KS-21113, L1 AND L2 RECTIFIERS
140 VOLTS, 200 AMPERES
ACME ELECTRIC COMPANY
OPERATING METHODS

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1. GENERAL

1.01 The KS-21113, Lists 1 and 2, rectifiers provide a regulated dc output voltage for automatically floating and charging a 70-cell, lead-acid battery plant. These rectifiers are primarily intended for use in the 415A power plants but may be used whenever their characteristics and design apply. The KS-21113, List 1, rectifier operates from 208/240 volts, 3-phase, 60 ±3 Hz ac input and a dc output of 152 volts. The KS-21113, List 2, rectifier operates from 480 volts, 3-phase, 60 ±3 Hz ac input and a dc output of 152 volts. When connecting the rectifier to ac power service, positive phase rotation must be observed. The KS-21113, L1 and L2, are positive output rectifiers. The KS-21113, L1 and L2, rectifiers provide rated current output of 0 to 200 amperes.

1.02 Whenever this section is reissued, the reason(s) for reissue will be given in this paragraph. This issue affects the Equipment Test List.

Danger 1: The voltages in this unit exceed 150 volts to ground. Avoid all contact with terminals or ungrounded metallic parts. Do not allow a test pick to touch two metal parts at the same time as destructive and dangerous short circuits may occur. Disconnect the ac input supply to the rectifier before working on the rectifier except when making necessary test.

Danger 2: No output fusing is provided in the rectifier; under no circumstance should the rectifier be operated on battery without the KS-21114 control and dc distribution bay or other approved means of fusing.

Warning: This rectifier unit includes automatically controlled equipment. Care must be exercised to prevent the power plant from transferring to those parts on which maintenance work is being performed. Before working on the unit, take the necessary steps to prevent the automatic transfer of equipment by operating keys, removing fuses, blocking relays, etc. When the maintenance work has been completed, restore the plant to the normal operating conditions.

1.03 This section is based on drawings SD-82352-01, Issue 1, and CD-82352-01, Issue 1. 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 SD and CD to determine the extent of the changes and the manner in which the section may be affected.

1.04 This rectifier is designed to be serviced and maintained from the front of the unit only. All electrical connections can be made and maintenance performed with the front covers removed (see Fig. 1). The rectifier controls, fuses, current meter, and printed circuit cards are mounted on a hinged control panel for access for maintenance, testing, and replacement of parts (Fig. 2).

1.05 The output polarity of the rectifier is positive with two wiring options (Y and Z) available. Option Y is required for those applications in which 480-volt ac input is available. Option Z is required for those applications in which 208/240-volt ac input is available.

1.06 Control circuits for the rectifiers are physically divided and arranged into functional groups consisting of:

- Four plug-in printed circuit boards (CP1, CP2, CP3, and CP4)
- Three identical screw terminal connected printed circuit assemblies (GATE)
- One plug connected printed circuit assembly (CP8).

1.07 The rectifier has the following electronic features:

- Float or charge capability for 70-cell battery
- Output current limiting at a safe value down to a battery voltage of 1.75 volts per cell
- Manual output volts adjustment to set the output voltage
- Automatic shutdown in the event of high voltage and lockout if high voltage reoccurs and/or is maintained for a specified period of time
- Automatic shutdown when service voltage drops below a preset level and automatic turnon when the service voltage is restored to an acceptable level
- Low output voltage in the event of an open remote sense lead
- Manual starting by depressing POWER ON/OFF switch to ON
- Manual stopping by depressing POWER/OFF switch to OFF
- Isolation of output from the ac source
- Manual output current adjustment to set the full load regulating point at which the crossover from voltage regulation to current regulation occurs
- Rectifier failure alarm to provide a (ground) signal to the plant when the rectifier shuts down and locks out for self protection (RFA lead)
- Shutdown but not lockout (TR lead) in accordance with ground signals from the plants
- Shutdown and lockout due to high voltage if the output current exceeds 10 amperes (HV lead) in accordance with ground signals from the plants
- Output volts and REG test jacks
- Output ammeter which indicates the output current with an accuracy of ±5 amperes
- Lamps to indicate rectifier operating status
- Forced air cooling.

1.08 On initial charge for new battery installation, the output voltage of the rectifier may be increased to 175 volts. For further assistance for charging batteries, reference should be made to Section 157-629-701.

1.09 Keep ventilating passages of the rectifier unobstructed to ensure adequate cooling during operation.

1.10 If the rectifier is held in stock or otherwise is out of service exceeding 30 months, the polar-

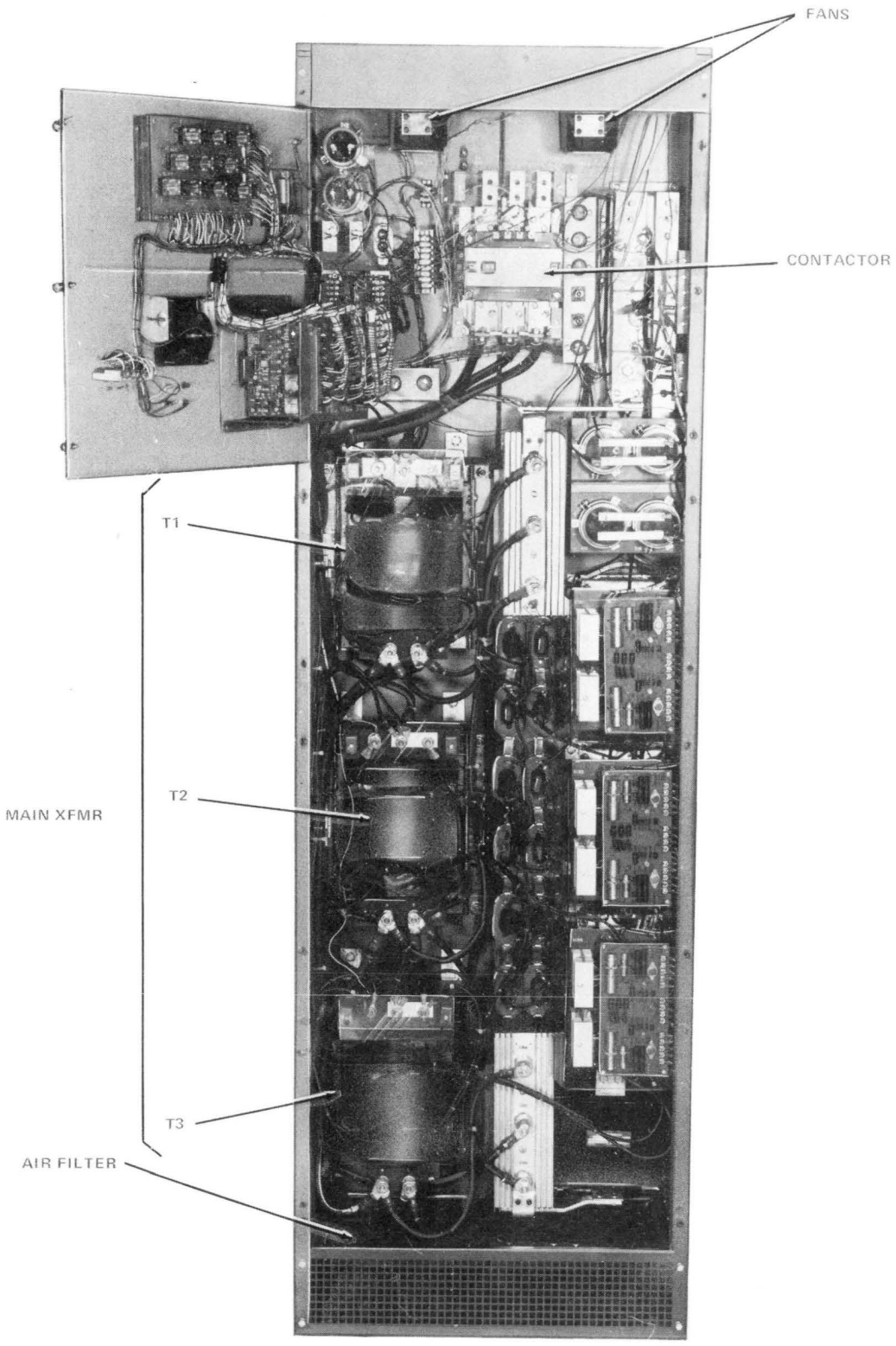

Fig. 1—KS-21113 Rectifier—Front Covers Removed

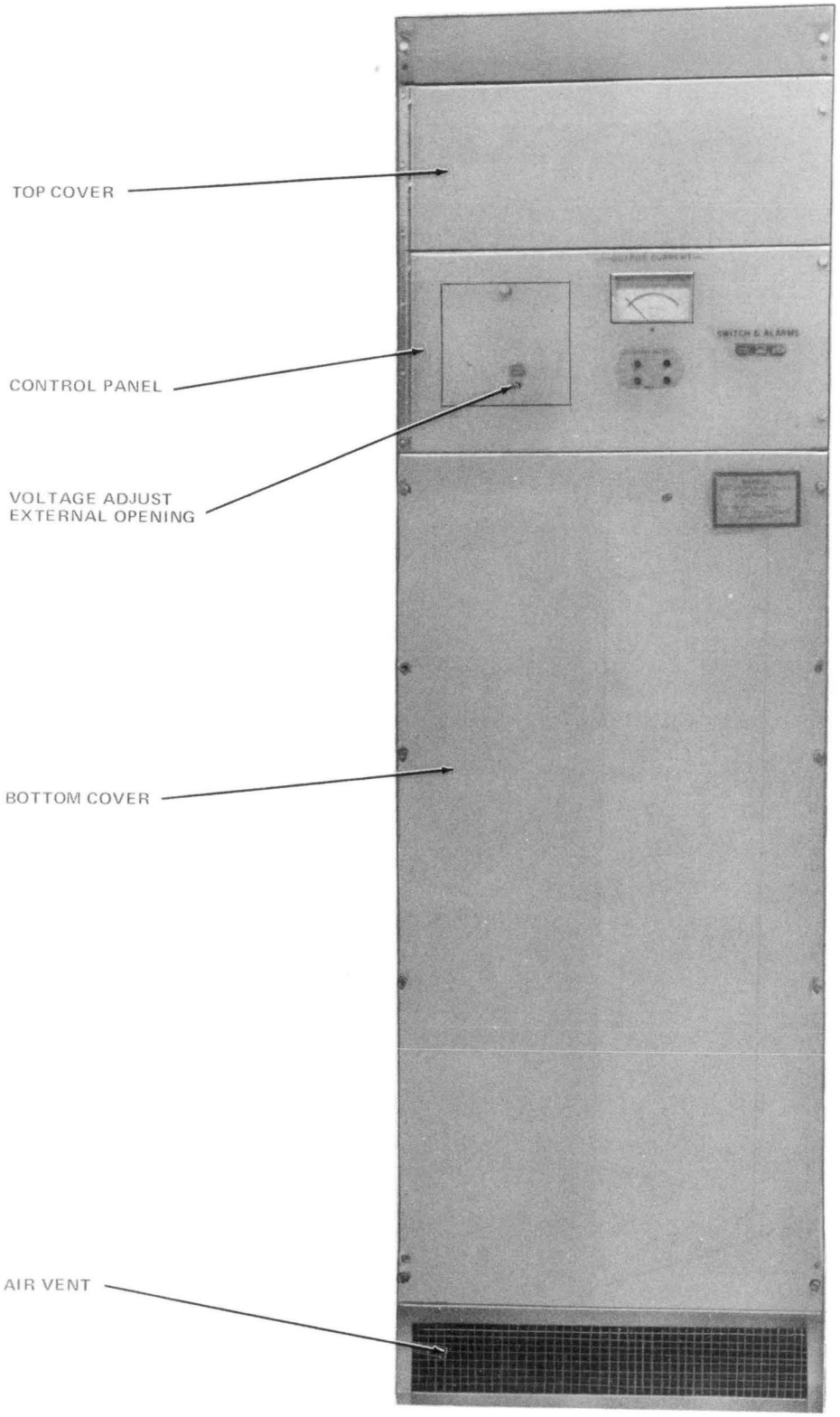

Fig. 2—KS-21113 Rectifier—Front Cover in Place

ized electrolytic capacitors should be checked and serviced in accordance with Section 032-110-701.

2. APPARATUS

2.01 *List of Tools and Test Apparatus:*

TOOLS

R-1005	Jewelers Screwdriver
	Trimpot Screwdriver or KS-6854 Screwdriver
KS-21113, L249	Extender Board

TEST APPARATUS

KS-20599, L4	Digital Multimeter or equivalant (4-1/2 digits minimum)

3. OPERATION

3.01 ***Preparing the Rectifier for Service:*** When preparing to place the rectifier in service, proceed as follows:

(1) Remove the CHG fuse and ALM fuse from the KS-21114 dc distribution bay.

(2) Set associated circuit breaker or switch and fuse unit in the ac distribution cabinet to OFF.

(3) Check that all other fuses and lamps are installed in their respective holders.

(4) Connect the KS-20599, L4, digital multimeter (DMM), set to the 1K DCV scale, to the OUTPUT VOLTS test jacks on the rectifier control panel.

Requirement: The dc voltage is zero.

(5) Disconnect the KS-20599, L4, DMM from the OUTPUT VOLTS test jacks.

(6) Verify that ac input and dc output connections are properly made and secure in accordance with SD-82352-01.

(7) Verify that the plant connector (P5) is disconnected.

(8) Verify that the circuit packs are inserted firmly in their respective holders.

(9) Verify that the transformers are connected for the correct input voltage (208/240 volts for List 1, or 480 volts for List 2).

3.02 ***Starting Rectifiers:*** To place the rectifier in service for normal operation, proceed as follows:

(1) Verify that the procedures in paragraph 3.01 have been completed.

(2) Operate the associated circuit breaker or switch and fuse unit in the ac distribution cabinet to the ON position.

Requirement: The POWER OFF lamp on the rectifier is lighted.

Note: RECT FAIL lamp may light also. If RECT FAIL lamp is on, depress POWER ON/POWER OFF switch once only. The RECT FAIL LAMP extinguishes.

(3) Depress the POWER ON/POWER OFF switch.

Requirement: The rectifier and the ventilating fans start. The POWER OFF lamp is extinguished and the POWER ON lamp is lighted.

(4) Connect the KS-20599, L4, digital multimeter (DMM), set to the 1K DCV scale, to the OUTPUT VOLTS test jacks on the rectifier control panel.

(5) Rotate the OUTPUT VOLTS ADJ potentiometer (R25) located on CP3 until the DMM indicates 152.0 volts.

(6) At the KS-21114 dc distribution bay, install the CHG fuse; then install the associated ALM fuse. The rectifier is now connected to the battery.

Warning: If the rectifier is shut down and the CHG fuse removed, the filter capacitors in the rectifier will discharge in approximately 1 minute. The rectifier must be restarted to recharge the output capacitors prior to installing the CHG fuse.

(7) Depress the POWER ON/POWER OFF switch.

Requirement: The rectifier stops and POWER OFF and RECT FAIL lamps are lighted.

(8) Reconnect plant connector (P5) to cabinet mounted jack (J5).

Requirement: RECT FAIL lamp is extinguished.

(9) Depress the POWER ON/POWER OFF switch to POWER ON.

Requirement: The rectifier starts. The POWER OFF lamp is extinguished, and the POWER ON lamp is lighted.

3.03 ***Stopping:*** To stop the rectifier, depress the POWER ON/POWER OFF switch to POWER OFF.

Requirement: The rectifier shuts down and the ventilating fans stop. The POWER ON lamp is extinguished, and the POWER OFF lamp is lighted.

Note: The rectifier is connected to the battery until the CHG fuse is removed from the KS-21114 control and dc distribution bay.

3.04 ***Taking the Rectifier Out of Service:*** To take the rectifier out of service, proceed as follows:

(1) Depress the POWER ON/POWER OFF switch.

Requirement: The rectifier shuts down, the POWER ON lamp is extinguished, and the POWER OFF lamp is lighted. The ventilating fans stop.

(2) Remove the CHG fuse and ALM fuse from the KS-21114 dc distribution bay.

(3) Operate the associated circuit breaker or switch and fuse unit in ac distribution cabinet to the OFF position.

(4) Disconnect plant connector (P5).

Warning: All power should be disconnected before attempting maintenance in the power sections of the rectifier. The battery should be disconnected when the rectifier is shut down for extended periods or for maintenance. Be careful not to short circuit the battery or sensing terminals.

3.05 ***Test Mode:*** To place the rectifier in test mode, proceed as follows:

(1) Depress the POWER ON/POWER OFF switch to POWER OFF.

Requirement: The rectifier shuts down, the POWER ON lamp is extinguished, and the POWER OFF lamp is lighted.

(2) At the KS-21114 dc distribution bay, remove the ALM fuse associated with the CHG fuse; then remove the CHG fuse.

(3) Disconnect the plant connector (P5).

Note: When the rectifier is turned on in the test mode, the RECT FAIL lamp will light while the dc capacitors discharge. The rectifier cannot be restarted until the RECT FAIL lamp is extinguished. This requires approximately 1 minute.

(4) Depress the POWER ON/POWER OFF switch to restart the rectifier.

Requirement: The POWER OFF lamp is extinguished, the POWER ON lamp is lighted, and the rectifier starts.

Note: The rectifier will start and run in the test mode without the CHG fuse installed if plant connector (P5) is disconnected and no voltage is present at the output terminals prior to turnon.

4. ROUTINE CHECKS AND ADJUSTMENTS

Warning: Do not attempt to service the rectifier when the red AUTO-START lamp is lighted. The unit is not locked out and can restart from remote action without notice.

4.01 Routine checks and adjustments are intended to detect and correct defects, particularly in infrequently operating parts of the equipment, and to guard against circuit failures which interfere with service. Routine checks should be made when they will not interfere with service.

Danger: Voltages inside the rectifier may exceed 150 volts to ground. Avoid all

contact with terminals. Do not allow a test pick to touch two metal parts at the same time since destructive and dangerous short circuits may occur.

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 cleared periodically while the rectifier is shut down. Remove dust from all accessible components inside the rectifier cabinet with a long handle, blade-type brush. Vacuum the floor area inside the rectifier cabinet to remove all dust and dirt. The period between clearings should be determined by local conditions.

4.03 ***Air Filter:*** To insure proper air flow through the unit, the air filter must be replaced periodically. The period of maintenance will depend upon the cleanliness of the area. To remove and replace the air filter, proceed as follows:

Caution: Remove all power from rectifier before removing the filter element.

(1) Remove the four screws holding the perforated kickplate.

(2) Remove the kickplate from the rectifier.

(3) Pull the air filter at the front and remove.

(4) Replace the air filter.

(5) To replace, observe air flow direction on air filter and slide to rear.

(6) Replace perforated kickplate and replace the four screws.

(7) Operate the POWER ON/POWER OFF switch to the POWER ON position.

4.04 Perodically check the output float voltage on the associated power plant voltmeter when the unit is operating on voltage control. If the voltage is not correct, readjust the rectifier float voltage as outlined in paragraph 4.07.

4.05 Electrolytic capacitors should be maintained in accordance with Section 032-110-701.

4.06 If the relays are mounted on circuit boards, they can be checked by use of the extender board furnished with the rectifier, and must be replaced in case of malfunction. If possible, periodically check all other relays for condition of contacts, making sure that they are in accordance with the circuit requirements table and Bell System Practices which apply.

Caution: When using a portable testing instrument, the leads should be carefully examined to make sure the insulation is undamaged. The leads should be properly connected to the test instrument before making any contact with the circuit to be tested. If connections are to be changed from one instrument range to another, the power should first be disconnected from equipment being tested or, if test picks are being used, they should be removed from the equipment under test.

4.07 ***Output Voltage Adjustment:*** To adjust the output voltage, proceed as follows:

(1) Place rectifier in the test mode of operation as given in paragraph 3.05.

(2) Verify that the POWER ON/POWER OFF switch is set to the POWER ON position.

Requirement: The POWER OFF lamp is extinguished, and the POWER ON lamp is lighted.

(3) Connect the KS-20599, L4, digital multimeter (DMM), set to the 1K VDC scale, to test jacks REG− and REG+ on the rectifier front panel.

Requirement: The voltage indicated on the KS-20599, L4, DMM is equal to the battery float requirement at the associated power plant or 2.17 volts per cell if no battery float requirement is given. Verify that the voltmeter on the associated KS-21114 dc distribution bay indicates 152 volts dc.

(4) If the KS-20599, L4, DMM does not indicate the required float voltage, adjust the OUTPUT VOLTS ADJ potentiometer (R25) on the rectifier until 152 volts dc (2.17 volts per cell) is met.

(5) Disconnect the KS-20599, L4, DMM.

(6) Verify that the voltmeter on the KS-21114 dc distribution bay indicates the required battery float voltage.

(7) If no further checks or adjustments are to be performed, return the rectifier to normal service according to paragraph 3.02.

SHUTDOWN AND ALARM FEATURE CHECKS

4.08 ***PWB Interlock Check:*** To check the PWB Interlock, proceed as follows:

(1) Place the rectifier in the test mode of operation according to paragraph 3.05.

(2) Depress the POWER ON/POWER OFF switch to POWER OFF.

Requirement: The rectifier shuts down, the POWER ON lamp is extinguished, and the POWER OFF lamp is lighted.

(3) Carefully remove any circuit board from the card holder.

(4) Depress the POWER ON/POWER OFF switch one time.

Requirement: The rectifier does not start.

(5) Reconnect the circuit board.

Requirement: The rectifier does not start.

(6) Depress the POWER ON/POWER OFF switch to POWER OFF, then to POWER ON.

Requirement: The rectifier starts, the POWER OFF lamp is extinguished, and the POWER ON lamp is lighted.

(7) Repeat Steps (3) through (6) for each circuit board.

(8) If no further checks or adjustments are to be performed, return the rectifier to normal service according to paragraph 3.02.

4.09 ***Fuse Alarm Check:*** To check the fuse alarm, proceed as follows:

(1) Place the rectifier in the test mode of operation according to paragraph 3.05.

(2) Depress the POWER ON/POWER OFF switch to POWER OFF.

Requirement: The rectifier shuts down; the POWER ON lamp is extinguished; the POWER OFF lamp is lighted.

(3) Replace F1 with a blown fuse.

Requirement: The RECT FAIL lamp is lighted and extinguishes after approximately 30 seconds.

(4) Depress the POWER ON/POWER OFF switch once.

Requirement: The rectifier does not start.

(5) Replace the blown fuse with a good fuse.

Requirement: The rectfier does not start.

(6) Depress the POWER ON/POWER OFF switch to POWER OFF, then to POWER ON.

Requirement: The rectifier starts and the POWER OFF lamp is extinguished. The POWER ON lamp is lighted.

(7) Repeat Steps (3) through (6) for fuse F2.

(8) If no further checks or adjustments are to be performed, return the rectifier to normal service according to paragraph 3.02.

4.10 ***AC Monitor Check:*** To check the ac monitor, proceed as follows:

(1) Place the rectifier in the test mode of operation according to paragraph 3.05.

(2) Operate the associated ac circuit breaker or switch and fuse unit to the OFF position.

Requirement: The POWER ON lamp is extinguished and the POWER OFF and red AUTO START lamps should light. The lamps will remain lighted momentarily while the dc capacitors discharge.

(3) Before the lamps extinguish and the RF relay releases, operate the ac circuit breaker or switch to the ON position.

Requirement: The rectifier should restart and run after a short delay.

(4) If no further checks or adjustments are to be performed, return the rectifier to normal service according to paragraph 3.02.

4.11 ***Internal High-Voltage Monitor Check:*** To check the internal high-voltage monitor, proceed as follows:

(1) Place the rectifier in the test mode operation according to paragraph 3.05.

(2) Verify that the POWER ON/POWER OFF switch is set to POWER ON.

Requirement: The POWER OFF lamp is extinguished, and the POWER ON lamp is lighted.

Warning: Do not exceed 177 volts in checking the internal high-voltage monitor circuit. If the rectifier does not shut down and a trouble condition is encountered, refer to Section 169-746-305, Trouble Locating.

(3) Rotate OUTPUT VOLTS ADJ (R25) clockwise until the rectifier shuts down.

Requirement: The POWER ON lamp is extinguished; the POWER OFF, red AUTO START, and RECT FAIL lamps are lighted. (This indicates the shutdown was from high voltage.)

(4) Rotate OUTPUT VOLTS ADJ (R25) a few turns counterclockwise and depress the POWER ON/POWER OFF switch to POWER OFF then to POWER ON to cancel the alarm and restart the rectifier.

Requirement: The rectifier starts. The POWER OFF and RECT FAIL lamps are extinguished. The POWER ON lamp is lighted.

(5) Connect the KS-20599, L4, digital multimeter (DMM), set to the 1K VDC scale, to the OUT– and OUT+ test jacks on the rectifier front panel.

(6) Adjust the OUTPUT VOLTS ADJ (R25) until the KS-20599, L4, DMM indicates 152 volts dc.

(7) Disconnect the KS-20599, L4, DMM.

(8) If no further checks or adjustments are to be performed, return the rectifier to normal service according to paragraph 3.02.

4.12 ***Ventilating Fan Fail Check:*** To check fan failure alarm, proceed as follows:

(1) Place the rectifier in the test mode operation according to paragraph 3.05.

(2) Depress the POWER ON/POWER OFF switch to POWER OFF.

Requirement: The rectifier shuts down, the POWER ON lamp is extinguished, and the POWER OFF lamp is lighted.

(3) Disconnect connector for FAN 1.

(4) Depress the POWER ON/POWER OFF switch to POWER ON.

Requirement: The rectifier starts but FAN 1 does not run. After a short delay (20 seconds), the FAN FAIL lamp should light.

(5) Depress the POWER ON/POWER OFF switch to POWER OFF.

Requirement: The rectifier shuts down. The POWER ON and FAN FAIL lamps are extinguished. The POWER OFF lamp is lighted.

(6) Replace connector for FAN 1.

(7) Repeat Steps 3 through 6 for FAN 2.

(8) Disconnect connectors for both FAN 1 and FAN 2.

(9) Depress POWER ON/POWER OFF switch to POWER ON.

Requirement: FAN 1 and FAN 2 will not run. After a short delay, the rectifier shuts down. The POWER OFF, RECT FAIL, and FAN FAIL lamps are lighted.

(10) Replace connectors for FAN 1 and FAN 2.

(11) Depress the POWER ON/POWER OFF switch to POWER OFF, then to POWER ON.

Requirement: The rectifier starts. The POWER OFF, RECT FAIL, and FAN FAIL lamps are extinguished. The POWER ON lamp is lighted.

(12) If no further checks or adjustments are to be performed, return the rectifier to normal operation according to paragraph 3.02.

5. TROUBLES

5.01 The purpose of this part is to present to the user some of the more common types of failures that may be experienced during operation of this rectifier, and to provide possible causes in an effort to aid in the restoration of normal charging functions in a minimum amount of time. All control circuitry is located on removable printed circuit cards to facilitate in localizing trouble and replacing the defective components or circuitry with a properly operating card. Whenever a trouble condition is encountered in the operation of the rectifier, refer to Section 169-746-305, Trouble Locating.

5.02 In the event of a rectifier failure with no evidence of component failure or damage, the following visual checks should be made:

(a) Examine wiring on printed circuit card sockets for shorts, broken wires, etc.

(b) After replacing cards, be sure all cards are secure in their sockets. The removal of any one card opens the interlock circuit and shuts the rectifier down.

(c) Check that all fuses are in their sockets and are not operated. All alarm fuses shut the rectifier down upon failure.

(d) Overheating will cause F8 fuse to operate, shutting the rectifier down. Check for visual obstruction of air flow (dirty air filters) causing rectifier to overheat. Replace fuse after a cooling down period and restart rectifier.