NEGATIVE 330-VOLT SUPPLY CIRCUIT TEST PROCEDURES

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1. GENERAL

1.01 This section contains information used in testing and maintaining the negative 330-volt supply circuit.

1.02 This section is reissued to provide coverage of changes caused by the replacement of the Weston Sensitrol* meter relay by the M1 Meter Relay LFE Corporation LFE/API† #0824232500, 0-60 mA meter relay (M1 CURRENT milliammeter relay). The requirement for annual replacement of V3 and V4 has been changed to a recommendation for annual testing of the tubes, and replacement if necessary. The format has also been updated to conform to present specifications.

*Trademark of Weston Co, Inc.

†Trademark of Assembly Products, Inc.

1.03 The following testing equipment is required:

- One KS-20538 volt-ohm-milliammeter (VOM) or equivalent
- One pair of insulated long nose pliers.

Note: If a KS-15560 Hickok tube tester is available in the office, it should be used for testing the electron tubes of the supply circuit. Information for using the tube tester in conjunction with Western Electric Company electron tubes is included in Section 100-635-101.

2. ADJUSTMENTS

A. Initial Adjustments

2.01 The initial adjustments are to be made before placing the equipment in service.

Procedure

2.02 When the rectifier panel is provided alone for use in connection with an 119C1 telegraph signal biasing set, connect the supply lead from the 119C1 set to test point −TEST of the rectifier circuit. Measure the voltage between test points −TEST and +TG by connecting the test meter between these points and adjusting the VOLTAGE ADJ potentiometer until the meter reads −300 volts. (This voltage is less than 330 because of the drop across resistor R16). In this case, disregard the normal adjustment procedures included in (1) to (12), inclusive, below:

Caution: Before proceeding with (1) below, ascertain that the reserve power supply is disconnected from the distribution panel by disconnecting the Amphenol connector on the upper battery panel. Hazardous voltage may otherwise be encountered.

(1) Before connecting ac power to the rectifier circuit and with both primary and reserve

sources of power disconnected from the distribution network at the Amphenol connectors, connect the lead from terminal E of the associated Amphenol connector to terminal +22-1/2 of battery BT5. Turn the BAT ADJ switch of the upper reserve supply panel to its lowest setting (Point 1).

(2) Before connecting ac power to the rectifier circuit, connect the negative 330-volt office load to the distribution network by soldering the supply leads to terminal lugs on the rear of the distribution panel.

(3) Operate ALM key to OFF. GUARD lamp should light.

(4) Connect ac power to the rectifier circuit and connect both the primary and reserve sources of power to the distribution network by coupling the Amphenol connectors on the rectifier and upper battery panels.

(5) Adjust the bus voltage to −330 volts by turning the VOLTAGE ADJ potentiometer on the front of the rectifier panel.

(6) Adjust the filament voltage of V1 of the distribution network by adjusting potentiometer R2 from the rear of the upper battery panel until the filament voltage is 6.1 ± 0.1 volts. This voltage is measured between terminals C and D of the Amphenol connector on the upper battery panel.

(7) ▶If the M1 CURRENT relay is an LFE/API #0824232500 relay, a single knob located near the bottom of the meter face is used in freeing the pointer of the milliammeter relay in accordance with (8) below.◀

Caution: If the M1 CURRENT relay is a Weston Sensitrol meter, the instrument will be seriously damaged unless the right and left knobs are turned in the directions indicated. The knobs located near the top of the meter face are used in freeing the pointer of the milliammeter relay in accordance with (8) below. The right knob should be turned clockwise and the left knob counterclockwise in freeing the pointer from the right or left side, respectively. Each knob is spring loaded to automatically return to its original position when released.

(8) Set the upper and lower indices of the M1 CURRENT relay on the front of the rectifier panel to 60 and 0, respectively, and if necessary, free the pointer. The pointer of the meter relay should now indicate a load current of a few tenths of a milliampere for each supply lead connection.

(9) The load current should be over 25 mA. If it is below 25 mA, strap two or more of the supply lugs on the rear of the distribution panel to dummy load lug DL until the milliammeter relay indicates over 25 mA. In no case should only one supply resistor be strapped to the dummy load.

Caution: In making the battery adjustments in (10) below, disconnect the reserve power supply from the distribution panel by disconnecting the Amphenol connector on the upper battery panel. Hazardous voltages may otherwise be encountered. Reconnect the Amphenol connector on the upper battery panel after each battery adjustment to observe the current reading.

(10) Change the connection to battery BT5 one step at a time (toward the negative end of the battery) until a decrease of more than one milliampere is noticed on the M1 CURRENT relay. Move the connection to the next higher voltage tap (toward the positive end of the battery).

(11) Reconnect the Amphenol connector of the reserve power supply and set the operating limit indices of the milliammeter relay so that the lower index is on 20 mA and the upper index is on 55 mA.

(12) Restore ALM key to ON position. GUARD lamp should be extinguished and the alarm restored to service.

B. Routine Adjustments

2.03 ***Monthly Adjustments:*** The following procedures should be conducted at monthly intervals.

Caution: Do not disconnect the primary and reserve sources of power simultaneously from the distribution network as this will cause serious service interruption.

Procedure

2.04 When the rectifier panel is provided alone for use in connection with a 119C1 telegraph signal biasing set, check the output voltage at monthly intervals by connecting the test meter between test points −TEST and +TG. Readjust the output voltage, if necessary, by turning the VOLTAGE ADJ potentiometer until the voltage is −300 volts. (This voltage is less than 330 because of the drop across resistor R16.) In this case, disregard the normal adjustment procedures in (1) to (4), inclusive, below:

(1) Operate ALM key to OFF to disable the alarm circuit. GUARD lamp should light.

(2) Observe the current reading on the M1 CURRENT relay of the rectifier panel and then gradually lower the bus bar voltage to −320 volts by turning the VOLTAGE ADJ potentiometer. The meter reading should now be at least 4 mA lower than when the bus bar voltage was −330 volts. Restore the bus bar voltage to −330 volts by turning the potentiometer in the opposite direction.

(3) If the current reading has not been reduced by 4 mA or more in (2) above, turn the BAT ADJ switch of the upper reserve supply panel to the next higher point and repeat (2) above. Repeat (2) and (3), if necessary, until the requirement in (2) is met. If the requirement in (2) cannot be met with the BAT ADJ switch at its highest point, replace the batteries.

(4) Restore ALM key to ON. GUARD lamp should be extinguished and the office alarm restored to service.

2.05 ***Annual Tube Testing:*** At yearly intervals, remove the ac power from the primary supply and check V3 (6SN7GT-type) and V4 (423A-type) in a tube tester, if available. Replace tubes if results are poor or marginal. Reconnect ac power to the circuit and readjust the VOLTAGE ADJ potentiometer, if necessary, to bring the output voltage to −330 volts. If a tube tester is ***not available,*** replace the tubes.

C. Service Adjustments

2.06 ***Load Variations:*** It is usually necessary to add to or remove supply lead connections from the rear of the distribution panel without disconnecting power from the circuit. This is done to avoid interference with working circuits. Each supply terminal lug is protected by a 68,000-ohm resistor. Although this should provide adequate shock protection, it is advisable to use insulated tools in making load changes.

2.07 ***Procedure:***

(1) Using insulated pliers, connect or remove supply leads from terminal lugs as required.

(2) After making the changes in useful load, check the load current. If it is below 25 mA, increase the dummy load by strapping spare resistors until the total load exceeds 25 mA. If the total load exceeds 40 mA, disconnect some or all but two of the resistors strapped to the dummy load until the current is between 25 and 40 mA.

(3) If the value of the total load has been changed appreciably, reset the operating limit indices of the relay so that the lower index is on 20 mA and the upper index is on 55 mA.

2.08 ***Primary Power Failure:*** If the rectifier circuit fails, the load will be transferred automatically from the primary (rectifier) to the reserve (dry battery) supply. The M1 CURRENT relay should alarm unless the rectifier is provided alone without a reserve source of power. Primary power failure will be indicated by an alarm and a zero reading on the milliammeter relay which indicates that the load probably has been transferred to the reserve source. This can be verified by freeing the pointer of the milliammeter relay and thereby permitting the meter to indicate current flow from the rectifier supply. If the milliammeter relay and the alarm circuit are not provided, failure can be determined only by checking the output voltage of the rectifier. In case of a primary power failure, proceed as follows:

(1) Turn ALM key, when provided, to OFF to disable the alarm. GUARD lamp should light.

(2) If a VOLTS M2 meter is provided, check the bus bar voltage. If the bus bar voltage is below −320 volts, turn the BAT ADJ switch one or two points higher until the voltage is −320 or slightly higher. Operate the BAT ADJ switch sparingly in order to avoid introducing transients in the output voltage.

Caution: Avoid service failures by maintaining the output voltage above − 300 volts at all times.

(3) Examine the filaments of V1, V2, and V3 to determine if the power failure is due to loss of ac power or to trouble in the rectifier equipment. If one or more of the tube filaments is lighted, the rectifier is probably at fault. In this case, omit (4) below and proceed, after disconnecting the rectifier circuit from the distribution network, to clear the trouble by the methods outlined in Part 3. Disconnecting the rectifier circuit from the distribution network is done by uncoupling the Amphenol connector on the rear of the rectifier panel. If no filament is lighted, it indicates probable loss of ac power. In this case, check the ac supply 1 AMP fuse on the face of the rectifier panel and replace it, if necessary. If the fuse is ***not*** blown, it indicates loss of ac power and nothing needs to be done until the power is restored.

(4) Upon restoration of ac power, the load will be automatically restored to the rectifier circuit. This will be indicated by the fact that the VOLTS M2 meter indicates −330 instead of approximately −320 volts. After the load has been restored to the rectifier circuit, manually reset the pointer of the milliammeter relay by turning the upper left knob counterclockwise. Turn ALM key to ON. GUARD lamp should be extinguished and the alarm restored to service.

2.09 ***Total Failure of Supply Circuit:*** In case of total failure of the supply circuit, as indicated by a zero or excessively low reading of the VOLTS M2 meter, attempt to clear the trouble as indicated below:

Note: If the bus bar voltage appears too high, replace V3 and V4 of the rectifier. If this does ***not*** correct the high-voltage condition, attempt to clear the trouble by the procedures outlined in Part 3.

(1) Turn the BAT ADJ switch to a higher or lower point as the battery circuit may not be closed through the switch contact.

(2) If the voltage remains below −300, replace V1 of the distribution network and observe that the filament of the new tube is lighted. Also check the negative 130-volt telegraph battery fuse on the fuse panel.

(3) If the trouble persists, it may be due to a ground applied to a short-circuited GT resistor. In this case, disconnect both sources of power from the distribution network by uncoupling the Amphenol connectors and attempt to clear the trouble as outlined in Part 3(C).

3. TROUBLE LOCATION

A. Primary Power Supply (Rectifier)

3.01 The following tests should be conducted while service is being maintained by the reserve supply and with the rectifier circuit disconnected from the distribution network at the Amphenol connector, which appears on the rear of the rectifier panel. When ac power is connected to the rectifier, always measure the dc voltage with the VOM by inserting the prods through openings in the grid shield on the rear of the panel.

(1) Do not attempt to measure voltages on the secondary of transformer T1 as these voltages exceed the limits of the test meter ac range.

(2) Always disconnect ac power from the rectifier before removing the grid shield and replace the grid shield before reconnecting ac power.

3.02 ***Tube Tests:***

(1) With ac power connected to the rectifier, check the voltage between pins 7 and 2 of V4, using the VOM. This voltage should be approximately 100 volts. If the voltage is incorrect, check resistor R14.

(2) Disconnect ac power from the rectifier and then remove V1, V2, and V3. If a Hickok tube tester is available, test the tubes; otherwise replace the tubes with new ones.

(3) Reconnect ac power to the rectifier and check that the filaments of V1, V2, and V3 are lighted.

(4) Using the VOM check the voltage between test points −TEST and +TG. If the voltage can be adjusted to −340 volts by means of the VOLTAGE ADJ potentiometer, restore the rectifier to service by coupling the Amphenol connector and adjusting the bus bar voltage to −330 volts. Also reset the pointer of the milliammeter relay, if necessary. If the rectifier voltage cannot be properly adjusted by turning the VOLTAGE ADJ potentiometer, continue with the tests indicated below.

3.03 With ac power connected to the rectifier, make the voltage observations indicated in Table A using the VOM as a dc voltmeter. Check the apparatus listed in the last column of the table for trouble in the event the required voltage is not obtained.

3.04 If the trouble is located, make the necessary apparatus replacements and check the voltage between test points −TEST and +TG while turning the VOLTAGE ADJ potentiometer. If a voltage of −340 volts cannot be obtained by turning the voltage ADJ potentiometer, check the continuity through resistor R16 and the winding of the M1 CURRENT relay. When the proper voltage is obtained between test points −TEST and +TG, reconnect the rectifier to the distribution network by coupling the Amphenol connector. Adjust the VOLTAGE ADJ potentiometer until the bus bar voltage is −330 volts and reset the pointer of the milliammeter relay, if necessary.

B. Reserve Power Supply (Dry Battery)

3.05 With the reserve power supply disconnected from the distribution network at the Amphenol connector (on the front of the upper battery panel), check the voltages indicated in Table B while service is maintained by the primary source of power. These voltages should be measured by inserting the prod tips of the test meter into the terminal openings of the connector jack.

3.06 If the trouble is located in Table B, replace the defective apparatus and reconnect the reserve power supply to the distribution network. Adjust the battery voltage by the routine procedure in 2.04.

C. Distribution Network

3.07 With both supply sources disconnected from the distribution network, proceed as follows:

(1) Replace V1 and V2 of the distribution panel.

(2) Measure the value of resistor R121 by connecting the VOM as an ohmmeter between pins 6 and 8 of V1. This resistor has a nominal value of 0.22 megohm.

(3) Examine each GT resistor for evidence of overheating.

(4) If the GT resistors appear normal, measure the value of each by connecting the VOM between the associated terminal lug and pin 3 or 5 of either V1 or V2. If a supply lead or dummy load is connected to the terminal lug, disconnect it before checking the resistance in each case. Each GT resistor has a nominal value of 68,000 ohms. Replace any resistor found to be defective and leave all supply and dummy load leads disconnected from their lugs.

(5) Measure the resistance of each supply or dummy load lead to ground by means of the VOM and investigate any lead having a resistance appreciably below 10,000 ohms.

(6) Reconnect all supply or dummy load leads to their respective terminal lugs.

(7) Connect the primary and reserve supplies to the distribution network by coupling the Amphenol connectors on the rectifier and upper battery panels. Connect the VOM between the side wire of the potentiometer R2 in the reserve source of power and ground and observe that V1 is lighted and that the filiament voltage is 6.1 ± 0.1 volts. Observe the voltage on the VOLTS M2 meter and adjust the VOLTAGE ADJ potentiometer until the bus bar voltage is −330 volts. If there is no voltage reading on M2, check the Littlefuse* fuse adjacent to the meter.

*Trademark of Littlefuse Co., Inc.

(8) Check the indication of the VOLTS M2 meter by measuring the voltage between bus bar and ground, using the VOM. Connect the test leads between pin 3 or 5 of V1 or V2 and ground. If the meters do not agree, ascertain which is

TABLE A

RECTIFIER TROUBLESHOOTING

VOM (+ DC LEAD)	VOM (– DC LEAD)	REQUIRED VOLTAGE READING	APPARATUS/ COMPONENTS
Pin 3, V2	Term. 4, coil L1	370 ± 50V	Capacitors C1 and C2, ac fuse 1 amp, coil L1, and trans T1†
Pin 8, V2*	Term. 4, coil L1	190 to 230V	Resistors R1, R2, R3, R4, R5, R6, R7, R9, R10, R11, R16; Capacitor C3
Term. + TG	Pin 8, V3	130 ± 5V	—130 volt telegraph battery fuse, capacitor C4, relay K1, and resistor R15
Pin 3, V3	Pin 6, V3	19 ± 2V	Resistors R12 and R8

* Measure this voltage while turning VOLTAGE ADJ potentiometer.

† If trouble is suspected in transformer T1 or coil L1, disconnect ac power from the rectifier and check the continuity of the windings using the VOM as an ohmmeter.

in error and, if necessary, have the VOLTS M2 meter repaired.

(9) Reset the pointer of the meter relay, if necessary, and check the availability of the reserve supply by making the routine adjustment in 2.04.

4. REFERENCES

4.01 The following Bell System Practices provide additional information on the negative 330-volt supply circuit.

SECTION	TITLE
312-215-100	Negative 330-Volt Supply Circuit—Description and Operation
807-401-162	Negative 330-Volt Supply for No. 2 And No. 9B Telegraph Serviceboards—Equipment Design Requirements—Data Systems

4.02 The following schematic drawing (SD), circuit description (CD), and "J" Drawings contains pertinent information on the negative 330-volt supply circuit.

TABLE B

RESERVE POWER SUPPLY TROUBLESHOOTING

BAT ADJ SWITCH POINT	VOM (+ DC LEAD)	VOM (–DC LEAD)	REQUIRED VOLTAGE READING	APPARATUS/ COMPONENT
(1)	Amphenol connector contact B	Amphenol connector contact E	168-192	BAT ADJ switch, resistor R3, battery connections
(2)	Amphenol connector contact B	Amphenol connector contact E	4-1/2V higher than 1st point reading	BAT ADJ switch, resistor R4, battery connections
(3)	Amphenol connector contact B	Amphenol connector contact E	10-1/2V higher than 1st point reading	BAT ADJ switch, resistor R5, battery connections
(4)	Amphenol connector contact B	Amphenol connector contact E	16-1/2V higher than 1st point reading	BAT ADJ switch, resistor R6, battery connections
(5)	Amphenol connector contact B	Amphenol connector contact E	22.5V higher than 1st point reading	BAT ADJ switch, resistor R7, battery connections
—	Amphenol connector contact A	Amphenol connector contact + TG	125 to 135V	—130 volt battery fuse

NUMBER	TITLE		
SD- & CD-70627-01	DC Telegraph—Telegraph Service Bds. No. 2 & 9B —330 Volt Bias Supply Ckt.	J70104A	Distribution Panel Equipment
		J70104B	Rectifier Panel Equipment
		J70104C	Reserve Battery Equipment