RECTIFIER
J86207W
OPERATING METHODS

CONTENTS

1. GENERAL

1.01 This section covers the operation of the J86207W automatically regulated electron-tube or semiconductor rectifier using phase-shift control.

1.02 This section is reissued:

(a) To add information for the KS-19699 solid-state Thyratrons.

(b) To add Fig. 1.

(c) To bring the section up to date.

Since this reissue covers a general revision, the arrows ordinarily used to indicate changes have been omitted.

1.03 This rectifier is adaptable for connection to a 210-, 230-, or 250-volt, ±5%, 50- to 60-cycle, ±2%, single-phase power source and is designed to operate without batteries into a continuous or intermittent resistance load. When equipped with electron-tube Thyratrons, the dc output rating is 8 amperes at 130 volts. When equipped with KS-15968 (early design) or KS-19699 (later design) solid-state Thyratrons, the dc output current capacity is increased from 8 to 9 amperes. The dc voltage regulation is ±0.5 percent for output currents of 0.5 ampere to full load and including ±5 percent ac input voltage variation.

1.04 ***Caution: Voltages inside the rectifier exceed 200 volts to ground. Avoid all contact with terminals. Do not allow a test pick to touch two metal parts at the same time or destructive and dangerous short circuits may occur. The door switch behind the hinged front panel, when open, disconnects the ac from the transformers but leaves a number of terminals and contacts at the service voltage and usually at voltage to ground. The door switch is provided for the protection of personnel and should not be made inoperative. Disconnect the ac supply before opening covers to work inside the rectifier except as necessary to make tests.***

1.05 Wiring options are provided to permit the rectifier to be used with either the positive or negative output leads grounded.

1.06 A grid battery (grid-bias rectifier unit or battery eliminator) is required for operation of the rectifier. The grid-bias unit and battery eliminator are mechanically interchangeable with the grid battery.

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

1.08 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.

1.09 The instructions are based on the following drawings and the associated circuit descriptions.

SD-80937-01 for the J86207W rectifier.

SD-81563-01 for the KS-15968 solid-state Thyratrons.

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

Solid-State Thyratron Conversion

1.11 The J86207Y, L4 conversion kit consists of the necessary equipment and wiring for field replacement of the V1 and V2 electron tubes with solid-state Thyratrons.

Note: Conversion kits of early design were furnished with KS-15968 L1 solid-state Thyratrons. Conversion kits of later design are furnished with KS-19699 L4 solid-state Thyratrons.

Caution: When the V1 and V2 electron tubes are being replaced in the field by the solid-state Thyratron conversion kit, all procedures and adjustments covered in 3.01, 3.02, and 3.03 must be followed before returning the rectifier to service.

2. TOOLS, TEST APPARATUS, AND MATERIALS

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
—	3-Inch C Screwdriver
TEST APPARATUS	
KS-14510 L1	Volt-Ohm-Milliammeter
MATERIALS	
—	Abrasive Paper — Garnet, 4/0 or Flint, Extra Fine
—	Hardwood Toothpicks, Flat at One End and Pointed at Other

3. OPERATION

Preparing to Start Initially

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

(a) Following fuses are removed.

AC power supply fuses (not in rectifier).

CHG G fuse.

(b) ON-OFF switch is in the OFF position.

(c) External load is disconnected. See 3.02(c).

(d) Correct taps on T1 and T2 transformers are selected, as covered on the SD drawings, for the ac service voltage. Use the KS-14510 meter to measure the voltage.

(e) Correct electron tubes are in the sockets.

(f) In semiconductor rectifiers, the correct solid-state Thyratrons are in the sockets.

(g) Grid battery, if provided, is installed and properly poled.

(h) Grid-bias rectifier unit, if provided, is adjusted correctly.

(i) Grid-battery eliminator, if provided, is properly installed.

(j) AUTO-MAN switch rheostat control is in the MAN position and the control is turned as much counterclockwise as possible without snapping the switch to the AUTO position.

(k) N rheostat screwdriver control is in the maximum clockwise position.

(l) REG potentiometer screwdriver control is in the maximum counterclockwise position.

(m) H resistor is wired in the circuit for 130-volt output. See SD-80937-01.

Note: The H resistor should be strapped out for 120-volt output. See "V" option wiring on the SD drawing.

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

(o) Hinged control panel is closed tightly so that door switch is operated properly.

(p) An adequate office load or an adjustable test load capable of carrying 10 amperes or more at 150 volts is available.

Initial Adjustments

3.02 For manual operation and test, proceed as follows.

(a) Insert the ac power supply fuses of the proper size.

(b) Apply the input power by operating the ON-OFF switch to the ON position and check the operation time of the TD relay as covered in 4.01(d).

Note 1: After approximately a 1-minute delay, V voltmeter should indicate a small potential.

Note 2: When starting with room temperature between 40 F and 50 F, the electron tubes probably will not deliver output current after the TD time-delay relay operates, until they are warmed by their filaments from 2 to 20 minutes.

Note 3: Rectifiers equipped with solid-state Thyratrons will deliver output current as soon as the TD time-delay relay operates.

(c) Install CHG G fuse to connect the test load.

Note: Electron-tube rectifiers should always be started with the external load disconnected.

(d) Adjust the test load for the rectifier rated output current.

Note: Do not permit the output to exceed 8 amperes for rectifiers equipped with V1 and V2 electron tubes, and 9 amperes for rectifiers equipped with solid-state Thyratrons.

(e) Adjust the AUTO MAN control slowly clockwise, observing that the output voltage can be increased to 130 volts as indicated on the V voltmeter.

Note: The AUTO-MAN switch rheostat control should always be in the position stated in 3.01(j) when the rectifier is turned on before constant voltage adjustments have been made and when used under manual control. This will prevent overloading the rectifier.

3.03 For automatic operation and test, proceed as follows.

(a) With the rectifier operating as covered in 3.02, rotate the AUTO MAN control counterclockwise to the AUTO position (indicated by the operation of the rotary snap switch on the control shaft).

(b) Adjust the REG control clockwise to secure the desired output voltage.

(c) Verify that the N rheostat control is in the maximum clockwise position. Adjust the control counterclockwise until the rectifier output starts to hunt. See Notes 1 and 2. Then operate the control clockwise approximately one-quarter turn. Do not operate the control clockwise, if the control has been adjusted to the maximum counterclockwise position and if hunting does not occur.

Note 1: Hunting: In electron-tube type rectifiers, hunting is evidenced by considerable flickering of the V1 and V2 rectifier tubes, together with unstable indications on the V voltmeter.

Note 2: Adjusting the N control too far counterclockwise may cause the rectifier output to hunt and adjusting too far clockwise will cause the output to follow variable loads too slowly.

Routine Adjustments

3.04 For routine starting and stopping when the voltage regulation of the rectifier is in adjustment, it is only necessary to operate the ON-OFF switch to the ON or OFF position. Install the CHG G fuse to start the rectifier. See 3.02(c).

4. ROUTINE CHECKS

4.01 The following should be performed.

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

(b) *Grid Battery:* Using the KS-14510 meter, periodically check the voltage of the grid battery. Unless otherwise specified on the SD drawing or local instructions, replace a battery if the voltage is less than the cut-off voltage value for the battery specified in Section 157-421-501.

Note: Grid batteries used with the rectifier have an initial peak voltage which decreases to a lower value in a few days or weeks. The voltage then remains almost constant, dropping off gradually during almost all of the life of the battery.

(c) After an electron tube is replaced or it becomes necessary to install a new grid battery, adjustment of the REG control will usually be required.

(d) Check the time between applying the ac input power and the operation of the TD relay as evidenced by the operation of the GR relay. In electron-tube rectifiers, if the time is other than 45 ±10 seconds, adjust the TD relay as covered in Section 040-640-701.

(e) Periodically readjust the REG control to secure the output voltage as required, with the rectifier on automatic operation.

(f) With the rectifier operating manually, adjust the AUTO MAN control clockwise and check that the output voltage increases. Snap the AUTO MAN control counterclockwise to the AUTO position and note that the output voltage decreases.

(g) 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 requirements and sections which apply.

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

5. TROUBLES

5.01 ***Electron-Tube Rectifiers:*** Where "G" option wiring is used in the rectifier, ac service interruptions ranging from 5 to 45 seconds will seriously reduce the life of V1 and V2 Thyratron electron tubes. See SD-80937-01.

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

5.03 Control rheostats and potentiometers are totally enclosed and should be replaced if they become defective in any respect.

5.04 The W 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.

5.05 If V4 amplifier tube or the grid battery is replaced, it will be necessary to readjust the REG control to secure the desired output voltage.

5.06 ***Hunting:*** If the output voltage varies in a regular periodic manner as indicated on the V voltmeter, readjust the N control slightly clockwise until hunting stops. If the control has reached its maximum clockwise position before hunting stops, replace the grid battery and readjust the N control at full load as covered in 3.03(c).

5.07 Erratic operation may be due to a depleted grid battery even when the REG control has not been turned to its maximum clockwise position.

5.08 Where more than one electron tube may cause a trouble, replace those tubes with new ones until the trouble is corrected. Then put back the used electron tubes one at a time until the defective electron tube or tubes have been located. Replace the defective tube or tubes with new ones.

5.09 Short life of rectifying electron tubes may be due in part to low filament emission, short time delay for heating the filament and a dirty, corroded surface with insufficient spring tension in the anode cap connector clip. The low filament emission may be due to dirty contacts in the electron-tube socket. This can be corrected by burnishing the prongs on the tube base and the springs in the socket. For the latter, use abrasive paper over a toothpick to brighten the spring contact surfaces within the socket. The anode lead at the top of the electron tube is soldered to the cap and may become unsoldered due to heating caused by dirty contact surfaces between the cap and the clip. Whenever electron tubes are replaced, the anode cap connector should be cleaned on the contact surface with abrasive paper. If the cap connector has lost its spring tension and is loose, it should be replaced. The electron tube caps should similarly be cleaned. Caps which become unsoldered can usually be resoldered if the lead and cap surfaces can be cleaned. Only a very short amount of anode lead sticks through the depression in the cap and careful work will be required.

Trouble Chart

5.10 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 aging or drift in the constants of some faulty component. If one 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 point-to-point resistance measurements with the circuit completely de-energized comparing the measurements with the values shown on the SD drawings so that such faults may be found.

TROUBLE	POSSIBLE CAUSE
(a) No dc output	Failure or disconnection of the input power
	Blown or missing ac supply fuse or CHG G fuse
	SW1 door switch open
	Failure of V1 and/or V2 electron tubes (or solid-state Thyratrons)
	Failure of V3 and/or V4 electron tubes
	Failure of AC relay to operate
	Failure of GR relay to operate caused by aged W varistor
	Failure of TD time-delay relay to operate
	Shorted C1 through C4 filter capacitors
(b) Low dc output voltage	Line voltage more than 5 percent low
	Incorrect T1 input transformer taps used
	Failure of V1 and/or V2 electron tubes (or solid-state Thyratrons)
	Failure of V3 and/or V4 electron tubes
	Breakdown of C1 through C4 filter capacitors
	Incorrect adjustment of rheostat and/or potentiometer controls
(c) High dc output voltage	High line voltage
	Incorrect T1 input transformer taps used
	Incorrect adjustment of rheostat and/or potentiometer controls
(d) Erratic dc output	Defective connections
	Intermittent open or short circuit in any component

6. POINT-TO-POINT VOLTAGES

6.01 As long as the rectifier 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, these values may be useful in locating defects or trouble conditions.

6.02 High voltages to ground are present within the rectifier. Every precaution should be observed to avoid any bodily contact with exposed metal parts or terminals when the rectifier is in operation or not in operation but connected to the input power source or load.

6.03 For electron-tube rectifiers, the time required for the output voltage to stabilize after the power is connected is approximately 1 minute.

6.04 The voltage readings listed in the table are approximate and typical for a rectifier adjusted as indicated in 6.06. The voltages are measured with a KS-14510 meter. Connecting the KS-14510 meter to observe readings does not appreciably affect the rectifier output.

Caution: When using any portable instrument, the leads should be carefully examined to make sure the insulation is undamaged. The leads should be properly connected to the 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

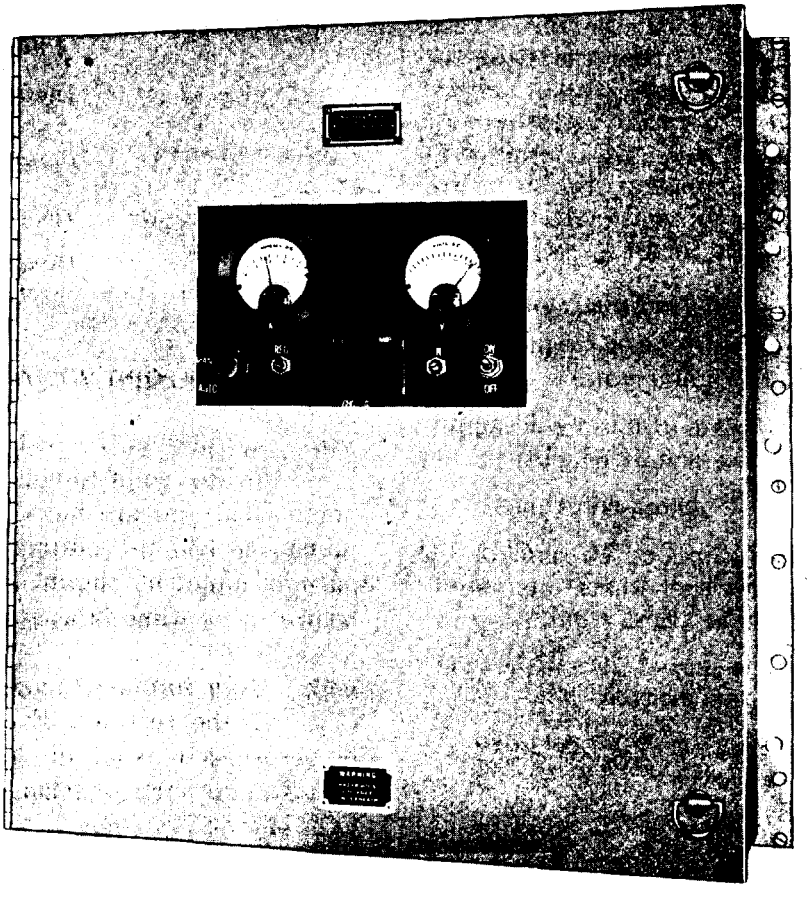

Fig. 1 – J86207W Rectifier — Front View

first be disconnected from the equipment being tested or, if test picks are being used, they should be removed from the equipment under test.

6.05 The procedure for making measurements is as follows. Unfasten and open the hinged front cover of the rectifier and operate the door switch with some insulating material in order to make the point-to-point voltage measurements. When the tests are completed, remove the insulating material from the door switch. Close and fasten the cover and check that the door switch is operated properly.

6.06 ***Table of Point-to-Point Voltages:*** The rectifier should be connected to the proper input power supply and adjusted at the point of regulation for a 130-volt output.

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

VOLTAGES FOR J86207W ELECTRON-TUBE RECTIFIER

MEASUREMENT MADE				KS-14510 METER		
FROM		*TO		SCALE AC OR DC	RANGE (volts)	READING (volts)
APP	TERM.	APP	TERM.			
V4	2	V4	5	DC	300	95
T1	1	T1	5	AC	600	420
T1	2	T1	4	AC	600	360
T2	3	T2	5	AC	12	5
T2	6	T2	7	AC	12	10
T2	8	T2	10	AC	300	140
T2	11	T2	13	AC	12	5
T3	"R" LEAD	T3	"R-W" LEAD	AC	300	75
T3	"G" LEAD	T3	"BL" LEAD	AC	300	150

*"TO" terminal should be connected to the negative jack of the meter.