RECTIFIERS
J86207A, D, G, H, K, L, M, and U
OPERATING METHODS

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1. GENERAL

1.01 This section covers the operation of the J86207A, D, G, H, K, L, M, and U electron tube rectifiers using magnitude control regulation.

1.02 This section is reissued to delete the information for the J86207E rectifier which is now covered in Section 169-232-301 and to bring the section up to date. Since this reissue covers a general revision, arrows ordinarily used to indicate changes have been omitted.

1.03 This section covers the features which apply to the rectifiers as a group and all items do not necessarily apply to any one unit. Exceptions that apply to a specific rectifier are noted as such.

1.04 Input and output ratings of these rectifiers are covered in Table B in Part 6 of the section.

1.05 The J86207A, G, and H are half-wave rectifiers. The J86207D, K, L, M, and U are full-wave rectifiers. The J86207G, H and U rectifiers are intended to operate into a resistance load and require an external current-limiting device when used with batteries. The rectifiers intended for charging and floating batteries require an external filter when operating into a resistance load.

1.06 All of these rectifiers are equipped with ac plugs for connection to the ac power supply. Only the J86207U is equipped with a plug for connection to the dc load.

Note: Where switches are available in the ac circuit, it is satisfactory to operate them instead of disconnecting or connecting the ac plug.

1.07 ***Caution: The voltages in these units exceed 115 volts to ground. Avoid all contact with terminals. Do not allow a test pick to touch two metal parts at the same time as destructive and dangerous short circuits may occur. Before opening the covers or removing any protective guard behind the covers to work inside the rectifier, the dc output should be reduced to zero, the ac supply and dc output should be disconnected, and all dc fuses including the charge fuse and the regulating lead fuse associated with the rectifier, should be removed. The door switch, when furnished, is provided for the protection of personnel and should not be made inoperative. The door switch, when open, disconnects only one side of the power supply. Some ac terminals may be alive or at service voltage to ground with the switch open.***

1.08 On some models of these rectifiers, there is an appreciable fixed dc load in the unit that is indicated on the ammeter even when no external load is applied. Where the term "no load" or "low load" is used, it refers to external load and does not refer to this internal load.

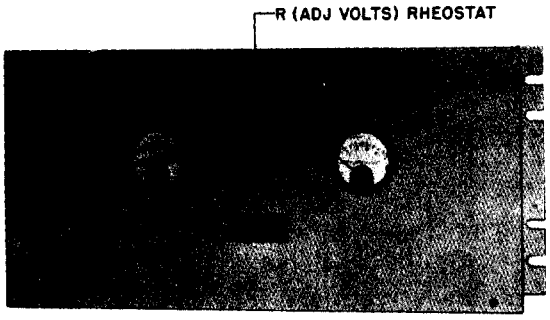

Fig. 1 — J86207H Rectifier

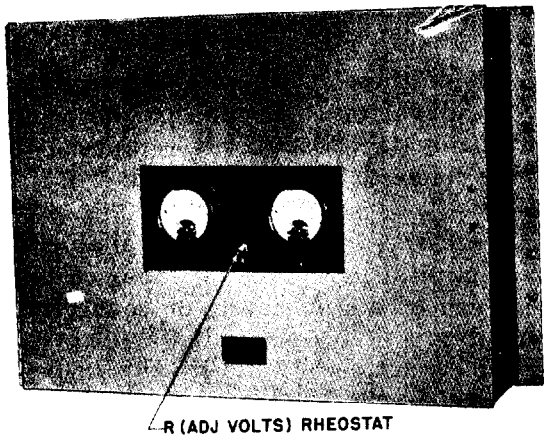

Fig. 2 — J86207U Rectifier

1.09 On some models of these rectifiers at low loads, the output voltage will vary slightly as indicated by an oscillating voltmeter pointer and flickering in the rectifier tubes. This is caused by the filter capacitors charging for a few cycles after which the tube cuts off for a few cycles while the capacitor discharges. Flickering is also to be expected where the rectifier is connected to a ringing battery.

1.10 Keeping the ventilating passages clean is especially important to avoid excessive heating.

1.11 Routine checks are intended to detect defects, particularly in infrequently operated parts of the equipment, and insofar as possible 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 a minimum interference with service.

1.12 The instructions are based on the circuit drawings and their associated circuit descriptions. The circuit drawings are listed in Table B in Part 6 of the Section.

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

2. TOOLS AND TEST APPARATUS

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
—	3-Inch C Screwdriver (or the replaced 3-inch cabinet screwdriver)
TEST APPARATUS	
KS-8039	Volt-Milliammeter
KS-14510 L1	Volt-Ohm-Milliammeter (or the replaced M9B volt-ohm-milliammeter)

3. OPERATION

Preparing to Start Initially

3.01 When preparing to put the rectifier into service initially, check that:

(a) AC power input plug is removed or the AC switch is in the OFF position.

(b) DC output plug (J86207U), charge and regulation fuses associated with the rectifier are removed.

(c) Transformer taps as specified on the SD drawing are correct for the following conditions as required.

Note: Use the KS-14510 meter to measure the voltage.

(1) For the ac service voltage.

(2) On battery charging rectifiers, for the number of cells in the battery.

(3) On batteryless rectifiers, for the rated output voltage.

(4) On the J86207A and H, the T1 transformer secondary taps, depending on the initial adjustment of the rectifier (see 3.05 and 3.06).

(d) Grid battery or disc rectifier is installed and properly poled.

Note: Some rectifier units require more than one grid battery.

(e) Proper grid battery taps as specified on the SD drawing are selected.

(1) In the J86207A, K, L, and M for the number of cells in the battery to be charged.

(2) In the J86207H for the regulated output voltage.

(f) Correct electron tubes are in the sockets.

(g) Relays are properly adjusted.

(h) Proper fuses, as specified on the SD drawing, are provided in the unit.

(i) R rheostat control is in the maximum counterclockwise position.

(j) All external connections are made in accordance with the SD drawing covering the associated circuit of which the rectifier is a part.

Initial Adjustments

3.02 Connect the ac power supply. Check the time between applying the power and the operation of the TD relay as evidenced by the operation of the GR relay. If the time is other than 45 ±5 seconds, readjust the TD relay.

Notes.

(1) Early models of the J86207A and D require connection to the battery during starting to protect the electron tubes.

(2) On some rectifiers, a continuous source of ac power is provided so that a full 45-second warmup time is not required after short power service interruptions.

(3) On early models of the J86207G having a MAN ST switch, the control should be held in the FIL HT (second) position for approximately 45 seconds before switching to the START position where it should be held for approximately 3 seconds and then switched to the RUN position.

3.03 ***Rectifiers Not Connected to Batteries:*** Install the associated dc fuses and connect the load. Adjust the R rheostat control clockwise until the dc regulated output voltage is at the value specified for the office as indicated on the rectifier voltmeter.

3.04 ***Rectifiers Connected to Batteries (see 3.05 and 3.06 for J86207A and H).*** Install the dc charge fuse and the fuse in the regulating lead. Proceed as follows to adjust for voltage regulation.

Note: Regulated voltage for battery charging is provided for in some associated power plants and is covered in the circuit descriptions. An example of this is the provision of counter emf cells and switches with the regulating lead connected on the load side of the counter emf cells.

(a) Adjust the R rheostat control clockwise to charge the battery to a value between 2.16 and 2.18 volts per cell. If the office load is too much for the rectifier unit to carry and still charge the battery to this value, adjust R rheostat so that the output current is as high as possible but not exceeding the rated continuous full load. When the external load is lighter, make the final adjustment. To overcharge the battery, proceed as covered in (b).

(b) Higher unregulated voltage can be obtained by opening the regulating lead, usually designated "-RC". Where there is a fuse in this lead, removal of the fuse is the best means of opening the regulating lead for overcharge. It is to be noted, however, that in some rare cases removal of the fuse does

not result in higher output voltages. Under these conditions, open the lead to the tube grids by insulating the proper contacts of the GR relay. In some power plants, a switch has been provided for convenient opening of the regulating lead to obtain higher voltages.

Caution: While the regulating lead is open, watch the output meters to make sure that neither voltage nor current exceeds the rated limits of the rectifier.

Note: While the regulating lead is open, the R rheostat has no control of the rectifier output.

(c) Close the regulating lead, if open, and quickly adjust the R rheostat control until the voltage output of the rectifier is equal to the battery float voltage requirement (see Section 157-601-301) with the current from 25 to 35 per cent of the rated continuous output. Repeat the adjustment, as required, to secure the proper float voltage value.

Note: Use the KS-8039 voltmeter for measuring the float voltage when making the adjustments.

3.05 ***J86207A Rectifier—Selection of T1 Transformer Secondary Taps:*** Select the proper secondary taps on the T1 transformer as specified on the SD drawing.

Note: A 100-ohm variable rheostat or a fixed resistance of approximately the battery voltage divided by 0.6 may be required across the battery to get the output within the specified range. If the voltage of the battery is not at 2 volts per cell, adjust the variable rheostat for a load in amperes as follows.

(1) 0.01 ampere below 0.6 ampere for each 0.025 volt above 2 volts.

(2) 0.01 ampere above 0.6 ampere for each 0.025 volt below 2 volts.

3.06 ***J86207H Rectifier—Selection of T1 Transformer Secondary Taps:*** Select the proper secondary taps on the T1 transformer as specified on the SD drawing.

Routine Adjustments

3.07 Regulation is entirely automatic at the normal output voltage and should not require adjustment from day to day, but only when required, as determined by observation.

Note: Starting and stopping the rectifier unit is done by connecting and disconnecting the ac input power supply usually by means of the ac plug. When the alternating current is to be disconnected for more than a day, disconnect the direct current output also, by removal of the dc fuses.

4. ROUTINE CHECKS

4.01 The following should be performed.

(a) Periodically observe the output current and voltage. The voltage may be below the value for which it was adjusted, particularly if the output current is greater than the value at which the voltage adjustment was made, namely, about 1/3 rated full-load current. Experience will indicate the voltage to be expected at various loads. As required, make the voltage adjustment of the rectifier only when the dc output current does not exceed the value specified in Table A.

TABLE A

J86207 RECTIFIER	MAXIMUM DC OUTPUT CURRENT (amperes)
A	0.3
D, K, and U	1
L and M	3
G and H	0.6

(1) Adjustment of the J86207G, H and U rectifiers when not connected to batteries should be made with the R rheostat control until the voltage is at the value specified for the office.

(2) Adjustment of rectifier units connected to batteries may be made at output currents specified in Table A by first charging the battery and then allowing the battery to carry part of the load. See 3.04(a).

(b) ***Alternate Method for Voltage Adjustment:*** An alternate method of adjusting a rectifier unit used with a battery may be advantageous particularly where the load is liable to be so high at the time a maintenance man visits the installation, that it does not permit charging the battery. This method is essentially one of artificially putting a voltage equivalent to 2.18 volts per cell on the regulating potentiometer circuit. At this voltage, the rectifying tubes should block or stop firing. To do this, open the potentiometer circuit at the negative end as at the REG fuse or the -RC terminal. Connect the KS-8039 voltmeter from the open end of the potentiometer circuit to the positive end. Connect across the open, in series with the potentiometer circuit, a combination of dry cell block battery (probably 4.5 volts) and a rheostat with the positive end of the battery toward the negative output or the -RC terminal. The rheostat may be in series with the battery or as a potentiometer across the dry battery, depending on the particular rectifier involved. Turn the R rheostat control to the maximum clockwise position. By varying the test rheostat, the voltage as indicated by the KS-8039 voltmeter may be adjusted to 2.18 volts per cell, at which voltage the rectifying tubes should stop conducting in normal operation. With the tubes firing, turn the R rheostat control counterclockwise until they just stop. Check this adjustment by use of the test rheostat and then restore the circuit to normal without changing the position of the R rheostat control.

(c) When a tube fails or it becomes necessary to install a new grid battery, adjustment of the R rheostat control will usually be required.

(d) Periodically check the condition of the electron tubes using whatever electron tube tester is available, in accordance with the information for the tester.

(e) Periodically check the grid battery voltage using the KS-14510 meter.

(f) As often as local experience demands, inspect the relays for adjustment and condition of contacts to make sure that they are in accordance with the circuit requirement tables and sections which apply.

(g) Electrolytic capacitors should be maintained in accordance with Section 032-110-701.

5. TROUBLES

5.01 *General*

(a) Unsatisfactory operation of either rectifying tube in a full-wave rectifier using two rectifying tubes gives unsatisfactory operation of the rectifier unit. To eliminate the defective tube, change both tubes to get satisfactory operation. Then put back the old tubes one at a time to determine which is defective. The following conditions within the tube are causes of failure.

(1) ***Flash-Over:*** Current passing in the wrong direction through the tube which usually occurs when the tube is nearing the end of its life. Flash-over will probably blow the charge fuse and burn out the ballast lamp.

(2) ***Cathode Trouble:*** Usually consisting of open filament or low cathode emission.

(3) ***Grid Trouble: (high firing point or grid emission):*** High firing point exists when too high a voltage is necessary to start the tube firing. To some extent this can be compensated for by changing the R rheostat control setting. However, a tube with this trouble is inclined to be unstable at low output loads. Grid emission sometimes occurs due to cathode material which has been carried over to the grid. The effect of this is negligible until the temperature of the tube becomes high enough to cause this active material on the grid to give off electrons which causes the grid to lose control. This effect disappears as the tube

cools so that satisfactory operation may be possible at low loads when it is not possible at full load after approximately 1 hour of operation.

(b) When a rectifier unit is functioning properly, clockwise operation of the R rheostat control will increase the dc output and counterclockwise operation will decrease the output. For battery charging, counterclockwise operation of the R rheostat control should decrease the output current to at least 10 per cent of the rectifier rated output current. If smooth control of the output stops at a higher current value, such a performance is known as ***high drop-out.*** This condition may be due to the use of improper transformer taps or to a rectifying tube having a ***high firing point.***

5.02 The H varistor may fail due to aging (increase in the resistance of the cells) and not supply the proper dc current to operate the GR relay.

5.03 At times, troubles may be caused by faulty relay operation.

5.04 Control rheostats that are totally enclosed should be replaced if they become defective in any respect.

Note: Rheostats in early models of the rectifiers may be so constructed that the contacts may be cleaned. See Section 069-365-801.

5.05 ***Grid Battery:*** Erratic operation may be due to a depleted grid battery even when the R rheostat control has not been turned to its maximum clockwise position. Unless otherwise specified on the SD drawing or local instructions, replace the grid battery if the voltage when measured with any available voltmeter is less than the cut-off voltage value for the battery specified in Section 157-421-501.

Trouble Chart

5.06 Should any of the following troubles develop, it is suggested that the possible causes listed be checked. If the trouble is not found, look for loose or open connections, or short circuits due to foreign matter lying across wiring terminals. A loose connection generally causes heating. Any one of the following troubles may be caused by an open or short circuit or by an aging or drift in the constants of some faulty component. If one of the possible causes listed below does not lead to the location of the trouble, it is advisable to make point-to-point resistance measurements with the circuit completely de-energized, comparing the measurements with the values shown on the SD drawing so that such faults may be found.

TROUBLE	POSSIBLE CAUSE
(a) No dc output	Failure or disconnection of the input power
	Blown ac supply fuse and/or charge fuse caused by defective V1 and/or V2 electron tubes or defective main filter capacitor
	Failure of GR relay to operate caused by aged H varistor
	Failure of TD relay to operate
	Failure of V1 and/or V2 electron tubes
	Failure of ballast lamp
	Main filter capacitor shorted (J86207A, G, H, and U are equipped with main filter designated C. On early models of the J86207G the capacitor is designated E)
(b) Low dc output voltage	Failure of V1 and/or V2 electron tubes
	Aged grid battery or disc rectifier unit
	Aged ballast lamp
	R rheostat out of adjustment
	Incorrect transformer taps used

TROUBLE	POSSIBLE CAUSE
(c) High dc output current	Incorrect transformer taps used
	Failure of GR relay to close its contacts
	Failure of V1 and/or V2 electron tubes
	Blown or open fuse in the regulating circuit
(d) High dc voltage	Rectifier unit disconnected from the load or battery
(e) High battery voltage	DC output current high
	Capacitor associated with H varistor either open or of low capacity and adjustment of R rheostat control does not result in smooth control of the output current (see 5.01b)
(f) Erratic operation of time delay relay	Loose bimetallic strip assembly (tighten screw)
(g) AL series alarm relay chattering (J86207A, H, and late models of the G rectifier)	Failure of main filter capacitor

6. RECTIFIER RATINGS

TABLE B

J86207		INPUT	DC OUTPUT		
CODE	CIRCUIT DRAWING	50-60 CYCLES (volts)	VOLTS	AMPERES	
				CONTINUOUS	INTERMITTENT
A	SD-80614-01	190-250	17-45	0.6	0.6
D	SD-80616-01	115-230	50	3	—
G	SD-80659-01	190-250	120-130	0.6	—
	SD-80659-02	190-250	130	0.6	0.6
H	SD-80629-01	190-250	52-75	0.6	—
	SD-80629-02	190-250	48-75	0.6	—
K	SD-80616-02	115-230	34-48	3	—
L	SD-80764-02	120-230	24-34	8	10
M	SD-80764-01	120-230	24-34	8	10
U	SD-80871-01	115-230	130	3	—