

KS-21520 RECTIFIER
48 VOLTS, 400 AMPERES
WARREN G-V COMMUNICATIONS
OPERATING METHODS

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1. GENERAL

1.01 The KS-21520 rectifiers (Fig. 1) are rated at 48 volts at 400 amperes. They provide an isolated, filtered, constant negative dc voltage for automatically charging and floating 23 or 24 cells of lead acid battery. In addition, L11 and L12 rectifiers are equipped with end cell charging capacity allowing 25 or 27 cells to be floated or charged at voltages up to 2.3 volts per cell. The L11 and L12 rectifiers are primarily intended for use in the 301C, 302A, and 302B; while the L21 and L22 rectifiers are intended for use in the 303A, 326A, 326B, and 111A power plants. However, they may be used whenever the voltage, current capacities, and regulation characteristics meet the requirements with which they will be associated. These rectifiers are designed for continuous operation, and during normal operation are energized and connected to the load. The input power is 3-phase, 3-wire, 60 ±3 Hz ac within the limits of 184 to 254 volts for List 11 and List 21 or 425 to 508 volts for List 12 and List 22. The List 11 and List 21 rectifiers are provided with taps on the main transformers for 208/240 volt operation.

1.02 Whenever this section is reissued, the reason for reissue will be listed in this paragraph. This issue does affect the Equipment Test List.

1.03 The KS-21520 rectifier is intended to replace the KS-20489 and KS-20490 rectifiers.

1.04 This issue of the section is based on SD-82410-01, Issue 1. For a detailed description of circuit operation, see the corresponding circuit description. If this section is to be used with equipment or apparatus that is associated with a later issue of the 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.

1.05 For more detailed information on the operation and maintenance of individual apparatus, refer to the appropriate Bell System Practices.

1.06 The abbreviations cw and ccw refer to clockwise and counterclockwise, respectively.

2. LIST OF TOOLS AND TEST EQUIPMENT

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
—	3-Inch C Screwdriver
TEST APPARATUS	
KS-20599 L4	Digital volt-ohm-milliammeter or equivalent
—	Dummy Load — ITE 5317, 30 Kilowatt

NOTICE

Not for use or disclosure outside the
Bell System except under written agreement

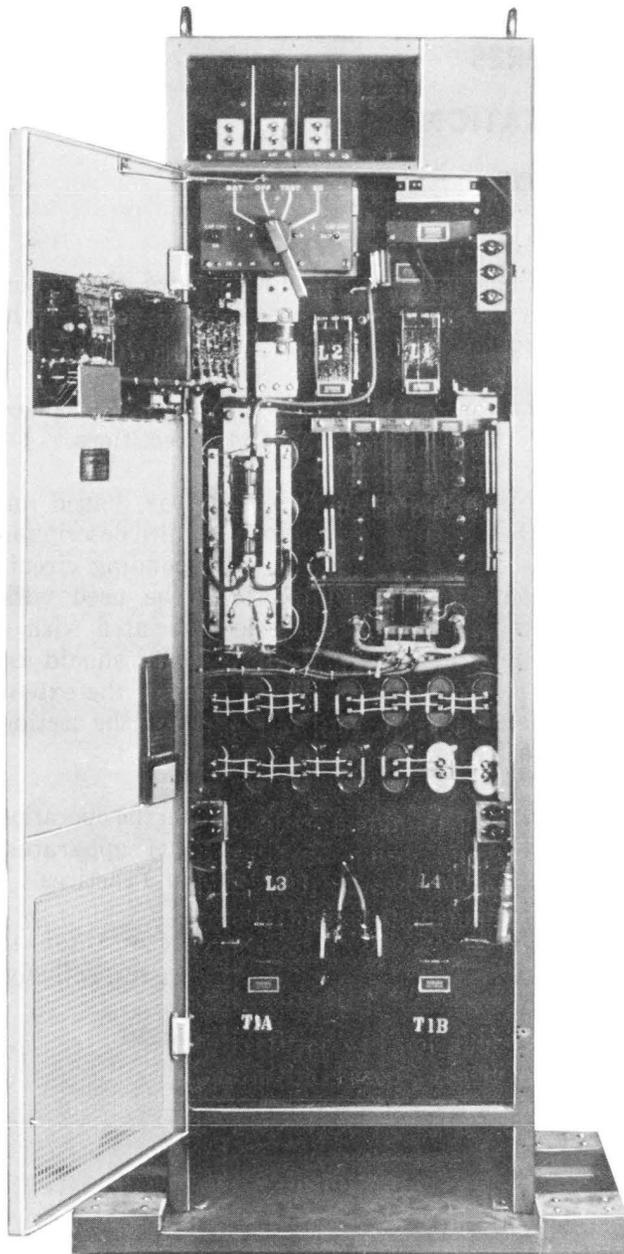


Fig. 1—KS-21520 Rectifier—Warren G-V Communications (Heat Deflector and Shield, Kickplate and Upper Panel Removed)

3. OPERATION

3.01 Enclosure: The rectifier is enclosed in a cabinet structure having front access only. The entire control panel is visible from the exterior through a recess in the front door. All of the

adjustable controls are accessible without opening the front door.

3.02 Preparing to Start

- (1) When preparing to put the rectifier into service, the controls should be initially positioned as follows.

Danger: Voltages inside the rectifier cabinet are over 150 volts to ground. Avoid all contact with terminals. Do not allow a test pick to touch two metal parts at the same time or destructive and dangerous short circuits may occur. Always disconnect the ac supply before working on the rectifier except when necessary to make tests.

- (a) POWER switch S601 is in the OFF position.
- (b) The DC OUTPUT switch (S1) is in the OFF position.
- (c) Associated switch and fuse unit or circuit breaker in the ac bus duct or power service cabinet is in the OFF position or the fuses are removed.
- (d) The plant connector (J1) is disconnected from the rectifier.
- (e) The SIMULATED OUTPUT CURRENT potentiometer (R201) is in the fully ccw position.

Note 1: R201 is located on the CP200 board. Access requires opening the circuit board access door on the meter panel.

Note 2: Do not attempt to zero adjust the ammeter with the unit off; the ammeter circuit is electronically controlled and zero adjustment must be made with the unit operating in the TEST mode.

- (2) Make the following verifications.

- (a) Verify that AC input connections are secure at the ST2 input contactor. Phase rotation is not critical but should be in 1,2,3 order for future maintenance and checking.

(b) On L11 and L21 rectifiers, verify that T1A and T1B transformers are connected properly for the expected input voltage (208 or 240 VAC) and that connectors are secure. The voltage ranges are 184 to 220 VAC for the 208-volt tap and 212 to 254 for the 240-volt tap. For L12 and L22 units, the input voltage range is 424 to 508.

Note 1: L11 and L21 rectifiers are shipped from the factory connected for 240-volt input. For 208-volt input connections, see note 104 on SD-82410-01.

Note 2: Access to the T1 transformer terminals requires removal of the front guard and the metal heat deflector.

Danger: Make certain that all input power has been removed before removing the front guard and heat deflector.

Warning 1: The terminals (solderless connectors) on the input wires (W1, W2, W3) must be in direct contact with the terminals on the T1 transformer windings. No hardware (flatwashers or nuts) should be between the terminals.

Warning 2: All hardware on unused transformer taps must be in place and secure to properly restrain the terminals and provide for tap interconnections.

(c) On L11 and L21 option units, verify that the T2 control power and T3 monitor transformer tap connections at TB1 are correct for the expected input voltage and are in agreement with the T1 tap connections.

(d) Verify that all fuses in the rectifier are properly installed and are of correct value and type.

(e) Verify that all circuit packs are correctly installed.

(f) Verify that plant connections are properly made to the J1 connector but do not install the connector.

(g) Verify that all shields and panels are in place and that all hardware is securely replaced.

Warning: Never operate the rectifier for prolonged periods with the T1 transformer shield/baffle (heat deflector) not in place since proper convection air flow is dependent on this part.

(h) Verify that the DC connections are secure and properly made and that correct battery voltage and polarity is present at the GRD, BAT, and/or EC terminals.

Danger: Always exercise extreme caution when working around live battery connections as accidental shorting can be destructive and dangerous.

3.03 Starting: To start the rectifier proceed as follows:

Warning: If improper indications are noted, do not proceed further but refer to Trouble Locating Section 169-748-312.

(1) Operate the DC OUTPUT switch to the TEST position.

Note: The switch has a thumb operated lock release on the handle. Depress the thumb button to change switch position. Once the switch has been disengaged, it is not necessary to maintain the thumb button depressed while the switch is in motion. The locking pin will drop into the locking hole and stop the switch in the correct position.

(2) Close the rectifier door and secure the latches.

Requirement: Only the TEST indicator lamp lights.

(3) Connect the KS-20599 L4 digital volt-ohm-milliammeter, set to the 100-volt dc scale, to the OUTPUT VOLTS TEST jacks.

(4) Operate the POWER switch to ON.

Requirement: The POWER ON and POWER OFF-AUTOSTART lamps light.

Note: This indicates that ac power is not yet connected to the unit.

- (5) Return the POWER switch to the OFF position and replace the fuses in the ac disconnect if necessary.
- (6) Operate the ac disconnect or circuit breaker to the ON position to apply ac voltage to the rectifier.
- (7) Again position the POWER switch to the ON position.

Requirement 1: The POWER ON lamp lights.

Requirement 2: The rectifier starts and runs.

- (8) Observe the voltmeter connected in (3).

Requirement: The voltmeter reading is approximately 49.3 volts.

Note 1: Rectifiers are shipped from the factory adjusted to float 23 cells at 2.17 volts per cell assuming that a single silicon diode is in series with the remote sensing connection in the plant. If other conditions prevail or if voltage is misadjusted, a correction can be made by rotating the OUTPUT VOLTAGE ADJUST potentiometer accessible through the hole in the circuit board access door.

Note 2: The OUTPUT VOLTAGE ADJUST potentiometer is a multiturn type and is located on CP100.

Note 3: If the voltage is readjusted for more than 23-cell operation, readjustment of the high voltage monitor may also be required.

- (9) Observe the OUTPUT CURRENT ammeter on the control panel.

Requirement: The reading is 0 amperes. (The SIMULATED OUTPUT CURRENT control, located on CP200, is fully ccw.)

- (10) Check the rectifier regulation, current limit, and alarm circuits for proper operation per Part 4 before connecting the rectifier to the plant.

3.04 Connecting to Plant: To connect the rectifier to the plant, proceed as follows:

- (1) Connect the KS-20599L4 digital volt-ohm-milliammeter, set to the 100-volts dc scale, to the OUTPUT VOLTS TEST jacks.
- (2) Place the plant connector J1 firmly into the P1 connector making sure that the locking chips engage properly with the mounting bracket.
- (3) Operate the POWER switch to OFF.
- (4) Open the door of the rectifier and operate the CAP CHG toggle switch to either the BAT or EC position depending on which mode of operation will be selected. Hold the switch in position for 15 seconds or until the voltage metered at the output volts test jack stabilizes.

Note 1: There is an EC position on L11 and L12 rectifiers only.

Note 2: The CAP CHG switch is a momentary type.

Note 3: If the rectifier has just been de-energized from the TEST mode, little or no charging time may be required.

Warning: Operating the DC output switch to either BAT or EC position with greater than a 5-volt difference of potential between battery and the rectifier capacitor bank will cause high current flow sufficient to permanently degrade the contact portions of the DC OUTPUT switch.

- (5) Release the CAP CHG switch and immediately close the DC OUTPUT switch to the BAT or EC position.

Note: Always close the DC OUTPUT switch briskly, releasing the locking pin while the switch is in motion. The pin will drop into the locking hole and stop the switch in the correct position.

- (6) Remove the KS-20599 L4 meter plugs from the OUTPUT VOLTS TEST jacks.
- (7) Close the door of the rectifier and secure the latches.
- (8) Operate the POWER switch to the ON position.

Requirement 1: The rectifier starts and runs.

Requirement 2: The POWER ON indicator lights.

Requirement 3: If operating in the EC position, the END CELL indicator lights.

Note: The rectifier is equipped with a gradual increase of current feature which is activated for a short time after energizing the unit. The rectifier will take approximately 10 seconds to assume full load.

- (9) Using the plant voltmeter, verify that the battery voltage is within proper limits.

Note 1: Adjust the output voltage in accordance with the appropriate Bell System plant practice. In the absence of a practice, adjust the OUTPUT VOLTS ADJUST control for 2.17 volts per cell across the battery.

Note 2: If the rectifier does not deliver current after turn-on, its voltage may be set below the voltage of the other rectifiers operating in parallel. SLOWLY rotate the OUTPUT VOLTAGE ADJUST control cw until load current is indicated on the rectifier ammeter.

Note 3: If the rectifier current increases to near or in excess of 400 amperes when turned on, the unit may be operating in current limit. If plant voltage is at or above proper limits, slowly rotate the OUTPUT VOLTAGE ADJUST potentiometer ccw until the load current falls below 400 amperes.

Note 4: It is never necessary to attempt to adjust units to share load. The suggested time to set the rectifier voltage is during a period when plant load is less than the rating of the rectifier such that other paralleled units

can be shut down. In this way current limiting or the other chargers will not affect the plant voltage. Each unit of a paralleled set should be individually adjusted for output voltage within specified limits.

Note 5: With 400-ampere load, the voltage difference between the plant voltage and the value at the output voltage test jacks should not exceed 2 volts.

No other adjustments should be necessary.

3.05 Stopping and Removing From Service

- (1) To stop the rectifier, operate the POWER switch to OFF.

Requirement: No rectifier indicators are lighted.

- (2) To remove the rectifier from service, proceed as follows:

- (a) Stop the rectifier and open the associated AC switch and fuse unit or circuit breaker in the power service cabinet or bus duct.

- (b) Open the rectifier door and move the DC OUTPUT switch to the OFF position.

Requirement: The RECT FAIL indicator lights and a plant alarm sounds.

- (c) Remove the plant connector J1 and take other necessary steps to cancel plant alarm conditions in accordance with appropriate plant Bell System Practices.

Danger: The capacitors in the rectifier require several seconds to discharge. With the rectifier OFF, wait 1 minute before removing shields and 5 minutes before working near the DC capacitor bank with metallic tools.

Warning: If the rectifier will be out of service for an extended period, 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.

3.06 Restoring to Service: To restore the rectifier to service, replace the J1 plant disconnect, reconnect the ac service, and perform 3.04.

3.07 Test Mode and Simulated Output Current

(1) The unit will start and run in a test mode when the DC OUTPUT switch is in the TEST position. The plant connector, J1, may be in or out. During this operation, the TEST indicator will be illuminated. Rectifier voltage sensing (RB & RG) and high voltage monitor sensing are connected directly to the + TEST and - TEST connections in the rectifier when operating in this mode. All alarms and controls are functional and a simulated output current circuit is activated which will apply a signal to deflect the ammeter and operate the LO relay and current limit circuits. If actual load is applied to the test load connections, the ammeter and current circuits will respond to the sum of real plus simulated current. The simulated current is actually limited at the current limit set point and further rotation of the simulated current potentiometer will cause the rectifier output voltage to decrease. This action is identical to the response incurred when real load is applied to the unit beyond its limiting setting.

Note: The time constant of the control circuits is longer in the TEST mode and the simulated current control should always be adjusted slowly.

(2) All circuits in the unit can be tested and adjusted in the TEST mode by using a resistive test load and without interfering with plant operation.

(3) To place the rectifier in the TEST mode, move the DC output switch to the TEST position.

4. ROUTINE CHECKS

4.01 The following checks shall be made in accordance with the Equipment Test List or after the rectifier has been out of service for an extended period and is to be returned to service, or if maintenance is performed which may affect the setting of the rectifier controls. All checks are made with the rectifier operating in the TEST

mode and with the plant connector, J1, disconnected. If indicator and relay conditions are not as described, refer to Section 169-748-312, Trouble Locating.

Note 1: It is assumed that all status input signals are wired to indicate a closure on alarm condition. If other wiring options are chosen, modify requirements accordingly.

Note 2: It is assumed that the RFA [8] plant terminal extends ground on alarm. If the ground strap is cut at the P1 connector, then test for closure on alarm from pins 8 to 13 of P1.

4.02 All relays and other components are coded as shown in the circuit schematic drawing SD-82410-01. Some relays are not adjustable and should be replaced in the event of a malfunction. The capsulated MB type relay cannot be visually inspected, but all other relays should be inspected periodically for contact adjustment and contact erosion.

4.03 Clean, test, and adjust the DC OUTPUT (S1) switch in accordance with Section 169-748-502.

4.04 Circuit Board Interlock Check: A circuit path exists through all plug-in circuit boards which allows the interlock relay INT to pick up. To verify that this path is interrupted when a circuit board is improperly positioned or removed, proceed as follows:

(1) Place the POWER switch in the OFF position.

Requirement: The TEST indicator lights.

(2) Remove the CP100 circuit pack.

Requirement 1: The RECT FAIL indicator lights.

Requirement 2: A ground signal is present at RF(8) at P1.

Requirement 3: Continuity is established between SIF(28) and SIFR(29) at P1.

(3) Operate the POWER switch to the ON position.

Requirement: The POWER ON indicator lights, the TEST indicator remains lighted, but the rectifier does not start.

- (4) Operate the POWER switch to OFF and then replace the circuit pack.

Requirement: The POWER ON and RECT FAIL indicators extinguish.

- (5) Repeat the above steps with each circuit pack.

Note: When the CP100 circuit board is removed, the TEST indicator will extinguish because the test relay, TST, is mounted on CP100.

4.05 Voltage Adjustment: The large potentiometer on the CP100 circuit board, designated OUTPUT VOLTS ADJUST, will adjust the output voltage from 48 to 65 volts; check the range as follows:

- (1) Rotate the potentiometer fully ccw.

Requirement: The voltage at the output voltage test jacks reads 48 volts or less.

- (2) Rotate the potentiometer fully cw.

Requirement: The voltage at the output voltage test jacks reads 65 volts or greater.

Note: Trimming potentiometer R102 on the CP100 board adjusts the level of reference voltage and will consequently shift the range of the OUTPUT VOLTAGE ADJUST control (R101). The value of the reference voltage may be monitored at TP101 and should be approximately 10 volts. This control is factory adjusted to yield the required output voltage adjust range. If operation of the rectifier is incorrect, it is unlikely that adjusting this control will remedy the problem. Refer to Section 169-748-312, Trouble Locating.

Warning: The rectifier must not be operated at voltages above 65 VDC for prolonged periods of time.

- (3) Reset the voltage to the desired level.

Note: If diodes or other voltage dropping elements will be present in the remote sensing connections when the rectifier is reconnected to the plant, it may be necessary to take account of these voltage drops when setting the output voltage in the test position.

- (4) Move the POWER switch to OFF.

4.06 Current Limit Full Load Set Point and Adjustment:

The CURRENT LIMIT FULL LOAD control, R202, on the CP200 circuit board adjusts the value of current at which the rectifier will cease maintaining voltage and begin limiting current. To verify the set point, proceed as follows:

Note 1: The CURRENT LIMIT FULL LOAD set point is normally 400 amperes.

Note 2: The CURRENT LIMIT FULL LOAD adjustment range is 200 to 400 amperes.

- (1) Move the POWER switch to ON.

Requirement 1: The rectifier starts.

Note: Wait 10 seconds for the walk-in time constant to expire.

- (2) Rotate the SIMULATED OUTPUT CURRENT potentiometer on the CP200 board slowly cw.

Requirement: The output current ammeter shows an increase of current, although no real load is applied to the rectifier.

- (3) When the output current indication reaches the current limit set point, the rectifier output voltage at the output voltage test jacks will decrease sharply. Also the current indication on the ammeter will no longer increase. The action of the current limit circuit is also indicated by a sharp increase in the voltage across the CUR LIM + and CUR LIM - test jack on the CP100 board.

Note: If the simulated output current is increased quickly, the ammeter indication may overshoot the current limit set point but will decrease slowly and eventually regulate at that value. A one- or two-volt decrease in

output voltage is sufficient to indicate the current limit set point.

- (4) Rotate the SIMULATED OUTPUT CURRENT control fully ccw.

Note: If it is desired to reset the current limit point, continue as follows.

- (5) Loosen the lock nut and turn the CURRENT LIMIT FULL LOAD potentiometer fully cw.
- (6) Using the simulated output current control, set the ammeter indication to a value approximately 5 percent greater than the desired current limit point. As an example, for a 400-ampere set, the simulated current should be set at 420 amperes.
- (7) Rotate the CURRENT LIMIT FULL LOAD potentiometer slowly ccw until the ammeter decreases to the desired value.
- (8) Lock the CURRENT LIMIT FULL LOAD potentiometer in place by tightening the shaft lock nut.
- (9) Rotate the SIMULATED OUTPUT CURRENT control fully ccw and move the POWER switch to the OFF position.

4.07 Partial Load Current Limit Set Point

and Adjustment: On L11 and L12 option rectifiers, a second current limit control is provided labeled CURRENT LIMIT-PARTIAL LOAD. The range and action of this control are identical to the full load current limit adjustment. When ground (battery positive) is connected to terminal PL(4) of the P1, plant connector, the PL relay on the CP200 circuit board will transfer the current limit circuitry to the partial load control. To check this feature, proceed as follows:

Note 1: The CURRENT LIMIT PARTIAL LOAD set point is normally 200 amperes.

Note 2: The CURRENT LIMIT PARTIAL LOAD adjustment range is 0 to 200 amperes.

- (1) Connect a ground signal to PL(4) of the plant connector P1.
- (2) Move the POWER switch to ON.

Requirement: The rectifier starts.

Note: Wait 10 seconds for the walk-in time constant to expire.

- (3) When the output current indication reaches the current limit set point, the rectifier output voltage at the output voltage test jacks will decrease sharply. Also the current indication on the ammeter will no longer increase. The action of the current limit circuit is also indicated by a sharp increase in the voltage across the CUR LIM + and CUR LIM - test jack on the CP100 board.

Note: If the simulated output current is increased quickly, the ammeter indication may overshoot the current limit set point but will decrease slowly and eventually regulate at that value. A one- or two-volt decrease in output voltage is sufficient to indicate the current limit set point.

- (4) Rotate the SIMULATED OUTPUT CURRENT control fully ccw.

Note: If it is desired to reset the current limit point, continue as follows.

- (5) Loosen the lock nut and turn the CURRENT LIMIT-PARTIAL LOAD potentiometer (R203) fully cw.
- (6) Using the SIMULATED OUTPUT CURRENT control, set the ammeter indication to a value approximately 5 percent greater than the desired current limit point. As an example, for a 200-ampere set, the simulated current should be set at 210 amperes.
- (7) Rotate the CURRENT LIMIT-PARTIAL LOAD potentiometer slowly ccw until the ammeter decreases to the desired value.
- (8) Lock the CURRENT LIMIT-PARTIAL LOAD potentiometer in place by tightening the shaft lock nut.
- (9) Rotate the SIMULATED OUTPUT CURRENT control fully ccw and move the POWER switch to the OFF position.
- (10) Remove the ground from PL(4) of the plant connector P1.

4.08 LO Relay Operation and Adjustment:

The CP200 circuit board contains the LO relay and circuitry to actuate it. The signal from the DCCT is amplified and, when a reference level is exceeded, the LO relay picks up. Contacts provide the CA-CB loop closure at plant disconnect terminals CA(9) and CB(10) and enable the high voltage shutdown circuit.

Note: The CA-CB closure is specified for L11 and L12 units only, but because the LO relay is required in all option units, the CA-CB contacts are provided and wired to the plant disconnect terminals in all option units.

To check the LO relay operation, proceed as follows:

- (1) Connect a KS-20599 L4 volt-ohm-milliammeter, set to the ohm function, to indicate when continuity exists between plant disconnect terminals CA(9) and CB(10) and make certain that the SIMULATED OUTPUT CURRENT control is fully ccw.
- (2) Move the POWER switch to ON.

Requirement: The rectifier starts.

Note: Wait 10 seconds for the walk-in time constant to expire.

- (3) Slowly rotate the SIMULATED OUTPUT CURRENT potentiometer cw.

Requirement: At an indication of between 30 to 40 amperes, the LO relay picks up and the meter indicates continuity through the CA-CB closure.

- (4) After the LO relay picks up, slowly rotate the SIMULATED OUTPUT CURRENT control ccw.

Requirement: The LO relay drops out and the CA-CB closure opens before the simulated current reaches 20 amperes as indicated on the ohmmeter.

Note 1: It is possible to detect the operation of the LO relay by listening for the audible sound the relay makes when operating.

Note 2: The LO relay set point adjustment (R207) is factory adjusted and the potentiometer is sealed with Glyptal. If the LO relay does not operate or if the operate and release points differ greatly from the values stated above, a more serious difficulty than misadjustment is indicated. Refer to Section 169-748-312, Trouble Locating.

- (5) Turn the SIMULATED OUTPUT CURRENT adjustment fully ccw and move the POWER switch to OFF.
- (6) Disconnect the KS-20599 L4 meter from the plant disconnect terminals CA(9) and CB(10).

4.09 High Voltage Monitor Divider Check:

For the purpose of detecting high voltage at the battery or rectifier output, the voltage presented to the HVG-HVB terminals is sampled through a precise ten-to-one divider.

Note: In the test mode the HVG and HVB terminals are automatically connected to the plus and minus test terminations in the rectifier. The ten to one value is chosen as a convenience in determining the set point of the high voltage monitor. The monitor operate point is fixed by an adjustable reference level on the CP300 circuit pack. This reference level is continuously compared to the output of the ten-to-one divider and if the output voltage rises to ten times the reference, the monitor will operate. The set point can be determined at any time by reading the reference voltage and multiplying by ten. The accuracy of this reading depends on the accuracy of the divider.

To check the divider, proceed as follows.

- (1) Move the POWER switch to ON.

Requirement: The rectifier starts.

Note: Wait 10 seconds for the walk-in time constant to expire.

- (2) Using the KS-20599 L4 digital meter, set to the DCV function, connect positive to the plus output volts test jack.
- (3) Connect the meter negative to the minus output volts test jack and note the reading.

- (4) Move the meter negative only to the VDC/10 test point (J301) on the CP300 circuit pack.

Requirement: The voltage reading is one-tenth the previous reading plus or minus 5 in the last digit.

Note: The divider is factory adjusted and the adjustment control R303 is sealed with Glyptal.

- (5) Move the POWER switch to OFF.
- (6) Disconnect the KS-20599 L4 meter.

4.10 High Voltage Monitor Circuit Check:

The high voltage monitor provides a protective shutdown for overvoltage conditions. To prevent all paralleled rectifiers from shutting down for a single malfunction, the LO relay provides an inhibit signal to insure only rectifiers delivering current will shutdown. To check the operation of the high voltage monitor, proceed as follows.

- (1) Using the KS-20599 L4 digital meter, set to the DCV function, connect the positive lead to the plus output volts test jack.
- (2) Connect the negative meter lead to the REF test point on CP300 (J302) and move the POWER switch to ON.
- (3) Using the HIGH VOLTAGE MONITOR adjustment (R306), set the voltage at the test point to exactly one-tenth the shutdown voltage recommended for the plant in which the rectifier is being used.

Note 1: Typically, this will be 51.6 volts ± 0.1 volt for 23-cell plants and 53.8 ± 0.1 volt with 24-cell plants.

Note 2: Set the REF voltage at 5.16 ± 0.01 or 5.38 ± 0.01 .

- (4) Move the negative meter lead to the minus output volts test point and, using the OUTPUT VOLTS ADJUST control, set the output voltage to 0.1 volts higher than monitor setting just made above.

Note: The rectifier will not shut down even if the output is increased greatly above the

monitor setting because the LO relay is not energizing and this will inhibit shutdown.

- (5) Slowly rotate the SIMULATED OUTPUT CURRENT control slowly cw. The rectifier will shut down within 250 milliseconds after the LO relay picks up.

Requirement 1: The POWER ON, RECT FAIL, TEST, and POWER OFF-AUTOSTART indicators are lighted.

Requirement 2: Ground is present at the RF(8) plant terminal.

Requirement 3: Continuity is established between plant terminals SID(24) and SIDR(25).

- (6) Restore the SIMULATED OUTPUT CURRENT control to the fully ccw position.
- (7) Operate the POWER switch to OFF.

Requirement: The POWER ON, RECT FAIL, and POWER OFF-AUTOSTART indicators extinguish.

- (8) Operate the POWER switch to ON and reset the OUTPUT VOLTAGE ADJUST control for normal voltage.
- (9) Disconnect the KS-20599 L4 meter.

4.11 HV Shutdown and Remote Start Circuit Checks:

Because spurious shutdowns are possible, provisions are made to allow the rectifier to be restarted from a remote location or by a signal from the plant. To check the operation of the plant HV shutdown and restart signals, proceed as follows:

- (1) Connect a ground signal to the HV(6) plant terminal at P1.
- (2) Connect a jumper between the RS(14) and RSR(15) plant terminals at P1.
- (3) Operate the POWER switch to ON position.

Requirement: The rectifier starts.

- (4) Slowly rotate the SIMULATED OUTPUT CURRENT control cw.

Requirement: The rectifier shuts down after the LO relay picks up but restarts in approximately 2 seconds and finally shuts down after a short delay.

- (5) Turn the SIMULATED OUTPUT CURRENT control fully ccw. Momentarily remove one side of the jumper from the RS(14) plant terminal then reconnect it.

Requirement: The rectifier restarts and runs.

- (6) Remove the RS and RSR jumper and HV ground signal, readjust the OUTPUT VOLTAGE ADJUST control to the desired output value and move the POWER switch to OFF.

4.12 Rectifier Failure Alarm Check: The rectifier failure alarm circuitry located on the CP400 circuit board provides for a shutdown and lockout of the rectifier in the event severely unbalanced operation occurs, a circuit pack, CP100-CP500 and CP800, is not in place, or a critical fuse operates. To check the operation of the failure circuitry:

- (1) Connect the ITE 5317 dummy load to the + TEST and - TEST terminations on the rectifier buses.
- (2) Operate the POWER switch to ON and set the load to 50 amperes.
- (3) Move the POWER switch to OFF and remove the AC CAPACITOR fuse F9 or F10 to unbalance the rectifier.

Danger: Do not attempt to remove or replace fuses with the rectifier operating.

- (4) Operate the POWER switch to ON.

Requirement 1: The rectifier starts and shuts down after a short delay.

Requirement 2: The POWER ON, TEST, and RECT FAIL indicators light.

Requirement 3: Continuity is established between plant terminals SIF(28) and SIFR(29) at P1.

- (5) Operate the POWER switch to OFF.

Requirement: The POWER ON and RECT FAIL indicators extinguish.

- (6) Replace fuse F9 or F10 and remove the dummy load.
- (7) One at a time remove fuses DC OUTPUT ALARM, F601, OUTPUT CAP ALARM, F603, RELAY ALARM, F604, and REG, F605, and replace with a blown type 70 fuse.

Note: Removing RELAY ALARM, F604, fuse removes power which illuminates the TEST, POWER ON, and EC (L11 and L12) indicators.

Requirement 1: When the blown fuse is present in each holder, the RECT FAIL indicator lights.

Requirement 2: Continuity is established between plant terminals SIF(28) and SIFR(29) at P1.

- (8) For each blown fuse, attempt to start the rectifier by moving the POWER switch to ON.

Requirement: The rectifier will not start with a blown fuse in the holders.

- (9) Remove the blown fuse and replace all control and alarm fuses in their proper positions.

Requirement: With the POWER switch in the OFF position, only the test lamp lights.

4.13 AC Voltage Monitor TEST Indicator Circuit Check: The ac voltage monitor insures that adequate power line voltage is available for proper operation. If inadequate it shuts down the unit or prevents it from starting. To check the operation of this circuit, proceed as follows:

- (1) Operate the POWER switch to ON.

Requirement: The rectifier starts and runs.

- (2) Operate the associated ac switch or circuit breaker in the AC distribution cabinet or bus duct to OFF.

Requirement 1: The rectifier shuts down.

Requirement 2: The POWER ON, TEST, and POWER OFF-AUTOSTART indicators light.

Requirement 3: Continuity is established between plant terminals SIB(20) and SIBR(21) at P1.

- (3) Operate the AC switch or circuit breaker in the AC distribution cabinet or bus duct to ON.

Requirement: The rectifier starts and runs.

- (4) Operate the POWER switch on the rectifier to OFF and remove CONTROL POWER and AC MONITOR fuses F3, F4, and F5 one at a time. While each one of the fuses is removed, attempt to start the rectifier.

Requirement: The POWER ON and POWER OFF-AUTOSTART indicators light, but the rectifier does not start.

- (5) With the POWER switch in the OFF position, replace each fuse making sure that the fuses are in their proper positions and secured.
- (6) After each replacement, operate the POWER switch to ON.

Requirement: The TEST and POWER ON indicators light and the rectifier starts and runs.

Note: The POWER OFF—AUTOSTART indicator extinguishes when the fuse is replaced.

4.14 TR Shutdown Check: To provide for turning rectifiers on and off from a remote

location or automatically from the plant, a TR feature is provided. To check the operation of this circuit, proceed as follows:

- (1) Operate the POWER switch to ON.

Requirement: The rectifier starts and runs.

- (2) Place a ground signal on plant terminal TR(7) at P1.

Requirement 1: The rectifier shuts down immediately.

Requirement 2: The POWER ON, TEST, and POWER OFF-AUTOSTART indicators light.

Requirement 3: Continuity is established between plant terminals SIC(22) and SICR(23) at P1.

- (3) Remove the ground signal from the TR plant terminal.

Requirement: The rectifier starts and runs.

- (4) Operate the POWER switch to OFF and remove the ground signal from plant terminal TR(7) at P1.

4.15 Load Carrying Bolts Check: To assure that bolted connections remain tight, on a 12-month interval, tighten all bolted connections.

5. TROUBLES

5.01 Whenever a trouble condition is encountered in the operation of the rectifier, refer to Section 169-748-312, Trouble Locating.