

J86207J RECTIFIER UNIT

1. GENERAL

1.01 This section covers the operation of the J86207J automatically regulated tube-type rectifier unit using the magnitude method of control. It was designed to provide regulated d-c power from an a-c power service and, except the list 6, for floating batteries in telephone power plants. Its output is rated at 50 volts, 8 amperes continuous, 10 amperes intermittent, direct current. The input power requirement is 105/115/125 volts or 190/210/230/250 volts \pm 5% and 60 cycles \pm 2%. The rectifier unit is suitable for use in room temperatures from 0 to 104°F (-18 to 40C).

1.02 This rectifier unit has extensive application in small central offices and PBXs, both manual and dial. It may be used for other equipment for which its capacity, voltage range, and circuit arrangements are satisfactory.

Caution: Voltages inside the rectifier case are higher than those usually encountered in telephone power plants. Avoid all contact with terminals as high voltages are present. Do not allow a test pick to touch two metal parts at the same time or destructive and dangerous short circuits may occur. Disconnect both the a-c supply and the d-c output before doing any work inside of the rectifier case.

1.03 In this section, the term capacitor is used for all apparatus coded as either a capacitor or a condenser and the term resistor is used for all apparatus coded as either a resistor or a resistance.

1.04 The abbreviations CW and CCW, used herein, refer to clockwise and counterclockwise rotation, respectively.

1.05 Routine checks are intended to detect defects, particularly in infrequently operated parts of the equipment, and insofar as possible to guard against circuit failures liable to interfere with service. Checks and adjustments, other than those required by trouble conditions, should be made during a period when they will cause the least unfavorable reaction to service.

1.06 The instructions are based on drawings SD-80606-02 and SD-80606-08. For

detailed description of the operation, see the corresponding circuit descriptions.

1.07 The life of a grid battery starts with the completion of its manufacture. Time between that date and actual installation represents so much loss of useful life. This should be kept to a minimum consistent with other factors, such as availability and the necessity for immediate replacement in case of failure. It is important that the correct number of cells be used. Do not add cells to compensate for decreased battery voltage. When the regulated voltage can no longer be obtained by adjustment of the regulating rheostat, ADJ VOLTS, check the grid battery voltage with a voltmeter and replace a battery which measures less than 41.9 volts. A small automatically regulated metallic rectifier unit is sometimes used instead of a grid battery and such unit is called the grid rectifier unit.

1.08 More detailed information on the operation and maintenance of individual pieces of apparatus, such as instruments and relays, is given in other sections and the attendant should, of course, be familiar with them. All apparatus is assumed to have been adjusted in accordance with these sections and with the circuit requirements table or the circuit description associated with the circuit drawing. Refer to such sections as:

A401.562 Meters and Instruments
A438.961 Electrolytic Capacitors
A462.012 KS-5596 Time-delay Relay
A801.303 Regulated Tube Rectifiers
A801.910 Artificial Loads

1.09 Battery readings called for herein may be made with the plant voltmeter or voltmeter relay, a KS-8093 voltmilliammeter, or a Weston Model 280 voltmeter, provided that the instrument has been calibrated for accuracy at float voltage.

1.10 Information in this section is arranged under the following headings:

1. GENERAL
2. OPERATION
 - 2.01 Description
 - 2.06 Preparing to Start
 - 2.07 Initial Adjustments
 - 2.11 Routine Adjustments
3. ROUTINE CHECKS
4. TROUBLES

2.02 Tubes V1 and V2 rectify the power under control of their grids, utilizing the magnitude of the grid-to-filament potential as a means of regulation. The d-c output is filtered by retardation coil L1 which is externally mounted, and limited by ballast lamp V3. Capacitors H, H1, and D, and retardation coils L3 and L4 suppress radio interference generated in the rectifier tubes, while capacitor T serves to prevent carrier and low radio frequencies from being induced in the a-c and d-c circuits. Ammeter A is provided to indicate the output current.

2.03 The regulating potentiometer circuit consists of resistor B, rheostat ADJ VOLTS, and varistor H, connected in series between the positive output lead and a fuse connected to the negative output. The varistor operates as a rectifier and inserts a d-c potential, filtered by capacitor C, into the circuit serving to compensate for changes in line voltage. The common point of B and ADJ VOLTS is connected through a grid bias supply shunted by resistor S, to the 1B contact of relay GR which closes the circuit through to the common point of E and F, and thence to the grids of the two tubes. In list 6 units, rheostat ADJ VOLTS is located externally to the rectifier unit. A rheostat, AH, is inserted between the common point of B and ADJ VOLTS and the grid bias supply. Capacitor A is associated with AH to furnish an adjustable antihunt feature. The ballast lamp is replaced by a fuse. See the drawing and associated CD for details.

2.04 A connection is carried from the negative terminal of varistor H to the 3B contact of relay GR, which is closed when GR is released, and through E and F to the grids. This makes the grids highly negative during the warming-up period, thus protecting the filaments while they are coming up to operating temperature. On starting, relay GR remains released until operated by relay TD, not shown, after a delay of 4.5 ± 5 seconds.

2.05 A discussion of the theory of the magnitude control operation of these rectifier units is given in the Educational Information Section, A801.303.

Preparing to Start

2.06 When preparing the rectifier for initial operation, check against the SD drawing to see that:

- (a) The transformer taps used are correct for the power service voltage.
- (b) The correct tubes are in the sockets.
- (c) The correct d-c fuse is in place.
- (d) The proper grid bias battery or rectifier unit is in the circuit.
- (e) The grid bias rectifier unit, if provided, has been adjusted correctly.

(f) The regulating rheostat, ADJ VOLTS, is in its extreme CCW position.

(g) There is available sufficient office load to load one rectifier unit fully or an artificial load of like capacity.

Initial Adjustments

2.07 To adjust the rectifier unit to float a 24-cell battery, rotate the ADJ VOLTS rheostat in a CW direction until the battery voltage, as indicated by the plant voltmeter or voltmeter relay is at the correct value specified for the office, with the output current within the limits given in the following table. These limits depend upon the power service voltage at the time of making the adjustment. Use a portable a-c voltmeter for reading the service voltage and observe the rectifier ammeter.

Nominal Volts	Power Supply Observed Volts		Output Amperes	
	Min.	Max.	Min.	Max.
105	102	113	2	7
	97	102	2	5
115	112	124	2	7
	106	112	2	5
125	121.5	135	2	7
	115	121.5	2	5
190	184	206	2	7
	174	184	2	5
210	204	226	2	7
	194	204	2	5
230	224	248	2	7
	212	224	2	5
250	243	270	2	7
	230	243	2	5

2.08 If the plant load at the time of adjustment is less than the minimum value as given in 2.07, an artificial load may be used to bring it up to the required value. As an alternative allow the battery to discharge, by rotating rheostat ADJ VOLTS to its extreme CCW position. After a suitable interval, try again to raise the adjustment to the required value, relying on the battery charging current to provide sufficient load on the rectifier unit to maintain the output above the minimum. If, however, the load is in excess of the desired value, rotate rheostat ADJ VOLTS in a CW direction to charge the battery until its voltage is above the float value. After a short time, proceed to adjust the rectifier, relying on the battery to furnish a part of the load.

2.09 To adjust the rectifier unit to float a 23-cell battery, remove the fuse in the -RC lead, allowing the unit to operate at full output. When the battery voltage, as indicated by the plant voltmeter or voltmeter relay, is at the upper end of the floating range, replace the fuse and turn rheostat ADJ VOLTS until the output is approximately 3 amperes, with the voltage still at the upper end of the floating range. The output current will, in several minutes, change to the value required to float the load and the voltage will remain in the floating range if the current is less than

8 amperes. With larger output current, the voltage will decrease to approximately 46 volts. Never attempt to adjust the voltage by means of rheostat ADJ VOLTS when the voltage is not at the upper end of the regulating range.

2.10 Check the time between turning on the power and the operation of the TD relay, as evidenced by the operation of the GR relay. Readjust, if this time is other than 45 \pm 5 seconds.

Routine Adjustments (Day to Day Operation)

2.11 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.

3. ROUTINE CHECKS

3.01 Periodically, observe the voltage and current to see that the average float voltage is close to the value specified for the office, with lower values under heavy load and higher values under light loads, not exceeding 52 volts for a 24-cell battery or 50 volts for a 23-cell battery. Make minor adjustments of the ADJ VOLTS rheostat as required.

3.02 The output current of a rectifier unit may usually be brought within the limits for adjustment by the use of one of the following procedures. If the current is high, raise the output voltage for a short period to charge the battery, and proceed to make the adjustment while the battery is carrying a part of the load. If the current is low, lower the output voltage for a short period allowing the battery to discharge, and proceed to make the adjustment while the rectifier is carrying the load and recharging the battery. In either case, avoid going outside the voltage limits applying to the office.

3.03 The following alternate method of adjusting a rectifier unit will be of advantage where the load is so high at the time the maintenance man visits the installation that it does not permit charging the battery as outlined above. This method is essentially one of applying to the regulating potentiometer circuit a voltage of the value at which cut-off of the tube is desired, and of adjusting the ADJ VOLTS rheostat to produce cut-off at that value. Obtain a portable voltmeter, a 4.5-volt dry cell battery (preferably a block battery) and a small potentiometer of 500 ohms resistance, minimum, and one watt rating, minimum. Connect the resistance terminals of the potentiometer to the battery and bring out connections from one of these terminals and from the movable contact of the potentiometer. To proceed, open the regulating potentiometer circuit at the negative end, for example at the -RC terminal or at the REG fuse. Connect the voltmeter from the open end of the

potentiometer circuit to its positive end, to indicate the voltage across it, and connect the potentiometer and test battery across the open to add to the voltage. Turn rheostat ADJ VOLTS to its extreme CW position. By varying the test potentiometer, bring the voltage across the regulating potentiometer circuit to 52.4 volts for a 24-cell battery or 50.1 volts for a 23-cell battery. Turn ADJ VOLTS slowly CCW until the tubes stop firing. Check this adjustment by varying the test rheostat and then restore the circuit to normal without changing the position of the ADJ VOLTS rheostat.

3.04 When a tube fails, or it becomes necessary to install a new grid battery, adjustment of the ADJ VOLTS rheostat will usually be required.

4. TROUBLES

4.01 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. Flash-over of a tube is current passing in the wrong direction through the tube and it renders the tube unsatisfactory for further use. It usually occurs after a tube has been used for some time and is nearing the end of its life. Flash-over will probably blow the charge fuse and burn out the ballast lamp. Cathode trouble usually consists of an open filament or low emission and tubes with cathode trouble are unsatisfactory for further use. Grid trouble may be high firing point or grid emission. High firing point is the condition where too high voltage is necessary to fire the tube. While this can be compensated for to some extent by changes in ADJ VOLTS rheostat setting, the tube is inclined to be unstable at light loads. It should be replaced if causing erratic operation. 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 light loads when it is not possible at full load after one hour of operation.

4.02 When a rectifier unit is functioning properly, clockwise operation of the ADJ VOLTS rheostat will increase the output and counterclockwise operation decrease it. For battery charging, counterclockwise operation of this rheostat should decrease output current to 10 per cent of rated output or less and if smooth control stops at a higher value, it is known as high drop-out. High drop-out may be due

to the use of the wrong transformer tap or to a tube having a high firing point (see 4.01).

4.03 Large fluctuations or "kicks" of the ammeter needle may be due to a depleted grid battery even when the regulating rheostat has not been turned to its extreme CW position. Any grid battery whose voltage, as read on a Weston Model 280 voltmeter, is less than 41.9 volts should be replaced. Similarly, if full output can not be obtained with the ADJ VOLTS rheostat in its extreme CW position the grid battery should be replaced.

4.04 A control rheostat should be replaced if it becomes defective in any respect.

Trouble Chart

4.05 Should any of the following troubles develop, it is suggested that the possible cause be checked in the order given. If the trouble is not found, look for loose or open connections, or short circuits due to foreign matter lying across wiring terminals. If a check of the possible causes listed below or the use of the point-to-point voltage table does not lead to the location of the trouble, it is advisable to make resistance measurements with the circuit completely de-energized, comparing the measured values with the values shown in Fig. 1.

<u>Trouble</u>	<u>Possible Cause</u>
No output current	Power failure Blown a-c fuse Disconnected a-c plug Failure of rectifying tube Failure of ballast lamp Charge fuse blown Failure of GR relay to operate
A-C input fuse blown	Defective rectifying tube
Low d-c voltage	Low output from grid bias supply Low emission in rectifying tube ADJ VOLTS rheostat out of adjustment or contact failing Ballast lamp aged
High Current	Open in regulating circuit REG fuse blown Grid emission in rectifying tubes ADJ VOLTS rheostat out of adjustment GR relay failing to close its contact Capacitor associated with the varistor is defective

<u>Trouble</u>	<u>Possible Cause</u>
Output erratic under light load	Variable voltage from grid bias supply Rectifying tube has high firing point or high drop-out

5. POINT-TO-POINT VOLTAGES

5.01 As long as the rectifier unit operates satisfactorily, point-to-point voltage values are not needed and are not operating requirements to be checked in routine. In case the rectifier output cannot be obtained, they may be useful in locating defective conditions.

5.02 High voltages to ground are present within the rectifier unit and every precaution should be observed to avoid any contact with exposed metal parts or terminals when the rectifier unit is in operation, or when not in operation, but connected to the line.

Caution: When using any portable instrument, the leads should be carefully examined to make sure the insulation is undamaged. The leads should be connected at the instrument before making contact with the circuit to be tested. If connections are to be changed from one instrument range to another, the test picks should first be removed from the equipment being tested.

5.03 The readings given in the table are approximate and typical of a rectifier unit adjusted as indicated. They are made with the M9B meter which is accurate to ± 5 per cent on alternating current and to ± 2 per cent on direct current. It will not seriously affect the output of the rectifier unit when connected for making the readings.

Caution: The readings shown in the following table are for a typical rectifier unit in good working condition. A defect in a rectifier unit may leave a high voltage charge on a capacitor and other parts of the circuit with the power off. A defective rectifier unit with the power connected may have quite different voltages than those shown. Therefore, it may be desirable to use a higher voltage jack in the meter until readings indicate the proper jack to use for the defective condition.

5.04 Rectifier unit adjusted to 51.6 volts at the output terminals, output current as indicated in the table, with normal power supply.

POINT-TO-POINT VOLTAGES

<u>Voltage Across</u>	<u>M9B Preparation</u>		<u>Connection of M9B to Apparatus</u>				<u>Typical Reading</u>	
	<u>V Jack</u>	<u>Toggle Switch</u>	<u>V Jack</u>		<u>-V Jack</u>		<u>Volts Output</u>	
			<u>App.</u>	<u>Term.</u>	<u>App.</u>	<u>Term.</u>	<u>1 amp</u>	<u>8 amp</u>
Filament	15	A-C	V1	+	V1	-	2.6	2.6
Bias	30	D-C	Term	A+	GR	2B	3.7	2.3
Varistor	15	A-C	H	2	H	4	8.7	8.7
Varistor	15	D-C	H	1	H	3	9.9	9.7
Output	150	D-C	Term	A+	L	2	51.6	51.6
Grid Battery	150	D-C	S	C+	S	C-	45.0	45.0
Ballast Lamp	15	D-C	V3	Term	V3	Term	0.2	5.9

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