POWER PLANT
425A (J86439)
12 VOLTS, 800 AMPERES
OPERATING METHODS

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1. GENERAL

1.01 This section covers the operation of the 425A (J86439) automatic power plant. This plant provides a negative 12-volt filament supply for loads from 60 to 800 amperes.

1.02 This section is reissued to add information covering the alarms associated with the rectifiers. This reissue does not affect the Equipment Test List.

1.03 Routine checks are intended to detect defects, particularly in infrequently operated parts of the equipment, and to guard against circuit failures which interfere with service. Checks and adjustments other than those required by trouble conditions should be made during a period when there will be minimum interference with service.

1.04 For more detailed information on the operation and maintenance of individual equipment or apparatus, refer to the appropriate Bell System Practices. All relays and other apparatus should be adjusted, when required, in accordance with these sections and the circuit requirement tables on the circuit drawings.

1.05 The instructions are based on drawings SD-81086-01, SD-81088-01, and SD-81733-01. For detailed description of the operation of each circuit, see the corresponding circuit description.

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

2. LIST OF TEST APPARATUS

CODE OR SPEC NO.	DESCRIPTION
TEST APPARATUS	
35 Type	Test Set
141	Cord Tip
411B	Test Pick
720A	Test Battery Pickup (for use with 70-Type Fuse Mounting)
W1AF	Cord
KS-8039	Volt-Milliammeter

Note: Equivalents may be substituted.

3. OPERATION

Description

3.01 Automatically regulated rectifier units are used in the 425A (J86439) plant to convert 60-Hz input power to 12-volt direct current for loads up to 800 amperes. These rectifier units are permanently connected to the battery with no disconnecting equipment other than the ac and dc fuses. Each rectifier unit is equipped with an ammeter to indicate its output current. The overall plant is furnished with an ammeter to indicate total plant load and a voltmeter to read battery volts. The rectifier units that are standardized for use in this plant are of two distinct types as described in (a) and (b).

(a) ***J86244A Rectifiers:*** These units are rated at 200 amperes each and rectify only single-phase ac power to regulated dc power. They utilize a vacuum-tube-type control circuit.

(b) ***KS-19424 Rectifiers:*** These units are rated at 400 amperes each. The KS-19424 L1 rectifier is for use on 3-phase ac service and the KS-19424 L2 rectifier is for use on single-phase inputs. These rectifiers are physically smaller than the J86244A units and utilize semiconductor-type circuitry.

3.02 A 6-cell battery provides a reserve supply in case of power failure. Resistances, in series with the load leads during normal operation, are short-circuited in case of low battery voltage to maintain voltage on the equipment. The short-circuiting contactors are automatically operated under control of the low-voltage contact of the float-voltage relay. As a safeguard, these contactors are also operated under control of the low-voltage contact of the high-low voltage relay.

3.03 Provision is made to charge the battery as required by manual operation of a FLT-CHG key, which changes the regulated output voltage of the rectifiers from a floating to a charging voltage.

3.04 If the output current of any rectifier unit is less than 10 amperes, an RCT unbalance lamp is lighted.

3.05 A power failure, in plants not equipped with the NV (no voltage) relay circuit, disconnects the rectifier failure office alarm.

3.06 A power failure or a rectifier shutdown in plants equipped with the NV relay circuit results in an immediate rectifier failure office alarm.

3.07 If the battery voltage drops below the limits of the FLOAT relay and remains low for about 3 minutes, this relay lights the FLOAT lamp, gives an alarm, and, if the trouble was not due to a power failure, sends a rectifier failure office alarm. The local audible alarms may be cut off by the ACO key, leaving the FLOAT lamp lighted.

3.08 If the battery voltage rises above the limits of the FLOAT relay and remains high for about 3 minutes, this relay lights the FLOAT lamp, gives an alarm, and shuts down the rectifier causing the high voltage.

3.09 An HLV high-low voltage relay with wider limits than the FLOAT relay gives an immediate alarm and lights the HLV lamp when the battery voltage reaches those limits. If the voltage remains high for about 30 seconds, the rectifiers causing the high voltage are shut down.

3.10 ▶Failure of a discharge fuse, REG fuse, or VR1 or VR2 fuse operates the FA relay which lights the FA (RFA/FA, Option E) lamp and provides audible and visual alarms to the office alarm circuit.

3.11 A charge fuse failure in itself causes no alarm unless the plant voltage becomes low enough to cause a low-voltage alarm condition described in 3.07. Under some conditions, a rectifier failure will cause no indication of failure except the lighting of the RCT unbalance lamp and a subsequent low-voltage alarm condition. However, with Option E provided, a blown F1 CHARGE fuse or a blown −12V SUPPLY fuse (due to a rectifier circuit failure) in the KS-19424 rectifier will operate the FA relay, lighting the RFA/FA lamp and providing audible and visual alarms to the office alarm circuit.◀

3.12 In some plants, a remote restoral feature has been added to the J86244A rectifier which permits the rectifier to be restarted from a remote location if the REG circuit breaker has

inadvertently operated. If a J86244A rectifier has been started from a remote location, the regulator BY-PASS lamp on the rectifier will light.

Preparing to Start

3.13 Before putting the plant in service, check that:

(a) Spare fuses of correct size are available.

(b) Discharge resistors have been connected in accordance with SD-81086-01 for each of the loads.

(c) The rectifier units have been adjusted as follows (see Note).

(1) ***J86244 Rectifiers:*** Each rectifier unit is adjusted as closely as practicable for floating at 13.0 volts at any load from 50 to 150 amperes, and charging at 13.2 volts at any load between 50 and 150 amperes. See Section 169-617-301.

(2) ***KS-19424 Rectifiers:*** Each rectifier unit is adjusted as closely as practicable for floating at 13.0 volts at any load from 100 to 300 amperes and charging at 13.2 volts at any load between 100 to 300 amperes. See Section 169-728-301.

Note: Maximum charging voltage is determined by circuit voltage limitations.

(d) Rectifier adjustments have been made in accordance with Sections 169-617-301 and 169-728-301 for the J86244 and KS-19424 rectifiers, respectively.

(e) Load contactors operate as required. To check this, manually hold the L1 relay operated. The L2 relay, all L-C relays, and all C contactors should operate in succession. After checking, release the L1 relay.

Starting

3.14 No plant adjustments are required. To put the plant in service:

(a) Install all ac and dc fuses.

(b) Starting with the lowest numbered rectifier, operate the circuit breaker of each rectifier to the ON position and allow at least a 1-minute warmup.

Operation of Plant

3.15 ***Stopping Rectifier***

(a) ***J86244 Rectifiers:*** Operate REGULATOR circuit breaker to OFF.

Caution: Power is not disconnected from the main transformer and other parts of the rectifier with the circuit breaker in the OFF position. If the rectifier is to be left out of service, remove the ac supply fuses and the dc charge and regulation fuses.

(b) ***KS-19424 Rectifiers:*** Operate AC INPUT circuit breaker to OFF.

Caution: Power is not disconnected from terminal strips TS2 and TS3. If the rectifier is to be left out of service, remove the ac supply fuses and the dc charge and regulation fuses.

3.16 ***Starting Rectifier***

(a) Check that correct size ac power supply, dc charge, and associated regulation fuses are in place.

(b) ***J86244 Rectifiers:*** Operate REGULATOR circuit breaker to ON and allow at least 1 minute to heat the control tube.

(c) ***KS-19424 Rectifiers:*** Operate AC INPUT circuit breaker to ON.

3.17 ***Equalizing or Boost Charges:*** Operate the CHG-FLT key to CHG. The CHG lamp, if provided, will light. After charging is completed, operate the CHG-FLT key to FLT. The CHG lamp, if provided, will be extinguished.

4. ROUTINE CHECKS

4.01 ***Automatic Operation:*** The plant is entirely automatic and should require no operating attention other than periodic charging, adjustment

of rectifier for maximum current, and check of float voltage.

4.02 ***Batteries:*** Periodically check the batteries as covered in Section 157-601-701.

4.03 ***Rectifiers:*** Periodically check the rectifiers as covered in Sections 169-617-301 and 169-728-301.

4.04 ***Relays:*** Check the power plant relays in accordance with the associated circuit requirement tables and BSP sections whenever operation indicates trouble or doubtful adjustment. Monthly routine checks should be made until local experience indicates a longer interval will be satisfactory.

4.05 ***C Load Contactors***

(a) To check the operation of the C load contactors, proceed as follows.

(1) ***J86244 Rectifiers:*** Rotate the MAN potentiometer fully counterclockwise and operate the NOR-TST 1 switch to TST 1 on enough rectifiers to cause closure of the low contacts of the FLOAT voltage relay.

(2) ***KS-19424 Rectifiers:*** Rotate the MANUAL ADJUST potentiometer fully counterclockwise and operate the REGULATION key to the MAN position on enough rectifiers to cause closure of the low contact of the FLOAT voltage relay.

(b) After the FLOAT voltage relay operates, the L1 relay and C load contactors should operate. When the C load contactors have operated, check the voltage at the radio bay load distribution lugs associated with the C contactors using the KS-8039 volt-milliammeter. If the C contactors are wired as shown in SD-81086-01, Fig. 14, the voltage measured at each distribution lug shall be 11.3 to 11.8 volts. In the case of C contactors wired as shown in SD-81086-01, Fig. 5 and 9, the voltage shall be 11.65 to 12.39 volts.

(c) Release the contactors as follows.

(1) ***J86244 Rectifiers:*** Restore the NOR-TST 1 switch to NOR.

(2) ***KS-19424 Rectifiers:*** Operate the REGULATION key to the AUTO position.

(d) The low contacts of the FLOAT voltage relay should open and the L1 relay and C contactors should release. Check the voltage at the distribution lugs with the contactors released. This voltage in all cases shall be 10.9 to 11.1 volts. In the case of C contactors wired as shown in Fig. 5 and 9, the voltage with the contactors released shall be at least 1.25 volts lower than the corresponding voltage with the contactors operated.

4.06 ***Alarms:*** Periodically check the following alarms.

(a) ***FA (RFA/FA, Option E) Fuse Alarm:*** Check the FA fuse alarm associated with each discharge alarm fuse, REG fuse, and VR fuse. If Option E is provided, check the RFA/FA fuse alarm by performing (1) and (2) on F2 CHARGE ALARM fuse on the KS-19424 rectifier. Proceed as follows.

(1) Using the 141 cord tip, connect a W1AF cord equipped with a 411B test pick to the 360 tool on the 720A test battery pickup. Remove the alarm fuse from its fuse holder and insert the fuse cap of the 720A test battery pickup in its place.

(2) Check the FA alarm by carefully inserting the test pick through the aperture in front of the fuse holder, adjacent to the colored fuse bead, to a point where contact is made with the alarm surface of the fuse cap. This should cause the FA (RFA/FA, Option E) lamp to light and audible alarm to sound.

(b) ***FLOAT and HLV High-Voltage Alarms (Rectifier Shutdown):*** Check the FLOAT and HLV high-voltage alarms and consequent rectifier shutdown as follows.

(1) ***General:*** The following procedure is arranged so that high voltage is applied only once to each voltage relay and each rectifier shutdown is checked individually thereafter by blocking relays. Checking the rectifier shutdowns individually should prevent excessive drops in plant voltage and thus avoid operating the load contactors. Some J86244A

rectifiers may be equipped with an applique unit consisting of a TD-1 timer and a CO-1 relay. This unit functions in parallel with the rectifier CO relay to open the rectifier circuit breaker and shut down the rectifier for a high-voltage condition if the CO relay fails to operate. Each of the rectifier shutdown features is checked individually. Where rectifiers are not equipped with this applique unit, disregard reference to it.

(2) Remove the TD-2 timer and block released the L1 relay. Connect the 35-type test set to the 24-volt and ground terminals of the relay test block. Remove the VR1 fuse and connect the test set to the positive and negative terminals of the VR1 relay for use as a variable resistor. With the voltage set at 13.0 volts, slowly increase the voltage, ▶by means of the slide wire on the 35-type test set,◀ until the VR1 relay makes on its high contact (do not exceed 13.7 volts).

Requirement: ▶The VR1 relay should make on its high contact at 13.5 volts and the H1 relay should operate immediately.◀

(3) Restore the circuit to normal as follows. Remove the 35-type test set; insert the VR1 fuse; remove the block from the L1 relay; and insert the TD-2 timer.

(4) On all rectifiers except the rectifier being tested, block released the CO relay in each J86244 rectifier and block operated the K1 relay in each KS-19424 rectifier to prevent operation of the associated circuit breakers. If the J86244 rectifiers are equipped with an applique unit containing the TD-1 timer and the CO-1 relay, remove the TD-1 timer from these rectifiers. (Take off applique unit plastic cover to remove TD-1 timer.)

(5) Block operated the H1 relay.

Requirement: Within 1-1/2 to 3-1/2 minutes later, the FLOAT alarm should be given; the circuit breaker in the rectifier being tested should operate and thus shut down that rectifier; and a RECT FAIL office alarm should be given.

(6) Remove the blocking from the H1 relay first and then manually close the rectifier circuit breaker.

Note: For these tests, the J86244 rectifiers should be adjusted so that the output is sufficiently high to keep the low contact of the rectifier ammeter relay open.

(7) If a J86244 rectifier being tested is equipped with an applique unit consisting of the TD-1 timer and CO-1 relay, block the CO relay released and restore the TD-1 timer only in that rectifier being tested. (The CO relays in the other J86244 rectifiers should be blocked released and the associated TD-1 timers removed.) Repeat (5) and (6). When done, remove the TD-1 timer.

(8) Remove the blocking from the CO relay (in J86244 rectifier) or K1 relay (in KS-19424 rectifier) in the next rectifier to be tested. In the rectifier previously tested, block released the CO relay (in J86244 rectifier) or block operated the K1 relay (in KS-19424 rectifier). Repeat (5), (6), and (7).

(9) If more than two rectifiers are provided, repeat (8) until each rectifier has been tested.

(10) After the last rectifier FLOAT high-voltage shutdown has been checked and with the circuit still blocked for shutdown of the last rectifier only, remove the TD-2 timer. Block released the L3 relay and connect the 35-type test set to the 24-volt and ground terminals of the relay test block. Adjust the test set to 13.0 volts. Remove the VR2 fuse and connect the test set to the positive and negative terminals of the VR2 relay for use as a variable resistance. With the voltage set at 13.0 volts, slowly increase the voltage, ▶by means of the slide wire on the 35-type test set,◀ until the VR2 relay makes on its high contact and thus causes operation of the H2 relay (do not exceed 14.2 volts).

Requirement: ▶The VR2 relay should make on its high contact at 14.0 volts.◀ The HLV alarm should be given immediately and, within 30 seconds, the circuit breaker on the last rectifier should open and shut down the rectifier.

(11) Restore the circuit to normal as follows. Remove the 35-type test set; insert the VR2 fuse; and remove the block from the L3 relay.

(12) Manually close the rectifier circuit breaker. Remove blocking from all rectifier CO and K1 relays. Restore the TD-2 timer. Where rectifiers are equipped with the applique unit, restore all TD-1 timers and put back the applique unit cover.

Caution: When putting the plant back to normal, check that all relay blocking and insulators are removed so that automatic operation of the plant is not impaired.

(c) ***FLOAT Low Voltage, RECT FAIL, and RECT Alarms:*** Check the FLOAT low voltage, RECT FAIL, and RECT alarms as follows.

(1) Insulate top contacts 1, 3, and 5 on the L1 relay by placing a piece of Bell System bond paper over each contact and fold the paper so that it will not be detached when the relay operates. This should prevent operation of the C contactors and avoid changes of filament voltage in associated radio system. When preparing the paper for insulating contacts, avoid lint by cutting instead of tearing the paper to the required size.

(2) ▶Block released the L1 relay. Connect the 35-type test set to the 24-volt and ground terminals of the relay test block. Remove the VR1 fuse and connect the 35-type test set to the positive and negative terminals of the VR1 relay for use as a variable resistor. With the voltage set at 13.0 volts, remove the block from the L1 relay and then slowly decrease the voltage, by means of the slide wire on the 35-type test set, until the VR1 relay makes on its low contact.

Requirement: The VR1 relay should make on its low contact at 12.5 volts and the L1 relay should operate immediately.

(3) Block released the L1 relay. Remove the 35-type test set and insert the VR1 fuse. Leave top contacts 3 and 5 insulated but remove the insulator from top contact No. 1 on the L1 relay, taking care to relieve the pressure of the contacts against the insulator while removing the insulator. Remove the block from the L1 relay.

(4) Block operated the R1 relay and L1 relay.

Requirement: The FLOAT and RECT FAIL alarms operate, and the RCT lamp lights, within 1-1/2 to 3-1/2 minutes after blocking the relays. (The RCT lamp will light immediately if the K option is used.)

(5) Operate the ACO key to silence the alarms. Retire the alarms by first unblocking the R1 relay and L1 relay and then removing the insulation from the contacts of the L1 relay.◀

(6) Operate the circuit breaker (REG for J86244A rectifier or AC INPUT for KS-19424 rectifier) to the OFF position on one rectifier with the other rectifiers operating.

Requirement: The RCT lamp should light. If the plant is equipped with the NV relay circuit, the RECT FAIL office alarm should immediately operate. At the same time, the other rectifiers should carry the load and maintain the float voltage.

(7) Operate the circuit breaker to the ON position.

(8) Repeat (6) and (7) for each rectifier.

(d) ***HLV Low-Voltage Alarms:*** Check the HLV voltage alarms as follows.

(1) Insulate top contacts 1, 3, and 5 on the L3 relay by the method covered in (c)(1).

(2) ▶Block released the L3 relay. Connect the 35-type test set to the 24-volt and ground terminals of the relay test block. Remove the VR2 fuse and connect the test set to the positive and negative terminals of the VR2 relay for use as a variable resistor. With the voltage set at 13.0 volts, remove the block from the L3 relay and then slowly decrease the voltage by means of the slide wire on the 35-type test set until the VR2 relay makes on its low contact.

Requirement: The VR2 relay should make on its low contact at either 12.5 (ZB Option) or 11.5 (ZA Option) and the L3 relay and HLV alarm should operate immediately.

(3) Block released the L3 relay. Remove the 35-type test set and insert the VR2 fuse. Remove the insulation from the L3 relay contacts and unblock the L3 relay.◀

(e) ***REGULATOR BY-PASS AC Alarm:*** To check the REGULATOR BY-PASS AC feature of a J86244A rectifier used in the plant, proceed as follows.

(1) ▶Operate the REGULATOR circuit breaker to the OFF position.

Note: If the rectifier is in operation, the output will reduce to zero and various alarms will operate when the REGULATOR circuit breaker is operated to the OFF position. Depress the ACO key to silence the alarms.

(2) Momentarily connect a ground lead to the No. 2 terminal on the B terminal strip in the J86439A charge-discharge bay. Check that the REGULATOR BY-PASS AC lamp lights. (This indicates that the B relay is operated.)

(3) Operate the S4 nonlocking switch, located on the REGULATOR BY-PASS AC panel, to the RESET POSITION. Check that the REGULATOR BY-PASS AC lamp is extinguished, indicating the B relay is released.

(4) Release the S4 switch to the NOR position.

(5) To restore the rectifier to normal operation, operate the REGULATOR circuit breaker to the ON position.◀

4.07 *Float Voltage Check*

(a) Check the total load as shown on the plant ammeter. Then, check to see that each rectifier is carrying its proper share of the load in accordance with the procedure covered in (b).

(b) Add "2" for each KS-19424 rectifier being used and "1" for each J86244 rectifier and divide the sum into the total load. The value thus calculated represents the load that each J86244 rectifier should carry, whereas twice this value should be carried by each KS-19424 rectifier.

(c) If necessary, adjust each rectifier to its proper load value (within $\pm$20 percent) by rotating the VOLTAGE ADJUST (for KS-19424) or ADJUST VOLTS (for J86244) potentiometer cw to increase or ccw to decrease the load current. Make sure that the reading on the BAT VOLTS voltmeter in the plant is maintained at 13.0 volts. If the voltage is low, increase the output of the rectifier producing the lowest current. If the voltage is high, decrease the output of the rectifier producing the highest current. Although not a requirement, it is desirable to have the KS-19424 rectifiers adjusted so that the LO CUR alarm lamp is not lighted and the J86244 rectifier adjusted so that the LC relay is not operated.

5. TROUBLES

5.01 The following table shows the alarm lamps in alphabetical order, together with the functions. Action to be taken is also given.

LAMP	INDICATION	ACTION
FA	Discharge fuse blown; REG fuse blown; VR fuse blow.	Correct cause of blown fuse before replacing fuse.
FLOAT	Float voltage out of limits	Check output of rectifiers. Check VR1 relay and VR1 fuse.
HLV	Battery voltage out of limits	Check output of rectifiers. Check VR2 relay and VR2 fuse.
RCT	Rectifier failure or rectifier unbalance	Check rectifier adjustments.

5.02 No maintenance is required for TD-1, TD-2, and TD-3 time delay relays. Replace these relays if defective.

5.03 ***Trouble Chart:*** The trouble and possible causes listed are not necessarily all-inclusive but are merely indicative of some of the difficulties that may be encountered when the 425A plant is not operating normally.

TROUBLE	POSSIBLE CAUSE
Battery voltage high or low	Rectifier out of adjustment or defective component in rectifier.
	VR1 (FLOAT) relay out of adjustment or failing to close contacts.
Hunting	Rectifier out of adjustment.