometer fully ccw.
- (14) Rotate the HIGH VOLTS ADJ (R161) potentiometer fully cw.
- (15) Operate the OFF-NOR (S4) switch to OFF and then to the NOR position.

Requirement: The RECT FAIL (DS5) lamp extinguishes and the CMD (RFA) signal is removed.

- (16) Operate the CC TST (S3) switch to ON and if necessary hold operated.

Requirement: The AM1 ammeter indicates 100 amperes. [Adjust the CC TST (R36) potentiometer as required to maintain the K13 relay released.]

- (17) Rotate the VOLT ADJ (R26) potentiometer cw until the test meter indicates an output voltage of 25.0 volts dc for 11 cells or 27.2 volts dc for 12 cells.
- (18) Slowly rotate the HIGH VOLTS ADJ (R161) potentiometer ccw until the rectifier shuts down and locks out.

Requirement: The RECT FAIL (DS5) lamp lights and the CMD (RFA) signal is given.

- (19) Release the CC TST (S3) switch.
- (20) Rotate the VOLT ADJ (R26) potentiometer fully ccw.
- (21) Operate the OFF-NOR (S4) switch to OFF and then to the NOR position.

Note: The RECT FAIL (DS5) lamp extinguishes and the CMD (RFA) signal is removed when

the S4 switch is operated to the OFF position. The rectifier starts when the S4 switch is operated to the NOR position.

- (22) Operate the CC TST (S3) switch to ON and if necessary hold operated.

Requirement: The AM1 ammeter indicates 100 amperes. [Adjust the CC TST (R36) potentiometer as required to maintain the K13 relay released.]

- (23) Repeat (11) to check the high voltage setting.

Requirement: The rectifier shuts down at 25.0 ± 0.1 volts dc for 11 cells or 27.2 ± 0.1 volts dc for 12 cells.

Note: If the requirement is met in (23), continue with (24). If the requirement is not met, readjust the high voltage setting as given in (12) through (18).

Selective Shutdown

- (24) Release the CC TST (S3) switch and rotate the CC TST (R36) potentiometer fully ccw.
- (25) Rotate the VOLT ADJ (R26) potentiometer fully ccw.
- (26) Operate the OFF-NOR (S4) switch to OFF and then to the NOR position.

Requirement: The RECT FAIL (DS5) lamp extinguishes and the CMD (RFA) signal is removed.

- (27) Rotate the VOLT ADJ (R26) potentiometer fully cw.

Requirement: The rectifier should *not* shut down.

Note: If the requirement is met in (27), continue with (28). If the rectifier shuts down, check for proper operation of the K13 relay as given in 4.07. If the K13 relay operates properly, repeat (24) through (27) to check for selective shutdown. If the rectifier shuts down, replace the high voltage monitor circuit pack.

- (28) Rotate the VOLT ADJ (R26) potentiometer fully ccw.
- (29) Operate the OFF-NOR (S4) switch to the OFF position.
- (30) Disconnect the 1800-ohm, 2-watt resistor and then readjust the rectifier output voltage as given in 4.04.1.◆
- (b) **Not Equipped With High Voltage Monitor:**
When not equipped with the high voltage monitor, check the high voltage shutdown feature as follows.
 - (1) Remove the rectifier from service in accordance with the appropriate power plant Bell System Practice.
 - (2) Operate the OFF-NOR (S4) switch to the OFF position.
 - (3) Operate the S1 dc output selector switch to the OFF position.
 - (4) Operate the NOR-TST (S5) key to the TST position.
 - (5) Place ground on the plant HV lead, using a suitable cord, as follows.
 - (a) ◆If equipped with a blocking diode in the plant HV lead (ZQ option), connect a temporary frame ground to terminal 11 of TS2 terminal strip.
 - (b) If not equipped with a blocking diode in the plant HV lead (ZP option), disconnect the plant HV lead at terminal 11 of TS2 terminal strip. Connect a temporary frame ground to the rectifier lead at terminal 11 of TS2 terminal strip.◆
 - (6) Operate the OFF-NOR (S4) switch to the NOR position.
 - (7) Operate the ◆CC TST (S3)◆ switch to ON, and if necessary hold operated.
 - (8) Rotate the CC TST (R36) potentiometer slowly cw until the rectifier ammeter AM1 indicates about 40 amperes.

Requirement: The K13 relay releases at the minimum load signal setting [4.07(7)] to operate the K14 relay which shuts down ◆and locks out◆ the rectifier. The RECT FAIL (DS5) lamp lights and the ◆CMD (ZM option) or RFA (ZN option) signal is given.◆

- (9) Release the CC TST (S3) switch and rotate the CC TST (R36) potentiometer fully ccw.
- (10) Remove the temporary frame ground from terminal ◆11 of TS2◆ terminal strip.

Requirement: The rectifier does not restart.

- (11) Operate the OFF-NOR (S4) switch to OFF and then to the NOR position.

Requirement: ◆The RECT FAIL (DS5) lamp extinguishes and the CMD (RFA) signal is removed when the S4 switch is operated to the OFF position. The rectifier starts when the S4 switch is operated to the NOR position.◆

- (12) Operate the OFF-NOR (S4) switch to the OFF position.
- (13) ◆If the plant HV lead was disconnected in (5), reconnect the lead.◆
- (14) To restart the rectifier, perform 3.03.

5. TROUBLES

5.01 ◆When a trouble is encountered in the operation of the rectifier, refer to Section 169-704-311 for trouble-locating procedures.◆

Caution: *Cyclic hunting (fluctuation of the output) should be corrected as soon as possible to prevent damage to the rectifier.*

5.02 Hunting: To stop hunting, slowly rotate the ANTI-HUNT (R21) potentiometer ccw until hunting ceases. If the rectifier still hunts after rotating the ANTI-HUNT (R21) potentiometer fully ccw, continue as follows.

- (1) Rotate the ANTI-HUNT (R21) potentiometer fully cw.

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- (2) Rotate the GAIN (R24) potentiometer one-eighth turn ccw.
- (3) Rotate the ANTI-HUNT (R21) potentiometer ccw until hunting ceases.
- (4) If the rectifier still hunts after rotating the ANTI-HUNT (R21) potentiometer fully ccw, repeat (1) through (3) until hunting is corrected.