J86244 RECTIFIER

1. GENERAL

1.01 This section covers the operation of a metallic-type rectifier using a saturable reactor control. The J86244 rectifier is used in the TD-2 radio relay system. It was designed to provide a regulated voltage for floating and charging 12-volt batteries in 425-type telephone power plants. The rectifier is rated 12 volts, 200 amperes direct current. It should give regulation within ±1 per cent from 5 to 200 amperes when adjusted to give voltage regulation between 12.5 and 13.5 volts, provided the power service variations do not exceed ±5 per cent in voltage and ±2 per cent in frequency. It is designed to use 230 volts, ±5 per cent single-phase, 60-cycle power but may be connected to 210-, 220-, 240-, or 250-volt service by using an input autotransformer. The rectifier is self-regulating and is suitable for use in room temperatures from 40 to 110F (4 to 43C).

Caution: Voltages inside the rectifier case are over 150 volts. 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. Remove all the dc fuses from the rectifier and the ac fuses from the ac cabinet before removing any protective guards behind the covers to work on the inside of the unit. There are connections protected from the battery only by a large CHARGE fuse. Operating REGULATOR circuit breaker to off only turns the rectifier "down," not off.

1.02 This section is reissued to change the title and to revise Fig. 3 in accordance with the latest changes in the circuit drawing. Fig. 3 was formerly Fig. 1. Fig. 1 and 2 have been added and the section has been brought up to date.

1.03 The abbreviations cw and ccw, used herein, refer to clockwise and counterclockwise rotation, respectively.

1.04 Keeping the ventilating passages and rectifier cells clean is especially important to prevent excessive heating. Care should be taken when soldering above stacks to prevent solder splashes from shorting cells in a rectifier stack.

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 drawing SD-81088-01. For detailed description of the operation, see corresponding circuit description.

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

A301.823 - 425A Power Plant - J86439
A401.528 - Small Circuit Breakers
A401.562 - Meters and Instruments
A401.522 - Ammeter Relay
A801.910 - Test Loads for Power Equipment

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

1. GENERAL
2. OPERATION
   - 2.01 How the Rectifier Works
   - 2.03 Regulation
   - 2.04 Manual Control
   - 2.06 Preparing to Start Initially
   - 2.08 Initial Adjustments
   - 2.15 Routine Adjustments
3. ROUTINE CHECKS
4. GENERAL TROUBLES
5. POINT-TO-POINT VOLTAGES

1.09 List of Tools and Gauges (Equivalents may be substituted)

Electron tube test set

Pad, felt

Screwdriver, cabinet, 3 inch

Thermometer, 0° to 110C, R1032

Voltmeter, ac, Weston Model 155, 150-volt scale

Volt milliammeter, KS-8039

Volt-ohm-milliammeter, KS-14510, List 1

2. OPERATION

How the Rectifier Works (See Fig. 3 - Simplified Schematic and Block Diagram)

2.01 Single-phase power is fed either directly or through an autotransformer to the buck boost control circuit consisting of T6 transformer and L2 saturable reactor. The output voltage of T6, related to the line voltage, determines the primary voltage applied to step-down transformer T5 which delivers alternating current to the rectifying element SR1 to SR4, where the alternating current is rectified to direct current. The voltage drop in the L2 saturable reactor, in series with part of the T6 autotransformer, is controlled by the degree of saturation in the cores of the saturable reactor. As the saturation increases, the impedance of the saturable reactor decreases, resulting in an increased voltage applied to the rectifying element, thus increasing the rectifier output. Conversely, a decrease in saturation reduces the rectifier output. The rectifier output is filtered by the L1 filter coil.

2.02 The saturable reactor L2 has one dc winding (terminals 5-6) and two ac windings (terminals 1-2 and 3-4). The two ac windings and the primary of autotransformer (terminals 2-3) are connected across the power supply. The impedance of the reactor ac windings is controlled by the output current of the electronic control circuit. This current is indicated by the saturating current ammeter SAT CUR. The TST switches and a MAN potentiometer are also provided for manual regulation and for circuit checks.

Regulation

2.03 The electronic control circuit is essentially an auxiliary rectifier whose output is controlled by a V2 series tube, the resistance of which is varied by changes in grid-cathode bias resulting from the amplified effects of variations in either the output voltage or output current of the main rectifier. In general, the regulation will be on a voltage basis unless the load at the regulated voltage has exceeded full load as determined by the setting of the CUR MAX potentiometer. If the electronic control circuit fails and the output voltage goes high due to excessive charging current, a signal from the associated plant will cause CO to operate and open circuit breaker REGULATOR which shuts down the rectifier. Current is normally limited to 225 amperes, as determined by the setting of the high contact on the output current ammeter relay. Some rectifiers are equipped with a TD1 timer (22 seconds max) and a CO1 relay, paralleled with the CO relay which will operate to reduce the output of the rectifier if the CO relay fails to operate. When a rectifier shuts down due to an ac failure or when the REG circuit breaker operates the NV relay sends an alarm signal to the associated plant. If the REG circuit breaker fails to open when required, the REG fusetron will blow and open the ac supply thus lowering the output of the rectifier.

Fig. 1 - J86244 Rectifier Electronic Control Panel

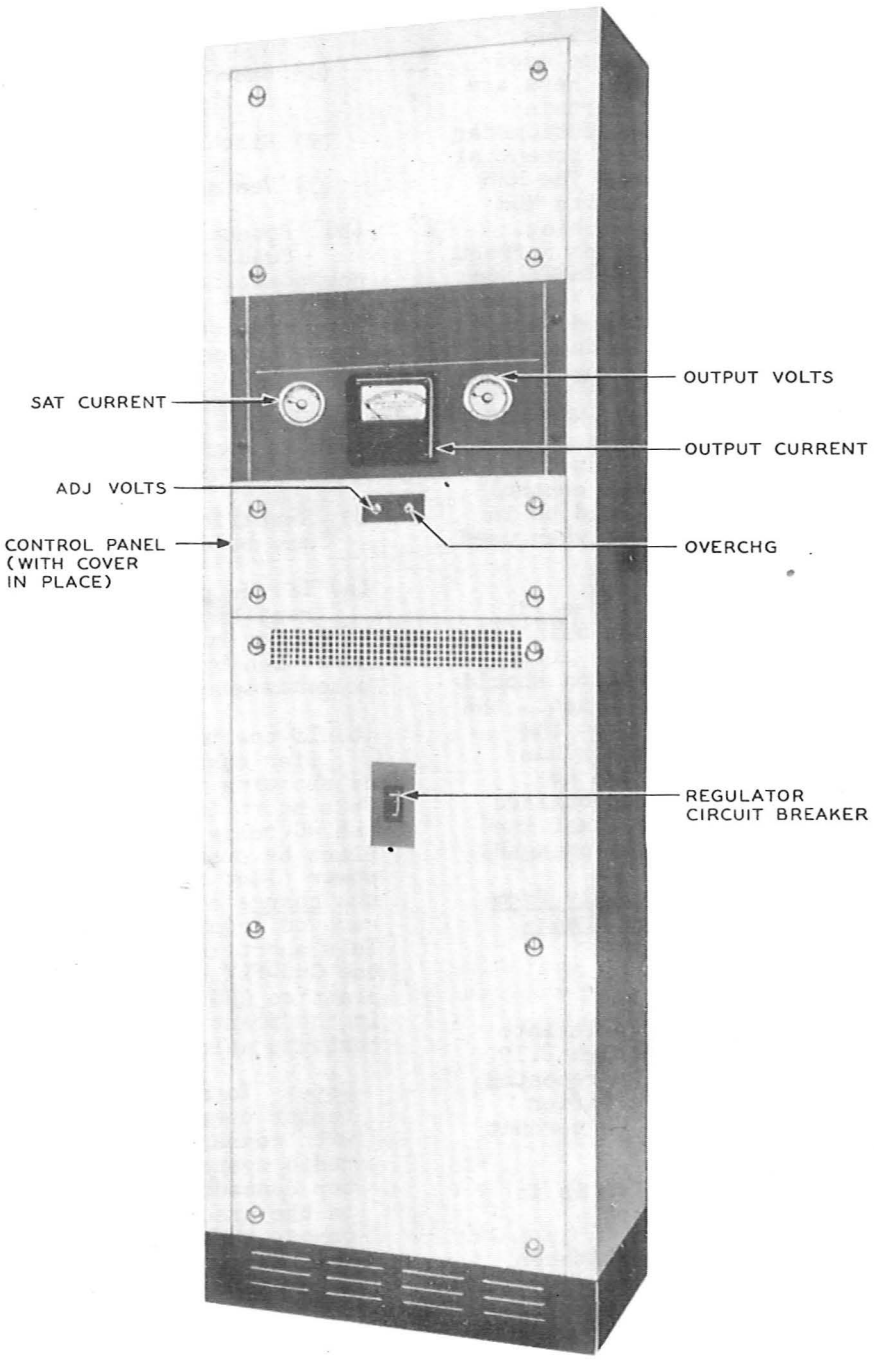

Fig. 2 - J86244 Rectifier

Manual Control

2.04 The MAN potentiometer and R11 resistor are connected across the plate supply as shown in Fig. 3. They provide an adjustable voltage for use in testing various parts of the control circuit and are used for manual regulation. Three test keys are provided to connect cathodes of certain tubes to terminal 3 of the MAN potentiometer, instead of their normal sources of potential in the automatic control circuit. The MAN potentiometer should always be in its NOR (extreme ccw) position before switching. Rotation cw increases the saturating current, thus raising the output. The NOR-TEST 1 key in its TEST 1 position affects the V2 tube only. It locks in this position and should be used when manual regulation is desired. The NOR-TEST 2 key in its nonlocking TEST 2 position, permits testing the 6-7-8 half of V5, which is the final amplifier. NOR-TEST 3 in its nonlocking TEST 3 position permits testing the 6-7-8 half of the V6 tube, which is the second stage of the current control amplifier. All TEST-NOR keys should be in their locking NOR positions except when used in testing.

2.05 An aging tap is provided on the T5 transformer for use when the main rectifier element has aged, usually after a long period of use. The connection should not be changed from tap 3 to tap 2 until the rated output cannot be obtained from the rectifier and until a thorough check has been made to be sure that there are no troubles. If rated output can be obtained with manual control, it indicates that the transformer taps do not need to be changed.

Caution: Disconnect power supply from the rectifier before changing transformer taps.

Preparing to Start Initially

2.06 When putting the rectifier unit into service initially, 2.06 through 2.17 are to be followed and need not be repeated for Routine Checks. Test each rectifier individually. Check against the SD circuit drawing to see that:

(a) The REGULATOR circuit breaker is in its OFF position (see Fig. 2).

(b) TEST 1, TEST 2, and TEST 3 switches are in their NOR positions.

(c) If input autotransformer is provided, the correct taps are used for the power supply voltage.

(d) Correct tubes are in sockets.

(e) Proper REGULATOR circuit breaker fuse FN and voltmeter fuse VM are in place.

(f) Proper ac power supply fuses are available.

(g) Adequate office load or a variable load capable of carrying 230 amperes at 12 to 14 volts is available. Battery must be in parallel with the load.

Note: The following expedients may be desirable in obtaining specified loads:

(1) Change output of another rectifier in the plant.

(2) Discharge of battery.

(3) Use of test load (see Section A801.910).

(h) Potentiometers MAN, OVER CHG, and COARSE ADJUST are in their extreme ccw positions. Potentiometer AH and CUR MAX are in their extreme cw position. Potentiometer ADJ VOLTS is in its approximate midposition.

(i) A suitable voltmeter having an accuracy within one half of one per cent is available. The panel voltmeter on the rectifier is for rough checks only.

2.07 Rectifier float or charge conditions may be obtained as follows:

(a) If the plant is not connected, the rectifier is normally in the charge condition but may be put in the float condition by rotating the OVER CHG potentiometer to its maximum ccw position.

(b) If the plant is connected, the rectifier may be put in the float condition by shorting the OVER CHG potentiometer. This short is normally applied through the OC relay in the associated 425A power plant by operating the CHG-FLT key in the power plant to FLT. The rectifier is in the charge condition when the short is removed from the OVER CHG potentiometer. This short is normally removed by operating the CHG-FLT key in the associated power plant to CHG. This operates the OC relay in the plant and opens the normally closed contacts which constitutes the short.

Note: To avoid undesirable load contactor operation in the associated plant with consequent voltage changes in the radio system during this test, insulate top contacts 1,3, and 5 of the L1 relay, in the associated plant. Be sure to remove these contact insulators after this test has been made on all rectifiers.

Initial Adjustments

2.08 Observe the directions in 2.06. Connect the power supply, the load, and the battery to the rectifier. Operate the TEST 1-NOR key to the TEST 1 position. Operate the REGULATOR circuit breaker to the ON position and allow a few minutes for the tubes to heat. Rotate the shaft of the MAN potentiometer slowly cw, observing the milliammeter SAT CURRENT, and the OUTPUT

CURRENT ammeter relay located near the top of the bay (see Fig. 2). Check to see that rated output can be obtained, as read on the OUTPUT current ammeter relay and OUTPUT VOLTS, by rotating the MAN potentiometer cw and adding load to obtain rated current and voltage. Restore the MAN potentiometer to its NOR (extreme ccw) position, the TEST 1-NOR key to its NOR position and remove the load. Operate the REGULATOR circuit breaker to its OFF position.

2.09 The OUTPUT CURRENT ammeter relay ordinarily should have the low contact set at 10 amperes and the high contact set at 225 amperes unless otherwise specified on the job drawings or the plant operating section.

2.10 Operate the rectifier to the float condition (see 2.07). See that all TST switches are in their NOR positions. With the rectifier warmed up, turn the COARSE ADJ VOLTS and the ADJ VOLTS potentiometers cw to obtain 13.0 volt output at between 50-and 150-ampere load.

2.11 Operate the rectifier to the charge position (see 2.07). Turn the OVER CHG potentiometer cw to obtain 13.5 volt output at between 50- to 150-ampere load.

2.12 To adjust potentiometer CUR MAX, add a dummy load of approximately 225 amperes to the rectifier. Vary the load and the CUR MAX potentiometer until an output of 205 to 215 amperes at 12.5 volts is obtained. [For other methods of adjusting the CUR MAX potentiometer, see 3.04 (c) and (d)].

2.13 In general it will be found that after the adjustments and tests have been completed, the potentiometer AH (anti hunt) will work most satisfactorily when left beyond the midpoint in the cw position.

Note: Some small periodic swings might occur due to the beacon lights flashing on and off. SAWMILLS TOO!

2.14 As a final step in the initial adjustments of the rectifier, adjust the rectifier for float condition and vary the load until an output of 175 amperes and 13 volts is obtained. Connect a KS-8039 voltmeter, or equivalent, across the regulating jacks REG+ and REG-. If necessary, readjust the ADJ VOLTS potentiometer to obtain exactly 13.0 volts as read on the KS-8039 voltmeter. Reduce the load to 50 amperes. if the voltage rises more than 0.2 volts, the regulating circuit is not functioning properly. Rotation of the AH potentiometer too far ccw will degrade regulation considerably. Restore the load to 175 amperes. Put the rectifier in the charge condition and observe the output current. If the output current exceeds 210 amperes, readjust it to 210 by changing the CUR MAX potentiometer. Reduce the load to about 100 amperes and allow the charging voltage to stabilize (approximately 30 minutes). If necessary, readjust the OVER CHG potentiometer to obtain exactly 13.5 volts. Since any one of these adjustments may affect the others, a recheck of the operation should be made to see if any change is necessary in adjustment of the CUR MAX potentiometer. Restore the plant to the float condition, removing the portable voltmeter and any artificial loads if used.

Routine Adjustments (Day-to-Day Operation)

2.15 The rectifier is completely automatic in the regulation of the float voltage and should require no routine adjustments. If the load exceeds the safe capacity of the rectifier, the regulating circuit automatically switches over to constant current control. As the load diminishes, the rectifier returns to float voltage regulation.

2.16 The rectifier should start and build up its output in less than one minute unless the associated plant causes a greater delay. The amount of current in the regulating coils of the saturable reactor is indicated on the SAT CURRENT ammeter. The output voltage and current of the rectifier are indicated on the OUTPUT VOLTS voltmeter and OUTPUT CURRENT ammeter relay respectively. All adjustments of float voltage should be made using the plant voltmeter or an accurate voltmeter connected across the REG+ and REG- jacks.

2.17 Measure the input voltage to the stacks when the stacks are new and the rectifier is operating at rated current, voltage, and normal line input, with a Weston Model 155 voltmeter or an equivalent 0.5 per cent accurate meter. Record these readings, together with the SAT CUR ammeter reading, and place them on the rectifier for future reference (see 4.10).

3. ROUTINE CHECKS

3.01 The rectifier has no disconnecting switches and is connected to both the ac power and the battery when the associated fuses are in place. The REGULATOR circuit breaker is used to connect and disconnect ac power for the electronic control. With this breaker in the OFF position, the rectifier output is zero and it may be used to remove the load from the rectifier before removing the battery and power fuses. While opening the circuit breaker reduces the rectifier output to zero, it does not disconnect power from the rectifier main transformers, the rectifying element, and other parts of the rectifier.

3.02 As often as local experience demands, the relays should be inspected for adjustment and condition of contacts, making

sure that they are in accordance with the circuit requirement tables and sections which apply.

3.03 Float or charge voltages should be observed on the BAT VOLTS voltmeter in the 425A plant. Total load current may be observed on the LOAD CUR ammeter in the plant. Rectifier output current may be observed on the OUTPUT CURRENT ammeter. If it is necessary to shut down any rectifier during the following tests, restore the power as soon as possible as the rectifier requires at least 30 minutes heating to assure stability.

3.04 It is recommended that the routine checks and adjustments in the following paragraphs be made monthly until operating experience indicates a longer interval.

(a) After the rectifiers have warmed up by operating for at least 30 minutes and are in the float condition, check to see that each rectifier is carrying its share (within ±20 per cent) of the total load. To determine the load each rectifier should carry, divide the total load current by the number of rectifiers used and, if necessary, adjust each rectifier with the ADJ VOLTS potentiometer to approximately this calculated value and also obtain exactly 13.0 volts on the BAT VOLTS voltmeter in the plant. This adjustment may drift with time, but need not be changed until one of the rectifiers is supplying less than 14 amperes. If the voltage is low, increase the output of the rectifier producing the lowest current, and if the voltage is high, decrease the output of the rectifier producing the highest current.

(b) Check and if necessary adjust the voltage, while in the charge condition, to 13.5 volts as observed on the BAT VOLTS voltmeter in the plant with the OVER CHG potentiometer.

(c) Check the maximum rectifier current by using a load (see 2.12). If a dummy load is not available and the office load exceeds 210 amperes, check the CUR MAX potentiometer adjustment as follows. Operate the NOR-TEST 1 switch on a rectifier carrying part of the load to TEST 1 position. Rotate the MAN potentiometer until the rectifier under test is carrying a load of over 210 amperes. Vary the MAN potentiometer (on rectifier operating on manual) and the CUR MAX potentiometer (on rectifier under test) until an output of 205 to 215 amperes at 12.5 volts is obtained.

(d) To adjust the CUR MAX potentiometer when no load is available and the office load is less than 210 amperes, the following procedure should be used.

Note1: In some cases it is difficult to obtain entirely satisfactory results with this procedure.

With the rectifiers in the charging condition and the MAN potentiometer in the NOR position, operate the TEST 1-NOR switches on all rectifiers to their TEST 1 position until the battery voltage decreases to 12.0 volts. Restore the TEST 1-NOR switch to NOR on one of the rectifiers and observe the output current on that rectifier when the battery voltage has increased to 12.5 volts. Adjust the CUR MAX potentiometer, if necessary, to obtain an output current between 205 and 215 amperes at the 12.5-volt point. Return that rectifier to manual operation by operating its TEST 1-NOR switch to TEST 1 position and repeat the CUR MAX test on the other rectifiers, one at a time, allowing the battery to drop to 12.0 volts between each rectifier test.

Note2: To avoid undesirable load contactor operation in the associated plant with consequent voltage changes in the radio system during this test, insulate top contacts 1, 3, and 5 of the L1 relay in the associated plant. Be sure to remove these contact insulators after this test has been made on all rectifiers.

3.05 Routine checks on the rectifier shutdown operation and no-voltage alarm are covered in the associated plant, Section A301.823.

3.06 If the V2 tube (421A) draws excessive grid current, the rectifier may lose regulation control. As checking this tube in an electron tube test set may not indicate this defect, make the following in-circuit test with the rectifier operating for at least 30 minutes. Connect a KS-14510, List 1, voltmeter (60-volt dc scale, 20,000 ohms per volt) across the R16 resistor as follows. Connect the positive lead to terminal punching TP1 and the negative lead to jack P. If the reading exceeds one volt, the V2 tube should be replaced and the new tube checked after 30 minutes of operation. This test should be made monthly until operating experience indicates otherwise. Failures of this tube have been reported as a fairly common source of trouble.

3.07 Routine checks of the V6 tube (396A) should be made in any available electron tube test set every six months until operating experience indicates otherwise. The filament activity test for this tube is particularly important. When replacing tubes not meeting the requirements, check the new tubes for filament activity before installing.

4. GENERAL TROUBLES

4.01 The J86244 rectifier, like most closely regulated rectifiers, consists of a main power circuit controlled through a feed-back regulating circuit whose input is the output voltage and in this case also the output current, and whose output is introduced into the main power circuit to effect the desired power output corrections. In the maintenance of any equipment having a considerable degree of intricacy, any trouble must be localized in an orderly way, and this is rendered rather difficult in the case of a feed-back circuit because trouble anywhere in the loop will give indications of faulty operation of other parts of the loop which may be trouble free. In this rectifier unit, certain features have been included so that it is possible to open the loop to pin down the trouble a step at a time by checking the performance of each major subdivision of equipment in turn until the subdivision in trouble is located. This is done using the test switches as outlined in 3.03.

> Caution: The MAN potentiometer should always be turned completely ccw to the NOR position before operating a TEST key to avoid excessive output voltage and current.

4.02 Although the saturating current may vary widely with extreme conditions when observed in connection with daily routine and compared with operating experience, it can serve as a guide to the causes of unusual operation or trouble conditions. The purpose of the SAT CURRENT milliammeter is to give a continual indication of the output of the electronic control circuit, which output also controls the input to the main rectifying circuit (see Fig. 3). The saturating current supply circuit and main rectifier circuit are generally performing satisfactorily if increasing the amount of saturating current increases the rectifier output and decreasing the saturating current decreases the rectifier output. The grid-to-cathode potential of the first voltage stage of amplification may be varied by adjusting the ADJ VOLTS potentiometer and that of the first current stage by varying the rectifier output current. Provision is also made to manually control this saturating current, in which case most of the features of the more complex regulating circuit are temporarily disabled. The test switches are provided to permit the application of a manually adjustable potential in the grid-to-cathode circuit of the several triodes beyond the first stage of current amplification and the first stage of voltage amplification.

4.03 To see if trouble is in the main rectifier circuit or the connected plant, reduce output to minimum by maximum ccw rotation of the COARSE ADJ VOLTS potentiometer and remove the associated charge lead fuse in the connected plant. Trouble in the rectifier is now indicated if the output voltage, as read on the OUTPUT VOLTS voltmeter is not now controlled by rotation of the COARSE ADJ VOLTS potentiometer. If operation seems normal, restore rectifier to service by reducing output to minimum, replacing charge lead fuse, and adjusting for float as outlined in 3.05(a).

4.04 When any kind of trouble is encountered in the rectifier, it is necessary first to decide whether to locate the trouble with the equipment operating or de-energized. This rectifier has been designed to make parts accessible for testing with the power connected. All parts over 150 volts to ground have been covered or shielded by insulating guards. Trouble is easier to find if the equipment can be fully energized, but if the trouble is of a nature that causes excessive output from the equipment, it will be necessay to take the initial steps with the system de-energized, energizing it in subdivisions for short periods only while electrical measurements are made. Also, operation for more than a few minutes at a time while trouble exists, even though the output may not be excessive, may result in overheating of some component. In other words, it is essential when testing to be alert for quickly shutting down the rectifier at any time until the trouble is localized and cleared.

4.05 In general, the only items likely to become defective with use are the V1 to V6 tubes. These are subject to aging but should have long life. Check the electron tubes in any available electron tube test set in accordance with its associated instructions one at a time, or mark the tubes as interchanging tubes may spoil adjustments. Grid emission or cathode-to-grid shorts may not occur until the tube is fully heated and therefore may not be detected in the tube test set but may cause a rectifier failure after several hours of heating. Flashover on a rectifier tube will render it unsatisfactory for further use.

4.06 KS-13790 control potentiometers are totally enclosed and should be replaced if they become defective in any respect.

4.07 KS-13674 switches are totally enclosed and should be replaced if they become defective in any respect.

4.08 Rectifier stacks will age with use and after a period of years it may become necessary to change the connection from the NEW to the AGED tap (terminal 3 to terminal 2) on transformer T5 (see 2.05). If replacement of stacks is necessary due to aging, replace all stacks. If, however, a single stack opens or shorts when the others are comparatively new, the single

stack may be replaced with one of the same code. Do not combine stacks from different manufacturers.

4.09 If the rectifier stacks seem hot, check the temperature with a thermometer as follows. Hold the bulb of the thermometer against the stack, covering that part of the bulb which is not in contact with the stack with a piece of felt, or equivalent. If the temperature exceeds 90C, the stacks are probably nearing the end of their useful life and the supervisor should be notified so that replacement of stacks may be considered.

4.10 An alternate method for determining if the rectifier stacks are approaching the end of their useful life is to measure the ac input voltage to the rectifier stacks when the rectifier is operating under the same conditions as outlined in 2.17, with a Weston Model 155 voltmeter or an equivalent 0.5 per cent meter. Compare these values with those obtained initially in 2.17. When the voltage difference between the two sets of readings exceeds 2 volts or if the SAT CUR ammeter reading changed appreciably from the initial value, refer the matter to the supervisor as the rectifier stacks may have to be replaced.

Trouble Chart

4.11 Should any of the following troubles develop, it is suggested that the possible causes be checked in the order listed. If 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 measurements with the values shown on the circuit drawing.

Trouble	Possible Cause
Rectifier failure	If high-float or high-voltage alarm came in, check V2, V3, or V5. If no alarm came in, check V1.
No dc output current	Power failure Blown ac supply fuse or charge fuse
	ADJ VOLTS or COARSE ADJ VOLTS potentiometer out of adjustment
	Failure of V1, V2, V3, or V5 tube
	No saturating current
	Open breaker REGULATOR, possibly due to operation of CO relay
Low dc output current or voltage Low saturing current	ADJ VOLTS, COARSE ADJ VOLTS, or CUR MAX potentiometer out of adjustment
	Line voltage more than 5 percent low.
	V1, V2, V3, or V5 tube low emission or aged
	Aged voltage reference V4 tube
Rated output current not obtainable with saturating current maximum under MAN control	High resistance at some contact in line or charge circuit
	Rectifier cells high resistance due to aging
	Line voltage too low
	Incorrect tap used on T7
No CUR MAX adustment	Check V3 (see 4.05)
	Check V6 (see 3.08 and 4.05)
High dc output current or voltage	Line voltage more than 5 per cent high
High saturating current	V6 tube failure
	ADJ VOLTS, COARSE ADJ VOLTS, or CUR MAX potentiometer out of adjustment
	V2, V3, or V5 tube defective (see 4.05)
High dc output voltage in TST1 with MAN control max ccw	Line voltage more than 5 per cent high
	V2 has high grid current
Output excessively noisy	L1 retard coil short or partially short-circuited
OC relay opening and reclosing	Defective V6 tube
	Current maximum adjustment (3.05) drifted to above 225 amperes and load unbalanced between rectifier units

Trouble	Possible Cause
OC relay opening and reclosing	Line voltage more than 5 per cent high
	V6 tube failure
	ADJ VOLTS, COARSE ADJ VOLTS, or CUR MAX potentiometer out of adjustment
	V2, V3, or V5 tube defective (see 4.05)
Low float voltage	V3 tube trouble (constant current misadjustment or drift)
Output current varying or pulsing periodically	Defective L1 filter coil, replace coils having manufacturing date prior to 9-50
	Beacon lights flashing
	Defective L2 filter coil

Note: Step changes in load or power service voltage encountered in certain applications will cause fluctuation of the load voltage at too high a rate for the regulating circuit to follow, and of too great a value for the battery of the installation to hold close voltage limits. This should not be interpreted as erratic operation of the rectifier.

5. POINT-TO-POINT VOLTAGES

5.01 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 secured, they may be useful in locating defective conditions. As given in the tables, they are typical of a rectifier connected to normal supply adjusted to the float voltage of the battery and carrying load as indicated.

5.02 High voltages to ground are present within the rectifier and every precaution should be observed to avoid any contact with exposed metal parts or terminals when the rectifier is in operation.

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

5.03 The time required for the output voltage to completely stabilize after the power is connected is about 30 minutes.

5.04 Readings should be made with a KS-14510, List 1, voltmeter. The output of the rectifier will not be appreciably affected by connecting the voltmeter leads to the circuit elements.

5.05 Access for making measurements is as follows.

Caution: The readings shown in the following Table A 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 shown. Therefore, in order to protect the voltmeter, it is recommended that a higher meter scale than that given in Table A be used until readings indicate that it is safe to use the meter scales in Table A. Remove all ac and dc fuses before removing any protecting guards behind the covers to work inside the rectifier.

(a) Remove the 11-inch high cover on the front of the rectifier. This gives access to the test switches, test jacks, and adjusting potentiometers.

(b) By unfastening the two fasteners at the top of the control panel, the panel may be turned down, giving access to the back of the control panel and equipment mounted behind this panel. This equipment is covered by lucite guards which give mechanical protection but afford access for test prods. The tubes are also located in this space.

(c) If access to the power coils is required, unfasten and remove the lower front cover.

(d) When tests are completed, turn up and fasten the control panel, and replace and fasten the covers that were removed.

Table of Point-to-Point Voltages

5.06 For this test, the rectifier is adjusted for 13.0-volt, 100-ampere output with 230-volt, 60-cycle power supply.

TABLE A

Voltage Across	Measurements Taken From App	From Term.	To (Note) App	To (Note) Term.	Voltmeter Scale	Reading Volts
Bat.	Jack	Reg+	Jack	Reg-	60 dc	13.2
C1	Jack	S+	Jack	S-	300 dc	60
C2	Jack	B	Jack	P	300 dc	120
C3	Ring B	1	Ring B	4	0.3 dc	0.16
C4	Ring B	10	Ring B	8	0.3 dc	0.05
C6	Ring C	9	Ring C	8	12 dc	4.5
C8	Jack	P	TP	2	300 dc	148
R7	Jack	P	P4	2	60 dc	51
R12	TP	11	RV3	3	60 dc	12.5
R19	TP	5	Jack	Reg-	300 dc	180
R25	Jack	P	Ring C	8	60 dc	32
V1 Output	Jack	SP	Jack	S-	300 dc	286
V2	Jack	SP	Jack	S+	300 dc	242
V3 (6-8)	Ring B	7	Ring B	10	12 dc	7
V3 (4-2)	Ring B	6	Ring B	1	300 dc	84
T1	T1	3	T1	4	600 ac	360
	T1	4	T1	5	600 ac	360
	T1	6	T1	7	12 ac	5
T2	T2	3	T2	4	300 ac	110
	T2	5	T2	6	12 ac	6.5
T3	T3	3	T3	4	60 ac	33
	T3	4	T3	5	600 ac	442
Input	T3	1	T3	2	300 ac	230
T4	T4	1	T4	6	300 ac	115
	T4	8	T4	11	12 ac	6
T5	T5	1	T5	3	300 ac	250
	T5	4	T5	5	60 ac	18
T6	T6	1	T6	2	300 ac	126
	T6	2	T6	3	300 ac	76

Note: "To Term." should be connected to jack -V of meter.