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TM 11-955

WAR DEPARTMENT TECHNICAL MANUAL

U.S. Dept. of Army

RECTIFIER

RA-37

WAR DEPARTMENT • 21 JUNE 1944

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WAR DEPARTMENT,
WASHINGTON 25, D. C., 21 June 1944.

TM 11–955, War Department Technical Manual, Rectifier RA–37, is published for the information and guidance of all concerned.

[A. G. 300.7 (11 May 44).]

BY ORDER OF THE SECRETARY OF WAR:

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Chief of Staff.

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Major General,
The Adjutant General.

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For explanation of symbols, see FM 21–6.

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CONTENTS

	Paragraph	Page
SECTION I. Description.		
Purpose	1	1
Detailed description	2	1
Power	3	2
II. Installation and operation.		
Equipment lay-out	4	4
Setting up and connecting	5	4
Operation	6	8
III. Functioning of parts.		
Rectifying element	7	9
Power transformer	8	9
Filter choke	9	9
Filter capacitors	10	9
Bleeder resistor	11	9
IV. Maintenance.		
Daily inspection	12	12
Weekly inspection	13	12
Procedure when rectifier fails	14	12
Continuity tests of components	15	15
Replacing parts	16	16
Moistureproofing and fungiproofing	17	16
V. Supplementary data.		
List of maintenance parts for Rectifier RA–37	18	19

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DESTRUCTION NOTICE

WHY —To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN—When ordered by your commander.

HOW —1. *Smash.* Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools, large rocks.

2. *Cut.* Use axes, handaxes, machetes.
3. *Burn.* Use gasoline, kerosene, oil, flame throwers, incendiary grenades.
4. *Explosives.* Use firearms, grenades, TNT.
5. *Disposal.* Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.

WHAT—1. *Smash.* Rectifier stack, transformer, capacitors, chest, and all other parts.

2. *Cut.* Wiring, cables, etc.
3. *Burn.* Technical manuals and chest.
4. *Bury or scatter.* Any or all of the above pieces after smashing, cutting, and/or burning.

DESTROY EVERYTHING

SAFETY NOTICE

SEVERE SHOCK MAY RESULT FROM CONTACT WITH CURRENT-CARRYING PARTS OF THIS EQUIPMENT. ALWAYS BE SURE THE SWITCH IS AT *OFF* BEFORE MAKING ADJUSTMENTS ON THE TAP-CHANGING PANEL.

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Section I

DESCRIPTION

1. PURPOSE. Rectifier RA–37 is designed to convert electric power from standard power lines for operating teletypewriter line units.

2. DETAILED DESCRIPTION. Rectifier RA–37 is a full-wave, bridge-circuit type using selenium disks as the rectifying element. Figure 1 shows the rectifier packed for transportation in Chest CH–51. Complete weight is 24 pounds. Outside dimensions are 6½ inches high by 12½ inches long by 8¼ inches deep. Rectifier RA–37 is built on a welded steel chassis and is completely inclosed by a steel chassis-base and a folded steel cover. The entire unit is finished with a smooth, durable, black paint. The tap-changing panel can



Figure 1. Rectifier RA–37, packed for transportation in Chest CH–51.

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be reached through a hinged door on the cover (fig. 2). On the front of the chassis are a twist-type receptacle for the d–c load, an ON-OFF line switch, and a 6-foot attached cord and plug for connection to a power source (figs. 2 and 9). On top of the chassis cover is a plate containing operating instructions; fastened inside the cover are a practical wiring diagram and a schematic wiring diagram. A tapped transformer (figs. 7 and 8) is bolted on top of the chassis to supply alternating current to the selenium dry-disk rectifier mounted next to the transformer and across one end of the chassis. Mounted on the other end of the chassis are an iron-core choke coil and two high-capacity electrolytic capacitors which filter current from the selenium rectifier unit. A tap-changing panel mounted at one end of the power transformer has eight primary taps for setting to the proper line voltage. A pair of fuse clips on the tap-changing panel provide for a 5-ampere a-c line fuse. A bleeder resistor is mounted inside the chassis below the tap-changing panel (figs. 8 and 11). DO NOT use a fuse larger than 5 amperes. A smaller fuse may be used.

3. POWER. a. Input. The primary source of power required to operate Rectifier RA–37 is a 95- to 125-volt, 55- to 65-cycle, a-c power line. The power input required from the a-c line for full-load output is approximately 90 watts.

b. Output. Rectifier RA–37 supplies up to 0.4 ampere of direct current at 115 volts.

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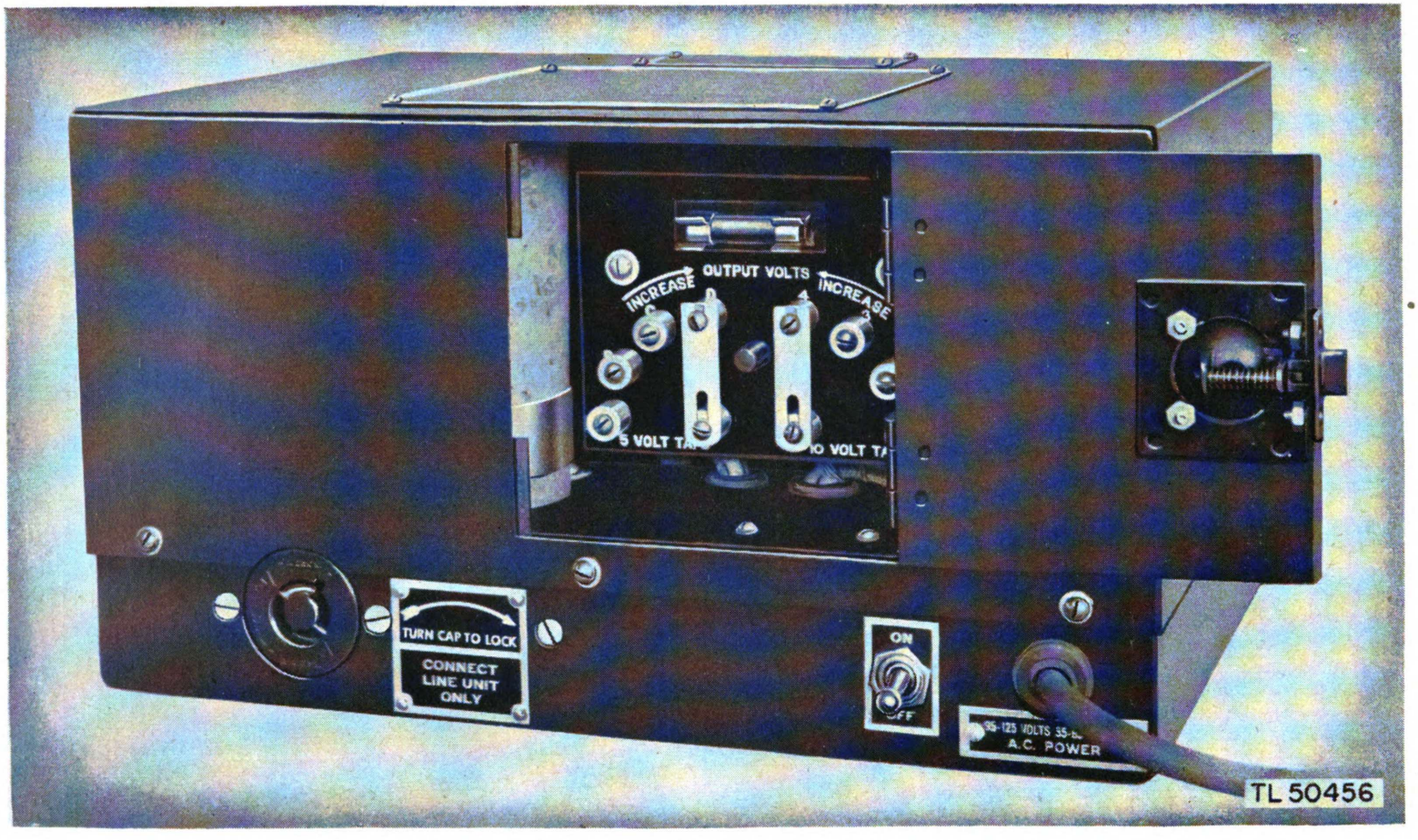


Figure 2. Rectifier RA–37—front view.

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INSTALLATION AND OPERATION

4. EQUIPMENT LAY-OUT. Locate the rectifier so that it has ample ventilation and, if possible, is not in direct sunlight. Make certain that it is placed to permit easy connection of the teletypewriter with the line unit to the receptacle, and connection of the line cord of the rectifier to a power source.

5. SETTING UP AND CONNECTING. a. Unpacking. Remove the rectifier from Chest CH–51, using the louvres (ventilation openings) at the ends of the rectifier as lifting handles. Be careful not to entangle the attached line cord with foreign objects. If the rectifier does not slip easily from the packing chest, hold the chest with the feet or knees. The chest may be used as a support to aid in setting the voltage taps and to keep the rectifier off damp ground or dirty floors.

b. Check. Check the rectifier for loose or broken parts. Shake it to see if any loose parts can be detected. Repair any defects found.

c. Power source. Be sure that the available power source is *95- to 125-volt*, 55- to 65-cycle, a-c (fig. 2).

Caution: *Never connect the input power cord to a d-c source.*

d. Power source test. If doubt exists as to whether the power source is alternating or direct current, check it with the d-c voltmeter on the line unit. Low-frequency a-c voltage will give a very small vibrating or jiggling indication on the d-c voltmeter. The voltage of a 55 to 65 cycles alternating current causes the meter needle to move slightly to one side and then return to zero. Jiggling of needle will not be noticeable at these frequencies. D-c voltage gives a steady reading (other than zero). Figure 3 shows in detail how to make this test.

e. Tap-control links. Open the door on the front of the rectifier by pulling the latch ring out until the latch releases. See that the two tap-control links are in place and firmly secured; one between the 10-volt tap common post and one of the numbered posts, the other between the 5-volt tap common post and one of the lettered posts (figs. 2 and 5). Check to see that the fuse is good and is held firmly in the fuse clips.

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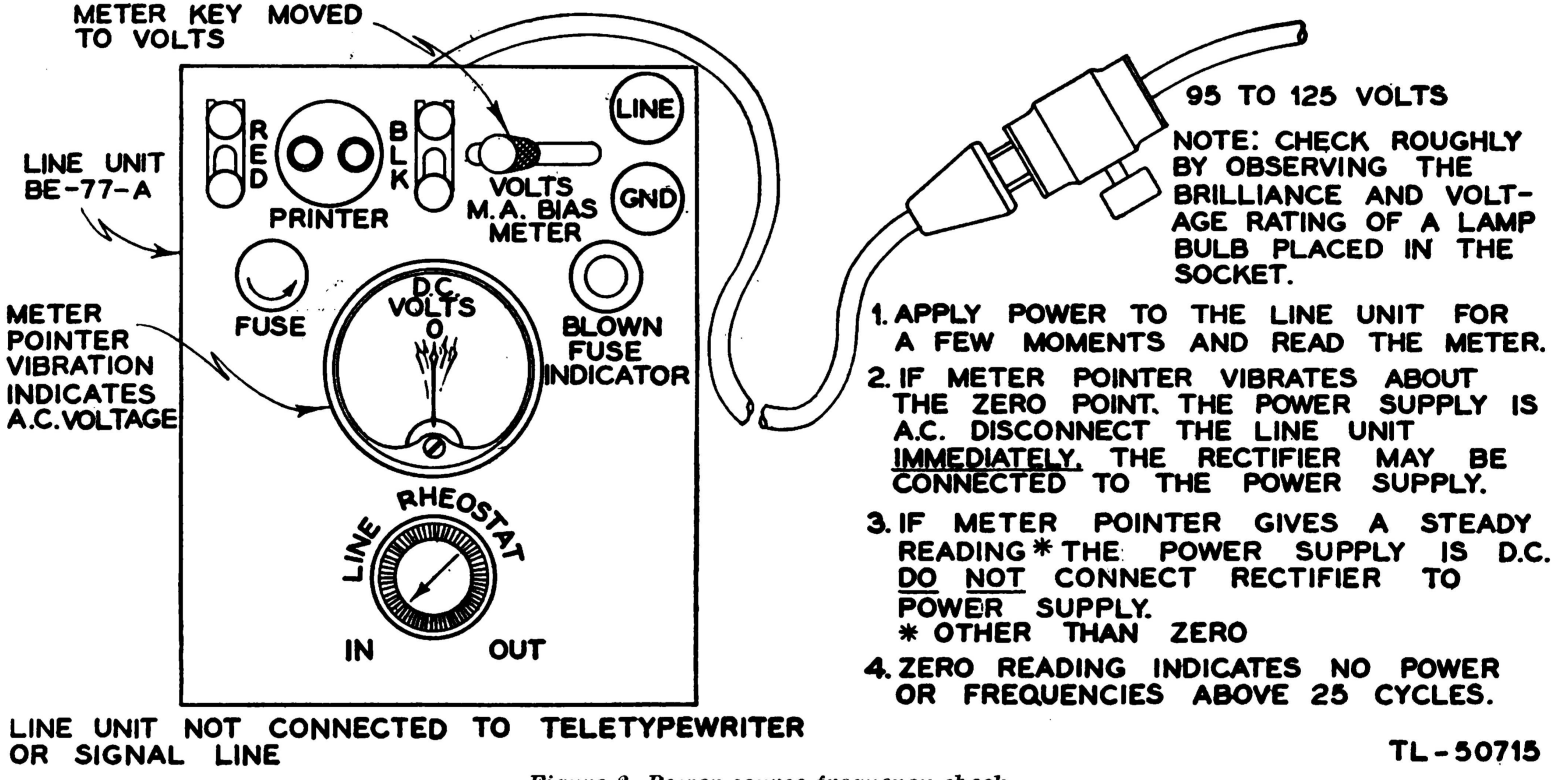


Figure 3. Power source frequency check.

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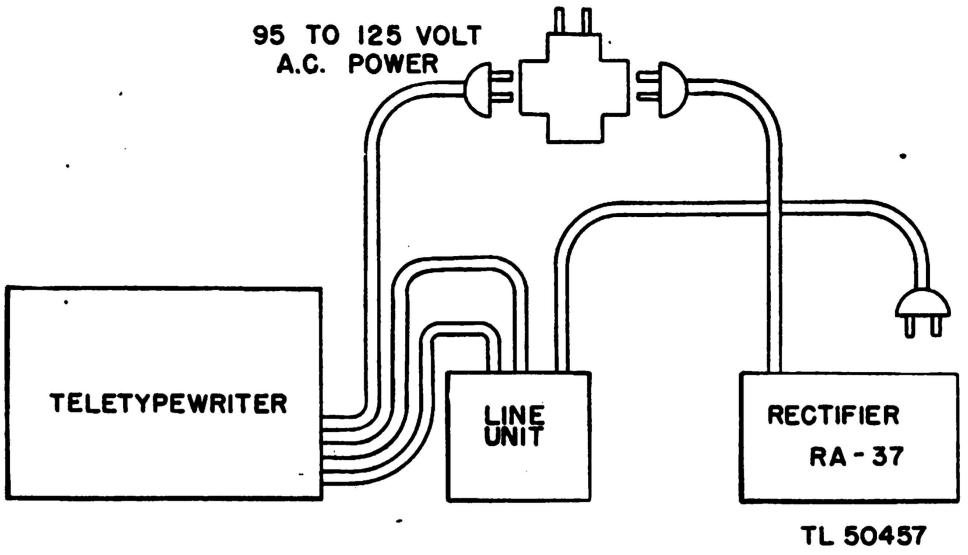


Figure 4. Typical cording diagram.

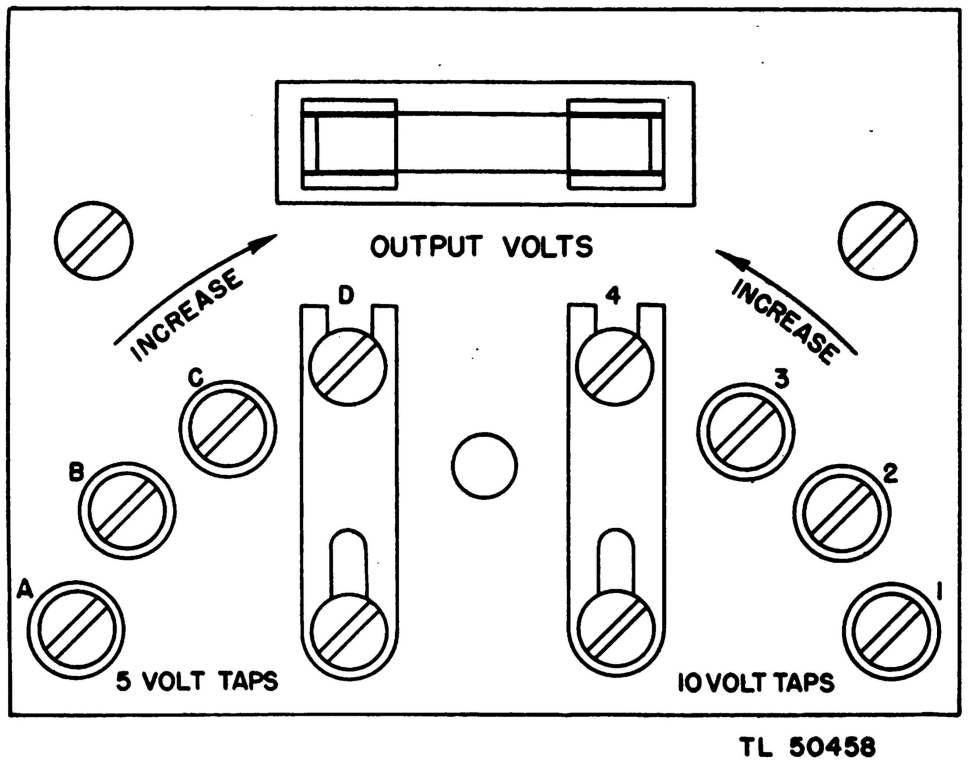


Figure 5. Rectifier tap panel.

f. Connection to line unit. With the rectifier ON-OFF switch at OFF, connect the teletypewriter line unit cord to the rectifier receptacle by inserting the plug with prongs turned to the left. To lock the plug in tightly, twist it to the right as indicated by the arrow on the escutcheon plate at the right of the receptacle. Figure 4 shows a typical cording diagram.

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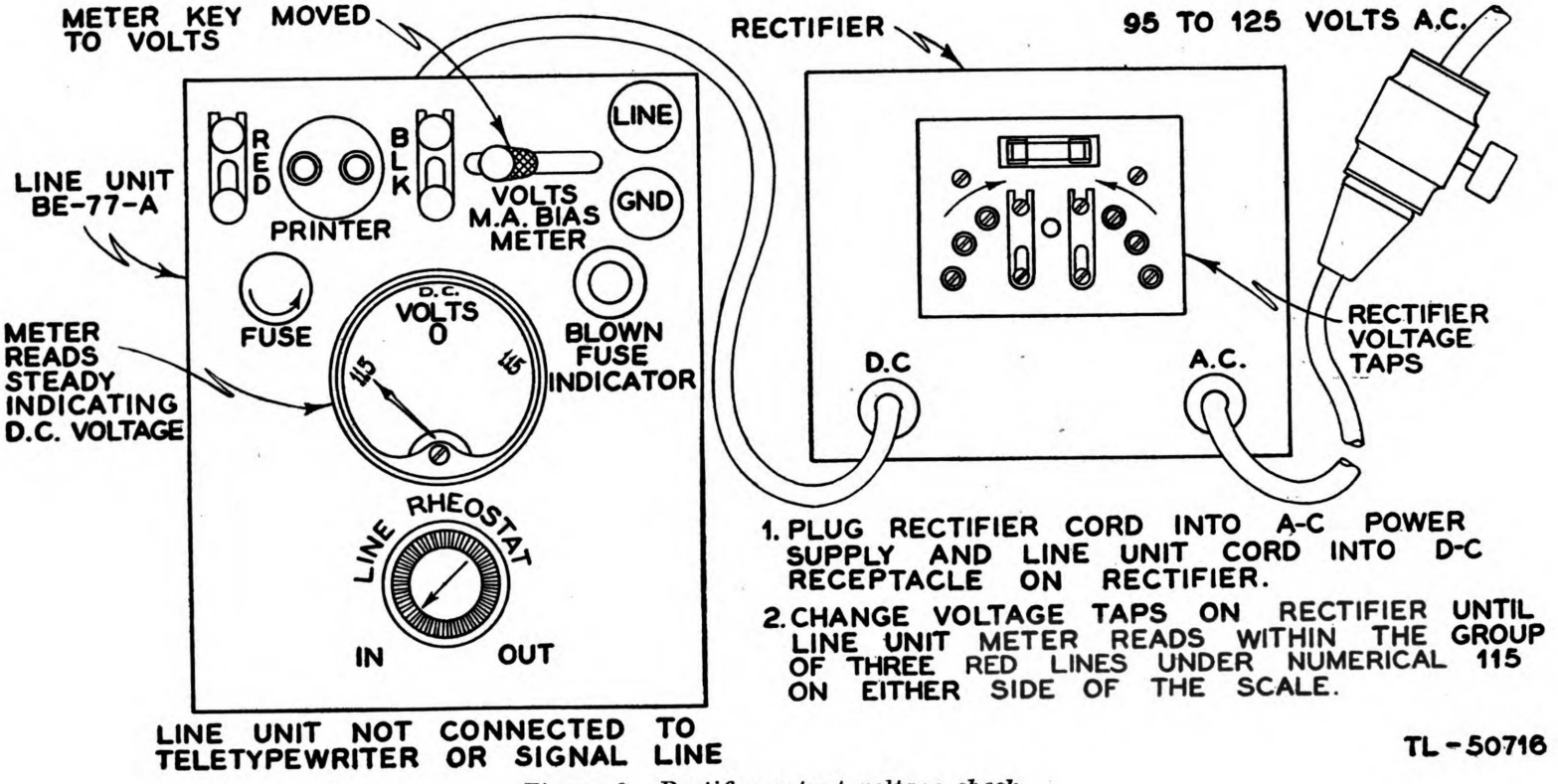


Figure 6. Rectifier output voltage check.

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Caution: Do not connect the teletypewriter line unit to an a-c receptacle, except momentarily, when using the line unit voltmeter to determine whether power source is alternating or direct current (see d above).

g. Output voltage check. Turn the rectifier ON-OFF switch to ON and check the output voltage on the line unit voltmeter. If the voltage is not within 5 volts of 115 volts, turn the rectifier off and change one of the tap links (figs. 2 and 5). Move the tap link to increase or decrease the output voltage as required. Again turn the ON-OFF switch to ON and check the voltage. Repeat the tap-link adjustment until the correct output voltage is obtained. Figure 6 illustrates details of the output voltage check.

6. OPERATION. When installed and connected, Rectifier RA–37 can be started and stopped by means of its ON-OFF switch (figs. 2 and 9). The rectifier is silent in operation except for a slight line-frequency hum in the transformer. This hum can be heard only when the ear is placed close to the rectifier. In normal operation under full load, the temperature of the rectifier rises slowly and reaches maximum normal operating temperature after 4 or 5 hours.

Caution: Large changes in the supply voltage may require changes in the tap-changing links to maintain the required output voltage. Always turn the rectifier ON-OFF switch to OFF when changing taps.

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FUNCTIONING OF PARTS

7. RECTIFYING ELEMENT. The rectifying element (fig. 7) consists of four sections of rectifying selenium disks connected as a full-wave bridge rectifier. Alternate sections carry current on each half-cycle of the input alternating current. The d-c potential existing across its output terminals is pulsating with a large ripple component. The no-load ripple is approximately 65 volts and is about 7 percent greater at full load.

8. POWER TRANSFORMER. The power transfer supplies alternating current to the selenium rectifier and separates the selenium rectifier from the power supply line. The primary taps permit adjustment to the power supply voltage, and may be used to compensate for aging of the selenium rectifier. The normal secondary voltage is 157 volts at no load and 152 volts at full load.

9. FILTER CHOKE. The filter choke offers a high-impedance path to the d-c ripple of the rectifier output, but a low resistance to the d-c component, resulting in a reduction of the ripple voltage remaining in the current after the current has passed through the choke. The choke is a swinging type, the inductance changing from 2.3 henrys at a 15-milliamperes load to 0.18 henry at a 400 milliampere load. The swinging choke provides better voltage regulation than can be obtained with an ordinary smoothing choke.

10. FILTER CAPACITORS. The two filter capacitors shunt most of the ripple current remaining in the direct current after the current has flowed through the choke, providing a nearly pure d-c source at the output receptacle of Rectifier RA–37. The ripple voltage is less than 0.5 percent at the rated load.

11. BLEEDER RESISTOR. The bleeder resistor (fig. 8) stabilizes the d-c voltage at very low loads. If no bleeder resistor is used, the variation of the no-load voltage is directly proportional to the value of the leakage resistance of the capacitor. If the leakage resistance increases, the variation in the no-load voltage increases; if the leakage resistance decreases, the variation in the no-load voltage de-

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creases. The bleeder resistor also reduces the inherently high no-load voltage of a choke input system. The result is a smaller change in voltage from no-load to full-load.

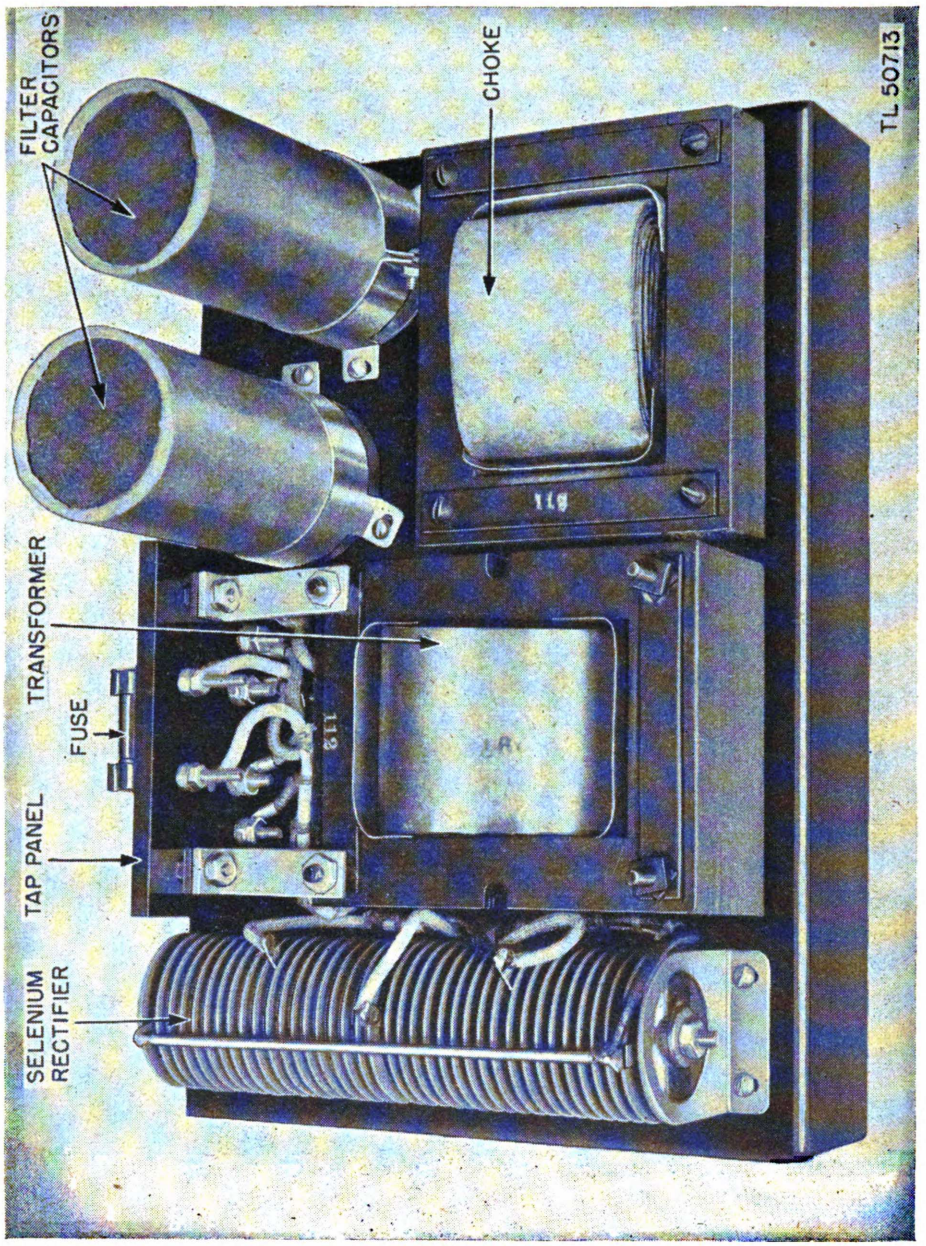


Figure 7. Rectifier RA-37—inside view.

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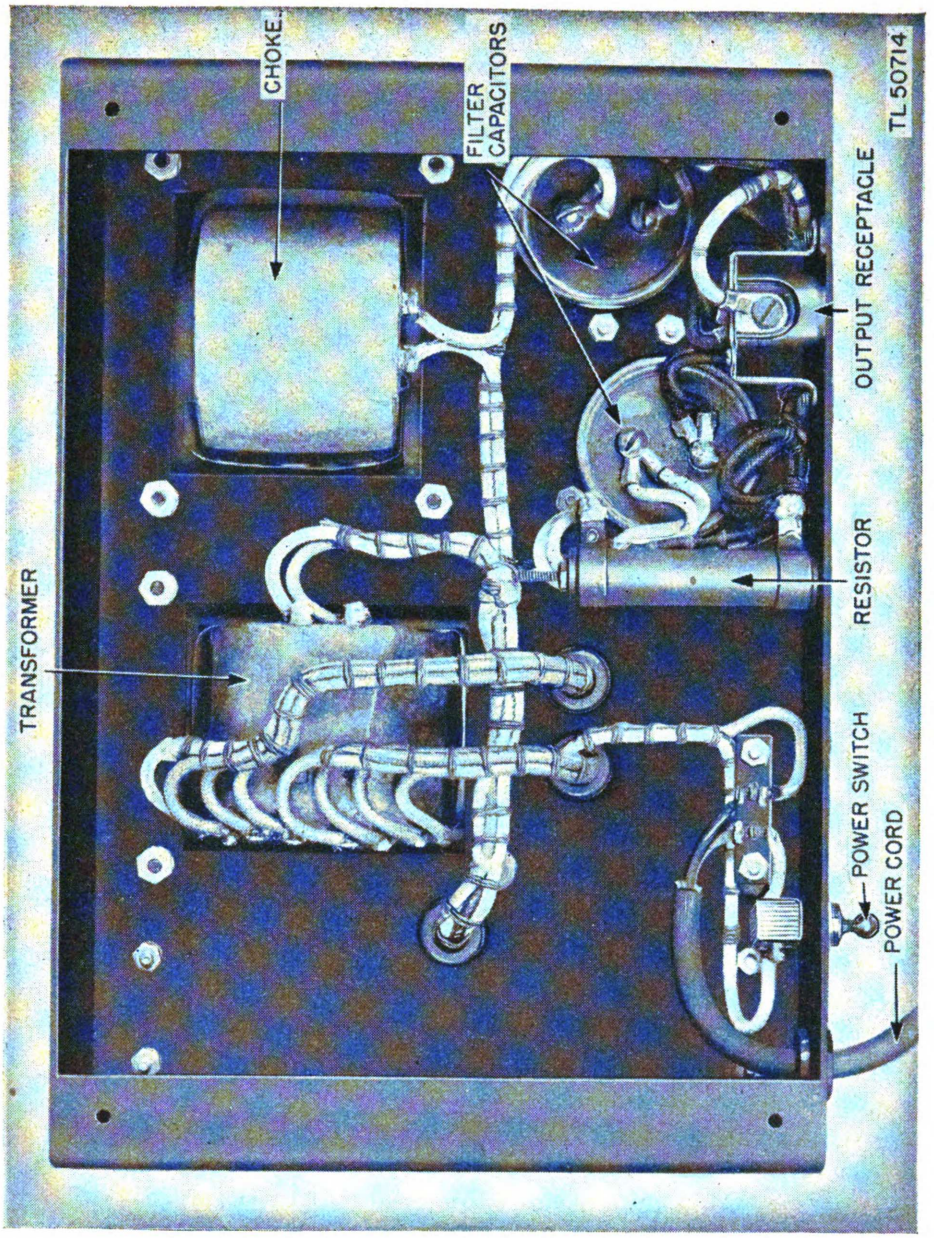


Figure 8. Rectifier RA-37—bottom view.

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MAINTENANCE

Note. UNSATISFACTORY PERFORMANCE OF THIS EQUIPMENT WILL BE REPORTED IMMEDIATELY ON W. D., A. G. O. FORM NO. 468. IF FORM NO. 468 IS NOT AVAILABLE, SEE TM 38-250.

12. DAILY INSPECTION. Examine component parts. Check all cordage to make certain that connections to associated equipment are good. Examine all accessible components for dust. Clean if necessary.

13. WEEKLY INSPECTION. With the rectifier ON-OFF switch at OFF, thoroughly inspect the complete installation as follows:

a. Remove the chassis cover and bottom plate (fig. 9). Blow the accumulated dust and dirt from all parts, especially from between the radiating disks of the rectifying element.

b. Make certain that all wiring is in place, that mounting brackets are rigidly fastened, and that lock washers are tight under each machine screw nut.

c. See that tap links are connected tightly to the proper terminals.

d. Inspect the plug for proper fit and the receptacle for bent contacts. Pry bent contacts back to normal positions with a small screw driver.

e. See that the cartridge fuse ((5), fig. 11) is tight in its clip. If loose, remove the fuse and bend the clips by hand until they grip the fuse tightly. Clean the clips, fuse ends, and all other contact surfaces.

f. After completing the inspection, replace the chassis cover and the bottom plate. Remake connections with associated equipment.

14. PROCEDURE WHEN RECTIFIER FAILS. a. Failure of the rectifier to operate properly is usually caused by worn, broken, or disconnected cords, plugs, or sockets, or by defective fuses. Check these items thoroughly before investigating component parts. Schematic and wiring diagrams are shown in figure 10.

Caution: *Do not change fuses or make repairs with the cord plugged into the a-c power supply line.*

b. Excessive humidity may cause moisture to collect on terminal panels or terminal connections. Check this, and take precautions to keep moisture out (par. 17).

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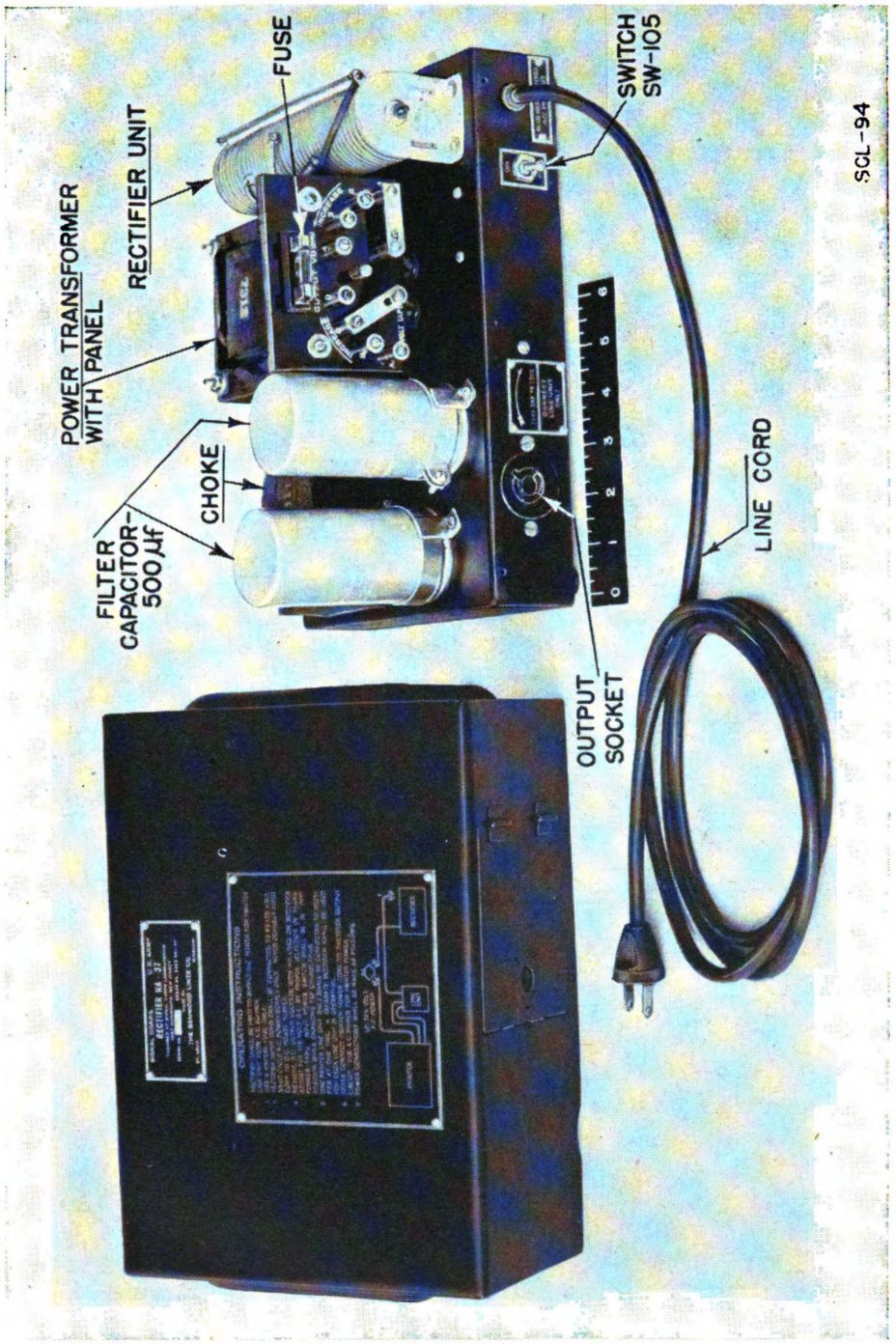
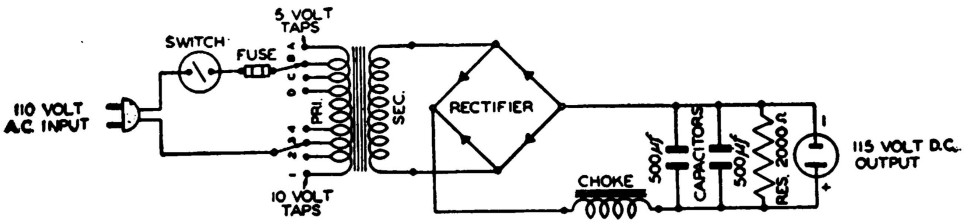


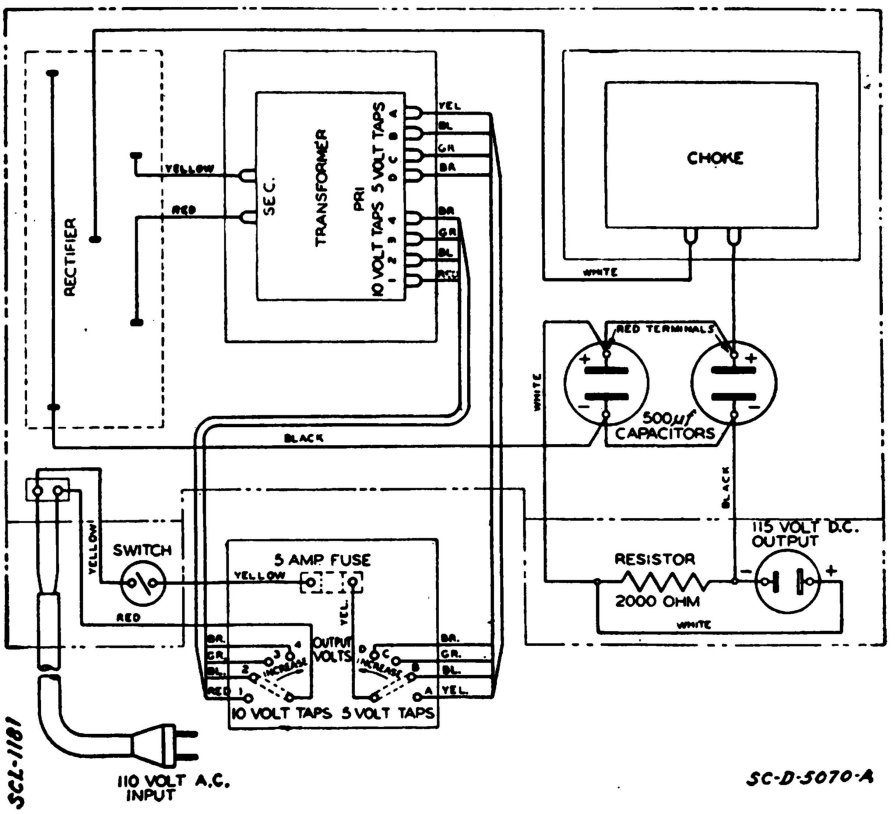
Figure 9. Rectifier RA-37—cover removed.

Caution: Do not attempt to dry the rectifier with very hot air. The hot air might injure the capacitors and the rectifier disks. A free flow of warm air through the chassis will do the drying more quickly than hot air not in motion.

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① *Schematic diagram.*



② *Wiring diagram.*

Figure 10. Rectifier RA–37—schematic and wiring diagrams.

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c. The following causes of trouble may be present if the rectifier fails to operate properly (reference symbols as shown on figure 11 and in paragraph 18):

Symptom	*Cause*
No d-c output voltage.	Burned out fuse (5).
	Open power cord (8).
	Short-circuited power cord.
	Poor plug contact.
	Loose tap links (6).
	Loose receptacle terminal.
	Burned out transformer.
	Defective switch (10).
	Defective choke (1).
	Defective rectifier (7).
	Defective capacitor (3).
	Grounded bleeder resistor (4).
	Shorted wires.
	Broken wires.
Excessively high d-c voltage.	Shorted choke (1).
	Open resistor (4).
Excessive ripple in d-c output.	Defective choke.
	Defective capacitor.
	Defective rectifier.

15. CONTINUITY TESTS OF COMPONENTS. a. Transformer.

	Primary	*Secondary*
Terminals	*Resistance*	
A to 1	1.4 ohms	2.2 ohms
D to 4	1 ohm	
1 to 2	0.1 ohm	
2 to 3	0.1 ohm	
3 to 4	0.1 ohm	
A to B	0.05 ohm	
B to C	0.05 ohm	
C to D	0.05 ohm	

b. Rectifying element. The resistance of the rectifying element depends upon the voltage at which the measurement is made. The usual low-voltage tester reveals little that is useful regarding the rectifying element. While a low-voltage test should not be considered as an indication of whether or not the element is defective, such a test shows a resistance of 1,000 to 2,000 ohms in one direction and 20,000 to 50,000 ohms in the reverse direction. The unit should be disconnected from the circuit and the jumper removed for the test.

c. Capacitor. As with the rectifying element, low-voltage tests on the capacitor mean little, since the usual tester applies less than 3

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volts to the unit and the capacitors are designed to operate at 115 volts. A resistance of several thousand ohms will be indicated for one polarity and a somewhat lower resistance in the other direction. Due to the large capacitance of the capacitors, the resistance reading takes several seconds or even minutes to come to a steady reading.

d. Filter choke. Resistance is 1.8 ohms, plus or minus 10 percent.

e. Bleeder resistor. Resistance is 2,000 ohms, plus or minus 10 percent.

16. REPLACING PARTS. **a.** Before defective parts can be removed, the chassis cover and bottom plate must be taken off. To remove the cover, take out the six screws which extend through the holes near the bottom of the cover and are tapped into the chassis. To remove the bottom plate, take out the four corner screws.

b. Remove the transformer or choke from the chassis by unsoldering the cable and releasing the mounting bolts.

c. To remove the capacitor from the chassis, loosen the screw in its mounting clamp, unscrew the terminals, and slip the capacitor out.

Caution: Take particular care in the unsoldering or resoldering of leads to the terminals of the rectifier. A drop of solder falling between the radiating fins might short out a rectifying junction.

17. MOISTUREPROOFING AND FUNGIPROOFING. **a. General.** Communication failures commonly occur when Signal Corps equipment is operated in tropical areas where temperature and relative humidity are extremely high. The following troubles are typical of Rectifier RA–37:

(1) Resistors and capacitors fail.

(2) Electrolytic action takes place in chokes, transformer windings, etc., causing eventual break-down.

(3) Hook-up wire and cable insulation break down. Fungus growth accelerates deterioration.

(4) Moisture forms electrical leakage paths on terminal boards and insulating strips causing flash-overs.

b. Treatment. A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection against fungus growth, insects, corrosion, salt spray, and moisture in general. The treatment involves the use of a moisture and fungi-resistant varnish applied by means of a spray gun and/or brush.

c. Step by step instructions. (1) *Preparation.* (*a*) Make all repairs and adjustments necessary for the proper operation of Rectifier RA–37.

(*b*) All parts of Rectifier RA–37 which are to be processed must be thoroughly cleaned of dirt, dust, rust, fungus, oil, grease, etc.

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(2) *Disassembly.* (*a*) With the rectifier turned upside down, remove the four roundhead machine screws and the bottom cover.

(*b*) With the rectifier upright, remove the 10 roundhead machine screws (three on each side and two on each end) and the top cover.

(3) *Masking.* Completely mask or cover the selenium rectifying unit to prevent varnish from contacting it.

(4) *Drying.* Place the rectifier in an oven and dry it for 2 to 3 hours at 160° F.

(5) *Varnishing.* After drying, remove the rectifier from the oven and apply three coats of moistureproofing and fungiproofing varnish. Use either Fungus Resistant Lacquer No. 86, manufactured by Mass and Waldstein Company, Newark, N. J., or Tuff-On 74F, distributed by the Wipe-On Corporation, New York, N. Y. Apply the varnish with a brush to the edges of the bakelite panel and to the wiring and soldered connections on the underside and above the chassis.

(6) *Reassembly.* After treatment, remove the masking from the selenium rectifying unit, reassemble the rectifier, and test for operation.

(7) *Marking MFP and date of treatment.* Label or mark the rectifier to show that it has been moistureproofed and fungiproofed, together with date of processing.

Example: MFP—24 Apr 44.

d. Reference. For a full description of the varnish-spray and brush methods of moistureproofing and fungiproofing, refer to TB Sig 13.

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